mc-12.1.GB

Graupner | JR

REMOTE CONTROL

mc-12

ROTARY-SELECT

Programming manual

Contents

Safety notes
Please read this section carefully!

We want you to enjoy your modelling hobby over a period of many years, and you can help to ensure this by reading these instructions thoroughly, and in particular by observing the safety notes.
If you are a beginner to radio-controlled model aircraft, boats and cars, it is really essential that you ask an experienced model pilot for help in the early stages.
If you ever sell or dispose of this set, be sure to pass on these instructions to the new owner together with the equipment.

Application
This radio control system may only be used for the purpose for which it was designed by the manufacturer, i.e. for controlling *radio-controlled models which do not carry people.* No other usage is permitted.

SAFETY IS NO ACCIDENT

Safety notes
Radio-controlled models are not playthings! 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 can fly off at great speed, causing considerable injury. Propellers, helicopter rotors and any other rotating parts which are driven by a motor or engine represent a constant injury hazard. Do not touch these items with any part of your body. *For example, a propeller spinning at high speed can easily slice off a finger. Take care that noobject every touches a propeller which is rotating.*
Electric-powered models: when the main drive battery is connected to the power system, **never** stand in the hazardous region around the propeller. Protect all electronic equipment from dust, dirt, damp, vibration and foreign bodies. Never subject these components to excessive heat or cold. Radio control equipment should only be used in "normal" outside temperatures, i.e. within the range -15°C to +55°C.
Avoid subjecting the equipment to shock and pressure, and 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 and the same material, and genuine *GRAUPNER* plug-in crystals designed for your choice of 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. Take great care to avoid reverse polarity and short-circuits involving connecting leads, as the components are not protected against such errors.

Installing the receiving system, deploying the receiver aerial
The receiver should be mounted in the model aircraft behind a strong bulkhead or former, packed in soft shock-absorbing foam. In a model car or boat make sure that the receiver is protected from dust and spray.
The receiver must not make direct contact with any part of the fuselage or chassis at any point, as this would subject it directly to motor vibration and landing shocks.
If you are installing the receiving system in a model powered by a glowplug motor, be careful to install all the components in such a way that they cannot come into contact with exhaust gas or oil residues. This applies in particular to the ON/OFF switch, which is often installed on the outside of the model. Make sure that the receiver cannot move in the model, otherwise the aerial, servo leads and switch harness may be placed under tension.The receiver aerial is permanently attached to the receiver. It is about 100 cm long, and must not be either shortened or extended.
The aerial should be deployed as far away as possible from electric motors, servos, metal pushrods, high-current cables etc. However, it is best not to arrange the aerial in a dead straight line; in a model aircraft, for instance, it is best to run the wire to the fin tip and then deploy the end (about 10 - 15 cm) at an angle, forming an "L". This avoids reception "blind spots" when flying. If this is not possible, we recommend that you arrange part of the aerial in a short "S" shape inside the fuselage, e.g. close to the receiver.

Safety notes
Please read this section carefully!

Installing the servos
Always use the vibration-absorbing rubber grommets supplied with the servos when installing the units in a model. The grommets provide a useful measure of protection, and prevent vibration and shocks damaging the servos.

Installing the mechanical linkages
As a basic rule the mechanical linkages must always be smooth and free-moving. It is particularly important to ensure that all servo output arms are able to complete their full movements without being obstructed or striking mechanical limits.
It is important to be able to stop a running motor at any time, and this means that the throttle must be set up in such a way that the carburettor barrel is fully closed when the stick and trim are moved to their "idle" end-points. Ensure that no metal parts are able to vibrate against each other, e.g. when control surfaces are moved, as this may give rise to electrical "noise" which can cause interference to the receiving system.

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 in the hope 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 checks
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 transmitters on the same channel are switched on at the same time, 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 switched on at any time when its transmitter is switched 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 control movements, and could easily cause personal injury or damage to property. The servos may run to their end-stops and damage the gearbox, linkage, control surface etc. If your model has a mechanical gyro, please note the following:
Before you switch off your receiver, disconnect the power supply from the gyro so that there is no chance that the motor could run up to speed accidentally. *As gyros run down, they often produce so much voltage that the receiver detects what appears to be a valid throttle signal, and this can cause the motor to burst into life suddenly and unexpectedly!*

Range test
Before every session check that the system works correctly in every respect, and has adequate range. This means checking that all the control surfaces respond immediately and in the appropriate direction to the transmitter commands, at a suitable ground range.
Repeat this check with the motor running, with an assistant holding the model for you.

Operating the model: fixed-wing, helicopter, boat or car
Never fly over spectators or other pilots. Never deliberately endanger people or animals. Never fly your model in the vicinity of high-tension overhead cables. Do not run your model boat close to canal locks and sluice gates, and keep well clear of full-size vessels.
Never run your model vehicle on a public street, path or square used by pedestrians.

Checking the transmitter and receiver batteries
For safety's sake it is always best to stop operating your model in good time, with a generous safety margin. When the voltage of the transmitter battery falls to a dangerous level, the message "BAT" appears on the screen, and you will hear an audible warning signal. If this happens, immediately land your aircraft or stop operating your model. Fit new dry cells or recharge the battery packs.
It is particularly important to monitor the state of the receiver battery at regular intervals. Do not wait until you notice the servos actually slowing down, as the battery could then fail completely without warning. Replace exhausted dry cells in good time.

Safety notes
Please read this section carefully!

Be sure to read and observe the charging information supplied by the battery manufacturers; keep to the recommended charge times in particular. Don't leave batteries on charge unsupervised. Never attempt to recharge dry cells, as they may explode. All rechargeable batteries must be fully charged before a session.
To avoid short-circuits, first connect the banana plugs on the charge leads to the battery charger, taking care to maintain correct polarity, and only then connect the plug on the charge lead to the transmitter or receiver battery charge sockets. Always disconnect all batteries in your model if you are not about to run it immediately.

Capacity and operating times
This rule applies to all forms of electrical power source: at low temperatures battery capacity is greatly reduced, i.e. operating times are shorter in cold conditions. It is also true that incorrect handling of rechargeable batteries leads to reduced capacity. Make it routine to check your batteries at regular intervals, and establish that their capacity is still sufficient for the task.

Suppressing electric motors
All electric motors in the model must be adequately suppressed, otherwise there is no chance that the radio control system will work correctly. The reason is that all conventional electric motors produce sparks between commutator and brushes, which produce more or less serious interference to the radio control system, depending on the motor type. In electric-powered models every motor must therefore be suppressed carefully. Purpose-designed filters suppress such interference signals effectively, and should always be fitted if possible. Please read the notes regarding assembling and operating the model supplied with your kit.
For further details of suppression filters please refer to the main *GRAUPNER* FS catalogue.

Servo suppression filters for extension leads
Order No. **1040**
These servo suppression filters are necessary if you are using unusually long servo leads, which will otherwise tend to affect the tuning of the receiver. The filter is connected directly to the receiver input. In very difficult cases a second filter arranged at the servo end of the lead may help.

The use of electronic speed controllers
A wide range of electronic speed controllers is available, and the correct type must be chosen according to the size of the electric motor you are using.To avoid overloading and damaging the speed controller, the unit's current handling capacity should be at least half the maximum stall current of the motor.
Particular care is required when selecting a controller for a "hot" motor with a low number of turns on the winding, as the stall current of such motors may be several times higher than their-nominal current, and this can easily wreck the speed controller.

Electrical ignition systems
Ignition systems for petrol engines can also produce interference which can seriously affect the radio control system.
Be sure to fit a separate battery to power the electrical ignition system. Spark plugs must be correctly suppressed, and the same applies to spark plug caps and shielded ignition leads.
Keep the receiving system components as far from the ignition system as possible.

Maintenance
Clean the case, the transmitter aerial etc. with a soft, dry cloth only. Never use cleaning agents, petrol, water or any similar fluid.

Liability exclusion / compensation
As manufacturers, we at *GRAUPNER* 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 deny all liability for loss, damage or costs which are incurred due to the incompetent or incorrect installation and operation of our products, or which are connected with such usage in any way. Unless otherwise prescribed by binding law, the obligation of the *GRAUPNER* company to pay compensation, regardless of the legal argument employed, is limited to the invoice value of that quantity of *GRAUPNER* products which was immediately and directly involved in the event which caused the damage. 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-12
Foreword to manual

Our series of highly successful micro-processor controlled radio control systems has now been expanded to include a new transmitter. The compact, ultra-rigid case of the mc-12 is packed with the latest hardware technology, combined with sophisticated software which can handle all the requirements of today's demanding modeller.

The mc-12 radio control system has been specially developed to suit the beginner, but even so it can cope with all the current types of model without problem, including fixed-wing aircraft and helicopters, model cars and boats.

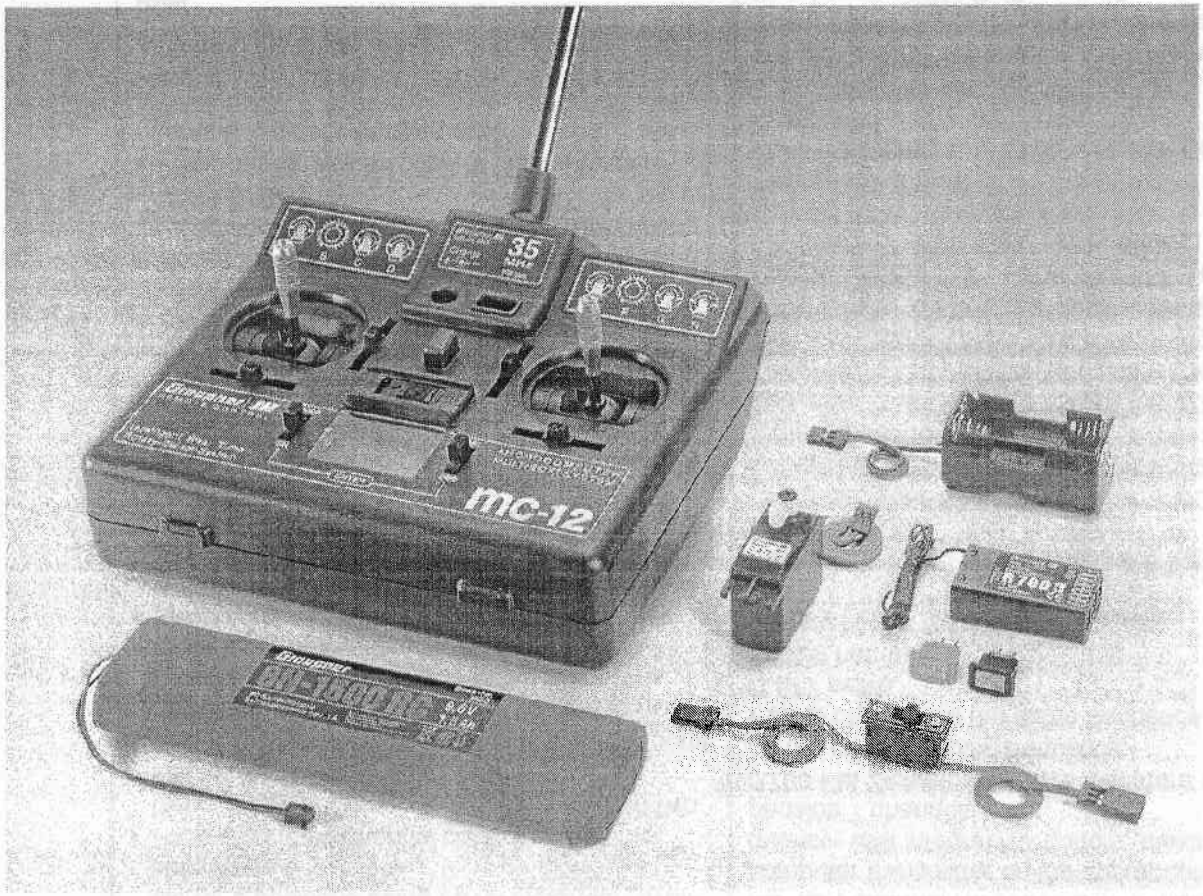
Modern fixed-wing model aircraft and helicopters often require complex mixed functions, especially involving flaps and ailerons (fixed wing) and swashplate control systems (helicopters). Computer technology makes this possible just by pushing a few buttons, and the mc-12 transmitter is capable of handling a vast range of model requirements in this way. Simply run the mc-12's setup program and select the appropriate type of model; the software then automatically makes available to you all the mixing and coupling functions you need for that type of model. No extra modules are required in the transmitter to im plement complex coupled and superimposed functions, and the need for complicated mechanical mixer arrangements in the model is completely eliminated. The mc-12 offers outstanding levels of safety and reliability. The clear, comprehensible program structure makes it easy for even the complete beginner to become familiar with a wide range of functions quickly and straightforwardly. Just two rocker buttons either side of the high-contrast LCD screen are all you need to navigate your way through the program. In no time at all you can learn how to set up and exploit all the options required to operate the radio-controlled models which correspond to your current level of experience.
In the presentation of this programming manual we have taken particular care to keep to a logical, clearly structured method of explaining the operating and programming procedures.
The opening chapter covers all the general operating procedures. The second section starts by explaining the functions which apply in common to all three model types: "UNIFLY (FL)", "ACROBATIC-NAUTIC-CAR (AC)" and "HELICOPTER (HE)". The third section covers the model-specific functions. For each model type the individual sections of the overall program which are available are summarised in a clearly laid-out and comprehensible flow diagram.
For each of the three model types the manual describes the program's facilities and how to set up and use them, followed in each case by a programming example covering fixed-wing model aircraft, boats, cars and helicopters.
The manual is completed with an appendix which includes, amongst other things, detailed information regarding *GRAUPNER* NAUTIC modules, and additional optional accessories for your mc-12 radio control system.

Please take the time to read through these instructions carefully, and check all the functions thoroughly before you attempt to operate the model. This is done simply by connecting servos to the receiver supplied in the set, and observing how they respond to the transmitter controls. This is the quick, easy way to learn how best to set up and use the comprehensive facilities and functions offered by your mc-12.

All of us in the *GRAUPNER* Team wish you every success with your mc-12 computer system.

Kirchheim-Teck, July 2000

mc-12 computer system
4 / 7-channel FM radio control set



A 7-channel computer radio control system with multi-soft software, incorporating refined top-quality technology and the Rotary Select set-up system.

- 8-bit computer system ensures excellent reliability, simplified rotary programming system for straightforward set-up; all menus can be called up in an endless loop (Rotary Select system). A proven, high-contrast multi-data screen makes displays visible even in brilliant sunlight. Screen displays include adjustment values, directions of rotation, trim values, mixer functions, programming information in the case of multi-function programs, and transmitter battery operating voltage.
- High-quality radio control system for F3A, F3B, F3C, F3D and F3E models; also an excellent hand-held transmitter for RC cars and model boats.
- Compatibility with standard FM and FMsss (PPM) systems.
- 8 model memories for different models
- Real-time Processing System
- Real-time processing system with direct display of parameters. Multi-function software menus with 2-way Rotary Select System (RSS) for ease and convenience of programming.
- Convenient mode selector switches quickly between stick modes 1 - 4 (throttle right/left). All mixers, adjustments, reverse and memory data are transferred automatically when you change mode.
- Complex but easily set-up basic multi-function fixed-wing programs for F3A, F3B, F3C, F3D and F3E (ready-made programmed multi-mixer units, which can be supplemented by three additional freely programmable mixers; mixer inputs and offsets are variable, and mixers can be turned on and off by means of external switches).
- Standard mixer systems, combined with accurately variable end-point and centre positions for all servos make the system ideal for use with model aircraft, boats and cars.
- Super-heli program for standard, Heim and 120° swashplate systems.
- Programmable reverse function for all servos.

- Dual Rates for 3 servo functions, programmable for 2 positions using travel expander, available range 5 to 125%.
- Progressive exponential control curves for three servo functions, switchable between two values.
- Sub-trim memory system for offset centre point on all servos; also useful for adjusting to old servos, or servos with non-standard centre pulse width.
- Single-side servo throw (separate travel adjustment for both end-points of all servos), adjustment range 0 - 150%. This new facility makes it possible to program symmetrical and asymmetrical servo travels.
- Integral computer alarm system
- Stopwatch (0...999 seconds) and countdown timer
- Two NAUTIC Multi-Split modules and decoders can be connected. Each module expands one proportional function to provide five servo channels.
- Model memory with lithium back-up battery, safeguards data even if the transmitter battery is completely flat.
- Prepared for use as pupil or teacher transmitter in a Trainer arrangement.

GRAUPNER mc-12
4 - 7-channel micro-computer radio control system
Sets
Order No. **4724** For the 35 MHz band
Order No. **4724.B** For the 35 MHz B-band
Order No. **4725** For the 40 MHz band
Order No. **4725.41*** For the 41 MHz band
For export only

Sets contain
mc-12 4-channel ROTARY SOFT micro-computer transmitter on the appropriate frequency, with integral NC battery, maximum expansion 7 channels,
R700 FM 7-channel PPM18 miniature receiver on the corresponding frequency,
Pair of crystals on the same frequency band,
C 577 servo,
Switch harness,
Battery holder for receiving system.

Factory-prepared rechargeable 4.8 V receiver batteries, e.g.:
Order No. **2566** SAFT NiMH 4.8 V/3000 mAh
Order No. **3465** VARTA RSH 4.8 V/2000 mAh
Order No. **3448** VARTA RSE 4.8 V/1700 mAh
Order No. **3464** SANYO AR 4.8 V/770 mAh
Order No. **3446** VARTA RS 4.8 V/600 mAh
Order No. **3463** SANYO AA 4.8 V/270 mAh*
* For special applications (brief operation only)
Please see the main *GRAUPNER* FS catalogue for details of other 4.8 V NC batteries.

Replacement part
Order No. **3100.6** Telescopic transmitter aerial

Please see the appendix and the main *GRAUPNER* FS catalogue for details of additional accessories for the mc-12.

Specification - mc-12 computer transmitter

Transmission system	FM/FMsss (PPM)
FMsss T crystals	35 MHz band, channels 61 - 80 35 MHz B-band, channels 182-191 40 MHz band, channels 50 - 59 and 81 - 92 41 MHz band*
Channel spacing	10 kHz
Max. channels	7
Channels, basic unit	4 proportional channels
Optional supplementary channels	3, proportional or switched

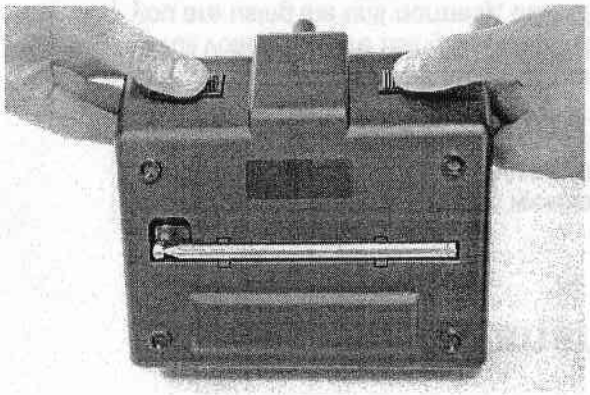
Specification - R700 FM receiver

Receiver type	R700 FM 7-channel PPM Micro-SUPERHET
35 MHz band 35 MHz B-band 40 MHz band 41 MHz band	Order No. 3551 Order No. 3551.B Order No. 7051 Order No. 7051.41*
Operating voltage	4.8 ... 6 V **
Current drain approx.	13 mA
Sensitivity approx.	10 µV
Servo functions	7
Temperature range	-15° ... +55°C
Aerial length approx	950 mm
Dimensions approx.	47 x 25 x 16 mm
Weight approx.	16 g

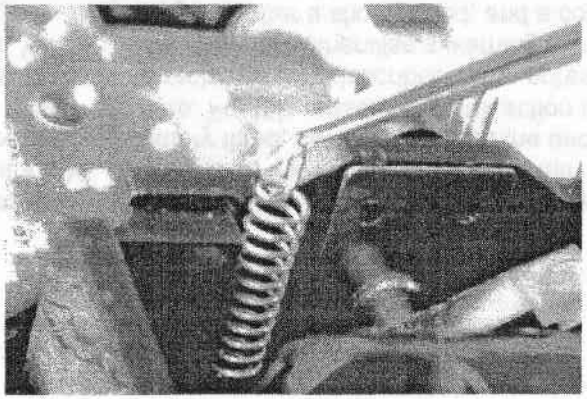
* For export only
** 4 NC cells or 4 dry cells

Operating the transmitter

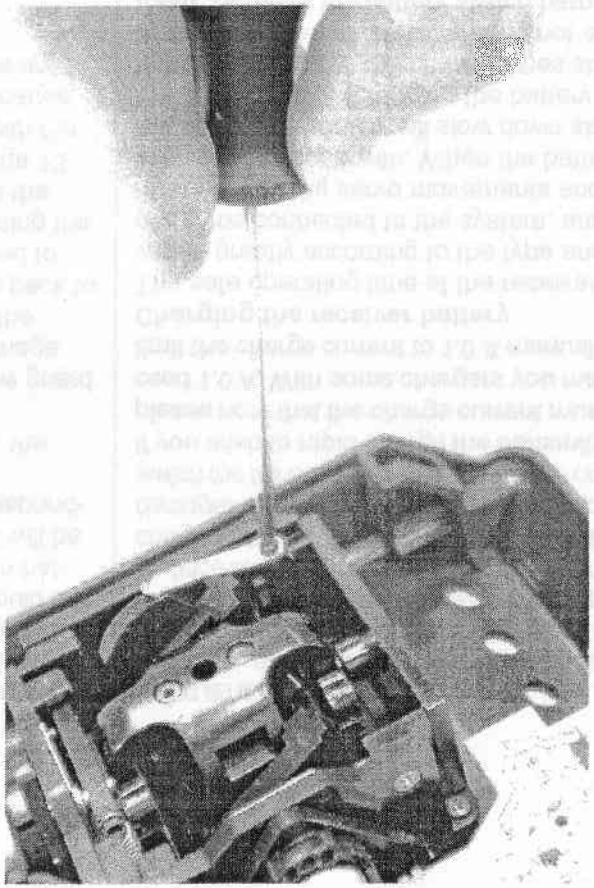
Opening the transmitter case
Before opening the case be sure to switch off the transmitter (power switch to "**OFF**"). Slide both latches inward as far as they will go, in the opposite direction to the arrows, until the back panel of the case can be folded out and disengaged. To close the transmitter again, engage the bottom edge of the back panel, fold it closed and push both sliders outwards in the direction of the arrows. Take care that no cables are snagged in the joint when you close the back.
Note:
Do not make any modifications of any kind to the transmitter circuit, as this would invalidate the guarantee and also nullify the official type approval.
Whenever you have to work on the inside of the transmitter, disconnect the battery to eliminate any danger of short-circuits on the transmitter circuit board.



Converting the primary proportional controls
Both vertical (fore-and-aft) stick planes can be changed from self-neutralising to non-neutralising operation, so that you can switch throttle control from the left to the right stick or vice versa. When set to non-neutralising, the stick stays wherever you put it.
The first step is to disconnect the centring spring from the appropriate stick unit. Fold the centring arm up, disconnect it, and store it in a safe place together with the coil spring. Locate the ratchet leaf spring supplied in the set, and screw it in place with the ribbed side pressing down on the corresponding plastic bar. Tighten the screw to secure the ratchet spring; you can adjust the stick unit spring tension to any setting you like from soft to hard by doing up the screw more or less tightly.

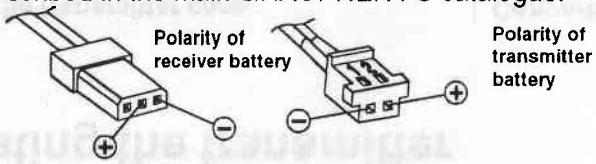


If you change the mechanical function from left to right or vice versa, you must also carry out the corresponding electronic change between the control functions 1-4. This is carried out using the code "MOD", which is part of the basic transmitter programming procedure, as described on page 19.

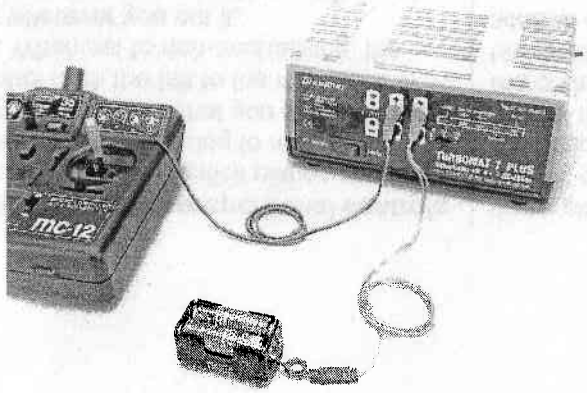


Operating the transmitter

Installing the transmitter and receiver batteries
The transmitter is fitted as standard with a 9.6 V NC battery. For details of other types of battery please refer to the main *GRAUPNER* FS catalogue. It is important to ensure that the battery is at full voltage before using the transmitter. When you are using the unit normally, the voltage is displayed on the LCD screen. To be on the safe side you should always stop operating your model in good time, but in any case you must stop when the battery alarm sounds. Recharge the battery before you operate your model again.
Note regarding data back-up: You don't need to worry about losing your programmed data. If the transmitter battery is completely flat, or even if you remove it from the transmitter, all the programmed data is retained, as the memory is powered by a lithium battery which typically lasts about 5 to 7 years. Ask the GRAUPNER Service Centre to replace it when it eventually fails.
The receiver battery holder included in the set can be fitted with four separate AA-size dry cells or NC cells. Wrap a rubber band round the pack for added security, or shrink a length of heat-shrink sleeving round it. To avoid the danger of short-circuits, apply tape over the exposed contacts to which the socket lead is soldered. For more protracted usage we recommend the use of factory-prepared NiCd battery packs, as described in the main *GRAUPNER* FS catalogue.



Charging the transmitter and receiver batteries
The mc-12 transmitter is supplied with an NC battery fitted, but the pack is in the uncharged state. For this reason your first action should be to recharge it as described in the notes on battery charging, otherwise a warning signal will be triggered after a short period, and a corresponding message will appear on the screen.
When you charge the transmitter battery, the ON/OFF switch must be left at "OFF".
The mc-12 is equipped with a reverse flow guard in the charging circuit which prevents damage due to reverse polarity or short-circuit at the charge socket. If you wish to connect the pack to an automatic battery charger, you will need to by-pass this feature; this is done by inserting the jumper (2-pin shorting plug - supplied) on the transmitter circuit board, as shown on page 13.
***Caution**: if you do this, be very careful with the charge lead banana plugs, as you could cause damage to the transmitter if the two plugs are shorted..*



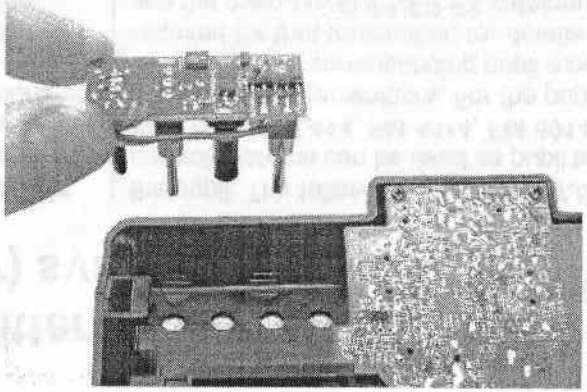
Using an automatic battery charger:
If you are using an automatic charger be sure that all the connections are sound, and make secure contact. Any interruption in the circuit, even if it is only brief - perhaps due to an intermittent contact - can cause the charge voltage to rise to such an extent that the voltage damages the transmitter. This can also happen if you switch the transmitter on briefly while it is on charge..
If you wish to rapid-charge the transmitter battery please note that the charge current must not exceed 1.0 A. With some chargers you may have to limit the charge current to 1.0 A manually.
Charging the receiver battery
The safe operating time of the receiver battery varies greatly according to the type and number of servos connected to the system, and also the frequency of the servo movements and the loads they have to cope with. When the battery is nearly flat the servos will slow down significantly, but don't put off recharging the battery until that happens! Observe the charge times stated by the battery manufacturer, and do not exceed them. Some of the battery switch harnesses listed in the main *GRAUPNER* catalogue are fitted with an integral or separate charge socket. The battery can be connected directly to a charger by this means. See the main *GRAUPNER* catalogue for details of battery chargers.

Don't dispose of exhausted NiCd or dry batteries by throwing them in the ordinary household waste bin. Take them instead to your local toxic waste collection point (ask your local council), where proper measures are taken to recycle the materials; alternatively dispose of them in an environmentally safe manner.

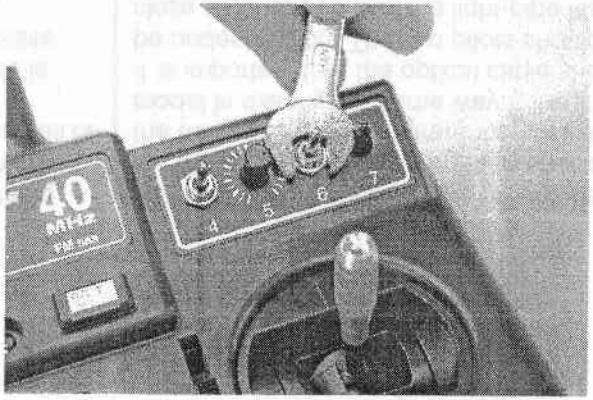
Operating the transmitter

Adjusting the length of the sticks
The length of both sticks is infinitely variable, so that you can set up the transmitter exactly to suit your preferences, for optimum fine control.
Undo the locking screw using an allen key (2 mm A/F), then screw the stick top in or out to reduce or extend the length. Tighten the grub-screw again carefully to lock the setting.

Installing supplementary modules
Optional accessories for the mc-12 transmitter include switched channel modules and rotary modules, external switches for controlling the Dual Rates function (see page 21) and switching mixers on and off (see page 27), NAUTIC modules, and also a trainer module for converting the unit into a pupil transmitter. These items are described on pages 12-13 and in the appendix.
The transmitter case is supplied with pre-cut holes for fitting the optional modules. The basic principle is that the modules are installed from inside the case, then secured with nuts on the outside. See the next section "Installing supplementary modules". See page 13 for details of connecting the modules to the transmitter circuit board.



Retaining supplementary modules
The transmitter is fitted as standard with decorative blanking plates over the module wells on the front of the case, and these should first be removed. Open the transmitter case and carefully press them out using a suitable tool, then replace each one with a perforated bezel (Order No. **4146.2**).
Remove the nuts from the module shafts. Place the module in the transmitter, and fit the control shafts through the holes, facing out. Fit the nuts you have just removed on the module shafts, and tighten them carefully using the correct size of spanner to secure the module. If the module features proportional controls, fit the rotary knobs on the shafts, align the index mark with the scale, and tighten the grubscrew.
The best tool for securing external switches is the special nut spanner, Order No. **5733**.



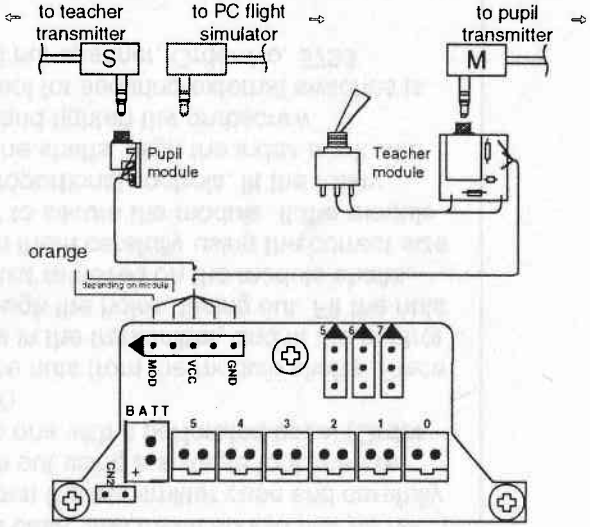
Operating the transmitter
Teacher-pupil (trainer) system

mc-12 as teacher transmitter or pupil transmitter
The opto-electronic trainer system provides a convenient method of training a newcomer to radio control flying, as all the control functions can be transferred between the teacher's transmitter and the pupil's unit. The RF signal is broadcast on the channel determined by the teacher's transmitter (crystal). For trainer operations the crystal in the pupil transmitter must be removed. For the mc-12 transmitter to be used in trainer mode, it must be fitted with either the teacher module, Order No. **3290.12**, or the pupil module, Order No. **3290.10**; the module is installed in a vacant module well (see appendix), and should be connected as shown in the drawing on this page. For actual training operations the teacher and pupil transmitters are connected to each other by means of the optical light-pipe cable, Order No. **3290.4**.
The pupil socket on the mc-12 transmitter can also be used to control a flight simulator when connected to a PC.

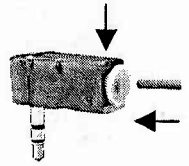
Trainer operations
The commands given by the pupil at his transmitter are transferred with complete reliability to the teacher transmitter by means of the optical trainer cable. For the pupil to have control of the model, the teacher simply operates the momentary switch mounted on the teacher module. If a critical flight situation develops, the teacher just releases the trainer switch, and he immediately regains full control of the model. Once the teacher has returned the model to a safe flight attitude, he operates the trainer switch again, and control of the model is transferred back to the pupil. The following *GRAUPNER/JR* radio control systems can be used as pupil transmitters: D 14, FM 414, FM 4014, FM 6014 and all of the mc-series transmitters. For the pupil transmitter the corresponding pupil module is required for that transmitter; for details please see the main *GRAUPNER* FS catalogue.

Using the trainer system:
Using the mc-12 transmitter as pupil transmitter in conjunction with a teacher transmitter of the mc-18 (ROM after mc-20 X), mc-20 or mc-24 type:
An mc-12 transmitter equipped with a pupil module can also be used with an mc-18, mc-20 or mc-24 teacher transmitter, and in this case it is possible for the teacher to transfer individual control functions to the pupil, one by one. In this arrangement the mc-12 transmitter should be operated in its basic mode, i.e. you must erase the selected model memory ("RST", see page 18), set the stick mode ("MOD", see page 19) to suit the pilot's requirements, and remove the crystal from the mc-12 pupil transmitter. When used in conjunction with other *GRAUPNER/JR* transmitters, the mc-12 must be set up exactly as the teacher transmitter, i.e. the settings for model, mixing, coupling, servo functions etc. on the teacher and pupil transmitters must be identical.
The teacher and pupil transmitters must both be fitted with a transmitter battery. The transmitters should only be used with fully charged transmitter batteries.
Before actually embarking on trainer operations, be sure to carry out a check of all the functions, and do a range check on the ground before flying the model. The main point to check is that the two transmitters operate the controls on the model in exactly the same way.
It is important that the optical cable should not be under tension. The two pilots should stand close together, so that the light-pipe lead can hang down loosely.

Wiring diagram: pupil module to teacher module

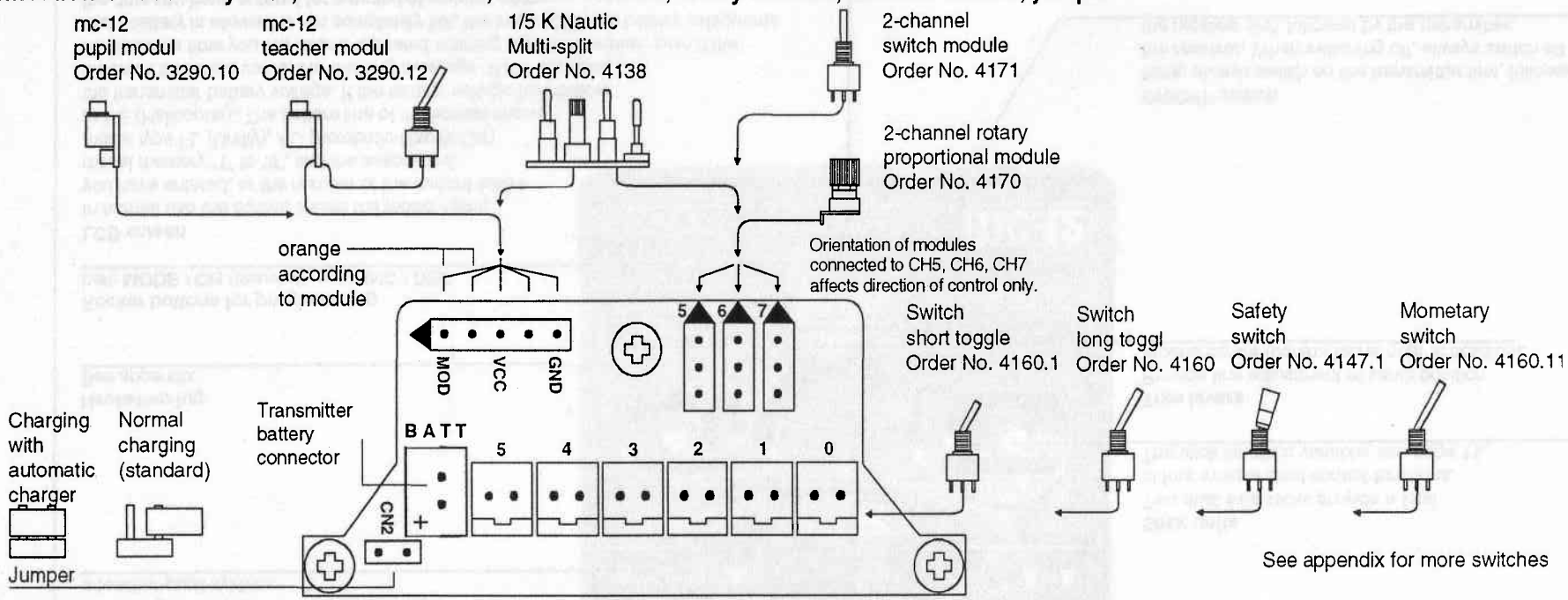


If any function works incorrectly, check that the wiring is set up correctly, and that the optical cable is connected properly.:
Disengage the clamp mechanism on the "S" and "M" plug in turn by pressing on the end of the plug with your finger, and slide the light-pipe lead in again as far as it will go, as shown in the illustration.



Transmitter circuit board connections

Connections: Trainer system, NAUTIC module, switch module, rotary module, external switch, jumper



External switch pin assignment

External switch socket	Model type		
	UNIFLY FL	ACROBATIC-NAUTIC-CAR AC	HELICOPTER HE
0	Dual-Rate and Exponential for aileron (helicopter: roll)		
1	Dual-Rate and Exponential for elevator (helicopter: pitch-axis)		
2	Dual-Rate and Exponential for rudder (helicopter: tail rotor)		
3	Flap → elevator mixer Flap → aileron mixer	Snap-roll program (aerobatics) Freely programmable mixer "C"	Auto-Rotation
4		Elevator → flap mixer Freely programmable mixer "B"	Idle-up Collective pitch curve
5		Auto-landing (automatic landing aid) Freely programmable mixer "A"	

Description of transmitter

Socket for telescopic aerial
Storage well on the rear panel

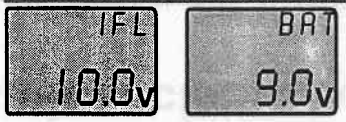
Charge socket
See page 10 for information on battery charging.
Please note the polarity of the charge socket marked on the transmitter.

Option wells
See page 11 and the appendix for details of fitting out the transmitter with external switches, switch and rotary modules, NAUTIC modules and a teacher-pupil system.

Neckstrap lug
See appendix

Rocker buttons for programming
Left: **MODE / CH** (channel), right: **INC / DEC**

LCD screen
In normal use the screen shows the model name you have entered, or the number of the current active model memory "1" to "8", and the associated model type FL (Unifly), AC (Acrobatic-Nautic-Car) or HE (Helicopter). The bottom line of the screen shows the transmitter battery voltage. If the battery voltage falls below a certain threshold value, the warning message "BAT" appears. At the same time you will hear a repeated warning signal. However, even if the main battery is allowed to run completely flat, the integral lithium battery safeguards the data you have entered for a period of several years.



Normal mode

Battery alarm

Crystal socket
The transmission channel of the transmitter is determined by plug-in crystals. The transmitter must be used with FMsss plug-in crystals, or precision crystals for the appropriate frequency band; see appendix for details. The frequency band and channel number of the plug-in transmitter crystal must be the same as that in the receiver. Use genuine *GRAUPNER* plug-in crystals with the protective cap exclusively. Transmitter crystals bear the code letter "**T**" (Transmitter), receiver crystals "**R**" (Receiver).

Stick units
Two dual-axis sticks provide a total of four independent control functions.
The stick length is variable; see page 11.

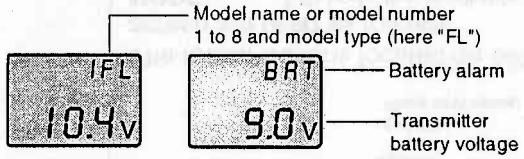
Trim levers
Provide fine adjustment of servo position around centre (control travel neutral position).

ON/OFF switch
Note: always switch on the transmitter first, followed by the receiver. When switching off, always switch off the receiver first, followed by the transmitter.

Using the system for the first time

Using the transmitter for the first time

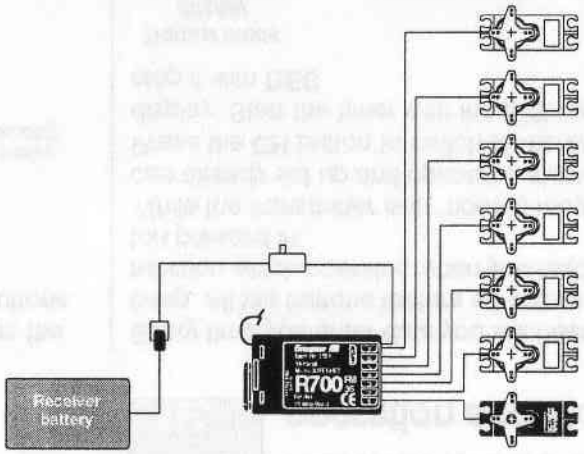
Don't switch on the transmitter until you have screwed the aerial into its socket; operating the transmitter without the aerial can damage the integral RF module. When you switch the mc-12 transmitter on, it is in the "normal mode" of operation, and the LCD screen displays the following information: in the top line the current model name or - if no name has been entered - the model number (1 to 8), plus the current model type FL, AC or HE, and in the bottom line the transmitter battery voltage.



The mc-12 transmitter includes three basic programs which cater for different classes, or types, of model. The standard base setting is the model type "UNIFLY (FL)". You will find a description of the model types on pages 32, 48 and 62. The method of selecting the correct "model type" for your purposes is explained later; see page 18. Please note that the mc-12 transmitter is supplied with a rechargeable battery as standard, but in a discharged state, so after a few minutes the screen will show the warning message "BAT". This message, and the repeated audible warning beeps, indicate that you must recharge the battery. If the battery alarm ever sounds while you are operating a model, cease operations immediately.

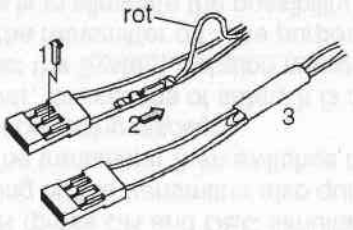
Installing the receiving system

Please read the notes regarding installation of the receiver and receiver aerial on pages 3 and 4 of these instructions.
The channel number of the receiver crystal must be the same as that printed on the transmitter crystal. Locate the receiver crystal opening, and push the crystal firmly into the socket. It is important that you only use the plug-in crystals listed in the table on page 83; all receiver crystals are printed with the code letter "R" (Receiver).
The receiver is fitted with polarised connectors, so that the servos and switch harness can only be connected with correct polarity (i.e. the right way round). If you look at the connectors you will see that they are chamfered on one edge to match the sockets. Connect the ON/OFF switch harness to the receiver socket marked "Batt", and connect the battery to the switch harness.



Note:

If you wish to use a speed controller with an integral BEC system, the positive contact (red wire) of the 3-pin connector attached to it must be removed and insulated:



Carefully raise the central lug (1) of the connector using a small screwdriver, withdraw the red wire (2) and wrap it in insulating tape (3) to prevent any danger of short-circuit.

Switch on the transmitter first, followed by the receiver.

and at the end of the session:

Switch off the receiver first, followed by the transmitter.

Receiver channel sequence

The basic order of the receiver sockets varies according to the model type you have selected: "UNIFLY (FL)", ACROBATIC-NAUTIC-CAR (AC)" or "HELICOPTER (HE)". The default (standard) setting for the mc-12 transmitter is "UNIFLY" mode.

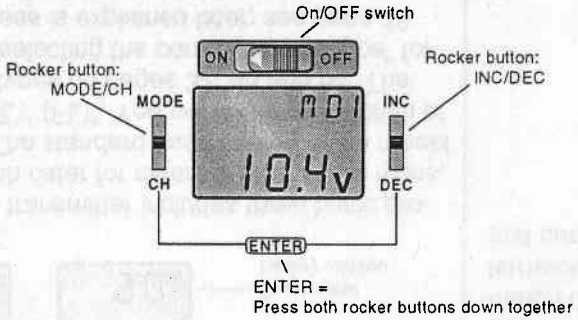
	Sequence
UNIFLY »FL«	Page 32
ACROBATIC-NAUTIC-CAR »AC«	Page 48

Multi-data terminal

Basic operating procedures

The mc-12 is extremely simple to program; the whole process requires only two rocker buttons.

Operating terminal

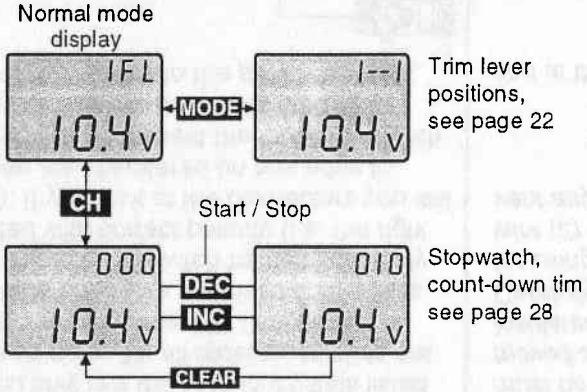


The rocker buttons located on either side of the screen are used as follows:

MODE	Selects the available functions. In the basic display, **MODE** switches to the trim lever positions for control functions 2, 3 and 4
CH (Channel)	Selects the appropriate channel or the associated control function 1 ... 7
INC (Increment)	Increases the value of the selected function
DEC (Decrement)	Reduces the value of the selected function
ENTER	Confirm button: press both rocker buttons down simultaneously in the direction of **CH** and **DEC**.
CLEAR	Erase button: simultaneously press the left-hand rocker button down (towards **CH**) and the right-hand rocker button up (towards **INC**).

Normal mode of operation and stopwatch

Every time you enter data you will hear a brief beep. All the buttons feature an automatic repeat function which operates when you hold the button pressed in.
While the transmitter is in "normal mode" you can already set up and operate a stopwatch:
Press the **CH** button to switch to the stopwatch display. Start the timer with the **INC** button, and stop it with **DEC**



To reset the display to "000", press both rocker buttons simultaneously in the direction **CH** and **INC** (= **CLEAR**). In addition to this standard stopwatch function you can set up a count-down timer; this has to be selected within the *Setup Rotation* procedure. As an option, both timers can be started and stopped by means of external switches, or by the throttle stick; see page 28 for more details.
If you press **MODE**, the screen switches from the normal display to the trim position display; see page 22-23 for an explanation.

Software-structure

~~System- und Einstellprogramme~~

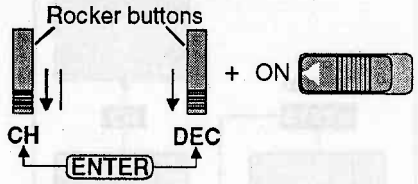
System program, setup program
Software structure
The software is divided into two menus which are activated in different ways:

1. System Rotation
Used to set the basic transmitter functions, such as model number 1 ... 8, model type, model name, stick mode, etc.
2. Setup Rotation
Used to select and program model-specific data, such as servo settings, programmable mixers, ready-made multi-function programs etc.
In both menus the codes available are called up in turn by pressing the left-hand rocker button in the **MODE** direction. When you reach the last code, the program sequence restarts from the beginning ("Rotary Select" process).
You can leave either of the two menus "*System Rotation*" and "*Setup Rotation*" by pressing **ENTER** (press **CH** and **DEC** simultaneously); switching off the transmitter also quits the system. The transmitter then switches back to the *normal operating display*.
However, for reasons of safety it is only possible to select the System Rotation menu by first switching the transmitter off. The purpose of this feature is to eliminate the possibility of accidentally making a change to the programmed basic functions when you are actually operating a model, such as switching to a different model memory.
Note:
In System Rotation mode the transmitter does not broadcast a signal to the receiver.

System Rotation

System Rotation programs

Switching on System Rotation



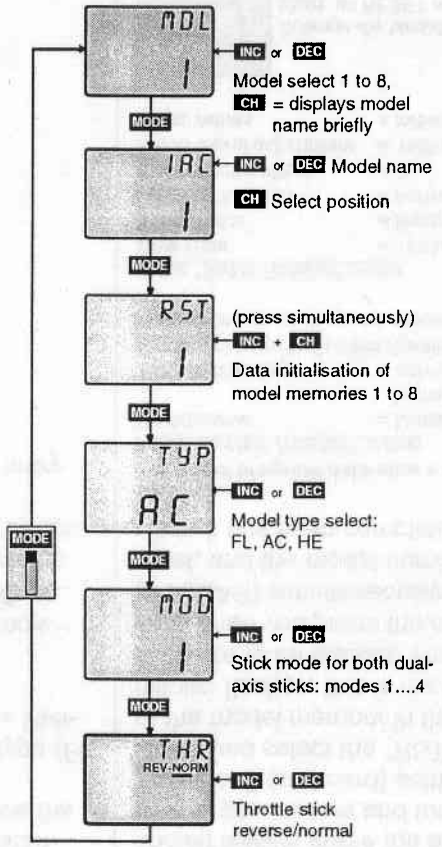
1. Hold both rocker buttons pressed down (= **ENTER**), and at the same time switch the transmitter on. You will hear a confirmation beep.
2. The screen now displays the first of a total of six program points.
3. Select the code you wish to access using the **MODE** button, and adjust the settings using **INC** or **DEC**. Note that **CH** is used to change position when entering a name.
4. Press the **ENTER** buttons again to end *System Rotation* at any point.
5. The program then switches back to normal operating mode.

The next column shows the flow diagram of the *System Rotation* program. The manual then explains all the six *System Rotation* codes in full.

Flow diagram System Rotation

Programming the basic settings

System Rotation flow diagram



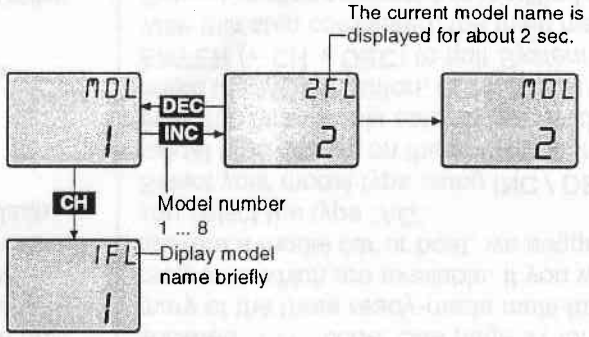
Model characters

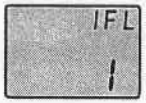
Switching model memories 1 to 8

The mc-12 transmitter provides the means for you to store all the settings for eight complete models.

First select the code "MDL" in *System Rotation* using the **MODE** rocker button, then select the model with the **INC** or **DEC** buttons. From this point on, all the settings you enter apply to the model number you have selected in this menu.

If you switch model memories, the current model name appears in the top line of the screen for about two seconds. You can also display the model name at any time by pressing **CH** briefly.

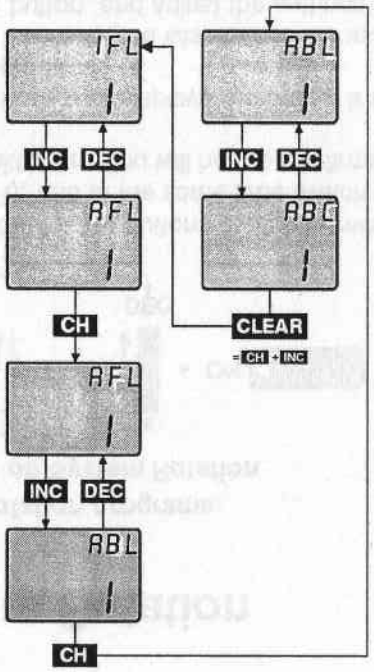




Model name

Entering a three-character model name

The first time you access a model memory (or after carrying out a reset), you will see a standard 3-character entry on the screen above the model number:
Model number (1...8) and current model type (FL = Unifly, AC = Acrobatic-Nautic-Car, HE = Helicopter).
Examples: 1FL, 3HE, ...
The left-hand character flashes; you can now change that character by pressing the **INC** or **DEC** buttons. The characters available are the letters A...Z, 0...9, + and -. Press the **CH** button to move to the next character.
CLEAR resets the name to the standard entry.



Data initialisation

Erasing data, resetting all data

Before you re-program a model memory you should always erase the existing data, to ensure that all parameters and functions are returned to the default (standard) settings.
When you select the "RST" function, the number of the model memory in the bottom line of the display flashes; this is the memory whose settings are to be erased. The erasure actually occurs when you press the buttons **CH** + **INC** (=**CLEAR**) simultaneously. This is known as a reset, and the model number ceases to flash when it has been completed.

Initialised program data after a reset:

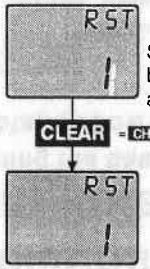
In the "*System Rotation*" menu:

Model name	= Model name and current Model type
Throttle direction	= normal ("NORM")

No data change in *System Rotation* for the following codes:
Model number, stick mode, model type

In the "*Setup Rotation*" menu:

Dual Rate	= 100%
Exponential	= linear ("LN")
Reverse function	= normal ("NORM")
Servo centre offset	= 0
Servo travel adjustment	= 100%
Mixer values	= initialised default values



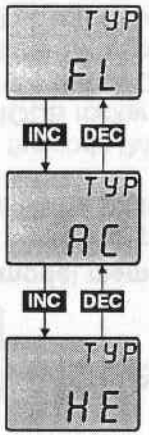
Solange die Modellnummer blinkt, ist RESET noch nicht ausgeführt.

Model type

Unifly, Acrobatic-Nautic-Car, Helicopter

The mc-12's program differentiates between a total of three model types, or classes. You must select the model type before you start re-programming a model in the *Setup Rotation menu* (see page 20), because this determines the options which you can call up using the associated "TYP" code. See page 31 for a summary of the three ready-made multi-function programs which are available. If you wish to operate a model car or boat, we suggest that you select the type "AC".
Select your model type using **INC** / **DEC**. The model type display on the screen flashes. However, the type is only actually selected when you press the **MODE** button, or when you press **ENTER** (= **CH** + **DEC**) to quit *System Rotation*.
With this step completed, the main menus in the *Setup Rotation* program are modified accordingly. All the original setup parameters of this model memory are lost when you switch to a new model type.

Ready-made programs:



FL = Unifly
See page 32 for description

AC = Acrobatic-Nautic-Car
See page 48 for description

HE = Helicopter
See page 62 for description

Stick mode

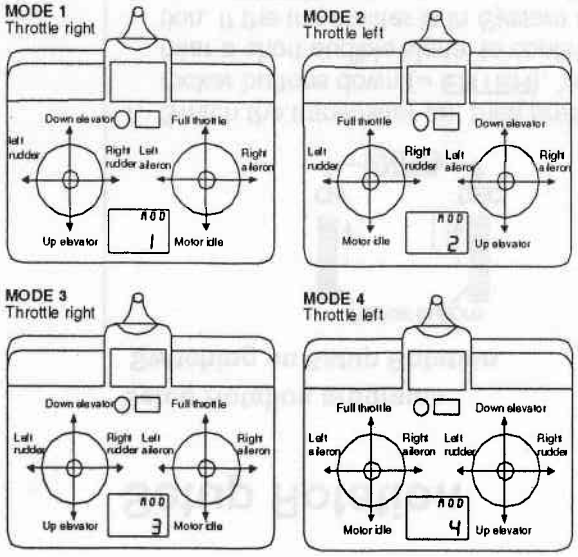
Assigning the control functions 1 to 4

Basically there are four different methods of assigning the four primary functions to the two dual-axis sticks; the primary functions are: ailerons, elevator, rudder and throttle (or airbrakes) on a fixed-wing model, and roll-axis, pitch-axis, tail rotor and throttle / collective pitch on a model helicopter. Which of these alternatives is used depends solely on the pilot's personal preference.

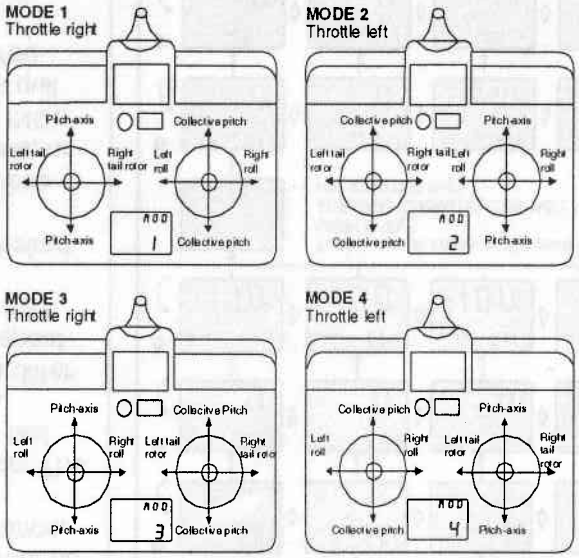
Select one of the options 1 to 4 using **INC / DEC**, using the diagrams below as a guide.

Changing the stick mode - abbreviated to "MOD" - has no effect on the receiver socket sequence, nor on any programming you might already have completed.

Stick modes for fixed-wing models:



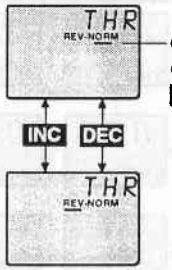
Stick modes for model helicopters:

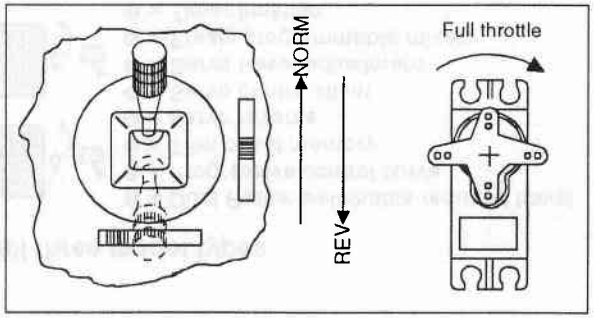


Throttle

Reversing the direction of effect of the throttle stick

This setting enables the user to set the direction of effect of the throttle stick, function 1. It is available for all model types, but is primarily intended for the model type "HE". You can switch between "NORM" and "REV" using **INC** and **DEC**. The functions of all other mixers which affect function 1 depend on this setting (in the helicopter program "HE" this means the throttle and collective pitch function, e.g. idle-up, tail rotor mixer, collective pitch trim etc.).

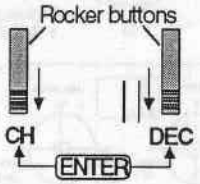




Setup Rotation

Setup Rotation programs

Switching on Setup Rotation

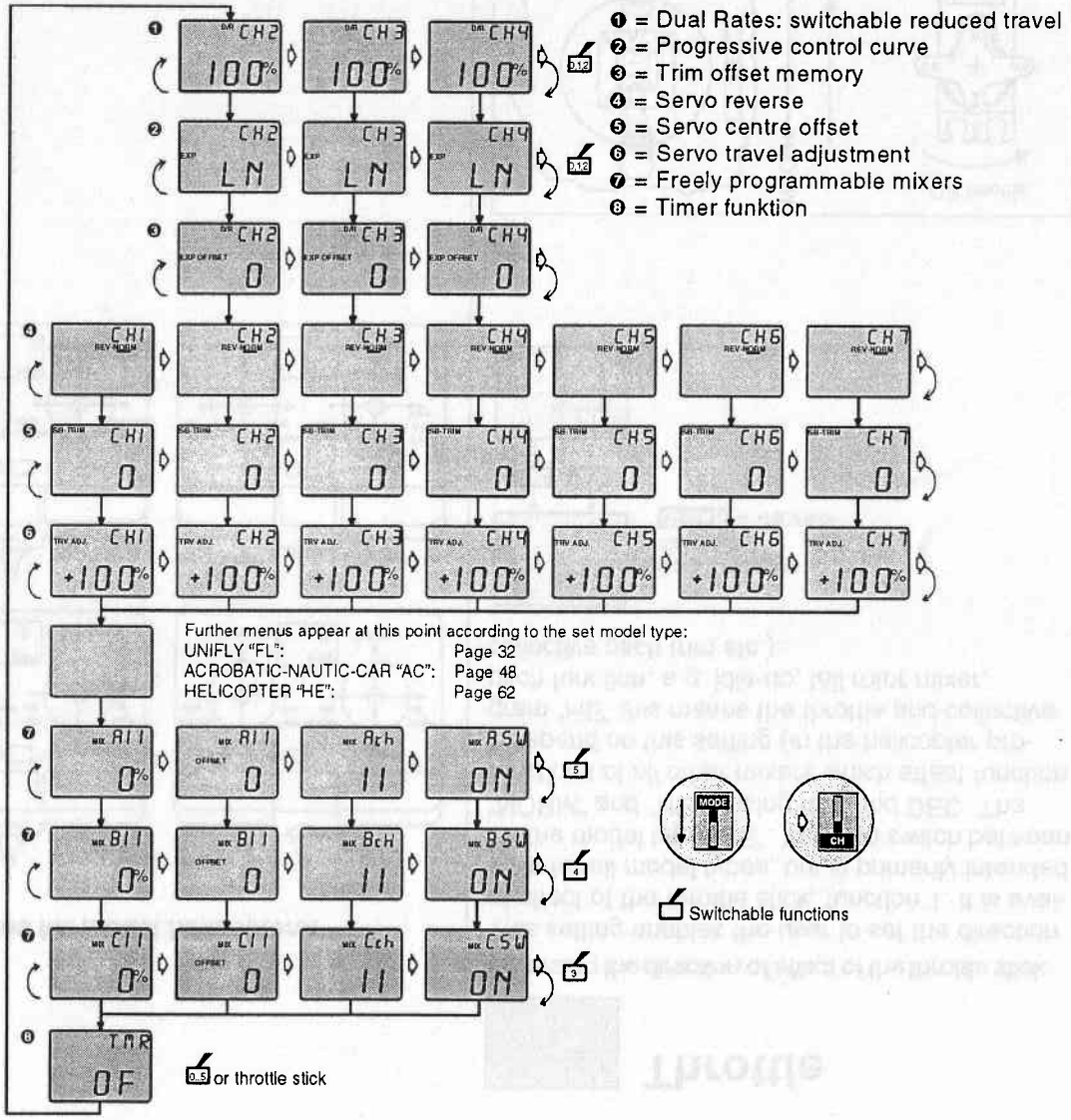


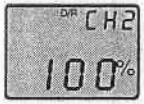
1. Switch the transmitter on, then press both rocker buttons down (= **ENTER**). You will hear a short audible signal to confirm your action. If the transmitter is in *System Rotation*, press **ENTER** to quit the program first.
2. The transmitter is now in *Setup Rotation*. The screen displays the menu function you last used when you accessed the program.
3. If you wish to change the settings for a different function, press the **MODE** button repeatedly, or hold it pressed in, until the desired function appears on the LCD screen.
4. Press the **CH** button to switch to the desired channel (1 to 7).
5. Adjust the values using the **INC** (**INC**rease value) or **DEC** (**DEC**rease value) buttons, or reset the value using **CLEAR** (= **CH** + **INC**).
6. From any point in the program you can quit the menu by pressing **ENTER** again. You then return to normal operating mode.

This first flow diagram - printed on this page - shows those parts of "*Setup Rotation*" which are common to all three model types. The codes which are specific to the three model types are described in the section starting on page 31.

Setup Rotation flow diagram

Program section which is common to all three model types





Dual Rates

Control travel selection

The Dual Rates function enables the pilot to select full or reduced control travel when the model is in flight by means of an external switch. The travels can be set to any value within the range 0 to 125% of normal travel, and you can set the values separately for both switch positions. D/R affects all the servos which are controlled by the sticks 2, 3 or 4. To use this facility you must first connect the appropriate external switches to the transmitter circuit board (see page 13). The external switch selects both Dual Rates and Exponential; see EXPO / DUAL RATE.

Socket sequence for the model types UNIFLY (FL) and ACROBATIC-NAUTIC-CAR (AC):

Control function	Function	External switch
2	Aileron	Socket 0
3	Elevator	Socket 1
4	Rudder	Socket 2

Socket sequence for the model type HELICOPTER (HE):

Control function	Function	External switch
2	Roll-axis	Socket 0
3	Pitch-axis	Socket 1
4	Tail rotor	Socket 2

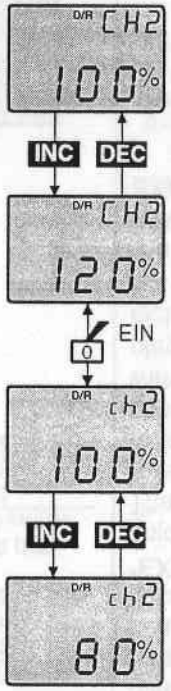
First select the code "D/R", then press **CH** to select the desired control function (CH2 to CH4). The control travel is adjusted using the **INC** and **DEC** buttons, after moving the switch to the appropriate position. The switch position is shown on the screen as follows:

Die Schalterposition wird im Display angezeigt:

CH: Setting I (switch OFF)

ch: Setting II (switch ON)

For safety reasons it is not possible to reduce the Dual Rates value right down to 0%, as this would mean that the associated transmitter control had no effect at all on the servo.



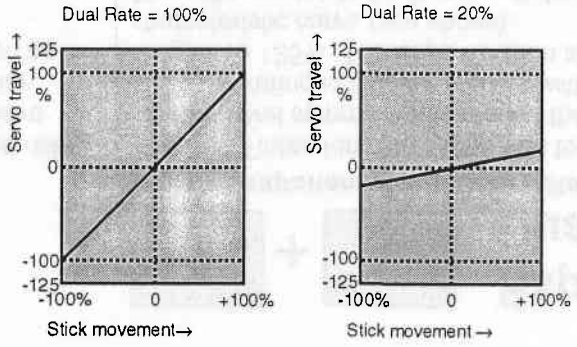
Select stick 2, 3 or 4 with **CH**

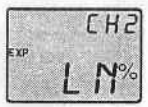
ON External switch "ON" (see table on the next page), screen display changes from CH (= OFF) to ch (= ON) and previously set value, and vice versa.

Set desired value with **INC** or **DEC**

Quick reset to 100% (if desired) with **CLEAR** = **CH** + **INC**

Examples:

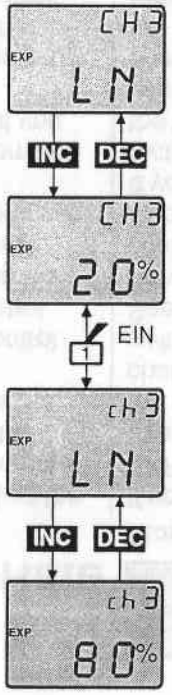




Exponential

Progressive control characteristic

This function provides fine control of the model around the centre position of the control function, but full travel at the end-point of the stick. The degree of "progression" can be adjusted from linear "LN" (corresponds to 0%) to 100%. If EXPO is set to "LN", it therefore has no effect. The D/R and Expo functions are operated using the same switch; see also EXPO / DUAL-RATE. As with Dual Rates, exponential affects all the servos which are operated using the corresponding transmitter stick.



Select stick 2, 3 or 4 with **CH**

External switch "ON" (see table) Screen display switches from CH (= OFF) to ch (= ON) and previously set value, and vice versa.

Set desired value with **INC** or **DEC**
Quickly reset to "LN" (linear) = 0% with **CLEAR** = **CH** + **INC**

The control characteristic value is adjusted using the **INC / DEC** rocker buttons, after you have moved the switch to the appropriate position. The switch position is shown on the screen as follows: CH: Setting I (switch OFF)
ch: Setting II (switch ON)

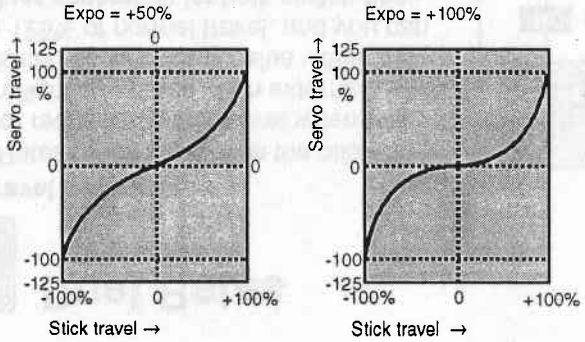
Socket sequence for the model types UNIFLY (FL) and ACROBATIC-NAUTIC-CAR (AC):

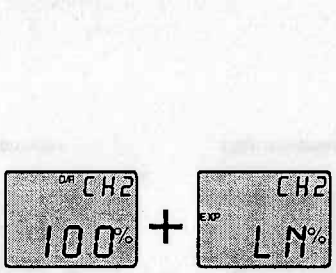
Control function	Function	External switch
2	Aileron	Socket 0
3	Elevator	Socket 1
4	Rudder	Socket 2

Socket sequence for the model type HELICOPTER (HE):

Control function	Function	External switch
2	Roll-axis	Socket 0
3	Pitch-axis	Socket 1
4	Tail rotor	Socket 2

Examples:



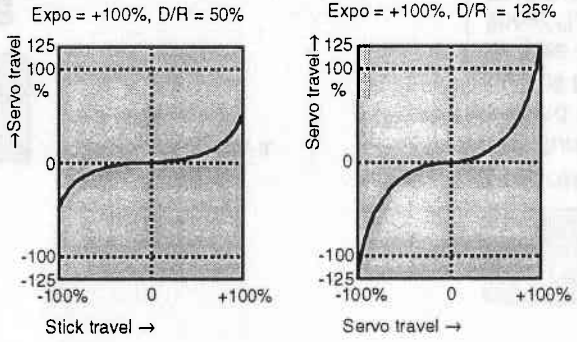


Expo / Dual-Rate

Coupled exponential and Dual Rates

The Dual Rates function allows you to adjust the control travel symmetrically around the neutral point, operating in a linear manner within the range 0 to 125%. The Expo function alters the characteristic curve (see above).
Since the associated external switches control both DUAL RATES and EXPO for the control functions 2, 3 and 4, it is possible to set up the control characteristics very accurately to suit your personal preference, i.e. both functions can be used together.
It can offer considerable advantages to combine "EXPO" and "DUAL RATES" - especially if you enjoy flying very high-speed models.
The mc-12 software allows you to program two independent values in the control travel characteristic memory, e.g. 20% travel for one switch position and 125% for the other switch position, with a characteristic curve of, say, linear (display: LN) and 80%. Note that the EXPO setting dictates the "degree of progression", and does not affect servo travel. **For reasons of safety the Dual Rate value should not be set below 20%.**

Examples:



Storing trimm offsets

Storing and recovering trim lever positions

If you set up the DUAL RATE and EXPONENTIAL functions, and if the associated trim lever is moved from its neutral position when the stick is at centre, the trim of the model could change when you operate the external D/R switch. The trim offset code avoids this problem. See the example on page 24. This function also provides a means of setting the correct trim lever positions again when you switch models, or even if you move the setting accidentally.
If you use the DIFFERENTIAL mixer, which affects aileron travel (see page 37), the effect of the trim lever on the "down" aileron side when you give an aileron command is reduced, corresponding to the mixer value you have set; if you set 100% differential ("split" setting), then the trim has no effect at all. In this case the trim offset code enables you to transfer the current trim settings to the servo.
The trim (offset) position of the sticks (shown on the screen by CH2, CH3 or CH4) can be stored independently for all the model memories 1 to 8.
You can ignore this function if all the trim levers for the functions 2 ... 4 are at or close to the centre position.

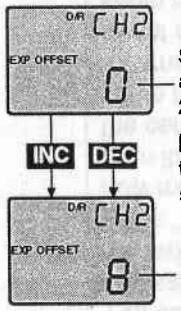
Procedure:
Erasing the offset memory:

1. Before setting up a new model, we recommend that you erase all the offset memories. To do this first set all the sticks and trim levers to the neutral position. Press the **CLEAR** button, and all memory contents are automatically erased. If you now press the **INC** or **DEC** button, you may find that individual memories contain values other than 0.

This is not significant, and does not require an adjustment of the trim pots in the transmitter case in order to reset the mechanical zero position accurately.

Storing the trim offset

2. Set the trim levers as required for the model in question. *This initial adjustment should be carried out with the standard default settings of D/R = 100%, EXPO = LN and DIFF = 0%.* Once you have established the optimum position for your model, just press **INC** or **DEC**, taking care to leave the sticks at their centre positions as you do so. If you need to adjust the trim levers subsequently, the new positions must be re-stored by repeating the procedure. You can discover the contents of the memory by pressing the **CH** button; the settings are then displayed on the screen.



Set to 0 with **CLEAR**, adjust trim levers 2, 3 and 4 as required.

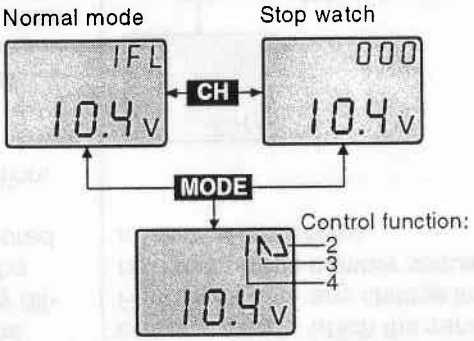
INC or **DEC** stores all three trim offset values (CH2, CH3, CH4) simultaneously.

Current trim offset values (CH2, CH3, CH4) are stored; press **CH** to display the values again.

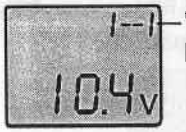
Recovering past trim lever positions

If you accidentally lose the trim settings, or change them after switching models, you can easily recover the stored positions.

The trim lever positions are represented by symbols on the screen, which are displayed when the transmitter is in *normal* or *stopwatch* mode. If *Setup Rotation* is still active, press **ENTER** to return to the normal display. Now press the **MODE** rocker button:



The symbols in the top line of the screen indicate the direction in which the trim levers must be moved, in order to recover the *stored* position. The sticks must be in the neutral position when you do this. The correct settings are shown on the screen as follows:



"Correct" trim lever positions

If you have not set the "TRIM OFFSET MEMORY", or if it has been erased, these symbols will appear around the mechanical centre position of the associated trim levers and sticks. With the sticks at neutral, move the trim levers in the direction of the arrows, until the set of symbols shown here is displayed.

Key to the symbols:

a) for control functions 2 (aileron / roll-axis) and 4 (rudder / tail rotor)

Symbol	Movement of trim lever
٢	left
I	correct position
٦	right

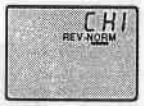
b) For control function 3 (elevator / pitch-axis)

Symbol	Movement of trim lever
٨	up
—	correct position
٧	down

Note:
*Pressing **MODE** to switch from the stopwatch display to the trim lever position display resets the stopwatch to the start value.*

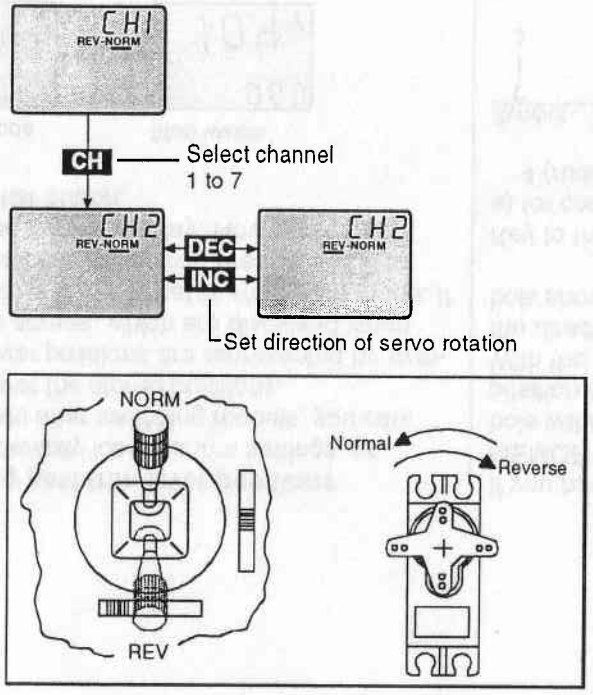
Example of the EXPO function in practice
You select one of the control functions 2, 3 or 4, and set the exponential value "LN" for the external switch position "OFF", and an exponential value "100%" for the switch position "ON". If you now move the corresponding trim lever away from its neutral position, the reference point at the centre position of the stick changes from one curve to the other, i.e. when you operate the external switch the servo takes up a slightly different neutral position. This movement in the servo position is suppressed if you have stored the altered trim position.
The same applies to the DUAL RATE function.

Note:
When you switch models, you will either have to adjust the trim lever positions again and store the appropriate offsets, or you can restore them to their old position, i.e. to the stored values, using the procedure described above.



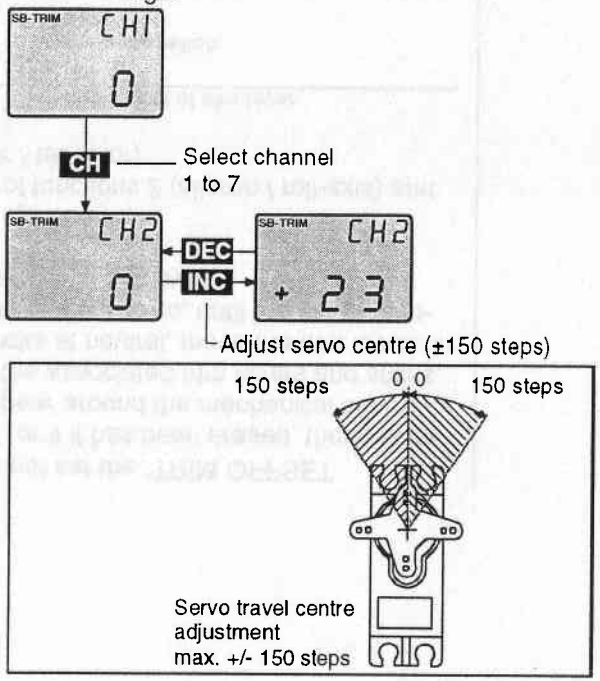
Servo reverse

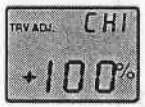
Reversing the direction of rotation of the servos
The set direction of servo rotation is shown on the screen by an underline cursor which is located under "REV" or "NORM". Use the **CH** button to select the desired channel, and reverse the direction of servo rotation with the **INC** or **DEC** button. **CLEAR** always resets the direction to "NORM".
The channel number refers directly to the receiver output to which the servo is connected. For this reason, any change in stick mode has no effect on the number sequence or direction of rotation of the servos.



Freely programmable mixers A-C

Creating your own mixer combi
Using the code "SB-TRIM" you can adjust the servo neutral position within the range +/- 150 steps (approx. +/- 80%), independently of the trim levers and any mixer settings. However, this facility must not be used as an excuse for sloppy mechanical arrangements. Always adjust the mechanical linkage as accurately as you can, otherwise you may find that servo travel might be severely restricted in one direction. Select the appropriate channel with **CH**, and adjust the centre position to meet your requirements using **INC** or **DEC**. **CLEAR** resets the position to "0". This setting applies directly to the associated servo, and is independent of all other trim and mixer settings.



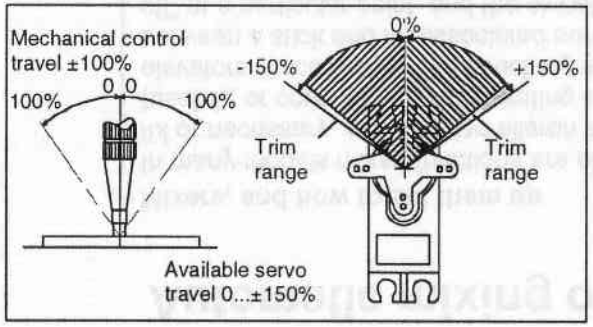


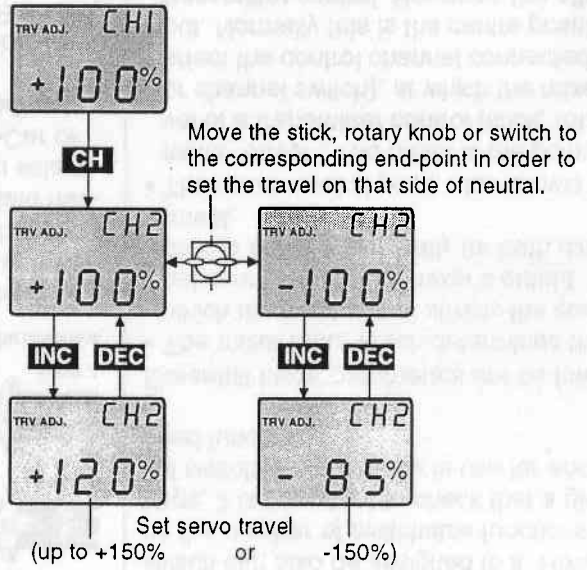
Servo travel adjustment

Adjusting servo travel

The term "TRV ADJ." stands for "Travel Adjust", and this function enables you to set the servo travel separately for each side of neutral within the range 0 to 150% of standard servo travel. The purpose of this facility is to prevent damage and other problems caused by servos striking mechanical stops or obstructions in the model. The adjustment refers directly to the servo concerned, regardless of how the servo signal is generated, i.e. whether it is controlled directly by a stick, or by any mixer functions you might have set.

Select the channel number (1 ... 7) with **CH**. The bottom line of the screen shows the set servo travel, and the prefix (+ or -) indicates the side of neutral. To display and adjust the travel, move the corresponding transmitter control (stick, rotary module or switched channel) to the appropriate end-point. You can now adjust the servo travel using **INC** and **DEC**, or reset it to 100% by pressing **CLEAR**.



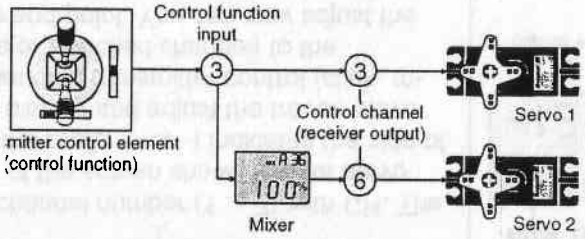


Automatic mixing of multiple functions

Mixers, and how to set them up

In many models mixed functions are either useful or necessary, e.g. coupled aileron and rudder (useful), or coupled servos operating separate elevators (necessary). The direct signal path between a stick and its associated servo is "bled off" at a particular point, and the signal can then be used in a defined way to affect other receiver outputs.

Example: controlling two elevator servos from the elevator stick:



Note: 0% ... +125% =same direction, -125% ... 0% = opposite directions

The mc-12 transmitter's software contains a large number of pre-programmed coupling functions as standard, designed to mix together two (or more) control channels. The appropriate mixers are automatically activated when you select the model type (Unifly, Acrobatic-Nautic-Car or Helicopter) in the *System Rotation* procedure; see page 31 for further details.

The mc-12's software also makes available three freely programmable mixers, termed A, B and C, for all three model types. You can assign any *control function* (stick, rotary module, channel switch) as an input to the three freely program mable mixers. The mixer output affects a (freely selectable) *control channel* which routes the signal to the servo; the channel can only be affected by the servo reverse, servo centre offset and servo travel functions. One *control function* (transmitter control) can be used simultaneously for several mixer inputs. By the same token, several mixer outputs can be set to affect one and the same *control channel*.

In software terms the freely programmable mixer is always switched on, although an ON/OFF switch can also be assigned to it. However, since the number of switchable functions is very large, it is important to check that a given physical switch is not already in use for another switched function.

Essential mixer parameters are as follows:

- The *mixer ratio*, which determines the extent to which the input signal affects the control channel connected to the mixer's output. The mixer ratio is set symmetrically for both directions of travel.
- The mixer neutral point, also known as the mixer "offset". The offset is the point on the travel of a transmitter control (stick, rotary module or channel switch), at which the mixer begins to affect the control channel connected to its output. Normally this is the centre position of the transmitter control. However, the offset can be set to any point on its travel.

Freely programmable mixers A-C

Creating your own mixer combinations

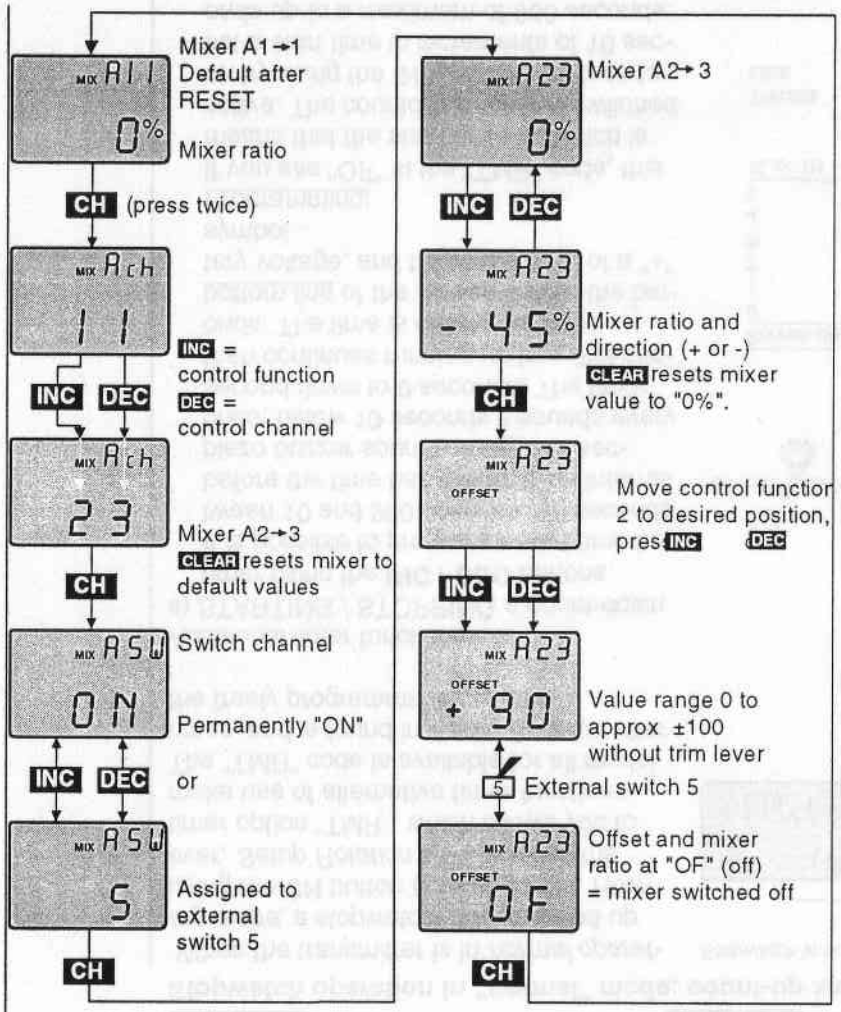
The basic programming of a free mixer, using mixer "A" as an example:

Press the rocker button **CH** repeatedly until the display "Ach" appears. Press **INC** to determine the number of the control function (= transmitter control 1...7), and press **DEC** to set the number of the control channel (= output 1...7). The selected channels are displayed in the bottom line. (pressing **CLEAR** at this point resets the mixer to the default settings).

Press **CH**: the display changes to: "ASW" (SW = Switch). At this point you determine whether the mixer is to be switched on permanently (screen shows "ON"), or, alternatively, whether an external switch is to be assigned to it, so that you can switch it on or off at will. To do this press **INC** or **DEC** at this point in the program. The bottom line of the screen shows the number of the socket on the transmitter circuit board to which an external switch should be connected; see page 13.

Mixer	External switch	also affects	
A	socket 5	"LDE/F/S"	Page 52
B	socket 4	"E-F", GL1/0"	Page 52, 70
C	Socket 3	"FE1/0", "FA1/0"	Page 36, 38
		"SRA/E/R", "ATR"	Page 54, 71

Select one of these two settings, i.e. "ON" or "5", and press **CH**. You can now set a mixer value in the range 0 and +/- 125% using **INC** or **DEC**; this value acts symmetrically around the neutral point (**CLEAR** resets this parameter to "0%"). If you have assigned an external switch to the mixer, you can now use it to switch the mixer off; the screen now shows "OF" (off).



Pressing **CH** again takes you to the OFFSET point; move the transmitter control to the desired position and hold **INC** or **DEC** pressed in until the position is accepted. The offset is displayed on the screen (value range approx. -100 to +100 without trim lever). Once again, **CLEAR** resets the value to "0". If you have assigned an external switch, and the switch is at the OFF position, the screen also shows "OF". Note: if you store the offset and then change the *control function*, you will need to store the offset again.

This completes the programming of mixer A. The procedure for mixers B and C is essentially identical.

Notes:

Please note: if you set up a freely programmable mixer whose output affects one of the ready-made programs (as provided for the different model types), the servos concerned will react in different ways according to the selected model type:

Unifly model type

In the program for the model type "FL", receiver outputs 2 and 5 are already linked in software for the aileron control function.

If (for example) one control function affects output 2, the two servos will move in the same direction, but if the same control function affects output 5, the servos will move in opposite directions.

Helicopter model type

In the helicopter program control function 6 cannot be used as the input signal for a mixer. Control 6 (rotary module connected to CH 6) affects only the collective pitch servos (see page 63), and provides a means of fine adjustment to collective pitch with the model in flight. The helicopter software places a limit on the travel of this function of 25% of standard travel.

Acrobatic-Nautic-Car model type

In the "AC" program, when the "LDS" function is activated in the "Auto-landing" menu, a transmitter control connected to CH7 on the transmitter circuit board cannot be used. In other respects the considerations described for the model type "FL" apply in principle, as they also do for the "HE" model type.

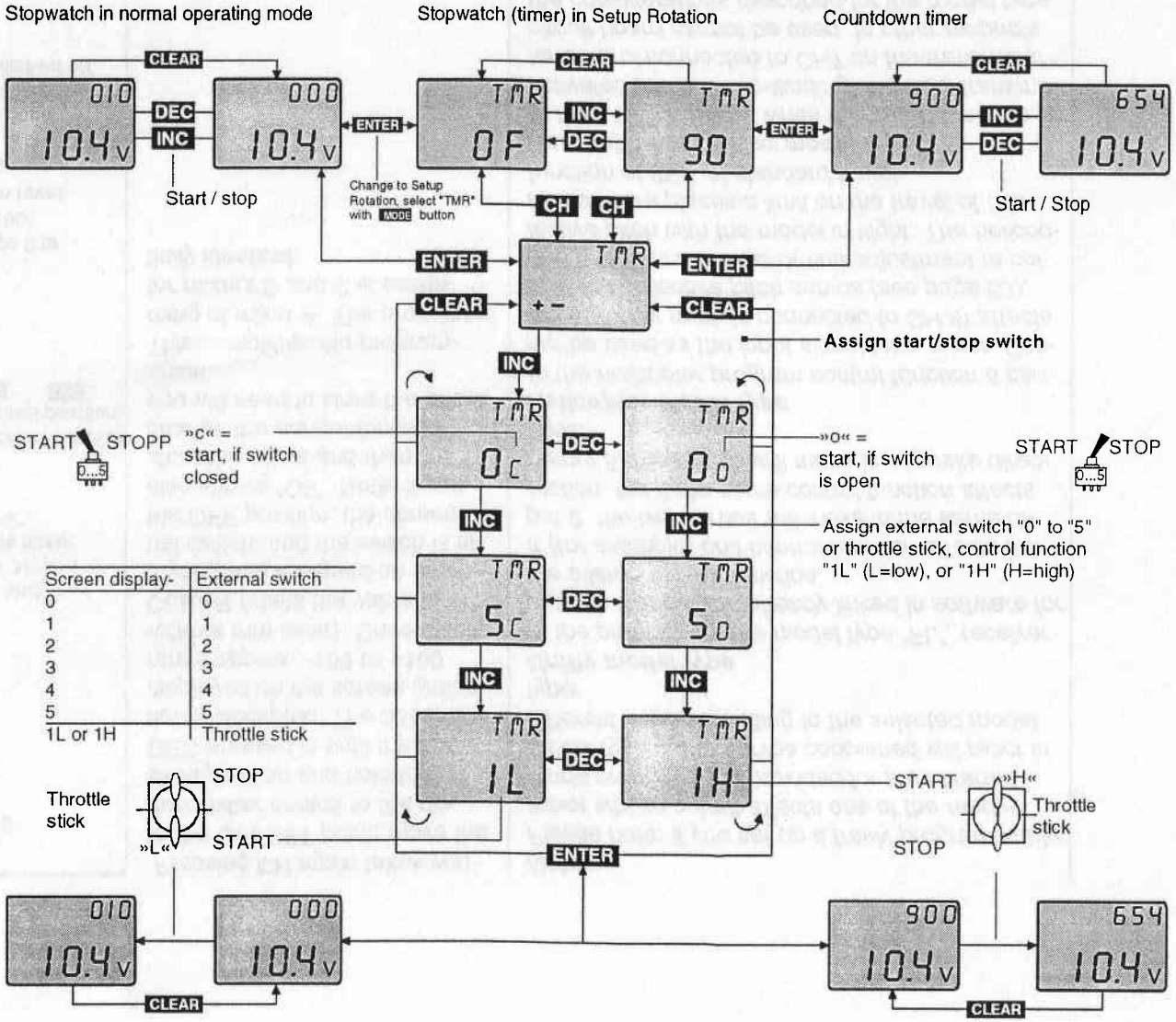
Stopwatch and Countdown timer

Stopwatch operation in "normal" mode; count-up and count-down timers in Setup Rotation

When the transmitter is in *normal operating mode*, a stopwatch can be called up using the **CH** button (see page 16). However, *Setup Rotation* also includes the timer option "TMR", which allows you to make use of alternative timer functions. The "TMR" code is available for all model types, and is found in *Setup Rotation* after the freely programmable mixers.

Additional timer functions:

a) STARTING / STOPPING a count-down timer using the **INC / DEC** buttons.
It is possible to program a start time between 10 and 900 seconds. 20 seconds before the time has elapsed, an internal piezo buzzer sounds every two seconds; below 10 seconds it sounds every second down to 0 seconds. The timer then continues running up to + 999 seconds. The time is displayed in the bottom line of the screen before the battery voltage, and takes the form of a "+" symbol.
Programming:
If you see "OF" in the "TMR" code, this means that the standard stopwatch is active. The countdown timer is switched on by using the **INC** or **DEC** buttons to set a start time in increments of 10 seconds up to a maximum of 900 seconds. Note that the bottom line of the screen only shows the number of increments, i.e. a display of, for example, "36" means a start time of 360 seconds (**CLEAR** switches the countdown timer



off: screen shows "OF"). Leave *Setup Rotation*, then press **ENTER**; you can now use **INC** / **DEC** to start and stop the timer. Press **CLEAR** to reset the display to the programmed start time.
Note: if you make a change in the trim lever position display, it also resets the timer to the start value.

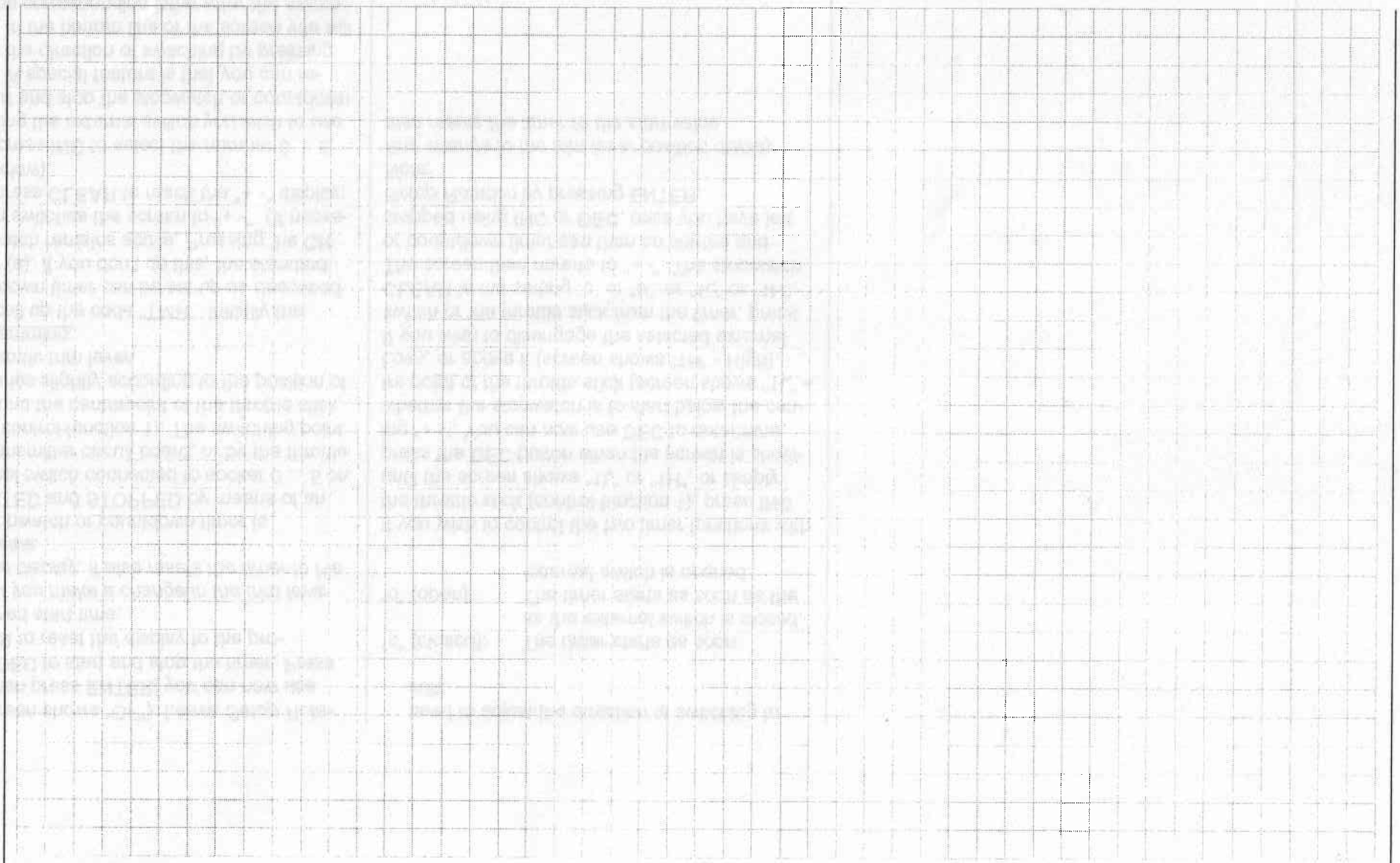
b) The stopwatch or countdown timer is STARTED and STOPPED by means of an external switch connected to socket 0 ... 5 on the transmitter circuit board, or by the throttle stick (control function 1). The switching point is around the centrepoint of the throttle stick, but varies slightly according to the position of the throttle trim lever.
Programming:
First call up the code "TMR". Initially the countdown timer can be set up as described under (a). If you don't do this, the standard stopwatch remains active. Pressing the **CH** button switches the screen to "+ -". (If necessary press **CLEAR** to reach the "+ -" display; see below).
Now press **INC** to select the number 0 ... 5, denoting the external switch you wish to use to start and stop the stopwatch or countdown timer. A special feature is that you can reverse the direction of switching by pressing **DEC**. In the bottom line of the screen you will see the corresponding letter after the switch number.

If the switch you have selected also controls one of the many mixer and coupling functions (see table on page 13), this facility can be used to adjust the direction of switching to suit:

"c" (closed): The timer starts as soon as the external switch is closed.
"o" (open): The timer starts as soon as the external switch is opened.

If you wish to control the two timer functions with the throttle stick (control function 1), press **INC** until the screen shows "1L" or "1H", or simply press the **DEC** button when the screen is showing "+ -". You can now use **DEC** to determine whether the stopwatch is to start below the centre point of the throttle stick (screen shows "1L" = Low), or above it (screen shows "1H" - High).
If you wish to disengage the selected external switch or the throttle stick from the timer, press **CLEAR** in the setting "c" or "o", or "1L" or "1H". The screen then reverts to "+ -". The stopwatch or countdown timer can then be started and stopped using **INC** or **DEC**, once you have left *Setup Rotation* by pressing **ENTER**.
Note:
Any change to the trim lever position display also resets the timer to the start value.

For your notes



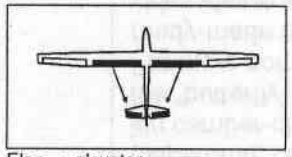
Summary of the ready-made multi-function programs contained in the model type classes: UNIFLY, ACROBATIC-NAUTIC-CAR and HELICOPTER

TYP FL

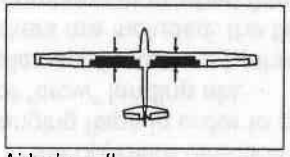
FL = UNIFLY

See page 32 for description

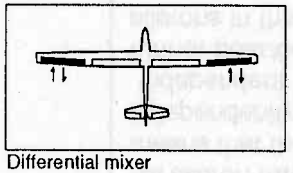
Mixer	Code	Switch to socket
Flap > elevator	FE1/0	3
Differential mixer	DIF	-
Flap > aileron	FA1/0	3
Spoiler > flap	S-F	-
V-tail (rudder/elevator)	VTL	-
3 prog. mixers	A/B/C	A=5, B=4, C=3



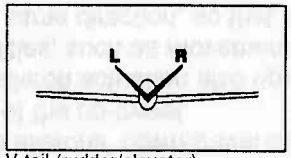
Flap → elevator



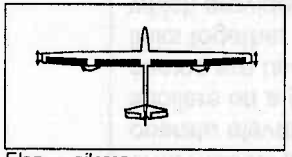
Airbrake → flap



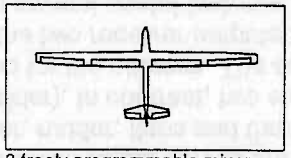
Differential mixer



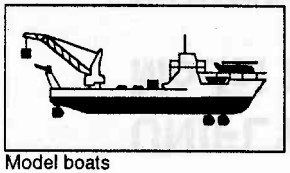
V-tail (rudder/elevator)



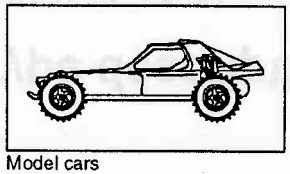
Flap → aileron



3 freely programmable mixers



Model boats



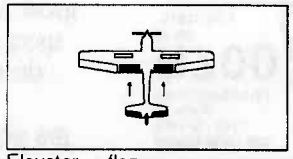
Model cars

TYP AC

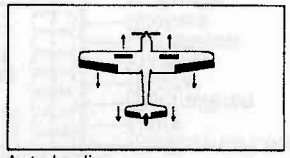
AC = ACROBATIC-NAUTIC-CAR

See page 48 for description

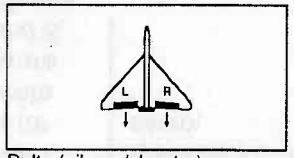
Mixer	Code	Switch to socket
Elevator > flap	E-F	4
Landing, elevator	LDE	5, (control function 1)
Landing, flap	LDF	5, (control function 1)
Landing, spoiler	LDS	5, (control function 1)
Automatic landing	LDA	Set switch point Control function 1
Snap roll, aileron	SRA	3
Snap roll, elevator	SRE	3
Snap roll, rudder	SRR	3
Delta mixer	DLT	-
Flaperon	FPR	-



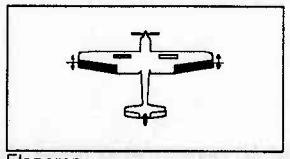
Elevator → flap



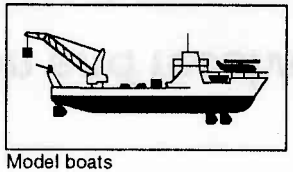
Auto-landing



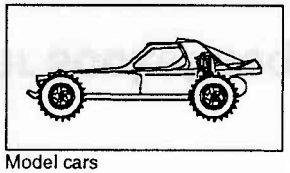
Delta (aileron/elevator)



Flaperon (aileron as flaps)



Model boats



Model cars

TYP HE

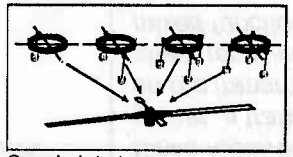
HE = HELICOPTER

See page 62 for description

Mixer	Code	Switch to socket
Idle-up	GL1/0	4
Collective pitch curve	PL1/0	4
Static mixer	STA	-
Dynamic mixer	DYN	-
3 programmable mixers	A/B/C	A=5, B=4, C=3

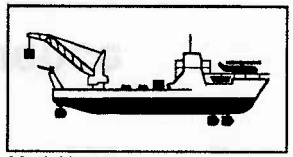
Static mixer

Dynamic mixer

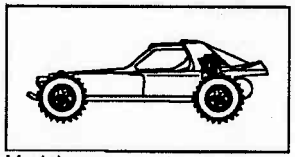


Swashplate type

3 freely programmable mixers



Model boats



Model cars

UNIFLY
Model type description and receiver socket sequence

This model type caters for all gliders and powered models in which single servos are used to operate elevator, rudder, flaps and throttle (or spoilers on a glider). In contrast, two separate servos are used for the ailerons. The software links together the two receiver outputs 2 and 5, which provides several useful features: differential aileron travel is simple to set up, which means that the ailerons' down-travel can be set independently of the up-travel.

Independent aileron actuation also opens up further possibilities, such as movement of both ailerons in the same direction, so that they work as camber-changing flaps or landing flaps (flaperons), or in the opposite direction to existing camber-changing flaps in order to provide the "butterfly" or "crow" landing aid.

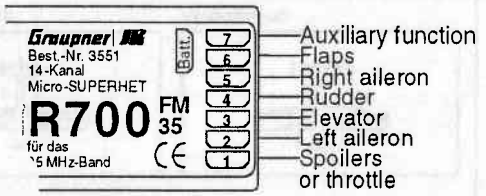
For more complex applications a further two ready-made mixers are included: the first provides elevator compensation when flaps are raised or lowered, and the second is a spoiler / flap mixer. These mixers and combinations of them do not have to be used, but if you need them they can easily be selected to meet the requirements of the model. They can also be modified or expanded further by combining them with the three freely programmable mixers.

Even if all the options mentioned above are used, receiver output 7 is still available for auxiliary functions such as retractable undercarriage, tow-release etc.

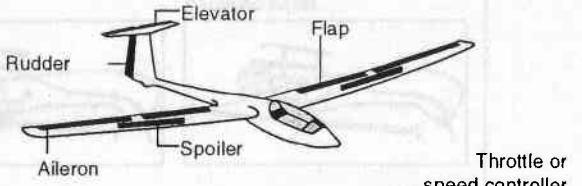
A special V-tail mixer is available, and can simply be switched on if the model features a V-tail instead of a conventional tail configuration. This mixer superimposes the functions of elevator and rudder in such a way that both tail surfaces operate as elevators and rudders; the only requirement is that each is actuated by its own servo.

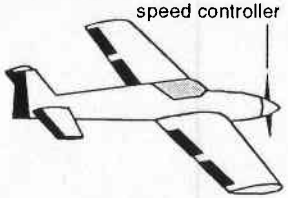
Note:
Since receiver outputs 2 + 5 are coupled together, a transmitter control connected to CH5 on the transmitter circuit board does not directly affect receiver output 5; it is only available for mixed functions.

Standard model with two aileron servos

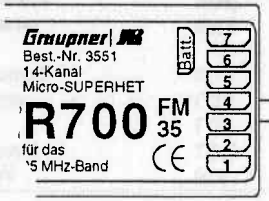


Auxiliary function
Flaps
Right aileron
Rudder
Elevator
Left aileron
Spoilers
or throttle

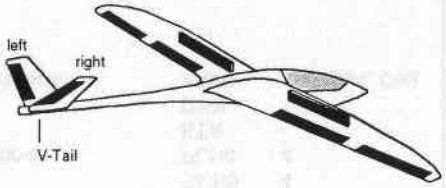




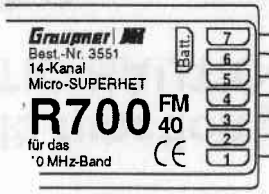
V-tail



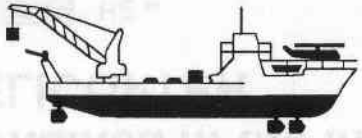
Rudder/elevator servo,right
Rudder/elevator servo, left



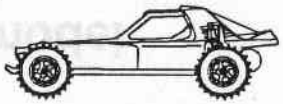
Nautic und Car



Auxiliary function
Auxiliary function
Auxiliary function
Rudder/steering
Auxiliary function
Auxiliary function
Throttle or
speed controller

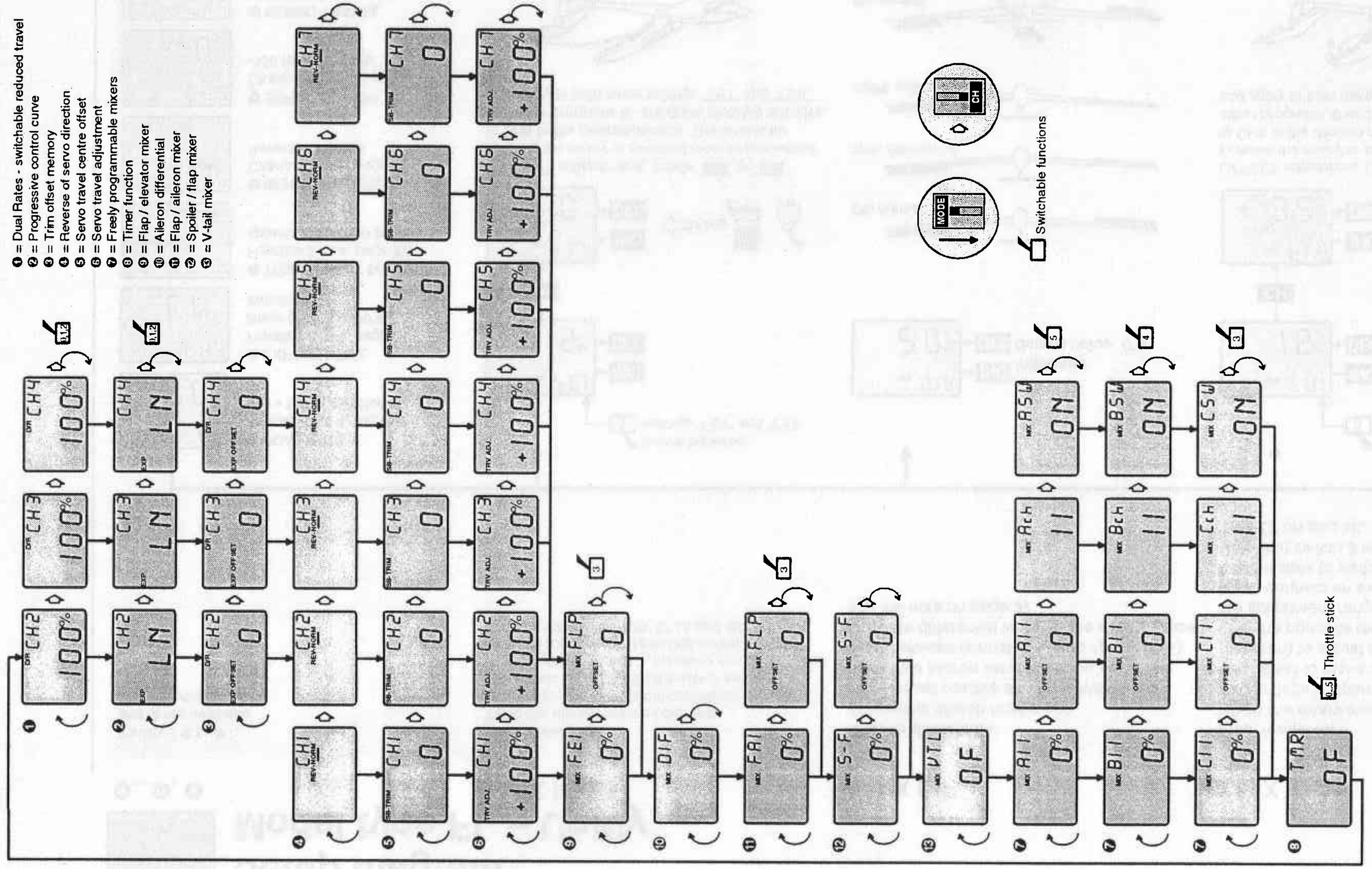


Note that in the standard set-up outpus 2 + 5 are coupled togehter.



Setup Rotation - UNIFLY

❶ = Dual Rates - switchable reduced travel
❷ = Progressive control curve
❸ = Trim offset memory
❹ = Reverse of servo direction
❺ = Servo travel centre offset
❻ = Servo travel adjustment
❼ = Freely programmable mixers
❽ = Timer function
❾ = Flap / elevator mixer
❿ = Aileron differential
⓫ = Flap / aileron mixer
⓬ = Spoiler / flap mixer
⓭ = V-tail mixer



Setup diagram
Model type FL = Unifly

❶...❻, ❽

Facilities ❶ to ❻ and ❽ are available for all model types

❾ MIX FE0/1

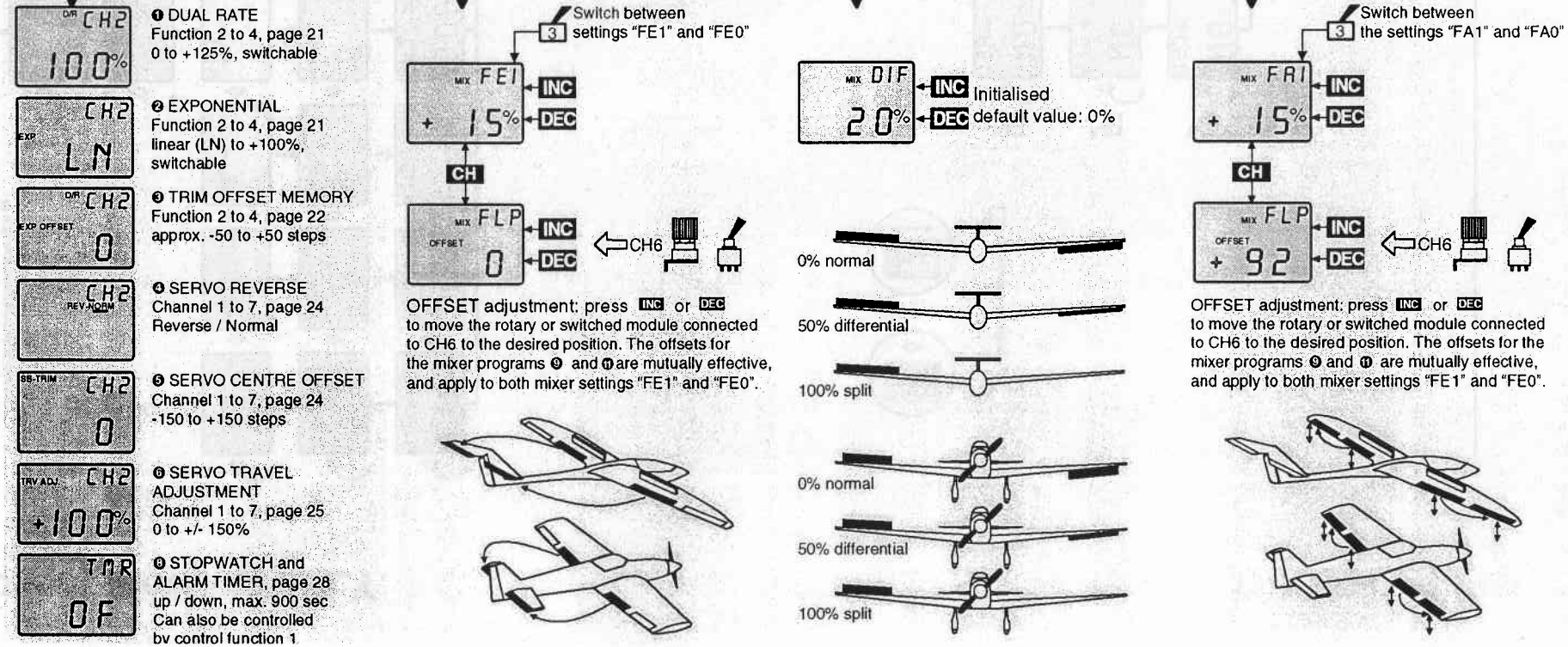
Flap → elevator
When the flap servos are operated, the elevator moves to a programmable degree (mixer ratio +/-125%). If an external switch is connected to socket 3, the mixer can be switched between two settings. Note that switch 3 also turns the mixer "MIX C" on and off.

❿ MIX DIF

Aileron differential
Differential aileron movement, i.e. unequal positive and negative travels of the two aileron servos; can be set to any point between normal (0%) and split (100%). If aileron differential works in the wrong sense, see the note on page 37.

⓫ MIX FA0/1

Flap → aileron
When the rotary module (CH6) for the flaps is operated, both aileron servos can be set to move in the same direction (flaperon) to adjust the overall wing camber, or in the opposite direction (butterfly / crow); the adjustment range is 0 ... 125%.
If you connect an external switch to socket 3, it is possible to switch between two settings. Note that switch 3 also turns the mixer "MIX C" on and off.



⑫ MIX S-F

Spoiler → flap
When you operate control function 1 you can arrange for the flap servos to be lowered automatically for the landing approach; adjustment range 0 ... +/- 125%. Elevator trim is possible in combination with mixers ❾ and ⓫, and the ailerons can be moved in the same or opposite directions, according to the set direction of mixing.

⑬ MIX VTL

V-tail mixer
Couples the two servos connected to receiver outputs 3 + 4 to provide superimposed elevator and rudder control. The mixing ratio of the two servos can be varied using DUAL RATE for control functions 3 and 4.
If the elevator servos work in the wrong "sense", see the note on page 40.

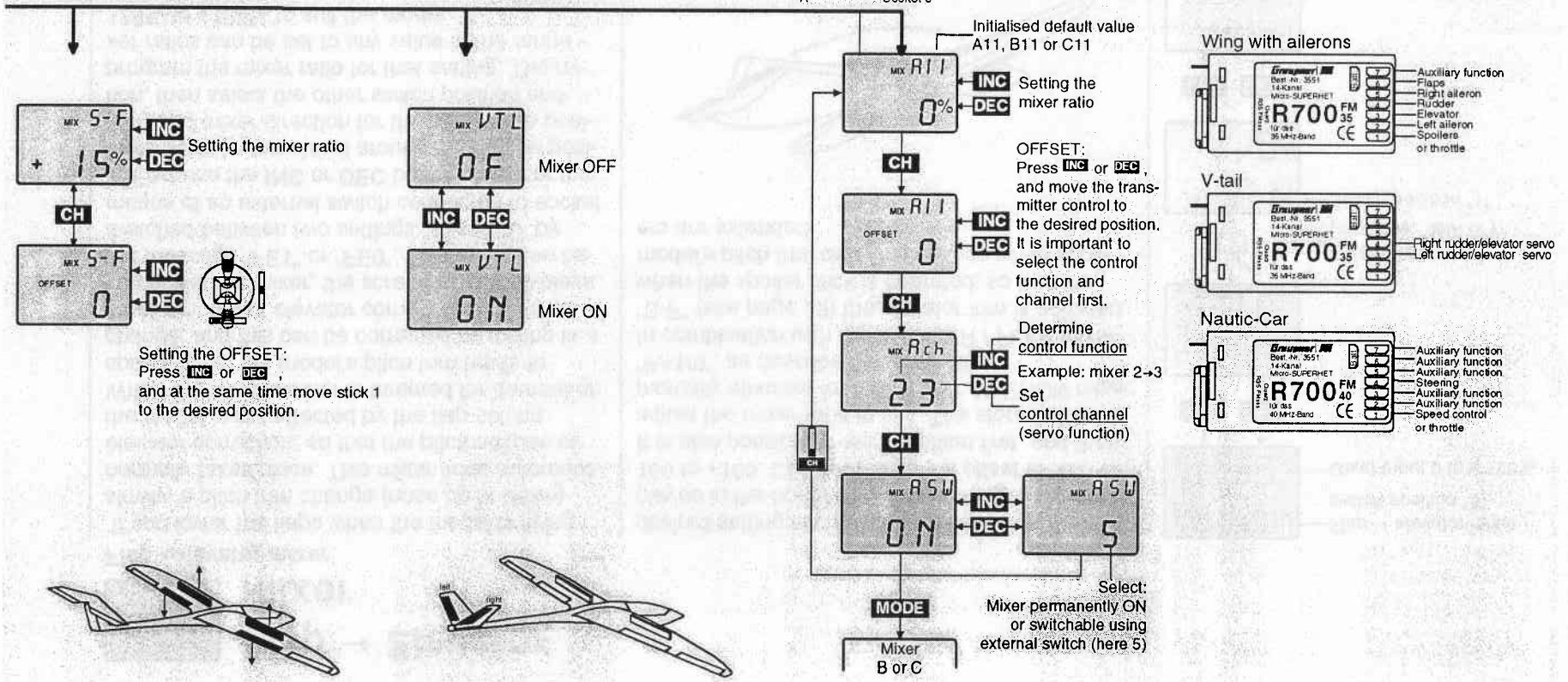
❼ MIX A, B, C

Freely programmable mixers
These mixers allow you to select the mixer program (servo functions 1 ... 7) and the mixer ratios (0 to +/- 125%) to suit your individual requirements. The mixers can be left permanently "ON", or switched on and off by means of external switches.

Notes:
If you are using the "FL" model type, control function 2 is always linked in the software to channel 5, regardless of any other mixers you set up. If your arrangement involves a freely programmable mixer, please note that the mixer ratios are superimposed; see page 27.

Mixer	External switch	Note possible dual use
C	Socket 3	Mixer "FE1/0" and "FA1/0"
B	Socket 4	
A	Socket 5	

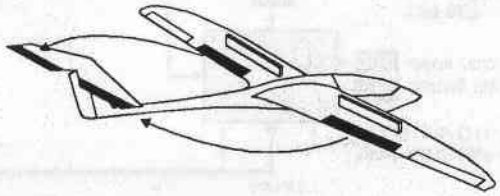
Receiver channel sequence, UNIFLY type
For normal models with two aileron servos, outputs 2 + 5 are linked. If you switch on the V-tail mixer, the two receiver outputs 3 + 4 are also coupled to provide superimposed elevator and rudder control.

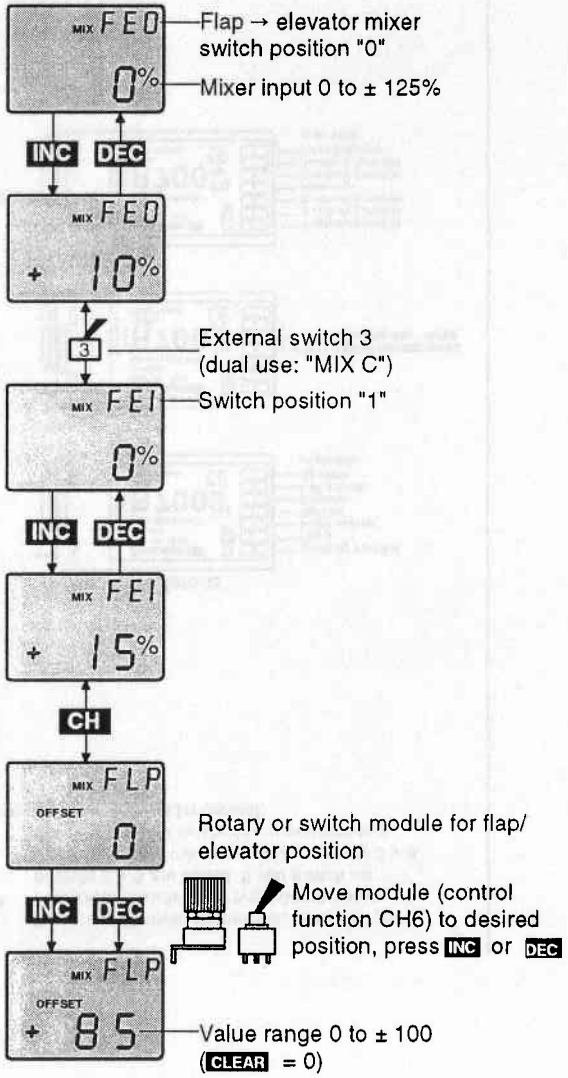


Flap → Elevator mixer

Flap - elevator mixer

If you lower the flaps when the model is flying slowly, a pitch trim change (nose up or down) normally takes place. This mixer adds automatic elevator correction, so that the pitch attitude of the model is not affected by the flap setting.
When the wing camber is trimmed for thermal or speed flying, the model's pitch trim tends to change, and this can be corrected by mixing in a small amount of elevator compensation. When you select the mixer, the screen initially displays the message "FE1" or "FE0". This mixer can be switched between two settings "1" and "0" by means of an external switch connected to socket 3. First use the **INC** or **DEC** buttons to enter the mixer ratio (symmetrical around the neutral position) and mixer direction for the one switch position, then select the other switch position and program the mixer ratio for that setting. The mixer ratios can be set to any value in the range -125% to +125% to suit the model.
You can also enter an offset for the mixer. This is a variation from the centre position of the transmitter control; see the explanation on page 26. To set an offset, press the **CH** button. The screen changes to "FLP" (flap position). You now have to assign the mixer to the position of the transmitter control (rotary module or switch connected to CH6 on the transmitter circuit board) for the camber-changing flaps which corresponds to normal flight (i.e. neutral flap position). The offset you enter will be the same for both switch positions.
Turn the rotary module to the desired position and press the **INC** or **DEC** button; alternatively hold one of the two buttons pressed in while you change the position of the rotary module until the desired setting is obtained. The offset is displayed in the bottom line. Value range: approx. -100 to +100. **CLEAR** resets the offset to "0".
It is also possible to set the offset first, and then adjust the mixer ratio to suit. The stored offset is mutually effective for the FLAP / AILERON mixer "FA1/0", as described on page 38.
In combination with the SPOILER / FLAP mixer "S-F" (see page 39) the elevator trim is adjusted when the spoiler stick is operated, so that the model's pitch trim does not change when spoilers are extended.





Aileron differential

Differential mixer for aileron servos

Aileron differential is designed to correct an undesirable side-effect of the use of ailerons, generally known as "adverse yaw": the drag of the down-going aileron is greater than the drag of the up-going aileron, and the result is a yawing motion around the vertical axis which occurs in the opposite direction to the desired turn. This effect is more marked with model gliders with high aspect ratio wings, and is less problematic with conventional powered aircraft with short moment arms. The effect usually has to be corrected by applying rudder at the same time in the opposite direction to the yaw. However, this causes additional drag, and therefore affects the model's flight performance.

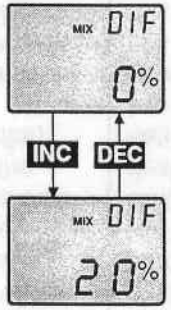
Differential aileron travel can be used to ease the problem, provided that each aileron is operated by its own servo. The effect is to reduce the angular travel of the down-going aileron compared with the movement of the up-going aileron, and this can reduce the adverse yaw tendency substantially.

Differential can also be incorporated by mechanical methods, but these usually have to be set once and for all when the model is built. It is also true that a large degree of differential in a mechanical system tends to involve serious play in the control system. In any case, electronic differential offers significant advantages:

Each aileron is controlled by its own servo, and this means that the aileron servos can be installed in the wings, which is a great advantage with plug-in wing panels, ensuring a reliable and virtually slop-free aileron control system. The degree of differential can be set to any value you like; the up-going travel is simply left unchanged, while you set the down-going travel exactly as you wish. In its most extreme form, differential travel can be set up in such a way that the down-going aileron does not move at all, and this is sometimes termed a "split" setup. This arrangement not only suppresses adverse yaw very effectively, but in some cases produces slight positive yaw, i.e. the model tends to yaw in the same direction as the turn. This method allows model gliders to be turned neatly and smoothly using ailerons alone; without aileron differential this is not at all easy, and sometimes completely impossible.

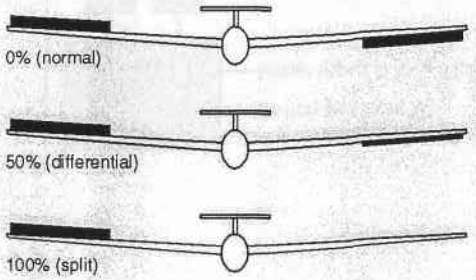
The adjustment range is between 0% (no differential) and 100% (split mode).

For aerobatics it is essential to use low absolute differential values, otherwise the model will not roll truly axially, i.e. around the fuselage centreline. For smooth turns when thermalling gliders, average values around -50% or +50% are typical. The split setting, +100%, is popular with slope-soaring glider fans, as many pilots prefer to fly these models using ailerons alone.



Notes:

- *•Don't use differential if your model only features one aileron servo. The result would be a marked reduction in servo travel in one direction; if you select the SPLIT setting, the ailerons will not move at all in one direction.*
- *If you have to move the aileron trim lever from the central position, we recommend the use of the code "TRIM OFFSET MEMORY" (page 22). However, it is important to reset the differential to 0% before you make this adjustment.*
- *If the aileron differential works the wrong way round (more "down" than "up"), swap over servos 2 and 5 at the receiver sockets.*
- *In the UNIFLY model type the two control functions 2 and 5 (ailerons) are linked together in the software, with the consequence that a transmitter control (rotary module) connected to control function 5 has no direct effect on receiver output 5. However, control function 5 can still be used as an input signal for freely selectable mixers. Please read the notes on this subject in the section entitled "Freely programmable mixers".*



Flap → aileron-mixer

Flap-aileron mixer

This mixer superimposes a variable proportion of the flap control signal (flap, control function 6) on the aileron channels 2 and 5 (aileron), with the effect that the ailerons also move when a flap command is given. They usually move through a smaller angle than the flaps, and can be set to deflect in the same direction as the flaps, or alternatively in the opposite direction (butterfly / crow function).

If the ailerons and flaps move in the same direction, the result is more even lift distribution over the wingspan. You may need to reduce aileron differential (see page 37), as the extreme up-travel of the ailerons in butterfly mode tends to make them less effective for turning, and at the same time the aileron down-travel is reduced or even suppressed altogether by the differential movement. It is not possible to increase the up-travel further to compensate for this, as the ailerons are already in an extreme position.

Über einen an Steckplatz 3 angeschlossenen Externschalter kann zwischen zwei Einstellungen »FA1« und »FA0« umgeschaltet werden, z. B.:

If an external switch is connected to socket 3, you can switch between two settings "FA1" and "FA0", e.g.:

"FA0": ailerons move in the same direction as the flaps;

"FA1": ailerons move in the opposite direction to the flaps

or

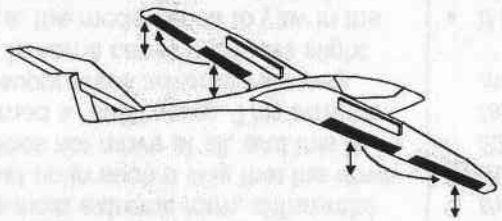
"FA0": mixer switched off (mixer value: 0%);

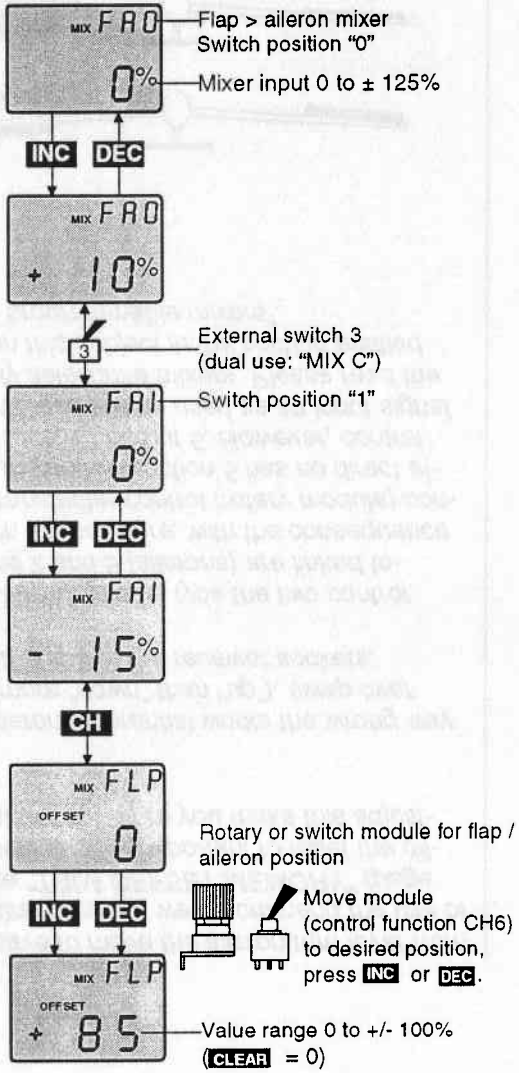
"FA1": ailerons move in the same or opposite direction to the flaps, depending on the set direction of mixing.

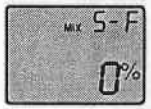
When you have set the mixer values for "FA1" and "FA0", the mixer must be informed of the position of the rotary or switch module (control function CH6) for the flaps in normal flight (neutral position). This "offset" is the same for both switch positions. Turn the rotary knob to the desired position, then press **INC** or **DEC**; alternatively adjust the pot while holding one of the two buttons pressed in until the desired setting is obtained. The offset is displayed in the bottom line of the screen. **CLEAR** resets the offset to 0. It is also possible to set the offset first, and then adjust the mixer input.

The stored offset is mutually effective for the FLAP / ELEVATOR mixer, as described on page 36.

If the mixer is used in combination with the SPOILER / FLAP mixer (see page 39), the flaps move down and both ailerons also move either up or down (depending on the direction of the mixer input) when the spoilers are extended.





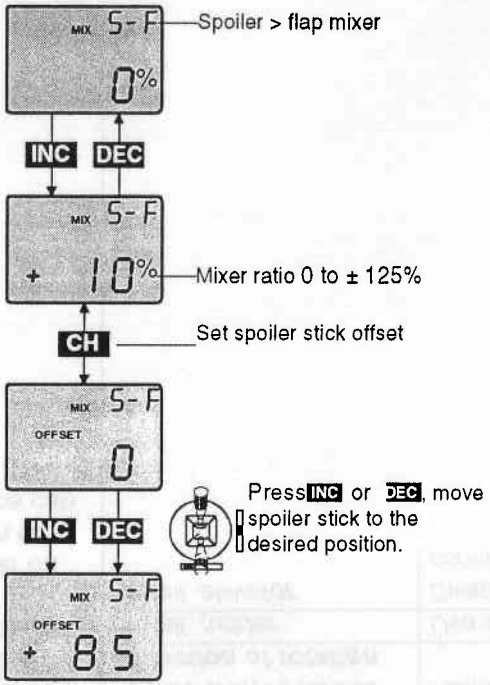


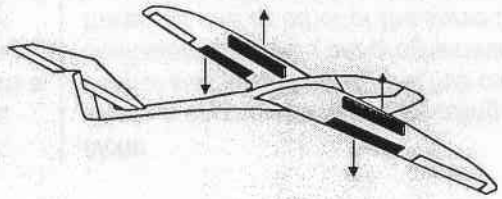
Spoiler → flap mixer

Spoiler > flap mixer

When the spoiler stick (control function 1) is operated, the flaps can be set to deflect to any point within the range 0% to +/- 125% to slow the model on the landing approach.
The setting is adjusted using the **INC** or **DEC** buttons; **CLEAR** resets it to the default value of 0.
You can also set an offset (deviation of the spoiler stick from the centre position) by pressing the **CH** button. The spoilers are normally retracted at the top or bottom end-point of the stick travel (this varies according to the set direction of operation of the throttle stick, which is decided in System Rotation), and this means that the offset should be set to the same end-point. To do this move the stick to the required position and hold the **INC** or **DEC** button pressed in until the required value is set. Value range: approx. -100 to +100. (**CLEAR** = 0).

Caution:
You must define the spoiler stick offset before you enter the offsets for the FLAP / ELEVATOR (see page 36) or FLAP / AILERON (see page 38) mixers.





Notes:
The flap / elevator mixer (see page 36) can be set up in such a way that the model aircraft's pitch trim does not change (compared with normal flight) when the spoilers are extended.

If the mixer is used in combination with the FLAP / AILERON mixer (see page 38), the flaps move down and both ailerons also move either up or down (depending on the direction of the mixer input) when the spoilers are extended.

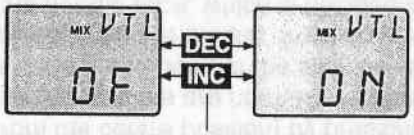
You may also find it useful to superimpose all three flap mixers, so that when you operate the spoiler stick, the flaps and ailerons are extended in the butterfly (crow) configuration, and the elevator compensates for any change in pitch trim.

V-tail mixer

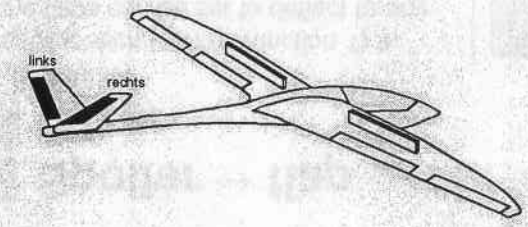
Mixer for servos 3 and 4

Models which feature a V-tail have to be controlled by mixed elevator and rudder functions, i.e. the two channels are superimposed in such a way that both tail surfaces move up and down together to provide elevator control, and in opposite directions (one up, one down) to provide rudder control. In contrast to mechanical V-tail mixers, each control surface is controlled by its own servo. The advantage of this system is that the linkage can be very accurate and virtually slop-free, and more servo power is available to operate the control surfaces.

Press **INC** or **DEC** to switch the V-tail mixer on or off. **CLEAR** always switches the system off ("OF"). The elevator and rudder mixer ratios can be adjusted using DUAL RATE; see page 21.



Switching VTL
(V-tail mixer) On/Off



Note:
There are various ways of installing servos and control surface linkages, and this can cause confusion when you are programming the V-tail mixer, as one or other of the servo functions may be reversed. The table below provides the solution.

Servo with reversed direction of rotation	*Remedy*
V-tail, rudder	*Use servo reverse*
V-tail, elevator	*Swap over servo connectors 3 + 4*

For your notes

Programming example: Model type UNIFLY "FL"

In the next few pages we present some typical examples of programming, showing in a practical way how to set up the system for a fixed-wing model aeroplane.

The descriptions are based on fixed-wing models with elevator and rudder, plus ailerons controlled by two separate servos.

In our imaginary model we wish the rudder to follow the movement of the ailerons to a pre-set degree (known as a combi-mixer or CAR - coupled aileron / rudder), which makes the model easier to turn smoothly. The rudder stick can still be used separately to control the rudder.

The programming example also provides for the optional feature that the two (separately actuated) ailerons can be deflected up simultaneously using the throttle / spoiler stick to act as a landing aid. If you prefer a rotary module or switched channel to control this function, you will find an alternative method of programming the "landing aid" at the end of the programming example.

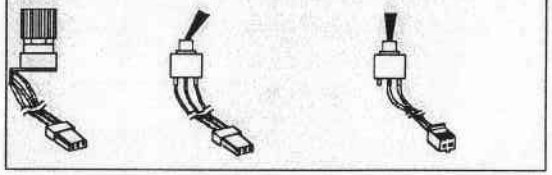
If your model does not feature ailerons, or if both ailerons are actuated by a single servo, just leave the corresponding receiver outputs unused. In this case simply skip the associated programming steps which concern the ailerons.

The description which follows includes the essential procedures in *System Rotation*, and also those in *Setup Rotation*. Please note that we cannot predict the optimum mixer values for your model; you will have to carry out experiments to find the best settings for your particular application.
Be sure to check all the settings carefully before you fly your model, as a programming error can endanger your model.

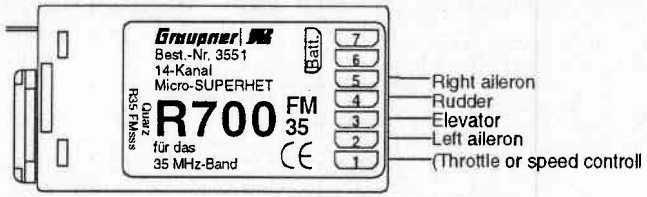
Standard model with two aileron servos

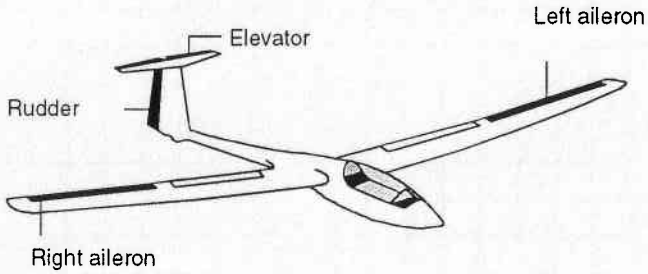
Transmitter accessories required if the "landing aid" is used

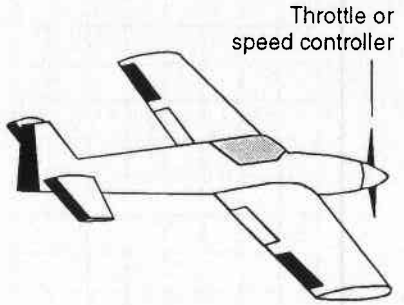
Rotary module or switched module (your choice)
Order No. **4170** Order No. **4171**
External switch
Order No. **4160**
or **4160.1**

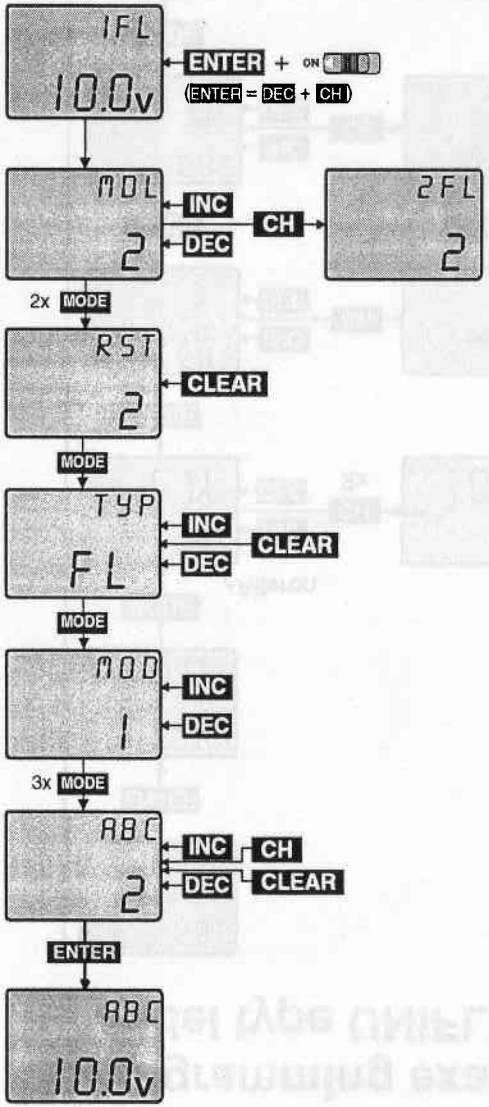


Receiver channel sequence









Switching on *System Rotation* to program the basic settings — **Page**

Press both rocker buttons down (= **ENTER**) and at the same time switch on the transmitter. System Rotation can only be activated when you switch the transmitter on; this avoids the danger of accidentally making crucial changes in flight, e.g. switching model memory. 17

.

Model selection

Press **INC / DEC** to select a vacant model memory from 1 to 8, e.g. "2".
Press **CH** and the current model name will appear briefly on the screen (here: "2" = model memory, "FL" = model type Unifly). 17

.

Reset

Reset all data in the selected model memory to the standard default values before entering new data. 18

Model type

For the selected model memory (in this case "2") select the model type using **INC** or **DEC**; in this case: "FL" (Unifly). The system only accepts your newly selected model type when you press **ENTER** or **MODE**. If you press **CLEAR**, you return to the current type, with no loss of data, provided that the new model type has not yet been confirmed. 18

Stick mode 1 ... 4

"1": Throttle / aileron on the right stick, elevator / rudder on the left stick.
The sequence of receiver outputs is not affected by the stick mode; it is simply a matter of personal preference. 19

.

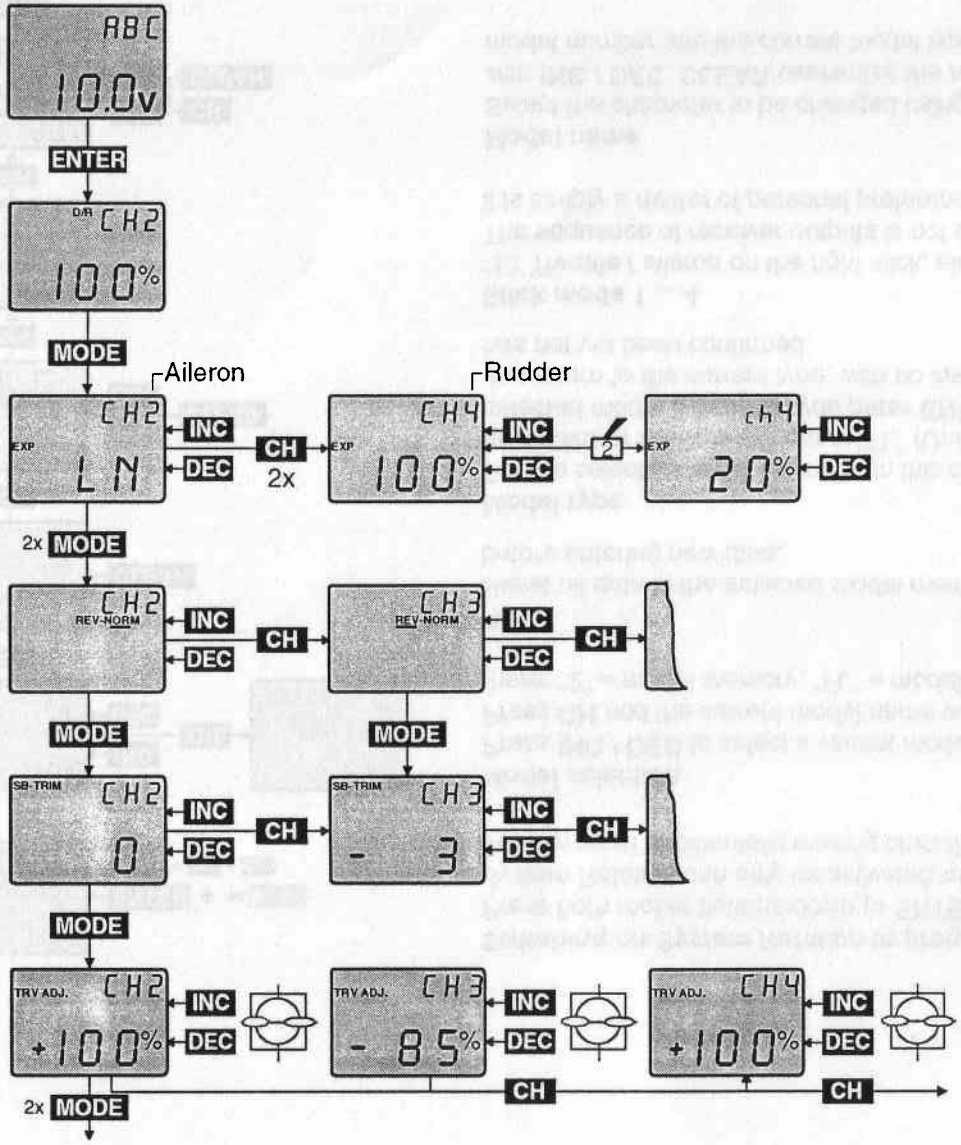
Model name

Select the character to be changed using **CH**. Select the alpha-numeric symbol with **INC / DEC**. **CLEAR** overwrites the new model name with the current model number and the current model type (here: "2FL"). 18

Return to normal operating display

Press **ENTER** to quit System Rotation. The screen shows the newly programmed model name "ABC".

Programming example:
Model type UNIFLY "FL"



Setup Rotation — Page

From the normal operating display press **ENTER** to move to *Setup Rotation*. If you are still in *System Rotation*, press **ENTER** twice. 20

Setup Rotation now appears on the screen, showing the code which you last accessed. Press **MODE** to move to the next code within *Setup Rotation*.

Exponential control curve, e.g. rudder CH4

The servo normally follows the movement of the rudder stick in a linear fashion. For finer control around the centre of the sticks travel select a value between LN (= linear) and 100%. External switch 2 switches between the two rudder settings. 21

Servo reverse

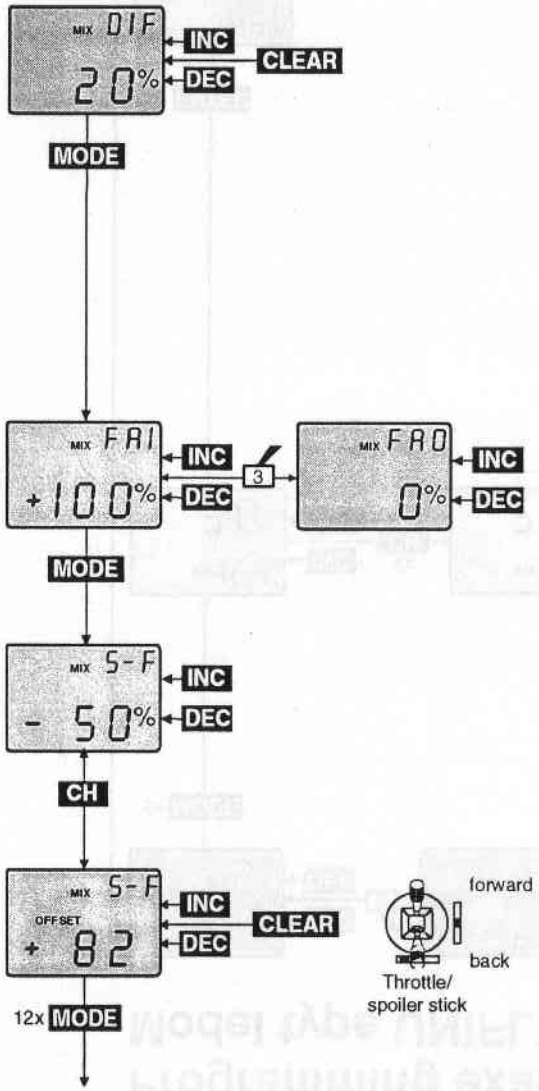
If the servo rotates in the wrong direction, press **INC** / **DEC** to correct it. An underline cursor shows the current direction: "REV" or "NORM". 24

Servo centre adjustment

Before you use this code it is important to adjust the mechanical control linkage to centre the system as accurately as possible. Using this facility to adjust a poorly centred system will restrict the available servo travel to one side of centre. 24

Servo travel adjustment

Check the servo travels with the system installed in the model, and limit the travels for each direction separately if required. Move the associated stick in the appropriate direction before making any change. 25



Differential mixer (must not be used if the model only has one aileron servo!) **Page**

If the ailerons are actuated by two separate servos, differential travel provides reduced down-travel coupled with full up-travel. The actual optimum setting must be found during flight testing. 37

Optional programming feature: ailerons as landing aid

For the landing approach you want to be able to deflect both ailerons up by the same amount using the throttle / spoiler stick: the spoiler / flap mixer "S-F" is used, with the effect that the spoiler stick also operates a flap servo. However, this output also acts simultaneously as the input for the flap / aileron mixer "FA1/0", acting upon both ailerons. This could cause the model to balloon up on the landing approach, so automatic down-elevator compensation must be programmed in. This is done using the flap / elevator mixer "FE1/0".

Flap > aileron mixer "FA1/0"

Set this mixer to +100%. If you connect a switch to socket 3 on the transmitter circuit board, you can set and select a second mixer value (note dual use: "MIX C"). However, the airbrakes are not yet set up to be controlled by the throttle / spoiler stick. To do this you use the spoiler-flap mixer, which is described next. 38

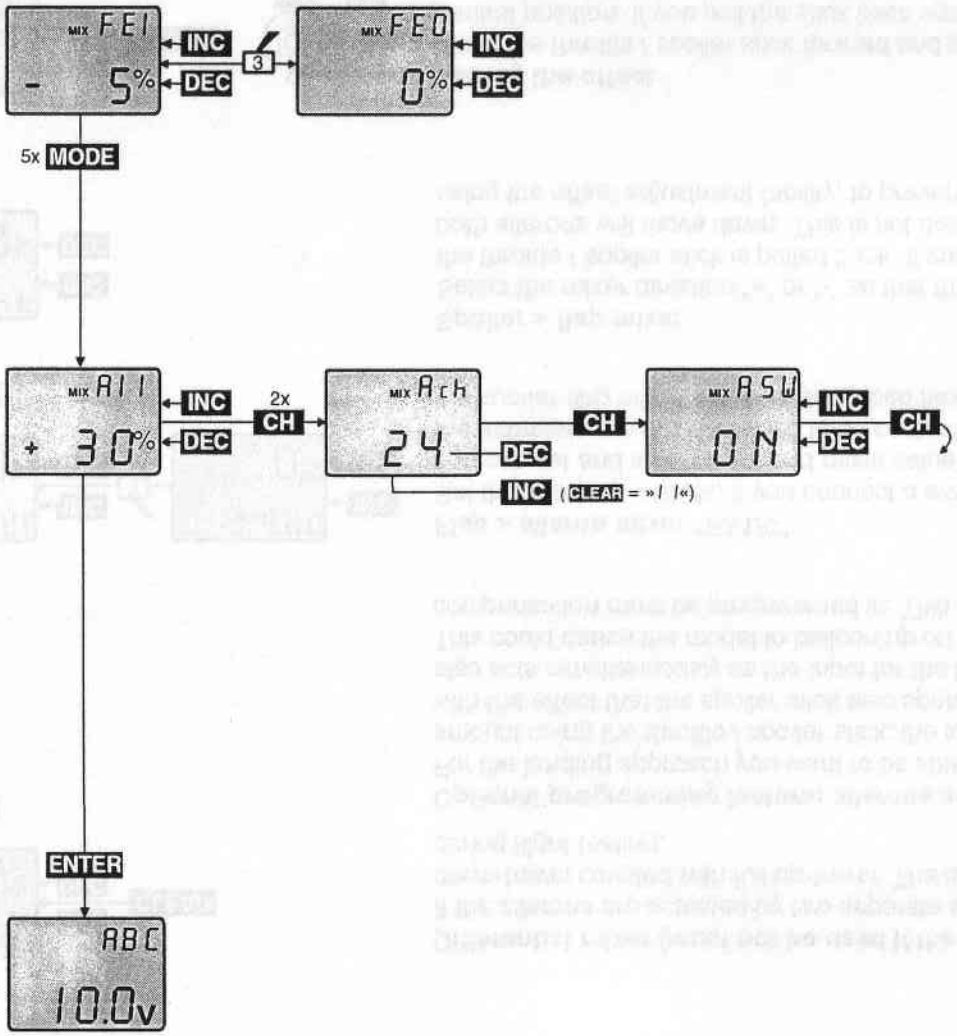
Spoiler > flap mixer

Select the mixer direction "+" or "-" so that the ailerons deflect up in parallel when the throttle / spoiler stick is pulled back. If you now move the stick forward from the centre position, both ailerons will move down. This is not desired, so the mixer neutral point must be moved using the offset adjustment facility, to prevent it occurring. 39

Setting the offset

Move the throttle / spoiler stick forward and press **INC** or **DEC**. The flaps now return to the neutral position. If you pull the stick back again at this point, the ailerons follow the movement of the flaps, but to the degree dictated by the mixer ratio set for the "S-F" mixer.

Programming example:
Model type UNIFLY "FL"



Flap → elevator mixer **Page**

At this point we apply a little down-elevator via the mixer value, with the purpose of preventing the model ballooning up on the landing approach when the flaps are deployed. The amount of down-elevator required varies from model to model. As with the mixer "FA1/0", switch 3 allows you to switch between two mixer values (note dual use of switch 3: "MIX C").
This completes the programming of the landing aid system.
Please note the alternative programming on page 47. 26

.

Combi-mixer: aileron → rudder

For example: select mixer "A" and switch to the display "MIX Ach": assign the control function "2" (aileron) as *mixer input* using **INC**, and assign the receiver output "4" (rudder) as *mixer output* using **DEC**.
Now switch to "MIX ASW" and use **INC / DEC** to decide whether the mixer is to be permanently active (screen shows "ON") or is to be switchable by means of an external switch connected to socket 5 on the transmitter circuit board (screen shows "5"). Now press **CH** again to determine the mixer ratio, and set the mixer direction using **INC / DEC**.
An OFFSET adjustment is not required in this case (value "0"), as this mixer is required to follow the movement of the aileron stick proportionally to both sides from the centre point. 26

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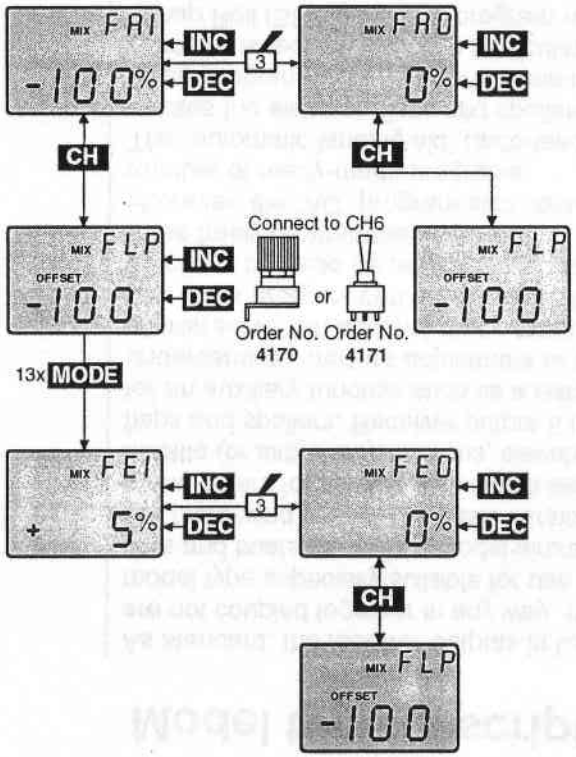
Return to normal operating display



Ailerons as landing aid, using a rotary or switch module **Page**

Connect a rotary or switch module to CH6 on the transmitter circuit board to allow both ailerons to deflect up on the landing approach.
The rotary module provides proportional control of this function, but it is also possible to use a switch module to select either of two settings. External switch 3 allows you to switch to the second mixer value "FA0".

Flap → aileron mixer ("FA1/0")

Call up this mixer in Setup Rotation, and set the direction of mixing so that both ailerons deflect up when you operate the rotary or switch module. Here again, switch 3 allows you to switch between two mixer values. The optimum mixer value varies according to the model. 38

Offset adjustment

As the ailerons are only required to deflect up on the landing approach, the mixer neutral point has to be shifted: rotate the rotary module (for example) to the left-hand stop, or move the switch module to the up position, and press **INC** or **DEC**. The ailerons will now return to the neutral position, and will move in accordance with the mixer value, starting from these positions of the transmitter controls.

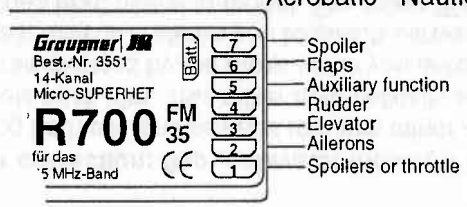
Elevator correction: flap → elevator mixer ("FE1/0")

Deploying both ailerons as flaps requires minor down-elevator correction to maintain the models pitch trim. This mixer automatically superimposes slight down-elevator, to a degree dictated by the mixer value you enter, when that transmitter control is operated. Here again, switch 3 allows you to switch between two mixer values. The optimum mixer value varies from model to model. The mixer "FA1/0" automatically accepts the "FLP" offset. 36

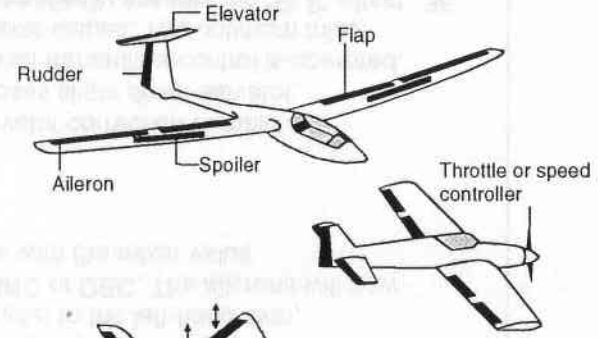
ACROBATIC-NAUTIC-CAR
Model type description and receiver socket sequence

As standard, the receiver outputs in this program are not coupled together in any way, making this model type especially suitable for use with model cars and boats as well as model aircraft.
For fixed-wing aircraft the basic version of this menu caters for models with single servos for throttle (or airbrakes), ailerons, elevator, rudder, flaps and spoilers. Receiver output 5 is available for an auxiliary function such as a retractable undercarriage, mixture adjustment or a second aileron servo. An optional ready-made elevator / flap mixer program can be called up. Other mixer functions can also be programmed using the three freely programmable mixers.
However, the "AC" program also contains a number of ready-made programs:
The "automatic landing aid" (auto-landing) facility causes the elevator, flaps and spoilers to run to freely programmable positions when motor speed (throttle) is reduced below a particular level. The "Snap Roll (SR)" aerobatic program moves the elevator, rudder and ailerons to pre-defined positions.
The wing program "WING (WNG)" contains the programs DELTA and FLAPERON. Delta and flying wing model aircraft have no tail surfaces, so the elevator and aileron functions are superimposed on common control surfaces on each wing panel, which move in opposition for aileron control, and in the same direction for elevator control. For these mixers to work, each elevon must be controlled by its own servo. The FLAPERON function links receiver outputs 2 and 6, which are then controlled as ailerons and/or flaps.

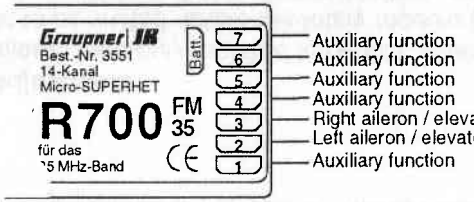
Acrobatic - Nautic - Car - standard models



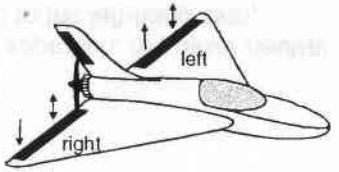
- Spoiler
- Flaps
- Auxiliary function
- Rudder
- Elevator
- Ailerons
- Spoilers or throttle



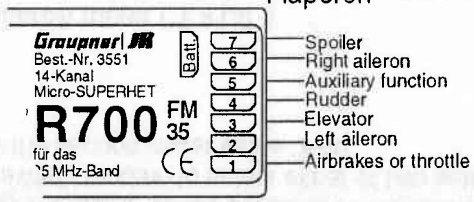
Delta models



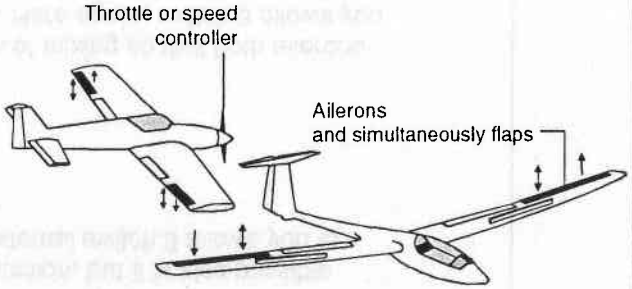
- Auxiliary function
- Auxiliary function
- Auxiliary function
- Auxiliary function
- Right aileron / elevator servo
- Left aileron / elevator servo
- Auxiliary function



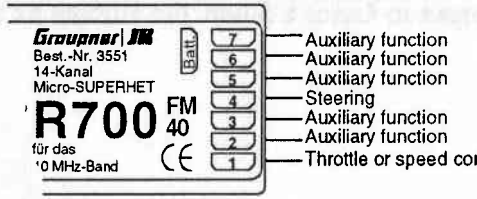
Flaperon



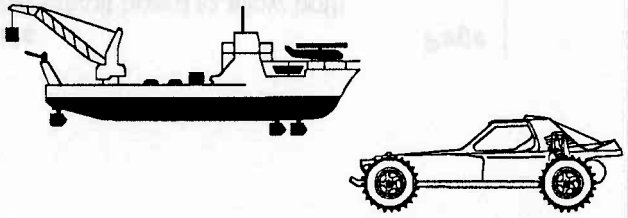
- Spoiler
- Right aileron
- Auxiliary function
- Rudder
- Elevator
- Left aileron
- Airbrakes or throttle



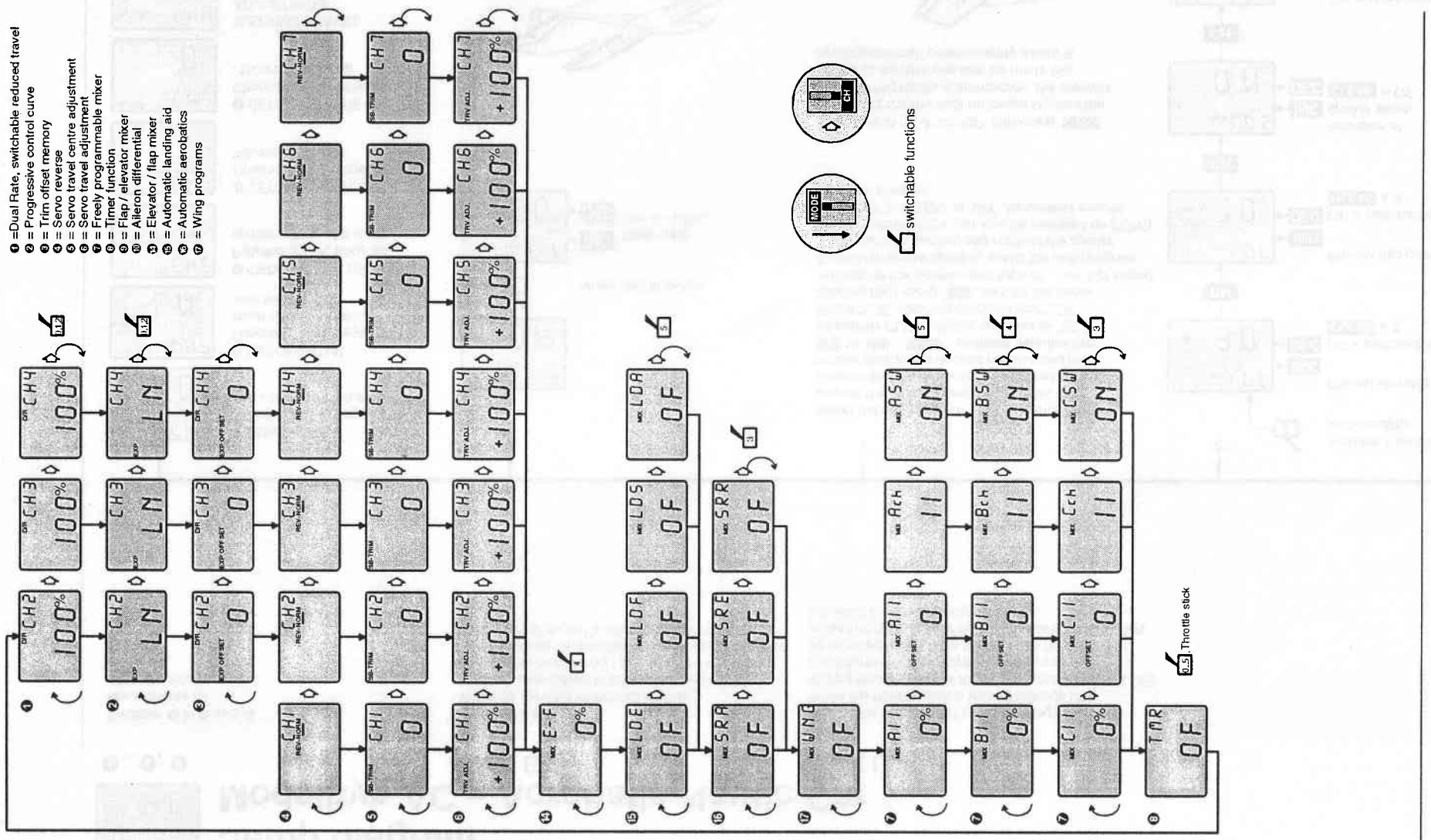
Nautic and Car



- Auxiliary function
- Auxiliary function
- Auxiliary function
- Steering
- Auxiliary function
- Auxiliary function
- Throttle or speed controller



Setup Rotation ACROBATIC-NAUTIC-CAR



Setup diagram
Modelltyp AC = Acrobatic-Nautic-Car

❶...❻, ❽

Facilities ❶ to ❻ and ❽ are available for all model types

⓮ MIX E-F

Elevator > flap
When an elevator command is given, the flaps also deflect to an extent governed by the programmable mixer ratio (0% to +/- 125%). The mixer can be switched off by an external socket connected to socket 4 (note dual use: "MIX B").

⓯ MIX LDE

Automatic landing aid (auto-landing)
When the throttle stick is moved towards idle, at a particular point the flaps (LDF) and elevator (LDE) are automatically deployed. Spoilers can also be included (LDS). This function can be switched on and off by means of an external switch connected to socket 5 (note dual use: "MIX A").

❶ DUAL RATE
Function 2 to 4, page 21
0 to +125%, switchable

❷ EXPONENTIAL
Function 2 to 4, page 21
linear (LN) to +100%, switchable

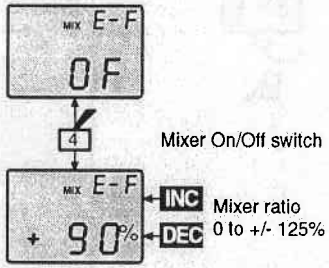
❸ TRIM OFFSET MEMORY
Function 2 to 4, page 22
approx. -50 to +50 steps

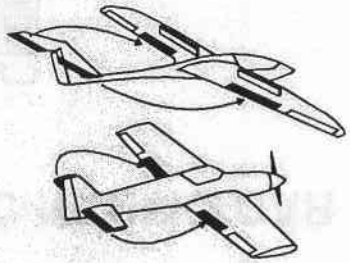
❹ SERVO REVERSE
Channel 1 to 7, page 24
Reverse / Normal

❺ SERVO CENTRE OFFSET
Channel 1 to 7, page 24
-150 to +150 steps

❻ SERVO TRAVEL ADJUSTMENT
Channel 1 to 7, page 25
0 to +/- 150%

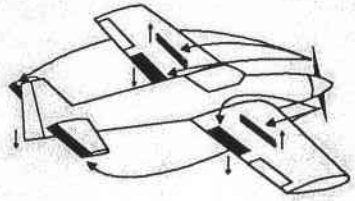
❽ STOPWATCH and ALARM TIMER, page 28
forward / reverse, max. 900 sec
Can also be controlled by control function 1

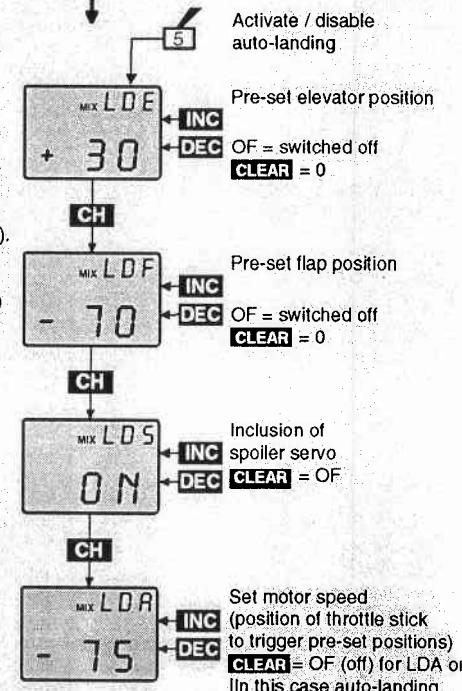




Select the sub-program "LDA" (auto-landing), and set the motor speed below which the auto-landing system is to be triggered. Move the throttle stick to the desired position and press INC or DEC . CLEAR switches auto-landing off entirely ("LDA" display switches to "OF"). Select "LDE" (landing elevator) and "LDF" (landing flap) using CH , and set the servo settings for the elevator and flaps (0 ... +/- 125 steps). If you wish to use spoilers, select the sub-program "LDS" (landing spoiler) and connect the spoiler servo to channel 7; it can now be switched on ("ON") or off ("OF"). If "LDS" is "ON", transmitter control input 7 is blocked.

Note:
If you switch "LDA" to "OF" (off) using CLEAR , so that the throttle stick no longer triggers the auto-landing facility automatically, the elevator, flaps and spoilers can only be run to the pre-programmed position using switch 5.





⑯ MIX SRA

Automatic aerobatics (snap roll)
When the snap roll switch (switch connected to socket 3) is operated, the servos for aileron, elevator and rudder move to pre-programmed positions (note dual use: "MIX A").
To eliminate the danger of switching on the program accidentally, the SRA function can be switched off by pressing CLEAR (screen display "OF").
For safety reasons you should only use a momentary switch, Order No. **4160.11**, for this function.

⑰ MIX WNG

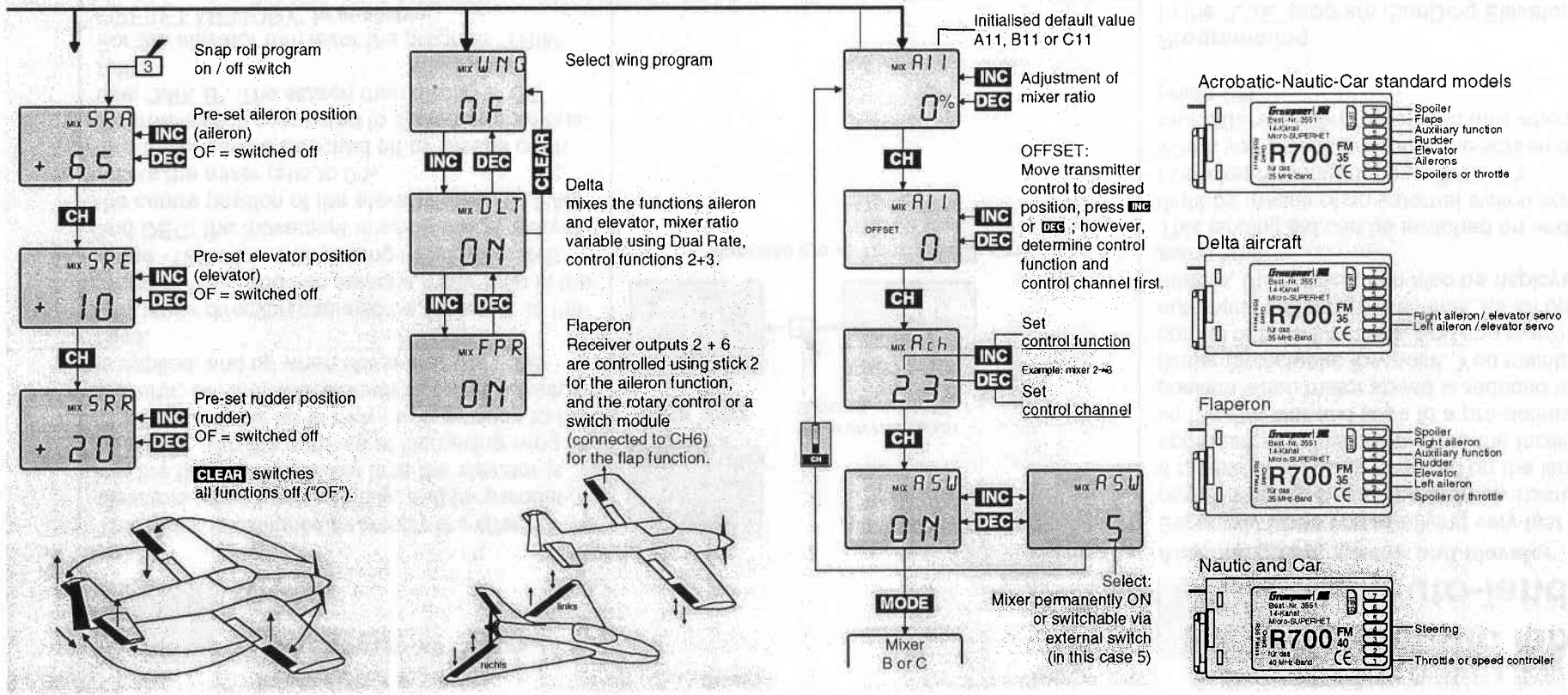
Wing programs (DLT, FPR)
Two different wing programs are available, which can be selected by pressing the INC or DEC buttons. CLEAR switches the program off (screen shows "OF").
In the "DLT" program the travel adjustment for servo 2 is carried out using "TRV ADJ. CH2", while "TRV ADJ. CH6" affects both servo travels, but only with reference to the rotary module 6 which controls the flap function. If the elevator servo rotates in the wrong direction in the "DLT" program, see the note on page 55.

❼ MIX A, B, C

Freely programmable mixers
It is possible to select both the mixer program (servo functions 1 ... 7) and the mixer ratios (0 to +/- 125%) individually. The mixers can be left permanently "ON", or switched on and off by means of external switches.
Important: please note that the mixer ratios are superimposed differently if you are using one of the ready-made mixers in conjunction with a freely programmable mixer; see notes on page 27. If you switch on the "LDS" function in the auto-landing program, a transmitter controlled connected to CH7 on the transmitter circuit board will have no effect.

Mixer	External switch	Note dual use
C	Socket 3	Mixer "SRA/E/R"
B	Socket 4	Mixer "E-F"
A	Socket 5	Mixer "LDE/F/S"

Receiver channel sequence ACROBATIC-NAUTIC-CAR type
Provided that no ready-made programs are in use, all receiver outputs are de-coupled from each other, making this program ideal for model boats and cars as well as aircraft. If you select DELTA, outputs 2 + 3 are linked in the software to provide simultaneous aileron and elevator control.
The FLAPERON mixer links receiver outputs 2 + 6 so that servos connected to those outputs can be used for superimposed aileron and flap functions.



Acrobatic-Nautic-Car standard models

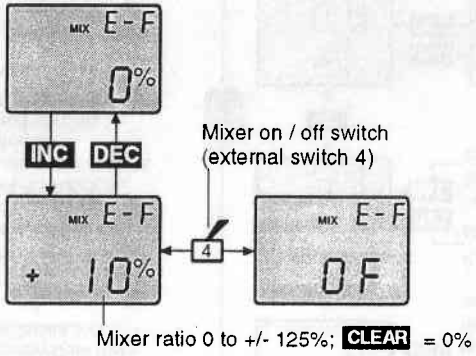
Delta aircraft

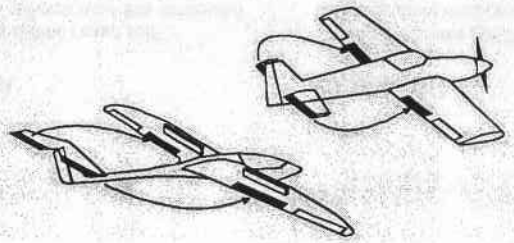
Flaperon

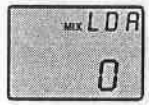
Nautic and Car

Elevator → flap-mixer

This mixer is designed to amplify the effect of the elevators when turning tightly, and for aerobatics; the flaps deflect every time the elevator is operated, with the purpose of increasing wing lift. The flaps are set up to move in opposition to the elevator, i.e. they move down when up-elevator is applied, and up when down-elevator is applied.
The mixer direction can also be reversed. In the program "E-F" you can select a mixer ratio in the range -125% to +125% using the buttons **INC** and **DEC**; the movement is symmetrical around the centre position of the elevator stick. **CLEAR** resets the mixer ratio to 0%.
The mixer can be switched off by means of an external switch connected to socket 4 (note dual use: "MIX B". The screen then displays "OF" (off).
For the elevator trim lever the program "TRIM OFFSET MEMORY" is available.



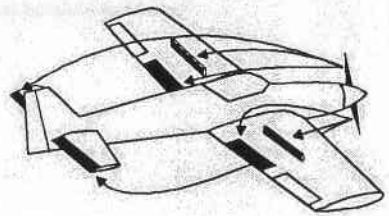




Automatic landing aid (auto-landing)

Automatic flap, spoiler and elevator
Especially when you are flying very fast F3A power models, it can be extremely useful to have a means of reducing airspeed on the landing approach, and this code offers the facility to move the elevator and flaps to a pre-defined position when motor speed is reduced to a particular (selectable) low point. You maintain full control of both functions, and can over-ride the automatic settings at any time. As an optional feature, the spoilers can also be deployed at the same time.
This landing aid can be switched on and off in flight by means of an external switch connected to socket 5 (note dual use: "MIX A").
When you select this code, the screen displays four different sub-programs in turn when you press **CH**.

Programming
In the "LDE" program (LanDing Elevator) you can set the elevator offset within the range +/- 125 steps using **INC** / **DEC**. A similar setting is made in the "LDF" (LanDing Flap) part of the program. Press **CH** again, and you can decide whether spoilers are also to be extended when the auto-landing aid is triggered. If necessary, switch on "LDS" (LanDing Spoiler) using **INC** / **DEC**.



Requirement: for this system to work, the spoiler servo must be connected to receiver output 7 (see receiver socket sequence, page 48), as it is reserved for this function. If "LDS" is set to "ON", any transmitter control (rotary or switch module) connected to CH7 on the transmitter circuit board has no effect, and the servo runs from its neutral position to one end-point. Servo travel is set using the code "Servo travel adjustment"; see page 25.

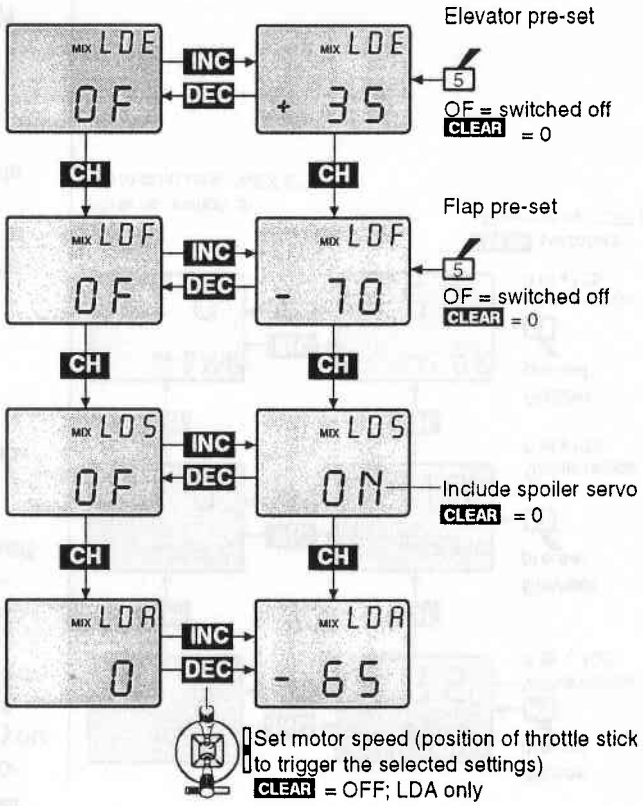
Activating the landing aid system with the throttle stick

In the sub-program "LDA" (LanDing Auto) you set the position of the throttle stick below which the automatic landing aid is to be triggered; below this point the servos run to their pre-programmed positions. To set this value, move the throttle stick to the desired position and press **INC** or **DEC**. The screen then displays the current value. If the throttle stick is "above" (advanced beyond) this position, or if the entire program is switched off using external switch 5, the message "OF" (off) appears in the sub-programs "LDE" and "LDF".

Activating the landing aid system without the throttle stick

If you wish to be able to move the elevator, flaps and spoilers to the pre-selected positions regardless of motor speed, this can be done by operating external switch 5 only, provided that you have already switched the sub-program "LDA" to "OF" (off) by pressing **CLEAR**.

We cannot state generally applicable optimum values for the pre-selected positions; you have to carry out experiments with your model to find the best settings.



Caution:

If the AUTOMATIC AEROBATIC program "Snap Roll" is switched on at the same time (see page 54), the function "LDE" (preset elevator) is blocked!

Automatic aerobatics

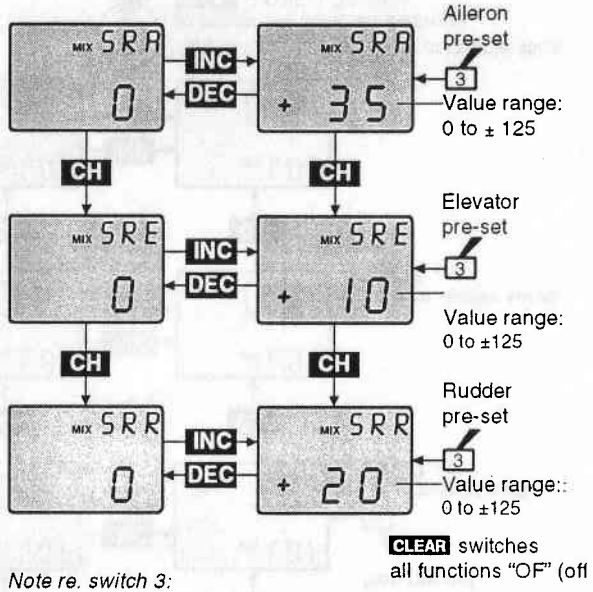
Snap roll program: aileron, elevator, rudder

The snap roll switch must be connected to socket 3 on the transmitter circuit board. When you operate it, the aileron, elevator and rudder servos run to previously programmed positions. For safety reasons we recommend using a momentary switch, Order No. **4160.11**, for this program, so that the model only carries out automatic aerobatics for as long as you hold the self-neutralising switch in the ON position.

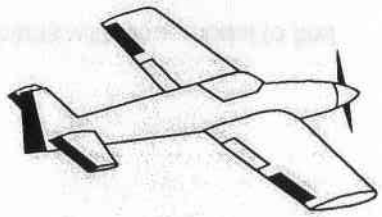
The parameters are contained in the three sub-programs
"SRA" (Snap Roll Aileron)
"SRE" (Snap Roll Elevator)
"SRR" (Snap Roll Rudder),
and are adjusted using **INC** and **DEC**.
CLEAR resets all snap roll functions simultaneously to "OF" (off), regardless of the position of external switch 3, while **INC** or **DEC** switch it back on again. Note that switch 3 also controls "MIX C".
Call up the three settings in turn using **CH**.

Notes

For as long as you hold the snap roll switch in the "ON" position, controls 2, 3 and 4 have no effect on their associated servos, and they can also no longer function as mixer inputs and outputs. If the snap roll program is switched on and you accidentally activate the AUTOMATIC LANDING AID (auto-landing), only the function "LDE" of the automatic landing aid is blocked.



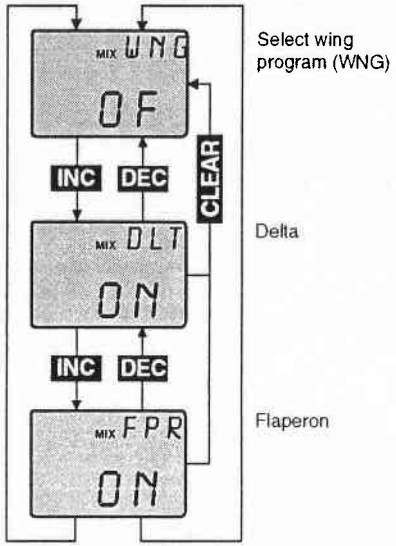
Note re. switch 3:
Note dual use: "MIX C"



Wing programs

Delta and flaperon

This code contains two special mixers which can be switched on with **INC / DEC**.



1. 1. For delta model aircraft "DLT" the aileron and elevator functions are mixed; the servos should be connected to receiver outputs 2 and 3 (throttle to 1, rudder to 4).

Set-up notes:

- *Direction of rotation and servo centre (see page 24):*
  You may have to change the neutral point and direction of rotation of the servos, depending on the orientation of the servos in the model; this is done using the appropriate codes.
- *•Mixer ratio:*
  You can set the mixer ratio using the "Dual Rate" code (control function CH2 for rudder travel, CH3 for elevator travel; see page 21).

2. Aileron / flap mixer: "FP" stands for "flaperon", and superimposes the travels of two servos connected to receiver outputs 2 and 6. The control surfaces then work as follows:
   - as ailerons, if you move the stick for control function 2;
   - as flaps, if you move the control for function 6.

   Set-up notes:
   - *Direction of rotation and servo centre (see page 24):*
     You may have to change the neutral point and direction of rotation of the servos, depending on the orientation of the servos in the wings; this is done using the appropriate codes.
   - *Mixer ratio:*
     The mixer ratio of the aileron control system - control function 2 - can be adjusted using "DUAL RATE" and "EXPONENTIAL". CH2 then affects outputs 2 and 6 in common.
   - *The mixer ratio of the flap function can be adjusted using servo travel adjustment for CH6 (page 25).*

     In both cases you need to move the control for CH6 to the appropriate end-point in order to set the travel separately for each side of centre.

Note:
As there are many possible methods of installing the servos and linkages in a model delta, you may find that the direction of rotation of one or both servos is incorrect. The following table shows how to correct the problem.

Servo with reversed direction	*Remedy*
Aileron	*Use servo reverse*
Elevator	*Swap over servos 2 + 3*

Programming example
ACROBATIC-NAUTIC-CAR model type "AC"

The "AC" program is an excellent choice for model boats and cars, as, in contrast to the model types Unifly "FL" and especially Helicopter "HE", the receiver outputs are not coupled together in the system software. Each receiver output can therefore be controlled separately from the transmitter. Nevertheless, you still have the three freely programmable mixers "A", "B" and "C" available for mixing two outputs together, for example, if you wish to use two separate servos for the steering of a model car or the trim tabs on a model boat.

Tip:
Of course, you can also operate model cars and boats using the Unifly model type; in this case receiver outputs 2 + 5 are coupled together for two aileron servos, but this mixer can also be used for trim tabs on a boat. In this case you can also use the differential mixer "MIX DIF" (page 37).

If the mc-12's maximum of seven servo channels is not sufficient for you, you can use 1/5 K NAUTIC Multi-Split modules (Order No. **4138**), which are ideal for multi-function models such as trucks and the more complex boats. Two modules can be installed in the transmitter, and each module expands one proportional channel to provide five servo functions. At the receiver end of the system you need a 1/5 K NAUTIC Multi-Split decoder (Order No. **4139**) for each transmitter module; the system then provides five independent servo functions from each of the corresponding receiver outputs.

Please see the appendix for a full description of these modules.

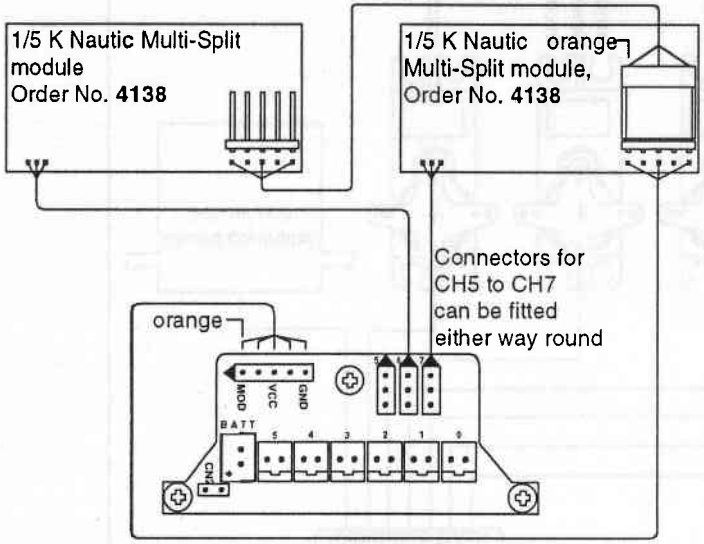
The example which follows shows you in detail how to program the mc-12 transmitter to cater for a model boat in which two Jet propulsion units are to be operated; the system exploits the features of a freely programmable mixer.
The set-up procedure for a model car is very similar.

The use of NAUTIC modules is intended for auxiliary functions, and the functions themselves are left to the builder's discretion. The methods of wiring the equipment and the set-up parameters associated with these modules are explained on the next page.

If you wish to use external switches please note the possible dual use factor; see page 13 or 31 for more details.

Connecting NAUTIC Multi-Split modules at the transmitter

Requirements for connecting and operating the 1/5 K NAUTIC Multi-Split module



The following channels can be used for connecting a NAUTIC Multi-Split module at the transmitter, and a NAUTIC Multi-Split decoder at the receiver, depending on the model type. Please be sure to note the special requir .

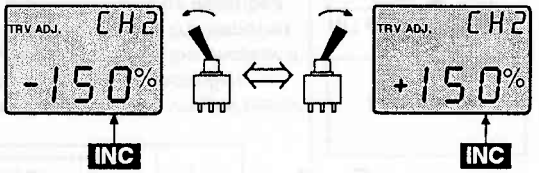
Model type	Channels to be used
"FL"	6 and 7
"AC"	5, 6 and 7
"HE"	5

The mc-12 transmitter can be fitted with one or two 1/5 K NAUTIC Multi-Split modules. The modules can be installed in the left-hand or right-hand option wells, and are fitted as described on page 11 of the manual.
When using NAUTIC modules it is always best to set the model type ACROBATIC-NAUTIC-CAR "AC", which you select in the "TYPE" menu in *System Rotation*, as the basic programming of this model type does not mix or link outputs 1 to 7 in any way. For example, if you wish to use the model type UNIFLY "FL", the control function input CH5 cannot be used for a 1/5 K NAUTIC Multi-Split module. If you wish to use the model type HELICOPTER "HE", channel 5 is reserved for use with a 1/5 K NAUTIC module.

Using the NAUTIC system

1. CH5, CH6 and CH7 must not be used either as a mixer input signal or as a mixer output signal!
2. Servo reverse for the channel you decide to use must be set to "NORM"; see code "REV NORM", page 24.
3. Servo travel adjustment (see code "TRV ADJ." - page 25) for the channel you wish to use must be set to +150% and -150%; you must set the values separately for each side of centre. The method of making this adjustment is as follows: connect a substitute switch module or rotary module (see appendix) to socket CH5, CH6 or CH7 on the transmitter circuit board to which the NAUTIC module is to be connected.

To set the servo travel, move the substitute switch module or rotary module to each end-point in turn.

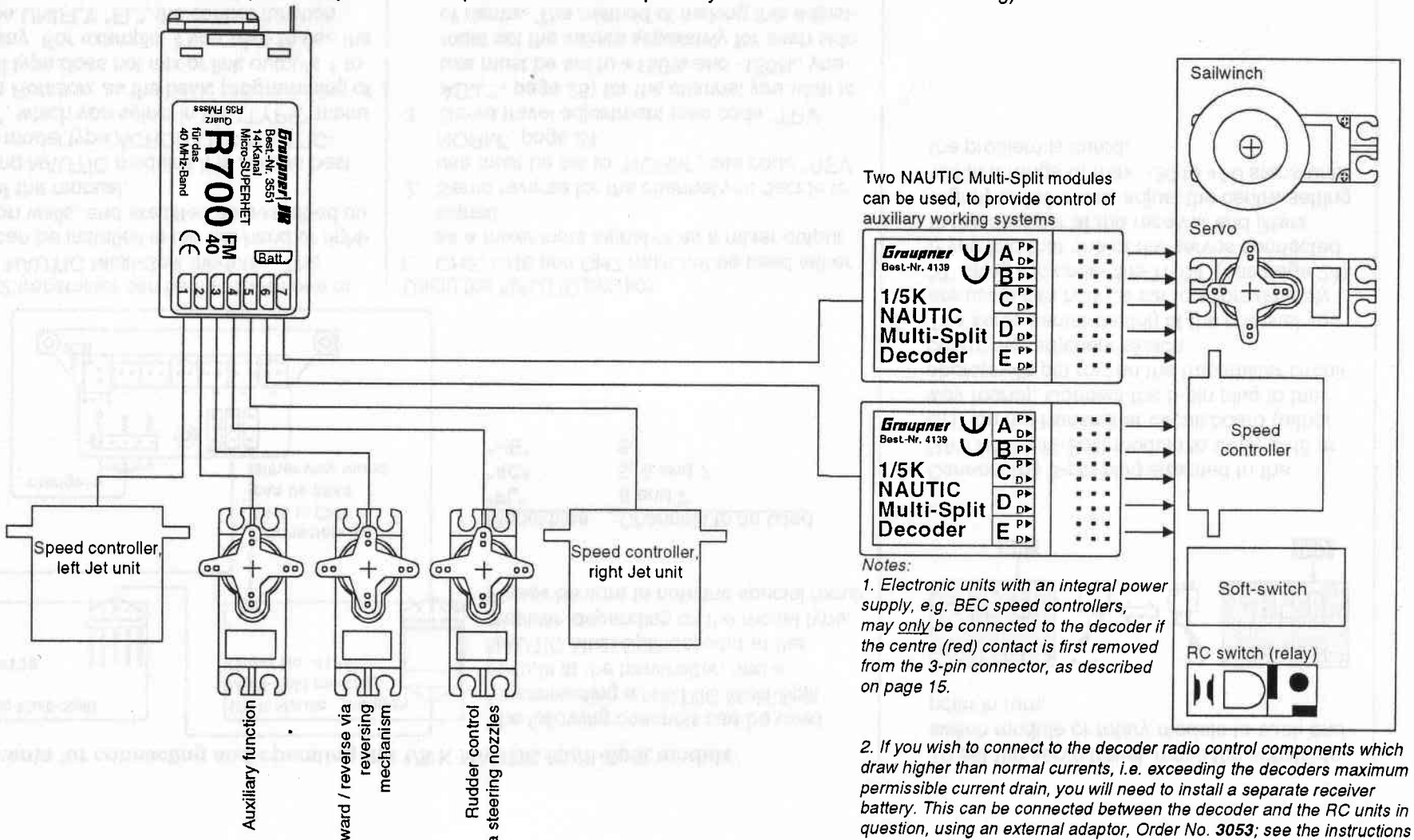


4. Connect the 3-pin plug attached to the NAUTIC Multi-Split module to CH5, CH6 or CH7 on the transmitter circuit board (either way round). Connect the 5-pin plug to the appropriate pin row on the transmitter circuit board; see adjacent sketch.
5. The servo centre setting of the channel you are using can now be set to approximately "0" using the code "SB-TRIM" (see page 24). If you find that one of the servos connected to the decoder at the receiver end jitters slightly at full travel, adjust the centre setting within a range of max. -20 to +20 steps until the problem is cured.

Socket sequence

Example: model boat with two separate Jet propulsion systems

(this arrangement allows you to adjust the two speed controllers separately even when the boat is running)

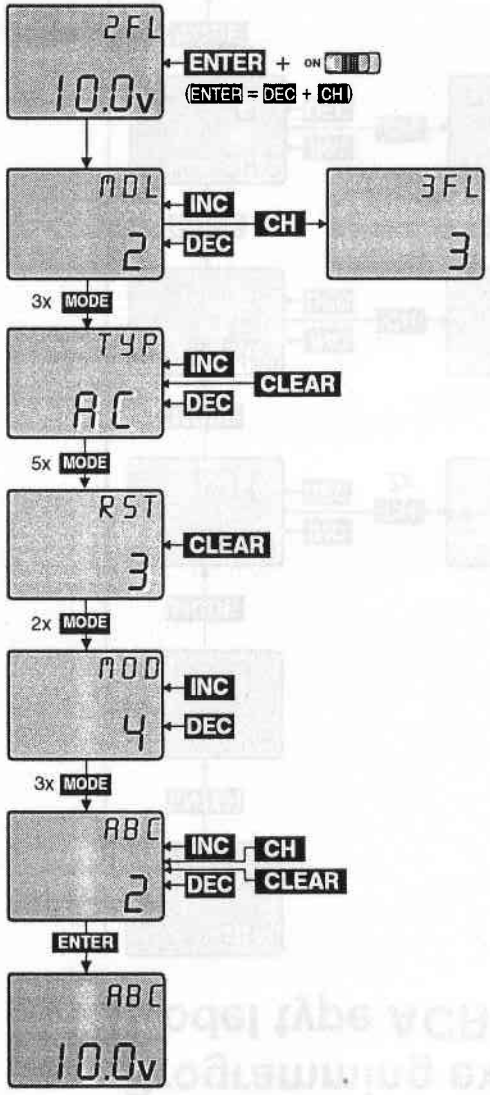


Notes:

1. Electronic units with an integral power supply, e.g. BEC speed controllers, may only be connected to the decoder if the centre (red) contact is first removed from the 3-pin connector, as described on page 15.

*2. If you wish to connect to the decoder radio control components which draw higher than normal currents, i.e. exceeding the decoders maximum permissible current drain, you will need to install a separate receiver battery. This can be connected between the decoder and the RC units in question, using an external adaptor, Order No. **3053**; see the instructions supplied with the decoder.*

Programming example
Model type ACROBATIC-NAUTIC-CAR "AC"



Switching on *System Rotation* to program the basic settings **Page**

Press both rocker buttons down (= **ENTER**) and at the same time switch on the transmitter. System Rotation can only be activated when you switch the transmitter on; this avoids the danger of accidentally making crucial changes in flight, e.g. switching model memory. 17

Model selection

Select a vacant model memory 1 to 8 using **INC** / **DEC**, e.g. "3". Use **CH** to display the current model name (here: "3" = model memory, "FL" = model type Unifly). 17

Model type

Select the model type for the selected model memory "3" using **INC** or **DEC**; in this case: "AC" (ACROBATIC-NAUTIC-CAR). The program only accepts the newly selected model type when you press **ENTER** or **MODE**. If you wish to revert to the current model type (with no data loss), press **CLEAR** before confirming the new model type. 18

Reset

Before entering any new data, reset the selected model memory to the default values. You do not need to carry out this command if you have already changed the model type. 18

Stick mode 1 ... 4

"4": Throttle / motor speed on the left-hand stick, rudder on the right-hand stick. The receiver output sequence is not affected by this. The way you assign the two dual-axis sticks is entirely a matter of your personal preference. 19

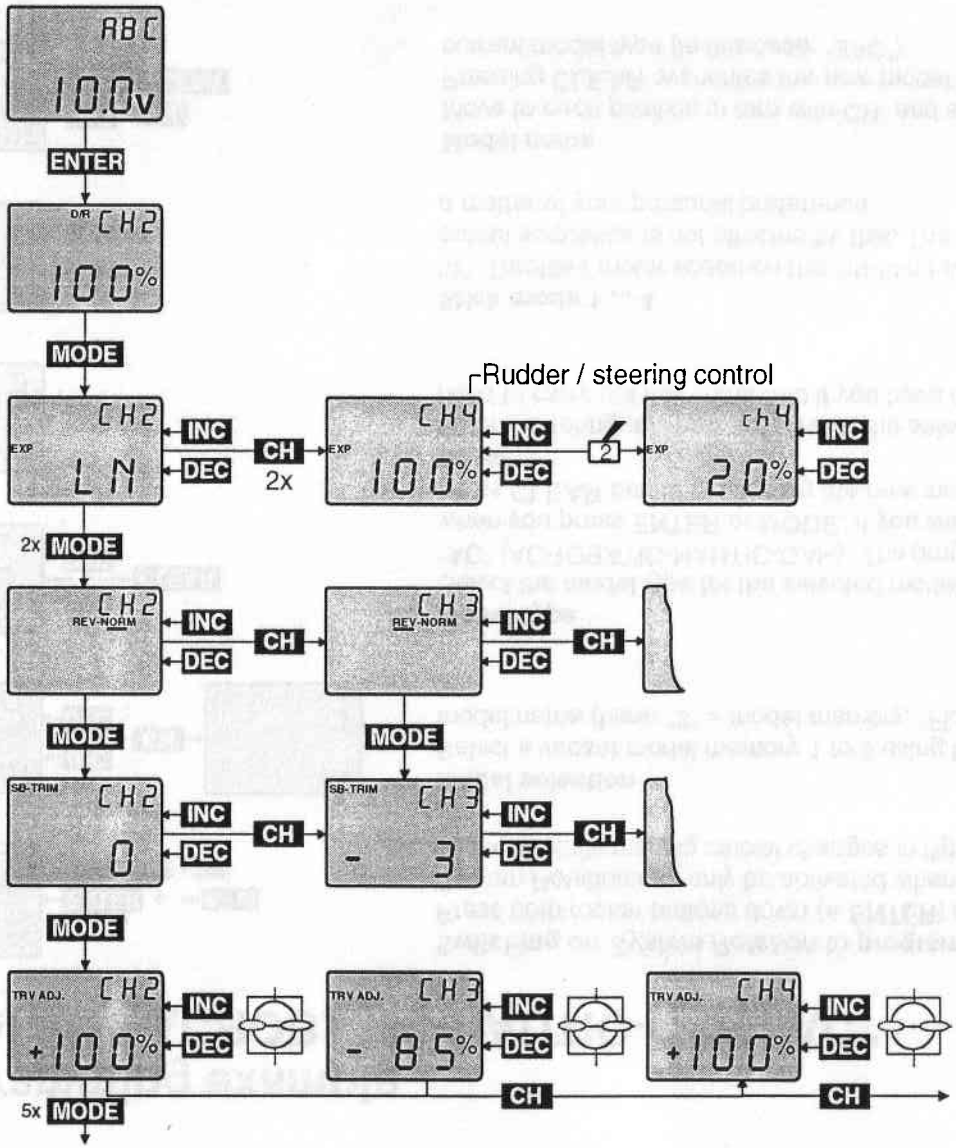
Model name

Move to each position in turn with **CH**, and select the alpha-numeric symbols with **INC** / **DEC**. Pressing **CLEAR** overwrites the new model name with the current model number and the current model type (in this case: "3AC"). 18

Return to normal operating display

Press **ENTER** to quit *System Rotation*. The screen now shows the model name you have just programmed: "ABC".

Programming example
Model type ACROBATIC-NAUTIC-CAR “AC”



Setup rotation — Page

Starting from the normal operating screen, press **ENTER** to select *Setup Rotation*. If you are still in *System Rotation*, press **ENTER** twice. 20

The screen now shows the code you last accessed in *Setup Rotation*. Within *Setup Rotation* you press **MODE** to move to the next code.

Exponential control curve, e.g. rudder control

Normally the servo follows the movement of the stick in a linear fashion. For finer control around the stick centre position, select a value between LN (= linear) and 100%. External switch 2 switches between two settings. 21

Servo reverse

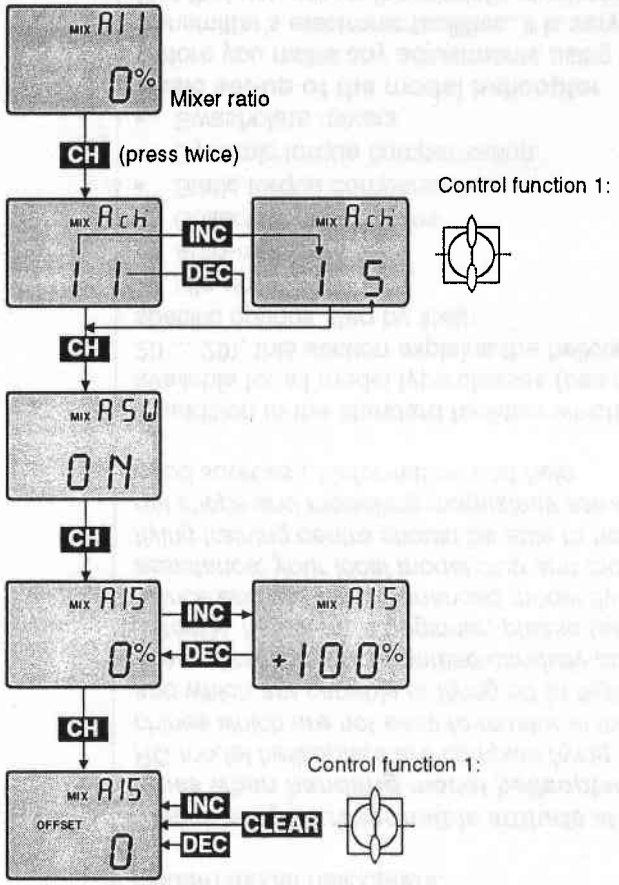
Set the correct direction of servo rotation using **INC** / **DEC**. An underline cursor shows you the current direction of rotation: “REV” or “NORM”. If you are using a speed controller it is generally necessary to select “NORM”. 24

Servo centre offset

Take the trouble to adjust the mechanical control systems as accurately as you can before you use this code, to avoid having to set high positive or negative values for servo centre. A large offset may restrict the servo travel on one side unnecessarily. If you have connected NAUTIC modules to CH5 to CH7 (optional), please read the notes on page 57. 24

Servo travel adjustment

Check the servo travels in the model, and set any limits required for each direction from centre. Move the stick in the appropriate direction before making adjustments to that side of travel. Servo travel for NAUTIC module channels should be set to -150% and +150%. 25



Freely programmable mixer for coupling two speed controllers **Page**

Within *Setup Rotation*, select the appropriate model memory and switch to one of the unused freely programmable mixers, e.g. "A".
In our example we wish to operate two speed controllers from the throttle stick (control function 1); the controllers are connected to receiver outputs 1 and 5. 26

Setting the mixer input and output

Press **INC** to select control function "1", which is the channel required to operate the two speed controllers. If you press **DEC** to select control channel "5" as the output, the stick will simultaneously control the second speed controller too.

Setting the mixer switch

Since this mixer is to be switched on permanently (display "ON"), no further change is required at this point. Note: if you press **INC** / **DEC**, an external switch connected to socket 5 on the transmitter circuit board would automatically be assigned to this mixer, which could then be switched on and off as required.

Programming the mixer ratios

For parallel operation of the two speed controllers enter "+100%". In fact, you may find you need to adjust the mixer value when you operate the model, if you find that the thrust of the two Jet propulsion units is not exactly identical.

Setting the Offset

Ensure that the offset, i.e. the mixer neutral point, is set to "0". To check this, move the stick to its neutral position and press **INC** or **DEC**. You can erase any Offset by pressing **CLEAR**. 27

Adjusting the speed controllers

Now adjust the two speed controllers, as described in the operating instructions supplied with them, to ensure that both controllers respond to the stick commands in the same way, e.g. full throttle, motor stop, EMF brake and any Cut-Off system (to prevent the batteries becoming deep-discharged).

HELICOPTER
Model type description

The mc-12 transmitter's helicopter program features all the essential options for controlling modern model helicopters.

Please adopt a responsible attitude at all times when handling model helicopters!
RC model helicopters are complex flying machines which are not easy to master in the air, and which are capable of flying off at high speed in any direction if not handled carefully and competently. If you are a beginner, please take our advice and ask an experienced model flyer for assistance; your local model club and model flying training centre should be able to help. Model shops and modelling magazines are also good sources of information and help.

In addition to the standard facilities which are available for all model type classes (see pages 20 ... 29), this section explains the helicopter-specific options step by step:

- Idle-up
- Auto-rotation
- Collective pitch curves
- Static torque compensation
- Dynamic torque compensation
- Swashplate mixers

Basic set-up of the model helicopter
Before you make any adjustments using the transmitter's electronic facilities, it is very important that you set up the model's mechanical control systems correctly. This means:

- Adjust all mechanical linkages as described in the instructions supplied with your model helicopter.
- Fit the output lever on each servo in such a way that when the sticks and trims are at centre, the output arm is at right-angles to the pushrod connected to it.
- When the sticks are at the centre position, the swashplate must be exactly horizontal, and the main and tail rotor blades must be set at the pitch angle stated in the helicopter instructions.
- The length of the output arm on the throttle servo must be selected correctly to provide the same linear travel as the carburettor arm, and the pushrod to the carburettor must be adjusted in such a way that the throttle stick moves the carburettor barrel from idle to full-throttle, and the motor can be stopped at the idle position of the throttle stick by full movement of the trim lever. The servo travel must not be restricted or obstructed at any point through the mechanical end-points of the throttle mechanism or linkage.

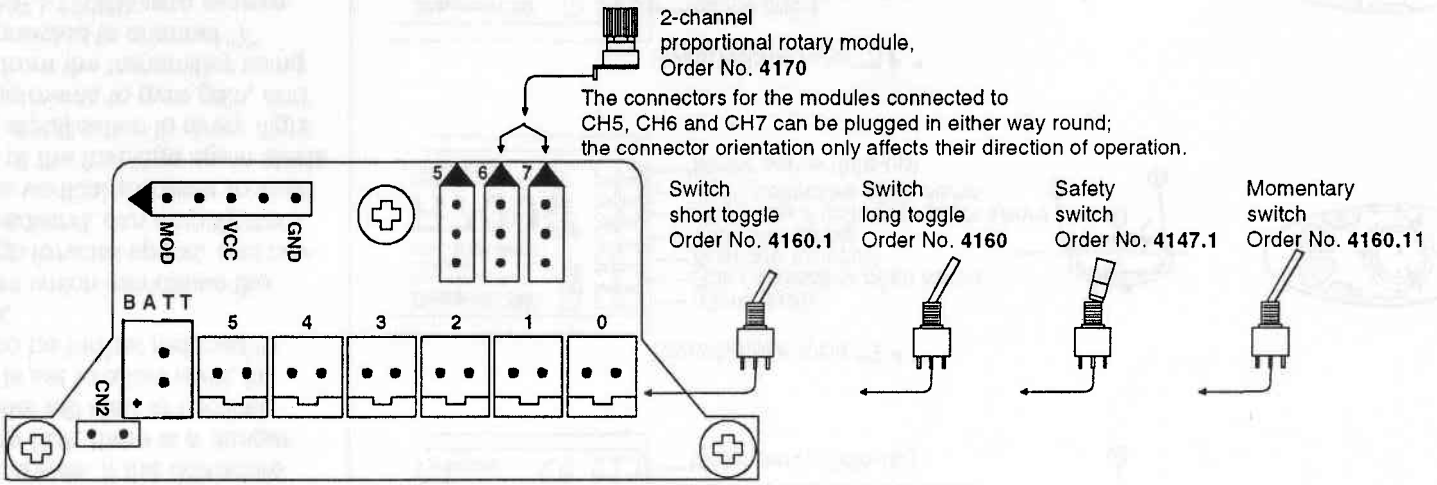
Programming a model helicopter, model type "HE"
The first step in setting up the transmitter for controlling a helicopter is to select the model type in *System Rotation* (see pages 17 ... 19). One important point here is the stick mode, which assigns the control functions roll, pitch-axis, tail rotor and throttle / collective pitch to the two dual-axis sticks. You must also set the direction of the throttle control channel, which determines whether throttle / collective pitch minimum is at the "forward" or "back" position of the stick. These basic settings depend less on the model itself than on the general preference of the pilot.

The model-dependent setup procedure, i.e. adjusting the parameters to suit the individual model helicopter, is carried out in *Setup Rotation*, which is activated by pressing the **ENTER** button after you have switched the transmitter on, or after quitting *System Rotation*; see the section starting on page 20.
The programming procedure for a model helicopter should follow the sequence described below. Note that this differs from the standard code sequence, which has to fulfil internal technical requirements:

Menu	Code	Page
Swashplate type	„SWA"	68
Servo travel reverse	„REV NORM"	24
Servo centre offset	„SB-TRIM"	24
Servo travel adjustment	„TRV ADJ."	25
Idle-up	„GL1/0"	70
Auto-rotation	„ATR"	71
Pitch curve	„PH"	72
Static torque compensation	"STA"	74
Dynamic torque compensation	"DYN"	74
Dual rates	"D/R"	21
Exponential	"EXP"	21
Expo/Dual Rate		22
Storing trim offsets	"EXP OFFSET"	22
Freely programmable mixers*	"A, B, C"	26

** These mixers are not generally necessary for helicopter applications, and are only likely to be useful for non-standard auxiliary functions. However, if you do wish to set up and use one of the free mixers, please be sure to read the "Notes" on page 27 of the manual. In particular, remember that a transmitter control connected to CH6 on the transmitter circuit board is dedicated to fine adjustment of the collective pitch servo, and for this reason the control travel on this channel is limited to 25%.*

Connecting control elements to the transmitter circuit board for the Helicopter program



In the helicopter program six external switches can be connected to sockets 0 to 5, and their functions are as follows (see also page 13):

0	D/R / Expo "roll-axis"
1	D/R / Expo "pitch-axis"
2	D/R / Expo "tail-rotor"
3	Auto-rotation and freely prog. mixer "C"
4	Idle-up and freely prog. mixer "B"
5	Freely programmable mixer "A"

Two additional rotary modules (Order No. **4170**) can also be connected to sockets CH6 and CH7:

CH6	Overall collective pitch trim In a model helicopter the throttle / collective pitch stick operates the throttle servo and the collective pitch servo simultaneously. A rotary knob connected to CH6 can be used to adjust the collective pitch setting individually, i.e. separately from the throttle servo. Maximum trim travel is 25% of full movement.
CH7	Gyro gain adjustment*

*** Notes regarding gyro gain:**
Some gyros, e.g. the *GRAUPNER/JR* PIEZO 450, 900, 2000 and 3000 gyro systems, permit infinitely variable proportional adjustment of gyro gain from the transmitter, via a rotary module connected to socket CH7 on the transmitter circuit board. At the "-100%" end-point of the rotary module, gyro gain is reduced to zero; at "+100%", gyro gain is at its maximum. If you wish, you can reduce the range of effect of the rotary module by limiting servo travel using the "TRV ADJ" facility. You can also change the direction of effect of the rotary module using servo reverse "REV NORM".

The facility of (static) variation of gyro gain allows you, for example, to fly the helicopter at "normal" slow speed with maximum gyro stabilisation, and to reduce gyro gain for high-speed circuits and aerobatics.

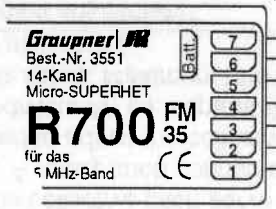
Setting up the gyro system:
If you wish to set up the gyro system to provide maximum possible stabilisation of the helicopter

- around the vertical (yaw) axis, please note the following important points:
- The tail rotor control system should be as free-moving as possible.
- The pushrod must have no "spring" or slop in it.
- Use a powerful, high-speed tail rotor servo.

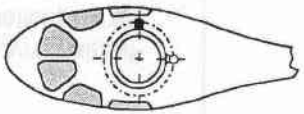
When the gyro system detects an unwanted rotation of the model, it sends a corrective signal to the rudder servo. The faster this signal is converted into a corresponding correction in the tail rotor, the more you can advance gyro gain by rotating the rotary module "7", without causing the tail of the model to oscillate (wag to and fro). The higher the gain, the better the model's stability around the vertical axis. If the corrective circuit is not sufficiently fast, there is a danger that the tail of the model will start to oscillate even when gyro gain is set to a low level, in which case gain has to be further reduced to eliminate the problem.
There are other factors which can cause the gyro to over-react: high forward speed, and hovering in a powerful headwind, can amplify the stabilising effect of the vertical stabiliser to such an extent that the tail of the fuselage again starts to oscillate. Optimum stabilisation in every flight situation calls for adjustments to gyro gain, and this can be achieved from the transmitter using the rotary module connected to channel "7".
(If you are using the NEJ-120BB gyro system (Order No. 3277 - now discontinued), please note the information in the operating instructions regarding setting up the two gyro adjustors).

Receiver socket sequence for the model type "Helicopter"

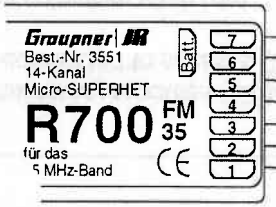
Swashplate type "N"



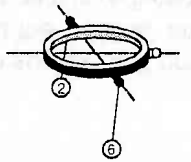
(Gyro gain)
Collective pitch servo
Auxiliary function
Tail rotor servo
Pitch-axis servo
Roll-axis servo
Motor servo (idle-up)

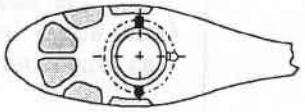


Swashplate type "2"

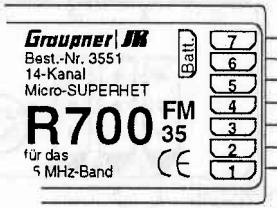


(Gyro gain)
Roll / collective pitch servo
Auxiliary function
Tail rotor servo
Pitch-axis servo
Roll / collective pitch servo
Motor servo (idle-up)

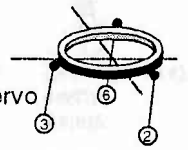


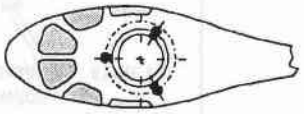


Swashplate type "3 ┤ "

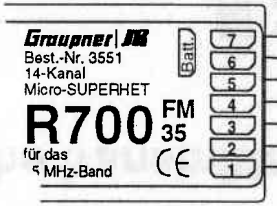


(Gyro gain)
Roll / collective pitch servo
Auxiliary function
Tail rotor servo
Pitch-axis / collective pitch servo
Roll / collective pitch servo
Motor servo (idle-up)

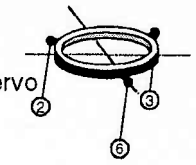


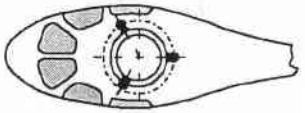


Swashplate type "3 ┣ "



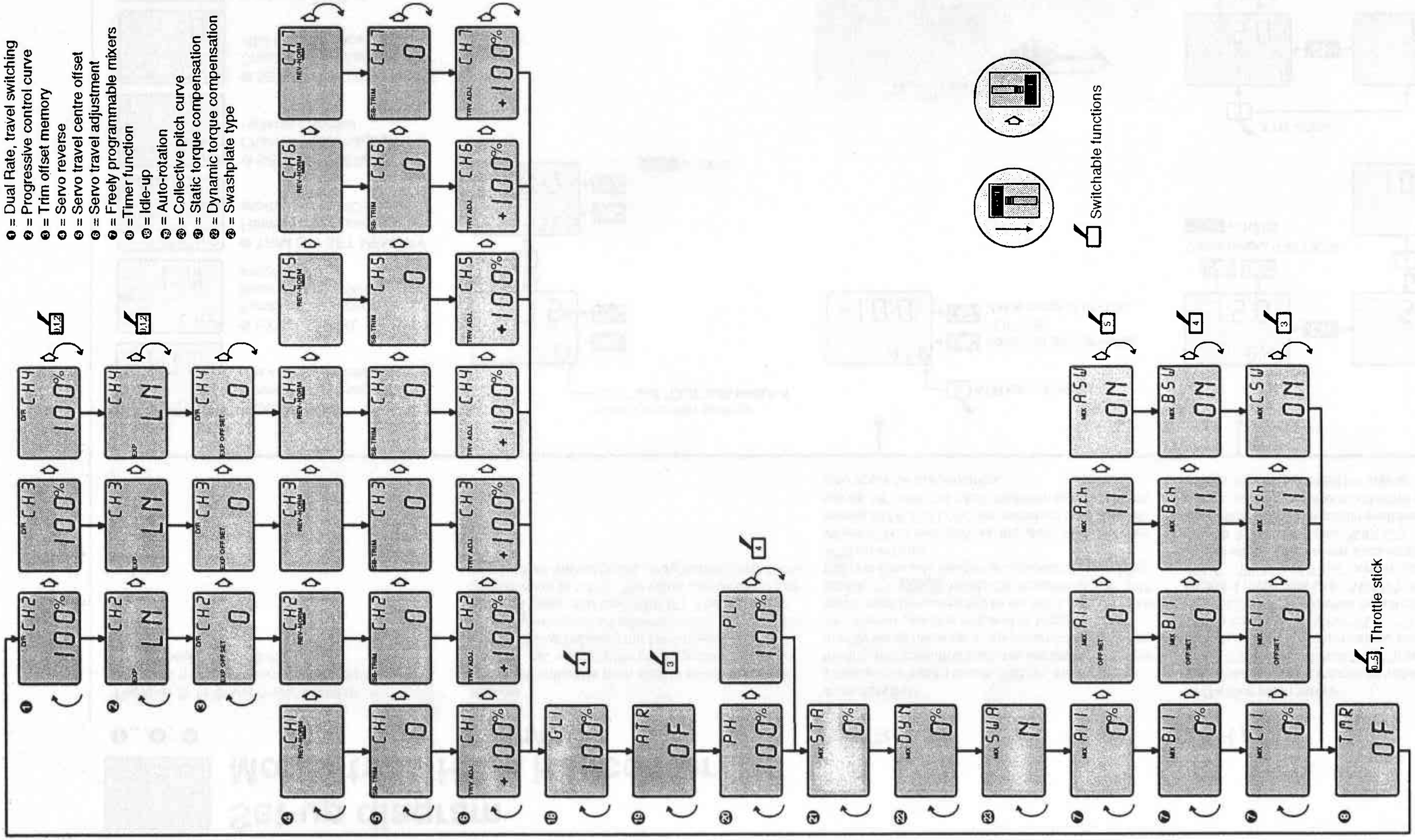
(Gyro gain)
Roll / collective pitch servo
Auxiliary function
Tail rotor servo
Pitch-axis / collective pitch servo
Roll / collective pitch servo
Motor servo (idle-up)

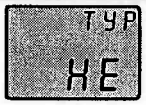




Setup Rotation HELICOPTER

1 = Dual Rate, travel switching
2 = Progressive control curve
3 = Trim offset memory
4 = Servo reverse
5 = Servo travel centre offset
6 = Servo travel adjustment
7 = Freely programmable mixers
8 = Timer function
18 = Idle-up
19 = Auto-rotation
20 = Collective pitch curve
21 = Static torque compensation
22 = Dynamic torque compensation
23 = Swashplate type





Set-up diagram
Model type HE = Helicopter

❶...❻, ❽

Facilities ❶ to ❻ and ❽ are available for all model types. See page 26 for details of the freely programmable mixers

⑱ GL1/0

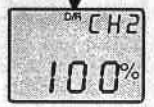
Idle-up
When the collective pitch stick is below the hover position, i.e. normally the centre position, you can switch idle-up between the two values "GL1" and "GL0" by means of an external switch connected to socket 4 (note dual use: "MIX B"). The initialised default value is 100%. The value can be set to any value within the range 0% (drag throttle) and 150%.

⑲ ATR

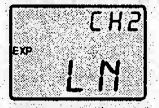
Auto-rotation
When auto-rotation is switched on, the functions throttle and collective pitch are separated, and the throttle servo takes up a pre-programmed position. An external switch is required to trigger ATR, and it must be connected to socket 3 (note dual use: 93MIX C"). CLEAR resets the function to "OF" (off); this prevents any danger of accidentally switching ATR on in flight.
When ATR is switched on, the static and dynamic mixers (STA and DYN) are switched off. Different values for collective pitch minimum and maximum also apply for auto-rotation.

⑳ PH / PL

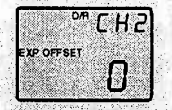
Collective pitch curve
Two collective pitch maximum values (normal mode "PH", auto-rotation "PHA"), and three collective pitch minimum values are available. These are: normal mode "PL1", "PL0", which is switchable via an external switch connected to socket 4 (note dual use: "MIX B"), and auto-rotation "PLA". "PHA" and "PLA" contain the collective pitch values which apply when auto-rotation is active (switch 3, note dual use: "MIX C").
As switch 4 simultaneously switches between two idle-up settings, different collective pitch minimum values are programmed for idle-up 1 and 0.



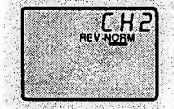
❶ DUAL RATE
Function 2 to 4, page 21
0 to +125%, switchable



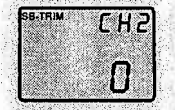
❷ EXPONENTIAL
Function 2 to 4, page 21
linear (LN) to +100%, switchable



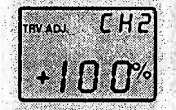
❸ TRIM OFFSET MEMORY
Function 2 to 4, page 22
approx. -50 to +50 steps



❹ SERVO REVERSE
Channel 1 to 7, page 24
Reverse / Normal

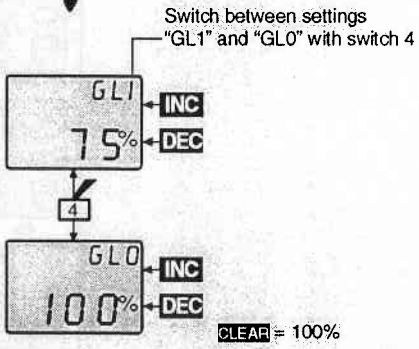


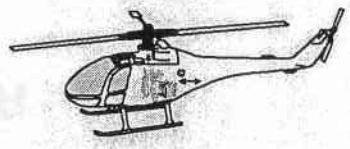
❺ SERVO CENTRE OFFSET
Channel 1 to 7, page 24
-150 to +150 steps

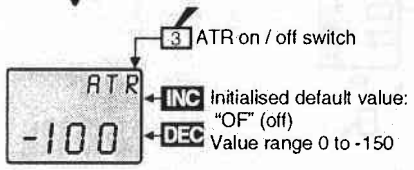


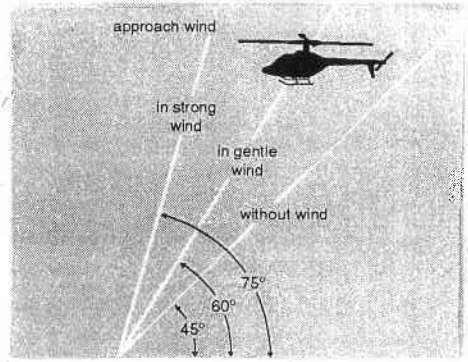
❻ SERVO TRAVEL ADJUSTMENT
Channel 1 to 7, page 25
0 to +/- 150%

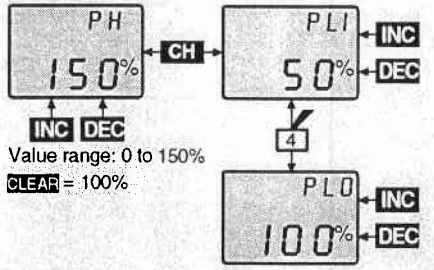
❽ STOPWATCH and ALARM TIMER, page 28
forward / reverse, max. 900 sec
Can also be controlled by control function 1

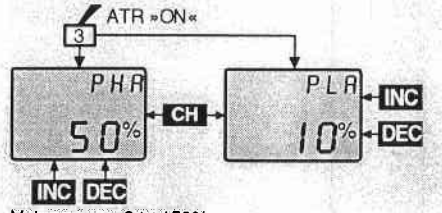


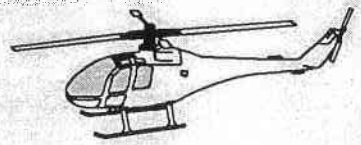






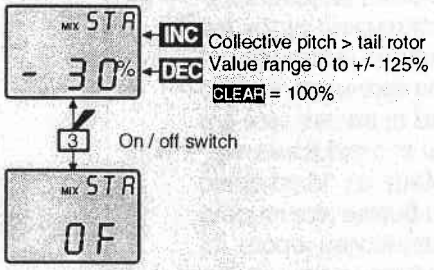




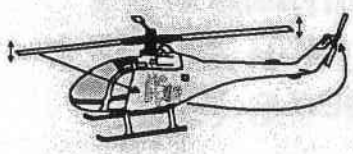


㉑ MIX STA

Static torque compensation
The mixer ratio for the collective pitch / tail rotor mixer can be set within the range -125% to +125% using the INC / DEC buttons.
The direction of mixing depends on the direction of main rotor rotation. The travel of the tail rotor servo varies according to the collective pitch maximum and minimum values you have selected, and is set by adjusting the mixer ratio.
The static mixer is switched off automatically when auto-rotation is selected.

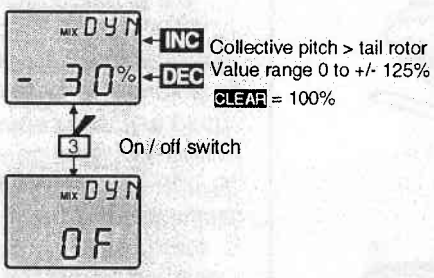


Note re. switch 3:
Dual use: "MIX"

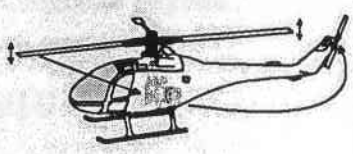


㉒ MIX DYN

Dynamic torque compensation
This collective pitch / tail rotor mixer works during the acceleration phase of the main rotor, i.e. when its rotational speed rises or falls. Primarily the mixer is intended for model helicopters which do not feature collective pitch. Use the INC / DEC buttons to enter the mixer ratio and direction.
The dynamic mixer is switched off automatically when auto-rotation is selected.

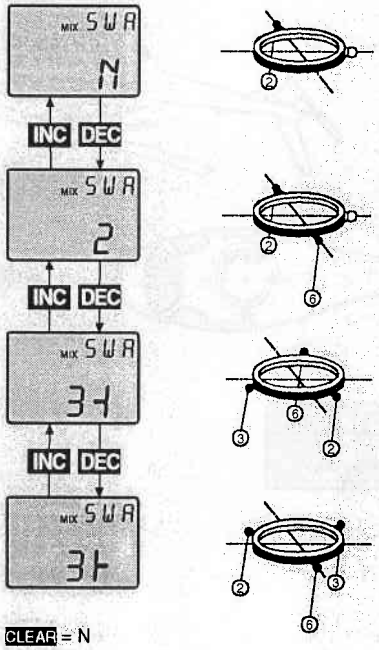


Note re. switch 3:
Dual use: "MIX"



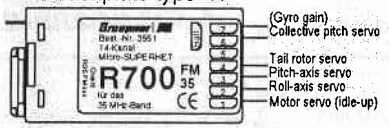
㉓ MIX SWA

Swashplate type (swash mixer)
Four different programs are provided for the swashplate type:
"N": = 1 pitch-axis servo, 1 roll-axis servo, 1 collective pitch servo
"2": = 2 roll / collective pitch servos for simultaneous roll-axis and collective pitch control, 1 pitch-axis servo
"3H": = 2 roll / collective pitch servos, 1 pitch-axis / collective pitch servo at front for simultaneous three-point swashplate control, 120° servo arrangement
"3P": = 2 roll / collective pitch servos, 1 pitch-axis / collective pitch servo at rear for simultaneous three-point swashplate control, 120° servo arrangement

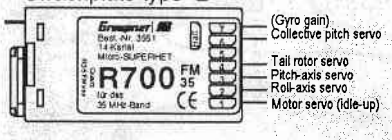


Receiver socket sequence, HELICOPTER model type
The servos should be connected to the receiver in the order shown in the drawings below, according to the swashplate type you have selected.
Output 5 can be used for a NAUTIC Multi-Split decoder if necessary; please read the notes on page 57.

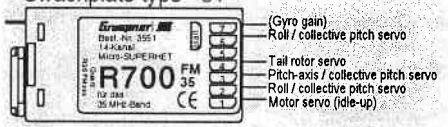
Swashplate type "N"



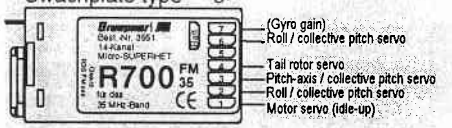
Swashplate type "2"



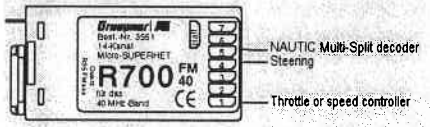
Swashplate type "3H"

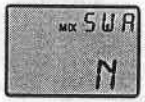


Swashplate type "3P"



NAUTIC-CAR





Swashplate type

Mixer for different types of swashplate linkage

The mc-12 transmitter includes four different programs designed to control a helicopter swashplate:

»N«: (Normal) The swashplate is tilted by the roll and pitch-axis servos, but it does not move axially, i.e. along the rotor shaft. Collective pitch is controlled by a separate servo. This swashplate type is also used for model helicopters which incorporate mechanical mixing of collective and cyclic blade pitch, i.e. they also count as type "N".

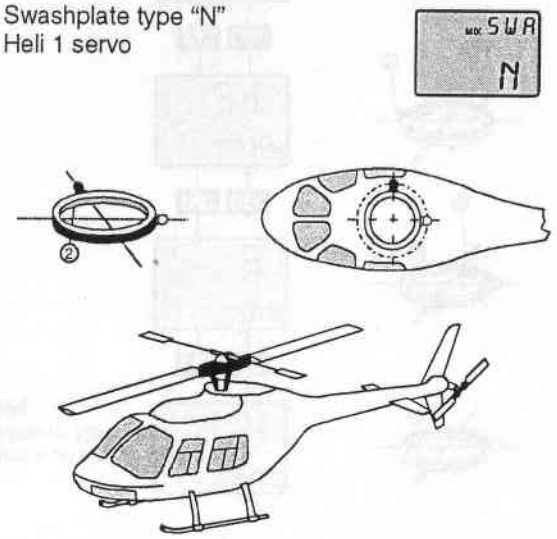
»2«: The swashplate is moved axially by two roll-axis servos to provide collective pitch control; pitch-axis control is de-coupled by a mechanical compensating rocker (original HEIM mechanics).

»3 H«: Symmetrical three-point control of the swashplate by three linkage points, arranged at 120° to each other, with one pitch-axis servo at the front and two roll servos, one on each side. All three servos move the swashplate axially (along the rotor shaft) to provide collective pitch control.

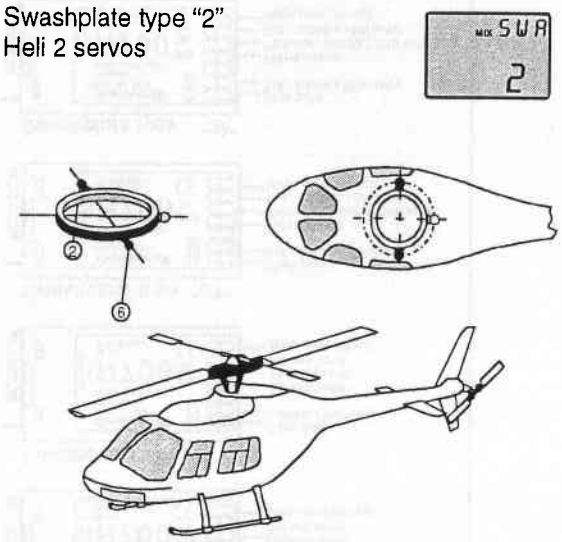
»3 H«: As above, but with the pitch-axis servo arranged at the rear.

The swashplate type is selected using the code "SWA" and the **INC / DEC** buttons. **CLEAR** resets the swashplate type to the default "N".

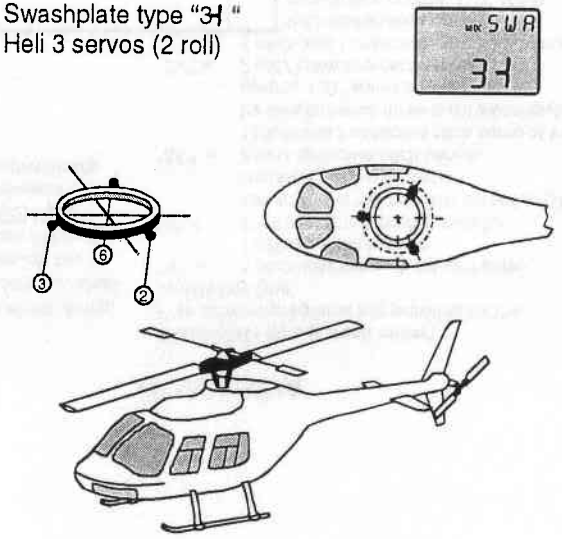
Swashplate type "N"
Heli 1 servo



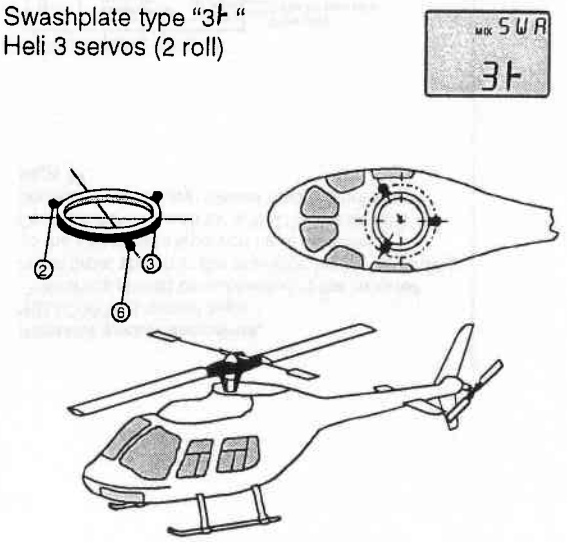
Swashplate type "2"
Heli 2 servos



Swashplate type "3H "
Heli 3 servos (2 roll)



Swashplate type "3H "
Heli 3 servos (2 roll)



General notes on the inter-action of throttle and collective pitch

The inter-action between throttle and collective pitch, i.e. the match between the motor's power curve and the collective pitch angle of the main rotor blades, is the most important factor when setting up any model helicopter. The aim of this process is to achieve constant rotational speed of the main rotor over the full range of collective pitch in flight, and to ensure that the hover point of the helicopter is located as accurately as possible at the centre point of the throttle / collective pitch stick.

The first step should always be to adjust the throttle servo pushrod mechanically as carefully as possible, to enable you to fine-tune the settings of the throttle and collective pitch servos accurately. Ensure in particular that the throttle servo is not mechanically obstructed or stalled when the carburettor is fully open or closed, otherwise it will be under constant load and draw a heavy current.

The trim lever for control function 1 affects both the throttle servo and the collective pitch control system. When the model is in the air, the trim lever should be left at the forward stop (or at the bottom stop if you have reversed the direction of the throttle / collective pitch stick in *System Rotation*). The carburettor and its linkage should be adjusted so that the carburettor is just completely open when the throttle / collective pitch stick is at the full-throttle position. At the idle position of the stick it should be possible to stop the motor reliably by moving the trim lever to the opposite end-point. Mechanical adjustment of the collective pitch system should be continued to the point where the model hovers more or less correctly on its own; this is usually the case provided that you follow the set-up instructions supplied by the kit manufacturer. The settings are correct if the model lifts off when the collective pitch stick is at centre, and then hovers at the correct motor speed. If this is not the case, use the following procedure to correct them.

Take care over this procedure, as all further adjustments are based on it!

The model does not lift off until the collective pitch stick is advanced past the centre point

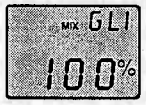
1. Motor speed too low:	Remedy: open the carburettor further by shifting the throttle servo centre using "SB TRIM", then reduce servo travel in the "full throttle" direction until the carburettor can just be fully opened, but the servo is not mechanically stalled.
2. Motor speed too high:	Remedy: increase the main rotor pitch angle in flight, for example, by rotating the rotary module connected to CH6, and then adjust the pushrod from the swashplate to the blade pitch arms accordingly.

The model lifts off before the collective pitch stick is advanced to the centre point.

1. Motor speed too high:	Remedy: close the carburettor further by shifting the throttle servo centre using "SB TRIM", then adjust servo travel in the "full throttle" direction until the carburettor can just be fully opened, but the servo is not mechanically stalled.
2. Motor speed too low:	Remedy: reduce the main rotor pitch angle in flight, for example, by rotating the rotary module connected to CH6, and then adjust the pushrod from the swashplate to the blade pitch arms accordingly.

Note:
Persevere with these adjustments until the model hovers smoothly at the centre setting of the throttle / collective pitch stick, with the rotor turning at the correct speed; the carburettor should be just fully open when the stick is at the full throttle position.

Von der korrekten Ausführung ist die gesamte weitere Einstellung abhängig!



Idle-up

Pre-setting the "throttle low" point

•The purpose of this code is to set a stable idle speed for the motor when the mechanical trim lever is left in the forward position, as described above.

If a switch (Order No. **4160** or **4160.1**) is connected to socket 4 in the transmitter, it is possible to switch to a second, higher idle speed, which is generally termed "idle-up".

The primary aim of idle-up is to prevent the system rotational speed falling too far when collective pitch is reduced below the hover point. Logically then, idle-up must only take effect when the collective pitch stick is below the hover position, i.e. normally the centre setting.

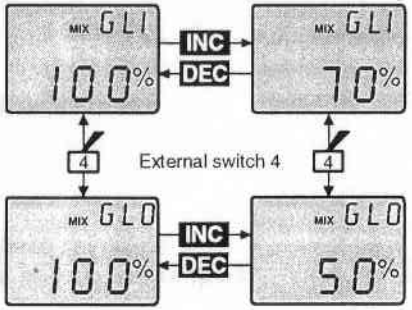
Set-up

When you select the program, the screen will show "GL1" or "GL0" (GL = Gas Low), depending on the position of the switch. The idle settings "Idle-up 1" and "Idle-up 0" can be adjusted to any point within the range 0 to 150% using the **INC** and **DEC** buttons.

(**CLEAR** = reset to 100%. The **CH** button has no effect in this program).

For the idle setting we suggest that you select the switch setting "GL0". Now adjust the idle setting in such a way that the motor can be started at the idle position of the throttle / collective pitch stick, and runs at a stable speed without any danger of the centrifugal clutch engaging.

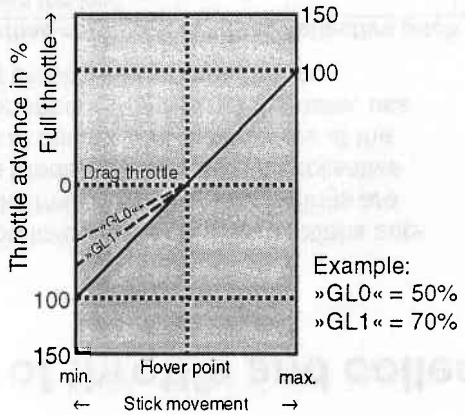
The second setting - corresponding to switch position "GL1" - should now be selected in such a way that the model can be allowed to descend from forward flight at great altitude with collective pitch reduced to its full extent, without the rotational speed either increasing or falling off. The transition point should correspond to the hover, i.e. the centre position of the collective pitch stick.



Value range: 0 to 150%
CLEAR = 100%

Please note:

External switch 4 also switches between different collective pitch minimum values in the "Collective pitch curve" program (see page 72).



Note:

When you have sufficient experience handling model helicopters you may prefer to reduce the idle-up setting to "0%", which produces the "drag throttle" situation, which is a borderline case. With this arrangement the throttle is not influenced by the collective pitch control system below the transition point, and instead stays at a constant value corresponding to the stick position at the set transition point. Above the transition point the throttle follows collective pitch in the normal way. In many model helicopters a drag throttle set-up of this type can be advantageous for aerobatics; however, for models with HEIM mechanics this setting should be avoided. If you prefer the drag throttle mode, and you shift the transition point to just below the hover setting, you will find that this gives an advantage in the hovering manoeuvres of the FAI competition program, as it enables you to run up the rotor to full speed during the lift-off phase. In some cases idle-up is also used to increase the system rotational speed for particular flight manoeuvres, mostly in the case of model helicopters whose flexible rotor design does not permit constant rotational speed for hovering and aerobatics. In such situations idle-up should be adjusted so that its effect extends beyond the hover range. In both cases the transition point could be implemented by means of a 7 → 1 mixer, provided that control function 7 is not already in use (perhaps for gyro gain adjustment). The mixer ratio determines the offset of the transition point. If the mixer offset is set at one of the end-points of control function 7, then you can determine whether the transition point should be moved up

Auto-rotation

or down with reference to the hover point. If the mixer "MIX B" is also used, and if you arrange external switch 4 to switch it on and off, it is possible to switch between the normal idle-up (transition point at collective pitch stick centre point) using the idle-up setting "GL0" (for example), and the "GL1" setting, which would be idle-up with an offset transition point.

However, for normal flying and aerobatics these settings are not recommended, as they would cause a major change in system rotational speed during a steep descent, which could in turn result in instability in the model's overall set-up.

Emergency landing system

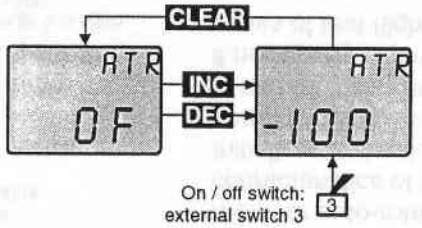
The term 'auto-rotation' refers to a flight situation in which the pitch of the main rotor blades is set in such a way that the air flowing through them during a descent keeps the rotor spinning at high speed. The energy stored in the blades in this way can then be transformed into upthrust by changing the pitch angle at the bottom of the descent. This allows the model to flare out and land more or less safely.
Auto-rotation is used both by full-size helicopters and model helicopters as a means of landing safely without power, e.g. if the motor fails.
The main requirement for a successful "auto" landing is a skilful, experienced pilot who is familiar with his machine. Fast responses and good judgement are necessary, as the rotational energy stored in the spinning rotor can only be exploited to flare out once.
When auto-rotation is called in a competition, the motor must be stopped completely for the manoeuvre. However, for practising "autos" it is better to keep the motor running at idle during the auto-rotation, so that full throttle can be applied immediately if the situation becomes critical.

Set-up:
Auto-rotation can only be activated using an external switch connected to socket 3 on the transmitter circuit board (note dual use: "MIX C").
When auto-rotation is switched to active, the functions "throttle" and "collective pitch" are separated, the throttle servo runs to a position preset in the "ATR" program, and collective pitch is controlled in the usual way by the collective / throttle stick.

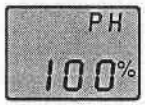
At the same time the following programs are switched off:

- "STA" mixer, for static torque compensation (collective pitch > tail rotor, see page 74)
- "DYN" mixer, for dynamic torque compensation (collective pitch > tail rotor, see page 74).
- Collective pitch maximum (high) "PH" and collective pitch minimum (low) "PL", take up the auto-rotation settings "PHA" and "PLA"; see page 72.

When you call up the ATR program the screen initially shows "ATR OF" (off). Press **INC** or **DEC** to activate auto-rotation, and you can then set the position of the throttle servo for auto-rotation within the range 0 ... -150. The exact value must be found by practical experiment.
If you do not intend to use the ATR function, you should switch it off with the **CLEAR** button (screen shows "OF" - off), in order to eliminate any danger of activating it accidentally by operating the relevant external switch.



Value range: 0 to -150
Note re. switch 3:
Note dual use: "MIX C"!



Collective pitch curve

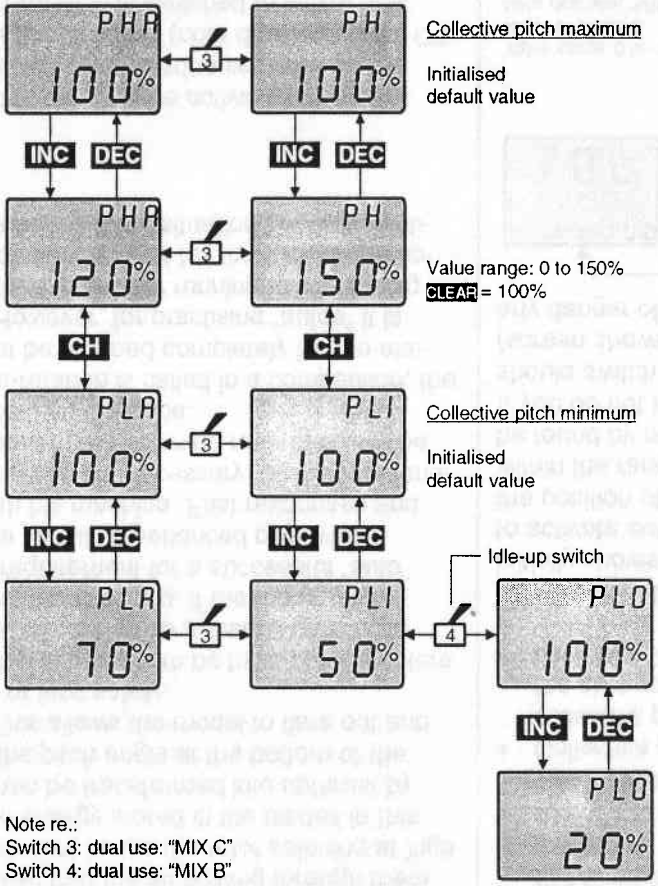
Setting collective pitch maximum and minimum

This code is used to store the collective pitch maximum values for the two flight states "normal flight" and "auto-rotation", and the separate collective pitch minimum values for "normal flight", "normal flight with idle-up" and "auto-rotation".
Use the **CH** button to select collective pitch maximum (PH = Pitch High) and collective pitch minimum (PL = Pitch Low). External switch 3 is used to switch between "normal flight" and "auto-rotation", while the idle-up switch 4 is responsible for switching between "normal flight" and "normal flight with idle-up" (note dual use: "MIX B".)
The screen displays the value which is currently being adjusted:

»PH« = Collective pitch maximum, normal flight
»PHA« = Collective pitch maximum, auto-rotation
»PL1« = Collective pitch minimum, normal flight
»PL0« = Collective pitch minimum, normal flight with idle-up
»PLA« = Collective pitch minimum, auto-rotation

Use the **INC** and **DEC** buttons to set the values within the range 0 ... 150%. **CLEAR** resets collective pitch minimum and maximum to the initialised default values of 100% servo travel.

The collective pitch maximum setting for normal flight should be set at a value which maintains constant main rotor rotational speed if full throttle / collective pitch is applied from the hover.
If system rotational speed collapses when you do this, you need to reduce the collective pitch maximum value; if the rotational speed rises, you need to increase the collective pitch maximum value. The setting varies according to the power of the motor you are using.



The main factor which determines the optimum value for collective pitch maximum for auto-rotation is the aerodynamic characteristics of the main rotor blades. Initially you should set a value which corresponds to collective pitch maximum in normal flight, then increase the setting if necessary when you have carried out a series of test flights.

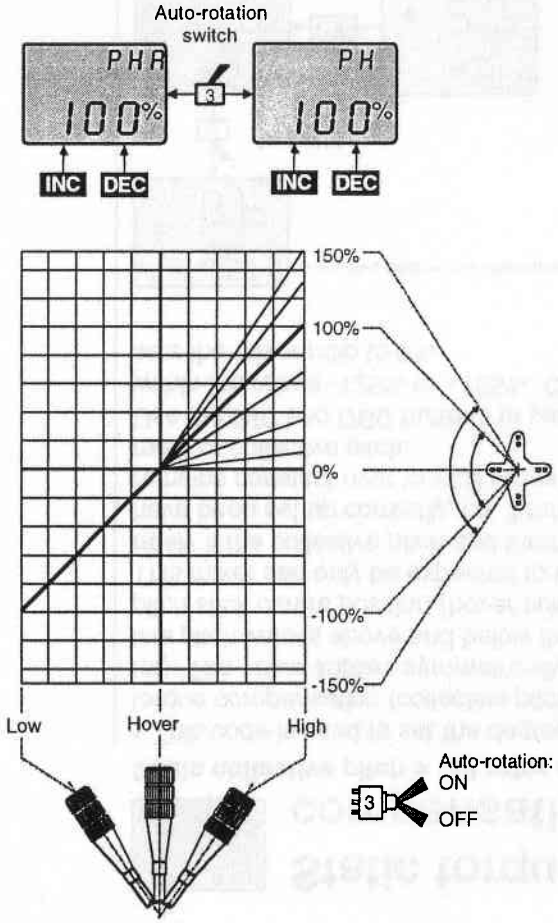
Collective pitch minimum for normal flying, and for flying with idle-up, should be set in such a way that the model descends from fast forward flight at an angle of about 60 ... 80 degrees if the throttle / collective pitch stick is pulled back to its full extent. At the same time the idle-up setting should be adjusted to ensure that the rotational speed of the main rotor stays constant during the descent. Collective pitch minimum without idle-up can be set to a lower value if you wish to practise your hovering skills.

Collective pitch minimum for auto-rotation is approximately the same as the setting for normal flight with idle-up; the fine tuning can be carried out according to individual preferences.

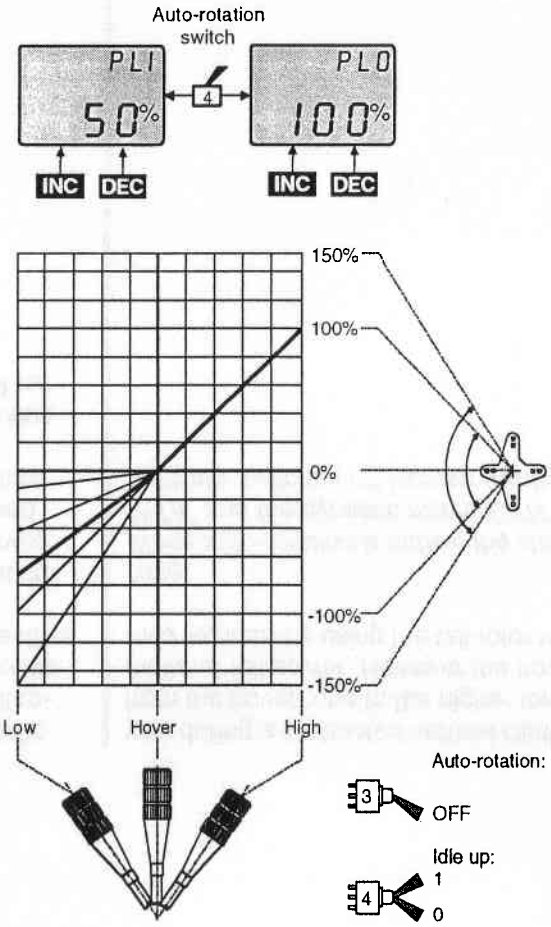
See page 73 for examples of typical collective pitch curves.

Examples of collective pitch curves

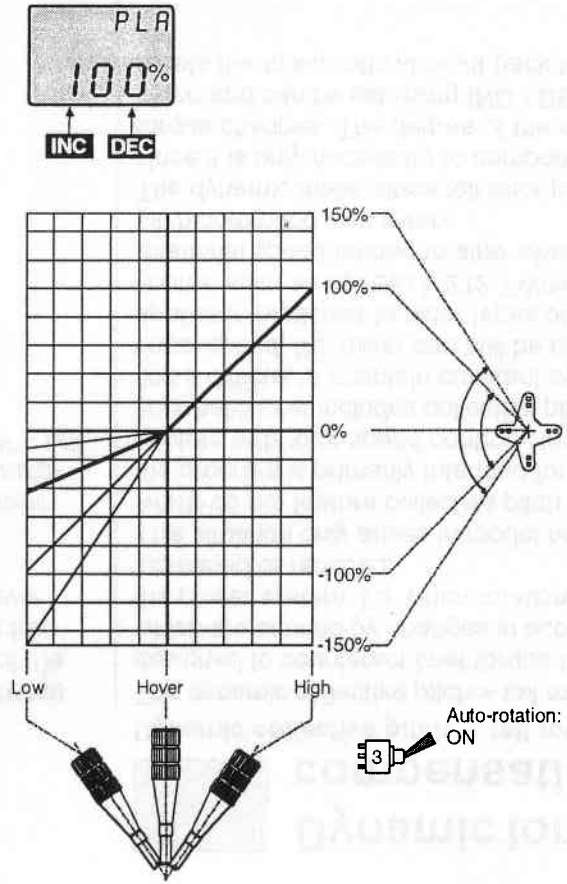
Pitch High
This program is used to set the upper value for collective pitch.
External switch 3 can be used to switch to increased collective pitch values for auto-rotation landings.



Pitch Low - idle-up 0: "GL0"
- idle-up 1: "GL1"
Different collective pitch low values can be programmed for the two idle-up settings "GL0" and "GL1".



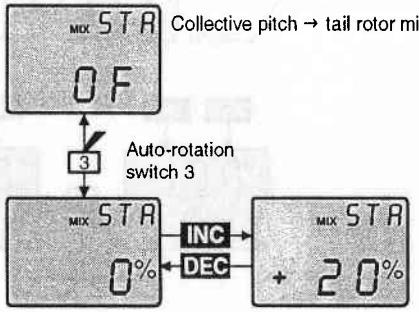
Pitch Low - auto-rotation
For auto-rotation you can program a separate collective pitch low value, independent of the idle-up switch position.



Static torque compensation

Static collective pitch > tail rotor mixer

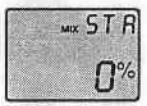
• This code is used to set the degree of static torque compensation (collective pitch > tail rotor). The value applies symmetrically for collective pitch values above and below the collective pitch stick centre position (hover point).
This mixer can only be expected to work accurately if the collective pitch and throttle curves have been set up correctly, i.e. if rotor speed remains constant over the full range of adjustment of collective pitch.
Use the **INC** and **DEC** buttons to set the value within the range -125% to +125%. **CLEAR** resets the mixer ratio to 0%.



Value range: 0 to ±125%
CLEAR = 0%

Mixer direction:
The mixer direction varies according to the direction of main rotor rotation: for right-hand rotation systems (main rotor turns clockwise as seen from above), you must set a negative value; left-hand rotation rotors require a positive value.
The aim when setting up this mixer is to find a value at which the helicopter does not tend to yaw during a protracted vertical climb, initiated from the hover, due to the higher torque of the motor at full power. However the hover is trimmed exclusively using the tail rotor trim lever.

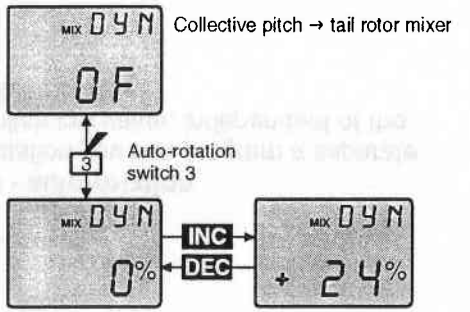
Note:
When auto-rotation is active, the static mixer "STA" and the dynamic mixer "DYN" are automatically switched off (screen display "OF" - off).



Dynamic torque compensation

Dynamic collective pitch → tail rotor mixer

The dynamic collective pitch > tail rotor mixer is designed to counteract brief torque fluctuations which are caused by changes in acceleration in the power system, i.e. when rotational speed is increased or reduced.
This situation only arises in model helicopters which do not feature collective pitch control, so the program is primarily intended for model helicopters with rotor speed control. However, if your helicopter includes collective pitch, but you find it difficult to maintain constant system rotational speed, the mixer can still be useful. This applies in particular to older types of model helicopter, such as the BELL 212 TWIN JET, whose rotational speed tended to alter when a collective pitch command was given.
The dynamic mixer alters tail rotor pitch briefly, since it is only necessary to compensate for brief torque changes. The degree of the corrective command can be set using **INC / DEC**. **CLEAR** resets the mixer ratio straight back to 0%.



Value range: 0 to ±125%
CLEAR = 0%

For your notes

Mixer direction
The mixer direction varies according to the direction of main rotor rotation: for right-hand rotation systems (main rotor turns clockwise as seen from above), you must set a negative value; left-hand rotation rotors require a positive value.
If you have a modern model helicopter, all of which are flown with constant rotor speed over the full range of collective pitch, this mixer is not required, and should therefore not be activated.

Note:
When auto-rotation is active, the static mixer "STA" and the dynamic mixer "DYN" are automatically switched off (screen display "OF" - off).

Programming example
Model type HELICOPTER "HE"

The following programming example shows just how little effort is required to program the mc-12 transmitter so that you can use it to fly a simple model helicopter, such as the H-Trainer 2000, Order No. **1292.N**.
We assume that you have carried out the mechanical adjustments as described in the helicopter instructions.

Model helicopters do require more than usual attention and care. Be sure to read and observe all the safety notes included in the kit instructions concerning the handling of these models. If you are a newcomer, please do not be tempted to fly your new model helicopter on your own; it is really not possible without the assistance of an experienced pilot, not least because model helicopters must be considered to be dangerous flying objects if they get out of control. Our advice is to enquire at a model flight training centre or join a good local model club before you even think about flying your model yourself.
The model in question is operated using a total of five servos. A gyro system for tail rotor stabilisation is looped in between receiver output 4 and the tail rotor servo. Gyro gain is adjusted by a rotary module connected to channel 7. If a rotary module is connected to input CH6 on the transmitter circuit board, the collective pitch function can be trimmed separately from the throttle servo. This is a dedicated helicopter function, and for this reason travel is limited to 25% of the normal full value. An external switch is set up in the auto-rotation menu, but in this case solely to allow the pilot to cut the motor immediately.

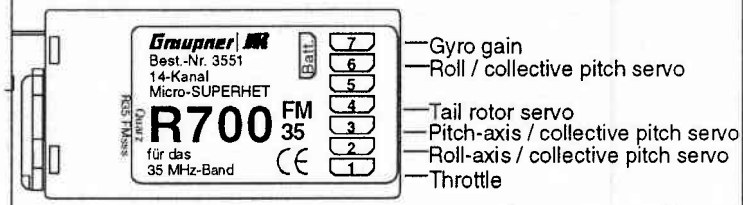
Standard model helicopter with symmetrical three-point linkage (Heim system)

Transmitter accessories required

2 rotary modules
Order No. **4170**

External switch
Order No. **4160**

Receiver socket sequence



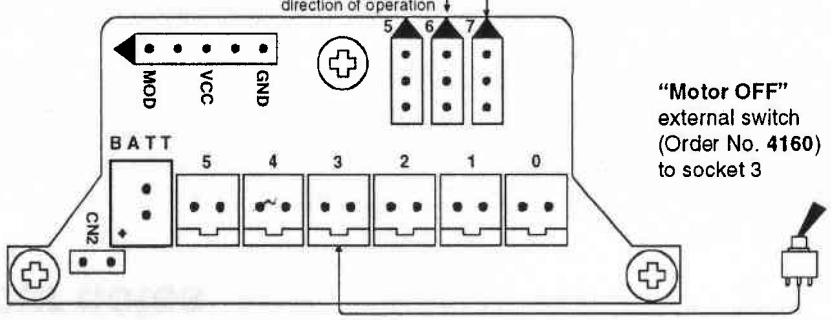
- Gyro gain
- Roll / collective pitch servo
- Tail rotor servo
- Pitch-axis / collective pitch servo
- Roll-axis / collective pitch servo
- Throttle

Transmitter circuit board connections

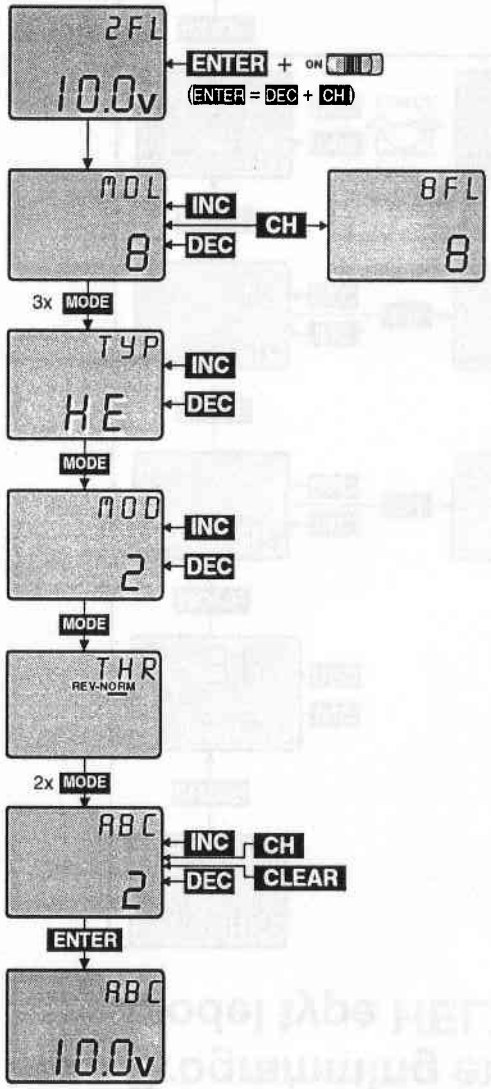
Rotary module for collective pitch trim
Connect to CH6

Rotary module for gyro gain
Connect to CH7

Connector orientation only changes direction of operation



"Motor OFF"
external switch
(Order No. **4160**)
to socket 3



Switch on System Rotation to program the basic settings **Page**

Press both rocker buttons down (= **ENTER**) and at the same time switch on the transmitter. *System Rotation* can only be activated when you switch on the transmitter. This avoids the danger of accidentally making crucial changes in flight, e.g. switching model memory. 17

Model selection

Select a vacant model memory (1 to 8) using **INC** / **DEC**, e.g. "8". Press **CH** to display the current model name (in this case: "8" = model memory, "FL" = model type Unifly). 17

Model type

Use **INC** or **DEC** to select the model type for the selected model memory "8"; in this case: "HE". When you complete this change, all the contents of that memory are reset to the default values. If it is not necessary to re-program the model type to "HE" for the currently selected model memory ("8"), you should now reset the memory to the default values using the "RST" menu. 18

Stick mode 1 ... 4

"2": Collective pitch + throttle / tail rotor on the left-hand stick, pitch-axis / roll on the right-hand stick. The receiver output sequence is not affected by the stick mode. The assignment of the two dual-axis sticks is entirely a matter of your personal preference. 19

Direction of throttle control

Leave this at the "NORM" setting, if collective pitch maximum and full throttle are to be located at the "stick forward" position.

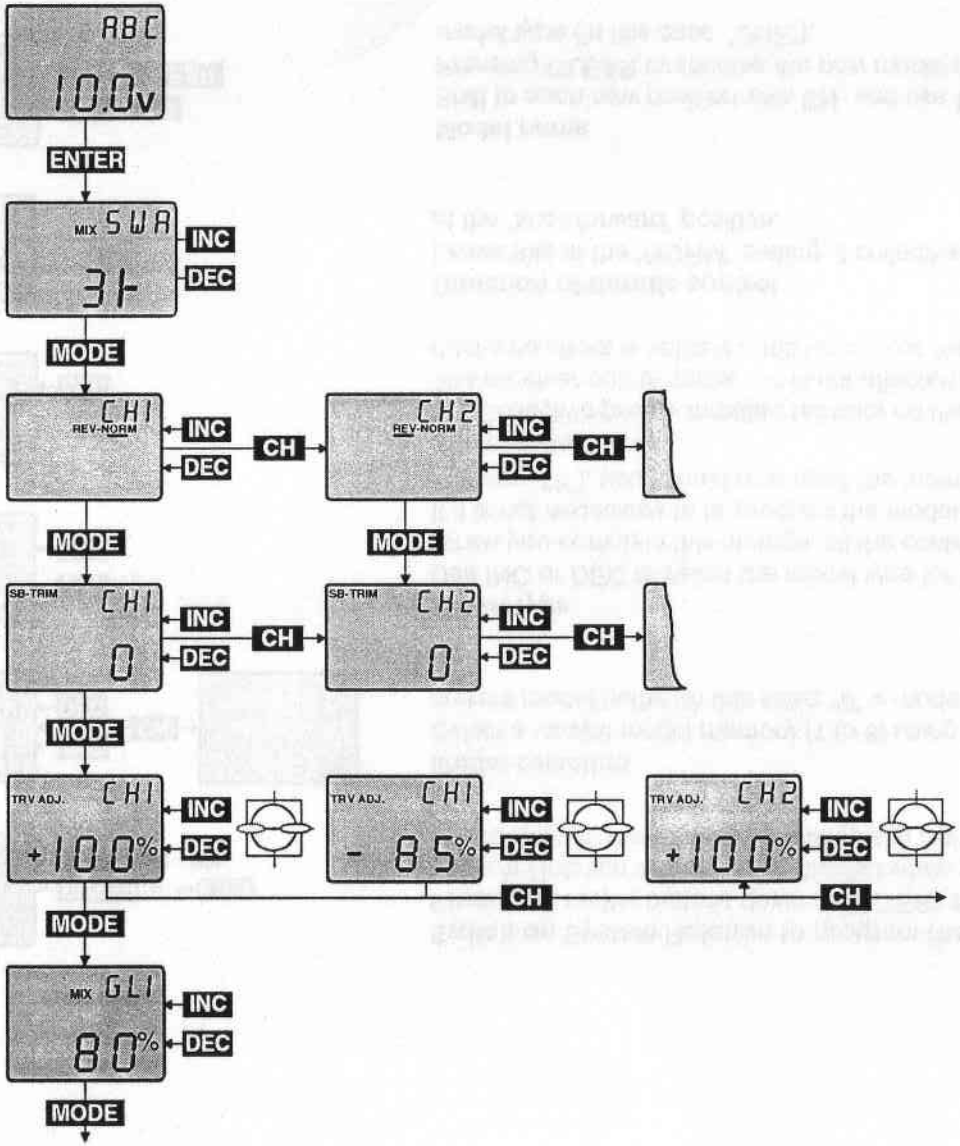
Model name

Shift to each new position with **CH**, and use **INC** / **DEC** to select the alpha-numeric symbols. Pressing **CLEAR** overwrites the new model name with the current model number and the current model type (in this case: "3HE"). 18

Return to normal operating display

Press **ENTER** to quit System Rotation. The screen now shows the newly programmed model name: "ABC".

Programming example
Model type HELICOPTER “HE”



78 Programming example „HE“

Setup Rotation — Page

From the normal operating screen select *Setup Rotation* by pressing **ENTER**. If you are still in *System Rotation*, press **ENTER** twice. 20

Swashplate type

In *Setup Rotation* the screen shows the code you last accessed. First switch to the menu “Swashplate type SWA” with the **MODE** button, and select the type “3↓“ (in the case of the H-Trainer 2000). 68

Servo reverse

Set the correct directions of servo rotation using **INC** / **DEC**. If you are using *GRAUPNER/JR* servos, set the servos connected to outputs 1, 2, 3 and 4 to “REV”. 24

Servo centre offset

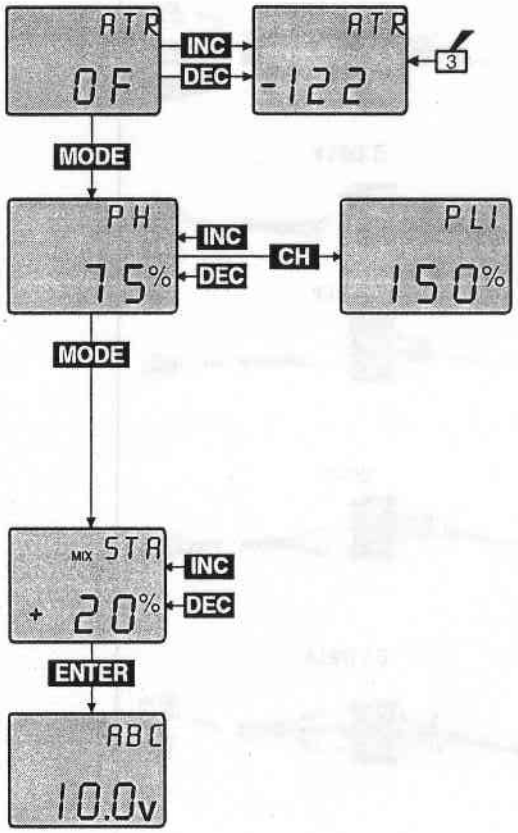
Be sure to adjust the mechanical linkages as accurately as possible before you use this code. 24

Servo travel adjustment

Check the servo travels in the model, and set any limits on each side of centre as required. To make an adjustment, move the stick in the appropriate direction. Wherever possible leave all travels at 100%, and only use this option to adjust the full-throttle position of the throttle servo. 25

Idle-up

The first step in adjusting idle-up is to set a stable motor idle speed with collective pitch reduced to minimum, to ensure that the motor runs at a smooth idle when started from cold. The throttle / collective pitch trim lever should be left at the full-throttle end-point at this stage. If you fit an external switch, it is possible to switch to a second value; this is optional. 70



Auto-rotation **Page**

If you operate external switch 3, the throttle servo and the two collective pitch servos run to previously programmed values. However, for this model we only want to use the auto-rotation setting to be able to stop the motor immediately at any time by operating switch 3. Set a value here which causes the motor to stop reliably when the switch is operated. The external switch is used for this. 71

Collective pitch setting with motor stopped

First set the collective pitch stick to centre (hover position), and check that the trim lever is at the full-throttle position. The three swashplate servos should now be at neutral. On the H-Trainer 2000 you should now adjust the rotor blades to +5° using a blade pitch gauge.
If you program the collective pitch maximum value "PH" to about 75% and collective pitch minimum "PL" to about 150%, you should obtain a blade pitch angle at maximum collective pitch of around 10°, and at minimum collective pitch about -5° ... -6°. Please read the instructions supplied with your model helicopter on this point. For this model we do not need to be able to switch between the values, but if that were the case we would use an external switch connected to socket 4 on the transmitter circuit board. Leave the setting for "PHA" at 100%, when the auto-rotation switch 3 is operated, but set "PLA" to 150%. 72

Static torque compensation

This mixer causes the tail rotor servo to follow the setting of the throttle / collective pitch stick proportionally to a variable degree, with the purpose of preventing the fuselage swinging around the vertical (yaw) axis when a change is made to collective pitch. The H-Trainer features a left-hand rotation rotor (as seen from above), and therefore requires a positive value; we suggest that you start with +20%. The dynamic torque compensation mixer "DYN" is not required for this model. 74

Return to the normal operating display

Accessories

4160.11

Momentary switch
Order No. **4160.11**
Self-neutralising, for momentary switched functions

4160.22

Differential switch, 3-position switch
Order No. **4160.22**
Switches between two mixer functions (optional)

4160

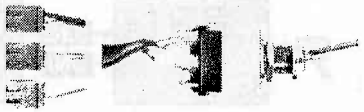
External switch
Order No. **4160** switches one function; long toggle

4160.1

Order No. **4160.1** switches one function; short toggle

4160.2

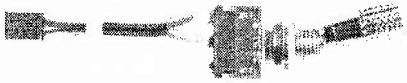
Order No. **4160.2** switches two functions simultaneously; short toggle



4160.3

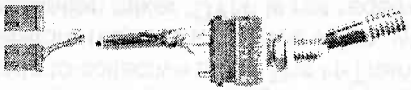
Order No. **4160.3** switches three functions simultaneously; short toggle

On / Off switches and change-over switches for auxiliary functions, e.g. mixers, Dual Rates and Exponential



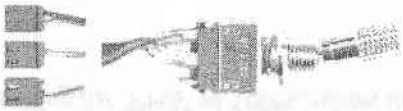
4147.1

Safety external switch
Order No. **4147.1** switches one function



4147.2

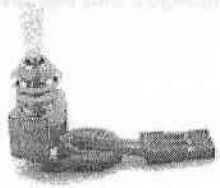
Order No. **4147.2** switches 2 functions simultaneously



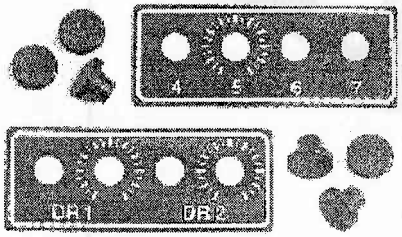
4147.3

Order No. **4147.3** switches 3 functions simultaneously
The safety On/Off switch features a mechanical latch which makes it impossible to operate it accidentally. The switch can only be operated by lifting and simultaneously moving the toggle. Safety switches should always be used to safeguard important coupled functions which would cause the model to crash if switched on or off accidentally.

2-channel proportional rotary module
Order No. **4170**
Expands the transmitter by one proportional function. For instance, it can be used to control an additional, independent servo.

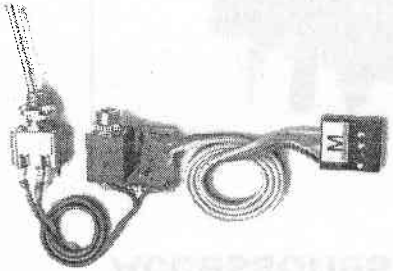


2-channel switch module
Order No. **4171**
This switch has three positions, and expands the transmitter by one switched function. For instance, it can switch a speed controller to the settings "forward - Stop - Reverse", or move a servo right, centre and left.

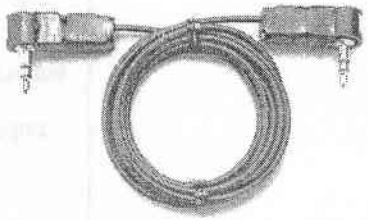


Cover plates
Order No. **4146.2**
The transmitter is supplied as standard with blanking plates, which can be replaced with these self-adhesive panels when additional modules are to be fitted. Any openings not required can be sealed with the plugs supplied.

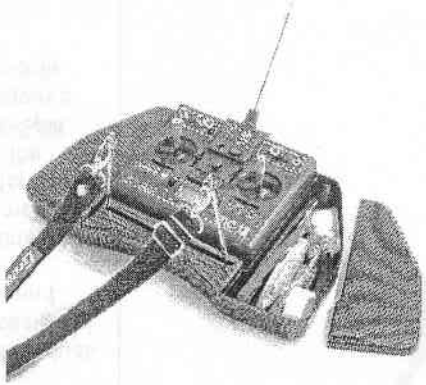
mc-12 pupil module
Order No. **3290.10**
Required if the mc-12 transmitter is to be operated as a pupil transmitter. This module can also be used to link the transmitter to a PC in order to control a flight simulator program. The unit is connected to the mc-12 transmitter circuit board as shown in the sketch on page 12 / 13 of the instructions.
The following units can be used as teacher transmitters: D 14, FM 414, FM 4014, FM 6014, mc-10, mc-12, mc-15, mc-16, mc-16/20, mc-17, mc-18, mc-20 and mc-24.



mc-12 teacher module
Order No. **3290.12**
Converts the mc-12 transmitter into the master unit in a trainer arrangement. When the integral momentary switch is operated, all the teacher transmitter's control functions are transferred simultaneously to the pupil transmitter. The module is connected to the mc-12 transmitter circuit board as shown in the sketch on page 12 / 13 of the instructions.



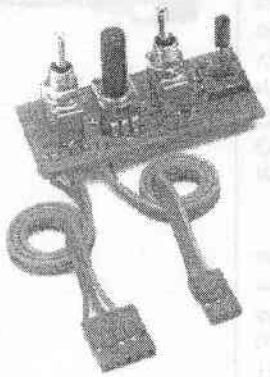
Opto-electronic light-pipe cable
Order No. **3290.4**
Connecting lead between pupil and teacher transmitters. Connect the plug marked "M" to the teacher module, and the plug marked "S" to the pupil module.



Profi transmitter tray, "carbon"
Order No. **3092**
New carbon-fibre look material. Broad, high-grip handrest surfaces ensure fine, accurate control even over protracted periods of use. Double-shell design (top and bottom sections) for extra rigidity. The sealed box on each side provides convenient storage space for tools, spare parts, sunglasses etc.
(Supplied without neckstrap, suspension set and contents).
Neckstrap, e.g. Order No. **1125** (30 mm wide), other neckstraps: see main *GRAUPNER* FS catalogue.
Suspension set, Order No. **1127**

Neckstrap for hand-held transmitter with centre neckstrap lug
Order No. **70** 30 mm wide, with quick-release spring hook. Extra-soft neck padding for maximum comfort, even during long competition flights. Neck pad is attached with Velcro, and can be removed for cleaning.
Printed "*GRAUPNER*" logo.
Order No. **1121** 20 mm, with quick-release spring hook. Special adjustable-length version.

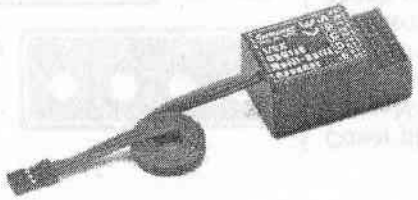
Accessories



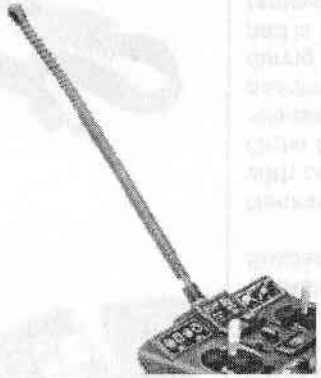
1/5 K NAUTIC Multi-Split module
Order No. **4138**
The NAUTIC Multi-Split module expands one proportional function to produce five servo functions:

- First switched channel with 3-position switch
- Rotary potentiometer for proportional channel
- Second switched channel with 3-position switch
- Two servo channels operated by dual-axis mini-"joystick". Joystick designed for: boat cranes, fire monitors and similar auxiliary functions.

The mc-12 transmitter can be fitted with one or two NAUTIC Multi-Split modules. Please note the requirements for using NAUTIC modules: page 57. At the receiver end one NAUTIC Multi-Split decoder, Order No. **4139**, is required for each NAUTIC Multi-Split module.



1/5 K NAUTIC Multi-Split decoder
Order No. **4139**
The NAUTIC Multi-Split decoder expands one receiver channel to provide five servo functions, provided that the 1/5 K NAUTIC Multi-Split module (Order No. **4138**) is fitted to the transmitter.
The decoder module is simply connected to the appropriate receiver output socket; the operating voltage and control signals are supplied by the receiver.



Helical aerial
Short, flexible aerial for optimum freedom of movement, for use with all *GRAUPNER/JR* tray-type transmitters.
The laws of physics dictate that the radiated power with the helical aerial is not as high as that of a telescopic aerial extended to full length.
Where safety requirements are particularly exacting, e.g. with helicopters, high-speed models, large-span gliders etc., the helical aerial should not be used.
Overall length approx. 400 mm
Order No. **1149.35** for the 35 MHz band
Order No. **1149.40** for the 40 MHz band

Quarzliste

Steckquarze und Frequenzflaggen für *GRAUPNER/JR* Fernlenkanlagen

Frequenzband	Zulassung	Kanal Nr.	Sende-Frequenz MHz	FMsss Quarze Sender Best.-Nr.	FMsss Quarze Empfänger Best.-Nr.	Präzisions-Quarze Sender Best.-Nr.	Präzisions-Quarze Empfänger Best.-Nr.	DS Doppelsuper-Quarze Best.-Nr.	Flagge Best.-Nr.	Zugelassen in den Ländern (ohne Gewähr) D	B	A	DK	F	I	L	N	NL	S	CH
MHz-Band Band A	FE (nur für Flugmodelle zugelassen)	61	35,010	3864.61	3865.61	3264.61	3265.61	3270.61	35.61	■	■	■	■		■	■	■	■		■
		62	35,020	.62	.62	.62	.62	.62	.62	■	■	■	■		■	■	■	■		■
		63	35,030	.63	.63	.63	.63	.63	.63	■	■	■	■		■	■	■	■	■	■
		64	35,040	.64	.64	.64	.64	.64	.64	■	■	■	■		■	■	■	■	■	■
		65	35,050	.65	.65	.65	.65	.65	.65	■	■	■	■		■	■	■	■	■	■
		66	35,060	.66	.66	.66	.66	.66	.66	■	■	■	■		■	■	■	■	■	■
		67	35,070	.67	.67	.67	.67	.67	.67	■	■	■	■		■	■	■	■	■	■
		68	35,080	.68	.68	.68	.68	.68	.68	■	■	■	■		■	■	■	■	■	■
		69	35,090	.69	.69	.69	.69	.69	.69	■	■	■	■		■	■	■	■	■	■
		70	35,100	.70	.70	.70	.70	.70	.70	■	■	■	■		■	■	■		■	■
		71	35,110	.71	.71	.71	.71	.71	.71	■	■	■	■		■	■	■	■	■	■
		72	35,120	.72	.72	.72	.72	.72	.72	■	■	■	■		■	■	■		■	■
		73	35,130	.73	.73	.73	.73	.73	.73	■	■	■	■		■	■	■	■	■	■
		74	35,140	.74	.74	.74	.74	.74	.74	■	■	■	■		■	■	■	■	■	■
		75	35,150	.75	.75	.75	.75	.75	.75	■	■	■	■		■	■	■		■	■
		76	35,160	.76	.76	.76	.76	.76	.76	■	■	■	■		■	■	■	■	■	■
		77	35,170	.77	.77	.77	.77	.77	.77	■	■	■	■		■	■	■		■	■
		78	35,180	.78	.78	.78	.78	.78	.78	■	■	■	■		■	■	■	■	■	■
		79	35,190	.79	.79	.79	.79	.79	.79	■	■	■	■		■	■	■	■	■	■
		80	35,200	.80	.80	.80	.80	.80	.80	■	■		■		■	■	■		■	■
Band B Nur für Geräte, die für das Band B zugelassen sind. Nachstimmen bisheriger Geräte über den Service.	(nur für Flugmodelle zugelassen)	182	35,820	3864.182	3865.182	3264.182	3265.182	3270.182	35.182	■										
		183	35,830	.183	.183	.183	.183	.183	.183	■										
		184	35,840	.184	.184	.184	.184	.184	.184	■										
		185	35,850	.185	.185	.185	.185	.185	.185	■										
		186	35,860	.186	.186	.186	.186	.186	.186	■										
		187	35,870	.187	.187	.187	.187	.187	.187	■										
		188	35,880	.188	.188	.188	.188	.188	.188	■										
		189	35,890	.189	.189	.189	.189	.189	.189	■										
		190	35,900	.190	.190	.190	.190	.190	.190	■										
		191	35,910	.191	.191	.191	.191	.191	.191	■										
MHz-Band	MF	50	40,665	4064.50	4065.50			3240.50	40.50	■	■	■	■		■	■	■	■	■	■
		51	40,675	.51	.51			.51	.51	■	■	■	■		■	■	■	■	■	■
		52	40,685	.52	.52			.52	.52	■	■	■	■		■	■	■	■	■	■
		53	40,695	.53	.53			.53	.53	■	■	■	■		■	■	■	■	■	■
	(nur für Schiffs- und Automodelle zugelassen)	54	40,715	4064.54	4065.54			54	.54	■					■	■	■			■
		55	40,725	.55	.55			.55	.55	■					■	■	■			■
		56	40,735	.56	.56			.56	.56	■					■	■	■			■
		57	40,765	.57	.57			.57	.57	■					■	■				■
		58	40,775	.58	.58			.58	.58	■					■	■	■			■
		59	40,785	.59	.59			.59	.59	■					■	■	■			■
		81	40,815	.81	.81			.81	.81	■					■					■
		82	40,825	.82	.82			.82	.82	■					■					■
		83	40,835	.83	.83			.83	.83	■					■					■
		84	40,865	.84	.84			.84	.84	■					■					■
		85	40,875	.85	.85			.85	.85	■					■					■
		86	40,885	.86	.86			.86	.86	■										■
		87	40,915	.87	.87			.87	.87	■										■
		88	40,925	.88	.88			.88	.88	■										■
		89	40,935	.89	.89			.89	.89	■										■
		90	40,965	.90	.90			.90	.90	■										■
		91	40,975	.91	.91			.91	.91	■										■
		92	40,985	.92	.92			.92	.92	■										■

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: **mc-12**
declares that the product

Verwendungszweck: **Funkanlage zur Fernsteuerung von Modellen**
Intended purpose: **Radio equipment for remote controlling of models**

Geräteklasse: **2**
Equipment class

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))
ETS 300 683	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	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))
BABT 222 ZV 129	Zulassungsvorschrift für Funkanlagen zur Fernsteuerung von Modellen Licence spezification for radio equipment to be used for remote controlling of models

Kirchheim, 19. Juli 2000

Hans Graupner, Geschäftsführer
Hans Graupner, Managing Director

Graupner GmbH & Co. KG Henriettenstraße 94-96 D-73230 Kirchheim/Teck Germany
Tel: 07021/722-0 Fax: 07021/722-200 EMail: office.gmk@asmail.de

Sample registration form

Note: transmitter and receiver for the 40 MHz band do not require registration, and no licence fee is payable.

(1) Antragsteller:
Heinz Mustermann
Garten str. 1a
70153 Stuttgart

(2) Geburtsdatum: 12.03.1969

(3) bei Firmen Ansprechpartner für Rückfragen (Name, Rufnummer):

Regulierungsbehörde für Telekommunikation und Post
Außenstelle

Tel. 0711/763666 Ort, Datum Stuttgart, 19.03.2000

Antrag auf Zuteilung von Frequenzen zur Nutzung für eine Funkanlage zur Fernsteuerung von Modellen

☒ Neuantrag ☐ Änderungsantrag

Hinweis gem. Bundesdatenschutzgesetz §§ 13, 14: Die Erhebung von personenbezogenen Daten erfolgt ausschließlich zum Zwecke der Erfüllung der uns durch Gesetz der Regulierungsbehörde (RegTP) zugewiesenen Aufgaben und unter strikter Wahrung der Datenschutzbestimmungen. Ihr Antrag auf Zuteilung von Frequenzen gemäß § 47 Telekommunikations-Gesetz (TKG) zur Nutzung für das Betreiben der o.a. Funkanlage kann nur bearbeitet werden, wenn die im Antrag erbetenen Angaben vollständig gegeben werden. Ohne die erbetenen Angaben ist ein Erteilen der beantragten Frequenzzuteilung nicht möglich. Die Daten werden ggf. in automatisierten Dateien gespeichert und ggf. zu statistischen Zwecken verwendet.

(4) Frequenzzuteilungsnummer (bei Änderungen):	(5) Kassenzeichen (wenn bekannt):	(6) Inbetriebnahmedatum:
		1.04.2000

Kennzeichnung der Sendefunkanlage

(7) ☒ seriengeprüftes Sendefunkgerät

☐ Eigenbaugerät

(8) Gleichstromeingangsleistung: Watt

(9) Frequenzbereich(e): 35.010 - 35.200 MHz; 35.820 - 35.910 MHz

(10) Zusätzliche Angaben oder Erläuterungen

Allgemeine Hinweise
Zugeteilte Frequenzen dürfen nur zum Betreiben solcher Funkanlagen genutzt werden, die den jeweiligen Vorschriften und Anforderungen für den vorgesehenen Anwendungszweck entsprechen. Serienge prüfte Sendefunkgeräte müssen entsprechend gekennzeichnet sein.

Heinz Mustermann
(Unterschrift des Antragstellers; bei Firmen rechtsgültige Zeichnung)

(Bei Minderjährigen Unterschrift der/des gesetzlichen Vertreter/s)

Stand: 11.99, Reg TP F3.087

Garantieurkunde

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

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D-73220 Kirchheim
☎ (00 49)(07 02 1) 72 21 30

Servicehotline
Graupner GmbH & Co. KG
Montag - Freitag
9^{30} -11^{30} und 13^{00} -15^{00} Uhr
☎ (00 49)(0 180 5) 47 28 76

Andorra
Sorteny 2 MODELISME
Lluis Villasevil
Av.Santa Anna.13
Les Escaldes
☎ (00 37) 86 08 27

Belgie/Belgique/Nederland
Jan van Mouwerik
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GiMax
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Sverige
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40227 Göteborg
☎ (00 46)(03 1) 70 73 00 0

Luxembourg
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8009 Strassen
☎ (00 35) 23 12 23 2

Ceská Republika/
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16100 Praha 6 - Ruzynè
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C. Avinyo 4
08240 Manresa
☎ (00 34)(09 3) 87 34 23 4

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Garantie-Urkunde
Warranty certificate / Certificat de garantie
Computer-System mc-12

o 35 MHz Best.-Nr. **4724**
o 40 MHz Best.-Nr. **4725**
o 35 MHz B-Band Best.-Nr. **4724.B**
o 41 MHz Best.-Nr. **4725.41**

Übergabedatum:
Date of purchase/delivery:
Date de remise:

Name des Käufers:
Owner´s name:
Nom de l´acheteur:

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 :

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GERMANY
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