COMPUTER-SYSTEM

MC-16 MC-20

Programming Manual

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WARNING:

This symbol highlights the adjacent or following instructions, which absolutely must be adhered to by the user! Any disregard of these instructions, can affect the safe operation and safety of the operator as well as bystanders.

ATTENTION:

This symbol highlights the adjacent or following instructions which must be observed by the user! Any disregard of these instructions can lead to damage of any kind, loss of guarantee and so on.

This symbol without specific headline emphasizes the adjacent or following notes and tips which should be strictly observed by the user! Any disregard of these instructions and tips can result in damage of any kind.

This symbol highlights hints and tips of all kinds, which should be observed by the user.

This symbol highlights information about cleaning the device, which should be strictly observed by the operator in order to ensure a long life of the device.

Safety notices

Be sure to pay attention!

In order to enjoy your modelling hobby for a long time, please read these instructions thoroughly and give particular attention to the safety notices.

If you are a beginner with remote controlled model aircraft, ships or cars, you should really ask an experienced model pilot for assistance.

INTENDED USE

ATTENTION:

This remote control system may only be used for the purpose intended by the manufacturer, i.e. for the operation of unmanned remote controlled models. Any other usage is not permissible and can cause damages to the remote control system, to other things and/or to the people. For damages derived from other use we offer no warranty and take no liability.

ATTENTION:

NOT SUITABLE FOR KIDS UNDER 14 YEARS OLD***,*** SAFETY IS NO ACCIDENT and REMOTE CONTROLLED MODELS ARE NOT TOYS

… because even small models can cause substantial property damage and/or personal injuries if they are not handled properly - even if caused by third parties.

This manual is an important part of the set, it contains important information for a proper and safe use and maintenance. If this remote control system changes ownership, these instructions should surely be included with remote control system.

Failure to comply with the operating instructions and the safety instructions will void the warranty.

Other notes and warnings

Technical defects of an electrical or mechanical nature can lead to unexpected startup of a motor and/or parts being hurled through the air to pose a danger of injury to you and to others.

Short circuit conditions are to be avoided absolutely! A short circuit condition may not only destroy parts of the remote control system but, depending on the circumstances and the battery energy involved, may also pose acute danger of incineration or even explosion.

All motor-driven parts, such as aircraft or ship propellers, helicopter rotors, open gearboxes etc. represent a constant danger. Contact with these parts must be avoided. A rapidly turning aircraft propeller can, for example, sever a finger. Also pay attention that other objects do not come into contact with driven parts.

When a drive battery is connected or a motor is running: **never** get into the danger zone of driving mechanisms.

Be sure to pay attention that motors do not start up unintentionally while performing programming operations. Disconnect the fuel supply or battery terminals to motors before programming.

Protect all units from dust, dirt, moisture and other foreign parts. Never expose these units to vibrations or excessive hot or cold temperatures. Remote control operation may only be performed under "normal" outdoor temperatures, i.e. within a range of -10 °C to +55 °C.

Avoid mechanical jarring and pressure stresses. Always check units for damage to housings and cables. Do not use units which have been damaged or become wet, even after they are dry again.

Only those components and accessories which we recommend may be used. Always use original *Graupner* plug and jack connectors which are made for one another out of the same materials.

When routing cables, pay attention that they are not stressed, unduly kinked or broken. The sharp edges of adjacent parts also represent a hazard for insulated conductors.

Be sure that all plug and jack connections are firmly seated. Do not pull on the cable to disconnect a plugged connector.

No modifications whatsoever may be made to units. Modifications will void the operating permit and all insurance protection. If necessary, send the device concerned to your local *Graupner* Service Centre; see page <?>.

Installing the receiver

The receiver is to be installed with a cushion of foam rubber to afford protection against jarring; in aircraft models behind a strong rib, for a car or ship model the location must be protected against dust and spray water. However, do not enclose your receiver completely, otherwise it may overheat in use.

The receiver may not be mounted in direct contact with the hull or chassis as this would allow motor vibrations and/or roadway jarring to be transferred directly to the receiver. When a receiver system is installed in a model with a combustion motor, all receiver parts should always be protected against the intrusion of exhaust gases and oil residue. Above all, this applies to the model's ON/OFF switch, which is typically built into the model's outer surface.

Position the receiver such that connecting cables to the servos and the power supply are routed with a bit of slack and that the receiver's antennas are at least 5 cm away from any large metal parts or wiring except for other receiver wires/cables. In addition to steel, this also includes carbon fiber parts, servos, electric motors, fuel pumps and all sorts of cables, etc.

Optimally the receiver should be placed at a readily accessible location that is well away from all other equipment. Under no circumstances may a servo cable be wrapped around the antenna or routed close to it.

Make sure that cables near the antenna cannot move about during flight.

Routing the receiver's antennas

The receiver and its antennas must be positioned as far away as possible from drives of any kind. If the model's hull is made of carbon fiber material, the ends of the antennas must extend outside of the hull.

If your model features a carbon fibre fuselage, the aerial tips must always extend outside the fuselage for a length of at least 35 mm. If this is not possible, it is essential to substitute longer aerials for the standard ones (approx. 145 mm long) fitted to HoTT receiver(s).

The orientation of the aerial(s) is not critical, but it is advantageous to install one receiver aerial in a vertical – upright – position in the model. If your receiver is a Diversity type – two aerials – the active tip of the second aerial should be positioned at 90° to the tip of the first aerial, and ideally the distance between the two tips should be greater than 125 mm.

Servo installation

Always mount servos with the provided rubber vibration-damper parts, see "installation notes" on page 54. Only in this manner can these parts be protected against excessively hard vibrations.

Installing control rods

Control rods must be installed such that they operate freely and smoothly. It is particularly important that all rudder levers are able to move to their full limits, i.e. not otherwise mechanically blocked.

In order to be able to stop a running motor at any time, control rods must be adjusted such that the carburettor tap is completely closed when the joystick and trim lever are brought into their end idle position.

Pay attention that no metal parts, e. g. as a result of rudder actuation, vibration, rotating parts, etc., rub against one another. Metal-to-metal contact causes electrical "noise" which can interfere with the correct operation of the receiver.

Transmitter antenna orientation

Transmission field strength is minimal in an imaginary line extending straight out from the end of the transmitter's antenna. This means that "pointing" the mc-16 HoTT and mc-20 HoTT transmitter's antenna directly toward the model will not produce good reception but rather degrade reception.

When multiple remote controls are operating simultaneously, pilots should position themselves in a loose group. Pilots standing off to themselves not only endanger their own models but those of others as well.

However, when 2 or more pilots using 2.4 GHz remote control systems are closer than 5 m to one another this can lead to return channel overdrive which, in turn, will trigger a range warning much too early. Increase your distance between one another until the range warning ceases.

Pre-start checks

Before switching the receiver on, be sure the throttle control is at its Stop/Idle position.

Always switch the transmitter on first and then the receiver.

Always switch the receiver off first and then the transmitter.

If this sequence is not maintained, such that the receiver is still switched on when the corresponding transmitter is switched to "OFF", then the receiver may respond to other transmitters or general radio frequency noise. This can cause the model to execute uncontrolled operations that may cause personal injuries and/or property damage.

In particular, for models *equipped with a mechanical gyro:* before switching off the receiver, disconnect the model's power supply to prevent the motor from revving up unintentionally.

The residual spin of a gyro often produces so much voltage that the receiver may falsely interpret a throttle signal! This will then cause the motor to start up unexpectedly.

WARNING:

If this order is not respected, that the receiver is turned on, but the corresponding transmitter is "OFF", the receiver could respond by other transmitters and any interference.

The model can be run as a result uncontrolled steering movements, thus possibly causing property damage and / or personal injury.

In particular with a mechanical gyro for models:

Before you switch your receiver off, make sure by interrupting the power supply, that the motor can not run up unintentionally.

An expiring gyro can generate such a voltage that the receiver picks up as an apparently valid throttle command. Then, the motor may start unintentionally!

Range test and function test

Perform checks for proper operation and range before every session. Secure the model adequately in place and ensure that no one is in front of the model.

Perform a complete functional test on the ground and execute a complete simulated flight to exclude the possibility of system faults or problems with the model's programming. When doing this, be sure to follow the notices provided on pages 84 and 94.

Never operate the transmitter in Model mode, i.e. for flying or driving, without an antenna. Be sure the antenna is firmly seated in its socket.

Safety notices

WARNING:

If the range and functional test, and flight simulation are not carried out in detail and conscientiously, this may have undetected malfunction and / or reception failures result in eg loss of control or even a crash of the model and can lead to significant things and / or personal injury as a result.

Operating a winged aircraft, helicopter, ship or car

WARNING:

- **Never fly over spectators or other pilots. Never endanger humans or animals. Never fly in the vicinity of high-voltage wires. Do not operate the model in the vicinity of sluice locks or where real boats or ships are operating. Do not operate a model on public streets or highways, paths or plazas, etc.**
- **Never switch the transmitter off whilst operating a model! If this should happen accidentally, keep your nerve and wait until the transmitter screen is entirely blank, i.e. until the transmitter has shut down completely; this takes at least three seconds. Do not switch your transmitter on again until this has occurred. If you neglect this, there is a risk that the transmitter will "hang" immediately after being switched on, and you will lose control of the model. In this case your only recourse is to switch the transmitter off again, allow it to shut down completely, and then switch on once more after the correct interval.**

Aero-towing

WARNING:

When operating a powered tug, ensure that the receiving systems in the two models are always at least 50 cm apart. We recommend the use of satellite receivers in such situations. If you neglect this, there is a chance of interference from the downlink channel.

Monitoring transmitter and receiver batteries

You must stop running the model to recharge the transmitter's battery no later than when low transmitter battery voltage triggers the "**Batt must be recharged!!**" display and acoustic signal.

Check the charge in batteries routinely, particularly the receiver's battery. Do not wait until the movements of controlled mechanisms are noticeably slower. Replace expended batteries before they cause problems.

The battery manufacturer's charging instructions are always to be followed, this includes mandatory adherence to the length of charging time. Never leave batteries being charged unattended.

Never attempt to charge primary batteries (non-rechargeable batteries) because they can explode.

All secondary batteries (rechargeable batteries) must be charged before every session. To avoid short circuit conditions, first connect the charger cable's banana plugs, polarity correct, into the charger and thereafter connect the charger cable's plugs to the transmitter and receiver batteries.

Disconnect all power sources from the model when it is not to be used for an extended period of time.

Never attempt to use defective batteries, damaged batteries or mixed-type battery combinations as a single group. Do not use mixed combinations of old and new batteries or batteries of different manufacture.

Capacity and operating time

The rule: "capacity is reduced with every successive recharging", applies to all batteries. Internal resistance increases at low temperatures to further reduce capacity. As a consequence, the battery's ability to provide current and hold its voltage is reduced.

Frequent charging or the use of battery maintenance programs can also result in gradual loss of battery capacity. Therefore the capacity of batteries should be checked at regular intervals, not in excess of every six months, and replaced if performance is found to be significantly deficient.

Purchase only genuine *Graupner* batteries!

Interference suppression for electric motors

All conventional electric motors produce sparks between their collector and brushes. Depending on the type of motor involved, this may cause more or less interference with the functionality of the remote control system.

The electric motors of a properly built system should therefore have interference suppression features. For electric drive models it is particularly important that every one of its motors is provided with proper interference suppression. Interference filters extensively suppress such disturbances and should always be included.

Follow the respective recommendations included in the motor's operating and installation notices.

For further details about interference filters, refer to the *Graupner* RC main catalog or in Internet at www.graupner.de.

Servo interference filters for extension cables
No. **1040**

The servo interference filter is necessary when an extended-length servo cable is used. This filter is attached directly to the receiver output. In critical cases a second filter can be attached to the servo.

Using electronic speed controllers

Choosing the right electronic controller is largely a matter of matching controller performance to the motor to be controlled.

In order to prevent an overload or damage to the speed controller, its current rating should be at least half of the maximum locked-rotor current draw of the motor to which it is connected.

Particular attention is appropriate for so-called "tuning motors". Because of their low-turns coils these motors can draw a multiple of their rated current in a locked-rotor condition and this can lead to the destruction of the speed controller.

Electric ignition systems

Combustion motor ignition systems also produce interference that can negatively influence remote control functionality.

Always supply power to an electric ignition system from a separate, dedicated battery.

Use only interference-suppressed spark plugs, spark caps and shielded ignition leads.

Mount the receiver sufficiently far away from ignition system components.

Static charges

WARNING:

A remote control system will be destroyed by the magnetic shock waves produced by a lightning strike – even if the storm is miles away. Therefore, stop flying right away if a storm is approaching. Static charging via the antenna also represents a lethal hazard.

Attention

- In order to fulfill FCC HF emission requirements for mobile transmitters, a distance of at least 20 cm must be maintained between this system's antenna and other persons when this system is operating. Operation of this system at a lesser distance is therefore not recommended.
- To avoid disturbance caused by the electrical characteristics and emissions of other transmitters, keep at least a 20 cm distance from other transmitters.
- Operation of the remote control system requires a correct program setting for the given country in the transmitter unit. This is necessary for compliance with diverse regulations like FCC, ETSI, CE etc. Follow the respective instructions provided for this with the transmitter and receiver.
- Prior to every flight, perform a complete functional test, range test and execute a complete simulated flight in order to exclude the possibility of system faults or problems with the model's programming.
- Never program the transmitter or receiver while the model is being operated.

Care and maintenance

Never clean the housing, antenna, etc. with cleaning agents, gasoline, water or similar means. Use only a dry, soft cloth.

Components and accessories

WARNING:

As manufacturer of this equipment *Graupner* GmbH & Co. KG recommends only components and accessories which have been tested and approved by *Graupner* for their suitability, functionality and safety. If this recommendation is followed, *Graupner* accepts responsibility for the product.

***Graupner* cannot accept any responsibility for the parts or accessories of other manufacturers which have not been approved and *Graupner* cannot evaluate every individual product made by other companies to assess if they are safe to use.**

Liability exclusion / damage compensation

This manual serves only as a source of information and can be changed without prior notification. *Graupner* accepts no responsibility or liability for errors or inaccuracies which may be contained in this manual.

Graupner cannot monitor compliance with the assembly instructions, the operating instructions or the conditions and methods under which remote control components are installed, operated, utilized or maintained. Therefore *Graupner* accepts no form of liability for loss, damage or costs consequential to incorrect usage or operation or which can be attributed to same.

Unless otherwise prescribed by law, the obligation of *Graupner* to provide damage compensation, regardless of legal grounds, is limited to the invoice value of the quantity of *Graupner* goods contributing directly to the damage-inducing event. This does not apply if *Graupner* is found to be subject to unlimited liability pursuant to binding legal stipulations with respect to intent or gross negligence.

Furthermore we will only consider claims if a log file is present; see page 26 under "Data recording" so as page 159 under "Flight time". For the same reason the transmitter must always be updated to the latest software status.

It is essential that you register at https://www.graupner.de/en/service/product_registration.aspx to ensure that you are constantly informed of important software updates. This is the only means by which we can automatically keep you aware of new updates by e-mail.

Safety notices and handling regulations for Lithium-Ion (LiIo) and Lithium-Polymer (LiPo) batteries

As applicable for all highly technical products, observance of the following safety notices and handling instructions is essential for a long service life, fault-free operation, and harmless utilization of lithium/polymer batteries.

These instructions are to be safeguarded. If the unit is transferred to another user, these instructions should certainly be passed along to the new user.

LiIo-/LiPo batteries require particularly attentive handling. This applies to charging, discharging as well as for storage and other handling. Adherence to the following special specifications is necessary:

Special notices for charging LiIo-/LiPo batteries from *Graupner*

WARNING:

- Since *Graupner* GmbH cannot supervise the correct charging and discharging of cells, the entire guarantee is void in cases of improper charging or discharging.
- Only approved chargers with appropriate charging cables may be used for charging LiIo-/LiPo batteries. Any manipulation to the charger or charger cables can lead to severe damage.
- The maximum charging capacity must be limited to 1.05 times the battery's capacity.

  Example: 700 mAh battery = 735 mAh max. charging capacity
- Use only the outlet-charger included with the set or a specially designed charger/discharger from *Graupner* to charge and discharge LiIo-/LiPo batteries, refer to page 18 or www.graupner.de.
- Ensure the settings for the number of cells or for final charging voltage and final discharge voltage are correct. Be sure to observe the operating instructions for your charger/discharger.
- Under these conditions *Graupner* LiIo-/LiPo batteries can be charged with a maximum of 2 C (the value 1 C corresponds to the cell capacity) charging current. At a voltage of maximum 4.2 V per cell and above, charging must continue a constant voltage of 4.2 V per cell until charging current drops below 0.1 … 0.2 A.
- The permissible temperature range for charging and storing LiIo-/LiPo batteries is 0 … +50 °C.
- Never leave batteries being charged unattended.
- The battery to be charged must be placed on a non-combustible, heat resistant, non-conducting surface during the charging process. Combustible or readily ignited objects are to be kept away from the charging configuration. Batteries may only be charged under supervision.
- Avoid short circuit. Never pierce a LiIo/LiPo battery, by doing it you may cause a short circuit and a fire, explosion and other problems.
- Charging voltage over 4.20 V per cell must be avoided absolutely as the cell would otherwise be permanently damage and could cause a fire. In order to prevent the over-charging of individual cells in a pack, a cut-off voltage between 4.1 … 4.15 V per cell should be set to increase service life.
- Incorrect handling can lead to explosions, fire, smoke and poisoning hazards. Furthermore, disregard for instructions and warnings can lead to performance losses and other defects.
- Before every use check the state of your batteries. Damaged or ruined batteries or cells should not be used.
- LiIo/LiPo batteries contain electrolytes and electrolyte vapours which are unhealthy. Never enter in touch directly with electrolytes. In case of contact with eyes, skin or other parts of the body, wash soon with a lot of water and call soon a doctor.
- The battery's capacity is reduced by every charge/discharge cycle. Storing the battery at temperatures which are too high or too low can also lead to a gradual reduction in capacity. In model operation, battery capacity drops to about 50 … 80 % of new battery capacity after about 50 charge/discharge cycles – even though all charge/discharge rules are followed. This is due in part to the high discharge currents and inductive currents caused by motors.
- **Never attempt to charge battery cells with the wrong polarity. Abnormal chemical reactions take place when batteries are charged with reversed polarity and the battery will be useless. This can cause breaks, smoke and flames.**
- Battery packs may only be connected in series or parallel in exceptional cases as cell capacities and charged state can differ too greatly. This is why the battery packs we deliver are selected.
- **LiIo-/LiPo batteries connected in series within a pack may only be charged as a group if the voltage of individual cells do not differ by more than 0.05 V. The LiIo battery included with the set is equipped with a special safety circuit such that "compensation" for voltage differences between individual cells, by way of an otherwise typical balancer plug connection, is not necessary.**
- Individual battery cells and batteries are not toys and must therefore not get into the hands of children. Batteries/cells must be kept out of the reach of children.

- Batteries must not get into the vicinity of babies or small children. If a battery is swallowed, immediately go to a doctor or emergency medical facility.
- Batteries must not be put in a microwave oven or put under pressure. Smoke, fire and more can be the consequences.
- Never dismantle a LiIo-/LiPo battery. Dismantling a battery can cause internal short-circuits. Gas, fire, explosions and other problems can result.
- The electrolyte and electrolytic vapors in LiIo-/LiPo batteries are harmful. Absolutely avoid all direct contact with electrolytes. If electrolytes come into contact with skin, eyes or other body parts, immediately wash out or rinse out with generous amounts of fresh water then be sure to consult a doctor.
- Batteries built into equipment must always be removed from that equipment when it is not currently in use. Always switch off equipment after it is used to prevent deep discharging. Always charge batteries before it is too late. Store batteries on a non-combustible, heat resistant, non-conducting surface! Deep-discharged LiIo-/LiPo batteries are defective and may no longer be used!

Storage

LiIo-/LiPo cells should have a 10 … 20% charge capacity when stored. If cell voltage drops below 3V, then LiIo-/LiPo cells must absolutely be recharged to a capacity of 10 … 20% of full capacity. Otherwise, further deep-discharging of the battery will make it useless during storage in a discharged state.

Special notices for discharging Lilo-/LiPo batteries from *Graupner*

- A continuous current rate of about 1C does not represent a major problem for *Graupner* LiIo-/LiPo batteries. For larger currents, please follow the catalog specifications. In any case, observe the maximum current rating for the connector system, see maximum discharge current on the battery.
- Discharging below 2.5V per cell damages cells permanently and is therefore to be avoided absolutely.

  Short circuit conditions are to be avoided absolutely. Permanent short circuits lead to destruction of the battery, high temperatures and perhaps even self-ignition may follow.
- During discharge, battery temperature must not rise, in any case, to over +70°C. Otherwise, better cooling or a lower rate of discharge must be introduced. The temperature can easily be checked with the infrared thermometer, No. **1963**. The battery must never be discharged via the transmitter's charging socket. This socket is not suitable for this purpose.

Other handling notices

- Never short-circuit the battery. A short-circuit allows very high current to flow and this heats up the cells. This will lead to loss of electrolyte, the production of gases and perhaps even explosions. In the vicinity of, or while handling, *Graupner* LiIo-/LiPo batteries, avoid electrically conducting surfaces because of the danger of creating a short-circuit condition.
- Battery packs may only be connected in series or parallel in exceptional cases as cell capacities and charged state can differ too greatly. This is why the battery packs we deliver are selected.

Handling connectors

- These connectors are not as robust as for other batteries. This applies particularly to the plus pole connector. The connections can easily be broken off. Due to thermal transfer, the connector tabs may not be soldered directly.
- The connections of LiLo / LiPo batteries are not as robust as those of other batteries. This applies in particular to the positive pole connection. The connections can easily break off.

Cell connection

Direct soldering on battery cells is not permitted.

The heat of direct soldering can damage battery components, such as separator or isolator.

Battery connections should only be made by industrial spot welding. A professional repair made by the manufacturer or distributor is necessary to replace missing or torn-off cables.

Replacing individual battery cells

The replacement of battery cells may only be made by the manufacturer or distributor and never by the user himself.

Damaged cell usage

Damaged cells may never be used or returned to service.

Characteristics of damaged cells include: damaged housing packing, deformed battery cells, electrolyte or leaking electrolyte. In these cases, further use of the battery is not permissible.

Damaged or useless cells are hazardous waste items and must be appropriately disposed.

General warning notices

Batteries must never be put in fire or burned.

Battery cells must not be submerged in liquids, such as water, seawater or beverages. Any contact with liquids, of whatever nature, is to be avoided.

Notes for environmental protection

Notice for remote control set mc-16 HoTT and mc-20 HoTT

No. **33016** / **33020**

These radio control sets are fitted as standard with a LiIo transmitter battery with integral protective circuit (changes reserved). Once the factory preset voltage limit of 3.60 V has been reached, a warning will appear in the display.

Disposal of used batteries

Some countries have laws requiring that all used batteries be turned over to an authorized collection centre.

Disposing of batteries along with common household garbage is forbidden. Old batteries can be turned into communal collection centres for disposal at no charge or they can be returned to one of our dealerships or anywhere else where batteries of that given type are sold. Used batteries we have delivered can also be sent back to us, at your cost, through the mail. Use the return address below:

Graupner GmbH
Service: Used batteries
Henriettenstr. 94-96
D-73230 Kirchheim unter Teck

This represents an essential contribution to environmental protection.

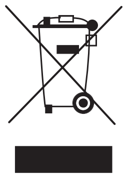
Caution:

Damaged batteries require among other things, special packaging, because they are very toxic!

Environmental protection notices

The symbol on this product, its operating instructions or packaging gives notice that this product may not be discarded as common household waste at the end of its service life. It must be turned over to a recycling collection point for electric and electronic apparatus.

The materials can be recycled according to their markings. You make an important contribution to protection of the environment by utilizing facilities for reuse, material recycling or other means of exploiting obsolete equipment.



Batteries must be removed from the unit and disposed of separately at an appropriate collection point.

Please inquire with local authorities about the responsible waste collection locations.

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mc-16 HoTT and mc-20 HoTT
The Newest Generation of Remote Control Technology

The technical advances across the entire spectrum of model building is an ever-present challenge to design engineers. This is why the introduction of new transmission technology in the 2.4 GHz band represents a new milestone.

The HoTT-System (**Ho**pping **T**elemetry **T**ransmission) developed by *Graupner* is a synthesis of know-how, engineering and testing done around the world by professional pilots.

Established *Graupner* HoTT techniques theoretically permit over 200 models to be operated at the same time. However, because of the interspersed radio-frequency utilization permitted by certification for the 2.4 GHz ISM band, this number is significantly lower in practical application. Nevertheless, in general more models can be operated simultaneously in the 2.4 GHz band than would be the case in conventional 35 or 40 MHz frequency bands. The real limiting factor is – as often before – is still likely to be the size of available operating space (i. e. airspace for aircraft). Alone the fact that it is no longer necessary to coordinate transmitting frequencies with other pilots in the vicinity (which is sometimes quite difficult in broken landscapes, such as on hillside slopes) represents an enormous boost for remote control operating security.

Bidirectional communication between transmitter and receiver, by way of a return channel built into the receiver, permits convenient access to data and programming in the HoTT receiver. For example, this makes it possible to swap receiver outputs or to divide up control functions among multiple servos (channel mapping). Servo travel and servo rotation directions in the receiver can also be matched to one another with these facilities. Telemetry data, like VARIO and GPS data, can be called up from optionally available modules.

The **mc-16** HoTT and **mc-20** HoTT radio control sets are based on the *Graupner/JR* **mc-24** computer radio control system, which was introduced back in 1997. The new equipment has been specially developed for the advanced RC pilot. The transmitters of this series offer an unprecedented level of security and reliability combined with outstanding operating convenience and ease of use.

Both these HoTT systems can easily be used to operate all current model types, whether your preference is for fixed-wing model aircraft or helicopters, model cars or boats.

For example, every **mc-16** HoTT and **mc-20** HoTT transmitter is fully equipped in terms of software and hardware to allow the use of the renowned NAUTIC modules. A further innovation is the “channel sequencer” – available only on the **mc-20** HoTT – which provides a means of automating servo sequences involving up to three servos.

However, it is fixed-wing model aircraft and helicopters in particular which call for complex mixed functions involving the control surfaces or swashplate control system. In this respect the latest computer technology makes it extremely simple to program the system to cope with a vast range of model requirements: simply select the appropriate model type in the program of your HoTT transmitter, and the software automatically sets up all the relevant mixing and coupling functions. Separate modules for implementing complex coupling functions are no longer required, and complicated mechanical mixers in the model are completely superfluous.

Additional flight-phase-specific settings can be stored in every model memory location. For example, such settings can be made for various parameters that can be called up to implement particular flight maneuvers at the “press of a button”. Additional model memories can be stored on the SD card, which is included standard with the set. Even telemetry data can be recorded for subsequent evaluation on a PC.

Since the **mc-20** HoTT is equipped with two displays, the lower display has been optimized for comprehensible, simple operation of the software. The graphic representation of mixer functions is particularly helpful. The upper display allows telemetry data to be called up from the receiver.

Functionally-related options are clearly arranged by content in a simple organization. The clear, comprehensible program structure permits a beginner to quickly become familiar with the various functions and able to use all options pertinent to his level of expertise with remote control models.

This handbook describes every menu in detail. There are tips, many notices and programming examples to supplement the descriptions and also explanations for model specific technical terms, like transmitter control, dual rate, butterfly, and so on.

Please observe the safety notices and technical notices. Read through the instructions attentively. Before usage, test all functions by simply attaching servos to the receiver included in the set. While doing this, observe respective notes on page 77. This will help you learn the essential operating techniques and functions of your HoTT transmitter.

Always handle your remote controlled model with a sense of responsibility so that you do not endanger yourself or others.

The *Graupner* team wishes you much pleasure and success with your HoTT transmitter system, the newest generation of remote control systems.

Kirchheim-Teck, june 2015

MC-16 HoTT and MC-20 HoTT series computer systems

two remote control sets with 2,4-GHz-*Graupner*-HoTT technology (**Ho**pping **T**elemetry **T**ransmission)

The illustration shows the contents of the MC-20 HoTT transmitter set.

Technology that enthralls.

The superior functional security of *Graupner* HoTT technology accomplished with bidirectional communications between transmitter and receiver with integrated telemetry, freely programmable voice output via headset connector, and ultra-fast response times.

Simplified programming using capacitive touch-buttons on the MC-20 HoTT and four-way push-buttons on the MC-16 HoTT.

High-contrast eight-line graphic screen provides a clear display of all set-up parameters. Switchable blue backlighting. The MC-20 HoTT features an independent second screen for displaying telemetry data. Storage of telemetry data on a micro SD memory card.

USB connection to read and write the model's memories as well as for making firmware updates.

- Integrated *Graupner* HoTT 2.4 GHz transmission system
- The high-speed primary processor is used for data transfer, ensuring ultra-fast response times. No additional delays through detours via a module processor.
- Maximum interference immunity made possible by optimized frequency hopping through as many as 75 channels and wider channel spread
- Intelligent data transfer with correction function
- Over 200 systems can be used simultaneously
- The HoTT technique of bidirectional communication between sender and receiver, as well as the fastest possible transmission rate (10 ms) assures extremely short reaction times.
- Modulation can be switched by software: when necessary, you can switch from "HoTT" to "EXT." or "SP." by pressing a button.
- Case incorporates integral patch aerial
- Transmitter features integral slot for SD and SDHC memory cards, formatted to FAT or FAT32, for saving log files, model programming data and supplementary functions such as transmitter firmware updates.
- Transmitter features alternative method of battery charging via the USB socket.
- 6 different languages (Dutch, English, French, German, Italian and Spanish) available per software update.
- Simplified arrangement of operating elements, such as joysticks, external switches, proportional controls and trim levers as control functions
- CONVENIENCE MODE SELECTOR to simplify changeovers between operating modes 1 … 4 (e. g. throttle left/throttle right)
- Extremely wide receiver operating voltage range of 3.6 V to 8.4 V (functional to 2.5 V)

mc-16 HoTT and mc-20 HoTT series computer systems

two remote control sets with 2,4-GHz-*Graupner*-HoTT technology
(**Ho**pping **T**elemetry **T**ransmission)

- Fail-safe, free channel assignment (channel mapping), mixer functions and all servo settings are simple to program
- Swashplate limiting: This function limits the swashplate's tilt angle to prevent the potential for mechanical collision in helicopter 3D operation at full-limit roll and pitch-axis
- Multi-channel function for operating *Graupner* product line NAUTIC modules
- Digital trimming, effective per specific flight-phase
- C1 changeover, brake/elec. motor: This changeover can be implemented very easily via enhanced flight phase programming. The pilot determines the joystick positions (forward/rear) at which the motor is to switched off or the airbrakes are to be retracted.
- Twelve freely programmable mixers for fixed-wing or helicopter models, each with freely selectable input and output functions; four curve mixers with innovative 6-point curve technology for easy to set and adjust curve values at up to eight points for throttle, pitch, tail or other nonlinear characteristics. The arithmetic unit in the CPU employs an ingenious method of calculating polynomial approximations for truly-rounded, ideal MPC (multi-point curve) mixer curves.
- Curve mixer points can be offset in both axes using the four-way buttons.
- Up to seven flight-phase programs can be individually adapted for each model and given a name. The switchover time is programmable separately.
- SUPER SERVO menu with a perfect overview of all servo setting data and simple parameter correction at four "levels": direction of rotation, mid-point setting, separate servo travel on both sides and separate travel limiting on both sides for 8 (mc-16 HoTT) respectively 12 servos (mc-20 HoTT) with a total of 48 respectively 72 setting options.
- DUAL-RATE, EXPO menu with 36 potential setting variants for three servo functions and up to seven flight phases
- Servo display hot-key: from virtually any menu, pressing the ◄ and ► buttons of the left-hand four-way button takes you directly to the servo display
- Highly practical multi-function menus for fixed-wing model aircraft and helicopters. Entering the number of aileron and flap servos, or collective pitch servos, automatically sets up all the relevant mixer functions in the appropriate multi-function menu.
- Helicopter swashplate mixer for 1, 2, 3, or 4 point steering.
- Future-proof design: updatable, high-speed 32-bit operating system with modern flash memory, simple update capability via the USB port and the micro-SD card.
- Transmitters feature sockets for PC USB interface, earphone, SMART-BOX, DSC system as standard; they are prepared for Trainer mode operations
- **ESC** button switches the screen from the Main menu to the »**Telemetry**« menu and back.
- Comprehensive telemetry displays, programming and analysis functions directly on the transmitter screen
- Wired and wireless Trainer systems with total transfer; all settings are entered at the Teacher transmitter.

mc-16 HoTT

- 20 model memories with storage of all model-specific programming and set-up parameters
- Eight control functions as standard, can be expanded to twelve at extra cost
- MULTI-DATA GRAPHIC LCD monitor with blue backlighting for greatly improved legibility in difficult lighting conditions.
- Function encoder with two four-way push-buttons for simplified programming and accurate settings
- Key-Lock function guards against accidental operation
- Transmitter features two 3-position switches (SW 5/6 + SW 11/12), two side-mounted proportional controls (Lv1 + 2) and two proportional sliders (Sl1 + 2) as standard; controls can be assigned to any function

mc-20 HoTT

- 24 model memories with storage of all model-specific programming and set-up parameters
- Maximum twelve control functions
- Two MULTI-DATA GRAPHIC LCD monitors with blue backlighting for improved legibility in difficult lighting conditions
- A function encoder with two touch-sensitive, four-way keys („CAP Touch") permit simplified programming and precise settings
- Twelve toggle switches (three 3-position switches (SW 2/3, 5/6 + 11/12), five 2-position switches (SW 4, 7, 9, 13 + 15), two centre-biased 2-position switches (SW 8 + 14), two 2-position locking switches (SW 1 + 10), two momentary switches on the rear of the transmitter (SW 16 + 17 / 18 + 19), two INC/DEC buttons (CTL 5 + 6), two side-mounted proportional controls (Lv1 + 2) and two proportional sliders (Sl1 + 2) installed as standard; controls can be assigned to any function

- Key-Lock function guards against accidental operation
- Voice and, as applicable also MP3 file, output over headset output or loudspeaker
- Ring-limiter: functions similar to swashplate limitation but is used for control of up to three Voith-Schneider drives in ship models.
- Channel sequencer for automating servo motion sequences of up to three servos, e. g. to automate the lowering of landing gear or to extend/retract drives in self-launching gliders.

Model programs

- Model type icon: graphic model type indicator (fixed-wing / helicopter)
- Transmitter operating hours timer
- Flight phase switch assignments: six switches, two with a priority function. Every switch combination can be named freely. This makes the number of flight phases independent of the number of flight phase switches.
- Tail type normal, V-tail, Delta/flying-wing and 2 HR Sv 3+8 (which immediately makes two coupled elevator servos available without using free mixers or dual mixers)
- Expanded transmitter control menu: single-sided centre offset facility. With the exception of the trims, all transmitter control elements can be assigned as transmitter controls. Option of assigning two switches to each input to act as a genuine three-stage function.
- Wing mixers: New concept for the multi-flap menu to simplify settings of one to eight wing servos on a flight-phase specific basis in a comprehensible manner without requiring the use of free mixers
- Expanded servo centre adjustment range: now +/-125 %
- Number of flight phases: fixed-wing: 7, helicopter: 6 + AR
- Phase trim available on all axes of fixed-wing models
- Servo assignments can be swapped at the receiver output

Only on the mc-20

- Flap count 4 AIL/4 FL: Full support of eight wing servos, even without use of free mixers
- »**Logical switches**«: this function permits two switches to be coupled as »and« or »or« logic functions. The result can be employed as a virtual switch. Typical application: The activation of certain functions should only be possible in conjunction with other functions, e. g. wheel brake can only be activated when the landing gear is down. A number of functions which are normally independent of one another, are to be put in their base settings by way of an »Emergency switch«. This program automation can be activated by multiple switches that also select the appropriate program. (Standard only on the **mc-20** HoTT, optional on the **mc-16** HoTT.)
- Flight phase switching cutoff delay: the delay time can be switched off for individual channels on a flight-phase basis (e. g. for motor off in electric models or to activate/deactivate helicopter head lock). (Standard only on the **mc-20** HoTT, optional on the **mc-16** HoTT.)

General HoTT features

- Simple, extremely fast binding for each model
- Ultra-fast re-binding even at maximum range
- Any number of receivers can be bound to provide additional channels (max. 32 channels)
- Range: test and warning function
- Low-voltage warning
- GR-16 and GR-24 receivers used in SAME mode can simultaneously address a maximum of four servos as a block, with a frame rate of 10 ms (digital servos only!)
- Thanks to cycle time reduced down to as little as 10 ms, extremely short response times are achieved.
- Real-time telemetry analysis on the transmitter screen. As an option, telemetry data can also be displayed on the SMART-BOX.
- Selectable cycle time: 10 ms or 20 ms/30 ms, depending on receiver and operating mode
- *Channel mapping* in the receiver allows free distribution of control functions.

  The travel distance and rotation direction settings integrated into the receiver make it possible, for example, to match up mapped servos with one another.
- The programmable fail-safe functions »Hold«, »Off« and »Move to preset positions« that are built into the receiver for every individual servo channel can be set separately.

mc-16 HoTT and mc-20 HoTT series computer systems

two remote control sets with 2,4-GHz-*Graupner*-HoTT technology
(**Ho**pping **T**elemetry **T**ransmission)

The No. 33016 set includes

- Microcomputer transmitter mc-16 HoTT with built-in LiIo transmitter battery 1s4p/4000 mAh/3.7 V and two 3-position switches, two proportional sliders on the centre console and two side-mounted proportional rotary controls (change reserved)
- plug-in charger (4.2 V, 500 mA)
- Short and long stick-tops (No. **33000.2** and **33000.3**)
- bidirectional receiver *Graupner* GR-12L HoTT (No. **S1012**) for connection of up to 6 servos GR-16 HoTT (No. **33508**) for connection of up to 8 servos
- USB adapter/interface (No. **7186.6**) including suitable USB cable for connection to a PC and an adapter cable (No. **7186.6S**) for receiver updates
- Micro-SD card (4 GB) with an adapter for a card reader
- Hand rests
- Transmitter strap

Replacement parts

No.	Description
3080	Aluminum transmitter case, HoTT, 400 x 300 x 150 mm
33000.1	Transmitter battery, flat LiIo, single cell six-pack/6000 mAh 3.7 V TX
33002.1	Micro-SD card, 4 GB for HoTT transmitter
33012.2	Transmitter metal hanger for mc-16 and mc-20 HoTT
33012.3	Hand rests for the transmitters mc-16 and mc-20 HoTT (2 piece)

The No. 33020 set includes

- Microcomputer transmitter mc-20 HoTT with built-in LiIo transmitter battery 1s6p/6000 mAh/3.7 V and twelve toggle switches (three 3-position switches, five 2-position switches, two centre-biased 2-position switches and two 2-position locking switches), two momentary switches on the back of the transmitter, two INC/DEC buttons (CTL 5 + 6) plus two side-mounted proportional rotary controls and two proportional sliders (specification reserved)
- plug-in charger (4.2 V, 500 mA)
- Short and long stick-tops (No. **33000.2** and **33000.3**)
- bidirectional receiver *Graupner* GR-12L HoTT (No. **S1012**) for connection of up to 6 servos and GR-24 HoTT (No. **33512**) for connection of up to 12 servos
- USB adapter/interface (No. **7186.6**) including suitable USB cable for connection to a PC and an adapter cable (No. **7186.6S**) for receiver updates
- Micro-SD card (4 GB) with an adapter for a card reader
- Metal hanger for transmitter straps
- Transmitter strap
- Hand rests
- Aluminum transmitter case

Accessories

No.	Description
71.26	Transmitter straps, *Graupner* HoTT
72.40	Transmitter straps, deluxe
	Teacher/pupil cable for the transmitters mc-16 HoTT and mc-20 HoTT, see page 221

Other accessories in Internet at www.graupner.de. Contact or visit your local dealer. He will be glad to provide advice.

Technical data

mc-16 HoTT and mc-20 HoTT transmitter

Frequency band	2.4 … 2.4835 GHz
Modulation	FHSS
Transmission power	100mW EIRP
Control functions	mc-16 HoTT: 8 functions, 4 of these can be trimmed, can be expanded to 12 functions at extra cost mc-20 HoTT: 12 functions, 4 of these can be trimmed
Temperature range	-10 … +55 °C
Antenna	Integral patch aerial inside case
Operating voltage	3.2 … 4.8 V
Current draw	about 400 mA
Range	up to about 4 000 m
Dimensions	about 235 x 228 x 66 mm (without hand rests)
Weight	about 1200 g with transmitter battery, without accessorys

GR-12L HoTT receiver (No. S1012)

Operating voltage	3.6 … 8.4 V*
Current draw	about 70 mA
Frequency band	2.4 … 2.4835 GHz
Modulation	FHSS
Antenna	1 diversity antenna, about 145 mm long, about 115 mm of this length encapsulated and about 30 mm active
Plug-in servos	6
Sensor sockets	1 (in place of servo 5)
Temperature range	-10 … +55 °C
Dimensions	about 36 x 21 x 10 mm
Weight	about 7 g

GR-16 HoTT receiver (No. 33508)

Operating voltage	3.6 … 8.4 V*
Current draw	about 70 mA
Frequency band	2.4 … 2.4835 GHz
Modulation	FHSS
Antenna	2 diversity antennas, about 145 mm long, about 115 mm of this length encapsulated and about 30 mm active
Plug-in servos	8
Sensor sockets	1
Temperature range	-10 … +55 °C
Dimensions	about 46 x 21 x 14 mm
Weight	about 12 g

GR-24 HoTT receiver (No. 33512)

Operating voltage	3.6 … 8.4 V*
Current draw	about 70 mA
Frequency band	2.4 … 2.4835 GHz
Modulation	FHSS
Antenna	2 diversity antennas, about 145 mm long, about 115 mm of this length encapsulated and about 30 mm active
Plug-in servos	12
Sensor sockets	1
Temperature range	-10 … +55 °C
Dimensions	about 46 x 31 x 14 mm
Weight	about 16 g

* *The specification for permissible operating voltage range applies only to the receiver. Please note in this context that receiver input voltage is applied without regulation to connected servos but the voltage range for most connectable servos (speed controls, gyros, etc.) is only 4.8 to 6 V*

General operating notices

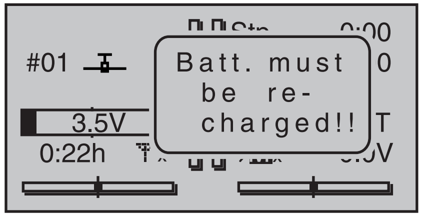
MC-16 HoTT and MC-20 HoTT transmitters

Transmitter power supply

The MC-16 HoTT is fitted as standard with a rechargeable Lithium-Ion 1s4p battery with 4000mAh and the MC-20 HoTT with a 1s6p Li-Ion battery with 6000mAh capacity. (Subject to change.)

However, the standard built-in battery is not charged upon delivery of the transmitter.

When the transmitter is used, its battery voltage should be monitored by way of the indicators provided in the LCD display. If battery voltage drops below the adjustable voltage setting (set via item "Batterie warning" in the "**Basic Settings**" menu, page 270,), default value 3,60 V, an audible warning signal will sound and the message window shown below will appear in the screen



No later than now, operation must be terminated so the battery can be charged again.

<u>*Notice:*</u>

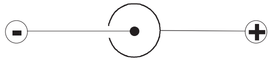
Be sure that the correct battery type is set in the "Basic Settings" menu, page 270! "Lith" must be set as standard.

The transmitter's rechargeable LiIo battery can be charged by way of the charger socket located behind a cover on the left, front side of the transmitter – as viewed from the front – with the included plug-in charger (No. **32032.4**).

The charging socket is protected as standard with a protective diode against reverse polarity. Original Graupner automatic chargers nevertheless recognize the voltage level of the battery. Note Setting the charger used.

MC-charging jack polarity

The charger cables on the market from other manufacturers often have different polarities. Therefore use only an original *Graupner* charger cable, No. **3022**.



Charging the transmitter battery using the plug-type charger

With the plug-type charger (4.2 V / 500 mA) included in the set the charge time for the transmitter battery is up to about fifteen hours, depending on the pack's initial state of charge.

Never use any other type or make of plug-type charger, nor a charger designed for other types of battery. There is a risk of excessive output voltage and incorrect connector polarity (see below), either of which can result in very serious damage. We recommend that you label the standard charger to avoid confusion. Please read the Safety Notes on pages 8 … <?>.

The transmitter must be switched "OFF" during the entire charging procedure. Never switch on the transmitter when it is connected to the charger. Even a brief interruption to charging can cause charging voltage to rise to a level that will immediately damage the transmitter with over-voltage. Also for this reason, be sure all connectors are always plugged in securely and have good contact.

Charging the transmitter battery via the USB socket

The transmitter is supplied fitted with a genuine *Graupner* transmitter battery with integral protective circuit which can also be charged via the USB port of the MC-16 HoTT and MC-20 HoTT transmitter at the usual current available at USB ports; see "mini-USB socket" on page 28.

With the transmitter powered on, the charge status is symbolized by slow rhythm on and off lines in the voltage display on the left side of the display.

WARNING:

Charging a battery without integral protective circuit via the USB socket incurs a serious risk of fire!

Charging with automatic chargers

To achieve quicker recharging of the single cell LiIo battery, *Graupner* automatic chargers can also be used. The table below shows a selection of these chargers.

Recommended chargers (accessory)

Order No.	Designation	Input voltage 220 V	Input voltage 12 V	suitable for battery types: NiCd	NiMH	LiPo/LiIo	lead battery	integr. balancer
6411	Ultramat 8	x	x	x	x	x		
6463	Ultramat 12 plus		x	x	x	x	x	x
6464	Ultramat 14 plus	x	x	x	x	x	x	x
6466	Ultra Trio plus 14	x	x	x	x	x	x	x
6468	Ultramat 16S	x	x	x	x	x	x	x
6469	Ultra Trio Plus 16	x	x	x	x	x		x
6470	Ultramat 18	x	x	x	x	x	x	x

6475	Ultra Duo Plus 45	x	x	x	x	x	x	x
6478	Ultra Duo Plus 60	x	x	x	x	x	x	x
6480	Ultra Duo Plus 80	x	x	x	x	x	x	x

Charger cable, No. **3022** *is additionally needed for the transmitter and charger cable, No.* **3021** *is additionally needed for the receiver.*

Other charger units and details about the listed chargers can be found in the Graupner RC main catalog or in Internet at www.graupner.de.

First connect the charger cable's banana plugs to the charger and only then connect the cable's other end into the charging jack on the transmitter. Never allow the bare ends of the banana plugs to come into contact with one another when the other end of the cable is plugged into the transmitter.

Charging current may not exceed 1.5 A as otherwise the diode, and perhaps other components, could be damaged. If necessary, limit the current at the charger.

Removing the transmitter's battery

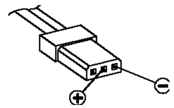
To remove the transmitter battery locate the cover of the battery compartment in the back of the transmitter and slide it off in the direction of the arrow:

Lift one side of the battery and withdraw it from the hook-and-loop tape without using force. Then disconnect the transmitter battery's connector by carefully pulling on the supply line cable.

(The photo shows the battery of the mc-20 HoTT transmitter.)

Inserting the transmitter's battery

The battery connector is protected against a reverse polarity connection by two slanted edges, see illustration. When correctly plugged in, the unconnected pin of the connector is at the bottom, as shown in the illustration. The plus pole (red lead) is in the middle and the minus pole (brown or black lead) is toward the antenna side.



Transmitter connector polarity

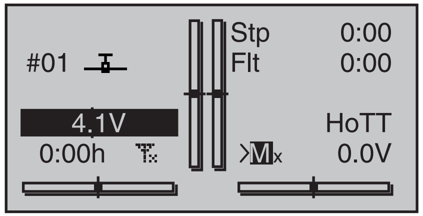
Never try to force the connector onto its circuit-board socket.

Place the battery into its compartment and close the transmitter's cover.

Battery operation timer at the bottom left of the screen

This timer shows the transmitter's cumulative operating time since the transmitter's battery was last charged.

This timer is automatically reset to "0:00" when the transmitter is switched on and its battery voltage is significantly higher than when the transmitter was last used, e. g. because the battery was charged.



General charging notices

- The charging instructions for the charger as well as for the battery from its manufacturer to be observed.
- Pay attention to the maximum permissible charging current specified by the battery's manufacturer. In order to prevent damage to the transmitter, charging current should never exceed 1 A. If necessary, limit the current at the charger.
- If the transmitter battery is nevertheless to be charged at a current rate in excess of 1 A, then it is imperative that this is done outside the transmitter. Otherwise there is a risk of damage to the transmitter's board due to overloading its printed circuit paths and/or overheating of the battery.
- If an automatic charger is to be used for charging, perform several test charging procedures to ensure the flawless functionality of its automatic shut-off. This applies particularly if you want to charge the standard installed Lithium battery with an automatic charger unit. You may need to alter the charger's cut-off behaviour if the charger you are using offers this option.
- Do not execute a battery discharge or battery maintenance program through the charger jack. The charger jack is not suitable for this purpose.
- Always connect the charger cable to the charger first and then to the receiver or transmitter battery. This avoids the possibility of shorting the bare banana plug ends together.
- If the battery heats up significantly, check the battery's condition, replace the battery or reduce the charging current.
- **Never leave a charging battery unattended.**
- **Follow the safety notices and handling instructions provided on page 8.**

Opening the transmitter housing

Carefully read the notices below before opening the transmitter housing. It may be better if unexperienced users ask a *Graupner* Service location to take care of the procedures described below.

The transmitter should only be opened in the following situations:

- to convert a neutralized joystick to a non-neutralized joystick or a non-neutralized joystick to a neutralized joystick.
- to adjust joystick return tension.

Switch off the transmitter before opening its cover.

Open the battery compartment as described on the previous double-page. If the handrests are fitted, undo the three lower retaining screws of the six screws in each handrest.

Now undo the five recessed screws in the back of the transmitter and the battery well using a PH1-size cross-point screwdriver; see illustration:

Note that the screw-holes are inclined slightly to the rear, so the cross-point screwdriver should be applied at the corresponding angle.

Hold the two housing sections together by hand then turn the transmitter upright over a suitable surface so these 5 screws can fall out without getting lost. Now lift up on the backplate carefully and place it to one side.

<u>Important notices:</u>

- ***Ensure that the shorter screw – in the battery well – does not fall inside the transmitter.***
- ***Make no modifications of any kind to the circuitry as this will void the guarantee as well as the unit's official permit.***

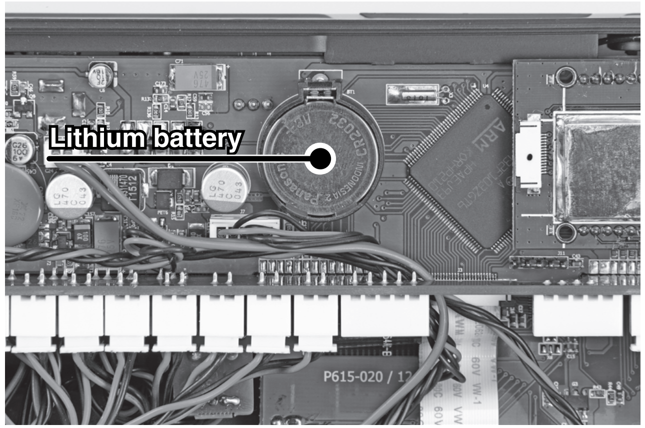
  This applies in particular to the switches installed on both sides of the front screen. If you wish to change the arrangement, contact your nearest Graupner Service Centre.
- ***Be sure not to touch the circuit boards with any metallic objects. Do not touch contacts with your fingers.***
- ***Never switch the transmitter on when its housing is open.***

When you close the transmitter again, be sure that …

- … no cables are caught between housing edges when the backplate is put into position.
- … both housing parts are properly seated with one another before screwing them together. Never force the housing sections together.
- Turn the screws down into the existing housing threads without stripping them out.
- … fit the shorter of the five screws in the battery compartment again.
- … reconnect the battery.
- … re-install the handrests if you wish.

Lithium battery CR 2032

When you remove the transmitter back panel, you will see the holder for a CR 2032 battery on the circuit board below the aerial base, slightly left of centre:



This battery maintains the date and time settings during a transmitter power supply outage, for example when the transmitter's main battery is being replaced.

Stick conversions

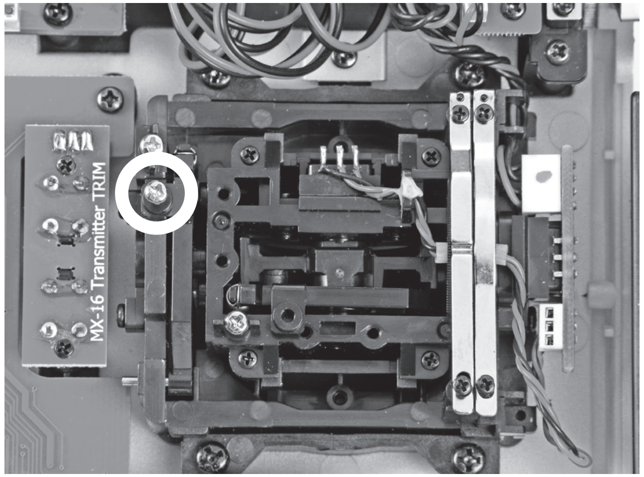
Neutralization

Both the left and the right joystick can be configured for neutralized or non-neutralized operation. Open the transmitter.

To change the joystick's factory setting, locate the screw shown in the figure below enclosed in a white circle.

Note:

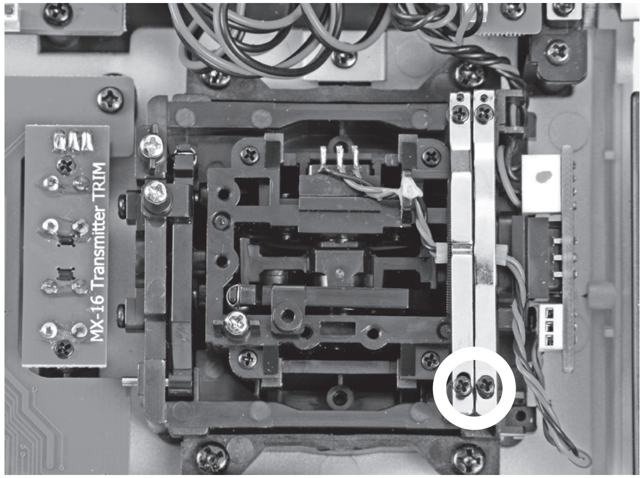
The aggregate for the right joystick is a mirror image of the left joystick so the corresponding screw for the right joystick is on the right side just below the middle.



Now turn this screw down until the respective joystick is free to move from limit to limit – or turn the screw out until the joystick again completely self-restoring.

Brake spring and ratchet

The outboard screw of the two marked in the next figure adjusts the braking force and the inboard screw adjusts the strength of the ratchet for the respective joystick:



Note:

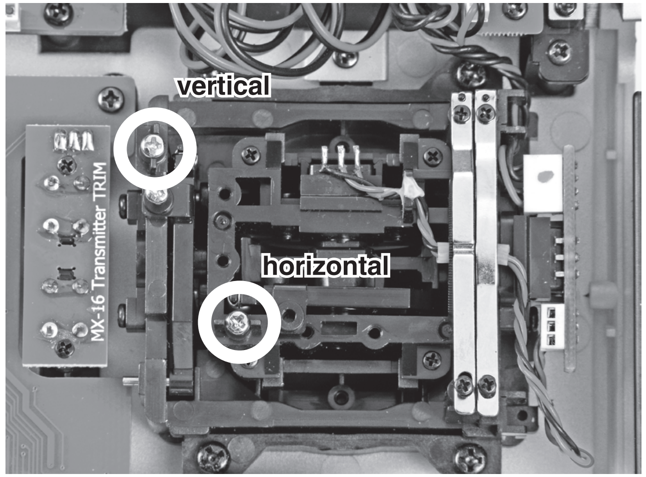
The aggregate for the right joystick is a mirror image of the left joystick so corresponding screws for the right joystick are located at the top left.

Joystick restoring force

The joystick's restoring force can also be adjusted to the pilot's preference. The adjustment is located next to the return springs, see markings in the figure below.

Spring force for the given direction of motion can be adjusted by turning the respective screw with a Phillips screwdriver.

- *clockwise = stronger return,*
- *counter-clockwise = weaker return.*



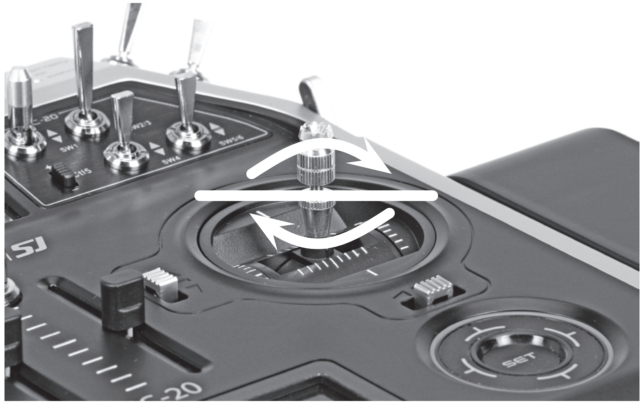
Note:

The aggregate for the right joystick is a mirror image of the left joystick so corresponding screws for the right joystick are located to the right of the middle.

Stick length adjustment

The length of both joysticks can be continuously adjusted to adapt these transmitter controls to the pilot's preference.

Hold the lower half of the knurled grip in place then turn the upper section to release its counter-locked threads:



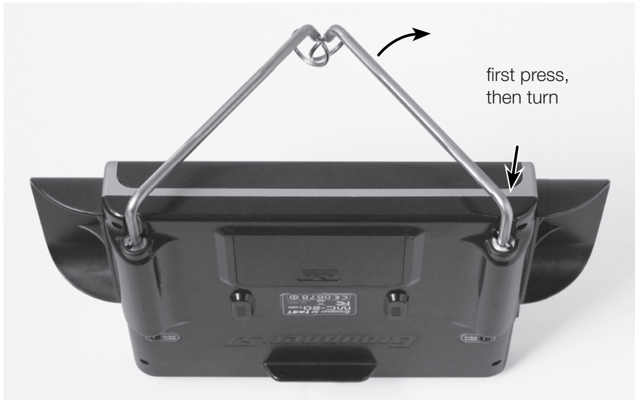
Now pull up or push down on the joystick's end to the desired length. When the length is suitable, tighten the counter-locked threads of the upper and lower sections again.

The procedure is the same if you wish to replace the short stick-tops with the longer ones also supplied in the set.

Transmitter neckstrap support bars

As standard the mc-20 HoTT transmitter set includes a strong support system for the attachment of a neckstrap. The mc-16 HoTT transmitter can be retro-fitted with the transmitter support system, No. **33012.2**, at any time.

The support bars are inserted in the sockets in the transmitter case, and locked in place. After the transmitter has been used, they can be removed again in similar way:

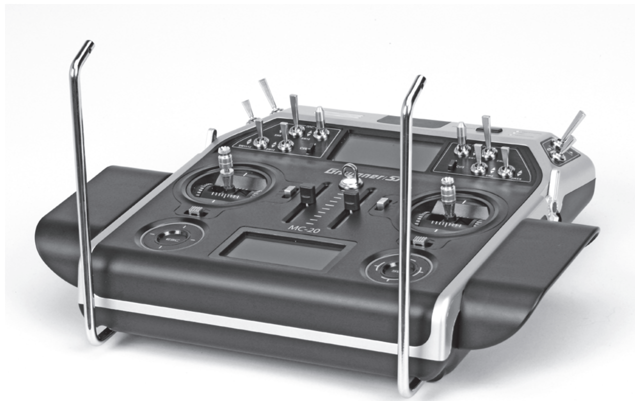


The support bars are installed as follows: push one of the bars into the socket in the transmitter case, angled towards the centre of the transmitter as shown above. Now ensure that the retaining pin attached to the bar is in line with the slot in the socket, and press the bar against the spring in the direction of the transmitter for a distance of about one centimetre. At the same time fold the bar outwards (do not use force) in order to lock it in place. Install the second support bar in the same manner.

To remove the support bars first unlock one of the bars by lightly pressing it inwards, and then fold it towards the centre of the transmitter. As soon as the retaining pin is free, you can withdraw the support bar from its guide. Repeat the procedure with the second support bar.

The following straps are available as accessories:

No.	Description
71.26	Transmitter straps, *Graupner* HoTT
72.40	Transmitter straps, deluxe



Transmitter description

Front side

(The illustration shows the mc-20 HoTT transmitter.)

Integral aerial inside case

Connector sockets
on the face side, protected by a cover, see beginning page 24

Option wells for switches and buttons:
The following are fitted as standard:
mc-16 HoTT: 2 three-position switches
mc-20 HoTT: 12 switches of various type and 2 INC/DEC buttons

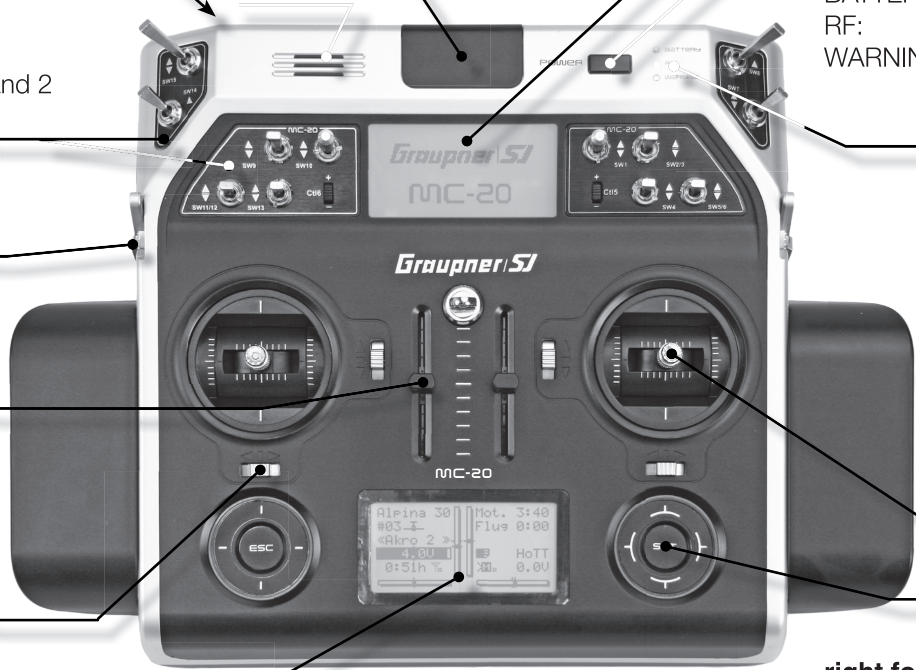
Function module
rotary control: left side "Lv1", right side "Lv2"

Function module
two sliders "Sl1" and "Sl2"

Digital trim
For the fine-tuning of servo positions (travel neutralization). Each click produces an increment of adjustment (position indicator in display). The trim increment can be selected in the »**Stick settings**« menu.

LC Display (more details available on page 30.)

Loud speaker



ON/OFF switch (ON/OFF with LED display)
Hold the ON/OFF switch pressed in for about one second to switch the transmitter on. Hold it pressed in for about three seconds to switch off.

LED indicators

BATTERY:	illuminates when voltage is sufficient
RF:	illuminates during RF radiation
WARNING:	blinks, for example, when "Throttle too high", "no pupil signal", "Transmitter battery voltage too low", …

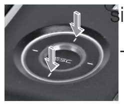
Joystick
Two joysticks for a total of four independent control functions. The length of the joysticks can be adjusted. The correlation of control functions 1 … 4 can be set on a model type basis by way of the »**Basic settings, model**« menu, e. g. throttle left or right. The throttle joystick can be converted from neutralizing to non-neutralizing, see page 21.

touch sensitive keys, left and right

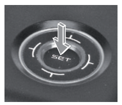
left four-way button:

ESC = select/confirm
ESC touched for about 1 s: Changeover between telemetry menu and basic display
= scroll in one of the four directions with every tap (◄, ►, ▲, ▼)

simultaneous horizontal tap (◄ ►)
= changeover between basic display and servo display



+



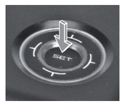
Simultaneous vertical tap of the left (▲▼) keys + "**SET**" of the right four-way button = changeover to the "secret mode", see page 36.

LC Display (more details available on page 30.)
Contrast adjustment in the »General settings« menu; see page 269.

Warning indicators:

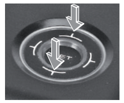
- for underrun of preset battery voltage threshold
- for fault function of the teacher/pupil system
- C1 joystick too far toward full throttle when transmitter is switched on
- …

right four-way button:

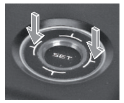


SET = select/confirm
= scroll or change value with every touch of one of the four direction symbols (◄, ►, ▲, ▼)

Circle with the finger around the circumference
= scroll/change values. Alternative values selection with the left four-way button (◄, ►, ▲, ▼)



or



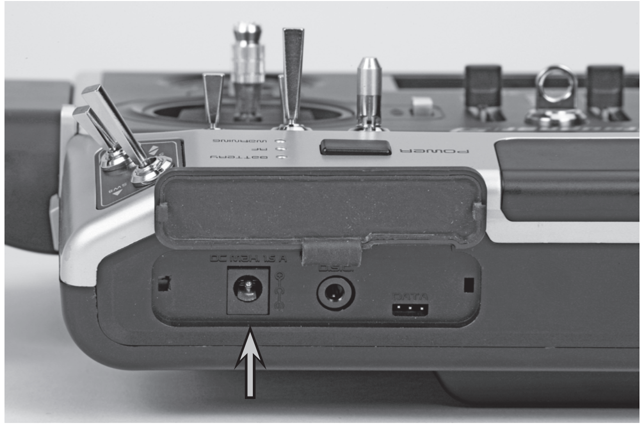
simultaneous tap on ▲▼ or ◄ ► = **CLEAR**

Face-side connections

Charger socket

(The illustration shows the mc-20 HoTT transmitter.)

The *left-hand* side flap provides access to the charge socket of the mc-16 HoTT and mc-20 HoTT transmitter:



The transmitter's rechargeable LiIo battery can be charged by way of the charger socket located behind a cover on the left, front side of the transmitter – as viewed from the front – with the included plug-in charger (No. **32032.4**).

Maximum permissible charging current with *Graupner* automatic chargers: 1,5 A.

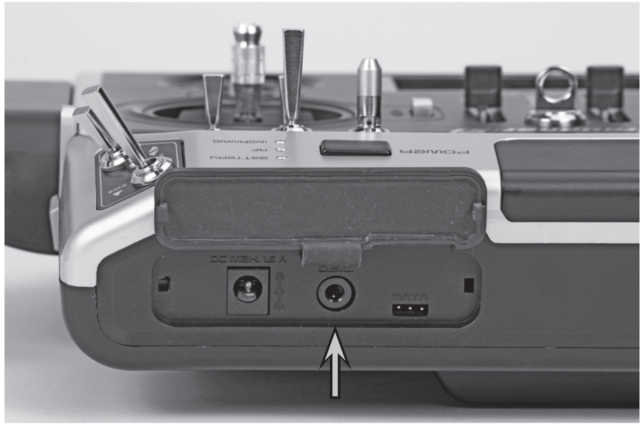
Never use plug-in chargers from other manufacturers or chargers intended for other battery types. Charger output voltage which is too high or possibly even different plug polarity, see further below, can cause immense damage.

More information about charging the transmitter's battery can be found on page 18. Observe the safety notices beginning on page 8 when handling lithium batteries.

DSC jack

The acronym "DSC" is a carryover which stands for the original "Direct Servo Control" function. However, in HoTT systems the "direct servo control" function is no longer available via a diagnose cable due to technical reasons.

Once the *left-hand* side flap has been moved away, the DSC socket is accessible:



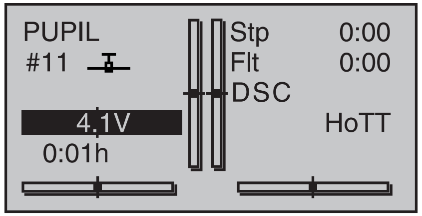
The two-pole DSC socket fitted as standard to mc-16 HoTT and mc-20 HoTT transmitters serves both as Trainer socket (Teacher and Pupil) and also as interface for flight simulators and external RF modules.

To ensure a proper DSC connection, please observe:

1. Make any necessary menu changes.

   Refer to the section beginning on page 218 to adapt the transmitter to a teacher/pupil system.
2. When operating a flight simulator or when operating the transmitter as a *pupil* transmitter, **ALWAYS switch OFF** the transmitter as only in this position does the transmitter's RF module remain inactive after the DSC cable is inserted. This also reduces the transmitter's power consumption somewhat.

   Only the red LED should remain constantly illuminated and the transmitter's basic display should show the character string "DSC" below the operating time clock. At this time, the display of telemetry data and symbols will be suppressed.

   The transmitter's upper display will show the message "CANNOT RECEIVE DATA" during this time.

   Thus the transmitter is ready for operation.

   In contrast, the transmitter in teacher mode is to be **switched on prior** to plugging in the respective cable.
3. Connect the other end of the cable to the desired unit in compliance with the given operating instructions for that unit.

   Important:

   Pay attention that all plugs are inserted securely into their respective sockets and use only the prescribed 2-pole TRS connector plugs on the DSC-side.
4. In the line "DSC Output" in the »**Basic settings, model**«, page 85 or 95, – depending on the number of functions transferred – one of the following modes can be set: PPM10, PPM16, PPM18 or PPM24. Default setting: PPM10.

<u>*Notice about flight simulators:*</u>

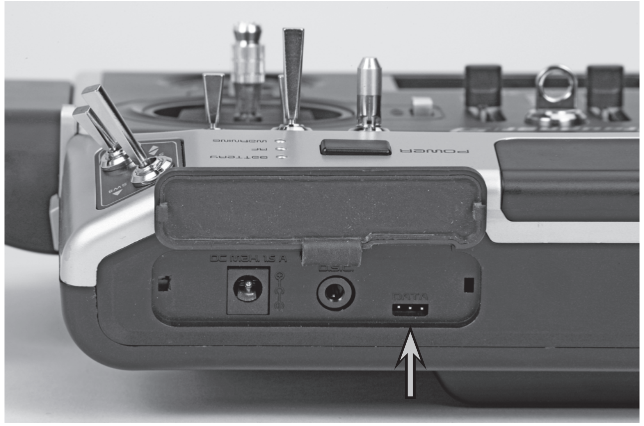
Because of the myriad of flight simulators available on the market, it may be necessary to have the contact layout of the audio plug or DSC module appropriately modified by Graupner Service.

CAUTION:

For direct connection of your transmitter to a PC or a laptop via cable (DSC-cable) and / or PC interface for your simulator it may possibly result in destruction of the transmitter by electrostatic discharge! This type of connection may therefore only be used if you are, for example, using a grounding strap against electrostatic discharge protection (commercially available in electronic shops) during the simulator operation. Therefore Graupner strongly recommends to use only simulators with wireless transmission technology.

Data jack

The *left-hand* side flap provides access to the DATA socket of the mc-16 HoTT and mc-20 HoTT transmitter:



This jack is intended for connection of the optional Smart-Box, No. **33700**. Details about the Smart-Box can be found with the given product in the *Graupner* RC main catalogue or in Internet at www.graupner.de.

However, the Data socket can also be used to connect external RF modules made by other manufacturers; see “EXT.” and “SP.” in the “Module” section of the “Basic model settings” menu on pages 81 and 91.

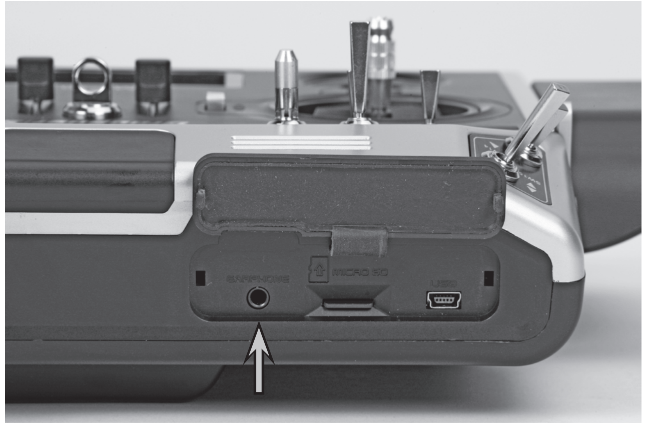
The operation of a Smart-Box or a Bluetooth module, see below, is in the “SP mode” generally not possible

Firmware version V1102 and higher

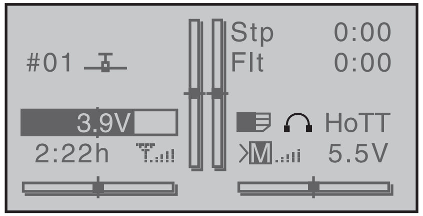
From firmware version V1102 it can be connected to the Data jack now not only the Smart-Box or alternatively an external RF module, but also the external Bluetooth module of MZ transmitter, No. 8351 can be operated. For details on switching between the respective operating modes of the socket, see in “Data sel.” the description of the menu “general settings“ on page 271.

Headset connector

Once the right face-side cover has been moved away, the transmitter’s headset connector is accessible:



The jack is intended for connecting conventional earplugs or a headset by way of a 3.5 mm TRS plug. (not included in the set) An appropriate symbol will appear in the basic display when a headset is connected:



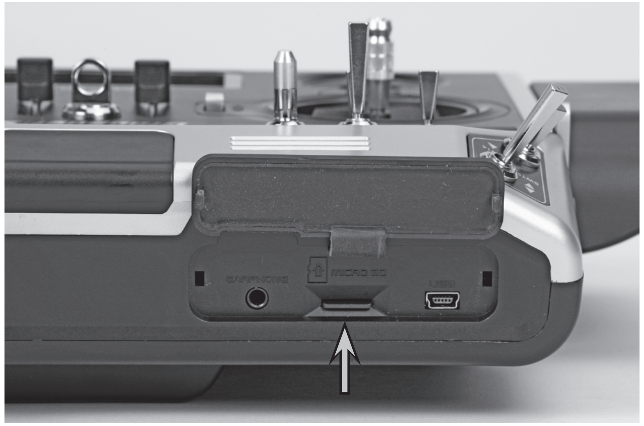
The transmitter’s acoustic signals as well as those signals associated with the telemetry menu are output via this connection. These announcements are made in German language by default. More about this can be found under “Voice output” in the section »**SECRET MODE**« beginning on page 36 and »**Telemetry**« beginning on page 236.

The volume of signals and voice output sent to the headset can be adjusted individually in the lines “Voice volume”, “Vario volume”, and “Beeps volume” of the »**General basic settings**« menu, page 266.

Card slot

micro SD and micro SDHC

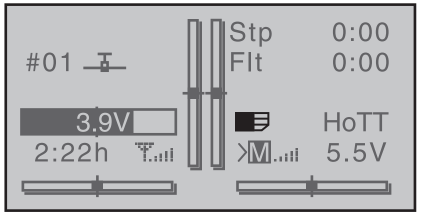
The transmitter’s card slot for type micro-SD and micro-SDHC memory cards becomes accessible once the *right* face-side cover has been turned away.



Although a memory card is supplied as standard, the slot also accepts any standard commercial micro-SD memory cards of up to 2 GB capacity and micro-SDHC cards of up to 32 GB capacity. However, as a manufacturer we recommend the use of memory cards no larger than 4 GB as this is completely adequate for all normal situations.

The type of memory card to be used in the transmitter is that known in conjunction with digital cameras and cell phones. It is to be pushed into the slot, contacts up, until it latches, see photos above. Once the memory card has been inserted, the transmitter’s cover flap can be closed again.

If the standard memory card is inserted – or another card which has already been inserted in the transmitter at least once – then the card is immediately ready for use when the transmitter is switched on. When the transmitter is switched on again after inserting such a card, the stylised memory card icon appears in the base display:



If the card has not previously been inserted, the transmitter first creates a number of folders on it; this is indicated in the transmitter’s base display by a card symbol which slowly fills from left to right. The memory card is ready for use as soon as this animation ceases.

You can remove the prepared memory card from the transmitter when required, and insert it in a suitable card reader. Connect the reader to your PC or laptop, and copy the files – previously downloaded from the Download page for your transmitter – into the appropriate folder. Now remove the memory card from your card reader and insert it in the transmitter once more.

Removing the memory card

Press the SD or SDHC card a bit further into the card slot to release the slot’s latch then pull out the memory card.

Data acquisition / storage

The storage of data on the SD card is coupled to the flight timer. If this timer is started – when a suitable memory card is inserted in the card slot and a telemetry link to the receiver exists – data acquisition is also started. Data acquisition will stop again when the flight timer is stopped. The flight timer is started and stopped as described in the section »**Timers (general)**” on page 159.

The amount of data written on the memory card is presented as a black bar graph (■) which grows from left to right as data fills the memory card .

After a data acquisition session is finished, there will be an (empty) folder “Models” and a “LogData” folder on the memory card. Within the “LogData” folder there will be log files, that are designated with names in the format 0001_year-month-day.bin, 0002_year-month-day.bin, etc., in sub-folders named “model name”. If a model memory is still “unnamed” the respective log files can be found in a sub-folder designated “NoName” when the memory card is removed from the transmitter and inserted into the card slot of a PC or laptop. There is a PC program available on the transmitter’s download web page at www.graupner.de with which the stored data can be evaluated on a compatible PC.

Importing voice files

As mentioned in section “Headsets”, here at the right, the transmitter’s acoustic signals as well as those signals and announcements associated with the »**Telemetry«** menu can be output by way of the headset connector. These announcements are made in German language by default. These announcements are summarized in a voice packet which is stored in a transmitter-internal memory but can be replaced by a voice packet of a different language at any time. More information about this can be found in the section »**SECRET MODE**« beginning on page 36.

Transmitter firmware updates

The transmitter firmware can be updated and – if necessary – replaced at this menu point, using the procedure described in the previous section entitled “Importing voice files”; the screen language can also be changed here. For more details of this please refer to the section entitled “SECRET MODE” which starts on page 36.

In addition to a German can be found on the supplied standard SD card at the time of revision of this guide as an English, French, Dutch, Italian and Spanish firmware version.

Updates and more information can be found on the product page for your specific HoTT transmitter; see the Download section at www.graupner.de.

Important notes:

- ***No claim can be considered unless a log file is present; see left under “Data recording / storing”.***
- ***For the same reason the transmitter must always be updated to the latest software status.***
- ***It is essential that you register at https://www.graupner.de/en/service/product_registration.aspx to ensure that you are constantly informed of important software updates. This is the only means by which we can automatically keep you aware of new updates by e-mail.***

Importing/exporting model memories

Any model memory can be stored to an inserted memory card or from an inserted card into the transmitter. This feature is intended to support data exchange between identical transmitters or even use as data backup. More information about this can be found in the section »**Copy / Erase**« beginning on page 72.

Notes:

- *Some special symbols that can be used in model names are subject to specific restrictions associated with the FAT or FAT32 file system used by the memory cards and these special symbols will be replaced during the copy process with a tilde (~).*
- *In principle the model memories of the* **mx-20** *and* **mc-20** *transmitters are compatible, BUT:*

  If you wish to carry out an “Import from SD card” in the other transmitter you must first copy or move the appropriate model memory to the appropriate folder on a PC. For example: from \\Models\mc-20 to \\Models\mx-20, or vice versa.

  See page 74 for more information on “Import from SD card”.

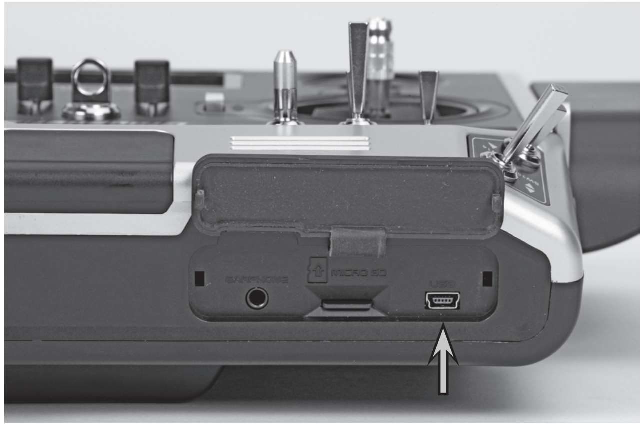
  C A U T I O N :

  After you have carried out an “Import from SD card” it is absolutely essential to check all the model functions with great care.

  Note also that the transmitter control and switch functions may need to be adjusted to suit the new transmitter.

Mini-USB connector

The *right-hand* side flap of **mc-16** HoTT and **mc-20** HoTT transmitters provides access to the software update socket, which is also used for altering the date and time via a PC using the Windows XP, Vista or 7 operating system; this socket is located on the right-hand side under the flap:



The USB cable, No. **32032**, which is included with the set is to be connected to this jack. The procedure for carrying out a software update via a PC is described on page 50.

The PC software required, as well as the suitable USB driver, can be found on the download page for the given product on the *Graupner* website at www.graupner.de.

Once the necessary driver and software is installed on the PC, this USB connection can be used to update the transmitter or even just to set the transmitter's date and time. To set the transmitter's date and time by way of this jack, refer to the »**Info display**« menu, beginning page 278.

Note:

***mc-16** HoTT and **mc-20** HoTT transmitters can also be charged using this USB socket at the standard currents present at USB ports; see page 16.*

Bottom side transmitter interior

(The illustration shows the mc-20 HoTT transmitter.)

Lithium battery CR2032 (not rechargeable)
Independent backup for the transmitter's date and time settings, see »**Info display**« menu on page 278.

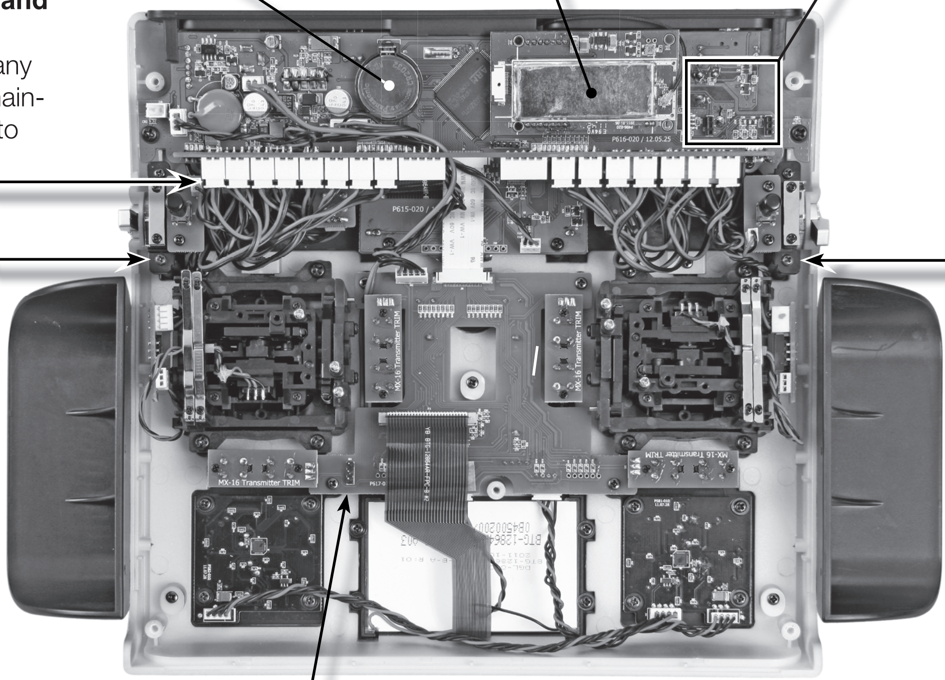
RF modul

Socket for optional Bluetooth module
No. **33002.5**

Sockets for optional transmitter controls and switches
(In principle you can connect the switches in any order, but we strongly recommend that you maintain the same sequence as the case legends to avoid confusion.)

SW16/PB18 (when transmitter is closed), see “Physical control, switch and control switch assignments” on page 60

SW17/PB19 (when transmitter is closed), see “Physical control, switch and control switch assignments” on page 60



Transmitter battery plug
For charging the battery and a list of suitable automatic chargers, see page 18

ATTENTION:

Disconnect the transmitter battery at its connector when performing any type of work inside the transmitter. Never allow solder points to come into contact with objects as this can create short circuit conditions.

All jacks and plugs not described are to be left unconnected.

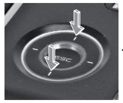
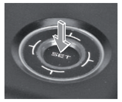
Display and keypad

(The illustration shows the control pad of the MC-20 HoTT transmitter.)

left four-way button:

ESC = select/confirm
ESC touched for about 1 s: Changeover between telemetry menu and basic display
= scroll in one of the four directions with every tap (◄, ►, ▲, ▼)

simultaneous horizontal tap (◄ ►)
= changeover between basic display and servo display


+


simultaneous vertical tap of the left (▲ ▼) keys + "**SET**" of the right four-way button = changeover to the "secret options", see page 36.

Flight phase name
see menu »**Phase settings**«, page 148 or 152

Model memory location
MC-16: 1 … 20
MC-20: 1 … 24

Model type indicator winged model, helicopter

Model name

No pupil signal!	Throttle too high!	Batt. must be re-charged!!	Fail Safe setup t.b.d.

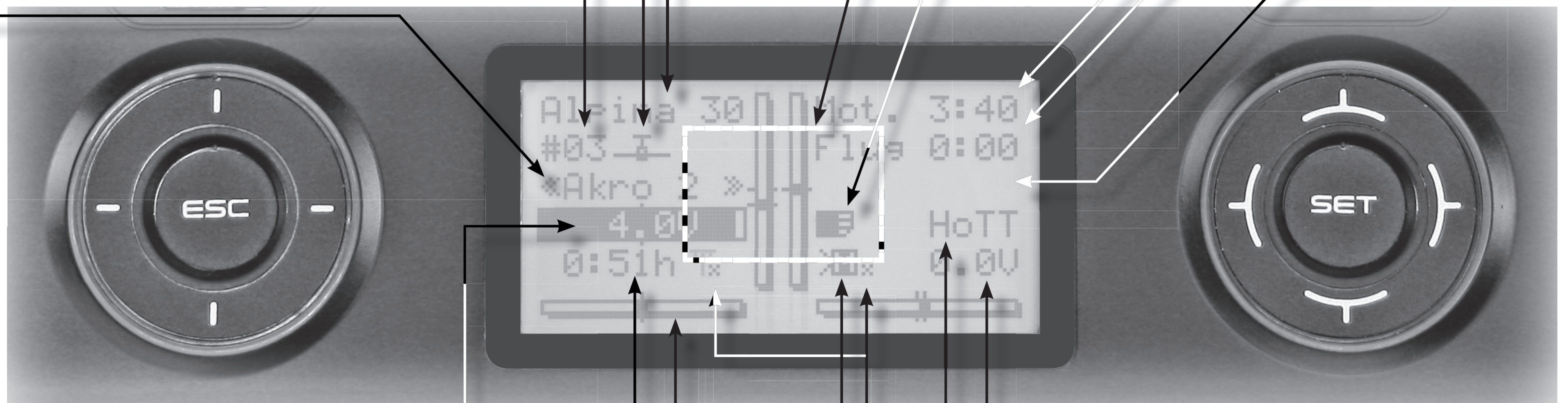
A selection of potential warnings and notices. More about this on page 35.

micro-SD card inserted

Stopwatch in min:s (upward/downward)

Flight timer in min:s

Flight phase timer display, if available; see "Flight phase timers", page 162.



Transmitter battery voltage with dynamic bar indicator. If the lithium battery voltage underruns the 3.60V (adjustable) threshold a warning message will appear and an acoustic warning will sound. (Switchover for NiMH batteries.)

Transmitter operating time. This will automatically be reset to zero after a charging process.

Display diagram for all four digital trim levers with numeric indicator and direction indicator

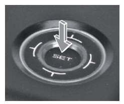
M = Model operation
P = Pupil (pupil transmitter)

Signal strength

Operating mode

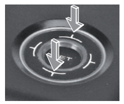
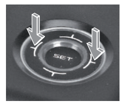
Receiver battery voltage RX-SPG

right four-way button:



SET = select/confirm
= scroll or change value with every touch of one of the four direction symbols (◄, ►, ▲, ▼)

Circle with the finger around the circumference
= scroll/change values. Alternative values selection with the left four-way button (◄, ►, ▲, ▼)


or


simultaneous tap on ▲▼ or ◄ ► = **CLEAR**

Operating the "data terminal"

Entry keys **ESC** and **SET**

Display symbols

Displayed telemetry symbols

- T⊘ the active model memory has not yet been "bound" to a HoTT receiver. More about the "Binding" process can be found on page 80 or 90.
- T:: Switched off on RF transmitter side
  blinking antenna symbol:
  The last receiver bound to the active model is inactive or out of range
- >M x no telemetry signal to receive
- >M .ııl signal strength indicator of the connection to the model
- >P .ııl signal strength indicator of the connection to the pupil transmitter in the display of the teacher transmitter for wireless teacher/pupil operation

Keys left of the display

- **ESC** key
  each brief tap on the **ESC** key will cause a stepwise return in function selection or even further to the base screen. Any changes made to settings remain.
  Momentarily touching the **ESC** key for about 1 s while in the base screen will open and close the »**Telemetry«** menu.
- Selection keys ◄ ► ▲▼
  1. A tap on one of these keys will scroll, appropriate for the given arrow direction, through lists, such as through the model selection list or the multi-function list or within menus though the menu's lines.
  2. A brief simultaneous tap on the ◄ ► keys will cause a switch from the transmitters base screen, as well as from almost any menu position, into the »**Servo display**« menu.

Keys to the right of the display

- **SET** key
  1. After switching the transmitter on, a brief tap on the **SET** key will cause a jump from the displayed base screen to the Multi-function menu. In the same manner, a selected menu can now be called up with the **SET** key.
  2. Within menus having settings, activate / deactivate (confirm) the given setting fields with a tap on the **SET** key.
- Selection keys ◄ ► ▲▼
  1. "Leafing through" the multi-function menu, and the menu lines within the set-up menus, in the same manner as the Select buttons of the left-hand four-way button, or – on the mc-20 transmitter – in the same manner as "circling" over the four Select buttons.
  2. Select or set parameters in setting fields after their activation with a tap on the **SET** key, whereby the ►▲ and ◄▼ keys will have the same given function. In this case it is completely irrelevant which of these two keys are used.
  3. A brief simultaneous tap on the ▲▼ *or* ◄ ► keys will set a changed parameter value in the entry field back to its default value (**CLEAR)**.

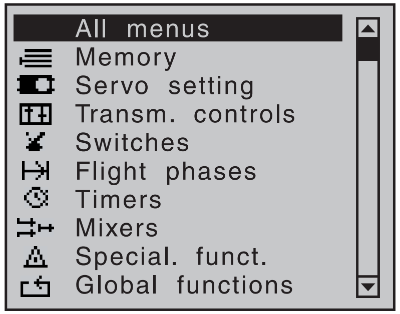
<u>*Notes:*</u>

- *In contrast to the four-way buttons of the mc-16 HoTT transmitter, which are "pressed" in the same way as micro-switches, the touch-sensitive Cap-Touch buttons of the mc-20 HoTT respond to the lightest of touches.*
- *Touching the given four-way button does not itself initiate the given action but rather the end of the touch.*
- *In the event the four-way buttons do not exhibit any functionality immediately after switching the transmitter off and then on again right away, this is not a fault. Just switch the transmitter off again then wait for several seconds before switching it on again.*

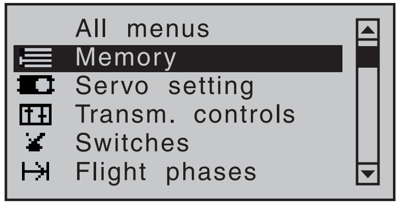
Shortcuts

The following key combinations can be used to directly call up certain menus and options:

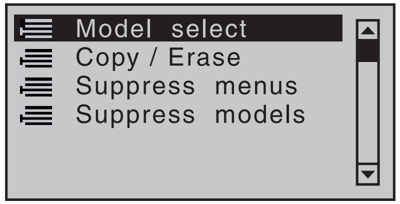
- **CLEAR**
  A brief simultaneous tap on the ▲▼ *or* ◄ ► keys of the right four-way button will reset a changed parameter value in the active entry field back to its default value.
- »**Servo display**«
  A brief simultaneous tap on the ◄ ► keys of the left four-way button will change from the transmitter's base screen or from almost any menu position to the »**Servo display**« menu, see page 274.
- »**Telemetry**« menu
  Tap the centre **ESC** key of the left four-way button for about 1 s to call up the »**Telemetry**« menu from the transmitter's base screen or return to the base screen again, see text beginning on page 228.
- **Graphic display of telemetry data**
  Briefly touching one of the selection keys of the left or right four-way button will cause a jump from the base screen directly to the transmitter's graphic display of telemetry data or will allow paging back and forth between individual graphic displays.
  A brief tap on the centre **ESC** or **SET** key will cause a return back to the base screen.
- »**SECRET MODE**«
  (Language selection, Firmware update, Stick calibration etc.)
  Touch and hold the ▲▼ selection keys of the left four-way button then momentarily touch the **SET** key of the right four-way button, see text beginning on page 36.
- **Entry lockout**
  Entry lockout is activated and deactivated from the base screen by simultaneously touching the **ESC** and **SET** keys for about 2 s.
- **Quick-Select**
  From the multi-function list, a jump can be made into a "Structure overview" by way of a brief, simultaneous tap on the ▲▼ *or* ◄ ► keys of the right four-way button. Menus are arranged in clear groups in this overview.



Now the desired group can be selected with the ▲▼ selection keys of the left or right four-way button …



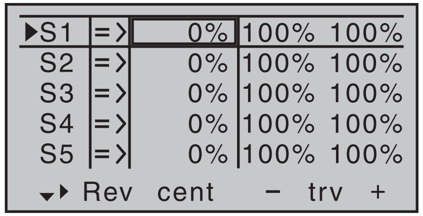
… then finally tap the centre **SET** key of the right four-way button briefly. As soon as the key is released, only the respective generic term for the given menu will remain listed. For example:



Now you can select the desired menu point using the ▲▼ *or* ◄ ► buttons, and then call it up by pressing the **SET** button of the right-hand four-way button.

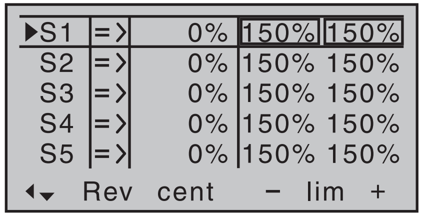
Concealed menu columns

Some menus have concealed columns to improve legibility. Menus with concealed columns can be recognized by virtue of a triangle pointing to the right in the bottom left corner of the screen. For example, in the menu »**Servo settings**«:

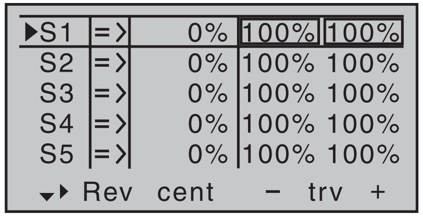


In this menu, e. g. the column "- lim +" (servo travel limit) to the right of column "- travel +" is "concealed".

To reach this column, use the pointing triangle at the bottom left of the screen to push the frame marker with the arrow key ▶ of the left or right four-way button to just beyond the column for "- travel +":



To again return to the now-concealed column "- travel +" or even further to the left, push the frame marker with arrow key ◀ of the left or right four-way button appropriately to the left:



This procedure is analogous for the other menus.

Function fields in the display

CLR, **SEL**, **STO**, **SET**, **SYM**, **ASY**, **POS**,

Depending on the given menu, certain function fields will appear on the bottom display line:

A marked function is activated with a tap on the **SET** key.

Function fields

- **CLR** (clear) erase
- **SEL** (select) selection
- **SET** (set) “set” or adjust a value
- **STO** (store) store (e. g. control position)
- **SYM** set values symmetrically
- **ASY** set values asymmetrically
- **POS** Only in »**Trim memory**« menu
- switch field symbol (assignment of all types of switches)
- within a menu, change to the second page, (menu continuation)

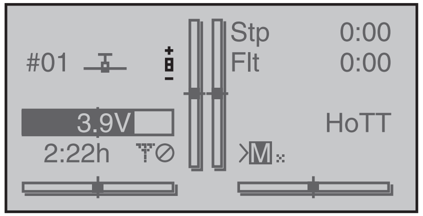
Position indicator

INC/DEC buttons CTL 5 and 6

When you operate one of the two INC/DEC buttons CTL 5 + 6, which are fitted to the two switch boards of the mc-20 HoTT transmitter only, a small symbol appears on the left of the screen adjacent to the two vertical position indicators:

At the same time, for the duration of the control‘s operation, the position indicator for the two vertical bars in the middle will change from displaying current trim position to a display of the respective current position of the controls CTL 5 & 6.

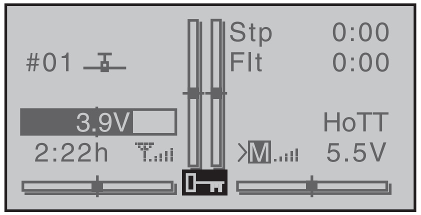
Logically, the left control (CTL 6) is displayed by the left bar indicator and the right bar indicator displays the position of the right control (CTL 5). The two horizontal bars continue to show current trim positions of respective stick trim controls:



About 2 seconds after operating one of the controls has ended, the display will again revert to display of current trim positions of the four trim controls generated by the two sticks.

Entry lockout

On the mc-20 HoTT transmitter it is available a lockout for the touch keys, and thus protection against inadvertent use of all setting options, can be established by touching and holding the **ESC** and **SET** keys simultaneously for about two seconds while the transmitter is in its basic display. This lockout condition is indicated by a key symbol, located at the intersection point of the trim bars, which is displayed in reverse video.



The lockout is effective immediately but controls remains operationally ready.

This lockout can be removed by again touching and holding the **ESC** and **SET** keys for about two seconds.

Warning notices

Batt. must
be re-
charged!!

Transmitter operating voltage is too low

BIND. N/A
OK

“Bind not available“
A receiver has not yet been bound to the currently active model memory. A brief tap on the **SET** key will cause a direct jump to the appropriate option.

Attention!
Switch-OFF
the Receiver first!

This warning appears if you try to change models in the »**Model select**« menu with the receiver of the previously active model still switched on.

CAN‘T
RECEIVE
DATA
OK

No bound receiver in range

Please select
RF on/off?
ON OFF

Only for a receiver that has already been bound:
Please select RF “on“ or “off“? RF

RF
must be
OFF
OK

Request to switch off the RF section.

Fail Safe
setup
t.b.d.

Failsafe has not yet been activated

Thr
too
high!

The throttle stick of a fixed-wing model, or stick and/or throttle limiter of a helicopter, is too far in the direction of full-throttle.

No
pupil
signal

Connection between teacher and pupil transmitter is interrupted

SD-CARD
INSERT
OK

No SD or SDHC memory card in the card slot or card is not legible

- Within the line “Power on” the menu “general. Settings “(page 270) set time the transmitter has not been operated. The display shows ...

Power on warning
is active!

- ..., The “WARNING” LED to the right of the ON / OFF switch will blink and acoustic signals will sound.
  If the transmitter is now still not actuated switches
- If battery voltage is too low, a model switch is blocked for reasons of safety. An appropriate message will appear in the screen:

not possible now
voltage too low

- Is the “wireless teacher/pupil connection” that was active when the transmitter was last used to be continued, **ACT** or switched off **INH**?

Please select
Trainer link?
ACT INH

Please select
Trainer link?
ACT INH

HIDDEN MODE

Language selection, Firmware update, Stick calibration etc.

The mc-16 HoTT and mc-20 HoTT transmitter's »**HIDDEN MODE**« menu can be called up from almost any menu position by touching and holding the ▲▼ selection keys of the left four-way button and the **SET** key of the right four-way button for at least 3 seconds. This will produce the display shown below.

```
   ✱ HIDDEN MODE ✱
>VOICE              =>
 FIRMWARE UPDATE    =>
 STICK CALI.
 BLUETOOTH INIT.
```

VOICE

As mentioned in section "Headsets" on page 25, the transmitter's acoustic signals as well as those signals and announcements associated with the »**Telemetry«** menu can be output by way of the headset connector. These announcements are made in German language by default. These announcements are summarized in a voice packet which is stored in a transmitter-internal memory but they can be replaced by a voice packet of a different language at any time.

At the time of this manual's revision, the standard SD card delivered with the set includes the following languages:

- Dutch
- English
- French
- German
- Italian
- Spanish

The given active language packet can be swapped out either with the PC program available as a download from the transmitter's web page at www.graupner.de or with the SD card, as described below.

If not already done, insert the SD card or SDHC card into the transmitter as described on page 26. Once the memory card is inserted in the transmitter, switch the transmitter on *with RF switched off.*

```
 Please select
  RF on/off?
  ON    OFF
```

Now move to the »**HIDDEN MDE**« menu as described earlier in this section:

Language change

Use the selection keys of the left or right four-way button to select the line "VOICE" line:

```
   ✱ HIDDEN MODE ✱
>VOICE              =>
 FIRMWARE UPDATE    =>
 STICK CALI.
 BLUETOOTH INIT.
```

Use the centre **SET** key of the right four-way button to switch to the selection page for the "VOICE" line:

```
FILE LIST
►VOICE2_DUTCH.VDF
 VOICE2_ENGLISH.VDF
 VOICE2_FRANCE.VDF
 VOICE2_GERMAN.VDF
 VOICE2_ITALIANO.VDF
 VOICE2_SPAIN.VDF
```

Now use the ▲▼ keys of the left or right four-way button to choose the desired language, for example:

```
FILE LIST
 VOICE2_DUTCH.VDF
►VOICE2_ENGLISH.VDF
 VOICE2_FRANCE.VDF
 VOICE2_GERMAN.VDF
 VOICE2_ITALIANO.VDF
 VOICE2_SPAIN.VDF
```

Confirm the choice with another tap on the centre **SET** key of the right four-way button. The selected language packet will be loaded into the transmitter's memory:

```
   ✱ HIDDEN MODE ✱
>VOICE              =>
 FIRMWARE UPDATE    =>
 STICK CALI.
 BLUETOOTH INIT.

               22/100%
```

The loading process is finished as soon as the progress bar at the lower edge of the display disappears:

```
   ✱ HIDDEN MODE ✱
>VOICE              =>
 FIRMWARE UPDATE    =>
 STICK CALI.
 BLUETOOTH INIT.
```

When this process is finished, switch off the transmitter.

All settings stored in the transmitter remain intact after a change of language has been made.

Notes:

- *If the warning …*

```
    RF
  must be
    OFF
    OK
```

*… appears, then the transmitter's RF radiation is still active. Jump to the »**Base setup model**« menu, select the "RF transmit" line, select its "OFF" option then repeat the procedure*

- *If the warning …*

```
SD-CARD
INSERT
OK
```

… appears then the transmitter does not detect a memory card in its card slot or the card found cannot be read.

- *If the selection window is empty …*

```
FILE LIST
```

… then the transmitter could not find an appropriate file on the inserted memory card. Check the contents of the SD card's "VoiceFile" directory on a PC or laptop.

FIRMWARE UPDATE
Change display language

Important notice:

Be sure to check the charge status of your transmitter's battery or charge its battery as a precaution before every update. Also backup all occupied model memories so they can be restored if that should become necessary.

```
  * HIDDEN MODE *
 VOICE               =>
>FIRMWARE UPDATE     =>
 STICK CALI.
 BLUETOOTH INIT.
```

In the same manner as described above in the section "VOICE", this menu item can be used to update or change the transmitter's firmware, including its display language. At the time of this manual's revision, the standard SD card delivered with the set includes the following languages:

- Dutch
- English
- French
- German
- Italian
- Spanish

Additional languages will follow at a later date.

Updates and additional information for your system can be found on the product page for your specific HoTT transmitter in the Download section at www.graupner.de.

Navigate by pressing the central **SET** key of the right four-way button on the selection side of the "Firmware Update" option:

```
FILE LIST
>MC-20_1V234_Dutch.bi
 MC-20_1V234_English.
 MC-20_1V234_France.b
 MC-20_1V234_German.b
 MC-20_1V234_Italiano
 MC-20_1V234_Spain.bi
```

Now use the ▲▼ selection keys of the left or right four-way button to choose the desired firmware version, for example:

```
FILE LIST
 MC-20_1V234_Dutch.bi
>MC-20_1V234_English.
 MC-20_1V234_France.b
 MC-20_1V234_German.b
 MC-20_1V234_Italiano
 MC-20_1V234_Spain.bi
```

Confirm the choice with another tap on the centre **SET** key of the right four-way button. The loading of firmware into the transmitter's memory will be started and following two displays, visible only very briefly, which only make reference to the firmware update …

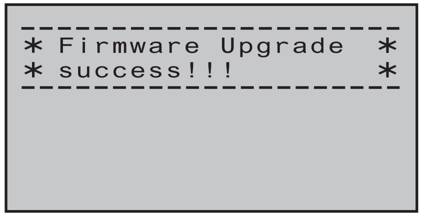
```
---------------------
* Firmware Download *
* Prozess Start     *
* Please Wait....   *
---------------------
```

```
---------------------
* Boot Download     *
* Success!!!        *
* Please Wait....   *
---------------------
```

…, the message:

```
---------------------
* Firmware          *
* Downloading...    *
* Progress  023/201 *
---------------------
```

… will appear in the display. As soon as the counter to the left of the "/" character reaches the value shown on the right as the volume to be loaded, the message …



… will appear. After a few seconds this message disappears, and the transmitter switches itself off. The transmitter is now ready for use.

<u>Notes:</u>

- *If the warning …*

*…, then the RF section of the transmitter is still active. Switch it off in the "RF module" line of the »**Basic settings**« menu, and repeat the procedure.*

- *If the warning …*

… appears then the transmitter does not detect a memory card in its card slot or the card found cannot be read.

- *If the selection window is empty …*

… then the transmitter could not find a suitable firmware file on the inserted memory card. Check the contents of the SD card's "Firmware" directory on a PC or laptop.

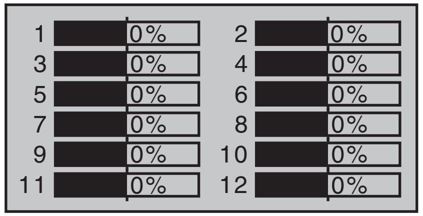
STICK CALIBRATION

If you feel the neutral position of your self-centreing sticks (controls 1 … 4) are not exactly 0 % of their control travel, then this can be checked and, if necessary, corrected as follows:

Jump to the »**Model select**« menu and initialize a free model memory as described on page 71. Whether the model to be initialized is a winged aircraft or a helicopter is irrelevant.

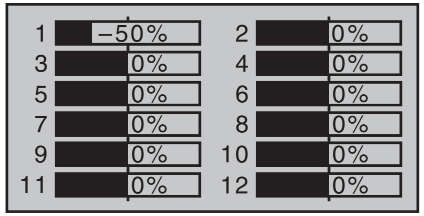
Wait for the notices which typically appear in the transmitter's base screen following a model change then jump to the »**Servo display**« menu, for example by simultaneously touching the ◄► keys of the left four-way button WITHOUT any interim changes to trim settings or other program settings.

If all four of your transmitter's stick functions are still self-neutralizing, this display should ideally look like the one shown below:

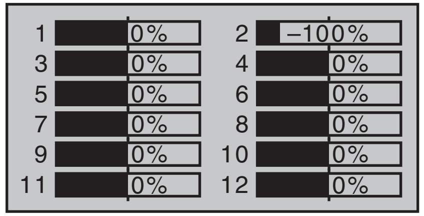


<u>*Note:*</u>
The screen-shot above, and the two which follow, show the screen of the mc-20 HoTT transmitter. The screen of the standard eight-channel mc-16 HoTT shows correspondingly fewer channels.

Otherwise the graph bars show current setting percentages for joystick control functions which are not self-neutralizing – typically for the "C1" throttle/brake or throttle/pitch stick. For example, if the throttle/brake stick is in its "quarter-throttle" position, the display would appear as shown below:

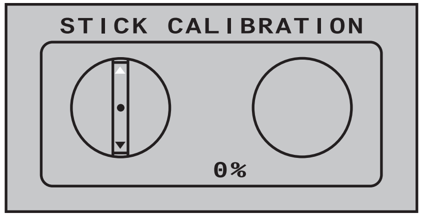


One after the other, put both sticks into each of their four possible limit positions *without* exerting force at the limit position. In each of these eight possible limit positions, the – side dependent – indication for exactly -100 % or +100 % should be displayed. For example, if transmitter control 2 is at its right limit and the other three stick functions are in their respective middle positions then the transmitter's display should look like the one shown below:

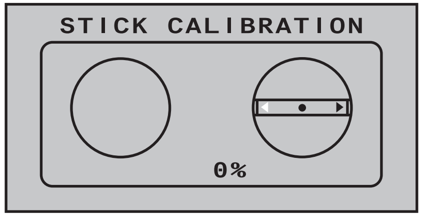


Regardless of the number of self-neutralizing stick functions available on your transmitter, if these checks produce four 0 % results and eight 100 % results then your transmitter's sticks are optimally calibrated. You can terminate this process then, if appropriate, delete the model memory just created.

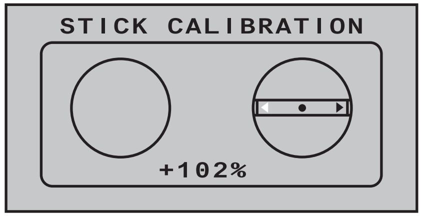
Otherwise jump (as described at the outset of the previous double page) to the “STICK CALIBRATION” line in the »**SECRET MODE**« menu then briefly touch the centre **SET** key of the right four-way button.



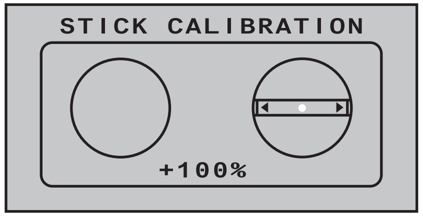
The ◄ ► selection keys of the right four-way button will now allow you to cyclically select the four calibrated stick planes, e. g. the left/right plane of the right stick:



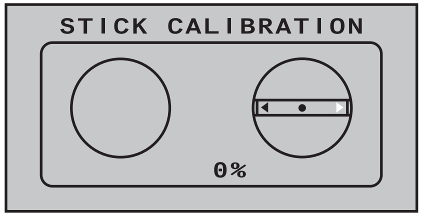
Now position the *right* stick – without exerting extra force – to its left limit corresponding with the on-screen blinking arrow pointing to the left:



… and briefly tap the centre **SET** key of the right four-way button. This concludes this example calibration of the right stick’s left limit. The circle in the middle of the stylized stick plane will now blink as confirmation of the calibration:

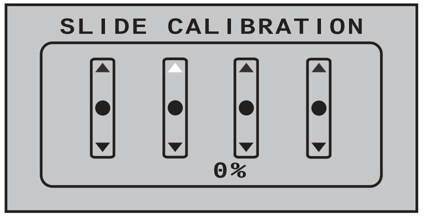


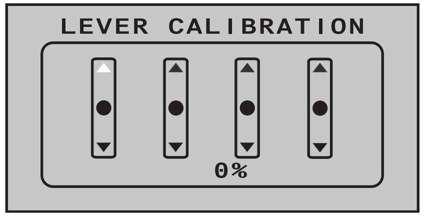
Now release the self-neutralizing stick so it can return to its centre position and then tap again on the centre **SET** key to calibrate the stick’s centreed position. The right triangle marker will begin to blink:



Repeat the calibration process for the *right* limit of the right stick. The other stick planes are calibrated analogously.

Proceed similarly to calibrate the two sliders mounted in the middle console and the two proportional rotary controls on the sides of the transmitter. The calibration options for these proportional controls can be reached by repeatedly tapping on the ◄ or ► selection keys of the right four-way button until the desired calibration position is reached, e. g. …



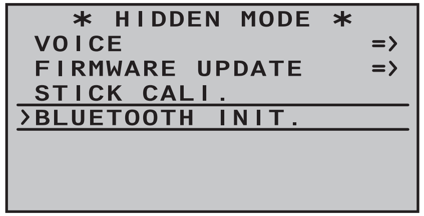


Notes:

- *Correct any bad calibrations by repeating the respective process.*
- *Within a given stick plane, each of the three calibration positions can be selected directly with the ▲▼ selection keys of the left or right four-way button.*

Briefly touching the centre **ESC** key of the left four-way button will terminate the process and return to the submenu “STICK CALIBRATION”.

Bluetooth initialization

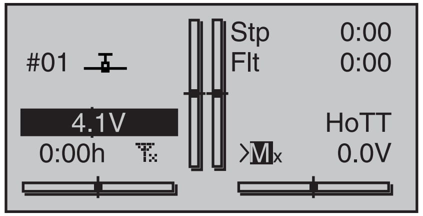


If you install a Bluetooth module, No. **33002.5**, you should use this menu point to initialise it as described in the instructions supplied with the unit.

Telemetry data display

The mc-16 HoTT transmitter features a single screen below the aerial socket which is used both for operating the transmitter and also to display telemetry data in graphic form. You can switch between the two operating modes by pressing one of the Select buttons ▲▼ or ◄ ► of the *left-hand* four-way button in the base display.

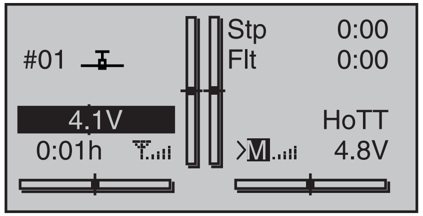
The mc-20 HoTT transmitter has two independent displays; a display for operating the transmitter and a display just below the antenna socket for the graphic display of telemetry data. This display is activated automatically as soon as the transmitter receives telemetry data from the receiver via the return channel.



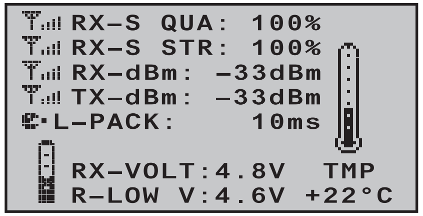
If however, at the lower edge of the base display, only "X" – as shown in the figure above – is displayed at two locations instead of "..ııl", then the telemetry display will show the warning …

…, on the front screen of the mc-20 HoTT, displaced shortly afterwards by the *Graupner* logo and the transmitter name …

…, and this means that there is no receiver within range capable of exploiting the telemetry link. Switch on the model's receiver system or bind a receiver to the active model memory as described in detail on page 80 or 90.



If a telemetry link is present, the front screen of the mc-20 HoTT shows the "Receiver" display by default. The same occurs on the mc-16 HoTT transmitter after you select the Telemetry display mode …



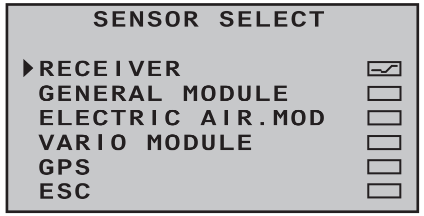
… which is described in more detail in a section by the same name on the next page.

Sensor Select

Up to four sensors can be connected, in any combination, to a telemetry-capable receiver.

The data output of these sensors in the graphic displays described below must be accepted if they have been properly connected before turning on the receiver on this and afterwards also recognized automatically via the return channel from the transmitter.

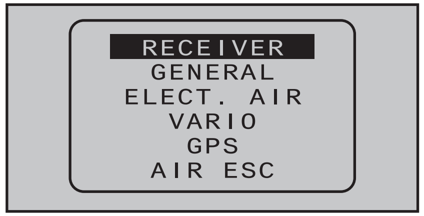
For transmitters with firmware version number lower than V1.010 (mc-16) or V1.030 (mc-20), in contrast, as described on page 250 under the sub-menu "SENSOR (SELECT)" of the "Telemetry" - described menus, ...



… in order to activate their display. This data from the selected sensors is then appropriately prepared for illustration by the graphic indicators as described below. You must also ensure that the receiver selected in the "Telemetry receiver" line of the »**Telemetry**« menu (Bind 1 or 2) is the one to which the sensors are connected; see pages 80 and 90. If you select the "wrong" receiver, the "Receiver" display will only show the data from that unit.

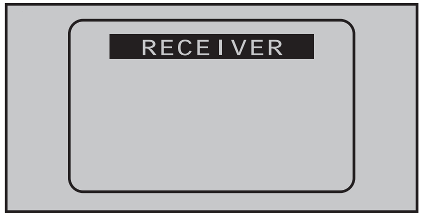
Furthermore, only sensors activated in the »SETTING & DATAVIEW« sub-menu of the »**Telemetry**« menu, beginning page 238, according to the instructions included with the given sensor will be responsive.

To switch between the screens for activated sensors in the »SENSOR SELECT« sub-menu of the »**Telemetry**« menu, tap briefly on one of the ▲▼ selection keys of the left or right four-way button …



… and, after the selected screen has been displayed, use one of the ▲▼ two keys to select the line of the desired sensor.

If no sensor is activated, then all display lines and sensors described in the next column, except for the "RECEIVER" line, are blended out of the display and the selection list:

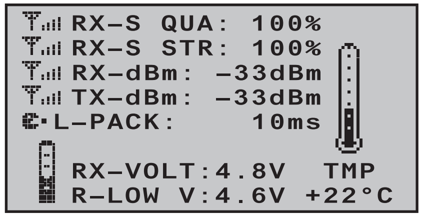


The selection can be confirmed right away by activating the centre **SET** key of the right four-way button or by simply waiting until, after a brief pause, the main display of the given selected sensor appears automatically.

<u>*Notes:*</u>

- *The sequence of the below described displays is a consequence – starting from the given main display – of taps on the ▶ key.*
- *More details about the following named modules can be found in the appendix and in Internet at www.graupner.de in the web page for the given product.*

RECEIVER



This screen presents the »**RX DATAVIEW**« of the »**Telemetry«** menu's »**SETTING & DATAVIEW**« sub-menu, see page 238, with data processed and displayed graphically.

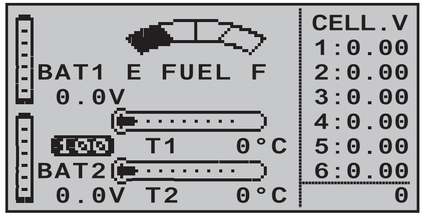
The displayed items are as follows:

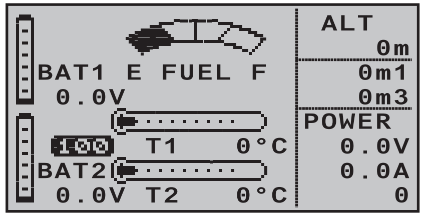
Value	**Explanation**
RX-S QUA	signal quality in %
RX-S STR	signal strength in %
RX-dBm	Reception power in dBm
TX-dBm	transmit power in dBm
L-PACK	Indicates the longest time span in ms in which data packages are lost in the transmission from the transmitter to the receiver.
RX-VOLT	current operating voltage of the receiver's power supply in volts
R-LOW V	Lowest receiver operating voltage since last startup, in volts
TMP	the thermometer depicts the receiver's current operating temperature

<u>*Note:*</u>

Detailed explanations of the "Value" column quoted terms, see "RX DATA VIEW" on page 238.

GENERAL MODULE





If attached to the receiver, this screen will display the data acquired by a General-Engine module, No. **33610,** or a General-Air module, No. **33611**. More details about these modules can be found in the appendix or in Internet at www.graupner.de in the web page for the given product.

Depending on how this module is equipped with sensors, this screen can permanently display the data shown in the table below.

At the top left of the switching state of flux and the right of it a level indicator of the fuel tank. Law including the used energizing period in the current fuel quantity in ml.

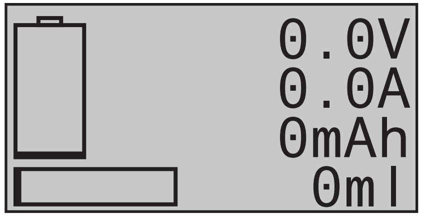
Among the left of possibly connected to the module temperature / voltage sensors (No. 33612 or 33613), if necessary, measured current voltages of up to two battery packs (BAT1 and BAT2) and right next to the associated temperatures.

The inverse display between “BAT1” and “BAT2” visualizes the quality of the incoming signal from the transmitter in%.

On the right side alternately either a list of the current cell voltages is an output of up to six-cell LiPo battery or the current altitude relative to location, climb / descent in m / 1s and m / 3 s, the actual current in amperes and actual voltage of the battery connectet to the module. The displayed items are as follows:

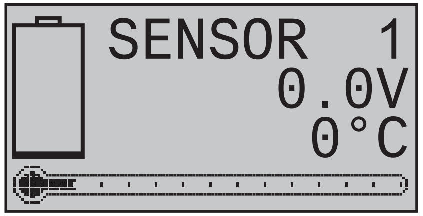
Value	Explanation
ON	Current control ON
BAT1 / BAT2	battery 1 or 2
100	Signal quality in % (RX-S QUA)
FUEL	fuel level / tank gage
E / F	empty **/** full
ml	Used fuel quantity in ml
T1 / T2	temperature of sensor 1 or 2
CELL V	cell voltage of cells 1 … max. 6
ALT	current altitude
0m1	m/1 s ascent/decent rate
0m3	m/3 s ascent/decent rate
V	battery voltage
A	current draw in amperes

Battery and consumption indicators



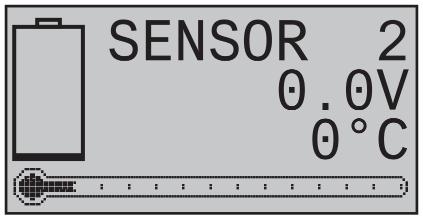
This display depicts current voltage, current current draw and, if attached, the expended capacity of “Batt 1” connected to the General-Engine module (No. **33610**) or General-Air (No. **33611**) module And at the last line the value of the Fuel sensor (No. 33614) registers the fuel consumed in ml.

SENSOR 1



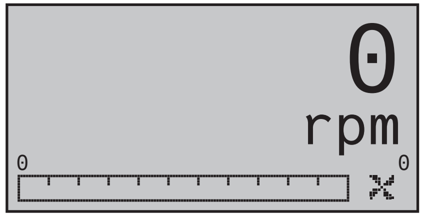
If attached, this display depicts currently measured voltage and temperature from a temperature/voltage sensor, No. **33612** or **33613**, connected to “T(EMP)1” of the General-Engine module (order no. **33610**) or the General-Air module (No. **33611**).

SENSOR 2



If attached, this display depicts currently measured voltage and temperature from a temperature/voltage sensor, No. **33612** or **33613**, connected to “T(EMP)2” of the General-Engine module (No. **33610**) or the General-Air module (No. **33611**).

Rotary speed sensor



If attached, this display depicts the measured rotary speed of a speed sensor (No. **33615** or **33616**) attached to a General-Engine module (No. **33610**) or a General-Air module (No. **33611**).

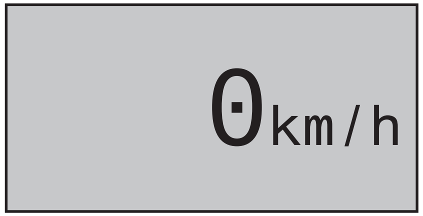
Note:

The appropriate blade count must first be set in the module’s telemetry menu before the correct speed can be displayed.

Vario

If attached, this display will depict the altitude (in m) relative to location, starting location as well as the current rate of ascent/descent (in m/s) data originating from a Vario integrated into a General-Engine module (No. **33610**) or General-Air module (No. **33611**).

Speed display

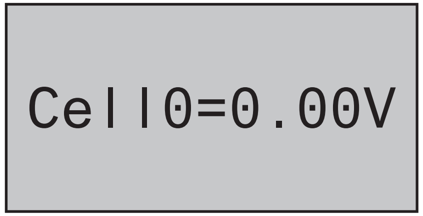


If the corresponding sensor is available, this screen displays the model's actual speed over the ground.

Air pressure display

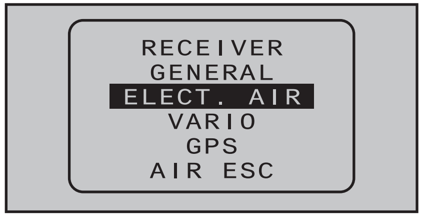
If the corresponding sensor is available, this screen displays the actual air pressure.

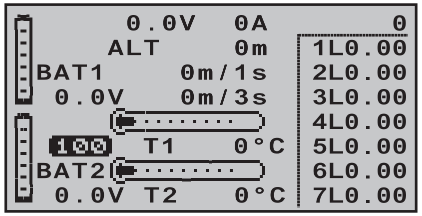
"Weakest cell"

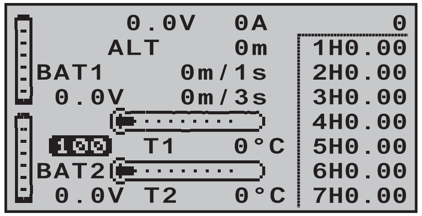


If the corresponding sensor is available, this screen displays the voltage of the weakest cell in a battery block, together with the number of that cell.

ELECTRIC AIR MODUL







If attached to the receiver, this display will depict the data acquired by an Electric-Air module, No. **33620**. More details about this module can be found in the appendix or in Internet at www.graupner.de in the web page for the given product.

Depending on how this module is equipped with sensors, this screen can permanently display the data shown in the adjacent table.

The current voltage of up to two batteries (BAT1 and BAT2), up to two temperature measurements (T1 and T2), current altitude with respect to the starting location, the model's ascent/decent rate in m/1 s and m/3 s and, in the middle of the screen, the current draw currently being taken from a power source.

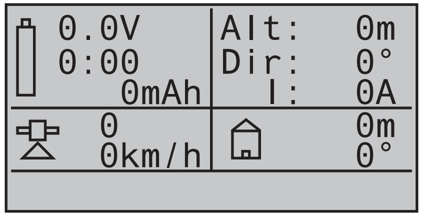
In the centre including the current level relative to the location and the climb / descent of the model in m / 1s and m / 3 s and the left of it connected by possibly the module temperature / voltage sensors (No. **33612** or **33613**) possibly measured current voltages of up to two battery packs (and BAT1 BAT2). In the middle below the corresponding temperatures.

Along the right edge of the screen is a table of alternating values for cell voltages at balancer connections (L) or voltages for up to 7 attached battery cell packs (H).

The displayed items are as follows:

Value	Explanation
ON	Current control ON
V	current voltage
A	current current
BAT1 / BAT2	battery 1 or 2
ALT	current altitude
m/1s	m/1 s ascent/decent rate
m/3s	m/3 s ascent/decent rate
100	Signal quality in % (RX-S QUA)
T1 / T2	temperature of sensor 1 or 2
L or H	cell voltage of cells 1 … max. 14 L = balancer connection 1 H = balancer connection 2

Micro-copter display

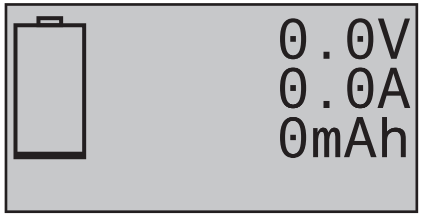


This screen displays the data generated by a HoTT-compatible micro-copter. Key, reading from top left to bottom right:

Value	Explanation
V	Actual voltage
“0:00“	Period switched on
mAh	Battery capacity consumed
“0“	Position number of the satellites
km/h	Speed over ground, according to GPS system
Alt	Actual altitude
Dir	Direction of movement
I	Actual current
m	Distance from take-off point, according to GPS system
°	Position in degrees relative to take-off point, according to GPS system

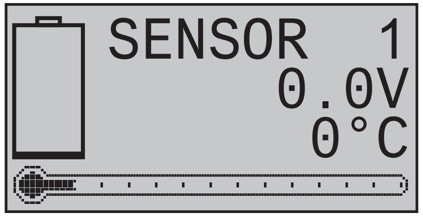
Any messages from the micro-copter sensor are displayed in the bottom line of the screen, which is empty in the screen-shot shown above.

ACCU



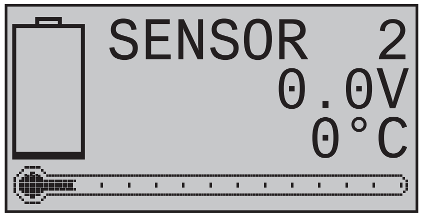
This display depicts current voltage, current current draw and, if attached, the expended capacity of “Batt 1” connected to the Electric-Air module (No. **33620)**.

SENSOR 1



If attached, this display depicts currently measured voltage and temperature from a temperature/voltage sensor (No. **33612** or **33613**) connected to “T(EMP)1” of the Electric-Air module (No. **33620**).

SENSOR 2

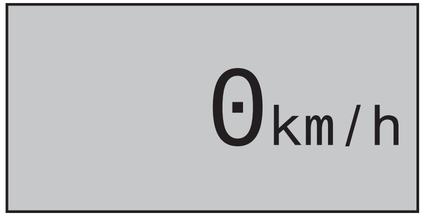


If attached, this display depicts currently measured voltage and temperature from a temperature/voltage sensor (No. **33612** or **33613**) connected to “T(EMP)2” of the Electric-Air module (No. **33620**).

Vario

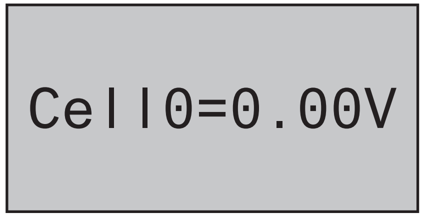
If attached, this display will depict the altitude (in m) relative to location, starting location as well as the current rate of ascent/descent (in m/s) data originating from a Vario integrated into a Electric-Air module (No. **33620**).

Speed display



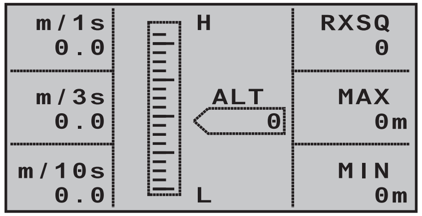
If the corresponding sensor is available, this screen displays the model’s actual speed over the ground.

“Weakest cell”



If the corresponding sensor is available, this screen displays the voltage of the weakest cell in a battery block, together with the number of that cell.

VARIO

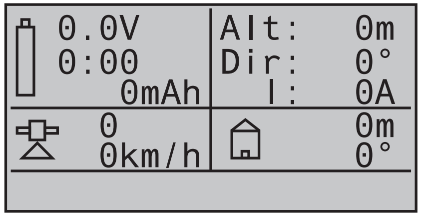


If attached to the receiver, this display will depict the data acquired by a Vario module, No. **33601**.

The displayed items are as follows:

Value	Explanation
ALT	current altitude
RXSQ	Signal quality of the signal received by the receiver in %, see page 238.
MAX	the preset maximum altitude limit relative to starting location at which, when exceeded, will cause an audible warning to be sounded
MIN	the preset minimum altitude limit relative to the starting location at which, when underrun, will cause an audible warning to be sounded
m/1s	m/1 s ascent/decent rate
m/3s	m/3 s ascent/decent rate
m/10s	m/10 s ascent/decent rate

Micro-copter display



This screen displays the data generated by a HoTT-compatible micro-copter. Key, reading from top left to bottom right:

Value	Explanation
V	Actual voltage
“0:00“	Period switched on
mAh	Battery capacity consumed
“0“	Position number of the satellites
km/h	Speed over ground, according to GPS system
Alt	Actual altitude
Dir	Direction of movement
I	Actual current
m	Distance from take-off point, according to GPS system
°	Position in degrees relative to take-off point, according to GPS system

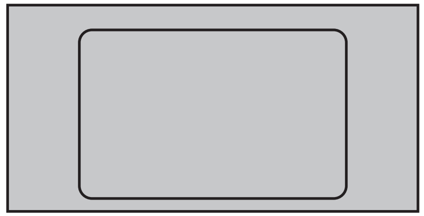
Any messages from the micro-copter sensor are displayed in the bottom line of the screen, which is empty in the screen-shot shown above.

Vario

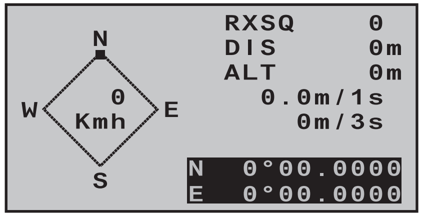
If attached, this display will depict altitude relative to location or starting location (in m) as well as the current rate of ascent/decent (in m/s) from data acquired by a Vario module (No. **33601**).

Text display

If the corresponding sensors are available, text from them showing 2 x 10 or 3 x 7 characters can be superimposed in the two following displays when required:



GPS



Note:

As long as the two fields are highlighted in black on the bottom right, yet there are no current GPS data.

If attached to the receiver, this display will depict the data from a GPS module with integrated Vario, No. **33600**.

Aside from the model's current position and speed, the centre section of this screen will also display current altitude with respect to the starting location as well as the model's current ascent/decent rate in m/1 s and m/3 s, current reception quality and the model's distance from its starting location.

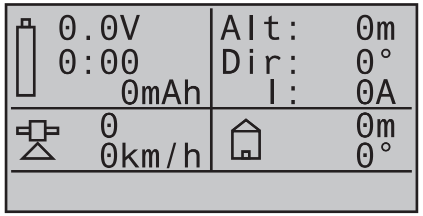
The displayed items are as follows:

Value	Explanation
W/N/E/S	west / north / east / south
Kmh	Speed over ground, according to GPS system
RXSQ	return channel signal quality, see page 238
DIS	distance
ALT	current altitude with respect to starting
m/1s	m/1 s ascent/decent rate
m/3s	m/3 s ascent/decent rate

Note:

With firmware version 1.072 the GPS functionality of the mc-16 and mc-20 HoTT has been extended: Once out of what ever reason, the telemetry link to the model longer than three seconds interrupted and as long as the transmitter is not switched off, the last remain get correctly transmitted GPS data is saved in the transmitter's memory. These data can be read from the GPS display when required by return by appropriately pressing the four-way keys of the transmitter.

Micro-copter display

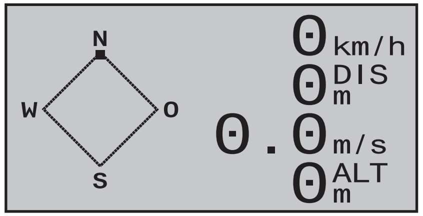


This screen displays the data generated by a HoTT-compatible micro-copter. Key, reading from top left to bottom right:

Value	Explanation
V	Actual voltage
"0:00"	Period switched on
mAh	Battery capacity consumed
"0"	Position number of the satellites
km/h	Speed over ground, according to GPS system
Alt	Actual altitude
Dir	Direction of movement
I	Actual current
m	Distance from take-off point, according to GPS system
°	Position in degrees relative to take-off point, according to GPS system

Any messages from the micro-copter sensor are displayed in the bottom line of the screen, which is empty in the screen-shot shown above.

GPS



If attached to the receiver, this display will depict the data from a GPS module with integrated Vario, No. **33600**.

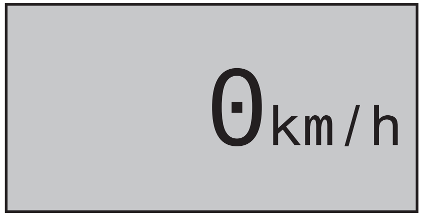
The displayed items are as follows:

Value	Explanation
W/N/E/S	west / north / east / south
km/h	speed
DIS	horizontal distance in m
m/s	ascent/decent rate in m/s
ALT	altitude relative to starting location in m

Vario

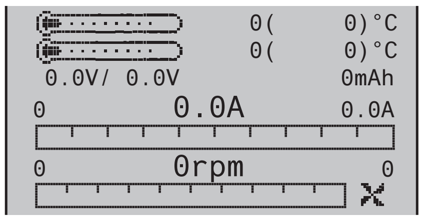
If attached, this display will depict the altitude (in m) relative to location, starting location as well as the current rate of ascent/descent (in m/s) from data originating from the Vario integrated into the GPS-/Vario module (No. **33600**).

Speed display



If the corresponding sensor is available, this screen displays the model's actual speed over the ground.

AIR ESC



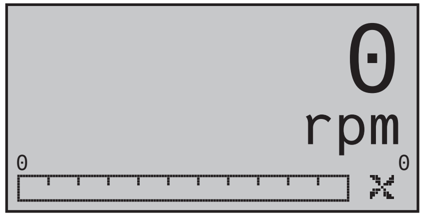
This screen displays the data generated by a brushless speed controller with internal telemetry, No. **33718** to **33770** and **33850** (correct at time these instructions were revised), which is connected to the receiver.

Regardless of any regulator values the operating temperature and the maximum temperature reached in the current energizing period of a telemetry-capable electric motor is visualized in the second line of the display.

Key, reading from top left to bottom right:

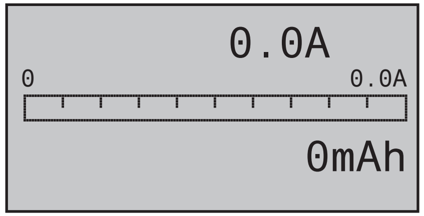
Value	Explanation
V	Left-hand value: actual battery voltage Right-hand value: actual battery voltage in present power-on period
°C	Graphical representation and left-hand value: actual speed controller temperature Value in brackets: maximum controller and motor temperature in actual power-on period
mAh	Battery capacity consumed in actual power on section
A	Centre and bar display: actual current Right-hand value: maximum current in present power-on period
rpm	Centre and bar display: actual rotational speed of the motor connected to the speed controller. Right-hand value: maximum rotational speed in present power-on period

RPM display



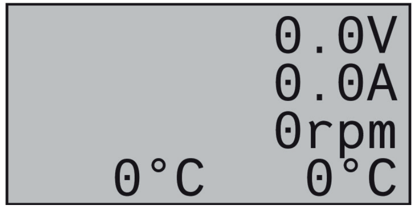
This screen displays the current rotational speed of the motor connected to the brushless speed controller.

Current / consumption display



This screen displays the actual current consumption, the peak drain which has occurred in the present power-on period, and the capacity drawn from the battery connected to the brushless speed controller within the same period.

Voltage, current, speed and temperature display



This display visualizes the current power supply voltage of the motor, the power currently flowing through the controller and the speed of the drive motor and left the operating temperature of the brushless controller and the right temperature of a telemetry-capable drive motor.

Commissioning the transmitter

Preliminary remarks about the mc-16 HoTT and mc-20 HoTT transmitters

Preliminary remarks

The *Graupner* HoTT system theoretically permits simultaneous operation of more than 200 models. However, because of the interspersed radio-frequency utilization permitted by certification for the 2.4 GHz ISM band, this number is significantly lower in practical application. The real limiting factor is – as often before – still likely to be the size of available operating space (i. e. airspace for aircraft). Alone the fact that it is no longer necessary to coordinate transmitting frequencies with other pilots in the vicinity (which is sometimes quite difficult in broken landscapes, such as on hillside slopes) represents an enormous boost for remote control operating security.

Battery charged?

Since the transmitter is delivered with an empty (not charged) battery, the battery must first be charged according to the charging instructions on page 18. Otherwise a warning tone will be sounded and an appropriate message will be blended into the basic display if the low voltage threshold set in the "Battery warning" line of the »**General basic settings**« menu, see page 270, is underrun.

```
Batt. must
 be  re-
 charged!!
```

Transmitter startup

From firmware version V 1.090 "Motor on C1 forward / back" is after switching the station when a surface model of the type analyzed the position of the output to 1 or when the Helimodell connected to the output 6 throttle servo.

Should the respective servo be outside the idling range thus is a risk of a high-speed motor, for safety reasons the RF module remains switched off.

In all other cases, the RF module is activated with the switch on the transmitter and appear in the centre of the transmitter displays appears:

```
Please select
RF on/off?
 ON    OFF
```

You can now either wait until the display after a few seconds automatically disappears, or manually shorten the waiting time by tapping the centre **SET** key of the right four-way button.

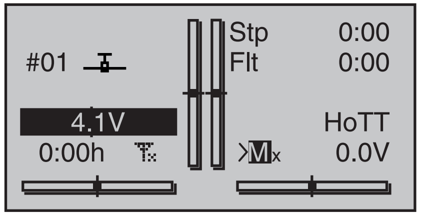
Within this brief period there is an opportunity to switch RF transmission off by using the ▲ or ▶ key of the right four-way button to shift the position of the field shown in inverse video to the right so that **ON** is in standard video and **OFF** is presented in inverse:

```
Please select
RF on/off?
 ON    OFF
```

Now switch the RF module off by tapping on the centre **SET** key of the right four-way button.

The meantime glowing green "RF" LED to the right of the switch turns off. Then you are in the basic display of the transmitter and the front display the Graupner logo and type designation of the sender is displayed:

Graupner
mc20



The symbol combination means that the currently active model memory has already "bounded" with a *Graupner*-HoTT receiver but there is no connection to that receiver at the moment. (In this example, RF transmission has been switched off.)

If, however, the transmitter is switched on *without* switching RF transmission off, the symbolic antenna mast will blink. At the same time, an acoustic warning will sound until a connection is established with the respective receiver. As soon as the connection is established, the "X" at the base of the symbolic antenna will be replace with a field strength indicator, for example , and the visual and acoustic warnings will cease.

If a telemetry connection has also been established for the incoming signal, that is output by the receiver in the model, then the right side of this same screen line will display a similar indication of signal strength for this reception of the receiver's transmitted signal (>M) as well as the current voltage of the receiver's power supply.

On the other hand, if the symbol combination appears in the display and the front display shows the message "Can't receive data" then the currently active model memory is not "bound" to any receiver at the moment.

Under-voltage warning

If the transmitter's voltage drops below a certain value set in the »**General basic settings**« menu, page 270, 3.60 V by default, there will be visual and acoustic under-voltage warnings issued.

Important notices:

- *The transmitter in the set is already preset, as delivered, with default values which are correct for operation in most European countries (except France).*
- *Up to eight servos can be operated with the GR-16 receiver supplied in the mc-16 HoTT set; this receiver is supplied already bound to the first model memory.*

  Up to twelve servos can be operated with the GR-24 receiver supplied in the mc-20 HoTT set; this receiver is supplied already bound to the first model memory.

  In order to achieve the greatest possible flexibility but still preclude unnecessary inadvertent operator errors, control channels 5 … 8 respectively 5 … 12 have not been assigned to any controls. This means that servos connected by way of these channels will remain in their middle positions until an operator element has been assigned. Practically all mixers are initially inactive for this same reason. More about this can be found on page 112 (winged aircraft) or 116 (helicopter models).
- *The fundamental procedure for initial programming of a new model memory location can be found on page 68 and the programming examples that begin on page 282.*
- *When the remote control system is switched on, being bonded or when making settings, that the transmitter's antenna is always far enough away from the receiver's antennas. If the transmitter's antenna is brought too close to the receiver's antennas this will cause receiver over-modulation and its red LED will illuminate. At the same time the return channel will drop out and, as a consequence, the field strength indicator in the transmitter's screen will be replaced by an "x" and the receiver's current battery voltage display will show 0.0 V. The remote control is then in Fail-Save mode, see page 208, i.e. servos will remain in their current positions until a new, valid signal can be received. In such a case, increase the distance (between the transmitter and the model containing the receiver) until the indicators are again "normal".*

WARNING:

Never switch the transmitter off whilst operating a model! If this should happen accidentally, keep your nerve and wait until the transmitter screen is entirely blank, i.e. until the transmitter has shut down completely; this takes at least three seconds. Do not switch your transmitter on again until this has occurred. If you neglect this, there is a risk that the transmitter will "hang" immediately after being switched on, and you will lose control of the model. In this case your only recourse is to switch the transmitter off again, allow it to shut down completely, and then switch on once more after the correct interval.

Transmitter firmware updates

The necessary for updating a station programs and files you find-grouped into a software package with the relevant product on www.graupner.de.

Note:

After registering your transmitter under https://www.graupner.de/de/service/produktregis-trierung.

aspx You will be automatically informed via email about new updates.

Download this software package from the Internet and unpack it on your PC or laptop.

For details, please refer to the internet page related to the item, at the same page detailed instructions are available.

Firmware updates of the transmitter can be carried out in two ways. However, in both cases please note the following “Important notes”.

Per memory card

Download as described above, a current software package from the Internet and unpack it on your PC or laptop.

Plug the included mini-SD card into the card slot of your PC or laptop and copy afterwards the required firmware file from the unzipped software package in the left hand on the memory card folder “firmware”. Then, remove the memory card to your PC or laptop and insert it into the card slot of the transmitter as described on page 26.

Turn on your transmitter with switched off RF. Change to the submenu “Firmware Update” menu “hidden mode” and proceed further as described on page 37.

The USB interface cable (USB-A to mini-B-USB 5-pole) included with the set, will be needed to update the transmitter’s software via the transmitter’s face-side USB interface connector. This cable’s connector has to be directly plugged into the 5-pole mini-USB connector socket on the rear side of the transmitter.

Per front-side USB connector...

... By means of a PC or laptop running Windows XP, Vista, 7 or. 8

Download as described above, a recent update of the transmitter software package from the Internet and unzip it on your PC or laptop.

Connect mini- your off station with the standard USB cable (USB A to mini-B USB 5-pin) port on your PC or laptop to by the in the 5-pin one end of the USB cable directly plug in USB connector under-seen from the front-right cover of the transmitter and the other end into an available USB port on your computer. For details, please refer to the place as well in the Internet detailed update instructions.

Important notes:

- ***Please note that the HoTT components in your radio control system can only communicate perfectly if the firmware is compatible. That is why all the programs and files required to update all HoTT components are grouped together in one file, the current version of which is entitled “HoTT_Software_V4.zip”.***
- ***Always use your transmitter only with the current software version. At the time of revision of this manual can be found relevant information http://www.graupner.de/de/supportdetail/cc489e1d-0c1c-4cdd-a133-398d908bc27d.***
- ***If this link does not work, you can achieve the same information: www.graupner.de => Service & Support => Update and Revision History for Graupner HoTT components.***
- ***Be sure to check the charge status of your transmitter’s battery or charge its battery as a precaution before every update. Also backup all occupied model memories so they can be restored if that should become necessary.***
- ***It is essential not to disconnect the transmitter from the PC or laptop during an update process! Please ensure that the lead between the transmitter and the computer is making good contact at both ends.***
- ***Check after every update that all model functions operate properly.***

Restoring the transmitter software

If a firmware update of the station have failed, or the transmitter software “hang” and allows the transmitter may also no longer on the “POWER” switch off, then please disconnect the transmitter battery connector and plug it after a few seconds.

Leave the transmitter off!

Download in this case download an actual software package from the Internet and unzip it on your PC or Laptop and if you have already done this, restart the PC program gr_Studio and follow the details of the section “restore” following the instructions contained in the software package.

Receiver initialization

Preliminary remarks

Receiver system

Included with the remote control sets mc-16 HoTT is a bi-directional 2.4GHz receiver type GR-16 for the connection of up to 8 servos and supplied with the remote control sets mc-20 HoTT is a bidirectional 2,4 GHz-type receivers GR-24 for the connection of up to 12 servos.

In addition, each of the two sets includes a receiver GR-12L for connection of up to 6 servos.

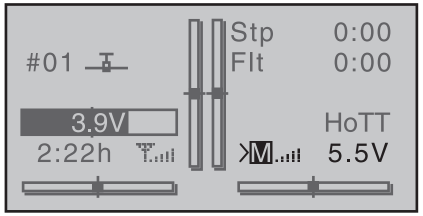
If you have to set the mc-16 HoTT with the included GR-16 HoTT receiveror the Set the mc-20 HoTT with the included GR-24 HoTT receiver is turned on and “his” transmitter is not in range or turned off, or possibly even the transmitter is on the “wrong” model memory, the red LED lights of the respective receiver for about one second and then starts flashing slowly. This means that the receivers (still) are not connected to a Graupner HoTT transmitter. Once communication is established, a green LED lights up permanently and the red goes out.

To be able to connect to the transmitter, a Graupner HoTT receiver must be “connected” to “his” Graupner HoTT transmitter with “his” model memory initially.

This process is known as “binding”, see pages 80 and 90. This “binding” is only required once per receiver / model memory combination or - after appropriate conversion of one or more model memory, see page 79 or 89 - only each receiver / transmitter combination and was factory made in each kit receiver GR-16 HoTT or GR-24 HoTT for the model memory 1, so that the “binding” is necessary only when additional receivers or a space change occur (and at any time can be repeated).

On-board voltage display

The current voltage of the receiver’s power supply will be shown in the right side of the transmitter’s screen if a telemetry link exists between the receiver and transmitter:



Temperature warning

Should the receiver’s temperature sink below an adjustable threshold (default value -10 °C) or rise above an adjustable threshold (default value +55 °C), an acoustic warning will be issued by the transmitter in the form of a uniform beep of about 1 s duration. The aforementioned threshold limits are stored and adjusted in the receiver.

Servo connections and polarity

Graupner HoTT receiver servo connections are numbered. The connectors used are keyed against polarity reversal. Pay attention to the small side chamfers when plugging in these connectors. Never use force.

The supply voltage is bussed across (i. e. common for) all numbered connections.

The two vertical sockets at the extreme edge of the GR-16 and GR-24 receivers are intended for the battery connection. On the GR-16 these two sockets are marked “1+B-” and “6+B-”. On the GR-24 these two sockets are marked “11+B-” and “12+B-”. However, you can also connect the corresponding servos to these two sockets in parallel with the power supply simply by using a Y-lead, No. **3936.11**.

CAUTION:

Do not reverse the polarity of this connection. Reversed polarity could destroy the receiver and devices attached to it.

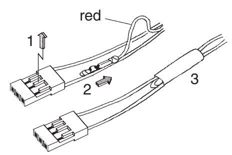
The function of every individual channel is determined by the transmitter used, not by the receiver. It is not only the throttle servo connection which is different for every manufacturer and model type. For example, in *Graupner* remote control systems the throttle servo is on channel 1 for winged aircraft and on channel 6 for helicopter models.

Follow the installation instructions on page 54 for the receiver, the receiver antenna and for mounting the servo.

Concluding notices:

- *The significantly greater servo resolution characteristic of the HoTT system produces a noticeably firmer response behaviour in comparison to previous technology. Please take the time to familiarize yourself with this sensitive behaviour.*
- *If you have a speed controller with integrated BEC* arranged in parallel with the receiver battery, its positive pole (red cable) may to be removed from the 3-pole connector. Be sure to look for notices about this in the instructions for the speed controller used.*

  With a small screwdriver, carefully lift up the connector’s centre latch (1) just a bit then pull out the red lead (2) and tape it up with insulation tape to prevent possible short circuits (3).



* *Battery Elimination Circuit*

Receiver firmware updates

Reset

To execute a reset of the receiver, press and hold the SET button on the receiver's top-side while switching the power supply on. Hold the receiver's SET button pressed in for about three seconds until the LED, flashing slowly red / green, goes out for about two seconds.

If in the receiver GR-12L, also included in the set as default, only the red LED lights up for about 3 seconds, then goes out for about 3 seconds and starts to light red constant after this break.

Release the button once the red LED goes out.

If you have carried out the reset with the transmitter switched off, or with an unbound receiver, the green and red LEDs fitted to the GR-16 and GR-24 receivers (supplied as standard in the sets) flash four times for around three seconds, after which both LEDs go out for just on three seconds, before only the red LED continues to flash. Release the button as soon as the LEDs go out.

At the transmitter and receiver it is now possible to carry out a Binding procedure immediately.

If the reset is done on a bound receiver and the corresponding model memory is active in the powered on transmitter, the LED will illuminate in green after 2 or 3 seconds as an indication that the transmitter/receiver system is again ready for operation.

Please note the following:

A receiver RESET will cause ALL receiver settings, except for binding information, to return to their factory settings.

Therefore if a RESET is triggered unintentionally, any custom settings that had been present in the receiver before the reset will have to be established again by way of the »Telemetry« menu.

A deliberate RESET is recommended, especially if a receiver is to be "transferred" into another model. This is a rather simple method to eliminate settings which are no longer applicable.

Receiver firmware updates for the GR-16 and GR-24 receivers, which are supplied as standard in the RC sets, are carried out using the side-mounted Telemetry socket marked "- + T" and a PC or laptop running Windows XP, Vista or 7. You will also require the USB leads supplied in the **mc-16** HoTT and **mc-20** HoTT sets, together with the USB interface, No. **7168.6**, and the adapter lead, No. **7168.6S**, both of which are also included. The programs and files also needed can be found in Internet on the *Graupner* website at www.graupner.de under the downloads for the particular product. For more information please take a look on our web site in the related section.

<u>Note:</u>

After registering your receiver at https://www.graupner.de/en/service/product_registration.aspx, you will automatically receive notification of future updates per email.

Installation notices

Secure receiver settings

In the entrance to the section "Update the transmitter software" on page 50, downloaded from the Internet and unzipped on the PC or laptop software package there is, among other things the PC program "Firmware_Upgrade_grStudio" included.

You may even have already installed this program on your PC or laptop.

With the menu item "Receiver settings" This PC program "Firmware_Upgrade_grStudio" it is always possible to save all settings programmed in a receiver to a file on the PC or laptop, so you also can transfer back to the receiver these if necessary. The otherwise possibly necessary reprogramming of a receiver via the menu "**Telemetry**" is therefore unnecessary.

For this program the default to Fernsteuersets mc-16 HoTT (No. **33016**) and mc-20 HoTT is (No. **33020**) included USB interface (No. **7168.6**) and also the supplied interface cable (No. **7168.S**) needed.

For details, please refer to the internet page related to the product for detailed instructions.

Receiver installation

Regardless of which *Graupner* receiver system you use, the procedure is always the same.

Please pay attention that the receiver's antennas must be mounted at least 5 cm away from all large metal parts or any wiring that is not directly routed out of the receiver itself. In addition to steel parts, this also includes carbon fiber parts, servos, fuel pumps and all kinds of cables etc. Optimally the receiver should be placed at a readily accessible location that is well away from all other equipment. Under no circumstances may servo cables be wrapped around the antennas or routed close to it.

Please note that cables are subject to the acceleration forces which occur during flight and these forces may cause such cables, to shift in position. Therefore be sure the cables in the vicinity of the antennas are not able to move. Such moving cables can cause reception disturbances.

Tests have shown that a single receiver aerial should be deployed in the vertical (upright) orientation for best results during long landing approaches. If your receiver is an aerial diversity type – two aerials – then the active tip of the second aerial should be positioned at 90° to the tip of the first aerial, and ideally the distance between the two tips should be greater than 125 mm.

If your model features a carbon fibre fuselage, the aerial tips must always extend outside the fuselage for a length of at least 35 mm. If this is not possible, it is essential to substitute longer aerials (300 mm, No. **33500.2**, or 450 mm, No. **33500.3**) for the standard ones (approx. 145 mm long) fitted to HoTT receiver(s).

The sockets marked "X+B-" on the HoTT GR-16 and GR-24 receivers supplied in the sets are intended for the battery connection. The power supply is passed through all the numbered sockets, and in principle the battery can be connected to any of the eight (or twelve) sockets. A Y-lead can then be used to connect the corresponding servo.

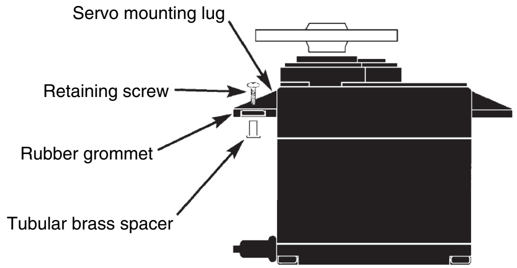
However, please note that the transverse sockets of the GR-12 should not be used for the connection of a receiver battery due to additional voltage losses.

The function of every individual channel is determined by the transmitter used, not by the receiver. However, channel assignments can be changed in the receiver by programming done in the »**Telemetry**« menu. However, it is advisable to carry this out at the transmitter using the »**Tx. output swap**« option; this is available only on the mc-20 HoTT transmitter

Several notices and suggestions for installing remote control components into a model are provided below.

1. Wrap the receiver in a foam rubber pad that is at least 6 mm thick. Attach the foam rubber to the receiver with rubber bands so it will be protected against vibration and/or the jars of a hard landing. However, do not enclose your receiver completely, otherwise it may overheat in use.
2. All switches must be installed such that they are not affected by exhaust gases or vibration. The switch knob must be freely accessible over its entire range of movement.

3. Mount servos on rubber bushes/spacers with hollow brass bearings to protect them from vibration. Do not tighten the fastening screws down too tight as this would negate the vibration protection to be provided by the rubber bush/spacer. Only when servo fastening screws are properly tightened will this arrangement provide security and vibration protection for your servos. The figure below shows how a servo is mounted properly. The brass bearings are to be pushed into the rubber bushes/spacers from below.



4. Servo arms must be free to move throughout their entire range of motion. Pay attention that there are no objects which could hinder servo arm motion.
5. Connect the power supply cable or the receiver as well as the power connection cable as shown below at the receiver,

... but never so:

CAUTION:

At the receiver GR-24 servos or other components can be connected horizontally only at the terminals 8 to 10. Under no circumstances may be connected across the other terminals 1 to 7, 11 and 12 components and especially the receiver battery as shown demonstratively in the figure above. The same applies to the terminals 1 ... 6 of the receiver GR-12L. A plug in "cross" over 2 to 3 terminals away, immediately leads to a short circuit of the receiver battery; the destruction of possibly connected components and the immediate loss of warranty claims.

The sequence in which servos are connected to the receiver depends on the type of model. Follow the connection layouts provided for this on pages 65 and 67.

Also observe the safety notices provided on pages 4 … 10.

In order to prevent uncontrolled movements of servos connected to the receiver during startup

always first switch on the transmitter and then the receiver

and when finished with operation

first switch off the receiver

and then the transmitter.

When programming the transmitter, be sure that electric motors cannot start running without control or that a combustion motor equipped with automatic starting cannot start up unintentionally. To be safe, disconnect the receiver's drive battery or, in the case of a combustion motor, disconnect the fuel supply.

Receiver power supply

Among other aspects, the safe operation of a model depends on a reliable power supply. In the event that, despite smooth operating rods, fully charged battery, battery leads with adequate cross-section, minimum contact resistances at connectors, etc., the transmitter indicates repeated receiver voltage collapses or is receiver voltage is generally too low; please give attention to the following notices:

Give primary attention to fully charged batteries when model operation is to be started. Be sure that the contact surfaces of connectors and switches really are low resistance. If necessary, measure the voltage drop across installed switch cables when they are under load because even new heavy-duty switches can cause a voltage drop of up to 0.2 V. This value can increase in contacts by factors as a consequence of aging and oxidation. The constant vibrations and jarring also takes its toll on contacts to produce a creeping increase of contact resistance.

Servos present another possible problem source. Even rather small servos like a *Graupner/JR* DS-281 can draw up to 0.75 A of current when it is blocks under load. Just four of these servos in a "foam" model can therefore load down the on-board power supply by as much as 3 A …

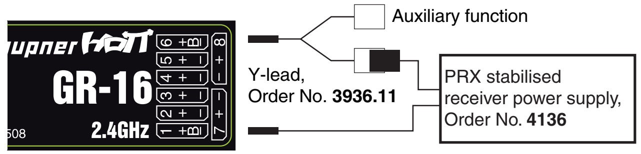
A further factor is that 2.4 GHz receivers generally pass control signals to servos at a higher rate than with comparable receivers used in earlier frequency ranges. This equates to shorter "off" periods, which also has an effect on the power consumption of the receiving system. The current drain of many of today's digital servos is also higher, reflected by their greatly improved ability to hold the prescribed position between control signals. Therefore you should choose a power supply which will not break down under greater loads but rather always deliver sufficient voltage. To "calculate" necessary battery capacity you should always figure on at least 350 mAh for every analog servo and at least 500 mAh for every digital servo.

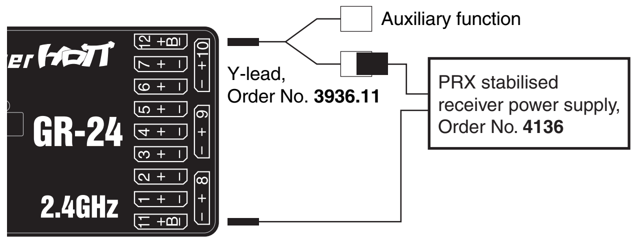
For example, from this point of view a battery with 1400 mAh would be the absolute minimum to power a receiver system with a total of 4 analog servos. But be sure to also consider the receiver itself into the calculation because its bidirectional functionality will draw about 70 mA of current too.

Regardless, it is generally recommended that you connect the receiver via two cables to the power supply: cable "1" is to be as usual, plugged into the "12 + B" port of the receiver and cable "2" at the opposite, with "11 + B - "label, the end of the edge connector of the receiver.

For example, by using a switch or voltage regulator with two leading to the receiver power supply cable. If necessary, use to connect them to the receiver a V or Y cable No. **3936.11**, see figure, if you need one or both terminals of the receiver and to connect a servo, speed controller etc.. They reduce by the double connection to the switch or voltage regulator not only the risk of a cable break, but also ensure more power to the connected servos.

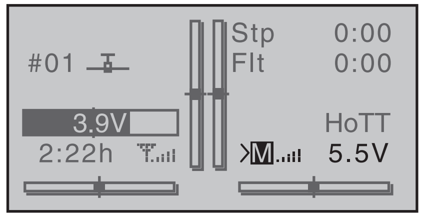
If a separate battery is connected to each receiver battery connection, be absolutely sure the batteries have the same voltage and power rating. Never connect different battery types or batteries charged to significantly different levels to the receiver. This can lead to effects similar to short circuit conditions. In such cases, insert voltage stabilizers, such as the PRX-5A receiver power supply, between the batteries and the receiver.





For reasons of safety, do not use battery boxes or dry cell batteries.

The voltage of the on-board power supply will be displayed at the bottom right of the transmitter's screen while the model is in operation:



If the voltage falls below the warning threshold – 3.80 V as standard – set in the "RX SERVO TEST" display of the "SETUP, DISPLAYS" sub-menu of the »**Telemetry**« menu, page 250, then the system generates a visual and audible low voltage warning.

Despite this feature, be sure to check the condition of the battery at regular intervals. Do not wait for the warning to be issued before recharging the battery.

Note:

An overview of available batteries, chargers and current source test instruments can be found in the Graupner RC main catalog or in Internet at www.graupner.de. A selection of suitable Computer chargers are listed in the table on page 18.

Receiver system power supply

NiMH 4-cell battery packs

In compliance with the aforementioned conditions, your *Graupner* HoTT receiver system can be readily operated with traditional 4-cell battery packs as long as the packs have adequate capacity and voltage level.

NiMH 5-cell battery packs

Five-cell battery packs offer a greater voltage tolerance than do 4-cell packs.

However, be aware that not every servo available on the market is able to tolerate the voltage level output by a 5-cell pack over the long term, this is particularly true when the battery pack is freshly charged. Some of these servos react to this with a noticeable "grinding" sound.

Therefore pay attention to the specifications of the servos you use before making a choice for a 5-cell battery pack..

LiFe 6.6 V batteries with 2 cells

From a contemporary perspective, these new cells are the very best choice.

LiFe cells are also available in hard plastic casings to protect them from mechanical damage. Like LiPo cells, LiFe cells can be quick charged in suitable chargers and they are comparatively robust.

This type of secondary cell battery is also rated for a significantly greater number of charge/discharge cycles than, for example, LiPo batteries The nominal 6.6V output of a 2-cell LiFe battery pack does not present a problem for either *Graupner* HoTT receivers nor for those servos, speed controllers, gyros and other devices which have been specifically approved for operation in this–higher–voltage range.

Please note however that practically all servos, speed controllers, gyros and other devices built in the past and most such devices currently still offered on the market have only a permissible voltage range of 4.8 to 6V. Use of these batteries in conjunction with these devices demand use of a stabilized voltage regulator, e.g. the PRX, No. **4136**, see appendix. Otherwise there is danger that attached devices will incur damage within a short period of time.

LiPo 2-cell packs

For a given capacity, LiPo batteries are lighter than, for example, NiMH batteries. LiPo batteries are also available in hard plastic casings to protect them from mechanical damage.

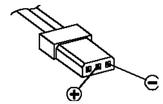
The comparatively high nominal voltage, 7.4V, for a 2-cell LiPo pack does not present a problem for either *Graupner* HoTT receivers nor for those servos, speed controllers, gyros and other devices which have been specifically approved for operation in this–higher–voltage range.

Please note however that practically all servos, speed controllers, gyros and other devices built in the past and most such devices currently still offered on the market have only a permissible voltage range of 4.8 to 6V. Use of these batteries in conjunction with these devices demand use of a stabilized voltage regulator, e.g. the PRX, No. **4136**, see appendix. Otherwise there is danger that attached devices will incur damage within a short period of time.

Charging the receiver battery

Charger cable, No. **3021**, can be plugged directly onto the receiver's battery for charging. If the battery in the model is connected by way of an No. **3046**, **3934**, **3934.1** or **3934.3** power supply cable, then charging can be accomplished via the charging jack or special charging connector integrated into the switch. The switch in the power supply cable must be in its "OFF" position for charging.

Receiver battery connection polarity



Definitions of terms

Control function, control, function input, control channel, mixer, kind of switches

To make use of this manual easier, a number of the terms used repeatedly throughout this manual have been defined below.

Control function

A “control function” is to be perceived – initially independent of its signal path – as a signal intended to affect a given control function. For example, this could be for throttle, rudder or aileron in a winged aircraft or pitch, roll or crow for a helicopter.

A control function signal can be applied directly over a single control channel or also through a mixer and then applied over multiple control channels. A typical example of multiple control channels is separately operated aileron servos or the use of two roll or crow servos in helicopters. The control function explicitly includes the influence of the control’s mechanical travel on the respective servo. This can not only be spread or compressed by software but even the travel characteristic can be modified from linear to extremely exponential.

Control

“Controls” include all operating elements on the transmitter, which are directly activated by the pilot, that impose an effect on servos, speed controllers etc. connected to the receiver. This includes:

- both *sticks* for control functions 1 through 4, whereby these four functions can be freely swapped around for both model types (“winged aircraft” and “helicopters”) by way of software “Mode” settings, e. g. throttle left or right. The stick function for throttle/airbrake control at “winged aircraft” or throttle/pitch control at “helicopters” is often also referred to as the C1 control (channel 1).
- both proportional controls located on the transmitter’s sides, which are, for example, given the designations Lv1 (left-side “rotary slider”) and Lv2 (right-side “rotary slider”) in the »**Control adjust**« menu, page 112 and 116.
- the two INC/DEC buttons, which are fitted on both sides of the front screen on both mc-16 and mc-20 HoTT transmitters. These are typically labelled Cn5 and 6 in the »**Control adjust**« menu; see sections starting on page 112 and 116.

If they are assigned as transmitter controls in the »**Control adjust**« menu, these buttons can be used to move a servo in 1 % increments relative to the servo travel currently set (as selected in the »**Servo adjustment**« menu.) When you press one of the INC/DEC buttons, the positions are briefly superimposed on the base display.

They are ideal for tasks such as setting flight phase specific flap positions and similar fine trimming. If a button is held pressed in, the rate of change automatically speeds up – indicated by a faster sequence of audible beeps; a different beep indicates the centre position. Since you can opt for the (trim) position of these two transmitter controls to be stored separately for each flight phase – provided that they have been assigned to one of the inputs 5 … 12 in the “Control adjust” menu – you can use one and the same INC/DEC button in the same way for all flight phases you may have programmed. This does not apply to position-dependent proportional transmitter controls.

- the two proportional sliders in the middle console designated SI1 and 2, for example as shown in the »**Control adjust**« menu, page 112 and 116,
- the switches present, if they are assigned to a control channel in the »**Control adjust**« menu.

The proportional operating elements produce a direct effect on servos which is commensurate with the control’s position whereas switch modules can only effect a two or three increment change.

Just which of these controls and switches operate which of the servos 5 … 8 respectively 5 … 12 is freely programmable.

<u>Important notice:</u>

The transmitter is supplied with default programming in which certain inputs are “free”, i. e. not yet assigned to any function. These inputs are: 5 … 7 (mc-16) and 5 … 11 (mc-20) for model helicopters, and 5 … 8 (mc-16) and 5 … 12 (mc-20) for fixed-wing model aircraft.

Function input

This is an imaginary point in the signal path and must not be considered the same as the point on the circuit board where the transmitter control is connected. The choice of “**Stick mode**” and settings in the »**Control adjust**« menu have their effect “downstream” of these imaginary connection points. Thus differences between the physical control’s number and the number of the downstream control channel can indeed emerge.

Control channel

From the point at which a signal contains all control information necessary for a particular servo – whether directly from the physical control or indirectly by way of a mixer – the term “control channel” is used.

(For example, for a fixed-wing model aircraft set up as the model type “2AIL”, this means that the “Aileron” *control function* is divided into the *control channels* left and right aileron. Similarly: for a helicopter set up as the "3Sv(2roll)" type, the "Roll" *control function* is split into the *control channels* left and right roll servo.)

The signal of this type of control channel can only be further influenced by the settings entered in the »**Servo adjustment**« menu (and in the »**Tx. output swap**« menu, which is available in the mc-20 HoTT transmitter only); the signal then leaves the transmitter via the RF module.

Once it arrives at the receiver, this signal may still be modified by settings made in the »**Telemetry«** menu before finally being applied as a control quantity for the respective servo.

Mixer

The transmitter's software contains a variety of mixer functions. These can be used to apply one control function to multiple servos or, conversely, to apply multiple control functions to a single servo. Please look over the numerous mixer functions in the text beginning on page 165 of this manual.

Switches

The standard toggle switches, the 3-way switches and both push-button switches can also be incorporated into control programming. However, these switches are generally intended for switching program options, e.g. to start and stop timers, to switch mixers on and off, or as a teacher/pupil switchover, etc. Each of these switches can be assigned any number of functions.

Appropriate examples are detailed in the manual.

Control switches

Since it is very practical to have some functions automatically switched on or off for a certain control's position (e.g. switch on/off of a stopwatch for acquisition of model run time, automatic extension of spoilers and other possibilities), four control switches have been integrated into mc-16 HoTT and mc-20 HoTT software.

These software switches, designated "C1 … C4", are merely defined by virtue of their contact state along the physical control's course of travel by the touch of a key. The switching action can be correlated to the physical control's travel direction by software.

Of course control switches can also be freely combined with the aforementioned physical switches to solve even more complex problems.

There is a series of instructive examples which make this programming child's play. Learn about this by taking advantage of the programming examples beginning on page 280.

Logical switches

This function, which is available as standard on the mc-20 transmitter only, allows two switches, control switches and / or logical switches, or any combination of the above, to be linked in an "AND" or "OR" circuit. Eight logical switches "L1 … L8" can be programmed in total; see page 144.

Fixed switches FXI and FX

This type of switch turns a function, e.g. a timer, permanently on (closed fixed switch) or off (open fixed switch) or they can provide a fixed input signal for a control function, e.g. FXI = +100 % and FX = -100 %. For example, in flight phase programming, these fixed switches can be used to switch a servo or speed controller between two settings.

Physical control, switch and control switch assignments
Principle procedure

Maximum flexibility is offered by the mc-16 Hott and mc-20 HoTT system when it comes to assigning standard equipment operating elements to certain functions.

Since the assignment of controls and switches is done in the same way, even though different menus may be involved, it is appropriate at this point to explain the fundamental programming technique so that users can concentrate on the particular contents when reading the detailed menu descriptions.

Transmitter control assignment

It is possible to assign any direction of transmitter control (Ch1 … Ch4), and also any available transmitter control...

```
▶In5  GL  fr   ---    0%
 In6  GL  fr   ---    0%
 In7  GL  fr   ---    0%
 In8  GL  fr   ---    0%

◆◆◆   typ  SEL   ⌐/-   offset
```

... to inputs 5 … 8 (mc-16) and 5 … 12 (mc-20) at the transmitter, in order to operate servos. This is carried out in the third column of the »**Control adjust**« menu; see the sections starting on pages 112 and 116. When you press the central **SET** button of the right-hand touch-key the following window appears on the screen:

```
Move desired
control adj.
```

Now simply operate the transmitter control you wish to use.

<u>*Note:*</u>

The software only detects the transmitter control after it has moved a certain distance: move it left or right, or forward or back, until the assignment is displayed on the screen. If the travel in one direction is not sufficient, move the control in the opposite direction.

The same method is used throughout the other menus when transmitter controls have to be assigned.

Switch assignment

Wherever programming permits a switch to be assigned, a switch symbol will appear in the screen's bottom display line:

⌐/-

Use the selection keys in the left or right four-way button to select the appropriate column.

How to assign a switch

1. Briefly touch the **SET** key of the right four-way button. The message shown below will appear in the screen.

   ```
   Move desired switch
   to ON position
   (ext. switch: SET)
   ```

2. Now it is only necessary to put the selected switch into the desired "ON" position or, as described at the right in "Assignment of external switches", to select a switch from the list of "External switches". This concludes the assignment. The switch symbol to the right of the switch's number indicates the current state of the particular switch.

Special features of SW 16 + 17 / SW 18 + 19

These two "push-buttons" are fitted in line with the side-mounted proportional sliders on the back of the mc-20 HoTT transmitter only, and can be assigned to operate in either of two ways:

- Change-over On / Off switch "SW 16" or "SW 17", i. e. the switched state ("on" or "off") changes every time you press the button briefly.
- Momentary switch (push-button) "SW 18" and "SW 19", i. e. the switch only remains ON for as long as the button is held pressed.

<u>***Important note:***</u>

When the transmitter is switched on, the switches "SW 16" and "SW 17" are always set to the "OFF" position by default.

Changing switch action

If the activation of a switch is to result in the opposite action, put the switch or stick in the desired OFF position, again activate the switch assignment and reassign the switch again so it will respond with the desired action.

Clear switch

A switch which has been assigned as described under point 1 can be cleared with a brief simultaneous tap on the ▲▼ or ◀ ▶ key combination in the right four-way button (**CLEAR**).

Assignment from the "external switch" list

Those menus in which the message …

```
Move desired switch
to ON position
(ext. switch: SET)
```

… appears permit the assignment of switches belonging to the so-called “external switches”.

Do this by confirming the message text with the **SET** key. A new window will appear with a list of the four control switches “C1 … C4”, followed by two so-called “FX” fixed switches and the eight logical switches “L1 … L8”.

```
Control/Logic/fix sw
C1   C2   C3   C4   FX
FXi  L1   L2   L3   L4
```

Use the selection keys in the left or right four-way button to select the desired switch then assign it with a brief tap on the centre **SET** key of the right four-way button.

Notes:

- *Switching for some special functions may be better implemented from a certain freely programmable control position rather than switching them manually with a normal switch.*

  *To this end, there are a total of 4 so-called “control switches”, C1 … C4, available whose switching direction can be established, even inverted, in the »**Control switch**« menu, page 141.*
- *Logical switches, which are available as standard on the mc-20 transmitter only allow two switches and / or control switches to be linked together logically in an “AND” or “OR” circuit. See the “Logical switches” menu on page 144. A total of 8 logical switches “L1 … L8” (as well as another 8 inverted logical switches with inverted switching direction) are available.*

  The result of a logical switch function can also be used as an input for another logical switch function. Refer to the appropriate menu for more details about this.
- *The two FX switches switch a function on “FXI” or off “FX” permanently.*
- *All switches mentioned can have multiple assignments. Pay attention that you do not UNINTENTIONALLY assign reciprocally conflicting functions to a single switch. If necessary, note down the given switch functions.*

Typical applications:

- *Shut-off of an on-board glow plug heater upon underrun or overrun of an idle threshold point programmed for the C1 stick. In this case the glow plug heater switch is controlled by a transmitter mixer.*
- *Automatic switch on/off of the timer to measure pure “flight time” for a helicopter by way of a control switch on the throttle limiter.*
- *Automatic switch off of the “Al ➔ Rud” mixer when brake flaps are extended, for example to adapt the roll of a model to the ground when making a landing on a slope without inducing a change of flight direction due to influence on the rudder.*
- *Extending landing flaps with elevator trim adjustment during a landing as soon as the throttle stick is moved beyond its switch point.*
- *Switch on/off of the timer for measuring the operating time of electric motors.*

Digital trim

Functional description and description of C1 cut-off

Digital trim with visible and audible indicators

Both sticks are equipped for digital trimming. When you give the trim lever a brief push (one “click“), the neutral position of the associated stick channel changes by one increment. If you hold the trim lever in one direction, the trim value changes continuously in the corresponding direction with increasing speed.

These changes can be made “audible“ by way of different frequency tones. This makes finding the mid-point during flight easy, without looking at the screen. When the midpoint is overrun, a brief pause will be inserted.

Current trim values are automatically stored when a model memory change is made. Furthermore, digital trim exercises flight phase specific control within a memory location (except for throttle/brake flaps trim) – the socalled “C1“ (channel 1) control function. These default settings can be altered to “global” in the »**Stick mode**« menu, which is available as standard on the mc-20 HoTT transmitter only, see pages 108 and 110.

This C1 trim includes yet another special function for winged aircraft and helicopter models, it allows the carburettor‘s idle setting to easily be found for a combustion motor.

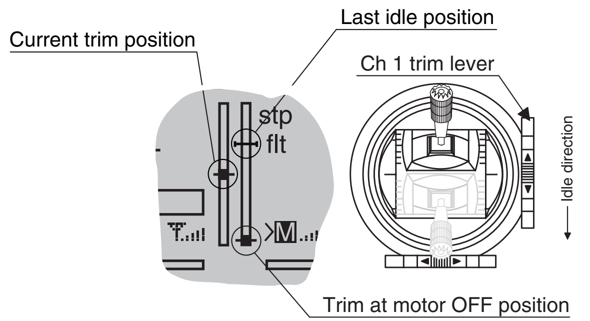
Since the trim functions described in these instructions are only effective in the direction “Motor off“, the presentation in the screen of your transmitter may only change with respect to individual throttle or Pitch-min positioning of the C1 stick in the “forward“ or “back“ direction, such as throttle/pitch “left stick“ or “right stick“.

The illustrations in these instructions are always based on “Throttle/Pitch right“ for both types of models and “Throttle back“ for winged aircraft and helicopters.

1. Winged models

C1 trimming has a special cut-off trim function intended especially for combustion motors. This cut-off trim function is configured as follows: First put the motor into a safe idle speed.

Now if you push C1 trim in a single motion toward its “Motor cut-off“ direction until it is in its furthest travel position then an additional end-position marker will remain in the display. When the motor is restarted you can again immediately set the last idle speed with a single movement in the direction of “more gas“.



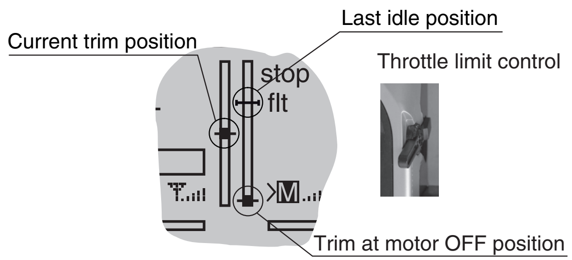
This cut-off trim will be deactivated when “None” is entered on the “Motor at C1” line of the »**Model type**« menu, see page 98.

Notice:

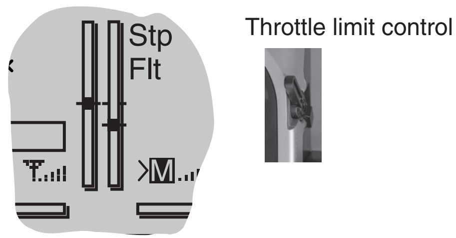
*Since this trim function is only effective in the “Motor off” direction, the display illustrated above will change appropriately if the C1 stick’s control direction for minimum throttle is changed from “back” to “front” (on which the above illustration is based) in the “Motor at C1” line of the “**Basic Settings**” menu.*

2. Helicopter models

In addition to the “Cut-off trim“ function described below in “Winged aircraft models“, C1 trimming also has another characteristic which is made possible by combining it with a so-called “Throttle limit“ function see page 122. As long as the throttle limit control – as standard the right-hand proportional rotary control Lv2 on the right-hand side of the transmitter – remains in the “rear“ half of its travel path, i. e. in the startup range, C1 trimming acts on the throttle servo as idle trim and the indication for idle trim is visible in the screen‘s display:



However, in contrast to winged aircraft models, the position indicator (⟷) will be hidden and any preset idle position will be deleted when the throttle limit control is in the “front-side“ half of its travel path.



Notice for helicopters:

C1 trimming affects only the throttle servo, not the pitch servo. Notice also that the helicopter throttle servo must be connected to receiver output 6, see receiver layout on page 67!

Convenient support is provided for up to four aileron servos and four flap servos on normal models or, for V-tail and flying wing/delta models, up to two aileron/elevator servos plus four flap servos.

The majority of motorized and glider models belong to the tail unit type “normal” and are equipped with one servo each for elevator, rudder and ailerons in addition to a motor throttle or electronic speed controller (or for brake flaps in the case of a glider model). Beyond this, tail unit type “2 HR Sv 3+8” permits the connection of two elevator servos to receiver outputs 3 and 8.

“V-tail” is to be selected from the »**Model type**« menu if the model has a V-tail instead of a “normal” tail. This V-tail option provides coupled control functions for elevator and rudder such that both tail flaps – each controlled by a separate servo – are able to handle both elevator and rudder functionality.

For delta and flying wing aircraft models, aileron and elevator functionality is affected by way of a common rudder flap on the trailing edge of each side (right and left) of the wing. The program contains appropriate mixer functions for both servos.

If ailerons, and conditionally the flaps, are each actuated with two separate servos then settings can be made for differentiated control of all aileron and flap pairs in the »**Wing mixers**« menu, i. e. settings for downward rudder throw independent of upward throw. And finally, the ideal method of controlling flap positions is to use one of the two INC/DEC transmitter controls, which are fitted as standard on the mc-20 HoTT transmitter only.

Alternatively, there is a phase-dependent trim function available for flaps, ailerons and elevators in the »**Phase trim**« menu.

Up to 7 flight phases can be programmed into each of the 20 respectively 24 model memory locations.

Except for C1 trim, digital trim will be stored on a flight-phase basis. C1 trim permits easy location of a carburettor idle setting.

Two timers are always available for flight operation. The transmitter operating time expired since the last battery charge is also displayed.

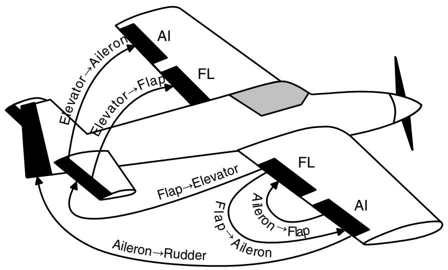
All transmitter controls and switches can be assigned in the »**Control adjust**« menu to inputs 5 … 8 respectively 5 … 12 with almost no restrictions.

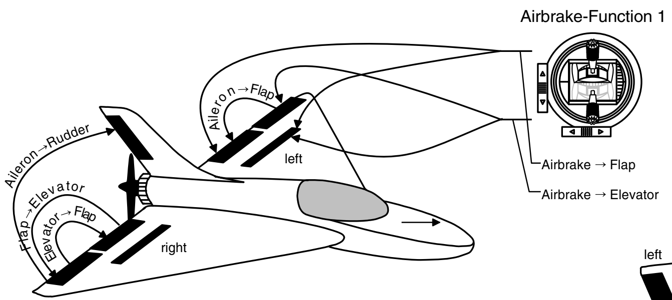
The “Dual Rate” and “Exponential” functions for ailerons, rudder and elevators are separately programmable and each are convertible between the two variations on a specific flight-phase basis.

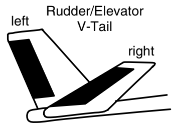
In addition to eight freely assignable linear mixers, four curve mixers (»**Free mixers**« menu) and four dual mixers (»**Dual mixers**« – available as standard on the mc-20 HoTT transmitter only), flight-phase specific six-point curves are available for control channel 1 (throttle / brake); see »**Channel 1 curve**« menu.

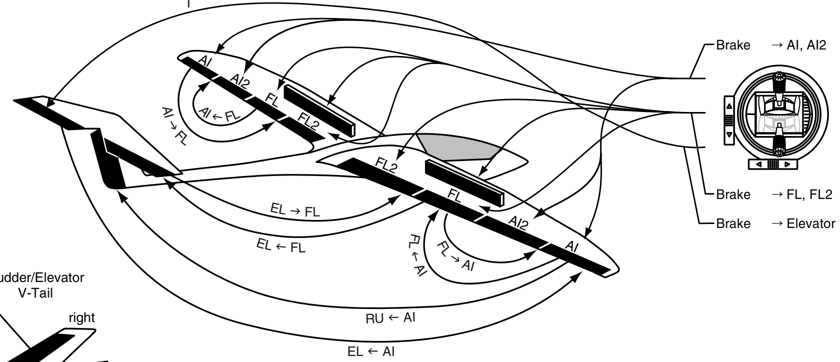
Depending on the number of wing servos, fixed-definition mix and coupling functions can be selected from a list in the »**Wing mixers**« menu.

- Multi-flap menu: control of flaps as ailerons, the influence aileron trim on flaps controlled as ailerons, flap differentiation, flap function throw magnitude for all aileron and flap pairs, ailerons controlled as flaps, elevator mixer ➔ flaps
- Brake settings: butterfly, differential reduction, elevator curves
- aileron ➔ rudder mixer
- flaps ➔ elevator mixer







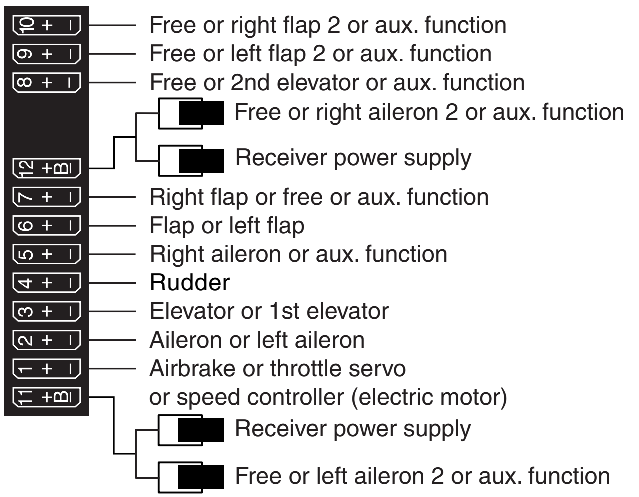


Installation notices

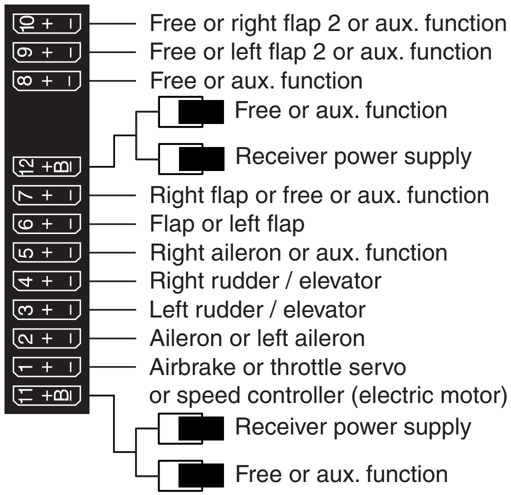
Servos MUST be connected to the receiver in the sequence illustrated here. Outputs which are not used are simply left empty. **Also be sure to follow the notices on the next pages.**

Winged aircraft with and without motor having up to 4 aileron servos and up to 4 flap servos …

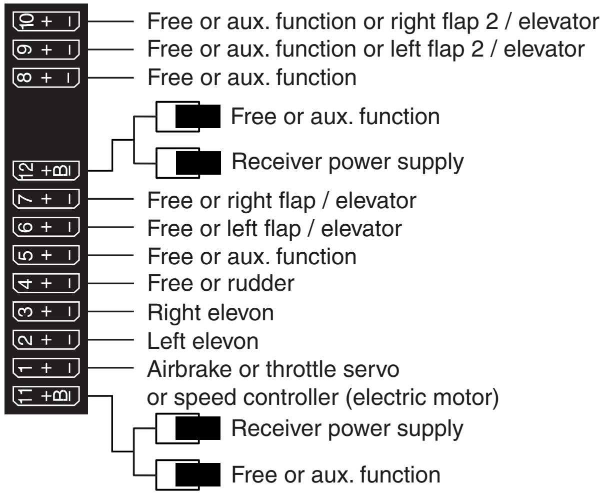
… and tail plane type "normal" or "2 elevator servos"



… and tail plane type "V tail unit"



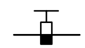
Delta/flying wing aircraft models with and without motor having up to 4 aileron/elevator servos and up to 4 flap/elevator servos



Because of orientation differences for installed servos and their rudder linkages, the actuating direction of some servos may be initially backward. The table below provides remedies.

Model type	Servo direction wrong	Remedy
V tail	Rudder and elevator reversed	Reverse polarity of servos 3 & 4 in the »**Servo adjustment**« menu
	Rudder correct, elevators reversed	Swap servos 3 & 4 on the receiver
	Elevators correct, rudder reversed	Reverse polarity of servos 3 & 4 in the »**Servo adjustment**« menu AND swap them on the receiver
Delta, flying wing	Elevator and aileron reversed	Reverse the polarity of servos 2 & 3 in the »**Servo adjustment**« menu
	Elevator correct, aileron reversed	Reverse polarity of servos 2 & 3 in the »**Servo adjustment**« menu AND swap them on the receiver
	Aileron correct, elevators reversed	Swap servos 2 & 3 on the receiver

All "program descriptions" for menus relevant to a winged aircraft model are marked with a winged aircraft symbol …



… so only these menus need to be dealt with to program a winged aircraft model.

The advanced developments incorporated into the transmitter as well as those now in helicopter models and their components like gyros, speed regulators, rotor blades, etc. make it possible to master a helicopter even in 3D acrobatic flight. On the other hand, a beginner needs only a few settings to get started with hovered flight training then, step-by-step, take advantage of HoTT transmitter features with increasing expertise.

All current model helicopters with one to four collective pitch servos can be operated using the programs provided by the mc-16 HoTT and mc-20 HoTT.

Six flight phases plus autorotation are available within a model memory, see menus »**Control adjust**«, »**Phase settings**« and »**Phase assignment**«.

As with winged aircraft, here too, in addition to the basic screen's standard timers there are additional timers as well as a lap counter with flight-phase-dependent stopwatch functionality which are available for selection (menus »**Timers (general)**« and »**Fl. phase timers**«).

Depending on the transmitter, it is possible to store the digital trims in "flight phase specific" or "global" form – for all flight phases; this does not apply to collective pitch / throttle trim. C1 trim permits easy location of an idle setting.

The control assignments for inputs 5 … 8 respectively 5 … 12 is made separately for each flight phase (**»Control adjust«** menu).

A flight phase copy function is helpful during flight trials (»**Copy / Erase**« menu).

"Dual Rate" and "Exponential" functions can be coupled for roll, nick and tail rotor and programmable in two variations in every flight phase.

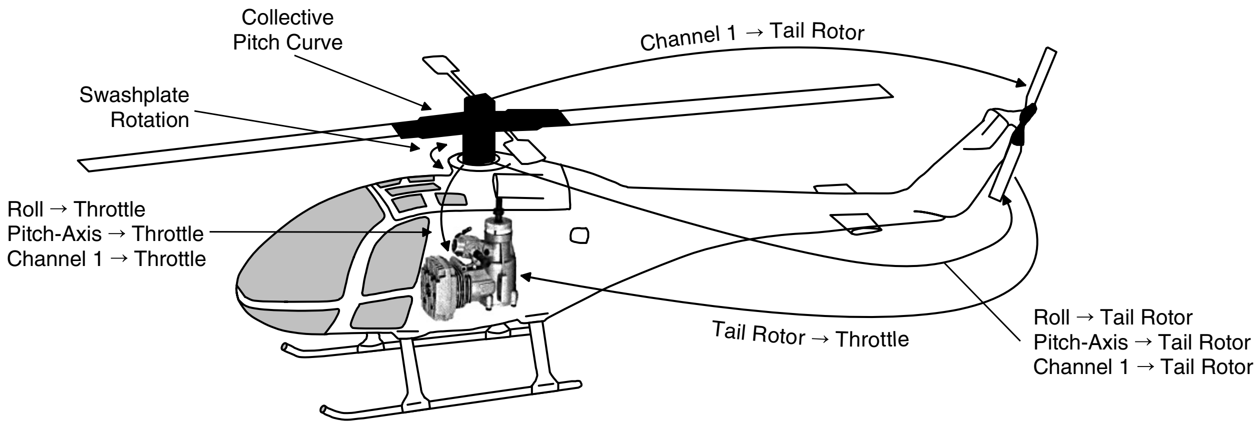
There are 8 freely assignable linear mixers. There are also 4 curve mixers that can be programed and these can also be switched on or off, depending on the flight phase, in the »**MIX active/phase**« menu. Four dual mixers are also available (»**Dual mixers**« menu, provided as standard on the mc-20 HoTT transmitter only).

The **»Helicopter mixer«** menu provides flight-phase-dependent 6-point curves for the non-linear characteristics pitch, throttle and tail rotor mixer as well as two independent swashplate mixers each for roll and nick. Independent of this, the control curve of the channel 1 stick can be defined with up to a total of 6 points in every flight phase. The beginner will initially only adapt the hover flight point to the control middle for the non-linear characteristics.

Pre-programmed mixers in the **»Helicopter mixer« menu**:

1. Pitch curve (6-point curve)
2. C1 ➔ throttle (6-point curve)
3. Channel 1 ➔ tail rotor (6-point curve)
4. Tail rotor ➔ throttle
5. Roll ➔ throttle
6. Roll ➔ tail rotor
7. Pitch-axis ➔ throttle
8. Pitch-axis ➔ tail rotor
9. Gyro suppression
10. Swashplate rotation
11. Swashplate limiter

The "Throttle limit" function (input "Lim." in the **»Control adjust«** menu) allows the motor to be started in any flight phase. From firmware version 1103 is the input "Lim." however, by default no longer preset and thus disables the throttle limiter, but it can be re-activated at any time by assigning an encoder. This "throttle limiter" establishes – depending on its given position – the maximum possible throttle servo position. This makes it possible for the motor to be controlled in the idle range, if necessary even by the proportional regulator. The throttle curves become effective only when the proportional regulator is pushed toward the full throttle direction.



Notice for those transitioning from older Graupner systems:

In comparison to previous receiver layouts, servo connector 1 (pitch servo) and servo connector 6 (throttle servo) have exchanged places. The servos must therefore be as shown at right bottom connected to the outputs of the receiver. Outputs not required are simply left vacant.

For more detailed information on each swashplate type please refer to the »**Base settings**« menu, described on page 102.

Installation notices

Servos MUST be connected to the receiver in the sequence illustrated here.
Outputs which are not used are simply left empty.

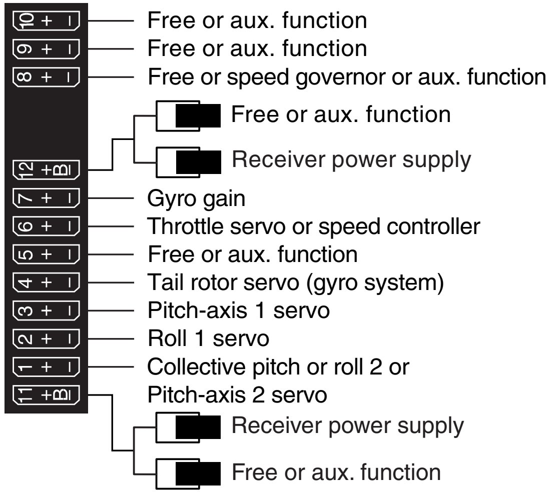
For more detailed information on each swashplate type please refer to the »**Helicopter type**« menu, described on page 102.

Also be sure to follow the notices on the next pages.

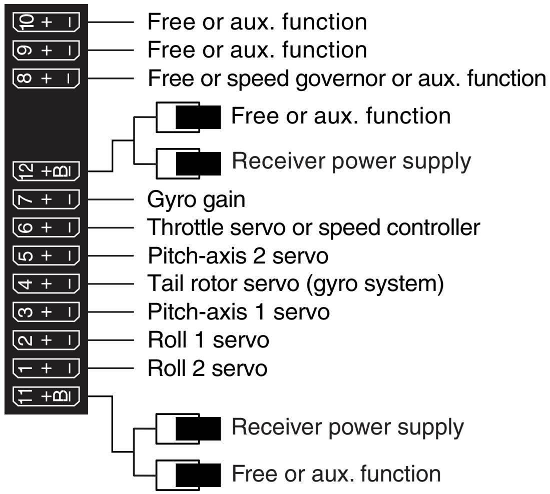
Note:

For comfort and safety use the features of the throttle limiter (see page 122), and connect a speed controller to the receiver occupancy is instead to receiver output "8" to the receiver output "6" . Refer to page 189.

Receiver allocation for helicopter models with 1 to 3 swashplate servos



Receiver allocation for helicopter models with 4 swashplate servos



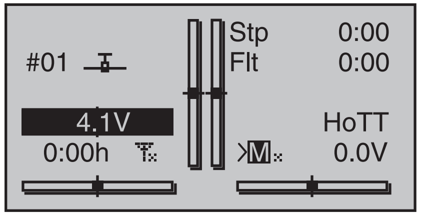
All menus relevant to helicopter models are marked in the "program descriptions" section with a helicopter symbol …

… so only these menus need to be dealt with to program a helicopter model.

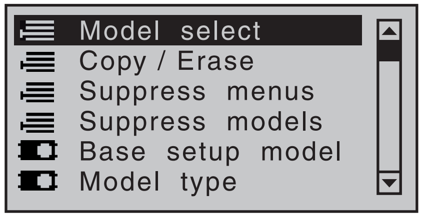
Detail program description
Loading a new memory location

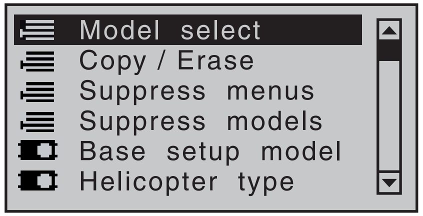
Anyone who has worked through to this part of the manual has certainly already tried out a bit of programming. Nevertheless a detailed description of every menu should not be left out.

This section begins with the loading of a “free” memory location, a procedure which would be performed if a new model was being “programmed”:



From the basic display, a jump to the “Multi-function list” is made with a tap on the centre **SET** key of the right four-way button. (The centre **ESC** key of the left four-way button will cause a jump back to the basic display.) By default, when the multi-function list is called for the first time after switching on the transmitter, the »**Model select**« menu option will be active and displayed in inverse video. Otherwise use the ▲▼ or ◄ ► selection keys of the left or right four-way button to select the »**Model select**« menu option, whereby the upper of the two following figures shows a selection list for a fixed-wing model and the lower shows the selection list for a helicopter model.





Tap briefly on the centre **SET** key of the right four-way button to open this menu option:

In the transmitter’s delivered state, the first model memory is initialized to the “**fixed-wing model**” type and the receiver in the delivery is “bound” to this model. This is indicated by the pictogram of a fixed-wing model aircraft in the second column from left, and the receiver identification displayed at far right; in the example above this is R12.

In the above example, “E12” as a synonym for the receiver included with the mc-20 HoTT GR-24 HoTT set. At the “M” on the left of this is to recognize that the receiver with the default preset option “memory-specific” connected to the memory model 1 was, so that it only responds to the control signals that a model memory of his station. For details, see page 79 and 89.

A “transmitter-specific” and therefore “global” bound receiver is symbolized by a “G”.

… If the model memory is not “bound”, you will see “---” instead of the receiver identification.

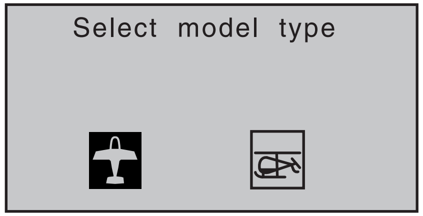
The remaining memory locations, marked with “✱✱✱free✱✱✱”, are still unoccupied and therefore also “non-bound”.

If you wish to program a fixed-wing model then, after leaving the »**Model select**« menu with a tap on the centre **ESC** key of the left four-way button, programming of the model can begin right away … or now use the ▲ or ▼ keys of the left or right four-way button to select one of the free memory locations …

Afterward you will be prompted to select the basic model type, i. e. either “winged model” or “helicopter model”:

and then tap on the centre **SET** key of the right four-way button to confirm the choice.

You are invited to select the basic model type, ie either “fixed wing” or “helicopter model”:



Use the ◄ or ► keys of the left or right four-way button to select the basic model type then tap on the centre **SET** key of the right four-way button. This initializes the selected model memory with the selected model type and the display will return to the base screen. The memory location is now accordingly occupied.

Changing over to another model type is still possible if you first erase this memory location (**»Copy / Erase«** menu, page 72).

<u>Notes:</u>

- *If the currently active model memory is to be erased then immediately after the erase action one of the two model types, "Winged" or "Heli" must be defined. You cannot avoid this selection even if you switch the transmitter off. Only afterward the undesired occupation of that model memory erase from another memory location.*

  If a non-active memory location is erased, it will subsequently be marked as "∗∗∗free∗∗∗" in the "Model select" menu.
- *After the selected model memory is initialized with the desired model type, the display will switch to the base screen of the freshly occupied model memory. At this time the warning …*

BIND. N/A
OK

*… will appear for several seconds as notification that a binding connection to a receiver is "**n**ot **a**vailable". A brief tap on the centre **SET** key of the right four-way button will cause a direct jump to the appropriate option:*

01 M E 12
02 ∗∗∗free∗∗∗
03 ∗∗∗free∗∗∗
04 ∗∗∗free∗∗∗
05 ∗∗∗free∗∗∗
06 ∗∗∗free∗∗∗

Further details about binding a receiver can be found on page 80 or 90.

- *The "BIND n/a" warning closes automatically, after which the following warning also appears for a few seconds …*

  Fail Safe
  setup
  t.b.d.

  … will appear (also for just a few seconds) to indicate that no fail safe settings have yet been made. More about this can be found on page 216.
- *If the screen should display the warning …*

  Thr
  too
  high!

  ... appears, then move the throttle / pitch control stick, in the helicopter type if necessary, the limiter, by default the right side proportional rotary slider SD2, in the idle position.

  Until this happens, the RF module of the transmitter remains switched off.

  *Whether or not this warning appears also depends on the settings selected for the "Motor on C1" and "Pitch min." options in the »**Model type**« menu, see page 98, or »**Helicopter type**« menu, see page 102.*

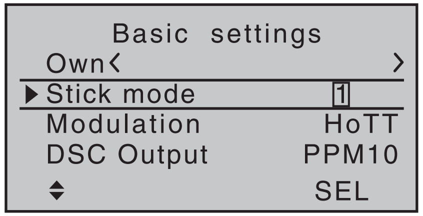
  For winged aircraft models, select "None" to deactivate this message if you have no motor to enter.
- *If the transmitter already has occupied model memories then sub-menus of the »**Copy / Erase**« menu will display a pictograph of the selected model type at the respective memory location followed by a blank line or the model name which was entered in the »**Basic settings, model**« menu, page 78 or 88.*
- *If battery voltage is too low, the model switchover cannot be made due to reasons of safety. An appropriate message will appear in the screen:*

  not possible now
  voltage too low

As a basic principle, there are four different ways to assign the four control functions, aileron, elevator, rudder and throttle or brake flaps for winged models as well as rolling, pitching, tail rotor and throttle/pitch for helicopter models, to the two sticks. Just which of these methods is used depends on the preferences of the individual model pilot. This function is set for the currently active model memory in the "**Stick mode**" line of the »**Basic settings, model**« menu, page 78 or <?>:

Base setup model
Mod.name ‹ ›
► Stick mode 1
module HoTT n/a n/a
DSC Output PPM10
BD1 BD2

If this setting is desired as a default for future models, the setting can also be entered into the »**General basic settings**« menu, page 267:



It should be noted here once again that, in the interest of greatest flexibility in combination with the prevention of unintentional operating errors, no controls are preassigned to control channels 5 … 8 respectively 5 … 12 by default.

This means that, in the system's delivered state, only servos attached to receiver outputs 1 … 4 can typically be operated by the two sticks and that any servos attached to receiver connectors 5 … max. 12 will remain in their middle positions.

Firmware version V1102 and lower

A newly initialized helicopter model is also able to more-or-less move servo 6 – depending on the position of the right-side proportional rotary slider, which is the default throttle limiter control.

Firmware version V1103 and higher

A newly initialized helicopter model is also able to more-or-less move servo 6.

With either model type, this situation will only change after appropriate assignments have been made in the »**Control adjust**« menu.

On the other hand, if a newly initialized model memory is to be put into operation then it MUST first be appropriately "connected" with one or more receivers before the servos attached to the receiver/s can be operated. More about this can be found in the section "Binding" on page 80 or 90.

A fundamental description of programming steps for a winged aircraft model can be found in the programming examples section beginning on 280, or for helicopter models beginning on page 320.

The menu descriptions below are arranged in the sequence individual menus are listed in the multi-function list. However, since the **mc-16** HoTT and **mc-20** HoTT transmitter types covered by this manual differ in their software structure as well as their hardware features, these instructions always indicate the "soft" differences between the individual transmitter types at the start of a menu description, as they are in the Contents. The key is as follows:

mc	
16	20
☐	☑

Key:

16	applicable to **mc-16** HoTT
20	applicable to **mc-20** HoTT
☑	standard option
☐	option is unavailable

Model select

Call up model 1 … 20 (mc-16) or 1 … 24 (mc-20)

mc 16	mc 20
☑	☑

This option is available on both transmitter types.

The basic operation of the transmitters keys was explained on pages 30 and 31 and, on the previous double-page, explanations were provided for navigating to the multi-function list and about how to make allocations for a new model memory. At this point we now wish to begin with the "normal" description of individual menu items in the sequence they are arranged in the transmitter. Therefore we will begin with the menu …

Model select

```
Model select
Copy / Erase
Suppress menus
Suppress models
Base setup model
Model type
```

```
Model select
Copy / Erase
Suppress menus
Suppress models
Base setup model
Helicopter type
```

Select the »**Model select**« menu with the selection keys of the left or right four-way button then briefly tap on the **SET** key of the right four-way button.

Notes:

- **Firmware V109x up to V1100**

```
Attention!
Switch-OFF
the Receiver first!
```

If this message appears, there is a telemetry link to a receiving system operational. Turn off this and wait until the display is briefly hidden afterward automatically.

- **Firmware V1101**

If the currently active model "Global" bound, a model change is only possible after switching off the receiving system for safety reasons:

```
Attention!
Switch-OFF
the Receiver first!
```

If this message appears, there is a telemetry connection to an operationally ready receiver system. Switch that receiver system off:

```
01  GRAUBELE   MR12
02  ULTIMATE   GR12
03  STARLET    MR12
04  BELL47G     ---
05  ***free***
06  ***free***
```

As many as 20 respectively 24 complete model settings, including digital trim values for the trim buttons, can be stored. Trimming is stored automatically such that a switch-over from one model to another does not cause a loss of current trim settings. To the right of the model number, each occupied model memory line in this display shows a pictograph of the model type as well as the model's name entered for the model in its »**Basic settings, model**« menu, page 78 or 88.
The code, if present, for the receiver "bound" to the model memory location will appear in right the line.
Now, with the ▲▼ selection keys of the left or right four-way button, select the desired model memory from the list and activate it with a tap on the **SET** key. A tap on the **ESC** key will cause a return to the previous menu page without activating a model change.

Notes:

- *If, after a model change, the "Throttle too high" warning appears, the throttle/pitch stick (C1) or the throttle limiter – by default, the right-side proportional rotary slider – is too far in the full throttle direction.*

Notes:

- *If a model change causes the message …*

```
Thr
 too
  high!
```

… appears, then the throttle / collective pitch stick (Ch1) or the throttle limiter – by default the right-hand side-mounted proportional rotary slider – is too far in the direction of full-throttle.

- *If a model change causes the message …*

```
BIND. N/A
   OK
```

… to appear then binding settings should be checked.

- *If a model change causes the message …*

```
Fail Safe
setup
t.b.d.
```

… to appear then respective fail safe settings should be checked.

- *If battery voltage is too low, the model switchover cannot be made due to reasons of safety. An appropriate message will appear in the screen:*

```
not possible now
voltage  too low
```

Copy / Erase

Erase model, copy model → model, copy from or to SD card, copy flight phases

mc 16 ☑ mc 20 ☑ *This option is available on both transmitter types.*

Use the ▲▼ selection keys on the left or right four-way button to select the »**Copy / Erase**« option in the multi-function menu:

```
Model select
Copy / Erase
Suppress menus
Suppress models
Base setup model
Model type
```

```
Model select
Copy / Erase
Suppress menus
Suppress models
Base setup model
Helicopter type
```

Open this menu option with a tap on the centre **SET** key of the four-way button pad:

Erase model

```
Erase model          =>
Copy model–>model    =>
Export to SD         =>
Import from SD       =>
Copy flight phase    =>
```

Select the "Erase model" sub-menu with the ▲▼ selection keys of the left or right four-way button then briefly tap on the **SET** key.

<u>*Note:*</u>

```
Attention!
Switch-OFF
the Receiver first!
```

If this message appears, there is an active telemetry link to a receiving system. Turn off this and wait until the display is briefly automatically hidden afterward.

Choose the model to be erased with the ▲▼ selection keys of the left or right four-way button …

```
model to be erased :
01  GRAUBELE   MR12
02  ULTIMATE   GR12
03  STARLET    MR12
04  BELL47G    M–––
```

… whereby another tap on the **SET** key will cause the confirmation request …

```
Model really
  01  GRAUBELE
to be erased?
  NO      YES
```

… to appear. A **NO** response will cause the process to be canceled and a return to the previous screen. Selecting the **YES** response with the ► selection key of the left or right four-way button followed by confirmation of the selection with a brief tap on the **SET** key will erase the selected model memory.

<u>***Caution:***</u>

This erase process cannot be undone. All data in the selected model memory will be erased completely.

<u>*Note:*</u>

If the currently active model memory is to be erased, a model type "Winged" or "Heli" must be defined immediately after the erase process. If, however, an inactive memory location is erased, it will subsequently appear in "Model select" list as "✱✱✱free✱✱✱".

Copy model → model

Select the "Copy model → model" sub-menu with the ▲▼ selection keys of the left or right four-way button then tap the **SET** key:

```
Erase model          =>
  SWITCHING RF OFF
        OK
```

If the message shown above should appear, the transmitter's RF module is still active.

You can interrupt the process by pressing the central **ESC** button of the left-hand four-way button.

Pressing the **SET** button of the right-hand four-way button resumes the process. However, if the receiving system is switched on, you should switch it off before doing this.

Choose the model to be copied with the ▲▼ selection keys of the left or right four-way button …

```
Copy from model:
01  GRAUBELE   MR12
02  ULTIMATE   GR12
03  STARLET    MR12
04  BELL47G    M–––
```

… then, following the change into the “Copy to model” window caused by another tap on the **SET** key of the right four-way button, the destination memory can be selected with the ▲▼ selection keys of the left or right four-way button. Yet another tap on the **SET** key will then confirm the copy process or a tap on **ESC** key will cause the copy to be cancelled. A memory location which is already occupied can be overwritten.

```
Copy to model:
01  GRAUBELE   MR12
02  ULTIMATE   GR12
03  STARLET    MR12
04  BELL47G    M–––
05     ***free***
```

After confirming the selected model memory with a tap on the **SET** key, a confirmation request will appear:

```
Modell really

   01    ULTIMATE
 –▶03     ***free***
to be copied?
      NO       YES
```

A **NO** response will cancel the process and return the screen to the originating screen. If the ▶ **YES** response is selected and confirmed with a tap on the **SET** key then the selected source model will be copied into the selected model memory destination.

Note:

- *If a memory specifically bound model copied to any other model memory from the same transmitter, the receiver in the destination memory is to rebind.*
- *When a station is specifically bound model copied to any other model memory from the same transmitter, the receiver existing bond is retained.*

Exporting to SD card

Use the ▲▼ selection keys of the left or right four-way button to select the “Export to SD” sub-menu.

```
 Erase model           =>
 Copy model–>model     =>
▶Export to SD          =>
 Import from SD        =>
 Copy flight phase     =>
```

... and tap on the **SET** key,

Note:

```
Attention!
Switch-OFF
the Receiver first!
```

If this message appears, there is an active telemetry link to a receiving system. Turn off this and wait until the display is briefly automatically hidden afterward.

Choose the model to be exported with the ▲▼ selection keys of the left or right four-way button …

```
 export to SD-CARD:
01  GRAUBELE   MR12
02  ULTIMATE   GR12
03  STARLET    MR12
04  BELL47G    M–––
```

After confirming the selected model memory with a tap on the **SET** key, a confirmation request will appear:

```
modell

   01    ULTIMATE
 –▶SD-CARD
export ?
     NO       YES
```

A **NO** response will cancel the process and return the screen to the originating screen. If the ▶ **YES** response is selected then confirmed with a tap on the **SET** key, the selected model will be copied to the SD card.

Notes:

- *Should the notice …*

```
SD-CARD
INSERT
  OK
```

… appears instead of a screen for model selection, there is no SD card in the transmitter’s card slot, see page 26.

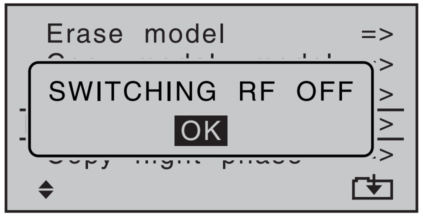
- *In addition to model data, binding data is also copied by this process. This means that a receiver system which was/is bound to the original model memory can also be operated in the SAME transmitter by its copy without establishing the bond again.*
- *An exported fixed-wing model will be stored on the memory card in the \\Models\mc-16 respectively \\Models\mc-20 folder with a filename format of “aModelname.mdl” and a helicopter model with a filename format of “hModelname.mdl”. On the other hand, if a “nameless” model is exported, its data will be stored on the memory card under “aNoName.mdl” or “hNoName.mdl”, as appropriate.*
- *Some special characters that can be used in model names are subject to specific restrictions associated with the FAT or FAT32 file system used by the memory cards and these special characters*

will be replaced during the copy process with a tilde (~).

- *A model file already on the memory having the same name as the file to be copied will be overwritten without warning.*

Importing from SD card

Use the ▲▼ selection keys of the left or right four-way button to select the "Import from SD" sub-menu then tap on the **SET** key.

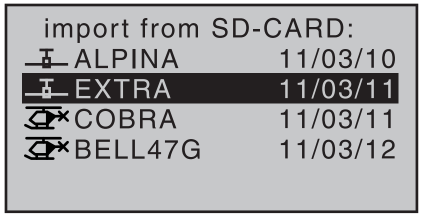


If the message shown above should appear, the transmitter's RF module is still active.

You can interrupt the process by pressing the central **ESC** button of the left-hand four-way button.

Pressing the **SET** button of the right-hand four-way button resumes the process. However, if the receiving system is switched on, you should switch it off before doing this.

Select the model to be imported from the SD memory card with the ▲▼ selection keys of the left or right four-way button:

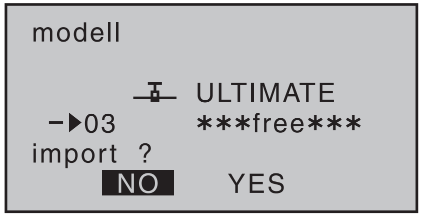


Note:

The export date posted at the right end of each model name line is represented in the format "year/month/day".

After another tap on the **SET** key of the right four-way button, the "import from SD-CARD" window will appear. Now the destination memory location can be selected with the ▲▼ selection keys of the left or right four-way button then confirmed with a tap on the **SET** key, or the process can be canceled with a tap on the **ESC** key. A memory location which is already occupied can be overwritten.

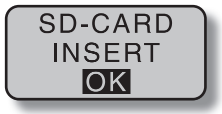
After confirming the selected model memory with a tap on the **SET** key, a confirmation request will appear:



A **NO** response will cancel the process and return the screen to the originating screen. If the ▶ **YES** response is selected and confirmed with a tap on the **SET** key then the selected source model will be imported into the selected destination model memory.

Notes:

- *If the message …*



… appears instead of a screen for model selection, there is no SD card in the transmitter's card slot, *see page 26.*

- *If a memory specifically bound and in the meantime on the SD card, for example, for backup purposes, the same model is loaded back into the original model memory from the same transmitter, the receiver existing binding is retained.*

  On the other hand, the same model is copied to a different model memory, or even in another channel, the affected receiver MUST be re-bound.

- *In addition to model data, binding data is also imported by this process. This means that a receiver system which was/is bound to the original model memory can also be operated in the SAME transmitter by its copy without establishing the bond again.*

- *In principle the model memories of the* **mx-20** *and* **mc-20** *transmitters are compatible, BUT:*

  If you wish to carry out an "Import from SD card" in the other transmitter you must first copy or move the model memory concerned to the appropriate folder on a PC. For example: from \\Models\mc-20 to \\Models\mx-20, or vice versa.

  C A U T I O N :

  After you have carried out an "Import from SD card" it is absolutely essential to check all the model functions with great care.

  Note also that the transmitter control and switch functions may need to be adjusted to suit the new transmitter.

Copy flight phase

Select the "Copy flight phase" sub-menu with the ▲▼ selection keys of the left or right four-way button then tap on the **SET** key.

```
  Erase model              =>
  Copy model–>model        =>
  Export to SD             =>
  Import from SD           =>
▶ Copy flight phase        =>
```

Note:

Attention!
Switch-OFF
the Receiver first!

If this message appears, there is an active telemetry link to a receiving system. Turn off this and wait until the display is briefly automatically hidden afterward.

In the "Copy flight phase" sub-menu …

```
Copy  from  phase:
1               2
3               4
5               6
7
```

… the flight phase to be copied (1 … 7 for fixed-wing models or 1 … 6 for helicopter models) is selected with the selection keys of the left or right four-way button then confirmed with a brief tap on the **SET** key of the right four-way button. In the next window to appear …

```
Copy  to  phase:
1               2
3               4
5               6
7
```

… a destination must be selected and it must be confirmed too. Another confirmation request will follow:

```
     Phase  to:
  1  Normal  –>2  Launch
     to  be  copied?

        NO      YES
```

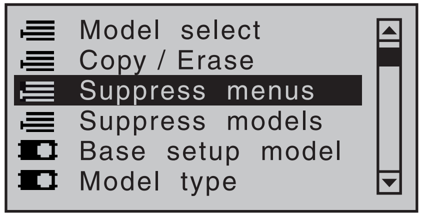
A **NO** response will cancel the process and return the screen to the originating screen. If the ▶ **YES** response is selected and confirmed with a tap on the **SET** key then the selected source model will be imported into the selected destination model memory.

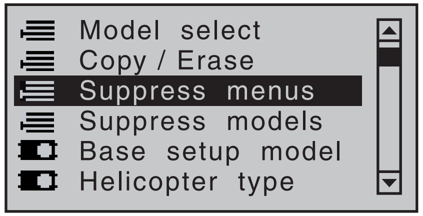
Suppress menus

Suppression of menus in the multifunction list

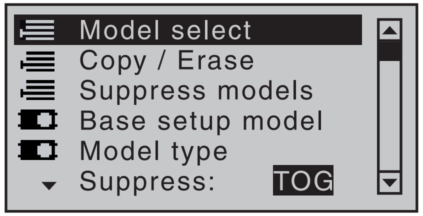
This option is available on both transmitter types.

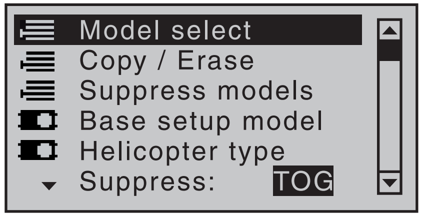
Use the ▲▼ selection keys on the left or right four-way button to select the »**Suppress codes**« option in the multi-function menu:





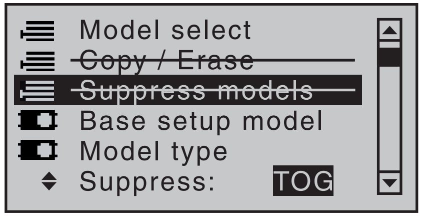
Open this menu option with a tap on the centre **SET** key of the four-way button pad.

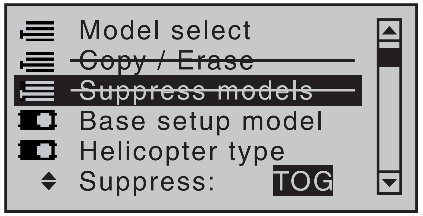




In the menu which then appears, menu items which are no longer needed or those which should not be changed, can be blocked from appearing in the multi-function list.

The option to be suppressed/displayed is selected with the selection keys of the left or right four-way button then its status is switched over with a tap on the centre **SET** key of the right four-way button:





This can reduce the multi-function list considerably, in some cases to only a few menus, thus substantially improving clarity of the multi-function list. Options are not deactivated by being suppressed. They will simply no longer appear in the list. This also blocks direct access to these functions.

Tip:

*If you do not wish to block access to the multi-function list, in the interests of security we recommend that you use this list to suppress the »**Code lock**« menu from the multi-function list. This menu is available on the mc-20 HoTT transmitter only. This setting also makes it a little more difficult for any unauthorised person to block access to the transmitter.*

Suppress models

Suppression of model memory locations

mc 16 ☐ 20 ☑

This option is available on the mc-20 HoTT transmitter only.

Use the ▲▼ selection keys on the left or right four-way button to select the »**Suppress models**« option in the multi-function menu:

```
Model select
Copy / Erase
Suppress menus
Suppress models
Base setup model
Model type
```

```
Model select
Copy / Erase
Suppress menus
Suppress models
Base setup model
Helicopter type
```

Open this menu option with a tap on the centre **SET** key of the four-way button pad.

Model memories which are rarely needed or to which access is to be blocked for other reasons can be hidden from the model selection list. This also clarifies the overview layout for model selection.

The model to be suppressed/displayed is selected with the selection keys of the left or right four-way button then its status is switched over with a tap on the centre **SET** key of the right four-way button.

01 GRAUBELE MR12
~~02 ULTIMATE GR12~~
03 STARLET MR12
04 BELL47G M–––
05 ***free***
Suppress: TOG

A model memory which is "stricken through" will no longer appear in the »**Model select**« menu:

```
01 GRAUBELE MR12
03 STARLET   MR12
04 BELL47G   M–––
05 ***free***
06 ***free***
07 ***free***
```

Model-specific base settings for winged aircraft models

mc
16 20
☑ ☑

This option is available on both transmitter types.

Before programming specific parameters, there are some basic settings to be made which effect the currently active model memory.

Use the ▲▼ selection keys on the left or right four-way button to select the »**Base setup model**« option in the multi-function menu:

```
Suppress models
Base setup model
Model type
Servo adjustment
Stick mode
Control adjust
```

Open this menu option with a tap on the centre **SET** key of the four-way button pad:

Model name

```
   Base  setup  model
▶Mod.name  <          >
 Stick  mode            1
 module  HoTT   n/a   n/a
 DSC  Output        PPM10
```

Change to the next screen page with a brief tap on the **SET** key of the right four-way button. This will open a screen of characters for entry of the model's name. A maximum of 9 characters can be used to specify a model name.

```
!"#$%&'()*+,-./0123
456789:;<=>?@ ABCDE
FGHIJKLMNOPQRSTUVWX
YZ[¥]^_`abcdefghijk
Mod  Name <GRAUB      >
```

Now the desired characters can be selected with the selection keys of the left four-way button. Move to the next position to select the next character with a tap on the centre **SET** key of the right four-way button.

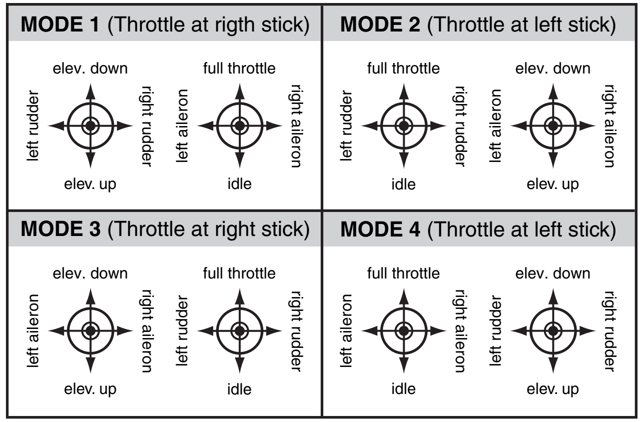
A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR)** will place a space character at the current position.

Positioning to any character position within the entry field can be done with the ◀ ▶ keys of the right four-way button.

A return to the previous menu screen is accomplished with a tap on the centre **ESC** key of the left four-way button.

A model name entered in this manner will appear in the base screen of the »**Model select**« menu and in the sub-menus of the »**Copy / Erase**« menu item.

Stick mode



There are four fundamental options for assigning the four control functions (aileron, elevator, rudder and throttle/brake flap) for a winged aircraft model to the two sticks. Just which of these options is chosen depends on the individual preferences of the individual model pilot.

Use the ▲▼ selection keys of the left or right four-way button to select the "Stick mode" line. The option field will be framed.

```
   Base  setup  model
 Mod.name    <GRAUBELE>
▶Stick  mode           [1]
 module  HoTT   n/a   n/a
 DSC  Output        PPM10
                      SEL
```

Tap on the **SET** key. The currently displayed stick mode will be displayed in inverse video. Now use the selection keys of the right four-way button to select from among options 1 through 4.

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset the display to stick mode "1".

Another tap on the **SET** key will again deactivate option selection so a change to another line can be affected.

Binding type

Note:

This menu item is only visible as long as no receiver is bound to the currently active model memory.

An “unbound” model memory can be changed at any time from the default preset memory specific HoTT transmitter-specific synchronization, and vice versa.

So If necessary, change the line “Binding Type” and press the **SET** button to the right four-way button.

```
   Base  setup  model
Mod.name   <GRAUBELE>
Stick  mode          1
▶Binding type    Model
Module HoTT   n/a  n/a
⇕                 SEL
```

... And change with the selection keys of the left or right four-way button, the setting in “global” (or vice versa):

```
   Base  setup  model
Mod.name   <GRAUBELE>
Stick  mode          1
▶Binding type   Global
Module HoTT   n/a  n/a
⇕                 SEL
```

Note:

- “**Global**”, ie specific sender, receiver bound to respond to the signals of all model memories “their” station, which is why firmware version V1101 for safety reasons, a model change only after switching off the receiving system is possible.
- “**Model**” -specific bound receivers respond only to signals of them explicitly allocated memory model. One, possibly unintentional, operating on an unallocated model space is not therefore possible.
- The HoTT synchronization behavior of a copied or imported model memory depends on several factors. For details, refer to the appropriate section.
- The respective HoTT synchronization type of “bound” model memory is left of the synonym for the receiver type in the menu “Model select” recognizable:
  “Model” -specific bound receiver with an “M” and “global”, ie Transmitter far, bound receiver with a “G”.
  As an illustration of this, the model memory 01, 03 and 04 with model-specific and model memory 02 are in the figure below exemplified with transmitter-specific binding:

```
01  GRAUBELE    MR12
02  ULTIMATE    GR12
03  STARLET     MR12
04  BELL47G     M–––
05  ***free***
06  ***free***
```

Module

The MC-16 HoTT and MC-20 HoTT are fitted as standard with a HoTT RF module. However, it is also possible to switch to a non-*Graupner* external RF module by software, if such a module is connected to the transmitter. This is accomplished by using the Select buttons of the left or right-hand four-way button to move to the left, to the “Module select” value field:

```
   Base  setup  model
Mod.name   <GRAUBELE>
Stick  mode          1
▶module  HoTT bind n/a
Rcv  Ch  Map  R12  n/a
⇕             BD1  BD2
```

HoTT

To be able to connect to the transmitter, Graupner HoTT receiver must be connected to at least one model memory “of their” Graupner HoTT transmitter. This process is commonly referred to by the English term “binding” and can be repeated anytime. This “binding” of a receiver is by default always memory-specific, but may at any time and for any unbound model memory of a transmitter in the menu that appears row “binding type”, see above, to transmitter specific, and can be reversed, changed.

Important notices:

- ***During the binding procedure be sure the transmitter’s antenna is always far enough away from the receiver’s antenna. To be on the safe side, keep them at least one meter apart. Otherwise there is a risk of a faulty connection to the return channel and malfunctions will result.***
- ***Pay close attention to the correct power supply of the receiving system. Too low supply voltage while responding the LEDs of the receiver as described below on your Binding effort, yet there is no proper HoTT Synchronization.***
- ***When binding additional receivers, note that any other – switched on – receivers already bound to the transmitter will fall into Fail safe mode during the transmitter-side “binding” period.***

“Binding” multiple receivers per model

Multiple receivers per model can be bound if desired, whereby respective mc-16 HoTT and mc-20 HoTT programs offer the potential for managing up to two receivers directly and for dividing up the transmitter’s 8 or 12 control channels (max) in any arrangement among these receivers under menu control. Refer to additional details further down in this section. First bind the receivers individually as described below.

When the system is actually in use, the only receiver which creates a telemetry link to the transmitter is either the last receiver to be bound, or the receiver which you selected in the “TEL.RCV.” line of the »Telemetry« menu, for example:

```
TELEMETRY

▶TEL.RCV.      RCV CH1
 SETTING & DATA VIEW
 SENSOR SELECT
 RF STATUS VIEW
 VOICE TRIGGER
```

Any telemetry sensors which may be built into the model should therefore be connected to this receiver because the transmitter only receives and evaluates data from the return channel of the receiver *activated on this line*. The second, and all other receivers, operate in parallel but are fully independent in slave mode.

“Binding” transmitter and receiver

Use the ▲▼ selection keys of the left or right four-way button to move into the “Module” line:

The marker frame will be positioned by default to the column for the next free binding channel. In the example shown in the figure below, the marker frame is positioned above the column label “BD2” because the binding channel in the column labelled “BD1” is already in use by default for the receiver which was delivered with the set:

```
   Base setup model
 Mod.name   <GRAUBELE>
 Stick mode          1
▶module  HoTT bind  n/a
 Rcv Ch  Map   R12  n/a
 ♦             BD1  BD2
```

If already off, now switch the receiver on:

Receiver GR-16 and GR-24

The red LED on the receiver will blink..

Hold the SET button on the receiver pressed in for about three seconds while the LED flashes red; it will then flash red / green for a further three seconds. The SET button on the receiver can now be released. As long as this LED blinks red/green, the receiver is in bind mode.

Now, within this 3 second period, start the so-called “receiver binding” process for the receiver to the currently active model memory with a brief tap on the centre SET key of the right four-way button. At this time, the screen’s display will blend in a message window for the duration of the “binding” process.

```
   Base setup model
 Mod.name   <GRAUBELE>
 Stick mode          1
▶modu Finding...  d  n/a
 Rcv Ch  Map   R12  n/a
 ♦             BD1  BD2
```

If the receiver’s LED, again blinking red, changes within about 10 seconds to continuous illumination in green, the binding process has been successfully completed. Your model-memory to receiver combination is now operationally ready. At this time the screen will now display “ bind “ (bound) instead of “n/a” (not attached), for example:

```
   Base setup model
 Mod.name   <GRAUBELE>
 Stick mode          1
▶module  HoTT bind bind
 Rcv Ch  Map   R12  R08
 ♦             BD1  BD2
```

On the other hand, should the LED on the receiver blink red for longer than about 10 seconds, the binding process has failed. In this case the screen will continue to show the status as “n/a”. If this should happen, try changing the position of antennas then repeat the entire procedure.

Receiver GR-12L

At the receiver, the red LED lights. Press and hold the SET button on the receiver until the red LED goes out after about 3 seconds for a further 3 seconds. You can now release the SET button on the receiver. As long as the LED is off, the receiver is in bind mode. Start now-as described above-within these 3 s to bind the receiver to the current model memory. If the LED of the receiver is still dark and the display in the transmitter changes to “b”, the binding process has been completed successfully. However, the red LED will light up red again at the receiver, the binding process has failed. At the same time appear in the line "module" of the display again "n / a". If necessary, change the positions of the antennas involved and repeat the entire procedure.

Binding other receivers

The binding channel you have chosen is already bound (as indicated by the "bind" status). This binding is to be replaced by another. After initiating the RF bind process, instead of displaying "BINDING", the message shown below appears:

Press the central **SET** button of the right-hand four-way button to erase the message.

Drop down two lines in the screen and switch off the RF module as described on the page in section "RF module". Afterward, return again to the "Module" line and restart the binding process as described above.

Alternatively, the transmitter can be switched off briefly then, after switching it back on again, respond to the message window that appears …

… with "OFF" …

… then confirm the selection with a brief tap on the centre **SET** key of the right four-way button. From the base screen jump again into the "Module" line of the »**Basic settings, model**« menu and restart the binding process.

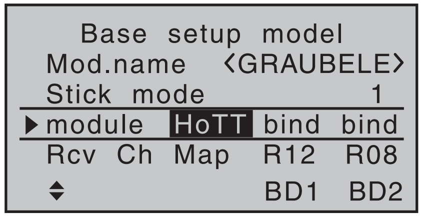
Dissolving a bond

Proceed as described above to initiate the binding process but WITHOUT first putting a receiver in binding readiness.

EXT. (PPM signal at DSC socket)

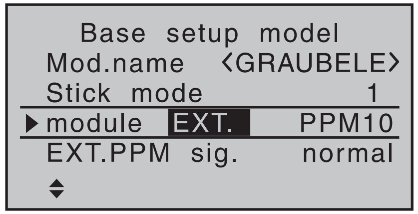
If your transmitter is fitted with a non-*Graupner* external RF module connected to the DSC / Data socket, you can switch between the standard internal HoTT RF module and the external module when you switch model memories in the "Module" line by choosing either "HoTT", "EXT.", or "SP.", as described in the following section.

You can now use the arrow button ◄ of the right-hand four-way button to move to the first Value field in the "Module" line before pressing the central **SET** button of the right-hand four-way button:

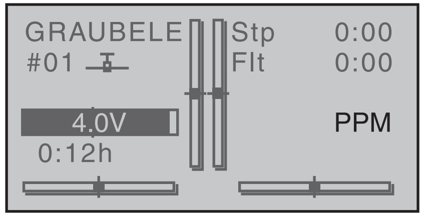


In the active Value field you should now use the Select buttons to choose "EXT." or – if appropriate – the "SP." mode (described below) instead of "HoTT".

When you select "EXT.", the HoTT-specific value fields are replaced by the modulation type already selected in the "DSC output" line; see page 85:



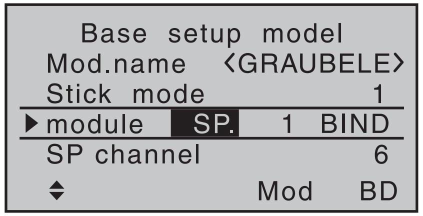
The lines of the "Receiver output" and "Range test" options (described below) are also suppressed, as are all the HoTT-specific displays in the base display; "PPM" is also superimposed instead of "HoTT":



Press the central **SET** button of the right-hand four-way button to conclude the Select process.

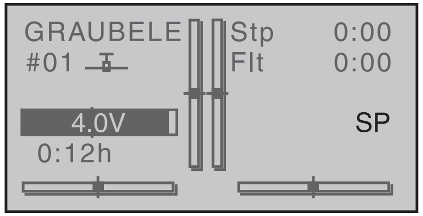
SP. (digital signal at Data socket)

However, if you require a special digital signal instead of the analogue PPM signal for the non-*Graupner* external RF module, then connect this to the DATA socket and select "SP." in the "Module" line:

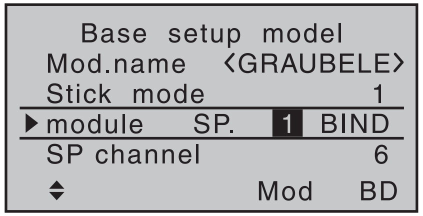


Once again, press the central **SET** button of the right-hand four-way button to conclude the Select process.

The lines of the "Receiver output" and "Range test" options (described below) are also suppressed, as are all the HoTT-specific displays in the base display; "SP." is also superimposed instead of "HoTT":



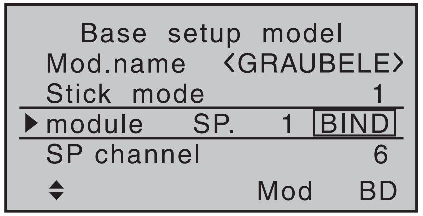
"Mode" column



In this column you select the transmission mode of the external RF module:

- Mode "1": 2-channel hopping
- Mode "2": x-channel hopping

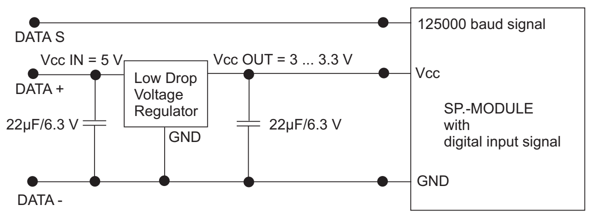
"BIND" column



The "BIND" column in the right-hand column can be used to initiate the "Bind" process of the non-*Graupner* system – **the transmitter's RF section must be switched off when the transmitter is first switched on**.

Important notes:

- ***The output voltage of the DATA socket is around 5 V, and must be reduced to the power supply voltage generally required by external digital RF modules (3 to max. 3.3 V). This is accomplished using the circuit which is shown here in diagrammatic form:***



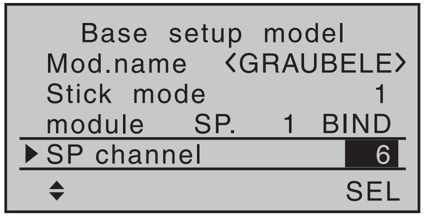
- ***Servo travels must be limited to max. 128 %.***

SP channels

Note:

This menu line is suppressed in the "Module" line if you select "HoTT" or "EXT.".

If necessary, use the Select buttons ▲▼ of the left or right-hand four-way button to move to the "SP channels" line, then briefly press the central **SET** button of the right-hand four-way button to activate the Value window:



You can now select "6" or "8" channels using the right-hand Select buttons. The procedure is concluded by again pressing the central **SET** button of the right-hand four-way button.

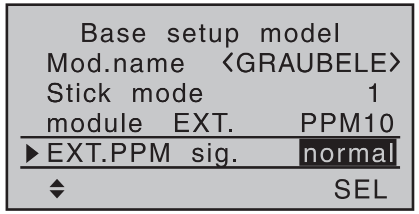
At the transmitter this selection only affects the number of control channels transferred to the external RF module via the DATA socket. If you choose "6", then these are control channels 1 … 6; if you choose "8", these are channels 1 … 8.

Simultaneously pressing the ▲▼ or ◀ ▶ buttons of the right-hand four-way button (**CLEAR**) returns the display to "6".

EXT. PPM signal

Note:

This menu line is suppressed in the "Module" line if you select "HoTT".



Some RF modules which can be connected to the DSC connector (page 24) require an inverted input signal. Be sure to follow the respective module's installation instructions for this.

Observe, however, observe the installation instructions of the relevant module.

The choice of “inverted” instead of the default preset “normal” allows for appropriate adaptation of the provided PPM signal.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset the display to “normal”.

Receiver channel mapping

Note:

This menu line is suppressed in the “Module” line if you select “EXT.” or “SP.”.

As long as there is at least one “bound” HoTT receiver in the “Module” line, the next line down will be the “Rcv Ch map” line:

```
   Base  setup  model
 Mod.name   <GRAUBELE>
 Stick  mode          1
 module  HoTT  bind  bind
►Rcv  Ch  Map  [R12]  R08
 ◆              SET   SET
```

As already mentioned in the introduction to the section entitled “Binding receivers”, mc-16 HoTT and mc-20 HoTT transmitters feature a menu point in which the transmitter’s control channels can be redistributed in any way you like *within one receiver*, and also include an option to distribute the transmitter’s control channels to a *maximum of two receivers* in any arrangement you desire. These are the eight control channels of the mc-16 HoTT transmitter, and the twelve control channels of the mc-20 HoTT. This redistribution is termed “*mapping*” or “*channel mapping*” (channel assignment) in the following section.

Select the receiver to be “mapped” with the selection keys of the left or right four-way button then tap briefly on the centre **SET** key of the right four-way button.

Channel mapping within a receiver

This menu point provides a simple means of re-mapping the transmitter’s control channels in any way you like, in a similar manner to the channel assignment function termed “Channel mapping” in the »**Telemetry**« menu, as described on page 241. This means that you can re-distribute the transmitter’s control channels, which are present at the receiver inputs, to the selected receiver’s outputs / servo sockets in any way you like:

```
  Receiver  CH – BIND1
►In Ch [1]   -> Out Ch   1
 In Ch  2    -> Out Ch   2
 In Ch  3    -> Out Ch   3
 In Ch  4    -> Out Ch   4
 ▼
```

After selection of the desired *output* with the selection keys of the left or right four-way button, the appropriate value field will be framed. Briefly tap on the centre **SET** key of the right four-way button. The current setting will be displayed in inverse video. Now use the selection keys of the right four-way button to select the desired input channel’s respective transmitter output, see page 226.

BUT CAUTION:

If, for example, “2AIL” has been specified in the “Aileron/camber flaps” line of the »**Model type**« menu then the transmitter will have allocated *control function 2* (*ailerons)* to *control channels 2 & 5 for the left and right ailerons*. The corresponding *receiver inputs* to be assigned in this case would be channels 2 & 5, refer to the example below.

Examples:

- *You would like to control each aileron of a large model with two or more servos.*

  Assign each of the appropriate outputs *(servo connections) to one and the same* input *(control channel). In this case, depending on left or right wing, as the respective* input *to one of the two default aileron control channels (2 or 5).*
- *You would like to control the rudder of a large model with two or more servos.*

  Assign each of the appropriate outputs *(servo connections) to one and the same* input *(control channel). In this case, the default rudder channel (4), see figure right.*

Notes:

- *The maximum number of lines (outputs) available corresponds to the maximum number of servos which can be connected to the receiver in question.*
- *If you see the warning …*

  ```
  CAN‘T
  RECEIVE
  DATA
  OK
  ```

  … then there is no bound receiver within range.
  If the case may be, switch the RF module or/and your receiving system on.
- *With the »**Tx. output swap**« option, which is available only on the mc-20 transmitter, see page 226, the transmitter’s control functions can be interchanged in any way; it is also possible to assign multiple outputs to one and the same control function. In the interests of clarity however we strongly advise that you use only one of these two options.*

Channel assignment on second receiver

As already mentioned, the “Receiver channel mapping” menu point can be used to map (re-distribute) the transmitter’s control channels in any way amongst a maximum of two receivers; these are the eight control channels of the mc-16 HoTT transmitter, and the twelve channels of the mc-20 HoTT transmitter. In this case the numbering of the outputs (servo sockets) and the maximum number of lines (outputs) available reflects the maximum number of servos which can be connected to the receiver in question.

```
  Receiver CH – BIND2
▶ In Ch [8]  –> Out Ch  1
  In Ch  8   –> Out Ch  2
  In Ch  8   –> Out Ch  3
  In Ch  8   –> Out Ch  4
  ▼
```

```
  Receiver CH – BIND2
▶ In Ch[12]  –> Out Ch  1
  In Ch 12   –> Out Ch  2
  In Ch 12   –> Out Ch  3
  In Ch 12   –> Out Ch  4
  ▼
```

<u>*Note:*</u>

The upper screen-shot above shows the screen of the mc-16 HoTT eight-channel transmitter; the lower one the screen of the mc-20 HoTT twelve-channel transmitter.

After selection of the desired *output* with the selection keys of the left or right four-way button, the respective input field will be framed. Tap the centre **SET** key of the right four-way button. The current setting will be displayed in inverse video. Now select the desired input channel with the selection keys of the right four-way button. For example, suitable to the above rudder example:

```
  Receiver CH – BIND2
  In Ch  4   –> Out Ch  1
  In Ch  4   –> Out Ch  2
  In Ch  4   –> Out Ch  3
▶ In Ch  4   –> Out Ch  4
  ▲▼
```

<u>*Note:*</u>

The maximum number of lines (outputs) available reflects the maximum number of servos which can be connected to the receiver in question.

RF transmit

This menu line provides an option for manually switching the transmitter’s RF transmission on and off to specific models while the transmitter is in operation. For example, to save power while a model is being programmed.

If this line option was set to OFF, it will be canceled (i.e. set to ON) the next time the transmitter is switched on.

If necessary, use the ▲▼ selection keys of the left or right four-way button to move into the “RF transmit“ line then activate the option with a brief tap on the centre **SET** button of the right four-way button:

```
   Base setup model
  Stick mode              1
  module   HoTT bind  bind
  Rcv Ch Map   R12    R08
▶ RF transmit            ON
  ▲▼                    SEL
```

The right selection keys can now be used to choose between **OFF** and **ON**. Another tap on the centre **SET** key of the right four-way button will conclude the entry.

Range test

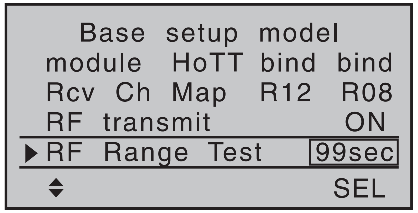
<u>*Note:*</u>

This menu line is suppressed if you select “EXT.” or “SP.” in the “Module” line.

The built-in range test reduces transmission power to an extent that a functional test can be carried out even within a distance of less than 100 m.

Perform a range test on the *Graupner* HoTT system according to the following instructions. If necessary, have someone assist you in carrying out the range test.

1. Preferably, the receiver already bound to the transmitter should be installed into the model in its intended position.
2. Switch remote control on and wait for the green LED to light up on the receiver/s. Now servo movements can be observed.
3. Place the model on a level surface (pavement, low-cut grass or bare ground) such that receiver antennas are at least 15 cm above ground level. It may be necessary to put something under the model to raise it up enough for this.
4. Hold the transmitter at hip level and at some distance from one’s body.
5. If necessary, use the ▲▼ selection keys of the left or right four-way button to reach the “RF range test” line in the menu then start range test mode with a tap on the centre **SET** key of the right four-way button:



Note:

- If the message...

SWITCH RF ON

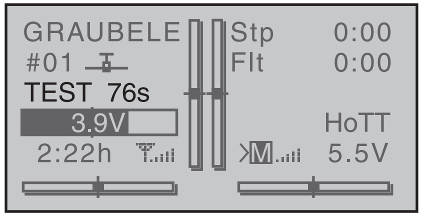
... appears, the RF module of the transmitter is inactive. Turn on the RF module and try again.

- If instead, the message ...

CAN'T RECEIVE DATA

... is displayed, there is no connection to a receiver. Switch on the receiving system of your model or check the radio connection to your model and repeat the process afterwards.

When the range test has been initiated, the transmitter's transmission power will be significantly reduced and the green LED just to the right of the main switch on the transmitter, marked RF, will begin to blink; this will also be accompanied by acoustic tones. At the same time, the timer in the transmitter's display will start counting down and every 5 seconds a two-frequency tone will sound.



Five seconds prior to the end of the range test a three-frequency tone will sound once every second. After expiration of the range test's 99th second the transmitter will again be switched to full output power and the LED just to the right of the main switch on the transmitter will again illuminate constantly.

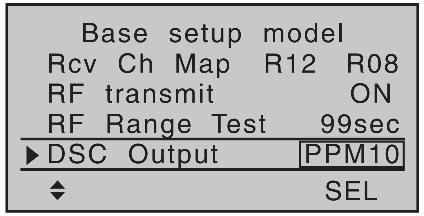
6. Move away from the model while manipulating the sticks during this timespan. If you notice an interruption anytime while still within a distance of about 50 m, try to reproduce this malfunction.
7. If there is a motor in the model, it may be necessary to switch it on to further check noise immunity.
8. Continue moving away from the model until perfect control is no longer possible.
9. Wait at this distance for the remainder of the test period with the still-operationally-ready model to expire. After the range test is ended it should again respond correctly to all RC controls. If this is not 100 % the case, do not use the system. Contact your area's *Graupner* service partner.
10. Perform the range test before each flight and, in doing so, simulate all servo movements which also take place during flight. The range must always be at 50 m on the ground in order to assure safe model operation.

Caution:

Never start the range test on the transmitter during normal operation of the model.

DSC output

If necessary, use the ▲▼ selection keys of the left or right four-way button to switch to the "DSC Output" line then, with a brief tap on the centre **SET** key of the right four-way button, activate the value window:



Now you can use the right selection keys to choose between four types of modulation "PPM10", "PPM16", "PPM18" and "PPM24". Touch the centre **SET** key of the right four-way button again to complete the entry.

This choice primarily influences the maximum number of control channels which can be attached to the DSC (direct servo control) socket, and thus also available to a flight simulator or teacher/pupil system. By selecting "PPM10" this will be control channels 1 … 5, for "PPM16" channels 1 … 8, for "PPM18" channels 1 … 9 and for "PPM24" channels 1 … 12.

By simultaneously pressing the ◄► or ▲▼ keys on the right four-way button (CLEAR), the display returns to the default "PPM10" back.

Cut off

Note:

This menu line is suppressed if "None" or "None/inv" is selected for the "Motor on C1" line.

Depending on the "idle forward or back" choice made in the "Motor on C1" line of the »**Model type**« menu, this motor "cut off" option can be coupled to a switch for throttling down a speed controller or to move a servo on the carburettor of a motor to the OFF position. This option can be used on the mc-16 HoTT and mc-20 HoTT transmitters as an emergency OFF function as well as an alternative “cut-off trim”, see “digital trims” on page 62.

This motor OFF position (Thr. CutOff) is specified in the left column field over the column label **SEL** and its value is to be established through trial and error.

However, the speed controller or throttle servo only moves to the selected position when two conditions are fulfilled: a switch is operated, and a particular servo position or switching threshold is exceeded.

This is done by setting the desired servo position (threshold value) into the middle column field, directly over the column label **STO**, then selecting the appropriate ON/OFF switch function in the right column.

- If the percentage value specified for the middle column is *greater* than the current servo position, i. e. the current servo position lies *below* the threshold, the switchover will occur as soon as the switch is put into its ON position.
- If the percentage value specified for the middle column is *less* than the current servo position, i. e. the current servo position is *above* the threshold, the speed controller will initially reduce motor speed or close the carburettor’s throttle servo only to the extent dictated by the value in the left column as soon as the servo’s position once *underruns* the threshold (max. +150 %) after the switch is changed over to its ON position.

  The speed controller or throttle servo will remain in this cut-off position only until the selected switch is again changed over followed by a one-time throttle servo or speed controller movement beyond the preset threshold with the throttle/brake stick control.

The factory setting for the left column is -100 % for the throttle servo “cut-off” position and a threshold of +150 % servo position setting in the middle column.

```
    Base setup model
 RF transmit          ON
 RF Range Test     99sec
 DSC Output        PPM10
▶cut off  –100% +150% –––
 ⇕          SEL   STO
```

Programming procedure

To change the throttle servo’s preset “cut-off” position, tap on the centre **SET** key of the right four-way button. The current setting will be displayed in inverse video. Now use the selection keys of the left or right four-way button to set a value at which the motor is reliably “off”. If a combustion motor is involved, be sure the throttle servo does not perform mechanical runout, e. g. -125 %:

```
    Base setup model
 RF transmit          ON
 RF Range Test     99sec
 DSC Output        PPM10
▶cut off  –125% +150% –––
 ⇕          SEL   STO
```

The – upper – preset value in the middle column ensures the motor can be stopped, throughout the maximum possible positioning range of the servo or speed controller, alone by the switch to be assigned in the right column.

However, if you wish to set a lower threshold, by which an underrun will cause the throttle servo or speed controller with closed switch to switch into the cut-off position, reduce the preset servo travel from +150 % by placing the throttle servo or speed controller into the desired position with the throttle/brake stick then touch the centre **SET** key of the right four-way button.

```
    Base setup model
 RF transmit          ON
 RF Range Test     99sec
 DSC Output        PPM10
▶cut off  –125% +100% –––
 ⇕          SEL   STO
```

Finally, use the column at the right to specify a switch with which you can cut off the motor directly (emergency) or which will be activated by the threshold.

```
    Base setup model
 RF transmit          ON
 RF Range Test     99sec
 DSC Output        PPM10
▶cut off  –125% +100%  8
 ⇕          SEL   STO
```

Notes:

- *Be sure the throttle servo does not run out mechanically when the cut-off function is activated.*
- *A threshold over +100 % is reached by temporarily increasing the travel for servo 1 in the »**Servo adjustment**« menu to over 100 % then, after storing the threshold, change servo travel back to the original value.*

Auto timer reset

```
    Base setup model
 RF Range Test     99sec
 DSC Output        PPM10
 cut off  –125% +100%  8
▶Auto timer reset    yes
 ⇕                   SEL
```

The “yes/no” setting made in this line determines whether or not all of the transmitter’s timers (except for “Model time” and “Transmitter operating time”) are automatically reset to their given starting values when the transmitter is switched on. In contrast, the "slot time" – see page 159 – is ***always*** reset to the starting value when the transmitter is switched on.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset the display to "yes".

Base setup model

Model-specific base settings for helicopter models

mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

Before programming specific parameters, there are some basic settings to be made which effect the currently active model memory.

Use the ▲▼ selection keys on the left or right four-way button to select the »**Base setup model**« option in the multi-function menu:

```
Suppress models
Base setup model
Helicopter type
Servo adjustment
Stick mode
Control adjust
```

Open this menu option with a tap on the centre **SET** key of the four-way button pad:

Model name

```
   Base  setup  model
▶Mod.name   <          >
 Stick  mode           1
 module  HoTT   n/a  n/a
 DSC  Output      PPM10
```

Change to the next screen page with a brief tap on the **SET** key of the right four-way button. This will open a screen of characters for entry of the model's name. A maximum of 9 characters can be used to specify a model name.

```
!"#$%&'()*+,-./0123
456789:;<=>?@ ABCDE
FGHIJKLMNOPQRSTUVWX
YZ[¥]^_`abcdefghijk
Mod  Name <STARL           >
```

Now the desired characters can be selected with the selection keys of the left four-way button. Move to the next position to select the next character with a tap on the centre **SET** key of the right four-way button.

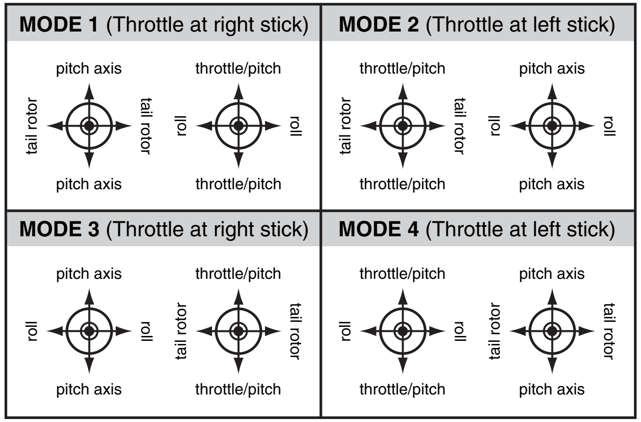
A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR)** will place a space character at the current position.

Positioning to any character position within the entry field can be done with the ◀ ▶ keys of the right four-way button.

A return to the previous menu screen is accomplished with a tap on the centre **ESC** key of the left four-way button.

A model name entered in this manner will appear in the base screen of the »**Model select**« menu and in the sub-menus of the »**Copy / Erase**« menu item.

Stick mode



Basically there are four different ways to assign the four helicopter control functions, roll, nick, tail rotor and throttle/pitch to the two sticks. Just which of these is used depends on the preferences of the individual model pilot.

Use the ▲▼ selection keys of the left or right four-way button to select the "Stick mode" line. The option field will be framed.

```
   Base  setup  model
 Mod.name   <STARLET  >
▶Stick  mode         [1]
 module  HoTT   n/a  n/a
 DSC  Output      PPM10
                    SEL
```

Tap on the **SET** key. The currently displayed stick mode will be displayed in inverse video. Now use the selection keys of the right four-way button to select from among options 1 through 4.

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset the display to stick mode "1".

Another tap on the **SET** key will again deactivate option selection so a change to another line can be affected.

Binding type

Note:

This menu item is only visible as long as no receiver is bound to the currently active model memory.

An “unbound” model memory can be changed at any time from the default preset memory specific HoTT transmitter-specific synchronization, and vice versa.

So If necessary, change the line “Binding Type” and press the **SET** button to the right four-way button.

```
  Base  setup  model
Mod.name   <STARLET  >
Stick  mode          1
▶Binding type    Model
Module HoTT    n/a   n/a
⇕                  SEL
```

... And change with the selection keys of the left or right four-way button, the setting in “global” (or vice versa):

```
  Base  setup  model
Mod.name   <STARLET  >
Stick  mode          1
▶Binding type   Global
Module HoTT    n/a   n/a
⇕                  SEL
```

Note:

- “**Global**”, ie specific sender, receiver bound to respond to the signals of all model memories “their” station, which is why firmware version V1101 for safety reasons, a model change only after switching off the receiving system is possible.
- “**Model**” specific bound receivers respond only to signals of them explicitly allocated memory model. One, possibly unintentional, operating on an unallocated model space is not therefore possible.
- The HoTT synchronization behavior of a copied or imported model memory depends on several factors. For details, refer to the appropriate section.
- The respective HoTT synchronization type of “bound” model memory is left of the synonym for the receiver type in the menu “**Model select**” recognizable:
  “Model” specific bound receiver with an “M” and “global”, ie Transmitter far, bound receiver with a “G”.
  As an illustration of this, the model memory 01, 03 and 04 with model-specific and model memory 02 are in the figure below exemplified with transmitter-specific binding:

```
01    GRAUBELE   MR12
02    ULTIMATE   GR12
03    STARLET    MR12
04    BELL47G    M–––
05    ***free***
06    ***free***
```

Module

The mc-16 HoTT and mc-20 HoTT are fitted as standard with a HoTT RF module. However, it is also possible to switch to a non-*Graupner* external RF module by software, if such a module is connected to the transmitter. This is accomplished by using the Select buttons of the left or right-hand four-way button to move to the left, to the “Module select” value field:

```
  Base  setup  model
Mod.name   <GRAUBELE>
Stick  mode          1
▶module  HoTT  bind  n/a
Rcv  Ch  Map  R12  n/a
⇕             BD1  BD2
```

HoTT

To be able to connect to the transmitter, Graupner HoTT receiver must be connected to at least one model memory “of their” Graupner HoTT transmitter. This process is commonly referred to by the English term “binding” and can be repeated anytime. This “binding” of a receiver is by default always memory-specific, but may at any time and for any unbound model memory of a transmitter in the menu that appears row “binding type”, see above, to transmitter specific, and can be reversed, changed.

Important notices:

- ***During the binding procedure be sure the transmitter’s antenna is always far enough away from the receiver’s antenna. To be on the safe side, keep them at least one meter apart. Otherwise there is a risk of a faulty connection to the return channel and malfunctions will result.***
- ***Pay close attention to the correct power supply of the receiving system. Too low supply voltage while responding the LEDs of the receiver as described below on your Binding effort, yet there is no proper HoTT Synchronization.***
- ***When binding additional receivers, note that any other–switched on–receivers already bound to the transmitter will fall into Fail safe mode during the transmitter-side “binding” period.***

"Binding" multiple receivers per model

Multiple receivers per model can be bound if desired, whereby respective mc-16 HoTT and mc-20 HoTT programs offer the potential for managing up to two receivers directly and for dividing up the transmitter's 8 or 12 control channels (max) in any arrangement among these receivers under menu control. Refer to additional details further down in this section. First bind the receivers individually as described below.

When the system is actually in use, the only receiver which creates a telemetry link to the transmitter is either the last receiver to be bound, or the receiver which you selected in the "TEL.RCV." line of the »Telemetry« menu, for example:

```
TELEMETRY

▶TEL.RCV.      RCV CH1
 SETTING & DATA VIEW
 SENSOR SELECT
 RF STATUS VIEW
 VOICE TRIGGER
```

Any telemetry sensors which may be built into the model should therefore be connected to this receiver because the transmitter only receives and evaluates data from the return channel of the receiver *activated on this line*. The second, and all other receivers, operate in parallel but are fully independent in slave mode.

"Binding" transmitter and receiver

Use the ▲▼ selection keys of the left or right four-way button to move into the "Module" line:

The marker frame will be positioned by default to the column for the next free binding channel. In the example shown in the figure below, the marker frame is positioned above the column label "BD2" because the binding channel in the column labelled "BD1" is already in use by default for the receiver which was delivered with the set:

```
   Base setup model
 Mod.name   <STARLET  >
 Stick mode          1
▶module  HoTT bind  n/a
 Rcv Ch  Map  R12   n/a
 ⇕            BD1   BD2
```

If already off, now switch the receiver on:

Receiver GR-16 and GR-24

The red LED on the receiver will blink..

Press and hold the SET button on the receiver while the LED continues to blink red for about 3 seconds, then begins to blink red/green for about another 3 seconds. The **SET** button on the receiver can now be released. As long as this LED blinks red/green, the receiver is in bind mode.

Now, within this 3 second period, start the so-called "receiver binding" process for the receiver to the currently active model memory with a brief tap on the centre **SET** key of the right four-way button. At this time, the screen's display will blend in a message window for the duration of the "binding" process.

```
   Base setup model
 Mod.name   <STARLET  >
 Stick mode          1
▶modu Finding...  d  n/a
 Rcv Ch  Map  R12   n/a
 ⇕            BD1   BD2
```

If the receiver's LED, again blinking red, changes within about 10 seconds to continuous illumination in green, the binding process has been successfully completed. Your model-memory to receiver combination is now operationally ready. At this time the screen will now display " bind " (bound) instead of "n/a" (not attached), for example:

```
   Base setup model
 Mod.name   <STARLET  >
 Stick mode          1
▶module  HoTT bind  bind
 Rcv Ch  Map  R12   R08
 ⇕            BD1   BD2
```

On the other hand, should the LED on the receiver blink red for longer than about 10 seconds, the binding process has failed. In this case the screen will continue to show the status as "n/a". If this should happen, try changing the position of antennas then repeat the entire procedure.

Receiver GR-12L

At the receiver, the red LED lights. Press and hold the SET button on the receiver until the red LED goes out after about 3 seconds for a further 3 seconds. You can now release the SET button on the receiver. As long as the LED is off, the receiver is in bind mode. Start now-as described above-within these 3 s to bind the receiver to the current model memory. If the LED of the receiver is still dark and the display in the transmitter changes to "b", the binding process has been completed successfully. However, the red LED will light up red again at the receiver, the binding process has failed. At the same time appear in the line “module” of the display again “n / a”. If necessary, change the positions of the antennas involved and repeat the entire procedure.

Binding other receivers

The binding channel you have chosen is already bound (as indicated by the “bind” status). This binding is to be replaced by another. After initiating the RF bind process, instead of displaying “BINDING”, the message shown below appears:

Press the central **SET** button of the right-hand four-way button to erase the message.

Drop down two lines in the screen and switch off the RF module as described on the page in section “RF module”. Afterward, return again to the “Module” line and restart the binding process as described above.

Alternatively, the transmitter can be switched off briefly then, after switching it back on again, respond to the message window that appears …

… with “OFF” …

… then confirm the selection with a brief tap on the centre **SET** key of the right four-way button. From the base screen jump again into the “Module” line of the »**Basic settings, model**« menu and restart the binding process.

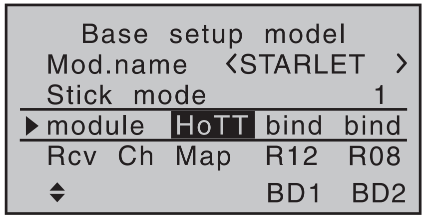
Dissolving a bond

Proceed as described above to initiate the binding process but WITHOUT first putting a receiver in binding readiness.

EXT. (PPM signal at DSC socket)

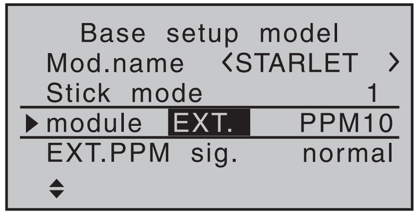
If your transmitter is fitted with a non-*Graupner* external RF module connected to the DSC / Data socket, you can switch between the standard internal HoTT RF module and the external module when you switch model memories in the “Module” line by choosing either “HoTT”, “EXT.”, or “SP.”, as described in the following section.

You can now use the arrow button ◄ of the right-hand four-way button to move to the first Value field in the “Module” line before pressing the central **SET** button of the right-hand four-way button:

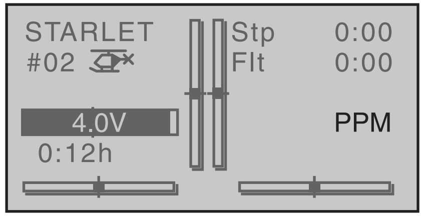


In the active Value field you should now use the Select buttons to choose “EXT.” or – if appropriate – the “SP.” mode (described below) instead of “HoTT”.

When you select “EXT.”, the HoTT-specific value fields are replaced by the modulation type already selected in the “DSC output” line; see page 95:



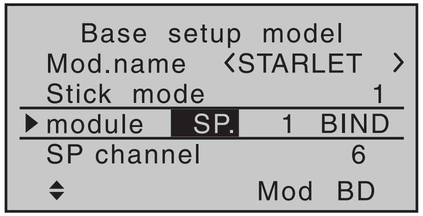
The lines of the “Receiver output” and “Range test” options (described below) are also suppressed, as are all the HoTT-specific displays in the base display; “PPM” is also superimposed instead of “HoTT”:



Press the central **SET** button of the right-hand four-way button to conclude the Select process.

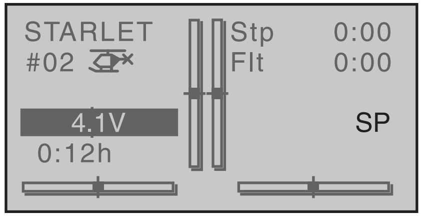
SP. (digital signal at Data socket)

However, if you require a special digital signal instead of the analogue PPM signal for the non-*Graupner* external RF module, then connect this to the DATA socket and select “SP.” in the “Module” line:

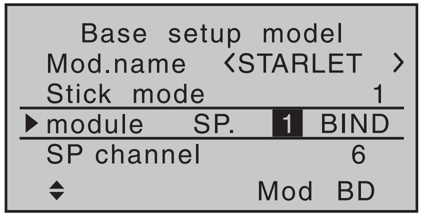


Once again, press the central **SET** button of the right-hand four-way button to conclude the Select process.

The lines of the "Receiver output" and "Range test" options (described below) are also suppressed, as are all the HoTT-specific displays in the base display; "SP." is also superimposed instead of "HoTT":



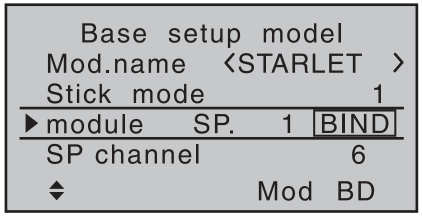
"Mode" column



In this column you select the transmission mode of the external RF module:

- Mode "1": 2-channel hopping
- Mode "2": x-channel hopping

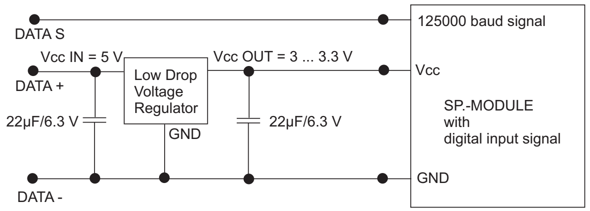
"BIND" column



The "BIND" column in the right-hand column can be used to initiate the "Bind" process of the non-*Graupner* system – **the transmitter's RF section must be switched off when the transmitter is first switched on**.

Important notes:

- ***The output voltage of the DATA socket is around 5 V, and must be reduced to the power supply voltage generally required by external digital RF modules (3 to max. 3.3 V). This is accomplished using the circuit which is shown here in diagrammatic form:***



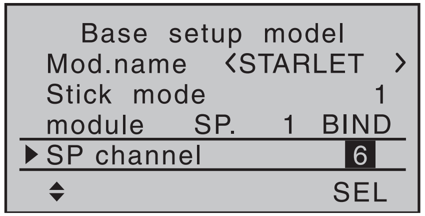
- ***Servo travels must be limited to max. 128 %.***

SP channels

Note:

This menu line is suppressed in the "Module" line if you select "HoTT" or "EXT.".

If necessary, use the Select buttons ▲▼ of the left or right-hand four-way button to move to the "SP channels" line, then briefly press the central **SET** button of the right-hand four-way button to activate the Value window:



You can now select "6" or "8" channels using the right-hand Select buttons. The procedure is concluded by again pressing the central **SET** button of the right-hand four-way button.

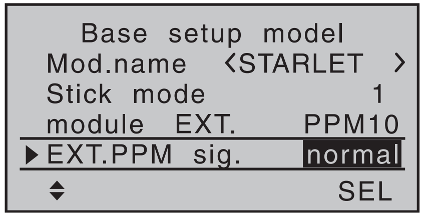
At the transmitter this selection only affects the number of control channels transferred to the external RF module via the DATA socket. If you choose "6", then these are control channels 1 … 6; if you choose "8", these are channels 1 … 8.

Simultaneously pressing the ▲▼ or ◀ ▶ buttons of the right-hand four-way button (**CLEAR**) returns the display to "6".

EXT. PPM signal

Note:

This menu line is suppressed in the "Module" line if you select "HoTT".



Some RF modules which can be connected to the DSC connector require an inverted input signal. Be sure to follow the respective module's installation instructions for this.

Observe, however, the installation instructions of the relevant module.

The choice of “inverted” instead of the default preset “normal” allows for appropriate adaptation of the provided PPM signal.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset the display to “normal”.

Receiver channel mapping

Note:

This menu line is suppressed in the “Module” line if you select “EXT.” or “SP.”.

As long as there is at least one “bound” HoTT receiver in the “Module” line, the next line down will be the “Rcv Ch map” line:

```
   Base  setup  model
 Mod.name   <STARLET  >
 Stick  mode            1
 module  HoTT  bind  bind
►Rcv  Ch  Map  [R12]  R08
 ⇕                SET  SET
```

As already mentioned in the introduction to the section entitled “Binding receivers”, mc-16 HoTT and mc-20 HoTT transmitters feature a menu point in which the transmitter’s control channels can be re-distributed in any way you like *within one receiver*, and also include an option to distribute the transmitter’s control channels to a *maximum of two receivers* in any arrangement you desire. These are the eight control channels of the mc-16 HoTT transmitter, and the twelve control channels of the mc-20 HoTT. This re-distribution is termed “*mapping*” or “*channel mapping*” (channel assignment) in the following section.

Select the receiver to be “mapped” with the selection keys of the left or right four-way button then tap briefly on the centre **SET** key of the right four-way button.

Channel mapping within a receiver

This menu point provides a simple means of re-mapping the transmitter’s control channels in any way you like, in a similar manner to the channel assignment function termed “Channel mapping” in the »**Telemetry**« menu, as described on page 241. This means that you can re-distribute the transmitter’s control channels, which are present at the receiver inputs, to the selected receiver’s outputs / servo sockets in any way you like:

```
  Receiver CH – BIND1
►In Ch [1]   –> Out Ch  1
 In Ch  2    –> Out Ch  2
 In Ch  3    –> Out Ch  3
 In Ch  4    –> Out Ch  4
 ▼
```

After selection of the desired *output* with the selection keys of the left or right four-way button, the appropriate value field will be framed. Briefly tap on the centre **SET** key of the right four-way button. The current setting will be displayed in inverse video. Now use the selection keys of the right four-way button to select the desired input channel’s respective transmitter output, see page 226.

BUT CAUTION:

If you wish to operate two servos with one control function, for example such as transmitter control function 2 (roll) which is divided up into control channels 1 & 2 for left and right roll servos for the “3Sv(2Roll)” option in the »**Helicopter type**« menu; then “map” the corresponding transmitter outputs, in this case for channels 1 & 2 (= inputs to the receiver) accordingly.

Notes:

- *The maximum number of lines (outputs) available corresponds to the maximum number of servos which can be connected to the receiver in question.*
- *If you see the warning …*

```
    CAN‘T
   RECEIVE
    DATA
     OK
```

  … then there is no bound receiver within range. If the case may be, switch your receiving system on.
- *With the »**Tx. output swap**« option, which is available only on the mc-20 transmitter, see page 226, the transmitter’s control functions can be interchanged in any way; it is also possible to assign multiple outputs to one and the same control function. In the interests of clarity however we strongly advise that you use only one of these two options.*

Channel assignment on second receiver

As already mentioned, the “Receiver channel mapping” menu point can be used to map (re-distribute) the transmitter’s control channels in any way amongst a maximum of two receivers; these are the eight control channels of the mc-16 HoTT transmitter, and the twelve channels of the mc-20 HoTT transmitter. In this case the numbering of the outputs (servo sockets) and the maximum number of lines (outputs) available reflects the maximum number of servos which can be connected to the receiver in question.

```
Receiver CH – BIND2
▶ In Ch [8]   –> Out Ch  1
  In Ch  8    –> Out Ch  2
  In Ch  8    –> Out Ch  3
  In Ch  8    –> Out Ch  4
```

```
Receiver CH – BIND2
▶ In Ch [12]  –> Out Ch  1
  In Ch 12    –> Out Ch  2
  In Ch 12    –> Out Ch  3
  In Ch 12    –> Out Ch  4
```

Note:

The upper screen-shot above shows the screen of the mc-16 HoTT eight-channel transmitter; the lower one the screen of the mc-20 HoTT twelve-channel transmitter.

After selection of the desired *output* with the selection keys of the left or right four-way button, the respective input field will be framed. Tap the centre **SET** key of the right four-way button. The current setting will be displayed in inverse video. Now select the desired input channel with the selection keys of the right four-way button. For example, appropriate for the above example with roll servos:

```
Receiver CH – BIND2
  In Ch  1    –> Out Ch  1
▶ In Ch [2]   –> Out Ch  2
  In Ch 12    –> Out Ch  3
  In Ch 12    –> Out Ch  4
```

Note:

The maximum number of lines (outputs) available reflects the maximum number of servos which can be connected to the receiver in question.

RF transmit

This menu line provides an option for manually switching the transmitter's RF transmission on and off to specific models while the transmitter is in operation. For example, to save power while a model is being programmed.

If this line option was set to OFF, it will be cancelled (i.e. set to ON) the next time the transmitter is switched on.

If necessary, use the ▲▼ selection keys of the left or right four-way button to move into the "RF transmit" line then activate the option with a brief tap on the centre **SET** button of the right four-way button:

```
   Base  setup  model
 Stick  mode              1
 module   HoTT  bind  bind
 Rcv  Ch  Map   R12   R08
▶RF  transmit            ON
                        SEL
```

The right selection keys can now be used to choose between **OFF** and **ON**. Another tap on the centre **SET** key of the right four-way button will conclude the entry.

Range test

Note:

This menu line is suppressed if you select "EXT." or "SP." in the "Module" line.

The built-in range test reduces transmission power to an extent that a functional test can be carried out even within a distance of less than 100 m.

Perform a range test on the *Graupner* HoTT system according to the following instructions. If necessary, have someone assist you in carrying out the range test.

1. Preferably, the receiver already bound to the transmitter should be installed into the model in its intended position.
2. Switch remote control on and wait for the green LED to light up on the receiver/s. Now servo movements can be observed.
3. Place the model on a level surface (pavement, low-cut grass or bare ground) such that receiver antennas are at least 15 cm above ground level. It may be necessary to put something under the model to raise it up enough for this.
4. Hold the transmitter at hip level and at some distance from one's body.
5. If necessary, use the ▲▼ selection keys of the left or right four-way button to reach the "RF range test" line in the menu then start range test mode with a tap on the centre **SET** key of the right four-way button:

```
   Base  setup  model
 module   HoTT  bind  bind
 Rcv  Ch  Map   R12   R08
 RF  transmit            ON
▶RF  Range  Test    [99sec]
                        SEL
```

Note:

- If the message...

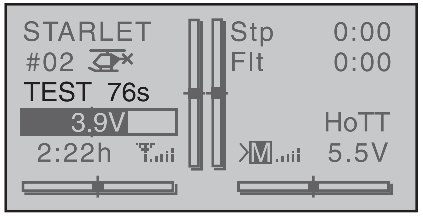
```
SWITCH RF ON
```

... appears, the RF module of the transmitter is inactive. Turn on the RF module and try again.

- If instead, the message ...

... is displayed, there is no connection to a receiver. Switch on the receiving system of your model or check the radio connection to your model and repeat the process afterwards.

When the range test has been initiated, the transmitter's transmission power will be significantly reduced and the green LED just to the right of the main switch on the transmitter, marked RF, will begin to blink; this will also be accompanied by acoustic tones. At the same time, the timer in the transmitter's display will start counting down and every 5 seconds a two-frequency tone will sound.



Five seconds prior to the end of the range test a three-frequency tone will sound once every second. After expiration of the range test's 99th second the transmitter will again be switched to full output power and the green LED just to the right of the main switch on the transmitter will again illuminate constantly.

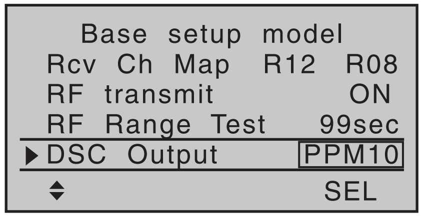
6. Move away from the model while manipulating the sticks during this timespan. If you notice an interruption anytime while still within a distance of about 50 m, try to reproduce this malfunction.
7. If there is a motor in the model, it may be necessary to switch it on to further check noise immunity.
8. Continue moving away from the model until perfect control is no longer possible.
9. Wait at this distance for the remainder of the test period with the still-operationally-ready model to expire. After the range test is ended it should again respond correctly to all RC controls. If this is not 100 % the case, do not use the system. Contact your area's *Graupner* service partner.
10. Perform the range test before each flight and, in doing so, simulate all servo movements which also take place during flight. The range must always be at 50 m on the ground in order to assure safe model operation.

Caution:

Never start the range test on the transmitter during normal operation of the model.

DSC output

If necessary, use the ▲▼ selection keys of the left or right four-way button to switch to the "DSC Output" line then, with a brief tap on the centre **SET** key of the right four-way button, activate the value window:



Now you can use the right selection keys to choose between four types of modulation "PPM10", "PPM16", "PPM18" and "PPM24". Touch the centre **SET** key of the right four-way button again to complete the entry.

This choice primarily influences the maximum number of control channels which can be attached to the DSC (direct servo control) socket, and thus also available to a flight simulator or teacher/pupil system. By selecting "PPM10" this will be control channels 1 … 5, for "PPM16" channels 1 … 8, for "PPM18" channels 1 … 9 and for "PPM24" channels 1 … 12.

Autorotation

Autorotation is that state of descending flight in which the pitch of main rotor blades are set such that the rotor's speed matches the natural forces of air flowing through, like a windmill. The rotational energy stored in the mass of the rotor by this process can then be converted into upthrust by adjusting blade pitch, in order to halt the descent and "rescue" the model.

Autorotation is a means by which real and model helicopters are able to land safely in emergency situations, e. g. in the event of a motor failure. However, the prerequisite for this is a well-trained pilot familiar with the helicopter's characteristics. Quick reaction and good perceptiveness are necessary because the rotor's inertia can only be used once to generate recovery lift.

When this technique is evaluated during competitions, the motor must be switched off for autorotation. On the other hand, for training mode it is advantageous to keep the motor at idle for autorotation.

The Autorotation switch causes a switchover to the autorotation flight phase in which control of "throttle" and "pitch" are separate and all mixers which have an effect on the throttle servo are switched off.

Corresponding parameter settings are made in the »**Helicopter mixer**« (see page 184); refer also to the "Principle of the Auto. C1 Pos." topic which follows.

The "Autorotation" name is permanently assigned to this phase and it is included in the base screen and the screens of all flight phase dependent menus. This name can NOT be changed. It is only possible to assign a switch to this option at the right of this display, as described on page 60. **If a switch is assigned, it will have absolute priority over all other flight-phase switches:**

```
    Base  setup  model
 RF  transmit          ON
 RF  Range  Test    99sec
 DSC  Output       PPM10
▶Autorotation        ---
 ⇕                     
```

More about flight-phase programming can be found in the text beginning on page 184 in the»**Helicopter mixer**« section.

Autorotation C1 position

The autorotation flight-phase can alternatively be activated by a threshold point for the C1 throttle/pitch stick. To do this, use the ▲▼ selection keys of the left or right four-way button to move into the "Autorot. C1-Pos." line.

As soon as this display line has been selected, its value field, located above the column label **STO** will be framed.

```
    Base  setup  model
 RF  Range  Test    99sec
 DSC  Output       PPM10
 Autorotation        ---
▶Auto.C1 Pos.     0% ---
 ⇕             STO     
```

Move the C1 stick into the desired threshold switch-over position then tap the centre **SET** key of the right four-way button. The current value will be displayed, e. g.:

```
    Base  setup  model
 RF  Range  Test    99sec
 DSC  Output       PPM10
 Autorotation        ---
▶Auto.C1 Pos.   –66% ---
 ⇕             STO     
```

After this has been done, use the selection keys to move into the column above the switch symbol then assign a switch to this field, as described in section "Physical control, switch and control switch assignments" on page 60:

```
    Base  setup  model
 RF  Range  Test    99sec
 DSC  Output       PPM10
 Autorotation        ---
▶Auto.C1 Pos.   –66%  9
 ⇕             STO     
```

Once this activation switch is closed, the first occurrence of a threshold underrun will cause the program to switch over to "Autorotation" and then remain independent of C1 position in this flight phase until the activating switch, in this example switch 4, is again "OFF".

"Autorot. C1-Pos." has precedence over all other flight-phase switches.

Corresponding parameter settings for …

- pitch servos
- throttle servo
- tail rotor servo
- swashplate rotation, if available
- gyro setting

… are made in the »**Helicopter mixer**« menu, page 184.

Cut off

Within the framework of autorotation settings for the mc-16 HoTT and mc-20 HoTT transmitter's helicopter program, there are parameters for an emergency "cut off" of the throttle servo or motor actuator, refer to the programming proposal on page 326. However, this option is not available if an idle position is specified in the "Throttle position AR" line of the »**Helicopter mixer**« menu instead of an (emergency) OFF position; for example, to avoid restarting the motor after every landing during autorotation practice.

This option can be used on the mc-16 HoTT and mc-20 HoTT transmitters as an emergency OFF function as well as an alternative "cut-off trim", see "digital trims" on page 62.

Depending on the "forw./rear" choice made for the "Pitch min" line of the »**Helicopter type**« menu, this "cut off" option can be coupled to a switch for throttling down a speed controller or a carburettor servo to the motor OFF (or idle) position.

This cut-off (or idle) position is specified in the left column's field, above the **SEL** column label, and its value is to be established through trial and error.

However, the speed controller or throttle servo only moves to the selected position when two conditions are fulfilled: a switch is operated, and a particular servo position or switching threshold is exceeded. This is done by setting the desired servo position (threshold value) into the middle column field, directly over the column label **STO**, then selecting the appropriate ON/OFF switch function in the right column.

- If the percentage value specified for the middle column is *greater* than the current servo position, i. e. the current servo position lies *below* the threshold, the switchover will occur as soon as the switch is put into its ON position.
- If the percentage value specified for the middle column is *less* than the current servo position, i. e. the current servo position is *above* the threshold, the speed controller will initially reduce motor speed or close the carburettor's throttle servo only to the extent dictated by the value in the left column as soon as the servo's position once *underruns* the threshold (max. +150 %) after the switch is changed over to its ON position.

  The speed controller or throttle servo will remain in this cut-off position only until the selected switch is again changed over followed by a one-time throttle servo or speed controller movement beyond the preset threshold with the throttle/brake stick control.

The factory setting for the left column is -100 % for the throttle servo "cut-off" position and a threshold of +150 % servo position setting in the middle column:

```
   Base  setup  model
 DSC  Output        PPM10
 Autorotation         –––
 Auto.C1 Pos.    –66%  9
▶cut  off  –100%  +150% –––
 ⇕           SEL    STO
```

Programming procedure

To change the throttle servo's preset "cut-off" position, tap on the centre **SET** key of the right four-way button. The current setting will be displayed in inverse video. Now use the selection keys of the left or right four-way button to set a value at which the motor is reliably "off". If a combustion motor is involved, be sure the throttle servo does not perform mechanical runout, e. g. -125 %:

```
   Base  setup  model
 DSC  Output        PPM10
 Autorotation         –––
 Auto.C1 Pos.    –66%  9
▶cut  off  –125%  +150% –––
 ⇕           SEL    STO
```

The – upper – preset value in the middle column ensures the motor can be stopped, throughout the maximum possible positioning range of the servo or speed controller, alone by the switch to be assigned in the right column.

However, if you prefer to set a lower switching threshold, i. e. the point below which the throttle servo or speed controller moves to the motor OFF position when the switch is closed, then use the throttle / collective pitch stick and – if in use – the throttle limiter (by default the right-hand side-mounted proportional rotary control) to move the throttle servo to your preferred position, and then press the central **SET** button of the right-hand four-way button:

```
   Base  setup  model
 DSC  Output        PPM10
 Autorotation         –––
 Auto.C1 Pos.    –66%  9
▶cut  off  –125%  +100% –––
 ⇕           SEL    STO
```

Finally, use the column at the right to specify a switch with which you can cut off the motor directly (emergency) or which will be activated by the threshold.

```
   Base  setup  model
 DSC  Output        PPM10
 Autorotation         –––
 Auto.C1 Pos.    –66%  9
▶cut  off  –125%  +100% 18
 ⇕           SEL    STO
```

<u>*Notes:*</u>

- *Be sure the throttle servo does not run out mechanically when the cut-off function is activated.*
- *A threshold over +100 % is reached by temporarily increasing the travel for servo 1 in the »**Servo adjustment**« menu to over 100 % then, after storing the threshold, change servo travel back to the original value.*

Auto timer reset

```
   Base  setup  model
 Autorotation         –––
 Auto.C1 Pos.    –66%  9
 cut  off  –125%  +100% 18
▶Auto  timer  reset    yes
 ▲                     SEL
```

The "yes/no" setting made in this line determines whether or not all of the transmitter's timers (except for "Model time" and "Transmitter operating time") are automatically reset to their given starting values when

Establishing winged aircraft model type

the transmitter is switched on.

In contrast, the “slot time” – see page 159 – is *always* reset to the starting value when the transmitter is switched on.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset the display to “yes”.

mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

Use the ▲▼ selection keys on the left or right four-way button to select the »**Model type**« option in the multi-function menu:

```
Suppress models
Base setup model
Model type
Servo adjustment
Stick mode.
Control adjust
```

Open this menu option with a tap on the centre **SET** key of the four-way button pad.

This “Model type” menu is used to establish the type of model to be programmed. This also activates all characteristic mixers, coupling functions, etc. in preparation for subsequent programming of the specified model type.

Motor at C1

When you open the »**Model type**« menu, the input field of the “Motor at C1” line is generally already framed (selected). If this is not the case, use the Select buttons ▲▼ of the left or right-hand four-way button to move to the “Motor at C1” line:

```
      Model type
►Motor at C1          None
 Tail type          Normal
 Aile/flaps           1AIL
 Brake Off   +100%    In 1
 ▼                     SEL
```

Briefly tap the centre **SET** key of the right four-way button: The current setting will be displayed in inverse video. Now use the selection keys of the right four-way button to select from among the following four options:

- **“none“**
  For operation of a model without a propulsion.
  The warning “Throttle too high”, see page 35, is *deactivated* and the “Brake settings” sub-menu of the »**Wing mixers**«, beginning page 180, is available without any restrictions.
- **“back”**
  The idle position for the throttle/brake flaps stick (C1) is to the rear, i.e. toward the pilot.
  The warning “Throttle too high”, see page 35, as well as the “cut off” option in the »**Basic settings, model**« menu, see page 85, are *activated* and the “Brake settings” sub-menu of the »**Wing mixers**« menu, beginning page 180, will be available if the entry in the “Motor” column of the »**Phase settings**« menu, page 148, for the currently active flight phase is “none”.
- **“front”**
  The idle position for the throttle/brake flaps control stick (C1) is at the front, i.e. away from the pilot.
  The warning “Throttle too high”, see page 35, as well as the “cut off” option in the »**Basic settings, model**« menu, see page 85, are *activated* and the “Brake settings” sub-menu of the »**Wing mixers**« menu, beginning page 180, will be available if the entry in the “Motor” column of the »**Phase settings**« menu, page 148, for the currently active flight phase is “none”.

Notes:

- ***Be sure to pay attention during the programming procedures that motors do not start up unintentionally. Disconnect the fuel supply or battery terminals to motors before programming.***
- *C1 trimming will operate according to the choice made between “normal” or only “back” or “front”, that is, either over the control’s entire travel path or only in the respective idle direction.*

Tail type

After selecting the “Tail type” line with the ▲▼ selection keys of the left or right four-way button, the corresponding entry field will be framed.

```
        Model  type
 Motor  at  C1          None
►Tail  type           Normal
 Aile/flaps             1AIL
 Brake  Off    +100%    In 1
 ⇕                       SEL
```

Briefly tap the centre **SET** key of the right four-way button: The current setting will be displayed in inverse video. Now select the type appropriate for the model with the selection keys of the right four-way button.

- **“normal“**

  Elevators and rudder are each operated by a single servo.

- **“V-tail”**

  Elevator and rudder control is affected by way of two separate, articulated, V-shaped rudders. The coupling function for rudder and elevator control will be automatically taken over by the program. The relationship of rudder-to-elevator proportion is set in the »**Dual Rate / Expo**« menu, page 126, and servo travel in the »**Servo adjustment**« menu, page 106.

  If you also wish to apply differential to the rudder travel, then an alternative method of controlling the V-tail should be chosen. This requires the »**Dual mixer**« menu – see page 214 – which is available on the mc-20 HoTT transmitter only. However, in this case it is *essential* to set the tail type to “normal”.

- **“Delta/fl”**

  If you choose “2 AIL” in the “Aile / flaps” line – see below – then your model requires one servo in each wing panel for aileron and elevator control.

  If you choose “2/4 AIL 2/4 FL”, then aileron and elevator are controlled in accordance with the settings in the “Multi-flap” menu; see page 177.

- **“2ELSv3+8”**

  This option is intended for models with two elevator servos. The servo connected to output 8 will operate in parallel with servo 3 to actuate elevators. Elevator trim affects both servos.

  <u>Note on “2ELSv3+8”:</u>

  *One control, which assigns input 8 by way of the »**Control adjust**« menu, is then disconnected from servo “8” by software for reasons of safety i. e. it is made ineffective.*

Aileron/camber flaps

After selecting the “Aileron/camber flaps” line with the ▲▼ selection keys of the left or right four-way button, the corresponding entry field will be framed:

```
        Model  type
 Motor  at  C1          None
 Tail  type           Normal
►Aile/flaps             1AIL
 Brake  Off    +100%    In 1
 ⇕                       SEL
```

Briefly tap the centre **SET** key of the right four-way button: The current setting will be displayed in inverse video. Now use the selection keys of the right four-way button to select the number of wing servos to be programmed for the model …

… on the mc-16 transmitter with the standard eight channels:

No. of wing flaps	Control channel used
1AIL	2
1AIL 1FL	2 | 6
2AIL	2 & 5
2AIL 1FL	2 & 5 | 6
2AIL 2FL	2 & 5 | 6 & 7

… on the mc-20 transmitter with twelve channels, and the mc-16 transmitter with the optional twelve channels:

No. of wing flaps	Control channel used
1AIL	2
1AIL 1FL	2 | 6
2AIL	2 & 5
2AIL 1FL	2 & 5 | 6
2AIL 2FL	2 & 5 | 6 & 7
2AIL 4FL	2 & 5 | 6 & 7 / 9 & 10
4AIL 2FL	2 & 5 / 11 & 12 | 6 & 7
4AIL 4FL	2 & 5 / 11 & 12 | 6 & 7 / 9 & 10

Depending on the option selected here, the given mixers needed and their settings will be activated in the »**Wing mixers**« menu, beginning page 180.

<u>Tips:</u>

- *Settings for all wing flap pairs (AIL and Al2, FL and FL2) can be trimmed on a flight-phase basis in both the »**Phase trim**« menu as well as in the **Wing mixers**« menu, page 180.*

- *The functionality of all wing flap pairs (AIL and AI2, FL and FL2) can also be operated by way of the "Throttle/brake-flap stick" if this stick has not been assigned to other use, e. g. for certain brake settings, see »**Wing mixers**« menu, page 180. To configure this it is only necessary to assign "Control 1" to input 6 in the »**Control adjust**« menu, page 112. (If it is preferable to operate flaps with switches, one of the transmitter's two or three position switches are good for this purpose.)*

Brake offset

This function not only has potential for gliders and electric models but also for models with combustion motors and landing flaps.

The mixers described in the "Brake settings" line of the »**Wing mixers**« menu, page 180, can be operated by the C1 stick ("input 1") or another transmitter operating element which has been assigned to input 7 or 8 in the »**Control adjust**« menu in the case of the standard mc-16 HoTT eight-channel transmitter. Inputs 7, 8 or 9 are available for the same purpose on the twelve-channel mc-20 HoTT transmitter. In this latter case, retain the "GL" default setting for the "Type" column in the »**Control adjust**« menu so the selected control can operate independent of flight phase.

In the majority of cases the default setting for "input 1" will remain as it is and the brake will be operated by way of the non-neutralizing C1 stick.

However, use of input 7, 8 or – if avalaible – 9 makes it possible to operate the brake in an alternative manner, even by way of a supplementary control, if the C1 stick is to be used for something else.

The neutral point (offset) can be set to any desired position. This is done by placing the control for input 1, 7, 8 or 9 into the position at which the landing flaps are to be retracted, i. e. closed, then setting this "Offset" point in the column above the column label **STO**.

The selection of this offset point in this context determines not only the control position at which the brake system is to be retracted, i. e. closed, but also the activation direction of the C1 stick for extending the brake system.

- Brake offset values with a "+" prefix will cause flaps affected by the "Brake settings" option of the »**Wing mixers**« menu to be extended when the C1 stick is moved *from front to rear,* in the direction of the pilot.
- Brake offset values with a "-" prefix will cause flaps affected by the "Brake settings" option of the »**Wing mixers**« menu to be extended when the C1 stick is moved *from rear to front,* in the direction away from the pilot.

If the offset point is not set at the far end of control element travel, the remainder of travel to the end point will be "free travel", i. e. this "free travel" will no longer influence any mixer available for "Brake settings" in the »**Wing mixers**« menu. This idle path ensures that all brake settings remain at "neutral", even with minor deviations from the limit of the brake flap control. At the same time, the effective control path is automatically spread to 100 %:

```
       Model type
Motor at C1          None
Tail type          Normal
Aile/flaps           1AIL
►Brake Off   +90%    In 1
▲                 STO SEL
```

<u>*Tip:*</u>

Preferably, the servo intended for operating any airbrake flaps that may be on the model should be connected to the receiver output operated by the brake input channel, e. g. connect airbrake servo onto (free) receiver output 8 if input 8 has been chosen for the "brake", etc. A second airbrake servo is most conveniently operated by way of a free mixer.

Helicopter type

Establishing helicopter model type

mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

Use the ▲▼ selection keys on the left or right four-way button to select the »**Helicopter type**« option in the multi-function menu:

```
Suppress models
Base setup model
Helicopter type
Servo adjustment
Stick mode
Control adjust
```

Open this menu option with a tap on the centre **SET** key of the four-way button pad.

This "Model type" menu is used to establish the type of model to be programmed. This also activates all characteristic mixers, coupling functions, etc. in preparation for subsequent programming of the specified model type.

Swashplate type

Control of the swashplate will require an appropriate program variant which corresponds to the number of servos operating pitch control.

In the meantime this selection is also influenced by the type of control exercised on swashplate servos. Since Flybar systems generally do not require transmitter-side swashplate mixers, when such a system is in use, "1 Servo" is generally to be selected as the swashplate type, regardless of the actual number of swashplate servos present.

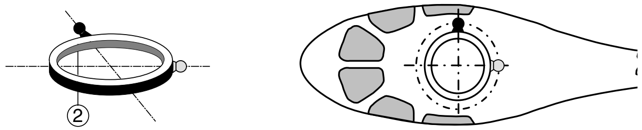
In this context, be sure the Flybar system complies with the included adjustment instructions as otherwise there is a risk the helicopter will not fly.

When you open the »**Helicopter type**« menu the input field of the "Swashplate type" line is generally already framed (selected). If not, use the Select buttons ▲▼ of the left or right-hand four-way button to move to the "Swashplate type" line:

```
         Heli  type
►Swashplate          1 Servo
 Linear.  swashpl.        no
 Rotor  direct         right
 Pitch  min.            back
 ▼                       SEL
```

Briefly tap the centre **SET** key of the right four-way button. The current setting for number of pitch servos will be displayed in inverse video. Now choose the variant needed with the selection keys of the right four-way button.

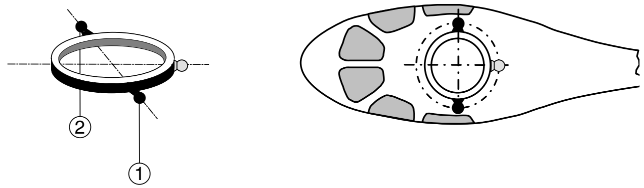
- **"1 Servo"**



A Flybar system is in use or the swashplate is tipped with one servo each for roll and pitch-axis. Pitch control will be affected by *one* separate servo.

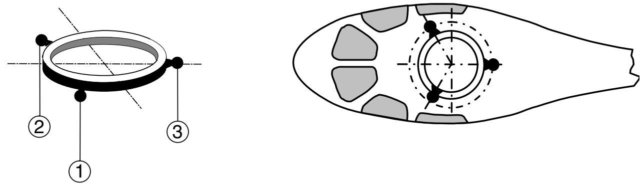
(Since helicopter models, which are operated with only 1 pitch servo, neither need any of the three swashplate servos for pitch, pitch-axis and roll, like Flybar systems, NOR the transmitter's mixer functions for pitch, pitch-axis and roll, the **»Swashplate mixer«** menu (*page 216*) option will be suppressed in the Multi-function menu.)

- **"2 Servo"**



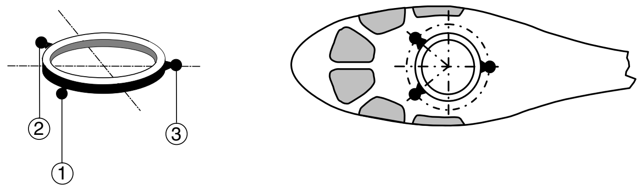
Two roll servos will displace the swashplate axially to affect pitch control; nick control will be decoupled by a mechanical compensation rocker.

- **"3Sv(2Roll)"**



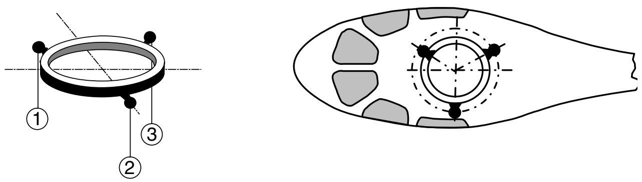
Symmetric three-point control of the swashplate with three, radially offset articulation points, each offset by 120°, connected to one pitch-axis servo (front *or* rear) and two roll servos (left and right). All three servos push the swashplate axially to affect pitch control.

- **"3Sv (140°)"**



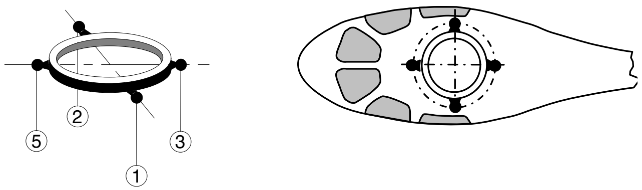
Asymmetrical three-point control of the swashplate is affected at three articulation points connected to one nick servo (rear) and two roll servos (front left and right). All three servos push the swashplate axially to affect pitch control.

- **“3Sv (2Nick)”**



Symmetric three-point control as described above but radially offset by 90°, one lateral roll servo and two pitch-axis servos, front and rear.

- **“4Sv (90°)”**



Four-point swashplate control affected by two roll servos and two nick servos.

Simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset the option back to “1 Servo”.

<u>*Note:*</u>

*Except for the “1 Servo” choice, swashplate mixer proportions must also be set in the »**Swashplate mixer**« menu, page 216.*

Swashplate linearization

After selecting the “Linear. swashpl.” line with the ▲▼ selection keys of the left or right four-way button, the entry field will be framed:

```
       Heli  type
 Swashplate     3Sv(2rol)
►Linear. swashpl.     no
 Rotor  direct      right
 Pitch  min.         back
 ⇕                    SEL
```

The “yes” entry will prevent undesired side effects such as pitch change due to a roll function or tension between swashplate servo rods.

This type of tension can arise when effected servos strain for different displacement positions due to travel which deviates from one another.

Linearizing will require a bit of familiarization on the part of the pilot because, in order to linearize the entire rotation travel of the servo arm, servo travel is reduced in small control movements – similar to a pronounced exponential setting.

Rotor direction

After selecting the “Rotor direction” line with the ▲▼ selection keys of the left or right four-way button, the entry field will be framed:

```
       Heli  type
 Swashplate     3Sv(2rol)
 Linear. swashpl.      no
►Rotor  direct      right
 Pitch  min.         back
 ⇕                    SEL
```

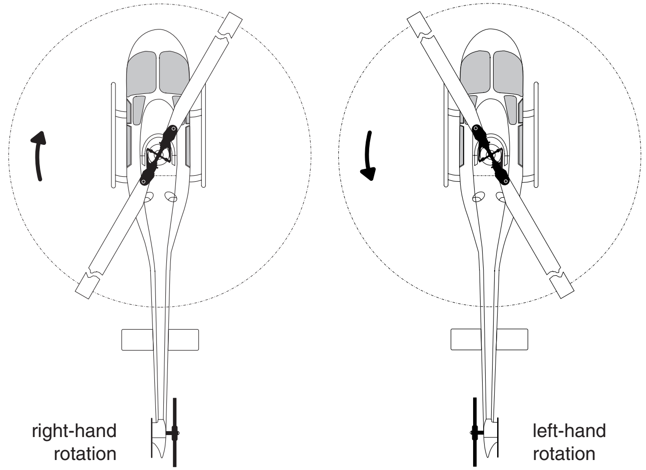
After a tap on the centre **SET** key, the main rotor’s direction of rotation is entered in the “Rotor direction” line with the selection keys of the right four-way button:

- **“right”**

  The main rotor turns clockwise when viewed from above.
- **“left”**

  The main rotor turns counter-clockwise when viewed from above.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will set the option to “right”.



This entry is necessary for the correct orientation of torque and power compensation mixer settings made in the »**Helicopter mixer**« menu:

Pitch,
Channel 1 ➔ Throttle,
Channel 1 ➔ Tail rot.,
Tail rotor ➔ Throttle
Roll ➔ Throttle
Roll ➔ Tail rot.
Pitch ➔ Throttle,
Pitch-axis ➔ Throttle
Pitch-axis ➔ Tail rotor

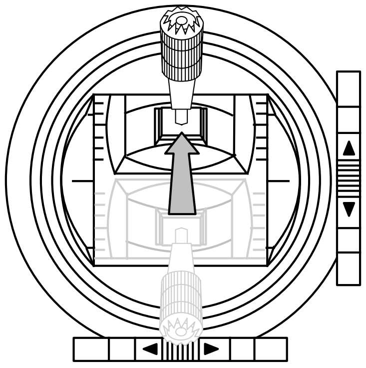
Pitch min

After selecting the »Pitch min.« (pitch minimum) line with the ▲▼ selection keys of the left or right four-way button, the entry field will be framed:

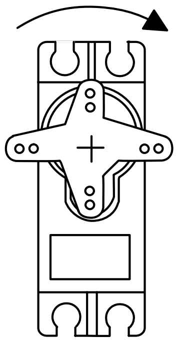
```
        Heli  type
 Swashplate      3Sv(2rol)
 Linear.  swashpl.      no
 Rotor  direct       right
▶Pitch  min.         back
 ⬍                     SEL
```

The “Pitch min.” line is used to adapt the actuation direction of the throttle/pitch stick to personal control preferences. All other helicopter program options which involve throttle and pitch functions, e. g. throttle curve, idle trimming, tail rotor mixer, etc., are dependent on this setting.

Tap the centre **SET** key of the right four-way button. The operating direction of the throttle/pitch stick will be displayed in inverse video. Now choose the variant needed with the selection keys of the right four-way button.



Pitch



These mean:

- **“front”**
  minimum pitch setting when the pitch stick (C1) is “forward”, i. e. away from the pilot.
- **“back”**
  minimum pitch setting when the pitch stick (C1) is “back”, i. e. toward the pilot.

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will set this option to “back”.

<u>*Notes:*</u>

- *The C1 trim only affects the throttle servo or the collective pitch servos, depending on the settings in the “Tr” column of the »**Stick mode**« menu, which is available as standard on the mc-20 HoTT transmitter only.*
- *Up to firmware version 1102 the so-called “throttle limit” is set by default, see text beginning page 122, by way of input “Lim.” in the »**Control adjust**« menu with which the throttle servo can be limited, independent of the pitch servo, in the full throttle direction. From firmware version 1103 it can be optionally set.*
- *Since a given user’s models will typically be operated with the same pitch-min direction, this specification can be conveniently preselected in the “transmitter-specific” »**Basic settings**« menu, page 269. This specification will then be adopted automatically when a new model memory is created in the »**Helicopter type**« menu but, if desired, can be adapted on a model-specific basis as described.*

Expo throttle limit

After selecting the “Expo thro lim.” line with the ▲▼ selection keys of the left or right four-way button, the entry field will be framed:

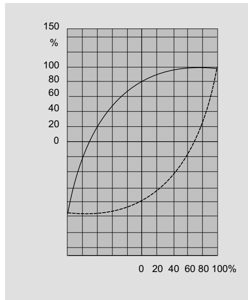
```
        Heli  type
 Linear.  swashpl.      no
 Rotor  direct       right
 Pitch  min.          back
▶Expo  thro  lim.       0%
 ▲                     SEL
```

The “Throttle limit” function described in the »**Control adjust**« menu can be assigned an exponential characteristic curve.

With the selection buttons, a value between ± 100% of the rate of progression can be adjusted by pressing the central **SET** key of the right four-way button.

For example, it is practical to have the throttle limit – by default, the right-side proportional rotary slider – also regulate the idle setting. Further details about the throttle limit can be found in the text for the »**Control adjust**« menu beginning page 122,.

An example of two exponential throttle limit curve characteristics for 100 % servo travel.
continuous line: negative exponential values;
dashed line: positive exponential values



Servo adjustment

Servo direction, midpoint, travel and limit

This option is available on both transmitter types.

Use the ▲▼ selection keys on the left or right four-way button to select the »**Servo adjustment**« option in the multi-function menu:

```
Suppress models
Base setup model
Model type
Servo adjustment
Stick mode
Control adjust
```

```
Suppress models
Base setup model
Helicopter type
Servo adjustment
Stick mode
Control adjust
```

Open this menu option with a tap on the centre **SET** key of the four-way button pad:

```
▶S1 => 0% 100% 100%
 S2 => 0% 100% 100%
 S3 => 0% 100% 100%
 S4 => 0% 100% 100%
 S5 => 0% 100% 100%
 ▾▸ Rev  cent   –  trv  +
```

This menu is used to set the direction, neutralization, travel and limit parameters for a given selected servo exclusively. Begin setting servo parameters in the left column.

Basic procedure:

1. Select the desired servo, 1 … 8 or 1 … 12, with the ▲▼ selection keys of the left or right four-way button.
2. If necessary, use the ◄► selection keys of the left or right four-way button to reach the desired column then, if desired, move the respective control out of its midpoint to make an asymmetric setting.
3. Briefly tap the centre **SET** key of the right four-way button. The corresponding input field is shown highlighted.
4. Use the selection keys of the right four-way button to set the desired value.
5. Briefly tap the centre **SET** key of the right four-way button to complete data entry.
6. A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will any setting made back to its respective default value.

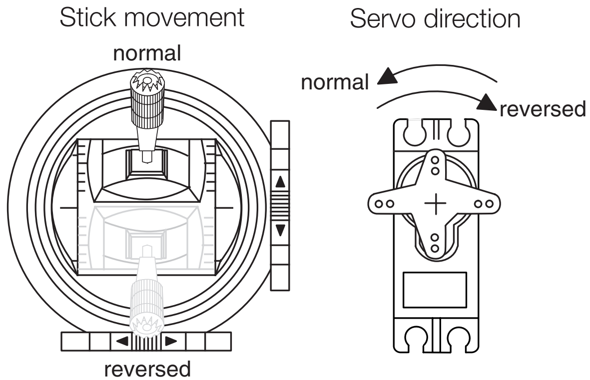
Important:

Servo designation numerals are based on the respective receiver outputs to which they are connected, provided that no swapping of transmitter and/or receiver outputs has been specified. This means that even a change of stick mode will not effect the numbering of servos.

Column 2 "rev"

The direction in which a servo turns is adapted to the practical reality of the given model so that the assembly of control rods and joints do not need to accommodate a specific servo rotation direction. Rotation direction is symbolized by the "=>" and "<=" character combinations. Servo rotation direction must be specified before making settings for the options which follow below.

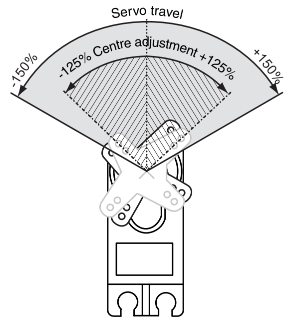
A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset rotation direction back to "=>".



Column 3 "cent."

The servo midpoint (centre) setting is intended for adapting a non-standard servo (a servo whose midpoint position does not correspond to a pulse length of 1.5 ms, i. e. 1500 µs), as well as for *minor* adjustments, e. g. for the fine tuning of the neutral position of model rudders.

Independent of trim levers and any mixer settings, the neutral point can be shifted in a range of -125 to +125 % *within* a maximum servo travel of ±150 %. Independent of all other trim and mixer settings, this setting is always based directly on the respective servo.



Note that extreme offsets of the neutral point can lead to one-sided restrictions of servo travel because overall travel is limited by both electronic and mechanical aspects to a maximum of ±150 %.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset the entry field value displayed in inverse video back to "0 %".

Column 4, "– trv +"

```
▸S1  =›    0% 100% 100%
 S2  =›    0% 100% 100%
 S3  =›    0% 100% 100%
 S4  =›    0% 100% 100%
 S5  =›    0% 100% 100%
 ▾▸ Rev  cent    –  trv  +
```

This column is used to set servo travel symmetrically or asymmetrically for each side. The setting range is 0 … 150 % of normal servo travel. The values set are based on the settings that have been made for the "midpoint" column.

To create a *symmetric* travel path, i. e. control-side independent travel, the respective control (stick, proportional control or switch) is to be put into a position which covers travel to *both sides* of the marked frame.

<u>*Note:*</u>

*It may be necessary to first assign a control attached to one of the control channels 5 … 8 or 5 … 12. If necessary, this is to be done in the »**Control adjust**« menu, see page 112 or 116.*

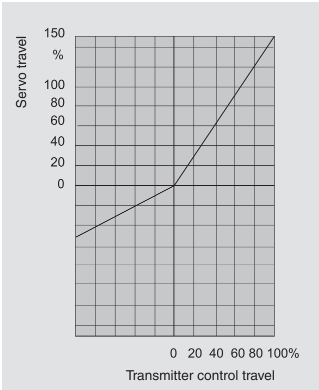
To set *asymmetric* travel, the respective control (stick, proportional control or switch) is to be moved to the side on which the marked frame only includes the value to be changed.

The value setting is activated with a brief tap on the centre **SET** key of the right four-way button. The value field is shown highlighted. Values can be changed with the selection keys of the right four-way button. Complete the entry with a tap on the centre **SET** key of the right four-way button.

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset the changed parameter displayed in inverse video back to "100 %".

<u>*Important:*</u>

*In contrast to settings made with the »**Control adjust**« menu, all settings made in this menu affect exclusively the respective servo, independent of how the control signal for this servo is produced, i. e. directly by a stick or by way of any mixer functions.*



The adjacent figure shows and example of a side-dependent servo setting, -50 % and +150 %.

Column 5 "– lim +"

The "– lim +" column is reached by moving the marker frame, with the ▶ selection keys of the left or right fouray button, to the right beyond the "– travel +" column:

```
▸S1  =›    0% 150% 150%
 S2  =›    0% 150% 150%
 S3  =›    0% 150% 150%
 S4  =›    0% 150% 150%
 S5  =›    0% 150% 150%
 ◂▾  Rev  cent    –  lim  +
```

To create a *symmetric* limit, i. e. control-side independent limit, the respective control (stick, proportional control or switch) is to be put into a position such that the marker frame covers *both sides* of the travel setting.

To set *asymmetric* travel, the respective control (stick, proportional control or switch) is to be moved to the side where it is to be set such that the marker frame only includes the value to be changed.

<u>*Note:*</u>

*You may first need to assign a transmitter control to a servo connected to one of the control channels 5 … 8 or 5 … 12 in the »**Control adjust**« menu; see the sections starting on pages 112 and 116.*

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset the entry field value displayed in inverse video back to "0 %".

<u>*Example:*</u>

A servo is controlled separately by two controls over a mixer and but, for model-specific reasons, must only be operated over a servo travel path of 100 % because, for example, the rudder would mechanically collide with the elevator if moved more than 100 %.

As long as only one control is used at a time, this is no problem. But this does become a problem when the signals are summed by the simultaneous use of both controls (e. g. aileron and rudder) to total travel in excess of 100 %. The linkage and servos could be strained excessively …

To prevent this, the travel should certainly be limited by way of an individual travel limit. In the case of the rudder used in the example, this would be a value slightly less than 100 % – because it is assumed the rudder would collide at 100 %.

Stick mode

Setting stick mode 1 through 4

mc 16 ☐ 20 ☑ *This option is available on the mc-20 HoTT transmitter only.*

Both sticks are equipped for digital trimming. With each brief push (one "click") on a trim switch-key it will change its neutral position by one increment. Holding the trim switch-key longer will cause trimming to run in the corresponding direction at increasing speed.

The current position is shown on the screen and the adjustment is also made "audible" with acoustic tones. This makes finding the mid-point during flight easy, without looking at the screen. If the mid-point is overrun, a brief motion pause will be inserted.

Current trim values are automatically stored when a model memory change is made.

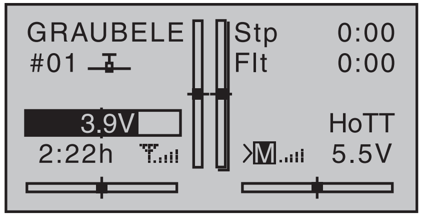
By default the digital trims of the mc-16 HoTT and mc-20 HoTT transmitters always apply to each flight phase separately within a particular model memory – with the exception of the throttle / brake stick trim, generally abbreviated to control function "C1" (channel 1).

If the »**Stick mode**« menu is unlocked, it is possible to convert the digital trims from the default "PH" (phase) setting to "GL" (global), although the C1 trim is always "global", i. e. it is independent of flight phases.

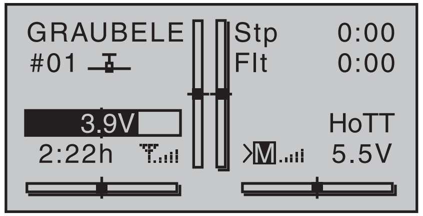
This settings are visualized in the base screen by a "shadow" on trim bars:

- shadow present = global,
- no shadow = flight phase dependent.

By default this means that the base display of the mc-16 HoTT and mc-20 HoTT transmitters looks as follows (assuming "stick mode 1"):

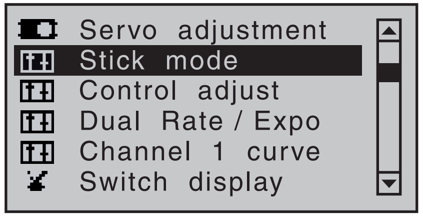


In the following screen-shot of the base display of a transmitter with »**Stick mode**« unlocked (as shown in the screen-shot on the right under the title ""Tr" column"), the aileron trim is shown as "flight phase dependent"; this is the left / right function of the right-hand stick, and assumes the default "Mode 1" transmitter configuration:

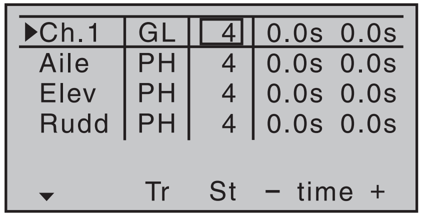


Basic procedure:

Use the selection keys on the left or right four-way button to scroll to the »**Stick mode**« option in the multi-function menu:



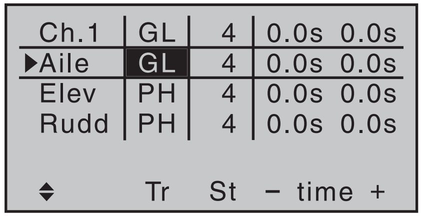
Open this menu option with a tap on the centre **SET** key of the four-way button pad:



Column "Tr"

Except for "Channel 1", the desired line can be reached by using the selection keys of the left or right four-way button. Once the appropriate function field has been selected and then the centre **SET** key of the right four-way button is touched briefly, the field will appear in inverse video and the desired setting can be made with the selection keys of the right four-way button.

This column can be used to switchover trim effect from "GL(obal)" to "PH(ase)" and vice versa, for example:



- **"Global"**
  The position of the respective trim function is effective "globally" for all flight-phases programmed for the given model, page 146.
- **"Phase"**
  The position of the respective trim function is effective on a phase-specific basis and will be automatically stored upon change of flight phase so that the setting is again available following a return to this flight phase.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset the option back to "Global".

Column "St"

The four digital trim switch-keys shift the neutral point of the respective stick in the given direction by one adjustable increment, as set here, for each "click". This is where the increment size (step) can be adjusted for a given direction, whereby maximum trim travel, independent of the selected number of trim steps, is always about ±30 % of control travel.

After selecting the "St" column ((trim) steps) and the desired trim control with the ▲▼ selection keys of the left or right four-way button, the corresponding entry field will be framed, for example:

Ch.1	GL	4	0.0s	0.0s
Aile	GL	4	0.0s	0.0s
▶Elev	PH	4	0.0s	0.0s
Rudd	PH	4	0.0s	0.0s
⬍	Tr	St	– time	+

Briefly tap the centre **SET** key of the right four-way button. The current setting will be displayed in inverse video. Now select the desired value, between 1 and 10, with the selection keys of the right four-way button, for example:

Ch.1	GL	4	0.0s	0.0s
Aile	GL	4	0.0s	0.0s
▶Elev	PH	8	0.0s	0.0s
Rudd	PH	4	0.0s	0.0s
⬍	Tr	St	– time	+

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset any change made to the active field back to "4".

Column "- time +"

The rate of control signal change with respect to the speed of stick motion can be influenced by the entries made in the "– time +" column. Each stick movement direction, i. e. stick control channels 1 through 4, can be set individually. This means that respective servos will then follow rapid control position changes only at an accordingly delayed rate. This time delay has a direct effect on the control function and therefore also any servos controlled by this function.

The time can be programmed symmetrically for both sides or separate for each control direction. This setting has a programmable range of 0 s to 9.9 s. In the case of side-separate settings, the stick is to be moved to the respective side so that the inverse video field will switch between sides to the one for which the change is to be made – for example, even to ensure gentle rev-up of the propulsion motor despite a (too) fast motion of the C1 stick.

▶Ch.1	GL	4	0.0s	1.1s
Aile	GL	4	0.0s	0.0s
Elev	PH	4	0.0s	0.0s
Rudd	PH	4	0.0s	0.0s
▼	Tr	St	– time	+

On the other hand, for reasons of safety, the motor cut-off should always be "immediate".

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset any change made to the active field back to "0.0 s".

Stick mode

Setting stick mode 1 through 4

mc 16 20 ☐ ☑ *This option is available on the mc-20 HoTT transmitter only.*

Both sticks are equipped for digital trimming. With each brief push (one "click") on a trim switch-key it will change its neutral position by one increment. Holding the trim switch-key longer will cause trimming to run in the corresponding direction at increasing speed.

The current position is shown on the screen and the adjustment is also made "audible" with acoustic tones. This makes finding the mid-point during flight easy, without looking at the screen. If the mid-point is overrun, a brief motion pause will be inserted.

Current trim values are automatically stored when a model memory change is made.

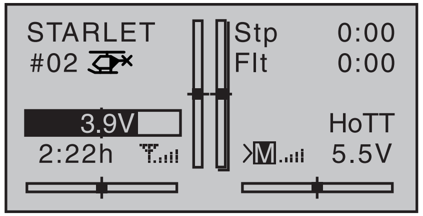
By default the digital trims of the mc-16 HoTT and mc-20 HoTT transmitters always apply to each flight phase separately within a particular model memory – with the exception of the throttle / collective pitch stick trim, generally abbreviated to control function "C1" (channel 1).

If the »**Stick mode**« menu is unlocked, it is possible to convert the digital trims from the default "PH" (phase) setting to "GL" (global), although the C1 trim is always "global", i. e. it is independent of flight phases.

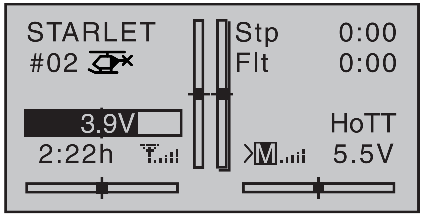
This settings are visualized in the base screen by a "shadow" on trim bars:

- shadow present = global,
- no shadow = flight phase dependent.

By default this means that the base display of the mc-16 HoTT and mc-20 HoTT transmitters looks as follows (assuming "stick mode 1"):

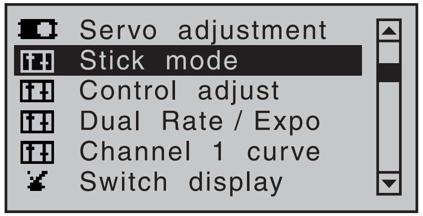


In the following screen-shot of the base display of a mc-20 HoTT transmitter with »**Stick mode**« unlocked (as shown in the second screen-shot on the right under the title "Tr" column"), the tail rotor trim is shown as "flight phase dependent"; this is the left / right function of the left-hand stick, and assumes the default "Mode 1" transmitter configuration:

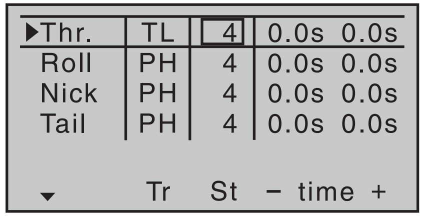


Basic procedure:

Use the selection keys on the left or right four-way button to scroll to the »**Stick mode**« option in the multi-function menu:

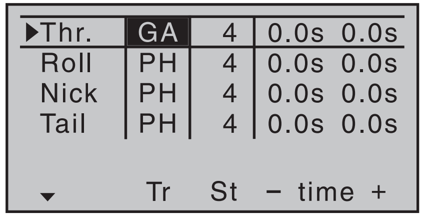


Open this menu option with a tap on the centre **SET** key of the four-way button pad:



Column "Tr"

The setting variants are tailored to the requirements of helicopter models, which is why you can switch in the line "gas" to activate the selection field with the selection keys between:



- **"TL"** (Throttle Limit)
  C1 trimming operates as idle trimming when the "throttle limit" function regulates the motor for starting, see »**Control adjust**« menu, page 122.
- **"TA"** (Throttle Autorotation)
  C1 trim operates as idle trim exclusively in the «Autorot» flight phase.
  This makes it possible to assign a principle (fixed) preset AR throttle position in the »**Helicopter mixer**« menu, page 198, e. g. during autorotation practice with the trim function "varied".
- **"PT"** (Pitch)
  Due to internal coupling, C1 trimming acts equally on all pitch servos available without influencing the throttle servo.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset the option back to "TL", "TA" or "PT".

On the other hand, the trim effects of respective digital trim controls for the lines “Roll”, “Pitch ax” and “Tail rot.” can be switched over from “Gobal” to “Phase” and vice versa, for example:

Thr.	GA	4	0.0s	0.0s
Roll	PH	4	0.0s	0.0s
Nick	PH	4	0.0s	0.0s
▶Tail	**GL**	4	0.0s	0.0s
▲	Tr	St	– time +	

- **“Global”**
  The position of the respective trim function is effective “globally” for all flight-phases programmed for the given model, page 146.
- **“Phase”**
  The position of the respective trim function is effective on a phase-specific basis and will be automatically stored upon change of flight phase so that the setting is again available following a return to this flight phase.

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset the option back to “Global”.

Column “St”

The four digital trim switch-keys shift the neutral point of the respective stick in the given direction by one adjustable increment, as set here, for each “click”. This is where the increment size (step) can be adjusted for a given direction, whereby maximum trim travel, independent of the selected number of trim steps, is always about ±30 % of control travel.

After selecting the “St” column ((trim) steps) and the desired trim control with the ▲▼ selection keys of the left or right four-way button, the corresponding entry field will be framed, for example:

Thr.	GA	4	0.0s	0.0s
Roll	PH	4	0.0s	0.0s
▶Nick	PH	$\boxed{4}$	0.0s	0.0s
Tail	GA	4	0.0s	0.0s
▲▼	Tr	St	– time +	

Briefly tap the centre **SET** key of the right four-way button. The current setting will be displayed in inverse video. Now select the desired value, between 1 and 10, with the selection keys of the right four-way button, for example:

Thr.	GA	4	0.0s	0.0s
Roll	PH	4	0.0s	0.0s
▶Nick	PH	**8**	0.0s	0.0s
Tail	GL	4	0.0s	0.0s
▲▼	Tr	St	– time +	

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset any change made to the active field back to “4”.

Column “- time +”

The rate of control signal change with respect to the speed of stick motion can be influenced by the entries made in the “– time +” column. Each stick movement direction, i. e. stick control channels 1 through 4, can be set individually. This means that respective servos will then follow rapid control position changes only at an accordingly delayed rate. This time delay has a direct effect on the control function and therefore also any servos controlled by this function.

The time can be programmed symmetrically for both sides or separate for each control direction. This setting has a programmable range of 0 s to 9.9 s.

In the case of side-separate settings, the stick is to be moved to the respective side so that the inverse video field will switch between sides to the one for which the change is to be made.

__Example:__
All three servos are to be actuated for swashplate pitch control, e g. a “Pitch” control movement for a “3Sv (2Roll)” swashplate. However, travel for the middle servo is greater than that of the other two servos on the shorter lever.

A rash “Pitch” control movement would not operate the nick servo in the middle as quickly as it would the two roll servos on the shorter lever. This would cause a momentary control motion in the “nick” direction. However, if response time for the “pitch” control function were to be reduced by at least the positioning time for the servo in the middle then all three servos would reach their proper positions at the same time. The necessary delay times typically amount to only a few tenths of a second. For example:

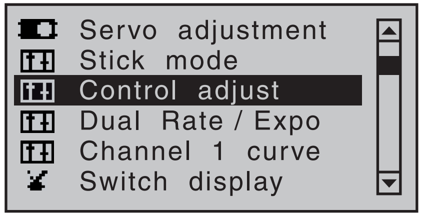
▶Thr.	GA	4	**0.2s**	**0.2s**
Roll	PH	4	0.0s	0.0s
Nick	PH	8	0.0s	0.0s
Tail	GL	4	0.0s	0.0s
▼	Tr	St	– time +	

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset any change made to the active field back to “0.0 s”.

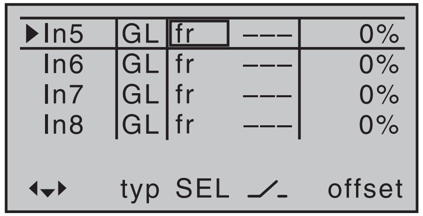
Basic procedure for transmitter control and switch assignment

mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

Use the selection keys on the left or right four-way button to scroll to the »**Control adjust**« option in the multi-function menu:



Open this menu option with a tap on the centre **SET** key of the four-way button pad:



Although the basic hardware features of the mc-16 HoTT and mc-20 HoTT transmitters are the same, i.e. two dual-axis sticks for control functions 1 to 4 and the associated trim levers, the standard supplementary controls fitted to the two transmitters are different.

- **mc-16 HoTT**
  - two 3-way switches (SW 5/6 & 11/12)
  - two proportional sliders on the middle console, designated Sl 1 & 2 in the menu
  - two side-mounted "rotary sliders", designated Lv1 and 2 in the menu
- **mc-20 HoTT**
  - three 3-way switches (SW 2/3, 5/6 & 11/12)
  - five 2-way switches (SW 4, 7, 9, 13 & 15)
  - two self-restoring 2-way switches (SW 8 & 14)
  - two unlockable 2-way switches (SW 1 & 10)
  - two push-buttons on the back-side of the transmitter (SW 16 & 17 bzw. 18 & 19)
  - two switch-keys (Gb5 & Gb6)
  - two proportional sliders on the middle console, designated Sl 1 & 2 in the menu
  - two side-mounted "rotary sliders", designated Lv1 and 2 in the menu

In contrast to the two sticks which, when initialized for a new model memory as a "Winged aircraft" model type will already be configured to operate the servos connected to receiver outputs 1 … 4, these "other" operating elements initially remain inactive.

Thus, at least in the system's delivered state – as already mentioned on page 70 – or even after initialization of a new model memory with an "aircraft" model type and its "binding" to the receiver intended for installation, only those servos connected to the two sticks by way of receiver outputs 1 … 4 are able to be operated; any servos which may be connected to receiver outputs 5 and upper will initially remain inactive in their middle positions.

While this may appear a bit awkward at first glance … this is the only way to ensure a completely free selection from among "additional" operating elements while, at the same time, not requiring the "deactivation" of unused operating elements.

This is because:

The only way to ensure an unused operating element can have no effect on the model, even if operated by accident, is to make it inactive, i.e. not assigned to any function.

All of the aforementioned operating elements can be freely assigned in this »**Control adjust**« menu to any function input, see page 58, just to accommodate personal requirements. Equally, this also means that each of these operating elements can also be assigned to multiple functions at the same time, as needed. For example: the exact same toggle switch assigned to an input in this menu can, at the same time, also have an assignment in the »**Timers (general)**« menu as an "On/Off" switch, etc.

Furthermore, *all* inputs can be selectively set to *global* or *flight-phase specific* operation if they have been defined for flight-phases in the »**Phase settings**« menu, page 148, and »**Phase assignment**« menu, page 154. The names assigned to given flight phases then appear in the second-from-the-bottom display line, e.g. «Normal».

Notes:

In contrast to servo travel the control travel setting affects all outgoing mixer and coupling functions, and thus all servos which are operated via the relevant operating element.

Basic procedure

1. Use the ▲▼ selection keys of the left or right four-way button to select the desired input, "In5 … In8" or "In5 … In12".
2. If necessary, use the ◄► selection keys of the left or right four-way button to change to the desired column.
3. Briefly tap the centre **SET** key of the right four-way button. The corresponding input field is shown highlighted.
4. Operate the chosen operating element or set the desired value with the selection keys of the right four-way button.
5. Briefly tap the centre **SET** key of the right four-way button to complete data entry.
6. A simultaneous tap on the ▲▼ or ◄► keys of the

right four-way button (**CLEAR**) will any setting made back to its respective default value.

Column 2, "Typ"

Similar to the previously described »**Stick mode**« menu, this column can be used to define whether further settings for the given input are to have a "GL(obal)" or a "PH(ase-specific)" effect. Do this by using the selection keys of the left or right four-way button to select the desired input 5 through 8 or 5 through 12 in the column labelled "Typ", for example:

- **"GL(obal)"**
  The settings for the input in question affect all flight phases programmed (if any) and thus act "globally" on the model memory in question.
- **"PH(ase)"**
  The settings for this input take effect per flight phase and must therefore be configured separately for each flight phase.

Notes:

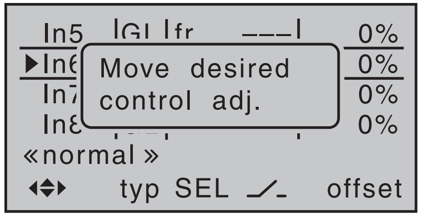
- *The current positions of the INC/DEC buttons CTL 5 & 6, which are generally assigned to inputs 5 … 8 or 5 … 12, are stored in accordance with your chosen entry in the "Type" line, i. e. the settings are not lost when you switch flight phases or change models.*
  The particular advantage of these two transmitter controls – especially if you select the "PH" setting - lies in the fact that you can use one and the same INC/DEC button as trim controls in all the programmed flight phases, but – in contrast to a position-related proportional control – the trim values are retained even if you switch models.
- *See page 146 for more information about flight phases.*

Column 3,
"Transmitter control and switch assignment"

Select an input, 5 through 12 max., with the ▲▼ selection keys of the left or right four-way button.

Transmitter control assignment

Use the selection keys to move into the column labelled **SEL**. After completing the activation of transmitter control assignment by tapping the centre **SET** key of the right four-way button, the message shown below will appear in the display:



Now actuate the desired transmitter control: The notice window will disappear and the designation of the selected transmitter control will appear in the transmitter control assignment window.

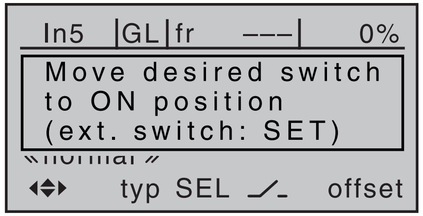
Switch assignment

If the input is to be actuated like a switch module, the input can alternatively be assigned to a switch.

A simple switch can be used to switch back and forth between two limit values, for example motor On/Off.

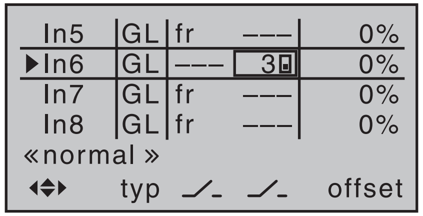
A 3-way momentary or toggle switch achieves the same effect as a 2-channel switch module, for example motor Off/Half/Full.

Use the selection keys to move into the column above the switch symbol label. Briefly tap the centre **SET** key of the right four-way button to activate the option for assigning a switch:



Actuate the desired toggle switch from its "OFF" to its "ON" position or, for a 3-way switch, *beginning from its middle position*, assign a switch direction – preferably the "second" direction. This means, if a function is to be switched on by moving the switch forward two positions, i. e. away from the pilot, then begin from the switch's middle position and move the switch away from the pilot.

The display will then present the switch number together with a symbol indicating the given switch direction. At the same time, the column label in the footer line will change from **SEL** into another switch symbol:



Now put the 3-way switch back into its middle position. Move the marker frame as necessary to the left into the column labelled with the new switch symbol, briefly tap on the centre **SET** key of the right four-way button then assign the switch's other switch direction by once again starting from the middle position but this time move the switch in the other direction.

The display will now present the given switch number together with a symbol indicating the given switch direction, for example:

Tips:

- *When assigning switches, pay attention to the desired switching direction and also that all unused inputs remain "free" or are again reset to "free". This is necessary to ensure that inadvertent actuations of these unused controls cannot cause malfunctions.*
- *The travel setting described below allows the appropriate end state to be established for an assigned switch.*

Erasing a transmitter control or switch assignment

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) while on an input line with an active transmitter control or switch assignment – see above figures – will reset the given input back to "fr" and "---".

Column 4, "offset"

The control centre for the given control, i. e. its zero point, can be changed in this column. The adjustment range lies between -125 % and +125 %.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset the entry field value displayed in inverse video back to "0 %".

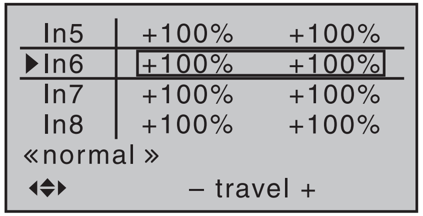
Column 5, "– travel +"

The "-Travel+" column is accessed by using the Select button ► of the left or right-hand four-way button to shift the marker frame to the right, beyond the "Offset" column, as indicated by the right-pointing arrow at bottom left of the screen.

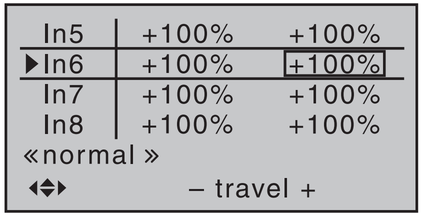
This column is used to set servo travel symmetrically or asymmetrically for each side. The setting range is ±125 % of normal servo travel.

Select an input, 5 through 8 or 5 through 12, with the ▲▼ selection keys of the left or right four-way button.

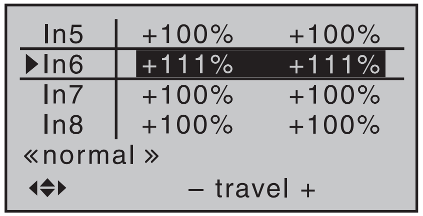
To set *symmetric* travel, i. e. control-side independent travel, the respective operating element (transmitter control or switch) is to be put into a position in which the travel setting will be covered on both sides by the marker frame:



To set *asymmetric* travel, the respective operating element (transmitter control or switch) is to be moved to the side to be set such that the marker frame only includes the value to be changed:



The value setting is activated by briefly touching the centre **SET** key of the right four-way button. The value field/s will be displayed in inverse video. Values can be changed with the selection keys of the right four-way button:



```
 In5 | +100%   +100%
▶In6 | +100%    +88%
 In7 | +100%   +100%
 In8 | +100%   +100%
«normal»
◀⬍▶        – travel +
```

Another brief tap on the centre **SET** key of the right four-way button will complete the entry.

Negative and positive parameter values are possible in order to appropriately adapt the control's direction or effect.

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset the changed parameter displayed in inverse video back to "+100 %".

Column 6, "– time +"

Each of the function inputs 5 … 8 or 5 … 12 can be assigned a symmetrical or asymmetric time delay of between 0 and 9.9 s.

Move the marker frame to the right beyond the column labelled "– travel +" with the ▶ selection key of the left or right four-way button.

To set a *symmetric*, i. e. control-side independent, time delay, the respective operating element (transmitter control or switch) is to be put into a position in which the time setting is covered on both sides by the marker frame:

```
 In5 |  0.0s    0.0s
▶In6 | [0.0s]  [0.0s]
 In7 |  0.0s    0.0s
 In8 |  0.0s    0.0s
«normal»
◀⬍          – time +
```

To set an ***asymmetric*** time delay, move the given transmitter control (proportional control or switch) as necessary to the side to be set such that only the value to be changed is covered:

```
 In5 |  0.0s    0.0s
▶In6 |  0.0s   [0.0s]
 In7 |  0.0s    0.0s
 In8 |  0.0s    0.0s
«normal»
◀⬍          – time +
```

Briefly tap the centre **SET** key of the right four-way button to activate value setting. The value field will be displayed in inverse video. Use the selection keys of the right four-way button to change the value in a range of 0.0 to 9.9 s.

Another brief tap on the centre **SET** key of the right four-way button will complete the entry.

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset the changed parameter displayed in inverse video back to 0.0s.

Note:

Suggestions for the structure of temporal sequences, see "Controlling timed sequences" on page 310

Control adjust

Basic procedure for transmitter control and switch assignment

mc 16	mc 20
☑	☑

This option is available on both transmitter types.

Use the selection keys on the left or right four-way button to scroll to the »**Control adjust**« option in the multi-function menu:

Servo adjustment
Stick mode
Control adjust
Dual Rate / Expo
Channel 1 curve
Switch display

Open this menu option with a tap on the centre **SET** key of the four-way button pad. On the standard eight-channel mc-16 HoTT transmitter this looks as follows:

Firmware version V1102 and lower

By default, the input preset to the right side of the transmitter mounted proportional rotary slider SD2 "Lim.":

In5	GL	fr	---	0%
Thro	GL	fr	---	0%
Gyro	GL	fr	---	0%
In8	GL	fr	---	0%
▶Lim.	GL	Lv2	---	0%
◂▴▸	typ	SEL	⁄	offset

On the twelve-channel mc-20 HoTT transmitter, this looks as follows:

In5	GL	fr	---	0%
Thro	GL	fr	---	0%
Gyro	GL	fr	---	0%
In8	GL	fr	---	0%
In9	GL	fr	---	0%
In10	GL	fr	---	0%
In11	GL	fr	---	0%
▶Lim.	GL	Lv2	---	0%
◂▴▸	typ	SEL	⁄	offset

Note:

To save space the remaining screen-shots in this section are based on the display of the standard eight-channel mc-16 HoTT transmitter. The pictures also apply in similar manner to the twelve-channel mc-20 HoTT transmitter, since the only difference between the transmitter displays is the lines "In8" to "In11" located between "Gyro" and "Lim.".

Firmware version V1103 and higher

From the firmware version of the "Lim" input after initializing a new model memory with the model type "Helicopter" is enabled by default "free":

Gas	GL	fr	---	0%
Gyro	GL	fr	---	0%
In8	GL	fr	---	0%
▶Lim	GL	fr	---	0%
▴▸	typ	SEL	⁄	offset

Although the basic hardware features of the mc-16 HoTT and mc-20 HoTT transmitters are the same, i.e. two dual-axis sticks for control functions 1 to 4 and the associated trim levers, the standard supplementary controls fitted to the two transmitters are different.

- **mc-16 HoTT**
  - two 3-way switches (SW 5/6 & 11/12)
  - two proportional sliders on the middle console, designated Sl 1 & 2 in the menu
  - two side-mounted "rotary sliders", designated Lv1 and 2 in the menu
- **mc-20 HoTT**
  - three 3-way switches (SW 2/3, 5/6 & 11/12)
  - five 2-way switches (SW 4, 7, 9, 13 & 15)
  - two self-restoring 2-way switches (SW 8 & 14)
  - two unlockable 2-way switches (SW 1 & 10)
  - two push-buttons on the back-side of the transmitter (SW 16 & 17 bzw. 18 & 19)
  - two switch-keys (Gb5 & Gb6)
  - two proportional sliders on the middle console, designated Sl 1 & 2 in the menu
  - two side-mounted "rotary sliders", designated Lv1 and 2 in the menu

In contrast to the two sticks which, even for a newly initialized "Helicopter" model type will automatically use the servos attached to receiver outputs 1 … 4 and 6, the aforementioned "other" operating elements – except for the standard assignment of servo 6 to the right-side proportional slider, designated in this menu as Lv2 (throttle limiter) – are initially inactive.

One of the effects of this is that (as already mentioned on page 70) with a factory-fresh system – as with a newly initialized model memory for a "Helicopter" model type following its "binding" to the intended receiver – only those servos connected to receiver outputs 1 … 4 and – depending on the position of the throttle limiter – servo 6 can be moved by the two sticks. Any servos connected to plug-in locations 5, 7 and 8 or 5, 7 through 12, on the other hand, will simply remain at their centre positions.

While this may appear a bit awkward at first glance … this is the only way to ensure a completely free selection from among "additional" operating elements while, at the same time, not requiring the "deactivation" of unused operating elements.

This is because:

The only way to ensure an unused operating element can have no effect on the model, even if operated by accident, is to make it inactive, i.e. not assigned to any function.

All of the aforementioned operating elements can be freely assigned in this »**Control adjust**« menu to any function input, see page 58, just to accommodate personal requirements. Equally, this also means that each of these operating elements can also be assigned to multiple functions at the same time, as needed. For example: the exact same toggle switch assigned to an input in this menu can, at the same time, also have an assignment in the »**Timers (general)**« menu as an "On/Off" switch, etc.

Furthermore, *all* inputs can be selectively set to *global* or *flight-phase specific* operation if they have been defined for flight-phases in the »**Phase settings**« menu, page 152, and »**Phase assignment**« menu, page 154. The names assigned to given flight phases then appear in the second-from-the-bottom display line, e.g. «Normal».

<u>*Note:*</u>

- *As a rule, input 6 must kept "free" for a helicopter model. On this, see "Throttle" on the next double page.*
- *However, unlike the travel adjustment affects all of the control travel setting outgoing mixer and coupling inputs, ie all servos which are operated by the control.*

Basic procedure

1. Use the ▲▼ selection keys of the left or right four-way button to select the desired input: In5, Thro, Gyro or Lim. respectively In5, Thro, Gyro, In8 … 11 or Lim.
2. If necessary, use the ◀ ▶ selection keys of the left or right four-way button to select the desired column.
3. Briefly tap the centre **SET** key of the right four-way button. The corresponding input field is shown highlighted.
4. Operate the chosen operating element or set the desired value with the selection keys of the right four-way button.
5. Briefly tap the centre **SET** key of the right four-way button or the central **ESC** key of the left four-way button to complete data entry.
6. A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will any setting made back to its respective default value.

Column 2, "typ"

Similar to the previously described »**Stick mode**« menu, this column can be used to define whether further settings for the given input are to have a "GL(obal)" or a "PH(ase-specific)" effect. Do this by using the selection keys of the left or right four-way button to select the desired input In5, Thro, Gyro or Lim. respectively In5, Thro, Gyro, In8 through In11 or Lim. in the column labelled "typ", for example:

```
▶In5  |GL|fr  ––– |      0%
 Thro |GL|fr  ––– |      0%
 Gyro |GL|fr  ––– |      0%
 In8  |GL|fr  ––– |      0%
«normal»
◂▾▸     typ SEL ⟋     offset
```

- **"GL(obal)"**
  The settings for the input in question affect all flight phases programmed (if any) and thus act "globally" on the model memory in question.
  "PH(ase)"
  The settings for this input take effect per flight phase and must therefore be configured separately for each flight phase.

<u>*Notes:*</u>

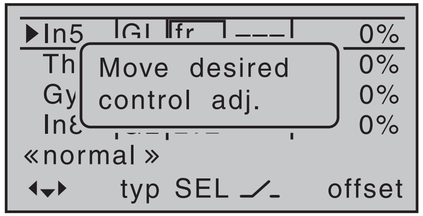
- *The current positions of the INC/DEC buttons CTL 5 & 6, which are generally assigned to inputs 5 … 8 or 5 … 12, are stored in accordance with your chosen entry in the "Type" line, i.e. the settings are not lost when you switch flight phases or change models.*
  The particular advantage of these two transmitter controls – especially if you select the "PH" setting – lies in the fact that you can use one and the same INC/DEC button as trim controls in all the programmed flight phases,
  but – in contrast to a position-related proportional control – the trim values are retained even if you change models.
- *See page 146 for more information about flight phases.*

Column 3, "Transmitter control/switch assignment"

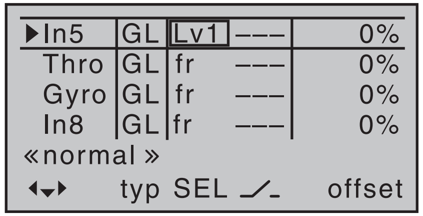
Using the ▲▼ selection keys of the left or right four-way button to select an input: In5, Thro, Gyro or Lim. respectively In5, Thro, Gyro, In8 … 11 or Lim.

Transmitter control assignment

Use the selection keys to move into the column labelled **SEL**. After completing the activation of transmitter control assignment by tapping the centre **SET** key of the right four-way button, the message shown below will appear in the display:



Now actuate the desired transmitter control: The notice window will disappear and the designation of the selected transmitter control will appear in the transmitter control assignment window:



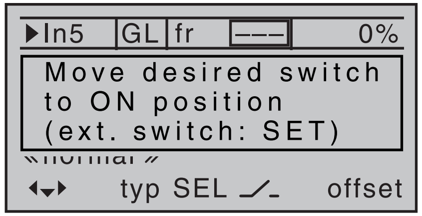
Switch assignment

If the input is to be actuated like a switch module, the input can alternatively be assigned to a switch.

A simple switch can be used to switch back and forth between two limit values, for example motor On/Off.

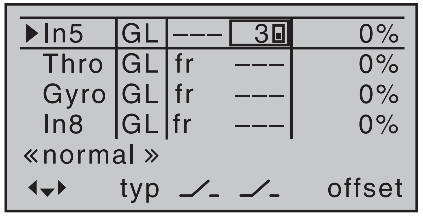
A 3-way momentary or toggle switch achieves the same effect as a 2-channel switch module, for example motor Off/Half/Full.

Use the selection keys to move into the column above the switch symbol label. Briefly tap the centre **SET** key of the right four-way button to activate the option for assigning a switch:



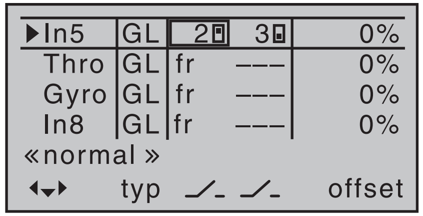
Actuate the desired toggle switch from its "OFF" to its "ON" position or, for a 3-way switch, *beginning from its middle position*, assign a switch direction – preferably the "second" direction. This means, if a function is to be switched on by moving the switch forward two positions, i.e. away from the pilot, then begin from the switch's middle position and move the switch away from the pilot.

The display will then present the switch number together with a symbol indicating the given switch direction. At the same time, the column label in the footer line will change from **SEL** into another switch symbol:



Now put the 3-way switch back into its middle position. Move the marker frame as necessary to the left into the column labelled with the new switch symbol, briefly tap on the centre **SET** key of the right four-way button then assign the switch's other switch direction by once again starting from the middle position but this time move the switch in the other direction.

The display will now present the given switch number together with a symbol indicating the given switch direction, for example:



Tips:

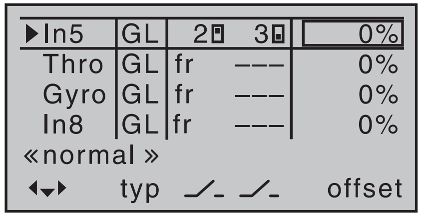
- *When assigning switches, pay attention to the desired switching direction and also that all unused inputs remain "free" or are again reset to "free". This is necessary to ensure that inadvertent actuations of these unused controls cannot cause malfunctions.*
- *The travel setting described below allows the appropriate end state to be established for an assigned switch.*

Erasing a transmitter control or switch assignment

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) while on an input line with an active transmitter control or switch assignment – see above figures – will reset the given input back to "fr" and "---".

Column 4, "Offset"

The control centre for the given control, i.e. its zero point, can be changed in this column. The adjustment range lies between -125 % and +125 %.



A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset the entry field value displayed in inverse video back to "0 %".

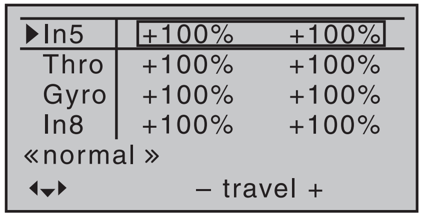
Column 5, "– travel +"

The "- travel +" column is accessed by using the Select button ► of the left or right-hand four-way button to shift the marker frame to the right, beyond the "Offset" column, as indicated by the right-pointing arrow at bottom left of the screen.

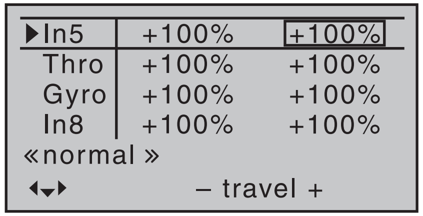
This column is used to set servo travel symmetrically or asymmetrically for each side. The setting range is ±125 % of normal servo travel.

Select an input, In5, Thro, Gyro or Lim. or In5, Thro, Gyro, In8 through 11 or Lim., with the ▲▼ selection keys of the left or right four-way button.

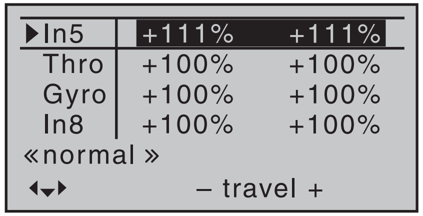
To set *symmetric* travel, i. e. control-side independent travel, the respective operating element (transmitter control or switch) is to be put into a position in which the travel setting will be covered on both sides by the marker frame:

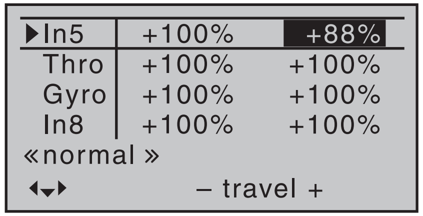


To set *asymmetric* travel, the respective operating element (transmitter control or switch) is to be moved to the side to be set such that the marker frame only includes the value to be changed:



The value setting is activated by briefly touching the centre **SET** key of the right four-way button. The value field/s will be displayed in inverse video. Values can be changed with the selection keys of the right four-way button:





Another brief tap on the centre **SET** key of the right four-way button will complete the entry.

Negative and positive parameter values are possible in order to appropriately adapt the control's direction or effect.

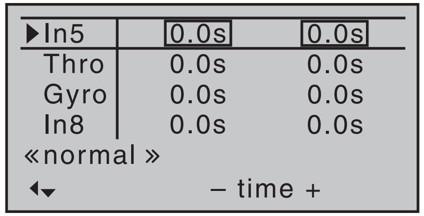
A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset the changed parameter displayed in inverse video back to "+100 %".

Column 6, "– time +"

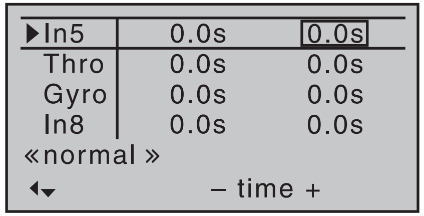
Each of the function inputs In5, Thro, Gyro or Lim. or In5, Thro, Gyro, In8 … 11 or Lim. can be assigned a symmetrical or asymmetric time delay of between 0 and 9.9 s.

Move the marker frame to the right beyond the column labelled "– travel +" with the ► selection key of the left or right four-way button.

To set a *symmetric*, i. e. control-side independent, time delay, the respective operating element (transmitter control or switch) is to be put into a position in which the time setting is covered on both sides by the marker frame:



To set an *asymmetric* time delay, move the given transmitter control (proportional control or switch) as necessary to the side to be set such that only the value to be changed is covered:



Briefly tap the centre **SET** key of the right four-way button to activate value setting. The value field will be displayed in inverse video. Use the selection keys of the right four-way button to change the value in a range of 0.0 to 9.9 s.

Another brief tap on the centre **SET** key of the right four-way button will complete the entry.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset the changed parameter displayed in inverse video back to 0.0s.

__Note:__

Suggestions for the structure of temporal sequences, see "Controlling timed sequences" on page 310.

"Thro(ttle)"

In principle, the helicopter program also permits the individual inputs to be assigned to any existing transmitter control (proportional controls and switches).

However, please note here that some of the inputs available on this menu are already assigned to helicopter-specific functions, and therefore cannot be re-assigned in this way.

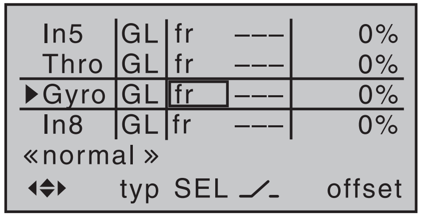
Nevertheless, the receiver layout on page 67 indicates that the throttle servo or the speed controller of an electrically-powered helicopter must be connected to receiver output "6", since control channel "6" is reserved for motor power regulation.

Unlike a fixed-wing model aircraft, the throttle servo or speed controller is not directly controlled by the stick or other transmitter control but rather by a complex mixer system, see »**Helicopter mixer**« menu beginning page 184. Furthermore, the "Throttle limit function" described on the next page also influences this mixer system.

Assigning a transmitter control or switch on the "Throttle" line, or to its supplementary control signal, would unnecessarily "confuse" this complex mixer system.

For this reason the "Throttle" input MUST be left "free".

"Gyro"



Most of the latest gyro systems not only feature infinitely variable proportional gyro gain setting, but also offer a choice of two separate types of gain mode on the transmitter.

If the gyro in use also has this feature then this menu option provides the opportunity to specify both a "normal" gyro effect as well as a "heading-lock mode" in the "Offset" column within a range of ±125 %. Such a specification can include a certain effect to fly normal, slow flights with maximum stability or the reduction of the gyro effect for fast circuit flights and aerobatics.

To proceed as described above, use flight phase switching to enter different settings on the "Gyro" line.

__Important notice:__

The value of this option is identical to the offset value set in the "Gyro offset" option of the »Helicopter mixer« menu, page 193. For this reason, any changes made always affect the other menu directly, and vice versa.

Beginning with these preset–static–flight phase-specific settings, a transmitter control assigned to the "Gyro" line, for example one of the middle console sliders, can be used to vary the gyro effect around the respective "offset point". The centre point of the control corresponds to the setting specified by the offset. If the transmitter control is moved from this centre point in the direction of full travel, gyro gain increases proportionally;

it diminishes when moved in the opposite direction. This provides a fast and straightforward method of adjusting gyro effect even in flight – e. g. to suit changing weather conditions – or to test-fly optimal settings. Furthermore, the range of the gyro's effect within transmitter control travel in both directions can be restricted by software.

In this context, be sure to comply with the instructions accompanying the gyro, otherwise there is a risk the helicopter will be impossible to fly.

On the mc-16 HoTT transmitter the obvious choice as transmitter control for the gyro is one of the two sliders on the centre console, or alternatively to install one of the optional INC/DEC buttons on the mc-16 HoTT transmitter, as fitted to the mc-20 HoTT transmitter as standard. These buttons are virtually ideal for this type of task, since – in contrast to a position-related proportional control – their current position is automatically stored, and is therefore reproducible at any time, even after you change models:

In5	GL	fr	---	0%
Thro	GL	fr	---	0%
▶Gyro	PH	Cn6	---	0%
In8	GL	fr	---	0%
«normal»				
◂⬍▸	typ	SEL	⟋	offset

Adjusting the gyro sensor

To achieve the maximum possible level of stabilization for the helicopter with the gyro along the vertical axis, observe the following:

- The controls should have as little friction and "play" as possible.
- There should be no "spring" in the control linkage.
- Use a strong and – in particular – a fast servo.

When the gyro sensor detects a model rotation, the faster its response – a corresponding corrective change to tail rotor thrust – takes effect, the further the gyro gain adjuster can be moved without causing the tail of the model to start oscillating, and the better the model's stability about its vertical axis. If the response is slower, there is a risk that the model's tail will start to oscillate even at low gyro gain settings. Here, further reductions to gyro gain will need to be made – either by using the default value under "Gyro" or the associated transmitter control – to eliminate the oscillation.

If the model is flying forward at high speed or hovering in a powerful headwind, the net result of the stabilizing effect of the vertical fin combined with the gyro may also lead to an overreaction that once again manifests itself through tail oscillation. To achieve optimum gyro stabilization under all conditions, make use of the option to adapt gyro effect with one of the transmitter's proportional controls.

Firmware version V1103 and higher

From this firmware version if the input is “Lim.” after initializing a new model memory with the model type “Helicopter” is by default “free”:

Gas	GL	fr	---	0%
Gyro	GL	fr	---	0%
In8	GL	fr	---	0%
▶Lim	GL	fr	---	0%
	typ	SEL		offset

However, by assigning a switch, for example, the above default assigned right side proportional slider SD2 described below option “Throttle limit” can be re-activated at any time and adjusted as described below.

ATTENTION:

The throttle limiter only remains disabled as long as the input “Lim” is free! Otherwise this input cannot be used.

Firmware version V1102 and lower

“Lim.”

The proportional slider Lv2, mounted on the right side of the transmitter, is assigned by default to input “Lim.”:

In5	GL	fr	---	0%
Thro	GL	fr	---	0%
Gyro	GL	fr	---	0%
In8	GL	fr	---	0%
▶Lim.	GL	Lv2	---	0%

This pre-assignment makes it unnecessary to program the two flight phases as may be familiar from use of other remote control systems – one “with idle-up” and one “without idle-up” – because the given options of the transmitters mc-16 HoTT and mc-20 HoTT offers a much more flexible approach to fine-tuning and optimizing increases to system rotational speed below the hover point than the so-called “idle-up”. If it is nevertheless preferable for the helicopter to be programmed “with idle-up”, then deactivate the “throttle limit” function described below by setting input “Lim.” to “fr”.

Meaning and application of “throttle limit”

As already mentioned under “Throttle”, and in contrast to fixed-wing models, the power output of a helicopter’s drive system is not controlled directly with the C1 stick, but only indirectly via the throttle curve settings in the »**Helicopter mixer**« menu or – if the model features a speed controller – via that mechanism.

<u>*Note:*</u>

Of course for different flight phases, flight phase programming can be used to set individual throttle curves.

Nevertheless, both methods of output control de facto result in the helicopter carburettor never approaching anything near its idle speed under “normal” flight conditions, and that the motor can therefore neither be started or stopped cleanly without some other means of intervention.

The “throttle limit” feature resolves this problem elegantly by using a separate transmitter control – by default the Lv2 proportional slider mounted on the right side of the transmitter – to *limit* the throttle servo or the output level of a speed controller. In this way, it is possible to “throttle back” with the throttle limit control, even as far as the idle setting, at which point the trim control for the throttle/pitch stick takes over or directly shuts off an electric drive.

Conversely, the throttle servo or speed controller can only open up to its full-throttle position if the throttle limit control has also released the full servo travel path.

The value set on the (right-hand) plus side of the “travel” column must therefore always be set high enough to ensure that the maximum setting of the throttle limit control never restricts the full-throttle position achievable with throttle curve settings – which typically means setting a value in the range +100 % to 125 %.

In5	+100%	+100%
Thro	+100%	+100%
Gyro	+100%	+100%
▶Lim.	+100%	+125%
«normal»		
	– travel +	

The value on the (left-hand) minus side of the “travel” column should be set so that the throttle limit control can safely cut off an electric drive or close a carburettor sufficiently to cut off a combustion motor in conjunction with – digital – C1 trim. Because of this, leave this value (initially) at +100 %.

Furthermore, this variable “limitation” of throttle travel not only provides a convenient means to start and stop the motor but may also prove to be more than an insignificant safety improvement! For example, just imagine what could happen if, while carrying the helicopter to the take-off site with the motor running, the C1 stick were to be inadvertently operated …

If the carburettor or speed controller is open too far when the transmitter is switched on, an audible warning will be sounded and the basic display will show the message:

Tip:

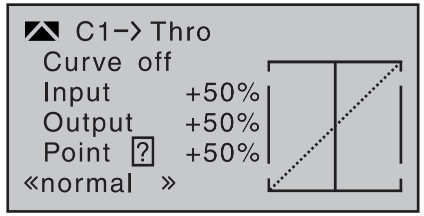
*Take advantage of the »**Servo display**« to observe the influence of the throttle limit control. The »**Servo display**« screen can be reached from almost any menu position with a simultaneous tap on the ◄ ► selection keys of the left four-way button, Bear in mind that servo output 6 controls the throttle servo on the mc-16 HoTT and mc-20 HoTT transmitters!*

Basic idle setting

Put the throttle limit into its "full throttle" position by pushing the throttle limit regulator – by default, the right side proportional slider Lv2 – all the way to its forward position limit. Set the throttle/pitch stick to the maximum pitch position and also check the sub-menu "C1 ➔ Throttle" of the menu …

»Helicopter mixer« (beginning page 184)

… to ensure that a standard throttle curve is active. If, for example, the standard throttle curve has already been changed following the initialization of a model memory then this must be at least temporarily reset to the values "Point L = -0 %", "Point 1 = +50 %" and "Point H = +100 %":



Note:

Since throttle trim has no effect if the throttle limiter is open, its position here is meaningless.

Now – without starting the combustion motor – adjust the throttle servo, preferably mechanically and, if necessary, also by way of the servo 6 travel adjustment option in the »**Servo adjustment**« menu, so that the carburettor is completely open.

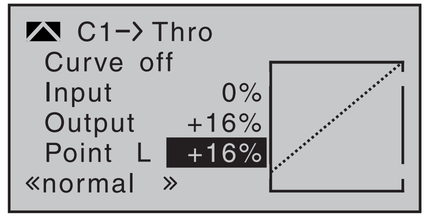
Now close the throttle limiter completely by moving the side proportional slider all the way to its rear limit. Use the trim lever of the Throttle/Pitch stick to place the trim position marker into the motor OFF position or actuate the "Thr. CutOff" option, see page 96.

Note:

In contrast, when the throttle limiter is closed, the position of the throttle/collective pitch stick is meaningless. It can therefore remain at the maximum collective pitch position so that, when adjusting carburettor linkages, the throttle limiter alone can be used to switch between full throttle (throttle limiter open) and "Motor OFF" (throttle limiter closed).

Now, with the throttle limiter closed, adjust the carburettor linkages so that the carburettor is (just) completely closed. Take extreme care to ensure that the throttle servo does not become mechanically blocked in either of its end positions (full throttle/motor OFF).

To complete this basic configuration, the idle trim adjustment range must now be matched against point "L" on the throttle curve. Do this by setting Point "L" of the "C1 ➔ Throttle" mixer, in the »**Helicopter mixer**« menu, to about +15 to +18 %.



To configure a smooth transition from the idle trim to the throttle curve *exactly*, the collective pitch stick should be moved to and fro slightly at its minimum position with the throttle limiter closed and the idle trim fully open.

The throttle servo must not move as well! Any further adjustments to the throttle curve must of course be made later in flight.

The engine or motor is always started with the throttle limiter completely closed; the trim lever of the throttle / collective pitch stick trim only affects the idle range, and the motor engine is stopped using the "cut-off trim" function of the digital trims; see page 62.

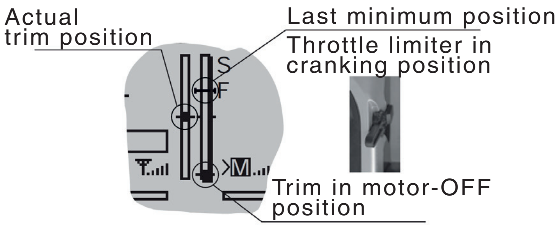
Throttle limiter in conjunction with digital trim

In conjunction with the throttle limiter-default the right side proportional rotary slider Lv2 sets the C1 trim mark at the set idle position of the motor can be turned off from the from the motor through the trim.

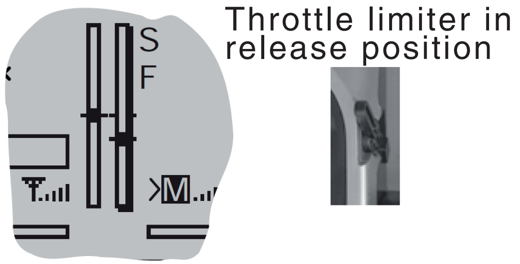
On the other hand, another marker is located in the end zone, see display area in the figure below, so you can reach by clicking once again the original idle setting, see page 62.

The cut-off is only in the latter half of the throttle limit rotary vane path as idle.

That is, only in this area, the marker line is set and stored.

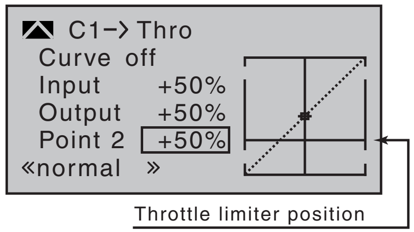


For this reason, the label is also hidden, as long as the throttle limit transmitter is in front of the middle position:



Notes:

- *Since this trim function "from Motor" is effective only in direction, the display of your transmitter will change accordingly if the encoder direction to the collective pitch minimum position of the C1 stick from "back" - whereupon the above figures change on "front "menu" helicopter type in the line "pitch min" . Also replace the effects shown the page, if you pitch left in the line change of Pitc right "control assignment" of the menu Basic setting model".*
- *Take advantage of the »**Servo display**« to observe the influence of the throttle limit control. The »**Servo display**« screen can be reached from almost any menu position with a simultaneous tap on the ◄ ► selection keys of the left four-way button, Bear in mind that servo output 6 controls the throttle servo on the transmitters mc-16 HoTT and mc-20 HoTT!*
- *A servo connected to output 8 or 12 can be used, independently of this, for other purposes by means of mixers, provided that this servo is decoupled from the operating element specified by input function "Lim." via the »**Mix only channel**« menu; see page 212.*
- *The throttle restriction set by the throttle limiter is shown as a horizontal bar in the throttle curve diagram on the second display page of the "C1 → Throttle" option in the »**Helicopter mixer**« menu (see page 188). The output signal for the throttle servo cannot be higher than the level set by the horizontal bar:*

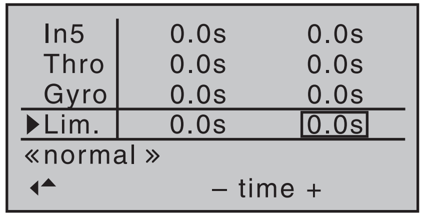


The above diagram shows precisely this scenario: in the above example, the throttle limit control is set to about +20 % and thus restricts the movement of the throttle servo to about +20 % of full travel.

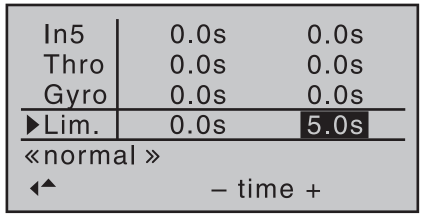
Time delay for the throttle limiter

To safely prevent the carburettor from opening too rapidly, assign the throttle limiter input "Lim." to a time delay that takes effect only in the direction of full throttle. This applies especially if the throttle limiter is controlled by a switch rather than, as preset, with the right-side proportional rotary slider.

To set a delay time, push the throttle limit control to its forward limit or move the switch into its full-throttle position then use the selection keys of the left or right four-way button to select the "– time +" column:



After a brief tap on the centre **SET** key of the right four-way button, the selection keys of the left or right four-way button can be used to select the desired time delay, e.g. 5 seconds:



A brief tap on the centre **SET** key of the right four-way button or the **ESC** key of the left four-way button will complete the entry.

Throttle limit in combination with “AR” in the »**Stick mode**« menu

As already described on page 110, the digital trim of the throttle / collective pitch stick is only active in the “Auto-rotation” flight phase, assuming that you have selected “AR” in the “Throttle” line of the following menu …

»Stick mode« (page 110)

```
▶Thro  AR   4  0.0s 0.0s
 Roll  GL   4  0.0s 0.0s
 Nick  GL   4  0.0s 0.0s
 Tail  GL   4  0.0s 0.0s

 ▼     Tr  St  – time +
```

…. which is available on the mc-20 HoTT transmitter only. This means that the idle of the motor or engine cannot be controlled in the “normal” flight phases using the C1 trim lever. To ensure that adequate adjustment is still available, we recommend that you use “Expo throttle limit”.

The exponential curve characteristic offered by the …

»Helicopter type« (page 102)

```
        Heli type
 Linear. swashpl.     no
 Rotor direct      right
 Pitch min.         back
▶Expo thro lim.      0%
 ▲                   SEL
```

… menu’s sub-menu can be used to alter the control behavior of the throttle limit control such that the latter provides sufficiently sensitive regulation of the idle setting and can also stop the motor.

In this case, with a completely closed throttle limiter – in contrast to the previously described setting – use the »**Control adjust**« menu set the “-” side of the column labelled “- travel +” for the “Lim.” line such that the throttle limiter fully closes the carburettor, i. e. the motor is safely switched off at this control position.

Following this, move the throttle limit control to its centre point and change the % value of the “Expo thro lim.” line in the »**Helicopter type**« menu, page 104, until the carburettor is in a position suitable for starting the motor. Now start the motor, and adjust the value if necessary until the motor idles reliably in this throttle limit control position.

The value for the plus side of the “- travel +” column should be increased, as described before, to +125 % so that the full-throttle position of the throttle servo is also reliably released from the throttle limiter.

Finally, set an asymmetrical time delay of, say 4.0 seconds, so the motor also picks up speed gradually even if the side proportional slider is pushed forward too quickly. Select the time preset to correlate to how far the carburettor opens up at the minimum collective pitch position. The value set is to be optimized by testing.

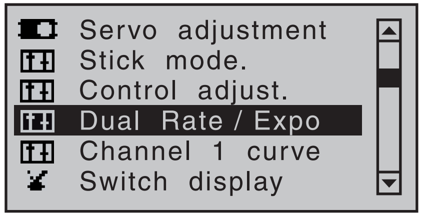
Dual Rate / Expo

Configurable control characteristics for aileron, elevator and rudder

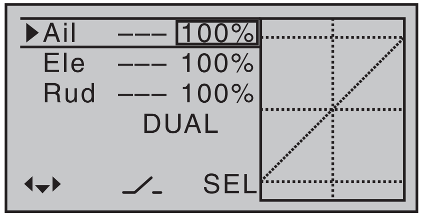
mc 16 20 ☑ ☑

This option is available as standard on both transmitter types.

Use the selection keys of the left or right four-way button to scroll to the »**Dual Rate / Expo**« menu option in the Multi-function menu:



Open this menu option with a tap on the centre **SET** key of the right four-way button:



The *Dual-Rate-/Expo function* permits flight-phase dependent switching and control over the deflection and characteristics of the aileron (Ail), elevator (Ele) and rudder (Rud) (control functions 2 … 4) by way of switches.

It is possible to set up an individual curve for control function 1 (throttle / brake) using a maximum of six separately programmable points. This is carried out in the »**Channel 1 curve**« menu, which is available on the mc-16 HoTT and the mc-20 HoTT transmitter; see the section starting on page 134.

Similar to control travel settings in the »**Control adjust**« menu, **Dual Rate** operates directly on the respective *control function*, independent of whether it is an individual servo or multiple servos connected via complex mixer and coupling functions.

The control travel for each switch position can be set to between 0 and 125 % of normal full travel.

Expo, on the other hand, enables finer-grained control of the model for values larger than 0 % around the centre position of the primary control function (aileron, elevator and rudder), without forfeiting full movement at the end-points of stick travel. For values less than 0 %, the reverse is true: control increases around the neutral position and diminishes towards the end-points. The degree of "progression" can therefore be set within a total range of -100 % to +100 %, where 0 % equates to the normal, linear control characteristics.

Rotary-output servos, now generally commonplace, offer another application. This is because the actual control surface movement is not linear: as the rotational angle of the output disc or lever increases, the control surface rate of travel over the control linkage continually decreases. This effect can be counteracted with Expo values greater than 0 % such that rotational angle travel increases over-proportionally with increasing stick throw.

The Expo setting also affects the relevant control function directly, whether this controls a single servo or multiple servos – via any number of mixer and coupling functions.

For both Dual Rate and Expo functions, switch assignment can be set up in any way desired, which therefore permits the triggering of multiple functions using one and the same switch. This, in turn, offers the opportunity to link the triggering of Dual Rate and Expo functions to a single switch: this offers many advantages – particularly for very high-speed models.

The graphic screen displays the curve characteristics directly. After selecting the appropriate line, the dotted vertical line will follow the movement of the respective stick so a better evaluation of the transmitter-control-travel dependent curve value can be made.

Flight phase-dependent Dual Rate and Expo settings

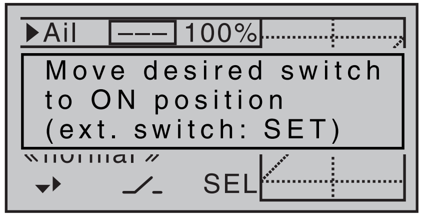
If flight phases are set up in the »**Phase settings**«, page 148, and »**Phase assignment**« menus, page 154, and each assigned a name, e. g. "Normal", the name in question will be displayed at the bottom left of the display. Just actuate the respective switch to switch between flight phases.

Basic procedure

1. Switch to the desired flight phase then use the ▲▼ selection keys of the left or right four-way button to select the desired line: "Aileron", "Elevator" or "Rudder".
2. Use the ◄ ► selection keys of the left or right four-way button to select the right column or the as-yet invisible column for Expo values, see page 33.
3. Tap the centre **SET** key of the right four-way button. The corresponding input field is shown highlighted.
4. Use the selection keys of the right four-way button to set the desired value.
5. Tap the centre **SET** key of the right four-way button or the central **ESC** key of the left four-way button to complete the entry.
6. A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will any setting made back to its respective default value.

Dual Rate function

If a switchover between two variants is desired, assign a switch in the column labelled with the ⁄ switch symbol (as described in the section "Physical control, switch and control switch assignments" on page 60):

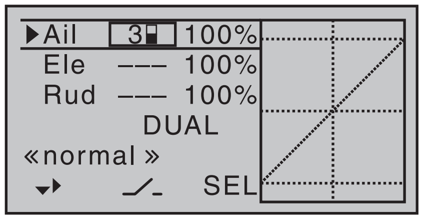


If necessary, this may also be one of the transmitter control switches C1 … C4 or C1i … C4i or one of the logical switches L1 … L8 or L1i … L8i from the list of "expanded switches".

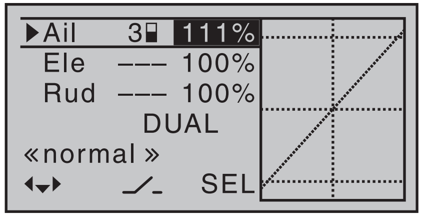
The switch so assigned appears on the display, together with a switch icon that indicates the switch's switching direction.

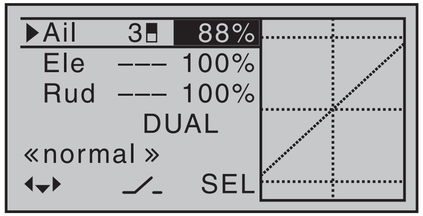
In the case of "C" or "L" switches, the stick or another transmitter control or a certain switching logic can itself be used as a switch. However, such a control switch must have been appropriately defined in the »**Control switch**« menu, see page 141, and a logical switch must have been appropriately defined in the »**Logical switch**« menu, see page 144 – provided that this menu point is unlocked (available) on the transmitter concerned.

Whichever switch has been assigned … the respective switch will appear in the display together with a switch symbol indicating the switch's direction if actuated, e. g. in the «Normal» flight phase.



Once the value field has been activated with a brief tap on the **SET** key of the right four-way button, use the selection keys of the left or right four-way button to move into the Dual-Rate value column labelled **SEL** at the bottom edge of the display in order to separately change the dual-rate values shown in inverse video for each of the two switch positions:



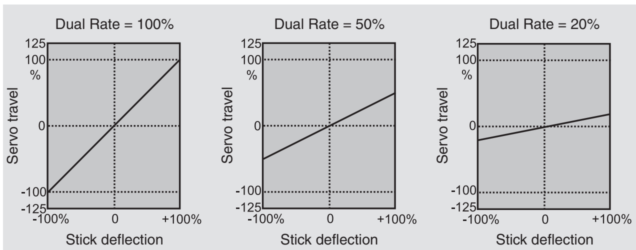


At the same time, the Dual-Rate curve will be presented in the graph. A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset a changed entry field value displayed in inverse video back to "100 %".

Caution:

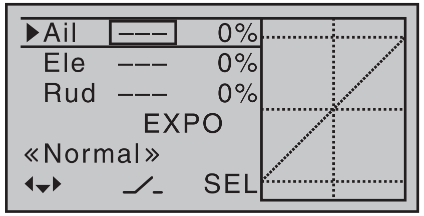
For safety reasons, Dual Rate value settings should not be less than 20 %.

Some examples of Dual Rate values:

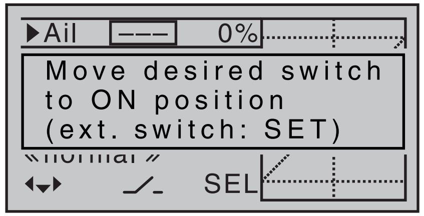


Exponential function

If you wish to program the Expo function, use the ▶ button of the left or right-hand four-way button to move to the right, beyond the Dual Rate value column, until the word "EXPO" is displayed in the centre of the screen instead of "DUAL":



If a switchover between two variants is desired, assign a switch in the column labelled with the ⁄ switch symbol (as described in the section "Physical control, switch and control switch assignments" on page 60):

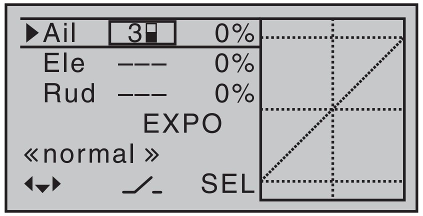


If necessary, this may also be one of the transmitter control switches C1 … C4 or C1i … C4i or one of the logical switches L1 … L8 or L1i … L8i from the list of "expanded switches".

The switch so assigned appears on the display, together with a switch icon that indicates the switch's switching direction.

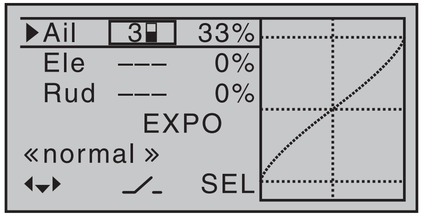
In the case of "C" or "L" switches, the stick or another transmitter control or a certain switching logic can itself be used as a switch. However, such a control switch must have been appropriately defined in the »**Control switch**« menu, see page 141, and a logical switch must have been appropriately defined in the »**Logical switch**« menu, see page 144 – provided that this menu point is unlocked (available) on the transmitter concerned.

Whichever switch has been assigned … the respective switch will appear in the display together with a switch symbol indicating the switch's direction if actuated, e. g. in the «Normal» flight phase.



Select the right-hand column at the lower edge of the display marked with **SEL** and activate the value field with a brief tap on the centre **SET** key of the right four-way button, the selection keys on the left or right four-way button can now be used to alter the EXPO value shown in the highlighted field, separately for each of the two switch positions.

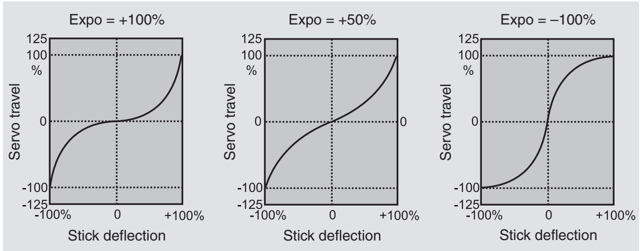
Now, for example, there is an opportunity to fly with a linear curve characteristic with the switch in one direction, and to preset a value other than 0 % for the other switch direction:



At the same time, the Expo curve will be presented in the graph.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset a changed entry field value displayed in inverse video back to "0 %".

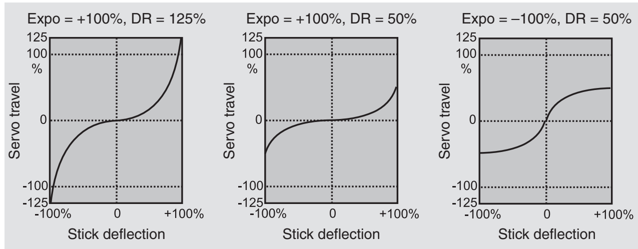
Some examples of Expo values:



In each of these examples, the Dual Rate value equals 100 %.

Combining Dual Rate and Expo

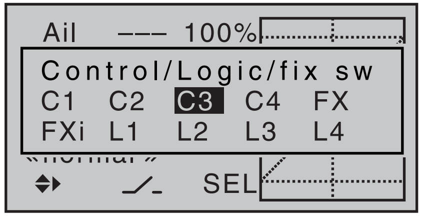
If values have been entered for both the Dual Rate and the Expo function, the effects of both functions will overlap, for example, as follows:



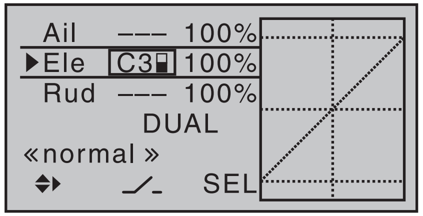
Asymmetric setting of Dual Rate and Expo

To make an asymmetric setting, i. e. a Dual Rate or Expo setting dependent on the direction of the respective stick, first access the »**Control switch**« menu and assign one of the C1 … C4 control switches – "C3", for example – to the desired transmitter control, e. g. control 3 for the elevator function. Do not change the switching point for the stick's neutral position (0 %). Now return to the »**Dual Rate / Expo**« menu and select the corresponding control function ("Elevator" in this example).

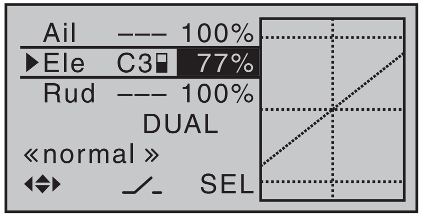
Now, with a brief tap on the centre **SET** key of the right four-way button, activate the switch assignment and change to the expanded switches then use the selection keys to move on to the previously defined "C3" control switch:



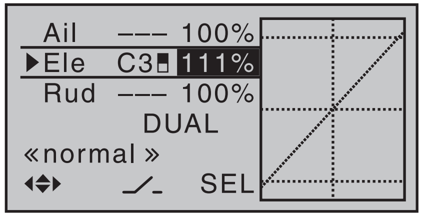
A brief tap on the centre **SET** key of the right four-way button will confirm the assignment of this switch:



Now use one of the selection keys to move into the right column then move the elevator stick into its appropriate end-point to enter a separate Dual Rate value for each direction, e. g. for "Up elevator" …



… and "Down elevator":



Note:

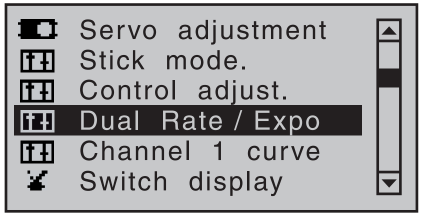
The vertical dashed line shows the current elevator stick position. Set the Expo values as necessary in the same manner.

Dual Rate / Expo

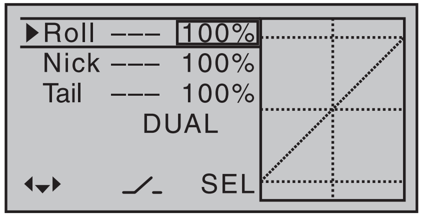
Configurable control characteristics for roll, pitch-axis and tail rotor

mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

Use the selection keys of the left or right four-way button to scroll to the »**Dual Rate / Expo**« menu option in the Multi-function menu:



Open this menu option with a tap on the centre **SET** key of the right four-way button:



The *Dual Rate / Expo function* permits switching or controlling of control travels and characteristics for the control functions roll, pitch-axis, tail rotor, i.e. control functions 2 … 4; it is switch-driven and flight-phase independent.

It is possible to set up an individual curve for control function 1 (throttle / collective pitch) using a maximum of six separately programmable points. This is carried out in the »**Channel 1 curve**« menu, which is available on the mc-16 HoTT and the mc-20 HoTT transmitter; see the section starting on page 137. It can also be set up for throttle and collective pitch separately in the »**Helicopter mixer**" menu, which is available on both transmitters; see the sections starting on pages 184 and 324.

Similar to control travel settings in the »**Control adjust**« menu, **Dual Rate** operates directly on the respective *control function*, independent of whether it is an individual servo or multiple servos connected via complex mixer and coupling functions.

The control travel for each switch position can be set to between 0 and 125 % of normal full travel.

Expo, on the other hand, enables finer-grained control of the model for values larger than 0 % around the centre position of the primary control function (roll, pitch-axis, tail rotor), without forfeiting full movement at the end-points of stick travel. For values less than 0 %, the reverse is true: control increases around the neutral position and diminishes towards the end-points. The degree of "progression" can therefore be set within a total range of -100 % to +100 %, where 0 % equates to the normal, linear control characteristics.

Rotary-output servos, now generally commonplace, offer another application. This is because the actual control surface movement is not linear: as the rotational angle of the output disc or lever increases, the control surface rate of travel over the control linkage continually decreases – depending on the position of the linkage point on the output disc. This effect can be counteracted with Expo values greater than 0 % such that rotational angle travel increases over-proportionally with increasing stick throw.

The Expo setting also affects the relevant control function directly, whether this controls a single servo or multiple servos – via any number of mixer and coupling functions.

For both Dual Rate and Expo functions, switch assignment can be set up in any way desired, which therefore permits the triggering of multiple functions using one and the same switch. This, in turn, offers the opportunity to link the triggering of Dual Rate and Expo functions to a single switch: this offers many advantages – particularly for very high-speed models.

The graphic screen displays the curve characteristics directly. Once you select a menu line, the dotted vertical line follows the movement of the respective stick, so you can clearly see the dependency of the curve value on the transmitter control.

Flight phase-dependent Dual Rate and Expo settings

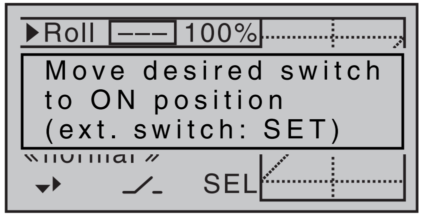
If flight phases are set up in the »**Phase settings**«, page 152, and »**Phase assignment**« menus, page 154, and each assigned a name,e.g. "Normal", the name in question will be displayed at the bottom left of the display. In this scenario, you can operate the corresponding switch to switch between flight phases.

Basic procedure

1. Switch to the desired flight phase then use the ▲▼ selection keys of the left or right four-way button to select the desired line: "Roll", "Pitch ax" or "Tail rot".
2. Use the ◀ ▶ selection keys of the left or right four-way button to select the right column or the as-yet invisible column for Expo values, see page 33.
3. Tap the centre **SET** key of the right four-way button. The corresponding input field is shown highlighted.
4. Use the selection keys of the right four-way button to set the desired value.
5. Tap the centre **SET** key of the right four-way button or the central **ESC** key of the left four-way button to complete the entry.
6. A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will any setting made back to its respective default value.

Dual Rate function

If a switchover between two variants is desired, assign a switch in the column labelled with the switch symbol (as described in the section "Physical control, switch and control switch assignments" on page 60):

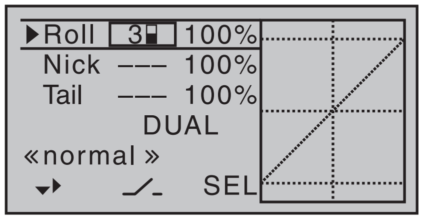


If necessary, this may also be one of the transmitter control switches C1 … C4 or C1i … C4i or one of the logical switches L1 … L8 or L1i … L8i from the list of "expanded switches".

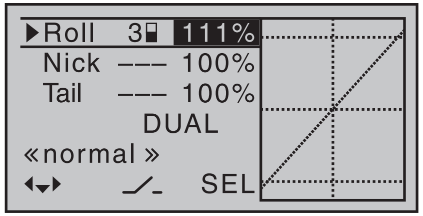
The switch so assigned appears on the display, together with a switch icon that indicates the switch's switching direction.

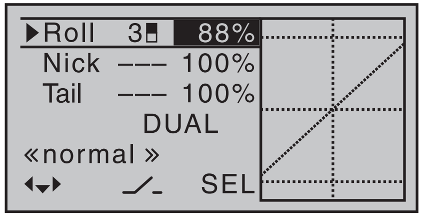
In the case of "C" or "L" switches, the stick or another transmitter control or a certain switching logic can itself be used as a switch. However, such a control switch must have been appropriately defined in the »**Control switch**« menu, see page 141, and a logical switch must have been appropriately defined in the »**Logical switch**« menu, see page 144 – provided that this menu point is unlocked (available) on the transmitter concerned.

Whichever switch has been assigned … the respective switch will appear in the display together with a switch symbol indicating the switch's direction if actuated, e. g. in the «Normal» flight phase.



Once the value field has been activated with a brief tap on the **SET** key of the right four-way button, use the selection keys of the left or right four-way button to move into the Dual-Rate value column labelled **SEL** at the bottom edge of the display in order to separately change the dual-rate values shown in inverse video for each of the two switch positions:





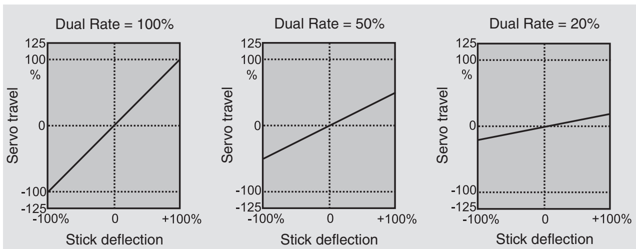
At the same time, the Dual-Rate curve will be presented in the graph.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset a changed entry field value displayed in inverse video back to "100 %".

Caution:

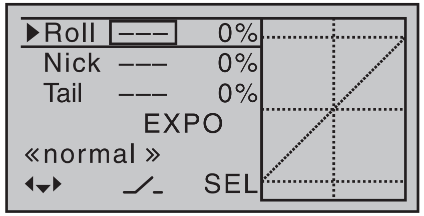
For safety reasons, Dual Rate value settings should not be less than 20 %.

Some examples of Dual Rate values:

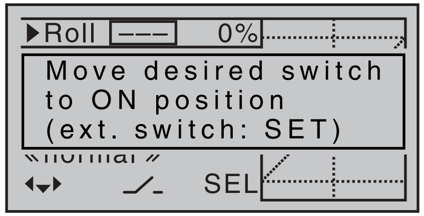


Exponential function

If you wish to program the Expo function, use the ► button of the left or right-hand four-way button to move to the right, beyond the Dual Rate value column, until the word "EXPO" is displayed in the centre of the screen instead of "DUAL":



If a switchover between two variants is desired, assign a switch in the column labelled with the switch symbol (as described in the section "Physical control, switch and control switch assignments" on page 60):

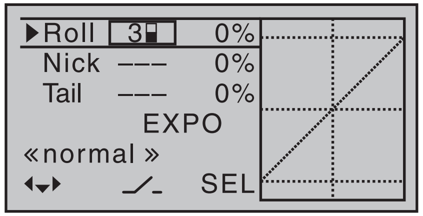


If necessary, this may also be one of the transmitter control switches C1 … C4 or C1i … C4i or one of the logical switches L1 … L8 or L1i … L8i from the list of "expanded switches".

The switch so assigned appears on the display, together with a switch icon that indicates the switch's switching direction.

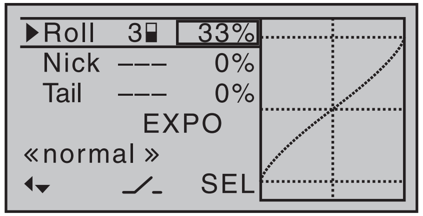
In the case of "C" or "L" switches, the stick or another transmitter control or a certain switching logic can itself be used as a switch. However, such a control switch must have been appropriately defined in the »**Control switch**« menu, see page 141, and a logical switch must have been appropriately defined in the »**Logical switch**« menu, see page 144 – provided that this menu point is unlocked (available) on the transmitter concerned.

Whichever switch has been assigned … the respective switch will appear in the display together with a switch symbol indicating the switch's direction if actuated, e. g. in the «Normal» flight phase.



Select the right-hand column at the lower edge of the display marked with **SEL** and activate the value field with a brief tap on the centre **SET** key of the right four-way button, the selection keys on the left or right four-way button can now be used to alter the EXPO value shown in the highlighted field, separately for each of the two switch positions.

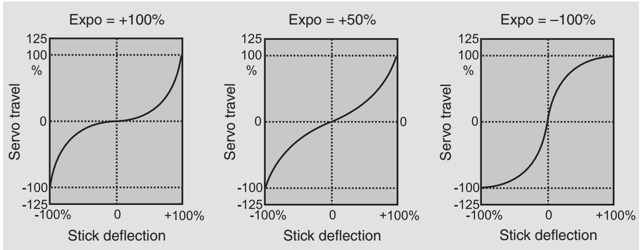
Now, for example, there is an opportunity to fly with a linear curve characteristic with the switch in one direction, and to preset a value other than 0 % for the other switch direction:



At the same time, the Expo curve will be presented in the graph.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset a changed entry field value displayed in inverse video back to "0 %".

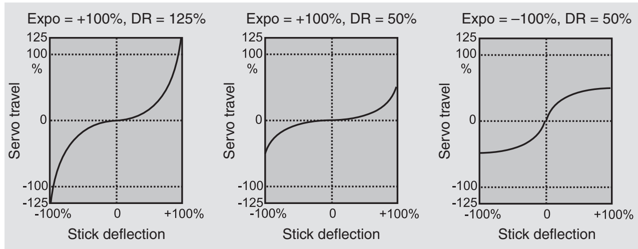
Some examples of Expo values:



In each of these examples, the Dual Rate value equals 100 %.

Combining Dual Rate and Expo

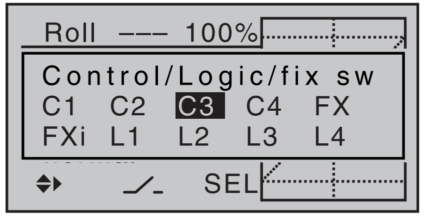
If values have been entered for both the Dual Rate and the Expo function, the effects of both functions will overlap, for example, as follows:



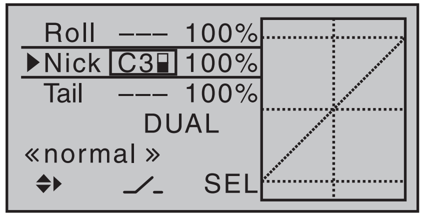
Asymmetric setting of Dual Rate and Expo

To make an asymmetric setting, i. e. a Dual Rate or Expo setting dependent on the direction of the respective stick, first access the »**Control switch**« menu and assign one of the C1 … C4 control switches – "C3", for example – to the desired transmitter control, e. g. control 3 for the nick function. Do not change the switching point for the stick's neutral position (0 %). Now return to the »**Dual Rate / Expo**« menu and select the corresponding control function ("Nick" in this example).

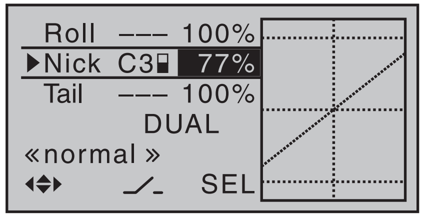
Now, with a brief tap on the centre **SET** key of the right four-way button, activate the switch assignment and change to the expanded switches then use the selection keys to move on to the previously defined "C3" control switch:



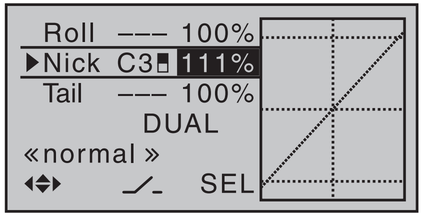
A brief tap on the centre **SET** key of the right four-way button will confirm the assignment of this switch:



Now use one of the selection keys to move into the right column then move the nick stick into its appropriate end-point to enter a separate Dual Rate value for each direction, e. g. for "Nick back" …



… and "Nick forward":



The vertical dashed line shows the current nick stick position. Set the Expo values as necessary in the same manner..

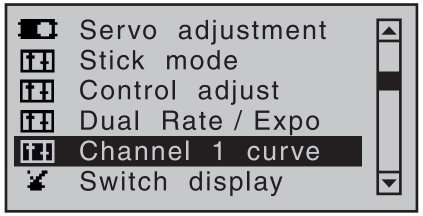
Channel 1 curve

Control characteristics for throttle/spoiler stick

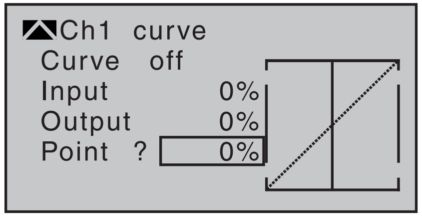
mc 16 20 ☑ ☑

This option is available on both transmitter types.

Use the selection keys of the left or right four-way button to scroll to the »**Channel 1 curve**« menu option in the Multi-function menu:



Open this menu option with a tap on the centre **SET** key of the right four-way button:



Since the carburettor response or the effect of the airbrakes or spoilers is often non-linear, you can make compensatory adjustments to these in this menu.

The menu therefore enables you to change the *control characteristics of the throttle / airbrake stick*, regardless of whether this control function affects the servo connected to control channel 1 directly or affects multiple servos via various mixers.

If flight phases have been specified in the »**Phase settings**« and »**Phase assignment**« menus (see pages 148 and 154) this option can be adapted on a flight-phase basis. The given flight phase name, e.g. «normal», will be shown at the bottom left of the screen.

The control curve can be defined by up to 6 points (termed “reference points” below) placed anywhere along the path of stick travel.

While the on-screen graph considerably simplifies the process of setting and adjusting the reference points, we recommend that you set fewer reference points to begin with.

In the basic software set-up, 2 reference points – namely the end-points at the bottom end of stick travel (“L”, low = -100 % travel) and the top end of stick travel (“H”, high = +100 % travel) – define a linear characteristic curve.

First, switch to your chosen flight phase, if necessary.

Setting reference points

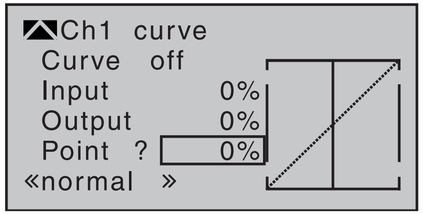
By moving the transmitter control (throttle/airbrake stick), you can reposition the vertical line in the graph between the two end-points “L” and “H”.

The current stick position is also displayed in numerical form on the “Input” line (-100 % to +100 %). The point at which this line crosses the curve is termed the “Output”, and can be varied at the reference points within the range -125 % to +125 %. The control signal altered in this way will then affect all subsequent mixer and coupling functions.

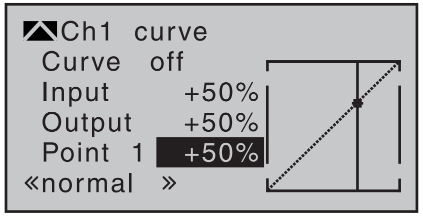
In the example above, the stick is at 0 % of control travel and also generates an output signal of 0 %, since the characteristic curve is linear.

Up to 4 additional reference points can be set *between* the two end-points “L” and “H”, although the distance between neighboring reference points must not be less than approx. 25 %.

If necessary, use the left or right-hand arrow button ▼ to move the marker frame down to the “Point” line:



Move the stick. If a question mark can be seen in the “Point” frame, then the next reference point can be set with a tap on the centre **SET** key of the right four-way button. Simultaneously, the “?” is replaced by a number and the value field to the right of the reference point number will be shown in inverse video.



The order in which you generate the (maximum) 4 reference points between the end-points “L” and “H” is irrelevant, since the reference points are continuously renumbered automatically from left to right as they are entered.

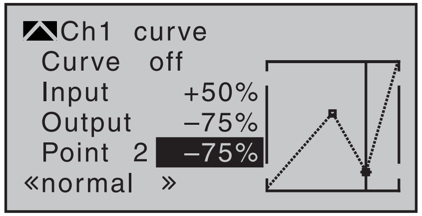
Erasing reference points

To delete one of the reference points (1 to max. 4), use the stick to move the vertical line into the vicinity of the reference point in question. As soon as the reference point number and the associated value are superimposed in the “Point” line, you can activate the Value field by pressing the central **SET** button of the right-hand four-way button, then erase it by simultaneously pressing the ▲▼ or ◄ ► buttons of the right-hand four-way button (**CLEAR**). A brief press of the central **SET** button of the left-hand four-way button or the **ESC** button concludes the procedure.

Changing reference point values

Move the stick into the range of the reference point that is to be changed: “L” (low), 1 … 4 or “H” (high). The number and current curve value of this point are displayed. Press the central **SET** button of the right-hand four-way button to activate the Value field. The reference point value displayed in inverse video can be changed in a range of -125 % to +125 % without influencing the neighboring reference points.

Example:



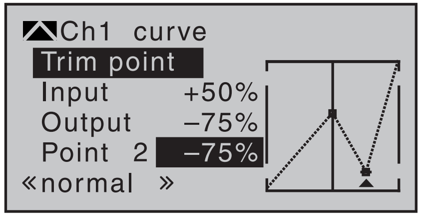
In this sample screen image, reference point “2” has been set to -75 %.

Note:

If the stick does not coincide with the exact reference point, please note that the percentage value on the “Output” line always relates to the current stick position.

Trim point function

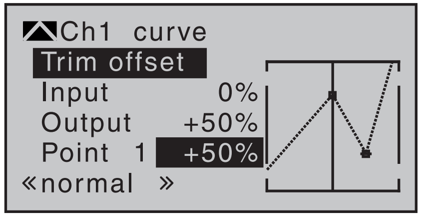
Alternatively, jumping through *active* reference points, in ascending or descending order, can be done with the ◄ ► selection keys of the left four-way button. Note that “active” reference points are those which have already been set. When a jump is made from one to another, the point value field for the jump’s destination reference point in the screen’s Point line will be displayed in inverse video and its position in the graph will be marked (L, 1 … max. 4 and H) in inverse video and with a small triangle. The selection keys on the right four-way button can then be used to change the reference point jumped to as described above, entirely independently of the control position.

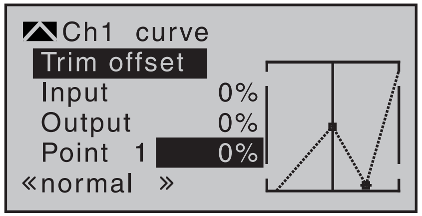


One touch on the centre **ESC** key of the left four-way button terminates this trim point function.

Trim offset function

When a value field is active, i. e. in inverse video, it is not only possible, as previously described, to jump to and change a reference point already set with the ◄ ► selection keys of the left four-way button but also an existing curve can be vertically repositioned with the ▲▼ keys of the left four-way button within a range of ±25 %:

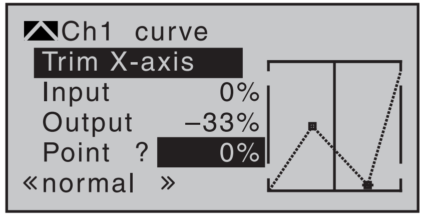




A tap on the centre **ESC** key of the left four-way button will also terminate this function.

Trim x-axis function

This function is activated by tapping the left (◄) or right (►) selection key of the right four-way button with an active (i. e. inverse video) value field. You can then use the selection keys on the right four-way button to reposition the active point horizontally or vertically as you wish:



Notes:

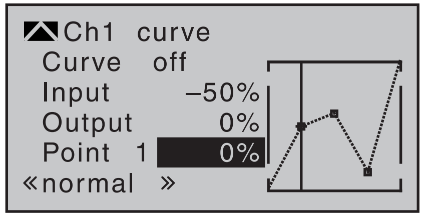
- *If the point is repositioned horizontally further away from the current control position than approx. ±25 %, a “?” sign will reappear in the line Point. This question mark does not refer to the repositioned point, however: instead, it signifies that a further point can be set at the current control position.*
- *Please note that the percentage value on the “Output” line always relates to the current stick position and not to the position of the point.*

Smoothing the Channel 1 curve

In the example below, sample reference points have been set:

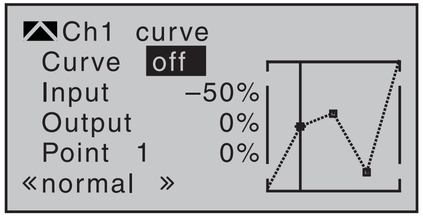
reference point 1 to 0 %,
reference point 2 to +25 % and
reference point 3 to -75 %

as described in the last section:

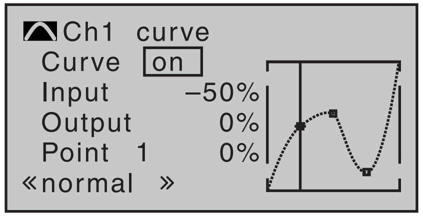


This "jagged" curve profile can be smoothed automatically simply by pressing a button.

Starting from the situation in the previous illustration, first press the **SET** button of the right-hand four-way button to conclude the procedure. Use the Select button ▲ of the right-hand four-way button to move up to the Value field of the "Curve" line, then press the **SET** button of the right-hand four-way button once more:



Now press one of the Select buttons of the right-hand four-way button in order to switch from "(Curve) off" to "(Curve) on" (or vice versa).



Note:

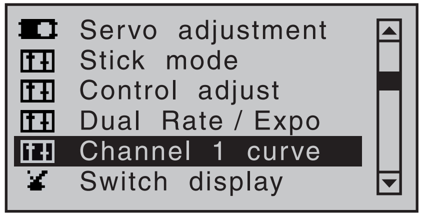
The curves shown here are for demonstration purposes only and are not at all representative of real throttle or airbrake curves. A specific application example can be found in the programming examples on page 286.

Channel 1 curve

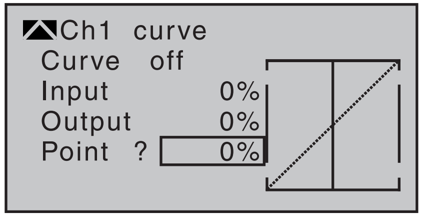
Control characteristics for throttle/collective pitch stick

This option is available on both transmitter types.

Use the selection keys of the left or right four-way button to scroll to the »**Channel 1 curve**« menu option in the Multi-function menu:



Open this menu option with a tap on the centre **SET** key of the right four-way button:



Since the carburettor response or the effect of collective pitch is often non-linear, you can make compensatory adjustments to these in this menu.

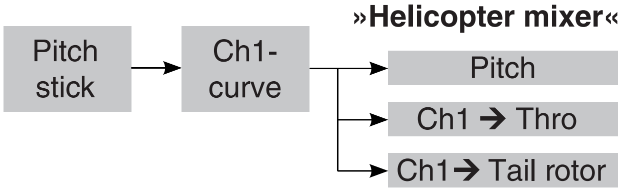
The menu therefore enables modification of the *control characteristics of the motor/collective pitch stick*, regardless of whether this control function affects the servo connected to control channel 1 directly or affects multiple servos via various mixers.

If flight phases have been specified in the »**Phase settings**« and »**Phase assignment**« menus (see pages 152 and 154) this option can be adapted on a flight-phase basis. The given flight phase name, e.g. «normal», will be shown at the bottom left of the screen.

The control curve can be defined by up to 6 points (termed “reference points” below) placed anywhere along the path of stick travel.

While the on-screen graph considerably simplifies the process of setting and adjusting the reference points, we recommend that you set fewer reference points to begin with.

Please note that the curve characteristic you set here acts as the input signal for specific mixers in the »**Helicopter mixer**« menu, page 184.



In the basic software set-up, 2 reference points – namely the end-points at the bottom end of stick travel (“L”, low = -100 % travel) and the top end of stick travel (“H”, high = +100 % travel) – define a linear characteristic curve.

First, switch to your chosen flight phase, if necessary.

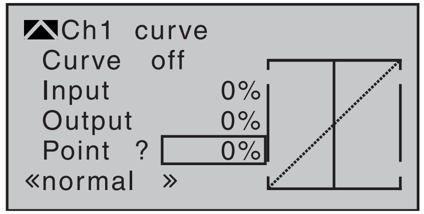
Setting reference points

By moving the transmitter control (motor/collective pitch stick), you can reposition the vertical line in the graph between the two end-points “L” and “H”. The current stick position is also displayed in numerical form on the “Input” line (-100 % to +100 %). The point at which this line crosses the curve is termed the “Output”, and can be varied at the reference points within the range -125 % to +125 %. The control signal altered in this way will then affect all subsequent mixer and coupling functions.

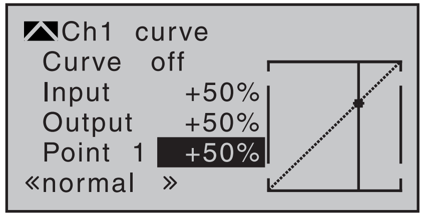
In the example above, the stick is at 0 % of control travel and also generates an output signal of 0 %, since the characteristic curve is linear.

Up to 4 additional reference points can be set *between* the two end-points “L” and “H”, although the distance between neighboring reference points must not be less than approx. 25 %.

If necessary, use the left or right-hand arrow button ▼ to move the marker frame down to the “Point” line:



Move the stick. If a question mark can be seen in the “Point” frame, then the next reference point can be set with a tap on the centre **SET** key of the right four-way button. Simultaneously, the “?” is replaced by a number and the value field to the right of the reference point number will be shown in inverse video:



The order in which you generate the (maximum) 4 reference points between the end-points “L” and “H” is irrelevant, since the reference points are continuously renumbered automatically from left to right as they are entered.

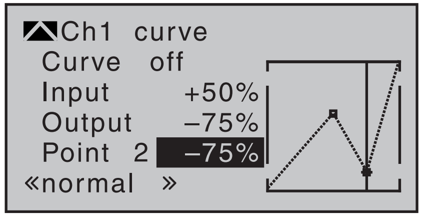
Erasing reference points

To delete one of the reference points (1 to max. 4), use the stick to move the vertical line into the vicinity of the reference point in question. As soon as the reference point number and the associated value are superimposed in the “Point” line, you can activate the Value field by pressing the central **SET** button of the right-hand four-way button, then erase it by simultaneously pressing the ▲▼ or ◄ ► buttons of the right-hand four-way button (**CLEAR**). A brief press of the central **ESC** button of the left-hand four-way button concludes the procedure.

Changing reference point values

Move the stick into the range of the reference point that is to be changed: “L” (low), 1 … 4 or “H” (high). The number and current curve value of this point are displayed. Press the central **SET** button of the right-hand four-way button to activate the Value field. The reference point value displayed in inverse video can be changed in a range of -125 % to +125 % without influencing the neighboring reference points.

Example:



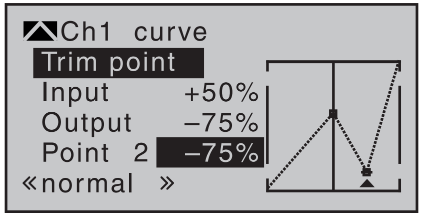
In this sample screen image, reference point “2” has been set to -75 %.

Note:

If the stick does not coincide with the exact reference point, please note that the percentage value on the “Output” line always relates to the current stick position.

Trim point function

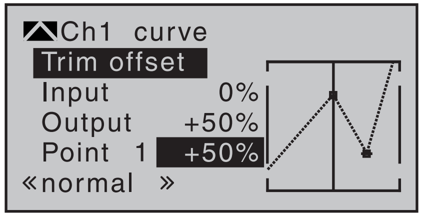
Alternatively, jumping through *active* reference points, in ascending or descending order, can be done with the ◄ ► selection keys of the left four-way button. Note that “active” reference points are those which have already been set. When a jump is made from one to another, the point value field for the jump’s destination reference point in the screen’s Point line will be displayed in inverse video and its position in the graph will be marked (L, 1 … max. 4 and H) in inverse video and with a small triangle. The selection keys on the right four-way button can then be used to change the reference point jumped to as described above, entirely independently of the control position.

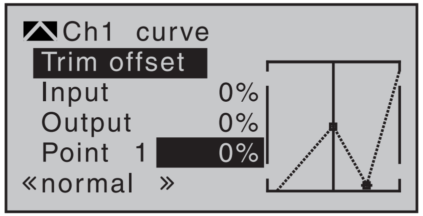


One touch on the centre **ESC** key of the left four-way button terminates this trim point function.

Trim offset function

When a value field is active, i. e. in inverse video, it is not only possible, as previously described, to jump to and change a reference point already set with the ◄ ► selection keys of the left four-way button but also an existing curve can be vertically repositioned with the ▲▼ keys of the left four-way button within a range of ±25 %:

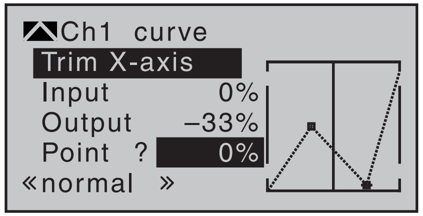




A tap on the centre **ESC** key of the left four-way button will also terminate this function.

Trim x-axis function

This function is activated by tapping the left (◄) or right (►) selection key of the right four-way button with an active (i. e. inverse video) value field. You can then use the selection keys on the right four-way button to reposition the active point horizontally or vertically as you wish:



Notes:

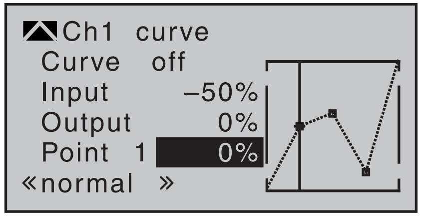
- *If the point is repositioned horizontally further away from the current control position than approx. ±25 %, a “?” sign will reappear in the line Point. This question mark does not refer to the repositioned point, however: instead, it signifies that a further point can be set at the current control position.*
- *Please note that the percentage value on the “Output” line always relates to the current stick position and not to the position of the point.*

Smoothing the Channel 1 curve

In the example below, sample reference points have been set:

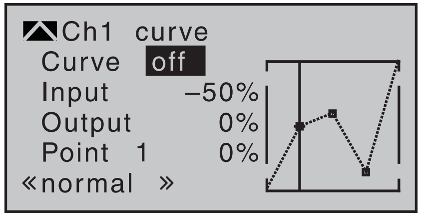
reference point 1 to 0 %,
reference point 2 to +25 % and
reference point 3 to -75 %

as described in the last section:

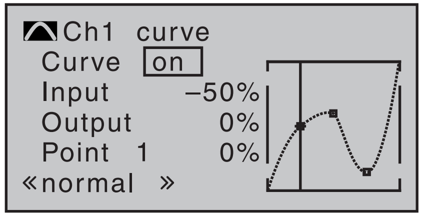


This “jagged” curve profile can be smoothed automatically simply by pressing a button.

Starting from the situation in the previous illustration, first press the **SET** button of the right-hand four-way button to conclude the procedure. Use the Select button ▲ of the right-hand four-way button to move up to the Value field of the “Curve” line, then press the **SET** button of the right-hand four-way button once more:



Now press one of the Select buttons of the right-hand four-way button in order to switch from “(Curve) off” to “(Curve) on” (or vice versa).



Note:

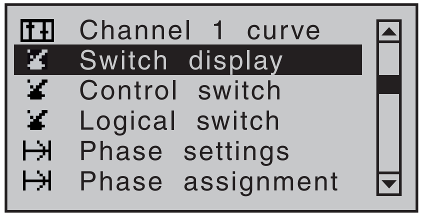
The curves shown here are for demonstration purposes only and are not at all representative of real throttle or airbrake curves. A specific application example can be found in the programming examples on page 286 and 325.

Switch display

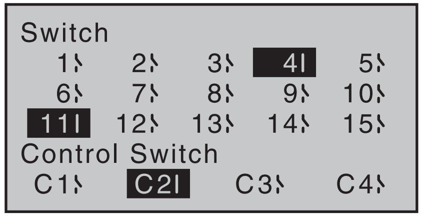
Displaying switch positions

mc 16 20 *This option is available as standard on the mc-20 HoTT transmitter only.*

Use the selection keys of the left or right four-way button to scroll to the »**Switch display**« menu option in the Multi-function menu:



Open this menu option with a tap on the centre **SET** key of the right four-way button:



This feature is used to check the functions and give an overview of switches 1 … 15 and the programmable control switches C1… C4.

If a switch is pressed, the switch number is revealed by one of the display items changing from an OFF to an ON symbol (or vice versa). To improve the legibility of this screen, a closed switch field is also shown in inverse video (i. e. on a dark background).

For control switches C1 … C4, activation of the corresponding transmitter control – which must have been previously assigned on the »**Control switch**« menu – will reveal the control switch number and direction.

<u>*Note:*</u>

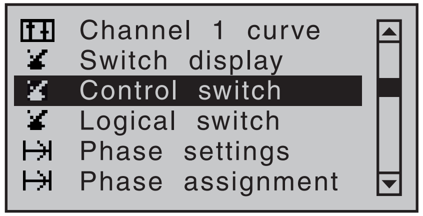
Switch numbering 1 to 15 as shown here corresponds to the labeling of switch plug-in locations on the transmitter's circuit board and not necessarily to the numbering of the transmitter's switch board. The numbering of the switches has no effect on the programming of the transmitter, however.

Control switches

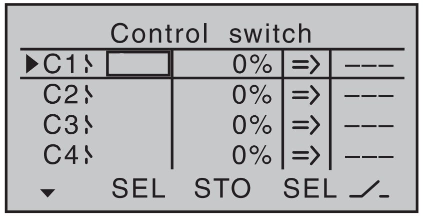
Programming the control switches

mc 16 ☑ 20 ☑ *This option is available on both transmitter types.*

Use the selection keys of the left or right four-way button to scroll to the »**Control switch**« menu option in the Multi-function menu:



Open this menu option with a tap on the centre **SET** key of the right four-way button:



With many functions, it makes sense not to trigger their actuation by using one of the normal switches, but to trigger them automatically by the specific, freely programmable position of a transmitter control or stick.

<u>*Typical applications:*</u>

- *On/Off switching of an on-board glow plug in conjunction with the carburettor setting and/or motor speed. (The glow plug heater switch for this will be controlled by a transmitter-side mixer.)*
- *Switching a stopwatch on or off to measure the simple running time of electric motors*
- *Automated switch-off of a combi “aileron → rudder” mixer when extending the airbrakes, e. g. so as to match the bank attitude of the model to the ground slope when landing on a ridge, without the direction of flight also being affected by the rudder (if the mixer were active).*
- *Lowering landing flaps, adjusting elevator trim and/or executing specific Dual Rate, Exponential and Differential switchings when coming in to land, as soon as the throttle stick is moved beyond the switching point. If required, a control switch can be overridden using a separately assigned switch in the 5th column.*

The programs of the transmitters mc-16 HoTT and mc-20 HoTT are equipped with a total of four so-called control switches (“C1” to “C4”).

Accordingly, anywhere where switches can be assigned you have the option not only of using the maximal 19 possible transmitter switches, but also of choosing and assigning one of the “C1” … “C4” control switches from the list of expanded switches – as described in the section “Physical control, switch and control switch assignments” on page 60.

Furthermore, combining a control switch with an additional switch (as described later) also permits more complex switching permutations.

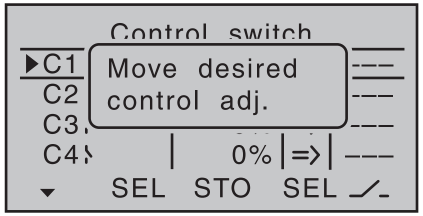
Basic procedure:

1. If no transmitter control is assigned, the corresponding input field of the column labelled **SEL** (second column from the left) will be empty.
2. Use the selection keys of the left or right four-way button to select the line for the desired control switch (1 to 4).
3. Briefly tap the centre **SET** key of the right four-way button .
4. Move your selected transmitter control.

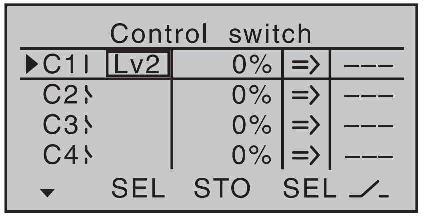
   The associated transmitter control number appears in the input field of the column above the left **SEL**.
5. Use the selection keys on the left or right four-way button to move to the right into the column labelled **STO**.
6. Move the transmitter control to the desired switching point then briefly tap on the centre **SET** key of the right four-way button to save the switching point.
7. Complete the remaining settings such as switching direction, etc.
8. Exit from the menu with a tap on the centre **ESC** key of the left four-way button .

Assigning a transmitter control to a control switch

Using the selection keys on the left or right four-way button, select your chosen line (1 to 4). Following a final tap on the centre **SET** key of the right four-way button to activate the control assignment, the message shown below will appear in the display:

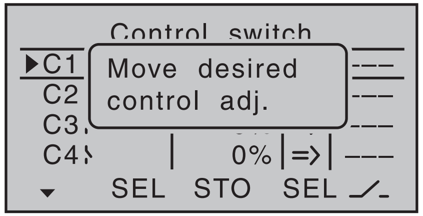


For example, the right-side proportional slider is now to be assigned to control switch “C1”, the default throttle limiter for a helicopter model memory. So just move this control in any direction. As soon as this is detected, the control name appears on the display:



Resetting a control switch back to “free”

To reset a control switch back to “free”, make sure the display is as below …

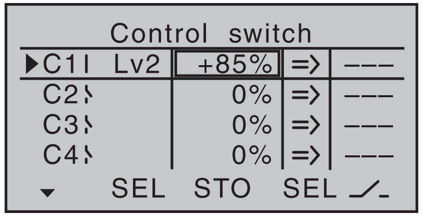


… then, with a brief simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**), the entry for a control will be erased.

Defining the switching point

Using the ► selection key of the left or right four-way button to move the marker frame into the column labelled **STO** (store).

Move the selected transmitter control to the position at which the switching point, i. e. the switch between OFF/ON, should trigger and briefly tap the centre **SET** key of the right four-way button. The current position is displayed, for example “+85 %”:



The switching point can be altered at any time with another tap on the centre **SET** key of the right four-way button.

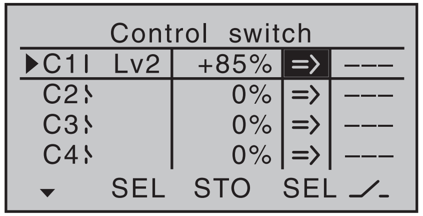
<u>Note:</u>

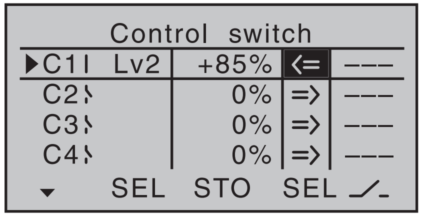
Do not, however, set a switching point at a transmitter control’s travel end-point, since this makes reliable switching impossible. If a 2-way or 3-way switch is used to operate a control switch, the switch point should be programmed in advance with one of the transmitter’s proportional controls.

First, assign the corresponding proportional control in the 2nd column and set the switching point in such a way that will ensure the subsequent configuration for the 2-way or 3-way switch will reliably exceed this value. If you do not, the switching function will be unreliable, since the control switch triggers only if a value unambiguously fails to meet or exceeds the value set! To complete the procedure, cancel the transmitter control assignment then assign the 2-way or 3-way switch.

Setting the switching direction

The switching direction of the control switch is changed as required in the 4th column. Use the ► selection key of the left or right four-way button to move the marker frame into the column labelled **SEL** (select). Following a brief tap on the centre **SET** key of the right four-way button, the switch direction can by changed back-and-forth between “normal” and “reversed” with the selection keys of the left or right four-way button:





A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset the switch direction back to “=>”.

The current switch position of the control switch is displayed in the leftmost column by the switch icon next to the number of the control switch.

<u>Notes:</u>

- *In this example control switch ”C1” is open as long as transmitter control “Lever 2” (the throttle limiter for a helicopter) is less than +85 % of control travel. It closes once the switching point is exceeded, i. e. by a value over +85 % and up to the upper limit.*
- *In the above example with the switching direction reversed, control switch “C1” remains closed while the transmitter control is at less than +85 % of full travel. As soon as the switching point is exceeded, in this example a value between +85 % and the upper travel end-point, “C3” will open.*
- *If a control switch – e. g. “C1” – has multiple assignments, you should bear in mind that the switching direction set here applies to all C3 switches.*
- *The switch state can also be inverted by reversing the control in the »**Control adjust**« menu.*

Combining a control switch with a switch

The control switch can be overridden by a further switch, so that e.g. in certain flight situations the function to be triggered can be activated independently of the control position and thus the position of the control switch.

Change to the value field in the 5th column, the column above the rightmost switch symbol. In the simplest case, select one of the switches mounted in the two switch panels, as described in the section "Physical control, switch and control switch assignments" on page 60. The number of this switch, e.g. "10", appears on the display in the next-to-the last column at the right, together with a switch icon indicating the switch's current state.

```
      Control  switch
▶C1I  Lv2  | +85% |=>| 10
 C2        |   0% |=>| ---
 C3        |   0% |=>| ---
 C4        |   0% |=>| ---
 ▼    SEL   STO   SEL
```

While this switch is open, the "C1" control switch is active, i.e. it triggers at the switching point; if the switch is closed, the control switch now remains permanently closed as well, independently of the control position and switching direction:

```
      Control  switch
▶C1I  Lv2  | +85% |=>| 10I
 C2        |   0% |=>| ---
 C3        |   0% |=>| ---
 C4        |   0% |=>| ---
 ▼    SEL   STO   SEL
```

Combining two control switches

For more complex applications, however, it can prove necessary to override this control switch with a second control switch.

<u>Example:</u>
Control switch "C1" will now be assigned to control function 3 (= control 3) instead of its previous assignment "Lever2". The switching point is at its centre point, i.e. at 0%. The switch chosen in the next-to-the-last right column is "C2" from the list of expanded switches. This "C2" control switch will now be allocated in its own line to the right proportional slider "Slide2", whose switch-point is +50%:

```
       Control  switch
 C1  Cn3 |    0% |=>| C2
▶C2  Sl2 |  +50% |=>| ---
 C3      |    0% |=>| ---
 C4      |    0% |=>| ---
 ▲▼    SEL   STO   SEL
```

The switching directions indicated in the fourth column from the left will now show control switch "C2" as being closed as long as stick (control 3) and/or "Slide 2" are located on the other side of their switch-points.

Application

In order to make these control switches usable, they can be specified in those menus which use switches by calling them up via the additional "expanded switches" selection menu:

```
Move desired switch
to ON position
(ext. switch: SET)
```

A brief tap on the centre **SET** key of the right four-way button will afford access to the expanded switches:

```
Control/Logic/fix sw
C1   C2   C3   C4   FX
FXi  L1   L2   L3   L4
```

Now use the selection keys to pick the desired control switch "C1 … C4", fixed switch "FX" or logical switch "L1 … L8" or the respected inverted switch "C1i … C4i", "FXi" or "L1i … L8i", for example, "C3":

```
Control/Logic/fix sw
C1   C2   C3   C4   FX
FXi  L1   L2   L3   L4
```

A brief tap on the centre **SET** key of the right four-way button will adopt the selected switch into the menu:

```
VOICE TRIGGER
 REPEAT       10SEC   7
 TRIG                 8
 VARIO         AUTO  15
 TRANSMITTER
▶RECEIVER

  ▲
```

<u>Note regarding the inverted switches:</u>

If you select an inverted switch during the assignment process – e.g. "G3i" instead of "G3" – the only difference is that the switching direction is simply reversed, i.e. if a particular switch is intended to activate a function – e.g. a mixer – when turned on, then the same switch with the "i" suffix (= inverted) activates this function when it is turned off. Typical applications might be a need for one and the same switch to turn one function on, and simultaneously to turn a second function off, and vice versa. These facilities, especially when used in conjunction with logical switches (described in the following section) can be exploited to cope with extremely complex switching systems.

Logical switches

Programming logical switches

mc 16 20 ☐ ☑

This option is available on the mc-20 HoTT transmitter only.

Use the selection keys of the left or right four-way button to scroll to the »**Logical switches**« menu option in the Multi-function menu:

```
Channel 1 curve
Switch display
Control switch
Logical switch
Phase settings
Phase assignment
```

Open this menu option with a tap on the centre **SET** key of the right four-way button:

```
  Logical  switch
▶L1 |---|AND |  --- |L1
 L2 |---|AND |  --- |L2
 L3 |---|AND |  --- |L3
 L4 |---|AND |  --- |L4
 ▼       SEL
```

This function, which is available only on the mc-20 HoTT, can be used to link together two switches, control switches and / or logical switches, or any combination of the above, in an "AND" or "OR" arrangement. A total of eight logical switches "L1 … L8" can be programmed in every model memory.

The result of such a logical switch function – shown in the display's rightmost column – can be used as another switch function. Allocation of a switch to a logical function is done in the familiar manner in the columns labelled by the two switch symbols, as described in the section "Physical control, switch and control switch assignments" on page 60. That is, by moving the respective switch from OFF to ON or, after a tap on the centre **SET** key of the right four-way button, by selecting one of the expanded switches with the selection keys:

```
  Logical  switch
Move desired switch
to ON position
(ext. switch: SET)
 ▼       SEL
```

```
  Logical  switch
Control/Logic/fix sw
C1   C2   C3   C4   FX
FXi  L1   L2   L3   L4
 ▼       SEL
```

<u>*Potential applications for this:*</u>
Multiple functions, which are normally independent of one another, are to be put into a defined state by way of an »Emergency switch«.

"AND" / "OR"

Once a given value field has been activated in the column labelled **SEL**, the "AND" and "OR" logic operator can be selected with the selection keys.

- **"AND" function**
  The logical switch is only closed when both input switches are closed.
- **"OR" function**
  The logical switch is closed when at least one of the input switches is closed.

<u>*Note:*</u>

The difference between AND and OR logic switches is made clear by the settings and input states of the display figure below.

```
  Logical  switch
 L1 | 1  |AND |  2  |L1
 L2 | 3  |OR  |  4  |L2
▶L3 | L1 |AND | L2  |L3
 L4 | --- |AND | --- |L4
 ◆       SEL
```

"L3" is only closed when both the "L1" and "L2" switches are closed. This means that both switches, 1 and 2, must be closed and, at the same time, either 3 or 4.

Application

In order to make these logical switches usable, they can be specified in those menus which use switches by calling them up via the additional "expanded switches" selection menu:

```
Move desired switch
to ON position
(ext. switch: SET)
```

A brief tap on the centre **SET** key of the right four-way button will afford access to the expanded switches:

```
Control/Logic/fix sw
C1   C2   C3   C4   FX
FXi  L1   L2   L3   L4
```

Now use the selection keys to pick the desired control switch "C1 … C4", fixed switch "FX" or logical switch "L1 … L8" or the respected inverted switch "C1i … C4i", "FXi" or "L1i … L8i", for example, "L3i":

```
Control/Logic/fix sw
C2i  C3i  C4i  L1i  L2i
L3i  L4i  L5i  L6i  L7i
```

A brief tap on the centre **SET** key of the right four-way button will adopt the selected switch into the menu:

```
 Model  time    12:34h –––
 Batt.  time     1:23h
 Top   :Stop        0s  L3I
▶Centr:Flight       0s  L3I

        SEL   Alarm
```

Remark about inverted switches:

Selection of an inverted switch for a switch assignment, e. g "L1i" instead of "L1", simply specifies the opposite switch direction (state), i. e. non-inverted usage results in a certain switch activating a particular function when it is in its switched-on state but inverted usage results in a certain switch activating a particular function when it is in its switched-off state. Such applications arise when, for example, one and the same switch is to switch one function on but, at the same time, it is to switch a second function off, and vice versa. Logical switches permit other, quite complex, switching options to be created.

How is a flight phase programmed?

The concept of flight phase programming

General information on flight phase programming

During a flight, you will often want to apply different settings – e. g. flap or trim settings for a fixed-wing aircraft or collective pitch and throttle servo settings for a helicopter – at particular times in the flight (e. g. take-off, approach, hover, auto-rotate, etc.). With transmitters mc-16 HoTT and mc-20 HoTT, you can access such presets automatically using switches or control switches.

Flight phases are also of great utility during flight testing. You can configure various set-ups and then switch between them during the flight: this enables you to identify the most appropriate program set-up for your model quickly and easily.

The basic programming procedure is a three-stage process

1. First, you have to set up the different flight phases, i. e. you assign names to phases 1 … max. 7. Each name is then shown in all phase-specific menus and also on the basic display. To avoid abrupt transitions when switching between the various phases, you can also program a period of time during which a “soft” transition to the next phase takes place.

   For fixed-wing aircraft programs, these settings are made in the »**Phase settings**« menu. The programming of helicopters begins with either the »**Basic settings, model**« menu, if you wish to set up autorotation or, otherwise, with the »**Phase settings**« menu.
2. In the second stage, you use the »**Phase assignment**« menu to set up the required “phase switches”.
3. Once these are set, you can then move to the flight phase-dependent menus (see the tables below) to start programming the settings for the individual flight phases.

List of the flight phase relevant menus which are available (☑) in the fixed-wing program of the …

… transmitter mc-16 HoTT:

■	Menu	Page
☑	»**Control adjust**«	112
☑	»**Dual Rate / Expo**«	126
☑	»**Channel 1 curve**«	134
☑	»**Phase settings**«	148
☑	»**Phase assignment**«	154
☑	»**Phase trim**«	156
☐	»**Non-delayed channels**«	157
☑	»**Flight phase timers**«	162
☑	»**Wing mixers**«	166
☐	»**Mix active / phase**«	211
☑	»**Trim memory**«	232

… transmitter mc-20 HoTT:

■	Menu	Page
☑	»**Control adjust**«	112
☑	»**Dual Rate / Expo**«	126
☑	»**Channel 1 curve**«	134
☑	»**Phase settings**«	148
☑	»**Phase assignment**«	154
☑	»**Phase trim**«	156
☑	»**Non-delayed channels**«	157
☑	»**Flight phase timers**«	162
☑	»**Wing mixers**«	166
☑	»**Mix active / phase**«	211
☑	»**Trim memory**«	232

List of the flight phase relevant menus which are available (☑) in the helicopter program of the …

… transmitter mc-16 HoTT:

■	Menu	Page
☑	»**Control adjust**«	116
☑	»**Dual Rate / Expo**«	130
☑	»**Channel 1 curve**«	137
☑	»**Phase settings**«	152
☑	»**Phase assignment**«	154
☐	»**Non-delayed channels**«	157
☑	»**Flight phase timers**«	162
☑	»**Helicopter mixer«**	184
☐	»**Mix active / phase**«	211
☑	»**Trim memory**«	234

… transmitter mc-20 HoTT:

■	Menu	Page
☑	»**Control adjust**«	116
☑	»**Dual Rate / Expo**«	130
☑	»**Channel 1 curve**«	137
☑	»**Phase settings**«	152
☑	»**Phase assignment**«	154
☑	»**Non-delayed channels**«	157
☑	»**Flight phase timers**«	162
☑	»**Helicopter mixer«**	184
☑	»**Mix active / phase**«	211
☑	»**Trim memory**«	234

All other menus are model-specific and thus cannot be programmed separately for each flight phase. Accordingly, changes you make in all other menus apply uniformly to all flight phases for that specific model. In some cases it may be desirable to use the »**Suppress codes**« menu (see page 76) to remove non-alterable menus from the multi-function list while programming flight phases. Two examples of flight phase programming can be found in the text beginning on page 300.

Phase settings

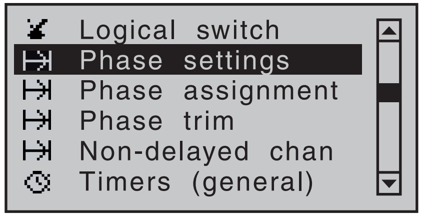
Setting up flight phases

mc 16 20 ☑ ☑

This option is available on both transmitter types.

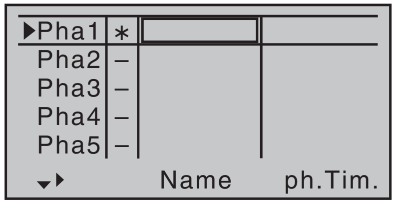
Within one model memory, the transmitters mc-16 HoTT and mc-20 HoTT lets you program up to 7 discrete groups of settings for various conditions met during the flight. The grouped settings are typically termed “flight phases” and are programmed in the corresponding menus.

Use the selection keys of the left or right four-way button to scroll to the »**Phase settings**« menu option in the Multi-function menu:



Open this menu option with a tap on the centre **SET** key of the right four-way button.

Depending on the setting in the “Motor at Ch1” line of the »**Model type**« menu (page 98), your transmitter’s screen will offer you the additional columns “Motor” and “Sw.time” (transition time) or just the column “Sw. time” (transition time) for your settings to the…



... right of the “ph. Tim” (flight phase timers) when you call up the »**Phase settings**« menu point

Setting up flight phases

When you set up flight phases for fixed-wing aircraft models, you start with this menu. You assign individual phases a name and also assign a period of time for a (soft) transition into each phase. Note that – depending on your model and your settings – switch times much longer than the default 0.1 s have proven useful. You can also set up several phases with names and transition times even if you don’t currently have a use for them, since the decision as to which of the “occupied” phases you activate is made only on the »**Phase assignment**« menu, page 154, when setting “phase switches”.

Whether or not one of the phases 1 … 7 currently has an assigned switch and the state of the switch can be seen in the “status” column second from left:

Symbol	Meaning
–	No switch assigned
+	Phase can be accessed via switch
*	Indicates the phase currently active

“Name” column

Briefly tap on the centre **SET** key of the right four-way button then assign the needed phases (phase 1 up to maximum of 7 phases) by picking their names from the selection list with the selection keys of the left or right four-way button.

The order in which phases 1 to max. 7 are assigned is entirely irrelevant and you can leave gaps as you wish. Nonetheless, you should always start with “Phase 1”, the “Normal phase”, which is always active if …

- … no phase switch is set in the »**Phase assignment**« menu or if
- no phase has been assigned to specific combinations of switches.

The definition of the phase name “Normal” could therefore be a useful one to adopt for “Phase 1”. The names themselves have absolutely no technical significance for programming; their only purpose is to help you to identify which phase is active at any time and are thus displayed in all flight phase-dependent menus and also on the transmitter’s basic display.

Column “ph.Tim.”

In addition to the standard timers on the basic screen display, other timers are also available whose settings are configured in the »**Flight phase timers**« menu, page 162.

Clk 1, Clk 2, Clk 3, Lap, Time1, Time2

The flight phase timers “Clk 1 … 3” plus “Time1” and “Time2” run only in the flight phase to which they have been assigned in this menu. During other flight phases they are stopped (and hidden) and the assigned stop/start switch then has no effect.

The lap counter, once started, continues to run through changes of phase, however, although it can be stopped during any flight phase via the centre **ESC** key of the left four-way button.

While you can obviously record lap times using “Lap” and a switch, the two timers “Time1” and “Time2” have the following meaning:

- **Time1**
  This timer will only measure time during which the switch or control switch assigned in the “Lap time/Tim tab” line of the »**Flight phase timers**« menu, page 162, is “closed”. The frequency at which the switch is activated is shown on the basic display. This counter field is highlighted as soon as the switch for the “Time1” timer is “opened”, i. e. the timer is stopped:

```
GRAUBELE      Stp     0:00
#01           Flt     0:00
«Speed  »     Time1   00
   3.9V              0:00.0
2:22h                 5.5V
```

When necessary, the selection keys can be used to access and read the sequence of switching times.

Application:
Measurement of e.g. motor switch-on times, if the same switch also actuates the motor.

- **Time2**
  This timer stores both the “off” and the “on” periods for the associated switch, i.e. every switch actuation in either direction will cause a record to be written for the timer, the timer will be reset then starts incrementing by “1” again as time passes.
  Each time count can be suspended with the centre **ESC** key of the right four-way button, without actuating the switch itself. Activating the switch, in turn, increments the counter by 1 and restarts the “Time2” timer.
  In order to read out the time memory with the selection keys, the “Time2” timer must first be suspended by using the **ESC** key of the right four-way button.

  Application:
  In addition to the motor runtimes, for example, the unpowered glide times between these could also be recorded.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset suspended timers shown in the basic display.

Column “Motor”

Note:
*This column is only available if “forward/back” is present in the “Motor on C1” line of the »**Model type**« menu.*

```
►Pha1 ∗ Normal    yes
 Pha2 + Launch    yes
 Pha3 + Dist.     yes
 Pha4 –           yes
 Pha5 –           yes
         Name    motor
```

- **“yes”**
  The motor connected to receiver output 1 will be controlled by the C1 stick (throttle/brake stick).
  The brake system to be set up on the »**Wing mixers**« menu is deactivated:

```
   Brake  settings

        OFF

«normal»
```

- **“no”**
  The motor connected to receiver output 1 is decoupled from the C1 stick (throttle/brake stick) and is held in its OFF position – as specified by the setting “Throttle min. forward / back” – automatically.
  The brake system to be set up in the »**Wing mixers**« menu is activated and is actuated by the C1 stick:

```
   Brake  settings
►Crow     0%
 D.red    0%
 Elevat  curve      =>
«normal»
        AILE
```

Note:
*The settings available depend on the number of control surface servos selected on the line “Ailerons/Camber-changing flaps in the »**Model type**« menu.*

Column “Sw. time”

When you switch between flight phases, it is advisable to use this column to program a switch time for a “soft” transition INTO (!) the respective phase. Accordingly, there is also an option for specifying a different time for the switchover from any phase to, for example, Phase 3 than for a switchover to Phase 1.

Use the ► selection key of the left or right four-way button to move the marker frame to the right beyond the column labelled “Timer” and, if applicable, also the column labelled “Motor”.

```
►Pha1 ∗ Normal    0.1s
 Pha2 + Launch    0.1s
 Pha3 + Dist.     0.1s
 Pha4 –           0.1s
 Pha5 –           0.1s
         Name    Sw.time
```

Following a brief tap on the centre **SET** key of the right four-way button, the switchover time value in the field displayed in inverse video can be changed within a range of 0 and 9.9s:

Example:

▶Pha1	∗	Normal	4.0s
Pha2	+	Launch	3.0s
Pha3	+	Dist.	2.0s
Pha4	–		0.1s
Pha5	–		0.1s
◀▼		Name	Sw.time

The switchover time from any other phase to Phase 1 «normal» will take 4,0 s.

The time for a switchover from, for example, Phase 1 to Phase 3, is set to 2,0 s and the time for a switchover from Phase 1 or 3 to Phase 2 "Launch" is 3,0 s.

Such asymmetric transition times can be useful when, e. g. switching between extremely different flight phases, such as between aerobatics and normal flight.

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset the time in the currently active value field back to 0,1 s.

Note:

*The "switch time" set here applies uniformly to all settings that are specific to flight phases, and thus to all mixers activated in the »**Wing mixers**« menu, see page 166. Accordingly, the transition between flight phase-specific mixers does not occur abruptly. However, if individual servos are to be switched without a delay then these can be defined accordingly in the »**Non-delayed chan**« menu on the* mc-20 HoTT*, see page 157.*

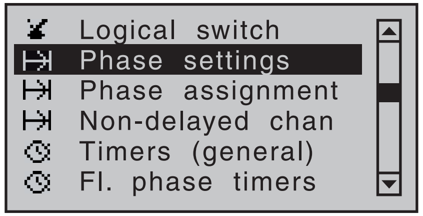
Phase settings

Setting up flight phases

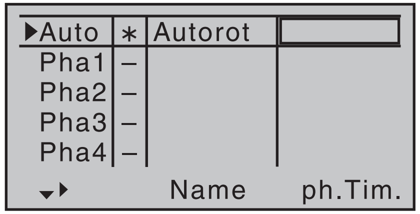
mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

Within one model memory, the transmitters mc-16 HoTT and mc-20 HoTT lets you program up to 6 discrete groups of settings for various conditions met during the flight. These are in addition to the auto-rotation flight phase that can be set up in the »**Basic settings, model**« menu (page 95). The grouped settings are typically termed “flight phases” and are programmed in appropriate menus.

Use the selection keys of the left or right four-way button to scroll to the »**Phase settings**« menu option in the Multi-function menu:



Open this menu option with a tap on the centre **SET** key of the right four-way button.



Setting up flight phases

When you set up flight phases for helicopter models, you start with this menu. You assign individual phases a name and also assign a period of time for a (soft) transition into each phase. Note that – depending on your model and your settings – switch times much longer than the default 0.1 s have proven useful. You can also set up several phases with names and transition times even if you don’t currently have a use for them, since the decision as to which of the “occupied” phases you activate is made only on the »**Phase assignment**« menu, page 154, when setting “phase switches”.

The “Status” column, second from the left, shows which one of the phases 1 … 6, including the autorotation phase this is 7, has already been assigned to a switch, plus the current status of that switch:

Symbol	Meaning
–	No switch assigned
+	Phase can be accessed via switch
∗	Indicates the phase currently active

Note:
*The “Copy flight phase” option on the »**Copy / Erase**« menu is a useful aid when programming the various flight phases. First, you need to determine the parameters for a specific flight phase; these are then copied to the next flight phase, where they can then be modified as appropriate.*

Column “Name”

The first line, and thus the first flight phase, is reserved for autorotation flight, see »**Basic settings, model**« menu. Accordingly, the predefined name cannot be changed.

Use the selection keys to move to the line “Phase 1”. Briefly tap on the centre **SET** key of the right four-way button then assign the needed phase (phase 1 up to maximum of 6 phases) by picking the respective name from the selection list with the selection keys of the left or right four-way button.

The order in which phases 1 to max. 6 are assigned is entirely irrelevant and you can leave gaps as you wish. Nonetheless, you should always start with “Phase 1”, the “Normal phase”, which is always active if …

- … no phase switch is set in the »**Phase assignment**« menu or if
- no phase has been assigned to specific combinations of switches.

The definition of the phase name “Normal” could therefore be a useful one to adopt for “Phase 1”. The names themselves have absolutely no technical significance for programming; their only purpose is to help you to identify which phase is active at any time and are thus displayed in all flight phase-dependent menus and also on the transmitter’s basic display.

Column “ph. Tim.”

In addition to the standard timers on the basic screen display, other timers are also available whose settings are configured in the »**Flight phase timers**« menu, page 162.

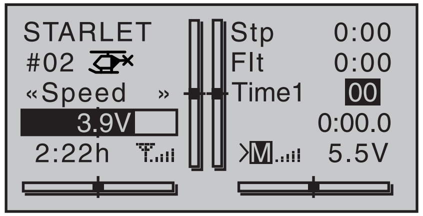
Clk 1, Clk 2, Clk 3, Lap, Time1, Time2

The flight phase timers “Clk 1 … 3” plus “Time1” and “Time2” run only in the flight phase to which they have been assigned in this menu. During other flight phases they are stopped (and hidden) and the assigned stop/start switch then has no effect.

The lap counter, once started, continues to run through changes of phase, however, although it can be stopped during any flight phase via the centre **ESC** key of the left four-way button.

While you can obviously record lap times using “Lap” and a switch, the two timers “Time1” and “Time2” have the following meaning:

- **Time1**
  This timer will only measure time during which the switch or control switch assigned in the “Lap time/Tim tab” line of the »**Flight phase timers**« menu, page 162, is “closed”. The frequency at which the switch is activated is shown on the basic display. This counter field is highlighted as soon as the switch for the “Time1” timer is “opened”, i. e. the timer is stopped:



When necessary, the selection keys can be used to access and read the sequence of switching times.

Application:
Measurement of (e. g.) flight phases with increased motor speed, if the same switch is used to actuate flight phase switching.

- **Time2**

  This timer stores both the "off" and the "on" periods for the associated switch, i. e. every switch actuation in either direction will cause a record to be written for the timer, the timer will be reset then starts incrementing by "1" again as time passes.

  Each time count can be suspended with the centre **ESC** key of the right four-way button, without actuating the switch itself. Activating the switch, in turn, increments the counter by 1 and restarts the "Time2" timer.

  In order to read out the time memory with the selection keys, the "Time2" timer must first be suspended by using the **ESC** key of the right four-way button.

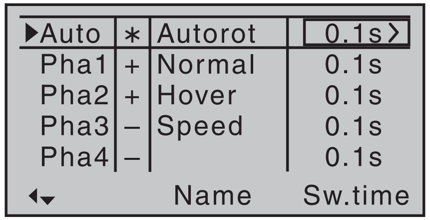
A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset suspended timers shown in the basic display.

Column "Sw. time"

When you switch between flight phases, it is advisable to use this column to program a switch time for a "soft" transition INTO (!) the respective phase. Accordingly, there is also an option for specifying a different time for the switchover from any phase to, for example, Phase 3 than for a switchover to Phase 1.

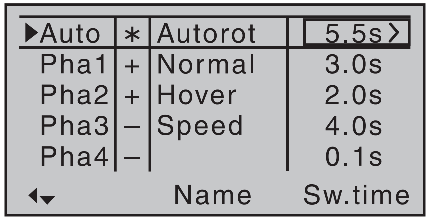
However, for reasons of safety, transition into the autorotation flight phase should **ALWAYS** be set to switch without any time delay. The arrow "->" in the column labelled "Sw.time" at the end of the "Autorot" line indicates that a delay can be set when transitioning FROM (!) autorotation INTO (!) another phase.

Use the ► selection key of the left or right four-way button to move the marker frame to the right beyond the "ph.Tim." column:



Following a brief tap on the centre **SET** key of the right four-way button, the switchover time value in the field displayed in inverse video can be changed within a range of 0 and 9,9 s.

Example:



A delay of 5,5 s applies when switching FROM autorotation into any other phase. A delay of 0,0 s always applies when switching TO auto-rotation.

The switchover time from any other phase to Phase 1 «normal» will take 3,0 s.

When switching from e. g. Phase 1 to Phase 3, the switch time is set to 4,0 s.

Such asymmetric transition times can be useful when, e. g. switching between extremely different flight phases, such as between aerobatics and normal flight.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset the time in the currently active value field back to 0,1 s.

Note:

*The "switch time" set here applies uniformly to all settings that are specific to flight phases, and thus to all mixers activated in the »**Helicopter mixer**« menu, see page 184. Accordingly, the transition between flight phase-specific mixers does not occur abruptly. If you want individual servos to be switched without a delay, however, define these accordingly in the »**Non-delayed channels**« menu, see page 157, which is available as standard on the mc-20 HoTT transmitter only.*

Phase assignment

Setting up flight phases

mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

Use the selection keys of the left or right four-way button to scroll to the »**Phase assignment**« menu option in the Multi-function menu:

```
Logical switch
Phase settings
Phase assignment
Phase trim
Non-delayed chan
Timers (general)
```

```
Logical switch
Phase settings
Phase assignment
Non-delayed chan
Timers (general)
Fl. phase timers
```

Open this menu option with a tap on the centre **SET** key of the right four-way button.

```
   Phase assignment
prior.           combi
[A] B          C  D  E  F

                 <1        >
```

Note:

*A phase name appears to the right of the phase number at the bottom right of the display only if you have assigned the name beforehand on the »**Phase settings**« menu.*

In the »**Phase settings**« menu, described above separately for fixed-wing and helicopter models, you will have set up names for your phases. On this menu – which is identical for both model types – you must now specify the switches or switch combinations that you want to use to trigger each phase. One exception for helicopter menu: one of the two auto-rotation switches must be set on the menu »**Basic settings, model**« (page 95).

Please note the following priorities:

- If *no* flight phase switches nor these names have been assigned in this menu, the model is in flight phase "1". Accordingly, by the time you start programming flight phases, you should therefore have already given this flight phase the phase name "Normal".
- Independent of the phases with allocated switch settings made *in this menu*, the autorotation phase only present for the "Helicopter" model type and to be assigned a switch in the »**Basic settings, model**« menu (page 88) always (!) takes precedence. Accordingly, as soon as the auto-rotation switch in question is activated, the following warning appears:

```
   Phase assignment
prior.           combi
[A] B   [ Autorot ]  E  F

            <1          >
```

- Phase switch "A" is given priority over all subsequent switch positions, from "B" to "F"
- Phase switch "B" is given priority over all subsequent switch positions, from "C" to "F"
- 3-way switches should *always* be assigned from the middle position.

Therefore use switch "A" and/or switch "B" only if you wish to change from any other flight phase – apart from the helicopter's autorotation phase – directly into the phase that is assigned to this switch.

Programming flight phase switches

Once you have configured your desired switch position, "A" to "F", using the selection keys on the left or right four-way button, a switch (whether a "normal" switch or an expanded switch) is then assigned as described in the section "Physical control, switch and control switch assignments" on page 60.

The order in which assignment is made is irrelevant: you must ensure only that you assign what are, for you, the "correct" switches. (In the helicopter program, for example, you should also take care to ensure you do not use this menu to re-assign any auto-rotation switch already assigned on the »**Basic settings, model**« menu.)

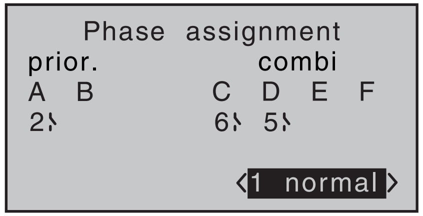
Example: 4 flight phases with phase priority

```
   Phase assignment
prior.           combi
A  B          C [D]  E  F
2             6  5

           <1  normal >
```

Assigning flight phases to switch positions

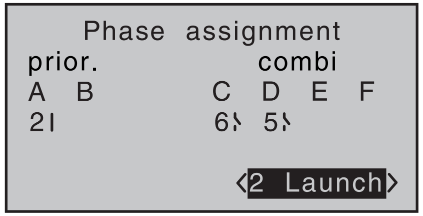
Now that names have been assigned to the flight phases (1 … max. 6) in the »**Phase settings**« menu and also programmed switches in this menu, but … at the bottom right of the display screen, you only see <1 Normal > – regardless of the positions the switches are in!?

Use the selection keys on the left or right four-way button to move the marker frame down and to the right and then briefly tap the centre **SET** key of the right four-way button:



Now close one (or more, as required) of the switches that you have assigned, and assign one of the flight phase names from the list you selected beforehand on the »**Phase settings**« menu to this switch position or combination.

Here, for example, we assign the "Launch" phase to the closed ("I") priority switch "A" …



… if, for example, we wish to switch to this phase regardless of the "C" … "F" switch positions, because the same switch activates an electric motor, etc.

Use the same approach to set the other switches or combinations of switches.

Theoretically – for the situation where all three are closed – you could use the three single switches shown in the example to define an additional fifth flight phase on the »**Phase settings**« menu. However, since this example assumes just four flight phases, you can leave the default phase name as «1 Normal» for this switch position.

Leave this menu in the familiar way, with a tap on the centre **ESC** key of the left four-way button.

Tips:

- *If you have named more phases than you currently have switches defined for then this is not really problematic. You can repeat and change your switch assignment as you wish at any point in time. And you can also name additional phases at any time and then assign switches to them.*
- *When assigning switches, check whether the switches are already otherwise assigned to ensure that you avoid duplicate assignments.*

Important notice:

Before a phase switch is assigned, the model settings configured are now to be found in the flight phase «1 Normal», i.e. all flight phase-dependent menus are reset to the standard configurations for all other flight phases.

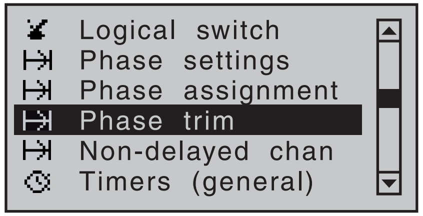
To avoid having to start from scratch in every flight phase, you can copy over these standard settings by using the command "Copy flight phase" on the "Copy / Erase" menu to replace them with flight data obtained from the «Normal» flight phase. You then need only to make further flight phase-specific changes to the settings.

Phase trim

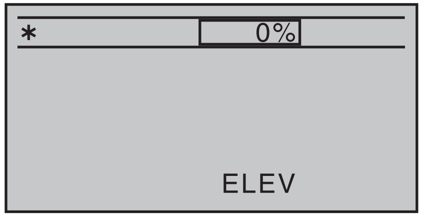
Flap settings specific to flight phases

This option is available on both transmitter types.

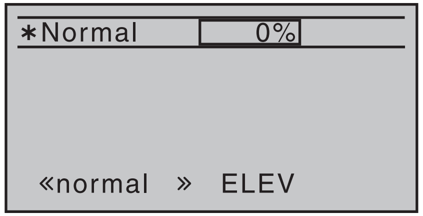
Use the selection keys of the left or right four-way button to scroll to the »**Phase trim**« menu option in the Multi-function menu:



Open this menu option with a tap on the centre **SET** key of the right four-way button.

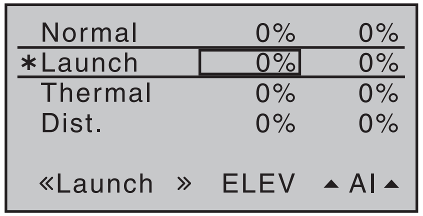


Depending on the settings made on the "Aileron/camber flaps" line of the »**Model type**« menu, page 98, and in the »**Phase settings**« menu, page 148, this menu offers at least one control function for ELEV …



… on the standard eight-channel MC-16 HoTT transmitter up to three control functions (ELE, AIL and FLAP) for flight phase specific trim settings.

On the twelve-channel MC-20 HoTT transmitter, up to five control functions (ELE, AIL, AIL2, FLAP and FLAP2) for flight phase specific trim settings. The setting of the flight phase switches, to be defined beforehand in the »**Phase assignment**« menu, determines the line that is chosen. An asterisk marks the flight phase currently active. At the same time, the name of the respective flight phase is also shown at the bottom left of the screen. You can enter settings only for the currently active flight phase, e. g.:



Column **"ELEV"**

Settings in this column have a direct effect and accordingly on the trim indicator of the elevator trim in the basic display. In return, the elevator trim controls acts, if necessary depending on the setting "global / phase" in the line "ELEV" of the MC-20 HoTT available only at the transmitter menus »Stick mode" (page 108), to the values of this column "Global" or "phase" specific.

Column **"AI"** and **"FL"**

... on the MC-16 HoTT transmitter

Spalten "**▲AI▲**", "**▲AI2▲**", "**FL**", "**FL2**"…

… on the MC-20 HoTT transmitter:

The values in these columns (max. 4) are identical to those in the "Fl.pos" (flap position) line on the "Multi-flap menu" within the »**Wing mixers**« menu, see page 177.

For this reason, any changes made always affect the other menu directly – and vice versa. After selecting the appropriate column with the selection keys of the left or right four-way button and a brief tap on the centre **SET** key of the right four-way button, these values can be entered, independent of one another, with the selection keys within a range of ±150 %.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset a changed value in the currently active value field back to 0 %.

Important notice:

- *The possibly existing columns "**▲AI2▲**", "**FL**" and "**FL2**" can be reached by change with the selection keys ◄► of the left or right four-way button on the right margin and according to head back.*
- *Settings made in this column have an immediate effect on elevator trim and, accordingly, the trim setting display.*
- *Please note in this context that the "**▲AI▲**", "**▲AI2▲**", "**FL**" and "**FL2**" trims are defined by default as "flight phase specific" on the MC-16 HoTT transmitter. However, this standard setting can be changed to "global" using the optional »**Stick mode**« menu, page 108.*
- *Please note in this context that the "elevator", "aileron" and "rudder" trims are defined by default as "flight phase specific" on the MC-20 HoTT transmitter. However, this standard setting can be changed to "global" using the »**Stick mode**« menu, page 108.*

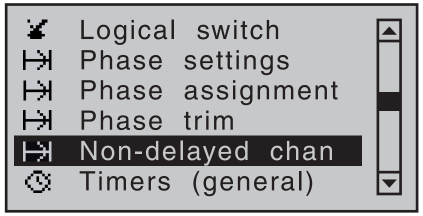
Non-delayed channel

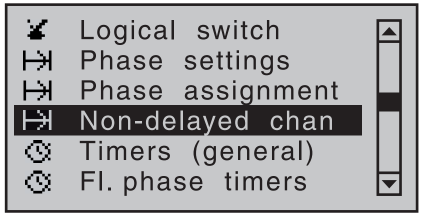
Channel-dependent delays to switching

mc
16 ☐ 20 ☑

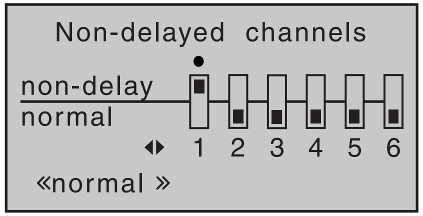
This option is available on the mc-20 HoTT transmitter only.

Use the selection keys of the left or right four-way button to scroll to the »**Non-delayed channel**« menu option in the Multi-function menu:





Open this menu option with a tap on the centre **SET** key of the right four-way button.



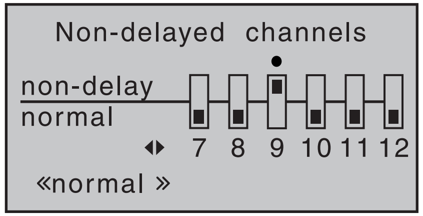
On the »**Phase settings**« menu, you will have set the necessary switch times for flight phase transitions.

In this menu, which is available as standard on the mc-20 HoTT transmitter only, you can now disable the transition delay set previously, per flight phase and for individual control channels – e. g. for the motor channel for electric models or heading-lock systems for helicopter gyros, etc.

Switch over to the corresponding flight phase. This is shown at the bottom left of the display.

Use the selection keys of the left or right four-way button to move the "●" onto the corresponding channel then briefly tap the centre **SET** key of the right four-way button.

The switch icon changes from "normal" to "non-delay" and vice versa:

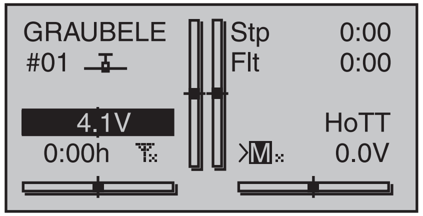


Timers (general)

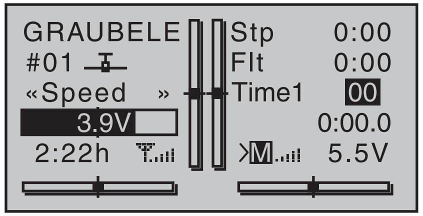
Timers on the basic display

mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

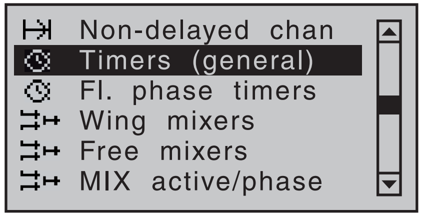
The default transmitter display shows a total of three timers. These are: the transmitter operating time on the left of the display, plus a “Top” and a “Centr” timer on the right of the display:

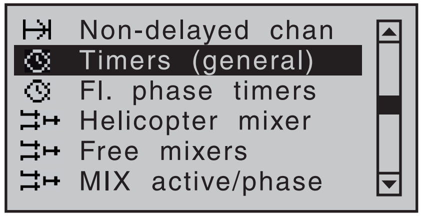


Another, flight-phase specific timer can also be configured with settings in the two menus »**Flight phase timers**«, page 162, and »**Phase settings**«, pages 148 and 152. This optional flight phase timer – such as the lap time timer – appears underneath the “Centr” (flight time) timer:

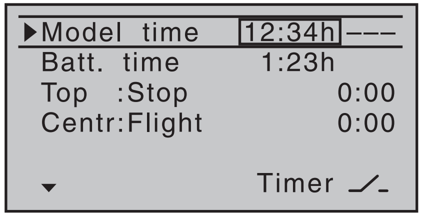


To configure the “Top” and/or “Centr” timer, use the selection keys on the left or right four-way button to access the menu option »**Timers (general)**« in the Multi-function menu:





Open this menu option with a tap on the centre **SET** key of the right four-way button:



“Model time”

This timer shows the currently registered total access time to the currently active model memory location. If necessary, this automatic time acquisition can also be influenced by assigning an on/off switch to this “Model time” timer in the rightmost column labelled with the switch symbol. This timer can then be switched on and off as desired. This switch is assigned (and erased again as required) as described in the section “Physical control, switch and control switch assignments“ on page 60.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset the time back to “0:00 h”.

“Batt. time”

This operating hours timer records the transmitter’s total switch-on time since the last time the battery was charged, thus monitoring the transmitter battery. A switch cannot be assigned to this function.

This timer is automatically reset to “0:00 h” when the transmitter detects that the voltage of the battery is significantly higher than the last time it was switched on, e. g. as a result of a charge process or the installation of a replacement battery.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will also reset this time back to “0:00 h”.

“Top” and “Centr”

These two timers are located at the top right of the basic display (see the screen image immediately to the left) and can be assigned a different name; their function and mode of operation varies according to the name you give them. Independently of the name each is given, the “Top” and “Centr” timer can be programmed to run any length of time forwards or backwards – see further below.

Use the selection keys of the left or right four-way button to select your desired timer and complete your selection with another tap on the centre **SET** key of the right four-way button:

“Stop (watch)” or “Motor(runtime)”

Both of these two timer variants can be started and stopped using any of the available switches.

The timer defined as “Stopwatch” or “Motor runtime” sums the “ON” times continually, so that once your aircraft has landed, you can read off the sum of all switch “ON” times since the timer was last reset.

"Flight(time)**"**

This timer is especially for measuring flight time: it can be started with an assigned switch and stopped (once the switch has been re-opened) on the basic display with a tap on the centre **ESC** key of the left four-way button. Once in a stopped state, it can be reset to its starting value with a simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button at the same time (**CLEAR**).

If you wish to assign a control switch, you must first define the switch on the »**Control switch**« menu and specify the switching point along the travel of the transmitter control. As an example, the timer can then be started by "opening the throttle" or by opening the throttle limiter for helicopter models.

CAUTION:

Any claims can only be considered in the presence of a log file, see page 7. Use therefore in your own interest, the option of running in parallel to the flight timer storage of telemetry data on the SD card inserted into the card slot of the transmitter. Keep in mind, however, that for technical reasons during playback of MP3 files NO data recording is possible.

<u>Note:</u>

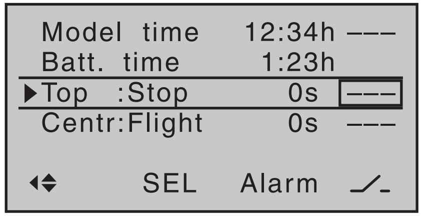
The combination of the flight time timer and stopwatch means that you can glance at the display at any time and see how long you have been flying since the timers were started, plus the total motor runtime within this particular period of flight time.

"Frame (time)**"**

The time frame timer is intended primarily for use by competition pilots, who are frequently given a time-frame within which they must complete certain tasks. The timer is started in precisely the same way as the flight time timer. To stop the timer, first ensure the timer switch is at its OFF position. Then touch and hold the ▲▼ or ◄ ► selection keys then touch the centre **ESC** key.

Switch assignment

Use the ► selection key of the left or right four-way button to move the marker frame next to the triangle as shown in the screen image shown below to the right-most column of the relevant line:

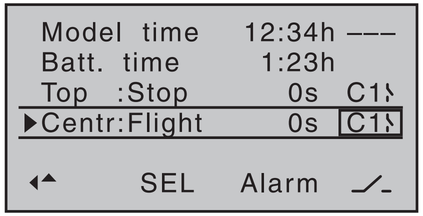


Here, you assign a switch as described in the section "Physical control, switch and control switch assignments" on page 60.

<u>*Typical application:*</u>

The "stop watch" and "flight timer" are both to be started simultaneously using the C1 stick as soon as a user-defined switching point is exceeded.

*For this purpose, define a control switch, e.g. "C1", in the »**Control switch**« menu, page 141. To complete the procedure, you select this from the expanded switches (see the section "Physical control, switch and control switch assignments" on page 60) and assign it to both these lines:*



*The stopwatch will now stop when the stick is below the switching point and resume running above the switching point. The same is not true for the flight time timer, however, which also starts the first time the switching point is exceeded. It can be stopped (with a tap on the centre **ESC** key of the left four-way button) only once the stopwatch is stopped; it can then be reset to its starting value with a simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**).*

Switchover between "forward" and "backward"

Timer runs forwards (stopwatch function)

Following switch assignment, if the stopwatch shown on the basic display is started with the initial value of "0:00", then it will run forwards for max. 179 min and 59 s and then restart from 0:00.

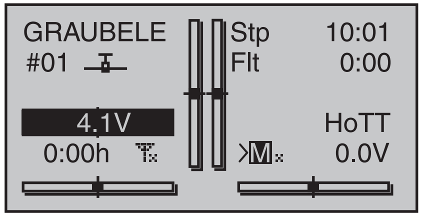
Timer runs backwards (countdown function)

In the – left – minutes field, select a start time between 0 and 179min …

… and in the – right – seconds field, select a start time between 0 and 59 s (or any combination of these):

Procedure

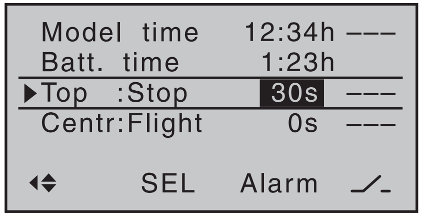
1. Select the desired input field with the ◀ ▶ selection keys of the left or right four-way button.
2. Now tap on **SET** in the centre of the right touch pad.
3. Make a time selection in the inverse video minutes or seconds field with the selection keys of the right four-way button.
4. Complete the entry with a tap on the centre **ESC** key or the centre **SET** key of the left four-way button.
5. A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset any setting made back to “0” or “00”.
6. Following a switch back to the basic display (by tapping the centre **ESC** key of the left four-way button as many times as required), make sure the stopwatch is stopped then simultaneously tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) to switchover the stopwatch to the “timer” function. Look at the top right in the following figure.



After the assigned switch is activated, the stopwatch starts at the initial value set and runs *backward* (“countdown clock function”). Once the timer reaches zero it does not stop, but continues to run to enable you to read off the time elapsed after it reached 0:00. To make this absolutely clear, the timer is shown highlighted.

“Alarm” timer

The “Alarm” column is accessed by moving the marker frame to the right with the ▶ selection key of the left or right four-way button until it is over the column labelled “Alarm”. In the “Alarm” column a time between 5 and 90 seconds (in 5-second increments) can be defined. This is the amount of time the timer is to count down before issuing an acoustic signal. This eliminates the need to repeatedly check the display continually during the flight, for example:



A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset any settings made back to “0 s”.

Audible signal sequence

30 s before zero:	Triple beep
	Single beep every two seconds
20 s before zero:	Double beep
	Single beep every two seconds
10 s before zero:	Single beep
	Single beep every second
5 s before zero:	every second a single beep at a higher frequency
zero:	longer beep signal and changeover of display presentation to inverse video

Resetting *suspended* timers

In the case of timers which were previously halted, they are reset to the programmed Start value in the base display by simultaneously pressing the ▲▼ or ◀ ▶ buttons of the right-hand four-way button (**CLEAR**).

Notes:

- *Timers that are running backwards are shown on the basic display with a flashing colon (:) between the minutes and the seconds fields.*
- *A typical application, “Timer activation via the C1 stick”, can be found on page 296.*
- *Remember that the timer switches also remain active during programming.*
- *An interim timer function change becomes active after timer/s have been suspended and subsequently reset by a simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**). Similarly, an in between modified clock function is enabled by stopping the clock (s) in the basic display and reset by simultaneously pressing the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**).*

Fl. phase timers

Selecting and setting

mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

A description of how timers are assigned to a flight phase has already been provided in the text for the »**Phase settings**« menu, page 148 and 152. The same section has also described the properties of "Time1" and "Time2". This section now proceeds to describe "Timer 1, 2 and 3" and the "lap counter/time table" timer variants.

The additional, flight phase-specific timer selected is displayed on the basic display underneath the "centre" timer, as shown below:

```
GRAUBELE      Stp    0:00
#01           Flt    0:00
«Speed  »     Clk1   0:00
   3.9V              HoTT
 2:22h        M      5.5V
```

Use the selection keys of the left or right four-way button to scroll to the »**Fl. phase timer**« menu option in the Multi-function menu:

```
Non-delayed chan
Timers (general)
Fl. phase timers
Wing mixers
Free mixers
MIX active/phase
```

```
Non-delayed chan
Timers (general)
Fl. phase timers
Helicopter mixer
Free mixers
MIX active/phase
```

On this menu you can now program "Clks 1 … 3" as stopwatches (i. e. timers that run forward) or as countdown/alarm timers (i. e. timers that run backwards). You can assign any switch to these timers, and the same is true of the "lap counter/timetable" timer:

```
►Timer1          0:00   0s ---
 Timer2          0:00   0s ---
 Timer3          0:00   0s ---
 Lap time/Tim tab          ---
 Lap Display               ---
▼                 SEL  SEL
```

The flight phase timers "Timer 1 … 3" and the "Time1"/"Time2" timers (described in the »**Phase settings**« section, pp. 148 and 152) run only in the flight phase to which they have been assigned. They are also shown as appropriate on the basic display. During other flight phases they are stopped (and hidden) and the assigned stop/start switch then has no effect.

The lap counter, once started, continues to run through changes of phase (as discussed further below), however, although it can be stopped during any flight phase via the centre **ESC** key of the left four-way button.

Clks 1, 2 and 3

These timers are started and stopped via a switch or control switch. To do so, first use the selection keys to select the appropriate column via the switch icon at the bottom right. Then set the switch that you want by briefly tapping the centre **SET** key of the right four-way button, as described in the section "Physical control, switch and control switch assignments" on page 60. Here, too, a control switch offers you the option of activating the timer via one of the sticks or proportional controls. The switching point along the transmitter control travel is set on the »**Control switch**« menu, page 141.

Remember that the timer switches also remain active in programming mode.

Switching between "forwards" and "backwards"

Stopwatch mode (timer runs forwards)

In this mode, the timer starts at the initial value "0:00" (min:sec) when you operate the assigned switch. If it reaches the maximum time of 179 min. and 59 s, it will re-start at "0:00".

"Countdown" (timer runs backwards)

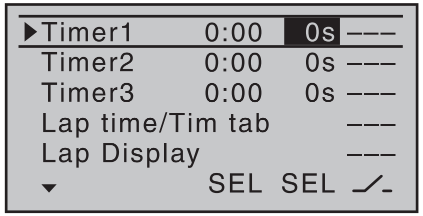
Following the activation of the corresponding value fields (by tapping the centre **SET** key of the right four-way button), if a time in minutes (maximum 179 min) and/or a time in seconds (maximum 59 s, right field) is set, then the timers will run backwards from this initial value following the activation of the assigned switch (see section "Physical control, switch and control switch assignments" on page 60), i. e. a "count-down" function will apply. Once the timer reaches zero it does not stop, however, but continues to run (highlighted) so you can read off the time elapsed after reaching zero.

Note:

Timers that are running backwards are shown on the basic display with a flashing colon (:) between the minutes and the seconds fields.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset entry values in the currently active field back to zero.

"Alarm" timer



The input field in the "Alarm" column is activated with a tap on the centre **SET** key of the right four-way button. In this field, use the selection keys on the left or right four-way button to define a time between 5 and 90 seconds (in 5-second increments) before zero is reached: at this point an audible signal will be emitted, which eliminates the need for you to check the screen continually during the flight.

Audible signal sequence

30 s before zero:	Triple beep Single beep every two seconds
20 s before zero:	Double beep Single beep every two seconds
10 s before zero:	Single beep Single beep every second
5 s before zero:	every second a single beep at a higher frequency
zero:	longer beep signal and changeover of display presentation to inverse video

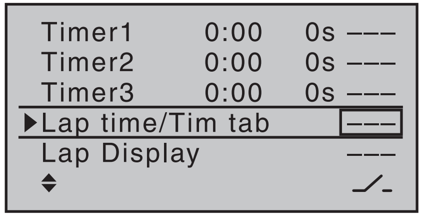
A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset entry values entered in the currently active field to "0 s".

<u>*Note:*</u>

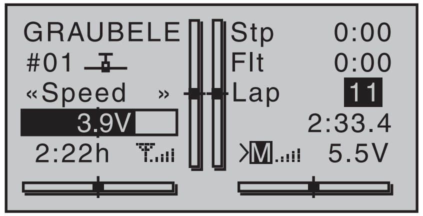
*If timer functionality has been changed at any point, then the new changes to settings are made active only after the timer(s) have been stopped on the basic display then making a simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) to reset them.*

Like the two standard timers positioned above it, this third, phase-specific timer is reset to its starting value with a simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**). It is stopped in all flight phases at the same time, even if it has not been stopped separately in the other flight phases.

Lap counter/timetable



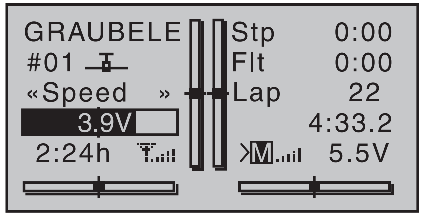
On the "Lap time/tim tab" line, assign a switch only as described in the section "Physical control, switch and control switch assignments" on page 60. Preferably, make use of a momentary switch, which are included as standard equipment only in the switch panels of the mc-20 HoTT transmitters. The lap count is incremented each time by one lap while simultaneously (and automatically) the lap time elapsed during this lap is stopped (and recorded). This momentary switch simultaneously starts the stopwatch for the next lap. As the timer is triggered, the lap or switch impulse counter is shown highlighted:



"Time1" and "Time2" operate in the same manner; for more details please read the section on the »**Phase settings**« menu option on page 148 or 152.

Up to 99 lap times can be recorded and accessed, each with a maximum duration of 99 minutes and 59.9 seconds.

To stop the timer in question, tap the centre **ESC** key of the left four-way button on the basic display after the flight is over. The lap or switch impulse counter is now shown in "normal" mode:



A simultaneously tap on the ▲▼ or ◀ ▶ keys of the right four-way button at the same time (**CLEAR**) will reset the counter to "00" **and deletes the stored times**. However, the timers *must* have been stopped before this.

<u>*Notes:*</u>

- *If you have selected a normal switch to operate the lap counter, take care to ensure that this switch is set to "OFF" before touching the centre **ESC** key of the left four-way button.*
- *If you should forget to switch off the lap counter in a phase which is now not currently active, simply touch the centre **ESC** key of the left four-way button.*

To swap between the basic display and the "Lap Display" …

01	01:23.4	07	00:00.0
02	02:34.5	08	00:00.0
03	03:45.6	09	00:00.0
04	04:56.7	10	00:00.0
05	05:67.8	11	00:00.0
06	06:78.9	12	00:00.0

… go to the line …

Lap display

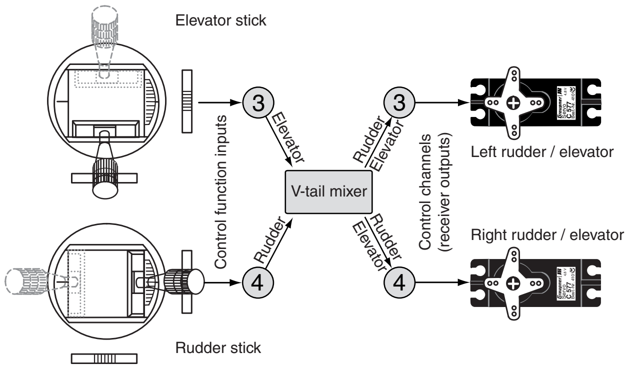
Timer1	0:00	0s	---
Timer2	0:00	0s	---
Timer3	0:00	0s	---
Lap time/Tim tab			---
▶Lap Display			---

… and use the switch assigned. You assign this switch as described in the section “Physical control, switch and control switch assignments” on page 60.

What is a mixer?
Basic functionality

With many models, a mix of the model's functions is often desirable, i. e. coupling aileron to rudder or coupling two servos together, in cases where rudder control surfaces with the same functionality are to be controlled together using a single servo. In all cases, the signal flow at the "output" of the control function on the transmitter control-side "branches" – , this also means: "downstream" of transmitter control options such as e. g. »**Dual Rate / Expo**«, »**Control adjust**«, »**Channel 1 curve**« etc. – in order for the signal to have its predefined effect on the "input" of another control channel and thus on another receiver output.

Example: V-tail mixer



The mc-16 HoTT and mc-20 HoTT transmitter software contains a large number of pre-programmed coupling functions as standard, which are designed to mix together two (or more) control channels. Accordingly, the mixer named in the example just above can be activated in the "Tail type" line of the »**Model type**« menu by selecting "V-tail", see page 99.

In addition, for each model memory in the fixed-wing and helicopter programs, the software makes available a total of eight freely programmable linear mixers, four freely programmable curve mixers and four dual mixers; these are available as standard on the mc-20 HoTT only.

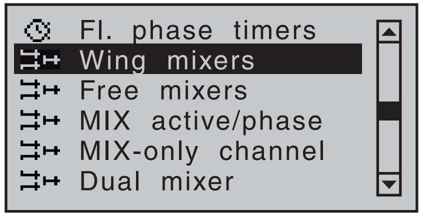
Also be sure to read the general remarks about "free mixers" in this manual, beginning on page 200.

Calibrating the wing flap system

mc 16 20 ☑ ☑

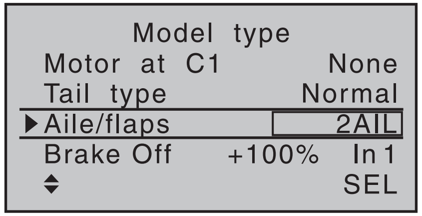
This option is available on both transmitter types.

Within the menu tree of the menu »**Wing mixers**« the sub-menus and options available depend entirely on the number of aileron and flap servos set up on the »**Model type**« menu, page 98 …

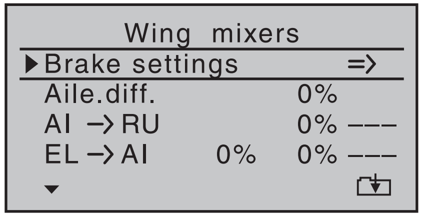


… which means that the only settings listed are the ones that can actually be configured. The resulting menu structure gains not only in clarity but also prevents potential programming errors.

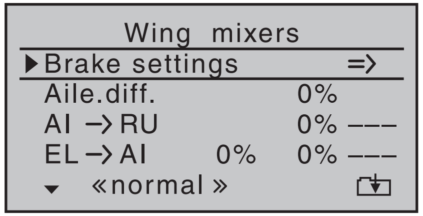
For example, if "2AIL" has been preset, display of the »**Wing mixers**« menu would appear (without camber flaps)



as shown below:



If various flight phases are envisioned in the settings of the »**Phase settings**«, page 148, and »**Phase assignment**«, page 154, menus, and these flight phases have been given names, the flight phase names will appear along the bottom display edge, e. g. «Normal»:



All options can then also be programmed specific to a flight phase.

<u>*Notices and comments:*</u>

- *In the »**Model type**« menu, see page 98, the airbrake mixer control can be re-programmed from control input 1 to 7 or 8 on the standard eight-channel mc-16 HoTT transmitter, and from 1 to 7, 8 or 9 on twelve-channel mc-20 HoTT transmitter. In both variants it is also possible to define the associated Offset point.*
- *Braking with raised ailerons and, if present, lowered flaps (crow system) can be implemented by making appropriate settings on the "Crow" line of the "Brake settings" sub-menu.*
- *If you would like to alternate between the C1 stick controlling an electric drive system and a butterfly system, then you can use the options in the "Motor" column on the »**Phase settings**« menu – see page 148 or refer to the example on page 292.*
- *You can also use the opportunity to set switch times for a "soft" transition from flight phase to flight phase on the »**Phase settings**« menu, see page 148.*
- *If your model features multiple wing flaps and a "crow / butterfly system" (see below), but without additional airbrakes, then you can separate output 1 (usually freed up by the above system) from control function input 1 (throttle/brake stick) on the »**Mix-only channel**« menu, which is available as standard on the mc-20 HoTT transmitter only, see page 212, and use it for another purpose with the help of a "free mixer", see page 201.*
- *If "2AIL" is set in the »**Model type**« menu, page 98, then flight-phase dependent flap functionality can be achieved with appropriate offset settings for input 5 in the »**Control adjust**« menu, page 156, or alternatively can be achieved by setting appropriate values in the "Offset" column for Input 5 in the »**Control adjust**« menu, see page 112. However, in the interests of clarity you should always make use of only one of the two facilities.*
- *For almost any menu option, you have the option of checking your settings by switching to the servo display screen, which is accessed with a simultaneous tap on the ◄ ► selection keys of the left four-way button.*
  Caution:
  *With aileron actuation the bars of the »**Servo display**« move in the same manner and in the opposite manner with camber changing flap actuation.*

- *Note that if two flap servos have been selected, any transmitter control assigned to input 7 will be decoupled in the software in order to avoid errors in operating the flaps. The same applies to input 10 if you select "2/4AIL 4FL" on the twelve-channel* **mc-20** *HoTT transmitter only.*
- *A range of options are available for positioning flaps. You can …*
  - a) *… simply accept one position per flight phase, by setting only the corresponding trim values.*
  - b) *… vary the flaps positioned by a) with a transmitter control assigned to "Input 6" in the »**Control adjust**« menu, page 112, and if desired by also selecting flight-phase dependency "PH" in the "Type" column.*

    *The selected transmitter control directly controls the two flap servos located on receiver outputs 6 and 7 and, as required, also the two FL2 servos connected to outputs 9 and 10 – assuming that corresponding flaps have been specified on the "Aileron/camber flaps" line in the »**Model type**« menu. This transmitter control indirectly controls the flap position of the ailerons via the percentage value entered in the "AILE" (and "AIL2") column on the "FLAP" line of the multi-flap menu.*

    The two INC/DEC buttons, CTL 5 or 6, are virtually ideal for this type of task, since their position is automatically stored. These buttons are fitted on the **mc-20** *HoTT transmitter only. The particular advantage of these two transmitter controls – especially if you select the "PH" setting – lies in the fact that you can use one and the same INC/DEC button as flap trim controls in all the programmed flight phases, but – in contrast to a position-related proportional control – the trim values are retained even if you switch models.*

    *However, in order to improve control sensitivity for flap settings, travel should be reduced to about 25 % in "Input 6" line of the »**Control adjust**« menu.*
  - c) *… alternatively, you can also leave the default entry of "0 %" in the "AILE" (and "AIL2") column on the "FLAP" line of the multi-flap menu, and use the »**Control adjust**« menu to assign both input 6 and input 5 to the* same *transmitter control. You can then set the degree to which both flap pairs are affected, optionally making this flight phase-dependent by selecting "PH" in the "Type" column, with the respective travel adjustment.*

Basic programming procedure

1. Select the desired line with the ▲▼ selection keys of the left or right four-way button.

   Depending on the line selected, the bottom line of the display will either show the "Next page" (⍗) icon or a switch icon.
2. Depending on the line selected, you will either switch to the next page – on which you carry out the same procedure as below – or the desired value field is activated by tapping the centre **SET** key of the right four-way button.
3. Use the selection keys to set the mixer ratio or degree of differential.

   To configure symmetrical mixer values, move the transmitter control or stick to its centre position, so that the marker frame surrounds both value fields. To configure asymmetric values, move the transmitter control/stick to the corresponding side.

   Negative and positive parameter values are possible, in order to be able to adjust the respective function to the direction of servo rotation or flap orientation.
4. A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset the entry value in the given active (inverse video) field back to its default value.
5. Complete the entry with a tap on the centre **ESC** key of the left four-way button or the centre **SET** key of the right four-way button.

Assigning switches

Wing mixers "AI ➔ RU" and "FL ➔ EL" can be made optionally on/off switchable by way of a switch or expanded switch. Accordingly, when the respective line is selected, the familiar switch symbol (⟋) will appear on the lower edge of the screen.

A switch can be assigned as described in the section entitled "Physical control, switch and control switch assignments" on page 60.

Switching delays

The delay time or switch time configured on the »**Phase settings**« menu, page 148, for the respective flight phase also affects all wing mixers and thus avoids abrupt changes to flap configurations when switching between the flight phases.

Mixer neutral points (Offset)

For all mixers on the "Brake settings" sub-menu, the "brake offset" to be set on the »**Model type**« menu is to be configured to the transmitter control position at which the airbrakes are retracted.

For this reason you should define which of the inputs 1, 7 or 8 you wish to use as the brake control, and enter the appropriate offset, in the "Brake offset" line of the »**Model type**« menu on the standard eight-channel **mc-16** HoTT transmitter, corresponding to your personal preference; see page 100. The same procedure is used with the twelve-channel **mc-20** HoTT transmitter, with the exception that Input 9 is also available as an alternative. When selecting "input 1", please note also that you may need to specify your desired "Throttle min" position "forward/back" before establishing the offset point in the "Motor at C1" line.

Note:

If the offset is not set right at the end of the transmitter travel, the rest of the travel is a "dead zone", i. e. the transmitter control does not influence any mixers on the "Brake settings" sub-menu. Otherwise, the mixer travel is expanded back to 100 % automatically.

All other mixers in the »**Wing mixers**« menu have their neutral point with the control at its centre, i. e. they have no effect at this control position. The value set is mixed in at full travel.

Mixer functions

The individual options in the »**Wing mixers**« menu are discussed below, separately for single-, dual- and multi-flap models. Before we start, a number of remarks on the differentials for ailerons and flaps:

Aile. diff. or Diff. (Aileron-Differential)

```
     Wing  mixers
 Brake settings       =>
►Aile.diff.         0%
 AI  -> RU          0% ---
 EL -> AI     0%    0% ---
 ▼  «normal»
```

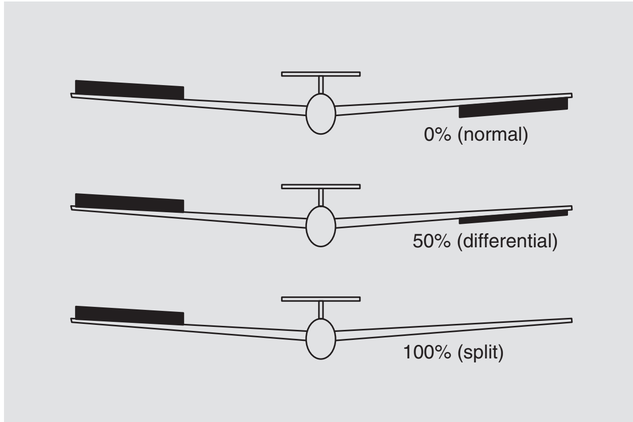
```
   ▲ AI ▼          +100%
 Ail-tr            +100%
►Diff.                0%
 fl.pos               0%
«normal»
 ⇕►                 AILE
```

Note:

The upper display corresponds to the choice of "2AIL" in the line "Aileron. / Flaps" of the "**Model type**" menu and the bottom of a choice of "2/4 AIL 1/2/4 FL".

For aerodynamic reasons, the drag generated on an aileron oriented downwards is greater than that generated by the same aileron when it is oriented upwards by the same amount. One effect of this unequal distribution of drag produces is a yawing motion around the vertical axis and, accordingly, a "turning away" from the intended direction of flight, which is why this undesirable side effect is also termed "adverse yaw". This effect is naturally greater on the comparably long aerofoils possessed by model gliders, compared to e. g. powered aircraft models, which generally have relatively short moment arms. For the former, it must normally be compensated for by making a simultaneous rudder deflection in the opposite direction. However, this rudder deflection also generates drag and therefore further degrades flight characteristics.

If, on the other hand, a differential is applied to the aileron orientations, by giving the aileron oriented downwards a smaller deflection than the aileron oriented upwards, the (undesirable) adverse yaw can be reduced – and possibly entirely negated. However, the basic precondition for this is that each aileron must have its own servo present, which can therefore also be embedded straight into the aerofoils. In addition, the shorter linkage paths produce an additional benefit: reproducible aileron configurations that also exhibit less "play".



Unlike mechanical solutions, which not only commonly need to be designed and built in when constructing the model but also produce a slightly increased "play" in the control system for strong differentials, the transmitter-based differential typically used today offers considerable benefits.

The degree of differential can be changed at any time, for example, and, in extreme circumstances, the downward deflection of an aileron, in what is termed a "split" position, can be suppressed entirely. This approach not only reduces or even suppresses "adverse yaw", but can, in certain circumstances, even generate a positive yaw: in such cases, an aileron command will generate a yaw about the vertical axis in the direction of the turn.

For large glider models in particular, this approach lets such aircraft fly "clean" turns using just the ailerons, which is not otherwise possible unaided.

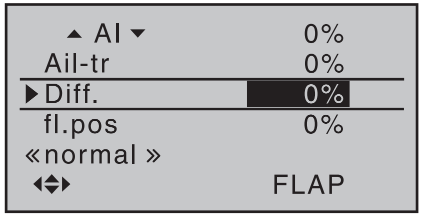
The adjustment range of -100 % to +100 % makes it possible to set a differential appropriate for each side, regardless of the direction of rotation of the aileron servos. While "0 %" corresponds to a normal linkage, i. e. no differential, "-100 %" or "+100 %" represents the "split" function.

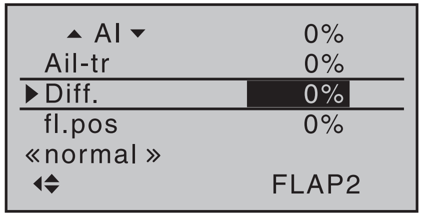
For aerobatic flying, low absolute values are required to ensure the model rotates exactly along its longitudinal axis when an aileron command is given. Values near to the centre (-50 % or +50 %) are typical for facilitating turns in thermals. The split setting (-100 %, +100 %) is popular with slope fliers, where ailerons alone are often used for turning the model.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset a changed value in a given active (inverse video) field back to 0 %.

Note:
Negative values are not usually necessary if channels are assigned properly.

Diff. (Flap differentiation)





The "▲AI▼" (topmost) line in the Multi-flap menu, description starting on page 177, can be used to set the extent to which the flaps act as ailerons and follow the aileron stick.; this value is entered as a percentage. The flaps differential – to be set on the line "Diff." (two lines below) – works in a similar way to the aileron differential, i. e. where an aileron command acts on the flaps, the respective deflection downwards can be reduced.

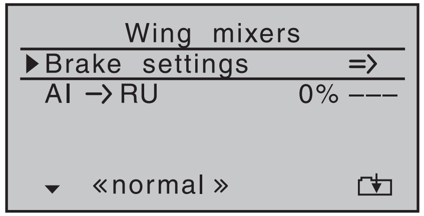
The adjustment range of -100 % to +100 % makes it possible to set a differential appropriate for each side, regardless of the direction of rotation of the servos. A value of 0 % is equal to normal linkage, i. e. the servo travel downwards is the same as the travel upwards. A value of -100 % to +100 % means that travel downwards will be reduced to zero for aileron commands affecting the flaps ("split" mode).

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset a changed value in a given active (inverse video) field back to 0 %.

Note:
Negative values are not usually necessary if channels are assigned properly.

Model type: "1AIL"

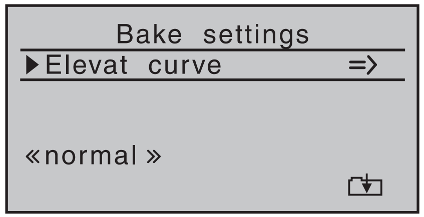
If you have entered "1AIL" for the "Aileron/camber flaps" line on the »**Model type**« menu, page 98, then the "Wing mixers menu" on your transmitter will match the following screen image:



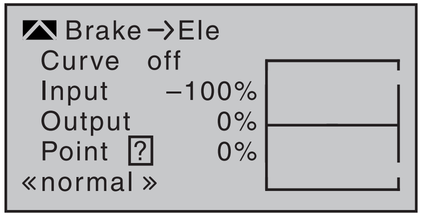
From the first line on this display screen, you can switch to the sub-menu with a brief tap on the centre **SET** key of the right four-way button …

Brake settings

Note:
*The "Brake settings" menu is switched "off" if: "Motor on C1 forward / back" in the »**Model type**« menu, page 98, AND the "Motor" column of the »**Phase settings**« menu, page 148, are set to "yes" for the currently active flight phase. Switch the flight phase if required:*



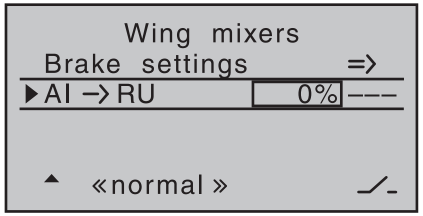
Since you cannot set up a butterfly or aileron differential in a model with only a single aileron servo, this menu offers no further configuration options with the exception of a "pointer" to the "Elevat curve" sub-menu. Therefore, move ahead from here with another tap on the centre **SET** key of the right four-way button:



If required, i. e. if you have the feeling that you will need to set pitch trim compensation when the airbrakes are extended, you can program an appropriate automatic mixer affecting the elevator at this point.

For detailed instructions on setting a curve mixer, please refer to the »**Channel 1 curve**« menu option text beginning page 134.

AI → RU (Aileron → Rudder)



Here, you can set the degree to which the rudder follows commands acting on ailerons. This is used in particular in connection with aileron differential to suppress adverse yaw and thus make it easier to fly “clean” curves. You can of course still issue separate commands to the rudder.

The adjustment range of ±150 % lets you set the direction of deflection as appropriate. Optionally, this mixer can be activated and deactivated with one of the switches that is not self-restoring or a control switch so the model can be controlled with only the ailerons or rudder if desired.

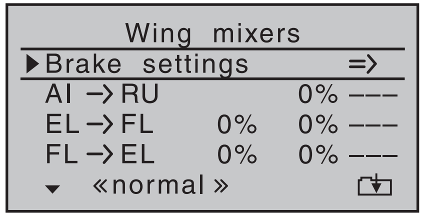
Typically, this mixer is set so that the rudder is deflected to the same side as the upward-oriented aileron, and you will find that setting a value of around 50 % is usually highly appropriate.

Settings are always made symmetrically relative to the neutral point of the aileron stick.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset a changed value in a given active (inverse video) field back to 0 %.

Model type: “1AIL 1FL”

If you have entered “1AIL 1FL” for the “Aileron/camber flaps” line on the »**Model type**« menu, page 98, then the “Wing mixers menu” on your transmitter will match the following screen image:

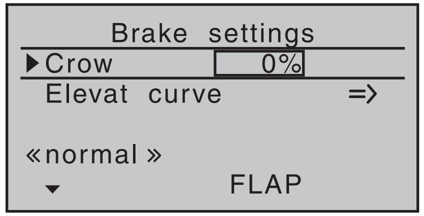


From the first line on this display screen, you can switch to the sub-menu with a brief tap on the centre **SET** key of the right four-way button …

Brake settings

Note:

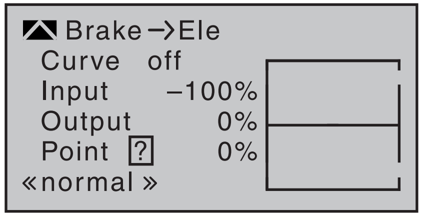
*The “Brake settings” menu is switched “off” if: “Motor on C1 forward / back” in the »**Model type**« menu, page 98, AND the “Motor” column of the »**Phase settings**« menu, page 148, are set to “yes” for the currently active flight phase. Switch the flight phase if required:*



Appropriate to the model type selected, you can now enter a suitable value in the “Crow” line to lower the flap when you activate the brake control – which is typically the C1 stick.

To configure the setting, first position the brake control in the brake position at full travel (i. e. its end-point). Then, briefly tap the centre **SET** key of the right four-way button and enter a suitable value using the selection keys on the left or right four-way button. To ensure a sufficiently strong braking effect, note that you should try to lower the flap as low as is mechanically possible.

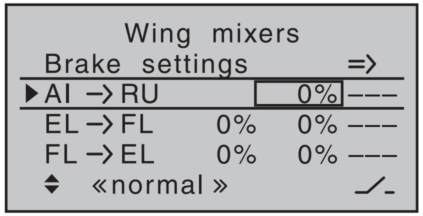
From the second line on this display screen, you can switch to the sub-menu “Elevat curve” by briefly tapping the centre **SET** key of the right four-way button:



If required, i. e. if you have the feeling that you will need to set pitch trim compensation when the flaps and/or airbrakes are extended, you can program an appropriate automatic mixer affecting the elevator at this point.

For detailed instructions on setting a curve mixer, please refer to the »**Channel 1 curve**« menu option text beginning page 134.

AI → RU (Aileron → Rudder)



Here, you can set the degree to which the rudder follows commands acting on ailerons. This is used in particular in connection with aileron differential to suppress adverse yaw and thus make it easier to fly “clean” curves. You can of course still issue separate commands to the rudder.

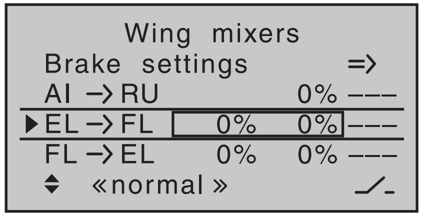
The adjustment range of ±150 % lets you set the direction of deflection as appropriate. Optionally, this mixer can be activated and deactivated with one of the switches that is not self-restoring or a control switch so the model can be controlled with only the ailerons or rudder if desired.

Typically, this mixer is set so that the rudder is deflected to the same side as the upward-oriented aileron, and you will find that setting a value of around 50 % is usually highly appropriate.

Settings are always made symmetrically relative to the neutral point of the aileron stick.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset a changed value in a given active (inverse video) field back to 0 %.

EL → FL (Elevator → Flap)



To provide support for the elevator for tight turns and aerobatics, this mixer can be used to make the flap function follow controls sent to the elevator. The mixer direction chosen must ensure that the flaps are deflected downwards when the elevator is oriented upwards and vice versa for a downward-oriented elevator – i. e. in opposite directions. This mixer can be made optionally on/off switchable with one of the switches that is not self-restoring or a control switch.

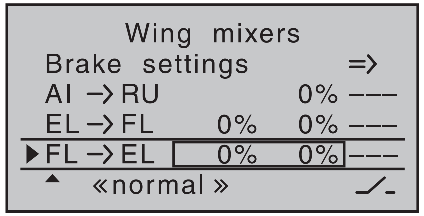
To configure symmetrical mixer values, move the elevator stick to its centre position, so that the marker frame surrounds both value fields. To configure asymmetric values, move the stick to the corresponding side.

Values in the range -150 % to +150 % are possible, so as to adjust the function to the direction of servo rotation or direction of flap deflection.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset a changed value in a given active (inverse video) field back to 0 %.

The “typical” values configured for this mixer are single-digit or low two-digit values.

FL → EL (Flaps → Elevator)



This mixer is used to set elevator (pitch-trim) compensation when a flap command is given. This typically enables you to adjust the model’s airspeed automatically when flaps are lowered.

If you have used the »**Control adjust**«, page 112, to assign Input 6 to a transmitter control or switch then this also affects this mixer.

To configure symmetrical mixer values, move the flap control to its centre position, so that the marker frame surrounds both value fields. To configure asymmetric values, move the stick to the corresponding side.

Values in the range -150 % to +150 % are possible, so as to adjust the function to the direction of servo rotation or direction of elevator movement.

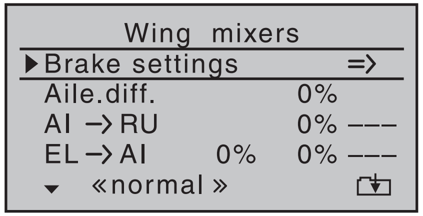
A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset a changed value in a given active (inverse video) field back to 0 %.

If required, the mixer can be switched on or off by assigning a switch in the right column.

The values configured for this mixer are typically in the single-digit range.

Model type: "2AIL"

If you have entered "2AIL" for the "Aileron/camber flaps" line on the »**Model type**« menu, page 98, then the "Wing mixers menu" on your transmitter will match the following screen image:

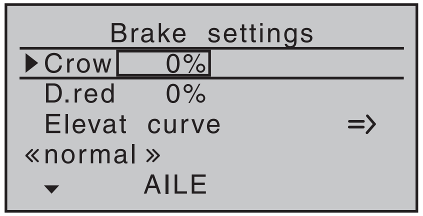


From the first line on this display screen, you can switch to the sub-menu with a brief tap on the centre **SET** key of the right four-way button…

Brake settings

Note:

*The "Brake settings" menu is switched "off" if: "Motor on C1 forward / back" in the »**Model type**« menu, page 98, AND the "Motor" column of the »**Phase settings**« menu, page 148, are set to "yes" for the currently active flight phase. Switch the flight phase if required:*



Depending on the model type selected, setting options will now be available in the "**Crow**" and "**D**(ifferential) **red(**uction**)**" lines for the column labelled "**AILE**". These options should be utilized by …

- … putting the transmitter control for "Brake" (refer to the »**Model type**« menu description on page 98) – typically the C1 stick – in its limit position in the brake direction. Switch to the "Crow" line, briefly tap on the centre **SET** key of the right four-way button and use the selection keys on the left or right four-way button to set a value that moves the aileron upwards as far as possible to brake the model or, if you are using airbrakes as the main braking system, the aileron should be set to elevate only minimally to provide an extra braking effect.

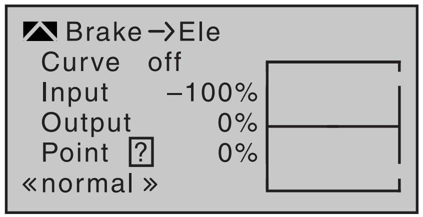
  Note:

  *To reliably prevent the servos mechanically striking their end-stops – which draws a heavy current – you can set an appropriate limit value in the column labelled "– limit +" in the »**Servo adjustment**« menu, page 106.*

- … then finally, moving to the "D.red" line, set a % value there which is greater than or equal to that value set (or to be set) in the "Aileron differential" line of the display screen "before" this one.

  In this way, you can suppress the aileron differential when braking, thus ensuring that you can count on sufficient aileron response despite your ailerons being deflected upwards.

From the lowest line, "Elevator curve", you can switch to setting the "Elevator curve" mixer by briefly tapping the centre **SET** key of the right four-way button:



If required, i. e. if you have the feeling that you will need to set pitch trim compensation when the flaps and/or airbrakes are extended, you can program an appropriate automatic mixer affecting the elevator at this point.

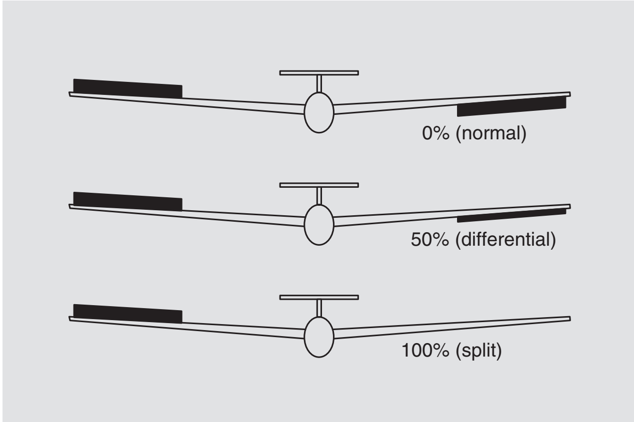
For detailed instructions on setting a curve mixer, please refer to the »**Channel 1 curve**« menu option text beginning page 134.

Aile.diff. (Aileron differentiation)

```
      Wing  mixers
  Brake  settings       =>
 ▶Aile.diff.          [0%]
  AI  -> RU            0% ---
  EL -> AI     0%      0% ---
 ⬍   «normal »
```

The adjustment range of ±100 % makes it possible to set the correct direction of differential, regardless of the direction of rotation of the aileron servos. While "0 %" corresponds to a normal linkage, i. e. no transmitter-side differential, "-100 %" or "+100 %" represents the "split" function.

For aerobatic flying, low absolute values are required to ensure the model rotates exactly along its longitudinal axis when an aileron command is given. Values near to the centre (-50 % or +50 %) are typical for facilitating turns in thermals. The split setting (-100 %, +100 %) is popular with slope fliers, where ailerons alone are often used for turning the model.



A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset a changed value in an active (inverse video) field back to 0 %.

Note:
Negative values are not usually necessary if channels are assigned properly.

AI → RU (Aileron → Rudder)

```
      Wing  mixers
  Brake  settings       =>
  Aile.diff.           0%
 ▶AI  -> RU           [0%] ---
  EL -> AI     0%      0% ---
 ⬍   «normal »
```

Here, you can set the degree to which the rudder follows commands acting on ailerons. This is used in particular in connection with aileron differential to suppress adverse yaw and thus make it easier to fly "clean" curves. You can of course still issue separate commands to the rudder.

The adjustment range of ±150 % lets you set the direction of deflection as appropriate. Optionally, this mixer can be activated and deactivated with one of the switches that is not self-restoring or a control switch so the model can be controlled with only the ailerons or rudder if desired.

Typically, this mixer is set so that the rudder is deflected to the same side as the upward-oriented aileron, and you will find that setting a value of around 50 % is usually highly appropriate.

Settings are always made symmetrically relative to the neutral point of the aileron stick.

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset a changed value in a given active (inverse video) field back to 0 %.

EL → AI (Elevator → Aileron)

```
      Wing  mixers
  Brake  settings       =>
  Aile.diff.           0%
  AI  -> RU            0% ---
 ▶EL -> AI    [0%      0%] ---
 ▲   «normal »
```

To provide support for the elevator for tight turns and aerobatics, this mixer can be used to make the aileron function follow controls sent to the elevator. The mixer direction chosen must ensure that the ailerons are deflected downwards when the elevator is oriented upwards and vice versa for a downward-oriented elevator – i. e. in opposite directions. This mixer can be made optionally on/off switchable with one of the switches that is not self-restoring or a control switch.

To configure symmetrical mixer values, move the elevator stick to its centre position, so that the marker frame surrounds both value fields. To configure asymmetric values, move the stick to the corresponding side.

Values in the range -150 % to +150 % are possible, so as to adjust the function to the direction of servo rotation or direction of aileron movement.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset a changed value in a given active (inverse video) field back to 0 %.

The “typical” values configured for this mixer are single-digit or low two-digit values.

Model type: “2/4AIL 1/2/4FL”

If you have entered “2AIL 1FL” for the “Aileron/camber flaps” line on the »**Model type**« menu, page 98, then the “Wing mixers menu” on your transmitter will match the following screen image:

```
        Wing  mixers
►Multi-flap  menu        =>
 Brake  settings         =>
 Aile.diff.           0%
 AI  -> RU            0% –––
 FL -> EL      0%     0% –––
 ▼   «normal »
```

However, if you have entered “2AIL 2FL” in the “Aileron/flap” line of the »**Model type**« menu, see page 98, of the standard eight-channel mc-16 HoTT transmitter, or “2/4AIL 2/4FL” on the twelve-channel mc-20 HoTT, then your transmitter’s “Wing mixer menu” should look like this:

```
        Wing  mixers
►Multi-flap  menu        =>
 Brake  settings         =>
 AI  -> RU            0% –––
 FL -> EL      0%     0% –––
 ▼   «normal »
```

Regardless of the combination of aileron and flap servos you choose, all of the parameters available can be adjusted separately for each flight phase.

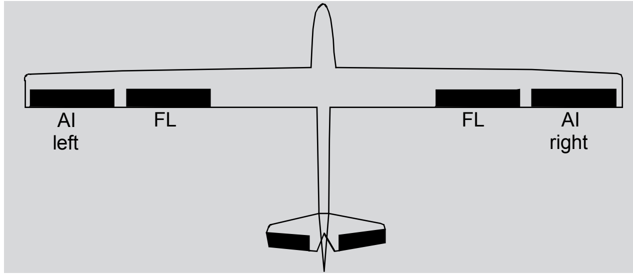
Note:

*For almost any menu option, you have the option of checking your settings by switching to the servo display screen, which is accessed with a simultaneous tap on the ◄ ► selection keys of the left four-way button. If you do, note however that the bars on the »**Servo display**« move in the same direction for ailerons and in the opposite direction for flaps.*

Before we address the details of this menu we would like to provide a brief explanation of the different display modes for the multi-flap menu:

Model type: “2 AIL 1 FL”

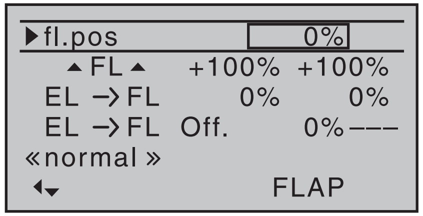
If servos have been connected to the receiver as described on page 65 and selected accordingly in the »**Model type**« menu, page 98, then the abbreviations “AILE” and “FLAP” refer to the following flaps:



Since the options available on the wing mixer menu and its sub-menus vary according to the number of aileron and flap servos specified on the »**Model type**« menu, page 98, the list contains only those set-up options available for the given model.

```
►fl.pos              0%
   ▲ FL ▲         0%       0%
 EL  -> FL        0%       0%
 EL  -> FL  Off.       0% –––
«normal »
 ▼►                  AILE
```

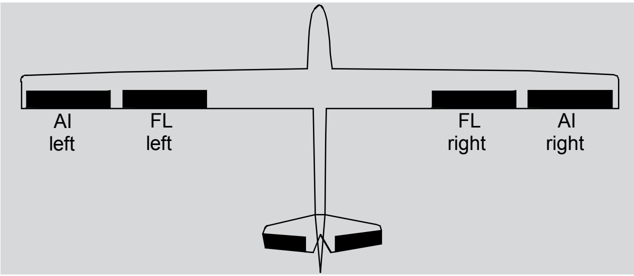
Therefore, with a preset to “2AIL 1FL”, the options for setting aileron functions to flaps will be suppressed, and it will only be possible to shift to the right by one column – to the “FL” column:



In addition, the settings for "Aile(ron) diff(erential)" are not found on the "multi-flap menu", as with "2AIL 2/4FL", but one level higher in the "Wing mixers" menu, see the screenshot on start of this section.

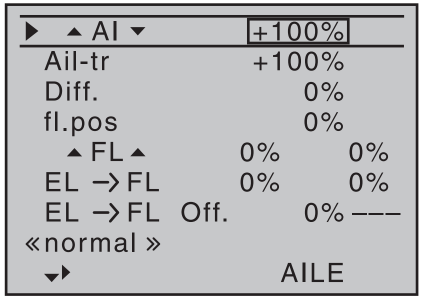
Model type: "2AIL 2FL"

If servos have been connected to the receiver as described on page 65 and selected accordingly in the »**Model type**« menu, page 98, then the abbreviations "AILE" and "FLAP" refer to the following flaps:

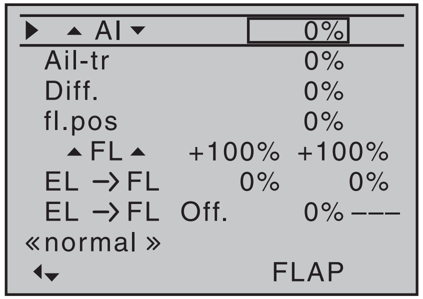


Since the options available on the wing mixer menu and its sub-menus vary according to the number of aileron and flap servos specified on the »**Model type**« menu, page 98, the list contains only those set-up options available for the given model.

This means that if values are preset to "2AIL 2FL", then all configuration options for the aileron pair …



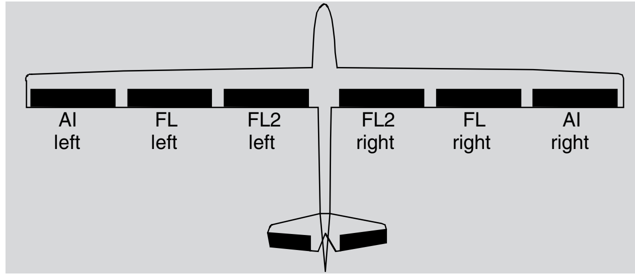
… are shown, and – one "step" to the right – all options for the flap pair as well:



Moving one further column to the right, however – to the "FLAP2" column – is not possible.

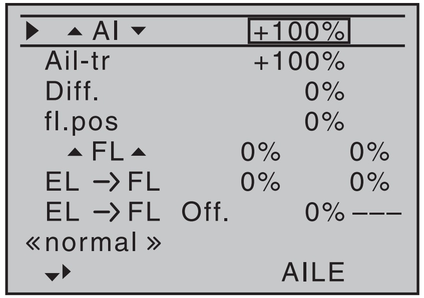
Model type: "2AIL 4FL"

If you have connected the servos to the receiver as described on page 65, and selected them for the appropriate tasks in the »**Model type**« menu, see page 98, of the twelve-channel mc-20 HoTT transmitter only, then the abbreviations "AIL", "FL" and "FL2" refer to the following control surfaces:

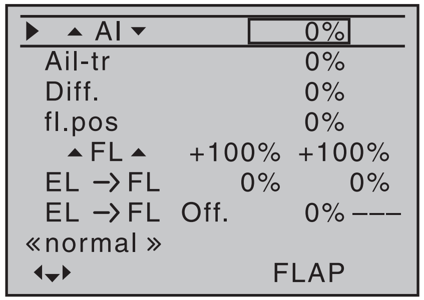


Since the options available on the wing mixer menu and its sub-menus vary according to the number of aileron and flap servos specified on the »**Model type**« menu, page 98, the list contains only those set-up options available for the given model.

This means that if values are preset to "2AIL 4FL", then all configuration options for the aileron pair …



… are shown, and – one "step" to the right – all options for the first flap pair …

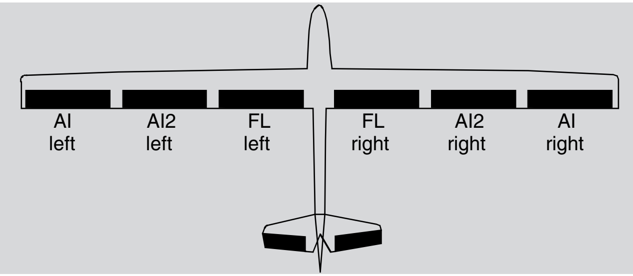


… are shown, and – one further "step" to the right – all options for the second flap pair as well:

```
▶  ▲ AI ▼              [  0%]
  Ail-tr                  0%
  Diff.                   0%
  fl.pos                  0%
   ▲FL▲        +100%  +100%
  EL  -> FL       0%      0%
  EL  -> FL  Off.         0% –––
«normal»
 ◀▼                    FLAP2
```

Model type: "4AIL 2FL"

If you have connected the servos to the receiver as described on page 65, and selected them for the appropriate tasks in the »**Model type**« menu, see page 98, of the twelve-channel mc-20 HoTT transmitter only, then the abbreviations "AIL", "AIL2" and "FL2" refer to the following control surfaces:



Since the options available on the wing mixer menu and its sub-menus vary according to the number of aileron and flap servos specified on the »**Model type**« menu, page 98, the list contains only those set-up options available for the given model.

This means that if values are preset to "4AIL 2FL", then all configuration options for the first aileron pair …

```
▶  ▲ AI ▼           [+100%]
  Ail-tr             +100%
  Diff.                 0%
  fl.pos                0%
   ▲FL▲          0%      0%
  EL  -> FL      0%      0%
  EL  -> FL  Off.        0% –––
«normal»
 ▼▶                     AILE
```

… are shown, and – one "step" to the right – all options for the second aileron pair …

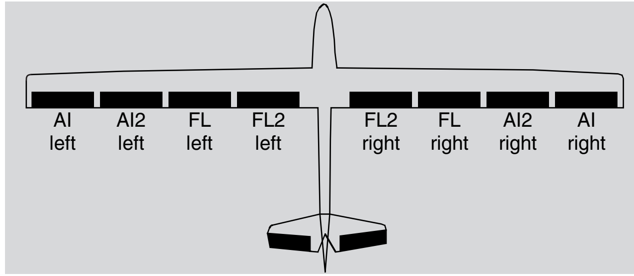
```
▶  ▲ AI ▼           [+100%]
  Ail-tr             +100%
  Diff.                 0%
  fl.pos                0%
   ▲FL▲          0%      0%
  EL  -> FL      0%      0%
  EL  -> FL  Off.        0% –––
«normal»
 ◀▼▶                   AILE2
```

… are shown, and – one further "step" to the right – all options for the flap pair as well:

```
▶  ▲ AI ▼              [  0%]
  Ail-tr                  0%
  Diff.                   0%
  fl.pos                  0%
   ▲FL▲        +100%  +100%
  EL  -> FL       0%      0%
  EL  -> FL  Off.         0% –––
«normal»
 ◀▼                     FLAP
```

Model type: "4AIL 4FL"

If you have connected the servos to the receiver as described on page 65, and selected them for the appropriate tasks in the »**Model type**« menu, see page 98, of the twelve-channel mc-20 HoTT transmitter, then the abbreviations "AIL", "AIL2", "FL" and "FL2" refer to the following control surfaces:



Since selecting "4AIL 4FL" means choosing the maximum number of control surface servos, the columns "AILE" …

```
▶  ▲ AI ▼           [+100%]
  Ail-tr             +100%
  Diff.                 0%
  fl.pos                0%
   ▲FL▲          0%      0%
  EL  -> FL      0%      0%
  EL  -> FL  Off.        0% –––
«normal»
 ▼▶                     AILE
```

… and "AILE2" …

```
▶ ▲AI▼        +100%
 Ail-tr       +100%
 Diff.           0%
 fl.pos          0%
   ▲FL▲      0%      0%
 EL ->FL     0%      0%
 EL ->FL  Off.   0% –––
«normal»
 ◆             AILE2
```

… are supplemented by the columns “FLAP” …

```
▶ ▲AI▼           0%
 Ail-tr          0%
 Diff.           0%
 fl.pos          0%
   ▲FL▲   +100%  +100%
 EL ->FL     0%      0%
 EL ->FL  Off.   0% –––
«normal»
 ◆              FLAP
```

… and “FLAP2”:

```
▶ ▲AI▼           0%
 Ail-tr          0%
 Diff.           0%
 fl.pos          0%
   ▲FL▲   +100%  +100%
 EL ->FL     0%      0%
 EL ->FL  Off.   0% –––
«normal»
 ◆             FLAP2
```

Delta/flying wing type models with more than two wing flaps

If you have selected the “Delta/fl“ tail type and selected the number of wing flaps in the “Aile/flaps” line on the »**Model type**« menu (following the instructions given in that section on page 99), then the two ailerons will normally not move when you move the elevator stick – and the same will be true for the inner flaps (FL) and FL2 (if present). The reason for this is the default mixer ratio of 0% for all wing flaps, set for the “EL ➔ FL” mixer that is to be found on the multi-flap menu:

```
  ▲AI▼          +100%
 Ail-tr         +100%
 Diff.             0%
 fl.pos            0%
   ▲FL▲       0%      0%
▶EL ->FL      0%      0%
«normal»
 ◆               AILE
```

Accordingly, you must first specify your desired elevator control on the “EL ➔ FL” line. Take care to ensure that up/down activation occurs in the right sequence.

Note:

The “Brake settings” sub-menu (see page 177) is also suitable for setting up the butterfly (crow) function with delta and flying wing models. In fine-tuning the deflection of the flap pairs AIL, FL and (if present) AIL2 and/or FL2, however, ensure that the moments created by one pair of flaps compensate the moments created by the other pair of flaps in each case. For example: the “up” effect of ailerons when deflected up should be compensated by a “down” effect from flaps when they are lowered.

Multi-flap menu

Important notice:

*Depending on the flap pairs specified in the »**Model type**« menu, page 98, this menu will present the column “AILE2” and/or the columns “FLAP” and “FLAP2” in addition to the “AILE” column. Since both the columns “AILE” and “AILE2” and the columns “FLAP” and “FLAP2” are identical except for the label shown at the bottom right, further display of the columns “AILE2” and “FLAP2” is avoided below for reasons of saving space.*

▲AI▼ (Aileron ➔ Flaps)

Note:

Suppressed by “2AIL 1FL”.

```
▶ ▲AI▼        +100%
 Ail-tr       +100%
 Diff.           0%
 fl.pos          0%
«normal»
 ◆              AILE
```

```
▶ ▲AI▼           0%
 Ail-tr          0%
 Diff.           0%
 fl.pos          0%
«normal»
 ◆              FLAP
```

The “▲AI▼“ line can be used to make flight-phase dependent settings for the percentage of aileron action to result for the camber flap pair “FLAP” and, if present, also “FL2” when aileron control is exercised. (In the “AILE” and, if present, “AILE2” column it is also possible to adjust the deflection of the aileron pair, if required.) Normally, however, the flaps should follow the ailerons with less of a deflection, i.e. the mixer ratio should be smaller than 100%.

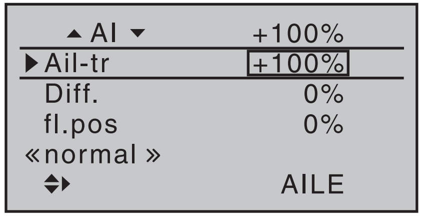
The adjustment range of -150% to +150% means the direction of deflection can be adjusted, depending on the direction of rotation of the servos, to suit the ailerons.

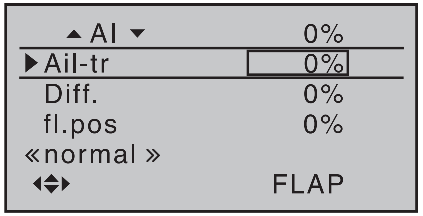
A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset the given active (inverse video) field to its default value shown in the figure.

Ail-tr (Aileron trim)

Note:

Suppressed by "2AIL 1FL".





In this line, you specify the percentage rate with which aileron trim is to affect "AILE", "FLAP" and – if present – "AILE2" and/or "FLAP2".

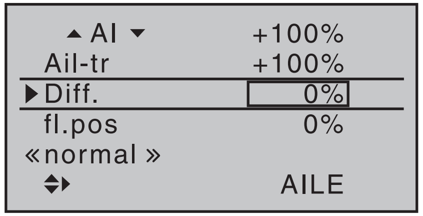
The available range of values is -150% to +150%, relative to the adjustment range of the trim lever.

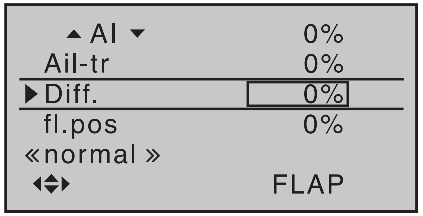
A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset the given active (inverse video) field to its default value shown in the figure.

Diff. (Differential for aileron function)

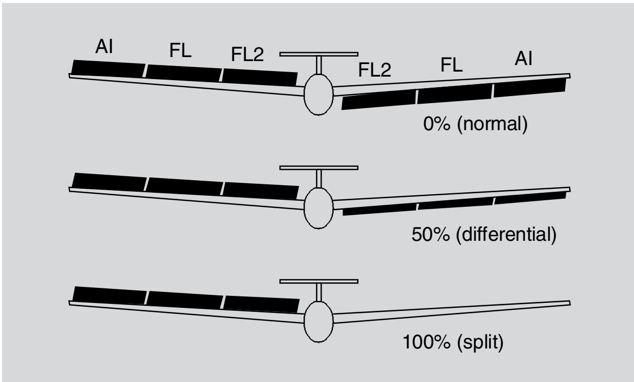
Note:

*With "2AIL 1FL", at one level higher in the »**Wing mixers**« menu, see figure on page 174.*





On this line, you set the aileron differential, plus the differential for the FLAP and FLAP2 wing flaps – if the latter are being activated as ailerons.

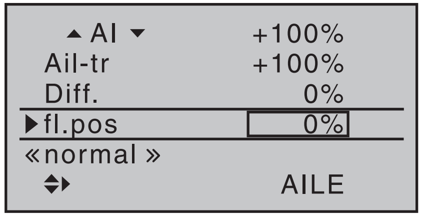


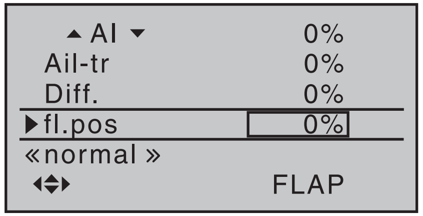
If you are unsure about the meaning of differential travel, please read the appropriate explanation at the start of this section on page 168.

The setting range of -100% to +100% permits correct differentiation direction adjustment regardless of the direction of rotation of aileron and flap servos.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset the given active (inverse video) field to its default value shown in the figure.

fl.pos. (Flap position)





Here, you set the flight phase-specific wing flap positions for all of the flaps present on the model in question. In this way, you can specify the flap positions that apply to each flight phase.

The adjustment range of -100% to +100% makes it possible to set the correct direction of travel regardless of the direction of rotation of the aileron and flap servos.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset the given active (inverse video) field to its default value shown in the figures.

Note:

The values shown in the line "Fl.pos" access to the same record about how to comparable point in the column "▲Al▲", "▲Al2▲", "FL" and possibly "FL2" menu "**phase trim**" (page 156) displayed, which is why changes always have a direct effect mutually.

▲FL▲ (Effect of flap control)

This line specifies the percentage of effect produced on aileron and flaps by the settings (if applicable, also flight-phase dependent settings) made for Input 6 in the »**Control adjust**« menu, page 112.

```
 Ail-tr          +100%
 Diff.              0%
 fl.pos             0%
▶ ▲FL▲         0%      0%
«normal»
                   AILE
```

```
 Ail-tr             0%
 Diff.              0%
 fl.pos             0%
▶ ▲FL▲      +100%  +100%
«normal»
                   FLAP
```

For each flap pair, you can define either a symmetrical or an asymmetric effect. Position the transmitter control accordingly – either centrally or to the relevant side.

If each travel adjustment is left at +100 % on the »**Control adjust**« menu, page 112, then values between 5 % and 20 % should generally be sufficient here.

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset the given active (inverse video) field to its default value shown in the figures.

Note:

- *By default, NO transmitter control is assigned to input 6 on the »**Control adjust**« menu. However, you can assign a transmitter control or switch to this input at any time – also in a flight phase-dependent way – thus enabling different flap settings within a flight phase; see also example 2 on page 304.*
- *As already mentioned in the remarks in the section starting on page 166, the two INC/DEC buttons (CTL 5 or 6) are virtually ideal for this purpose, as their position is automatically stored. They are fitted as standard to the mc-20 HoTT transmitter.*

EL → FL (Elevator → flaps)

To provide support for the elevator for tight turns and aerobatics, this mixer can be used to make the flap function follow controls sent to the elevator. The mixer direction chosen must ensure that the flaps are deflected downwards when the elevator is oriented upwards and vice versa for a downward-oriented elevator – i. e. in opposite directions.

For each flap pair, you can define either a symmetrical or an asymmetric effect. Position the transmitter control accordingly – either centrally or to the relevant side. Values in the range -150 % to +150 % are possible:

```
 Diff.              0%
 fl.pos             0%
   ▲FL▲        0%      0%
▶EL → FL       0%      0%
«normal»
                   AILE
```

```
 Diff.              0%
 fl.pos             0%
   ▲FL▲     +100%  +100%
▶EL → FL       0%      0%
«normal»
                   FLAP
```

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset the given active (inverse video) field to its default value shown in the figures.

The "usual" values for this mixer are in the low two-digit range.

If a switch is assigned in the next line, **"EL → FL"** then the effect produced on flaps can be switched on and off with the elevator.

Important general notice:

Do not let control surfaces and servos strike their mechanical end-stops when large deflections are set! This is especially relevant in relation to the functions "▲Al▼" and "▲FL▼". Use the "- limit +" option (travel limit) available in the "Servo adjustment" menu (page 102), as required.

EL → FL Off. (symm. elevator offset)

```
 fl.pos             0%
   ▲FL▲        0%      0%
 EL → FL       0%      0%
▶EL → FL  Off.      0% ---
«normal»
                   STO
```

A value entered into the **"EL → FL"** line offers support to the elevator during tight curves and aerobatics.

This **“EL → FL Offset”** line determines the offset value introductory point where this percentage of effect on flaps is to take place for elevator action.

- With an offset value of 0 %, flaps will be affected by elevator action beginning with the neutral position of the elevator stick by the percentage set in the **“EL → FL”** line.
- With an offset value other than 0 %, flaps will be affected by movement of the elevator stick, in either the “up” or “down” direction, only after reaching the preset offset point.

To set this offset point, put the elevator stick at the offset point to be set (in either of the two possible directions). A brief tap on the centre **SET** key of the right four-way button will store this position.

Tap on the centre **SET** key of the right four-way button with the elevator stick in its centred position to set the offset value back to 0 % again. If a switch is assigned in column “Switch”, the effect produced with the elevator on flaps can be switched on and off.

With the “switch” column assigned switch the entrainment of the flaps can be switched on and off by the elevator. The assignment of a switch is performed as described in the “transmitter controls, switches and control switch assignments” on page 60:

```
 fl.pos                0%
   ▲FL▲         0%       0%
 EL  →FL        0%       0%
▶EL  →FL  Off.         0%|---|
«normal»
◂▴                    STO  ⁄_
```

Brake settings

Notes:

- *The “Brake settings” menu is switched “off” if: “Motor on C1 forward / back” in the »**Model type**« menu, page 98, AND the “Motor” column of the »**Phase settings**« menu, page 148, are set to “yes” for the currently active flight phase. Switch the flight phase if required:*
- *The “brake mixers” described below can also – and should also – be configured to be specific to individual flight phases.*

Crow (Butterfly)

```
      Brake  settings
▶Crow  |  0%|    0%     0%
 D.red    0%     0%     0%
 Elevat  curve          =>
«normal»
 ▾       AILE  FLAP FLAP2
```

The “Crow” mixer function is actuated by control function 1, 7, 8 or 9, depending on the input assigned on the “Brake Offset” line in the »**Model type**« menu, see page 98.

```
         Model  type
 Motor  at  C1        None
 Tail  type         Normal
 Aile/flaps         2AIL2FL
▶Brake  off     +90%   In 1
 ▴                STO   SEL
```

Note:

*The Offset, i. e. the activation direction, is also set in the »**Model type**« menu, page 98. This offset should be set to about +90 % of stick travel (if the C1 stick is used, this is generally located at the forward position of the stick).*

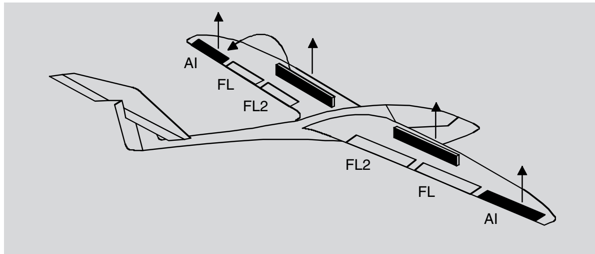
To extend the flaps, the stick must therefore be moved back towards the pilot. The remaining stick travel of around 10 % then has no effect, although it is not “lost”, since the control travel is automatically expanded back to 100 %.

Use the select fields of the columns labelled “AILE”, “AILE2”, “FL” and, if present, “FL2” to specify the extent and the direction that corresponding flap pairs are to follow when the airbrake control (control function 1, 7, 8 or – if present – 9) is operated. If the model has no airbrakes, leave the corresponding receiver output free or set it to “Mix-only” in the »**Mix-only channel**«, which is available as standard on the mc-20 HoTT transmitter only, so that you can use it for other purposes.

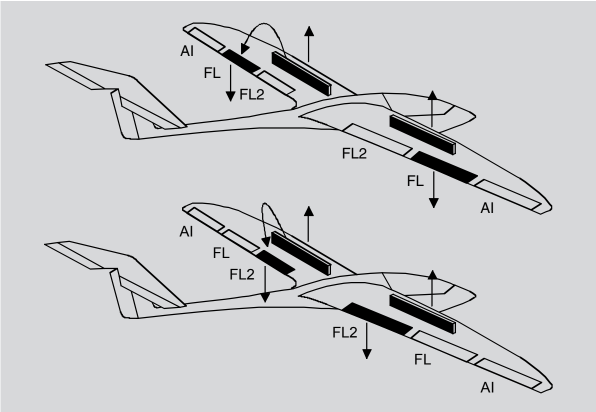
Values in the range -150 % to +150 % are possible.

A simultaneous tap on the ▲▼ or ◀▶ keys of the right four-way button (**CLEAR**) will reset the given active (inverse video) field to its default value shown in the figure.

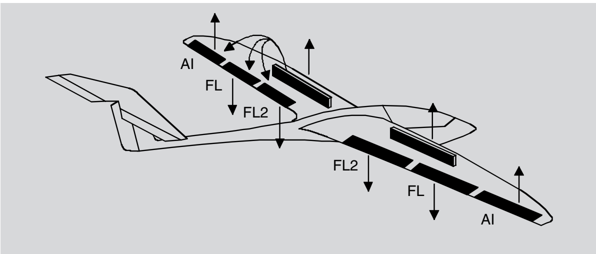
- **“AILE” and – if present – “AILE2” column**
  When braking the model as it comes in to land, neither of the aileron flaps should ever be deflected more than half of the possible travel upwards, to ensure that enough travel is available to control the model along its longitudinal axis (aileron function).



- **"FLAP" and – if present – "FLAP2" column**
  As the model is braked on the landing approach, both pairs of flaps can be set to deflect by different amounts, e. g.:



- **Combining AILE(2) and FLAP(2) for "Crow"**



Though the airbrake mixers are set as described above, there is a special flap constellation, called *"crow position"* or *"butterfly"*, that can also be set. This airbrake setting causes both *ailerons move moderately upward while the flaps move downward as far as possible.* Another mixer – see below, under the section "Elevat. curve" – is then used to trim the elevator such that the flight speed does not change significantly in comparison to the normal flight position. Otherwise, there is a danger that the model loses too much speed and then, after the braking system is retracted (e. g. to extend a landing approach that was too short, for example), pancakes or even stalls.

<u>*A tip for "seeing" the effect of brakes:*</u>

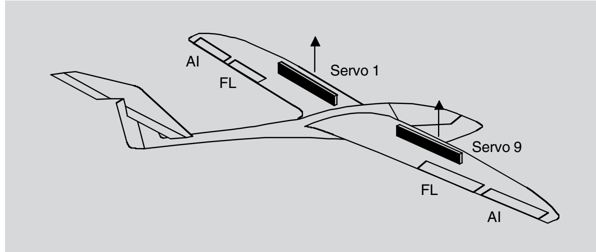
Lift the flaps and look over and under the surface from the front. The larger the surface projected by the lifted flap, the greater the braking effect achieved.

<u>*Tips for activating airbrakes:*</u>

- *When, in addition to aileron and camber flap servos, there is also a built-in servo for actuating wing airbrakes, it can be most simply connected to that receiver output – if free – whose input has been selected for the brake function, i. e. either on 1, 7, 8 or – if present – 9. If this is not possible then, as an alternative, use a free mixer to connect the selected brake control channel with the airbrake servo.*
- *To activate two airbrake servos, the best approach is to leave one servo on output 1 and to connect the second servo to a free output of your choice – for example, output 9. You then also assign this output to transmitter control 1 (as standard) on the »**Control adjust**« menu, page 112, see figure.*

In5	GL	fr	– – –	0%
In6	GL	fr	– – –	0%
In7	GL	fr	– – –	0%
▶In8	GL	Cn1	– – –	0%
«normal»				
	typ	SEL		offset

As you do, leave the settings for offset, travel, etc. at their default values. Also leave the default "GL" value in the column labelled "TYP" so that the second airbrake, like the first, operates in the same way across all flight phases.



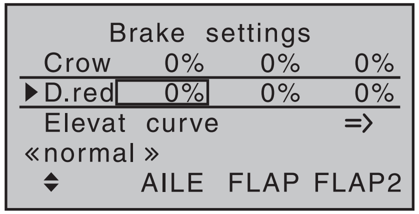
*You can assure yourself that this works as stated by accessing the »**Servo display**« menu, accessible from almost any menu level with a brief simultaneous tap on the ◀ ▶ keys on the left four-way button, see page 274:*

1	+100%	2	0%
3	0%	4	0%
5	0%	6	0%
7	0%	8	0%
9	+100%	10	0%
11	0%	12	0%

*If this relatively simply variant should prove impossible for whichever reasons, then the alternative is a solution with two free mixers – and potentially involving the »**Mix-only channel**« menu, see page 212, which is available as standard on the mc-20 HoTT transmitter only. and potentially involving*

*The airbrake travels must then be fine-tuned on the »**Servo adjustment**« menu, page 106.*

D.red (Differential reduction)



Earlier, we discussed the problems with the butterfly (crow) configuration. Namely: that with the use of aileron differential, the aileron effect can be strongly (negatively) affected by the aileron elevation. This is firstly because further deflection of the one aileron upwards is (almost) no longer possible and secondly because the downward-deflected aileron – depending on the elevation and degree of differential configured – is often unable to achieve even its "normal" position.

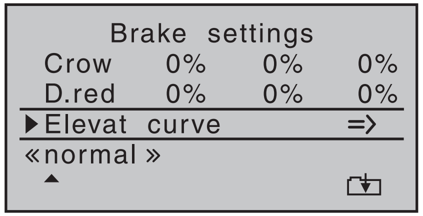
To be able to restore the effect of the aileron altered in this way as far as possible, you should ensure that you make use of the automated "Differential reduction" feature. This feature continuously reduces the degree of aileron differential as the airbrake system is extended. The feature is configurable and can even be set to suppress differential entirely.

A value of 0 % means that the "aileron differential" set at the transmitter remains fully in force. An entry that equals the % value set for aileron differential means the differential is fully eliminated once the butterfly function is at maximum travel, i. e. with flaps fully extended. Setting a reduction value greater than the aileron differential configured will eliminate the latter even before the full travel of the airbrake stick.

Values can be set in the range 0 to 150 %.

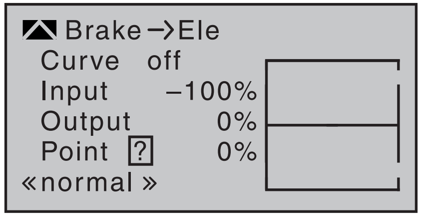
A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset a changed value in a given active (inverse video) field back to 0 %.

Elevat curve (Brake ➔ elevator)



If the airbrake control – to be set to 1, 7, 8 or – if present – 9 on the "Brake Offset" line of the »**Model type**« menu, page 100 – is used to extend the flaps as described previously for the "Brake settings" menu, this will often have a negative effect on the aircraft model's airspeed. This mixer can be used to compensate this type of effect by applying a corrective value to the elevator.

A brief tap on the centre **SET** key of the right four-way button will switch to the display screen shown below:



Setting notices for "Elevat curve"

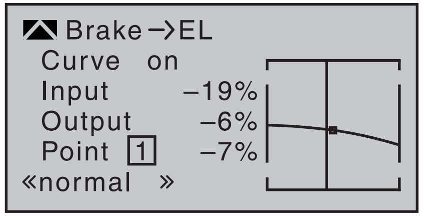
The offset set in the »**Model type**« menu, page 100, affects this mixer:

The vertical line on the display that indicates the position of the airbrake control only moves from the edge of the graph when the configured offset is exceeded. In doing so, airbrake control travel is automatically expanded back to 100 %, as described in the »**Model type**« menu.

Accordingly, the mixer's neutral point always lies on the left edge, independently of the offset configured.

Now adjust the elevator curve in the direction of the opposite end-point in accordance with requirements.

Note that this method for setting the 6-point curve mixer follows the same principles that are applicable to the curve mixers, already described on page 134 in the context of the »**Channel 1 curve**« menu.



The selected setting should certainly be tried out in sufficient altitude and, if necessary, readjusted. When doing this, be sure to pay attention that the model does not slow down too much while the brake system is extended! Otherwise, you run the risk that, after the braking system is retracted, e. g. to extend a landing approach that was too short, for example, your model pancakes or even stalls.

Display “Wing mixer”

Aile.diff. (Aileron differential)

Note:

Only for “2AIL 1FL”. For the “2/4AIL 2/4 FL” selection, this is included on the Multi-flap menu, see page 177.

```
       Wing  mixers
  Multi-flap  menu        =>
  Brake  settings         =>
 ▶Aile.diff            0%
  AI  -> RU            0% –––
  ⬍     «normal »
```

On this line you can set the aileron differential for the two aileron servos.

If you are unsure about the meaning of differential travel, please read the appropriate explanation at the start of this section on page 168.

The setting range of ±100 % permits correct differentiation direction adjustment regardless of the direction of rotation of aileron and flap servos.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset a changed value in a given active (inverse video) field back to 0 %.

AI → RU (Aileron → Rudder)

```
       Wing  mixers
  Multi-flap  menu        =>
  Brake  settings         =>
 ▶AI  -> RU            0% –––
  FL -> EL     0%      0% –––
  ⬍     «normal »        ⁄
```

Here, you can set the degree to which the rudder follows commands acting on ailerons. This is used in particular in connection with aileron differential to suppress adverse yaw and thus make it easier to fly “clean” curves. You can of course still issue separate commands to the rudder.

The mixer direction is typically chosen to ensure that the rudder moves in the direction of the aileron that is deflected upwards.

Settings are always made symmetrically relative to the neutral point of the aileron stick.

The adjustment range of ±150 % lets you set the direction of deflection as appropriate. Optionally, this mixer can be activated and deactivated with of the switches or a control switch that is not self-restoring so the model can be controlled with only the ailerons or rudder if desired.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset a changed value in an active (inverse video) field back to 0 %.

A value of around 50 % is generally an excellent starting point.

FL → EL (Flaps → Elevator)

```
       Wing  mixers
  Multi-flap  menu        =>
  Brake  settings         =>
  AI  -> RU            0% –––
 ▶FL -> EL     0%      0% –––
  ▲     «normal »        ⁄
```

When setting camber-changing flaps, one side-effect can be to generate moments causing movement around the transverse axis. Equally, however, it may also be desirable that e. g. your aircraft model opts for a more pacey flight style with the flaps slightly raised. This mixer can be used to achieve both results.

With this mixer, the extension of the flaps – depending on the value configured – automatically ensures the elevator position follows suit. Symmetrical or asymmetrical settings relative to the neutral point of the flap control are possible.

If required, the mixer can be switched on or off by assigning a switch in the right column.

Values can be set in the range ±150 %. The “typical” values configured for this mixer are single-digit or low two-digit values.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset a changed value in a given active (inverse video) field back to 0 %.

Note:

Have you, as described under “▲FL▼” on page 179, assigned to a control or switch in the menu “Transmitter control settings”, then this also affects this mixer.

Helicopter mixer

Flight phase-specific setting of collective pitch, throttle and tail rotor

mc 16	mc 20
☑	☑

This option is available on both transmitter types.

In this menu »**Helicopter mixer**« all of the flight phase-specific helicopter mixers are described, with the exception of the mixers for auto-rotation flight (discussed from page 198 onward.)
These mixers are used for the basic set-up of a model helicopter:

```
   Base  setup  model
 RF  Range Test     99sec
 DSC  Output        PPM10
 Autorotation         ---
▶Auto.C1-Pos.      0% ---
 ⬍                STO  ⁄
```

... A switchover in the so-called auto-rotation phase is activated (page 95). With one of the non-resetting switch the transmitter can then be switched between the "Normal" phase (and possibly further stages of flight), and the flight phase "Auto-rotation". The "other" phases of flight shall be followed in the menus »**Phase settings**« (page 152) and "**Phase assignment**" (page 154) to be activated.

However, switching to autorotation always has priority over all other flight phases.

In the to be discussed in the following menu "helicopter mix" with the exception will be discussed starting on page 198 for the auto-rotation flight phase of the mixer, described all the phase-specific helicopter mixers. These mixers are used for basic settings of the model helicopter.

So Scroll with the selection keys of the left or right four-way button to the menu item "helicopter mix" of the multifunction menu:

```
 Fl.  phase  timers
 Helicopter  mixer
 Free  mixers
 MIX  active/phase
 MIX-only  channel
 Dual  mixer
```

By briefly pressing the central **SET** key of the right four-way pad to open this menu item.

If you »Phase settings« and »Phase assignment" have already created flight phases and each assigned an appropriate name in the menu, these will be displayed at the bottom left, for example, «Normal». So pressing if necessary the appropriate switch to switch between the flight phases:

```
▶Pitch                =>
 C1->Throttle         =>
 C1->Tail             =>
 Tail  ->Throttle     0%
 Roll  ->Throttle     0%
 Roll  ->Tail         0%
 Nick->Throttle       0%
 Nick->Tail           0%
 Gyro  suppress       0%
 Gyro  gain           0%
 Swash  rotation      0°
 Swash  limiter      OFF
▾ «normal»
```

In each of these flight phases – with the exception of the auto-rotation phase – the typical helicopter mixing and coupling functions shown in the screen-shot above are available for setting up the model helicopter. These functions are described in the first part of this comprehensive chapter.

General information on mixers,
(see also pages 165 and 200)

An arrow "➔" indicates a mixer. A mixer "branches off" the signal flow of a control function at a particular point, in order to use this flow to cause a predetermined effect on a further control channel and, ultimately, the receiver output. "C1 ➔ Tail" mixer means, for example, that when the pitch-axis stick is actuated, the tail rotor servo must also react within the scope of its setting.

Basic programming procedure:

1. Select the mixer by using the selection keys of the left or right four-way button.
   Depending on the mixer involved, the bottom display line will show either **SEL** or the ⮋ (indicating a change to a second page is necessary).
2. A brief tap on the centre **SET** key of the right four-way button will permit direct settings for linear mixer ratios. Use the selection keys to set the mixer ratio.
   Otherwise you will need to switch to the second screen page where you can set up the appropriate curve mixer.
   A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset a changed value in a given active (inverse video) field back to 0%.
3. Another tap on the centre **SET** key of the right four-way button will complete the entry.
4. A tap on the centre **ESC** key of the left four-way button will cause a return to the previous display page.

Description of helicopter mixers

To set collective pitch curves as well as the two mixers, "C1 ➔ Throttle" and "C1 ➔ Tail", there are curve mixers available in all flight phases. Accordingly, these mixers also permit the programming of non-linear mixing ratios along the path of stick travel, if required. Switch to the display screen for curve settings with a brief tap on the centre **SET** key of the right four-way button, see description below.

The curve is set up basically in the same way as the Channel 1 curve for helicopters, but we will describe it again here in detail using pitch configuration as an example, to save you having to leaf through the manual.

In the remaining lines, first activate the value field and then use the selection keys of the left or right four-way button to set a mixer value in the value field (inverse video).

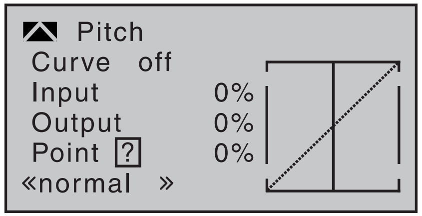
The settings available are rounded off with the "Swashplate limiter" option: This option can be set to restrict maximum deflection of the swashplate servo in the sense of a limiter. Together, these settings configure the basic set-up of the helicopter model.

In the "Autorotation" flight phase as described on page 198, however, the mixers "C1 ➔ Throttle" and "C1 ➔ Tail" are not needed and therefore switched to a configurable default value.

Changed parameters can be reset to their respective default values at any time with a simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**).

Pitch (Pitch curve (C1 ➔ Pitch))

If necessary, use the ▲▼ selection keys of the left or right four-way button to move to the "Pitch" line then tap briefly on the centre **SET** key of the right four-way button:



Unlike the »**Channel 1 curve**« menu, this display is only associated with the control curve of pitch servos, whereas the "Channel 1 curve" affects all servos controlled by the throttle/pitch stick.

Note that the output signal of the "Channel 1 curve" option thus functions as an input signal for the collective pitch curve programmed here: In the graph, the vertical line is synchronized with the throttle/collective pitch stick and therefore follows the current Channel 1 curve characteristic.

The control curve can be defined (separately per flight phase) by up to 6 points, termed "reference points", placed at any point along the stick travel.

Initially, however, fewer reference points are adequate for setting up the collective pitch curve. We recommend beginning with three reference points to start with. These three points, namely the two end-points "Pitch low (L)" (= -100 % control travel) and "Pitch high (H)" (= +100 % control travel) plus a point at the centre of control travel still to be set, define an initially linear profile for the pitch curve.

Programming details

First, switch to your chosen flight phase, e. g. «Normal».

The throttle/collective pitch stick is used to move the vertical line in the graph between the two end-points "Point L" (minimum pitch at -100 %) and "Point H" (maximum pitch at +100 % control travel): at the same time, the current stick position is shown numerically on the "Input" line (-100 % to +100 %).

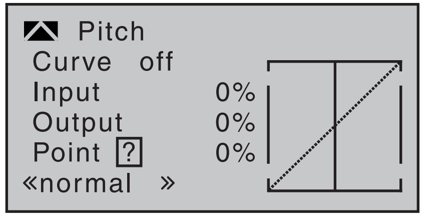
The point at which the vertical line crosses the curve is termed the "Output", and can be varied at the maximum of 6 reference points within the range -125 % to +125 %. A control signal modified in this way affects only the collective pitch servos.

In the example to the left, the stick is at exactly 0 % of control travel and also generates an output signal of 0 %, since the characteristic curve is linear.

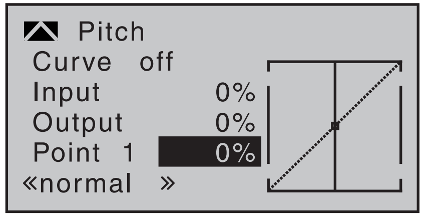
Up to six additional reference points can be set between the two end-points "L" and "H", although the distance between neighboring reference points must not be less than approx. 25 %.

Setting reference points

If necessary, use the left or right-hand arrow button ▼ to move the marker frame down to the "Point" line:



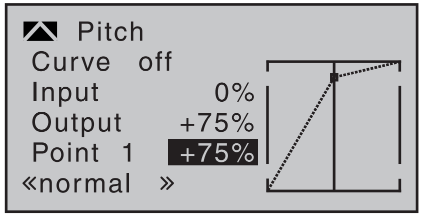
Move the stick. If the display shows a framed question mark, then you can set the next reference point with a tap on the centre **SET** key of the right four-way button. Simultaneously, the "?" is replaced by a number and the value field to the right of the reference point number is highlighted:



The order in which up to four reference points are generated between the end-points "L" and "H" is irrelevant since these reference points are continuously renumbered automatically from left to right as they are entered.

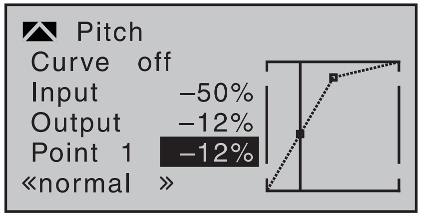
Configuring reference points

To configure a point, use the stick to move the vertical line onto the point you wish to change. The number and current curve value of this point are displayed on the left side of the display, on the "Point" line. Briefly tap the centre **SET** key of the right four-way button. Use the selection keys on the right four-way button to change the current curve value shown in the highlighted field. The possible range is -125 % to +125 % and changes do not affect neighboring reference points.

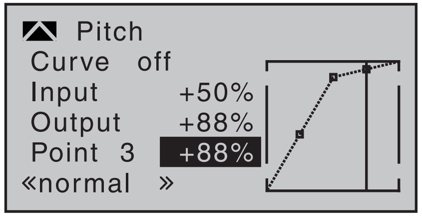


In this sample screen image, reference point "1" has been set to +75 %.

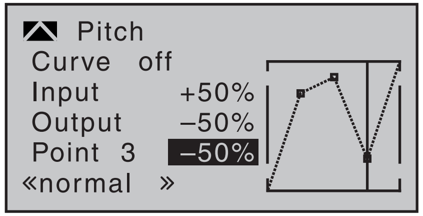
If you wish, however, other points can also be set. At -50 %, for example …



… and/or a further point at +50 %:



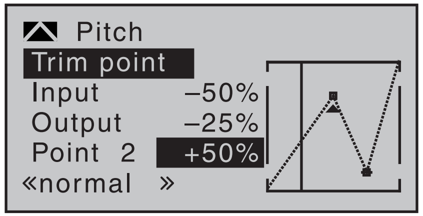
This point can now be adjusted as previously described …



… or reset again with a simultaneous tap on the ▲▼ or ◄► selection keys of the right four-way button (**CLEAR**).

Trim point function

Alternatively, you can skip reference points L, 1 … max. 4 and H in the active (i. e. highlighted) Value field using the Select buttons ◄► of the left-hand four-way button in the ascending or descending direction. The selection keys on the right four-way button can then be used to change the reference point jumped to as described above, entirely independently of the control position, for example:



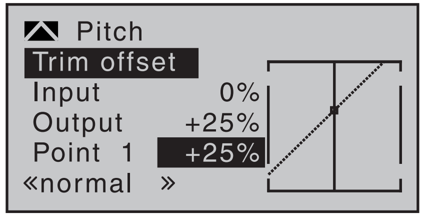
In this simple example, the pitch stick – represented by the vertical line – is halfway between "Pitch minimum" and the midpoint of control travel (input = -50 %).

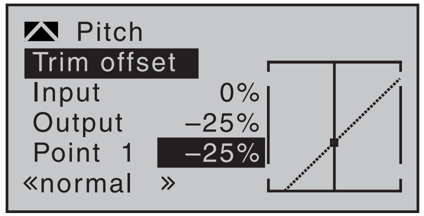
However, "Point 1" will be relocated to control centre at a point value of +50 %, resulting in a momentary output value of -25 %.

One touch on the centre **ESC** key of the left four-way button terminates this trim point function.

Trim offset function

When a value field is active, i. e. in inverse video, it is not only possible, as previously described, to jump up or down to reference points already set with the ◄► selection keys of the left four-way button and to make a change with the selection keys of the right four-way button, but also an existing curve can be vertically repositioned within a range of ±25 % through use of the ▲▼ keys on the left four-way button. Starting with a point value for "Point 1" at 0 %, the control curves in both of the following figures have been vertically shifted within the ±25 % range by the trim offset function:

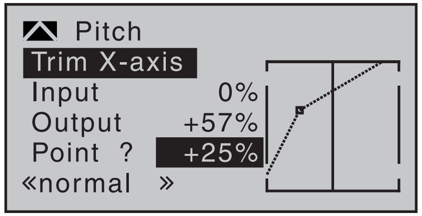




A tap on the centre **ESC** key of the left four-way button will also terminate this function.

Trim x-axis function

This function is activated by tapping the left (◀) or right (▶) selection key of the right four-way button with an active (i. e. inverse video) value field. You can then use the selection keys on the right four-way button to reposition the active point horizontally or vertically as you wish. In the figure below, "Point 1" which was just shifted to +25 % with the trim point function, will now be shifted to the left:



Notes:

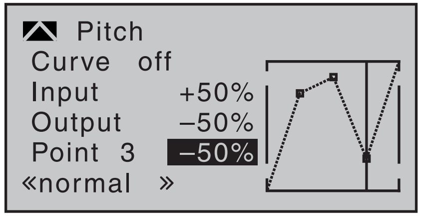
- *If the point is repositioned horizontally further away from the current control position than approx. ±25 %, a "?" sign will reappear in the line Point. This question mark does not refer to the repositioned point, however: instead, it signifies that a further point can be set at the current control position.*
- *Please note that the percentage value on the "Output" line always relates to the current stick position and not to the position of the point.*

Smoothing the collective pitch curve

In the example below, sample reference points have been set …

reference point 1 to +50 %,
reference point 2 to +75 % and
reference point 3 to -50 %

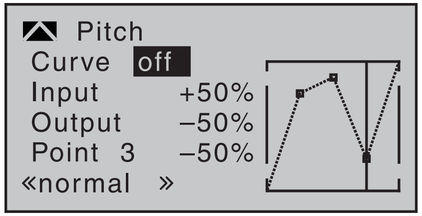
… as described in the last section:



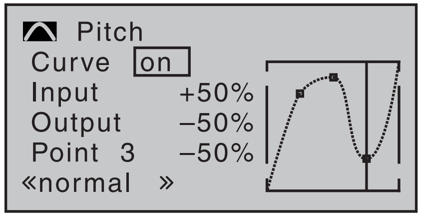
This "jagged" curve profile can be smoothed automatically simply by pressing a button.

Starting from the situation shown in the previous illustration, disable the Value field by pressing the central **ESC** button of the left-hand four-way button, or the **SET** button of the right-hand four-way button.

Now use the arrow buttons of the left or right-hand four-way button to move the marker frame up to the "Curve" line, and press the central **SET** button of the right-hand four-way button once more to activate the Value field of the "Curve" line:



Now use the arrow buttons of the right-hand four-way button to set the Value field from "off" to "on", and then briefly press the central **SET** button of the right-hand four-way button, or the central **ESC** button of the left-hand four-way button, to conclude the procedure:



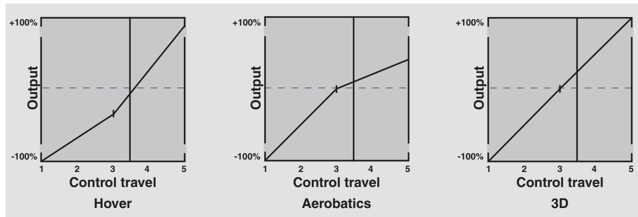
Notes:

- *If the stick does not coincide with the exact reference point, please note that the percentage value on the "Output" line always relates to the current stick position.*
- *The figures on these pages show control curves created only for the purpose of illustration. Please note, therefore, that the curve characteristics displayed do not in any way represent real-life collective pitch curves. A specific application example can be found in the programming examples on page 324.*

The following three graphs show typical 3-point pitch curves for various flight phases, such as hovering, aerobatics and 3D flight.

The vertical bar depicts the current stick position. Please note that trim values greater than +100 % and less than -100 % cannot be presented in the display.

Sample collective pitch curves for various flight phases:



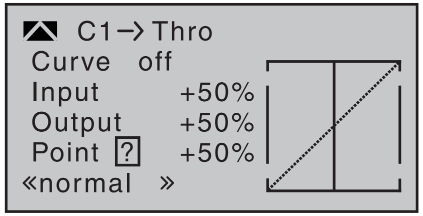
Erasing reference points

To delete one of the reference points (1 to max. 4), use the stick to move the vertical line into the vicinity of the reference point in question. As soon as the reference point number and its associated value is shown on the "Point" line (see screen image above), following activation of the value field on the "Point" line now in inverse video with a simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) it can be erased.

Complete the operation with a brief tap on the centre key **ESC** of the left four-way button.

The “L” and “H” points, on the other hand, CANNOT be deleted.

C1 → Throttle (Throttle curve)



Unlike the »**Channel 1 curve**« menu, this display is only associated with the control curve of the throttle servo, whereas the the “Channel 1 curve” affects all servos controlled by the throttle/pitch stick.

Note that the output signal of the “Channel 1 curve” menu thus functions as an input signal for the throttle curve programmed here: In the graph, the vertical line is synchronized with the throttle/collective pitch stick and therefore follows the current Channel 1 curve characteristic.

The throttle curve can also be defined (separately per flight phase) by up to 6 points, termed “reference points”, placed at any point along the stick travel.

The reference points are defined, adjusted and erased in the usual way, as explained in the previous section on the collective pitch curve. Start by defining the throttle curve with three points, namely the points “L” and “H” at the extremes, plus the Point “1” still to be set in the control centre in order to match the motor power curve to the collective pitch curve.

Helicopter with carburettor or electric drive system with speed CONTROLLER

This setting relates only to the control curve of the throttle servo or the speed controller.

Setting the throttle curve to suit a helicopter equipped with a speed governor is discussed in the following section.

As with the configuration of the collective pitch curve (see previous page), the throttle curve can also be defined by up to 6 points.

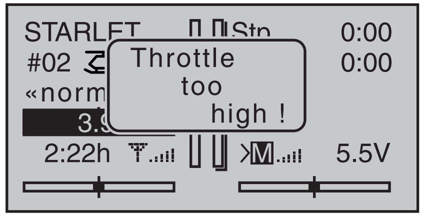
- In each case, set the control curve so that when the throttle/collective pitch stick is in its end position, the carburettor is fully open or the controller of an electrically-powered helicopter is set to maximum (except for auto-rotation flight, see page 198).
- For the hover point, which is normally at the control centre, the carburettor setting or power control for the speed controller must be matched to the collective pitch curve so that the correct system rotational speed is obtained.
- At the minimum position of the throttle/collective pitch stick, the throttle curve must first be configured so that a glow motor runs at a speed considerably higher than idle speed and the clutch is firmly engaged.

Starting and stopping of the motor – whether combustion or electric drive – should always take place within the given flight phase as a consequence of the throttle limiter and the “Cut Off trim” option of the digital trim (see below).

This makes it unnecessary to program the two flight phases that may be familiar to you from using other remote control systems – namely “with idle-up” and “without idle-up”, and with the associated “waste” of a flight phase for this purpose – since the program of the transmitters mc-16 HoTT and mc-20 HoTT offers a much more flexible approach to fine-tuning and optimizing increases to system rotational speed below the hover point than the “idle-up” approach.

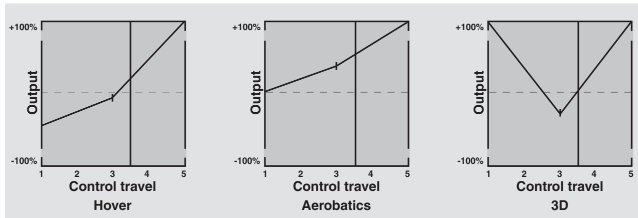
Ensure that the throttle limiter is closed before starting a motor with carburettor, i.e. so that the carburettor can be adjusted within the idle range only with trim.

Ensure that you follow the safety instructions on page 197 at all times. If the throttle is set too high when switching on the transmitter, you will receive audible and visible warnings!



The following three graphs show (typical) 3-point throttle curves for various flight phases, such as hovering aerobatics and 3D flight.

Sample throttle curves for various flight phases:



Notes on using the “throttle limit” function:

- *The throttle limit function should be used in any case (»**Control adjust**« menu, page 122). At the rear limit of the default transmitter control, the right-side throttle limit proportional rotary slider, the throttle servo is completely decoupled from the throttle curve, the motor is at idle and will respond only to C1 trim. This option permits the motor to be started in any flight phase and to shut the motor off with the “Cut Off trim” option of the digital trim. See below and/or* *page 62.*

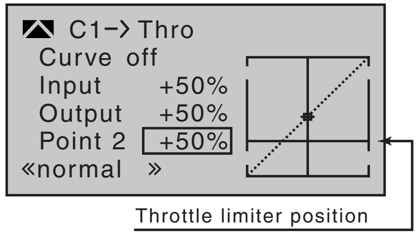
Once the motor has started, push the throttle limiter **slowly** *in the direction of the opposite end-point to put actuation of the throttle servo fully under the control of the throttle/collective pitch stick once again. In order to prevent the throttle servo from being restricted by the throttle limiter in the full throttle direction, set control travel on the plus-side of the column labelled "travel" to +125 % in the "Lim." line of the »**Control adjust**« menu. Leave the default value of "GL" in the "Type" column alone, however, to configure this setting globally for all flight phases.*

For a more finely-tuned control travel curve for the throttle limit control, you can also use the "Expo throttle limiter", page 104. This gives you the option of defining the idle setting at the throttle limit control's centre position, as readily determined both visually and audibly.

Set the throttle limiter to its centre position and adjust the "EXPO thro lim." value as far as is needed until the motor is idling smoothly with the throttle limit control set at its centre point. In this position, the motor will then start without any problems.

To switch off, turn or push the throttle limit control – that is, without C1 cutoff trim – to its rearmost end-point. As you do, ensure that the affected servo cannot hit an end-stop mechanically.

The throttle restriction set by the throttle limiter is made visible as a horizontal bar in the diagram:



The output signal for the throttle servo can never be higher than that set by the horizontal bar. In this example, about a maximum of +25 %.

- *Since electric drive systems have no need for an idle setting, the basic configuration of settings for an electrically-powered helicopter merely involves making sure that the control range of the throttle limiter is both higher and lower than the adjustment range of the speed controller (usually -100 % to +100 %) by a safe margin. If necessary, therefore, adjust the "travel" setting of the throttle limiter as appropriate on the "Lim." line of the »**Control adjust**« menu. Leave the default value of "GL" in the "Type" column alone, however, to configure this setting globally for all flight phases.*

  Fine-tuning of the throttle curve itself, however, must take place in flight – as with a glow-powered helicopter.
- *If you wish to record the flight time of a (glow-powered) helicopter, you can assign a control switch to the throttle limit slider, and then use this to switch a timer on and off; see page 141.*

For auto-rotation flight, an automatic switch-over is made from this mixer to a configurable default value; see page 198.

Helicopter with speed REGULATOR

Unlike speed *controllers*, which merely adjust output level in a manner similar to a carburettor, a speed regulator keeps speed in the system it monitors constant by regulating its output autonomously. In the case of combustion motor powered helicopters, the regulator therefore controls the throttle servo itself as appropriate or, for an electric helicopter, the motor's speed controller. *Therefore, speed regulators do not need a traditional throttle curve but rather only a speed setting.* A deviation from the preset speed will therefore only take place if the level of output required exceeds the maximum level available.

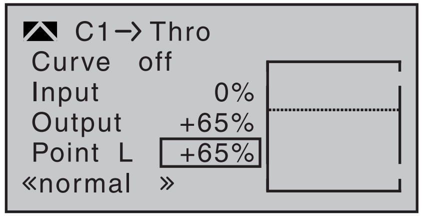
Usually, receiver output 8 is reserved for connecting a speed *regulator*, refer to the receiver layout on page 67. However, if this connection is used there will be no throttle limit function because the throttle limit function can only be implemented via the "C1 ➔ Thro" mixer which is on the – then unused – output 6.

To make the comfort and safety features of a throttle limiter available, a speed regulator should be connected to receiver output 6 (contrary to the general connection notices) and only requires appropriate adaptation to the throttle curve so it can take over the task of the "conventional" transmitter control.

Since in this case the "throttle curve" only regulates the target speed of the motor controller and this target motor speed should typically remain constant over the entire collective pitch adjustment range, the "C1 ➔ Thro" mixer must be used to set a horizontal line – i. e. every (pitch) input value will result in the same ("throttle") output value – whose "height" is defined by the target motor speed.

First, therefore, the reference points "1" to "4" – if present and set – are erased.

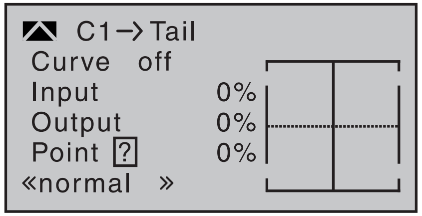
Following this, the reference points “L” (input = 0 %) and “H” (input = +100 %) are then each set to the same value, for example:



The value to be set depends both on the speed controller used and on the target motor speed that is desired, and can, of course, be varied according to the flight phase.

For auto-rotation flight, an automatic switch-over is made from this mixer to a configurable default value; see page 198.

C1 → Tail (Static torque compensation)



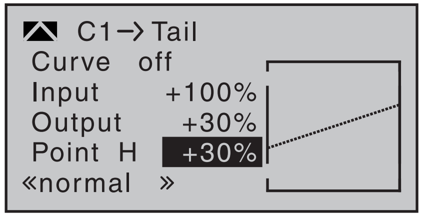
The default approach here is to preset a torque compensation curve with a linear mixer ratio of a uniform 0 %, as is required for a gyro sensor working in “heading lock mode” – see the screen image above.

ATTENTION:

In this context, ensure that you comply with the instructions on adjusting your gyro: if not, you risk making adjustments that render your helicopter impossible to fly.

If, on the other hand, you use your gyro sensor in the “normal” operating mode, or if it only has what is termed “normal mode”, then configure the mixer as follows:

As with the configuration of the collective pitch curve (see page 185), the control curve of the tail rotor can also be defined by up to 6 points. If required, therefore, you can modify the mixer at any time and preset both symmetrical and asymmetric mixer ratios both above and below the hover point. Before you do, however, ensure you have entered the correct direction of rotation for the main rotor on the »**Helicopter type**« menu(see page 103).



Starting with values of -30 % for point “L” and +30 % for point “H”, the mixer is to be configured in such a way that the helicopter, even during prolonged vertically ascending or descending flights, does not deviate from the yaw axis as a result of the main rotor’s altered torque while hovering. For hovered flight, trim should only be affected by way of the (digital) tail rotor trim lever.

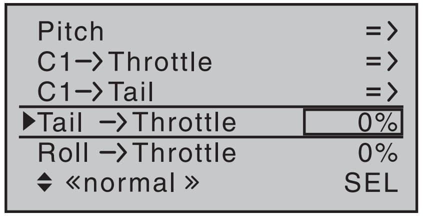
For a reliable torque compensation setting, it is essential that the collective pitch and throttle curves have been set up correctly, i. e. that the rotor speed remains constant over the collective pitch’s full adjustment range.

This third curve mixer applies only to the control curve of the tail rotor servo when the throttle/collective pitch stick is moved, whereas the “Channel 1 curve”, see page 137, acts on all servos that are affected by the throttle/collective pitch stick.

Note that the output signal of the “Channel 1 curve” option also functions as an input signal for the tail rotor curve programmed here: In the graph, the vertical line is synchronized with the throttle/collective pitch stick and follows the current Channel 1 curve characteristic from the »**Channel 1 curve**« menu.

In the auto-rotation flight phase this mixer is automatically switched off, see page 198.

Tail → Throttle



While the tail rotor normally compensates for the effect of main rotor torque on the fuselage, it is also used to control the helicopter around the vertical axis. Increasing tail rotor thrust requires a corresponding adjustment to motor power, however, to avoid a fall-off in system rotational speed.

This mixer sets the extent to which the throttle follows the tail rotor. The throttle will follow on one side only, to the side on which the tail rotor thrust is increased. The setting range is therefore 0 to +100 %. The direction depends on the main rotor’s direction of rotation (left or right), and this must first be set correctly on the »**Helicopter type**« menu. For left-hand rotation systems, the throttle follows the tail rotor when the tail rotor stick is moved to the left, and vice versa for right-hand rotation systems.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will reset a changed value in an active (inverse video) field back to 0 %.

In the auto-rotation flight phase this mixer is automatically switched off.

<u>Set-up notes:</u>

To set the mixer value accurately you should either first fly several high-speed pirouettes against the direction of main rotor rotation or, if a strong wind is blowing, hover at right angles to the wind with a sufficiently large tail rotor deflection. Set the mixer value so that there is no fall-off in system rotational speed.

Roll → Throttle and Nick → Throttle

C1→Tail	=>
Tail →Throttle	0%
Roll →Throttle	0%
Roll →Tail	0%
▶Nick→Throttle	0%
⇕ «normal»	SEL

Increasing collective pitch is not the only change that requires the throttle to follow suit: major cyclic control movements also require this, i. e. if the swashplate is tilted in any direction. The program of the transmitters mc-16 HoTT and mc-20 HoTT lets you adjust the degree of throttle follow separately for roll and pitch-axis controls.

This offers particular advantages in aerobatic flying, e. g. when flying a roll: here, with moderate collective pitch values and the carburettor only about half-open, cyclic control travels are nonetheless executed that require much higher performance from the motor.

The mixer value can be varied within the range 0 to +100 %. The correct mixer direction is automatically taken into account.

A simultaneous tap on the ▲▼ or ◀ ▶ keys of the right four-way button (**CLEAR**) will reset a changed value in an active (inverse video) field back to 0 %.

In the auto-rotation flight phase this mixer is automatically switched off.

Roll → Tail and Nick → Tail

Roll →Throttle	0%
Roll →Tail	0%
Nick→Throttle	0%
▶Nick→Tail	0%
Gyro suppress	0%
⇕ «normal»	SEL

Increasing pitch is not the only change that requires a corresponding torque compensation via the tail rotor: major cyclic control movements also require this, e. g. if the swashplate is tilted in any direction. Here, too, the program of the transmitters mc-16 HoTT and mc-20 HoTT lets you configure settings for both types of tilt movement (roll and pitch-axis) separately.

For advanced aerobatics in particular, which involve very large control deflections in the pitch-axis controls, e. g. the "Bo-turn" (vertical pull-up followed by tipping over around the pitch-axis) and tight loops, the uncompensated torque present in these flights causes the model to turn to a greater or lesser degree around the yaw axis. This spoils the appearance of the maneuver.

These two mixers permit static torque compensation to be activated by the swashplate tilting in any direction. The mixers work by always increasing tail rotor thrust, starting from the centre point of the roll and pitch-axis sticks, i. e. they always generate a tail rotor deflection in the same direction regardless of the direction of the command.

The mixer value can be varied within the range 0 to +100 %.

The mixer direction is determined automatically by your definition of the direction of main rotor rotation on the »**Helicopter type**« menu, page 102.

In the auto-rotation flight phase this mixer is automatically switched off.

Gyro suppress

Nick→Throttle	0%
Nick→Tail	0%
▶Gyro suppress	0%
Gyro gain	0%
Swash rotation	0°
⇕ «normal»	SEL

Important:

In normal situations, this function should not be used if your model is fitted with a modern gyro system. In this context, ensure that you comply with the instructions on adjusting your gyro: if not, you risk making adjustments that render your helicopter impossible to fly. *This menu has nonetheless been retained in order to cater to a full range of requirements and flying habits.*

With this option, the effect of the gyro sensor ("gyro") can be varied according to the tail rotor stick position; this assumes the use of a gyro system whose gyro gain can be controlled from the transmitter via an auxiliary channel. This channel will be channel 7 for *Graupner* remote control systems.

The gyro suppression function reduces gyro gain in a linear progression as the pilot increases the tail rotor deflection. Without gyro suppression – i. e. when set to 0 % – the gyro effect is constant, regardless of the stick position.

With a transmitter control assigned on the “Gyro” line on the »**Control adjust**« menu, page 120, e. g. one of the proportional sliders mounted in the middle console; as applicable, also made flight-phase dependent and/or with infinitely variable gyro effect between minimum and maximum. In this case, gyro gain is maximum at full deflection of the slider, and zero at the opposite end-point.

Of course, the software lets you limit the gyro gain range on both sides by altering the transmitter control travel.

Depending on the transmitter control’s position, the gyro gain at full travel on the tail rotor stick is:

“current control position
minus
gyro suppression value”.

Accordingly, if the transmitter control is at the neutral point, and gyro suppression is set to 100 %, the gyro gain is reduced to zero as the tail rotor deflection increases. For values between 100 % and the maximum value of 199 %, the gyro can be fully suppressed – depending on the transmitter control position – well before full deflection of the tail rotor; see the diagram on the next page.

For the *Graupner* gyro NEJ-120 BB, No. **3277**, both the upper and the lower values are set via rotary controls: control 1 sets the *minimum* gyro gain at the *bottom* position of the slider; control 2 sets the *maximum* gain at the *top* end-point of the slider; the transition between these two values occurs roughly in the middle of the slider travel.

In contrast, the PIEZO 900, PIEZO 2000 and PIEZO 3000 gyro systems feature proportional, infinitely variable adjustment of gyro gain; see below for typical diagrams.

As an example, the option to configure flight phase-specific – and static – gyro gain gives you the opportunity to exploit maximum stabilization for normal, slow flying, but to reduce gyro gain for fast circuits and aerobatics.

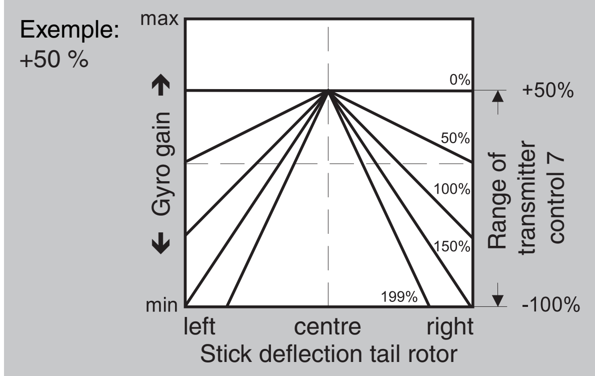
Samples of various gyro settings and configuration

- *Linear gyro suppression: 0 % to 199 %.*

  With the tail rotor stick in the centre position, the resulting gyro effect is set using the selected transmitter control. Using a proportional rotary control or slider, the effect is infinitely variable between zero (“min”) and maximum (“max”), provided transmitter control travel is not restricted. With full tail rotor deflection, the effective gyro gain is as follows:

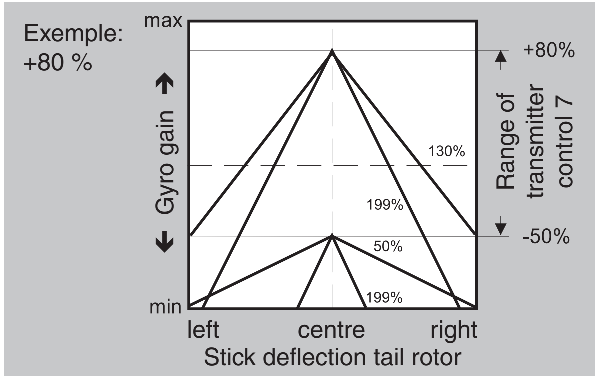
  “current control position
  minus
  gyro suppression value”.

  This means that at 0 % gyro suppression, gyro gain is constant for tail rotor stick movement; at 50 % suppression, gyro gain is reduced to half if the assigned transmitter control is moved to the +50 % position (as shown here); and only at >150 % suppression is gain reduced to zero with the slider at this position, well before full tail rotor deflection.



- *Linear gyro suppression with reduced control travel, e. g. -50 % to +80 % of full travel.*

  Gyro gain is infinitely variable within these transmitter control limits. Here too, for purposes of illustration, we plot gyro gain values in relation to tail rotor deflection for various parameter values of gyro suppression.



Adjusting the gyro sensor

To achieve the maximum possible level of stabilization for the helicopter with the gyro along the vertical axis, observe the following:

- The controls should have as little friction and “play” as possible.
- There should be no “spring” in the control linkage.

- Use a strong and comparably fast servo.

When the gyro sensor detects a model rotation, the faster its response – a corresponding corrective change to tail rotor thrust – takes effect, the further the gyro gain adjuster can be moved without causing the tail of the model to start oscillating, and the better the model's stability about its vertical axis. If the response is slower, there is a risk that the model's tail will start to oscillate even at low gyro gain settings. Here, further reductions to gyro gain will need to be made to eliminate the oscillation.

If the model is flying forward at high speed or hovering in a powerful headwind, the net result of the stabilizing effect of the vertical fin combined with the gyro may also lead to an overreaction that once again manifests itself through tail oscillation. To achieve optimum gyro stabilization under all conditions, you can make use of the option to adjust gyro gain from the transmitter using a transmitter control assigned to input "7", in connection with gyro suppression and/or the two settings on the Gyro NEJ-120 BB.

Further notes on gyros with configurable multilevel gyro gain (e. g. NEJ-120 BB)

Since you cannot specify the gyro gain from the transmitter proportionally via the transmitter control, the gyro's own control 1 must be used to set the (weaker) gyro gain (e. g. for aerobatics) and control 2 the stronger gyro gain (e. g. for hovered flight). Even though a proportional control is used for control function 7, only a switch-over between these two values takes place and the setting is therefore not proportional.

You should therefore advance control 2 to the point where the model is on the brink of oscillating when hovering in calm conditions, and advance control 1 to the point where the model does not oscillate with its tail even when flying at maximum speed into a strong headwind. Depending on the state of the weather and the flight program planned, you can also switch over the gyro gain from the transmitter – also with gyro suppression dependent on tail rotor deflection if required.

Gyro gain (Gyro Offset)

Important notice:

The value of this option is identical to the offset value set in the "Gyro" line of the »Control adjust« menu, page 120. For this reason, any changes made always affect the other menu directly – and vice versa.

Most of the latest gyro systems not only feature infinitely variable proportional gyro gain setting, but also offer a choice of two separate types of gain mode on the transmitter.

If the gyro in use has at least one of these features then this alternative offset setting provides an opportunity to preset both "normal" gyro gain as well as, as appropriate, to specify a "heading-lock mode" whereby, even within this pre-selection, gyro gain can be reduced by a particular gain type for normal, slow flight with maximum flight stabilization, fast circuit flights and aerobatics.

To proceed as described above, use flight phase switching to enter different settings on the "**Gyro offset**" line. Values between -125 % and +125 % are possible:

Nick → Throttle	0%
Nick → Tail	0%
Gyro suppress	0%
▸Gyro gain	0%
Swash rotation	0°
⇕ «normal»	SEL

Based on these flight-phase specific (offset) settings, gyro gain can also be infinitely varied by a transmitter control assigned in the "Gyro" line of the »**Control adjust**« menu, page 120.

Swash rotation

Nick → Throttle	0%
Nick → Tail	0%
Gyro suppress	0%
Gyro gain	0%
▸Swash rotation	0°
⇕ «normal»	SEL

Some rotor head control systems make it necessary to incline the swashplate in a different direction from the intended inclination of the rotor plane when a cyclic control command is given. If your model features a four-bladed main rotor, for example, you may need to use this menu to set up a software-driven 45° rotation of the control linkage to the right, so that the push-rods from the swashplate to the rotor head can be set exactly vertical, ensuring that the blade control system works correctly, without unwanted differential effects. This eliminates the need to make mechanical changes to the control linkages. Negative angles equate to a virtual rotation of the rotor head to the left; positive angles a virtual rotation to the right.

Swash limiter

```
Nick->Tail              0%
Gyro  suppress          0%
Gyro  gain              0%
Swash  rotation         0°
▶Swash  limiter       OFF
▲ «normal»            SEL
```

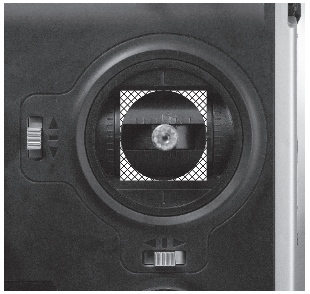
This function works like a circular mechanical surround acting upon the stick which controls the swashplate, restricting the normally square stick travel to a circular range. In fact, if the helicopter is set up in such a way that the deflections for roll and/or pitch-axis exploit the maximum travel mechanically possible, e. g. for 3D helicopters, then the total tilt applied to the swashplate if full roll and pitch-axis commands are applied simultaneously will be considerably greater (141 % in numerical terms). The swashplate mechanism may then strike its end-stops and, in the worst case, the ball-links could even be disengaged.

The mc-16 HoTT and mc-20 HoTT transmitter contains a configurable software function for limiting the total swashplate travel, i. e. it restricts the tilt angle of the swashplate from 100 % (the travel is limited to the value obtainable either with roll or pitch-axis alone) to 149 % (no effective limit). In addition, the function can be set to “Off” and hence completely deactivated. The swash limiter can also be configured per model and per flight phase.

This software solution is therefore much more flexible than a physical circular surround attached to the stick unit: the latter can, in any case, only be used if the roll and pitch-axis functions are controlled by a common stick unit.

The adjacent sketch illustrates the effect for a 100 % setting. The cross-hatched area of travel is curtailed and appears as a “dead zone”..

If this function is used, “Dual Rate” should be set to 100 % and Dual Rate values above 100 % should also not be used. If not, and you set a swashplate limit of 100 %, for example, then swashplate movement will be restricted even if roll and pitch-axis commands are given separately.



Setting range: 100 … 149 % and “off”.

You can reset an altered value to “OFF” by simultaneously pressing the ▲▼ or ◀ ▶ buttons of the right-hand four-way button (**CLEAR**) in the active (highlighted) field.

Fine-tuning the throttle and collective pitch curve
Practical approach

Although the throttle and collective pitch control systems are based on separate servos, they are always operated together by the throttle/pitch stick (except during autorotation flight). This coupling is performed by the helicopter program automatically.

In principle, the trim lever for control function 1 only affects the throttle servo in the programs of the mc-16 HoTT and mc-20 HoTT transmitters – with the exception of the choice of "PT" in the "Throttle" line of the »**Stick mode**« menu, page 110, which is available on the mc-20 HoTT transmitter only. This »**Stick mode**« menu also enables you to define whether the trim lever of control function 1 is to be used as part of the throttle limiter function ("GA"), or for idle trimming during auto-rotation exercises ("AR").

The process of fine-tuning throttle and collective pitch, i.e. setting the motor power curve to match the collective blade pitch setting, is the most important aspect of setting up a model helicopter. The software of the transmitters mc-16 HoTT and mc-20 HoTT provides for independent configuration of the throttle, collective pitch and torque compensation curves, in addition to the C1 control curve (»**Channel 1 curve**« menu, page 137).

While these curves can be modelled using up to six points, fewer points are generally sufficient. We recommend starting with three-point curves to begin with. This involves setting individual values for the centre point and other (optional) reference points, and for the two end-points ("L", "low", and "H", "high") of the throttle/collective pitch stick: together, these define the control curves.

Before setting the throttle and collective pitch function, the rods of all servos should be mechanically pre-adjusted correctly according to the set-up instructions for the given helicopter.

Note:

The hover point should normally be set to the centre position of the throttle / collective pitch stick. In special cases, e.g. for "3D" flight, deviating hover points can also be programmed. For example, one point for normal flight attitude above the centre and one point for inverted flight attitude below the centre.

Idle setting and throttle curve

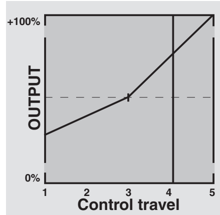
Note:

Since electric drive systems have no need for an idle setting, motor idling does not need to be calibrated. Fine-tuning of the throttle and collective pitch curve(s), however, must take place as for glow-powered helicopters.

The idle setting, whose detailed description begins on page 123, always takes place with the throttle limiter closed – normally with the trim lever of the C1 function and only in special cases is the throttle limiter itself also utilized (as standard, the right-sided proportional rotary slider (Lv2)).

The programming of a corresponding value for the "L" point of the throttle curve acts to set the descent speed of the motor, without influencing the hover configuration.

Here, for example, flight phase programming can be used to set different throttle curves. This increased system rotational speed below the hover point proves to be useful in certain circumstances, e.g. for fast, steep landing approaches with greatly reduced collective pitch, and for aerobatics.



The figure depicts a curve with a slightly changeable throttle setting below the hover point at the control centre.

Different throttle curves are programmed to be flight-phase dependent in order to achieve the given optimal adaptation to hovering flight as well as aerobatics:

- Low system rotational speed with smooth, gentle control response and low noise when hovering
- Higher rotor speed for aerobatics with motor power set close to the maximum. In this case, the throttle curve must also be adjusted in the hover range.

Basic set-up procedure

Even though pitch and throttle curves can be set electronically over a wide range with the mc-16 HoTT and mc-20 HoTT transmitter, all linkage in the model should already be mechanically pre-adjusted correctly according to the instructions for the given helicopter. Experienced helicopter pilots will be glad to help with this basic set-up.

The carburettor linkage must be set so that the throttle is just past the fully open setting with collective pitch set to maximum or, for electric helicopters, with the speed controller set to full. When the throttle limiter is closed, however, it must be possible to just close off the carburettor using the C1 trim lever (rapid throttle setting of the "digital trim", see page 58), without the servo mechanically striking its end-stop. For electric helicopters, it must be possible to cut the electric motor's speed controller safely with the throttle limiter closed.

Take great care when configuring these settings, by adjusting the control linkage as required and/or altering the linkage point on the servo or carburettor lever. Only then should the throttle servo's fine-tuning be electronically optimized.

Caution:

Inform yourself thoroughly about the dangers and safety precautions applicable to handling motors and helicopters before starting the motor for the first time!

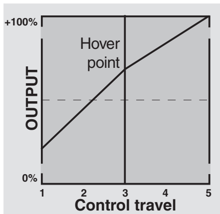
With this basic set-up complete, the motor should be started in accordance with the motor operating instructions: idling can then be configured using the trim lever of the throttle/collective pitch stick. The preset idle position will be displayed on the transmitter's basic display by a horizontal bar next to the C1 trim lever position indicator. Refer to the description of digital trim on page 62 of this manual.

The model should lift off the ground with the collective pitch stick roughly at its centre point and hover roughly at the expected rotational speed. If this is not the case, proceed as follows:

1. The model does not lift off until the collective pitch stick is above the centre point:

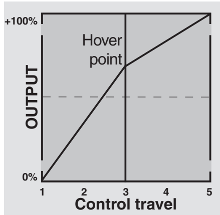
a) Rotational speed is too low

Remedy: On the graph page for "*C1 → Throttle*" increase the value for point "1".



b) Rotational speed is too high

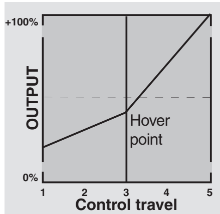
Remedy: Increase the blade angle of attack pitch by increasing the value of point "1" on the "*Pitch*" graph page.



The model lifts off before the centre point is reached:

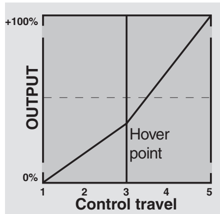
a) Rotational speed is too high

Remedy: Decrease the carburettor opening by reducing the value of point "1" on the graph page for "*C1 → Throttle*".



b) Rotational speed is too low

Remedy: Decrease the blade angle of attack pitch by reducing the value of point "1" on the graph page for "*Pitch*".



Important:

These settings must be reconfigured until the model hovers at the correct rotational speed with the throttle/collective pitch stick at its centre point. The configuration of all other model parameters depends on these settings being made correctly!

Standard set-up

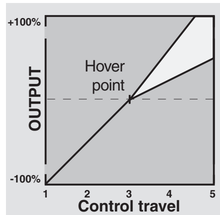
Standard set-up is completed on the basis of the basic set-up described above, whereby the model hovers in normal flight at the correct rotational speed with the throttle/collective pitch stick set to its centre point: This means a set-up with which the model is capable of both hovering and flying circuits in all phases while maintaining a constant rotational speed.

Climb settings

The combination of throttle hover setting, collective pitch setting for the hover and the maximum collective pitch setting (point "H") now permits, in a simple manner, a means of attaining a constant rotational speed from hovering right through to maximum climb.

First, perform a prolonged, vertical climb by moving the collective pitch stick to its end-point. Compared to the hover configuration, motor speed should remain unchanged.

If motor speed falls off in the climb, even with the drive system working at full power and therefore no further power increase is possible, then reduce maximum blade pitch angle at full deflection of the collective pitch stick, i. e. the value of point "H". Conversely, the attack angle should be increased if motor speed is to increase while climbing. Therefore, on the "Pitch" graph page, put the vertical line on Point "H" by moving the pitch stick then change this point's value appropriately with the ▲▼ selection keys of the right four-way button.

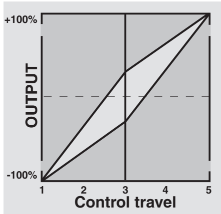


This diagram shows only the changes when setting the maximum collective pitch value.

Then bring the model back to hover, which should, in turn, be achieved with the C1 stick at its centre point. If the hover flight point is now achieved only by moving the pitch stick away from its centre point toward "higher" values then this deviation should be compensated by increasing the hover-flight pitch value – i. e. for point "1" – a little until the model once again hovers with the stick at its centre point.

Conversely, if the model hovers below the mid-point, correct this by reducing the angle of attack appropriately.

It may also be necessary to correct the carburettor opening for the hover point (point "1") with "C1 ➔ throttle".

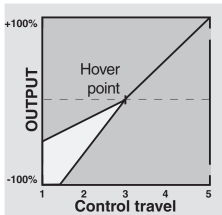


This diagram shows only the change to the hover point, i. e. collective pitch minimum and maximum are both left at -100 % or +100 %.

Modify these settings until they really result in a constant rotational speed over the full control range between hovering and climbing flight.

Descent setting

The descent setting should now be configured by placing the model in a steady descent from forward flight at a considerable altitude by fully reducing collective pitch; adjust the collective pitch minimum value (point "L") so that the model descends at an angle of 60° … 70°. Therefore, on the "Pitch" graph page, put the vertical line on Point "L" by moving the pitch stick then change this point's value appropriately with the selection keys of the right four-way button.



This diagram shows only the changes when setting the minimum collective pitch value.

Once the model can fly this maneuver properly, set the value for "Throttle min" – the value for point "L" on the graph page for "C1 ➔ Throttle" – so that the rotational speed neither increases nor decreases. This completes the set-up procedure for throttle and collective pitch.

Some important closing remarks

⚠ Before starting the motor, ensure that the throttle limiter is fully closed: this ensures that the carburettor now responds only to the C1 trim lever. There will be a visual and an acoustic warning if the carburettor is open too wide when the transmitter is switched on. Otherwise, if the carburettor or speed controller is open too far when the motor starts, there is a danger that the motor will run up to speed immediately after starting, and the centrifugal clutch will engage immediately.

Accordingly,

always hold the rotor head firmly when starting.

Nevertheless, if the motor is accidentally started with the carburettor too wide open, the golden rule is this:

Don't panic!
Hold the rotor head securely!
Don't let go!

Instead, close the throttle limiter immediately, even if this risks damaging the drive system (in the worst case scenario).

YOU must ensure the helicopter never moves in an uncontrolled manner.

The costs of repairing a clutch, a gearbox or even the motor itself are negligible in comparison to the injuries and damage that an uncontrolled model helicopter can cause if it is allowed to thrash about with spinning rotor blades.

Always make sure no other person is present in the helicopter's hazard area.

The switchover from idle to a flight setting with increased system rotational speed must not take place abruptly. This will cause the rotor to accelerate very quickly, resulting in premature wear to the clutch and gear train. Since the main rotor blades are generally mounted on a freewheeling unit, they will be unable to keep pace with such rapid acceleration; they will respond by swinging far out of their normal position and may even cause a boom strike.

Therefore, after the motor is started, system rotational speed should be increased slowly by way of the throttle limiter. If a switch has been assigned to the throttle limiter, always ensure the »**Control adjust**«" menu, page 116, is used to program a time constant of about 5 seconds to run up system rotational speed (opening the throttle limiter). Do not, however, program a delay for closing the throttle limiter. Leave the default value of "GL" in the "Type" column alone, however, to configure this setting globally for all flight phases.

Helicopter mixer
Auto-rotation setting

Auto-rotation permits both full-size and model helicopters to land safely in a crisis, e. g. if the motor should fail. Moreover, if the tail rotor should fail, cutting the motor and landing using auto-rotation is also the only possible way to avoid a high-speed, uncontrollable rotation around the vertical axis and a resulting catastrophic crash – which is why a switchover TO the auto-rotation phase takes place immediately.

Firmware version V1102 and lower

When the switchover to the auto-rotation phase is made, the Helicopter mixer menu screen changes as follows:

```
►Pitch                 =>
 Thr setting AR      –90%
 Tailoffset AR         0%
 Gyro suppress         0%
 Gyro gain             0%
 Swash rotation        0°
 Swash limiter        OFF
▾ «Autorot»
```

Firmware version V1102 and higher

Following the trend for electric helicopters, the default value in the line “AR throttle position” a newly initialized model memory is now -100%:

```
►Pitch                 =>
 Thr setting AR     –100%
 Tailoffset AR         0%
 Gyro suppress         0%
 Gyro                  0%
 Swash rotation        0°
 Swash limiter        OFF
▾ «Autorot»
```

During auto-rotation flight, the main rotor is no longer driven by the motor but only by its own momentum and the airflow through the rotor plane during descent. Since the energy stored by a rotor kept spinning in this way is rapidly consumed if the helicopter flares, pilots must not only have experience in handling helicopter models but must also consider carefully how the relevant functions should be configured.

The advanced pilot should therefore practice auto-rotation landings at regular intervals. Not only to be able to demonstrate mastery of the maneuver at competitions, but also to ensure the pilot can land the helicopter undamaged from a great height if the motor should fail. For this purpose, the program provides a range of adjustment options designed to help the pilot fly a motorized model in its unpowered state.

Note that the auto-rotation settings comprise a complete seventh flight phase, which provides access to all the flight phase-specific configuration options, and to trims, collective pitch curve settings, etc., in particular. The following functions have special features not present in the powered flight phases:

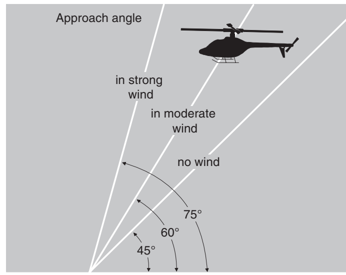
Pitch (Collective pitch curve (C1 → Pitch))

In powered flight, the maximum blade pitch angle is limited by available motor power. In auto-rotation, however, it is limited only by the point at which airflow ceases over the main rotor blades. Greater maximum collective pitch must therefore be set to ensure sufficient thrust when flaring the helicopter even as rotational speed is falling off. To do so, briefly tap the centre **SET** key of the right four-way button to switch to the “Pitch” graph page and then use the stick to move the vertical line to point “H”. Start by setting a value that is about 10 to 20 % *greater* than your “normal” maximum value for collective pitch. Initially, however, do NOT set a value that is considerably greater than for normal flight, since, if this is done, the behavior of the collective pitch controls may then be very unfamiliar following the switchover. Indeed, there is a danger that the pilot will oversteer during the flare and the model will balloon: this will case the rotor speed to collapse at a considerable altitude and the model will then crash to the ground. The value can always be readjusted later after flying some test auto-rotations.

The minimum value for collective pitch can differ from that set for normal flight. This depends on the pilot’s usual style for normal flight. For auto-rotation, however, always set a sufficiently generous minimum value for collective pitch at point “L” to ensure the model can be brought out of forward flight at moderate speed into a descent at an angle of around 60 … 70 degrees when collective pitch is reduced to a minimum.

If, like most helicopter pilots, you have used this kind of setting for normal flight anyway, then this value can simply be transferred.

If, however, you normally let your model “fall” at a shallower angle, then you should increase the value at point “L”, and vice versa.



Approach angle for various wind conditions

As a rule, the collective pitch stick itself is not positioned right at the bottom of its travel for auto-rotation. Instead, it is typically between the hover position and the bottom end-point. This offers the pilot an option for further adjustment, e. g. via pitch inclination through pitch-axis controls.

The approach can be shortened by pulling back slightly on the pitch-axis stick and gently reducing pitch or by extending the approach by pushing forward on the pitch-axis stick and carefully increasing pitch.

Throttle setting AR

Although pilots will be expected to cut the glow motor completely during competitions, This is rather inconvenient during training sessions because the motor must be restarted after every practice auto-rotation landing.

Therefore, for training sessions, set this line's value such that a combustion motor is held at a safe idle without the clutch engaging during the auto-rotation phase; electric drive systems should be set safely to "Off".

Note:
*The "Motor Stop" option in the »**Base setup model**« menu offers an alternative "Emergency STOP" function.*

Tail rotor AR

In normal flight, the tail rotor is set so that it compensates for motor torque while the model is hovering. It therefore generates some a certain amount of thrust even in its normal position. The level of thrust is then varied by the tail rotor control system, and also by the various mixers which provide all manner of torque compensation, while the tail rotor trim is also used to compensate for varying weather conditions, fluctuations in system rotational speed and other influences.

For auto-rotation, however, the main rotor is not driven by the motor, but by the "windmill" principle. Since this, in turn, does not generate any torque for which the tail rotor must compensate, all corresponding mixers are switched off automatically.

Since the absence of torque in auto-rotation also means the above-mentioned thrust is superfluous, however, a different tail rotor configuration is also required:

Cut the motor and place the helicopter on the ground in a level attitude. With the transmitter and receiving system switched on, select the flight phase "Auto-rotation" and then fold the tail rotor blades down. Now change the value on the "Tail rotor" line until the tail rotor blade angle of attack is zero degrees. Viewed from the tail, the tail rotor blades should be parallel to one another.

Depending on the friction and running resistance of the gearbox, the fuselage may still yaw slightly, however. This relatively slight torque must then be corrected if necessary by adjusting the tail rotor blade pitch angle. This value will always be a figure between zero degrees and a pitch angle opposed to the pitch angle in normal flight.

General notes on freely programmable mixers

The previous pages have described a wealth of ready-to-use built-in coupling functions, in the context of the two menus »**Wing mixers**« and »**Helicopter mixers**«. The fundamental significance of mixers and the principle by which they work are described on page 165. The following section provides information about the so-called "free mixers".

In addition to the pre-programmed mixers mentioned above, the transmitters mc-16 HoTT and mc-20 HoTT also offers a number of freely programmable mixers in every model memory location, whose inputs, outputs and mixer ratios can be defined to meet one's own requirements. These include:

- 8 linear mixers, numbered 1 through 8
- 4 curve mixers, numbered 9 through 12

These 12 mixers are certainly adequate for most applications and are certainly sufficient when the potential of the pre-programmed coupling functions are utilized. The »**MIX act. / phase**« menu, which is available as standard on the mc-20 HoTT transmitter only, see page 211, also provides a means of activating or disabling any of these twelve mixers separately for each flight phase.

For the "free mixers", the signal present at any control function (1 to 8 or 1 … 12) can be assigned as the *input signal* or, for a so-called "switch channel" (see further below), the signal from any switch can be utilized. The signal that is present at the control channel and passed to the mixer input is always influenced by its own transmitter control and by any control characteristic that may have been set, e.g. those specified by the »**Dual Rate / Expo**«, »**Channel 1 curve**« and »**Control adjust**« menus.

The mixer output acts on a control channel (1 to – depending on transmitter and receiver type – a maximum of 12) that can also be assigned freely.

Before this channel routes the signal to the servo, it can only still be influenced by the »**Servo adjustment**« menu, i.e. by the servo reverse, neutral point offset, servo travel and servo travel limit functions, and possibly by the »**Tx. output swap**« option, which is available as standard on the mc-20 HoTT transmitter only.

One control function can be used for any number of mix inputs simultaneously: if, for example, several mixers are to be switched to act in parallel.

Conversely, it is possible for any number of mixers to affect one and the same control channel. Particularly in the latter case, however, it is very important to ensure that the servo concerned does not strike its mechanical end-stops when several mixer signals accumulate excessively. For safety's sake, it may therefore be necessary to set an appropriate travel limit in the »**Servo adjustment**« menu, page 106.

For more complex applications, mixers can be switched in sequence. In this case, it is not the (transmitter) signal at the "output" of a control function which forms the input signal of the "series-wired" mixer, but the (mixed) signal "further back" at the "input" of a control channel. The following description of the free mixers includes several examples of this type.

In the software, a "free mixer" is always initially activated. Optionally the mixer can also be assigned to an ON/OFF switch. Since there are so many functions to which switches can be assigned, be careful to avoid (undesired) multiple assignments to a single switch.

The two key mixer parameters are:

- … the **mixer ratio**, which defines the extent to which the input signal acts on the output of the control channel connected to the mixer output.

  The mixer ratio for linear mixers can be set as symmetrical or asymmetric.

  Curve mixers can also be configured with up to 6 points to suit one's own application and even implement extremely non-linear curves.
- … **the neutral point** of a mixer, which is also referred to as the "offset".

  The offset is that specific point along the movement of a transmitter control (stick, proportional control or switch) at which the mixer no longer influences the control channel connected to its output. Normally, the neutral point is the centre point of the transmitter control. However, the offset can also be set at any other point along the control travel. Since there are no restrictions on the design of the curve mixers, setting a mixer neutral point only makes sense for the 8 linear mixers.

Switch channel "S" as a mixer input

Occasionally, however, only a constant control signal is required at the mixer output, e.g. for a slightly increased "up-elevator" trim when the aero-tow release is closed – fully independently of its normal trim setting.

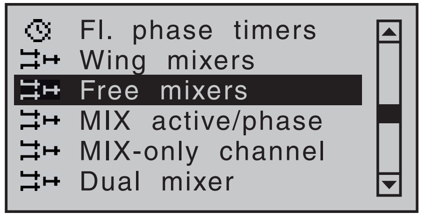
In this case a switch is assigned both to the aero-tow release and the mixer; it is then used not only to open and close the release, but also to pass the desired trim signal to the elevator via the mixer ratio. To identify this special arrangement, this mixer input control function in the program is designated "S" for "Switch channel".

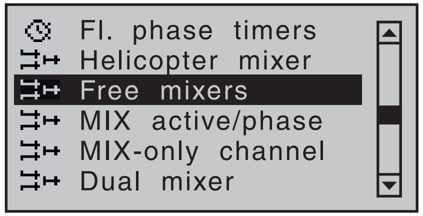
In addition, if the corresponding "target channel" should now no longer be influenced by its "normal" transmitter control, separate its transmitter control from the function input of the associated control channel in the »**Mix-only channel**«, see page 212, which is available as standard on the mc-20 HoTT transmitter only. Here too, for clarification of this there is an example of the function provided in the following menu description.

Free mixers

Freely-programmable linear and curve mixers

Use the selection keys of the left or right four-way button to scroll to the »**Free mixers**« menu option in the Multi-function menu:

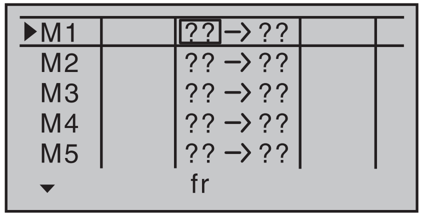




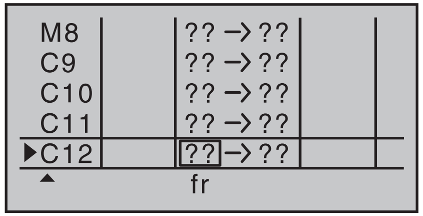
Open this menu option with a tap on the centre **SET** key of the right four-way button.

mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

Regardless of the model type selected, each of the 20 (mc-16 HoTT) or 24 (mc-20 HoTT) model memory locations offers eight linear mixers (M1 … 8) …



… and 4 curve mixers (C9 … 12), which also offer non-linear control characteristics:



The »**MIX act. / phase**« menu, see page 211, which is available as standard on the mc-20 HoTT transmitter only also provides a means of activating and disabling specific mixers separately for each flight phase.

On the "Free mixers" menu, the blocked mixers are then suppressed in the corresponding flight phase. If you are hunting for a mixer that is not shown, you should therefore switch to the appropriate flight phase!

In this first section, however, we will concentrate on how to program the first screen page of the "free mixers". We will then move on to the method of programming mixer ratios, both for linear mixers and curve mixers, as found on the second screen page of this menu.

Basic programming procedure

1. Select the mixer you want by using the ▲▼ selection keys on the left or right four-way button.
2. Tap the centre **SET** key of the right four-way button. The input field on the column marked "fr" at the lower edge of the screen is now shown highlighted.
3. Use the selection keys on the right four-way button to select the "fr" mixer input.

   Additional column names now appear in the bottom line of the screen.
4. Tap the centre **SET** key of the right four-way button; using the ▶ selection key of the left or right four-way button, switch to the column marked "to" at the lower edge of the screen then tap the centre **SET** key of the right four-way button once again.

   The input field "to" is shown highlighted.
5. Use the selection keys on the right four-way button to select the "to" mixer output.
6. Tap the centre **SET** key of the right four-way button. Optionally use the ◀ selection key of the left or right four-way button to switch to the column marked "ty" at the lower edge of the screen in order to include the trim of the respective stick in the mixer input signal ("Tr" for trim or "P" for phase) and/or to add series switching ("➔") for mixers …

   … and/or use the ▶ selection key of the left or right four-way button to change into the column marked with the switch icon ("⌐") on the lower edge of the screen.

To do this, tap the centre **SET** key of the right four-way button once again and assign a switch as described in the section "Physical control, switch and control switch assignments" on page 60.

7. Using the ► selection key of the left or right four-way button, switch to the column ("»") then tap the centre **SET** key of the right four-way button.
8. Define the mixer ratios on the second screen page.
9. Return to the first page by using the centre **ESC** key of the left four-way button.

"fr(om)"

After selecting a mixer line and a subsequent tap on the centre **SET** key of the right four-way button, select one of the control functions, 1 … 8 respectively 1 … 12 or S, for the value field now in inverse video with the selection keys of the right touch.

For the sake of clarity, control functions 1 … 4 are marked as follows when setting wing mixers:

C1	Throttle/airbrake stick
AI	Aileron stick
EL	Elevator stick
RU	Rudder stick

… and, for the helicopter program:

1	Throttle/collective pitch stick
2	Roll stick
3	Pitch-axis stick
4	Tail rotor stick

<u>*Note:*</u>

*If you select any of the control functions 5 … 12 max. for fixed-wing models or 5, 7 … 12 max. for helicopter models, do not forget to assign a transmitter control for each of these in the »**Control adjust**« menu!*

"S" as switch channel

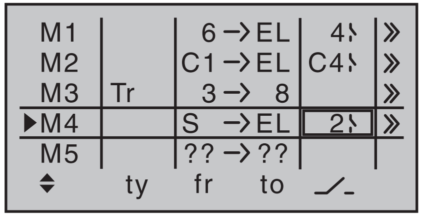
Selecting "S" (switch channel) in the "**fr**" column has the effect of passing a ***constant*** input signal to the mixer input, e. g. in order to add a little more "up-elevator" trim when the aero-tow release is closed, as mentioned on the previous page.

After assigning a control function or the "S" switch channel in the "fr" column, the following is also displayed …

"to"

… on the lower edge of the screen.

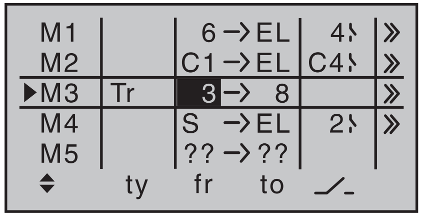
Use this column's input field to specify the destination of the mixer, i. e. assign mixer output, to one of the control channels. At the same time, additional fields will appear in the bottom line of the screen:



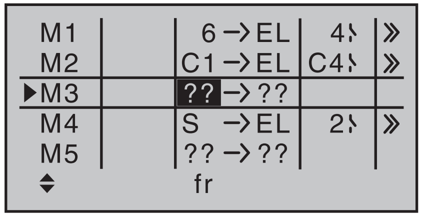
In this example, four mixers have already been defined. The second mixer is already familiar in principle as "Elevat curve" from the "Brake settings" sub-menu of the »**Wing mixers**« menu and the third is familiar from the line "Tail" ("2ELSv3+8") of the »**Model type**« menu. As a general rule, however, you should first make use of the pre-programmed mixers. However, if you need asymmetric mixer ratios, want to program non-linear curves or need to offset the mixer neutral point, then you should set or leave the pre-programmed mixers at "0 %" and replace these with free mixers.

Erasing mixers

To erase a previously-defined mixer, select the appropriate line with the ▲▼ selection keys on the left or right four-way button, switch to the "fr" column, if necessary, with the ◄► selection keys then briefly tap the centre **SET** button on the right four-way button:



The field in the "fr" column for the mixer you want to delete will now be shown in inverse video: tap both ▲▼ selection keys or ◄► on the right four-way button at the same time (**CLEAR**):



Mixer switches

In the sample screen image shown above, switches "4" and "2" have been assigned to linear mixers 1 and 4 and to mixer 2 of the control switch "C4".

The switch symbol to the right of the switch number shows the current switch state.

Any mixers not assigned to a switch, as indicated by an empty cell for the column marked by the switch icon ("⁄") on the screen's bottom line, are fundamentally active!

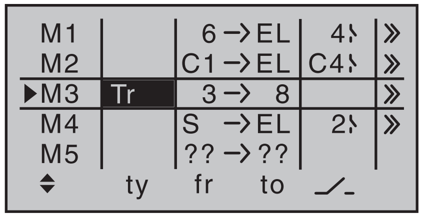
A switch *must* be assigned to LinearMIX 4 if you wish to switch between two fixed mixer values (still to be set) that correspond to the two end-points of a (proportional) transmitter control. Accordingly, the "switch channel" mixer cannot also be switched "on" or "off" as with the other mixers.

If you intend to assign a control switch (G1 … G4) or a logical switch (L1 … 8) as the mixer switch, then please remember that you also must define the switch as such in the »**Control switches**« menu, or in the »**Logical switches**« menu, which is available as standard on the mc-20 HoTT transmitter only. If you do not, you will assign an undefined control or logical switch and therefore one that functions as a fixed switch.

"Ty(pe)"

Including the trim

For control functions 1 … 4, you can also allow trimming of the digital trim lever for the given stick effect the mixer's input. In this case, briefly tap the centre **SET** key of the right four-way button then use the selection keys to select "Tr" in the inverse video field:



The effect of the C1 trim lever on mixer output will depend on the function assigned in the »**Model type**« menu, page 98, in the "Motor on C1" column for fixed-wing models …

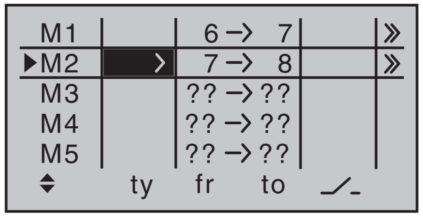
Trim	Effect on mixer output
None	linear over full trim lever travel
Forward	Only effective if C1 stick is forward
Back	Only effective if C1 stick is back

… or – in the case of model helicopters – in the "Thr." line of the »**Stick mode**« menu, which is available on the mc-20 HoTT transmitter only:

Trim	Effect on mixer output
TA (Thr-AR)	linear over full trim lever travel to output 6 (throttle servo)
TL (Throttle limit)	only effective at minimum position of the assigned throttle limit control (the right side proportional rotary control as standard)
PT (Pitch)	linear over full trim lever travel to control function "Pitch"

Switching mixers in series

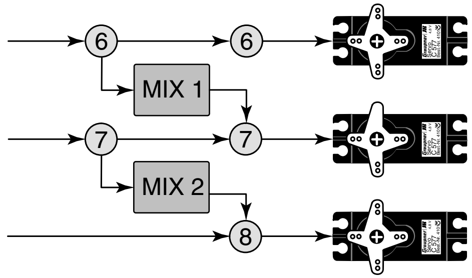
As already explained on page 200, you can also switch mixers in series: Where mixers are switched in "sequence", the "input signal" of a control channel already on its way to the servo "branches off" and is directed to a further channel. In the "ty" column, select the right angle bracket "›" or "Tr ›", if the trim should also act simultaneously on the mixer input:



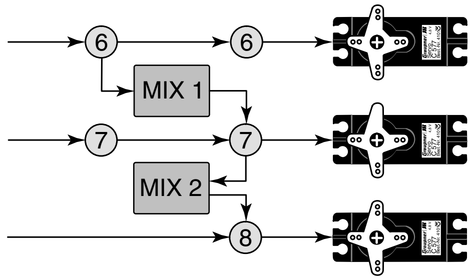
Example:

Two mixers (MIX 6 → 7 and 7 → 8):

a) WITHOUT series switching:



b) The same mixers WITH series switching:

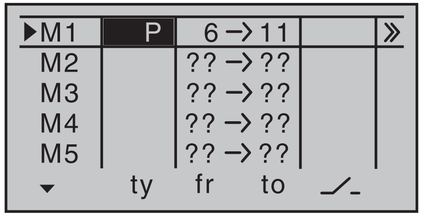


In this highly simplified example, if mixer 2 is switched in series, then it does not "take over" solely the transmitter signal of control function 7 – as shown under a) – but, instead, the entire (mixed) signal present at the servo side of control channel 7, as shown under b).

It then directs this in accordance with its configured mixer ratio forwards to control channel 8. In this case, the effect of transmitter control "6" extends as far as output "8". This kind of serial linkage can be extended as far as you wish. For example, another mixer "8 → 12" can be used to route the control signal from "6" as far as output "12", taking into consideration the associated mixer ratios. Of course, even with an active serial link, each separate mixer can still be controlled via the transmitter control assigned to the mixer input. Fixed-wing and helicopter mixers also work in the same way, when set up to switch "in sequence".

Including phase trim

If you wish to apply the FLAP channel ("6") or FLAP2 channel ("9") trim values stored in the »**Phase trim**« menu – flight phase dependent – then first tap the centre **SET** key of the right four-way button and use its selection keys to select "P":



Depending on the mixer value configured, a mixer can, as shown in the example above, route the signal from a flap control present (e.g.) on input 6 to control channel 11, while also applying the FLAP trim value set on the »**Phase trim**« menu, page 156, for the respective flight phase.

Other special features of free mixers

Mixer input = mixer output

If you set up a mixer whose input is the same as its output, e.g. "C1 → C1", you can achieve some very special effects in conjunction with the option of switching a free mixer on and off in any way you like. A typical application of this can be found at the end of this section, as Example 2 on page 210.

<u>*Tip:*</u>

*If you separate a control function – for example ,"9" – in the »**Mix-only channel**« menu, see page 212, then the servo's response is determined exclusively by the mixer input of a mixer programmed from "9 → 9". This menu is available as standard on the mc-20 HoTT transmitter only.*

*Thus, with linear mixers M1 … 8 or curve mixers C9 … 12, 6-point control curves can be defined for any transmitter control in a manner analogous to that described in the »**Channel 1 curve**« menu and these can also be used in flight phase switching if needed. This method of "linking" is not only also switchable but can even be subject to a delay by assigning an appropriate delay in the "– time +" column of the »**Control adjust**« menu. Details, can be found in Programming example for "Controlling timed sequences" on page 310.*

Mixer output affecting default software coupling of aileron, camber-changing flap or collective pitch servos

Before we start specifying the mixer ratio, we must first give some thought to what happens if we permit a mixer to affect the default software coupling of aileron, camber-changing flap or collective pitch servos:

- **Fixed-wing models:**

  Depending on the number of wing servos available on the "Aile/flaps" line of the »**Model type**« menu, control channels 2 and 5 are connected via special mixers for the "aileron" function, 6 and 7 for the "flap" function, outputs 9 and 10 (if present) for the FLAP2 servos and 11 and 12 for AILE2 servos.

  If mixer outputs are programmed to affect these kinds of couplings, then their effect on the respective flap pair derived from the "receiving" control channel must be accounted for:

Mixer	Effect
N.N.* → 2	servo pair 2 + 5 responds with an aileron function
N.N.* → 5	servo pair 2 + 5 responds with a flap function
N.N.* → 6	servo pair 6 + 7 responds with a flap function
N.N.* → 7	servo pair 6 + 7 responds with an aileron function
N.N.* → 9	servo pair 9 + 10 responds with a flap function
N.N.* → 10	servo pair 9 + 10 responds with an aileron function
N.N.* → 11	servo pair 11 + 12 responds with a flap function
N.N.* → 12	servo pair 11 + 12 responds with an aileron function

- **Model helicopters:**

  With helicopter mixers, collective pitch control may be provided by up to 4 servos connected to receiver outputs 1, 2, 3 and 5, depending on helicopter type. The software links these together to control collective pitch, roll and pitch-axis.

  Other than within the »**Helicopter mixers**« menu, it is **not** advisable to mix a free mixer into these channels because this can lead to very complex interactions. One of the few exceptions is "Collective pitch trim using a separate transmitter control" – see example 3 on page 210.

<u>***Important notices:***</u>

- ***With serial links in particular, remember that the travels of the individual mixers are cumulative if multiple stick commands are made simultaneously: there is a risk that the servo(s) may strike a mechanical end-stop. If necessary, reduce "servo trav-***

* *N.N. = Nomen Nominandum (that indicates the named name)*

el" to avoid this; alternatively, set "Travel limit" on the "Servo adjustment" menu and/or reduce mixer values.

- ***Take advantage of the ever-present option to switch over to the transmitter's »Servo display« menu, see page 274. This menu is reached from almost any menu with a brief, simultaneous tap on the ◄ ► keys of the left four-way button. This menu gives you the opportunity to check the effects of all of your settings on a single screen.***

Mixer ratios and mixer neutral point

Now that we have explained the wide-ranging nature of the mixer functions, the following section describes how to program linear and non-linear mixer curves.

For each of the 12 available mixers, the mixer curves are programmed on a second page of the screen display. Use the selection keys ▲▼ on the left or right four-way button to select the desired mixer line. If necessary, use the four-way button's selection keys to move to the right column ("»") then briefly tap the centre **SET** key of the right four-way button to access the graph page**.**

M1 … 8: Setting linear mixer values

As a practical example, we will now define a linear mixer curve to resolve the following problem:

For a motorized aircraft model, the two servos connected to receiver outputs 6 and 7 – defined on the "Aile/flaps" line of the »**Model type**« menu as "… 2FL" – are to be used for actuating landing flaps. That is; when a transmitter control is moved, they must deflect downwards only. This requires a simultaneous elevator trim, however.

First allocate, for example, input 6 to the left slider control SI1 located in the middle of the console by making settings in the »**Control adjust**« menu. A transmitter control on input 6, – as shown in the above table – will control the two servos connected to receiver outputs 6 and 7 by default as flaps. Leave the default value of "GL" in the "Type" column alone, however, to configure this setting globally for all flight phases – as is the case for the free mixer.

***»Control adjust«** menu*

```
 In5  |GL|fr   ---|   0%
►In6  |GL|SI1  ---|   0%
 In7  |GL|fr   ---|   0%
 In8  |GL|fr   ---|   0%
«normal»
      typ SEL      offset
```

Note:

Note that if two flap servos have been selected, any transmitter control assigned to input 7 will be decoupled in the software in order to avoid errors in operating the flaps. However, in the interests of safety, you should make a habit of leaving all inputs not currently required to "free", or of resetting these back to "free"!

Start by moving this transmitter control to its forward limit and adjust the landing flaps so that they are retracted or closed in this position. If you now move the dial to the rear, the flaps should move downward; if not the direction of servo rotation must be adapted.

We now turn our attention to the first mixer shown in the screen image on page 202 ("6 ➔ EL"), to which switch 4 was assigned:

```
►M1  |   | 6 -> EL |  4  | »
 M2  |   |C1 -> EL | C4  | »
 M3  |   |?? -> ?? |     |
 M4  |   | S -> EL |  2  | »
 M5  |   |?? -> ?? |     |
       ty   fr    to
```

Briefly tap the centre **SET** key of the right four-way button to open the second screen page:

```
L.Mix 1        6->EL

          OFF
```

If this screen appears, the mixer has not yet been activated in combination with the assigned toggle switch – "4", in this example. If so, operate the switch:

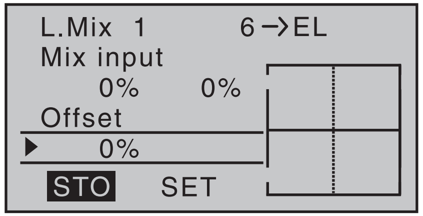
```
L.Mix 1        6->EL
Mix input
►   0%     0%
Offset
    0%
SYM    ASY
```

The continuous vertical line represents the current position of the transmitter control linked to input 6. (However, it is not visible in the above graphic because it is at the left edge since slider control SI1, in this example assigned to input 6 (see previous page), is at its forward limit.) The dotted vertical line in the middle of the diagram indicates the position of the mixer neutral point – see under "Offset", below. The solid horizontal line shows the mixer ratio, which currently has the value zero over the entire stick travel; accordingly, the elevator will not yet follow the movement of the flaps.

First, the …

Offset (mixer neutral point)

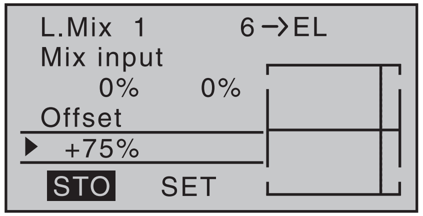
… should be defined. This is accomplished by using the Select button ▼ of the left or right-hand four-way button to move to the line below “Offset”:



The dotted vertical line in the middle of the diagram indicates the position of the mixer neutral point (“Offset”), i.e. the specific point along the control travel at which the mixer does NOT influence the control channel connected to its output. The default position for this point is at the control centre.

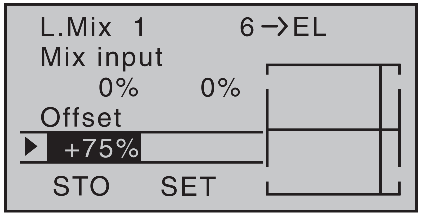
However, since in our example the flaps should be closed or retracted with the slider control at its forward limit and therefore the elevator should not be further influenced in this position, the mixer neutral point must be relocated to precisely this point. To do so, push the slider control used (in this example, slider control Sl1) to its forward limit if you have not already done so, then briefly tap the centre **SET** key of the right four-way button. The dotted vertical line moves across to this point, the new mixer neutral point, which by definition always retains the “initial” value of zero.

However, to better illustrate our example, we now wish to set this “Offset” value to only -75 %:



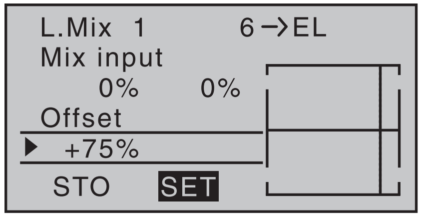
Notes:

- *By selecting **SET** with the ▶ selection key of the left or right four-way button followed by a tap on the centre **SET** key of the right four-way button …*



… the offset value can be set manually or adjusted in 1 % increments with the selection keys on the left or right four-way button.

- *By selecting **SET**, the mixer’s neutral point is automatically set back to control centre with a simultaneous tap on both the ▲▼ or ◀ ▶ selection keys of the right four-way button (**CLEAR**).*



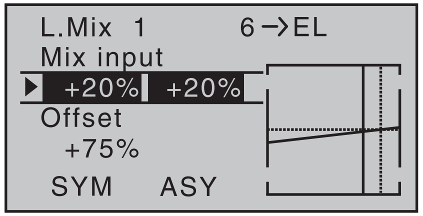
Symmetrical mixer ratios

The next task is to define the mixer values above and below the mixer neutral point – starting from its current position. Now select the “Mix input” section moving by pushing the ▲ key.

If necessary, use selection keys ◀ ▶ on the left or right four-way button to select the **SYM** field in order to establish a mixer value which is symmetric to the offset point just set. Following a brief tap on the centre **SET** key of the right four-way button, set both **SYM** fields (now in inverse video) via the selection keys of the right four-way button to values between -150 % and +150 %. *Note that the mixer value set always refers to the input signal of the respective transmitter control (control signal)!* Negative mixer values reverse the direction of the mixer.

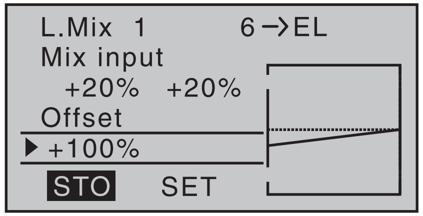
A simultaneous tap on the ▲▼ or ◀ ▶ selection keys of the right four-way button (**CLEAR**) will erase the mixer ratio in the inverse video field.

The “optimum” value in our example will certainly need flight-testing.

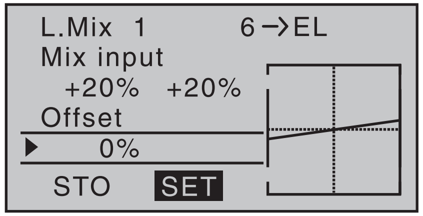


Earlier, we set the mixer neutral point at -75 % of control travel: as a result, the elevator (“EL”) will exhibit a (slight) down-elevator effect even at the neutral point of the landing flaps and this is naturally undesirable. Accordingly, you should reposition the mixer neutral point to -100 % of control travel, as described earlier:

* *N.N. = Nomen Nominandum (that indicates the named name)*



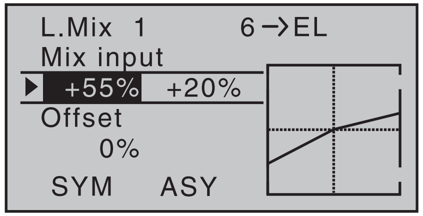
If the offset, now -100 %, is reset to 0 % of control travel by using selection key ▶ on the left or right four-way button to select the **SET** field then tapping either the selection key combination ▲▼ or ◀ ▶ on the right four-way button (**CLEAR**), the following screen will appear:



Asymmetric mixer ratios

In many cases, however, we require different mixer values on each side of the mixer neutral point.

Do this by first resetting the offset of the mixer used in the example, "6 ➔ EL" again to 0 %, if necessary, refer to the figure above. Now select the **ASY** field with the selection key ▶ on the left or right four-way button then tap the centre **SET** key of the right four-way button. If slider control SI1, assigned to input 6 in this example, is now moved in each corresponding direction, the mixer ratios for each of the two control directions, i. e. left and right of the established offset point, can be adjusted with the selection keys of the right four-way button:



Note:

If you are using a type "S ➔ N.N." switch channel mixer you will need to actuate the assigned switch. The vertical line then jumps between the left and right side.*

Setting curve mixers C9 … 12

These four curve mixers allow the definition of extremely non-linear mixer curves by placing up to four freely positionable points between the two endpoints "L" (low = -100 % control travel) and "H" (high = +100 % control travel) along the control travel.

If you have already read the »**Channel 1 curve**« menu description (see page 134 to 137) or about programming 6-point curves in the »**Helicopter mixers**« menu (see page 185), you can safely skip the following description.

Programming details

The control curve is defined by up to 6 points, known as "reference points". In the default software configuration, 2 reference points are already defined, namely only the two end-points, "L" and "H"; see the next screen image.

The following section applies to "any" mixer to which we wish to assign a non-linear curve characteristic.

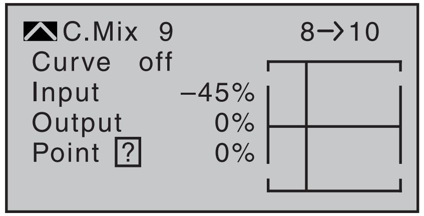
The examples shown in the following section are merely illustrative, however, and they do not represent real-life mixer curves.

* N.N. = Nomen Nominandum (the named name)

Setting reference points

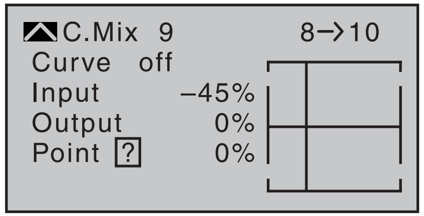
When you move the transmitter control assigned to the mixer input – here control function 8 – a vertical line in the graph follows the movement between the two end-points. The current control position is also shown numerically on the "Input" line. The point at which this line intersects with the curve in question is named the "Output" and can be varied between ± 125 %; see further below. This control signal acts on the mixer output.

In the above example, the transmitter control is on input 8 at -50 % of control travel. The output signal continue to show 0 %, however, since no value has yet been entered.

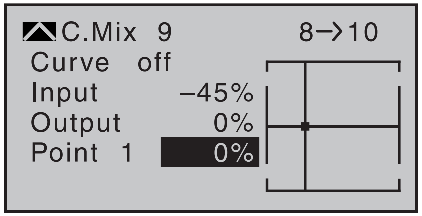


Up to four additional reference points can be set *between* the two end-points "L" and "H", although the distance between neighboring reference points must not be less than approx. 25 %.

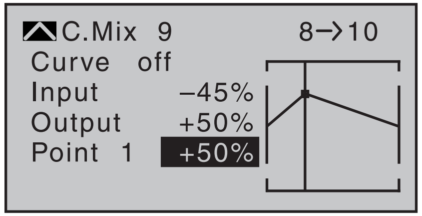
Move the transmitter control of the control channel you have selected – in this example the left of the two proportional sliders fitted to the centre console ("SI1").



When you now briefly tap the centre **SET** key of the right four-way button, the "?" is replaced by a point number and the value field to the right is activated, i. e. presented in inverse video:



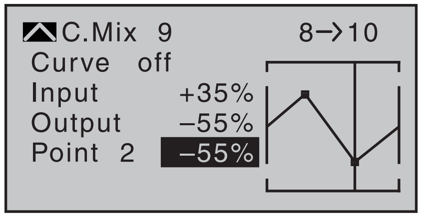
Using the selection keys on the right four-way button you can now change the point value within a range of ±125 %, e. g.:



Note:

If the stick does not coincide with the exact reference point, please note that the percentage value on the "Output" line always relates to the current stick position.

Continue in this way to set other reference points. Note that the order in which you generate the (maximum) four reference points between end-points "L" and "H" is irrelevant, since the reference points are continuously renumbered automatically from left to right as they are entered:



With the Value field now highlighted, press the two Select buttons ▲▼ or ◄ ► of the right-hand four-way button (**CLEAR**) simultaneously

Erasing reference points

To erase one of the reference points between "L" and "H", use the transmitter control in question to move the vertical line onto or into the vicinity of the reference point in question. The reference point number and associated reference point value are shown on the "Point" line. If necessary, activate the Value field by pressing the central **SET** button of the right-hand four-way button.

With the Value field now highlighted, press the two Select buttons ▲▼ or ◄ ► of the right-hand four-way button (**CLEAR**) simultaneously.

The selected reference point is erased, and the numbering of the remaining reference points is updated as required. Briefly tap the centre **ESC** key of the left four-way button to complete the procedure.

Note that the reference points "L" and "H" cannot be erased.

Changing reference point values

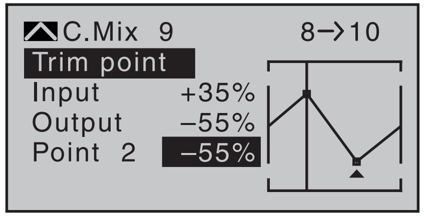
To change reference point values, use the associated transmitter control to move the vertical line onto the point you wish to change: "L", 1 … 4 or "H". The number and current curve value of this point are displayed. After activating the value field on the "Point" line by briefly tapping the centre **SET** key, use the selection keys on the right four-way button to change the current curve value shown in the highlighted field. The possible range is -125 % to +125 % and changes do not affect neighboring reference points. Briefly tap the centre **ESC** key of the left four-way button to complete the procedure.

Note:

If the stick does not coincide with the exact reference point, please note that the percentage value on the "Output" line always relates to the current stick position.

Trim point function

Alternatively, with the Point value field active (i. e. highlighted) you can use the Select buttons ◄ ► of the left-hand four-way button to skip reference points L, 1 … max. 4 and H which you have already set, in the ascending or descending direction. The selection keys on the right four-way button can then be used to change the reference point jumped to as described above, entirely independently of the control position.



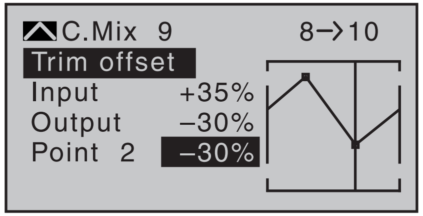
In this simple example, slider control SI1 – represented by the vertical line – is halfway between the backward limit and the midpoint of control travel (input = -50 %). However, "Point 2" will be relocated to control centre at a point value of -55 %, resulting in a momentary output value of -55 %.

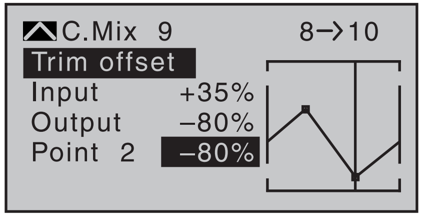
One touch on the centre **ESC** key of the left four-way button will terminate this trim point function.

Trim offset function

When a value field is *active*, i. e. in inverse video, it is not only possible, as previously described, to jump up or down to reference points already set with the ◄ ►

selection keys of the left four-way button and to make a change with the selection keys of the right four-way button, but also an existing curve can be vertically repositioned within a range of ±25 % through use of the ▲▼ keys on the left four-way button. Starting with a point value for "Point 1" at -55 %, the control curves in both of the following figures have been vertically shifted within the ±25 % range by the trim offset function:

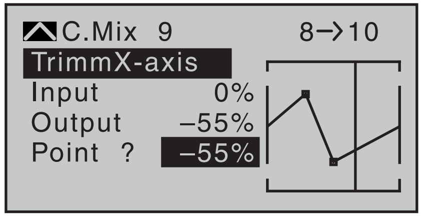




You can also exit this function by tapping the centre **ESC** key of the left four-way button.

Trim x-axis function

This function is activated by tapping the left (◄) or right (►) selection key of the right four-way button with an active (i. e. inverse video) value field. You can then use the selection keys on the right four-way button to reposition the active point horizontally or vertically as you wish. In the figure below, "Point 2" which was just shifted to -55 % with the trim point function, will now be shifted to the left, from input value +35 % to 0 %:



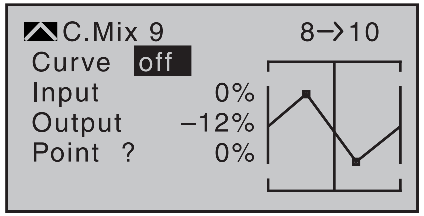
Notes:

- *If the point is repositioned horizontally further away from the current control position than approx. ±25 %, a "?" sign will reappear in the line Point. This question mark does not refer to the repositioned point, however: instead, it signifies that a further point can be set at the current control position.*
- *Please note that the percentage value on the "Output" line always relates to the current stick position and not to the position of the point.*

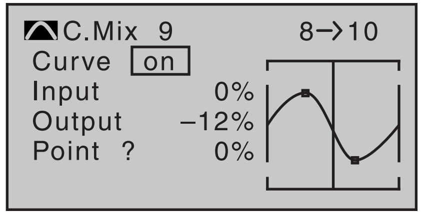
Smoothing the curve

This "angular" curve profile created in the example can be smoothed automatically simply by pressing a button.

Starting from the situation in the previous illustration, first press the **SET** button of the right-hand four-way button to conclude the procedure. Now use the Select button ▲ of the right-hand four-way button to move up to the Value field of the "Curve" line, and press the **SET** button of the right-hand four-way button once more:



Now press one of the Select buttons of the right-hand four-way button in order to switch from "off" to "on", then briefly press the central **SET** button of the right-hand touch-button, or the central **ESC** button of the left-hand touch-button, to conclude the procedure:

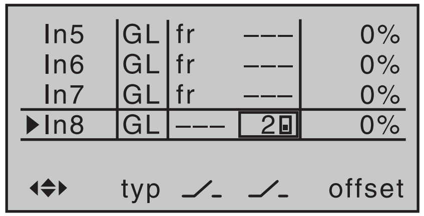


Note:

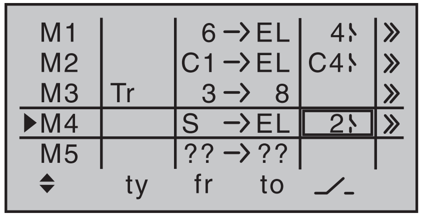
The curves shown here are for demonstration purposes only and are not at all representative of real mixer curves. For real-world application examples, see the programming examples on pages 286 and 325.

Examples

1. To open and close an aero-tow, a switch, e. g. SW 2, has already been assigned to control channel 8 in the »**Control adjust**« menu:

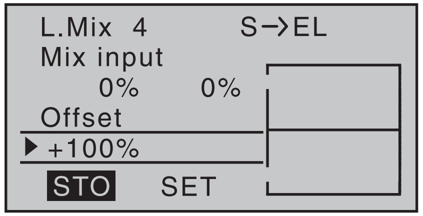


Subsequent aero-tow flying has proven that you always have to fly with the up-elevator held slightly in during the tow. The solution will be to set up a mixer that applies slight up-elevator trim to the elevator servo connected to receiver output 3 when the aero-tow release is closed. The screen-shot will be familiar from page 202: here, the fourth linear mixer has been set up for this function, with the switch channel "S" as mixer input: Move the selected switch to the OFF position and then switch …



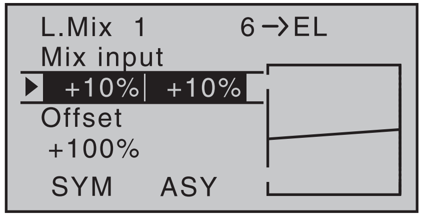
… to the mixer configuration page.

Here select **STO** under "Offset" then tap the centre **SET** key of the right four-way button briefly … depending on the selected travel setting in the »**Control adjust**« menu and the switch setting, the offset value will jump to +X% or -X%, for example:

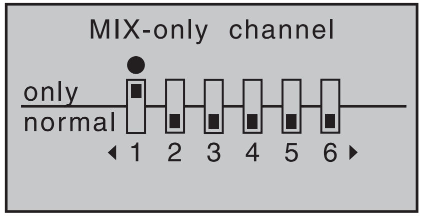


Now use the Select button ▲ of the left or right-hand four-way button to move to the line below "Mix input". Select **SYM** if appropriate, then press the central **SET** button of the right-hand four-way button. The value fields are now highlighted.

After you have moved the selected switch to the mixer ON position, use the selection keys on the right four-way button to set the required symmetrical mixer ratio, for example:



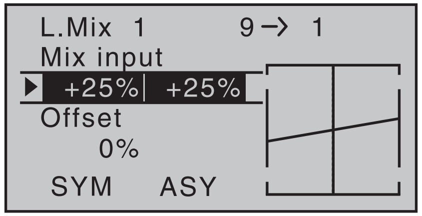
2. If a multi- flap wing featuring a "crow or butterfly system" with (additional) airbrakes is intended, and this brake system is to be tested with and without airbrakes, then move to the »**Mix-only channel**« menu, see page 212. This menu is available as standard on the mc-20 HoTT transmitter only. Simply set Channel 1 to "MIX-only" …



… and follow this by programming a free mixer "C1 ➔ C1" to restore control over the airbrakes via servo 1. If you also assign a switch to this mixer, then you will be able to switch this mixer on and off as you please.

3. The final example applies to model helicopters:

In the helicopter program, if you wish affect pitch trim with a proportional control, e. g. one of the slider controls in the middle of the console, then assign one of these controls to this function in the »**Control adjust**« menu; for example the "In9" input. (However, leave the default value of "GL" in the "Type" column as it is so this configuration, analogous to the free mixer yet to be programmed, will be applicable globally for all flight phases.). Finally, simply define a LinearMIX "9 ➔ 1" with a symmetric mixer ratio of, for example, 25 %. Due to the internal coupling, this transmitter control then acts equally on all of the model's collective pitch servos without affecting the throttle servo.



However, you should also de-couple the assigned transmitter control from control channel 9, so that any servo which may be connected to receiver output 9 can no longer be operated by this transmitter control. This is accomplished in the »**Mix-only channel**« menu, see page 212, which is available as standard on the mc-20 HoTT transmitter only.

MIX active / phase

Selecting free mixers for flight phases

mc 16 ☐ 20 ☑ *This option is available on the mc-20 HoTT transmitter only.*

Use the selection keys of the left or right four-way button to scroll to the »**MIX active / phase**« menu option in the Multi-function menu:

```
Fl. phase timers
Wing mixers
Free mixers
MIX active/phase
MIX-only channel
Dual mixer
```

```
Fl. phase timers
Helicopter mixer
Free mixers
MIX active/phase
MIX-only channel
Dual mixer
```

Open this menu option with a tap on the centre **SET** key of the right four-way button:

```
   Mix act. in phase
►LinearM1     6 → EL | yes
 LinearM2    C1 → EL | yes
 LinearM3     3 →  8 | yes
 LinearM4    S  → EL | yes
                       SEL
```

The “free mixers” on the previous menu can be enabled and disabled for specific flight phases. You therefore have complete freedom in assigning specific mixers only to specific flight phases.

Switch to your chosen flight phase and use the selection keys to page through this menu. The mixers on the »**Free mixers**« menu are displayed in the centre column.

Following the activation of the value field by briefly tapping the centre **SET** key of the right four-way button, if the respective mixer is set to “no” by using the selection keys on the left or right four-way button, then this mixer is deactivated in the flight phase shown at the bottom of the display and, simultaneously, removed from the »**Free mixers**« menu list:

```
   Mix act. in phase
 LinearM1     6 → EL | yes
►LinearM2    C1 → EL | no
 LinearM3     3 →  8 | yes
 LinearM4    S  → EL | yes
 «Speed »              SEL
```

If a mixer is “lost” in the »**Free mixers**« menu …

```
►M1 |    |  6 → EL |  4 | »
 M3 |    |  3 →  8 |    | »
 M4 |    | S  → EL |  2 | »
 M5 |    | ?? → ?? |    |
 M6 |    | ?? → ?? |    |
       ty   fr   to
```

… then you should either switch through the flight phases until it appears again … or, alternatively, switch to this menu and temporarily reactivate the mixer you are looking for:

```
 M1 |    |  6 → EL |  4  | »
►M2 | Tr | C1 → EL | C4  | »
 M3 |    |  3 →  8 |     | »
 M4 |    | S  → EL |  2  | »
 M5 |    | ?? → ?? |     |
       ty   fr   to
```

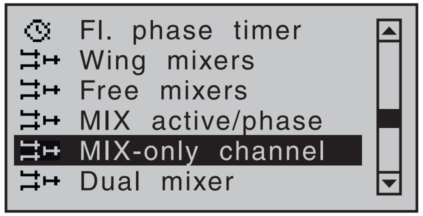
MIX-only channel

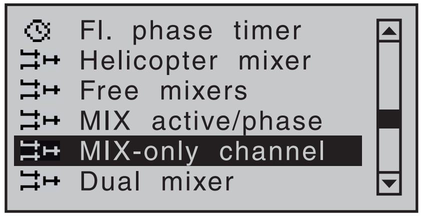
Separating control functions from control channels for all flight phases

mc 16 20

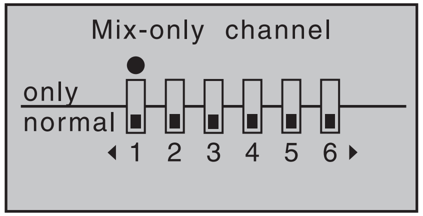
This option is available on the mc-20 HoTT transmitter only.

Use the selection keys of the left or right four-way button to scroll to the »**MIX-only channel**« menu option in the Multi-function menu:





Open this menu option with a tap on the centre **SET** key of the right four-way button:



This menu can be used to interrupt the normal signal flow between the input side *control function* and the output side *control channel*, therefore the "classic" control-to-servo connection is actually separated.

Use the potential offered by this *flight phase independent* menu, particularly to keep one of the control channels "free" in all flight phases from assignment to a transmitter control or switch for specific flight phases in the »**Control adjust**« menu.

Conversely of course, such a stick, transmitter control or switch "robbed" of its servo can still be used freely as a control in other way – indeed even in flight phase dependence –, refer to the programming examples at the end of this section.

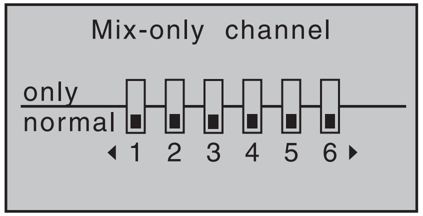
A stick, transmitter control or switch robbed of its servo by setting the channel to "MIX only" will then namely affect mixer inputs only …

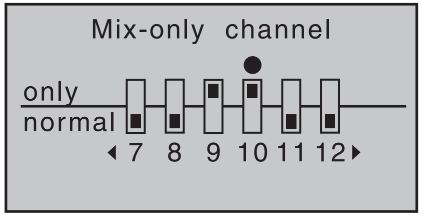
… and the servo connected to a channel set to "MIX only" is then also only accessible from the mixers programmed to its control channel, i. e. "(with) MIX(ers) only".

Accordingly, for any channel set to "MIX only", you can utilize both its control function and its control channel entirely independently of one another for any special functions you need; see the examples at the end of this section. A further option provided by a channel set to "MIX-only" status is the facility to program timed sequences using a mixer programmed to the same channel, and set up using the "- Time +" option of the »**Control adjust**« menu; see pages 112 and 116. See page 310 for a programming example.

Basic programming procedure

Use the selection keys on the left or the centre **SET** key of the right four-way button to select the desired channel to switch at will between "normal" and "MIX only" modes:

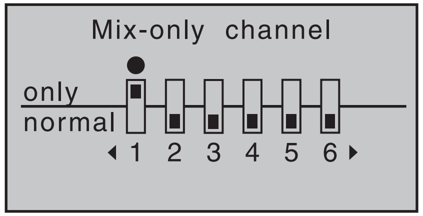




<u>*Examples:*</u>

- *For model glider aircraft without airbrakes, the butterfly function, page 180, is generally used as a landing aid. Just as with "normal" airbrakes, this is generally controlled using the C1 stick. While the (airbrakes) servo typically connected to channel 1 is then generally absent as a rule, receiver output 1 is still not "free", since the control signal of the brake stick is still present at this location.*

  *Its control signal – which in this specific case is not desired – can be decoupled from control channel "1" to thus "free up" this channel from the C1 stick signal by setting channel 1 to "MIX only" in the »**MIX-only channel**« menu. This makes it possible to use control channel "1", together with receiver connection "1", at any time for other purposes, via freely-programmable mixers – e. g. to connect up a speed controller.*



- *If your model has built-in airbrakes, however, and you would like to perhaps test the performance of a butterfly system with and without airbrakes, simply set channel 1 to “MIX only” and program a free mixer “C1 → C1”, so as to restore your ability to control the airbrakes via servo 1. If you also assign a switch to this mixer, then you will be able to switch this mixer on and off as you please.*

Dual mixers

Same-sense/opposite-sense mixing of two control channels

mc 16 20 — *This option is available on the mc-20 HoTT transmitter only.*

☐ ☑ Use the selection keys of the left or right four-way button to scroll to the »**Dual mixers**« menu option in the Multi-function menu:

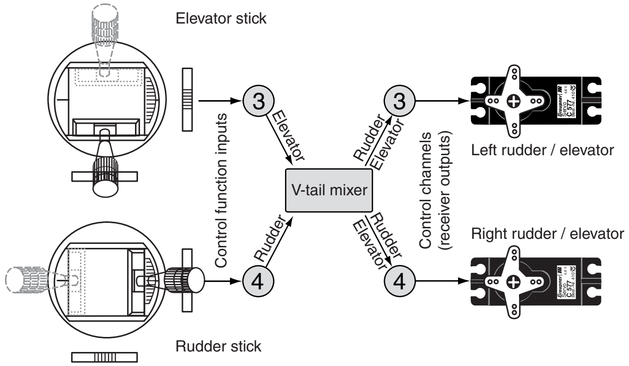
```
Fl. phase timers
Wing mixers
Free mixers
MIX active/phase
MIX-only channel
Dual mixer
```

```
Fl. phase timers
Helicopter mixer
Free mixers
MIX active/phase
MIX-only channel
Dual mixer
```

Open this menu option with a tap on the centre **SET** key of the right four-way button:

```
        Dual mixer
▶Mixer1 ▲??▲▲??▼     0%
 Mixer2 ▲??▲▲??▼     0%
 Mixer3 ▲??▲▲??▼     0%
 Mixer4 ▲??▲▲??▼     0%
▼                 Diff.
```

Similarly to a V-tail mixer, the four flight phase independent dual mixers couple …



… a same-sense "▲ ▲" and an opposite-sense "▲ ▼" control function, although they permit any channel to be used and offer differential travel for the opposing function.

Important notice:

*Since the same and opposite sense influences of the given input on the two servos or rudder flaps – coupled to one another by the dual mixer – are determined by, among other things, their installation situation and the direction of rotation specified in the »**Servo adjustment**« menu, the symbols "▲ ▲" and "▲ ▼" are to be perceived more as synonyms rather than as consistently appropriate definitions! Accordingly, if wing flaps are deflected in the wrong direction, simply swap the two inputs or use the "servo reverse" option in the »**Servo adjustment**« menu; see page 106.*

In the software, the V-tail mixer already mentioned is supplemented by other "dual mixers" for realization of the two aileron servos on receiver outputs 2 and 5 and for the flap pairs on outputs 6 and 7, possibly also 9 and 10. These are activated via the aileron stick and the transmitter control that has been assigned to input "6" on the »**Control adjust**« menu.

In the same way, the four freely-programmable dual mixers on this menu can be used to couple two further control functions, a feature that would otherwise only be possible with time-consuming programming of free mixers.

Here, we will use a "V-tail with rudder differential" as our example to explain the programming of a dual mixer (see also the examples on page 298):

Use the Select buttons of the left or right-hand four-way button to select the column you wish to access. Press the central **SET** button of the right-hand four-way button to activate the Value field, and then set the desired value using the Select buttons:

```
        Dual mixer
▶Mixer1 ▲EL▲▲RU▼   +25%
 Mixer2 ▲??▲▲??▼     0%
 Mixer3 ▲??▲▲??▼     0%
 Mixer4 ▲??▲▲??▼     0%
▼                 Diff.
```

In the dual mixer shown in our example the two servos connected to receiver outputs 3 and 4 move in the same or opposite direction depending on the direction of movement of the associated stick, and thus operate as elevators or rudders. The differentiation, according to dual mixer configuration, is only effective for rudder activation.

In this case, both corresponding trim lever are effective. No additional free mixers are required for this arrangement.

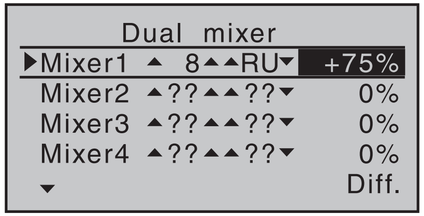
When using this mixer, however, the tail type MUST be entered as “normal” on the “Model type” menu.

<u>Tip:</u>

*All settings can be checked directly in the »**Servo display**« menu, which can be accessed from almost any other menu by simultaneously tapping the ◄ ► keys on the left four-way button.*

<u>Example:</u>

Model with two rudders, with differential travel and outward movement (e. g. swept-back flying wing):



*When a rudder command is given, the second servo connected to output 8 follows suit. (With this type of programming, differential travel can be configured for the rudders.) In this case, too, trim from the rudder stick affects both servos. If the rudders are also required to deflect outwards when the airbrakes are activated, then you should assign the C1 stick (transmitter control 1) to input 8 on the »**Control adjust**«“ menu. Afterwards, change to the “Offset” column then modify the offset value until both rudders are again in their neutral positions. It may be necessary to “play” a bit with the offset and travel adjustments.*

Swashplate mixer

Collective pitch, roll, pitch-axis mixer

mc 16 ☑ 20 ☑ *This option as standard on both transmitter types.*

Note:

*If "1 servo" is selected on the "Swashplate" line of the »**Helicopter type**«" menu, this option is not shown on the multi-function menu.*

Use the selection keys of the left or right four-way button to scroll to the »**Swashplate mixer**« menu option in the Multi-function menu:

```
Helicopter mixer
Free mixers
MIX active/phase
MIX-only channel
Dual mixer
Swaschplate mixer
```

Open this menu option with a tap on the centre **SET** key of the right four-way button:

```
   Swashplate mixer
► Pitch          +61%
  Roll           +61%
  Nick           +61%

                 SEL
```

The number of servos installed in your helicopter for pitch control was established in the "Swashplate" line of the »**Helicopter type**« menu, see page 102. This information is used to automatically couple together the functions for roll, pitch-axis and collective pitch, so that you do not need to define any other mixers yourself.

For helicopter models with only a single collective *pitch servo*, this »**Swashplate mixer**« menu option is of course superfluous because the software controls a total of three swashplate servos for pitch, nick and roll independently of one another, i. e. without a mixer. In this scenario, this menu option is therefore no longer available to you from the multi-function menu.

With all other swashplate linkages employing 2 … 4 pitch servos, mixer ratios and mixer directions are set up by default as shown above. The default is +61 % in each case but the value can be varied from -100 % to +100 % if required by briefly tapping the centre **SET** key of the right four-way button and its selection keys.

Simultaneously tapping both ▲▼ or ◄ ► selection keys on the right four-way button (**CLEAR**) will reset the mixer ration in inverse video again to the +61 % default value.

If the swashplate control system (collective pitch, roll and pitch-axis) does not respond to the sticks properly, you should alter the mixer directions ("+" or "-") before trying to correct the directions of servo rotation.

Note:

Ensure that changed mixer values do not result in the servos mechanically striking their end-stops.

Fail-safe

Fault condition setpoints

mc 16 ☑ 20 ☑ *This option is available on both transmitter types.*

Use the selection keys of the left or right four-way button to scroll to the »**Fail-safe adjust**« menu option in the Multi-function menu:

```
Fail-safe adjust
Teacher / pupil
Tx. output swap
Profi trim
Trim memory
Telemetry
```

Open this menu option with a tap on the centre **SET** key of the right four-way button:

```
      Fail-safe adjust
Pos
hold
     ◄1  2  3  4  5  6►
 DELAY :  0.25s      STO
```

The higher level of operating safety exhibited by the HoTT system when compared to traditional PPM technology results from the fact that the microprocessor built into the HoTT receiver not only exclusively processes the signals of "its" transmitter, but can also clean up "dirty" control signals that it receives. Only when these signals become too error-prone or garbled due to outside interference does the processor automatically replace the disrupted signals with the last received correct signal, temporarily stored in the receiver. This feature is configured by the settings as described below. This feature also suppresses brief interference caused by e. g. local drops in field strength, which otherwise result in the familiar "glitches". In this case, the red LED lights up on the receiver.

If you have not already programmed Fail-Safe settings in the currently active model memory, the following message will appear in the base display for a few seconds when you switch the transmitter on:

Programming procedure

The “Fail Safe” function determines the behavior of the receiver if communication between the transmitter and the receiver is disrupted. Receiver outputs 1 … 8 on the mc-16 HoTT transmitter, or 1 … 12 on the mc-20 HoTT transmitter can optionally …

- ... Immediately take after switching the receiving system and as long as there is no radio connection to the transmitter, previously stored in the receiver positions. Completely independent of whether the corresponding output to “hold” or “Pos” is programmed.

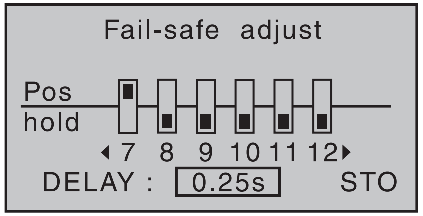
  By default, set to the first save of the fail-safe positions the centre position.

- ... in the event of a fault either ...

1. preserve the current position (“hold”):
   If communication is disrupted, all servos programmed to “hold” mode remain at the positions judged to be the last valid positions by the receiver until the receiver picks up another valid control signal, or
2. move to a freely selectable position (“Pos”) if interference should occur, following the expiry of the “time delay”.

Use selection keys ◄ ► on the left or right four-way button to select the desired servo connection 1 … 8 (●) or 1 … 12 (●) then briefly tap the centre **SET** key of the right four-way button to freely switch between “hold” and “Pos” mode:

Following this, use the selection keys ◄ ► on the left or right four-way button to select the “DELAY” option shown at the bottom of the display …

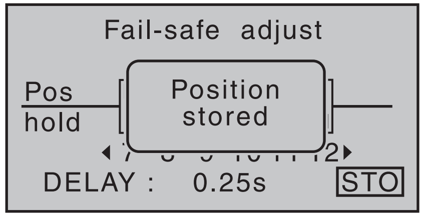


… and then briefly tap the centre **SET** key of the right four-way button. Now use the four-way button’s selection keys to make your choice from the four possible time delays (0.25 s, 0.5 s, 0.75 s and 1 s) offered.

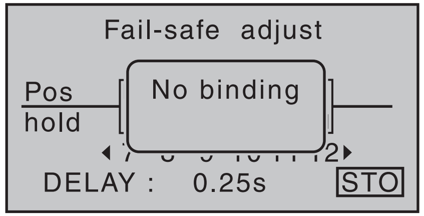
A simultaneous tap on the ▲▼ or ◄ ► selection keys of the right four-way button (**CLEAR**) will reset the inverse video field to its default value 0.25 s.

Afterwards, select the **STO** field at the bottom right of the display with the ◄ ► selection keys on the left or right four-way button. Now put the servos which have been switched into position mode into their desired positions SIMULTANEOUSLY with the respective operating elements.

Briefly tap the centre **SET** key of the right four-way button to store these positions as the fail-safe setting for the receiver, so that it can revert back to them if interference is experienced. Successful storage of the positions is confirmed briefly on the screen:



However, if instead the message ...



... is displayed, there is no connection to a receiver. So switch on if necessary the RF module of the transmitter and / or receiver system of your model.

<u>Attention:</u>

- ***Please note that decisive fail-safe settings are stored in the receiver! Therefore, following a change of receivers, these fail-safe settings should be renewed and in the previous receiver they should be erased, if necessary per Reset, see page <?>.***
- ***Ensure you make use of this safety net by at least programming the following for a fail-safe incident: for glow-powered models, set the motor throttle position to idle; for electric models, set the motor function to stop, or “Hold” for helicopter models. If interference should occur, the model is then less likely to fly off on its own and cause damage to property or even personal injury. Consider asking an experienced pilot for advice.***

Teacher/pupil

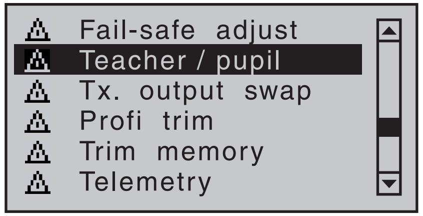
Connecting two transmitters for trainer mode with a trainer lead

mc 16 ☑ 20 ☑

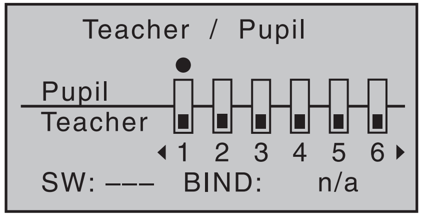
This option is available on both transmitter types.

The transmitters mc-16 HoTT and mc-20 HoTT are equipped as standard – as viewed from the front, under the left front flap – with a DSC socket. This is not only usable for connecting flight simulators – as described on page 24 – but also to integrate the transmitter into a cable-coupled teacher/pupil system.

To accommodate the settings necessary for this, scroll with the selection keys on the left or right four-way button to the »**Teacher/pupil**« menu option in the Multi-function menu:



Open this menu option with a tap on the centre **SET** key of the right four-way button:



Note:

The screen image shown above shows the menu in its initial state: No transmitter controls have been released by the pupil (▯) and no switch is assigned ("SW: ---" bottom left in the screen image).

Teacher-pupil settings

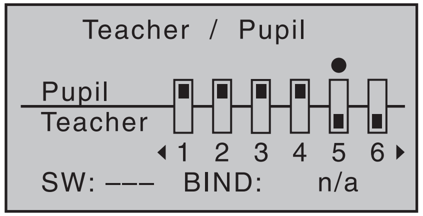
Up to eight *function inputs* (see "Definitions of terms" on page 58) of an mc-16 HoTT transmitter set up as Teacher transmitter can be transferred individually, or in any combination you wish, from the Teacher transmitter "L" to the Pupil transmitter "S". The same applies with a maximum of twelve *function inputs* (see "Definitions of terms" on page 58) of a twelve-channel mc-20 HoTT transmitter set up as Teacher transmitter.

The lower display line, designated with "Teacher", therefore indicates the **function inputs** with which control functions 1 … 4 (stick functions for fixed-wing and helicopter models) are permanently connected as well as inputs 5 … max. 12, which can be freely assigned in the **»Control adjust«** menu.

Note:

*Just which controls are assigned to any inputs turned over to the pupil is basically of no consequence. However, their assignment in the »**Control adjust**« menu is possible only when the trainer mode connection is inactive.*

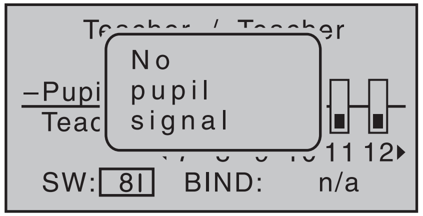
Use the ◄ ► selection keys of the left or right four-way button *to select the function inputs 1 through max. 12 for transfer to the pupil* (●) then briefly tap centre **SET** key of the right four-way button for each switch to be switched between "Teacher" (▯) and "Pupil" (▯):



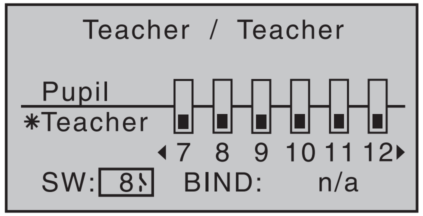
Channel	Function
1	Motor throttle/collective pitch
2	Aileron/roll
3	Elevator/pitch-axis
4	Rudder/tail rotor

To be able to carry out the transfer, you must then assign a trainer mode switch on the left of the display. Do this by placing the marker just to the right of the "SW" at the bottom left of the screen display by using the selection keys of the left or right four-way button then assign a switch as described in the section "Physical control, switch and control switch assignments" on page 60.

Preferably you should utilize a momentary switch to allow a return of control to the teacher transmitter at any time:



Since at this early stage of programming a trainer system it is unlikely that an operational pupil transmitter is connected to the teacher transmitter, the transmitter responds immediately to the switches closed during the switch assignment process with appropriate visual and audible warning notices. You should therefore re-open the switch you have just assigned:



Note:

The switch assignment just described also determines the transmitter used to issue the teacher and pupil functions, respectively. For this reason, a pupil transmitter must NEVER be assigned a switch on this menu. ***The header line therefore also switches from "Teacher / Pupil" to "Teacher / Teacher" once a switch has been assigned.***

The model to be controlled by the pupil *must be programmed completely* – i. e. with all its functions including trims and any mixer functions – in one of the model memories of the **mc-16** HoTT or **mc-20** HoTT teacher transmitter. The HoTT receiver of the model in question must also be "bound" to the teacher transmitter, since the latter ultimately controls the model, even in pupil mode.

ALWAYS ENSURE YOU SWITCH ON THE teacher transmitter FIRST BEFORE PLUGGING THE CONNECTION CABLE INTO THIS UNIT. Otherwise the RF module will not be activated.

The **mc-16** HoTT or **mc-20** HoTT teacher transmitter can be connected to any suitable pupil transmitter, even transmitters using the "traditional" 35/40 MHz range. This means, for example, that a **mc-16** HoTT or **mc-20** HoTT teacher transmitter can indeed also be connected to a **mc-24** pupil transmitter.

However, if the pupil-side connection is NOT made via a two-pole DSC socket but rather via a three-pole trainer socket (for example, out of the *Graupner* product line), **then the basic prerequisite for a correct connection to a pupil transmitter – which is completely independent of the type of modulation used in the teacher transmitter – must ALWAYS be set to modulation type PPM (10, 16, 18 or 24) in the pupil transmitter.**

Pupil transmitter set-up

The model to be controlled by the pupil *must be programmed completely*, i. e. with all its functions including trims and any mixer functions, in one of the model memories of the teacher transmitter and, if applicable, the HoTT receiver of the model in question must also be "bound" to the *teacher* transmitter. In principle, a **mc-16** HoTT or **mc-20** HoTT pupil transmitter can also be connected to a teacher transmitter operating on the "traditional" 35/40 MHz bands. This is possible because the PPM signal required by the teacher transmitter is available in the (pupil) transmitter's DSC socket.

Almost any transmitter with at least four control functions from previous and current *Graupner* series can be used as a pupil transmitter. More detailed information can be found in the RC main catalogue and on the www.graupner.de/en website.

If required, the pupil transmitter should be fitted with the connection module for pupil transmitters. This is to be connected to the transmitter board in accordance with the supplied installation instructions.

Information on the pupil modules required in each case can be found in the *Graupner* RC main catalog and on the www.graupner.de website.

The connection to the teacher transmitter is made using the appropriate lead; see the following double page.

The control functions of the pupil transmitter MUST act directly on the control channels, i. e. the receiver outputs, without intermediary mixers.

If you are using an "**mc**" or "**mx**" series transmitter, it is best to activate a free model memory with the required model type ("Fixed-wing" or "Heli"). Assign the model name "Pupil" and set up the stick mode (mode 1 … 4) and "Throttle min. forward/back" to suit the pupil's preferences. All other settings are left at their default values, however. If you have selected the "Helicopter" model type, you must also set the throttle/ collective pitch direction and idle trim on the pupil transmitter. All other settings, including mixer and coupling functions, are configured exclusively on the teacher transmitter, which in turn transmits them to the model.

If the pupil transmitter is a **mx-20** HoTT, **mc-16** HoTT, **mc-20** HoTT or **mc-32** HoTT series model then it may also be necessary to adapt the type of modulation in the "DSC output" line of the »**Base setup model**« menu in order to accommodate the *number* of control channels to be transmitted. For example, the signal packet for modulation type "PPM10" contains only control channels 1 … 5 but not channel 6 and upper. However, if this channel is to be used by the pupil then a modulation type must be selected in which it is included. A further point is that "HoTT" must be entered in the "Module" line of the »**Base setup model**« menu if you wish to set up one of the transmitters in Pupil mode, but using an existing model memory rather than a newly initialised memory. If you neglect this it is possible that the PPM signal present at the DSC socket will be inverted.

For transmitters of – older – type "**D**" and "**FM**" it is necessary to check servo operating directions and their control correlations. It may be necessary to reconnect cables appropriately. All mixers must also be switched off or set to "zero".

If other control functions are to be transferred to the pupil transmitter in addition to the functions of the two dual axis sticks (1 … 4), access the »**Control adjust**« menu in the pupil transmitter and assign those *inputs* which correspond to enabled *function inputs 5 …*

max. 12 as shown in the »**Teacher/pupil**« menu of the teacher transmitter. Afterwards, assign the operating elements appropriately.

Important:

- ***If you should forget to assign a transmitter control on the pupil side, then the affected servo or servos will remain in the centre position when the transfer is made to the pupil transmitter.***
- ***The pupil transmitter must always be operated in PPM mode, regardless of the RF connection type used between the teacher transmitter and the model.***
- ***If the transmitter is connected using a DSC socket on the pupil side, ALWAYS leave the pupil transmitter's On/Off switch in the "OFF" position: this is the only way to guarantee that no RF signal is sent from the pupil transmitter's transmitter module, even after the DSC lead has been plugged in.***

Trainer mode operations

Both transmitters are connected to one another using a suitable lead (see summary on next page): The plug marked "**M**" (master) must be inserted into the socket on the teacher transmitter, and the plug marked "**S**" (student) into the pupil transmitter's socket. (Note that not all leads may have such "M" and "S" labeling.)

Important notices:

- ***Check that the model aircraft is operational and check that all functions issue the correct commands BEFORE setting up trainer mode.***
- ***The ends of the trainer lead, usually marked as either "S" or "M", terminate in a three-pole TRS jack. Do not insert these jacks into a DSC system socket, as it is not suitable for this application. The DSC socket is exclusively designed for cables with 2-pole TRS jacks.***

Checking functionality

Activate the assigned trainer mode switch:

- The trainer mode system is working properly if the display now changes from "∗ Teacher" to "∗ Pupil".
- However, if the WARNING LED at the right, next to the transmitter's On/Off switch, blinks and an acoustic signal sounds off at the same time, then the connection between pupil and teacher transmitters is faulty.

  The basic display also displays the following warning notice …

  No
  pupil
  signal

  … and the left side of the screen display for the »**Teacher/pupil**« menu will change to show "-Pupil". In this case, all control functions are retained by the teacher transmitter automatically, regardless of switch position: this ensures the model is always under control.

Possible faults:

- Pupil transmitter not ready
- Interface in pupil transmitter not correctly connected in place of the RF module
- Cables connected wrongly: see right for cable connections
- Pupil transmitter not switched over to PPM (10, 16, 18, 24) mode
- Teacher transmitter not properly "bound" to HoTT receiver in training model
- "EXT.PPM" in »Base settings« menu is "reverse".

Trainer cables

4179.1 for trainer operation between any two *Graupner* transmitters equipped with DSC sockets – distinguished by a two-pole TRS jack at both ends.

3290.7 trainer cable for connecting a teacher transmitter with DSC socket (e. g. **mx-12** … **mc-32** HoTT) or a transmitter retrofitted with an optional DSC module, No. **3290.24**) to a *Graupner* pupil transmitter with an opto-electronic system pupil socket – identifiable by the mark "**S**" on the side of the three-pole TRS jack.

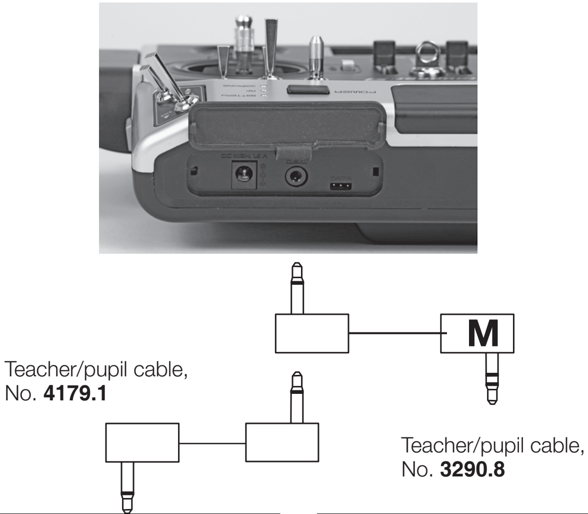
3290.8 trainer cable for connecting a pupil transmitter with DSC socket (e. g. **mx-12** … **mc-32** HoTT or a transmitter retrofitted with an optional DSC module, No. **3290.24**) to a *Graupner* teacher transmitter with an opto-electronic system teacher socket – identifiable by the mark "**M**" on the side of the three-pole TRS jack.

Further details about the cables and modules mentioned in this section for teacher and pupil transmitters can be found in the respective transmitter handbook, in the *Graupner* RC main catalogue or in Internet at www.graupner.de.

Trainer mode with the transmitters mc-16 HoTT and mc-20 HoTT

Due to the continuous improvements made to the product range, please consult our website at www.graupner.de for the latest information

Pupil transmitter **mc-16** HoTT and **mc-20** HoTT

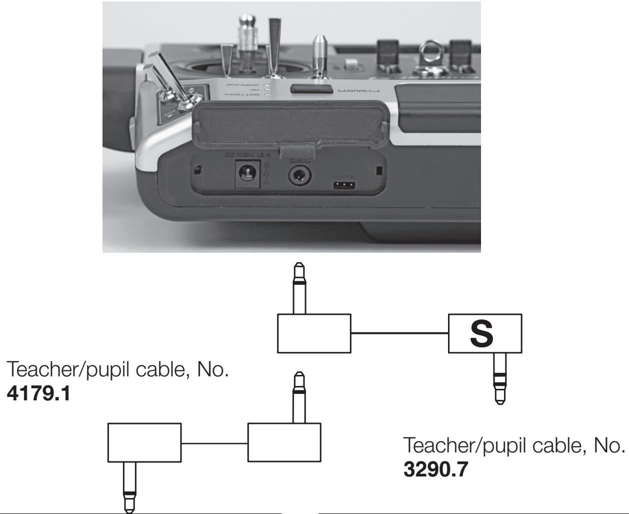


Teacher transmitter with DSC socket	Teacher transmitter with teacher module, No. **3290.2, 3290.19, 3290.22**

mc-16 HoTT
mc-20 HoTT
mc-32 HoTT
mx-12 HoTT,
mx-16 HoTT,
mx-20 HoTT
mz-10 HoTT
mz-12 HoTT
mz-18 HoTT
mz-24 HoTT

mc-19 to **mc-24**,
mx-22(iFS), **mx-24**s

Teacher transmitter **mc-16** HoTT and **mc-20** HoTT



Pupil transmitter with DSC socket	Pupil transmitter with pupil module, No. **3290.3, 3290.10, 3290.33**

mc-16 HoTT
mc-20 HoTT
mc-32 HoTT
mx-12 HoTT,
mx-16 HoTT,
mx-20 HoTT
mz-10 HoTT
mz-12 HoTT
mz-18 HoTT
mz-24 HoTT

D 14, FM 414, FM 4014,
FM 6014, **mc-10** … **mc-24**,
mx-22(iFS), **mx-24s**

Note:

The lists present the possible transmitters/transmitter combinations at the time of going in revision.

Wireless operation of the mc-16 HoTT and mc-20 HoTT trainer mode system is also possible. To do so, the teacher transmitter must be "connected" to a pupil transmitter as described below. Prior to this, however, the training model's receiver must be bound to the PUPIL transmitter. This configuration is possible between transmitters which have the "BIND:" option in the »**Teacher/pupil**« menu.

Preparing for training mode

Teacher transmitter

The training model *must be programmed completely,* i.e. with all of its functions including trims and any mixer functions, in one model memory of the HoTT teacher transmitter.

The model to be used for training must therefore be under the complete control of the teacher transmitter.

mc-16 Firmware up to V 1.002

mc-20 Firmware up to V 1.019

The final step in preparation, however, is to bind the training model to the pupil transmitter. For a detailed description of the binding process, please consult pages 80 and 90.

mc-16 Firmware V 1.003 or higher

mc-20 Firmware V 1.020 or higher

The training model remains bound to the teacher transmitter.

Important note:

Completely independent being bound to the pupil transmitter of the relevant provisions of the teacher transmitter, the training model MUST always be bound to a student type transmitter **mx-10** HoTT with firmware version V 1a20, . In addition, it is imperative for proper training operation that the model memory of the Teacher transmitter used to train are deleted in the line "module" of the menu "Basic adjustment model", page 79 and 89, the right of "HOTT" any particle receiver bonds. Is "n / a" registered so in the two values fields over BD1 and 2 respectively.

Pupil transmitter

If you are using an "mc" or "**mx**" or "**mz**" series transmitter, it is best to activate a free model memory with the required model type ("Fixed-wing" or "Heli"). Assign the model name "Pupil" and set up the stick mode (mode 1 … 4) and "Throttle (or collective pitch) min. forward/back" to suit the pupil's preferences. All other options are left at their default values. All other settings, including all mixer and coupling functions, are configured exclusively on the teacher transmitter, which in turn transmits them to the model.

When assigning control functions, the usual conventions must be observed:

Channel	Function
1	Motor throttle/collective pitch
2	Aileron/roll
3	Elevator/pitch-axis
4	Rudder/tail rotor

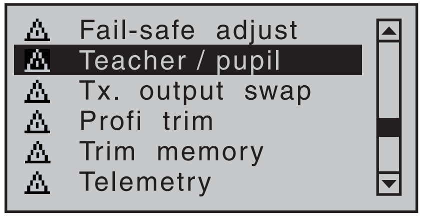
If other control functions are to be transferred to the pupil transmitter in addition to the functions of the two dual axis sticks (1 … 4), access the »**Control adjust**« menu in the pupil transmitter and assign those *inputs* which correspond to enabled *function or transmitter control inputs 5 … max. 12* as shown in the »**Teacher/pupil**« menu of the teacher transmitter. Afterwards, assign the operating elements appropriately.

Important:

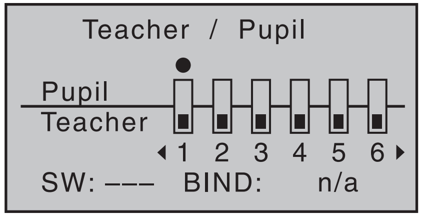
If you should forget to assign a transmitter control on the pupil side, then the affected servo or servos will remain in the centre position when the transfer is made to the pupil transmitter.

Preparing the teacher and pupil transmitters

Once you have bound the training model to the pupil transmitter, now switch on the teacher transmitter. On both transmitters, use the selection keys on the left or right four-way button, to page to the »**Teacher/pupil**« menu option on the multi-function menu:



Briefly tap the centre **SET** key of the right four-way button to open this menu option:

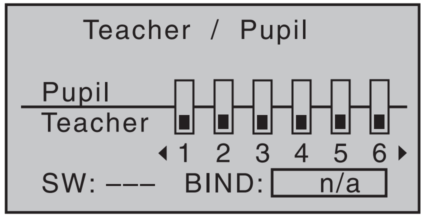


Note:

The screen image shown above shows the menu in its initial state: No transmitter controls have been released to the pupil (▯) and no switch has been assigned ("SW: ---" bottom left in the screen image).

Pupil transmitter

Use the selection keys on the left or right four-way button to move the marker frame to the "BIND" input field. If there is a switch shown at the right of "SW:" then this *must* first be erased, see screen image:



Teacher transmitter

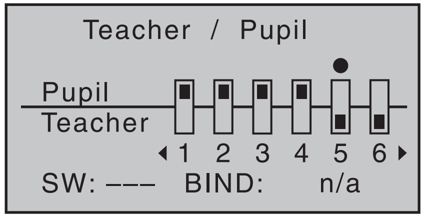
Up to eight *function inputs* (see "Definitions of terms" on page 58) of an mc-16 HoTT transmitter set up as Teacher transmitter can be transferred individually, or in any combination you wish, from the Teacher transmitter "L" to the Pupil transmitter "S". The same applies with a maximum of twelve *function inputs* (see "Definitions of terms" on page 58) of a twelve-channel mc-20 HoTT transmitter set up as Teacher transmitter.

The lower display line, designated with "Teacher", therefore indicates the **function inputs** with which control functions 1 … 4 (stick functions for fixed-wing and helicopter models) are permanently connected as well as inputs 5 … max. 12, which can be freely assigned in the **»Control adjust«** menu.

Note:

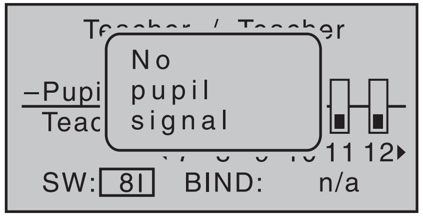
*Just which controls are assigned to any inputs turned over to the pupil is basically of no consequence. However, their assignment in the »**Control adjust**« menu is possible only when the trainer mode connection is inactive.*

Use the ◄ ► selection keys of the left or right four-way button *to select the function inputs 1 through max. 12 for transfer to the pupil* (●) then briefly tap centre **SET** key of the right four-way button for each switch to be switched between "Teacher" and "Pupil":

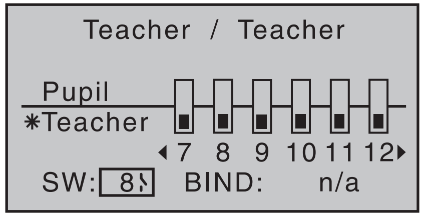


To be able to carry out the transfer, you must now assign a trainer mode switch. Do this by placing the marker frame just to the right of the "SW:" at the bottom left of the screen display by using the selection keys of the left or right four-way button then assign a switch as described in the section "Physical control, switch and control switch assignments" on page 60.

Preferably you should utilize a momentary switch to allow a return of control to the teacher transmitter at any time:



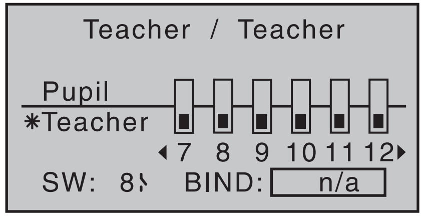
Since at this stage of programming the wireless trainer system no connection yet exists to a pupil transmitter, the transmitter responds immediately to the switches closed during the switch assignment process with appropriate visual and audible warning notices. You should therefore re-open the switch you have just assigned:



Note:

The switch assignment just described also determines the transmitter used to issue the teacher and pupil functions, respectively. For this reason, a pupil transmitter must NEVER be assigned a switch on this menu. ***The header line therefore also switches from "Teacher / Pupil" to "Teacher / Teacher" once a switch has been assigned.***

Using the selection keys on the left or right four-way button, now move the marker frame to the right, to "BIND: n/a":

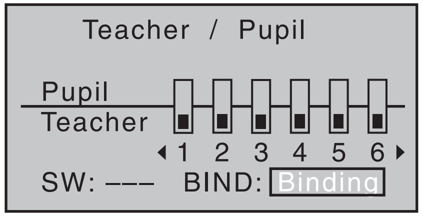


Binding the pupil transmitter to the teacher transmitter

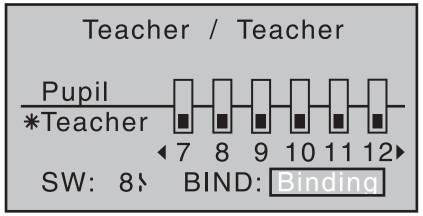
Note:

The distance between the two transmitters should not be too great during the binding process. If necessary, change the positions of the transmitters and initiate the binding process again.

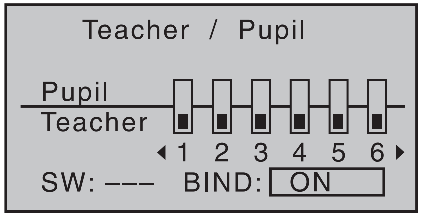
Initiate the "BINDING" process from the pupil transmitter by tapping the centre **SET** key of the right four-way button …

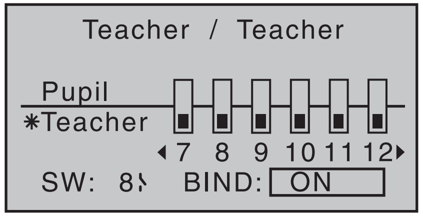


… and repeat this immediately on the teacher transmitter:



As soon as this process is complete, both screens will show “ON” instead of the flashing “BINDING”:





You can return to the basic display on both screens and start the training session after carefully checking all of the relevant functions.

If neither transmitter or only one transmitter displays “**ON**”, this means the binding process has failed: try changing the positions of both transmitters and then repeat the entire procedure.

Important notice:

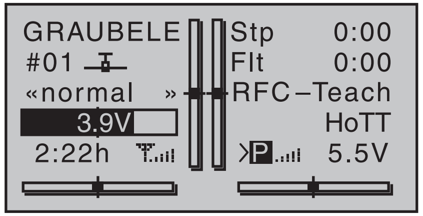
Check that the model aircraft is operational and check that all functions issue the correct commands BEFORE setting up trainer mode.

During the …

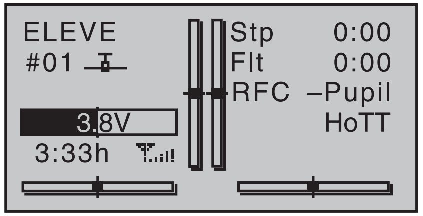
Training session

… the teacher and pupil can maintain a variable distance from one another. But you should stay “within earshot” (max. 50 m) under any circumstances, however, no one else should be standing between the teacher and the pupil since these persons could reduce the connection range of the return channel used by the two transmitters.

In this operating mode, the basic display of the teacher transmitter is as shown below …



… and the pupil transmitter’s display will look something like this:



If, however, the connection between the teacher and pupil transmitters should be lost during the training session, then the teacher transmitter will automatically assume control of the model.

If the trainer mode switch is in the “Pupil” position when connectivity is lost, the Warning LED on the teacher transmitter will blink and audible warning signals will also be sounded for as long as the signal is lost. The basic display also displays the following warning notice:

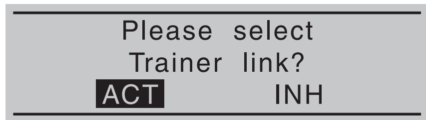
However, if only the character string “HF –” blinks on the transmitter’s basic display accompanied by the audible warning signals, the pupil signal has been lost but the trainer mode switch is set to the “Teacher” position.

In both cases, your first step should be to reduce the distance between the two transmitters. If this does not help, then you should land immediately and establish the cause.

If both transmitters are operational and the receiver system is switched off, then the teacher transmitter’s basic display will show the ▪ icons instead of the “familiar” . The antenna icon will also flash and an audible warning signal will sound twice per second.

Resuming trainer mode

If you switch off one or both transmitters during the session – for whatever reason – then the basic display of the transmitter(s) shows the following question after being switched back on:



If “**INH**” (set) is confirmed by tapping the centre **SET** key of the right four-way button or, alternatively, by waiting for approx. two seconds until the message disappears. Then you will reset the transmitter in question back to its “normal” operating mode.

You will then have to re-establish a connection between the teacher and pupil transmitters.

mc-16 Firmware up to V 1.002

mc-20 Firmware up to V 1.019

If, on the other hand, the selection keys on the left or right four-way button are used to select "**INH**" …

```
Please select
Trainer link?
ACT        INH
```

… and this selection is confirmed by tapping the centre **SET** key of the right four-way button, then the existing teacher connection is restored. The same approach is used if the transmitter is configured as a pupil transmitter.

mc-16 Firmware V 1.003 or higher

mc-20 Firmware V 1.020 or higher

If, on the other hand, the selection keys on the left or right four-way button are used to select "**INH**" …

```
Please select
Trainer link?
ACT        INH
```

… and this selection is confirmed by tapping the centre **SET** key of the right four-way button, then the existing teacher connection is restored. Then you will reset the transmitter in question back to its "normal" operating mode.

For immediate resumption of "normal" model operation, then switch to the line "RF module" of the menu "**Basic adjustment model**", page 84 and 94, and put this in the corresponding value field back to "ON". Alternatively, turn off for a few seconds from the transmitter and confirm the appearing after restarting the transmitter query ...

```
Please select
RF on/off?
ON    OFF
```

... by briefly pressing the central **SET** key of the right four-way button.

Binding to a teacher or pupil transmitter must then be made if necessary again.

Tx. output swap

Swapping the outputs on the transmitter

mc 16	mc 20
☐	☑

This option is available on the mc-20 HoTT transmitter only.

Use the selection keys of the left or right four-way button to scroll to the »**Tx. output swap**« menu option in the Multi-function menu:

```
Fail-safe adjust
Teacher / pupil
Tx. output swap
Profi trim
Trim memory
Telemetry
```

Open this menu option with a tap on the centre **SET** key of the right four-way button:

```
     Tx. output swap
▶Tx Ch  1  ->  Output  1
 Tx Ch  2  ->  Output  2
 Tx Ch  3  ->  Output  3
 Tx Ch  4  ->  Output  4
▾       SEL
```

To ensure that receiver channel assignment is as flexible as possible, the software includes the facility to swap over any of transmitter outputs 1 to maximum 12 as a standard feature. This option lets you distribute the transmitter's 8 or 12 "*control channels*" to any of the *transmitter outputs* 1 … 8 or 12. If you do, you must remember that the »**Servo display**« screen – accessible from almost any menu option by simultaneously tapping the ◀ and ▶ keys on the left four-way button – refers exclusively to the "control channels" as preset by the receiver socket assignment: it therefore does NOT take any output swaps into account.

Programming procedure

Use the ▲▼ selection keys on the left or right four-way button to select the channel/output combination to be changed then briefly tap the centre **SET** key of the right four-way button. You can now use the right selection keys to assign your selected (control) channel to the desired output, confirming this with the **SET** key …

```
     Tx. output swap
▶Tx Ch  6  ->  Output  1
 Tx Ch  2  ->  Output  2
 Tx Ch  3  ->  Output  3
 Tx Ch  4  ->  Output  4
▾       SEL
```

… or, by tapping the ▲▼ or ◀ ▶ selection keys on the right four-way button at the same time (**CLEAR**), you can restore the original assignment.

Any subsequent changes, such as servo travel adjustments, Dual Rate / Expo, mixers etc., **must always be performed in accordance with the original receiver socket assignment!**

<u>*Example:*</u>

In the helicopter program of the mc-16 HoTT and mc-20 HoTT transmitters, the outputs for a collective pitch servo and the throttle servo are swapped around, compared to some older GRAUPNER **mc** *units. The throttle servo now occupies transmitter output "6" and the collective pitch servo output "1". Perhaps, however, you wish to retain the previous configuration? In this case, you will swap over channels 1 and 6 as appropriate, so that (control) channel 6 is located on output 1 and vice versa – as shown above:*

<u>*Note:*</u>

"Channel Mapping" (channel assignment) is the receiver-side channel correlation function integrated into the mc-16 HoTT and mc-20 HoTT transmitter's telemetry menu. With channel mapping, the transmitter's control channels (12 maximum) can be freely distributed to multiple receivers or receiver outputs having the same control function, for example to operate two servo controls per aileron surface instead of just being able to control one servo, etc. To keep controls manageable, however, we strongly recommend using only one of the options at a time.

Flaps and aileron trimming

mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

The transmitters mc-16 HoTT and mc-20 HoTT has an integrated software function for direct trimming of all flaps and ailerons.

This feature, named »**Profi trim**« because of its functional similarity to the Profi-Trim module for the **mc-24** but only available on that transmitter as a retrofit option. Select this feature from the multi-function menu with the selection keys of the left or right four-way button …

```
Fail-safe adjust
Teacher / pupil
Tx. output swap
Profi trim
Trim memory
Telemetry
```

… then open this menu option with a brief tap on the centre **SET** key of the right four-way button.

Profi trim	▲AI▼	▼▲AI▲	▲FL▼	▼▲FL▲
▶TR	OFF	OFF	OFF	OFF
CTL	---	---	---	---
ON/OFF	---			
▼	SET	SET	SET	SET

Programming procedure

Programming is done in three steps:

First of all, in the “TR” line it will be established just which flap pair is to be trimmed as “AI” and/or “FL”.

The “CTL” line specifies the control channel over which the given trim function is to be performed and, finally, a switch is defined in the “ON/OFF” line by which this profi-trim function can be switched on or off globally.

To set the desired option, move the marker frame onto the desired line or column with the selection keys of the left or right four-way button then briefly tap the centre **SET** key of the right four-way button. Select the desired entry in the field now displayed in inverse video with the selection keys on the left or right four-way button or move the desired transmitter control. Conclude the procedure with a tap on the **ESC** key.

TR

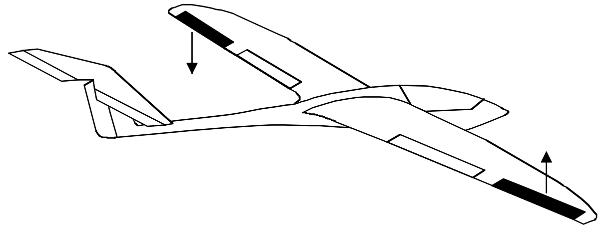
<u>*Notes:*</u>

- *Please note that, depending on the number of aileron and flap servos specified in the »**Model type**« menu, page 99, some settings cannot be used. For example, with only 1 aileron and/or 1 flap servo there is no aileron-on flap activation possible, and the opposite is also true. Since this is the case, a number of settings in various columns remain ineffective.*
- *Pay attention to potential double-assignments when making trim control choices.*

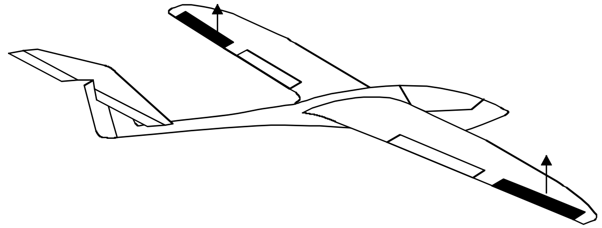
The trim functions which can be activated (ON) or deactivated (OFF) on the first line of this menu, either individually or in any combination, make pre-flight corrections to aileron and flap settings quick and easy, without the complexity of having to call up individual setting options.

Individually, these are functions for …

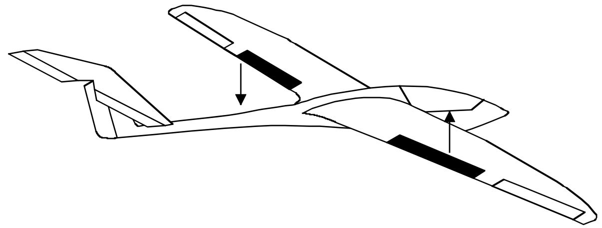
- Trim of the *aileron function* for aileron (“▲AI▼”)



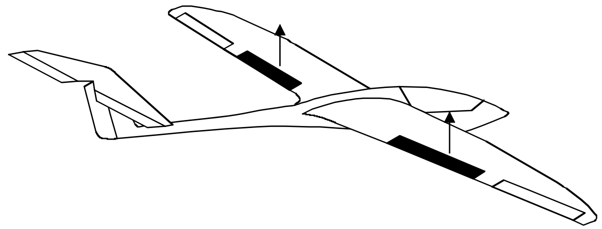
- Trim of the *flap function* for aileron (“▲AI▲”)



- Trim of the *aileron function* for flaps (“▲FL▼”)



- Trim of the *flap function* for flaps (“▲FL▲”)



Tap on the ▲▼ or ◄ ► selection keys of the right four-way button at the same time (**CLEAR**) to reset the value of the field displayed in inverse video back to “OFF”.

Note:

Regardless of a switch’s ON/OFF setting (see further below), the reset of a value field in the “Trim” line has the effect an immediate return of the affected trim function to its original reference point.

CTL

```
          Profi  trim
      ▲ AI ▼▲ AI ▲ ▲ FL ▼▲ FL ▲
 TR     ON    ON     OFF  OFF
►CTL   ---   ---     ---  ---
 ON/OFF      ---
 ⇕      SET   SET    SET  SET
```

The second line of this menu is for selecting transmitter control assignments which appear advantageous from the many controls available on the transmitter.

To assign a transmitter control, use the selection keys to navigate to the desired column then tap briefly on the centre **SET** key of the right four-way button …:

```
          Profi  trim
         Move  desired     FL ▲
 TR      control  adj.     OFF
►CT                        ---
 ON/OFF      ---
 ⇕      SET   SET    SET  SET
```

… and move the desired transmitter control:

```
          Profi  trim
      ▲ AI ▼▲ AI ▲ ▲ FL ▼▲ FL ▲
 TR     ON    ON     OFF  OFF
►CTL   Lv1   ---     ---  ---
 ON/OFF      ---
 ⇕      SET   SET    SET  SET
```

The mid-point position of enabled proportional controls corresponds to the programmed flap setting.

The trim range for a given transmitter control is about ±25 %. However, these “trim” controls are only effective when, as described in section “ON/OFF” further below, has been assigned a profi-trim switch and switched on.

An active transmitter control assignment can be erased with a simultaneous tap on the ▲▼ or ◄ ► selection keys of the right four-way button (**CLEAR**).

Note:

Trim values retain their settings until the next closure of the ON/OFF switch, even then when the trim functions in the “Control” line have been temporally reset to “free”.

ON/OFF

The “ON/OFF” line is used to assign a switch which permits the profi-trim function to be switched on/off globally. This assignment is done in the manner described in the section “Physical control, switch and control switch assignments” on page 60. Another option is to select an “FX” switch from the range of expanded switches, if you wish the “Profi-Trim” option to remain switched on permanently.

In this context, pay attention to the following dependencies:

- Only when the ON/OFF switch in the “Trim” line is set to “ON” will the trim functions assigned to trim controls in the “TR” line be able to affect trim within a range of ±25 %.
- As soon as the ON/OFF switch is opened or erased, the current trim positions will be stored and the selected trim controls become ineffective.

A tap, at the same time, on the ▲▼ or ◄ ► selection keys of the right four-way button (**CLEAR**) when a switch assignment is active will reset a field’s value back to “---”:

```
          Profi  trim
      ▲ AI ▼▲ AI ▲ ▲ FL ▼▲ FL ▲
 TR     ON    ON     OFF  OFF
 CTL    Lv1   Lv2    ---  ---
►ON/OFF      FXI
 ▲      SET   SET    SET  SET
```

Profi trim

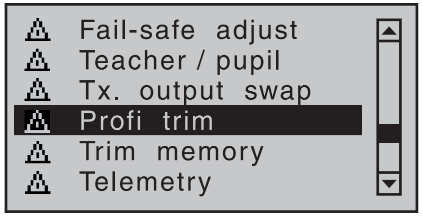
Pitch, throttle, tail-rotor, and C1 curve trimming

mc 16 20 ☑ ☑

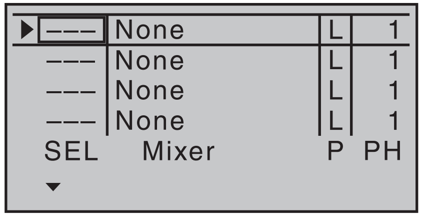
This option is available on both transmitter types.

The mc-16 HoTT and mc-20 HoTT transmitter's software has an integrated function for additional trimming of 6-point curves; in Heli programs »**Channel 1 curve**« page 137, and »**Helicopter mixer**« page 184. These are intended for "Pitch", "C1 → Throttle" and "C1 → Tail" curves.

This feature, named »**Profi trim**« because of its functional similarity to the Profi-Trim module for the **mc-24** but only available on that transmitter as a retrofit option. Select this feature from the multi-function menu with the selection keys of the left or right four-way button …



… then open this menu option with a brief tap on the centre **SET** key of the right four-way button.



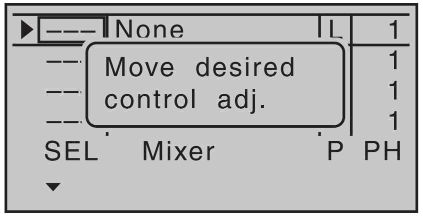
1. Column "Trim control"

Note:

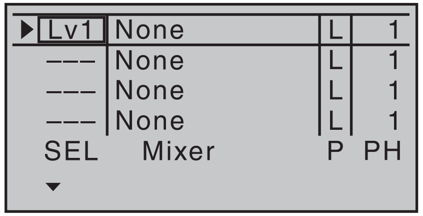
Pay attention to potential double-assignments when making trim control choices.

This menu's first line is for assigning those transmitter controls (from the available on the transmitter) which appear most advantageous for this purpose.

To assign a transmitter control, use the selection keys to navigate to the desired line then tap briefly on the centre **SET** key of the right four-way button …

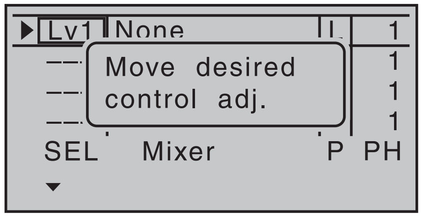


… then move the desired transmitter control:



Erase trim control

Select the transmitter control assignment in the appropriate line as already described, e. g.:

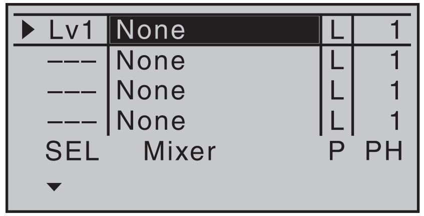


A tap, at the same time, on the ▲▼ or ◄► selection keys of the right four-way button (**CLEAR**) will now reset the field's value back to "free".

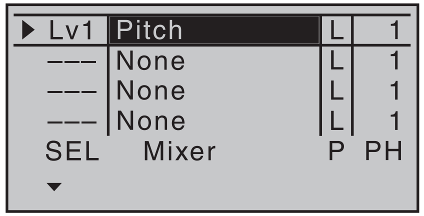
2. Column "Mixer"

This column contains a total of four Value fields, in which you can select one of the mixers "Collective pitch", "Ch1 → throttle" and "Ch1 → tail" as well as "Channel 1 curve" from a list, either individually or in any combination.

To do this, use the selection keys on the left or right four-way button to change to the desired value field. Then briefly tap the centre **SET** key of the right four-way button …



… and select the desired mixer with the selection keys of the left or right four-way button, for example:



Another tap on the centre **SET** key of the right four-way button or the **ESC** key of the left four-way button will conclude the entry. This procedure is the same for the other lines.

A tap, at the same time, on the ▲▼ or ◄► selection keys of the right four-way button (**CLEAR**) will reset a field displayed in inverse video back to "None".

3. Column "P" (Point)

The lines of the column "Mixer" were used to select one or mixers. Now, in the "Point" column, the reference points to be trimmed will be set.

To do this, use the selection keys on the left or right four-way button to move to the desired value field. Then briefly tap the centre **SET** key of the right four-way button …

```
▶ Lv1 | Pitch  | 1 |  1
  --- | None   | L |  1
  --- | None   | L |  1
  --- | None   | L |  1
  SEL   Mixer    P   PH
  ▼
```

If a undefined point is selected – in the basic version, only points "L" and "H" are set – the respective regulator will remain ineffective.

The point offset (in a maximum range of about ±12 %) for the selected mixer will simultaneously be displayed in the curve diagrams of the respective »**Helicopter mixer**« or »**Channel 1 curve**« menu so that the offset can also be checked visually.

4. Column "PH" (Phase)

The rightmost column is used, if desired, to determine which programmed flight phase the given regulator is to be active. The number preceding flight phase names, in the example "1" (Normal)", are based on the phase numbers as found in the »**Phase assignment**« menu on page 154:

```
▶ Lv1 | Pitch  | 1 |  2
  --- | None   | L |  1
  --- | None   | L |  1
  --- | None   | L |  1
  SEL   Mixer    P   PH
  ▼
```

However, the current position of the regulator will be – contrary to the corresponding fixed-wing program – set to a new zero point when …

- … by a change of flight phase, individual or all trim controls become active or
- … the given trim control is erased or
- … meanwhile the function assigned in the "Mixer" column is to be changed.

In all of these cases, the current regulator position will be stored and automatically overridden, i. e. adopted into the curve characteristic, by the pre-programmed curve points specified by the »**Channel 1 curve**« and »**Helicopter mixer**« menus. In this manner it is possible to simultaneously optimize up to four arbitrary curve points during the flight.

The memory storage option described here is, for example, useful during the first test flights of a new model as this permits the "flown" flight corrections to be immediately recorded in the program.

However, in order to have a clearly defined reference point prior to the first time a store is done, it is important to put all regulators into their middle positions.

But always be careful that, after repeated stores, servo travel is not too severely restricted on one side. Check and correct the control linkage if necessary.

Sometimes, despite an optimal basic setting for the model, it becomes necessary to temporarily change reference points, for example, when the weather has changed and the motor requires a short-term correction or even when the muffler gets a leak unexpectedly, etc. Of course, in all of these cases, the corrected settings should not be stored via the Profi trim option. Storage can be prevented by ensuring that the regulator is in its middle position before activation or deactivation.

__Note:__

*Yet another point, independent of this, can be regulated via the "Trim point function" through use of the selection keys. This is described in detail along with the programming of 6-point curves in section »**Channel 1 curve**« on page 137.*

Trim memory

Storing the current trim position

MC 16 20 ☑ ☑

This option is available on both transmitter types.

Use the selection keys of the left or right four-way button to scroll to the »**Trim memory**« menu option in the Multi-function menu:

```
Fail-safe  adjust
Teacher / pupil
Tx.  output  swap
Profi  trim
Trim  memory
Telemetry
```

Open this menu option with a tap on the centre **SET** key of the right four-way button:

```
        Trim  memory
CH1          0%       0%
AILE         0%       0%
ELEV         0%       0%
RUDD         0%       0%
            POS      SET
```

This menu permits selective storage of the given current position for the four digital trim controls in order to return them afterward to their visual middle points. This makes the last stored trim positions in the respective middle positions of trim levers for control functions 1 … 4 available again following a model memory location change or after long flight pauses.

The storage of the trim values are-if necessary. Considering your settings are available in the "Tr" column of the MC-20 Hott transmitter only in the menus »Stick mode" (page 108) "GL (obal)" or "PH (ase)" - in the »**Phase settings**« (page 148) and »**Phase assignment**« menus (page 154) have defined flight phases. The active flight phase is then also displayed on the bottom of the display, for example:

```
        Trim  memory
CH1          0%       0%
AILE         0%       0%
ELEV         0%       0%
RUDD         0%       0%
«normal »   POS      SET
```

Storing trim positions

The model has been flight tested and trimmed during the test flights. Current trim positions are now displayed in the column "POS" located approximately in the middle of the display. (The trim range is about ±30 % of total control travel.) The right column displays trim memory content, currently filled uniformly with 0 % because values have not yet been stored. Therefore, the display appears like as follows:

```
        Trim  memory
CH1          0%       0%
AILE        +5%       0%
ELEV        +3%       0%
RUDD        –7%       0%
«normal »   POS      SET
```

Now use the selection keys on the left or right four-way button to move to the line where a trim value is to be written into trim memory, e. g. the elevator trim value:

```
        Trim  memory
CH1          0%       0%
AILE        +5%       0%
ELEV        +3%       0%
RUDD        –7%       0%
«normal »   POS      SET
```

The trim value is stored in the trim memory when you press the central **SET** button of the right-hand four-way button; the setting is displayed in the right-hand column:

```
        Trim  memory
CH1          0%       0%
AILE        +5%       0%
ELEV         0%      +3%
RUDD        –7%       0%
«normal »   POS      SET
```

Now, if desired, change the flight phase and repeat the procedure. Perform the same procedure for the other control functions, as necessary.

Erasing stored trim positions

Use the selection keys on the left or right four-way button to move to the line where a trim value is to be erased from trim memory, e. g.:

```
        Trim  memory
CH1          0%       0%
AILE        +5%       0%
ELEV         0%      +3%
RUDD        –7%       0%
«normal »   POS      SET
```

Simultaneously tap on the ▲▼ or ◄ ► selection keys of the right four-way button (**CLEAR**) reset the value field again back to "0 %".

```
        Trim  memory
CH1          0%       0%
AILE        +5%       0%
ELEV         0%       0%
RUDD        –7%       0%
«normal »   POS      SET
```

However, if you do not erase a trim memory before storing a new value, the new value will be added to the stored value.

Although this an “elegant” way to effectively offset servo throw beyond the normal trim range of about ±30 %, do keep in mind that excessive offsets for servo travel can lead to anomalies including one-sided restriction. It is then prudent to check control linkages and make corrections as necessary.

Trim memory

Storing the current trim position

mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

Use the selection keys of the left or right four-way button to scroll to the »**Trim memory**« menu option in the Multi-function menu:

```
  Fail-safe  adjust
  Teacher / pupil
  Tx.  output  swap
  Profi  trim
  Trim  memory
  Telemetry
```

Open this menu option with a tap on the centre **SET** key of the right four-way button:

```
        Trim  memory
 ▶PT/thr        0%       0%
  Roll          0%       0%
  Nick          0%       0%
  Tail          0%       0%
 ▾             POS      SET
```

This menu permits selective storage of the given current position for the four digital trim controls in order to return them afterward to their visual middle points. This makes the last stored trim positions in the respective middle positions of trim levers for control functions 1 … 4 available again following a model memory location change or after long flight pauses.

The storage of the trim values are-if necessary. Considering your settings are available in the “Tr” column of the mc-20 Hott transmitter only in the menus »Stick mode” (page 108) “GL (obal)” or “PH (ase)” - in the »**Phase settings**« (page 148) and »**Phase assignment**« menus (page 154) have defined flight phases. The active flight phase is then also displayed on the bottom of the display, for example:

```
        Trim  memory
 ▶PT/thr        0%       0%
  Roll          0%       0%
  Nick          0%       0%
  Tail          0%       0%
 ▾ «normal » POS        SET
```

Storing trim positions

The model has been flight tested and trimmed during the test flights. Current trim positions are now displayed in the column “POS” located approximately in the middle of the display. (The trim range is about ±30 % of total control travel.) The right column displays trim memory content, currently filled uniformly with 0 % because values have not yet been stored. Therefore, the display appears like as follows:

```
        Trim  memory
 ▶PT/thr        0%       0%
  Roll         +5%       0%
  Nick         +3%       0%
  Tail         –7%       0%
 ▾ «normal » POS        SET
```

Now use the selection keys on the left or right four-way button to move to the line where a trim value is to be written into trim memory, e. g. the elevator trim value:

```
        Trim  memory
  PT/thr        0%       0%
  Roll         +5%       0%
 ▶Nick         +3%       0%
  Tail         –7%       0%
 ⬍ «normal » POS        SET
```

The trim value is stored in the trim memory when you press the central **SET** button of the right-hand four-way button; the setting is displayed in the right-hand column:

```
        Trim  memory
  PT/thr        0%       0%
  Roll         +5%       0%
 ▶Nick          0%      +3%
  Tail         –7%       0%
 ⬍ «normal » POS        SET
```

Now, if desired, change the flight phase and repeat the procedure. Perform the same procedure for the other control functions, as necessary.

Erasing stored trim positions

Use the selection keys on the left or right four-way button to move to the line where a trim value is to be erased from trim memory, e. g.:

```
        Trim  memory
  PT/thr        0%       0%
  Roll         +5%       0%
 ▶Nick          0%      +3%
  Tail         –7%       0%
 ⬍ «normal » POS        SET
```

Simultaneously tap on the ▲▼ or ◀ ▶ selection keys of the right four-way button (**CLEAR**) reset the value field again back to “0 %”.

```
        Trim  memory
  PT/thr        0%       0%
  Roll         +5%       0%
 ▶Nick          0%       0%
  Tail         –7%       0%
 ⬍ «normal » POS        SET
```

⚠ **However, if you do not erase a trim memory before storing a new value, the new value will be added to the stored value.**

Although this an “elegant” way to effectively offset servo throw beyond the normal trim range of about ±30 %, do keep in mind that excessive offsets for servo travel can lead to anomalies including one-sided restriction. It is then prudent to check control linkages and make corrections as necessary.

Telemetry

Read-in and settings for telemetry data

mc 16	mc 20
☑	☑

This option is available on both transmitter types.

The receiver's settings, as well as optional telemetry sensor settings, can be called up and programmed in real-time by way of the »**Telemetry**« menu. Communication with the transmitter is accomplished over the return channel built into the HoTT receiver.

A maximum of four sensors can be connected to the Telemetry sockets of the following receivers, using Y-leads where necessary: GR-12S HoTT (No. **33505**), GR-12 HoTT (No. **33506**), GR-16 (No. **33508**), GR-24 HoTT (No. **33512**) and GR-32 DUAL (No. **33516**), provided that they feature the current firmware.

The update capability of these and future receivers, which can be performed by the user, will keep the respective »**Telemetry**« menu up to date with the latest version and ensure enhancement with future functions or languages.

<u>Note:</u>

After registering your product at https://www.graupner.de/en/service/product_registration.aspx you are automatically informed of new updates.

<u>Important notices:</u>

- *This manual is based on the functions available at the time of revision of this manual.*
- *As already mentioned in the section entitled "Binding multiple receivers" on pages 80 and 90, it is also possible to bind more than one receiver per model if required.*

The software of mc-16 HoTT and mc-20 HoTT transmitters is capable of directly managing a maximum of two receivers, and the menu system can also be used to distribute up to twelve transmitter control channels between these two receivers in any configuration you wish.

However, only the receiver selected in the line "TEL.RCV" of the "Telemetry" menu is able to establish a telemetry connection to the transmitter!

```
TELEMETRY

▸TEL.RCV.     RCV CH1
 SETTING & DATA VIEW
 SENSOR SELECT
 RF STATUS VIEW
 VOICE TRIGGER
```

*However, that also means the inverse, that only this receiver can be addressed through the »**Telemetry**« menu! If necessary, therefore, the selection must be changed before settings can be made on a specific receiver. The second and following receiver work in the so called parallel Slave-mode.*

- *Since the telemetric data between transmitter and receiver is only exchanged after the fourth data package, the data transmission requires a certain amount of time for technical reasons, so the reaction to the operating keys and changes to settings take place with a delay. Therefore, the delay is not due to an error.*
- ***When adjusting the settings of the remote control, make absolutely sure that the transmitter antenna is always far enough away from the receiver antennae! To be on the safe side, keep them at least one meter apart.***
- ***Otherwise there is a risk of a faulty connection to the return channel and malfunctions will result.***
- ***When operating a powered tug for aero-towing, ensure that the receiving systems and the aerials in the two models are always at least 50 cm apart; we recommend the use of satellite receivers in such situations. If you neglect this, there is a chance of interference from the downlink channel.***
- *Programming on the model or on sensors may only take place if the model is on the ground. Only carry out the settings with the motor switched off and the battery disconnected! Otherwise, undesired programming cannot be ruled out.*

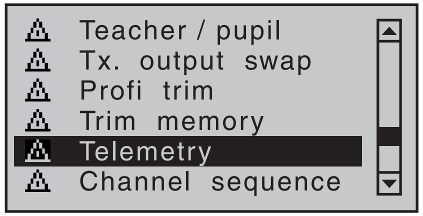
  For example, a servo test initiated accidentally could cause the model to crash and cause personal injury and/or property damage. Observe the safety instructions on pages 4 … <?> of this manual and the respective separate manuals.
- *All settings (such as fail-safe, servo direction reversal, servo travel, mixer and curve settings, etc.) made through the »**Telemetry**« menu are stored only in the receiver and therefore are adopted along with it if it is implemented as a receiver in another model. Therefore, to be on the safe side, re-initialize your HoTT receiver if you want to use the receiver in a different model; see "Reset" on page 53.*
- *Only program the servo direction reversal, servo travel, mixer and curve settings through the respective transmitter's standard menus »**Servo adjustment**« page 106, »**Dual Rate / Expo**« page 126 or page 130, »**Channel 1 curve**« page 134 or 137, and so on.*

Otherwise, the settings superimpose one another, which can lead to complexity or even problems in the later operation.

- *The channel assignment function, called "Channel mapping", integrated into the »**Telemetry**« menu of the mc-16 HoTT and mc-20 HoTT transmitters can also freely distribute control functions over multiple receivers or even distribute a single control function over multiple receiver outputs, such as two servos per aileron instead of only one individual servo, etc.*
  We also recommend exercising extreme during the programming.

Telemetry

The menus gathered under the heading »**Telemetry**« can be called up from the mc-16 HoTT and mc-20 HoTT transmitter's basic display with a tap of about one second duration on the centre **ESC** key of the left four-way button. The same menus can, like other transmitter menus, also be opened in the multifunction menu with a tap on the centre **SET** key of the right four-way button:



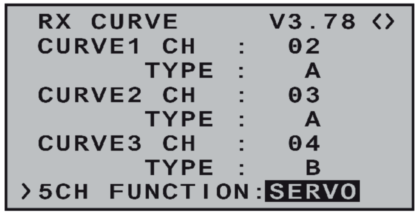
Basic operation

Operating the »**Telemetry**« menu is essentially the same as for the remaining mc-16 HoTT and mc-20 HoTT transmitter menus. The few differences are described in the following:

The ◄ ► selection keys of the left or right four-way button can be used to switch between individual pages of the Telemetry menu. Corresponding directional indicators can be found at top right of each display page in the form of angled brackets (**‹ ›**), refer to the figures below. If only one angled bracket is visible, you are on either the first or last respective page. In this case, changing pages is only possible in the indicated direction.

Menu lines in which parameters can be changed are identified with the aforementioned angled bracket (**›**). The "**›**" pointer will jump a line forward or back with a tap on the ▲▼ selection keys of the left or right four-way button. Lines to which a jump cannot be made are unalterable.

In order to change a parameter, briefly touch the centre **SET** key of the right four-way button (the parameter will be displayed in inverse video),...



... change the value within the permissible adjustment range via the selection keys of the *right* four-way button and adopt the value with another tap on the **SET** key. A brief tap on the centre **ESC** key of the left four-way button will cause a return to the starting position again.

Now use the ▲▼ selection keys of the left or right four-way button to pick the desired sub-menu. However, if the message …

… appears instead of the desired sub-menu after touching the centre **SET** key of the right four-way button then no connection has been established with a receiver. Therefore, switch on your receiver system or, if applicable reconnect the addressed receiver as described on page 80 or 90 or activate it as described under "Important Notices" on the previous page.

On the first display page...

RX DATAVIEW

... of the sub-menu “SETTINGS & DATAVIEW” of the »**Telemetry**« menu, overwritten with …

```
TELEMETRY

 TEL.RCV.     RCV CH1
▶SETTING & DATA VIEW
 SENSOR SELECT
 RF STATUS VIEW
 VOICE TRIGGER
```

… no settings can be made. This page is only provided for information:

```
 RX DATAVIEW V3.78   >
S–QUA100%S–dBM–030dBM
S–STR100% R–TEM.+28°C
L PACK TIME 00010msec
R-VOLT  :05.0V
L.R-VOLT:04.5V
SENSOR1 :00.0V   00°C
SENSOR2 :00.0V   00°C
```

Value	Explanation
Vx.xx	Receiver’s firmware version
S-QUA	Signal quality in % of the transmitter signal packets received by the receiver
S-dBm	Reception power in dBm of the transmitter signal received by the receiver
S-STR	Signal strength in % of the transmitter signal received by the receiver
R-TEM.	Receiver temperature in °C
L PACK TIME	Indicates the time in ms in which the longest data package is lost during the transmission from the transmitter to the receiver
R-VOLT	Current operating voltage of the receiver in volts
L.R-VOLT	Lowest operating voltage of the receiver since it was last turned on, in volts
SENSOR1	Indicates values of optional telemetric sensor 1, in volts and °C
SENSOR2	Indicates values of optional telemetric sensor 2, in volts and °C

Signal quality (S-QUA)

The signal quality (S-QUA) is sent “live” over the receiver’s return channel to the transmitter and indicates the signal quality in %.

Reception power (S-dbm)

When specifying “dBm” is a logarithmic value for a relatively clear indication of extremely large level differences, where a level of 0 dBm corresponds to a power of exactly 1 mW. Services> 1mW therefore have positive dBm values, achievements <1mW accordingly negative.

In the (remote control) practice, this means that, due to the propagation of radio waves and the associated attenuation of the signal on its way to the receiver, for example, of the 100mW transmit power of a standard-compliant transmitter (= 20dBm) usually (considerably) less than 1 mW, and thus arrive at a level <0dBm, the recipient. It follows that the appears on the display in dBm specified reception level usually with a negative sign. That but also:

The higher the following on the minus symbol number, the worse the reception level! This is important, among other things the range test before starting the model operation.

Perform the range test as described on page 84 or 94 before each flight and, in doing so, simulate all servo movements which also take place during the flight. The range must be at least 50 m on the ground with the range test activated. At this distance, the value shown under “S-dBm” in the “**RX DATAVIEW**” display may not be greater than -90 dBm in order to guarantee safe operation. The model should never be operated with a lower value (e. g. -95 dBm). Check the installation of the receiver system and the position of the antenna.

The reception power should not drop below -90 dBm during operation. Otherwise, reduce the distance of the model. Normally, however, the acoustic range warning (peep tone interval 1 s) is triggered before this value is reached in order to guarantee safe operation.

Signal strength (S-STR)

The signal strength (S-STR) is displayed in %. In general, an acoustic range warning (peep tone interval 1 s) is issued as soon as the receiver signal becomes too week in the return channel. However, since the transmitter has a significantly higher transmission power than the receiver, the model can still be safely operated. For the sake of safety, the distance to the model should be reduced until the warning tone goes silent again.

Receiver temperature (R-TEM.)

Make sure the receiver remains within the permissible temperature range during all flight conditions (ideally between -10 and 55 °C).

The receiver temperature limit, at which a warning is issued, can be adjusted in the sub-menu »**RX SERVO TEST**« under “ALARM TEMP+” (50 … 80 °C and “ALARM TEMP-” (-20 … +10 °C). When the value is under-run or over-run, an acoustic signal sounds (continuous peep tone) and “**TEMP.E**” will appear at the top right of all “RX” receiver sub-menus. Additionally, the parameter “**R-TEM**” will be displayed in inverse video on the »**RX DATAVIEW**« display page.

Data packages (L PACK TIME)

Indicates the longest time span in ms in which data packages are lost in the transmission from the transmitter to the receiver. In practice, that is the longest time span in which the remove control system has entered into fail-safe mode.

Receiver operating voltage (R-VOLT)

Always check the operating voltage of the receiver. Never operate or even start your model if the operating voltage is too low.

The receiver low voltage warning can be adjusted between 3.0 and 7.5 volts in “ALARM VOLT” of the »**RX SERVO TEST**« sub-menu. If this range is under-run, an acoustic signal is sounded (repetitive double peep tone (long/short)) and “**VOLT.E**” will appear at the top right of all »**RX** …« receiver sub-menus. In addition, the parameter “**R-VOLT**” will be displayed in inverse video in the »**RX DATAVIEW**« sub-menu.

The current receiver battery voltage is also displayed in the main display, see page 30.

Minimum receiver operating voltage (L.R-VOLT)

“L.R-VOLT” indicates the minimum operating voltage of the receiver since the last time it was switched on.

If this voltage should deviate significantly from the current “R-VOLT” operating voltage, the receiver battery may be too heavily encumbered by the servos. The consequence is voltage drops. In this case, use a more powerful voltage supply in order to achieve maximum operational safety.

Sensor 1 + 2

Indicates the values of optional telemetric sensors 1 and 2, if present, in volts and °C.

RX SERVO

```
 RX SERVO      V3.78 <>
>OUTPUT CH: 01
 REVERSE  : OFF
 CENTER   : 1500µsec
 TRIM     : –000µsec
 LIMIT–   : 150%
 LIMIT+   : 150%
 PERIOD   : 20msec
```

It is very important that you read the notices on page 236 before doing any programming on this display page.

Value	Explanation	Possible settings
OUTPUT CH	Channel selection	1 … depending on receiver
REVERSE	Servo reversal	OFF / ON
Centre	Servo centre in µs	if active (inverse), dependent on control position
TRIM	Trim position in µs deviating from the Centre position	-120 … +120 µs
LIMIT–	Travel limit on the "–" side of servo travel in % servo travel	30 … 150 %
LIMIT+	Travel limit on the "+" side of servo travel in % servo travel	30 … 150 %
PERIOD	Cycle time in ms	10 or 20 ms

OUTPUT CH (channel selection)

If applicable, select the line “OUTPUT CH” with the selection keys. Touch the **SET** key of the right four-way button. The value field is shown highlighted. Now set the desired channel (e. g. 01) with the selection keys on the right four-way button. **The following parameters are always based on the channel set here.**

Reverse (servo reversal)

Set the rotational direction of the servo connected to the selected servo channel: ON / OFF

Centre (servo centre)

For the control channel selected in the “OUTPUT CH” line, the “Centre” line displays the currently stored pulse width for “servo centre” in µs. The default channel pulse width of 1500 µs represents the standard centre position, and corresponds to the usual servo centre setting.

In order to change this value, select the “Centre” line then tap the **SET** key of the right four-way button. The Value field is highlighted. Now move the respective transmitter control, stick and/or trim lever to the desired position and store the current control’s position with another tap on the **SET** key. This position is saved as the new neutral position.

The – new – value now displayed varies according to the current setting of the transmitter control which affects this control channel, and the position of its trim is saved with another tap on the **SET** key.

TRIM (trim position)

In the "TRIM" line" you can carry out the fine adjustment of the neutral position of a servo connected to the control channel selected in the "OUTPUT CH" line using the selection keys of the right four-way button in 1 µs increments. The value in the "Centre" line can be adjusted by the TRIM value set here in a range of ± 120 µs.

Factory setting: 0 µs.

LIMIT–/+ (side dependent travel limit –/+)

This option is provided for the adjustment of a side-dependent limit (limiting) of the servo travel (rudder throw) of the servo connected to the control channel selected in the "OUTPUT CH" line.

The settings for both directions are separate but both are in a range of 30 … 150 %.

Factory setting: 150 % each.

PERIOD (cycle time)

In this line you determine the time interval of the individual channel impulse. This setting is adopted for all control channels.

With the use of only digital servos, a cycle time of 10 ms can be set.

In mixed operation or with use of only analog servos, 20 ms should absolutely be set, because the latter can otherwise be "over-strained" and react with "shaking" or "quivering" as a result.

RX FAIL SAFE

```
 RX FAIL SAFE  V3.78<>
>OUTPUT CH: 01
 INPUT  CH: 01
 MODE     : HOLD
 F.S.POS. : 1500µsec
 DELAY    : 0.75sec
 FAIL SAFE ALL: NO
 POSITION : 1500µsec
```

The description of this menus necessitates a few words of warning in advance:

"Do nothing" is the absolute worst thing to be done in this regard. "HOLD" is prescribed in the base setup model of the HoTT receiver.

In the event of a failure, in the best case scenario the model flies straight ahead for an indefinite amount of time and then hopefully "lands" somewhere without causing significant damage! However, if something like this happens in the wrong place at the wrong time, the model may become uncontrollable and "tear" across the flight field completely out of control, putting the pilot and spectators at risk.

Therefore, it would obviously be beneficial to program the the function "Motor off" at the very least, in order to prevent such risks. If necessary, seek the advice of an experienced pilot in order to find a "logical" setting for your model.

And then another brief notice regarding the three possible versions of the mc-16 HoTT and mc-20 HoTT transmitters for the setting of Fail Safe:

The easiest, and recommended, way to fail-safe settings is the use of the »**Fail Safe**« menu, which can be reached from the multifunction menu, see page 216.

Similarly, in order to achieve the same result somewhat more laboriously, the "FAIL SAFE ALL" option described on the following pages is also available.

In addition, there are the relatively elaborate methods of the individual adjustment using the options "MODE", "F.S.Pos." and "DELAY". The description of these variants begins with the "MODE" option further below.

Value	Explanation	Possible settings
OUTPUT CH	Output channel (servo connection of the receiver)	1 … depending on receiver
INPUT CH	Input channel (channel coming from the transmitter)	1 … max. 12
MODE	Fail-Safe mode	HOLD FAIL SAFE OFF
F.S.POS.	Fail-safe position	1000 … 2000 µs
DELAY	Reaction time (delay)	0.25, 0.50, 0.75 and 1.00 s
FAIL SAFE ALL	Save of the Fail-safe positions of all control channels	NO / SAVE
POSITION	Display of the saved Fail-safe position	Between approx 1000 and 2000 µs

OUTPUT CH (servo connection)

In this line you select the respective OUTPUT CH (servo connection of the receiver) to be set.

INPUT CH (selection of the input channel)

As already mentioned on page 236, the eight control functions of the mc-16 HoTT transmitter and the mc-20 HoTT transmitter can be arbitrarily distributed to multiple receivers, if necessary, or even assigned to multiple receiver outputs with the same control function.

For example, this might be used in order to be able to control two servers for each aileron flap or an oversize rudder with linked servos instead of an individual servo.

Distribution to multiple HoTT receivers, in turn, offers the advantage of not having to use a long servo cable, e.g. for large models. In this case, bear in mind that only the receiver selected in the line "TEL.RCV." through the »**Telemetry**« menu can be addressed!

The 8 respectively 12 control channels (INPUT CH) of the mc-16 HoTT or mc-20 HoTT transmitter can be appropriately managed through so-called "Channel Mapping" (channel assignment) whereby a different control channel is assigned to the servo connection selected in the OUTPUT CH line for the receiver in the INPUT CH line.

BUT CAUTION:

If, for example, "2AIL" is specified in the transmitter on the "Aileron/camber flaps" line of the »**Base setup model**« menu then *control function 2* (*Aileron)* will already be assigned in the transmitter to *control channels 2 and 5 for distribution to the left and right ailerons.* The receiver's corresponding *INPUT CH*, which must also be mapped, would be the channels 02 and 05 in this case; see the following example.

Examples:

- *You would like to control each aileron of a large model with two or more servos.*

  Assign one of the two standard aileron control channels 2 or 5 as INPUT CH to the corresponding OUTPUT CH (servo connections) depending on the left or right bearing surface.

- *You would like to control the rudder of a large model with two or more servos.*

  Assign the same INPUT CH (control channel) to the corresponding OUTPUT CH (servo connections). In this case, this is the standard rudder channel 4.

MODE

The settings of the options "MODE", "F.S.Pos." and "DELAY" determine the behavior of the receiver in the event of a failure in the transmission from transmitter to receiver.

The setting programmed under "MODE" is *always* based on the channel set in the OUTPUT CH line.

The factory setting for all servos is "HOLD".

For each selected OUTPUT CH (servo connection of the receiver) you can choose between:

- FAI(L) SAFE

  With this selection, in the event of a failure the corresponding servo moves to the position shown in the "POSITION" line for the remainder of the failure until the "Delay time" set in the "DELAY" line has lapsed.

- HOLD

  With a setting of "HOLD", in the event of a failure the servo maintains the last correctly received servo position for the duration of the failure.

- OFF

  With a setting of "OFF", in the event of a failure the receiver discontinues the retransmission of (temporarily stored) control impulses for the respective servo output for the duration of the failure. In other words, the receiver switches the impulse line "off".

  BUT CAUTION:

  Analog servos and even some digital servos no longer put up any resistance against the previous control pressure during the failure of the control impulse and are more or less pushed out of their position as a result.

F.S.POS. (Fail-safe position)

For each OUTPUT CH (receiver servo connection), set the position the given servo should assume in "FAI(L) SAFE" mode, i.e. in the event of a failure, via the "F.S.POS." line. This is done by first activating the value field (inverse representation) with a tap on the **SET** key of the right four-way button then using the selection keys of the right four-way button to choose the servo position. The adjustment takes place in 10-µs increments.

Factory setting: 1500 µs (servo centre).

Important notice:

The function "F.S.POS." has an additional meaning in all three modes, "OFF", "HOLD" and "FAI(L) SAFE" in the event that the receiver is switched on, but (still) does not receive a valid signal.

The servo immediately travels to the fail-safe position predefined in the "Position" line. In doing so, the landing gear, for example, is prevented from retracting of the receiver is accidentally switched on while the transmitter is switched off. In normal model mode, on the other hand, the corresponding servo behaves in accordance with the set "MODE" in the event of a failure.

DELAY (fail-safe reaction time or delay)

Here you adjust the delay time after which the servos should move to their predetermined positions in the event of a signal interruption. This setting is adopted for all channels and only pertains to the servos programmed to the "FAIL SAFE" mode.

Factory setting: 0.75 s.

FAIL SAFE ALL (global fail-safe setting)

This sub-menu allows servo fail-safe positions to be established at the “push of a button” in a similar manner to that described on page 216 for the »**Fail Safe**« menu.

Switch to the “FAIL SAFE ALL” line and activate the value field by touching the centre **SET** key of the right four-way button. “**NO**” will be displayed in inverse video. Then adjust the parameter to “**SAVE**” with one of the selection keys of the right four-way button. Now, using the operating elements of the transmitter, move all servos to the desired fail-safe position you assigned or want to assign in the line “MODE” “FAI(L) SAFE”. The current position of the control for the channel which was just set is shown in the bottom “Position” line:

```
 RX FAIL SAFE  V3.78<>
 OUTPUT CH: 01
 INPUT  CH: 01
 MODE      : FAI-SAFE
 F.S.POS. : 1500µsec
 DELAY     : 0.75sec
>FAIL SAFE ALL: SAVE
 POSITION : 1670µsec
```

After a tap on the centre **SET** key of the right four-way button, the display will change again, from “**SAVE**” to “**NO**”. The saved the positions of all servos affected by this measure and adopted them in parallel to the line “F.S.Pos.” and the display then immediately shows the following for the current OUTPUT CH (servo connection):

```
 RX FAIL SAFE  V3.78<>
 OUTPUT CH: 01
 INPUT  CH: 01
 MODE      : FAI-SAFE
 F.S.POS. : 1500µsec
 DELAY     : 0.75sec
>FAIL SAFE ALL: NO
 POSITION : 1670µsec
```

Switch off the transmitter and check the fail-safe positions based on the servo throws.

“Fail Safe” in combination with “Channel Mapping”

In order to ensure that the mapped servos – that is to say servos which are controlled from a common control channel (INPUT CH) – react the same way even in the event of a failure, *the corresponding settings of the INPUT CH determine the behavior of the mapped servos!!!*

Therefore, the servo connections 6, 7 and 8 of a receiver are mapped, for example, with one another, whereby the OUTPUT CH (servo connections) 06, 07 and 08 are assigned as INPUT CH of the same respective control channel “04” …

```
 RX FAIL SAFE  V3.78<>
>OUTPUT CH: 06
 INPUT  CH: 04
 MODE      : OFF
 F.S.POS. : 1670µsec
 DELAY     : 0.75sec
 FAIL SAFE ALL: NO
 POSITION : 1670µsec
```

```
 RX FAIL SAFE  V3.78<>
>OUTPUT CH: 07
 INPUT  CH: 04
 MODE      : OFF
 F.S.POS. : 1230µsec
 DELAY     : 0.75sec
 FAIL SAFE ALL: NO
 POSITION : 1670µsec
```

```
 RX FAIL SAFE  V3.78<>
>OUTPUT CH: 08
 INPUT  CH: 04
 MODE      : HOLD
 F.S.POS. : 1770µsec
 DELAY     : 0.75sec
 FAIL SAFE ALL: NO
 POSITION : 1670µsec
```

… the INPUT CH 04 determines the fail-safe behavior of these three servos connected to the control channel 4 completely independently of the individual settings of the respective OUTPUT CH:

```
 RX FAIL SAFE  V3.78<>
>OUTPUT CH: 04
 INPUT  CH: 04
 MODE      : FAI-SAFE
 F.S.POS. : 1500µsec
 DELAY     : 0.75sec
 FAIL SAFE ALL: NO
 POSITION : 1500µsec
```

This is also the case, for example, if this is mapped with INPUT CH 01:

```
 RX FAIL SAFE  V3.78<>
 OUTPUT CH: 04
>INPUT  CH: 01
 MODE      : FAI-SAFE
 F.S.POS. : 1500µsec
 DELAY     : 0.75sec
 FAIL SAFE ALL: NO
 POSITION : 1500µsec
```

In this case, the servo connection 04 would, in turn, react according to the fail-safe settings of CH 01.

The reaction or delay time set in the “DELAY” line, on the other hand, always applies uniformly for all channels set to “FAI(L) SAFE”.

RX FREE MIXER

```
 RX FREE MIXERV3.78 <>
>MIXER     : 1
 MASTER CH: 00
 SLAVE CH : 00
 S–TRAVEL–: 100
 S–TRAVEL+: 100
 RX WING MIXER
 TAIL TYPE: NORMAL
```

Value	Explanation	Possible settings
Vx.xx	Receiver's firmware version	None
MIXER	Mixer selection	1 … 5
MASTER CH	Signal source or source channel	0, 1 … depending on receiver
SLAVE CH	Target channel	0, 1 … depending on receiver
S-TRAVEL–	Admixing to the "-" side of servo travel in% servo	0 … 100 %
S-TRAVEL+	Admixing to the "+" side of servo travel in% servo	0 … 100 %
RX WING MIXER TAIL TYPE	tail type	NORMAL, V-TAIL, ELEVON (vertical/horizontal mixer for delta and flying wing)

MIXER

Up to five mixers can be programmed simultaneously. Use "MIXER" to switch between mixers 1 … 5.

The following settings in this display *always* for just the mixer selected in the "MIXER" line.

Important notice:

If you have already programmed mixer functions in the »Wing mixer« or »Free mixer« menus, make absolutely sure that these mixers do not overlap with those in the menu "RX FREE MIXER"!

MASTER CH ("from")

According to the same principles described in the section "Free mixer" on page 200, the signal applied at the MASTER CH (signal source or source channel) is mixed to a variable extent to the SLAVE CH (target channel).

Select "00" if no mixer should be set.

SLAVE CH ("to")

The signal of the MASTER CH (source channel) is mixed proportionally to the SLAVE CH (target channel). The mix ratio will be determined by the percentages entered in the lines "TRAVEL–" and "TRAVEL+".

Select "00" if no mixer should be set.

TRAVEL–/+ (proportion of the admix in %)

With the settings of these two lines the percentage of the admix is specified in relation to the MASTER signal separately for each direction.

RX WING MIXER TAIL TYPE (tail unit type)

The following model types are also available in the "Tail" line of the »**Model type**« menu, on page 98 and should, preferentially, be preset there. In this case, *always* leave the TAIL TYPE set to NORMAL.

However, if you would prefer to use the mixer integrated in the receiver, you can select the already pre-adjusted mixer functions for the corresponding model type:

- **NORMAL**

  This setting corresponds to the classic aircraft type with rear tail unit and separate rudder and elevator. No mixer function is necessary for this model type.

- **V-TAIL (V-tail unit)**

  With this model type the elevator and rudder control functions are connected, so that each of the two tail unit flaps – each controlled with a separate servo – assume both the elevator and rudder function.

  The servos are normally connected to the receiver as follows:

  OUTPUT CH 3: Left V-tail servo

  OUTPUT CH 4: Right V-tail servo

  If the servo's direction of rotation is incorrect, please observe the notices on page 65.

- **ELEVON (delta/flying wing models)**

  The servos connect at the outputs 2 and 3 assume the aileron and elevator function. The servos are normally connected to the receiver as follows:

  OUTPUT CH 2: Left horizontal/vertical

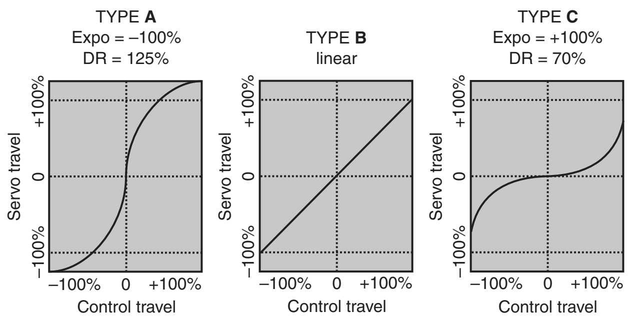
  OUTPUT CH 3: Right horizontal/vertical

  If the servo's direction of rotation is incorrect, please observe the notices on page 65.

RX CURVE (EXPO)

```
 RX CURVE      V3.78 <>
>CURVE1 CH  :  02
       TYPE :   B
 CURVE2 CH  :  03
       TYPE :   B
 CURVE3 CH  :  04
       TYPE :   B
```

Value	Explanation	Possible settings
Vx.xx	Receiver's firmware version	None
CURVE1, 2 or 3 CH	Channel assignment of the respective curve setting	1 … depending on receiver
TYPE	Curve type	A, B, C see figure



Normally a non-linear control function, if applicable, is used for the aileron (channel 2), elevator (channel 3) and rudder (channel 4). These channel defaults also correspond to the factory settings.

BUT CAUTION:

This assignment only applies when, on the transmitter side, neither "2HRSv3+8" is specified in the "Tail type" line nor is "2AIL" or "2AIL 2FL" specified in the "Aileron/camber flaps" line of the »**Model type**« menu, page 126. Otherwise, assignments will have already been made in the transmitter for *control function 3 (elevator)*, which will then be split between *control channels 3 & 8*, or *control function 2* (*aileron)*, which will then be split between *control channels 2 & 5 for the left and right ailerons.* The corresponding *control channels (INPUT CH) in the receiver* would in both cases be channels 03 & 08 or 02 & 05.

Therefore if, for example, "2AIL" has been specified on the transmitter side and the intent here is to utilize the RX CURVE option instead of the mc-16 HoTT or mc-20 HoTT transmitter's individually adjustable »**Dual Rate / Expo**« menu, see page 126 or 130, then two curves must be set. Otherwise, the left and right ailerons have different control characteristics:

```
 RX CURVE      V3.78 <>
 CURVE1 CH  :  02
       TYPE :   A
>CURVE2 CH  :  05
       TYPE :   A
 CURVE3 CH  :  04
       TYPE :   B
```

With the RX CURVE function you can manage the control characteristics for up to three servos:

- **CURVE 1, 2 or 3 CH**

  Select the desired *control channel* (INPUT CH) of the first servo.

  The following setting in TYPE only pertains to the channel selected here.

  TYPE

  Select the servo curve:

  A: EXPO = -100 % and DUAL RATE = 125 %

  The servo reacts strongly to movements of the stick around the neutral position. As the rudder throw increases, the curve becomes flatter.

  B: Linear setting.

  The servo follows the stick movement linearly.

  C: EXPO = +100 % and DUAL RATE = 70 %

  The servo reacts weakly to the stick movements around the neutral position. As the rudder throw increases, the curve becomes steeper.

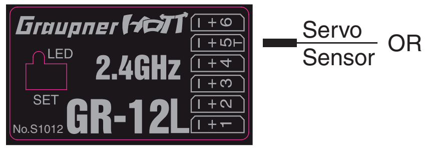
Note:

The control characteristics programmed here also affect the mapped receiver outputs.

5CH FUNCTION: "SERVO" or "SENSOR"

```
 RX CURVE      V3.78 <>
>CURVE1 CH  :  02
       TYPE :   B
 CURVE2 CH  :  03
       TYPE :   B
 CURVE3 CH  :  04
       TYPE :   B
 5CH FUNCTION:SERVO
```

Some receivers have a specific servo connection which has been made switchable rather than an independent telemetry connection. Thus, for example, on the GR-12 receiver included with the mc-16 HoTT and mc-20 sets, No. **33112,** servo connector 5 has an extra "T" mark and can be alternatively connected …



… not only via an No. **7168.6S** adapter cable to upgrade the receiver but also connected to a telemetry sensor.

However, in order for the receiver to correctly recognize the given connected device correctly, servo connection 5 (in this case) MUST be appropriately set for either "SERVO" or "SENSOR".

This switchover is accomplished by moving the ▼ with the selection key of the left or right four-way button until the "›" symbol is at the left margin of the bottom line then tapping on the centre **SET** key of the right four-way button:

```
 RX CURVE      V3.78 ‹›
 CURVE1 CH   :  02
        TYPE :   A
 CURVE2 CH   :  03
        TYPE :   A
 CURVE3 CH   :  04
        TYPE :   B
›5CH FUNCTION:SERVO
```

Now use one of the ▲▼ selection keys on the right four-way button to select the alternative setting "SENSOR".

```
 RX CURVE      V3.78 ‹›
 CURVE1 CH   :  02
        TYPE :   A
 CURVE2 CH   :  03
        TYPE :   A
 CURVE3 CH   :  04
        TYPE :   B
›5CH FUNCTION:SENSOR
```

Another tap on the centre **SET** key of the right four-way button will close the selection and, with appropriate repetitive taps on the centre **ESC** key of the left four-way button, a return to the transmitter's basic display is accomplished.

RX SERVO TEST

The RX SERVO TEST function allows you to test the servos connected to the currently active receiver:

```
 RX SERVO TEST V3.78‹
›ALL-MAX   : 2000µsec
 ALL-MIN   : 1000µsec
 TEST      : STOP
 ALARM VOLT : 3.8V
 ALARM TEMP+: 55°C
 ALARM TEMP-:-10°C
 CH OUT TYPE:ONCE
```

Value	Explanation	Possible settings
Vx.xx	Receiver's firmware version	None
ALL-MAX	Servo travel on the "+" side for all servo outputs for the servo test	1500 … 2000 µs
ALL-MIN	Servo travel on the "-" side for all servo outputs for the servo test	1500 … 1000 µs
TEST	Test procedure	START / STOP
ALARM VOLT	Alarm threshold of the receiver undervoltage warning	3.0 … 7.5 V factory setting: 3.8 V
ALARM TEMP+	Alarm threshold for excessively high temperature of the receiver	50 … 80 °C Factory setting: 55 °C
ALARM TEMP–	Alarm threshold for excessively low temperature of the receiver	-20 … +10 °C Factory setting: -10 °C
CH OUTPUT TYPE	Channel sequence	ONCE, SAME, SUMI, SUMO and SUMD

ALL-MAX (servo travel on the "+" side)

In this line you set the maximum servo travel on the plus side of the control travel for the servo test.

2000 µs corresponds to the full throw; 1500 µs corresponds to the neutral position.

Make sure that the servos do not overrun mechanically during the test routine.

ALL-MIN (servo travel on the "-" side)

You adjust the maximum servo travel on the minus side of the control path for the servo test in this line.

1000 µs corresponds to the full throw; 1500 µs corresponds to the neutral position.

TEST

You start and stop the servo test integrated in the receivers in this line.

A brief tap on the centre **SET** key of the right four-way button will open the entry field:

```
 RX SERVO TEST V3.78‹
 ALL-MAX   : 2000µsec
 ALL-MIN   : 1000µsec
›TEST      : STOP
 ALARM VOLT : 3.8V
 ALARM TEMP+: 55°C
 ALARM TEMP-:-10°C
 CH OUT TYPE:ONCE
```

Now, with one of the selection keys of the right four-way button, select **START**:

```
 RX SERVO TEST V3.78‹
 ALL-MAX   : 2000µsec
 ALL-MIN   : 1000µsec
›TEST      : START
 ALARM VOLT : 3.8V
 ALARM TEMP+: 55°C
 ALARM TEMP-:-10°C
 CH OUT TYPE:ONCE
```

A brief tap on the centre **SET** key of the right four-way button will now start the test run. The input field is shown as "normal" again:

```
 RX SERVO TESTV3.78 <
 ALL-MAX  : 2000µsec
 ALL-MIN  : 1000µsec
>TEST     : START
 ALARM VOLT : 3.8V
 ALARM TEMP+: 55°C
 ALARM TEMP-:-10°C
 CH OUT TYPE:ONCE
```

To stop the servo test, reactivate the entry field as described above, select **STOP** and confirm this selection with the **SET** key of the right four-way button.

ALARM VOLT (receiver undervoltage warning)

The receiver voltage is monitored through ALARM VOLT. The interval can be adjusted between 3.0 and 7.5 Volt. If the set alarm threshold is undercut, an acoustic signal is issued (interval peep tone long/short) and "**VOLT.E**" blinks in the top right of all »**RX …**« displays:

```
 RX SERVO    VOLT.E <>
>OUTPUT CH: 01
 REVERSE  : OFF
 CENTER   : 1500µsec
 TRIM     : -000µsec
 TRAVEL-  : 150%
 TRAVEL+  : 150%
 PERIOD   : 20msec
```

The parameter "**R-VOLT**" is also represented inversely in the »**RX DATAVIEW**« display:

```
 RX DATAVIEW VOLT.E  >
S-QUA100%S-dBM-030dBM
S-STR100% R-TEM.+28°C
L PACK TIME 00010msec
R-VOLT  :03.7V
L.R-VOLT:03.5V
SENSOR1 :00.0V   00°C
SENSOR2 :00.0V   00°C
```

ALARM TEMP +/-
(recommended temperature monitoring)

These two options monitor the receiver temperature. A lower threshold "ALARM TEMP-" (-20 … +10 °C) and an upper threshold "ALARM TEMP+" (50 … 80 °C) can be programmed. When these specifications are exceeded or undercut, an acoustic signal (continuous peep tone) sounds and "**TEMP.E**" appears in the top right of all receiver displays. In addition, the parameter "**R-TEM**" is shown inversely on the "»**RX DATAVIEW**«" display page.

Make sure that your receiver remains within the permissible temperature range during all flight conditions (ideally between -10 and 55 °C).

CH OUTPUT TYPE (connection type)

Here you select how the receiver outputs are controlled.

- **ONCE**

```
 RX SERVO TEST V3.78<
 ALL-MAX  : 2000µsec
 ALL-MIN  : 1000µsec
 TEST     : START
 ALARM VOLT : 3.8V
 ALARM TEMP+: 55°C
 ALARM TEMP-:-10°C
>CH OUT TYPE:ONCE
```

  The servo connections of the receiver are controlled successively. This is recommended for analog servos.

  This setting automatically operates servos in a 20 ms cycle – or in a 30 ms cycle for a 12 channel GR-24 receiver (No. **33512**) –, regardless of what is set or displayed in the "PERIOD" line of the »**RX SERVO**« screen!

- **SAME**

```
 RX SERVO TEST V3.78<
 ALL-MAX  : 2000µsec
 ALL-MIN  : 1000µsec
 TEST     : START
 ALARM VOLT : 3.8V
 ALARM TEMP+: 55°C
 ALARM TEMP-:-10°C
>CH OUT TYPE:SAME
```

  The signals are passed to the receiver servo sockets in parallel blocks. For example, the control signals are sent simultaneously to the servos connected to sockets 1 to 4 and 5 to 8 of the GR-16 receiver (No. **33508**), and the servos connected to sockets 1 to 4, 5 to 8 and 9 to 12 of the GR-24 receiver (No. **33512**).

  This is recommended for digital servos when multiple servos are used for one function (e. g. aileron), so that the servos can run absolutely synchronized.

  When only using digital servos, we recommend setting the "PERIOD" line of the »**RX SERVO**« to 10 ms in order to be able to utilize the fast reaction of digital servos. With the use of analog servos or in mixer mode, 20 ms must be selected!

  With this setting, pay particular attention to the sufficient dimensioning of the receiver current supply. Since up to four servos can always operate simultaneously, the requirement is higher.

- **SUMO** (sum signal OUT)

  A HoTT receiver configured as SUMO permanently generates a so-called sum signal from the control signals of all of its control channels and provides this by default in the case of the receivers supplied as standard in the sets GR-16 (No. **33508**) at servo socket 6 and GR-24 (No. **33512**) at servo socket 8.

On receivers whose right of "SUMO", an additional two-digit number in the display appears …

```
RX SERVO TEST V3.78<
ALL-MAX  : 2000µsec
ALL-MIN  : 1000µsec
TEST     : START
ALARM VOLT : 3.8V
ALARM TEMP+: 55°C
ALARM TEMP-:-10°C
>CH OUT TYPE:SUMO 08
```

… after confirmation of "SUMO" with a brief tap on the centre **SET** key of the right four-way button, the active field changes to the right for channel selection. With this selection you specify the *highest* of the transmitter channels contained in the SUMO signal:

```
RX SERVO TEST V3.78<
ALL-MAX  : 2000µsec
ALL-MIN  : 1000µsec
TEST     : START
ALARM VOLT : 3.8V
ALARM TEMP+: 55°C
ALARM TEMP-:-10°C
>CH OUT TYPE:SUMO 08
```

Either confirm the default with another tap on the centre **SET** key of the right four-way button or use the selection keys to pick another channel between 04 and 16 and confirm that with **SET**.

Receiver outputs will be controlled successively in a 20 ms cycle (30 ms with the GR-32 DUAL receiver, No. **33516**), even if 10 ms is set in the "PERIOD" line of the the »**RX SERVO**« screen.

Primarily intended for the "Satellite mode" of two HoTT receivers, as described below, the sum signal generated by the SUMO-designated receiver can also be used, for example, to control of Flybar systems (provided they have an appropriate input) or to control flight simulators via an adapter cable, No. **33310**.

In …

Satellite mode

… two HoTT receivers are connected to one another through a three-wire connecting cable (No. **33700.1** (300 mm) or **33700.2** (100 mm)) at receiver-type-specific servo connections. Type GR-16 No. **33508** and GR-24 No. **33512** receivers, for example, are to be connected with one another at servo output 8. Type GR-32 DUAL No. **33516** receiver, features a proper sumdsignal output labelled with "+ S" on the left lower side. More detailed information can be found on the Internet at www.graupner.de.

All the channels of the HoTT receiver configured as SUMO (or the channels selected in the "CH OUT TYPE" line) and designated satellite receiver, are passed constantly to the second HoTT receiver via this connection; this is the primary receiver, which is designated …

- **SUMI** (sum signal IN)

… the designation for the main receiver. Therefore, the signal always goes toward SUMI:

```
RX SERVO TEST V3.78<
ALL-MAX  : 2000µsec
ALL-MIN  : 1000µsec
TEST     : START
ALARM VOLT : 3.8V
ALARM TEMP+: 55°C
ALARM TEMP-:-10°C
>CH OUT TYPE:SUMI
```

The receiver defined as SUMI, however, only uses the sum signal coming from SUMO in the event of a failure of receipt if at least one channel in SUMI is programmed to fail-safe.

If the receiver programmed as the SUMO satellite receiver has a reception outage, the servos connected to this receiver assume the fail-safe positions which were programmed into the satellite receiver, completely independent of the main receiver.

On the other hand, if two receivers have a reception outage *simultaneously*, the fail-safe settings in the current receiver software at the time this manual went to revision (in principle, the SUMO's fail-safe settings) become effective.

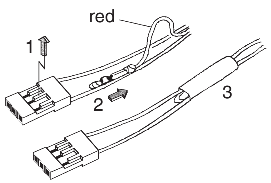
In the individual case, however, interactions cannot be ruled out, **which is why we urgently recommend performing an appropriate test BEFORE commissioning a model.**

This receiver combination is recommended if, for example, one of the two receivers is installed in the model at an unfavorable position for receiving or as a result of nozzles, carbon fibre material or the like, there is the danger that the receipt signal is weakened due to the flight position, so that interruptions of the range must be taken into account.

Therefore, make sure to connect the most important control functions to the main receiver programmed as SUMI, so that, in the event of a failure, the model remains controllable when the SUMO satellite receiver no longer receives a signal.

Telemetry data, such as the voltage of the on-board electricity supply, on the other hand, is only sent to the transmitter by the satellite receiver configured as SUMO. For this reason telemetry sensors must be connected to the satellite receiver (SUMO), and this receiver must also be defined as such in the “TEL. RCV.” line of the »**Telemetry**« menu (Bind 1 … 2); see “Important notes” on page 244. Each receiver should be connected with its own supply line from the common voltage supply. With receivers with a high current load, it may even be beneficial to connect them with two supply lines to the same current supply. .

On the other hand, if each of the two receivers should be supplied from its own voltage source, the centre cable must be removed from one of the two plugs of the satellite cable; see figure.



If you would like to carry out additional programming, such as fail-safe settings, disconnect the three-pole satellite connection between the two receivers and switch on only the relevant receiver. It may be necessary to also change the connection sequence.

- **SUMD** (digital sum signal)

  A HoTT receiver configured as SUMD, as described above, constantly generates a digital sum signal from the control signals of a (user-defined) number of its control channels, and makes this available at the following receiver outputs (receivers supplied in the sets as standard) GR-16 and GR-24 at servo socket 8

  At the time these instructions were revised this type of signal is exploited by a few of the latest electronic developments in the fields of flybarless systems, high-capacity power supply systems, etc.

However, if you wish to use this facility it is essential to read and observe the set-up notes supplied with the device connected to the receiver, otherwise there is a risk that your model will be uncontrollable.

```
RX SERVO TEST      <
ALL-MAX   : 2000µsec
ALL-MIN   : 1000µsec
TEST      : START
ALARM VOLT : 3.8V
ALARM TEMP+: 55°C
ALARM TEMP-:-10°C
>CH OUT TYPE:SUMDHD12
```

When you confirm “SUMD” by briefly pressing the central SET button of the right-hand four-way button, the active Value field moves to the right, where you can select one of three possible receiver responses in the case of reception failure (Fail-Safe):

```
RX SERVO TEST      <
ALL-MAX   : 2000µsec
ALL-MIN   : 1000µsec
TEST      : START
ALARM VOLT : 3.8V
ALARM TEMP+: 55°C
ALARM TEMP-:-10°C
>CH OUT TYPE:SUMDHD12
```

- **HD** (“hold“)

  The signals last detected as correct are “held” at the output.
- **FS** (Fail Safe)

  The signals stored previously as the Fail-Safe positions are passed to the output; see the section entitled “Fail Safe” on page 216.
- **OF** (OFF)

  No signals are passed to the servos during the period of interference.

When you again press the central SET button of the right-hand four-way button, the active field finally moves to Channel Select: at this point you can determine the *highest* transmitter channel which is to be included in the SUMD signal:

```
RX SERVO TEST      <
ALL-MAX   : 2000µsec
ALL-MIN   : 1000µsec
TEST      : START
ALARM VOLT : 3.8V
ALARM TEMP+: 55°C
ALARM TEMP-:-10°C
>CH OUT TYPE:SUMDHD12
```

<u>Note:</u>

In most cases a value higher than “12” is not required by devices likely to be connected to the system.

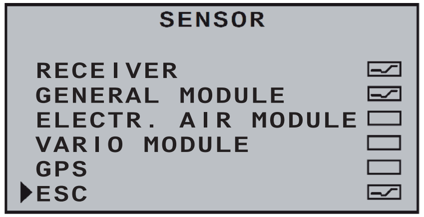
SETTING & DATAVIEW sensor(s)

If one or more sensors are connected to a receiver, and this receiver is a telemetry link, you can view the displays of any sensor subsequent to the above-described display “RX SERVO TEST” and if necessary change its settings.

Type transmitter mc-16 HoTT with firmware version V1.010 or higher, or type transmitter mc-20 HoTT with firmware V1.030 or later recognize automatically a sensor connected to the receiver:

```
         SENSOR

RECEIVER
GENERAL MODULE
ELECTR. AIR MODULE
VARIO MODULE
GPS
ESC
```

There is no automatic detection of connected sensors, these are shown here in the »**Telemetry**« menu’s »**SENSOR SELECT**« sub-menu (described below) then its settings can be manually select or activate in addition to the previously described receiver screens:



However, to actually gain access to this data, the selected sensor/s must be connected to the receiver system and this receiver system must have an active telemetry connection.

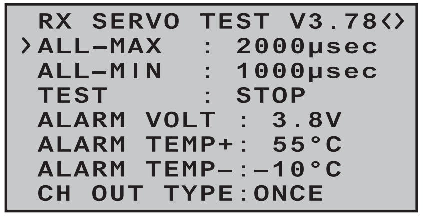
If, as described in the next section, there is at least one sensor activated which has the support of current firmware, then it is possible to directly switch between individual modules. However, if sensors with older firmware are in use, it *may* be necessary to select “etc.” instead of the direct sensor selection.

In either case, tap the ▲ or ▼ selection key of the *left* four-way button …

Between the displays automatically or possibly in the submenu “**SENSOR SELECT**” of the “Telemetry” menus manually activated sensors switch by ▲ or ▼ either selection key of the left four-way key briefly ...

… ... And select to display the selection window with one of the two selection keys ▲ or ▼ the line of the required sensor:

If the selected module, in this case a Vario module, is active then on the last receiver screen (“RX SERVO TEST”), at the top right there will also be an additional “ ›” symbol pointing to the right. This symbol is located just to the right of the left-pointing “**<**” symbol and is the visible indicator that additional display screens can be accessed:

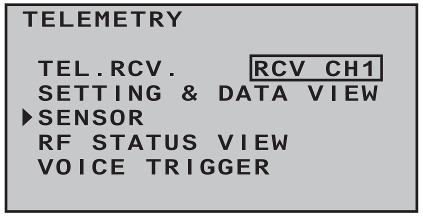


Now use one of the ▶ selection keys on the left or right four-way button to switch to the selected sensor’s displays and check or change its settings as described in the manual delivered with the sensor.

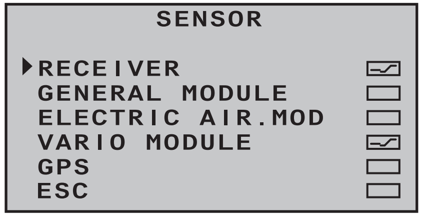
SENSOR

Display of active / inactive sensors

Type transmitter **mc-16** HoTT with firmware version V1.010 or higher, or type transmitter **mc-20** HoTT with firmware V1.030 or later recognize automatically a sensor connected to the receiver.



Activate ( ) or inactive ( ) sensors are automatically marked in this submenu. A manual selection of sensors is therefore no longer necessary and also not possible:

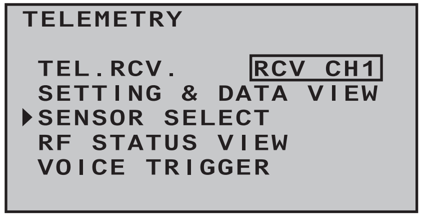


SENSOR SELECT

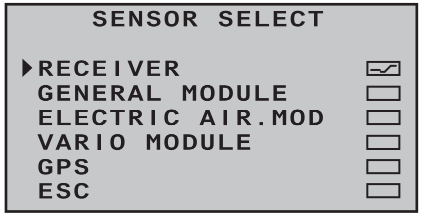
Selecting sensors

Type transmitter **mc-16** HoTT with firmware version V1.010 or higher, or type transmitter **mc-20** HoTT with firmware V1.030 or later recognize automatically a sensor connected to the receiver.

After selection of the desired menu line with the ▲▼ selection keys of the left or right four-way button …

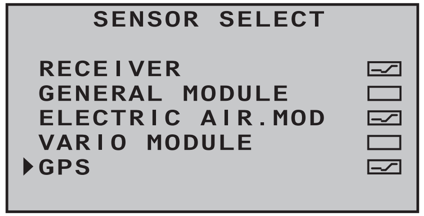


… and a subsequent tap on the centre **SET** key of the right four-way button, the selected sub-menu will open.



This menu option can be used to determine which of the graphic displays described on page 40, as well as those described previously for sub-menu »**SETTING & DATAVIEW**«, can be selected and which remain hidden.

Activate ( ) or deactivate ( ) the display of respective sensors by selecting the desired lines with the ▲▼ selection keys of the left or right four-way button then tapping on the centre **SET** key of the right four-way button, e. g.:



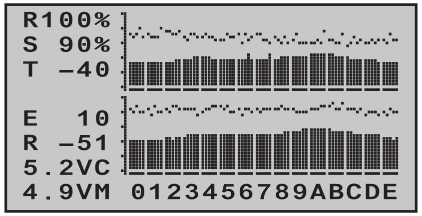
You must make this selection in order to include the corresponding sensor in the “SELECT VOICE MESSAGE” sub-menu, see page 252, and to display telemetry data in the respective data displays, starting on page 40.

RF STATUS VIEW

After selection of the desired menu line with the ▲▼ selection keys of the left or right four-way button …

```
TELEMETRY

 TEL.RCV.      RCV CH1
 SETTING & DATA VIEW
 SENSOR SELECT
▶RF STATUS VIEW
 VOICE TRIGGER
```

… and a subsequent tap on the centre **SET** key of the right four-way button will open the selected sub-menu. This provides a visualization of the quality of the connection of transmitter and receiver:



Top row:	*Reception power of the channels 1 … 75 of the 2.4 GHz band in dBm coming from the receiver to the transmitter.*
Bottom row:	*Reception power of the channels 1 … 75 of the 2.4 GHz band in dBm coming from the transmitter to the receiver.*

Comments:

- *Since reception power is measured and presented in dBm, reception power is increasingly worse the higher the bar is and vice versa; refer also to "Reception power (S-dBm)" on page 238 about this.*
- *The points above the bars mark the poorest reception since switching on the transmitter or the last reset of the display with a simultaneous tap on the▲▼ or ◀▶ keys of the right four-way button* (**CLEAR**).

Additional figures are shown to the left of the graphic representation of the reception power. These mean:

Value	Explanation
R	Signal quality in % of the signal received by the receiver
S	Signal quality in % of the signal received from the receiver
T	Reception power in dBm
E	Indicates the longest amount of time in increments of 10 ms, are lost in the data packets during transmission from transmitter to receiver
R	Reception power in dBM of the signal received by the receiver
VC	Current operating voltage of the receiver in volts
VM	Lowest receiver operating voltage since last startup, in volts

VOICE TRIGGER

After selection of the desired menu line with the ▲▼ selection keys of the left or right four-way button …

```
TELEMETRY

 TEL.RCV.       RCV CH1
 SETTING & DATA VIEW
 SENSOR SELECT
 RF STATUS VIEW
▶VOICE TRIGGER
```

… and a subsequent tap on the centre **SET** key of the right four-way button will open the selected sub-menu.

Firmware version V1101 and lower

```
VOICE TRIGGER
▶REPEAT      10SEC  ---
 TRIG               ---
 VARIO              ---
 TRANSMITTER
 RECEIVER
 GENERAL MODULE
 ELECTRIC AIR.MOD
 VARIO MODULE
 GPS
 AIR ESC
▼
```

Note:

- *Independently by the firmware version the sensors displayed by your transmitter here vary according to the information you have entered in the “SELECT SENSOR” sub-menu; see page 250.*
- *The screen-shot above shows the maximum number of options, corresponding to “all sensors selected”.*

Firmware version V1102 and higher

```
VOICE TRIGGER
▶REPEAT      10SEC  ---
 TRIG               ---
 VARIO        AUTO  ---
 TRANSMITTER
 RECEIVER
 GPS
▼
```

REPEAT

```
VOICE TRIGGER
▶REPEAT      10SEC  ---
 TRIG               ---
 VARIO        AUTO  ---
 TRANSMITTER
 RECEIVER

▼
```

In order to be able to start the voice output through the headphone connection, at the very least the “REPEAT” line must be assigned to a switch. The takes place as described in the section “Physical control, switch and control switch assignments” on page 60:

```
VOICE TRIGGER
 Move desired switch
 to ON position
 (ext. switch: SET)

▼
```

```
VOICE TRIGGER
▶REPEAT      10SEC   7
 TRIG               ---
 VARIO        AUTO  ---
 TRANSMITTER
 RECEIVER

▼
```

With this switch you can have the last respective voice trigger repeated for the duration of the time set to the left of the switch, as long as the assigned switch is closed.

Simultaneously pressing the Select buttons ▲▼ or ◀▶ of the right-hand four-way button (**CLEAR**) resets the time value to “1 SEC.”.

TRIG

With a switch assigned to this line, preferably a push-button, switch the selected voice messages in rotation on to the next voice message for the below-described “TRANSMITTER”, “RECEIVER” and “SENSOR” options.

```
VOICE TRIGGER
 REPEAT       5SEC   7
▶TRIG                8
 VARIO        AUTO  ---
 TRANSMITTER
 RECEIVER

▼▲
```

VARIO

Firmware version V1101 and lower

If the “VARIO MODULE” line is activated () in the »**SENSOR SELECT**« sub-menu, as described on page 250, a switch assigned to one of these lines can be used to call up vario-specific voice messages for the headset connection which are completely independent of other voice messages, i. e. voice messages triggered by altitude changes, such as the message “slowly ascend/descend”:

```
VOICE TRIGGER
 REPEAT       5SEC   7
 TRIG                8
▶VARIO              15
 TRANSMITTER
 RECEIVER

▼▲
```

Firmware version V1102 and higher

If in the model several Vario sensors are available, for example because a General Electric and a GPS module are installed, determining Vario sensor of the announcement will be selected from firmware version V1103:

```
VOICE TRIGGER
 REPEAT       5SEC   7
 TRIG                8
▸VARIO        AUTO  15
 TRANSMITTER
 RECEIVER
```

The choices are: VARIO, GAM, EAM, GPS and AUTO. (In the AUTO position the relevant sensor is selected according to the order of the mentioned sensors.)

TRANSMITTER

After selection of the desired menu line with the ▲▼ selection keys of the left or right four-way button …

```
VOICE TRIGGER
 REPEAT      10SEC   7
 TRIG                8
 VARIO        AUTO  15
▸TRANSMITTER
 RECEIVER
```

… and a subsequent tap on the centre **SET** key of the right four-way button will open the selected sub-menu.

```
▸TX VOLT:
 MODELTIME:
 BATTERYTIME:
 TIMER(GE.)TOP:
 TIMER(GE.)CENTER:
 PHASE TIMER:
 TIME:
```

Here, after selection of the desired line with the ▲▼ selection keys of the left or right four-way button and a subsequent tap on the centre **SET** key of the right four-way button, the selected voice message can be activated ( ) or deactivated ( ).

```
 TX VOLT:
 MODELTIME:
▸BATTERYTIME:
 TIMER(GE.)TOP:
 TIMER(GE.)CENTER:
 PHASE TIMER:
 TIME:
```

RECEIVER

After selection of the desired menu line with the ▲▼ selection keys of the left or right four-way button …

```
VOICE TRIGGER
 REPEAT      10SEC   7
 TRIG                8
 VARIO        AUTO  15
 TRANSMITTER
▸RECEIVER
```

… and a subsequent tap on the centre **SET** key of the right four-way button will open the selected sub-menu:

```
▸TEMP:
 STRENGTH:
 RX VOLT:
 LOWVOLT:
```

Here, after selection of the desired line with the ▲▼ selection keys of the left or right four-way button and a subsequent tap on the centre **SET** key of the right four-way button, the selected voice message can be activated ( ) or deactivated ( ).

"Sensors"

These lines only appear, according to the firmware version, if you have already activated at least one sensor in the "SELECT SENSOR" sub-menu of the »**Telemetry**« menu; see page 250. The method of selecting corresponding voice messages is as described in the previous sections.

Note:

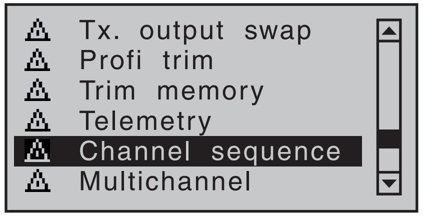
The points you select here are entirely independent of the "VARIO" messages.

Channel sequencer

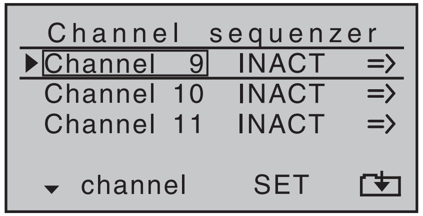
Programming the motion sequences of up to 3 servos

mc 16 ☐ 20 ☑ *This option is available on the mc-20 HoTT transmitter only.*

Use the selection keys on the left or right four-way button to scroll to the »**Channel sequence**« menu option in the multi-function menu:



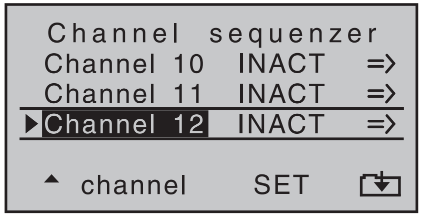
Tap briefly on the centre **SET** key of the right four-way button to open this menu option:



The »**Channel sequence**« menu option can be used to execute up to 9 exactly coordinated steps for up to three servos over a period of up to 30 seconds. Such a sequence can be triggered by a single switch and begin at an initial servo position which is freely adjustable. For example, this makes the opening of undercarriage doors, complete with subsequent extension of the retractable gear, just as simple to program as opening a wheel well with renewed closing of one undercarriage door once the landing gear has been lowered or to program the raising of a cockpit canopy with subsequent head turns and waving performed by the pilot. However, the prerequisite for all these actions is the "parsing" of the desired motion sequence into practical, individual steps.

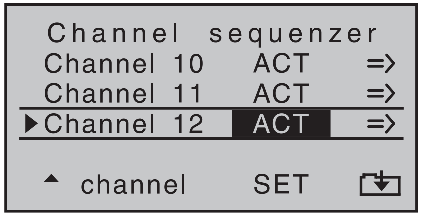
Programming procedure

On this menu option's first display page, see figure below left, either accept the three preset channels, 9, 10 and 11, or select an available channel, 5 … 12, for each line to form any other desired combination, e.g.:



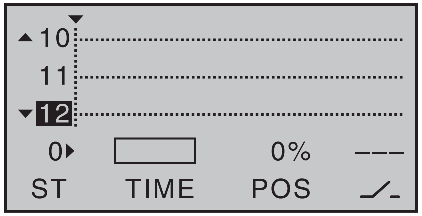
With a simultaneous tap on the ▲▼ or ◄ ► selection keys of the right four-way button (**CLEAR)**, the given channel is reset back to 5, 6 or 7.

The next step makes the control channels needed for the channel sequence available. This is done in the "**SET**" column by changing settings from "INACT" to "ACT" and thus making the individual channels "available" to the program for sequencing. Conversely, this also means that channels defined as "active" in the »**Channel sequence**« menu are *not* available for other purposes:



With a simultaneous tap on the ▲▼ or ◄ ► selection keys of the right four-way button (**CLEAR)**, the given channel is reset back to "INACT".

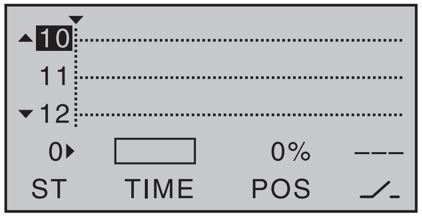
Once control channels and their activity statuses have been set, switch to the right column then tap on the centre **SET** key of the right four-way button to reach the second page, the »**Channel sequence**« menu's choreography page. Since the call-up of the second page in this example was issued from the "Channel 12" line, this servo remains the object of focus after the page change:



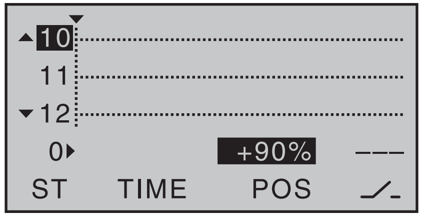
The previous display page permitted the selection of participating servos and their incorporation into the sequence. This display page will now be used to establish the sequence of steps for participating servos, beginning with initial positions yet to be defined. The step number, from "0►" to a maximum of "◄9", will be shown in the column labelled "ST" near the bottom left of the display.

Step 0: Setting initial position

Keep the focus of attention on "(Channel) 12" or change to any other of the three servos by using the ▲▼ keys of the *left* four-way button, e.g. upward to "(Channel) 10":



Use one of the ▲▶ selection keys of the *right* four-way button, as necessary, to shift the marker frame to the right from the column "TIME" to the value field above the column labelled "POS" then, after a tap on the centre **SET** key of the right four-way button, alter this value within a range of ±100 % until the servo is in the desired initial position. For example:



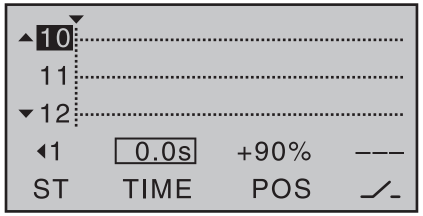
Repeat this procedure as necessary for the other two servos.

With a simultaneous tap on the ▲▼ or ◀▶ selection keys of the right four-way button (**CLEAR)**, the given position value will be reset back to"0 %".

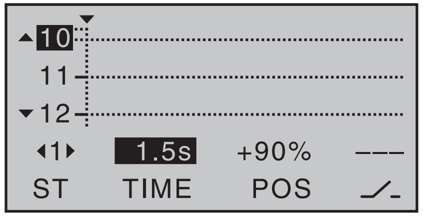
Step ◀1 (first event)

Now that initial positions have been established, the first step can be set. This is a matter of defining what is to be done, or not done, first, following a certain span of time.

Do this by first using the ▲▼ selection keys of the *left* four-way button to select one of the servos. Now tap the ▶ key of the *left* four-way button. The step number, which was previously indicated by a "0▶" is now replaced by a "◀1" and the value "0.0s" will appear in the field above "TIME". Use the selection keys of the *right* four-way button as necessary to shift the marker frame to the "TIME" column:

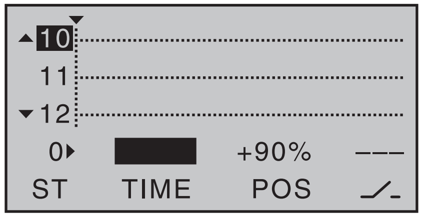


Now briefly tap on the centre **SET** key of the right four-way button to set the activation time into the value field for the "TIME" column, e. g. 1.5 s. The current position in time is represented in the graphic by the dotted vertical line. It will move to the right according to the time setting and, at the same time, the course of servo positions will be presented as dotted lines between time-point "0▶" and time-point "◀1":



Now set the desired servo positions for the end of the first time span (with the same procedure as already described for "Step 0") or leave one or more of these servos in the same position they were in for the previous step.

A simultaneous tap on the ▲▼ or ◀▶ keys of the right four-way button (**CLEAR)** will reset the inverse video value displayed if the TIME field back to "blank" and erase the current sequence, in this example only Step "◀1":

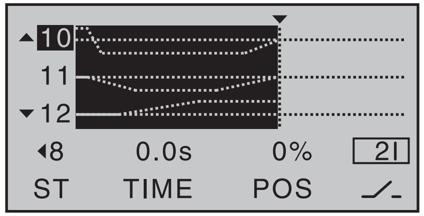


Step ◀2▶ … max ◀ 9

Repeat the previously described procedure for every other step to be defined until the servos have reached their terminal positions.

Switch assignment

In conclusion, assign the sequence of events created to a switch (as described in the section "Physical control, switch and control switch assignments" on page 60) with which the servos can be switched between their initial and terminal positions:



As soon as this switch is closed, the servos' sequence of movements can be followed in the graphic. The servo curves will be shown in inverse video according to the preset time windows. All movements will sequence in reverse when the switch is opened again.

Important notices:

- *The sequence shown is only for demonstration purposes and is not at all representative of a real sequence of servo movements.*
- *The settings made in the "POS" value field replace the otherwise "conventional" transmitter control signal. Therefore it is necessary, before programming such a sequence, to check in the »**Servo display**« menu to make sure none of the channels planned for the sequence are actuated by any other transmitter operating element. If this were to be the case, it could lead to unpredictable excursions in the motion sequence.*

Use the options of the »Only MIX channel« menu (page 212) of the mc-20 HoTT transmitter.

- *The settings made in the »**Servo adjustment**« and »**Tx. output swap**« menus are not affected by settings in this menu. When preparing and creating a sequence, be absolutely sure the servos do not collide mechanically. If necessary, use the "Travel limit" option in the »**Servo adjustment**« menu (page 106).*

Multichannel

Channel multiplier for special functions

mc 16 20 ☑ ☑ *This option is available on both transmitter types.*

The transmitter mc-16 HoTT and mc-20 HoTT has an integrated multi-function channel built into the transmitter's software. This facility permits up to two control channels to be used for up to four or eight special functions. Every available switch (including the so-called expansion switches, see page 60) or transmitter control can be assigned on the transmitter side.

On the receiver side, the following modules are available as accessories, whereby *at one time* a maximum of two modules can be operated via the »**Multi-channel**« menu.

NAUTIC-Expert, switching module, No. **4159**

The NAUTIC-Expert switching module expands a servo's functionality to 16 switched functions. By appropriately wiring the connecting cable, loads can either be operated from a common power supply or also separately by multiple power sources.

NAUTIC-Multi-Prop mini-decoder No. **4142.N**

The 1/4 C-NAUTIC-Multi-Prop mini-decoder expands a proportional function to four proportional functions.

Light module No. **2381**

A module for switching the light signals of rail, road and airborne vehicles with true authenticity.

Sound switch for vehicle models No. **2382.F**

start, stop and supplementary sounds as well as typical vehicle signals

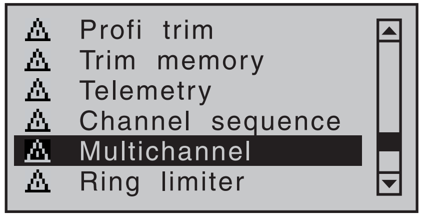
Sound switch for ship models No. **2382.S**

start, stop and supplementary sounds as well as typical ship signals.

Further information can be found in Internet at www.graupner.de. Use the search mask by entering the respective No. Alternatively, contact or visit your local dealer.

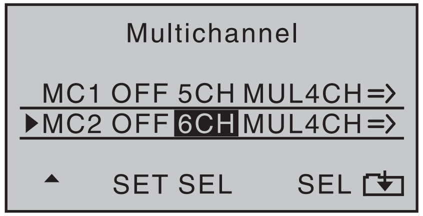
Programming procedure

Use the selection keys on the left or right four-way button to scroll to the menu option »**Multichannel**« menu option in the multi-function menu:



… then open this menu option with a brief tap on the centre **SET** key of the right four-way button.

Here, in the second column from the left, each of the two multi-channel functions can be activated ("ACT") or deactivated ("OFF") as desired and in the third column the given function can be assigned to one of the transmitter channels, 5CH through 8CH, in a list:



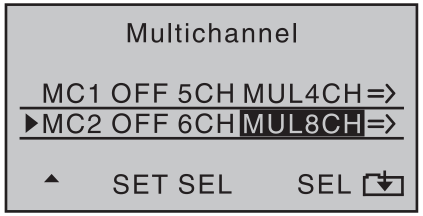
<u>*Note:*</u>

*When a changeover is made to the »**Servo display**« or if »**Servo adjustment**« is used to select the "- travel +" or "- lim +" columns for these previously set channels, their respective cells will flash to indicate that these channels have been activated in the »**Multichannel**« menu. The preset values of 100 % or 150 % should not be changed.*

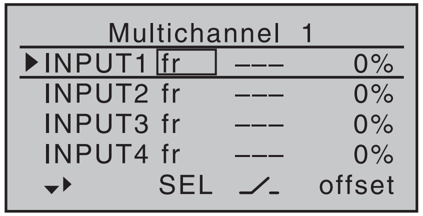
Prior to channel selection, please observe the following notices:

1. Switch to the "SETTINGS/DISPLAYS" line of the »**Telemetry**« menu and tap on the centre **SET** key of the right four-way button:
   - on the "RX SERVO" page, select the "20 ms" setting in the last line "PERIOD", see page 240.
   - On the "RX SERVO TEST" display page, select the "SAME" option for the last line "CH OUT TYPE", see page 246.
2. The control channel used may not be used as an input nor as an output channel for any mixer! For example, if 5CH is selected, be sure that the "Aile/flaps" line of the »**Model type**« menu is preset to "1AIL" or that the "Swashplate type" line of the »**Helicopter type**« menu is preset to "1 servo".
3. The channel settings intended for NAUTIC control channel purposes in the »**Control adjust**« and »**Servo adjustment**« menus are to be left as they are or reset back to their original settings. Do not assign any transmitter control or switch to the respective input either. Also be sure that the servo's direction of rotation is not reversed. Leave the servo middle at 0 %.

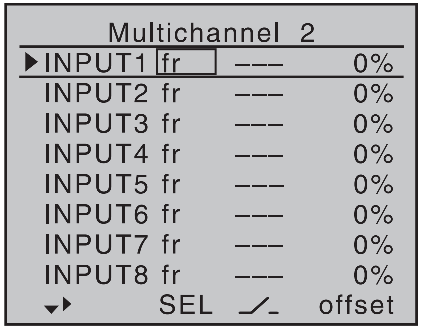
In the next column to the right, make a separate channel count specification for each of the two multi-channels; "MUL4CH" for the NAUTIC-Multi-Prop mini decoder, No. **4142.N** or "MUL8CH" for the NAUTIC-Expert switching module, No. **4159**, for example:



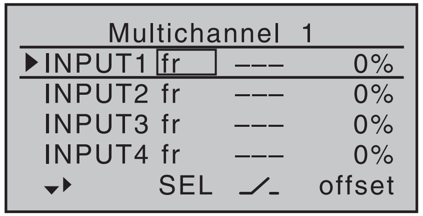
Afterward, use the right arrow symbol at the bottom line's right end to switch over to the second page of settings for the »**Multichannel**« menu. On this second page you can now enter the individual settings separately for "MC1" (Multichannel 1" …



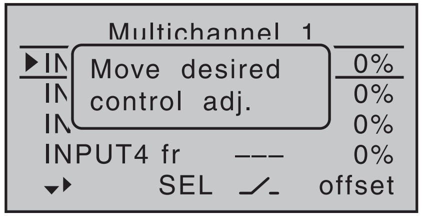
… and "MC2" (Multichannel 2) …



Column 2 "Control"



Use the arrow keys to move to the column over **SEL**. After completing the activation of transmitter control assignment by tapping the centre **SET** key of the right four-way button, the message shown below will appear in the display:

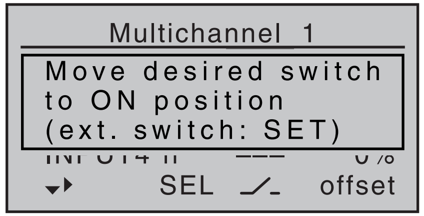


Now operate the transmitter control you wish to use: the information window closes, and instead the Value field displays the name of the transmitter control you have chosen.

Note:

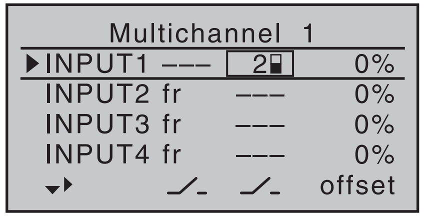
*If you are using the Nautic-Expert switch module, No. **4159**, any proportional controls you assign act like switches when close to their end-points.*

Column 3 "Switch"



This column is used to assign each of the inputs used, 1 through 8 (maximum), to any switch available on the transmitter. These assignments are done as described in the section "Physical control, switch and control switch assignments" on page 60:

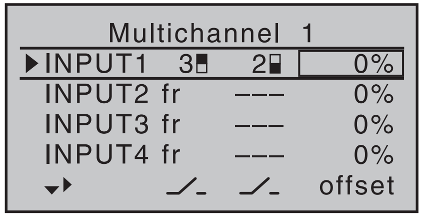
Any controls which were previously assigned in the second column will be erased. In this case, instead of **SEL**, the switch symbol will be displayed at the bottom of the 2nd column such that now a second "normal" switch, or even a transmitter control switch, logical switch, … can be assigned as needed from the group of "expanded switches". In general it is sufficient to assign a simple switch or transmitter control.



Erasing transmitter controls or switches

With transmitter control / switch assignment active, simultaneously pressing the ▲▼ or ◄ ► buttons of the right-hand four-way button (**CLEAR**) – see screen-shots above – resets the corresponding input to "fr" and "---".

Column 4 “offset”



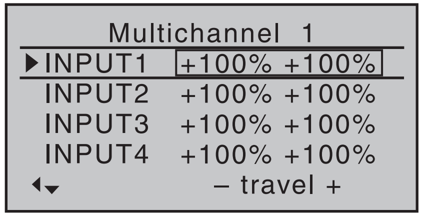
The control centre for the given control, i. e. its zero point, can be changed in this column. The adjustment range lies between -100 % and +100 %.

Simultaneously tapping on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset the value displayed in inverse video back to its “0 %” value.

Note:
Leave the offset setting at 0 % while making switch assignments.

Column 5 “– travel +“

To adjust servo travel, move to the right, beyond the “Offset” column, following the right-pointing arrow in the bottom left-hand corner of the screen:

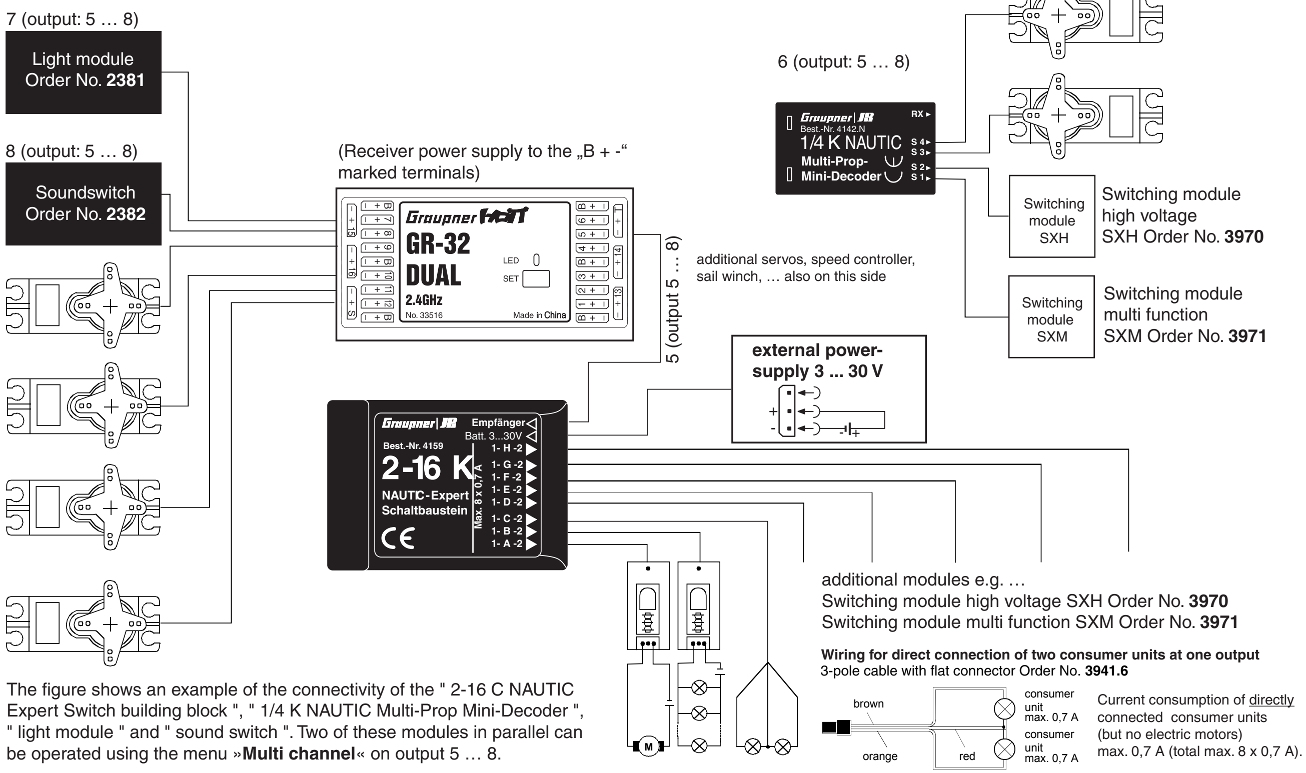


Finally, transmitter control travel is set for both sides in the column “-travel+”. The range for this lies between -100 % and +100 %. This is accomplished by moving the associated transmitter control to the centre – if you wish to set symmetrical travels – or in one direction or the other in order to set “travel” separately for each side of centre.

If the assignment is for a switch, leave the setting at the default value of 100 %.

Receiver *Graupner* HoTT GR-32 attachment example

Before first time operation of the NAUTIC modules make the above described settings.



The figure shows an example of the connectivity of the " 2-16 C NAUTIC Expert Switch building block ", " 1/4 K NAUTIC Multi-Prop Mini-Decoder ", " light module " and " sound switch ". Two of these modules in parallel can be operated using the menu »**Multi channel**« on output 5 … 8.

Note:

Due to technical reasons, servos connected to a 1/4 C NAUTIC Multi-Prop mini decoder may operate somewhat hesitatingly. This is not a fault.

Connection notes for the Nautic-Expert switching module, No. 4159

As many as 16 switched functions can be controlled per switching module.

Eight loads, like lamps, LEDs, etc. – but not electric motors –, with a load current of up to 0.7 A each can be connected directly.

Two switch functions per connector socket are possible via the three conductor cable, No. **3941.6** , see bottom right figure.

Electric motors and loads drawing substantial current should be connected by other means, e. g. via switching modules. Ask your dealer about this.

Ring limiter

Control of Voith Schneider propellers in model ships

This option is available on the mc-20 HoTT transmitter only.

mc 16: ☐ mc 20: ☑

Scroll with the selection keys on the left or right four-way button to the menu option »**Ring limiter**« in the multi-function menu:

```
Trim memory
Telemetry
Channel sequence
Multichannel
Ring limiter
MP3 player
```

Tap briefly on the centre **SET** key of the right four-way button to open this menu option:

```
      Ring limiter
▶ 4  3 |  4  3   OFF =>
  4  3 | 10  9   OFF =>
  4  3 | 12 11   OFF =>
  X  Y    X  Y
 Input   Output    SET
```

This »**Ring limiter**« menu point is available as standard on the mc-20 HoTT transmitter only, and is primarily intended for controlling a maximum of three Voith-Schneider power systems as employed in model boats. These are positioned beneath the ship where they are exposed to a free flow of water in all directions. The control of these drives and turning their vertically oriented propeller blades is done with two servos per Voith Schneider propulsion unit whereby, for mechanical reasons, the propellers of this type offered by *Graupner* under No.. **2358** and **2358.BL** have a maximum control travel limitation of 4 mm each.

As long as the sticks for forward/reverse and left/right are operated individually (see section "Column Input") this is no problem because travel for the two servos can be appropriately adjusted, both mechanically as well as in the »**Servo adjustment**« menu. However, this becomes problematic when, for example, one stick is 100 % forward and, *at the same time*, the other stick is pushed completely to the right to arithmetically produce a 141 % sum for the two servo travel vectors. The mechanical controls of the Voith Schneider propellers will collide with their limits; in best case only drawing an unnecessary amount of electric current, in worst case causing damage or even bursting the linkage..

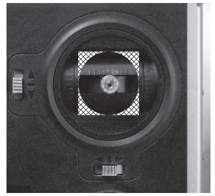
This problem can be circumvented by using "ring limiters", which are featured only on the mc-20 HoTT transmitter. There are a maximum of three "ring limiters" available in the "**SET**" column of this option's first display page (see figure at left) that can be switched "ON" or "OFF" individually. In the first line on the setting page for a given "ring limiter", its maximum travel can then be set for a range of between 25 and 125 %. The second line provides a setting for the size of limitation of overall deflection between:

0 % circular limit (O)

100 % no limit (☐)
(limitation is strictly a matter of the given stick's mechanical stop)

Important notice:

When this function is used, leave the respective setting values in the »Dual Rate / Expo« and »Servo adjustment» menus at 0 and 100 % or reset them back to their default values.



The adjacent sketch illustrates the effect for a 0 % setting. The cross-hatched area of travel is curtailed and appears as a "dead zone".

Column, "Input"

With the standard preset control mode 1, all three ring limiters are pre-assigned to inputs 3 (forward/reverse) and 4 (left/right) which are actuated by the left stick. However, this pre-assignment can be replaced anytime by any other transmitter control combination. Use the selection keys on the left or right four-way button to move the marker frame to the desired value field then briefly tap the centre **SET** key of the right four-way button:

```
      Ring limiter
  4  3 |  4  3   OFF =>
▶ 4  3 | 10  9   OFF =>
  4  3 | 12 11   OFF =>
  X  Y    X  Y
 Input   Output    SET
```

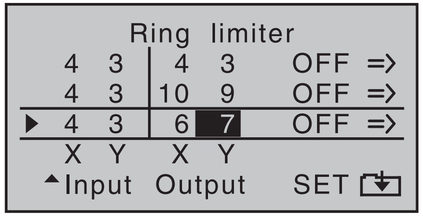
Select the desired control channel (1 … 12 max.) for the value field now displayed in inverse video by using the ▲▼ or ◀ ▶ selection keys. However, do not forget that if a control channel in the range of 5 … 12 max. is selected, it must also be assigned to a control in the »**Control adjust**« menu, see page 112. Briefly tap the centre **ESC** of the left four-way button or the centre **SET** key of the right four-way button to conclude your entry.

In principle, the other inputs are to be handled in the same manner.

A tap on the ▲▼ or ◀ ▶ keys of the right four-way button at the same time (**CLEAR)** will reset the active value field back to its given default value.

Column, “Output”

The three ring limiters are pre-assigned to receiver outputs 3/4, 9/10 and 11/12 by default, whereby the outputs in column “X” are for the forward/reverse function and the outputs in column “Y” are for the left/right function. However, this preset combination of receiver outputs can be replaced as necessary by any other combination at any time. This is essentially done in the same manner as described previously under “Input”, for example:

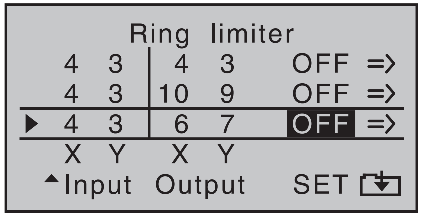


Note:

Watch out for undesirable overlaps if you use one of the outputs within a mixer.

Column, “SET”

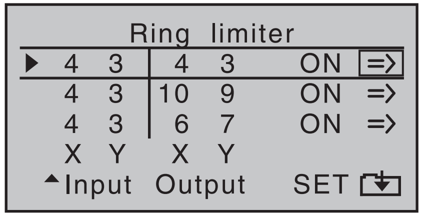
The **SET** column is used to determine just which of the ring limiters is to be “OFF” and which are to be “ON”, i. e. active. Use the selection keys on the left or right four-way button to move the marker frame to the desired value field in the **SET** column then briefly tap the centre **SET** key of the right four-way button:



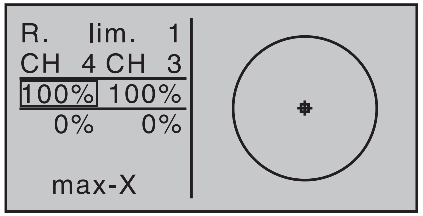
In the value field now displayed in inverse video, make a choice between the two options, “ON” and “OFF”, with the ▲▼ or ◄ ► selection keys then conclude the entry with a brief tap on the centre **ESC** key of the left four-way button or on the centre **SET** key of the right four-way button.

A tap on the ▲▼ or ◄ ► keys of the right four-way button at the same time (**CLEAR**) will reset the active value field back to its “OFF” default value.

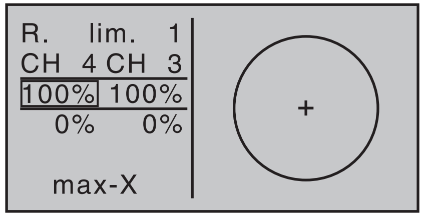
“Settings page“



Following a selection of one of the three lines with the selection keys, switch to the settings page for the selected ring limiter (1 … 3) with a brief tap on the centre **SET** key of the right four-way button:



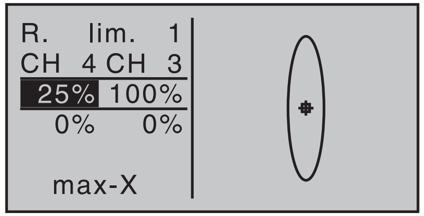
If, however, the small diamond at the centre of the circle in the figure above (which represents the current stick position) is not visible …



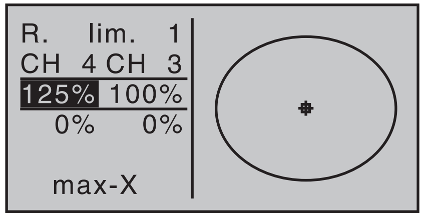
… then the respective ring limiter is still switched “OFF”. In this case, switch back to the previous page with a brief tap on the centre **ESC** key of the left four-way button then switch the respective ring limiter “ON” as previously described.

Programming procedure

The two upper value fields – labelled at the bottom left of the display as “max-X” or “max-Y”, depending on the position of the marker frame – are used to specify separate settings for each of the two control functions, “left/right” and “forward/reverse” within a range of 25 …



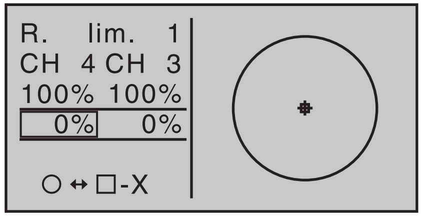
… and 125 %:

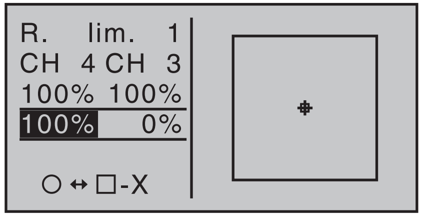


In practice, the setting is made by changing the given value until the respective servos in the model just reach the point where they no longer move.

A tap on the ▲▼ or ◄► keys of the right four-way button at the same time (**CLEAR)** will reset the changed value in the active value field back to its “100 %” default value.

In the next line down – labelled at the bottom left of the display as “O<=>☐-X” or “O<=>☐-Y”, depending on the position of the marker frame – the setting values, in a range from 0 % and a maximum of 125 %, affect the form of limitation between “circular” and “rectangular”, whereby a setting value here may never be greater than the value of the field above it.





A tap on the ▲▼ or ◄► keys of the right four-way button at the same time (**CLEAR)** will reset the changed value in the active value field back to its “0 %” default value.

When finished with these settings, switch back to the first display page for this option then repeat this procedure, as applicable, for the lines of ring limiter 2 or 3.

Final note:

This option can, of course, also be used as necessary and applicable for fixed-wing models.

MP3 player

Replay program for MP3 files, such as music files

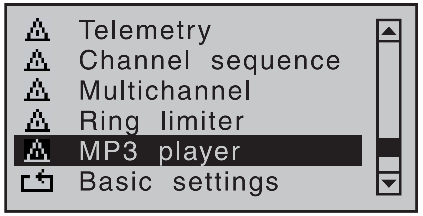
This option is available on the mc-20 HoTT transmitter only.

mc 16 20

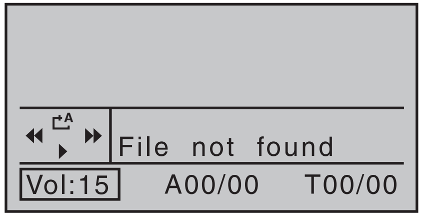
ATTENTION:

Note that for technical reasons during playback of MP3 files NO data recording is possible.

Scroll with the selection keys on the left or right four-way button to the menu option »**Ring limiter**« in the multi-function menu:

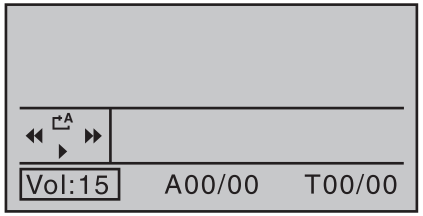


Tap briefly on the centre **SET** key of the right four-way button to open this menu option:

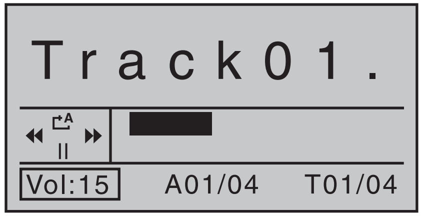


If the message "File not found" appears near the middle of the display when this menu option is called then the transmitter has been unable to find any suitable MP3 files on the SD card. If this should happen, use a PC or laptop to check the content of the "MP3" directory on the SD card and copy suitable MP3 files into this directory if it is empty.

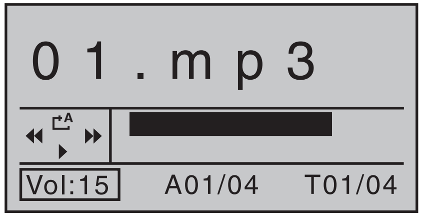
Therefore, insert a SD card containing MP3 files in a directory named "MP3" and, after switching the transmitter on, open the »**MP3-Player**« menu option:



Briefly tap the ▼ key of the left four-way button to start replay of the first MP3 file of album 1. The replay will start immediately, however, the display of data about the number of albums and titles as well as playing time for the current MP3 file – depending on the size of the MP3 file – will only appear after some delay.



The automatic replay of album 1 will continue to run until it is stopped with a tap on the ▼ key of the left four-way button …



… or the transmitter is switched off.

During ongoing replay, the menu can be exited at any time and the transmitter can be used without restriction.

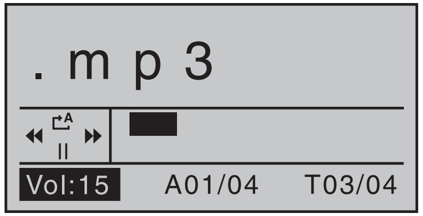
<u>Note:</u>

If voice output is activated it will be blended in with the playing MP3 file.

Volume

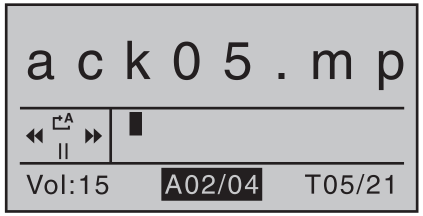
You may need to use the Select buttons of the right-hand four-way button to move to the left-hand Value field in the bottom line.

Activate the Value field by pressing the central **SET** button of the right-hand four-way button, then use the Select buttons of the right-hand four-way button to adjust the playback volume in the range "0" (muted) to "30" (very loud):



Album

Use the Select buttons of the *right-hand* four-way button to select the central Value field in the bottom line, and then press the central **SET** button of the right-hand four-way button:



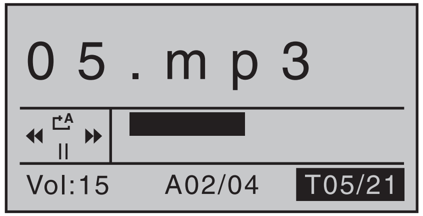
Use the ▲▼ selection keys of the *right* four-way button to select the desired album number (from 1 to a maximum of 10) in this value field. Briefly tap the centre **SET** key of the right four-way button to confirm the selection.

Note:

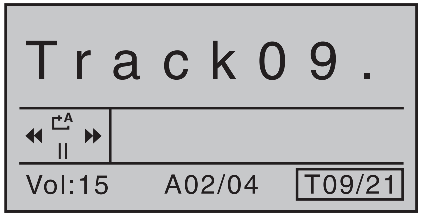
The number of albums right of the slash ("/") is a consequence of the number of files present in subdirectories of the "MP3" directory on the SD card, not the sum of album names which may be stored in identically named meta-data fields of the MP3 file.

Titel

Use the Select buttons of the *right-hand* four-way button to select the right-hand Value field in the bottom line, and then press the central **SET** button of the right-hand four-way button:



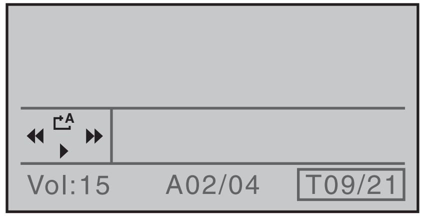
Now select the desire title by using the ▲▼ selection keys on the *right* four-way button. Briefly tap the centre **SET** key of the right four-way button to start this selection.



Notes:

- *The title displayed will be the filename of the MP3 file, not any identically named title which may be stored in the MP3 file as a meta-data field.*
- *However, such may only contain characters of the alphanumeric Character! Once in the title and only one character from another character table is included, the Title field is left blank. Within an album are the title either in alphabetical order, or, actionable numerical information should be included in the filename, played in numerical order.*
- *The right of the "/" indicated number of titles in the "A ..." selected "Albums" is derived from the number of MP3 files in the current directory.*
- *Mandatory requirement to show a title is the presence of two font files in the MP3 directory. These two files can be found if necessary in HoTT_Software_Vx package that you, as described in the section "Updating the transmitter software" on page 50, available on the Internet. Open this package on a PC or laptop and copy the two subdirectory \\ SD card \ MP3 files contained with the extension * .fnt in the same directory on your SD card. Insert afterwards the accordingly added SD card back into the card slot of your transmitter and start playing an MP3 file. Now the title should appear. The number of the title per album is a consequence of the number of MP3 files per directory.*

MP3 player operator field



- ◀◀ ▶▶
  Analogous to corresponding keys on a MP3 and other players, jump one title forward or back for each tap on one of the ◀ ▶ selection keys of the *left* four-way button.
- ▶ / ❚❚
  Analogous to corresponding keys on a MP3 and other players, start and stop the MP3 player with a tap on the ▼ selection keys of the *left* four-way button.
- ↱A / ↱1 / ⌐1
  Switch between these three options with the ▲ selection keys of the *left* four-way button:
  ↱A Replay of the selected album will repeat in an endless loop until it is either stopped or the transmitter is switched off.
  ↱1 Replay of the current title will repeat in an endless loop until it is either stopped or the transmitter is switched off.
  ⌐1 Replay will stop automatically at the end of play for the current title.
  A tap on the centre **ESC** key of the left four-way button will exit the menu option *without* stopping any replay that may be running.

Basic settings

Basic transmitter settings

mc 16 20 *This option is available on both transmitter types.*

☑ ☑ Use the selection keys on the left or right four-way button to scroll to the »**Basic settings**« menu option in the multi-function menu:

```
MP3 player
Basic settings
Servo display
Servo test
Code lock
Info display
```

Tap briefly on the centre **SET** key of the right four-way button to open this menu option:

```
       Basic settings
▶Voice Vol   [5] fr    –––
 Vario Vol    7  fr    –––
 Beeps Vol    7  fr    –––
 Own‹                    ›
 Stick mode              1
 Modulation           HoTT
 DSC Output          PPM10
 Pitch min            back
 Top LCD Contrast        0
 Bottom LCD Contr.       0
 Display light       unlim.
 Power-on beep         yes
 Battery type        Lith.
 Battery warning     3.60V
 Power on warn.      unlim
 Touch Sense             2
 DATA sel        Telemetry
 BT Headset            OFF
                       0/0
 ID PAIR               OFF
 BT Volume               8
▼          SEL   SEL
```

Basic settings are made in this menu. Transmitter-specific settings, such as volume regulation for acoustic signals and voice messages output via the built-in speaker or headset connector, the owner's name, country setting and even specifications for new model memories. The settings made in this menu on the lines …

- "Stick mode",
- "Modulation",
- "DSC Output" and
- "Pitch min"

… therefore have no influence whatsoever on already existing model memories; instead, they are only *defaults* which are automatically adopted into newly initialized model memories and can be changed there individually at any time in the »**Basic settings, model**« and »**Helicopter type**« menus. A change to the "Preset" settings in value fields of *this* menu therefore only affects *those model memories created new at a later time.*

Note:

The settings in this menu are only specified once in the entire transmitter. Therefore, after opening this menu in another model memory, the last valid settings always appear.

Programming procedure

Select the desired line with the ▲▼ selection keys of the left or right four-way button then tap the centre **SET** key of the right four-way button. The value in the field now displayed in inverse video can be changed. After a change has been made, the entry can be concluded with another tap on the centre **SET** key of the right four-way button or the centre **ESC** key of the left four-way button.

Voice volume / Vario volume / Beeps volume

```
       Basic settings
 Voice Vol    7  fr    –––
 Vario Vol    7  fr    –––
▶Beeps Vol   [3] fr    –––
 Own‹                    ›
⇕          SEL   SEL
```

These three lines can be used to individually set the volume of the three groups of acoustic signals and voice messages. This involves selection from among a total of three variants, whereby the variants two and three offers option for individually regulating the volume even after leaving this menu.

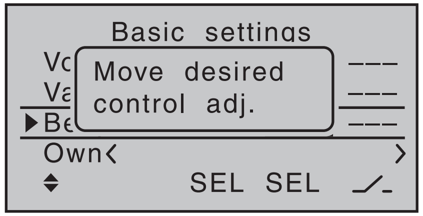
Pre-setting a value

Use the selection keys on the left or right four-way button to move the marker frame to the desired value field in the column above the left **SEL** at the display's lower edge then briefly tap the centre **SET** key of the right four-way button. The desired volume for the selected group can be specified in increments between 0 and 10 in the value field now displayed in inverse video by using the selection keys of the left or right four-way button. Another tap on the centre **SET** key of the right four-way button or the **ESC** key of the left four-way button will conclude the process.

Following a simultaneous tap on the ▲▼ or ◀▶ keys of the right four-way button (**CLEAR**), the display will return to its "7" default value.

via proportional control

Use the selection keys on the left or right four-way button to move the marker frame to the desired value field in the column above the right **SEL** label at the display's lower edge then briefly tap the centre **SET** key of the right four-way button. The message shown below will then appear in the display:

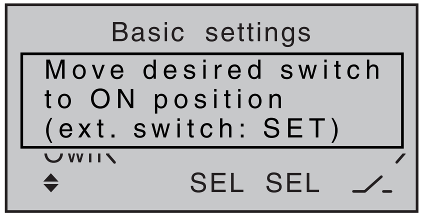


Now move the desired control, for example, the right proportional slider SI2. Afterward, this slider can be used anytime to incrementally regulate volume for the selected group between 0 and 10.

Following a simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**), the display will return to its “fr” default value.

via three position switch

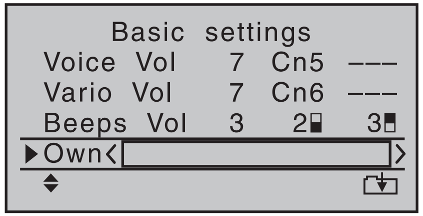
Use the selection keys on the left or right four-way button to move the marker frame to the column above the switch symbol at the display’s lower edge then briefly tap the centre **SET** key of the right four-way button. The message shown below will then appear in the display:



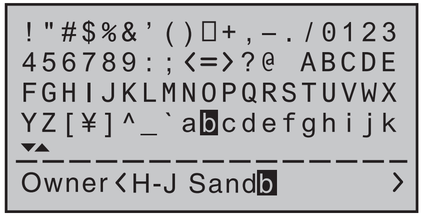
Now, assign a switch as described in the section “Physical control, switch and control switch assignments” on page 60. Ideally a self-neutralizing three position switch, e. g. like that offered by *Graupner* under No. **33001.5**. Afterward, this switch can be used anytime to incrementally regulate volume for the selected group between 0 and 10.

Following a simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**), the display will return to its “---” default value.

Own(er)



Up to 15 characters can be used to specify the owner’s name. Change to the next screen page (⎗) with a brief tap on the centre **SET** key of the right four-way button:



Select the desired characters with the selection keys of the left four-way button. With a brief tap on the ► selection key of the right four-way button or its centre **SET** key, move to the next position in which a character can be selected. A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will place a space character at the current position.

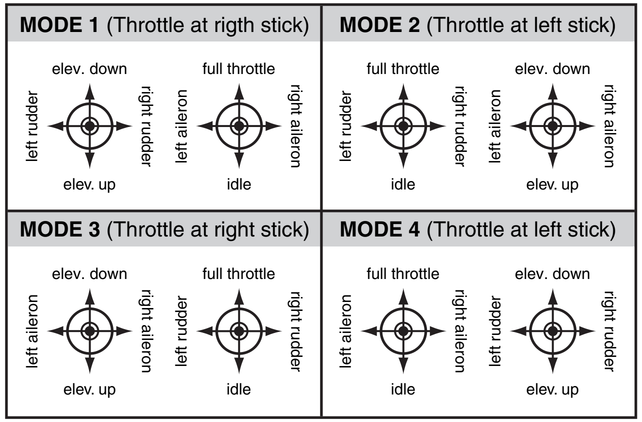
Positioning to any character position within the entry field can be done with the ◄ ► keys of the right touch pad.

A brief tap on the centre **ESC** key of the left four-way button will cause a return to the previous menu page.

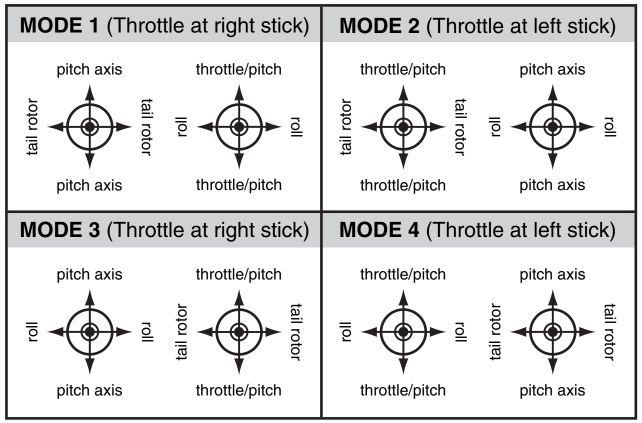
(Pre-set) Stick mode

As a basic principle, there are four different ways to assign the four control functions, aileron, elevator, rudder and throttle or brake flaps for winged models as well as rolling, pitching, tail rotor and throttle/pitch for helicopter models to the two sticks. Just which of these options is chosen depends on the individual preferences of the individual model pilot:

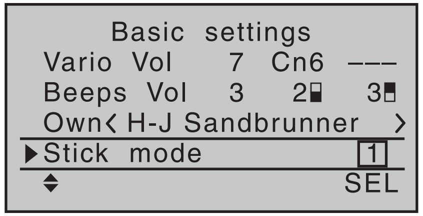
Winged model stick mode



Helicopter model stick mode



Use the ▲▼ selection keys of the left or right four-way button to select the "Stick mode" line. The option field will be framed.



Tap on the SET key briefly. The currently displayed stick mode will be displayed in inverse video. Now use the selection keys of the right four-way button to select the variant, from 1 to 4, you most frequently use. In the future this will be used for newly initialized model memories, but can be changed on an individual basis for up to 20 respectively 24 model memories.

Following a simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**), the display will return to stick mode "1".

With another tap on the SET key, the selection field will be deactivated again to permit a change to another line.

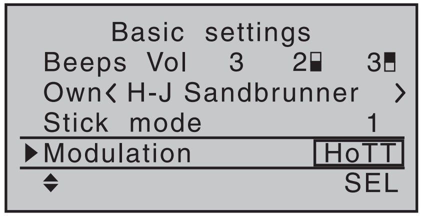
(Pre-set) **Modulation**

Standard equipment for the mc-16 HoTT and mc-20 HoTT transmitters includes a HoTT transmitter module and, under the left front cover – as viewed from the front – a DSC jack and a DATA jack, see page 24.

It is also possible to switch between three RF module variants in the "Module" line of the »**Base setup model**« menu – see pages 79 and 89 – by selecting "HoTT", "EXT." or "SP." for each model memory separately. The most frequently used variant should logically be selected for the "Pre-set modulation" line in the »**Basic settings**« menu.

In the future this will be used for newly initialized model memories, but can be changed on an individual basis for up to 20 respectively 24 model memories.

Briefly tap the centre SET key of the right four-way button:



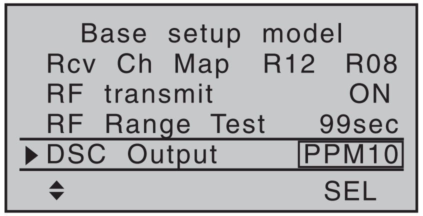
Now use the selection keys of the right four-way button to select the variant from among "HoTT", "EXT." and "SP.".

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will return the display back to modulation "HoTT".

With a brief tap on the SET or ESC key, the selected field is deactivated to permit a switch to another line.

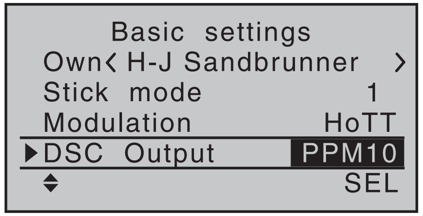
(Pre-set) **DSC Output**

In the line with the same name in the »**Basic settings, model**« menu, page 85 or 95, a separate specification can be made from among the four available modulation types which is specific to each model memory and will then provided at the DSC socket. This choice primarily influences the maximum number of control channels which can be attached to the DSC (direct servo control) socket, and thus also available to a flight simulator or teacher/pupil system. By selecting "PPM10" this will be control channels 1 … 5, for "PPM16" channels 1 … 8, for "PPM18" channels 1 … 9 and for "PPM24" channels 1 … 12:



In a manner similar to "(Pre-set) Stick mode", in *this* »**Basic settings**« menu the selection made for the "(Pre-set) DSC Output" line will determine which of the four possible modulation types will be adopted as the ***default*** variant for a newly initialized model memory.

If necessary, use the ▲▼ selection keys of the left or right four-way button to switch to the "DSC Output" line then, with a brief tap on the centre SET key of the right four-way button, activate the value window:



Now a choice can be made from among the four possible modulation types: "PPM10", "PPM16", "PPM18" and "PPM24", with the selection keys of the right four-way button. Another tap on the centre SET key of the right four-way button will conclude the entry.

A simultaneous tap on the ▲▼ or ◄ ► keys of the right four-way button (**CLEAR**) will reset this option back to "PPM10".

(Pre-set) **Pitch min** (only relevant to helicopter models)

In a manner similar to the previously described options "Stick mode" and "DSC Output", enter the preferred actuation direction for the throttle/pitch stick on this line so the choice will already be present by default for model memories newly initialized in the future. The functionality of all other helicopter program options (to the extent they affect throttle and/or pitch) are dependent on this setting; in other words the throttle curve, idle trim, Channel 1 ➔ tail rotor mixer, etc.

This means:

- **"forwrd"**
  minimum front pitch setting, the pitch stick (C1) points away from the pilot.
- **"back"**
  minimum rear pitch setting, the pitch stick (C1) points towards the pilot.

A simultaneous tap on the ▲▼ or ◄► keys of the right four-way button (**CLEAR**) will set this option to "back".

Note:

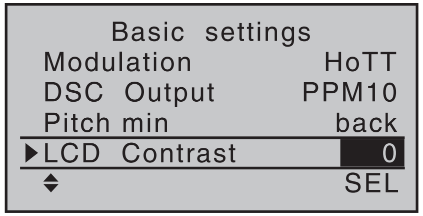
*The C1 stick's control direction for "Throttle min front/rear" in the fixed-wing program can be changed individually in the »**Model type**« menu.*

LCD Contrast (upper display / lower display)

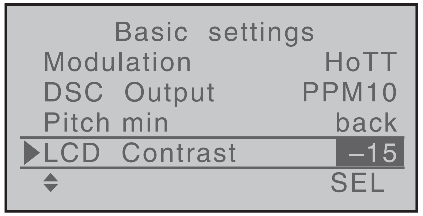
In assure optimal legibility of the transmitter mc-16 HoTT or mc-20 HoTT displays under all weather and temperature conditions, their contrast settings can be adjusted separately.

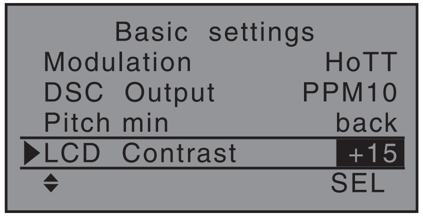
mc-16 HoTT

The contrast of the front screen of the mc-16 HoTT transmitter – located between the switch boards – can be adjusted as follows: select the "LCD Contrast" line using the Select buttons of the left or right-hand four-way button, and then briefly press the central **SET** button of the right-hand four-way button:



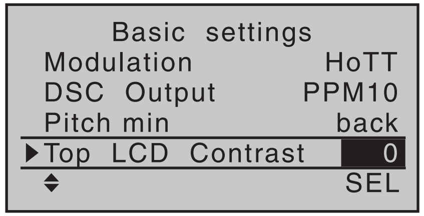
Now display contrast can be adjusted in the value field displayed in inverse video within a range of ±20 by using the selection keys of the right four-way button:



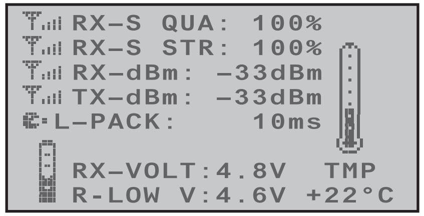


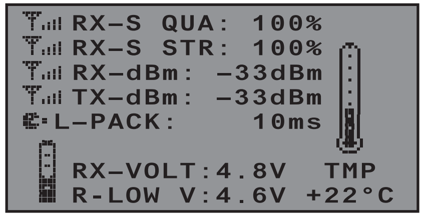
mc-20 HoTT

Contrast for the forward display of the transmitter mc-20 HoTT, located between the switch panels, is adjusted by selecting the "Top LCD contrast" line with the selection keys of the left or right four-way button then briefly tapping on the centre **SET** key of the right four-way button.

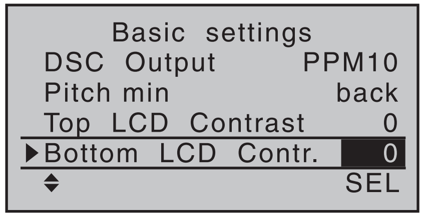


Now display contrast can be adjusted in the value field displayed in inverse video within a range of ±20 by using the selection keys of the right four-way button:

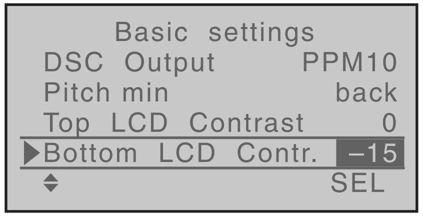


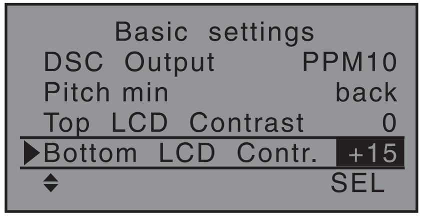


Contrast for the rear display, located between the four-way buttons, is adjusted by selecting the "Bottom LCD contrast" line with the selection keys of the left or right four-way button then briefly tapping on the centre **SET** key of the right four-way button.



Now display contrast can be adjusted in the value field displayed in inverse video within a range of ±20 by using the selection keys of the right four-way button:





Simultaneously tapping the ▲▼ or ◀ ▶ selection keys of the right four-way button (**CLEAR**) will reset the inverse video field back to “0”.

Display light

This line determines how long the transmitter display’s backlight illumination is to remain on after switching the transmitter on or after the last activation of a transmitter operating element.

Available options are “unlim(ited)”, “30 s”, “60 s”, “120 s” and “off”.

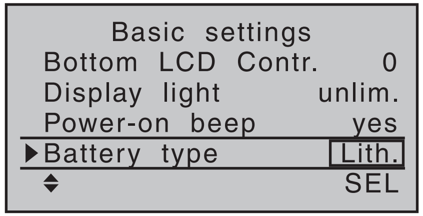
A simultaneous tap on the ▲▼ or ◀ ▶ selection keys of the right four-way button (**CLEAR**) will reset the inverse video field to “unlimited”.

Power on/off beep

A power on/off beep for the transmitter can be switched on (“yes”) and off (“no”) in this line.

A simultaneous tap on the ▲▼ or ◀ ▶ selection keys of the right four-way button (**CLEAR**) will switch this option shown in inverse video back to “yes”.

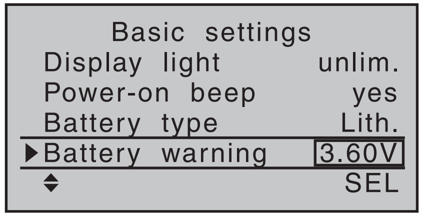
Battery type



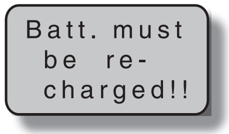
This line specifies whether transmitter power is provided by a four-cell NiMH battery or a single-cell LiPo battery. As a consequence of this setting, the next line will offer a suitable voltage range for the “Battery warning” threshold.

A simultaneous tap on the ▲▼ or ◀ ▶ selection keys of the right four-way button (**CLEAR**) will switch this option shown in inverse video back to “Lith.”.

Battery warning (threshold)



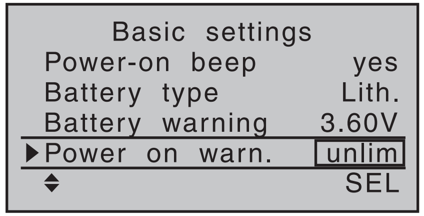
You can arbitrarily specify the warning threshold for the display …



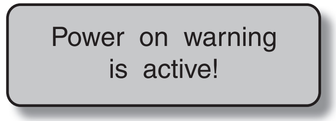
… – contingent on the battery type selection in the line above – in increments of 0.01 volt between 4.50 and 5.50 V (NimH battery) or 3.40 and 4.20 V (LiIo/LiPo battery). Make sure that you do not enter a value which is too low, so that you still have sufficient time to safely land your model in the event of a battery warning.

A simultaneous tap on the ▲▼ or ◀ ▶ selection keys of the right four-way button (**CLEAR**) will switch the field shown in inverse video back to its factory setting, 4.70 V (NiMh) or 3.60 V (Lith.).

Power on warning



In this line you can determine how long the transmitter should wait after the last actuation of an operating element until the activation of an optical and acoustic power-on warning …

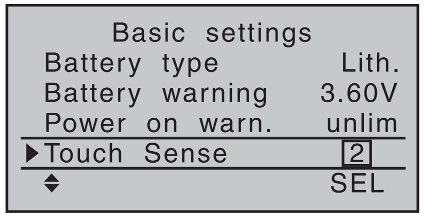


… before the transmitter switches off automatically one minute later.

The values “unlim(ited)”, “30 s” and 1, 5, 10, 20, 30 and 60 minutes are optional selections.

A simultaneous tap on the ▲▼ or ◀ ▶ selection keys of the right four-way button (**CLEAR**) will reset the inverse video field to “unlimited”.

Touch Sense



In this line you can select the touch sensitivity of the four-way buttons in a range from 1 to 10. The lower this number is, the more sensitive the four-way button will be to taps and vice versa.

A simultaneous tap on the ▲▼ or ◀ ▶ selection keys of the right four-way button **(CLEAR)** will reset the field shown in inverse video back to “2”.

DATA sel

Firmware version V1102 and higher

From firmware version V1102 it can be connected to the Data socket not only a Smart-Box or alternatively an external RF module, but also the external Bluetooth module of MZ transmitter, No. 8351 can be operated. The data protocol consequently required in each case on the “Data jack” can be selected in the “DATA SEL.” line:

```
      Basic  settings
  Battery  warning    3.60V
  Power  on  warn.    unlim
  Touch  Sense          2
▶DATA sel          Telemetry
 ⬍                      SEL
```

“Telemetry”

The signal data protocol at the data socket corresponds to the previous protocol and is suitable for connecting an external RF module and the data output on the Smart-Box under the menu “EXTERNAL MONITOR”.

“Bluetooth”

The signal at the data socket Data Protocol is to meet the needs of the external Bluetooth module, No. 8351, matched and thus particularly for the transmission of telemetry data and any language editions on the suitable “Graupner HoTT Viewer App for Android” compatible smartphones and / or tablets.

The output via “Bluetooth” mode data can be authenticated in a rudimentary when needed using the Smart Box and the option “MODEL SELECT”.

Note for Smart-Box:

The menus under the heading “SETTING AND DATA VIEW” complement HoTT transmitter of the first generation to the functions of the same menu item in today’s HoTT transmitter telemetry menu, see section “Set view” on page 238.

Completely regardless of directly connected to the Smart Box sensors it can be adjusted at any time and displayed with the help of these menu items.

When a receiver is directly connected, however, the display of the Smart box remains empty.

BT headset and following lines

Notes:

- *This menu point, and the menu points which follow it, are only relevant if you have installed the optional Bluetooth module, No.* ***33002.5****, in your transmitter, and have initialised it as described on page 39.*
- *A detailed description of the Bluetooth module, No.* ***33002.5****, and the method of operating the following menu points, can be found in the instructions supplied with every BT module, and also on the Internet at www.graupner.de. For this reason the following section only includes a brief description of the individual options:*

The option …

```
      Basic  settings
  Power  on  warn.    unlim
  Touch  Sense          2
  DATA sel         Telemetry
▶BT  Headset            OFF
 ⬍                      SEL
```

… is used to detect and couple Bluetooth devices. The same line can be used to select one of the two available transmission processes. It is also possible to remove all coupled BT devices again by simultaneously pressing the select buttons ▲▼ or ◀ ▶ of the right-hand four-way button (**CLEAR**) when the Value field is active.

The number of Bluetooth devices detected during a coupling procedure is displayed at far right in the next line down.

You can select the BT device (1 … max. 9) you wish to use in the Value window to the left of this; its name is then displayed on the left of the same line; for example:

```
      Basic  settings
  Touch  Sense          2
  DATA sel         Telemetry
  BT  Headset          A2DP
▶BTH002                 1/3
 ⬍                      SEL
```

In the line …

```
      Basic  settings
  Data sel         Telemetry
  BT  Headset          A2DP
  BTH002                1/3
▶ID PAIR       OK        ON
 ⬍                      SEL
```

… you can start and stop the connection to the selected BT device, and in the line …

```
      Basic  settings
BT  Headset          A2DP
BTH002                1/3
ID PAIR      OK        ON
►BT Volume             [8]
 ▲                    SEL
```

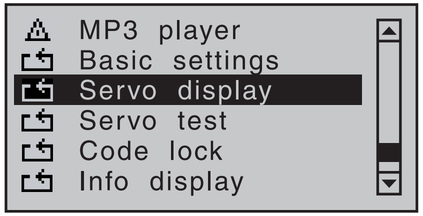
… you can adjust the volume of your BT device using the same procedure described earlier for adjusting volume for the “Speech volume”, “Vario volume” and “Button volume” options.

Servo display

Display of the servo position

MC 16 20 ☑ ☑ *This option is available on both transmitter types.*

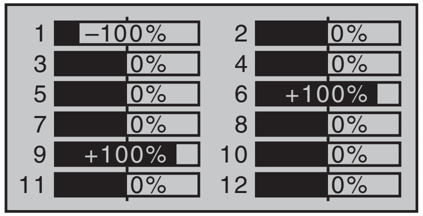
Use the selection keys on the left or right four-way button to scroll to the menu option »**Servo display**« menu option in the multi-function menu:



Briefly tap the centre SET key of the right four-way button to open this menu option.

The screen of the standard eight-channel MC-16 HoTT transmitter looks as follows:

… while the screen of the twelve-channel MC-20 HoTT transmitter, looks like this:



However, the visual display of current servo positions can not only be opened by selecting this menu, but also – directly from the transmitter's base screen as well as nearly all other menu positions – with a simultaneous tap on the ◄► keys of the left four-way button. A brief tap on the centre ESC key of the left four-way button will cause a return to the respective point from which it was called.

The current position of each servo is displayed in a bar diagram between -150 % and +150 % of normal travel with consideration for the control and servo settings, the dual-rate/expo functions, the interplay of all active linear and curve mixers, etc. 0 % corresponds precisely to the servo centre position. This way, you can quickly check your settings without having to switch on the receiver. However, this does not absolve you from first carefully testing all program steps, as well as on the model, prior to the first operation of the model in order to eliminate errors!

For winged models the display takes place according to the following scheme:

Bar 1	Throttle/brake servo
Bar 2	Aileron or left aileron
Bar 3	Elevator
Bar 4	Rudder
Bar 5	Right aileron
Bar 6	Camber-changing flap (left) / free channel
Bar 7	Camber-changing flap (right) / free channel
Bar 8	Free channel / second elevator servo
Bar 9	Free channel / Left FL2
Bar 10	Free channel / Right FL2
Bar 11	Free channel / Left AI2
Bar 12	Free channel / Right AI2

… and for helicopter models::

Bar 1	Pitch or roll (2) or pitch (2) servo
Bar 2	Roll (1) servo
Bar 3	Nick (1) servo
Bar 4	Tail servo (gyro)
Bar 5	Nick (2) servo / free channel
Bar 6	Throttle servo or speed controller
Bar 7	Gyro sensitivity / free channel
Bar 8	Speed controller / free channel
Bar 9	Free channel
Bar 10	Free channel
Bar 11	Free channel
Bar 12	Free channel

<u>*Notes:*</u>

- *However, please note that the servo display always refers to the original servo sequence, i. e. it does not take into account any changes you may have made to the output sequence in the »**Tx. output swap**« menu (which is available as standard on the MC-20 HoTT transmitter only), or in the "Receiver output" sub-menu of the »**Base setup model**« menu.*
- *Please also note that, by default, bar diagram tracking is opposite to the left/right movements of a stick.*
- *The number of channels shown in this menu correspond to the control channels available in the respective transmitter. However, the number of actually usable channels depends on the receiver type as well as the number of servos connected to it and, therefore, may be considerably lower under certain circumstances.*
- *Use this display during the model programming, because you can immediately check all settings on the transmitter. However, this does not absolve you from first carefully testing all program steps, as well as on the model, prior to the first operation of the model in order to eliminate errors!*

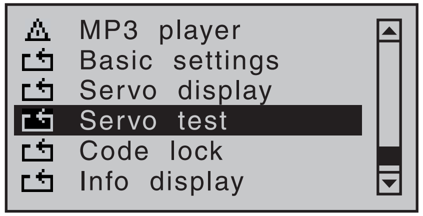
Servo test

Function test of Servo 1 … 8

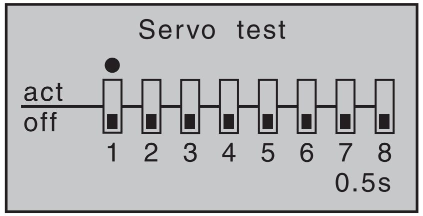
This option is available on the mc-20 transmitter only.

mc 16 ☐ 20 ☑

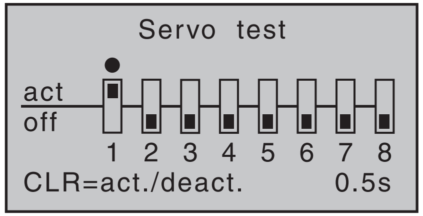
Use the selection keys on the left or right four-way button to scroll to the menu option »**Servo test**« menu option in the multi-function menu:



Tap briefly on the centre **SET** key of the right four-way button to open this menu option:



Any of the inputs 1 … 8 can be activated for the servo test by selecting with the selection keys of the left or right four-way button and then briefly tapping the **SET** key of the right four-way button. As soon as you have set only one of the inputs 1 … 8 to "active", the following notice appears at the bottom of the display screen:

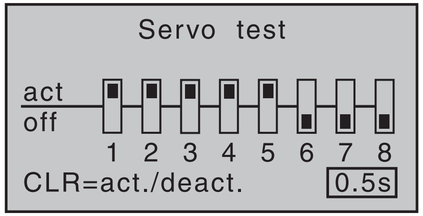


A simultaneous tap on the ▲▼ or ◄ ► selection keys of the right four-way button (**CLEAR**) would now start and stop, for example, a servo test of input "1" with a cycle time of 0.5 s.

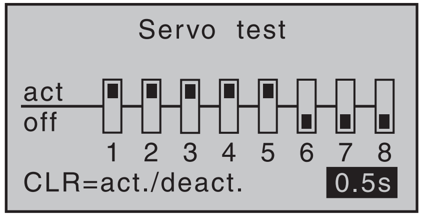
However, start a servo test only in a model memory without mixer specially constructed for this purpose!

Doing so will produce unpredictable power swings.

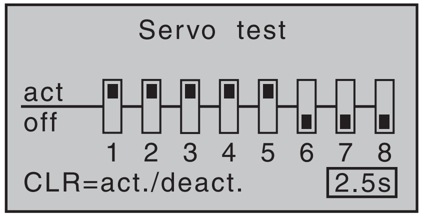
To change cycle time, select the loop symbol at the bottom right of the display with the selection keys of the left or right four-way button:



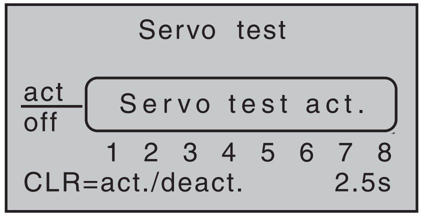
Once this value field has been activated with a brief tap on the centre **SET** key of the right four-way button …



… the motion cycle can be changed for the value field shown in inverse video within a range of 0.5 s and 3.0 s in 0.5 s increments. Briefly tap the centre **SET** key of the right four-way button to finish time selection.



As soon as the servo test has been started by a simultaneously tap on the ▲▼ or ◄ ► selection keys of the right four-way button (**CLEAR**) a window will open:



The "servo test" function automatically operates the servos as though the corresponding transmitter controls were being simultaneously and continuously moved back and forth between -100 % and +100 % during the preset time. All active mixing and coupling functions in the respective model memory, therefore, are effective and the servos move within the specified servo paths and servo delimitations.

Another tap simultaneously on the ▲▼ or ◄ ► selection keys of the right four-way button (**CLEAR**) will terminate the test.

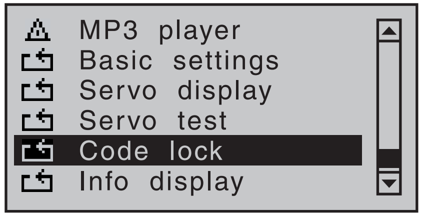
Code lock

Locking the multifunction menu

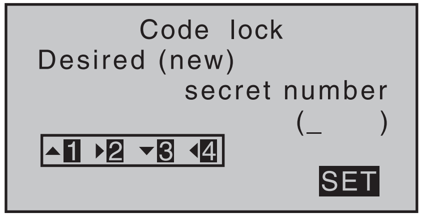
mc 16 20

This option is available on the mc-20 transmitter only.

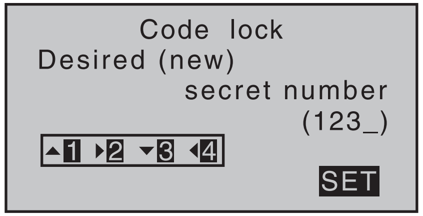
Use the selection keys on the left or right four-way button to scroll to the menu option »**Code lock**« menu option in the multi-function menu:



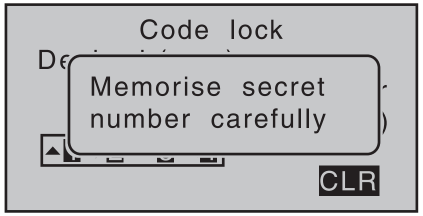
Tap briefly on the centre **SET** key of the right four-way button to open this menu option:



Access to the multifunction menu can be locked against unauthorized use by a four-digit secret code comprised of the numbers 1 to 4. This code lock is entered by way of the selection keys of the left four-way button according to the scheme shown in the display, for example:



As soon as another tap of a left four-way button selection key occurs after the fourth number has been entered, the message shown below will appear in the display:

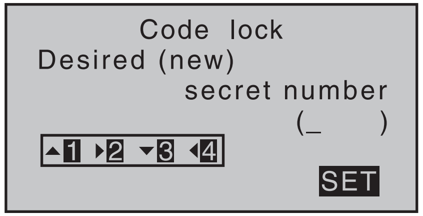


A brief tap on the centre **ESC** key of the left four-way button will *confirm the entered secret code and exit the menu*.

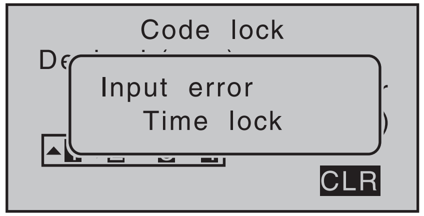
On the contrary, a brief tap on the centre **SET** key of the right four-way button will confirm the currently active **CLR** field at the bottom right of the display and thus *erase the entered digits*.

Make note of the secret code and keep it safe. Otherwise, the transmitter must be sent in to *Graupner* service for decoding.

The lock becomes active the next time the transmitter is switched on. However, the control remains ready for operation. However, a call-up of the multi-function menu, and thus also a model change, can no longer be accomplished without entering the correct number combination:

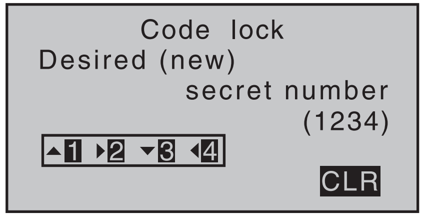


A renewed attempt following an incorrect entry is only possible after the lapse of a time-out:

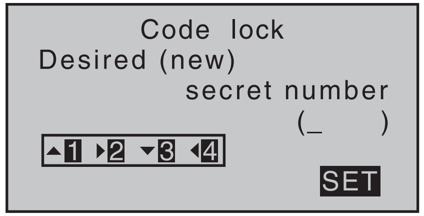


Deletion of the secret code

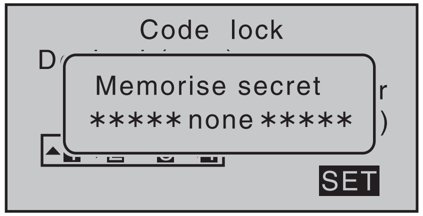
If the secret code is to be erased later on, tap *twice* on the centre **SET** key of the right four-way button right after calling up this menu option.



The first activation of the centre **SET** key of the right four-way button will erase the secret code (**CLR**):



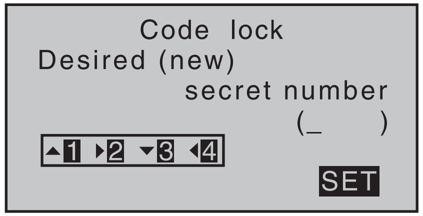
And the second activation will confirm the empty entry field (**SET**). The message shown will appear in the display:



Now exit the menu with a brief tap on the **ESC** key of the left four-way button.

Leaving the menu without input of a secret code

To leave the menu opened out of curiosity or by accident when no other key has been touched. Therefore, the display appears as follows:



You can leave the menu by pressing the central **ESC** button of the left-hand four-way button.

Tip:

*If you generally want to dispense with a programming lock, that option should be removed from the multifunction menu by way of »**Suppress menus**«. This will prevent unauthorized persons from entering a secret code "on the sly".*

Info display

Transmitter ID, date, time and memory card

mc 16 ☑ 20 ☑

This option is available on both transmitter types.

Use the selection keys on the left or right four-way button to scroll to the menu option »**Info display**« menu option in the multi-function menu:

```
MP3 player
Basic settings
Servo display
Servo test
Code lock
Info display
```

Tap briefly on the centre **SET** key of the right four-way button to open this menu option:

```
▸RFID             ABCDEF12
 firmware ver.       1.234
 date      2012/07/01(SUN)
 time          11:22:33s
 SD-Card               0MB
 available             0MB
                        0%
```

Transmitter-specific information is shown in this menu and – insofar as necessary and beneficial – can also be changed.

Programming procedure

Select the appropriate line with the ▲▼ selection keys of the left or right four-way button then briefly tap on the centre **SET** key of the right four-way button. The given default value in the value field displayed in inverse video can now be changed – insofar possible and necessary – with the selection keys of the right four-way button followed by another tap on the centre **SET** key or the central **ESC** key of the right four-way button to conclude the entry.

RFID

```
▸RFID             ABCDEF12
 firmware ver.       1.234
 date      2012/07/01(SUN)
 time          11:22:33s
 SD-Card               0MB
```

The RF identification number of the transmitter is shown in this line. It is transmitter-specific, is only issued once per transmitter and cannot be changed. During the connection process, this is sent to the receiver, among other things, so that it is always capable of identifying the radio signals of "its" transmitter.

Firmware version

```
 RFID             ABCDEF12
▸firmware ver.       1.234
 date      2012/07/01(SUN)
 time          11:22:33s
 SD-Card               0MB
```

The current version number of the transmitter software is shown in this line.

At the time these instructions were revised, you can decide whether a current update of the transmitter's operating system is available by comparing the number displayed here with the information offered on the Internet using the link http://www.graupner.de/en/supportdetail/4d589f17-24b4-4e50-97d2-13a0f39b-d13d. If the link does not work, the same information can be obtained by working through www.graupner.de => "Service & Support" => "Update and revision history for *Graupner* HoTT components".

If applicable, the version number is also required for inquiries with the service department.

Date

```
 RFID             ABCDEF12
 firmware ver.       1.234
▸date      2012/07/01(SUN)
 time          11:22:33s
 SD-Card               0MB
```

If necessary, select this line with the selection keys of the left or right four-way button and, as necessary, select the month or date field. After activating the respective value field with a tap on the centre **SET** key of the right four-way button, the year, month or day can be set with the selection keys of the right four-way button. Another tap on the centre **SET** key of the right four-way button will close the given entry. Years ranging from 2000 through 2135 are available for selection.

The abbreviated day of the week to the right outside in brackets is automatically generated from the respective date.

Notes:

- *If the transmitter is connected to a PC as described on page 50, the date and time can also be set through the PC program provided for the respective product via the Internet page at www.graupner.de.*
- *The date and time are protected against data loss due to power failure by a buffer battery for situations like a battery change, see page 20.*

Time

```
 RFID              ABCDEF12
 firmware  ver.       1.234
 date       2012/07/01(SUN)
▶time          11:22:33s
 SD-Card               0MB
```

If necessary, select this line with the selection keys of the left or right four-way button and, as applicable, the minute field. After activation of the respective value field by a tap on the centre **SET** key of the right four-way button, the hour or minute can be adjusted with the selection keys of the right four-way button. Another tap on the centre **SET** key of the right four-way button will close the given entry.

In contrast, the seconds display cannot be set directly; it can only be restarted at “00” with a brief tap on the centre **SET** key of the right four-way button.

<u>*Note:*</u>

- *If the transmitter is connected to a PC as described on page 50, the date and time can also be set through the PC program provided for the respective product via the Internet page at www.graupner.de.*
- *The date and time are protected against data loss due to power failure by a buffer battery for situations like a battery change, see page 20.*

SD-Card

```
 RFID              ABCDEF12
 firmware  ver.       1.234
 date       2012/07/01(SUN)
 time          11:22:33s
▶SD-Card            2048MB
```

In this line the memory capacity of a memory card inserted in the transmitter, if applicable, is shown in MB.

Depending on the memory capacity of the inserted micro SD or micro SDHC memory card, it may take several minutes until the correct value is shown after switching on the transmitter.

available

```
 firmware  ver.       1.234
 date       2012/07/01(SUN)
 time          11:22:33s
 SD-Card            2048MB
▶available          1234MB
```

Display of the available storage space in MB.

As mentioned before, display of the available storage space – depending on the capacity of the inserted memory card – does not appear until some time has passed after switching on the transmitter.

The display of the available storage space in relation to the total memory capacity is shown in the line below:

```
 date       2012/07/01(SUN)
 time          11:22:33s
 SD-Card            2048MB
 available          1234MB
▶                      60%
```

As mentioned before, display of the available storage space – depending on the capacity of the inserted memory card – does not appear until some time has passed after switching on the transmitter.

Programming models in an mc-16 HoTT or mc-20 HoTT transmitter …

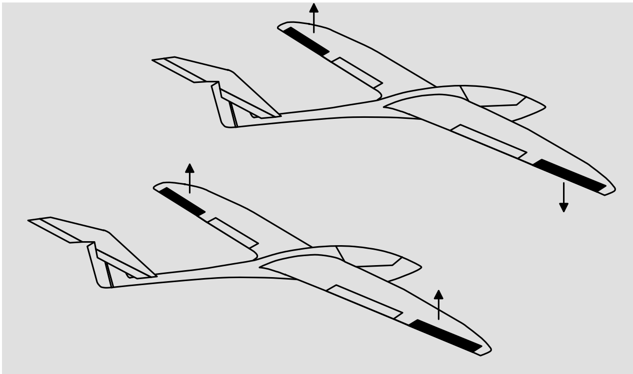
… is easier than it may appear at first!

The primary prerequisite for "clean" programming, and this applies not only to the mc-series but is also a principle for all programmable transmitters, is a mechanically correct installation of all remote control components in the model! Therefore, it should be ensured no later than on connection of the linkages that the servos are in their respective neutral position and their rudder lever is also in the desired position. Otherwise you should loosen the rudder and re-fasten it with an offset of a few lobes. If servos are positioned with the help of a servo tester, e. g. RC tester, No. **2894.12**, then the "correct" positions can be determined very easily.

The possibility of changing the neutral position of a servo in practically every modern transmitter is only intended for *fine-tuning*. Greater deviations from "0" can result to further asymmetries in the course of the further signal processing in the transmitter. In the same manner: A car with a bent chassis does not get any straighter if only the steering wheel is trimmed to "straight"!

An additional important point is the adjustment of the rudder paths: This should take place through a corresponding adjustment of the steering points, insofar as possible. Ultimately this is far more efficient than extensive efforts with the path adjustments in the transmitter! In this case: Path adjustments serve first and foremost for to compensate for the manufacturer-stipulated tolerances for the servos and their *fine-tuning*, and less for the compensation of carelessness.

If two separate aileron servos are used for a winged model, the ailerons, controlled through the corresponding activated wing mixer – see the following pages – can be assigned with both the flap function and raised with the brake flaps – however this would make more sense in a glider or electro glider than in a motor model.



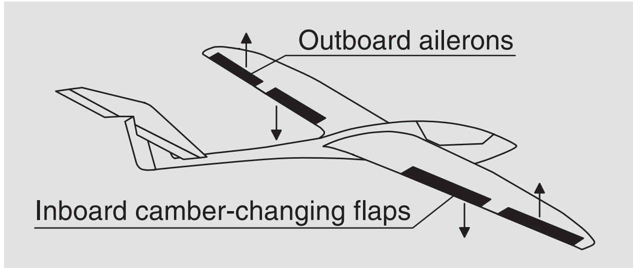
In this case the rudder arms – starting from the neutral position – should be tilted forward one lobe, pointing toward the nose, set to the respective servo.

The mechanical differentiation achieved through this asymmetric assembly contributes to the fact that the brake effect of the elevated ailerons increases with their deflection and, therefore, does normally require a greater path upward than downward.

Correspondingly, when planning to operated separately controlled flap servos, they should also be integrated into a crow system. Since the brake effect of this flap position referred to as a "crow position" is influenced less by the elevated ailerons than the downward deflection of the flaps, the rudder arms should be installed somewhat toward the rear in this case, tilted toward the trailing edge.

As a result, there is a greater available path for the downward deflection. With such a combination of lowered flaps with raised ailerons, however, the latter should only be elevated moderately, because they have more of a stabilizing and controlling function than a braking function in this type of crow system.

A "tip" for seeing the brake effect in this connection: lift the flaps and look over and under the surface from the front. The greater the projected surface of the protruding rudder, the greater the brake effect.



(Similar asymmetric installation of rudder arms can be meaningful, e. g. for open-cowl flaps or landing flaps, even in a motorized model.)

If a model is completed and mechanically attuned in this respect, you can basically begin with the programming of the transmitter. The following examples, an attempt is made to follow the practice of first describing the general basic settings and then fine-tuning or specializing them in the subsequent steps. After the initial flight and over the course of the further flying in of a model, it may be necessary to occasionally adjust some of the settings. As a pilot's experience increases, however, so does the desire for enhancements and expansions of settings.

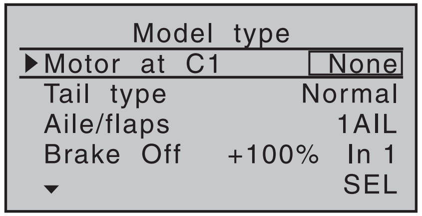
For this reason, the sequence of options is not always adhered to or some options are even mentioned multiple times.

Of course, just the opposite can also be the case, that not everyone of the described steps is relevant for a certain model, just as some users may miss the description of a certain step for their model …

Whatever the case may be, you should consider a logical assignment of the control mechanisms before you begin with the model programming.

For models in which the emphasis is on the "motor", regardless of whether it is powered by an electric or combustion motor, there should be no problem in this respect, because the assignment of the two stick units essentially lies in the four basic functions "Power regulation (= throttle)", "Side", "Altitude" and "Transverse"! However, in the menu …

»Model type« (beginning on page 98)



… you should determine whether you would like the minimum throttle position in the "front" or "rear", because "none (motor)" is entered by the program in the creation of a model memory as a basic principle.

The difference between "none" and "idle front/rear" is not only the effect on C1 trimming, which covers the entire scope of stick travel with "none" but with "idle front/rear" only has an effect in the idle direction.

In the process, the "effective direction" of the C1 stick is adapted accordingly, so that with a change from "front" to "rear" or vice versa, the rotational direction of the throttle servo or brake system do not have to be adapted as well. In addition, with an "idle front/rear" setting, a warning indication appears in the display for safety reasons and issues a warning beep, if the throttle stick is too far in the full-throttle direction:

In any case, it will be necessary to give some thought to "special functions".

With electro gliders, on the other hand, it is only occasionally different. In this regard, one must ask how the drive and brake system are actuated. Certain solutions have shown to be practical and others have shown to be less practical.

For example, it is certainly less practical, if you have to release a stick for the approach of a glider model in order to be able to appropriately control the spoilers or a crow position using one of the other controls. It may be more advantageous to either design the function of the C1 stick to be switchable, see Example 4, beginning on page 292, or to leave the control of the brake system at the stick and to control the motor through one of the other controls or even with a switch!

Since this type of model does not normally have a motor, and just a "start assistance" function to either "lift" the model in the sky with full force or, in any case, to "tow" it with "half" force by a wind field, When this is also mounted in a convenient to grip location, the motor can be switched on and off without letting loose of one of the sticks – even during the landing approach.

If you do not decide immediately to have the three-function stick switch, No. **33000.13**, installed by a *Graupner* Service Centre, then we recommend that you use one of the three-position switches fitted as standard, and preferably the switch on the side of the transmitter away from the hand which holds the model when launching. In other words: If the model is started from the right hand, the motor switch should be mounted on the left side and vice versa.

The idea is the same for the control of flaps, regardless of whether only ailerons or flaps covering the entire wingspan (combinations) are raised or lowered. A 3-position switch with a long grip generally suffices for control of camber flaps, preferably mounted outboard on the throttle/brake stick side There it is always accessible without having to let loose of the stick.

If everything is now in order, you can begin with the programming.

Initial steps for the programming of a new model

Example: Winged model with two ailerons and – initially – without motor propulsion

In the context of **initial commissioning a new transmitter**, in the selection menu …

»Basic settings« (beginning on page 266)

```
      Basic  settings
▶Voice  Vol   [5]  fr     –––
 Vario  Vol    7   fr     –––
 Beeps  Vol    7   fr     –––
 Own<                       >
 Stick  mode             1
 Modulation           HoTT
 DSC  Output         PPM10
 Pitch min            back
 Top  LCD  Contrast      0
 Bottom  LCD  Contr.     0
 Display  light      unlim.
 Power-on  beep         yes
 Battery  type        Lith.
 Battery  warning     3.60V
 Power  on  warn.     unlim
 Touch  Sense            2
 DATA sel         Telemetry
 BT Headset             OFF
                        0/0
 ID PAIR                OFF
 BT Volume                8
 ▼           SEL  SEL
```

… some basic information should be entered. This serves various purposes:

The first three lines of this menu can be used to individually regulate, in increments between 0 and 10, the volume of voice and signal output emitted via the built-in loudspeakers or the transmitter's headset connector.

The fourth line of this menu is used to record the transmitter owner's name and the lines "**Stick mode**", "**Modulation**", "**DSC Output**" and "**Pitch min**" are for the storage of *pre-set values* used *as defaults for new models*.

These are then adopted on the activation of a new model memory in its basic settings, but can be changed there at any time.

The "**LCD Contrast**" or "**Top / Bottom LCD Contrast**" lines can be used to adapt the contrast of respective displays to ambient light conditions as necessary by changing the standard pre-set "0" in a range of ±20.

The setting in the "**Display light**" line determines how long display lighting remains illuminated after the transmitter is switched on or after the last activation of a transmitter operating element.

The selection of "yes/no" in the "**Power-on beep**" line determines whether the "recognition melody" is to sound when the transmitter is switched off or on again.

The "**Battery type**" line indicates to the transmitter whether its power comes from a four-cell NiMH battery or a single-cell Lith battery and the "**Battery warning**" line can be used to individually set the threshold for the battery warning. Make sure that you do not enter a value which is too low, so that you still have sufficient time to safely land your model in the event of a battery warning.

If necessary, the "**Power on warning**" line can be used to determine how long the transmitter should wait after the last activation of an operating element before issuing a visual and acoustic stick warning, followed about three minutes later by the transmitter switching itself off.

In the "DATA SEL." line you can specify which abuts the two possible data logs to the located under the left front cover Data socket. By default, it is the data output on the Smart-Box, No. **33700**, suitable "telemetry" protocol.

On the other hand, the setting made in the "**Touch Sense**" line is merely a personal comfort setting. The lower this number is, the more sensitive the four-way button will be to taps and vice versa.

In contrast, the "BT Headset" menu point, and the lines which follow it, are only relevant if you have installed the optional Bluetooth module, No. **33002.5**, in your transmitter, and have initialised it as described on page 39.

For more information on this please refer to the instructions supplied in the set.

This menu can be exited after completing "general settings" with a return to the multi-function menu by way of the centre **ESC** key of the left four-way button.

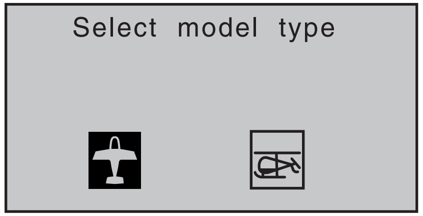
To program a new model, now use the selection keys of the left or right four-way button to switch to the menu …

"Model select" (page 71)

…, and use the selection keys of the left or right four-way button to select a free model memory location:

```
01                ME 12
02   ***free***
03   ***free***
04   ***free***
05   ***free***
06   ***free***
```

Right after a tap on the centre **SET** key of the right four-way button to confirm this selection, the type of model to be programmed will be requested:



Since the objective is to work with a winged model in this section, the symbol for a winged model is to be confirmed with a tap on the centre **SET** key of the right four-way button. The display switches back to the base screen.

Notes:

Of course, you can also use the predefined default "winged model" supplied with the receiver as model memory 01 for the programming of your first model.

- *Once the "Select model type" option has been opened, the process can no longer be canceled! Even if you switch off the transmitter, this selection must be made! After a selection has been made, the selected model memory can only be made "free" again by erasing it subsequently from a different model memory; see page 72.*
- *If battery voltage is too low, the model switchover cannot be made due to reasons of safety. An appropriate message will appear in the screen:*

```
not possible now
voltage  too low
```

Once this first hurdle has been taken, the binding of the receiver built into the model to this model memory can be done in the menu …

»Base setup model« (beginning on page 78)

... to bind:

Note:

After confirmation of the model selection in the base screen, if you confirm the message appearing in the screen for a few seconds …

```
BIND. N/A
   OK
```

*… with a tap on the **SET** key of the right four-way button, this line is accessed automatically.*

"Binding type"

If your transmitter is equipped with the latest firmware or has since been updated accordingly, you should briefly deal yet with the differences between the two available HoTT synchronization methods before the actual binding process. Set default "model":

```
   Base  setup  model
 Mod.name   <GRAUBELE>
 Stick  mode          1
►Binding type     Model
 Module HoTT   n/a  n/a
 ⇕              RC1 RC2
```

- "Model" -specific bound receivers respond only to signals of them explicitly allocated memory model. One, possibly unintentional, operating on an unallocated model memory is not possible.
- "Global", ie specific sender, receiver bound to respond to the signals of all model memories "their" station! A "wrong" model memory if necessary to recognize only the warning of the missing return channel.

So If necessary, change the line "**Binding type**" and change the setting accordingly:

```
   Base  setup  model
 Mod.name   <GRAUBELE>
 Stick  mode          1
►Binding type    Global
 Module HoTT   n/a  n/a
 ⇕                  SEL
```

"Module"

In this line the binding process between model memory and receiver is initiated, as described in detail on page 80. Otherwise, you cannot address the receiver.

Afterward, use the ▲ selection key of the left or right four-way button to move up to the first line and begin with the actual model programming in the "**Model name**" line:

```
   Base  setup  model
►Mod.name   <          >
 Stick  mode           1
 module  HoTT  n/a   n/a
 DSC  Output       PPM10
 ▼
```

The "**Model name**" can now be entered here by a brief tap on the centre **SET** key of the right four-way button to switch to the character table:

```
!"#$%&'()*+,-./0123
456789:;<=>?@ ABCDE
FGHIJKLMNOPQRSTUVWX
YZ[¥]^_`abcdefghijk
▼▲_ _ _ _ _ _ _ _ _ _ _ _ _ _ _
Mod  Name <GRAUB        >
```

The *pre-sets* for "**Stick mode**", "**Modulation**" and "**DSC Output**" are adopted from data stored in the »**Basic settings**« menu and these should be reviewed and changed as necessary.

In the menu …

Model type (page 98)

```
      Model type
▶Motor at C1        None
 Tail type        Normal
 Aile/flaps         1AIL
 Brake Off   +100%  In 1
▾                    SEL
```

… the principle arrangement of the servos in the model is selected and communicated to the transmitter. The following selections are available:

"Motor at C1"

- "none"

  Trimming works independently of the stick position and the "Brake settings" sub-menu of the »**Wing mixers**« menu, beginning on page 166, is available without limitation.

  The "Throttle too high" warning message, see page 35 and/or 98, and the "Motor stop" option, page 85, are *deactivated*.
- "(Idle) front or back"

  C1 trimming is affected in the front or rear and the "Motor stop", page 85, option is *activated*.

  If the throttle stick is too far in the full throttle direction when the transmitter is switched on, this will be indicated with the warning message "Throttle too high".

  In parallel with this, the "Brake settings" sub-menu of the »**Wing mixers**« menu, beginning on page 166, will only then be available if the "Motor" column of the »**Phase settings**« menu, page 148, has the entry "none" for the currently active flight phase.

In the next two lines, the principle arrangement of the servos in the model is selected and communicated to the transmitter:

```
      Model type
 Motor at C1        None
▶Tail type        Normal
 Aile/flaps         1AIL
 Brake Off   +100%  In 1
⬍                    SEL
```

- **Tail type**

  "normal", "V-tail", "Delt/fl.wing" or "2 Sv EL 3+8"
- **Aileron/camber flaps**

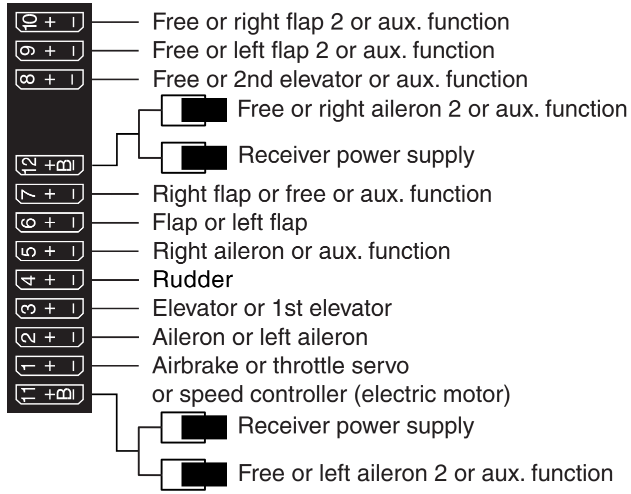
  1 or 2 AIL servos and 0, 1 or 2 FL servos

  in the 8 channels mc-16 HoTT transmitter and 1, 2 or 4 AIL servos and 0, 1, 2 or 4 FL servos

  in the 12 channels mc-20 HoTT transmitter

Since we want to actuate the brake system of the "Brake settings" sub-menu under the »**Wing mixers**« menu with the C1 stick, we will leave the outer right setting in the "**Brake Offset**" line with "Input 1". With the "Offset value" to the left of this, you should only place the mixer neutral point at the point where the brake system is retracted or inactive. If, in the process, the offset is not place completely at the end of the control path, the rest of the path is "idle travel", which means the mixer is not influenced in this range of the stick movement. This free travel ensures that all brakes remain even with slight deviations from the stop of the airbrakes control in the neutral position. At the same time the effective control travel is automatically spread to 100%.

By now at the latest, servos should be plugged into the receiver in the standard *Graupner*'ish sequence:



<u>*Comments:*</u>

- *If a V-tail unit should move incorrectly either "high/low" or "left/right", please observe the information in the table on page 65 in the right column. The same process applies for the ailerons and flaps.*
- *If in a V-tail "elevator" and / or run "rudder" are moving in the wrong direction, then please follow the instructions in the table on page 65, right column. Is similar to, if necessary, to proceed with the ailerons and flaps.*
- *The settings described in the following are based on a model with "normal" tail unit and "none (motor)". The settings are adopted for models with a V-tail with practically no changes at all. However, the transfer of this information is not so simple for delta/flying-wing models. Therefore, a special programming example for this model type is provided on page 312.*

In the menu …

»Servo adjustment« (page 106)

S1	=>	0%	100%	100%
S2	=>	0%	100%	100%
S3	=>	0%	100%	100%
S4	=>	0%	100%	100%
S5	=>	0%	100%	100%
	Rev	cent	– trv +	

… servos can now be adapted for appropriate "**direction of rotation**", "**neutral position**", "**travel**" and "**limitation**" to the requirements of the model.

In this sense, all settings which serve to compensate servos and make *minor* adaptations to the model are "necessary".

Notes:

- *The maximum possible throw of a Graupner servo is 150 % per side, based on both mechanical and electrical reasons. For example, if the sum of the values of the column "Centre" and one of both columns of "Servo travel" exceed this limit, the respective servo can no longer follow the control commands starting from this point. Therefore, please bear in mind that mixers and settings in the »**Dual Rate / EXPO**« menu also have an influence on servo travel.*
- *The settings options provided in this menu for asymmetric servo travel do NOT serve for achieving differentiations for ailerons and/or flaps. There are options better suited for this purpose in the »**Wing mixers**« menu, page 168.*

In the last column, "**- limit +**", the basic settings of 150 % can, and perhaps should be, significantly reduced.

The values entered in this position act as a "limiter", whereby the setting is actually for which point of travel the respective servo may not exceed, so that it does not start up mechanically and thus unnecessarily draw current. In this case it is the *end* of available mechanical play on the servo, rudder and/or steering which is decisive for the value to be set.

An example of this would be the selection of a model with cruciform tail, with which the rudder moves in a wedge-shaped cutout of the elevator. In order to prevent the rudder on the elevator starting up and possibly blocking it, the travel is normally mechanically adjusted (at the linkage) so that the rudder does not start with the full throw of the stick. As long as the rudder is only controlled with the corresponding stick, there will not be any further problems with this. But at the moment, when in addition to the normal rudder signal a mixer also influences the rudder, such as an "AIL ➔ RUD" mixer (aileron to rudder), it is possible that the two signals can sum to an excessive extent.

A correctly set limit of travel intercedes precisely at this point and thus reliably prevents the mechanical starting of the rudder. The limit of travel should, however, not be too small, so that the rudder throw is permanently and excessively limited.

Of course, the travel on both sides could also be reduced, so that a start-up would not even occur with an addition of the maximum values. With this method, however, the prevention of an occasionally occurring event would result in a permanent reduction of the normal rudder throw.

The following menu, which is only available as standard on the mc-20 HoTT transmitter, is not just of interest to model aircraft specialists:

»Stick mode« (page 108)

Ch.1	GL	4	0.0s	0.0s
Aile	PH	4	0.0s	0.0s
Elev	PH	4	0.0s	0.0s
Rudd	PH	4	0.0s	0.0s
	Tr	St	– time +	

In addition to the generally interesting adjustment of the increments in the column "Tr" (number of trim increments for each "trim lever click") for digital trimming – separate adjustments for each of the four trim lever – in the case of the (later) programming of flight phases in the second column of this menu you can select whether the trimming of transverse, altitude and side should operate "GL(obally)" in equal measure over all flight phases or separately in each (flight) "PH(ase)".

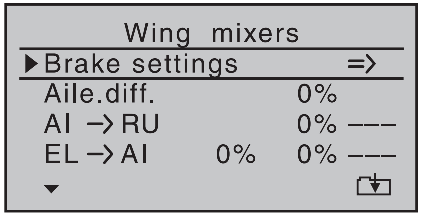
The "Time" column, on the other hand, is not of interest for this initial programming.

The settings made up to this point are sufficient to permit basic flight of winged and motorized models – though the latter does require a correctly set idle stick direction in the "Motor on C1" line of the »**Model type**« menu. However, the "fine-tuning" is still missing. The fine-tuning certainly adds to the enjoyment of flying over the course of time. Therefore, if you can already fly your model safely, you should delve into the menu…

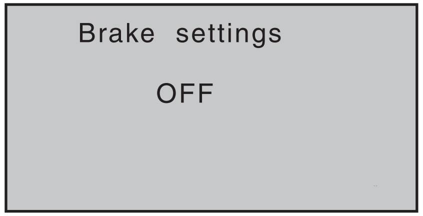
»Wing mixer« (beginning on page 166)

… where various options are available, depending on the specifications made in the »**Model type**« menu, page 98.

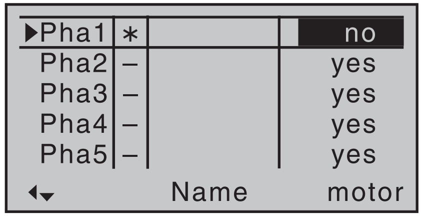
Since this section deals with a model having only 2 servos in the wings, the Multi-flap menu beginning on page 177 is not shown.



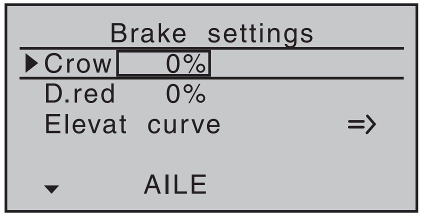
Therefore, we begin with the “Brake settings” sub-menu:



If this display appears, your model is equipped with a motor, contrary to the assumption of this section, and therefore you have selected “front/back” instead of “none” in the line “Motor on C1” of the »**Model type**« menu, page 98. Therefore, change this setting temporarily or change the “yes” entry in the “Motor” column of the »**Phase settings**« menu, page 148, to “no” for the currently active flight phase – Phase 1 in this case.



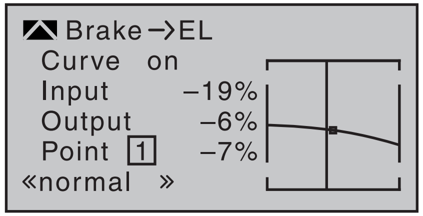
…



After this statement about mutual dependencies, back to the topic:

If the ailerons are to be elevated for braking, an appropriate value is entered into the “**Crow**” line after activating the “AILE” column’s value field. In addition, a value should always be entered in the line below it, “**D.red**” (differentiation reduction), which corresponds to the value you entered or would like to enter on the first page of the »**Wing mixers**« menu in the line “Aile. diff.” (see figure above)! With this entry, on actuation of the brake stick, the set aileron differentiation is hidden again proportionally in order to increase the downward the throw of the raised ailerons and thus significantly improve its effect in the braking phase (see the related section on page 182).

A setting of the “**Elevat. curve**” mixer is then only necessary if the flight speed of the model changes too dramatically on actuation of the brake system. In any case, you should try out the setting at a sufficient and readjust, if necessary, whereby you should focus less on the flight position than on maintaining the “normal” flight speed of the model. Otherwise there is the risk that the model plunges when engaging the brake system, because it became too slow in the meantime:



After exiting the “Brake settings”, the “**Aileron differentiation** can be set:

This serves to eliminate the negative torque. The downward deflected aileron normally generates a higher level of resistance during the flight than when deflected upward the same distance, whereby the model is pulled to the “wrong” side. In order to prevent this, with the input of a differentiation of the travel of the respective servo deflected downward is reduced accordingly. A value between 20 and 40 %, in this case, seldom arises, however, the “correct” setting must be sought.

However, this function should be made switchable with the assignment of a switch if you ever have aerobatic flight ambitions. (The author, for example, switches off this mixer “automatically” when switching to the “Speed” flight phase, in which he assigns both options to the same switch accordingly.)

The option “**AI → RU**” (aileron → rudder) also serves a similar purpose, as well as for the comfortable control of a model. A value of about 50 % is a practical initial value.

The last option in the »**Wing mixers**« menu, the “**El → Fl**” mixer, is not yet of interest at the moment.

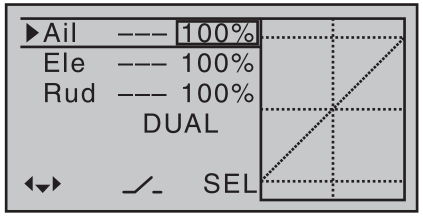
If the model-specific settings were made thus far, the initial start can be considered. If course, at first you should perform a “dry run”, meaning you should carefully check all the settings once again on the ground. Incorrect programming can damage more than just the model! In case of doubt, ask the advice of an experienced model pilot.

If you should find during the testing that one or multiple settings must be made for the adjustment of the rudder effects to your control habits, the control throws are too long or short on the whole, you should adjust this in the …

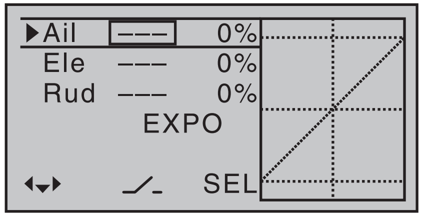
»Dual Rate / Expo« (page 126)

… to your own requirements and habits.

“**Dual Rate**” establishes a relationship between stick travel and control travel, see page 126:



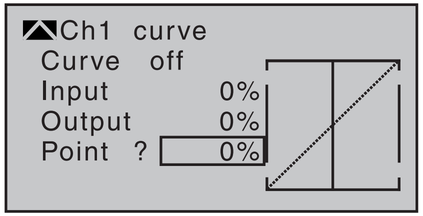
On the other hand, if the maximum throws are OK and only the reactions around the centre position are to strong for more sensitive controls, then the “exponential” functions comes (additionally) into play:



If a switch is also assigned, switching can even take place between two dual-rate/expo settings during the flight.

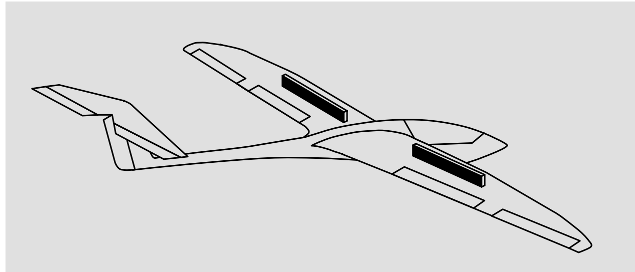
This is similar for the option …

»Channel 1 curve« (page 134)



With this option, one or multiple points of the control curve of the throttle/brake stick can be influenced in such a way that a pleasant or even purposeful behavior is guaranteed.

An example of this would be the “dead” travel of spoilers. The flaps first pass through this after a certain “idle travel” of the brake stick from the wing. With a corresponding “bending” of the curve, the “dead’ travel is covered more quickly. The spoilers come out from the wing earlier and then the remaining travel can be controlled with greater sensitivity. (This also applies for the control of a motor in the same manner, which can be controlled through C1 as an alternative.)



Finally, the receiver’s behavior in the event of a failure should certainly be established in the menu…

»Fail safe« (page 216)

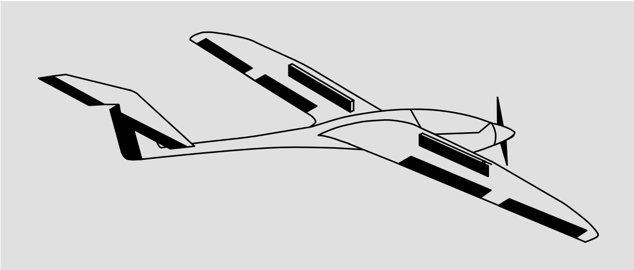
… because “doing nothing” is the worst thing which can be done for a winged model.

In the transmitter’s home position, “Hold” is specified and “Hold” means that the receiver continuously sends the last correctly recognized control impulse to the servos in the model. In the best case scenario the model flies straight ahead for an indefinite amount of time and then hopefully “lands” somewhere without causing significant damage! However, if something like this happens in the wrong place at the wrong time, the model may become uncontrollable and “tear” across the flight field completely out of control, putting the pilot and/or spectators at risk. Therefore, it would obviously be beneficial to program the function “Motor off” at the very least, in order to prevent such risks.

With electro gliders, on the other hand, the fail-safe setting “motor off” can also be used, for example, for outlanding, to reliably stop the motor or its propeller by immediately switching off the transmitter after the landing.

The author usually prefers a “braking finish” within eyeshot to floating off “somewhere else”.

Integration of an electric drive into the model programming



An electric drive can be controlled in different ways: The simplest method to integrate one such drive into the model programming is with the use of a throttle/ brake stick (C1). However, since this is already specified for the brake system in the course of the model programming described above, either the switchable solution described beginning on page 292 or even the use of an alternative control is possible.

As a suitable alternative, one of the two 3-position switches would be better than one of the proportionals controls. However, either one of the two side proportional rotary controls are also well suited to activation of a motor without having to let go of the stick. An alternative would also be one of the two-stage switches. Basically, whatever switch is used should be located where it is within convenient reach.

Before we turn to the individual examples, it is important must be noted that all inputs in the »**Control adjust**« menu can be selectively programmed as flight-phase specific ("PH" in the "type" column) or model memory specific ("GL" in the "type" column)!

However, since the drive should usually be available depending on the current flight phase, we recommend leaving the standard default "GL" ("global") in the "type" column which your are using.

```
 In5  GL fr  ---    0%
 In6  GL fr  ---    0%
 In7  GL fr  ---    0%
▶In8  GL fr  ---    0%

     typ SEL       offset
```

A common option in the following examples 1 … 5, the automatic tracking of the elevator trimming in the power flight, should also be mentioned at the beginning of this section:

If it becomes apparent after the initial power flights that the model must be continuously corrected with the elevator while the motor is switched on, this situation can be corrected by setting a free mixer and adjusting it accordingly. For this purpose, switch to the menu …

»Free mixers« (beginning on page 201)

… and program one of the linear mixers, M1 … 8, or even one of the curve mixers, C9 … 12, from "channel controlling the motor" according to "EL", for example:

```
▶M1        8 → EL
 M2       ?? → ??
 M3       ?? → ??
 M4       ?? → ??
 M5       ?? → ??
      ty  fr   to
```

On its second screen page, the required – usually low – correction value is entered:

```
 L.Mix  1       8 → EL
 Mix input
▶  +4%    +4%
 Offset
  –100%
 SYM     ASY
```

Note:

*The adjustment of a curve mixer is described in detail in the section »**Channel 1 curve**« starting on page 134.*

Example 1

Proportional control usage

If one of these controls is used, the connection is very simple. Only the motor controller (speed control) has to be connected to a free servo connection 5 … 12 max. of the receiver.

Bear in mind that, depending on the model type and number of aileron and flap servos, the output 2 + 5 and may be 6 + 7 are already linked.

Therefore connect your speed controller to the next free input and assign the selected input – for example, "In8" – to one of the transmitter's proportional controls, for example the left-side proportional rotary control. This is done in the menu …

»Control adjust« (page 112)

Select the desired line with the ▲▼ selection keys of the left or right four-way button. A tap on the centre **SET** key of the right four-way button will activate the "Control assignment".

Now move the selected proportional control. After a short time, an entry, e. g. “Lv2”, will appear in the inverse video field:

In5	GL	fr	---	0%
In6	GL	fr	---	0%
In7	GL	fr	---	0%
▶In8	GL	Lv2	---	0%
◆▶	typ	SEL		offset

However, since propulsion must usually be available, independent of the current flight phase, leave the default value “GL” in the “type” column – as already mentioned earlier in this section.

If you need to adjust the travels to suit the speed controller, use one of the arrow buttons to move right to the “- Travel +” column, following the right-pointing triangle at bottom left:

In5	+100%	+100%
In6	+100%	+100%
In7	+100%	+100%
▶In8	+100%	+100%
◀◆▶	– travel +	

This fields of this column can be use to set the travel required, even asymmetric if necessary.

A simultaneous tap on the ◀ ▶ keys of the left four-way button now will switch over to the »**Servo display**« where the selected proportional control can be activated to watch the bars for channel 8 “wander” from one side to the other and back.

However, if the proportional control is moved too fast – in practice – the resulting sudden motor acceleration can briefly strain the entire drive train (too much). In this case, be sure to enter a value in the “- time +” column to counteract such a condition.

Therefore, using one of the selection keys, switch one column to the right, to the “- time +” column then move the selected control close to “full throttle” so the marker frame is only placed around one value field. Now enter a value of at least 1 s …

In5	0.0s	0.0s
In6	0.0s	0.0s
In7	0.0s	0.0s
▶In8	0.0s	1.1s
◀◆	– time +	

… with which a movement of the proportional control in the “ON” direction which is too fast is processes move gently, and you can check immediately this by switching to the »**Servo display**«.

Note:

No delay is entered on the “OFF” side, so that the drive can be switched off instantly at any time. This does not additionally stress the drive, because it merely “runs down”.

The adjustment of the appropriate control travel and directions for the motor control (speed control) is normally carried out in the »**Control adjust**« menu in the “- trv +” column. Alternatively, these settings can also be made in the menu …

»Servo adjustment« (page 106)

S4	=>	0%	100%	100%
S5	=>	0%	100%	100%
S6	=>	0%	100%	100%
S7	=>	0%	100%	100%
▶S8	=>	0%	100%	100%
◆▶	Rev	cent	– trv	+

Example 2

2-way switch usage

This variant realizes a purely ON/OFF function.

On the receiver side, either a simple electronic switch or – if a gentle motor start-up, for example, is desired – an appropriate motor control (speed control) is required.

With the exception of assigning a different operating element, the settings required for this are essentially the same as those described under Example 1. Therefore, the same comments and recommendations also apply.

Apart from the infinitely variable motor control under Example 1 and the two-stage motor control in this example, the selection of the two transmitter control types only has an effect on the type of timer control, see page 296.

Only the nature of the assignment and representation of the selected switch in the display of the menu …

»Control adjust« (page 112)

… differ. As in example 1, change over to the line of a free input, activate the “Switch assignment” in the second column as described on page 60, then move the selected switch, in this case for example switch 2, from the desired motor OFF position in the direction of motor ON:

	In5	GL	fr	---	0%
	In6	GL	fr	---	0%
	In7	GL	fr	---	0%
▶	In8	GL	---	2	0%
		typ			offset

Here again – as already mentioned earlier in this section – leave the standard default "GL" in the "Typ" column.

The setting of the appropriate control travel for the motor control (speed control) is made in the "- trv +" column. If the motor should up gently with the use of a motor control (speed control), an appropriate delay time can be set – as described in Example 1 – in the "- time +" column:

	In5	0.0s	0.0s
	In6	0.0s	0.0s
	In7	0.0s	0.0s
▶	In8	0.0s	1.1s
		– time +	

All other settings – as already mentioned earlier in the example – are made analogous to Example 1. Therefore, the same comments and recommendations also apply.

<u>Note:</u>

No delay is entered on the "OFF" side, so that the drive can be switched off instantly at any time. This does not additionally stress the drive, because it merely "runs down".

Example 3

3-way switch usage

This variant realizes a three-stage speed setting, such as Motor OFF, "half" and full power.

A corresponding motor control (speed control) is required on the receiver side.

The required settings are basically the same as those described under Example 1 and 2. Therefore, the same comments and recommendations also apply.

Apart from the infinitely variable motor control under Example 1 and the three-stage motor control in this example, the selection of the operating element only has an effect on the type of clock control, see page 296, and the nature of the assignment.

Here again – as already mentioned earlier in this section – leave the standard default "GL" in the "type" column.

Put the desired 3-way switch into its middle position then activate the "Switch assignment" above the column with the switch symbol, as described on page 60. Now put the selected 3-way switch forward, *out of its middle position*:

	In5	GL	fr	---	0%
	In6	GL	fr	---	0%
	In7	GL	fr	---	0%
▶	In8	GL	---	3	0%
		typ			offset

Now put the activated switch from its forward position back into its middle position.

Now move the marker frame to the left and into the column above the column now labelled with a second switch symbol instead of the previous label **SEL**. Reactivate the "Switch assignment" for this column then move the 3-way switch *out of its middle position toward the rear*:

	In5	GL	fr	---	0%
	In6	GL	fr	---	0%
	In7	GL	fr	---	0%
▶	In8	GL	2	3	0%
		typ			offset

The setting of the appropriate control travel for the motor control (speed control) is made in the "- trv +" column. The motor should rev up gently with a motor control (speed control), to this end a suitable delay time can be set – as described in examples 1 and 2 – in the "- time +" column:

All other settings – as already mentioned earlier in the example – are made analogous to Example 1. Therefore, the same comments and recommendations also apply.

<u>Note:</u>

*By shifting the neutral position and subsequent adjustment of travel, the "half throttle position" can be influenced in the »**Control adjust**« menu by reducing travel from the offset value on the side to which the neutral point has been shifted and adding it to the other side. For example, an offset value of -20 % results in +80 % on the minus side of the travel setting and +120 % on the plus side, and vice versa.*

Example 4

Before we discuss the programming of this fourth example or turn to the expansion of the previously described basic programming, a few words should be said about the position of the throttle/brake stick with “Motor OFF” or “Brake OFF”. Normally the C1 control stick is moved forward for the throttle control and backward for the extension of the brake. However, if for this type of “traditional” assignment, for example, a switchover of the brake system is to take place for the “Motor OFF” condition (stick “back”) then a switchover to “full brake” would take place immediately after the pre-set switchover time specified in the »**Phase settings**« menu, and the opposite will take place when “brakes retracted” is switched over to propulsion causing the motor to switch over to “full power” within this time range …

A “glider pilot” can make the best of this “Emergency” – normally with “brake retracted = front” – by switching to motor “ON” only if necessary so that power decreases, if applicable (and hopefully not forgetting to push the C1 stick “forward” again when switching back). A typical “motor pilot”, on the other hand, operates in the opposite manner, only switching to the brake if necessary, etc. You can also combine the “Zero point” of both systems to avoid confusion, whereby a “glider pilot” would tend prefer the “front” and a “motor pilot”, on the other hand”, would likely prefer the “rear”.

Whichever the case may be, the mc-16 HoTT and mc-20 HoTT transmitters permits both variants. In the following text, however, the combination of the two “OFF” positions to “front” is assumed. However, if you have a different preference, it is not a problem: The only difference from the described version lies in the logical selection of “Throttle min rear/front” and, if applicable, of a corresponding brake offset in the menu …

»Model type« (page 98)

Here you first specify in the “motor” line whether the throttle minimum position (= Motor “OFF” position) should be at the “front” or “back” – as already discussed: In the following programming example, “Motor OFF” and “Brake OFF” are combined at “front”:

```
      Model  type
▶Motor  at  C1        front
 Tail  type          Normal
 Aile/flaps            1AIL
 Brake  Off    +100%   In 1
▼                       SEL
```

Note:

With the selection of “Throttle min front/back” the trimming will then only have an effect in the “idle” direction of the motor and is not the same as with the “none” entry, having the same effect at every position of the C1 stick. Since the C1 trimming is not normally used with electric drives, however, this has no further relevance.

You adjust the “Tail type” according to your model, in this case “normal”.

In the “Aileron/flaps” line you enter the correct number of aileron and flap servos – in this example “2 AIL”.

In the last line you leave the standard entries for the selection of “Brake retracted = front”. On the other hand, if the preference is for “Brake retracted = back”, select the “Brake offset” line and define the offset point – as described on page 100 – as “back”. In the process, if the offset point is not placed completely at the end of the control travel, the remainder of the travel is “idle” up to this limit.

```
      Model  type
 Motor  at  C1        front
 Tail  type          Normal
 Aile/flaps            2AIL
▶Brake  Off    –90%    In 1
▲                STO    SEL
```

This idle path ensures that all brake settings remain at “neutral”, even with minor deviations from the limit of the brake flap control. At the same time, the effective control path is automatically spread to 100 %.

For this reason, in the next step it must be ensured that the influence of the C1 stick on the motor can be influenced. For this purpose, switch to the menu …

»Phase settings« (page 148)

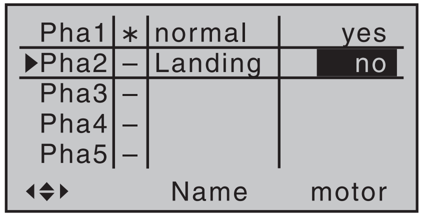
… and assign a meaningful name, such as “Normal”, from the list for “Phase 1” after activation of the selection field in the “Name” column. The asterisk in the second column indicates which phase is currently active. As long as no phase switch has been assigned, this is always Phase 1. “Phase 2” can be given, appropriate to the example, the name «Landing».

In the “ph.Tim” column you can assign a so-called flight phase timer for the measurement of the motor running time and/or the gliding times as necessary for each phase. You could, for example, assign one of the “Timers 1 … 3” to the “Normal” flight phase in order to measure the total motor runtime via the C1 stick:

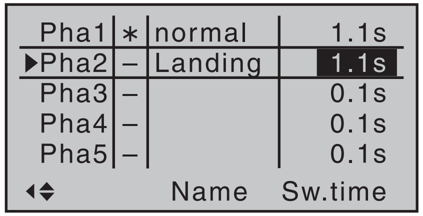
```
 Pha1 * normal    Clk 1
▶Pha2 – Landing
 Pha3 –
 Pha4 –
 Pha5 –
▲▼▶       Name     ph.Tim
```

Then the timer is controlled through a corresponding control switch to be defined on the C1 stick. As soon as you switch to the “Landing” flight phase, this flight phase timer is automatically stopped and hidden in the base screen. More about this can be found on page 162.

Now move the marker frame over the “ph.Tim” column to the “Motor” column to the right. Here you can decide with “yes/no” in which phase the motor is controlled by the throttle/brake stick and the brake system to be adjusted in the “Brake settings” sub-menu of the »**Wing mixers**« menu should be shut off (= “yes”) and vice versa (= “no”):



Now move the marker frame once more to the right and enter an appropriate switching time after activation of the value field of the “Sw.Time” column; for example:

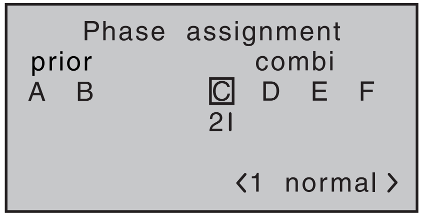


Then you must assigned these two flight phases to a switch with which you can switch between the two flight phases during the flight. In this case, a single switch is sufficient. It should be easy to reach, however, so that you can still switch between “motor” and “brake” during a landing approach, for example, without having to release a stick.

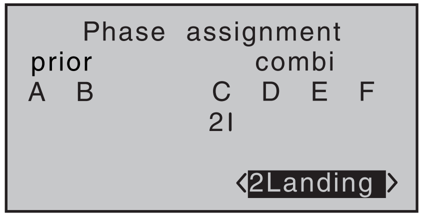
The assignment of the selected switch takes place in the menu …

»Phase assignment« (page 154)

Select the switch symbol under “C” with one of the selection keys. Following a brief tap on the centre **SET** key of the right four-way button, actuate the desired switch, e.g “2”.



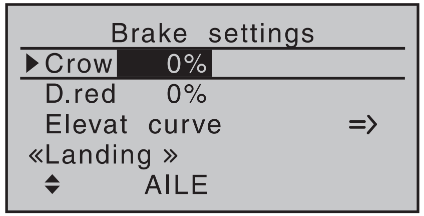
Both switch positions, in other words ON (I) and OFF ( ), are initially assigned at the bottom right of the display to phase «1 Normal». Select this value field with one of the selection keys then activate the phase selection list that was set up in the »**Phase settings**« menu with a brief tap on the centre **SET** key of the right four-way button. For example, you name the phase for the front switch position “normal” and “landing” for the rear position (or vice versa):



These phase names then appear in all flight-phase dependent menus and, of course, also in the base screen of the transmitter.

Now switch to the «**Landing**» flight phase and in the “Crow” line of the sub-menu …

»Brake settings« (page 180)



… of the »**Wing mixers**« menu, set the desired throw of the ailerons by actuation of the C1 stick (“brake”) upward. Then, if applicable, switch to the “FL” column in order to specify the desired through of the flaps with C1 actuation downward (hidden in the figure above). This flap position is referred to as “Crow position” or “Butterfly; see also page 180.

In the line “D.red” (differentiation reduction), enter a value which corresponds to the value entered or want to enter on the first page of the »**Wing mixers**« menu in the “Aile.diff.” line.

With the “Elevat curve” mixer the normally occurring “Upward tilting” of the model on the raising of the ailerons can be automatically suppressed. The suitable correction values for the respective value must be tested out through flight. Set this mixer so that the flight speed of the model does not change too much with the brake system extended in comparison with the “normal” flight speed. Otherwise, there is the risk, among other things, that the model plunges when the brake system is retracted, e. g. for the extension of a landing approach which is too short.

If everything is correctly set so far, only the motor is controlled with the C1 stick in the "Normal" flight phase, whereas this should be switched off in the flight phase "landing" (Servo 1 in »**Servo display**« independent of "Throttle min front/rear" to -100 % or adequately for a servo travel setting deviating by 100 %, if necessary). In this flight phase the C1 stick then only controls the raising of the ailerons and, if applicable, the lowering of the flaps with the neutral point in the C1 control position selected per offset.

Example 5

If, contrary to the assumptions of the preceding Example 4, the model has additional spoilers or only spoilers, they can be incorporated into the control of the model by means of the following programming.

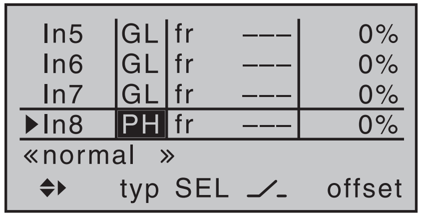
Do this by programming the menus »**Model type**«, »**Phase settings**« and »**Phase assignment**« in the same manner as described under Example 4. The settings described there in the "Brake settings" sub-menu of the »**Wing mixers**« menu are only then relevant if an additional crow system is to be employed in parallel with the spoilers.

With the settings described under Example 4, the control of the E-motor and, if applicable, that of a crow system will function as usual. Only the control of a spoiler connected to Output 8, for example, must additionally be programmed. For this purpose, switch to the menu …

»Control adjust« (page 112)

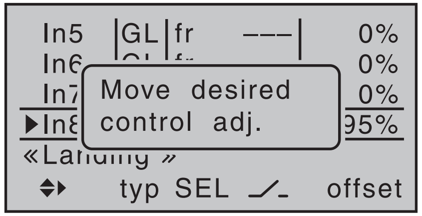
… and switch into the «**normal**» flight phase.

Now use the selection keys to switch to the left into the "typ" column to set the parameter in this line, e.g. "In8" from "GL(obal)" to "PH(ase)", so that the settings too follow become effective on a flight-phase specific basis.

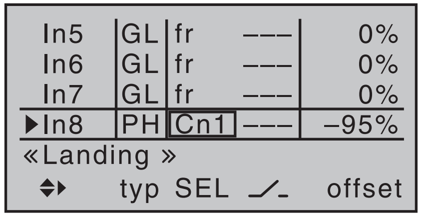


Afterward, switch to the "Offset" column and, following activation of the value field with a brief tap on the **SET** key of the right four-way button, change the offset value for this Input 8 value field now displayed in inverse video until the spoilers are again "retracted", e.g.:

Confirm this setting with a brief tap on the centre **ESC** key of the left or the centre **SET** key of the right four-way button then switch to the left into the column above **SEL**. Now switch to the flight phase «**Landing**» then briefly tap on the centre **SET** key of the right four-way button. The display shows the window …



Now move the C1 stick. As soon as this is recognized, "Cn1" will appear in the display instead of "fr":



Leave the offset value in this flight phase at "0 %". It may be necessary to change the leading symbol of the travel setting to reverse the control direction. Do this by switching the travel setting from +100 % to -100 % in the "trv" column.

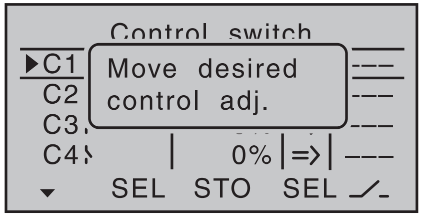
Now we are practically finished. Check the programming in the »**Servo display**« menu, which you can reach from the base screen of the transmitter as well as nearly every other menu position with a simultaneous tap on ◄ ► keys of the left four-way button. You will discover that "Servo 1" (motor control) is controlled in the "Normal" phase and in the "landing" phase only the spoiler is controlled at "Servo 8" and, if applicable the aileron and flap servos – just as we intended.

Timer confirmation with control or switch

If model programming is to be continued for **Example 4,** page 292, or **Example 5,** page 295, as described on previous pages or, completely independent of this example programming, the C1 stick (throttle/brake stick) is to be used for power regulation, then a control switch can be used to automatically start and stop the stopwatch. For this purpose, first switch to the menu …

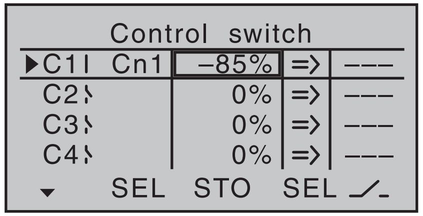
»Control switch« (page 141)

… and select the line of a control switch which has not been assigned yet with the selection keys. After activation of the control assignment with a brief tap on the centre **SET** key of the right four-way button, the following window will appear:



Now simply move the C1 stick (throttle/brake stick) from the motor "OFF" position in the motor "ON" direction.

Thereafter, change to the column above **STO** by using the appropriate selection key, move the C1 stick close to its motor "OFF" position then set the switch-point at the selected position with a brief tap on the centre **SET** key of the right four-way button. The switch's state will be displayed at the right of the control number, e. g.:



Note:

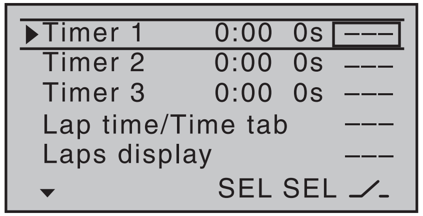
Do not, however, set a switching point at a transmitter control's travel end-point, since this makes reliable switching impossible.

Towards "full throttle" should now G1 be used here as example, "closed" and again "open" under setpoint. However, should this be the other way around the case, go to the column on the right-hand SEL and correct this by changing the shifting direction of "=>" in "<=".

To assign the newly created control switch the desired timer now, you have to change a timer programming according to example 4 and possibly according to example 5 in the menu ...

»Phase timers« (page 162)

..., And select by the selection keys, the line of the selected clock to, in this example "timer 1":



Note:

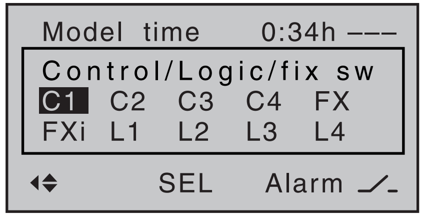
In the case described in these two examples, "switchable" use of the C1 stick flight phase timers for the separate measurement of the motor run and possibly gliding times must be used.

Otherwise, each operation of the C1 stick would have only one common time table stop described below as result. The assignment of the selected transmitter switch is as described below in »Timers (general.)".

Otherwise, go to the menu ...

»Timers (general)« (page 158)

… and select the line "Top" with the selection keys. This is the standard line assigned to the stopwatch. In this line, move the marker frame over the "Timer" column to the right, to the column above the switch symbol, using the appropriate selection key of the left or right four-way button. Now tap twice on the centre **SET** key of the right four-way button: The first tap will activate the "Switch assignment", the second tap will call up the list of "expanded switches":



Now select the previously programmed control switch, C1 in the example, and assign it to the timer with a brief tap on the centre **SET** key of the right four-way button:

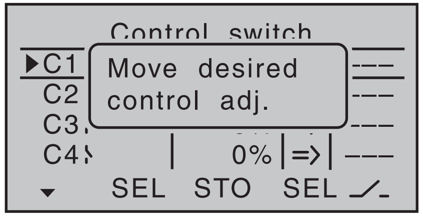
The timer in the base screen now starts with movement of the C1 stick toward full throttle and stops if you pull the C1 stick back over the switching point.

Example 1 of the preceding pages

If you have decided to continue with the model programming described on the previous pages in Example 1 on page 289, first switch to the menu …

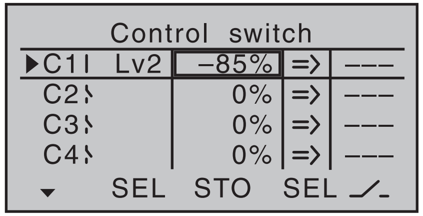
»Control switch« (page 141)

… and select the line of a control switch which has not been assigned yet with the selection keys. After activation of the control assignment with a brief tap on the centre **SET** key of the right four-way button, the following window will appear:



Now simply move the respective proportional control, e.g. the left side proportional rotary control from its motor "OFF" position toward the motor "ON" direction.

Thereafter, change to the column above **STO** by using the appropriate selection key, move the selected control near its motor "OFF" position then set the switch-point at the selected position with a brief tap on the centre **SET** key of the right four-way button. The switch status is shown to the right of the control number:



Note:

Do not, however, set a switching point at a transmitter control's travel end-point, since this makes reliable switching impossible.

C1 used in the example here should be "closed" in the "full throttle" direction and "open" below the switching point.

Towards "full throttle" should now G1 be used here as example, "closed" and again "open" under setpoint. However, should this be the other way around the case, go to the column on the right-hand SEL and correct this by changing the shifting direction of "=>" in "<=".

Now switch to the menu …

»Timers (general)« (page 158)

… and select the line "Top" with the selection keys. This is the standard line assigned to the stopwatch.

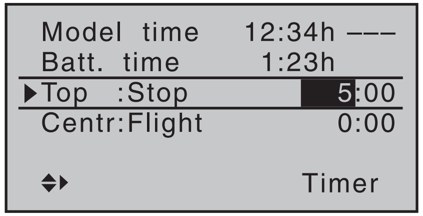
The stopwatch in the basic display now starts with movement of the proportional rotary control toward full throttle and stops if it is turned back again over the switch-point.

Examples 2 and 3 of the preceding pages

If you control your motor with a switch, on the other hand, you do not need the control switch described above. It is completely sufficient if you assign the same switch to the timer, so that it also begins to run when you switch on the motor.

Tip:

If the motor run time for an E-model is limited by the battery capacity, you can have the stopwatch count down. Enter the maximum permissible motor run time in the "Timer" column, e.g. "5 min", and shortly before expiration of permissible time, e.g. "30 s" before, have the transmitter issue an acoustic warning signal:



Parallel operating servos

A second servo running in parallel is often required, such as when brake flaps or spoilers installed in the wings or the left and right elevator or a double fin should be actuated by a servo or a large rudder flap should be simultaneously controlled by two servos due to high throw forces.

In principle, this task could also be solved by connecting the servos together on the model side using Y-cable. However, the disadvantage here is that servos combined in this manner can no longer be adjusted individually and separately from the transmitter – thus negating the potential for finely tuning respective servos to one another with a computerized remote control system. A similar situation is given for the so-called "Channel mapping" feature of the »**Telemetry**« menu. Here too there are certain limitations involved when compared to the transmitter's adjustment possibilities.

The first example, therefore, describes the coupling of two brake or spoiler servos, the second describes the operation of two or more throttle servos and the third describes the coupling of two elevator servos.

The "two rudder servos" example on the next page describes the coupling of two rudder servos, whereas Variant 1 is preferable for applications of this type because this solution is easier and quicker to program, using one of the »**Dual mixer**« menu, which is available on the mc-20 HoTT transmitter only. In contrast, the second variant, also described on the next page, additionally permits asymmetric and/or non-linear curves through use of the »**Free mixer**« menu.

Two brake or spoiler servos

In a situation where there is one installed servo for operation of brake flaps and/or spoilers in each wing half then the pre-set linear control characteristics for the »**Channel 1 curve**« menu should remain unchanged.

Then connect one of the two servos to Output 1, provided for this purpose by standard, and the second to an arbitrary free receiver connection 5 … 12 max., such as Output "8". Subsequently switch to the menu …

»Control adjust« (page 112)

… and, using the selection keys, assign "Control 1" in the Input 8 line :

In5	GL	fr	---	0%
In6	GL	fr	---	0%
In7	GL	fr	---	0%
▶In8	GL	Cn1	---	0%
	typ	SEL		offset

Since the spoiler on Output 1 can normally only be operated on a flight-phase independent basis, it is strongly recommended that the "Type" column for the input used is left at its "GL" ("global") default setting.

Also the remaining values should be left at their default settings. If necessary, carry out the required servo travel adjustments in the »**Servo adjustment**« menu (page 106). There you can also adjust the travel of servo 1 and 8 to one another, if necessary.

Multiple-motor aircraft

As described above, a model can also be operated with two or more motors.

The first throttle servo and/or the first motor control is connected as usual to (receiver) Output 1 and each additional throttle servo and/or each additional motor control is connected to a free (receiver) Output 6 … 12 max. The inputs of respective assigned control channels are then each assigned to Control 1; for example:

In8	GL	Cn1	---	0%
In9	GL	Cn1	---	0%
In10	GL	Cn1	---	0%
▶In11	GL	Cn1	---	0%
	typ	SEL		offset

The remaining values should be left at the default settings. If you need to adjust servo travels, it is better to use the »**Servo adjustment**« menu (page 106), where you can adjust the settings as required without having to switch menus.

Since the motor control unit should be available regardless of a currently active flight phase, make sure to leave the standard default "GL" ("global") in the "Type" column.

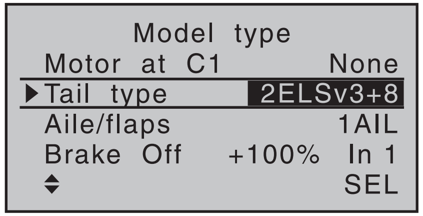
Two elevator servos

Two elevator servos should be switched in parallel. According to the receiver assignment plan, see page 65, the receiver output 8 is intended for the connection of the second elevator servo.

This would be taken into account on the software side in the pre-configuration of a corresponding mixer. You can find this in the …

»Model type« (page 98)

In this menu, switch to the “Tail type” line using the selection keys, activate the value field with a brief tap on the centre **SET** key of the right key pad then select the entry “2EL Sv 3+8”:



Then do the fine-tuning for travel of the two servos “in the now familiar manner” in the »**Servo adjustment**« menu (page 106).

Two rudders

We want to switch two rudders “in parallel”. The second rudder is located at the free receiver output 8.

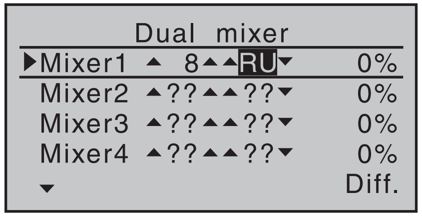
Variant 1

The basis of this variant, as already mentioned the on page 214, for the “normal” installation of the servos in the fuselage and their connection to the rudder. That is, both servos are parallel to each other vertically or horizontally mounted in the fuselage, and both rudders are either externally or internally connected in the same direction of rotation to the servo arm.

In the following menu…

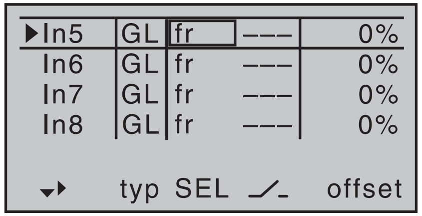
»Dual mixer« (page 214)

… on the mc-20 HoTT transmitter only select one of the dual-mixers and enter “8” and “RU” in its left and centre value fields, as shown in the figure:



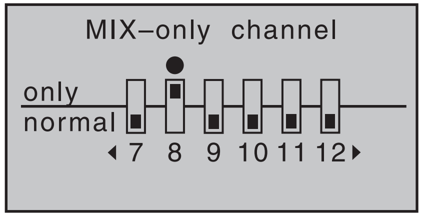
The same deflection “▲ ▲”, which would take place through “Input 8” must not have an effect here. Therefore, you should make absolutely sure in the …

»Control adjust« (page 112)



… menu, that “Input 8” “GL(obal)” is set to “free” so the control function is separate from the control channel over all flight phases.

Alternatively you can set Input 8 to “no transmitter control” *for all flight phases* in the »**Mix-only channel**« menu, which is available as standard on the mc-20 HoTT transmitter only, by setting channel 8 to “Mix-only”.

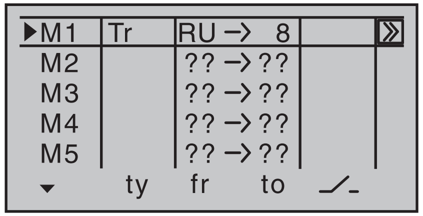


Variant 2

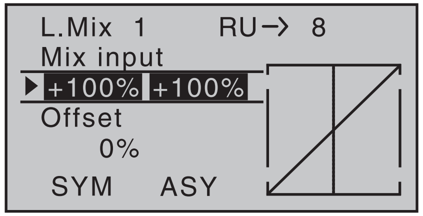
This variant uses the …

»Free mixers« (beginning on page 201)

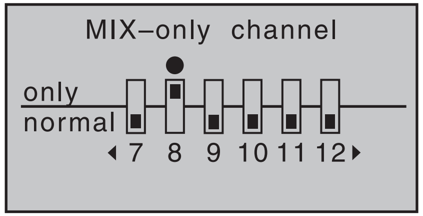
… menu to set a mixer “Tr RU → 8”. In the “ty(pe)” column, select the setting “Tr” so that the rudder trimming affects both rudder servos:



Afterwards, switch to the graphic screen and set a symmetric mix of +100 %:



Here too, “Input 8” should also be programmed – if applicable, for all flight phases – to “free” by way of the »**Control adjust**« menu. However, it is simpler to separate control function “8” from control channel “8” using the »**Mix-only channel**« menu – see page 212. This applies to all flight phases, and is available as standard on the mc-20 HoTT transmitter only.



Up to 7 different flight phases (flight conditions) can be programmed with settings independent of one another within each the model memory.

Each of these flight phases can be called with a switch or a switch combination. This makes it possible to program different settings for various flight states, such as «Normal», «Thermal», «Speed», «Distance», etc., then make in-flight changeovers in a most convenient manner. However, with the flight phase programming you can also make slight modifications, e. g. of mixers, to try out by switching during the flight in order to find the optimal settings for each model more easily.

However, as owner of an mc-20 HoTT you really should think about the use of flight phases even before you start the actual programming procedure, and consider whether you wish to be able to adjust the digital trims for aileron, elevator and rudder separately in each flight phase – this is the default "PH(ase)" setting – or whether you want them to take effect in all flight phases – the alternative "GL(obal)" setting.

If you decide in favour of a phase-specific trimming of the rudder, for example, switch the menu …

»Stick mode« (page 108)

… and change the standard "GL(obal)" default accordingly:

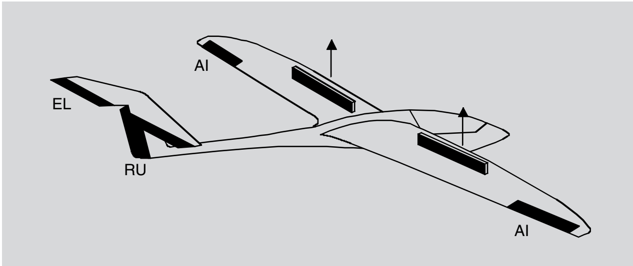
Ch.1	GL	4	0.0s	0.0s
Aile	PH	4	0.0s	0.0s
Elev	PH	4	0.0s	0.0s
▶Rudd	GL	4	0.0s	0.0s
▾		Tr	St	– time +

The same applies for the number of trimming steps in the "Tr" column:

Ch.1	GL	4	0.0s	0.0s
Aile	PH	4	0.0s	0.0s
Elev	PH	4	0.0s	0.0s
▶Rudd	GL	4	0.0s	0.0s
▾		Tr	St	– time +

Example 1 …

… continuing with the previous programming of an electric glider with 2 aileron servos.



Control of the electric motor is accomplished, independent of the C1 stick, with one of the two side proportional rotary controls or one of the two standard 3-way switches mounted into the switch panels. The motor's speed control is connected to receiver output 8 as described on page 289 and continued in Examples 1 and 2. This is why "none" was selected for the "Motor on C1" line in the »**Model type**« menu. This not only causes the column "Motor" in the »**Phase settings**« menu to be unavailable but also allows all options to be available without restriction in the "Brake settings" submenu of the »**Wing mixers**« menu.

1st Step

»Phase settings« (page 148)

Initially, one or more multiple flight phases are provided with a specific identification ("Name") for the respective flight status. This identification has no influence on the programming of the transmitter; it only serves for an improved differentiation of the individual flight phases and is shown later in all flight-phase dependent menus and in the base screen.

The selection of the respective line, a name and the setting of the switchover time is done in the "usual" manner, with a tap on the appropriate key(s) of the two four-way buttons.

Pha1	*	normal	
Pha2	–	Thermal	
Pha3	–	Speed	
▶Pha4	–	Launch	
Pha5	–		
⇕▶		Name	ph.Tim

<u>Note:</u>

With the exception of Phase 1, which should always be assigned with the name "Normal" since it is always active, if the flight phases are deactivated, it is completely irrelevant which name is assigned to which phase!

In everyday use by a model pilot, three to a maximum of four flight phases are usually completely sufficient:

- "Start" with the climb settings
- "Thermal" for "Flying high",
- "Normal" for normal conditions and
- "Speed" for high gear.

In the "Sw.time" column (switching time).

a "blend-in" time can be established for the time in which a changeover from any other flight phase into this given flight-phase is to be accomplished in order to permit a “smooth” transition for different servo positions.

Pha1	∗	normal	4.0s
Pha2	+	Thermal	3.0s
Pha3	+	Speed	2.0s
▶Pha4	+	Launch	1.0s
Pha5	–		0.1s
◂⬍		Name	Sw.time

Thus, an increased stress of the model under certain circumstances with a “hard” change of rudder or flap positions, for example, is prevented. The “Status” column shows you the currently active flight phase with an asterisk “∗”.

2nd Step

In order to actually be able to switch between the individual flight phases, the assignment of one or multiple switches is necessary. Either one of the two three-way switches is ideally suited for switching between up to three flight phases.

Each of the two switch end positions *starting from the centre position* will be assigned to one of the flight phase switches A … F. The assignment of the switch takes place in the menu …

»Phase assignment« (page 154)

First select “C” with the marker frame. Then briefly tap on the centre **SET** key of the right four-way button and move the switch from its centre position to one of its end-positions, for example, forward:

```
     Phase  assignment
prior             combi
A   B          [C]  D   E   F
                6I
                   ‹1  normal ›
```

Move the switch back to the centre position and then select “D”, and after activation of the switch assignment, move the switch to the other limit position, for example, back:

```
     Phase  assignment
prior             combi
A   B          C  [D]  E   F
               6⌇  5I
                   ‹1  normal ›
```

Now the 3-way switch is programmed.

Now and additional switch could be assigned for the “start” flight phase, if applicable. In this case under “A”, so that the “start” phase is always switched to from every other flight phase in parallel to the switching-on of the motor:

```
     Phase  assignment
prior             combi
[A]  B          C   D   E   F
7I              6⌇  5⌇
                   ‹1  normal ›
```

The given switch positions must then be assigned to respective flight phases (names). Although some flight phases have already been assigned to names, the phase name «1 Normal» will always initially appear at the right in the display; see the figures above.

First move the 3-way switch to one of its limit positions, for example to the back, and switch with the marker frame in the display down to the right to set the flight phase name. Briefly tap on the centre **SET** key of the right four-way button to activate the entry field then select the desired flight phase for this switch position, in this example «2 Thermal», with the selection keys:

```
     Phase  assignment
prior             combi
A   B          C   D   E   F
7⌇             6⌇  5I
                  ‹2 Thermal›
```

Proceed in the same manner for the other switch limit position, which is assigned the name “3 Speed”.

If applicable move Switch 2 and assign this switch combination the name “4 Start”.

A brief tap on the centre **ESC** of the left four-way button or the centre **SET** key of the right four-way button will complete the phase name assignment.

The flight-phase dependent model settings made before the assignment of phase switches are now in the flight phase «1 Normal». This is the phase which is called with the open «Start» switch in the centre position of the 3-way switch.

3rd Step

In order to not have to carry out all previously made settings for the model in the “new” flight phase from the ground up, we recommend first copying the already tested programming of the flight phase “Normal” to the other flight phases. This is carried out in the menu …

»Copy / Erase« (page 72)

```
 Erase model            =>
 Copy model–>model      =>
 Export to SD           =>
 Import from SD         =>
▶Copy flight phase      =>
```

Here, select the “Copy flight phase” menu item with the selection keys then briefly tap the centre **SET** key of the right four-way button.

In the window which now appears, “Copy from phase”, “1 Normal” is selected …

```
Copy  from  phase:
1 normal       2 Thermal
3 Speed        4 Launch
5              6
7
```

… and a subsequent brief tap on the centre **SET** key of the right four-way button will change the display to “Copy to phase”. Now the target is to be selected (initially “2 Thermal”) and confirmed by another tap on the centre **SET** key of the right four-way button. After confirmation of the subsequent safety query, all settings are copied according to the selection.

Proceed in the same manner with the other two phases (“1 Normal” to “3 Speed” and “1 Normal” to “4 Start”).

4th Step

Now three or four phases are programmed, the settings are also copied and there is even a “soft” transfer, but … there are still no flight-phase specific settings.

Now, if applicable, in order to adapt the flap positions to the different requirements of the individual flight phases, in the menu …

»Phase trim« (page 156)

Starting from the “normal” flight phase, switch to one of the other flight phases, whose name will appear at bottom left in accordance with the switch position; for example, the «Thermal» phase.

Now move the marker frame to the “▲ AIL ▲” column, and enter any settings for the ailerons which differ from the “normal” flight phase. Both positive and negative changes to travel are possible. Enter these settings separately for each flight phase, for example:

```
 Normal        0%     0%
 Thermal       0%    –7%
 Speed         0%    +5%
*Launch        0%   –11%
 «Launch  »
           ELEV  ▲ AI ▲
```

5th Step

Any necessary phase-specific trimming of the elevator is made with the help of the digital trimming of the elevator stick.

Important note:

This is true provided that you have left at least the elevator trim at the standard “Phase” setting in the »Stick mode« menu, which is available as standard on the mc-20 HoTT transmitter only, as shown at the start of the programming example.

Alternatively, these settings can also be made in the »Phase trim« menu …

6th Step

In the menu …

»Wing mixers« (beginning on page 166)

… the flight phase name of the newly activated flight phase appears at the bottom edge of the display. If the switch position is now changed, the name of the flight phase selected with the switch appears, but with the previously copied settings of the flight phase “Normal”. Here you set your values phase-specifically for the aileron differentiation, the share of the mixture of transverse to side, and if applicable, also a mixture of altitude to transverse. (The latter increases the agility over the transverse axis when “Turning”.)

```
       Wing  mixer
 Brake  settings       =>
 Aile.diff.         33%
 AI  -> RU          55% ---
▶EL  -> FL     0%    0% ---
    «Thermal»
```

Note:

*The list of displayed options depends on the number of servos entered in the “Ailerons/flaps” line in the »**Model type**« menu, in this example “2 AIL”.*

Now switch to the sub-menu …

… and enter the raised height of aileron brakes for individual flight phases in the “Crow” line.

With “D.red” (differentiation reduction), you should enter the value previously set in the aileron differentiation line in order to suppress it again while breaking. About it please refere to the page 182

In the “Elevat. curve” sub-menu, enter a correction value for the elevator, see page 156.

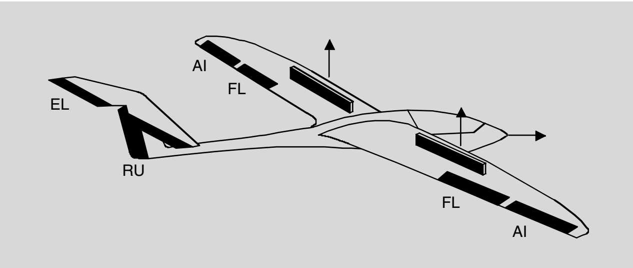
```
    Brake  settings
 Crow  +30%
 D.red  +33%
▶Elevat  curve        =>
«normal»
 ⬍        AILE         
```

Note:

*The “Brake settings” sub-menu of the »**Wing mixers**« menu is switched “off” when: for the “Motor at C1 front/rear” column of the »**Model type**« menu, page 98, AND for the “Motor” column of the »**Phase settings**« menu, page 148, a “yes” is entered for the currently active flight phase. Change the flight phase, if applicable.*

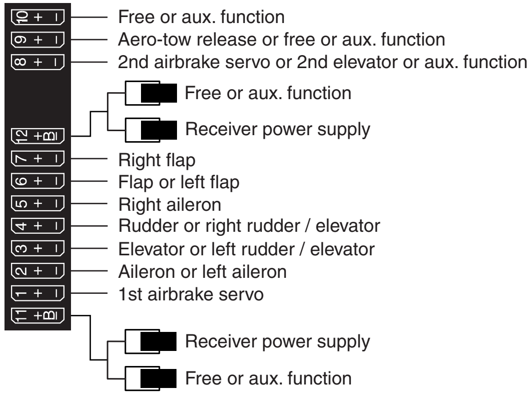
Example 2

Glider with four flap wings, two large flaps and tow coupling



The following example is based on the assumption that you have already mechanically pre-adjusted the model and you have already ensured the correct deflection of all rudders or checked this again in the scope of this programming and made adjustments, if applicable, through servo switching at the receiver and/or through the »**Servo adjustment**« menu.

This programming example is based on an assignment of the receiver connections in accordance with the following diagram:



Begin with the new programming of the model in a free model memory location.

Essentially, the »**Base setup model**« menu, beginning on page 78, is used to bind the receiver to the transmitter. Enter a model name and select or review the selection of appropriate stick mode. Later on this menu will also be used to activate the range test before the start of flight operations.

In the menu …

»Model type« (page 98)

…leave "Motor at C1" at "none", and the tail type at "normal". However, set "2 AIL 2 FL" in the "Aileron/flaps" line.

In the "Brake offset" line program or leave "In1", because the two brake or spoiler servos connected to 1 + 8 will eventually be controlled by the C1 stick, in addition to the butterfly (crow) braking system which is set up in the "Brake settings" sub-menu of the »**Wing mixer**« menu:

```
      Model  type
 Motor  at  C1        None
 Tail  type         Normal
 Aile/flaps        2AIL2FL
►Brake  Off    –90%   In 1
                STO   SEL
```

The setting in the "Brake Offset" value field defines the neutral position of all mixers specified by the "Brake settings" sub-menu of the »**Wing mixers**« menu. Place this neutral point at approx. +90 %, insofar as the brake system should be retracted in the front position of the C1 stick.

The remaining path between +90 % and the full throw of the sticks, +100 %, is then assigned as idle travel.

This assures that the rudders or flaps addressed by the mixers of "Brake settings" remain in their "normal" positions even for slight deviations from the limit position of the C1 control. At the same time, the effective control path is automatically spread to 100 %.

In the menu …

»Control adjust« (page 112)

… assign a switch, for example In 9, to operate the aero-tow coupling. In order for this switch to work independently of the flight phase, leave the standard default "GL" in the "type" column of this input. With "– Travel +" you can adjust the control travel for the switching of the switch:

```
 In6  GL fr   –––     0%
 In7  GL fr   –––     0%
 In8  GL fr   –––     0%
►In9  GL –––    8     0%

      typ               offset
```

With a simultaneous tap on the ◄ ► keys of the left four-way button, the setting can be checked in the »**Servo display**«.

Since the C1 control should actuate Servo 8 simultaneously with Servo 1, establish this link by way of the »**Control adjust**« menu.

For this reason, also switch to the line before and assign "Control 1" to Input 8.

```
 In6  GL fr   –––     0%
 In7  GL fr   –––     0%
►In8  GL Cn1  –––     0%
 In9  GL –––    8     0%

      typ  SEL          offset
```

However, please note in this connection, that a non-linear control curve programmed in the »**Channel 1 curve**« menu has as little effect on this input as brake offset set to less than 100 %, which you can check very easily in the »**Servo display**« menu. You can reach this from nearly every menu position with a simultaneous tap on the ◄ ► keys of the left touch pad:

The travel, and if applicable also the direction of rotation, for spoiler servo 1 as well as the second spoiler servo connected to Output 8 can be adjusted in the menu …

»Servo adjustment« (page 106)

```
►S1 =>    0% 100% 100%
 S2 =>    0% 100% 100%
 S3 =>    0% 100% 100%
 S4 =>    0% 100% 100%
 S5 =>    0% 100% 100%
 ▼► Rev  cent   –  trv  +
```

In the Multi-flap menu of the …

»Wing mixers« (beginning on page 166)

… you now enter the first mixer values for the four wing flaps; for example:

```
  ▲ AI ▼       +100%
 Ail-tr        +100%
►Diff.          +50%
 fl.pos           0%

 ▲▼►            AILE
```

```
  ▲ AI ▼        +66%
 Ail-tr         +66%
►Diff.          +33%
 fl.pos           0%

 ◄▲▼            FLAP
```

Note:

The parameter values shown here are model-dependent and must be determined by test flights.

In the line…

- **▲AI▼**

  … determines the percentage share with which the two flap pairs "AI" and "FL" are to respond to *aileron steering*. Also check whether the ailerons are deflected in the right direction during the adjustment of the parameter values.

  The adjustment range from ±150 % enables the correct throw direction adjustment regardless of the direction of rotation of the servos.

- **AI-Tr.**

  … determines the percentage share with which *aileron trimming* should effect the AI and FL.

- **Diff.**

  … the entry to specify *aileron steering differentiation* for AI and FL flaps is made here. Refer to page 168 about the significance of differentiation.

  The adjustment range from ±100 % enables the correct differentiation direction adjustment regardless of the direction of rotation of the aileron and flap servos.

- **FL-Pos.**

  The flight-phase specific positions for all camber flaps present on the given model are set in this line.

  In the process, you can determine the positions the flaps assume for each flight phase.

  Note:

  *The values appearing in this line are based on the same data set as in the comparable position in the »**Phase trim**« menu, which is why changes always take effect in both directions.*

- **▲FL▲**

  Since all inputs in the »**Control adjust**« menu are set to "free" by default, neither the ailerons nor the camber flaps can be operated with these default settings. In this respect, you also leave the default entry here.

  However, if flap positions are to be varied with a switch or proportional control by the position specified in the "FL-Pos." line, assign the desired control to Input 6 in the »**Control adjust**« menu and set the desired reaction to the movement of the control selected for this purpose by way of a percentage in this line.

- **EL → FL**

  This mixer induces a partial reaction from aileron (AI) and camber flaps (FL) during elevator activation.

  The mixing direction is to be selected so that all flaps are deflected downward with the elevator pulled up and deflected upward with the elevator pushed down (= hydroplane). The mix proportion is normally in the low double-digit range.

- **EL → FL Off.**

  In the "EL → FL" line you may have entered a value to amplify the effect of elevator commands in tight turns and aerobatics. In this "EL → FL offset" line you can enter an Offset value which determines the "onset point" of the flaps when elevator is applied:

- If you leave the Offset value at 0 %, the flaps follow the travel of the elevator from the neutral point of the elevator stick, at the percentage rate set in the “EL ➔ FL” line.
- If you set an Offset value other than 0 %, the flaps only follow the travel of the elevator in the “down” and “up” direction after the elevator command has reached the selected Offset point.

Now, within the »**Wing mixers**« menu, switch to the “Brake settings” …

```
     Brake  settings
  Crow  +44%  +66%
  D.red +77%  +55%
 ▶Elevat  curve       =>
```

<u>*Note:*</u>

*The “Brake settings” menu is switched “off” if: “Motor on C1 forward / back” in the »**Model type**« menu, page 98, AND the “Motor” column of the »**Phase settings**« menu, page 148, are set to “yes” for the currently active flight phase. Change the flight phase, if applicable.*

- **Crow**

  In the menu “Model type” (page 100), we have set the C1 stick for the airbrake control. Further above in this text section, the C1 stick was set for brake system steering.

  In this line you determine the share with which the AI and FL should be included on actuation of C1 in the manner that both ailerons are deflected “slightly” upward and both flaps are deflected as far downward as possible.

  Now with a simultaneous tap on the ◄ ► keys of the left four-way button, a change to the »**Servo display**« menu can be affected for observation of servo movements and, in particular, to ensure that no influence on the flaps takes place above the adjusted brake offset, e. g. +90 % and beyond to the throw limit of the C1 control (“Idle travel” of the C1 stick).
- **D.red**

  The value previously entered into the aileron differentiation line should also be entered in this “Differentiation reduction” line to fade this out during braking.
- **Elevat. curve**

  This line is used for the entry of any correction factor that may be required for the elevator, see page 182.

Insofar as necessary, again check all flap throws and, by way of the »**Servo adjustment**« menu (page 106), adjust the servo centre, the servo travel and the travel limit.

It may also be time to start the initial flight testing, insofar as all global settings – that is to say, all flight-phase independent settings – are completed.

Two additional flight phases are now to be set up below, each of which requires a somewhat different flap position.

Therefore, switch to the menu …

»Phase settings« (page 148)

… and activate the assignment of phase names in the “Name” column with a brief tap on the centre **SET** key of the right four-way button:

```
▶Pha1 ∗
 Pha2 –
 Pha3 –
 Pha4 –
 Pha5 –
          Name    ph.Tim
```

Now give Phase 1 – the “Normal phase” – that is also the phase which includes the previous settings, the name “Normal”, which you select from a list with the selection keys.

Phase 2 is given the name “Thermal” and Phase 3 is given the name “Speed”. Now conclude the entries with a brief tap on the **ESC** key of the left four-way button or the **SET** key of the right four-way button:

```
 Pha1 ∗ normal
 Pha2 – Thermal
▶Pha3 – Speed
 Pha4 –
 Pha5 –
          Name    ph.Tim
```

Now move the marker frame beyond the “ph.Tim” column to the right into the column “Sw. time” and set a “switching time” from any other phase into the given phase in order to avoid an abrupt phase change; in other words to avoid erratic changes of flap positions. Now try out different switching times. In this example we have specified 1 s in each case:

```
 Pha1 ∗ normal     1.0s
 Pha2 – Thermal    1.0s
▶Pha3 – Speed      1.0s
 Pha4 –            0.1s
 Pha5 –            0.1s
          Name    Sw.time
```

Whether or not one of the phases 1 … 7 currently has an assigned switch and the state of the switch can be seen in the "status" column at the second column from left:

Symbol	Meaning
–	No switch assigned
+	Phase can be called via switch
∗	Indicates the currently active phase

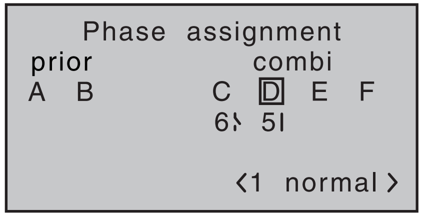
Since, except for phase 1, all other phases are still designated with a "–" symbol, now switch in the menu …

»Phase assignment« (page 154)

… and assign the previously defined flight phases to appropriate switches with which a selection from among three phases is possible.

Since there is no particular priority here, assign for example switch "C" in the display to one of the two end settings of one of the two 3-way switches.

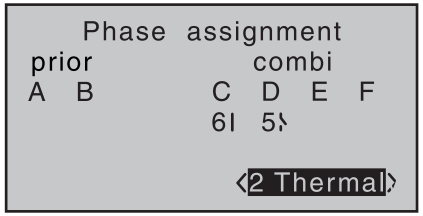
Thus activating the switch assignment as described in "transmitter controls, switches and control switch assignments" on page 60 and assign the selected switch from the middle position. Afterward put the selected switch again into its middle position, activate the switch assignment under "D" then move the selected 3-way switch again out of its middle position and into the other end position, as shown below:

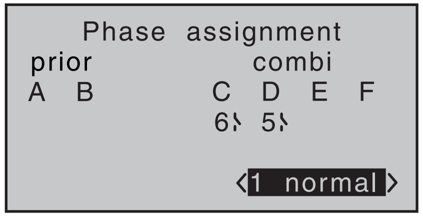


After the switch assignment is complete, use the selection keys to switch to the bottom right and activate the assignment of phase names with a brief tap on the centre **SET** key of the right four-way button.

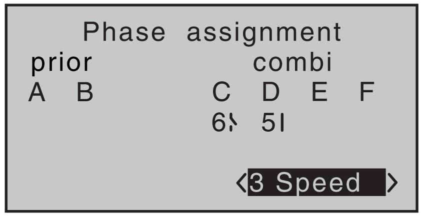
Now close for example switch "6" by moving the selected 3-way switch forward.

Assign the name "<2 Thermal>" to this switch position and leave the name of its "OFF" position as "<1 normal>".





Finally, move the 3-way switch to the rear toward "5"-position and assign this switch position the name "<3 Speed>":

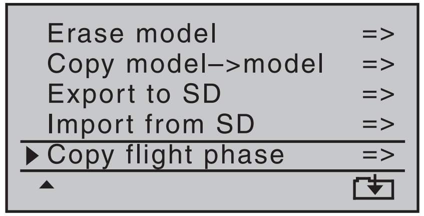


The phase names selected in the programming are now shown, depending on the switch status, in all flight-phase dependent menus, see the table on page 146.

Since we have already made some settings in flight-phase dependent menus, such as in the »**Wing mixers**« menu, we will now copy these settings to the «Thermal» flight phase. For this purpose, open the menu …

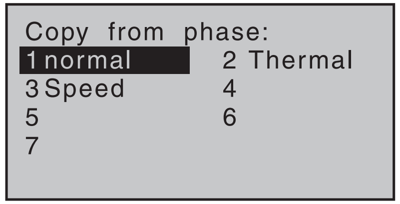
»Copy/Erase« (page 72)

… and switch to the "Copy flight phase" line:



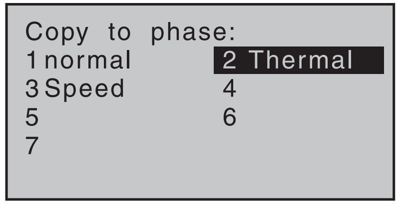
All seven possible flight phases are listed in "Copy from phase":

Select the flight phase to be copied, e. g. "1 Normal".



With a brief tap on the centre **SET** key of the right four-way button, switch the window to entry of the target memory "Copy to phase".

Select phase "2 Thermal" as the target:



Confirm the selection with a brief tap on the centre **SET** key of the right four-way button.

A security query follows, who should be confirmed with "Yes":

```
      Phase  to:
1 Normal    → 2 Thermal
 to  be  copied?

      NO        YES
```

Then repeat the process with flight phase “3 Speed”.

Now we will program the required settings in the flight phase “Thermal” as an example.

In order to vary camber flap positions in the «Thermal» phase, it is merely necessary to switch over to the menu …

»Control adjust« (page 112)

… then change Input 6 – as described beginning on page beginning on page 112 – from “GL(obal)” to “PH(ase)” and finally assign it to an operating element.

To do this, first use the selection keys to switch into the “typ” column for “In6” and change this setting from “GL” to “PH”:

```
▶In6  |PH|fr    ---|     0%
 In7  |GL|fr    ---|     0%
 In8  |GL|Cn1   ---|     0%
 In9  |GL|---    8▘|     0%
«Thermal»
 ⇕▸     typ  SEL  ⁄      offset
```

Thereafter change one column to the right into the column above **SEL** …

```
▶In6  |PH|fr    ---|     0%
 In7  |GL|fr    ---|     0%
 In8  |GL|Cn1   ---|     0%
 In9  |GL|---    8▘|     0%
«Thermal»
 ⇕▸     typ  SEL  ⁄      offset
```

… and now assign this input, as described in the section “Physical control, switch and control switch assignments” on page 60, the left proportional slider in the middle console to, for example:

```
▶In6  |PH|Lv1   ---|     0%
 In7  |GL|fr    ---|     0%
 In8  |GL|Cn1   ---|     0%
 In9  |GL|---    8▘|     0%
«Thermal»
 ⇕▸     typ  SEL  ⁄      offset
```

This control will allow the ailerons (2 + 5) and camber flaps (6 + 7) to be continuously adjusted (as camber flaps) with a mixer ratio yet to be set via the »**Wing mixers**« menu.

If you assign the still free second three-stage switch to Input 6 instead, you can call three different FL positions of the ailerons (AIL) and camber changing flaps (FL) as well as three elevator positions (Elev) in the “Thermal” flight phase, see the following page. (These three switch positions correspond to the centre position and the two limit positions of the previously mentioned proportional rotary control.)

Note:

*The FL and AIL flap positions in the two limit switch positions or in the switch centre depend on the value set in the column “- trv +” as well as the offset value and the mixer proportion set in the “Multi-flap menu” of the »**Wing mixers**« menu, see further below.*

Leave the (control) “- trv +” at its standard symmetric settings of +100 % and the offset value at 0 %. Specifying a symmetric or asymmetric time for smooth switching between the three switch positions – in the example “1.2 s 1.2 s” – in the column “- time +” is recommended:

```
▶In6  |    1.2s       1.2s
 In7  |    0.0s       0.0s
 In8  |    0.0s       0.0s
 In9  |    0.0s       0.0s
«Thermal»
 ◂⇕              – time +
```

In the “Multi-flap menu” of the …

»Wing mixers« (beginning on page 166)

… menu, subsequently change only the values for “FL. pos” and “▲FL▲” in the «Thermal» flight phase:

- **FL.pos**
  It is here that AILE and FLAP positioning takes place during the «Thermal» flight phase in the event that the assigned control (proportional control or 3-way switch) is in its neutral or middle position:

```
 ▲ AI ▼          +100%
 Ail-tr          +100%
 Diff.            +55%
▶fl.pos          [ –9%]
«Thermal»
 ⇕▶               AILE
```

- **▲FL▲**
  Enter in this line the share of influence for aileron and camber flap servos, when used as camber flaps, is to be produced by the selected control (see above) or 3-way switch. Be sure to set these values low enough that the flaps can be controlled with appropriate sensitivity, for example:

```
 Ail-tr          +100%
 Diff.            +55%
 fl.pos            –9%
▶ ▲FL▲    [+10%] [+10%]
«Thermal»
 ⇕▶               AILE
```

```
 Ail-tr           +60%
 Diff.            +33%
 fl.pos           –14%
▶ ▲FL▲    [+15%] [+15%]
«Thermal»
 ◀⇕               FLAP
```

A simultaneous tap on the ▲▼ or ◀ ▶ key combination of the right four-way button (**CLEAR**) will reset changed values back to their standard default values.

<u>*Note:*</u>

Due to the improved lift distribution, the degree of mix ratios should be set so that the camber flaps are slightly "lower" than the ailerons.

With a simultaneous tap on the ◀ ▶ keys of the left four-way button, the reaction of the AILE and FLAP servos can be checked in the »**Servo display**« by actuation of the selected camber flap control. (Push the C1 stick to the front position so that the "AILE" and "FLAP" positions can be better followed on actuation of the corresponding control.)

<u>***Caution:***</u>

With aileron actuation the bars of the »Servo display« move in the same manner, for camber flap actuation they will move in the opposite manner.

- In the control's middle position, the – example's – "FL-pos." setting only has a -9 % effect for the AI and -11 % for the FL.
- In one transmitter control end-position, AILE and FLAP are again closer to the neutral position because the mix ratio specified in the example reduces the FL.pos setting, whereas …
- … in the other limit position, AILE and FLAP reach the maximum downward offset prescribed by the mixer percentage.

In order to set a – corrective – admix for the elevator, exit the "Multi-flap menu" and return to the base screen of the »**Wing mixers**« menu:

```
       Wing  mixer
 Multi-flap  menu      =>
 Brake  settings       =>
 AI  -> RU          0% ---
▶FL  -> EL  [+5%  +5%]---
 ▲    «Thermal»
```

In the two limit positions of the three-stage switch the elevator is moved symmetrically in this example with +5 % (true to side). If, on the other hand, you use a proportional control, the elevator is deflected according to the degree for the control position.

Then make the settings for the "Speed" flight phase in the same manner.

<u>*Notes:*</u>

- *The digital trims for aileron, elevator and rudder are always "phase-specific" in operation at standard, regardless of these settings.*
- *The current positions of the INC/DEC buttons, CTL 5 + 6, which may be assigned to inputs 5 …8 or 5 … 12, are stored in accordance with your preference entered in the "Type" line, i. e. the positions are not lost when you switch flight phases, nor even when you change models.*
  The particular advantage of these two transmitter controls – which are fitted to the mc-20 HoTT transmitter only – lies in the fact that you can use one and the same INC/DEC button as trim controls in all the programmed flight phases, but – in contrast to a position-related proportional control – the trim values are retained even if you switch models.
- *All settings vary by model. Make the settings on your finished model or during the flight.*

Control of temporal processes
using time delay and curve mixers

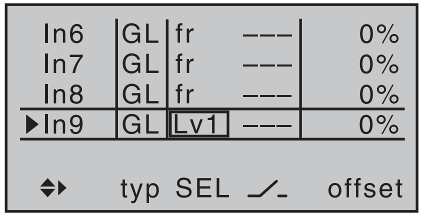
An interesting, but little known, facility included in the software of the »**MIX-only channel**« and «**Channel sequencer**« options, of the mc-20 HoTT transmitter, is the ability to set up virtually any servo movement to last up to 9.9 seconds via a switch, in addition to the features available in the »**Channel sequencer**« menu; see page 254.

The programming for this should be shown on the basis of some examples in the following. Additional applications can certainly be found once you become familiar with these capabilities.

The programming is begin in the menu …

»Control adjust« (page 112 or 116)

… and in order to be able to approach any point of the control curve during the programming, first assign one of the proportional controls to the desired control channel – in this example the side-mounted left proportional slider "Lv1" to the Input 9. However, leave the standard default "GL" in the "typ(e)" column so that this setting is effective for all flight phases analogously to the free mixers to be programmed in the following:



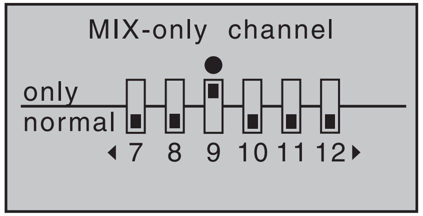
However, if necessary you can create phase-specific sequences using the "PH" option in the »**Control adjust**« menu, and the »**Mix active / phase**« menu; see page 211.

The input of a time delay in the "- time +" column most right should also be dispensed with initially:

Then in the menu …

»Mix-only Channel« (page 212)

… of the selected control channel, "9" in this case, is set to "only":

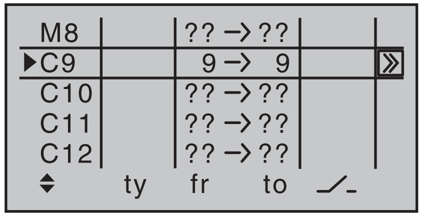


It is mandatory that this is set to "only (MIX)", because the control curves of the curve mixers described in the following example only function on the output of the same channel as desired if there is no direct connection between the control and output! Only then can the linear control signal be manipulated almost arbitrarily around a curve mixer and to the appropriate output.

Therefore, in the next step, switch to the menu …

»Free mixers« (beginning on page 201)

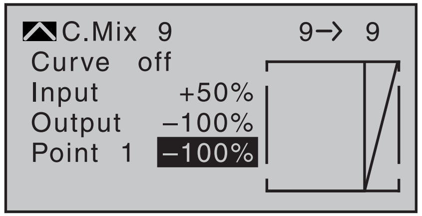
… and program a curve mixer for the same channel, e. g. from "9" to "9":



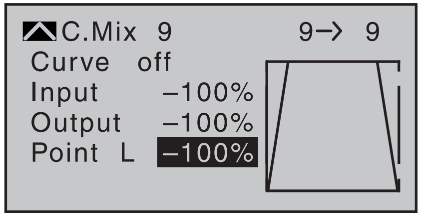
On this second screen the desired path of the control curve is then set, whereby the following examples should only be "food for thought" for the design of your own control curves.

For example, the control curve could be for …

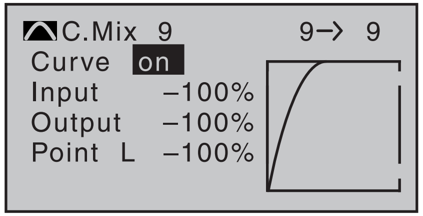
… delayed lighting of a headlight after the beginning of the extension of the landing gear:



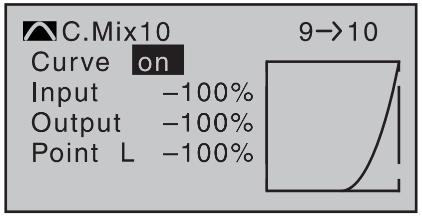
… the control of a landing gear flap which closes again after the landing gear is extended:



… a smooth motor start-up or the extension of a self-launch …



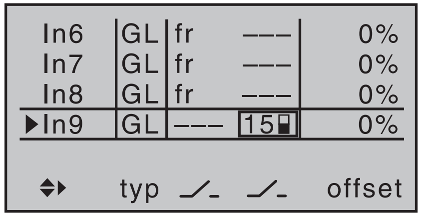
… triggered by the same switch, but with a delayed startup of the drive motor connected to Output 10:

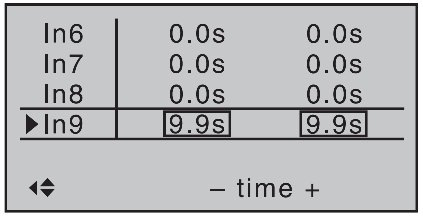


The function you programmed functions as desired according to these suggestions – which you can verify at any time after switching to the »**Servo display**« by simultaneously pressing the keys ◄ ► of the left four-way button – then to, complete the programming, an arbitrary switch, such as "SW 15" is assigned in the menu …

»Control adjust« (page 112 or 116)

… to the control channel used instead of the selected side-mounted proportional control – in these examples "Lv1" to channel "9" – and the desired symmetric or asymmetric time span is set in the "– Time +" column for the amount of time in which the function should ultimately take place:



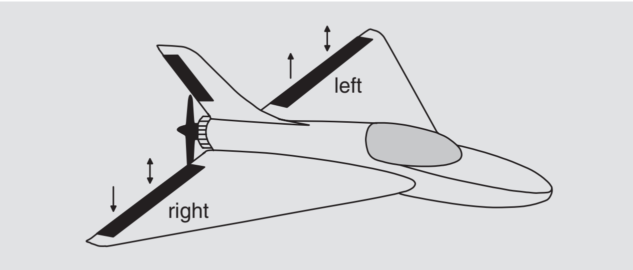


Notice:

In the course of the switch assignment, always bear in mind that you can also trigger multiple functions with one switch! For example, with the same switch a landing gear connected to Output 6 can be started and, as shown here as an example, the time-controlled landing gear flaps connected to Output 9 and/or the headlight, etc.

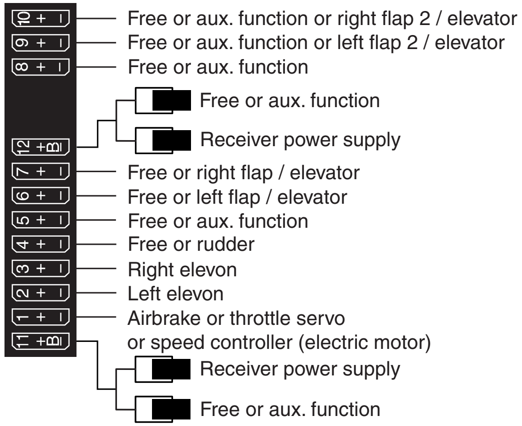
Delta and flying wing

Of course, the general comments regarding the installation and the adjustment of the RC system to a model at the beginning of the wing model programming on page 278 also applies for delta and flying wing models! Similarly, the comments for test flying and fine-tuning the settings to the programming of flight phases also apply.



Delta and flying wing models differ significantly from a "normal" flight model due to their unique characteristic shape and geometry. The differences in the servo arrangement, on the other hand, are more subtle. For example, with "classic" delta/flying wing models, only two rudders are normally provided. They are responsible for both "transverse" and "height/depth", like the side rudder/elevator function on a V-tail unit.

With more elaborate designs, on the other hand, it may be the case that one (or two) interior rudders have only an elevator function and the exterior ailerons only support the height/depth function, under certain circumstances. Even with a 4, or indeed up to 8, flap wing the use of camber flap functions and/or even a crow system is nowadays entirely possible. In all these cases, however, the following assignment of the receiver outputs should be used, see also page 65. Unneeded outputs a simply left free:



According to the assignment of the receiver outputs, in the menu …

»Model type« (page 98)

```
      Model  type
Motor  at  C1        None
▶Tail  type      Delta/fl
Aile/flaps           2AIL
Brake  Off   +100%   In 1
⇕                     SEL
```

… the necessary settings are made:

- **"Motor an C1"**
  "None" or "Throttle min front/back"
- **"Tail type"**
  "Delta/fl"
- **"Aileron/camber flaps"**
  "2AIL" (appears automatically).
  To the extent necessary – and if with the respective transmitter possible – expand default "2 AIL" by 4 AIL or 1, 2 or 4 camber flaps ("1 FL", "2 FL" or "4 FL").
- **"Brake"**
  stays as is, only interesting for a delta wing or flying wing of type "2/4 AIL 1/2/4 FL". In this case, refer to the text under "Brake offset" on page 100.

These model type specifying settings primarily affect the functions made available in the »**Wing mixers**« menu. Therefore, the options are discussed separately for two-flap and multi-flap models in the following:

Delta/flying wing of the type: "2AIL"

```
      Model  type
Motor  at  C1        None
Tail  type       Delta/fl
▶Aile/flaps          2AIL
Brake  Off   +100%   In 1
⇕                     SEL
```

By retaining the standard default "2 AIL" in the "Aileron/flaps" line, elevator and aileron control, including the trim function, are automatically mixed by percentage on the software side. However, on the transmitter side, the percentage effect of the elevator and aileron stick can be influenced in the »**Dual Rate / Expo**« menu, page 126.

Settings in the menu …

»Wing mixers« (beginning on page 166)

… are, if need be, advantageous with the "AI → RU" mixers and are "played' with a great deal of "feel" for flying behavior with minor differentiation values.

```
      Wing  mixers
Brake settings        =>
Aile.diff          +10%
▶AI -> RU          +50% ---
▲
```

Due to the specific idiosyncrasies of this model type, additional settings lead to moments which cannot be compensated.

Delta/flying wing of the type: “2 / 4 AIL 1 / 2 / 4 FL”

```
        Model  type
Motor  at  C1          None
Tail  type          Delta/fl
▶Aile/flaps         2AIL4FL
Brake  Off   +100%   In 1
⇕                      SEL
```

With delta/flying wing constructions with more than two flaps, more moments can be compensated for. For example, the “lifting” moment caused by the raising of the ailerons (= elevator effect) can be compensated with camber changing flaps lowered correspondingly wide (= hydroplane effect).

If you decide in favor of this model type and have assigned the receiver outputs in accordance with the connection plan shown above, the aileron function of the two (exterior) aileron servos will function correctly immediately, but not the elevator function of the two aileron servos and, if applicable, the (interior) camber changing flaps.

This is only then achieved for “2/4 AIL 1/2/4 FL” when, in the “**Multi-flaps menu**” of the …

»Wing mixers« (beginning on page 166)

… menu, is set appropriately in the “HR ➔ WK” line to “Aileron, camber flaps” or, if applicable, “Camber flap 2”:

```
Diff.                0%
fl.pos               0%
  ▲FL▲          0%        0%
▶EL  ->FL       0%        0%

▲▶                   AILE
```

```
Diff.                0%
fl.pos               0%
  ▲FL▲       +100%   +100%
▶EL  ->FL       0%        0%

◀▲▶                  FLAP
```

```
Diff.                0%
fl.pos               0%
  ▲FL▲       +100%   +100%
▶EL  ->FL       0%        0%

◀▲                   FLAP2
```

Note:

Contrary to the separately set aileron trimming, see below, the trimming is transferred proportionally to the set mixer value with the mixer “EL ➔ FL”.

The following settings are model-specific and may not be adopted without checking that they are correct!

In the top line of this “Multi-flap menu”, analogous to “normal” four, six or eight flap wings, the effect of the aileron stick will be set to aileron (2), camber flap and, if applicable to FL2. One line below, in the line “Ail-tr.” line, will set the influence of aileron *trimming* on ailerons and camber changing flaps.

The setting of a differentiation is rather tricker due to the model type and should only take place based on a feel for the flight behavior of the model.

The line “▲FL▲” should then be set to the standard default of +100 % in the “FLAP” (or “FL2”) column – as shown – to 0 %, *just to be safe*:

```
Diff.                0%
fl.pos               0%
▶ ▲FL▲          0%        0%
 EL  ->FL       0%        0%

◀⇕▶                  FLAP
```

```
Diff.                0%
fl.pos               0%
▶ ▲FL▲          0%        0%
 EL  ->FL       0%        0%

◀⇕                   FLAP2
```

Even though all inputs are set to “free” by default in the **»Control adjust«** menu**,** should a control be assigned sometime by mistake … then it will at least have no effect.

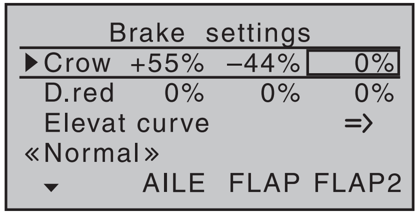
The last line, “EL ➔ FL”, was explained at the beginning of this section.

In principle, the author of this manual had programmed a delta model years ago operated with the **mc-20** *of that time and a crow system as landing assistance … entirely without tilting moments through correspondingly attuned wing mixers “Brake ➔ Aileron” and “Brake ➔ Camber flap”, whereby “Aileron” refers to the exterior rudder pair and “Camber flap” refers to the interior rudder pair.*

To achieve this now with todays **mc-16** Hott or **mc-20** HoTT also, switch to “**Brake settings**” in the …

»Wing mixers« (beginning on page 166)

… menu, and enter the values for the ailerons to be raised and the “flaps” to be lowered in the “Crow” line so that the occurring moments compensate one another and the altitude of the model remains stable. In the process, however, you should leave the flaps with enough “play” for the elevator function!!! Therefore, do not utilize the entire servo travel for the crow alone; for example:

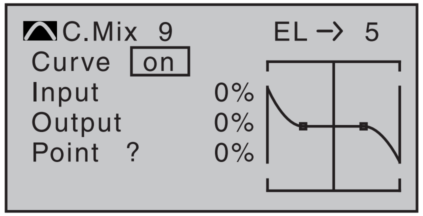


You can ignore all other settings in this menu.

Note:

*The “Brake settings” menu is switched “off” if: “Motor on C1 forward / back” in the »**Model type**« menu, page 98, AND the “Motor” column of the »**Phase settings**« menu, page 148, are set to “yes” for the currently active flight phase. Change the flight phase, if applicable.*

Similarly, a modern, tapered flying wing air craft can also be operated. With some of these models there are also interior and exterior rudders: The prior is in front of the centre of gravity and the latter is behind. A downward throw of the central rudder(s) increases the ascending forces and has an elevator effect. An upward throw has the opposite effect. On the exterior ailerons, on the other hand, the effect is just the opposite: A downward throw shows an elevator effect and vice versa. With appropriate adjustment of the “leading” mixer to the setting of curve mixers in order to achieve a supporting effect from the external rudder pair with only extreme stick deflection in the height/depth direction, “everything” is possible here. The author of this manual uses a curve mixer for his model, which is defined by a total of four points:



In this example the two interpolation points 1 and 2 are each at 0 % as well as the left edge point at +60 % and the right edge point at -65 %. In conclusion, the curve was rounded.

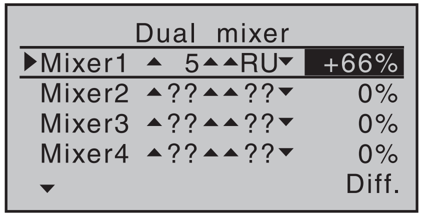
In this case: Regardless of which type of servo arrangement was selected, any type of differentiation should be set with caution! On a tail-less model, differentiations show a single-sided height/depth elevator effect, so we urgently recommend beginning at least the initial flights with a setting of 0 %! Over the course of the further flight testing, under certain circumstances it may be advantageous to experiment with differentiations deviating from zero.

With larger models, rudders in the winglets – the “ears” mounted on the wing ends – can be beneficial. If these are controlled with two separate servos, one of the mixers in the »**Dual mixer**« menu can be used; this is available on the mc-20 HoTT transmitter only.

In this menu …

»Dual mixer« (page 214)

… the rudder signal can be “split” very easily and even differentiated, whereby the second rudder servo is connected to one of the still free receiver outputs. For a model with a “Delta/fl” tail type, receiver output “5” should still be unoccupied and it can then be used as indicated below:



Differentiation is necessary in *this* case because, when flying curves, the respective exterior rudders will have a greater curve radius than the interior rudders, so this is comparable to the front wheel positions on a car when driving in curves.

Note:

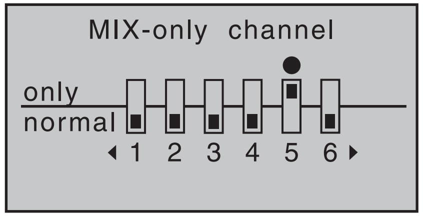
The rudder can only be differentiated as programmed above!

If these two rudders are also to deflect outward upon actuation of a brake system with the C1 stick, this can be achieved, for example, by setting an additional mixer “C1 ➔ 5” with an appropriate travel setting. Set the mixer’s offset according to personal preference, “front” (+100 %) or “rear” (-100 %), because the winglet rudder should deflect outward only for proportional extension.

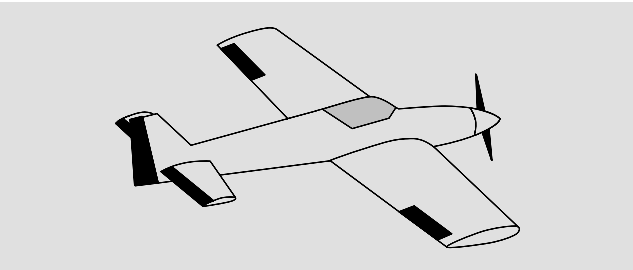
Independent of this, finish up by uncoupling the “false” control function from the control channel to which the second servo was connected – even though all inputs in the »**Control adjust**« menu are “free” by default – or shift into the menu …

»Mix-only channel« (page 212)

… which applies to *all flight phases*, and is available as standard on the mc-20 HoTT transmitter only, in the interests of safety. In keeping with the above example, control channel 5 should therefore be set to “MIX only”.


MIX-only channel
only
normal
1 2 3 4 5 6

F3A models are a part of the group of motor-driven winged models. They are powered by a combustion or electric motor. Electric-powered model aircraft are now becoming prevalent in the international F3A model aerobatic class as well as being eligible for the F5A electric aerobatic class.



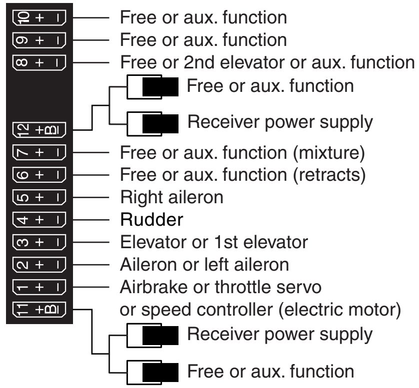
The basic comments and notices for the mechanical installation of a remote controlling system, which was already referred to in the first programming example on page 278, also applies, of course, for F3A models and does not need to be mentioned here again.

Faultlessly constructed F3A models exhibit a largely neutral flying behavior. Ideally, they react with a good nature but precisely to control movements without the individual flight axes influencing one another.

F3A models are controlled with ailerons, elevator and rudders. Normally, each aileron is actuated by a separate servo. There is also the regulation of the drive output of the motor (throttle function) and a retractable landing gear in many cases. The assignment of the channels 1 to 5, therefore, do not differ from the previously described winged models.

The additional "Retractable landing gear" function is to be provided on one of the auxiliary channels 6 to 8 or 6 … 12. It is best to actuate the landing gear with a switch without central position. In addition, another mix offset for the carburettor can – if necessary – be provided.

You normally use one of the two proportional controls on the transmitter, which actuates one of the unassigned auxiliary channels.



With the assignment of auxiliary channels at the transmitter, we recommend making sure that the operating elements required for this are easily within reach, because during flight – especially in competition – you have "very little time" to release the stick.

Programming procedure

Since the basic programming of the transmitter was already described in detail on pages 280 … 288, only F3A-specific tips are added here.

In the menu …

»Servo adjustment« (page 106)

▶S1	=>	0%	100%	100%
S2	=>	0%	100%	100%
S3	=>	0%	100%	100%
S4	=>	0%	100%	100%
S5	=>	0%	100%	100%
▼▶ Rev	cent	–	trv	+

… the settings for the servos are carried out. Experience has shown that working with at least 100 % servo throw is beneficial, because the control precision is significantly better if greater servo travel is used.

This should already be taken into account during the construction of the model in the design of the rudder linkages. Check the servo's direction of rotation. The servo centre should be adjusted mechanically, insofar as possible.

Any corrections can be made on the software side in the third column during the initial test flights.

Through the menu …

»Model type« (page 98)

… the idle trim is activated for Channel 1 (normally "back", because full throttle is "front"). The trimming then only works in the idle direction:

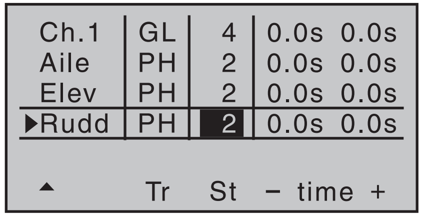
Model type		
▶Motor at C1		back
Tail type		Normal
Aile/flaps		2AIL
Brake Off	+100%	In 1
▼		SEL

The remaining settings are made or left as shown in the figure.

After the model is test-flown and trimmed, we recommend reducing trim travel for the elevator and ailerons. The model has significantly less of a reaction to a movement of the trim lever. "Over-trimming" can be avoided, because with full trim travel, under certain circumstances, the movement by just one trimming step can have too strong of an effect: Therefore, the model which previously pulled slightly to the left, hangs somewhat to the right after the trimming. Go, if you have a transmitter mc-20 HoTT, in its menu …

»Stick mode« (page 108)

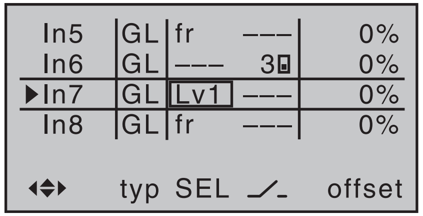
… and reduce the number of trim steps in the "Tr" column appropriately:



It may also be necessary to assign appropriate operating elements and inputs for other model features, e. g. retractable landing gear, fuel-mix, etc. Make these assignments with the …

»Control adjust« (page 112)

… menu where a specific input can be assigned to an operating element, for example, the landing gear can be assigned to an ON/OFF switch on Input 6 and the fuel-mix can be assigned to one of the proportional sliders in the middle console, e. g. the side-mounted left proportional slider to Input 7. However, since it involves flight-phase independent settings, leave the standard default "GL" in the "typ" column:



The control travel of the operating elements must be adapted and can also be reversed with a negative travel setting.

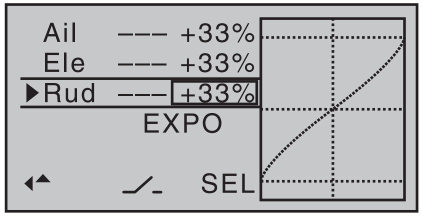
Note:

For retractable landing a delay during opening and closing can be specified that will not work for the Landing Gear Servo C 713 MG, No. **3887**.

F3A models fly comparatively fast and thus react "harshly" to the control movements of the servos. However, since small control movements and corrections are not optically perceptible, because this results in inevitable point deductions in competition, we recommend setting an exponential control characteristic of the stick. For this purpose, switch to the menu …

»Dual Rate / Expo« (page 126)

Experience has shown positive results with values of approx. +30 % on the ailerons, elevator and rudders, which you set in the right column with the selection keys. In order to be able to control the F3A model to run smoothly and cleanly:

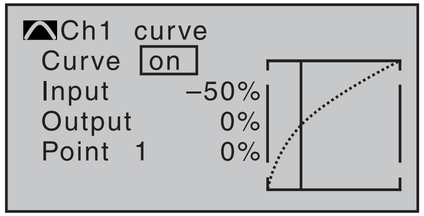


(Some experts even use up to a +60 % exponential ratio.)

Since (some) combustion motors do not react linearly to movements of the throttle stick, through the menu …

»Channel 1 curve« (page 134)

… a "bowed" or, in other words, non-linear throttle curve can be set. Four-stroke engine with Roots pumps, in particular, such as OS Max FS 120, require a steep ascension of the curve in the lower speed range. However, the corresponding values must be adapted. The C1 control curve for the motor could appear as follows:



Only three interpolation points, "L" at -100 %, "H" at +100 % and "1" at -50 % give the control travel the rounded curve above.

Basic procedure:

- Move the C1 stick and, along with it the vertical line in the graph display, toward idle to about -50 % of control travel then briefly tap on the centre **SET** key of the right touch pad.
- In order to attain the curve shape shown, raise this point with the selection keys to approx. 0 % in the inverse video value field in the "Point" line.
- Finally, round the characteristic curve by moving the marker frame upward, select with a brief tap on the centre **SET** key of the right touch pad then change the value from "Off" to "On" with the selection keys.

If additional interpolation points between the left ("L") and right ("H") end are necessary, repeat Steps 1 and 2 analogously.

Since F3A models normally have two aileron servos, experience has shown that it is beneficial to move both ailerons upward *somewhat* when landing. In the process, the model usually approaches somewhat slower and, above all, more *steadily* for the landing. In order to do this it is necessary to program mixers through the menu …

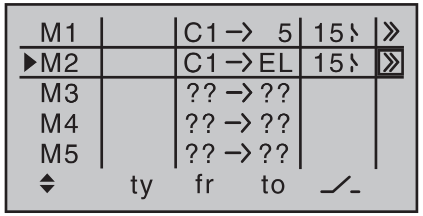
»Free mixers« (beginning on page 201)

… accordingly.

The ailerons are extended as landing assistance depending on the position of the throttle stick, starting from approximately half throttle toward idle. The further the stick is moved toward idle, the more the ailerons deflect upward. Just the opposite applies when "throttling"; the ailerons are retracted again in order to prevent a sudden rise of the model.

In order to prevent the model from climbing with the aileron landing flaps extended, the elevator must be mixed in somewhat.

For this purpose, set the two linear mixers shown in the following display. The activation of the mixers takes place with one and the same switch, such as "15", to which both mixers must be assigned with identical switching direction.



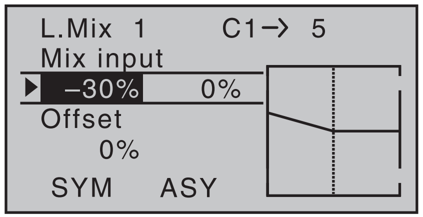
Then switch to the second respective display screen in order to adjust the respective mixing degrees. In both cases the mixer neutral point is at the C1 control centre.

Enter 0% above the control centre after selection of the **ASY** field for both mixers and below the control centre toward idle for:

MIX 1: -60%… -80% and

MIX 2: -5%… -10%.

Example Linear MIX 1:



With this, the base setup model of an F3A model is concluded.

Compensation of model-specific errors

Unfortunately, there are nearly always minor model-specific "errors" through the mixers of a computer remote control which must be compensated for. However, before you begin with these settings, it should be ensured that the model is faultlessly constructed, optimally balanced over the longitudinal and transverse axes and the down thrust and side thrust are correct.

Influence of longitudinal and transverse axes by the rudder

The actuation of the rudder often influences the behavior of the longitudinal and transverse axes. This is particularly disruptive in so-called knife-edge flying, in which the lift of the model with the rudder deflected should be created by the fuselage alone. In the process, the model can rotate and change directions as though it were controlled with the ailerons and elevator. Therefore, a correction over the transverse axis (elevator) and/or the longitudinal axis (ailerons) must be made, if applicable.

This can also be done easily with the »**Free mixers**« available in the mc-16 HoTT or mc-20 HoTT system. For example, if the model drifts away to the right over the longitudinal axis with the rudder extended in knife-edge flying, the aileron can be deflected slightly to the left with the mixer. Changes in direction over the transverse axis can be performed analogously with a mixer on the elevator:

- Correction over the transverse axis (elevator)
  Linear MIX 3: "RU → EL"
  Asymmetric setting. The appropriate values must be tested in flight.
- Correction over the longitudinal axis (aileron)
  Linear MIX 4: "RU → Al"
  Asymmetric setting. The appropriate values must be tested in flight.

Relatively small mixer values are usually sufficient in this case, the range lies below 10%, but can vary from model to model. With the use of curve mixers, the mix ratios can be adapted even more precisely to the corresponding throw of the rudder. Again, no values are indicated for this, because this would be model-specific.

Vertical ascent and descent

Some models have a tendency to deviate from the ideal line in vertical ascents and descents.

In order to compensate for this, it is necessary to have a centre position of the elevator dependent on the throttle stick position. If, for example, the model begins to hold off on its own in the vertical descent with a throttled motor, some elevator must be mixed in at this throttle position.

For this purpose, program a free mixer "C1 → EL". The corresponding mixer values are normally under 5% and must also be tested in flight.

Turning away over the longitudinal axis in idle

If the throttle is reduced, the model may begin to turn away over the longitudinal axis in idle. This can be counteracted with the aileron.

However, the more elegant solution is to correct this effect with a free mixer "C1 → AL".

The input values here are usually very low (approx. 3%) and the settings should be made in calm weather. It often suffices to only use the mixer between half throttle and idle. Therefore program the mixer asymmetrically, if applicable.

Turning away with the ailerons/landing flaps extended

If you move the ailerons upward for the landing, the result is often a turning away over the longitudinal axis due to various servo paths of the aileron servos or due to design precision. Therefore, the model begins to automatically hang the left or right wing. This is also easy to compensate for with a mixer "C1 ➔ AI" depending on the position of the ailerons/landing flaps.

The mixer must be switched on and off with the same switch with which you can switch the aileron/landing flap function on and off (see previous page). Therefore, it only works with the aileron/landing flap function activated. The appropriate value must be tested in flight.

One additional comment regarding …

"FAIL-SAFE setting"

⚠ You utilize the safety potential of this option by programming at least the motor throttle position for combustion models to idle and the motor function for electrically powered models to stop for a Fail-Safe case. If interference should occur, the model is then less likely to fly off on its own and cause damage to property or even personal injury. If you additionally program the fail-safe positions of the rudders to that the model flies in gently sinking circles in the event of a failure, there is a good chance that the model even lands relatively gently on its own in the event of a continuing connection failure. You also have sufficient time to re-establish the connection if the entire 2.4 GHz frequency band is temporarily disrupted.

In the receiver's condition as supplied, however, the servos maintain their last validly recognized position ("hold") in the event of a fail-safe situation. As described on page 216, you can define a "Fail-safe position" for each receiver servo output (Fail-safe mode).

Summary

The settings described on this page are especially useful for the "expert" who would like to have an entirely neutral, precisely flying F3A model acrobatic model at his or her disposal.

It should be mentioned this takes a lot of time, effort, instinct and know-how. Experts even program during the flight. To do this, however, is not suggested for an advanced beginner who ventures into an F3A acrobatic model. It would be best to turn to an experienced pilot and carry out the settings step by step until the model has the desired neutrality in its flight behavior. Then the pilot can begin to learn the not always easy to perform acrobatic figures with a model which flies faultlessly.

With this programming example, you must have already covered the description of the individual menus and you must be familiar with the use of the transmitter. In addition, the helicopter's mechanical construction should correspond exactly to the corresponding manual. The electronic capabilities of the transmitter should by no means be used to straighten out rough mechanical imprecision.

As is often the case in life, there are also various ways and possibilities to achieve a specific goal when programming the mc-16 HoTT or mc-20 HoTT transmitter. The following example should provide you with a clearer structure for logical programming. If there are multiple possibilities, the simplest and most clearly arranged solutions are recommended first. In order for the helicopter to function faultlessly later on, you are, of course, free to try out other solutions which may be better for you.

The programming example is based on the clockwise-rotating STARLET 50 helicopter from *Graupner* with three pivot points each offset 120° of the swashplate type "3Sv(2 Roll)", beginner adjustment without increased throttle curve; without heading-lock gyro system and without transmitter-side gyro influence of the "normal operating mode" and without speed regulator.

This simple program was also consciously selected to demonstrate that a helicopter which flies really well can also be attained with relatively little (programming) effort.

However, we do not want to dispense entirely with the enhancement possibilities: Therefore, after the basic description, you will find adjustment information for the gyro effect, the speed regulators and for the flight-phase programming.

<u>*Note:*</u>

If you are not interested in the combustion helicopter described here, but a electric helicopter, please continue reading anyhow! With the exception of the omitted idle settings, you can practically adopt most of the settings described in the following unchanged.

In the scope of the initial commissioning of a new transmitter, in the selection menu …

»Basic settings« (page 266)

```
       Basic  settings
▶Voice  Vol   [5]  fr     –––
 Vario  Vol    7   fr     –––
 Beeps  Vol    7   fr     –––
 Own‹                        ›
 Stick  mode            1
 Modulation          HoTT
 DSC  Output        PPM10
 Pitch min           back
 Top  LCD  Contrast     0
 Bottom  LCD  Contr.    0
 Display  light    unlim.
 Power-on  beep       yes
 Battery  type      Lith.
 Battery  warning   3.60V
 Power  on  warn.   unlim
 Touch  Sense           2
 DATA sel       Telemetry
 BT Headset           OFF
                      0/0
 ID PAIR              OFF
 BT Volume              8
 ▼          SEL  SEL
```

… some basic information should be entered. This serves various purposes:

The first three lines of this menu can be used to individually regulate, in increments between 0 and 10, the volume of voice and signal output emitted via the built-in loudspeakers or the transmitter's headset connector. The fourth line of this menu is used to record the transmitter owner's name. Select the characters for this from an extensive character list on the second display screen, which can be reached via the symbol with a brief tap on the centre **SET** key of the right touch pad:

```
!"#$%&'()□+,-./0123
456789:;<=>?@ ABCDE
FGHIJKLMNOPQRSTUVWX
YZ[¥]^_`abcdefghijk
▼▲
Owner‹H-J Sandb                ›
```

The *pre-set for* "**Stick mode**" can be selected according to the criteria described on page 267.

The same applies to the *pre-sets for* "**Modulation**" and "**DSC Output**", page 268.

The *pre-set for* "**Pitch min**" is a matter of personal control habits, page 104.

The pre-sets established here for "**Stick mode**", "**Modulation**", "**DSC Output**" and "**Pitch forward/back**" will be initially adopted when a new model memory is created but they can also be freely changed within a given model memory location to any other available option.

The settings in the "**Top/Bottom LCD Contrast**" lines determine the legibility of the given displays under poor light conditions and the setting in the "**Display light**" line determines how long display lighting remains illuminated after the transmitter is switched on without any actuation of a control afterward or after the last control actuation.

The selection of “yes/no” in the “**Power-on beep**” line determines whether the “recognition melody” is to sound when the transmitter is switched off or on again.

The “**Battery type**” line specifies whether the transmitter is supplied with current from a “NiMH or a “Lith.” battery, and the “**Battery warning**” line below it specifies the voltage at which the transmitter’s low-voltage warning should trigger. Do not enter a value that is too low here, so you have enough time to land your helicopter.

The setting made in the “**Stick warning**” line determines how long the transmitter will wait after the last actuation of an operating element before issuing visual and acoustic warning signals to indicate it is still switched on. Following the warning, you still have about three minutes to actuate the transmitter so the warning will abate. Otherwise the transmitter will switch itself off when this time expires.

The value set in the “**Touch Sense**” line is a matter of adapting the transmitter to personal preferences.

*In the “***DATA sel.***” line you can specify which abuts the two possible data logs to the located under the left front cover Data socket. By default, it is the data output on the Smart-Box, No.* **33700***, suitable “telemetry” protocol.*

Finally, if you are using a **Bluetooth headset**, you can bind and configure it as described in the instructions supplied with the optional Bluetooth module, No. **33002.5**; see the section entitled “BT Headset”.

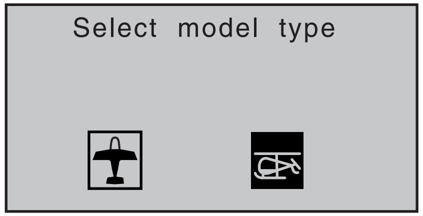
Once these settings have been taken care of, commissioning continues with the menu …

»Model select« (page 71)

Use the selection keys to pick a free memory location …

```
01 ⊥                M E 12
02   ***free***
03   ***free***
04   ***free***
05   ***free***
06   ***free***
```

… and call it up with a brief tap on the centre **SET** key of the right touch pad. In the display which then appears, use the ▶ key of the left or right touch pad …



… to select the “helicopter” model type. The display immediately switches to the base screen if the selection is confirmed by a brief tap on the centre **SET** key of the right touch pad.

<u>Notes:</u>

- *If the “Select model type” option has been opened, the process cannot be canceled. Even if you switch off the transmitter, this selection must be made! In any case, you can undo this by subsequently deleting the respective model memory.*
- *If the “Throttle too high” warning appears, it can be erased by turning the right-side proportional rotary control to its backward limit or the throttle / pitch control stick of your transmitter to the idle or Pitch minimum position.*
- *If battery voltage is too low, the model switchover cannot be made due to reasons of safety. An appropriate message will appear in the screen:*

```
not possible now
voltage  too low
```

Once this first hurdle is cleared, the connection of the receiver built into the model at this model memory must be made in the menu …

»Base setup model« (beginning on page 88)

To this end, switch to the line “**module**”:

```
  Base  setup  model
Mod.name  <           >
Stick  mode           1
▶module  HoTT  n/a  n/a
DSC  Output       PPM10
⬍                BD1  BD2
```

<u>Note:</u>

After confirmation of the model selection in the base screen, if you confirm the message appearing in the screen for a few seconds …

```
BIND. N/A
   OK
```

… with a tap on the **SET** *key of the right touch pad, this line will be accessed automatically.*

”Binding type”

If your transmitter is equipped with the latest firmware or has since been updated accordingly, you should briefly deal yet with the differences between the two available HoTT synchronization methods before the actual binding process. Set default “model”:

```
   Base  setup  model
 Mod.name   <           >
 Stick  mode            1
▶Binding type       Model
 Module HoTT    n/a   n/a
 ⬍                   SEL
```

- “Model” specific bound receivers respond only to signals of them explicitly allocated memory model. One, possibly unintentionally, operating on an unallocated model memory is not possible.
- “Global” a receiver, bound ie to a specific transmitter, responds to the signals of all model memories from “its” transmitter! A “wrong” model memory if necessary is recognized only by the warning of the missing return channel.

So If necessary, change the line “Binding Type” and change the setting accordingly:

```
   Base  setup  model
 Mod.name   <           >
 Stick  mode            1
▶Binding type      Global
 Module HoTT    n/a   n/a
 ⬍                   SEL
```

The line “module” initiates a binding process between model memory and receiver, as described in detail on page 89. Otherwise, you cannot address the receiver.

Afterward, use the ▲ selection key of the left or right four-way button to move up to the first line and begin with actual model programming in the “Model name” line. Now give the model memory an appropriate name, …

```
   Base  setup  model
▶Mod.name   <[          ]>
 Stick  mode            1
 module  HoTT  bind   n/a
 Rcv  Ch  Map   R12   n/a
 ▾
```

… which must be assembled from characters available on the second page of the “**Model name**” line:

```
!"#$%&'()□+,-./0123
456789:;<=>?@ ABCDE
FGHIJKLMNOPQRSTUVWX
YZ[¥]^_`abcdefghijk
▾▴
Mod  Name <STARL        >
```

After entering the “**Model name**”, the settings adopted from »**Basic settings**« for “**Stick mode**” and “**DSC Output**” are to be checked and changed as necessary for the given memory location.

Another option is to be activated in the “**Autorotation**” line. Even if you are not an advanced pilot, the autorotation switch should at least be set as an emergency shutoff switch for the motor.

Do this by selecting the “**Autorotation**” line with a brief tap on the centre **SET** key of the right touch pad, activate the switch assignment, assign a 2-way switch, e. g. “7”, and put it in its “ON” position:

```
   Base  setup  model
 RF  transmit        ON
 RF  Range  Test   99sec
 DSC  Output       PPM10
▶Autorotation       [7I]
 ⬍
```

The selected switch should be in a location on the transmitter which is easily within reach – without letting loose of a stick – e. g. above the pitch stick.

Note:

More more information about the setting of this “emergency shutoff”, see further in this section.

Another tip:

Make a habit of giving all switches a common switch-on direction; then a quick glance over the transmitter prior to the flight should suffice – all switches off.

Setting options for the “**Autorotation C1 position**”, “**Motor stop**” and “**Stick warning**” are not yet of particular interest …

… and you should only leave or set the “**Auto timer reset**” line to “yes” if you actually want the timers to be reset to the appropriate initial value every time you switch the transmitter on.

Additional settings specific to helicopters are made in the menu …

»Helicopter type« (page 102)

In the “**Swashplate type**” line, select control for swashplate or pitch function. In this example: “3Sv(2rol)”.

The “**Linearis. swashpl.**” line is not yet of interest.

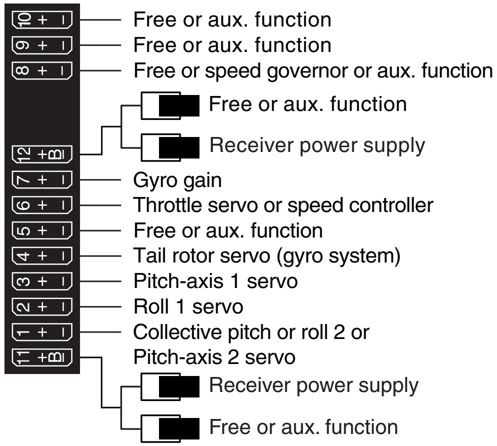
In the “**Rotor direction**” line, it is established whether the rotor – as viewed from above – turns to the right (clockwise) or left (counter-clockwise). In other words, whether it rotates counterclockwise or clockwise. In this example “right”.

Check the default for “**Pitch min**”, which was adopted from »**Basic settings**«, to confirm that the entry “front” or “rear” is in keeping with personal preferences or should be changed:

```
       Heli  type
 Swashplate       3Sv(2rol)
 Linear.  swashpl.       no
 Rotor  direct        right
▶Pitch  min.           back
⇕                       SEL
```

"**Expo throttle lim.**" in the bottom line of this display, are currently of no interest.

By now, the servos should be plugged into the receiver in the intended sequence:



Note:

Please note that on the newer Graupner **mc** *and* **mx** *remote control systems, the first pitch servo and the throttle servo are swapped in comparison to some older systems.*

Mix ratios and mix directions for swashplate pitch, roll and nick servos are already pre-adjusted to +61 % in the menu …

»Swashplate mixer« (page 216)

```
   Swashplate  mixer
▶ Pitch          +61%
  Roll           +61%
  Nick           +61%

▼                 SEL
```

If the swashplate mixer should not follow stick movements properly, first change the mixing directions from "+" to "-" before changing servo directions in the menu …

»Servo adjustment« (page 106)

```
▶S1 =>     0% 100% 100%
 S2 =>     0% 100% 100%
 S3 =>     0% 100% 100%
 S4 =>     0% 100% 100%
 S5 =>     0% 100% 100%
▼▶ Rev  cent    -  trv  +
```

This menu can also be used to adapt travel and direction for individual servos. However, one must attempt to retain 100 % servo travel so as to achieve the best possible resolution and control accuracy. The direction of travel is determined with "Rev." and, in the process, make sure that the direction is correct. The tail rotor servo must run so that the nose (!) of the helicopter follows the tail stick direction.

In the following menu…

»Stick mode« (page 110)

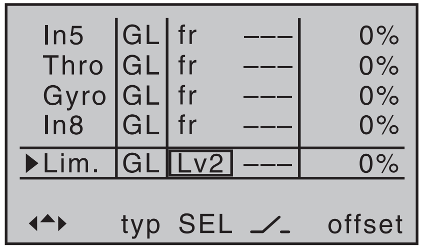
```
▶Thr.  TL   4  0.0s 0.0s
 Roll  PH   4  0.0s 0.0s
 Nick  PH   4  0.0s 0.0s
 Tail  PH   4  0.0s 0.0s

▼      Tr   St  -  time  +
```

… of the **mc 20** HoTT transmitter the column "**Tr**" is used to set the increment size of each "click" on the digital trim keys.

The C1 trimming only affects the throttle servo for the helicopter. At this point there is no need to go into the particulars of this trimming ("cut-off trim") once again. Please read more about this on page 62. (Thanks to *digital* trimming, trim values can be saved automatically when a model change is affected. In the **mc-16** HoTT and **mc-20** HoTT systems these can even be stored automatically when a change of flight phase takes place.)

An additional setting which is specific to helicopters can also be made in this menu in which you determine which function the trim lever on the pitch stick should have. This is accomplished by selecting the "**TL**" setting in the "Thr(ottle)" line or leaving it as it is. This roughly corresponds to trim for the familiar idle trim function. If the trim indicator marker is moved all the way forward by "turning" the trim lever (remember: "pitch min rear" = "throttle forward") the throttle limit will later take over the throttle limit for throttle enable seamlessly in the menu …

»Control adjust« (beginning on page 116)



… where input “Lim.” is assigned and all other inputs are “fr(ee)” by default.

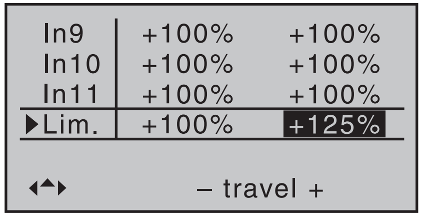
This “Lim.” input serves as the **throttle limiter**. Its effect is *exclusively* on output “6”, where the throttle servo is connected. The throttle limiter is assigned by default to the right-side proportional rotary control.

- *In firmware versions up to and including 1102 the throttle limiter to the right side proportional rotary slider SD2 is assigned by default, as shown above. As of firmware version 1103 is the input “Lim.” Default “free” and consequently deactivates the throttle limiter function. To enable this feature, only needs to input “Lim.” Another donor, for example, the original proportional rotary slider SD2, are assigned.*

Once again as a reminder:

- *With the use of the “throttle limiter” function, you do not have to program a flight phase “throttle pre-selection”.*
- *The throttle limiter does not control the throttle servo; it only limits the travel of the throttle servo in the full throttle direction according to its position. The throttle servo is generally controlled from the pitch stick via »**Helicopter mixer**« menu setting/s for throttle curve/s, which is why input 6 must absolutely remain “free”. Refer to pages beginning on page 188 in this manual about this.*
- *The C1 trimming also affects only the throttle servo for the helicopter. At this point there is no need to go into the particulars of this trimming once again. Please read more about this on page 62. (Thanks to the digital trimming, trim can be automatically saved values with a model changeover as well as with a change of the flight phase).*
- *A detailed description of the idle run base setup model and the adjustment of idle and throttle limit can be found beginning on page 122.*

Then switch to the “travel” column with the ▶ selection key of the left or right touch pad and increase the now inversely highlighted value from +100 % to +125 % with a fully opened throttle limiter with a brief tap on the centre **SET** key of the right touch pad:



In doing so, it is assured that the throttle limiter releases the entire throttle travel with the pitch stick later during flight.

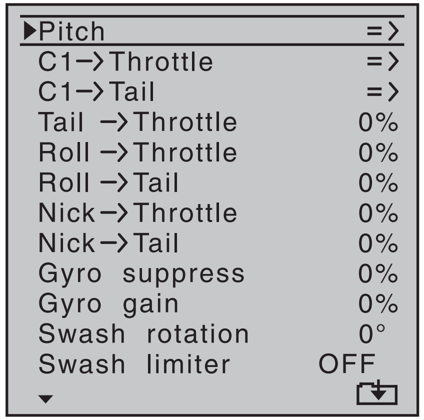
Adjustment notice for electric helicopters:

Since electric drive systems have no need for an idle setting, the basic configuration of settings for an electrically-powered helicopter merely involves making sure that the control range of the throttle limiter is both higher and lower than the adjustment range of the speed controller (usually -100 % to +100 %) by a safe margin. If necessary, therefore, the adjustment of the “travel” setting of the throttle limiter described above must be modified accordingly, for example, to symmetric +110 %. The further adjustment, however, can take place analogously to the combustion helicopter described here.

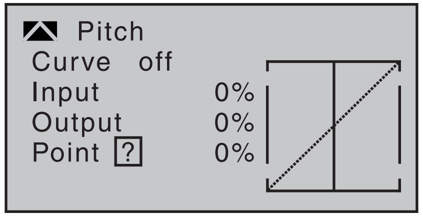
With this process, you have carried out the basic settings for the transmitter as they are needed again later for further model programming.

The actual helicopter-specific settings take place primarily in the menu …

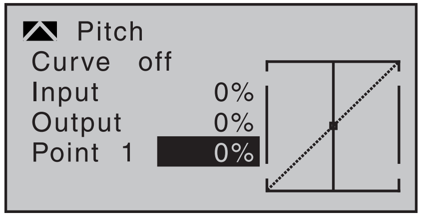
»Helicopter mixer« (beginning on page 184)



The “Pitch” function appears right in the first line. A tap on the centre **SET** key of the right touch pad will cause a switch to the corresponding sub-menu. The graphic representation of the pitch curve appears here; it is initially only defined by the points “L” and “H”:



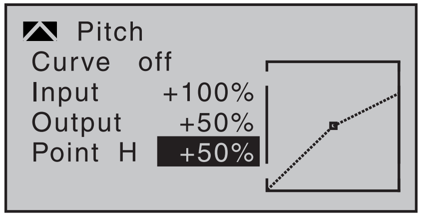
Now place point “1” in the centre with a brief tap on the centre **SET** key of the right touch pad:



Always try to make due with these three points initially; more points can "over-complicate" the matter and are more of a burden at this point.

The reference point for the hovering should generally be the mechanical centre position of the pitch stick, because this position comes closest to the normal control feel. Although the curve adjustment enables other settings, you must know exactly what you are doing. First set the pitch stick in the centre. The servos which you had previously set according to manufacturer specifications have their levers at positioned perpendicularly to the servo housing (normally). A hovering pitch value of 4° to 5° is now mechanically set at the control rods to the rotor blades. In principle, all known helicopters fly with this setting.

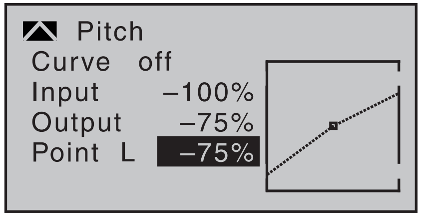
Then move the pitch stick towards maximum pitch until the limit position. (The vertical line shows you the current stick position.) Now change the pitch curve's point "H" with the selection keys of the right touch pad such that the main rotor's blades have a maximum pitch of about 9°. A value of +50 % should be about right:



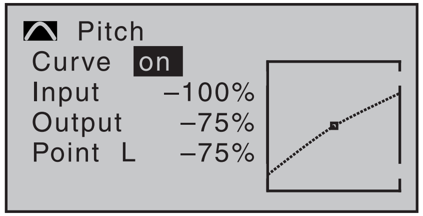
Note:

A rotor blade adjustment gage, such as the Graupner pitch gage, No. ***61****, is quite useful for reading the angle.*

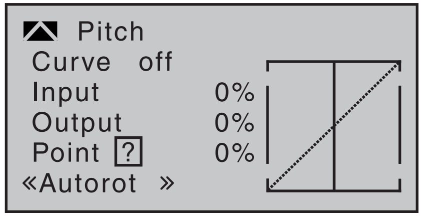
Now move the pitch stick toward the pitch minimum position until its limit position. Depending on the ability of the pilot, adjust the value of point "L" so that the blade angle of approach is 0 to -4°. Now a slightly pitched line arises at the hovering points, the so-called pitch curve, which can appear as follows:



Now you can, if you like, move the marker frame upward with the selection keys to the "Curve" line and after activation of the value field with a brief tap on the centre **SET** key of the right touch pad, set the curve function of the mixer to "on".



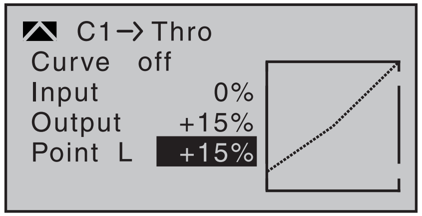
If you now switch to autorotation phase – at the bottom left of the display the flight phase name "Autorot" appears – the "old" pitch curve is again:



Now carry out the same setting as before in the normal phase. Only at point "H" – at maximum pitch – is it possible to increase pitch angle by about 2°. In doing so, you will have somewhat more of an angle to catch the model later on (!).

After setting pitch curve, move the autorotation switch back then return to the helicopter mixer menu selection with a brief tap on the centre **ESC** key of the left touch pad. In that display, change to the "**C1 → Thro**" line to set the throttle curve.

The adjustment range for idle trim must first be matched to the throttle curve. Do this by putting the pitch stick into its minimum position then set point "L" to about +15 %:



With the throttle limiter *closed* and idle trim completely open, move the pitch stick back and forth somewhat at the minimum limit position. The throttle servo may not move with it in the process. No you have established a seamless transition from the idle trim to the throttle curve. The further settings along the throttle curve must be carried out later in flight.

If you switch from this graphic to the autorotation phase for testing purposes, the following appears instead of the accustomed representation:

```
      C1→Thro

         OFF


«Autorot  »
```

That means that this mixer is switched off and the throttle servo is switched to a fixed value, which can be adjusted as follows:

Return to the menu list with a tap on the **ESC** key. As long as you are still in the autorotation phase, new sub-menus are listed; specifically:

```
▶Pitch                =>
 Thr  setting  AR  –100%
 Tailoffset  AR       0%
 Gyro  suppress       0%
 Gyro  gain           0%
▾ «Autorot»
```

The line "Thr. setting AR" is important. Enter the value to the right, depending on servo direction, to either approximately +125 % or -125 %.

```
 Pitch                =>
▶Thr  setting  AR  –125%
 Tailoffset  AR       0%
 Gyro  suppress       0%
 Gyro  gain           0%
⬍ «Autorot»          SEL
```

In doing so, the motor is safely switched off in the autorotation phase (in case of emergency). Later, when you have gained enough experience to practice the autorotation flight, a more stable idle can be entered here.

Adjustment notice for electric helicopters:

Since the motor must also be shut off for electrically powered helicopters in case of an emergency, this setting is to adopted without change.

The further sub-menus are not important at the moment. By switching off "autorotation", it returns to the first menu list.

Select the "**C1 → Tail**" settings page in order to set static torque compensation for the tail rotor. In this case, also work with a maximum of three interpolation points; everything else is reserved for the experienced pilot. Do this by changing the heading-lock systems from their intended uniform pre-setting of 0 % at point "L" (minimum pitch) to -30 % and at the opposite end, at point "H" to +30 % (maximum pitch). These values may have to be corrected in flight. It may also be necessary to set point "1" in the middle.

```
   C1→Tail
 Curve   off
 Input       0%
 Output      0%
 Point ?     0%
```

Now, for testing purposes, switch back to the autorotation phase. Here the setting is also deactivated; the tail servo no longer reacts to pitch movements (no torque usually arises when the main rotor is not powered).

All additional interpolation points are not currently of importance yet. Navigate by pressing the central **ESC** button of the left-hand four-way button one level up:

```
 Pitch                =>
 Thr  setting  AR  –125%
▶Tailoffset  AR       0%
 Gyro  suppress       0%
 Gyro  gain           0%
⬍ «Autorot»          SEL
```

Set the helicopter horizontally on with the engine off. With activated transmitting and receiving system, fold the tail rotor blades down and change the line "Tail rotor AR" by pressing the central **SET** key of the right four-way button to activate the value field, until the value of the tail rotor blades angle is zero degrees. The tail rotor blades are then viewed from behind parallel.

Depending on the friction and running resistance of the gearbox, it may be that the fuselage still rotates slightly. This relatively weak torque must be corrected on the tail rotor blade pitch then optionally. In any case, this value is between zero degrees and a pitch angle opposed to the direction of tail rotor pitch required for normal flight.

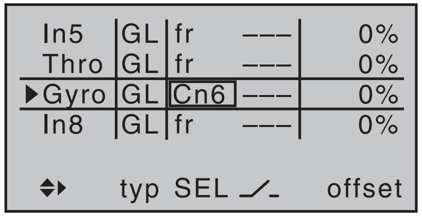
All other sub-items are not currently important. Therefore switch back to the normal phase.

If, contrary to the default setting, the gyro has a transmitter-side sensitivity setting, another free proportional control will be needed.

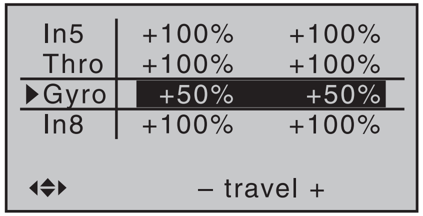
This can be assigned in the …

»Control adjust« (beginning on page 116)

… menu to "Gyro" input. Activate the control assignment with a brief tap on the centre **SET** key of the right touch pad then move the selected control until its control number appears in the display:



Conclude this entry with a brief tap on the **ESC** key of the left touch pad then change to the column "- travel +" with the ▶ selection key of the left or right touch pad. After a tap on the centre **SET** key of the right touch pad, the gyro's maximum sensitivity can be set in the value field displayed in inverse video, e. g. to 50 %. To this end, move the selected control into its middle position or, if applicable also to the side, such that only one value field is displayed in inverse video:

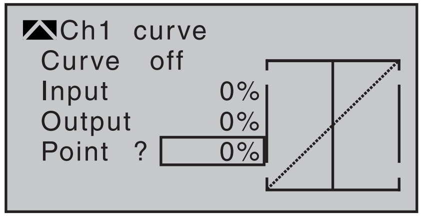


This produces a fixed value for as long as the control remains at the right limit position. The correct value must be adjusted in flight.

⚠ **In the process, however, always observe the adjustment instructions accompanying your gyro sensor, because your helicopter will not be able to fly otherwise!**

To conclude this initial programming, a few words should be mentioned about the menu …

»Channel 1 curve« (page 137)



This function is a type of "convenient exponential curve" for the throttle/pitch stick and the mixer functions connected to it.

If ever, this curve should only be applied "cautiously" at the very end, when all adjustments have been made. It should never be used for the throttle/pitch adjustment! The over-lapping result in "nasty" effects.

With this, all helicopter-specific settings which can be made on the "workbench" are now completed. The further fine-tuning must take place in flight. The flight-tested, (hopefully) minor (digital) trim settings are automatically saved.

Larger deviations should first be mechanically adjusted or adjusted according to the previously discussed settings.

Further settings

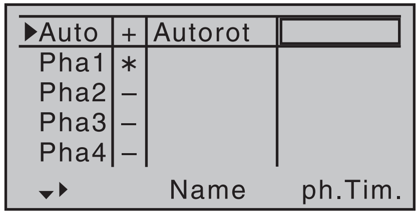
Following this programming example, you have provided a helicopter with a basic adjustment for the hovering training and simple trips. Depending on your knowledge and experience as a pilot, additional functions can, of course, also be activated.

If you want to fly at different speeds and with different trimming, you activate the so-called "flight phases", which can be called with assigned switches as an alternative to the previously described "normal phase". For this purpose, first open the menu …

»Phase settings« (page 152)

… whereby the symbols appearing in the second column, sometimes only after a switch assignment in the »**Phase assignment**« menu, have the following meanings:

"–": no phase switch present
"+": phase switch present
"∗": currently active phase



However, consider in advance whether these are to be implemented with individual switches or, more reasonably, with 3-way switches because as many as 6 flight phases can be activated in addition to the autorotation phase. The latter possibility is more logical and usually more clearly laid out.

The "**Autorot**" line is already selected in the figure above. When activated, the autorotation phase always has precedence over any other phases you assign switches to.

However, in the "Name" column you first assign "meaningful" names to Phases 1 to 3, which are adopted from a list. These identifications serve for the better differentiation and are shown later in the base screen and for all flight-phase dependent menus, see listing on page 146, for example:

```
Auto |+|Autorot |
Pha1 |*|Normal  |
Pha2 |+|Hover   |
▶Pha3|–|Speed   |
Pha4 |–|        |
◆▶       Name     ph.Tim.
```

Then, in the fourth column from the left, enter the switching time with which FROM phase should switch TO the next respective phase. Approximately 1 s should suffice:

```
Auto |+|Autorot |  5.0s>
Pha1 |*|Normal  |  1.1s
Pha2 |+|Hover   |  1.1s
▶Pha3|–|Speed   |  1.1s
Pha4 |–|        |
◀◆       Name     Sw.time
```

This value can also be adjusted later according to your personal preferences. Please observe in the process that TO the autorotation phase, whose name is defined as "**Autorot**", is switched without a time delay. If necessary, enter the time with which a change FROM the autorotation phase to a different phase should be affected.

In order to be able to switch between the individual flight phases, the assignment of the individual switches or the three-stage switch is necessary.

The assignment of the switch takes place in the menu …

»Phase assignment« (page 154)

Under "C" and "D", for example, assign the one of the two standard 3-way switches mounted into the switch panels, e. g.:

```
   Phase  assignment
prior          combi
A  B          C  D  E  F
              6  5

             <1 Normal >
```

Now the given switch position must be assigned to the respective flight phase in the **»Phase settings« menu**. Since these phases already have names, the name «1 Normal» will initially appear at the right in the display. If the already assigned autorotation switch was activated, the following warning message appears in the display:

```
   Phase  assignment
prior          combi
A  B  [ Autorot ]  E  F

             <1 Normal >
```

As a reminder:

The autorotation phase has absolute precedence.

Therefore, move the autorotation switch back again then put the selected switch, in the example the three-stage switch connected to switch plug-in locations 5 and 6, initially to one of its limit positions. Now use the selection keys to change to the bottom right and activate this entry field:

```
   Phase  assignment
prior          combi
A  B          C  D  E  F
              6I 5

             <1 Normal >
```

Now use the selection keys to select the desired flight phase for this – for example "2 Hover" …

```
   Phase  assignment
prior          combi
A  B          C  D  E  F
              6I 5

             <2 Hover  >
```

… and confirm this selection with a brief tap on the centre **SET** key of the right touch pad or go ahead and put the switch into its other limit position and define the name for this new switch position, such as «3 Speed».

```
   Phase  assignment
prior          combi
A  B          C  D  E  F
              6  5I

             <3 Speed  >
```

The switch's middle position then receives the name "1 Normal":

```
   Phase  assignment
prior          combi
A  B          C  D  E  F
              6  5

             <1 Normal >
```

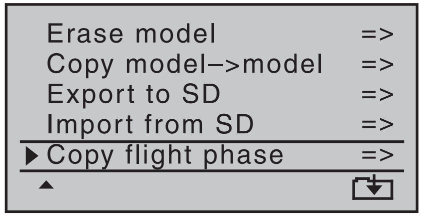
Note:

Exchanged or different name assignments for the three switch positions are, of course, also possible. Thus, for example, implementation of a programmed speed controller (as described beginning in the next column) can make a sequence like "normal / hover / acro" quite logical.

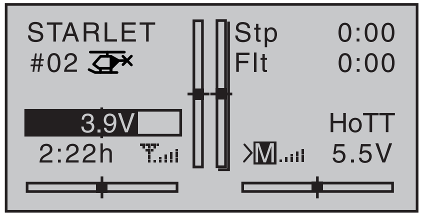
The model settings made before the assignment of a phase switch are now in the flight phase "Normal". This is the phase which is called after the above definition in the switch centre position.

This normal setting, which was already tested in flight, can be copied to a different flight phase so that flying can take place in the same manner in every phase at first. For this purpose, use the menu …

»Copy/Erase« (page 72)



With the operation of the flight phases, it is possible to carry out changes in the phase-dependent menu for each individual phase. Since the mc-16 HoTT and mc-20 HoTT transmitters has digital trimming, in addition to the flight-phase dependent menu settings in the helicopter program, the trim positions of roll, nick and tail rotor stick can also be selected for storage on a flight-phase dependent basis, see **»Stick mode« menu,** page 110:



Enhancement recommendation: Speed controller

At some point in time you may want to install a rotational speed regulator in the helicopter, in order to be able to fly with speeds automatically kept at a constant. In the process, it is logical to couple the individual rotational speeds with the flight phases so that further additional adjustments are possible.

It is mandatory for the transmitter-side programming that the rotational speed regulator was installed and programmed according to the manufacturer's instructions. Of course, the mc-16 HoTT and mc-20 HoTT transmitters here too offers multiple possibilities to realize various speeds in individual phases. A practical proposal which retains the throttle limiter function can be found beginning on page 190.

If you have adjusted your helicopter according to this programming principle, it is not yet a competition helicopter, but it already permits sophisticated flying.

You should only activate additional functions if the model flies faultlessly so that the (desired) improvements are also easy to follow. Insofar as possible, activate individual functions on an individual basis so that you can actually recognize and attribute the change. Bear in mind that it is not the quantity of functions used that distinguishes good pilots, but what they can do in terms of flying with relatively little input.

FCC Information

Graupner **MC-16 / 20 HoTT**

FCC ID: ZKZ-MC-16

FCC ID: ZKZ-MC-20

FCC Label Compliance Statement

This device complies with Part 15C of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

WARNING:

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15C of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

RF Exposure Statement

This device has been evaluated to meet the FCC RF exposure requirement when used in combination with the genuine *Graupner* HoTT accessoires and operated with a minimum distance of 20 cm between the antenna and your body.

Declaration of Conformity

CE 14

EU-Konformitätserklärung
EU-Declaration of Conformity

Hiermit bestätigen wir, dass das nachfolgend bezeichnete Gerät den angegebenen Richtlinien entspricht.
We herwith confirm that the following appliance complies with the mentioned directives.

Artikelbezeichnung: Article description:	mx-10 HoTT, mx-12 HoTT, mx-16 HoTT, mx-20 HoTT, mc-16 HoTT, mc-20 HoTT, mc-32 HoTT GR-12L HoTT, GR-12S HoTT, GR-12 HoTT, GR-16 HoTT, GR-24 HoTT, GR-32 HoTT
Artikelnummer: Article number:	33110, 33112, 33116, 33124, 33016, 33020, 33032 S1012, 33505, 33506, 33508, 33512, 33516
Geräteklasse: Equipment class:	2
Firmenanschrift: Company adress:	*Graupner*|*SJ* GmbH Henriettenstrasse 96 D-73230 Kirchheim/Teck

Einschlägige EU-Richtlinien / Governing EU-directives / Directives CE concernées :

☑ 1. Elektromagnetische Verträglichkeit (EMV) Electromagnetic compatibility (EMC) 2004/108/EC	☑ 2. Niederspannungs-Richtlinie Low-voltage directive 2006/95/EC
☐ 3. Maschinenrichtlinie Mashine directive 2006/42/EC	☐ 4. Medizinprodukte (Klasse 1) Medical device directive (Class 1) 93/42/EEC
☑ 5. Funkanlagen u. Telekommunikationseinrichtungen Radio a. Telecommunication Terminal Equipment R&TTE 1999/5/EC	☐ 6. Ökodesign-Richtlinie Energy related products directive (ErP) 2009/125/EEC

☐ 7. Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektron kgeräten
Restriction of the use of certain hazardous substances
2011/65/EC

Harmonisierte EN-Normen / Harmonised EN-Standards

Der Artikel entspricht folgenden, zur Erlangung des CE-Zeichens erforderlichen Normen:
The article complies with the standards as mentioned below which are necessary to obtain the CE-symbol:

zu 1:
EN 301 489-1 V1.9.2
EN 301 489-17 V2.1.1
EN 62479:2010

zu 2:
EN 60950-1 + A11 + A1 + A12 + A2:2013

zu 5:
EN 300 328 V1.8.1

Unterschrift / Signature

Position: Geschäftsführer / Managing Director

Ausstellungsdatum / Date of issue: 15.01.2015

Graupner

Warranty Certificate

Wir gewähren auf dieses Erzeugnis eine Garantie von 24 Monaten
This product is warrantied for 24 months
Sur ce produit nous accordons une garantie de 24 mois

***Graupner* central service**

Mail box:
Graupner GmbH
Service
Henriettenstrasse 96
D-73230 Kirchheim

Email:
service@graupner.de

Servicehotline
Mo - Th:
9:15 am - 5:00 pm
Friday:
9:15 am - 1:00 pm

☎ from Germany:
07021 72 21 30
☎ from outside Germany:
0049 7021 72 21 30

Other service and information can be found on
http://www.graupner.de/de/service/servicestellen.aspx

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Garantie-Urkunde

Warranty certificate / Certificat de garantie

Set mc-16 HoTT

☐ Best.-Nr. **33016**

Set mc-20 HoTT

☐ Best.-Nr. **33020**

Übergabedatum:
Date of purchase/delivery:
Date d'achat :

Name des Käufers:
Owner´s name:
Nom de l`acheteur :

Straße, Wohnort:
Complete address:
Adresse complète :

Firmenstempel und Unterschrift des Einzelhändlers:
Stamp and signature of dealer:
Cachet et signature du détaillant :

Graupner HoTT

HOPPING.TELEMETRY.TRANSMISSION

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D-73220 KIRCHHEIM/TECK
GERMANY

http://www.graupner.de

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