mc-22s.GB

Graupner | JR
REMOTE CONTROL

COMPUTER-SYSTEM

mc-22s

3D-Rotary Programming System

Programming manual

Contents

Safety notes

We all want you to have many hours of pleasure in our mutual hobby of modelling, and safety is an important aspect of this. It is absolutely essential that you read right through these instructions and take careful note of all our safety recommendations.

If you are a beginner to the world of radio-controlled model aircraft, boats and cars, we strongly advise that you seek out an experienced modeller in your field and ask him for help and advice.

These instructions must be passed to the new owner if you ever sell the equipment.

Application

This radio control system may only be used for the purpose for which the manufacturer designed it, i.e. for operating radio-controlled models which do *not carry humans*. No other type of use is approved or permissible.

Safety notes

SAFETY IS NO ACCIDENT

and …

RADIO-CONTROLLED MODELS ARE NOT PLAYTHINGS

… because even small models can cause serious personal injury and damage to property if they are handled incompetently.

Technical problems in electrical and mechanical systems can cause motors to rev up or burst into life unexpectedly, with the result that parts may fly off at great speed, causing considerable injury.

Please take every possible care to avoid short-circuits of all types. “Shorts” can easily destroy parts of the radio control system, but the stored energy in the battery constitutes an even more serious danger: in unfavourable circumstances there is a serious risk of fire and even explosion.

Propellers, helicopter rotors and all other rotating parts which are driven by a motor or engine represent a permanent injury hazard. Do not touch these items with any object or part of your body. *Remember that a propeller spinning at high speed can easily slice off a finger. Never stand in the primary danger zone, i.e. in the rotational plane of the propeller or other rotating parts.*

When an electric flight or drive battery is connected to the power system, **never** touch or even come close to the propeller or propellers!

When you are programming the transmitter it is important to avoid the risk of an electric motor or I.C. engine bursting into life unexpectedly. The best course is to disconnect the fuel supply or the flight / drive battery before carrying out any work.

Protect all electronic equipment from dust, dirt, damp, vibration and foreign bodies. Avoid subjecting the equipment to excessive heat or cold. Radio control equipment should only be used in “normal” ambient temperatures, i.e. within the range -15°C to +55°C.

Avoid subjecting the radio control system to shock and pressure. Check the units at regular intervals for damage to cases and leads. Do not re-use any item which is damaged or has become wet, even after you have dried it out thoroughly.

Use only those components and accessories which we expressly recommend. Be sure to use only genuine matching *GRAUPNER* connectors of the same design with contacts of the same material. Insofar as they are still required, use only genuine *GRAUPNER* plug-in crystals on the appropriate frequency band.

When deploying cables, note that they must not be under tension, and should never be bent tightly or kinked, otherwise they may fracture. Avoid sharp edges which could wear through the cable insulation.

Check that all connectors are pushed home firmly before using the system. When disconnecting components, pull on the connectors themselves – not on the wires.

It is not permissible to carry out any modifications to the RC system components. Avoid reverse polarity and short-circuits of all kinds involving the connecting leads, as the equipment is not protected against such errors.

Installing the receiving system and deploying the receiver aerial

In a model aircraft the receiver must be packed in soft foam and stowed behind a stout bulkhead, and in a model boat or car should be protected effectively from dust and spray.

The receiver must not make contact with the fuselage, hull or chassis at any point, otherwise motor vibration and landing shocks will be transmitted directly to it.

When installing the receiving system in a model with a glowplug or petrol engine, be sure to install all the components in well protected positions so that no exhaust gas or oil residues can reach the units and get inside them. This applies above all to the ON / OFF switch, which is usually installed in the outer skin of the model.

Secure the receiver in such a way that the aerial, servo leads and switch harness are not under any strain.

The receiver aerial is permanently attached to the receiver. It is about 100 cm long and must not be shortened or extended. The aerial should be routed as far away as possible from electric motors, servos, metal pushrods and high-current cables. However, it is best not to deploy the aerial in an exactly straight line, but to angle it: e.g. run it straight to the tailplane, then leave the final 10 - 15 cm trailing loosely, as this helps to avoid reception “blind spots” when the model is in the air. If this is not feasible, we recommend that you lay out part of the aerial wire in an S-shape inside the model, close to the receiver if possible.

Installing the servos

Always install servos using the vibration-damping grommets supplied. The rubber grommets provide some degree of protection from mechanical shocks and severe vibration.

Safety notes

Installing control linkages

The basic rule is that all linkages should be installed in such a way that the pushrods move accurately, smoothly and freely. It is particularly important that all servo output arms can move to their full extent without fouling or rubbing on anything, or being obstructed mechanically at any point in their travel.

It is important that you can stop your motor at any time. With a glow motor this is achieved by adjusting the throttle so that the barrel closes completely when you move the throttle stick and trim to their end-points.

Ensure that no metal parts are able to rub against each other, e.g. when controls are operated, when parts rotate, or when motor vibration affects the model. Metal-to-metal contact causes electrical "noise" which can interfere with the correct working of the receiver.

Always extend the transmitter aerial fully before operating your model

Transmitter field strength is at a minimum in an imaginary line extending straight out from the transmitter aerial. It is therefore fundamentally misguided to "point" the transmitter aerial at the model with the idea of obtaining good reception.

When several radio control systems are in use on adjacent channels, the pilots should always stand together in a loose group. Pilots who insist on standing away from the group endanger their own models as well as those of the other pilots.

Pre-flight checking

If there are several modellers at the site, check carefully with all of them that you are the only one on "your" channel before you switch on your own transmitter. If two modellers switch on transmitters on the same channel, the result is interference to one or both models, and the usual result is at least one wrecked model.

Before you switch on the receiver, ensure that the throttle stick is at the stop / idle end-point.

Always switch on the transmitter first, and only then the receiver.

Always switch off the receiver first, and only then the transmitter.

If you do not keep to this sequence, i.e. if the receiver is at any time switched on when its transmitter switch is set to "OFF", then the receiver is wide open to signals from other transmitters and any interference, and may respond. The model could then carry out uncontrolled movements, which could easily result in personal injury or damage to property. The servos may run to their end-stops and damage the gearbox, linkage, control surface etc..

Please take particular care if your model is fitted with a <u>mechanical gyro</u>:

Before you switch your receiver off, disconnect the power supply to ensure that the motor cannot run up to high speed accidentally.

The gyro can generate such a high voltage as it runs down that the receiver picks up apparently valid throttle commands, and the motor could respond by accelerating unexpectedly.

Range checking

Before <u>every</u> session check that the system works properly in every respect, and has adequate range. This means checking that all the control surfaces respond correctly and in the appropriate direction to the transmitter commands, at a suitable ground range.

Repeat this check with the motor running, while a friend holds the model securely for you.

Operating your model aircraft, helicopter, boat or car

Never fly directly over spectators or other pilots, and take care at all times not to endanger people or animals. Keep well clear of high-tension overhead cables. Never run your model boat close to docks and full-size boats. Model cars should never be run on public streets or motorways, footpaths, public squares etc..

Checking the transmitter and receiver batteries

It is essential to stop using the radio control system and recharge the batteries well before they are completely discharged. In the case of the transmitter this means – at the very latest – when the message "**Battery must be charged**" appears on the screen, and you hear an audible warning signal.

It is vital to check the state of the receiver battery at regular intervals. When the battery is almost flat you may notice the servos running more slowly, but it is <u>by no means</u> safe to keep flying or running your model until this happens. Always replace worn-out batteries in good time.

Keep to the battery manufacturer's instructions, and don't charge the batteries for longer than stated. Do not leave batteries on charge unsupervised.

Never attempt to recharge dry cells, as they may explode.

Rechargeable batteries should always be recharged before every session. When charging batteries it is important to avoid short-circuits. Do this by first connecting the charge lead banana plugs to the charger, taking care to maintain correct polarity. Only then connect the charge lead to the transmitter or receiver battery.

Disconnect all batteries and remove them from your model if you know you will not be using it in the near future.

Capacity and operating times

This rule applies to all forms of electrical power source: effective capacity diminishes with every charge cycle. At low temperatures capacity is also greatly reduced, i.e. operating times are shorter in cold conditions.

Please note that frequent charging can also result in a gradual loss of capacity, as can the use of battery maintenance (cycling) programs. It is important to monitor your batteries regularly – at least every six months – and check that they still have adequate capacity for their purpose.

Use only genuine *GRAUPNER* rechargeable batteries!

Suppressing electric motors

All conventional electric motors produce sparks between commutator and brushes, to a greater or lesser extent depending on the motor type; the sparking generates serious interference to the radio control system.

In electric-powered models every motor must therefore be effectively suppressed. Suppressor filters reliably eliminate such interference, and should always be fitted.

Read the information in the Operating Instructions and Installation Instructions supplied with your electric motors for more information on this subject.

Refer to the main *GRAUPNER* FS catalogue for details of suppressor filters.

Servo suppressor filters for extension leads
Order No. **1040**

Servo suppressor filters are required if you are obliged to use long servo extension leads, as they eliminate the danger of de-tuning the receiver. The filter is connected directly to the receiver input. In very difficult cases a second filter can be used, positioned close to the servo.

Using electronic speed controllers

Electronic speed controllers must be chosen to suit the size of electric motor which they are required to control.

There is always a danger of overloading and possibly damaging the speed controller, but you can avoid this by ensuring that the controller's current-handling capacity is at least half of the motor's maximum stall current.

Particular care is called for if you are using a "hot" (i.e. upgrade) motor, as any low-turn motor (small number of turns on the winding) can draw many times its nominal current when stalled, and the high current will then wreck the speed controller.

Electrical ignition systems

Ignition systems for internal combustion engines can also produce interference which has an adverse effect on the working of the radio control system.

Electrical ignition systems should always be powered by a separate battery – not the receiver battery.

Be sure to use effectively suppressed spark plugs and plug caps, and shielded ignition leads.

Keep the receiving system an adequate distance away from the ignition system.

Static charges

Lightning causes magnetic shock waves which can interfere with the operation of a radio control transmitter even if the thunderstorm actually occurs several kilometres away. For this reason ...

... **always cease flying operations immediately if you notice an electrical storm approaching. Static charges through the transmitter aerial can be life-threatening!**

Caution:

Radio control systems may only be operated on the frequency bands and spot frequencies approved in each EU country. You will find information on frequencies in the section "Approved operating frequencies" on page 168. It is prohibited to operate radio control systems on any other frequency, and the authorities are entitled to take appropriate legal action in such cases.

Care and maintenance

Don't use cleaning agents, petrol, water or other solvents to clean this equipment. If the case, the whip aerial etc. gets dirty, wipe them clean with a soft dry cloth.

Components and accessories

As manufacturers, the company of *GRAUPNER* GmbH & Co. KG recommends the exclusive use of components and accessories which have been tested by *GRAUPNER* and approved for their capability, function and safety. If you observe this rule, *GRAUPNER* accepts responsibility for the product.

***GRAUPNER* cannot accept liability for non-approved parts or accessories made by other manufacturers. It is not possible for *GRAUPNER* to assess every individual item manufactured by other producers, so we are unable to state whether such parts can be used without incurring a safety risk.**

Liability exclusion / Compensation

We at *GRAUPNER* are unable to ensure that you observe the operating instructions, and are not in a position to influence the way you install, operate and maintain the radio control system components. For this reason we are obliged to refute all liability for loss, damage or costs which are incurred due to the incompetent or incorrect use and operation of our products, or which are connected with such operation in any way.

Unless otherwise prescribed by law, the obligation of the *GRAUPNER* company to pay compensation is limited to the invoice value of that quantity of GRAUPNER products which was immediately and directly involved in the event in which the damage occurred. This does not apply if *GRAUPNER* is found to be subject to unlimited liability according to binding legal regulation on account of deliberate or gross negligence.

mc-22s – a new generation of radio control technology

The proven mc-22s is now being produced in a new version under the designation mc-22s, featuring a PLL Synthesizer RF module as standard. The hardware has also been modified in several respects. For example, "non-volatile memory" is now used to store model data, eliminating the need for a Lithium back-up battery if the main battery should be discharged.

The software has also been expanded by the introduction of a language select facility: the entire menu system can now be switched at any time to German, English, French or Italian at will, without requiring any changes to the programming.

An optional DSC module is now available under Order No. **3290.24**. When fitted with this module the mc-22s transmitter is ideally equipped for use as the control unit with flight simulators; it can also be connected directly to a receiver using a DSC lead (see Appendix). The direct connection is useful for set-up and testing, as servo signals are transferred to the receiver without the transmission of an RF signal.

The many advantages of the previous mc-22 have made the system extremely popular, with many thousands of sets already in use, and – as you would expect – these outstanding features are retained in full in the new version.

In conjunction with the "DS 24 FM S" mini dual-conversion receiver, the transmitter can control up to twelve servos individually. This means that it is straightforward to use two or more servos on the rudder or elevators for the more extreme models.

Fitting the well-known NAUTIC modules provides additional expanded functions, which means that fans of scale model boats and multi-function ships can also exploit the advantages of the mc-22s.

If used with the new "smc"-series receivers, the mc-22s can provide servo travel at extremely high resolution with 1024 control increments, ensuring super-fine control using the SUPER-PCM digital modulation mode. Naturally we guarantee full compatibility with earlier PPM / FM receiver systems.

The mc-22s and its software are designed to handle the widely varying requirements of the modern modeller, as well as the more demanding programming required by the advanced and competition flyer. The hardware incorporates all the latest developments, and is laid out in such a way that it can easily exploit future software development, which continues all the time.

Operating the transmitter's software could hardly be simpler: a digital rotary control and just four "softkeys" make model programming speedy and direct.

The beginner in particular will certainly appreciate the carefully designed lay-out of the menus and screen, conceived with clarity in mind. However, if you encounter a problem and the manual is not immediately to hand, a quick button-press calls up the integral "on-line help" which will quickly get you back up to speed.

It is important for the beginner's first attempts at programming the transmitter to be as painless as possible, and with this in mind our developers decided to restrict the menus available initially to just the basic programming essentials. Of course, you can activate all the facilities of the suppressed menus at any time if you wish; alternatively you can set the mc-22s transmitter to work in "Expert" (unrestricted) mode from the outset.

The software is carefully arranged in a neatly structured menu system. Options which are inter-connected in terms of function are clearly organised by content, and are symbolised by the following pictograms:

- Memory
- Basic settings: transmitter, servos, model
- Transmitter control settings
- Switches
- Flight phases
- Timers
- Mixers
- Special functions
- Global functions

The mc-22s provides thirty model memories, each of which can store model settings for up to four flight phases. Flight phases can be called up in flight simply by operating a switch, so that you can try out different settings quickly and without risk.

The large graphic screen provides a clear display of all functions, making the transmitter very easy to use. The settings of the various mixers, Dual-Rate / Exponential and the Channel 1 curve can all be displayed in graphic form, and this is extraordinarily helpful when setting up non-linear curve characteristics.

This manual describes each menu in detail, and also provides dozens of useful tips, notes and programming examples to complement the basic information. More general modelling terms, such as transmitter controls, Dual Rates, butterfly and many others, are all explained in the manual, which also includes a comprehensive index at the end. You will find a quick-access tabular summary of the essential operating procedures on pages 38 to 44.

Please read the Safety Notes and the technical information. We recommend that you start by checking all the functions as described in the instructions. When you have programmed a model, it is important to check all the programmed settings on the ground before committing the model to the air. Always handle your radio-controlled model with a responsible attitude to avoid endangering yourself and others.

We in the *GRAUPNER* team offer our grateful thanks to all the many modellers who have helped us develop this system by passing on constructive suggestions, valuable tips and programming examples, and in so doing have helped us design and produce this version of the system and its operating manual.

Kirchheim-Teck, January 2007

COMPUTER-SYSTEM mc-22s

Expandable radio control system for up to 10 control functions (PPM24: 12 functions)

Professional high-technology micro-computer radio control system. Ultra-speed low-power single-chip micro-computer with 256 kByte (2 Mbit) flash memory, with 16 kByte (128 kbit) RAM, 73 ns command cycle!

With integral high-speed precision A/D converter and proven, highly practical dual-function rotary encoder and 3D rotary select programming technology.

- World's first: four-language dialogue menu (German, English, French, Italian)
- The latest hardware and integral Synthesizer system for channel selection, with security menu to prevent switching the transmitter on accidentally
- Up to twelve control functions (PPM24)
- Simplified assignment of transmitter controls such as control sticks, external switches, proportional controls, trim levers as transmitter controls
- 30 model memories
- 3D rotary encoder in conjunction with four programming buttons for accurate adjustment and excellent programming convenience
- MULTI-DATA high-resolution GRAPHIC LCD screen provides superb monitoring facilities, accurate graphical representation of multi-point curves for throttle, collective pitch, tail rotor etc., plus EXPO / DUAL RATE functions and mixer curves
- CONVENIENT MODE SELECTOR allows easy switching between stick modes 1 to 4 (e.g. throttle right / throttle left)
- Real Time Processing (RTP). All selected settings and changes take immediate effect at the receiver output, virtually in real time
- ADT Advanced Digital Trim system for all four stick trim functions, with easily variable throttle / idle trim and variable trim increment
- **Four switchable types of modulation:**

  PPM 18

  The most widely used standard transmission process (FM and FMsss).

  For C 6, C 8, C 12, C 16, C 17, C 19, DS 18, DS 19, DS 20 receivers, and XP 4, XP 8, XP 10, XP 12, XN 12, XM 16, R16SCAN, R 600 light, R 600, R 700, C 6 FM, SB6 SYN 40 S, SR6SYN miniature receivers

PPM24
PPM multi-servo transmission mode for simultaneous operation of up to twelve servos. For the DS 24 FM S receiver

PCM 20
PCM with system resolution of 512 steps per control function. For mc-12, mc-20, DS 20 mc receivers.

SPCM 20
Super PCM modulation with high system resolution of 1024 steps per control function.
For smc-14 S, smc-16 SCAN, smc-19, SMC-19 DS, smc-20, smc-20 DS, smc-20 DSYN, smc-20 DSCAN receivers

- Six freely programmable mixers for fixed-wing models and helicopters, of which two in each case are five-point curve mixers, freely variable in 1% increments. An ingenious polynomial approximation process is applied, generating an ideally rounded curve based on your selected mixer reference points.
- The five-point throttle and collective pitch curves available in the helicopter menu also feature a multi-point curve system (MPC). An ingenious polynomial approximation process is applied, generating an ideally rounded curve based on your selected mixer reference points.
- Two-stage Expo / Dual Rate system, individually variable, switchable in flight, separately variable for each model
- Helicopter swashplate mixers for 1, 2, 3 and 4-point linkages
- Integral flight phase menus, sub-trim for neutral point adjustment of all servos, aileron differential mixer, butterfly (crow) mixer, flaperon mixer
- Graphical servo display provides a fast, straightforward overview for checking servo settings
- Servo travel limiting for all servo channels, variable separately for each end-point (single-side servo throw)
- Programmable fail-safe function with variable time hold or pre-set function (PCM and SPCM only)
- Stop-watch / count-down timers with alarm function
- Operating hours timer, available separately for each model
- HELP button provides valuable hints on programming and the currently selected programming menu
- Model copy function for all model memories
- Prepared for an interface module for copying between two mc-22s transmitters, mc-22 / mc-22s, or between mc-22s and PC
- Two NAUTIC modules and decoders can be connected for function expansion: each NAUTIC module expands one receiver output to form eight switched channels or four proportional functions.
- Prepared for use as Pupil or Teacher transmitter in a Trainer system
- Non-volatile memory for data back-up even with transmitter battery removed or completely discharged

mc-22s
Micro-computer Radio Control System

Radio control sets:

Order No. **4737**	35 / 35B MHz band
Order No. **4738**	40 / 41* MHz band

Transmitters alone:

Order No. **4737.77**	35 / 35B MHz band
Order No. **4738.77**	40 / 41* MHz band

* *41 MHz approved for use in France only*

Set contents:

mc-22s micro-computer transmitter with factory-fitted NiMH transmitter battery, can be expanded from six to max. ten proportional control functions.

Synthesizer RF module on the appropriate frequency.

R16SCAN PLL Synthesizer FM receiver on the same frequency (max. eight servo functions), C 577 servo, Switch harness,

4.8 V NC receiver batteries: see main *GRAUPNER* FS catalogue.

Recommended battery chargers (optional)

Order No. **6422** Minilader 2
Order No. **6427** Multilader 3
Order No. **6426** Multilader 6E*
Order No. **6428** Turbomat 6 Plus*
Order No. **6429** Turbomat 7 Plus*

Automatic battery chargers with special NiMH charge programs:

Order No. **6419** Ultramat 5*, **
Order No. **6410** Ultramat 10*,
Order No. **6412** Ultramat 12*, **
Order No. **6414** Ultramat 14*,
Order No. **6417** Ultramat 25*, **
Order No. **6416** Ultra Duo Plus 30*, **

Specification - mc-22s computer system

Transmission system	SPCM 20, PCM 20, PPM 18, PPM 24 - switchable
Radio Frequency section	Integral (10 kHz spacing), 35, 35B, 40 or 41 MHz band
Spot frequencies	35 MHz band: chan. 61 - 80, 281*, 282* 35 MHz B-band: channels 182 - 191 40 MHz band: 50 - 59 and 81 - 92 41 MHz band: 400 - 420*
Channel spacing	10 kHz
Max. control functions	SPCM = 10, PCM = 10, PPM = 12
Control functions, basic version	4 functions, with digital trims plus 2 proportional functions
Optional extra channel functions	4 proportional or switched
Channel pulse width	1,5 ms ± 0,5 ms
Control resolution	SPCM 20: 10 Bit (1024 Steps), PCM 20: 9 Bit (512 Steps)
Aerial	Telescopic aerial, ten sections, approx. 1470 mm long
Operating voltage	9,6 ... 12 V
Current drain	approx. 55 mA (excl. active RF module)
Dimensions approx.	225 x 215 x 70 mm
Weight approx.	980 g incl. transmitter battery

* *To recharge the mc-22s system you will also need the transmitter charge lead, Order No. **3022**, and the receiver battery charge lead, Order No. **3021**.*

** *12 V power source required.*

Please refer to the main *GRAUPNER* FS catalogue for details of other chargers.

Specification - R16SCAN receiver

Type	PLL-SCAN narrow-band FM SUPERHET synthesizer receiver
35 / 35B MHz band 40 / 41 MHz band	Order No. **7052** Order No. **7054**
Spot frequencies: 35 MHz 40/41 MHz	 61 …282*/182 …191 50 … 92 /400 … 420*
Operating voltage	4,8 ... 6 V **
Current drain approx.	24 mA
Channel spacing	10 kHz
Sensitivity approx.	10 µV
Modulation	PPM 18
Servo sockets	8 Stück***
Temperature range approx.	-15° ... +55 °C
Aerial length approx.	1000 mm
Dimensions approx.	46 x 25 x 15 mm
Weight approx.	17 g

* *Channels 281, 282 and channels on the 41 MHz frequency band are not approved for use in Germany. See page 168 for frequency table.*

** *4 NC / NiMH cells or 4 dry cells*

*** *Servo 8 is connected to the socket marked "8 / Batt." using a Y-lead Order No. **3936.11** or **3936.32**, in parallel with the receiver battery.*

Replacement part

Order No. **4300.6** Telescopic transmitter aerial

Stainless steel telescopic aerial

Order No. **4300.60**

10-section telescopic aerial, ultra-robust construction. Can be used instead of the standard telescopic aerial.

Please refer to the Appendix and the main *GRAUPNER* FS catalogue for details of additional accessories for the mc-22s radio control set.

Operating notes

Opening the transmitter case

Before opening the transmitter, please check that it is switched off (move Power switch to "**OFF**"). Slide both latches inwards as far as they will go, in the opposite direction to the arrows, until the case back can be folded open and disengaged. To close the transmitter, engage the bottom edge of the case back, fold the panel up again and slide both latches outwards in the direction of the arrows. Take care that no wires get caught when you close the back.

Notes:

- ***Do not modify the transmitter circuit in any way, as this invalidates your guarantee and also invalidates official approval for the system.***
- ***Never touch the circuit boards with any metallic object. Don't touch any electrical contacts with your fingers.***
- ***Whenever you wish to work on the transmitter, start by disconnecting the transmitter battery from the transmitter circuit board to avoid the possibility of short-circuits (see column at far right).***

Power supply

The battery compartment is fitted as standard with a high-capacity 9.6 V NiMH battery (8NH-3000 CS, Order No. **3238** – specification may change). However, this battery is not charged when the transmitter is delivered.

When you are using the transmitter you can monitor the battery voltage on the LCD screen. If the voltage of the transmitter battery falls below a certain point, you will hear an audible warning signal. The screen then displays a message reminding you that the transmitter battery needs to be recharged:

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

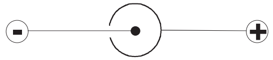
Charging the transmitter battery

The rechargeable transmitter battery can be charged via the charge socket fitted to the side of the case.

The transmitter *must* be switched off and left at "OFF" for the whole period of the charge process. *Never* switch on the transmitter when it is still connected to the charger; even a very brief interruption in the charge process can cause the charge voltage to rise to the point where the transmitter is immediately damaged by the excess voltage. Alternatively the interruption may trigger a new charge cycle, which means that the battery will inevitably be totally overcharged.

For this reason check carefully that all connectors are secure and are making really good contact. Interruptions due to an intermittent contact, no matter how brief, will inevitably cause the charger to malfunction.

Polarity of the mc-22s charge socket



Commercially available battery charge leads produced by other manufacturers are often made up with reversed polarity. For this reason use genuine *GRAUPNER* charge leads exclusively.

Charging the transmitter battery using a standard charger

The integral transmitter charge socket is fitted with a safety circuit which prevents reverse current flow. This is designed to prevent damage to the transmitter if the charge lead is connected with reverse polarity, or if the bare ends of the lead short out.

This protective measure makes it **impossible** to recharge the transmitter battery using an automatic charger, as the charger is unable to check and monitor the battery voltage properly. Automatic chargers usually respond to this by terminating the charge process prematurely, throwing up error messages or refusing completely to charge the pack.

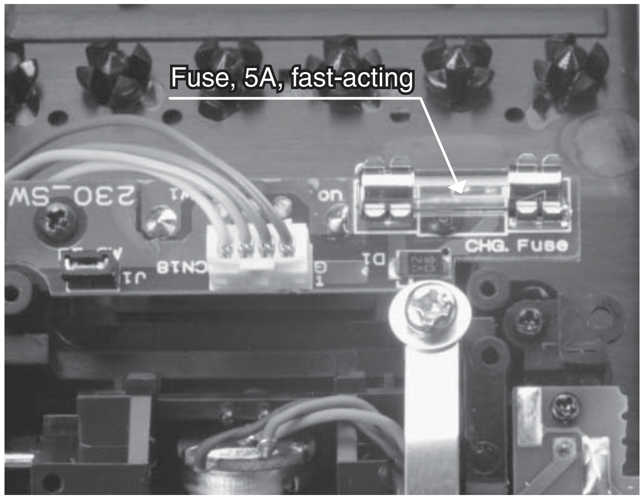
The basic rule for charging a flat battery with a standard charger (without automatic cut-off) is: charge for fourteen hours at a current corresponding to one tenth of the capacity printed on the pack. This is 300 mA for the transmitter battery fitted as standard. It is up to the user to terminate the charge at the correct time …

Charging the transmitter battery with an automatic charger
By-passing the reverse flow safety circuit

If you wish to use an automatic charger to recharge the transmitter battery, the reverse flow safety circuit (protective diode) mentioned in the previous column must be by-passed. This is done by fitting a 20 mm cartridge fuse (5 Amp, fast-acting) in the fuse holder. **If you by-pass the reverse flow safety circuit, there is a constant danger of *short-circuit* between the charge lead plugs.** If a short-circuit or reverse polarity occurs, the transmitter's charge circuit fuse will immediately blow.

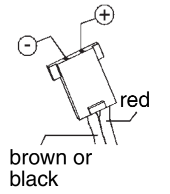
A blown fuse must always be replaced by a new 20 mm glass cartridge fuse (5A, fast-acting). Never attempt to repair the fuse by by-passing it. Replacement fuses are available in any electronics supply shop.

Maximum charge current
To avoid damage to the transmitter the maximum charge current should not exceed 500 mA (0.5 A) with the charge circuit fuse out of circuit (not fitted); with the charge circuit fuse in place: max. 1.5 A.



Removing the transmitter battery

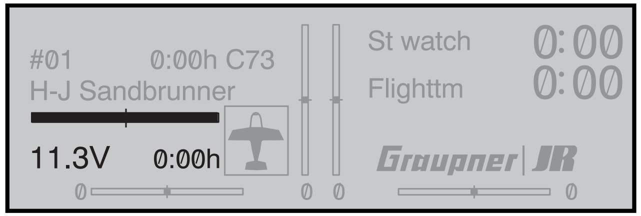
To remove the transmitter battery, carefully disconnect the plug from the transmitter circuit board, pulling the connector upwards by the cable. Locate the rubber bands at the battery compartment and push them to the side slightly. The battery can then be slid out of the compartment sideways.



Transmitter charge plug polarity

Check the state of the batteries at regular intervals. Don't wait to recharge the batteries until you notice the servos working more slowly than usual.

On-screen battery operating hours display



This timer shows the cumulative operating time of the transmitter battery since the last time the battery was recharged.

This timer is automatically reset to the value "0:00" as soon as the transmitter circuit detects that the voltage of the transmitter battery is significantly higher than last time, i.e. the pack has been recharged in the meantime.

Operating notes

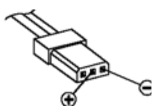
Charging the receiver battery

A wide variety of rechargeable 4.8 V NC and NiMH batteries is available, varying in capacity. For safety reasons always use ready-made battery packs from the *GRAUPNER* range; **never** use dry cells.

There is no direct method of checking receiver battery voltage when operating a model.

For this reason it is important to make it a standard part of your routine to check the state of your batteries at regular intervals. Don't wait until you notice the servos running more slowly than usual before recharging the packs.

The charge lead, Order No. **3021**, can be connected directly to the NC receiver battery for charging. If the battery is installed in a model and you have installed one of the following switch harnesses: Order No. **3046**, **3934**, **3934.1** or **3934.3**, the battery can be charged via the separate charge socket, or the charge socket which is built into the switch. The switch on the switch harness must be left at the "OFF" position for charging.



Polarity of receiver battery

Standard chargers

Order No. **6422** Minilader 2
Order No. **6427** Multilader 3
Order No. **6426** Multilader 6E*
Order No. **6428** Turbomat 6 Plus*
Order No. **6429** Turbomat 7 Plus*

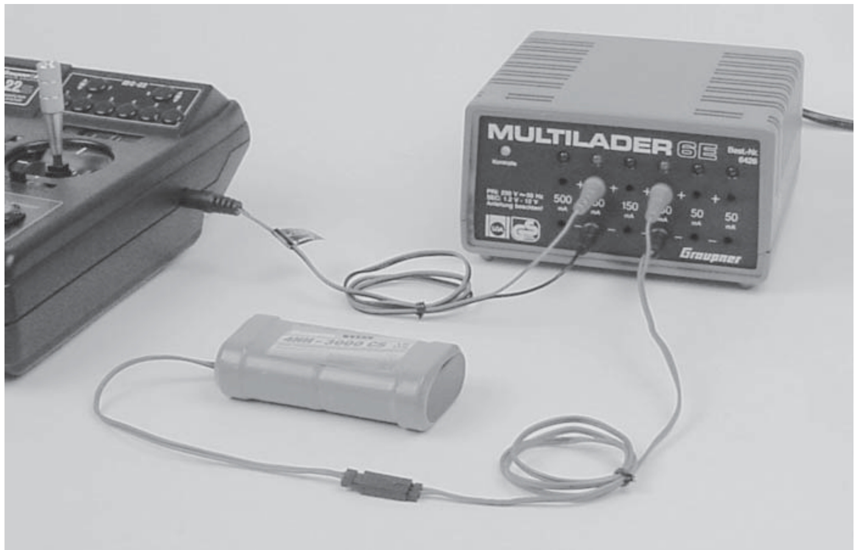
Automatic chargers with special NiMH charge programs

Order No. **6419** Ultramat 5*, **
Order No. **6410** Ultramat 10*, **
Order No. **6412** Ultramat 12*, **
Order No. **6414** Ultramat 14*, **
Order No. **6417** Ultramat 25*, **
Order No. **6416** Ultra Duo Plus 30*, **

* *To recharge the mc-22s system you will also need the transmitter charge lead, Order No.* ***3022****, and the receiver battery charge lead, Order No.* ***3021****.*

** *12 V power source required.*

Please refer to the main *GRAUPNER* FS catalogue for an overview of batteries, battery chargers and measuring equipment.



General notes on battery charging

- Keep to the recommendations provided by the manufacturers of the charger and the battery at all times.

  Observe the maximum permissible charge current stated by the battery manufacturer. To avoid damage to the transmitter circuitry, the maximum charge current for the transmitter battery is 1.5 A; limit the charge current to this value on the charger.

  If you wish to charge the transmitter battery at a current higher than 1.5 A, it is absolutely essential to remove the pack from the transmitter for charging. If you ignore this, you risk damaging the transmitter circuit board by overloading the tracks and / or overheating the battery.

- If you are using an automatic battery charger, carry out a series of test charges to ensure that the automatic charge termination circuit works correctly with your battery.

  This applies in particular if you are recharging the standard NiMH battery using an automatic charger designed for NiCd batteries.

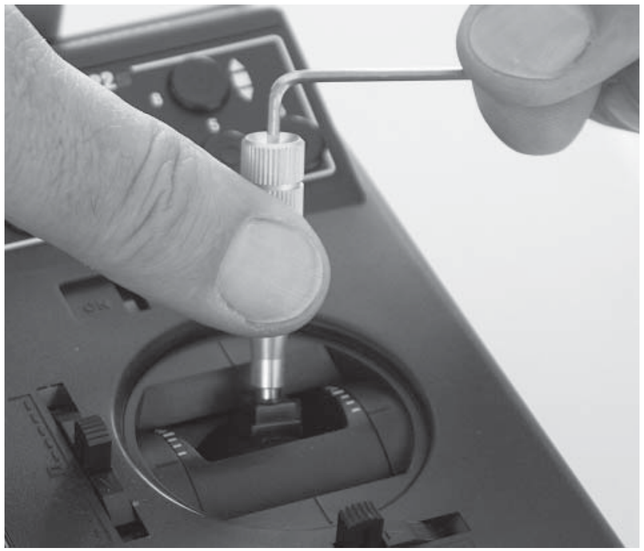
  You may need to adjust the Delta Peak trigger voltage, if your charger provides this option.

- Do not discharge the battery or carry out a battery maintenance program via the integral charge socket. The charge socket is not suitable for this application.
- Always connect the charge lead to the charger first, and only then to the transmitter or receiver battery. Observing this rule eliminates the danger of accidental short-circuits between the bare contacts of the charge lead plugs.
- **Never leave batteries on charge unsupervised.**

Adjusting stick length

Both sticks are infinitely variable in length over a broad range, enabling you to set them to suit your personal preference to provide fine, accurate control.

Loosen the retaining screw using a 2 mm allen key, then screw the stick top in or out to shorten or extend it. Tighten the grubscrew again carefully to lock the set length.

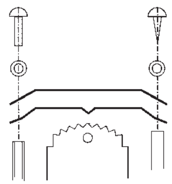


Changing the stick mode

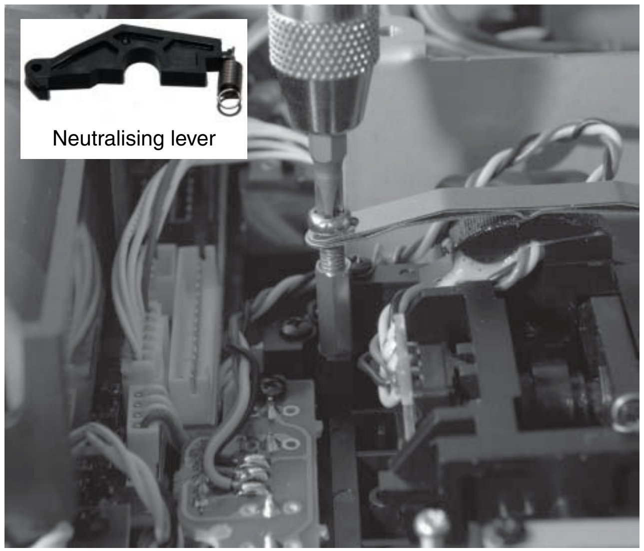
Either or both sticks can be converted from self-neutralising to non self-neutralising (ratchet) action: open the transmitter as already described.

If you wish to change the standard setting, use this procedure:

1. Disconnect the centring spring from the appropriate neutralising arm using a pair of tweezers. If you are not sure, move the stick to check. Raise the neutralisation return arm and disconnect it.
2. Fix the ratchet spring (supplied) to the plastic pillar using the black self-tapping screw, then screw the M3 screw in or out to set the desired spring force on the side of the hexagon sleeve.
3. Check that the stick functions work correctly, then close the transmitter case again.



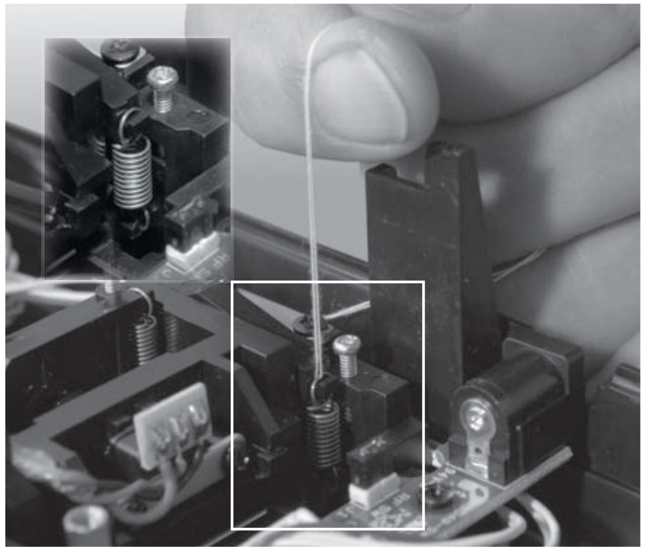
Brass pillar



Changing back to "self-neutralising" action

Open the transmitter as already described.

1. Remove the ratchet spring, as shown in the illustration on the left.
2. Now re-connect the neutralising lever on the side of the stick unit where the ratchet spring was located.
3. First loosen the stick force adjustment screw slightly – see the illustration on the next page – and then draw a length of thin thread through the top loop in the spring, but without tying it. Connect the spring to the bottom loop of the adjustment system using a pair of tweezers, then pull the top end of the spring up using the thread, and connect it to the neutralising lever. Once the spring is positioned correctly, withdraw the thread again.
4. Adjust the stick centring spring force as described in the next section.

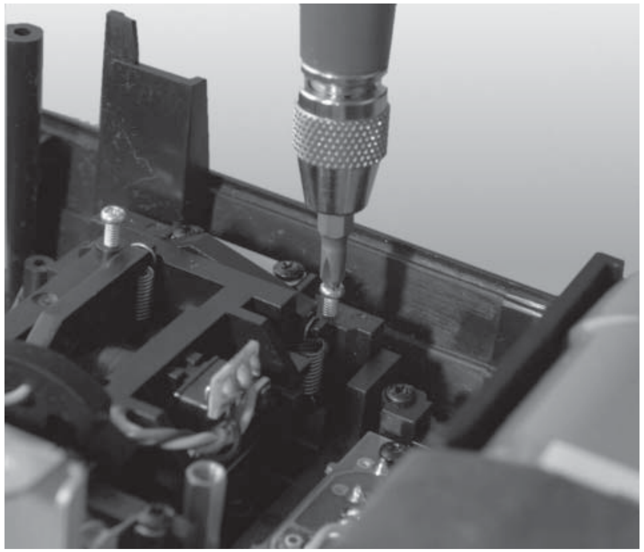


Operating notes

Stick centring force

The tension of the stick unit centring springs can be adjusted to suit your personal preference: the adjustment system is located adjacent to the centring spring. Rotate the adjustor screw with a cross-point screwdriver to set your preferred spring force:

- Turn to the right (clockwise) = spring force harder;
- Turn to the left (anti-clockwise) = spring force softer.



Changing frequency bands and channels

The mc-22s transmitter is equipped as standard with a PLL Synthesizer RF module. The channel you wish to use is selected using the rotary control; plug-in crystals are not required for the transmitter.

A detailed description of the procedure for using the Synthesizer module and setting the appropriate channel is found in the section entitled “Using the transmitter for the first time – selecting channels” on page 22.

The set channel is displayed on the screen. A security system prevents an RF signal being generated when the transmitter is switched on. The RF module must first be activated in the software, which provides an additional margin of safety.

Two sets / two transmitters are available for the 35 / 35B MHz band and the 40 / 41 MHz band:

Radio control sets:

Order No. **4737**	35 / 35B MHz band
Order No. **4738**	40 / 41* MHz band

Transmitters alone:

Order No. **4737.77**	35 / 35B MHz band
Order No. **4738.77**	40 / 41* MHz band

* *Channels 281 and 282 in the 35 MHz band, and all channels in the 41 MHz band, are not approved for use in Germany. Please refer to the frequency table on page 168, The table also lists the channels which may legally be used for the various model types, i.e. model aircraft, model boats and model cars.*

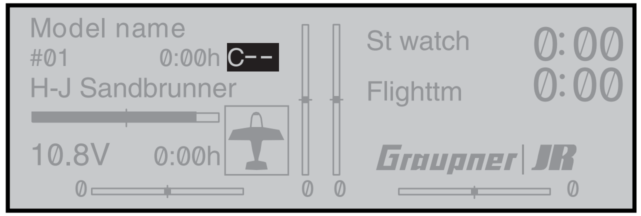
Please refer to the frequency table on page 168 for a list of the channels which are valid in the European continent at time of going to press.

The receiver must be operated on the same channel and on the same frequency band as the transmitter.

You can use any *GRAUPNER* PLL Synthesizer receiver with the transmitter, together with all earlier crystal-controlled *GRAUPNER* receivers, provided that they are compatible with the transmission modes PCM20, SPCM, PPM18 and PPM24 (see pages 7 and 8 and the main *GRAUPNER* FS catalogue for more information on this subject).

If you wish to use earlier crystal-controlled *GRAUPNER* receivers, it is essential to use genuine *GRAUPNER* FMsss plug-in crystals exclusively (see page 168). The receiver crystal is marked “R” (Receiver), and should be pushed firmly into the socket in the receiver.

<u>*Important note:*</u>
The RF-Synthesizer module is connected to the transmitter circuit board by means of two cables. If the cables are not plugged in correctly, or if the 4-pin plug is withdrawn in order to install a Pupil module (see page 163), the transmitter switches directly to the basic display when switched on. Instead of a channel number, the screen now displays the flashing symbol “C—”; in order to indicate that the RF module is not ready for use:



Changing frequency bands:

For reasons of safety a switch of RF module from the 35 / 35B MHz to the 40 / 41 MHz band (or vice versa) can only be carried out by a *GRAUPNER* Service centre.

Re-positioning the telescopic aerial

Screw the ten-section telescopic aerial into the ball-and-socket base. The angle of inclination of the aerial can be adjusted mechanically as follows: loosen the cross-point screw to the side of the socket, swivel the aerial to your preferred angle, then carefully tighten the screw again.

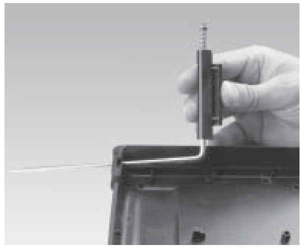
<u>Notes:</u>

- *When you switch on the transmitter, do not activate the RF module without the aerial screwed into its socket. The telescopic aerial should always be extended to its full length for controlling a model "in earnest", and even for protracted testing.*
- *The field strength radiated by the transmitter is at its lowest in an imaginary line extending straight out from the tip of the transmitter aerial. Never point your aerial straight at the model in an attempt to obtain good reception; the opposite is true.*

Installing the transmitter support bars

The transmitter can be fitted with the optional transmitter support system, Order No. **1127**. This is the procedure: open the transmitter and remove the case back, which is prepared to accept the support system bars. Locate the four holes in the case back which are designed to accept the support bars, and push a cross-point screwdriver through them from the rear to clear the openings, twisting it gently to act as a drill.

Now push the metal bars of the support system through the holes in the back panel, working from the inside.



Slide the plastic retainer bracket for the metal bars between the lugs in the back panel, and fit two screws from the underside into each bracket.

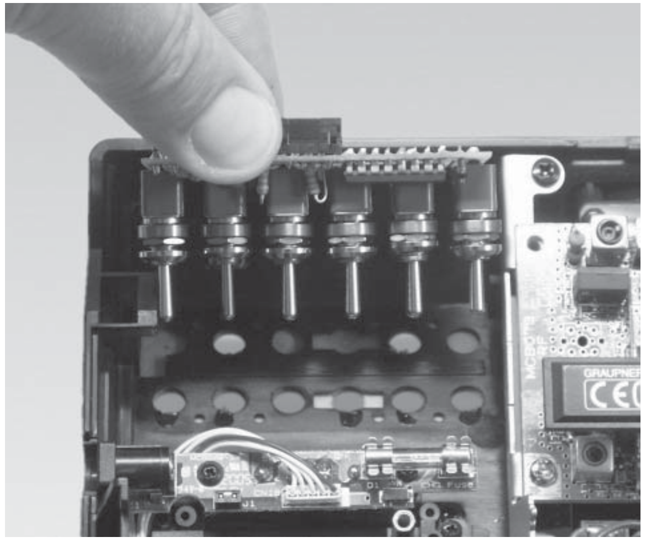
The support bars are held in place under strong tension by a long spring. If you find the spring tension uncomfortably high, shorten the spring accordingly.

Installing NAUTIC modules, external switches, switch modules and rotary modules

The transmitter case is supplied with all the holes for the installation of optional modules already present. Start by disconnecting the transmitter battery to avoid short-circuits.

The holes are sealed by blind grommets which can easily be pushed out from the inside.

Using a suitable blunt instrument, press out the module covers on the front face of the transmitter from the inside by pushing through the existing holes. Place the new bezel in position, and check that it fits correctly. Remove the backing paper from the adhesive surface of the bezel, position it carefully, then press it down firmly. Peel the protective film from the printed front surface of the bezel. The module can now be fitted in the prepared module well from the inside, ensuring that the row of sockets on the module faces the centre of the transmitter.



Secure the module using the nuts and rotary knobs which you previously removed from the potentiometers and switches. Screw the nuts onto the shafts on the outside of the transmitter and tighten them carefully using a suitable box spanner.

We recommend the use of the special box spanner, Order No. **5733**, for tightening the decorative nuts which retain the external switches.

The last step is to fit the rotary knobs on the potentiometer shafts, line them up with the graduated scale, and tighten the grubscrews.

External switches, rotary modules and switch modules are installed in a similar way.

Take great care not to touch the solder pads on the transmitter circuit board with any metallic object.

Socket assignment on the transmitter circuit board

You will find on a sketch of the transmitter circuit board on page 19.

Additional transmitter controls can be connected to function sockets CH5 ... CH10 on the transmitter circuit board; these include rotary controls, sliders and switch modules (see Appendix).

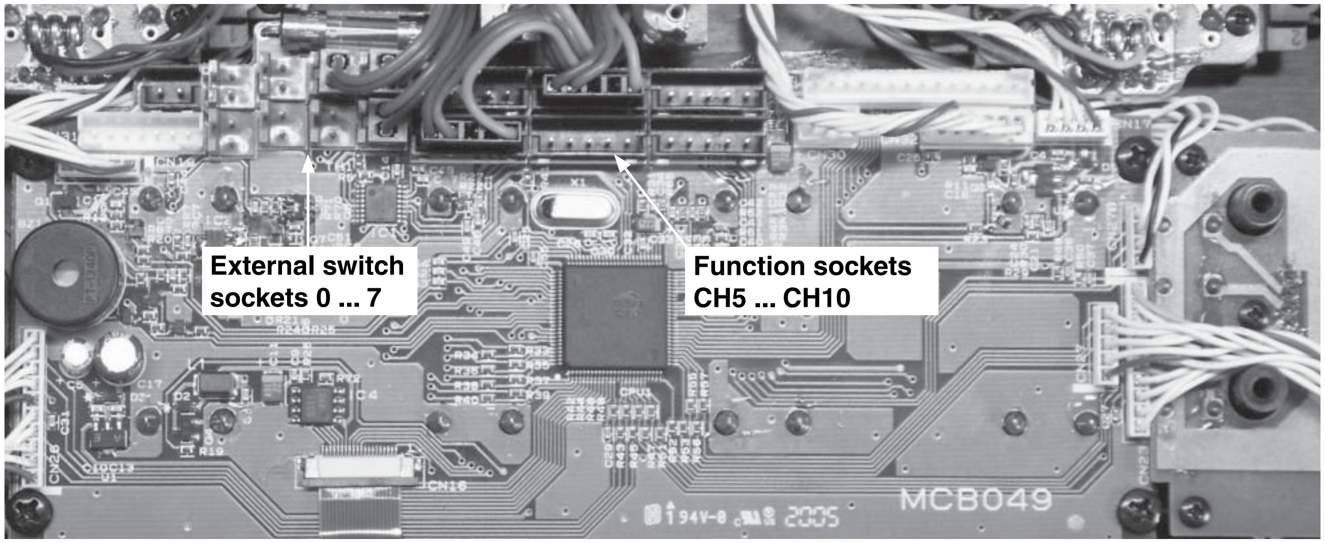
Note:
Two additional inputs can be assigned to controls such as external switches by software, so that up to twelve separate control functions are available at the transmitter when using the DS 24 FM S receiver.

In its standard form the transmitter features two 2-channel sliders installed in the centre console; these controls are connected to sockets CH6 and CH7 as standard. If you wish, you can reverse the direction of operation of the transmitter control "mechanically" by turning the connector through 180° at the transmitter circuit board. However, a more elegant method is to use the »**Control adjust**« menu, where you can reverse and adjust the transmitter controls using the system software.

The external switch sockets can be assigned in any arrangement you wish, as you define the external switch for software assignment simply by operating it, which means that the number of the socket is irrelevant.

However, in the interests of clarity and comprehensibility we do recommend that you assign the sockets in numerical order, and install the corresponding switches in the proper sequence – from 0 to max. 7 – in the transmitter case, insofar as that is possible.

The NAUTIC module (Order No. **4141** or **4108**) or the Teacher module (Order No. **3290.2** or **3289**) can be connected directly to the 14-pin connector using the mc-22(s) / mc-24 adaptor (Order No. **4184.1**). If you install the mc-22(s) interface distributor, Order No. **4182.3**, you can connect both modules to the transmitter in parallel. A full description of the individual modules is included at the appropriate point in this manual.



DSC socket
Direct Servo Control

The original function of this socket was for "Direct Servo Control", and that's why the abbreviation is still in use. However, it is now much more versatile than simply providing a means of controlling servos by cable. The DSC socket can now be used as an alternative to the Teacher socket (see pages 115 and 162), also as an interface for flight simulators.

For the DSC connection to work you must check the following:

1. Carry out any adjustments required in the appropriate menus:

   If you are connecting the transmitter to a flight simulator (for example), these settings are found in the »**Modulation**« line of the »**Base setup model**« menu – "**PPM**" is usually required.

   If you are connecting a Diagnosis lead (Order No. **4178.1**), the *modulation* must be selected to suit the receiver – see below.
2. **Always** leave the **transmitter's On / Off switch** in the "**OFF**" position, for only at this setting is the RF section of the transmitter module switched off (no RF signal) even when the DSC lead is plugged in. This is particularly important if you are using a Diagnosis lead, otherwise you could still cause interference to other pilots.
3. Connect the appropriate connecting lead to the optional DSC socket on the back of the transmitter. This renders the transmitter ready for use, circumventing the channel select process, and the LCD screen operates. At the same time the letters "**DSC**" appear on the LCD screen, instead of the usual display of the transmission channel you have selected.
4. Connect the other end of the connecting lead to the desired piece of equipment, after referring to the operating instructions supplied with it. If you wish to use the Diagnosis lead, Order No. **4178.1**, do not connect it directly to the receiver. First connect the lead to a receiver battery using a Y-lead (Order No. **3936.11** or **3936.32**), and connect this to the receiver's battery input socket instead of the receiver battery. The end with the barrel plug can then be connected to the appropriate socket on the back of the transmitter. Once the transmitter is connected to the receiver as described above, you can check the control functions or make changes to settings even if another pilot is using "your" frequency. Since (power = "**OFF**") the transmitter does not broadcast a radio signal in this state, you can, for example, prepare your model ready to fly without causing interference to other pilots. Another advantage is that the transmitter's current drain is reduced to only about 70 mA, since the transmitter's RF section is not active in this mode of operation. Diagnosis mode operations therefore extend the operating time of the transmitter battery considerably.

Important:
Ensure that all the cables are firmly plugged in.

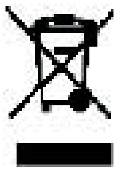
Note regarding flight simulators:
The range of flight simulators available commercially is now very wide, and you may find that it is necessary to swap over certain contacts at the battery plug or the DSC module. Do not attempt this work yourself; it must be carried out by a GRAUPNER Service Centre.

Caution:
Certain receivers – such as the R16SCAN – feature a battery socket to which a servo can also be connected via a Y-lead. In this case it is not possible to use a DSC lead.

Environmental protection notes

Notes regarding environmental protection

Do not discard exhausted dry or rechargeable batteries in the ordinary domestic refuse. As end-user you are legally required (by the "Battery Regulation") to return old and exhausted dry cells and rechargeable accumulators. For example, you can take them to your local community recycling centre, or to any retail outlet where batteries of the same type are sold.



The presence of this symbol on a product, in the user instructions or the packaging, means that you must not dispose of that item, or the electronic components contained within it, in the ordinary domestic waste when the product comes to the end of its useful life. The correct method of disposal is to take it to your local collection point for recycling electrical and electronic equipment. Dry cells and rechargeable batteries must be removed from the device and taken separately to a suitable battery disposal centre.

Individual markings indicate which materials can be recycled and re-used. You can make an important contribution to the protection of our shared environment by re-using the product, recycling the basic materials or re-processing redundant equipment in other ways.

If you don't know the location of your nearest disposal centre, please enquire at your local council office.

Description of transmitter

Ball / socket aerial base
Storage well on back panel

Option well for PC interface, Order No. 4182

Option wells
Locations for external switches, switch modules, rotary modules, NAUTIC modules; see Appendix.

Switches and function modules

- 3 external switches as standard
- 2 sliders as standard

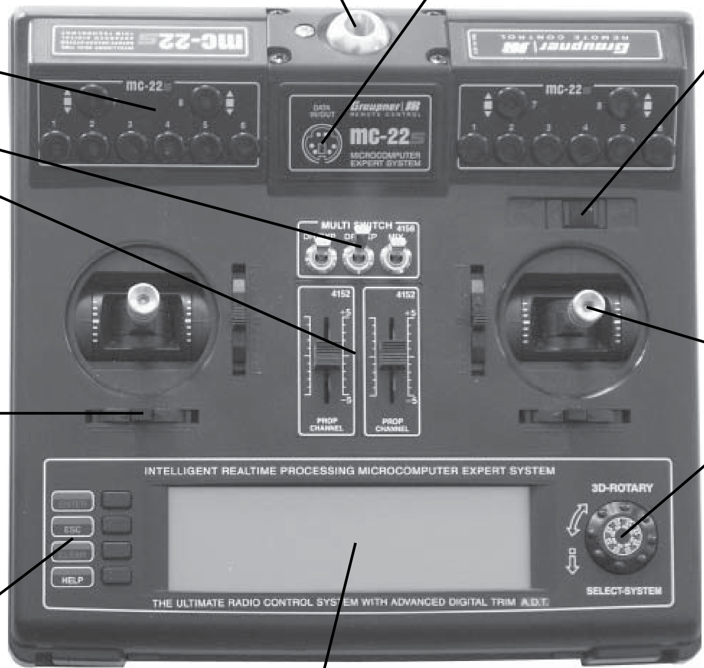
Digital trims
For fine adjustment of servo (neutral) position. A brief push produces a single increment of offset (increment size variable in »**Base setup model**« menu). The screen shows the trim position.

Operating buttons:

ENTER	Input button
ESC	Return button
CLEAR	Erase button
HELP	Help button

LCD screen
See page 20 for a full description.
Contrast adjustment: press rotary control and rotate simultaneously.
Warning signals:

- If battery voltage falls below set threshold
- If Trainer system malfunctions
- If Channel 1 stick is at full-throttle when transmitter is switched on
- If Fail-Safe settings are not correct



ON / OFF switch

Note:
Always switch the transmitter on first, then the receiver. After a flight: switch the receiver off first, then the transmitter.

Stick units
Two dual-axis stick units providing four independent control functions. Variable-length sticks. The primary control functions (i.e. stick mode) can be assigned within the »**Base setup model**« menu, e.g. throttle left or right. The throttle stick can also be set to self-neutralising or ratchet action; see page 13.

Rotary control, provides two-level control (normal and pressed-in)

Switches between individual lines within a menu when *held pressed-in*.

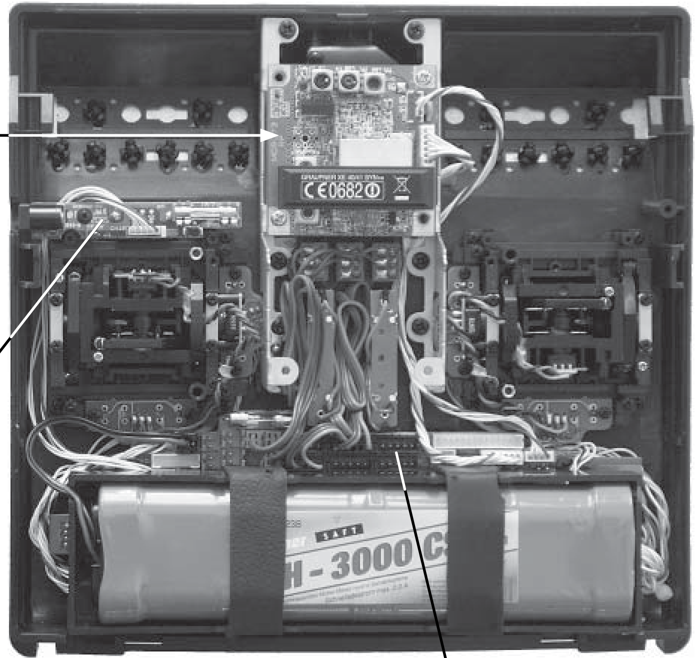
Changes the input field, or confirms your input, when pressed briefly.
A brief press on the rotary control at the basic display switches to »**Servo display**«.

If rotated in its *normal (non-pressed)* state, the rotary control selects the desired Code from the list in the multi-function menu. If you call up a menu point, the rotary control also changes the entered value in an inverse-video field which appears at the bottom edge of the screen in (light characters on dark background). Set values take effect immediately, and are also stored immediately.

Synthesizer RF module:

The channel is selected in the software when you switch the transmitter; see page 22.

For safety reasons the RF module can only be switched from the 35 / 35B MHz to the 40 / 41 MHz band (or vice versa) by an authorised *GRAUPNER* Service centre.



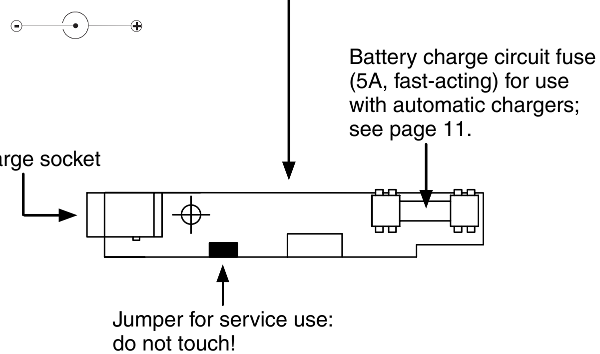
Note:

Whenever you intend to work on the interior of the transmitter, remember to disconnect the transmitter battery from the power socket.

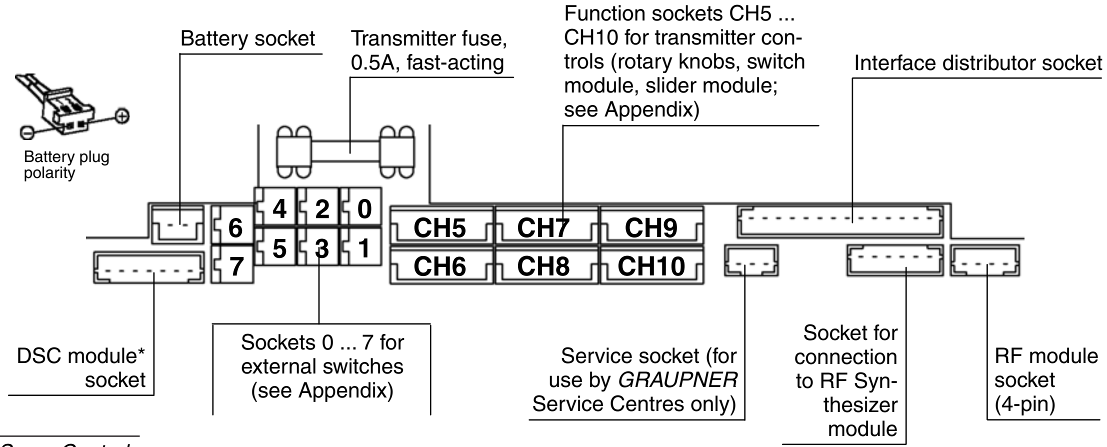
Take great care not to touch soldered joints with any metallic object, as this could cause a short-circuit.

It does not matter which way round you connect the external switches.

Reversing the orientation of the control connector simply reverses its direction of effect.



Transmitter circuit board



* *DSC = Direct Servo Control. see page 17 and Appendix*

Description of LCD screen

ENTER (Input button):
Switch to multi-function list, call up a menu

ESC (Escape button)
Return step by step from any menu to the basic display

CLEAR (Erase button)
Resets altered values to default settings

HELP (Help button)
Provides a brief help message relating to any menu

Superimposed warning messages*:

None student-signal	Thr too high!	Batt must be re-charged!!	Fail Safe setup
Trainer mode problem	Throttle stick at full-throttle**	Charge battery	Only in PCM20 and SPCM20 mode

Notes:

* *If the transmitter battery voltage is too low, the message "Not currently possible; battery voltage too low" appears in the »**Model Select**« and »**Copy / Erase**« menus.*

** *For safety reasons this warning can only be disabled by selecting an unpowered fixed-wing model: this is done by selecting "none" in the "Motor" line of the »**Model Type**« menu; see page 52.*

User's name (max. 15 characters)

Model memory 1 ... 30

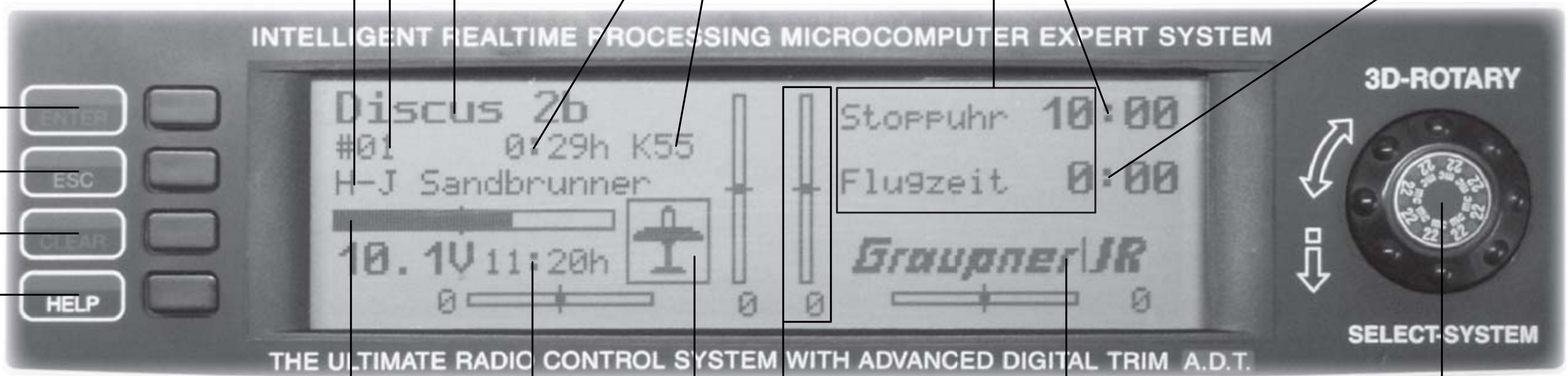
Model name

Model operating time

Number of the selected transmission channel

Stopwatch in minutes (count-up / count-down)

Flight time in minutes (count-up / count-down)



Battery voltage with dynamic bar display. If voltage falls below the pre-set level a warning message appears and a buzzer sounds.

Transmitter operating time. This value is automatically reset to zero when the battery is recharged.

Model type display: fixed-wing aircraft or helicopter

Display diagram for all four digital trim levers with numeric and directional display: „▼" or „▲". Special cut-off trim for Ch. 1 (see page 32).

Dual-level rotary control
<u>Adjusts screen contrast</u> in basic transmitter display with control pressed in.

GRAUPNER logo; alternatively flight phase name,
Flight phases are selected using a physical switch

Using the system for the first time
Preliminary notes, selecting the menu language

Preliminary notes

In its default state the mc-22s transmitter is programmed to the **PPM18** transmission mode, which suits "FM-PPM" type receivers. If you have purchased a standard radio control set on the 35 or 40 MHz bands, you can immediately operate the supplied R16SCAN receiver using this transmission mode.

In addition to **PPM18** the following transmission modes can be selected:

- **PCM20** mode for all *GRAUPNER/JR* "mc" and "DS mc" type receivers.
- **SPCM20** mode for *GRAUPNER/JR* "smc" type receivers.
- **PPM24** mode for the *GRAUPNER/JR* DS 24 FM S receiver.

This mode switching facility enables the mc-22s transmitter to operate all *GRAUPNER* receiving systems supplied to date, i.e. all receivers supplied with PPM-FM and PCM transmitters (with the exception of the FM6014 / PCM 18).

If you do not own a "PPM18" type receiver, this means that you first need to change the type of modulation to suit the receiver you wish to use. If you neglect to do this, the transmitter will not operate the receiver correctly.

The transmission mode can be set in the »**Base setup model**« menu (description: page 50) for the **current** model, or pre-set in the »**Basic settings**« menu (description: page 117) for all **future** model memories.

As standard, the two proportional sliders in the transmitter's centre console are connected to sockets CH6 and CH7 on the transmitter circuit board. For the purposes of further programming it does not matter which socket numbers are assigned to the three switches on the "Multi Switch Board".

Which crystals can be used?

The mc-22s requires no plug-in crystals. The transmission channel is selected by software: see the next page.

Battery charged?

When you first take delivery of your transmitter, the battery will be in the discharged state, so you must first charge it as described on pages 10 … 12. If you do not do this, the battery will soon fall below the pre-set threshold voltage (approx. 9.3 V), and you will see and hear a warning signal to remind you to recharge it.

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

Aerial fitted?

Never switch the transmitter on **unless the aerial is screwed in. Even for prolonged testing you should always fit the aerial and extend it fully**, otherwise the transmitter may malfunction, with possible damage to the RF module.

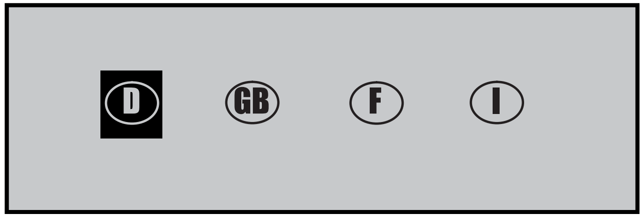
When you wish to control a model **it is fundamentally essential to screw the ten-section telescopic aerial into the transmitter and extend it fully**. Transmitter field strength is at a minimum in an imaginary line extending straight out from the transmitter aerial. It is therefore fundamentally misguided to "point" the transmitter aerial at the model with the intention of obtaining good reception.

Selecting the language

The mc-22s transmitter offers the facility to select any of four languages:

- German
- English
- French
- Italian

To change the menu language, hold the HELP button pressed in when you switch the transmitter on; you will then see this display:



You can now select the desired language by turning the rotary control. A brief press on the rotary control (or pressing the ENTER button) confirms your choice.

All settings stored in the transmitter are retained in full when you switch languages.

Using the transmitter for the first time
Selecting a channel

Switching the transmitter on / selecting a channel

Every time you switch the transmitter on you must first confirm to the integral Synthesizer system that you wish to use the set frequency. This takes the form of a security query, intended to prevent you switching the system on accidentally while the transmitter is set to the wrong channel. The software asks you to confirm: “HF off / on”. The last set channel is initially highlighted (inverse video – black background) and flashes:

C61
HF off

switch on Channel
NO YES ➡

If you wish to activate this channel, use the rotary control to move to “YES”, and press **ENTER**, or press the rotary control briefly; this switches the RF module on with the set channel. If not, move to the arrow „➡“ symbol. Press the rotary control or the **ENTER** button to take you to the Channel Select list. The channels available at that point vary according to the RF module currently fitted:

Frequency band	Channels
35 / 35 B MHz band	61 … 80/281, 282 and 182 … 191
40/41 MHz band	50… 92/400 … 420

K61	K62	K63	K64	K65	K66
K67	K68	K69	K70	K71	K72
K73	K74	K75	K76	K77	K78
K79	K80	K281	K282	K182	K183
K184	K185	K186	K187	K188	K189
K190	K191				

Note:

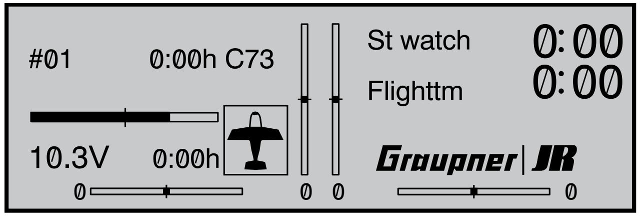
Channels 281 and 282 in the 35 MHz band, and all channels in the 41 MHz band, are not approved for use in Germany. Please refer to the frequency table on page 168, which lists the channels valid in the European continent at the time of going to press (information not guaranteed).

Use the rotary control to select the channel you wish to use. However, please check before you do this that no other model flyer is operating a radio control system on the channel you intend to use. Press the rotary control, **ENTER** or **ESC** to confirm your choice, and the screen reverts to the previous screen page:

C73
HF off

switch on Channel
NO YES ➡

Now switch the RF module on as previously described, by moving the highlighted square to “**YES**”. The selected channel number now appears (no longer flashing) in the basic display:



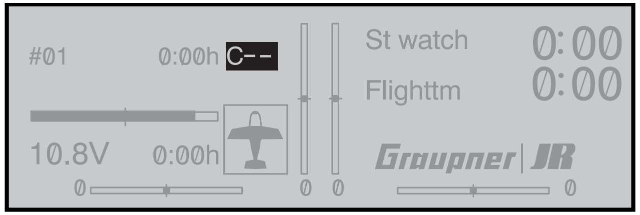
The transmitter is now ready for use.

If you wish to change the channel again, the transmitter must first be switched off, then on again.

On page 46 you will find a description of the basic procedure for initially programming a new model memory; helpful programming examples are in the section starting on page 120.

Note:

The RF-Synthesizer module is connected to the transmitter circuit board by means of two cables. If the cables are not plugged in correctly, or if the 4-pin plug is withdrawn in order to install a Pupil module (see page 163), the transmitter switches directly to the basic display when switched on. Instead of a channel number, the screen now displays the flashing symbol “C—”; in order to indicate that the RF module is not ready for use:

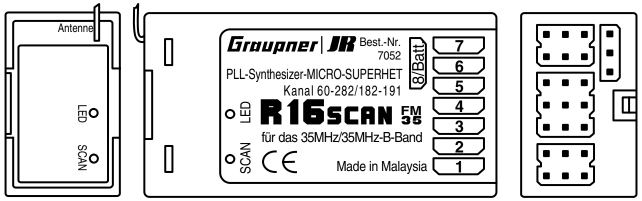


WARNING

Never, ever, switch off the transmitter when you are flying a model! If you do, you run a serious risk of losing the model, as you will be highly unlikely to be able to re-activate the RF signal quickly enough, since the transmitter always responds with the security query “RF signal on YES / NO” when switched on.

Using the receiver for the first time

Receiving system



The mc-22s radio control set is supplied complete with a PLL-SCAN narrow-band FM superhet receiver on the 35 / 35B MHz band or the 40 / 41 MHz band. The following section describes how to set the receiver channel to match the transmitter's channel. The approved channels at the time of going to press are listed in the table on page 168.

As mentioned on page 21, the mc-22s transmitter is pre-programmed to what is known as **PPM18** mode, which suits receivers of the "FM-PPM" type. If you have purchased a standard radio control set on the 35 or 40 MHz bands, you can immediately operate the supplied R16SCAN receiver using this transmission mode.

If in the meantime you have changed the transmission mode, and you wish to use the receiver supplied in the set, your first task is to set the transmitter back to PPM transmission. Next you should select the desired channel on the transmitter, as described on the preceding page. *However, you must not activate the channel on the transmitter until you have checked carefully that no other pilot is flying his model on your chosen frequency.* When you are confident of this, switch the receiver on. You will see a blue LED light up on the receiver, indicating that the unit is (basically) ready for use.

Setting the receiver to match the transmitter channel

1. Prepare the transmitter ready for use, with the aerial fitted and extended, and place it in the immediate vicinity of the receiver. The scan program which is run next binds the receiver to the most powerful transmitter signal, so you must ensure that no other radio control transmitter is located very close to your receiver.
2. Locate the push-button marked "SCAN" on the receiver, and use a tool such as a ball-point pen to hold the button pressed in until the LED goes out; this takes about three seconds.
3. When the LED is extinguished, press the SCAN button again immediately: the LED now flashes at a high rate. This indicates that the "Scan" process is under way. As soon as the receiver "finds" the transmitter frequency, the LED will light up again constantly. The receiver stores this channel, so that you do not need to repeat the process each time you switch the receiver on; you only need to do this if you change channels.
4. If the LED flashes slowly after a few seconds, it is unable to lock onto the transmitter frequency. Check the transmitter, then repeat steps 1 to 3.

Always carry out a range check with the model on the ground before every flight.

<u>*Note:*</u>
If you wish to connect a servo in parallel with the receiver battery, i.e. to the socket on the R16SCAN receiver marked "8 / Batt", you need to use a Y-lead, Order No. ***3936.11*** *or* ***3936.32****.*

Please read the information on installing the receiver and receiver aerial on pages 3 to 5 of these instructions.

If you wish to use a different *GRAUPNER* receiver (Synthesizer or crystal-controlled), please note that you must set the appropriate transmission mode (PPM18, PPM24, PCM20 or SPCM20) on the transmitter; the frequency band and channel number of the receiver must also match those of the transmitter. Please refer to the main *GRAUPNER* FS catalogue for details of the full range of receivers.

The R16SCAN receiver is fitted with polarised connector sockets, so that the servos and battery can only be connected the right way round. Genuine *GRAUPNER* plugs feature a slight chamfer on one side to match the sockets. Connect the receiver battery to the receiver socket marked "Batt" via an ON / OFF switch harness.

Installation notes

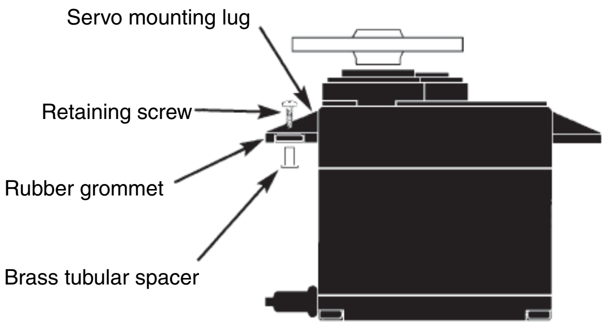
Your receiving system must be installed correctly in the model. The following are a few suggestions when using *GRAUPNER* equipment:

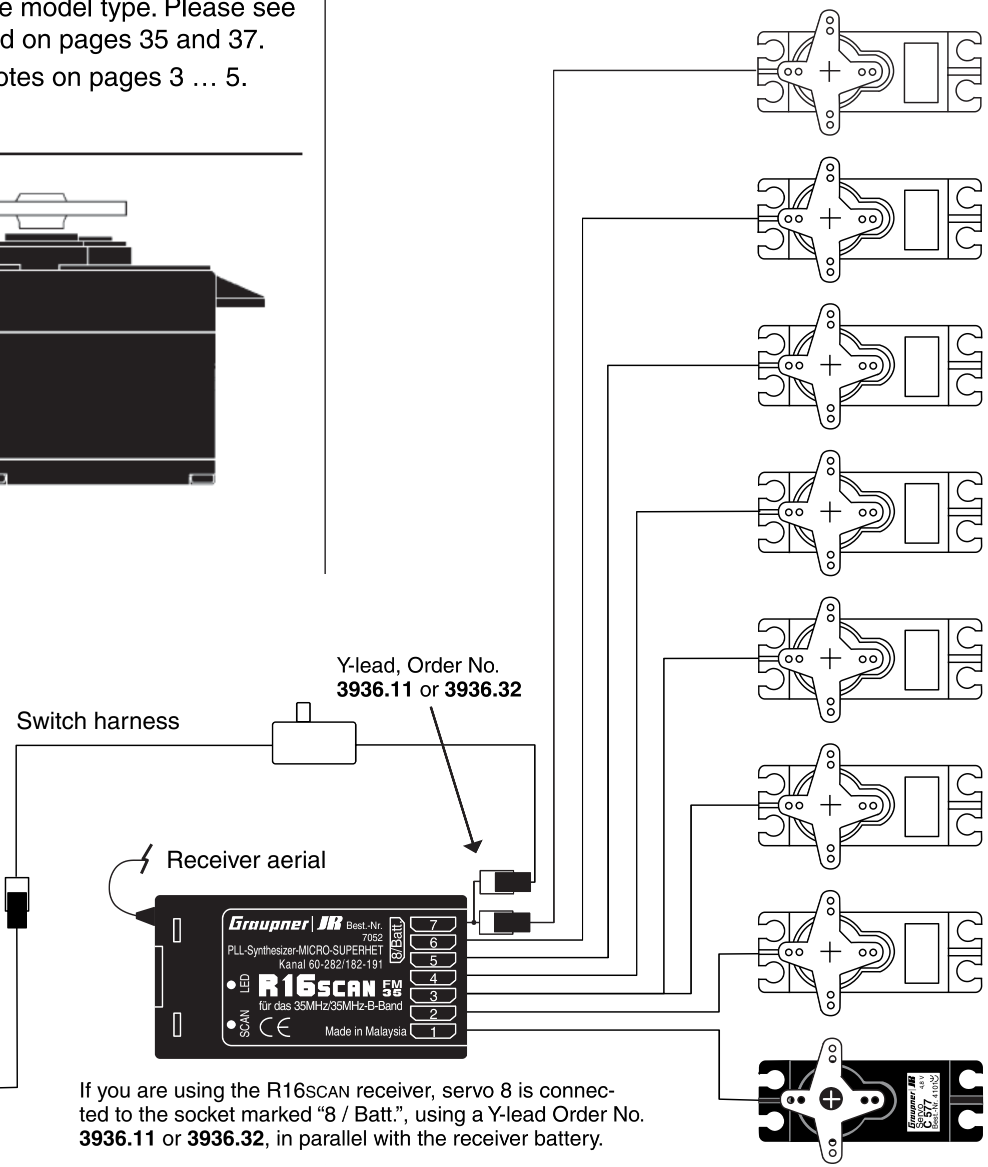
1. Wrap the receiver in (anti-static) foam rubber at least 6 mm thick. Fix the foam round the receiver using rubber bands to protect it from vibration, hard landings and crash damage.
2. The receiver aerial must be secured in the model, so that there is no chance of it becoming tangled in the propeller or control surfaces. However, it is best not to deploy the aerial in an exactly straight line, but to angle it: e.g. run it straight to the tailplane, then leave the final 10 - 15 cm trailing freely, as this avoids reception “blind spots” when the model is in the air. If this is not possible, we recommend that you lay out part of the aerial wire in an S-shape inside the model, as close to the receiver as possible.
3. All switches must be installed in a position where they will not be affected by exhaust gases or vibration. The switch toggle must be free to move over its full range of travel.
4. Always install servos using the vibration-damping grommets and tubular metal spacers supplied. The rubber grommets provide some degree of protection from mechanical shocks and severe vibration. Don’t over-tighten the servo retaining screws, as this will compress the grommets and thereby reduce the vibration protection they afford. The system offers good security and vibration protection for your servos, but only if the servo retaining screws are fitted and tightened properly. The picture on the right shows how to install a servo correctly. The brass spacers should be pushed into the rubber grommets from the underside.
5. The servo output arms must be free to move over their full arc of travel. Ensure that no parts of the mechanical linkage can obstruct the servo in its movement.

The sequence in which the servos are connected to the receiver is dictated by the model type. Please see the socket assignments listed on pages 35 and 37.

Be sure to read the safety notes on pages 3 … 5.

Servo mounting

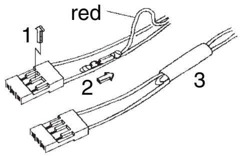




If you are using the R16SCAN receiver, servo 8 is connected to the socket marked “8 / Batt.”, using a Y-lead Order No. **3936.11** or **3936.32**, in parallel with the receiver battery.

<u>Note:</u>

If you wish to use a receiver battery and a speed controller with integral BEC system, the positive (red) wire must normally be disconnected from the 3-pin plug, although this does vary according to the type of controller. Please be sure to read the instructions supplied with your speed controller before you do this.*



Using a small screwdriver, carefully raise the centre lug of the plug (1), withdraw the red wire (2) and insulate the exposed contact with insulating tape to prevent possible short-circuits (3).

* *Battery Elimination Circuit*

If the receiver is ever switched on when the transmitter is off, the servos may carry out uncontrolled movements. You can avoid this by *switching the system on* in this order:

Always switch the transmitter on first, then the receiver.

When *switching the system off*:

Always switch the receiver off first, then the transmitter.

When programming the transmitter you must always ensure that any electric motors in the system cannot possibly start running accidentally, and that an I.C. engine fitted with an automatic starter cannot start unintentionally. In the interests of safety it is always best to disconnect the flight battery, or cut off the fuel supply.

Range checking:

Before every session you should always check that each working system is functioning correctly, and carry out a range check with the model on the ground. The transmitter aerial should be fitted but collapsed completely. Walk away from the model holding the transmitter. All the functions should work smoothly and correctly during this test, even at the limit of ground-range. If your model is powered, repeat the check with the motor running to ensure that it does not cause interference.

Definition of terms

Control functions, transmitter controls, function inputs, control channels, mixers, external switches, control switches, fixed switches

To make it easier for you to understand the mc-22s manual, the following two pages contain definitions of many terms which crop up again and again in the remainder of the text, together with a basic flow diagram showing the course of the signal from the transmitter control to the point at which it is radiated from the transmitter aerial.

Control function

The term “control function” can be thought of as the signal generated for a particular function which needs to be controlled – initially regardless of its subsequent progress through the transmitter. In the case of fixed-wing model aircraft the control functions include throttle, rudder and aileron, whereas collective pitch, roll-axis and pitch-axis are typical of those used for helicopters. The signal of a control function may be assigned directly to one control channel, or to several control channels simultaneously via mixers. A typical example of the latter is separate aileron servos, or paired roll-axis or pitch-axis servos in a model helicopter. In particular, a control function includes its influence on the mechanical travel of the corresponding servo. This can be expanded or contracted by software, and the characteristic curve of its travel can also be modified from linear to extreme exponential.

Transmitter control

The term “transmitter control” refers to the mechanical elements on the transmitter which are operated directly by the pilot. Their movements in turn generate corresponding movements in the servos, speed controllers etc. at the receiver end. The transmitter controls include the following:

- The two dual-axis stick units for the control functions 1 to 4; these four functions can be interchanged in any way you like through software, e.g. throttle left or right, without having to re-connect the servos; this applies both to fixed-wing model aircraft and helicopters. The dual-axis stick function for throttle (or airbrakes) is often referred to as the Ch1 (Channel 1) control.
- The two proportional sliders, which are connected to sockets CH6 and CH7 on the transmitter circuit board in the default configuration. If an optional two-channel switch module (Order No. **4151.2** or **4151.3**) is installed, it can be used to provide three-position control of a servo, speed controller or similar device (see Appendix, page 165).

  Which transmitter control affects which of the servos 5 … max. 12 is entirely programmable, without having to re-position connectors inside the transmitter, i.e. the default assignments can be changed at any time in the »**Control adjust**« menu (pages 58 and 60). In the Heli menu the inputs 6, 7 and 12 are termed “Throttle”, “Gyro” and “Throttle limit” respectively, since helicopter-specific functions are operated using these inputs.

In the case of these six control functions the servos follow the movement of the transmitter controls continuously and proportionally (in the case of the switch module only three-position movement is possible, as already mentioned).

For our purposes, and in physical terms, each transmitter control ends after the function input …

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 two menus »**Stick mode**« and »**Control adjust**« affect the course of the signal “after” these points, and it is possible (and likely) that there will be differences between the number of the transmitter control (as stated above) and the number of the subsequent control channel.

Control channel

There is a point in the signal path where the signal contains all the control information required for a particular servo – this may be generated directly by a transmitter control or indirectly via a mixer – and from this point on we call the signal a control channel. This signal is specific to an individual servo, and leaves the transmitter via the RF module in order to actuate the corresponding servo in the model.

Mixer

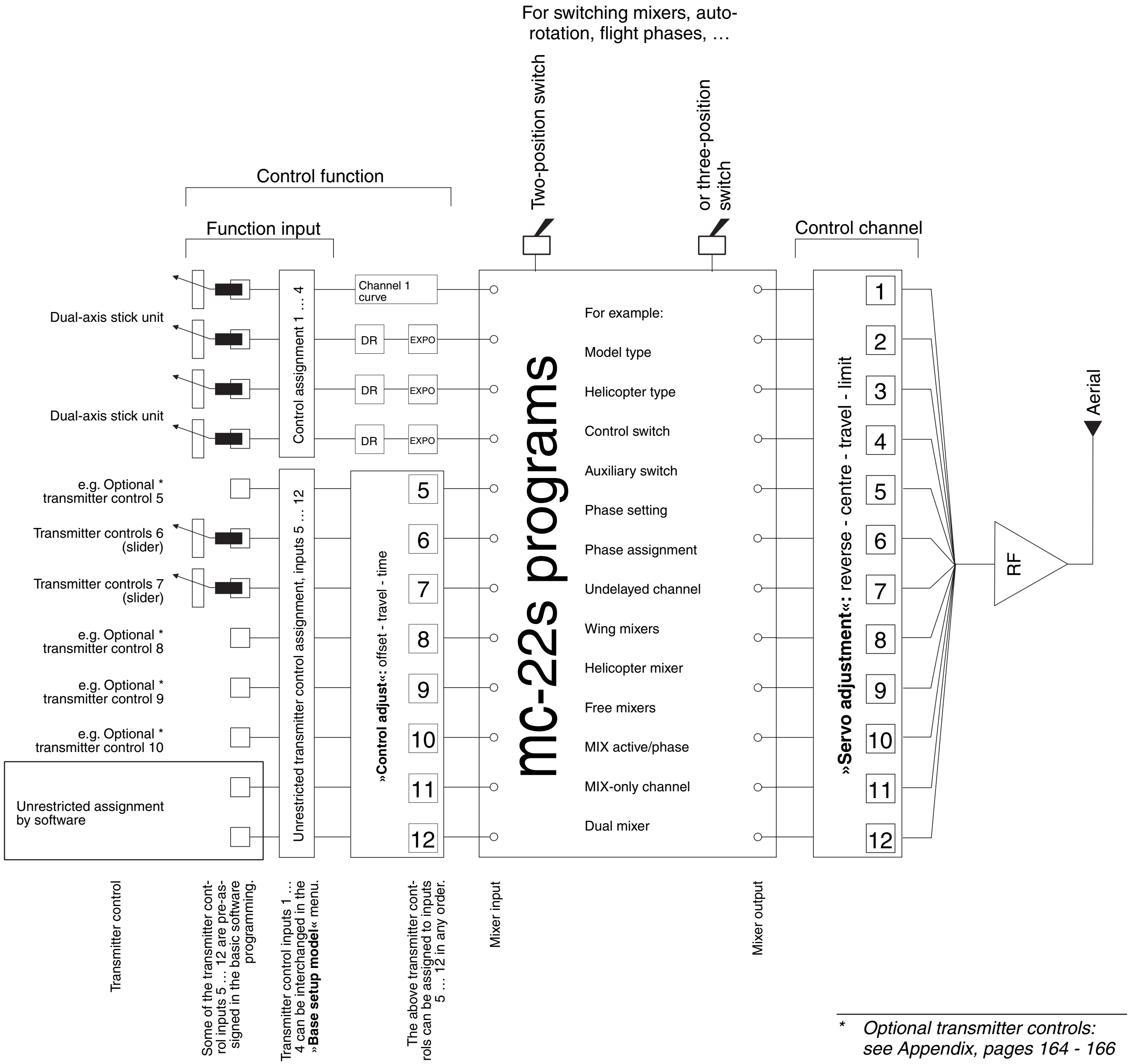
In the signal flow diagram you will see a wide range of mixer functions. Their purpose is to enable a control function to affect multiple servos at the branching point of the mixer input. The range of mixer programs is extremely wide-ranging; for more information please refer to the numerous mixer functions as described in the section starting on page 84 of the manual.

External switch

The three standard two-position switches on the centre console, and other optional two-position and three-position switches (see Appendix), can also be incorporated into the programming of the transmitter controls, to provide two-position or three-position control of a servo, speed controller or similar device. A three-position switch operates in exactly the same way as the two-channel switch module mentioned above (see also the Appendix, page 165).

However, all these external switches are also capable of controlling various program options, e.g. starting and stopping timers, switching mixers on and off, transferring control in Trainer mode etc.

Each external switch (a total of eight can be connected to the transmitter circuit board) can be assigned to as many functions as you wish. Numerous examples are described in the manual.



* *Optional transmitter controls: see Appendix, pages 164 - 166*

Transmitter control switch

It is often extremely desirable to switch a function on or off automatically at a particular position of another transmitter control, e.g. at a defined position of one of the dual-axis sticks. Typical examples are switching a stopwatch on and off to allow you to record the motor run time, lowering landing flaps automatically, and many others.

The program of the mc-22s includes a total of four “switches” of this type. These software switches are termed “G1 … G4”, and to use one all you have to do is define the trigger point along the travel of the transmitter control; this is done simply by pressing a button. There are also “inverted switches”, which have the same function but the reversed direction of effect. They are therefore termed “G1i … G4i”.

Of course, control switches can also be combined in any way with the external switches described previously; in this way many more complex problems can be solved.

This manual includes a range of instructive examples which make programming as simple as child’s play. Please refer to the programming examples in the section starting on page 72, 102 and 132.

Fixed switches: FXI and FX

This type of switch switches a function – such as a timer – on permanently (closed fixed switch) or off permanently (open fixed switch); alternatively it supplies a fixed input signal to a control function, e.g. FXI = +100% and FX = -100%. For example, a fixed switch can be used in flight phase programming to switch a servo or a speed controller between two settings. You will find another example on page 107.

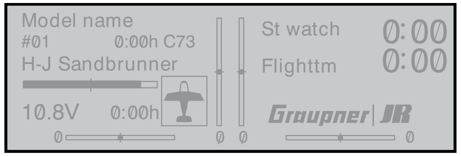
Basic operation of the “3-D rotary control”
Screen contrast adjustment, multi-function list, menu settings

Rotary control functions

The basic method of using the rotary control has already been described on page 18. Here we show an example of using the rotary control in a practical application, to provide a better idea of its functionality.

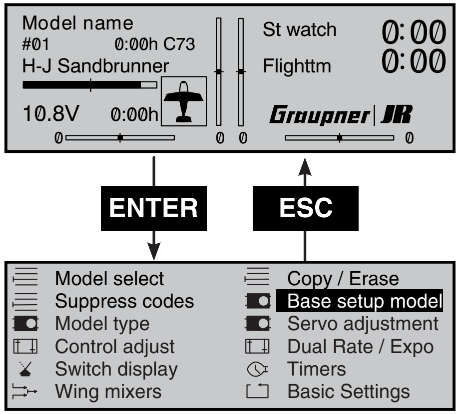
First switch the transmitter on. Set the transmission channel (see page 22), and you will move to the basic screen display.

- **Adjusting screen contrast**



Press and rotate:

- **Select multi-function list**

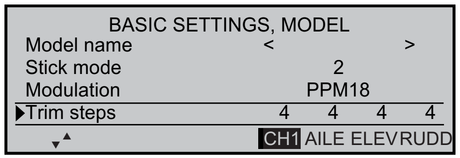


Rotate: (select menu)

- **Menu settings**

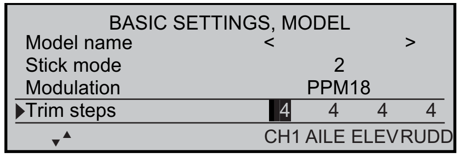
  Press the rotary control (or **ENTER**) briefly to move to a menu.

Now select a line:



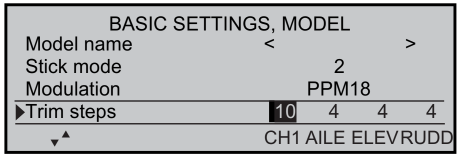
Press and rotate:

Call up an input field:



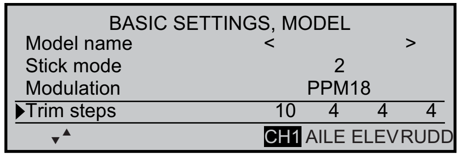
Brief press:

Change a value:



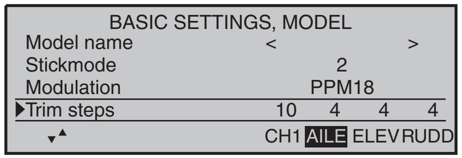
Rotate:

Confirm input and quit:



Brief press:

Call up next parameter field:



Rotate:

Turn the rotary control to change the rest of the parameter fields, in this case CH1, AILE, ELEV, RUDD (in each case the element which can be changed appears in inverse video, i.e. with a black background), and press it to move from the selected parameter field to the change field, etc.

Finally press **ESC** to return to the multi-function list.

Using the “Data Terminal” LCD screen

Input buttons and function fields

ENTER, ESC, CLEAR, HELP, SEL, STO, CLR, SYM, ASY, , E/A, ➡, ENT

The basic method of operating the software

The transmitter is programmed using just four buttons situated to the left of the screen, in conjunction with the crucial element: the rotary control (“3D rotary control”).

Input buttons:

- **ENTER**

  the first time you press the **ENTER** button you move from the basic screen display to the multi-function menus. You can also call up a selected menu by pressing **ENTER**.
- **ESC**

  pressing the **ESC** button takes you one step back at the function select stage, and continues to return you through the system until you reach the basic display.
- **CLEAR**

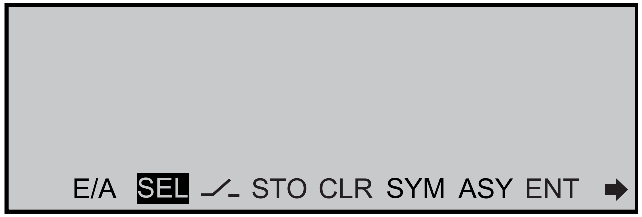
  at the programming stage, pressing **CLEAR** resets a changed parameter back to the default value. **CLEAR** is also used to leaf backwards through the pages within the Help function.
- **HELP**

  at any point in the programming process you can press this button to call up a concise help text which informs you how to use the individual menu in which you are currently located. Within the Help text you can leaf through the screen pages by pressing the **HELP** button again, and leaf through backwards using the **CLEAR** button.

In the »**Code lock**« menu (see page 119) you can enter a confidential number which bars access to all menus. In this case the four input buttons are used in a different way to that outlined above.

Function fields:

In some menus the bottom line of the screen displays function fields which can be called up using the rotary control:



The function fields which appear on the screen vary according to the menu you have called up.

Turn the rotary control to switch between the function fields.

Press the rotary control to activate a function field.

Function field functions

- **SEL** (select):

  select this point
- **STO** (store):

  store (e.g. a transmitter control position)
- **CLR** (clear):

  erase (e.g. an input or a reference point on a curve)
- **SYM**:

  set a symmetrical mixer value
- **ASY**:

  set asymmetrical mixer values
- :

  switch symbol field (assignment of external, fixed and control switches)
- **E/A**:

  switches menus on and off
- ➡:

  shifts to second page within a menu (following menu)
- **ENT** (enter):

  only in the »**Code lock**« menu; see page 119.

Assigning external switches and control switches
Basic procedure, meaning of the fixed switch “FX”

At many points in the program there is the option of assigning a switch to a particular function, using an external switch or a control switch (see below), or using a switch to select one of two settings, e.g. curve settings, the DUAL RATE / EXPO function, flight phase programming, mixers etc.. In all situations the mc-22s allows you to assign several functions to one switch, if you wish.

The process of assigning switches is exactly the same in all the menus concerned, and we will explain the basic programming procedure at this point so that you can concentrate on the special features when reading the detailed menu descriptions.

A switch symbol appears in the bottom line of the screen at all programming points where switches can be assigned:

If you move to this field using the rotary control, the switch symbol field changes to inverse video (black background):

This is how you assign an external switch:

1. Brief press on the rotary control

2. The following field appears on the screen:

   Move desired switch
   to ON position
   (ext. switch: ENTER)

   Simply move the *external switch* you wish to use to the “ON” position – *regardless* of the socket number 0 ... 7 to which the switch is connected. This completes the assignment process; the switch concerned (external or control switch) now appears in the appropriate menu. A switch symbol adjacent to the switch number indicates the current state of the switch concerned.

   <u>*Note:*</u>
   *The position to which you eventually move the switch (in order to assign it) is accepted by the transmitter as the ON position. For this reason you should move the external switch to the <u>preferred</u> **OFF** position before you activate the switch symbol.*

3. Changing the direction of switching

   If the switch turns out to work in the wrong direction, correct it as follows: move the switch to the desired OFF position, select the switch symbol once more and assign the switch again, this time with the direction of switching you prefer.

4. Erasing a switch

   Activate the switch symbol as described under point 2, then press the **CLEAR** button to erase the switch.

Using transmitter control switches

For some special functions it may be preferable to trigger the switching action at a particular (selectable) position of a stick, slider or rotary knob (termed the control position), rather than manually using a *normal external switch*.

Four switches of this type, termed *control switches* G1 ... G4, are available for this purpose. Note that the number is <u>simply the number of the control switch</u>; it <u>does not indicate</u> the number of the transmitter control to which it is assigned, i.e. one of the control functions 1 ... 4.

This is how you assign a control switch:

Start by selecting the switch symbol field (inverse video):

1. Brief press on the rotary control

2. The screen now displays the following field:

   Move desired switch
   to ON position
   (ext. switch: ENTER)

   Now press the **ENTER** button:

   Move
   (ext. s
   Cntrl/fixed switch
   G1 G2 G3 G4 FXI
   FX G1i G2i G3i G4i

3. Use the rotary control to select the control switch G1 ... G4 you wish to use, or a software “reversed” control switch G1i ... G4i (i - “inverted”):

   Move
   (ext. s
   Cntrl/fixed switch
   G1 G2 G3 G4 FXI
   FX G1i G2i G3i G4i

4. Press the **ENTER** button to confirm your selection, or press the rotary control briefly.

5. To erase the control switch:

   Press the **CLEAR** button at the following display:

   Move desired switch
   to ON position
   (ext. switch: ENTER)

   The control switch must now be assigned to the control (transmitter control) you wish to use: 1 ... max. 10. You also have to define the switching point between ON and OFF or vice versa. Both points are carried out in the »**Control switch**« menu; see page 72.

Meaning of the fixed switch "FX"

The two FX switches which appear in the above list are known as "fixed switches", which switch a function on *permanently* …

FXI

or *off permanently*.

FX\

Possible applications are included in example 2 on page 107.

The two switches can also be used for the transmitter control inputs in the »**Control adjust**« menu:

The closed fixed switch "FXI" generates a fixed travel of +100%, the open fixed switch "FX\" a value of -100%. Other values can be obtained by changing the servo travel.

<u>Note:</u>
All switches can also be assigned to multiple functions. Please take care to avoid assigning several functions to one switch <u>accidentally</u>! We recommend that you take careful note of the switch functions you have assigned.

Digital trims
Description of function, and Ch1 cut-off trim

Digital trims with visual and audible indicators

Both the dual-axis stick units are fitted with digital trim systems. When you give the trim lever a brief push (one "click"), the neutral position of the stick channel changes by one increment, the size of which you can select. If you hold the trim lever in one direction, the trim value changes continuously in the corresponding direction with increasing speed. In the »**Base setup model**« menu (page 50) you can set the increment per click to any value in the range "1" to "10". The screen shows the current trim position and its numerical value.

The degree of trim offset is also "audible", as the pitch of the tone changes to reflect the setting. With a model in flight you can find the trim centre position easily without having to look at the screen: If you over-run the centre position, the trim stays in the centre position for a moment.

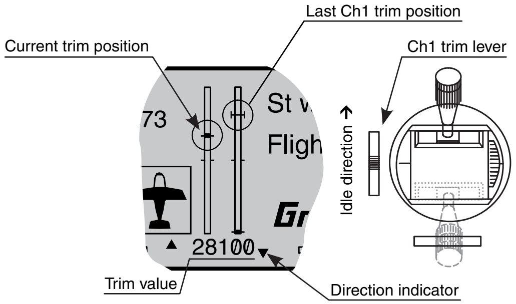
The current trim values are automatically stored when you switch from one model memory to another. The digital trims are also stored separately for each flight phase within a model memory, with the exception of the "Ch1" function (Channel 1), which is the throttle / airbrake trim on a fixed-wing model.

The Ch1 trim includes another special function which makes it easy to re-locate the idle throttle setting of a glowplug motor – provided that you have previously entered "forward" or "back" in the motor line of the »**Model type**« menu; see page 52.

1. **Fixed-wing models**

   The Ch1 trim features a special cut-off trim which is designed for glowplug motors:

   You initially use the trim lever in the usual way to select a reliable idle setting for the motor. If you now move the Ch1 trim lever towards "motor cut-off" as far as its end-point (i.e. you hold the trim lever at its end-point continuously until the audible signal ceases), pushing the lever in a single movement, a marker appears on the screen in the last position. You can now return to the idle setting for starting the motor simply by pushing the idle lever once in the direction of "more throttle".



Notes:
*The cut-off trim is disabled if you enter "none" in the Motor line of the »**Model type**« menu (see page 52).*

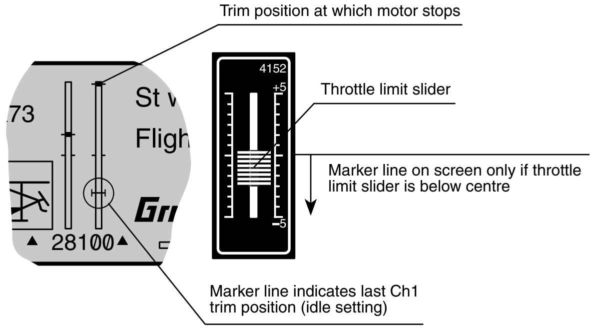
*Since this trim function is only effective in the direction of "motor off", the illustration above will look different if you reverse the control direction for the throttle minimum position of the Ch1 stick from "back" (as set in the picture above) to "forward" in the "Motor" line of the »**Model type**« menu.*

*Of course, you can set the left-hand stick as the Ch1 stick if you prefer; see the »**Base setup model**« menu.*

2. **Model helicopters**

   In helicopter mode the Ch1 trim has another feature in addition to "cut-off trim" as described under "Fixed-wing models"; this time in conjunction with the "Throttle limit function":

   While the throttle limit slider is in the bottom half of its travel, i.e. in the "start-up range", the Ch1 trim lever acts as idle trim on the throttle limit.



For more information please read the section entitled "Throttle limit" on page 62.

Note:
The Ch1 trim only affects the throttle servo – not the collective pitch servos – and it works equally over the full stick travel. Please note that the throttle servo for a helicopter must be connected to receiver output 6 (see "Receiver assignments" on page 37).

Fixed-wing model aircraft

This program provides straightforward, carefully tailored support for conventional models with up to two aileron servos and two flap servos, models with V-tail, flying wings and deltas with two elevon (aileron / elevator) servos and two flap servos. The vast majority of power models and gliders belong to the “normal” tail type with one servo each for elevator, rudder, ailerons and throttle (or electronic speed controller, or airbrakes on a glider). There is also the special model type “2Elev.Sv3+8” which provides a means of connecting two elevator servos to channels 3 and 8.

If the model has a V-tail instead of a standard tail configuration, you should select the “V-tail” type in the »**Model type**« menu, as this mixes together the elevator and rudder functions in the required way, i.e. each tail control surface is actuated by a separate servo, and both assume superimposed elevator and rudder functions.

If your model features two separate aileron servos, the aileron travels can be set up with differential movement, i.e. the down-travel can be set independently of the up-travel. Finally the program caters for camber-changing flaps which can be operated by the transmitter control connected to socket “CH6”.

The “flap differential” function can be used to provide differential travel when the flaps are programmed to follow the aileron function.

For deltas and flying wings it is easy to set up mixed elevons, i.e. the aileron and elevator functions can be carried out via single control surfaces at the trailing edge of the right and left wing. The program contains the appropriate mixer functions for the two servos as standard.

Up to four flight phases can be programmed in each of the thirty model memories (see »**Phase settting**« and «**Phase assignment**« menus). A copy facility is provided, making the setting of individual flight phases much easier (»**Copy / Erase**« menu).

Two timers are available at all times when flying. The screen also displays the transmitter operating time and the time which has elapsed for each model memory.

The digital trim positions are stored separately for each flight phase with the exception of the Ch1 trim. The Ch1 trim provides a simple means of re-locating the correct idle throttle setting.

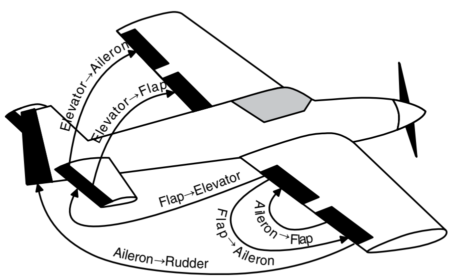
“Dual Rate” and “Exponential” can be programmed for aileron, rudder and elevator, giving two modes of control in each flight phase.

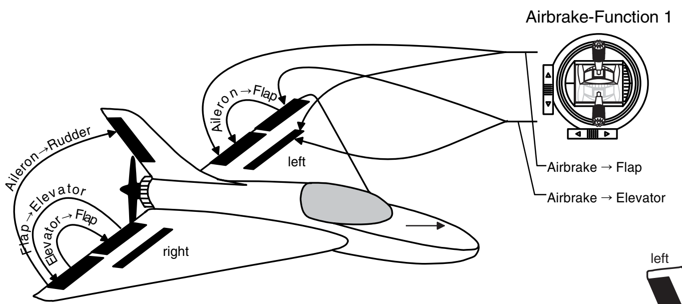
As an option, a transmitter control (rotary knob, slider or switch module) can be assigned to inputs 5 ... 8 separately for each flight phase (see »**Control adjust**« menu).

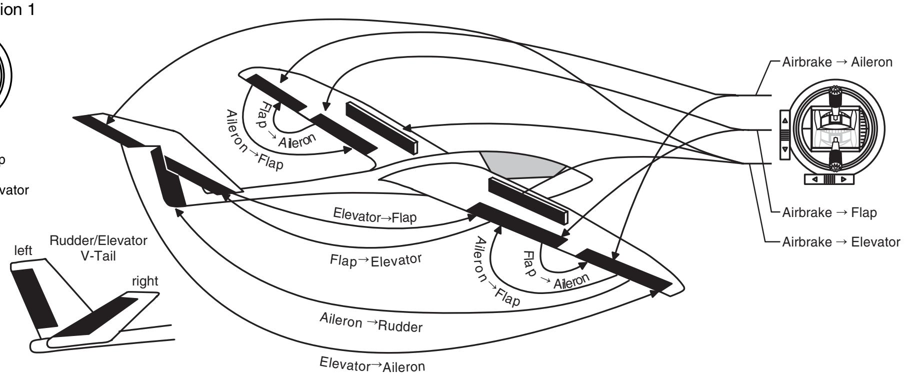
In addition to four freely assignable linear mixers, the program offers two curve mixers (»**Free mixers**« menu), two dual mixers (»**Dual mixers**« menu) and a five-point curve (»**Channel 1 curve**«) for channel 1 (throttle / brake).

Depending on the model type you have selected, the “Wing mixers” menu presents you with a list of predefined mixers and coupling functions from which you can choose:

1. Aileron differential
2. Flap differential
3. Aileron ➔ rudder (switchable),
4. Aileron ➔ flap (switchable)
5. Airbrake ➔ elevator (switchable)
6. Airbrake ➔ flap (switchable)
7. Airbrake ➔ aileron (switchable)
8. Elevator ➔ flap (switchable)
9. Elevator ➔ aileron (switchable)
10. Flap ➔ elevator (switchable)
11. Flap ➔ aileron (switchable)
12. Differential reduction



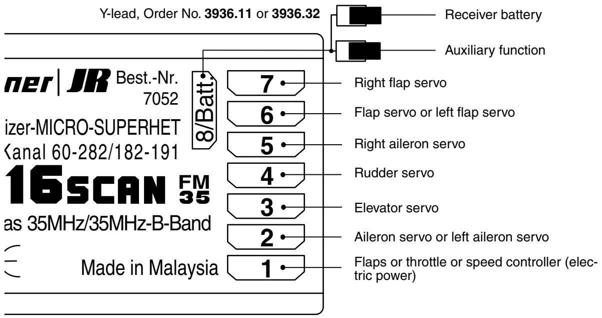




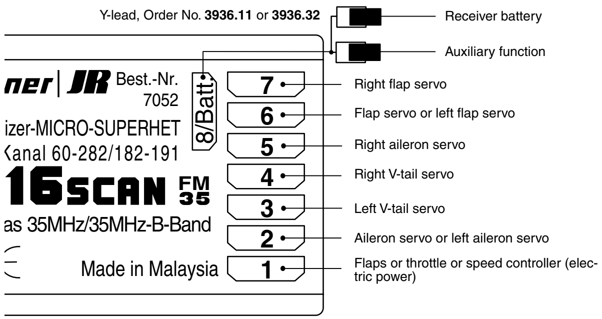
Receiver socket sequence

The servos **must** be connected to the receiver outputs in the following order:

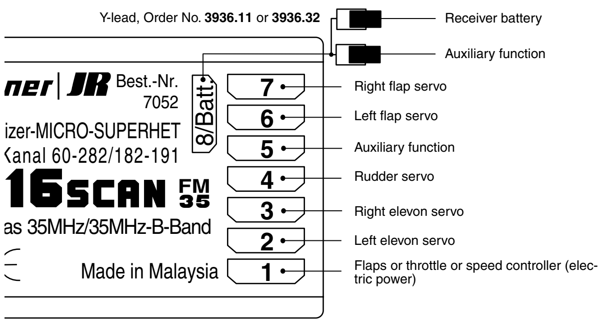
Models with “normal” tail type:



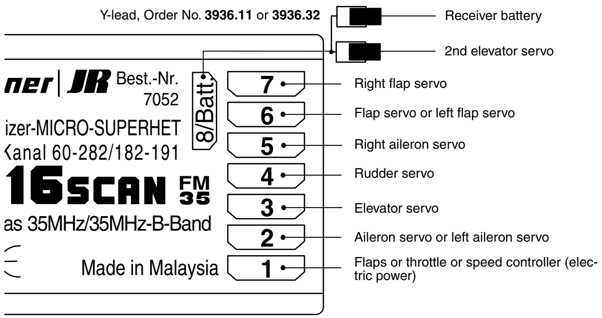
Models with “V-tail”:



Models with “Delta / Flying wing” tail type:



Models with “2 Elev.Sv3+8” tail type:



Outputs not required are simply left unused.

If you are using a *GRAUPNER* transmitter to control a model fitted with a PPM-FM receiving system made by another manufacturer*, which was formerly flown using a different make of transmitter, e.g. when using the mc-22s for Trainer mode operations, it may be necessary to re-arrange the servo sequence at the receiver outputs. However, an alternative method is to use the “**Receiver output**” sub-menu of the »**Base setup model**« menu; see page 51. Different methods of installing servos and control linkages may make it necessary to reverse the direction of rotation of some servos when programming. In both cases this is carried out in the »**Servo adjustment**« menu; see page 56.

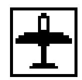
* *GRAUPNER does not guarantee that GRAUPNER radio control systems will work correctly in conjunction with receiving systems and radio control equipment made by other manufacturers.*

As there are several possible combinations of servo orientation and control surface linkage, you may find that the direction of rotation of one or more servos is incorrect.

Use the following table to solve the problem.

Model type	Servo rotating in wrong direction	Remedy
V-tail	Rudder and elevator reversed	Reverse servos 3 + 4 in the »**Servo adjustment**« menu
	Rudder correct, elevator reversed	Swap over servos 3 + 4 at the receiver
	Elevator correct, rudder reversed	Reverse servos 3 + 4 in the »**Servo adjustment**« menu, and swap over at the receiver
Delta, flying wing	Elevator and ailerons reversed	Reverse servos 2 + 3 in the »**Servo adjustment**« menu
	Elevator correct, ailerons reversed	Reverse servos 2 + 3 in the »**Servo adjustment**« menu, and swap over at the receiver
	Ailerons correct, elevator reversed	Swap over servos 2 + 3 at the receiver

All menus which are relevant to fixed-wing models are marked with an “aeroplane” symbol in the “Program descriptions”:



This means that you can easily skip irrelevant menus when programming a fixed-wing model aircraft.

Model helicopters

The continued development of model helicopters and helicopter components, such as gyros, speed governors, rotor blades etc., has led to the current position where helicopters are capable of sophisticated 3-D aerobatics. In contrast, the beginner to helicopter flying needs a simple set-up so that he can quickly get started on the initial stages of hovering practice, and then gradually work up to more complex models which exploit all the options provided by the mc-22s.

The helicopter program of the mc-22s can cope with all current model helicopters equipped with 1 ... 4 servos for collective pitch control.

Each model memory can include three flight phases plus auto-rotation (see »**Auxiliary switch**«, »**Phase setting**« and »**Phase assignment**« menus).

Four timers are constantly included in the basic screen display.

The digital trim settings are stored separately for each flight phase. You can return to the correct idle throttle trim for Ch1 simply by pressing a button.

The transmitter control assignment for inputs 5 ... 8 can also be set separately for each flight phase (»**Control adjust**« menu).

During the test-flying phase the “Copy flight phase” function can be particularly helpful (»**Copy / Erase**« menu).

“Dual Rate” and “Exponential” are available for roll, pitch-axis and tail rotor, and they can be coupled together and programmed to provide two settings in each flight phase.

You can set up four freely assignable linear mixers, two curve mixers and two dual mixers, and they can be switched on or off separately in each flight phase in the »**MIX active / phase**« menu.

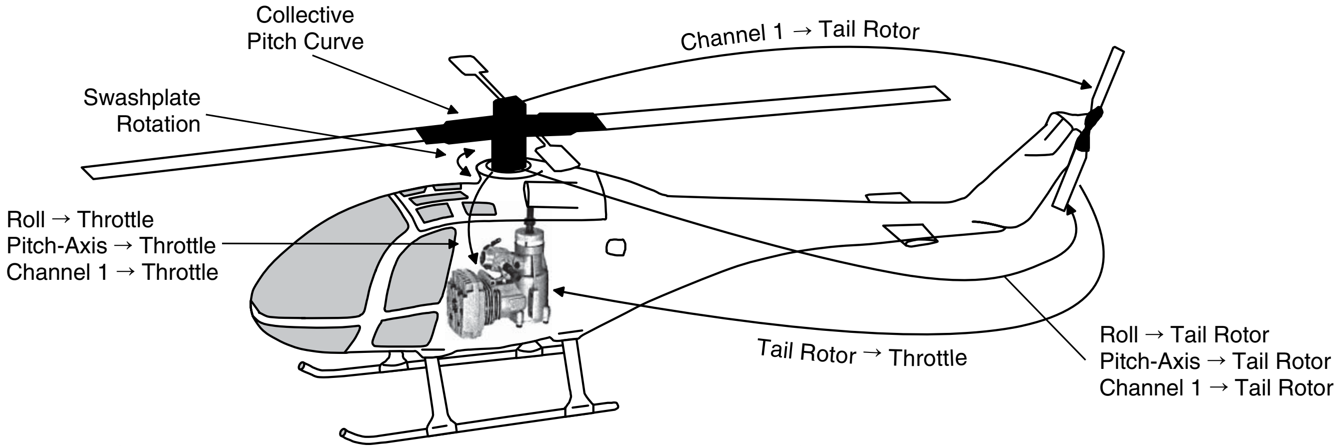
Five-point curves are provided for the collective pitch, throttle and tail rotor mixers, variable separately for each flight phase, giving non-linear mixer characteristics as often required for the roll and pitch-axis functions. Independently of this feature, the control curve for the Channel 1 stick can also be defined using five points, separately for each flight phase; this feature is not available for fixed-wing models. These advanced features are not needed by the beginner, who will usually start simply by setting the hover point to coincide with stick travel centre.

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

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

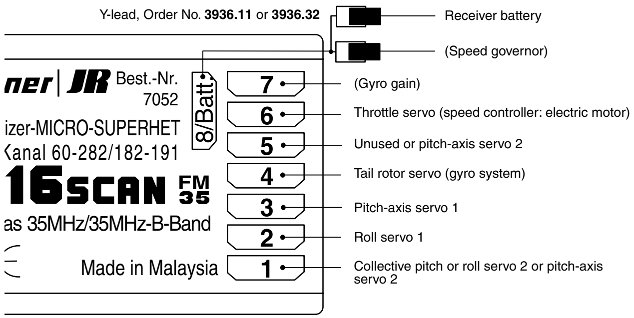
The “throttle limit” function (Input 12 in the »**Control adjust**« menu) provides an effective means of starting the motor in any flight phase. By default the slider connected to CH7 on the transmitter circuit board is assigned to input 12, and this control function determines the maximum throttle servo position, i.e. the slider controls the motor over the idle range.

If the slider is moved in the direction of full-throttle, the programmed throttle curves then take effect.



Receiver socket sequence

The servos **must** be connected to the receiver output sockets in the following sequence:



Outputs not required are simply left unused.

For more details on the different types of swashplate please refer to the »**Helicopter type**« menu described on page 53.

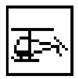
If you are flying a model helicopter fitted with a PPM-FM receiver made by another manufacturer*, which was previously flown using another make of transmitter, e.g. with the mc-22s for Trainer mode operations, it may be necessary to re-arrange the receiver servo outputs. However, an alternative method is to use the "**Receiver output**" sub-menu of the »**Base setup model**« menu; see page 51. Different methods of installing servos and control linkages may make it necessary to reverse the direction of rotation of some servos when programming. In both cases this is carried out in the »**Servo settings**« menu; see page 56.

<u>*Notes for modellers upgrading from the mc-20:*</u>

- *Compared with the mc-20, the collective pitch and throttle servo sockets are interchanged at the receiver; see the table in the left-hand column.*
- *A standard feature of the mc-20 is a slider for collective pitch trim, connected to the CH6 socket on the transmitter circuit board. If you want to retain the slider for collective pitch trim on the mc-22s you will need to set up a suitable mixer in the »**Free mixers**« menu, e.g. a mixer 8 ➔ 1, program a symmetrical mixer input of around 30%, and assign transmitter control 6 or 7 to mixer input "8" in the »**Control adjust**« menu – depending on the input to which the slider is connected. This assumes that the slider is not already in use for another purpose. However, we also recommend that you de-couple transmitter control 6 or 7 from input 6 or 7 in the »**MIX-only channel**« menu, so that control 6 or 7 cannot also operate the associated servo. See example 3 on page 107.*

Different methods of installing servos and control linkages may make it necessary to reverse the direction of rotation of some servos when programming. You can correct such problems by using the servo reverse facility located in the »**Servo adjustment**« menu on page 56.

All Codes (menus) which are relevant to model helicopters are marked with a "helicopter" symbol in the "Program descriptions":



This means that you can easily skip irrelevant menus when programming a model helicopter.

* *GRAUPNER does not guarantee that GRAUPNER radio control systems will work correctly in conjunction with receiving systems and radio control equipment made by other manufacturers.*

Brief programming instructions
for all fixed-wing and helicopter programs

Menu	✈	🚁	Display	Description of program expansions and operating notes	Page
Model memories					
≣	•	•	Model select	Selects a free or occupied model memory 1 ... 30	47
≣	•	•	Copy / Erase	Erase a model memory Copy one model memory to another memory Copy from / to mc-22s, to a PC, or between an mc-22s, an mc-22 and / or an mx-22 Copy individual flight phases within one model memory Back-up all models to a PC	47
≣	•	•	Suppress codes	Suppress functions from the multi-function select list within a memory; used for settings which are not to be altered, or which are not required. *Note:* *By default some menus are already suppressed. If necessary, move to the »**Basic settings**« menu and switch on "Expert mode", which activates all available menus, BEFORE you set up a new model.*	49
Basic settings / Servos					
	•	•	Basic setup model	Model name: max. 11 characters (letters, numbers, special symbols). Characters selected using rotary control. Stick modes, fixed-wing model aircraft: 1: Elevator, rudder: left and throttle/brake, aileron: right 2: Throttle/brake, rudder: left and aileron, elevator: right 3: Aileron, elevator: left and throttle/brake, rudder: right 4: Throttle/brake, aileron: left and elevator, rudder: right Stick modes, helicopter: 1: Pitch-axis, tail rotor: left and motor/coll. pitch, roll: right 2: Motor/coll. pitch, tail rot: left and pitch-axis, roll: right 3: Pitch-axis, roll: left and motor/coll. pitch, tail rotor: right 4: Motor/coll. pitch, roll: left and pitch-axis, tail rotor: right Modulation: PCM20 for all "mc" or "DS mc" type PCM receivers (512 steps) SPCM20 for all "smc" type SPCM receivers (1024 steps) PPM18 for all PPM-FM receivers to date except DS 24 FM PPM24 for "DS 24 FM" PPM FM receiver Trim increment: Setting of increment size for all four digital trim levers, range 1 to 10 Receiver output: Interchange the receiver outputs. Swapping the outputs does not affect any other coupling and mixer functions, servo settings etc., i.e. you do not have to adjust these settings if you	50

Menu			Display	Description of program expansions and operating notes		Page
					interchange the outputs. Exception: Fail-Safe is always defined with reference to the receiver sockets.	
	•		Model type	Motor:	Direction of effect of Ch1 function, throttle minimum “back”, “forward” or “none”. The Ch1 trim acts only “back”, “forward” or over the full range respectively.	52
				Tail type	**Servo count**	
				„normal“	Optionally up to two aileron servos and up to two flap servos	
				“V-tail”	Optionally up to two aileron servos and two flap servos	
				“Delta / flying wing”	Two elevon servos and up to two flap servos	
				„2 Elev. Sv 3+8“	Two elevator servos, plus optionally up to two aileron servos and two flap servos	
				Brake:	The wing mixers “brake → 5 aileron”, “brake → 6 flap” and “brake → 3 elevator” can optionally be controlled by a transmitter control connected to “input” 1, 8 or 9. Variable mixer neutral point (offset). If the neutral point is not set at the end of travel, the remaining travel is a dead zone.	
		•	Helicopter type	Swashplate type: Rotor direction: Coll. pitch min.: Expo throttle limit:	Select the number of servos (1 ... 4) for collective pitch “right” (clockwise) or “left” (anti-clockwise) as seen from above Minimum collective pitch angle, channel 1 control “forward” or “back”, see also »**Basic settings**« menu. “Throttle limit” can be set to exponential in »**Control adjust**« menu.	53
	•	•	Servo adjustment	Servo direction: Neutral setting: Servo travel: Servo travel limit:	Left or right Offset centre point within range -125% to +125% Symmetrical or asymmetrical, range 0 to 150% Symmetrical or asymmetrical, range 0 to 150%. Typical application: if servo travel is mechanically restricted.	56
Transmitter controls						
	•		Control adjust	Assignment and de-coupling (display = “free”) of transmitter controls (rotary control, sliders, switch modules) 5 to 10. Inputs 5 ... 8 are programmable separately for each flight phase. External switches, control switches or the fixed switch “FX” can also be assigned if required. Note: two external switches at one input correspond to the function of the *GRAUPNER* 2-channel switch module, Order No. **4151** or **4151.1**. Travel: Variable control travel, symmetrical or asymmetrical between -125% and +125%; direction of control’s effect can also be reversed. Offset: The centre point of the transmitter control can be offset within the range -125% to +125% Time: Symmetrical or asymmetrical reduction of transmitter control transit speed. Available range: 0 ... 9.9 sec., e.g. for scale processes, “soft” motor acceleration, etc..		58

Brief programming instructions
for all fixed-wing and helicopter programs

Menu	Fixed-wing	Helicopter	Display	Description of program expansions and operating notes	Page
		•	Control adjust	Assignment and de-coupling (display = “free”) of transmitter controls (rotary control, sliders, switch modules) 5 to 10. Inputs 5 ... 8 are programmable separately for each flight phase. External switches, control switches or the fixed switch “FX” can also be assigned if required. Note: two external switches at one input correspond to the function of the *GRAUPNER* 2-channel switch module, Order No. **4151** or **4151.1**. <u>*Note:*</u> *Input 12 is reserved for the “throttle limit” function. The assigned transmitter control **only** operates the throttle servo in addition to servo 12. For this reason servo 12 can only be accessed via a mixer using the »**MIX-only channel**« function. Application of “throttle limit”: see page 62. Transmitter control 7 (slider as standard) is assigned to this in the software.* Travel: Variable control travel, symmetrical or asymmetrical between -125% and +125%; direction of control’s effect can also be reversed. Offset: The centre point of the transmitter control can be offset within the range -125% to +125%. Time: Symmetrical or asymmetrical reduction of transmitter control transit speed. Available range: 0 ... 9.9 sec., e.g. for scale processes, “soft” motor acceleration, etc..	60
	•	•	Dual Rate / Expo	Affects control functions aileron, elevator and rudder, or roll, pitch-axis and tail rotor. DUAL RATE and EXPO are programmable separately for each flight phase. **DUAL RATE**: Altered control travel within the range 0 to 125% of normal control travel. Switch can be assigned, enabling user to switch between two settings in flight. **EXPO**: Sets an exponential control curve without changing total travel. Variable rate of progression within the range -100% to +100%; optionally can be switched between two settings using external switch or control switch. <u>Asymmetrical DUAL RATE or EXPO curves</u> can be programmed if the control switch is set to the stick centre position in the »**Control switch**« menu, and the stick is moved in the corresponding direction.	64/66
	•	•	Channel 1 curve	Defines the characteristic curve of the throttle / airbrake function or motor / collective pitch <u>stick</u>: The momentary stick position of the transmitter control for the input channel is indicated on the screen by a vertical bar. (“Input” shows the associated % value. “Output” gives the corresponding value of the control output). Between the two extreme points “L” (low) and “H” (high) up to three additional curve reference points can be defined: all three points can be positioned along the control travel when “Point ?” appears on the screen. Set the desired “point” value in the inverse-video field using the rotary control, press rotary control to confirm. The points are automatically numbered sequentially from 1 to 3. To re-position points L, 1, 2, 3 or H subsequently, move the associated transmitter control to select the appropriate reference point, then press the CLEAR button to erase points 1 ... 3. Pressing the left-hand ENTER button switches a curve-rounding algorithm “on” and “off”. With model helicopters this function can be programmed separately for each flight phase.	68/70

Menu	✈	🚁	Display	Description of program expansions and operating notes	Page
Switches					
⌁	•	•	Switch display	When an external switch or control switch is operated, this displays the associated switch number and switch position.	72
⌁	•	•	Control switch	Assign the control switches 1 ... 4 to the transmitter controls 1 ... 10. Pressing **STO** (press the rotary control) in column 3 stores the current control position as the switching point. Reverse the switching direction in column 4, and assign a switch to activate (and disable) a control switch in column 5. Column 6 displays the switch status.	72
⌁		•	Auxiliary switch	Auto-rotation: a switch assigned to this function activates the Auto-rotation flight phase. It has priority over all other flight phase switches and the Auto-rotation Ch1 position switch. Auto-rotation Ch1 Pos.: Alternative auto-rotation switch: defines a switching point on the Ch1 stick, can be activated using **STO**. External switch required! For more details see »**Phase setting**« menu.	75
Flight phases					
⇥	•		Phase setting	Name: In the »**Phase assignment**« menu names from a list are assigned to up to four phases (normal, launch, ...), according to the position of the flight phase switches. The names are shown in the basic display and in all programs which are flight phase-specific. Transition time: It is advisable to set a transition time at this point (0 ... 9.9 sec) to avoid abrupt changes between different flight phases; this provides a “soft” transition. Meaning of symbols in right-hand column: ∗ Indicates the phase assigned to each switch position. Phase 1 by default if no other switches are assigned, or if all phase switches are at the base position. + A switch position is provided for this phase in the »**Phase setting**« menu. – The phase is not in use.	78
⇥		•	Phase setting	In contrast to »**Phase setting**« for fixed-wing models, the name of the auto-rotation phase cannot be changed. This flight phase can be activated if a switch is defined in the »**Auxiliary switch**« menu. For more information see the »**Phase assignment**« menu. Transition time: It is advisable to set a transition time at this point (0 ... 9.9 sec) to avoid abrupt changes between different flight phases; this provides a “soft” transition. **If auto-rotation is selected, the switch takes place without any delay**; any set delay only takes effect when you quit auto-rotation. Meaning of symbols in right-hand column: see »**Phase setting**« menu for fixed-wing model	79
⇥	•	•	Phase assignment	Each of the four (fixed-wing model) or three (model helicopter) available flight phases can be assigned to any combination of up to four switches; the phases can be assigned names in the »**Phase setting**« menu. In the basic setting all switches always generate “Phase 1”; the same applies to non-assigned switch combinations. <u>Priority of the switch assigned under “A”:</u> The flight phase assigned to this switch has precedence over the flight phase switch positions “B”, “C” and “D”.	80

Brief programming instructions

for all fixed-wing and helicopter programs

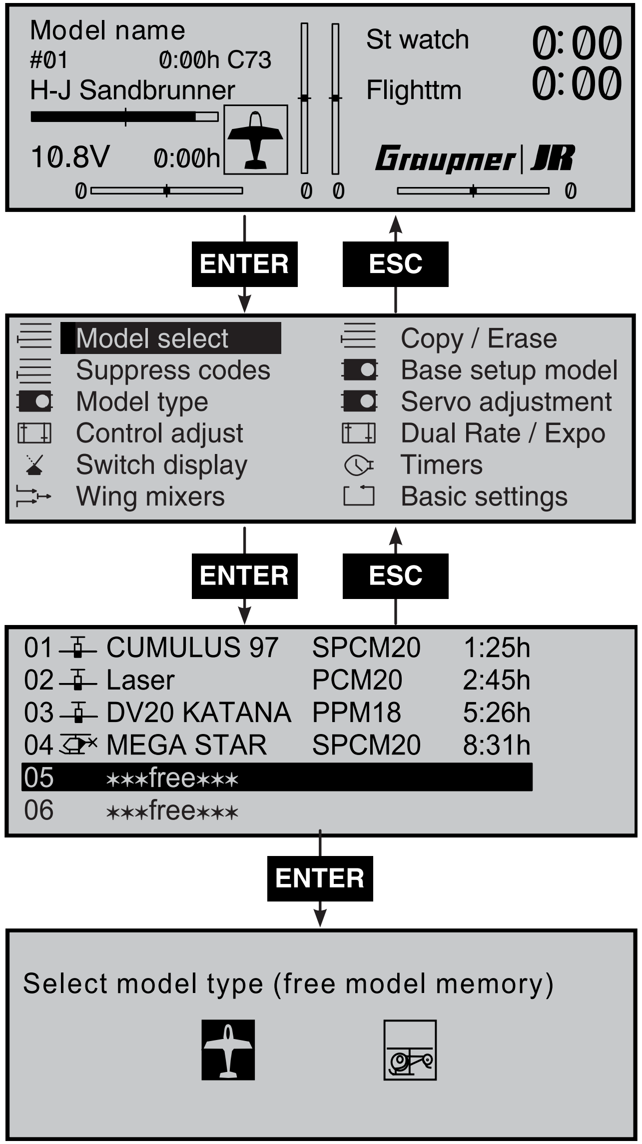
Menu			Display	Description of program expansions and operating notes	Page
	•	•	Undelayed channel	The delay when a new flight phase is selected can be switched off for individual channels, separately for each flight phase. Examples: motor OFF with electric models, activating and disabling heading lock with gyro systems.	81
Timers					
	•	•	Timers	“Model time”: Reset with brief press on the rotary control when the **CLR** field is active (timer switchable). “Battery time”: Automatic reset when battery is recharged; can also be reset by pressing **CLR**. “Stopwatch”: The stopwatch is switched on and off by means of the switch assigned on the right of the screen. Pressing **CLEAR** in the basic display resets the stopwatch to zero, but only if the timing process has already been halted. “Flight timer“: The flight timer is switched on via the switch assigned on the right. Operate the same switch and press **ESC** at the basic display to stop the timer; **CLEAR** resets it to zero. “Timer” column: Preset 0:00 means count-up timer; time preset via rotary control (maximum 180 min 59 sec) generates count-down timer (flashing colon (:) in the basic display). “Alarm” column: Time and sequence of the warning sounds until the alarm timer passes through zero (max. 90 sec.).	82
Mixers					
	•		Wing mixers	Number of available mixers varies according to »**Model type**« menu: aileron differential, flap differential, aileron 2 → 4 rudder, aileron 2 → 7 flaps, brake → 3 elevator, brake → 6 flap, brake → 5 aileron, elevator 3 → 6 flaps, elevator 3 → 5 aileron, flaps 6 → 3 elevator, flaps 6 → 5 aileron and differential reduction. All mixers: the mixer ratio can be varied within the range -150% and +150%, separately for each flight phase. All wing mixers with flap or elevator inputs can also be programmed separately for each side of neutral. The neutral point (offset) of the “aileron, elevator, flap → NN” mixers is the zero point of the transmitter control; the neutral point (offset) of the “brake → NN” mixer can be programmed in the »**Model type**« menu. All mixers are switchable.	84
		•	Helicopter mixer	Programming separately for each flight phase: a) Non-linear five-point curves for: collective pitch, channel 1 → throttle and channel 1 → tail rotor; adjusted as in »**Channel 1 curve**« menu, and b) linear mixer ratios (0 ... 100%) for the following mixers: tail rotor → throttle, roll → throttle, roll → tail rotor, pitch-axis → throttle and pitch-axis → tail rotor. Gyro suppression: Suppression of gyro effect through tail rotor deflection (0 ... 199%), variable separately for each flight phase, dependent on tail rotor stick position. Programmed values above 100% produce full suppression before full tail rotor deflection. Also available in the auto-rotation phase. Swashplate rotation: (Virtual) rotation of the swashplate in either direction (-90° ... +90°). <u>The following mixers are available in the auto-rotation phase:</u>	90

Menu			Display	Description of program expansions and operating notes	Page
				non-linear five-point collective pitch curve, AR throttle position (-125% ... +125%) and tail rotor offset (AR), gyro suppression and swashplate rotation.	
	•	•	Free mixers	Select linear mixer 1 ... 4 or curve mixer 5 or 6 with the rotary control pressed in. Define mixer input (any control function) in "from / to" column; select "from" and output "to" using associated **SEL** function and rotary control. If a constant control function is required as input, e.g. motor ON / OFF, then select letter "S" in the "from" column (corresponds to DUMMY mixer in the mc-20), and assign mixer switch in column 4. Include preceding mixers (symbol "➔") and / or trim ("Tr") of stick 1 ... 4, after setting mixer input in the "Type" column. Select corresponding symbol "➔", "Tr" or "Tr➔" using rotary control. An (optional) switch can be assigned to any mixer. **Setting mixer ratio and direction with linear mixers:** switch to "Setup" column on the screen page with brief press on rotary control. Select **ASY** or **SYM** and set mixer ratio within the range 0 to +/-150% using the rotary control. To set asymmetrical values, select the side of neutral using the input channel (vertical line on graph), or by operating the switch in the case of the switched channel "S". **Setting non-linear mixer curves with curve mixers 5 and 6:** three additional reference points can be defined between the two end-points "L" (low) and "H" (high). Basic operating instructions: see »**Channel 1 curve**« menu on page 68 / 70. **Shifting the offset point (mixer neutral point):** use the transmitter control to move the bar in the graph to the appropriate position, select **STO** and press the rotary control briefly. Press the bottom **CLR** field to move the offset point back to centre. *<u>Notes:</u>* *DUAL RATE may limit the offset range of the vertical line!* *Mixers may be suppressed in the »**MIX active / phase**« menu!*	102
	•	•	MIX active / phase	The mixers 1 ... 6 can be disabled separately for each flight phase. In the »**Free mixers**« menu they are then suppressed separately for each flight phase!	108
	•	•	Mix-only channel	This function separates the link between transmitter control 1 ... 10 and the associated servo, i.e. the control only affects the relevant channel as a mixer input. In this case the de-coupled servo is only accessible via a mixer.	108
	•	•	Dual mixer	Two mixers designed for coupling two channels in such a way that they work in the same direction and in opposed directions. Example: camber-changing flaps (receiver outputs 8 and 9) with aileron function: define dual mix „▲ 8 ▲, ▲ 9 ▼". In the »**Control adjust**« menu assign a (free) transmitter control, e.g. control 7, to input 8 for the flap function, and in the »**Free mixers**« menu define the mixer „AIL ➔ 9" to provide an aileron function. If necessary reverse the direction of rotation in the »**Servo adjustment**« menu, and set the required aileron differential (0 ... 100%) in the last column "Diff". Also suitable for other applications, e.g. differential rudder deflection with a V-tail. In this case "EL" is defined as a same-direction mixer: ▲ EL ▲, and "RU" as an opposed mixer:, ▲ RU ▼", Please note that in this case the tail type <u>must be</u> entered as "normal" in the »**Model type**« menu!	110

Menu	Fixed-wing	Helicopter	Display	Description of program expansions and operating notes	Page
		•	Swashplate mixer	Mixer ratios for collective pitch, roll and pitch-axis are separately variable (-100% ... +100%), with the exception of helicopters with only one collective pitch servo. **CLEAR** resets changed values to 61%. *Important:* *Ensure that servos are not mechanically obstructed if you set large values.*	111
Auxiliary functions					
	•	•	Fail-safe adjust	**In PCM20 mode:** „Time“: all servos to “hold” mode, or enter a delay time (1, 0.5 or 0.25 sec.) using rotary control, after which servos 9 and 10 take up the neutral position, and servos 1 ... 8 take up a position definable using **STO**. “Battery F.S.”: three possible servo positions can be selected (-75%, 0%, +75%, plus “off”) for servo 1 in fixed-wing models and model helicopters. **In SPCM20 mode:** Servos 1 ... 8 can be programmed to hold-mode or position mode. Save selected position using **STO**. Servos 9 and 10 remain in hold mode.	112 114
	•	•	Teacher/pupil	After assigning a switch (preferably a momentary switch or kick-button), control functions 1 ... 8 can be transferred to a Pupil transmitter. All model programming is carried out at the Teacher transmitter. The pupil transmitter’s control functions must affect the control channels, i.e. the receiver outputs, directly, without any mixers or other settings being involved. The modulation of the Pupil transmitter must be set to PPM! Only stick mode, throttle / collective pitch reverse and idle trim should be set up to suit the pupil’s preferences.	115
Global functions					
	•	•	Basic settings	Owner’s name: max. 15 characters (letters, numbers, special symbols). Use rotary control to select characters from the symbol table on the second screen page. Preset stick mode: the stick mode selected at this point is adopted as standard for all **new** model memories. Preset modulation: PCM20 for all “mc” or “DS mc” type PCM receivers (512 steps) SPCM20 for all “smc” type SPCM receivers (1024 steps) PPM18 for all PPM-FM receivers to date except DS 24 FM PPM24 for “DS 24 FM” PPM FM receiver Expert mode: „no“: some menus are suppressed in the multi-function list when a new model is set up; simplifies programming for the beginner. Suppression of menus can be reversed in the »**Suppress Codes**« menu if desired. “yes” all mc-22s menus are accessible when a new model is set up. Preset coll. pitch min.: Defines the collective pitch minimum position of the Ch1 stick – “forward” or “back”.	117

Menu	✈	🚁	Display	Description of program expansions and operating notes	Page
				<u>*Note:*</u> *the presets for “stick mode”, “modulation” and “collective pitch min.” are automatically adopted when you call up a model memory, but can then be changed separately for that memory in the »**Base setup model**« menu, if preferred.*	
⮌	•	•	Servo display	The servo outputs can be checked on-screen, taking into account all coupling and mixer functions etc. when you operate the corresponding transmitter control (useful aid when programming).	118
⮌	•	•	Code lock	A four-character code number can be entered using the four side buttons, or erased with a short press of the rotary control (**CLR**) and subsequently corrected. Confirm by pressing the ENTER button. When you switch the mc-22s on again access to the multi-function menu remains barred until you enter the correct code.	119

If you have already read through to this point in the manual you will undoubtedly have already made your first attempt at programming the system. Even so, it is important to describe each menu here in detail, to ensure that you have comprehensive instructions for each application you are likely to encounter. In this section we start with setting up a “free” model memory prior to “programming” a new model:



Basic transmitter display

The first steps should be to select the menu language and then select a transmission channel, as described on pages 21 and 22. Adjust the screen contrast if necessary by pressing and turning the rotary control.

From the basic display press **ENTER** to shift to the “Multi-function menu”. You can return to the basic screen at any time by pressing **ESC**.

If necessary select the »**Model select**« menu from the list using the rotary control.

Note:
If the expert mode has been set to “no” in the »Basic settings« menu, you will only see a limited selection of menus at this point. The »Fail-Safe« menu only appears if the transmitter is set to “PCM20” or “SPCM20” transmission mode.

Now press **ENTER** or the rotary control to shift to the »**Model select**« menu.

The model memories marked „∗∗∗free∗∗∗∗“ are not yet in use. Memories which are already occupied appear with the model name at the appropriate point, together with the type of modulation and the model operating time. The model name is the one you have entered in the »**Base setup model**« menu (page 50). Use the rotary control to select one of the free model memories 1 to 30, then press **ENTER** or the rotary control.

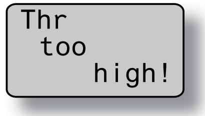
You are now invited to define the basic model type, i.e. either “fixed-wing” or “helicopter”.

Use the rotary control to select the appropriate type, then press the **rotary control** or the **ENTER** button to confirm your choice. The screen switches back to the basic display: the model memory is now reserved.

Changing to another model type for this model memory is now only possible if you first erase the model memory (»**Copy / Erase**« menu, page 47).

Caution:

- *All the transmitter’s functions are barred, and the transmitter does not broadcast a signal to the servos, until you confirm the model type you have selected. If you switch off the transmitter before you set the model type, the screen automatically reverts to the screen shown at the bottom when turned on again. You must always define a model type!*
- *If the warning ...*



… appears on the screen, move the throttle stick back in the direction of idle.

Note:
*The appearance of this warning also depends on the settings you have made in the “Motor” line of the »**Model type**« menu (see page 52). Select “none” if the motor is not powered. The warning is then disabled.*

- *If the message ...*

*... appears on the screen, please read the section on the »**Fail-safe**« menu on pages 112 / 114.*

The following description of the menus follows the sequence of the multi-function menu list.

Model select

Model select 1 … 30

01	✈	CUMULUS 97	SPCM20	1:25h
02	✈	Laser	PCM20	2:45h
03	✈	DV20 KATANA	PPM18	5:26h
04	🚁	MEGA STAR	SPCM20	8:31h
05		∗∗∗free∗∗∗		
06		∗∗∗free∗∗∗		

The transmitter can store up to thirty complete sets of model settings, including the digital trim values set by the four trim levers. The trims are automatically stored, which means that the settings you have carefully established through test-flying are not lost when you swap models.

If you have entered a model name in the »**Base setup model**« menu (page 50), the name appears after the model number, together with the model type in pictogram form, the type of modulation and the model's operating time.

Use the rotary control to select from the list the model you wish to use. Confirm your selection by pressing the rotary control, or press **ENTER**. Pressing **ESC** takes you back without switching models.

Notes:

- *If the warning message "Throttle too high" appears when you switch models, the throttle stick "Ch1" is set towards full throttle, and should be returned to idle.*
- *If the message "Fail-Safe setup" appears when you switch models, you should check your Fail-Safe settings. This only applies if the transmitter is set to PCM20 or SPCM20 transmission mode.*
- *If the battery voltage is too low, it may not be possible to switch model memories for safety reasons. In this case the screen displays this message:*

```
Not currently possible
Battery voltage too low
```

Copy / Erase

Model copy and flight phase copy function

Erase model	=>
Copy model → model	=>
Copy MC22 → external	=>
Copy external → MC22	=>
Copy flight phase	=>
Secure all models → PC	=>

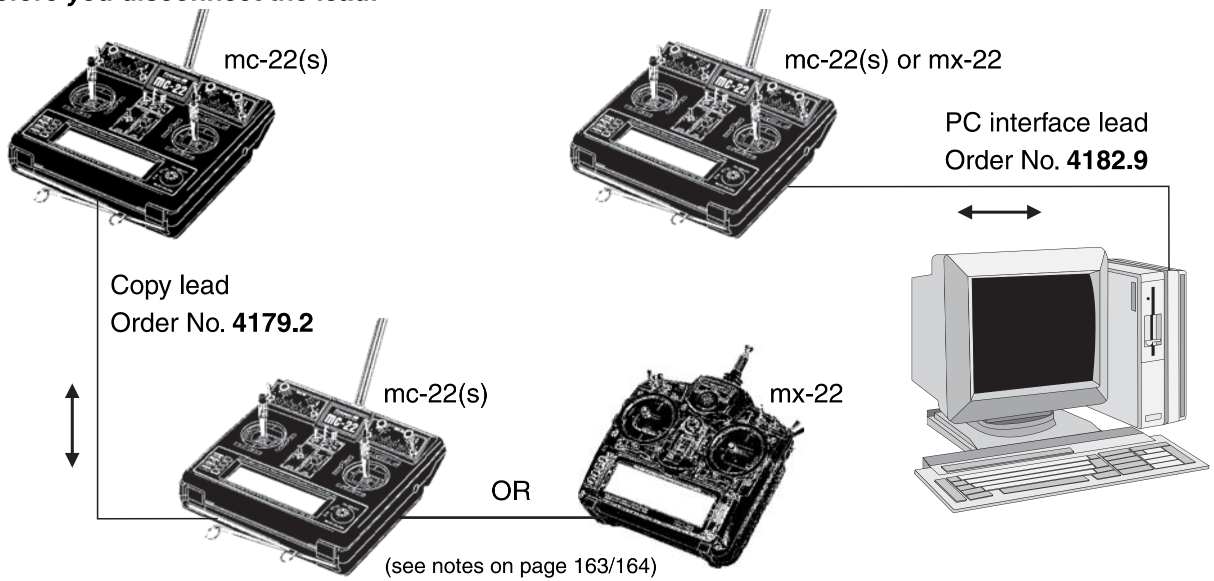
This menu is used to:

- erase a model memory;
- copy internally from one model memory to another;
- copy a model memory from one mc-22s transmitter to another, from the mc-22s to the mc-22 or mx-22, and from the mc-22s to an industry-standard PC;
- copy individual flight phases within one and the same model memory.
- back up the data contained in all the model memories to a compatible PC.

To connect the transmitter to a PC you will need the PC interface mc-22(s) / PC set, Order No. **4182**. This is an optional accessory which is connected to the interface distributor (supplied in the set), in order to transfer model data to the PC, to back up the data on diskette or hard disc, and – if necessary – to load it back into the transmitter (or another transmitter). Full details are included in the set (the PC interface lead and interface distributor are also available separately; see Appendix). To transfer data between two mc-22s transmitters, both transmitters must be fitted with the mc-22(s) interface distributor, Order No. **4182.3**. You will also need the copy lead, Order No. **4179.2**, to make the actual transfer.

Caution – essential information:

Be sure to connect the PC or the second transmitter to your mc-22s using the interface or copy lead before you switch the mc-22s transmitter on. When the process is completed, switch the transmitter(s) off before you disconnect the lead!



First select the desired option with the rotary control pressed in, then call it up by pressing ENTER or the rotary control:

"Erase model"

Select model to be erased:

01	CUMULUS 97	SPCM20	1:25h
02	Laser	PCM20	2:45h
03	DV20 KATANA	PPM18	5:26h
04	MEGA STAR	SPCM20	8:31h
05	∗∗∗free∗∗∗		

Select the model to be erased using the rotary control. Pressing ESC returns you to the previous screen page. Press ENTER or the rotary control to shift to the next screen page:

Model really
01 CUMULUS 97
to be erased?
NO YES

Select "**NO**" or "**YES**" using the rotary control and confirm your choice by pressing ENTER or the rotary control.

Caution:
All the data stored in the selected model memory is erased. The erasure process is irrevocable.

If you erase the currently active model memory in the basic display, you will be required to define the model type "Heli" or "fixed-wing" immediately. However, if you erase a non-active model memory, then the message „∗∗∗free∗∗∗" appears in the Model select menu.

"Copy model → model"

Copy from model:

01	CUMULUS 97	SPCM20	1:25h
02	Laser	PCM20	2:45h
03	DV20 KATANA	PPM18	5:26h
04	MEGA STAR	SPCM20	8:31h
05	∗∗∗free∗∗∗		

Select the model to be copied in the "Copy from model" window, and confirm by pressing ENTER or the rotary control. A further window "Copy to model" appears, where you have to enter the destination memory and confirm your choice, or interrupt the process by pressing ESC. A model memory which is already occupied can be overwritten. In the interests of safety you have to confirm the copy process once more.

Model really
03 DV20 KATANA → 06 ∗∗∗free∗∗∗
to be copied?
NO YES

"Copy mc22 → external"

Select the model memory in the "Copy from model" window, then confirm the copy process to a PC or a compatible transmitter (mc-22, mc-22s, mx-22).

Model really
02 Laser
be copied to PC or other transmitter?
NO YES

The progress of the copy process is indicated by a horizontal bar.

"Copy external → mc22s"

Select the destination memory in the "Copy to model" window, and confirm the input as already described. Once again, you are required to confirm the copy process from a PC or from another transmitter:

Model really
05 MEGA STAR
be loaded from PC or other transmitter?
NO YES

The transfer process then has to be initiated from the second transmitter or the PC.

Note:
If the transmitter is not connected to a PC or another transmitter, you must interrupt the copy process by switching off the receiving transmitter, then switching it on again.

"Copy flight phase"

Copy from phase:

1 Normal	2 Launch
3	4

In the "Copy from phase" menu, use the rotary control to select the flight phase 1 ... 4 (fixed-wing model or helicopter) to be copied, confirm your choice by pressing ENTER or the rotary control, then select the destination in the new "Copy to phase" window and confirm your choice. For safety's sake you will be invited to confirm your choice once more.

“Back-up all models → PC”

must all models be
saved in a file on PC?

NO YES

In this case all *occupied* model memories are automatically transferred to the PC in sequence for backing-up, in contrast to the “Copy mc22 → external” command.

Note:
If the transmitter battery voltage is too low, the transmitter blocks all copy and erase functions in the interests of safety. The following message then appears on the screen:

Erase model =>
Copy m...
Copy M...
Copy external → MX22 =>
Copy flight phase =>
Secure all models → PC =>

Not currently possible
Battery voltage too low

Suppress Codes

Suppressing Codes from the multi-function list

Model select	Copy / Erase
Base setup model	Model type
Servo adjustment	Control adjust
Dual Rate / Expo	~~Channel 1 curve~~
Switch display	~~Control switch~~
Suppress : TOG	

In this menu you can suppress any functions in the multi-function list which are not required for the currently active model, or which must not be changed.

For example, if you are programming different flight phases, it is advisable to suppress all global settings such as modulation, stick mode, servo settings etc.. The multi-function list can then be restricted to just a few menus, and the function select list becomes easier to read. Suppressing the menus does not disable those functions; it just means that they can no longer be accessed directly.

Select the function to be suppressed using the rotary control, then press the rotary control briefly to suppress it, or re-activate it if already suppressed.

Tip:
*If you do not wish to use a program block at all, we recommend for safety’s sake that you remove the »**Code lock**« menu from the multi-function list using the »**Suppress codes**« menu, otherwise it would be relatively easy for an unauthorised person to enter a secret code number, which would block your access to the multi-function list.*

Caution:
*In the transmitter’s default state the expert mode is set to “no” in the »**Basic settings**« menu. This means that some menu points are suppressed as standard. If you wish to have all menu points available when you call up a new model memory, you should first set this menu point to “yes”.*

*Exceptions: the »**Fail-Safe**« menu is only available when the transmitter is set to the “PCM20” or “SPCM20” transmission mode; the »**Swashplate mixer**« menu only appears if you set more than one swashplate servo.*

Base setup model

Basic model-specific settings

```
        BASIC SETTINGS, MODEL
▶Model name          <              >
 Stick mode                2
 Modulation             PPM18
 Trim steps         4     4     4     4
 receiver output                    =>
    ▼
```

Before you start programming flight-specific parameters, some basic settings must be entered which apply only to the currently active model memory. Select the menu line in the usual way with the rotary control pressed in.

Model name

You can enter up to 11 characters to define a model name. Switch to the next screen page (➡) with the rotary control pressed in; here you can enter the model name by selecting characters from a symbol list:

```
   ! #$%&´( )*+,-./0123456789:;<=>?
  @ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_
  `abcdefghijklmnopqrstuvwxyz{}~ᶜN
  Ç  éâäàåçêëèïîìÄÅÉæÆôöòûùÿÖÜ
 Model name              <DV20 KA        >
                                ◄--►
```

Use the rotary control to select the first character in the symbol field, which is displayed in inverse video (black background). A brief press on the rotary control (or turning it when pressed in) shifts to the next position in the name. Pressing **CLEAR** inserts a space at that point.

Select each character with the rotary control pressed in. The next space is indicated by a double arrow <–> in the bottom line.

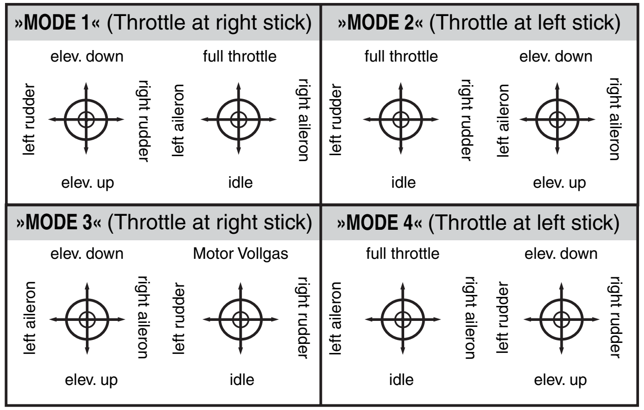
The model name appears in the basic display, and also in the »**Model select**« and »**Copy / Erase**« menus.

Stick mode

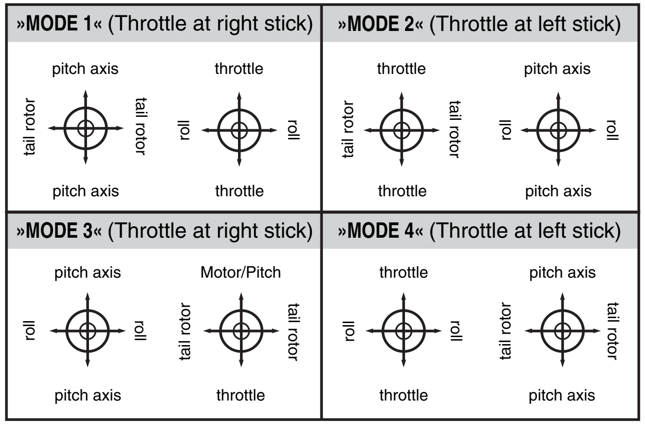
Basically there are four possible ways of arranging the principal control functions relative to the two dual-axis sticks: the primary functions are aileron, elevator, rudder and throttle (or airbrakes) for a fixed-wing model, and roll, pitch-axis, tail rotor and throttle / collective pitch on a model helicopter. Which of these possible options you select depends on your individual preferences and flying style.

At the bottom edge of the screen you will see **[SEL]**. Press the rotary control, and the current stick mode appears with a black background. Now use the rotary control to select one of the options 1 to 4. **CLEAR** resets the function to stick mode "1".

Fixed-wing stick modes:



Helicopter stick modes:



Modulation

Select this line, then press and turn the rotary control to select the required transmission mode (modulation type). The modulation you set takes effect at once, i.e. you can immediately test the signal transmission to the receiver.

CLEAR switches to "PCM20" modulation.

The mc-22s differentiates between four different types of modulation:

PCM20: System resolution of 512 steps per channel, for "mc" and "DS mc" type PCM receivers, for up to ten servos.

SPCM20: Super PCM modulation with high system resolution of 1024 steps per control function, for "smc" type receivers, for up to ten servos.

PPM18: Most widely used transmission mode (FM or FMsss) for all other *GRAUPNER* PPM-FM receivers, for up to nine servos.

PPM24: PPM multi-servo transmission mode for simultaneous operation of twelve servos; for the "DS 24 FM S" receiver only.

Note:
*If you operate all your models using the same stick mode and perhaps also with the same modulation, you should select these preset values in the global »**Basic settings**« menu (see page 117). These two presets are automatically transferred when you open a free model memory, but you can still change them to suit a particular model if you wish.*

Increment size

The four digital trim levers shift the neutral point of the relevant stick function every time you push ("click") the trim lever in either direction by one increment; the size of the increment can be varied in this menu:

BASIC SETTINGS, MODEL				
Model name	<			>
Stick mode	2			
Modulation	PPM18			
▶Trim steps	10	4	4	4
▾▴	CH1	AILE	ELEV	RUDD

Use the rotary control to select "CH1", "AILE" (aileron trim lever), "ELEV" (elevator trim lever) or "RUDD" (rudder trim lever). Press the rotary control briefly and set a value within the range 1 to 10.

In the helicopter program you change the trim increments in the same way, this time for "THRO", "ROLL", "NICK" and "TAIL". In all cases the maximum trim range is around +/-30% of full servo travel.

Receiver output

For maximum flexibility in terms of receiver socket assignment, the mc-22s program provides the means to swap over the servo outputs 1 to max. 12; this is carried out on the second page of this sub-menu.

Press the rotary control briefly to move to the next page of the display. Here you can assign the "control channels" for servos 1 … 12 to any receiver output you wish to use. However, please note that the display in »**Servo display**« – which you can reach from the basic display with a brief press on the rotary control – refers exclusively to the "*control channels*", i.e. the outputs are *not* swapped over.

RECEIVER OUTPUT			
▶Servo	1	→	Output 1
Servo	2	→	Output 2
Servo	3	→	Output 3
Servo	4	→	Output 4
▾	SEL		

Hold the rotary control pressed in, and turn it to select the servo / output combination you wish to change, then give the rotary control a brief press to assign the desired servo to the selected output … or alternatively press CLEAR to revert to the default sequence.

Please note that any changes to servo settings, such as servo travel, Dual Rate / Expo, mixers etc., **must be carried out according to the original (default) receiver socket sequence.**

Typical applications:

- *If you wish to use a smaller receiver with six or even just four servo sockets, it may be necessary to swap over the receiver sockets in order to be able to operate a second camber-changing flap, a second aileron servo or a speed controller.*
- *It may also prove necessary to swap servos for Trainer mode operations, if you are using a model set up for another make * of equipment, to avoid having to re-connect the servos at the receiver.*
- *In the helicopter program of the mc-22s the outputs for one collective pitch servo and the throttle servo have been interchanged compared to earlier GRAUPNER/JR mc systems:*
  The throttle servo is now assigned to receiver output "6", and the collective pitch servo to output "1". However, you may possibly wish to retain the previous configuration. In this case you need to program outputs 1 and 6 as shown in the illustration below:

RECEIVER OUTPUT			
Servo	6	→	Output 1
Servo	2	→	Output 2
Servo	3	→	Output 3
Servo	4	→	Output 4
Servo	5	→	Output 5
▶Servo	1	→	Output 6
▾▴ SEL			

Note:
Please note that the Fail-safe "hold-mode" and "position" programming in SPCM mode always affect the "outputs", i.e. the receiver socket numbers; this still applies if you swap the receiver outputs.

* *GRAUPNER does not guarantee that GRAUPNER radio control systems will work correctly in conjunction with receiving systems and radio control equipment made by other manufacturers.*

Model type

Defining the fixed-wing model type

```
        M O D E L   T Y P E
▶Motor                        None
 Tail type                    Normal
 Aileron/camber flaps         1 AIL
 Brake      Offset  +100%    Enter    1
   ▼                          SEL
```

In this menu you define all the functions which apply to your model. Select the line, press the rotary control briefly, and select the required option:

Motor

„none“: The model is a glider, with no motor. Selecting this option disables the “Throttle too high” warning; see pages 20 and 46.

„Thr. min rear“: The idle position of the throttle / airbrake stick (Ch1) is back, i.e. towards the pilot.

„Thr. min front“: The idle position of the throttle / airbrake stick (Ch1) is forward, i.e. away from the pilot.

<u>Notes:</u>

- *The Ch1 trim acts only at the idle end of the range, i.e. only at the “back” or “forward” end of the stick travel. You can check the setting in the »**Servo display**« menu.*
- *Cut-off trim: this special function is described on page 32.*

Tail

„Normal“: Most fixed-wing model aircraft have a “normal tail”. For example, this includes all powered models and gliders in which each of the functions elevator, rudder and throttle (or speed controller or airbrakes) is operated by one servo.

„V-tail“: The elevator and rudder controls are operated by two control surfaces set in a V-shape, each controlled by a separate servo. The two-way coupling function for the rudder and elevator control systems is automatically carried out by the system software. The program caters for up to two aileron and flap servos. The ratio of rudder to elevator travel can be adjusted using the »**Dual Rate**« menu (page 64). The servo travels can be adjusted in the »**Servo adjustment**« menu (page 56).

„Delt/fl.wing“: The mixed elevon (aileron and elevator) control system requires two separate aileron servos. Two additional wing flaps can also be controlled.

„2Elev.Sv3+8“: This option is designed for model aircraft with two elevator servos. When the elevator stick is moved, the servo connected to receiver output 8 moves in tandem with the standard elevator servo. The elevator trim lever affects both servos.

*In this mode a transmitter control which is assigned to input 8 in the »**Control adjust**« menu is de-coupled from servo “8”; this is for safety reasons.*

Ailerons / camber-changing flaps

You can define the number of aileron and flap servos at this point.

<u>*Note:*</u>
*The only time that all the receiver outputs can control separate servos individually is when the “normal” model type is selected, with no more than one aileron servo and one flap servo. At all other times the receiver outputs are coupled together by software in various ways as standard. The software provides <u>ready-made</u> mixers for up to two aileron servos and two flap servos. The associated mixers and their set-up facilities are activated in the »**Wing mixers**« menu, regardless of the pre-set values entered in this menu point.*

*Additional wing-mounted servos can be integrated very simply by using the »**Dual mixer**« menu; see page 110.*

Brake

This function is likely to interest electric-powered model enthusiasts, and pilots of glow-powered models fitted with <u>landing flaps</u>. The following mixers:

- Brake → 3 elevator
- Brake → 6 flap
- Brake → 5 aileron

are described in the »**Wing mixers**« menu (see page 84), and can be operated by the Ch1 stick (“Input 1”) or by an auxiliary proportional control or switch which is assigned (already or subsequently) to input 8 or 9 (see »**Control adjust**« menu). This parameter is also programmed using the rotary control in the usual way.

Once you have selected the input, and – if you are using “Input 1” – have already entered the setting in the “Motor” line, the mixer neutral point (“Offset”, see page 101) can be shifted to any point you wish: switch to the **STO** field, move the transmitter control for the selected input 1, 8 or 9 to the desired position (landing flaps in neutral position), and set the offset point with a brief press on the rotary control. If the offset is not located right at the end of the control travel, the remaining travel is a “dead zone”, i.e. it no longer affects any of the mixers listed above.

Helicopter type

Defining the helicopter model type

```
              HELI TYPE
 Swashplate type                 1 Servo
▶Rotor direction                 left
 Pitch min.                      forwrd
 Expo throttle lim.                0%
      ▼▲                          SEL
```

The mc-22s includes several programs for controlling the swashplate, differing in the number of servos which are used to provide collective pitch control. Hold the rotary control pressed in initially to select the "Swashplate type" line, then press the rotary control briefly to set the number of servos in the inverse field. The remainder of the parameters in lines 2 to 4 are set in the same way (details below).

The servos must be connected to the receiver outputs in the sequence described on page 37.

Swashplate type

„1 Servo": The swashplate is tilted by one roll / pitch-axis servo. Collective pitch is controlled by one separate servo.

„2 Servo": The swashplate is moved axially by two roll servos to provide collective pitch control; pitch-axis control is decoupled by a mechanical compensating rocker (HEIM mechanics).

„3Sv (2roll)": Symmetrical three-point swashplate linkage using three linkage points arranged equally at 120°, actuated by one pitch-axis servo (front or rear) and two roll servos (left and right). For collective pitch control all three servos move the swashplate axially.

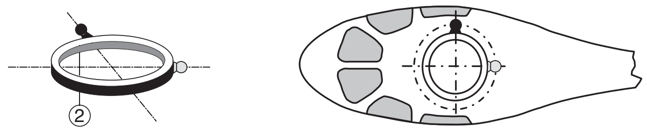
„3Sv (2p.ax)": Symmetrical three-point linkage as above, but rotated through 90°, i.e. one roll servo on one side, and two pitch-axis servos front and rear.

„4Sv (90°)": Four-point swashplate linkage using two roll and two pitch-axis servos.

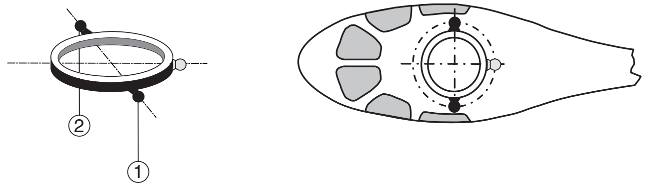
Pressing **CLEAR** resets the swashplate type to "1 Servo". The swashplate mixer ratios are set in the »**Helicopter mixers**« menu, as is swashplate rotation.

<u>*Note:*</u>
*If none of the swashplate mixers is correct for your model, you can adjust one of them to suit your own swashplate type in the »**Helicopter mixer**« menu under "Swashplate rotation".*

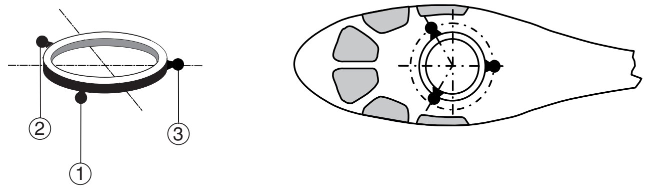
Swashplate type: 1 servo



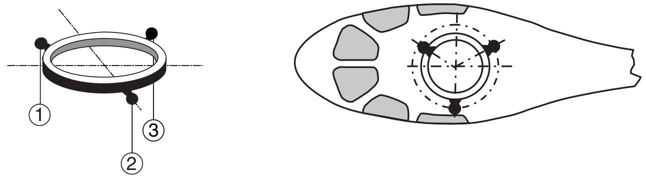
Swashplate type: 2 servo



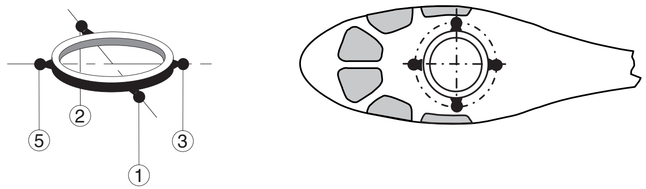
Swashplate type: 3 servos (2 roll)



Swashplate type: 3 servos (2 pitch-axis)



Swashplate type: 4 servos (90°)



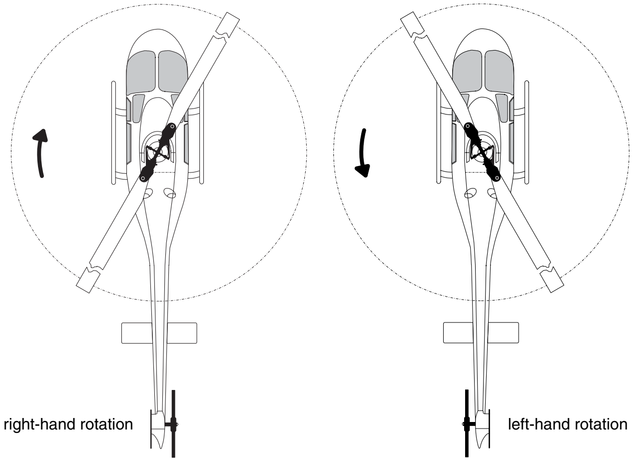
Direction of rotation of main rotor

In this line you enter the direction of rotation of the main rotor:

„left“: viewed from above, the main rotor rotates anti-clockwise.

„right“: viewed from above, the main rotor rotates clockwise.

Pressing **CLEAR** switches to “left”.



The program requires this information in order to set up the mixers to work in the correct “sense”; this applies to the following mixers which compensate for rotor torque and motor power:

»**Helicopter mixer**« menu:

Channel 1 ➔ tail rotor,
Tail rotor ➔ throttle,
Roll ➔ tail rotor,
Roll ➔ throttle,
Pitch-axis ➔ tail rotor,
Pitch-axis ➔ throttle.

Collective pitch min.

At this point you can set up the direction of operation of the throttle / collective pitch stick to suit your preference. This setting is crucial to the correct functioning of all the other options in the helicopter program which affect the throttle and collective pitch function, i.e. the throttle curve, idle trim, channel 1 ➔ tail rotor mixer etc..

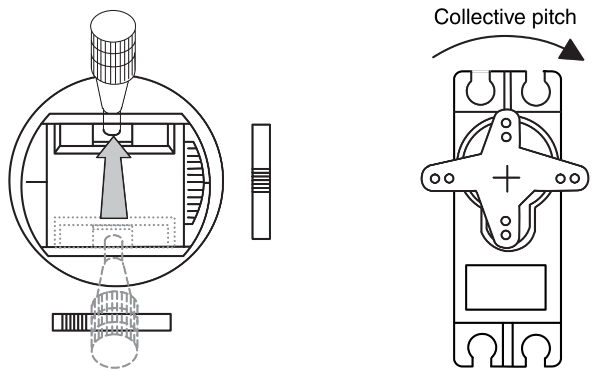
The meaning is as follows:

„forward“: Minimum collective pitch when the collective pitch stick (Ch1) is forward (away from you);

„back“: Minimum collective pitch when the collective pitch stick (Ch1) is back (towards you).

Pressing **CLEAR** sets it to “forward”.

Note:
The Ch1 trim always affects the throttle servo only. If you need to trim the collective pitch servo use the procedure described in Example 3 on page 107.



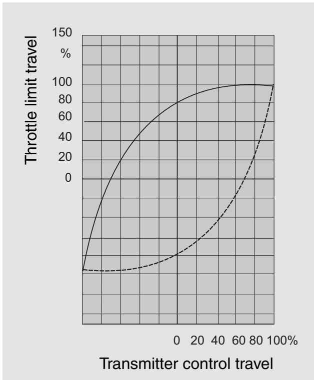
Notes:

- *If you operate all your models using the same collective pitch stick sense, you can select this preset value in the global »**Basic settings**« menu (page 117). This preset is automatically adopted when you open a free model memory with the “Heli” model type, but you can still change it to suit a particular model if you wish.*
- *As standard what is known as the “throttle limiter” is set (see page 62); this limits the travel of the throttle servo in the direction of maximum throttle, acting separately from the collective pitch servos. This point can be programmed in the »**Control adjust**« menu for Input 12.*

Expo throttle limit

The “Throttle limit” function is described in the »**Control adjust**« menu (see page 62); note that an exponential curve can be assigned to it by setting the rate of progression within the range -100% to +100% using the rotary control. This is sensible if, for example, the throttle limiter is required to regulate the idle setting at the same time. For further details on the throttle limiter see the »**Control adjust**« menu.

Example of two exponential curves for the throttle limit, using 100% servo travel:
solid line:
negative expo values;
dotted line:
positive expo values



Servo adjustment

Servo direction, centre, travel, limit

▶Servo 1	=>	0%	100%	100%	150%	150%
Servo 2	=>	0%	100%	100%	150%	150%
Servo 3	=>	0%	100%	100%	150%	150%
Servo 4	=>	0%	100%	100%	150%	150%
	Rev	cent.	- travel	+	- limit	+
▾	SEL	SEL	SYM	ASY	SYM	ASY

In this menu you can adjust parameters which only affect the servo connected to a particular receiver output, namely the direction of servo rotation, neutral point, servo travel and (if required) a travel limit.

The basic procedure:

1. Hold the rotary control pressed in and select the relevant servo (1 to 12).
2. Turn the rotary control to select **SEL**, **SYM** or **ASY** in the bottom line, prior to making the adjustments required.
3. Press the rotary control: the corresponding input field goes into inverse video (black background).
4. Set the appropriate value using the rotary control.
5. Finally press the rotary control again to end the input process.

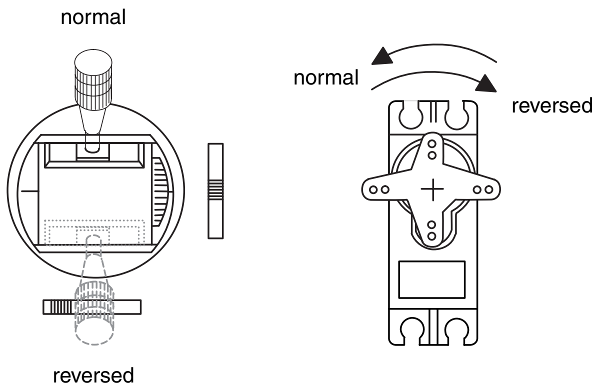
Important:
The numbers in the servo designations refer to the receiver output socket to which a particular servo is connected. These numbers do not necessarily coincide with the numbering of the transmitter control function inputs, and indeed any coincidence would be purely accidental. The sophisticated programs of the mc-22s mean that the numbers are unlikely to be the same in any case. For example, changing the stick mode does not affect the numbering (i.e. receiver socket sequence) of the servos.

As a basic rule, always start with the servo setting in the left-hand column!

Column 2 "Rev"

The direction of servo rotation can be adjusted to suit the actual installation in your model. This means that you don't need to concern yourself with servo directions when installing the mechanical linkages in the model, as you can reverse them if necessary. The direction of rotation is indicated by the symbols "=>" and "<=". Be sure to set the appropriate direction of servo rotation before you start adjusting the remaining options!

Pressing **CLEAR** resets the direction of rotation to "=>".

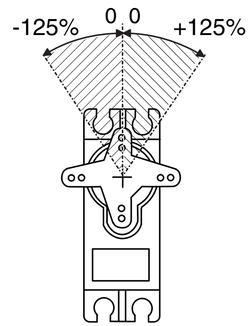


Column 3 "cent."

The facility to offset the servo travel centre is intended for adjusting servos whose centre setting is not standard (servo centre point at 1.5 ms), and also for minor adjustments, e.g. for fine-tuning the neutral position of the model's control surfaces.

The neutral position can be shifted within the range -125% to +125% of normal servo travel, regardless of the trim lever position and any mixers you have set up. The centre setting affects the associated servo directly, independently of all other trim and mixer settings.

Pressing **CLEAR** resets the value to "0%".



Servo centre adjustment

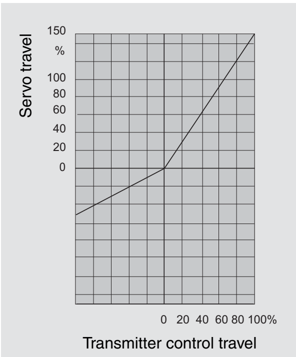
Column 4 "travel"

In this column you can adjust servo travel symmetrically or asymmetrically (different each side of neutral). The adjustment range is 0 ... +150% of normal servo travel. The reference point for the set values is the setting in the "Centre" column.

To set a "symmetrical" travel, i.e. to adjust travel equally on both sides of neutral, select **SYM**; select **ASY** to set asymmetrical travel. In the latter case move the associated transmitter control (stick, slider, rotary knob or switch module) to the appropriate end-point; when you press the rotary control the inverse servo travel field switches between the left field (negative direction) and the right field (positive direction).

Pressing **CLEAR** resets the changed parameter to 100%.

Important:
*In contrast to the »**Control adjust**« menu, this setting affects the servos directly, regardless of how the control signal for the individual servo is generated, i.e. either directly by a stick channel, or by means of any type of mixer function.*



The graph alongside shows an example of asymmetrical servo travel, with a travel setting of -50% and +150%.

Column 5 "limit"

The servo travels generated by superimposed mixers, and by other parameters such as substantial centre offsets and increased travel, are cumulative, and at the extremes these can exceed the normal limits. All *GRAUPNER/JR* servos have a reserve of an aditional 50% beyond normal travel, so the transmitter normally limits servo travel to 150% to avoid damage caused by the servos striking their end-stops.

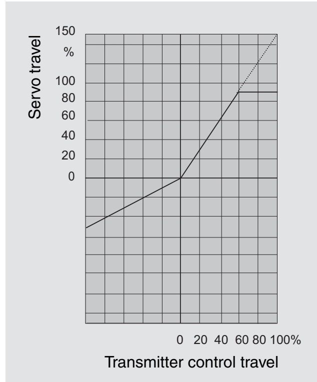
In some cases it may be advisable to set the limiter to restrict servo travel to a lower value, for example, if there are mechanical restrictions in the linkage; this should only be done if the control travels normally required in flight will not be reduced unnecessarily by decreasing servo travel in this way.

Example:
A servo may be controlled by two transmitter controls through different mixers. For reasons specific to the model, the maximum servo travel must be restricted to 100%, because – for example – the rudder would collide with the elevator at more than 100%. This presents no problems as long as only one of the two transmitter controls is used. The problem arises when both controls (e.g. aileron and rudder) are used simultaneously, with the result that the rudder signal is greater than 100%. Under these circumstances the linkages and the servos could be overloaded, and could even fail.

To avoid this problem it is really essential to limit the rudder's travel by setting individual travel limiters. In our example – the rudder – the value should be just under 100%, as we know that the control surfaces collide at 100%.

Select the **SYM** field to set a symmetrical travel limit, and select a value within the range 0 to 150% of normal travel. If you wish to set different limits for each side of neutral, select the **ASY** field. Now press the rotary control briefly, and set the travel limit values in each inverse field in turn using the rotary control. For an asymmetrical setting move the associated transmitter control to each end-point in turn; the inverse field then switches between the negative and positive directions.

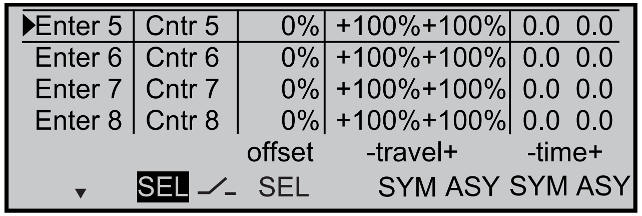
(**CLEAR** = 150%).



The graph shows the servo travel limited to 90%, with a travel setting of +150%.

Control adjust

Settings for transmitter control inputs 5 to 12



In addition to the two dual-axis stick units for the control functions 1 to 4, supplementary transmitter controls (sliders, rotary knobs, switch modules) can be connected to the sockets marked CH5 to CH10 on the transmitter circuit board.

Inputs 11 and 12 are pure “software inputs” and can only be occupied by controls CH5 ... CH10, or by external switches, fixed switches (FXI or FX) or control switches (G1 ... G4 and G1i ... G4i).

In the standard configuration the two controls in the centre console of the mc-22s are connected to the following inputs:

Control	Transmitter socket	Function input
Left slider	CH6	6
Right slider	CH7	7

These two sliders, and also any other transmitter controls connected to sockets CH5 to CH10, can now be assigned freely to any function input you like (see pages 26 / 27), with *absolutely no restriction*. A side-effect of this arrangement is that one transmitter control can also be set to operate several function inputs simultaneously, e.g. 11 *and* 12.

It is also possible to assign an external, fixed or control switch to each input; see below for details.

Function inputs 5 to 8 can also be assigned differently for each flight phase, provided that you have defined flight phase programs in the »**Phase setting**« and »**Phase assignment**« menus. In this case the names assigned to each flight phase are displayed in the bottom line of the screen, e.g. «Normal». Inputs 9 to 12 can only be assigned once in each model memory (1 to 30). For this reason a transmitter control assigned to these inputs affects all flight phases equally.

The basic procedure:

1. Select the appropriate input (5 to 12) with the rotary control pressed in.
2. Use the rotary control to select **SEL**, the **switch symbol**, **SYM** or **ASY** in the bottom line of the screen, so that you can carry out the desired adjustments.
3. Press the rotary control: the input field you wish to modify now switches to inverse video (black background).
4. Carry out the adjustment using the rotary control.
5. Press the rotary control to conclude the input process.

Column 2 “Control or switch assignment”

Hold the rotary control pressed in, and turn it to select one of the function inputs 5 to 12.

Use the rotary control to move to **SEL**, or – if **SEL** is already selected – press the rotary control briefly to select the assignment facility:

a) Operation using transmitter control:

Select transmitter control 5 to 10 (if the appropriate socket on the transmitter circuit board is occupied), or switch it to “free” if you wish to de-couple the input from the transmitter control. In this case (and also if you have assigned a non-existent transmitter control) the servo associated with this input stays at neutral, and can then only be controlled by a mixer or mixers.

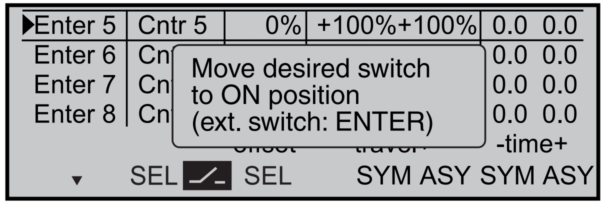
Tip:
It is a good idea to switch all inputs not currently required to “free”, to eliminate the risk of operating them accidentally using transmitter controls which are not meant to be assigned.

b) Operation using external switch:

If you wish to operate the input like a switch module, but there are no more actual switch modules available, an alternative method is to assign an external switch to the input concerned. Using a simple switch (e.g. Order No. **4160**, **4160.1** and others; see Appendix) you can switch between the two end-points, e.g. motor ON / OFF.

You can obtain the same effect as with a two-channel switch module, Order No. **4151**, using a two-way momentary switch (Order No. **4160.44**) or differential switch (Order No. **4160.22**); see Appendix.

The first step is to select the switch symbol field and then press the rotary control:



Starting from the centre position of the two-way switch, assign a switching direction; preferably this should be the “second” one. For example, if you wish to switch a function forward in two stages, i.e. away from you, then start from the centre, moving the switch toggle away from you. The screen will now display an additional switch button instead of the left-hand **SEL** field. Move the switch back to the centre and select the new switch symbol. Press the rotary control again briefly, then assign the other switch direction starting from the centre position once more.

The screen now displays the switch number, with a switch symbol which indicates the direction of operation, e.g.:

▸Enter 5	8▪ 7▪	0%	+100%	+100%	0.0	0.0
Enter 6	Cntr 6	0%	+100%	+100%	0.0	0.0
Enter 7	Cntr 7	0%	+100%	+100%	0.0	0.0
Enter 8	Cntr 8	0%	+100%	+100%	0.0	0.0
		offset	-travel+		-time+	
▾		SEL	SYM	ASY	SYM	ASY

(The switch number refers to that shown in the »**Switch display**« menu; see page 72).

As mentioned on page 27, the transmitter control itself can also be used as a switch, i.e. the input can be toggled to and fro between the two end-points at a position of the transmitter control which you can define in the »**Control switch**« menu.

Instead of moving a switch to the "ON position", press **ENTER** to move on to the "expanded switches":

Move … (ext. s…

Cntrl/fixed switch
G1 G2 G3 G4 FXI
FX G1i G2i G3i G4i

Use the rotary control to select the control switch G1 ... G4 or one of the software "inverted" control switches G1i ... G4i, and confirm your choice with a brief press on the rotary control.

The two fixed switches pass a constant signal to the input:

FXI = +100%, FX = -100%

(Other values can be selected by altering the default setting in the "Travel" column.)

To erase a switch, press the **CLEAR** button when you see the message:

"Move desired switch in ON position".

For further information on *control switches* please refer to the »**Control switches**« menu on page 72. *If you have assigned a control switch, it is essential to assign a transmitter control to it in that menu!*

Column 3 "Offset"

The centre point of each transmitter control, i.e. its zero point, can be changed in this column; the adjustment range is -125% to +125%. Pressing **CLEAR** resets the offset value to 0%. See pages 81 and 135 for typical applications of this feature in conjunction with flight phase programming.

Column 4 "–Travel+"

In this column you can set the travel of the transmitter control to any value within the range -125% to +125%. At the same time you can use the software to reverse the direction of effect of the transmitter control. In contrast to altering servo travel, changing the transmitter control travel setting affects all mixer and coupling inputs, i.e. all servos which are influenced by that transmitter control.

Transmitter control travel can be adjusted symmetrically (**SYM**) to both sides, or asymmetrically (**ASY**). In the latter case you must move the stick in the appropriate direction before altering the setting. When the field changes to inverse video (black background) you can change the setting using the rotary control.

Pressing **CLEAR** resets the transmitter control travel to 100%.

Note:
For technical reasons the control travel of the two sliders in the centre console may be limited to less than +/-100%. If necessary, you can compensate for this by increasing the control travel.

Tip:
*You can call up the »**Servo display**« menu to check the new settings directly.*

Column 5 "Time"

A delay within the range 0 to 9.9 sec. can be programmed for all function inputs 5 ... 12, either symmetrically or asymmetrically. Use the rotary control to select **SYM** or **ASY** in the right-hand column, then press the rotary control.

If you opt for an asymmetrical delay setting, you must move the transmitter control in question to the appropriate end-point (or move the switch in the corresponding direction), so that the inverse video field changes from one side to the other. You can then set the delay separately for each side of neutral using the rotary control.

Application:
Retractable undercarriage with wheel doors (controlled by two servos):

- *Extend:* *doors fast, wheels slow;*
- *Retract:* *wheels fast, doors slow.*

Example:
Wheel doors: *Servo 11*
Wheels: *Servo 12*

Enter 9	Cntr 9	0%	+100%	+100%	0.0	0.0
Enter10	Cntr 10	0%	+100%	+100%	0.0	0.0
Enter11	8▪	10%	+120%	+ 95%	2.5	0.0
▸Enter12	8▪	- 15%	+106%	+110%	0.0	2.5
		offset	-travel+		-time+	
▴		SEL	SYM	ASY	SYM	ASY

*You can also adjust the travel characteristics of servos 11 and 12 using the "Offset" and "Travel" points in the transmitter control menu. Use the »**Servo display**« menu to check the results of your actions.*

Settings for transmitter control inputs 5 to 12

```
▶Enter 5 | Cntr  5 |    0% | +100%+100% | 0.0  0.0
 Throt 6 |  free   |    0% | +100%+100% | 0.0  0.0
 Gyro  7 |  free   |    0% | +100%+100% | 0.0  0.0
 Enter 8 | Cntr  8 |    0% | +100%+100% | 0.0  0.0
                     offset    -travel+     -time+
   ▾          SEL       SEL     SYM ASY  SYM ASY
```

As well as the two dual-axis stick units for control functions 1 to 4, supplementary transmitter controls (sliders, rotary knobs, switch modules) can also be connected to the sockets CH5 to CH10 in the Heli program.

Inputs 11 and 12 are pure “software inputs” and can only be occupied by controls CH5 ... CH10, or by external switches, fixed switches (FXI or FX) or control switches (G1 ... G4 and G1i ... G4i).

In the standard configuration the two controls in the centre console of the mc-22s are connected to the following inputs:

Control	Transmitter socket	Function input
Left slider	CH6	6
Right slider	CH7	7

These two sliders, and also any other transmitter controls connected to sockets CH5 to CH10, can now be assigned freely to any function input you like (see pages 26 / 27), with *absolutely no restriction*. A side-effect of this arrangement is that one transmitter control can also be set to operate several function inputs simultaneously, e.g. 11 *and* 12.

It is also possible to assign an external, fixed or control switch to each input; see below for details.

However, function input “6” is de-coupled in the software (“free” setting), i.e. it has no effect, as this control channel is reserved for the throttle channel in the Helicopter menu.

Transmitter control 7 is used to control gyro suppression; see the »**Helicopter mixer**« menu on page 94.

Function input 12 is termed Throttle limit; its function is explained on the next double page.

Function inputs 5 to 8 can also be assigned differently for each flight phase, provided that you have defined flight phases in the »**Phase setting**« and »**Phase assignment**« menus. In this case the names assigned to each flight phase are displayed in the bottom line of the screen, e.g. «Normal». Function inputs 9 to 12 can only be assigned once in each model memory (1 to 30). For this reason a transmitter control assigned to these inputs affects all flight phases equally.

The basic procedure:

1. Select the appropriate input (5 to 12) with the rotary control pressed in.
2. Use the rotary control to select **SEL**, the **switch symbol**, **SYM** or **ASY** in the bottom line of the screen, so that you can carry out the desired adjustments.
3. Press the rotary control: the input field you wish to modify now switches to inverse video (black background).
4. Carry out the adjustment using the rotary control.
5. Press the rotary control to conclude the input process.

Column 2 “Control or switch assignment”

Hold the rotary control pressed in, and turn it to select one of the function inputs 5 to 12.

Use the rotary control to move to **SEL**, or – if **SEL** is already selected – press the rotary control briefly to select the assignment facility:

a) Operation using transmitter control:

Select transmitter control 5 to 10 (if the appropriate socket on the transmitter circuit board is occupied), or switch it to “free” if you wish to de-couple the input from the transmitter control. In this case (and also if you have assigned a non-existent transmitter control) the servo associated with this input stays at neutral, and can then only be controlled by a mixer or mixers.

Tip:
It is a good idea to switch all inputs not currently required to “free”, to eliminate the risk of operating them accidentally using transmitter controls which are not meant to be assigned.

b) Operation using external switch:

If you wish to operate the input like a switch module, but there are no more actual switch modules available, an alternative method is to assign an external switch to the input concerned. Using a simple switch (e.g. Order No. **4160**, **4160.1** and others; see Appendix) you can switch between the two end-points, e.g. motor ON / OFF.

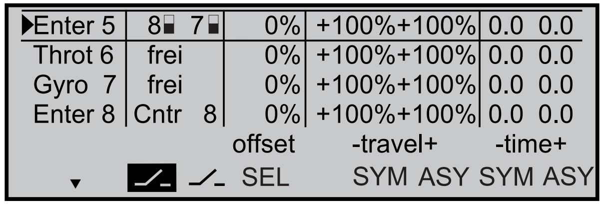
You can obtain the same effect as with a two-channel switch module, Order No. **4151**, using a two-way momentary switch (Order No. **4160.44**) or differential switch (Order No. **4160.22**); see Appendix.

The first step is to select the switch symbol field and then press the rotary control:

```
▶Enter 5 | Cntr  5 |    0% | +100%+100% | 0.0  0.0
 Throt 6 |  fr Move desired switch      | 0.0  0.0
 Gyro  7 |  fr to ON position           | 0.0  0.0
 Enter 8 | Cn (ext. switch: ENTER)      | 0.0  0.0
                                          -time+
   ▾     SEL        SEL     SYM ASY  SYM ASY
```

Starting from the centre position of the two-way switch, assign a switching direction; preferably this should be the “second” one. For example, if you wish to switch a function forward in two stages, i.e. away from you, then start from the centre, moving the switch toggle away from you. The screen will now display an additional switch button instead of the left-hand **SEL** field. Move the switch back to the centre and select the new switch symbol. Press the rotary control again briefly, then assign the other switch direction starting from the centre position once more.

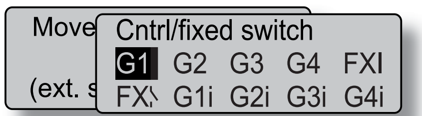
The screen now displays the switch number, with a switch symbol which indicates the direction of operation, e.g.:



(The switch number refers to that shown in the »**Switch display**« menu; see page 72).

As mentioned on page 27, the transmitter control itself can also be used as a switch, i.e. the input can be toggled to and fro between the two end-points at a position of the transmitter control which you can define in the »**Control switch**« menu.

Instead of moving a switch to the “ON position”, press **ENTER** to move on to the “expanded switches”.



Use the rotary control to select the control switch G1 ... G4 or one of the software “inverted” control switches G1i ... G4i, and confirm your choice with a brief press on the rotary control.

The two fixed switches pass a constant signal to the input:

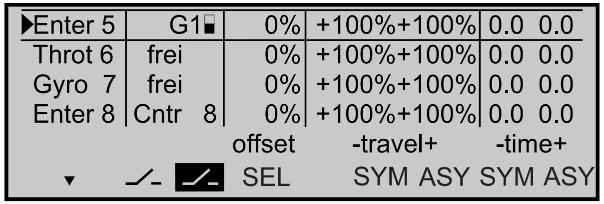
FXI = 100%, FX = - 100%

(Other values can be selected by altering the default setting in the “Travel” column.)

To erase a switch, press the **CLEAR** button when you see the message:

“Move desired switch in ON position”.

Typical display of control switches:



For further information on *control switches* please refer to the »**Control switch**« menu on page 72. *If you have assigned a control switch, it is essential to assign a transmitter control to it in that menu!*

Column 3 “Offset”

The centre point of each transmitter control, i.e. its zero point, can be changed in this column; the adjustment range is -125% to +125%.

Pressing **CLEAR** resets the offset value to 0%.

Column 4 “–Travel+”

In this column you can set the travel of the transmitter control to any value within the range -125% to +125%. At the same time you can use the software to reverse the direction of effect of the transmitter control. In contrast to altering servo travel, changing the transmitter control travel setting affects all mixer and coupling inputs, i.e. all servos which are influenced by that transmitter control.

Transmitter control travel can be adjusted symmetrically (**SYM**) to both sides, or asymmetrically (**ASY**). In the latter case you must move the stick in the appropriate direction before altering the setting. When the field changes to inverse video (black background) you can change the setting using the rotary control.

Pressing **CLEAR** resets the transmitter control travel to 100%.

Note:
For technical reasons the control travel of the two sliders in the centre console may be limited to less than +/-100%. If necessary, you can compensate for this by increasing the control travel.

Tip:
*You can call up the »**Servo display**« menu to check the new settings directly.*

Column 5 “Time”

A delay within the range 0 to 9.9 sec. can be programmed for all function inputs 5 ... 12, either symmetrically or asymmetrically. Use the rotary control to select **SYM** or **ASY** in the right-hand column, then press the rotary control.

If you opt for an asymmetrical delay setting, you must move the transmitter control in question to the appropriate end-point (or move the switch in the corresponding direction), so that the inverse video field changes from one side to the other. You can then set the delay separately for each side of neutral using the rotary control.

Application:
Retractable undercarriage with wheel doors (controlled by two servos):

- *Extend:* *doors fast, wheels slow;*
- *Retract:* *wheels fast, doors slow.*

Example:
Wheel doors: *Servo 11*
Wheels: *Servo 12*

(See page 59, right column, for the method of setting up this example.)

*You can also adjust the travel characteristics of servos 11 and 12 using the “Offset” and “Travel” points in the transmitter control menu. Use the »**Servo display**« menu to check the results of your actions.*

Control adjust
Throttle limit function

Throttle limit: input 12 (throttle limit and Ch1 trim, throttle limit and expo throttle limit)

The meaning and application of “throttle limit”

In contrast to fixed-wing model aircraft, the power of a model helicopter’s motor or engine is not controlled directly using the Ch1 stick, but indirectly via the throttle curve, which is set up in the »**Helicopter mixer**« menu. (For separate flight phases you can set different throttle curves using flight phase programming; see pages 78 - 81).

Note:
If the model helicopter is fitted with a speed governor (regulator), this assumes control of motor output.

Generally speaking, the throttle servo does not move anywhere near the idle position at any time during “normal” flying – even if a governor is in use. This means that the motor cannot be started, as the throttle is too far open; nor can it be stopped reliably.

This is where the “throttle limiter” comes into its own. In the Heli program, the “Throttle limiter 12” input in the »**Control adjust**« menu is reserved for the “Throttle limit” function. Using a separate transmitter control – generally the right-hand slider – connected to socket 7 on the transmitter circuit board, the position of the throttle servo (connected to receiver output 6) can be limited to any value. This means that the “throttle” setting can be reduced right down to the idle position. At the other extreme, the throttle servo can only follow the throttle curve and reach the full-throttle position if the throttle limit control is moved to the point where full servo travel is released.

The value in the (right) “+” side of the “Travel” column must therefore be set within the range 100% to 125%, to ensure that there is no chance that it will restrict the full-throttle setting available via the Ch1 stick when the control is at its maximum position. The value on the left side of the “– Travel +” column should be set in such a way that the throttle is closed completely when the digital Ch1 trim is also used, so that you can reliably stop the motor. For this reason you should leave the bottom value of the throttle limit slider at +100%.

Enter 9	Cntr 9	0%	+100%	+100%	0.0	0.0
Enter10	Cntr10	0%	+100%	+100%	0.0	0.0
Enter11	free	0%	+100%	+100%	0.0	0.0
▶Th.L.12	Cntr 7	0%	+100%	+125%	0.0	0.0
		offset	-travel+		-time+	
▲	SEL	SEL	SYM	ASY	SYM	ASY

However, this variable “limiting” of the throttle travel does not only provide a convenient method of starting and stopping the motor; it also offers a convenient method of recording flight times. To achieve this, all you have to do is program a transmitter control switch close to the full-throttle point of the throttle limit slider, and then assign this to the timer to act as the On / Off switch.

At the same time this arrangement provides a significant additional level of safety. Just imagine what might happen if, for example, you are carrying the helicopter to the take-off point with the motor running, and accidentally move the Ch1 stick …

To avoid this danger, you will hear an audible warning if the throttle is too far open when you switch on the transmitter; at the same time the following message appears on the basic display:

```
Thr
 too
   high!
```

CAUTION:
Setting the “Throttle limit 12” input to “free” does not switch the throttle limit function off; it just sets the limiter to “half-throttle”.

Tip:
*You can call up the »**Servo display**« menu to check the influence of the throttle limit slider. Bear in mind that servo output 6 controls the throttle servo on the mc-22s.*

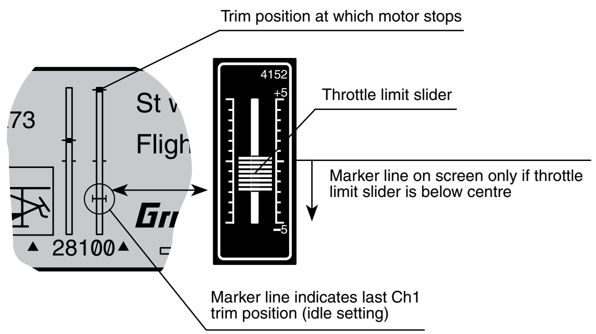
Note:
*If you connect a servo to output 12, it can be used independently for other purposes by means of mixers. All you have to do is separate this servo from the transmitter control connected to function input 12 in the »**MIX-only channel**« menu; see page 108.*

Throttle limit in conjunction with the digital trim:

When used with a throttle limit slider, the Ch1 trim places a marker at the set idle position of the motor. At this point the motor can be stopped using the trim. If a second marker is set in its end-range (see display), then a single click immediately takes you back to the marker, i.e. to the pre-set idle position – see page 32.

The cut-off trim only acts as idle trim on the throttle limit in the bottom half of the slider travel, i.e. the marker is only set and stored within this range.

Above the centre point the motor cut-off trim has no effect; for this reason the corresponding display is then suppressed.



For this reason: move the throttle limiter in the direction of motor idle before you start the motor. The throttle servo now only responds to the position of the Ch1 trim lever, and not to the throttle / collective pitch stick. Once the motor is running you should check that the motor can also be stopped reliably using the Ch1 trim lever.

Throttle limit in conjunction with "Expo throttle limit" in the "Helicopter type" menu, page 54

The sensitivity of the throttle limit slider can be changed by setting an exponential curve. For example, this may be desirable if the throttle limiter is used to regulate the idle setting. The expo throttle limit curve is described in the »**Helicopter type**« menu; see page 54.

Time delay for the throttle limiter

The throttle limiter could cause an abrupt opening of the throttle, and to avoid this it is advisable to assign an asymmetrical time delay to the throttle limiter (input 12) when the control is moved to its forward end-point. This applies in particular if you wish to use an external switch or a switch module to control the throttle limiter.

Example:
*The Ch1 stick is at the collective pitch minimum position, but the throttle servo is not at the motor idle setting, in accordance with the throttle curve set in the »**Helicopter mixer**« menu. The throttle limiter control (slider) has already been assigned.*

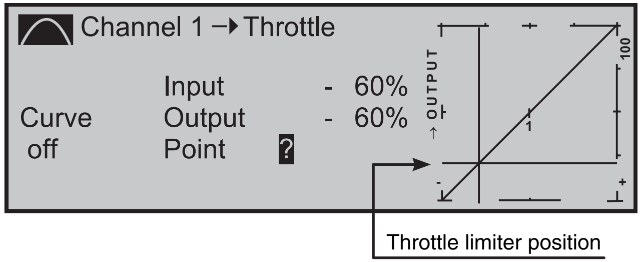
In the "Travel" column, set the control travel in such a way that the motor idle position is located at the bottom end-stop:

1. *Use the rotary control to select the **ASY** or **SYM** field.*
2. *Press the rotary control.*
3. *If you have selected **ASY**, move the control in the appropriate direction. Set the required maximum and minimum values (normally +100% and +125%) in the inverse video fields using the rotary control.*
4. *Press the rotary control to conclude the input process.*
5. *Select the **ASY** field in the "–Time +" column.*
6. *Move the assigned control to the forward end-point, so that the inverse video field moves to the right.*
7. *Use the rotary control to enter the desired time delay, e.g. 4.0 sec. The pre-set time should be selected to suit the throttle opening at the collective pitch minimum position. You will need to carry out practical testing to check that the set value suits you.*
8. *Press the rotary control or the **ESC** button to complete the process.*

The screen display might now look like this:

Enter 9	Cntr 9	0%	+100%+100%	0.0 0.0
Enter10	Cntr10	0%	+100%+100%	0.0 0.0
Enter11	free	0%	+100%+100%	0.0 0.0
▶Th.L.12	Cntr 7	0%	+100%+125%	0.0 4.0
		offset	-travel+	-time+
▲	SEL	SEL	SYM ASY	SYM ASY

Note:
*The throttle restriction set by the throttle limiter is shown as a horizontal bar in the "Channel 1 ➔ throttle" curve of the »**Helicopter mixer**« menu; see pages 92 … 93:*

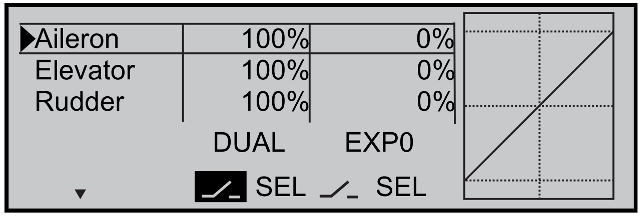


The output signal to the throttle servo set by the Ch1 stick cannot be greater than the set position of the horizontal bar.

In this example the throttle limit control is set to -60%, and therefore restricts the effect of the Ch1 stick on the throttle servo to around -60% of full travel.

Note:
*Of course, an alternative method of setting the motor to a low idle for starting would be to use a flight phase switch (see »**Auxiliary switch**«, »**Phase setting**« and »**Phase assignment**« menus; pages 75 … 80), either by switching to the auto-rotation phase ("AR") or another flight phase, and pre-selecting the AR throttle servo setting using the »**Helicopter mixer**« menu; see page 90. Set up the "Channel 1 ➔ throttle" mixer in such a way that the motor is at idle when the collective pitch stick is at the minimum position. However, these two alternative methods are seldom used. We recommend instead that you should immediately start using the <u>throttle limiter</u> and get used to the new system; see also page 92.*

Control characteristics for aileron, elevator and rudder



The *Dual Rate function* provides a means of switching to reduced control travels for aileron, elevator and rudder (control functions 2 ... 4) in flight via an external switch; the D/R values can be set separately for different flight phases. A separate menu (»**Channel 1 curve**«) is provided for setting up a curve for control function 1 (throttle / brake). This curve can feature up to five separately programmable points.

The control travels for each switch position can be set to any point within the range 0 to 125%, separately for each direction. Dual Rate works in a similar way to servo travel adjustment in the »**Servo adjustment**« menu, but the Dual Rate function does not affect the servo directly; instead it affects the corresponding *stick function*, regardless of whether that function controls a single servo or multiple servos via any number of complex mixer and coupling functions.

The *exponential control characteristic* works in a different way. If you set a value greater than 0%, exponential provides fine control of the model around the centre position of the primary control functions (aileron, elevator and rudder), without forfeiting full travel at the end-points of the stick arc. If you set a value lower than 0%, travel is increased around the neutral position, and diminishes towards the extremes of travel. The degree of "progression" can be set within the range -100% to +100%; 0% equates to normal, linear control characteristics.

A further application for exponential is to improve the linearity of rotary-output servos, which are the standard nowadays. The movement of the control surface is inevitably non-linear with a rotary servo, as the linear movement of the output disc or lever diminishes progressively as the angular movement increases, i.e. the rate of travel of the control surface is reduced steadily towards the extremes, dependent upon the position of the linkage point on the output disc or lever. You can compensate for this effect by setting an Expo value greater than 0%, with the result that the angular travel of the output device increases disproportionately as stick travel increases.

Like Dual Rates, the Expo setting applies directly to the corresponding stick function, regardless of whether that function controls a single servo or multiple servos via any number of complex mixer and coupling functions. The Expo function can also be programmed asymmetrically, can be switched on and off in flight if a switch is assigned to it, and can also be programmed separately for different flight phases.

Since switches can be assigned to the Dual Rate and Expo functions with complete freedom, it is also possible to operate several functions using one and the same switch. The result of this is that Dual Rates and Expo can be controlled simultaneously using a single switch, and this can be advantageous – especially with very high-speed models.

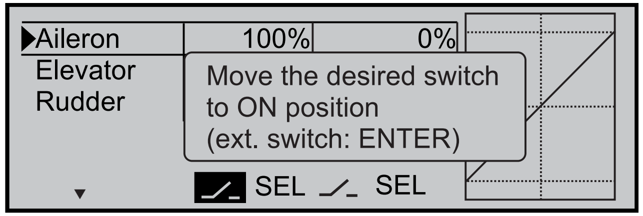
The graphic screen displays the curve characteristics directly. When you select the appropriate menu line, the central vertical line follows the movement of the stick concerned, so that you can easily observe how the curve value changes relative to movement of the transmitter control.

Different Dual Rate and Expo settings in flight phases:

If you wish to try out different flight phases in the »**Phase setting**« and »**Phase assignment**« menus, the assigned flight phase name – e.g. «Normal» – is displayed at bottom left of the screen. Operate the appropriate switch to move between flight phases.

Dual Rate function

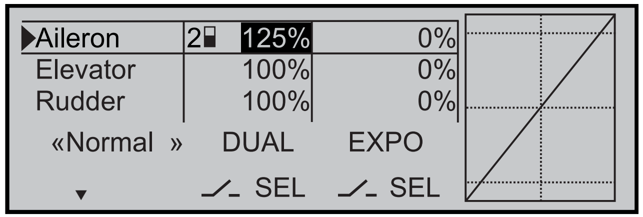
If you wish to switch between two possible D/R settings, select the field and assign an external switch ...



... or one of the control switches G1 ... G4 (or one of the inverted control switches G1i ... G4i), as described in the section entitled "Assigning external and control switches" on page 30.

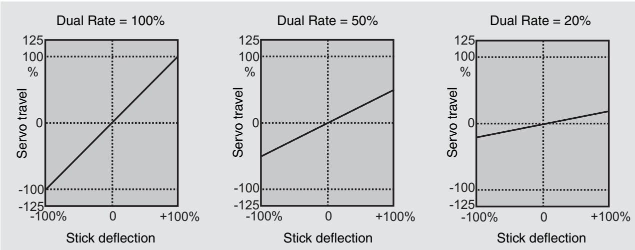
If you use one of the "G" switches, the stick position itself acts as the switch (see page 27). In this case it is *essential* (!) to move to the »**Control switch**« menu and assign the control switch to the stick you wish to use. The switch you have assigned appears in the screen display together with a switch symbol which indicates the direction of operation when you move the switch.

Select the **SEL** field to change the Dual Rate value, and use the rotary control in the inverse video field to set the values for each of the two switch positions separately, e.g. in the "normal" flight phase:



The Dual Rate curve is shown simultaneously in the graph
(CLEAR = 100%).

Examples of different Dual Rate values:



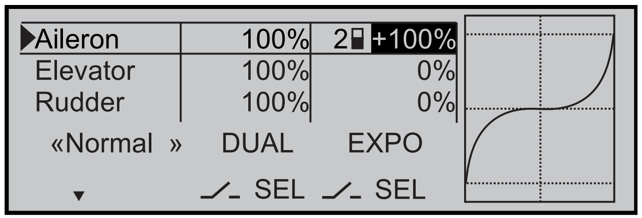
Caution:
The Dual Rate value should always be at least 20% of total control travel, otherwise you could lose all control of that function.

Exponential function

If you wish to switch between two possible settings, select the field and assign an external switch or one of the control switches, as described on page 30. The assigned switch appears in the screen display together with a switch symbol which indicates the direction of operation when you move the switch.

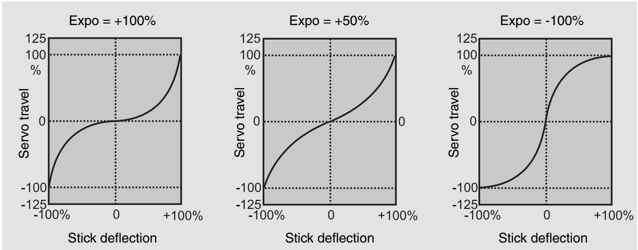
For example, the system enables you to fly with a linear curve characteristic in the one switch position, and to operate with a pre-set value other than 0% in the other switch position.

To change the Expo value, first select the **SEL** field, then use the rotary control in the inverse video field to set separate values for each of the two switch positions, e.g. in the "normal" flight phase:



The Expo curve is displayed simultaneously in the graph.

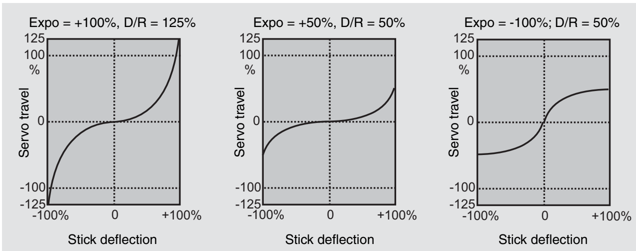
(CLEAR = 0%.)



Examples of different Expo values:
In these examples the Dual Rate value is 100% in each case.

Combination of Dual Rate and Expo

If you have assigned Dual Rates and Expo to the same switch, both functions are switched simultaneously, e.g.:

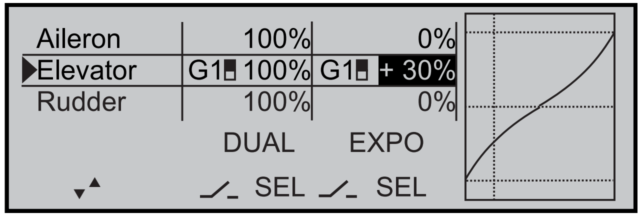


Asymmetrical setting of Dual Rate and Expo

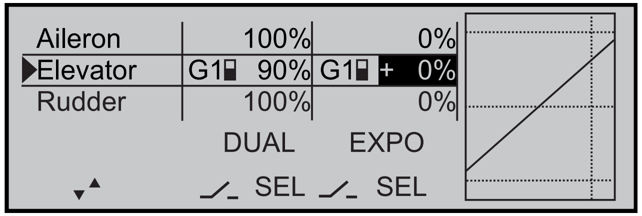
If you wish to set asymmetrical Dual Rate and / or Expo values, i.e. varying according to the direction of stick movement, you must define one of the control switches G1 ... G4 or G1i ... G4i when selecting switches.

In the »**Control switch**« menu you could assign, say, "Control 3" (= elevator stick) to the control switch "G1", but leave the switching point at the neutral position of the stick. Now return to the Dual Rate / Expo menu. Move the elevator stick to the appropriate endpoint, and enter the Dual Rate and / or Expo value for each side of neutral, e.g. for:

"up-elevator":



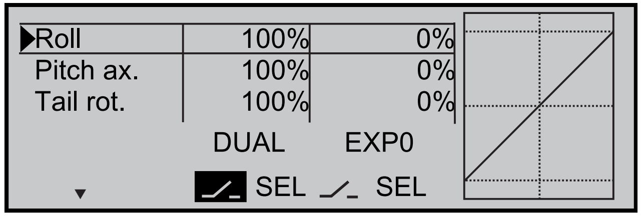
and "down-elevator":



The dotted vertical line shows the current elevator stick position.

Dual Rate / Expo

Control characteristics for roll, pitch-axis, tail rotor



The *Dual Rate function* provides a means of switching to reduced control travels for the roll, pitch-axis and tail rotor servos (control functions 2 ... 4) in flight via an external switch; the D/R values can be set separately for different flight phases. A separate curve for control function 1 (motor / collective pitch) can be set in the »**Channel 1 curve**« menu, or separately for throttle and collective pitch in the »**Helicopter mixer**« menu. These curves can feature up to five separately programmable points.

The control travels for each switch position can be set to any point within the range 0 to 125%, separately for each direction. Dual Rate works in a similar way to servo travel adjustment in the »**Servo adjustment**« menu, but the Dual Rate function does not affect the servo directly; instead it affects the corresponding *stick function*, regardless of whether this function controls a single servo or multiple servos via any number of complex mixer and coupling functions.

The *exponential control characteristic* works in a different way. If you set values greater than 0%, exponential provides fine control of the model around the centre position of the primary control functions (roll, pitch-axis and tail rotor), without forfeiting full travel at the end-points of stick travel. If you set values lower than 0%, travel is increased around the neutral position, and diminishes towards the extremes of travel. The degree of "progression" can be set within the range -100% to +100%; 0% equates to normal, linear control characteristics.

A further application for exponential is to improve the linearity of rotary-output servos, which are the standard nowadays. The movement of the control surface is inevitably non-linear with a rotary servo, as the linear movement of the output disc or lever diminishes progressively as the angular movement increases, i.e. the rate of travel of the control surface is reduced steadily towards the extremes, dependent upon the position of the linkage point on the output disc or lever. You can compensate for this effect by setting an Expo value greater than 0%, with the result that the angular travel of the output device increases disproportionately as stick travel increases.

Like Dual Rates, the Expo setting applies directly to the corresponding *stick function*, regardless of whether this controls a single servo or multiple servos via any number of complex mixer and coupling functions. The Expo function can also be programmed asymmetrically, can be switched on and off in flight if a switch is assigned to it, and can also be programmed separately for different flight phases.

Since switches can be assigned to the Dual Rate and Expo functions with complete freedom, it is also possible to operate several functions using one and the same switch. The result of this is that Dual Rates and Expo can be controlled simultaneously using a single switch, and this can be advantageous, especially with very high-speed models. See below for more details.

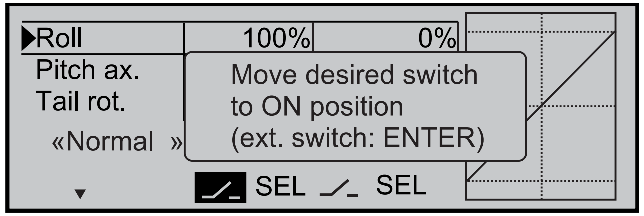
The graphic screen displays the curve characteristics directly. When you select the appropriate menu line, the central vertical line follows the movement of the stick concerned, so that you can easily observe how the curve value changes with control travel.

Different Dual Rate and Expo settings in flight phases:

If you wish to try out different flight phases in the »**Auxiliary switch**«, »**Phase setting**« and »**Phase assignment**« menus, the assigned flight phase name is displayed at bottom left of the screen, e.g. «Normal». Operate the appropriate switch to move between flight phases.

Dual Rate function

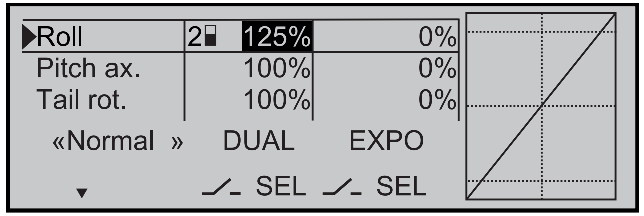
If you wish to switch between two possible D/R settings, select the field and assign an external switch ...



... or one of the control switches G1 ... G4 (or one of the inverted control switches G1i ... G4i), as described on page 30.

If you use one of the "G" switches, the stick position itself acts as the switch. In this case it is *essential* (!) to move to the »**Control switch**« menu and assign the control switch to the stick you wish to use. The assigned switch appears in the screen display together with a switch symbol which indicates the direction of operation when you move the switch.

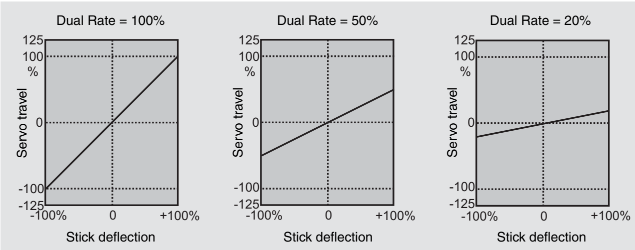
Select the **SEL** field to change the Dual Rate value, and use the rotary control in the inverse video field to set the values for each of the two switch positions separately, e.g. in the "normal" flight phase:



The Dual Rate curve is shown simultaneously in the graph.

(CLEAR = 100%.)

Examples of different Dual Rate values:



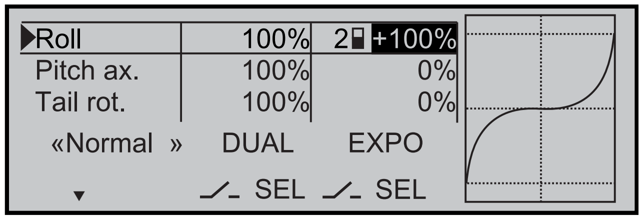
Caution:
The Dual Rate value should always be at least 20% of total control travel, otherwise you could lose all control of that function.

Exponential function

If you wish to switch between two possible settings, select the field and assign an external switch or one of the control switches, as described on page 30. The assigned switch appears in the screen display together with a switch symbol which indicates the direction of operation when you move the switch.

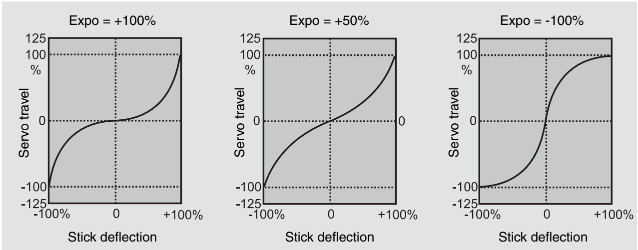
For example, the system enables you to fly with a linear curve characteristic in the one switch position, and to operate with a pre-set value other than 0% in the other switch position.

To change the Expo value, first select the **SEL** field, then use the rotary control in the inverse video field to set separate values for each of the two switch positions, e.g. in the “normal” flight phase:



The Expo curve is displayed simultaneously in the graph.

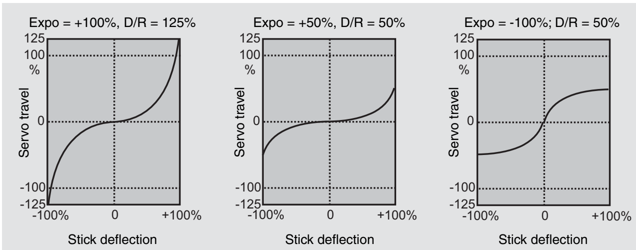
(**CLEAR** = 0%.)



Examples of different Expo values:
In these examples the Dual Rate value is 100% in each case.

Combination of Dual Rate and Expo

If you have assigned Dual Rates and Expo to the same switch, both functions are switched simultaneously, e.g.:

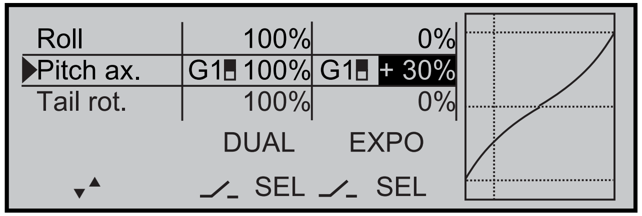


Asymmetrical setting of Dual Rate and Expo

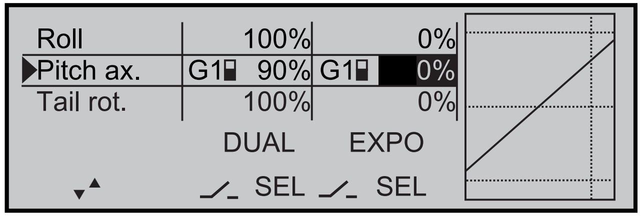
If you wish to set asymmetrical Dual Rate and / or Expo values, i.e. varying according to the direction of stick movement, you must define one of the control switches G1 ... G4 or G1i ... G4i when selecting switches. Select the relevant control function, e.g. “Pitch-axis”, and select a control switch, e.g. “G1”. In the »**Control switch**« menu you could assign, say, “Control 3” (= pitch-axis stick) to this control switch, but leave the switching point at the neutral position of the stick.

Now select the **SEL** field in the “DUAL” or “EXPO” column. Move the “pitch-axis” stick to the appropriate end-point, and enter the Dual Rate and / or Expo value for each side of neutral in the inverse field using the rotary control, e.g. for:

“pitch-axis, back”:



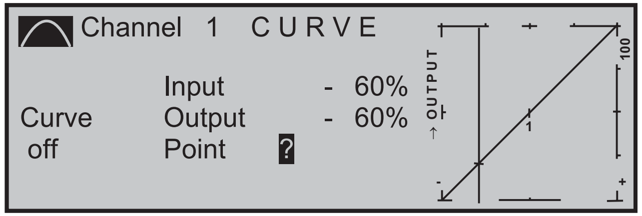
and “pitch-axis, forward”:



The dotted vertical line shows the current pitch-axis stick position.

Channel 1 curve

Control characteristic for throttle / airbrakes



In the default state of the mc-22s transmitter this menu is initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49). Alternatively, move to the »**Basic settings**« menu (see page 117) and select "yes" for the Expert mode; this must be carried out *before* you set up a new model memory.

In most cases the throttle response or the effect of the airbrakes or spoilers is not linear, and in this menu you can set up a curve to compensate for the non-linearity. The menu enables you to change the *control characteristic of the throttle / airbrake stick*, regardless of whether the stick function controls a single servo or multiple servos via various mixers.

The control curve can be defined by up to five points, termed "reference points" in the following section, which can be positioned at any point along the stick travel.

The on-screen graph considerably simplifies the process of setting and adjusting the reference points. In the basic software set-up three reference points define a linear "curve" as the base setting, namely the two end-points at the bottom end of the stick travel "L" (low = -100% travel) and the top end of the stick travel "H" (high = +100% travel), together with point "1", which is exactly in the centre of the stick travel.

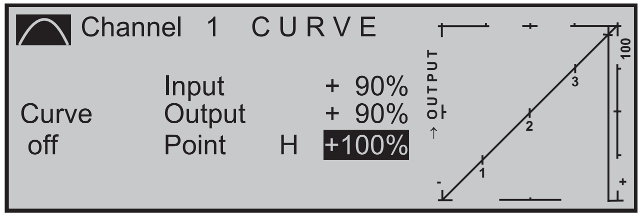
Setting and erasing reference points

You will find a vertical line in the graph, and you can shift this between the two end-points "L" and "H" by moving the relevant transmitter control (throttle / airbrake stick). The current stick position is also displayed in numeric form in 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%. This control signal affects all subsequent mixer and coupling functions. In the example above the stick is at -60% control travel, and also generates an output signal of -60%, since the curve is linear.

Between the two end-points "L" and "H" you can now insert a maximum of three reference points. The minimum spacing between two adjacent reference points is around 30% control travel.

If you now move the stick, the inverse video question mark ? immediately appears, and you can place a reference point at the corresponding stick position by pressing the rotary control. Up to two further points can be placed between the extreme points "L" and "H"; the order in which you place them is not significant, as the reference points are automatically renumbered sequentially from left to right in any case.

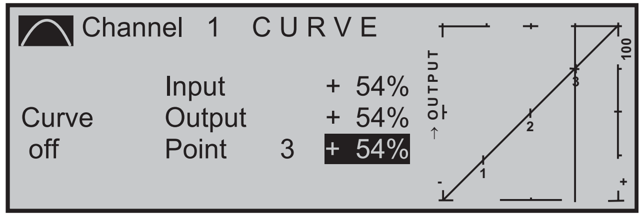
Example:



Note:
In this example the stick is located in the immediate vicinity of the right reference point "H". That is why the "point" value "+100%" is in inverse video (black background).

If you wish to erase one of the set reference points 1 to 3, move the stick close to the reference point in question. The reference point number and the associated reference point value now appear in the "Point" line. Press the **CLEAR** button to erase that point.

Example - erasing reference point 3:

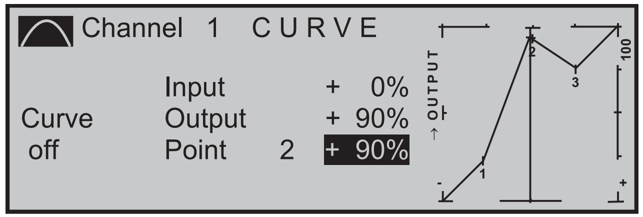


When the point has been erased, the inverse question mark ? re-appears after "Point".

Changing the reference point values

Move the stick to the reference point "L (low), 1 ... 3 or H (high)" which you wish to change. The number and the current curve value of this point are displayed on the screen. You can now use the rotary control to change the momentary curve value in the inverse field within the range -125% to +125%, without affecting the adjacent reference points.

Example:



As an example the reference point "2" has been set to +90% in this screen shot.

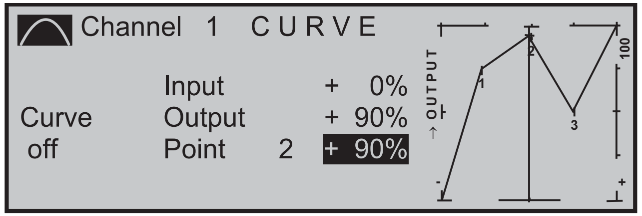
Pressing the **CLEAR** button erases the reference point.

Note:
If the stick is not set to the exact reference point, please note that the percentage value in the "Output" line always refers to the momentary stick position.

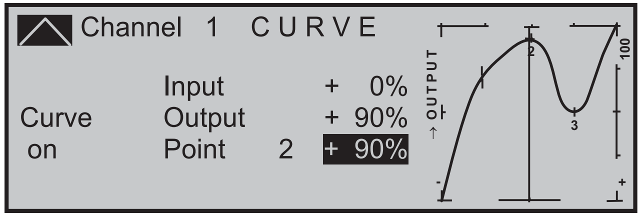
Rounding off the Channel 1 curve

In the following example the reference points have been set as follows, as described in the last section:

Reference point value 1 to +50%,
Reference point value 2 to +90%, and
Reference point value 3 to +0%.



This “jagged” curve profile can be rounded off automatically simply by pressing a button. Press the **ENTER** button next to the “curve symbol”:

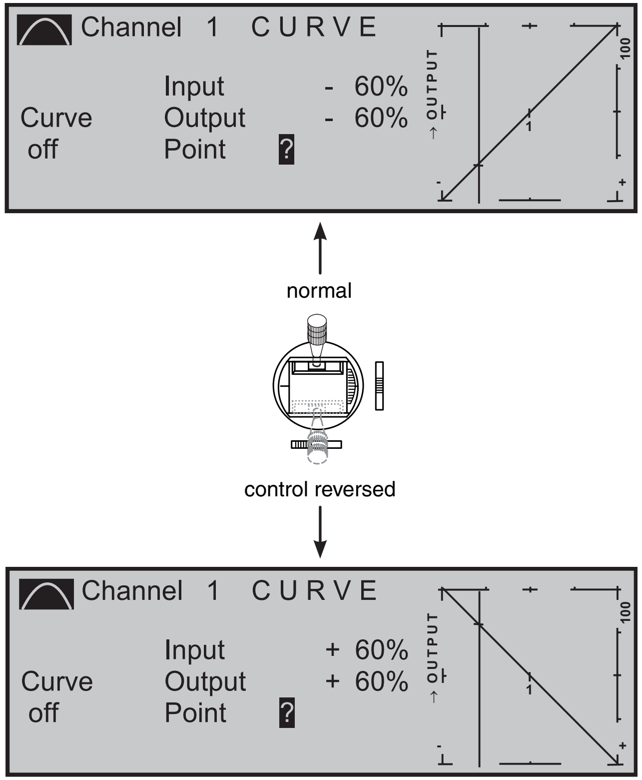


Note:
The curves shown here are only for demonstration purposes, and by no means represent realistic throttle / airbrake curves.

“Real world” examples of this application can be found in the programming examples on pages 125 and 147.

Example: reversing a transmitter control

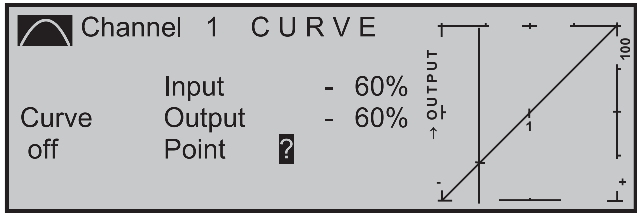
To reverse the direction of a transmitter control, e.g. to operate airbrakes, so that the airbrakes are retracted when the stick is “back” (towards you) and extended in the “forward” position, you simply need to produce the “mirror-image” of the Channel 1 curve. Raise point “L” to +100% and lower point “H” to -100%. The following example shows how to reverse a simple linear control curve:



*Of course, the direction of the Ch1 control can also be reversed in the »**Model type**« menu by pre-setting the “throttle minimum position”. In this case the direction of effect of the Ch1 trim is also reversed; see page 52.*

Channel 1 curve

Control characteristic for throttle / collective pitch curve



In the default state of the mc-22s transmitter this menu is initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49). Alternatively, move to the »**Basic settings**« menu (see page 117) and select "yes" for the Expert mode; this must be carried out *before* you set up a new model memory.

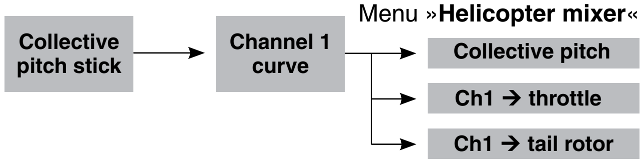
In most cases the throttle response or the collective pitch response is not linear, and in this menu you can set up a curve to compensate for the non-linearity.

The menu enables you to change the *control characteristic of the throttle / collective pitch stick*, i.e. the curve you program here affects the throttle servo and the collective pitch servos equally.

In contrast to the «**Channel 1 curve**« menu for fixed-wing models, in the Heli menu system the curve can be adjusted separately for each flight phase in a given model memory, provided that you have already specified flight phases in the »**Auxiliary switch**«, »**Phase setting**« and »**Phase assignment**« menus (pages 75, 79, 80). The name of each flight phase is displayed on the screen (see above); in this case "Hover".

The control curve can be defined by up to five points, termed "reference points" in the following section, which can be positioned at any point along the stick travel.

In this case please note that the curve set at this point acts as input signal for the mixers in the »**Helicopter mixer**« menu, page 90:



In the basic software set-up, three reference points define a linear "curve" as the base setting, namely the two end-points at the bottom end of the stick travel "L" (low = -100% travel) and the top end of the stick travel "H" (high = +100% travel), together with point "1", which is exactly in the centre of the stick travel.

We recommend that you leave both end-points of the "Channel 1 curve" at +/-100%, otherwise you may not be able to exploit the full extent of the curve in the subsequent curve mixers located in the »**Helicopter mixer**« menu.

If you have not already done so, switch to the appropriate flight phase.

Setting and erasing reference points

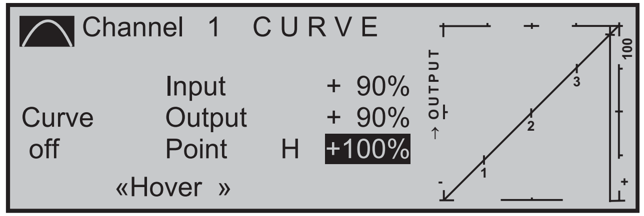
You will find a vertical line in the graph, and you can shift this between the two end-points "L" and "H" by moving the relevant transmitter control (throttle / collective pitch stick). The current stick position is also displayed in numeric form in the "Input" line.

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%. This control signal affects the throttle and collective pitch servos, and all subsequent mixer and coupling functions. In the example above, the stick is at -60% control travel and also generates an output signal of -60%, since the curve is linear.

Between the two end-points "L" and "H" you can now insert a maximum of three reference points. The minimum spacing between two adjacent reference points is around 30% travel of the transmitter control.

If you now move the stick, the inverse video question mark ? immediately appears, and you can place a reference point at the corresponding stick position by pressing the rotary control. Up to two further points can be placed between the extreme points "L" and "H"; the order in which you place them is not significant, as the reference points are automatically renumbered sequentially from left to right in any case.

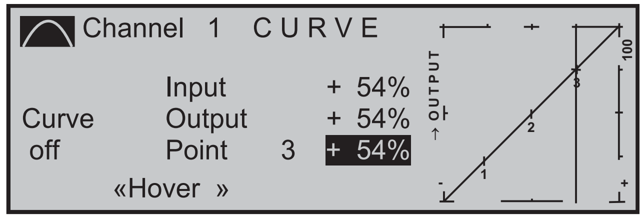
<u>*Example:*</u>



<u>*Note:*</u>
In this example the stick is located in the immediate vicinity of the right reference point "H". That is why the "point" value "+100%" is in inverse video (black background).

If you wish to erase one of the set reference points 1 to 3, move the stick close to the reference point in question. The reference point number and the associated reference point value now appear in the "Point" line. Press the **CLEAR** button to erase that point.

<u>*Example - erasing reference point 3:*</u>

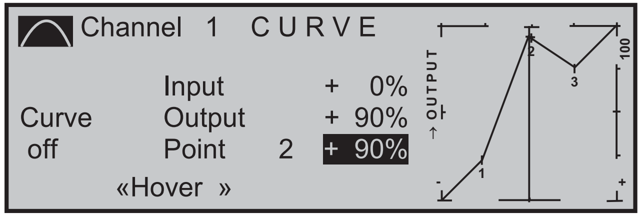


When the point has been erased, the inverse question mark ? re-appears after "Point".

Changing the reference point values

Move the stick to the reference point “L (low), 1 ... 3 or H (high)” which you wish to change. The number and the current curve value of this point are displayed on the screen. You can now use the rotary control to change the momentary curve value in the inverse field within the range -125% to +125%, without affecting the adjacent reference points.

Example:



As an example, the reference point “2” has been set to +90% in this screen shot.

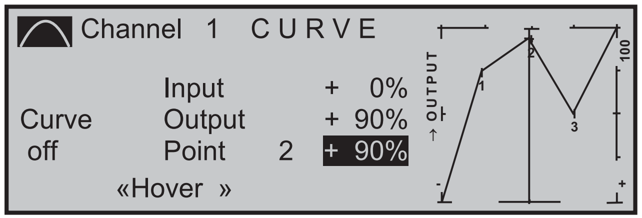
Pressing the **CLEAR** button erases the reference point.

Note:
If the stick is not set to the <u>*exact*</u> *reference point, please note that the percentage value in the “Output” line always refers to the momentary stick position.*

Rounding off the Channel 1 curve:

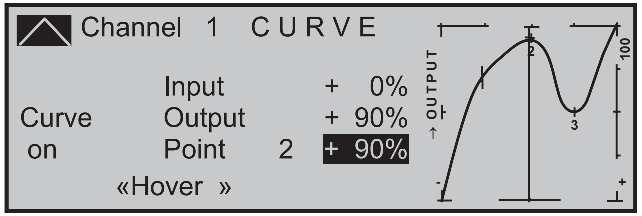
In the following example the reference points have been set as follows, as described in the last section:

Reference point value 1 to +50%,
Reference point value 2 to +90%, and
Reference point value 3 to +0%.



This “jagged” curve profile can be rounded off automatically simply by pressing a button.

Press the **ENTER** button next to the “curve symbol” :



Note:
The curves shown here are only for demonstration purposes, and by no means represent realistic throttle / collective pitch curves.

Switch display

Switch settings

Switch	1	2	3	4	5	6	7	8
Contrl Switch	G1	G2	G3	G4				

This display enables you to check the various functions, and provides an overview of the external switches installed in your transmitter, together with the programmable control switches.

When you operate an external switch, the number of that switch becomes obvious on-screen because its normal OFF symbol changes to an ON symbol, and vice versa. Closed (ON) switches are always displayed in inverse video, i.e. on a dark background, to make them more readily noticeable.

The same applies to the control switches G1 ... G4: when you operate the associated transmitter control (i.e. the one assigned in the »**Control switch**« menu) you can immediately see the number of the control switch and the direction of switching.

Note:
The numbering 1 to 8 of the external switches shown here equates to the numbers 0 to 7 on the transmitter circuit board. However, the switch numbers are of no importance for programming.

Control switch

Assigning control switches

CONTROL SWITCH

G1	free	0%	=>		G1
G2	free	0%	=>		G2
G3	free	0%	=>		G3
G4	free	0%	=>		G4
	SEL				

In the default state of the mc-22s transmitter this menu is initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49). Alternatively, move to the »**Basic settings**« menu (see page 117) and select "yes" for the Expert mode; this must be carried out *before* you set up a new model memory.

Many auxiliary functions are best controlled automatically by a particular (freely programmable) position of a transmitter control or stick, rather than by a conventional switch.

<u>Typical applications:</u>

- Switching an on-board glowplug energiser on and off, according to the throttle position or motor speed. In this case the switch for the plug energiser is controlled by a mixer at the transmitter.
- Switching a stopwatch on and off, to time the motor run of an electric motor.
- Switching a "combi-switch" mixer (coupled aileron / rudder) on and off automatically when airbrakes are extended, for example, to allow you to match the model's angle of bank to the slope of the ground when landing on a ridge, as the mixed rudder would affect the model's heading at this time.
- Changing various settings on the landing approach when the throttle stick is reduced below a pre-set switching point; the settings could be: extending landing flaps, altering the elevator trim, and / or triggering specific Dual Rate, Exponential and Differential settings. An external switch can also be assigned separately in column 5, to override the control switch.

The mc-22s program features four of these control switches, designated G1 to G4, and they can be included without restriction in the free programming of the external switches, i.e. they can be assigned to a function and reversed (inverted) if necessary.

This means that you have the opportunity to assign switches at all points in the program where their use makes sense. At these points you can select one of up to eight external switches, one of the control switches G1 ... G4, or alternatively one of the inverted control switches G1i ... G4i, all of them presented in a list.

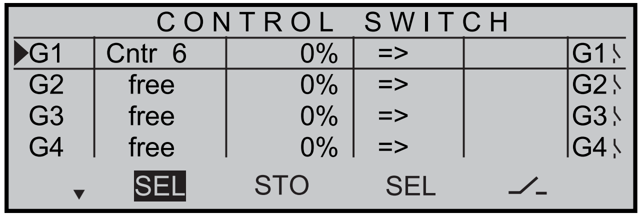
The inverted control switches can be used in combination with a separate external switch (see below) to generate more complex switch combinations.

The basic procedure:

1. Initially only the **SEL** function field features at the left of the bottom line.
2. Hold the rotary control pressed in, and select the control switch 1 to 4 you wish to use.
3. Press the rotary control briefly.
4. Use the rotary control to select the associated transmitter control.
5. Press the rotary control to end the select procedure.
6. You will now see additional fields (**STO**, **SEL**, **switch symbol**) which you can select by turning the rotary control.
7. Press the rotary control.
8. Select the setting using the rotary control.
9. Press the rotary control to end the input procedure.
10. Press the **ESC** button to leave the menu.

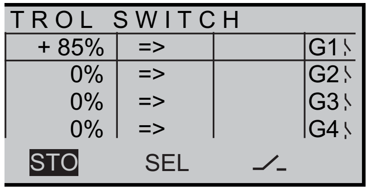
Assigning a transmitter control to a control switch

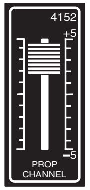
Select one of the control switches 1 to 4 and assign it to one of the transmitter controls 1 to 10 using the rotary control. For example, you may wish to assign the control switch “G1” to “Control 6”. (Pressing **CLEAR** resets it to “free”). Additional fields now appear at the bottom edge of the screen.



Defining the switching point

Move the inverse field to the **STO** column (**STO** = store).





Define the switching point:

move the transmitter control to the appropriate position and press the rotary control briefly.

Move the selected transmitter control to the position at which the switching point, i.e. the ON / OFF change-over, is to be located, and press the rotary control once. The current position is displayed on the screen: in our example “+85%”. The switching point can be changed again at any time.

Note:

It is not a good idea to set the switching point right at the end-point of a transmitter control’s travel, as this would not guarantee a reliable switch-over.

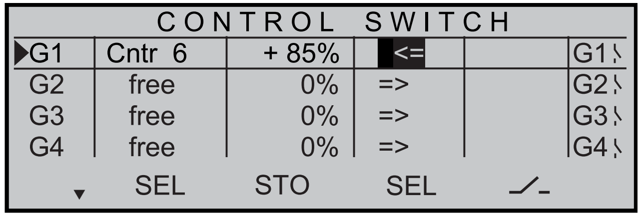
In the example shown above the control switch “G1” is open as long as transmitter control 6 (in our example, the throttle limiter) is below +85% of the control travel; it closes as soon as the trigger point is exceeded, i.e. at any point in the range +85% to the upper end-point.

Tip:

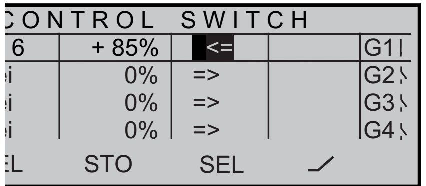
*If you subsequently assign this programmed G1 switch to, say, the stopwatch in the »**Timers**« menu, the timer starts running when you move the (throttle limit) slider to its upper end-point, and vice versa. This can be a practical arrangement with glow-powered model helicopters.*

Direction of operation of the control switch

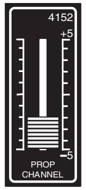
In column 4 the direction of operation of the control switch has been reversed by the rotary control; it is shown in an inverse field:



You need to select the **SEL** field before you reverse the direction. Pressing **CLEAR** resets the direction of switching to “=>”.



„G1“ open



„G1“ closed

The current position of the control switch is indicated by the switch symbol in the column at far right.

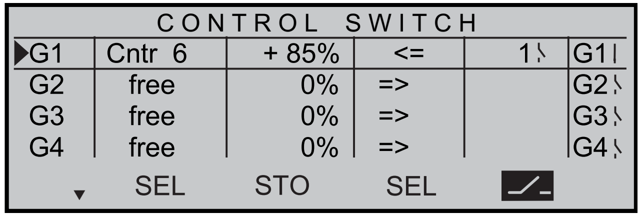
Notes:

- *If the control switch, e.g. G1, operates more than one function, it is important to check that the direction of switching applies to all G1 and G1i switches that you have set.*
- *The switched state can also be reversed by turning the connector through 180° at the transmitter circuit board, or by reversing the transmitter control in the »**Control adjust**« menu.*

Combining a control switch with an external switch

You can set up a separate physical switch to disable the control switch; this enables you to switch the function on only in particular flight situations, regardless of the position of the transmitter control (and therefore of the control switch).

To do this, move to the field in column 5. The simplest method is to select one of the external switches (as described in the section entitled “Assigning external switches and control switches” on page 30). The number of this external switch, e.g. No. 1, appears on the screen in the penultimate column, together with a switch symbol which shows the current status of the external switch.



As long as this external switch is open, the control switch “G1” in the right-hand column is active, i.e. it switches its associated function at the set switching point; if the external switch is closed, the control switch also stays permanently closed, regardless of the position of the transmitter control and the programmed direction of operation.

Combining two control switches

Some more complex applications may require you to override this control switch with a second control switch.

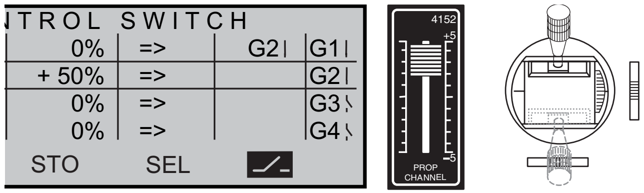
Example:

The control switch “G1” has been assigned to control function 1 (= transmitter control 1). The switching point is located, say, at its centrepoint, i.e. at 0%. You could now assign the transmitter control “G2” to a slider, which (for example) has been assigned to “Input 7” in the »**Control adjust**« menu, and the switching point of this control might be at +50%. If the switch directions are as stated in column 4 of the screen shots, the control switch “G1” now remains closed as long as the stick (Ch1) and / or “Control 7” is positioned beyond the switching point:

CONTROL SWITCH

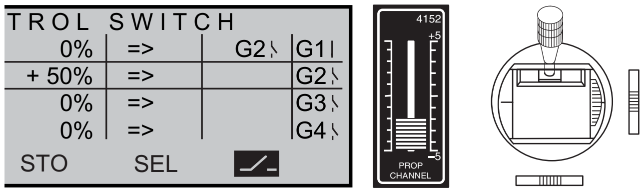
G1	Cntr 1	0%	=>	G2	G1
▶G2	Cntr 7	+ 50%	=>		G2
G3	free	0%	=>		G3
G4	free	0%	=>		G4
▾▴	SEL	STO	SEL		

Transmitter control positions and control switch positions:



„G2“ closed

„G1“ always closed, regardless of position of control 1



„G2“ open

„G1“ closed, if control is forward

Note:
*The direction of switching also varies according to the orientation of the slider connector at the transmitter circuit board, and according to the choice of “Throttle min. back / forward” or “Collective pitch min. back / forward” as set in the »**Model type**« or »**Helicopter type**« menus.*

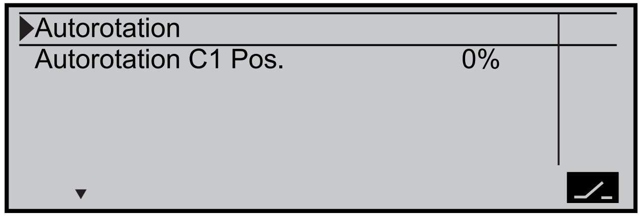
This comprehensive range of switching facilities offers plenty of scope for special applications in the whole field of model flying.

Note:
*If you wish to operate the control switch using a **two-position switch module** (Order No. **4151**, see Appendix) connected to one of the sockets CH5 … CH10, you **must** first program the switching point by means of a proportional control, e.g. using one of the integral sliders.*

*Start by assigning the “substitute” proportional control in column 2, and set the switching point in such a way that the switch position of the three-position switch will reliably exceed that value, e.g. -10% or +10%. If you neglect this, the switching function will not be reliable, as the control switch is only triggered when the signal **clearly** exceeds or falls below the set value. The final stage is to reverse the control assignment, and re-assign the three-position switch which you actually wish to use.*

Auxiliary switch

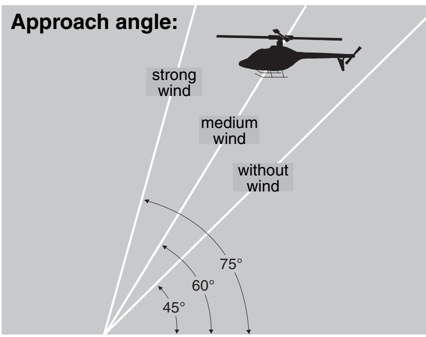
Switches: Auto-rotation, Auto-rot. Ch1 position



Within a given model memory the mc-22s software enables you to program a total of four independent settings for each model helicopter, in order to cope with the different stages of a flight; these include the auto-rotation flight phase which is covered by this menu. The three other flight phase switches can be defined in the »**Phase setting**« and »**Phase assignment**« menus. If you are a relative beginner to helicopter flying, please start by reading the "Helicopter" programming example on page 150; and especially the section entitled »**Auxiliary switch**« on page 152.

The meaning of Auto-rotation

The term auto-rotation describes a flight situation in which the helicopter is descending under no power, with the main rotor kept spinning at high speed by the air flowing through the blades, which are set at a pitch angle designed to promote this; the principle is that of the windmill. The energy stored in the spinning rotor can then be converted into upthrust just before touch-down by changing the pitch angle, enabling the model to flare out and land safely.



Approach angle under varying wind conditions.

Auto-rotation is used by full-size and model helicopters, and makes them capable of landing safely with the engine stopped, e.g. if the motor should fail in flight. However, an auto-rotation landing can only be successful if the pilot is highly skilled and experienced, and is thoroughly familiar with his model helicopter. Fast reactions, a good "eye" and fine judgement are essential, as the rotational energy in the rotor can only be exploited once for the flare.

In a competition flight the motor must be stopped if an auto-rotation landing is called. For practice, however, it is sensible to keep the motor running at idle when practising "autos", so that full throttle can be applied immediately if a critical situation should develop.

Auto-rotation

Operating the auto-rotation switch invokes the auto-rotation flight phase, in which the controls for "throttle" and "collective pitch" are separated, and all mixers which affect the throttle servo are switched off. This flight phase is assigned the fixed name «Autorot», which appears in the basic display and all menus which can be set separately for different flight phases (see page 76 for list).

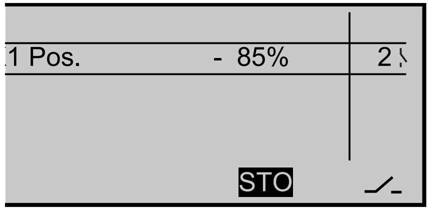
Defining the auto-rotation switch

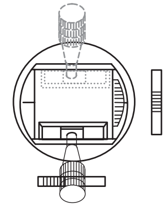
Press the rotary control and assign a switch to this function as described on page 30. ***This switch has absolute priority over all other flight phase switches.***

Auto-rotation Ch1 position

Alternatively the auto-rotation flight phase can be invoked by means of a switching point on the throttle / collective pitch stick Ch1. When you select this line on the screen, the **STO** (store) field appears.

Move the Ch1 stick to the switching position you wish to use, and press the rotary control: the screen displays the current value. In the right-hand column you can now assign an activation switch.





Move Ch1 stick to the desired position.

How the "Autorot Ch1 Pos." works

Assuming that you have operated the activation switch, the Heli program immediately switches to "auto-rotation" when the Ch1 stick is moved below the set switching point, and stays in that flight phase until you move the activation switch (in this example No. 2) back to the "OFF" position. It does this regardless of the position to which you move the Ch1 stick.

"Auto-rotation Ch1 Pos." always has precedence over the remaining three flight phase switches, as assigned in the »**Phase setting**« and »**Phase assignment**« menus.

Auto-rotation parameter settings

The following parameters

- collective-pitch servos
- throttle servo
- tail rotor servo
- any swashplate rotation
- gyro setting

are programmed in the »**Helicopter mixer**« menu (see page 99).

All the other menus which apply to auto-rotation are listed in the table on page 76.

How do I program a flight phase?
The meaning of flight phase programming

General notes on flight phase programming

Often there are particular stages in a flight where you always need to use particular settings: perhaps different flap settings for launch and landing with a fixed-wing aircraft, or different collective pitch and throttle settings for hover and auto-rotation with a helicopter. The mc-22s enables you to program these different settings and call them up automatically using an external switch or even a control switch.

Another very useful application for flight phases is the flight testing procedure with a new model. You can set up different flight phases with alternative control surface settings, then switch between them in flight in order to establish the most effective set-up for the model in question.

The basic programming procedure is carried out in three stages

1. First you have to set up the different flight phases, i.e. you assign names to individual phases which are then included in the basic screen display. It is also possible to program a time frame for a “soft” transition into the next phase, so that the model moves smoothly from one phase to the next, rather than abruptly.

   For fixed-wing model aircraft these settings are programmed in the »**Phase setting**« menu. In the Heli program you start in the »**Auxiliary switch**« menu if you wish to set up an auto-rotation facility, otherwise you also start programming in the »**Phase setting**« menu.
2. In the second stage you set up the required “phase switches” in the »**Phase assignment**« menu.
3. Once these preliminary steps have been completed, you can move to the specific phase menus and start programming the settings for the individual flight phases, as shown in the tables below.

List of fixed-wing menus which are variable separately for each flight phase:

Menu	Page
»Control adjust«	58
»Dual Rate / Expo«	64
»Phase setting«	78
»Phase assignment«	80
»Undelayed channel«	81
»Wing mixers«	84
»MIX active/phase«	108

List of helicopter menus which are variable separately for each flight phase:

Menu	Page
»Control adjust«	60
»Dual Rate / Expo«	66
»Channel 1 curve«	70
»Auxiliary switch«	75
»Phase setting«	79
»Phase assignment«	80
»Undelayed channel«	81
»Helicopter mixer«	90
»MIX active/phase«	108

All the other menus are model-specific, i.e. they cannot be programmed separately for different flight phases. All changes you make in the other menus apply equally to all flight phases. In some cases you may wish to remove the non-specific menus from the multi-function list when programming flight phases; this is carried out in the »**Suppress Codes**« menu (see page 49). An example of flight phase programming can be found on page 134.

Phase setting

Setting up flight phases

▶Phase 1		0.0s	∗
Phase 2		0.0s	-
Phase 3		0.0s	-
Phase 4		0.0s	-
	Name	Switch time	status
▾	SEL	SEL	

In the default state of the mc-22s transmitter this menu is initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49), or set this menu point to "yes" in the »**Basic settings**« menu (see page 117) *before* you set up a new model memory.

The mc-22s enables you to program up to four groups of settings within any one model memory; the settings typically differ from each other in order to cater for different stages of a flight; these grouped settings are generally termed flight phases.

When setting up flight phases for fixed-wing models you start at this menu point, where individual phases are assigned names, and a transition time can be set to provide a smooth transition from one phase into the next.

"Name" column

Press the rotary control and select the most suitable phase name for Phases 1 to 4 from the on-screen list. The phase name will be included in all phase-specific menus (see list on page 76) and is also shown in the basic display. Note that you do not necessarily have to start with Phase 1 and continue in turn.

However, "Phase 1" is always the "normal phase", i.e. this phase is always active if:

- no phase switch has been programmed in the »**Phase assignment**« menu, and
- no phase has been assigned to particular switch combinations.

The phase name «Normal» would therefore be a sensible choice for "Phase 1". The names themselves have absolutely no technical significance in terms of programming; their only purpose is to help you identify them in the course of further programming, and know which flight phase is switched on at any one time.

"Switch time" column

When you switch between flight phases, it is advisable to program a "soft" transition *into* (!) the next phase; this is carried out by entering a transition time in this column; the range available is 0 to 9.9 sec. The mc-22s also allows you to set different transition times for switching from, say, Phase 1 to Phase 3, and from Phase 3 to Phase 1 (**CLEAR** = 0.0 sec).

<u>Example:</u>

▶Phase 1	Normal	4.0s	+
Phase 2	Launch	2.0s	∗
Phase 3	Landing	5.0s	+
Phase 4		0.0s	-
	Name	Switch time	status
▾	SEL	SEL	

In this example the set transition time from any other phase into Phase 1 "normal" is 4.0 seconds, but if you switch from, say, Phase 1 to Phase 3 the transition time is 5.0 seconds.

Unequal transition times as shown in our example can be useful when switching between flight phases which differ widely, such as between aerobatics and normal flight.

<u>Note:</u>
*The "switch time" set here also applies to the »**Wing mixers**« menu; see page 84, to avoid abrupt changes between phase-specific mixers.*

The next stage is to select the »**Phase assignment**« menu (see page 80) and define the "phase switches" you wish to use. Once these are set, you can get started on programming the settings for the individual flight phases in the phase-specific menus.

"Status" column

The phases 1 ... 4 which have already been assigned to a switch are shown in the right-hand column of the screen display:

Symbol	Symbol
–	No switch assigned
+	Phase can be called up by switch
∗	Indicates the currently active phase number

<u>Note:</u>
*A useful aid when programming different flight phases is the "Copy flight phase" option which you will find in the »**Copy / Erase**« menu. The first step is to establish the parameters for a particular flight phase; you then copy these settings into the next flight phase where they can be modified to meet the requirements of the new stage of flight.*

Phase setting

Setting up flight phases

	Name	Switch time	status
▶Autorot	Autorot	0.0s →	-
Phase 1		0.0s	∗
Phase 2		0.0s	-
Phase 3		0.0s	-
▼		SEL	

The mc-22s enables you to program a maximum of three groups of settings within any one helicopter model memory in addition to the auto-rotation flight phase, which can be set up in the »**Auxiliary switch**« menu; the settings typically differ from each other in order to cater for different stages of a flight.

When setting up flight phases you start in this menu point, where individual phases are assigned names, and a transition time can be set to provide a smooth transition from one phase *into* the next.

"Name" column

The first line, i.e. the top flight phase, is reserved for Auto-rotation; see »**Auxiliary switch**« menu. Consequently the pre-set name *cannot* be altered.

Select Phases 1 to 3 in turn, then press the rotary control and select the most suitable phase name for them from the on-screen list. Press the rotary control to confirm your choice. Note that you do not necessarily have to start with Phase 1 and continue in turn.

However, "Phase 1" is always the "normal phase", i.e. this phase is always active if:

- no phase switch has been programmed in the »**Phase assignment**« menu, and
- no phase has been assigned to particular switch combinations.

The phase name «Normal» would therefore be a sensible choice for "Phase 1". The names themselves have absolutely no technical significance in terms of programming; their only purpose is to help you identify them in the course of further programming, and know which flight phase is switched on at any one time. The phase name is included in all phase-specific menus (see list on page 76) and is also shown in the basic display.

"Switch time" column

When you switch between flight phases, it is advisable to program a "soft" transition *into* (!) the next phase; this is carried out by entering a transition time in the inverse field in this column; the range available is 0 to 9.9 sec. The mc-22s also allows you to set different transition times for switching from, say, Phase 1 to Phase 3, and from Phase 3 to Phase 1.

However, for reasons of safety there is never any delay when you switch *into* the auto-rotation flight phase. The arrow "→" in the column "switch time" indicates that a delay time can still be set *out of* (!) auto-rotation and *into* (!) any other phase.

(**CLEAR** = 0.0 sec)

<u>Example:</u>

	Name	Switch time	status
▶Autorot	Autorot	2.0s →	+
Phase 1	Normal	3.0s	∗
Phase 2	Akro	1.0s	+
Phase 3		0.0s	-
▼		SEL	

„Autorot": *The transition time <u>from</u> this phase <u>into</u> any other is 2.0 sec. Conversely, there is <u>always</u> zero (0.0 sec) delay when switching <u>into</u> Auto-rotation.*

„Phase 1": *The transition time <u>into</u> this phase <u>from</u> phase 2 (and 3*) is set to 3.0 sec, giving a smooth transition.*

„Phase 2": *The transition time <u>into</u> this phase <u>from</u> phase 1 (and 3*) is set to 1.0 sec.*

* *In our example Phase 3 is not in use.*

Unequal transition times as shown in our example can be useful when switching between flight phases which differ widely, such as between aerobatics and normal flight.

<u>Note:</u>
*The "transition time" set here also applies to the »**Helicopter mixer**« menu; see page 90, to avoid abrupt changes between phase-specific mixers.*

The final stage is to select the »**Phase assignment**« menu and define the "phase switches" you wish to use. Once these are set, you can get started on programming the settings for the individual flight phases.

"Status" column

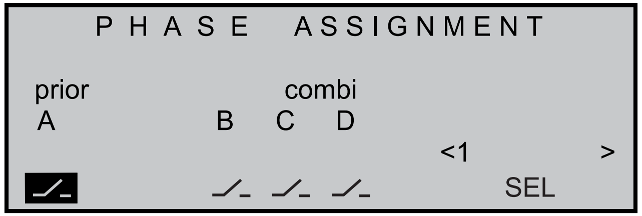
The phases which have already been assigned to a switch are shown in the right-hand column of the screen display:

Symbol	Note
–	No switch assigned
+	Phase can be called up by switch
∗	Indicates the currently active phase number

<u>Note:</u>
*A useful aid when programming different flight phases is the "Copy flight phase" option which you will find in the »**Copy / Erase**« menu. The first step is to establish the parameters for a particular flight phase; you then copy these settings into the next flight phase where they can be modified to meet the requirements of the new stage of flight. Note that the Auto-rotation flight phase cannot be copied.*

Phase assignment

Setting up flight phases

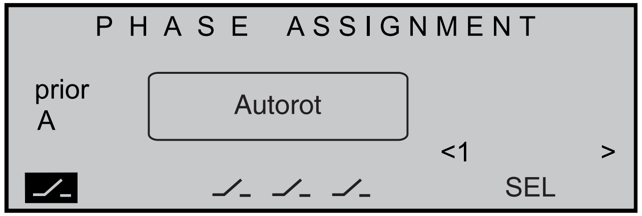


In the default state of the mc-22s transmitter this menu is initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49), or set this menu point to "yes" in the »**Basic settings**« menu (see page 117) *before* you set up a new model memory.

In the previous menus – »**Phase setting**« for helicopters and fixed-wing models – you have already defined names for the flight phases. In this menu you now have to determine the switch or switch combinations by which you want to call up each phase. There is one exception to this rule in the Heli menu: you must set one of the two auto-rotation switches in the »**Auxiliary switch**« menu.

Please note the following priorities:

- The auto-rotation phase (Heli mode only) *always* (!) has precedence, regardless of the switch settings of the other phases. As soon as the auto-rotation switch is operated, this display appears on the screen:



- Phase switch "A" has priority over all subsequent switch settings "B" to "D".

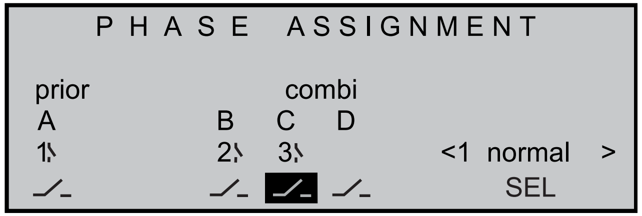
For this reason you should only use switch "A" if you wish to change from any other flight phase – apart from auto-rotation – directly into the phase which is assigned to this switch.

Programming the flight phase switches

The external switches (or software control switches) are assigned in the usual way. The sequence of assigning them is unimportant; you simply have to ensure that you assign the "right" switches for your own purposes. In the Heli program it is therefore important to check that you do not accidentally assign a switch a second time which you have already assigned as the auto-rotation switch in the »**Phase assignment**« menu.

Example: fixed-wing model with phase priority for four phases

You require (typically) two simple ON / OFF switches, e.g. Order No. **4160** or **4160.1.**



Assign the switches using the rotary control, then move to the **SEL** field and assign a phase name to each switch position or combination of switch positions; the phase names are selected from the »**Phase assignment**« menu; for example «1 normal», «2 launch», «3 distance», «4 landing».

It makes sense to assign the closed ("I") priority switch "A" to the phase into which you wish to switch directly, regardless of the positions of switch "B" and "C", e.g. the "Launch" phase, if the same switch is used to switch an electric motor on, or into the "normal" phase … e.g. in an emergency. When switch "A" is open ("\") you can select the remaining three phases for the switch positions "B" and "C" to suit your own preference; see table below.

Example:

Phase switch & socket				Phase number & phase name
A	B	C	D	
1	2	3		
I	\ or I	\ or I		«2 Launch»
\	\	\		«1 Normal»
\	I	\		«3 Launch»
\	\	I		«4 Landing»
\	I	I		not in use; i.e. by default: «1 Normal»

In this example the three external switches 1, 2 and 3 have been assigned (in accordance with the numbering in the »**Switch display**« menu); these switches are fitted as standard in the centre console.

You are now in a position to make the required adjustments in all the phase-specific menus.

Tips:
Instead of the two individual switches connected to sockets 2 and 3 you could use the optional differential switch (three-position switch), Order No. ***4160.22****.*
If you use flight phases regularly, we recommend this option in preference to individual switches, as it is then easier to distinguish the selected flight phase at a glance.

*It can also be particularly useful to exploit the travel offset adjustment facility in the »**Control adjust**« menu:*

For example, you may like to select different camber-changing flap settings for the flap servos (receiver outputs 6 + 7) and for the aileron servos (receiver outputs 2 + 5) for each flight phase.

Select the "Offset" column and adjust the values for the ailerons and flaps where they vary from the "normal" flight phase. Please remember this rule:

Undelayed channels

Channel-specific flight phase delay

Enter 5	free	- 7%	+100%+100%	0.0 0.0
▶Enter 6	free	-12%	+100%+100%	0.0 0.0
Enter 7	Cntr 7	0%	+100%+100%	0.0 0.0
Enter 8	Cntr 8	0%	+100%+100%	0.0 0.0
«Speed »		Offset	- Weg +	-Zeit+
▼▲	SEL		SYM ASY	SYM ASY

- *“Offset input 5” affects the flap setting of the ailerons;*
- *“Offset input 6” affects the corresponding setting of the flaps.*

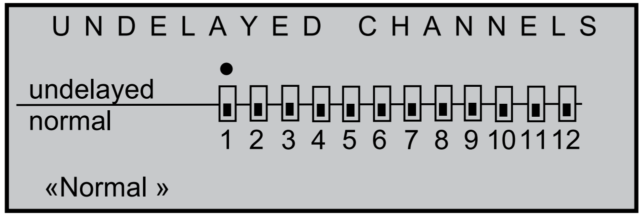
It is possible to program both positive and negative changes to the set travel.

Elevator corrections are made using the digital trim lever of the elevator stick. These trim settings are also stored separately for each flight phase.

Important notes:

- *If one flap position per flight phase is sufficient for your application, for safety’s sake it is best to set inputs 5 + 6 to “free”.*
- *However, if you wish to be able to vary the flap position defined by the offset, then assign inputs 5 + 6 to the same transmitter control, and reduce the travel to, say, 20%.*

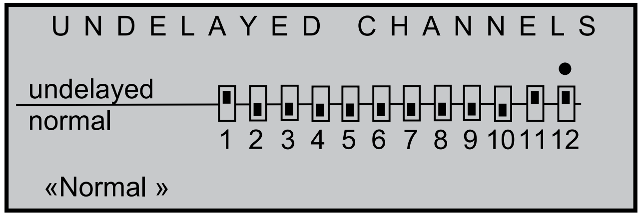
Please note the example “Using flight phases” on pages 134 … 135.



In the default state of the mc-22s transmitter this menu is initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49), or set this menu point to “yes” in the »**Basic settings**« menu (see page 117) *before* you set up a new model memory.

In the »**Phase setting**« menu you may have set up a transition time for the shift from one flight phase to another. In this menu you can switch off the delay again for particular channels for each flight phase separately, e.g. for the motor channel with electric models, heading lock mode for helicopter gyros etc..

Use the rotary control to move the „●“ symbol to the corresponding channel and press the rotary control. The switch symbol changes from “normal” to “non-delayed”.



Timers

Timers in the basic display

As standard the basic transmitter display contains four timers. Hold the rotary control pressed in and select the appropriate display line so that you can change the settings for that timer.

"Model time"

This timer displays the total access time of the current model memory. If you wish, you can assign an external switch or transmitter control on the right of the screen, and this switch is then used to control the "model timer". With the **CLR** field displayed in inverse video (black background), give a short press on the rotary control to reset the display to "0:00h".

"Battery time"

As an aid to monitoring the transmitter battery, this operating hours timer records the total time that the transmitter is switched on. An external switch cannot be assigned to this function.

This battery timer is automatically reset to "0:00" when the transmitter detects that the voltage of the transmitter battery is significantly higher than the last time it was switched on, e.g. as the result of a charge process, or the installation of a new, freshly charged pack.

With the **CLR** field displayed in inverse video (black background), give a short press on the rotary control to reset the display to "0:00h".

"Stopwatch" and "Flight timer"

These two timers, which can be set to count up or down, are located in the right-hand half of the basic screen display.

Select the "Stopwatch" or "Flight timer" line with the rotary control pressed in:

The stopwatch can be started and stopped using any available switch. To set the switch, select the switch symbol field at the bottom edge of the screen. Switches are assigned as described on page 30.

If the timer has been stopped, pressing **CLEAR** in the basic display resets it to the programmed start value; see below ("Alarm" and "Timer" sections).

The flight timer can be started using a switch assigned to the function. Once the switch is opened again, the timer can be stopped from the basic display by pressing **ESC**, and, once stopped, can be reset to the starting value by pressing **CLEAR**. For this reason it is advisable to use a momentary switch, Order No. **4160.11**, as the external switch for this application. If you select a control switch, please do not forget to assign it to the appropriate transmitter control in the »**Control switch**« menu, and to set the switching point along the transmitter control's travel. For example, the "timer start" signal usually coincides with the point at which the electric motor is switched on.

Switching between "count-up" and "count-down"

Count-up timer:

If you assign a switch to any timer, and program it to start running at the initial value "0:00", it will count "up" until max. 999 min. and 59 sec., at which point it will start again at 0:00.

"Timer" (count-down timer)

Use the left-hand **SEL** field in the "Timer" column to set a start time within the range 0 to 180 min. and use the right-hand **SEL** field to set a start time between 0 and 59 sec.

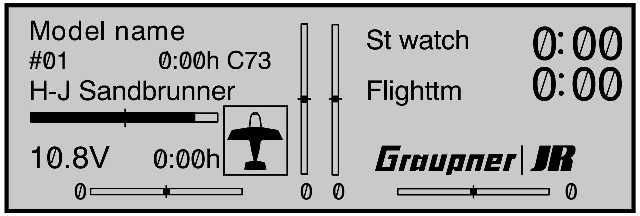
(Pressing **CLEAR** = "0" or "00" respectively).

Procedure:

1. Select the **SEL** field using the rotary control,
2. Brief press on the rotary control,
3. Set the pre-set time in the inverse minutes / seconds field using the rotary control (not pressed in),
4. A brief press on the rotary control concludes the process.

Once you operate the assigned switch, the timers start from this pre-set initial value and run backwards ("timer function"). If necessary, reset the timer after it has been stopped by pressing **CLEAR** in the basic display. When the pre-set time has elapsed, the timer does not stop; instead it continues running so that you can read off the over-run time, i.e. the time elapsed after zero.

Count-down timers are identified in the basic display by a flashing colon (:) between the minutes and seconds fields.



"Alarm" timer

In the "Alarm" column you can define a time within the range 5 to 90 seconds in 5-second increments. At the set time before zero you will hear an audible signal, eliminating the need for the pilot constantly to check the screen.

(Pressing **CLEAR** = 0 sec.)

Audible signal sequence:

90 sec. before zero:	every 10 seconds
30 sec. before zero:	triple tone
20 sec. before zero:	double tone
10 sec. before zero:	every second
5 sec. before zero:	every second, at higher frequency
Zero:	long tone

Press **CLEAR** with the timer stopped to reset the "Timer".

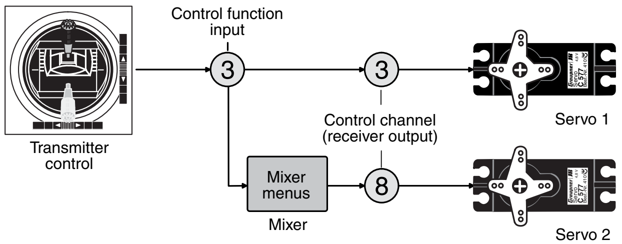
Note:
An example of "Operating the timer via the Ch1 stick" can be found on page 132.

What is a mixer?

The basic function

In many models it is often desirable to use a mixer to couple various control systems, e.g. to link the ailerons and rudder, or to inter-connect two servos where two control surfaces are actuated by separate servos. In all these cases the signal at the “output” of the control function at the transmitter stick – i.e. at the control function input (see sketch) – is “bled off”, and the derived signal is then allowed to affect the “input” of another control channel in a defined manner, so that it affects a particular receiver output.

Example: controlling two elevator servos from the elevator stick



The software of the mc-22s transmitter contains a large number of pre-programmed coupling functions as standard, which are designed to mix together two (or more) control channels. The mixer required in this example is supplied “ready-made”, and just has to be activated in the software by accessing the »**Model type**« menu.

The software also includes four freely programmable linear mixers, two curve mixers and two dual mixers (see below) in each of the fixed-wing and helicopter programs, all of which can be used in each model memory.

For more information, please refer to the general notes on »**Free mixers**« in this manual, in the section starting on page 102.

Wing mixers

Aileron difference			+	0%		
Flap difference			+	0%		
Ailerons	2 –>4	Rudder	+	0%		
Ailerons	2 –>7	Flaps	+	0%		
Brake	–>3	Elevator	+	0%		
Brake	–>6	Flaps	+	0%		
Brake	–>5	Ailerons	+	0%		
Elevator	3 –>6	Flaps	+	0%	+	0%
▶Elevator	3 –>5	Aileron	+	0%	+	0%
Flaps	6 –>3	Elevator	+	0%	+	0%
Flaps	6 –>5	Ailerons	+	0%	+	0%
Reduction of diff.			+	0%		
			SYM	ASY		

(Display varies according to model type selected in the »**Model type**« menu)

The mc-22s program contains a series of pre-programmed coupling functions, and all you have to do is set the mixer ratios and (optionally) assign a switch to the selected mixer.

The number of pre-programmed mixer functions in the mixer list will vary according to the “model type” you have already selected (tail type and number of wing servos – see page 52). Moreover, all mixer functions can be programmed separately for any different flight phases you have set.

If you have set up multiple flight phases in the »**Phase setting**” and »**Phase assignment**« menus, the name of the current flight phase will be displayed at the bottom of the screen, e.g. «Normal».

The screen shot above lists the (maximum) possible mixer functions. For example, if your model is not equipped with camber-changing flap servos, and you have not entered any flap servos in the »**Model type**« menu, all the flap mixers are automatically excluded from the program. This makes the menu clearer and easier to understand, and also helps to avoid programming errors.

<u>*Notes:*</u>

- *The transmitter control for the airbrake mixers can be re-programmed in the »**Model type**« menu from channel 1 to channel 8 or 9.*
- *The position of the camber-changing flaps in the individual flight phases is defined primarily by the Offset value you have set in the »**Control adjust**« menu; see right column on page 135. However, if you wish to be able to vary the flap settings in flight, or generally prefer manual flap control, any transmitter control assigned to “input 6” can be used; see »**Control adjust**«, page 58. For example, this might be one of the two sliders fitted as standard. This control operates the two flap servos connected to receiver output 6, or outputs 6 and 7, assuming that you have entered “... 1/2 FL” in the “Ailerons / flaps” line of the »**Model type**« menu. However, we recommend that you reduce the transmitter control travel to 25% or even less, as this ensures that you have fine control of the flaps using the slider.*
- <u>*Any transmitter control assigned to input 7 is decoupled by the software if your model has two flap servos; this is intended to avoid malfunctions and programming errors.*</u>
- *The flap function of the ailerons can be adjusted either in the »**Control adjust**« menu (see page 58), by programming input 5 in a similar way to input 6, or alternatively by programming the wing mixer Flap 6 ➔ 5 aileron.*
- *If you wish to set up a “Butterfly” (Crow) braking system, i.e. raised ailerons and lowered flaps, this is carried out independently of the procedures mentioned above; instead appropriate values are set in the wing mixers Brake ➔ 5 Aileron and (if required) Brake ➔ 6 flap.*
- *If your model features a multi-flap wing and a “Crow” or “Butterfly” braking system (see below), but without separate airbrakes, input 1 is not re-*

*quired. In the »**MIX-only channel**« menu (see page 108) it can now be separated from control function input 1 (throttle / brake stick), and used for some other purpose with the help of a "free mixer" (see page 102). For instance, it could be used to control an electric motor speed controller. The same applies if the model features no braking system at all, or no motor control at all.*

- *You can use the option of setting transition times to set up a "smooth" switch from one flight phase to the next. This is carried out in the »**Phase setting**« menu (see page 78).*

Basic programming procedure:

1. Select the mixer with the rotary control pressed in.

   Depending on the mixer, the bottom line of the screen now displays **SEL** or **SYM** and **ASY** (for setting mixer ratios separately for each side of centre), and also .
2. Select one of these fields using the rotary control.
3. Press the rotary control briefly (inverse field moves to the selected line).
4. Use the rotary control to set the degree of differential or the mixer ratio, and assign the switch (if required).

   Negative *and* positive parameter values can be set; this allows you to reverse the direction of servo rotation if necessary, i.e. if one of the control surfaces operates in the wrong "sense".

   (**CLEAR** = 0%).
5. Press the rotary control briefly to leave the menu.

Assigning switches

With the exception of aileron differential, flap differential and the differential reduction function (see later), *all* wing mixers can be assigned an (optional) external switch or control switch so that they can be switched on and off in flight. If you call up this line you will see the (by now) familiar switch symbol .

Mixer neutral points (offset)

The neutral point of the mixers

- Aileron ➔ NN
- Elevator ➔ NN
- Flap ➔ NN

is by default the zero point of the transmitter control, i.e. that is the point at which they have no effect. At full travel of the transmitter control the mixer provides the full mixer value.

The neutral point ("offset") of the mixer:

- Brake ➔ NN

is by default the position of the transmitter control at which the airbrakes are retracted.

The input (1, 8 or 9) and the *offset* are determined in the "Brake" line of the »**Model type**« menu; see page 52. If you select "Input 1" please note that you should enter your preferred "Throttle minimum" position (forward / back) before you set the offset point.

Note:
If the offset is not positioned right at the end of the transmitter control travel, the remainder of the travel is a "dead zone", i.e. the transmitter control does not affect any of the airbrake ➔ NN mixers from that point on.

Mixer functions

The number of aileron and flap servos set in the »**Model type**« menu determines the extent of the mixer list, but at least the "Brake ➔ 3 elevator" mixer will appear in addition to the "Aileron 2 ➔ 4 rudder" mixer.

In the following section all the individual options of the fixed-wing menu will be discussed in turn.

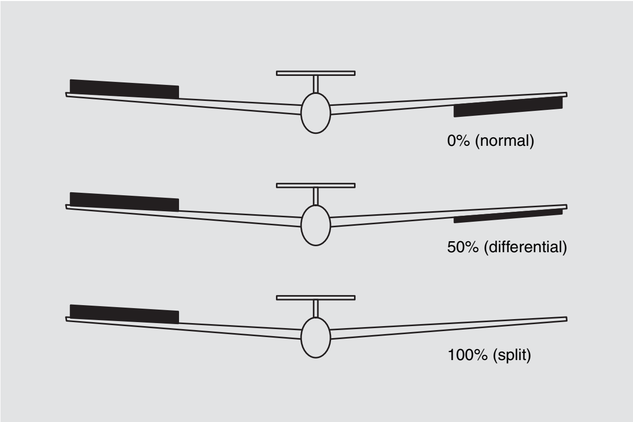
Aileron differential

Aileron differential compensates for an unwanted side-effect which occurs when ailerons are deflected: the problem known as "adverse yaw". When the ailerons are deflected, the drag generated by the down-going aileron is greater than that produced by the up-going aileron. The differential drag causes a yawing motion around the vertical axis, in the opposite direction to the desired turn. This effect is much more pronounced in model gliders with high aspect ratio wings and short tail moments than in power models, whose moment arms are much shorter. The pilot usually has to counter the adverse yaw by giving a simultaneous rudder deflection in the opposite direction to the yaw. However, this in turn causes additional drag and lowers the aircraft's efficiency.

The alternative solution is to set up differential aileron travel, i.e. the angular travel of the down-going aileron is less than that of the up-going aileron, and this reduces or even eliminates the (unwanted) adverse yaw. This method can only be used if a separate servo is employed for each aileron. This solution usually requires the aileron servos to be installed in the wing panels themselves. An additional advantage of this principle is that the shorter pushrods produce slop-free aileron actuation systems which always centre accurately.

Mechanical solutions are also possible, but they usually have to be "designed in" when the model is built, and in any case significant mechanical differential tends to cause additional slop in the control system. Electronic differential is the modern solution, as it offers the following important advantages:

The degree of differential can easily be varied without affecting the travel of the up-going aileron. In the extreme case it is possible to suppress the down-aileron deflection completely, i.e. only the up-going aileron moves at all, and this arrangement is sometimes called the "split" setting. "Split" ailerons not only tend to suppress adverse yaw, but can even generate positive yaw, which means that the model yaws in the direction of the turn when an aileron command is given. In the case of large model gliders smooth turns can then be flown using ailerons alone, which otherwise is usually by no means the case.



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 servos. "0%" corresponds to a normal linkage, i.e. no differential, while "-100%" or "+100%" represents the "split" function.

For aerobatic flying low absolute values are required, to ensure that the model rotates exactly around its longitudinal axis when an aileron command is given. Moderate values around -50% or +50% are typical for making thermal turns easier to fly. The split setting (-100%, +100%) is popular with slope flyers, as ailerons are often the only turning control fitted to this type of model.

Note:
Negative values are not usually necessary if the correct channels are used.

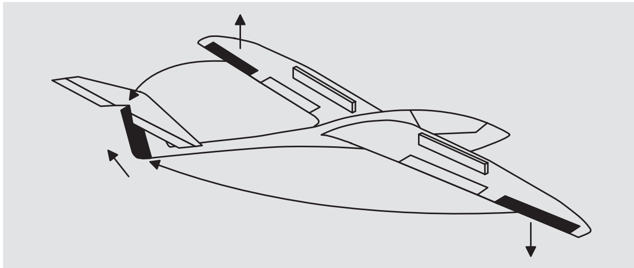
Camber-changing flap differential

The aileron / flap mixer (see below) is designed to superimpose an aileron function on the flaps. Flap differential works like aileron differential, and produces a reduced flap movement in the down-direction when the flaps are employed as ailerons.

The adjustment range of -100% to +100% makes it possible to set the correct direction of differential. "0%" corresponds to a normal linkage, i.e. the servo travel is the same up and down. A setting of "-100%" or "+100%" means that the down-travel of the flaps is reduced to zero when an aileron command is given.

Note:
Negative values are not usually necessary if the correct channels are used.

Aileron 2 → 4 rudder

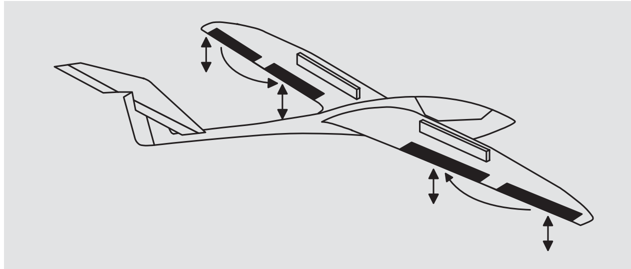


In this case the rudder automatically "follows" when an aileron command is given, and the mixer ratio (degree of following) can be set by the user. Coupled aileron / rudder (sometimes abbreviated to CAR) is especially useful for suppressing adverse yaw in conjunction with aileron differential, and this combination usually makes smooth turns very easy to fly. Naturally, the rudder can still be controlled separately by means of its dedicated stick. If an (optional) external switch or control switch is assigned to this function, the mixer can be switched on and off in flight, so that you can control the ailerons and rudder separately if and when you so desire.

A setting around 50% will seldom be far from the mark.

(**CLEAR** = 0%.)

Aileron 2 → 7 flap



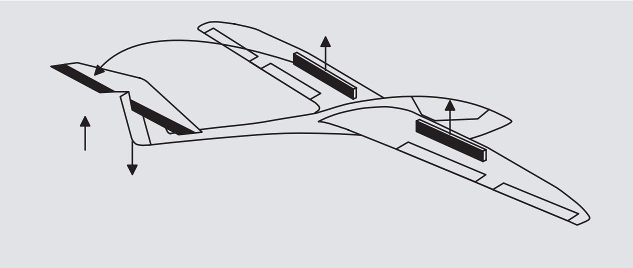
This mixer feeds a variable amount of the aileron signal into the flap channel. When an aileron command is given, the flaps "follow" the ailerons, although usually through a smaller angle, i.e. the mixer ratio is usually less than 100%. The adjustment range of -150% to +150% allows the user to set up the aileron direction to match the direction of the ailerons, regardless of the direction of rotation of the flap servos.

The camber-changing flaps should not follow the ailerons to a greater extent than 50% of the (mechanical) travel of the ailerons.

(**CLEAR** = 0%.)

The next three mixers "Brake → NN" are operated using the control function 1, 8 or 9, depending on the input you have assigned to the "Brake" function in the »Model type« menu. The offset (mixer neutral point) is also defined in that menu, with a "dead zone" if you wish.

Brake ➔ 3 elevator

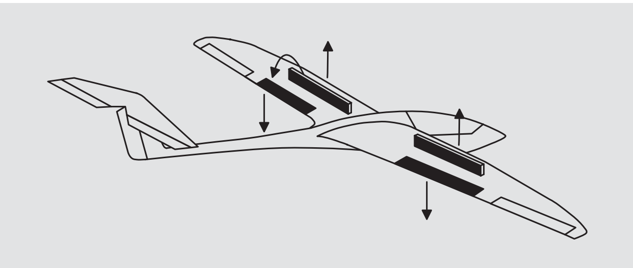


When any form of airbrakes is extended, there is usually an unwanted change in pitch trim (nose up or nose down); this is especially the case when a "butterfly" (crow) braking system is employed (see right-hand column). Similar problems can also be encountered if a motor is installed with the incorrect down-thrust angle, resulting in a pitch trim change when the throttle is opened or closed. This mixer feeds a corrective signal to the elevator to damp out this unwanted moment (adjustment range: -150% to +150%).

The "usual" values for this mixer are quite small: single digits to low double digits. You should certainly always check the selected setting at a safe altitude, and make adjustments as required.

(CLEAR = 0%.)

Brake ➔ 6 flap

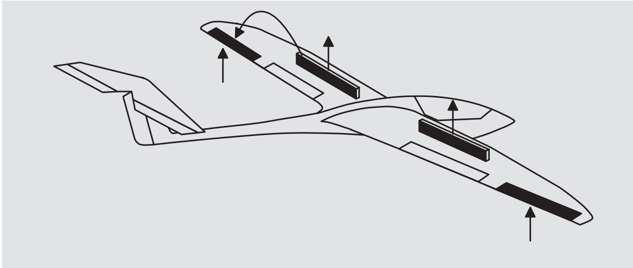


When you operate the brake function (1, 8 or 9), both flap servos move up or down together for the landing approach; the mixer ratio can be set to any value in the range -150% to +150%.

In this case the value should be selected so that the flaps deflect down by the maximum amount when the brake function (1, 8 or 9) is operated. However, do check that none of the servos is mechanically stalled at maximum travel.

(CLEAR = 0%.)

Brake ➔ 5 aileron

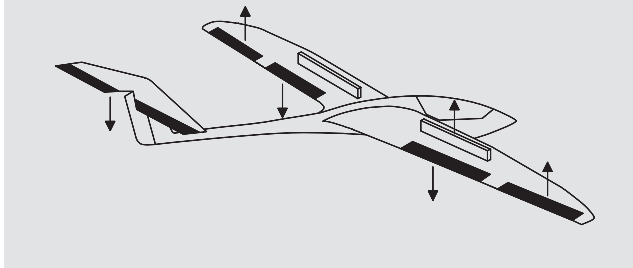


When you operate the brake function (1, 8 or 9), both aileron servos move up or down together for the landing approach; the mixer ratio can be set to any value in the range -150% to +150%. It is usual for the ailerons to deflect up slightly when the airbrakes are extended.

In this case the value should be selected so that the ailerons deflect up when the brake function (1, 8 or 9) is operated. However, do check that there is still sufficient aileron travel for directional control, and that none of the servos is mechanically stalled at maximum travel.

(CLEAR = 0%.)

Combination of the "brake ➔ NN" mixers "*Crow*" or "*Butterfly*" setting



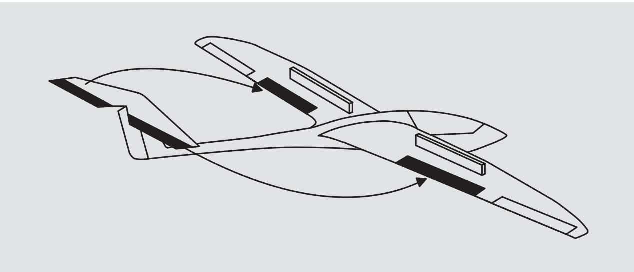
If you have programmed all three airbrake mixers for your model, it is then possible to program a special configuration known as the "*crow*" or "*butterfly*" setting to provide effective glide path control. In the butterfly setting *both ailerons are deflected up* and *both flaps down*. The third mixer provides elevator trim to counteract any unwanted pitch trim change, and maintain the model's airspeed at a safe level.

This inter-action between the flaps, ailerons and elevator is used to control the glide angle on the landing approach. Optionally the butterfly setting can also be used without the airbrakes or spoilers.

If your model features full-span (strip) ailerons which also operate as camber-changing flaps, the two mixers "Brake ➔ 5 ailerons" and "Brake ➔ 3 elevator" can be combined to provide glide path control. In this case extreme up-flap is applied, but the flaps can still be controlled as ailerons. Elevator pitch trim compensation is usually called for.

If you have programmed aileron differential, the aileron response will inevitably be adversely affected by the extreme "up" deflection of the ailerons in the butterfly setting, because the differential travel reduces or entirely suppresses the down-aileron deflection. However, the "up" travel of the ailerons is also greatly restricted because they are already at an extreme "up" position. The remedy here is to apply "Differential reduction", which is explained in its own section later.

Elevator 3 ➔ 6 flap

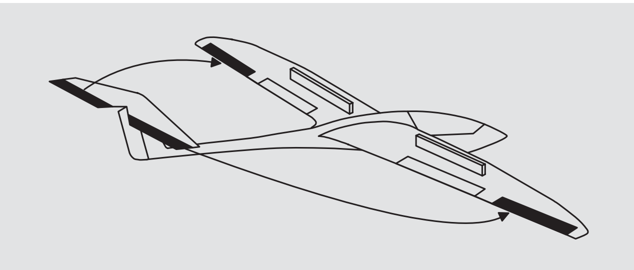


The flaps can be used to enhance the effect of the elevator in tight turns and aerobatics, and this mixer feeds part of the elevator signal to the flap servos to obtain this effect. The mixer direction must be set so that the flaps move down when up-elevator is applied, and vice versa.

The "usual" settings for this mixer are in the low double-digit area.

(CLEAR = 0%.)

Elevator 3 ➔ 5 aileron

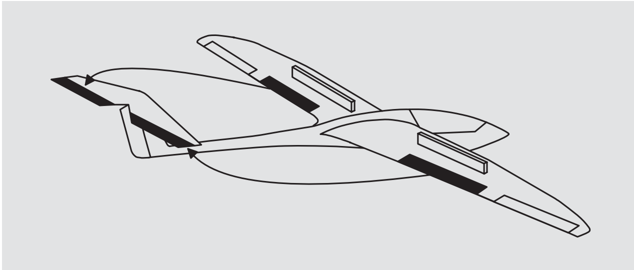


This mixer allows the ailerons to reinforce the elevator response in the same way as the previous mixer.

The "usual" settings for this mixer are in the low double-digit area.

(CLEAR = 0%.)

Flap 6 ➔ 3 elevator



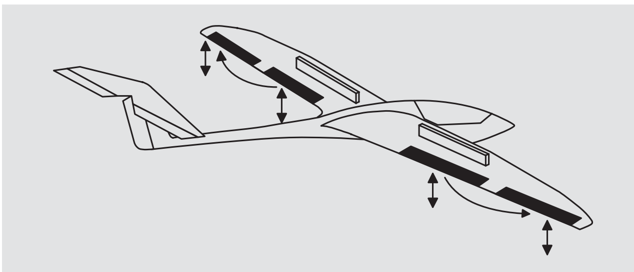
When camber-changing flaps are deployed, whether by an offset defined in the »**Control adjust**« or using a transmitter control assigned to "Input 6", a side-effect may be an unwanted nose-up or nose-down trim change. An alternative scenario may be that you wish the model to fly slightly faster than usual when the flaps are raised by a small amount. This mixer can be used to solve both problems.

If this mixer is invoked, a corrective elevator deflection automatically results when the flaps are deployed. Naturally the value is user-variable, i.e. the achieved effect varies only according to the magnitude of the set corrective value.

The usual settings for this mixer are in the single-digit area.

(CLEAR = 0%.)

Flap 6 ➔ 5 aileron



A variable proportion of the flap signal is mixed in with the aileron channels 2 and 5 so that the ailerons follow the movement of the flaps, but normally with a smaller deflection. This provides more even lift distribution over the full wingspan. The ailerons move in the same direction when the flaps are raised or lowered; usually travelling through a smaller angle.

This mixer is usually set up in such a way that the flap travel of the ailerons is slightly lower than that of the camber-changing flaps.

(CLEAR = 0%.)

Differential reduction

The problem of reduced aileron response in the butterfly configuration has been mentioned earlier: if aileron differential is employed, the aileron response may be adversely affected through the extreme "up" deflection of the ailerons, which means that greater "up" travel is (almost) impossible, and on the other hand the down-travel of the ailerons is more or less "obstructed" by the set differential. The net result is that aileron response is significantly reduced compared to the normal position of the control surfaces.

In this case "Differential reduction" is the answer, as it reduces the degree of aileron differential when you invoke the Butterfly setting. Differential is reduced progressively, or even eliminated altogether, as the airbrake stick is moved towards its end-point.

A value of 0% means that the full programmed "aileron differential" is retained. A value the same as the set percentage of the aileron differential means that differential is completely eliminated when the butterfly function is at its *maximum* setting, i.e. fully deployed. If you set a value above 100% the aileron differential is eliminated even before full travel of the airbrake stick is reached.

Helicopter mixers

Mixers variable separately in flight phases

Pitch		=>
Channel 1	→ Throttle	=>
Channel 1	→ Tail rot.	=>
Tail rot.	→ Throttle	0%
Roll	→ Throttle	0%
Roll	→ Tail rot.	0%
Pitch ax.	→ Throttle	0%
Pitch ax.	→ Tail rot.	0%
Gyro suppression		0%
Swashplate rotation		0%

This menu describes all the helicopter mixers which can be varied separately in each flight phase, with the exception of the mixers for the auto-rotation phase, which are covered in detail in the section starting on page 99. These mixers are used for the basic set-up of a model helicopter.

For details of flight phase programming please refer to the following menus:

- »**Auxiliary switch**«, page 75
- »**Phase setting**«, page 79
- »**Phase assignment**«, page 80

Whenever flight phases have been assigned, the active flight phase is displayed at the bottom edge of the screen, e.g. «Normal».

General information on mixers (see also pages 84 and 101)

An arrow "➔" indicates a mixer. The mixer "bleeds off" the signal flow of a control function at a particular point, and the derived signal is then allowed to affect the "input" of another control channel in a defined manner, so that it affects a particular receiver output. For example, if you set up a "Pitch-axis ➔ tail rotor" mixer, the tail rotor servo will follow the movement of the pitch-axis control system when you operate the pitch-axis (elevator) stick. The movement is proportional, and the degree of "following" can be varied.

Five-point curves are available for the collective pitch curve in all flight phases, and for the two mixers "Channel 1 ➔ throttle" and "Channel 1 ➔ tail rotor". This means that you can program a non-linear response curve along the travel of the corresponding stick; see also »**Channel 1 curve**« menu, page 70.

Switch to the screen page for setting a five-point curve with a brief press on the rotary control or the **ENTER** button; see below. The curve is set in basically the same way as the Channel 1 curve for helicopters, but we will describe it here again in detail to save you having to leaf through the manual again.

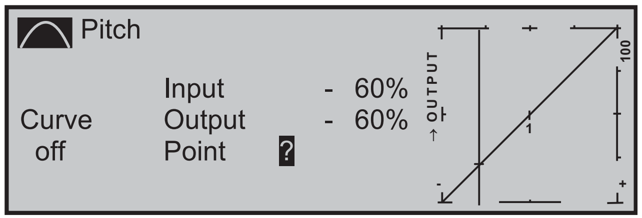
Basic programming procedure:

1. Select the mixer with the rotary control pressed in.

   The bottom line of the screen now shows **SEL** or the arrow button ➔ (depending on the mixer); select the arrow to switch to the second screen page.
2. A short press on the rotary control with the **SEL** field in inverse video allows you to set the mixer ratio directly: use the rotary control to set the appropriate mixer value.

   (**CLEAR** = 0%.)
3. A second short press concludes the input process.
4. Press **ESC** to move back to the first page.

Collective pitch



A short press on the rotary control or the **ENTER** button switches to the second screen page.

In contrast to the »**Channel 1 curve**« menu, this display refers *only* to the control curve of the collective pitch servos, whereas the "Channel 1 curve" menu affects all servos which are affected by the throttle / collective pitch stick.

Note:
The output signal of the »Channel 1 curve« acts as the input signal for the collective pitch curve which you program at this point: the vertical line in the diagram, which moves in parallel with the throttle / collective pitch stick, reflects the actual Channel 1 curve.

The control curve can be defined by up to five points, termed "reference points" in the following section. These can be placed at any point along the stick travel, and the locations can be different for each flight phase.

Initially the three standard reference points are all you need to set up the collective pitch curve. These three points, namely the two end-points at the bottom end of the stick travel "L" (low = -100% travel) and the top end of the stick travel "H" (high = +100% travel), together with point "1", which is exactly in the centre of the stick travel, initially define a linear characteristic for the collective pitch curve.

The programming procedure in detail:

If you have not already done so, switch to the flight phase whose name appears on the screen, e.g. «Normal».

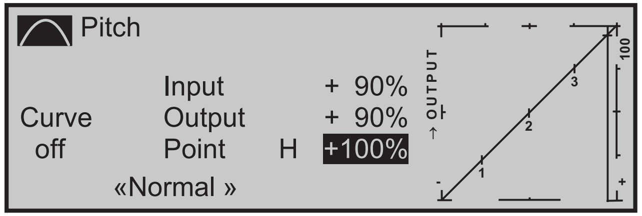
Setting and erasing reference points

You will find a vertical line in the graph, and you can shift this between the two end-points "L" and "H" by moving the associated transmitter control (throttle / collective pitch stick). The current stick position is also displayed in numeric form in the "Input" line. The value lies in the range -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%. This control signal affects only the collective pitch servos. In the example above, the stick is at -60% control travel and also generates an output signal of -60%, since the curve is linear.

Between the two end-points "L" and "H" you can now set a maximum of three reference points. The minimum spacing between two adjacent reference points is around 30% of the control travel. If you now move the stick, the inverse video question mark ? immediately appears, and you can place a reference point at the corresponding stick position by pressing the rotary control. Up to two further points can be placed between the extreme points "L" and "H", but the order in which you place them is not significant, as the reference points are automatically re-numbered sequentially from left to right in any case.

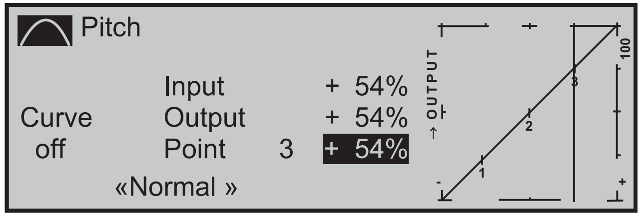
Example:



Note:
In this example the stick is located in the immediate vicinity of the right reference point "H". That is why the "point" value "+100%" is in inverse video (black background).

If you wish to erase one of the set reference points 1 to 3, move the stick close to the reference point in question. The reference point number and the associated reference point value now appear in the "Point" line. Press the **CLEAR** button to erase that point.

Example – erasing reference point 3:

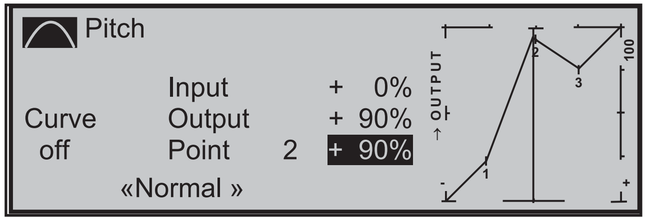


When the point has been erased, the inverse question mark ? re-appears after "Point".

Changing the reference point values

Move the stick to the reference point "L (low), 1 ... 3 or H (high)" which you wish to change. The number and the current curve value of this point are displayed on the screen. You can now use the rotary control to change the momentary curve value in the inverse field within the range -125% to +125%, *without* affecting the adjacent reference points.

Example:



As an example, the reference point "2" has been set to +90% in this screen shot.

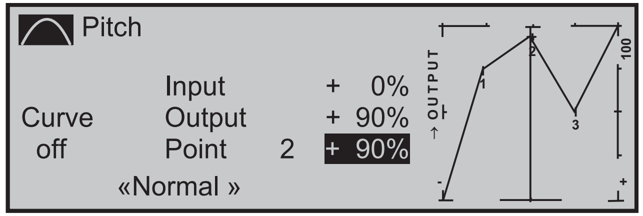
Pressing the **CLEAR** button erases the reference point.

Note:
If the stick is not set to the exact reference point, please note that the percentage value in the "Output" line always refers to the current stick position.

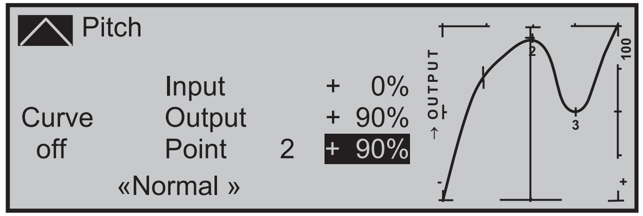
Rounding off the collective pitch curve

In the following example the reference points have been set as follows, as described in the last section:

Reference point value 1 to +50%,
Reference point value 2 to +90% and
Reference point value 3 to +0%.



This "jagged" curve profile can be rounded off automatically simply by pressing a button. Press the **ENTER** button adjacent to the "curve symbol":



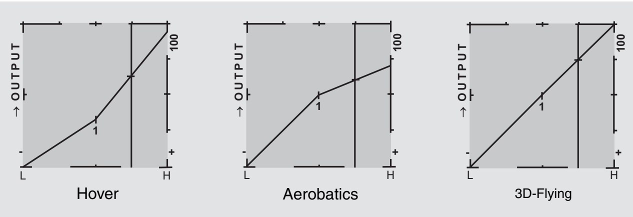
Note:
The curves shown here are only for demonstration purposes, and by no means represent realistic throttle / collective pitch curves.

Please refer to the programming examples on page 153 for a "real world" application.

The following three diagrams show typical three-point collective pitch curves for different flight phases, such as hover, aerobatics and 3-D flying.

The vertical bar reflects the current stick position. Please note that trim values greater than +100% and less than -100% cannot be displayed on the screen.

Typical collective pitch curves for different flight phases:

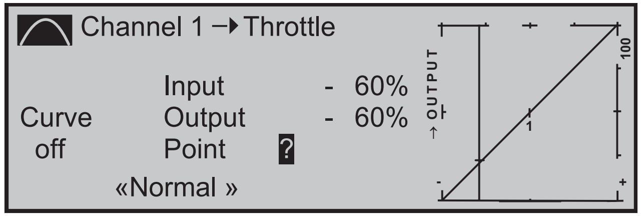


It can be very useful to adjust each individual reference point independently of the adjacent points using the rotary control!

Once you have defined the collective pitch curve, switch to the first screen page by pressing **ESC**, and then select the next line (if appropriate):

Channel 1 → throttle

A brief press on the rotary control or the **ENTER** button switches to the second screen page.



In contrast to the »**Channel 1 curve**« menu this display refers only to the control curve of the throttle servo, whereas the "Channel 1 curve" applies to all the servos which are affected by the throttle / collective pitch stick. Note that the output signal of the "Channel 1 curve" acts as input signal for the throttle curve programmed at this point: the vertical line in the diagram, which moves in parallel with the throttle / collective pitch stick, follows the actual Channel 1 curve.

The throttle curve can also be defined using a maximum of five points – termed "reference points" – along the full stick travel; different curves can be set for each flight phase.

The reference points are defined, adjusted and erased in the usual way, as explained in the previous section relating to the collective pitch curve. First define the throttle curve with the three points which are already set in the software, i.e. the two end-points "L" and "H" and Point "1" in the centre of the control arc, then adjust the motor power curve to match the collective pitch curve:

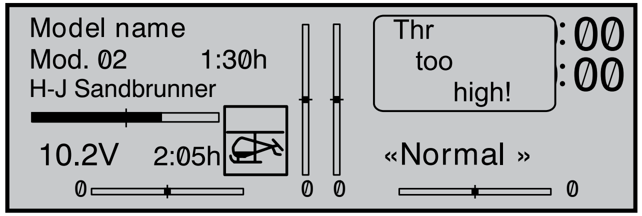
- The throttle must be fully open at the end-point of the throttle / collective pitch stick (exception: autorotation; see below).
- The hover point is normally located at the centre of the control travel, and the throttle setting must be adjusted in such a way relative to the collective pitch curve that the correct system rotational speed is obtained at this point.
- In the minimum position of the throttle / collective pitch stick, the throttle curve should be set up in such a way that the motor runs at a distinctly higher speed compared to the idle setting, with the clutch reliably engaged.

  In all flight phases the motor is started and stopped using the gas limiter (see below).

  If you are used to a different radio control system which uses two separate flight phases for this – "with idle-up" and "without idle-up" – please note that this complication is now superfluous, and for reasons of safety we strongly recommend that you adopt the new system.

  Note:
  Increasing system rotational speed below the hover point is more flexible and easier to control using the mc-22s program than using "idle-up" as employed in previous mc radio control systems.

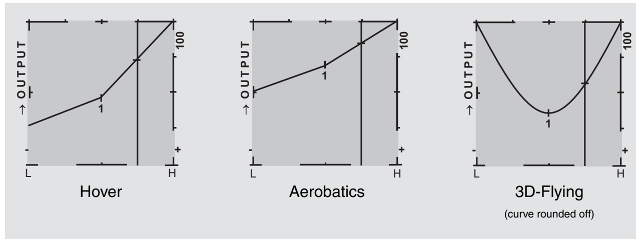
Ensure that the gas limiter is closed before you start the motor, i.e. the throttle can only be adjusted within the idle range using the idle trim. Please be sure to read the safety notes on page 98 which refer to this. If the idle is set too high when you switch the transmitter on, you will see and hear a clear warning!



The following three diagrams show typical three-point throttle curves for different flight phases, such as hover, aerobatics and 3-D flying.

Please note that trim values greater than +100% and less than -100% cannot be displayed on the screen.

Typical throttle curves for different flight phases:



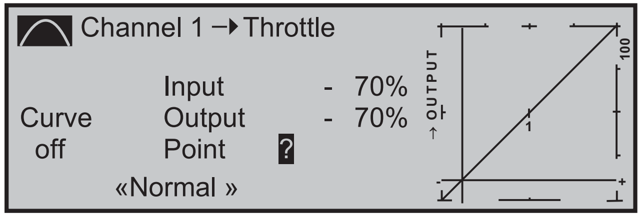
Notes on using the "Throttle limit" function:
*We strongly recommend that you make use of the throttle limit function (»**Control adjust**« menu, page 62). When you use this function, the throttle servo is completely disconnected from the throttle / collective pitch stick when the throttle limit slider is at its bottom end-point; the motor idles and only responds to the Ch1 trim. This feature enables you to start the motor from within any flight phase. Once the motor is running, slide the throttle limiter to the opposite end-point, so that full control of the throttle servo is returned to the throttle / collective pitch stick. It is important that the throttle limiter should not restrict the throttle servo at its top end-point; you can avoid this*

*by setting the control travel to 125% in the »**Control adjust**« menu.*

If you would like to obtain finer control of the throttle limit slider, you can also use “Expo throttle limit” (page 54). This gives you the opportunity to locate the idle setting exactly at the <u>ratcheted centre position</u> of the slider, which you can easily find at any time:

Set the throttle limiter to its centre detent, and adjust the value for “EXPO throttle limit” until the motor idles perfectly, i.e. without moving the slider from the ratcheted centre position. The motor can then be started without problem in this position. To cut the motor, slide the throttle limit control to the bottom end-point, i.e. without even touching the Ch1 cut-off trim.

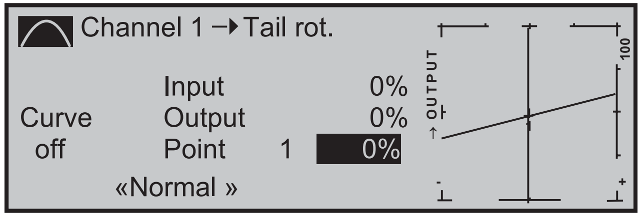
The limiting action of the throttle limiter is shown by a <u>horizontal</u> bar in the throttle curve graph:



The output signal to the throttle servo cannot be greater than the value dictated by the horizontal bar, in this illustration max. approx. -70%.

<u>Tip:</u>
If you wish to time the flight of a (glow-powered) model helicopter, you can assign a control switch to the throttle limit slider, and then use this to switch a timer on and off; see page 72.

Channel 1 → tail rotor



The purpose of this mixer is to provide static torque compensation. The first step is to ensure that the direction of main rotor rotation has been entered correctly in the »**Helicopter type**« menu, page 53.

This mixer should be set up in such a way that the helicopter does not rotate around the vertical (yaw) axis (i.e. deviate from the hover heading) during a long vertical climb or descent, due to the change in torque of the main rotor. At the hover the yaw trim should be set using the digital tail rotor trim lever only. For a reliable torque compensation setting it is essential that the collective pitch and throttle curves are already set up correctly, i.e. that main rotor speed remains constant over the full adjustment range of collective pitch.

This third five-point curve 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 70) applies to *all* servos which are affected by the throttle / collective pitch stick. Note that the output signal of the “Channel 1 curve” also acts as the input signal for the tail rotor curve which is programmed at this point: the vertical line in the diagram, which moves in parallel with the throttle / collective pitch stick, follows the actual Channel 1 curve as set in the »**Channel 1 curve**« menu.

As standard, the software includes a three-point tail rotor curve with a linear mixer ratio of 30%. Using the method described above, you can modify the mixer by placing two further reference points on the curve, and thereby set asymmetrical mixer ratios above and below the hover point.

In the auto-rotation flight phase this mixer is automatically switched off.

Tail rotor → throttle

The tail rotor normally compensates for the effect of main rotor torque on the fuselage, but it is also the primary method of controlling the helicopter around the vertical (yaw) axis. However, if you increase tail rotor thrust by giving a yaw command, motor power must also be increased to avoid a fall-off in system rotational speed.

In this menu you set the degree to which the throttle follows the tail rotor. The throttle only follows the tail rotor *on one side*, i.e. to the side where tail rotor thrust is increased, and the adjustment range is therefore 0 to +100%. The direction of mixing varies according to the rotational sense of the main rotor (left or right), and this must first be set correctly in the »**Helicopter type**” menu. For left-hand rotation systems, e.g. *HEIM/GRAUPNER* helicopters, the throttle follows the tail rotor when the tail rotor stick is moved to the left. Right-hand rotation systems: when the stick is moved to the right.

In the auto-rotation flight phase this mixer is automatically switched off.

<u>Programming notes:</u>
To set the mixer value accurately you should first fly several high-speed pirouettes in the opposite direction to main rotor rotation (i.e. with a HEIM system machine, pirouette to the left). Alternatively, hover the helicopter in a cross-wind heading on a fairly breezy day, holding in the required large tail rotor deflection. The mixer value should now be adjusted until the rotational speed does not fall off in this situation. For a HEIM system machine this value needs to be around 30%.

Roll ➔ throttle and pitch-axis ➔ throttle

Increasing collective pitch requires a corresponding adjustment to the throttle setting, and the same applies if a substantial cyclic command is given, i.e. if the swashplate is tilted in any direction. In the software of the mc-22s you can adjust the degree of throttle following for roll-axis and pitch-axis separately.

These mixers offer particular advantages in aerobatic flying, e.g. when flying a roll: collective pitch values are only moderate, and the throttle therefore only about half-open, but the roll requires major cyclic commands, and these require a much higher power input.

The mixer values can be varied within the range 0 to +100%. The program automatically sets the correct direction of mixing.

In the auto-rotation flight phase this mixer is automatically switched off.

Roll ➔ tail rotor and pitch-axis ➔ tail rotor

Increasing collective pitch requires a corresponding adjustment to the tail rotor setting, and the same applies if a major cyclic command is given i.e. if the swashplate is tilted in any direction.

In the software of the mc-22s you can adjust the dehgree of tail rotor following for roll-axis and pitch-axis separately.

This function can eliminate a problem which is encountered primarily in extreme aerobatics which involve very large control deflections in the pitch-axis control system, e.g. the “Bo-turn” (vertical pull up followed by tipping over around the pitch-axis) and tight loops. If the torque changes are not corrected by a mixer, the model tends to rotate to a greater or lesser extent around its vertical axis, and this spoils the appearance of the manoeuvre.

These two mixers provide static torque compensation when the swashplate is tilted in any direction. The mixers work by always increasing tail rotor thrust, starting from the centre point of the roll and pitch-axis sticks, i.e. they always affect tail rotor pitch 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 automatically determined when you define the direction of main rotor rotation in the »**Helicopter type**« menu, page 53.

In the auto-rotation flight phase this mixer is automatically switched off.

Gyro suppression

Right at the outset we should mention that this function should not and must not be used if your model is fitted with a modern gyro system. However, please read the operating instructions supplied with your gyro. This menu has been retained so that the program can still cater for all requirements and all pilots’ preferences.

In this program segment the effect of the gyro sensor (“gyro”) varies according to the tail rotor stick position; this assumes the use of a gyro system whose gain can be controlled from the transmitter via an auxiliary channel – this is channel 7 for *GRAUPNER/JR* mc radio control systems. The gyro suppression function reduces gyro gain in a linear progression as the tail rotor stick deflection increases, the rate of suppression varying according to the mixer value you have set. Without gyro suppression, i.e. with a mixer value of 0%, the gyro effect is constant, regardless of the tail rotor stick position.

However, gyro gain can *also* be varied proportionally between minimum and maximum by means of a slider assigned to the “Gyro 7” line in the »**Control adjust**« menu (see page 60). This could be transmitter control 7, which in the standard transmitter configuration is connected to socket CH7 on the transmitter circuit board. In this case gyro gain is maximum at full deflection of the slider, and zero at the opposite end-point. Of course, the software of the mc-22s allows you to limit the gain adjustment range by altering the setting for transmitter control travel to both sides of neutral.

At any position of the slider, gyro gain at full deflection of the tail rotor stick is:

“current slider position minus
gyro suppression value”,

i.e. when the slider is at the neutral position, a gyro suppression value of 100% will reduce gyro gain to zero with increasing tail rotor deflection, and a value between 100% and the maximum 199% suppresses the gyro completely well *before* full deflection of the tail rotor, depending on the slider position; see the diagram on next page.

If you are using the *GRAUPNER/JR* NEJ-120 BB gyro, Order No. **3277**, the bottom and top values are adjusted using separate rotary potentiometers: adjustor 1 sets the *minimum* gyro gain in the *bottom* position of the slider; adjustor 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.

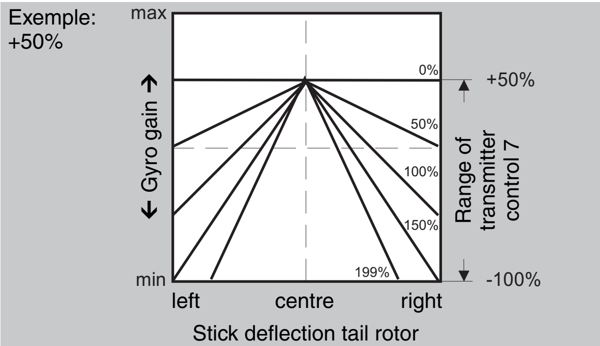
An example of using flight phase-dependent (static) gyro gain would be to exploit maximum stabilisation for normal, slow flying, but to reduce gyro gain for fast circuits and aerobatics.

1. *Linear gyro suppression: 0% to 199%.*
   At the centre position of the tail rotor stick the gyro gain is defined by the position of the slider control “7”. It can be adjusted proportionally by moving the slider 7 from zero (“min”) to maximum (“max”), un-

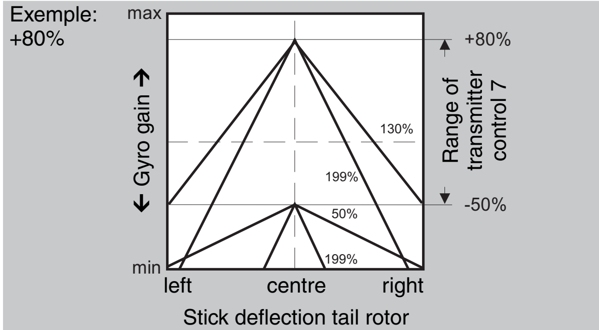
less you have set a reduction in control travel. Effective gyro gain at full tail rotor deflection can be defined as follows:

"current slider position minus gyro suppression value",

i.e. at 0% gyro suppression the gyro gain remains constant when a tail rotor command is given; at 50% suppression gyro gain is reduced to half if slider 7 is moved to the +50% position (as shown here); at >150% suppression, gain is reduced to zero before full tail rotor deflection in this slider position.



2. *Linear gyro suppression with reduced control travel, e.g. -50% to +80% travel. Gyro gain can be varied proportionally within these control limits. Here again, for demonstration purposes the illustration shows gyro gain varying according to tail rotor deflection for various values of the gyro suppression parameter.*



Adjusting the gyro sensor

To set up a gyro to achieve maximum possible stabilisation of the helicopter around the vertical axis, please note the following points:

- The control system must be as free-moving and accurate (slop-free) as possible.
- There should be no "spring" or "give" in the tail rotor linkage.
- You must use a powerful and – above all – fast servo.

When the gyro sensor detects a deviation in yaw, the faster it adjusts the thrust of the tail rotor, the further the slider "7" (or other gyro gain adjustor) can be advanced, without the tail of the model starting to oscillate, and the better is the machine's stability around the vertical axis. If the corrective system is not fast enough, there is a danger that the helicopter's tail will start to oscillate even at low gyro gain settings, and you then have to reduce gyro gain further using slider "7" to eliminate the oscillation.

If the model is flying forward at high speed, or hovering in a powerful headwind, the net result of the stabilising effect of the vertical fin combined with the gyro's stabilising effect may also be an over-reaction which manifests itself in tail oscillation. In order to obtain optimum stabilisation from a gyro in all flight situations, gyro gain has to be adjusted from the transmitter via slider "7" in conjunction with gyro suppression and / or the two adjustors on the NEJ-120 BB gyro.

Additional notes on gyros with multi-stage variable gyro gain (e.g. NEJ-120 BB)

Since you cannot pre-set gyro gain proportionally at the transmitter using the slider, it makes sense to set the lower level of gyro gain using adjustor 1 (e.g. for aerobatics), and the higher level of gain using adjustor 2 (e.g. for hovering). In this case you can only switch between these two set values, even if a proportional slider control is used for function 7, i.e. proportional adjustment is not available.

For this reason you should advance adjustor 2 to the point where the model is on the brink of oscillating when hovering in calm conditions, and advance adjustor 1 to the point where the model's tail does not oscillate even when the helicopter is at maximum speed and flying into a powerful headwind. Depending on the weather conditions and the type of flying you wish to carry out, you can then switch gyro gain to the appropriate setting from the transmitter, and – if you wish – set gyro suppression to vary with tail rotor control deflection.

Swashplate rotation

Note:
*If none of the types which can be selected in the "Swashplate type" line of the »**Helicopter type**« menu matches your model, then you can set up a unique system in this menu.*

With some rotor head control systems it is necessary to incline the swashplate in a direction which is not the same as the intentional inclination of the rotor plane when a cyclic control command is given. For example, if your model features the HEIM system and is fitted with a four-bladed main rotor, the control lin-

Setting up the throttle and collective pitch curves
A practical procedure

kage needs to be rotated to the right through 45° by the software, 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 menu point provides for this arrangement, eliminating 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.

Pressing **CLEAR** resets the input value to “0°”.

Although the throttle and collective pitch control systems are based on separate servos, they are always operated in parallel by the throttle / collective pitch stick (except when auto-rotation is invoked). The Helicopter program automatically couples the functions in the required way.

In the software of the mc-22s the trim lever of control function 1 only affects the throttle servo, e.g. as idle trim (see Motor cut-off trim, page 32).

The process of adjusting throttle and collective pitch correctly, i.e. setting the power curve of the motor to match the collective pitch setting of the main rotor blades, is the most important aspect of setting up any model helicopter. The program of the mc-22s provides independent adjustment facilities for the throttle, collective pitch and tail rotor control curves in addition to the Ch1 control curve (»**Channel 1 curve**« menu, page 70), as already described.

It is certainly possible to set up five-point curves for these functions, but as a general rule fewer points are sufficient. We would always advise that you start with three-point curves, as the program provides them as standard on the second screen page in each case. All you have to do to define the control curves is adjust the centre setting “1” and the two end-points (“low” and “high”) for the throttle / collective pitch stick.

However, before you set up the throttle / collective pitch function it is important to adjust the mechanical linkages from all the servos accurately, in accordance with the set-up notes provided by the helicopter manufacturer.

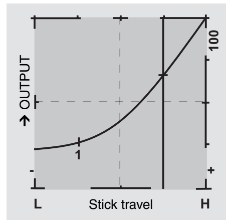
Note:

The hover point should normally be set to the centre position of the throttle / collective pitch stick. However, for some special cases, e.g. for “3-D” flying, you might wish to program hover points which deviate from this norm, for example, one point for normal flying may be above the centre, and another point for inverted flight below the centre.

Idle setting and throttle curve

The idle setting is adjusted exclusively with the throttle limiter closed, normally using the trim lever of the Ch1 function, but in special cases using the throttle limiter (slider) itself. The bottom point “L” (low) setting of the throttle curve defines the throttle setting when the helicopter is in a descent, but without affecting the hover setting.

This is a case where you can exploit flight phase programming to use different throttle curves – previously termed “idle-up” in earlier mc systems. 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 diagram shows a three-point curve with a slightly altered throttle setting below the reference point “1”. The curve has also been rounded off, as described earlier.

Different throttle curves are programmed for each flight phase, so that you can use the optimum set-up both for hovering and aerobatics:

- Low system rotational speed with smooth, gentle control response and low noise at the hover.
- Higher speed for aerobatics with motor power settings close to maximum. In this case the throttle curve also has to be adjusted in the hover range.

The basic set-up procedure

Although the mc-22s transmitter provides a broad range of adjustment for the collective pitch curve and throttle curve, it is essential that you start by adjusting all the mechanical linkages in the model in accordance with the information supplied by the helicopter manufacturer, i.e. all the system linkages should already be as close to absolutely correct as possible in mechanical terms. If you are not sure how to achieve this, an experienced helicopter pilot will be glad to help you with the basic mechanical set-up procedure.

The throttle linkage must be adjusted in such a way that the carburettor is just at the “fully open” position at the full-throttle setting. When the throttle limiter is at the idle setting, the Ch1 trim lever should just be able to close the carburettor barrel completely, without the servo striking its mechanical end-stop (servo stalled).

Take your time, and carry out these adjustments very carefully by altering the mechanical linkage and / or changing the linkage point on the servo output arm or the throttle lever. Only when you are confident that all is well should you start optimising and fine-tuning the throttle servo using the electronic facilities.

<u>Caution:</u>
Read all you can about motors and helicopters, so that you are aware of the dangers inherent in this activity, and the cautionary measures required before you attempt to start the motor for the first time!

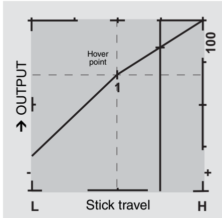
With the basic set-up completed, it should be possible to start the motor in accordance with the operating instructions supplied with it, and to adjust the idle setting using the trim lever of the throttle / collective pitch stick. The idle position which you set is indicated in the transmitter’s basic screen display by a horizontal bar at the display of the Ch1 trim lever’s position. Refer to page 32 of this manual for a full explanation of the digital trims.

The following procedure assumes that you wish to set up your helicopter “normally”, i.e. with the hover point exactly in the centre of the stick arc. Roughly at the mid-point of the collective pitch stick the model should lift off the ground and hover at the rotational speed you wish to use. If this is not the case, the settings can be corrected as follows:

1. The model does not lift off until the collective pitch stick is above the centre point

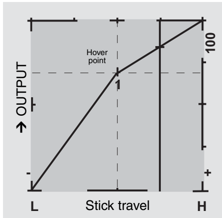
a) <u>Rotational speed too low</u>

Remedy: increase the value for the throttle servo parameter at the centre point of the stick travel in the *“Channel 1 ➔ throttle”* mixer.



b) <u>Rotational speed too high</u>

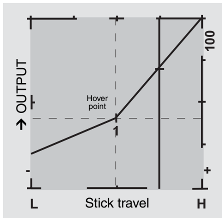
Remedy: increase the blade pitch value for *collective pitch* at the stick centre setting; this is carried out in the *“Collective pitch curve”* menu.



2. The model lifts off below the centre point

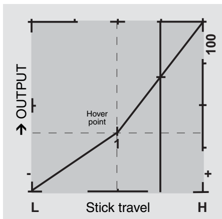
a) <u>Rotational speed too high</u>

Remedy: reduce the throttle opening in the *“Channel 1 ➔ throttle”* mixer at the stick centre point.



b) <u>Rotational speed too low</u>

Remedy: reduce the blade pitch value for *collective pitch* at the stick centre setting; this is carried out in the *“Collective pitch curve”* menu.



<u>Important:</u>
you should persevere with this adjustment until the model hovers at the correct rotational speed at the centre point of the throttle / collective pitch stick’s travel. All the other model settings depend upon the correct setting of this parameter!

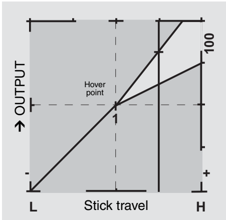
The standard set-up

The remainder of the standard adjustment procedure is completed on the basis of the fundamental set-up which you have just carried out, i.e. the model hovers in normal flight at the centre point of the throttle / collective pitch stick at the correct rotational speed. This means that your model helicopter is capable of hovering and also flying circuits in all phases whilst maintaining a *constant system rotational speed*.

The climb setting

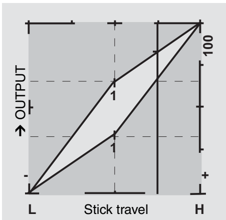
The combination of throttle hover setting, collective pitch setting for the hover and the maximum collective pitch setting (“Collective pitch high”) now provides you with a simple method of achieving constant system rotational speed from the hover right to maximum climb.

Start by placing the model in an extended vertical climb, holding the collective pitch stick at its end-point: motor speed should not alter compared with the hover setting. If motor speed falls off in the climb, when the throttle is already fully open and no further power increase is possible (this assumes that the motor is correctly adjusted), then you should reduce the maximum blade pitch angle at full deflection of the collective pitch stick, i.e. in the “collective pitch high” position. Conversely, if motor speed rises during a vertical climb, you should increase the blade pitch angle. This is carried out by selecting the point “H” (high) and changing the reference point value using the rotary control.



This diagram only shows the changes to the collective pitch maximum value “H”.

Now bring the model back to the hover, which again should coincide with the mid-point of the Ch1 stick. If you find that the collective pitch stick now has to be moved from the mid-point in the “higher” direction, then you should correct this deviation by increasing the collective pitch angle at the hover until the model again remains stationary at stick centre. Conversely, if the model hovers below the mid-point, correct this by reducing pitch angle again. You may find that it is also necessary to correct the throttle opening at the hover point.

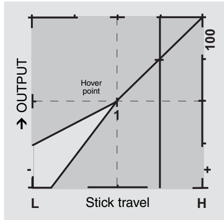


This diagram only shows the change in the hover point, i.e. collective pitch minimum and maximum have been left at -100% and +100% respectively.

Continue adjusting these settings until you really do achieve a constant rotational speed over the full range between hover and climb.

The descent setting

The descent adjustment should now be carried out by placing the model in a descent from forward flight at a safe height by fully reducing collective pitch; adjust the collective pitch minimum value (“Collective pitch low”) so that the model descends at an angle of 60° … 80°.



This diagram only shows the changes to the collective pitch minimum value “L”.

Once the model descends reliably as described, adjust the value for “Throttle low (L)” so that system rotational speed neither increases nor declines during the descent. This completes the set-up procedure for throttle and collective pitch.

Final important notes

Before you start the motor, check carefully that the throttle limiter is completely closed, so that the throttle can be controlled by the trim lever alone. If the throttle is too far open when you switch the transmitter on, you will see and hear a warning. If you ignore this and start the motor with the throttle too far advanced, there is a danger that the motor will immediately run up to speed after starting, and the centrifugal clutch will engage at once. For this reason you should

always grasp the rotor head firmly when starting the motor.

However, if you accidentally start the motor with the throttle open, the rule is this:

Don’t panic!

Hang on to the rotor head regardless!

Don’t let go!

Immediately close the throttle, even though there may be a risk of damaging the helicopter’s drive train, because:

YOU must ensure that the helicopter cannot possibly move off by itself in an uncontrolled manner.

The cost of repairing a clutch or even the motor itself is negligible compared to the damage which a model helicopter can cause if its spinning rotor blades are allowed to wreak havoc.

Make sure that nobody else is standing in the primary hazard zone around the helicopter.

It is important never to switch abruptly from idle to the flight setting by suddenly increasing system rotational speed. This would cause the rotor to accelerate quikkly, resulting in premature wear of the clutch and gear train. The main rotor blades are generally free to swivel, and they often cannot keep pace with such swift acceleration; they may respond by swinging far out of their normal position, perhaps resulting in a boom strike.

Once the motor is running you should slowly increase system rotational speed using the *throttle limiter*; if you have assigned an external switch for the throttle limiter, we strongly recommend that you program a time constant of about five seconds for running up the system rotational speed (opening the throttle limiter), but *zero* time delay for closing the throttle limiter. These values are set in the »**Control adjust**« menu; see page 62.

Auto-rotation settings

▶Pitch	=>
Thr setting AR	- 90%
Tailrotoroffset AR	0%
Gyro suppression	0%
Swashplate rotation	0°
▾ «Autorot»	

The adjustment facilities listed in this screen shot are displayed in the Heli mixers menu when you switch to the “Auto-rotation” phase or “Auto-rotation Ch1 Pos.”, i.e. auto-rotation must be active (see »**Auxiliary switch**«, page 75).

Auto-rotation allows full-size and model helicopters to land safely in a crisis, i.e. if the motor should fail. It can also be used if the tail rotor should fail, in which case cutting the motor and carrying out an auto-rotation landing is the only possible way of avoiding an uncontrollable high-speed rotation around the vertical axis, invariably terminating in a catastrophic crash.

During an auto-rotation descent the main rotor is not driven by the motor; it is kept spinning only by the airflow through the rotor plane caused by the fast descent.

The rotational energy stored in the still spinning rotor can be exploited to allow the machine to flare out, but this can only be done once. For this reason “autos” are only likely to be successful if the pilot has plenty of experience in handling model helicopters, and has also carefully set up the functions listed above.

Once you have sufficient experience, you should practise auto-rotation landings at regular intervals, not only so that you can demonstrate your all-round flying skill by flying the manoeuvre in competitions, but also so that you are in a position to land the helicopter undamaged from a great height if the motor should fail. For this purpose the program provides a range of adjustment facilities which are designed to help you fly your helicopter in its unpowered state.

Please note that the auto-rotation setting takes the form of a complete fourth flight phase, for which all the adjustment facilities are available which can be varied separately for all flight phases, i.e. transmitter control settings, trims, collective pitch curve settings etc.. Certain special features are also provided which are not available in the powered flight phases. These functions are:

- **AR throttle position:**

  Disconnection of the throttle servo from the collective pitch control system. In this case the throttle servo takes up the “-90%” position shown in the illustration. For further notes see the *“Throttle setting” section*.

- **Tail rotor offset:**

  Sets the tail rotor blade pitch to a value within the range -125% to +125%.

  (**CLEAR** = 0%.)

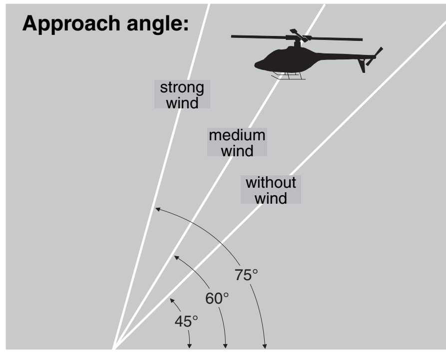
  The Channel 1 ➔ tail rotor mixer is switched off for auto-rotation. For notes on defining this value see the *“Tail rotor setting” section*.

Collective pitch setting: “Pitch”

In powered flight the maximum blade pitch angle is limited by the motor power which is available; however, in auto-rotation the angle is only limited by the point at which the airflow over the main rotor blades breaks away. Nevertheless, to provide sufficient upthrust even when rotational speed is falling off, it is necessary to set a greater maximum collective pitch value. Start by setting a value which is about 10 to 20% higher than the normal collective pitch maximum, to prevent the helicopter ballooning up again during the flare following the auto-rotation descent. If this happens, the rotational speed of the main rotor will quickly decline to the point where it collapses, and the helicopter ends up crashing to the ground from a considerable height.

Under certain circumstances the collective pitch minimum setting may also differ from the normal flight setting; this depends on your piloting style for normal flying. In any case you must set a sufficiently generous collective pitch minimum value for auto-rotation to ensure that your model can be brought from forward flight at moderate speed into a descent of around 60° ... 70° when collective pitch is reduced to minimum.

Most helicopter pilots already use such a setting for normal flying, and if this applies to you, you can simply adopt the same value.



Approach angle under varying wind conditions.

If the angle is too shallow, increase the value, and vice versa.

For auto-rotation the collective pitch stick itself may not be positioned right at the bottom of its travel; instead it is typically between the hover position and the bottom end-point, giving the pilot scope for correction if necessary, i.e. the chance to adjust the model’s pitch inclination using the pitch-axis control.

You can shorten the approach by pulling back on the pitch-axis stick and gently reducing collective pitch, or alternatively extend the approach by pushing forward on the pitch-axis stick and gently increasing collective pitch.

Throttle setting: "Thr setting AR"

In a competition the pilot is expected to cut the motor completely, but for practice purposes this is certainly not advisable. Instead set the throttle so that the motor runs at a reliable idle during auto-rotation, so that you can open the throttle immediately to recover from an emergency.

Tail rotor setting: "tail rotor offset AR"

For normal flying the tail rotor is set up in such a way that it compensates for motor torque when the helicopter is hovering. This means that it already generates a certain amount of thrust even in its neutral 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.

However, in an auto-rotation descent the main rotor is not driven by the motor, and therefore there is no torque effect for which compensation is required, i.e. which the tail rotor would have to correct. For this reason all the appropriate mixers are automatically switched off in auto-rotation mode.

However, the basic tail rotor setting must be different for auto-rotation, as the corrective thrust described above is no longer required.

Cut the motor and set the helicopter horizontal. With the transmitter and receiving system switched on, fold both tail rotor blades down and change the blade pitch angle to zero degrees using the "Tail rotor offset" menu. Viewed from the tail, the tail rotor blades should now be parallel to each other. Depending on the friction and running resistance of the gearbox, you may still find that the fuselage has a slight yawing tendency in an auto-rotation descent. The relatively small torque which causes this effect must then be corrected if necessary by adjusting the tail rotor blade pitch angle. This value will always be a small figure between zero degrees and a pitch angle opposed to the direction of tail rotor pitch required for normal flight.

General notes regarding freely programmable mixers

The two menus »**Wing mixers**« and »**Helicopter mixer**«, described on the preceding pages, contain a wide range of ready-programmed coupling functions. The basic meaning of mixers has already been explained on page 84, together with the principle on which they work. In the following section you will find more general information relating to "free mixers":

The mc-22s offers freely programmable mixers in every model memory, whose inputs and outputs can be selected to suit your exact requirements:

- four linear mixers, numbered 1 to 4;
- two curve mixers, numbered 5 and 6.

These six mixers are certainly adequate in most cases, but in any case are invariably sufficient when you incorporate the facilities of flight phase programming. In the »**MIX active/phase**« menu (see page 108) you can specify which of the six mixers is active or disabled in each flight phase separately.

Any *control function* (1 to 12) can be assigned as the *input signal* of a "free mixer". Alternatively any external switch can be assigned as the input signal using what is termed the "switch channel" (see below). The signal present at the control channel, and passed to the mixer input, is always affected by the associated transmitter control *and* the set transmitter control characteristics, as defined, for example, in the »**Dual Rate / Expo**«, »**Channel 1 curve**« and »**Control adjust**« menus.

The mixer output acts upon a <u>freely selectable</u> *control channel* (1 to max. 12 – depending on receiver type). Before the signal is passed to the associated servo the only influences which can act upon it are those defined in the »**Servo adjustment**« menu, i.e. the servo reverse, neutral point offset, servo travel and servo travel limit functions.

One *control function* can be set up to affect several mixer inputs simultaneously, if, for example, several mixers are to be arranged to work in parallel. Conversely it is possible for several mixer outputs to affect one and the same *control channel*.

For more complex applications several mixers can even be connected in series: in this case the input of the "series-connected" mixer is not the (transmitter control) signal at the "output" of a control function, but the signal (mixed or otherwise) present "further back", i.e. at the "input" of a *control channel*. The following description of the free mixers includes examples of such arrangements.

In software terms the freely programmable mixer is always switched on by default once set up, but it is possible to assign an optional ON / OFF switch to any mixer. However, since there are so many functions to which switches can potentially be assigned, you should take care not to assign too many functions to any particular switch.

The two vital mixer parameters are …

… the *mixer ratio*, which defines the extent to which the input signal acts on the output of the mixer.

If you are using linear mixers, the mixer ratio can be set symmetrically for both sides of centre, or asymmetrically; the two curve mixers 5 and 6 can be configured by defining a maximum of five points at the user's discretion, providing the means to implement extremely non-linear curves.

… the *neutral point* of a mixer, which is also termed the "offset".

The offset is that point on the travel of a transmitter control (stick, rotary knob or switch module) at which the mixer just has no influence on the control channel which is defined as its output. Normally this is the centre point of the transmitter control, but the offset can be placed at any point on the control's travel. Since there are no restrictions on the design of the curve mixers, setting a mixer neutral point only makes sense with the four linear mixers.

If you do not wish the corresponding mixer output or control channel to be affected by its normal transmitter control, then it can be separated from the control channel of the mixer output by a simple button-press in the »**MIX-only channel**« menu (see page 108). This might be the case, for example, if you wish to use output 1 for another purpose in the case of a glider not fitted with airbrakes. The following menu description will make this function clear with a practical example.

Switch channel "S" as mixer input

In many cases a constant control signal is all that is required as the mixer input; a typical application would be to apply slight up-elevator trim when the aero-tow coupling is closed.

If you assign the same switch to the aero-tow release and the mixer, the coupling can be opened and closed by operating the switch, and at the same time the appropriate up-elevator trim is applied automatically. To identify this special arrangement, this mixer input control function in the program is designated "S" for "Switch channel".

<u>*Note:*</u>
*In the default state of the mc-22s transmitter the »**Free mixers**« menu is initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49). Alternatively, move to the »**Basic settings**« menu (see page 117) and select "yes" for the Expert mode; this must be carried out <u>before</u> you set up a new model memory..*

Free Mixers

Linear and curve mixers

LinearMIX 1		??→??			- - - -
▶LinearMIX 2		??→??			- - - -
LinearMIX 3		??→??			- - - -
LinearMIX 4		??→??			- - - -
Curve MIX 5		??→??			- - - -
Curve MIX 6		??→??			- - - -
	type	from to			Adjust
▾▴		SEL SEL			

For each model memory (1 to 30) four linear mixers are available, and two curve mixers with the additional feature of non-linear characteristic curves.

The menu »**MIX active/phase**« (page 108) enables you to activate particular mixers separately for specific flight phase. ***In the interests of clarity the blocked mixers are then suppressed in the appropriate flight phase of the »Free mixers« menu.***

In the default state of the mc-22s transmitter this menus are initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49), or set this menu point to "yes" in the »**Basic settings**« menu (see page 117) *before* you set up a new model memory.

In the following first section we will concentrate on the programming procedure for the screen page shown at the top of this column. We will then move on to the method of programming mixer ratios, both for linear mixers and also curve mixers, as found on the second screen page of this menu.

Basic programming procedure:

1. Select mixer 1 ... 6 with the rotary control pressed in.
2. Define the mixer input "from" and the mixer output "to".
3. If required, enter a serial mixer link ("Type" column).
4. Optionally: include the trim levers for the mixer input signal ("Type" column).
5. Assign a mixer switch if required.
6. Define the mixer ratios on the second screen page.
7. Switch back to the first page by pressing **ESC**.

"from …" column

After a brief press on the rotary control, use the rotary control to enter the mixer input in the selected mixer line in the inverse video field of the "**from**" column. This must be one of the *control functions* 1 ... 12 or S.

In the interests of clarity the control functions 1 ... 4 are abbreviated as follows in the Fixed-wing program:

C1	Throttle / airbrake stick
AI	Aileron stick
EL	Elevator stick
RU	Rudder stick

And in the Heli program:

1	Throttle / collective pitch stick
2	Roll stick
3	Pitch-axis stick
4	Tail rotor stick

Note:
*Don't forget to assign a transmitter control to the selected control function 5... 12 in the »**Control adjust**« menu.*

Switch channel "S"

The letter "S" (switch channel) in the "**from**" column has the effect of passing a constant input signal to the mixer input, e.g. in order to apply a little extra up-elevator trim when the aero-tow coupling is closed, as already mentioned.

After assigning a control function or the letter "S", move on to the …

"… to" column

… where an additional **SEL** field now appears. At this point you can define the destination of the mixer, i.e. the mixer output, as one of the control channels. At the same time additional fields will also appear in the bottom line of the screen.

Example:

LinearMIX 1		6 → EL	6I	ein	=>
▶LinearMIX 2	Tr	C1 → EL	G4	aus	=>
LinearMIX 3		8 → 10			=>
LinearMIX 4		S → EL	7		=>
Curve MIX 5		?? → ??			- - - -
Curve MIX 6		?? → ??			- - - -
	type	from to			Adjust
▾▴	SEL	SEL SEL			➡

In this example four mixers have already been defined. The second mixer ("Brake → 3 elevator") is already familiar to us from the »**Wing mixers**« menu. As a general rule you should always use these pre-programmed mixers first if possible. Admittedly, if you need asymmetrical mixer ratios on both sides of centre, or wish to program a non-linear curve, or need to offset the mixer neutral point, then you should program one of the free mixers instead of the pre-programmed alternative.

Erasing mixers

If you need to erase a mixer that you have already defined, simply press the **CLEAR** button in the inverse video field of the "**from**" column.

Mixer switches

In the example shown above, the external switches and control switches "6", "G4" and "7" have been assigned to the three linear mixers 1, 2 and 4.

The switch symbol shows the current state of the switch. The extreme right-hand column shows whether the mixer in question is currently switched "off" or “on”. *Mixers to which no switch has been assigned are permanently switched on.*

A switch *must* be assigned to the 4th mixer if you wish to *switch* between two fixed mixer values (yet to be defined), corresponding to the two end-points of a (proportional) transmitter control. This means that the “switch channel” mixer cannot be switched “on” or “off” like the other mixers.

When selecting a control switch (G1 ... G4 or G1i ... G4i) please remember that you also have to assign it to a transmitter control; this is carried out in the »**Control switch**« menu.

“Type” column

Including the trim

If you are using one of the primary control functions 1 ... 4 you can set the trim value of the digital trim lever to affect the mixer input, if you wish. Use the rotary control to select “Tr.” in the inverse video field for the mixer in question.

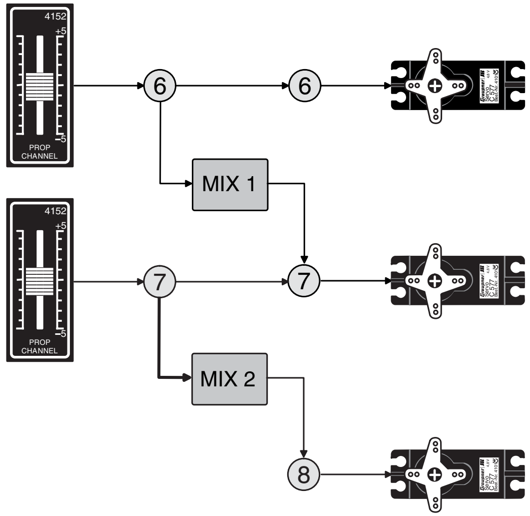
Serial mixer link

As has already been explained (see page 101), you can also link mixers together in series: in a similar way to a Y-lead, the “input signal” of a control channel branches off to the “series wired” mixer as it is on its way to the servo, and is passed to another channel; see page 27. In the “Type” column select the arrow “➔” to set up this link, or “Tr ➔” if you also wish the trim to act on the mixer input.

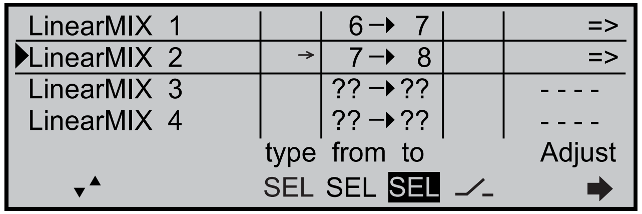
<u>*Example:*</u>
Serial connection of mixers according to the following arrangement:

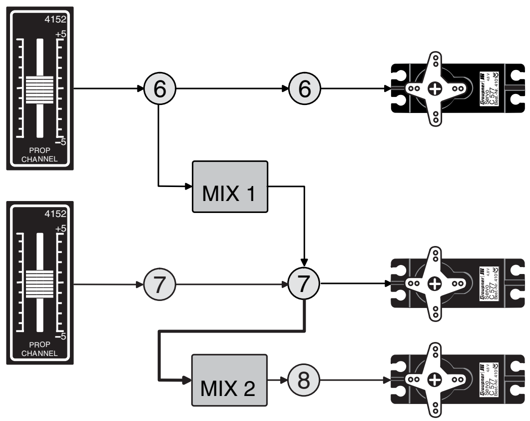
Two mixers (MIX 6 ➔ 7 and 7 ➔ 8):

a) without a serial link



b) the same mixers with a serial link





In this very simple example, where mixer 2 is connected in series, mixer 2 acts on the whole (mixed) servo signal present at control channel 7, and passes it on to control channel 8 in accordance with its set mixer ratio, as shown in b), and not just to the control signal from control function 7, as shown in a). The effect of control “6” therefore extends as far as output “8”. The serial link for additional subsequent mixers can be continued as far as you like, so that, for example, the effect of transmitter control signal “6” extends as far as output “12” if a mixer 8 ➔ 12 is programmed with its associated mixer ratio. Of course, each individual mixer can still be controlled via the assigned transmitter control even when a serial link has been set up. ***The fixed-wing and helicopter mixers also affect “series wired” mixers in the same manner.***

Additional 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, it is possible to achieve very special effects in conjunction with the option of switching a free mixer on and off.

A typical application for this type of mixer is described on pages 130 and 136.

<u>*Tip:*</u>
*If you separate the relevant control function, in this case “8”, from control channel “8” using the »**MIX-only channel**« menu (see page 108), then the servo response is defined only by the mixer ratio (which has not yet been programmed). This enables you to set up linear curves using the mixers 1 ... 4, or five-point control curves for any transmitter control using the curve mixers 5 and 6, as described in the »**Channel 1 curve**« menu. You can also include them in the flight phase switching, in which case this “connection” can be made switchable. However, in this case the “connection” is not just switchable, but can also be*

made to operate with a delay by assigning a time value in the "-Time+" column of the "Transmitter control settings" menu. For more information on this please refer to the programming example entitled "Controlling timed sequences" on page 136.

Before we move on to setting mixer ratios and conclude with a few examples, we have to consider what happens if we **allow a mixer input to act on the preset coupling of aileron servos, flap servos or collective pitch servos:**

- **Fixed-wing models:**

  Depending on the number of wing servos set in the »**Model type**« menu, outputs 2 *and* 5 at the receiver are reserved for the aileron servos, and outputs 6 *and* 7 for the two flap servos.

  When programming mixer outputs to act on such coupled functions, you have to consider the control channels upon which they act:

Mixer	Effect
NN → 2	Aileron effect retained
NN → 5	Aileron plus flap function
NN → 6	Flap effect retained
NN → 7	Flap plus aileron function

- **Model helicopters:**

  Depending on the heli type, up to four servos may be employed for collective pitch control, connected to receiver outputs 1, 2, 3 and 5; the mc-22s software links them together to provide the collective pitch, roll and pitch-axis functions. It is not advisable to mix one of the transmitter controls into these occupied channels using the free mixers available outside the »**Helicopter mixer**« menu, as you may inadvertently generate some extremely complex and unwanted inter-actions. One of the few exceptions to this rule is "Collective pitch trim via a separate transmitter control", as shown in Example No. 3 on page 107.

Important notes:

- *It is essential to remember when dealing with serial links that the travels of the individual mixers are cumulative when multiple stick commands are made simultaneously, and the servo concerned may then strike one of its mechanical end-stops at the extreme of travel. If necessary reduce the servo travel; alternatively use the "Travel limiting" function in the »**Servo adjust**« menu, and / or reduce the mixer values.*
- *When using a PCM transmission link the control data is compressed before being transmitted, and if you use more than eight servo outputs on a PCM receiver with a resolution of 512 steps per channel, the servos connected to receiver outputs 9 and 10 may be slightly less than smooth-running if you have set up the mixers "1 → 9", "1 → 10" and "2 → 10". If you are using one of the new SPCM receivers which offer higher system resolution, these effects may occur at outputs 9 and 10 if you have programmed mixer combinations in which several servos are operated in parallel by one transmitter control. This does not constitute a malfunction of the radio control system.*

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 six available mixers the mixer curves are programmed on a second page of the screen display. Select the number of the mixer you wish to adjust, and select the arrow button „➡" using the rotary control. A brief press on the rotary control or the **ENTER** button takes you to the graphic page.

Linear mixers 1 ... 4: setting linear curves

As an example with a practical application we will define a linear mixer curve in the following section designed to solve the following problem:

We have a powered model with two flap servos connected to receiver outputs 6 *and* 7, which were programmed in the »**Model type**« menu. The flaps are to be employed as landing flaps, i.e. when the associated transmitter control is operated, they deflect down only. However, this flap movement requires an elevator trim correction to counteract a pitch trim change.

In the »**Control adjust**« menu we assign a free linear slider to input 6, e.g. control 7. The control assigned to input 6 now controls the two servos connected to receiver outputs 6 and 7 in the standard way, operating as simple wing flaps.

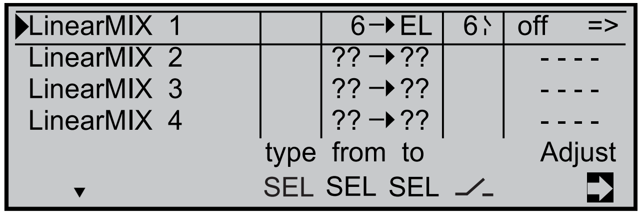
»**Control adjust**« menu:

Enter 5	Cntr 5	0%	+100%+100%	0.0 0.0
Enter 6	Cntr 7	0%	+100%+100%	0.0 0.0
▶Enter 7	free	0%	+100%+100%	0.0 0.0
Enter 8	Cntr 8	0%	+100%+100%	0.0 0.0
«normal »		offset	-travel+	-time+
σ	SEL	SEL	SYM ASY	SYM ASY

Note:
*If you select two flaps ("2 FL") in the »**Model type**« menu, input 7 is automatically blocked to avoid possible malfunctions. However, in the interests of safety we strongly recommend that you make it a routine matter to set all non-required inputs to "free" in any case.*

Start by moving this transmitter control to the forward end-point, and adjust the landing flap linkages so that they are in the neutral position at this slider setting. If you pull the slider back, the flaps should move down; if not, you must reverse the direction of servo rotation.

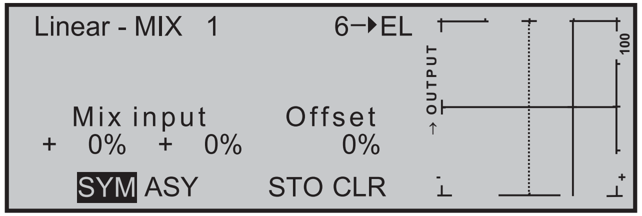
Now we turn to the first mixer on the screen shot shown on page 102: this is the elevator trim mixer „6 → EL“, to which switch 6 has been assigned:



Use the rotary control to move the inverse video field to the bottom line and onto the arrow: ➡. A brief press on the rotary control now switches to the second screen page:

If this display does appear, you have not activated the mixer by operating the assigned external switch – in this case “6”.

To correct this, operate the switch:



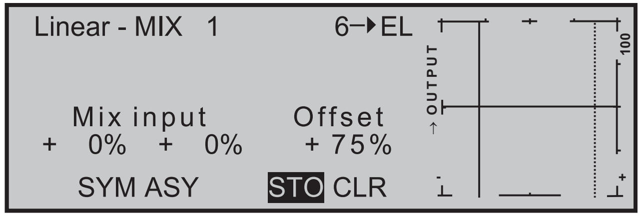
The solid vertical line in the graph represents the current position of the transmitter control assigned to input 6. The solid horizontal line shows the mixer ratio, which currently has the value “zero” over the whole stick travel; this means that the elevator will not “follow” when the flaps are operated.

The first step is to define the **offset** (*mixer neutral point*):

The dotted vertical line indicates the position of the mixer neutral point (“offset”), i.e. that point along the control travel at which the mixer has *no* influence on the channel connected to its output. As standard this point is set to the centre position.

In our example the neutral position of the flaps is located at the forward end-point of the slider, and for this reason no elevator trim correction is necessary at this point; we must therefore shift the mixer neutral point exactly to that point. Move control 6 in the direction of +100%, select **STO** using the rotary control and press the rotary control briefly. The dotted vertical line now moves to this point – the new mixer neutral point – which *always* retains the “OUTPUT” value of zero in accordance with the mixer definition.

As it happens, this setting is difficult to show in a screen shot, so we will change the “offset” value to just +75%.

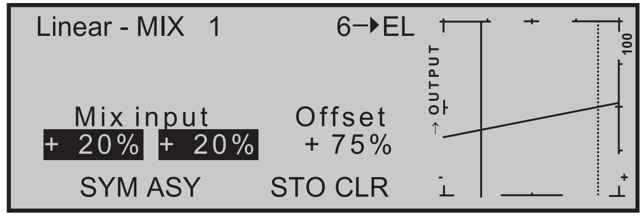


(You can automatically reset the mixer neutral point to centre by selecting **CLR**).

Symmetrical mixer ratios

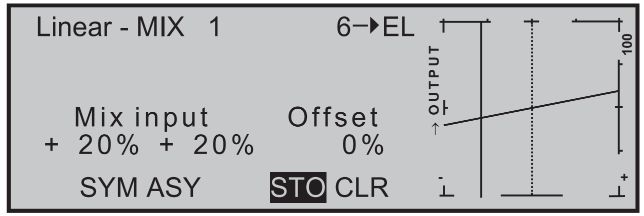
The next step is to define the mixer values above and below the mixer neutral point, starting from the current position of the mixer neutral point. Select the **SYM** field, so that we can set the mixer value symmetrically relative to the offset point we have just programmed. Press the rotary control briefly, then set the values in the two left-hand inverse video fields within the range -150% to +150%. Remember that *the set mixer value always refers to control travels value!* Setting a negative mixer value reverses the direction of the mixer, while pressing the **CLEAR** button erases the mixer ratio.

The “optimum” value for our purposes will inevitably need to be established through a flight testing programme.



Since we previously set the mixer neutral point at +75% of control travel, the elevator “EL” will already exhibit a (slight) down-elevator effect at the neutral point of the landing flaps, and this, of course, is not wanted. To avoid this problem we shift the mixer neutral point back to 100% control travel, as described earlier.

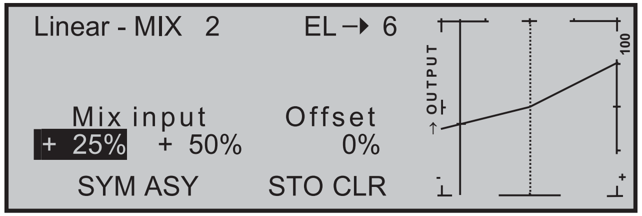
If you were now to reset the offset from 75% to, say, 0% control travel, the screen would look like this:



Asymmetrical mixer ratios

For many applications we need to set up different mixer values on either side of the mixer neutral point.

If you select the **ASY** field and (in our example) move the elevator stick in one direction, the mixer ratio for each direction of control can be set separately:



Note:
If you are setting up a switch channel mixer of the "S ➔ NN" type you must operate the assigned switch to achieve this effect. The vertical line then switches between the left and right sides.

Setting the five-point curve mixers 5 and 6

These two curve mixers enable you to define extremely non-linear mixer curves by placing up to three (freely positionable) points between the two end-points "L" (low = -100% control travel) and "H" (high = +100%) along the control travel.

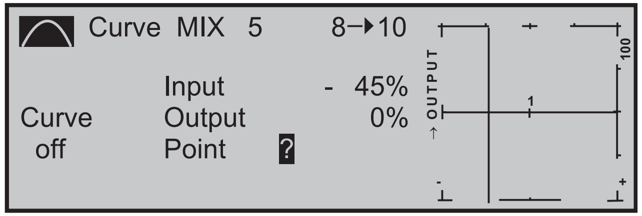
If you have already read the description of the »**Channel 1 curve**« menu, or the method of programming five-point curves in the »**Helicopter mixer**« menu, you can skip the following description.

Programming in detail

The control curve is defined by up to five points, known as "reference points". In the basic setting three reference points are already defined: the two end-points "L" and "H" and point "1", which is exactly in the centre of the curve – see next illustration.

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 only intended for demonstration purposes, i.e. they do not represent realistic mixer curves.



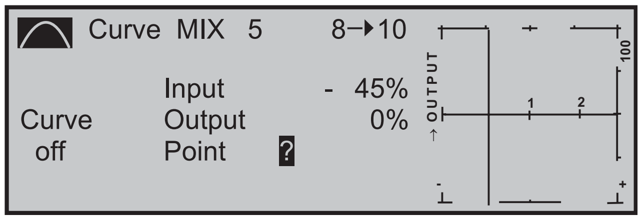
Setting and erasing reference points

When you move the transmitter control assigned to the mixer input – in this case function 8 – a vertical line in the graph moves in parallel between the two end-points. The current stick position is also displayed in numeric form in the "input" line. The point at which this line coincides with the current curve is termed the "output", and this point can be varied within the range -125% to +125% by setting the reference points (see below). This control signal acts upon the mixer output.

In the example above the stick is at -45% travel, but the output signal is still 0%.

Between the two end-points "L" and "H" a maximum of three reference points can be set with a minimum spacing of about 30% control travel. Move the stick, and a brief press on the rotary control fixes an additional reference point at the crossing point with the current control curve as soon as the inverse video question mark **?** is visible. The order in which you generate the additional points is unimportant, as all the reference points are automatically re-numbered sequentially from left to right.

Example:



With the transmitter control in this position you could now define the third reference point between "L" and "H".

If you wish to erase one of the set reference points between "L" and "H", move the stick to the reference point in question. The reference point number and the associated reference point value ("OUTPUT") are displayed in the "Point" line. Press the **CLEAR** button to erase the point. Note that the reference points "L" and "H" cannot be erased.

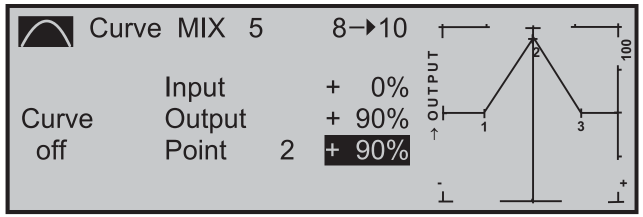
Note:
*For technical reasons the control travel of the two sliders in the centre console may be limited to less than +/-100%. In this case you may need to increase the control travel in the »**Control adjust**« menu in order to set points "L" or "H".*

Changing the reference point values

To change the reference point values move the stick to the reference point to be varied: "L, 1 ... 3 or H".

The screen displays the number of this point and its current curve value. Place the rotary control in the inverse video field, and you can change the current curve value within the range -125% to +125%, without affecting the adjacent reference points.

Example:



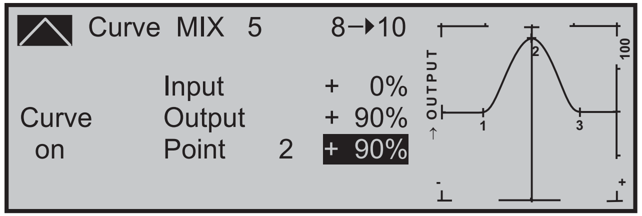
In this example reference point "2" is set to +90%.

Pressing the **CLEAR** button erases the marked reference point.

Note:
If the stick does not coincide with the exact reference point, please note that the percentage value in the "Output" line always relates to the current stick position, rather than the reference point position.

Rounding off the curve

This curve profile is "jagged", but it can easily be rounded off automatically simply by pressing a button. Press the **ENTER** button adjacent to the "curve symbol":

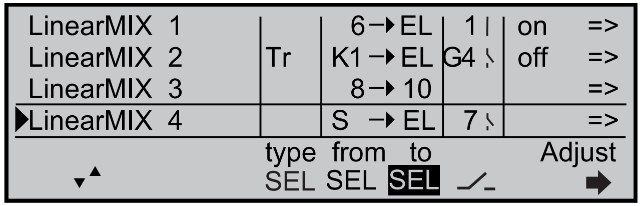


You will find typical examples of "real world" applications amongst the programming examples (page 140 or 147).

Examples:

1. *You wish to set up an (optional) external switch connected to socket 7 to open and close the aero-tow coupling. The switch has already been assigned to control channel 8 in the »**Control adjust**« menu. The aero-tow release is operated by a servo connected to receiver output 8.*

   During initial aero-tow flights it becomes evident that up-elevator has to be held in during the whole of the aero-tow procedure, so we need to add a little up-trim automatically to the elevator servo connected to receiver output 3 whenever the aero-tow coupling is closed. In the screen shot shown on page 102, the fourth linear mixer has already been set up for this, with the switched channel "S" as the mixer input. Now move the selected switch to the mixer OFF position …



   *... and use the ➡ symbol to move to the second page. Here you select **STO** using the rotary control, then press the rotary control briefly; the offset value now jumps to +100% or -100%, depending on the selected switch position.*

   *Move to **ASY** using the rotary control, move the selected switch to the mixer ON position, and set the required mixer input after a brief press on the rotary control.*

2. *The Ch1 stick is to be used alternately to control an electric motor and / or the braking system of a hot-line electric model. The basic requirements are as follows:*

   - *Ailerons: Receiver outputs 2 + 5*
   - *Elevator: Receiver output 3*
   - *Speed controller: Receiver output 6*

   If output 6 is already in use for some other purpose, the next free output socket must be used for the speed controller.

   *In the »**Model type**« menu select "2 AIL" and assign the brake stick to "Input 1".*

   The next step is to set up two flight phases.

   *For example, in the »**Control adjust**« menu leave the phase-specific input 6 at "free", and in the other flight phase assign the open fixed switch FX. Now assign a free mixer "Ch1 ➔ 6" for the speed controller, with a mixer ratio of 100%.*

   *In the »**MIX active/phase**« menu this mixer is activated in that flight phase in which input 6 is "free", and disabled in the flight phase in which the fixed switch is set up.*

   *Now use the same procedure to enter the settings for the two mixers "Brake ➔ 5 aileron" and "Brake ➔ 3 elevator" in the phase-specific »**Wing mixers**« menu, and check the brake offset setting for these mixers in the »**Model type**« menu.*

3. *The final example applies to model helicopters:*

   *If in the Heli program you wish to assign a slider to the collective pitch trim function, e.g. using transmitter control 6 assigned to input 8 (»**Control adjust**« menu, set input 6 to "free", assign input 8 to transmitter control 6), simply define a free mixer „8 ➔ 1" with a symmetrical mixer ratio of, say, 25%. Due to the internal coupling, this transmitter control then acts equally on all existing collective pitch servos, without affecting the throttle servo.*

MIX active/phase

Selecting mixers for individual flight phases

MIX ACTIVE IN PHASE			
LinearMIX	1	6 → EL	yes
LinearMIX	2	C1 → EL	yes
▶LinearMIX	3	8 → 10	no
LinearMIX	4	S → EL	yes
CurveMIX	5	?? → ??	yes
CurveMIX	6	?? → ??	yes
▾▴	«Normal »		SEL

In the default state of the mc-22s transmitter this menu is initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49). Alternatively, move to the »**Basic settings**« menu (see page 117) and select "yes" for the Expert mode; this must be carried out *before* you set up a new model memory.

The "free mixers" of the previous menu can be disabled separately in the various flight phases. You can assign particular mixers to individual flight phases without any restrictions.

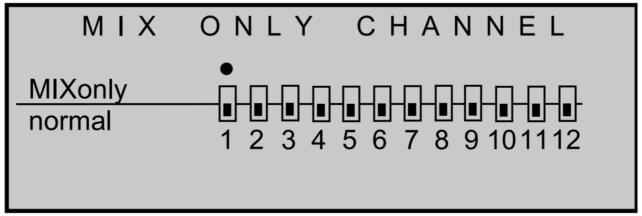
Switch to the flight phase in question and leaf through this menu with the rotary control pressed in. The mixers of the »**Free mixers**« menu are displayed in the centre column.

If you select the **SEL** field, give the rotary control a brief press, and set the mixer in the right-hand column of the mixers to "no"; it is then switched off in the flight phase displayed at the bottom of the screen, and will not appear in the list in the »**Free mixers**« menu.

<u>*Tip:*</u>
In the interests of clarity you should always set all non-used linear mixers and curve mixers to "no".

MIX-only channel

Separating control functions from control channels



In the default state of the mc-22s transmitter this menu is initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49). Alternatively, move to the »**Basic settings**« menu (see page 117) and select "yes" for the Expert mode; this must be carried out *before* you set up a new model memory.

In this menu you can interrupt the normal, direct signal flow between the *control function inputs* and the associated *control channels* at the output side, i.e. the "classic" connection between transmitter control and servo is broken.

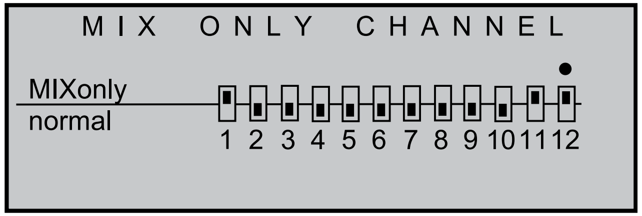
If you set a channel to "MIX-only", the stick, transmitter control (CH5 … CH10) or external switch which might be said to have "lost its servo" now only affect mixer inputs, …

… and the servo connected to a channel set to "MIX-only" is only accessible by means of mixers programmed to its control channel. That is why the term "Mix-only" is used for this function.

You can exploit this facility to use the transmitter controls and servos assigned to one or multiple channels independently of each other for any special functions you require; see the examples at the end of this section for more details.

Using the rotary control, select channel 1 to 12 (●) and give the rotary control a brief press to switch between "MIX only" (▮) and "normal" (▯).

<u>Typical setting:</u>



<u>Examples:</u>

- *If you have a model which does not feature airbrakes, the butterfly ("crow") function (see page 87) can be set up to act as landing aid. However, this is usually operated by the Ch1 stick, like "normal" airbrakes. The servo normally connected to channel 1 (airbrakes) is now usually not installed, but receiver output 1 is not still "free", as the control signal of the brake stick is still present.*

  *This unwanted control signal can be de-coupled from control channel "1", so that it is "freed" from the Ch1 stick signal. This is carried out by setting channel 1 to "MIX only" in the »**MIX-only channel**« menu. In this way control channel 1, and therefore also receiver socket 1, can be used for any other purpose by means of freely programmable mixers, e.g. for operating an electric motor speed controller.*

  *Starting from Example 2 on the previous page, you would need to program a "C1 → C1" mixer, and a second "S → C1" mixer in parallel with it. The same switch is then assigned to this second mixer, which is used to switch between the flight phases. The mixer is then set up in such a way that the motor is reliably "off" when you switch into the brake phase (you may need to reverse the direction of the mixer to achieve this). The next stage is to move to the »**MIX active/phase**« menu and activate or disable one of the two mixers alternately. For more details please read the programming example "Operating an electric motor and butterfly system with the Ch1* *stick", starting on page 129.*

- *In contrast, if your model features airbrakes and you wish, perhaps, to test the effect of the butterfly / crow system with and without the airbrakes, then simply set channel 1 to "MIX only" in order to be able to control the airbrakes via servo 1. If you assign a switch to this mixer, you could then switch it on and off whenever you like.*

Dual mixer

Same-sense / opposite-sense coupling of two channels

```
        D U A L   M I X E R

▶Mixer   1        ≙??≙     ≙??⩡  +   0%
 Mixer   2        ≙??≙     ≙??⩡  +   0%
                                   Diff.
     ▾            SEL      SEL     SEL
```

In the default state of the mc-22s transmitter this menu is initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49). Alternatively, move to the »**Basic settings**« menu (see page 117) and select “yes” for the Expert mode; this must be carried out *before* you set up a new model memory.

The two dual mixers are designed for coupling two channels together to provide same-sens „▲ ▲“ and opposite-sense „▲ ▼“ like a v-tail mixer, but with unrestricted choice of channels, and optional differential travel of the opposite-sense function.

In software terms this type of “dual mixer” is implemented as standard, with the two aileron servos connected to receiver outputs 2 and 5, and the two flap servos to outputs 6 and 7. The flaperons are controlled by the aileron stick and the transmitter control which is assigned to input “6” in the »**Control adjust**« menu. Any further “NN ➔ 2” mixer which you set up then operates the two ailerons as ailerons, while an “NN ➔ 5” mixer operates them as flaps. Similarly, a free mixer “NN ➔ 6” operates both flaps as flaps, while an “NN ➔ 7” mixer operates them as ailerons; see page 104.

The two freely programmable dual mixers in this menu can also be used to couple together two more receiver outputs in the same way; this would normally require more complex programming involving free mixers.

At this point we will give an example of this type of programming (see also the example on page 142):

Large scale gliders often feature six wing control surfaces rather than four, all of which are required to have superimposed aileron / flap functions. In our example the two additional wing flaps are connected to receiver outputs 8 and 9.

Start by selecting mixer 1 or 2 with the rotary control pressed in. After a brief press on the rotary control in the left-hand **SEL** field, enter output “8” in the inverse video „▲??▲“ field using the rotary control, and enter output “9” using the middle **SEL** field:

```
        D U A L   M I X E R

▶Mixer   1        ≙ 8≙     ≙ 9⩡  +25%
 Mixer   2        ≙??≙     ≙??⩡  +  0%
                                   Diff.
     ▾            SEL      SEL     SEL
```

Note:
*The symbols „▲ ▲“ and „▲ ▼“ indicate the same / opposed direction of travel of the control surface connected to the servo in question – not the direction of servo rotation! If the second control surface moves in the wrong “sense” (direction), simply interchange the two inputs, or use servo reverse in the »**Servo adjustment**« menu; see page 56.*

In the right-hand column define the “degree of differential”, as described in the »**Wing mixers**” menu (see page 85). The effect of this function is to reduce the travel of the down-going control surface compared to the full travel of the control surface on the opposite wing. This process generates exactly the dual coupling for servos 8 + 9 which is required. (Pressing **CLEAR** erases the dual mixer, or resets the degree of differential to 0%).

The two additional servos should now “follow” servos 2 + 5 as ailerons when an aileron command is given, and should follow servos 6 + 7 as flaps when a flap command is given. To operate this combination control system all you require is one more free mixer, linking the aileron stick to the two servos 8 and 9. Move to the »**Free mixers**« menu, locate a mixer which is not yet in use, e.g. linear mixer 1, and set it up as follows:

```
▶LinearMIX 1   |    | AI ➔ 9 | 6 | off   =>
 LinearMIX 2   |    | ?? ➔?? |   | - - - -
 LinearMIX 3   |    | ?? ➔?? |   | - - - -
 LinearMIX 4   |    | ?? ➔?? |   | - - - -
               type  from  to       Adjust
     ▾         SEL   SEL  SEL
```

An “AIL ➔ 8” mixer would move the two servos as flaps, i.e. in the same direction: „▲ ▲“.

Now define the mixer setting on the second display page. If you wish, you can assign a switch to the mixer, as shown in this example.

To be able to operate the two *additional* control surfaces as flaps (as well as ailerons), assign the *same* transmitter control to input 8 in the »**Control adjust**« menu as input 6 (e.g. control 6), which – of course – is already in use to control the existing flaps connected to outputs 6 and 7. An alternative method of assigning the transmitter control would be to define a second linear mixer “6 ➔ 8”, which has the same effect.

If you want the flap control system to be different in each flight phase, you will need to program additional free mixers, which you can then activate for the appropriate flight phase in the »**MIX active/phase**« menu. However, the degree of differential can only be set to one value, since the “Dual mixers” cannot be programmed separately for different flight phases.

Tip:
*You can check all the settings immediately in the »**Servo display**« menu.*

Swashplate mixers

Collective pitch, roll and pitch-axis mixers

Further typical applications:

- *Model with two airbrakes:*

  Dual mixer 1: „▲C1▲“ and „▲ 8▼“, diff.= 0%.

  *A second servo connected to output 8 moves in parallel with the first airbrake when the airbrake stick is operated. The trim acts on both servos. For safety’s sake you should set output 8 to “free” in the »**Control adjust**« menu.*
- *Model with two rudders and differential travel (e.g. sweptback flying wing):*

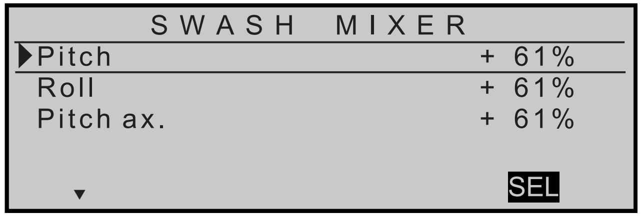
  Dual mixer 1: „▲ 8▲“ and „▲RU▼“, diff.= -75%.

  *When the rudder control is operated, the second servo connected to output 8 follows the first servo (with this programming it is possible to set differential travel for the rudders). The rudder trim acts on both rudders. If you want both rudders to deflect outward when you extend the airbrakes, assign one of the available sliders to input 8 in the »**Control adjust**« menu. You may then have to “experiment” a little with the offset and travel settings to obtain the results you want.*
- *V-tail with differential rudder travel:*

  *In the »**Model type**« menu you* **must** *enter the tail type as “normal” for this application.*

  *Dual mixer 1: „▲EL▲“ und „▲RU▼“, diff.= (*e.g.*)* *-75%*

  Depending on the way the transmitter controls are moved, both servos operate either as elevators or rudders. The differential is only effective when a rudder command is given, in accordance with the channel assignment of the dual mixer. In this case both trim levers are effective. An additional free mixer is not required for this arrangement.



In the »**Helicopter type**« menu you have defined the number of servos which are installed in your helicopter for collective pitch control; see page 53. With this information the mc-22s program automatically couples together the functions for roll, pitch-axis and collective pitch as required, so that you do not need to define any additional mixers yourself.

If you have a model helicopter which only has *a single collective pitch servo*, this menu point is – of course – superfluous, since the three swashplate servos for collective pitch, pitch-axis and roll are controlled independently of each other. In this case the swashplate mixer menu does not appear in 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 in the screen shot above. The pre-set value is 61% in each case, but the value can be varied within the range -100% to +100% if required, after a brief press on the rotary control.

(**CLEAR** = +61%.)

If the swashplate control system (collective pitch, roll and pitch-axis) does not respond to the transmitter sticks in the way you require, then the first step is to change the mixer directions (+ or –), before you attempt to correct the directions of servo rotation.

HEIM mechanics with two collective pitch servos:

- The *collective pitch mixer* acts on the two collective pitch servos connected to receiver sockets 1 + 2;
- the *roll mixer* also acts on the two collective pitch servos, but the direction of rotation of one servo is reversed;
- the *pitch-axis mixer* acts on the pitch-axis servo alone.

<u>*Note:*</u>

Ensure that the servos do not strike their mechanical end-stops if you change the servo mixer values.

Fail-Safe settings

Fail-safe in the "PCM20" transmission mode

```
   F A I L   S A F E  (P C M 2 0)

                 Time    Battery  F.S.
                 hold       off

                 SEL        SEL
```

This menu appears in the multi-function list *only if you have selected the PCM20 transmission mode*. This mode of operation must be pre-set in the memory-specific »**Base setup model**« menu. The PCM20 transmission mode can be used with all receivers with "mc" in the type designation (mc-12, mc-18, mc-20, DS 20 mc receivers, etc.).

Fail-safe programming for SPCM20 mode will be discussed in the next section.

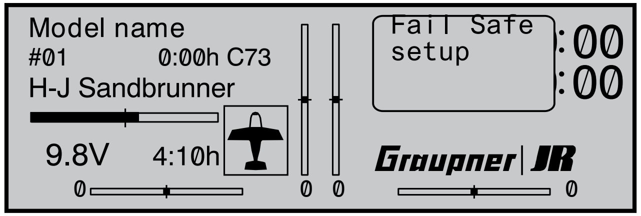
In this menu you can define the behaviour of the receiver when a problem arises in the link between transmitter and receiver, and you can also exploit the option of moving one servo to a particular position when the voltage of the receiver battery falls below a certain value ("battery fail-safe").

Fail-safe and interference

The operational security of Pulse Code Modulation (PCM) is inherently higher than that of Pulse Position Modulation (PPM), since the receiver incorporates an integral micro-processor which detects whether a received signal is valid, or is incorrect or garbled due to outside interference. In the latter case the receiver automatically replaces the invalid signal with the last received correct signal, which is stored in the receiver. This time-limited "holding" procedure suppresses brief interference caused by local drops in field strength and similar momentary problems, which otherwise result in the familiar "glitches".

<u>Caution:</u>
If you use either of the PCM transmission modes (PCM and SPCM), do make use of the enhanced safety features, by programming the throttle position of glow-powered models to idle and the motor function of electric-powered models to Stop if the Fail-Safe is triggered. It is then not so easy for the pilot to lose all control of the model if interference should occur; if this happens with the model on the ground, serious damage to property and even personal injury can result.

If you select the PCM 20 transmission mode but have not yet carried out the fail-safe programming, you will see a warning message on the screen when you switch the transmitter on. The message remains on-screen in the basic display for a few seconds:



If a longer period of interference affects the radio link between transmitter and receiver, the PCM20 operating mode offers two optional types of fail-safe programming, and you can select your preferred one using the *left-hand* **SEL** field.

1. **"Hold" mode**

   If you confirm the left-hand **SEL** field with a brief press on the rotary control, and then set "hold" in the inverse field, when interference strikes the servos will stay continuously at the position corresponding to the last valid signal until the receiver picks up another signal which it recognises as valid.

2. **Variable FAIL-SAFE programming with overwrite facility (display: ".25s, 0.5s or 1.0s")**

   If you set a pre-selected time instead of "hold" mode, the display initially changes as follows:

```
   F A I L   S A F E  (P C M 2 0)

      Position    Time    Battery  F.S.
                  .25s       off

        STO       SEL        SEL
```

With this arrangement "hold" mode is effective when interference first strikes, but after the set delay has elapsed the servos move to previously determined positions until the receiver again picks up a valid control signal. *As soon as* the receiver picks up valid control signals again, the "hold" phase or the servos' fail-safe position are abandoned again *immediately*.

The delay time, i.e. the time from the onset of interference to the triggering of the FAIL-SAFE mode, can be set to any of three values: 0.25 sec., 0.5 sec and 1.0 sec. These variations are designed to cater for models flying at different speeds.

Pressing **CLEAR** resets the fail-safe setting in the inverse video field to "hold".

Setting the servo positions

The FAIL-SAFE servo positions are freely programmable for the receiver outputs 1 ... 8. Use the rotary control to select the **STO** field. Now move servos 1 ... 8 to the appropriate positions using the transmitter controls, then briefly press the rotary control to store those positions as the fail-safe settings. This data is transmitted to the receiver at regular intervals, so that the receiver can always revert to them if interference should strike.

When you store the data – by giving the rotary control a *brief* press – the following message appears on the screen for a few moments:

```
   FAIL SAFE (PCM20)
  Position stored
        Position   Time    Battery F.S.
                   .25s        off

           STO     SEL         SEL
```

The FAIL-SAFE servo positions can be overwritten at any time by selecting the appropriate menu and storing the current transmitter settings anew.

Note:
Some PCM receivers feature outputs 9 and 10, but variable fail-safe settings are not available for them; both servos move to the centre position if interference occurs.

Receiver battery FAIL-SAFE

As soon as the receiver battery voltage falls below a particular value, the servo connected to receiver output 1 (which is assigned permanently to the "Battery F.S." function) runs to one of three pre-set positions. The purpose of this function is to indicate to the pilot that the receiver battery is failing.

```
   FAIL SAFE (PCM20)

        Position   Time    Battery F.S.
                   .25s        -75%

           STO     SEL         SEL
```

Caution:
The "Battery fail-safe" function is a useful contribution to flying safety, but you should never be tempted to rely upon it as a standard warning of "time to land", not least because the discharge behaviour of batteries varies widely according to type, and in any case the battery characteristics change as it ages.

You can program any of three positions as the battery fail-safe setting for servo 1, and they are selected using the *right-hand* **SEL** field:

- +75% travel in one direction,
- 0% servo centre, or
- -75% travel in the opposite direction.

Select your preferred servo position using the rotary control.

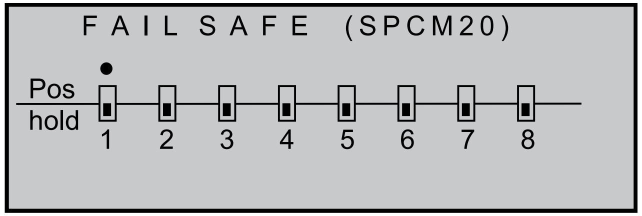
Pressing the **CLEAR** button switches the "Battery F.S." function off.

If the battery fail-safe signal is triggered, you can regain control of the affected channel by briefly operating it (i.e. by moving the throttle stick for a fixed-wing model, or the transmitter control of a mixer input which affects servo 1). This disengages the FAIL-SAFE servo, and it returns to the pilot's commanded position. If this should occur, you must immediately initiate the landing approach in order to have the best possible chance of landing the model under full control.

Warning:
Never, ever, switch off the transmitter when you are flying a model aeroplane – not even for test purposes! If you do, you run a serious risk of losing the model, as you will be highly unlikely to be able to re-activate the RF signal quickly enough, since the transmitter always responds with the security query "RF signal on YES / NO" when switched on.

Fail-Safe setting

Fail-safe in the “SPCM20” transmission mode



This menu appears in the multi-function list *only if you have selected the SPCM20 transmission mode.* This mode of operation must be pre-set in the memory-specific »**Base setup model**« menu. The SPCM20 transmission mode can be used with all receivers with “smc” in the type designation (smc-19, smc-20, smc-19 DS, smc-20 DS etc.).

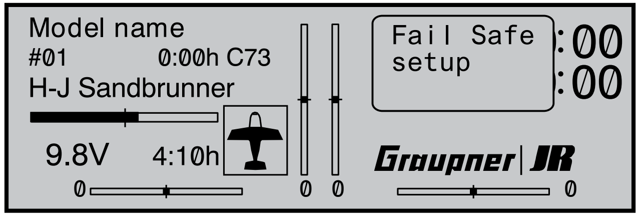
Fail-safe programming for the PCM20 mode is discussed in the previous section.

The operational security of Pulse Code Modulation (PCM) is inherently higher than that of simple Pulse Position Modulation (PPM), since the receiver incorporates an integral micro-processor which detects whether a received signal is valid, or is incorrect or garbled due to outside interference. In the latter case the receiver automatically replaces the invalid signal with the last received correct signal, which is stored in the receiver. This time-limited “holding” procedure suppresses brief interference caused by local drops in field strength and similar momentary problems, which otherwise result in the familiar “glitches”.

Caution:

If you use either of the PCM transmission modes (PCM and SPCM), do make use of the enhanced safety features, by programming the throttle position of glow-powered models to idle and the motor function of electric-powered models to Stop if the Fail-Safe is triggered. It is then not so easy for the pilot to lose all control of the model if interference should occur; if this happens with the model on the ground, serious damage to property and even personal injury can result.

If you select the SPCM 20 transmission mode but have not yet carried out the fail-safe programming, you will see a warning message on the screen when you switch the transmitter on or switch model memories. The message remains on-screen in the basic display for a few seconds:

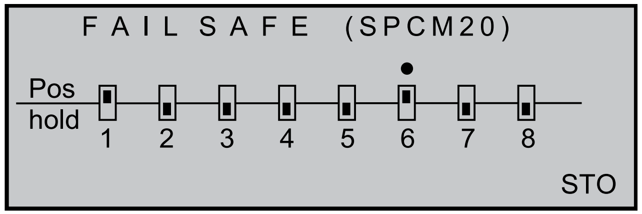


If interference affects the radio link between transmitter and receiver, the “Fail-Safe” function determines the receiver’s behaviour. In SPCM transmission mode the servos can either:

1. **maintain** (“hold”) **the current position** when interference strikes; the servos stay continuously at the position corresponding to the last valid signal until the receiver picks up another signal which it recognises as valid.
2. **move to a freely selectable position** (“Pos”) when interference strikes.

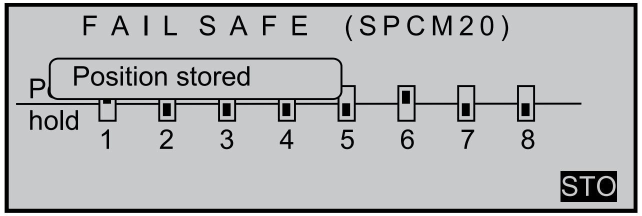
   In contrast to PCM20 mode the receiver outputs 1 ... 8 can be programmed *individually* to “hold” or “position” mode, without a pre-set delay time. Receiver outputs 9 and 10 always stay in “hold” mode.

Use the rotary control to select the channels 1 to 8 (●), and press the rotary control briefly to switch each channel between “hold” (▯) and “position” (▯) mode:



Use the rotary control to select the **STO** field. Now single out all the servos 1 ... 8 which you have set to Position mode, and move them to the appropriate positions using the transmitter controls – all servos *simultaneously* – before briefly pressing the rotary control to store the positions as the fail-safe settings. This data is transmitted to the receiver at regular intervals, so that the receiver can always revert to them if interference should strike.

You will briefly see the following message on the screen when you store the data:

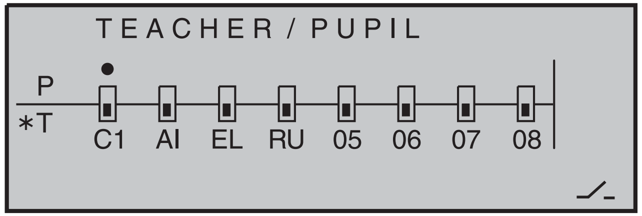


Warning:

Never, ever, switch off the transmitter when you are flying a model – not even for test purposes! If you do, you run a serious risk of losing the model, as you will be highly unlikely to be able to re-activate the RF signal quickly enough, since the transmitter always responds with the security query “RF signal on YES / NO” when switched on.

Teacher/pupil

Connecting two transmitters for Trainer (teacher / pupil, “buddy-box”) operations



In the default state of the mc-22s transmitter this menu is initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49). Alternatively, move to the »**Basic settings**« menu (see page 117) and select “yes” for the Expert mode; this must be carried out *before* you set up a new model memory.

Setting up the Teacher transmitter

Up to eight control functions of the Teacher transmitter “T” can be transferred to the Pupil transmitter “P”, either individually or in any combination.

Select channel 1 to (●) using the rotary control, and press the rotary control briefly to switch between “T (Teacher)” (▮) and “P (Pupil)” (▮) modes:

The model to be controlled by the pupil *must* be programmed *completely* in a model memory of the Teacher transmitter, with all its functions including trims and any mixer functions. The only functions of the Pupil transmitter which are used when control is transferred from the Teacher transmitter are the signals from the sticks and any other transmitter controls which are fitted.

The Teacher transmitter can be operated in PPM18, PPM24, PCM20 or SPCM20 mode.

You must assign a Trainer transfer switch in order to transfer control to the pupil; this is carried out on the right of the screen. We advise the use of the momentary switch, Order No. **4160.1**, or the kick switch, Order No. **4144**, (converted to momentary switch function; see Appendix), as these types of switch allow you regain control at the Teacher transmitter with the least possible delay.

All the parts required are included in the opto-electronic Trainer system, Order No. **3289**. Please refer to the Appendix for details of installing these components.

Setting up the Pupil transmitter

The Pupil transmitter must be fitted with the Trainer pupil module; this unit is connected to the transmitter circuit board in place of the RF (Synthesizer) module, and transfers the control signals via the light-pipe lead.

The following transmitters can be used as the Pupil unit: *GRAUPNER/JR* D14, FM414, FM4014, FM6014, mc-10, mc-12, mx-12, mc-14, mc-15, mc-16, mx-16s, mc-16/20, mc-17, mc-18, mc-19, mc-20, mc-22, mc-22s, mx-22 and mc-24, with four to eight control functions.

The Pupil modules required for the transmitters stated above are listed in the main GRAUPNER catalogue.

<u>Important:</u>
The Pupil transmitter must always be set to operate in PPM mode, regardless of the modulation set on the Teacher transmitter, and …

… the control functions you wish to transfer must act directly on the control channels, i.e. the receiver outputs, without any type of mixer being involved.

If you are using an **mc**- or **mx**-series transmitter, it is best to set up a free model memory with the appropriate model type (“Fixed wing” or “Heli”), and assign it the model name “Pupil”. The stick mode (Mode 1 … 4) and “throttle min. forward / back” should be set to suit the pupil’s preferences; all the other settings should be left at their defaults. If the model type is “Helicopter”, you should also check the throttle / collective pitch function on the Pupil transmitter and reverse it if necessary, and set the idle trim correctly. All other settings, mixers and coupling functions are carried out exclusively in the Teacher transmitter, and are transmitted from this unit.

With “**D**” and “**FM**” type transmitters you must also check the direction of servo rotation and the stick mode, and correct them if necessary by re-connecting the cables inside the transmitter. Switch off all mixers, or set them to “zero”.

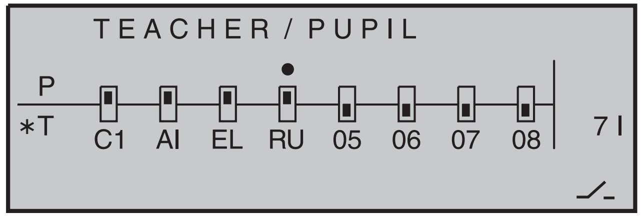
When assigning the control functions the usual conventions must be observed:

Channel	Function
1	Throttle / Collective pitch
2	Aileron / Roll
3	Elevator / Pitch-axis
4	Rudder / Tail rotor

Trainer mode operations

Link the two transmitters using the light-pipe lead, Order No. **3290.4** or alternatively the “ECO” Trainer lead, Order No. **3290.5**; see Appendix. The plug marked “**M**” (Master) must be fitted in the socket on the Teacher transmitter, and the plug marked “**S**” (Student) in the socket of the Pupil transmitter. Switch both transmitters on.

Now select the functions 1 ... 8 which are to be transferred from the Teacher transmitter:



Checking that the system works correctly

Operate the Trainer switch you have assigned:

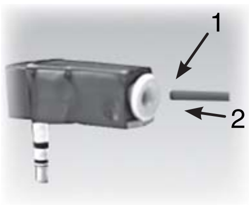
- If the Trainer system is working correctly, the display changes from "∗T" to "∗P".
- If the screen shows the warning message …

None
student-
signal

... in the "Trainer" menu and the basic display, and if the letter "–P" appears on the left of the screen while the transmitter emits audible signals, then the link between the Pupil transmitter and the Teacher transmitter is defective. If this should happen, all functions are transferred automatically to the Teacher transmitter regardless of the Trainer switch position, to ensure that the model is never out of control.

Possible faults:

- Interface in Pupil transmitter not connected correctly in place of the RF module
- Pupil transmitter not ready to use
- Pupil transmitter not set to PPM mode
- Light-pipe not connected properly
- Light-pipe lead loose in plug: if this should happen, press lightly on the end of the connector (1) to release the light-pipe clamp mechanism, then push the light-pipe lead (2) in as far as it will go.



In later systems the light-pipe is held in place by a crimped screw connector.

Check that there is no dirt or dust in the openings of the light-pipe.

Important note:

Never connect either end of the Trainer lead (marked with the letter "S" or "M") to a DSC system socket. The connector is a three-pole barrel type, and is not suitable for this use.

```
GENERAL BASIC SETTINGS
►Owners name           <         >
 Pre-set stick mode       1
 Pre-set modulation     PPM18
 Expert mode              no
 Pre-set min. Pitch     forwrd
  ▼
```

In this menu you can adjust the basic general settings which refer to the transmitter overall, such as the owner's name; you can also enter your personal default settings for new model memories.

Select the relevant line with the rotary control pressed in, then press the rotary control briefly.

In this menu you enter the following **presets**:

- „**Stick mode**",
- „**Modulation**",
- „**Expert mode**",
- „**Collective pitch min.**"

which are automatically adopted in any model memory when you open it *for the first time*. However, these settings can be changed subsequently using the following menus: »**Base setup model**«, »**Suppress Codes**« and »**Helicopter type**«. Changes to the "presets" in *this* menu therefore only affect the next, *newly opened* model memory.

Note:
The settings entered within this menu only have to be entered once, as they apply to the whole of the transmitter. For newly set-up model memories the last entry applies.

Owner's name

At this point you can enter a name with a maximum of 15 characters.

Hold the rotary control pressed in and switch to the next screen page (➡) …

```
 !“#$%&´( )*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_
`abcdefghijklmnopqrstuvwxyz{}~
Ç éâäàåçêëèïîìÄÅÉæÆôöòûùÿÖÜ
Owners name          <H-J Sandbrun      >
                          ◄–►
```

… where you can enter your name by selecting letters from the character list. Use the rotary control to select the character or symbol, and press the rotary control briefly to accept the chosen character and move on to the next position. Move to each character within the name in turn, holding the rotary control pressed in; (the screen shows a double arrow "<—>" at the appropriate point).

Pressing **CLEAR** inserts a space character at that point.

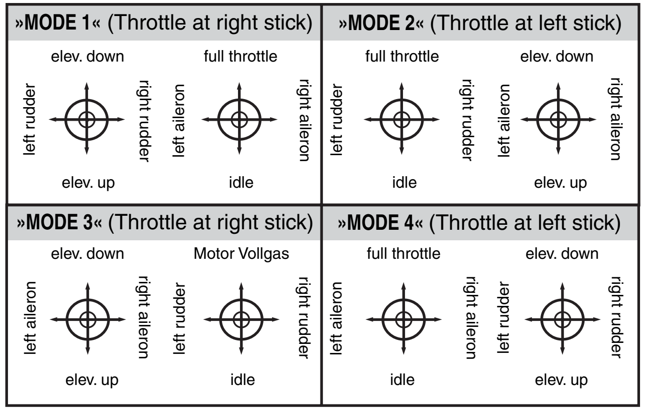
Stick mode

Basically there are four possible ways of arranging the principal control functions on the two dual-axis sticks: the primary functions are aileron, elevator, rudder and throttle (or airbrakes) for a fixed-wing model, and roll, pitch-axis, tail rotor and throttle / collective pitch for a model helicopter. Which of these possible options you select depends on your individual preferences and flying style.

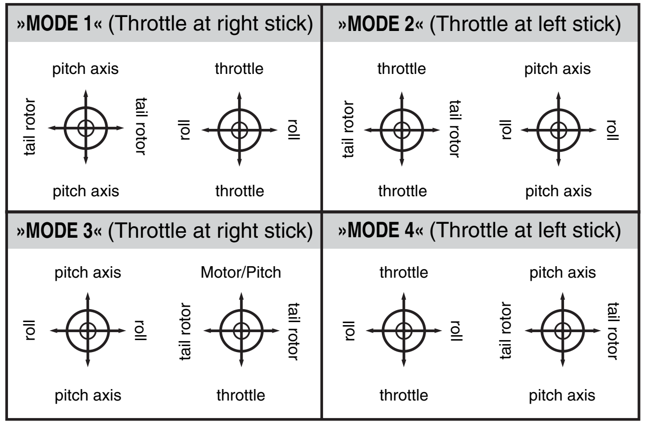
At the bottom edge of the screen you will see **SEL**. Press the rotary control, then use the rotary control to select one of the options 1 to 4.

Pressing **CLEAR** resets the function to stick mode "1".

Fixed-wing stick modes



Helicopter stick modes



Pre-set modulation

The mc-22s differentiates between four different types of modulation:

1. **PCM20**: system resolution of 512 steps per control function, for "mc" and "DS mc" type receivers.
2. **SPCM20**: Super-PCM modulation with high system resolution of 1024 steps per control function, for "smc" and "R330" type receivers.
3. **PPM18**: Most widely used standard transmission

mode (FM or FMsss) for all other *GRAUPNER/JR* PPM FM receivers.

4. **PPM24**: PPM multi-servo transmission mode for simultaneous operation of up to twelve servos, for the “DS 24 FM S” receiver.

Pressing **CLEAR** switches to the “PCM20” modulation type.

Expert mode

The “Expert mode” setting alters the contents of the multi-function list. The function only takes effect when you open a new model memory.

„**no**“: The multi-function list contains only a limited selection of menus. This mode is intended primarily for beginners, who generally only need a small number of options for programming their models. Regardless of the Expert mode setting, you can call up the »**Suppress Codes**« menu at any time to display the suppressed menus, or to suppress others.

„**yes**“: The multi-function list includes all the menus of the mc-22s.

<u>Exception:</u>
*The »**Fail-Safe**« menu is only included if the transmitter is set to the “PCM20” or “SPCM20” transmission mode.*

*The »**Swashplate mixer**« menu is only listed if you have entered more than “1 servo” for the swashplate type in the »**Heliicopter type**« menu.*

Collective pitch min. (model helicopters only):

At this point you define the operating direction of the throttle / collective pitch stick in the Heli programs; it should be selected to suit your preferred method of control. This is very important, as the function of all the other options in the helicopter program depends upon it, insofar as they affect the throttle and collective pitch functions, i.e. the throttle curve, idle trim, Channel 1 → tail rotor mixer etc..

Key to settings:

„**forward**“: minimum collective pitch setting when the collective pitch stick (Ch1) is forward (away from you)

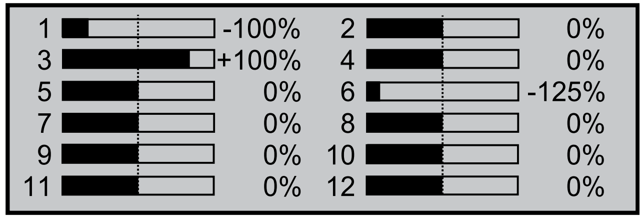
„**back**“: minimum collective pitch setting when the collective pitch stick (Ch1) is back (towards you).

Pressing **CLEAR** resets to “forward”.

<u>Note:</u>
*The direction of operation of the Ch1 stick for the fixed-wing program can be reversed in the »**Model type**« menu.*

Servo display

Display of servo positions



In this menu the current position of each servo is displayed accurately in bar diagram form, covering the range -150% to +150% of normal travel. The display takes into account the transmitter control settings, the servo settings, the Dual Rate / Expo functions, etc.. A setting of 0% corresponds exactly to the servo centre point.

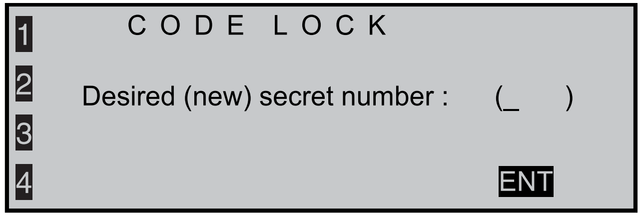
You can call up the »**Servo display**« by selecting this menu, and also with a brief press on the rotary control *directly from the transmitter’s basic display*.

<u>Notes:</u>

- *To avoid the possibility of programming errors, any interchanging of receiver outputs carried out in the »**Base setup model**« is not reflected in this display, as the programming always relates to the original default receiver assignment.*
- *The number of channels displayed in this menu corresponds to the twelve control channels available in the mc-22s transmitter. However, the number of channels actually present varies according to the receiver type you are using, and the number of servos connected to it; it could therefore be much lower.*
- *We recommend that you use this display constantly when programming a model, as you can then immediately check all the settings you have made at the transmitter. However, although this facility is useful, it does not relieve you of the need to test all the programming steps carefully before you operate the model for the first time. Thorough checking is essential to eliminate the danger of programming errors!*

Code lock

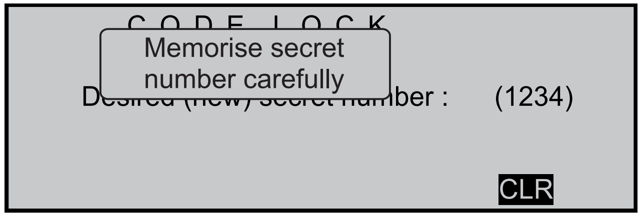
Barring access to the multi-function list



In the default state of the mc-22s transmitter this menu is initially suppressed. To activate it, move to the »**Suppress codes**« menu (see page 49). Alternatively, move to the »**Basic settings**« menu (see page 117) and select “yes” for the Expert mode; this must be carried out *before* you set up a new model memory.

You can protect the multi-function menu from unauthorised use by entering a four-digit code number using the numbers 1 to 4. The security number is entered using the set of buttons on the left-hand side.

Provided that the digits **1** … **4** are visible at the left-hand edge of the screen, you can enter the numbers using the buttons as follows: **ENTER** = 1, **ESC** = 2, **CLEAR** = 3 and **HELP** = 4.

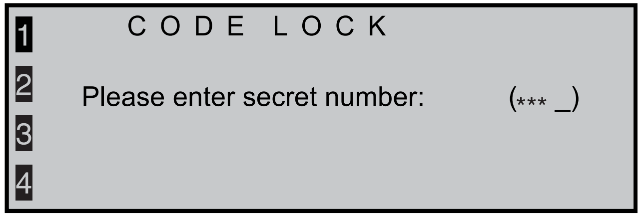


A brief press on the rotary control (**CLR**) erases the numbers you have entered.

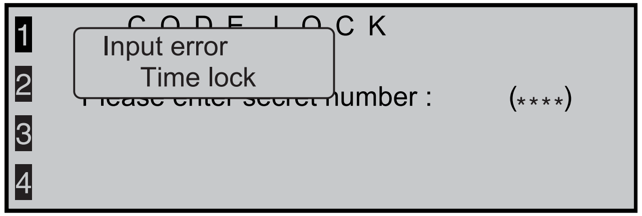
Make a careful note of the security code number; we suggest that you write it down and store it in a safe place. If you forget the number you will have to send the transmitter to the GRAUPNER Service Centre for de-coding.

When you are satisfied, press the **ENTER** or **ESC** button to confirm the four-digit security number.

The lock takes effect next time you switch the transmitter off. When you switch on, the controls work without restriction, but the next time you access the multi-function menu you will need to enter the correct number combination:



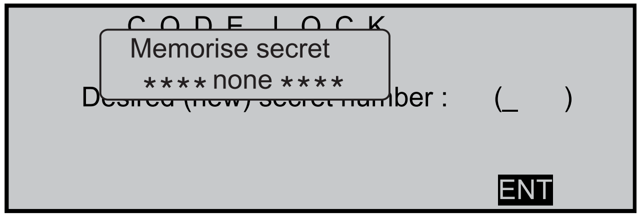
If you enter the code number incorrectly, you have to wait a certain period of time before you can try again.



Erasing the code number

If the code number is erased again at some later date, call up this menu and immediately press the rotary control twice.

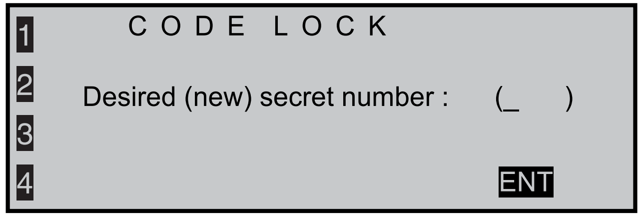
Pressing the rotary control once erases the code number (**CLR**). The second press calls up this display:



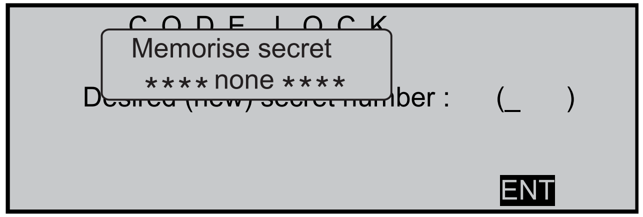
Now quit the menu by pressing the **ENTER** or **ESC** button. At this point the four inverse digits **1**, **2**, **3**, **4** disappear, so the side buttons revert to their original function.

Leaving the menu without entering a code number

You may have called up the menu out of curiosity or by mistake, and now wish to leave it without pressing any other buttons. At this point the screen looks like this:



Press the rotary control *once*. The following display appears:



Now quit the menu by pressing the **ENTER** or **ESC** button. At this point the four inverse digits **1**, **2**, **3**, **4** disappear, so the side buttons revert to their original function.

Tip:
*If you don’t want to use the programming lock at all, we advise you to remove this menu from the multi-function list using the »**Suppress Codes**« menu, otherwise an unauthorised person could enter a code number and thereby prevent you using your own transmitter.*

Preparation, e.g. with a fixed-wing model aircraft

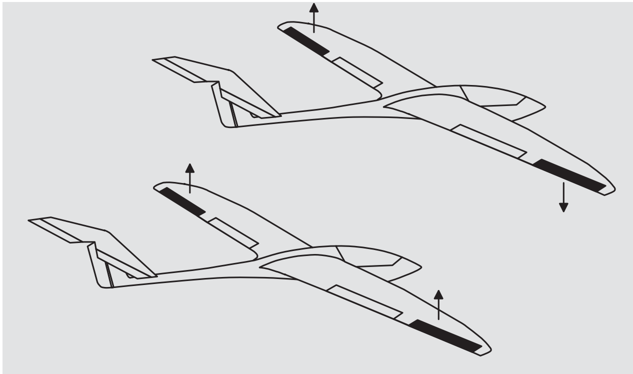
Programming model data into an mc-22s ...

... is easier than it may appear at first sight.

There is one basic rule which applies equally to all programmable radio control transmitters – not just to the mc-22s: if the programming is to go smoothly and the systems work as expected, the receiving system components must first be installed correctly in the model, i.e. the mechanical systems must be first-rate. This means: ensure that each servo is at its correct neutral position when you fit the output lever or disc and connect the linkage to it. If you find this is not the case, correct it! Remove the output arm, rotate it by one or more splines and secure it again. If you use a servo tester, e.g. the Digital Servo Analyzer, Order No. **763**, to centre the servos, it is very easy to find the "correct" position.

Virtually all modern transmitters offer facilities for offsetting the neutral position of servos, but this is no substitute for a correct mechanical installation; it is only intended for *fine tuning*. Any substantial deviation from the "0" position may result in additional asymmetry when the signal undergoes further processing in the transmitter. Think of it in this way: if the chassis of a car is distorted, you may be able to force the vehicle to run straight by holding the steering wheel away from centre, but it does not make the chassis any less bent, and the basic problem of inefficiency remains. Another important point is to set up the correct control travels as far as possible by using the appropriate linkage points in the mechanical system; this is much more efficient than making significant changes to the travel settings at the transmitter. The same rule applies: electronic travel adjustment facilities are designed primarily for fine adjustment and to compensate for minor manufacturing tolerances in the servos, and not to compensate for poor-quality construction and defective installation.

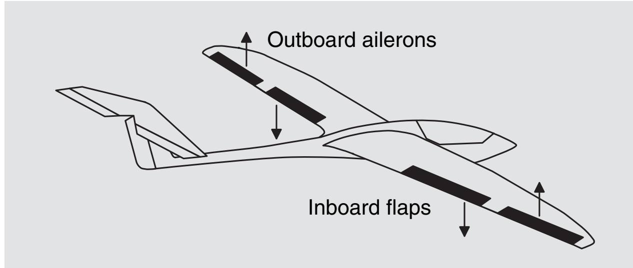
If two separate aileron servos are installed in a fixed-wing model aircraft, the ailerons can also be employed as airbrakes by deflecting both of them up, and as flaps by deflecting them down – simply by setting up suitable mixers. In general terms such systems are more often used in gliders and electric gliders than in power models. This option is covered on the next double page.



In such cases the servo output arms should be offset forward by one spline relative to the neutral point, i.e. towards the leading edge, and fitted on the servo output shaft in that position. The mechanical differential achieved by this asymmetrical installation takes into account the fact that the braking effect of the up-going ailerons increases with their angle of deflection, and this means that much less travel is usually required in the down-direction than the up-direction.

Similar reasoning applies to the installation of the flap linkage when separately linked flap servos are installed, designed to be used in a butterfly (crow) system. Here again an asymmetrical linkage point is useful. The braking effect of the crow system is provided primarily by the down-movement of the flaps rather than the up-movement of the ailerons, so in this case the servo output arms should point aft, i.e. offset towards the trailing edge, as this makes greater travel available for the down-movement. When this combination of lowered flaps and raised ailerons is used, the ailerons should only be raised to a moderate extent, as their primary purpose in this configuration is to stabilise and control the model rather than act as brakes.

You can "see" the difference in terms of braking effect by deploying the crow system, then looking at the top and bottom of the wing from the nose: the larger the projected area of the deflected control surfaces, the greater the braking effect.



This type of asymmetrical installation of the servo output arms can also make sense when you are setting up split flaps or landing flaps on a power model.

Once you have completed your model and set up the mechanical systems accurately in this way, you are ready to start programming the transmitter. The instructions in this section are intended to reflect standard practice by describing the basic general settings first, and then refining and specialising them to complete the set-up. After the first test-flight, and in the course of continued test-flying, you may need to adjust one or other of the model's settings. As your piloting skills improve and you gain experience, you might want to try out different control systems and introduce other refinements, and to cater for these requirements you may find that the text deviates from the obvious order of options, or that one or other of the options is mentioned more than once.

At this point, just before you start programming the model data, it is worthwhile thinking carefully about a sensible layout of the transmitter controls.

If the model in question is one with the emphasis on "power" – whether the power is from an electric motor or an internal combustion engine – you will probably encounter few problems in this matter, because you have already defined the stick mode, and the sticks are employed primarily to control the four basic functions "power control (= throttle)", "rudder", "elevator" and "aileron". Nevertheless, you still have to call up the ...

»Model type« menu (page 52)

MODEL TYPE			
▶Motor		Thr. min rear	
Tail type		Normal	
Aileron/camber flaps		1 AIL	
Brake	Offset +100%	Enter	1
▼		SEL	

… and define your preferred throttle direction, i.e. throttle minimum "forward" or "back", because the default setting is "none" (i.e. no motor).

The difference between "none" and "throttle min. forward / back" is the effect of the Ch1 trim. The trim is effective over the full stick travel if "none" is entered, but it only affects the idle range if you enter "throttle min. forward / back".

At the same time the "direction of effect" of the Ch1 stick is also changed accordingly, to avoid the necessity of reversing the throttle servo if you switch from "idle forward" to "idle back", or vice versa. A safety feature connected with the idle setting is the on-screen warning which appears when you switch the transmitter on, if the throttle stick is too far in the direction of full throttle; an audible alarm sounds at the same time. This only appears if you have set "Throttle min. forward / back".

```
Thr
 too
    high!!
```

Apart from these basic considerations, you will certainly want to think carefully how best to control any "auxiliary functions" included in your model.

In contrast, if your model is a glider or electric glider the whole situation may be rather different. The immediate question is: what is the best method of controlling the motor and braking system? Some solutions have proved to be practical, and others less so.

For example, it is not a good idea to be forced to let go of one of the primary sticks in order to extend the airbrakes or deploy the crow braking system when your glider is on the landing approach. It surely makes more sense to set up switchable functions for the Ch1 stick (see programming example: page 129), or to assign the braking system to the stick, and shift the motor control to a slider – or even a switch. With this type of model the electric motor is often little more than a "self-launching system", and is used either to drag the model into the sky at full power, or to pull it from one area of lift to the next at, say, half-power, and for such models a three-position motor switch is usually quite adequate. If the switch is positioned where you can easily reach it, then you can switch the motor on and off without having to let go of the sticks – even on the landing approach.

Incidentally, similar thinking can be applied to flap control systems, regardless of whether they are "just" the ailerons, or full-span (combination) control surfaces which are raised and lowered in parallel.

To control the flaps all you need is an external switch with a long toggle (Order No. **4160**), or the differential switch, Order No. **4160.22**, and the ideal location for it is on the outside edge of the transmitter on the same side as the throttle / brake stick. You can then reach the switch at any time without having to let go of the sticks.

In contrast, the motor can be controlled very effectively by means of a two-position or three-position switch (Order No. **4143** or **4113** respectively) mounted in the stick itself. These switches have to be installed by your local *GRAUPNER* Service Centre.

If you don't wish to use a stick switch, the motor should be controlled by a switch installed on the side of the transmitter opposite to the hand which holds the model for launching. In other words: if you launch the model with your right hand, then the motor switch should be in the "outside left" position, and vice versa.

Once you are satisfied that all these preparations have been completed successfully, you can make a start on programming.

First steps in programming a new model

Example: non-powered fixed-wing model aircraft

The first time you use a new transmitter you should select the ...

»Basic settings« (page 117)

GENERAL BASIC SETTINGS	
Owners name	<H-J Sandbrunner>
Pre-set stick mode	1
Pre-set modulation	PPM18
Expert mode	no
Pre-set min. Pitch	forwrd
	SEL

... and define a number of basic settings. These serve various purposes:

The owner's name which you enter in this menu appears in the basic screen display, while the options marked "Preset" – Stick mode, Modulation and Coll. pitch min. – really are just presets. The settings you enter here are adopted as the defaults when you open a *new* model memory, but they are only a *suggestion*, and you can still change them at any time.

In contrast, the preset in the **Expert mode** line only takes effect when you *initially set up* a model memory which was previously marked as "∗∗∗free∗∗∗". When "Expert mode" is set to "no", certain menus are suppressed which are generally relevant only to more advanced modellers, but this only applies *when you set up a new model memory*. However, once again the individual suppressed menus can be displayed again by calling up the »**Suppress Codes**« menu in the appropriate model memory.

When **programming a new model** you start in the menu ...

»Model select« (page 47)

01	CUMULUS 97	SPCM20	1:25h
02	Laser	PCM20	2:45h
03	DV20 KATANA	PPM18	5:26h
04	MEGA STAR	SPCM20	8:31h
05	∗∗∗free∗∗∗		
06	∗∗∗free∗∗∗		

... where you select a free model memory and confirm your choice by pressing the **ENTER** button, or giving the rotary control a brief press.

Once you have selected a free model memory, you are requested to select the type of model to be programmed:

Select model type (free model memory)

Since in this example we are programming a fixed-wing model, we select the fixed-wing model symbol using the rotary control, and confirm with **ENTER** or a brief press on the rotary control. The screen now reverts to the basic display.

Once you have called up the "Model select" option it is *__not__* *possible to interrupt the process, i.e. you* *__must__* *choose one or the other model type. However, if you make a mistake you can always correct it simply by erasing the model memory.*

Now that you have overcome this first hurdle, you can start entering the actual transmitter settings to suit the model by calling up the menu ...

»Base setup model« (page 50)

BASIC SETTINGS, MODEL				
Model name	<			>
Stick mode	2			
Modulation	PPM18			
Trim steps	4	4	4	4
receiver output				=>

At this point you can enter the "**Model name**", check the settings for "**Stick mode**" and "**Modulation**", and change those settings if necessary.

You can also set the trim increment for the digital trims, i.e. the number of trim increments for every "trim lever click". This can be done separately for each of the four trim levers.

The next menu is ...

»Model type« (page 52)

MODEL TYPE				
Motor			None	
Tail type			Normal	
Aileron/camber flaps			1 AIL	
Brake	Offset	+100%	Enter	1
			SEL	

... in which you select the basic arrangement of the servos in the model, and inform the transmitter of your choice.

The following options are available:

Motor:
- "none": trim works in all positions of the stick
- "Throttle min forward or back": Ch1 trim works over idle range only.

  If the throttle stick is too far in the direction of full throttle when you switch the transmitter on, a warning message "Throttle too high" appears on the screen; see page 20.

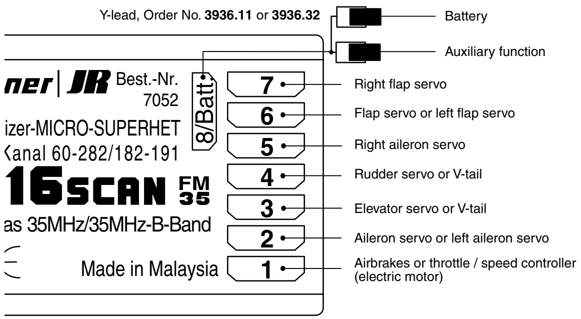
Tail: “Normal”, “V-tail”, “Delta / flying wing” or “2 EL Sv 3 + 8”

Ailerons / flaps: 1 or 2 aileron servos and 0, 1 or 2 flap servos

Brake: Airbrake servo control via Ch1 stick or (optionally) using a transmitter control connected to input 8 or 9 (»**Control adjust**« menu).

As we wish to operate the airbrake servo at output 1 using the Ch1 stick, we leave the setting under “Brake” at “Input 1”. The only change you need to make here is to move the mixer neutral point to the position at which the airbrakes are retracted; this is carried out via “Offset”. If the offset is not located right at the end of the control travel, the remaining travel is a “dead zone”, i.e. it no longer affects any mixers. However, this is only significant if you later use one of the three mixers “Brake ➔ NN”, in the »**Wing mixers**« menu.

At this juncture – if not before – you should check that the servos are connected to the receiver in the standard *Graupner* sequence:



<u>*Note:*</u>
If you set up a V-tail, but the “up / down” and / or “left / right” functions work the wrong way round, please refer to the table in the right-hand column of page 35. The same procedure can be used if you set up flaperons (superimposed ailerons and flaps) and they work the wrong way round.

The *following settings* apply to a model with a *“normal”* tail; if your model has a V-tail, the settings can be accepted virtually unchanged. However, if the model is a delta or flying wing the situation is not quite so simple. You will find a special programming example covering this model type on page 138.

»Servo adjustment« (page 56)

▶Servo 1	=>	0%	100%	100%	150%	150%
Servo 2	=>	0%	100%	100%	150%	150%
Servo 3	=>	0%	100%	100%	150%	150%
Servo 4	=>	0%	100%	100%	150%	150%
	Rev	cent.	- travel	+	- limit	+
▾	SEL	SEL	SYM	ASY	SYM	ASY

In this menu you can set various parameters relating to the servos, i.e. “**Direction of rotation**”, “**Neutral setting**”, “**Servo travel**” and “**Travel limit**” (maximum permitted servo travel) to suit the requirements of the model.

By “requirements” we mean adjustments to servo centre and servo travel which are needed to compensate for minor tolerances in servos and *slight* inaccuracies on the model.

<u>*Note:*</u>
*The facilities provided in this menu for setting asymmetrical servo travels are not intended for setting differential travel on ailerons and / or camber-changing flaps. There are functions designed specifically for this in the »**Wing mixers**« menu; for a V-tail the »**Dual mixer**« menu should be used.*

In the last column “**Travel limit**” – the basic settings of 150% in each case should be reduced significantly, since the values stated here act virtually as “limiters”. This setting defines the point on the servo’s travel beyond which it is not permitted to move, and is designed to prevent the servo striking its mechanical end-stop and stalling (drawing a heavy current). The deciding factor for this value is therefore the end of the mechanical movement available at the servo, control surface and / or linkage.

As an example of this we will consider a model with a standard (cruciform, “cross”) tail in which the rudder moves in a wedge-shaped cut-out in the elevator. The rudder must not deflect to the point where it fouls the elevator, as this could jam it, and it is usual practice to adjust the pushrod travel mechanically so that at full stick deflection the rudder has slight clearance to the elevator at both extremes of travel. Provided that the rudder is controlled solely by its dedicated stick, this system presents no further problems. However, if you set up a mixer which also affects the rudder, i.e. you add an additional signal to the normal rudder signal (e.g. an “aileron ➔ rudder” mixer), the cumulative effect of the two signals may be excessive, and the rudder may yet foul the elevator. Setting the travel limit correctly in this menu will reliably prevent the rudder deflecting too far. However, take care not to set the travel limit at too low a value, as this would place an excessive restriction on the rudder deflection.

When you have completed the settings to this point, a fixed-wing model – either powered or glider – will be ready to fly in its basic form; note that for a powered model you must also define the correct idle stick position in the »**Model type**« menu.

However, there are no “refinements” in this set-up, and it is the refinements which will give you more long-term pleasure in your flying. Assuming that you are already capable of flying your model safely, it is time to get a taste of these extra facilities; to this end we now move on to the menu ...

»Wing mixers« (page 84)

Aileron difference				+	0%		
Flap difference				+	0%		
Ailerons	2 –>4	Rudder		+	0%		
Ailerons	2 –>7	Flaps		+	0%		
Brake	–>3	Elevator		+	0%		
Brake	–>6	Flaps		+	0%		
Brake	–>5	Ailerons		+	0%		
Elevator	3 –>6	Flaps	+	0%	+	0%	
▶Elevator	3 –>5	Aileron	+	0%	+	0%	
Flaps	6 –>3	Elevator	+	0%	+	0%	
Flaps	6 –>5	Ailerons	+	0%	+	0%	
Reduction of diff.				+	0%		
▾▴				SYM	ASY		

<u>Note:</u>
*This menu will show a varying range of options depending on the information you have entered in the »**Model type**« menu.*

Of particular interest at the moment are “**Aileron differential**”, the “**Aileron 2 ➔ 4 rudder**” mixer – sometimes known as a Combi-Switch or CAR (coupled aileron and rudder) – and possibly the mixers “**Brake ➔ 5 aileron**” and “**Brake ➔ 6 flaps**”.

The purpose of “**Aileron differential**” is to eliminate adverse yaw. When a model aircraft turns (rolls), the down-going aileron produces more drag than the up-going one when both move through the same angle, and this causes the aeroplane to yaw in the opposite direction to the turn – see also page 85. This can be eliminated by setting differential servo travel. A value between 20% and 40% is usually a good starting point, but the “perfect” setting nearly always has to be established by practical testing.

The same applies to the “**Flap differential**” if your model is fitted with two camber-changing flap servos, assuming that you wish the flaps to have a superimposed aileron function, e.g. as set up using the “**Aileron 2 ➔ 7 flaps**” mixer.

The “**Aileron 2 ➔ 4 rudder**” mixer serves a similar purpose, but also makes many models generally easier to handle when turning. A value of around 50% is usually a practical starting point for this. However, it should be possible to switch this function off, particularly if you have ambitions as an aerobatic pilot; this can be achieved by assigning a physical switch to the mixer.

Setting up a “**Brake ➔ 3 elevator**” mixer is usually only necessary if your model suffers a marked pitch trim change (model balloons up or dives) when you deploy any form of braking system. This problem usually only arises if ailerons are set to deflect “up” for braking, or are used in combination with a butterfly (crow) system. If you set up such a mixer it is important to test the setting at a safe height, and adjust the trim compensation if necessary.

<u>Note:</u>
*This mixer “**Brake ➔ 3 elevator**” can also be “misused” for a similar purpose: to compensate for pitch trim changes which occur when the throttle is opened or closed. This problem is generally due to incorrect motor downthrust (angle of the motor’s thrustline relative to the model aircraft’s centreline). In this case all you have to do is move the “Brake offset” in the »**Model type**« menu to coincide with the idle stick position, and set a suitable value in this mixer.*

If you have selected “2 AIL” or “2 AIL 1/2 FL” in the “Ailerons / flaps” line of the »**Model type**« menu, …

M O D E L T Y P E			
Motor			None
Tail type			Normal
▶Aileron/camber flaps			2 AIL
Brake	Offset	+100%	Enter 1
▾▴			SEL

… and if the ailerons are required to operate as brakes when the throttle / brake stick (Ch1) is moved, then a suitable value needs to be entered in the “**Brake ➔ 5 aileron**” line.

Ailerons	2 –>4	Rudder	+	0%
Ailerons	2 –>7	Flaps	+	0%
Brake	–>3	Elevator	+	0%
Brake	–>6	Flaps	+	0%
▶Brake	–>5	Ailerons	+	0%
▾▴		«Landing»	SEL	

In principle the same applies if you select “2 AIL 1/2 FL” for the line “**Brake ➔ 6 flaps**” which is also available. However, this value should be selected in such a way that the flaps deflect down as far as possible when the brake stick is operated. Do ensure that none of the servos is mechanically obstructed (stalled) at this point.

If the ailerons are set up to act as brakes, either by deflecting them up or by setting up a full butterfly (crow) system (as already described), then you should *always* enter a value for “**Differential reduction**” (see page 88) – setting 100% is the safe option here!

Entering a value here provides proportional suppression of any aileron differential you have set, but <u>only when the brake stick is operated</u>, in order to increase the down-going aileron travel on the landing approach, with the aim of improving aileron response.

If the wing is equipped with two camber-changing flap servos in addition to two separately actuated ailerons, then the “**Aileron 2 ➔ 7 flaps**” mixer transfers the aileron movements to the flaps; we suggest that the flaps should not follow the movement of the ailerons to a greater extent than about 50%.

The “**Flaps 6 ➔ 5 aileron**” mixer works in the opposite direction: depending on the layout of the model; we suggest values between about 50% and 100% for this option.

The position of the camber-changing flaps in the in-

*dividual flight phases is determined primarily by the Offset value entered in the »**Control adjust**« menu; see page 58. However, if you wish to be able to vary the flap settings in flight, or generally prefer manual flap control, any transmitter control assigned to "input 6" can be used; see »**Control adjust**«, page 58; e.g. one of the two sliders fitted as standard. This control operates the two flap servos connected to receiver output 6, or outputs 6 and 7, assuming that you have entered "1/2 FL" in the "Ailerons / flaps" line of the »**Model type**« menu. However, we recommend that you reduce the transmitter control travel to 25% or even less, as this provides fine control of the flaps using the slider. A differential switch, Order No. **4160.22** (see page 164) is also suitable; it should be fitted in an easily accessible position.*

The remaining options in the »**Wing mixers**« menu are designed to provide further fine-tuning of multi-flap wing systems and are largely self-explanatory.

When you have completed the model-specific settings to this point, you are probably ready to consider the model's first flight. At this point you should certainly take the time to carry out a series of "dry runs", i.e. to check all the settings thoroughly while the model is still on the ground. Remember that a serious programming error may damage more than just the model. If you are not sure of any point, ask an experienced model pilot for advice.

If during the test phase you realise that one or other of the settings needs to be changed in order to tailor the model's control response to your preferences – perhaps the servo travels are overall too great or too small – then we suggest that you turn to the following menu ...

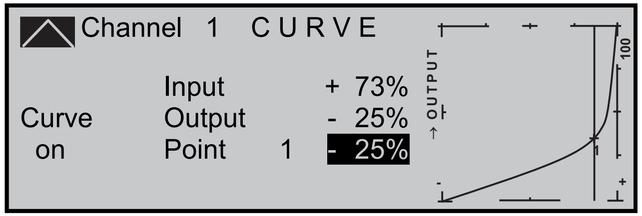
»Dual Rate / Exponential« (page 64)

... in order to adjust the overall set-up to suit your requirements and flying style.

Dual Rates are used to adjust the magnitude of the stick's effect. However, if it is only the control response around neutral which is too powerful for comfortable flying, i.e. the maximum travels are acceptable, then "Exponential" can also be employed. If an external switch is assigned to this function, it is even possible to switch between two different Dual Rate / Expo settings when the model is in flight.

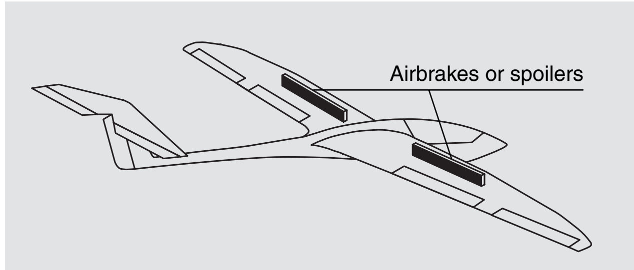
The same applies to ...

»Channel 1 curve« (page 68)

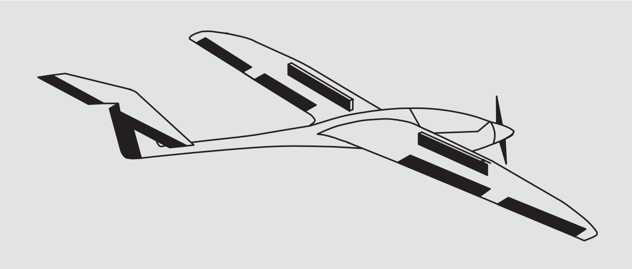


In this option you can place one or more reference points on the control curve of the throttle / brake servo in such a way that it responds to commands in exactly the way you wish.

A good example of this is adjusting the airbrake "dead zone". Usually the brakes only extend from the wing after the airbrake stick has been moved some distance, i.e. there is a "dead zone" in the airbrake stick travel. "Bending" the curve slightly will shorten the "dead zone". The airbrakes will then extend from the wing rather earlier, and you will have finer control over the rest of the travel. Similar arguments might also be applied to the motor control system, which could be controlled via Ch1 as an alternative.



Including an electric power system in the model programming



There are various ways of switching electric power systems on. The simplest method of including an electric motor in a model set-up is to use the throttle / brake stick. However, since we have already reserved the Ch1 transmitter control for the airbrakes in the course of programming, we have to explore other possibilities for controlling the motor: either the switchable solution described in the section starting on page 129, or the use of an alternative transmitter control. Depending on the features of your particular transmitter, this could be one of the two sliders which are fitted as standard in the transmitter's centre console, or one of the optional two-channel switch modules, Order No. **4151** or **4151.1** – see Example 1 on the right-hand side of the page.

However, the centre console controls are not particularly easy to reach during a hand-launch, which means that it is usually necessary to let go of one stick in order to operate them. The selected transmitter control should therefore be in a more accessible position, e.g. "outside left" or "outside right". In those positions it can be reached, for example, with the little finger, without having to let go of a stick.

A cheaper solution would be to remove one of the three external switches in the centre console and reposition it, although a better solution in the long-term would be to install an optional differential switch, Order No. **4160.22** – see Examples 2 and 3.

The next step is to turn to the individual examples, but first please note that *inputs 5 to 8 are programmable separately for each flight phase* in the »**Control adjust**« menu. *This means that they must also be programmed separately for each flight phase.*

However, you may want the power system to be available independently of the currently selected flight phase, and this means that you would need to repeat your settings in each flight phase separately, and also adjust the settings again after any changes you make – assuming that you wish to use these inputs 5 to 8.

This is clearly an extremely complicated procedure, and one which invites errors, so we strongly recommend that you use one of the inputs 9 to 12, which are <u>*independent*</u> *of the flight phases*, and therefore only have to be programmed once for a particular model.

This option does require you to program an additional free mixer if the receiver features fewer than nine outputs. However, the advantage is that you will not normally have to change anything else once you have completed the programming.

<u>*Note:*</u>

*Since the program of the mc-22s has been expanded compared to the mc-22 by the addition of the "**Receiver output**" sub-menu, you can achieve the same effect as setting up a free mixer from "9 to NN" (which is still described here in the interests of compatibility) simply by assigning servo 9 to the output NN; see page 51.*

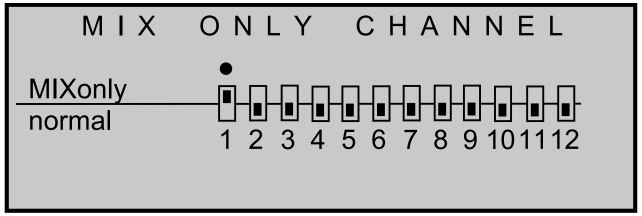
Example 1

Using a linear slider or a two-channel switch module

If you wish to use one of the integral two-channel sliders or an optional two-channel switch module (Order No. **4151** or **4151.1**), then it is a relatively simple matter to set it up to control an electric motor: all you have to do is connect the speed controller to a vacant servo socket at the receiver – in this example output "8" – then carry out adjustments in the »**Control adjust**« menu, and program a free mixer.

<u>*Note:*</u>

*If – in contrast to our example – you wish to use receiver output "1" because your model does not feature airbrakes, or you want to use a "small" receiver, then start the programming in the »**MIX-only channel**« menu (see page 108) and set channel "1" to "Mix only".*



After this, continue as described here, but note that you should now program the "LinearMIX" from "9" to "1".

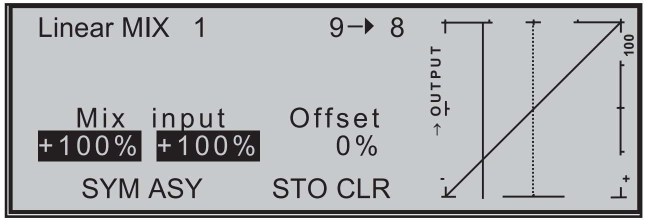
Connect a two-channel module to the (flight phase-<u>independent</u>) input CH9 on the transmitter circuit board, switch the transmitter on, and move to the menu …

»Free mixers« (page 102)

▶LinearMIX 1		9→ 8			=>
LinearMIX 2		??→??			- - - -
LinearMIX 3		??→??			- - - -
LinearMIX 4		??→??			- - - -
	type	from	to		Adjust
▼	SEL	SEL	SEL	⌐	⇨

… where you program a "LinearMIX" from "9" to, say, "8".

On the second screen of this menu you "simply" set a **SYM**metrical mixer input of +100%.



After this you switch to the menu …

»Control adjust« (page 58)

▶Enter 9	Cntr 7	0%	+100%	+100%	0.0	0.0
Enter10	Cntr 8	0%	+100%	+100%	0.0	0.0
Enter11	free	0%	+100%	+100%	0.0	0.0
Enter12	free	0%	+100%	+100%	0.0	0.0
		offset	-travel+		-time+	
▼▲	SEL ⌐	SEL	SYM	ASY	SYM	ASY

… and assign the *flight phase-independent* input "9" to the transmitter control you have just set up, or one of the other available transmitter controls. (For example, this could be the right-hand slider, connected by default to CH7.)

You can use the "Travel" column to set up the servo travel to match your speed controller. You may need to reverse the values (change to "–"), or use the "Reverse" facility in the »**Servo adjustment**« menu.

If you wish to set a soft-start for the motor (in order to avoid premature wear) even though you are using a motor switch, then set a delay time in the right column after selecting **ASY**.

<u>Note:</u>
*A **SYM**metrical setting would also generate a delay when switching the motor off, but this would not be sensible, as it would deny you the freedom to switch the motor off quickly in an emergency.*

In the interests of safety, you should now move to inputs "7" and "8" and set both to "free". If you have decided to use inputs and transmitter controls other than those suggested in this example, set the appropriate inputs to "free".

("Input 7" because "transmitter control 7" is entered here as standard, but it is used for a different purpose, and "Input 8", to de-couple any "transmitter control 8" which may be present from "Input 8".)

Enter 5	Cntr 5	0%	+100%	+100%	0.0	0.0
Enter 6	Cntr 6	0%	+100%	+100%	0.0	0.0
Enter 7	free	0%	+100%	+100%	0.0	0.0
▶Enter 8	free	0%	+100%	+100%	0.0	0.0
		offset	-travel+		-time+	
▼▲	SEL ⌐	SEL	SYM	ASY	SYM	ASY

You would normally make use of the "Travel" column at this point to set up the servo travel and direction to match your speed controller. Alternatively you can carry out these changes in the menu …

»Servo adjustment« (page 56)

Servo 5	=>	0%	100%	100%	150%	150%
Servo 6	=>	0%	100%	100%	150%	150%
Servo 8	=>	0%	100%	100%	150%	150%
▶Servo 8	=>	0%	100%	100%	150%	150%
	Rev	cent.	- travel	+	- limit	+
▼	SEL	SEL	SYM	ASY	SYM	ASY

… where you should first remember to select the line corresponding to your receiver socket. In our example this would be "Servo 8", as shown.

Example 2

Using a two-position external switch (external switch, Order No. 4160 or 4160.1)

This control variant implements a pure ON / OFF function.

At the receiver end you would use either a simple electronic switch, or – if you prefer a "soft" motor start – a proportional speed controller.

The settings required for this are basically as described under Example 1, and the same notes and recommendations apply.

The only area which differs from the previous description is the method of assigning the selected external switch in the menu …

»Control adjust« (page 58)

▶Enter 9	1	0%	+100%	+100%	0.0	0.0
Enter10	Cntr10	0%	+100%	+100%	0.0	0.0
Enter11	frei	0%	+100%	+100%	0.0	0.0
Enter12	frei	0%	+100%	+100%	0.0	0.0
		offset	-travel+		-time+	
▼▲	⌐ ⌐	SEL	SYM	ASY	SYM	ASY

Here again you move to the line for the *flight phase-independent* input "9" with the rotary control pressed in. In contrast to Example 1, where you used **SEL** in the second column, you now activate the switch symbol ⌐ to the right of this with a brief press on the rotary control, and then operate the desired external switch (in our case "1"), moving it from the desired motor OFF position to the motor ON position.

All the other settings are carried out as described in Example 1, as mentioned at the start of this example.

Example 3

Using a three-position external switch (Differential switch, Order No. 4160.22)

This variant implements a multi-stage switching system for the drive motor using the OFF – half-throttle – full throttle method. At the receiver end you require a proportional speed controller.

The settings required for this are basically as described under Example 1, and the same notes and recommendations apply.

The only area which differs from the previous description is the method of assigning the selected three-position switch, which is carried out in the menu …

»Control adjust« (page 58)

▶Enter 9	6 7	0%	+100%+100%	0.0 0.0
Enter10	Cntr 10	0%	+100%+100%	0.0 0.0
Enter11	free	0%	+100%+100%	0.0 0.0
Enter12	free	0%	+100%+100%	0.0 0.0
		offset	-travel+	-time+
▼▲		SEL	SYM ASY	SYM ASY

Here again you move to the line for the *flight phase-independent* input "9" with the rotary control pressed in. As in Example 2, you now activate the switch symbol in the second column, adjacent to **SEL**, with a brief press on the rotary control, and then operate the selected three-position external switch, e.g. "7". *Move the switch from the desired half-speed position (i.e. the centre position) to the full-throttle position.*

Now activate the left-hand switch symbol which is present in the same column. Move the three-position switch *from the half-throttle position to the motor OFF position*. This switch also appears on the screen.

Move to the »**Servo display**« to check that the system works correctly, and "experiment" with the various delay times available in the right-hand column until the system works exactly as you wish.

All the other settings are carried out as described in Example 1, as mentioned at the start of this example.

Controlling the electric motor and butterfly (crow) system using the Ch1 stick

(Butterfly / crow system as landing aid: ailerons up, flaps down)

Example 4

If you set the Expert Mode line in the »**Basic settings**« menu to “no” (the default setting) *before* you set up the appropriate model memory, please note that the multi-function menu for this model memory will only display a limited number of functions. In the menu …

»Suppress Codes« (page 49)

Model select	Copy / Erase
Base setup model	Model type
Servo adjustment	Control adjust
Dual Rate / Expo	~~Channel 1 curve~~
Switch display	~~Control switch~~
Suppress : TOG	

you can select the menu points required for this example using the rotary control, and include them again *in the current* model memory with a brief press on the rotary control.

Since this example really represents a procedure for “experts”, perhaps this is the time for you to consider setting the expert mode to “yes”, so that in future *all* the menus of the mc-22s will be available to you from the outset when you set up further “free” memories.

However, before we start the programming of this fourth example, and turn our attention to expanding the basic programming we have already discussed, we need to consider briefly the position of the throttle / brake stick at “motor OFF” or “brake OFF”. Usually the Ch1 stick is moved forward to open the throttle, and back (towards you) to extend the brakes.

However, if you adopt this “classic” configuration, and switch, say, from “motor OFF” (stick “back”) to the braking system, “full brake” would immediately be applied, and vice versa: if you switch from “brakes retracted” to power, this would instantly switch to “full power”.

These inter-connected effects are definitely not desirable, and to avoid them we recommend that you position the “zero point” of both systems so that they coincide. A “glider guider” would normally prefer the “forward” setting, while a “power man” would probably opt for “back”. The mc-22s allows either, so the choice is up to you.

In the menu …

»Model type« (page 52)

MODEL TYPE				
Motor			Thr. min front	
Tail type			Normal	
Aileron/camber flaps			1 AIL	
Brake	Offset	+100%	Enter	1
			SEL	

… move first to the “Motor” line and set the throttle minimum position to “forward” or “back”. In the following programming example we assume that “motor OFF” and “brake OFF” are both set to “forward”.

Note:

If you choose “Throttle min. forward / back”, the trim is then only active at the “idle” end of the travel, i.e. it does not affect the whole travel of the Ch1 stick as it would if you were to enter “none”. However, since the Ch1 trim is generally not used for electric power systems, this is not very important. More important, however, is the fact that …

… setting the motor to “none” automatically disables the “Throttle too high” power-on warning! For this reason please take great care to set the Ch1 stick to the correct position before you switch on the receiving system.

Set the “Tail” type to suit your model; in our case “normal”.

In the “Ailerons / flaps” line enter the appropriate number of aileron and flap servos.

In the last line leave the choice of “Throttle min. back” or “none” at the default settings. **However, if you opted for “Throttle min. forward”, select the “Brake” line and set the Offset point to “forward”, as described on page 52.**

MODEL TYPE				
Motor			Thr. min front	
Tail type			Normal	
Aileron/camber flaps			2 AIL 2 FL	
Brake	Offset	-100%	Enter	1
		STO	SEL	

The next step is to ensure that the effect of the Ch1 stick on the motor can be switched on and off.

This is carried out by moving to the menu …

»Phase setup« (page 78)

Phase 1	Normal	0.0s	*
Phase 2	Landing	0.0s	-
Phase 3		0.0s	-
Phase 4		0.0s	-
	Name	Switch time	status
	SEL	SEL	

… where you assign “Phase 1” with a brief press on the rotary control, followed by selecting the name “Normal” from the list. The asterisk (*) in the right-hand column indicates which phase is currently active. If you have not yet assigned a phase switch, this will always be Phase 1. For this reason you should always assign the “Normal” name to this phase. For this example we suggest that you assign the name “Landing” to “Phase 2”. You may also wish to enter a suitable phase switch transition time at this point.

The second stage is to assign a switch to these flight phases, so that you can switch between the two phases in flight. In this case a simple switch is sufficient, although it should be easily accessible so that you can switch between “Motor” and “Brake” on the landing approach without having to release a stick. A particularly good choice for this purpose is a two-function stick switch, which your local *GRAUPNER* Service Centre can install for you.

The selected switch is assigned in the menu …

»Phase assignment« (page 80)

PHASE ASSIGNMENT

prior		combi			
A	B	C	D		
	4I			<1 Normal >	
				SEL	

Use the rotary control to select the switch symbol under "B". After a brief press on the rotary control, operate the switch you wish to use, e.g. the switch with the number "4".

Initially the "normal" phase is assigned to both switch positions, i.e. ON (**I**) and OFF, and this is shown on the right of the screen. Select **SEL** using the rotary control. After a brief press on the rotary control, activate the select list for the phases which you have set up in the »**Phase setting**« menu.

For example, you could name the phase for the forward switch position «1 Normal», and for the back position «2 Landing» (or vice versa). These phase names now appear in all flight phase dependent menus, and – of course – also in the transmitter's basic display.

Now select the «Landing» flight phase, and in the menu …

»Wing mixers« (page 84)

Ailerons	2 –>4	Rudder	+	0%
Ailerons	2 –>7	Flaps	+	0%
Brake	–>3	Elevator	+	0%
Brake	–>6	Flaps	+	0%
Brake	–>5	Ailerons	+	0%
	«Landing»		SEL	

… set the desired travel of the ailerons when the Ch1 stick ("Brake") is *moved up*; this is carried out in the "Brake ➔ 5 aileron" line. Now move to the "Brake ➔ 6 flaps" line with the rotary control pressed in, where you can enter the desired *down-flap* deflection when the Ch1 stick is operated. This wing flap configuration is termed the "crow" or "butterfly" position; see also page 87.

In the «Landing» flight phase the Channel 1 stick is – of course – required not to switch the electric motor on. To prevent this happening, move to the menu …

»MIX-only channel« (page 108)

MIX ONLY CHANNEL

MIXonly
normal
1 2 3 4 5 6 7 8 9 10 11 12

… and set Channel 1 to "MIX only" with a brief press on the rotary control.

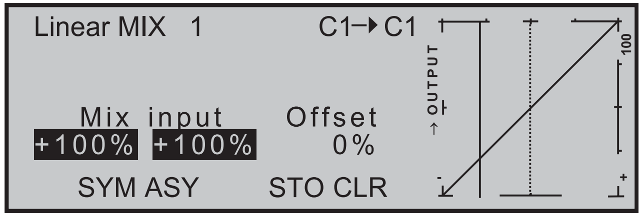
However, since the motor is to be operated by Ch1 in the «**Normal**» flight phase, but the »**MIX-only channel**« menu cannot be set separately for each flight phase, we have to move to the menu …

»Free mixers« (page 102)

LinearMIX 1	Tr	C1 ➔ C1	=>
LinearMIX 2		?? ➔ ??	- - - -
LinearMIX 3		?? ➔ ??	- - - -
LinearMIX 4		?? ➔ ??	- - - -
	type	from to	Adjust
	SEL	SEL SEL	

… and create this facility.

This is achieved by programming a free mixer, such as LinearMIX 1, from "Ch1 ➔ Ch1". On the second page of the menu set the mixer input to +100% on both sides (symmetrically).



Why? In the »**MIX-only channel**« you separated the control function Ch1 from output 1, so that the servo at output 1 can only be accessed using mixers (hence the name "MIX-only channel"). We have now set up just such a mixer. However, the result is that we have defeated our efforts thus far – unless we disable it in the flight phase «Landing» ("no" setting) in the menu …

»MIX active/phase« (page 108)

MIX ACTIVE IN PHASE

LinearMIX 1	C1 ➔ C1	no
LinearMIX 2	?? ➔ ??	yes
LinearMIX 3	?? ➔ ??	yes
LinearMIX 4	?? ➔ ??	yes
«Landing»		SEL

We're nearly there! Move to the »**Servo display**« menu and check your programming: you will find that the Ch1 stick controls only "servo 1" (speed controller) in the «Normal» flight phase, and only the aileron and flap servos in the «Landing» phase … but servo 1 remains fixed at 0% in this phase, with the result that the motor would run at around "half-throttle"!

This problem can be eliminated by setting up a second linear mixer. Move back to the menu …

»Free mixers« (page 102)

LinearMIX 1		C1 → C1			=>
LinearMIX 2		S → C1			=>
LinearMIX 3		?? → ??			- - - -
LinearMIX 4		?? → ??			- - - -
	Typ	from	to		Adjust
	SEL	SEL	SEL		

… and set, say, LinearMIX 2 to "S to Ch1". On the second page of the menu set a symmetrical mixer input of +100% once more.

If a switch is not assigned to this mixer, it delivers a constant, non-switchable signal to control channel 1 (see page 107), which keeps the speed controller at its OFF position. (If this is not reliably the case, you will need to correct the travel and / or direction appropriately.)

Finally you have to set this second mixer to "**no**" in the «**Normal**» phase of the »**MIX active/phase**« menu. (When you switch between the two flight phases, only one of the two mixers will ever be active.)

MIX ACTIVE IN PHASE			
LinearMIX	1	C1 → C1	yes
LinearMIX	2	S → C1	no
LinearMIX	3	?? → ??	yes
LinearMIX	4	?? → ??	yes
	«Normal »		SEL

If you have set up everything correctly, the Ch1 stick only controls the motor in the «Normal» flight phase, but the motor is switched off in the «Landing» flight phase (servo 1 in »**Servo display**« to -100%). In this flight phase the Ch1 stick only operates the wing flaps (ailerons up, flaps down), with a neutral point in the forward position of the Ch1 stick.

If the model also features airbrakes, these can be included by setting up a third mixer (e.g. "Ch1 to 8"), which is only active in the landing flight phase.

Operating the timers using transmitter controls or external switches

If you have followed the model programming described on the preceding pages for **Example 1** on page 126 or **Example 4** on page 129, or – in contrast to the programming examples – you are using the Ch1 stick (throttle / brake stick) for power control, then you can use a control switch to start and stop the stopwatch automatically.

To assign the desired timer to one of the control switches G1 to G4, you move to the menu ...

»Timers« (page 82)

Model time	0 : 20h		
Batt. time	4 : 45h		
▶St watch	0:00	0s	G1
Flighttm	0:00	0s	
	Timer	Alarm	
▾▴	SEL SEL	SEL	

… and select the appropriate line with the rotary control pressed in. Assign the desired timer to the transmitter control switch you wish to use as described on page 30.

You should now call up the menu ...

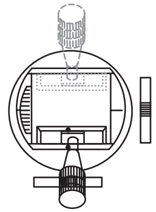
»Control switches« (page 72)

CONTROL SWITCH				
▶G1	Cntr 1	0%	=>	G1
G2	free	0%	=>	G2
G3	free	0%	=>	G3
G4	free	0%	=>	G4
▾	SEL	STO	SEL	

… and select the line for this control switch with the rotary control pressed in. Press the rotary control with the left-hand **SEL** field displayed in inverse video, then simply select the corresponding transmitter control, e.g. control 1 (= Ch1).

Use the rotary control to shift to the **STO** field …

NTROL SWITCH			
1	- 80%	=>	G1
	0%	=>	G2
	0%	=>	G3
	0%	=>	G4
	STO	SEL	



… and move the corresponding transmitter control in the direction of motor "OFF" (e.g. stick back towards you). Give a brief press on the rotary control to define the switching point. The right-hand column displays the status of the switch: above the switching point the G1 switch (in our example) is "closed", below that point it is "open". The stopwatch in the basic display now starts when you move the Ch1 stick towards full-throttle, and stops when you pull the stick back again.

In contrast, if you are controlling your motor with an external switch as described in **Example 2 or 3**, you do not need the control switches described above. It is quite sufficient simply to assign the stopwatch to the same switch, so that the timer starts running automatically when the motor is switched on.

Tip:

When using an electric motor, the motor run is usually limited by the capacity of the battery, and in this case you would normally set the stopwatch to "count down". Simply enter the maximum permitted motor run in the "Timer" column, e.g. "5 min.", and set the piezo buzzer to emit warning tones shortly before the permissible time has elapsed, e.g. "30 sec" beforehand.

Model time	0 : 33h		
Batt. time	5 : 03h		
▶St watch	5:00	30s	G1
Flighttm	0:00	0s	
	Timer	Alarm	
▾▴	SEL SEL	SEL	

With the stopwatch halted, press the **CLEAR** *button from the basic display, so that the stopwatch switches to the "Timer" function. The timer can now be started and stopped using the motor control stick.*

Servos operating in parallel

In many cases a second servo is required to run in parallel with an existing servo; for example, if a second elevator or rudder is to be actuated by a separate servo, or where a second servo is needed to cope with the very high control forces required by a large control surface. The same applies where two servos are required simply due to the high control forces involved.

This task could be solved simply by connecting both servos together in the model using a conventional Y-lead. However, this has the drawback that the linked servos cannot be adjusted individually from the transmitter, i.e. you forfeit the basic advantage of the computer radio control system: freely variable servo settings.

The first variant of the two examples in this section is preferable for applications of this type, as this kind of system is simpler and faster to program using a »**Dual mixer**«. In contrast to this, the second variant – using the »**Free mixers**« menu – has to be used where asymmetrical and / or non-linear curves are required.

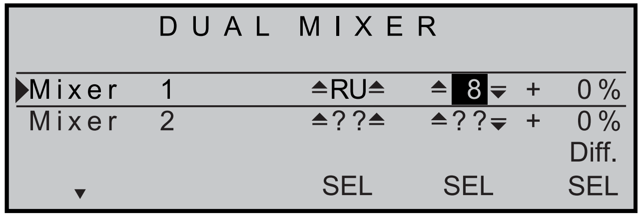
In this example we want to “wire two rudders in parallel”. The second rudder is connected to the otherwise vacant receiver output 8.

Variant 1

In the menu …

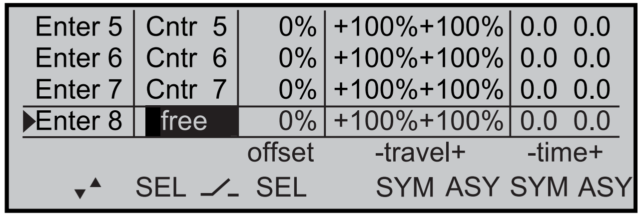
»Dual mixer« (page 110)

… select one of the two dual mixers, and enter “RU” and “8” using **SEL**, as shown in the screen shot:



Of course, the opposed movement „▲ ▼“, which would occur via “Input 8”, must not be allowed to take place in this application. For this reason it is essential to ensure in the menu …

»Control adjust« (page 58)



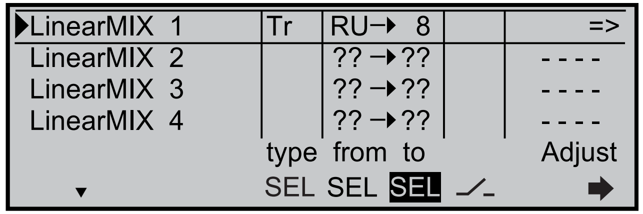
… that “Input 8” is set to “free”, so that the control function is separated from the control channel.

If both dual mixers are already in use for other purposes, you will need to fall back on the next solution.

Variant 2

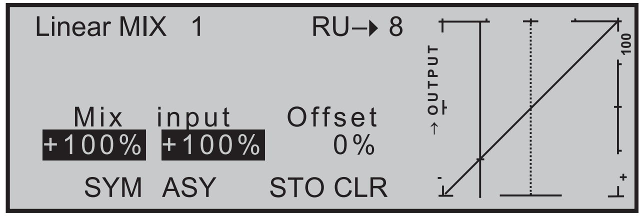
In this variant you set up a “Tr RU ➔ 8” mixer in the menu …

»Free mixers« (page 102)



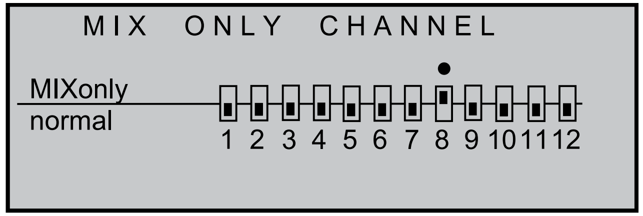
Selecting “Tr” setting in the “Type” column, so that the rudder trim acts upon both rudder servos.

Now move to the graphic page and set a **SYM**metrical mixer input of +100%:



Here again, “Input 8” should be programmed to “free” in the »**Control adjust**« menu. Alternatively you could separate control function “8” from control channel “8” in the menu …

»MIX-only channel« (page 108)



Using flight phases

Within any model memory you can program up to four different flight phases (stages of flight), each incorporating settings which can be entirely different to the others.

Each of these flight phases can be called up by means of a switch or a combination of switches. Flight phases represent the simplest and most convenient method of switching between different model settings in flight, as they can be programmed suit diverse stages of a typical flight, such as normal, thermal, speed, distance, etc.. However, flight phase programming can also be used as a straightforward means of trying out slight modifications to the control system while the model is in the air, such as different mixer ratios. This makes it much quicker to find the optimum settings for a particular model.

And this is how it's done ...

We assume that you have already programmed the model in the transmitter's model memory, set it up carefully, test-flown it and trimmed it accurately.

1st step

»Phase setting« (page 78)

Phase 1	Normal	2.0s	∗
Phase 2	Thermal	1.0s	-
Phase 3	Speed	3.0s	-
Phase 4		0.0s	-
	Name	Switch time	status
▾	SEL	SEL	

The first stage is to assign names to one or more flight phases, which should describe the various stages of flight. The name is important insofar as it helps you to differentiate between the individual phases, but it has no significance at all in terms of programming the transmitter. The name is always shown in the basic display, as well as in all the menus which are variable separately for each flight phase.

Selecting the appropriate menu line, choosing a name and setting the transition time are carried out by the "usual" method, i.e. by turning and pressing the rotary control.

Note:
The names you assign to the various phases are of no significance in programming terms – with the exception of Phase 1, which should always be assigned the name "Normal". As such it is always active even if you disable the flight phases.

For general model flying three flight phases are generally quite sufficient:

- «Thermal» for launch and "staying up",
- «Normal» for normal conditions, and
- «Speed» for flying in "top gear".

In the "Trans. time" column you can define the period over which the transition from one phase *into* (!) another flight phase occurs; this provides a smooth transition between the different servo settings, and can prevent a possibly damaging lurch when you make the switch under unfavourable circumstances. An asterisk (∗) in the "Status" column indicates the currently active flight phase.

2nd step

A physical switch must be assigned so that you can switch between the different flight phases. The ideal unit for switching up to three flight phases is the differential switch, Order No. **4160.22**, which should be installed towards the outside of the transmitter on either side.

One flight phase is then assigned to each of the two switch end-points, *starting from the centre point.*

The phase switch is assigned in the menu ...

»Phase assignment« (page 80)

PHASE ASSIGNMENT

prior combi
A B C D
4 5 <1 Normal >
SEL

First select the switch symbol below "B", press the rotary control briefly and move the switch to one end-point, before returning it to the centre position.

Now select the switch symbol below "C", give a brief press on the rotary control, and move the switch to the *opposite* end-point.

The phase switch is now programmed correctly, but you still have to assign flight phases to each switch position. Since you have already assigned names to the flight phases, you will now see the name of phase "1" on the right-hand side of the screen.

Move the switch to the one end-point, and select the **SEL** field on the right of the screen. Use the rotary control to select the name you wish to assign to this flight phase (in this example «2 Thermal»):

PHASE ASSIGNMENT

prior combi
A B C D
4I 5 <2 Thermal >
SEL

Repeat the procedure with the switch centre setting, to which you assign the name «1 Normal».

Finally assign the name «Speed» to the other end-point of the switch. A brief press on the rotary control concludes the name assignment process.

The model settings you programmed before you assigned the phase switch are now to be found in the flight phase «1 Normal». That is the phase which is called up when the switch is at the centre position.

3rd step

You have already programmed all the settings for your model in the primary flight phase, and you can avoid having to enter all the data again in the "new" flight phases (although you could do that, if you really wanted to) by copying the programmed settings – which you know from test-flying to be correct – from the «Normal» flight phase into the other two phases.

This is carried out in the menu ...

»Copy / Erase« (page 47)

Erase model	=>
Copy model → model	=>
Copy MC22 → external	=>
Copy external → MC22	=>
▸Copy flight phase	=>
Secure all models → PC	=>

Select the menu point "Copy flight phase" with the rotary control pressed in, then press ENTER or give a brief press on the rotary control.

A window now appears entitled "Copy from phase"; in it select "1 Normal" ...

Copy	from phase:
1 Normal	2 Thermal
3 Speed	4

… and then press ENTER again; the screen responds by switching to "Copy to phase". Select the destination (initially "2 Thermal"), and confirm by pressing ENTER again. Confirm your selection in the security query which subsequently appears, then wait while all the settings as defined in your programming are copied to the second phase.

Use the same procedure to copy the data to the third phase (normal → speed).

4th step

At this point all three phases are programmed and all the settings are copied; a "smooth" transition has also been programmed, but ... there are no settings which are specific to the different flight phases, i.e. all the phase settings are the same.

To program these settings, call up the menu ...

»Wing mixers« (page 84)

Aileron difference	+	0%
Flap difference	+	0%
▸Ailerons 2 –>4 Rudder	+	0%
Ailerons 2 –>7 Flaps	+	0%
Brake –>3 Elevator	+	0%
«Normal »	SEL	

… and you will see the name of the current flight phase at the bottom edge of the screen. If you now change the position of the phase switch, the name of the new flight phase assigned to that switch position appears, but the settings are still those copied from the «Normal» flight phase. At this point you can make the changes as required by the new flight phase – which will vary according to the phase you have selected by the switch position.

Note:

The displayed list of mixers varies according to the model type you have selected.

Once you have programmed all the settings, you will be able to switch to and fro between the various flight phases. However, when you operate the switch you will soon realise that nothing has changed in the basic settings of the control surfaces!

5th step

At this stage we have to make adjustments to meet the differing requirements of the individual flight phases. This is carried out in the menu ...

»Control adjust« (page 58)

Enter 5	free	- 7%	+100%+100%	0.0 0.0
▸Enter 6	free	- 12%	+100%+100%	0.0 0.0
Enter 7	Cntr 7	0%	+100%+100%	0.0 0.0
Enter 8	Cntr 8	0%	+100%+100%	0.0 0.0
«Speed »		offset	-travel+	-time+
	SEL	SEL	SYM ASY	SYM ASY

Move to the "Offset" column and modify the settings for (say) the ailerons and camber-changing flaps insofar as they differ from the «Normal» flight phase. Note these points: "Offset control 5" affects the ailerons, "Offset control 6" applies to the flaps. You can change the travels in either the positive or negative direction. Any elevator trim change required is made using the option "Flaps 6 → 3 elevator" in the »**Wing mixers**« menu. These adjustments have to be carried out separately for each flight phase.

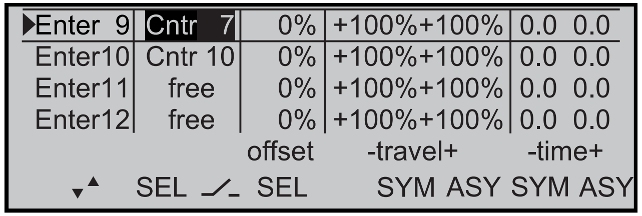
Controlling timed sequences
using time delay and curve mixers

An interesting but little know possibility with the software of the mc-22(s) is the facility to apply a delay of up to 9.9 seconds to virtually any servo movement, controlled by a switch.

The following section includes a number of examples which illustrate how such systems can be programmed. Once you have become familiar with these facilities you will undoubtedly think of other applications.

The first step in the programming is to move to the menu …

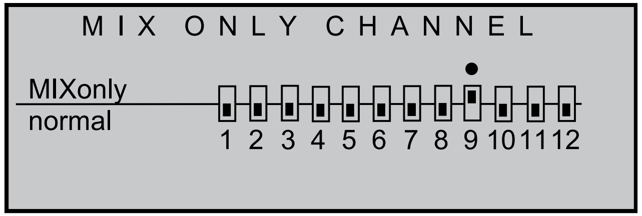
»Control adjust« (page 58)



… where you assign one of the standard sliders to the control channel you wish to use; the slider is then used as a tool to move to any point on the control curve during the programming procedure. In our example this is transmitter control 7 assigned to channel 9. Initially you should not enter a time delay in the "-Time+" column.

Next we move to the menu …

»MIX-only channel« (page 108)

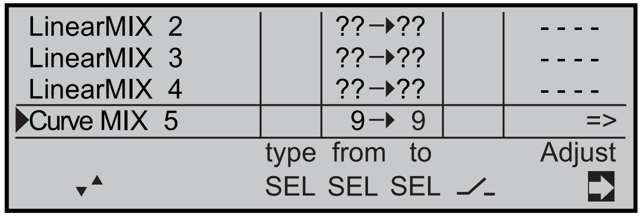


…where the selected control channel – in our example "9" – is set to "MIX only".

Setting the control channel to "MIX only" *is absolutely essential*, because the control curves of the curve mixers which are described in the following example can only influence the output of the same channel in the way we want *if there exists no direct connection* between the transmitter control and the output. Once this requirement is met, we can manipulate the transmitter control signal in almost any way on its detour via a curve mixer, before it is passed on to the appropriate output.

For this reason the next step is to move to the menu …

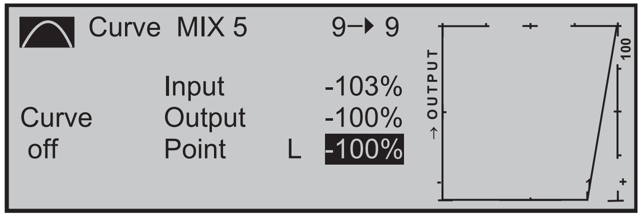
»Free mixers« (page 102)



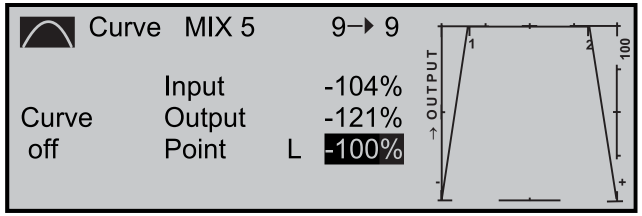
… where a same-channel curve mixer is programmed, e.g. from "9" to "9". On the second page of the menu we define the desired shape of the control curve; please note that the examples shown here are only intended stimulate your own ideas for designing control curves to suit your particular application.

For example, the control curve for …

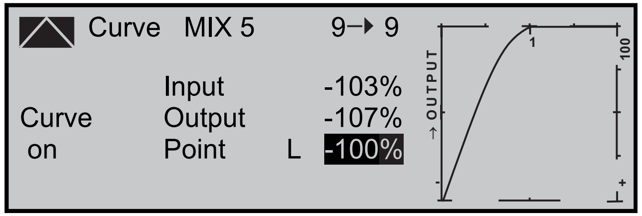
… delayed switching of a searchlight after the start of the undercarriage extension process might look like this**:**



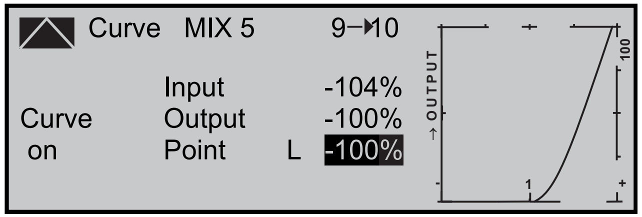
… while the actuation of a wheel door, which closes again after the undercarriage has extended, might look like this:



… and an exponential motor start-up, or the extension of a folding power system …



… with the drive motor (connected to output 10) starting under the control of the same switch, but with a time delay:



Once you have completed the programming of the function to meet your requirements, and have ensured that it works correctly – you can check this at any time by switching to the »**Servo display**« menu – then move to the menu …

»Control adjust« (page 58)

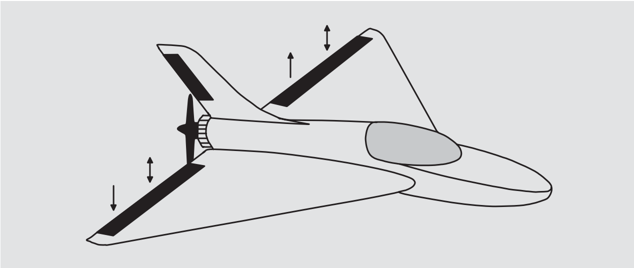
Enter 9	3	0%	+100%+100%	8.0 8.0
Enter10	Cntr 10	0%	+100%+100%	0.0 0.0
Enter11	free	0%	+100%+100%	0.0 0.0
Enter12	free	0%	+100%+100%	0.0 0.0
		offset	-travel+	-time+
		SEL	SYM ASY	SYM ASY

… in order to conclude the programming procedure. This is where you assign an On / Off switch instead of the slider. This can be any switch you like (e.g. “3”), assigned to the control channel you have selected – in these examples “transmitter control 7” to channel “9”. Enter the desired **SYM**metrical or **ASY**mmetrical time delay in the “–Time+” column; this is the period in which the function is to complete its course.

<u>Note:</u>
When assigning the switch to this function, please bear in mind that a single switch can be used to trigger several functions. For example, the same switch could be used to operate a retract system connected to output 6, and – as shown in this example – operate the time-delayed wheel doors connected to output 9, and / or the delayed-action searchlight, etc..

Programming example: deltas and flying wing model aircraft

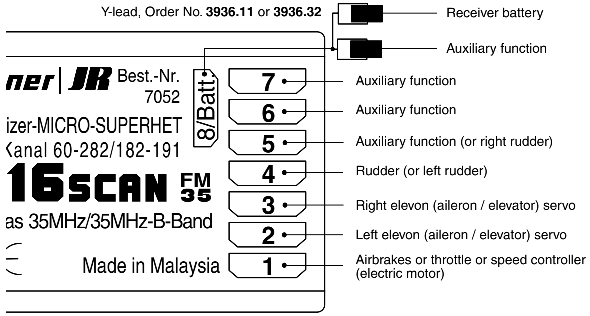
On page 120, where the section on fixed-wing model programming starts, you will find general notes regarding the installation and set-up of the RC system in a model, and – of course – this also applies to deltas and flying wings. The information on test-flying and refining the settings is also relevant, including the section on programming flight phases.



Even at first sight, deltas and flying wings differ very obviously from “normal” models in their characteristic shape and geometry, but the differences in the servo arrangements required are rather more subtle. The “classic” model delta or flying wing generally has only two control surfaces, which act both as ailerons (in opposite directions) and as elevators (in the same direction), in a similar way to the superimposed rudder / elevator functions of a V-tail.

Modern designs tend to be more complex than this: one (or two) inboard control surfaces may be used purely as elevators, while the outboard ailerons also act as elevators, but to a reduced extent. If a flying wing has four or even six wing control surfaces, it is certainly feasible nowadays to set them up with camber-changing flap functions and / or even a butterfly (crow) system.

However, most of these models still rank as “classic” deltas and flying wings, and for them the servos should be connected to the receiver as follows (see also page 35):



In accordance with this servo sequence we move to the menu …

»Model type« (page 52)

M O D E L T Y P E			
Motor			None
Tail type			Delt/fl.wing
▸Aileron/camber flaps			2 AIL
Brake	Offset	+100%	Enter 1
▾▴			SEL

and select the “**Delta / flying wing**” type in the “tail” line; at this point the “Ailerons / flaps” line below it automatically displays “**2 AIL**”.

These settings primarily affect the list of available mixers, because elevator and ailerons are automatically mixed together by the software when the “**Delta / flying wing**” tail type is selected. At the transmitter you can adjust the control travel of the elevator and aileron stick in the »**Dual Rate / Exponential**« menu (see page 64).

Note:

If your model features more than just these two control surfaces, then you should skip this section and continue reading in the right-hand column, under delta / flying wing designs of “modern” layout.

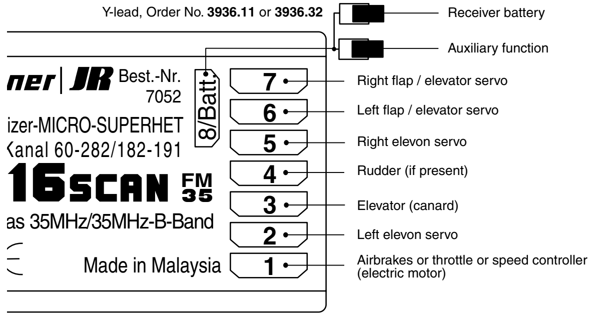
Certain settings in the »**Wing mixers**« menu (see page 84) may be useful with the “Aileron 2 ➔ 4 rudder” mixer, and you may even wish to experiment with low differential values if you are very sensitive to the nuances of flying characteristics.

▸Aileron difference	+	0%
Ailerons 2 –>4 Rudder	+	0%
Brake –>3 Elevator	+	0%
Reduction of diff.	+	0%
▾		SEL

Settings beyond those described can result in unwanted moments which it may be impossible to correct, due to the specific characteristics of this type of model.

In contrast, delta and flying wing designs featuring more than two wing flaps can sometimes cope with these moments. For example, the “ballooning” moment (= up-elevator effect), caused by deflecting both ailerons up, can be corrected by lowering the flaps (= down-elevator effect) to the requisite degree.

If your delta or flying wing is of this more “modern” configuration, the “normal” servo sequence has proved to be useful:



The first step here is to move to the menu ...

»Model type« (page 52)

MODEL TYPE			
Motor			None
▶Tail type			Normal
Aileron/camber flaps			2 AIL 2 FL
Brake	Offset	+100%	Enter 1
			SEL

… and make the following selections, according to the receiver output sequence:

„**Motor**": • „none" (no motor). Ch1 trim acts equally along the whole travel
• "Throttle min. forward / back". Trim acts only at idle range. The power-on warning "Throttle too high" appears if the Ch1 stick is too far towards full-throttle.

„**Tail type**": „Normal"

„**Aileron/camber flaps**": Two ailerons "2AIL" and – if present – one or two flaps "1FL" or "2FL".

„**Brake**": can be ignored; it is only of interest if the model features a motor and separate air-brakes.

If you opt for the "normal" tail type, and connect the servos to the receiver outputs as listed above, then the aileron function will immediately work correctly, but not the elevator function of the two aileron servos and (if present) of the flaps.

With this tail type setting, the required effect can only be achieved by moving to the menu …

»Free mixers« (page 102)

… and programming a mixer of the "Tr" type from "EL" to "5" and "6"; the appropriate settings also have to be made on the second page of the menu.

Check the settings and – above all – the directions of effect in the »**Servo display**« menu and on the model; you may need to reverse the prefixes.

▶LinearMIX 1	Tr	EL ➝ 5		=>
LinearMIX 2	Tr	EL ➝ 6		=>
LinearMIX 3		?? ➝ ??		- - - -
LinearMIX 4		?? ➝ ??		- - - -
	type	from to		Adjust
	SEL	SEL SEL		➡

Note:
*In theory the same effect could be achieved in the »**Wing mixers**« menu, using the "Elevator 3 ➔ 5 aileron" and "Elevator 3 ➔ 6 flaps" mixers, but in this case the elevator trim would not be transferred. In this case a trim control would need to be assigned to inputs 5 and 6 in the »**Control adjust**« menu, e.g. "transmitter control 7", which would be the right slider by default, with greatly reduced travel. Viewed overall, the method described here using the two free mixers is therefore the easiest to set up.*

The following settings are model-specific, and must not be adopted without careful checking!

After this we move to the menu …

»Wing mixers« (page 84)

… where the effect of the aileron stick on the flaps is set in the "Aileron 2 ➔ 7 flaps" line. In principle this is just like a "normal" four-flap wing (two ailerons and two flaps).

In contrast, setting up differential is rather tricky due to the type of model, and this should only be carried out very carefully, with due regard for the model's flying characteristics.

Aileron difference				+ 0%
Flap difference				+ 0%
Ailerons	2 –>4	Rudder		+ 0%
▶Ailerons	2 –>7	Flaps		+ 50%
Brake	–>3	Elevator		+ 0%
Brake	–>6	Flaps		+ 0%
Brake	–>5	Ailerons		+ 0%
Elevator	3 –>6	Flaps	+ 0%	+ 0%
Elevator	3 –>5	Aileron	+ 0%	+ 0%
Flaps	6 –>3	Elevator	+ 0%	+ 0%
Flaps	6 –>5	Aileron	+ 0%	+ 0%
Reduction of diff.				+ 0%
				SEL

In this special case, settings in the "Flaps 6 ➔ 5 aileron" line could be used for elevator trim if the appropriate transmitter controls are assigned in the »**Control adjust**« menu, but please read the note in the left-hand column. The same applies to the "Elevator 3 ➔ 5 aileron" line, and possibly "Elevator 3 ➔ 6 flaps".

The transmitter controls assigned to inputs 5 and 6 are active by default, and we must ensure that they have not somehow become superimposed. Move to the menu …

»Control adjust« (page 58)

Enter 5	free	0%	+100%+100%	0.0 0.0
Enter 6	free	0%	+100%+100%	0.0 0.0
▶Enter 7	free	0%	+100%+100%	0.0 0.0
Enter 8	Cntr 8	0%	+100%+100%	0.0 0.0
		offset	-travel+	-time+
	SEL	SEL	SYM ASY	SYM ASY

… and set these two inputs to "free".

If an auxiliary function servo is present at the "classic" elevator socket "3", then please don't forget to separate the control function input "3" from the elevator control channel in the menu …

»MIX-only channel« (page 108)

MIX ONLY CHANNEL												
MIXonly / normal	1	2	3	4	5	6	7	8	9	10	11	12

… so that the associated servo is not also operated by the elevator stick!

Many years ago the author operated a model delta with the mc-20, programmed exactly in this way, with a butterfly (crow) system as landing aid, exploiting the "Brake ➔ 5 aileron" and "Brake ➔ 6 flaps" wing mixers to provide complete compensation for pitch trim changes. In this case the term "ailerons" means the outboard wing control surfaces, and "flaps" the inboard pair of control surfaces. To achieve the same effect with the mc-22s, move back to the menu …

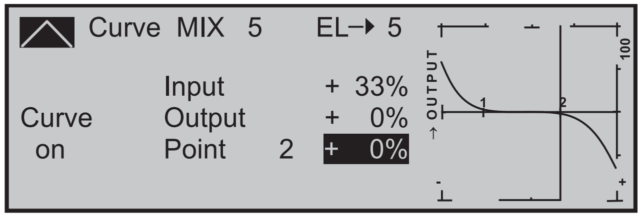
»Wing mixers« (page 84)

Aileron difference					+ 0%	
Flap difference					+ 0%	
Ailerons	2 –>4	Rudder			+ 0%	
Ailerons	2 –>7	Flaps			+ 50%	
Brake	–>3	Elevator			+ 0%	
Brake	–>6	Flaps			- 50%	
▶Brake	–>5	Ailerons			- 60%	
Elevator	3 –>6	Flaps	+	0%	+	0%
Elevator	3 –>5	Aileron	+	0%	+	0%
Flaps	6 –>3	Elevator	+	0%	+	0%
Flaps	6 –>5	Ailerons	+	0%	+	0%
Reduction of diff.					+ 0%	
					SEL	

… and enter the values for the up-aileron travel and the down-flap travel in the "Brake ➔ 5 aileron" and "Brake ➔ 6 flaps" lines in such a way that the pitching moments which occur in flight cancel each other out, i.e. the model's flight attitude remains stable. However, do take care to allow the control surfaces enough "elbow-room" for the elevator function: this means, don't exploit the full servo travel for the butterfly / crow system alone.

You can ignore all the other settings in this menu.

A modern sweptback flying wing can also be operated in the same way. Many of these models also feature inboard and outboard control surfaces: the former forward of the Centre of Gravity, the latter aft of it. Deflecting the inboard control surface(s) down increases lift and produces an up-elevator effect. Deflecting them up creates the opposite effect. In contrast, the outboard ailerons have the reverse effect: a down-deflection produces a down-elevator effect, and vice versa. In this case there are really no limits to what you can achieve with careful thought and the sophisticated mixers of the mc-22s. This could extend to setting up curve mixers which pass just a small degree of up / down travel to the outboard pair of control surfaces, and only at fairly extreme stick travels. For his own model this writer uses a curve mixer defined by a total of four reference points, i.e.:



In this example the two reference points 1 and 2 are set to 0%, the left end-point to +60%, and the right end-point to -65%; the curve is then rounded by pressing the **ENTER** button.

Please note that you should be extremely careful when setting differential travel with such a configuration, regardless of the type of servo arrangement you are using. This is because differential travels tend to produce an asymmetrical elevator effect on a tail-less model, rather than the desired adverse yaw reduction. For this reason it is advisable to start with a differential setting of 0%, at least for the first few flights. When you are familiar with the model and feel the need to experiment, it may then be feasible under certain circumstances to try differential settings deviating from zero.

For larger models it may be advisable to install winglets fitted with rudders, i.e. small vertical surfaces at the wingtips. If these are actuated by two separate servos, the rudder signal can very easily be "split" by using a mixer in the menu ...

»Dual mixers« (page 110)

DUAL MIXER				
▶Mixer	1	EL	RU	- 75%
Mixer	2	??	??	+ 0%
				Diff.
		SEL	SEL	SEL

… in which case you can also apply "split" or differential travel, with the second rudder servo connected to a free receiver output socket. If you have programmed the "**Delta / flying wing**" tail type at an earlier stage, receiver output "5" should still be free. If you have selected the "normal" tail type, output "3" (ELE) should still be free; this is the one we will use in the following example.

Select the »**MIX-only channel**« menu (see above), or the »**Control adjust**« menu (if the second servo is connected to one of the outputs 5 … 12), and de-couple the "wrong" control function from the control channel to which you have connected the second rudder servo.

The differential travel is *necessary* in this case, since the outside rudder turns through a larger radius than the inside rudder when the model is flying a turn; this is broadly analogous to the effect of front wheel toein on a car.

Note:
This is the only method of programming rudder differential.

You may also want both rudders to deflect outwards when a braking system is operated using the Ch1 stick, and this can be achieved as follows: if you have selected the “normal” tail type, set up a further “LinearMIX Ch1 ➔ 3” with a suitable travel setting. The offset should be set to +100%, as the Ch1 stick is usually at the forward end-point when the airbrakes are retracted, and the winglet rudders are required to deflect outwards proportionally when the brakes are deployed.

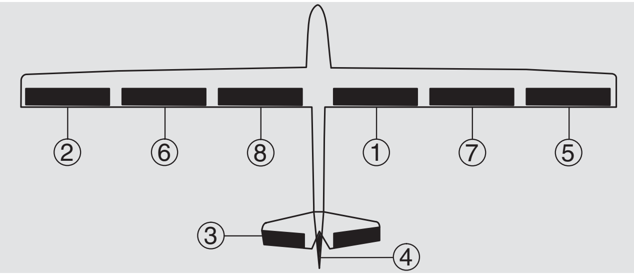
Six-flap wing

In its standard form the mc-22s fixed-wing program provides a convenient method of controlling a maximum of four servos for the superimposed aileron / flap functions.

If the wings are fitted with six control surfaces, a dual mixer and a free mixer can be set up to control two more servos (connected to receiver outputs 8 + 1) as supplementary inboard ailerons and flaps.

For this example we consider a glider without airbrakes in the wings.

Connect the servos to the receiver in the following sequence:

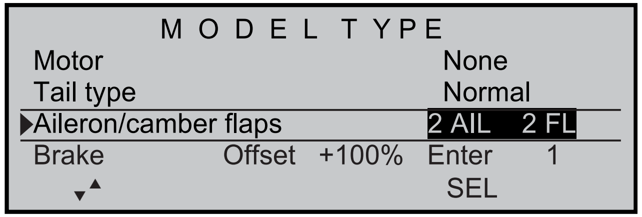


Control surface	Receiver output
Ailerons	2 + 5
Flaps	6 + 7
Supplementary flaps	8 + 1
Elevator	3
Rudder	4

To control all the wing flaps you will need the two sticks plus one or two linear sliders or rotary controls, or alternatively two-channel switched modules connected to inputs CH5, CH6 and CH8 on the transmitter circuit board (two-channel proportional module, Order No. **4152**, proportional rotary module, Order No. **4111**). The switch modules (Order No. **4151** or **4151.1 … 3**) are used to switch between pre-set flap settings.

To set up a control system for all the servos, first switch to the menu ...

»Model type« (page 52)



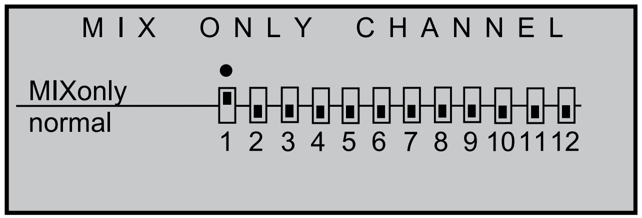
Select “2AIL 2FL” in the “Ailerons / flaps” line, then switch to the menu ...

»Dual mixers« (page 110)

… and set up mixer 1 to „▲ 8▲“ and „▲C1▼“.

This dual mixer combines servos 8 and 1 to act as ailerons (8 and 1 opposite movement: „▲C1▼“) and as flaps (8 and 1 same direction „▲ 8▲“). However, since the ailerons are not controlled by the Ch1 stick, but by the aileron stick, you must now move to the menu …

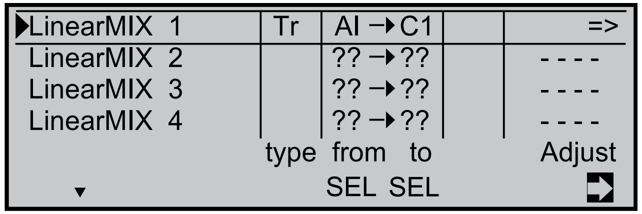
»MIX-only channel« (page 108)



… and set channel 1 to “MIX-only channel” status. This “disconnects” the throttle / brake stick (Ch1) from control channel 1.

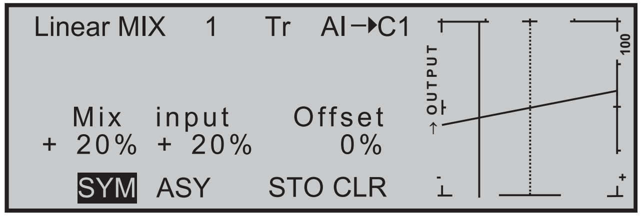
Now move to the menu ...

»Free mixers« (page 102)



… and assign “TR” and “AIL ➔ Ch1” to an unused linear mixer.

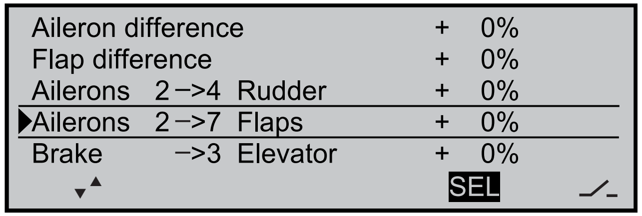
On the second screen page you can enter a mixer value to suit your model.



This mixer transfers the aileron function to the two inboard flap servos 8 + 1 with the help of the dual mixer which you set up previously.

Now we need to program the flap servos 6 + 7 to act as ailerons. Move to the menu ...

»Wing mixers« (page 84)



… and set an appropriate value for aileron control of the flaps in the “Ailerons 2 ➔ 7 Flaps” section.

The settings you have programmed up to this point should now be checked in the »**Servo display**« menu:

- The aileron servos 8 + 1 and 6 + 7 should move exactly in parallel with servos 2 + 5; the aileron trim lever acts upon servos 2 + 5 and 8 + 1, and …
- … the Ch1 stick still operates no servos.

Caution:
*Check the screen carefully! When the ailerons are operated, the bars in the »**Servo display**« should move in the same direction, but in opposite directions when the flaps are deployed.*

The next step is to select the menu ...

»Servo adjustment« (page 56)

▶Servo 1	=>	0%	100%	100%	150%	150%
Servo 2	=>	0%	100%	100%	150%	150%
Servo 3	=>	0%	100%	100%	150%	150%
Servo 4	=>	0%	100%	100%	150%	150%
	Rev	cent.	- travel	+	- limit	+
▼	SEL	SEL	SYM	ASY	SYM	ASY

… and make any changes required to obtain the correct directions of servo rotation and travel.

This completes the basic programming of the six-flap wing.

Flap settings in different flight phases

The flap positions can now be programmed to different settings for each flight phase.

Start by programming two or more flight phases using the menus »**Phase setting**« and »**Phase assignment**«. An example of programming flight phases can be found on page 134.

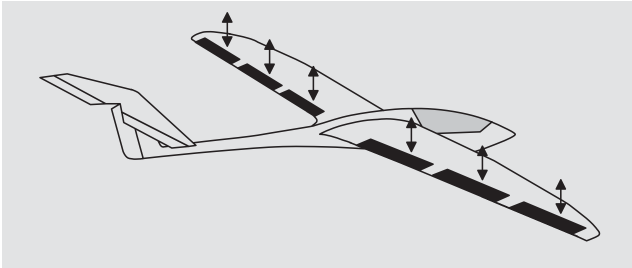
When you have completed this stage, move to the menu ...

»Control adjust« (page 58)

▶Enter 5	Cntr 5	0%	+100%	+100%	0.0	0.0
Enter 6	Cntr 6	0%	+100%	+100%	0.0	0.0
Enter 7	Cntr 7	0%	+100%	+100%	0.0	0.0
Enter 8	Cntr 8	0%	+100%	+100%	0.0	0.0
«Normal »		offset	-travel+		-time+	
▼	SEL	SEL	SYM	ASY	SYM	ASY

… which allows you to set the flap positions separately for each flight phase.

One flap setting for each flight phase



If one flap position is sufficient for each flight phase, move to the menu …

»Control adjust« (page 58)

▶Enter 5	free	+ 15%	+100%	+100%	0.0	0.0
Enter 6	free	+ 10%	+100%	+100%	0.0	0.0
Enter 7	Cntr 7	0%	+100%	+100%	0.0	0.0
Enter 8	free	+ 8%	+100%	+100%	0.0	0.0
«Thermal »		offset	-travel+		-time+	
▼	SEL	SEL	SYM	ASY	SYM	ASY

… and select the offset for inputs 5, 6 and 8 to match the position of the flaps ("phase trimming").

At the same time set inputs 5, 6 and 8 to "free" in each flight phase, so that any accidental movement of transmitter controls assigned to those inputs do not affect the wing flaps.

Note:
The offset required may need to be positive or negative; this depends on the orientation of the servos in the wings.

However, you may prefer to set up an alternative control method, such as …

Variable flap positions in each flight phase using only one slider (Order No. 4152) or a three-position switch module (Order No. 4151).

It is also possible to control all six wing flaps using only a single transmitter control. In the menu ...

»Control adjust« (page 58)

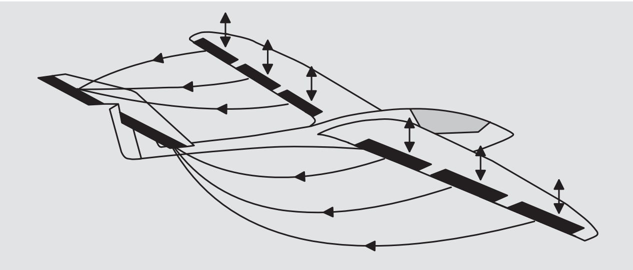
… assign the same slider or switch module connected to the transmitter circuit board, e.g. control 6, to inputs 5, 6 *and* 8. Ideally this would be a different transmitter control in each flight phase, so that the correct settings, once found, are retained when you switch from one flight phase to another:

Enter 5	Cntr 6	+ 10%	+100%	+100%	0.0	0.0
Enter 6	Cntr 6	+ 15%	+100%	+100%	0.0	0.0
Enter 7	free	0%	+100%	+100%	0.0	0.0
▶Enter 8	Cntr 6	+ 18%	+100%	+100%	0.0	0.0
«Thermal»		offset	-travel+		-time+	
▼▲	SEL	SEL	SYM	ASY	SYM	ASY

If you are using a switch, set the "deviation" from the offset point **SYM**metrically or **ASY**mmetrically in the "–Travel+" column.

However, if you wish to use a slider or rotary knob to position your model's flaps, you should reduce travel to about 50% or even less in the same menu, as this gives you much finer control of the flap trim.

Elevator trim compensation for flap commands



If elevator trim correction is required when the camber-changing flaps are deployed, this can be set up in the menu …

»Wing mixers« (page 84)

Brake	–>6	Flaps	+ 0%	
Brake	–>5	Ailerons	+ 0%	
Elevator	3 –>6	Flaps	+ 0%	
Elevator	3 –>5	Aileron	+ 0%	+ 0%
Flaps	6 –>3	Elevator	+ 0%	+ 0%
		«Normal »		SYM ASY

… by selecting the “Flaps 6 ➔ 3 Elevator” mixer, and entering a suitable value in each flight phase. If you have assigned the same transmitter control to inputs 5, 6 and 8 – as described above – then all six flaps move simultaneously, while the elevator moves in accordance with the set mixer input.

Flap following for elevator commands

The flaps can be set up to reinforce the effect of the elevator; this is normally used in high-speed flying to improve the model’s agility around the lateral axis, and is also set up in the menu ...

»Wing mixers« (page 84)

Brake	–>3	Elevator	+ 0%	
Brake	–>6	Flaps	+ 0%	
Brake	–>5	Ailerons	+ 0%	
Elevator	3 –>6	Flaps	+ 0%	
Elevator	3 –>5	Aileron	+ 0%	+ 0%
		«Normal »		SYM ASY

… by setting the mixers “Elevator 3 ➔ 6 Flaps” and “Elevator 3 ➔ 5 Aileron” separately for each flight phase. Both the secondary flaps (servos 6 + 7) and the ailerons (servos 2 + 5) follow the movement of the camber-changing flaps in accordance with the set mixer ratio – usually in the opposite direction to the elevator.

To force the two inboard flaps (servos 8 + 1) to “follow” this movement, move to the menu ...

»Free mixers« (page 102)

LinearMIX 1		AI ➔ C1		=>
LinearMIX 2		EL ➔ 8		=>
LinearMIX 3		EL ➔ 8		=>
LinearMIX 4		?? ➔ ??		- - - -
	type	from to		Adjust
		SEL SEL		

… and set up an “EL ➔ 8” mixer for each flight phase.

These mixers have the effect of making both inboard flaps follow in the *same direction* when an elevator command is given – provided that you have already set up the dual mixer as described on page 142.

On the second page of the screen, set up a mixer ratio suitable for the model and the flight phase in question.

To ensure that these mixers – in our example LinearMIX 2 and LinearMIX 3 – work as required in the appropriate flight phases, you now have to move to the menu ...

»MIX active/phase« (page 108)

MIX ACTIVE IN PHASE			
LinearMIX	1	AI ➔ C 1	yes
LinearMIX	2	EL ➔ 8	yes
LinearMIX	3	EL ➔ 8	no
LinearMIX	4	?? ➔ ??	yes
	«Normal »		SEL

… and determine which mixer is to be disabled in which flight phase. This is done by switching between the flight phases and setting the two mixers to “yes” or “no” as required.

Using airbrakes

If the model features airbrakes in addition to the wing flaps – and if your receiver still has a vacant output socket (9 or higher) – you can control them using the Ch1 stick, which until this point has not been assigned a function. To do this you have to set up a further free mixer “Ch1 ➔ 9”, which causes a servo connected to output 9 to extend and retract the airbrakes.

If necessary you can adjust the characteristics of the airbrake control system in the »**Channel 1 curve**« menu.

If your model needs automatic elevator trim correction when you extend the airbrakes, this can be achieved without the need for an additional mixer. Simply use the pre-programmed wing mixer “Brake ➔ 3 Elevator” in the »**Wing mixers**« menu.

However, you still have to ensure that the elevator is not affected by the Ch1 stick when the airbrakes are retracted, and to this end the mixer neutral point (offset) of the “Brake ➔ 3 elevator” mixer has to be adjusted accordingly.

This is carried out in the menu ...

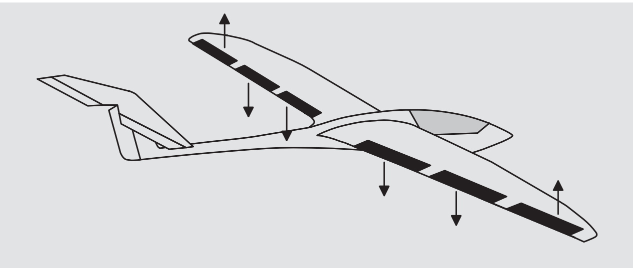
»Model type« (page 52)

M O D E L T Y P E			
Motor		None	
Tail type		Normal	
Aileron/camber flaps		2 AIL	2 FL
▶Brake	Offset + 90%	Enter	1
▲	STO	SEL	

In the “Brake” section, first move the Ch1 stick to the position at which this airbrake mixer is to be triggered – normally “forward” – then select **STO** and confirm the threshold point with a brief press on the rotary control.

If you now move the Ch1 stick *beyond* this point, the elevator follows the movement to the extent defined by the mixer ratio you have set. *Below* this point the mixer is inactive; you can select a “dead zone” for this if required.

Airbrake mixer (crow setting)



The “Brake ➔ 3 Elevator”, “Brake ➔ 5 Aileron” and “Brake ➔ 6 Flaps” mixers can be set up in such a way that the ailerons 2 + 5 deflect up and the flaps 6 + 7 move down, while an elevator trim correction occurs automatically (see »**Wing mixers**« section, page 87).

To make the inboard flaps 8 + 1 follow, you need to set up a further free mixer, “Ch1 ➔ 8”.

This mixer causes the inboard flaps to follow in the same direction, according to the position of the Ch1 stick.

Ideally the neutral point (offset) of this linear mixer will be located at the position on the Ch1 stick travel which you have defined as the offset point in the “Brake” line of the »**Model type**« menu (see left-hand column).

However, you may find that the programming you have already completed has already “used up” the four linear mixers available. In this case switch to the menu …

»Free mixers« (page 102)

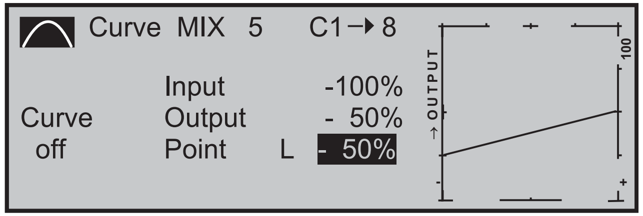
LinearMIX 2		EL ➔ 8	=>
LinearMIX 3		EL ➔ 8	=>
LinearMIX 4		C1 ➔ 9	=>
▶CurveMIX 5		C1 ➔ 8	=>
	type	from to	Adjust
▼▲		SEL SEL	➡

… and select a curve mixer.

Move to the second screen page, and start by erasing reference point 1 by moving to this point and pressing the **CLEAR** button at the side. Now move the Ch1 stick to the “Airbrakes retracted” position and set the associated reference point to “0%”.

Move the Ch1 stick in the direction of “Airbrakes extended” and place the second reference point at the required value.

This procedure sets up a linear mixer which only becomes effective when you extend the airbrakes, e.g.:



Note:
Naturally you could also set up a control curve for the pair of wing flaps 8 + 1 by defining additional reference points.

Reduction of aileron and flap differential (servos 2 + 5 and 6 + 7)

To improve aileron response in the crow configuration we recommend that you set up automatic suppression of any programmed aileron differential.

This is achieved using the “Differential reduction” point in the »**Wing mixers**« menu; this function continuously reduces aileron differential to the set level when you move the Ch1 stick to deploy the wing flaps to the “crow” position. See page 88 for more details.

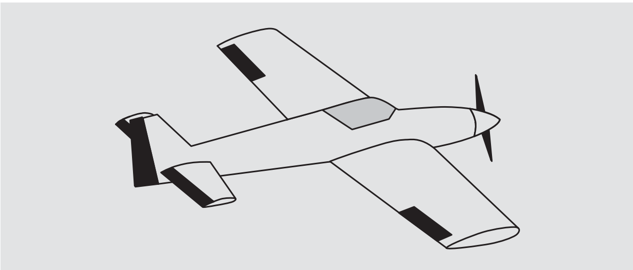
Aileron differential for the inboard flaps (servos 8 + 1)

You can set up differential travel of the secondary flaps 8 + 1 when an aileron command is given by selecting the »**Dual mixers**« menu (see above).

It is not possible to set differential reduction for the wing flaps 8 + 1 using the method described above. This is not usually necessary for the inboard wing flaps in any case.

F3A model aircraft

F3A models belong to the category of powered fixed-wing model aircraft designed for competition flying. They may be powered by an internal combustion engine or an electric motor. Electric-powered models are eligible to fly in the international F3A "pattern" class, and also in the F5A electric aerobatic class.

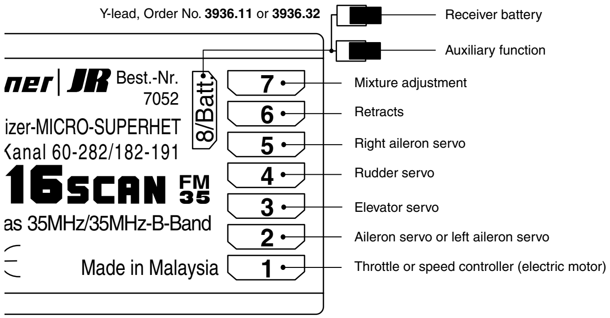


On page 120, where the section on fixed-wing model programming starts, you will find general notes regarding installing and setting up the RC system in a model, and – of course – all this information also applies to F3A models, and therefore does not need to be repeated at this point.

If an F3A model is accurately built, it usually exhibits flying characteristics which are almost completely neutral. The perfect aerobatic model has a very smooth but precise control response, and any movement around any one of its flight axes should not affect the other axes.

F3A models are flown using aileron, elevator and rudder controls. The use of separate servos for each aileron is almost universal with these aircraft. The flying controls are supplemented by control of motor power (throttle function) and in many cases a retractable undercarriage. As a result the servo assignment for channels 1 to 5 is no different to the fixed-wing models we have already described.

The auxiliary function "Retracts" is usually assigned to one of the auxiliary channels 6 to 9. Ideally the retracts are operated using a switch without a centre detent. An optional "extra" – used only if necessary – is mixture adjustment control for the carburettor. This is generally controlled by a slider on the transmitter connected to one of the auxiliary channels otherwise not in use.



When assigning functions to the auxiliary channels at the transmitter, it is advisable to ensure that the controls required are within easy reach, since the advanced aerobatic pilot has very little time to think about letting go of the sticks – especially when flying under contest conditions.

Programming

The basic programming of the transmitter has already been described in detail in the section starting on page 122, so this section concentrates on tips specific to F3A models.

In the menu ...

»Servo adjustment« (page 56)

▸Servo 1	=>	0%	100%	100%	150%	150%
Servo 2	=>	0%	100%	100%	150%	150%
Servo 3	=>	0%	100%	100%	150%	150%
Servo 4	=>	0%	100%	100%	150%	150%
	Rev	cent.	- travel	+	- limit	+
▾	SEL	SEL	SYM	ASY	SYM	ASY

… you can adjust the servo settings to suit your model. It has proved advisable to use at least 100% servo travel, as precision of control can be perceptibly improved if relatively large servo travels are employed. This should be borne in mind when building the model and designing the control surface linkages. Check the direction of servo rotation, and take care to set the servo centres accurately at the mechanical level.

Any minor corrections required can be made in the 3rd column of the »**Servo adjustment**« menu during the first few test-flights.

The next step is to select the menu ...

»Model type« (page 52)

MODEL TYPE			
▸Motor			Thr. min rear
Tail type			Normal
Aileron/camber flaps			2 AIL
Brake	Offset	+100%	Input 1
▾			SEL

… and select "Throttle min forward / back" in the "Motor" line to activate the idle trim for Channel 1 (normally "back"; i.e. full throttle forward). The digital trim now works only at the idle end of stick travel.

The "cut-off trim" (page 32) enables you to switch immediately from the "motor stopped" position to the idle position you have previously set, just be applying a single "click" on the trim lever.

The remaining settings can be left as shown in the illustration.

Once you have test-flown the model and trimmed it out carefully, we recommend that you reduce the trim travel for elevator and ailerons. The model then responds much more smoothly to any change you make using the trim levers. This avoids "over-trimming" the model; with full trim travel a single trim increment can have too powerful an effect: if the model tends to pull left, one click of the trim causes it to pull right.

If necessary, reduce the increment size of the digital trims in the menu ...

»Base setup model« (page 50)

BASIC SETTINGS, MODEL				
Model name	<			>
Stick mode	2			
Modulation	PPM18			
▶Trim steps	1	4	4	4
▼▲	CH1	AILE	ELEV	RUDD

… for all four trim levers. You can check the effect of the sensitivity you have selected in the »**Servo display**« menu.

You may find it necessary to assign transmitter controls to particular inputs to operate the retractable undercarriage and carburettor mixture adjustment. This is carried out in the menu ...

»Control adjust« (page 58)

Enter 5	Cntr 5	0%	+100%	+100%	0.0	0.0
Enter 6	Cntr 6	0%	+100%	+100%	0.0	0.0
Enter 7	Cntr 7	0%	+100%	+100%	0.0	0.0
▶Enter 8	2	0%	+100%	+100%	0.0	0.0
		offset	-travel+		-time+	
▼▲	SEL		SYM	ASY	SYM	ASY

For example, you may like to use an external ON / OFF switch connected to input 8 for the retracts, and a proportional control, e.g. slider 7 on the centre console (connected to input 7) for mixture adjustment.

Note:
A time delay for the retracts may be a useful feature, providing a more realistic retraction / extension speed, but this has no effect if you use the non-proportional retract servo C713, Order No. ***3887****.*

The retracts are extended and retracted when you operate switch "2". You may need to adjust the travel of the transmitter control, and perhaps reverse that channel by setting a negative value for the travel setting.

F3A models fly at extremely high speeds, and respond very "solidly" to corrective movements of the servos. However, in competition flying it is vital that all abrupt control movements and corrections should be kept to a minimum, as the judges will invariably notice any lack of smoothness and dock a few points from your score, so it is advisable to set exponential control characteristics on the stick functions.

Switch to the menu ...

»Dual Rate / Exponential« (page 64)

Aileron	100%	0%
▶Elevator	100%	+ 30%
Rudder	100%	+ 30%
	DUAL	EXPO
▼▲	SEL	SEL

Exponential values of around +30% on aileron, elevator and rudder have proved to be a good starting point, and you can set them in the right-hand column of this menu using the rotary control. These values provide smooth, well-defined control of the typical F3A model.

(Many experts use higher values; even up to +60% exponential.)

Since the response of (several) glowplug motors to the throttle stick is by no means truly linear, you may want to dip into the menu …

»Channel 1 curve« (page 68)

… to set what we might term a "bent", i.e. non-linear, throttle curve. In particular, four-stroke engines such as the OS Max FS 120 call for a steep rise in the curve at the bottom end of the speed range. However, you will need to experiment to find the perfect throttle curve. A typical Ch1 control curve for the motor might look like this:

Channel 1 CURVE			
	Input		- 50%
Curve	Output		- 0%
on	Point	1	0%

Only three reference points, namely -100% control travel (= "L, low"), +100% travel (= "H, high") and -50% control travel ("1") produce the curve shown here when rounded off.

This is the basic procedure:

1. Erase the reference point "1" which is present at the centre point in the basic software setting: move the Ch1 stick to centre and press the **CLEAR** button at the side.
2. Now move the Ch1 stick – and with it the vertical line in the graph – to around -50% travel in the direction of idle, and briefly press the rotary control.
3. To obtain the curve shape shown here, use the rotary control to raise this reference point to about 0% in the inverse video field of the "Point" line.
4. Finally round off the curve by pressing the left-hand **ENTER** button.

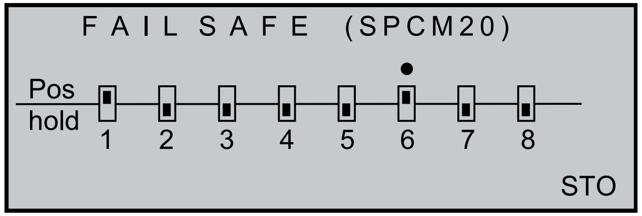
If you need to set additional reference points between the left ("L") and right ("H") ends, repeat steps 2 and 3 using the same procedure.

If you operate the radio control system in PCM-20 or SPCM-20 mode, it is advisable to store suitable fail-safe settings using the menu ...

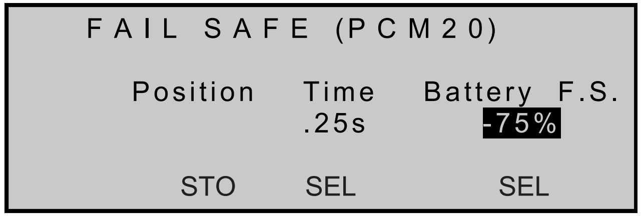
»Faile-safe adjust« (page 112 or 114)

… as "hold mode" is the default setting of the mc-22s transmitter.

In its default form the transmitter prescribes "hold mode" as the fail-safe setting; this equates to "do nothing", i.e. the receiver continuously passes the last valid signals to the servos in the model: it "holds them still”. This is more or less the worst possible setting for a power model, and might well result in the model tearing uncontrollably across the flying field, representing a serious risk to pilots and spectators alike. For this reason we strongly recommend that you should at least set the motor to stop or throttle back, to avoid precisely this risk; at the same time the undercarriage should also be set to extend automatically. Once you have carried out these settings, you should certainly check them again once the model has been test-flown and trimmed out fully.



In the next section we consider the “battery fail-safe” feature in PCM20 mode:



The “Battery fail-safe” function, which is triggered when the voltage of the receiver battery falls below a particular point, moves the carburettor to a pre-set value, which can be -75%, 0% or +75% of the throttle servo’s travel. This forced throttle closure can be eliminated again at any time simply by moving the throttle stick, but don’t waste any time: you should get the model down onto the ground as quickly as possible and recharge the battery.

Since F3A models generally have two aileron servos, it has proved useful to deflect both ailerons “up” for the landing. In most cases this causes the aircraft to fly slightly more slowly, and adopt a more *stable* attitude on the landing approach.

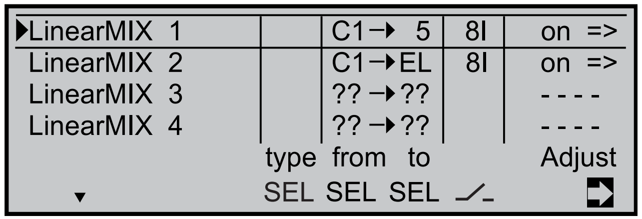
To achieve this you will need to program mixers in the menu ...

»Free mixers« (page 102)

Both ailerons are required to deflect “up” to act as a landing aid, in parallel with the movement of the throttle stick, but only from the half-throttle setting in the direction of idle. The further the stick is moved towards the idle position, the more the ailerons deflect up. The reverse should occur when you open the throttle: the ailerons / flaps retract to avoid the model suddenly ballooning up.

A little down-elevator must usually be mixed in to ensure that the model does not climb when the ailerons / flaps are extended.

To meet these two requirements you need the two linear mixers shown in the illustration below. The mixers are activated using one and the same external switch, e.g. switch No. “8”, which therefore has to be assigned to *both* mixers.



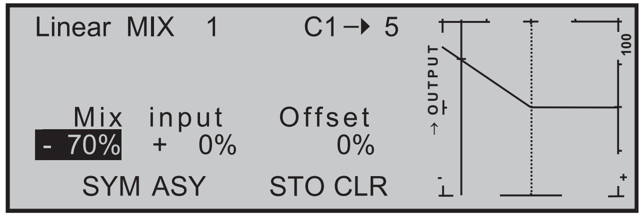
Move to the second screen page, and set the appropriate mixer ratios. In both cases the mixer neutral point should be left at the centre point of the Ch1 stick arc.

Select the **ASY** field, set 0% for both mixers above the centre point of the control, and the following settings below the centre point, i.e. in the direction of idle:

LinearMIX 1: -60%... -80% and

LinearMIX 2: -5% ... -10%.

Example of LinearMIX 1:



This completes the basic set-up for a typical F3A model.

Correcting model-specific errors

It is an unfortunate fact of life that even very carefully built models exhibit minute faults and inaccuracies which have to be corrected using the mixers of a computer radio control system. In this section we will describe how to carry out these adjustments, but please note the following points before we get started: it is vital to ensure that the model is built as *accurately* as humanly possible, that it is balanced perfectly around the lateral and longitudinal axes, and that motor downthrust and sidethrust are set correctly.

Rudder causes unwanted movement around the longitudinal and lateral axes

It is often the case that a rudder command causes the model to rotate slightly around the longitudinal and / or lateral axes. This is particularly troublesome in what is known as knife-edge flight, where all the model’s lift is generated by the fuselage, aided by the rudder deflection. The result is that the model rotates and changes heading slightly, as if the pilot were applying aileron or elevator at the same time. These tendencies have to be corrected with compensation around the lateral axis (elevator) and around the longitudinal axis (aileron).

This can be achieved easily with the mc-22s, exploiting the facilities of the »**Free mixers**« once again. For example, if the model rotates to the right around the longitudinal (roll) axis when the rudder is deflected, then a mixer has to be set up which deflects the ailerons slightly to the left. Heading changes around the lateral (elevator) axis can be corrected in a similar way using a mixer acting upon the elevator:

a) Correction around the lateral axis (elevator)

LinearMIX 3: „RU ➔ EL“

Asymmetrical setting. The exact values required must be found by flight testing.

b) Correction around the longitudinal axis (aileron)

LinearMix 4: „RU ➔ AI“

Asymmetrical setting. The exact values required must be found by flight testing.

In most cases relatively small mixer values are called for, typically below 10%, but this does vary from model to model. If you use one of the curve mixers 5 or 6, the mixer ratios can be adjusted even more accurately to match different rudder deflections. Again, no definite values can be stated, as they vary for each model.

Vertical climb and descent

Many models exhibit a tendency to deviate from the ideal line in vertical climbs and descents.

To correct this we need an elevator centre position which varies according to the throttle setting. For example, if the model tends to pull out of a vertical descent by itself when the motor is throttled back, slight down-elevator must be mixed in at this throttle setting using a "C1 ➔ EL" mixer.

This can be achieved in either of two ways: using the pre-programmed "Brake ➔ Elevator" mixer in the »**Wing mixers**« menu – in which case you must not forget to move the "brake offset" to coincide with your throttle minimum position in the »**Model type**« menu. Alternatively you could program a free mixer. If all the free mixers are in use, you can use the "CurveMIX 5" mixer as a linear mixer to achieve this function.

As a rule you will need to set mixer values below 5%, but once again there is no substitute for test-flying.

Rolling (movement around the longitudinal axis) at idle

When you reduce the throttle setting, the model may tend to roll slightly in one direction. Clearly an aileron correction has to be made.

However, it is much more elegant to let a "C1 ➔ AI" mixer correct this effect than to move the stick manually. Here again, a curve mixer is recommended, e.g. "CurveMIX 6", which is again programmed as a linear mixer, albeit this time with a very small mixer ratio.

The adjustment process should only be carried out in calm weather. Often all you need to do is apply the mixer in the control segment between half-throttle and idle. To achieve this, set one reference point in the centre of the stick travel.

Rolling when ailerons and flaps are extended

If you fly the landing approach with both ailerons deflected up, the model may show a tendency to roll slightly due to minor variations in aileron servo travel (or constructional inaccuracies). The model may turn to either side by itself. Once again, this tendency can easily be corrected using a "C1 ➔ AI" mixer to vary the compensation according to the position of the ailerons / landing flaps.

If you are using the pre-programmed »**Wing mixer**« "Brake ➔ 3 Elevator" to correct the fault described in the left-hand column under the title "Vertical climb and descent", you can still use CurveMIX 5.

You must provide a means of switching the mixer on and off using the external switch which controls the aileron / landing flap function. The mixer therefore only has any effect when the aileron / landing flap function is activated. The correct value must be found through test-flying.

Summary

The settings described on this page are intended primarily for the expert flyer who needs an F3A aerobatic model which flies with absolutely accurate, neutral control response.

Please bear in mind that refining the flying characteristics of a model to this extent involves tremendous effort, time, sensitivity and expertise. Some experts continue the programming procedure even when they are flying. It is not advisable to try this if you are just a moderately advanced pilot making your first attempt with an F3A aerobatic model. You would be well advised to request help from an experienced pilot, and carry out the fine-tuning adjustments mentioned here one by one, with the expert at your side, until your model exhibits the neutral flying characteristics you are aiming for. At this point, when your model is flying perfectly, you can forget all about trimming, and concentrate on flying the aerobatic manoeuvres themselves, which are not necessarily easy to fly well.

Model helicopter

In this programming example we assume that you have already read and understood the descriptions of the individual menus, and are by now familiar with the general handling of the transmitter. We also assume that you have built and adjusted the helicopter exactly according to the kit instructions. The electronic facilities provided by the transmitter should never be used to compensate for major mechanical inaccuracies.

As so often in life, there are various ways and means of reaching a particular destination when programming the mc-22s. In this example our intention is to provide a sensibly structured procedure, so that you develop a clear idea of logical programming techniques. Where there are several possible methods, we first describe the simplest and most easily understood solution. It is likely that the helicopter will work perfectly when set up in this way, but – of course – you are still free to try out other solutions at a later stage in case they may suit you better.

As our programming example we take the *GRAUPNER* STARLET 50 helicopter, with three swashplate linkage points distributed equally at 120° – “3 Sv(2 roll)” – a beginner’s set-up without enhanced throttle curve, with no method of influencing the gyro from the transmitter, and with no speed governor. We have deliberately chosen this simple programming project in order to demonstrate that it is possible to produce a helicopter which flies extremely well with relatively little programming effort.

Nevertheless, we don’t want to keep from you all the scope for possible refinements: the basic description is followed by set-up notes on gyro gain, speed governors and different helicopter mechanics.

At the initial programming stage you have to define a number of basic transmitter settings once only, to inform the transmitter of your preferred method of control. To do this switch to the menu ...

»Basic settings« (page 117)

```
GENERAL BASIC SETTINGS
 Owners name          <H-J Sandbrunner>
 Pre-set stick mode           1
 Pre-set modulation         PPM18
▶Expert mode                 no
 Pre-set min. Pitch         forwrd
                             SEL
```

First enter the “**Owner’s name**”, which will appear in the basic screen display. The letters and symbols for this are selected from the comprehensive character table on the second screen page, which you can reach with a brief press on the rotary control after selecting the arrow ⮕ symbol:

```
 !“#$%&´( )*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_
`abcdefghijklmnopqrstuvwxyz{}~
Ç éâäàåçêëèïîìÄÅÉæÆôöòûùÿÖÜ
Owners name          <H-J Sandbrun        >
```

Select your preferred “**Pre-set stick mode**” according to the criteria described on page 117.

The same applies to your preferred “**Pre-set modulation**”.

If you set “**Expert mode**” to “no”, some menus are automatically suppressed from the multi-function list *when you initialise a new model memory*.

However, the limited list of menus is generally sufficient for basic programming, so you do not need to make any changes at this point. Regardless of this setting, you can at any time switch the suppressed menus back on using the »**Suppress Codes**« menu.

These basic settings are completed by setting “**Preset min. pitch**” to “forward” or “back”; this setting is a matter of personal preference.

Within each model memory the presets “**Stick mode**”, “**Modulation**” and “**Coll. pitch min. forward / back**” are automatically adopted, but you can still change them if you wish.

Once you have completed these settings, move on to the menu ...

»Model select« (page 47)

… and choose a vacant model memory using the rotary control ...

```
01  CUMULUS 97    SPCM20   1:25h
02  Laser         PCM20    2:45h
03  DV20 KATANA   PPM18    5:26h
04  MEGA STAR     SPCM20   8:31h
05  ***free***
06  ***free***
```

… give a brief press on the rotary control (or press the **ENTER** button) to select the model type “Heli”.

```
Select model type (free model memory)
```

Confirm your choice with a brief press of the rotary control (or **ENTER**), and the screen immediately switches to the basic display.

If the warning “**Throttle too high**” appears, move the collective pitch stick to the minimum position, and the message will disappear.

The next step is to select a name for the model memory you have chosen; the name is entered in the menu …

»Base setup model« (page 50)

BASIC SETTINGS, MODEL				
▶Model name	<			>
Stick mode	2			
Modulation	PPM18			
Trim steps	4	4	4	4

Your choice of "**Model name**" is entered virtually in exactly the same way as the user name, which was described on the left-hand page under »**Basic settings**«.

Once you have entered the model name, you should again check the basic settings ("**Stick mode**" and "**Modulation**" in the »**Basic settings**« menu) you have already programmed, while you can still change them for the model memory you have selected.

Under "**Trim steps**" set the increment size for each "click" of the digital trim levers. In the Heli model type the Ch1 trim *only* affects the throttle servo. The throttle trim has several special features ("motor cut-off trim" etc.), but as they have already been described in detail we will not go into them again here; please read the sections on pages 32 and 62. Since the trims are digital, the trim values are automatically stored when you switch model memories.

We now come to the first setting which is specific to helicopters. Move to the menu ...

»Helicopter type« (page 53)

HELI TYPE	
Swashplate type	3Sv(2roll)
▶Rotor direction	right
Pitch min	forwrd
Expo throttle lim.	0%
	SEL

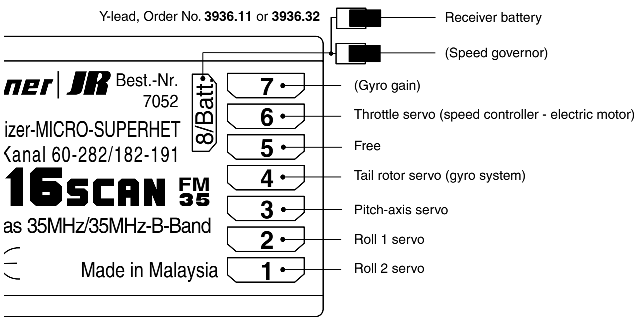
Under "**Swashplate type**" select the type of linkage for the swashplate / collective pitch function; in our example this is "3Sv(2roll)".

In the "**Rotor direction**" line we set the direction of rotation of the main rotor as viewed from above. This means: clockwise or anti-clockwise – in our example "right" (clockwise).

Check again that "**Pitch min.**" is set correctly, as it is adopted from the »**Basic settings**« menu. Ensure that the "forward" or "back" entry suits your personal preference.

We can safely ignore "**Expo throttle lim.**" for the moment.

At this point, if you have not already done so, the servos should be connected to the receiver in the following order:



Please note one important difference in the mx-16s, mc-19, mc / mx-22 and 22s and mc-24 compared with previous *GRAUPNER* mc radio control systems: the first collective pitch servo and the throttle servo have been interchanged.

The Heli program automatically sets the mixer ratios and mixer directions for the swashplate servos for collective pitch, roll and pitch-axis to +61% in each case. These settings are found in the menu ...

»Swashplate mixer« (page 111)

SWASH MIXER	
▶Pitch	+ 61%
Roll	+ 61%
Pitch ax.	+ 61%
	SEL

If the swashplate does not respond correctly to the stick movements, the first step is to change the mixer directions from "+" to "–" if necessary. The second recourse is to reverse the servo directions in the »**Servo adjustment**« menu.

Now move to the menu ...

»Servo adjustment« (page 56)

▶Servo 1	=>	0%	100%	100%	150%	150%
Servo 2	=>	0%	100%	100%	150%	150%
Servo 3	=>	0%	100%	100%	150%	150%
Servo 4	=>	0%	100%	100%	150%	150%
	Rev	cent.	- travel	+	- limit	+
	SEL	SEL	SYM	ASY	SYM	ASY

… where you can set up the travels and directions of rotation of the individual servos.

The basic aim here should be to keep servo travels at +/-100% wherever possible, as this maintains best possible resolution and accuracy. Use "Rev." if necessary to reverse the direction of rotation of any servo; do check carefully that the direction you set really is correct. The tail rotor servo must operate in such a way that the nose (!) of the helicopter moves in the same direction as the movement of the tail rotor stick.

A glance at the menu ...

»Control adjust« (page 60)

Enter 9	Cntr 9	0%	+100%+100%	0.0 0.0
Enter10	Cntr10	0%	+100%+100%	0.0 0.0
Enter11	free	0%	+100%+100%	0.0 0.0
▶Th.L.12	Cntr 7	0%	+100%+100%	0.0 0.0
		offset	-travel+	-time+
▲	SEL	SEL	SYM ASY	SYM ASY

… will show you that control 7 is assigned to input 12.

This input serves as the **throttle limiter**. It acts solely on output “6”, to which the throttle servo is connected. The slider, which is connected as standard to the CH7 socket on the transmitter circuit board, is assigned to the throttle limiter.

<u>*Just to remind you:*</u>
The throttle limiter does not control the throttle servo; it just restricts the travel of this servo in the forward direction, in accordance with the setting you select. The throttle servo is usually controlled by the collective pitch stick via the throttle curve you have programmed. For more details of these functions please read the sections on pages 62 and 92 of the manual.

Select the **ASY** field in the “Travel” column, and increase the value in the inverse field from 100% to 125%, with the throttle limiter pushed fully forward.

This ensures that the throttle limiter cannot possibly restrict the full throttle travel set by the collective pitch stick when the model is in flight.

An additional transmitter control needs to be activated in the menu ...

»Auxiliary switch« (page 75)

▶Autorotation		2
Autorotation C1 Pos.	0%	
▼		

Even if you are a beginner to flying and are not yet ready for this, it is advisable at least to define the auto-rotation switch, so that you have an “emergency off” switch for the motor.

This is carried out in the sub-menu “Auto-rotation”: press the rotary control briefly and move one of the ON / OFF switches (e.g. two-position switch, Order No. **4160**) to the “ON” setting. On the right the switch number (in our example “2”) appears, and this number will also identify the switch in the »**Switch display**« menu.

The AR switch should be located at a position on the transmitter where you can easily reach it without letting go of either stick, e.g. above the collective pitch stick.

<u>*Note:*</u>
Please refer to the next page for more details on setting up this “Emergency off switch”.

<u>*And another tip:*</u>
We recommend that you make it a routine matter to assign all the switches a common “on” direction; then a quick glance at the transmitter before flying will soon reassure you that all switches are “off”.

If you wish, you could at this point move to other submenus and assign flight phase switches, but our simple programming example does not include such refinements.

You have now completed the basic settings at the transmitter, i.e. the procedure which you will need to use time and again when setting up new models.

The actual set-up for your specific helicopter is carried out primarily in the menu ...

»Helicopter mixers« (page 90)

▶Pitch	=>
Channel 1 → Throttle	=>
Channel 1 → Tail rot.	=>
Tail rot. → Throttle	0%
Roll → Throttle	0%
Roll → Tail rot.	0%
Pitch ax. → Throttle	0%
Pitch ax. → Tail rot.	0%
Gyro suppression	0%
Swashplate rotation	0%
▼	

… where you will see the “**Pitch**” function in the very first line; a brief press on the rotary control will take you to the corresponding sub-menu. Here you will find a graph of the collective pitch curve, which is initially defined only by the three reference points “L” (low), “1” and “H” (high); in most cases this will be all you need.

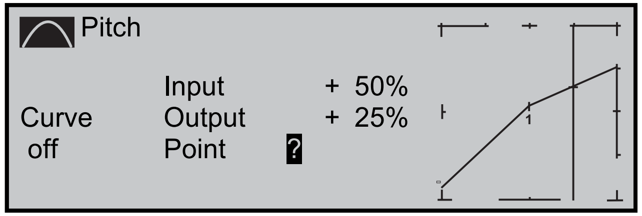
<u>*Tip:*</u>
We strongly advise that you initially set up your helicopter using just these three reference points; more points complicate the whole business, and at present are likely to be more trouble than they are worth.

The reference point for hovering should generally be the mechanical centre point of the collective pitch stick, as this position feels completely natural to most pilots. You can, of course, set up the curve to locate the hover at a different point, but please don’t be tempted to do this unless you know exactly what you are doing. Start by setting the collective pitch stick to centre. Assuming that you previously adjusted the servos in accordance with the manufacturer’s instructions, the servo output arms will now (usually) be at right-angles to the servo case. If you have not already done so, adjust the mechanical linkages to the rotor head so that all the blades are set to a collective pitch angle of 4° to 5° positive for the hover. All known helicopters will fly at this approximate setting.

Now push the collective pitch stick fully forward to the maximum collective pitch point (we have already set collective pitch minimum to the “back” position). The solid vertical line in the graph indicates the current stick position. You can now adjust this point “H” (high) on the collective pitch curve using the rotary control, with the aim of producing a collective pitch maximum setting of around 9° at the main rotor blades. Point “H” will need to be around 50%.

<u>Note:</u>
A rotor blade set-up gauge, e.g. the GRAUPNER item, Order No. ***61****, is very useful when setting up blade pitch angles.*

Now pull the collective pitch stick right back to the collective pitch minimum position: point “L” (low). Set the blade pitch angle for this setting to 0° to -4°, depending on the pilot’s flying ability. This process produces a slightly “bent” line (known as the “collective pitch curve”) at the hover point, and the graph may well look something like this:

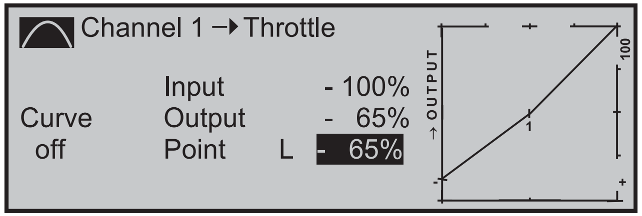


At this point you should round off the curve by simply pressing the left **ENTER** button again.

If you now switch to the auto-rotation phase – you will see the name of the flight phase “Autorot” at the bottom of the screen – you will find the “old” collective pitch curve once more. In this phase you should set the same values as in the normal phase, with the following exception: increase the collective pitch angle by about 2° at “H”, i.e. the extreme forward position of the stick. This gives slightly more rotor blade pitch for flaring the model when practising “autos” at a later (!) date.

Once you have set up the collective pitch curve, press **ESC** to return to the Helicopter mixers menu list, and move to the “**Channel 1 ➔ throttle**” line where you can set up the throttle curve.

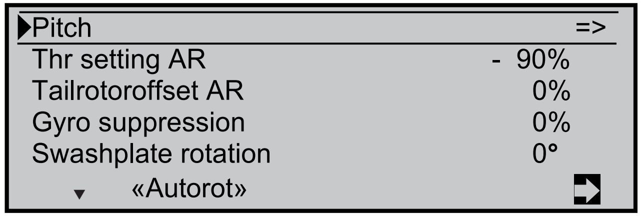
The first step here is to define the idle trim range by adjusting point “L” on the throttle curve; it should be set to around -65%.



With the throttle limiter *closed* and the idle trim fully open, pull the collective pitch stick to the “fully back” position, and move it slightly to and fro. The throttle servo should not respond to this movement. This arrangement gives you a seamless transition from idle trim to the throttle curve. You will probably need to make further adjustments to the throttle curve, but this must be carried out later as part of the flight-testing process.

If you temporarily switch from this graphic display to the auto-rotation flight phase (AR), the display “Channel 1 ➔ throttle off” appears, i.e. the throttle servo is switched to a fixed value which can be set up as follows:

Select **ESC** to return to the menu list. You will find that certain new sub-menus now appear in the list, but only as long as you stay in the auto-rotation phase. The new menus are:



The important line here is “**Thr setting AR**”. The value on the right of this line should be set to either approximately +125% or -125%, depending on the direction of rotation of the servo. If you are not sure of this, call up the »**Servo display**« menu to help you.

This setting ensures that the motor is reliably stopped in the auto-rotation phase (to cope with an emergency). Later, when you have gained sufficient experience to practise auto-rotation landings, the setting should be changed to a value which provides a reliable idle.

At present the remaining sub-menus are of no importance. Switch “AR” off, and we move back to the first menu list.

Call up the “Channel 1 ➔ tail rotor” line, in which you can set static torque compensation for the tail rotor. Here again, it is better to keep to just three reference points; anything more elaborate is strictly the province of experienced pilots. For the moment you can safely accept the pre-set values of “L” = -30% at the bottom end of stick travel and “H” = +30% at the opposite end, although you may find it necessary to correct the settings slightly later.

Now switch back to the AR phase for a moment. The set-up curve is disabled here, with the result that the tail rotor servo no longer responds to collective pitch commands (when the main rotor is not powered, there is no torque to be corrected). All the other sub-points are of no importance for the moment.

If your gyro features gain control from the transmitter – unlike the model we are using in this example – you can safely store the standard gain value in the model memory using the "**Gyro suppression**" line. To be able to adjust gyro gain from the transmitter you will need to set up another free linear slider, which you can assign to the "Gyro" input in the menu ...

»Control adjust« (page 60)

Enter 5	Cntr 5	0%	+100%+100%	0.0 0.0
Throt 6	free	0%	+100%+100%	0.0 0.0
▶Gyro 7	Cntr 6	0%	+100%+100%	0.0 0.0
Enter 8	Cntr 8	0%	+100%+100%	0.0 0.0
		offset	-travel+	-time+
▼▲	SEL	SEL	SYM ASY	SYM ASY

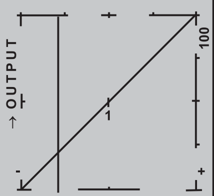
Push the slider fully forward, and move to the **ASY** field in the "Travel" column using the rotary control. At this point set the maximum gain of the gyro to a value such as 50%, which represents a safe fixed value when the slider is at its forward end-stop. You will probably need to adjust the value in the course of flight-testing. Additional notes on setting up gyros can be found in the section "Gyro suppression" on pages 94 … 95.

To conclude the initial programming procedure, a few words about the menu ...

»Channel 1 curve« (page 70)

Channel 1 C U R V E

	Input	- 60%
Curve	Output	- 60%
off	Point	?



This function represents a sort of "convenient exponential curve" for the collective pitch stick and the mixer functions associated with it; see page 70.

This curve should probably not be used at all initially, and if you do use it, be sure to use it "carefully", and even then not until the very last stage, when all the other settings have been completed. It must not be used to adjust the throttle / collective pitch function, as the superimposed signals may produce unpredictable effects.

You have now completed all the heli-specific adjustments which can be carried out in the calm of your workshop. Further fine-tuning must now be made with the model in the air. With a little luck, test-flying will show the need for only minor (digital) trim adjustments, which are – of course – stored automatically by the transmitter.

If a major change is necessary, you should carry out the mechanical correction required, or make adjustments to the programmed settings we have just discussed.

Further adjustments

If you have followed this programming example, you will have a helicopter which is set up properly, and in an ideal state for hovering practice and simple circuits. Of course, you may wish to activate further functions depending on your skill and flying experience.

If you wish to fly using different rotor speeds and trim set-ups, you will need to activate a series of "flight phases", which can be called up via switches which you assign.

The first step in this process is to call up the menu ...

»Phase setting« (page 79)

▶Autorot	Autorot	1.5s →	+
Phase 1	Normal	1.0s	∗
Phase 2	Hover	1.0s	-
Phase 3	Aerobat	1.0s	-
	Name	Switch time	status
▼		SEL	

… where the symbols in the "Status" column have the following meaning:

„–": no phase switch present

„+": phase switch present

„∗": currently active phase

However, before you set up the flight phases you should consider carefully whether you want to use individual switches to select them, or – more sensibly – use one three-position switch (differential switch, Order No. **4160.22**), which enables you to select up to three flight phases in addition to auto-rotation. The latter option is more logical and easier to remember.

In the menu you will find the "Autorot" line already selected. If the auto-rotation phase is activated, it always has absolute priority over any other phases to which you assign switches.

In this menu your first step is to assign unambiguous names to phases 1 to 3; the names are taken from a list. The phase name makes it easier to differentiate the phases, and is later displayed on the screen in all the phase-specific menus.

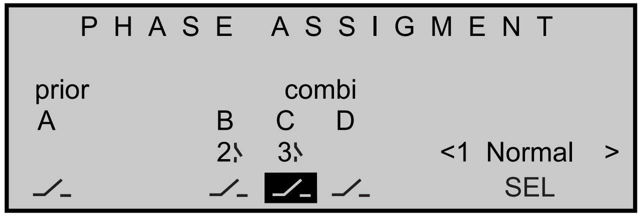
Move to the next column and set the transition time which you wish to apply when switching *from* one phase *into* a new one. A setting of about one second is usually ample.

Later this value can also be adjusted to suit your personal taste. Please note that there is always *zero delay* when switching into the auto-rotation phase, whose "Autorot" name cannot be changed. However, you can set the transition time which is to be used when you switch *from* auto-rotation into another phase.

You now need to set up a method of switching between different flight phases, and the individual phase switches or three-position switch are assigned as follows:

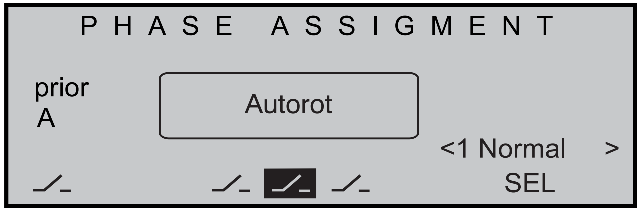
Phase switches are assigned in the menu ...

»Phase assignment« (page 80)



Assign the three-position switch under "B" or "C".

The next step is to allot the flight phases you have set up in the »**Phase setting**« menu to each of the switch positions. Since you have already assigned names to the flight phases, these names now appear on the screen: initially the name of Phase "1" is displayed on the right. If you operate the auto-rotation switch (which you have already assigned), the screen displays "Autorot".



Just to remind you:
The auto-rotation phase has absolute precedence.

Move the switch to the first end-point, and select the **SEL** field on the right of the screen. Use the rotary control to select the flight phase which you wish to assign to this switch position (in this example "2 Hover") and confirm with a brief press of the rotary control or **ENTER**. Move the switch straight to the other end-point, which is allotted the name "3 Acro". Proceed in exactly the same way with the centre position of the switch, to which we will assign the name "1 Normal".

Note:
Of course, it is also possible to swap over the phase names or use different names for the three switch positions. For example, if you wish to use a speed governor, as described in the section starting in the next column, a sequence of the "normal / hover / acro" type might well make sense.

The model settings which you entered before you assigned a phase switch are now located in flight phase 1 ("normal"). That is the phase which is called up when the phase switch is at the centre position.

These settings are known to be correct, i.e. you have test-flown the model using them, so it is a good starting point to copy them into the other flight phases, as this ensures that at least the model flies safely in each phase. This is done using the »**Copy / Erase**« menu; see page 47.

Once you have set up a series of flight phases, it is possible to make changes to the phase-specific menus for each phase separately. Since the mc-22s features digital trims, in the Heli program all four trim positions are stored separately for each flight phase, in addition to the other menu settings which you have entered separately for each flight phase (see page 32).

Suggested additional programming: speed governor

At some stage you will probably consider installing a speed governor (regulator), such as the mc-Heli-Control, in your helicopter. This unit provides a safe way of flying your helicopter with different system rotational speeds. It is sensible to couple the individual rotational speeds with the flight phases, so that you can make additional adjustments as required for each rotor speed.

Before you carry out the programming at the transmitter, it is essential to install the speed governor and program it exactly as described in the manufacturer's instructions. As you would expect, the mc-22s offers several possible methods of implementing different rotational speeds in individual flight phases. These include "ultra-convenient" facilities, but they do call for much greater programming effort at the transmitter, and for this reason are best reserved for the experienced pilot.

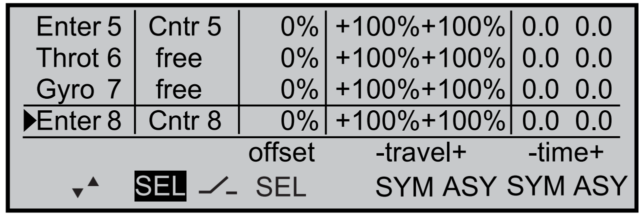
The following example involves certain restrictions in terms of convenience, but the efficiency of rotor speed governing is perfectly adequate, and the system is reasonably easy to program and – not least – easy to operate.

The procedure is similar to that previously described for setting up gyro gain. Once again, the "Travel" and "Offset" adjustment facilities in the »**Control adjust**« menu are used to adjust the end-points of a two-channel switch module, slider or rotary knob.

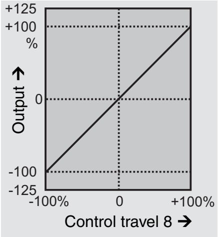
Depending on the features of your transmitter and the assignments you have selected for your transmitter controls, you can use either the standard transmitter control connected to socket CH6 on the transmitter circuit board, or an optional two-channel switch module with long toggle (Order No. **4151**) or short toggle (Order No. **4151.1**), connected to the CH8 socket.

To set up this system you again open the menu ...

»Control adjust« (page 60)



Requirement:
The governor must be programmed in such a way that the "back" position of the switch module (e.g. Control 8) equates to "governor off", while the forward position determines the actual rotational speed.



The transmitter control travel corresponds to the graph shown here.

In the “normal” flight phase the speed governor should always be switched off! This phase is used primarily for checking the motor and other general settings.

You can achieve this by selecting the “Input 8” line using the rotary control: check and correct the transmitter control assignment if necessary, then reduce the control travel symmetrically to zero initially, before shifting the “Offset” to -100% (max. -125%).

Call up the »**Servo display**« menu, and check that the indicated “servo travel” of channel 8 stays fixed at -100% (or max. -125%) regardless of the position of the transmitter control. The switch module now has no influence on the governor, which is what we want: the requirement is that the governor should be switched off at the -100% setting.

For this example we wish to set a low hover speed of around 1350 rpm for the “hover” flight phase (Phase 2). This is achieved as follows: switch to the appropriate flight phase and select “Input 8” again. The current flight phase is displayed at bottom left on the screen.

Move the switch module to the “forward” position, which equates to “speed governor active”. Since inputs 5 … 8 have to be assigned separately for each flight phase, start once again by checking and correcting the transmitter control assignment before selecting the **ASY** field in the “Travel” column, where you set the value to 0%.

You may need to change this value, depending on the type of governor. Later you will need to use a rev counter to set the rotor speed accurately. If you find you have to set a value below the 0 point, you will need to alter the value in the “Offset” column.

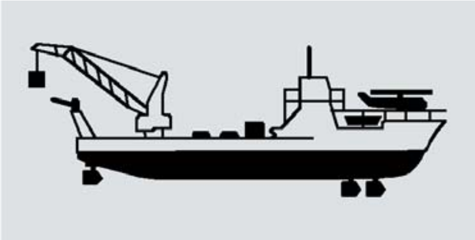
Repeat the procedure in flight phase 3 (Acro), this time with a percentage value of around 40% to provide a high rotor speed for aerobatics. Once again, this value will vary according to the type of governor you are using.

This method of programming the system to include a speed governor is comparatively simple, but it does provide a reliable method of calling up individual flight phases which are set to different rotational speeds. The switch module or slider must always be left in the “forward” position. Nevertheless, you can still switch off the speed governor at any time, in any flight phase, simply by moving the switch module to its “back” position.

If you have set up your helicopter as described in this programming example, you will find that it is capable of carrying out extremely challenging flight tasks even though it is no competition machine. We suggest that you should not make use of additional functions until your model is flying perfectly, so that you will be in a position to recognise and appreciate any improvements. It is always best to implement additional refinements one at a time whenever possible, otherwise you won’t know which change has brought about any improvement. Bear in mind that the good pilot is not recognised by the number of complex functions which he can manage successfully, but by the results he can obtain when flying a helicopter with a relatively simple set-up.

NAUTIC multi-proportional modules

For the PPM18 and PPM24 transmission modes



Module required at the transmitter

NAUTIC Multi-Prop module
Order No. **4141**
(up to two modules can be installed)

Method of working

The NAUTIC Multi-Prop module expands one standard control function to provide four functions, i.e. three additional servo sockets are available for each module at the receiver end. A maximum of two Prop modules can be installed in the transmitter.

Requirements for connecting NAUTIC Multi-Prop modules to the function inputs CH8 ... CH10:

1. The model memory to be used must first be erased using the “Erase model” option in the »**Copy / Erase**« menu, and programmed to the “Fixed wing” model type.
2. The transmitter and receiver must be set to **PPM18** or **PPM24** transmission mode.
3. The control function selected must not be in use simultaneously as the input channel or output channel of any mixer, whether »**Wing mixers**« or »**Free mixers**«.
4. In the »**Control adjust**« menu the settings of the control channel to be used for NAUTIC purposes must be left at the standard default settings, or reset to that status using **CLEAR**.
5. The “servo travel” of the control channel to be used for NAUTIC purposes must be set **SYMmetrically** to 150% in the »**Servo adjustment**« menu and the “travel limit” left at 150% or be reset to this value using **CLEAR**.
6. Make sure that the direction of servo rotation is standard (not reversed), and check that the servo centre is at 0%.

(If one of the servos connected to the decoder at the receiver end “jitters” slightly at full travel, adjust the servo centre within a range of about -20% to +20% until the jitter disappears.)

This completes the set-up procedure at the transmitter.

Installing and connecting NAUTIC modules in the mc-22s transmitter

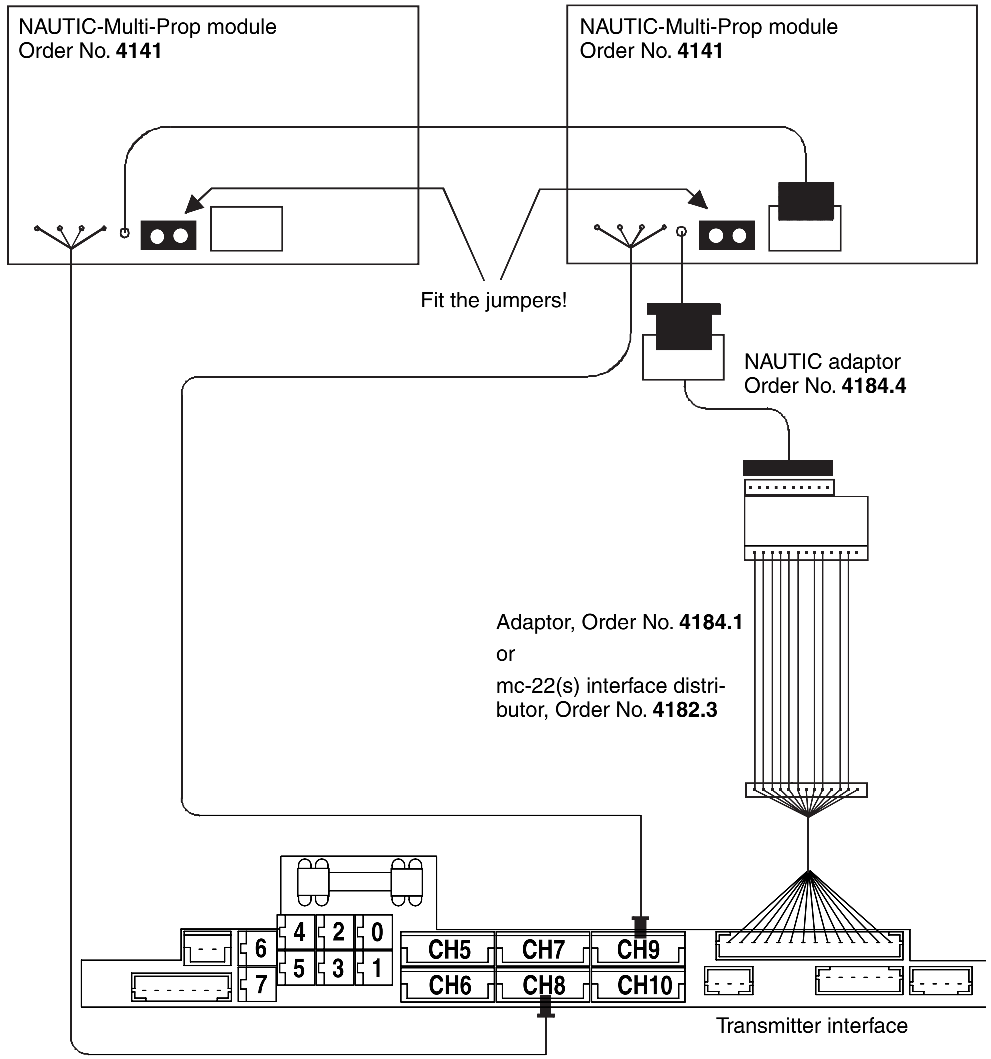
The modules are installed in vacant module wells as described in the notes on page 15 of this manual. Connect the five-pin plug to one of the sockets CH8 to CH10 on the transmitter circuit board, bearing in mind the requirements outlined above.

Locate the four-pin plug which terminates the single-core wire attached to the NAUTIC Multi-Prop module, and connect it to the socket on the transmitter circuit board using the interface distributor, Order No. **4182.3**, or the mc-22(s) / mc-24 adaptor, Order No. **4184.1**, using the adaptor lead, Order No. **4184.4**.

*The jumpers supplied with the adaptor lead **must** be fitted to the NAUTIC modules installed in the transmitter.*

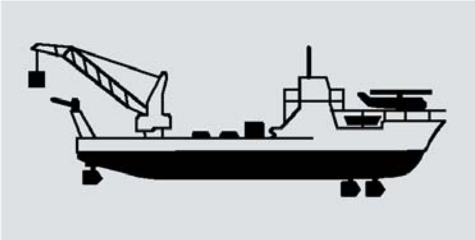
If a second module is installed, locate the single-core wire terminating in a four-pin plug, and connect it to the first module, which is already installed.

mc-22s transmitter connections

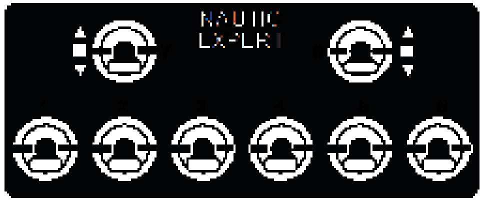


NAUTIC Expert switched functions

For the PPM18 and PPM24 transmission modes



Module required at the transmitter



16-channel NAUTIC Expert Module
Order No. **4108**
(up to two modules can be installed)

Method of working

The NAUTIC Expert Module expands one control function to provide sixteen switched channels. All eight switches have a centre position, providing a genuine forward – stop – reverse function; this requires the use of a switch module, Order No. **3754.1**, or a reversing module, Order No. **3754.2**, at the receiver. Three of the eight switches are self-neutralising from both directions, and two from one direction. The other three switches are designed for forward – stop – reverse functions, and are not self-neutralising. A maximum of two modules can be installed in the transmitter module wells, giving a total of thirty-two switched functions.

Requirements for connecting NAUTIC Expert modules to the function inputs CH8 ... CH10:

1. The model memory to be used must first be erased using the “Erase model” option in the »**Copy / Erase**« menu, and programmed to the “Fixed wing” model type.
2. The transmitter and receiver must be set to **PPM18** or **PPM24** transmission mode.
3. The control function selected must not be in use simultaneously as the input channel or output channel of any mixer, whether »**Wing mixers**« or »**Free mixers**«.
4. In the »**Control adjust**« menu the settings of the control channel to be used for NAUTIC purposes must be left at the standard default settings, or reset to that status using **CLEAR**.
5. The “servo travel” of the control channel to be used for NAUTIC purposes *must* be set **SYM**metrically to 150% in the »**Servo adjustment**« menu and the “travel limit” left at 150% or be reset to this value using **CLEAR**.
6. Make sure that the direction of servo rotation is standard (not reversed), and check that the servo centre is at 0%.

(If one of the servos connected to the decoder at the receiver end “jitters” slightly at full travel, adjust the servo centre within a range of about -20% to +20% until the jitter disappears.)

This completes the set-up procedure at the transmitter.

Installing and connecting NAUTIC modules in the mc-22s transmitter

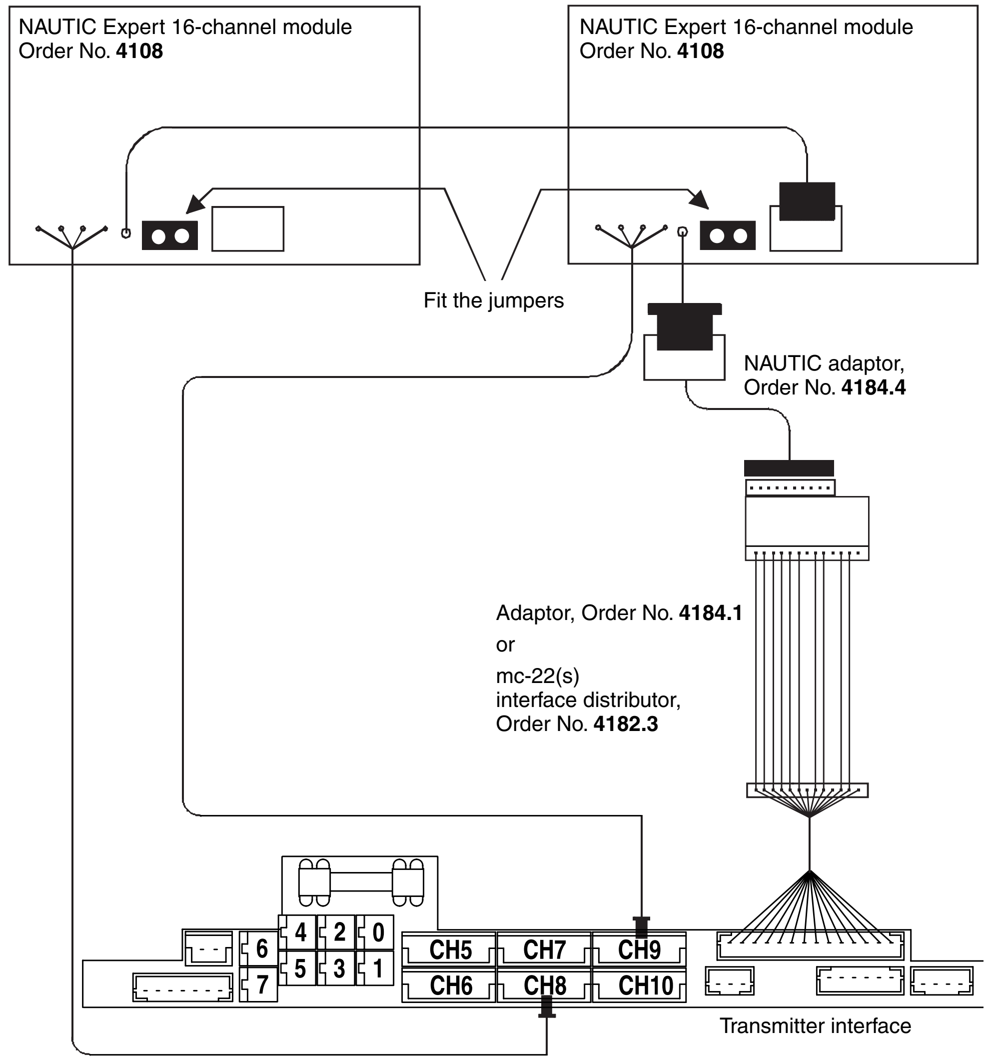
The modules are installed in vacant module wells as described in the notes on page 15 of this manual. Connect the five-pin plug to one of the sockets CH8 to CH10 on the transmitter circuit board, bearing in mind the requirements outlined above.

Locate the four-pin plug which terminates the single-core wire attached to the NAUTIC Multi-Prop module, and connect it to the socket on the transmitter circuit board using the interface distributor, Order No. **4182.3**, or the mc-22(s) / mc-24 adaptor, Order No. **4184.1**, using the adaptor lead, Order No. **4184.4**.

*The jumpers supplied with the adaptor lead **must** be fitted to the NAUTIC modules installed in the transmitter.*

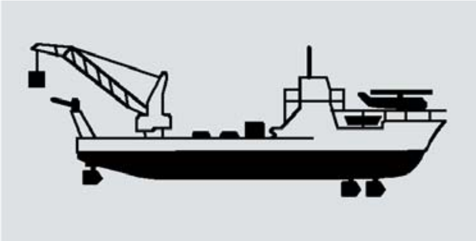
If a second module is installed, locate the single-core wire terminating in a four-pin plug, and connect it to the first module, which is already installed.

mc-22s transmitter connections



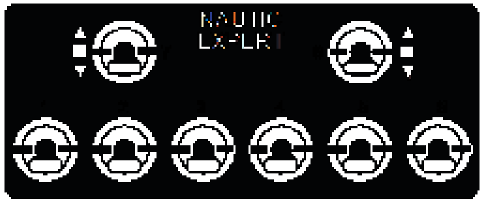
Combination of NAUTIC Prop and NAUTIC Expert modules

For the PPM18 and PPM24 transmission modes



Modules required at the transmitter

NAUTIC Multi-Prop module
Order No. **4141**



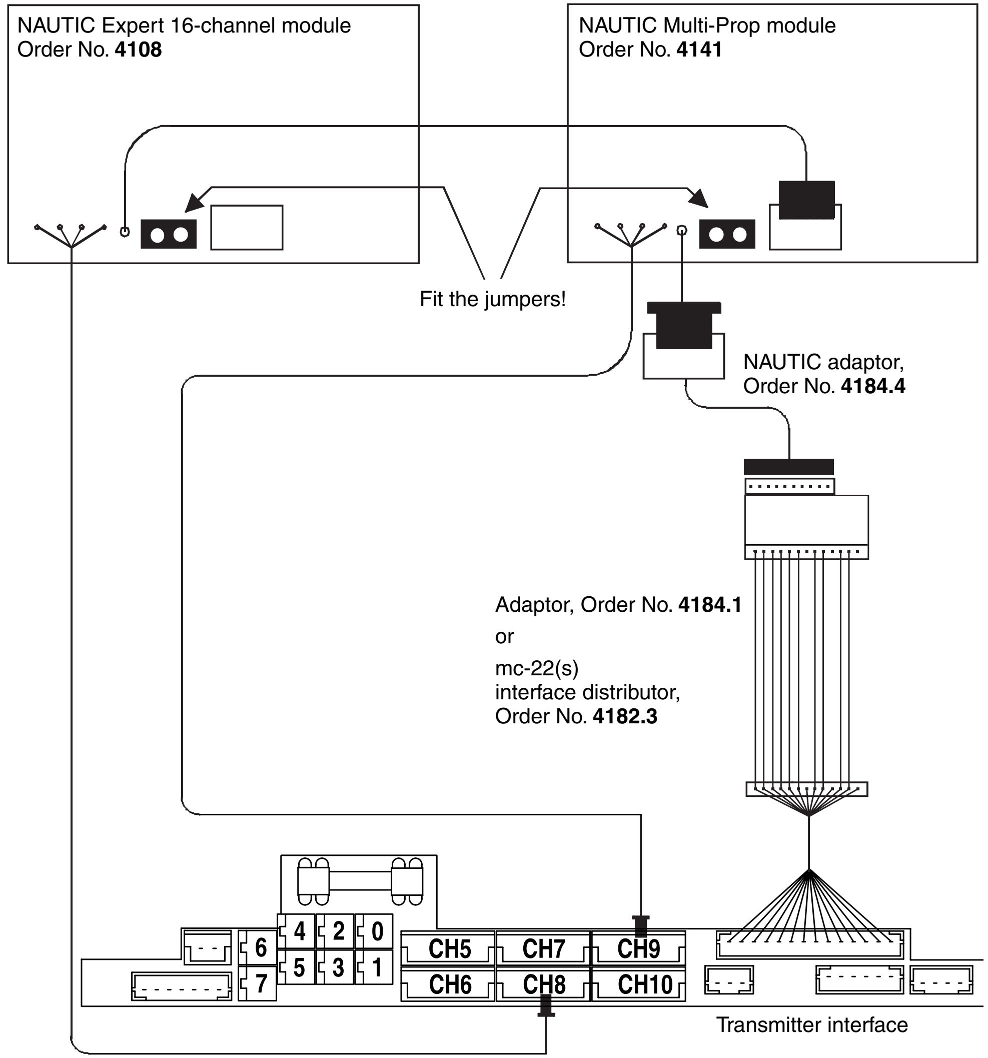
16-channel NAUTIC Expert module
Order No. **4108**
(See pages 157 / 158 for description of modules)

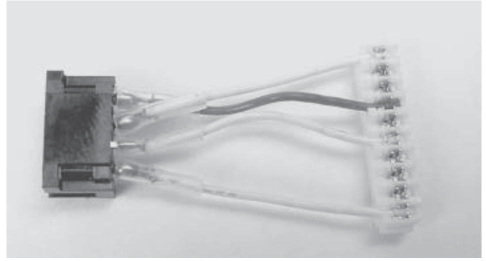
Method of working

If a combination of NAUTIC Expert and NAUTIC-Prop modules is used, one receiver output is expanded to provide four servo sockets, and the second receiver output provides sixteen switched functions. Both modules are installed and connected as already described on pages 157 and 158. Please read the set-up notes and requirements described at that point.

*The jumpers supplied with the adaptor lead **4184.4** <u>must be fitted to both</u> NAUTIC modules installed in the transmitter.*

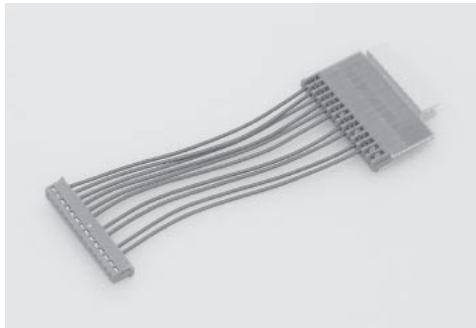
mc-22s transmitter connections





mc-19 / mc-22(s) / mc-24 NAUTIC adaptor
Order No. **4184.4**

For connecting NAUTIC modules to the mc-22s interface distributor, Order No. **4182.3**, or to the adaptor **4184.1**. The jumpers supplied with the adaptor lead must be fitted to the NAUTIC modules in the transmitter.



mc-22(s) / mc-24 adaptor
Order No. **4184.1**

This adaptor is required if the transmitter is not already fitted with an interface distributor, and only one Trainer system, PROFI-TRIM module or one / two NAUTIC modules is to be connected.

NAUTIC accessories

NAUTIC accessories

Required at the receiver end

Order No.	Module	Note
4159	2 / 16-channel NAUTIC-Expert switch module	For each 16-channel NAUTIC-Expert module in the transmitter, one 2 / 16 channel NAUTIC Expert switch module is required.
4142N	NAUTIC Multi-Prop decoder	Four servos can be connected
3941.6	Flat socket with 3-core lead	For connecting consumer units drawing up to 0.7 A per switched channel
3936.11 or **3936.32**	Y-lead, cable length 110 mm or 320 mm	For connecting NAUTIC switch modules or reverse modules
3754.1	NAUTIC switch module	Direct connection of two modules via synchronous distributor
3754.2	NAUTIC reverse module	Parallel connection to two channels or to one channel via synchronous distributor

Specification, NAUTIC Expert switch module, Order No. 4159

Current drain approx.	3 mAh
Dimensions approx.	69 x 42 x 20 mm
Weight approx.	47 g

Specification, NAUTIC Multi-Prop decoder, Order No. 4142N

Current drain approx.	10 mAh
Dimensions approx.	69 x 42 x 20 mm
Weight approx.	27 g

Connecting equipment to the NAUTIC Expert module at the receiver

Each switch module can operate up to sixteen switched functions.

The module can be connected directly to eight electrical consumer units, such as filament bulbs, LEDs etc. – but not electric motors – with a current drain of up to 0.7 A each. *See Fig. 1 for battery connection.*

Two switched functions per socket are possible using the three-core lead, Order No. **3941.6**. *See Fig. 2.*

NAUTIC switch or reverse modules are available for electric motors and other electrical consumers drawing higher currents. *See Figs. 3 + 4.*

To obtain a forward – stop – reverse function, connect the reverse module to the Expert switch module using the synchronous distributor lead, noting that one plug attached to the reverse module must be connected the "wrong" way round: file off the edges of the plug slightly to permit this.

An external power supply is required for directly connected electrical consumer units and for switching relays, e.g. a *GRAUPNER* receiver battery of adequate capacity. Other batteries up to max. 30 V can be connected using the connecting lead, Order No. **3941.6**. In this case take particular care to maintain correct polarity:

red wire = positive (+)

brown wire = negative (–).

Fig. 1

Battery connection via adaptor, Order No. **3941.6**

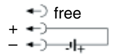


Fig. 2
Three-core lead with flat socket, Order No. **3941.6**

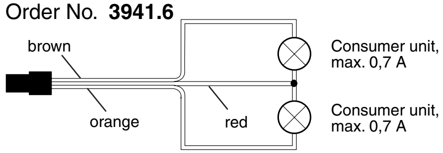


Fig. 3

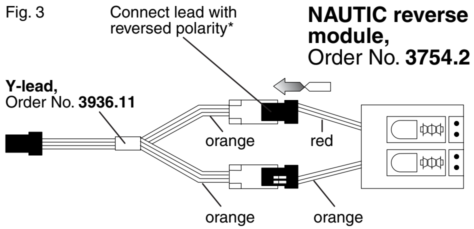
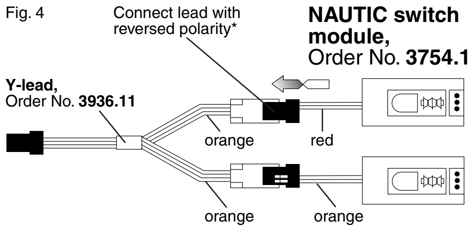
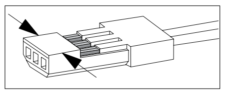
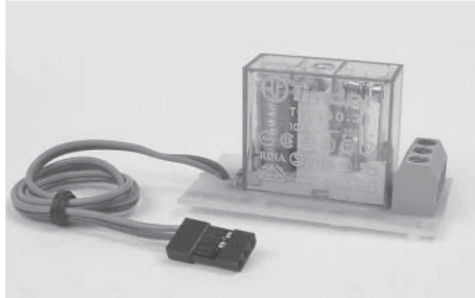


Fig. 4

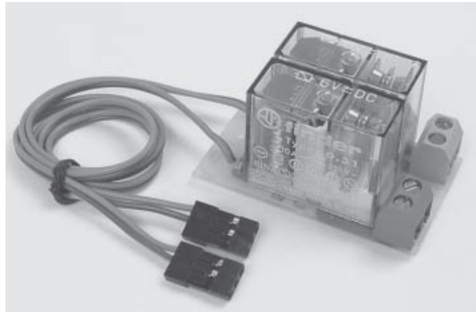


* *Bevel edges of plug as shown*





Nautic switch module, Order No. **3754.1**

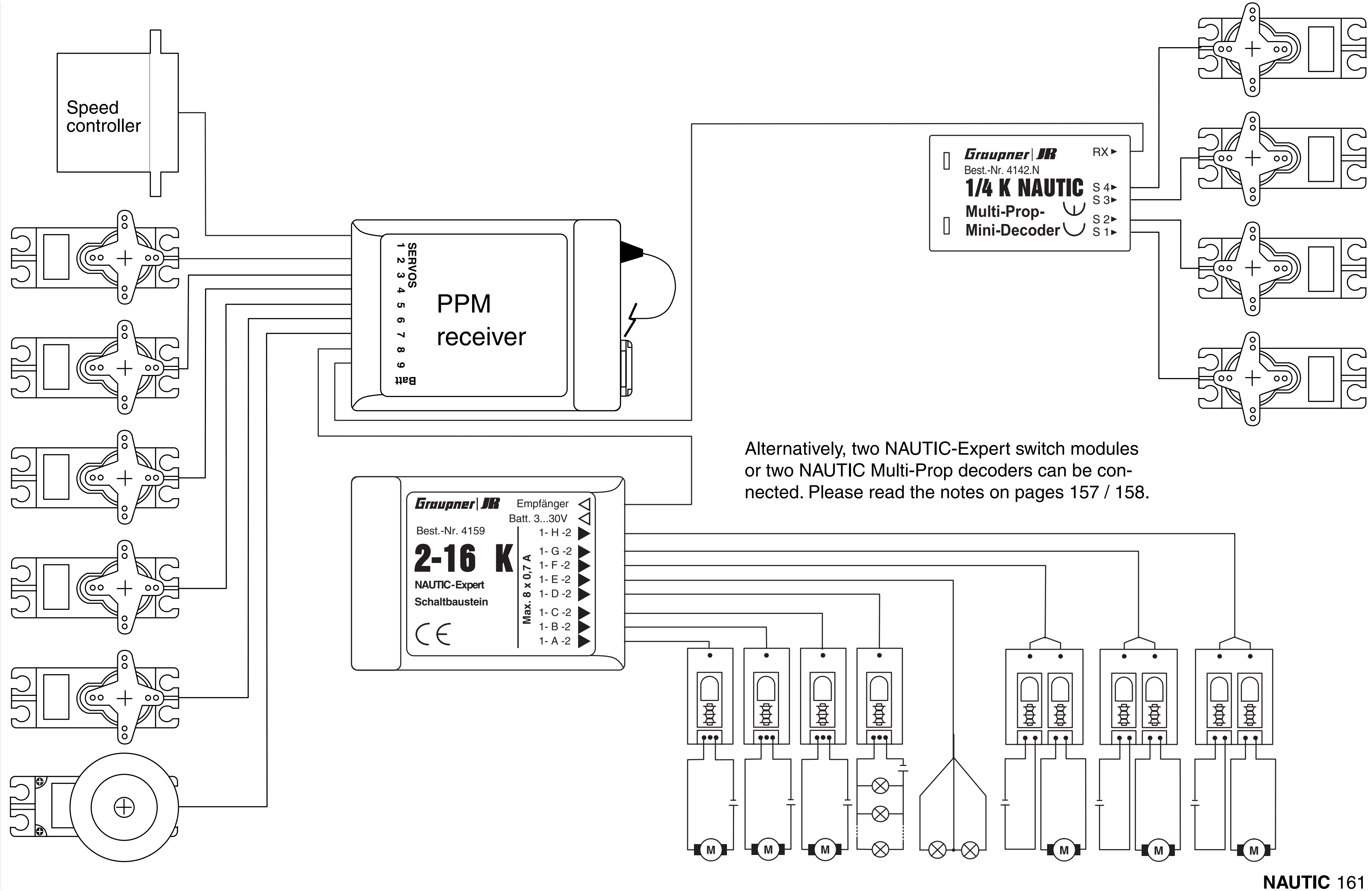


Nautic reverse module, Order No. **3754.2**

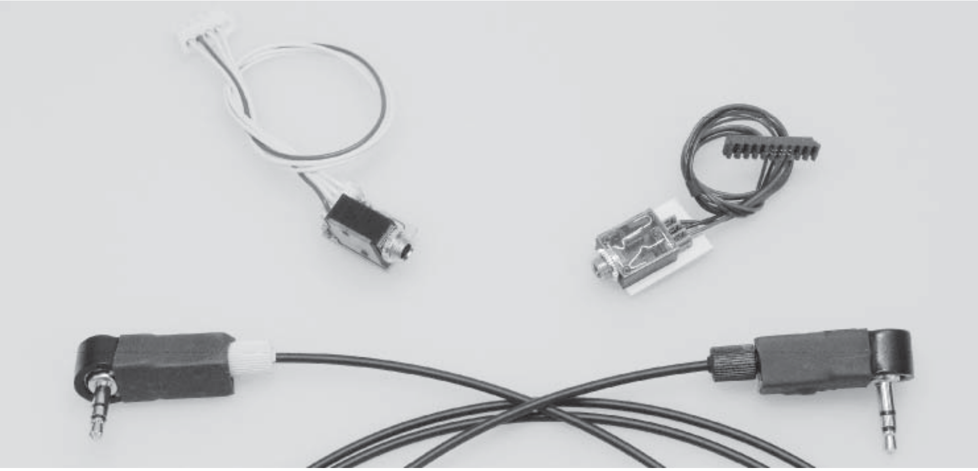
Specifications

	Switch module **3754.1**	Reverse module **3754.2**
Exciter voltage	4,8 ... 12 V	4,8 ... 12 V
Max. switched current	16 A	16 A
Max. switched voltage	24 V	24 V
Dimensions in mm approx.	50 x 27 x 26	50 x 30 x 26
Weight approx.	25 g	45 g

NAUTIC systems - typical wiring diagram



Alternatively, two NAUTIC-Expert switch modules or two NAUTIC Multi-Prop decoders can be connected. Please read the notes on pages 157 / 158.



Opto-electronic Trainer system with light-pipe lead
Order No. **3289**

This Trainer system enables you to transfer individual functions, several functions or all the functions to the Pupil transmitter. The set is designed for expanding the mc-22s transmitter for use as a Teacher transmitter.

Notes:
The Teacher transmitter must be fitted either with an adaptor, Order No. ***4184.1****, or the mc-22(s) interface distributor, Order No.* ***4182.3****, to allow the Trainer module contained in this set to be connected to the mc-22s transmitter.*

A momentary switch, Order No. ***4160.11****, or a kick button, Order No.* ***4144****, is required as a safe means of transferring control.*

If individual functions are to be transferred, the functions are selected in the »**Teacher/pupil**« menu (see page 115) of the Teacher transmitter, which may be operated using any of the four modulations PPM18, PPM24, PCM20 or SPCM20.

CAUTION:
In contrast to the Trainer system described here, a low-cost Trainer system, Order No. ***3290****, can only be used for Trainer mode operations in PPM mode; this version also requires a Pupil transmitter which is fully set up to suit the model.*

Suitable pupil transmitters:

D 14, FM 414, FM 4014, FM 6014, mc-10, mc-12, mx-12 mc-14, mc-15, mc-16, mx-16s, mc-16/20, mc-17, mc-18, mc-19, mc-20, mc-22, mc-22s, mx-22 and mc-24.

The Pupil transmitter is always operated in its basic (default) setting.

If the transmitter is an **mc**-series or **mx**-series unit, select a model memory with the appropriate model type, assign it the "model name" of "Pupil" and set up the stick mode to the suit the pupil pilot's preference. All other settings should be left at their defaults. If the model type is "Fixed wing", the "Throttle min forward / back" in the "Motor" line of the »**Model type**« menu should be set appropriately. If the model type is "Heli", the throttle / collective pitch direction and the idle trim should be set to suit the pupil in the same way. All other settings, such as mixer and coupling functions, are carried out and transferred by the Teacher transmitter.

If you are using a D 14, FM 414, FM 4014, FM 6014, FM 6014 / PCM 18 transmitter, you should check the direction of servo rotation and stick mode, and if necessary correct them by re-connecting the appropriate cables inside the transmitter. Any mixers should either be switched off or set to "zero".

Connections in the mc-22s Teacher transmitter

Install the Teacher module in the transmitter case at a suitable position. Connect the ten-pin plug attached to the Teacher module to the adaptor, Order No. **4184.1**, or the interface distributor, Order No. **4182.3**.

The Trainer module, Order No. **3290.19**, can be connected directly to the interface on the transmitter circuit board by means of the fourteen-pin connector.

When you connect the Teacher transmitter to a Pupil transmitter, locate the plug marked "**M**" (Master) on the Trainer lead and connect it to the Teacher module.

See the next page for a connection diagram for the Teacher transmitter.

Connections in the mc-22s Pupil transmitter

Disconnect the connecting lead from the Pupil module (it is not required with these transmitter types).

Install the Pupil socket in the transmitter case in a suitable position. Disconnect the four-pin connector attached to the RF module, and plug it into the four-pin Pupil socket.

See the next page for a connection diagram for the Pupil transmitter.

Teacher module for individual channel transfer, mc-22(s) / mc-24
Order No. **3290.2**

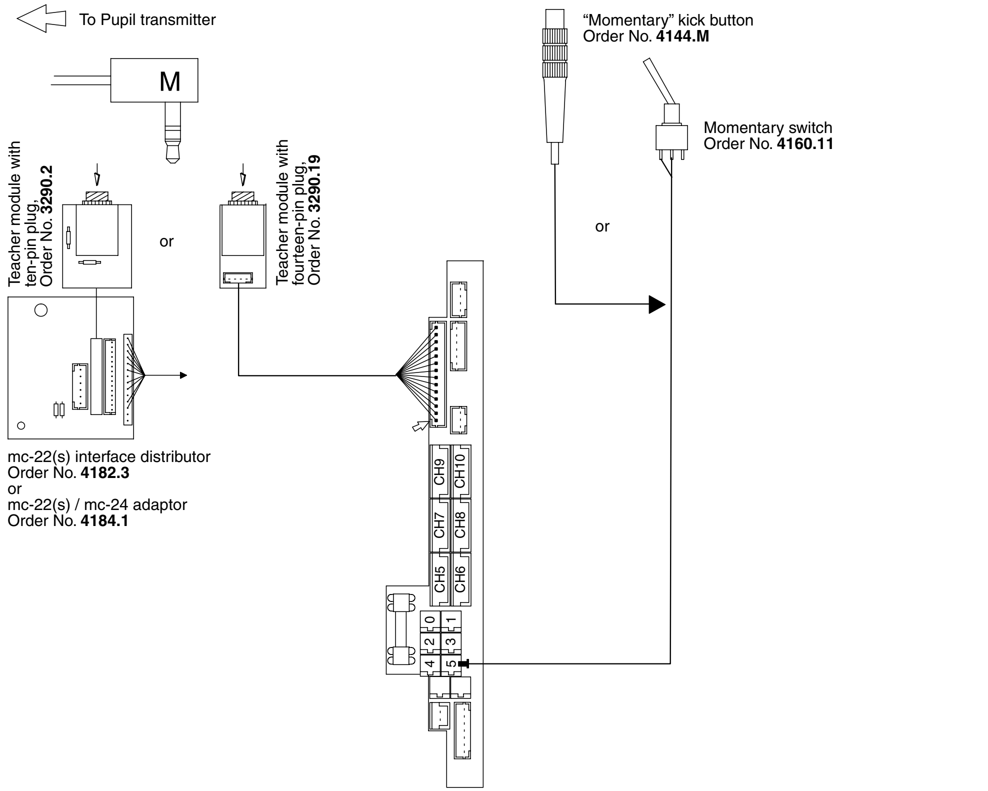
This expansion module is used to upgrade the opto-electronic Trainer system, Order No. **3290**, to form a professional Trainer system with individual channel transfer. To connect the module the mc-22s transmitter must already be fitted with the interface distributor, Order No. **4182.3**, or with the mc-22(s) / mc-24 adaptor, Order No. **4184.1**.

Teacher module for mc-19 / mc-22(s)
Order No. **3290.19**

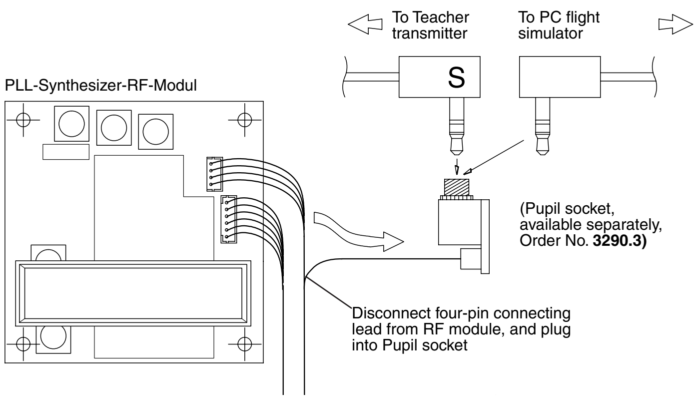
In contrast to the module, Order No. **3290.2**, this Teacher module features a fourteen-pin connector, so that it can be connected directly to the transmitter circuit board using the fourteen-pin interface.

Trainer system
Connections in the mc-22s transmitter

Connections in the mc-22s Teacher transmitter

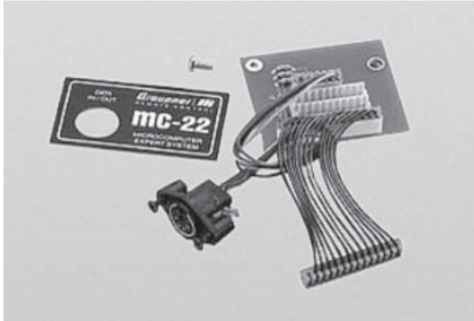


Connections in the mc-22s Pupil transmittert



Important note:
If you disconnect the four-pin plug from the RF module – as described in the installation instructions supplied with the Pupil socket – the transmitter skips the channel select procedure when switched on, and instead displays the selected channel "K—"; see also page 22.

Accessories



mc-22 / mc-22s interface distributor
Order No. **4182.3**

Required when multiple auxiliary systems are to be installed in the mc-22s transmitter, e.g. Trainer system or NAUTIC module, for copying between two mc-22(s) or between mc-22(s) and mx-22 transmitters using the copy lead, or to and from a PC using the PC interface lead. To install the DIN socket the RF module must be unscrewed and the decorative mc-22s bezel between the two module wells removed. The set includes a new bezel with the requisite hole. The unit can also be installed by your local *GRAUPNER* Service Centre if you prefer.

Module for other Pupil transmitters
Order No. **3290.3**

Required for additional Pupil transmitters which are to be operated using the opto-electronic Trainer system.

mc-22 / mc-22s PC interface lead, alone
Order No. **4182.9**

The PC interface lead is also available alone under this Order No., if the interface distributor is already installed in your mc-22s transmitter.

mc-22 / mc-22s PC interface (set)
Order No. **4182**

Required for communication (copying and storing) between the mc-22(s) transmitter and a Personal Computer (IBM-compatible PC). Set contents: PC connecting lead with integral interface, mc-22(s) interface distributor with adaptor (Order No. **4182.3**), software.

Stand Febr. 2008

Graupner

Lehrer / Schüler
RC-Anlagen-Verbindungen

Lehrer / Schüler	MC-10 MC-12	D-14 FM-414 FM-4014 FM-6014 MC-14 MC-15 MC-16 MC-16/20	MC-18 MC-20	MC-19(s) MC-22 MC-22s MC-24	MX-12 MX12s MX-16s(IFS)	MX-22(IFS) MX-24s	X-347 X-388 X-3810
MC-10 / MC-12	3290.12	3290	3290.2 *	3290.19 *		3290.22	
	3290.4 3290.5		3290.4 3290.5	3290.4 3290.5	3290.7	3290.4 3290.5	3290.7
	3290.10	3290.10	3290.10	3290.10	3290.10	3290.10	3290.10
D-14 / FM-414 / FM-4014 / FM-6014 MC-14 / MC-15 / MC-16 / MC-16/20 / MC-18 / MC-19(s) / MC-20 / MC-22 / MC-22S / MC-24	3290.12	3290	3289 *	3290.19 *		3290.22	
	3290.4 3290.5			3290.4 3290.5	3290.7	3290.4 3290.5	3290.7
	3290.3			3290.3	3290.3	3290.3	3290.3
MX-12 / MX12s / MX-16S(IFS)		**	3290.2 *	3290.19 *		3290.22	
	diese Kombination ist nicht möglich	3290.8	3290.8	3290.8	4179.1	3290.8	4179.1
MX-22(IFS) / MX-24s	3290.12	3290	3290.2 *	3290.19 *		3290.22	
	3290.4 3290.5		3290.4 3290.5 | 3290.8	3290.4 3290.5 | 3290.8	4179.1	3290.4 3290.5 | 3290.8	4179.1
	3290.33	3290.33	3290.33	3290.33		3290.33	
X-347 / X-388 / X-3810	3290.12	3290	3290.2 *	3290.19 *		3290.22	
	3290.4 3290.5		3290.4 3290.5 | 3290.8	3290.4 3290.5 | 3290.8	4179.1	3290.4 3290.5 | 3290.8	4179.1
	3290.33	3290.33	3290.33	3290.33		3290.33	

Sind im gelben Feld für Lehrer-Schüler-Kabel mehrere Bestellnummern aufgeführt, so sind diese alternativ und müssen mit dem direkt darunter liegenden Schüler-Modul im grünen Feld kombiniert werden.
Nicht ausgefüllte Felder bedeuten, dass das Lehrer- und/oder Schüler-Modul eine bereits vorhandene DSC-Buchse ist, bzw. diese Einzelkomponenten im L/S-Set enthalten sind (3289 bzw. 3290)
*****Zusätzlich wird ein Momentschalter benötigt (4144 oder 4160.11). ****** Lehrerbuchse über die Serviceabteilung beziehbar.

Alternativen:

3290.19 = 3290.2 + 4184.1 oder 3290.2 + 4184.3

Accessories

Copy lead:
mc-22(s) / mc-22(s), mc-22(s) / mx-22
Order No. **4179.2**

For copying data between two mc-22s transmitters, or between mc-22(s) and mx-22 transmitters. An interface distributor (Order No. **4182.3**) must be fitted to each transmitter. For connection to an mx-22 transmitter the Trainer / PC module, Order No. **3290.22** is required.

<u>Note:</u>
The model memory formats of the mc-22, mc-22s and mx-22 are compatible, i.e. a model programmed in the mc-22s can be copied into an mc-22 or mx22, and vice versa. Generally the assignment of the switches and transmitter controls will need to be checked and adjusted, as it is highly unlikely that the whole transmitter configuration will be identical.

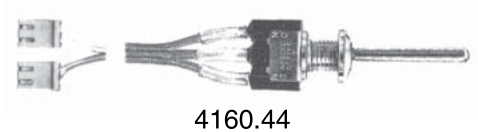
DSC* module for mc-19, mc-22(s) and mc-24 transmitters
Order No. **3290.24**

An optional module for connecting the transmitter to a flight simulator or to the DSC lead, Order No. **4178.1**. If the transmitter is switched off when the 3.5 mm mono barrel plug is connected to the module, the transmitter is activated without the RF section. This enables you to connect it to a flight simulator or a DSC* lead very simply, and operate the transmitter without broadcasting an RF signal.

** DSC = Direct Servo Control*

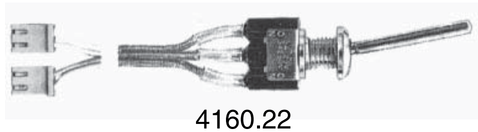
4160.11

Momentary switch
Order No. **4160.11**
Self-neutralising, for momentary switched functions. Required as start / stop switch for stopwatch functions.



4160.44

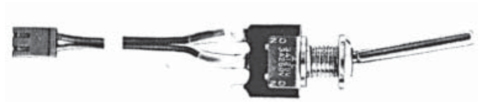
2-way momentary switch
Order No. **4160.44**
Self-neutralising, for two momentary switched functions controlled by a single switch.



4160.22

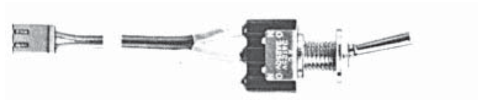
Differential (three-position) switch
Order No. **4160.22**
Switches between two or three mixer functions, flight phases, etc..

External switches
On / Off switches for operating auxiliary functions, e.g. mixers.



4160

Order No. **4160**
for switching one function; long toggle.



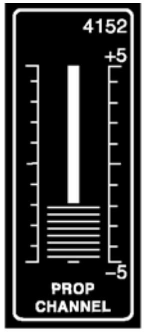
4160.1

Order No. **4160.1**
for switching one function; short toggle.

4147.1

Latching external switch
Order No. **4147.1**
for switching one function.

The latching On / Off switch has a mechanical lock which prevents the toggle being moved accidentally. The switch can only be operated by simultaneously lifting and tipping the toggle.
If you have assigned a switch to an important coupling function, and operating the switch accidentally would cause the model to crash, a latching switch should always be used.



Two-channel switch module
Order No. **4151** with long toggle
Order No. **4151.1** with short toggle

The switch has three positions, providing the means to switch a speed controller over the range forward - stop - reverse, for example. Also suitable for On / Off functions such as retracts, lamps etc.. Without its decorative bezel the switch module can be installed in any vacant option well in the transmitter.

Two-channel switch module
Order No. **4151.2** with short toggle
Order No. **4151.3** with long toggle

Upgrade module with On / Off switch.
Suitable for switching speed controllers, retracts, lamps etc..

Two-channel proportional module
Order No. **4152**

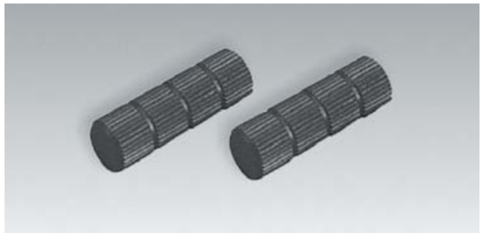
Expansion module for controlling full-travel linear functions; can also be used as a proportional transmitter control, e.g. for mixers, throttle limiter etc..

Proportional rotary module
Order No. **4111**

Expansion module for proportional rotary functions.

Pair of short stick tops
Order No. **1128**

For pilots who prefer to use their thumbs.



Protective stick switch caps
Order No. **4110** (pack of two)

These caps are made of high-quality aluminium and protect the delicate stick switches and kick buttons from damage – especially in the transport case.

Transmitter support bar system
Order No. **1127**

The support bars can be snapped into the “storage” and “support” positions. The entire transmitter top surface is unobstructed, for complete freedom of access. Bored for neckstrap attachment. The method of installation is described on page 15 of this manual. The neckstrap is not included in the set.

Luxury neckstrap
Order No. **71** 38 mm wide

Adjustable-length neckstrap with extra-soft neck padding. The padding features a Velcro closure, making it easy to remove for cleaning.

Luxury cross-over strap
Order No. **72** 38 mm wide
with two spring hooks

For pilots who like their transmitter to “stay put”. The cross-over strap is variable in length and can easily be adjusted to provide fatigue-free operation.

Wide neckstrap
Order No. **1125** 30 mm wide
with spring hooks

Accessories

Stick with rotary proportional knob*
Order No. **4112**

The rotary proportional knob integrated into the stick is designed for use with non self-neutralising functions, or to control a speed controller or similar special application.

Three-function stick switch*
Order No. **4113**

The change-over switch integrated into the stick has a centre detent and is designed to provide three switched functions.
Can be used for auxiliary functions e.g. launch, neutral and speed modes for high-speed and F3B models, or as motor switch (OFF / half-throttle / full-throttle) for F3E models.

Two-function stick switch*
Order No. **4143**

Stick unit with single-pole change-over switch for two switched functions. Ideal for auxiliary functions; especially useful for competition pilots.

Kick button**
Order No. **4144**

Pressing the button once turns the switch on; pressing it again causes the button to spring out to the "off" position again. The kick button can be converted into a momentary button by removing the latching spring; in this case the function remains switched "on" only as long as the button is held pressed in. We recommend having the kick button installed by your local *GRAUPNER* Service Centre.

* *Units are installed by your local GRAUPNER Service Centre. If the kick button, Order No.* ***4144****, is to be used as Trainer transfer switch, you must first convert it to momentary action.*

Aluminium mc-22 / mc-22s transmitter case
Order No. **10**

Rigid, high-quality, lockable aluminium case of attractive design. Foam padded insert provides shock protection for transmitter, receiver, servos and accessories for storage and transport.
Dimensions approx. 400 x 300 x 150 mm

CONTEST Carbon transmitter tray for mc-19, mc-22 and mc-22s
Order No. **3093***

Ergonomically efficient, designed to deliver the functionality desired and required by competition pilots.
Proven twin-shell construction with strong integral neckstrap support bars which support the transmitter very comfortably and securely.
The CONTEST mc-22(s) transmitter tray can be transported in the *GRAUPNER* aluminium transmitter case, Order No. **10** conveniently, without removing the transmitter, the support bars, neckstrap and optional rainshield, Order No. **3079**.

* *Supplied without transmitter, neckstrap and accessories.*

Helical aerial
Order No. **1149.35** for the 35 MHz band
Order No. **1149.40** for the 40 MHz band

A short flexible aerial, providing optimum freedom of movement and unfettered access to the transmitter. For technical reasons the radiated power of the helical aerial is not as high as that of a telescopic aerial extended to full length.
The standard telescopic aerial, as supplied with the transmitter, should be used for all applications where security and safety are top priority, e.g. high-speed models and large-scale model aircraft.

Overall length of helical aerial: approx. 400 mm.

Operating frequencies approved for use in EU countries

This radio control system may only be operated on the frequencies and channels approved for each EU nation. Please check the legal situation in your own country. It is prohibited to operate a radio control system on any frequency and channel other than those listed. If you are not using a PLL-SYNTHESIZER receiver, use only genuine *GRAUPNER* plug-in crystals; see the main *GRAUPNER* catalogue.

Frequency band	Channel No.	Frequency MHz	D	A	B	CH	CY	CZ	DK	E	F	GB	GR	I	IRL	IS	L	LT	N	NL	P	S	SK	SLO
35 MHz-A-Band	60	35,000		F	F	F	F	F						F				F			F		F	F
	61	35,010	F	F	F	F	F	F	F			F	F	F	F	F	F	F	F	F	F	F	F	F
	62	35,020	F	F	F	F	F	F	F			F	F	F	F	F	F	F	F	F	F	F	F	F
	63	35,030	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F
	64	35,040	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F
	65	35,050	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F
	66	35,060	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F
	67	35,070	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F
	68	35,080	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F
	69	35,090	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F
	70	35,100	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F
	71	35,110	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F
	72	35,120	F	F	F	F	F	F	F	F		F	F	F	F	F	F		F	F	F	F	F	F
	73	35,130	F	F	F	F	F	F	F	F		F	F	F	F	F	F		F	F	F	F	F	F
	74	35,140	F	F	F	F	F	F	F	F		F	F	F	F	F	F		F	F	F	F	F	F
	75	35,150	F	F	F	F	F	F	F	F		F	F	F	F	F	F		F	F	F	F	F	F
	76	35,160	F	F	F	F	F	F	F	F		F	F	F	F	F	F		F	F	F	F	F	F
	77	35,170	F	F	F	F	F	F	F	F		F	F	F	F	F	F		F	F	F	F	F	F
	78	35,180	F	F	F	F	F	F	F	F		F	F	F	F	F	F		F	F	F	F	F	F
	79	35,190	F	F	F	F	F	F	F	F		F	F	F	F	F	F		F	F	F	F	F	F
	80	35,200	F	F	F	F	F	F	F	F		F	F	F	F	F	F		F	F	F	F	F	F
	281	35,210		F	F	F	F	F						F					F		F		F	F
	282	35,220		F	F	F	F	F						F					F		F		F	F
35 MHz-B-Band	182	35,820	F					F																
	183	35,830	F					F																
	184	35,840	F					F																
	185	35,850	F					F																
	186	35,860	F					F																
	197	35,870	F					F																
	188	35,880	F					F																
	189	35,890	F					F																
	190	35,900	F					F																
	191	35,910	F					F																
40 MHz-Band	50	40,665	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB		CB	CB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB
	51	40,675	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB		CB	CB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB
	42	40,685	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB		CB	CB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB
	53	40,695	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB		CB	CB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB	FCB
	54	40,715	CB			F		FCB				CB	CB	FCB	FCB	FCB	FCB		CB	FCB	FCB	FCB	FCB	
	55	40,725	CB			F		FCB				CB	CB	FCB	FCB	FCB			CB	FCB		FCB	FCB	
	56	40,735	CB			F		FCB				CB	CB	FCB	FCB	FCB			CB	FCB		FCB	FCB	
	57	40,765	CB			F		FCB				CB	CB	FCB	FCB	FCB			CB	FCB		FCB	FCB	
	58	40,775	CB			F		FCB				CB	CB	FCB	FCB	FCB			CB	FCB		FCB	FCB	
	59	40,785	CB			F		FCB				CB	CB	FCB	FCB	FCB			CB	FCB		FCB	FCB	
	81	40,815	CB			F		FCB				CB	CB	FCB	FCB	FCB				FCB		FCB	FCB	
	82	40,825	CB			F		FCB				CB	CB	FCB	FCB	FCB				FCB		FCB	FCB	
	83	40,835	CB			F		FCB				CB	CB	FCB	FCB	FCB				FCB		FCB	FCB	
	84	40,865	CB			F		FCB				CB	CB	FCB	FCB	FCB				FCB		FCB	FCB	
	85	40,875	CB			F		FCB				CB	CB		FCB	FCB				FCB		FCB	FCB	
	86	40,885	CB			F		FCB				CB	CB		FCB	FCB				FCB		FCB	FCB	
	87	40,915	CB			F		FCB				CB	CB		FCB	FCB				FCB		FCB	FCB	
	88	40,925	CB			F		FCB				CB	CB		FCB	FCB				FCB		FCB	FCB	
	89	40,935	CB			F		FCB				CB	CB		FCB	FCB				FCB		FCB	FCB	
	90	40,965	CB			F		FCB				CB	CB		FCB	FCB				FCB		FCB	FCB	
	91	40,975	CB			F		FCB				CB	CB		FCB	FCB				FCB		FCB	FCB	
	92	40,985	CB					FCB				CB	CB		FCB					FCB		FCB	FCB	
41 MHz-Band	400	41,000									F													
	401	41,010									F													
	402	41,020									F													
	403	41,030									F													
	404	41,040									F													
	405	41,050									F													
	406	41,060									F													
	407	41,070									F													
	408	41,080									F													
	409	41,090									F													
	410	41,100									F													
	411	41,110									FCB													
	412	41,120									FCB													
	413	41,130									FCB													
	414	41,140									FCB													
	415	41,150									FCB													
	416	41,160									FCB													
	417	41,170									FCB													
	418	41,180									FCB													
	419	41,190									FCB													
	420	41,200									FCB													

Legende:

F C B = Alle Modelle
F = Nur Flugmodelle
C B = Nur Auto- und Schiffsmodelle

Key to symbols:

F C B = All models
F = Airplanes only
C B = Model cars and boats only

Légende:

F C B = Tous les modèles
F = Seulement pour modèles volants
C B = Seulement pour autos et bateaux

Legenda:

F C B = Tutti i modelli
F = Solo modelli di aerei
C B = Solo auto e imbarcazioni

Keine Haftung für Druckfehler! Änderungen vorbehalten!

Liability for printing errors excluded! We reserve the right to introduce modifications!

Nous ne sommes pas responsables d'éventuelles erreurs d'impression! Sous réserve de modifications!

Nessuna responsabilità per errori di stampa! Ci riserviamo la facoltà di apportare cambiamenti!

Approval certificates

CETECOM ICT Services GmbH
EC Identification Number 0682
authorized by the German Government

to act as Notified Body in accordance with the R&TTE Directive 1999/5/EC of 09. March 1999.

CERTIFICATE
EXPERT OPINION

Registration-No.:	E814614T-EO
Certificate Holder:	Graupner GmbH & Co. KG Henriettenstraße 94-96 73230 Kirchheim/Teck Germany
Product Designation:	mc-22s
Product Description:	Short Range Devices (model control)
Product Manufacturer:	Graupner GmbH & Co. KG Henriettenstraße 94-96 73230 Kirchheim/Teck Germany

Essential requirements	Specifications / Standards	Submitted documents	Result
Radio spectrum (R&TTE, Article 3.2)	EN 300 220-1 V1.3.1 (2000-09) EN 300 220-3 V1.1.1 (2000-09)	Test Report	conform

Marking: The product shall be marked with CE, our notified body number and the Class II identifier (Alert sign) as shown right hand.

CE 0682 ⓘ

The scope of this evaluation relates to the submitted documents only.
The certificate is only valid in conjunction with the following number of annexes.
Number of annexes: 1

Saarbrücken, 04.04.2006
Place, Date of Issue

Signed by Ernst Hüsinger
Notified Body

CETECOM ICT Services GmbH, Untertürkheimer Straße 6-10, D-66117 Saarbrücken, Germany
http://www.cetecom-ict.de

Annex 1 of the Certificate „EXPERT OPINION"
Registration no.: E814614T-EO Date: 04.04.2006
Page 1 of 1

Product Characteristics:

Transmitter for remote control model

Frequency Ranges	:	35.000 – 35.910 MHz 40.665 – 40.985 MHz 41.000 – 41.200 MHz
RF-Output Power (ERP)	:	≤ 100 mW
Type of Modulation	:	FM (F1D / F3D)
Number of Channels	:	33 (35 MHz) 43 (40 / 41 MHz)
Channel Separation	:	10 kHz
Antenna	:	rod aerial
Operating Temperature Range	:	-10 °C to +55 °C

Conformity Details:

Evaluated test reports	
Requirement	Standard, test report number, date & laboratory
Radio spectrum	EN 300 220-1 V1.3.1 (2000-09) EN 300 220-3 V1.1.1 (2000-09) Test Report 2-4286-01-02/06 issued 2006-03-27 by CETECOM ICT

Miscellaneous:

- TCF according to the application

******

Conformity certificate

CETECOM ICT Services GmbH
CETECOM™

CERTIFICATE OF CONFORMITY

Registration-No.:	E814614T-CC	Number of annexes: —
Certificate Holder:	Graupner GmbH & Co. KG Henriettenstraße 94-96 73230 Kirchheim/Teck Germany	
Product Designation:	mc-22s	
Product Description:	Short Range Devices (transmitter for remote control model)	
Product Manufacturer:	Graupner GmbH & Co. KG Henriettenstraße 94-96 73230 Kirchheim/Teck Germany	

Specifications and test reports:

Specification	Test report no. & date	Name of test laboratory	Notes
EN 300 220-1 V1.3.1 (2000-09) EN 300 220-3 V1.1.1 (2000-09)	2-4286-01-02/06 dated 2006-03-27	CETECOM ICT	conform

Statement: This equipment fulfils the requirements or parts thereof in the above mentioned specifications.

CETECOM ICT Services is authorized to act as Notified Body in accordance with the R&TTE Directive 1999/5/EC of 09. March 1999

Saarbrücken, 04.04.2006
Place, Date of Issue

Signed by Ernst Hüsinger
Notified Body

CETECOM ICT Services GmbH, Untertürkheimer Straße 6-10, D-66117 Saarbrücken, Germany

EU conformity declaration

Konformitätserklärung gemäß dem Gesetz über Funkanlagen und Telekomunikationsendeinrichtungen (FTEG) und der Richtlinie 1999/5/EG (R&TTE)
Declaration of Conformity in accordance 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	**mc-22s**
Verwendungszweck: Intended purpose	**Funkanlage zur Fernsteuerung von Modellen** **Radio equipment for remote controlling of models**
Geräteklasse: Equipment class	**2**

bei bestimmungsgemäßer Verwendung 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), when used for its intended purpose

Angewendete harmonisierte Normen:
Harmonised standards applied

EN 60950	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/-3	Schutzanforderungen in Bezug auf die elektromagnetische Verträglichkeit § 3 (1) 2, Artikel 3 (1) b)) Protection requirement concernig electromagnetic compatibility § 3 (1) 2, Artikel 3 (1) b))
EN 300 220-1/-3	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 0682 ⓘ

Kirchheim, 11. April 2006

Hans Graupner, Geschäftsführer
Hans 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

Index

Guarantee 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

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La société *Graupner* GmbH & Co. KG, Henriettenstraße 94-96, 73230 Kirchheim/Teck, Allemagne, accorde sur ce produit une garantie de 24 mois à partir de la date d´achat. La garantie prend effet uniquement sur les vices de fonctionnement et de matériel du produit acheté. Les dommages dûs à de l´usure, à de la surcharge, à de mauvais accessoires ou à d´une application inadaptée, sont exclus de la garantie. Cette garantie ne remet pas en cause les droits et prétentions légaux du consommateur. Avant toute réclamation et tout retour du prouit, veuillez s.v.p. cotrôler et noter exactement les défauts ou vices.

Garantie-Urkunde

Warranty certificate / Certificat de garantie

Computer-System mc-22s

☐ 4737 mc-22s 35-MHz Set
☐ 4737.77 mc-22s 35-MHz Transmitter only

☐ 4738 mc-22s 40/41-MHz Set
☐ 4738.77 mc-22s 40/41-MHz Transmitter only

Übergabedatum:
Date of purchase/delivery:
Date de remise:

Name des Käufers:
Owner´s name:
Nom de l`achateur:

Straße, Wohnort:
Complete adress:
Domicie et rue:

Firmenstempel und Unterschrift des Einzelhändlers:

Stamp and signature of dealer:

Cachet de la firme et signature du detailant :

Graupner | JR

REMOTE CONTROL

GRAUPNER GMBH & CO. KG
POSTFACH 1242
D-73220 KIRCHHEIM/TECK
GERMANY
http://www.graupner.de

Availability and changes to specifications reserved. Supplied only through approved specialist dealers. We will gladly supply addresses of retail outlets. We accept no liability for printing errors.

Printed in Germany PN.KF-01

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