Graupner/SJ HoTT

COMPUTER-SYSTEM

mc-32 HoTT

Programming Manual

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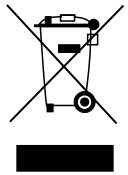
Environmentalprotection notices

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.

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 the information section of this manual.

Safety notices

Be sure to pay attention!

In order to enjoy your modeling hobby for a long time, please read these instructions thoroughly and give particular attention to the safety notices. You should also register yourself at *https://www.graupner.de/de/service/produktregistrierung.aspx* right away in order to automatically receive current information per email about your product.

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

If this remote control system changes ownership, these instructions should surely be included with remote control system.

Intended usage

This remote control system may only be used for the purpose intended by the manufacturer - specifically - for the operation of *unmanned remote controlled models*. Any other usage is not permissible.

Safety notices

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.

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 -15 ° 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.

Receiver installation

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.

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 gasses 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 antenna is 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.

Preferably, the receiver should be mounted in a readily accessible location in the model that is well apart from all electrically operated units. 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 antenna

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.

The orientation of antennas is not critical. Nevertheless, a vertical (upright) installation of receiver antennas is advantageous. In the case of diversity antennas (two antennas), the second antenna should be oriented at a 90° angle to the first antenna.

Servo installation

Always mount servos with the provided rubber vibration-damper parts. 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 carburetor 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 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, ensure that the gas 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.

Range 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 71 and77.

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.

Operating a winged aircraft, helicopter, ship or car

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.

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
Order 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

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

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.

Safety notices and handling instructions for nickel-metal-hydride rechargeable batteries

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

Safety notices

- 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 are to be checked for flawless condition prior to every use. Defective or damaged cells/ batteries may no longer be used.
- Cells/batteries may only be utilized within the limits specified by the technical data for the given battery type.
- **Batteries/cells may not be heated, burned, short-circuited or subjected to overload current or reverse polarity.**
- **Battery configurations formed by parallel connected cells, combinations of old and new cells, or cells of different production, size, capacity, manufacturer, brand or cell type may not be used.**
- Remove batteries from the unit prior to long-term storage periods (weeks or months). Always switch off units whenever they are no longer in use (short-term). Always charge batteries before it is too late.
- 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. The quick charge current rating for the given type of battery must never be exceeded.
- If the battery heats up during charging above 60 °C charging must be stopped immediately. Allow the battery to cool off to about 30 °C before resuming the charging process.
- Never charge batteries which are already charged, batteries which are hot or batteries which have not been discharged to their end-point voltage.
- No modifications may be made to the batteries. Never solder or weld directly on battery terminals.
- The mistreatment of batteries presents a danger of ignition, explosion, chemical burns and combustion burns. Use of an extinguishing blanket, CO_2-fire extinguisher or sand are suitable methods of extinguishing such a fire.
- Leaking electrolyte is caustic; do not allow it to contact the skin or eyes. In the event of an emergency, immediately rinse with a generous amount of water and get the care of a doctor.
- Battery vent openings may never be blocked or sealed, e.g. by solder. Soldering temperature may not exceed 220 °C and not be applied for longer than 20 seconds.
- To avoid deformation, do not exert excessive mechanical force.
- If a battery should become overcharged, proceed as follows:
  Simply disconnect the battery and place it on a non-combustible surface (e.g. masonry floor) until it has cooled off. To avoid the hazards associated with an explosion, never hold the battery in your hands.
- Pay attention that the charging and discharging rules are followed.

General notices

Battery capacity is reduced by every charge/discharge cycle. Storage can also be cause for a gradual reduction of battery capacity.

Storage

Batteries should only be stored when they are not in a completely discharged condition. They should be stored in a dry room having an ambient temperature between +5 °C to +25 °C. When stored for longer than 4 weeks, cell voltage should **not be more** than 1.2 V.

Matching up individual batteries

- To match new batteries with older ones, put a full charge on all of the batteries using a standard charging process. As a rule of thumb, an *empty* battery must be charged for 12 hours at a current rate equal to one tenth of its specified capacity ("1/10 C" method). The batteries are then all charged equally. Such a matching procedure should be repeated about every 10th charge cycle so that batteries are matched again, which contributes to longer battery life.
- If it is possible to discharge individual batteries, this should be done prior to every charging process. Otherwise the battery pack should be discharged to a voltage of 0.9 V per cell. For example, this corresponds to a charge voltage of 3.6 V for the 4-cell pack used in the transmitter.

Charging

Charging is only permissible at specified current rates, charging durations, temperature ranges and continuous

supervision. If a suitable quick charger is not available on which the exact charging current can be set, the battery can be charged by standard charging according to the 1/10 C-method, see example above.

Whenever possible, transmitter batteries should charged with the 1/10 C method because of the differing charge states of the cells. However, charging current may never be allowed to exceed the maximum permissible rate specified in the given transmitter's instructions.

Quick charging

- If your charger offers this option then set the delta peak charge cutoff voltage to 5 mV per cell. However, most chargers are set to a fixed value of 15 … 20 mV per cell so they can be used for both NiCd batteries as well as NiMH batteries If in doubt, find out if your charger is also suitable for NiMH batteries by referring to the charger's operating instructions or consulting a dealership. If you are unsure, charge your batteries at half of the specified maximum current rate.

Discharge

All batteries sold under the *Graupner* and *GM-Racing* trade names are, depending on battery type, suitable for a continuous maximum current load of 6 … 13 C (check the manufacturer's data). In general, the higher the continuous current load, the lower the battery's service life will be.

- Use your battery until its performance degrades or the under-voltage warning sounds.

  Attention:

  A cell voltage of 1.2 V should not be underrun during a long storage period. If necessary, charge the battery before putting it into storage.
- Reflex charging and charge/discharge programs unnecessarily shorten a battery's service life and are only useful in checking battery quality or to "revive" old cells. It is also meaningless to charge/discharge a battery before using it. The exception to this is if your intention is to check the battery's quality.

Disposal of used batteries

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

Disposing of batteries along with common household garbage is forbidden. Old batteries can be turned into communal collection centers 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 & Co. KG
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!

mc-32 HoTT the newest generation of remote control technology

HoTT (**Ho**pping **T**elemetry **T**ransmission) is a synthesis of know-how, engineering and testing done around the world by experienced model pilots. HoTT technology combines 2.4 GHz band transmission/reception with bi-directional communications via a "return channel" integrated into the receiver unit.

Based on the *Graupner/JR* computerized remote control system **mc-24** that was introduced in 1997, the **mc-32** HoTT remote control system has been especially developed for experienced RC pilots All conventional model types can be readily operated with the **mc-32** HoTT system, regardless of whether the model is a winged aircraft, helicopter, ship or land vehicle.

Complex mixed-control functions of guiding surfaces are often necessary for winged aircraft (rudder, elevators) and helicopter models (swashplate). Thanks to this computer technology it is possible to activate these diverse functional requirements with a single "press of a button". Simply select the given model type from the **mc-32** HoTT program and its software will automatically assemble significant mixed-control and coupled functions. This eliminates the need for separate modules in the transmitter to implement complex coupled functions and also makes sophisticated mechanical mixer mechanisms in the model unnecessary. The **mc-32** HoTT remote control system offers the highest level of safety and reliability.

Its software is clearly structured. Functionally-related options are clearly arranged by content in a simple organization.

The **mc-32** HoTT remote control system has 24 model memory locations. 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".

The large graphic display is well organized and simple to operate. The mixer's graphic representation is exceptionally helpful.

Familiarization with the various functions in this remote control system is quick, even for a beginner, because of its clear, straightforward program structure. The user makes his settings with the four-way, touch sensitive buttons located to the left and right of the high-contrast display. Thus, with only little practice, the pilot learns to implement all of the remote controlled model options with which he/she has experience.

This *Graupner* HoTT technique theoretically allows over 200 models to be operated simultaneously 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.

The integrated telemetry menu affords simple access to data and HoTT receiver programming. For example, this can be used to map receiver outputs, assign control functions to multiple servos, and to coordinate the magnitude and direction of multiple servo movements with one another.

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 transducer, dual rate, butterfly, etc.

An appendix is provided which contains additional information about the HoTT system. This manual is rounded out with the conformity declaration and the guarantee certificate for the transmitter.

Please observe the safety notices and technical notices. Read the instructions carefully then test all functions by simply attaching servos to the receiver included in the kit for order no. **33032**. When doing this, please observe the corresponding notice provided on page 20. This will help you learn the essential operating steps and functions of the **mc-32** HoTT in the least amount of time.

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 fun and success with your **mc-32** HoTT remote control system of the newest generation

Kirchheim-Teck, September 2011

Computer System mc-32 HoTT

12 channel remote control set in 2.4 GHz *Graupner* HoTT technology (**Ho**pping **T**elemetry **T**ransmission)

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.

Programming is simplified by a programming technique implemented with capacitive touch buttons.

High contrast, 8 line, blue illuminated graphic display for perfect presentation of all parameter settings and telemetry data. Storage of telemetry data on a micro SD memory card.

Integrated real time clock

4096 steps of 12-bit resolution on the channel signal assures extreme control sensitivity.

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

- Microcomputer remote control system in modern 2.4 GHz *Graupner* HoTT technology
- Bidirectional communications between transmitter and receiver
- Five different languages:
  German, English, French, coming soon per software update Italian and Spanish.
- Ultra fast response times due to reliable, direct transmission of data from the main processor to the 2.4 GHz HF module. No additional delays due to routing over a module processor.
- Telemetry menu for display of telemetry data and for programming optional attachment sensors and receiver outputs
- The telemetry screen provides many programming and evaluation functions to be presented directly in the transmitters display
- Voice output can be called up via freely programmable switches
- Digital servo cycle times of 10 ms selectable
- Short antenna, collapsible
- Operating and programming techniques are similar to the proven concepts implemented in **mc-19** to **mc-24**
- High contrast, blue illuminated graphic display assures perfect control of parameter settings like model type, model memory, clocks and operating voltage.
- Function encoder with two touch-sensitive, four-way buttons permit simplified programming and precise settings
- Key-lock function to prevent unintentional operation.
- 7 flight phases can be programmed

Computer System mc-32 HoTT

12 channel remote control set with 2.4 GHz *Graupner* HoTT technology (Hopping Telemetry Transmission)

- 24 model memories with storage for all model-specific programs and parameter settings
- 7 switches (2 three stage switches, 3 two stage switches and 2 touch switches) and 3 digital actuators are already built-in and can be used as desired
- Free assignment of switches to switched functions by simply switching the desired switch
- Simple programming of motor and brake switchover for electric gliders on the K1 joystick.
- Internal realtime clock for time-stamping log files
- User-replaceable CR2032 buffer battery for the internal realtime clock
- Model memory storage in a modern, non-volatile backup system
- 12 control functions with simplified arrangement of operating elements for supplementary functions like switches and proportional transducers make operating convenient
- Convenience mode selector for simplified switchover between MODES 1 … 4 (Gas left/right, etc.)

  All affected settings are also automatically switched over.
- Graphic servo position display for fast, simple overview and for checking servo movements
- Transmitter output swapping
- Extensive programs for winged aircraft and helicopter models:

  Winged aircraft menu for: 1 QR, 2 QR, 2 QR + 1, 2 and 4 WK as well as 4 QR + 2 and 4 WK, V tail unit, delta/all-wing, 2 elevator servos

  Surface mix: QR-diff, WK-diff, QR → SR, QR → WK, brake → HR, brake → WK, brake → QR, HR → WK, HR → QR, WK → HR, WK → QR and diff. reduction

  Heli menu for: 1-, 2-, 3- and 4-point linkage (1 Sv, 2 Sv, 3 Sv (2 roll), 3 Sv (140°), 3 Sv (2 nick), 4 Sv (90°))
- 16 free mixers, 8 linear mixers, 4 curve mixers and 4 cross mixers
- Swashplate limiter
- ±150 % servo adjustment for all servo outputs, independently adjustable per side (Single Side Servo Throw)
- Sub-trim in the ±125 % range for setting all neutral servo positions
- Servo reverse can be programmed for all servos
- Two stage DUAL RATE/EXPO system, individually adjustable for specific flight phase and switchable during flight
- Stop watches/countdown timers with alarm function
- Copy function for model memory
- Built-in DSC jack for connecting flight simulators or a teacher/pupil system
- Envisioned for a later update:

  Voith-Schneider limiter, works similar to a swashplate limiter

  Door sequencer, e.g. for putting down landing gear automatically or retractable powerplant with runout controller

  Nautical program

General HoTT features

- Maximum noise immunity due to optimized frequency hopping and wider channel spread
- Intelligent data transfer with correction function
- Realtime telemetry evaluation
- Over 200 systems can be used simultaneously
- Update capability via USB interface guarantees future viability
- Simple, very fast transmitter to receiver binding
- Binding with multiple receivers per model in parallel operation is possible
- Extremely fast rebinding, even at maximum distance
- Range test and warning function
- Receiver under-voltage warning in the transmitter's display
- Extremely wide receiver operating voltage range of 3.6 V to 8.4 V (fully functional to 2.5 V)
- Failsafe
- Arbitrary channel assignment (channel mapping), mix functions and all servo settings can be programmed in the telemetry menu
- Up to 4 servos can be controlled simultaneously as a block at a servo cycle time of 10 ms (digital servos only)

The Order No. **33124 set includes**

Microcomputer transmitter **mc-32** HoTT with built-in NiMH transmitter battery 4NH-2000 RX RTU flat (change reserved), plug-in charger and *Graupner* bidirectional receiver GR-24 HoTT.

Recommended charger units (accessories)

Order No.	Designation	Input voltage 220 V	Input voltage 12 V	appropriate for the following batteries				integr. balancer
				NiCd	NiMH	LiPo	lead battery	
6411	Ultramat 8	x	x	x	x	x		
6463	Ultramat 12 plus		x	x	x	x	x	x
6424	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

Transmitter charger cable, order no. ***3022*** *and receiver charger cable, order no.* ***3021*** *are also needed to charge batteries.*

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.

mc-32 HoTT technical data

Frequency band	2.4 … 2.4835 GHz
Modulation	FHSS
Transmit power	see country setting, page 225
Control functions	12 functions, 4 of these can be trimmed
Temperature range	-10 … +55 °C
Antennae	collapsible
Operating voltage	3.4 … 6 V
Current draw	about 800 mA
Dimensions	about 252 x 250 x 59 mm
Weight	about 1700 g with transmitter battery

Accessories

Order No.	Description
1121	Neck strap, 20 mm wide
70	Neck strap, 30 mm wide
3097	Hand transmitter wind protection
	Teacher/pupil cable for **mc-32** HoTT see page 201

Replacement parts

Order No.	Description
2498.4FBEC	4NH-2000 RX RTU flat
33800	HoTT transmitter antenna

Technical data, receiver GR-24 HoTT
Order No. **33512**

Operating voltage	3.6 … 8.4 V*
Current draw	about 140 mA
Frequency band	2.4 … 2.4835 GHz
Modulation	FHSS
Antenna	Diversity antennas, 4 x about 145 mm long, about 115 mm encapsulated and about 30 mm active
Plug-in servos	16
Plug-in sensors	1
Temperature range	about -10 … +55 °C
Dimensions	about 62 x 31 x 14 mm
Weight	about 26 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 connectible servos (speed controls, gyros, etc.) is only 4.8 to 6 V.*

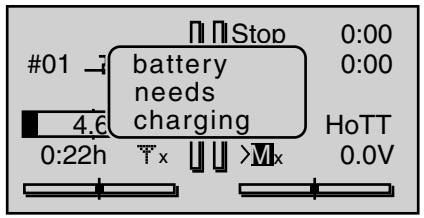
Other accessories are listed in the appendix or can be found in Internet at www.graupner.de. Feel free to contact your dealer too. He will be glad to provide advice.

Operating notices

Transmitter power supply

The **mc-32** HoTT transmitter has a highly capacitive, rechargeable NiMH battery, 4NH-2000 RX RTU (Order no. **2498.4FBEC**), as standard equipment. (changes reserved) **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 226,), default value 4.7 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.

Notice:
*Be sure that the correct battery type is set in the "**Basic Settings**" menu, page 224!* ***NiMH must be set as standard.***

Charging the transmitter's battery

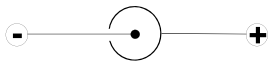
The transmitter's rechargeable NiMH battery can be recharged by connecting the charging jack located, on the right side of the transmitter, with the included charger (order no. **33116.2**).

As a rule of thumb for charging time, an *completely discharged* battery will require 12 hours to recharge at a current rate equal to one tenth of its specified capacity. For the standard transmitter battery and included charger, this is a current rate of 200 mA. However, you must yourself ensure that the charging process is terminated when it should be …

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.

mc-32 HoTT charging jack polarity

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



Charging with automatic chargers

The transmitter's charger jack does come standard with reverse polarity protection but nevertheless it can be used with suitable chargers for quick charging the transmitter's battery.

Set the quick charger unit, according to its manual, for a delta peak voltage difference of 5 mV … 20 mV or equivalent such that it is adapted for quick charging NiMH cells

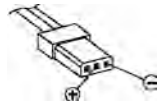
First connect the charger cable's banana plugs to the charger and only then connect the cable's other end into the charging jack on the transmitter. Never allow the bare ends of the banana plugs to come into contact with one another when the other end of the cable is plugged into the transmitter. In order to prevent damage to the transmitter, charging current should never exceed 1 A. If necessary, limit the current at the charger.

Removing the transmitter's battery

To remove the transmitter's battery, first unlatch the cover of the battery compartment on the rear side of the transmitter housing then remove the cover.

Take out the transmitter's battery then disconnect the transmitter battery's connector by carefully pulling on the supply line cable.

Inserting the transmitter's battery



Transmitter connector polarity

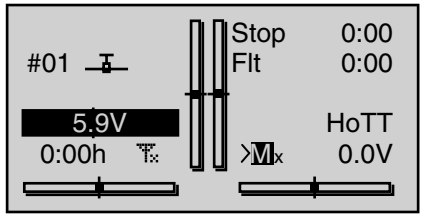
Hold the transmitter battery connector such that the black or brown cable is oriented toward the antenna side and the empty jack of the battery connector is oriented toward the floor side then push the battery connector in the direction of the board onto the three pins sticking out out of the board inside the transmitter. (The battery connector is protected against a reverse polarity connection by two slanted edges, see illustration.)

Place the battery into its compartment and close the cover.

Battery operation timer at the bottom left of the screen

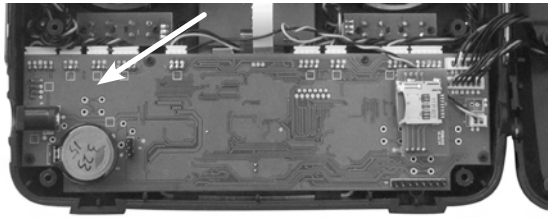
This timer shows the transmitter's cumulative operating time since the transmitter's battery was last charged.

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.



Lithium battery, CR 2032

At the left side of the transmitter board there is a fixture for a lithium battery. The user can replace this battery when necessary with another lithium battery of type CR 2032:



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.

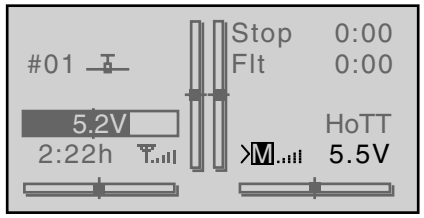
Operating notices

Receiver power supply

A selection of 4 and 5 cell NiMH battery packs having different capacities are available to power the receiver. If digital servos are in use, we recommend a 5 cell battery pack (6 V) to afford adequate battery capacity. If analog and digital servos are used in mixed operation, be sure to pay attention to the given maximum permissible operating voltage. A stabilized, adjustable power supply for the receiver with 1 or 2 receiver batteries can be provided, e.g. the PRX-unit, order no. **4136**, see appendix.

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.



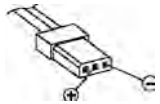
If the adjustable warning threshold (default value 3.8 V) set in the Telemetry menu, see page 217, is underrun, an optical and acoustic under-voltage warning will be issued.

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.

Notice:
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.

Charging the receiver battery

Charger cable, order 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 order 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

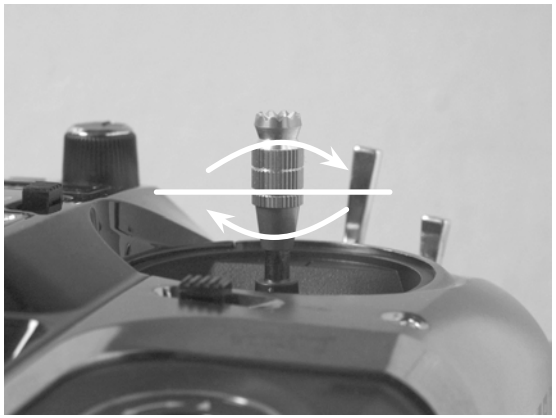
General charging notices

- 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 NiMH battery with an automatic charger unit intended for NiCd batteries Monitor the charger's shut-off behavior if it has that option.
- Do not execute a battery discharge or battery maintenance program through the charger jack. The charger jack is not suitable for this purpose.
- Alway 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.**

Joystick 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.

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 (power switch to "**OFF**").

Open the battery compartment as described on the previous double-page, remove the battery and if a micro SD card is inserted be sure to remove it too.

Once the battery and any micro SD card have been removed, loosen the six countersunk screws on the rear of the transmitter with a Phillips, size PH1, screwdriver, see illustration.

Housing screw locations

Hold the two housing sections together by hand then turn the transmitter upright over a suitable surface so these 6 screws can fall out without getting lost. Now lift up on the backplate carefully and turn it open to the right like you would open a book.

A T T E N T I O N:

Two multi-conductor cables connect the backplate with the transmitter electronics in the upper section. These connections must not be damaged.

Important notices:

- ***Make no modifications of any kind to the circuitry as this will void the guarantee as well as the unit's official permit.***
- ***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.*
- *… reconnect the battery.*

Operating notices

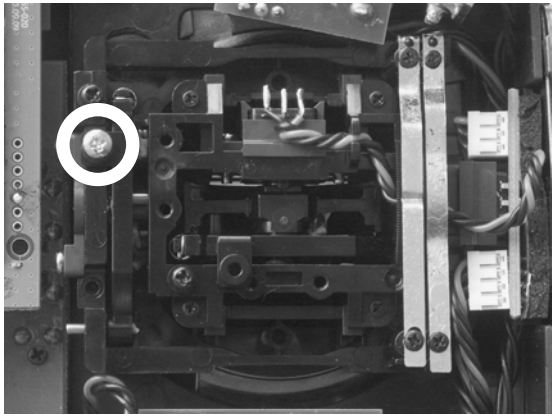
Converting joysticks

Neutralization

Both the left and the right joystick can be configured for neutralized or non-neutralized operation as desired. Open the transmitter housing as previously described.

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

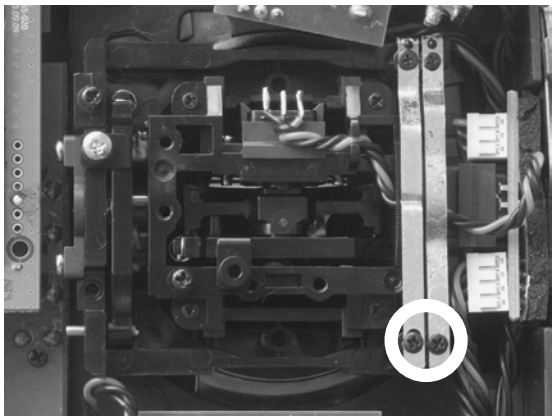
Notice:
The aggregate for the right joystick is a mirror image of the left joystick so the corresponding screw for the right joystick is on the right side just below the middle.



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.



Notice:

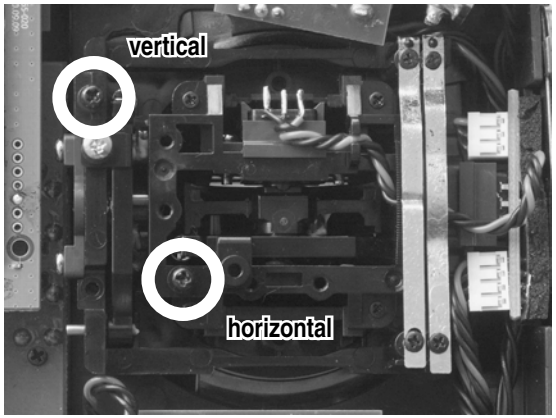
The aggregate for the right joystick is a mirror image of the left joystick so corresponding screws for the right joystick are located at the top left.

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.

- *Right turn (clockwise) = return harder,*
- *Left turn (counter clockwise) = return softer.*



Notice:

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.

Transmitter description

Transmitter operating elements

Attaching the transmitter's neck strap

There is an eyelet on the top side of the **mc-32** HoTT transmitter (see figure at the right) to which a neck strap can be attached. This anchor point has been chosen because the transmitter is optimally balanced here when it hangs from the strap.

Order No. **1121** Neck strap, 20 mm wide

Order No. **70** Neck strap, 30 mm wide

Important notice:

In its delivered configuration, the transmitter can only operate any servos attached to the receiver by way of the two joysticks. For reasons of flexibility, all other operating elements (CTRL 6 … 8, SW 1 … 9) are designated as "free" by the software. These other operating elements can be freely assigned to actuators as described in the text for the "Control adjust" menu on page 96 (winged aircraft models) or page 100 (helicopter models).

Transmitter rear side

Headset connector

The jack centered in the lower portion of the type plate on the back of the transmitter is for connecting conventional earplugs or a headset by way of a 3.5 mm audio plug. (not included in the set)

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 details about "Voice output" can be found in the section "**HIDDEN MODE**" beginning on page 28 and "**Telemetry**" beginning on page 208.

The headset connector's volume control can be adjusted in the "Voice volume" line of the "**Basic Settings**" menu, see page 227.

Mini-USB connector

This connector socket is used to establish a connection between the transmitter and a PC running a Windows operating system (XP, Vista or Windows 7). The PC software required, such as a 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 software is installed on the PC, this USB connection can be used to update the transmitter or even just to set the date and time in the transmitter.

Data jack

For connecting the optionally available Smart-Box, Order No. **33700**.

Details about the Smart-Box can be found with the given product in the *Graupner* RC main catalog or in Internet at www.graupner.de.

DSC
Direct Servo Control

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.

The standard two-pole DSC jack in the **mc-32** HoTT transmitter is used as the teacher *or* pupil jack as well as an interface to flight simulators.

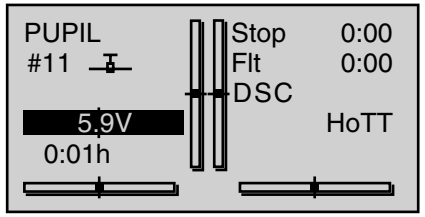
To ensure a proper DSC connection, please observe:

Make any necessary menu changes.

Refer to the section beginning on page **198** to adapt the mc-32 HoTT transmitter to a teacher/pupil system.

1. When operating a flight simulator or when operating the **mc-32** HoTT transmitter as a pupil transmitter, **ALWAYS** leave the transmitter's ON/OFF switch in the "**OFF**" position 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.

   The main status LED should now constantly illuminate red and the transmitter's basic setup screen should show the string "DSC pupil" on the right just below the middle timer. At the same time, the display of telemetry indicators will be suppressed.



   Thus the transmitter is ready for operation.

   To the contrary, teacher mode for the **mc-32** HoTT transmitter requires that the transmitter be switched on *prior* to plugging in the respective cable.

2. Connect the other end of the cable to the desired unit in compliance with the given operating instructions for that unit.

   Important:

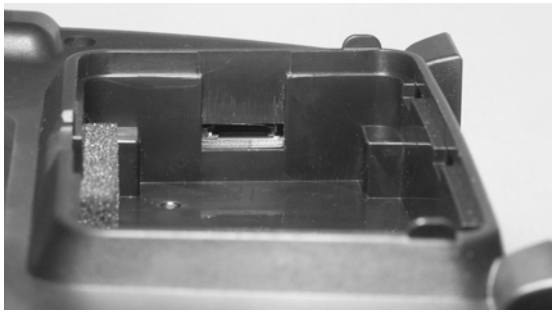
   Be sure that all connectors are seated firmly in their respective sockets.

Notice about flight simulators:
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.

Data storage
Card slot

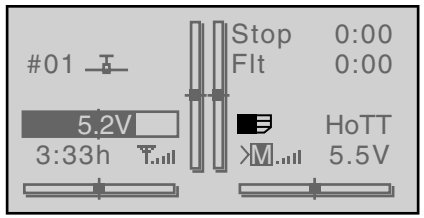
micro SD and micro SDHC

With the **mc-32** HoTT transmitter switched off, removing the battery compartment cover and the transmitter's battery will make the card slot accessible (located in the right sidewall of the battery compartment). This card slot is intended for micro SD and micro SDHC type memory cards.



All conventional micro SD memory cards up to 2 GB and micro SDHC cards up to 32 GB storage capacity can be used. 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 referred to here became known in conjunction with digital cameras and cell phones. It is to be pushed into the slot with its contacts upward, front facing the rear wall and latched in position there. After re-installing the battery and closing the battery compartment, the transmitter can be switched on again. The stylized image of a memory card will appear in the basic setup screen to indicate the presence of the inserted memory card.



Notice:
If a micro SD card is inserted, be sure to remove it BEFORE taking off the transmitter's backplate. Otherwise there is a risk of damaging 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 – both the timer and data acquisition will stop when the flight timer is stopped. The flight timer is started and stopped as described in the section "Timers (general)" on page 138.

While data acquisition is ongoing, the on-screen card image will blink continuously at a slow rate.

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 in sub-folders that are designated with names in the format 0001_year-month-day.bin, 0002_ year-month-day.bin, etc. If a model memory folder is still "unnamed" when the memory card is removed from the transmitter and inserted into the card slot of a PC or laptop, the respective log files can be found in a sub-folder designated "NoName". 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

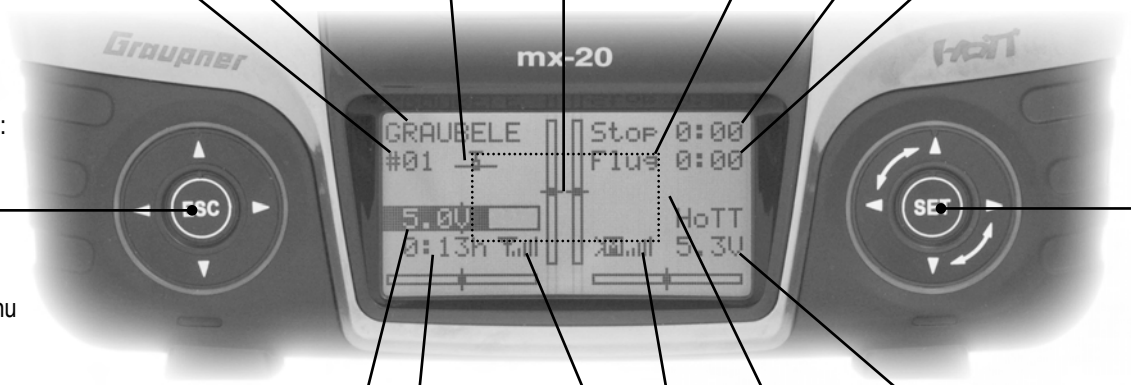
As already mentioned in the section "Headsets" on page 21, this connection can also be used to output the transmitter's acoustic signals as well as those signals and announcements associated with telemetry menu settings. These announcements are made in German language by default. These announcements 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. More information about this can be found in the section "**HIDDEN MODE**" beginning on page 28.

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 "**Copying/deleting**" beginning on page 64.

Notice:
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 (~).

Display and keypad



optical indication of trim lever positions or, during activation of speed controls CTRL 7 + 8, an alternative display of the current positions of these controls

Model name

Model type indicator (winged aircraft / helicopter)

possible warnings, see page 36

Memory location 1 … 24

Stopwatch in min:s (upward/downward)

Flight timer in min:s (upward/downward)

left touch pad

◄ ► ▲▼ paging

◄ ► simultaneously pressed: Change to the servo display menu

ESC = cancel/return

ESC touched for about 1 s: Change to the Telemetry menu and return to basic display

right touch pad:

◄ ► ▲▼

Paging / changing values

SET select / confirm

simultaneous pressing of ◄ ► or ▲▼ = **CLEAR**

Receiver power supply voltage

Battery voltage and charge state bars

(if the preset threshold voltage is underrun, a warning will appear – see "Warnings" on page 36 –, and an acoustic warning tone will sound)

Flight phase name switchover between flight phases by switch

Battery time since last re-charge in h:min

Signal strength indicator

Operating the "data terminal"

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

Display symbols

Displayed telemetry symbols

- the active model memory has not yet "bonded" with a HoTT receiver. More about the "Binding" process, see page 69 or 75.
- non-blinking: 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 signal strength indicator
- >P indicator for pupil signal strength on the teacher transmitter display

Keys left of the display

- **ESC** key
  brief repeated pressing the **ESC** key will cause a stepwise return to the function selection screen 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.
- arrow keys ◄ ► ▲▼
  1. Momentarily pressing one of these keys will cause analogous paging in the given arrow direction through lists, e.g. through the model selection list or the multi-function list or within menus though the menu's lines.
  2. Simultaneous pressing on ◄ ► will change the transmitter's base screen and almost any menu position to the "**Servo display**" menu.

Keys to the right of the display

- **SET** button
  1. After switching the transmitter on, briefly pressing 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. Momentarily pressing the **SET** key from within the Basic Settings menu will activate / deactivate (confirm) the given setting fields.
- arrow keys ◄ ► ▲▼
  1. "Paging" through the Multi-function menu and the menu lines within the Basic Settings menu analogous to the arrow keys of the left touch pad.
  2. Select or set parameters in setting fields after they have been activated by briefly touching the **SET** key, whereby the ►▲ keys and ◄ ▼ are used for the same corresponding functions. In this case it is completely irrelevant which of these two keys are used.
  3. By briefly pressing the ▲▼ *keys simultaneously* or ◄ ► an altered parameter value for the active entry field will again be restored to its default value (**CLEAR)**.

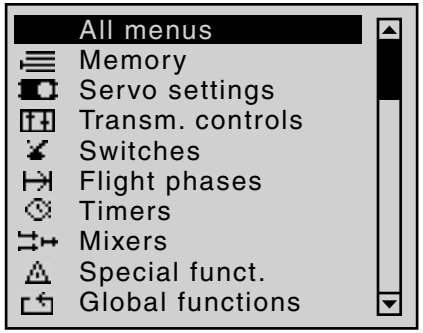
Notice:

- *Touching the given touch pad does not itself initiate the given action but rather the end of the touch.*
- *In the event the touch pads 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.*

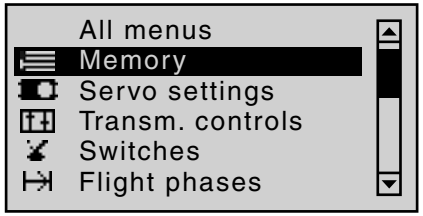
Shortcuts

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

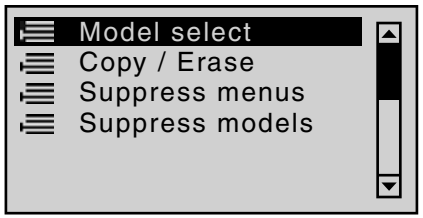
- **CLEAR**
  Brief simultaneous activation of the ▲▼ *keys or* ◄► on the right touch pad will restore the active entry field's changed parameter value back to its default value.
- "**Servo screen**"
  Brief simultaneous activation of the ◄► keys of the left touch pad will cause a jump from the transmitter's base screen or from almost any menu position to the "**Servo**" menu, see page 230.
- "**Telemetry**" menu
  Press the center **ESC** key in the left touch pad for about 1 s to call up the "Telemetry" menu from the transmitter's base screen, see text beginning on page 208, or to return to the base screen again.
- **Graphic display of telemetry data**
  Briefly touching one of the arrow keys of the left or right touch pad 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.
  Briefly touching the centered **ESC** or **SET** key will cause a return back to the base screen.
- "**HIDDEN MODE**"
  (language selection and contrast)
  Press and hold arrow keys ▲▼ of the left touch pad then momentarily touch the **SET** key of the right touch pad, see next double-page.
- **Entry lockout**
  Entry lockout is activated and deactivated from the base screen by simultaneously pressing the **ESC** and **SET** keys for a little longer (about 2 s).
- **Quick-Select**
  From the multi-function list, a jump can be made to a "Structure overview" by a brief, simultaneous touch on the ▲▼ *or* ◄► keys of the right touch pad. Menus are arranged in clear groups in this overview.



Now the desired group can be selected with the ▲▼ arrow keys of the left or right touch pad …



… and then briefly touching the center **SET** key in the right touch pad. As soon as the key is released, only the respective generic term for the given menu will remain listed. For example:



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**":

▶S1	=>	0%	100%	100%
S2	=>	0%	100%	100%
S3	=>	0%	100%	100%
S4	=>	0%	100%	100%
S5	=>	0%	100%	100%
▼▶	Rev	cent	–	trv +

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 touch pad to just beyond the column for "- travel +":

▶S1	=>	0%	150%	150%
S2	=>	0%	150%	150%
S3	=>	0%	150%	150%
S4	=>	0%	150%	150%
S5	=>	0%	150%	150%
◀▼	Rev	cent	–	lim +

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 touch pad appropriately to the left:

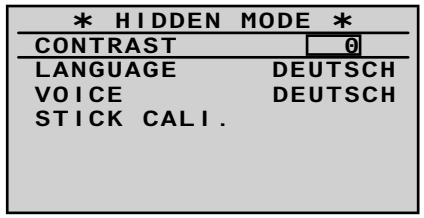
▶S1	=>	0%	100%	100%
S2	=>	0%	100%	100%
S3	=>	0%	100%	100%
S4	=>	0%	100%	100%
S5	=>	0%	100%	100%
▼▶	Rev	cent	–	trv +

This procedure is analogous for the other menus.

HIDDEN MODE

Language selection and display contrast

The **mc-32** HoTT transmitter's "**HIDDEN MODE**" can be reached from almost any menu position by pressing and holding the ▲▼ arrow keys of the left touch pad and the SET key of the right touch pad for about one second until the screen shown below is displayed.



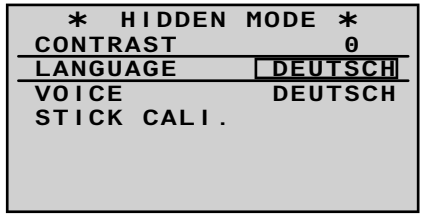
CONTRAST

The screen's contrast characteristic can be adapted as needed in this screen's "CONTRAST" line, as described in more detail on pages 226/226, by tapping on the center SET key of the right touch pad. Tapping again on the SET or ESC keys will cause a return to line selection.

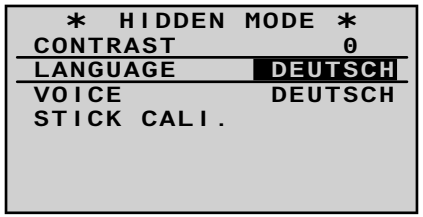
The line …

LANGUAGE

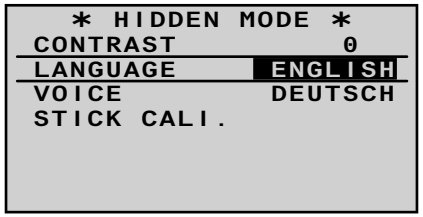
… can be reached by tapping arrow key ▼ in the left or right touch pad. One of the transmitter's available languages can then be selected from the screen which appears.



Activate language selection by pressing on the center SET key in the right touch pad.



Now the default language "GERMAN" can be replaced with the desired language by making a selection with the arrow keys of the right touch pad. For example:



Confirm the selection by tapping again on the center SET key in the right touch pad. All settings stored in the transmitter remain intact after a change of language has been made.

The following languages are available for selection at the time this handbook was printed:

- German
- English
- French

The Italian and Spanish languages are planned for inclusion at a later point in time. These will then be made available by way of an update download from the transmitter's web page at the Graupner website www.graupner.de.

VOICE TRIGGER

As mentioned in section "Headsets" on page 21, 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.

The following languages are available for selection at the time this handbook was printed:

- German
- English
- French

The Italian and Spanish languages are planned for inclusion at a later point in time. These will then be made available on the transmitter's download web page at the Graupner website www.graupner.de.

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

Preparation

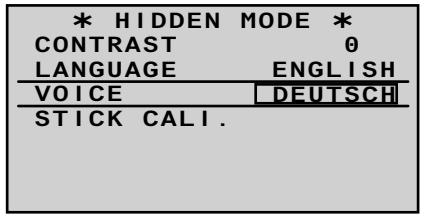
If not already done, insert the SD card or SDHC card into the transmitter as described on page 22. Now when the transmitter is switched on it will perform some operations which will include the creation of a "VoiceFile" on the memory card.

Take this memory card, which has now been prepared by the transmitter, out of the transmitter and insert it into a suitable card reader. If necessary, attach the card reader to your PC or laptop. Now copy the language

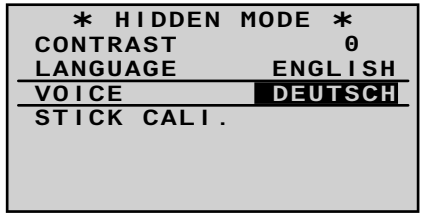
packet downloaded from the transmitter's web page (e.g. "voice_gb.vdf") into the folder created by the transmitter. Now take the memory card out of the card reader and re-insert it into the transmitter. Once the memory card is inserted in the transmitter, switch the transmitter on *with RF switched off*.

Language change

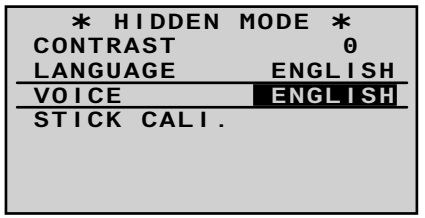
Use the left or right arrow touch key to select the line "VOICE".



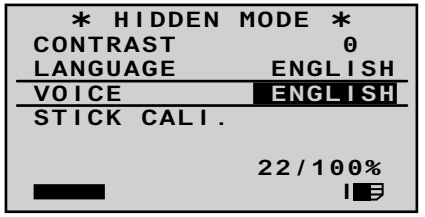
Activate language selection by pressing the center **SET** key in the right touch pad.



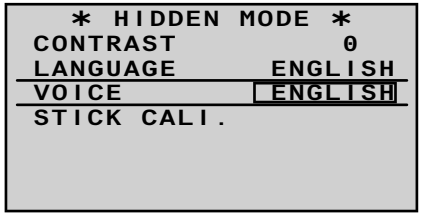
Now use the right touch pad arrow keys to replace the default language "DEUTSCH" with the language you want. For example:



Confirm your selection with another tap on the center **SET** key in the right touch pad. The selected language packet will be loaded into the transmitter's memory.



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



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.

Notice:

- *If the warning ...*

*... appears, then the transmitter's RF radiation is still active. Jump to the "**Basic settings**" menu, select the "RF transmit" line, select its "OFF" option and then 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 warning ...*

... appears then the transmitter could not find an appropriate file on the inserted memory card.

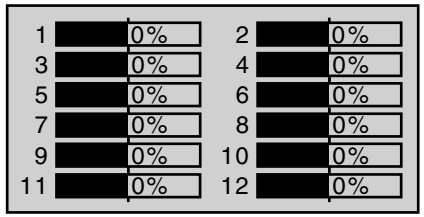
JOYSTICK CALIBRATION

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

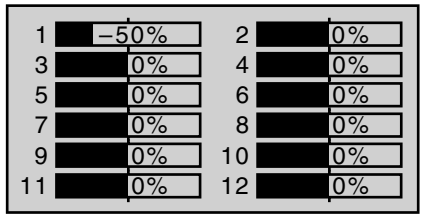
Jump to the "**Model select**" menu and initialize a free model memory as described on page 60. Whether the model to be initialized is a winged aircraft or a helicopter is irrelevant.

Wait for the notices which typically appear in the base screen following a model change then jump to the "**Servo display**" menu, for example by simultaneously touching the ◄ ► keys of the left touch pad (WITHOUT any interim change to trim settings or other program settings).

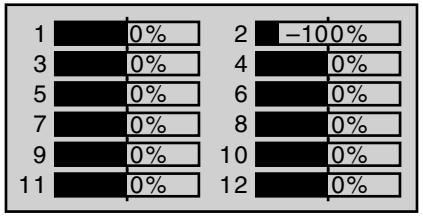
If all four of your transmitter's joystick functions are still self-neutralizing, this display should ideally look like the one shown below.



Otherwise the graph bars show current setting percentages for joystick control functions which are not self-neutralizing – typically for the "K1", throttle/brake or throttle/pitch, control stick. For example, if the throttle/brake control stick is in its "quarter-throttle" position, the display would appear as shown below.

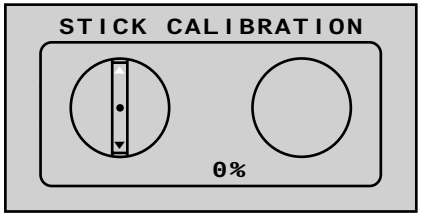


One after the other, put both joysticks into each of their four possible limit positions *without* exerting force at the limit position. In each of these eight possible limit positions, the – side dependent – indication for exactly -100 % or +100 % should be displayed. For example, if Control 2 is at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

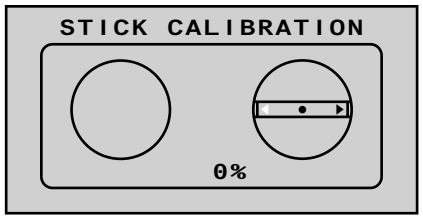


Regardless of the number of self-neutralizing joystick functions available on your transmitter, if these checks produce four 0 % results and eight 100 % results then your transmitter's joysticks are optimally calibrated. You can terminate this process then, if appropriate, delete the model memory just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

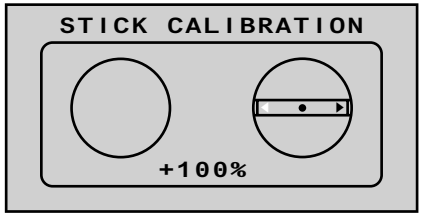
Otherwise jump (as described at the outset of the previous double page) to the "Stick cali." line in the "**HIDDEN MODE**" menu then briefly touch the center **SET** key in the right touch pad.



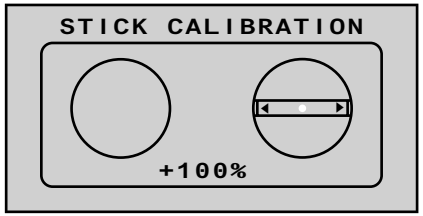
The arrow keys ◄ ► of the right touch pad will now allow you to cyclically select the four calibrated joystick planes, e.g. the left/right plane of the right joystick.



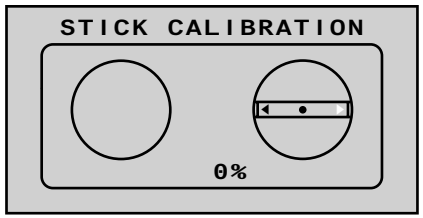
Now position the *right* joystick – without exerting extra force – to its left limit corresponding with the on-screen blinking arrow pointing to the left.



… and briefly touch the center **SET** key in the right touch pad. This concludes this example calibration of the right joystick's left limit. The circle in the middle of the stylized joystick plane will now blink as confirmation of the calibration.



Now release the self-neutralizing joystick so it can return to its center position and then tap again on the center **SET** key to calibrate the joystick's centered position. The right arrow marker will begin to blink.



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

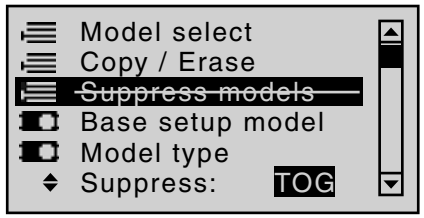
Notice:

- *Correct any bad calibrations by repeating the respective process.*
- *Within a given joystick plane, each of the three calibration positions can be selected directly with the ▲▼ arrow keys of the left or right touch pad.*

Briefly touching the center **ESC** key of the left touch pad will terminate the process and return to the sub-menu "Stick cali.".

Telemetry data display

As described on page 220 in the context of sub-menu "**SENSOR SELECT**" for the "**Telemetry**" menu …



… the output of sensors attached to the receiver can be processed and activated for graphic presentation on the screen. This data is then appropriately displayed by the graphic indicators described below.

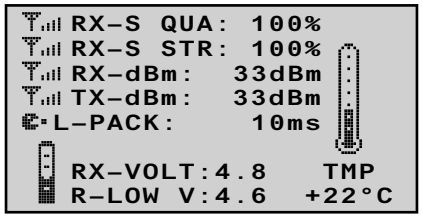
These graphic elements can be reached from the transmitter's base screen by briefly touching the ◄ or ► keys of the left or right touch pad. Page back and forth between individual graphic elements with the same keys and return to the base screen again with the **ESC** key.

Notice:

The sequence of the following element descriptions corresponds to their selection sequence when touching 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

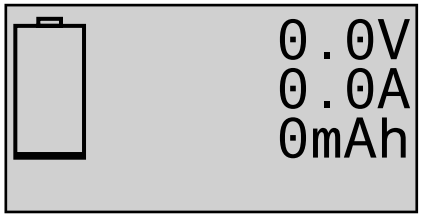


This screen presents the "**RX DATAVIEW**" of the Telemetry menu's "**SETTING & DATA VIEW**", see page 209, with data processed and displayed graphically.

The displayed items are as follows:

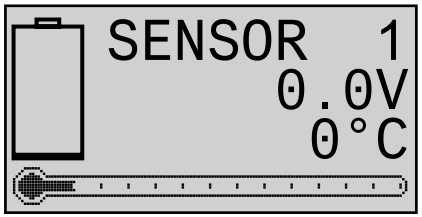
Value	Explanation
RX-S QUA	signal quality in %
RX-S ST	signal strength in %
RX-dBm	reception power in dBm
TX-dBm	transmit power in dBm
V PACK	Indicates the longest time span in ms in which data packages are lost in the transmission from the transmitter to the receiver.
RX-VOLT	current operating voltage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

AKKU 1 (GENERAL + ELECTRIC modules)



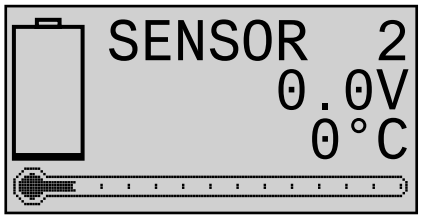
This display depicts current voltage, current current draw and, if attached, the expended capacity of "Batt 1" connected to the General-Engine (Order No. **33610**), General-Air (Order No. **33611**) or Electric-Air module (Order No. **33620)**.

SENSOR 1 (GENERAL + ELECTRIC module)



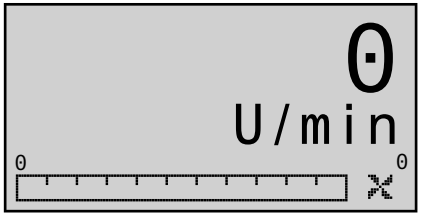
If attached, this display depicts currenly measured voltage and temperature from a "T(EMP)1" temperature/voltage sensor, Order No. **33612** or **33613** for General-Engine (Order No. **33610**), General-Air (Order No. **33611**) or Electric-Air module (Order No. **33620).**

SENSOR 2 (GENERAL + ELECTRIC modules)



If attached, this display depicts currently measured voltage and temperature from a "T(EMP)2" temperature/ voltage sensor, Order No. **33612** or **33613** for General-Engine (Order No. **33610**), General-Air (Order No. **33611**) or Electric-Air module (Order No. **33620).**

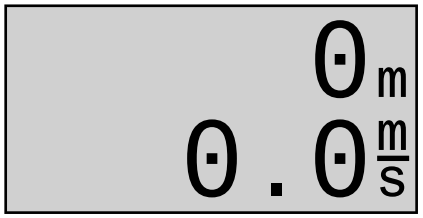
Rotary speed sensor



If attached, this display depicts the speed measured by a speed sensor, Order No. **33615** or **33616,** for a General-Engine (Order No. **33610**), General-Air (Order No. **33611**) or Electric-Air module (Order No. **33620).**

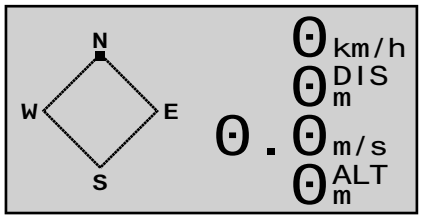
Notice:
The appropriate blade count must first be set in the module's telemetry menu before the correct speed can be displayed.

Vario



If attached, this display will depict altitude relative to location or starting location (in m) as well as the current ascent/decent rate (in m/s) from data provided by a GPS-/Vario module (Order No. **33600)** or Vario module (Order No. **33601)** connected to the receiver's telemetry connection.

GPS

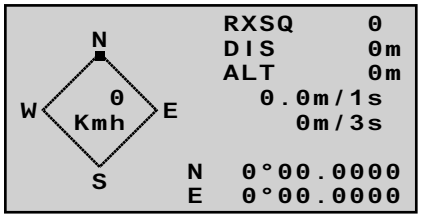


If attached to the receiver, this display will depict the data from a GPS module with integrated Vario, Order No. **33600**.

The displayed items are as follows:

Value	Explanation
km/h	Speed
DIS	horizontal distance in m
m/s	ascent/decent rate in m/s
ALT	altitude relative to starting location in m

GPS



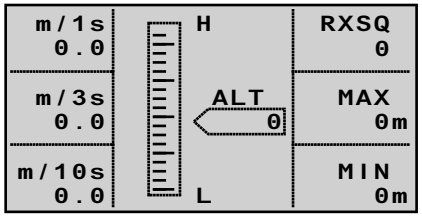
If attached to the receiver, this display will depict the data from a GPS module with integrated Vario, Order No. **33600**.

Aside from the model's current position and speed, the center 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, m/3 s and m/10 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
RXSQ	return channel signal strength
DIS	distance
ALT	current altitude with respect to starting
m/1 s	m/1 s ascent/decent rate
m/3 s	m/3 s ascent/decent rate
m/10 s	m/10 s ascent/decent rate

VARIO

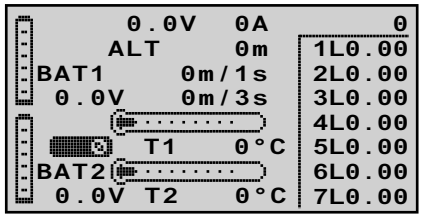


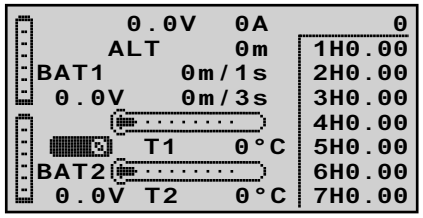
If attached to the receiver, this screen will display the data acquired by a Vario module, Order No. **33601**.

The displayed items are as follows:

Value	Explanation
ALT	current altitude
RXSQ	Signal strength of the signal received by the receiver in %, see page 209.
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/1 s	m/1 s ascent/decent rate
m/3 s	m/3 s ascent/decent rate
m/10 s	m/10 s ascent/decent rate

ELECTRIC AIR MODULE





If attached to the receiver, this screen will display the data acquired by an Electric-Air module, Order 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.

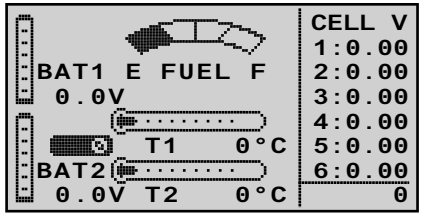
The current voltage of up to two batteries (BAT1 and BAT2), up to two temperature measurements (T1 and T2), current altitude with respect to the starting location, the model's ascent/decent rate in m/1 s and m/3 s and, in the middle of the screen, the current draw currently being taken from a power source.

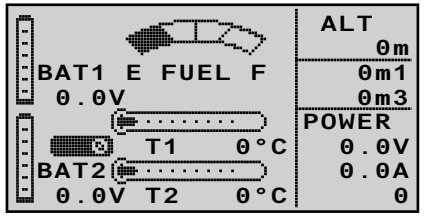
Along the right edge of the screen is a table of alternating values for cell voltages at balancer connections (L) or voltages for up to 7 attached battery cell packs (H).

The displayed items are as follows:

Value	Explanation
V	current voltage
A	current current
BAT1 / BAT2	battery 1 or 2
ALT	current altitude
m/1 s	m/1 s ascent/decent rate
m/3 s	m/3 s ascent/decent rate
T1 / T2	temperature of sensor 1 or 2
L or H	cell voltage of cells 1 … 14 (14 max) L = balancer connection 1 H = balancer connection 2

GENERAL MODULE





If attached to the receiver, this screen will display the data acquired by a General-Engine module, Order No. **33601**, or a General-Air module, Order 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.

The current voltage of up to two batteries (BAT1 and BAT2), the measurement results of up to two temperature sensors (T1 and T2) and a fill level gage for the fuel tank.

An alternating display along the screen's right edge will display a list of current cell voltages for a LiPo battery with up to six cells or operational data (current altitude with respect to the starting location, ascent/decent m/1 s and m/3 s, current current being drawn in amperes and current voltage of the battery connected to the sensor).

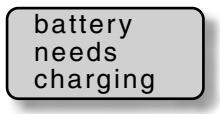
The displayed items are as follows:

Value	**Explanation**
BAT1 / BAT2	battery 1 or 2
FUEL	fuel level / tank gage
E / F	empty **/** full
T1 / T2	temperature of sensor 1 or 2
CELL V	voltage of cells 1 … 6 (6 max)
ALT	current altitude
0m1	m/1 s ascent/decent rate
0m3	m/3 s ascent/decent rate
A	current draw i amperes
V	battery voltage

Warning notices

"Bind not available"
A receiver has not yet been bound to the currently active model memory. Briefly touching the **SET** key will cause a direct jump to the appropriate option.

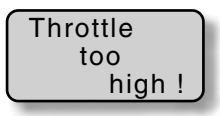
Please select RF transmission "ON" or "OFF".



Operating voltage is too low

Failsafe has not yet been activated

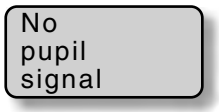
A suitable language file cannot be found on the memory card



Helicopter throttle joystick or limiter too high

Prompt to switch off RF transmission
(language file can only be loaded when RF is *switched off*)

No bound receiver in range



Connection between teacher and pupil is interrupted

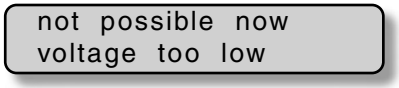
No SD or SDHC memory card in the card slot or card is not legible

- Is the "wireless teacher/pupil connection" that was active when the transmitter was last used to be continued, **CONT** or switched off **OFF**?

- After being switched on, the transmitter has not been used within the time limit preset in the "Power-on beep" line of the "**Basic Settings**" menu, see page 227. The message …

… will appear in the screen, the center LED will alternately blink red and blue and an acoustic warning tone will sound.
If the transmitter continues unused it will autonomously switch itself off after one minute.

- When battery voltage is too low, a model change is blocked for reasons of safety. The screen will show an appropriate message.



Function fields in the display

SEL, **STO**, **SYM**, **ASY**, ⁄_,

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

A marked function is activated by tapping on the **SET** key.

Function fields

- **CLR** (clear) delete
- **SEL** (select): selection
- **STO** (store): store (e.g. control position)
- **SYM** set values symmetrically
- **ASY** set values asymmetrically
- ⁄_ switch symbol field (assignment of all types of switches)
- within a menu, change to the second page (menu continuation)

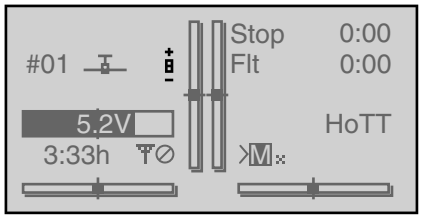
Position indicator

Proportional controls, CTRL 7 and 8

As soon as one of the proportional controls (CTRL 7 & 8) in the middle console is turned, a small symbol will appear to the left of 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 proportional controls CTRL 7 & 8.

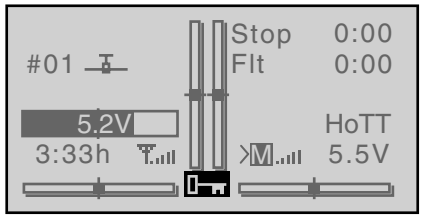
Logically, the left proportional control (CTRL 7) is displayed by the left bar indicator and the right bar indicator displays the position of the right proportional control (CTRL 8). The two horizontal bars continue to show current trim positions of respective joystick trim controls.



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

Entry lockout

The touch keys can be locked out to prevent unintended access and operation of settings. This lockout is established (when the mc-32 HoTT transmitter is displaying its base screen) by simultaneously pressing and holding both the **ESC** and **SET** keys for about two seconds. 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.

The lockout can be removed by again touching and holding the **ESC** and **SET** keys for about two seconds. A lockout condition is also removed the next time the transmitter is switched on.

Putting the transmitter into operation

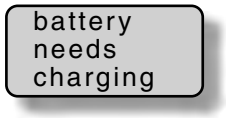
Preliminary remarks about the **mc-32** HoTT transmitter

Preliminary remarks

Graupner's 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. 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.

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 14. Otherwise a warning tone will be sounded when the low voltage threshold, preset in the "Batterie warning" line of the "**Basic Settings**", is underrun. This low voltage threshold can be set, as described on page 226. When this threshold is underrun, a warning tone will be sounded and an appropriate message will be overlaid on the base screen.



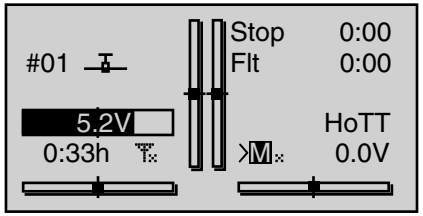
Transmitter startup

After being switched on, the message shown below will appear in the transmitter's screen for about two seconds.

Within this brief period you may be able to switch off RF transmission by using the ▲ or ► key of the right touch pad to shift the query's response from "ON" to "OFF" such that the **ON** option is displayed in normal video and the **OFF** option is highlighted in reverse video.

Now switch the RF module off by tapping on the center **SET** key in the right key pad.

The center LED, which in the meantime has been illuminating in blue, will change its color to red again and the transmitter's display will show the screen depicted below.



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

If the transmitter were to be switched on *without* switching off RF transmission, the center LED would illuminate in blue and the symbolic transmitter antenna in the screen would blink. At the same time, an acoustic warning will sound until a connection is established with the respective receiver. As soon as this connection is established, the "x" at the base of the antenna symbol will be replaced by a field strength indicator, for example T..ıll, and the optical and acoustic warnings will stop.

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 ..ıll) as well as the current voltage of the receiver's power supply.

On the other hand, if the screen displays the symbol combination T⊘ and the center LED illuminates in red continuously then the currently active model memory is not "bonded" to any receiver.

Under-voltage warning

If transmitter voltage drops below the adjustable threshold specified in the "**General Settings**" menu, see page 226 (default value, 4.7 V), an optical and an acoustic under-voltage warning will be 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).***

  If the remote control system is to be operated in France then the transmitter MUST be changed over to "FRANCE" mode, see page 227. IN NO CASE may the Universal/EUROPE mode be used IN FRANCE.
- ***The receiver included in the set with the mc-32 HoTT 2.4 transmitter (and already bound to the transmitter by settings made in the factory) is***

capable of operating up to 12 servos.
In order to achieve the greatest possible flexibility but still preclude unnecessary inadvertent operator errors, control channels 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 96 (winged aircraft) or 100 (helicopter models).

- ***The fundamental procedure for initial programming of a new model memory location can be found on page 60 and the programming examples that begin on page 236.***
- ***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 196, i.e. when signal reception drops out all servos will remain in their current positions until a valid signal is again received.***
  In such a case, increase the distance (between the transmitter and the model containing the receiver) until the indicators are again "normal".

Transmitter firmware updates are made at one's own risk by connecting the five-pole mini-USB connector on the rear side of the transmitter to a PC running Windows XP, Vista or Windows 7.

Current software and information is available in Internet at www.graupner.de under the download link for the given product.

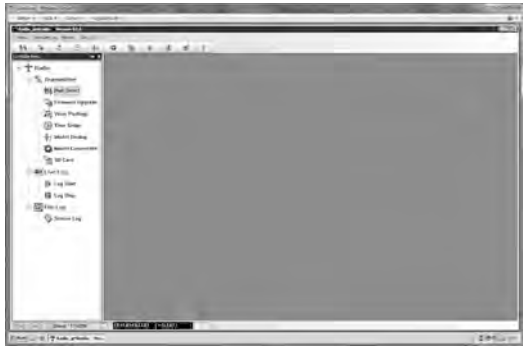
Notice:
You will automatically be notified of new updates per email after registering your transmitter at https://www.graupner.de/de/service/produktregistrierung.

The USB cable delivered with the USB interface option, Order No.**7168.6**, is also needed to make an update. This cable's connector is plugged directly into the 5-pole mini-USB connector socket on the rear side of the transmitter

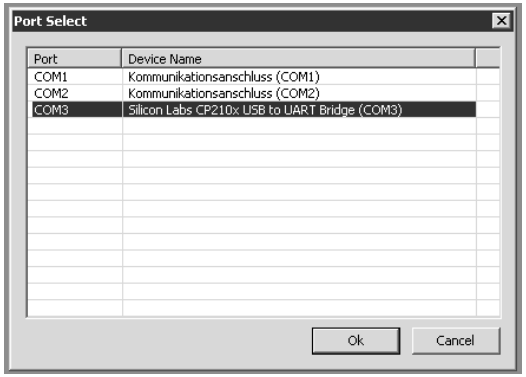
Updating mc-32 HoTT software

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.

1. **Installing drivers**
   Install the required driver software, included in the "USB Drivers" folder of the program packet, onto your PC or laptop so your computer can handle the transmitter's integrated USB interface.
   Start driver installation with a double-click on the respective file and follow the on-screen instructions. Once this software has been successfully installed, the computer must be re-started. Drivers only need to be installed once.
2. **Installing the software up-loader**
   Unpack file "Radio_grStudio_Install_VerXX.zip" and start the actual installation program "Radio_grStudio_Install_VerXX.msi" with a double-click then follow the instructions.
   This program is installed by default under "Start\Programs\Graupner\ Radio_grStudio\Radio_grStudio_Ver-SX.X".
3. **Establishing a transmitter-to-PC connection**
   With the transmitter switched off, connect the USB cable by way of its 5-pole mini-USB socket to the rear side of the transmitter.
4. **Updating mc-32 HoTT transmitter software**
   Start the "Radio_grStudio_Ver-SX.X" program from the respective folder, by default at "Start\Programs\Graupner\ Radio_grStudio\Radio_grStudio_Ver-SX.X".

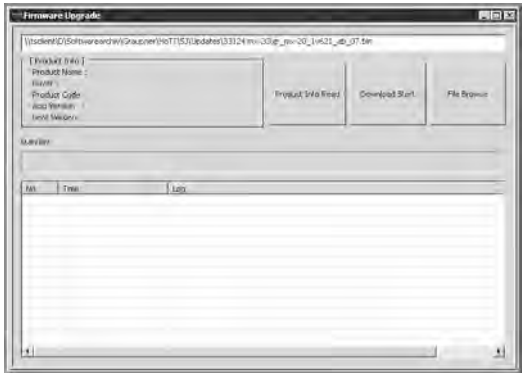


Use the selection sequence "Menu", "Port Setup" or open the "Controller Menu" and click on "Port select".



Now in the "Port select" window, select the COM port connected to the USB interface. The correct port can be recognized by its designation "Silicon Labs CP210x USB to UART Bridge" in the "Device Name" column. In the above example this would be the "COM 3" port.

Now call up menu option "Firmware Upgrade" from "Menu" or open the "Controller Menu" and click on "Firmware Upgrade".

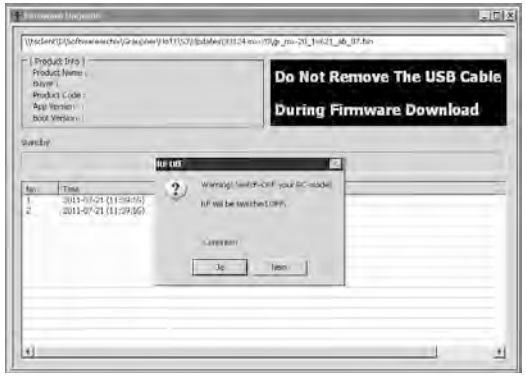


Click on the button labeled "File Browse" and select the desired firmware update file with a ".bin" filename extension from the "Open file" window.

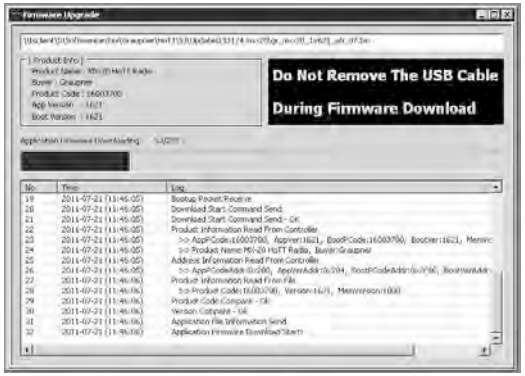
Firmware files are product-specifically coded, i.e. if you should accidentally select a file which does not correspond to the product (e.g. receiver update file instead of a transmitter update file), the "Product code error" popup window will appear and the block the update process from starting.

Now switch on the transmitter then start the transmitter update by clicking on the "Download Start" button.

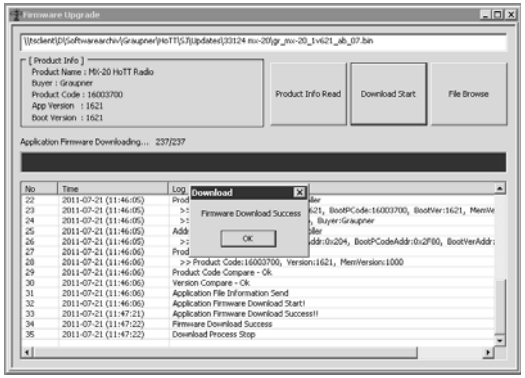
After a brief period a warning will appear stating that the transmitter's RF transmission will now be interrupted and that, because of this, any receiver system currently in operation should be switched off. Switch off your receiver system if it is switched on then click on "Yes".



This will start the actual update process. A progress bar will begin to operate above a sequence of running text lines.



Do not terminate the update process before the progress bar has reached its right end and the "Firmware Download Success" message appears.



Click on "OK". Subsequently switch off the transmitter and disconnect the USB cable between the transmitter and the PC or Laptop.

If the progress bar hangs up without showing any further progress, close the program and repeat the update process. Be sure to watch for any error messages that may appear.

Receiver initialization

Preliminary remarks about the GR-24 receiver

Receiver system

The **mc-32** HoTT remote control set includes a type GR-24, 2.4 GHz bidirectional receiver for connecting up to 12 servos.

After switching on this HoTT receiver, should "its" transmitter not be within range or switched off, then the receiver's red LED will illuminate continuously for about 1 s then begin to blink slowly. This indicates the receiver has not (yet) established a link to a *Graupner* HoTT transmitter. If a link has been established, the green LED will illuminate continuously and the red LED will extinguish.

In order to establish a link to the transmitter, the *Graupner* HoTT receiver must first be "bound" to "its" particular model memory in "its" *Graupner* HoTT transmitter. This procedure is known as "binding". This "binding" linkage is only necessary once for each receiver/model memory combination. Refer to pages 69 or 74. The "binding" procedure has been done at the factory for model memory 1 of the units delivered together as a set so this "binding" procedure will only be necessary to link additional receivers or if a memory location change becomes necessary (and – e.g. after a change of transmitter – can be repeated anytime).

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 profiles when plugging in these connectors. Never use force.

The two outer connections, having designations "11+B-" and "12+B-" are intended for the battery connections. These two connections plus the servo's respective connections can be combined into a single connector at each end by way of a V or Y cable, Order No. **3936.11**.

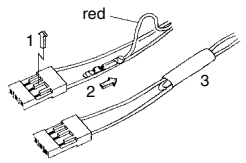
Do not reverse the polarity of this connection. Reversed polarity could destroy the receiver and devices attached to it.

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

Concluding notices:

- *The significantly greater servo resolution characteristic of the HoTT system produces a noticeably firmer response behavior in comparison to previous technology. Please take the time to familiarize yourself with this sensitive behavior.*
- *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.*

  Use a small screwdriver to carefully lift the connector's middle latch slightly (1), pull on the red wire to remove its connector pin from the connector (2) then put insulation tape around the removed connector pin to prevent possible short circuit conditions (3).



Follow the installation instructions on page 46 for the receiver, the receiver antenna and for mounting the servo.

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. Once power is on, release the button again.

If a receiver reset is done while the transmitter is switched off or on a receiver which is not bound, the receiver's LED will slowly blink red for about 2 or 3 seconds and then a binding procedure can be started right away on the transmitter.

If 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 a brief period as an indication that your transmitter/receiver system is again ready for operation.

* *Battery Elimination Circuit*

Receiver firmware updates

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 are made by way of the connector located on the side of the receiver and the help of a PC running under Windows XP, Vista or Windows 7. The optional USB interface cable needed for this is Order No. **7168.6** along with adapter cable, Order No. **7168.6A**. 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.

Notice:

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

Updating receiver firmware

Notice:

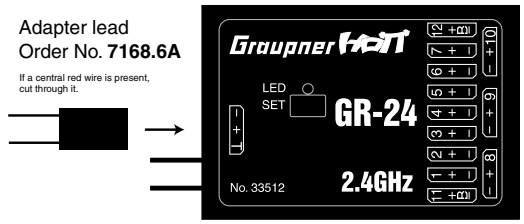
Before any update procedure, be sure to check the charged status of the receiver's battery. If necessary, charge the battery before beginning with an update.

1. **Installing drivers**

   If not already done, install the required driver software for the USB interface, Order No. **7168.6,** as described on page 39.

2. **Establishing a receiver / PC connection**

   Connect the USB interface cable, Order No. **7168.6**, via the adapter cable, Order No. **7168.6A**, with the "- + T" connector on the receiver. These connectors are protected against polarity reversal so pay attention to the small profiles on the sides of connectors. Do not use brute force, these connectors should latch in rather easily.



Attention:

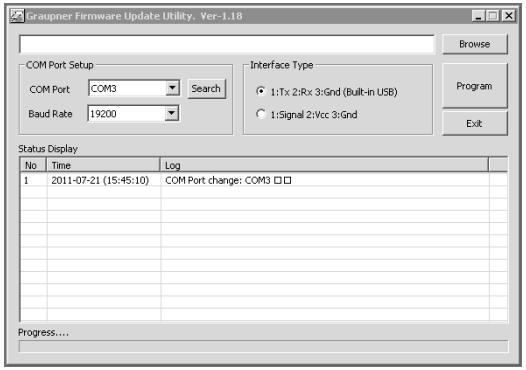
If the adapter cable is still has wires for all three poles, cut the red insulated wire for the middle connector pin of the adapter cable, Order No. 7168.6A.

Afterward, make the USB interface connection to the PC or laptop by way of the delivered USB interface cable (PC USB/mini-USB). If the USB interface is connect properly, a red LED on the interface board should illuminate for a few seconds.

If not already off, now switch the receiver off.

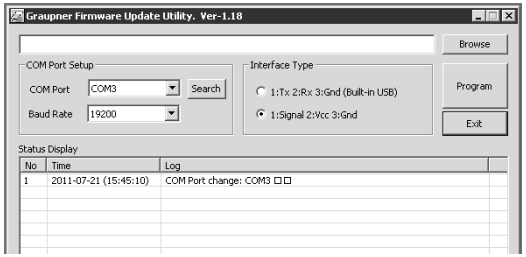
3. **Firmware update utility program**

   On the PC, start the "Graupner_Firmware_Update_Utility_VerX.XX.exe" program with a double-click. This program is located among the files in the "Firmware-Updater" folder. (At the time of printing for this manual, this program's current version is 1.18 and it can be started without first being installed.)



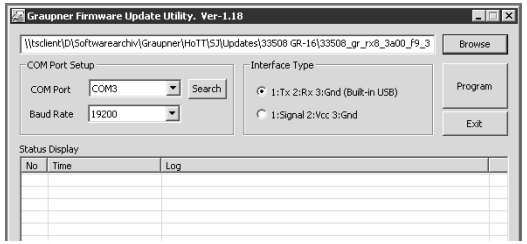
In the "COM Port Setup" group box, select the COM port to which the USB interface is connected. If you are not sure which selection is correct, press the "Search" control, choose the connection labeled "Silicon Labs CP210x USB to UART Bridge" from the popup window and then activate "OK". The "Baud Rate" setting should be "19200".

Afterwards, click on the "Signal 2:Vcc3:Gnd" radio button in the "Interface Type" group box.



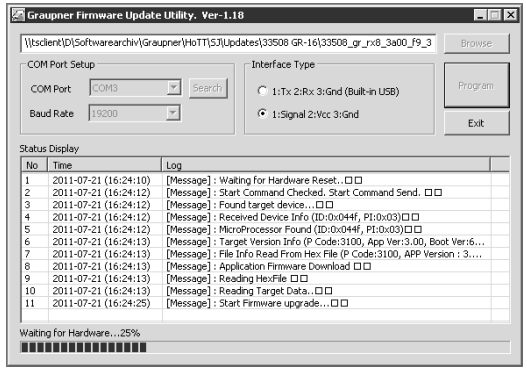
Now click on the control labeled "Browse" that is located at the top right corner of the window. From the "Open file" window which appears, select the appropriate firmware update file for your receiver. Such files always have the ".bin" filename extension.

Typically this file can be found in the folder whose name is prefixed with the order number of the receiver to be updated. This folder should contain the ZIP file that was downloaded and unpacked. Its filename should also be prefixed with the order number of the receiver to be updated. For the standard GR-12 receiver included in this set, the folder would be designated "33512_12CH_RX". The filename will appear in the corresponding window.



Firmware files are product-specifically coded, i. e. if you should accidentally select a file which does not correspond to the product (e. g. transmitter update file instead of a receiver update file), the "Product code error" popup window will appear and the block the update process from starting.

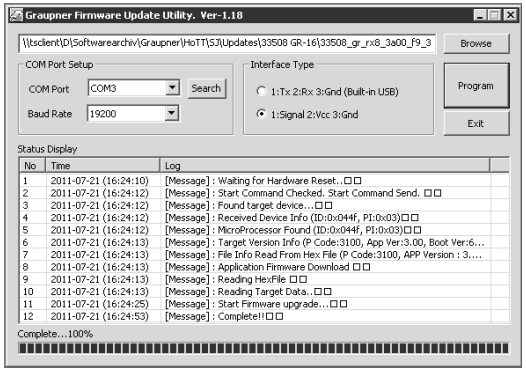
Activate the control labeled "Program". Wait for the progress bar to start. Depending on the speed of the computer being used, this may take several seconds. Now press and hold the receiver's **SET** button while switching on the receiver's power supply. After a few seconds the "Found target device …" message will appear in the status display. Now you can release the receiver's button. The actual firmware update will begin autonomously after this message has appeared.



However, if the receiver is not detected, the "Target device ID not found" popup window will appear.

If this process terminates before reaching the 100 % mark, switch off your receiver's power supply then try to start the update process all over again. Do this by performing the above steps again.

The status display and progress bar will show you the progress of the firmware update. The update is concluded when the text "Complete … 100 %" or "Complete!!" appears in the bottom line of the status display.



Both LEDs on the receiver will illuminate during the update process. Upon successful conclusion of the update process, the green LED will extinguish and the red LED will begin to blink.

Switch off the receiver, remove the interface cable and repeat the process for any other receivers you have which must be updated.

4. Receiver initialization

Following a successful update process you MUST perform a receiver initialization procedure before using the receiver again. This is necessary for reasons of safety.

Do this by pressing and holding the receiver's **SET** button then switching the receiver's power supply on. Now release the **SET** button again. When you subsequently switch the receiver on again, the receiver's green LED will illuminate continuously for about 2 or 3 seconds. Except for binding information, all other settings that may have been programmed into the receiver will now be reset to factory defaults and will have to be re-entered again if they are needed.

Installation notices

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.

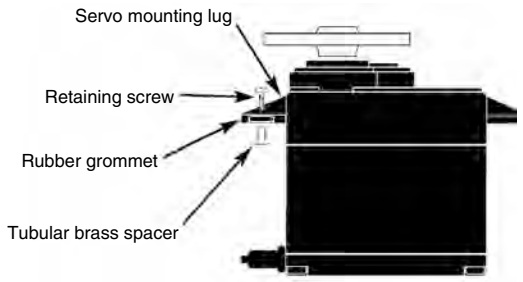
Tests have shown that vertical (upright) antennas provide the best results during wide-range flights. In the case of diversity antennas (two antennas), the second antenna should be oriented at a 90° angle to the first antenna.

The GR-24 HoTT receiver connections designated "11+B" and "12+B" are intended for battery connections. If necessary, an addition battery connection for a servo can be made if a V or Y cable is used, Order No. **3936.11.** The power supply is bussed across all numbered connections so it can be attached at any of these 12 connectors. However, due to additional voltage losses associated with the traverse connectors, connections 8, 9 and 10 should not be used for connecting the receiver's battery.

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. Nevertheless, it is recommended this be done on the transmitter side via the "Transmitter output" option, see page 206.

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.
2. All switches must be installed such that they are not affected by exhaust gasses 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.

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 57 and 59.

Also observe the safety notices provided on pages 4 … 9.

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 system 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.

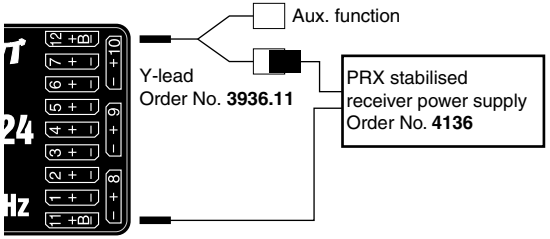
Give primary attention to fully charged batteries when model operation is to be started. Be sure that the contact surfaces of connectors and switches really are low resistance. If necessary, measure the voltage drop across installed switch cables when they are under load because even new heavy-duty switches 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 …

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.

It is also a good practice to connect the receiver to its power source with two cables rather than just one. Cable "1" could be connected to the "12+B" receiver connector as is usual and cable "2" could be connected to the opposite end of the row at the connector labeled "11+B". For example by using two power supply cables to connect one switch or voltage regulator to the receiver. Just use a V or Y cable, Order No. **3936.11** to accomplish this (see figure) if you should need one or both of the receiver's connectors to attach a servo, speed controller, etc. This double-connection technique to switches and speed controllers not only reduces the risk of a cable break but also ensures a more uniform supply of power to the connected servo.



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 6.6 V 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 6 V.** Use of these batteries in conjunction with these devices demand use of a stabilized voltage regulator, e. g. the PRX, Order 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, 7.4 V, 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 6 V.** Use of these batteries in conjunction with these devices demand use of a stabilized voltage regulator, e. g. the PRX, Order No. 4136, see appendix. Otherwise there is danger that attached devices will incur damage within a short period of time.

Term definitions

Control function, control, function input, control channel, mixer, switch, control switch, fixed switch

To make use of this **mc-32** HoTT manual easier, a number of the terms used repeatedly throughout this manual have been defined below.

Control function

A "control function" is a signal intended to affect a given control action – initially independent of its signal course in the – . For example, this could be for throttle, ruder 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.

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 joysticks (control functions 1 through 4), even though these four control functions can be freely swapped around for both model types ("winged aircraft" and "helicopters") by use of software "Mode" settings, e.g. throttle left or right. The dual-axis function for throttle/airbrake is often referred to as the C1 control (channel 1).
- the three proportional rotary controls, which are CTRL 6, 7 + 8,
- the switches, SW 4/5 and 6/7, which are CTRL 9 and 10,
- switches SW 1 … 3 as well as 8 and 9, if assigned to a control channel via the "**Transm. controls**" 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.

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 **"controls arrangement"** and settings in the **"Transm. controls"** menu have their effect "downstream" of this imaginary point of connection. 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. This signal is only yet to be influenced by settings made in the **"Servo adjustment"** menu and the "**Transmitter output**" menu before it leaves the transmitter's 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.

Mixers

The transmitter's software contains diverse 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 145 of this manual.

Switches

The three standard 2-position switches, SW 2, 3 and 8, the two 3-position switches, SW 4/5 and 6/7, as well as both pushbutton switches, SW 1 and 9, can also be combined with 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-32** HoTT software.

These software switches, designated "G1 … G4", are triggered by setting a switch-point along the physical control's course of travel. This "trigger setting" is simply defined with the press of a button. 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 226.

Fixed switches FXI and FX

This type of switch turns a function permanently on, e.b. timers (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

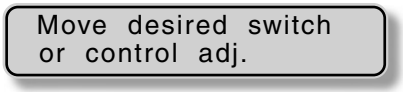
Principle procedure

The **mc-32** Hott system exhibits maximum flexibility when it comes to assigning standard equipment operating elements to specific 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.

Physical control and switch assignments

The "**Control adjust**" menu can be used to assign transmitter inputs 5 … 12 to operate servos, both from any given joystick direction (K1 … K4) as well as to assign any other physical control designated "CTRL" or switch designated "SW". After tapping on the center **SET** key in the right key pad, the screen shown below will appear.



Now simply activate the desired control (joystick 1 … 4, CTRL 6 … 10 or switch 1 … 3, 8 or 9).

Notice:
Rotary controls, CTRL 6 … 8, will not be recognized until they "detent". Therefore these controls can be turned back and forth until the correct assignment is shown in the screen. If adjustment travel is insufficient, activate the control in the other direction.

On the other hand, if you wish to assign a control in the "**Control switch**" menu, page 119, the "activate desired control" message will appear.

Important notice:
Controls to be assigned (particularly CONTROL 6 … 10) MUST be pre-assigned in the "Control adjust" menu to one of the inputs 5 through 12!

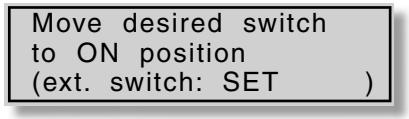
Control assignment

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

Use the arrow keys in the left or right touch pad to select the appropriate column.

How to assign a switch

1. Briefly press the **SET**-T key in the right touch pad. The message shown below will appear in the screen.



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.

   Since CTRL 9 and 10 as well as the 3-position switches, SW 4/5 and 6/7, are not only usable as controls but also function as pure switches, there is a total of 9 switches ("SW 1 … 9") available for use as desired.

Changing switch action

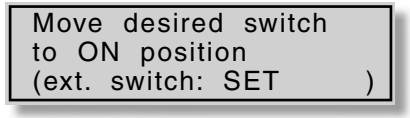
If the activation of a switch is to result in the opposite action, put the switch or joystick in the desired OFF position, again activate the switch assignment and reassign the switch again so it will respond with the desired action.

Clear switch

A switch which has been assigned as described under point 1 can be cleared by simultaneously pressing the ▲▼ or ◄ ► key combination briefly in the right key pad (**CLEAR**).

Assignment from the "external switch" list

Those menus in which the message …



… appears for switches designated with "SW" can be used to assign 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 four inverted switches "C1i... C4i".

Use the arrow keys in the left or right key pad to select the desired switch then assign it with a brief tap on the center **SET** key of the right touch pad.

Notices:

- *The two FX switches turn a function on "FXI" or off "FX\" permanently.*
- *All other 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.*

Application examples:

- *Shut-off of an on-board glow plug heater upon underrun or overrun of an idle threshold point programmed for the C1 joystick. 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 "AI → Rud" 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.*

The control switches, freely programmable in the "**Control switch**" menu, can be incorporated into switch programming, i.e. assigned to a function instead of a "normal" switch. At those program locations where switches can be assigned you always have the opportunity to assign one of the control switches, C1... C4, instead of a physical switch by selecting one of these out of the list of "external switches".

Digital trim

Functional description and description of C1 cut-off

Digital trim with visible and audible indicators

Both joysticks are equipped for digital trimming. When you give the trim lever a brief push (one "click"), the neutral position of the associated joystick 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 mid-point 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 so-called "C1" (channel 1) control function –.

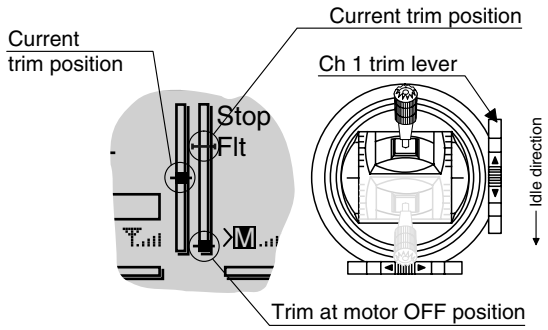
This C1 trim includes yet another special function for winged aircraft and helicopter models, it allows the carburetor's idle setting to easily be found for a combustion motor.

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 joystick 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".



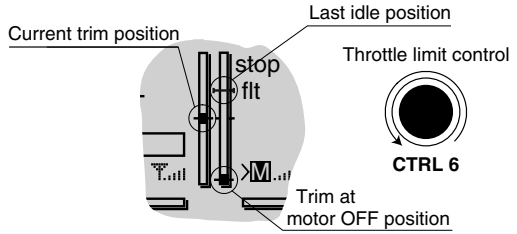
This cut-off trim will be deactivated when "None" is entered on the "Motor at C1" line of the **"Model Type"** menu, see page 82.

Notice:

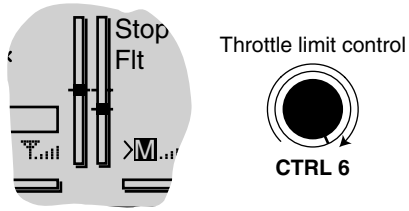
Since this trim function is only effective in the "Motor off" direction, the display illustrated above will change appropriately if the C1 joystick's control direction for minimum throttle is changed from "back" to "front" (on which the above illustration is based) in the "Motor at C1" line of the ***"Basic 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 104. As long as the throttle limit control remains in the "left" 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 "right" 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 59.

Winged models

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 "2HRSv3+8" permits the connection of two elevator servos to receiver outputs 3 and 8.

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 ruder throw independent of upward throw.

Finally, the position of flaps can be controlled by a control out of group CTRL 6 … 10. Alternatively, there is a phase-dependent trim function available for flaps, ailerons and elevators in the **"Phase trim"** menu.

The "V tail unit" is to be selected from the **"Model type"** menu if the model has a V tail unit instead of a normal tail unit. This V tail unit selection provides coupled elevator and ruder control functions for both tail flaps – each controlled by a separate servo – which handles both elevator and ruder 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.

Up to 7 flight phases can be programmed into each of the 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 carburetor idle setting.

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

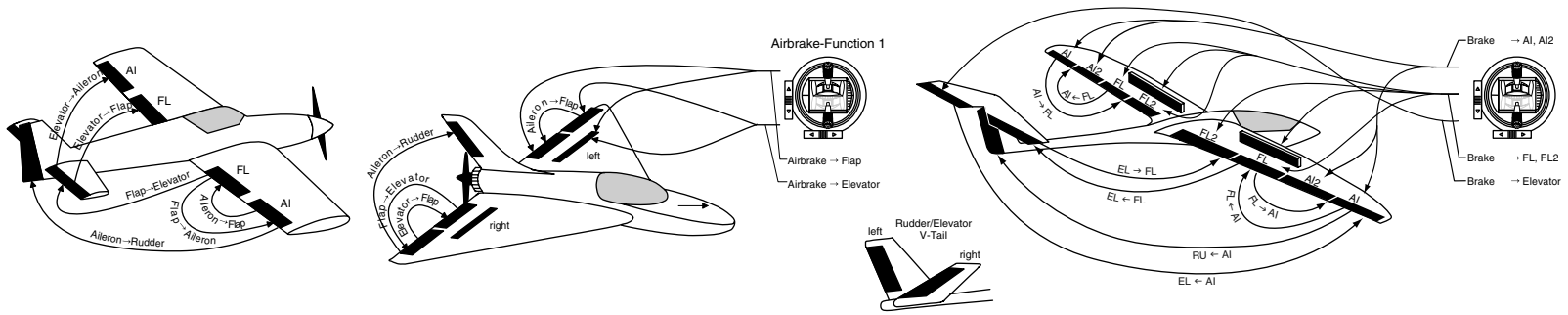
All transmitter controls (CTRL) and switches (SW) can be assigned in the **"Control adjust"** menu to inputs 5 … 12 with almost no restrictions.

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 8 freely allocatable linear mixers, 4 curve mixers ("**Free mixers**" menu) and 4 dual mixers ("**Dual mixer**" menu), there are also flight-phase dependent 6-point curves 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



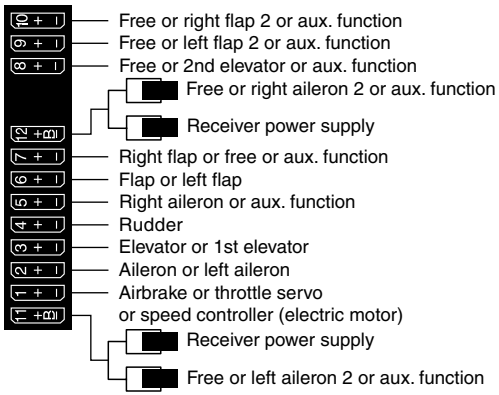
Installation notices

Servos MUST be connected to the receiver in the sequence illustrated here.

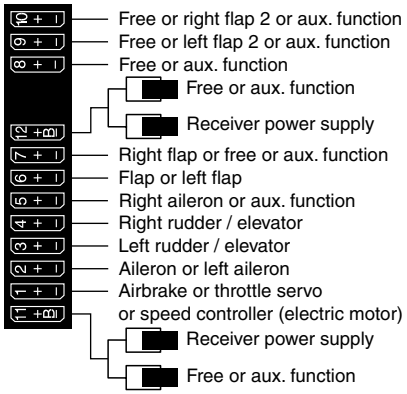
Outputs which are not needed are simply left empty.
Also be sure to follow the notices on the next pages.

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

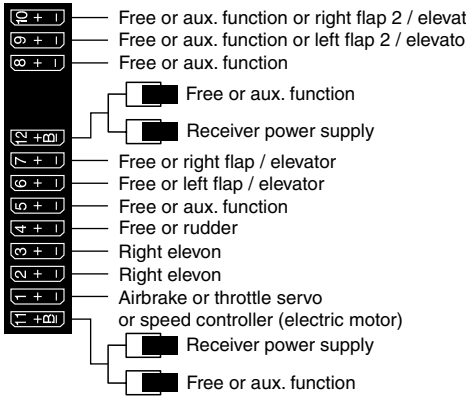
… and tail plane type "normal" or "2 elevator servos"



… and tail plane type "V tail unit"



Delta/flying wing aircraft models with and without motor having up to two aileron/elevator servos and up to 2 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 actuation direction wrong	Remedy
V tail	Rudder and elevator reversed	Reverse the polarity of servos 3 & 4 in the "**Servo adjustment**" menu
	Rudder correct, elevators reversed	Swap the connections for servos 3 & 4 on the receiver
	Elevators correct, rudder reversed	Reverse the polarity of servos 3 & 4 in the "**Servo adjustment**" menu AND 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 the polarity of servos 2 & 3 in the "**Servo adjustment**" menu AND on the receiver
	Aileron correct, elevators reversed	Swap servos 2 & 3 at 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.

Helicopter models

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 and then can take advantage of **mc-32** HoTT features, step-by-step, with increasing expertise.

The **mc-32** HoTT program can operate all conventional helicopters having 1 … 4 servos for pitch control.

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**").

Except for pitch/throttle trimming, digital trimming can be stored as "global" for all flight phases or as "flight phase specific". C1 trim permits easy location of an idle setting.

The control assignments of inputs 5... 12 can be made common to every flight phase or separate ("**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.

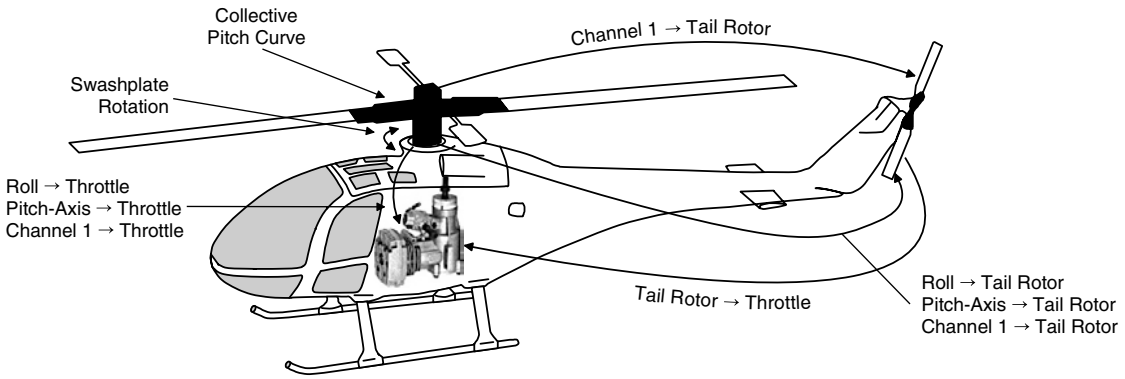
There are 8 freely assignable linear mixers. There are also 4 curve mixers that can be programed and these can also be switched on or off, depending on the flight phase, in the "**Mix active/Phase**" menu. Beyond this, there are also 4 dual mixers available.

Available in the **"Helicopter mixer"** menu are flight-phase-dependent 6-point curves for pitch, throttle and tail rotor mixer non-linear characteristics as well as two independent swashplate mixers each for roll and nick. Independent of this, the control curve of the channel 1 joystick can be defined with up to 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. Channel 1 → Throttle (6-point curve)
3. Channel 1 → Tail rotor (6-point curve)
4. Tail rotor → Throttle
5. Roll → Throttle
6. Roll → Tail rotor
7. Nick → Throttle
8. Nick → Tail rotor
9. Gyro suppress
10. Swash rotation
11. Swash limiter

The "Throttle limit" function (input 12 in the **"Control adjust"** menu) allows the motor to be started in any flight phase. Control 6 – the proportional rotation control, CTRL 6 top left – is assigned to input 12 by default. This "throttle limiter" establishes – depending on its given position – the maximum possible carburetor 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. Servos ***must*** *be connected to receiver outputs as illustrated at the right in the bottom figure. Outputs which are not used are simply left empty. More details about respective swashplate types can be found on page 86 in the* **"Basic settings"** *menu.*

Installation notices

Servos MUST be connected to the receiver in the sequence illustrated here.

Outputs which are not used are simply left empty.

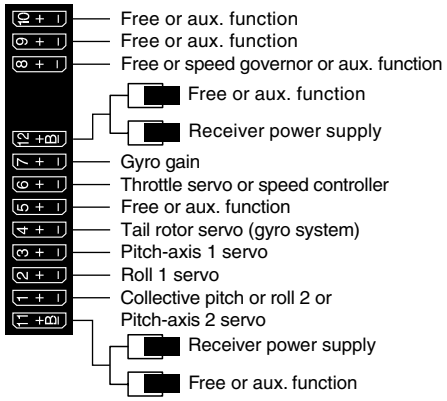
Also be sure to follow the notices on the next pages.

Notice:

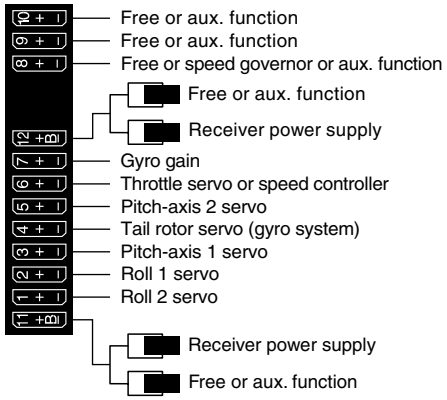
A speed regulator is also to be connected to receiver output "6" in order to take full advantage of the throttle limiter's convenience and safety features, see text beginning on page 104. See page 169 about this.

Receiver layout for helicopter models …

… with 1 to 3 swashplate servos



… with 4 swashplate servos



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

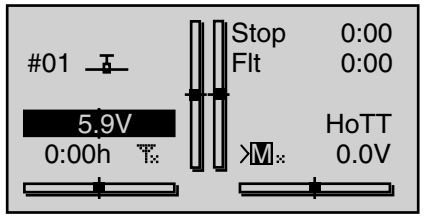
… so only these menus need to be dealt with to program a helicopter model.

Detail program description

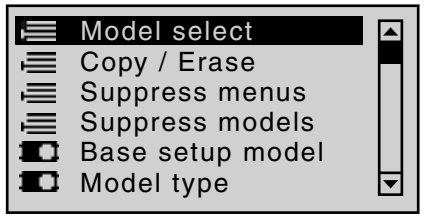
Loading a new memory location

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 base screen, a jump to the "Multi-function list" is made by tapping on the center **SET** button of the right touch pad. (The center **ESC** button of the left touch pad will cause a jump back to the base screen.) By default, when the multi-function list is called for the first time after switching on the transmitter, the "**Model select**" menu item will be active and displayed in reverse video. If this is not the case, use the arrow keys (▲▼, ◄ ►) of the left or right touch pad to select the "**Model select**" menu item …



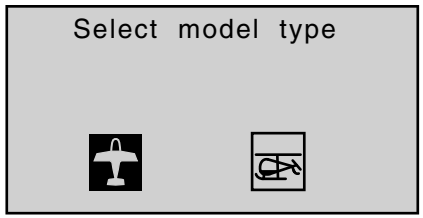
… then (again) tap the center **SET** button of the right key pad.

In the transmitter's delivered state, the first model memory is initialized to the "**winged aircraft**" model type and the receiver in the delivery is bound to this model memory location, recognizable by the displayed receiver code at the right end of the line. In the above example, R12 is a code for the GR-24 receiver included in the set. In contrast, a "non-bound" model memory would appear with the code placeholder "**---**".

The remaining memory locations, marked "***free***", are not occupied and thus also "non-bound". If you wish to program a winged aircraft model then, after leaving the "**Model select**" menu by tapping on the center **ESC** button of the left touch pad, programming of the model can begin right away … or now use the ▲ or ▼ keys of the left or right touch pad to select one of the free memory locations …

… and then tap on the center **SET** key of the right touch pad to confirm the choice.

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



Use the ◄ or ► of the left or right key pad to select the basic model type then tap the center **SET** button in the right key pad. 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.

On the other hand, if you wish to begin with a **helicopter** then use the ▲ or ▼ keys of the left or right key pad to select a memory location labeled "***free***" and tap briefly on the center **SET** button in the right key pad to confirm your choice. You will be now be prompted to select the basic model type, i.e. either "winged model" or "helicopter model". Select the appropriate symbol with the ◄ or ► keys of the left or right touch pad then tap briefly on the center **SET** button in the right touch pad to confirm your choice. This initializes the selected model memory with the selected model type and you can now program your model into this model memory.

Changing over to another model type is still possible if you first erase this memory location (**"Copy / Erase"** menu, page 64).

Notice:

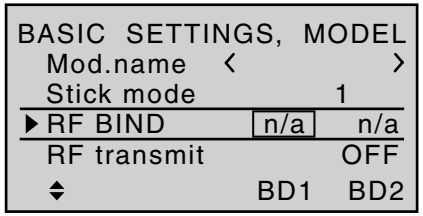
- *If, from the base screen, the currently active model memory is to be erased then immediately after the erase action one of the two model types, "Winged" or "Heli" must be defined. You cannot avoid this selection even if you switch the transmitter off. When*

the transmitter is switched on again the undesired occupation of the that model memory will have to be erased from another memory location.

In contrast, 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 ...*

... will appear in the screen for a few seconds as notification that a "bond" to a receiver does not exist. With a brief tap on the center **SET** *button in the right touch pad you can jump directly to the appropriate option.*

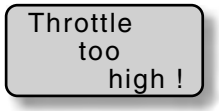


Further details about binding a receiver can be found on page 69 or 75.

- *After the aforementioned "BIND. N/A" warning message closes automatically, the warning ...*

... will appear (also for just a few seconds) to serve notice that no failsafe settings have yet been made. More about this can be found on page 192.

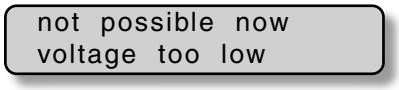
- *If the screen should display the warning ...*



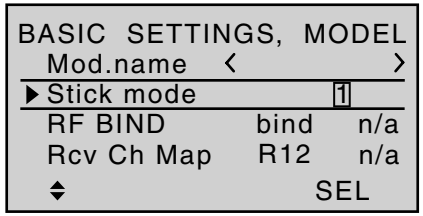
... then move the throttle joystick, or the limiter for a helicopter, into its idle position; by default this is rotary control CTRL 6.

The appearance of this warning also depends on the "Motor at C1" or "Pitch min" in the ***"Model type" menu,*** *refer to page 80 or "****Helicopter type****" page 84 for the selected setting. For winged aircraft models, select "None" to deactivate this message if you have no motor to enter.*

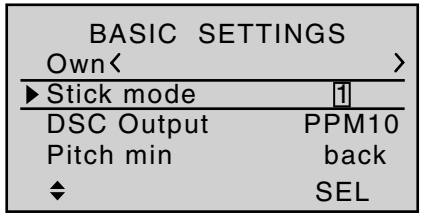
- *If the transmitter already has occupied model memories then submenus of the "****Copy / Erase****" menu will display a pictogram of the selected model type at the respective memory location followed by a blank line or the model name which was entered in the "****Basic settings*** *" menu (see page 68 or 74) and any bond that may exist between a receiver and this model memory.*
- *If battery voltage is too low, you cannot switch models for safety reasons. A corresponding message will appear in the display:*



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 joysticks. 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 68 or 74.



A default value for this setting can be made for future models in the generalized "**Basic Settings**" menu, page 216.



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 ... 12 by default.

This means that, in the system's **delivered state, only servos attached to receiver outputs 1 ... 4 can be moved by the two joysticks and that any servos attached to receiver connectors 5 ... 12 (max) will remain in their middle positions.** When a new helicopter model is initialized, servo 6 may perform a movement – depending on the throttle limiter's position,

* *N.N. = Nomen Nominandum (the name to be stated)*

CTRL 6 – . This condition changes for both model types only after the respective 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 69 or 75.

A fundamental description of programming steps for a winged aircraft model can be found in the programming examples section beginning on 226, or for helicopter models beginning on page 270.

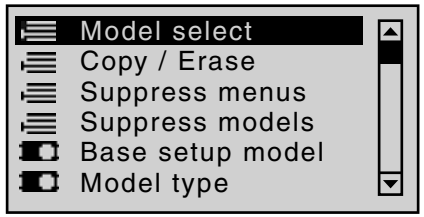
The menu descriptions below are arranged in the sequence individual menus are listed in the multi-function list.

Model select

Call up model 1 … 24

The basic operation of the transmitters keys was explained on pages 24 and 25 and, on the previous double-page, explanations were provided for navigating to the multifunction list and about how to occupy 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



As many as 24 complete model settings, including digital trim values for trim levers, can be stored. Trimming is stored automatically such that a switchover 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 68 or 74 and the code, if present, for the receiver "bound" to the model memory location.

Select the **"Model select"** menu with the arrow keys of the left or right touch pad then press briefly on the **SET** button in the right touch pad.

Now use the ▲▼ arrow keys of the left or right touch pad to select the desired model memory from the list and activate the selection by pressing the **SET** button. Pressing the **ESC** button will cause a return to the previous menu page without activating a model change.

Notice:

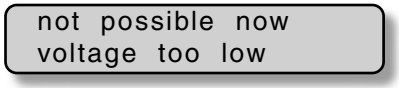
- *If a model change causes a "Throttle too high" warning to appear, the throttle/pitch joystick (C1) or the throttle limiter is too far in the full throttle direction.*
- *If a model change causes the message …*

… to appear then binding settings should be checked.

- *If a model change causes the message …*

… to appear then respective failsafe settings should be checked.

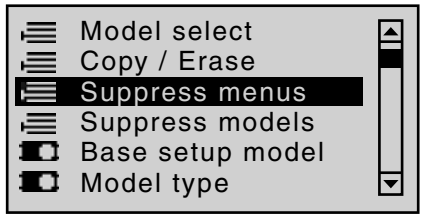
- *If battery voltage is too low, the model switchover cannot be made due to reasons of safety. An appropriate message will appear in the screen.*



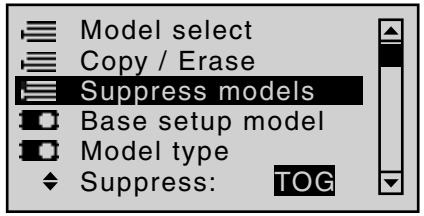
Copy / Erase

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

Select the "Copy / Erase" menu with the ▲▼ arrow keys of the left or right touch pad then briefly press the **SET** button.

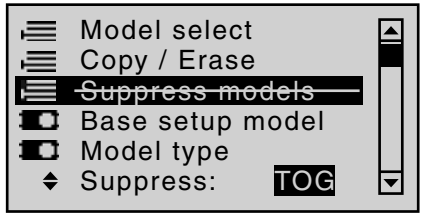


Erase model

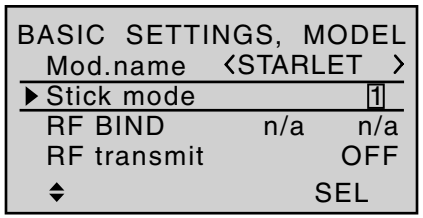


Select the "Erase model" sub-menu with the ▲▼ arrow keys of the left or right touch pad then briefly press the **SET** button.

Use the ▲▼ arrow keys of the left or right touch pad to select the model to be erased …



… now the next time the **SET** button is pressed, it will prompt the confirmation request …



… 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 ► arrow keys of the left or right touch pad followed by confirmation of the selection by briefly pressing the **SET** button will erase the selected model memory.

Attention:

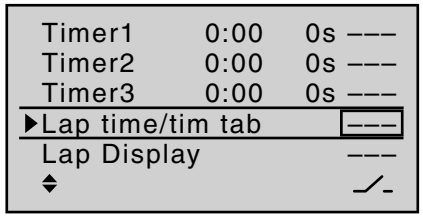
This erase process cannot be undone. All data in the selected model memory will be erased completely.

Notice:

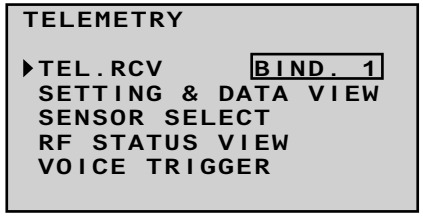
If the currently active model memory is to be erased, a model type "Winged" or "Heli" must be defined immediately after the erase process. On the other hand, if an inactive memory location is to be erased then it will subsequently appear in the model select screen as "✱✱✱free✱✱✱".

Copy model ➔ model

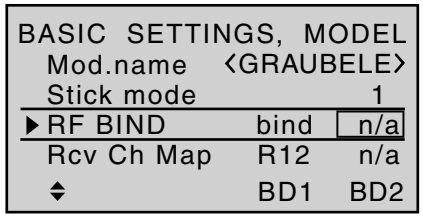
Select the "Copy model ➔ model" sub-menu with the ▲▼ arrow keys of the left or right touch pad then press the **SET** button.



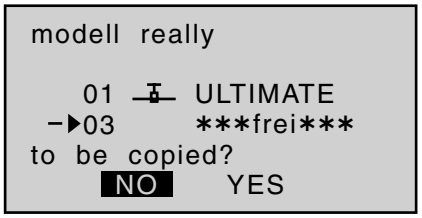
Select the model to be copied with the ▲▼ arrow keys of the left or right touch pad …



… whereby a second activation of the **SET** button in the right touch pad will allow the "Copy to model" window for the destination memory to be selected with the ▲▼ arrow keys of the left or right touch pad and then confirmed with yet another press of the **SET** button or canceled with the **ESC** button. A memory location which is already occupied can be overwritten.



Once selection of the model memory has been confirmed by pressing the **SET** button, a confirmation request will appear.



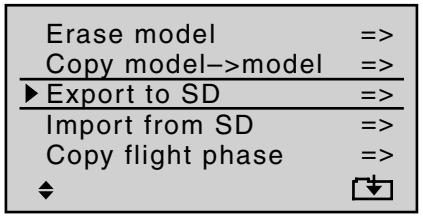
A **NO** response will cancel the process and return the screen to the originating screen. If the ► **YES** response is selected and confirmed by activating the **SET** button then the selected source model will be copied into the selected model memory destination.

Notice:

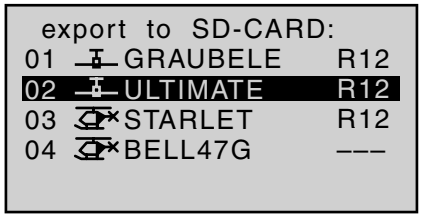
In addition to model data, binding data is also copied by this process. This means that a receiver system which was/is bound to the original model memory can also be operated by its copy without establishing the bond again.

Export to SD

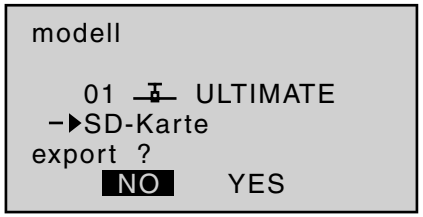
Select the "Export to SD" sub-menu with the ▲▼ arrow keys of the left or right touch pad and press the **SET** button.



Select the model to be exported with the ▲▼ arrow keys of the left or right touch pad.



After confirming the selected model memory by pressing the **SET** button, a confirmation request will appear.



A **NO** response will cancel the process and return the screen to the originating screen. However, if the ► **YES** response is selected then confirmed by pressing the **SET** button, the selected model will be copied to the SD card.

Notice:

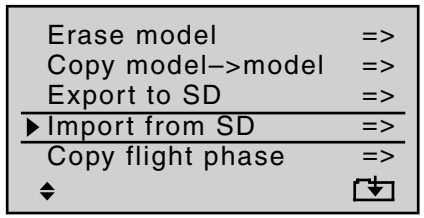
- *Should the notice …*

… appear instead of a screen for model selection, there is no SD card in the transmitter's card slot, see page 22.

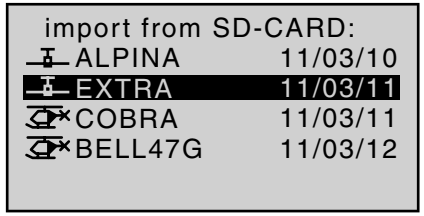
- *In addition to model data, binding data is also copied by this process. This means that a receiver system which was/is bound to the original model memory can also be operated in the SAME transmitter by its copy without establishing the bond again.*
- *An exported winged aircraft model will be stored on the memory card in the \\Models\mc-32 folder with a filename format of "aModellname.mdl" and a helicopter model with a filename format of "hModellname.mdl". On the other hand, if a "nameless" model is exported, its data will be stored on the memory card under "ahNoName.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.*

Import from SD

Select the "Import from SD" sub-menu with the ▲▼arrow keys of the left or right touch pad and press the SET button.



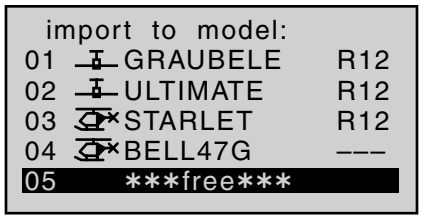
Select the model to be imported from the SD memory card with the ▲▼ arrow keys of the left or right touch pad.



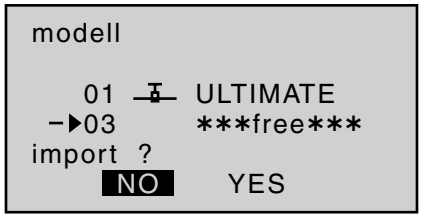
Notice:

The export date posted at the right end of each model name line is represented in the format "year/month/day".

After again pressing the **SET** button in the right touch pad, the "import to model" window will appear Now the destination memory location can be selected with the ▲▼ arrow keys of the left or right touch pad and confirmed by pressing the **SET** button or the process can be canceled with the **ESC** button. A memory location which is already occupied can be overwritten.



After confirming the selected model memory by pressing the **SET** button, a confirmation request will appear.



A **NO** response will cancel the process and return the screen to the originating screen. However, if the ► **YES** response is selected and confirmed by pressing the **SET** button then the selected source model will be imported into the selected destination model memory.

Notice:

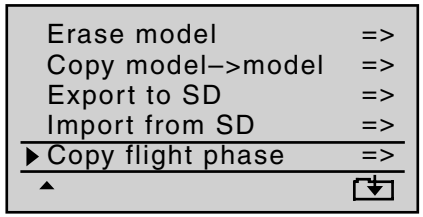
- *If the message ...*

... appears instead of a screen for model selection, there is no SD card in the transmitter's card slot, see page 22.

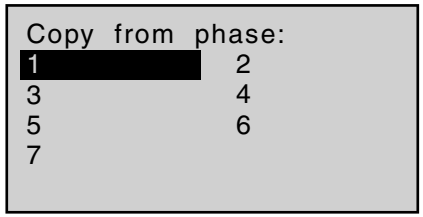
- *In addition to model data, binding data is also imported by this process. This means that a receiver system which was/is bound to the original model memory can also be operated in the SAME transmitter by its copy without establishing the bond again.*

Copy from phase

Select the "Copy from phase" sub-menu with the ▲▼ arrow keys of the left or right touch pad then press the **SET** button.



In the "Copy from phase" sub-menu ...

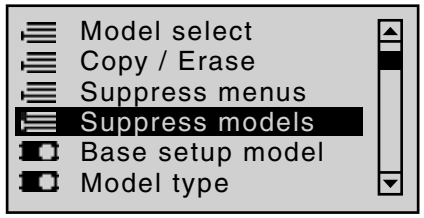


... the flight phase to be copied (1 ... 7 for winged aircraft models or 1 ... 6 for helicopter models) is selected with the arrow keys of the left or right touch pad then confirmed by briefly pressing the **SET** button in the right touch pad. The next window to appear will be the "Copy to phase" window. In that window the destination is to be selected and then also confirmed. As described above, another confirmation request will be issued.

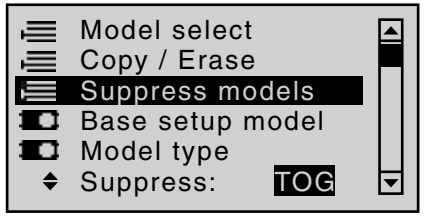
Suppress menus

Hide menus in the multifunction

Select the "Suppress menus" menu with the ▲▼ arrow keys of the left or right touch pad then briefly press the **SET** button.

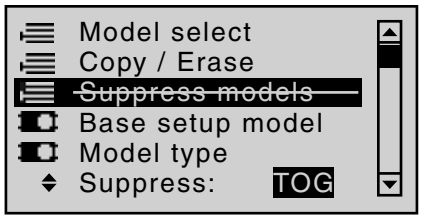


In the menu which then appears, menu items which are no longer needed or those which should not be changed, can be blocked from appearing in th multifunction list.



This reduces the appearance of the multi-function list considerably, in some cases to only a few menus, thus substantially improving the clarity of the function selection list. Functions are not deactivated because they are hidden. They will simply no longer appear in the list. This also blocks direct access to these functions.

The function to be hidden or displayed is to be selected with the arrow keys of the left or right touch pad then its (hide/display) status switched-over by means of the center **SET** button in the right touch pad.



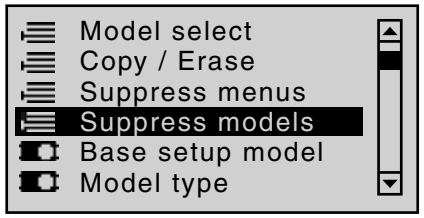
Tip:

*If you wish to forgo access-blockage to the multi-function list altogether, hide the **"Code lock"** menu in the multi-function list by way of this menu as a precautionary measure.*

Suppress models

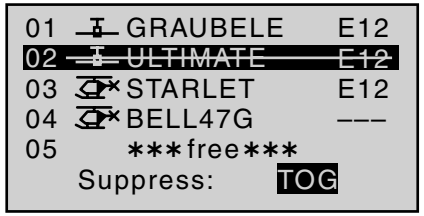
Hiding model memory locations

Select the "Suppress models" menu with the ▲▼ arrow keys of the left or right touch pad then briefly press the **SET** button.



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.

A model to be hidden/displayed is selected with the arrow keys of the left or right touch pad then its status is switched-over by means of the center **SET** button in the right touch pad.



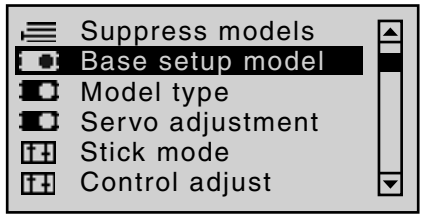
A model memory which is "stricken through" will no longer appear in the "**Model select**" menu.

Base setup model

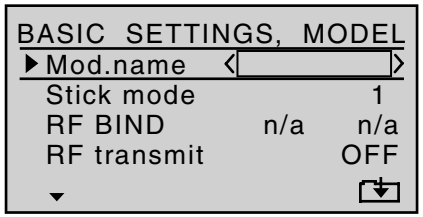
Model-specific base settings for winged aircraft models

Before programming specific parameters, there are some basic settings to be made which effect the currently active model memory.

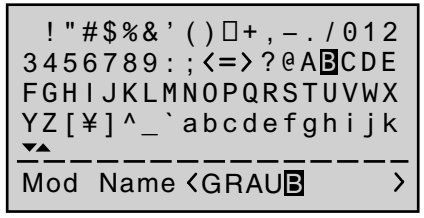
Select the **"Base setup model"** menu with the arrow keys of the left or right touch pad then press the center **SET** button in the right touch pad.



Model name



Change to the next screen page by pressing the **SET** button briefly. 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.



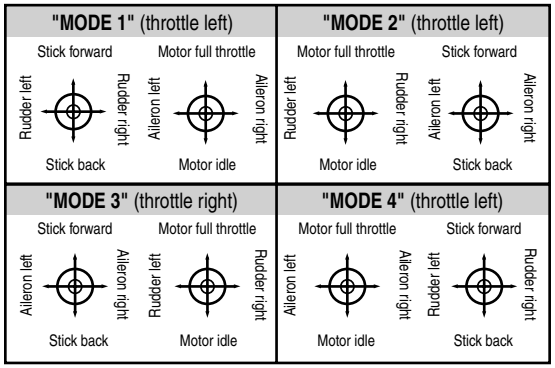
Select the desired characters with the arrow keys of the left touch pad. Move to select the next character position by pressing the ► arrow key of the right touch pad or its center **SET** button. Simultaneously pressing the ▲▼ or ◄► of the right touch pad (**CLEAR)** will place a space character at the position.

Positioning to any character position within the entry field can be done with the ◄► keys of the right touch pad.

A return to the previous menu screen is accomplished by pressing the center **ESC** button in the left touch pad.

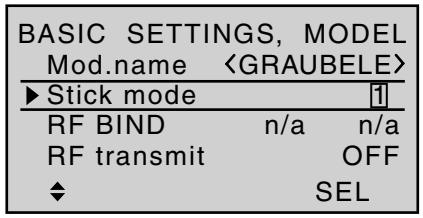
After entering the model name it will appear in the base screen of the "**Model select**" menu and in the sub-menu for the **"Copy /Erase"** menu item.

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 joysticks. Just which of these options is chosen depends on the individual preferences of the individual model pilot.

Select the "Stick mode" line with the ▲▼ arrow keys of the left or right touch pad. The option field will be enclosed in a frame.



Press the **SET** button. The currently displayed stick mode will be displayed in inverse video. Now use the arrow keys of the right touch pad to select from among options 1 through 4.

Pressing simultaneously on the ▲▼ or ◄► keys of the right touch pad (**CLEAR**) will return the option selection back to stick mode "1".

Pressing the **SET** button again will deactivate option selection so that you can change to another line.

Bound receiver

Graupner HoTT receivers must be "instructed" to communicate exclusively with one particular model (memory) in a *Graupner* HoTT transmitter. This procedure is known as "binding" and must only be done *once* for every new receiver/model memory location combination (and can be repeated anytime).

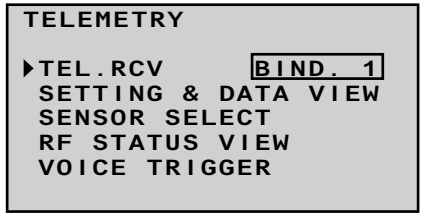
Important notice:

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 you run the risk of a faulty connection to the return channel and malfunctions will result.

"Binding" multiple receivers per model

Multiple receivers per model can be bound if desired, whereby respective **mc-32** HoTT programs offer the potential for managing a maximum of two receivers directly and for dividing up the 12 control channels (max) available on these two receivers as desired under menu control. Refer to additional details further down in this section. Binding two receivers is begun by first binding the individual receivers as described below.

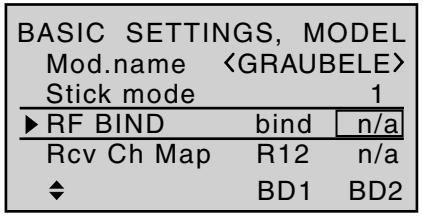
In subsequent operation of the model only one of these receivers will establish a telemetry bond to the transmitter; the one which was activated in the "Tel. RCV" line of the "Telemetry" menu. For example:



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.

"RF bind" of transmitter and receiver

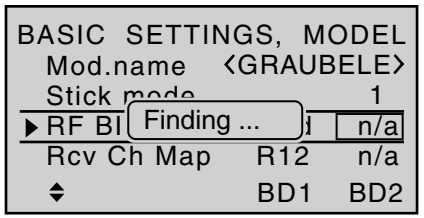
Use the ▲▼ arrow keys of the left or right touch pad to move to the screen's "RF bind" line" then select the desired binding channel. For an example like that shown in the figure below, choose "BD2" because the binding channel designated as "BD1" in the screen's bottom line is already used by default for the receiver which was delivered with the set.



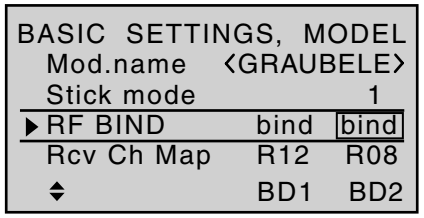
If not already off, now switch the receiver on. The red LED on the receiver will blink.

Press and hold the **SET** button on the receiver while the LED continues to blink red for about 3 seconds then after about another 3 seconds begins to blink red/green. You can now release the **SET** button 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 by briefly pressing the center **SET** button of the right touch pad. At this time the screen's display will begin to indicate the duration of the "bond"**.**



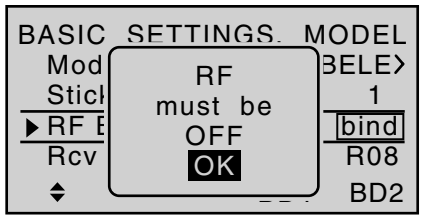
If the receiver's LED, again blinking red, changes within about 10 seconds to continuous illumination in green, the binding process has been successfully completed. Your model-memory to receiver combination is now operationally ready. At this time the screen will now display "bind" (bound) instead of "n/a" (not attached). For example:



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.

Binding other receivers

The binding channel you have chosen is already bound (as indicated by the "bind" status). with another binding channel. After initiating the RF bind process, instead of displaying "BINDING", the message shown below appears.



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 "RF BIND" line and restart the process to dissolve bond as described on the previous page.

Alternatively you can briefly switch off the transmitter then, after switching it back on again, respond to the message window that appears …

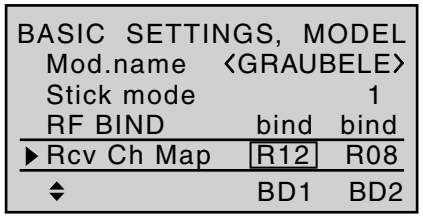
… with "OFF" …

… then confirm the selection by briefly pressing the center **SET** button in the right touch pad. From the base screen jump again into the "RF BIND" 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.

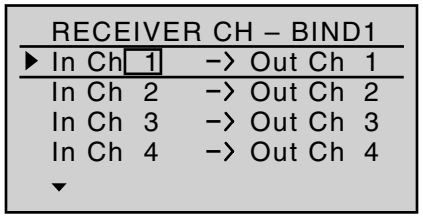
Receiver change map



As mentioned in the introduction to the "Binding receivers" section, the **mc-32** HoTT offers both the opportunity to freely divide up the transmitter's control channels *within a receiver* and the opportunity to distribute the transmitter's 12 control channels across *two receivers*. This redistribution is subsequently referred to as "mapping" or "channel mapping" (channel correlation). Select the receiver to be "mapped" with the arrow keys of the left or right touch pad then briefly press the center **SET** button in the right touch pad.

Channel mapping within a receiver

Analogous to the channel correlation function in the "Telemetry" menu on page **212**, described as "Channel Mapping", it is very simple to use this menu item to freely distribute the 12 control channels (inputs) to the outputs (servo connections) of the bound receiver specified by column BD1.



After selection of the desired *output* with the arrow keys of the left or right touch pad, the corresponding input field will be framed. Press briefly on the center **SET** button in the right touch pad. The current setting is displayed in inverse video. Now select the desired input channel (= transmitter output, see page 206) with the arrow keys of the left or right touch pad.

Notice:
The number of lines available in the list (outputs) corresponds to the maximum number of servos which can be attached to the given receiver.

BUT CAUTION: If, for example, you have already specified "2AIL" in the "Aile/flaps" line of the "**Model type**" menu then the transmitter will have allocated *control function 2* (*ailerons)* for left and right ailerons to *control channels 2 & 5*. The corresponding *inputs (to the receiver)* in this case would be channels 2 & 5 and these should be assigned accordingly, refer to the example below.

Examples:

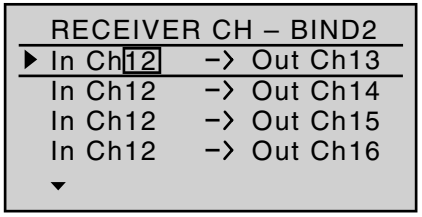
- *You would like to control each aileron of a large model with two or more servos.*
  Assign each of the appropriate outputs *(servo connections) to one and the same* input *(control channel). In the aforementioned case, to the given*input *of one of the two default aileron control channels (2 & 5) appropriate for the left or right wing.*
- *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 bottom right.*

Important notice:

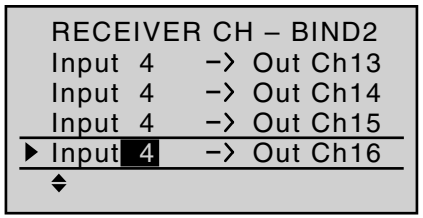
By using the **mc-32** *HoTT transmitter's "Tx. output swap " option the transmitter's 12 control functions can be freely swapped in a similar manner or multiple outputs can be assigned to the same control function. To avoid confusion, it is strongly recommended that only one of these two options is used.*

Channel assignment on the second receiver

As already mentioned, the "Receiver channel mapping" option can be used to freely distribute the **mc-32** HoTT transmitter's 12 control channels across *two receivers,* whereby the numbering sequence of outputs (servo connections) begun in the "BD1" column for bound "receiver 1" will be continued. For example, if "receiver 1" has enough connectors for 12 servos then the numbering of outputs in the "BD2" column (for the second bound receiver) will begin with 13.



After selection of the desired *output* with the arrow keys of the left and right touch pad, the corresponding input field will be framed. Press the center **SET** button in the right touch pad The current setting is displayed in inverse video. Now select the desired input channel with the arrow keys of the right touch pad. For example, suitable to the above rudder example.



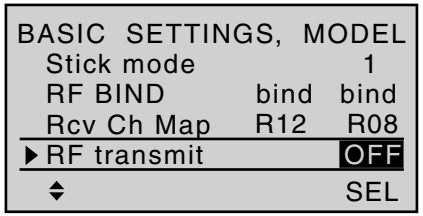
Notice:

The number of lines available (outputs) corresponds to the maximum number of servos which can be connected to receiver 2 and their numbering is dependent on the maximum number of servos which can be connected to receiver 1.

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 ▲▼ arrow keys of the left or right touch pad to reach the "RF transmit" line then activate the option with by briefly pressing the center **SET** button in the right touch pad



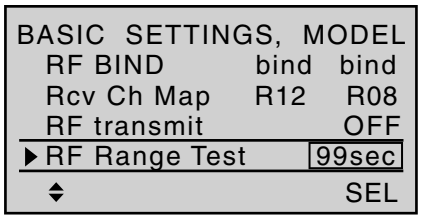
The right arrow keys can now be used to choose between **OFF** and **ON**. Again pressing the center **SET** button in the right touch pad will complete the entry.

Range test

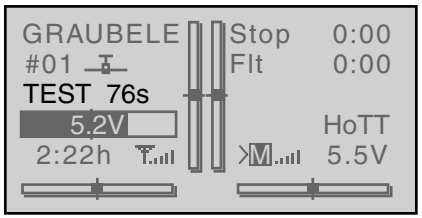
The built-in range test reduces transmission power to an extent that a function test can be carried out even within a distance of up to about 50 m.

Perform the 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 receiver's green LED to light up. 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. Do not point the antenna directly at the model but rather turn and/or kink the antenna's end so that it is oriented vertically during the test.
5. If necessary, use the ▲▼ arrow keys of the left or right touch pad to reach the "RF Range Test" line in the menu then start range test mode by pressing the center **SET** button in the right touch pad.



When the range test is activated, the transmitter's output power will be significantly reduced and the blue LED on the antenna's socket will begin to blink. At the same time, the timer display in the transmitter's screen 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 blue LED will again illuminate constantly.

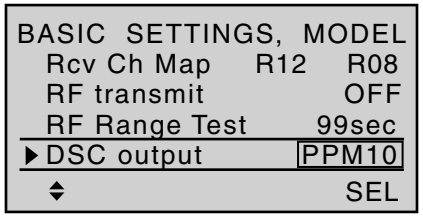
6. Move away from the model while manipulating the joysticks during this timespan. If you notice an interruption anytime while still within a distance of about 50 m, try to reproduce this malfunction.
7. If there is a motor in the model, it may be necessary to switch it on to further check noise immunity.
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* GmbH & Co. KG 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.

Attention:

Never start the range test on the transmitter during normal operation of the model.

DSC output

If necessary, use the ▲▼ arrow keys of the left or right touch pad to reach the "DSC output" line of the menu then activate this menu item by briefly pressing the center **SET** button in the right touch pad.



Now you can use the right arrow keys to choose between three types of modulation "PPM10", "PPM18" and "PPM24". Pressing the center **SET** button in the right touch pad again will 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. This maximum is control channels 1 ... 5 if "PPM10" is selected, control channels 1 ... 9 for "PPM18" and control channels 1 ... 12 for "PPM24".

Cut-off

Depending on the "idle forward or back" choice made in the "Motor at 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 carburetor of a motor to the OFF (or idle) position.

The motor OFF position (or idle setting) will then be preset by the left column directly over the "**SEL**" field. The appropriate value for this entry field is to be established through trial and error

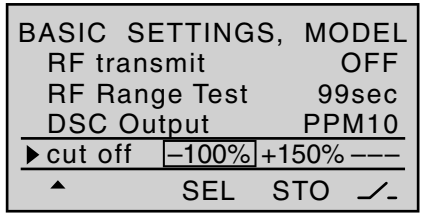
A speed controller or throttle servo will only take on this preset position when a certain servo position or threshold is underrun and a switch is activated. This is done by setting the desired servo position (threshold value) into the middle column, directly over the "**STO**" field then selecting the 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 carburetor'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.

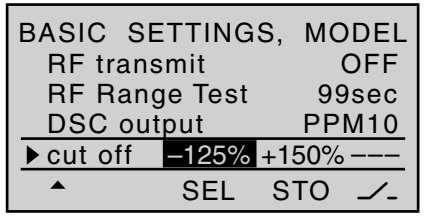
The speed controller or throttle servo will remain in this cut-off position only until the selected switch is again changed over followed by a one-time throttle servo or speed controller movement beyond the preset threshold with the throttle/brake joystick control.

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.



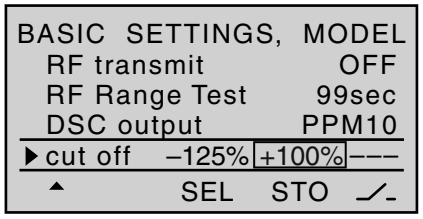
Programming

To change the preset "cut-off" position of the throttle servo, press the center **SET** button in the right touch pad. The current setting will be displayed in inverse video. Now use the arrow keys of the left or right touch pad 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 %.

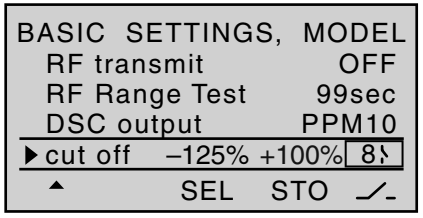


The –upper– preset value in the middle column ensures the motor can be stopped, throughout the maximum possible positioning range of the servo or speed controller, alone by the switch to be assigned in the right column.

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 joystick then press the center **SET** button in the right touch pad.



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.



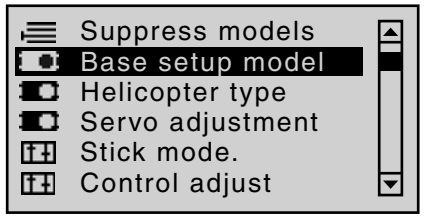
Notices:

- *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.*

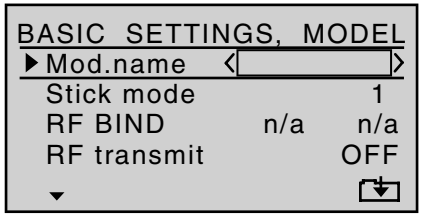
Base setup model

Model-specific base settings for helicopter models

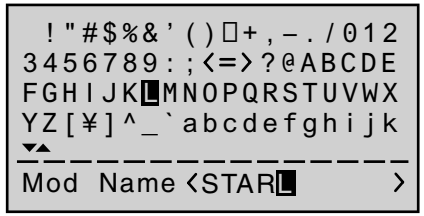
Before programming specific parameters, there are some basic settings to be made which effect the currently active model memory. Select the "Base setup model " menu with the arrow keys of the left or right touch pad then press the center **SET** button in the right touch pad.



Model name



Change to the next screen page by briefly pressing the **SET** button in the right touch pad. 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.



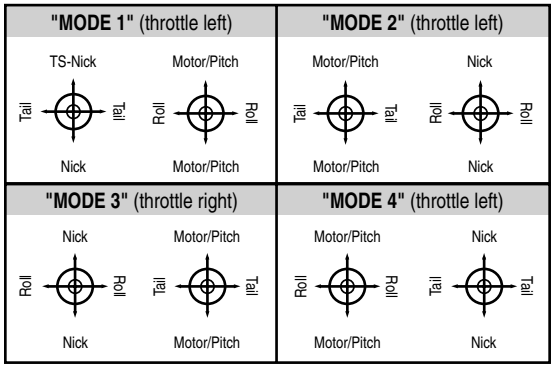
Select the desired characters with the arrow keys of the left touch pad. Move to select the next character position by pressing the ► arrow key of the right touch pad or its center **SET** button Simultaneously pressing on the ▲▼ or ◄ ► keys of the right touch pad (**CLEAR)** will place a space character at the position.

Positioning to any character position within the entry field can be done with the ◄ ► keys of the right touch pad.

A return to the previous menu screen is accomplished by pressing the center **ESC** button in the left touch pad.

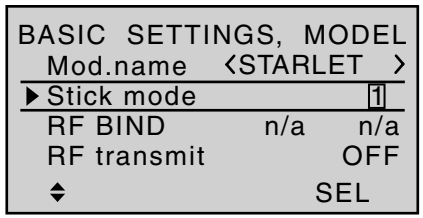
A model name entered in this manner will appear in the base screen of the "**Model select**" menu and in the sub-menus of the "**Copy / Erase**" menu item.

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 joysticks. Just which of these is used depends on the preferences of the individual model pilot.

Use the ▲▼ arrow keys of the left or right touch pad to select the "Stick mode" line. The option field will be framed.



Press the **SET** button. The currently displayed stick mode will be displayed in inverse video. Now use the arrow keys of the right touch pad to select from among options 1 through 4.

Pressing simultaneously on the ▲▼ or ◄ ► keys of the right touch pad (**CLEAR**) will return the option selection back to stick mode "1".

Pressing the **SET** button again will deactivate option selection so that you can change to another line.

Bound receiver

Graupner-HoTT receivers must be "instructed " to communicate exclusively with one particular model (memory) in a *Graupner*-HoTT transmitter. This procedure is known as "binding" and must only be done *once* for every new receiver/model memory location combination (and can be repeated anytime).

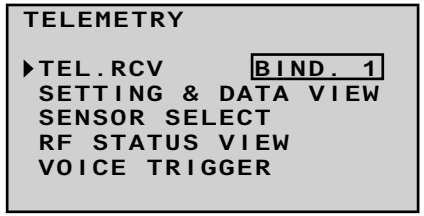
Important notice:
During the binding procedure be sure the transmitter's antenna is always far enough away from the receiver's antenna. To be on the safe side, keep them at least one meter apart. Otherwise you run the risk of a faulty connection to the return channel and malfunctions will result.

"Binding" multiple receivers per model

Multiple receivers per model can be bound if desired,

whereby respective **mc-32** HoTT programs offer the potential for managing a maximum of two receivers directly and for dividing up the 12 control channels (max) available on these two receivers as desired under menu control. Refer to additional details further down in this section. Binding two receivers is begun by first binding the individual receivers as described below.

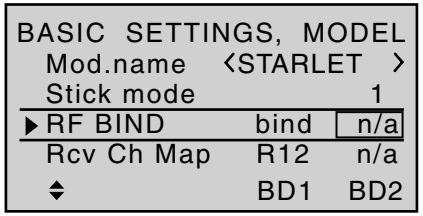
In subsequent operation of the model only one of these receivers will establish a telemetry bond to the transmitter; the one which was activated in the "Tel. RCV" line of the "Telemetry" menu. For example:



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" the transmitter and receiver

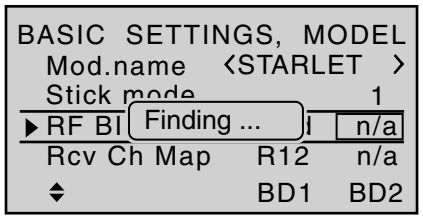
Use arrow keys ▲▼of the left or right touch pad to move to the screen's "RF bind" line then select the desired binding channel. For an example like that shown in the figure below, choose "BD2" because the binding channel designated as "BD1" in the screen's bottom line is already used by default for the receiver which was delivered with the set.



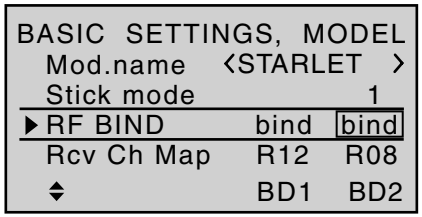
If not already off, now switch the receiver on. The red LED on the receiver will blink.

Press and hold the **SET** button on the receiver while the LED continues to blink red for about 3 seconds then after about another 3 seconds begins to blink red/green. You can now release the **SET** button 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 by briefly pressing the center **SET** button of the right touch pad. At this time the screen's display will begin to indicate the duration of the "bond".



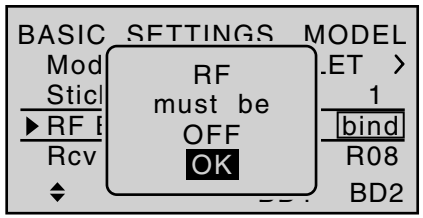
If the receiver's LED, again blinking red, changes within about 10 seconds to continuous illumination in green, the binding process has been successfully completed. Your model-memory to receiver combination is now operationally ready. At this time the screen will now display "bind" (bound) instead of "n/a" (not attached). For example:



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.

Binding other receivers

The binding channel you have chosen is already bound (as indicated by the "bind" status). with another binding channel. If, after initiating the RF bind process, the message shown below appears in the screen instead of displaying "BINDING"



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 "RF BIND" line and restart the process to dissolve bond as described on the previous page.

Alternatively you can briefly switch off the transmitter then, after switching it back on again, respond to the message window that appears …

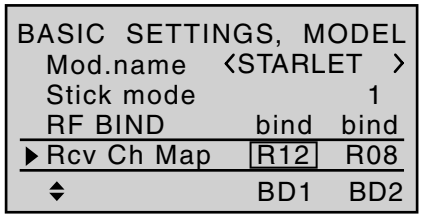
… with "OFF" …

… then confirm the selection by briefly pressing the center **SET** button in the right touch pad. From the base screen jump again into the "RF BIND" 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.

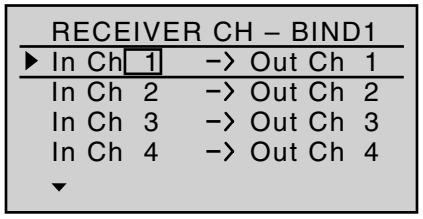
Receiver change map



As mentioned in the introduction to the "Binding receivers" section, the **mc-32** HoTT offers both the opportunity to freely divide up the transmitter's control channels *within a receiver* as well as the opportunity to distribute the transmitter's 12 control channels across *two receivers*. This redistribution is subsequently referred to as "mapping" or "channel mapping" (channel correlation). Select the receiver to be "mapped" with the arrow keys of the left or right touch pad then briefly press the center **SET** button in the right touch pad.

Channel mapping within a receiver

Analogous to the channel correlation function in the " Telemetry " menu on page **212**, described as "Channel Mapping", it is very simple to use this menu item to freely distribute the 12 control channels (inputs) to the outputs (servo connections) of the bound receiver specified by column BD1.



After selection of the desired *output* with the arrow keys of the left and right touch pad, the corresponding input field will be framed. Press briefly on the center **SET** button in the right touch pad. The current setting will be displayed in inverse video. Now select the desired input channel (= transmitter output, see page 206) with the arrow keys of the left or right touch pad.

Notice:
The number of lines available in the list (outputs) corresponds to the maximum number of servos which can be attached to the given receiver.

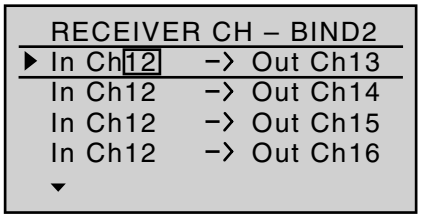
BUT CAUTION: If you wish to operate two servos with one control function, for example such as transmitter control function 2 (roll) which is divided up into control channels 1 & 2 for left and right roll servos by "3Sv(2Roll)" in the " in the "**Heli Type**" menu; then "map" transmitter outputs 1 & 2 (= inputs to the receiver) accordingly.

Important notice:
By using the **mc-32** *HoTT transmitter's "Tx. output swap" option, the transmitter's 12 control functions can be freely swapped in a similar manner or multiple outputs can be assigned to the same control function. To avoid confusion, it is strongly recommended that only one of these two options is used.*

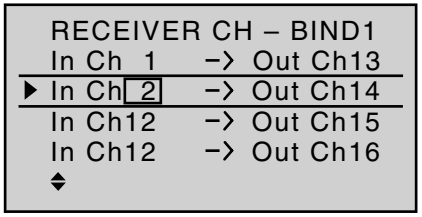
Channel assignment on the second receiver

As already mentioned, the "Receiver channel mapping" option can be used to freely distribute the **mc-32** HoTT transmitter's 12 control channels across *two receivers*, whereby the numbering sequence of outputs (servo connections) begun in the "BD1" column for bound "receiver 1" will be continued. For example, if "receiver 1" has enough connectors for 12 servos then the numbering of outputs in the "BD2" column (for the

second bound receiver) will begin with 13.



After selection of the desired *output* with the arrow keys of the left and right touch pad, the corresponding input field will be framed. Press the center **SET** button in the right touch pad The current setting will be displayed in inverse video. Now select the desired input channel with the arrow keys of the right touch pad. For example, appropriate for the above example with roll servos:

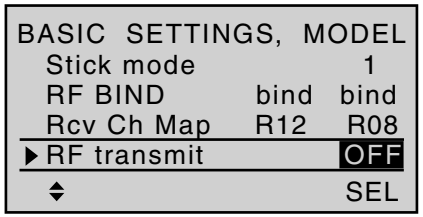


Notice:
The number of lines available (outputs) corresponds to the maximum number of servos which can be connected to receiver 2 and their numbering is dependent on the maximum number of servos which can be connected to receiver 1.

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 ▲▼arrow keys of the left or right touch pad to reach the "RF transmit " line then activate the option by briefly pressing the center **SET** button in the right touch pad.



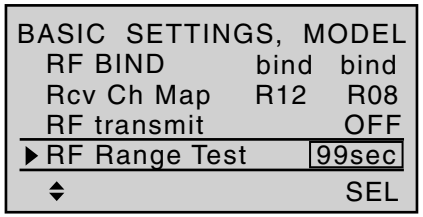
The right arrow keys can now be used to choose between **OFF** and **ON**. Again pressing the center **SET** button in the right touch pad will complete the entry.

Range test

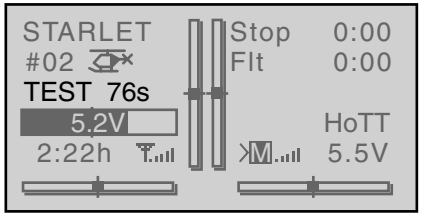
The built-in range test reduces transmission power to an extent that a function test can be carried out even within a distance of up to about 50 m.

Perform the 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 receiver's green LED to light up. 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. Do not point the antenna directly at the model but rather turn and/or kink the antenna's end so that it is oriented vertically during the test.
5. If necessary, use the ▲▼arrow keys of the left or right touch pad to reach the "RF Range Test" line in the menu then start range test mode by pressing the center **SET** button in the right touch pad.



When the range test is activated, the transmitter's output power will be significantly reduced and the blue LED on the antenna's socket will begin to blink. At the same time, the timer display in the transmitter's screen 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 blue LED will again illuminate constantly.

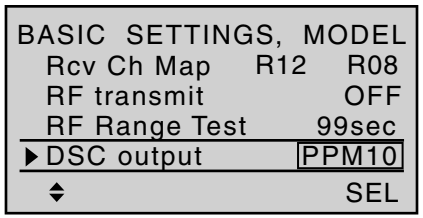
6. Move away from the model while manipulating the joysticks during this timespan. If you notice an interruption anytime while still within a distance of about 50 m, try to reproduce this malfunction.
7. If there is a motor in the model, it may be necessary to switch it on to further check noise immunity.
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* GmbH Co. KG 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.

Attention:

Never start the range test on the transmitter during normal operation of the model.

DSC output

If necessary, use the ▲▼ arrow keys of the left or right touch pad to reach the "DSC output" line then activate this menu item by pressing the center **SET** button of the right touch pad.



Now you can use the right arrow keys to choose between three types of modulation "PPM10", "PPM18" and "PPM24". Pressing the center **SET** button in the right touch pad again will 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. This maximum is control channels 1 ... 5 if "PPM10" is selected, control channels 1 ... 9 for "PPM18" and control channels 1 ... 12 for "PPM24".

Autorotation

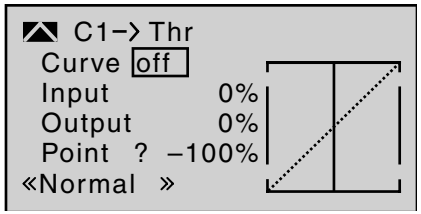
Autorotation is that state of descending flight in which the pitch of main rotor blades are set such that the rotor's speed matches the natural forces of air flowing through, like a windmill. This built-up energy can be used for "recovery" lift to brake a descent by appropriate blade pitch adjustment.

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. For training purposes it is better to keep the motor running at idle during 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**" menu (see page 178); refer also to the "Principle of the Auto. C1 Pos." topic which follows.

The "Autorotation" name is permanently assigned to phase 1 and it is included in the base screen of all flight phase dependent menus. This name can NOT be changed. It is only possible to assign a switch to this option, as described on page 52. **If a switch is assigned, it will have absolute priority over all other flight-phase switches.**

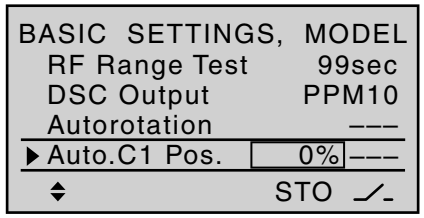


More about flight-phase programming can be found in the text beginning on page 164 in the **"Helicopter mixer"** section.

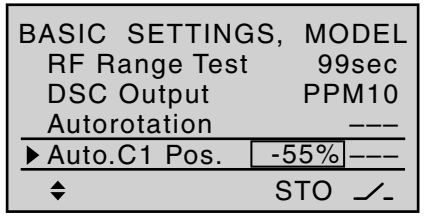
Auto.C1 Pos. (Autorotation C1 position)

The autorotation flight-phase can alternatively be activated by a threshold point for the C1 throttle/pitch joystick. To set such a threshold, use the ▲▼ arrow keys of the left or right key pad to reach the "Auto.C1 Pos." line.

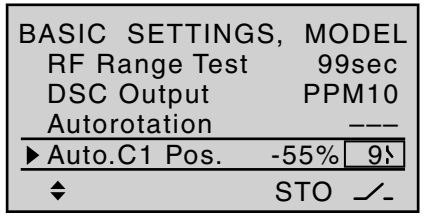
As soon as this line has been selected, the value field in its column directly above **STO** on the screen's bottom line will be framed.



Move the C1 joystick into the desired threshold switchover position then press the center **SET** button in the right touch pad. The current value will be displayed, e.g.:



After this has been done, use the arrow keys to move into the column above the switch symbol then assign a switch to this field, as described on page 52 in section "Switches, controls and control switches". Preferably the selection will be one of the two self-resetting switches, SW 1 or 9.



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 SW 9, is again "OFF".

"Auto. 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, see page 64.

Cut-off

Within the framework of autorotation settings for the **mc-32** 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 286. However, this option is not available if an idle position is specified in the "Thr setting 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. In this case it is better to use this option as a "cut off" rather than as an emergency OFF solution.

Depending on the "forw./back" choice made for the "Pitch min" line of the "**Heli Type**" menu, this motor "cut off" option can be coupled to a switch for throttling down a carburetor servo to the cut-off (or idle) position.

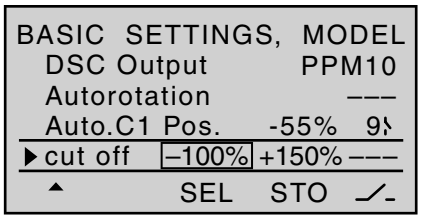
This cut-off (or idle) position is specified by the left column over the "**SEL**" field and its value is to be established through trial and error.

A speed controller or throttle servo will only take on this preset position when a certain servo position or threshold is underrun and a switch is activated. This is done by setting the desired servo position (threshold value) into the middle column, directly over the "**STO**" field 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 carburetor'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.

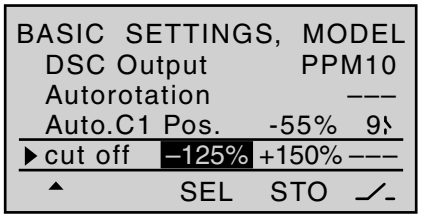
  The speed controller or throttle servo will remain in this cut-off position only until the selected switch is again changed over followed by a one-time throttle servo or speed controller movement beyond the preset threshold with the throttle/brake joystick control.

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.



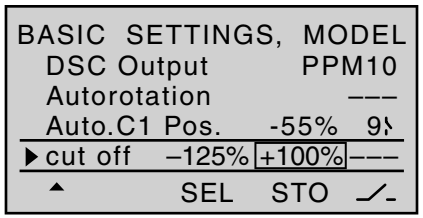
Programming

To change the preset "cut-off" position of the throttle servo, press the center **SET** button in the right touch pad. The current setting will be displayed in inverse video. Now use the arrow keys of the left or right touch pad to set a value at which the motor is reliably "off" without a startup of the throttle servo. For example -125 %:

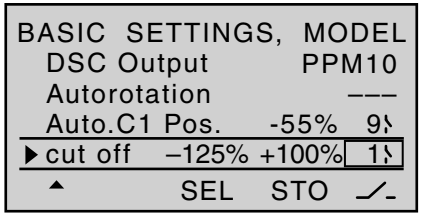


The – upper – preset value in the middle column ensures the motor can be stopped, throughout the maximum possible positioning range of the servo or speed controller, alone by the switch to be assigned in the right column.

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 and - if applicable, the throttle limiter - by placing the throttle/ pitch joystick into the desired position then press the center **SET** button in the right touch pad.



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.



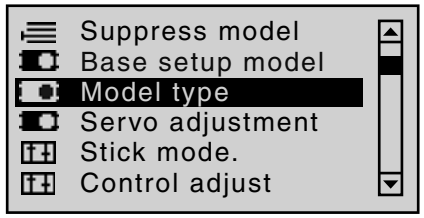
Notices:

- *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.*

Model type

Establishing winged aircraft model type

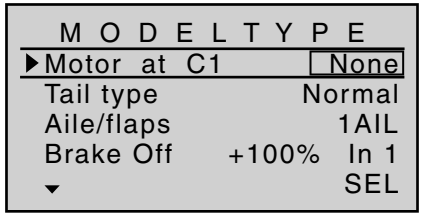
This "Model type" menu is used to establish the type of model to be programmed. This also activates all characteristic mixers, coupling functions, etc. in preparation for subsequent programming of the specified model type.



Press briefly on the center **SET** button in the right touch pad.

Motor at C1

After selecting the "Motor at C1" line with the ▲▼ arrow keys of the left and right touch pad, the corresponding entry field will be framed.



Press briefly on the center **SET** button in the right touch pad. The current setting will be displayed in inverse video. Now use the arrow keys of the right touch pad to select from among the following four options:

"none" For operation of a model without a propulsion.

The warning "Throttle too high", see page 36, is *deaktivated* and the "Brake settings" sub-menu of the "**Wing mixers**" menu (beginning page 146) is available without any restrictions.

"back": The idle position for the throttle/brake flaps control stick (C1) is to the rear, i.e. toward the pilot.

The warnings "Throttle too high", see page 36, as well as the "cut off" option in the "**Basic settings, model**" menu, see page 72, are *activated* and the "Brake settings" sub-menu of the "**Wing mixers**", beginning page 146, will be available if the entry in the "Motor" column of the "**Phase settings**" menu, page 128 for the currently active flight phase contains "none".

"forw.": The idle position for the throttle/brake flaps control stick (C1) is at the front, i.e. away from the pilot.

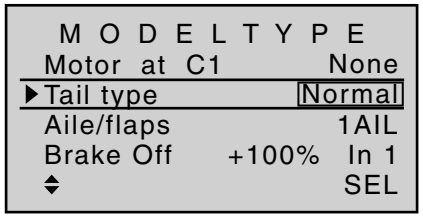
The warnings "Throttle too high", see page 36, as well as the "cut off" option in the "**Basic settings, model**", see page 72, are *activated* and the "Brake settings" sub-menu of the "**Wing mixers**", beginning page 146, will be available if the entry in the "Motor" column of the "**Phase settings**" menu, page 128 for the currently active flight phase is "none".

Notice:

- ***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 your choice between "normal" or only "back" or "fwd.", that is, either over the control's entire travel path or only in the respective idle direction.*
- *Pay attention to the "cut off trim" function described on page **54**.*

Tail type

After selecting the "Tail type" line with the ▲▼ arrow keys of the left or right touch pad, the corresponding entry field will be framed.



Press briefly on the center **SET** button in the right touch pad. The current setting will be displayed in inverse video. Now select the type applicable to your model with the arrow keys of the right touch pad.

"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 108 and servo travel in the "**Servo adjust**" menu, page 90.

If differentiated rudder throw is also desired then the V-tail should be

controlled instead by way of the "**Dual mixer**" menu, page 194. In this case however, the tail type entry specified here *must* be "normal".

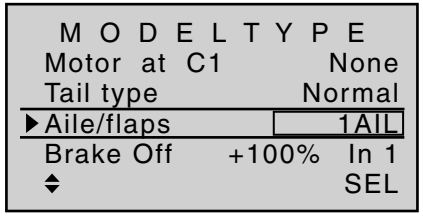
"Delta/fl": Aileron and elevator control is operated by one or two servos per wing half. However, elevator trimming is also affected by selecting the "QR 2WK" option – see below – but only on servos 2 & 3.

"2HRSv3+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 trimming affects both servos.

Notice about the "2HRSv3+8" option:
*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/Flaps

After selecting the "Aile/flaps" line with the ▲▼ arrow keys of the left or right touch pad, the corresponding entry field will be framed.



Press briefly on the center **SET** button in the right touch pad. The current setting will be displayed in inverse video. Now use the arrow keys of the right touch pad to select the number of wing servos to be programmed for the model.

Available	Control channel used
1QR	2
1QR 1WK	2 I 6
2QR	2 + 5
2QR 1WK	2 + 5 I 6
2QR 2WK	2 + 5 I 6 + 7
2QR 4WK	2 + 5 I 6 + 7 / 9 + 10
4QR 2WK	2 + 5 / 11 + 12 I 6 + 7
4QR 4WK	2 + 5 / 11 + 12 I 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 146.

Tips:

- *Settings for all wing flap pairs (QR and QR2, WK and WK2) can be trimmed on a flight-phase basis in both the "**Phase trim**" menu and in the "**Wing mixers**" menu, page 146.*
- *The functionality of all wing flap pairs (QR and QR2, WK and WK2) 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 146. To configure this it is only necessary to assign "Control 1" to input 6 in the "**Control adjust**" menu, page 96. (If you would rather operate flaps with switches, one of the transmitter's two or three position switches are good for this purpose.)*

Brake offset

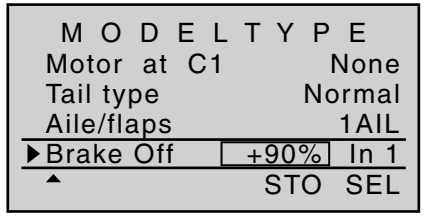
This function not only has potential for gliders and electric models but also for models with combustion motors and landing flaps.

The mixers described in the "Brake settings" line of the "**Wing mixers**" menu can be operated by the C1 control stick ("input 1") or another transmitter operating element which has been assigned to input 7, 8 or 9 in the "**Control adjust**" menu. 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 joystick.

However, use of input 7, 8 or 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.

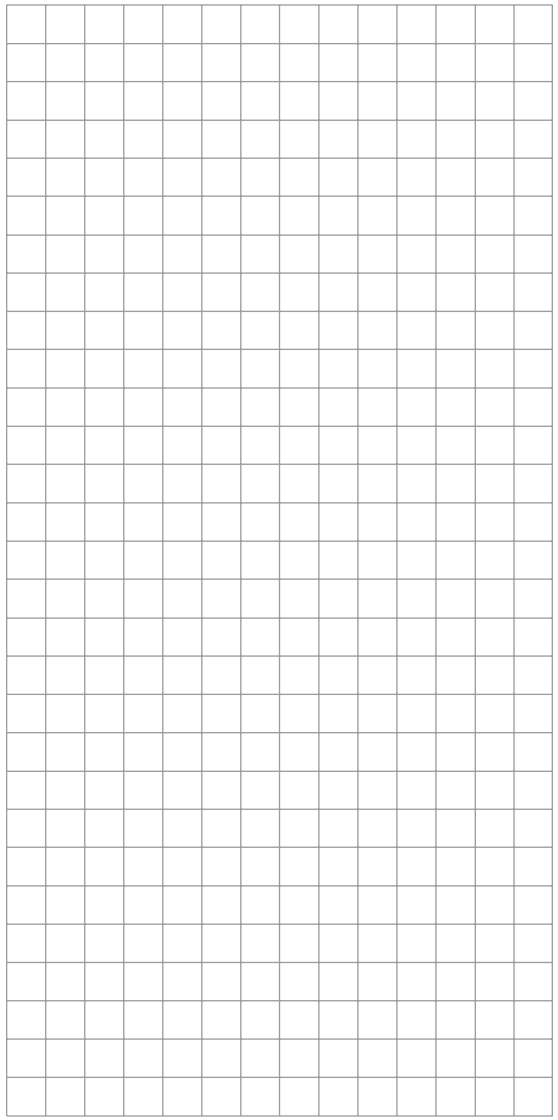
The neutral point (offset) can be set to any desired position. This is done by placing the control for input 1, 7, 8 o 9 into the position at which the landing flaps are to be in their neutral position then fixing this "Offset" point there with **STO**.

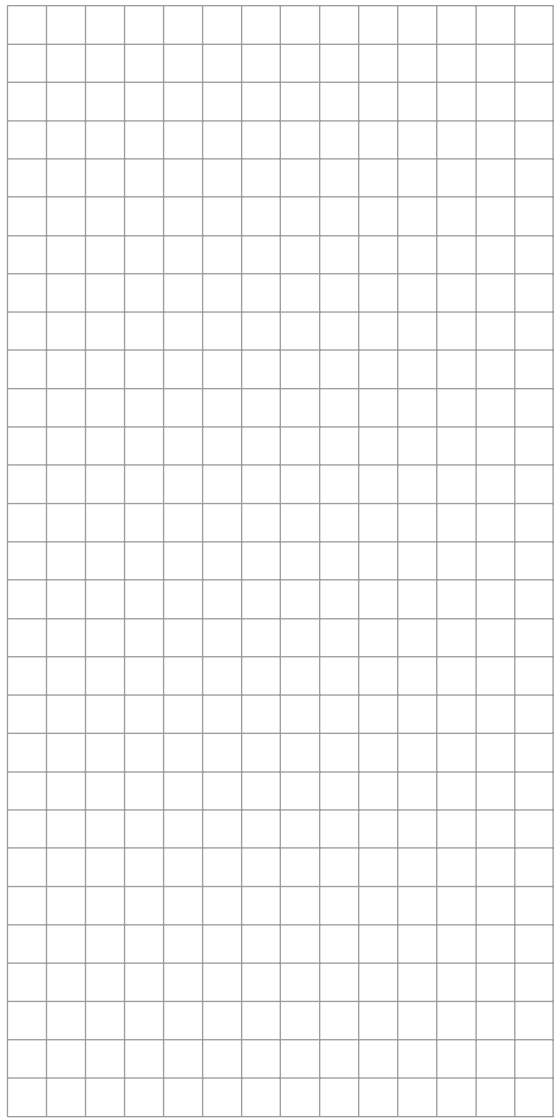


If the offset point is not set at the far end of control element travel, the remainder of travel to the end point will be "free travel", i.e. this "free travel" will no longer

influence any mixer available for "Brake settings" in the "**Wing mixers**" menu. This free travel ensures that, even if the brake flap control is not quite positioned to its full end of travel, it will still stop all brake settings at "neutral". At the same time, the effective control path is automatically spread to 100 %.

Tip:
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.

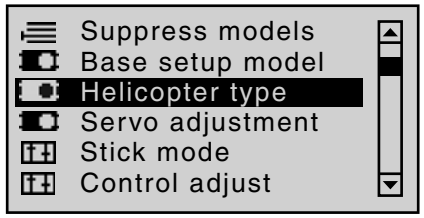




Helicopter type

Establishing helicopter model type

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.

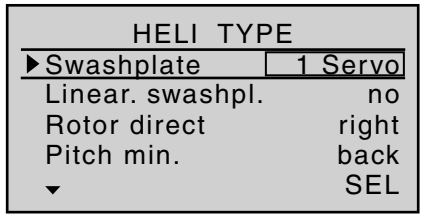


Press briefly on the center **SET** button in the right touch pad.

Swashplate type

Control of the swashplate will require an appropriate program variant which corresponds to the number of servos operating pitch control.

After selecting the "Swashplate" line with the ▲▼ arrow keys of the left or right touch pad, the corresponding entry field will be framed.



Press briefly on the center **SET** button in the right touch pad. The current setting for number of pitch servos will be displayed in inverse video. Now choose the variant needed with the arrow keys of the right touch pad.

"1 Servo": The swashplate will be tipped with one servo each for roll and nick. Pitch control will be affected by *a* separate servo.
(Since helicopter models operated with only 1 pitch servo will be operated WITHOUT the transmitter's mixer functions for pitch, nick and roll, the **"Swashplate mixer"** menu item in the Multifunction menu will be hidden.)

"2 Servos": Two roll servos will displace the swashplate axially to affect pitch control; nick control will be decoupled by a mechanical compensation rocker.

"3Sv (2Roll)": Symmetrical three-point control of the swashplate is affected at three articulation points, each radially offset from the others by 120°, which are connected to one nick servo (at the front *or* rear) and two roll servos (located laterally at the left and right). All three servos push the swashplate axially to affect pitch control.

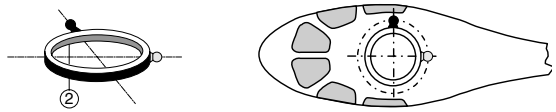
"3Sv (140)": Asymmetrical three-point control of the swashplate is affected at three articulation points connected to one nick servo (rear) and two roll servos (front left and right). All three servos push the swashplate axially to affect pitch control.

"3Sv (2Nick)": Symmetrical three-point control as described above but radially offset by 90°, one lateral roll servo and two nick servos, front and rear.

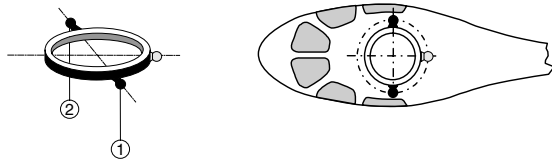
"4Sv (90°)": Four-point swashplate control affected by two roll servos and two nick servos.

Simultaneously pressing the ▲▼ or ◄► keys of the right touch pad (**CLEAR**) will set the option back to "1 Servo".

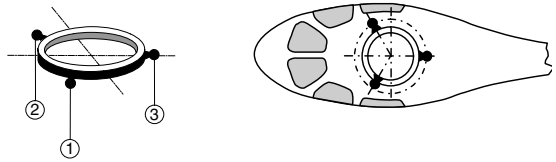
Swashplate type: 1 Servo



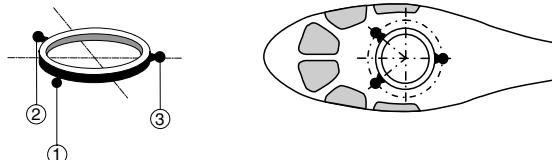
Swashplate type: 2 Servos



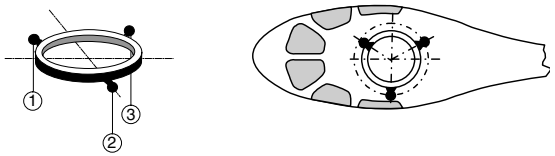
Swashplate type: 3 Servos (2 Roll)



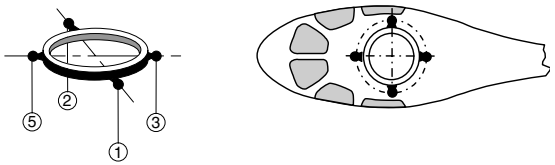
Swashplate type: 3 Servos (140°)



Swashplate type: 3 Servos (2 Nick)



Swashplate type: 4 Servos (90°) 2 Nick / 2 Roll



Notice:
*Except for the "1 Servo" choice, swashplate mixer proportions must also be set in the "**Swashplate mixer**" menu, page 196.*

Swashplate linearizing

After selecting the "Linear. swashpl." line with the ▲▼ arrow keys of the left or right touch pad, the corresponding 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 for the servo arm, servo travel can be appropriately reduced for small control movements –similar to a substantial Expo setting–.

Rotor rotation

After selecting the "Rotor direct" line (rotor direction) with the ▲▼ arrow keys of the left or right touch pad, the corresponding entry field will be framed.

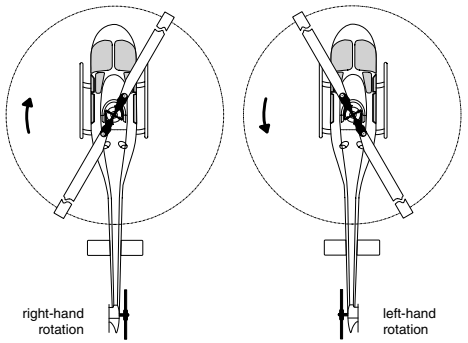
HELI TYPE	
Swashplate	3Sv(2rol)
Linear. swashpl.	no
▶Rotor direct	right
Pitch min.	back
◆	SEL

Once the choice for main rotor rotation direction is made with the arrow keys, it is set by pressing the center **SET** button in the right touch pad.

"right": The main rotor turns clockwise when viewed from above.

"left": The main rotor turns counter-clockwise when viewed from above.

Simultaneously pressing the ▲ ▼ or ◀ ▶ keys of the right touch pad (**CLEAR**) will set the option to "right".



This entry is necessary for correct operational orientation of the torque and power compensation mixer settings made in the **"Helicopter mixer"** menu:

Pitch,
C1 → throttle,
C1 → tail rotor,
Tail rotor → throttle,
Roll → throttle,
Roll → tail rotor,
Pitch → throttle,
Nick → throttle,
Nick → tail rotor.

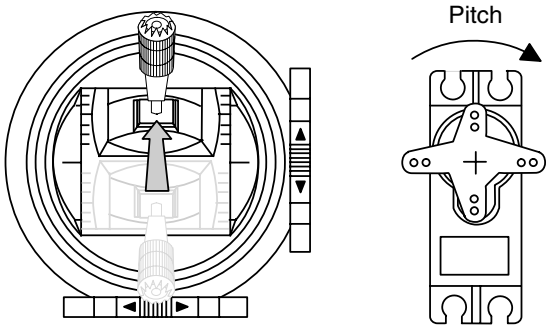
Pitch min

After selecting the "Pitch min" (pitch minimum) line with the ▲▼ arrow keys of the left or right touch pad, the corresponding 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 direction of operation for the throttle/pitch control stick to your 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.

Press the center **SET** button in the right touch pad. The operating direction of the throttle/pitch joystick will be displayed in inverse video. Now choose the variant needed with the arrow keys of the right touch pad.



These mean:

"fwrd.": minimum pitch setting when the pitch joystick (C1) is "forward", i.e. away from the pilot.

"back": minimum pitch setting when the pitch joystick (C1) is "back", i.e. toward the pilot.

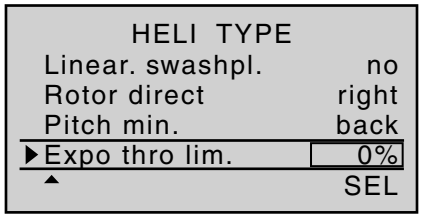
Simultaneously pressing the ▲▼ or ◄ ► keys of the right touch pad (**CLEAR**) will set this option to "rear".

Notices:

- *C1 trimming affects only the throttle servo.*
- *The so-called "throttle limiter" is set by default, see text beginning page 104, such that the throttle limiter for full throttle can be set independently of the pitch servo via input **"Th.L.12"** in the **"Control adjust"** menu.*
- *Since your 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 224. This specification will 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

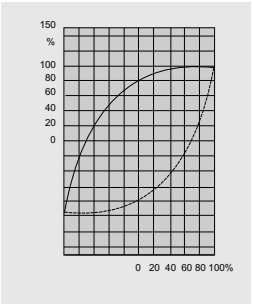
After selecting the "Expo thro lim."line with the ▲▼ arrow keys of the left or right touch pad, the corresponding entry field will be framed.



The "Throttle limit" function, described in the text for the "**Control adjust**" menu on page 104, can be assigned an exponential characteristic curve.

A pitch progression rate value between -100 % and +100 % can be set with the arrow keys.

For example, this is meaningful when the throttle limiter is to be regulated in parallel with the idle setting. Further details about the throttle limiter can be found in the text for the "**Control adjust**" menu on page 100.



An example of two Expo throttle limit curve characteristics for 100 % servo travel.

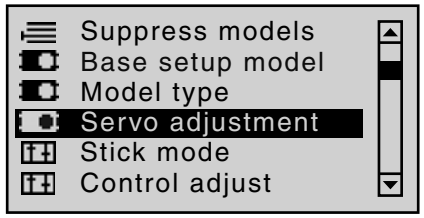
continuous line: negative expo values;

dashed line: positive expo values

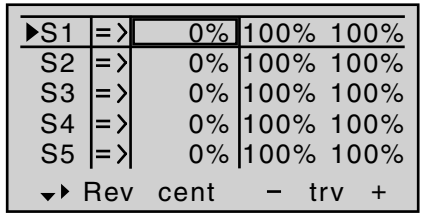
Servo adjustment

Servo direction, midpoint, travel and limit

This menu is used to set the direction, neutralization, travel and limit parameters for a given selected servo exclusively.



Briefly press the center **SET** button in the right touch pad.



Begin setting servo parameters in the left column.

Basic procedure steps:

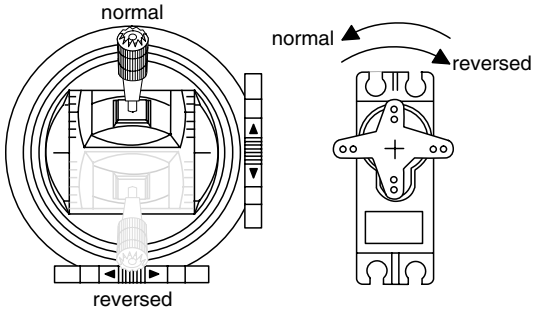
1. Select the desired servo, S1 ... S12, with the ▲▼ arrow keys of the left or right touch pad.
2. If necessary, use the ◄► arrow keys of the left or right touch pad to reach the desired column then, if desired, move the respective control out of its midpoint to make an asymmetric setting.
3. Briefly press the center **SET** button in the right touch pad. The respective entry field will be displayed in inverse video.
4. Use the arrow keys of the right touch pad to set the desired value.
5. Briefly press the center **SET** button in the right touch pad to complete the entry.
6. Simultaneously pressing the ▲▼ or ◄► keys of the right touch pad (**CLEAR**) will set any setting which has been made back to the given 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.

Simultaneously pressing the ▲▼ or ◄► keys of the right touch pad (**CLEAR**) will reset the rotation direction to "=>".



Column 3 "midpoint"

The servo midpoint 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 set in a range of -125 % to +125 % *within* a maximum servo travel scope of ±150 %. Independent of all other trim and mixer settings, this setting is always based directly on the respective servo.

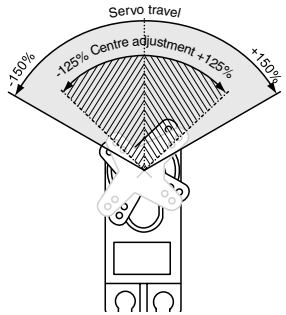
Note that extreme adjustments of the neutral point can lead to one-sided restrictions of servo motion because both the electronic and the mechanical aspects limit total travel to ±150 %.

Simultaneously pressing the ▲▼ or ◄► keys in the right touch pad (**CLEAR**) will reset the entry field displayed in inverse video back to its "0 %" value.

Column 4 "- Weg +"

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 (joystick, proportional rotary control or switch) is to be put into the position which covers travel to *both sides* of the marked



frame.

Notice:
*It may be necessary to first assign a control to a servo attached to one of the 5 ... 12 control channels. If necessary, this is to be done in the "**Control adjust**" menu, see page 96 or 100.*

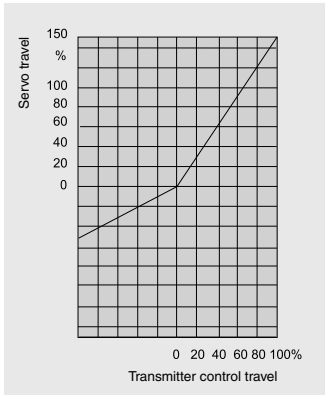
To create an *asymmetric* travel path, the respective control (joystick, proportional rotary control or switch) is to be moved to the side to be set such that it covers only the marked frame.

The value setting is activated by briefly pressing the center **SET** button in the right touch pad. The value field will be displayed in inverse video. Values can be changed with the arrow keys of the right touch pad. Pressing the center **SET** button in the right touch pad will complete the entry.

Simultaneously pressing the ▲▼ or ◄ ► keys in the right touch pad (**CLEAR**) will reset the changed parameter in the entry field back to 100 %.

Important:
*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 control 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 "limit"

The "- lim +" column is reached by pushing the marked frame with the ► arrow key of the left or right touch pad, analogous to the pointers at the bottom of the screen, to the right beyond the "- trv +" 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*, i.e. control-side independent limit, the respective control (joystick, proportional rotary control or switch) is to be put into the position in which the marked frame covers *both sides* of the travel setting.

To set *asymmetric* travel, the respective control (joystick, proportional rotary control or switch) is to be moved to the side on which the marked frame only includes the value to be changed.

Simultaneously pressing the ▲▼ or ◄ ► keys in the right touch pad (**CLEAR**) will reset the entry field displayed in inverse video back to its "0 %" value.

Example:
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 of both controls (e.g. aileron and rudder) combine to form an overall 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 % –.

Joystick setting

Setting stick mode 1 through 4

Both joysticks are equipped for digital trimming. With each brief push (one "click") on a joystick it will change its neutral position by one increment. Holding the stick longer will cause trimming to run in the corresponding direction at increasing speed.

The current position is shown on the screen and adjustment is also made "audible" by various high frequency 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.

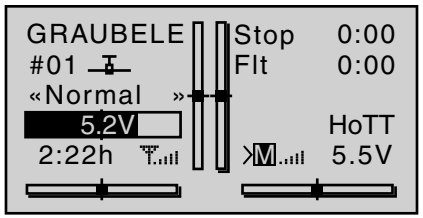
Current trim values are automatically stored when a model memory change is made.

Furthermore – except for trimming the throttle/brake joystick, commonly referred to as control function "C1" (channel 1) – digital trimming is effective within a model memory location selectively as either a global parameter (i.e. consistent in all flight phases) or as a flight-phase specific parameter. This specification as "global" or "phase" is made in the "Joystick setting" menu described here, whereas C1 trimming is always made "globally", i.e. independent of flight phases.

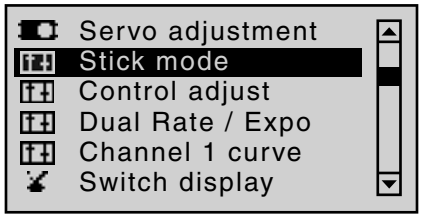
This setting is visualized in the base screen by a "shadow" on trim bars:

- shadow present = global,
- no shadow = flight phase dependent.

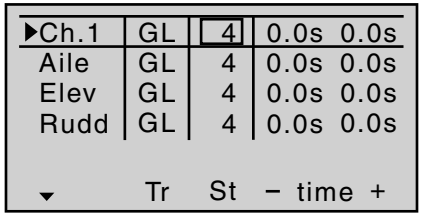
The following figure shows elevator trim – in the right column with standard Mode 1 – as being flight-phase dependent.



Scroll with the arrow keys of the left or right touch pad to the "**Stick mode**" menu item of the multifunction menu.



Open this menu item by pressing the center **SET** button in the right touch pad.

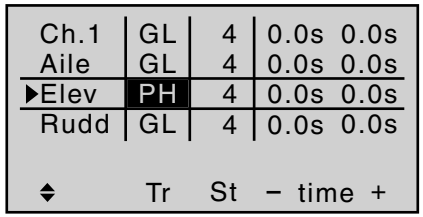


This menu, adapted for winged models, permits the trim effects of the four digital trim levers to be established and control functions 1 through 4 to be selectively "decelerated".

The desired line can be reached by using the arrow keys of the left or right touch pad. Once the appropriate function field has been selected and then the center **SET** button in the right touch pad is pressed briefly, the field will appear in inverse video and the desired setting can be made with the arrow keys of the right touch pad.

Column "Tr" (trim)

Except for "channel 1", this column can be used to switchover trim effect from "GL(obal)" to "PH(ase)" and vice versa. For example:



"GL": The position of the respective trim lever is effective for the given model "globally", i.e. across any flight phases which may be programmed for it, page126.

"PH": The position of the respective trim lever 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.

Simultaneously pressing the ▲▼ or ◄► keys of the right touch pad (**CLEAR**) switches the entry back to "GL".

Column "St" (trim steps)

The four digital trim levers push the neutral point of the respective joystick by one increment for each press ("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 column "St" (Steps) and then the desired trim control with the ▲▼ arrow keys of the left or right

touch pad, 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	GL	4	0.0s	0.0s
Rudd	GL	4	0.0s	0.0s
▲▼		Tr	St	− time +

Briefly press the center **SET** button in the right touch pad. The current setting will be displayed in inverse video. Now select the desired value, between 1 and 10, with the arrow keys of the right touch pad. For example:

Ch.1	GL	4	0.0s	0.0s
Aile	GL	4	0.0s	0.0s
▶Elev	GL	8	0.0s	0.0s
Rudd	GL	4	0.0s	0.0s
▲▼		Tr	St	− time +

Simultaneously pressing the ▲▼ or ◄► arrow keys of the right touch pad (**CLEAR**) will reset the change made in the active field back to "4".

Column "time"

The "time" column entries influence joystick acceleration speed/s – if applicable, for each movement direction for the four control sticks, 1 through 4, separately –. 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 joystick 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	GL	4	0.0s	0.0s
Rudd	GL	4	0.0s	0.0s
▼		Tr	St	− time +

On the other hand, for reasons of safety, the motor cut-off should always be "immediate".

Simultaneously pressing the ▲▼ or ◄► keys of the right touch pad (**CLEAR**) will reset the change made to the active field back to "0.0 s".

Joystick setting

Setting stick mode 1 through 4

Both joysticks are equipped for digital trimming. With each brief push (one "click") on a joystick it will change its neutral position by one increment. Holding the stick longer will cause trimming to run in the corresponding direction at increasing speed.

The current position is shown on the screen and adjustment is also made "audible" by various high frequency 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.

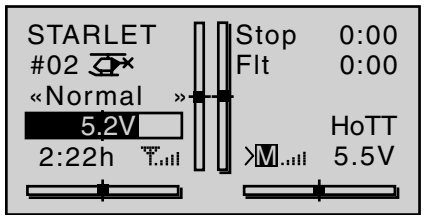
Current trim values are automatically stored when a model memory change is made.

Furthermore – except for trimming the throttle/brake joystick – digital trimming is effective selectively either as a global parameter, i.e. consistent in all flight phases, or as a flight-phase specific parameter. This specification as "global" or "phase" is made in the "Joystick setting" menu described here, whereas throttle trimming is always made "global" by software, i.e. independent of flight phases.

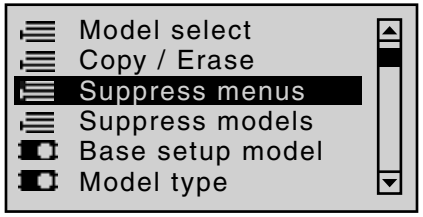
This setting is visualized in the base screen by a "shadow" on trim bars:

- shadow present = global,
- no shadow = flight phase dependent.

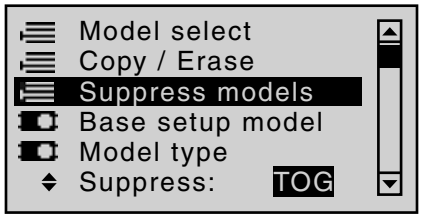
In the following figure nick trimming is used as an example of flight-phase dependence – presented in its default Mode 1 at the left –.



Scroll with the arrow keys of the left or right touch pad to the **" Stick mode "** menu item of the multifunction menu.



Open this menu item by pressing the center **SET** button in the right touch pad.

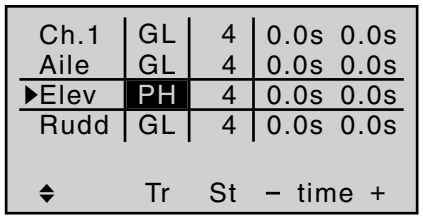


This menu, adapted for helicopter models, permits the trim effects of the four digital trim levers to be established and control functions 1 through 4 to be selectively "decelerated".

The desired line can be reached by using the arrow keys of the left or right touch pad. Once the appropriate function field has been selected and then the center **SET** button in the right touch pad is pressed briefly, the field will appear in inverse video and the desired setting can be made with the arrow keys of the right touch pad.

Column "Tr" (trim)

These setting variations are configured to accommodate the needs of helicopter models, which is why the following alternative options are available for the "Thr." line:



"TL": "throttle limit"

C1 trimming operates as idle trimming when the "throttle limit" function regulates the motor for starting, see "**Control adjust**" menu, page 104.

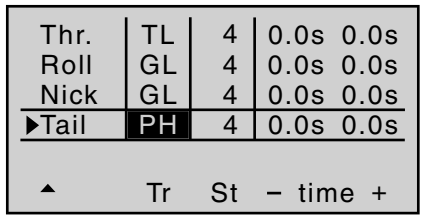
"AR": "autorotation throttle"

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 164, e.g. for use during autorotation practice, which can be "varied" with the idle trim lever.

Simultaneously pressing the ▲▼ or ◄► keys of the right touch pad (**CLEAR**) will switch this option back to "TL".

On the other hand, the trim effects of respective digital trimming controls for the lines "Roll", "Nick" and "Tail rotor" can be switched over from "GL" to "PH" and vice versa. Example:



"GL": The position of the respective trim lever is effective for the given model "globally", i.e. across any flight phases which may be programmed for it, page 126.

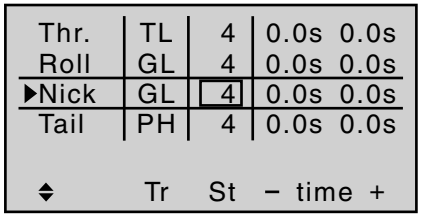
"PH": The position of the respective trim lever is effective on a phase-specific basis and will be automatically stored upon change of flight phase so that the setting is again available following a return to this flight phase.

Simultaneously pressing the ▲▼ or ◄► keys of the right touch pad (**CLEAR**) will switch the entry back to "GL".

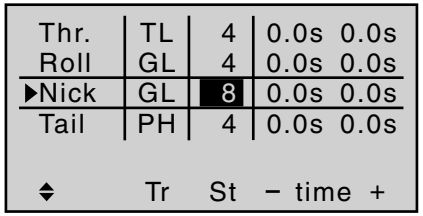
Column "St" (trim steps)

The four digital trim levers push the neutral point of the respective joystick by one increment for each press ("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 column "St" (Steps) and then the desired trim control with the ▲▼ arrow keys of the left or right touch pad, the corresponding entry field will be framed. Example:



Briefly press the center **SET** button in the right touch pad. The current setting will be displayed in inverse video. Now select the desired value, between 1 and 10, with the arrow keys of the right touch pad. For example:



Simultaneously pressing the ▲▼ or ◄► keys of the right touch pad (**CLEAR**) will reset any change made to the active field back to "4".

Column "time"

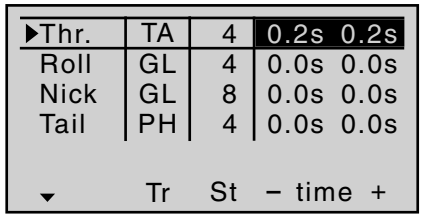
The "time" column entries influence joystick acceleration speed/s – if applicable, for each movement direction for the four control sticks, 1 through 4, separately –. This means that respective servos will then follow rapid control position changes only at an accordingly delayed rate. This time delay has a direct effect on the control signal and therefore also commensurately on any servos controlled by the effected controls.

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 this latter case, the given stick control 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.

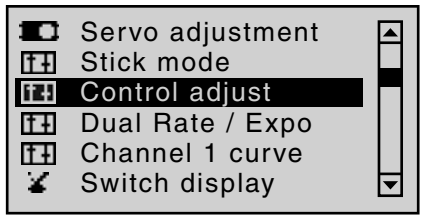
A rash "Pitch" control movement would not operate the nick servo in the middle as quickly as it would the two roll servos on the shorter lever. This would cause a momentary control motion in the "nick" direction. However, if response time for the "pitch" control function were to be reduced by at least 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:



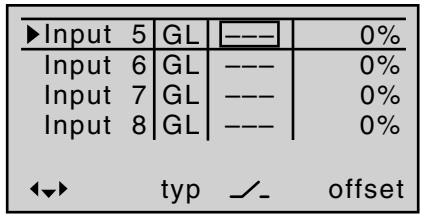
Simultaneously pressing the ▲▼ or ◄► keys of the right touch pad (**CLEAR**) will reset any change made to the active field back to "0.0 s".

Control adjust

Fundamental operating steps for control and switch assignments



Briefly press the center **SET** button in the right touch pad.



Aside from the two joysticks which operate control functions 1 through 4, a standard **mc-32** HoTT transmitter is also equipped with other operating elements:

- two 3 position switches: SW 4/5 or CTRL 9 and SW 6/7 or CTRL 10. These are assigned in this menu as "Ct9" and "C10".
- three proportional rotary controls: CTRL 6, 7 and 8. Respectively designated "Ct6", "Ct7" and "Ct8" in the menu.
- three 2 position switches: SW 2, 3 and 8. Respectively displayed in the menu as "2", "3" and "8" in combination with a switch symbol indicating the switching direction.
- two pushbutton switches: SW 1 and SW 9. Analogous to the aforementioned switches; designated as "1" and "9" and displayed in combination with a symbol indicating switching direction.

In contrast to the two joysticks 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 20 – or even after the initialization of a new model memory with the "Winged aircraft" model type and its "binding" to the intended receiver, only those servos connected to the two joysticks by way of receiver outputs 1 … 4 are able to be operated; any servos which may be connected to the receiver's outputs 5 … 12 will initially remain inactive in their middle positions.

Even though this may seem inconvenient at first glance, it is indeed just this state which offers full freedom to select and assign these "other" operating elements as desired and leaves any unused operating elements harmlessly dormant without taking any action to deactivate them. This has the advantage that:

An unused operating element will have no influence on your model's operation even if inadvertently operated; it will be inactive and therefore have no assigned function.

These "other" operating elements can be freely assigned to meet your needs and the features of your model. They can be assigned to any function input in the "**Control adjust**" menu, see page 50. But this also means that each of these operating elements can also be assigned to multiple functions at the same time. For example, one and the same toggle switch, SW X, assigned in this menu to an input, can at the same time be assigned to a "timer" as an On/Off switch in the **"Timers (general)"** menu...

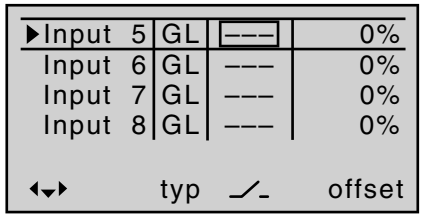
Furthermore, *all* inputs can be selectively made *global* or flight-phase specific (providing that flight phases have been defined in the menus "**Phase settings**", page 128, and "**Phase assignment**", page 134). The respective names for the given flight phases will then appear in the bottom screen line, e.g. "normal".

Basic procedure steps

1. Select the desired input, E5 ... 12 with the ▲▼ arrow keys of the left or right touch pad.
2. If necessary, use the ◄ ► arrow keys of the left or right touch pad to change to the desired column.
3. Briefly press the center **SET** button in the right touch pad. The respective entry field will be displayed in inverse video.
4. Actuate the desired operating element or use the arrow keys of the right touch pad to set the desired value.
5. Briefly press the center **SET** button in the right touch pad to complete the entry.
6. Simultaneously pressing the ▲▼ or ◄ ► arrow keys of the right touch pad (**CLEAR**) will reset any setting change back to its default value.

Column 2 "typ"

Analogous to the "**Stick mode**" menu already described, this column can be used to select whether other settings are to be made for the given input, e.g. "GL(obal)" or "PH(ase specific)" and vice versa.



"GL": The given input's settings will be "globally" effective for the respective model memory across any flight phases which may be programmed.

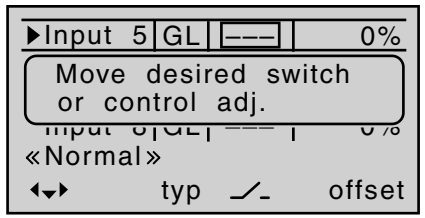
"PH": The settings for this input will be effective on a flight-phase basis and must therefore be explicitly set in each flight-phase where it is to be effective.

Notice:
More about flight phases on page 126.

Column 3 "Control or switch assignment"

Use the ▲▼ arrow keys of the left or right touch pad to select one of the inputs, 5 through 12.

Briefly press the center **SET** button in the right touch pad to activate the assignment.



Now activate the desired control (CTRL 6 through 10) or selected switch (SW 1 through 3, or 8 or 9) - whereby a proportional rotary control will only be detected after some "detenting" action has taken place and so may have to be activated a bit longer. If adjustment travel is insufficient, activate the control in the other direction.

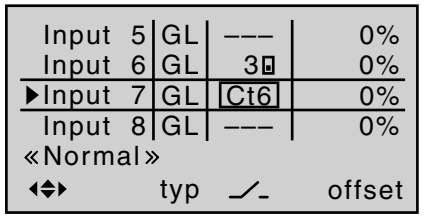
Two position switches can only switch back and forth between their fixed end states, e.g. motor ON or OFF. On the other hand, the 3 position switches, SW 4/5 or 6/7, that can be incorporated in this **"Control adjust"** menu as "Ct9" or "C10", also offer a middle position.

Simultaneously pressing the ▲▼ or ◄► keys of the right touch pad (**CLEAR**) for an active control or switch assignment – see figure above – will reset the input back to its "free" state.

Tips:

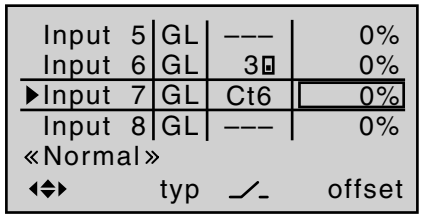
- *When assigning switches, pay attention to the desired switching direction and also that all unused inputs remain "free" or are again reset to "free" (if applicable, across all flight phases). This is necessary to ensure that inadvertent actuations of these unused controls cannot cause malfunctions.*
- *The travel setting described below allows the appropriate end state to be established for an assigned switch.*

For example, the screen will now show either the control's number or – in conjunction with a switch symbol indicating the switching direction – the switch's number.



Column 4 "offset"

The control midpoint for the given control, i.e. its zero point, can be changed in this column. The adjustment range lies between -125 % and +125 %.



Simultaneously pressing the ▲▼ or ◄► keys in the right touch pad (**CLEAR**) will reset the entry field displayed in inverse video back to "0 %".

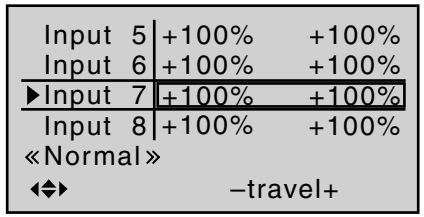
Column 5 "-travel+"

This column is used to set servo travel symmetrically or asymmetrically for each side. The setting range is ±125 % of normal servo travel.

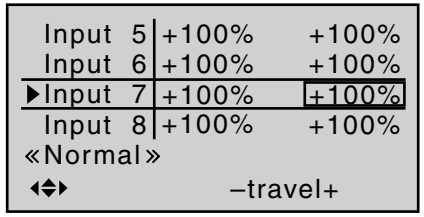
Use the ▲▼ arrow keys of the left or right touch pad to select one of the inputs, 5 through 12.

To set *symmetric* travel, i.e. control-side independent travel, the respective operating element (proportional rotary control or switch) is to be put into a position which

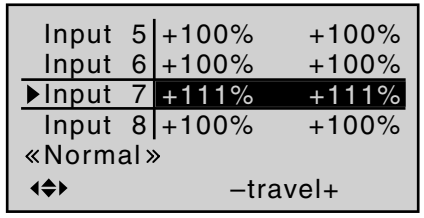
covers travel to both sides of the marked frame.

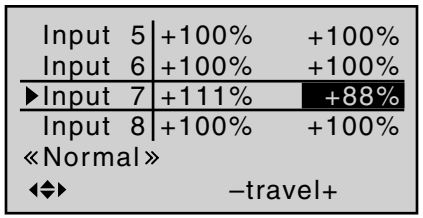


To set *asymmetric* travel, the respective control (proportional rotary control or switch) is to be moved to the side on which the marked frame only includes the value to be changed.



The value setting is activated by briefly pressing the center **SET** button in the right touch pad. The value field will be displayed in inverse video. Values can be changed with the arrow keys of the right touch pad.





Another brief press of the center **SET** button in the right touch pad will complete the entry.

Negative and positive parameter values are possible in order to appropriately adapt the control's direction or effect.

Simultaneously pressing the ▲▼ or ◀ ▶ keys in the right touch pad (**CLEAR**) will reset the changes parameter in the inverse video entry field back to +100 %.

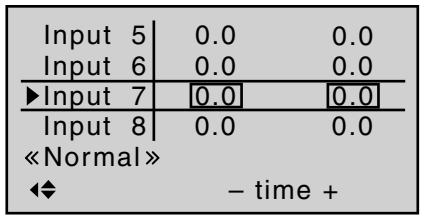
Important:
In contrast to the servo travel setting, control travel setting effects all derived *mixer and coupling functions, i.e. influences all servos which can be actuated by way of the respective control.*

Column 6 "time"

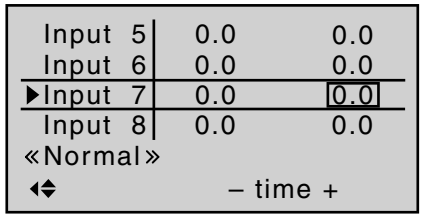
A symmetric or asymmetric time delay between 0 and 9.9 s can be applied to each of the 5 ... 12 function inputs.

Use the ▶ arrow keys in the left or right touch pad to push the marker frame to the right, beyond the "-travel+" column.

To set a *symmetric*, (i.e. control-side independent) time delay, the respective operating element (proportional rotary control or switch) must be put into a position which covers time to both sides of the marked frame.



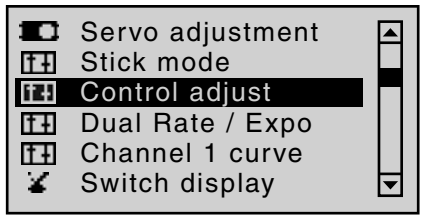
To set an *asymmetric* time delay, the respective control (proportional rotary control or switch) is to be moved to the side on which the marked frame only includes the value to be changed.



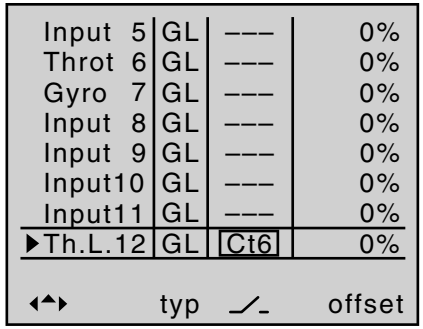
Notice:
Further suggestions for structuring timed flows can be found in the section "Control of timed flows" on page 266.

Control adjust

Basic procedure for transmitter control and switch assignment



Briefly tap the center **SET** key on the right touch pad:



In addition to the two dual axis sticks for control functions 1 to 4, the **mc-32** HoTT transmitter is equipped with other controls as standard:

- Two 3-stage switches: SW 4/5 and CTRL 9, plus SW 6/7 and CTRL 10. On this menu, these are assigned as "Ct9" and "Ct10".
- Three proportional rotary controls: CTRL 6, 7 and 8. Named as "Ct6", "Ct7" and "Ct8" on this menu.
- Three 2-stage switches: SW 2, 3 and 8. Labeled accordingly as "2", "3" and "8" on the menu. A switch icon indicating the switch direction is also shown.
- Two push-button switches: SW 1 and SW 9. Displayed as with the preceding switches, "1" and "9" with a switch icon indicating the switch direction.

Even with a newly-initialized model memory for the "Helicopter" model type, the two dual axis sticks will – in the absence of further configuration – influence only those servos connected to receiver outputs 1 … 4 and 6. Unlike these, the "additional" transmitter controls mentioned above are theoretically inactive at first. (The exception here is the CTRL 6 proportional rotary control (throttle limiter), which also affects servo 6.)

One of the effects of this is that (as mentioned back on page 20) with a factory-fresh unit, only the servos connected to receiver outputs 1 … 4 and – depending on the position of the throttle limiter – servo 6 can be moved using the two joysticks. (This also applies following the initialization of a new model memory with the "Helicopter" model type and its "binding" to the receivers to be installed in the model.) The servos connected to slots 5, 7 and 8, on the other hand, will simply stay "stuck" at their center points.

While this may appear more than a little awkward at first glance … this is the only way to ensure that you can select any of the "additional" transmitter controls as you wish and, in addition, do not need to waste time "disabling" control elements you do not require. This is because

the only way to ensure an unwanted control element has no effect on your model, even if operated by accident, is to make it inactive, i.e. unassigned to a function.

You can therefore use this "**Control adjust**" menu exactly as you wish, to assign the "additional" control elements as you want to any required function input; for further details, see page 50. Equally, this also means that you can assign individual transmitter controls to multiple functions at the same time, if required. As an example: the exact same rocker switch SW X that you assign to an input on this menu can simultaneously be assigned to "Timers" on the **"Timers (general)"** menu as an "On/Off" switch, etc.

Note:
As a rule, input 6 must kept "free" for a helicopter model. On this, see "Throttle" on the next double page.

Furthermore, if flight phases have been defined on the "*Phase settings*" menu (page *128*) and "**Phase assignment**" menu (page 134), then **all** inputs must be set either as global or flight phase-specific. The names assigned to each of these flight phases are then shown in the bottom line of the screen display, e.g. "Normal".

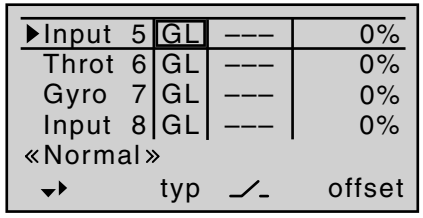
Basic procedure

1. Using the arrow keys ▲▼ on the left or right touch pad, select the input you want: Input 5, Throt 6, Gyro 7, Input 8 … 11 or Th.L.12.
2. If necessary, use the arrow keys ◄ ► on the left or right touch pad to select the column you want.
3. Briefly tap the center **SET** key on the right touch pad. The corresponding input field is shown highlighted.
4. Activate your chosen transmitter control or use the arrow keys on the right touch pad to set your chosen value.
5. Briefly tap the center **SET** key on the right touch pad to complete data entry.
6. If you tap the ▲▼ or ◄ ► keys on the right touch pad at the same time (**CLEAR**), this will reset any settings made back to their respective default values.

Column 2, "typ"

Similarly to the "**Stick mode**" menu described previously, this column can be used to define whether further settings for the input in question are to have a

"GL(obal)" or a "PH(ase-specific)" effect, as follows:



"GL": The settings for the input in question affect all flight phases programmed (if any) and thus act "globally" on the model memory in question.

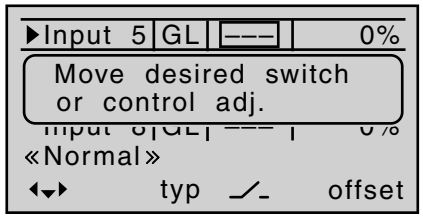
"PH": The settings for this input take effect per flight phase and must therefore be configured separately for each flight phase.

Note:
See page 128 for more information on flight phases.

Column 3, "Transmitter control/switch assignment"

Using the arrow keys ▲▼ on the left or right touch pad, select an input: Input 5, Throt 6, Gyro 7, Input 8 … 11 or Th.L.12.

Briefly tap the center **SET** key on the right touch pad to activate the assignment option:



Now move your chosen transmitter control (CTRL 6 to 10) or selected switch (SW 1 to 3, 8 and 9). Note, however, that the proportional rotary controls are only identified after a few "turns": this means you need to move them for slightly longer. If the control does not have enough travel, move the control in the opposite direction as required.

Once assigned, the 2-stage switches can be switched back and forth only between their respective end-points, e.g. headlights ON/OFF. In contrast, the 3-stage switches SW 4/5 and 6/7 also permit a center control position; these are configured as "Ct9" or "Ct10" on the **"Control adjust"** menu.

If a switch has been assigned, then tapping the ▲▼ or ◀ ▶ keys on the right touch pad at the same time (**CLEAR**) bei aktivierter Schalterzuordnung – see screen image above – will reset the input back to "free".

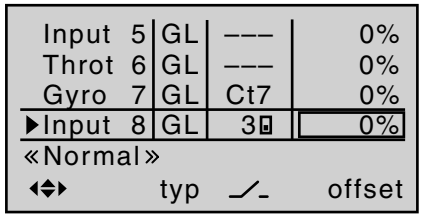
Tips:

- *When assigning switches, pay attention to the desired switching direction and also that all unused inputs remain "free" or are again reset to "free" (if applicable, across all flight phases). 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.*

The screen now shows either the control number or – alongside a switch icon that shows the switch direction – the switch number, e.g.:

Column 4, "offset"

In this column, you change the control center, i.e. the zero point, for the transmitter control in question. The adjustment range lies between -125 % and +125 %.



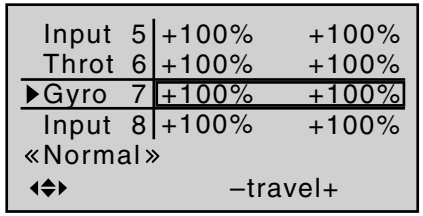
If you tap the ▲▼ or ◀ ▶ keys on the right touch pad (**CLEAR**) at the same time, this will reset the value in the highlighted field back to 0%.

Column 5, "–travel+"

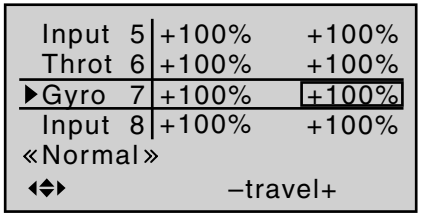
This column is used to set servo travel symmetrically or asymmetrically for each side. The setting range is ± 125 % of normal servo travel.

Using the arrow keys ▲▼ on the left or right touch pad, select an input: Input 5, Throt 6, Gyro 7, Input 8 … 11 or Th.L.12.

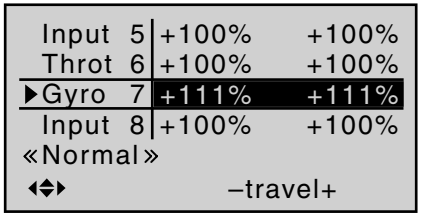
To configure *symmetrical* travel, i.e. one independent of the control side, move the affected transmitter control (proportional rotary control or switch) to a position at which the marker frame encloses both sides of the travel adjustment region:

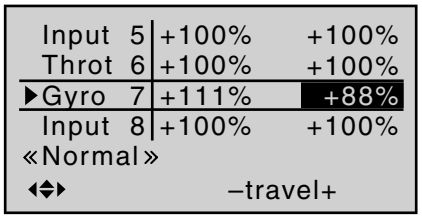


To configure *asymmetric* travel, move the affected transmitter control (proportional rotary control or switch) to the side on which you wish to configure it, so the marker frame encloses only the value you want to adjust:



Briefly tap the center **SET** key on the right touch pad to activate value configuration: The value field is shown highlighted. Use the arrow keys on the right touch pad to change the values:





Complete the configuration by tapping the center **SET** key on the right touch pad.

Negative and positive parameter values are possible in order to appropriately adapt the control's direction or effect.

If you tap the ▲▼ or ◀ ▶ keys on the right touch pad (**CLEAR**) at the same time, this will reset parameters changed in the highlighted field back to +100%.

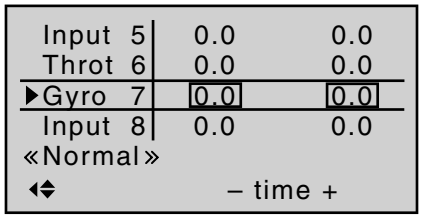
Important:
In contrast to altering servo travel, changing the control travel setting affects all "downstream" *mixer and coupling inputs, i.e. any and all servos that could be actuated by the transmitter controls concerned.*

Column 6, "– time +"

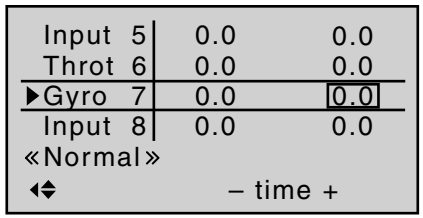
Each of the function inputs 5 … 12 can be assigned a symmetrical or asymmetric time delay of between 0 and 9.9. s.

Using the arrow key ▶ on the left or right touch pad, move the marker frame over the "– travel +" column and to the right.

To configure a *symmetrical* time delay, i.e. one independent of the control side, move the affected transmitter control (proportional rotary control or switch) as necessary to a position at which the marker frame encloses both sides of the time adjustment region:

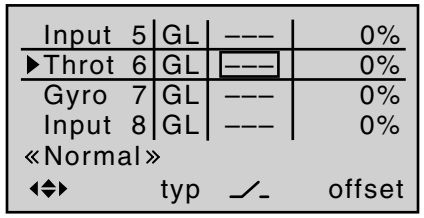


To configure an *asymmetric* time delay, move the affected transmitter control (proportional rotary control or switch) as required to the side on which you wish to configure it, so the marker frame encloses only the value you want to adjust:



Note:
Other suggestions for designing timed sequences can be found under "Controlling timed sequences" on page 266.

"Throt 6"



In the helicopter program, it is also theoretically possible to assign any transmitter control (rotary proportional controls and switches) to individual inputs.

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.

If we consult the receiver assignment table on page 59, for example, we see that the throttle servo (or speed controller of an electrically-powered helicopter) must be connected to receiver output "6", since control channel "6" is reserved for motor power control.

Unlike a fixed-wing model aircraft, however, the throttle servo or speed controller is *not* directly controlled by the throttle stick or other transmitter control, but by a complex mixer system – see the **"Helicopter mixers"** menu (from page 164). 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 7"

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 you are using also has this feature, then this menu option gives you the opportunity to specify both "normal" gyro gain and, as appropriate, to specify "heading-lock mode" in the "Offset" column in the range of ±125%, plus a particular gain type within this pre-selection, so as to be able to exploit maximum stabilization for normal, slow flight, but to reduce gyro gain for fast circuits and aerobatics.

To proceed as described above, use flight phase switching to enter different settings on the "Gyro" line.

From the starting-point of these predefined – static – flight phase-specific settings, you can then use a transmitter control assigned to the "Gyro 7" line, e.g. one of the rotary potentiometers CTRL 7 or 8, to vary the gyro gain around the respective "offset point": The center point of the control corresponds to the setting specified by the offset. If the transmitter control is moved from this center 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 gain even in flight – e.g. to suit changing weather conditions – or to test-fly optimum settings. In software terms you can even limit the gyro gain range in both directions by adjusting transmitter control travel.

In this context, ensure that you comply with the instructions on adjusting your gyro: if not, you risk making adjustments that render your heli impossible to fly.

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.

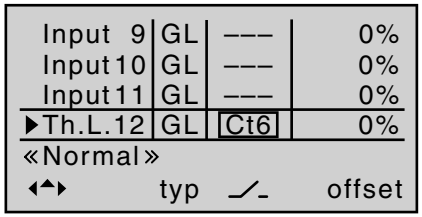
When the gyro sensor detects a model rotation, the faster its response – a corresponding corrective change to tail rotor thrust – takes effect, the further the gyro gain adjustor can be moved without causing the tail of the model to start oscillating, and the better the model's stability about its vertical 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, you should make use of the option to adjust gyro gain from the transmitter

control using either the CTRL 7 or 8 proportional rotary control.

"Thr.I 12"

As standard, the "Thr.I 12" input is assigned to the CTRL 6 proportional rotary control mounted on the top left of the transmitter.



This pre-assignment 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"" –, since the **mc-32** HoTT program offers a much more flexible approach to fine-tuning and optimizing increases to system rotational speed below the hover point than "idle-up". If you nonetheless prefer to program your helicopter "with idle-up", then deactivate the "throttle limit" function described below by setting input "Thr.I 12" to "free".

Meaning and application of "throttle limit"

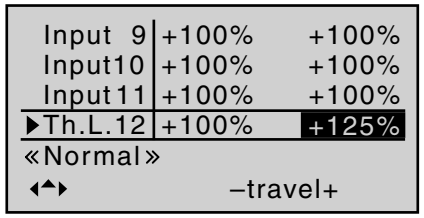
As already mentioned under "Throttle", and in contrast to fixed-wing models, the power output of a helicopter's drive system is not controlled directly using the C1 joystick, but only indirectly via the throttle curve settings on the **"Helicopter mixers"** menu or – if your model features a speed *governor* – by using this mechanism.

Note:
For separate flight phases, you can of course use flight phase programming to set specific throttle curves.

Nevertheless, both methods of output control de facto result in the helicopter carburetor 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 CTRL 6 proportional control mounted on the top left of the transmitter – to *limit* the throttle servo or the output level of the speed controller. In this way, it is possible to use the throttle limit control to "throttle back" as you wish as far as the idle setting – at which point the trim lever on the throttle/collective pitch stick takes over – or to cut out an electrical drive system directly. 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 to high enough to ensure that the maximum setting of the throttle limit control never restricts the full-throttle position that can be obtained using throttle curve settings – which typically means setting a value in the range +100% to 125%.

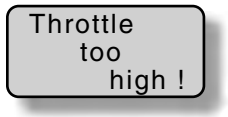


The value on the (left-hand) minus side of the "travel" column should be set so that the throttle limit control can be used to safely cut out an electrical drive system or close a carburetor down far enough that the glow motor can also be cut out in conjunction with the

the – digital – C1 trim. You should thus (initially) leave this value at +100%.

Furthermore, this variable "limiting" of throttle travel not only gives you a convenient method for starting and stopping the motor, but may also prove to have added a not inconsiderable increase in safety! For example, just imagine what could happen if you were carrying the helicopter to the take-off site with the motor running and you accidentally moved the C1 stick …

Accordingly, if the carburetor or speed controller is open too far, an audible warning is heard as soon as you turn on the transmitter, and the message below is shown on the basic display:



Tip:

*You can use the **"Servo display"** menu to observe the influence of the throttle limit slider. This menu can be accessed from almost any other menu by simultaneously pressing the ◄ ► keys on the left touch pad. Bear in mind that servo output 6 controls the throttle servo on the* **mc-32** *HoTT!*

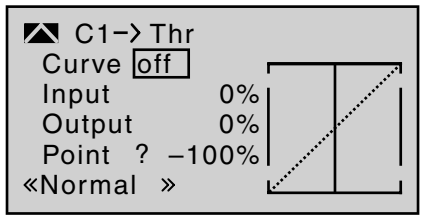
Basic idle setting

Start by turning the throttle limiter – by default the CTRL 6 proportional rotary control on the top left of the transmitter – clockwise as far as it will go. Set the throttle/collective pitch stick to the maximum pitch position and also check the submenu "C1 ➔ Thr" on the menu …

"Helicopter mixers" (pages 164 … 179)

… to ensure you have an active standard throttle curve.

If, for example, the standard throttle curve has already been changed following the initialization of a model memory, then this must be reset at least temporarily to the values "Point 1 = -100%", "Point 3 = 0%" and "Point 5 = +100%":



Note:

As the throttle trim lever has no effect if the throttle limiter is open, its position here is unimportant.

Now – without starting the glow motor – adjust the throttle servo, preferably mechanically and optionally using the servo 6 travel adjustment option in the "**Servo adjustments**" menu, so that the carburetor is completely open.

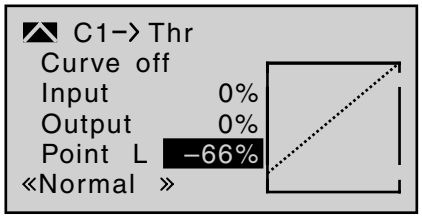
Now, close the throttle limiter completely by turning the CTRL 6 proportional rotary control in an anti-clockwise direction as far as it will go. Use the trim lever on the throttle/collective pitch stick to move the trim position marker to the "Motor OFF" position – see the figure in the next column.

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 carburetor 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 carburetor linkages so that the carburetor is (just) completely closed. Take extreme care to ensure that the throttle servo cannot travel mechanically to either of the two extreme positions (full thr./Motor OFF).

To complete this basic configuration, the idle trim adjustment range must now be matched against point "L" on the throttle curve. To do so, set point "L" for the mixer "C1 ➔ Thr" on the "**Helicopter mixers**" menu from about -65% to -70%:



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.

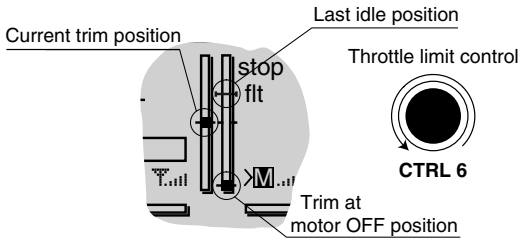
The motor is always started with the throttle limiter fully closed, whereby idle is set exclusively by using the trim lever of the throttle/collective pitch stick.

Throttle limit in conjunction with digital trim

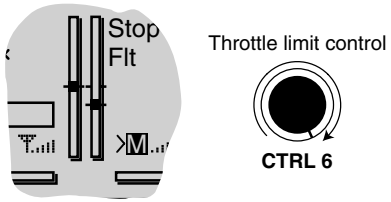
In conjunction with the CTRL 6 throttle limit rotary control, the C1 trim sets a marker (⟝) in the motor's configured idle position, from which the motor can be switched off via the trim. If, on the other hand, a further

marker is located at the *end-point* (see the partial display screenshot shown below), then you can simply click once to restore the original idle configuration (see also page 54).

This switch-off trim functions as an idle trim *only in the left half* of the throttle limit rotary control's path. That is: only within this range is the marker line set and also stored.

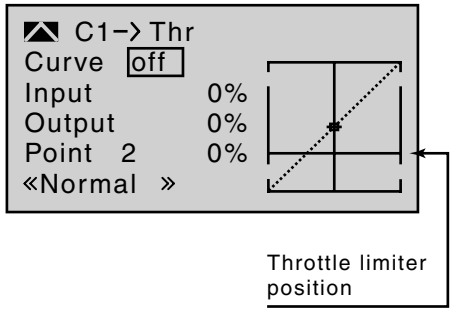


For this reason, the marker is hidden and may even be erased while the throttle limit rotary control points to the right of its center position:



Notes:

- *Since this trim function only takes effect in the "Motor OFF" direction, the screen image shown above changes appropriately if you alter the control direction for the pitch minimum position of the C1 stick from "back" (as shown in the above image) to "forward" in the "min. pitch" line on the menu* ***"Base setup model"****. The effects as shown also swap to the other side if you swap pitch right (as shown in the above screen images) to pitch left in the "Stick mode" line on the "****Base setup model****" menu (see page 74).*
- *You can use the* ***"Servo display"*** *menu to observe the influence of the throttle limit slider. This menu can be accessed from almost any other menu by simultaneously pressing the ◄ ► keys on the left touch pad. Bear in mind that servo output 6 controls the throttle servo on the mc-32 HoTT!*
- *A servo connected to output 12 can be used independently of this for other purposes by means of mixers, provided that you separate the servo from the transmitter control at function input 12 on the "****MIX-only channel****" menu; see page 193.*
- *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 "Channel 1 → Throttle" option on the "****Helicopter mixers****" menu (see page 168). The output signal for the throttle servo cannot be higher than the level set by the horizontal bar:*

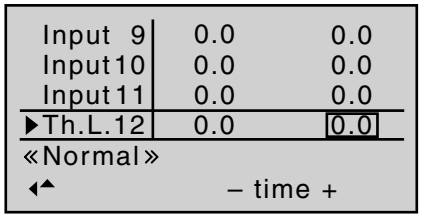


The above diagram shows precisely this scenario: in the above example, the throttle limit control is set to -60% and thus restricts the movement of the throttle servo to -60% of full travel.

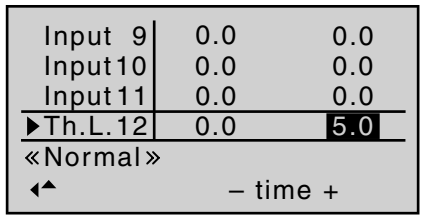
Time delay for the throttle limiter

To safely avoid the carburetor opening too rapidly, you should assign throttle limiter input 12 a time delay that takes effect only in the direction of full throttle. This applies especially if you are controlling the throttle limiter using a switch and not the default CTRL 6 proportional rotary control.

To set a delay time, proceed as follows: turn the throttle limit control as far to the right as it will go or move the relevant switch to the full-throttle position; then use the arrow keys on the left or right touch pad to select the "–time+" column:



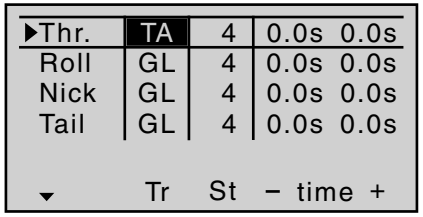
After briefly tapping the center **SET** key on the right touch pad, you can then use the arrow keys on the left or right touch pad to select your desired time delay, e.g. 5 seconds:



Briefly tap the center **SET** key on the right touch pad or the **ESC** key on the left touch pad to complete the setup procedure.

As already explained on page 94, selecting "Thr AR" in the "Thr." line on the menu …

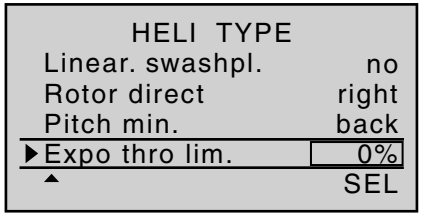
"Stick mode" (page 94)



… makes the digital trim of the throttle/collective pitch stick active only in the "Autorot" flight phase. As a result, in "normal" flight phases, the C1 trim lever can be used neither to control the motor's idling nor to stop the motor. To ensure you still retain sufficient adjustment options, we recommend using "Expo throttle limit" here.

This sub-menu for this is found on the menu …

"Helicopter type" (page 86)



… and the exponential curve characteristic it configures can adjust the control characteristics of the throttle limit control so that the latter provides sufficiently fine control of the idle setting and can also stop the motor.

In this case you should turn the throttle limiter fully to the left – unlike the previously described setting on the "Control adjust" menu – and adjust the "–" side of the "–travel+" column in the "Th.L.12" line so the throttle limiter fully closes the carburetor, i.e. the motor is safely switched off at this control position.

Following this, move the throttle limit control to its center point and change the % value of the "Expo thro lim." line in the "**Helicopter type**" menu (see page 86) until the carburetor 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.

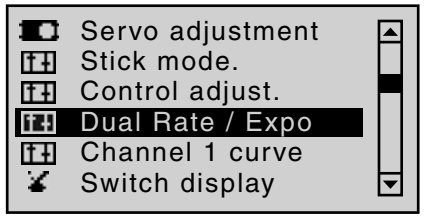
For the plus side of the "–travel+" column, increase the value to +125% as described before, so that the full-throttle position of the throttle servo is also released reliably by the throttle limiter.

Finally, set an asymmetrical time delay of, say, 4.0 seconds, so that the motor also picks up speed gradually even if you move the proportional rotary control too quickly to the right. Select the time preset to correlate to how far the carburetor opens up at the minimum collective pitch position. The value you set will need fine-tuning by practical testing.

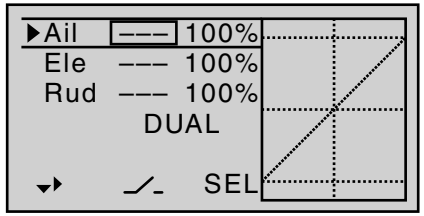
Dual Rate / Expo

Configurable control characteristics for aileron, elevator and rudder

Using the arrow keys on the left or right touch pad, page to the menu option "**Dual Rate / Expo**" in the multi-function list:



Tap the center **SET** key on the right touch pad to open the menu shown below:



The Dual Rate / Expo function permits switching or controlling of control travels and characteristics for aileron (Ail), elevator (Ele) and rudder (Rud) (control functions 2 … 4); it is switch-driven and flight-phase independent.

The "**Channel 1 curve**" menu (see p. 116f.) can be used to set an individual curve characteristic for control function 1 (throttle/brake), featuring up to 6 separately programmable points.

As with transmitter control travel adjustment on the **"Control adjust"** menu, **Dual Rate** affects the relevant *control function* directly, whether it controls a single servo or multiple servos – via mixer and coupling functions of arbitrary complexity.

The control travels for each switch position can be set to between 0% and 125% of the normal full travel.

Expo, on the other hand, enables finer-grained control of the model for values larger than 0% around the center position of the primary control function (aileron, elevator and rudder), without forfeiting full movement at the end-points of joystick 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. You can counteract this effect with Expo values greater than 0%, so that angular travel increases over proportionately as stick travel increases.

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 joystick, so you can clearly see the dependency of the curve value on the transmitter control.

Flight phase-dependent Dual Rate and Expo settings

If you have set up flight phases in the "**Phase settings**" and "**Phase assignment**" menus and assigned each of these a name – e.g. "normal" – the name in question is displayed at the bottom left. In this scenario, you can operate the corresponding switch to switch between flight phases.

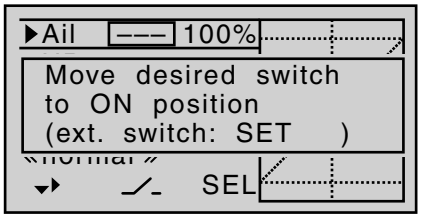
Basic procedure

1. Switch to the desired flight phase and then use the arrow keys ▲▼ on the left or right touch pad to select your chosen menu line, i.e. "Ail", "Ele" or "Rud".
2. Using the arrow keys ◄► on the left or right touch pad, select the right column or the as-yet invisible column for Expo values (see page 27).
3. Tap the center **SET** key on the right touch pad. The corresponding input field is shown highlighted.
4. Use the arrow keys on the right touch pad to set your chosen value.
5. Tap the center **SET** key on the right touch pad to complete data entry.
6. If you tap the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**), this will reset any settings made back to their respective default values.

Dual Rate function

If you want to be able to switch between two variants, assign a switch in the column marked with the switch icon ⁄‾ at the lower edge of the display, as described in the section "Assigning transmitter controls, switches and

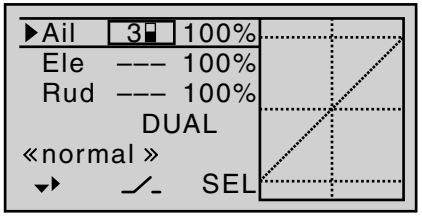
control switches" (page 52):



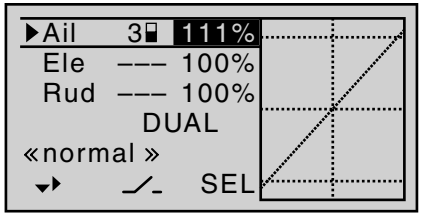
The switch so assigned appears on the display, together with a switch icon that indicates the switch's switching direction.

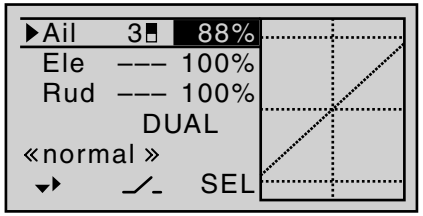
With "G" switches from the "expanded switches" menu, the joystick or another transmitter control acts as the switch itself. However, this kind of control switch must be defined appropriately beforehand on the "**Control switches**" menu (see page 123).

Whichever switch has been assigned …
the respective switch appears on the display together with a switch icon that indicates the switch's respective direction when moved.



If you select the right-hand column at the lower edge of the display marked with **SEL** and activate the value field by briefly tapping the center **SET** key on the right touch pad, you can use the arrow keys on the left or right touch pad to alter the Dual Rate value shown in the highlighted field separately for each of the two switch positions:

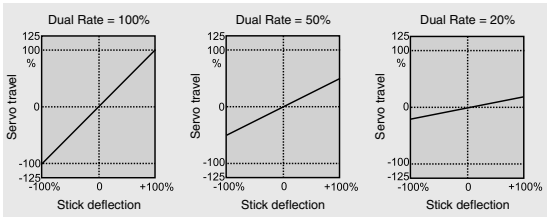




If you tap the ▲▼ or ◄ ► keys on the right touch pad at the same time (**CLEAR**), this will reset a value changed in the highlighted field back to 100%.

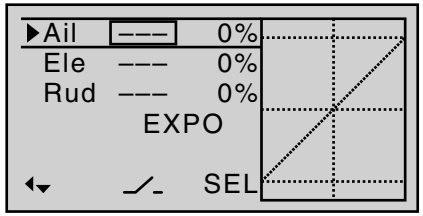
Caution:
For safety reasons, you should not set Dual Rate values lower than 20%.

Some examples of Dual Rate values:

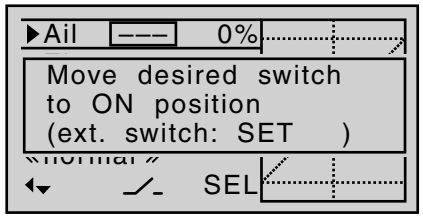


Exponential function

If you want to be able to switch between two variants, use the ► key on the left or right touch pad to move to the right beyond the Dual Rate value column, until the word "DUAL" (shown roughly in the middle of the display) changes to "EXPO":



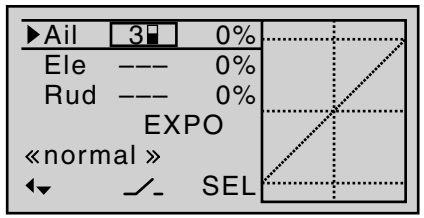
If you want to be able to switch between two variants, assign a switch in the column marked with the switch icon at the lower edge of the display, as described in the section "Assigning transmitter controls, switches and control switches" (page 52):



The switch so assigned appears on the display, together with a switch icon that indicates the switch's respective switching direction.

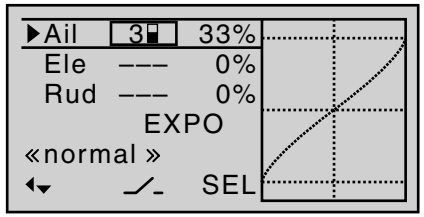
With "G" switches from the "expanded switches" menu, the joystick or another transmitter control acts as the switch itself. However, the control switch in question must be defined appropriately beforehand on the "**Control switches**" menu (see page 123).

Whichever switch has been assigned …
the respective switch appears on the display together with a switch icon that indicates the switch's respective direction when moved.



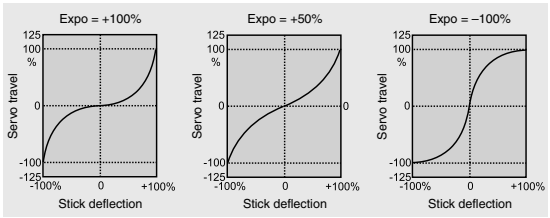
If you select the right-hand column at the lower edge of the display marked with **SEL** and activate the value field by briefly tapping the center **SET** key on the right touch pad, you can use the arrow keys on the left or right touch pad to alter the Expo value shown in the highlighted field separately for each of the two switch positions:

Now, for example, you have the opportunity to fly with a linear curve characteristic with the switch in one direction, and to pre-set a value other than 0% in the other switching direction:



If you tap the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**), this will reset a value changed in the highlighted field back to 0%.

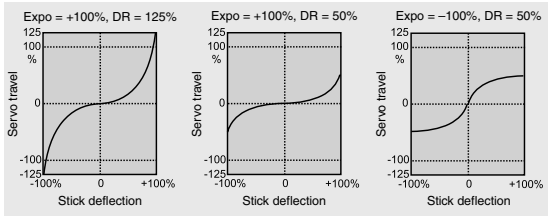
Some examples of Expo values:



In each of these examples, the Dual Rate value equals 100%.

Combining Dual Rate and Expo

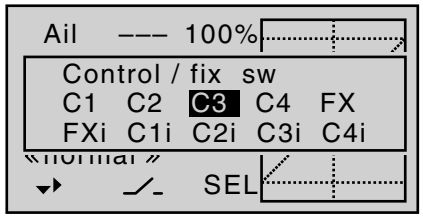
If you have entered values for both the Dual Rate and the Expo function, the effect from on function is superimposed on the other, as shown in these examples:



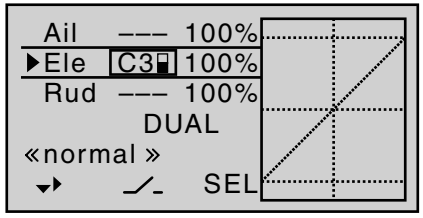
Asymmetric setting of Dual Rate and Expo

To make an asymmetric setting, i.e. a Dual Rate or Expo setting dependent on the direction of the respective joystick, first access the "**Control switches**" menu and assign one of the C1 … C4 control switches – "C3", for example – your chosen transmitter control, e.g. control 3 for the elevator function. Leave the switching point at the joystick's neutral position (0%), however. Now return to the "Dual Rate / Expo" menu and select the corresponding control function ("Elevator" in this example).

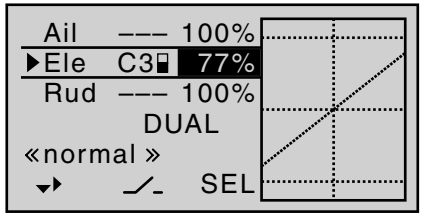
Activate "Switch assignment" and tap the center **SET** key briefly on the right touch pad to switch to the expanded switches. Here, use the arrow keys to continue switching to the control switch "G3" that you defined previously:



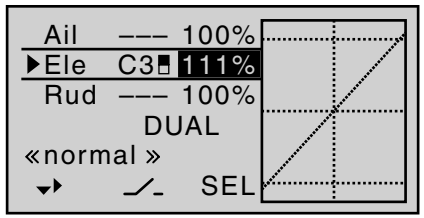
Tap the center **SET** key on the right touch pad to confirm the assignment of this switch:



Now use one of the arrow keys to move to the right column and then move the elevator joystick to the appropriate end-point in order to enter a separate Dual Rate value for each direction, e.g. for "Up elevator" …



… and "Down elevator":

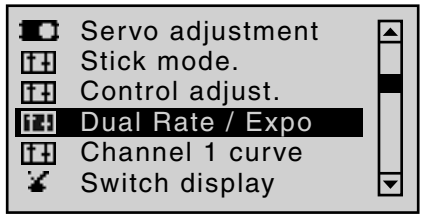


Set the Expo values in the same way.

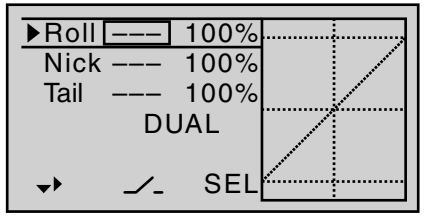
Dual Rate / Expo

Configurable control characteristics for roll, pitch-axis, tail rotor

Using the arrow keys on the left or right touch pad, page to the menu option "**Dual Rate / Expo**" in the multi-function list:



Tap the center **SET** key on the right touch pad to open the menu shown below:



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.

An individual curve characteristic for control function 1 (motor/collective pitch), featuring up to 6 separately programmable points, can be set either on the "**Channel 1 curve**" menu (page 119) or separately for throttle and collective pitch on the "**Helicopter mixers**" menu (see p. 165f.).

As with transmitter control travel adjustment on the **"Control adjust"** menu, **Dual Rate** affects the relevant *control function* directly, whether it controls a single servo or multiple servos – via mixer and coupling functions of arbitrary complexity.

The control travels for each switch position can be set to between 0% and 125% of the normal full travel.

Expo, on the other hand, enables finer-grained control of the model for values larger than 0% around the center position of the primary control function (roll, pitch-axis, tail rotor), without forfeiting full movement at the end-points of joystick 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. You can counteract this effect with Expo values greater than 0%, so that angular travel increases overproportionately as stick travel increases.

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 joystick, so you can clearly see the dependency of the curve value on the transmitter control.

Flight phase-dependent Dual Rate and Expo settings

If you have set up flight phases in the "**Phase settings**" and "**Phase assignment**" menus and assigned each of these a name – e. g. "normal" – the name in question is displayed at the bottom left. In this scenario, you can operate the corresponding switch to switch between flight phases.

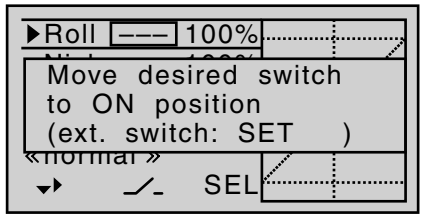
Basic procedure

1. Switch to the desired flight phase and then use the arrow keys ▲▼ on the left or right touch pad to select your chosen menu line, i.e. "Roll", "Nick" or "Tail".
2. Using the arrow keys ◄ ► on the left or right touch pad, select the right column or the as-yet invisible column for Expo values (see page 27).
3. Tap the center **SET** key on the right touch pad. The corresponding input field is shown highlighted.
4. Use the arrow keys on the right touch pad to set your chosen value.
5. Tap the center **SET** key on the right touch pad to complete data entry.
6. If you tap the ▲▼ or ◄ ► keys on the right touch pad at the same time (**CLEAR**), this will reset any settings made back to their respective default values.

Dual Rate function

If you want to be able to switch between two variants, assign a switch in the column marked with the switch

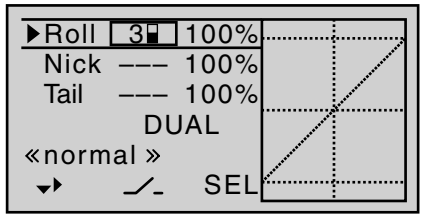
icon ⌐/_ at the lower edge of the display, as described in the section "Assigning transmitter controls, switches and control switches" (page 52):



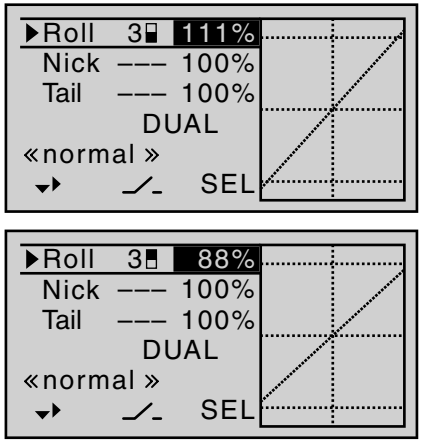
The switch so assigned appears on the display, together with a switch icon that indicates the switch's switching direction.

With "G" switches from the "expanded switches" menu, the joystick or another transmitter control acts as the switch itself. However, this kind of control switch must be defined appropriately beforehand on the "**Control switches**" menu (see page 123).

Whichever switch has been assigned …
the respective switch appears on the display together with a switch icon that indicates the switch's respective direction when moved.



If you select the right-hand column at the lower edge of the display marked with **SEL** and activate the value field by briefly tapping the center **SET** key on the right touch pad, you can use the arrow keys on the left or right touch pad to alter the Dual Rate value shown in the highlighted field separately for each of the two switch positions:



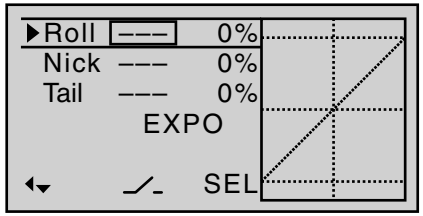
If you tap the ▲▼ or ◀ ▶ keys on the right touch pad (**CLEAR**) at the same time, this will reset a value changed in the highlighted field back to 100%.

Caution:
For safety reasons, you should not set Dual Rate values lower than 20%.

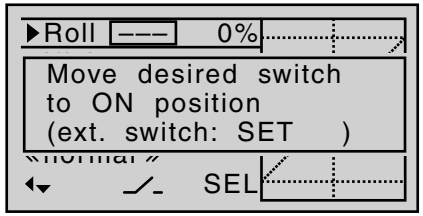
Some examples of Dual Rate values:

Exponential function

If you want to be able to switch between two variants, use the ▶ key on the left or right touch pad to move to the right beyond the Dual Rate value column, until the word "DUAL" (shown roughly in the middle of the display) changes to "EXPO":



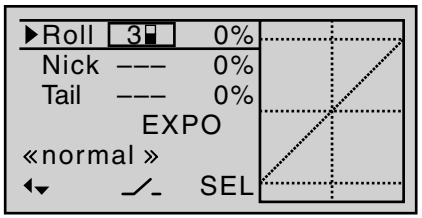
If you want to be able to switch between two variants, assign a switch in the column marked with the switch icon ⌐/_ at the lower edge of the display, as described in the section "Assigning transmitter controls, switches and control switches" (page 52):



The switch so assigned appears on the display, together with a switch icon that indicates the switch's respective switching direction.

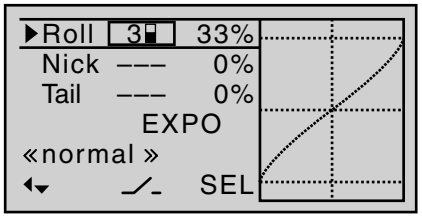
With "G" switches from the "expanded switches" menu, the joystick or another transmitter control acts as the switch itself. However, the control switch in question must be defined appropriately beforehand on the "**Control switches** " menu (see page 123).

Whichever switch has been assigned … the respective switch appears on the display together with a switch icon that indicates the switch's respective direction when moved.



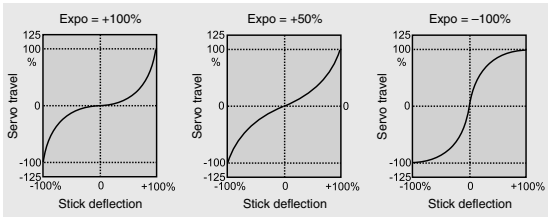
If you select the right-handcolumn at the lower edge of the display marked with **SEL** and activate the value field by briefly tapping the center **SET** key on the right touch pad, you can use the arrow keys on the left or right touch pad to alter the Expo value shown in the highlighted field separately for each of the two switch positions:

Now, for example, you have the opportunity to fly with a linear curve characteristic with the switch in one direction, and to pre-set a value other than 0% in the other switching direction:



If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset a value changed in the highlighted field back to 0%.

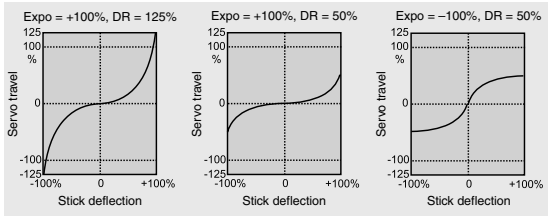
Some examples of Expo values:



In each of these examples, the Dual Rate value equals 100%.

Combining Dual Rate and Expo

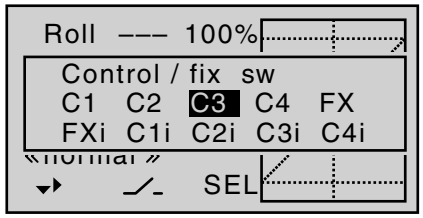
If you have entered values for both the Dual Rate and the Expo function, the effect from on function is superimposed on the other, as shown in these examples:



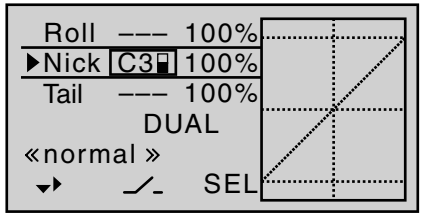
Asymmetric setting of Dual Rate and Expo

To make an asymmetric setting, i.e. a Dual Rate or Expo setting dependent on the direction of the respective joystick, first access the "**Control switches**" menu and assign one of the C1 … C4 control switches – "C3", for example – your chosen transmitter control, e.g. control 3 for the pitch-axis function. Leave the switching point at the joystick's neutral position (0%), however. Now return to the "Dual Rate / Expo" menu and select the corresponding control function ("Nick" in this example).

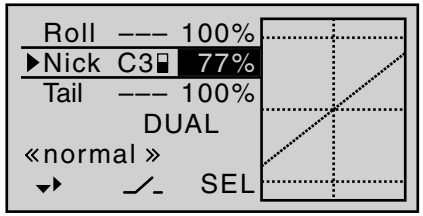
Activate "Switch assignment" and tap the center **SET** key briefly on the right touch pad to switch to the expanded switches. Here, use the arrow keys to continue switching to the control switch "G3" that you defined previously:



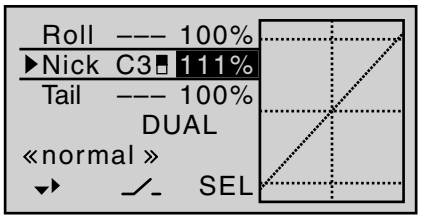
Tap the center **SET** key on the right touch pad to confirm the assignment of this switch:



Now use one of the arrow keys to move to the right column and then move the pitch-axis joystick to the appropriate end-point in order to enter a separate Dual Rate value for each direction, e.g. for "Pitch-axis up" …



and "Pitch-axis down":

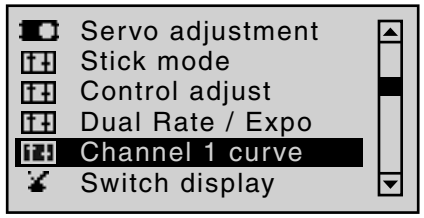


Set the Expo values in the same way.

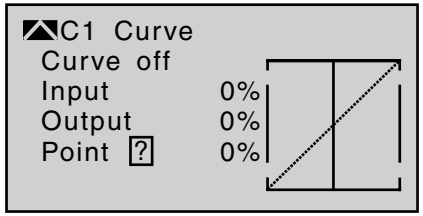
Channel 1 curve

Control characteristics for throttle/spoiler joystick

Using the arrow keys on the left or right touch pad, page to the menu option "**Channel 1 curve**" in the multi-function list:



Open this menu item by pressing the center **SET** button in the right touch pad.



Since the carburetor 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 joystick*, regardless of whether this control function affects the servo connected to control channel 1 directly or affects multiple servos via various mixers.

If you have used the "**Phase settings**" and "**Phase assignment**" menus (see pages 128 and 134) to specify flight phases, this option can be adjusted per flight phase. The flight phase name – e.g. "normal" – is always 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 joystick 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 joystick travel ("L", low = -100% travel) and the top end of joystick travel ("H", high = +100% travel) – define a linear characteristic curve.

First, switch to your chosen flight phase, if necessary.

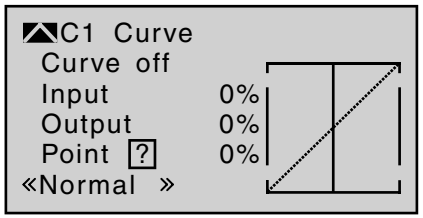
Setting reference points

By moving the transmitter control (throttle/airbrake joystick), you can reposition the vertical line in the graph between the two end-points "L" and "H". The current joystick 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.

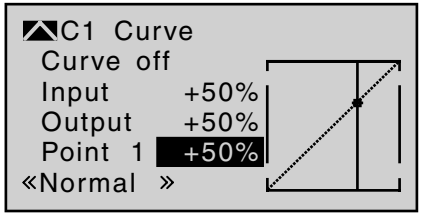
In the example above, the joystick is at 0% of control travel and also generates an output signal of 0%, since the characteristic curve is linear.

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 arrow key ▼ to drag the marker frame downwards, until it is at the "Point" line:



Move the joystick. If a question mark can be seen in the frame, then you can set the next reference point by tapping the center **SET** key on the right touch pad. 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 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.

Deleting reference points

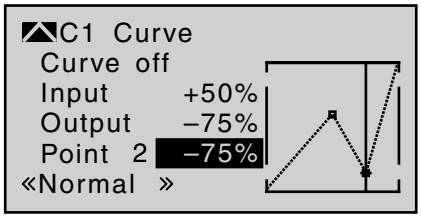
To delete one of the reference points (1 to max. 4), use the joystick to move the vertical line into the vicinity of the reference point in question. As soon as the reference point number and its associated value is shown on the "Point" line (see screen image above), you can activate the value field on the "Point" line to highlight it by simultaneously tapping the ▲▼ or ◄ ► keys on

the right touch pad (**CLEAR**) and then delete the value. Complete the operation by briefly tapping the center key **ESC** on the left touch pad.

Changing reference point values

Move the joystick 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. Activate the value field by briefly tapping the center **SET** key on the right touch pad. The point value field is now highlighted and can be set within the range -125% to +125%, and without influencing the neighboring reference points.

Example:

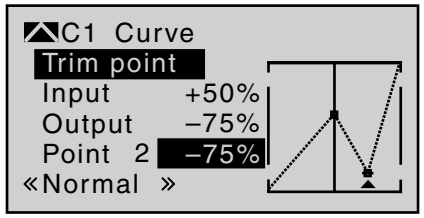


In this sample screen image, reference point "2" has been set to -75%.

Note:
If the joystick does not coincide with the exact reference point, please note that the percentage value on the "Output" line always relates to the current joystick position.

Trim point function

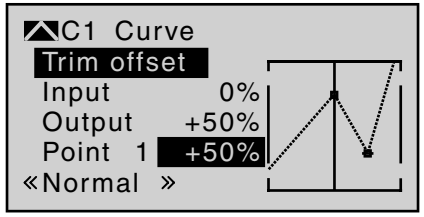
Alternatively, assuming the value field is active, i.e. highlighted, you can use the up or down arrow keys ◄ ► on the left touch pad to jump to reference points already set. In this case, a triangle is shown on the graph to indicate each point jumped to. The arrow keys on the right touch pad can then be used to change the reference point jumped to as described above, entirely independently of the control position:

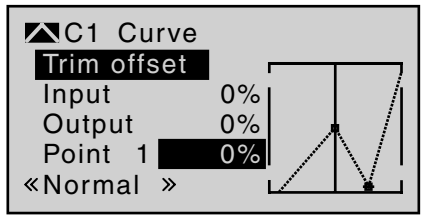


Exit from trim point function setting by tapping the center key **ESC** on the left touch pad.

Trim offset function

Assuming the value field is active, i.e. highlighted, you can not only use the up or down arrow keys ◄ ► on the left touch pad to jump to reference points already set and change their values, but you can also use the ▲▼ keys on the left touch pad to vertically reposition an existing curve within the range ±25%:

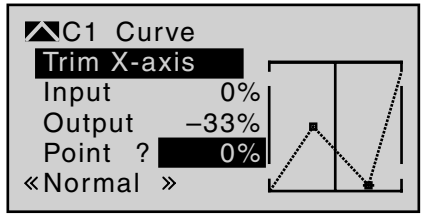




You can also exit from this function by tapping the center key **ESC** on the left touch pad.

Trim x-axis function

This function is activated by tapping the left (◄) or right (►) arrow key on the right touch pad with an active (i.e. highlighted) value field. You can then use the arrow keys on the right touch pad to reposition the active point horizontally or vertically as you wish.



Notes:

- *If you reposition the point horizontally further away from the current control position than approx. ±25%, a "?" sign re-appears in the line. 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 joystick position and not to the position of the point.*

Smoothing the Channel 1 curve

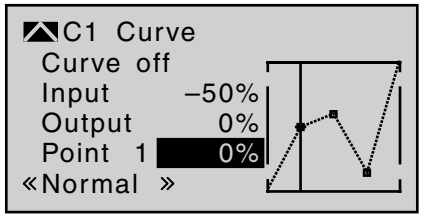
In the example below, sample reference points have been set:

Reference point 1 to 0%

Reference point 2 to +25%

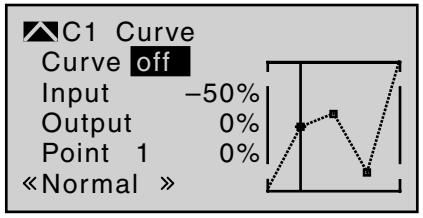
Reference point 3 to -75%

as described in the last section.

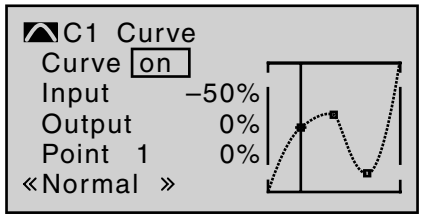


This "jagged" curve profile can be smoothed automatically simply by pressing a button.

First – assuming a situation is configured as presented above – tap the center **ESC** button on the left touch pad to deactivate the value field. Then use the arrow keys on the left or right touch pad to move the marker frame in an upwards direction to the "Curve" line. Now briefly tap the center **SET** key on the right touch pad to activate the value field on the "Curve" line:



Use the arrow keys on the right touch pad to set the curve value from "off" to "on" and complete this setup procedure by briefly tapping the center SET the center **SET** key on the right touch pad or the center **ESC** key on the left touch pad:



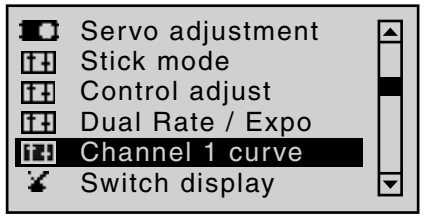
Note:

The curves shown here are for demonstration purposes only and are not at all representative of real throttle/ airbrake curves. For real-world application examples, see the programming examples from page 242 onwards.

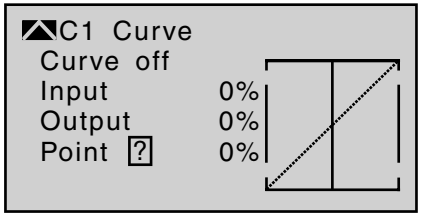
Channel 1 curve

Control characteristics for throttle/collective pitch stick

Using the arrow keys on the left or right touch pad, page to the menu option "**Channel 1 curve**" in the multi-function list:



Tap the center **SET** key on the right touch pad to open the menu shown below:



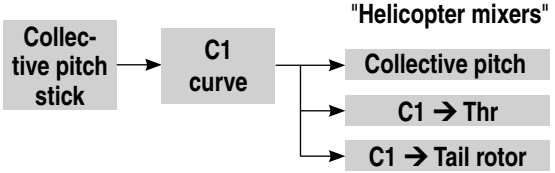
Since the carburetor response or the effect of collective pitch is often non-linear, you can make compensatory adjustments to these in this menu.

The menu therefore enables you to change 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 you have used the "**Phase settings**" and "**Phase assignment**" menus (see pages 128 and 134) to specify flight phases, this option can be adjusted per flight phase. The flight phase name – e.g. "normal" – is always 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 joystick 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 mixers**" menu (see page 164):



In the basic software set-up, 2 reference points – namely the end-points at the bottom end of joystick travel ("L", low = -100% travel) and the top end of joystick travel ("H", high = +100% travel) – define a linear characteristic curve.

First, switch to your chosen flight phase, if necessary.

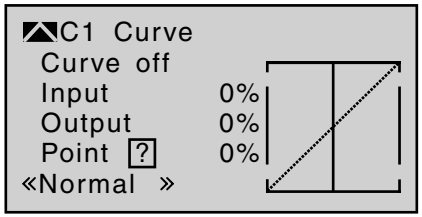
Setting reference points

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 joystick 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.

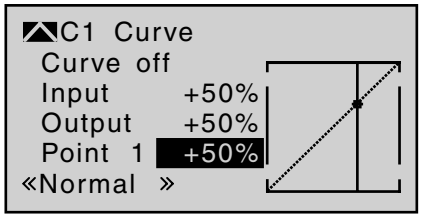
In the example above, the joystick is at 0% of control travel and also generates an output signal of 0%, since the characteristic curve is linear.

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 arrow key ▼ to drag the marker frame downwards, until it is at the "Point" line:



Move the joystick. If a question mark can be seen in the frame, then you can set the next reference point by tapping the center **SET** key on the right touch pad. 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 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.

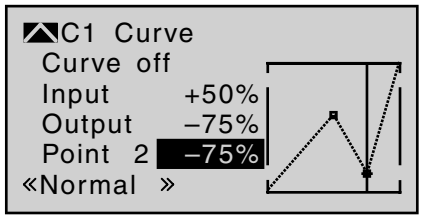
Deleting reference points

To delete one of the reference points (1 to max. 4), use the joystick 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), you can activate the value field on the "Point" line to highlight it by simultaneously tapping the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) and then delete the value. Complete the operation by briefly tapping the center key **ESC** on the left touch pad.

Changing reference point values

Move the joystick 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. Activate the value field by briefly tapping the center **SET** key on the right touch pad. The point value field is now highlighted and can be set within the range -125% to +125%, and without influencing the neighboring reference points.

Example:

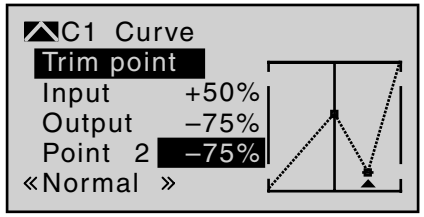


In this sample screen image, reference point "2" has been set to -75%.

Note:
If the joystick does not coincide with the exact reference point, please note that the percentage value on the "Output" line always relates to the current joystick position.

Trim point function

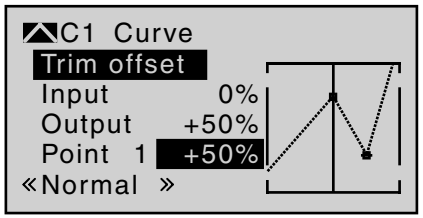
Alternatively, assuming the value field is active, i.e. highlighted, you can use the up or down arrow keys ◄► on the left touch pad to jump to reference points already set. In this case, a triangle is shown on the graph to indicate each point jumped to. The arrow keys on the right touch pad can then be used to change the reference point jumped to as described above, entirely independently of the control position:

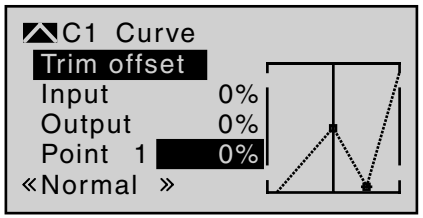


Exit from trim point function setting by tapping the center **ESC** key on the left touch pad.

Trim offset function

Assuming the value field is active, i.e. highlighted, you can not only use the up or down arrow keys ◄► on the left touch pad to jump to reference points already set and change their values, but you can also use the ▲▼ keys on the left touch pad to vertically reposition an existing curve within the range ±25%:

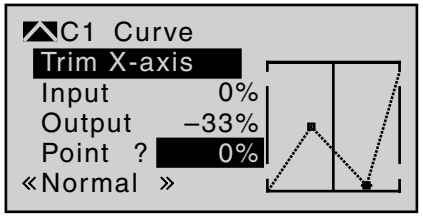




You can also exit from this function by tapping the center **ESC** key on the left touch pad.

Trim x-axis function

This function is activated by tapping the left (◄) or right (►) arrow key n the right touch pad with an active (i.e. highlighted) value field. You can then use the arrow keys on the right touch pad to reposition the active point horizontally or vertically as you wish.



Notes:

- *If you reposition the point horizontally further away from the current control position than approx. ±25%, a "?" sign re-appears in the line. 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 joystick position and not to the position of the point.*

Smoothing the Channel 1 curve

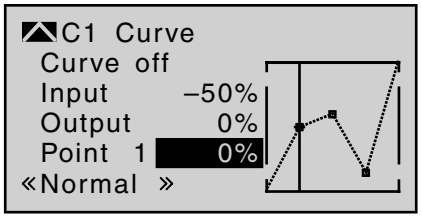
In the example below, sample reference points have been set:

Reference point 1 to 0%

Reference point 2 to +25%

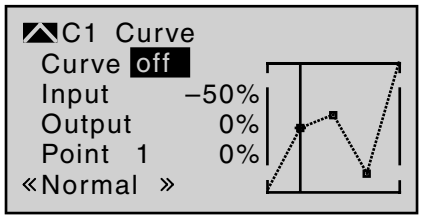
Reference point 3 to -75%

as described in the last section.

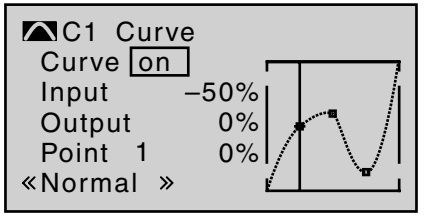


This "jagged" curve profile can be smoothed automatically simply by pressing a button.

First – assuming a situation is configured as presented above – tap the center **ESC** button on the left touch pad to deactivate the value field. Then use the arrow keys on the left or right touch pad to move the marker frame in an upwards direction to the "Curve" line. Now briefly tap the center **SET** key on the right touch pad to activate the value field on the "Curve" line:



Use the arrow keys on the right touch pad to set the curve value from "off" to "on" and complete this setup procedure by briefly tapping the center **SET** key on the right touch pad or the center **ESC** key on the left touch pad:



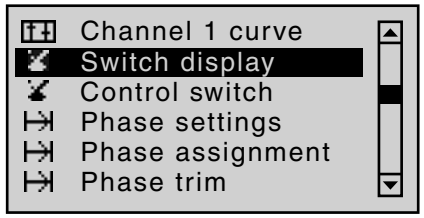
Note:

The curves shown here are for demonstration purposes only and are not at all representative of real throttle/ airbrake curves. For real-world application examples, see the programming examples on pages 242 and 285.

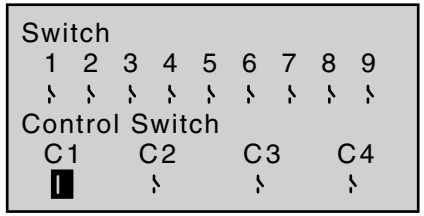
Switch display

Displaying switch positions

Using the arrow keys on the left or right touch pad, page to the menu option "**Switch display**" in the multi-function list:



Tap the center **SET** key on the right touch pad to open the menu shown below:



This feature is used to check the functions and give an overview of SW switches 1 … 9 and the programmable control switches.

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 highlighted (i.e. it is shown on a dark background).

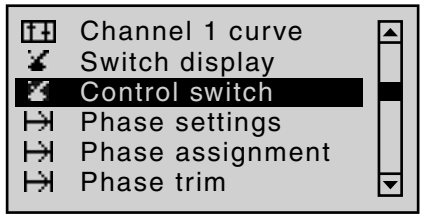
For control switches C1 … C4, activation of the corresponding transmitter control – which must have been previously assigned on the "**Control switch**" menu – will reveal the control switch number and direction.

Note:
The switch numbering 1 to 9 as shown here corresponds to the labeling of the switches on the transmitter housing. The numbering of the switches has no effect on the programming of the transmitter, however.

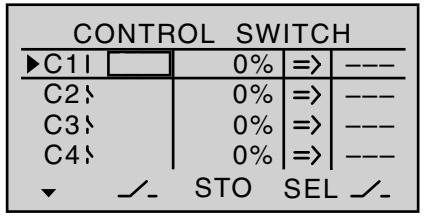
Control switches

Programming the control switches

Using the arrow keys on the left or right touch pad, page to the menu option "**Control switch**" in the multi-function list:



Tap the center **SET** key on the right touch pad to open the menu shown below:



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 joystick.

Typical applications:

- *Activation or deactivation of an onboard glowplug heating system depending on carburetor setting or motor speed (in this case, the switch for glowplug heating is controlled on the transmitter by a 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 joystick is moved beyond the switching point. If required, a control switch can be overridden using a separately assigned switch in the 5th column.*

The **mc-32** HoTT program is equipped with a total of 4 of these control switches ("C1" to "G4").

Accordingly, anywhere where switches can be assigned you have the option not only of using the 9 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 "Assigning transmitter controls, switches and control switches" on page 52.

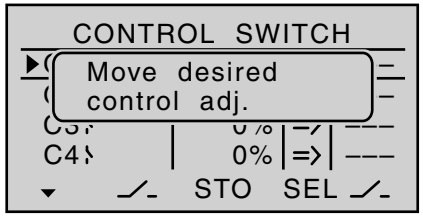
Furthermore, combining a control switch with an additional switch (as described later) also permits more complex switching permutations.

Basic procedure:

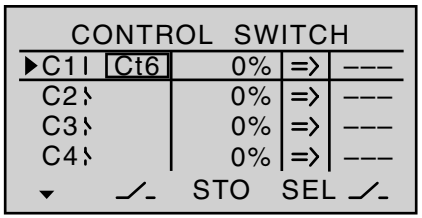
1. If no transmitter control is assigned, the corresponding input field in the column above the left switch icon will be displayed empty.
2. Using the arrow keys on the left or right touch pad, select the line for the control switch you want (1 to 4).
3. Briefly tap the center **SET** key on the right touch pad.
4. Move your selected transmitter control.
   The associated transmitter control number appears in the input field of the column above the left switch icon.
5. Using the arrow keys on the left or right touch pad, move to the right and the column above **STO**.
6. Move the transmitter control to the desired switching point and then briefly tap the center **SET** key on the right touch pad to save the switching point.
7. Complete the remaining settings such as switching direction, etc.
8. Exit from the menu by using the center **ESC** key on the left touch pad.

Assigning a transmitter control to a control switch

Using the arrow keys on the left or right touch pad, select your chosen line (1 to 4). After completing the activation of transmitter control assignment by tapping the center **SET** key on the right touch pad, the following message is shown:

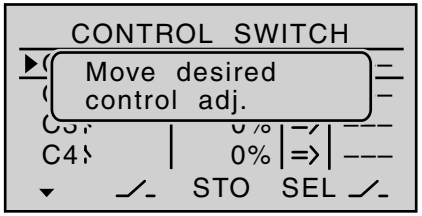


As an example, the CTRL 6 proportional rotary control on the upper left is now to be assigned to the "C3" control switch. Accordingly, turn the dial of this control in any direction you want. As soon as this is detected, the control name appears on the display:



Resetting a control switch back to "free"

To reset a control switch back to "free", make sure the display is as below …

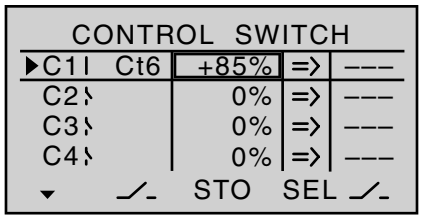


… and then press the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) briefly to erase the transmitter control assignment.

Defining the switching point

Using the arrow key ► on the left or right touch pad, move the marker frame into the **STO** (i.e. the STOre) column.

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 center **SET** key on the right touch pad. The current position is displayed, for example "+85%":



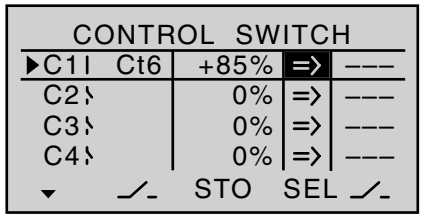
The switching point can be altered at any time by tapping the center **SET** key on the right touch pad again.

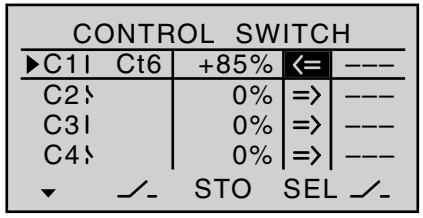
Note:

Do not, however, set a switching point at a transmitter control's travel end-point, since this makes reliable switching impossible. Where a 3-stage switch (CTRL 9 and 10) is used to operate a control switch you should therefore program the switching point beforehand using one of the proportional rotary controls (CTRL 6 to 8): 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 3-stage 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, de-assign the transmitter control and then assign the 3-stage switch.

Setting the switching direction

The switching direction of the control switch is changed as required in the 4th column. Using the arrow key ► on the left or right touch pad, move the marker frame into the **SEL** (i.e. the SELect) column. After briefly tapping the center **SET** key on the right touch pad, you can then use the arrow keys on the left or right touch pad to set the switching direction from "normal" to "reversed" and vice versa:





Tapping the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**) will reset the switching direction 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.

Notes:

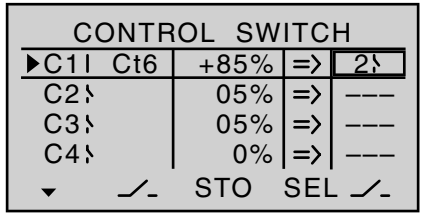
- *In this example, control switch "C1" remains open while transmitter control 6 (the throttle limiter for a heli) is at less than +85% of full travel. It closes once the switching point is exceeded, i.e. by a value between +85% and the upper travel end-point.*
- *In the above example with the switching 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, by a value between +85% and the upper travel end-point – "C3" opens.*

- *FIf 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 on the "**Control adjust**" menu.*

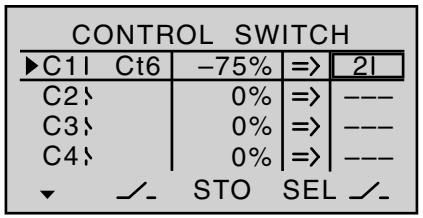
Combining a control switch with one of the SW 1 … 9 switches

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.

Switch to the value field in the 5th column, the column above the right switch icon. In the simplest case, select one of the switches SW 1 … 9 as described under "Assigning transmitter controls, switches and control switches" on page 52. The number of this switch, e.g. "2", appears on the display screen in the rightmost column, together with a switch icon that indicates the current state of the switch:



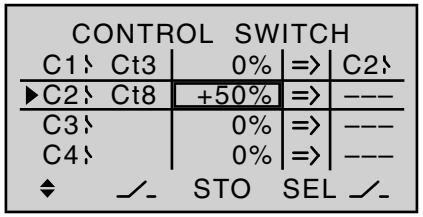
While this switch is open, the "C1" control switch is active, i.e. it triggers at the switching point; if the switch is closed, the control switch now remains permanently closed as well, independently of the control position and switching direction:



Combining two control switches

For more complex applications, however, it can prove necessary to override this control switch with a second control switch.

Example:
Instead of being assigned the CTRL 6 control as before, the "C1" control switch is now assigned control function 3 (transmitter control 3). The switching point is at its center point, i.e. at 0%. The switch chosen in the rightmost column is "C2", from the list of expanded switches. We now assign one of the two center proportional rotary controls to this control switch "C2", on its own line – e.g. the right CTRL 8, whose switching point lies at +50%:



Reading the switching directions given in the 4th column of the display, control switch "C3" remains closed while the joystick (K3) and/or "transmitter control 9" is/are beyond the switching point.

This diversity of switching options certainly offers you enough scope for specialized applications to suit any type of model.

How do I program a flight phase?

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 **mc-32** 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. For heli programs, you either start with the "**Base setup model**" menu if you wish to set up autorotation or, if not, you also start programming 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 flight phase-relevant menus for fixed-wing programs:

Menu	Page
"**Control adjust**"	96
"**Dual Rate / Expo**"	108
"**Channel 1 curve**"	116
"**Phase settings**"	128
"**Phase assignment**"	134
"**Phase trim**"	136
"**Non-delayed channels**"	137
"**Fl. phase timers**"	142
"**Wing mixers**"	146
"**MIX active/phase**"	192

List of flight phase-relevant menus for helicopter programs:

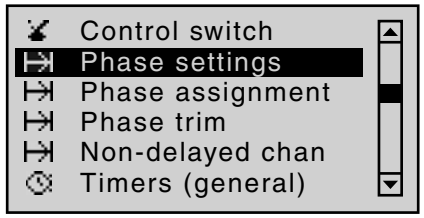
Menu	Page
"**Control adjust**"	100
"**Dual Rate / Expo**"	112
"**Channel 1 curve**"	119
"**Phase settings**"	132
"**Phase assignment** "	134
"**Non-delayed channels**"	137
"**Fl. phase timers**"	142
"**Helicopter mixers**"	164
"**MIX active/phase**"	192

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 you may wish to use the "**Suppress menus**" menu (see page 67) to remove the non-specific menus from the multi-function list when programming flight phases. A practical example of flight phase programming can be found on page 256).

Phase settings

Setting up flight phases

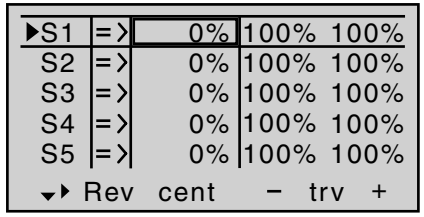
Using the arrow keys on the left or right touch pad, page to the menu option "**Phase settings**" in the multi-function list:



Tap the center **SET** key on the right touch pad to open this menu.

Within one model memory, the **mc-32** 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.

Depending on the setting "Throttle min. forward/back" or "None" in the "Motor on C1" line of the "**Model type**" menu, your transmitter's display will look as follows after accessing the "Phase settings" menu …



… either the columns "Motor" and "Sw. time" (switch time) to the right of the column "ph. Tim." (fl. phase timers) or only the column "Sw. time" will be available for your settings.

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 134) when setting "phase switches".

The "Status" column, second from the left, shows which one of the phases 1 … 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.*

"Name" column

Briefly tap the center **SET** key on the right touch pad and use the arrow keys on the left or right touch pad to assign the phases your require – phase 1 to max. phase 7 – appropriate names from the selection list.

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 on 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.

"ph. Tim." column

In addition to the standard timers on the basic screen display, other timers are also available, whose settings are configured on the "**Fl. phase timers**" menu (page 142).

Clk 1, Clk 2, Clk 3, Lap, Time1, Time2

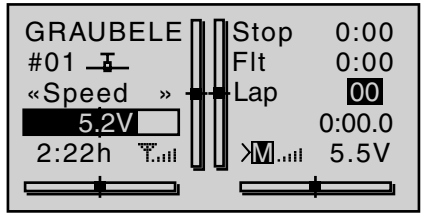
The flight phase timers "Clk 1 … 3" plus "Time1" and "Time2" run only in the flight phase to which they have been assigned in this menu. During other flight phases they are stopped (and hidden) and the assigned stop/start switch then has no effect.

The lap counter, once started, continues to run through

changes of phase, however, although it can be stopped during any flight phase via the center **ESC** key on the left touch pad.

While you can obviously record lap times using "Lap" and a switch (SW), the two timers "Time1" and "Time2" have the following meaning:

Time1 Only the times are measured at which the switch or control switch assigned in the "Lap timer/ timer" line of the "**Fl. phase timers**" menu (see page 142) 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:



If required, you can then use the arrow keys to access and read the times at which switches were made.

Application:
Measurement of e.g. motor switch-on times, if the same switch also actuates the motor.

Time2 "Time2" stores both the "Off" and the "On" times for the associated switch, i.e. each actuation of the switch restarts the time count again and the counter is incremented by "1".

Each time count can be stopped by using the center **ESC** key on the right touch pad, without activating the switch itself. Activating the switch, in turn, increments the counter by 1 and restarts the "Time2" timer.

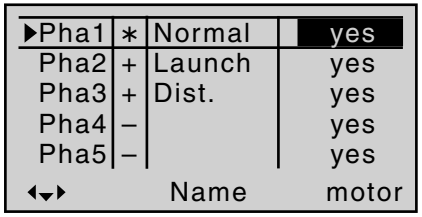
In order to read out the time memory by using the arrow keys, the "Time2" timer must first be stopped by using the **ESC** key on the right touch pad.

Application:
In addition to the motor runtimes, for example, the unpowered glide times between these could also be recorded.

Tapping the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**) will reset the display of stopped timers on the basic display.

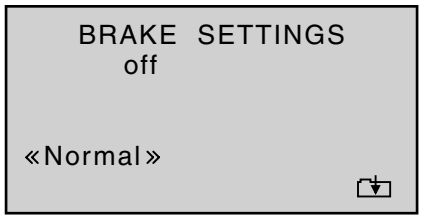
"Motor" column

Note:
*This column is only available if "Forward/back" is entered on the line "Motor on C1" on the "**Model type**" menu.*



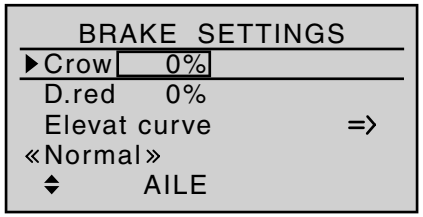
"Yes" The motor connected to receiver output 1 will be controlled by the C1 joystick (throttle/brake stick).

The brake system to be set up on the "**Wing mixers**" menu is deactivated:



"No" The motor connected to receiver output 1 is decoupled from the C1 joystick (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 on the "**Wing mixers**" menu is activated and is actuated by the C1 joystick.

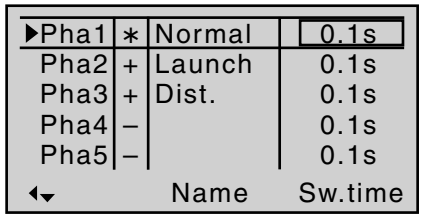


Note:
*The settings available depend on the number of control surface servos selected on the line "Ailerons/Camber-changing flaps in the "**Model type**" menu.*

"Sw. time" column

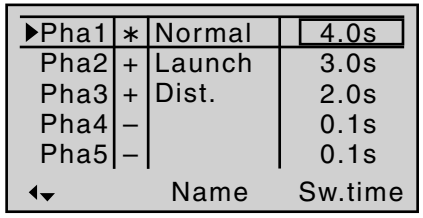
When you switch between flight phases, it is advisable to use this column to program a switch time for a "soft" transition INTO (!) the respective phase. Accordingly, there is also the option of specifying different times for different switches – e.g. from a phase into Phase 3 and the same phase into Phase 1.

Using the arrow key ► on the left or right touch pad, move the marker frame over the "ph. Tim." column – and "Motor" column, if applicable – to the right.



Briefly tap the center **SET** key on the right touch pad to highlight the value field. You can then select switch times between 0 and 9.9 s in this field.

Example:



The switch time is set to 4.0 s when switching from any phase to Phase 1 "Normal".

When switching from e.g. Phase 1 to Phase 3, the switch time is set to 2.0 s and to 3.0 s when switching from Phase 1 or 3 to Phase 2 "Launch".

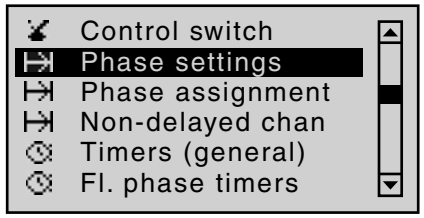
Such asymmetric transition times can be useful when (e.g.) switching between highly contrasting flight phases, such as e.g. between aerobatics and normal flight.
Tapping the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**) will reset the time to 0.1 in the active value field.

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 146). 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 137).*

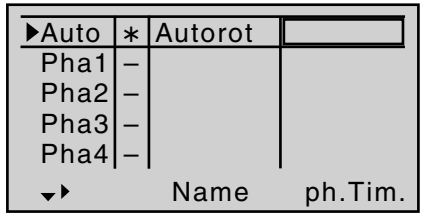
Phase settings

Setting up flight phases

Using the arrow keys on the left or right touch pad, page to the menu option "**Phase settings**" in the multi-function list:



Tap the center **SET** key on the right touch pad to open the menu shown below:



Within one model memory, the **mc-32**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 "**Base setup model**" menu. The grouped settings are typically termed "flight phases" and are programmed in the corresponding menus.

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 134) when setting "phase switches".

The "Status" column, second from the left, shows which one of the phases 1 … 6 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.*

"Name" column

The first line, and thus the flight phase with top priority, is reserved for auto-rotation flight – see the "**Base setup model**" menu. Accordingly, the predefined name cannot be changed.

Use the arrow keys to move to the line "Pha1". Briefly tap the center **SET** key on the right touch pad and use the arrow keys on the left or right touch pad to assign each of the phases your require – phase 1 to max. phase 6 – an appropriate name from the selection list.

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 on 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.

"ph. Tim." column

In addition to the standard timers on the basic screen display, other timers are also available, whose settings are configured on the "**Fl. phase timers**" menu (page142).

Clk 1, Clk 2, Clk 3, Lap, Time1, Time2

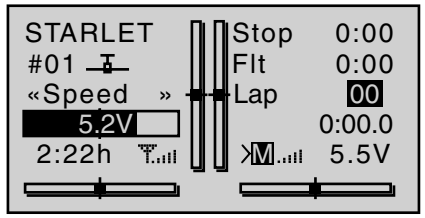
The flight phase timers "Clk 1 … 3" plus "Time1" and "Time2" run only in the flight phase to which they have been assigned in this menu. During other flight phases they are stopped (and hidden) and the assigned stop/start switch then has no effect.

The lap counter, once started, continues to run through changes of phase, however, although it can be stopped during any flight phase via the center **ESC** key on the left touch pad.

While you can obviously record lap times using "Lap" and a switch (SW), the two timers "Time1" and "Time2" have the following meaning:

Time1 Only the times are measured at which the switch or control switch assigned in the "Lap timer/ timer" line of the "**Fl. phase timers**" menu (see

page 142) 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:



If required, you can then use the arrow keys to access and read the times at which switches were made.

Application:
Measurement of (e.g.) flight phases with increased motor speed, if the same switch is used to actuate flight phase switching.

Time2 "Time2" stores both the "Off" and the "On" times for the associated switch, i.e. each actuation of the switch restarts the time count again and the counter is incremented by "1".

Each time count can be stopped by using the center **ESC** key on the right touch pad, without activating 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 by using the arrow keys, the "Time2" timer must first be stopped by using the **ESC** key on the right touch pad.

Tapping the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**) will reset the display of stopped timers on the basic display.

"Sw. time" column

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 the option of specifying different times for different switches – e.g. from a phase into Phase 3 and the same phase into Phase 1.

For safety reasons, however, the transition to the auto-rotation flight phase **ALWAYS** occurs without any time delay. The angled bracket ">" in the "Sw. time" column at the end of the "Auto" line indicates that a delay can be set when transitioning FROM (!) auto-rotation INTO (!) another phase.

Using the arrow key ► on the left or right touch pad, move the marker frame over the "ph. Tim." column to the right.

▶Auto	∗	Autorot	0.1s›
Pha1	+	Normal	0.1s
Pha2	+	Hover	0.1s
Pha3	–	Speed	0.1s
Pha4	–		0.1s
◄►		Name	Sw.time

Briefly tap the center **SET** key on the right touch pad to highlight the value field. You can then select switch times between 0 and 9.9 s in this field.

Example:

▶Auto	∗	Autorot	5.5s›
Pha1	+	Normal	3.0s
Pha2	+	Hover	2.0s
Pha3	–	Speed	4.0s
Pha4	–		0.1s
◄►		Name	Sw.time

A delay of 5.5 s applies when switching FROM auto-rotation into any other phase. A delay of 0.0 s always applies when switching TO auto-rotation.

The switch time is 3.0 s when switching from any other phase to Phase 1 "Normal".

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 highly contrasting flight phases, such as e.g. between aerobatics and normal flight.

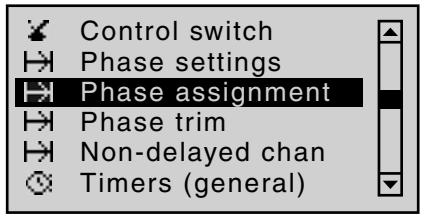
Tapping the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**) will reset the time to 0.1 in the active value field.

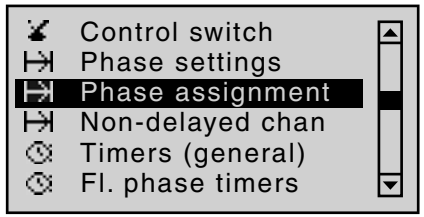
Note:
*The "switch time" set here applies uniformly to all settings that are specific to flight phases, and thus to all mixers activated in the "**Wing mixers**" menu (see page 146). Accordingly, the transition between flight phase-specific mixers does not occur abruptly. If you want individual servos to be switched without a delay, however, define these accordingly in the "**Non-delayed channels**" menu (see page 137).*

Phase assignment

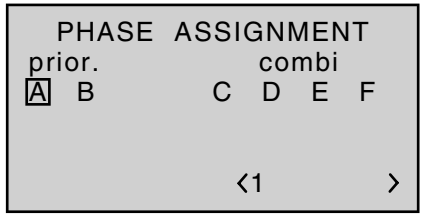
Setting up flight phases

Using the arrow keys on the left or right touch pad, page to the menu option "**Phase assignment**" in the multi-function list:





Tap the center **SET** key on the right touch pad to open the menu shown below:

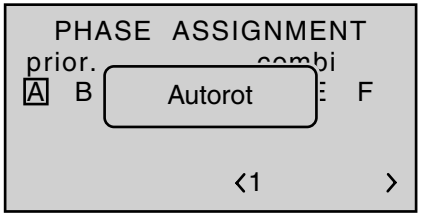


Note:
*A phase name appears to the right of the phase number at the bottom right of the display only if you have assigned the name beforehand on the "**Phase settings**" menu.*

On 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 heli menu: one of the two auto-rotation switches must be set on the menu "**Base setup model**".

Please note the following priorities:

- If you have not yet assigned *any* flight phase switches to any phase names, you will always find yourself 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".
- Independently of the switch positions of phases assigned to switches using **this menu**, the auto-rotation phase – applicable only to the "Helicopter" model type and whose switch is assigned on the "**Base setup model**" menu – always (!) takes precedence. Accordingly, as soon as the auto-rotation switch in question is activated, the following warning appears:



- 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"
- The two 3-stage switches, SW 4/5 and 6/7, should *always* be assigned from the center point position.

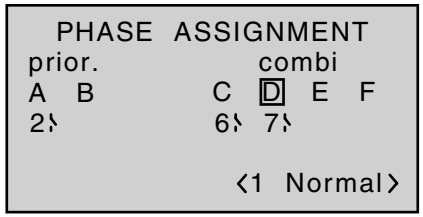
For this reason, use switch "A" and/or switch "B" only if you wish to change from any other flight phase – apart from the heli's auto-rotation phase – directly into the phase that is assigned to this switch.

Programming flight phase switches

Once you have configured your desired switch position, "A" to "F", using the arrow keys on the left or right touch pad, a switch (whether a "normal" switch or an expanded switch) is then assigned as described in the section "Assigning transmitter controls, switches and control switches" (page 52).

- 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 heli 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 "**Base setup model**" menu.**)**

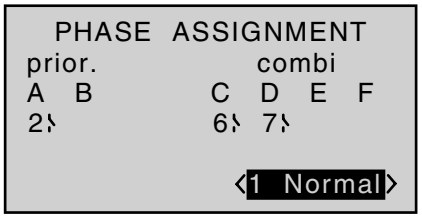
Example: 4 flight phases with phase priority



Assigning flight phases to switch positions

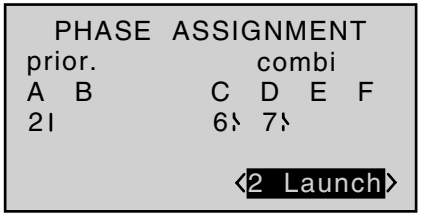
You have now assigned names to the flight phases (1 … max. 7) on the "**Phase settings**" menu and also programmed switches on this menu, but … at the bottom right of the display screen, you only see "<1 normal >" – regardless of the positions the switches are in!?

Use the arrow keys on the left or right touch pad to move the marker frame down and to the right and then briefly tap the center **SET** key on the right touch pad:



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.

You can leave this menu in the familiar way by pressing the center **ESC** key on the left touch pad.

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:

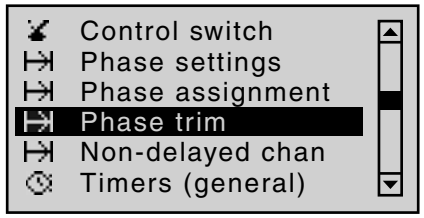
Before a phase switch is assigned, the model settings configured are now to be found in the flight phase "1 Normal", i.e. all flight phase-dependent menus are reset to the standard configurations for all other flight phases.

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.

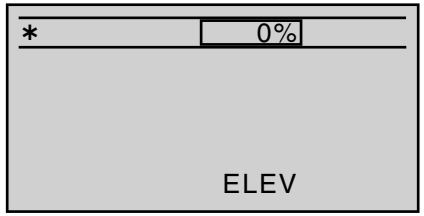
Phase trim

Flap settings specific to flight phases

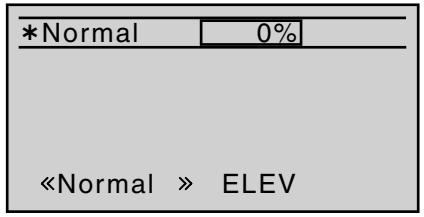
Using the arrow keys on the left or right touch pad, page to the menu option "**Phase trim**" in the multi-function list:



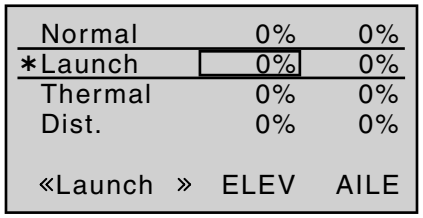
Tap the center **SET** key on the right touch pad to open the menu shown below:



Depending on the settings made on the "Aile/flaps" line from the "**Model type**" menu (page 82) and on the "**Phase settings**" menu, this menu makes available a set of control functions – 1 for EL …



… and up to 4 for EL, RU, AI and AI2 – for the configuration of trim settings that are specific to flight phases. The setting of the flight phase switches – to be defined beforehand on 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.:

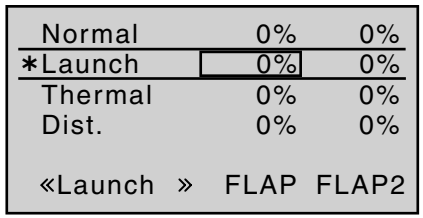


"**ELEV**" column In this column, you can store a phase-specific elevator trim setting.

Important notice:
*Settings made in this column have an immediate effect on elevator trim and, accordingly, the trim setting display. In turn, the elevator trim lever affects the values of this column either "globally" or "phase-specifically", depending on the "global/phase" setting made on the "Elev" line of the "**Stick mode**" menu.*

"**AILE**", "**FLAP**", "**FLAP2**"

The values in these columns (max. 3) are identical to those in the "Fl.pos" (flap position) line on the "Multi-flap menu" within the "**Wing mixers**" menu. For this reason, any changes made always affect the other menu directly – and vice versa.



Note:
If present, you can access the "FLAP" and "FLAP2" columns by using the arrow keys ◄ ► on the left or right touch pad to go beyond the right edge of the screen and back, as appropriate.

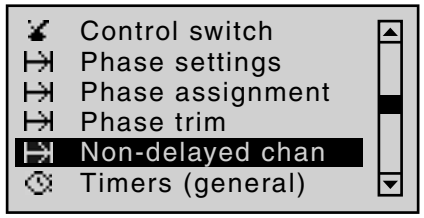
After selecting the appropriate column, by using the arrow keys on the left or right touch pad and then briefly tapping the center **SET** key on the right touch pad, you can then use the arrow keys to set the values independently of one another, within a range of ±150%.

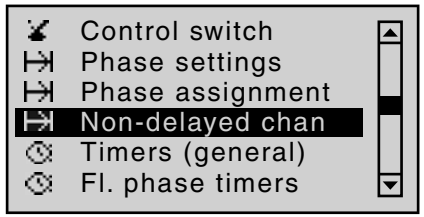
If you tap the ▲▼ or ◄ ► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the highlighted value field back to 0%.

Non-delayed channels

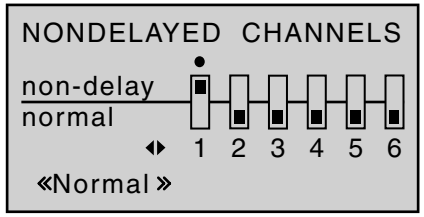
Channel-dependent delays to switching

Using the arrow keys on the left or right touch pad, page to the menu option "**Phase trim**" in the multi-function list:





Tap the center **SET** key on the right touch pad to open the menu shown below:



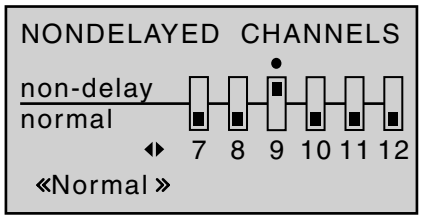
On the "**Phase settings**" menu, you will have set the necessary switch times for flight phase transitions.

In this menu, you can now deactivate 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 heli gyros, etc.

Switch over to the corresponding flight phase. This is shown at the bottom left of the display.

Use the arrow keys on the left or right touch pad to move the "●" onto the corresponding channel and then briefly tap the center **SET** key on the right touch pad.

The switch icon changes from "normal" to "non-delay" and vice versa. For example:



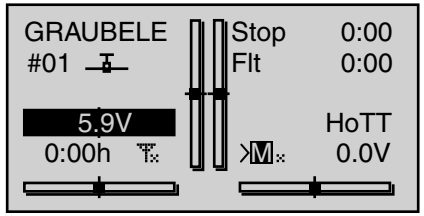
Note:

To access channels 7 … 12, follow the description on page 27: use the arrow keys ◄ ► on the left or right touch pad to go beyond the right edge of the screen and back, as appropriate.

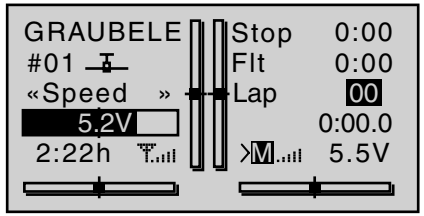
Timers (general)

Timers on the basic display

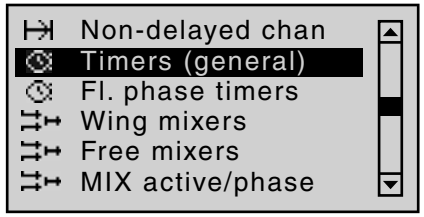
The default transmitter display shows a total of three timers. These are: the transmitter operating time on the left of the display, plus a "Top" and a "Centr" timer on the right of the display:

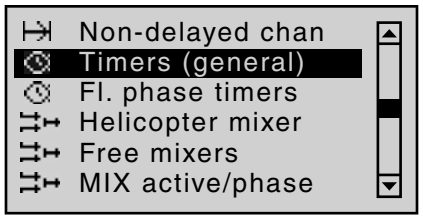


A further, flight-phase specific timer can also be configured, depending on your settings in the two menus "**Fl. phase timers**" (page 142) and "**Phase settings**" (pages 128 and 132). This optional flight phase timer – such as the lap time timer – appears underneath the "Centr" (flight time) timer:

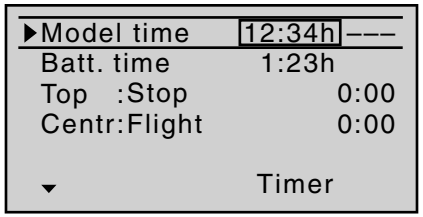


To configure the "Top" and/or "Centr" timer, use the arrow keys on the left or right touch pad to access the menu option "**Timers (general)**" in the multi-function list:





Tap the center **SET** key on the right touch pad to open the menu shown below:



"Model time"

This timer shows the currently recorded total access time to the currently active model memory. If necessary, you can also influence the automated time recording using a switch assigned at the right of the display, and use this switch to activate and deactivate the "Model time" timer as required. This switch is assigned (and erased again as required) as described in the section "Assigning transmitter controls, switches and control switches" on page 52.

Tapping the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**) will reset the time to "0:00h".

"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 "0:00h" 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.

Tapping the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**) will also reset the time here to "0:00h".

"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.

Using the arrow keys on the left or right touch pad, select the line for the "Top" or "Centr" timer. Tap the center **SET** key on the right touch pad briefly to activate the selection of a timer type:

Now use the arrow keys on the left or right touch pad to select your desired timer and complete your selection by once again tapping the center **SET** key on the right touch pad:

"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 designed for measuring the flight time: it can be started with an assigned switch and stopped (once the switch has been re-opened) on the basic display by tapping the center **ESC** key on the left touch pad. Once in a stopped state, it can be reset to its starting value by tapping the ▲▼ or ◄ ► keys on the right touch pad 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 heli models.

Note:

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 timeframe timer is intended primarily for use by competition pilots, who are frequently given a timeframe 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, press and hold the arrow keys ▲▼◄, and then press the center **ESC** key.

Switch assignment

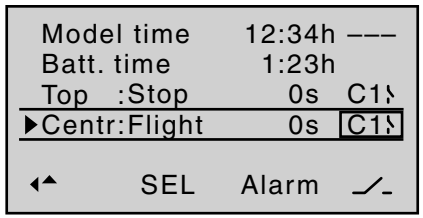
Using the arrow key ► on the left or right touch pad, move the marker frame next to the triangle as shown in the screen image shown below to the rightmost column of the relevant line:

Here, you assign a switch as described in the section "Assigning transmitter controls, switches and control switches" (page 52).

Typical application:

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, you will define e.g. "C1" on the **"Control switch"** *menu (page 123). To complete the procedure, you select this from the expanded switches (see the section "Assigning transmitter controls, switches and control switches" on page 52) 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 (by tapping the center **ESC** *key on the left touch pad) only once the stopwatch is stopped; it can then be reset to its starting value by tapping the ▲▼ or ◄ ► keys on the right touch pad at the same time (**CLEAR**).*

Switching between "forwards" and "backwards"

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. 180 min and 59 s and then restart from 0:00.

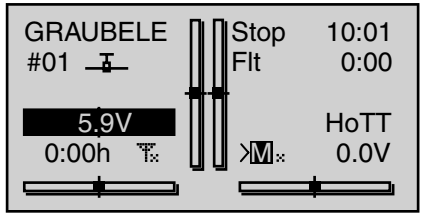
Timer runs backwards (countdown function)

In the – left – minutes field, select a start time between 0 and 180 min …

… and in the – right – seconds field, select a start time between 0 and 59 s (or any combination of these):

Procedure

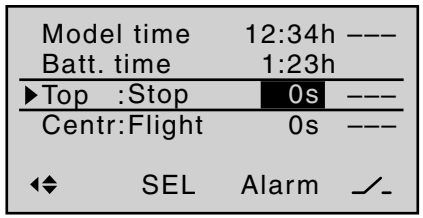
1. Select the desired input field using the arrow keys ◄ ► on the left or right touch pad.
2. Now tap **SET** in the center of the right touch pad.
3. Make your time selection in the highlighted minutes or seconds field, using the arrow keys on the right touch pad.
4. Complete your input by tapping the center **SET** key.
5. If you tap the ▲▼ or ◄ ► keys on the right touch pad at the same time (**CLEAR**), this will reset any settings made back to "0" or "00".
6. After switching back to the basic display (by tapping the center **ESC** key on the left touch pad as many times as required), make sure the stopwatch is stopped and then tap the ▲▼ or ◄ ► keys on the right touch pad (**CLEAR**) so that the stopwatch switches over to the "timer" function. Look to the top right in the following screen image:



After the assigned switch is activated, the stopwatch starts at the initial value set and runs *backwards* ("countdown 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 using the arrow key ► on the left or right touch pad to move the marker frame over the "Timer column to the right. In the "Alarm" column, you can 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.



If you tap the ▲▼ or ◄ ► keys on the right touch pad at the same time (**CLEAR**), this 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:	Single, higher-frequency beep every second
Zero:	Extended audible signal and screen switches to highlighted display

Resetting timers when *stopped*

Tapping the ▲▼ keys on the right touch pad at the same time (CLEAR) **will reset the display of previously** stopped timers on the basic display.

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 joystick", can be found on page 252).*

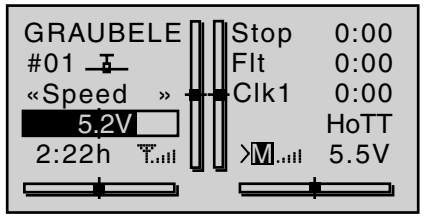
- *If you change timer functionality, these changes are made active by pausing the timer(s) and then tapping the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**) to reset them.*
- *Remember that the timer switches also remain active during programming.*
- *On the basic display, simultaneously tapping the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**) will reset the previously stopped timer to its programmed initial value – see the "Alarm" timer section.*

Fl. phase timers

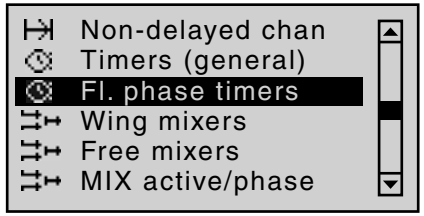
Selecting and setting

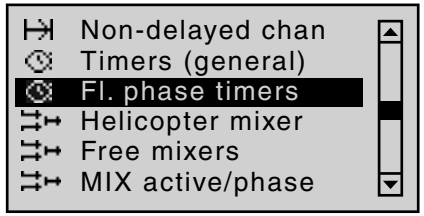
The discussion of the "**Phase settings**" menu on page 134 has already described how timers can be assigned to a flight phase. The same section has also described the properties of "Time1" and "Time2". This section now proceeds to describe "Clk 1, 2 and 3", plus the "lap counter/timetable" timer.

The additional, flight phase-specific timer selected is displayed on the basic display underneath the "center" timer, as shown below:

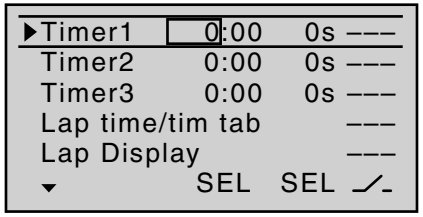


In this menu …





… 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:



The flight phase timers "Clks 1 … 3" and the "Time1"/"Time2" timers (described in the "**Phase settings**" section, pp. 128 and 132) 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 center **ESC** key on the left touch pad.

Clks 1, 2 and 3

These timers are started and stopped via a switch or control switch. To do so, first use the arrow 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 center **SET** key on the right touch pad, as described in the section "Assigning transmitter controls, switches and control switches" (p. 52). Here, too, a control switch offers you the option of activating the timer via one of the joysticks or proportional rotary controls. The switching point along the transmitter control travel is set on the "**Control switch**" menu (page 123).

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 180 min. and 59 s, it will re-start at "0:00".

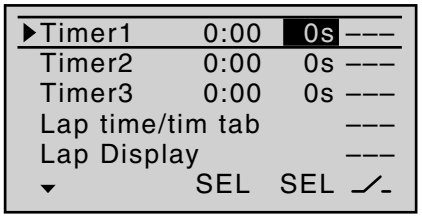
"Countdown" (timer runs backwards)

Following the activation of the corresponding value fields (by tapping the center **SET** key on the right touch pad), if a time in minutes (maximum 180 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 "Assigning transmitter controls, switches and control switches" on page 52), i.e. a "countdown" 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.

Tapping the ▲▼ or ◄ ► keys on the right touch pad at the same time (**CLEAR**) will reset the values entered in the currently active field to zero.

Alarm timer



The input field in the "Alarm" column is activated by tapping the center **SET** key on the right touch pad. In this field, use the arrow keys on the left or right touch pad 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

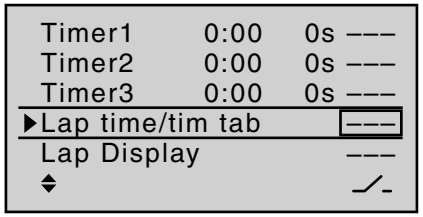
30 s before zero:	Triple beep Single beep every two seconds
20 s before zero:	Double beep Single beep every two seconds
10 s before zero:	Single beepl Single beep every second
5 s before zero:	Single, higher-frequency beep every second
Zero:	Extended audible signal and screen switches to highlighted display

Tapping the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**) will reset the values entered in the currently active field to "0s".

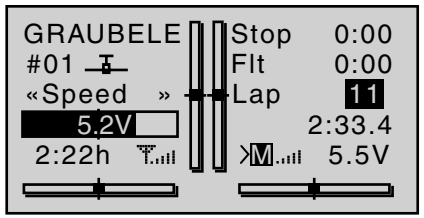
Note:
*If timer functionality has been changed at any point, then the new changes to settings are made active only after the timer(s) have been stopped on the basic display and by then tapping the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**) to reset them.*

Like the two standard timers positioned above it, this third, phase-specific timer is reset to its starting value by simultaneously tapping the ▲▼ or ◄► keys on the right touch pad (**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



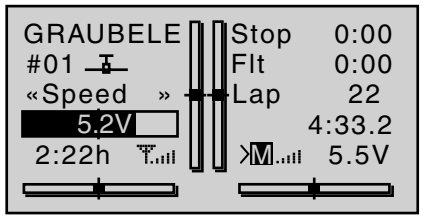
On the "Lap time/tim tab" line, assign a switch only as described in the section "Assigning transmitter controls, switches and control switches" (page 52). Preferably, you should make use of one of the two momentary switches (SW 1 or 9) at this point: in this way, the lap count is incremented each time 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.

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 center **ESC** key on the left touch pad on the basic display after the flight is over. The lap or switch impulse counter is now shown in "normal" mode:



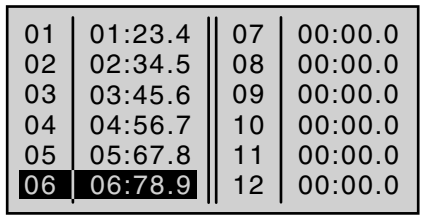
If you tap the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**), this resets the counter to "00" **and deletes the stored times**. However, the timers *must* have been stopped before this.

Notes:

- *If you have selected a normal switch to operate the lap counter, take care to ensure that this switch is set to "OFF" before you press the center **ESC** button on the left touch pad.*

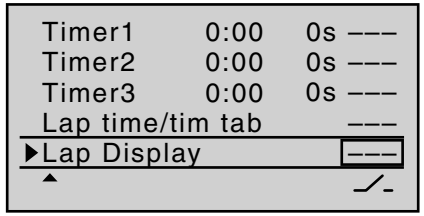
- *If you should forget to switch off the lap counter in a phase which is now not currently active, simply press the center* **ESC** *button on the left touch pad.*

To swap between the basic display and the "Lap Display" ...



... go to the line ...

Lap Display



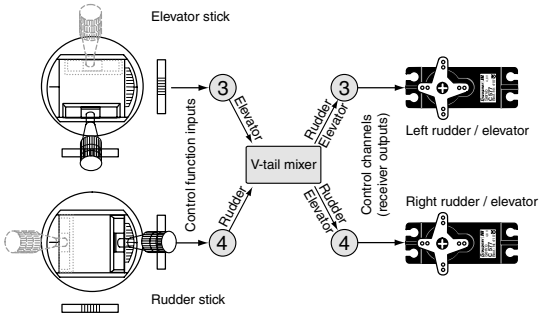
... and use the switch assigned. You assign this switch as described in the section "Assigning transmitter controls, switches and control switches" (page 52).

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" – i.e. also "after" 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 a different control channel and thus on a further receiver output.

Example: V-tail mixer



The **mc-32** 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" line of the **"Model type"** menu by selecting "V-tail".

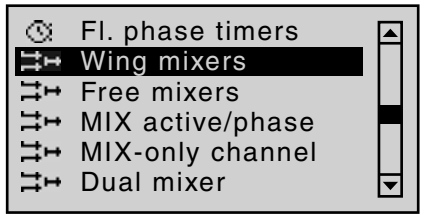
In addition, for each model memory in the fixed-wing and heli programs, the software makes available a total of eight freely programmable linear mixers, four freely programmable curve mixers and four dual mixers.

Also ensure you read the general remarks on "free mixers" in this handbook (p. 180).

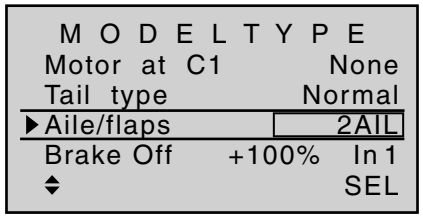
Wing mixers

Calibrating the wing flap system

Within the menu tree of the menu …

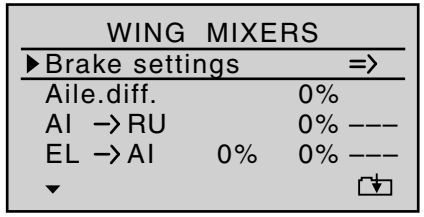


… the sub-menus and options available depend entirely on the number of aileron and flap servos set up on the "**Model type**" menu (page 82) …

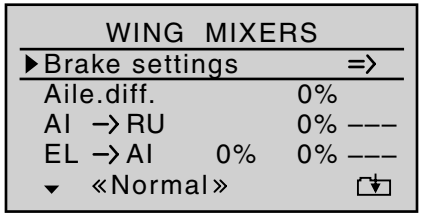


… which means that the only settings listed are the ones that can actually be configured. This not only makes the menu more compact but also avoids potential programming errors.

With a preset of e.g. "2AIL" (no flaps), the "**Wing mixers**" menu will be shown as follows:



If you have configured several flight phases on the menus "**Phase settings**" (page 128) and "**Phase assignment**" (page 134), and assigned these names, then the flight phase name, e.g. "Normal", will appear on the lower edge of the display:



All options can then also be programmed specific to a flight phase.

Comments:

- *Using the menu "**Model type**" (page 82), control of the airbrake mixers can be reprogrammed from control input 1 to 7 or 8 to 9, and the associated offset point can also be set.*
- *If you wish to set up a "butterfly" system, with the ailerons raised and the flaps (if present) lowered, this is achieved by entering the appropriate settings on the "Butterfly" line on 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 the example on page 248.*
- *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 128).*
- *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**" (see page 193) and use it for another purpose with the help of a "free mixer" (see page 190).*
- *If you set "2AIL" on the "**Model type**" menu (page 82), then the flight phase-dependent flap functionality can be achieved by making appropriate offset settings for input 5 on the "**Control adjust**" menu (page 96).*
- *For almost any menu option, you have the option of checking your settings by switching to the servo display screen, which is accessed by simultaneously tapping the arrow keys ◄ ► on the left touch pad.*

  Caution:

  *The vertical lines on the "**Servo display**" move in the same direction for ailerons and in the opposite direction for flaps.*
- *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 and the selection "2AIL 4FL".*
- *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 as at a) by using any transmitter control, assigned to "Input 6" on the "**Control adjust**" menu (page 96) – possibly also made flight phase-dependent by selecting "PH" in the "Type" column. Preferably, this should be one of the CTRL 6 … 8 proportional rotary controls.*

  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 "Aile/flaps" line on the **"Model type"** menu. This transmitter control indirectly controls the flap position of the ailerons via the percentage value entered in the "Ail" (and "Ail2") column on the "FLAP" line of the multi-flap menu.*

*To be able to provide more fine-grained control of flap positions, however, you should reduce travel to about 25% on the "Input 6" line of the "**Control adjust**" menu.*

c) *… alternatively, you can also leave the default entry of "0%" in the "Ail" (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 by using the arrow keys ▲▼ on the left or right touch pad.

   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 center **SET** key on the right touch pad.
3. Use the arrow keys to set the mixer ratio or degree of differential.

   To configure symmetrical mixer values, move the transmitter control or joystick to its center position, so that the marker frame surrounds both value fields. To configure asymmetric values, move the transmitter control/joystick 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. Tapping the ▲▼ or ◄► keys on the right touch pad at the same time (**CLEAR**) will reset the values entered in the currently active (highlighted) field to the default value.
5. Complete your input by tapping the center **ESC** key on the left touch pad or the center **SET** key on the right touch pad.

Assigning switches

The wing mixers "AI → RU" and "FL → EL" can be optionally switched on and off by using a switch or an expanded switch. Accordingly, when selecting the respective line, the familiar switch icon (⎽╱⎽) appears on the lower edge of the screen.

Switching delays

The delay time or switch time configured on the menu "**Phase settings**" (page 128) 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" submenu, 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.

Accordingly, specify the input 1, 7, 8 or 9 and the offset corresponding to your customary piloting in the "Brake offset" line on the "**Model type**" menu – see page 82. 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.

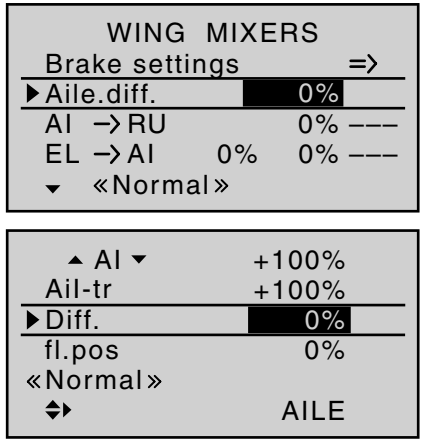
Note:
If the offset is not set right at the end of the transmitter travel, the rest of the travel is a "dead zone", i.e. the transmitter control does not influence any mixers on the "Brake settings" sub-menu. Otherwise, the mixer travel is expanded back to 100% automatically.

All other mixers on the "**Wing mixers**" menu have their neutral point with the control at its center, i.e. they have no effect at this control position. The value set is mixed in at full travel.

Mixer functions

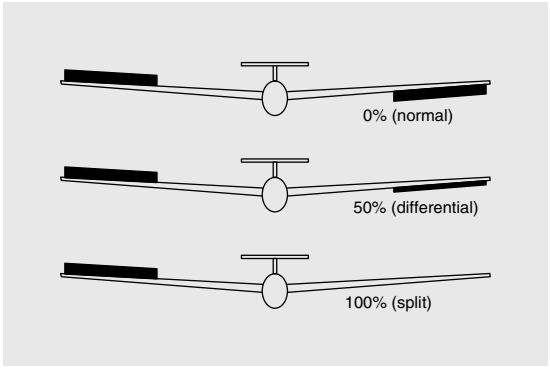
The individual options on the "**Wing mixers**" menu option are discussed below, separately for single-, dual- and multi-flap models. Before we start, a number of remarks on the differentials for ailerons and flaps:

Aile. diff. or **Diff.** (Aileron differential)



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 reduces the aircraft's efficiency.

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.

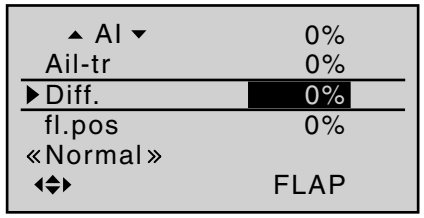
The adjustment range of -100% to +100% makes it possible to set a differential appropriate for each side, regardless of the direction of rotation of the aileron servos. While "0%" corresponds to a normal linkage, i.e. no differential, "-100%" or "+100%" represents the "split" function.

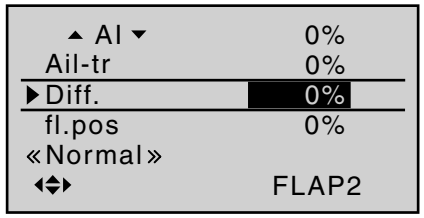
For aerobatic flying, low absolute values are required to ensure the model rotates exactly along its longitudinal axis when an aileron command is given. Values near to the center (-50% or +50%) are typical for facilitating turns in thermals. The split setting (-100%, +100%) is popular with slope flyers, where ailerons alone are often used for turning the model.

If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

Note:
Negative values are not usually necessary if channels are assigned properly.

Diff. (camber-changing flap differential)





In the "▲AI▼" line on the multi-flap menu, you can set the extent to which the flaps act as ailerons and follow the aileron joystick; the 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.

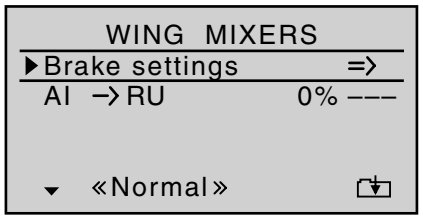
The adjustment range of -100% to +100% makes it possible to set a differential appropriate for each side, regardless of the direction of rotation of the servos. A value of 0% is equal to normal linkage, i.e. the servo travel downwards is the same as the travel upwards. A value of -100% to +100% means that travel downwards will be reduced to zero for aileron commands affecting the flaps ("split" mode).

If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

Note:
Negative values are not usually necessary if channels are assigned properly.

Model type: "1AIL"

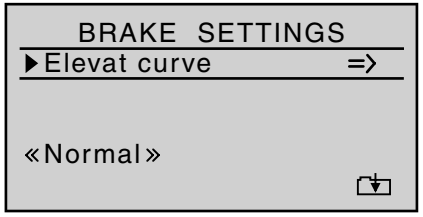
If you have entered "1AIL" for the "Aile/flaps" line on the "**Model type**" menu (page 82), then the "Wing mixers menu" on your transmitter will match the following screen image:



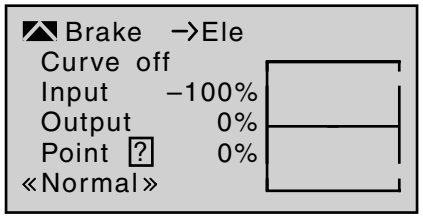
From the first line on this display screen, you can switch to the sub-menu by briefly tapping the center **SET** key on the right touch pad …

Brake settings

Note:
*The "Brake settings" menu is switched "off" if you entered "Motor on C1 forward / back" on the "**Model type**" menu (see page 82), and entered "Yes" for the currently active flight phase in the "Motor" column of the "**Phase settings**" menu (see page 128). Switch the flight phase if required:*



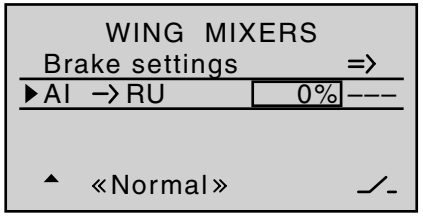
Since you cannot set up a butterfly or aileron differential in a model with only a single aileron servo, this menu offers no further configuration options with the exception of a "pointer" to the "Elevat curve" sub-menu. Accordingly, we proceed immediately further from here by once again tapping the center **SET** key on the right touch pad:



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 menu option "**Channel 1 curve**" (page 116 onwards).

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 by using one of the switches that do not reset themselves (SW 2 … 8) or a control switch. This means you can then also control the model using only the ailerons or rudder, as required.

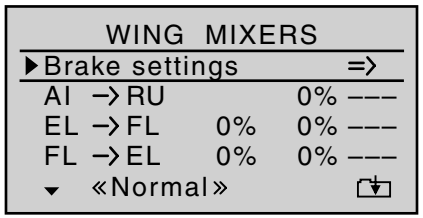
Typically, this mixer is set so that the rudder is deflected to the same side as the upward-oriented aileron, and you will find that setting a value of around 50% is usually highly appropriate.

Settings are always made symmetrically relative to the neutral point of the aileron joystick.

If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

Model type: "1AIL 1FL"

If you have entered "1AIL 1FL" for the "Aile/flaps" line on the "**Model type**" menu (page 82), then the "Wing mixers menu" on your transmitter will match the following screen image:

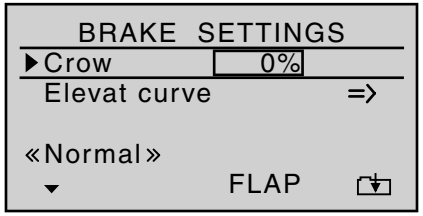


From the first line on this display screen, you can switch to the sub-menu by briefly tapping the center **SET** key on the right touch pad …

Brake settings

Note:

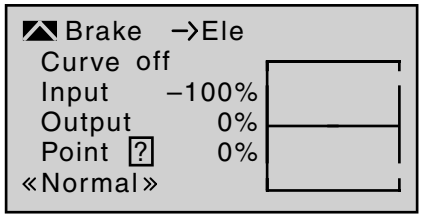
*The "Brake settings" menu is switched "off" if you entered "Motor on C1 forward / back" on the "**Model type**" menu (see page 82), and entered "Yes" for the currently active flight phase in the "Motor" column of the "**Phase settings**" menu (see page 128). Switch the flight phase if required:*



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 joystick.

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 center **SET** key on the right touch pad and enter a suitable value using the arrow keys on the left or right touch pad. To ensure a sufficiently strong braking effect, note that you should try to lower the flap as low as is mechanically possible.

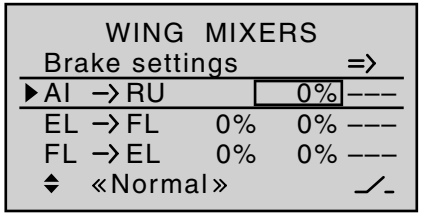
From the second line on this display screen, you can switch to the sub-menu "Elevat curve" by briefly tapping the center **SET** key on the right touch pad:



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 menu option "**Channel 1 curve**" (page 116 onwards).

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.

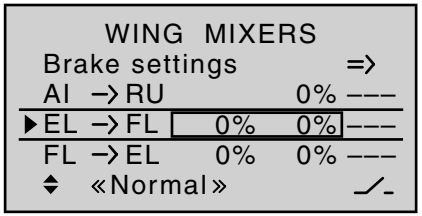
The adjustment range of ± 150% lets you set the direction of deflection as appropriate. Optionally, this mixer can be activated and deactivated by using one of the switches that do not reset themselves (SW 2 … 8) or a control switch. This means you can then also control the model using only the ailerons or rudder, as required.

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 joystick.

If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

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. Optionally, this mixer can be activated and deactivated by using one of the switches that do not reset themselves (SW 2 … 8) or a control switch.

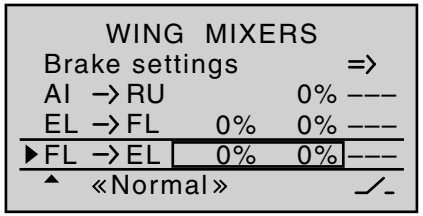
To configure symmetrical mixer values, move the elevator joystick to its center position, so that the marker frame surrounds both value fields. To configure asymmetric values, move the joystick to the corresponding side.

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.

If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

The "typical" values configured for this mixer are single-digit or low two-digit values.

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**" menu (page 96) to assign input 6 a transmitter control or switch – possibly flight phase-dependent – then this also affects this mixer.

Depending on the position of the flap control, either a symmetrical or asymmetric setting within the range ±150% is possible.

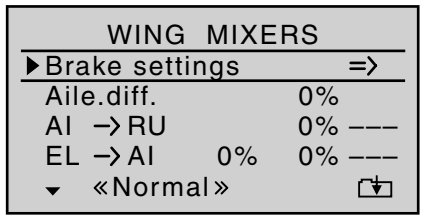
If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

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"

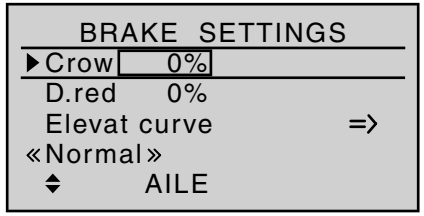
If you have entered "2AIL" for the "Aile/flaps" line on the "**Model type**" menu (page 82), then the "Wing mixers menu" on your transmitter will match the following screen image:



From the first line on this display screen, you can switch to the sub-menu by briefly tapping the center **SET** key on the right touch pad …

Brake settings

Note:
*The "Brake settings" menu is switched "off" if you entered "Motor on C1 forward / back" on the "**Model type**" menu (see page 82), and entered "Yes" for the currently active flight phase in the "Motor" column of the "**Phase settings**" menu (see page 128). Switch the flight phase if required:*



Depending on the model type selected, you will now have appropriate configuration options available in the lines "**Crow**" and "**D**(ifferential) **red**(uction)" for the "**AILE**" column. You should utilize these options by …

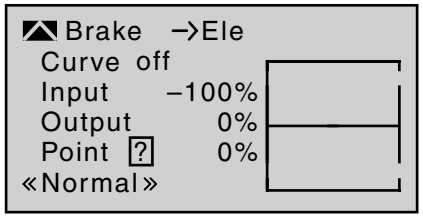
- … moving the transmitter control for "Brake" (see description for "**Model type**" menu on page 82 – typically the C1 joystick – to its braking end-point. Then switch to the "Crow" line, briefly tap the center **SET** key on the right touch pad and use the arrow keys on the left or right touch pad 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 "– lim +" column of the "**Servo adjustments**" menu (page 90).*

- … then, finally, moving to the "D. red" line and setting a % value that is greater than or equal to the "Aile. diff." value that you set (or have yet to set) on the display page "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.

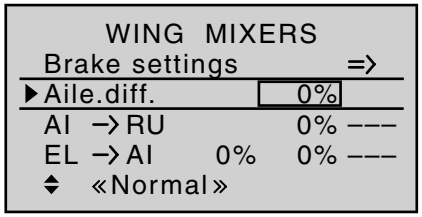
From the lowest line, "Elevat. curve", you can switch to setting the "Elevat. curve" mixer by briefly tapping the center **SET** key on the right touch pad:



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 menu option "**Channel 1 curve**" (page 116 onwards).

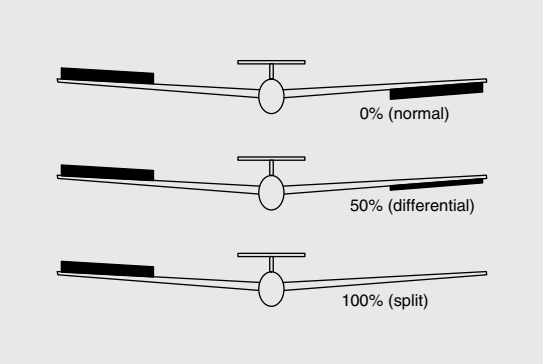
Aileron differential



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 differential on the transmitter, "-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 center (-50% or +50%) are typical for facilitating turns in thermals. The split setting (-100%, +100%) is

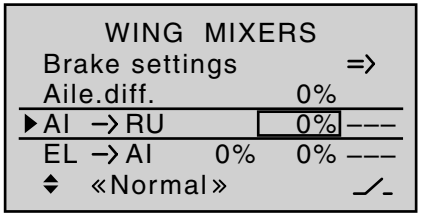
popular with slope flyers, where ailerons alone are often used for turning the model.



If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

Note:
Negative values are not usually necessary if channels are assigned properly.

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.

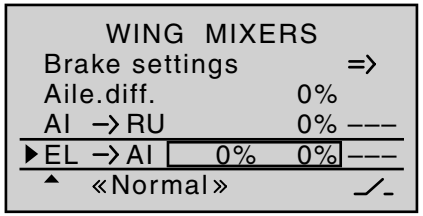
The adjustment range of ± 150% lets you set the direction of deflection as appropriate. Optionally, this mixer can be activated and deactivated by using one of the switches that do not reset themselves (SW 2 … 8) or a control switch. This means you can then also control the model using only the ailerons or rudder, as required.

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 joystick.

If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

Elevator → aileron



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 flaps are deflected downwards when the elevator is oriented upwards and vice versa for a downward-oriented elevator – i.e. in opposite directions. Optionally, this mixer can be activated and deactivated by using one of the switches that do not reset themselves (SW 2 … 8) or a control switch.

To configure symmetrical mixer values, move the elevator joystick to its center position, so that the marker frame surrounds both value fields. To configure asymmetric values, move the transmitter control to the corresponding side.

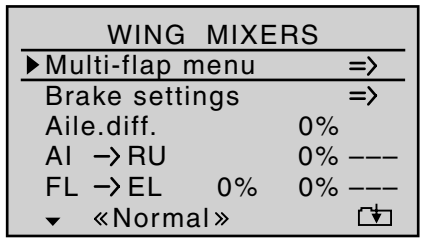
Values in the range -150% to +150 are possible, so as to adjust the function to the direction of servo rotation or direction of aileron deflection.

If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

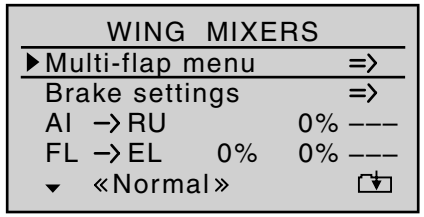
The "usual" values for this mixer are in the low two-digit range.

Model type: "2/4AIL 1/2/4FL"

If you have entered "2AIL 1FL" for the "Aile/flaps" line on the "**Model type**" menu (page 82), then the "Wing mixers menu" on your transmitter will match the following screen image:



If, on the other hand, you have entered "2/4AIL 1/2/4FL" for the "Aile/flaps" line on the "**Model type**" menu (page 82), then the "Wing mixers menu" on your transmitter will show the following:



Regardless of the combination of aileron and flap servos you choose, all of the parameters available can be adjusted separately for each flight phase.

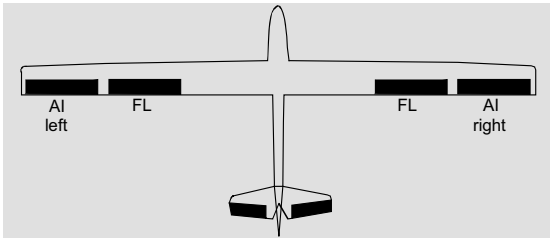
Note:

*For almost any menu option, you have the option of checking your settings by switching to the servo display screen, which is accessed by simultaneously tapping the arrow keys ◄ ► on the left touch pad. If you do, note however that the vertical lines on the "**Servo display**" move in the same direction for ailerons and in the opposite direction for flaps.*

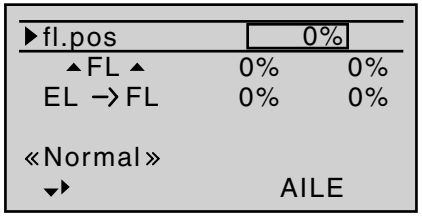
Before we address the details of this menu we would like to provide a brief explanation of the different display modes for the multi-flap menu:

Model type: "2 AIL 1 FL"

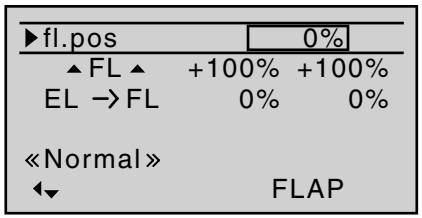
If you connect the servos to the receiver as described on page 57 and select them appropriately on the "**Model type**" menu (see page 82), then the abbreviations "AI" and "FL" refer to the following flaps:



Since the options available on the wing mixer menu and its sub-menus vary according to the number of flap servos specified on the "**Model type**" menu (page 82), the list contains only the set-up options that are possible for your model configuration.



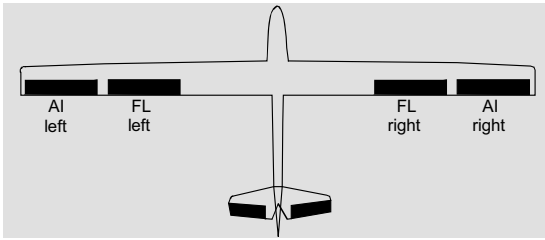
Accordingly, with values preset to "2AIL 1FL", the options to set aileron functions for flaps will be hidden and it will be possible to move only one column to the right, into the column "FLAP":



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 screen-shot at top left.

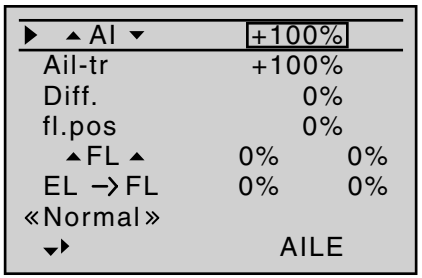
Model type: "2AIL 2FL"

If you connect the servos to the receiver as described on page 57 and select them appropriately on the "**Model type** menu (see page 82), then the abbreviations "AI" and "FL" refer to the following flaps:

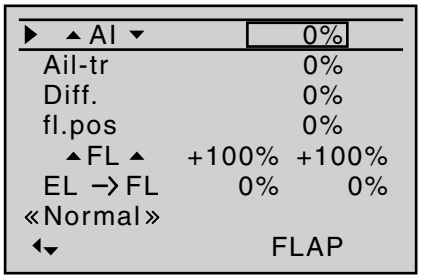


Since the options available on the "wing mixer menu" and its sub-menus vary according to the number of flap servos specified on the "**Model type**" menu (page 82), the list contains only the set-up options that are possible for your model configuration.

This means that if values are preset to "2AIL 2FL", then all configuration options for the aileron pair …



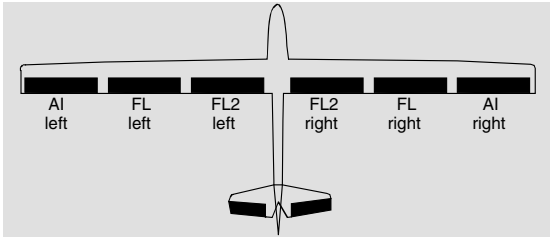
… are shown, and – one "step" to the right – all options for the flap pair as well:



Moving one further column to the right, however – to the "FLAP2" column – is not possible.

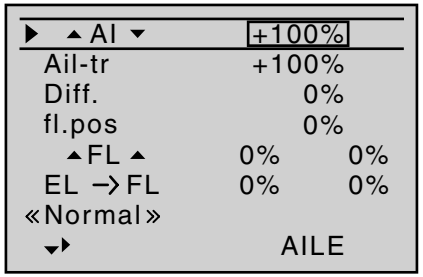
Model type: "2AIL 4FL"

If you connect the servos to the receiver as described on page 57 and select them appropriately on the "**Model type**" menu (see page 82), then the abbreviations "Al", "FL" and "FL2" refer to the following flaps:

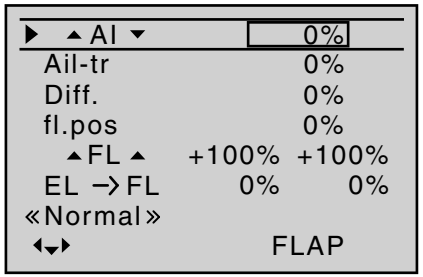


Since the options available on the "wing mixer menu" and its sub-menus vary according to the number of flap servos specified on the "**Model type**" menu (page 82), the list contains only the set-up options that are possible for your model configuration.

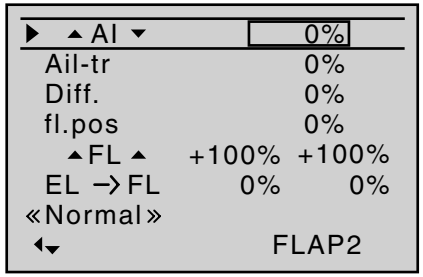
This means that if values are preset to "2AIL 4FL", then all configuration options for the aileron pair …



… are shown, and – one "step" to the right – all options for the first flap pair …

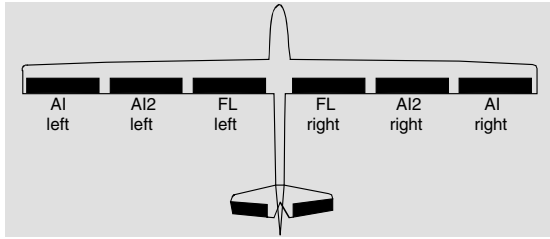


… are shown, and – one further "step" to the right – all options for the second flap pair as well:



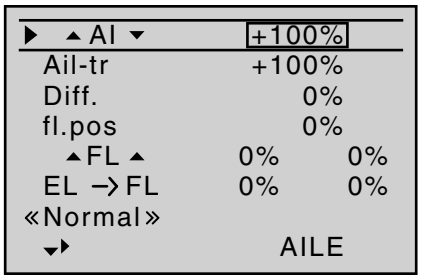
Model type: "4AIL 2FL"

If you connect the servos to the receiver as described on page 57 and select them appropriately on the "**Model type**" menu (see page 82), then the abbreviations "Al", "Al2" and "FL" refer to the following flaps:

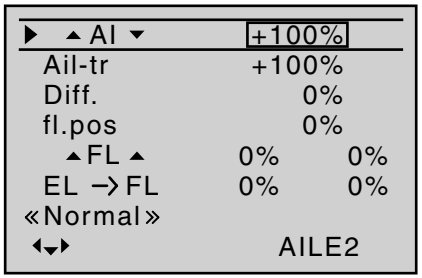


Since the options available on the "wing mixer menu" and its sub-menus vary according to the number of flap servos specified on the "**Model type**" menu (page 82), the list contains only the set-up options that are possible for your model configuration.

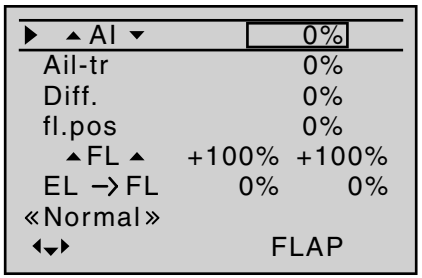
This means that if values are preset to "4AIL 2FL", then all configuration options for the first aileron pair …



… are shown, and – one "step" to the right – all options for the second aileron pair …

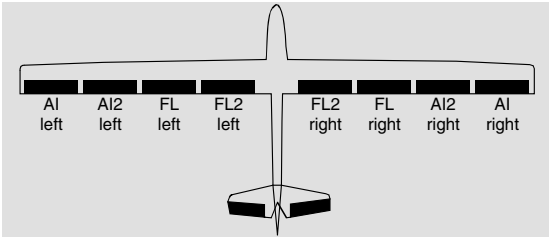


… are shown, and – one further "step" to the right – all options for the flap pair as well:

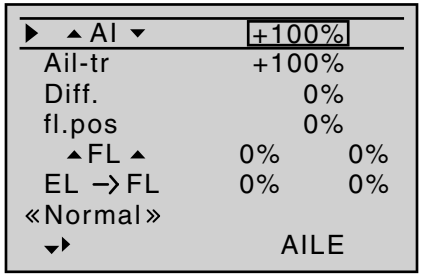


Model type: "4AIL 4FL"

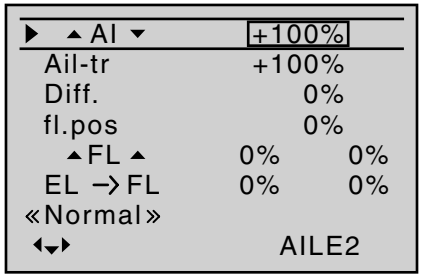
If you connect the servos to the receiver as described on page 57 and select them appropriately on the "**Model type**" menu (see page 82), then the abbreviations "AI", "AI2", "FL" and "FL2" refer to the following flaps:



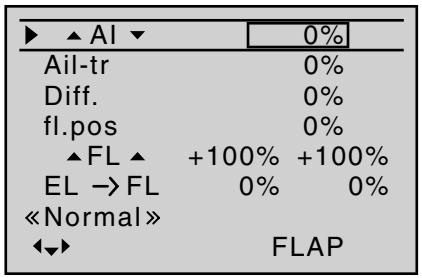
Since selecting "4AIL 4FL" means choosing the maximum number of control surface servos, the columns "AILE" …



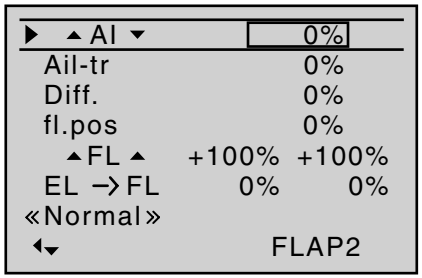
… and "AILE2" …



… are supplemented by the columns "FLAP" …

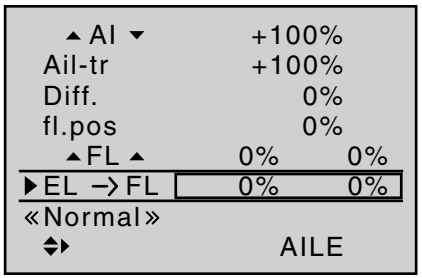


… and "FLAP2":



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), then the two ailerons will normally not move when you move the elevator joystick – 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:



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.

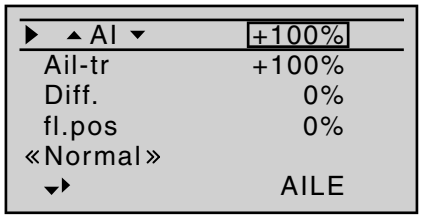
Note:
The "Brake settings" sub-menu (see next double page) is also suitable for setting up the butterfly (crow) function with delta and flying wing models. In fine-tuning the deflection of the flap pairs AIL, FL and (if present) FL2, however, ensure that the moments created by one pair of flaps compensate 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.

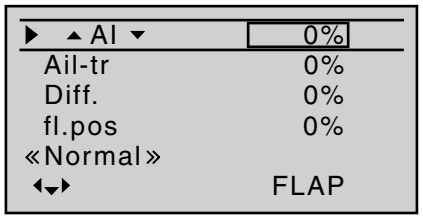
Multi-flap menu

Important notice:
*Depending on the flap pairs specified in the "**Model type**" menu, 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.*

▲Al▼ (Aileron ➔ flaps)

(Not shown for "2AIL 1FL".)





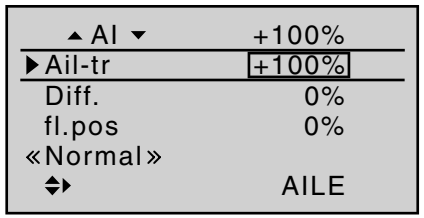
In the line "▲Al▼" you can set the percentage extent to which the wing flap pair "FLAP" (and, if present, "FL2") follow when an aileron command is given (the value can be entered separately for each flight phase). (In the "AILE" column it is also possible to adjust the deflection of the aileron pair, 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%.

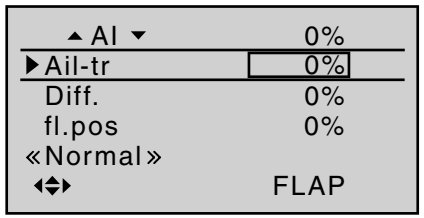
The adjustment range of -150% to +150% means the direction of deflection can be adjusted, depending on the direction of rotation of the servos, to suit the ailerons.

If you tap the ▲▼ or ◄ ► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to the default value (see screen image).

Ail-tr. (aileron trim)

(Not shown for "2AIL 1FL".)





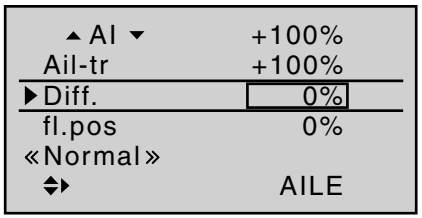
In this line, you specify the percentage rate with which aileron trim is to affect "AILE", "FLAP" and – if present – "FLAP2".

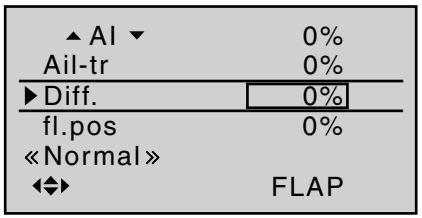
The available range of values is -150% to +150%, relative to the adjustment range of the trim lever.

If you tap the ▲▼ or ◄ ► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to the default value (see screen image).

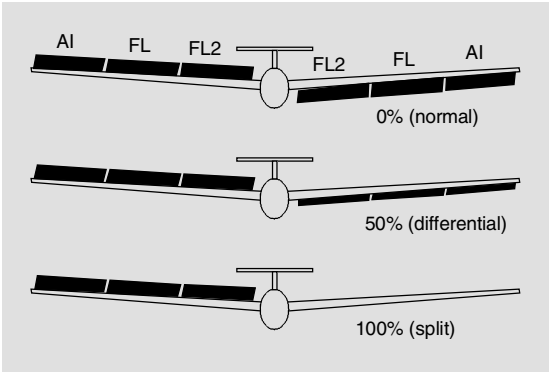
Diff. (Differential for aileron function)

(With "2AIL 1FL", found one level higher on the "**Wing mixers**" menu – see screen image on previous double page.)





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.

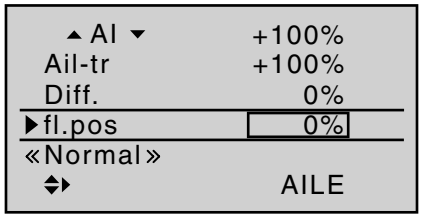


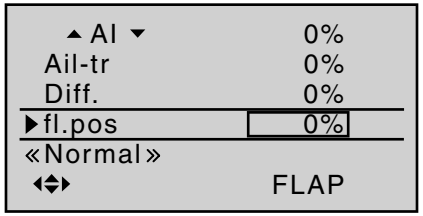
If you are unsure about the meaning of differential travel, please read the appropriate explanation at the start of this section on page 148.

The adjustment range of -100% to +100% makes it possible to set the correct direction of differential regardless of the direction of rotation of the aileron and flap servos.

If you tap the ▲▼ or ◀ ▶ keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to the default value (see screen image).

fl.pos (wing flap position)





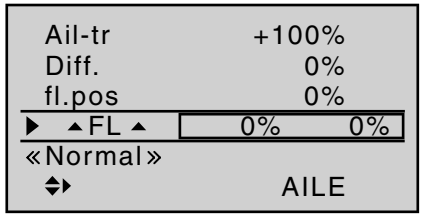
Here, you set the flight phase-specific wing flap positions for all of the flaps present on the model in question. In this way, you can specify the flap positions that apply to each flight phase.

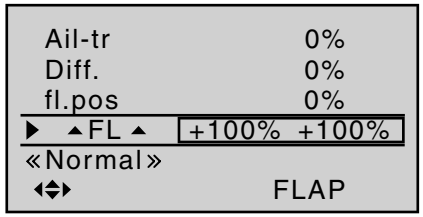
The adjustment range of -100% to +100% makes it possible to set the correct direction of travel regardless of the direction of rotation of the aileron and flap servos.

If you tap the ▲▼ or ◀ ▶ keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to the default value (see screen images).

▲FL▲ (Effects of flap controls)

In this line, you specify the percentage rate with which the settings for input 6 (as made on the "**Control adjust**" menu, page96, and potentially dependent on flight phase) will affect the wing flap positions of the aileron and camber-changing flaps.





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 you leave (or have left) each travel adjustment at +100% on the "**Control adjust**" menu (page 96), then values between 5% and 20% should generally be sufficient.

If you tap the ▲▼ or ◀ ▶ keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to the default value (see screen images).

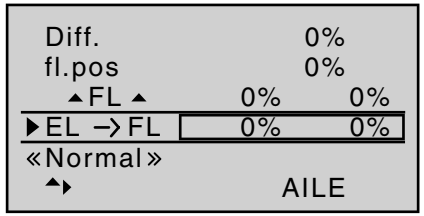
Note:
By default, NO transmitter control is assigned to input 6

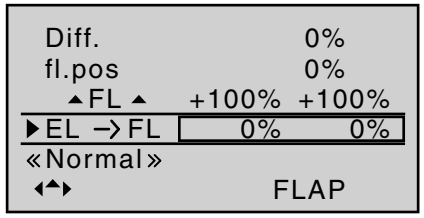
*on the "**Control adjust**" menu. However, you can assign a transmitter control or switch to this input at any time – also in a flight phase-dependent way – thus enabling different flap settings within a flight phase; see also example 2 on page 260.*

EL → FL (Elevator → flaps)

To provide support for the elevator for tights 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:





If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to the default value (see screen images).

The "usual" values for this mixer are in the low two-digit range.

Important general notice:

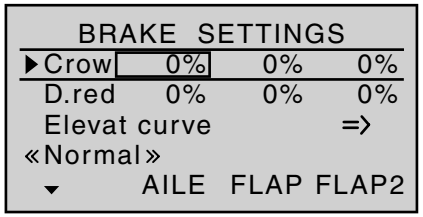
Do not let control surfaces and servos strike their mechanical end-stops when large deflections are set! This is especially relevant in relation to the functions "▲AI▼", "▲FL▼" and possibly "▲FL2▼". Use the "- lim +" option (travel limit) available on the "Servo adjustments" menu (page 90), as required.

Brake settings

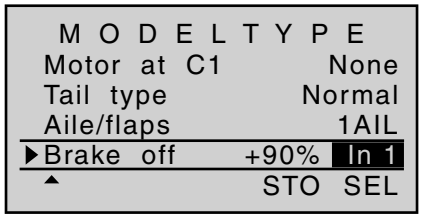
Notes:

- *The "Brake settings" menu is switched "off" if you entered "Motor on C1 forward / back" on the "**Model type**" menu (see page 82), and entered "Yes" for the currently active flight phase in the "Motor" column of the "**Phase settings**" menu (see page 128). 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



The "Crow" mixer function is actuated by control function 1, 7, 8 or 9, depending on the input that you have assigned on the "Brake Off" line on the "**Model type**" menu (see page 82).



Note:

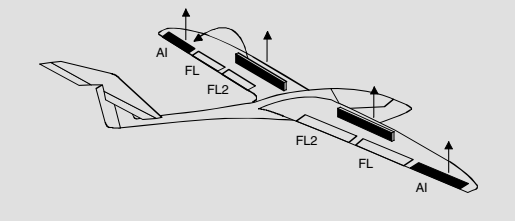
*On the "**Model type**" menu (see page 82), you should also define the offset, i.e. the direction of operation. The offset should be set to about +90% of stick travel (if the C1 stick is used, this is generally located at the forward position of the stick). To extend the flaps, the stick must therefore be moved back towards the pilot. The remaining joystick 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 for the AILE, FLAP and – if present – FL2 columns to define the extent and direction to which the corresponding pairs of flaps are to follow when the airbrake control (control function 1, 7, 8 or 9) is operated. If the model does not feature separate airbrakes, leave the corresponding receiver output free or use the "**MIX-only channel**" menu to set this to "MIX-only", to be able to use it elsewhere.

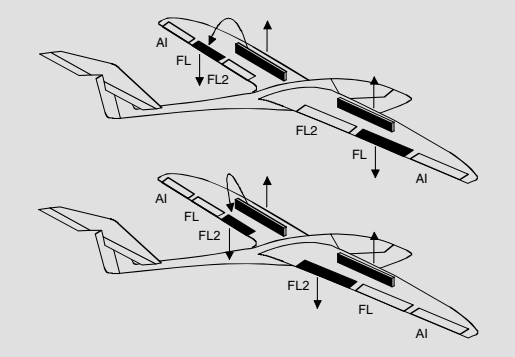
Values in the range -150% to +150% are possible.

If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to the default value (see screen image).

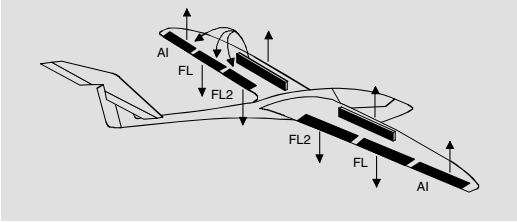
- **"AILE" column**
  When braking the model as it comes in to land, neither of the two aileron flaps should ever be deflected more than half of the possible travel upwards, to ensure that enough travel is available to control the model along its longitudinal axis (aileron function).



- **"FLAP" (and "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 and FLAP for "Crow"**

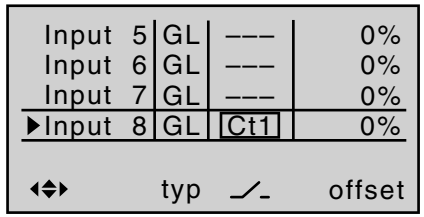


If the airbrake mixers are set as described above, then a special flap combination – also referred to as the *"crow position"* or *"butterfly"* – can be configured: With this airbrake setting, both *ailerons move moderately upwards* while the *flaps move as far as possible downwards*.
A further mixer – see below, under the section "Elevat curve" – is then used to trim the elevator in such a way that the model's airspeed changes very little compared 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.

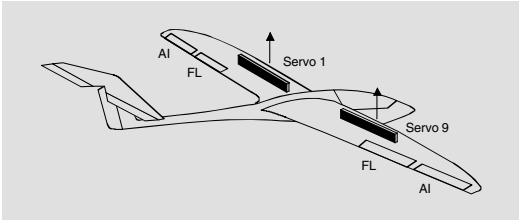
<u>A tip for "seeing" the effect of brakes:</u>
lift the flaps and look over and under the surface from the front. The larger the surface projected by the lifted flap, the greater the braking effect achieved.

<u>Tips for activating airbrakes:</u>

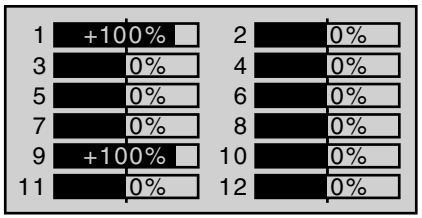
- *If you have installed a servo for operating conventional wing-mounted airbrakes in addition to the aileron and flap servos, the simplest method of controlling it is to connect it to the receiver output whose input you have selected for the brake function, i.e. either 1, 7, 8 or 9 – assuming it it is free. If this is not possible, then as an alternative you can set a free mixer, which connects up the brake control channel you have selected with the airbrake servo channel.*
- *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 8. You then also assign this output to transmitter control 1 (as standard) on the "**Control adjust**" menu (page 96) – see screen image:*



As you do, leave the settings for offset, travel, etc. at their default values. Also leave the default value at "GL" in the "typ" column, since the second airbrake, like the first, should be active in the same way across all flight phases.



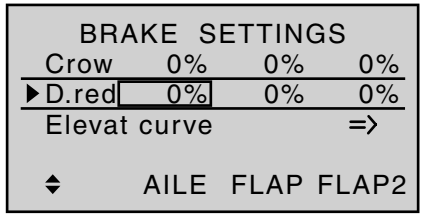
*You can assure yourself that this works as stated by accessing the "**Servo display**" menu, which you can access from almost any menu level by briefly pressing the ◄ ► keys on the left touch pad at the same time (see page 230):*



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 193).*

*In either case, however, the airbrake travels must then be fine-tuned on the "**Servo adjustment**" menu (see page 90).*

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.

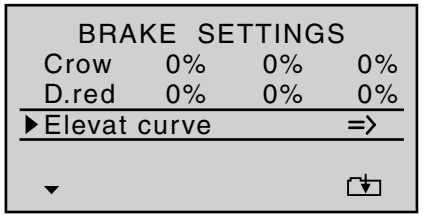
To be able to restore the effect of the aileron altered in this way as far as possible, you should ensure that you make use of the automated "Differential reduction" feature. This feature continuously reduces the degree of aileron differential as the airbrake system is extended. The feature is configurable 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 joystick.

Values can be set in the range 0 to150%.

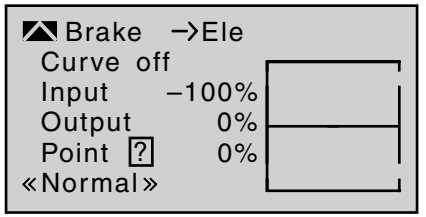
If you tap the ▲▼ or ◄ ► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

Elevat curve (Brake → elevator)



If the airbrake control – to be set to 1, 7, 8 or 9 on the "Brake Off" line of the "**Model type**" menu (page 83) – 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.

By briefly tapping the center **SET** key on the right touch pad, you can switch to the display screen as shown below:



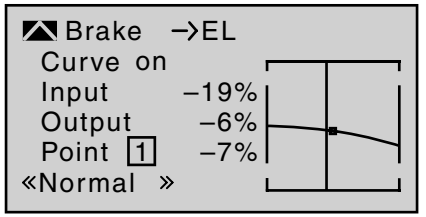
Configuration notes for "Elevat curve" (brake → EL)

The offset that you have configured on the "**Model type**" menu (page 82) 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. Simultaneously, the airbrake control travel is automatically expanded back to 100%, as described for the "**Model type**" menu.

Accordingly, the mixer's neutral point always lies on the left edge, independently of the offset configured.

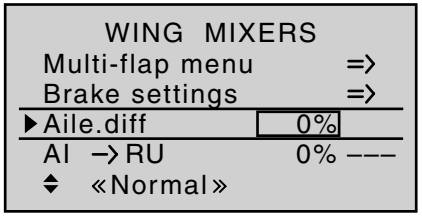
Now adjust the elevator curve in the direction of the opposite end-point in accordance with the requirements. Note that the approach taken to configuring this 5-point curve mixer follows the same principles as already described (within the scope of the "Channel 1 curve" menu, page **116**) as applicable to the curve mixers, i.e.:



In each case, you should test the setting selected at the appropriate altitude and re-adjust as required. As you do, however, ensure that your model does not slow down excessively with the braking system 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.

Aileron differential

(Only for "2AIL 1FL". If "2AIL 2/4 FL" is selected, included on the multi-flap menu, see page 157.)



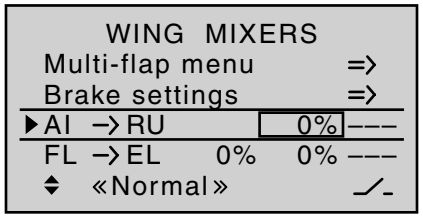
On this line you can set the aileron differential for the two aileron servos.

If you are unsure about the meaning of differential travel, please read the appropriate explanation at the start of this section on page 148.

The adjustment range of -100% to +100% makes it possible to set the correct direction of differential regardless of the direction of rotation of the aileron and flap servos.

If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

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 mixer direction is typically chosen to ensure that the rudder moves in the direction of the aileron that is deflected upwards.

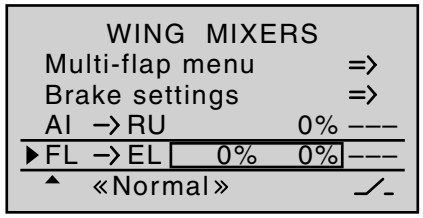
Settings are always made symmetrically relative to the neutral point of the aileron joystick.

The adjustment range of ± 150% lets you set the direction of deflection as appropriate. Optionally, this mixer can be activated and deactivated by using one of the switches that do not reset themselves (SW 2 … 8) or a control switch. This means you can then also control the model using only the ailerons or rudder, as required.

If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

A value of around 50% is generally an excellent starting point.

Flap → elevator



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.

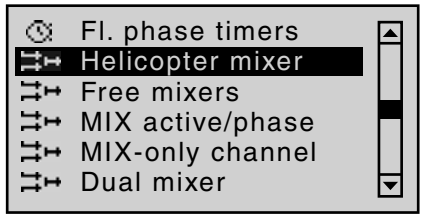
If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

Note:
*If you have used the "*Control adjust" menu to assign a transmitter control or switch, as described under ▲ *" on page **159**, then the latter will also affect this mixer.*

Helicopter mixers

Flight phase-specific setting of collective pitch, throttle and tail rotor

On this menu …

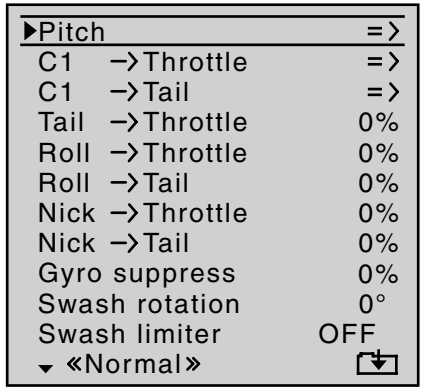


… all of the flight phase-specific helicopter mixers are described, with the exception of the mixers for auto-rotation flight (discussed from page 178 onwards.) These mixers are used for the basic set-up of a model helicopter.

For flight phase programming, see the menus:

- "**Base setup model**", page 74
- "**Phase settings**", page 132
- "**Phase assignment**", page 134

When you actuate a switch for a specific flight phase, then the associated flight phase, e.g. "Normal", is displayed at the lower left edge of the display screen:



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 145 and 180)

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. The "Nick ➔ Tail" mixer, for example, means that the tail rotor servo will be configured to follow commands from the pitch-axis joystick.

Basic programming procedure:

1. Select the mixer by using the arrow keys on the left or right touch pad.

   Depending on the mixer, the lower line of the display will show **SEL** or the "⍗" icon, which indicates that you need to move to a second page.
2. The linear mixer ratios can be set directly by briefly tapping the center **SET** key on the right touch pad: Use the arrow keys to configure the mixer ratio.

   Otherwise you will need to switch to the second screen page where you can set up the appropriate curve mixer.

   If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.
3. Complete the configuration by tapping the center **SET** key on the right touch pad again.
4. You can page back by tapping the center **ESC** key on the left touch pad.

Description of helicopter mixers

To configure collective pitch curve settings and the two mixers "Channel 1 ➔ Throttle" and "Channel 1 ➔ Tail rotor", curve mixers are available in all flight phases. Accordingly, these mixers also permit the programming of non-linear mixing ratios along the path of joystick travel, if required. Switch to the display screen for curve settings by briefly tapping the center **SET** key on the right touch pad – see discussion 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 arrow keys on the left or right touch pad to set a mixer value in the value field (now highlighted).

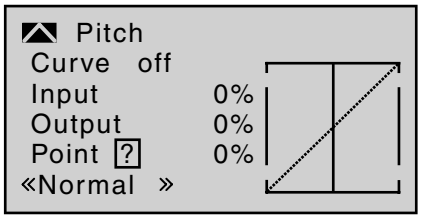
The settings available are rounded off with the "swash limiter" option: These option can be configured to limit the maximum deflection of the swashplate servo. Together, these settings configure the basic set-up of the helicopter model.

In the "Autorotation" flight phase as described on page 178, however, the mixers "C1 ➔ Throttle" and "C1 ➔ Tail" are not needed and therefore switched to a configurable default value.

If you want to reset any changed parameters to their default values, you can do so at any time by simultaneously tapping the ▲▼ or ◄► keys on the right touch pad (**CLEAR**).

Collective pitch (Collective pitch curve (C1 ➔ Pitch))

If necessary, use the arrow keys ▲▼ on the left or right touch pad to move to the "Pitch" line. Now briefly tap the center **SET** key on the right touch pad:



Unlike the "**Channel 1 curve**" menu, however, this display relates only to the control curve of the pitch servos: the "Channel 1 curve", on the other hand, affects all servos controlled via the throttle/collective 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 joystick 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 center of control travel still to be set – define an initial linear profile for the collective 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 joystick position is shown numerically on the "Input" line (-100% to +100%).

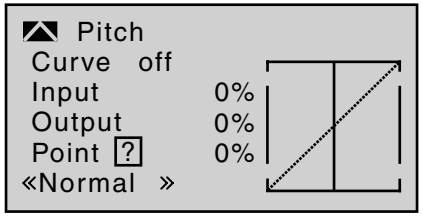
The point at which the vertical line crosses the curve is termed the "Output", and can be varied at the maximum of 6 reference points within the range -125% to +125%. A control signal modified in this way affects only the collective pitch servos.

In the example to the left, the joystick is at exactly 0% of control travel and also generates an output signal of 0%, since the characteristic curve is linear.

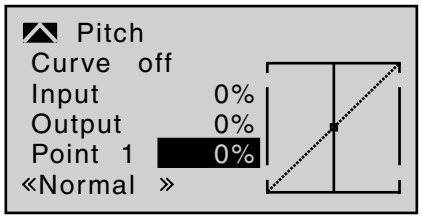
Up to 4 additional reference points can be set between the two end-points "L" and "H", although the distance between neighboring reference points must not be less than approx. 25%.

Setting reference points

If necessary, use the left or right arrow key ▼ to drag the marker frame downwards, until it is at the "Point" line:



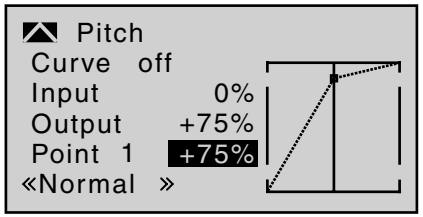
Move the joystick. If the display shows a framed question mark, then you can set the next reference point by tapping the center **SET** key on the right touch pad. Simultaneously, the "?" is replaced by its number and the value field to the right of the reference point number is highlighted:



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.

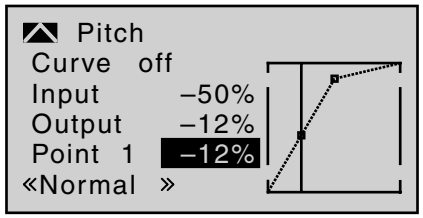
Configuring reference points

To configure a point, use the joystick 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 center **SET** key on the right touch pad. Use the arrow keys on the right touch pad 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.

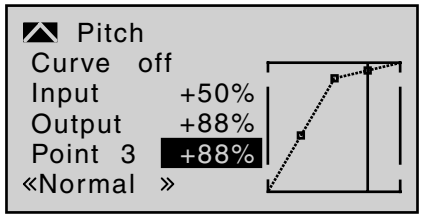


In this sample screen image, reference point "1" has been set to +75%.

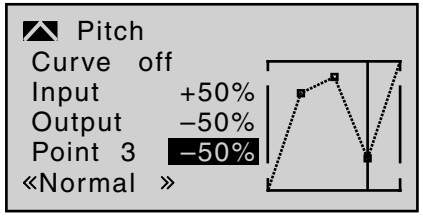
If you wish, however, other points can also be set. At -50%, for example …



… and/or a further point at +50%:



To do so, use the joystick to move to the corresponding area. As soon as a "?" appears in the frame on the "Point" line, the respective point can be set by pressing the arrow keys on the right touch pad. Just as with other points, this can be configured …

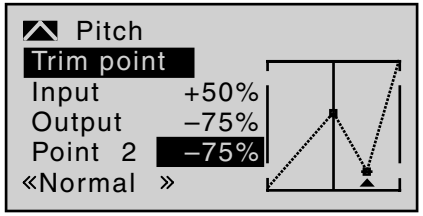


… or, by tapping the arrow keys ▲▼ or ◄► on the right touch pad at the same time (**CLEAR**), can be deleted once again.

The "L" and "H" points, on the other hand, CANNOT be deleted.

Trim point function

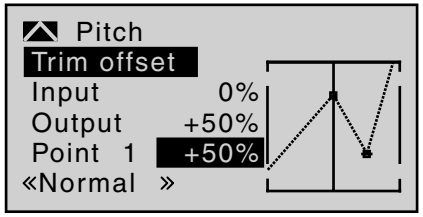
Alternatively, assuming the value field is active, i.e. highlighted, you can use the up or down arrow keys ◄► on the left touch pad to jump to reference points already set. In this case, a triangle is shown on the graph to indicate each point jumped to. The arrow keys on the right touch pad can then be used to change the reference point jumped to as described above, entirely independently of the control position:

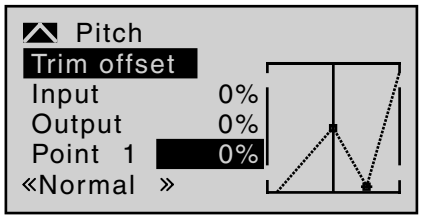


Exit from trim point function setting by tapping the center **ESC** key on the left touch pad.

Trim offset function

Assuming the value field is active, i.e. highlighted, you can not only use the up or down arrow keys ◄► on the left touch pad to jump to reference points already set and change their values, but you can also use the ▲▼ keys on the left touch pad to vertically reposition an existing curve within the range ±25%:

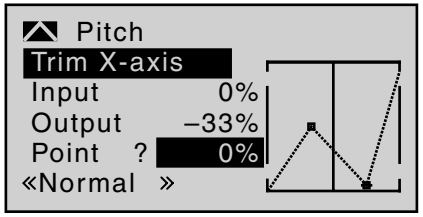




You can also exit from this function by tapping the center **ESC** key on the left touch pad.

Trim x-axis function

This function is activated by tapping the left (◄) or right (►) arrow key on the right touch pad with an active (i.e. highlighted) value field. You can then use the arrow keys on the right touch pad to reposition the active point horizontally or vertically as you wish.



Notes:

- *If you reposition the point horizontally further away from the current control position than approx. ±25%, a "?" sign re-appears in the line. 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 joystick position and not to the position of the point.*

Deleting reference points

To delete one of the reference points (1 to max. 4), use the joystick 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), you can activate the value field on the "Point" line to highlight it by simultaneously tapping the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) and then delete the value. Complete the operation by briefly tapping the center key **ESC** on the left touch pad.

Smoothing the collective pitch curve

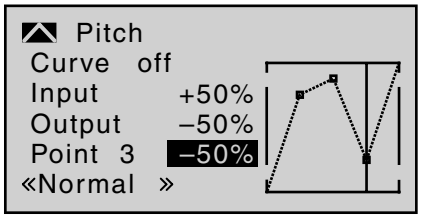
In the example below, sample reference points have been set …

Reference point 1 to +50%

Reference point 2 to +75%

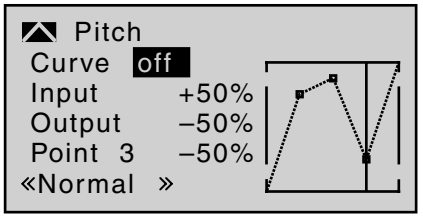
Reference point 3 to -50%

… as described in the last section.

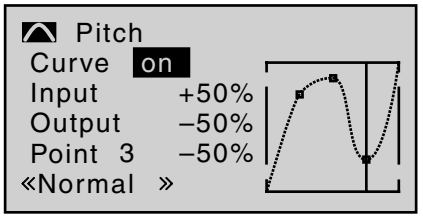


This "jagged" curve profile can be smoothed automatically simply by pressing a button.

First – assuming a situation is configured as presented above – tap the center **ESC** button on the left touch pad to deactivate the value field. Then use the arrow keys on the left or right touch pad to move the marker frame in an upwards direction to the "Curve" line. Now briefly tap the center **SET** key on the right touch pad to activate the value field on the "Curve" line:

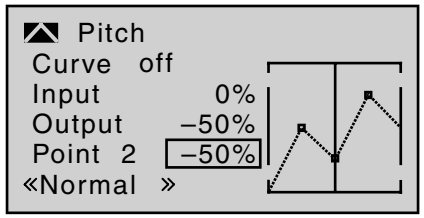


Use the arrow keys on the right touch pad to set the value field from "off" to "on" and complete this setup procedure by briefly tapping the center **SET** key on the right touch pad or the center **ESC** key on the left touch pad:

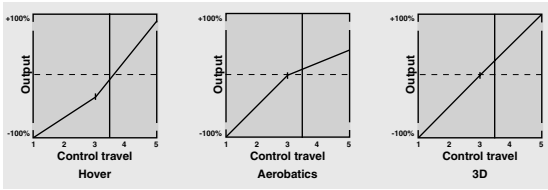


Notes:

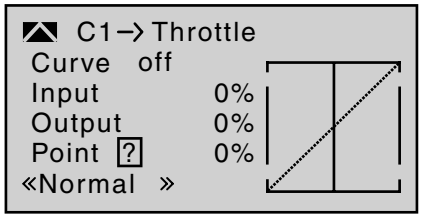
- *If the joystick does not coincide with the exact reference point, please note that the percentage value on the "Output" line always relates to the current joystick position.*
- *As with the other screen images on these pages, the following screen shot shows a control curve created purely for the purposes of illustration. Please note, therefore, that the curve characteristics displayed do not in any way represent real-life collective pitch curves.*



Sample collective pitch curves for various flight phases:



C1 → Throttle (Throttle curve)



Unlike the "**Channel 1 curve**" menu, however, this display relates only to the control curve of the throttle servo: the "Channel 1 curve", on the other hand, affects all servos controlled via the throttle/collective 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 joystick 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 center in order to match the motor power curve to the collective pitch curve.

Helicopter with carburetor 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.

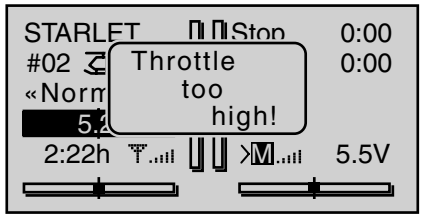
As with the configuration of the collective pitch curve (see previous page), the throttle curve can also be defined by up to 6 points.

- In each case, set the control curve so that when the throttle/collective pitch stick is in its end position, the carburetor is fully open or the controller of an electrically-powered helicopter is set to maximum (except for auto-rotation flight, see page 178).
- For the hover point, which is normally at the control center, the carburetor 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.

The starting and stopping of the motor – whether glow or electric – always takes place using the throttle limiter (see below) within the respective flight phase.

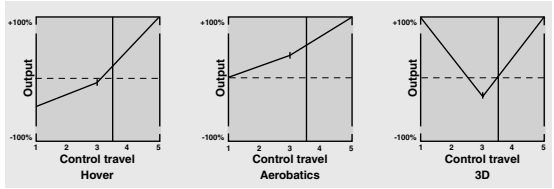
This makes it unnecessary to program the two flight phases that may be familiar to you from using other remote control systems – namely "with idle-up" and "without idle-up", and with the associated "waste" of a flight phase for this purpose – since the **mc-32** HoTT program offers a much more flexible approach to fine-tuning and optimizing increases to system rotational speed below the hover point than the "idle-up" approach taken by older **mc** radio control units.

Ensure that the throttle limiter is closed before you start the carburetor motor, i. e. so that the carburetor can be adjusted within the idle range only by using the idle trim. Ensure that you follow the safety instructions on page 177 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:

- *You should make use of the throttle limit function as a general rule (menu **"Control adjust"**, page 104). This will fully isolate the throttle servo from the throttle curve with the throttle limit proportional rotary*

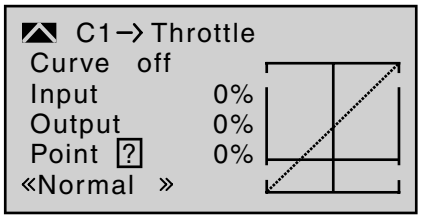
control turned fully to the left; the motor will be idling and respond only to C1 trim. This option permits you to start and also stop the motor from within any flight phase.

Once the motor has started, turn the throttle limiter slowly in the direction of the opposite end-point, so you can once again activate the throttle servo fully using the throttle/collective pitch stick. To stop the throttle limiter limiting the throttle servo at its top end-point, you should access the "Th.L.12" line on the ***"Control adjust"*** *menu and set the control travel to +125% on the plus side of the "travel" column. 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 107). This gives you the option of defining the idle setting at the throttle limit control's center position, as readily determined both visually and audibly.

Set the throttle limiter to its center position and adjust the "EXPO thro lim." value as far as is needed until the motor is idling smoothly with the proportional rotary control set at its center point. In this position, the motor will then start without any problems. To switch off, you will turn the throttle limit control – thus without also using C1 switch-off 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, it is thus max. ~50%.

- *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 "Th.L.12" 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 heli.
- *If you wish to record the flight time of a (glow-powered) heli, you can assign a control switch to the throttle limit slider, and then use this to switch a timer on and off; see page 123.*

For auto-rotation flight, an automatic switch-over is made from this mixer to a configurable default value; see page 178.

Helicopter with speedGOVERNOR

Unlike speed *controllers*, which merely adjust the output level – in a way similar to a carburetor – a speed *governor* keeps the speed of the system it is controlling constant by regulating the output provided autonomously. For glow-powered helis, the governor therefore controls the throttle servo itself as appropriate – or the speed controller of an electric heli in a comparable way. Accordingly, speed *governors do not therefore require a traditional throttle curve but 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.

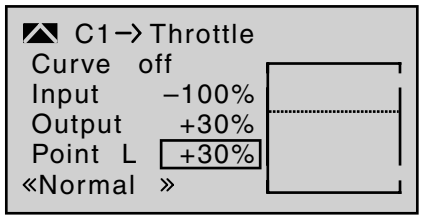
Usually, receiver output 8 is reserved for connecting a speed *governor*, see the receiver assignments on page 59. If this connection is in use, however, then the throttle limiter function is unavailable, since this exclusively affects the then unoccupied output 6, via the mixer "C1 ➔ Throttle".

To still make use of the comfort- and safety-related features of the throttle limiter, you should ignore the general connection advice and connect the speed governor to receiver output 6. You then need only adjust the throttle curve appropriately, so this can take over the role of the "usual" 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➔ Throttle" 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

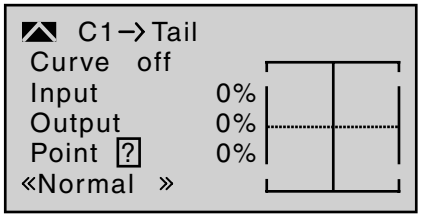
present and set – are erased. Following this, the reference points "L" (input = -100%) and "H" (input = +100%) are then each set to the *same* value, for example:



The value to be set depends both on the speed governor 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 178.

C1 → Tail (Static torque compensation)

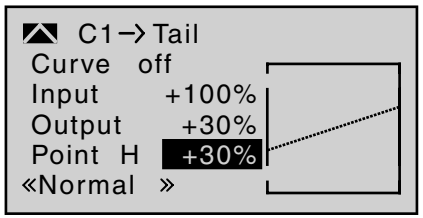


The default approach here is to preset a torque compensation curve with a linear mixer ratio of a uniform 0%, as is required for a gyro sensor working in "heading lock mode" – see the screen image above.

Important notice:
In this context, ensure that you comply with the instructions on adjusting your gyro: if not, you risk making adjustments that render your heli 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 165), 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.



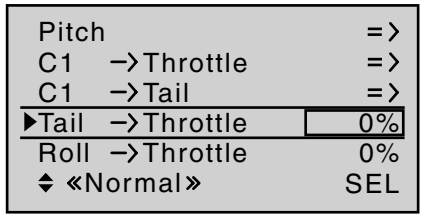
Starting with values of -30% for point "L" and +30% for point "H", the mixer is to be configured in such a way that the helicopter, even during prolonged vertically ascending or descending flights, does not deviate from the yaw axis as a result of the main rotor's altered torque while hovering. For hovering, trim should take place only via 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 119) 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.

Tail rotor → 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. Values in the range 0% to +100% are therefore possible. 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 joystick is moved to the left, and vice versa for right-hand rotation systems.

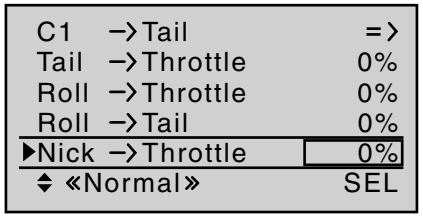
If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

In the auto-rotation flight phase this mixer is automatically switched off.

Set-up notes:

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



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 **mc-32** HoTT program lets you adjust the degree of throttle follow separately for roll and pitch-axis controls.

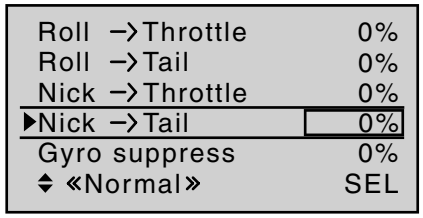
This offers particular advantages in aerobatic flying, e.g. when flying a roll: here, with moderate collective pitch values and the carburetor only about half-open, cyclic control travels are nonetheless executed that require much higher performance from the motor.

The mixer value can be varied within the range 0 to +100%. The correct mixer direction is automatically taken into account.

If you tap the ▲▼ or ◄► keys on the right touch pad (**CLEAR**) at the same time, this will reset values changed in the active (highlighted) field back to 0%.

In the auto-rotation flight phase this mixer is automatically switched off.

Roll → Tail and Nick → Tail



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 **mc-32** HoTT program 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 center 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 86.

In the auto-rotation flight phase this mixer is automatically switched off.

Gyro suppression

Nick –>Throttle	0%
Nick –>Tail	0%
▶Gyro suppress	0%
Swash rotation	0°
Swash limiter	OFF
◆ «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 heli 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 joystick 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 radio 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 joystick position.

With a transmitter control assigned on the "Gyro 7" line on the "**Control adjust**" menu (page 103), however, e.g. one of the CTRL 7 or 8 proportional rotary controls, the gyro gain can also be infinitely varied (optionally according to the flight phase) between minimum and maximum gain. 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 position, the gyro gain at full travel on the tail rotor joystick 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/JR* gyro NEJ-120 BB, order 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.

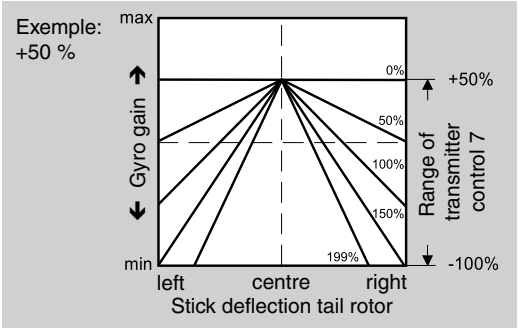
<u>Samples of various gyro settings and configuration notes</u>

- *Linear gyro suppression: 0% to 199%.*

  With the tail rotor joystick in the center position, the resulting gyro effect is set using the selected transmitter control. Using a proportional rotary control, 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".

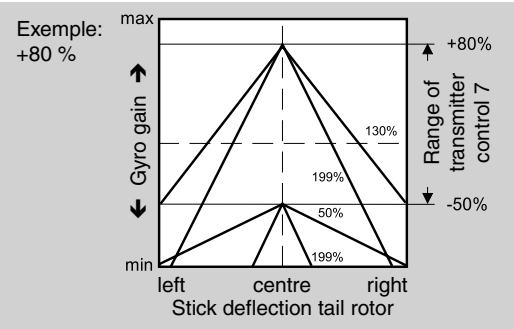
  Accordingly: at 0% gyro suppression, gyro gain is constant for tail rotor joystick movement; at 50% suppression, gyro gain is reduced to half if the assigned transmitter control is moved to the +50% position (as shown here); and only at >150% suppression is gain reduced to zero with the slider at this 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 – 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 adjustor 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.

<u>Further notes on gyros with configurable multilevel gyro gain (e.g. NEJ-120 BB)</u>

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 hovering). Even though a proportional rotary 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.

Swashplate rotation

Nick –> Throttle	0%
Nick –> Tail	0%
Gyro suppress	0%
▶Swash rotation	0°
Swash limiter	OFF
◆ «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 pushrods 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.

Swashplate limiting

Nick –> Throttle	0%
Nick –> Tail	0%
Gyro suppress	0%
Swash rotation	0°
▶Swash limiter	OFF
▲ «Normal»	SEL

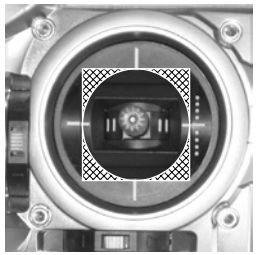
This function works like a circular mechanical surround acting upon the stick which controls the swashplate, restricting the normally square stick travel to a circular range. In fact, if the helicopter is set up in such a way

that the deflections for roll and/or pitch-axis exploit the maximum travel mechanically possible, e.g. for 3D helis, 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-32** 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 sketch shown alongside illustrates the effect when set to 100%: 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.

Adjustment range: 100 ... 149% and "Off".

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/collective pitch stick (except during auto-rotation flight). This coupling is performed by the helicopter program automatically.

In the **mc-32** HoTT program, the trim lever of control function 1 acts principally only on the throttle servo. However, in the "**Stick mode**" menu (see page 94) you can determine whether this should be used for idle trimming as part of the throttle limit function, or for idle trimming during the auto-rotation phase ("throttle 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 **mc-32** HoTT software 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 119).

While these curves can be modeled 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 center 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, however, you should accurately calibrate the mechanical linkages for all the servos, following the set-up instructions for the helicopter in question.

Note:

The hover point should normally be set to the center position of the throttle / collective pitch stick. For some special cases, however, e.g. for "3D" flight, you may wish to program hover points that deviate from this standard. For example: one point for normal flight attitude above the center and one point for inverted flight attitude below the center.

Idle setting and throttle curve

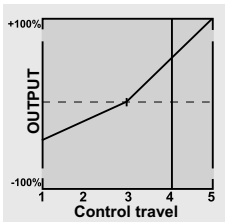
Note:

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 helis.

The idle setting described in detail on pages 105 to 107 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 CTRL 6 proportional rotary control).

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, you can use flight phase programming in order to configure a range of throttle curves. This increased system rotational speed below the hover point proves to be useful in certain circumstances, for example for fast, steep landing approaches with greatly reduced collective pitch, and for aerobatics.



The screen image depicts a curve with a slightly changeable throttle setting below the hover point at the control center.

Different throttle curves are programmed for each flight phase, so that you can use the optimum set-up for both hovering and 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

While the **mc-32** HoTT transmitter permits the electronic configuration of collective pitch curve and throttle curves to a large degree, first ensure that you have correctly set all of the model's mechanical linkages as specified by the helicopter manual. Experienced helicopter pilots will be glad to help you with this basic set-up.

The carburetor linkage must be set so that the throttle is just past the fully open setting with collective pitch set to maximum or, for electric helis, with the speed controller set to full. When the throttle limiter is closed, however, it must be possible to just close off the carburetor using the C1 trim lever (rapid throttle setting of the "digital trim", see page 54), without the servo mechanically striking its end-stop. For electric helis, 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 carburetor lever. Only then should you optimize throttle servo fine-tuning electronically.

Caution:

Inform yourself thoroughly about the dangers and

safety precautions applicable to handling motors and helicopters before starting the motor for the first time!

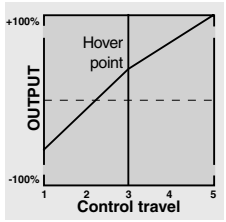
With this basic set-up complete, the motor should be started in accordance with the motor operating instructions: idling can then be configured using the trim lever of the throttle/collective pitch stick. The idle position that you set is displayed on the transmitter's basic display by a horizontal bar alongside the display of the C1 trim lever position. Refer to the description of digital trim on page 54 of this manual.

The model should lift off the ground with the collective pitch stick roughly at its center 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 center point.

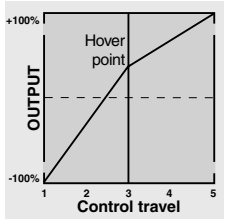
a) Rotational speed is too low

Remedy: On the graph page of the *"C1 → throttle"*, increase the value for point "1".



b) Rotational speed istoo high

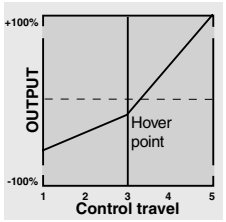
Remedy: Increase the blade angle of attack pitch by increasing the value of point "1" on the "*Pitch*" graph page.



2. The model lifts off before the center point is reached.

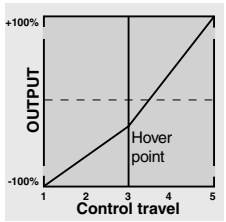
a) Rotational speed is too high

Remedy: Decrease the carburetor opening by reducing the value of point "1" on the graph page of the *"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 "*Pitch*" graph page.



Important:

These settings must be reconfigured until the model hovers at the correct rotational speed with the throttle/ collective pitch stick at its center 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 center point: This means a set-up with which your model is capable of hovering and flying circuits in all phases while maintaining a *constant rotational speed*.

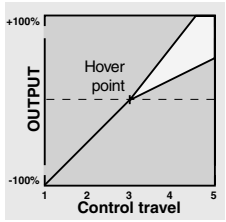
Climb settings

The combination of throttle hover setting, collective pitch setting for the hover and the maximum collective pitch setting (point "H") now provides you with a simple method of achieving constant system 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, you should increase the angle of attack if the motor speed increases during the climb. On the "Pitch" graph page, you should therefore use the collective pitch stick to move the vertical line to point "H" and change its value accordingly, using the arrow keys ▲▼ on the right touch pad.

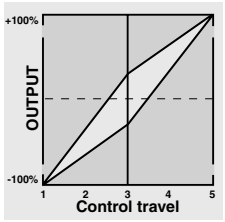
This diagram shows only the changes when setting the maximum collective pitch value.



Then bring the model back to hover, which should, in turn, be achieved with the C1 stick at its center point. If the hover point is now achieved only by moving the collective pitch stick from the center point towards "higher" values, then you should compensate for this hover deviation by slightly increasing collective pitch for hover – i.e. for point "1" – until the model once again hovers with stick at its center. Conversely, if the model

hovers below the mid-point, correct this by reducing the angle of attack appropriately.

You may also find that it is necessary to correct the carburetor opening for the hover point (point "1") at "C1 ➔ throttle".

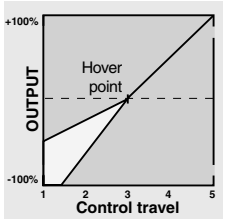


This diagram shows only the change to the hover point, i.e. collective pitch minimum and maximum are both left at -100% or +100%.

Continue adjusting these settings until you really do achieve a constant rotational speed over the full control range between hover and climb.

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°. On the "Pitch" graph page, you should therefore use the collective pitch stick to move the vertical line to point "L" and change its value accordingly, using the arrow keys on the right touch pad.



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 carburetor now responds only to the C1 trim lever. If the carburetor is open too far when you switch on the transmitter, you will receive a visual and audible warning. Otherwise, if the carburetor 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, you should

always hold the rotor head firmly when starting.

However, if you should accidentally start the motor with the carburetor too far open, the golden rule is this:

Don't panic!
Keep hold of the rotor head!
Don't let go!

Instead, close the throttle limiter immediately, even if this risks damaging the drive system (in the worst case scenario).

YOU are responsible for ensuring that the helicopter never flies off in an uncontrolled manner.

The costs of repairing a clutch, a gearbox or even the motor itself are negligible, if you compare these to the injuries and damage that an uncontrolled model helicopter can cause if it is allowed to fly around with its blades spinning wildly.

Always make sure that nobody else is standing near the helicopter where they could be injured.

In addition, you must never switch abruptly from idle to the flight setting by suddenly increasing system rotational speed. 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.

After starting the motor, you should therefore use the throttle limiter to increase the system rotational speed **slowly**. If you have assigned a switch to the throttle limiter, always ensure that you use the "**Control adjust**" menu (page 100) to program a time constant of about 5 seconds for running up the 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 phase

Helicopter mixers

Auto-rotation settings

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. Accordingly, switchover TO the auto-rotation phase takes place immediately.

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%
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 the airflow through the rotor disc caused by the rapid 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.

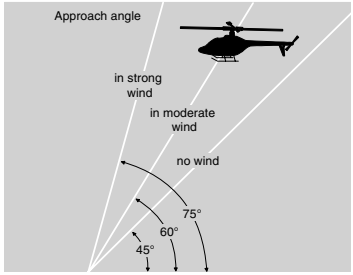
The advanced pilot should therefore practice auto-rotation landings at regular intervals. Not only to be able to demonstrate mastery of the maneuver at competitions, but also to ensure the pilot can can land the helicopter undamaged from a great height if the motor should fail. For this purpose, the 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:

Collective 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 center **SET** key on the right touch pad to switch to the "Pitch" graph page and then use the joystick to move the vertical line to point "H". Start by setting a value that is about 10% to 20% *larger* 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 you do so, 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. You can always re-adjust the value 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, you must always set a sufficiently generous minimum value for collective pitch at point "L" to ensure your model can be brought out of forward flight at moderate speed into a descent at an angle of around 60–70° when collective pitch is reduced to a minimum. If, like most heli pilots, you have configured this kind of setting for normal flight anyway, then you can simply copy this value across.

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, offering the pilot the option of further adjusting pitch inclination using the pitch-axis controls.

You can shorten the approach by pulling back on the pitch-axis stick and gently reducing collective pitch, or extend the approach by pushing forward on the pitch-axis stick and gently increasing collective pitch.

Throttle setting AR

Although pilots will be expected to cut the glow motor completely during competitions, this is rather less advisable during training sessions, since you would then need to restart the motor following each practice auto-rotation landing.

During the training phase, you should therefore set the

value on this line so that a glow motor is held at a safe idle during the auto-rotation phase without the clutch engaging; electric drive systems should be set safely to "Off".

Note:
*You may wish to make use of the "Motor Stop" option on the "**Base setup model**" menu as 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 145. The following section presents you with information relating to "free mixers".

In addition to the pre-programmed mixers previously mentioned, the **mc-32** HoTT offers a number of freely programmable mixers in every model memory, whose inputs, outputs and mixer ratios can be configured to suit your exact requirements:

- 8 linear mixers, numbered M1 to M8
- 4 curve mixers, numbered K9 to K12

These 12 mixers are certainly adequate for most applications and are invariably sufficient when you incorporate the pre-programmed coupling functions offered. On the "**Mix active/phase**" menu (see page 192), you are also free to specify which of these 12 mixers is activated or deactivated separately for each flight phase.

For the "free mixers", the signal present at any control function (1 to 12) can be assigned as the *input signal*. For the "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 12, depending on receiver type) that can also be *assigned freely*. Before this channel routes the signal to the servo, it can be influenced only by the "Servo adjustments" menu, i.e. by the the servo reverse, neutral point offset, servo travel and servo travel limit functions, and also possibly by "Tx. output swap".

One *control function* can be used for any number of mix inputs simultaneously: if, for example, several mixers should 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 to an excessive extent. For safety's sake it may be worth setting an appropriate travel limit on the "**Servo adjustments**" menu in such cases.

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, one "free mixer" is always initially activated. If you wish, however, the mixer can also be assigned an ON/OFF switch. Since there are so many functions to which switches can be assigned, you must be careful to avoid undesirable multiple assignments.

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.

  If you are using linear mixers, the mixer ratio can be set as symmetrical or asymmetric. Curve mixers can also be configured with up to 6 points to suit your application, enabling the implementation of highly non-linear curves.
- … **the neutral point** of a mixer, which is also referred to as the "offset".

  The offset is the specific point along the travel of a transmitter control (joystick, CTRL 6 … 8 proportional controls or switches 1 … 9) at which the mixer no longer influences the control channel connected to its output. Normally, the neutral point is the center 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

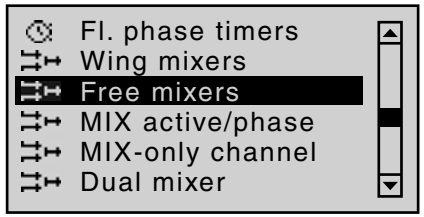
Occasionally, however, only a constant control signal is required at the mixer input. A typical application would be a slightly increased "up-elevator" trim when the aero-tow release is closed – fully independently of its normal trim setting.

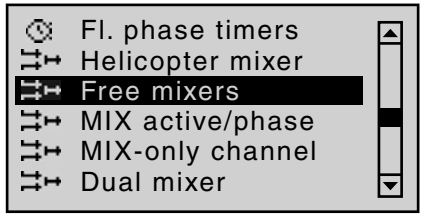
In this case a switch is assigned both to the aero-tow release and the mixer; it is then used not only to open and close the release, but also to pass the desired trim signal to the elevator via the mixer ratio. To identify this special arrangement, this mixer input control function in the program is designated "S" for "Switch channel".

In addition, if the corresponding "target channel" should now no longer be influenced by its "normal" transmitter control, then you should isolate the latter from the function input of the affected control channel on the **"MIX-only channel"** menu (page 193). In the menu description that follows, an example is also given to illustrate this function.

Using the arrow keys on the left or right touch pad, page

to the menu option …



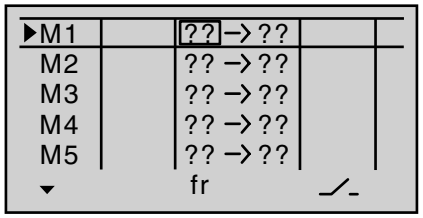


… on the multi-function list. Briefly tap the center **SET** key on the right touch pad to open this menu option.

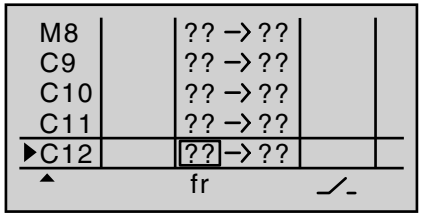
Free mixers

Freely-programmable linear and curve mixers

Regardless of the model type you have selected, each of the 24 model memory slots will offer you eight linear mixers (M1 … M8) …



… and 4 curve mixers (K9 … K12), which also offer you the option of setting non-linear control characteristics:



In addition, the "**MIX active/phase**" menu (page 192) enables you to enable and disable particular mixers separately for specific flight phases. **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 arrow keys ▲ ▼ on the left or right touch pad.
2. Tap the center **SET** key on the right touch pad. The input field on the line marked "fr" at the lower edge of the screen is now shown highlighted.
3. Use the arrow keys on the right touch pad to select the "fr" mixer input.
4. Tap the center **SET** key on the right touch pad; using the arrow key ► on the left or right touch pad, switch to the column marked "to" on the lower edge of the screen and then tap the center **SET** key on the right touch pad once again.

   The input field "to" is shown highlighted.
5. Use the arrow keys on the right touch pad to select the "to" mixer output.
6. Tap the center **SET** key on the right touch pad. Optionally, use the arrow key ◄ on the left or right touch pad to switch to the column marked "ty" on the lower edge of the screen, in order to include the trim of the respective joystick in the mixer input signal ("Tr" for trim) and/or to add series switching for mixers …

   … and/or use the arrow key ► on the left or right touch pad to switch to the column marked with the switch icon ⎍ on the lower edge of the screen. Here, tap the center **SET** key on the right touch pad once again and assign a switch, following the description given in the section "Assigning transmitter controls, switches and control switches" (page 52).
7. Using the arrow key ► on the left or right touch pad, switch to the » column and then tap the center **SET** key on the right touch pad.

8. Define the mixer ratios on the second screen page.
9. Return to the first page by using the center **ESC** key on the left touch pad.

"fr"

After selecting a mixer line and then tapping the center **SET** key on the right touch pad to highlight the value field, use the arrow keys on the right touch pad to select one of the *control functions*: 1 … 12 or S.

For the sake of legibility, 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 heli program:

1	Throttle/collective pitch stick
2	Roll stick
3	Pitch-axis stick
4	Tail rotor stick

Note:
If you select control functions 5 … 12 for fixed-wing models or 5, 7 … 12 for heli models, do not forget to assign a transmitter control in each case on the ***"Control adjust"*** *menu!*

"S" as switch channel

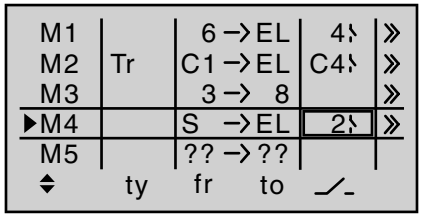
Selecting "S" (switch channel) in the "**fr**" column has the effect of passing a *constant* input signal to the mixer input, e.g. in order to add a little more "up-elevator" trim when the aero-tow release is closed, as mentioned on the previous page.

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.

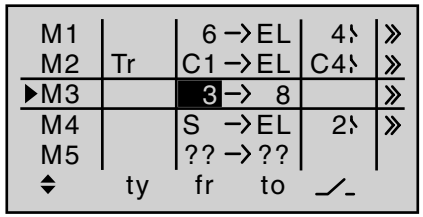
You use the input field in this column to route the destination of the mixer, i.e. the mixer output, to one of the *control channels*. At the same time, additional fields also appear on the bottom line of the screen:



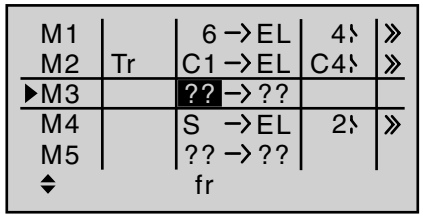
In this example, four mixers have already been defined. The second mixer is already familiar to us in principle as "Elevat curve" from the "Brake settings" sub-menu on the "**Wing mixers**" menu, and the third is familiar from the "Tail" line ("2ELSv3+8") on the "**Model type**" menu. As a general rule, however, you should first make use of the pre-programmed mixers. However, if you need asymmetric mixer ratios, want to go as far as programming 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 their use with free mixers.

Erasing mixers

If you need to erase a previously-defined mixer, select the appropriate line with the arrow keys ▲▼ on the left or right touch pad, switch to the "fr" column if you need to with the arrow keys ◄ ►and then briefly tap the center **SET** button on the right touch pad:



The field in the "fr" column for the mixer you want to delete will now be shown highlighted: tap both of the arrow keys ▲▼ or ◄ ► on the right touch pad 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 "G4".

The switch symbol to the right of the switch number shows the current switch state.

Any mixers that have not been assigned any switch, as shown in the line on the bottom of the screen marked with a switch icon ⎍, are on by default!

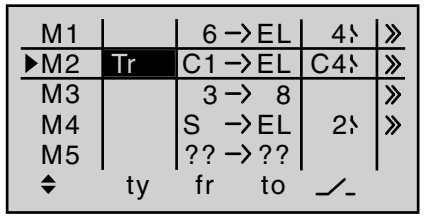
A switch *must* be assigned to the fourth mixer if you wish to switch between two fixed mixer values (still to be set) that correspond to the two end-points of a (proportional) transmitter control. Accordingly, the "switch channel" mixer cannot also be switched "on" or "off" as with the other mixers.

If you intend to assign a control switch (G1 … G4) as a switch, then please note that you must define this appropriately BEFOREHAND on the "**Control switch**" menu. If you do not, you will assign an undefined control switch and therefore one that functions as a fixed switch.

"Ty"

Including the trim

For control functions 1 … 4, you can also configure things so that the trim generated by the digital trim lever of the respective joystick affects the mixer input. In this case, briefly tap the center **SET** key on the right touch pad and then use the arrow keys to select "Tr" in the highlighted field:



The effect of the C1 trim lever on the mixer output will depend on the function assigned to it on the "**Model type**" menu (page 82), in the "Motor on C1" column for fixed-wing models …

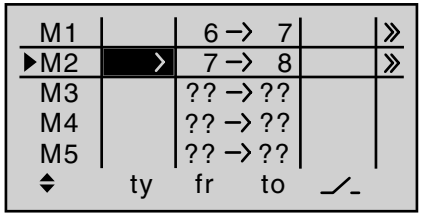
Trim	Effect on mixer output
None	Linear, over full trim lever travel
Forward	Only effective if C1 stick is forward
Back	Only effective if C1 stick is back

… or on the "Pitch" line of the "**Stick mode**" menu for helicopter models:

Trim	Effect on mixer output
AR (throttle limit)	Linear, over full trim lever travel
GA (throttle auto-rotation)	Only effective at minimum position of the assigned throttle limit control (CTRL 6 proportional rotary control as standard)

Switching mixers in series

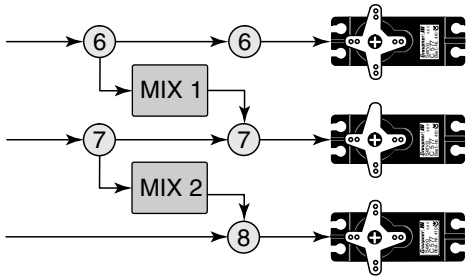
As already explained on page 180, you can also switch mixers in series: Where mixers are switched in "sequence", the "input signal" of a control channel already on its way to the servo "branches off" and is directed to a further channel. In the "ty" column, select the right angle bracket "›" – or "Tr ›", if the trim should also act simultaneously on the mixer input:



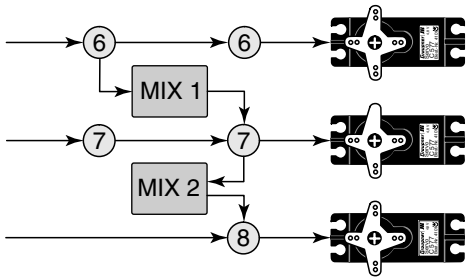
Example:

Two mixers (MIX 6 ➔ 7 and 7 ➔ 8):

a) WITHOUT series switching:



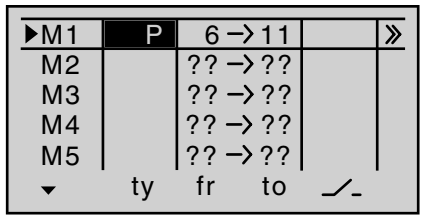
b) The same mixers WITH series switching:



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 trim values of the FLAP channel ("6") or the FLAP2 channel ("9") as stored on the "**Phase trim**" menu – and dependent on flight phase – then first tap the center **SET** key on the right touch pad and use its arrow 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 136) 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. Typical examples for this feature can be found at the end of this section as example 2 on page 190, plus others in the section "Controlling timed sequences" on page 266.

Tip:

*If you separate a control function, e.g. "9", from control channel 9" using the "**MIX-only channel**" menu (see page 193), then the servo response is defined only by the mixer ratio (yet to be specified) of the mixer programmed on the same channel. This enables you to set up linear curves using mixers M1 … 8 or 6-point control curves using curve mixers K9 … 12 for any transmitter control, as described in the "**Channel 1 curve**" menu, and also include them in flight phase switching if required. This method of "linking" is then 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. For more information, see the programming example entitled "Controlling timed sequences" on page 266.*

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 set on the **"Aile/flaps"** line of the **"Model type"** menu, control channels are connected together via special mixers as follows: channels 2 and 5 for the "Aileron" function; channels 6 and 7 for the "Flap" function; and channels 9 and 10 for the FLAP2 servos (if present).

  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	The servo pair 2 + 5 responds with an aileron function
N.N.* → 5	The servo pair 2 + 5 responds with a flap function
N.N.* → 6	The servo pair 6 + 7 responds with a flap function
N.N.* → 7	The servo pair 6 + 7 responds with an aileron function
N.N.* → 9	The servo pair 9 + 10 responds with a flap function
N.N.* → 10	The servo pair 9 + 10 responds with an aileron function
N.N.* → 11	The servo pair 11 + 12 responds with a flap function
N.N.* → 12	The servo pair 11 + 12 responds with an aileron function

- **Model helicopters:**

  With heli 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.

  Elsewhere than the **"Helicopter mixers"** menu, it is **not** advisable to mix a free mixer into these channels, since some extremely complex interactions can result from such attempts. One of the few exceptions is "Collective pitch trim using a separate transmitter control" – see example 3 on page 190.

Important notices:

- ***With serial links in particular, remember that 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 travel" to avoid this; alternatively, set "Travel limit" on the "Servo adjustments" menu and/or reduce mixer values.***

* *N.N. = Nomen Nominandum (the name to be stated)*

- ***Use the option available to you at any time of switching to the "Servo display" ◄ ► menu (see page 230). This menu is reached from almost any menu option on the transmitter's basic display by briefly tapping the keys on the left touch pad at the same time. 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 arrow keys ▲▼ on the left or right touch pad to select the desired mixer line. If necessary, use the touch pad's arrow keys to move to the right column (»), and then briefly tap the center **SET** key on the right touch pad in order to access the graph page.

Mixers M1 … 8: Setting linear mixer values

As a practical example, we will now define a linear mixer curve to resolve the following problem:

For our 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 deployed to activate landing flaps. That is: when a transmitter control is moved, they must deflect downwards only. This requires a simultaneous elevator trim, however.

First, use the **"Control adjust"** menu to assign a control such as the CTRL 6 proportional rotary control to input 6. Comment: in this case, a transmitter control on input 6 will control the two servos connected to receiver outputs 6 and 7 as flaps, by default – as you can see by consulting the above table. 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*

Input 5	GL	---	0%
▶Input 6	GL	Ct6	0%
Input 7	GL	---	0%
Input 8	GL	---	0%
◆▶		typ ⌐	offset

Note:

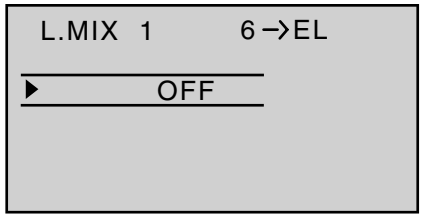
Note that if two flap servos have been selected, any transmitter control assigned to input 7 will be decoupled in the software in order to avoid errors in operating the flaps. However, in the interests of safety, you should make a habit of leaving all inputs not currently required to "free", or of resetting these back to "free"!

Start by moving this transmitter control to its left end-point and adjust the landing flaps so that they are retracted or closed in this position. If you now move the dial to the right, the flaps should move downwards; if not, you will need to adjust the direction of servo rotation.

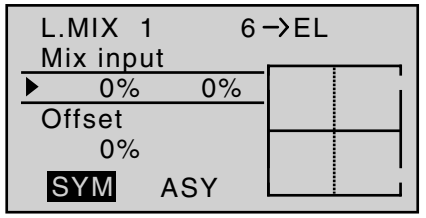
We now turn our attention to the first mixer shown in the screen image on page 182 ("6 →EL"), to which switch 4 was assigned:

▶M1		6 →EL	4%	»
M2	Tr	C1 →EL	C4%	»
M3		?? →??		
M4		S →EL	2%	»
M5		?? →??		
▼	ty	fr	to	⌐

Briefly tap the center **SET** key on the right touch pad to open the second screen page:



If this screen appears, the mixer has not yet been activated using the assigned toggle switch – "4", in this example. If so, operate the switch:

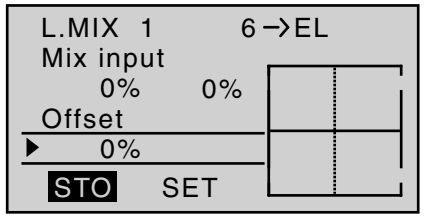


The solid vertical line represents the current position of the transmitter control on input 6. (In the above diagram, located at the left edge, since the CTRL 7 transmitter control assigned to input 6 in this example (see previous page) is turned fully to the left.) The dotted vertical line in the middle 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)

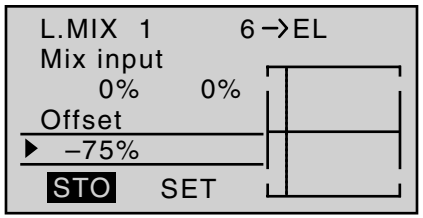
… should be defined. To do so, use the arrow key ▼ on the left or right touch pad to move to the line under "Offset":



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 center.

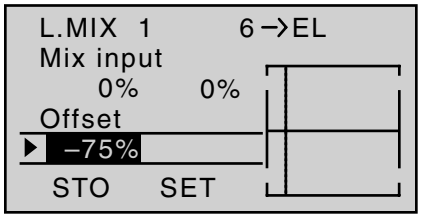
However, since in our example the flaps should be closed or retracted with the proportional rotary control turned fully to the left, and since the elevator should also not be further influenced in this position, we must relocate the mixer neutral point to precisely this point. To do so, turn the transmitter control used (in this example, CTRL 7) fully to the left if you have not already done so, and then briefly tap the center SET key on the right touch pad. 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 illustrate our example better we now wish to set this "Offset" value to only -75%.



Notes:

- *By selecting **SET** with the arrow key ► on the left or right touch pad and then tapping the center SET key on the right touch pad …*



… you can then use the arrow keys on the left or right touch pad to set or readjust the offset value manually in increments of 1%.

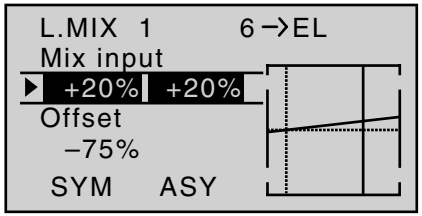
- *By selecting **SET** and then activating the value field by tapping the center SET key on the right touch pad – – see screen image shown above – – you can then reset the mixer neutral point back to the control center automatically by simultaneously tapping the two arrow keys ▲▼ or ◄► on the right touch pad (**CLEAR**).*

Symmetrical mixer ratios

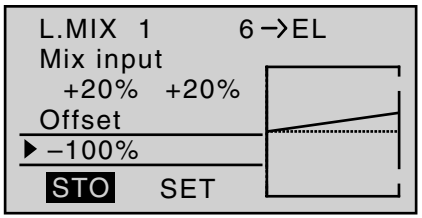
The next task is to define the mixer values above and below the mixer neutral point – – – starting from its current position. Move to the value field on the line beneath the "Mix input" line, using the arrow key ▲ on the left or right touch pad if necessary: If required, use the arrow keys ◄► on the left or right touch pad to select the **SYM** field, so as to configure the mixer value symmetrically with the offset point just set. After briefly tapping the center SET key on the right touch pad, you can then use the arrow keys on the right touch pad to set a value from -150% to +150% in the two highlighted fields. *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.

Simultaneously tapping the two arrow keys ▲▼ or ◄► on the right touch pad (**CLEAR**) will erase the mixer ratio in the highlighted field.

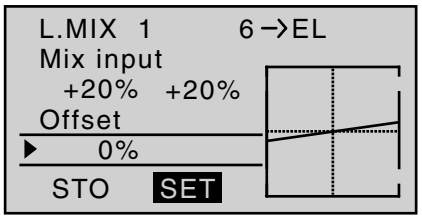
The "optimum" value in our example will certainly need flight-testing.



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.



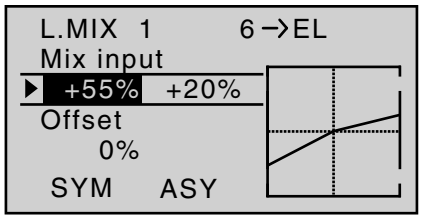
If you were now to reset the offset currently set at -100% back as far as 0% of control travel – by selecting the SET field with the arrow key ▶ on the left or right touch pad, activating the value field and then tapping the two arrow keys ▲▼ or ◀ ▶ on the right touch pad (**CLEAR**), then you will receive the following screen:



Asymmetric mixer ratios

In many cases, however, we require different mixer values on each side of the mixer neutral point.

First, reset the offset of the mixer used in the example "6 → EL" to 0%, if required (see screen image above). Using the arrow key ▶ on the left or right touch pad, select the **ASY** field and then tap the center **SET** key on the right touch pad. If you now move the proportional rotary control assigned to input 6 – in this example, CTRL 7 – in each of the corresponding directions, you can use the arrow keys on the right touch pad to configure the mixer ratios for each of the two control directions, i.e. left and right of the configured offset point:



Note:

If you are using a switch channel mixer of the "S → N.N." type, then you need to actuate the assigned switch. The vertical then jumps between the left and right side.*

Setting the curve mixers K9 … K12

These four curve mixers enable you to define extremely non-linear mixer curves by placing up to 4 freely positionable points between the two endpoints "L" (low = -100% control travel) and "H" (high = +100% control travel) along the control travel.

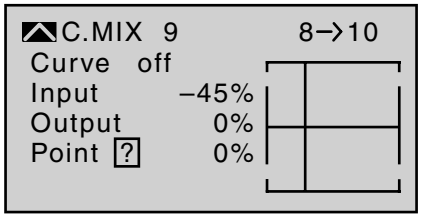
If you have already read the description of the "**Channel 1 curve**" menu, or the method of programming 6-point curves on the "**Helicopter mixers**" menu, you can safely skip the following description.

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.



Setting reference points

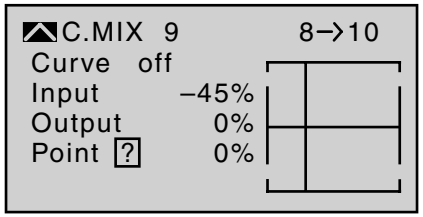
When you move the transmitter control assigned to the mixer input – here control function 8 – a vertical line in the graph follows the movement between the two end-points. The current control position is also shown numerically on the "Input" line. The point at which this line intersects with the curve in question is named the "Output" and can be varied between -125% and +125% by setting reference points; see further below. This control signal acts on the mixer output.

In the above example, the transmitter control is on input 8 at -45% of control travel. The output signal continue to show 0%, however, since no value has yet been entered.

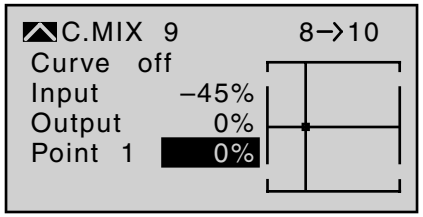
Up to 4 additional reference points can be set between the two end-points "L" and "H", although the distance between neighboring reference points must not be less than approx. 25%.

If necessary, use the left or right arrow keys on the left or right touch pad to drag the marker frame downwards, until it is on the "Point" line:

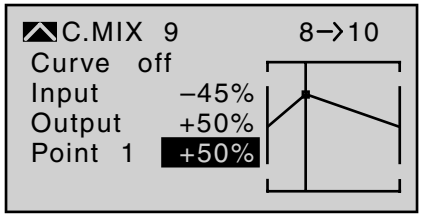
* *N.N. = Nomen Nominandum (the name to be stated)*



When you now briefly tap the center **SET** key on the right touch pad, the "?" is replaced by a point number and the value field to the right is activated:

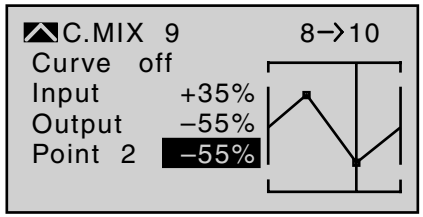


Using the arrow keys on the right touch pad you can now change the point value within the range of ±125%, e.g.:



Note:
If the joystick does not coincide with the exact reference point, please note that the percentage value on the "Output" line always relates to the current joystick position.

Continue in this way to set other reference points. Note that 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 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. The value field is highlighted, see screen image above.

If necessary, use the arrow keys on the left or right touch pad to move the marker frame onto the "Pitch" line. Now briefly tap the center **SET** key on the right touch pad. The value field is shown highlighted.

Now tap the two arrow keys ▲▼ or ◄► on the right touch pad at the same time (**CLEAR**).

The selected reference point is erased, and the numbering of the remaining reference points is updated as required. Briefly tap the center **ESC** key on the left touch pad to complete the procedure.

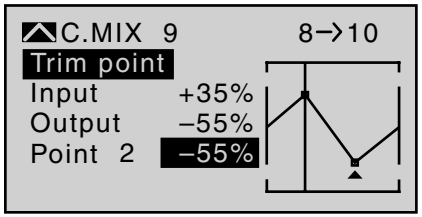
Note that the reference points "L" and "H" cannot be erased.

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 center **SET** key, use the arrow keys on the right touch pad 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 center **ESC** key on the left touch pad to complete the procedure.

Trim point function

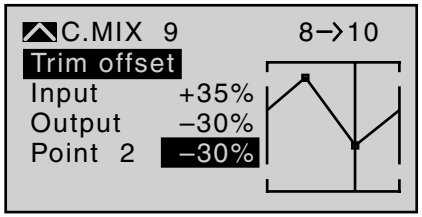
Alternatively, assuming the value field is active, i.e. highlighted, you can use the up or down arrow keys ◄► on the left touch pad to jump to reference points already set. In this case, a triangle is shown on the graph to indicate each point jumped to. The arrow keys on the right touch pad can then be used to change the reference point jumped to as described above, entirely independently of the control position:

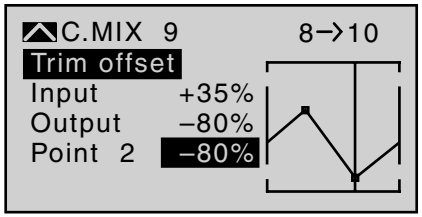


Exit from trim point function setting by tapping the center **ESC** key on the left touch pad.

Trim offset function

Assuming the value field is active, i.e. highlighted, you can not only use the up or down arrow keys ◄► on the left touch pad to jump to reference points already set and change their values, but you can also use the ▲▼ keys on the left touch pad to vertically reposition an existing curve within the range ±25%:

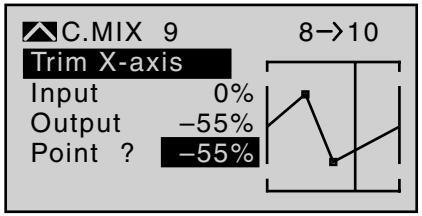




You can also exit from this function by tapping the center **ESC** key on the left touch pad.

Trim x-axis function

This function is activated by tapping the left (◄) or right (►) arrow key on the right touch pad with an active (i.e. highlighted) value field. You can then use the arrow keys on the right touch pad to reposition the active point horizontally or vertically as you wish.



Notes:

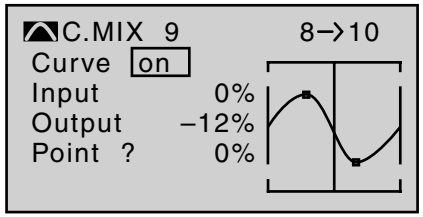
- *If you reposition the point horizontally further away from the current control position than approx. ±25%, a "?" sign re-appears in the line. This question mark does not refer to the repositioned point, however: instead, it signifies that a further point can be set at the current control position.*
- *Please note that the percentage value on the "Output" line always relates to the current joystick position and not to the position of the point.*

Smoothing the curve

This "jagged" curve profile can be smoothed automatically simply by pressing a button.

Then use the arrow keys on the left or right touch pad to move the marker frame in an upwards direction to the "Curve" line, as required. Now briefly tap the center **SET** key on the right touch pad to activate the value field on the "Curve" line:

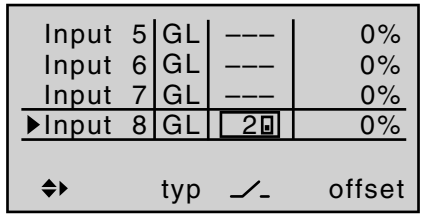
Use the arrow keys on the right touch pad to set the curve value from "off" to "on" and complete this setup procedure by briefly tapping the center **SET** key on the right touch pad or the center **ESC** key on the left touch pad:



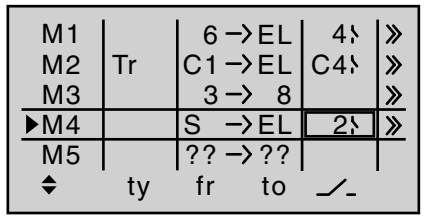
Note:
The curves shown here are for demonstration purposes only and are not at all representative of real mixer curves. For real-world application examples, see the programming examples on pages 242 and 285.

Examples:

1. To open and close an aero-tow, the switch SW 2 has already been assigned to control channel 8 on the **"Control adjust"** menu:

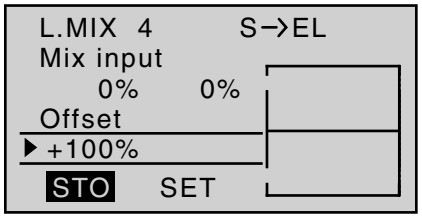


Subsequent aero-tow flying has proven that you always have to fly with the up-elevator held slightly in during the tow. The solution will be to set up a mixer that applies slight up-elevator trim to the elevator servo connected to receiver output 3 when the aero-tow release is closed. The screen-shot will be familiar from page 182: 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 …

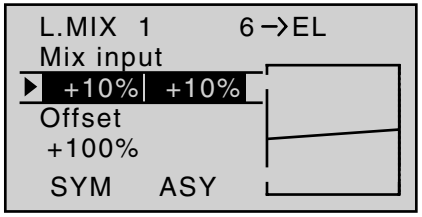


… to the mixer configuration page.

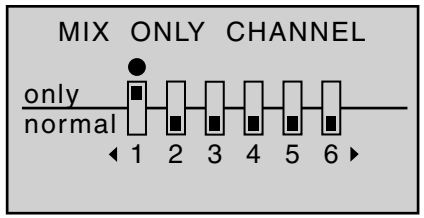
On this page, use the arrow key ▼ on the left or right touch pad to select the line under "Offset" and then tap the center **SET** key on the right touch pad. Depending on the travel adjustment selected on the **"Control adjust"** menu and the switch position, the offset value jumps to +X% or -X%, e.g.:



Now use the arrow ▲ key on the left or right touch pad to move to the line under "Mix input" and then tap the center **SET** key on the right touch pad. The value fields are now highlighted. After you have moved the selected switch to the mixer ON position, use the arrow keys on the right touch pad to set the required symmetrical mixer ratio.



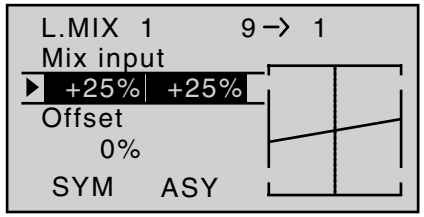
2. If you have a multi-flap wing featuring a "crow or butterfly system" with (additional) airbrakes, and you wish to test the effect of this braking system with and without airbrakes, then you should simply set channel 1 to "MIX-only" …



… and follow this by programming 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.

3. The final example applies to model helicopters:

   In the helicopter program, if you wish to assign collective pitch trim via one of the CTRL 6 … 8 proportional rotary controls, use the **"Control adjust"** menu to assign one of these transmitter controls to (e.g.) "Input 9". (Leave the default value of "GL" in the "Type" column alone, however, to configure this setting globally for all flight phases – as will be the case for the free mixer yet to be programmed. Finally, you then simply define a free mixer "9 → 11" with a symmetrical mixer ratio of e.g. 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.

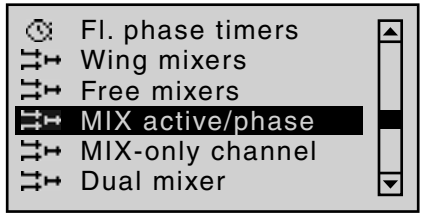


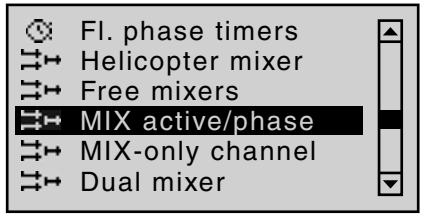
Decouple the assigned transmitter control from control channel 9 on the "**MIX-only channel**" menu, however, to ensure that any servo connected to receiver output 9 can no longer be operated by this transmitter control; see also page 193.

MIX active/phase

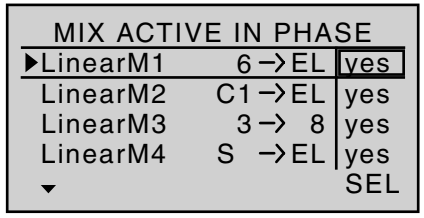
Selecting mixers for flight phases

Using the arrow keys on the left or right touch pad, page to the menu option …





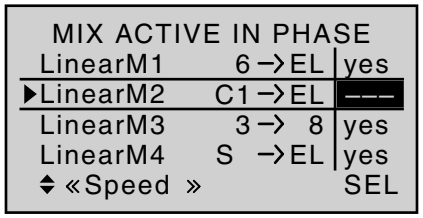
… on the multi-function list. Briefly tap the center **SET** key on the right touch pad to open this menu option.



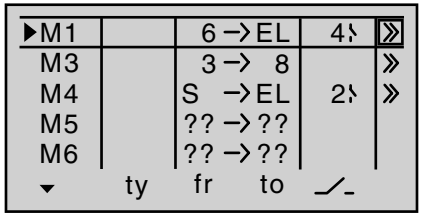
The "free mixers" on the previous menu can be enabled and disabled for specific flight phases. You therefore have complete freedom in assigning specific mixers only to specific flight phases.

Switch to your chosen flight phase and use the arrow keys to page through this menu. The mixers on the "**Free mixers**" menu are displayed in the center column.

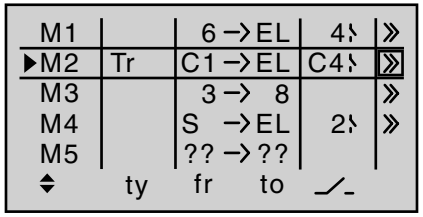
Following the activation of the value field by briefly tapping the center **SET** key on the right touch pad, if the respective mixer is set to "--" by using the arrow keys on the left or right touch pad, then this mixer is deactivated in the flight phase shown at the bottom of the display and, simultaneously, removed from the list on the "**Free mixers**" menu:



If you "lose" a mixer in this way from the "**Free mixers**" menu …



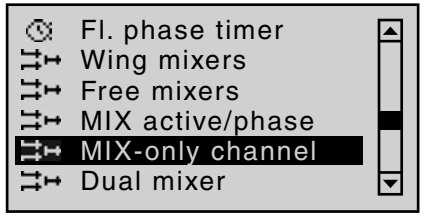
… then you should either switch through the flight phases until it appears again … or, alternatively, switch to this menu and temporarily reactivate the mixer you are looking for:

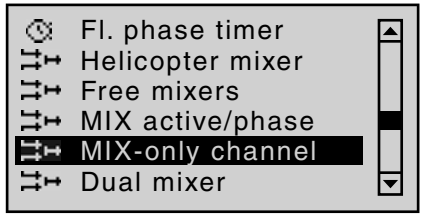


MIX-only channel

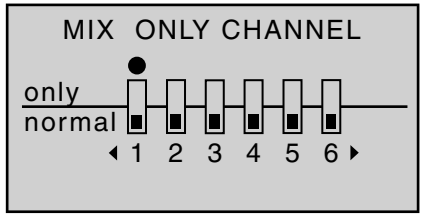
Separating control functions from control channels for all flight phases

Using the arrow keys on the left or right touch pad, page to the menu option …





… on the multi-function list. Briefly tap the center **SET** key on the right touch pad to open this menu option.



On this menu, you can interrupt the normal signal flow between the *control function* on the input side and the *control channel* on the output side: the "traditional" transmitter control/servo connection no longer applies.

One particular use of the options offered by this *flight phase-independent* menu might to reliably keep one of the control channels "free" in all flight phases, as these control channels can be assigned a transmitter control or switch for specific flight phases on the " Control adjust " menu.

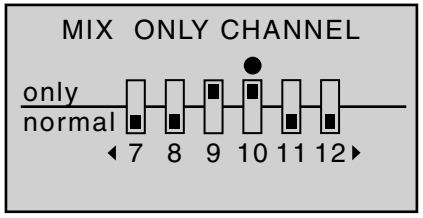
Conversely, a joystick, transmitter control (CTRL 6 … 10) or switch (SW 1 … 3, 8 and 9) "robbed" of its servo in this way can of course be used anywhere else as a transmitter control – even in a flight phase-specific way. See the programming examples to the right and on pages 255 and 266.

A joystick, transmitter control (CTRL 6 … 10) or switch (SW 1 … 3, 8 and 9) 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.

Use the arrow keys on the left or right touch pad to select the desired channel from 1 to 12 (●) and then briefly tap the center **SET** key on the right touch pad, so as to switch as you please between "normal" (▣) and "only" mode (▣):



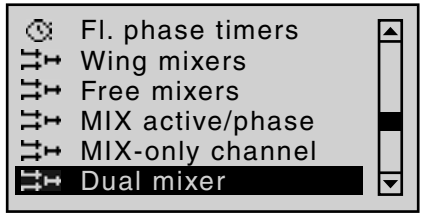
Examples:

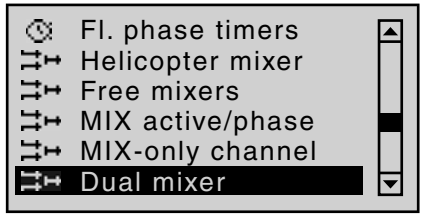
- *For model glider aircraft without airbrakes, the butterfly function (page 160) is generally used as a landing aid. Just as with "normal" airbrakes, this is generally controlled using the C1 stick. While the (airbrakes) servo typically connected to channel 1 is then generally absent as a rule, receiver 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 example is not required – can be decoupled from control channel "1", and thus "free up" this channel from the C1 stick signal, by setting channel 1 to "MIX only" on 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

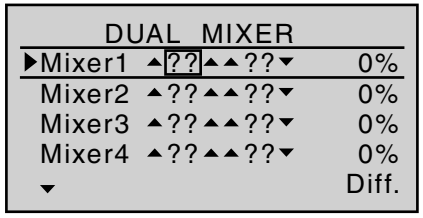
Same-sense/opposite-sense mixing of two control channels

Using the arrow keys on the left or right touch pad, page to the menu option …

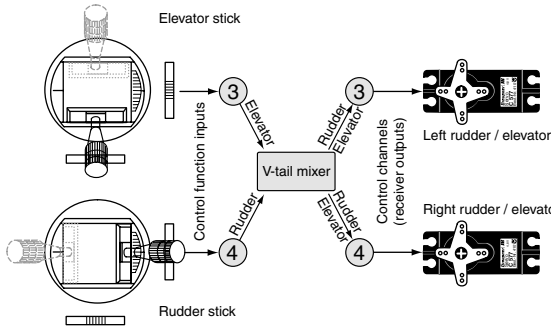




… on the multi-function list. Briefly tap the center **SET** key on the right touch pad to open this menu option.



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.

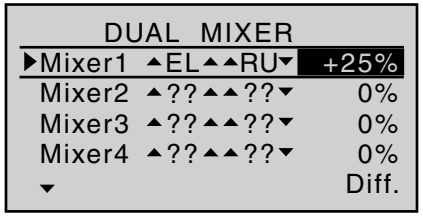
Note:

*The symbols "▲ ▲ " and " ▲ ▼" indicate that the corresponding inputs act upon the two servos coupled by the mixer in the same and opposed directions respectively – they do not indicate the servos' direction of rotation! Accordingly, if wing flaps are deflected in the wrong direction, simply swap the two inputs around or use the servo reverse function from the "**Servo adjustments**" menu; see page 90.*

In the software, the V-tail mixer already mentioned is supplemented by other "dual mixers" for the two aileron servos at receiver outputs 2 and 5 and for the flap pairs at outputs 6 and 7 (and 9 and 10 plus 11 and 12, if present). 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.

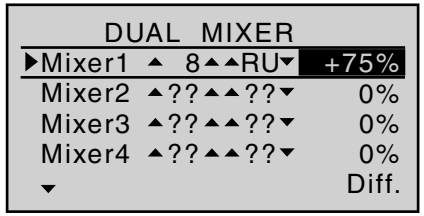
Here, we will use a "V-tail with rudder differential" as our example to explain the programming of a dual mixer (see also the example on page 255):



Depending on activation, both servos operate either as elevators or rudders. Differential travel is effective only when a rudder command is given, in accordance with dual mixer assignment. In this case, both associated trim levers 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.**

Example:

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

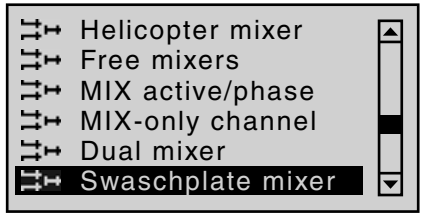
*affects both servos. If the rudders are also required to deflect outwards when the airbrakes are activated, then you should assign the C1 stick (transmitter control 1) to input 8 on the "**Control adjust**" menu. Finally, move to the "Offset" column and adjust the offset value until both rudders return to the neutral position. You may also need to "play" a little with the offset and travel adjustment settings.*

Tip:
*You can use the "**Servoanzeige**" menu to check all of the settings made in this way. This menu can be accessed from almost any other menu by simultaneously pressing the ◄ ► keys on the left touch pad.*

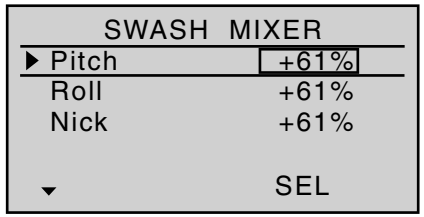
Swashplate mixer

Collective pitch, roll, pitch-axis mixer

Using the arrow keys on the left or right touch pad, page to the menu option …



… on the multi-function list. Briefly tap the center **SET** key on the right touch pad to open this menu option:



Note:
*If "1 servo" is selected on the "Swashplate" line on the "**Helicopter type**" menu, this option is not shown on the multi-function list.*

On the "Swashplate" line on the **"Helicopter type"** menu, you have already defined the number of servos that are installed in your helicopter for collective pitch control; see page 86. 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.

If you have a model helicopter which only has a *single collective pitch servo*, this "Swashplate mixer" menu option is of course superfluous, since the software will control the three swashplate servos for collective pitch, pitch-axis and roll independently of one other, i.e. without a mixer. In this scenario, this menu option is therefore *no longer* available to you from the multi-function list. With all other swashplate linkages employing 2 … 4 collective pitch servos, the mixer ratios and directions are set up by default, as can be seen above. The preset is +61% in each case, but the value can be varied from -100% to +100% if required, by briefly tapping the center **SET** key on the right touch pad and using the arrow keys.

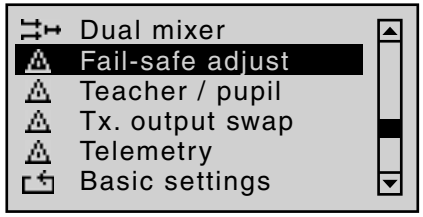
Simultaneously tapping the two arrow keys ▲▼ or ◄► on the right touch pad (**CLEAR**) will reset the mixer ratio in the highlighted field back to its default value of +61%.

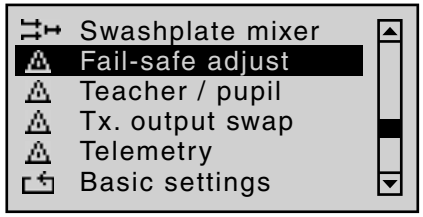
If the swashplate control system (collective pitch, roll and pitch-axis) does not respond to the joysticks properly, you should alter the mixer directions ("+" or "-") before trying to correct the directions of servo rotation.

Note:
Ensure that changed mixer values do not result in the servos mechanically striking their end-stops.

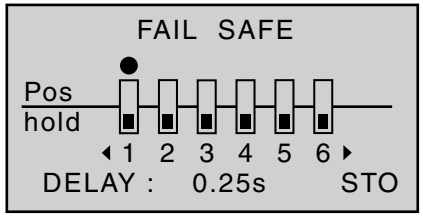
Fail-safe

Using the arrow keys on the left or right touch pad, page to the menu option …





… on the multi-function list. By briefly pressing the central **SET** key of the right touch pad, this menu item opens:



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.

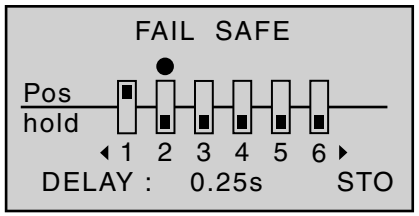
If you have selected a PCM transmission mode for the active model memory but have not yet carried out the fail-safe programming, you will see a warning message on the screen when you switch on the transmitter:

Programming procedure

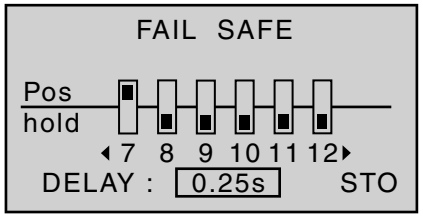
The "Fail Safe" function determines the behavior of the receiver if communication between the transmitter and the receiver is disrupted. Receiver outputs 1 … 12 can optionally …

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 the arrow keys ◄ ► on the left or right touch pad to select the desired servo connection from 1 to 12 (●) and then briefly tap the center **SET** key on the right touch pad, so as to switch as you please between the "hold" (▣) and "Pos" mode (▣):



Following this, use the arrow keys ◄ ► on the left or right touch pad to select the "DELAY" option shown at the bottom of the display …



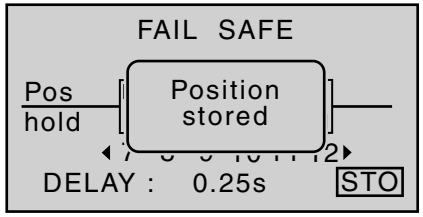
… and then briefly tap the center **SET** key on the right touch pad. Now use the touch pad's arrow keys to make your choice from the four possible time delays (0.25 s, 0.5 s, 0.75 s and 1 s) offered.

Simultaneously tapping the arrow keys ▲▼ or ◄ ► on the right touch pad (**CLEAR**)) will reset the highlighted field back to its default value of 0.25 s.

Following this, use the arrow keys ◄ ► on the left or right touch pad to select the **STO** field at the bottom right of the screen. Then, use the associated transmitter controls to move the servos, which you have switched to position mode, into the desired positions SIMULTANEOUSLY.

Briefly tap the center **SET** key on the right touch pad 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:



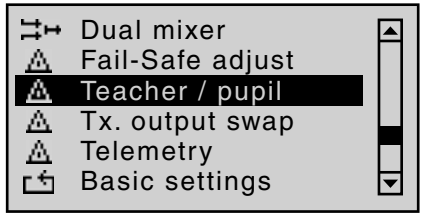
Caution:

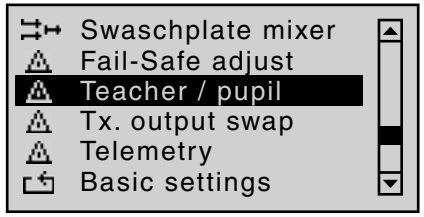
Ensure you make use of this safety net by at least programming the following for a fail-safe incident: for glow-powered models, set the motor throttle position to idle; for electric models, set the motor function to stop, or "Hold" for heli models. If interference should occur, the model is then less 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

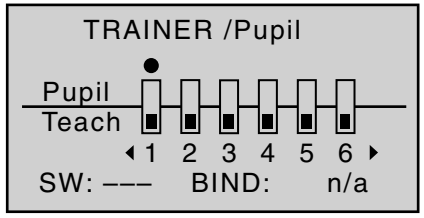
Connecting two transmitters for trainer mode with a trainer lead

Using the arrow keys on the left or right touch pad, page to the menu option "**Teacher/pupil**" on the multi-function list:





Briefly tap the center **SET** key on the right touch pad to open this menu option:



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

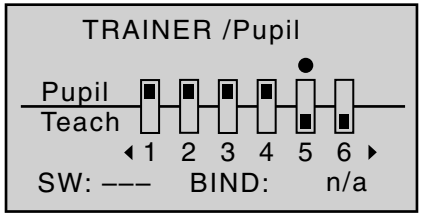
Up to twelve *control functions* of the teacher transmitter "Teach" can be transferred to the pupil transmitter "Pupil", either individually or in any combination.

The lower display line, named "Teach", therefore refers to the **transmitter controls** permanently connected to inputs 1 … 4 (dual axis stick functions for fixed-wing and heli model) and the CTRL 6 to 10 controls that are assigned or can be assigned to inputs 5 … 12 (optionally flight phase-specific) on the **"Control adjust"** menu.

Note:

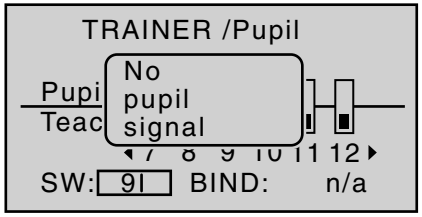
*The assignment of transmitter controls on the "**Control adjust**" menu is possible only when the trainer mode connection is inactive.*

Use the arrow keys ◄ ► on the left or right touch pad *to select the transmitter controls from 1 to 12* (●) to transfer to the pupil and then briefly tap the center **SET** key on the right touch pad in each case, so as to switch between "Teach" (Teacher)" (▮) and "Pupil" (▯):

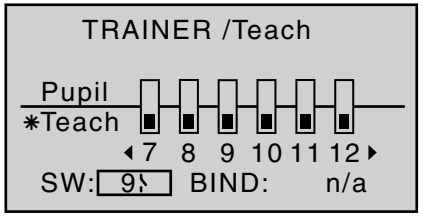


To be able to carry out the transfer, you must then assign a trainer mode switch on the left of the display. To do so, use the arrow keys on the left or right touch pad to move the marker to the bottom left, to the right of "SW:" Here, assign a switch as described on page 52.

Preferably, you should utilize one of the two momentary switches, SW 1 or SW 9, so as to be able to revert control back 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 "TRAINER /Pupil" to "TRAINER /Teach" 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-32** 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 mc-32 HoTT teacher transmitter FIRST BEFORE PLUGGING THE CONNECTION CABLE INTO THIS UNIT. If you do not, the RF module will not be enabled.

The **mc-32** HoTT teacher transmitter can be connected to any suitable pupil transmitter, even transmitters using the "traditional" 35/40 MHz range.

If the pupil-side connection does NOT utilize a two-pole DSC socket, however, but a three-pole trainer socket from the *Graupner* range (for example), then the **fundamental precondition for a correct connection to a pupil transmitter is that the modulation type PPM (18 or 24) must ALWAYS be configured in the pupil transmitter, regardless of the modulation type used in the teacher 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. If present, the HoTT receiver of the model in question must also be "bound" to the *teacher* transmitter. In principle, however, an **mc-32** HoTT pupil transmitter can also be connected to a teacher transmitter from the "traditional" 35/40 MHz range.

Almost any transmitter with at least 4 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 catalog and on the www.graupner.de 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 *Graupner's* 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.

With "**D**" and "**FM**" type transmitters, you must also check the direction of servo rotation and stick mode, and adjust as necessary by swapping the corresponding leads. All mixers must also be switched off or set to "zero".

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 you wish to transfer other control functions to the pupil transmitter in addition to the functions of the two dual axis sticks (1 … 4), access the **"Control adjust"** menu on the pupil transmitter and assign transmitter controls to the *inputs* that correspond to the control numbers **5 … 12** released on the teacher transmitter's "*Teacher/pupil"* menu.

Important:

- ***If you should forget to assign a transmitter control on the pupil side, then the affected servo or servos will remain in the center 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 a trainer lead 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 "∗Teach" to "∗Pupil".
- If the center LED rapidly flashes blue/red, however, and the unit beeps at the same time, then the pupil-teacher transmitter connection has been lost.

  The basic display also displays the following warning notice ...

  ... and the left side of the screen display on the "**Teacher/pupil**" menu changes 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, 18, 24) mode

Other possible faults:

- Teacher transmitter not properly "bound" to HoTT receiver in training model

Trainer leads

4179.1 For trainer mode operation between any two *Graupner* transmitters equipped with a DSC socket (identifiable by the two-pole TRS jacks at each end of the lead)

3290.7 Trainer lead for connecting a teacher transmitter with DSC socket (e.g. **mc-32** HoTT) or a transmitter retrofitted with the optional DSC module, order no. **3290.24**)) to a *Graupner* pupil transmitter with an optoelectronic pupil socket (identifiable by the label "**S**" on the end with the three-pole TRS jack).

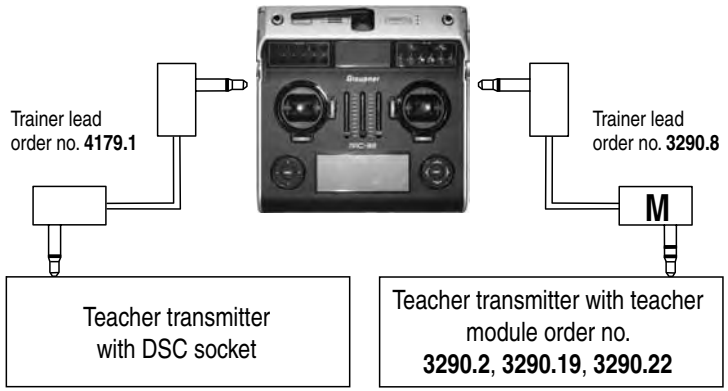
3290.8 Trainer lead for connecting a pupil transmitter with DSC socket (e.g. **mc-32** HoTT) or a transmitter retrofitted with the optional DSC module, order no. **3290.24**) to a *Graupner* teacher transmitter with an optoelectronic teacher socket (identifiable by the label "**M**" on the end with the three-pole TRS jack).

For further details about the cables and modules for teacher and pupil transmitters mentioned in this section, please consult the respective transmitter handbook, the *Graupner* RC main catalog or the www.graupner.de website.

Trainer mode with the **mc-32** transmitter

Due to the continuous improvements made to the product range, please consult our website at www.graupner.de for the latest information

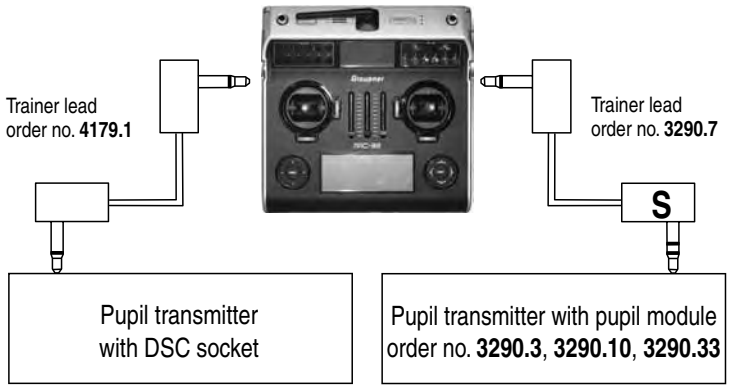
Pupil transmitter **mc-32** HoTT



mx-12 HoTT, **mx-16** HoTT, **mc-32** HoTT

mc-19(s, iFS + HoTT) up to **mc-24**, **mx-22**(iFS), **mx-24**s

Teacher transmitter **mc-32** HoTT



mx-12(s)HoTT, **mx-16s**/ iFS/HoTT, **mc-32** HoTT, **mx-22**(iFS), **mx-24s** and, if equipped with DSC socket order no. **3290.24**, **mc-19**(s + iFS), **mc-22**(s + iFS) and **mc-24**

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 to press.

The **mc-32** HoTT trainer mode system can also be operated wirelessly. 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 that have the "BIND:" option available on the "**Teacher/pupil**" menu.

Preparing for training mode

Teacher transmitter

The training model *must* be programmed completely – i.e. with all its functions including trims and any mixer functions – in one of the model memories of the HoTT teacher transmitter. **The model to be used for training must therefore be under the complete control of the teacher transmitter. The final step in preparation, however, is to bind the training model to the pupil transmitter. For a detailed description of the bind procedure, please consult pages 69 and 74.**

Pupil transmitter

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 (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:

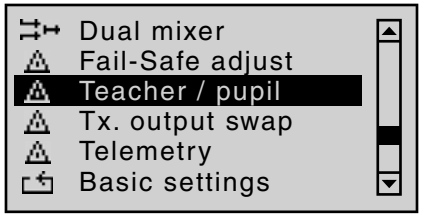
Channel	Function
1	Motor throttle/collective pitch
2	Aileron/roll
3	Elevator/pitch-axis
4	Rudder/tail rotor

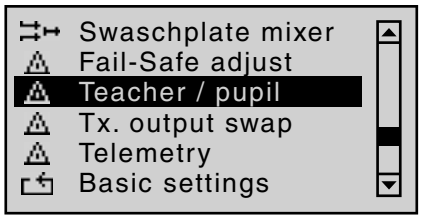
If you wish to transfer other control functions to the pupil transmitter in addition to the functions of the two dual axis sticks (1 … 4), access the **"Control adjust"** menu on the pupil transmitter and assign transmitter controls to the *inputs* that correspond to the control numbers **5 … 12** released on the teacher transmitter's "*Teacher/pupil"* menu.

Important:
If you should forget to assign a transmitter control on the pupil side, then the affected servo or servos will remain in the center position when the transfer is made to the pupil transmitter.

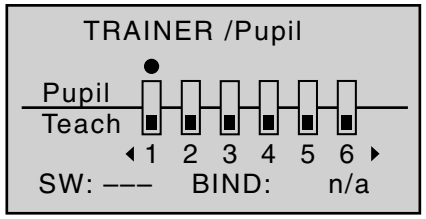
Preparing the teacher and pupil transmitters

Once you have bound the training model to the pupil transmitter, now switch on the teacher transmitter. On both transmitters, use the arrow keys on the left or right touch pad, page to the "**Teacher/pupil**" menu option on the multi-function list:





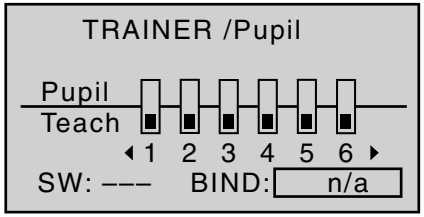
Briefly tap the center **SET** key on the right touch pad to open this menu option:



The screen image shown above shows the menu in its initial state: No transmitter controls have been released to the pupil (▯) and no switch is assigned ("SW: ---" bottom left in the screen image).

Pupil transmitter

Using the arrow keys on the left or right touch pad, move the marker frame to the "BIND" input field. If you can see a switch to the right of "SW:", then this *MUST* first be erased, see screen image:

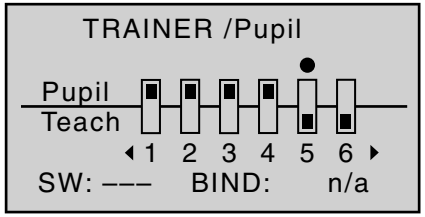


Teacher transmitter

Up to twelve *control functions* of the teacher transmitter "Teach" can be transferred to the pupil transmitter "Pupil", either individually or in any combination.

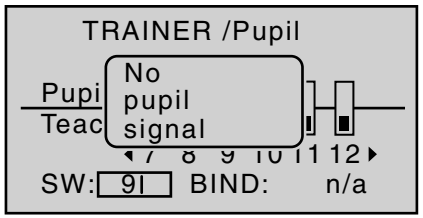
The lower display line, named "Teach", therefore refers to the **transmitter controls** permanently connected to inputs 1 … 4 (dual axis stick functions for fixed-wing and heli model) and the CTRL 6 to 10 controls that are assigned or can be assigned to inputs 5 … 12 (optionally flight phase-specific) **on the** "Control adjust" menu.

Use the arrow keys ◄ ► on the left or right touch pad *to select the transmitter controls from 1 to 12* (●) to transfer to the pupil and then briefly tap the center **SET** key on the right touch pad in each case, so as to switch between "Teach" (Teacher)" ( ) and "Pupil" ( ):

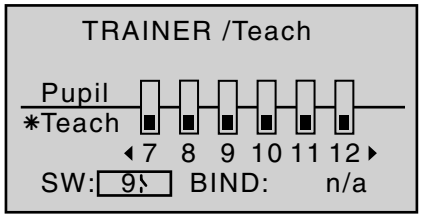


To be able to carry out the transfer, you must now assign a trainer mode switch. To do so, use the arrow keys on the left or right touch pad to move the marker frame to the bottom left, to the right of "SW:" now assign a switch as described in the section "Assigning transmitter controls, switches and control switches" (page 52).

Preferably, you should utilize one of the two momentary switches, SW 1 or SW 9, so as to be able to revert control back to the teacher transmitter at any time:



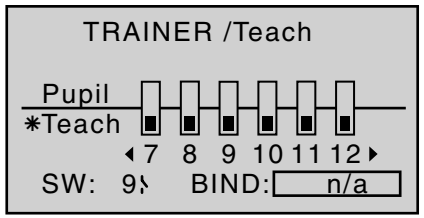
Since at this stage of programming the wireless trainer system no connection yet exists to a pupil transmitter, the transmitter responds immediately to the switches closed during the switch assignment process with appropriate visual and audible warning notices. You should therefore re-open the switch 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 "TRAINER /Pupil" to "TRAINER /Teach" once a switch has been assigned.***

Using the arrow keys on the left or right touch pad, now move the marker frame to the right, to "BIND: n/a":

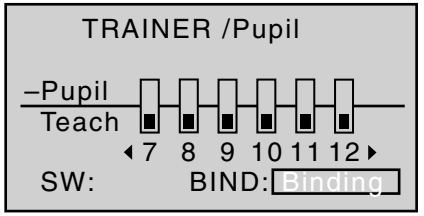


Binding the pupil transmitter to the teacher transmitter

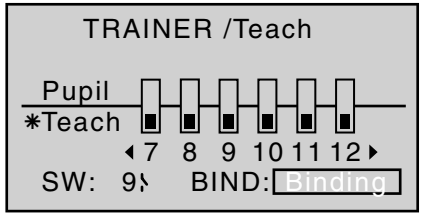
Note:

During the bind process, the two transmitters should not be very far apart. You may find you need to change the positions of the transmitters and then start the bind process again.

Initiate the "BINDING" process from the pupil transmitter by tapping the center **SET** key on the right touch pad …

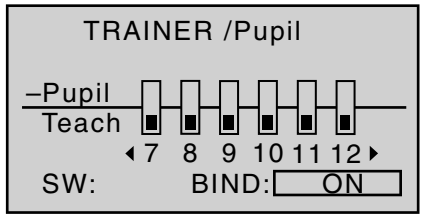


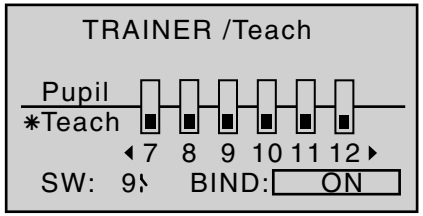
… and repeat this immediately on the teacher transmitter:



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:

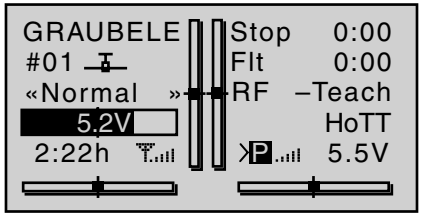
Check that the model aircraft is operational and check that all functions issue the correct commands BEFORE setting up trainer mode.

During the …

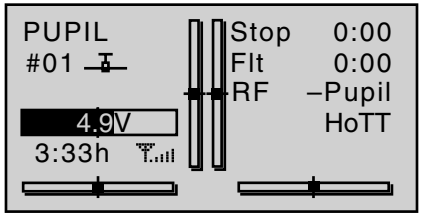
Training session

… the teacher and pupil can maintain a more "relaxed" distance from one another. The "reach of signal" (max. 50 m) should not be exceeded under any circumstances, however, nor should anyone else 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. Furthermore, you should remember that the return channel assigned for wireless trainer mode functionality is normally used for telemetry connections: accordingly, it will not be possible to transmit any model telemetry data.

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, then the center LED on the teacher transmitter will flash blue/red while the signal is lost and audible warning signals will also be given. The basic display also displays the following warning notice:

If only the character string "HF –" starts flashing on the transmitter's basic display, however, and (quieter) audible warning signals are given, the pupil signal has still 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 "familiar" instead of the two icons . 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 you either confirm "**INH**" by tapping the center **SET** key on the right touch pad, or alternatively wait 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.

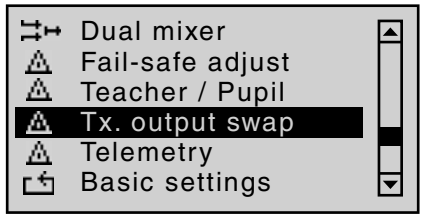
If, on the other hand, you use the arrow keys on the left or right touch pad to select "**ACT**" ...

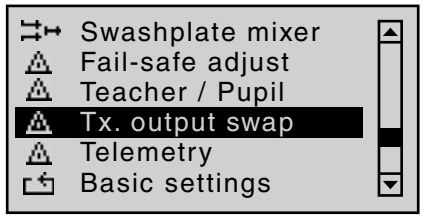
... and confirm this selection by tapping the center **SET** key on the right touch pad, then the existing teacher connection is restored. The same approach is used if the transmitter is configured as a pupil transmitter.

Tx. output swap

Swapping the outputs on the transmitter

Using the arrow keys on the left or right touch pad, page to the menu option "**Tx. output swap**" on the multi-function list:



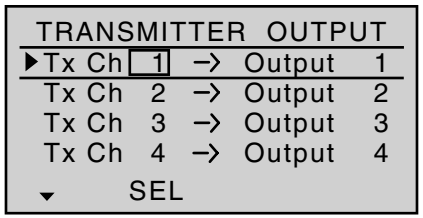


Briefly tap the center **SET** key on the right touch pad to open this menu option.

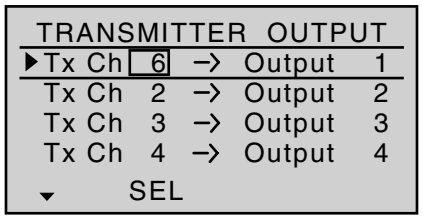
Tx. output swap

To achieve maximum flexibility regarding receiver socket assignment, the **mc-32** HoTT program offers you the option of swapping servo outputs 1 to 12 as you please.

This option lets you distribute the transmitter's 12 "*control channels*" to any of the *transmitter outputs* 1 … 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 touch pad – refers exclusively to the *"control channels"* as preset by the receiver socket assignment: it therefore does NOT take any output swaps into account.



Use the arrow keys ▲▼ on the left or right touch pad to select the channel/output combination that you wish to change and then briefly tap the center **SET** key on the right touch pad. You can now use the right arrow keys to assign your selected (control) channel to the desired output, confirming this with the **SET** key …



… or, by tapping the arrow keys ▲▼ or ◄► on the right touch pad 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!**

Example:

In the **mc-32** *HoTT helicopter program, the outputs for a collective pitch servo and the throttle servo are swapped around, compared to some older GRAUPNER/JR 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:*

Note:

The "Channel Mapping" (channel assignment) function integrated into the **telemetry menu on the** *mc-32HoTT receiver can also be used to distribute up to 12 control channels from the transmitter to multiple receivers. The function can also be used to map the exact same control function to multiple receiver outputs: this can be used to configure two servo controls per aileron surface instead of just the one, for example, etc. To keep controls manageable, however, we strongly recommend using only one of the options at a time.*

Telemetry

The transmitter and receiver data as well as the data for optional telemetric sensors (see Appendix) can be viewed and programmed in the "**Telemetry**" menu.

The receiver data is transmitted to the transmitter through the return channel integrated in the HoTT receiver.

One telemetry sensor can be connected through the telemetry input to each of the receivers GR-12S HoTT (Order No. **33505**), GR-12 HoTT (Order. No. **33506**), GR-16 (Order. No. **33508**) and GR-24 HoTT (Order. No. **33512**).

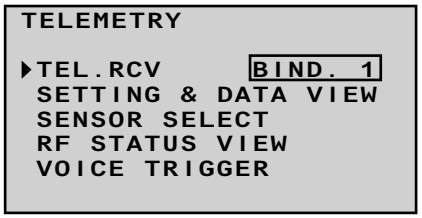
The corresponding "**Telemetry**" menus always keep these and future receivers up to date with the latest version and ensures enhancement with future functions or languages.

Note:

After registering your product at https://www.graupner.de/de/service/produktregistrierung you are automatically informed of new updates.

Important information:

- *This manual depicts the available functions at the time of printing.*
- *As already indicated in the section "Connection of multiple receivers" on page 69 and 74, multiple receivers can be connected as necessary for each model.* ***During the later operation, however, only the receiver which was activated in the line "TEL. EMPF." of the "Telemetry" menu, is capable of establishing a telemetric connection to the transmitter!*** *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:*

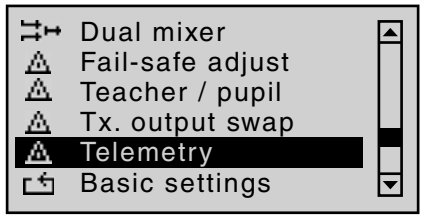


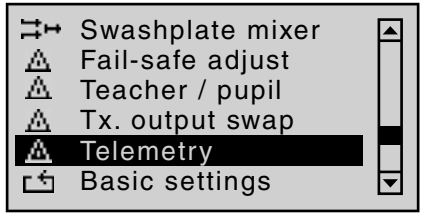
- ***When adjusting the settings of the remote control, make absolutely sure that the transmitter antenna is always far enough away from the receiver antennae! To be on the safe side, keep them at least one meter apart. Otherwise you run the risk of a faulty connection for the return channel and malfunction as a result.***
- *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.*
- *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 4-7 of this manual and the individual respective manuals.
- *All settings (such as fail-safe, servo direction reversal, servo travel, mixer and curve settings, etc.) made through the "**Telemetry**" menu are only saved in the receiver and, therefore, are adopted along with it in the course of the conversion of a receiver to a different model, if applicable. 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 43.*
- *Only program the servo direction reversal, servo travel, mixer and curve settings through the* **mc-32** *specific standard menus "**Servo adjustment**" page 90, "**Dual Rate / Expo**" page 108 and 112, "**Channel 1 curve**" page 116 and 119, etc. Otherwise, the settings superimpose one another, which can lead to complexity or even problems in the later operation.*
- *With the channel assignment function of the Telemetrymenu integrated in the mc-32 HoTT, control functions can also be assigned with distribution to multiple receivers or multiple receiver outputs can even be assigned with the same control function, such as the ability to activate two servos per aileron instead of only one individual servo, etc.* ***We also recommend exercising extreme during the programming.***

Telemetry

The menus comprised under the heading "**Telemetry**" can be called up from the default display of the transmitter **mc-32** HoTT by pressing the central **ESC** key of the left touch pad for approx. one second. The same menus can, like other menus of the transmitter, also be opened in the multifunction list by pressing the central **SET** key on the right touch pad:





Basic operation

The operation of the "**Telemetry**" is essentially the same as that of the other menus of the transmitter **mc-32** HoTT. The few differences are described in the following:

You can switch between the individual pages of the Telemetry menu with the arrow keys ◄ ► of the left or right touch pad. The corresponding directional indications can be found at top right of each display page in the form of angled brackets (<>); see the following figures. 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 (>). By pressing the arrow keys of the ▲▼ of the left or right tough pad, the ">" pointer jumps one line forward or one line back. Lines which you cannot jump to cannot be changed.

In order to change a parameter, briefly press the central **SET** key of the right touch pad (the parameter is represented inversely), change the value within the permissible adjustment range with the arrow keys of the *right* touch pad and adopt the value by pressing the **SET** key again. By briefly pressing the central **ESC** key of the left4-way pad, you return to the starting position.

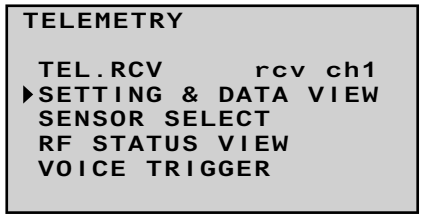
Now select the desired submenu with the arrow keys ▲▼ of the left or right touch pad. However, if the message …

… appears instead of the desired submenu after pressing the central **SET** key of the right touch pad, no connection has been established to the receiver. Therefore, switch on your receiver system or, if applicable reconnect the addressed receiver as described on page 68 and 74 or activate it as described under "Important Notices" on the previous page.

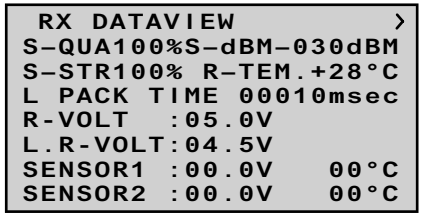
On the first display page of the submenu overwritten with …

RX DATAVIEW

…



… no settings can be made. This page is only provided for information:



Value	Explanation
S-QUA	Signal quality in %
S-dBm	Reception power in dBm
S-STR	Signal strength in %
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 the values of the optional telemetric sensor 1 in volts and °C
SENSOR2	Indicates the values of the optional telemetric sensor 2 in volts and °C

Signal quality (S-QUA)

The signal quality (S-QUA) is sent "live" over the return channel of the receiver to the transmitter and indicates the signal strength in %.

Reception power (S-dbm)

The reception power (S-dbm) is indicated with negative values, which means a value of zero is the maximum value (= best reception) and the lower the values are, the poorer the reception power! The range test before operation, among other things, is important for this.

Note:
With negative numbers the evaluation of a number is reversed: The higher the number following the minus symbol, the lower the value is. Therefore, a reception power of -80 dBm, for example , is poorer than one with -70 dBm.

Perform the range test as described on page 71 and 77 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 -80 dBm in order to guarantee safe operation. Your should never be operated with a lower value (e.g. -85 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 that your 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 submenu "**RX SERVO TEST**" under "ALARM TEMP+" (50 … 80 °C and "ALARM TEMP" (-20 … +10 °C). When the value is undercut or exceeded, an acoustic signal follows (continuous peep tone) and "**TEMP.E**" appears at the top right of all "RX" receiver submenus. In addition, the parameter "**R-TEM**" is shown inversely 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 6.0 volts in the submenu "**RX SERVO TEST**" under "ALARM VOLT". If this range is undercut, an acoustic signal is issued (repeating double peep tone (long/short)) and "**VOLT.E**" appears at the top right of all "**RX**" receiver submenus.l In addition, the parameter "**R-VOLT**" is shown inversely in the "**RX DATAVIEW**" submenu.

The current receiver battery voltage is also displayed in the default display, see page 24.

Minimum receiver operating voltage (L.R-VOLT)

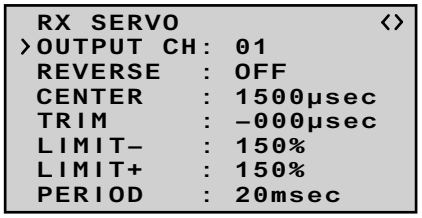
"L.R-VOLT" indicates the minimum operating voltage of the receiver since the last time it was switched on.

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 the optional telemetric sensors 1 and 2 in volts and °C, if applicable. A description of these sensors can be found in the appendix.

RX SERVO



Before any programming on this display page, observance of the notices on page 208 is mandatory.

Value	Explanation	Possible settings
OUTPUT CH	Channel selection	1 … depending on receiver
REVERSE	Servo reversal	OFF / ON
CENTER	Servo center in µs	if active (inverse), dependent on control position
TRIM	Trim position in µs deviating from the CENTER position	-120 … +120 µs
LIMIT–	Travel limit for % servo travel	30 … 150 %
LIMIT+	Travel limit for % 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 arrow keys. Press the **SET** key of the right touch pad. The value field is shown inversely. Now set the desired channel (e. g. 01) with the arrow keys of the right touch pad. **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

CENTER (servo center)

The *active* value field (inverse representation) in the "CENTER" line shows the current impulse time of the control channel selected in the "OUTPUT CH" line in µs.

The displayed value depends on the current position of the control influencing this control channel and, if applicable, the position of its trimming.

A channel impulse time of 1500 µs corresponds to the standard center position and thus the conventional servo center.

In order to change this value, select the "CENTER" line and press the **SET** key. Now move the corresponding control, joystick and/or trim lever to the desired position and save the current control position by pressing the **SET** key again. This position is saved as the new neutral position.

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 arrow keys of the right touch pad in 1 µs increments. The value in the "CENTER" line can be adjusted by the TRIM value set here in a range of ±120 µs.

Factory setting: 0 µs.

LIMIT–/+ (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 setting for both directions takes place in a range of 30 … 150 %.

Factory setting: 150 % each.

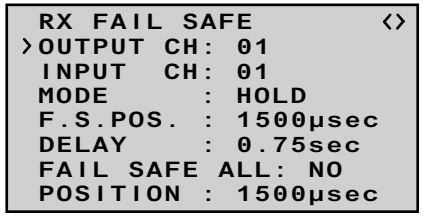
PERIOD (cycle time)

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 "overstrained" and react with "shaking" or "quivering" as a result.

RX FAIL SAFE



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 fine a "logical" setting for your model.

And then another brief notice regarding the three possible versions of the **mc-32** HoTT transmitter 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 list, see page 196.

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 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 … 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 208, the control functions of the **mc-32** 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 oversized 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.EMPF." through the "**Telemetry**" menu can be addressed!

The 12 control channels (INPUT CH) of the **mc-32** HoTT 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. ATTENTION: If, for example, you have specified "2AIL" for the transmitter side in the line "Aile/flaps" in the "**Base setup model**" menu, the *Control function 2* (*Aileron)* is already distributed to the *Control channels 2 and 5 for the left and right aileron*. The corresponding *INPUT CH of the receiver,* 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 flap with two or more servos for a large model:*
- *You would like to control each aileron flap with two or more servos for a large model:*

  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 with two or more servos for a large model:*

  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".

  ATTENTION: 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 (servo connection of the receiver), set the respective servo position, which the servo should assume in the event of a failure in "FAI(L) SAFE" mode, in the line "F.S.POS." after activation of the value field (inverse representation) by pressing the **SET** key in the right touch pad and with the arrow keys of the right touch pad. The adjustment takes place in 10-µs increments.

Factory setting: 1500 µs (servo center).

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 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)

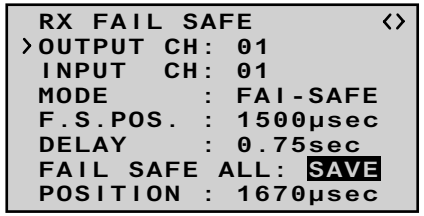
Here you adjust the delay time after which the servos should move to their predetermined positions in the event of a signal interruption. This setting is adopted for all channels and only pertains to the servos programmed to the "FAI(L) SAFE" mode.

Factory setting: 0.75 s.

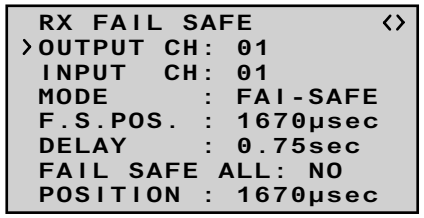
FAIL SAFE ALL (global fail-safe setting)

This submenu allows you to determine the fail-safe positions of Servos with a "push of a button" in a similar manner to the "Fail Safe" described on page **196**.

Switch to the line "FAIL SAFE ALL" and activate the value field by pressing the central **SET** key of the right touch pad. "**NO**" is represented inversely. Then adjust the parameter to "**SAVE**" with one of the arrow keys of the right touch pad. 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:



After pressing the central **SET** key of the right touch pad, the display switches back 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):



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 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          <>
>OUTPUT CH: 06
 INPUT  CH: 04
 MODE     : OFF
 F.S.POS. : 1670µsec
 DELAY    : 0.75sec
 FAIL SAFE ALL: NO
 POSITION : 1670µsec
```

```
 RX FAIL SAFE          <>
>OUTPUT CH: 07
 INPUT  CH: 04
 MODE     : OFF
 F.S.POS. : 1230µsec
 DELAY    : 0.75sec
 FAIL SAFE ALL: NO
 POSITION : 1670µsec
```

```
 RX FAIL SAFE          <>
>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          <>
>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          <>
>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 MIXER         <>
>MIXER     : 1
 MASTER CH: 00
 SLAVE CH  : 00
 S-TRAVEL-: 100
 S-TRAVEL+: 100
 RX WING MIXER
 TAIL TYPE: NORMAL
```

Value	Explanation	Possible settings
MIXER	Mixer selection	1, 2 or 3
MASTER CH	Signal source or source channel	0, 1 … depending on receiver
SLAVE CH	Target channel	0, 1 … depending on receiver
S-TRAVEL–	Admix negative	0 … 100 %
S-TRAVEL+	Admix positive	0 … 100 %
RX WING MIXER	Tail unit type (TAIL TYPE)	NORMAL, V-TAIL (V-LW) ELEVON (vertical/horizontal mixer for delta and flying wing)

MIXER

Up to three mixers can be programmed simultaneously. Switch between Mixer 1, Mixer 2 and Mixer 3 through "MIXER".

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" menu, 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 180, 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 degree of mixture is 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, page 82 and should, preferentially, be pre-set there. In this case, *always* leave the TAIL TYPE set to NORMAL.

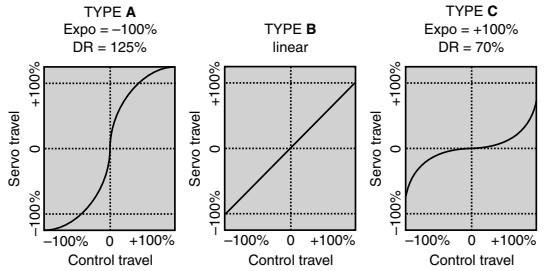
However, if you would prefer to use the mixer integrated in the receiver, you can select the already preadjusted mixer functions for the corresponding model type:

- **NORMAL**
  This setting corresponds to the classic aircraft type with rear tail unit and separate rudder and elevator. No mixing 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 at 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 57.
- **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 57.

RX CURVE

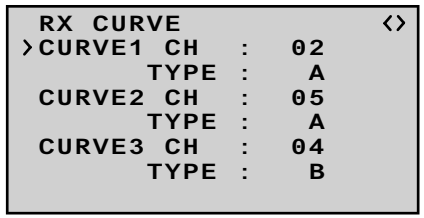
```
 RX CURVE                  <>
>CURVE1 CH   :   02
       TYPE  :    B
 CURVE2 CH   :   03
       TYPE  :    B
 CURVE3 CH   :   04
       TYPE  :    B
```

Value	Explanation	Possible settings
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. ATTENTION: This assignment only applies if "2HRSv3+8" is not specified in the line "Tail Unit" in the "**Basic Settings**" menu and "2AIL" or 2AIL 2FL" is not specified in the line "Ail./Flap"! Otherwise the *control function 3 (elevator)* which is already in the transmitter is split to the *control channels 3 + 8* or the *control function 2* (*aileron)* is split to the *control channels 2 + 5 for left and right aileron*. The corresponding *control channels (INPUT CH) of the receiver* in these two cases would be the channels 03 + 08 or 02 + 05.

Therefore, if you have specified "2AIL", for example, on the transmitter side and would like to utilize the option RX CURVE to be addressed here instead of the individually adjustable menu "**Dual Rate / Expo**", page 108, of the transmitter **mc-32** HoTT, two curves must be set:



Otherwise, the left and right ailerons have different control characteristics.

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 joystick around the neutral position. As the rudder throw increases, the curve becomes flatter.

  B: Linear setting.

  The servo follows the joystick movement linearly.

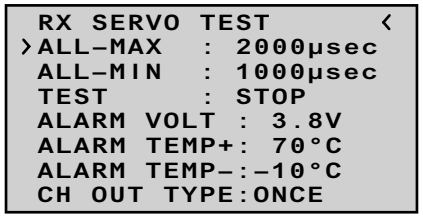
  C: EXPO = +100 % and DUAL RATE = 70 %

  The servo reacts weakly to the joystick movements around the neutral position. As the rudder throw increases, the curve becomes steeper.

Notice:

The control characteristics programmed here also affect the mapped receiver outputs.

RX SERVO TEST



Value	Explanation	Possible settings
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 … 6,0 V factory setting: 3.8 V
ALARM TEMP+	Alarm threshold for excessively high temperature of the receiver	50 … 80 °C Factory setting: 70 °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

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)

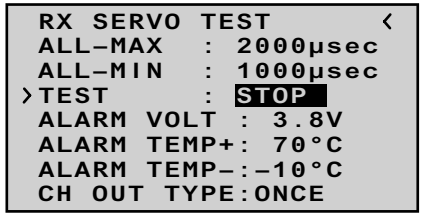
You adjust the maximum servo travel on the minus side of the control path for the servo test in this line.

1000 µs corresponds to the full throw; 1500 µs corresponds to the neutral position.

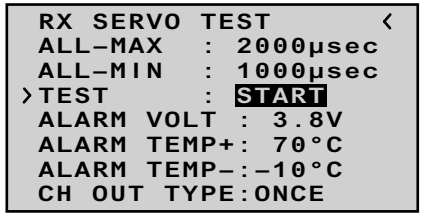
TEST

You start and stop the servo test integrated in the receivers in this line.

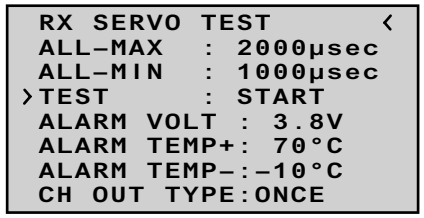
By pressing the central **SET** key of the right touch pad, you activate the input field:



With one of the arrow keys of the right touch pad, you now select **START**:



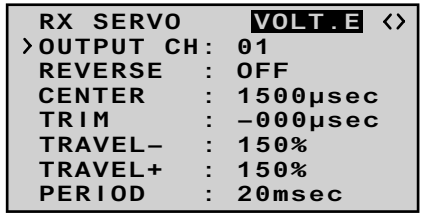
By pressing the central SET key of the right touch pad, you now start the test run. The input field is shown as "normal" again:



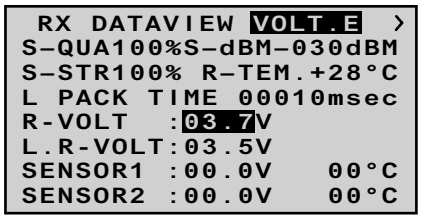
To stop the servo test, reactivate the input field as described above, select **STOP** and confirm this selection with the **SET** key of the right touch pad.

ALARM VOLT (receiver undervoltage warning)

The receiver voltage is monitored through ALARM VOLT. The interval can be adjusted between 3.0 and 6.0 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:



The parameter "**R-VOLT**" is also represented inversely in the "**RX DATAVIEW**" display:



ALARM TEMP +/- (recommended temperature monitoring)

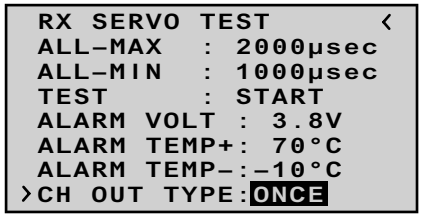
These two options monitor the receiver temperature. A lower threshold "ALARM TEMP-" (-20 ... +10 °C) and an upper threshold "ALARM TEMP+" (50 ... 80 °C) can be programmed. When these specifications are exceeded or undercut, an acoustic signal (continuous peep tone) sounds and "**TEMP.E**" appears in 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.

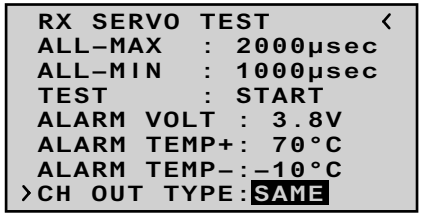
- **ONCE**



The servo connections of the receiver are controlled successively. This is recommended for analog servos.

With this setting the servos are automatically operated in a cycle of 20 ms – with a 12-channel receiver (Order No. **33512**) 30 ms – regardless of what is set or displayed in the "PERIOD" line in the "**RX SERVO**" display!

- **SAME**



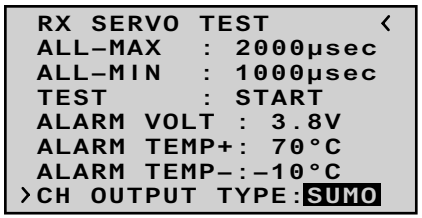
The servo connections of the receiver are controlled in parallel in blocks of four. That means the channels 1 to 4, 5 to 8 and 9 to 12 each receive the control signals simultaneously.

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!

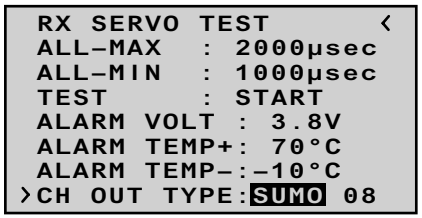
With this setting, pay particular attention to the sufficient dimensioning of the receiver current supply. Since up to four servos can always operate simultaneously, the requirement is higher.

- **SUMO (sum signal OUT)**

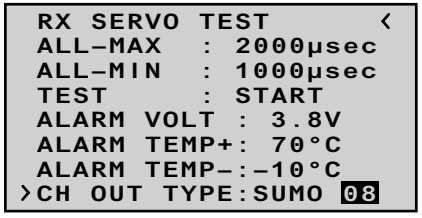


A HoTT receiver configured as SUMO permanently generates a so-called sum signal from the control signals of all of its control channels and provides this by default to the accompanying GR-24 receiver at servo connection 8.

On receivers whose display shows "SUMO" at the top right, an additional two-digit number appears ...



… the active field changes after confirmation of "SUMO" by briefly pressing the central **SET** key of the right touch pad for the channel selection. With this selection you specify the *highest* of the transmitter channels contained in the SUMO signal:



You can confirm the default by pressing the **SET** key of the right touch pad again or by selecting one of the other channels between 04 and 06 with the arrow keys and confirming with **SET**.

The receiver outputs are controlled successively in a cycle of 20 ms (30 ms with the receiver GR-24, Order No. **33512,**), even if 10 ms is set in the "PERIOD" line of the the "**RX SERVO**" display page.

Primarily intended for the "Satellite mode" of two HoTT receivers, as described in the following, the generated sum signal defined by the receiver as SUMO can be used for the control of flight simulators; this is also the case for the control of flyable systems, insofar as they have the corresponding input or the adapter cable with Order No. **33310**.

In …

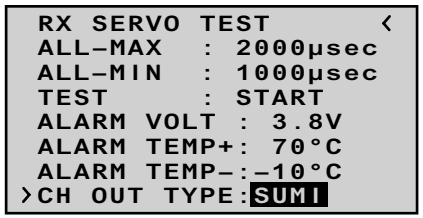
Satellite mode

… two HoTT receivers are connected to one another through a three-wire connecting cable (Order No. **33700.1** (300 mm) or **33700.2** (100 mm)) at receiver-type-specific servo connections. Receivers of the type GR-16 and GR-24, for example, are to be connected with one another at servo output 8. More detailed information can be found on the internet at www.graupner.de.

Through this connection, all channels of the HoTT receiver which was configured as SUMO and identified as a satellite receiver are transmitted to the second HoTT receiver, the main receiver, which is to be programmed as ...

- **SUMI (sum signal IN)**

  Therefore, the signal always goes toward 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 SUMO satellite receiver has a failure of receipt, the servos connected to this receiver assume the fail-safe positions programmed in the satellite receiver completely independently of the main receiver.

On the other hand, if a failure of receipt takes place with two receivers *simultaneously,* the receiver software current at the time of the printing of this manual falls back on the fail-safe settings of SUMO. 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 fiber 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.

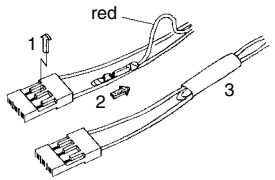
Therefore, make sure to connect the most important control functions to the main receiver programmed as SUMI, so that, in the event of a failure, the model

remains controllable when the SUMO satellite receiver no longer receives a signal.

Telemetry data, such as the voltage of the onboard electricity supply, on the other hand, is only sent to the transmitter by the satellite receiver configured as SUMO. Therefore, telemetry sensors are to be connected to the satellite receiver (SUMO).

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.

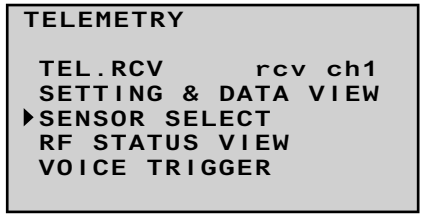
On the other hand, if each of the two receivers should be supplied from its own voltage source, the center cable must be removed from one of the two plugs of the satellite cable; see figure.



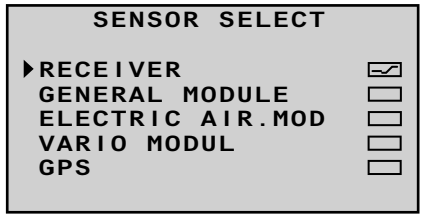
If you would like to carry out additional programming, such as fail-safe settings, disconnect the three-pole satellite connection between the two receivers and switch on only the relevant receiver. It may be necessary to also change the connection sequence.

SENSOR SELECT

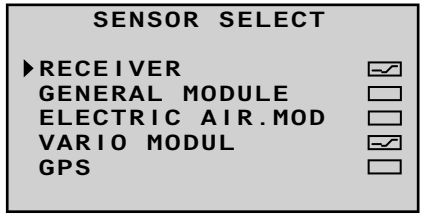
After selection of the desired menu line with the arrow keys ▲▼ of the left or right touch pad…



… and then pressing the central **SET** key of the right touch pad, the selected submenu opens:



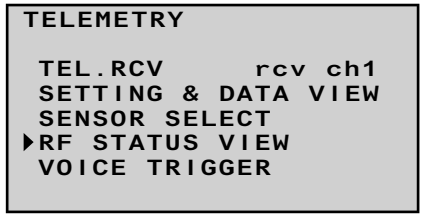
Here, after selection of the desired line with the arrow keys ▲▼ of the left of right touch pad and then pressing the central **SET** key of the right touch pad, activate (☑) or deactivate (☐)the data output of the sensor connected to a receiver with active telemetry connection. It is only possible to select one sensor, e.g.:



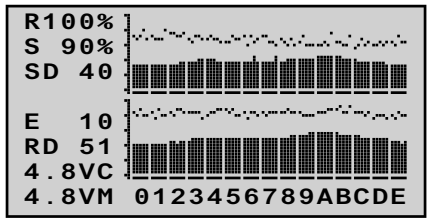
This selection is required to show the sensor in the "**VOICE TRIGGER**" submenu and for the display of the telemetry data in the corresponding graphic displays, page 32.

RF STATUS VIEW

After selection of the desired menu line with the arrow keys ▲▼ of the left or right touch pad …



… and then pressing the central **SET** key of the right touch pad, the selected submenu opens. 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:

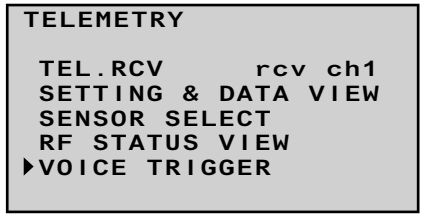
- *Since the reception power is measured and represented in dBm, the reception power is increasingly worse the higher the bar is and vice versa; for this purpose, see also "Reception power (S-dBm)" on page 224.*
- *Mark the points above the columns with the poorest reception power since switching on the transmitter or the resetting of the display by simultaneously pressing the keys ▲▼ or ◄► of the right touch pad (**CLEAR**).*

Additional figures are shown to the left of the graphic representation of the reception power. These mean:

Value	Explanation
E	Signal quality in % of the signal received from the receiver
S	Signal quality in % of the signal received by the receiver
SL	Reception power in dBm
P	Number of lost data packages of the receiver
RL	Reception power in dBM of the signal received by the receiver
RS	Current operating voltage of the receiver in volts
RM	Lowest receiver operating voltage since last startup, in volts

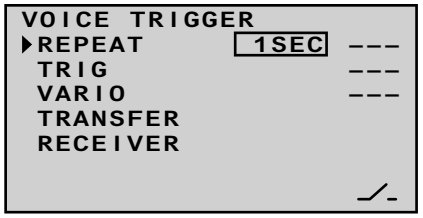
VOICE TRIGGER

After selection of the desired menu line with the arrow keys ▲▼ of the left or right touch pad …

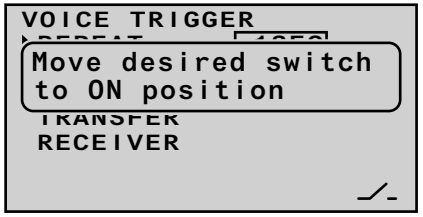


… and then pressing the central **SET** key of the right touch pad, the selected submenu opens:

REPEAT



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 "Switch and control switch assignments" on page 52:



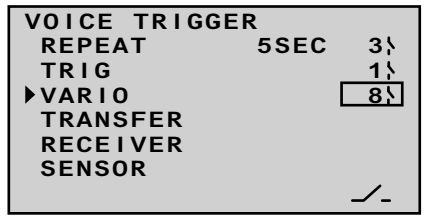
With this switch you can have the last respective voice trigger repeated for the duration of the time set to the left of the switch, as long as the assigned switch is closed:

TRIG

With a switch assigned to this line, preferably one of the two pushbuttons SW 1 or SW 9, switch to the next voice output in the rotation selected in the options "TRANSMITTER", "RECEIVER" and "SENSOR" as described in the following.

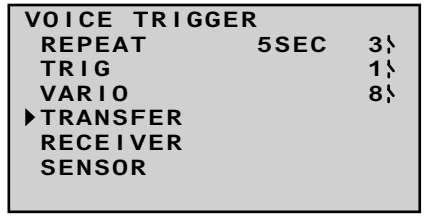
VARIO

If you activate the "VARIO MODULE" line(☑) in the "**SENSOR SELECT**" submenu, described on page 220, you can use the headphone connection to activate a switch assigned to this line completely independently of the other voice triggers, in other words voice triggers triggered by changes in altitude, such as "Slow climb/ descent", etc.

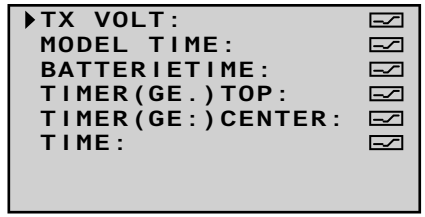


TRANSMITTER

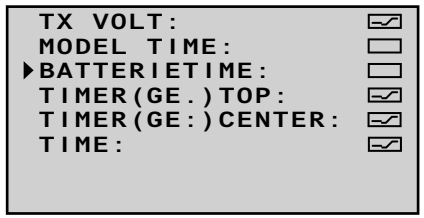
After selection of the desired menu line with the arrow keys ▲▼ of the left or right touch pad...



… and then pressing the central **SET** key of the right touch pad, the selected submenu opens:



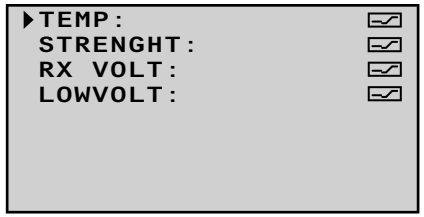
Here, after selection of the desired line with the arrow keys ▲▼ of the left or right touch pad and then pressing the central **SET** key of the right touch pad, activate (☑) or deactivate (☐) the data output of the selected voice trigger:



RECEIVER

After selection of the desired menu line with the arrow keys ▲▼ of the left or right touch pad …

… and then pressing the central **SET** key of the right touch pad, the selected submenu opens:

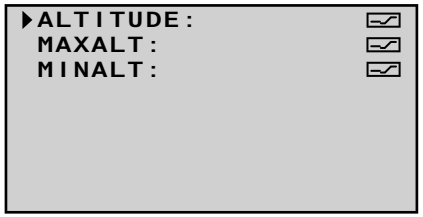


Here, after selection of the desired line with the arrow keys ▲▼ of the left or right touch pad and then pressing the central **SET** key of the right touch pad, activate (☑) or deactivate (☐) the selected voice trigger.

SENSOR

This line only appears if a sensor was first activated in the "**SENSOR SELECT**" submenu:

If, for example, the "**VARIO**" sensor was selected, after selection of the "SENSOR" line and then pressing the central **SET** key of the right touch pad, the following display appears:



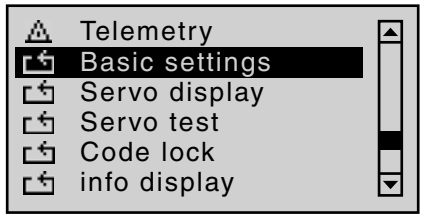
As described in the left column, you can also activate (☑) or deactivate (☐) the voice trigger of the desired line after pressing the central SET key of the right touch pad.

Notice:
The selection made here is completely independent of the "VARIO" voice triggers.

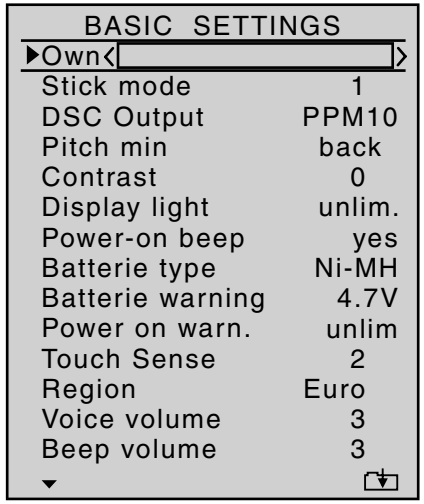
General settings

Basic transmitter settings

Using the arrow keys of the left or right touch pad, scroll to the "**Basic Settings**" menu item of the multifunction menu:



By briefly pressing the central **SET** key of the right touch pad, this menu item opens:



General basic settings are entered in this menu … specific to the transmitter, such as the owner's name and defaults for new model memories.

The settings saved in this menu in the lines ...

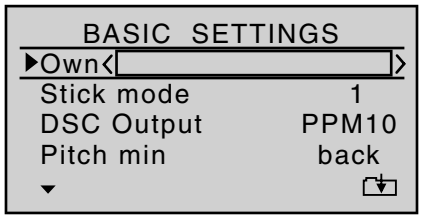
- "Stick mode",
- "DSC Output",
- "Pitch min"

… have no influence whatsoever on already existing model memories; they are only *defaults*, which are automatically adopted to newly initialized model memories and can be changed there on an individually basis at any time in the "**Basic model settings**" and "**Helicopter type**" menus. A change to the "specifications" in *this* menu, therefore, only *influences model memories created at a later time*.

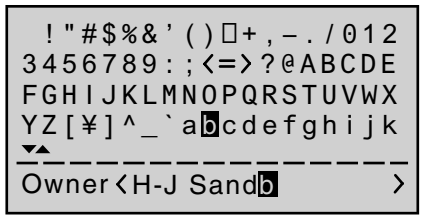
Notice:
Settings in this menu are only assigned once for transmitters. After opening this menu in another model memory, therefore, the last valid settings always appear.

Select the appropriate line with the arrow keys ▲▼ of the left or right touch pad and then press the central **SET** key of the right touch pad. In the inverse value field you can now change the respective specified value with the arrow keys of the right touch pad and complete your entry by pressing the central **SET** key of the right touch pad or the **ESC** key of the left touch pad.

Own(er)



Up to 15 characters can be used to specify the owner's name. Change to the next screen page (⊡) by pressing the SET key of the right touch pad:



Select the desired characters with the arrow keys of the left touch pad. Switch to the next position by briefly pressing the arrow key ► of the right touch pad of the **SET** key to be able to select the next character. A blank space can be entered by simultaneously pressing the keys ▲▼ or ◄► of the right touch pad (**CLEAR)**.

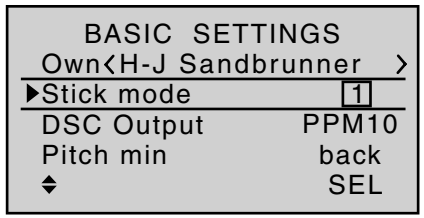
You can reach any arbitrary character position within the input field with the ◄► keys of the right touch pad.

You return to the previous menu page by briefly pressing the central **ESC** key of the left touch pad.

Stick mode (specification)

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 joysticks. The model pilot determines which way to do so according to individual preferences.

With the arrow keys ▲▼ of the left or right touch pad, select the "Stick mode" line. The selection field is shown in a box:

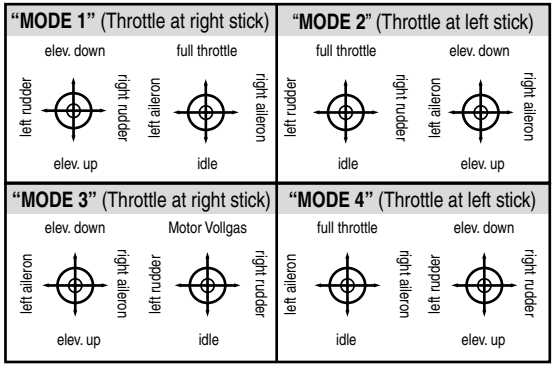


Briefly press the **SET** key. The current stick mode is shown inversely. Now, using the arrow keys of the right touch pad, select the alternative you use most frequently, from 1 to 4. In the future this will be used for newly initialized model memories, but can be changed on an individual basis for up to 24 model memories.

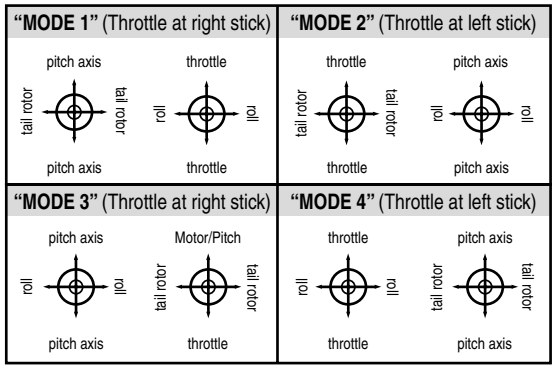
After simultaneously pressing the keys ▲▼ or ◄► of the right touch pad (**CLEAR**), the display returns to stick mode "1"

By pressing the **SET** key again, you deactivate the selection field in order to switch lines.

Winged model stick mode

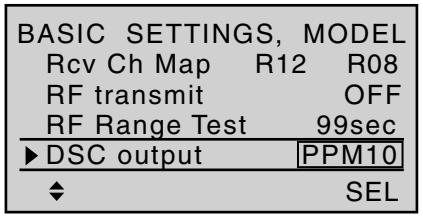


Helicopter model stick mode



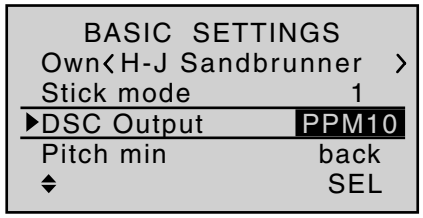
DSC Output (specification)

In the line with the same name in the "**Base setup model**" menu you can determine which of the three available modulation types should be provided for the DSC socket separately for each model memory. This selection primarily influences the number of maximum control channels available at the DSC socket and thus for a flight simulator or LS system connected at this socket. With the selection of "PPM10", this is the channels 1 ... 5, with "PPM18" the channels 1 ... 9 and with "PPM24" the control channels 1 ... 12.



In *this* "General settings" menu, you can determine which of the three possible "Modulation types" should be adopted as the *default* to a newly initialized model memory in the line "DSC Output" the same way as with "Stick mode".

If necessary, using the arrow keys ▲▼ of the left or right touch pad, switch to the "DSC Output" line and, by briefly pressing the central **SET** key of the right touch pad, activate the value window:



Now you case choose between the three possible modulation types "PPM10", "PPM18" and "PPM24" using the arrow keys of the right touch pad. By pressing the central **SET** key of the right touch pad again, you complete the entry.

Simultaneously pressing the keys ▲▼ or ◄► of the right touch pad (**CLEAR**) returns to "PPM10".

(Default) Pitch min
(only relevant for helicopter models)

Enter your preferred actuation direction for the throttle/pitch joystick analogously to the "Stick mode" and "DSC Output" options described above, in order to be able to find it for newly initialized model memories in the future. The functions of all other options of the helicopter program depend on this setting, insofar as they pertain to the throttle and pitch function, in other words the throttle curve, idle trim, Channel 1 → tail rotor mixer, etc.

The following meanings apply:

"**front**": minimum front pitch setting, the pitch joystick (C1) points away from the pilot.

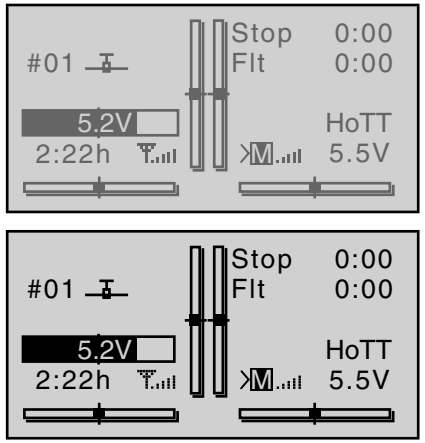
"**rear**": minimum rear pitch setting, the pitch joystick (C1) points towards the pilot.

Simultaneously pressing the keys ▲▼ or ◄► of the right touch pad (**CLEAR**) switches to "rear"

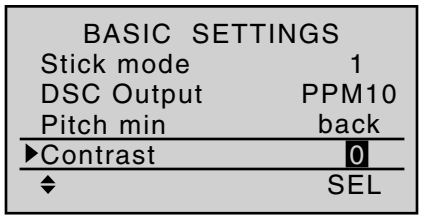
Notice:
*The stick mode of the C1 joystick in the winged model program for "Throttle min front/rear" can be individual changed in the "**Model type**" menu.*

Contrast

In order to guarantee the optimal visibility of the display of the **mc-32** HoTT in any weather and at any temperature, you can adjust its contrast:



For this purpose, using the arrow keys ▲▼of the left or right touch pad, select the "Contrast" line:



Then briefly press the central **SET** key of the right touch pad. Now you can adjust the display contract in a range of ±20 using the arrow keys of the right touch pad in the inverse value field.

Simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) resets the inverse field to "0".

Display light

In this line you can determine how long the backlight of the display should remain switched on after switching on the transmitter or the last key actuation.

The available options are "unlim(ited), "30 s", "60 s" and "120 s".

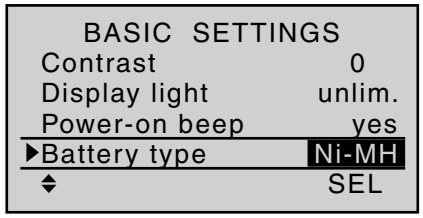
Simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) sets the inverse field to "unlimited".

Power-on beep

In this line you can switch the power-on beep of the transmitter on ("yes") and off ("no").

Simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) switch the inverse field back to "yes".

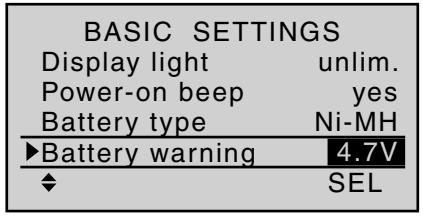
Battery type



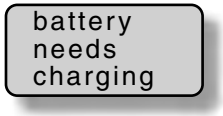
In this line you indicate to the transmitter whether its power supply is provided from a four-cell NiMH battery or a single-cell LiPo battery. Depending on this setting, you are offered a suitable voltage range in the (next) line "Battery warning".

Simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) switches back to "Ni-MH" in the inverse field.

Battery warning threshold



You can arbitrarily specify the warning threshold for the display ...

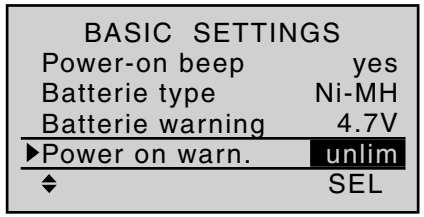


... – depending on the selection of the battery type in the line above it – in increments of 0.1 volt between 4.5 and 5.5 V (NimH battery) or 3.4 and 4.2 V (LiPo battery.

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.

Simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) switches back to the factory default values 4.7 or 3.4 V in the inverse field.

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.

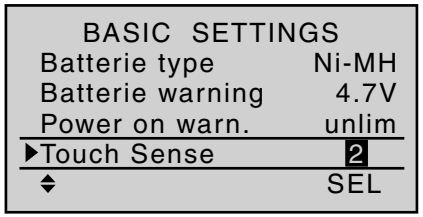
The values "unlim(ited)", "30 s" and 1, 5, 10, 20, 30 and 60 minutes are optional selections.

Simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) switches to "unlimited" in the inverse field.

Notice:

In order to be able to restart the transmitter after automatic shut-off, slide the power switch of the transmitter first towards the display, to the "OFF" position and, after approx. five seconds, back towards the antenna to the "ON" position.

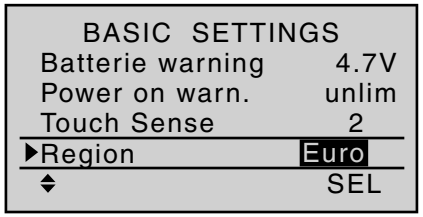
Touch sensitivity



In this line you can select the touch sensitivity of the touch pads in a range from 1 to 10.

Simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) resets to "2" in the inverse field.

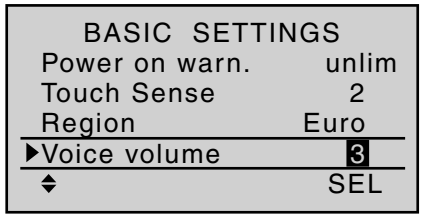
Region



The region is needed for compliance with various regulations (FCC, ETSI, IC etc.). In France, for example, the operation of a remote control is only permitted within a limited frequency band. Therefore, the region setting of the transmitter **MUST be switched to "France" mode as soon as it is operated in France**. In no case may the Universal/EURO mode be used in France!

Simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) resets to "Euro" in the inverse field.

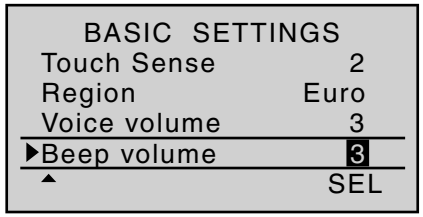
Voice volume



The volume of the voice output through the earpiece connection is defined in a range of "0" to "10" in this line.

Simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) resets to "3" in the inverse field.

Beep volume



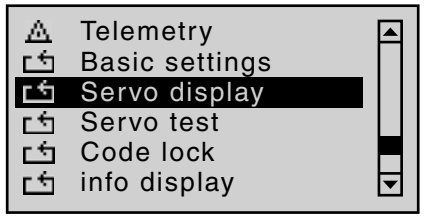
The volume of the transmitter's internal beep generator is defined in a range from "0" to "6" in this line.

Simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) resets to "3" in the inverse field.

Servo display

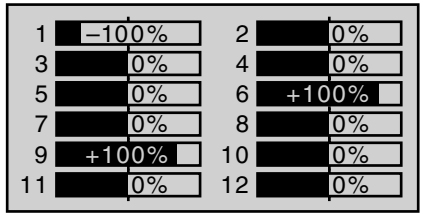
Display of the servo position

Scroll to the menu item "**Servo display**" of the multifunction menu using the arrow keys of the left or right touch pad:



By briefly pressing the central **SET** key of the right touch pad, you open this menu item.

The visual display of the current servo positions, however, can be opened both by selecting this menu and by simultaneously pressing the keys ◄ ► left touch pad directly from the base screen of the transmitter, as well as nearly all menu positions. By briefly pressing the central **ESC** key of the left touch pad, you return to the respective starting point.



The current position of a servo is displayed in a bar diagram between -150 % and +150 % of the normal path, in consideration of 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 center 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 = Right camber-changing flap / 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
Bar 12 = Free channel

… and with helicopter models:

Bar 1 = Pitch or roll (2) or pitch (2) servo
Bar 2 = Roll (1) servo
Bar 3 = Pitch (1) servo
Bar 4 = Tail servo (gyro)
Bar 5 = Pitch (2) servo / free channel
Bar 6 = Throttle servo or speed controller
Bar 7 = Gyro sensitivity / free channel
Bar 8 = Speed regulator / free channel
Bar 9 = Free channel
Bar 10 = Free channel
Bar 11 = Free channel
Bar 12 = Free channel

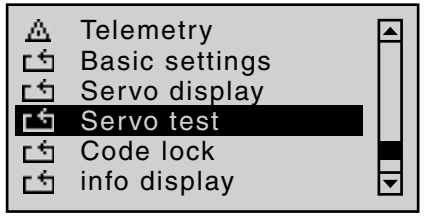
Notice:

- *However, please note that the servo display is only based on the original sequence of servos, so any switching of the outputs do not take place in either the "**Transmitter output**" menu or "**Receiver output**" menu.*
- *The number of channels shown in this menu correspond to the 12 control channels available in the* **mc-32** *HoTT transmitter. The number of actually usable channels, however, 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!*

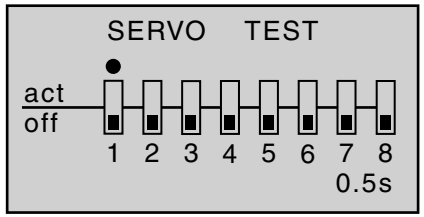
Servo test

Function test of Servo 1 ... 8

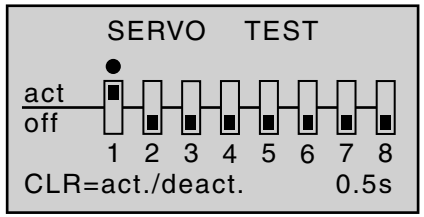
Scroll with the arrow keys of the left or right touch pad to the menu item "**Servo test**" of the multifunction menu:



By briefly pressing the central **SET** key of the right touch pad, this menu item opens:

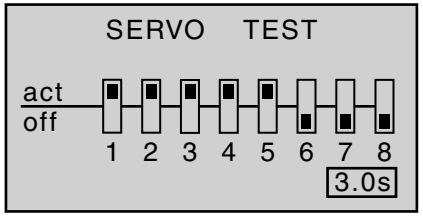


Any of the inputs 1 ... 8 can be activated for the servo test by selecting with the arrow keys of the left or right touch pad and then briefly pressing **SET** key of the right touch pad. As soon as you have set only one of the inputs 1 ... 8 to "active", the following notice appears at the bottom of the display screen:



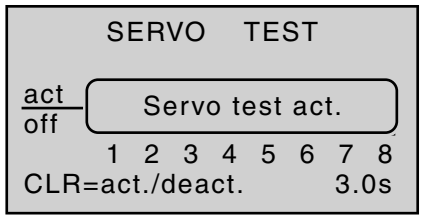
Simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) would now start and stop the servo test for input "1", for example, with a cycle time of 0.5 s.

To change the cycle time, select the time input field with the arrow keys of the left or right touch pad. After activation of the input field by briefly pressing the central **SET** key of the right touch pad, the movement cycle can be changed in 0.5 s increments between 0.5 s and 3.0 s using the arrow keys of the left or right touch pad. Briefly pressing the central **ESC** of the left touch pad or the central **SET** key of the right touch pad completes the time presetting.



The "servo test" function started by simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) automatically control all servos as though the would simultaneously and permanently move the corresponding control back and forth between -100 % and +100 % in the set 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.

As soon as you have started the servo test by simultaneously pressing the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**), a window opens:



Simultaneously press the arrow keys ▲▼ or ◄► of the right touch pad (**CLEAR**) in order to end the test.

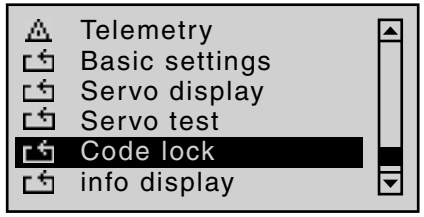
Important notice:

The shut-off of the transmitter does not automatically end an active servo test. Therefore, always stop a servo test manually BEFORE SHUTTING OFF the transmitter, because the servo test is otherwise restarted after switching on the transmitter again.

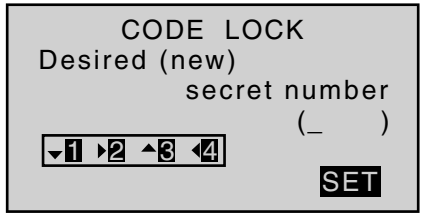
Code lock

Locking of the multifunction list

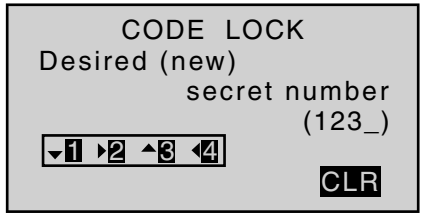
Scroll with the arrow keys of the left or right touch pad to the menu item ...



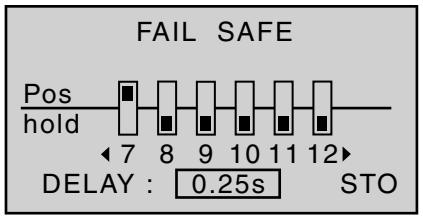
… of the multifunction menu. By briefly pressing the central **SET** key of the right touch pad, this menu item opens:



Access to the multifunction menu can be locked for unauthorized use by a four-digit secret code comprised of the numbers 1 to 4, which you enter according to the scheme shown in the display with the arrow keys of the left touch pad; for example:



As soon as you not enter the fourth number by pressing one of the other arrow keys of the left touch pad, the following notice appears in the display:

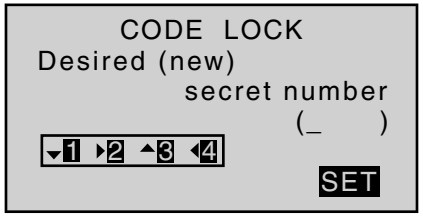


By briefly pressing the central **ESC** key of the left touch pad, *you confirm the secret code and leave the menu.*

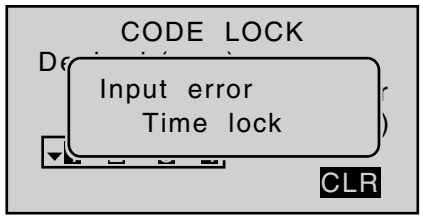
By briefly pressing the central **SET** key of the right touch pad, on the other hand, you confirm the active **CLR** field in the bottom right in the display and thereby *delete the number you entered.*

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. Calling the multifunction list and thereby a model change, for example, is no longer possible without entering the correct number combination:

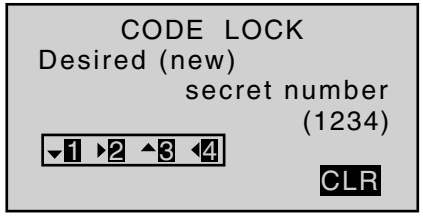


A renewed attempt following an incorrect entry is only possible after the lapse of a time-out.

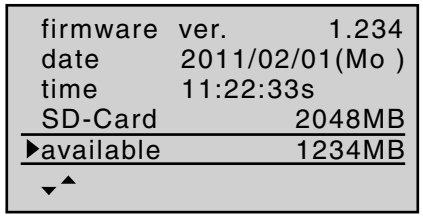


Deletion of the secret code

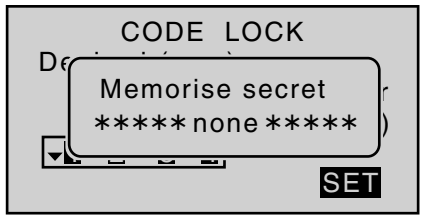
If the secret code should be deleted again at a later point in time, after opening this menu, immediately press the central *SET* key of the right touch pad **twice**:



The first time you press the central **SET** key of the right touch pad, the secret code is deleted (**CLR**):



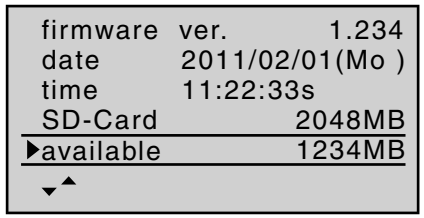
And the second time you press the key the empty input field is confirmed (**SET**). The display shows:



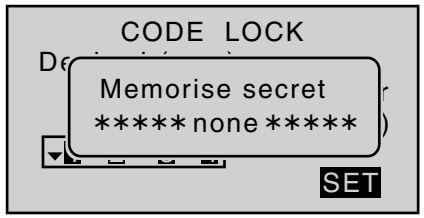
Now leave the menu by briefly pressing the central **ESC** key of the left touch pad.

Leaving the menu without input of a secret code

You would like to leave the menu opened out of curiosity or by accident and have not pressed any other key. Therefore, the display appears as follows:



Press the central **SET** key of the right touch pad **once**. The following display appears:



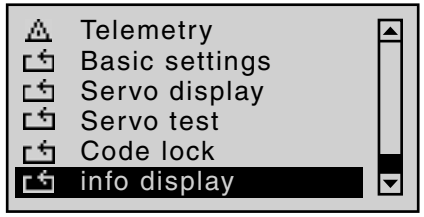
Now leave the menu by briefly pressing the **ESC** key of the left touch pad.

Tip:
*If you generally want to dispense with a programmer lock, you should, if applicable, remove this menu from the multifunction list with "**Suppress menus**" so that unauthorized persons cannot enter a secret code "on the sly".*

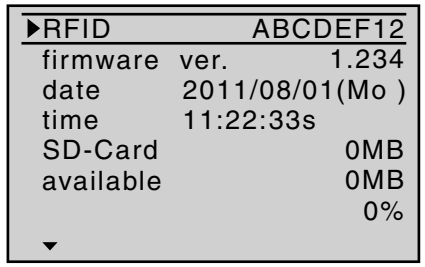
Info display

Transmitter ID, date, time and memory card

With the arrow keys of the left or right touch pad, scroll to the menu item ...



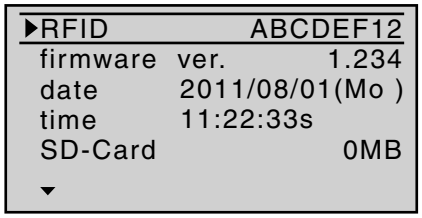
... of the multifunction menu. Briefly pressing the central **SET** key of the right touch pad opens this menu:



Transmitter-specific information is shown in this menu and – insofar as necessary and beneficial – also changed.

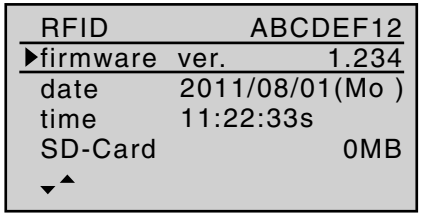
Select the appropriate line with the arrow keys ▲▼ of the left or right touch pad and then briefly press the central **SET** key of the right touch pad. In the inverse value field you can now change the respective default value – insofar as possible and necessary – with the arrow keys of the right touch pad and complete your entry by pressing the central **SET** key again.

RFID



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

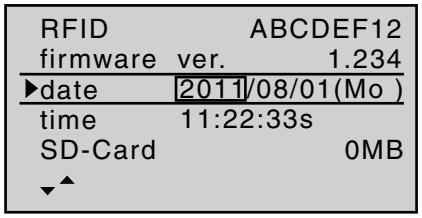


The current version number of the transmitter software is shown in this line.

Through a comparison of the number shown here with the update version offered on the internet download page of the corresponding product under www.graupner.de, you can determine whether a current update of the transmitter operating system is available.

If applicable, the version number is also required for inquiries with the service department.

Date



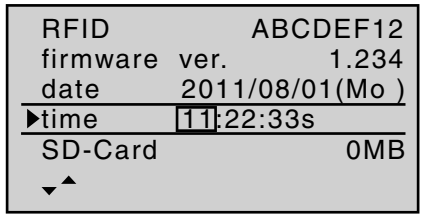
If necessary, select this line with the arrow keys of the left or right touch pad and, if applicable, the month or date field. After activation of the respective value field by pressing the central **SET** key of the right touch pad, the year, month or date can be set with the arrow keys of the right touch pad. Pressing the central **SET** key of the right touch pad again completes the respective entry. Years ranging from 2000 to 2135 are available.

The abbreviated day of the week to the right outside in brackets is automatically generated from the respective date.

Notice:

- *If the transmitter is connected to a PC as described on page 39, the date and time can also be set through the PC program provided for the respective product on 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 15.*

Time



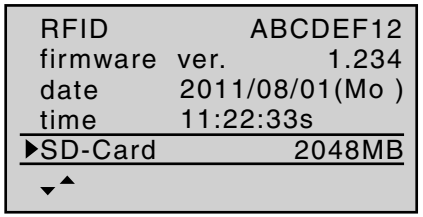
If necessary, select this line with the arrow keys of the left or right touch pad and the minute field, if applicable. After activation of the respective value field by pressing the central **SET** key of the right touch pad, the hour or minute can be adjusted with the arrow keys of the right touch pad. Pressing the central **SET** key of the right touch pad again completes the respective entry.

Contrary to this, the seconds display cannot be directly adjusted; it can only be restarted by briefly pressing the central **SET** key of the right touch pad with "00".

Notice:

- *If the transmitter is connected to a PC as described on page 39, the date and time can also be set through the PC program provided for the respective product on 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 15.*

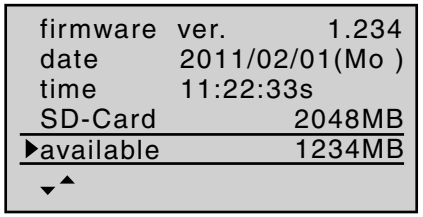
SD card



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.

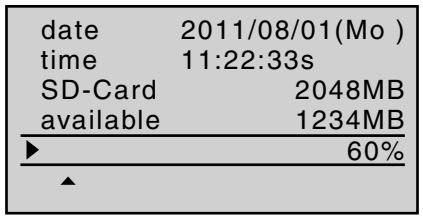
available



Display of the available storage space in MB.

As mentioned before, the 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 display.

The display of the available storage space in relation to the total memory capacity is shown in the line below:



As mentioned before, the 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 display.

mc-32 HoTT programming

Preparatory measures based on the example of a winged model

Programming models in an mc-32 HoTT ...

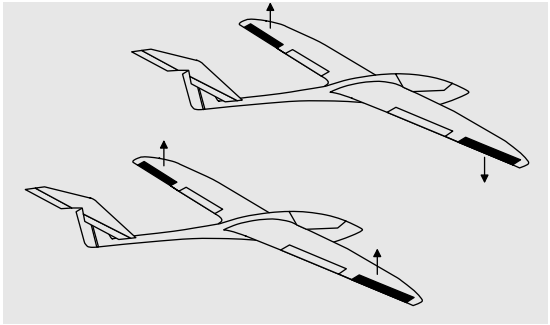
... is easier than it may appear at first!

The basic requirement for "clean" programming, however, and this applies not only to the **mc-32** HoTT, but basically to all programmable transmitters, is the 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, in the process, the servos are moved into position using a servo tester, such as the RC-Tester with Order No. **2894.12**, the "correct" position can be determined very easily.

The possibility of changing the neutral position of a servo in practically every modern transmitter is only intended for the *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.

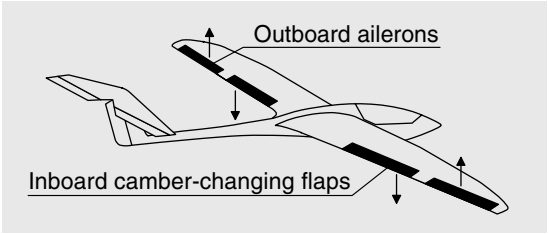


In this case the rudder arms – starting from the neutral position – should be tilted forward one lobe, pointing toward the nose, set to the respective servo.

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 not 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: Spread the flaps and look above and below the surface from the front. The greater the projected surface of the protruding rudder, the greater the brake effect.



(Eine ähnlich asymmetrische Montage der Ruderarme kann z. B. an Spreiz- bzw. Landeklappen auch in einem Motormodell sinnvoll sein.)

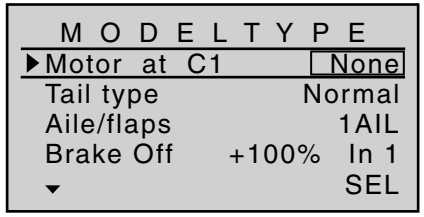
If a model is completed and mechanically attuned in this respect, you can basically begin with the programming of the transmitter. The following examples, an attempt is made to follow the practice of first describing the general basic settings and then fine-tuning or specializing them in the subsequent 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 joystick units essentially lies in the four basic functions "Power regulation (= throttle)", "Side", "Altitude" and "Transverse"! However, in the menu …

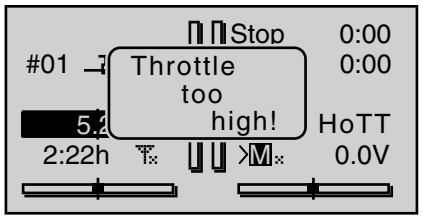
"Model type" (beginning 82)



… 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 "no" and "idle front/rear" is not only in the effect of the C1 trimming, which is over the entire joystick path with "none" and with "idle front/rear" only effects the idle direction. In the process, the "effective direction" of the C1 joystick 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 joystick is too far in the full-throttle direction:



In any case, you will also have to consider "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 joystick 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 joystick to be switchable (see Example 4, beginning on page 247) or to leave the control of the brake system at the joystick 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, Therefore, the motor can be switched on and off without having to release one of the joysticks – even in the approach. The selection is not difficult with the **mc-32** HoTT transmitter.

For the control of the motor you use a two-stage switch SW 3 or 8 or, even better, one of the two three-stage switches CTRL 9 or 10. In any case, select a switch which you can reach easily in order to perform this option without having to release the joystick. In addition, this procedure should take place on the transmitter side, which is modified for a holding hand with a manual start of the model. In other words: If the model is started from the right hand, the motor switch should be assigned to one of the switches available 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.

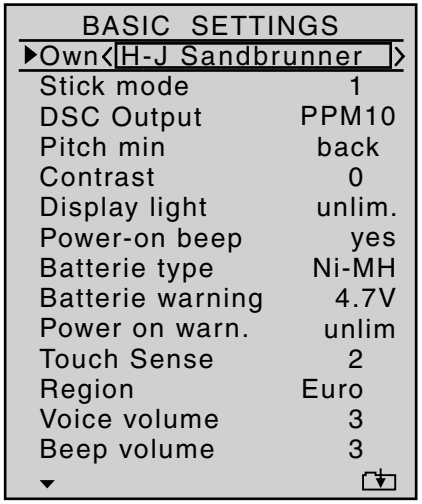
If everything is now in order, you can begin with the programming.

Initial steps for the programming of a new model

Example: Winged model with two ailerons and – initially – without motor propulsion

In the scope of the **initial commissioning of a new transmitter,** in the selection menu …

"General settings" (page 224)



… some basic information should be entered. This serves various purposes:

In this menu the name of the owner can be entered and defaults can be entered for new model memories in the lines "**Stick mode**", "**DSC Output**" and **Pitch min**". These are then adopted on the activation of a new model memory in its basic settings, but can be changed there at any time.

In the "**Contrast**" line, as an alternative to the line with the same name in the "**Hidden mode**" menu, page 28, you can adjust the display contrast by changing the standard default "0" in a range of ±20.

The setting in the "**Display light**" line determines how long the display lighting remains illuminated after the transmitter is switched on or after the last key actuation.

With the selection of "yes/no" in the "**Power-on beep**" you can determine whether the "Recognition melody", which sounds when switching on the transmitter, is switched on or off.

In the "**Battery type**" line you indicate to the transmitter whether its power supply comes from a four-cell NiMH battery or a single-cell LiPo- battery and in the "**Battery warning** " line you can determine the corresponding switching threshold for the battery warning on an individual basis. Make sure that you do not enter a value which is too low, so that you do not have sufficient time to safely land your model in the event of a battery warning.

In the "**Power-on warning**" line, you can determine, as necessary, 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, whereas the settings in the lines "**Touch sensitivity**", "**Voice volume**" and "**Signal volume**" are provided for personal comfort.

On the other hand, the setting in the "**Region**" is anything but a matter of taste and is determined by statutory regulations: **Therefore, when in France, only commission the transmitter with the "France" setting.**

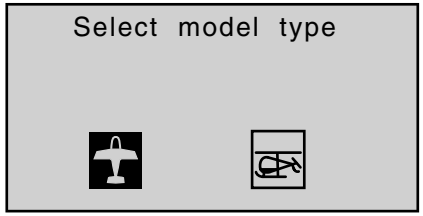
You can leave this menu after completion of your "General settings" with the central **ESC** key of the left touch pad to return to the multifunction list.

For the programming of a new model, now use the arrow keys of the left or right touch pad to switch to the menu ...

"Select model" (page 63)

…, and with the select a free model memory location with the arrow keys of the right or left touch pad:

Immediately after pressing the central **SET** key of the right touch pad for the confirmation of this selection, the type of model to be programmed is requested:

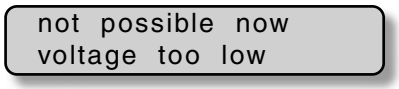


Since we want to work with a winged model in this section, the symbol for a winged model is confirmed by pressing the central **SET** key of the right touch pad. The display switches back to the base screen.

Notice:

- *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! In any case, you can undo this by subsequently deleting the respective model memory.*

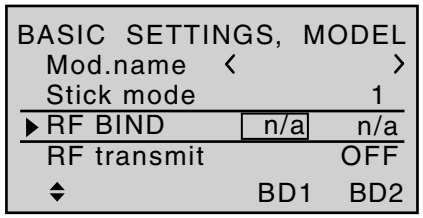
- *If the battery voltage is too low, you cannot switch models for safety reasons. A corresponding message appears in the display:*



Once this first hurdle is cleared, the connection of the receiver built into the model to this model memory can be made in the menu …

""Basic model settings" (page 68 … 73)

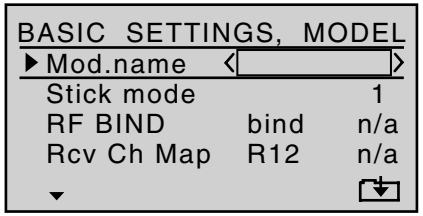
. For this purpose, switch to the line "**RF bind**":



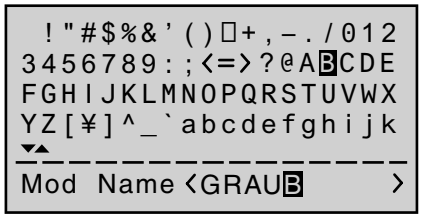
Notice:
After confirmation of the model selection in the base screen, if you confirm the message appearing in the screen for a few seconds …

… by pressing the **SET** *key of the right touch pad, you automatically come to this line.*

In this line you delete the connection process between model memory and receiver, as described in detail on page 69. Otherwise, you cannot address the receiver.
Afterwards, using the arrow keys ▲ of the left or right four-way pad, move up to the first line and begin with the actual model programming in the "**Mod. Name**" line:

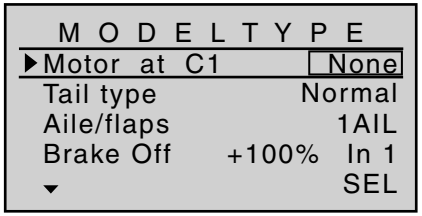


Now enter the "**Model name**" here by briefly pressing the central **SET** key of the right touch pad to switch to the character map:



If applicable, the defaults adopted from the "**General settings**" menu for **"Stick mode"** and **"DSC output"** are also checked and changed as necessary.
In the menu …

"Model type"

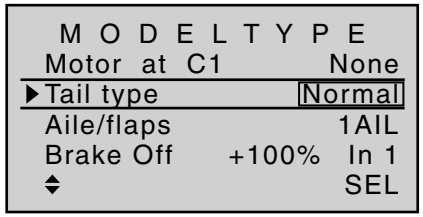


… the principle arrangement of the servos in the model is selected and communicated to the transmitter. The following selections are available:

"Motor at C1"

- "none"
  Trimming works independently of the joystick position and the "Brake settings" submenu of the "**Wing mixers**" menu, beginning on page 146, is available without limitation.
  The "Throttle too high" warning message, see page 36 and/or 61, and the "Motor stop" option are *deactivated*.
- "(Idle) front or rear"
  C1 trimming is affected in the front or rear and the "Motor stop" option is *activated*.
  If the throttle joystick is too far in the full throttle direction when switching on the transmitter, this is indicated to you with the warning message "Throttle too high".
  In parallel to this, the "Brake settings" submenu of the "**Wing mixers**" menu, beginning on page146, is only available if "none" is entered in the "Motor" column for the currently active flight phase in the "**Phase settings**" menu, page 128.

In the next two lines, the principle arrangement of the servos in the model is selected and communicated to the transmitter:

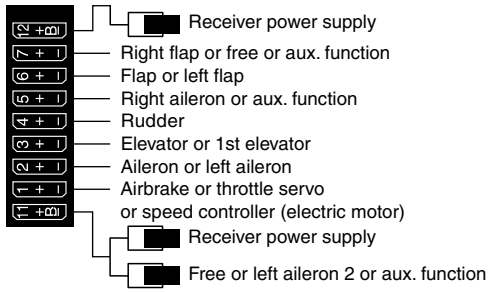


Tail type: "Normal", "V-ta(il)", "Delta/fl" or "2ELSv3+8"

"**Aile/flaps**": 1 or 2 AIL servos and 0, 1, 2 or 4 FL servos

Since we want to actuate the brake system of the "Brake settings" submenu under the "**Wing mixers**" menu with the C1 joystick, we will leave the setting to the outer right in the "**Brake off**" set to "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 joystick movement.

By now, the servos should be plugged into the receiver in the standard Graupner sequence:



Comments:

- *If a V-tail unit should move incorrectly either "high/low" or "left/right", please observe the information in the table on page 57 in the right column. The same process applies for 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 272.*

In the menu …

""Servo setting" (page 90)

▸S1	=›	0%	100%	100%
S2	=›	0%	100%	100%
S3	=›	0%	100%	100%
S4	=›	0%	100%	100%
S5	=›	0%	100%	100%
◂▸ Rev		cent	− trv	+

… the servos can now be adapted to the requirements of the model for "**Rotational direction**", "**Neutral position**", "**Servo travel**" and "**Travel limit**".

In this sense, all settings which serve for the compensation of the servos and *minor* adaptation to the model are "necessary".

Notice:

- *The maximum possible throw of a Graupner servo is 150% per side, based on both mechanical and electrical reasons. For example, if the the sum of the values of the columns "Center" and "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 the mixer and settings in the "**Dual Rate / EXPO**" menu also have an influence on the 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.*

In the last column, "**Lim. +**", the basic settings can and should be taken back significantly from 150% in each case.

The values entered in this position act as a quasi "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 the *End* of the available mechanical play on the servo, rudder and/or steering is crucial 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 joystick. As long as the rudder is only controlled with the corresponding joystick, there will not be any further problems with this. Currently, however, in addition to the normal rudder signal a mixer influences the rudder, such as an "AI → RU" mixer (aileron to rudder), and the two signals can combine to have an excessive effect.

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, of course, also be reduced to the that a start-up would not even occur with an addition of the maximum values. With this method, however, the prevention of an actually occurring event would result in a permanent reduction of the normal rudder throw.

The

menu …

"Joystick setting" is not only interesting for pilots of models with motors. (page92)

▶Ch.1	GL	4	0.0s	0.0s
Aile	GL	4	0.0s	0.0s
Elev	GL	4	0.0s	0.0s
Rudd	GL	4	0.0s	0.0s
▼		Tr St	− time	+

In addition to the generally interesting adjustment of the increments in the column St" (number of trim increments for each "Trim lever click") of the digital trimming – separately adjustable for each of the four trim levers – 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 work "globally" in equal measure over all flight phases or separately in each (flight) "phase".

The "Time" column, on the other hand, is not of interest for this initial programming.

With the previous settings, you can basically fly winged and motor models – the latter if you have set the idle joystick direction correctly in the "Motor at C1" of the **"Model type"** . 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" (page 146 … 163)

… where various options are available depending on the specifications made in the **"Model type"** menu, page 82. Since in this section we are dealing with a model with only two servos in the wings, the Multi-flap menu beginning on page 157 is not shown.

WING MIXERS			
▶Brake settings			=>
Aile.diff.			0%
AI –> RU			0% –––
EL –> AI		0%	0% –––
▼			

Therefore, we will begin with the submenu ...

BRAKE SETTINGS
off

If this display appears, you model is equipped with a motor, contrary to the assumption of this section, and therefore you have selected "front/rear" instead of "none" in the line "Motor to C1" of the "**Model type**" menu, page 82. Therefore, change this setting temporarily or change the "yes" entry in the "Motor" column of the " Phase setting " menu, page 128 to "no" for the currently active flight phase –Phase 1 in this case.

▶Pha1	*		no
Pha2	–		yes
Pha3	–		yes
Pha4	–		yes
Pha5	–		yes
◀▼		Name	motor

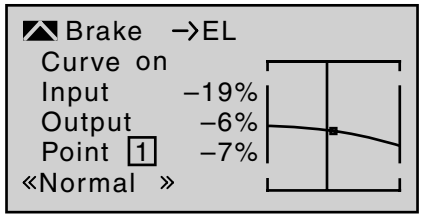
…

BRAKE SETTINGS		
▶Crow	0%	
D.red	0%	
Elevat curve		=>
▲▼	AILE	

After this statement about mutual dependencies, back to the topic:

If the ailerons should be elevated for braking, an appropriate value is then entered in the "**Crow**" line after activation of the value field of the "AILE" column. 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 joystick, 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.

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.

The option "**AI → RU**" (Aileron → rudder) also serves a similar purpose, as well as for the comfortable control of a model. A value around 50 % is a practical value to start with. 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 last option of the "**Wing mixers**" menu, "EL → AI" mixer, is not currently of interest.

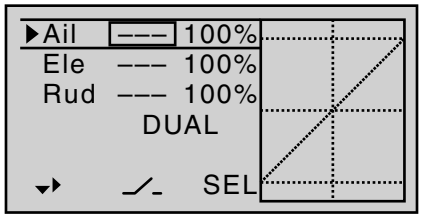
If the model-specific settings were made thus far, the initial start can be considered. If course, at first you should perform a "dry run", meaning you should carefully check all the settings once again on the ground. Incorrect programming can damage more than just the model! In case of doubt, ask the 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 …

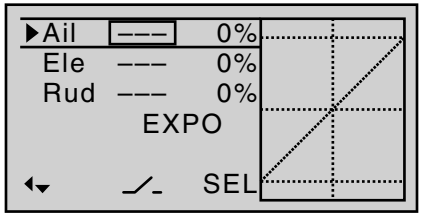
""Dual Rate / Expo" **menu** (page 108)

… to your own requirements and habits.

With "**Dual Rate**" the relationship of the joystick travel to control travel is adjusted, see page 108:



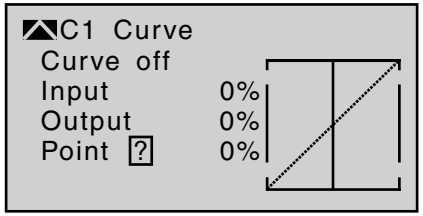
On the other hand, if the maximum throws are OK and only the reactions around the center position are to strong for more sensitive controls, then the "exponential" functions comes (additionally) into play:



If a switch is also assigned, switching can even take place between two dual-rate/expo settings during the flight.

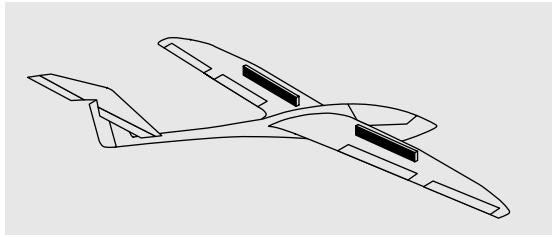
This is similar for the option …

"Channel 1 curve" (page 116)



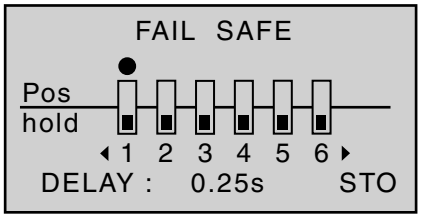
With this option, one or multiple points of the control curve of the throttle/brake joystick can be influenced in such a way that a pleasant or even purposeful behavior is guaranteed.

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 joystick 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.)



After this, you must define the behavior of the receiver in the event of a failure in the …

"Fail safe" **menu** (page 196)



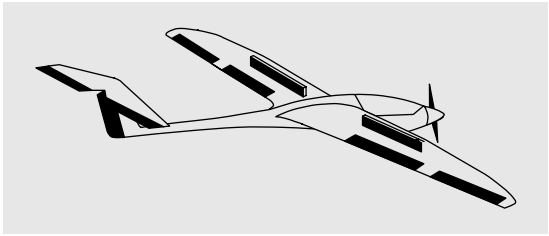
… because "doing nothing" is the worst thing which can be done for a winged model.

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 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

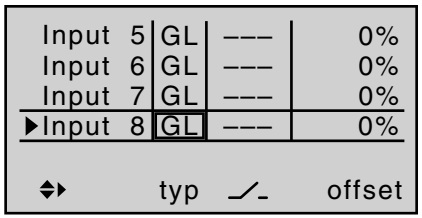


An electric drive can be controlled in different ways: The simplest method to integrate one such drive into the model programming is with the use of a throttle/ brake joystick (C1). However, since this is already specified for the brake system in the course of the model programming described above, either the switchable solution described beginning on page 247 or even the use of an alternative control is possible.

As such, one of the two three-stage switches CTRL 9 or 10 is better suited than the proportional rotary control CTRL 6 ... 8. (Unlike rotary controls, switches can be operated with one finger without having to release the joystick). An alternative would also be one of the two-stage switches. Basically, the switch should be positioned conveniently within 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.

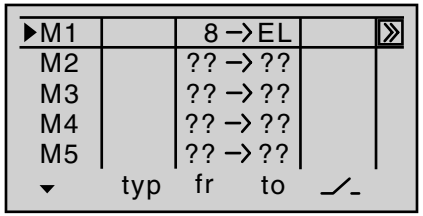


A common option in the following examples 1 ... 5, the automatic tracking of the elevator trimming in the power flight, should also be mentioned at the beginning of this section:

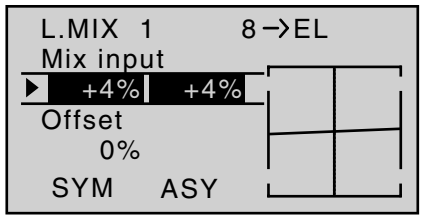
If it becomes apparent after the initial power flights that the model must be continuously corrected with the elevator while the motor is switched on, this situation can be corrected by setting a free mixer and adjusting it accordingly. For this purpose, switch to the menu ...

""Free mixers"

... and program one of the linear mixers M1 ... 8 or, if applicable, also one of the curve mixers K9 ... 12 from "channel controlling the motor" according to "Ele", e.g. of "8 → Ele":



On its second screen page, the required – usually low – correction value is entered:



Notice:
*The adjustment of a curve mixer is described in detail in the section "**Channel 1 curve**" starting on page 116.*

Example 1

Use of a proportional rotary control CTRL 6 ... 8

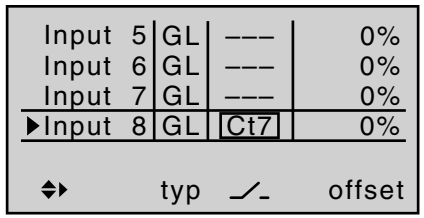
If one of these controls is used, the connection is very simple. Only the motor controller (speed control) has to be connected to a free servo connection 5 ... 12 of the receiver.

Bear in mind that, depending on the model type and number of aileron and flap servos, the output 2 + 5 or 6 + 7 are already linked.

Therefore connect your speed controller to the next free input and assign the selected input – for example, "Inp. 8" – one of the proportional rotary controls CTRL 6 ... 8. For example, CTRL 7. This is carried out in the menu ...

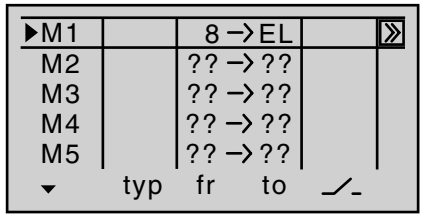
""Control adjust" (page 96)

With the arrow keys ▲▼ of the left or right touch pad, select the desired line. Then, by pressing the central **SET** key of the right touch pad, you active the "Switch and control assignment". Now turn the knob of the proportional rotary control. After a short time, the entry, e.g. "Control 7", appears in the inverse field.



Since the drive should usually be available depending on the current flight phase, if applicable, you should leave the standard default "GL" in the "Type" column – as already mentioned earlier in this section.

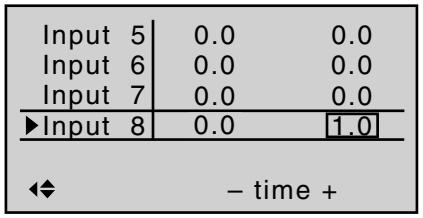
If applicable, for the necessary adjustment of the appropriate control travel for the motor control (speed control), use one of the arrow keys to switch to the right from the "Offset" column to the "- Travel +" column.



If you now switch to the ◄Servo display" by simultaneously pressing the keys of the left touch pad and then actuate the rotary control, you will see the columns of Channel 8 "wander from one side to the other and back.

However, if you rotate the proportional rotary control too fast – in practice – the resulting abrupt motor start-up can briefly strain the entire drive string. You should definitely counteract this effect ahead of time with an appropriate value in the "Time" column for such cases.

Therefore, using one of the arrow keys, switch one column to the right, to the "Time" column and then move the selected control close to "Full throttle" so that the marking frame is only placed around one value field. Now enter a value of at least 1 s, ...



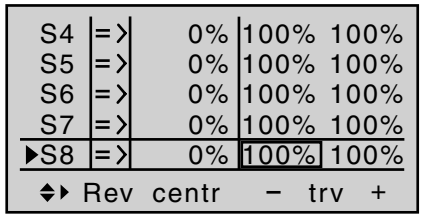
… with which a movement of the proportional control in the "ON" on direction which is too fast is processes move gently, and you can check immediately this by switching to the "**Servo display**".

Notice:

- *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".*
- *If you have defined flight phases in the "**Phase setting**" and "**Phase assignment**" menus, the settings described above must be made in the same manner for each active flight phase. Otherwise, you may wonder why the drive motor begins running at half power after a phase change, but does not react to movements or the rotary knobs …*

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 "- Travel +" column. Alternatively, you can also carry out these settings in the menu ...

""**Servo adjustment**" (page 90)



.

Example 2

Use of a three-stage switch CTRL 9 or 10

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. 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 two control types only has an effect on the type of clock control, see page 252.

Notice:

- *By shifting the neutral position and then adjusting the travel so that the offset value on the side to which the neutral point was shifted is subtracted from the travel and added to the other, the "Half throttle position" can be influenced in the "**Control adjust**" menu. Therefore, with an offset value of -20 %, for example: +80 % on the minus side of the travel setting and +120 % on the plus side and vice versa.*
- *If you have defined flight phases in the "**Phase***

***setting**" and "**Phase assignment**" menus, the settings described above must be made in the same manner for each active flight phase. Otherwise, you may wonder why the drive motor begins running at half power after a phase change, but does not react to movements or the switch …*

Example 3

Use of a two-stage switch SW 2, 3 or 8

This variant realizes a purely ON/OFF function.

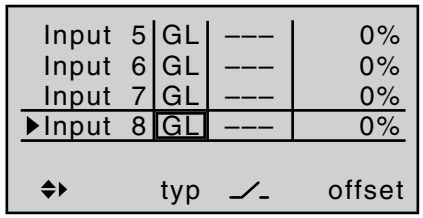
On the receiver side, either a simple electronic switch or – if a gentle motor start-up, for example, is desired – an appropriate motor control (speed control) is required.

With the exception of the assignment of a different control, 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 control types only has an effect on the type of clock control, see page 252.

Only the type of representation of the selected switch in the dispay of the menu …

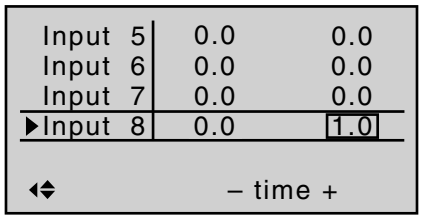
""Control adjust" (page 96) **differs from the description there.**



Like with example 1, you also switch to the line of a free input, activate the "Control and switch assignment" in the third column and then move the selected control, in this case Switch "2" from the desired Motor OFF position to Motor ON.

In this case – as already mentioned earlier in this section – you leave the standard default "GL" in the "Type" column.

The setting of the appropriate control travel for the motor control (speed control) is made in the "- Travel +" 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:



All other settings - as already mentioned earlier in the example - take place analogously to Example 1. Therefore, the same comments and recommendations apply.

Notice:

- *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".*
- *If you have defined flight phases in the "**Phase setting**" and "**Phase assignment**" menus, the settings described above must be made in the same manner for each active flight phase. Otherwise, you may wonder why the drive motor begins running at half power after a phase change, but does not react to movements or the switch …*

Example 4

Before we discuss the programming of this fourth example or turn the to the expansion of the previously described basic programming, a few words should be said about the position of the throttle/brake joystick with "Motor OFF" or "Brake OFF". Normally the C1 control joystick is moved forward for the throttle control and backward for the extension of the brake. If, in this "classic" assignment, you switch to the brake system with Motor "OFF" (= joystick "back"), for example, "full brake" would be applied after the switch time you specified in the "**Phase setting**" menu, or vice versa, if you switch to drive with the "brake retracted" the motor would be switched 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 and then the power decreases, if applicable (and hopefully you will not forget to push the C1 joystick "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".

Whatever the case may be, the **mc-32** HoTT transmitter enables 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" (beginning on page 82)

Here you first specify in the "motor" line whether the throttle minimum position (= Motor "OFF" position) should be at the "front" or "rear" - 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		2AIL
Brake Off	+100%	In 1
▼		SEL

Notice:
With the selection of "Throttle min front/rear" 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 joystick. Since the C1 trimming is not normally used with electric drives, however, this has no further relevance.

You adjust the "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 = rear". On the other hand, if you prefer "Brake retracted = front", select the "Brake offset" line and define the offset point – as described on page 83 – as "front":

MODEL TYPE		
Motor at C1		vorne
Tail type		Normal
Aile/flaps		2AIL
▶Brake Off	–90%	In 1
▲		STO SEL

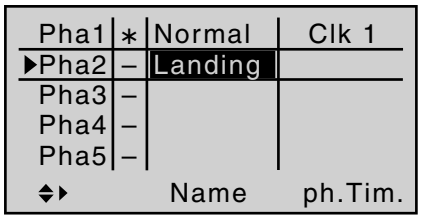
In the process, if the offset point is not placed completely at the end of the control travel, the remainder of the travel is "idle" up to this limit. This idle path ensures that all brake settings remain at "neutral", even with minor deviations from the limit of the brake flap control. At the same time, 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 joystick on the motor can be influenced. For this purpose, switch to the menu ...

"Phase setting" (page 128)

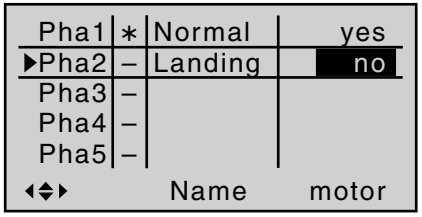
... and assign a meaningful name, such as "normal", from the list for "Phase 1" after activation of the selection field in the "Name" column. The asterisk in the second column indicates which phase is currently active.
As long as no phase switches are assigned, this is always Phase 1. Give "Phase 2" the name "Landing" in accordance with the example.

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 run time through the C1 joystick:

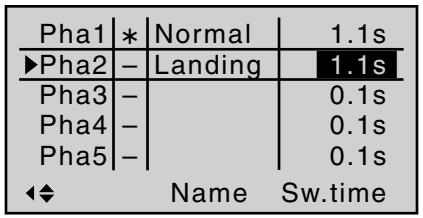


Then the timer is controlled through a corresponding control switch to be defined on the C1 joystick. As soon as you switch to the "Landing" flight phase, this flight phase timer is automatically stopped and hidden in the base screen. More about this can be found on page 142.

Now move the marking 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 joystick and the brake system to be adjusted in the "Brake settings" submenu of the "**Wing mixers**" menu should be shut off (= "yes") and vice versa (= "no"):



Now move the marking 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:

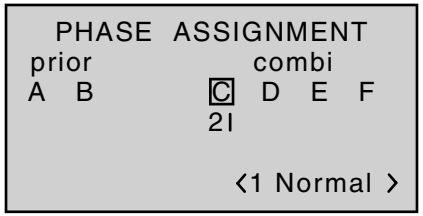


Then you must assigned these two flight phases to a switch with which you can switch between the two flight phases during the flight. In this case, a single switch is sufficient. It should be easy to reach, however, so that you can still switch between "motor" and "brake" during a landing approach, for example, without having to release a joystick.

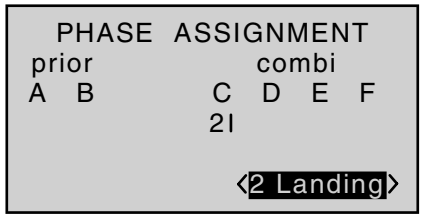
The assignment of the selected switch takes place in the menu ...

"Phase assignment" (page 134)

Select the switch symbol under "C" with one of the arrow keys. After briefly pressing the central **SET** key of the right touch pad, actuate the desired switch, such as "SW 2".



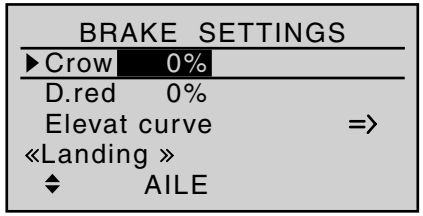
Both switch positions, in other words ON (I) and OFF (⌇) are initially assigned in the bottom right of the display to the phase "1 normal". With one of the arrow keys, select this value field and then, by briefly pressing the central **SET** key of the right touch pad, activate the selection list of the phases which you set up in the "**Phase setting**" menu. 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 submenu ...

""Brake settings" (page 160)



… of the "**Wing mixers**" menu, set the desired throw of the ailerons with actuation of the C1 joystick ("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 160.

In the line "D.red" (differentiation reduction), enter a value which corresponds to the value you entered or enter on the first page of the "**Wing mixers**" menu in the

line "Aile.diff."

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 joystick in the "normal" flight phase, whereas this should be switched off in the flight phase "landing" (Servo 1 in "**Servo display**" independently 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 joystick 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.

C1 joystick switchable between E-motor and spoiler

Example 5

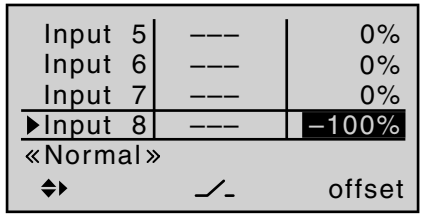
If, contrary to the assumptions of the preceding Example 4, the model has additional spoilers or only spoilers, they can be incorporated into the control of the model by means of the following programming.

For this purpose, program the menus "**Model type**", "**Phase setting**" and "**Phase assignment**" in the same manner as described under Example 4. The settings described there in the "Brake settings" submenu of the "**Wing mixers**" menu, on the other hand, are only relevant if you would like to use an additional crow system in parallel to your spoilers.

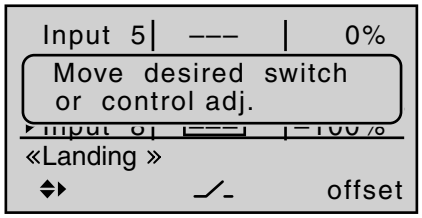
With the settings described under Example 4, the control of the E-motor and, if applicable, that of a crow system will function as usual. Only the control of a spoiler connected to Output 8, for example, must additionally be programmed. For this purpose, switch to the menu …

"Control adjust" (page 96)

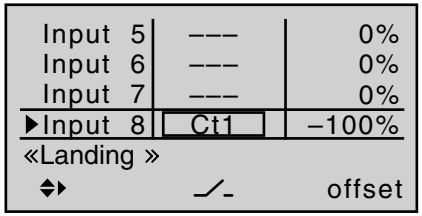
… and switch to the flight phase "**normal**". Now, using the arrow keys, switch to the "Offset" column of the line "Inp. 8". After activation of the value field by briefly pressing the central **SET** key of the right touch pad, change the offset value in the now inverse value field of Input 8 until your spoilers are "retracted" again:



Confirm this setting by briefly pressing the central **ESC** key of the left key pad or the central **SET** key of the right touch pad and then switch to the center column to the left. Now switch to the flight phase "**Landing**" and then briefly press the central **SET** key of the right touch pad. The display shows the window ...



Now move the C1 joystick As soon as this is recognized, "Ct1" appears in the display instead of "---":



Leave the offset value in this flight phase to "0 %". If necessary, however, you may have to change the leading symbol of the travel setting to reverse the control direction by switching the travel setting from +100 % to -100 % in the "Travel" 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 by simultaneously pressing the keys ◄ ► of the left touch pad. 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.

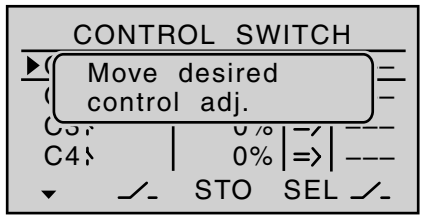
Timer confirmation with control or switch

Examples 4 and 5 of the preceding pages

If you have decided to continue with the model programming on described on the previous pages for **Example 4,** page 247 or **5,** page 250 or you intend to use the C1 joystick (throttle/brake joystick) for the power regulation completely independently of this example programming, you can use a control switch for the automatic starting and stopping of the timer. For this purpose, first switch to the menu …

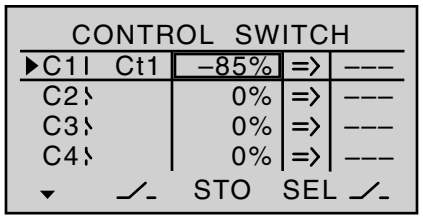
"Control switches" (page 123)

… and select the line of a control switch which has not been assigned yet with the arrow keys. After activation of the control assignment by briefly pressing the central **SET** key of the right touch pad, the following window appears:



Now simply move the C1 joystick (throttle/brake joystick) from the motor "OFF" position in the motor "ON" direction.

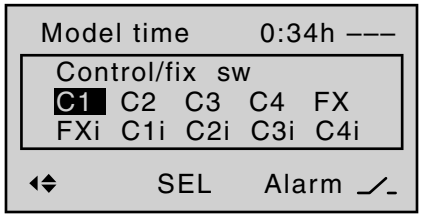
The switch to the column above **STO** using the appropriate arrow key and move the C1 joystick near the motor "OFF" position and define the switch point at the selected position by briefly pressing the central **SET** key of the right touch pad. The switch status is shown to the right of the control number:



In order to assign the control switch you just crated to the desired timer, switch to the menu ...

""Timers (gen.)" (page 138 … 141)

…, and, with the arrow keys, select the line "Top", to which the "Tim(ers)" are assigned by standard. In this line, move the marking frame over the "Timer" column to the right, to the column above the switch symbol, using the appropriate arrow key of the left or right touch pad. Now press the central **SET** key of the right touch pad twice: Pressing once activates the switch assignment and tapping again opens the list of the "expanded switches":



Now select the previously programmed control switch, Ct1 in the example, and assign it to the timer by briefly pressing the central **SET** key of the right touch pad:

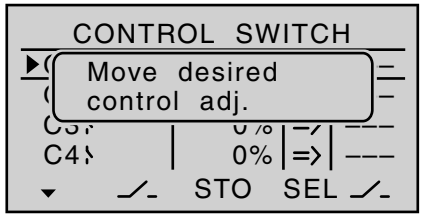
The timer in the base screen now starts with movement of the C1 joystick toward full throttle and stops if you pull the C1 joystick back over the switching point.

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 244, first switch to the menu ...

"Control switches" (page 123)

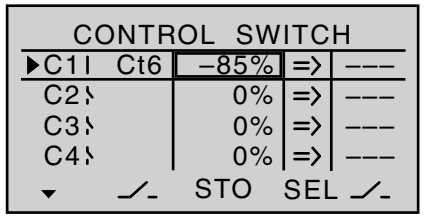
… and select the line of a control switch which has not been assigned yet with the arrow keys. After activation of the control assignment by briefly pressing the central **SET** key of the right touch pad, the following window appears:



Now simply move the respective proportional rotary control, e.g. CTRL 7, from the motor "OFF" position in the motor "ON" direction.

The switch to the column above **STO** using the appropriate arrow key and move the selected control near the motor "OFF" position and define the switch

point at the selected position by briefly pressing the central **SET** key of the right touch pad. The switch status is shown to the right of the control number:



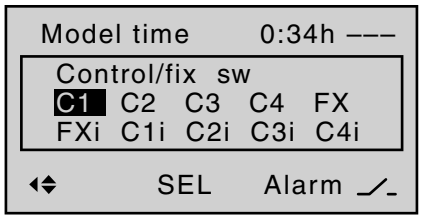
Notice:
Now place the switching point; but do not put it at the limit position of the control, because safe switching is not assured when doing so.

Ct1 used in the example here should be "closed" in the "full throttle" direction and "open" below the switching point.

Now switch to the menu ...

""Timers (gen.)" (page138 ... 141)

..., and, with the arrow keys, select the line "Top", to which the "Tim(ers)" are assigned by standard. In this line, move the marking frame over the "Timer" column to the right, to the column above the switch symbol, using the appropriate arrow key of the left or right touch pad. Now press the central **SET** key of the right touch pad twice: Pressing once activates the switch assignment and tapping again opens the list of the "expanded switches":



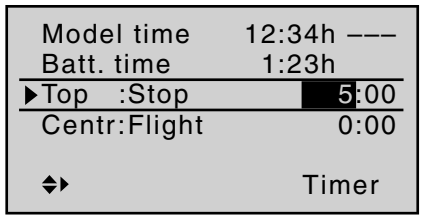
Now select the previously programmed control switch "Ct1" and then press the central **SET** key of the right touch pad.

The timer in the base screen now starts with movement of the proportional rotary control toward full throttle and stops if you pull it back over the switching 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 described 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 briefly before the expiration of the permissible time, e.g. "30 s" before, have the transmitter issue an acoustic warning signal:



Servos running in parallel

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 V-cable. However, this has the disadvantage that the servos combined in this manner can no longer be adjusted individually and separately from the transmitter – the advantage of a finely tuned adjustment of the respective servos to one another by a computer remote steering system would no longer be provided. This is similar for the so-called "Channel Mapping" described in the scope of the "**Telemetry**" menu: In comparison to the adjustment possibilities of the transmitter, there are also limitations with this process.

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 with the use of a "**cross-mixer**", because this is quicker and easier to program. Contrary to this, the second variant, also permits asymmetric and/or non-linear curves with the use of the "**Free mixer**" menu.

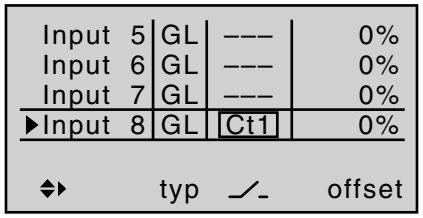
Two brake or spoiler servos

For the operation of your brake flaps and/or spoilers in each wing half you have installed a servo and kept the default linear control characteristics unchanged in the "**Channel 1 curve**" menu.

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, such as Output "8". Now switch to the menu …

" Control adjust" (page 96)

… and, using the arrow keys, assign the "Control 1" in the line of Input 8:



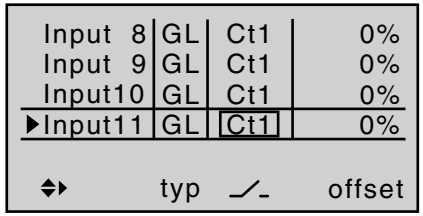
Leave the standard settings for the remaining values. If necessary, carry out the required servo travel adjustments in the "**Servo adjustment**" menu. There you can also adjust the travel of servo 1 and 8 to one another, if necessary.

Important notice:
*If you have defined flight phases in the "**Phase setting**" and "**Phase assignment**" menus, the settings must be made in the same manner for each active flight phase. Otherwise, you may wonder why only one spoiler can be moved as intended and the other remains in its half extended position …*

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 5 ... 12. The inputs of the corresponding assigned control channels are then each assigned to Control 1; for example:



Important notice:
Since the motor control unit should be available regardless of a currently active flight phase, make sure to leave the standard default "GL" in the "Type" column.

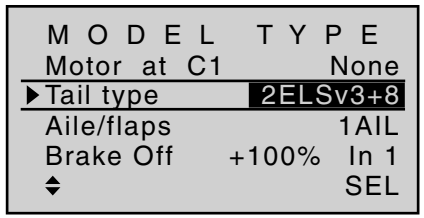
Two elevator servos

Two elevator servos should be switched in parallel. According to the receiver assignment plan, see page 57, 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 preconfiguration of a corresponding mixer. You can find this in the ...

"Model type" menu (page 82)

In this menu switch to the "Tail" line using the arrow keys, activate the value field by briefly pressing the central **SET** key of the right key pad and select the entry "2ELSv3+8":



Then carry out the fine-tuning of the travel of the two servos "as accustomed" in the "**Servo adjustment**" menu.

Two rudders

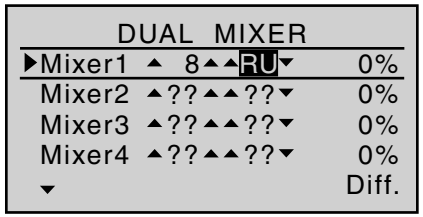
We want to switch two rudders "in parallel". The second rudder is located at the free receiver output 8.

Variant 1

In the menu …

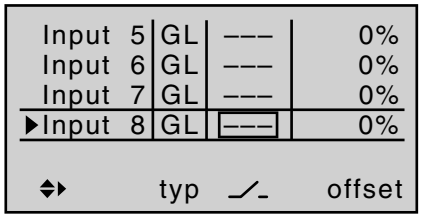
"Cross-mixer" (page 194)

… select one of the cross-mixers and enter "8" and "RU" in its left and center value fields, as shown in the figure:



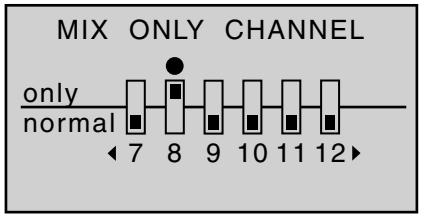
The same deflection "▲ ▲", which would take place through "Input 8" may not have an effect here. Therefore, you should make absolutely sure in the …

"Control adjust" **menu** (page 96)



… that "Input 8" is set to "free" so that the control function is separate from the control channel.

Alternatively, You can set Input 8 in the "**Only mix channel**" *to "no control"*, regardless of the flight phase, by setting Channel 8 to "only mix":

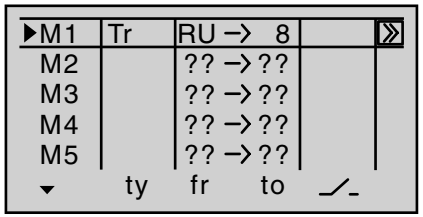


Variant 2

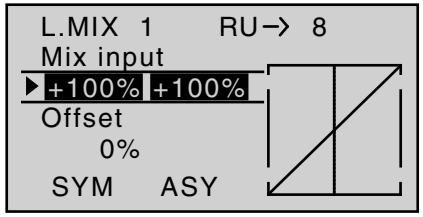
With this variant a mixer, "Tr Rudd 8" should be set in the menu …

" Free mixers " (page 181)

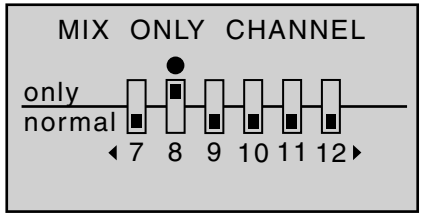
→. In the "Type" column, select the setting "Tr" so that the rudder trimming affects both rudder servos:



Then switch to the graphic screen and set a symmetric mixture of +100%.



"Input 8" should also be programmed to "free" here in the "**Control adjust**" - in all flight phases, if applicable. However, control function "8" can be separated from control channel "8" more easily in the flight-phase independent menu "**Only mix channel**", page 193:



Use of flight phases

Up to seven different flight phases (flight statuses) can be programmed with settings independent of one another within one of the model memories.

Each of these flight phases can be called with a switch or a switch combination. This makes it possible to switch between different settings for the various flight statuses, such as "Normal", "Thermal", "Speed", "Distance", etc., simply and conveniently. 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.

Before you begin with the actual programming of flight phases, you should consider whether the digital trimming of transverse, altitude and side should have be "global" – in other words, the same for all flight phases – or per "Phase" – in other words, each flight phase is individually variable.

If you decide in favor of a phase-specific trimming of the elevator, for example, switch the menu …

"Joystick setting" (page 92)

… and change the standard "global" default accordingly.

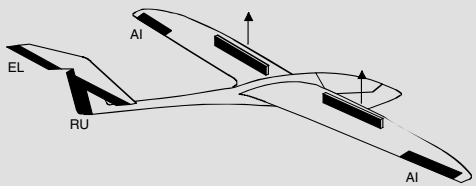
The same applies for the number

of trimming steps in the column "St":

Ch.1	GL	4	0.0s	0.0s
Aile	GL	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.



The control of the E-drive takes place independently of the C1 joystick with one of the two proportional rotary controls CTRL 7 or 8 or with one of the two three-stage switches CTRL 9 or 10. The motor control is connected to receiver Output 9 according to the description beginning on page 244 and Examples 1 and two which serve as the basis of this continuation. In the "**Model type**" menu, therefore, "None" was selected in the "Motor to C1" line, which has the consequence, among other things , that the "Motor" column in the "**Phase setting**" menu is hidden and the "Brake settings" submenu of the "**Wing mixers**" menu is available without limitation.

1. Step

"Phase setting" (page 128)

Pha1	∗	Normal	
Pha2	+	Thermal	
Pha3	+	Speed	
▶Pha4	+	Launch	
Pha5	–		
▲▼▶		Name	ph.Tim.

Initially, one or 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 switching time take place, as "usual", by pressing the corresponding key(s) of the two four-way touch pads.

Notice:
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) ...

Pha1	∗	Normal	4.0s
Pha2	+	Thermal	3.0s
Pha3	+	Speed	2.0s
▶Pha4	+	Launch	1.0s
Pha5	–		0.1s
◀▲▼		Name	Sw.time

… you can define the time for the "cross-fading" when switching from any other flight phase to this one in order

to enable a "smooth" transition of the various servo positions. 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 "*".

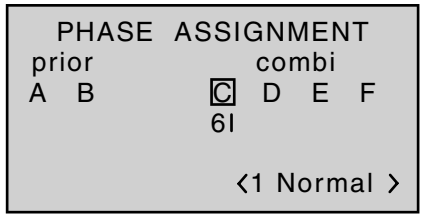
2. Step

In order to actually be able to switch between the individual flight phases, the assignment of one or multiple switches is necessary. One of the two three-stage switches (CTRL 9 or CTRL 10) is best suited for switching of up to three flight phases.

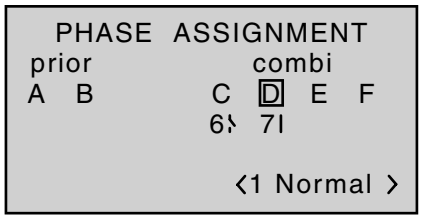
Each of the two switch limit positions is assigned to one of the flight phase switches A ... F, *starting from the center position*. The assignment of the switch takes place in the menu ...

"Phase assignment" (page 134)

First select "C" with the marking frame. The briefly press the central **SET** key of the right touch pad and move the switch from the center position to a limit position, for example, downward:

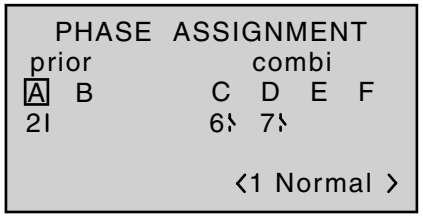


Move the switch back to the center position and then select "D", and after activation of the switch assignment, move the switch to the other limit position, for example, to the top:



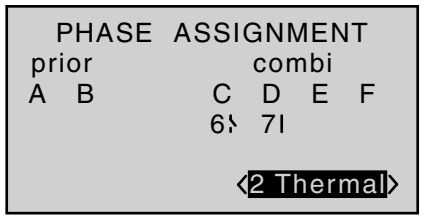
Now the three-stage switch is programmed.

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:



Then the respective switch positions must be assigned corresponding flight phases (names). Although you have already assigned names for some flight phases, the phase name "1 normal" still appears in the right of the display; see the figures above.

First move the three-stage switch to the limit position, for example to the top, and switch with the marking frame in the display down to the right to the value field for the flight phase name. Briefly press the central **SET** key of the right touch pad for the activation of the input field and select the desired flight phase for this switch position, in this example "2 Thermal", with the arrow keys:



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".

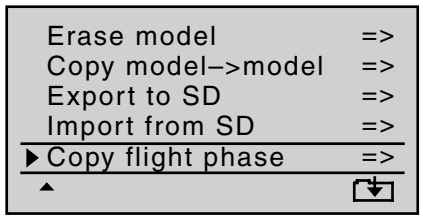
Briefly pressing the central **ESC** of the left touch pad or the central **SET** key of the right touch pad completes the time name assignment.

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 center position of the three-stage switch.

3. Step

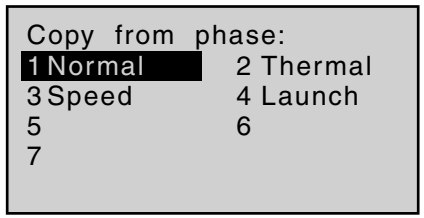
In order to not have to carry out all previously made settings for the model in the "new" flight phase from the ground up, we recommend first copying the already tested programming of the flight phase "Normal" to the other flight phases. This is carried out in the menu …

"Copy / Erase" (page 64)



Here, select the menu item "Copy flight phase" with the arrow keys and then briefly press the central **SET** key of the right touch pad.

In the appearing window, "Copy from phase", "1 Normal" is selected ...



… and then briefly press the central **SET** key of the right touch pad, whereby the display switches to "Copy to phase". Now the target is selected (initially "2 Thermal") and confirmed by pressing the central **SET** key of the right touch pad again. 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").

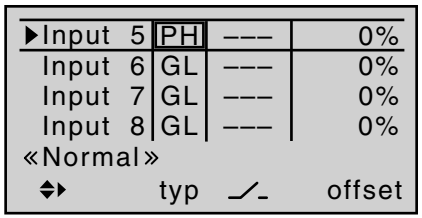
4. Step

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.

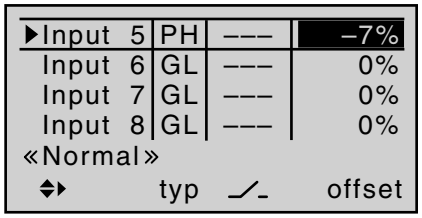
Now, if applicable, in order to adapt the flap positions to the different requirements of the individual flight phases, in the menu ...

"Control adjust" (page 96)

… the standard default "GL" is first changed to "PH" for "Phase" in the type column:



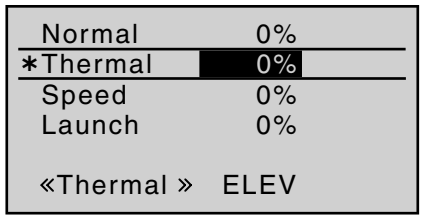
Then switch to the "Offset" column and make the settings deviating from the "Normal" flight phase for the ailerons. However, switch to the desired flight phase beforehand, whose name is shown at the bottom in the display, appropriate to the switch position. Both positive and negative throw changes are possible. These settings are to be made separately for each flight phase:



5. Step

Any necessary phase-specific trimming of the elevator is made with the help of the digital trimming of the elevator joystick. This requires that you have at least set the elevator trimming to "Phase" in the "**Joystick setting**" menu - as already shown in this programming example.

Alternatively, you can also carry out these settings in the "**Phase trim**" menu ...

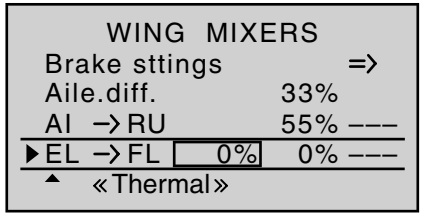


6. Step

In the menu …

"Wing mixers" (beginning on page 146)

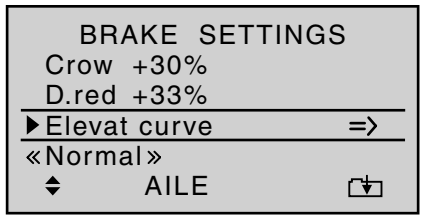
… the flight phase name of the newly activated flight phase appears at the bottom edge of the display. If the switch position is now changed, the name of the flight phase selected with the switch appears, but with the previously copied settings of the flight phase "Normal". Here you set you values phase-specifically 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".)



Notice:

*The list of displayed options depends on the number of servos entered in the "Ailerons/flaps" line in the "**Model type**" menu.*

Now switch to the submenu …



… and enter how wide the ailerons should be raised 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.

In the "Elevat curve" submenu, enter a correction value for the elevator, see page 162.

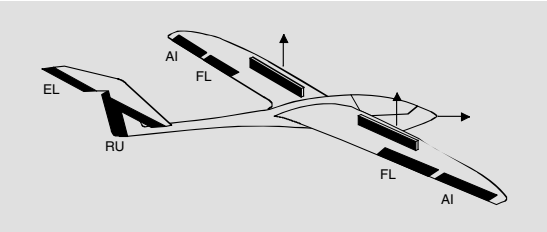
Notice:

*The "Brake settings" submenu of the "**Wing mixers**" menu is switched "off" if "yes" is entered for the current flight phase in the "**Model type**" menu, page 82 "Motor at C1 front/rear" and in the "Motor" column of the "**Phase setting**" menu, page 128. Change the flight phase, if applicable.*

Use of flight phases

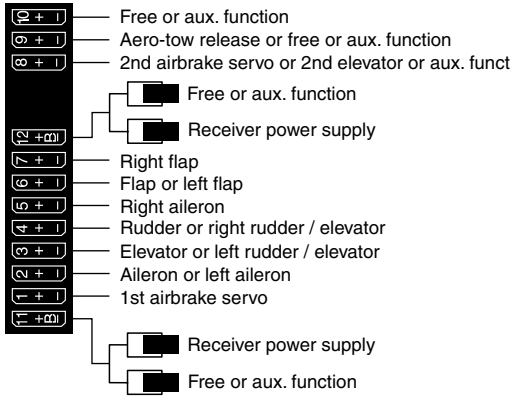
Example 2 …

Glider with four flap wings, two large flaps and tow coupling



The following example is based on the assumption that you have already mechanically preadjusted 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 setting**" 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.

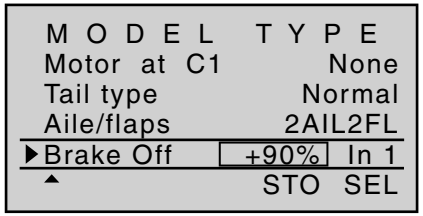
In the menu "**Base setup model**", connect your receiver to the transmitter, enter a model name and select or check, if applicable, the stick mode. Later, before the flight operation, also activate the range test in this menu.

In the menu …

"Model type" (page 82)

… leave "Motor to C1" at "None" and the tail type at "Normal". In the "Aile/flap" line, on the other hand, set "2 AIL 2 FL".

In the "Brake" line, program or leave "In1", because the brake and spoiler flap servos connected to 1 + 8 should be activated later with the corresponding C1 joystick as the control:

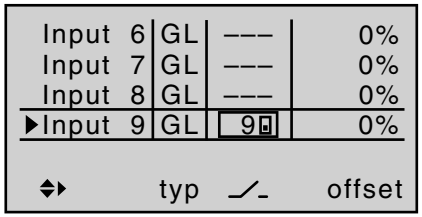


The setting in the "Brake offset" value field defines the neutral position of all mixers of the "Brake settings submenu of the "**Wing mixers**" menu. Place this neutral point at approx. +90%, insofar as the brake flaps should be retracted in the front position of the C1 joystick. The remaining path between +90 % and the full throw of the joysticks, +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" position, even with 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 96)

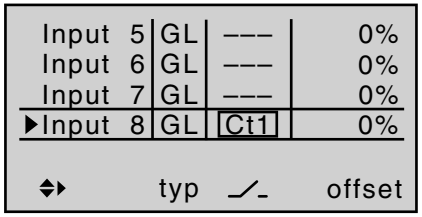
… assign a switch to Input 9, for example, for the operation of the tow coupling. In order for this switch to work independently of the flight phase, leave the standard default "GL" in the "Type" column of this input. With "– Travel +" you can adjust the control travel for the switching of the switch:



By simultaneously pressing the keys ◀ ▶ of the left touch pad, the setting in the "**Servo display**" can be checked.

Since the C1 control should actuate Servo 8 simultaneously with Servo 1, establish this link through the menu "**Control adjust**".

For this reason, also switch to the line before and assign "Control 1" to Input 8.

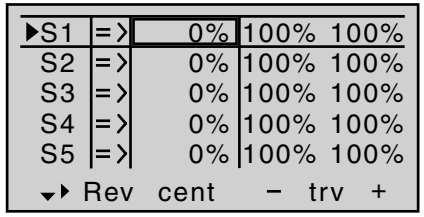


However, please note in this connection, that a non-linear control curve programmed in the "**Channel 1**

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 by simultaneously pressing the keys ◄ ► of the left touch pad:

The travel and, if applicable, the directions of rotation of the spoiler servos 1 and the second spoiler servo connected to Output 8 can be adjusted in the menu …

Servo adjustment (page 90)

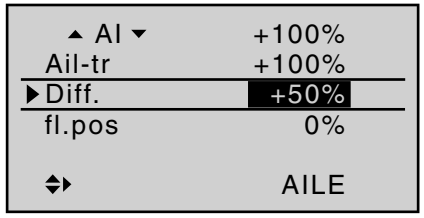


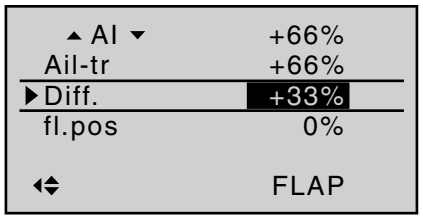
...

In the Multi-flap menu of the ...

"Wing mixers" menu (beginning on page 146)

… you now enter the first mixer values for the four wing flaps; for example:





Notice:
The parameter values shown here are model-dependent and must be determined by test flights.

In the …

▲AI▼ line you define the percentage with which the two flap pairs "AI and "FL" should follow the *aileron control*. Also check whether the ailerons are deflected in the right direction during the adjustment of the parameter values.

The adjustment range from -150 % … +150 % enables the correct throw direction adjustment regardless of the direction of rotation of the servos.

Ail-tr Here you determine the percentage with which the *aileron trimming* should affect the AI and FL.

Diff. Here you specify the *differentiation of the aileron control* on the AI and FL flaps. For the significance of the differentiation, see page 148.

The adjustment range from -100 % … +150 % enables the correct differentiation direction adjustment regardless of the direction of rotation of the aileron and flap servos.

fl.pos. In this line you set the flight-phase specific flap positions for all flaps available on the respective model. In the process, you can determine the positions the flaps assume for each flight phase.

Notice:
*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 flaps can be actuated in this standard setting. In this respect, you also leave the default entry here.

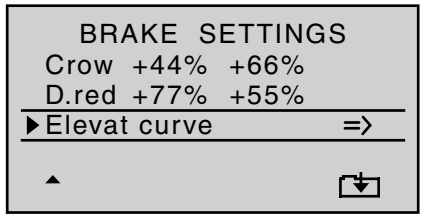
However, if you would like to be able to vary the flap positions with a switch or proportional rotary control by the position specified in the "fl.pos." line, assign the desired control to Input 6 in the "**Control adjust**" menu and set the desired reaction to the movement of the control selected for this purpose over the percentage in this lane.

EL→FL This mixer incorporates the ailerons (AI) and flaps (FL) with elevator actuation.

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 mixing proportion is normally in the low double-digit range.

Now switch to the "Brake settings" within the "**Wing**

mixers" menu ...



Notice:
*The "Brake settings" menu is switched "off" if "yes" is entered for the currently active flight phase in the "**Model type**" menu, page 82, "Motor to C1 front/rear" and in the "Motor" column of the "**Phase setting**" menu, page 128. If applicable, switch to the flight phase*

Crow Further above we designated the C1 joystick for the brake flap control.

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.

By simultaneously pressing the keys ◄ ► of the left touch pad, you switch to the **"Servo display"** menu so that you can observe the servo movement and, in particular, that there is no influence on the flaps above the adjusted brake offset, e.g. +90 %, up to the throw limit of the controller C1; see above ("Idle travel" of the C1 joystick).

D.red In the line "Differentiation reduction" you should enter the value previously set in the ailerons differentiation line in order to suppress it again during braking.

Elevat curve In this line you set another correction value for the elevator, see page 162.

Insofar as necessary, check and adjust all flap throws, the servo center, the servo travel and the travel limitation through the menu "**Servo adjustment**".

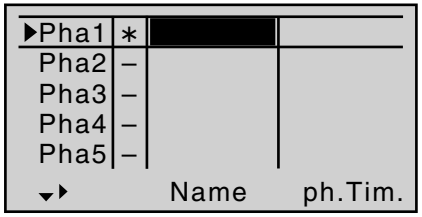
It may also be time to start the initial flight testing, insofar as all global settings - that is to say, all flight-phase independent settings - are completed.

Two additional flight phases should be set up in the following, each of which requires a somewhat different flap position.

Therefore, switch to the menu ...

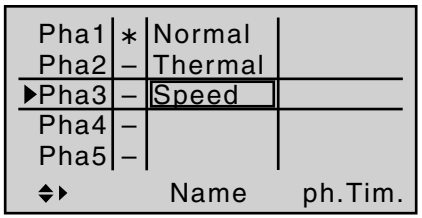
"Phase setting" (page 128)

... and activate the assignment of phase names in the "Name" column by briefly pressing the central **SET** key of the right touch pad:

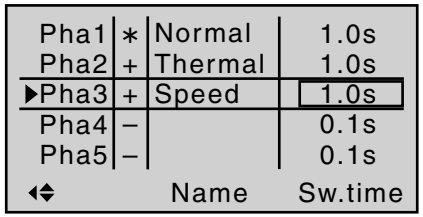


Now give Phase 1 - the "Normal phase" - that is also the phase which includes the previous settings, the name "Normal", which you select with the arrow keys.

Phase 2 receives the name "Thermal" and Phase 3 receives the name "Speed". Now conclude your entry by briefly pressing the **ESC** key of the left touch pad or the **SET** key of the right touch pad:



Now move the marking frame over the column "ph.Tim." to the right to the column "Sw.time" and set a "switching time" from any other phase to the respective phase in order to avoid an abrupt phase change ; in other words erratic changes of flap positions. Now try out different switching times. In this example we have specified 1 s in each case:

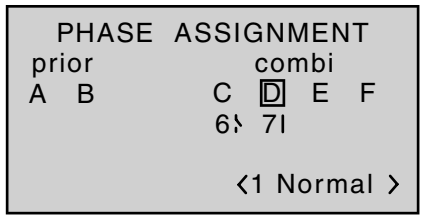


Now assign the corresponding switches for these flight phases in the menu ...

"Phase assignment" (page 134)

... with which you can switch between the three phases.

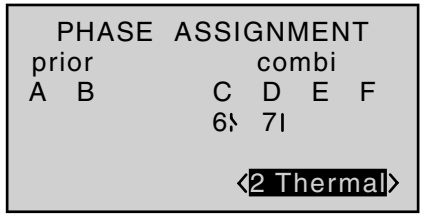
Since no special priority is necessary, assign the switch "C", for example, in the display and select one of the two limit positions of one of the two three-stage switches, CTRL 9 or 10 as the switch. Then move the selected switch back to the center position, activate the switch assignment under "D" and move the selected three-stage switch from its center position to the other limit position in order to:

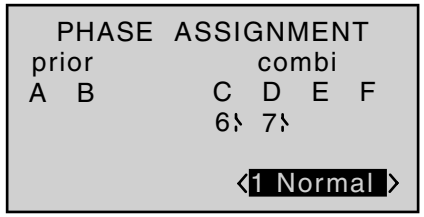


After the switch assignment is complete, use the arrow keys to switch to the bottom right and activate the assignment of phase names by briefly pressing the central **SET** key of the right touch pad.

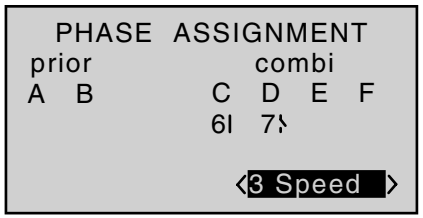
Now close "SW 7" by moving the selected three-stage switch upward.

Assign the name "<2 Thermal>" to this switch position and leave the name "<1 Normal>" in the "OFF position" of this switch.





Then move the three-stage switch down toward "SW 6" and assign the name "<3 Speed>" to this switch position:

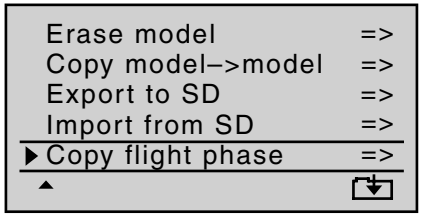


The phase names selected in the programming are now shown, depending on the switch status, in all flight-phase dependent menus, see the table on page 268.

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 ...

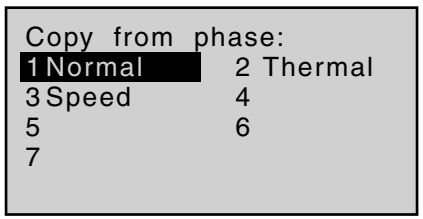
"Copy / Erase" (page 64)

… and switch to the "Copy flight phase" line:

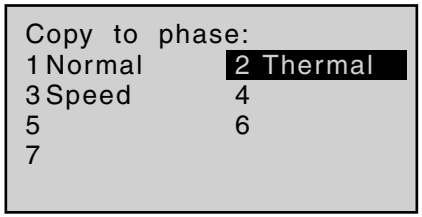


The maximum seven flight phases are listed in "Copy from phase":

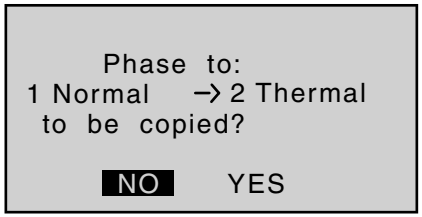
1. Select the flight phase to be copied, "1 Normal".



2. By briefly pressing the central **SET** key of the right touch pad, switch the window to the entry of the target memory "Copy to phase".
3. Select phase "2 Thermal" as the target:



4. Confirm the selection by briefly pressing the central **SET** key of the right touch pad.
5. A security query follows, who should be confirmed with "Yes":



6. Then repeat the process with flight phase "3 Speed".

Now we will program the required settings in the flight phase "Thermal" as an example.

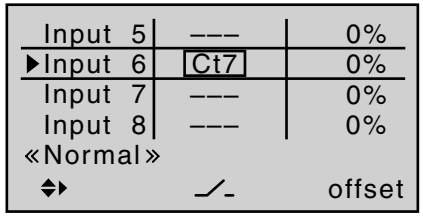
In order to also be able to vary the camper changing flap position in the "Thermal" phase, in the menu …

"Control adjust" (page 96)

… you assign an operating element to Input 6 – as described on page 96 .

If you assign one of the two proportional rotary controls to this input, independent of the flight phase if applicable (CTRL 7 in the example, the ailerons (2 + 5) and camber

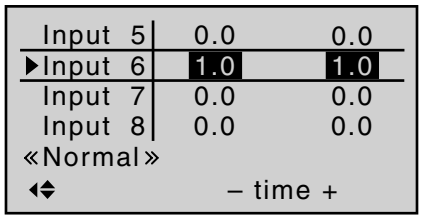
changing flaps (6 + 7) are moved continuously with a mixer proportion to be set in the "**Wing mixers** menu.



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 center position and the two limit positions of the previously mentioned proportional rotary control.)

Notice:
*The FL and AIL flap positions in the two limit switch positions or in the switch center depend on the value set in the column "- Travel +" as well as the offset value and the mixer proportion set in the "Multi-flap menu" of the "**Wing mixers**" menu, see further below.*

We will leave the (control) "- Travel +" at the standard settings of symmetric + 100 % and the offset value at 0 %. Specifying a symmetric or asymmetric time for smooth switching between the three switch positions - in the example "1.0 s 1.0 s" - in the column "- Time +" is recommended:



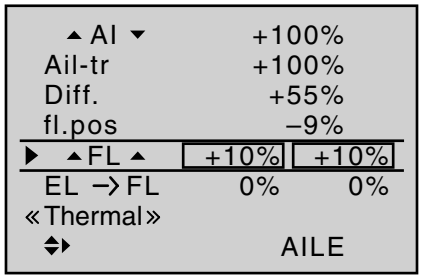
In the "Multi-flap menu" of the ...

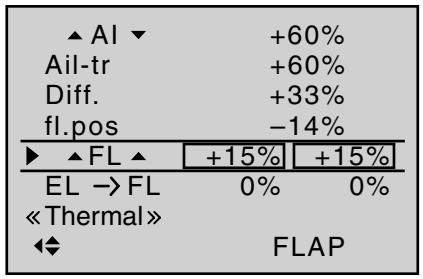
"Wing mixers" menu (beginning on page 146)

... change only the values for "FL-pos" and "▲FL▲" in the "Thermal" flight phase:

FL-pos Here you position the AIL and FL in the "Thermal" flight phase in case the assigned control (proportional rotary control or three-stage switch) is in its neutral or center position in the flight.

▲FL▲ In this line you specify the percentage at which the aileron and camber changing flap servos should be moved as camber changing flaps with the selected control (see above) or with the three-stage switch:





Simultaneously pressing the key combination ▲▼ or ◄► of the right touch pad (**CLEAR**) resets changed values back to the standard settings.

Notice:
Due to the improved lift distribution, the degree of mixture should be set so that the camber changing flaps are slightly "lower" than the ailerons.

By simultaneously pressing the keys ◄► of the left touch pad, you can check the reaction of the AIL and FL servos with actuation of the selected camber changing flap servo in the "**Servo display**". (Push the C1 joystick to the front position so that the "AIL" and "FL" flap positions can be better followed on actuation of the corresponding control.)

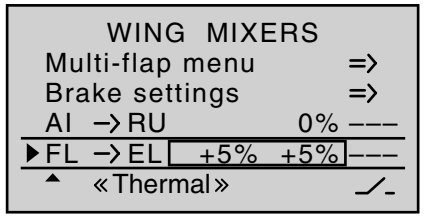
Attention:
With actuation of the ailerons, the bars of the "Servo display" move in the same way and the opposite way with the actuation of the camber changing flaps:

- In the control center position, only the – example – "FL-pos." setting of +10 % for the AIL and +15 % for the FL work.
- In the one limit position of the control, AIL and FL are back in their neutral position, because the degree

of mixture specified for the example compensates directly for the FL-pos. setting, whereas …

- … in the other limit position, AIL and FL 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:



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 rotary 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.

Notice:

- *The digital trimming of transverse, altitude and side work independently of these settings–depending on the setting selected in the "**Joystick setting**" menu, page 92–"Global" or for each "Phase".*
- *All setting values are model-dependent. Carry out the settings on your finished model and/or during the flight.*

Control of temporal processes

using time delay and curve mixers

A useful, but less known capability of the **mc-32** HoTT software is the ability to activate nearly any servo movements with a maximum duration of 9.9 seconds using a switch.

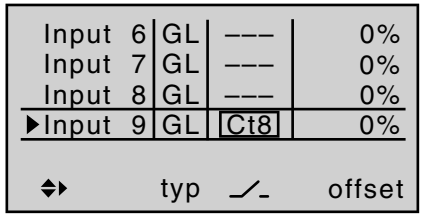
The programming for this should be shown on the basis of some examples in the following. Additional applications can certainly be found once you become familiar with these capabilities.

The programming is begin in the menu …

"Control adjust" (page 96)

… and in order to be able to approach any point of the control curve during the programming, first assign one of the proportional rotary controls to the desired control channel – in this example CTRL 8 to the Input 9. However, leave the standard default "GL" in the "Type" column so that this setting is effective for all flight phases analogously to the free mixers to be programmed in the following.

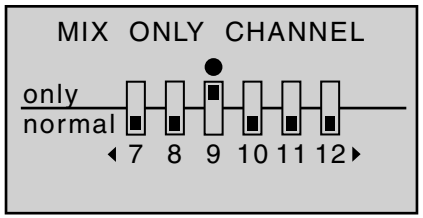
The input of a time delay in the "- Time +" column should also be dispensed with initially:



Then in the menu …

"Only mix channel" (page 193)

… of the selected control channel, "9" in this case, is set to "Only MIX":

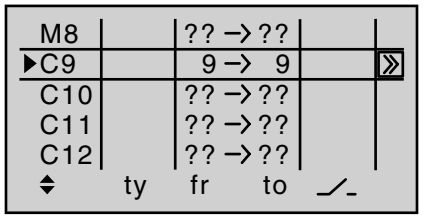


It is mandatory that this is set to "Only MIX", because the control curves of the curve mixers described in the following example only function on the output of the same channel as desired if there is no direct connection between the control and output! Only then can the linear control signal be manipulated almost arbitrarily around a curve mixer and to the appropriate output.

Therefore, in the next step, switch to the menu …

"Free mixers" (page 181)

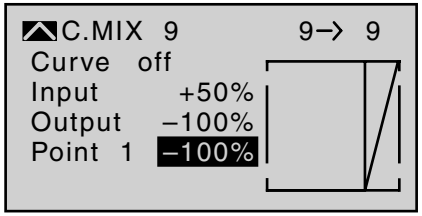
… and program a curve mixer for the same channel, e.g. from "9" to "9":



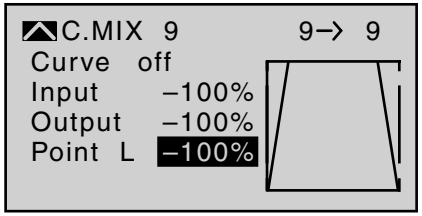
On this second screen the desired path of the control curve is then set, whereby the following examples should only be "food for thought" for the design of your own control curves.

For example, the control curve could be for …

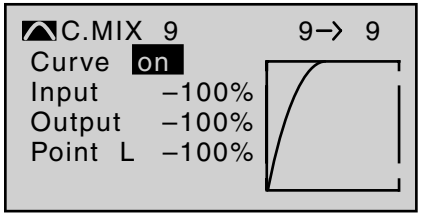
… delayed lighting of a headlight after the beginning of the extension of the landing gear:



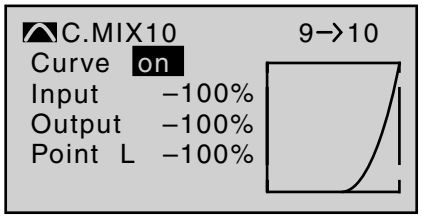
… the control of a landing gear flap which closes again after the landing gear is extended:



… a smooth motor start-up or the extension of a self-launch …



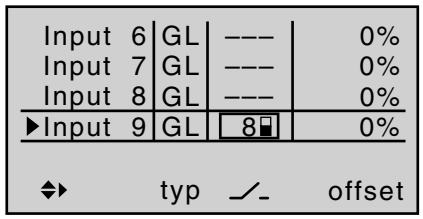
… triggered by the same switch, but with a delayed startup of the drive motor connected to Output 10:

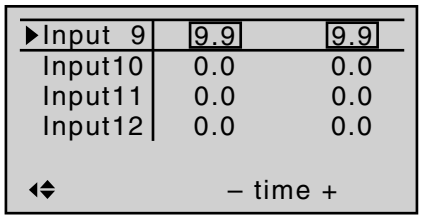


The function you programmed functions as desired according to these suggestions – which you can verify at any time after switching to the "**Servo display**" by simultaneously pressing the keys ◄ ► of the left touch pad – then to, complete the programming, an arbitrary switch, such as "SW 8" is assigned in the menu …

"Control adjust" (page 96)

… to the control channel used instead of the selected proportional rotary control – in in these examples "CTRL 8" 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:





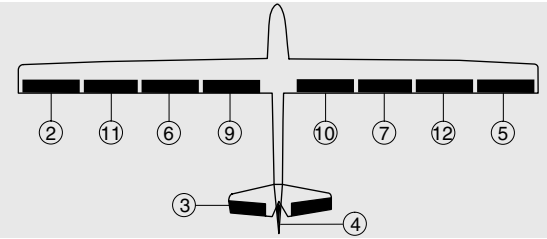
Notice:
In the course of the switch assignment, always bear in mind that you can also trigger multiple functions with one switch! For example , with the same switch a landing gear connected to Output 6 can be started and, as shown here as an example, the time-controlled landing gear flaps connected to Output 9 and/or the headlight, etc.

Eight-flap wing

By standard the **mc-32** HoTT supports the comfortable control of up to eight servos for the aileron/ camber changing flap functions.

In the following we will consider a model without motor drive and without spoilers in the wings. The example is also based on the assumption that you have already mechanically preadjusted 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.

The servos should be connected to a suitable receiver as follows:



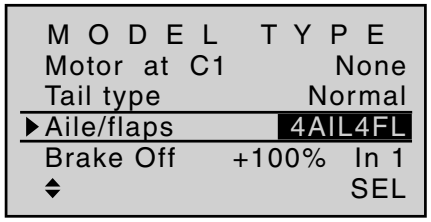
Rudder	Receiver output
Aileron	2 + 5
Aileron 2	11 + 12
Camber changing flaps (exterior)	6 + 7
Camber changing flaps 2 (interior)	9 + 10
Elevator	3
Rudder	4

For the control of all flaps, up to two additional proportional rotary controls are required in addition to the two joysticks or, alternatively up to two two-stage switches (SW).

In order to be able to control all servos, first switch to the menu …

"Model type" (page 82)

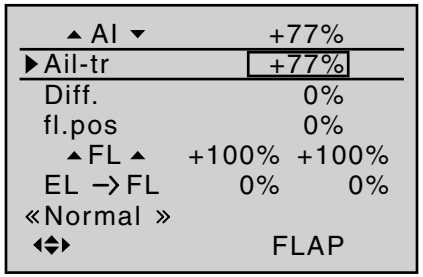
… and select "4AIL 4FL" in the "Ailerons/flaps" line.

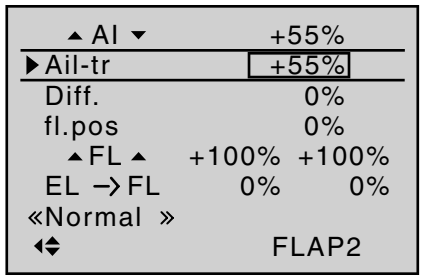


In order to also be able to actuate the camber changing flap servos 6 + 7 (FL) and 9 + 10 (FL2), if applicable, in the **Multi-flap menu** of the menu …

"Wing mixers" (beginning on page 146)

… set the corresponding values for the aileron control of the two camber changing flap pairs in the line "**▲AIL▼**" and in the line "**Ail-tr.**" for the adoption of the aileron trimming:





You can check the previous settings in the "**Servo display**" menu, which you can reach from nearly any menu position by simultaneously pressing the keys ◄ ► of the left touch pad:

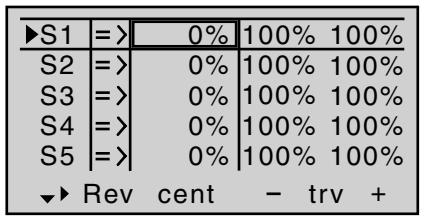
- The servos 6 + 7, 9 + 10 and 11 + 12 now move for the aileron control exactly like the servos 2 + 5. The aileron trimming lever also affects all these servos.
- The C1 joystick only actuates the servo connected to receiver output 1.

Attention:

With aileron actuation the bars of the "Servo display" move in the same manner and in the opposite manner with camber changing flap actuation.

The necessary fine-tuning of the servos is carried out in the …

"Servo adjustment" menu (page 90),



… if necessary.

In doing so, the basic programming of the eight-flap wing is completed.

Camber changing flap positioning and flight changes

First program two or more flight phases in the **"Phase setting"** and "**Phase assignment"** menus. On this occasion, also change the standard default "Global" to "Phase" in the **"Joystick setting",** page 92 for the effect of the digital trimming, if applicable, on your individual requirements.

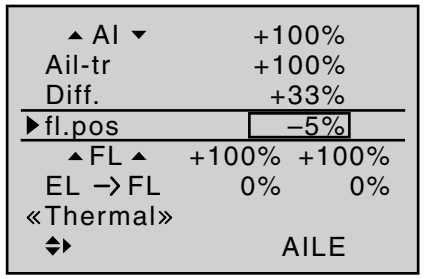
An example of flight phase programming can be found on page 256.

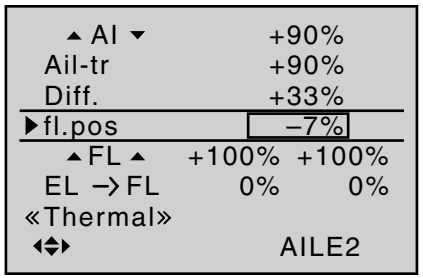
One camber changing flap setting per flight phase

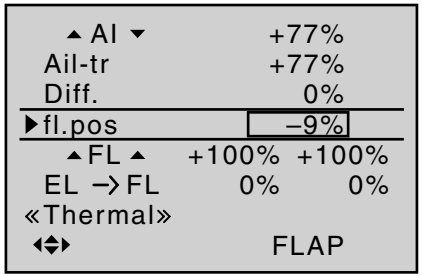
If one camber changing flap position per flight phase is sufficient for you, then in the **Multi-flap menu**" of the …

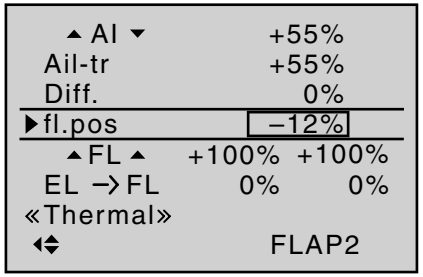
"Wing mixers" menu (beginning on page 146)

… in the line "FL-pos" adjust the camber changing flap position(s) of the servo pair "AIL" (2 + 5), "AIL2" (11 + 12), "FL" (6 + 7) and "FL2" (9 + 10) to your preferences in each of the programmed flight phases:









Notice:

Whether positive or negative values must be set in the "FL-pos." line depends on the installation of the servos, among other things.

Alternatively, if you would like

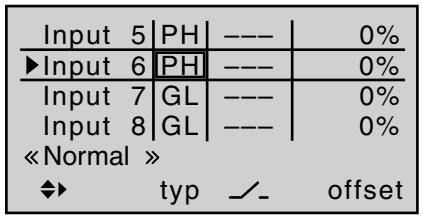
to set variable camber changing flap positions for each flight phase with a proportional rotary control,

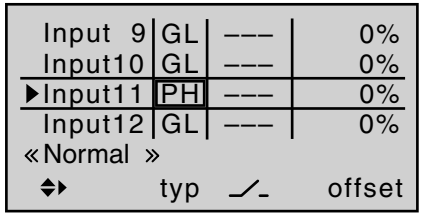
… you can additionally vary the basic settings of all eight flaps with a single control specific to each flight phase.

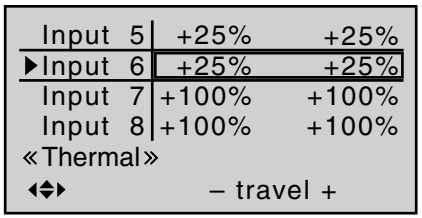
For this purpose, in the menu ...

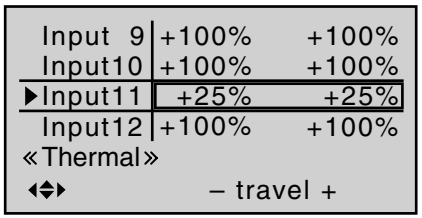
"Control adjust" (page 96)

… the inputs 5, 6 and 11 are assigned for each flight phase to the same respective control, for example the proportional rotary control CTRL 7, and in parallel, the travel is reduced to approximately 50 % or even less so that the flaps can be trimmed with the appropriate fine-tuning. With travel settings differing from one another, you can also attune the throws of the individual flap pairs to one another *specific to the flight phase* in *a* menu. For this purpose, you only have to switch the corresponding inputs from the standard default "GL" (global) to "PH" (phase):







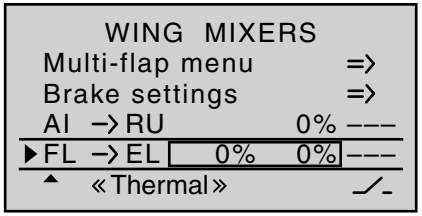


Notice:
With the use of a switch, set the respective "Deviation" of the offset point symmetrically or asymmetrically in the "- Travel +" column.

Elevator compensator with actuation of the camber changing flaps

If it should become evident in the flight that a correction of the elevator is necessary after setting the flaps, this correction can be made in the ...

"Wing mixers" menu (beginning on page 146)



. For this purpose, select the line "FL ➔ Elev" and enter an appropriate value independent of the flight phase.

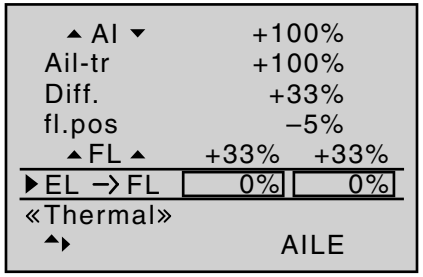
If you have assigned the same control to the inputs 5, 6 and 11 – as specified above – all eight flaps move simultaneously while the elevator follows the set degree of mixture.

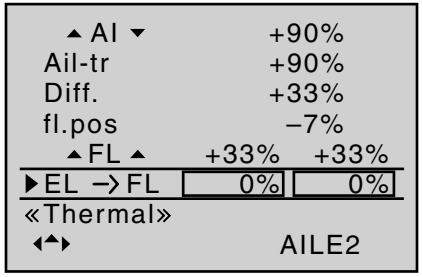
Camber changing flap movement on elevator actuation

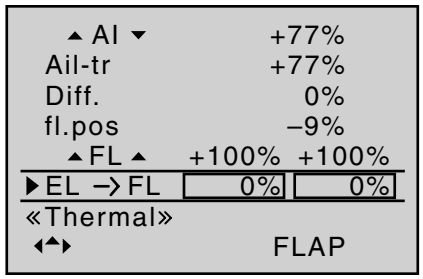
Camber changing flap movement on elevator actuation – normally only used in "High gear" to increase the agility over the transverse axis – is also carried out in the "Multi-flap menu" of the...

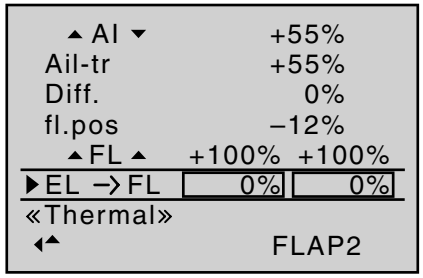
"Wing mixers" menu (beginning on page 146)

. Enter the desired flight-phase dependent values in the line "Elev->FL":









In addition to the two camber changing flap pairs (servos 6 + 7 and 9 + 10), the two aileron pairs (servos 2 + 5 and 11 + 12) are now tracked with the degree of mixture corresponding to the camber changing flaps - normally opposite the elevator.

Brake settings

Notice:
*The "Brake settings" menu is switched "off" if "yes" is entered for the currently active flight phase in the "**Model type**" menu, page 82, "Motor to C1 front/rear" and in the "Motor" column of the "**Phase setting**" menu, page 128 . Change the flight phase, if applicable.*

In the "**Brake settings**" submenu, which is also flight-phase specific, of the "**Wing mixers**" menu, you can make the settings so that the aileron pairs 2 + 5 and

11 + 12 extend upward and the camber changing flap pairs "FL" (6 + 7) and "FL2" (9 + 10) extend downward, whereas the elevator is trimmed in parallel to this, see page 162.

In order for the brake system to react to the C1 joystick as desired, however, the mixer neutral point (offset) of the brake system must be adjusted accordingly. This takes place in the menu …

"Model type" (page 82)

After selection of the line "Brake Off." the C1 joystick is moved to the position from which the mixer for the brake system should be set – normally just before the limit position – and after selection of the appropriate value field, the set point is defined by briefly pressing the central **SET** key of the right touch pad.

If the C1 joystick is not moved o*ver* this point toward the pilot, all mixers of the brake system are carried along according to their respective degree of mixing. *Below* this point the mixer remains inactive, whereas the selection of "dead travel" is possible.

If the model has additional brake flaps or spoilers and your receiver has another free Output 1, you can also control this through the C1 joystick by connecting the spoiler servo to receiver Output 1.

However, if you control the left and right spoiler each with its own servo, and not together, the receiver Output 8 is still available for the connection of the second spoiler servo. In this case, program the connection to the second spoiler servo as described in the section "Servos running in parallel" on page 254.

Reduction of the aileron and camber changing flap differentiation

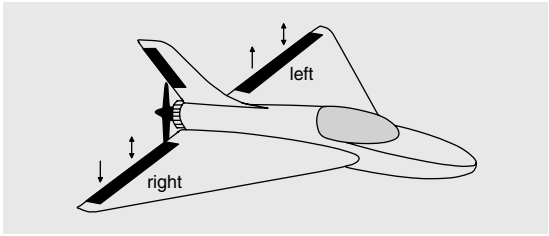
For the improvement of the aileron effect in the crow position, you should automatically suppress any programmed aileron differentiation.

For this purpose, use the "Differentiation reduction" in the "**Brake settings**" of the **"Wing mixers"** menu, which continuously reduces the degree of the aileron differentiation to a variable extent when you move the rudders to the crow position with the C1 joystick. For this purpose, see page 162.

.

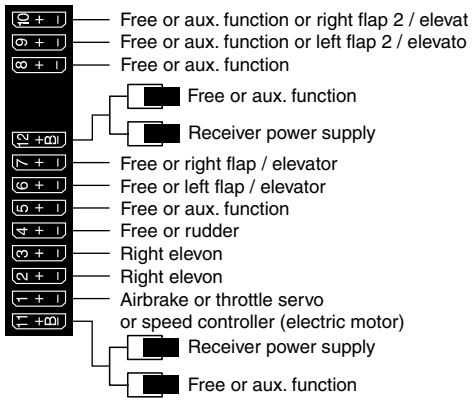
Delta and flying wing models

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 236 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 four or six-flap wing the use of camber changing flap functions and/or even a crow system is now entirely possible. In all these cases, however, the following assignment of the receiver outputs should be used, see also page 57. Unneeded outputs a simply left free:



According to the assignment of the receiver outputs, in the menu ...

"Model type" (page 82)

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 at C1**"	"none" or "Throttle min front/rear"
"**Tail type**"	"Delta/fl"
"**Aile/FL**"	"2AIL" (appears automatically). Insofar as necessary, expand the default "2AIL" with 1, 2 or 4 camber changing flaps ("1FL", "2FL" or "4FL").
"**Brake**"	remains or is only of interest with a delta or flying wing aircraft of the type "2 AIL 1/2/4 FL". In this case, see under "Brake offset" on page 83.

These settings specifying the model type affect the available "**Wing mixers**" first and foremost. 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

In keeping the standard default "2AIL" in the "Aile./FL" line, the elevator and aileron control, including the trimming function, are only mixed automatically on the software side. On the transmitter side, however, you can influence the effect of the elevator and aileron joystick in the "**Dual Rate / Expo**" menu, page 108.

Settings in the menu ...

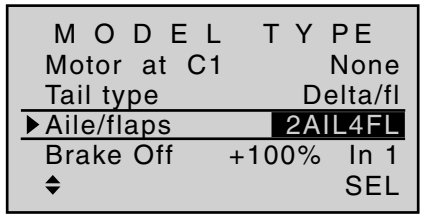
"Wing mixers" (beginning on page 146)

... are, if need be, advantageous with the "AIL → FL" mixers and are "played' with a great deal of "feel" for the 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 incompensable moments.

Delta/flying wing of the type: "2 AIL 1 / 2 / 4 FL"



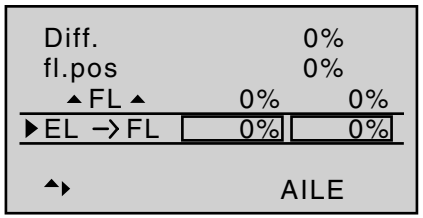
With delta/flying wing constructions with more than two flaps, more moments can be compensated for. For example , the "lifting" moment caused by the raising of the ailerons (= elevator effect) can be compensated for with camber changing flaps lowered correspondingly wide (= hydroplane effect).

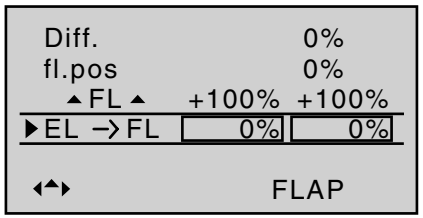
If you decide in favor of this model type and have assigned the receiver outputs in accordance with the connection plan shown above, the aileron function of the two (exterior) aileron servos will function correctly immediately, but not the elevator function of the two aileron servos and, if applicable, the (interior) camber changing flaps.

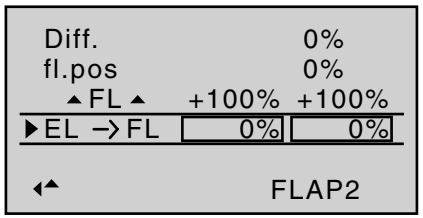
This is achieved with the specification of "2AIL 1/2/4 FL", if the effect of the elevator control, in the "**Multi-flap menu**" of the ...

"Wing mixer" menu (beginning on page 146)

... is set appropriately in the "Elev ➔ FL" line for aileron, camber changing flap and, if applicable, camber changing flap 2:







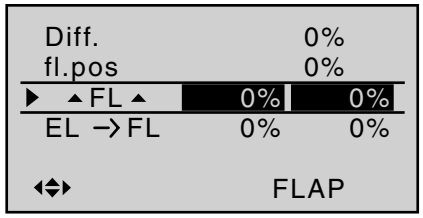
Notice:
Contrary to the separately set aileron trimming, see below, the trimming is transferred proportionally to the set mixer value with the mixer "Elev ➔ FL".

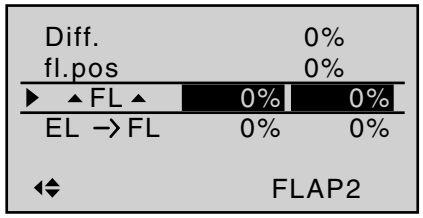
The following settings are model-specific and may not be adopted without checking that they are correct!

In the top line of this "Multi-flap menu", analogously to "normal" four or six flap wings, the effect of the aileron joystick on the aileron, camber changing flap and, if applicable on FL2 is set. In the line "Ail-tr." below this, on the other hand, the influence of the 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.

In the line "▲FL▲", *for the sake of safety,* you should set the standard setting +100 % in the "FL" and, if applicable "FL2" column – as shown – to 0%:





In the "**Control adjust**" menu, all inputs are set to "free" by default, but if there is ever confusion in regard to the assignment of a control ... this has little effect at all.

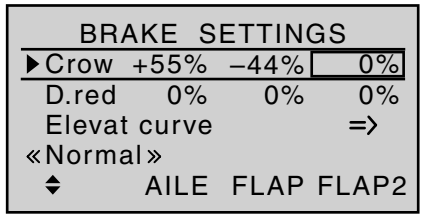
The last line, "Elev➔ FL", has already been addressed earlier in this section.

In principle, the author of this manual had programmed a delta model years ago operated with the **mc-20** *and a crow system as landing assistance ... entirely without tilting moments through correspondingly attuned wing mixers "Brake ➔ aileron" and "Brake ➔ camber changing flap", whereby "aileron" refers to the exterior rudder pair and "camber changing flap refers to the interior rudder pair.*

In order to now achieve this with the **mc-32** Hott, switch to the "**Brake settings**" of the …

"Wing mixers" menu (beginning on page 146)

… 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.

Notice:
*The "Brake settings" menu is switched "off" if "yes" is entered for the currently active flight phase in the "**Model type**" menu, page 82, "Motor to C1 front/rear" and in the "Motor" column of the "**Phase setting**" menu, page 128. 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 center 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 joystick 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:

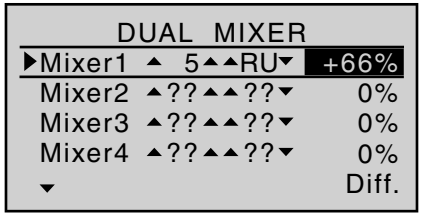
In this example the two interpolation points 1 and 2 are each at 0 % as well as the left edge point at +60 % and the right edge point at -65 %. Then the curve was rounded by pressing the central **SET** key of the right touch pad.

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, with the use of one of the mixers in the menu ...

"Cross-mixer" (page 194)

… 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 of the type "**Delta/Nf**", the receiver output "5" may still be free, and we want to use it in the following:



In *this* case a differentiation is necessary, because the respective exterior rudder flies over a larger curve radius than the interior rudder, which is comparable to the wheel position of the front wheels of a car when traveling on curves.

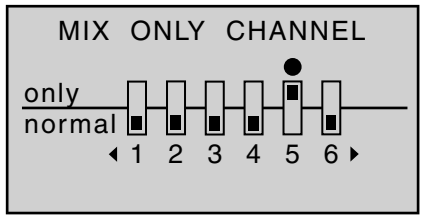
Notice:
The rudder can only be differentiated as programmed above!

If these two rudders should also deflect outward on the actuation of a brake system with the C1 joystick, this can be achieved, for example, by setting an additional mixer "**C1 → 5**" with an appropriate travel setting. Set the offset according to your habits to "front" (+100 %) or "rear" (-100 %), because the winglet rudder should deflect outward proportionally on extension.

Independently of this, you should, for safety's sake, uncouple the "false" control function from the control signal to which the second servo was connected – even if all inputs are "free" by default in the "**Control adjust**" menu – through the *flight-independent* menu …

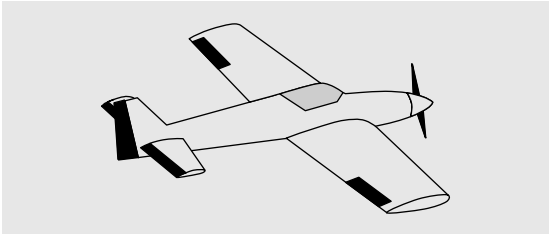
"Only mix channel" (page 193)

... for safety's sake! Corresponding with the above example, therefore, the control channel 5 should be set to "only MIX":



F3A model

F3A models are a part of the group of motor-driven winged models. They are powered by a combustion or electric motor. Models with electric motors can be used in both the electric acrobatic class F5A and are also competitive in the international model acrobatic class F3A.

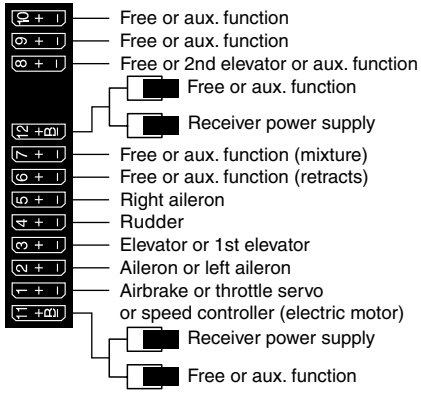


The basic comments and notices for the mechanical installation of a remote steering system, which was already referred to in the first programming example on page 236, also applies, of course, for F3A models and does not need to be mentioned here again.

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 9. It is best to actuate the landing gear with a switch without center position. In addition, another mix offset for the carburetor can – if necessary – be provided. You normally use one of the two proportional rotary 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 joystick.

Programming

Since the basic programming of the transmitter was already described in detail on pages 236 … 243, only F3A-specific tips are added here.

In the menu …

"Servo adjustment" (page 90)

▶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 center 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 82)

… the idle trim is activated for Channel 1 (normally "rear", because full throttle is "front"). The trimming then only works in the idle direction:

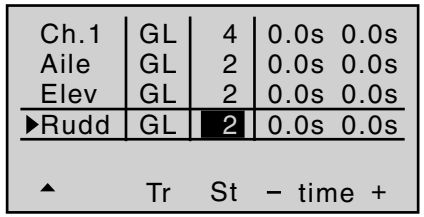
MODEL TYPE		
▶Motor at C1		back
Tail type		Normal
Aile/flaps		2AIL
Brake Off	+100%	In 1
▾		SEL

The remaining settings are made or left as shown in the figure.

After test-flying and trimming of the model, we recommend reducing the trim travel for the elevator and ailerons The model has significantly less of a reaction to a movement of the trim lever. "Overtrimming" 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. For this purpose, switch to the menu ...

"Joystick setting" (page 92)

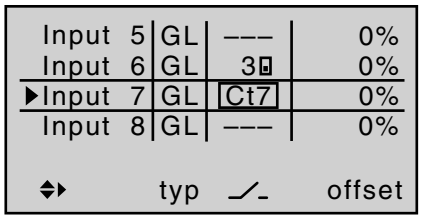
… and reduce the number of trimming steps accordingly in the "St" column:



It may also be necessary to assign a corresponding operating element to a specific input for the activation of the retractable landing gear and the mixer movement through the menu …

"Control adjust" (page 96)

… such as one of the ON/OFF switches to the Input 6 for the landing gear and one of the proportional rotary controls, e.g. CTRL 7, to the Input 7. However, since it involves flight-phase independent settings, leave the standard default "GL" in the "Type" column:



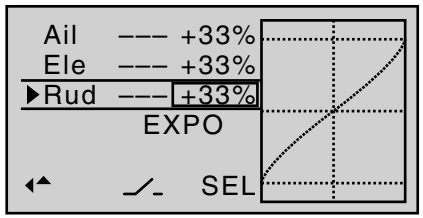
The control travel of the operating elements must be adapted and can also be reversed with a negative travel setting.

Notice:
A delay time for the extension and retraction can be specified for the retractable landing gear, which does not work, however, for the landing gear servo C 713 MG, Order 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 joystick. For this purpose, switch to the menu …

" Dual Rate / Expo " (page 108)

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 arrow keys. In order to be able to control the F3A model to run smoothly and cleanly:

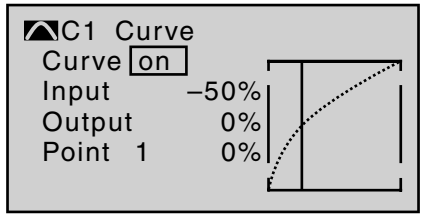


(Some experts even use up to a +60 % exponential degree.)

Since (some) combustion motors do not react linearly to movements of the throttle joystick, through the menu …

"Channel 1 curve" (page 116)

… a "bowed" or, in other words, non-linear throttle curve can be set. Four-cycle motors 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 joystick and, along with it, the vertical line in the graphic display toward idle to -50 % control travel and briefly press the central **SET** key of the right touch pad.
- In order to attain the curve shape shown, raise this point with the arrow keys to approx. 0 % in the inverse value field of the "Point" line.
- Then round the characteristic curve by moving the marking frame up to the "Curve" line, briefly pressing the central **SET** key of the right touch pad and then changing the value from "Off" to "On" with the arrow keys.

If additional interpolation points between the left ("L") and right ("H") end are necessary, repeat Steps 2 and 3 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 flies somewhat slower and, first and foremost, *more steadily* for the landing. For this reason, it is necessary to program mixers through the menu ...

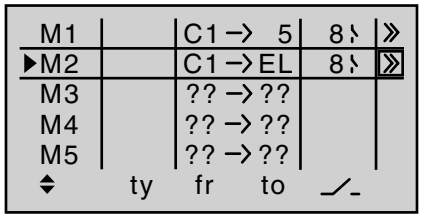
"Free mixers" (page 181)

... 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 joystick 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 SW 8, to which both mixers must be assigned with identical switching direction.



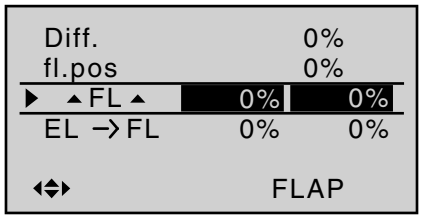
Then switch to the second respective display screen in order to adjust the respective mixing degrees. In both cases the mixer neutral point is at the C1 control center.

Enter 0 % above the control center after selection of the **ASY** field for both mixers and below the control center toward idle for:

MIX 1: -60 % ... -80 % and

MIX 2: -5 % ... -10 %.

Example L.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 carried out with the "**Free mixers**" of **mc-32** HoTT. If, for example, the model rotates away to the right over the longitudinal axis with the rudder extended in knife-edge flying, the aileron can be deflected 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)
  L.Mix 3: "Rudd ➔ Elev"
  Asymmetric setting. The appropriate values must be tested in flight.
- Correction over the longitudinal axis (aileron)
  L.Mix 4: "Rudd ➔ AIL"

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 center position of the elevator dependent on the throttle joystick 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 → Elev". 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 → Ail".

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 precisions. Therefore, the model begins to automatically hang the left or right wing. This is also easy to compensate for with a mixer "C1 → AIL" 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 the safety potential 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. Then, in the event of a failure, the model cannot become independent as easily and cause property damage 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 196, you can define a "Fail-safe position" for each of the individual servo outputs of your receiver (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.

Helicopter models

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 the case often is in life, there are also various ways and possibilities of achieving a specific goal with the programming of the **mc-32** HoTT. 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.

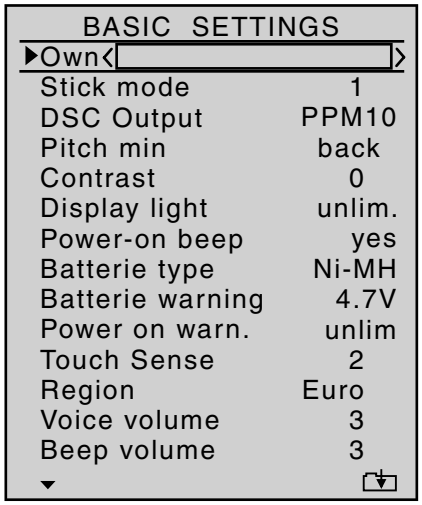
The programming example is based on the clockwise-rotating STARLET 50 helicopter from *Graupner* with three pivot points each offset 120° of the swashplate type "3sv(2 Roll)", beginner adjustment without increased throttle curve; without heading-lock gyro system and without transmitter-side gyro influence 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.

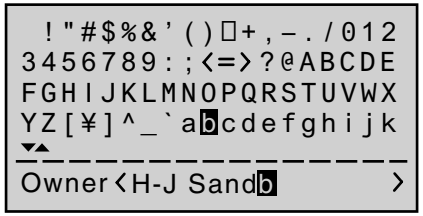
Notice:
If you are not interested in the combustion helicopter described here, but a electric helicopter, please continue reading anyhow! With the exception of the omitted idle settings, you can practically adopt most of the settings described in the following unchanged.

Some basic settings of the transmitter are necessary with the initial commissioning. For this purpose, switch to the menu …

"General settings (page 224)



… and start with the entry of the "**Owner name**". Select the characters for this from an extensive list on the second display screen, which you can reach through the symbol by briefly pressing the central **SET** key of the right touch pad:



Select the *default* "**Stick mode**" according to the criteria described on page 224.

The same applies for the *default* "**DSC output**".

The *default* "**Pitch min**" is based on your control habits.

With the creation of a new model memory you can

change these in the adopted defaults "**Stick mode**", "**DSC output**" and "**Pitch front/rear**" as well as within the respective model memory location.

The setting the "**Contrast**" line determines the legibility of the display under poor light conditions and the setting in the "**Display light**" line determines how long the display lighting remains illuminated after the transmitter is switched on or after the last key actuation.

With "**Power-on beep yes/no**" you determine whether the transmitter plays a recognition melody when switching on.

In the "**Battery type**" line you specify whether the transmitter is supplied with current from a "NiMH" or a "LiPo" battery, and in the "**Battery warning**" line below it, you determine the voltage at which the low-voltage warning of the transmitter should trigger. Do not enter a value that is too low here, so you have enough time to land your helicopter.

In the "**Power-on warn.**" line you can adjust how long the transmitter should wait after the last actuation of an operating element until it alerts you that it is still switched on with optical and acoustic warning signals.

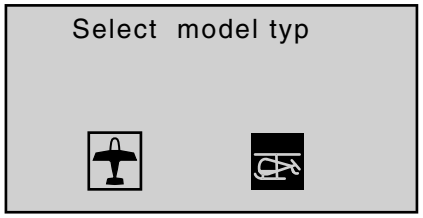
With the values of the lines "**Touch sense**", "**Voice volume**" and "**Signal volume**", you can adjust the corresponding behavior of the transmitter to your requirements. And, in the event that you (would like to) commission your transmitter in France, the setting in the "**Region**" line is important: The legal regulations of this country require the selection of "France" instead of the default setting "Euro".

If these settings are activated, it continues with the menu ...

"Model select" (page 63)

Select a free storage location with the arrow keys ...

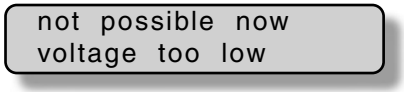
…and open this by briefly pressing the central **SET** key of the right touch pad. In the subsequently opening display, with the key ► of the left or right touch pad, select…



… the "Heli" model type. The display immediately switches to the base screen if you confirm this selection by briefly pressing the central **SET** key of the right touch pad.

Notice:

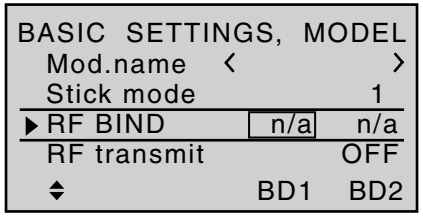
- *If the "Select model type" option has been opened, the process cannot be canceled. Even if you switch off the transmitter, this selection must be made! In any case, you can undo this by subsequently deleting the respective model memory.*
- *If the "Throttle too high" warning appears, this can be deleted by turning the proportional rotary control CTRL 6 counterclockwise until its limit.*
- *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:*



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" (page 74 … 80)

. For this purpose, switch to the line "**RF bind**":



Notice:

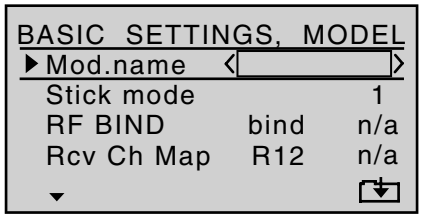
After confirmation of the model selection in the base screen, if you confirm the message appearing in the screen for a few seconds …

*… by pressing the **SET** key of the right touch pad, you automatically come to this line.*

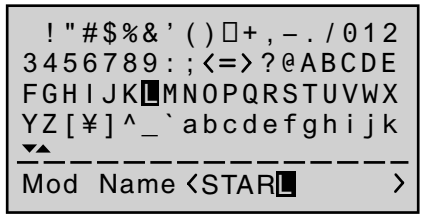
In the line"RF Bind." you delete the connection process between model memory and receiver, as described in detail on page 74. Otherwise, you cannot address the receiver.

Afterwards, using the arrow keys of the ▲ left or right four-way pad, move up to the first line and begin with the actual model programming in the "**Mod. Name**" line: Now enter an appropriate name for the model memory,

...



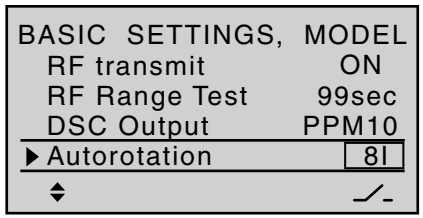
... which is comprised of the characters available for selection on the second screen of the "**Mod. Name**" line:



After entering the "**Model name**" the specifications for the "**Stick mode**" and "**DSC output**" adopted from the "**General settings**" are checked again, for which you can change the storage location, if applicable.

An additional option is activated in the line "**Autorotation**". Even if you are not an advanced pilot, the autorotation switch should at least be set an an emergency shutoff switch for the motor.

For this purpose, select the line "**Autorotation**", activate the switch assignment by briefly pressing the central **SET** key of the right touch pad and move one of the two-stage switches, e.g. SW 8, to the ON position:



The selected switch should be in a location on the transmitter which is easily within reach – without releasing a joystick – e.g. above the pitch joystick.

Notice:
More more information about the setting of this "emergency shutoff", see the beginning of the second following double-page.

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.

The possible settings of the lines "**Automatic C1 position**" and "**Motor stop**" are not of interest at first.

Additional settings specific to helicopters are made in the menu ...

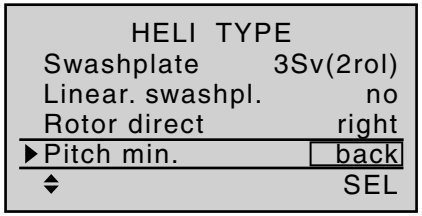
"Helicopter type" (page 86)

Under "**Swashplate type**", select the control of the swashplate and/or the pitch function. In this example: "3Sv(2rol)".

The line**Linear swashpl.**" is not of interest at first.

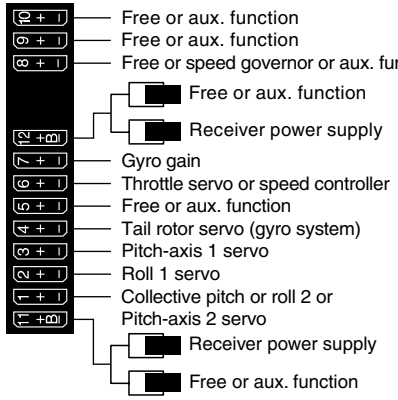
In the line "**Rotor direct**" you define whether the rotor - as viewed from above - rotates to the right or left. In other words, whether it rotates counterclockwise or clockwise. In this example "right".

With the default "**Pitch min**" adopted from the "**General settings**", it is checked whether the entry "front" or "back" corresponds to your habits and changed, if applicable:



"**Expo thro lim.**" in the bottom line of this display is not of interest yet.

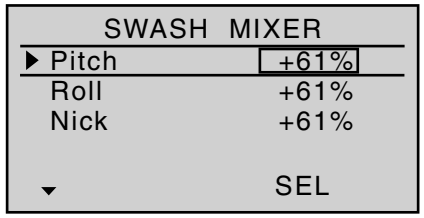
By now, the servos should be plugged into the receiver in the intended sequence:



Notice:
Please note that with the newer Graupner **mc** *and* **mx** *remote control systems the first pitch servo and the throttle servo are reversed when compared with the older systems.*

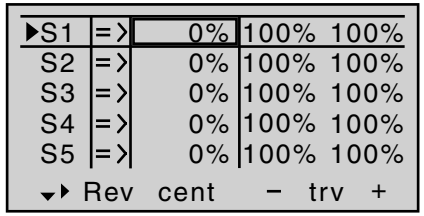
The degrees of mixing and mixing directions of the swashplate servos for pitch, roll and nick are already preadjusted to +61 % in the menu ...

"Swashplate mixer" (page 196)



... If the swashplate mixer should not follow the joystick movements properly, first change the mixing directions from "+" to "-" before you change the servo directions in the menu ...

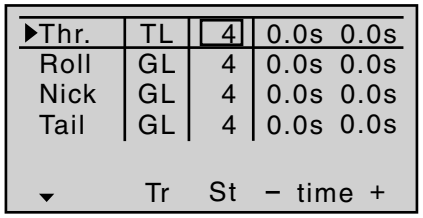
"Servo adjustment" (page 90)



... In this menu you can also adjust the travel and the directions of the individual servos. As a basic rule you should strive to maintain the servo travel 100 % in order to attain the best resolution and positioning precision. 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 joystick direction.

In the menu …

"Joystick setting" (page 94)

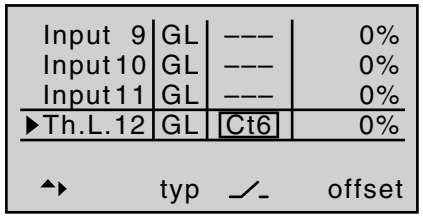


… adjust the incremental width for each "click" of the digital trim keys in the "**St**" column.

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. For this purpose, please refer to page 54. (Thanks to the *digital* trimming, trim values can be automatically saved with a model changeover and with the **mc-32** HoTT and even with a change of the flight phase).

An additional setting which is specific to helicopters can also be made in this menu in which you determine which function the trim slider on the pitch joystick should have. For this purpose, the setting "**TL**" is selected or left in the "Throttle" line. In doing so, the trim lever corresponds to the accustomed idle trim. If you "slide" it all the way to the front, the throttle limiter seamlessly adopts the throttle release later, which is assigned to "Th.L.12" in the ...

""Control adjust" menu (page 100 ... 107)



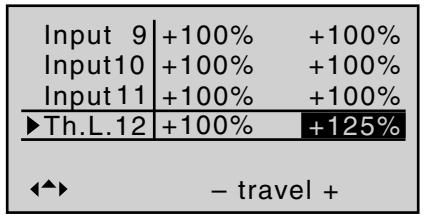
… whereas "free" is specified for all other inputs.

This input, "Th.L.12" serves as the **throttle limiter**. It *only* has an effect on output "6", where the throttle servo is located. The left proportional rotary control CTRL 6 is assigned to the throttle limiter by default.

Once again, as a reminder:

- *With the user of the "throttle limiter" function, you do not have to program a flight phase "throttle preselection".*
- *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. In general, the throttle servo is controlled through the throttle curve(s) set in the "**Helicopter mix**", which is why Input 6 must be left "free". In the respect, refer also to the pages 168 to 170 of the manual.*
- *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 ("cut-off trim") once again. For this purpose, please refer to page 54. (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 104.*

Then switch to the "Travel" column with the arrow keys ► of the left or right touch pad and increase the now inversely highlighted value from +100 % to +125 % with a fully opened throttle limiter after briefly pressing the central **SET** key of the right touch pad:



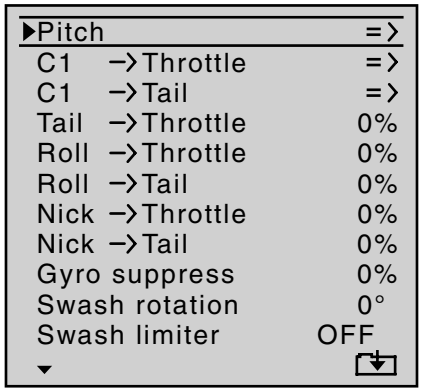
In doing so, it is assured that the throttle limiter releases the entire throttle travel with the pitch joystick later during flight.

Adjustment notice for electric helicopters:
Since electric drives do not, by nature, require an idle setting, in the scope of the base setup of an electrically driven helicopter it must only be ensured that the regulating range of the throttle limiter safely exceeds and undercuts the normally reached adjustment range of the motor control of -100% to +100 %. 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.

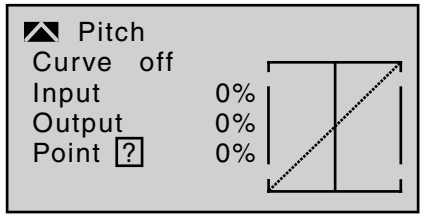
With this process, you have not carried out the basic settings for the transmitter as they are needed again later for further model programming.

The actual helicopter-specific settings take place primarily in the menu …

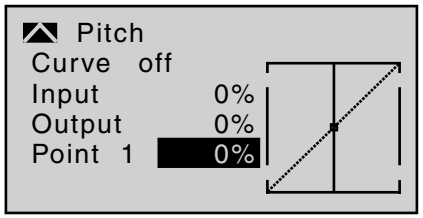
""Helicopter mix" (page 164 … 179)



The "Pitch" function appears right in the first line. By pressing the central **SET** key of the right touch pad, you switch to the corresponding submenu. The graphic representation of the pitch curve appears here; it is initially only defined by the points "L" and "H":



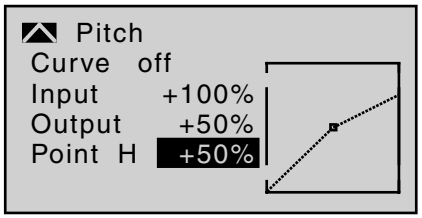
Now place point "1" in the center by briefly pressing the central **SET** key of the right touch pad:



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.

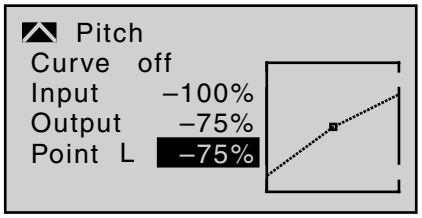
The reference point for the hovering should generally be the mechanical center position of the pitch joystick, because this position comes closest to the normal control feel. Although the curve adjustment enables other settings, you must know exactly what you are doing. First set the pitch joystick in the center. The servos which you had previously set according to manufacturer specifications have their levers at positioned perpendicularly to the servo housing (normally). The hovering pitch value of 4 ° to 5 ° is now mechanically set at the control levers for the blades. In principle, all known helicopters fly with this setting.

Then move the pitch joystick towards maximum pitch until the limit position. (The vertical line shows you the current joystick position.) Now change point "H" of the pitch curve with the arrow keys of the right touch pad so that the pitch maximum is approximately 9 ° at the rotor blades of the main rotor. With a value of approximately +50 % this may be the case:

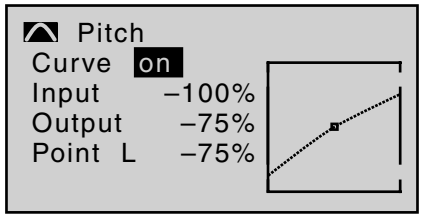


Notice:
A rotor adjustment gauge, such as the Graupner adjustment gauge, Order No. ***61*** *is very useful in reading the angle.*

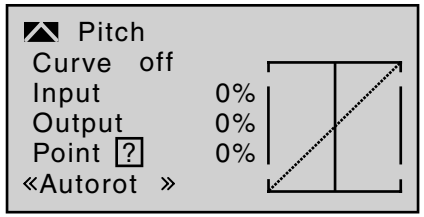
Now move the pitch joystick toward the pitch minimum position until its limit position. Depending on the ability of the pilot, adjust the value of point "L" so that the blade angle of approach is 0 to -4 °. Now a slightly pitched line arises at the hovering points, the so-called pitch curve, which can appear as follows:



Now you can, if you like, move the marking frame upward with the arrow keys to the "Curve" line and after activation of the value field by briefly pressing the central **SET** key of the right touch pad, set the curve function of the mixer to "on".



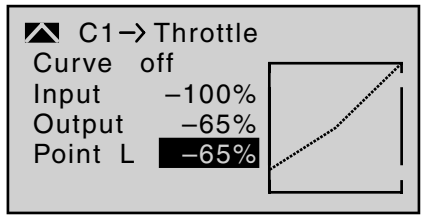
If you now switch to autorotation phase – at the bottom left of the display the flight phase name "Autorot" appears – the "old" pitch curve is again:



Now carry out the same setting as before in the normal phase. Only at point "H" – at pitch maximum – the pitch angle can be increased by approximately 2 °. In doing so, you will have somewhat more of an angle to catch the model later on (1).

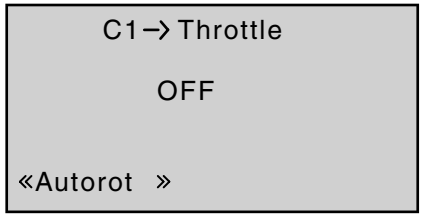
After setting the pitch curve, move the autorotation switch back and return to the helicopter mixer menu selection by briefly pressing the central **ESC** key of the left touch pad. From there, switch to the line "**C1 → Thro**" in order to adjust the throttle curve.

First the adjustment range of the idle trim must be adjusted with the throttle curve. For this purpose, move the pitch joystick to its minimum position and then set point "L' to approximately -65 %.



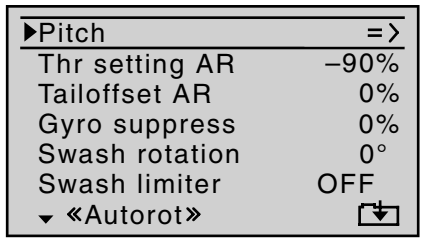
With the throttle limiter *closed* and the idle trim completely open, move the pitch joystick back and forth somewhat at the minimum limit position. The throttle servo may not move with it in the process. No you have established a seamless transition from the idle trim to the throttle curve. The further 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:

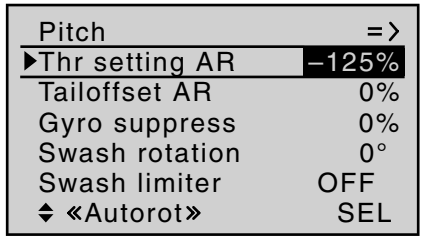


That means that this mixer is switched off and the throttle servo is switched to a fixed value, which can be adjusted as follows:

Return to the menu list by pressing **ESC**. As long as you are still in the autorotation phase, new submenus are listed; specifically:



The line "Thr. setting AR" is important. Enter the value to the right depending on the servo direction to either approximately +125 % or -125 %.

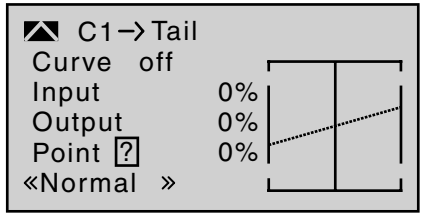


In doing so, the motor is safely switched off in the autorotation phase (in case of emergency). Later, when you have gained enough experience to practice the autorotation flight, a more stable idle can be entered here.

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 adopted without change.

The further submenus are not important at the moment. By switching off "autorotation", it returns to the first menu list.

Select the setting screen of "**C1 → Tail**" in order to adjust the static torque balance at the tail rotor. In this case, also work with a maximum of three interpolation points; everything else is reserved for the experienced pilot. For this purpose, change the presetting intended for heading lock systems from a uniform 0 % at point "L" (pitch minimum) to -30 % and at the opposite end, at point "H" to +30 % (pitch maximum). These values may have to be corrected in flight. If applicable, you must also set point "1" in the center when doing so:

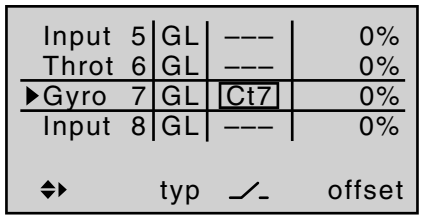


Now, for testing purposes, switch back to the autorotation phase. Here the setting is also deactivated; the tail servo no longer reacts to pitch movements (no torque usually arises when the main rotor is not powered). All additional interpolation points are not currently of importance yet.

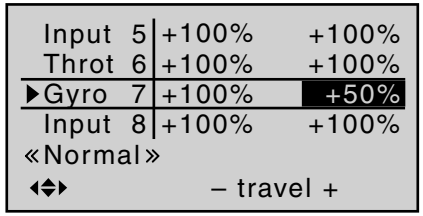
If, contrary to the specification, the gyro has a transmitter-side sensitivity setting, you still need a free proportional control, e.g. CTRL 7. In the menu …

"Control adjust" (page 100 … 107)

… you can assign this to the "Gyr" input. Activate the control assignment by briefly pressing the central **SET** key of the right touch pad and then turning the rotary control until its control number appears in the display:



Conclude this entry by briefly pressing the **ESC** key of the left touch pad and then switch with the arrow key ▶ of the left or right touch pad to the "- Travel +" column. After pressing the central **SET** key of the right touch pad, the maximum sensitivity of the gyro, e.g. 50 %, can now be set in the inverse value field. For this purpose, rotate the selected control to the corresponding screen so that only one value field is represented inversely:

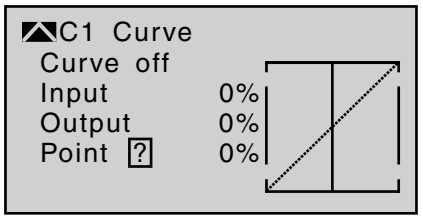


Now you have a fixed value as long as the rotary control is at the right limit position. The correct value must be adjusted in flight.

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 119)



This function is a type of "convenient exponential curve" for the throttle/pitch joystick 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 overlappings 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 …

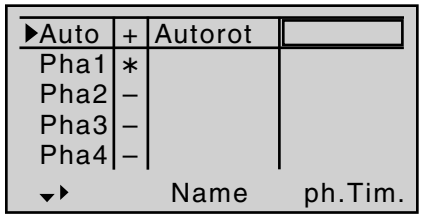
"Phase setting" (page 132)

… whereby the symbols appearing in the second column after the switch assignment in the "**Phase assignment**" menu have the following meanings:

"–": No phase switch available

"+": Phase switch available

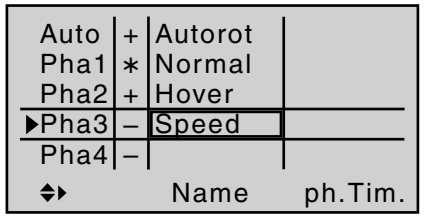
"∗": Currently active phase



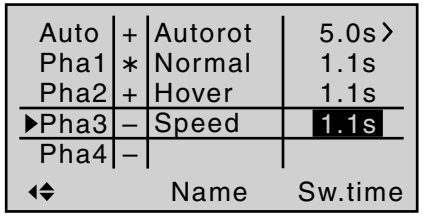
However, you should consider beforehand whether you want to activate the up to six additional flight phases with single switches or, more logically, with three-stage switches in addition to the autorotation phase. The latter possibility is more logical and usually more clearly laid out.

In the upper figure the line "**Autorot**" is already selected. 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, for example:



Then, in the fourth column, enter the switching time with which the FROM phase should switch TO the next respective phase. Approximately 1 s should suffice:



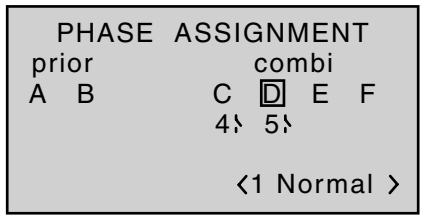
This value can also be adjusted later according to your personal preferences. Please observe in the process that TO the autorotation phase, whose name is defined as "**Autorot**", is switched without a time delay. If necessary, enter the time with which a change FROM the autorotation phase to a different 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.

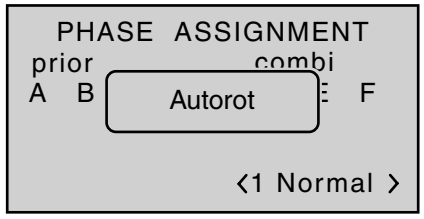
The assignment of the switch takes place in the menu …

"Phase assignment" (page 134)

Under "C" and "D" assign the three-stage switches SW 4 + 5, for example:

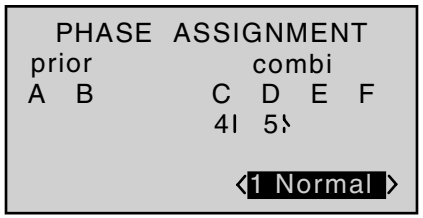


Now you must assign the corresponding flight phase from the **"Phase setting"** menu to the respective switch position. Since you have already assigned names, the name of the phase "1 Normal" appears to the right in the display. If the already assigned autorotation switch was activated, the following warning message appears in the display:

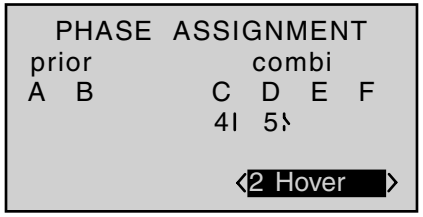


As a reminder:
The autorotation phase has absolute precedence.

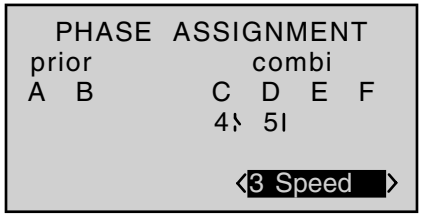
Therefore, move the autorotation switch back and then move the selected switch, in our example the three-stage switch SW 4 + 5, to the one limit position. Then switch to the bottom right with the arrow keys and activate this input field:



Now select the desired flight phase for this switch position - for example, "2 Hover" ...



… and confirm this selection by briefly pressing the central **SET** key of the right touch pad or move the switch to the other limit position and define the name for this switch position, such as "3 Speed".



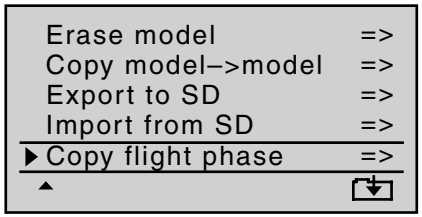
The switch center then receives the name "1 Normal" as shown above to the left.

Notice:
Exchanged or different name assignments for the three switch positions are, of course, also possible. For example, with the use of one of the rotational speed controllers programmed according to the description in the next column, a sequences like "normal / hover / acro" would be logical.

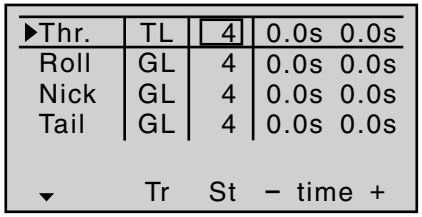
The model settings made before the assignment of a phase switch are now in the flight phase "Normal". This is the phase which is called after the above definition in the switch center position.

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 64)



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-32** HoTT 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 joystick are also saved depending on the flight phase, see menu **"Joystick setting"** page 94:



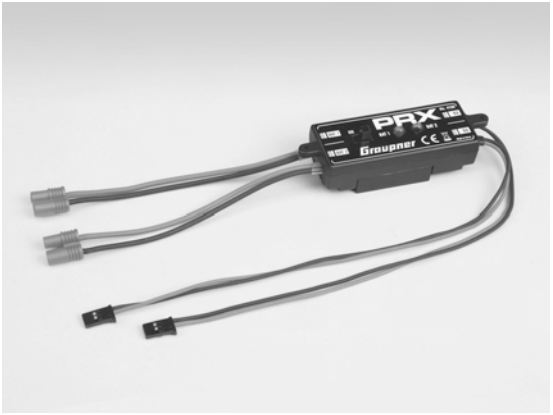
Enhancement recommendation:
Rotational speed regulator

At some point in time you may want to install a rotational speed regulator in the helicopter, such as mc-Heli-Control, 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-32** HoTT also enables further possibilities for the realization of different speeds in the individual phases. For a practical recommendation with maintenance of the throttle limiter function, see the description beginning on page 169.

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.

Appendix



PRX (Power for Receiver)
Order No. **4136**

Highly developed, stabilized receiver current supply with intelligent power management.

The unit ensures a stabilized and adjustable current supply of the receiver in order to increase the reliability of the current supply even further. Suitable for various receiver batteries in order to guarantee an uncomplicated and wide range of application. Even if the battery voltage is only interrupted for a short time, this is recorded and displayed in order to counteract an under-dimensioning or even the failure of the receiver battery with this notice.

- For the operation of one or two receiver batteries. (Simultaneous discharge with the operation of two batteries)
- Suitable for five or six-cell NiMH or two -cell LiPo or LiFe batteries. *Graupner*/JR, G3.5, G2 and BEC plug systems.
- Three adjustable levels for the output voltage for the supply of the receiver (5.1V / 5.5V / 5.9V).
- Two ultra-bright LEDs show the operating statuses of Battery 1 and Battery 2 separately.
- Integrated high-quality On/Off switch
- High-current resistant design
- Flatter design of the switch and the LEDS in order to not influence the appearance and characteristics of the model.
- Linear layout of fastening lugs, LEDs and switches for a simple installation using an accompanying hole template.

GPS/Vario module *Graupner* HoTT
Order No. **33600**

Vario with altitude signals and and five ascend and descend signal tones as well as integrated GPS with range finding, distance measurement, display of the flight direction and the coordinates

- Additional warning thresholds for min. altitude, max. altitude, rate of ascend and descend in two stages
- Altitude display and memory of the min. and max. altitude.
- Adjustable warning time: OFF, 5, 10, 15, 20, 25, 30 seconds, always
- Adjustable warning repetition time: Always, 1, 2, 3, 4, 5 min, once
- The GPS/Vario sensor can be connected directly at the telemetry input of the receiver.

Vario technical data:

- Altitude measurement: -500 m … +3000 m
- Resolution: 0.1 m
- Vario sensitivity: 0.5 m/3s, 1 m/3 s, 0.5 m/s, 1 m/1 s, 3 m/s programmable by tone
- Average calculation: 4 - 20 measurements programmable per measurement value

Vario module*Graupner* HoTT
Order No. **33601**

Vario with altitude signals and 5 ascend and descend signal tones each, altitude display and memory of the min. and max. altitude

- Additional warning thresholds for min. altitude, max. altitude, rate of ascend and descend in two stages
- Adjustable warning time: OFF, 5, 10, 15, 20, 25, 30 seconds, always
- Adjustable warning repetition time: Always, 1, 2, 3, 4, 5 min, once
- The Vario sensor can be connected directly at the telemetry input of the receiver.

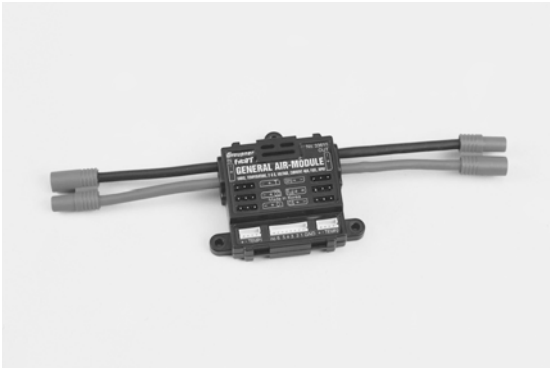
Technical data

- Altitude measurement: -500 m … +3000 m
- Resolution: 0.1 m
- Vario sensitivity: 0.5 m/3s, 1 m/3 s, 0.5 m/s, 1 m/1 s, 3 m/s programmable by tone
- Average calculation: 4 - 20 measurements programmable per measurement value

General Engine-Module *Graupner* HoTT
Order No. **33610**

General sensor for *Graupner* HoTT receivers and models with combustion or electric motor:

- 2x temperature and voltage measurements with warning thresholds for min. and max. voltage and min. and max. temperature
- Single cell measurement with warning thresholds for min. voltage
- Voltage, current and capacity measurement with warning thresholds for min. and max. voltage, max. capacity and max. current
- Programmable current limiting
- Current limiting with shunt resistors 2 x 1 mOhm parallel = 0.5 mOhm
- Rotational speed measurement and warning thresholds for min. and max. rotational speed
- Fuel measurement with warning thresholds in 25 % increments (after software update).
- Adjustable warning time: OFF, 5, 10, 15, 20, 25, 30 seconds, always
- Adjustable warning repetition time: Always, 1, 2, 3, 4, 5 min, once
- 2x temperature selectively 0 to 120 °C or 200 °C and voltage measurement up to 80 V DC
- 1x rotational speed measurement up to 100,000 rpm with a two-blade propeller
- 1x speed controller/servo input, 1x rotational speed regulatio n input, 1x speed controller/servo output for rotational speed regulation
- 1x current, voltage and capacity measurement up to 40 A (pulse 1 s up to 60 A) and up to 30 V
- 1x single cell monitoring for 2 - 6S lithium batteries (LiPo, LiIo, LiFe)
- etc.; see www.graupner.de for the respective product



General Air-Module *Graupner* HoTT
Order No. **33611**

General sensor for *Graupner* HoTT receivers and models with combustion or electric motor:

- Vario with altitude signals and ascend and descend signals and additional warning thresholds for min. altitude, max. altitude, rate of ascend and descend in two stages
- Altitude display (-500 … +3000 m) and memory of the min. and max. altitude.
- 2x temperature and voltage measurements with warning thresholds for min. and max. voltage and min. and max. temperature
- Single cell measurement with warning thresholds for min. voltage
- Voltage, current and capacity measurement with warning thresholds for min. and max. voltage, max. capacity and max. current
- Rotational speed measurement with rotational speed regulation (programmable) and warning thresholds for min. and max. rotational speed
- Fuel measurement with warning thresholds in 25 % increments.
- Adjustable warning time: OFF, 5, 10, 15, 20, 25, 30 seconds, always
- Adjustable warning repetition time: Always, 1, 2, 3, 4, 5 min, once
- 2x temperature selectively 0 to 120 °C or 200 °C and voltage measurement up to 80 V DC
- 1x rotational speed measurement up to 100,000 rpm with a two-blade propeller
- 1x speed controller/servo input, 1x rotational speed regulation input, 1x speed controller/servo output for rotational speed regulation
- 1x current and voltage and capacity measurement up to 40 A (pulse 1s: 60 A) and up to 30 V
- etc.; see www.graupner.de for the respective product

Electric Air-Module *Graupner* HoTT
Order No. **33620**

General sensor for *Graupner* HoTT receiver and models with electric motor

- Vario with altitude signals, ascend and descend signals as well as additional warning thresholds for min. altitude, max. altitude, rate of ascend and descend in two stages
- Altitude display (-500 … +3000 m) and memory of the min. and max. altitude.
- 2x temperature and voltage measurements with warning thresholds for min. and max. voltage and min. and max. temperature
- Single cell measurement 2 ... 14S with warning thresholds for min. voltage
- Voltage, current and capacity measurement with warning thresholds for min. and max. voltage, max. capacity and max. current
- Adjustable warning time: OFF, 5, 10, 15, 20, 25, 30 seconds, always
- Adjustable warning repetition time: Always, 1, 2, 3, 4, 5 min, once
- 2x temperature selectively 0 to 120 °C or 200 °C and voltage measurement up to 80 V DC
- 1x speed controller input, 1x speed controller output for single cell undervoltage correction
- 1x current and voltage and capacity measurement up to 150 A (short-term 1 sec 320 A) and up to 60 V
- 1x single cell monitoring for 2 - 14S lithium batteries (LiPo, LiIo, LiFe)
- 1x telemetry connection for receiver

RPM Magnet Sensor *Graupner* HoTT
Order No. **33616**

RPM Optical Sensor *Graupner* HoTT
Order No. **33615**

***Graupner* HoTT Smart-Box**
Order No. **33700**

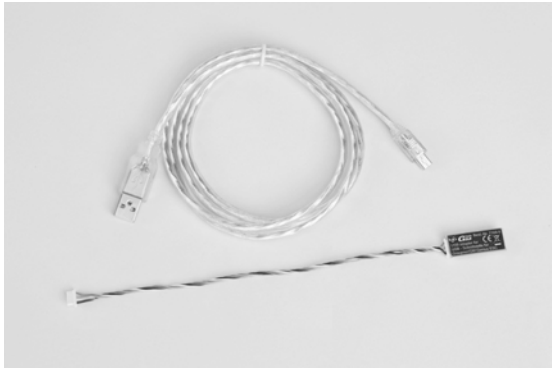
Wide-ranging functions combined into one device make the SMART BOX your future smart companion. Whether it comes to displaying real-time telemetry data or settings are made on your HoTT system, 8 x 21 characters on a large display enable easy use. An integrated sounder for the emission of an acoustic signal and warning tone enhances the flexible use of the BOX even further.

Using the accompanying installation set, the device can be mounted on brackets of the transmitter and is thus optimally positioned to enable the reading of real-time telemetry data even while controlling your model.

The capability of user-installed updates ensures that the SMART BOX always has the latest software and can be safely expanded with future functions.

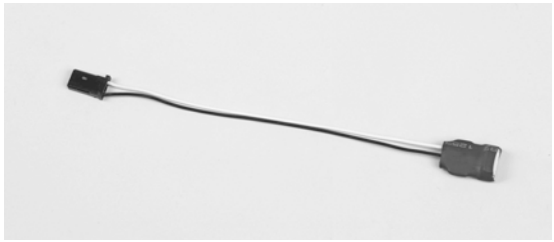
- Transmitter voltage display with adjustable warning threshold
- Range test
- Receiver temperature
- Servo reversal
- Servo travel
- Channel switching
- Mixer settings
- Region setting
- Signal quality
- Receiver voltage
- Servo neutral position
- Cycle time
- Fail-Safe settings
- Servo test

Dimensions: approx. 76 mm x 72 mm x 17 mm (L x W x H)
Weight: approx. 55 g



***Graupner* HoTT USB interface**
Order No. **7168.6**

This USB interface is required together with the separately available adapter cable, Order No. **7168.6A**, for the updating of receivers and sensors and the **mc-32** HoTT transmitter can be updated directly with the USB cable included in the scope of delivery of the interface.



***Graupner* HoTT adapter cable**
Order No. **7168.6A**

This adapter cable is required together with the separately available USB interface, Order No. **7168.6**, for the updating of receivers and sensors. The **mc-32** HoTT transmitter can be updated directly with the USB cable included in the scope of delivery of the interface.

FCC Information

Graupner mc-32 HoTT #33124

FCC ID: ZKZ-MC-32

FCC Statement

1. 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 un desired operation.
2. Changes or modifi cations 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 15 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.

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for un uncontrolled envirionment. This equipment should be installed and operated with a minimum distance of 20 cm between the antenna and your body.

Konformitätserklärung gemäß dem Gesetz über Funkanlagen und Telekomunikationsendeinrichtungen (FTEG) und der Richtlinie 1999/5/EG (R&TTE)

Declaration of Conformity in accordiance with the Radio and Telecomunikations Terminal Equipment Act (FTEG) and Directive 1999/5/EG (R&TTE)

Graupner GmbH & Co. KG
Henriettenstraße 94-96
D-73230 Kirchheim/Teck

erklärt, dass das Produkt:
declares that the product

mx-12 HoTT - No. 33112, mx-16 HoTT - No. 33116, mx-20 HoTT - No. 33124, GR-12 HoTT - No. 33506, GR-16 HoTT - No. 33508, GR-24 HoTT - No. 33512

Geräteklasse:
Equipment class

2

den grundlegenden Anforderungen des § 3 und den übrigen einschlägigen Bestimmungen des FTEG (Artikel 3 der R&TTE) entspricht.
complies with the essential requirements of § 3 and the other relevant provisions of the FTEG (Article 3 of the R&TTE Directive).

Angewendete harmonisierte Normen:
Harmonised standards applied

EN 60950:2006	Gesundheit und Sicherheit gemäß § 3 (1) 1. (Artikel 3 (1)a)) Health and safety requirements pursuant to § 3 (1) 1. (Article 3 (1) a))
EN 301 489-1 V1.7.1 **EN 301 489-3 V1.4.1**	Schutzanforderungen in Bezug auf elektromagnetische Verträglichkeit § 3 (1) 2, Artikel 3 (1) b)) Protection requirement concernig electromagnetic compatibility § 3 (1) 2, Artikel 3 (1) b))
EN 300 328 V1.7.1	Maßnahmen zur effizienten Nutzung des Frequenzspektrums § 3 (2) (Artikel 3 (2)) Measures for the efficient use of the radio frequency spectrum § 3 (2) (Article 3 (2))

CE 0678 !

Kirchheim, 09. März 2011

Stefan Graupner, Geschäftsführer
Stefan Graupner, Managing Director

Graupner GmbH & Co. KG Henriettenstraße 94-96 D-73230 Kirchheim/Teck Germany
Tel: 07021/722-0 Fax: 07021/722-188 EMail: info@graupner.de

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

Servicestellen / Service / Service après-vente

Graupner -Zentralservice
Graupner GmbH & Co. KG
Henriettenstrasse 94 - 96
D-73230 Kirchheim

Service hotline
☎ (+49) 0 18 05 47 28 76*
Monday ... Friday
9:30 ... 11:30 & 13:00 ...15:00

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☎ (+31) 10 59 13 59 4

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L 8009 Strassen
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RC Service Z. Hnizdil
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CZ 16100 Praha 6 - Ruzyne
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CH 8181 Höri
☎ (+41) 43 26 66 58 3

Espana
Anguera Hobbies
C/Terrassa 14
E 43206 Reus (Tarragona).
☎ (+34) 97 77 55 32 0
info@anguera-hobbies.com

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Box 5307
S 40227 Göteborg
☎ (+46) 31 70 73 00 0

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F 57601 Forbach-Oeting
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I 25064 Gussago
☎ (+39) 030 25 22 73 2

* *0.14 cent / minute from a German Telecom land-line. Calling price variations possible for calls from cell phones or from the land-lines of other providers.*

Graupner GmbH & Co. KG, Henriettenstrasse 94 - 96, D-73230 Kirchheim/Teck provides a warranty for this product of 24 months from the date of purchase. The warranty is only valid for the material or functional defects already present at the time of the purchase of the product. Schäden, die auf Abnützung, Überlastung, falsches Zubehör oder unsachgemäße Behandlung zurückzuführen sind, sind von der Garantie ausgeschlossen. Die gesetzlichen Rechte und Gewährleistunsansprüche des Verbrauchers werden durch diese Garantie nicht berührt. Bitte überprüfen Sie vor einer Reklamation oder Rücksendung das Produkt genau auf Mängel, da wir Ihnen bei Mängelfreiheit die entstandenen Unkosten in Rechnung stellen müssen.

Graupner GmbH & Co. KG, Henriettenstraße 94 - 96. D-73230 Kirchheim/Teck, Germany guarantees this product for a period of 24 months from date of purchase. The guarantee applies only to such material or operational defects which are present at the time of purchase of the product. Damage due to wear, overloading, incompetent handling or the use of incorrect accessories is not covered by the guarantee. The user´s legal rights and claims under guarantee are not affected by this guarantee. Please check the product carefully for defects before you are make a claim or send the item to us, since we are obliged to make a charge for our cost if the product is found to be free of faults.

La société *Graupner* GmbH & Co. KG, Henriettenstraße 94-96, D-73230 Kirchheim/Teck, accorde sur ce produit une garantie de 24 mois à compter de la date d'achat. La garantie ne s'applique qu'aux défauts de matériel et de fonctionnement du produit acheté. Les dommages dus à une usure, à une surcharge, à l'emploi d'accessoires non compatibles ou à une manipulation non conforme sont exclus de la garantie. Cette garantie ne remet pas en cause les droits légaux des consommateurs. Avant toute réclamation ou retour de matériel, vérifiez précisément les défauts ou vices constatés, car si le matériel est conforme et qu'aucun défaut n'a été constaté par nos services, nous nous verrions contraints de facturer le coût de cette intervention.

Garantie-Urkunde

Warranty certificate / Certificat de garantie

mc-32 HoTT Set

☐ Order No. **33124**

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 GMBH & CO. KG
POSTFACH 1242
D-73220 KIRCHHEIM/TECK
GERMANY

http://www.graupner.de

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Printed in Germany PN.PK-01