mc-16/2

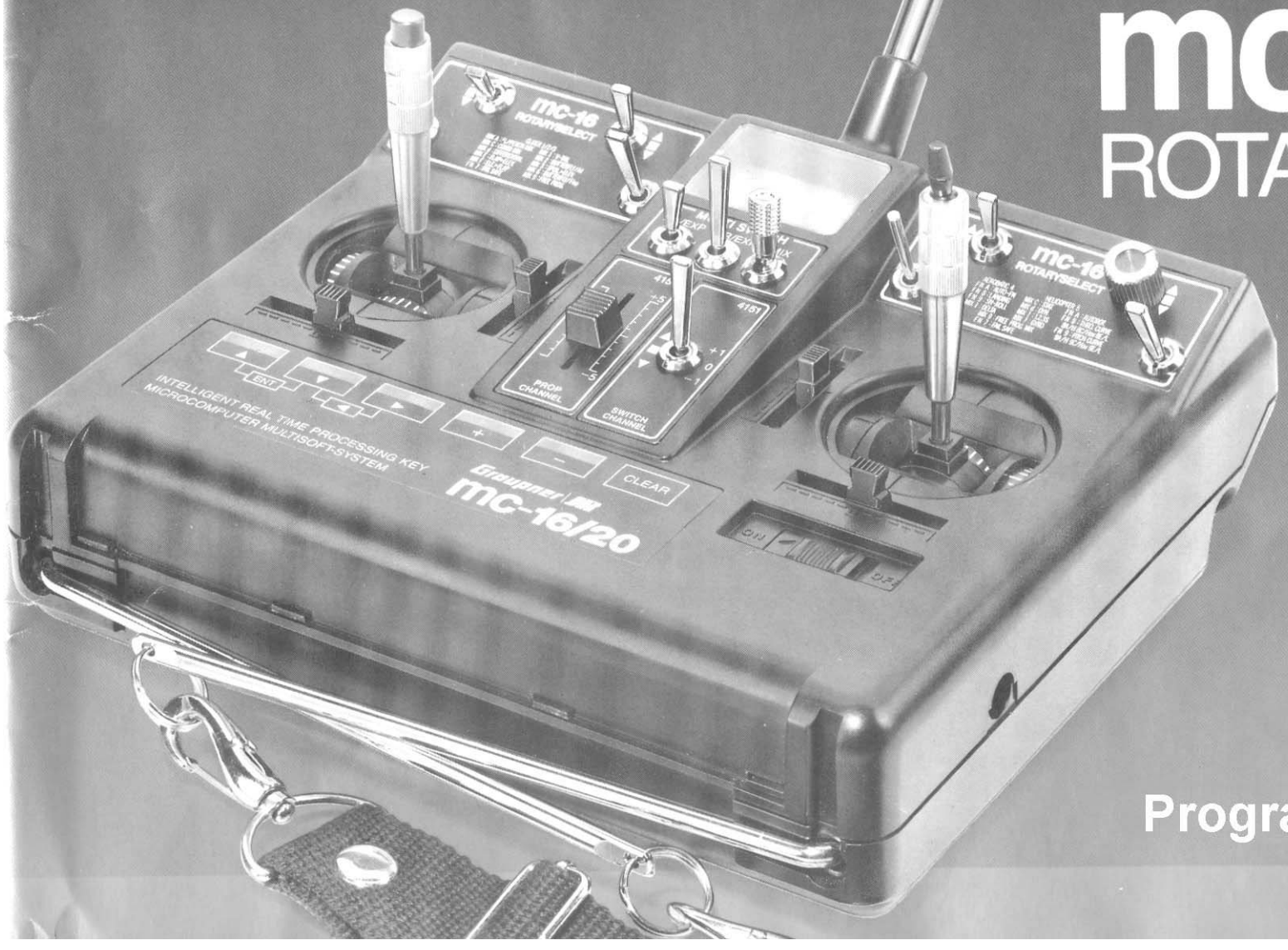
Graupner | JR

REMOTE CONTROL

COMPUTER SYSTEM

mc-16/20

ROTARYSELECT



Programming Handbook

Contents

mc-16/20

Expandable Radio Control Set for a maximum of 16 channels

Using the proven computer system mc-16 as the basis of the new mc-16/20 Microcomputer Remote Control set was developed. With the series already equipped with 20 model memories, the mc-16/20 offers features to beginners and more experienced equally.

The controls and ergonomically optimised transmitter case have been developed further and gain an LCD for precise and clear display of all functions. It also enables, even in bright sunlight, secure adjusting and reading of all model-specific parameters.

A more intelligent chip and complex software offer a maximum of security and reliability. Owing to this innovative technology, modules for the implementation of complex coupled functions are no longer required in the transmitter, and complex mechanical mixers become unnecessary in the model construction.

The program selection, based on experience, are simpler and offer the scope and flexibility to adjust complex control functions to suit the requirements of the user. In particular, importance was attached to the interests of the intermediate user.

The user is persuaded by the simple and clear menu structure, and the conveniently fast selection of most functions. In addition, the mc-16/20 copes with every request up to the demanding competition application.

Half the program functions are common to the five different model types. Each type of model, from the simple glider to the modern high speed helicopter, contains model type specific functions, which allow programming of a flight model. Depending upon personal requirement and operator ability, individual functions can be switched off with optional external switches.

You should take notice of the organisation of the completely revised programming manual, and in particular to the clear and detailed operation and programming structure it represents.

Since the software covers special programs for the operation of both fixed-wing models and modern model helicopters, the operating instruction are arranged into several sections:

After a section concerning general operating instructions, the second section gives transmitter basic adjustments. Thus adjustments independent of model type, are described like model storage, name, type and modulation mode, among other things.

Following this are adjustments such as servo direction, servo reversal, freely programmable Mixers, etc., since these functions are common to all model types at your disposal. Afterwards the program descriptions for model types of the class of gliders and power planes follows.

STANDARD,
UNIFLY,
F3B / BUTTERFLY and
AEROBATIC.

The fifth model type is dedicated to the helicopter. It covers all adjustment possibilities that available for the programming of a helicopter, even if they were already described for the fixed-wing models. This saves time consuming paging back and forward the instructions. Due to the complexity of the programs with this type of model it is recommended to observe the suggested programming order.

The reference sections are placed in front of the program sections for each type of model, and functions in clear flow charts and menu diagrams. Block diagrams clarify, in a simple way, the signal flow through the different functions that can be modified and between the control sticks and receiver outputs.

In the appendices the NAUTIC multi-function module is presented. It also contains information about further accessories, technical data etc.

Is advised that the beginner and less experienced model fliers initially attach as many servos as possible to the receiver and to first complete all functions in accordance with the guidance. He will learn, in the shortest possible time, the main operating steps of the mc-16/20 required to be able to make a meaningful program for the model to be finished.

Kirchheim Teck, in June 1993.

COMPUTER-SYSTEM mc-16/20
With ROTARY SELECT Programming

High security using modern single chip computer technology. Newly developed LCD multi-data display with integrated static driver for precise, clear digital display. The extremely high contrast enables, even with bright sunlight, a precise check of the functions displayed in the transmitter display such as operating voltage, input data, mixer functions, settings, direction of rotation, trim and programming information with multi-function programs.

- The transmitter has a 20 model memory with integrated backup Lithium battery (life span approx. 5 years).
- New, improved 6 key input terminal for program selection and adjustments (ROLL UP, ROLL DOWN, CH SEL, INC, DEC and CLEAR).
- Large, clear LCD multi-data display for adjustment of programs as well as input and viewing of data.
- Adjustable precision, height and spring centring force control sticks with electronic trim.
- High speed CPU with 10 bit A/D converter.
- Programming simplified by versatile and simple multi-function menus in combination with the new Rotary Select technology.
- New Real Time Processing system (RTP), programming with direct reading.
- Programmable Dual rate for three servo functions and adjustable between 0 and 125%.
- Exponential control characteristic switchable between two values for three servo functions.

- Sub Trim system for the neutral adjustment of all Servos and adjustment of older makes of servos with inconvenient neutral.
- Servo Throw (adjustment of full servo travel) adjustable between 0 and 160%. Allows setting symmetrically or asymmetrically to allow the servo to move more less in one direction
- Reverse function for all Servos.
- Differential mixer for ailerons.
- Selector for the easy switching of the control mode 1... 4 (throttle on the right left).
- Switchable modulation system PPM or PCM. PCM operation is only possible with the receivers mc-12, mc-18, mc-20 and DS 20-mc.
- High security by precise digital display of the operational data.
- Integrated computer alarm system.
- Stopwatch and alarm timer, linked to throttle stick.
- expandable with the Multi-Prop and NAUTIC-Expert modules.
- Can use all proportional & switch modules as well as external switches of FM 6014/4014 systems.
- Minimum switch computer concept. The system automatically switches functions, for safety reasons, if the beginner model constructor does without the switch.
- Five simple, yet complex, fixed-wing multifunction core programs, for F3A, F3B, F3C, F3D and F3E (completely programmed multi-mixer units, which can be stopped by using additional mixers accordingly).
- Mixer for V-tail and delta models.
- Super helicopter program for normal swashplate, HEIM, 120° systems or those with four linkages.
- Three freely programmable mixers.

mc-16/20

16 Channel Microcomputer Radio Control system

Sets
Part No. 4838* for the 35 MHz band
Part No. 4845* for the 40 MHz band
* In each case the transmitter battery, 9.6v / 1.4 Âh (Part No. 3407) needs to be added separately.

The sets contain

8 Channel Microcomputer ROTARYSOFT mc-16/20 Transmitter, expandable to 16 channels.
HF Transmitter module of the appropriate frequency.
16 channel MINI-SUPERHET C 16 S of the appropriate frequency.
Servo C 507
Switch harness
Pair of quartz crystals from the appropriate frequency band.

Power supply for transmitters and receivers
Removable 9.6v batteries for transmitters
Part No.
3407 Varta RSE 9.6v / 1700mAh
3208 Sanyo KR 9.6v / 1300mAh
3210 Graupner 9.6v / 700mAh
3408 Varta RS 9.6v / 500mAh
Removable 4.8v batteries for receivers
Part No.
3465 Varta RSH 4.8v / 2000mAh
3448 Varta RSE 4.8v / 1700mAh
3464 Sanyo KR 4.8v / 1400mAh
3444 Varta RS 4.8v / 600mAh
3446 Varta RS 4.8v / 600mAh
3463 Sanyo AA 4.8v / 300mAh[1)]
[1)]For special applications (short time use)

Further 4.8v batteries see Graupner main catalogue.

For fitting into the battery carrier
(designed for recipient 4 batteries)
Part No.
3659 Varta RS 1.2v / 500mAh
3617 Graupner RS 1.2v / 500mAh

Accessory for transmitters (see pages 94 – 95)
Part No. **1127** Transmitter Carrier
Part No. **1125** Wide Strap
Part No. **3082** PROFI transmitter tray
Part No. **3087** PROFI transmitter protector

Spare Parts
Part No. **4300.6** Telescopic Transmitter Aerial

Short Helical Aerial
Can be screwed on in place of the telescopic aerial contained in the Transmitter. See page 95.

Individual HF Transmitter modules
Part No. **4824.35** for 35Mhz band.
Part No. **4824.40** for 40Mhz band.

Individual Receiver C 16 S
Part No. **3867** for 35Mhz band.
Part No. **4067** for 40Mhz band.

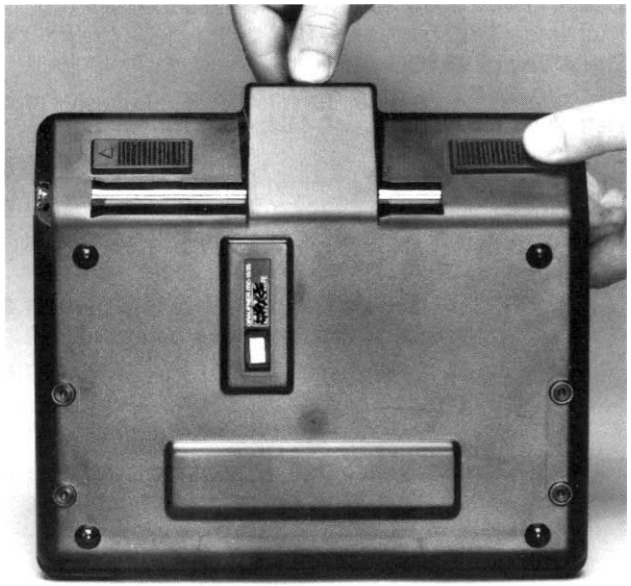
Further accessories – see the appendix and Graupner main catalogue.

Operating Instructions

Opening the Transmitter case

The removable back of the case is held by one locking catch and two interlock sliding catches.

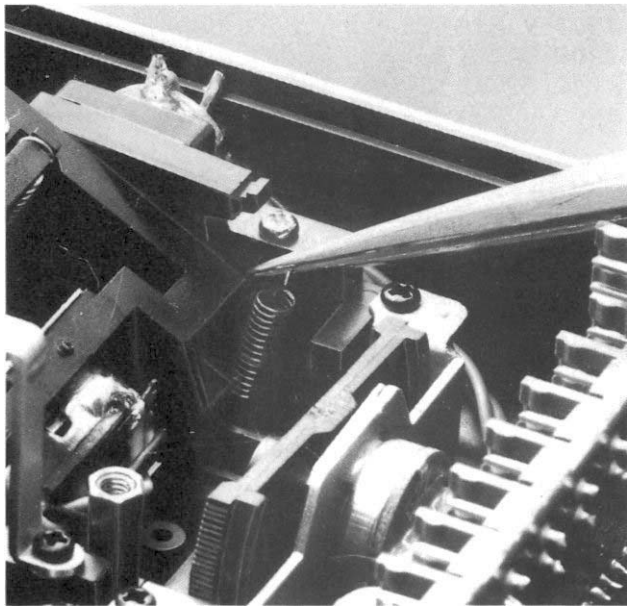
Before opening the Transmitter ensure the power switch is OFF. The sliding catches are moved against the direction of arrow (inward) until they hit the stop, then case back can be opened. To close, insert the case back into the housing at the lower edge. Push it closed and then slide both caches in direction of the arrow (outward).



Changing the proportional control sticks and changing the centring force.

Both vertical control stick directions can be changed between centring or non-centring (e.g. throttle on the right or left). With the transmitter open and at the appropriate centring lever, notice the feather/spring (figure below. Lift up the centring lever to be able to get access, remove and keep the spring.

In the case of mechanical conversion of the throttle function, an electronic conversion of the control functions must also be made using the code "MOD" during the basic transmitter programming, see page 15. The ratchet strap provided in the accessories is mounted to the two captive nuts on the inside of the control stick units (photograph on the right).



The resistance to movement of the control stick can be adjusted between low to high by tightening or loosening of the adjusting screw.

The centring force of the control sticks can be adjusted at the screws indicated in the figure by an arrow:

Clockwise rotation – centring force higher
Anti-clockwise rotation - centring force lower

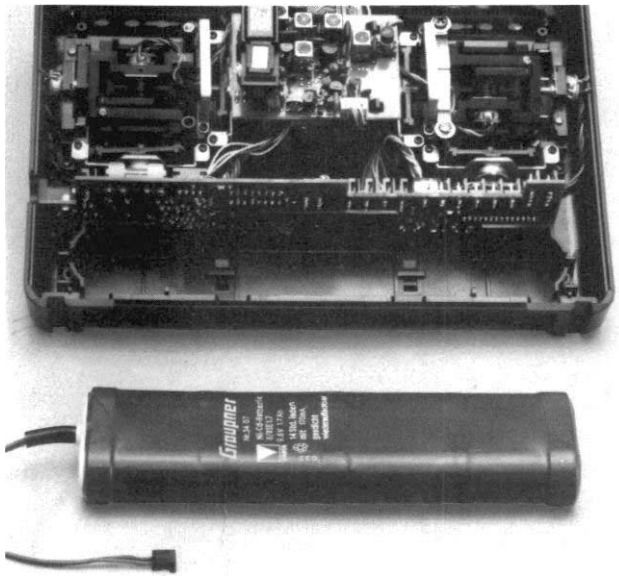
Power Supply
The battery tray in the transmitter is equipped with a 9.6v battery.

Different battery types are available to be selected. Into the battery mounting for the receiver, insert four AA cells of 1.2v and between 500 and 600mAh. Instead of the battery mounting, or in addition, a 4.8v battery with miniature plug can be used, see page 5.

Pay attention to the full battery voltage. If the rudder moves noticeably more slowly or display the goes under 9.6v back then stop operation and load new batteries (or recharge).

Charger devices and batteries - see Graupner main catalogue telex.

Your contribution to environmental protection:
Do not throw to used up batteries into the domestic refuse, but take these to an appropriate collecting point, in order for them to be recycled or disposed of in an environmentally friendly way.



Charging of the Transmitter battery
The rechargeable transmitter battery can be charged in the Transmitter using the socket on the side of the case. The set must be switched OFF while charging.

When using the automatic MULTILADER 5B or 6E the connection is made by charging cable Part No. 3022. For the MULTILADER 5 it is necessary to use the polarised charging cable Part No. 3040.

The remote control system is equipped with a reverse connection protection circuit for charging of the Transmitter battery. Thus damage is prevented by incorrect polarity or short-circuit. In order to disable this reverse current protection (e.g. for measuring purposes or when connecting an automatic loader), it is necessary that the enclosed two-pole plug link is attached directly to the link pins as short circuiting bridge.

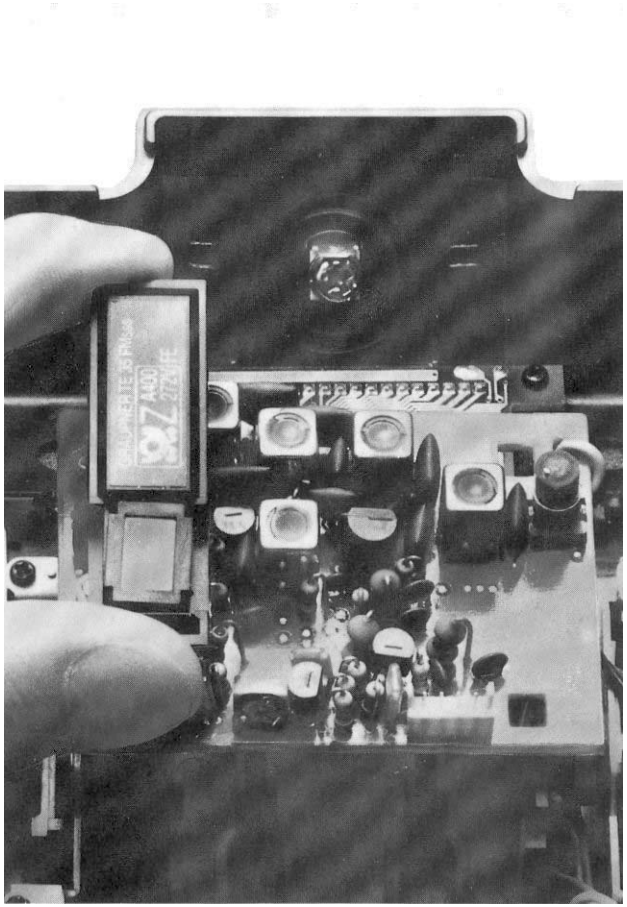
During rapid charging the transmitter battery charging current must not exceed 1.5A.

Charging the receiver battery.
The charging cable Part. No. 3021 for MULTILADERS 5B and MULTILADER 6E can used to connect the receiver battery directly to the charger. If the battery is in the model, then charging cables Part. No. 3023, 3046, 3377, 3934 or 3934,3 are attached making use of the connector integrated into the receiver switch harness. For the universal battery charger MULTILADER 5 the polarised charging cable Part. No. 3041 is necessary.

The period of operation of receiver batteries depends heavily on the battery type and on the frequency of servo movements and their load. In the PCM mode the "Fail Safe" function can be activated, which will display when the receiver battery falls below to a certain voltage, see page 25.

Operating Instructions

Frequency band and Channel change
Change frequency band: The Transmitter can be operated on different frequency bands by changing the High Frequency module. The removable HF module is held by four sprung pin fittings in the centre of the Transmitter. Two cables must be attached. Link **1** connects to the Transmitter circuit board. Link **2** connects the HF module to the aerial.

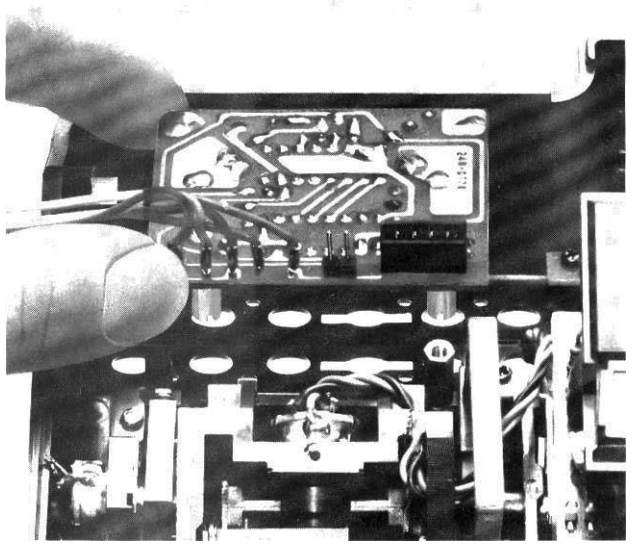


Changes of the HF channels: The channel is determined by the crystal. Only crystals of the correct type and the appropriate frequency band may be used (see page 98).

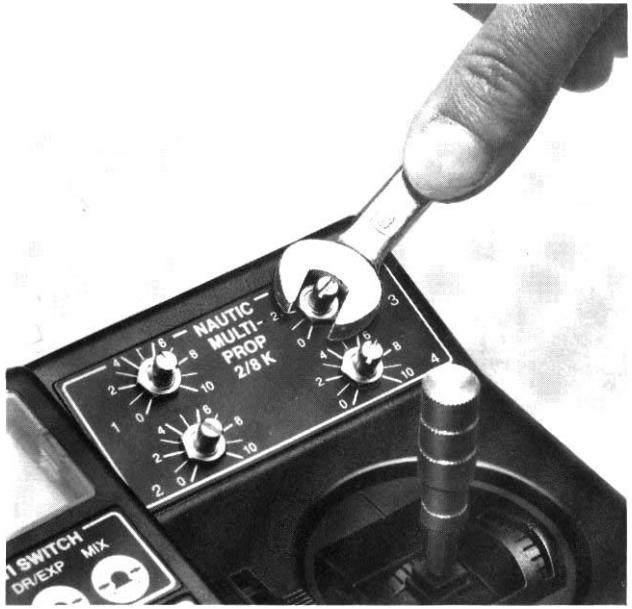
The Transmitter crystals “T” is put into the HF module. Frequency band and channel number of the crystal inserted must correspond with that in the Receiver.

Installation the Module
The Transmitter case is pre-drilled for the installation of the modules, like NAUTIC, Proportional and Switch Module. The blanking caps in the holes of the case can be removed pushing them outward with an appropriate object. To complete the assembly of the Proportional and Switch modules, Part. No. 4152 or 4151, they must be connected to the HF module.

The NAUTIC modules are installed by inserting the controls through the pre-drilled holes in the case (from the inside) (see next paragraph "fastening the modules"). Ensure that the connection socket of these modules points to the centre of the transmitter.



Fasten the NAUTIC modules
Insert the module into the intended location and that check it fits correctly. The protective plastic film on the printed fascia plate can be now taken off. Then remove the backing paper of the double sided tape and the attach the fascia plate lightly pressing it down. Insert the module from the inside into the prepared module location. The module is secured by fitting the washers and nuts to the potentiometers or switches and carefully tightening them with a suitable tool. Finally, mount the control knobs to the potentiometers so they correspond with the scale markings.

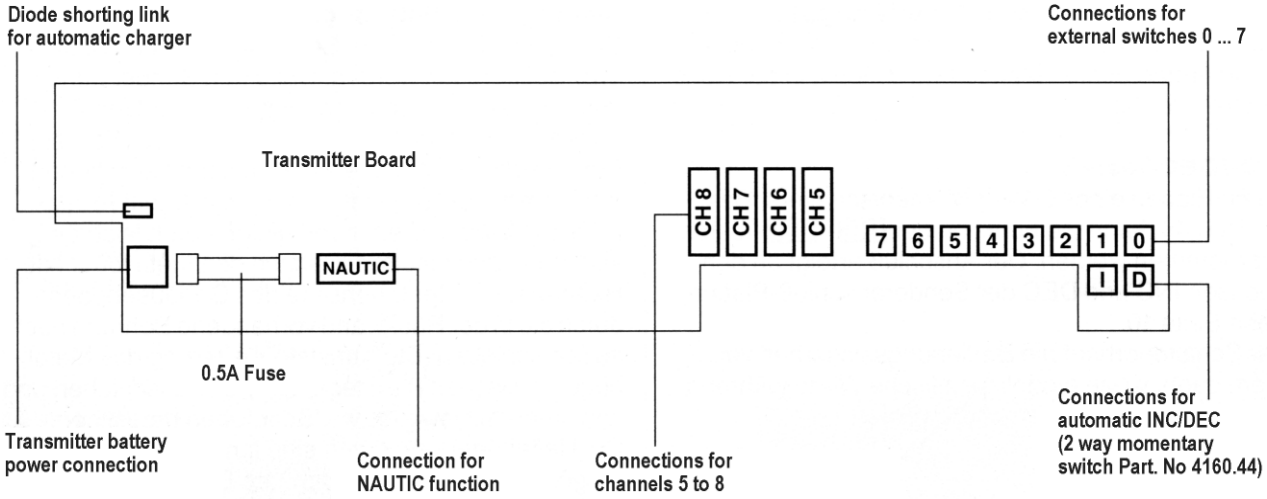


Length adjustment of the control sticks
The length of the control sticks can be adjusted up to the maximum length marking on the stick shaft.

INC/DEC Keys
By installation of a 2 way momentary switch, Part. No. 4160.44, the functions of the INC / DEC keys can be taken over. The connection is made to the sockets marked INC and DEC on the transmitter circuit board, see page 10.
The switch increases the operating ease, especially when model-specific values are programmed during operation.

Assembly of the Transmitter Carriers
The transmitter can be equipped with the transmitter mounting Part. No. 1127. Open the transmitter case and in remove the bottom blanking caps. The bottom of the case is already prepared for the assembly. The four mounting plate holes in the bottom of the case can be opened up by boring through using a screwdriver. From inside the case, insert the metal arms through the mounting holes. The plastic mounting plates are fed over the metal arms and screwed to the outside of the case, with two screws each. The carrier arms are strongly retained up a long coil spring. If softer folding of the carrier arms is required, the spring must be shortened accordingly.

Connection of External Control Elements



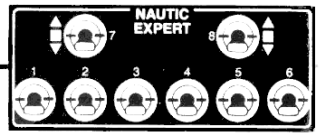
External Switch Connection	Model Type				
	Standard “FL”	Unifly “UN”	F3B/Butterfly “Fb”	Aerobatic “AC”	Helicopter “HE”
0	Dual-Rate and Exponential for: Aileron				Roll
1	Dual-Rate and Exponential for: Elevator				Pitch
2	Dual-Rate and Exponential for: Rudder				Tail Rotor
3	Combi-mix (Aileron ⇨ Rudder)				Autorotation
4	Mixer Elevator ⇨ Flap				Throttle Pre-set (Idle Up) Collective Pitch Curve
5	Mixer Flap ⇨ Elevator		Mixer Flap ⇨ Elevator	Auto-landing	Throttle Pre-set (Idle Up) Collective Pitch Curve
	Freely Programmable Mixer C				
6	-	Differential Mixer	Differential Mixer	Snap Roll	Static / Dynamic Torque Compensation
	Freely Programmable Mixer B				
7	-	Mixer Spoiler ⇨ Elevator	Butterfly ⇨ Aileron, Elevator & Flap Mixer	Snap Roll	Gyro Gain
	Freely Programmable Mixer A				

Module Installation Pattern

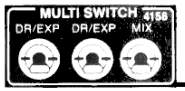
Function Modules

See page 91

NAUTIC-
Multi Prop. Module
Part No. **4141**

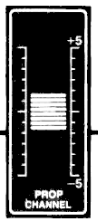


16 channel
NAUTIC Expert Module
Part No. **4108**



Multiple External
Switch Module
Part No. **4158**

2 channel
Switch Module
with long arm
Part No. **4151**
with short arm
Part No. **4151.1**

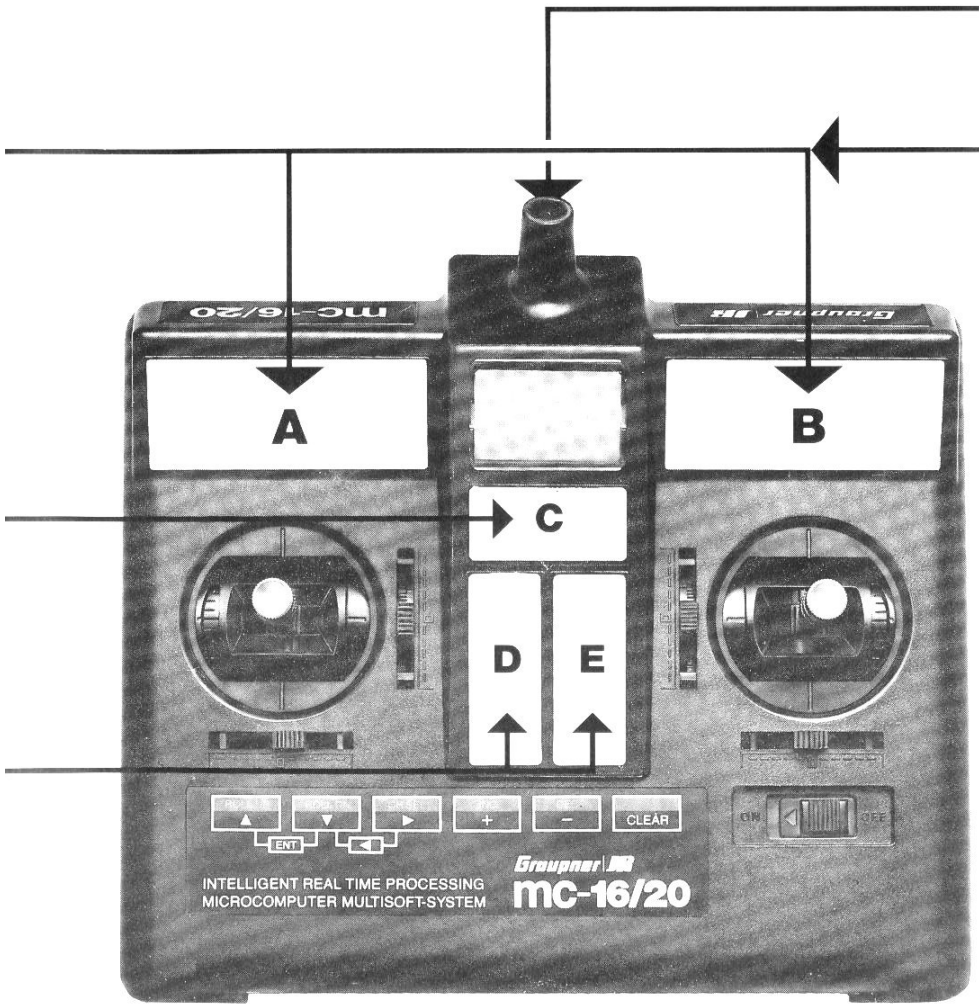


2 channel
Proportional
Module
Part No. **4152**

Switches, Controls

See page 91

Transmitter Modules



External Switch
with long arm
Part No. **4160** 1 way
with short arm
Part No. **4160.1** 1 way
Part No. **4160.2** 2 way
Part No. **4160.3** 3 way

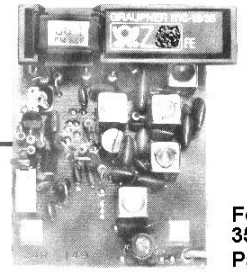
Momentary Switch
Part No. **4160.11**

Differential Switch
Part No. **4160.22**

2 way Momentary Switch
for Increment (INC) and
Decrement (DEC)
Part No. **4160.44**

External Safety Switch
Part No. **4147.1** 1 way
Part No. **4147.2** 2 way
Part No. **4147.3** 3 way

2 channel Proportional
Rotary Module
Part No. **4111**



For the
35MHz Band
Part No. **4824.35**

For the
40MHz Band
Part No. **4824.40**

Compatibility of Computer Systems mc-16/20

The mc-16/20 transmitter can be operated with all currently available Graupner FM PPM receivers, as well as other receivers with negative going pulses, from the 35 and 40 MHz frequency band. Slight reduction of servo travel can become countered by the transmitter up to a maximum of ±160%. Also the neutral position of servos attached receiver channels 1 to 8 can be adapted in ±125 steps, which is approximately ±70% of normal travel, for all 8 Servos.
In the mc-16/20 Transmitter an FM quartz crystal (black plastic cap) with corresponding channel number must be used.

Part No. **3864**, or
3264 for the 35 MHz band
Part No. **4064** for the 40 MHz band

Alternatively, the GRUNDIG receiver can be used, but it is to be made certain that these are equipped with a GRUNDIG FM quartz (green tab).

Basics

A protective plastic film is attached to the input keyboard of the transmitter, and can be taken off.

Only switch on transmitter with the aerial screwed in, otherwise it may malfunction and damage the HF module.

The allocation of the receiver outlets depends on the type of model selected, and is described on pages 28, 34, 42, 52 and 62.

In order to avoid uncontrolled movements of the servos attached to receiver outlets, first switch the transmitter on, then switch on the receiver. After the relevant operations switch off the receiver, then the transmitter.

Range Check
With a new model a range test on the ground, with the transmitter antenna screwed in but not extended, should be completed before the first flight. The model should be tested with the engine running and if available check the fail-safe operation.

Adjustment of the transmitter aerial
In the direction of the extension of the transmitter antenna, only a small field strength is formed. It is therefore wrong to point the antenna directly at the model.

Multi Data Terminal

Multi Data Information Display
The clear LCD MULTIDATA display with a static driver, was developed for the mc-16/20 Computer System. It offers a improved safety during operation, since all important functions are displayed. Even in bright sunlight, all the parameters on the display are represented in high contrast.

Possible screen-displays of the "Basic Transmitter Information":

- Normal operation

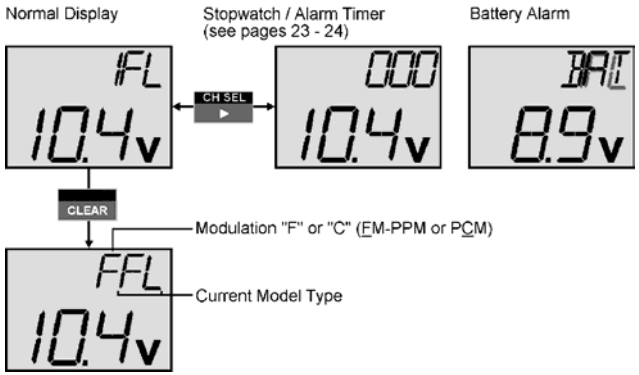
Three figure model name (or model number and type) and battery condition (under load) in volts. On pressing of the CLEAR key the current modulation mode is briefly displayed in place of the model name, as "F" (FM-PPM) or "C" (PCM) in conjunction with the type of model "FL, UN, Fb, AC or HE".

- Stop watch / alarm timer (see pages 23 - 24)

The upper display line changes, as soon as CH SEL is pressed.

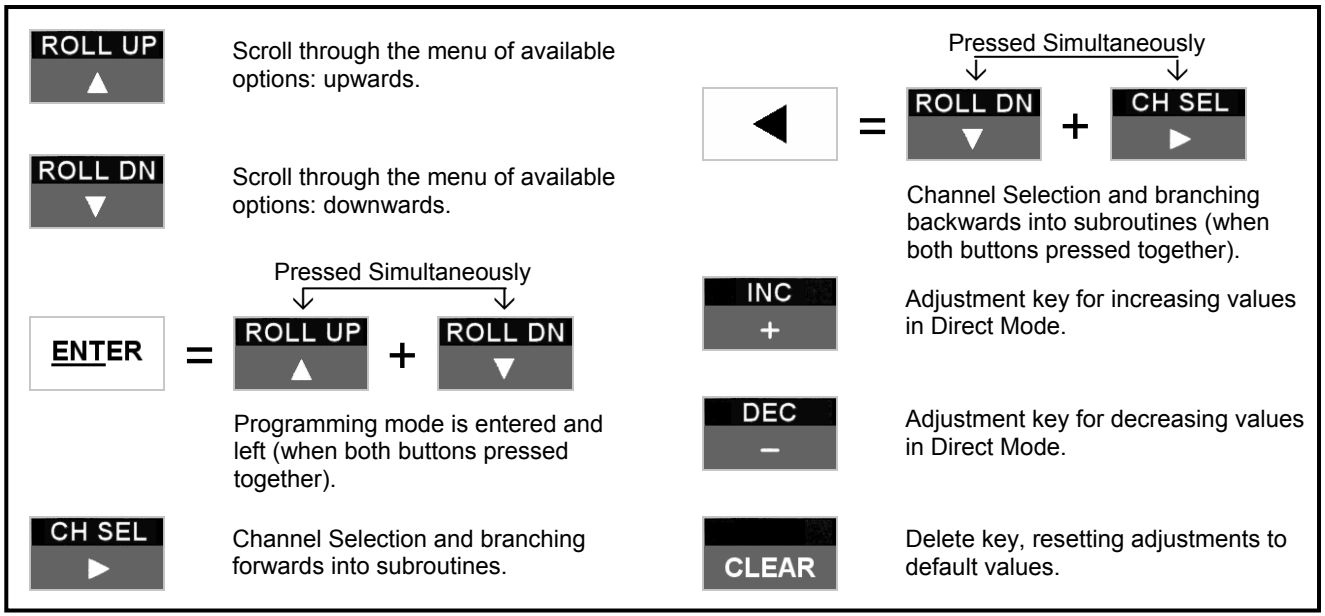
- Battery alarm

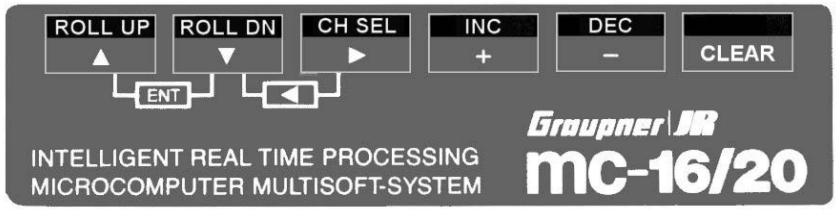
When the battery voltage drops under 9.0v the display alternating between the normal data and “BAT” caption. An audible warning signal sounds in parallel to it seven times consecutively. Landing of a model aircraft must made immediately after the "BAT" alarm display is reached, to allow recharging of transmitter battery.



Operation of the Multi Data Input Terminal
The program of the Transmitter is organised and uses only six keys for simple and clear programming. If a key remain pressed continuously, the instruction and setting codes automatically change with increased rate until the key is released.

Note:
The function of the INC and DEC keys can undertaken by a 2 way momentary switch, Part. No. 4160.44, which is connected to the sockets on the circuit board in the Transmitter intended for this function.





System Menu

Using the system for the first time and programming the basic transmitter data

Software Structure
The software is divided into two menus, which are activated in different ways.

1. System Menu
   Adjusting the basic transmitter functions.

2. Set-Up Menu
   Selecting, activating and programming the model specific data.

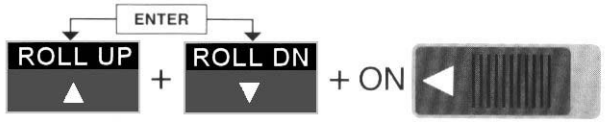
In each of these menus, the individual codes can be called up in rotation by the ROLL UP (upwards) or ROLL DN (Roll Down, downwards) buttons. When you reach the bottom code, the ROTART SELECT system returns you to the start of the list again, until you either leave the System or Set-Up Menu by pressing ENTER (ROLL UP and ROLL DN keys simultaneously), or by switching off the transmitter and thereby resetting it to normal operation.

To prevent accidental reprogramming, the System Menu can only be activated if the transmitter is switched off first. This makes it impossible for you to accidentally alter programmed these functions, e.g. switching model memory or changing modulation mode (FM-PPM/PCM), while you are using the system to control a model. Since the transmitter is not producing a modulated signal in this mode, it is impossible to transmit a signal to the receiver during this basic programming.

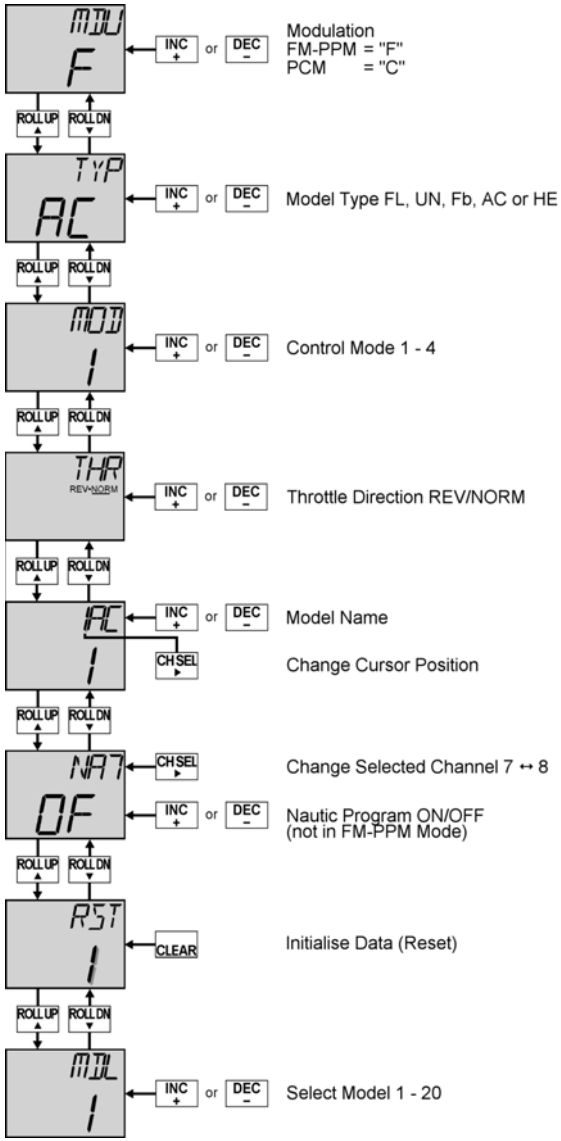
Basic method of using the System Menu

First you need to select the code you wish to alter by pressing the ROLL UP or ROLL DN button. Within this code, you select the function you require using the INC or DEC buttons.

Entering the System Menu
Simultaneously press the ROLL UP and ROLL DN buttons (= ENTER) whilst turning the transmitter on. An acoustic signal sounds. The program is now in the System Menu. The accompanying flow chart shows the programs of the primary system, whose functions are shown in the transmitter display. By repeat pressing of ENTER the software leaves the basic programming and automatically returns to normal transmitter operation.



Block diagram of the System Menu

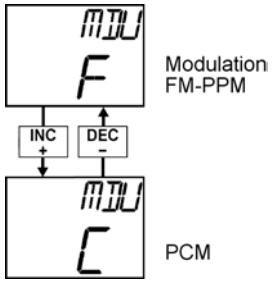


Leave the Menu at any place with ENTER.

MODULATION MODE

Selecting the Modulation Mode
(access via System Menu)

The first option in the System Menu is to set the type of modulation. This varies depending on the type of receiver you will be using. The mc-12, mc-18, mc-20 and DS 20 mc are PCM types (Pulse Code Modulation) and are used with the transmitter set to PCM modulation. This is indicated by a letter “C” in the display. For FM (Pulse Position Modulation) receivers the transmitter must be switched to FM (PPM) operation, and the display will show an “F”. Switch from one to the other by pressing the INC or DEC buttons.

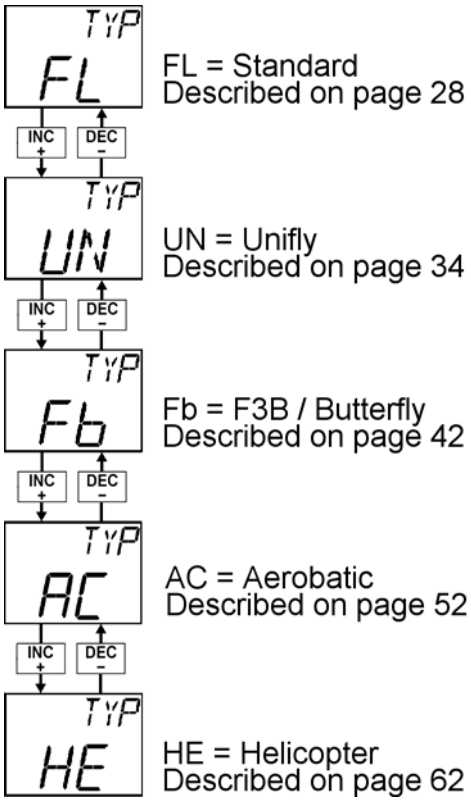


MODEL TYPE

Establishing the Model Type
(access via System Menu)

The mc-16/20’s Multisoft program differentiates between five different types of model. The selection must be made before re-programming a model using the Set-Up Menu (see later) because the menu determines which options can be called up by the Type. A summary of the five ready-made multi-function programs is on pages 26 – 27.
Your reach this code using the ROLL UP button. Five model types are available, each selected with the INC or DEC buttons. If you change the current model type using the INC / DEC buttons the new model type will flash in the display. It is not adopted until you confirm the selection with ENTER (ROLL UP + ROLL DN). When you confirm the selection, all the options in the Set-Up Menu will change accordingly. All the original set-up parameters of this memory will be lost when changing model type. If necessary, you can return to the current model by pressing the INC, DEC or CLEAR buttons before you press enter.

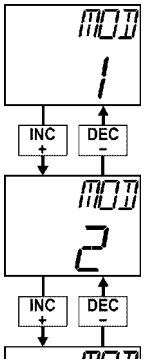
Summary of the ready-made multi-function programs



CONTROL MODE

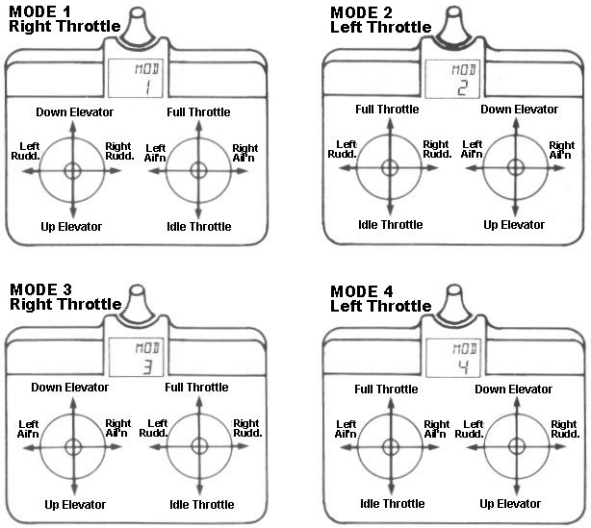
Transmitter Stick Functions for Channels 1…4
(access via System Menu)

Activate the System Menu and select “MOD” by pressing the ROLL UP (or ROLL DN). You can now change to mode 1 – 4 using the INC or DEC buttons. All other functions are automatically matched to the stick mode you have selected.



Modes 1...4 available

Stick Modes – Fixed-Wing Aircraft



Stick Modes – Helicopter (see page 66)

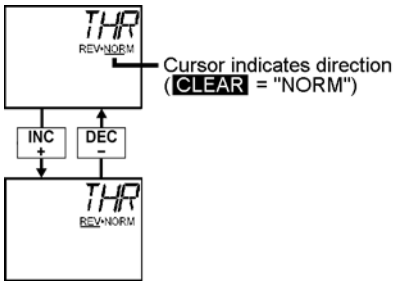
Throttle = Collective Pitch Elevator = Pitch
Aileron = Roll Rudder = Tail Rotor

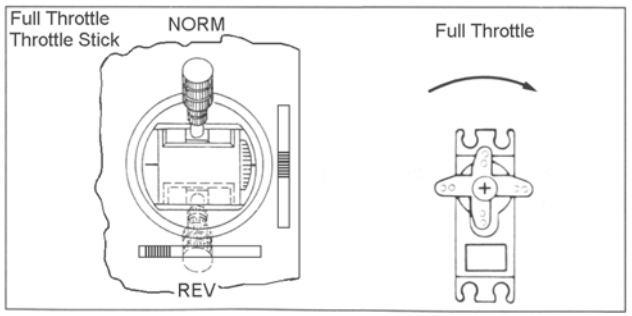
THROTTLE DIRECTION

Reversing the Direction of Throttle Control
(access via System Menu)

This reverse function is effective for all model types. This code provides a means to alter the direction of operation of the throttle stick (transmitter function 1) to suit your preference. You can toggle between "NORM" and "REV" by pressing the INC or DEC buttons.
There are several mixers which involve the throttle (function 1), and they can only work correctly if this setting is correct. In the helicopter program this means that throttle and collective pitch functions, e.g. throttle idle-up, tail rotor mixer, collective pitch trim, etc.
The idle trim is automatically switched to the other end of the stick arc when you reverse this function.

Important:
The effect of the idle trim system is that the trim slider for the throttle servo has no influence around the centre position and at the full throttle end of the stick arc.

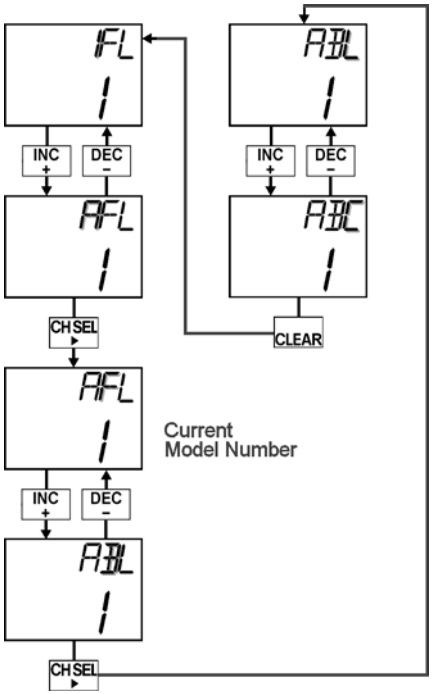




MODEL NAME

Entering the Model Name
(access via System Menu)

When you first select a model (or after a reset) a standard 3 character entry appears in the display above the model number. Example: 1FL, 19L, …
Model number 1 – 20 and current model type (FL = standard, UN = Unifly, Fb = F3B / Butterfly, AC = Aerobatic, HE = Helicopter).
The left-hand character flashes and can be changed by pressing the INC or DEC buttons. The characters available are A – Z, 0 – 9, + and –.
You move to the next character by pressing the CH SEL button. The name entered is stored as soon as you leave this code.
(For model numbers 10 – 20, only the last letter of the model type is displayed).



NAUTIC PROGRAM

Connecting Nautic Modules (only in PPM Mode)
(access via System Menu)

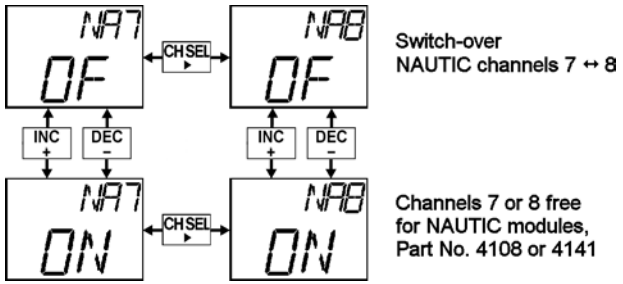
The "NA" function can only be selected if the transmitter is set to PPM mode.
Switching the NAUTIC function on using INC / DEC automatically reserves transmitter channels 7 and 8 exclusively for the NAUTIC module. Any mixers which involve channels 7 or 8 are automatically blocked, as the channels used by a NAUTIC module cannot be linked with other channels using a freely programmable or ready-made mixer (see block diagrams).
The channel number after the letters "NA" indicates which channel can be used.

Model Type	NAUTIC channels
FL (standard)	7 and 8
UN (Unifly)	7 and 8
Fb (F3B/Butterfly)	8 only
AC (Aerobatic)	8 only
HE (Helicopter)	8 only

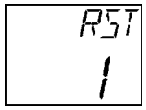
You can switch to the second channel by pressing the CH SEL button. More information on installation is included in the Appendix, page 82.

Note:
When using the model types "AC" and "HE" channels 5 and 7 can also be used for NAUTIC modules if necessary, in addition to the NAUTIC code.

Servo Reverse (see page 21)	NORM.
Servo Neutral (page 21)	0
Servo Travel (page 21)	±146%
AC: "Auto-landing" Code if ch 7 used (pages 54, 57)	off
HE: "Gyro Control" Code if ch 7 used (pages 61, 65)	off
HE: "Swashplate Type" Code if ch 5 used (page 66)	N, 2 or 3



NAUTIC multi-function facilities, see section starting on page 83



DATA INITIALISATION

Reset, erase data & reprogram the basic values
(access via System Menu)

Before you re-program a model memory, you should reset all data using this code in order to ensure that all parameters and functions are reset to the default 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 actual erasure occurs when you press the CLEAR button. As soon as the model number ceases to flash the erasure has taken place.

Re-initialised data after reset:

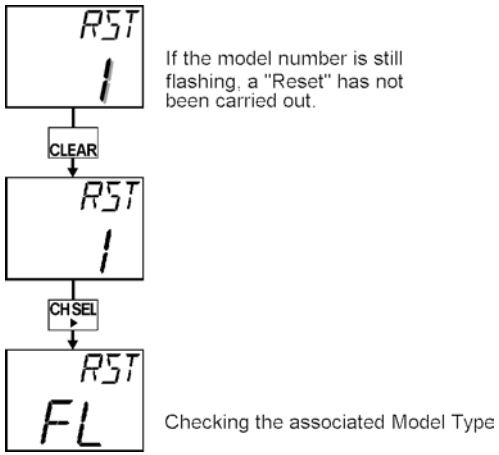
In the System Menu:

Model Name	Model number and current model type
Throttle Direction	Normal (“NORM”)
NAUTIC program	off (“OF”)

The settings for type of modulation, model number, stick mode and model type are unchanged.

In the Set-Up Menu

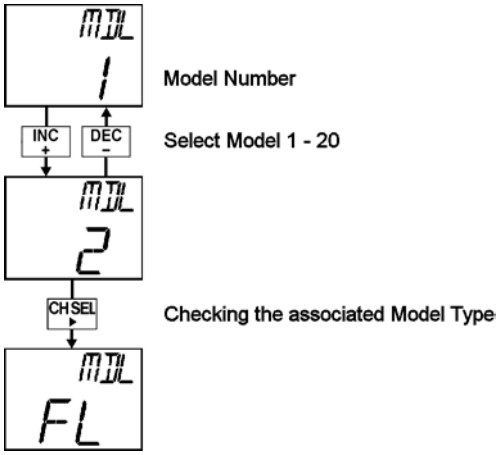
Dual-Rate	= 100%
Exponential	= Linear (“LN”)
Servo Reverse	= Normal (“NORM”)
Servo Neutral	= 0
Servo Travel	= 100%
Mixer Values	= Initial default values



MODEL SELECT

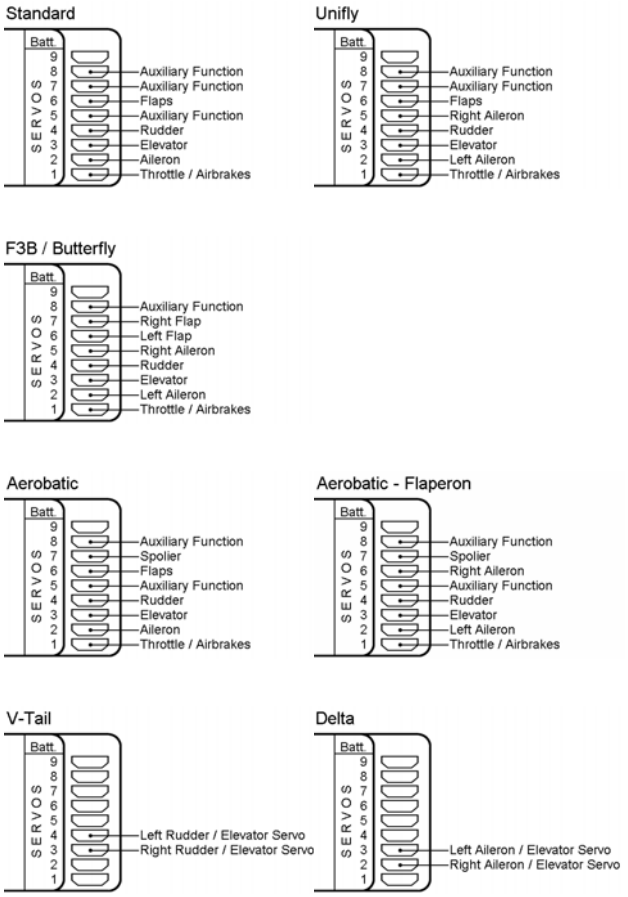
Switching Model Memory 1 – 20
(access via System Menu)

The mc-16/20 transmitter allows you to store all the settings for 20 different models.
After selecting the System Menu code “MDL”, by pressing the ROLL UP or ROLL DN button, press the INC or DEC buttons to select the model. All the adjustments which you subsequently make will then apply to the model number displayed in this menu.
The model type can be called up in the display by pressing the CH SEL button.



Receiver Connections (Channels 1 – 8)

The servos must be connected to the receiver outputs as shown in the diagrams below:



See the Helicopter section for those connections.

Set-Up Menu

General notes
You have concluded the basic programming of the transmitter. If no special functions, like servo travel adjustment, servo reversal, mixer and coupling function etc., are necessary, you can now already put your model into operation. Look up the basic outline of the multi-function finished programs on page 26 and 27, or test them using the detailed descriptions for the model type used.

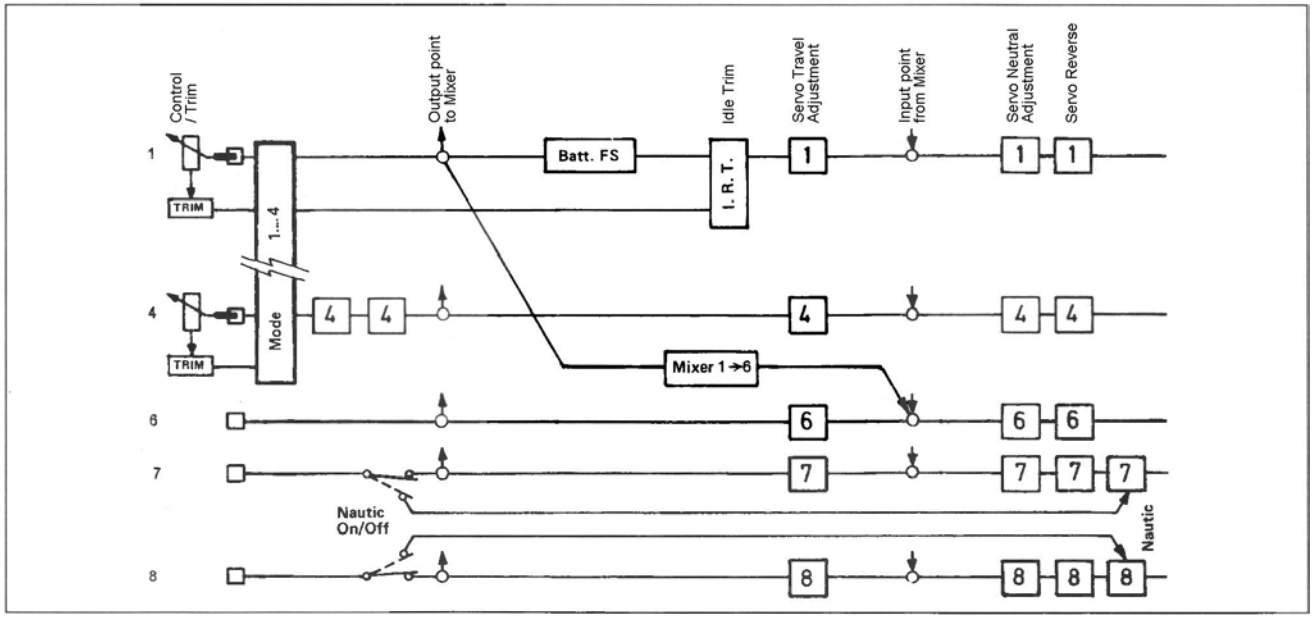
Model Type	See page
Standard (FL)	28
Unifly (UN)	34
F3B/Butterfly (Fb)	42
Aerobatic (AC)	52
Helicopter (HE)	62

The modelling beginner is recommended to choose models with control over rudders and elevators, and if necessary also over Ailerons. Select the standard model type "FL" in the system menu.

Flow charts and block diagrams
Those the individual sections placed in front flowcharts contain the available in each case codes. (see page 19).
From the block diagrams it can be inferred, in which place in the signal flow from the signal of the controls, i.e. can be influenced and changed between the control functions 1 – 8 and the receiver connections. For clarity the same designations and abbreviations were used as with respect to the descriptions of code. See the diagram below.
The controls at the transmitter are symbolically explained by the character . The control sticks 1 – 4 additionally possess a (electronic) trim.

Since these are not influenced by the dual rate and exponential function, their signal process is drawn separately. The cross connections show, which channels are linked together with certain finished programs. For the freely programmable mixers, see page 22 and 23, of importance are the "output point" and the " input point ". The program in the appropriate place tests, at which point in the signal flow a signal is to be measured (outputs) and which channel it is to affect (inputs).
Before the signal finally arrives at the receiver or at the servo, it can still be influenced by the servo travel, reversal and neutral adjustment.

Block Diagram (Partial View)



Set-Up Menu

Selecting and Adjusting the Program Settings

Switch on the transmitter and press ENTER to switch to the Set-Up Menu program. (If the System Menu is active, press ENTER twice).

The Multi-Data Information Display now switches from the basic information (normal operation or stopwatch) to the Set-Up Menu, and you will see the last selected function from this menu on the screen. If you wish to adjust a different function you should press ROLL UP or ROLL DN repeatedly (or hold it down) until the required function appears in the display.

You can switch to the channel (CH) or to any allowed sub-routine you want to adjust by pressing the CH SEL or the ◀ button.

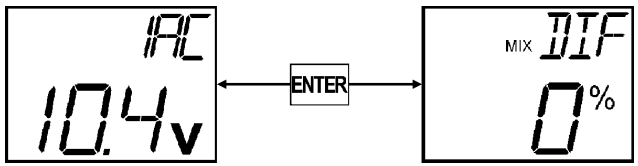
The actual values are always adjusted using the INC or DEC buttons, or a 2-way momentary switch (Part No 4160.44) if fitted. The switch is connected to the INC and DEC sockets on the transmitter circuit board. We strongly recommend installing the switch if you want to be able to alter parameters while you are flying / operating your model aircraft, boat or car.

The adjusted values are automatically stored in the model memory once you press ENTER, or change to the next code.

The menu can be left at any time by pressing ENTER. For the sake of clarity, we will describe only those functions which are available for all model types, and which are listed in the flow diagram. The multi-function programs for model aircraft are described in their own sections.

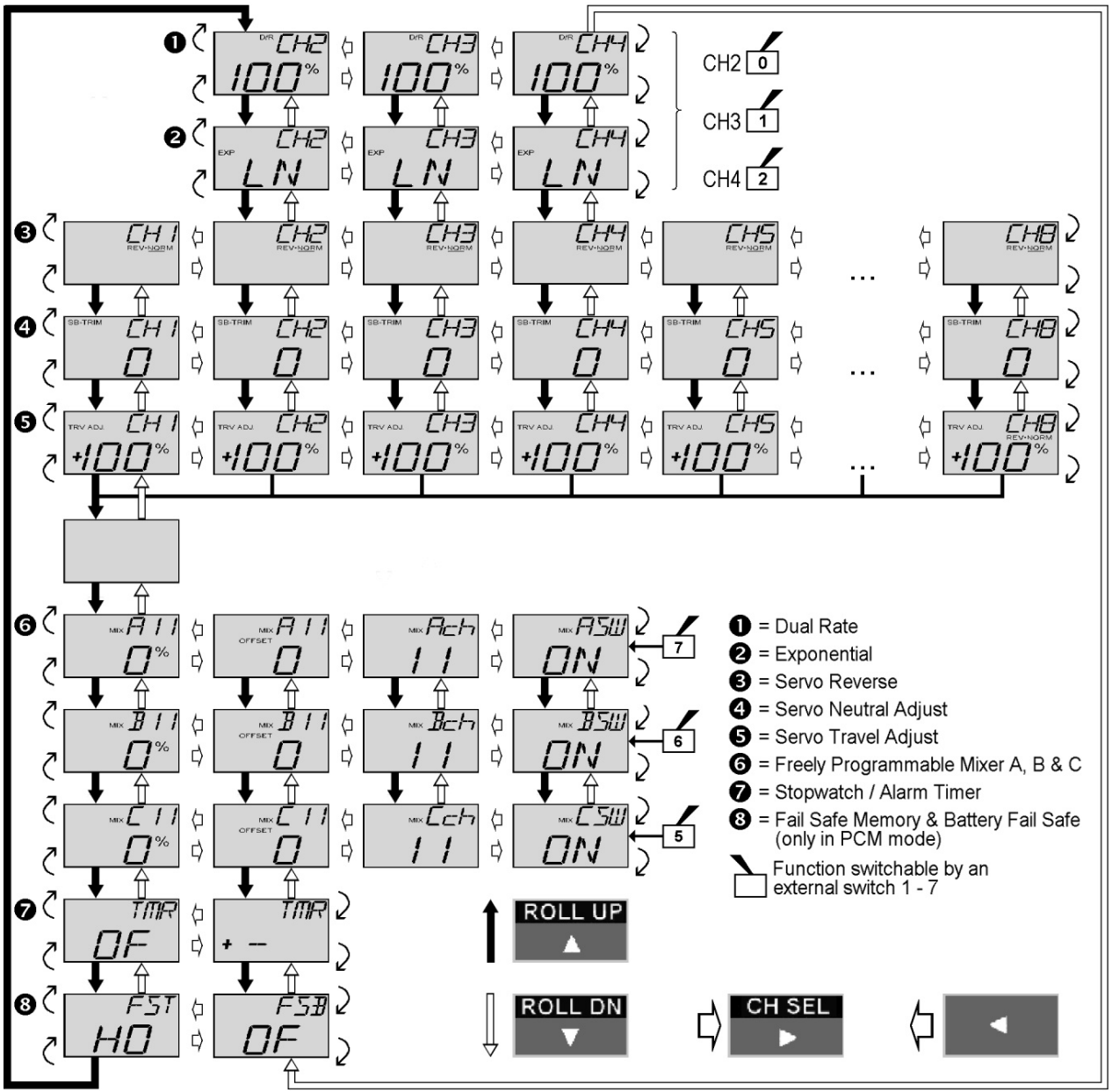
Normal Display

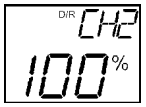
Transmitter in Set-Up Menu mode. The display shows the last selected function



Flow Diagram of Set-Up Menu (Partial View)

(includes only those functions which are common to all model types)





DUAL-RATE

Switchable Servo Travel
(access via Set-Up Menu)

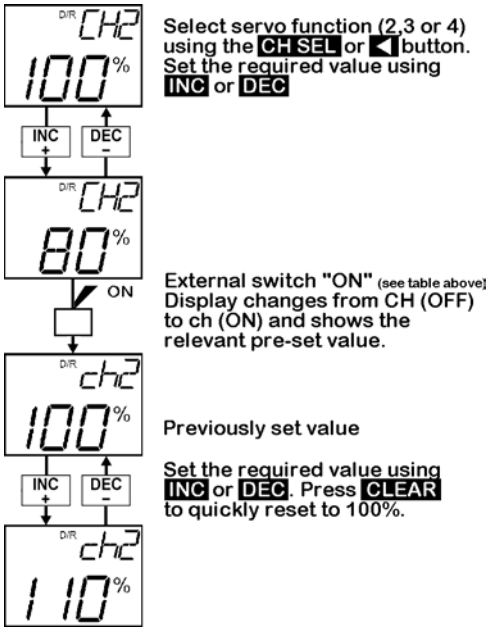
The Dual-Rate function lets you switch to a different amount of travel while the model is in flight, using an external switch. The travel for each of the two switch positions can be set to any value within the range 0 to 125% of normal servo travel. The “D/R” switches must first be connected to main circuit board in the transmitter (see page 10). After selecting the “D/R” code the first step is to select the channel (channel 2 to 4) using CH SEL:

Transmitter Ch.	Function	External Switch
2	Aileron	socket 0
3	Elevator	socket 1
4	Rudder	socket 2

Move the switch to the appropriate position, then set the required servo travel using INC and DEC.

Switch position in the display:
ch = closed (ON)
CH = open (OFF)

Never reduce the Dual-Rate value to 0, as this would mean that the function would not move at all after you’ve operated the switch.

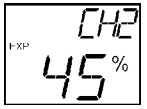


Select servo function (2,3 or 4) using the CH SEL or ◀ button. Set the required value using INC or DEC

External switch "ON" (see table above) Display changes from CH (OFF) to ch (ON) and shows the relevant pre-set value.

Previously set value

Set the required value using INC or DEC. Press CLEAR to quickly reset to 100%.



EXPONENTIAL

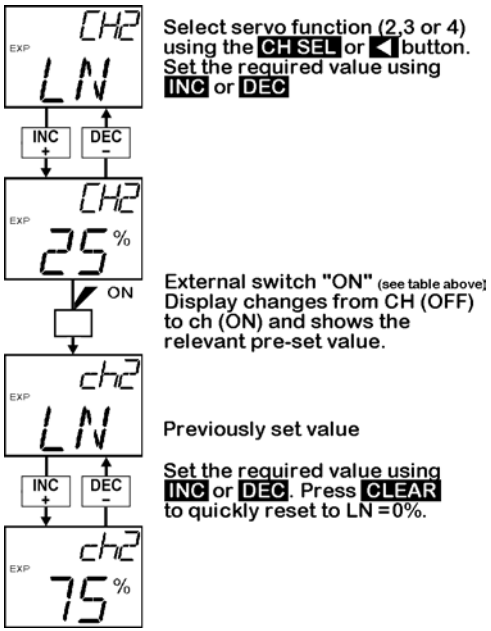
Progressive Servo Travel
(access via Set-Up Menu)

Exponential travel reduces the servo travel around the neutral position of the stick. Travel progressively increases towards the stick end-points, so that full servo travel is still available at the extremes. The degree of progression can be set from linear “LN” (or 0%) to 100%. The Exponential function therefore has no effect when set to “LN”. **Dual-Rates and the Exponential function are controlled by the same switch**, see EXPO-/DUAL-RATE:

Transmitter Ch.	Function	External Switch
2	Aileron	socket 0
3	Elevator	socket 1
4	Rudder	socket 2

Move the switch to the appropriate position, then set the required servo travel using INC and DEC.

Switch position in the display:
ch = closed (ON)
CH = open (OFF)

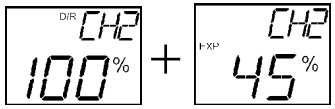


Select servo function (2,3 or 4) using the CH SEL or ◀ button. Set the required value using INC or DEC

External switch "ON" (see table above) Display changes from CH (OFF) to ch (ON) and shows the relevant pre-set value.

Previously set value

Set the required value using INC or DEC. Press CLEAR to quickly reset to LN =0%.

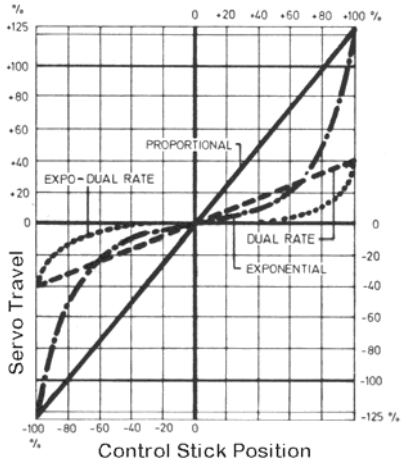


EXPO-/ DUAL-RATE

Coupled Exponential & Dual-Rate
(access via Set-Up Menu)

The Dual-Rate function provides a means of adjusting servo travel symmetrically around the neutral position to any point between 0 and 125%, and switching between the two settings by means of an external switch. The Exponential function alters the servo response curve. Since the external switches affecting control functions 2…4 control the Dual-Rate and Exponential functions simultaneously, it is possible for you to set-up the controls of your model very precisely, to suit your exact requirement. The combination of Dual-Rates and Exponential is particularly advantageous with very fast models. For example, the memory can be programmed with two independent values, separately for aileron, elevator and rudder, such as a servo travel of 20% for one external switch position and 125% for the other position, with an exponential curve of, say, linear or 80%. Note that this Exponential setting defines the “degree of progression” (the shape of the curve), not the extent of the servo travel itself. **For safety reasons the lowest the Dual-Rate value should be set to is 20% of normal travel.**

Characteristic Curves for various settings.



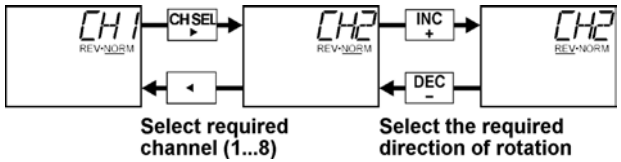
Dual-Rate	=	Linear reduction or increase of servo travel (0% to 125%)
Exponential	=	Progressive control characteristic with 100% servo travel
Expo-/Dual-Rate	=	Combined Exponential and Dual-Rate function

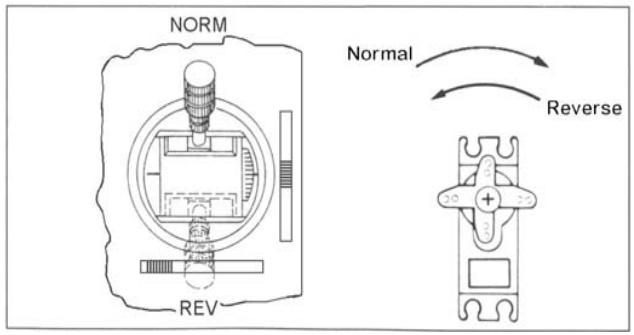
SERVO REVERSE

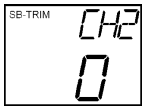
Reversing the Rotation of the Servos
(access via Set-Up Menu)

Using this option, you can reverse the direction of servo rotation.
The set servo rotation is shown in the display for all servo functions 1…8; you will see the cursor line under either “REV” or “NORM”. This eliminates the need to reconnect plugs in the transmitter or reverse the servos themselves. Press the CH SEL button repeatedly until the required channel you wish to alter appears in the display, then swap the direction using the INC or DEC buttons. The CLEAR button will always reset the direction to “NORM”.

Note:
The channel number refers to the receiver output to which the servo in question is connected. Any agreement with the numbering of the channel inputs is coincidental, and is unlikely to be the case when complex mixes are in use. For this reason a change in stick mode does not affect the numbering and direction of rotation of the servos.



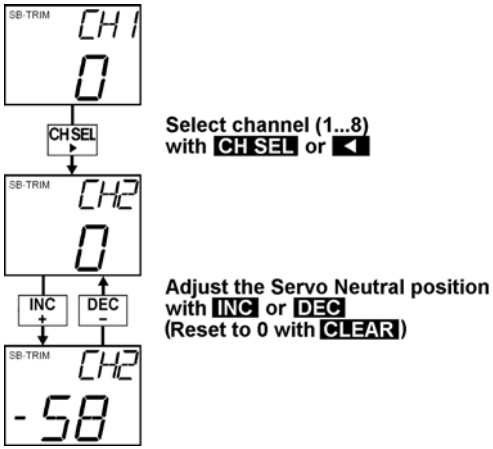


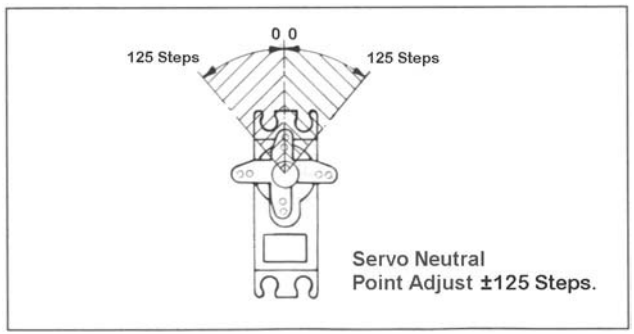


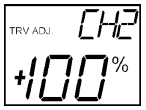
SERVO NEUTRAL POSITION

Servo Neutral Position
(access via Set-Up Menu)

This option can be used to match the system to non-standard pulse width servos or for other applications. The neutral position can be shifted within the range ±125 steps (approximately 70% travel) using the “SB TRIM” option, regardless of the trim lever position and any mixer settings.
Select the channel you want to adjust using the CH SEL button and then press INC or DEC repeatedly to shift the centre point, until the servo neutral is correct for you application. The CLEAR button can be used to reset the adjustment to 0, i.e. the servo the return to its original neutral position. This setting refers directly to the servo concerned, and is not affected by other trim and mixer settings.



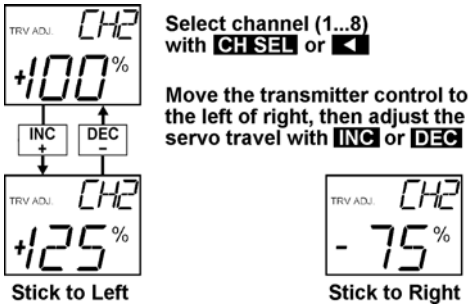


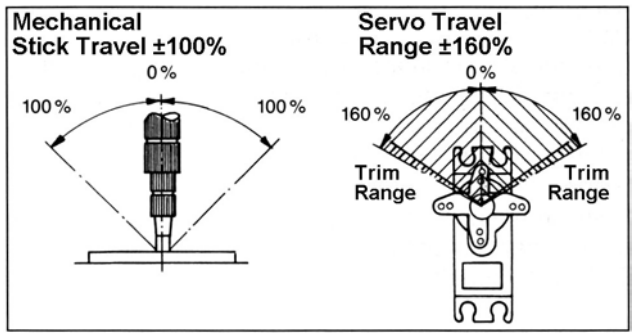


SERVO TRAVEL

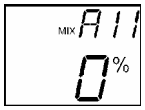
Servo Travel Adjustment
(access via Set-Up Menu)

The abbreviation “TRV ADJ” stands for Travel Adjust and provides adjustment of servo travel separately for either side of centre. The adjustment range is 0…160% of normal servo travel.
Press the CH SEL button repeatedly until the correct servo function (1…8) appears in the display. The bottom line of the display shows the servo travel set, with the prefix (+ or -) indicating the side of centre. If you wish to adjust (& display) a setting, you need to move the associated control (stick, slider, switch) to the relevant end-point. Adjust the travel with the INC or DEC buttons, and reset it to 100% with CLEAR.





MIXER FUNCTIONS



Freely Programmable Mixer

(access via Set-Up Menu)

The Multi-function menus "FL", "UN", "Fb", "AC" and "HE" contain numerous mixing functions, with which two (or more) control functions are mixed together. For example "Combi Mix ", here the rudder can be moved at the same time, without operating the rudder stick, on operating the ailerons. Nevertheless the rudder remains separately controllable. The amount the rudder is moved, by the Combi Mix, is determined by the mixing proportion and the mixing direction, which the model flier must program. The input signal of this mixer is the aileron control function (see the block diagram). The mixer output affects a control path, which before it affects the servo, will be influenced by the codes to the right of the “Input Point from Mixers” in the block diagram, sub trim and servo reversal.

To the mixers are besides external switches assigned, with which they can be switched on and off. A multiple reservation of an external switch is however because of the multiplicity of the mix functions inevitable

Additionally to the finished mixer functions three freely selectable mixers are programmable for each type of model (with the helicopter program two). First control function (mixer input) becomes and the control path (mixer output) of the user defines, then the mixing proportion or the mixing direction and the neutral point input.

The neutral point. in the following OFFSET mentioned. determines that point on the control way of a giver, with whom the mixer does not influence the control path attached at the output. I.d.R. is that the central position of a control stick.

The freely programmed mixer is by software always switched on, alternatively can for it in addition, an ON/OFF switch be assigned.

In addition to the finished mixer functions the model types “FL”, “UN”, “Fb”, “AC” have three, and the type "HE" has two, freely selectable mixers at your disposal. The mixers are accessed in the Set-Up menu by successively pressing the keys the ROLL UP or ROLL DN buttons. They are identified by the identification letters “A, B and C".

With the CH SEL or the ◀ button subroutines are branched to, in allow you to determine the mix proportion, offset (deviation of a control, e.g. joystick or sliding control, centre position), control function (=input signal), control path (=mix output) and mix switch.

Methodology, Example Mixer A:

CH SEL or the ◀ button is pressed repeatedly, until the display shows “Ach". Using the INC button the number the control function (=giver 1…8) and with the DEC button the number of the control path (=output 1…8) are determined. The selected channels are displayed in the lower line of the display. (pressing CLEAR resets this allocation).

Press CH SEL: The display changes to: “ASW”. Here, where the mixer is to remain constantly switched on, the display should show “ON”. Alternatively, an external switch can be assigned, in order to be able switch the mixer on and off. To change this setting press the INC or DEC buttons. In the lower line of the display the card connection number appears, to which an appropriate external switch should be attached:

Mixer	External Switch
A	Connection 7
B	Connection 6
C	Connection 5

Select either “ON” or " 7 " press the CH SEL button. A mix proportion between 0 and ±125%, symmetrical to the neutral point, can be set using the INC or DEC buttons (CLEAR resets the parameter to 0%). If an external switch was assigned, the mixer can be switched off and in the display would show “OF”.

One presses CH SEL again, for the OFFSET input: Move the control into the desired position and press CLEAR. The OFFSET is shown in the display (range approx. ±85). CLEAR resets the OFFSET to 0. If an external switch has been assigned and is switched off, the display also shows “OF” here. (The OFFSET position of the control function should again be stored as required.

Thus the programming of the mixer A is final. With the mixers B and C proceed in same way.

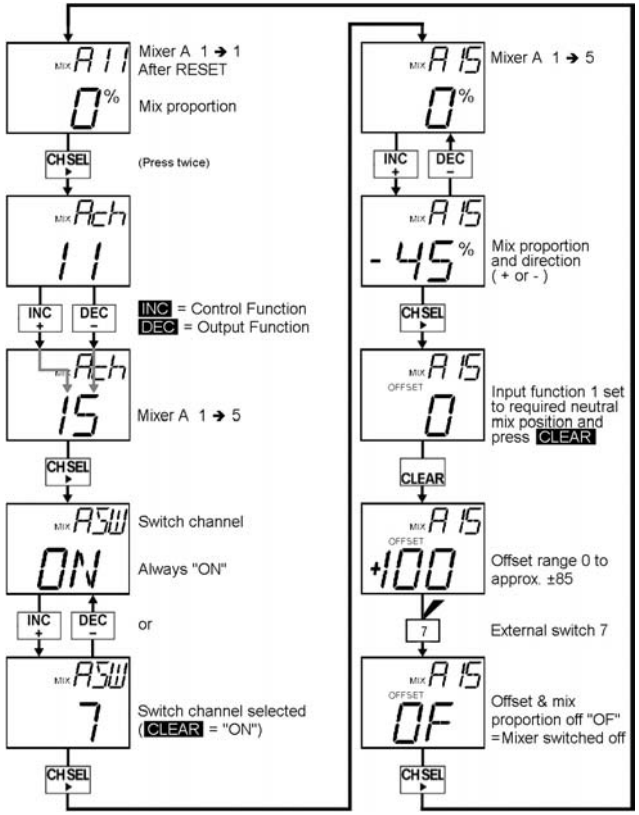
Note:

Mixing proportions of different mixers can be overlaid in such a manner that uneven servo movement is compensated for. E.g.: With the model types “UN” and “Fb”, receiver outputs 2 & 5 are already linked, by software, to the aileron control. If a freely programmable Mixer is set 2 ➔ 5 is set now with a mix quotient of +100%, then only servo 5 would move, and with -100% set only servo 2 moves.

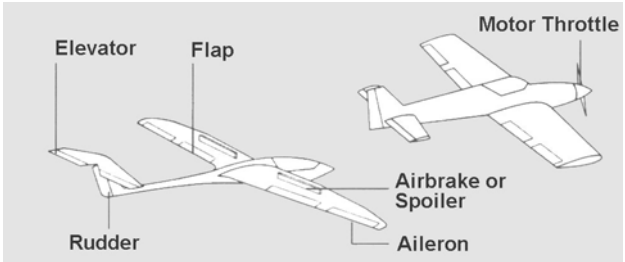
In the helicopter program control function 6 cannot be used as input signal for a mixer, since for this function the pitch trim with external potentiometer is reserved (see appropriate diagram page 61). The signal affects directly only the receiver output 6, whereby the control trim is limited to 25% of the normal throw. Depending on the type of swash plate (Swash Mixer), certain control paths are linked together (as with all finished mixers), so that similar considerations apply as with the types “UN” and “Fb”. E.g. the initial standard wash-out mixer links the "N" control function 1 with channel 6.

Programming Example

Aileron as landing aid with the type of model “UN”



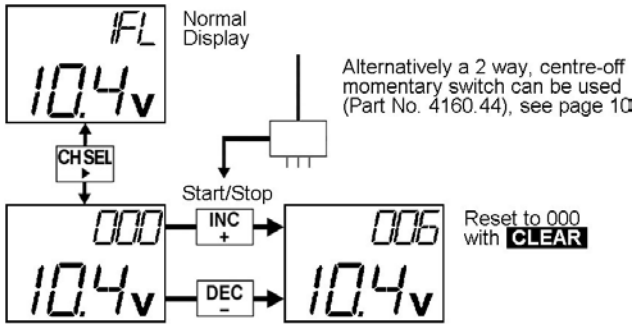
Note:
With the model type “Fb” this program flow is already completed at initialisation, see page 48.



STOPWATCH and ALARM TIMER

Stopwatch and Countdown Clock
(access via Set-Up Menu)

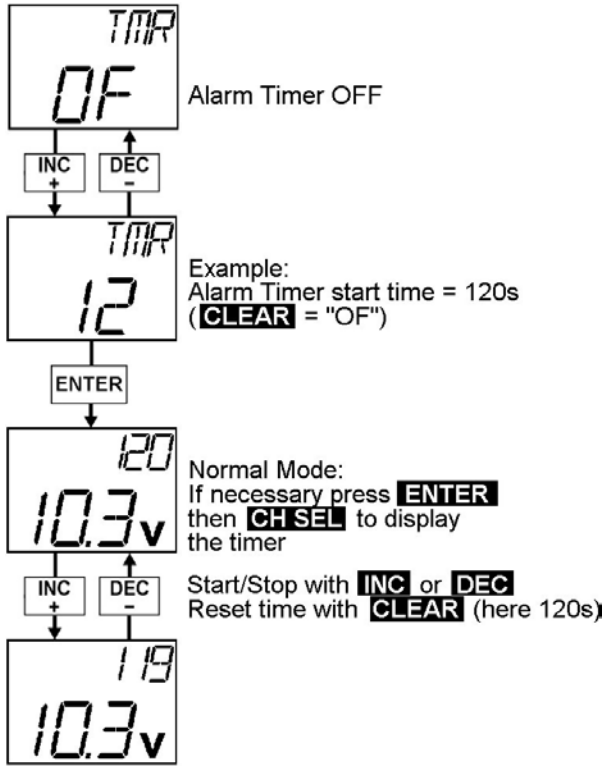
In normal operating mode the display can be set to timer display with the CH SEL button. The default, without having called code “TMR”, is a stopwatch (0...999s). The Start/Stop is using either INC or DEC and reset to “000” is by using CLEAR. If the transmitter is switched off & back on, the display last selected appears, i.e. either model name or "000".



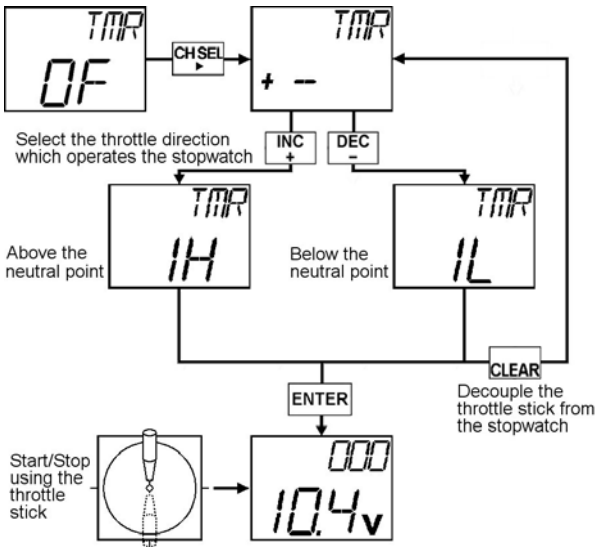
The code “TMR” allows the application possibilities to be extended:

1. **Countdown Clock** (Alarm Timer), which has an audible warning tone. The start time is set by the user and ranges from 10s to 900s. 20s before the end of the time, an internal buzzer sounds every 2s, below 10s every second to 0s. The clock then continues to run counting up to 999s. This additional time is shown by a "+" displayed in the lower line before the battery voltage. Start/Stop of timing is controlled by the INC / DEC buttons.
2. **Throttle Stopwatch**, as normal except the start/stop is controlled by the throttle stick. The switching point set independently to the position of the control lever centre. Additionally it can be determined whether the timer start is by pushing or pulling the throttle stick. With this option the true engine run time can be measured.
3. **Alarm Timer**, a countdown timer as 1 above, but controlled by the throttle stick as in option 2.

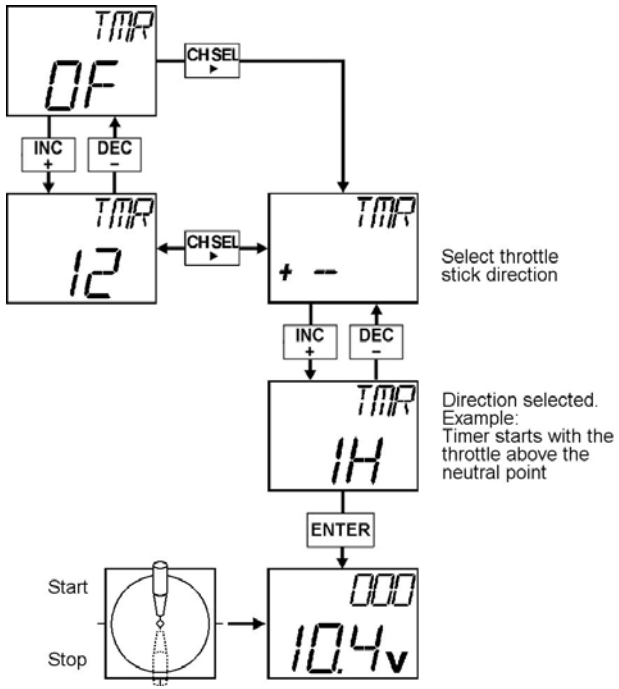
Programming:
Example 1: The display of “OF” shows the Alarm Timer is off, and stopwatch mode active. Pressing the INC button increases the time in 10s steps, up to a maximum of 900s, and actives the Alarm Timer mode. In the lower line of the display only the steps are counted, e.g. for a initial time of 360s, a display of “36" would be seen. Using the DEC button, the interval can be reduced (CLEAR sets the alarm timer off display “OF”).
In normal mode the transmitter the display can be swapped to timer mode by pressing the CH SEL button. Start/Stop is achieved using the INC or DEC button, and the CLEAR button resets the timer to its initial programmed value.



Example 2: To link the stopwatch with the throttle, CH SEL is pressed when the display shows “OF” (timer OFF). The display changes to "+-" indicating the switching direction needs to be selected using the INC / DEC buttons. This controls whether the stopwatch runs with the throttle above the neutral position, display "1H" (ch 1 = High), or below the neutral point with display “1L” (ch 1 = Low).
If CH SEL is pressed again, the direction is retained and will be used later. Where the display indicates "OF", it means only that the alarm timer is off and the stopwatch is active. This control only works with either "1H" or "1L" selected. To deactivate throttle stick operation, with the display showing "OF", press CH SEL and the display will show "1H" or "1L". Press CLEAR to return the display to "+ -", showing the throttle stick has been decoupled. Pressing CH SEL again returns to the display to "OF".
In the active condition the stopwatch does not run with the throttle stick in idle position. CLEAR returns the transmitter counter to the initial setting of “000".



Example 3: The switching function, described in (2.), can also be used with the alarm timer. Select the switching direction described above ("1H" or "1L") then press CH SEL (display shows "OF"). As in (1.) the time interval is adjusted in 10s steps using INC / DEC. In the normal display mode, the alarm timer is now controlled by the throttle stick.
To deactivate: Select code "TMR" and press CLEAR. The display changes to "OF" (alarm timer OFF = stopwatch mode). A press of CH SEL changes the display to "1H" or "1 L", which is cancelled by pressing CLEAR.The display will now show "+ -", indicating that the throttle control is decoupled from the timer.



FAIL SAFE MEMORY and Receiver Battery FAIL SAFE

Storage of Fail Safe data; only in PCM mode
(access via Set-Up Menu)

This function is only possible when in PCM mode and with receiver models mc-12, mc-18, mc-20 and DS 20 mc!

FAIL SAFE MEMORY

The higher working reliability of Pulse Code Modulation (PCM) in relation to the simple Pulse Position Modulation (PPM) results from the fact that the microprocessor built in the receiver recognizes, whether a received control signal was falsified or damaged by external interference. In these cases the receiver automatically replaces this disturbed signal by the last correctly received, which was stored in the receiver just in case. In this way brief interference, where the radio signal is weak or the like, is managed which would otherwise lead to the well-known "glitching".

When a longer lasting disturbance to the transmission between transmitters and receivers occurs, the mc-16/20 software offers two different options of FAIL SAFE programming. Using the INC / DEC keys, the "FST" (Fail Safe Time) can be selected:

1. HOLD program (display "HO"):
   In this case the Servos stops, in the case of a transmission disturbance to the receiver, in the position set by the last intact control signal. It remains in that position until a new, recognizable, control signal is detected by the receiver.
2. Variable programmable fail-safe with delay option (display: 0.3, 0.5 or 1.0):
   The servo moves to a pre-programmed set position, until the receiver receives an intact control signal. It is possible to set a delay time from the beginning of the interference to the operation of the fail safe program. This is settable in three steps (0.3s, 0.5s and 1.0s using the INC/DEC keys, taking into account different model speeds.

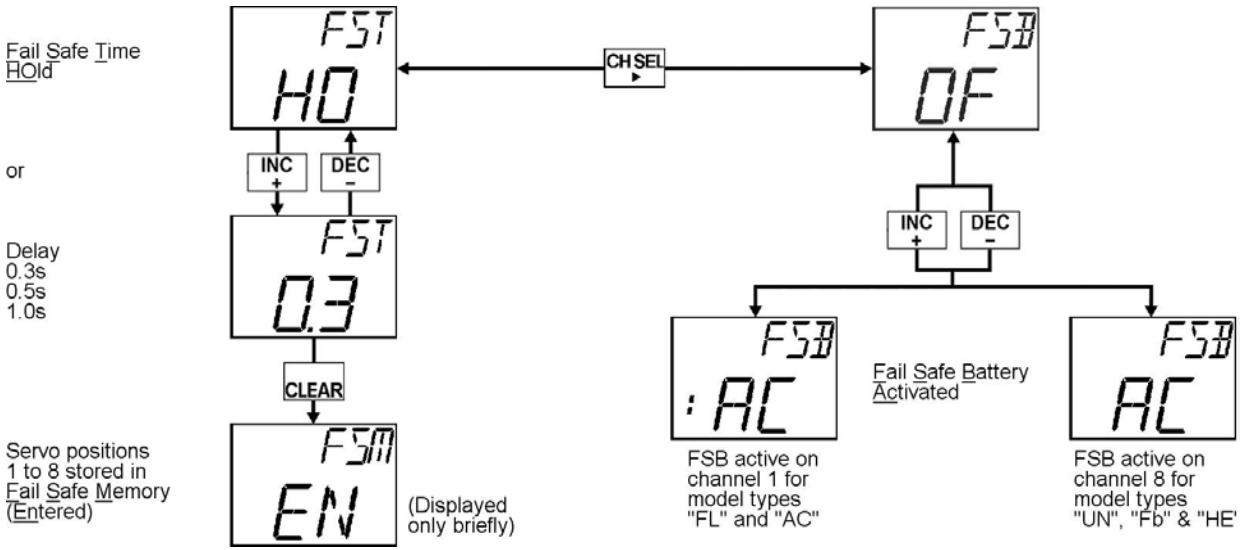
The desired positions of the servos on control functions 1 to 8, during the operation of fail safe, are simultaneously set at the transmitter and then the CLEAR key is pressed. These momentary positions are stored now as the fail safe positions. During operation these values are transferred to the receiver's memory, so that the receiver can fall back to them during interference. Storing is confirmed, in the display, by the brief display of "FSM EN", (Fail Safe Memory Entered). The fail-safe servo positions can be reset at any time, even in flight, by selecting the code and pressing CLEAR to be overwrite the existing settings.

This function is only possible when in PCM mode and with receiver models mc-12, mc-18, mc-20 and DS 20 mc!

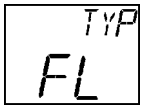
Receiver Battery FAIL SAFE

The output channel for the Receiver Battery FAIL SAFE is preset for model types "FL" and "AC" on channel 1 (throttle/spoiler), and for the types "UN", "Fb", "HE" on the channel 8.

As soon as the voltage of the receiver battery falls below a certain value, the associated servo goes to it's central position, to indicate the low battery voltage. By movement of control stick (1 or 8) the FAIL SAFE servo is release, so that servo again operates as desired by the pilot. The model must be landed immediately after the first FAIL SAFE message.

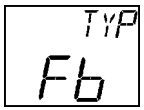


Summary of Ready-Made Multi-Function Programs



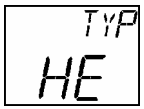
Standard (Fly)
Described on page 28.

Unifly
Described on page 34.



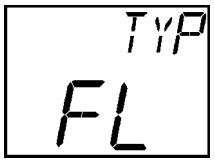
F3B / Butterfly
Described on page 42.

Acrobatic
Described on page 52.



Helicopter
Described on page 60.

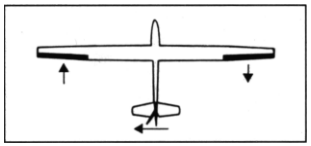
The five ready-made multi-function programs simplify programming considerably. Once you have determined the model type using the System Menu, you can call up any of the special functions listed in the following section. Most of the mixer functions can be switched on and off via external switches. You have to complete adjustment of the mixer values, to match the particular model, by flight testing.

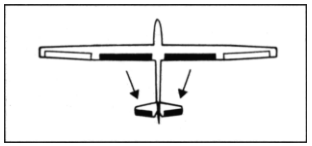


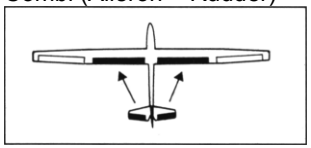
FL = STANDARD

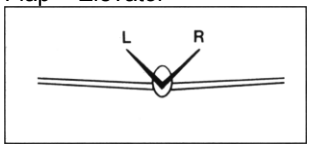
Described on page 28.

Mixer Function	Code	Switch	Std Value
Combi (Aileron – Rudder)	A-R	3	0%
Flap – Elevator	F-E	5	0%
Elevator – Flap	E-F	4	0%
V-Tail	WNG (VTL)	-	OFF
Delta	WNG (DLT)	-	OFF
Freely programmable mixers	A, B, C	7, 6, 5	0%

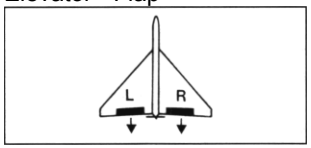

Combi (Aileron – Rudder)


Flap – Elevator

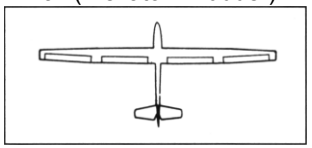

Elevator - Flap

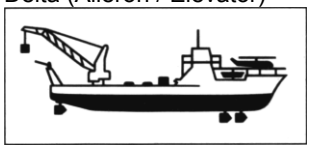


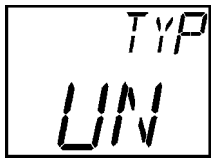
V-Tail (Elevator / Rudder)



Delta (Aileron / Elevator)


Freely Programmable

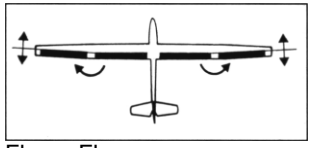

NAUTIC – channel 7, 8

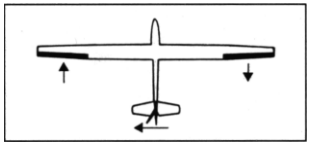


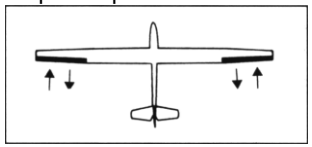
UN = UNIFLY

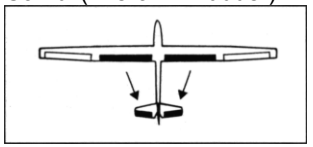
Described on page 34.

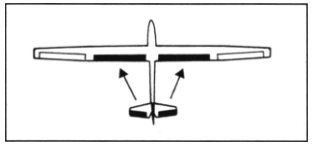
Mixer Function	Code	Switch	Std Value
Flap - Flaperon	F-A	-	0%
Combi (Aileron – Rudder)	A-R	3	0%
Differential	DIF	6	0%
Flap – Elevator	F-E	5	0%
Elevator – Flap	E-F	4	0%
V-Tail	WNG (VTL)	-	OFF
Spoiler	S-E	7	0%
Freely programmable mixers	A, B, C	7, 6, 5	0%

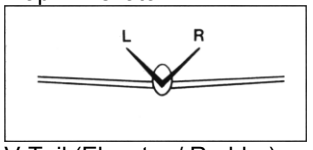

Flap – Flaperon


Combi (Aileron – Rudder)

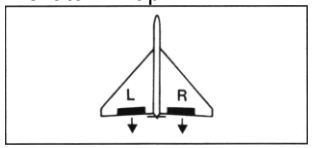

Differential


Flap – Elevator

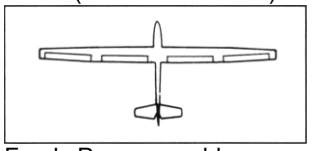

Elevator - Flap

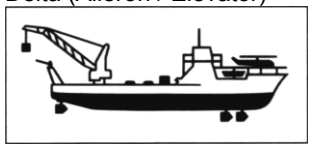


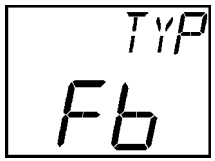
V-Tail (Elevator / Rudder)



Delta (Aileron / Elevator)


Freely Programmable

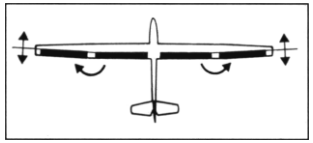

NAUTIC – channel 7, 8

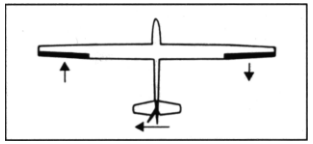


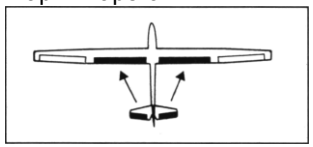
Fb = F3B, Butterfly

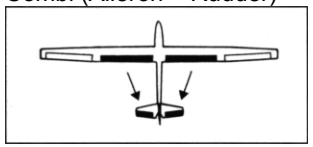
Described on page 42.

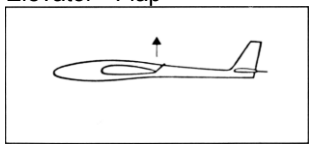
Mixer Function	Code	Switch	Std Value
Flap - Flaperon	F-A	-	0%
Combi (Aileron – Rudder)	A-R	3	0%
Differential	DIF	6	0%
Flap – Elevator	F-E	5	0%
Elevator – Flap	E-F	4	0%
V-Tail	WNG (VTL)	-	OFF
Butterfly – Flaperon	SA	7	0%
Butterfly – Elevator	SE	7	0%
Butterfly – Flap	SF	7	0%
Freely programmable mixers	A, B, C	7, 6, 5	0%

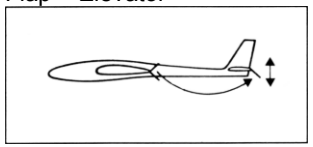

Flap – Flaperon

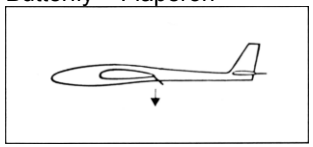

Combi (Aileron – Rudder)


Elevator - Flap

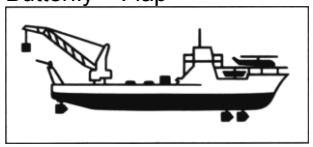

Flap – Elevator

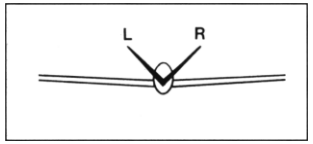

Butterfly – Flaperon


Butterfly – Elevator

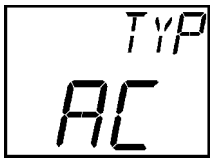

Butterfly – Flap


Differential


NAUTIC – channel 7, 8



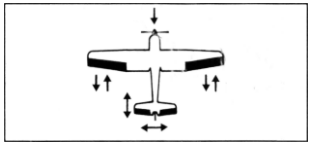
V-Tail (Elevator / Rudder)

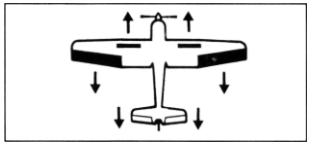


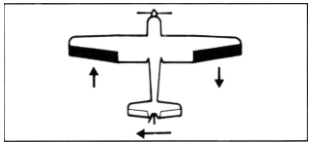
AC = ACROBATIC

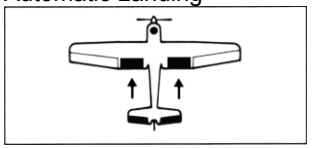
Described on page 52.

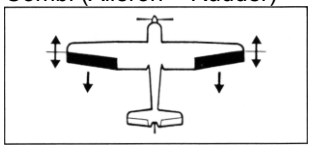
Mixer Function	Code	Switch	Std Value
Automatic Manoeuvre	SR…	6, 7	OFF
Auto-Coupled Dual Rate/Exp	AT4	-	OFF
Automatic Landing	LD…	5	OFF
Combi (Aileron – Rudder)	A-R	3	0%
Elevator – Flap	E-F	4	0%
Flaperon	WNG (FLP)	-	OFF
V-Tail	WNG (VTL)	-	OFF
Freely programmable mixers	A, B, C	7, 6, 5	0%

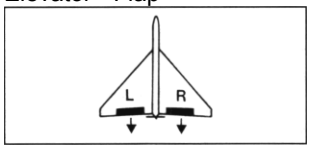

Automatic Manoeuvre


Automatic Landing

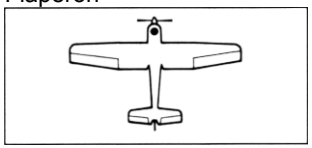

Combi (Aileron – Rudder)

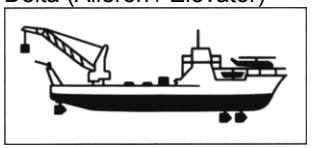

Elevator - Flap


Flaperon



Delta (Aileron / Elevator)

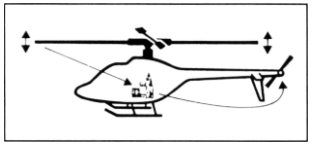

Freely Programmable

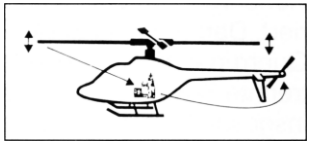

NAUTIC – channel 7, 8

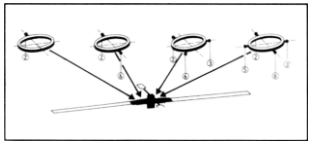
HE = HELICOPTER

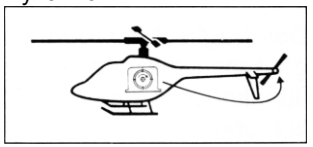
Described on page 60.

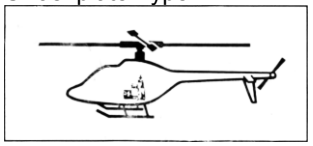
Mixer Function	Code	Switch	Std Value
Autorotation	ATR	3	OFF
Idle Up / Throttle Curve	T…	4, 5	±85%; 0
Pitch Curve	P…	4, 5	±85%; 0
Static Mix	ST…	6	0%
Dynamic Mix	DYN	6	0%
Swashplate Type	SWA	-	N
Gyro Control	GY…	7	OFF
Freely programmable mixers	A, B, C	7, 6, 5	0%

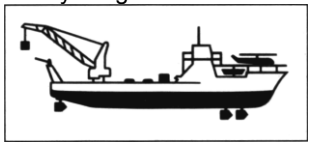

Static Mix


Dynamic Mix


Swashplate Type


Gyro Control


Freely Programmable


NAUTIC – channel 7, 8

STANDARD

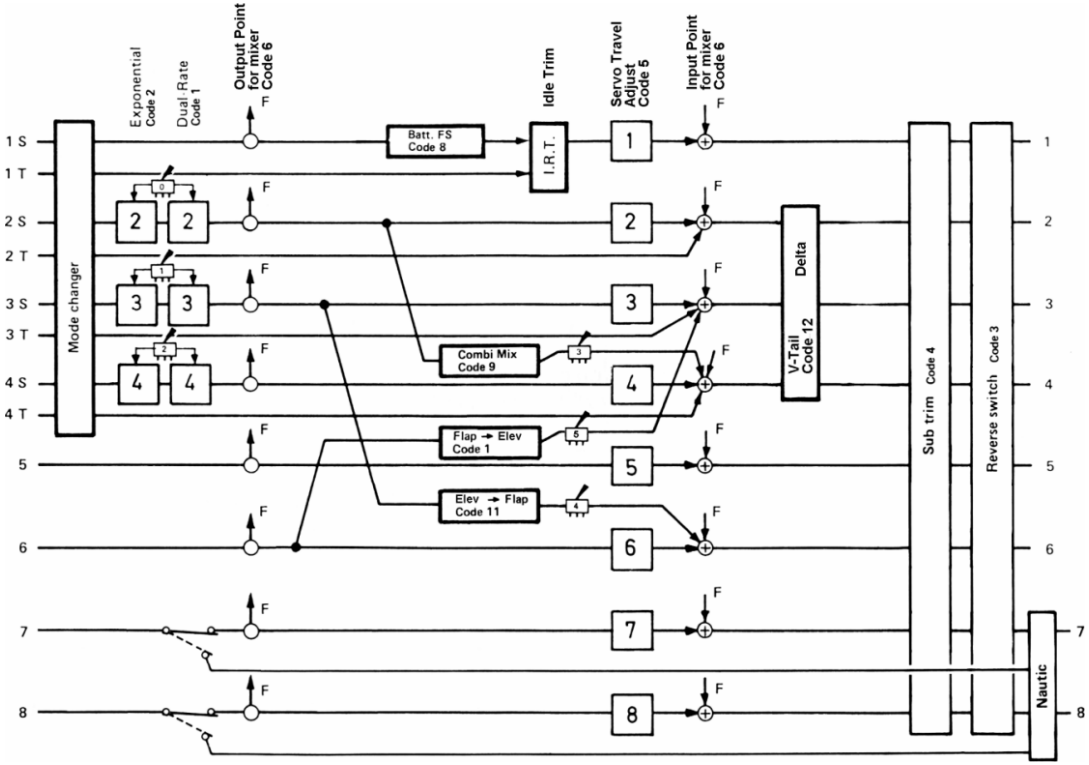
Model Type Described

Included under the STANDARD type are all motor and sailplane models, with which control over elevator, rudder, ailerons, engine throttle or rpm (and/or airbrakes for sailplane models) is possible. In this programme it is also possible, via additional control paths for auxiliary functions, to control features like retractable landing gear, cable release, mixture adjustment or also landing flaps (and/or variable flaps for sailplane models). All options, which are for this configuration possible and meaningful, are available here.

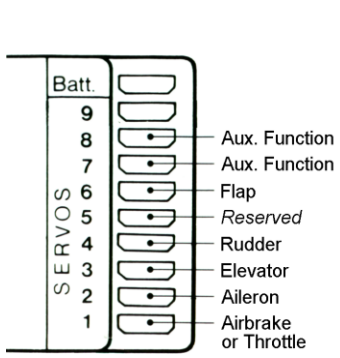
Some special mixers, such as combi-mix (aileron - rudder), elevator adjustment during flap operation and an elevator - flap mixers to the assist the elevator in manoeuvring, are already configured. Beyond that three freely programmable mixers are available for applications such as aileron or flap control using two separated servos or more complex mixing functions.

The program area titles "WING" covers the programs for delta and V-tail models. With delta and flying wing models, elevator and aileron share the same control surfaces on the left and right trailing edge of the wing. With V-tail models the elevator and rudder functions are linked with one another in an appropriate way to control the model.

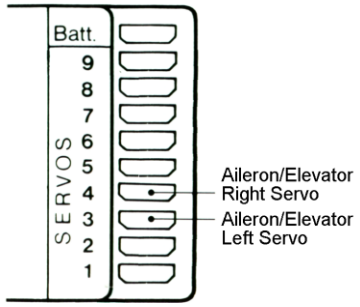
Block Diagram STANDARD (Fly) “FL”



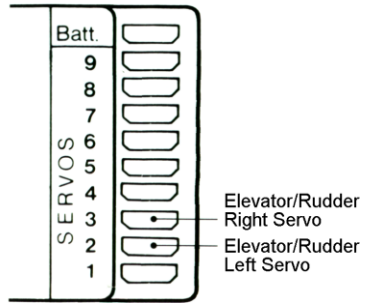
Allocation of Receiver Connections (ch 1 – 8)
The servos must be connected to the receiver connections as follows:



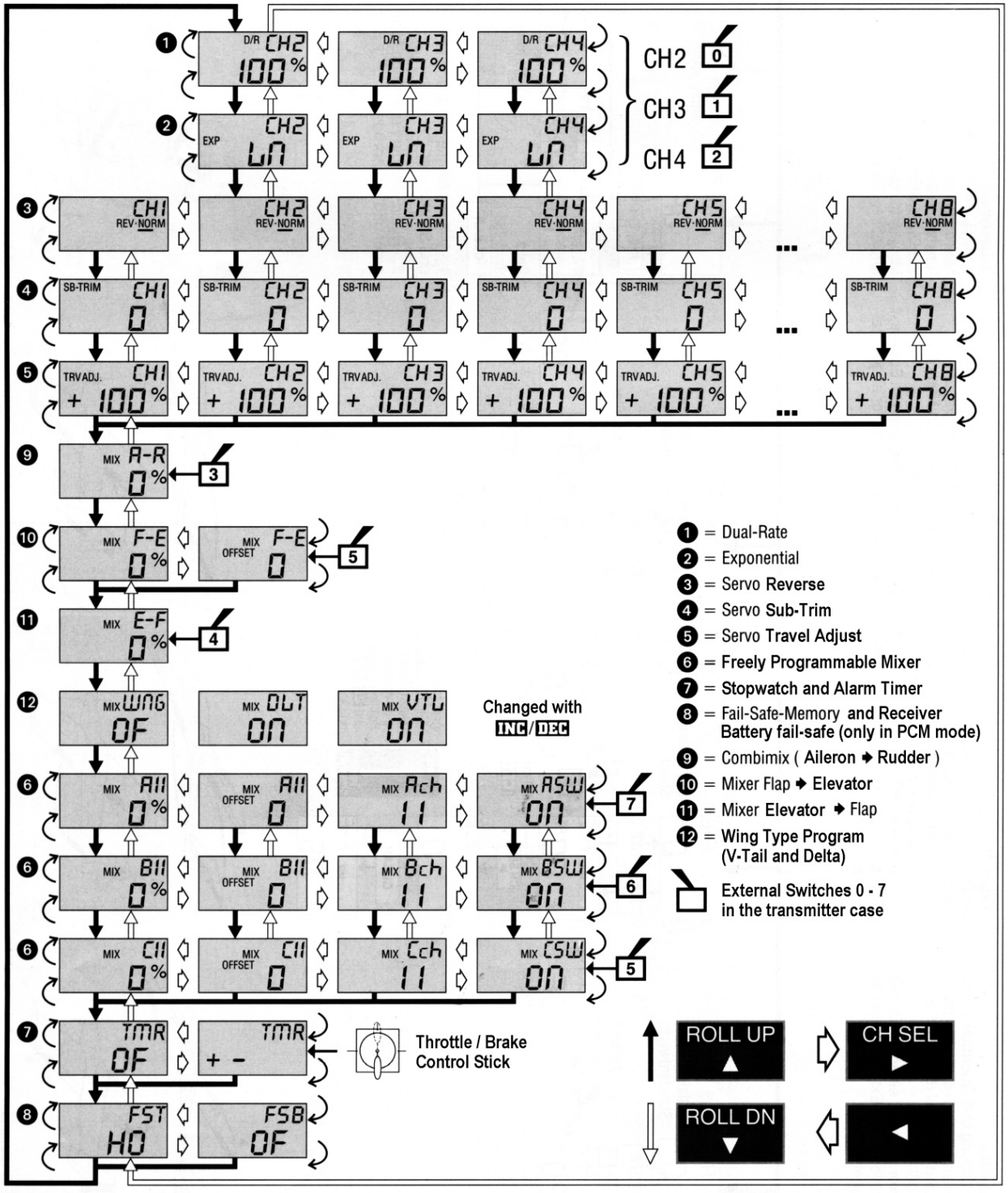
V-Tail



Delta + Tailless



Block Diagram STANDARD (Fly) »FL«



Set-up Diagram

TYP FL Model Type “FL” = STANDARD

All the mixers and adjustment values are set to 0 (= mixer off).
To adjust the mixer and adjustment values, while flying, we recommend fitting the 2-way momentary switch, Part No. 4160.44 (see page 10)

❶ ... ❺, ❼, ❽ | ❾ MIX A-R (Aileron ➧ Rudder) | ❿ MIX F-E (Flap ➧ Elevator) | ⓫ MIX E-F (Elevator ➧ Flap) | ⓬ MIX WNG (Wing)

Adjustments ❶ ... ❼, ❽ are available for all model types

D/R CH2 100 %
❶ DUAL-RATE
Functions 2 ... 4
(0 ... ±125%), page 20

EXP CH2 LN
❷ EXPONENTIAL
Functions 2 ... 4
(linear ... +100%), page 20

CH1 REV·NORM
❸ SERVO REVERSE
Channel 1...8, (Reverse/ Normal), page 21

SB-TRIM CH1 0
❹ SERVO SUB-TRIM
Channel 1...8, (0...±125 each side), page 21

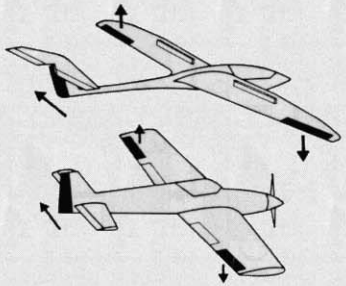
TRV ADJ. CH1 + 100 %
❺ SERVO TRAVEL ADJUST
Channel 1...8, (0...±160%), page 21

TMR OF
❼ STOPWATCH and ALARM TIMER, page 23/24

FST HO
❽ FAIL SAFE MEMORY and BATTERY F.S. (only in PCM mode), page 24/25

Combi-Mix
When an aileron command is given, the rudder also moves to a pre-programmed extent (0 ... ±125%).
The mixer can be switched on and off via an external switch connected to socket 3.

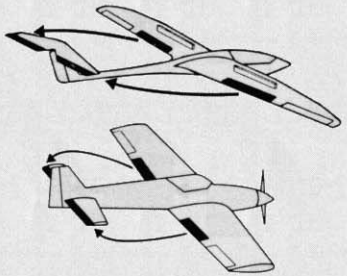
MIX A-R 0 % Standard Initialised Value
INC + DEC −
Switch 3
MIX A-R + 20 % → 3 → MIX A-R OF
Mix ratio (0 .... ±125%) (CLEAR = 0%)



Flap ➧ Elevator
When the flap servo is operated, the elevator is fed a pre-set corrective signal (0 ... ±125%)
The mixer can be switched on and off if an external switch is connected to socket 5.

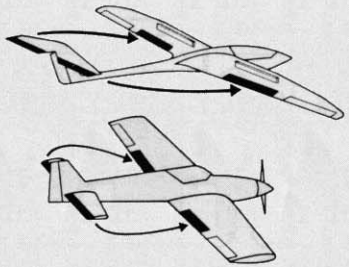
MIX F-E 0 % Standard Initialised Value
INC + DEC −
Switch 5
MIX F-E + 20 % → 5 → MIX F-E OF
Mix ratio (0 .... ±125%) (CLEAR = 0%)
CH SEL ▶
MIX OFFSET F-E 0
CLEAR
MIX OFFSET F-E + 85

4152 PROP CHANNEL
OFFSET Adjustment: Move the control for channel 6 to the required position and press CLEAR



Elevator ➧ Flap
When the elevator servo is operated, the flaps are fed a pre-set signal (0 ... ±125%)
The mixer can be switched on and off if an external switch is connected to socket 4.

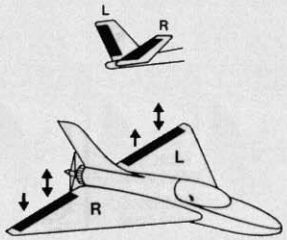
MIX E-F 0 % Standard Initialised Value
INC + DEC −
Switch 4
MIX E-F + 20 % → 4 → MIX E-F OF
Mix ratio (0 .... ±125%) (CLEAR = 0%)



V-Tail "VTL", Delta "DLT"
1. "VTL" = V-Tail
Mixer ratio adjustable via Dual-Rate, control functions 3 + 4.
2. "DLT" = Delta
Mixer ratio adjustable via Dual-Rate, control functions 2 + 3.

MIX WNG OF Wing Programme "OFF"
INC + DEC −
MIX DLT ON ⇄ MIX VTL ON
Delta V-Tail
CLEAR

1. "VTL": Mixes functions of elevator and rudder.
2. "DLT": Mixes functions of aileron and elevator..



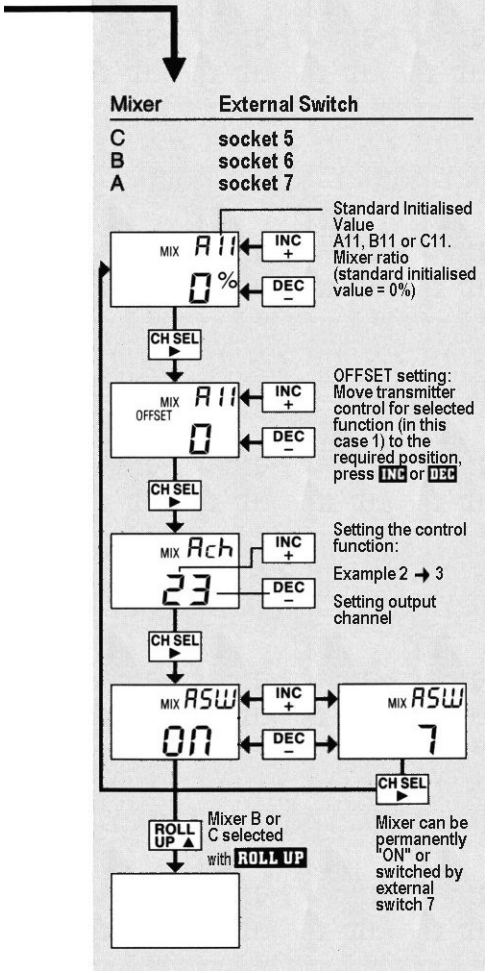
All mixer data can be reset to 0 by pressing the CLEAR button, i.e. turned off. When the display shows “OF” the external switch controlling the mixer is switched off.

For your Notes

❻ MIX A11, B11, C11

Freely Programmable Mixer

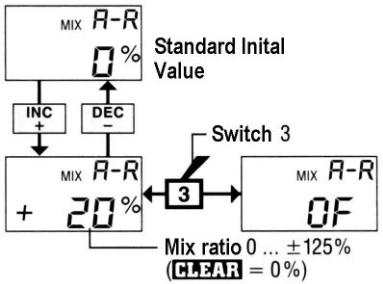
Both the mixer program (servo functions 1 ... 8) and the mixer ratio (0 ... ±125%) can be selected individually.
The mixers can be set permanently "ON" or switched on and off via the associated external switch

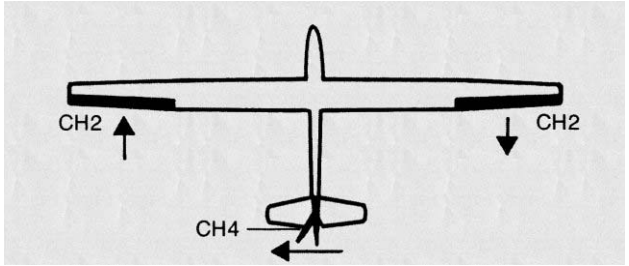


❾ MIX A-R 0% COMBI-MIX

Aileron ➡ Rudder Mixer
(access via Set-Up Menu)

When an aileron command is given, the rudder also moves to a pre-programmed extent. The rudder can be separately steered at any time with priority over the mixer.
After calling the code, the INC and DEC buttons are used to adjust the ratio up to the maximum of ±125%. The Combi-Mixer can be turned on and off using an external switch connected to socket 3.

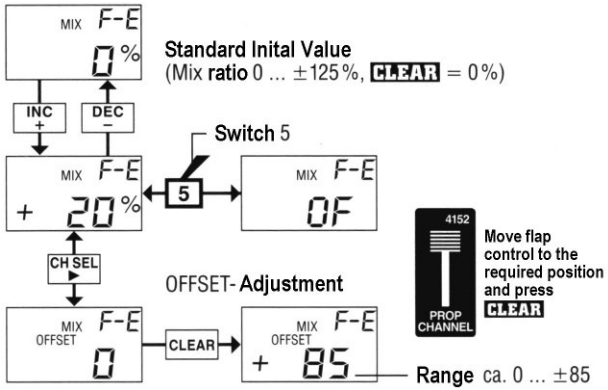


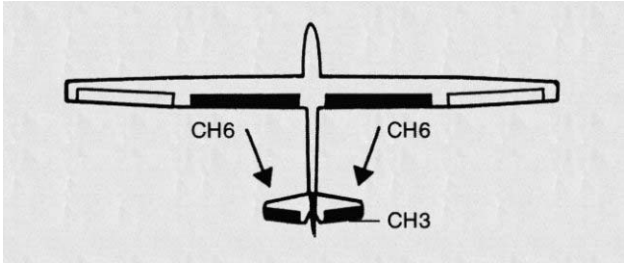


❿ MIX F-E 0% FLAP ➡ ELEVATOR MIXER

Flap ➡ Elevator Mixer
(access via Set-Up Menu)

During slow flight when extending flaps, automatic proportionally correction of elevator is made, thus the pitch attitude of the model becomes independent of the position of the flaps. The mix portion is entered in the code "F-E", the INC and DEC buttons, between 0 and ±125%. Next the mixer neutral point must be specified. The mixer must be informed which position of the input (normally sliding control 6) for the flaps, corresponds to normal flight (flaps neutral). Thus the elevator takes this position to be its neutral, and only when the flaps are moved from this position does the mixer affect the elevator. pressing the CH SEL button to call up the offset screen. Move the control to the required neutral position (e.g. the end position of the flap control) and press the CLEAR button. The offset, the deviation from the control centre position, is indicated in the display. A switch connected to socket 5 of the transmitter board can be used to switch off this function.

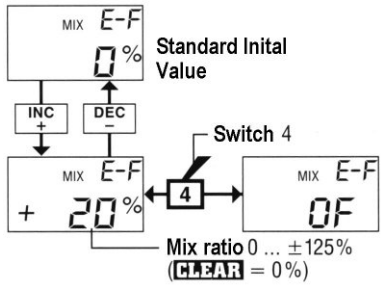


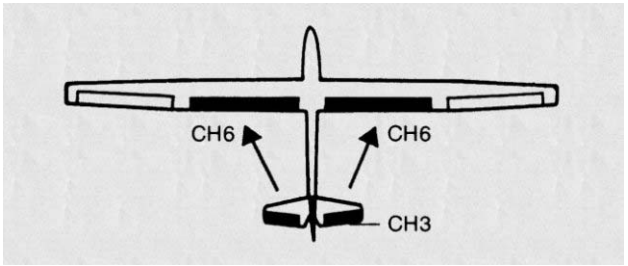


⓫ MIX E-F 0% ELEVATOR ➡ FLAP MIXER

Elevator ➡ Flap Mixer
(access via Set-Up Menu)

To assist the elevator with close turning flight and aerobatics, the flaps can be linked to the elevator and are driven out proportionally to the increase the wing lift. The value in the code "E-F" can be varied using, the INC and DEC buttons between 0 and ±125%. The mixer can be also switched off with an external switch connected to socket 4.



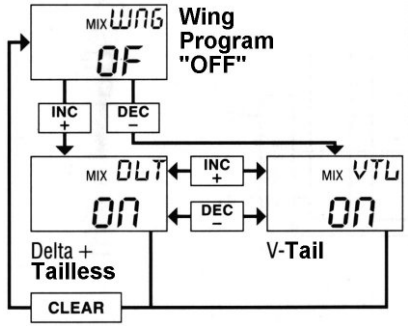


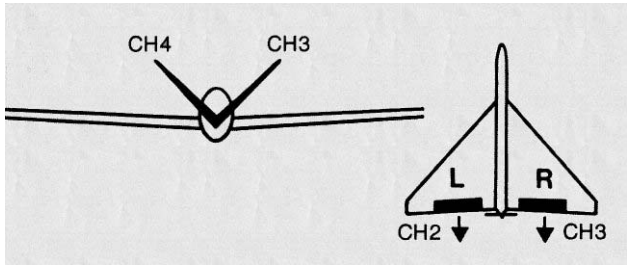
⑫

WING TYPE PROGRAMS

Wing Mixer for V-Tail, Delta and Tailless models (access via Set-Up Menu)

1. For models with a V-tail, "VTL", must be used to mix the functions of elevator and rudder.
   Elevator function: Both surfaces of the V-tail move in the same direction. The mix relationship is adjustable by the dual-rate function for channel 3, see page 20.
   Rudder function: The surfaces of the V-tail move in opposite directions. The mix relationship is adjustable by the dual-rate function for channel 4, see page 20.
2. With delta and flying wing models, "DLT", is used to mix the functions of aileron and elevator. The mix relationship is also determined using the dual-rate function (page 20): Elevator functions: D/R channel 3 and aileron functions: D/R channel 2.





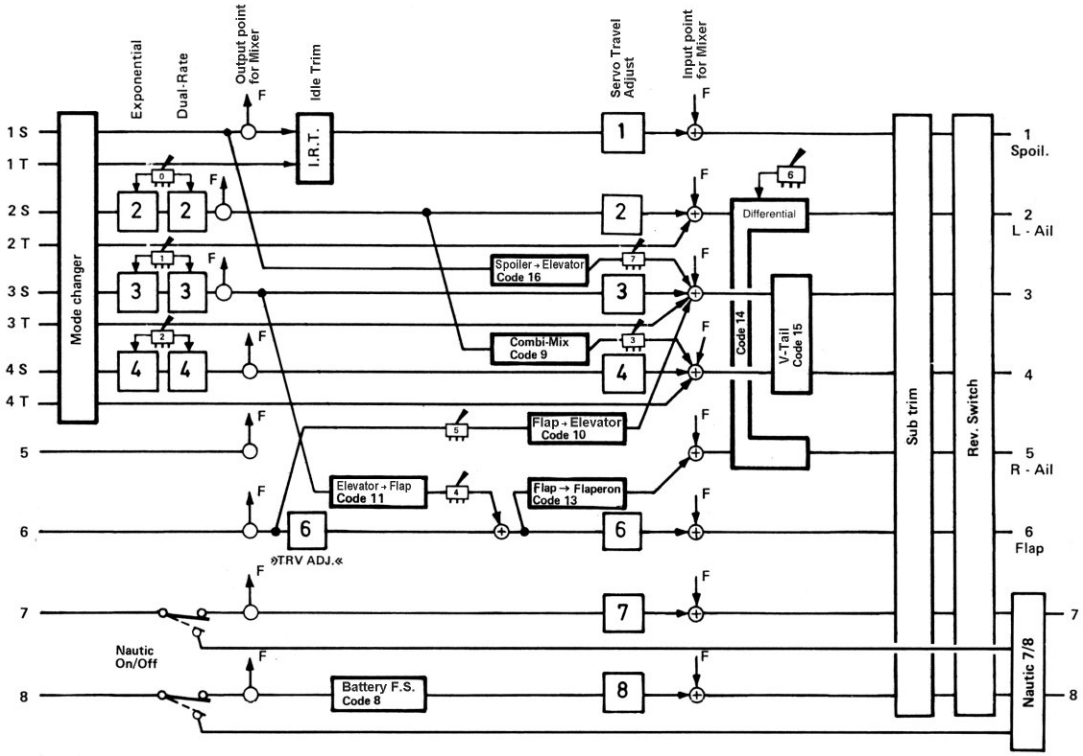
For your Notes

UNIFLY

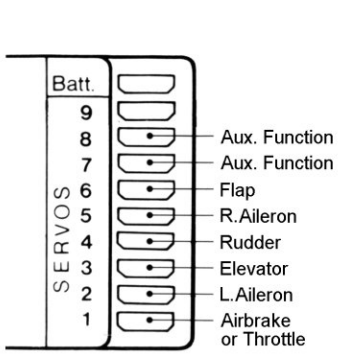
Model Type Described

In contrast to the Standard model type, the "UNIFLY" type is used where separate aileron servos are used, in place of a single common servo, which are by already software coupled. This permits independent adjustment of the aileron deflections upward and downward, which allows a differential mixer to be used.
In addition, the separate controlling of the aileron surfaces makes it possible to operate the both surfaces in the same direction giving a flap function, or Flaperons, e.g. realized using the mixer Flap ➡ Flaperon.
Also set-up is spoiler ➡ elevator mixing, which can be used in order to maintain a constant pitch attitude when using the flaps.
For further linkages, there are also three freely programmable mixers available.
A delta mixer is not intended with this type.

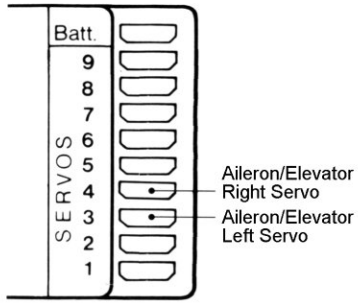
Block Diagram UNIFLY "UN"



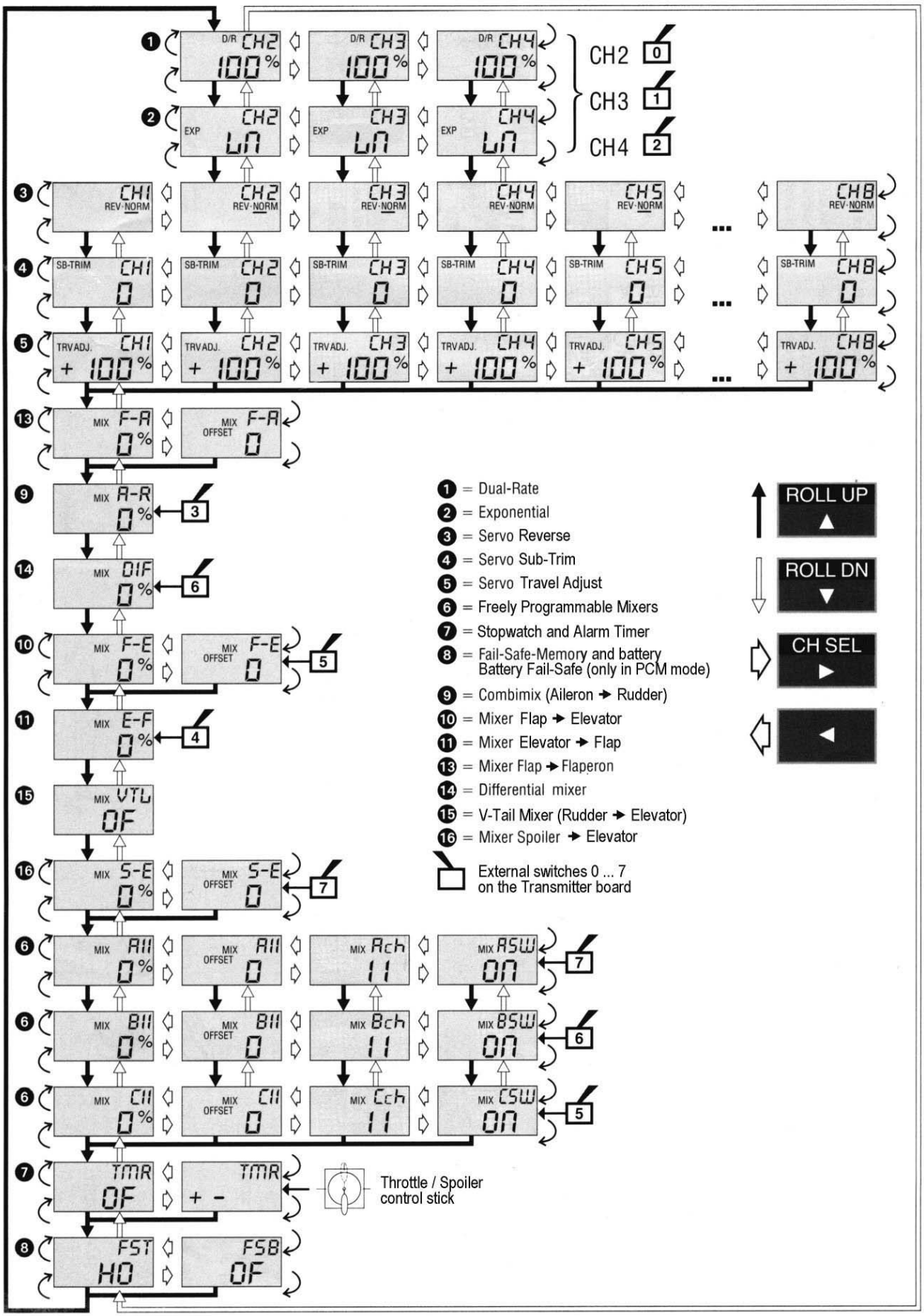
Allocation of Receiver Connections (ch 1 - 8)
The servos must be connected to the receiver connections as follows:



V-Tail



Block Diagram UNIFLY »UN«



Set-up Diagram

TYP UN Model Type “UN” = UNIFLY

All the mixers and adjustment values are set to 0 (= mixer off).
To adjust the mixer and adjustment values, while flying, we recommend fitting the 2-way momentary switch, Part No. 4160.44 (see page 10)

❶ ... ❺, ❼, ❽

Adjustments ❶ ... ❼, ❽ are available for all model types

❶ DUAL-RATE
Functions 2 ... 4
(0 ... ±125%), page 20

❷ EXPONENTIAL
Functions 2 ... 4
(linear ... +100%), page 20

❸ SERVO REVERSE
Channel 1...8, (Reverse/ Normal), page 21

❹ SERVO SUB-TRIM
Channel 1...8, (0...±125 each side), page 21

❺ SERVO TRAVEL ADJUST
Channel 1...8,
(0...±160%), page 21

❼ STOPWATCH and ALARM TIMER,
page 23/24

❽ FAIL SAFE MEMORY and BATTERY F.S.
(only in PCM mode),
page 24/25

⓭ MIX F-A (Flap ➧ Aileron)

Flap ➧ Aileron
When the flap slide control is moved (control input 6), this code moves both ailerons in the same direction as the flaps. This changes the camber of the entire wing. The adjustment range is 0 ... ±125%.

Standard Initialised Value

Mix ratio 0 ... ±125% (CLEAR = 0%)

OFFSET Adjustment: Move the control for channel 6 to the required position and press CLEAR

Range ca. −85 ... +85

❾ MIX A-R (Aileron ➧ Rudder)

Combi-Mix
When an aileron command is given, the rudder also moves to a pre-programmed extent (0 ... ±125%).
The mixer can be switched on and off via an external switch connected to socket 3.

Standard Initialised Value

Switch 3

Mix ratio (0 .... ±125%) (CLEAR = 0%)

⓮ MIX DIF

Differential
Differential movement of the ailerons, i.e. the ailerons having greater movement in one direction than the other. The amount of differential can be varied from 0% (Normal) to 100% (Split - only one aileron moves). You can switch between two different settings using an external switch connected to socket 6.

NORMAL = 0%

DIFFERENTIAL

SPLIT = 100%

❿ MIX F-E (Flap ➧ Elevator)

Flap ➧ Elevator
When the flap servo is operated, the elevator is fed a pre-set corrective signal (0 ... ±125%)
The mixer can be switched on and off if an external switch is connected to socket 5.

Standard Initialised Value

Switch 5

Mix ratio (0 .... ±125%) (CLEAR = 0%)

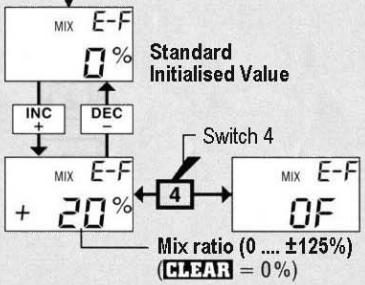
OFFSET Adjustment: Move the control for channel 6 to the required position and press CLEAR

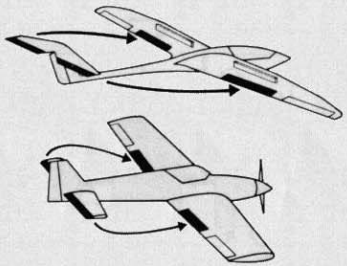
All mixer data can be reset to 0 by pressing the CLEAR button, i.e. turned off. When the display shows “OF” the external switch controlling the mixer is switched off.

⓫ MIX E-F (Elevator ➧ Flap)

Elevator ➧ Flap

When the elevator servo is operated, the flaps are fed a pre-set signal (0 ... ±125%) The mixer can be switched on and off if an external switch is connected to socket 4.

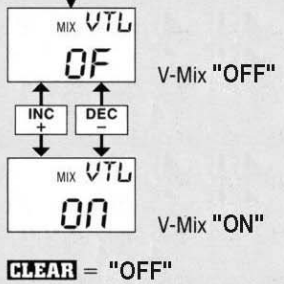


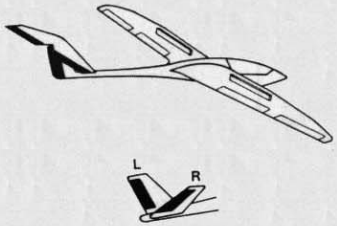


⓯ MIX VTL

V-Tail

This program couples channels 3 and 4 to provide rudder and elevator control. The mix ratio is adjustable using the Dual-Rates for channels 3 and 4.

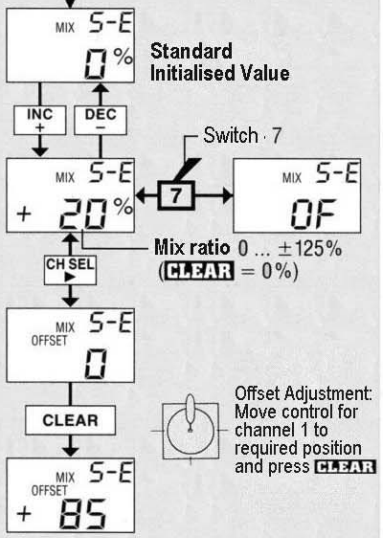


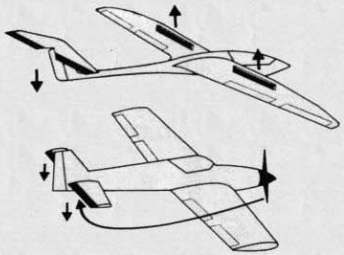


⓰ MIX S-E (Spoiler ➧ Elevator)

Spoiler ➧ Elevator

When the throttle / spoiler control stick is moved, this code allow the automatic movement of the elevator to compensate for any pitch trim change. The adjustment range is 0 ... ±125%.
The mixer can be switched on and off by an external switch connected to socket 7 on the transmitter board.

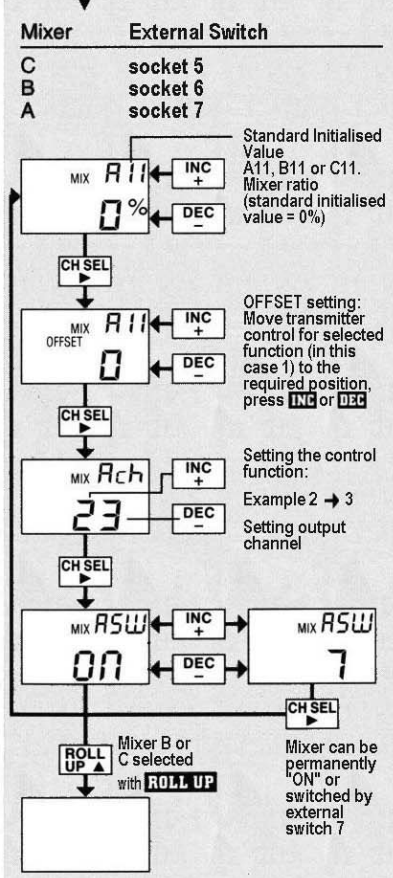




⓰ MIX A11, B11, C11

Freely Programmable Mixer

Both the mixer program (servo functions 1 ... 8) and the mixer ratio (0 ... ±125%) can be selected individually.
The mixers can be set permanently "ON" or switched on and off via the associated external switch

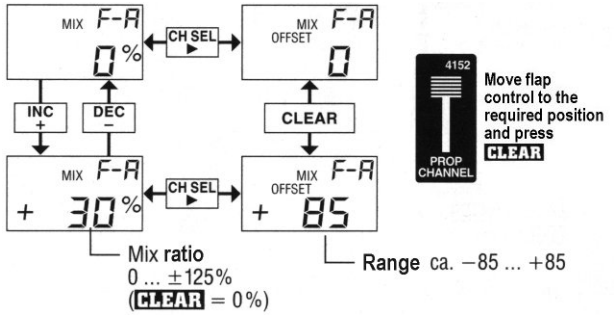


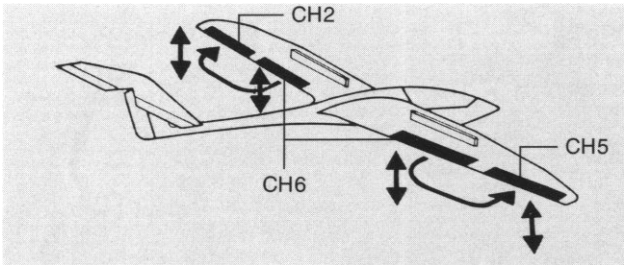
⓭

FLAP ➡ FLAPERON MIXER

Flap ➡ Flaperon Mixer
(access via Set-Up Menu)

The mixer "F-A" allows an adjustable portion of the flap control system to be fed to the aileron channels (2 and 5) so that the ailerons move with flap deflection in a manner like the flaps, but normally with smaller movement. The advantage is that a more even lift distribution over the span can be achieved. The mix proportion is entered using the INC and DEC buttons, between 0 and ±125%.
In order to tell the mixer, in which position of the control for the flaps relates to the normal flight position, CH SEL is pressed to call up the offset value. The value is set by moving the control to the required position and pressing the CLEAR button. The offset, the deviation from the control central position, is indicated in the display. You can also first set the offset and then adjust the mix proportion.



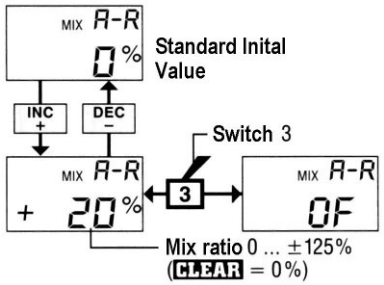


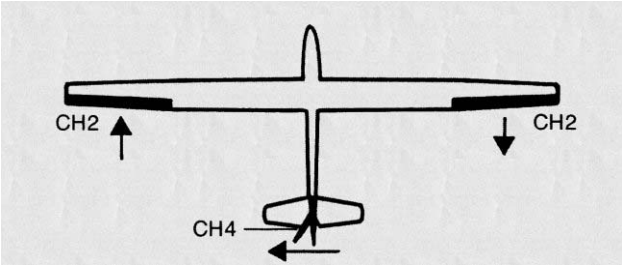
⓽

COMBI-MIX

Aileron ➡ Rudder Mixer
(access via Set-Up Menu)

In the case of operating the ailerons, the rudder is deflected by a programmable mix proportion. The rudder can, however, be steered separately at any time with priority.
After call of the code "A-R", the mix proportion is adjusted using the INC/DEC buttons and is stopped to automatically at the maximum value of ±125%.
The combi mixer can also be disabled by an external switch attached to socket 3 on the transmitter board.





⓮

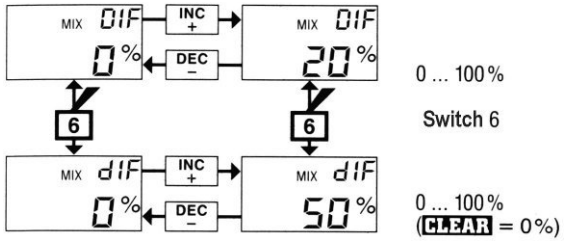
DIFFERENTIAL MIXER

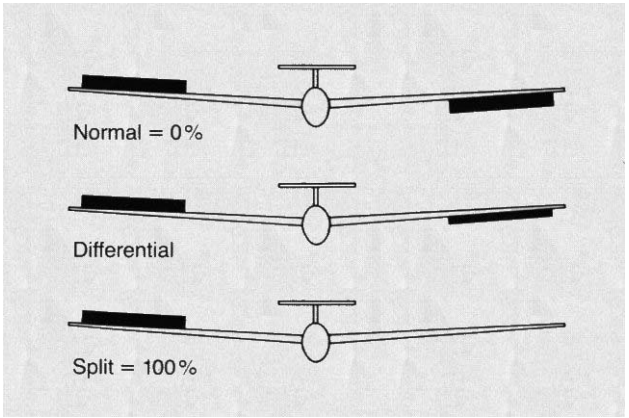
Aileron Differential Mixer
(access via Set-Up Menu)

The aileron differential is used to adjust for an unwanted yaw effect, which is called "negative yaw": The aileron deflecting downward creates a larger drag resistance than that developed by the upward deflecting aileron. This results in a torque around the vertical axis against the intended turn direction. This effect arises naturally and is more obvious with gliders with high aspect ratio wings, than with normal power planes, .due to the increased moment arm that the aileron drag has.
The aileron differential causes the downward aileron to deflect by a smaller distance than the upward moving aileron. The drag forces can be balanced and therefore the negative turning moment removed.
Using the INC/DEC buttons, the aileron differential is adjusted between the limits 0 and 100%:

0% = Normal, thus no differential.
100% = No downward aileron deflection, Split position mentioned above.

An external switch attached to connection 6, allows selection between two differential values. These are displayed as "DIF" and "dif" depending on the position of the switch. Each can have a different value to suit differing flight modes.



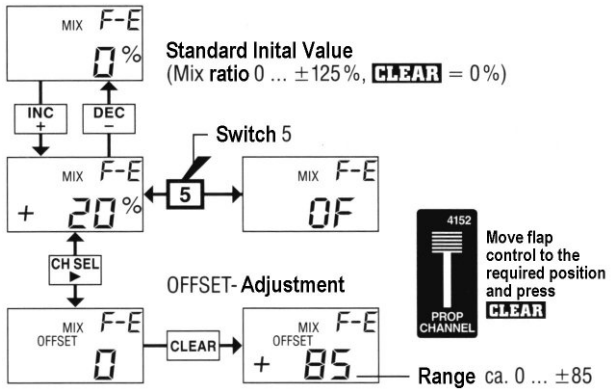


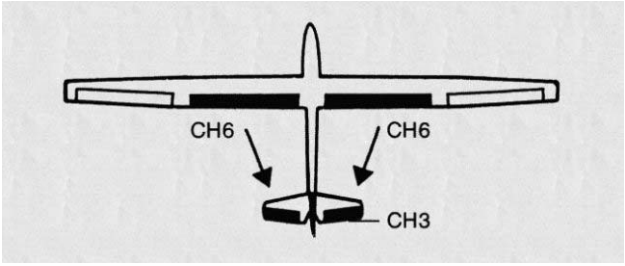
10

MIX F-E 0% FLAP ➡ ELEVATOR MIXER

Flap ➡ Elevator Mixer
(access via Set-Up Menu)

During slow flight when extending flaps, automatic proportionally correction of elevator is made, thus the pitch attitude of the model becomes independent of the position of the flaps. The mix portion is entered in the code "F-E", the INC and DEC buttons, between 0 and ±125%. Next the mixer neutral point must be specified. The mixer must be informed which position of the input (normally sliding control 6) for the flaps, corresponds to normal flight (flaps neutral). Thus the elevator takes this position to be its neutral, and only when the flaps are moved from this position does the mixer affect the elevator. pressing the CH SEL button to call up the offset screen. Move the control to the required neutral position (e.g. the end position of the flap control) and press the CLEAR button. The offset, the deviation from the control centre position, is indicated in the display. A switch connected to socket 5 of the transmitter board can be used to switch off this function.



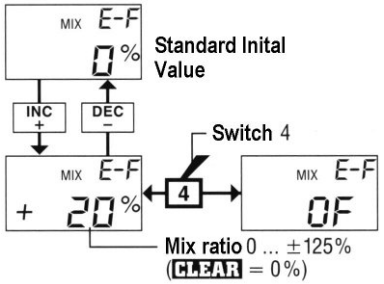


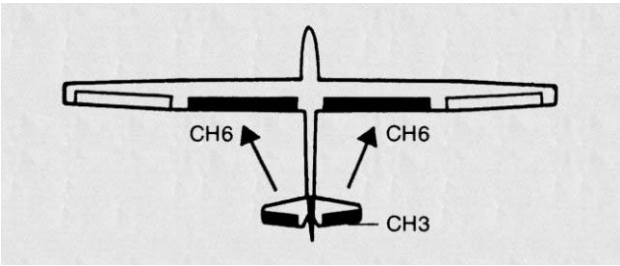
11

MIX E-F 0% ELEVATOR ➡ FLAP MIXER

Elevator ➡ Flap Mixer
(access via Set-Up Menu)

To assist the elevator with close turning flight and aerobatics, the flaps can be linked to the elevator and are driven out proportionally to the increase the wing lift. The value in the code "E-F" can be varied using, the INC and DEC buttons between 0 and ±125%. The mixer can be also switched off with an external switch connected to socket 4.



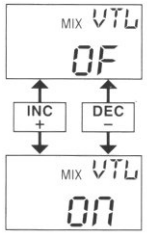


⑮

V-TAIL MIXER

Mixer for Models with V-Tails
(access via Set-Up Menu)

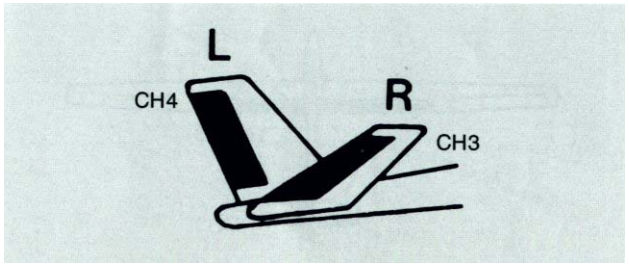
For models with a V-tail the functions of elevator and rudder must be mixed so with one another so that during elevator movement both surfaces are moved up or down in the same direction, and during rudder control the surfaces move in opposite directions , i.e. one surface upward and the other downward. The "VTL" Program contains the appropriate mixer, to control surfaces connected to separate servos. The function is activated using the INC / DEC buttons. Servos connected to outputs 3 and 4 of the receiver are automatically coupled with one another. The mix relationship is changed using the dual- rate setting, see page 20, where Ch4 changes the rudder effect and Ch3 the elevator effect.



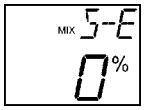
V-Tail "OFF"

CLEAR = »OF«

V-Tail "ON"



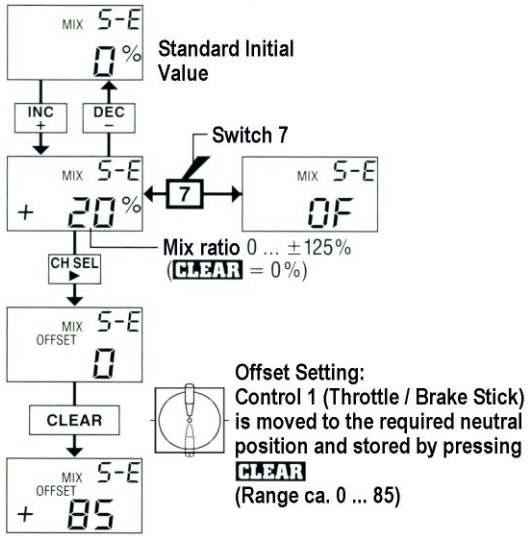
⑯

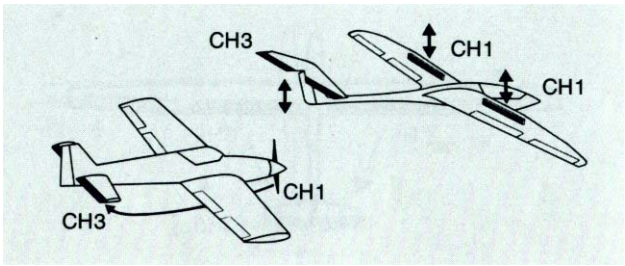


SPOILER ➡ ELEVATOR MIXER

Spoiler ➡ Elevator Mixer
(access via Set-Up Menu)

It is usually necessary to adjust the elevator when altering the spoiler setting due to the change in lift created by the wing.
This codes allows the elevator to be adjusted to suit the position of the spoiler stick (control function 1) during the landing approach, within the range of 0 to ±125%.
The mix proportion is determined using the code "S-E" and pressing the INC / DEC buttons.
Pressing the CH SEL button switches to the offset setting:
The mixer must be programmed, which position of the spoiler control (throttle / spoiler control stick 1) corresponds to normal flight. This would be the position with the spoilers retracted and therefore the neutral position of the elevator. To set this offset, the control is moved to the appropriate position and the CLEAR button is pressed. The offset, the deviation from the control centre position, is indicated in the display.
Using a switch connected to socket 7 of the transmitter board this function can be switched off.





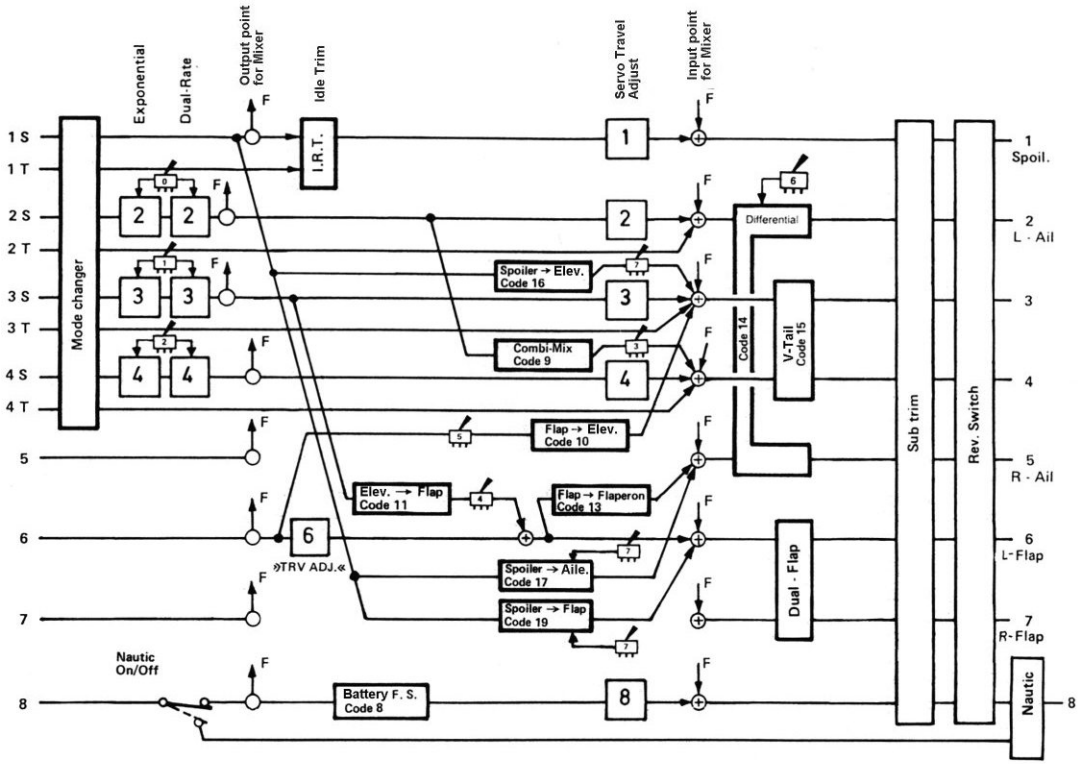
For your Notes

F3B/BUTTERFLY

Model Type Described

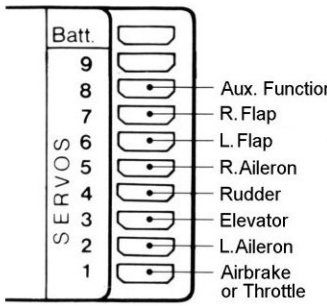
The F3B/BUTTERFLY type is intended for F3B competition models. It can be used, however, for other similar models. Depending on the external switches connected, functions can be switched on and off.
Beside two aileron servos, it is intended that two separate flap servos are used. This allows mixing flap ➡ elevator and/or elevator ➡ flap. Also the combi and differential functions plus flap ➡ flaperon and V-tail mixers with three further finished coupling functions. It is possible to extend the flaps downward and both ailerons upward (Butterfly) and adjust the elevator to re-trim so that when driving the pitch trim does not change from that of normal flight.
Additionally, an airbrake can be mixed with the above.
Also, without separate flaps, the ailerons can still be used as spoilers or as flaps (flaperons) and also in connection with the spoiler ➡ aileron and spoiler ➡ elevator mixes.

Block Diagram BUTTERYFLY “Fb”

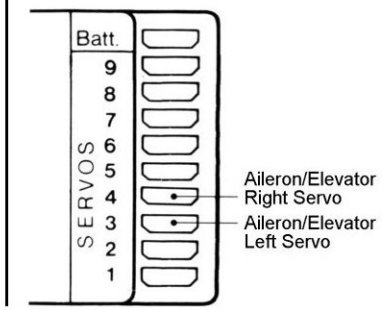


Allocation of Receiver Connections (ch 1 - 8)

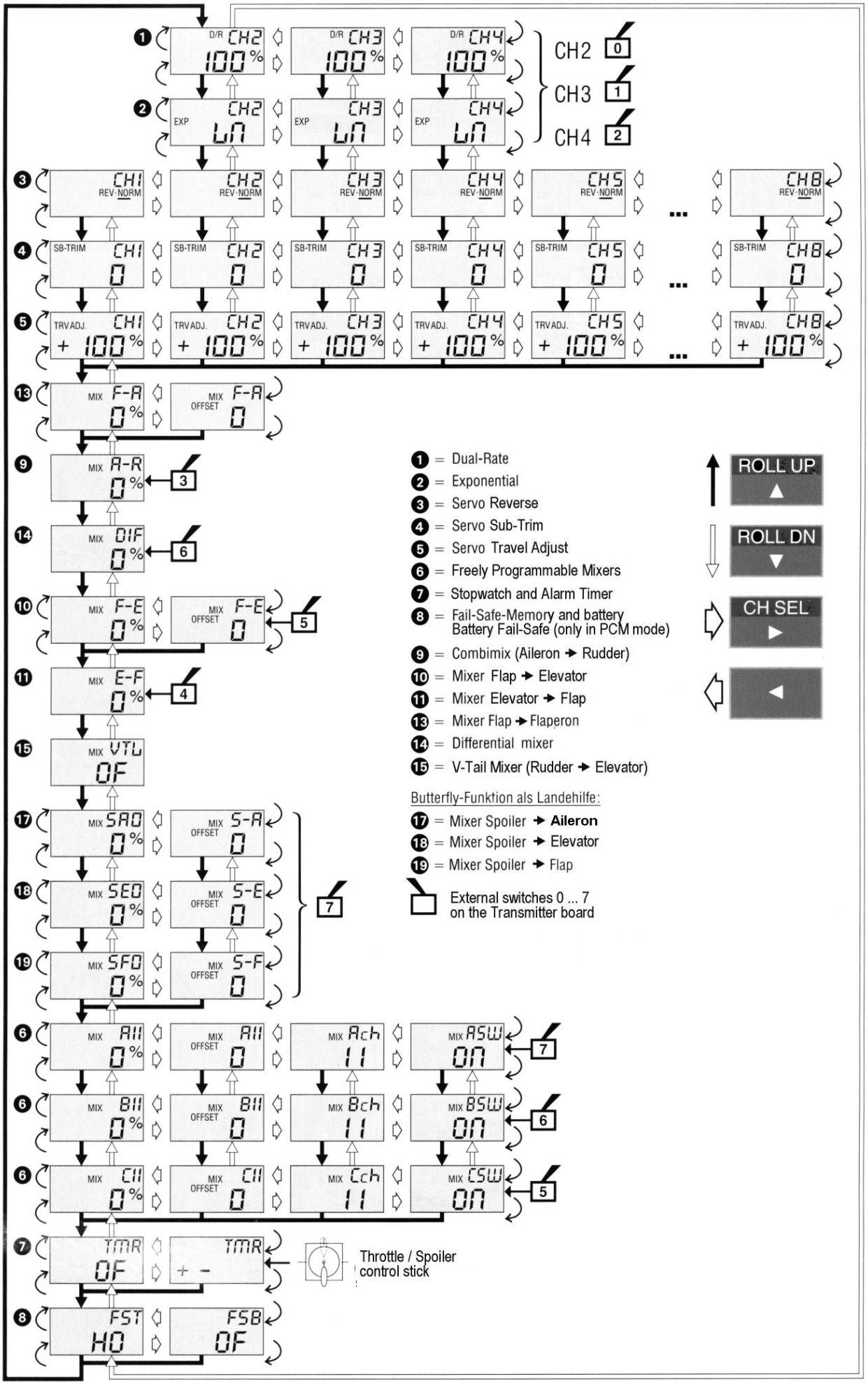
The servos must be connected to the receiver connections as follows:



V-Tail



Block Diagram F3B/BUTTERFLY »Fb«



Set-up Diagram

TYP Fb Model Type “Fb”
= F3B/BUTTERFLY

All the mixers and adjustment values are set to 0 (= mixer off).
To adjust the mixer and adjustment values, while flying, we recommend fitting the 2-way momentary switch,
Part No. 4160.44 (see page 10)

❶ ... ❺, ❼, ❽

Adjustments ❶ ... ❼, ❽ are available for all model types

D/R CH2 100 %
❶ DUAL-RATE
Functions 2 ... 4
(0 ... ±125%), page 20

EXP CH2 LN
❷ EXPONENTIAL
Functions 2 ... 4
(linear ... +100%), page 20

CH1 REV·NORM
❸ SERVO REVERSE
Channel 1...8, (Reverse/ Normal), page 21

SB-TRIM CH1 0
❹ SERVO SUB-TRIM
Channel 1...8, (0...±125 each side), page 21

TRV ADJ. CH1 + 100 %
❺ SERVO TRAVEL ADJUST
Channel 1...8,
(0...±160%), page 21

TMR OF
❼ STOPWATCH and ALARM TIMER,
page 23/24

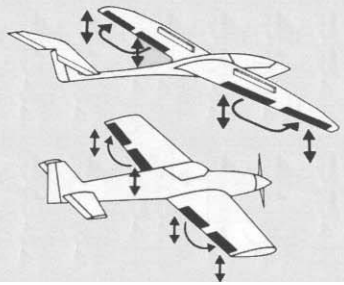
FST HO
❽ FAIL SAFE MEMORY and BATTERY F.S.
(only in PCM mode),
page 24/25

⓭ MIX F-A (Flap ➧ Aileron)

Flap ➧ Aileron
When the flap slide control is moved (control input 6), this code moves both ailerons in the same direction as the flaps. This changes the camber of the entire wing. The adjustment range is 0 ... ±125%.

MIX F-A 0 % — Standard Initialised Value
INC + / DEC −
MIX F-A + 20 % — Mix ratio 0 ... ±125% (CLEAR = 0%)
CH SEL ▶
MIX OFFSET F-A 0
CLEAR
MIX OFFSET F-A + 85 — Range ca. −85 ... +85

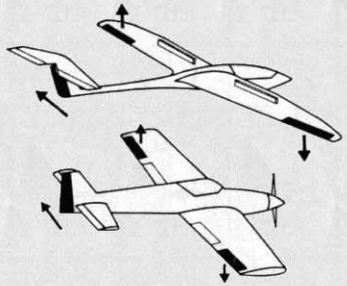
4152 PROP CHANNEL — OFFSET Adjustment: Move the control for channel 6 to the required position and press CLEAR



❾ MIX A-R (Aileron ➧ Rudder)

Combi-Mix
When an aileron command is given, the rudder also moves to a pre-programmed extent (0 ... ±125%).
The mixer can be switched on and off via an external switch connected to socket 3.

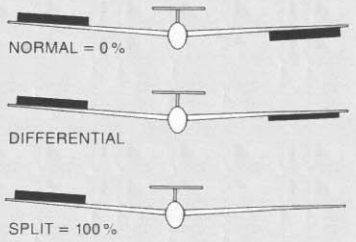
MIX A-R 0 % — Standard Initialised Value
INC + / DEC −
Switch 3
MIX A-R + 20 % ⇄ 3 ⇄ MIX A-R OF
Mix ratio (0 .... ±125%) (CLEAR = 0%)

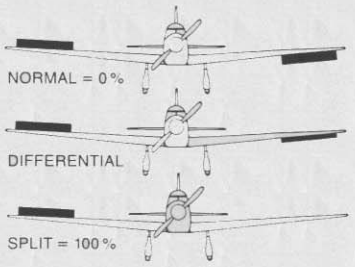


⓮ MIX DIF

Differential
Differential movement of the ailerons, i.e. the ailerons having greater movement in one direction than the other. The amount of differential can be varied from 0% (Normal) to 100% (Split - only one aileron moves). You can switch between two different settings using an external switch connected to socket 6.

MIX DIF 0 % ⇄ 6 ⇄ MIX dIF 0 %
INC + / DEC −



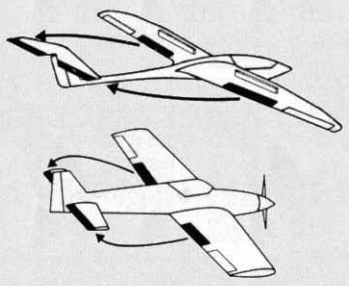


❿ MIX F-E (Flap ➧ Elevator)

Flap ➧ Elevator
When the flap servo is operated, the elevator is fed a pre-set corrective signal (0 ... ±125%)
The mixer can be switched on and off if an external switch is connected to socket 5.

MIX F-E 0 % — Standard Initialised Value
INC + / DEC −
Switch 5
MIX F-E + 20 % ⇄ 5 ⇄ MIX F-E OF
Mix ratio (0 .... ±125%) (CLEAR = 0%)
CH SEL ▶
MIX OFFSET F-E 0
CLEAR
MIX OFFSET F-E + 85

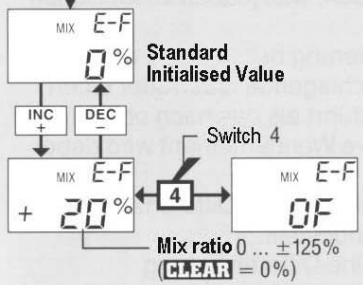
4152 PROP CHANNEL — OFFSET Adjustment: Move the control for channel 6 to the required position and press CLEAR

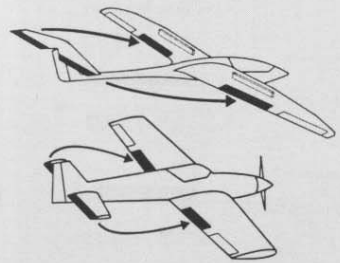


⓫ MIX E-F (Elevator ➧ Flap)

V-Tail

This program couples channels 3 and 4 to provide rudder and elevator control. The mix ratio is adjustable using the Dual-Rates for channels 3 and 4.



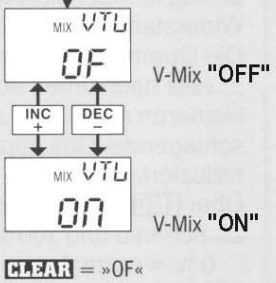


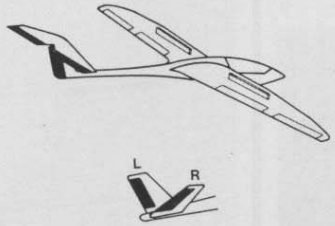
⓯ MIX VTL

Spoiler ➧ Elevator

When the throttle / spoiler control stick is moved, this code allow the automatic movement of the elevator to compensate for any pitch trim change. The adjustment range is 0 ... ±125%.

The mixer can be switched on and off by an external switch connected to socket 7 on the transmitter board.



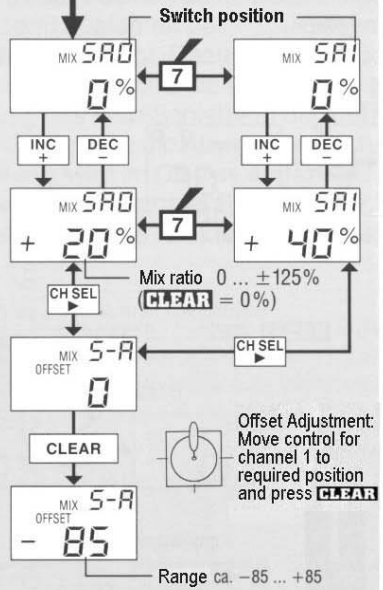


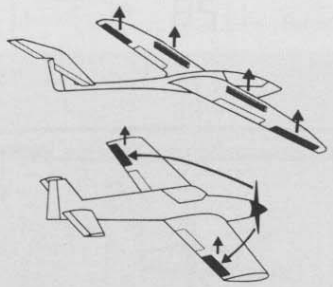
⓱ MIX SA0 (Spoiler ➧ Aileron)

Spoiler ➧ Aileron (Flaperon)

With movement of the throttle / spoiler stick both aileron servos can be moved in the same direction (= flaperon operation) between 0 and ±125%.

Using a switch attached to socket 7, the mixer can be switched between the settings "SA0" and "SA1".



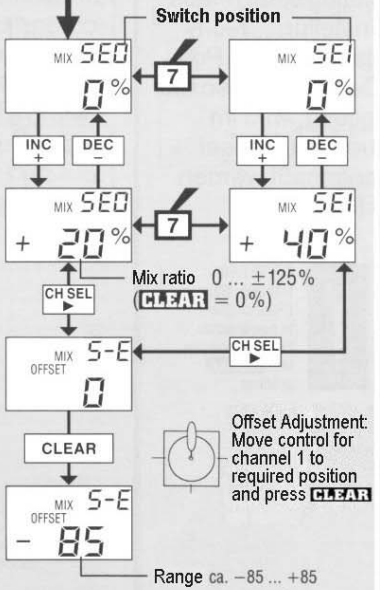


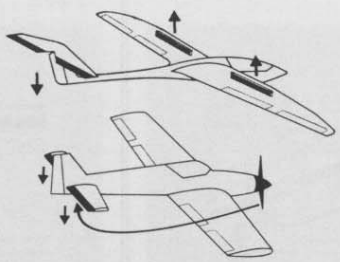
⓲ MIX SE0 (Spoiler ➧ Elevator)

Spoiler ➧ Elevator

With movement of the throttle / spoiler stick the elevator can be adjusted to assist in landing between 0 and ±125%.

Using a switch attached to socket 7, the mixer can be switched between the settings "SE0" and "SE1".



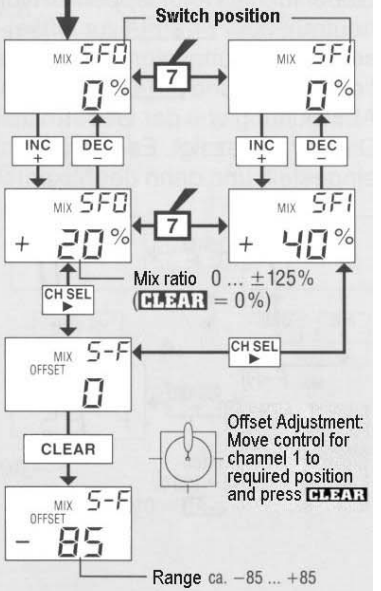


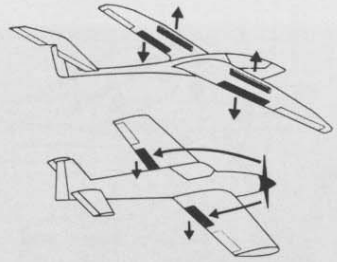
⓳ MIX SF0 (Spoiler ➧ Flap)

Spoiler ➧ Flap

With movement of the throttle / spoiler stick the flap can be adjusted to assist in landing between 0 and ±125%.

Using a switch attached to socket 7, the mixer can be switched between the settings "SF0" and "SF1".



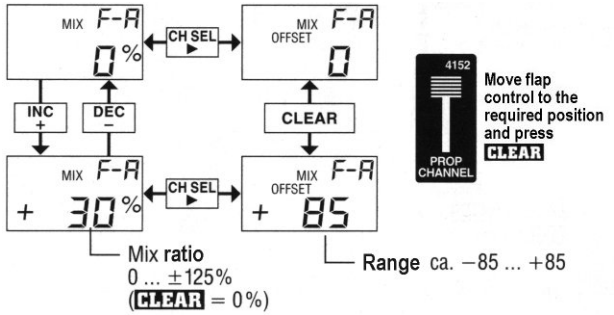


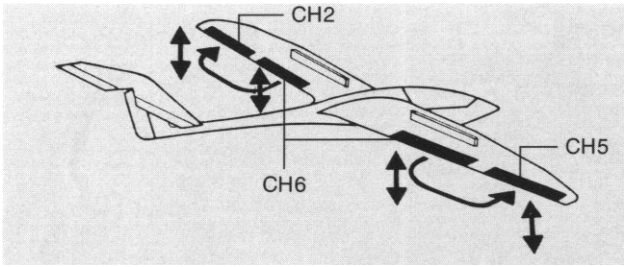
⓭

FLAP ➡ FLAPERON MIXER

Flap ➡ Flaperon Mixer
(access via Set-Up Menu)

The mixer "F-A" allows an adjustable portion of the flap control system to be fed to the aileron channels (2 and 5) so that the ailerons move with flap deflection in a manner like the flaps, but normally with smaller movement. The advantage is that a more even lift distribution over the span can be achieved. The mix proportion is entered using the INC and DEC buttons, between 0 and ±125%.
In order to tell the mixer, in which position of the control for the flaps relates to the normal flight position, CH SEL is pressed to call up the offset value. The value is set by moving the control to the required position and pressing the CLEAR button. The offset, the deviation from the control central position, is indicated in the display. You can also first set the offset and then adjust the mix proportion.



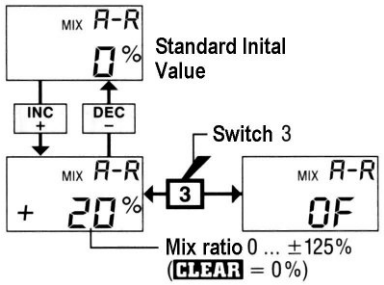


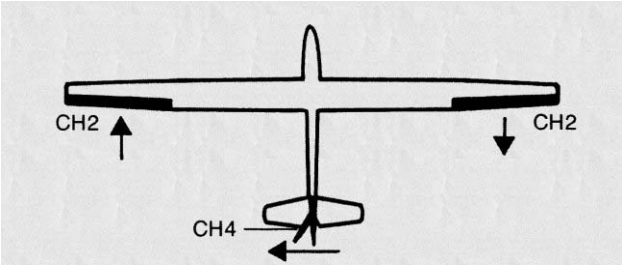
⓽

COMBI-MIX

Aileron ➡ Rudder Mixer
(access via Set-Up Menu)

In the case of operating the ailerons, the rudder is deflected by a programmable mix proportion. The rudder can, however, be steered separately at any time with priority.
After call of the code "A-R", the mix proportion is adjusted using the INC/DEC buttons and is stopped to automatically at the maximum value of ±125%.
The combi mixer can also be disabled by an external switch attached to socket 3 on the transmitter board.





⓮

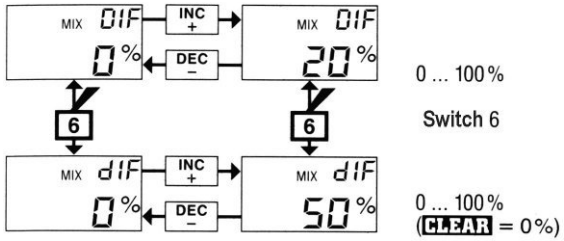
DIFFERENTIAL MIXER

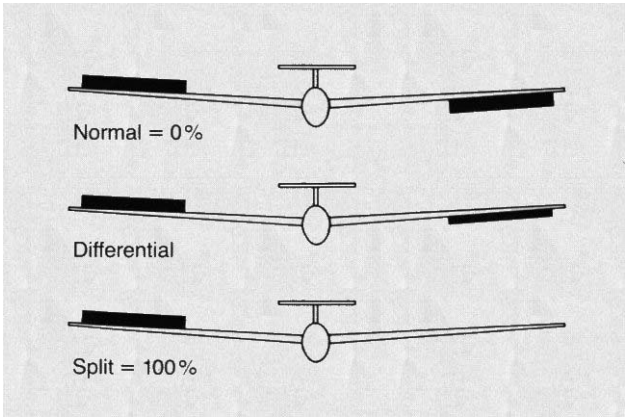
Aileron Differential Mixer
(access via Set-Up Menu)

The aileron differential is used to adjust for an unwanted yaw effect, which is called "negative yaw": The aileron deflecting downward creates a larger drag resistance than that developed by the upward deflecting aileron. This results in a torque around the vertical axis against the intended turn direction. This effect arises naturally and is more obvious with gliders with high aspect ratio wings, than with normal power planes, .due to the increased moment arm that the aileron drag has.
The aileron differential causes the downward aileron to deflect by a smaller distance than the upward moving aileron. The drag forces can be balanced and therefore the negative turning moment removed.
Using the INC/DEC buttons, the aileron differential is adjusted between the limits 0 and 100%:

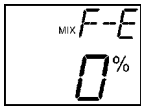
0% = Normal, thus no differential.
100% = No downward aileron deflection, Split position mentioned above.

An external switch attached to connection 6, allows selection between two differential values. These are displayed as "DIF" and "dif" depending on the position of the switch. Each can have a different value to suit differing flight modes.





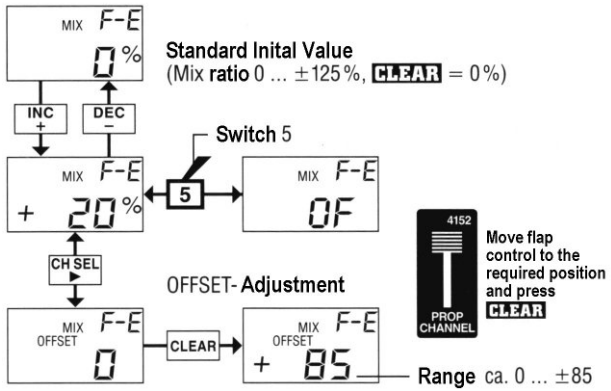
⑩

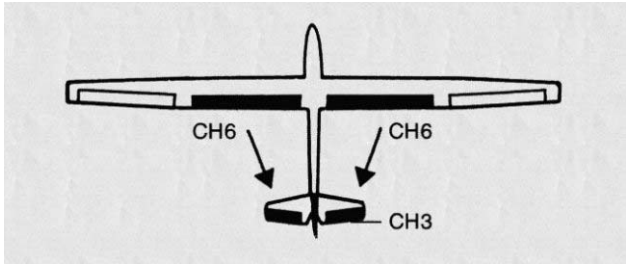


FLAP ➡ ELEVATOR MIXER

Flap ➡ Elevator Mixer
(access via Set-Up Menu)

During slow flight when extending flaps, automatic proportionally correction of elevator is made, thus the pitch attitude of the model becomes independent of the position of the flaps. The mix portion is entered in the code "F-E", the INC and DEC buttons, between 0 and ±125%. Next the mixer neutral point must be specified. The mixer must be informed which position of the input (normally sliding control 6) for the flaps, corresponds to normal flight (flaps neutral). Thus the elevator takes this position to be its neutral, and only when the flaps are moved from this position does the mixer affect the elevator. pressing the CH SEL button to call up the offset screen. Move the control to the required neutral position (e.g. the end position of the flap control) and press the CLEAR button. The offset, the deviation from the control centre position, is indicated in the display. A switch connected to socket 5 of the transmitter board can be used to switch off this function.



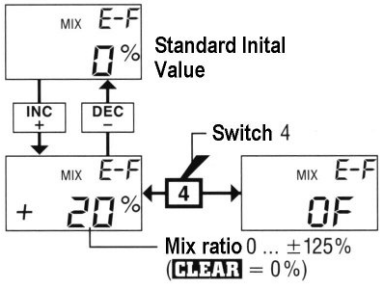


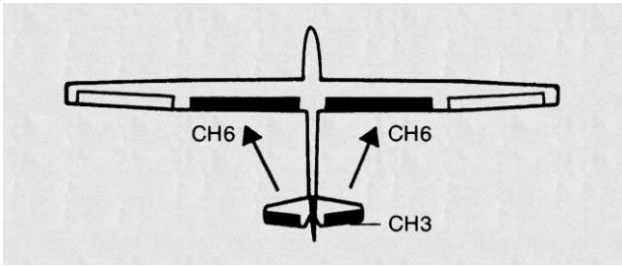
⑪

ELEVATOR ➡ FLAP MIXER

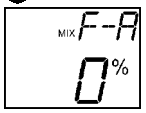
Elevator ➡ Flap Mixer
(access via Set-Up Menu)

To assist the elevator with close turning flight and aerobatics, the flaps can be linked to the elevator and are driven out proportionally to the increase the wing lift. The value in the code "E-F" can be varied using, the INC and DEC buttons between 0 and ±125%. The mixer can be also switched off with an external switch connected to socket 4.





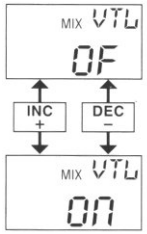
⓭



FLAP ➡ FLAPERON MIXER

Flap ➡ Flaperon Mixer
(access via Set-Up Menu)

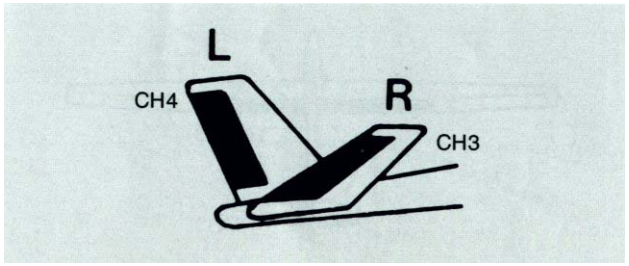
For models with a V-tail the functions of elevator and rudder must be mixed so with one another so that during elevator movement both surfaces are moved up or down in the same direction, and during rudder control the surfaces move in opposite directions , i.e. one surface upward and the other downward. The "VTL" Program contains the appropriate mixer, to control surfaces connected to separate servos. The function is activated using the INC / DEC buttons. Servos connected to outputs 3 and 4 of the receiver are automatically coupled with one another. The mix relationship is changed using the dual- rate setting, see page 20, where Ch4 changes the rudder effect and Ch3 the elevator effect.



V-Tail "OFF"

CLEAR = »OF«

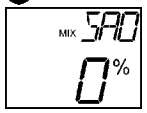
V-Tail "ON"



Butterfly Function as a Landing Aid Codes 17 … 19

The Butterfly function serves to increase the gliding angle as a landing aid; it can be used alone or additionally with existing airbrakes or spoilers.
The flight programme "Fb" contains finished mixers. Code 17 drives both ailerons downward with movement of the throttle/spoiler control stick so they act as flaperons. Code 19 drives them in the opposite direction so that they form Butterfly (or Crow) brakes. Code 18 allows the elevator to be trimmed with application of brakes to retain the same pitch trim. Each of these three mixers can be adjusted individually; and of course they can also be used individually.
So, for example, the spoiler ➡ elevator mixer, code 18, can be used in combination with normal airbrakes in order to maintain pitch trim when the airbrakes are deployed. The other two mixers would have the mix proportion set to 0%, so that they remain ineffective.
With ailerons that are full span, the mixers 17 (spoiler ➡ ailerons) and 18 (spoiler ➡ elevator) can be used together, to raise the flaperons at a large angle of deflection and also to re-trim the elevator accordingly.
However, particularly with the ailerons, the total travel must be considered with operation as aileron and flaperons. The settings in the dual rate function must be adapted, if necessary, in order not to let the servos reach their mechanical limits.
All three mixers can be changed between two programmable settings using a switch attached to socket 7 on the transmitter board. If the mix proportion is set to 0% in one switch setting it makes the respective mixer effectively inactive.

⓱

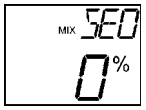


SPOILER ➡ FLAPERON MIXER

Spoiler ➡ Aileron Mixer
(access via Set-Up Menu)

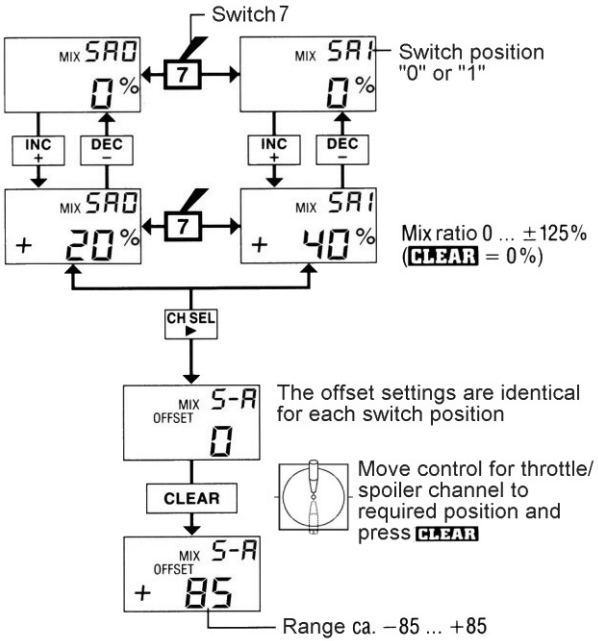
With movement of the throttle/spoiler control stick (control function 1) both aileron servos can be adjusted for landing using the INC / DEC buttons from 0 to ±125% (0% = mixer inactive).
A switch connected to socket 7 of the transmitter board, allows this function to be changed between two options "SA0" and "SA1" (spoiler ➡ ailerons).
The mixer must have the position, of control function 1, set that corresponds to normal flight, i.e. with the spoilers retracted, and the ailerons in their neutral position. The neutral point of this mixer is set after calling the subroutine "SA OFFSET" by pressing the CH SEL button: The spoiler control is moved into the appropriate neutral position, normally the bottom position of the control stick, and the CLEAR button is pressed. The display will indicate the offset, being the deviation from the control central position. The offset is identical for both switching positions and only needs to be set once.

Note:
When Butterfly landing mode is wanted, codes 17 & 19 are used with both ailerons (flaperons) deflected upward and the flaps extended downward.

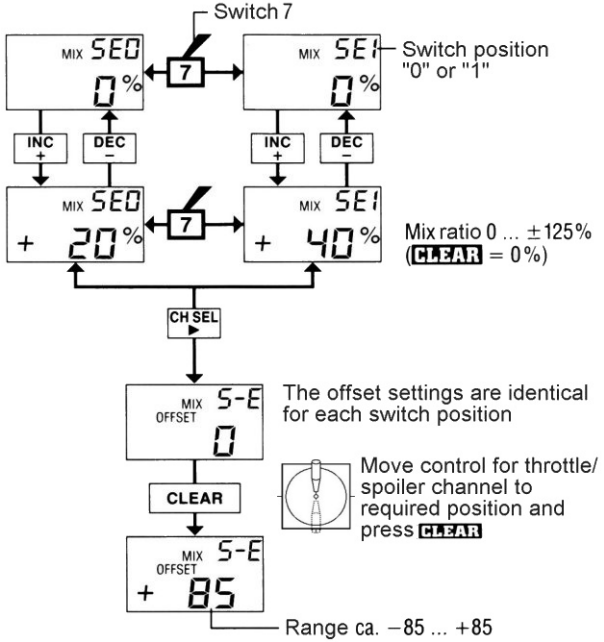


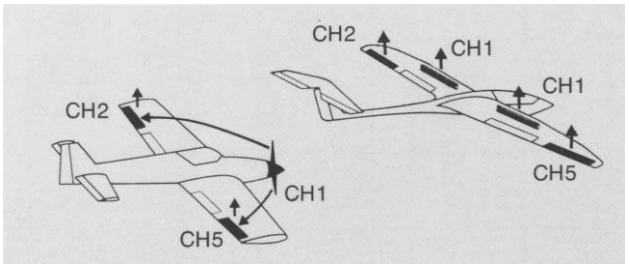
SPOILER ➡ ELEVATOR MIXER

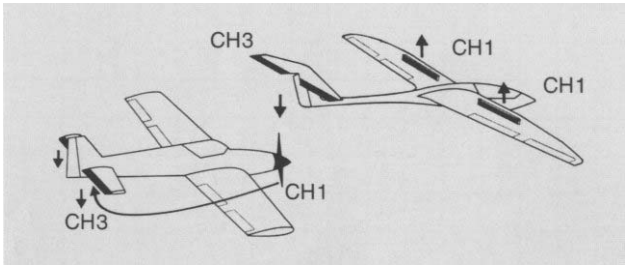
Spoiler ➡ Elevator Mixer
(access via Set-Up Menu)



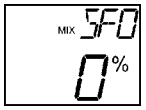
Due to the changing lift when extending the spoilers, the elevator must be adjusted by an appropriate amount to compensate.
The elevator compensation can be adjusted between 0 and ±125% of the spoiler stick travel for use during the landing approach (0% = mixers inactively).
A switch connected to socket 7 of the transmitter board, allows this function to be changed between two options "SE0" and "SE1" (spoiler ➡ elevator).
The mixer must have the position, of control function 1, set that corresponds to normal flight, i.e. with the spoilers retracted, and the ailerons in their neutral position. The neutral point of this mixer is set after calling the subroutine "SE OFFSET" by pressing the CH SEL button: The spoiler control is moved into the appropriate neutral position, normally the bottom position of the control stick, and the CLEAR button is pressed. The display will indicate the offset, being the deviation from the control central position. The offset is identical for both switching positions and only needs to be set once.







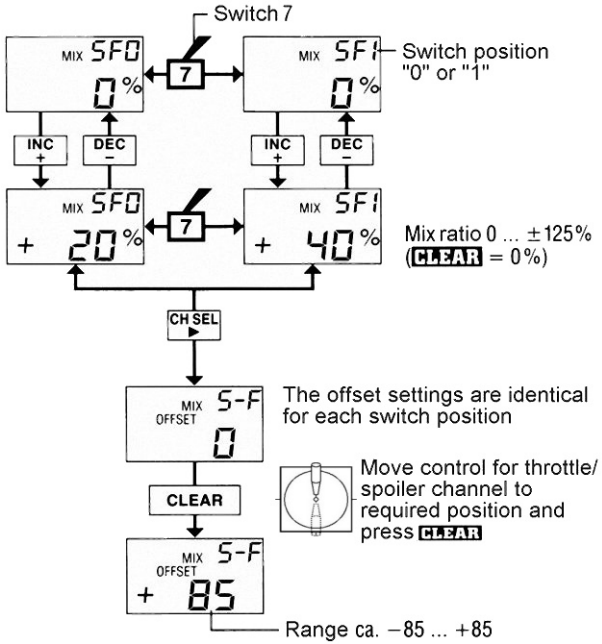
⑲



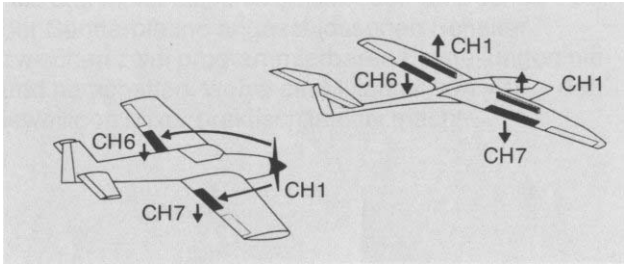
SPOILER ➡ FLAP MIXER

Spoiler ➡ Flap Mixer
(access via Set-Up Menu)

With movement of the throttle/spoiler control stick (control function 1) both aileron servos can be adjusted for landing using the INC / DEC buttons from 0 to ±125% (0% = mixer inactive).
A switch connected to socket 7 of the transmitter board, allows this function to be changed between two options "SF0" and "SF1" (spoiler ➡ flaps).
The mixer must have the position, of control function 1, set that corresponds to normal flight, i.e. with the spoilers retracted, and the ailerons in their neutral position. The neutral point of this mixer is set after calling the subroutine "SF OFFSET" by pressing the CH SEL button: The spoiler control is moved into the appropriate neutral position, normally the bottom position of the control stick, and the CLEAR button is pressed. The display will indicate the offset, being the deviation from the control central position. The offset is identical for both switching positions and only needs to be set once.



Note:
When Butterfly landing mode is wanted, codes 17 & 19 are used with both ailerons (flaperons) deflected upward and the flaps extended downward.
When only using 1 flap servo, connect it to socket 6 on the receiver.



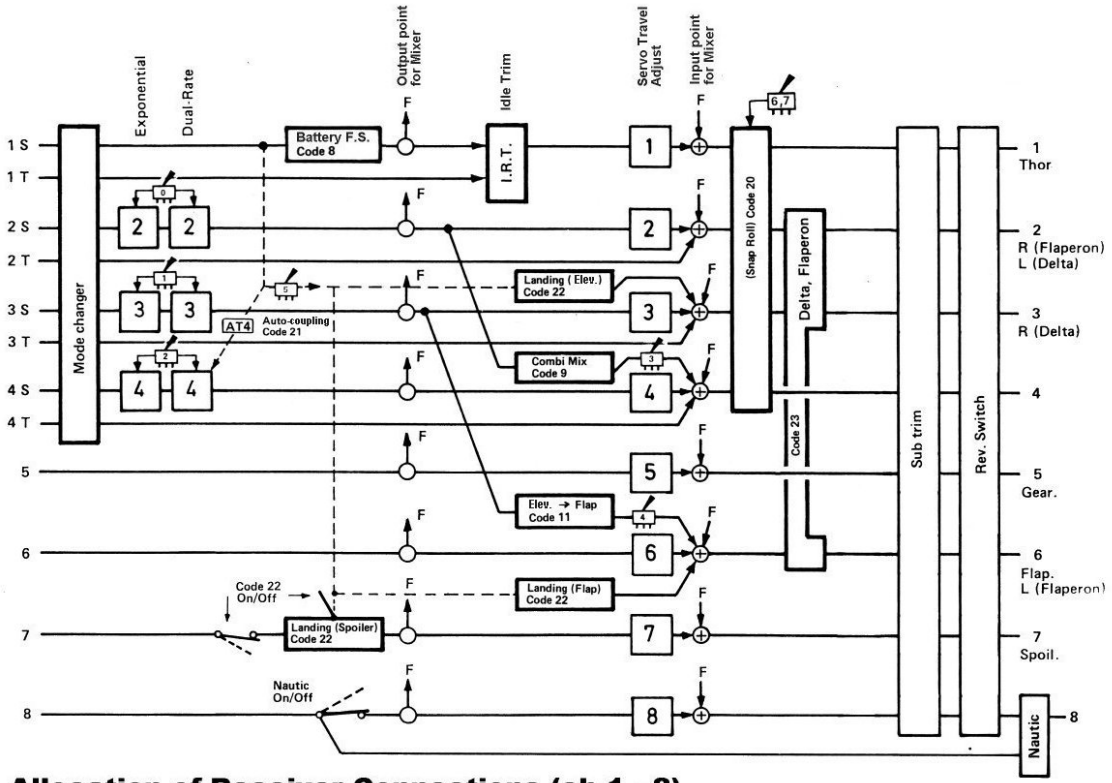
For your Notes

ACROBATIC

Model Type Described

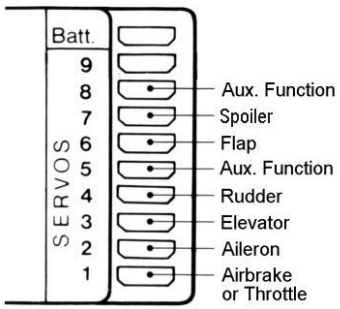
The basic version of this program allows Motor (or airbrake), Aileron, Elevator, Rudder, Flap and Spoiler. Receiver outputs 5 and 8 are available for auxiliary functions, e.g. retractable undercarriage, mixture control for the motor, etc. Also included is a ready made mixer for Elevator ➡ Flap mixing. Other mixing functions can be achieved using the 3 freely programmable mixers available.
The Combi-mixer for aileron ➡ rudder mixing is available. The main advantage of the ACROBATIC program is that many different tasks can be achieved by activating the preset mixers available.
The “Automatic Landing” program allows control of the motor, elevator, flaps and spoilers in a freely programmable set-up. The “Automatic Manoeuvre” program can be set-up to provide two different Snap-Roll directions by controlling the elevator, rudder and aileron whilst the motor servo is driving to a fixed position.
The wing programs allow Delta and Flaperon models to be accommodated. With Delta (or tailless) models, the elevator and aileron functions are mixed to the common surfaces full width along the trailing edge. The surfaces are moved in the same direction for elevator control and in opposition for aileron control. The servos must be connected to receiver outputs 2 and 6.

Block Diagram ACROBATIC “AC”

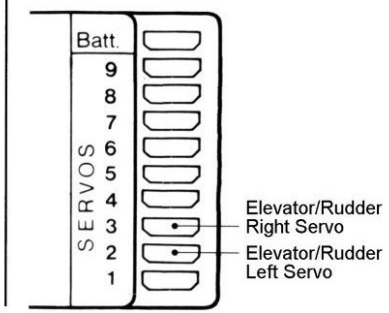


Allocation of Receiver Connections (ch 1 - 8)

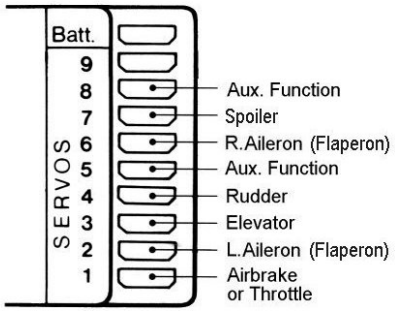
The servos must be connected to the receiver connections as follows:



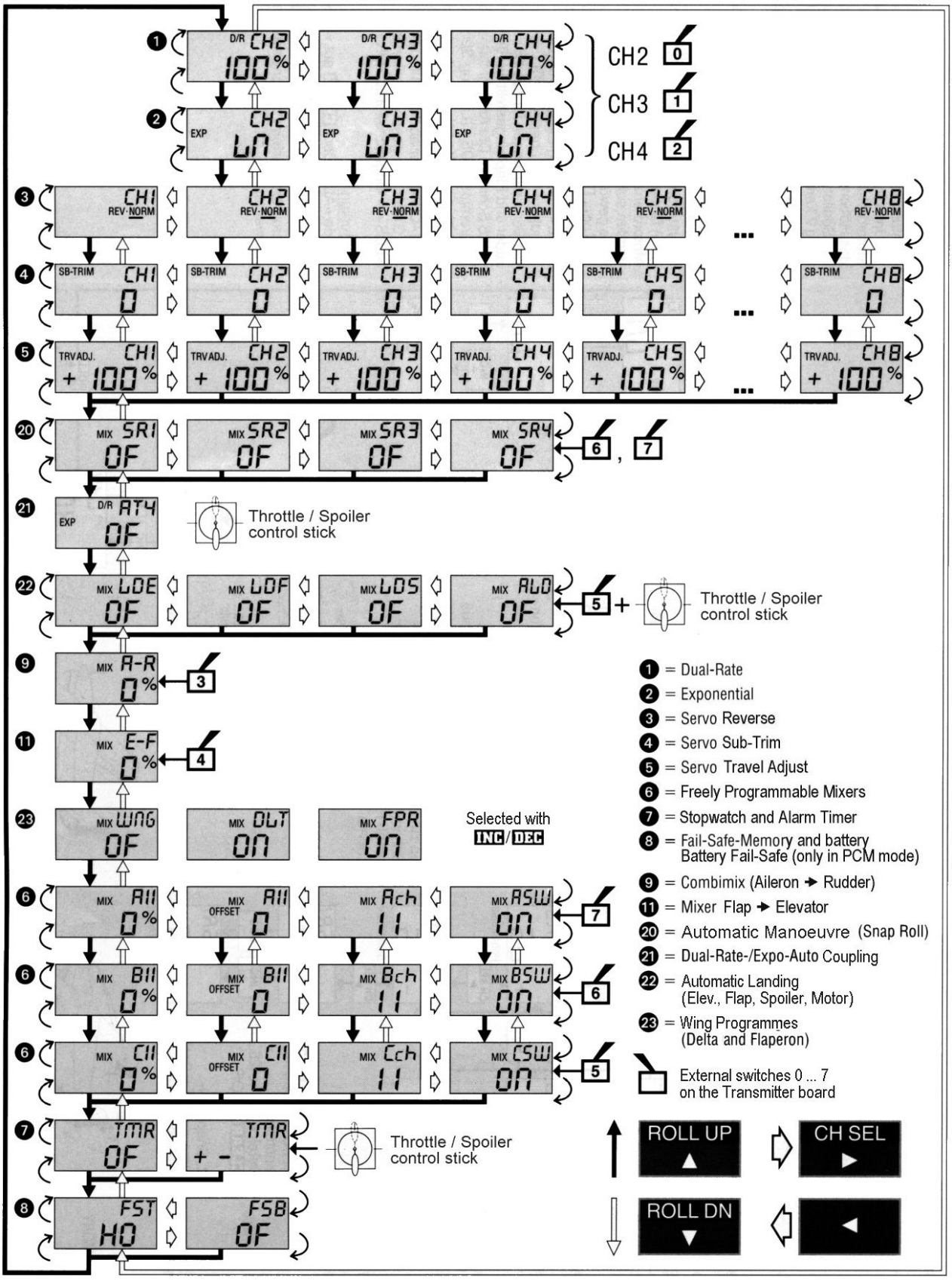
Delta + Tailless



Flaperon



Block Diagram ACROBATIC »AC«



Set-up Diagram

All the mixers and adjustment values are set to 0 (= mixer off).
To adjust the mixer and adjustment values, while flying, we recommend fitting the 2-way momentary switch, Part No. 4160.44 (see page 10)

TYP AC Model Type "AC" = ACROBATIC

❶ ... ❺, ❼, ❽

Adjustments ❶ ... ❼, ❽ are available for all model types

❶ DUAL-RATE
Functions 2 ... 4
(0 ... ±125%), page 20

❷ EXPONENTIAL
Functions 2 ... 4
(linear ... +100%), page 20

❸ SERVO REVERSE
Channel 1...8, (Reverse/ Normal), page 21

❹ SERVO SUB-TRIM
Channel 1...8, (0...±125 each side), page 21

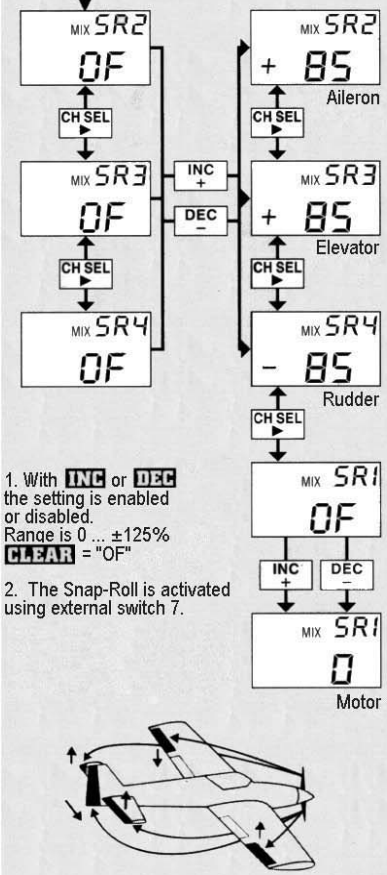
❺ SERVO TRAVEL ADJUST
Channel 1...8,
(0...±160%), page 21

❼ STOPWATCH and ALARM TIMER, page 23/24

❽ FAIL SAFE MEMORY and BATTERY F.S. (only in PCM mode), page 24/25

⓴ MIX SR ... (Snap Roll)

Automatic Manoeuvre
With operation of the Snap-Roll switch the servos for ailerons, elevator, rudder and throttle move to a pre-programmed position.
There are two Snap-Roll programs available, i.e. Snap roll left & right.



1. With INC or DEC the setting is enabled or disabled.
Range is 0 ... ±125%
CLEAR = "OF"

2. The Snap-Roll is activated using external switch 7.

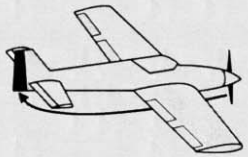
㉑ AT 4

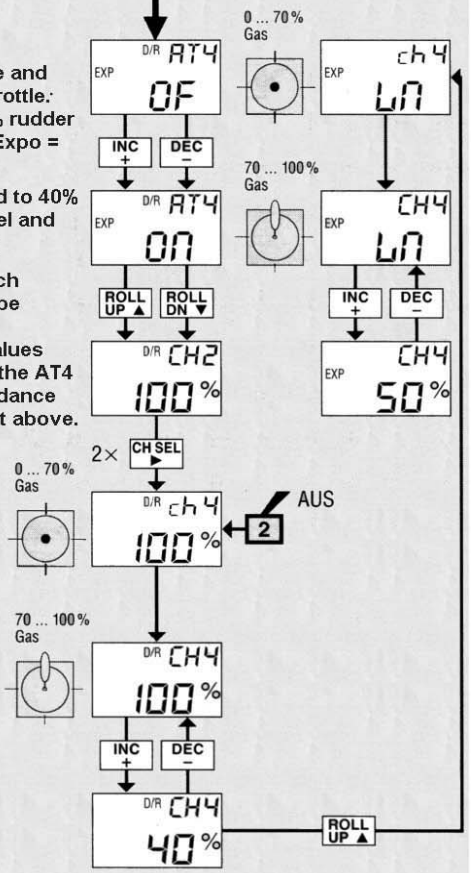
Dual Rate and Exponential Auto-coupling
When the position of the throttle stick is approx. 70% towards full power, the Dual-Rate and Exponential function for the rudder automatically switches to the alternate setting. This only works if the associated Dual-Rate / Exponential switch (in transmitter board socket 2) is switched off.

Programming Example:
Automatic switching of Dual-Rate and Exponential for rudder at 70% throttle.
0 ... 70% throttle: D/R at 100% rudder travel and Expo = LN (linear)

70% ... 100% throttle: D/R reduced to 40% rudder travel and Expo = 50%

The Dual-Rate / Exponential switch for channel 4 (in socket 2) must be switched off.
The dual rate and Exponential values can be programmed before with the AT4 function switched off or in accordance with the accompanying flow chart above.





㉒ MIX LD ...(Auto-Landing)

Automatic Landing
When the throttle stick is moved near the idle position, pre-programmed positions for flap "LDF", and elevator "LDE" are automatically selected. Additionally, a Spoiler attached to receiver output 7 can also be set-up to move to a pre-programmed position. The function can be switched on and off using an external switch connected to socket 5

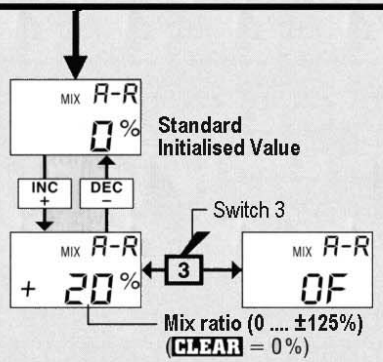
In the program "ALD" (Auto-Landing) it is necessary to specify below which throttle setting the program is to become effective. The value is adjusted by pressing INC or DEC until the desired throttle stick position is achieved. (CLEAR sets "ALD" to "OF"). After selection of "LDE" (Landing Elevator) or "LDF" (Landing Flap) using CH SEL the servo positions for the elevator or flap can be set (0... ±125 steps). The selection of the subroutine "LDS", permits, a spoiler servo attached to channel 7 to be switched on or off. The control for channel 7 is disabled so long as "LDS" is switched on.

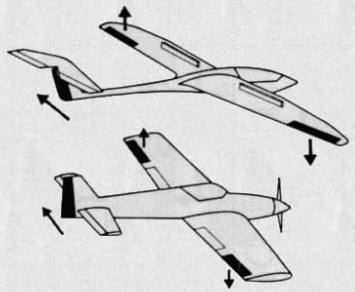
Note:
If "ALD" was switched to "OF" using CLEAR the elevator, flap and spoilers can be driven to pre-programmed positions with switch 5 .

❾ MIX A-R (Aileron → Ruder)

Combi-Mix

When an aileron command is given, the rudder also moves to a pre-programmed extent (0 ... ±125%).
The mixer can be switched on and off via an external switch connected to socket 3.

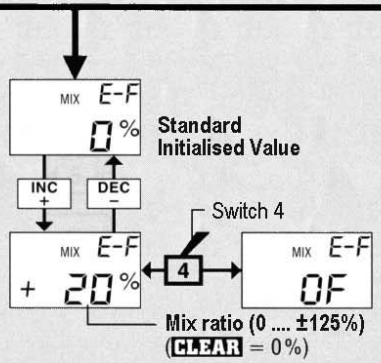


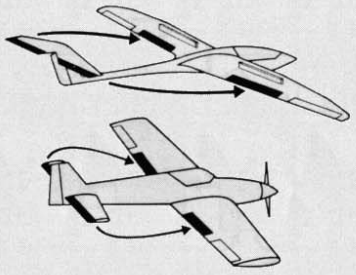


⓫ MIX E-F (Elevator → Flap)

Elevator → Flap

When the elevator servo is operated, the flaps are fed a pre-set signal (0 ... ±125%)
The mixer can be switched on and off if an external switch is connected to socket 4.



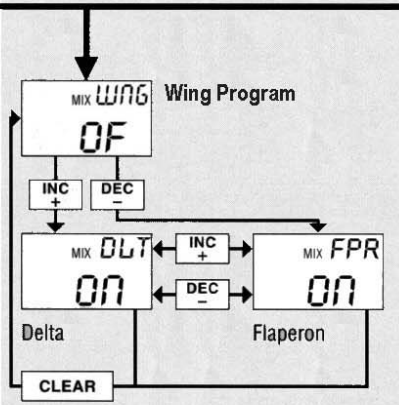


㉓ MIX WNG (Wing)

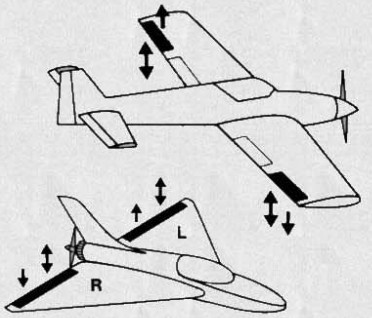
Delta "DLT" & Flaperon "FPR" mix

1. "DLT": Delta mixer operating channels 2 and 3.
2. "FPR": Flaperon

The receiver outputs 2 and 6 are mixed so that control stick 2 gives aileron operation and the flap slider gives a flap function.



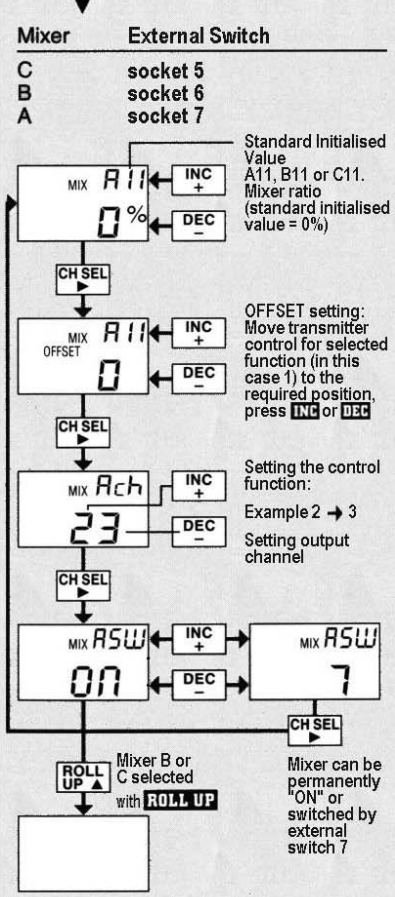
"DLT": The mix proportions are adjusted using the Dual-Rates function for control functions 2 and 3.
"FPR": The ratio for the aileron function is set using the Dual-Rate function for channel 2.
The flap setting is adjusted using the Servo Travel Adjustment code for control function 6.

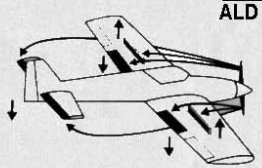


❻ MIX A11, B11, C11

Freely Programmable Mixer

Both the mixer program (servo functions 1 ... 8) and the mixer ratio (0 ... ±125%) can be selected individually.
The mixers can be set permanently "ON" or switched on and off via the associated external switch





Elevator Setting
CLEAR = "0"
"OF" if switch 5 is off

Flap Setting
CLEAR = "0"
"OF" if switch 5 is off

Spoiler active/ inactive setting (receiver output 7)
CLEAR = "OF"

Setting the operating point: Put throttle at the desired switching point and press INC or DEC.
CLEAR turns ALD off.

20

AUTOMATIC MANOEUVRE

Two Snap-Roll programs
(access via Set-Up Menu)

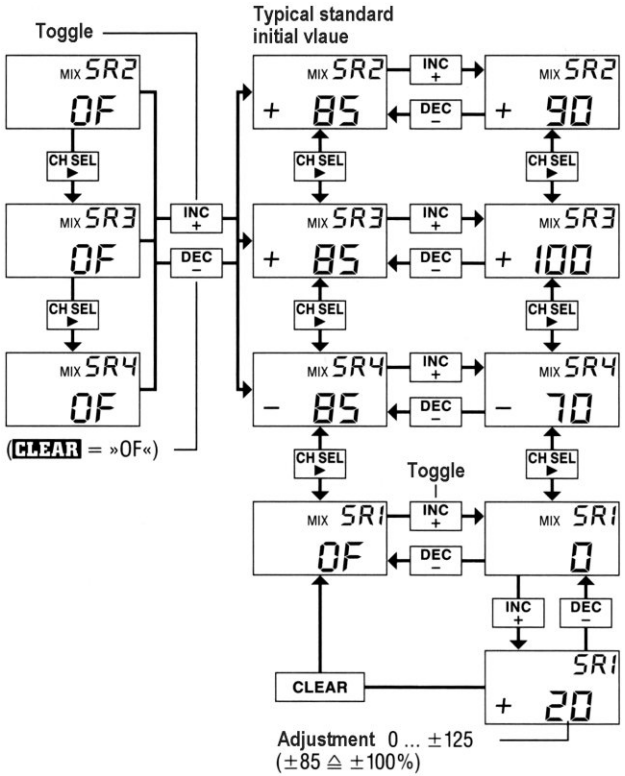
The switches to operate the Snap-Roll program must be connected to socket 6 and/or 7 of the transmitter board. This code allows the programming of aileron, elevator and rudder positions, plus the pre-setting of the throttle position. Two Snap-Roll programs are available, i.e. Snap-Roll to left and right. To control this function, momentary switches, part No. 4160.11, 4160.44 or kick-switch M4144, are needed to select the Snap-Roll program “SR…”, and to turn off the function immediately the switch is released.
The both programs differ as shown in the following tables, The final program to be activated is always indicated in the display.

Switch	Display	Function	Ch
Socket 6	SR1	Throttle	1
	SR2	Aileron	2
	SR3	Elevator	3
	SR4	Rudder	4
Socket 7	SRT	Throttle	1
	SRA	Aileron	2
	SRE	Elevator	3
	SRR	Rudder	4

Note:
If two separate momentary switches are used, and both are turned on together, the one connected to socket 7 has precedence. Simultaneous activation of the Automatic Landing (code 22) using switch 5, the Snap-Roll program will be inactive underneath the switch point of the Automatic Landing

Consecutive presses of the CH SEL button moves through the channels “SR2” through “SR4” and/or “SRA, “SRE”, and “SRR”. The three channels can be set independent of the position of switches 6 and 7, or turned off using the CLEAR button. The first of the codes “SR1” and/or “SRT” for the throttle control is actually the fourth code that appears. The function selection is changed by the CH SEL button, with the CLEAR button cancelling a setting.

Now the servo setting for each sub-code “SR…” can be set using the INC and/or DEC buttons in the range 0 … ±125%



Momentary operation of switch 7 changes the display between "SRA", "SRE", "SRR", "SRT".

21

DUAL-RATE / EXPO- AUTO-COUPLING

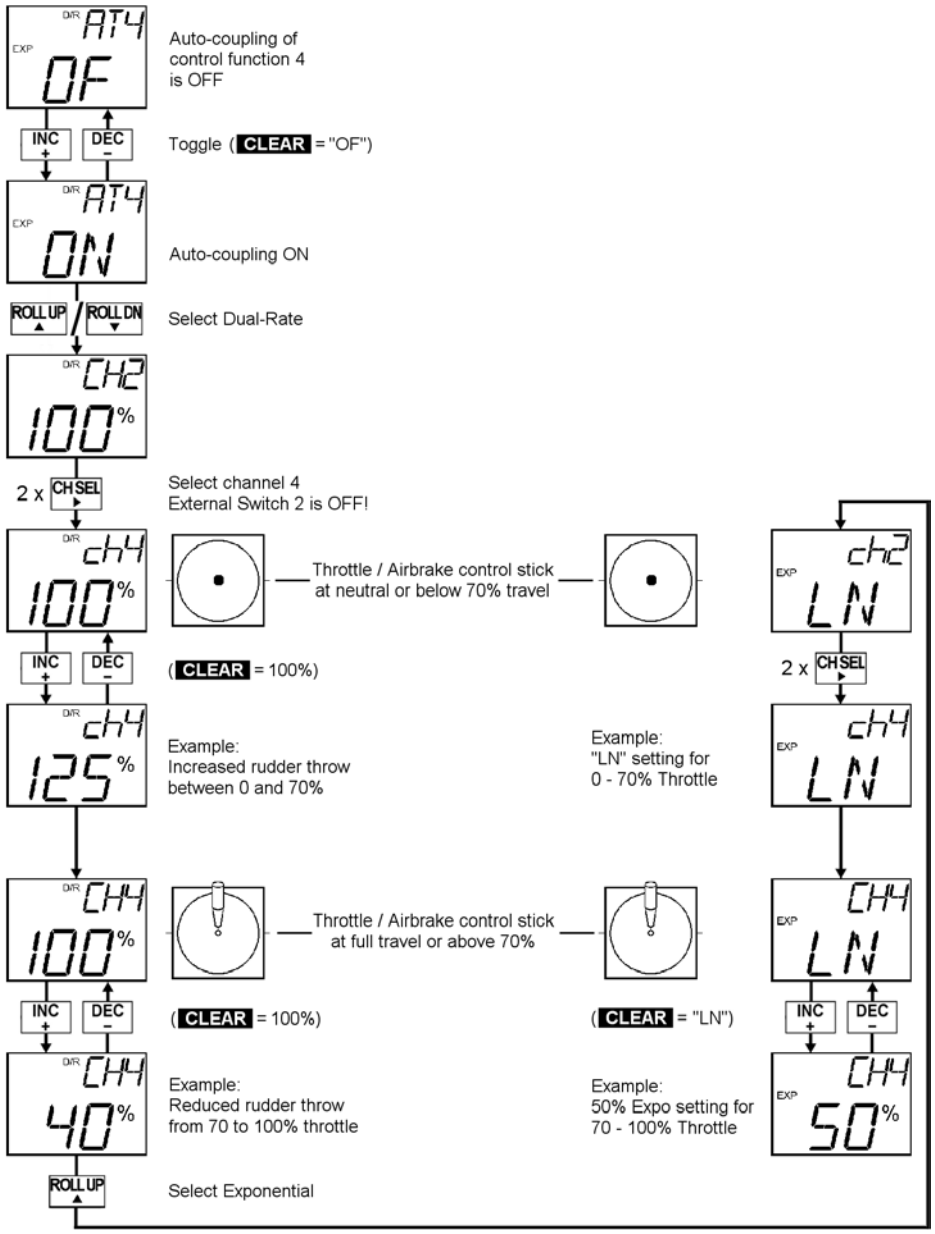
Automatic switching of control characteristics
(access via Set-Up Menu)

The normal Dual-Rate (D/R) and Exponential functions for channels channel 4 (rudder), see page 20, can be linked to the throttle control stick to automatically switch between the two settings at about 70% of full throttle.
Example:

0 … 70% throttle	Rudder travel increased to 125%, with linear motion (“LN”).
70% … 100% throttle	Rudder travel decreased to 40% and exponential set to 50%.

The auto-coupling function will only operate if the external switch at connection 2 is turned off.
In the D/R / Exponential setting, the selection for rudder (channel 4) below 70% throttle travel is indicated by “ch4”, with above 70% being shown by “CH4”.
With the auto-coupling disabled, i.e. AT4 = "OF", the D/R and Exponential for the rudder uses the normal switching, as described on page 20
or
With the "AT4" function activated, the external D/R / Exponential switch (connection 2) must be in the off position for the auto-coupling to function. The desired values are set using INC & DEC.

Note:
The auto-coupling affects control function 4 in accordance with the block diagram on page 52. Thus to the left of the output point for mixers, it can operate other control paths using the freely programmable mixers A, B and C, and the same from the right of the input point for mixers. For example mix "A47" and a setting of 100% would give similar auto-coupling effect to control paths 4 and 7.



(22)

AUTO-LANDING

Automatic Landing Assistance
(access via Set-Up Menu)

Around the landing approach, in particular to reduce the speed of very fast F3A models, this code offers the possibility, when falling below a certain pre-selectable engine speed, of putting the elevator and flaps into a defined position. Both functions, however, remain separately controllable. Optionally an airbrake / spoiler can also be driven out. This landing aid can be switched off during the flight using an external switch attached to socket 5 of the main board.

After selection of this code, four different subroutines are available in the information display, successively selected using the CH SEL button:

In the program "LDE" the elevator adjustment can be set using the INC and/or DEC buttons over a range of ±125 steps. The setting for the flaps takes place in the same way using the program "LDF". If the CH SEL button is pressed again, it can be decided whether the airbrake is to be driven out on activation of the automatic landing aid.

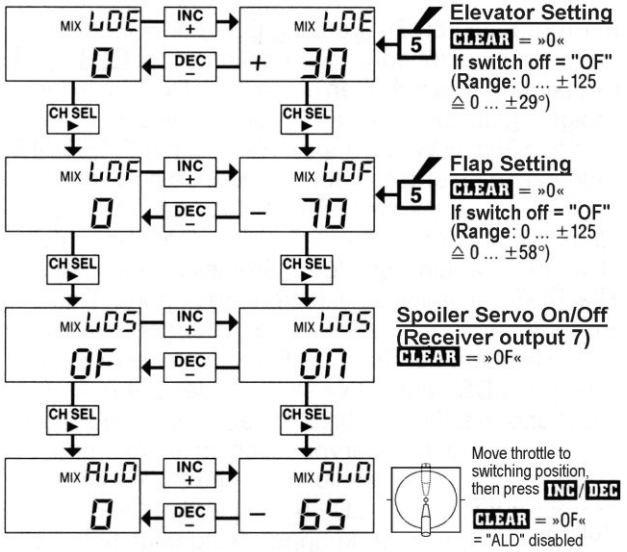
If required "LDS" is toggled between "ON" and “OF” by pressing the INC or DEC button: The airbrake servo is to be attached to the receiver output 7, which is reserved for this function. As long as "LDS" remains on "ON", the output 7 is closed and the servo drives from its neutral point to the end position. The servo excursion is over the code "servo way attitude", page 21, to specify.

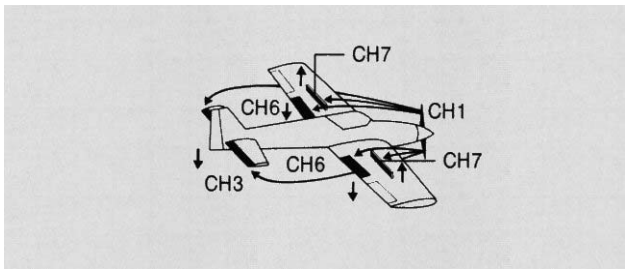
The subroutine "ALD" is used to specify the position of the throttle stick, below which the automatic landing aid is to be activated. The throttle stick is moved to the required operating position and the INC or DEC buttons is pressed to store the position. The current value is indicated in the display. If the throttle stick is above this position, or if the entire program is switched off using external switch 5, the message "OF" will appear in the display for the codes "LDE" and "LDF".

If the "ALD" subroutine were previously switched off by pressing CLEAR, can move the elevators, flaps and airbrake to their pre-determined auto-landing positions by operating external switch 5.

The settings for the control surfaces must be determined experimentally during flight and then adapted to the requirements.

Warning:
If the automatic manoeuvre, see page 56 is simultaneously switched on, it will be inactive when control function 1 is below the switching point for auto-landing!

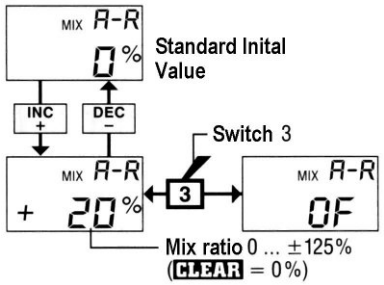


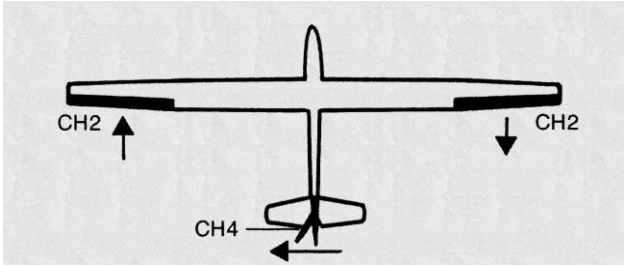


⑨ MIX A-R 0% COMBI-MIX

Aileron ➡ Rudder Mixer
(access via Set-Up Menu)

In the case of operating the ailerons, the rudder is deflected by a programmable mix proportion. The rudder can, however, be steered separately at any time with priority.
After call of the code "A-R", the mix proportion is adjusted using the INC/DEC buttons and is stopped to automatically at the maximum value of ±125%.
The combi mixer can also be disabled by an external switch attached to socket 3 on the transmitter board.

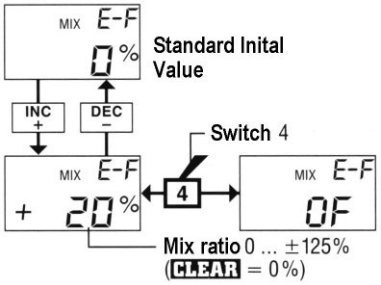


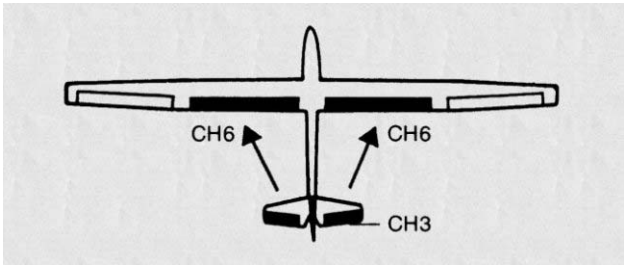


⑩ MIX F-E 0% FLAP ➡ ELEVATOR MIXER

Flap ➡ Elevator Mixer
(access via Set-Up Menu)

To assist the elevator with close turning flight and aerobatics, the flaps can be linked to the elevator and are driven out proportionally to the increase the wing lift. The value in the code "E-F" can be varied using, the INC and DEC buttons between 0 and ±125%. The mixer can be also switched off with an external switch connected to socket 4.





㉓

WING TYPE PROGRAMS

Wing Mixer for Delta and Flaperon models
(access via Set-Up Menu)

After calling this program "WNG OF" appears in the Info-Display . Two special mixers are available with this code, which can be selected using INC/DEC.

1. For Delta models, "DLT" combines the functions of Ailerons and Elevators, where the servos are connected to receiver outputs 2 and 3 (Throttle to 1, Rudder to 4). The mix ratio is adjusted using the code "Dual-Rate" (Control function 2 for Ailerons and 3 for Elevator, see page 20).

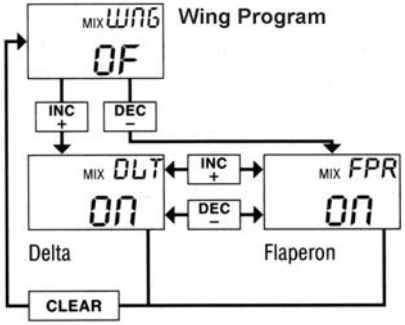
   Note:
   Depending on the installation of the servos, the direction of rotation and neutral position may be adjusted using the appropriate codes on page 21.
   Servo travel adjustment:
   Ch 2 affects the servo travel for servo 2.
   Ch 3 affects the servo travel for servo 2 during aileron control, but it affects both Servos 2 + 3 together during elevator travel. For safety reasons, the servo travel must amount to at least 50%!

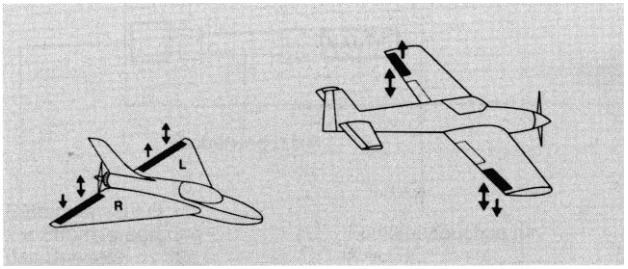
2. Aileron / Flap mixer: "FPR" stands for Flaperon and affects two servos attached to receiver output 2 and 6 as follows:

   ● Aileron, if the control stick for control function 2 is moved.

   ● Flap, if the control element for function 6 is moved.

   Note:
   Depending on the installation of the servos, the direction of rotation and neutral position may be adjusted using the appropriate codes on page 21.
   Servo travel adjustment:
   Servo 2 can be altered using the code servo travel adjustment for "CH2". The setting for "CH6" affects both exits when control function 6 is used for the flap position.
   The mix portion of the aileron control, function 2. can be changed using the Dual-Rate and Exponential settings. The setting doe CH2 affects both outputs 2 and 6 together.





HELICOPTER MODELS – General Information

With these helicopter programs the mc-16/20 transmitter provides all the options for the controlling a modern model helicopter.

To facilitate programming the following helicopter specific functions are available:

- Idle Up
- Throttle curve
- Pitch curve
- Autorotation
- Static
- Dynamic
- Mixer
- Gyro control

Additionally the functions previously described in the Fixed Wing section can be used:

- Dual-Rate
- Exponential
- Servo reverse
- Servo neutral point
- Servo travel adjust
- Free mixers
- Stopwatch and alarm timer
- Fail safe memory & battery fail safe

Warning

RC Helicopters are complicated aircraft which can not the mastered simply. They are aerodynamically unstable and can fly in any direction if control is lost. There is a constant danger of injury when operating them.

Beginners are strongly recommended to find an experienced modeller, club or model flying school. Further advice is available from model shops and modelling publications.

Preparations

Before reviewing the setting of the model into the transmitter, the model should be set accurately using the mechanical adjustments.

That is:

- All controls are set in accordance with the respective helicopter instructions.
- All controls are assembled so that with the control linkages at the middle position, and the trim neutral, the servo arm is at a right angle to the control rod.
- With the control sticks centred, the main rotor head is horizontal, and the tail rotor blades are at the required pitch angle.
- The size of the servo arm was chosen such that the throttle control rod movement matches the carburettor movement required between idle and full throttle, and that the motor will idle with the joystick fully back and the trim appropriately set. The servo movement is unrestricted and does not foul by appropriate mechanical or electronic limits.

The user should familiarise himself with the individual programs starting on page 66.

Programming a Helicopter, model type “HE”

The initial set-up of the transmitter for helicopter models is achieved using the System Menu, see pages 14 – 17. The basic set-up depends less on the model itself than on the general control preferences of the pilot.

The most important setting, above all others, is the control mode (MOD), including whether the throttle stick should pushed or pulled for maximum pitch (THR). Both settings should be reviewed in all cases before beginning with the set-up of the model.

The model dependent parameter settings are grouped in the Set-Up Menu, that is activated from the initial position of the transmitter and/or leaving the System Menu by pressing of the key ENTER.

In both menus, the desired functions are displayed by scrolling through the options by pressing the ROLL UP and/or ROLL DN buttons.

Connection of external control elements to the transmitter board for the helicopter program

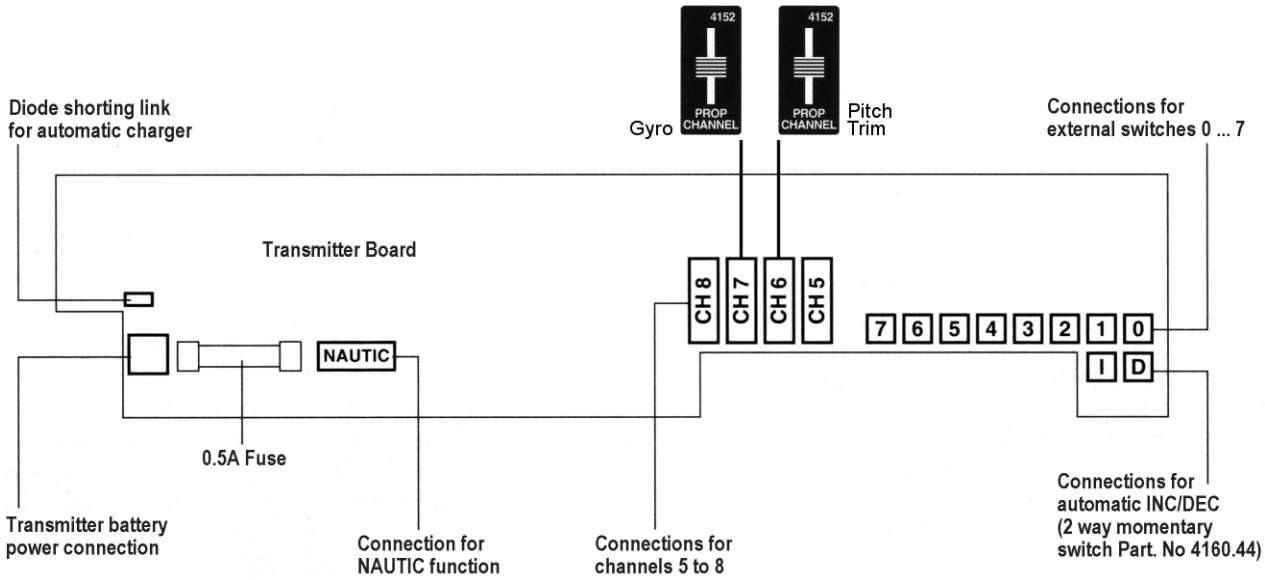
In the helicopter program, you can connect up to eight external switches, which have the following functions :

0 Dual Rate / Exponential Roll
1 Dual Rate / Exponential Pitch
2 Dual Rate / Exponential Tail Rotor
3 Autorotation
4 Throttle and Collective Pitch curve (1)
5 Throttle and Collective Pitch curve (2)
6 Static & Dynamic mixers and freely programmable mixer B
7 Gyro control and freely programmable mixer A

Also on the board of the transmitter are additional connectors that allow the installation of two slider controls for the following functions:

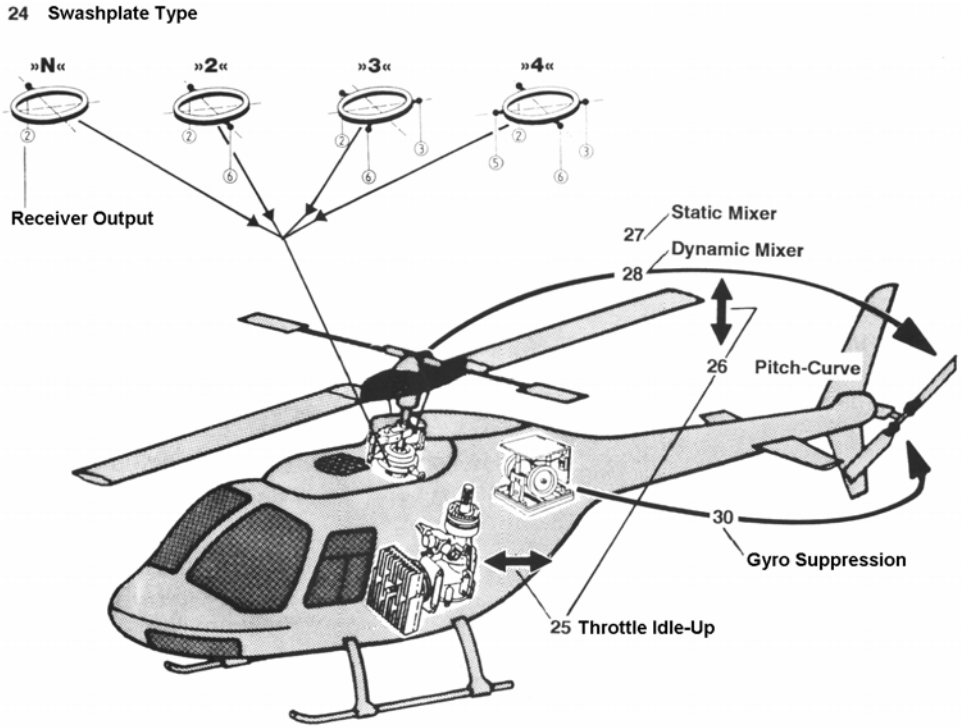
CH6 Collective Pitch Trim
With this slider control the Collective Pitch setting can be adjusted independently to the throttle servo up to around 25% of the maximum servo travel.

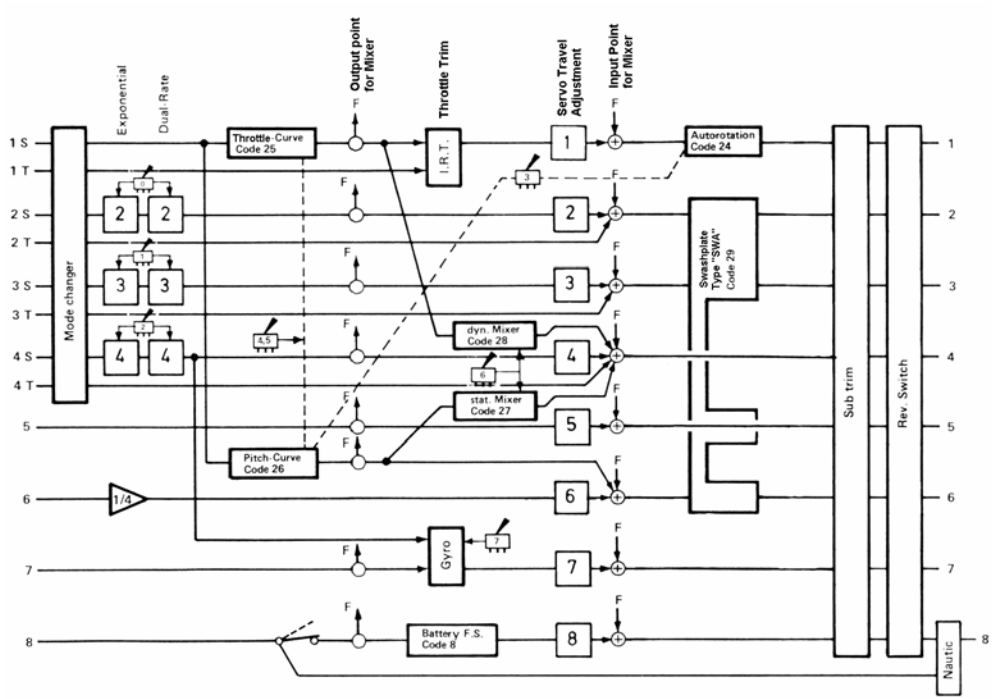
CH7 Setting for the Gyro



HELICOPTER MODELS

Block Diagram for the HELICOPTER “HE” Program





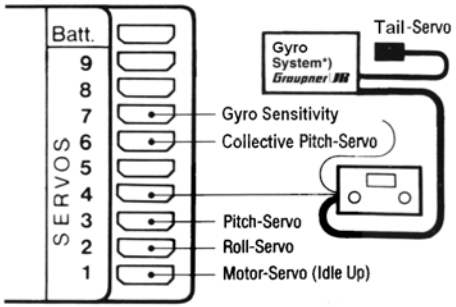
Allocation of Receiver Connections (Ch 1 – 8)

The servos must be connected to the radio receiver as shown in the diagrams below:

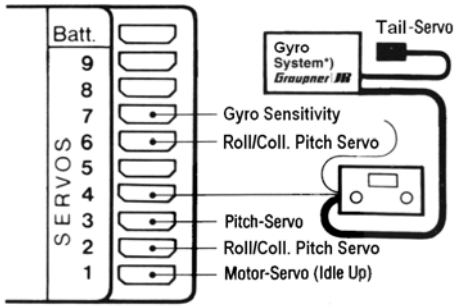
*) Gyro	Part No
Mini-Gyro	3274
NEJ-120BB	3277
NEJ-120BB ECO	3278

*) Gyro	Part No
NEJ-1001	3906
Piezo 2000	3285

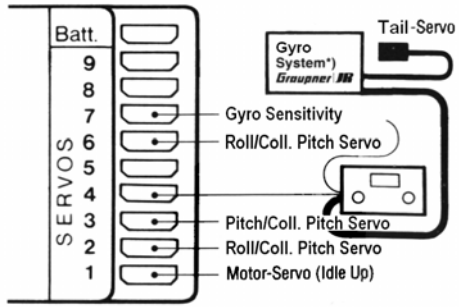
Swashplate Type N



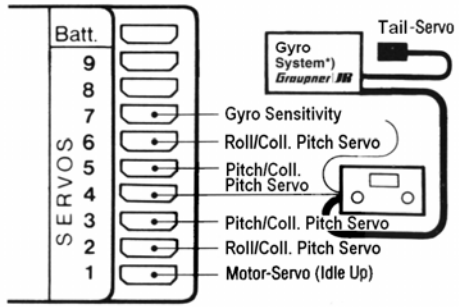
Swashplate Type 2



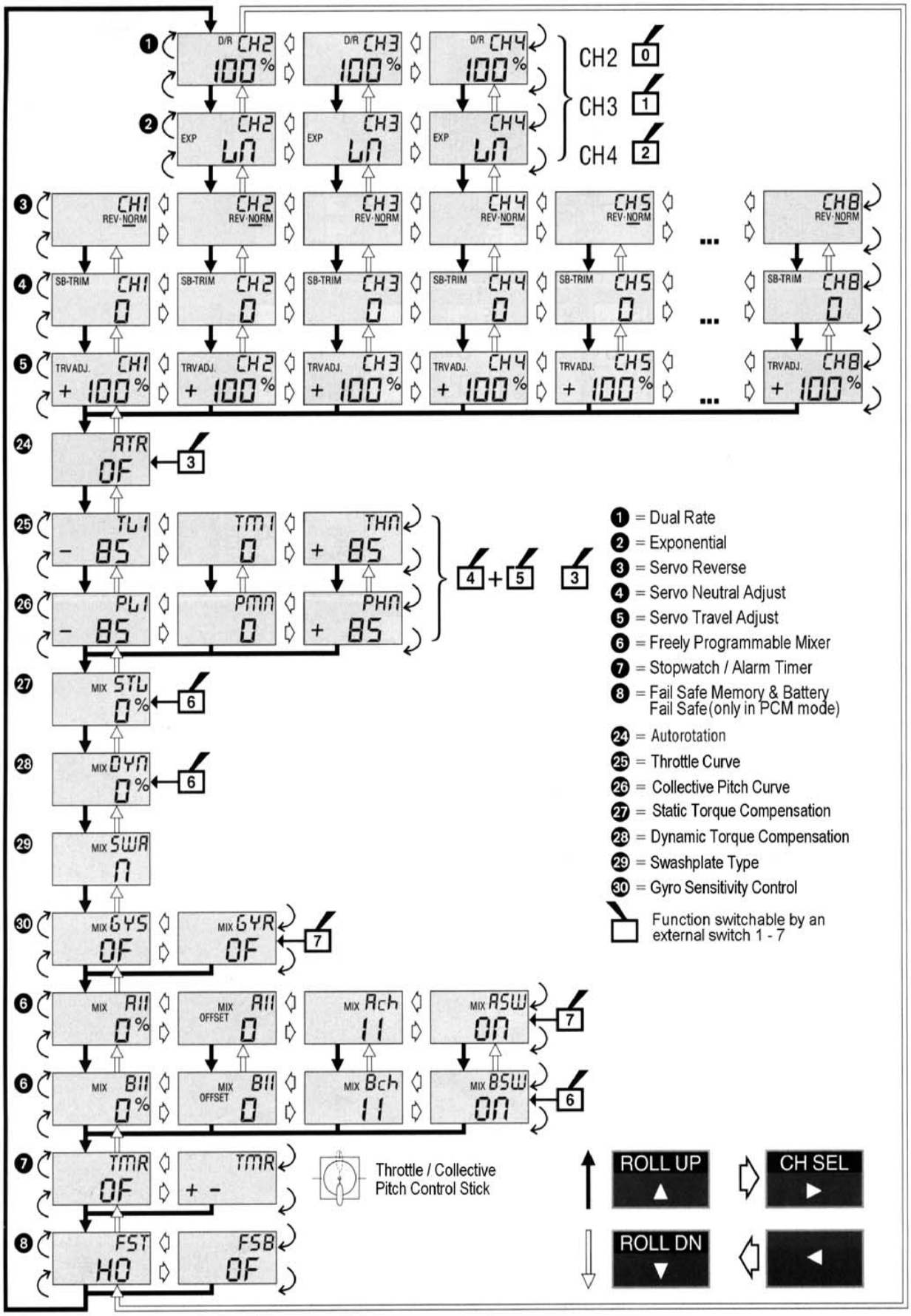
Swashplate Type 3



Swashplate Type 4



Block Diagram HELICOPTER "HE"



Set-up Diagram

TYP HE Model Type “FL” = STANDARD

All the mixers and adjustment values are set to 0 (= mixer off).
To adjust the mixer and adjustment values, while flying, we recommend fitting the 2-way momentary switch, Part No. 4160.44 (see page 10)

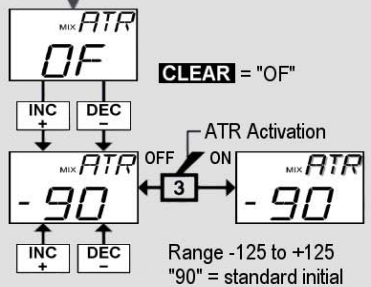
❶-❺, ❼, ❽

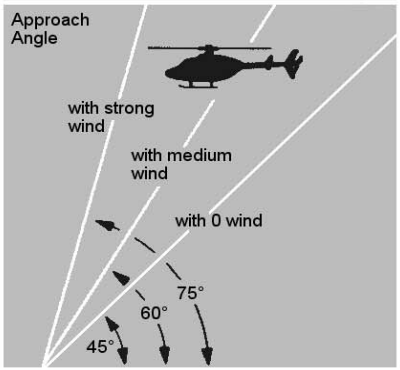
Adjustments ❶-❼, ❽ are available for all model types

- ❶ DUAL RATE — Functions 2 - 4 (0 - ±125%), Page 81
- ❷ EXPONENTIAL — Functions 2 - 4 (linear - +100%), Page 81
- ❸ SERVO REVERSE — Channel 1 - 8 (Reverse / Normal), Page 68
- ❹ SERVO SUB-TRIM — Channel 1 - 8 (0 - ±125 steps), Page 68
- ❺ SERVO TRAVEL ADJUST — Channel 1 - 8 (0 - ±160%), Page 68
- ❼ STOPWATCH and ALARM TIMER — Page 82
- ❽ FAIL SAFE MEMORY and BATTERY FAIL SAFE (only in PCM mode) — Page 83

❷❹ ATR

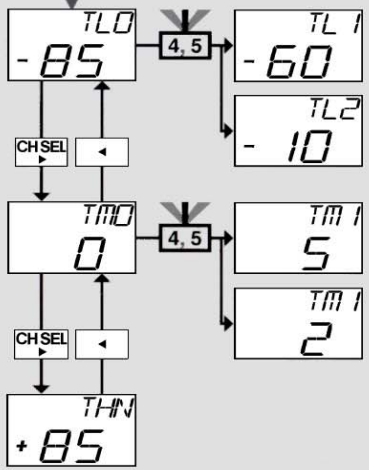
Autorotation
The functions throttle and collective pitch are separated, with the throttle servo taking a preset position. For autorotation an external switch connected to socket 3 is necessary. **CLEAR** deactivates the functions ("OF"), to prevent inadvertent change over to ATR. With ATR activated the static (ST...) and dynamic (DYN) torque compensation are switched off. The minimum, hovering and maximum collective pitch settings still apply.



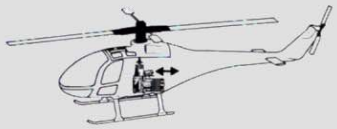


❷❺ TL/M/H ...

Throttle Curves (Throttle Low / Hover / High)
Three different throttle curves can be set and switched between during the flight. The full throttle position (THN) is the same for all three curves, but different values can be set for hovering flight (TM0, 1, 2) and minimum throttle (TL0, 1, 2).

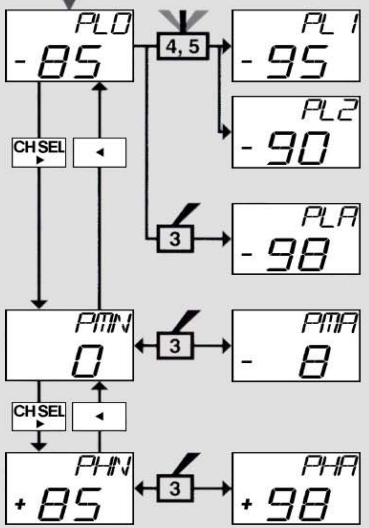


Select the desired value with **INC** or **DEC**. Range -125 to +125



❷❻ PL/M/H ...

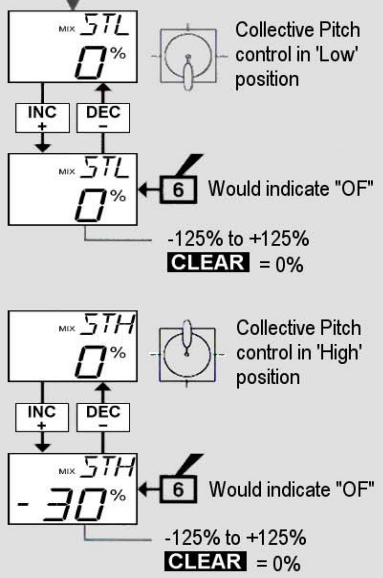
Collective Pitch Curves (Pitch Low / Hover / High)
Three different collective pitch curves can be set and switched between during the flight. The maximum collective pitch (PHN) and hover pitch (PMN) are fixed together for all three curves; a separate value can be set for for pitch minimum (PL0,1,2). Additionally a fourth, separate pitch curve can be programmed and be activated with the ATR switch attached to socket 3.



Select the desired value with **INC** or **DEC**. Range -125 to +125

❷❼ MIX STL/H

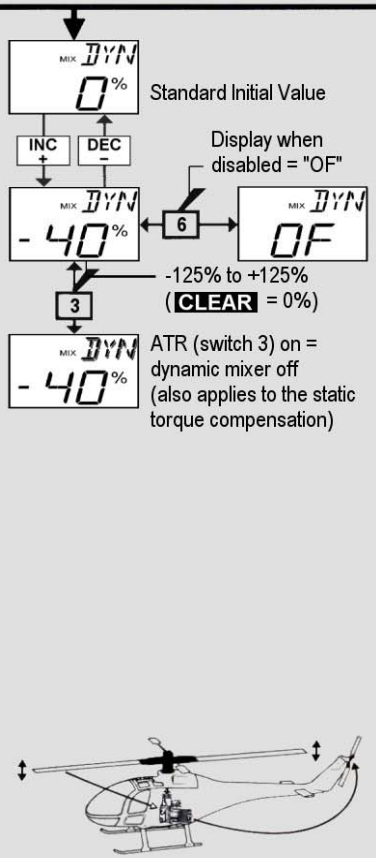
Static Torque Compensation
Using **INC** / **DEC** the low (STL) and high collective pitch (STH) static torque mix for Pitch ➡ Tail Rotor pitch. The position of the tail rotor Servos depends on the maximum and minimum pitch values set here. The mix direction must be selected according to the direction of rotation or the main rotor. Using an external switch at socket 6 the mix can be switched off; with autorotation the mix is automatically switched off.



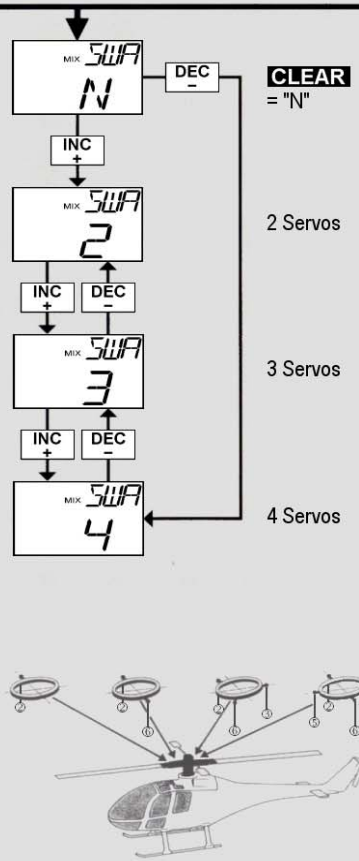
All mixer data can be set to 0, i.e. switched off using the CLEAR key. Display "OF" = the external mixer is switched off.

㉘ MIX DYN

Dynamic Torque Compensation
This throttle to tail rotor mixer works during changes in pitch and roll of the main rotor and is primarily intended for helicopters without collective pitch. Mix proportion and direction are set using **INC** / **DEC** (range: 0 to ±125%). This mixer can be switched off with an external switch connected to socket 6 . When in autorotation mode the mix is automatically turned off (flashing announcement "DYN").

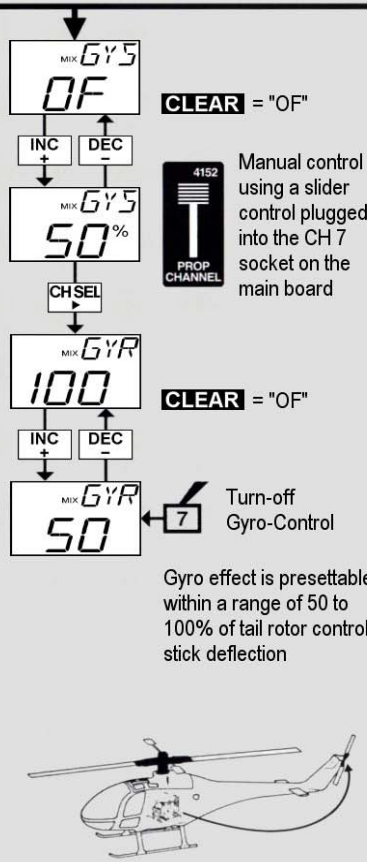


㉙ MIX SWA



㉚ MIX GYS

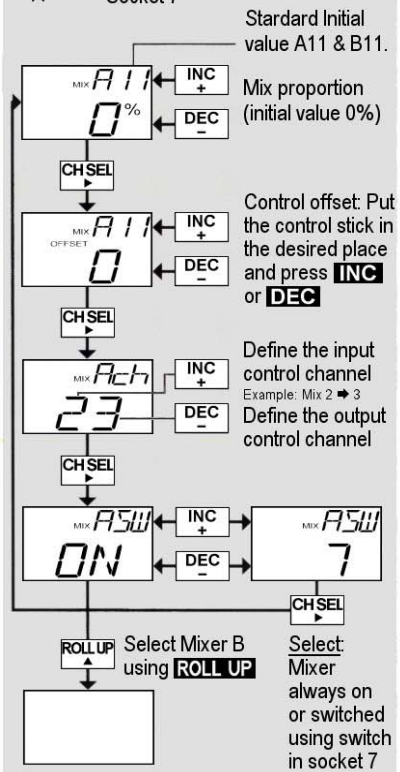
Gyro Gain Control
With a proportional module, Part No 4111 or 4152 connected to function socket 7 the gyro effect can be altered. The gain of the automatic gyro effect of the Gyro sensor with increasing tail rotor control stick movement can be reduced.
This gyro gain effect can also be disabled using a switch attached to socket 7.



⑥ MIX A11, B11

2 Freely Programmable Mixers
Both the channels (1-8) to be linked by the mixer, the mix portion and mix direction (±125%) can be individually selected.
The mixers can be continually "ON" or using external switches, turned on and off.

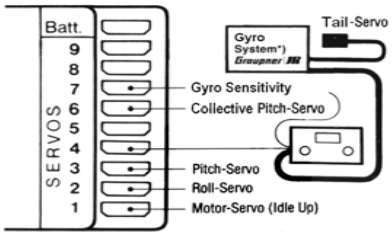
Mixer	External Switch
B	Socket 6
A	Socket 7



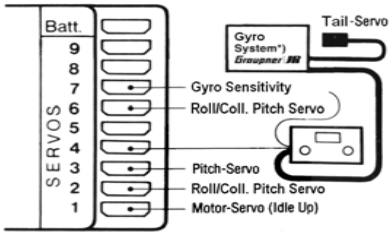
Connections to the receiver (Ch 1 to 8)

The servos must be connected to the receiver outputs as shown below:

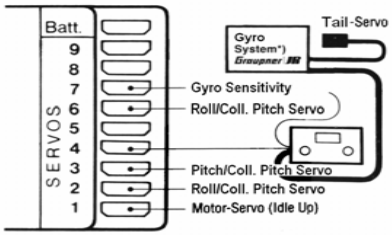
Swashplate Type N



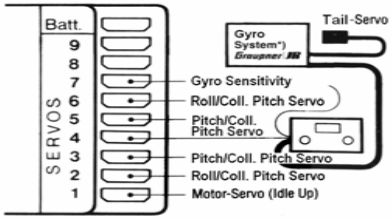
Swashplate Type 2



Swashplate Type 3



Swashplate Type 4



HELICOPTER Adjustment Instructions

Programming System
The following programming guidance orients itself around the practical programming conditions and not at the consequence of the options in the transmitter. For the initial programming of a helicopter it is advisable to observe this order since it represents a logical operational sequence.

SYSTEM Menu
(The options are described in further detail on the pages indicated for each option)

Model Selection (see page 17)
The mc-16/20 transmitter permits the storage of 20 model settings. If you get into the habit of adjusting the controls so that the trim levers are centred, it is much simpler when changing models as you don't need to reset the trim positions for the selected model.

Model Name (see page 16)
To simplify selecting the correct model settings in the 20 memory model names can be entered, which can consist of three letters and/or numbers. This name is indicated in the upper display line, as long as the stopwatch is not in use.

Model Reset (see page 17)
With the reset option it is possible to set all the model parameters back to the default values. You should use this option when setting up a new model where the current setting in that memory is a model of same type (HE in this case). With a change of model type the reset is automatically performed.

Model Type (see page 15)
The mc-16/20 transmitter supports 5 different model types. The model type selection must take place at the beginning of reprogramming a model as the other options available are dependant on the model type selected.

Control Mode (see page 15)
There are four different control modes which affect assignment of the four control functions (fore/aft, roll, tail rotor pitch and throttle/collective pitch) to the two control sticks. The control mode to be used depends on the preference of the individual model flyer.
For controlling a model helicopter it is preferred to have the controls for fore/aft and roll (thus the entire cyclic control) on a common stick, and the other stick to have the tail rotor and throttle/collective pitch. Therefore control mode 2 or 3 is recommended.

Throttle/Collective Pitch Direction (THR)
(see page 16)
This option permits the flyer to select the direction of operation of the throttle & collective pitch control stick to suit their preferred direction.
After call this setting, the direction can be swapped, between pushing and pulling for increased pitch, by pressing the INC or DEC buttons. The current active setting is indicated in the display:
NORM = Push for increased pitch
REV = Pull for increased pitch

All the other function options of the helicopter program depend on this setting, as it affects the throttle and collective pitch functions, thus for example throttle and collective pitch curves, mixers for torque compensation, etc.

SET-UP MENU
Adjust the values for the model.
The remaining model-dependent value setting takes place in the set-up menu. To access the set-up menu from the basic operating screen of the transmitter (e.g. after switching on), the keys ROLL UP and ROLL DN are pressed simultaneously (marked on the keyboard as ENTER).

29

SWASHPLATE TYPE

Swashplate Mixer
(access via Set-Up Menu)

Four different programs exist for the control of the swashplate:

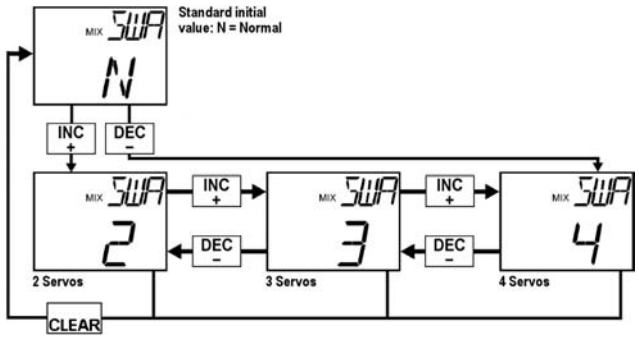
"N" (Normal) The swashplate is tilted for roll by a servo; the collective pitch control is by a separate servo. Type "N" also includes those helicopters with mechanic mixers to achieve the collective and cyclic blade control.

"2" The swash plate is axially moved for collective pitch by two roll / collective pitch servos; fore & aft pitch control is decoupled by a mechanical mixer (HEIM mechanics).

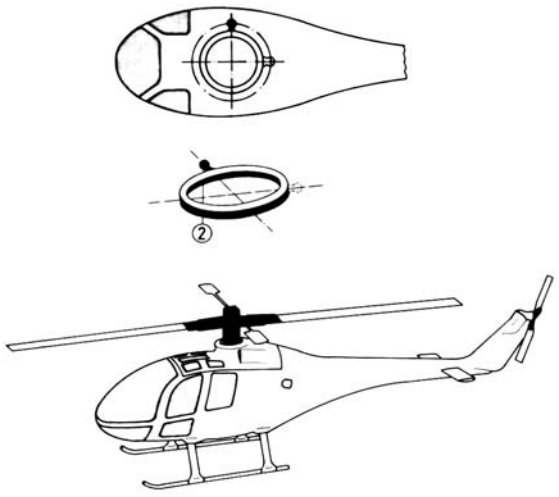
"3" Symmetrical three point control of the swashplate using three coupling points at 120°, to which a fore & aft pitch / collective pitch servo (in front or at the rear) and two roll / collective pitch servos (laterally on the left and right) are connected. For collective pitch all three servos move together to move the swashplate axially.

"4" Four point control of the swashplate with two roll / collective pitch and two fore & aft pitch / collective pitch servos.

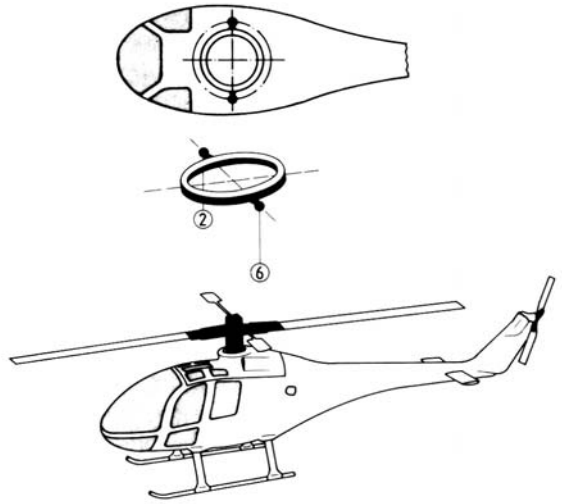
The selection of the code is achieve using the INC / DEC buttons.



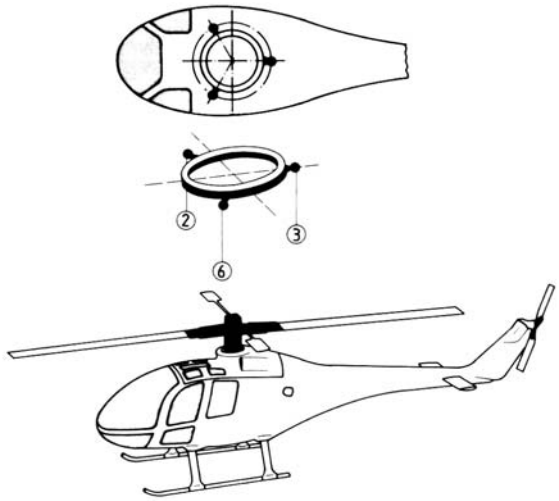
Program »N«
1 Servo



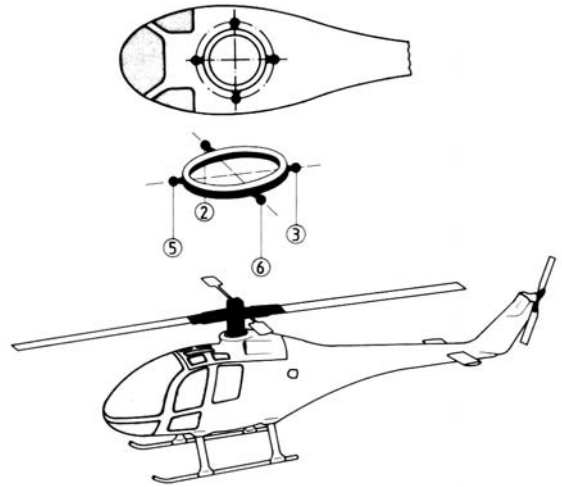
Program »2«
2 Roll servos



Program »3«
2 Roll servos and 1 Pitch servo



Program »4«
2 Roll servos and 2 Pitch servos

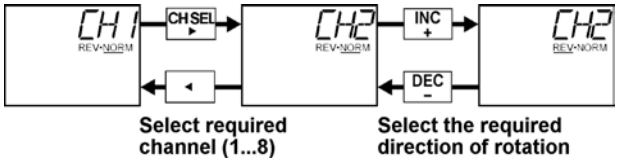


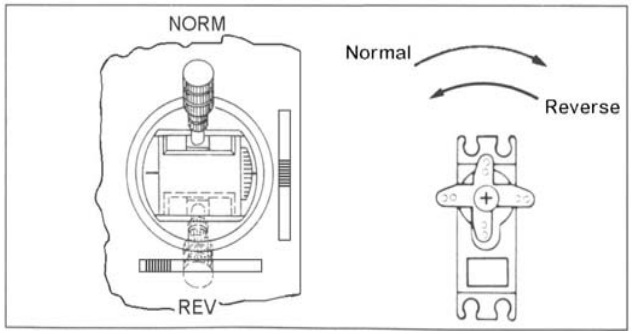
SERVO REVERSE

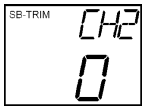
Reversing the Rotation of the Servos
(access via Set-Up Menu)

Reversing the direction of servo rotation.
The set servo rotation is shown in the display for all servo functions 1…8; you will see the cursor line under either “REV” or “NORM”. This eliminates the need to reconnect plugs in the transmitter or reverse the servos themselves. Press the CH SEL button repeatedly until the required channel you wish to alter appears in the display, then swap the direction using the INC or DEC buttons. The CLEAR button will always reset the direction to “NORM”.

Note:
The channel number refers to the receiver output to which the servo in question is connected. Any agreement with the numbering of the channel inputs is coincidental, and is unlikely to be the case when complex mixes are in use. For this reason a change in stick mode does not affect the numbering and direction of rotation of the servos.



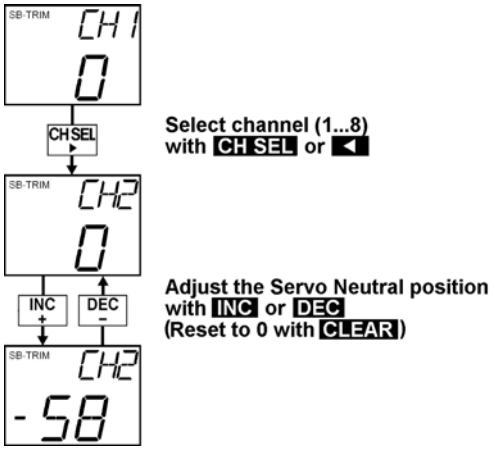


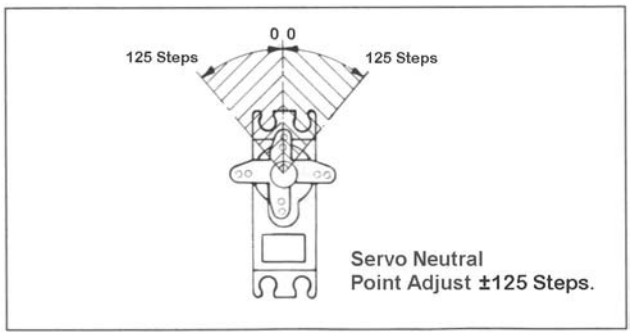


SERVO NEUTRAL POSITION

Servo Neutral Position
(access via Set-Up Menu)

This can be used to adjust for non-standard pulse width servos (≠1.5ms) or other reasons.
The neutral position can be shifted within the range ±125 steps (approximately 70% travel) using the “SB TRIM” option, regardless of the trim lever position and any mixer settings.
Select the channel you want to adjust using the CH SEL button and then press INC or DEC repeatedly to shift the centre point, until the servo neutral is correct for you application. The CLEAR button can be used to reset the adjustment to 0, i.e. the servo the return to its original neutral position. This setting refers directly to the servo concerned, and is not affected by other trim and mixer settings.

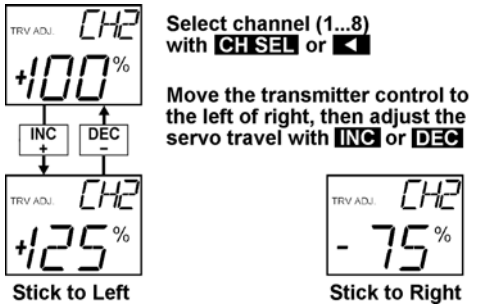


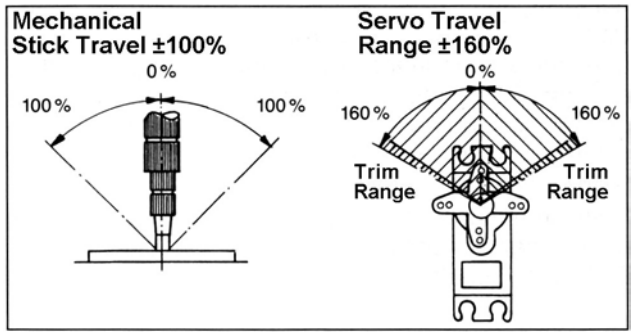


SERVO TRAVEL

Servo Travel Adjustment
(access via Set-Up Menu)

The abbreviation “TRV ADJ” stands for Travel Adjust and provides adjustment of servo travel separately for either side of centre. The adjustment range is 0…160% of normal servo travel.
It can be determined from the block diagram what impact this setting has on the servo concerned. Some mixers are not affected by this setting as they feed directly into the „Input Point for Mixers“, whilst the output of others are adjusted according to this setting.
Press the CH SEL button repeatedly until the correct servo function (1…8) appears in the display. The bottom line of the display shows the servo travel set, with the prefix (+ or -) indicating the side of centre. If you wish to adjust (& display) a setting, you need to move the associated control (stick, slider, switch) to the relevant end-point. Adjust the travel with the INC or DEC buttons, and reset it to 100% with CLEAR.





Setting the Throttle and Collective Pitch curves: Fundamental Explanations

Setting the Throttle and Collective Pitch
The tuning of throttle and collective pitch, and thus the performance curve of the engine and collective pitch control, is the most important adjustment procedure with a helicopter model. The goal of this tuning is it to achieve a constant main rotor speed throughout the entire collective pitch range in flight, and to ensure that at the point at which the helicopter hovers is achieved with the throttle / collective pitch stick as near as possible to a central position.

Firstly a wide-spread misunderstanding must be clarified for model helicopter pilots:
The model helicopter throttle servo must NEVER be connected just to an auxiliary channel and operated via a proportional module alone!!!

Although throttle and collective pitch are controlled by separate servos, these are always operated together by the throttle / collective pitch control stick (the only exception is Autorotation). This coupling is done by the helicopter program in the transmitter. The trim levers for the throttle / collective pitch control stick work, in the helicopter program, exclusively on the throttle servo and then only in the minimum throttle position of the control stick.
A proportional module attached to CH 6 permits a shift of the collective pitch range around by range of ±25% without influencing the throttle servo.

The helicopter program of the mc-16/20 transmitter permits the programming of independent throttle and collective pitch curves.

In addition to the central position and two end positions appropriate to the throttle / collective pitch control stick, individual values entered for the collective pitch and throttle are stored in each case.

No-load setting and throttle preselect
The no-load operation setting makes it possible to set the engine RPM for no-load, without influencing the hovering flight setting.
With the option “TL1” the throttle servo position is set in such a way that with the control stick in the idle position one achieves stable no-load operation. With the trim lever and the idle setting, the engine can be turned off.
During flight it is possible to switch over to a limited throttle setting (i.e. minimum RPM), which is generally called “Idle-up”.
The “Idle Up” setting acts to prevent excessive rotor RPM and is primarily for use when the collective pitch is taken under the point of hovering flight, for example with fast, steep approach flights. Therefore it may only be effective below the hovering flight position (central position) of the pitch control stick. Occasionally a changeover of the throttle curve is used for an increase in the system RPM for certain flight manoeuvres, usually for helicopter models whose rotor construction does not permit a constant RPM for hovering flight and aerobatics. In addition it is used to ensure the settings for both hovering flight and aerobatics are optimal: Low system RPM for calm, soft stick reactions and low noise in hovering flight, higher RPM for aerobatics, within the range of the maximum power of the engine. In this case the throttle curve is also changed within the hovering flight range.

In order to allow for all these requirements, the mc-16/20 transmitter possesses a changeover system for throttle and collective pitch curves which goes far beyond simple idle-up. If you attach additional external switches to connections 4 and 5 on the transmitter plate, they allow up to two alternative throttle and pitch curves to be programmed and called up during flight.

The announcement appearing in the display for the option of “TL...” depends on the switch positions:

“TL1:” Both switches in the OFF position
”TL0:” Switch 4 = ON, switch 5 = OFF
”TL2:” Switch 4 = ON or OFF, switch 5 = ON

Preferable to two independent switches is the use of the 3-way differential switch, Part No 4160.22, which then gives the following switching:

Lower position: Throttle / Pitch Curve 0
Centre position: Throttle / Pitch Curve 1
Upper position: Throttle / Pitch Curve 2

In this case use curve 0 for the basic adjustment in place of curve 1

Not only can the throttle minimum values for all three switching positions be set differently, but also the values for hovering flight throttle and minimum collective pitch. The value for full power is set and shared for all switching positions together, likewise hovering flight collective pitch and maximum collective pitch.

Throttle and Collective Pitch curves: Practical Procedure

Basic Adjustment
Although the pitch and throttle curves can be set electronically over a wide range in the mc-1620 transmitter, the hovering point of the helicopter should be at least approximately correctly preset mechanically (see introduction). If you pay attention to the instructions of the respective helicopter kit for adjusting the controls this is usually the case.

The control of the carburettor must be so adjusted such that the throttle servo can move during operation of the throttle control stick, (including both end positions of the trim lever), over the full travel, without the carburettor hitting a mechanical stops. The carburettor must be completely open with the control stick in the full power position, and with the control stick and trim at the lower end the carburettor should be completely closed, without the servo stalling.

This setting should be achieved as best as possible mechanically by adjusting the control linkages and changing of the position on linkages on the servo and carburettor horns.

Only the remaining small adjustment should thereafter be made electronically, with the servo travel setting ("TRV ADJ", "CH1"). This basic adjustment is the basis for all further settings and must therefore be completed as accurately as possible.

With this basic adjustment the engine should be able to be started and the idle speed adjusted using the trim lever.

The model should then with the throttle / collective pitch control stick in central position, take off and with the intended RPM hover.

If that is not the case, then one proceeds as follows:

1.) The model takes off only with the stick above the central position.

a) The rotor RPM is too low.

Remedy: Using the "TM…" setting open the carburettor slightly at the stick central position.

b) The rotor RPM is too high.

Remedy: Using setting "PM...", increase of the blade angle (collective pitch) for the stick central position.

2.) The model takes off with the stick below the central position.

a) The rotor RPM is too high.

Remedy: Using the "TM…" setting close the carburettor slightly at the stick central position.

b) The rotor RPM is too low.

Remedy: Using setting "PM...", decrease of the blade angle (collective pitch) for the stick central position.

WARNING:
A long time should be taken over this setting, ensuring the model hovers at the correct RPM with the throttle / collective pitch expensive stick in the central position. The correct execution the remaining model parameters is dependent on this!

Climbing Flight Setting
The combination of the options "TM..." (hovering flight throttle) with "PHN" (maximum collective pitch) and "PMN" (hovering collective pitch) it makes possible to achieve problem-free flight from hovering to maximum climb rate with a constant rotor RPM.

To do this, proceed as follows:
First perform a long vertical climb, with the collective pitch stick in it's end position. Whilst doing this the rotor RPM should not change relative to that during hovering flight. This is dependent on the power of the engine and on the model weight. If the rotor RPM drops in the climb and the carburettor is already completely open, thus no further increase in output power is possible, using "PHN" (maximum collective pitch) reduce the maximum blade angle; with rising rotor RPM in the climb, increase the value of "PHN". If this setting is correct, bring the model back to hovering flight, which should be achieved with a central position of the collective pitch stick.
If the stick position for hovering flight has moved away from centre towards the maximum point, compensate for this using "PMN" (hovering collective pitch), by increasing it's value, until the model hovers with the stick in the central position. In the opposite case, with the model hovering with the stick below the central position, the value of "PMN" is reduced accordingly. It may also be necessary to reduce the setting of "TM…" (hovering flight throttle), until an constant rotor RPM for hovering flight and climb results.

Descending Flight Setting
During the previous setting it was assumed that any external switches possibly attached for throttle and pitch curve change-over were in the basic position, i.e. that for the hovering flight throttle setting "TM0" (or without an external switch the only option available is "TM1" which was used instead of "TM0").

This switching position is always selected when starting the engine and the rotor. To fly you move the switch from the start into the flight position, (throttle preselect is switched on and the display shows "TM1").

Before the next setting you should transfer the value for hovering flight throttle "TM0", determined during the preceding adjustments into "TM1". Switching from the start to the flight position should show no effect now.

The switch is brought to the flight position and the rotor is started.

The descending flight setting is adjusted as follows. Let the model, from forward flight at a reasonable height, sink with the collective pitch stick fully back. "PL1" (pitch minimum) should be adjusted so that the model descends at an angle of 60 – 80°. Once this is achieved one sets the throttle preselect value ("TL1") so that the rotor RPM neither increases or decreases. Once this has been managed, the basic tuning of throttle and pitch is complete.

Alternative Flight Setting
For special applications you can program an alternative flight setting, which can be switched to when required.
It is possible for example to set "TL2" to "0" whereby a throttle hold results. The throttle is no longer affected below the point of hovering flight as the collective pitch reduces, but remains to a constant value. Above the point of hovering flight the throttle control takes place normally via the throttle / collective pitch control stick.
With some model helicopters such a setting can have advantages during aerobatics, for example with models with four-stroke motors.

A further application possibility for this alternative setting is the hovering flight figures of the FAI competition program. In order to achieve the full rotor RPM in the take-off phase, you again select “0” for “TL2”. For the normal flying operation this setting is not recommended as during steep descending flight the rotor RPM will increase rapidly leading to flight instability. After the hovering flight figures are completed you switch back to the normal flight setting ("TM1") for the aerobatics figures.

Important Notes
Before starting the engine you should make sure that throttle selector switch is in the start position, otherwise after starting the engine will immediately increase to high RPM and the centrifugal clutch will engage.

Therefore always hold the rotor head when starting

If the engine should be started inadvertently with throttle pre-select switched on:

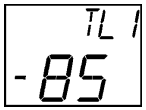
Do not panic!

Hold the rotor head rigidly!

Do not release it under any circumstances!

even if the result is that the clutch is damaged! The repair of a clutch is negligible compared to the damage, which uncontrolled with the rotor blades can cause striking things around the model.

The changeover from start to flight setting should not be done at the no load pitch position.
The rotor is accelerated suddenly which can lead to a premature lock of clutch and transmission system. Also the free moving main rotor blades do not stabilise during such a jerky acceleration and can swivel far from their normal positions, which can in extreme cases lead to a tail boom strike.



Throttle Curve

Throttle Curve (Low, Middle, High)
(access via Set-Up Menu)

Three different profiles for the carburettor response can be adjusted and called up in flight by external switches; the function of the throttle pre-select is included in this changeover.

The curves are determined in each case by three points:

- The low collective pitch / throttle stick position, called "TL..." (Throttle Low),
- The middle collective pitch / throttle stick position, called "TM..." (Throttle Middle),
- The high collective pitch / throttle stick position, called "TH…" (Throttle High).

The three sets of adjustment are successively called using the CH SEL button.

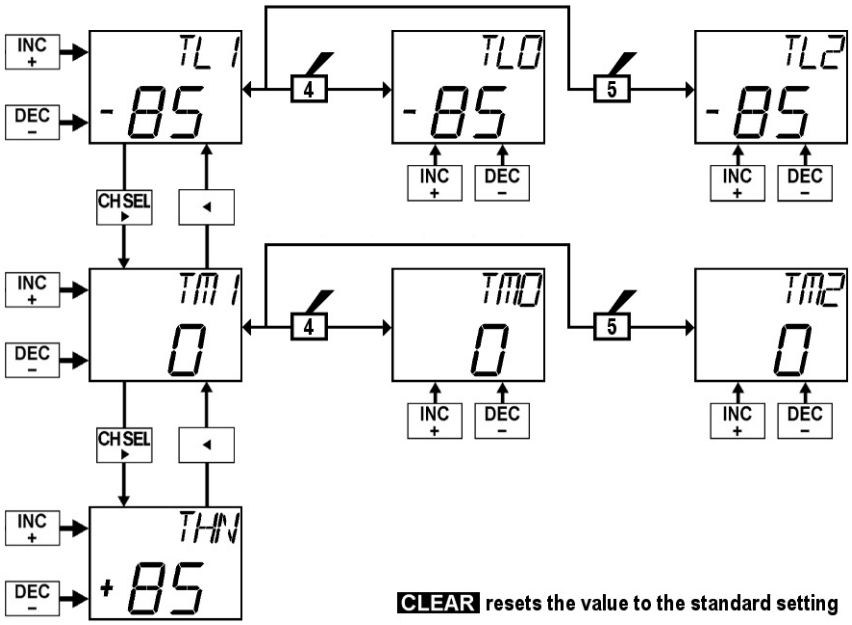
Selection of which of the three possible curves are to be adjusted is by operation of the external switches connect to the transmitter board connections 4 and 5; the display announcement changes accordingly:

Switch 3 = OFF, ATR inactive

Both switches in OFF position	“T…1”
Switch 4 = ON, Switch 5 = OFF	“T…0”
Switch 4 = ON or OFF, Switch 5 = ON	“T…2”

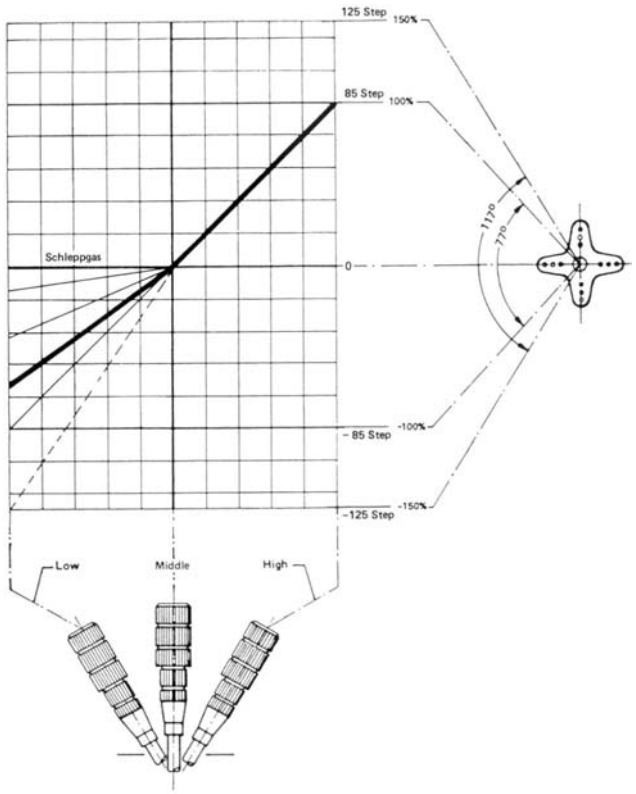
Switch 3 = ON, ATR activated
Switch 4 and 5 = ON or OFF
The appropriate notice flashes as warning that the autorotation changeover is activated and the indicated value is not effective; instead the throttle servo takes the position programmed in the setting for autorotation (ATR).

Setting
After selection of the point required using the CH SEL button and operation of the appropriate external switches, the value displayed can be set using the INC and/or DEC buttons over a range of 0... ±125 steps; pressing the CLEAR button resets the value to the standard setting.

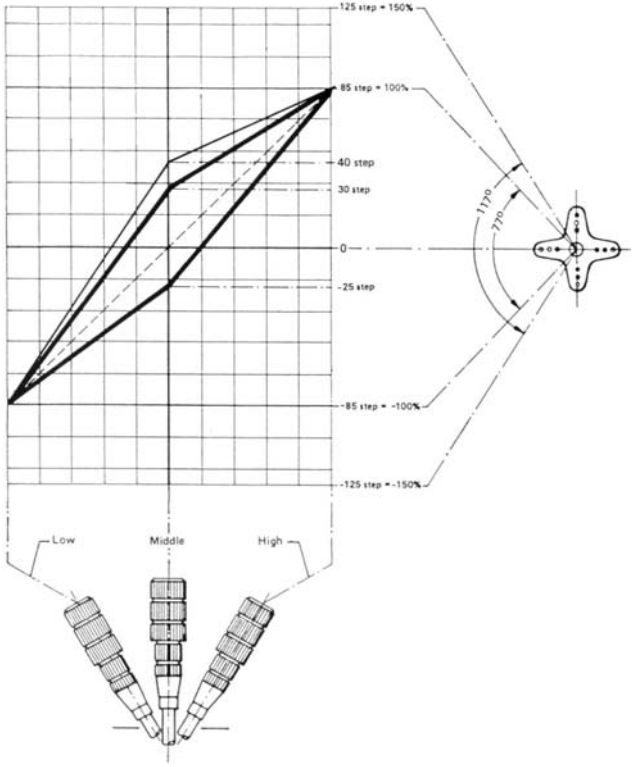


Examples of setting the Throttle pre-select

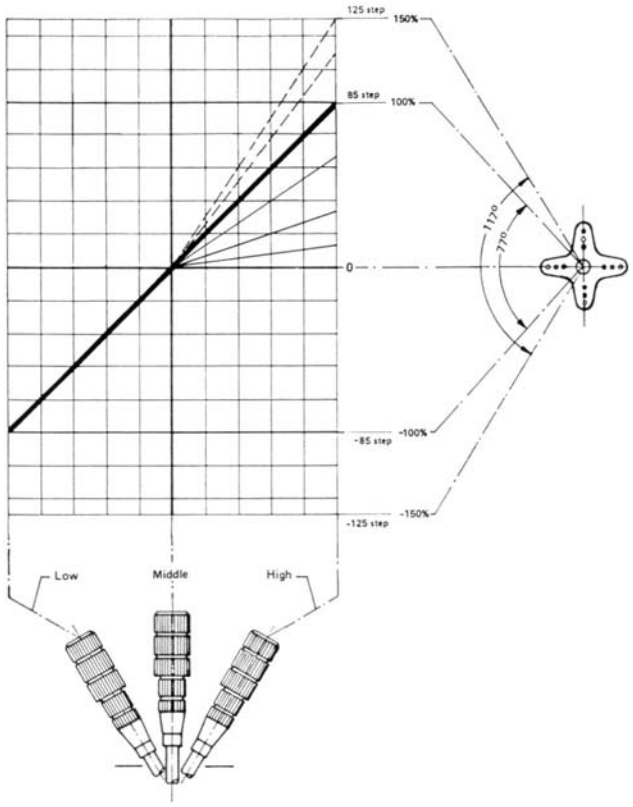
Throttle Low – "TL0", "TL1", "TL2"
With this option you can programme three alternative throttle pre-selects for different flight tasks.

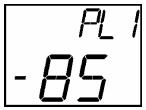


Throttle Middle – "TM0", "TM1", "TM2"
With "TM0" through "TM2", three alternative hover point throttle settings can be programmed.



Throttle High – "THN"
When a helicopter program is initialised the Throttle High value is automatically set at +85 steps = 100% servo travel and can be adjusted with the INC or DEC buttons to optimally suit the mechanical range of the carburettor.





Pitch Curve

Pitch Curve (Low, Middle, High)
(access via Set-Up Menu)

Four different profiles for the collective pitch response can be adjusted and called up in flight by external switches. Three curves are available for normal flight (under motor power), and a separate curve is available for autorotation.

The curves are determined in each case by three points:

- The low collective pitch / throttle stick position, called "PL..." (Pitch Low),
- The middle collective pitch / throttle stick position, called "PM..." (Pitch Middle),
- The high collective pitch / throttle stick position, called "PH…" (Pitch High).

The three sets of adjustment are successively called using the CH SEL button.

Selection of which of the possible curves to be adjusted achieved is by operation of the external switches connect to the transmitter board connections 3, 4 and 5; the display changes accordingly:

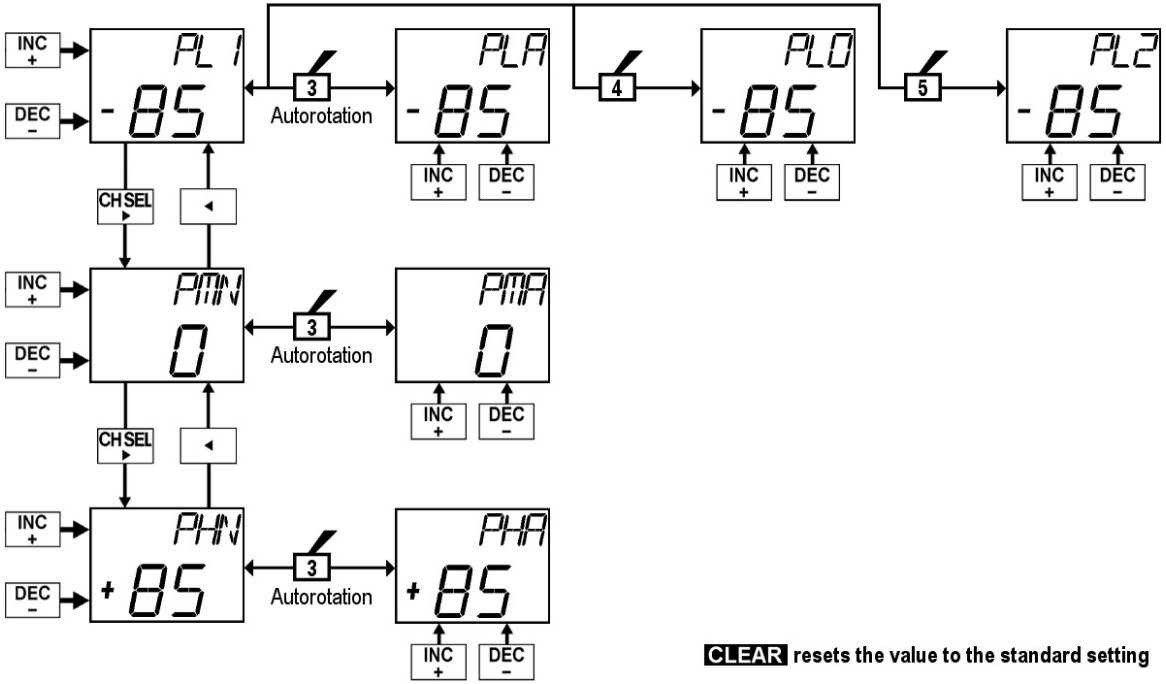
Switch 3 = OFF, ATR inactive

Both switches in OFF position	“PL1”
Switch 4 = ON, Switch 5 = OFF	“PL0”
Switch 4 = ON or OFF, Switch 5 = ON	“PL2”

Switch 3 = ON, ATR activated

Switch 4 and 5 = ON or OFF	“P…A”

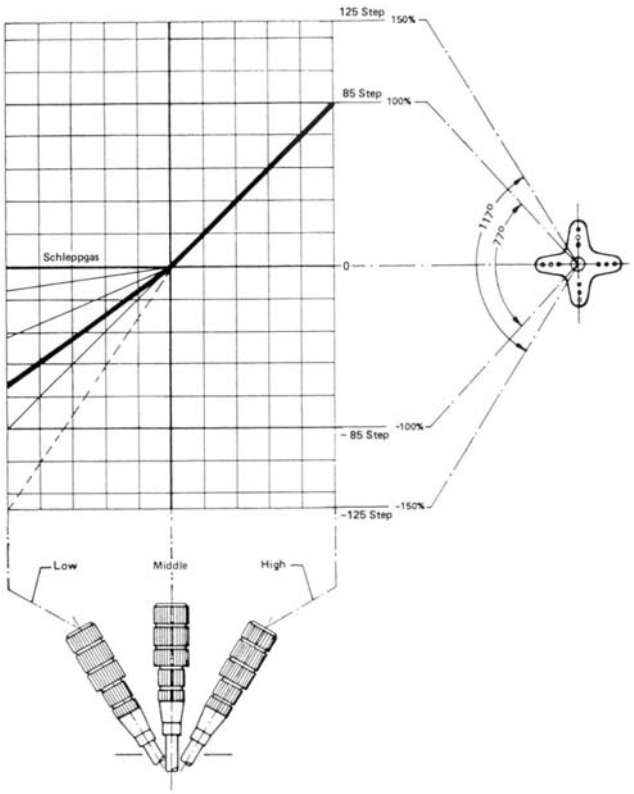
Setting
After selection of the point required using the CH SEL button and operation of the appropriate external switches, the value displayed can be set using the INC and/or DEC buttons over a range of 0... ±125 steps; pressing the CLEAR button resets the value to the standard setting.



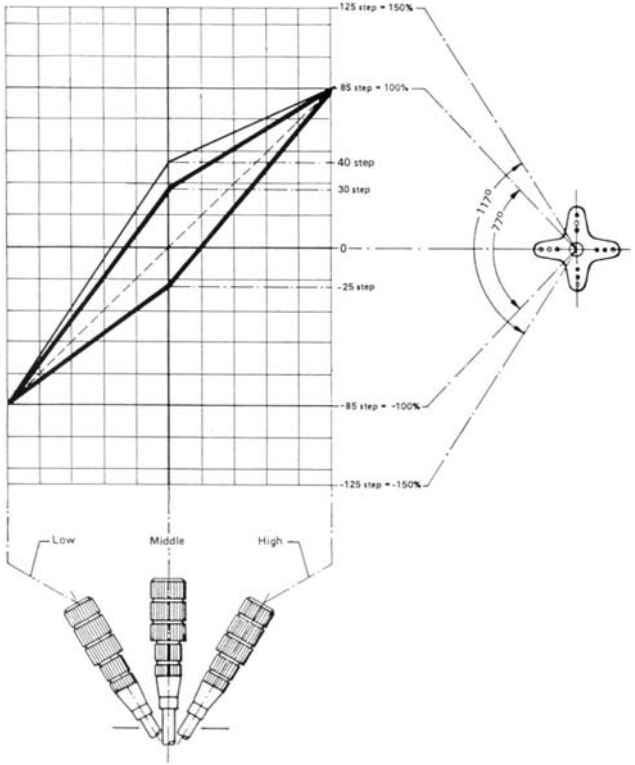
CLEAR resets the value to the standard setting

Examples of setting the Throttle pre-select

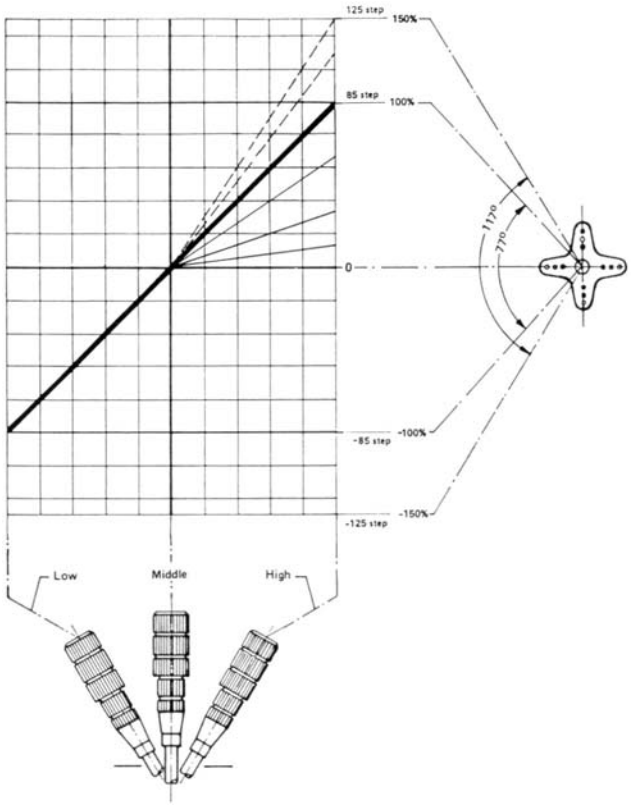
Pitch Low – "PL0", "PL1", "PL2"
For the three throttle pre-select settings "TL0", "TL1" and / or. "TL2" different low collective pitch values are programmable.
Operation of the autorotation switch in socket 3 allows a fourth low collective pitch value "PLA" to be programmed.



Pitch Middle – "PLM"
With this option the pitch value for the hovering flight is set.
Using the autorotation switch in socket 3 allows "PMA" to be selected and a collective pitch value for the autorotation landing to be set..



Pitch High – "PHN"
With pitch High the upper collective pitch value is adjusted.
Operating the autorotation switch in socket 3 allows selection of "PHA" and an increased collective pitch value to be programmed for autorotation landings..



AUTOROTATION

Switching to Autorotation
(access via Set-Up Menu)

Autorotation is a helicopter flight condition, in which the main rotor is no longer powered by the engine but by the air flow trough the rotor in descending flight. So that sufficient main rotor RPM remains, the rotor blades must be brought, with the collective pitch control stick, to a suitably small angle of incidence. The ground approach angle lies depends on the wind strength and is between 45° (zero wind) and 80° (strong wind). Landing from this descending flight is achieved by increasing the blade angle, using the energy stored in the rotor to create lift.

Using autorotation both a full-size as well as model helicopters able to safely land without power, e.g. with engine breakdown.

Also in case of a loss of the tail rotor, immediate shutdown of the engine and the landing using autorotation is the only possibility, otherwise an uncontrollable spin develops around the vertical axis and the model will crash.

A requirement to be able to do this is a suitably trained pilot, who is familiar with the aircraft and in this flight condition. Fast reactions and a good judgement by eye are also needed, since the rotational energy stored in the rotor is available only for a very limited time at the point of landing as rotor speed decreases rapidly when producing lift.

With autorotation as task in competitions, the engine is required to be turned off. However, during training autorotation landings it is favourable to keep the engine at idle so if necessary the autorotation can be aborted and the model is able to resume normal powered flight.

The mc-16/20 transmitter offers the ability to switch the use of autorotation, using an external switch attached to socket 3 of the transmitter board.

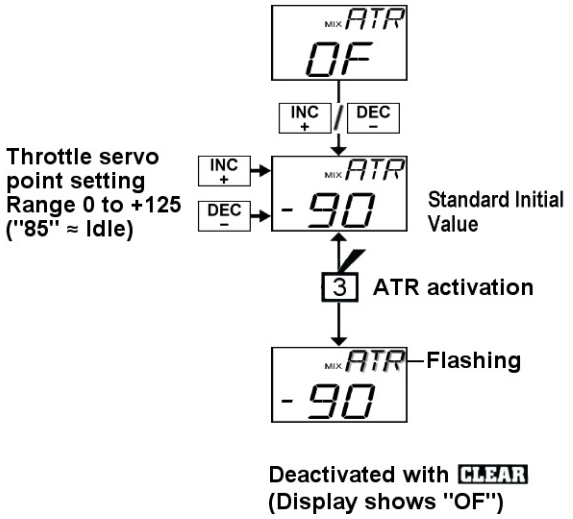
The throttle function is separated from the control stick, which still controls the collective pitch; the throttle servo takes a position set in the "ATR" program.

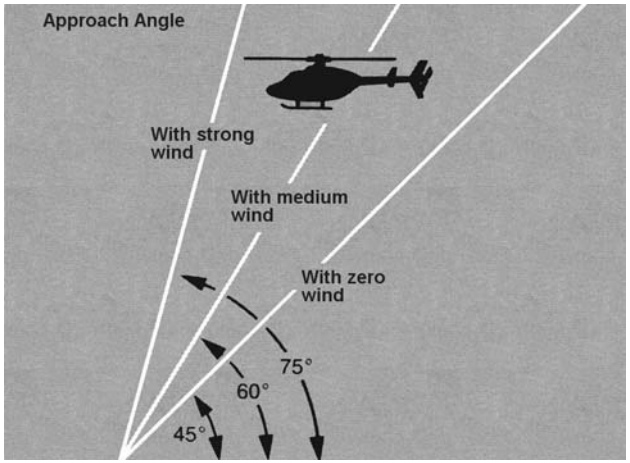
Additionally the activation of the autorotation switch causes the following:

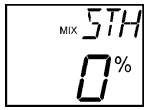
- The mixers "ST..." for the static and "DYN" for dynamic torque compensation are switched off. The announcements "STH", "STL" or "DYN" flash in the display.
- The set values of the throttle curves are no longer effective, which is indicated by "TL0", "TL1" or "TL2" flashing in the display.
- The autorotation pitch curve setting become effective as set using "PLA", "PMA" and "PHA" (see page 73).

Set-Up
After selection the display initially shows "ATR OF" - The autorotation program is switched off. The program is switched on by the INC or DEC key and the position of the throttle servo for autorotation can now be adjusted over the range of 0 to +125.

In order to prevent inadvertent switching on autorotation, and turning the engine off, the autorotation option can be deactivated using the CLEAR button (announcement "ATR OF").







STATIC TORQUE COMPENSATION

Static Mixer
(access via Set-Up Menu)

Using this option the static torque compensation (Pitch ➔ Tail) can be adjusted, separately for the climbing, indicated "STH", and descending flight, indicated "STL" representing above and below the collective pitch control stick central position.

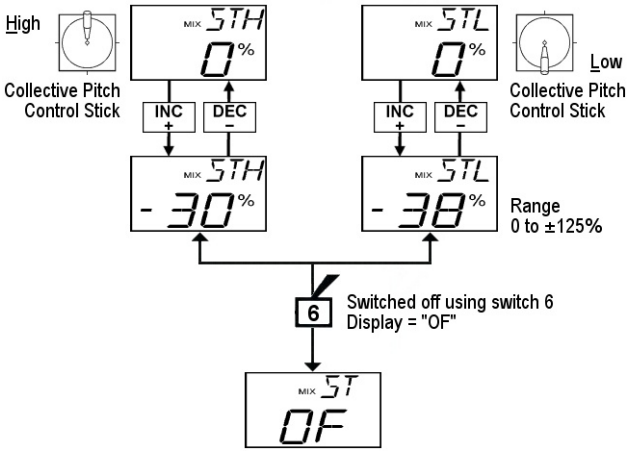
It is the goal of this option is to find settings to compensate for the change in torque, compared to that for hovering flight, to prevent the helicopter turning during climbing and descending flight. It is not intended to trim for hovering flight which is carried out exclusively with the tail rotor trim lever.

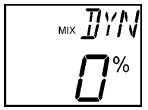
Required for a useful setting of torque compensation is that the pitch and gas curves were correctly set, ensuring a constant rotor speed through the entire range of collective pitch (see page 70).

The **mix direction** depends on the direction of the main rotor rotation: For anti-clockwise rotating systems (anti-clockwise as seen from above, e.g. HEIM-system) positive values are to be set, for clockwise rotating rotors use negative values.

Set-Up:
A separate setting is made for both directions of stick movement, which swap as the control stick is brought into the relevant position, using the INC or DEC buttons, in a range from -125% to +125%.
CLEAR puts the mix proportion back to 0%.
Using switch 6 this mixer can be turned off at the same time as the dynamic torque mixer.

Note:
During autorotation the static mixer is automatically turned off, which is indicated by the flashing announcement "STL" or "STH".





DYNAMIC TORQUE COMPENSATION

Dynamic Mixer
(access via Set-Up Menu)

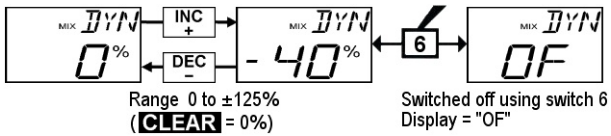
With the dynamic mixer Throttle ➔ Tail momentary torque fluctuations can be compensated for, which are caused by acceleration delay in the drive.
It is mainly intended for older helicopters without collective pitch and RPM controls lift, however, it can be used with helicopters that, although equipped with collective pitch control, do not maintain constant system RPM, but with the collective pitch control change the RPM at the same time. This applies particularly to older models, for example the BELL 212 TWIN JET.

The mixer limits the tail rotor adjustment temporarily and thereby compensates the brief torque changes.
The size of overshoot is set using INC / DEC.
CLEAR puts the mix proportion back to 0%.
Using switch 6 this mixer can be turned off at the same time as the static torque mixer.

The **mix direction** depends on the direction of the main rotor rotation: For anti-clockwise rotating systems (anti-clockwise as seen from above, e.g. HEIM-system) positive values are to be set, for clockwise rotating rotors use negative values.

With **modern helicopters**, which are flown with constant RPM throughout the entire collective pitch range, **this mixer is not needed** and therefore should not be activated.

Note:
During autorotation the dynamic mixer is turned off automatically, which is indicated by the flashing announcement "DYN.



Gyro Control

Automatic Gyro Gain Control
(access via Set-Up Menu)

With this option you can reduce the effect of the Gyro sensor with increasing tail rotor stick excursion. This will only work with a gyro system which allows the gain to be control from an auxiliary channel of the transmitter.
In central position of the tail rotor control stick and a proportional module attached at socket CH 7 of the transmitter plate the set gyro effect results. With manipulation of the tail rotor control this effect is reduced to the value, which corresponds to lower setting of the control slider (CH7).The position of the tail rotor control stick at which this minimum value is reached can be adjusted.
The automatic gyroscope gain reduction can be switched off using a switch attached to switch position 7 on the transmitter board.

Basic adjustment of the Gyro sensor
In order to obtain as optimal a stabilisation of the helicopter around the vertical axis as possible by the gyroscope, the following suggestions should be considered:

- The control linkage to the tail rotor should be as low-friction and as free from play as possible.
- The control linkage should be rigid (no flexing).
- A strong and above all fast servo should be used.

The faster the reaction of the Gyro sensor in recognising a turn of the model, and then making the necessary change to the tail rotor thrust to correct the turn, the further gyroscope gain effect be increase by rotating the gain adjusters. This should be done so that the tail of the model does not begin to oscillate, and will give better is stability around the vertical axis. Otherwise the danger exists that the tail of the model would begin to oscillate during small gyro signals.

In addition, during high forward speeds and/or when hovering with a strong head wind the stabilising effect of the vertical fin in addition to the gyro's effect can lead to a over reaction, where oscillating of the tail again becomes noticeable.

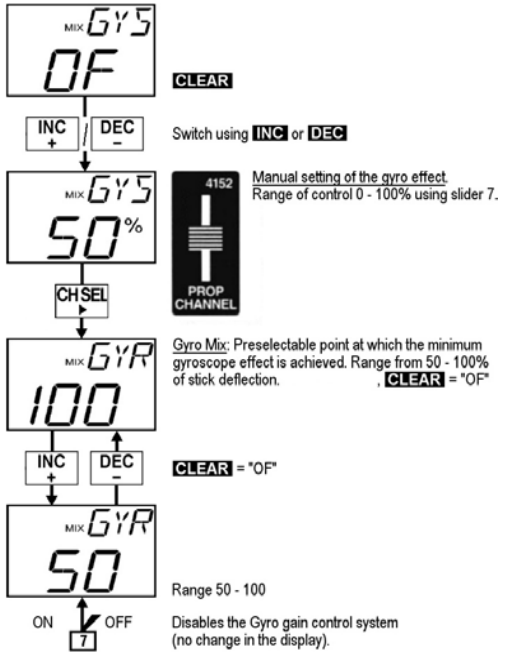
In order to achieve an optimum stabilisation in each situation, the gyro effect can be adapted from the transmitter using a slider control in connection 7. In the upper end position of the control only gyro adjuster 2 is effective. This is adjusted in such a way that with zero wind in hovering flight the model does not oscillate. In the lower end position of the control 7 only gyro adjuster 1 is effective. If you rotates this to the minimum gyroscope effect, the gyro effect can be set anywhere between "0" and the maximum effect set (with adjuster 2) using control 7.
Under normal conditions you would however normally set adjuster 1 so that the model does not oscillate with the maximum speed or extreme head wind. You can then vary the gyro sensitivity from the transmitter to suit the weather conditions and the intended flight program.

Notice:
The effective stabilisation amount provided by the Gyro sensor depends on the settings of the two adjusters on the gyro:

Adjuster 1 set the minimum gyro effect and adjuster 2 the maximum effect.

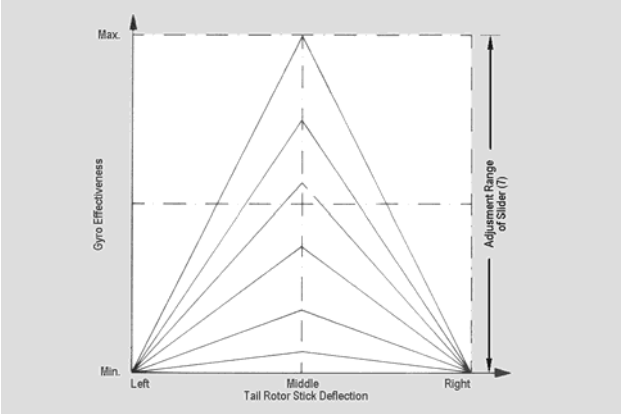
The effect can be set between these two limits using the slider control on channel 7.

Setting the Gyro control (Automatic Gain)
After selection of this option the display initially shows "GYS OF" (gain system is not programmed). The option is switched on with the INC or DEC buttons, and the display will now show the gyro effect setting, from the control slider, where "100%" correspond to the upper limit and "0%" the lower limit. With CH SEL the Gyro control setting screen is selected. Using the INC and/or DEC buttons the tail rotor control stick displacement point can be specified, at which the gyro effect is reduced to the value given by the low position of slider 7. "100%" means full-scale (slow gain reduction) and "50%" half travel of the tail rotor control stick (fast gain reduction). After swapping back with the CH SEL button you can now observe the gyro gain reduction effect in the display when moving the control stick. Witt CLEAR the gyro control can be switched off again, which can also be done with switch 7.



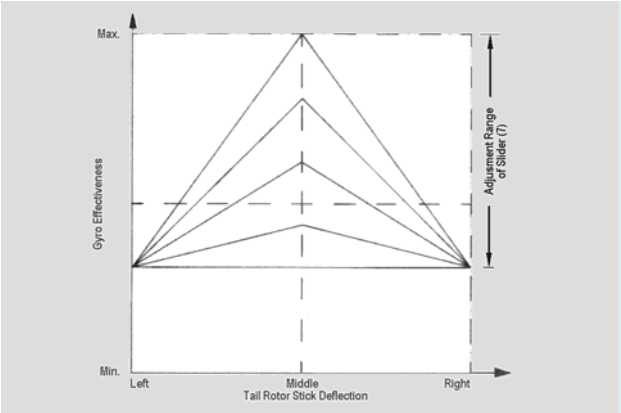
Example:

1. Adjuster 1: Left stop, Adjuster 2: Maximum, Gyro Mix at 100%



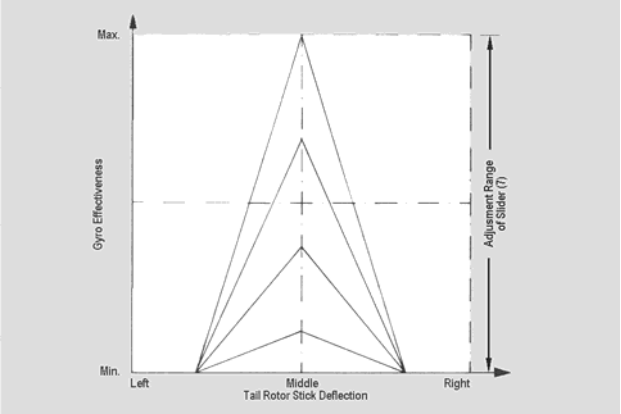
With the slider control 7 the gyro effect can be set anywhere from "0" up to the maximum. During operation of the tail rotor control the gyros effect has a linear reduction, where the "0" value is reached at stick full travel position.

2. Adjuster 1: 30%, Adjuster 2: Maximum, Gyro Mix at 100%



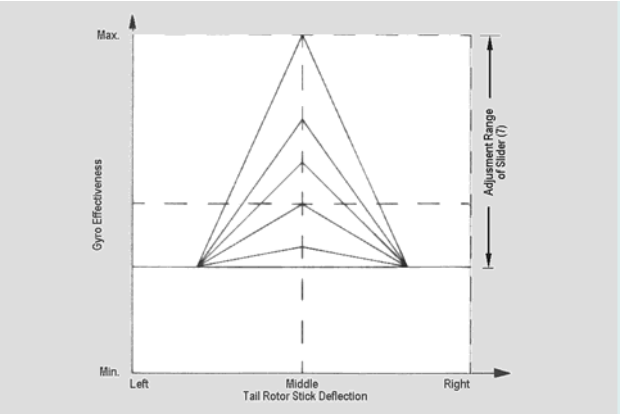
The gyro effect can be varied with slider control 7 between the two adjusted values. Automatic gyro gain takes place only down up to the value set with adjuster 1.

3. Adjuster 1: Left stop, Adjuster 2: Maximum, Gyro Mix at 60%

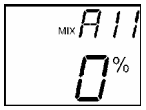


In contrast to example 1 the gain reduction is when the tail rotor control stick has moved 60% of its travel.

4. Adjuster 1: 30%, Adjuster 2: Maximum, Gyro Mix at 60%



The minimum gyro effect is reached with 60% stick deflection. This is not, however, at "0" gain, as in the previous example, but corresponds to the setting of adjuster 1 of the Gyro sensor.



Freely Programmable Mixer

Free Programmable Mixer
(access via Set-Up Menu)

Additional to the pre-programmed mixer functions contained in the helicopter program are two freely selectable mixers, which are characterized by the letters A and B and the number of the input function and the output channel. The lower display line will show either the mix portion and direction, or "OF" if the mixer is switched off using the associated external switch.

Setting example for mixer "A"

1. Channel Selection.
Firstly the CH SEL button is pressed until in the upper display line "Ach" appears. Using the INC key the number of the input channel 1 to 8 is entered (left digit), with the DEC key the channel of the receiver output 1 to 8 (right digit). Pressing the CLEAR button performs a reset and sets input function and output channel to "1", mix proportion and offset to 0% and the mixer switch on "ON".

2. Allocation of a mixer switch.
Pressing the CH SEL button changes the display to "ASW" (A-Switch). This is where it is specified whether the mixer remains constantly switched on, (display "ON" is shown), or whether it is turned on and off by an assigned external switch. The selection is made with the INC or DEC keys. The lower line of the display shows the transmitter board socket for the external switch allocated:

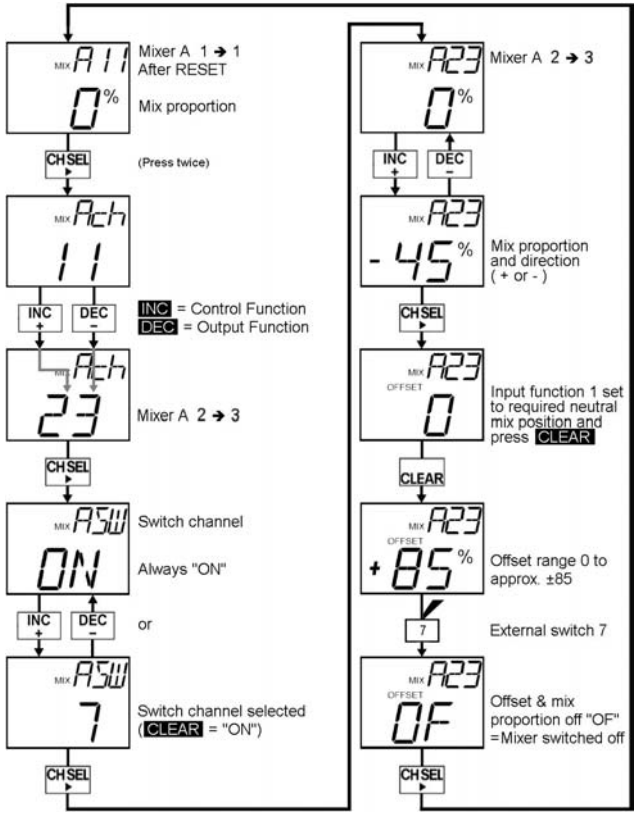
Mixer	Transmitter Socket
A	7
B	6

Note:
Switch 6 also simultaneously switches the mixers for static and dynamic torque compensation, and switch 7 the automatic gyro gain reduction.

3. Setting mix proportion and mix direction.
By pressing the CH SEL button the option for adjusting the mix proportion and direction appears. Using the INC and/or DEC buttons the mix proportion can be set between 0 and ±125%, symmetrically to the neutral point (pressing CLEAR resets the value to 0%). If an external switch was assigned, the mixer can be switched off now and the display will show "OF".

4. Specify the mixer neutral point (offset setting).
If CH SEL is pressed again, you arrives at the offset setting. To set the offset place the control stick in the desired position and press the CLEAR key. The offset is indicated in the display. (value range: approx. -85 to +85).
If an external switch has been assigned and is switched off, the display shows "OF".
(If you want to change the stored offset, the mixer offset setting is re-entered and the new position stored as above).
Thus the programming of mixer A is completed. The setting of mixer B is completed in the same way.

Note:
In the helicopter programs control function 6 cannot be used as input signal for a mixer as it does not possess an “output point for mixers” (see the block diagram on page 62). The signal from this channel only affects receiver output 6 directly and servo travel is limited to 25% of the normal value. Dependent on the type of swashplate (Swash Mixer) certain control paths are linked with one another (as with all finished mixers). For example, the basic standard mixer "N" links control function 1 with channel 6. The mix proportions of a finished and a freely programmable mixer can be overlaid in such a way that a servo movement is changed.



❶

DUAL-RATE

Switchable Servo Travel
(access via Set-Up Menu)

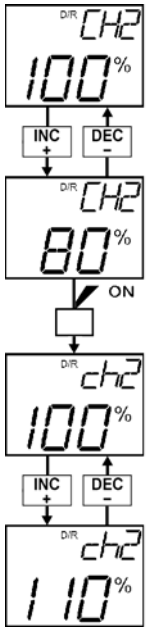
The Dual-Rate function lets you switch to a different amount of travel while the model is in flight, using an external switch. The travel for each of the two switch positions can be set to any value within the range 0 to 125% of normal servo travel. The “D/R” switches must first be connected to main circuit board in the transmitter (see page 10). After selecting the “D/R” code the first step is to select the channel (channel 2 to 4) using CH SEL:

Transmitter Ch.	Function	External Switch
2	Roll	socket 0
3	Fore & Aft Pitch	socket 1
4	Tail Rotor	socket 2

Move the switch to the appropriate position, then set the required servo travel using INC and DEC.

Switch position in the display:
ch = closed (ON)
CH = open (OFF)

Additionally without switches fitted this option can be used for travel adjustment.



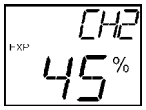
Select servo function (2,3 or 4) using the CH SEL or ◀ button. Set the required value using INC or DEC

External switch "ON" (see table above) Display changes from CH (OFF) to ch (ON) and shows the relevant pre-set value.

Previously set value

Set the required value using INC or DEC. Press CLEAR to quickly reset to 100%.

❷



EXPONENTIAL

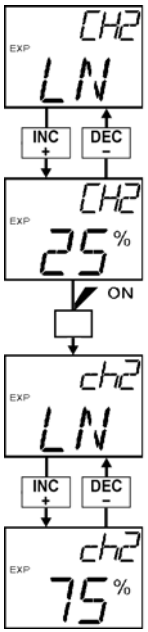
Progressive Servo Travel
(access via Set-Up Menu)

Exponential travel reduces the servo travel around the neutral position of the stick. Travel progressively increases towards the stick end-points, so that full servo travel is still available at the extremes. The degree of progression can be set from linear “LN” (or 0%) to 100%. The Exponential function therefore has no effect when set to “LN”. Dual-Rates and the Exponential function are controlled by the same switch, see EXPO-/DUAL-RATE:

Transmitter Ch.	Function	External Switch
2	Roll	socket 0
3	Fore & Aft Pitch	socket 1
4	Tail Rotor	socket 2

Switch position in the display:
ch = closed (ON)
CH = open (OFF)

Additionally without switches this option can be used for adjusting the control stick characteristics.



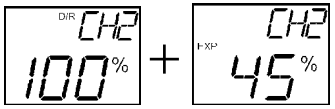
Select servo function (2,3 or 4) using the CH SEL or ◀ button. Set the required value using INC or DEC

External switch "ON" (see table above) Display changes from CH (OFF) to ch (ON) and shows the relevant pre-set value.

Previously set value

Set the required value using INC or DEC. Press CLEAR to quickly reset to LN = 0%.

❶ ❷

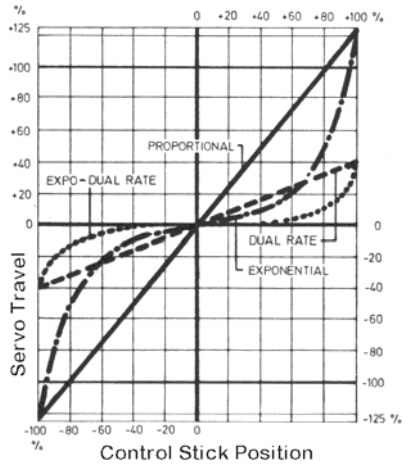


EXPO-/ DUAL-RATE

Coupled Dual-Rate & Exponential
(access via Set-Up Menu)

The Dual-Rate function provides a means of adjusting servo travel symmetrically around the neutral position to any point between 0 and 125%, and switching between the 2 settings by means of an external switch. The Exponential function alters the servo response curve. As the external switches affecting control functions 2…4 control the Dual-Rate and Exponential functions simultaneously, it is possible for you to set-up the controls of your model very precisely, to suit your exact requirement. You can program two independent values, separately for roll, fore & Aft pitch and tail rotor, such as a 20% servo travel for one external switch position and 125% for the other position, with an exponential curve of, say, linear or 80%. Note that this Exponential setting defines the “degree of progression” (the shape of the curve), not the extent of the servo travel.
Note: For safety reasons the lowest the Dual-Rate value should be set to is 20% travel.

Characteristic Curves for various settings.



Dual-Rate = Linear reduction or increase of servo travel (0% to 125%)

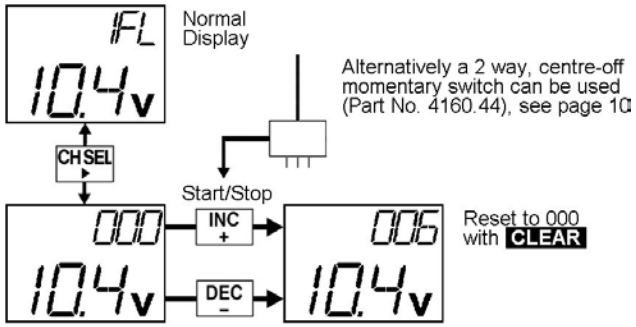
Exponential = Progressive control characteristic with 100% servo travel

Expo-/Dual-Rate = Combined Exponential and Dual-Rate function

STOPWATCH and ALARM TIMER

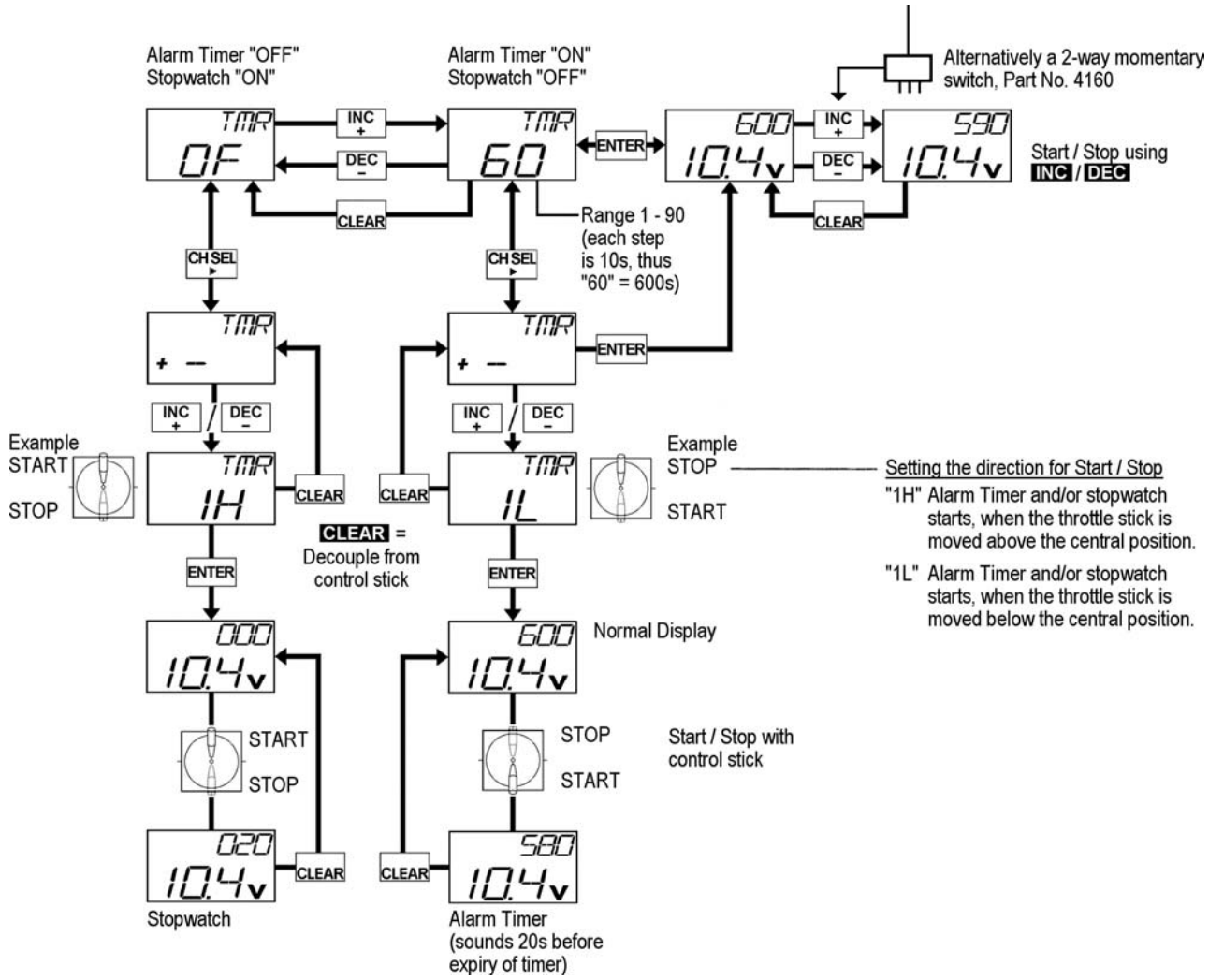
Stopwatch and Countdown Clock
(access via Set-Up Menu)

In normal operating mode the display can be set to timer display with the CH SEL button. The default, without having called code “TMR”, is a stopwatch (0...999s). The Start/Stop is using either INC or DEC and reset to “000” is by using CLEAR. If the transmitter is switched off & back on, the display last selected appears, i.e. either model name or "000".



The code “TMR” allows the application possibilities to be extended:

1. **Countdown Clock** (Alarm Timer), which has an audible warning tone. The start time is set by the user and ranges from 10s to 900s. 20s before the end of the time, an internal buzzer sounds every 2s, below 10s every second to 0s. The clock then continues to run counting up to 999s. This additional time is shown by a "+" displayed in the lower line before the battery voltage. Start/Stop of timing is controlled by the INC / DEC buttons.
2. **Throttle Stopwatch**, as normal except the start/stop is controlled by the throttle stick. The switching point set independently to the position of the control lever centre. Additionally it can be determined whether the timer start is by pushing or pulling the throttle stick. With this option the true engine run time can be measured.
3. **Alarm Timer**, a countdown timer as 1 above, but controlled by the throttle stick as in option 2.



FST HO FAIL SAFE MEMORY and SB-TRIM CH2 0 Receiver Battery FAIL SAFE

Storage of Fail Safe data; only in PCM mode
(access via Set-Up Menu)

This function is only possible when in PCM mode and with receiver models mc-12, mc-18, mc-20 and DS 20 mc!

FAIL SAFE MEMORY

The higher working reliability of Pulse Code Modulation (PCM) in relation to the simple Pulse Position Modulation (PPM) results from the fact that the microprocessor built in the receiver recognizes, whether a received control signal was falsified or damaged by external interference. In these cases the receiver automatically replaces this disturbed signal by the last correctly received, which was stored in the receiver just in case. In this way brief interference, where the radio signal is weak or the like, is managed which would otherwise lead to the well-known "glitching".

When a longer lasting disturbance to the transmission between transmitters and receivers occurs, the mc-16/20 software offers two different options of FAIL SAFE programming. Using the INC / DEC keys, the "FST" (Fail Safe Time) can be selected:

1. HOLD program (display "HO"):
   In this case the Servos stops, in the case of a transmission disturbance to the receiver, in the position set by the last intact control signal. It remains in that position until a new, recognizable, control signal is detected by the receiver.
2. Variable programmable fail-safe with delay option (display: 0.3, 0.5 or 1.0):
   The servo moves to a pre-programmed set position, until the receiver receives an intact control signal. It is possible to set a delay time from the beginning of the interference to the operation of the fail safe program. This is settable in three steps (0.3s, 0.5s and 1.0s using the INC/DEC keys, taking into account different model speeds.

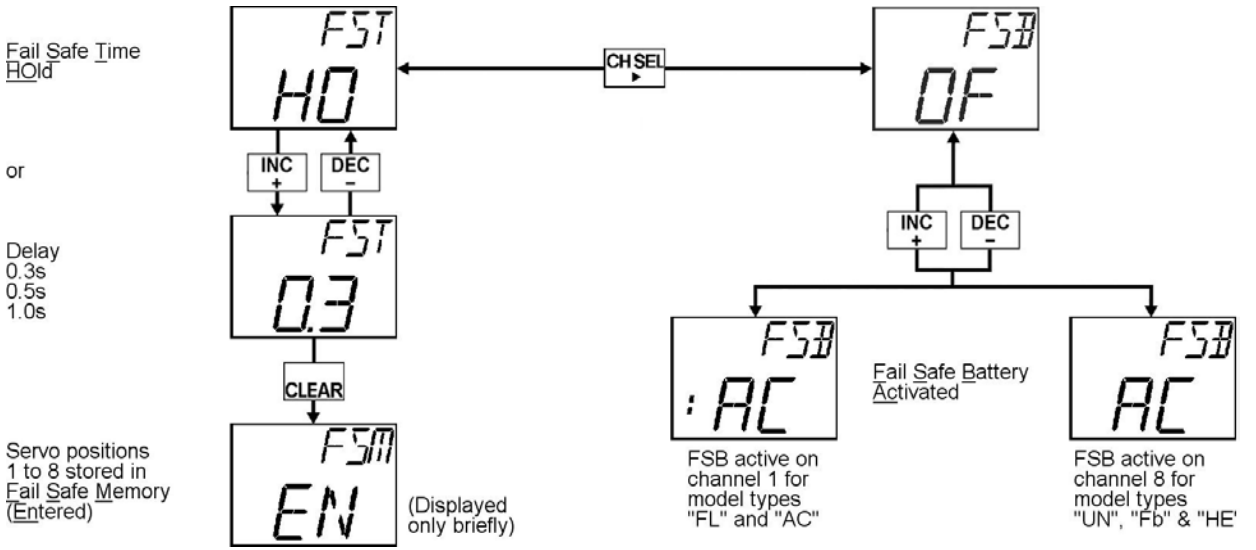
The desired positions of the servos on control functions 1 to 8, during the operation of fail safe, are simultaneously set at the transmitter and then the CLEAR key is pressed. These momentary positions are stored now as the fail safe positions. During operation these values are transferred to the receiver's memory, so that the receiver can fall back to them during interference. Storing is confirmed, in the display, by the brief display of "FSM EN", (Fail Safe Memory Entered). The fail-safe servo positions can be reset at any time, even in flight, by selecting the code and pressing CLEAR to be overwrite the existing settings.

This function is only possible when in PCM mode and with receiver models mc-12, mc-18, mc-20 and DS 20 mc!

Receiver Battery FAIL SAFE

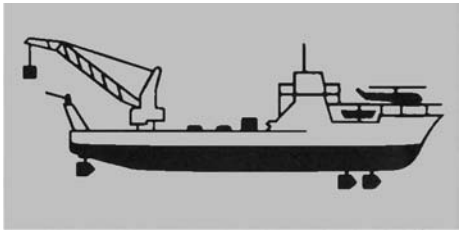
The output channel for the Receiver Battery FAIL SAFE is preset for model types "FL" and "AC" on channel 1 (throttle/spoiler), and for the types "UN", "Fb", "HE" on the channel 8.

As soon as the voltage of the receiver battery falls below a certain value, the associated servo goes to it's central position, to indicate the low battery voltage. By movement of control stick (1 or 8) the FAIL SAFE servo is release, so that servo again operates as desired by the pilot. The model must be landed immediately after the first FAIL SAFE message.



NAUTIC Multi-Prop Modules

Only available in PPM Mode



Optional Transmitter Module

NAUTIC Multi-Proportional Module
Part No. **4141**
Up to two modules are connectable,
(Described on page 92)

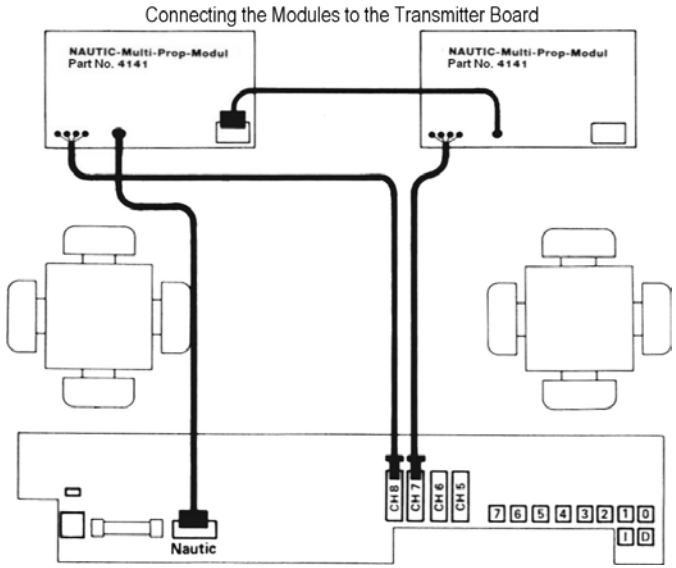
Function Notes
The NAUTIC Multi-Prop module allows two proportional function channels be split into eight proportional channels, i.e. at the receiver connections three additional servo connections are available per module. Two prop. module can transmitter lateral be inserted

Fitting and connection to the mc-16/20 transmitter.
The modules are installed as shown in the instructions on page 8/9 of this manual.
If the NAUTIC program in system menus "NA7" and/or. "NA8" are switched to "ON" (sees page 16), control paths 7 and/or 8 are automatically reserved for NAUTIC modules dependent on the model type.

Model Type	NAUTIC Channels
FL (Standard)	7 and 8
UN (Unifly)	7 and 8
Fb (F3B/Butterfly)	7 and 8
AC (Acrobatic)	7 only
HE (Helicopter)	7 only

The 5-pole connector of the module should to be inserted, e.g. into socket "CH7", and the 4-pole plug on the single-wire cable connected to the "NAUTIC" socket on the transmitter plate. If necessary a second module can be connected to "CH8". The 4-pole plug of the 2nd module is connected to the module already inserted.

Connecting the Modules to the Transmitter Board



Both model types "AC" and "HE" can additionally, if necessary, use channel 5 as well as channel 7 for the NAUTIC modules, under the following conditions:

1. Servo reverse (page 21) NORM
2. Servo Neutral Point (page 21) 0
3. Servo Travel (page 21) ±146%
   The setting is most easily done before inserting the proportional or switch modules (Part No. 4152 or 4151). During the servo travel setting when the NAUTIC modules are connected the display can flicker, which makes reading the exact value more difficult.
4. AC: Code “AUTOLANDING” if using ch 7 (page 57, 58) OFF
5. HE: Code “GYRO-CONTROL” if using ch 7 (page 78, 79) OFF
6. HE: Code “SWASHPLATE TYPE” if using ch 7 (page 66) Type 2 or 3

The transmitter set-up for the NAUTIC modules is now complete.

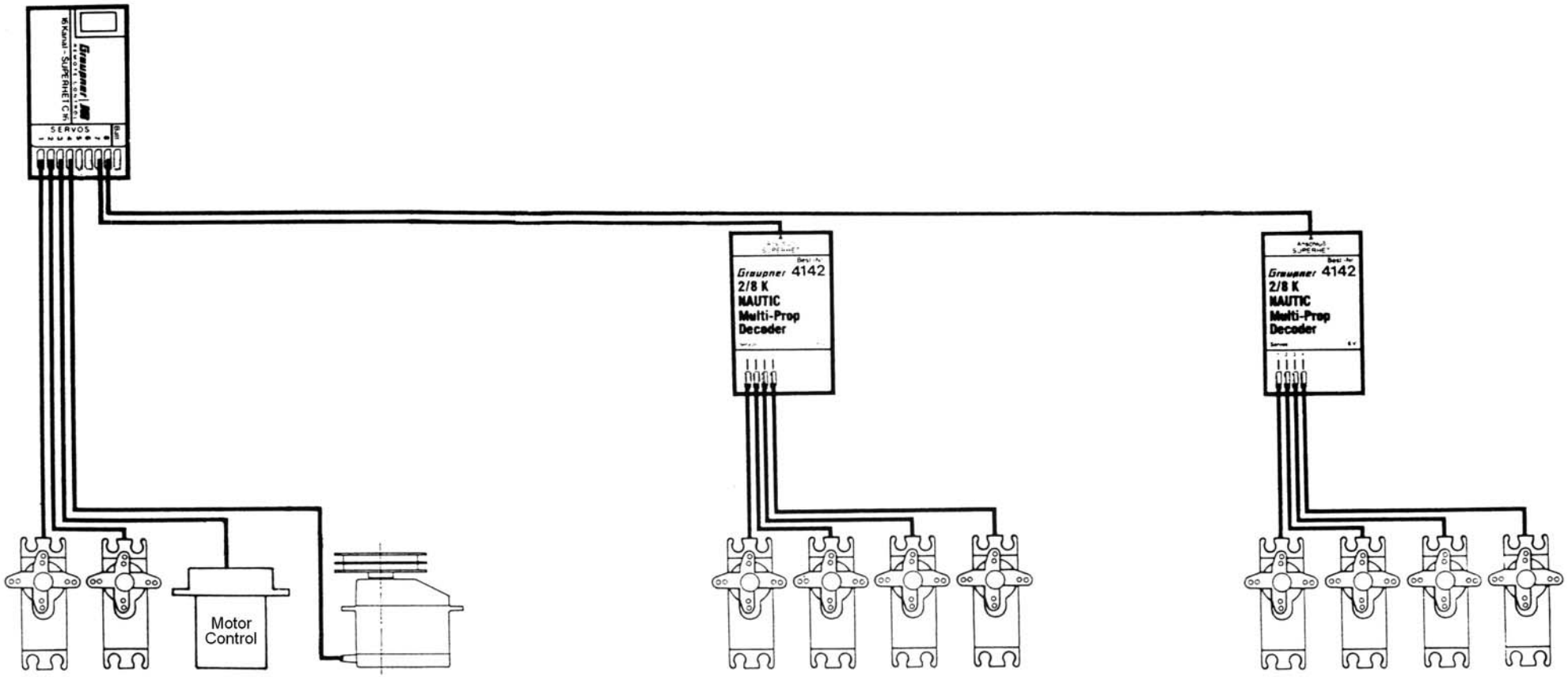
Receiver Requirements

NAUTIC Multi-Prop Decoder
Part No. **4142**
(Described on page 92)

Remark
For each NAUTIC Multi-Prop module a NAUTIC Multi-Prop decoder is necessary.

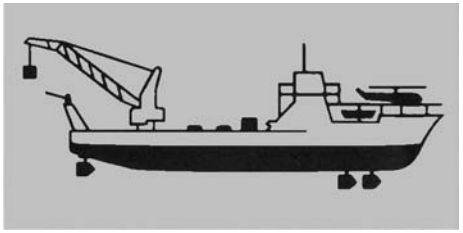
Note:
The NAUTIC Multi-Prop decoder extends two proportional channels (1 servo each), for a transmitter fitted with the NAUTIC Multi-Prop module, to eight proportional channels (4 servos each).

For a trouble free function at least three of the four possible servos should be attached to the NAUTIC Multi-Prop decoder.
An external power supply is not necessary. The servos are supplied via the receiver battery, which should be of sufficient capacity, e.g. 4.8V / 1.4Ah, Part No. 3448.

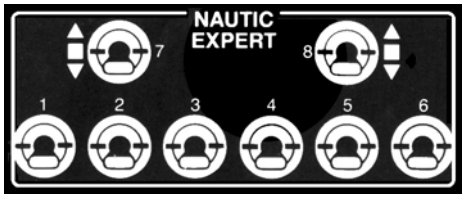


NAUTIC Expert Switch Function Modules

Only available in PPM Mode



Optional Transmitter Module



16 Channel NAUTIC Expert Module
Part No. **4108**
Up to two modules are connectable, (Described on page 92)

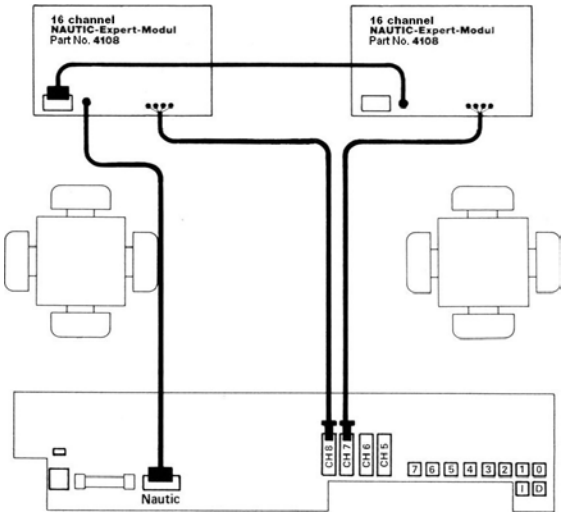
Function Notes

The NAUTIC Expert module extends two proportional channels to 16 signal paths. All eight switches have a central position, providing a genuine forwards–stop–backwards function, if at the receiver a switch module, Part No. 3754.1 or a Dual-Switch **module Part No. 3754.2 is used. Of the 8 switches, 3 switches are sprung-off and 2 are sprung-off in one direction. The remaining 3 switches are intended for forwards–stop–backwards functions and are not self-centring. Transmitter-laterally two modules with altogether 32 switching functions can be installed onto the module blow-out.**

Fitting and connection to the mc-16/20 transmitter.
The modules are installed as shown in the instructions on page 8/9 of this manual.
If the NAUTIC program in system menus "NA7" and/or. "NA8" are switched to "ON" (sees page 16), control paths 7 and/or 8 are automatically reserved for NAUTIC modules dependent on the model type.

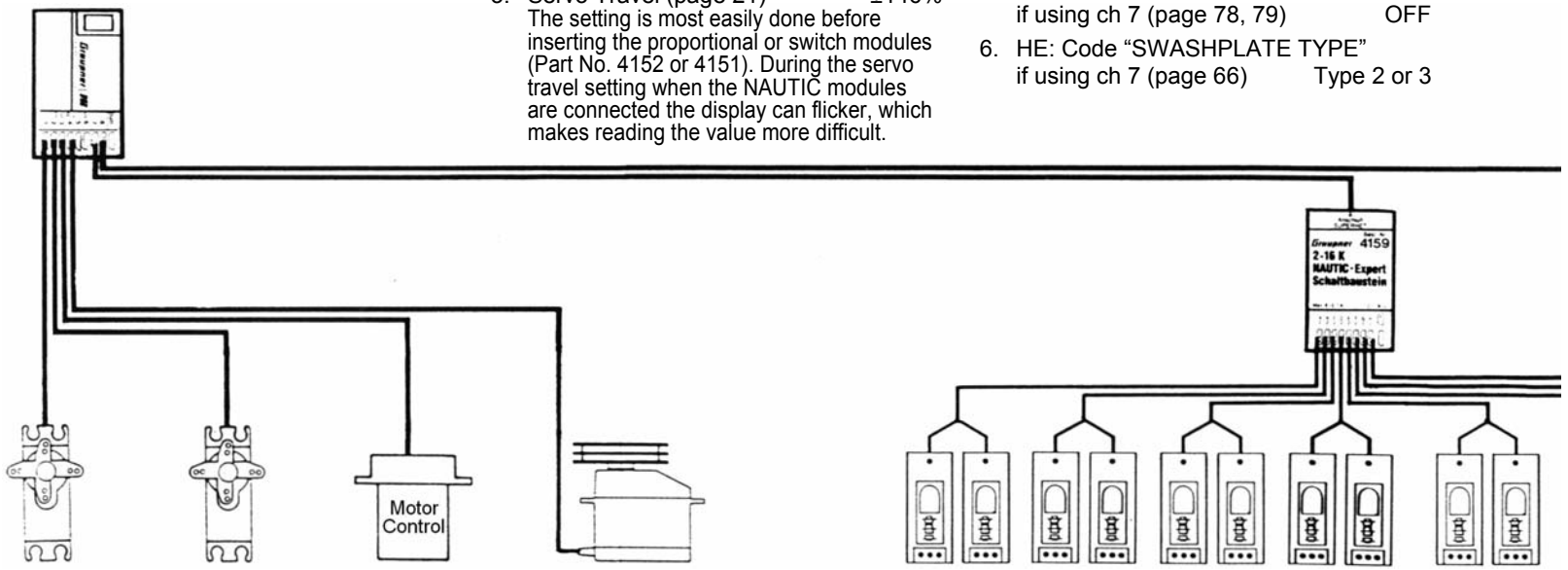
Model Type	NAUTIC Channels
FL (Standard)	7 and 8
UN (Unifly)	7 and 8
Fb (F3B/Butterfly)	7 and 8
AC (Acrobatic)	7 only
HE (Helicopter)	7 only

The 5-pole connector of the module should to be inserted, e.g. into socket "CH7", and the 4-pole plug on the single-wire cable connected to the "NAUTIC" socket on the transmitter plate. If necessary a second module can be connected to "CH8". The 4-pole plug of the 2nd module is connected to the module already inserted.



Both model types "AC" and "HE" can additionally, if necessary, use channel 5 as well as channel 7 for the NAUTIC modules, under the following conditions:

1. Servo reverse (page 21) NORM
2. Servo Neutral Point (page 21) 0
3. Servo Travel (page 21) ±146%
   The setting is most easily done before inserting the proportional or switch modules (Part No. 4152 or 4151). During the servo travel setting when the NAUTIC modules are connected the display can flicker, which makes reading the value more difficult.
4. AC: Code "AUTOLANDING" if using ch 7 (page 57, 58) OFF
5. HE: Code "GYRO-CONTROL" if using ch 7 (page 78, 79) OFF
6. HE: Code "SWASHPLATE TYPE" if using ch 7 (page 66) Type 2 or 3



Receiver Requirements

Part No.	Module	Comments
4159	2 / 16 channel NAUTIC Expert switch element (see page 92)	This module is required for the transmitter switch module to work
3941.6	Socket with 3-core lead	For connecting devices, max. 0.7A / channel
3936 or 3936.1	Y-lead 320 with 100mm cable length	For connecting NAUTIC Switch or Dual-Switch modules
3754.1	NAUTIC Switch Module	Direct link or 2 modules using a Y-lead
3754.2	NAUTIC Dual-Switch Module	Direct link to 2 channels or 1 channel using a Y-lead

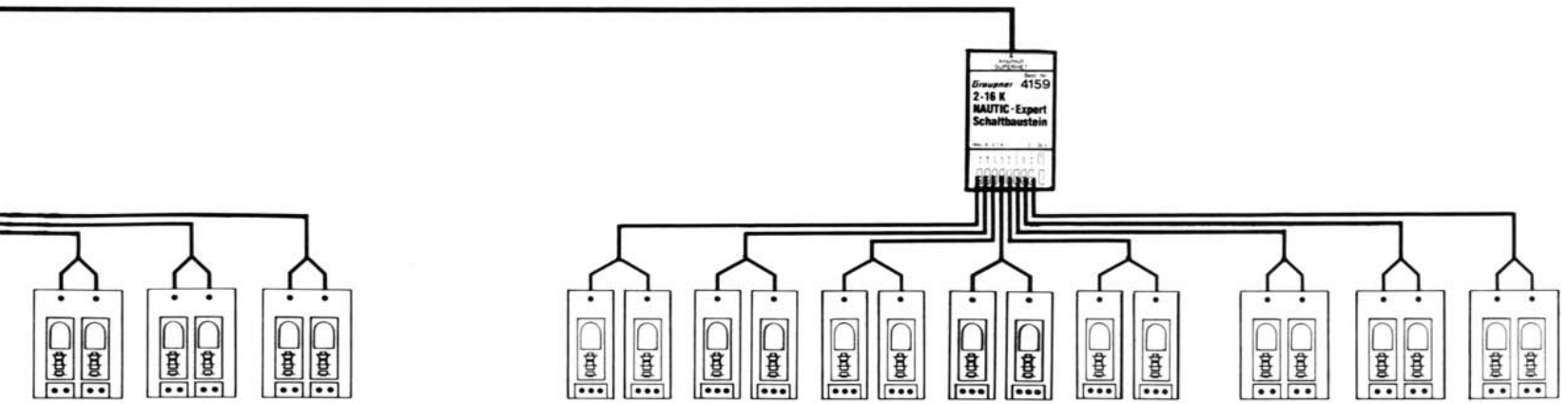
Connection

16 switching functions are available per switching component, and 8 devices, like lamps, LEDs, etc., (electrical motors excluded), with a power requirement of up to 0.7A for each can be directly attached. For each female connector there are two switching functions are possible via the three-core cable Part No. 3941.6 (fig. 2). For electric motors and devices with higher currents the NAUTIC switch or NAUTIC Dual-Switch module is available (fig. 3 + 4). In order to achieve the forward-stop-backwards function, the Dual-Switch module is connected to via a Y-lead. For correct operation one plug of the Dual-Switch module must be inserted in the opposite polarity (sand off the edges of this plug as necessary).

For directly attached consumers and for switching the relays an external power supply is necessary, e.g. a GRAUPNER receiver battery of sufficient capacity, see page 5. Other batteries to a maximum of 30V can be connected with a cable Part No. 3941.6.

Note:

When building your own switch modules, a protection diode is to be soldered across the terminals of the relay coil.



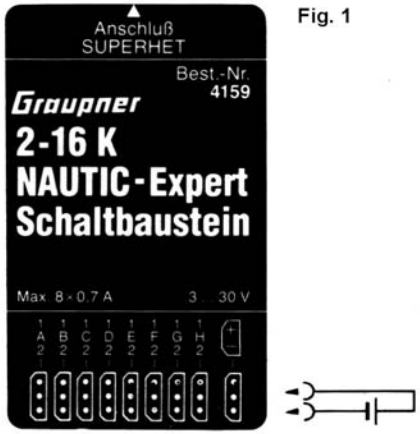


Fig. 1

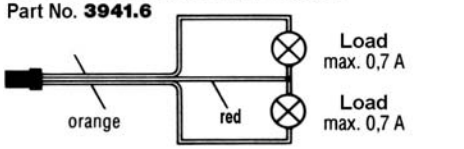


Fig. 2

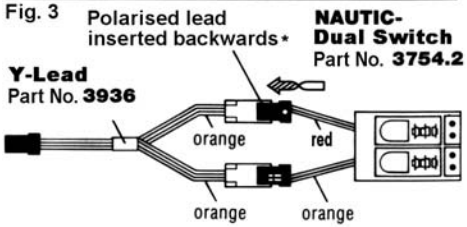


Fig. 3

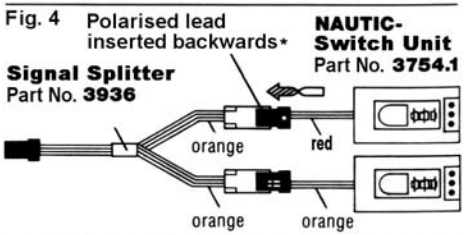
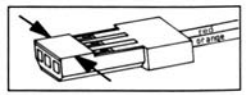


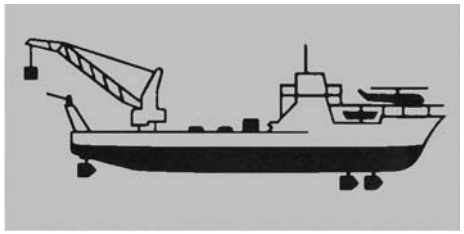
Fig. 4

*Taper the other edges of the socket



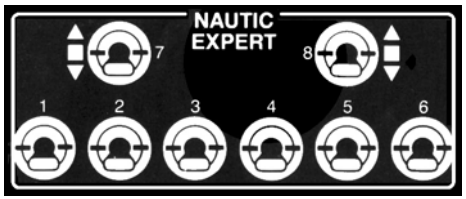
NAUTIC Multi-Prop and Expert Switch Modules

Only available in PPM Mode



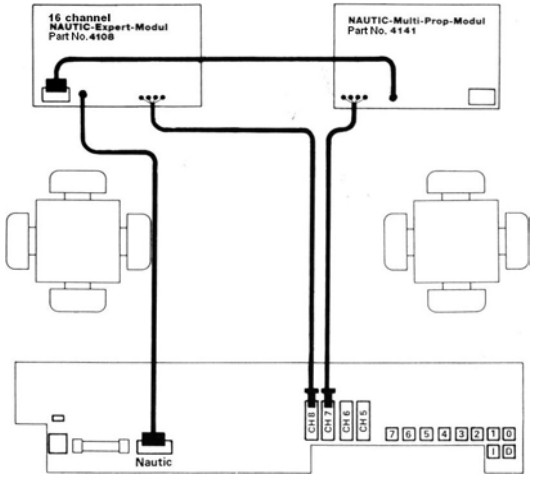
Optional Transmitter Module

NAUTIC Multi-Proportional Module
Part No. **4141**
(Described on page 92)



16 Channel NAUTIC Expert Module
Part No. **4108**
(Described on page 92)

Function Notes
In the case of using a combination of NAUTIC Expert and NAUTIC Multi-Prop modules, 2 channels (sockets CH7 and CH8 on the transmitter board) are extended to 16 switched outputs and 4 proportional channels (4 servos). The connection of both modules takes place as previous described on pages 84 and/or 86.

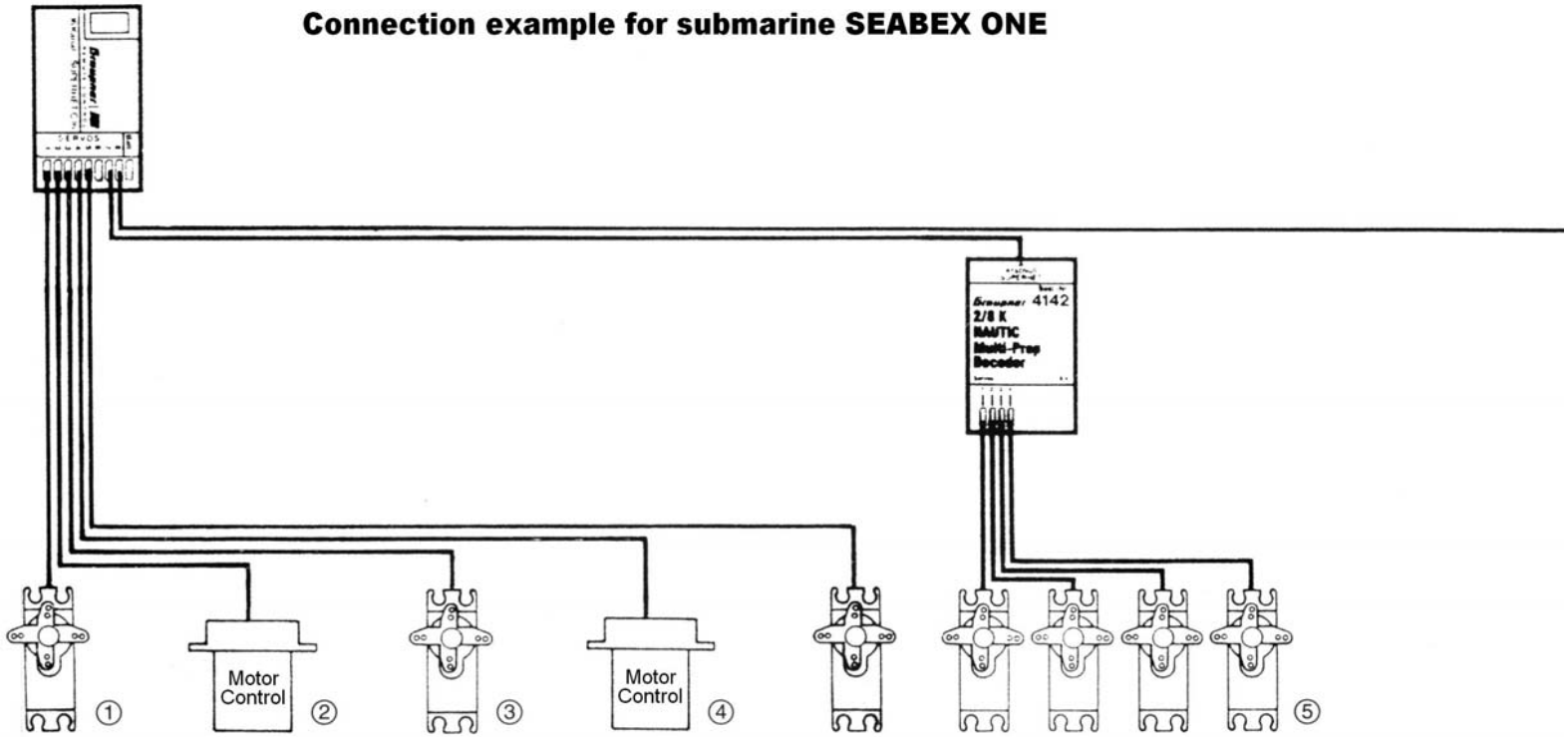


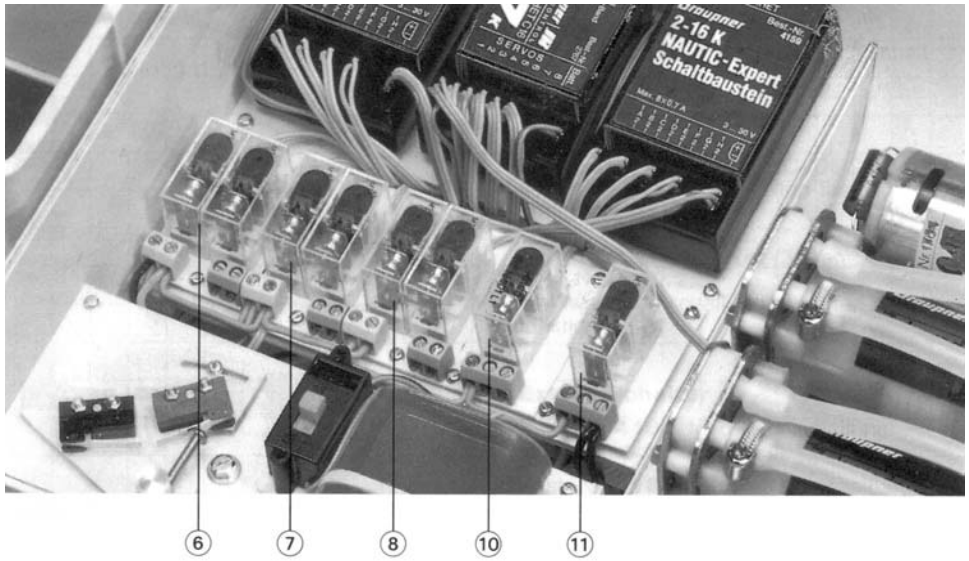
Receiver Requirements

Part No.	Module	Comments
4142	NAUTIC Multi-Prop Decoder	4 servos connected
4159	2-16 channel NAUTIC Expert Switch Module	For 16 switch functions
3941.6	Socket with 3-core lead	For connection of devices max. 0.7 A per signal path
3939 or	Y-Lead 320 with 100 mm	For connection of NAUTIC
3936.1	cable length	Switch or Dual-Switch modules
3754.1	NAUTIC Switch module	Direct connection or via a Y-Lead
3754.2	NUATIC Dual-Switch	Connection 2 channels via a Y-Lead

◁ Connection of the modules to the transmitter board

Connection example for submarine SEABEX ONE





Connection example for submarine SEABEX ONE

Proportional Functions

① Tail propeller direction drive servo right/left

② Tail propeller motor drive forward–stop–backward

③ Tail propeller direction drive servo right/left

④ Tail propeller motor drive forward–stop–backward

⑤ Other proportional function as required

Dual-Switch Functions

(Connected via a Y-Lead, Part No. 3636)

⑥ Crane jib up/down

⑦ Crane rotate left/right

⑧ Crane hook up/down

⑨ Anchor chain up/down

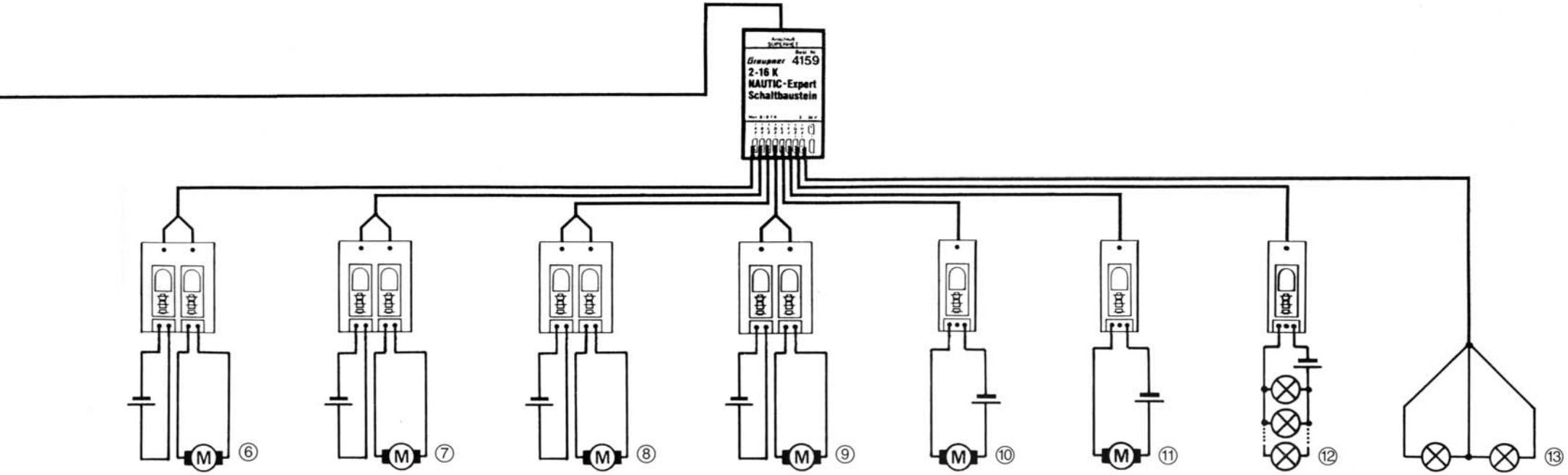
Switch Functions

⑩ Fire pump on/off

⑪ Helicopter rotor on/off

⑫ Ships lighting on/off

⑬ Low current application on/off (Connected by a 3-lead cable, Part No. 3641.6)



ERROR MESSAGE

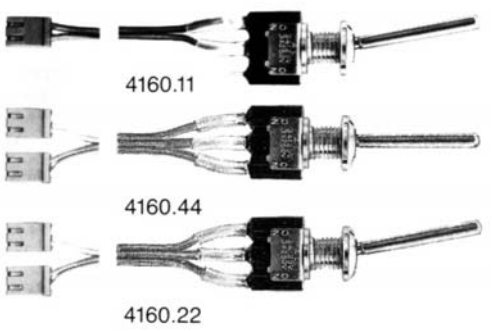
Storage Error

This message appears in the case of an error of the internal memory, i.e. all the entered data has been deleted and the memory contents reverted to the standard values!
The error can be caused by the complete discharge of the lithium battery on the transmitter plate. It has a duration of up to approx. 5 years and it ensures that the data stored in the memory remains, even when the transmitter remains switched off for a long period of time or excessive discharge of transmitter battery. As soon as the lithium battery voltage drops, the announcement appears after switching on.

appears in the display, and an acoustic warning signal sounds. The error message is cleared by pressing any key.
When this error message appears your transmitter should be returned to a GRAUPNER Service Centre. To avoid damage, the changing of the lithium battery should be undertaken by a GRAUPNER Service Centre.

For You Notes

Switches & Modules



Momentary Switch
Part No. **4160.11**
Sprung-off for momentary switching functions.

2-way Momentary Switch
Part No. **4160.44**
Used in place of INC/DEC for and required as a start/stop key for stopwatch

Differential Switch (3-way switch)
Part No. **4160.22**
For switching between 2 mixing functions.

External Switches

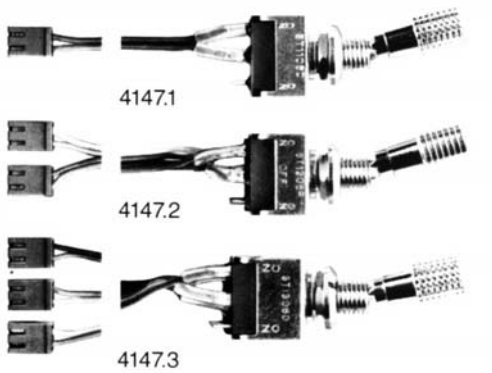
Part No. **4160** for switching one function – long arm

Part No. **4160.1** for switching one function – short arm

Part No. **4160.2** for simultaneous switching of 2 functions – short arm

Part No. **4160.3** for simultaneous switching of 3 functions – short arm

On/Off switching of special functions, e.g. Mixers



Locking External Switches

Part No. **4147.1** for switching of one function

Part No. **4147.2** for simultaneous switching of 2 functions

Part No. **4147.3** for simultaneous switching of 3 functions

Locking switches have a mechanical locking device, which prevents unplanned operation during use. Only by simultaneous lifting and moving the lever can the switch operated.
Important mixing functions, which inadvertent use could lead to the crash of the flight model, should be secured with locking switches.

4151

4152

2 channel Switch Module
Part No. **4151** with long arm
Part No. **4151.1** with short arm

The switch has 3 positions, so that for example electric motors can be switched forward-stop-backwards. Also for suitable on/off functions, like switching loads, lamps, etc.

2 channel Switch Module
Part No. **4151.2** with short arm
Part No. **4151.3** with long arm

Self-centring on/off switch module. Suitable for switching electric motors, other loads, lamps, etc.

2 channel Proportional Module
Part No. **4152**

Linear control channel, or can be used as proportional control, e.g. with mixers.


4111

Rotary Proportional Control
Part No. **4111**

Rotary control channel, or can be used as proportional control, e.g. with mixers.

4158

External Multiple Switch Module
Part No. **4158**

Three toggle switches without central position, for the operation of Exponential / Dual-rate options or other switching functions. For further auxiliary functions, e.g. mixers, it can be retrofitted with other external switch (Part Nos. 4160, 4160.1, 4160,2 or 4160.3).

NAUTIC Modules

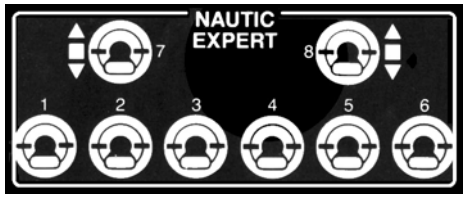
NAUTIC Multi-Prop Module
Part No. **4141**

The module extends proportional functions by using 2 channels to make 8 channels. This module can be inserted at the module places of the transmitter. Thus the ship modeller has a large number of proportional functions available for multi-function ships. At the receiver the NAUTIC Multi-Prop decoder (Part No. 4142) is necessary.

NAUTIC Multi-Prop Decoder
Part No. 4142

The NAUTIC Multi-Prop Decoder allows 2 proportional channels, when using the transmitter Multi-Prop module (Part NO 4141), to become 8 proportional channels. Thus an extension to the Multi-System of 3 servos is possible per Multi-Prop Decoders connected to the servo socket of the receiver.

Power Required, ca.	**10 mA**
Dimensions, ca.	**69 x 42 x 20 mm**
Weight, ca.	**27g**



16 Ch NAUTIC Expert Switch Module
Part No. **4108**

This module extends 2 channels to 16 switch outlets. All 8 switches have a central position, which makes it possible to switch a function forward-stop-backwards where required.

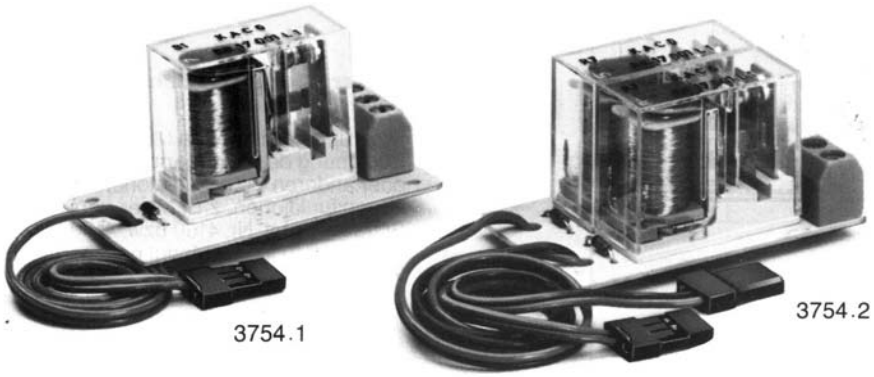
3 switches are sprung-off and 2 are sprung-off in one direction. 2 models can be mounted in the transmitter, and together providing 32 switch functions.

For each module, the receiver requires a 2-16K NAUTIC Expert Switch module (part No. 4159).

2-16K NAUTIC Switch Block
Part No. **4159**

With the retrofitting of the transmitter with the NAUTIC Expert module, Part No. 4108, and the receiver connected to 2 NAUTIC Expert switch blocks it is possible to extend to 32 switch outlets.

The devices can be supplied from a common power source or, if using the appropriate wiring leads, by several power sources.



NAUTIC Switch Module
Part No. **3754.4**

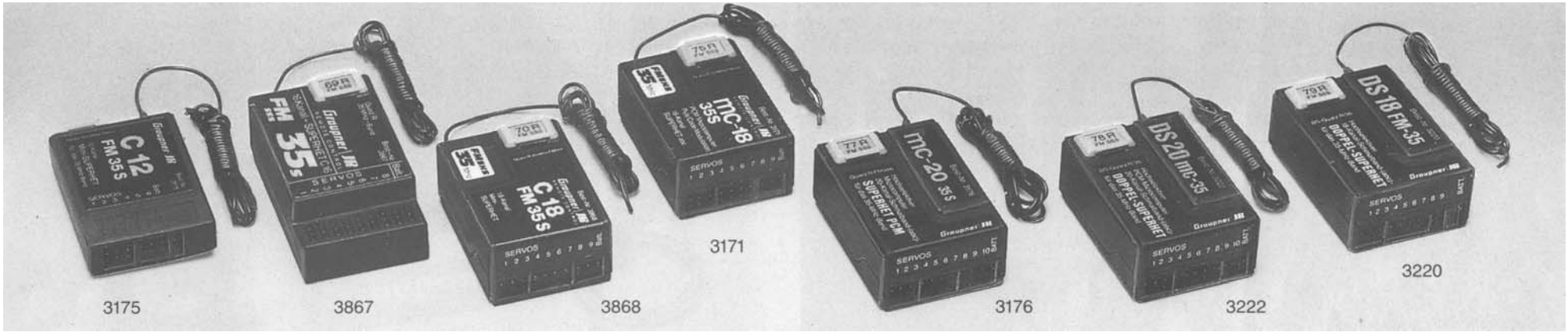
NAUTIC Dual-Switch Module
Part No. 3754.2

The modules are attached via their leads to the 2-16K NAUTIC Expert Switch Block, Part No. 4159.
The high-quality, durable relays permit the switching of devices of high power, e.g. electric motors, lamps, pumps etc. The 2 relays of the Dual-Switch Module, Part No. 3754.2, are wired in such a way that an attached electric motor can be operated forward-stop-backwards. The loads are attached using the screw terminal strips.

Technical Data

	Switch Module 3754.1	Dual-Switch Module 3754.2
Receiver Voltage	4.8 – 12V	4.8 – 12V
Max. Current	16A	16A
Switching Voltage	24V	24V
Dimensions, ca.	50 x 27 x 26 mm	50 x 30 x 26 mm
Weight, ca.	25g	45g

Receivers



Miniature SUPERHET C 12
12 Channel Narrow Band Receiver
Part No. **3175** for the 35MHz band
Part No. **4075** for the 40MHz band

Miniature SUPERHET C 16
16 Channel Narrow Band Receiver
Part No. **3867** for the 35MHz band
Part No. **4067** for the 40MHz band

Miniature SUPERHET C 18
18 Channel Narrow Band Receiver
Part No. **3868** for the 35MHz band
Part No. 4068 for the 40MHz band

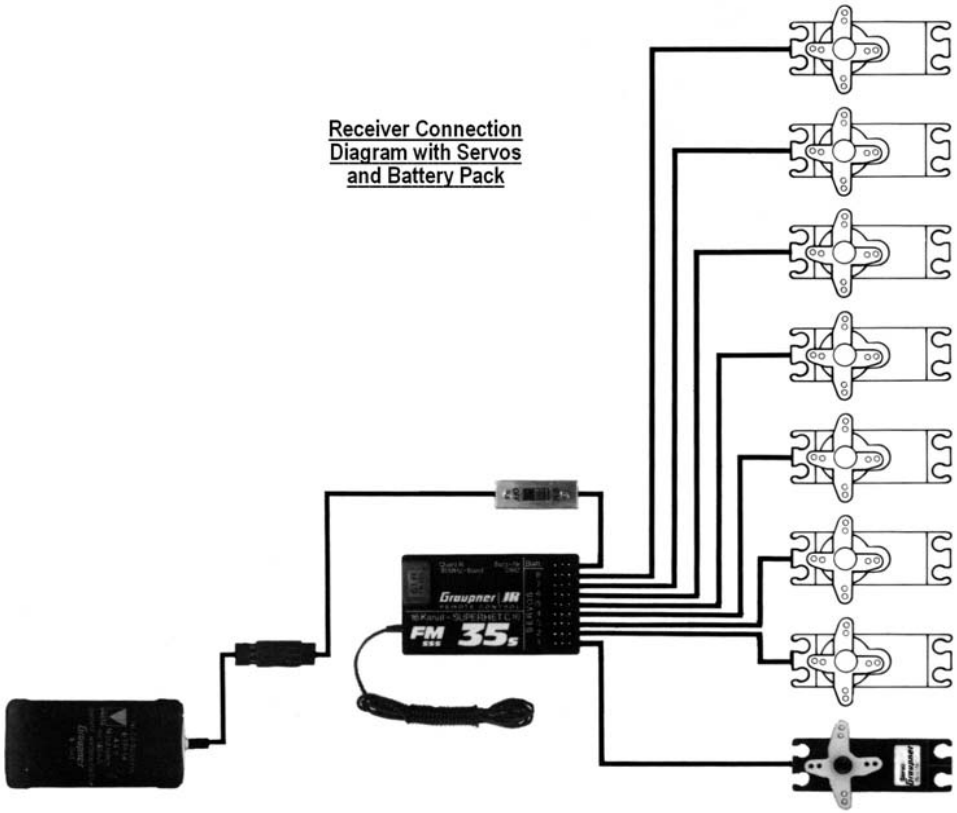
Miniature SUPERHET C 19 (not shown)
18 Channel Narrow Band Receiver
Part No. **3179** for the 35MHz band
Part No. **4074** for the 40MHz band

Mini SUPERHET mc-18
18 Ch FM/PCM Narrow Band Receiver
Part No. **3171** for the 35MHz band
Part No. **4071** for the 40MHz band

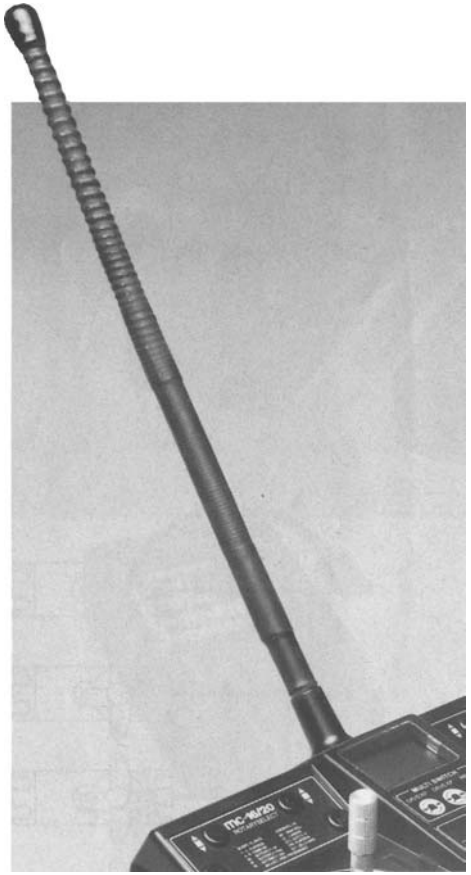
Mini SUPERHET mc-20
20 Ch FM/PCM Narrow Band Receiver
Part No. **3176** for the 35MHz band
Part No. **4046** for the 40MHz band

Mini SUPERHET DS 18
18 Ch PPM Narrow Band Receiver
Part No. **3220** for the 35MHz band
Part No. **4041** for the 40MHz band

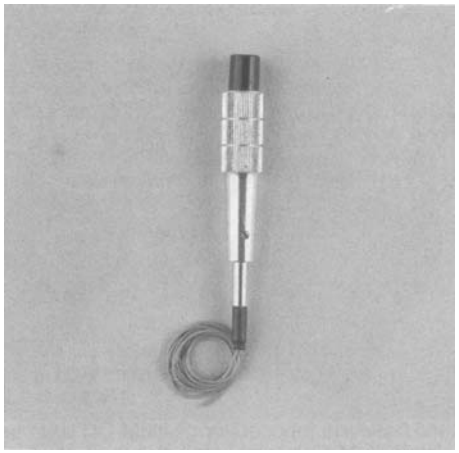
Mini SUPERHET DS20 mc
20 Ch FM/PCM Narrow Band Receiver
Part No. **3222** for the 35MHz band
Part No. **4042** for the 40MHz band



Accessories for Transmitters



Flexible Antenna
Flexible short antenna for optimal freedom of movement and unrestricted use of the transmitter. The radiation achieved is similar to that of the telescopic antenna at full length. For models needing high safety requirements, e.g. for speed and large-scale models and for longer distances, you should use the telescopic antenna supplied with the transmitter.
Dimensions max, ca. 400 mm
Part No. 1149.35 for 35MHz band
.40 for 40MHz band



Push Button
Part No. **4144***
With pressure on the button the switch is operated and it releases to the "off" only when pressing the button again position. The Push Button can be changed, by removing a locking link, to a momentary button, where the function remains "on" only whilst the button is pressed.

HF Transmitter Module (shown on page 11)

Part No. **4824.35** for 35MHz band
4824.40 for 40MHz band

For technical data see page 99.

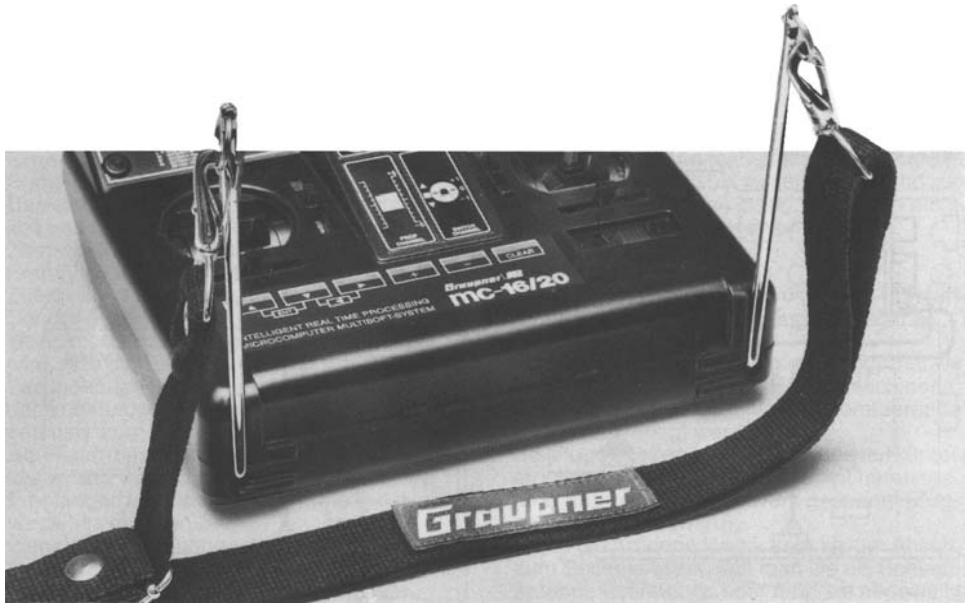
By fitting the appropriate quartz crystal the frequency channel is selected. The crystal inserted in the transmitter must carry the same channel number as that inserted in the receiver.
Only original GRAUPNER FMsss quartz crystal should be used (see page 98)!

2 Function Stick Switch
Part No. **4143***
A control stick with a single pole for operating 2 functions. For special applications, particularly for competition pilots.

3 Function Stick Switch
Part No. **4113***
A control stick with an integral switch with centre-off position for operating 3 functions.
Suitable for special functions, e.g. for high-speed and F3B-models to switch between start, neutral and speed settings or with F3E models as a motor switch for off, half and full throttle.

Rotary Proportional Control Stick
Part No. **4112***
A rotary proportional control integrated in a control stick for trim and setting functions, or as automatic an engine speed controller. It is also usable for similar special functions.

*Installation has to be made by a GRAUPNER service centre.



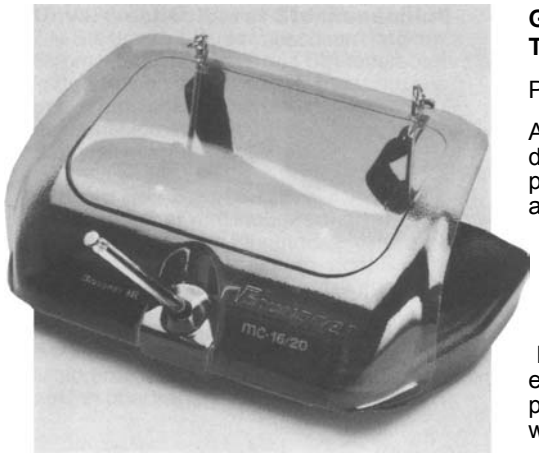
Transmitter Suspension System
Part No. **1127**

The retaining arms can be locked in the stowed and working positions. The entire transmitter upper surfaces is accessible and unhindered. It features holes for the attachment of a neck strap.

Neck Strap
Part No. **1125**

Adjustable length, 30mm wide and fitted with attachment clips.

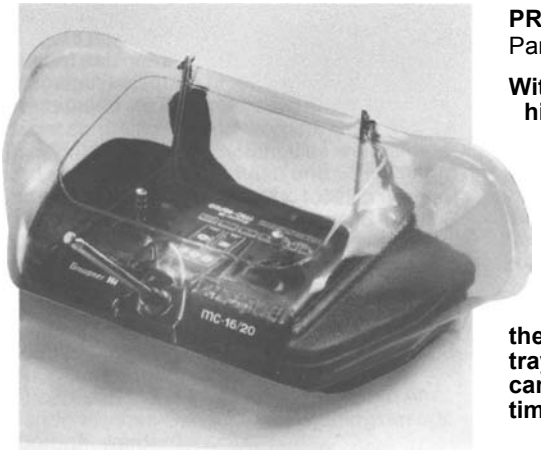
PROFI Transmitter Tray
Part No. **3082**
Wide hand rest surfaces make possible sensitive, precise steering even over extended periods.
The outer is shaped with a double bowl technology. Two user removable covers provide access to storage boxes for small articles such as crystals , other small accessories or to accommodate sunglasses etc,.



GRAUPNER for the PROFI Transmitter Tray Rain Cover

Part No. **3085** (for Transmitter Tray 3082)

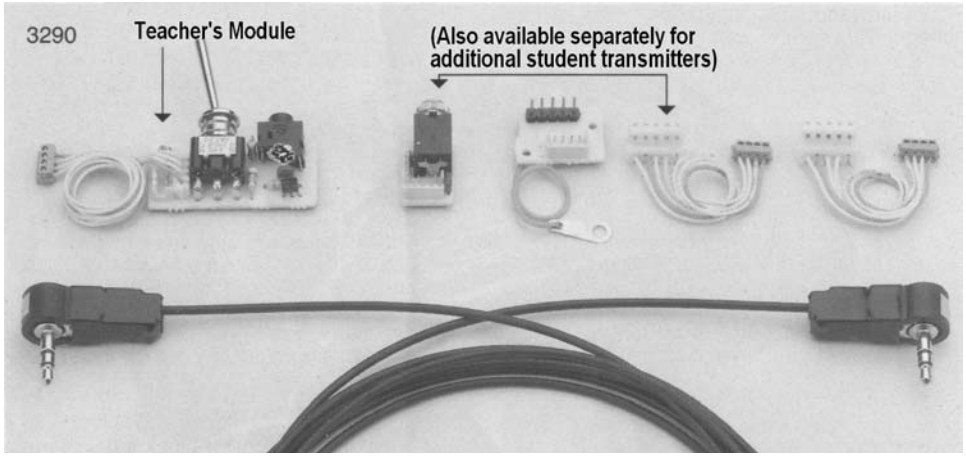
An ergonomically designed rain cover developed by an experienced competition pilot. Both the transmitter and the hands are protected from unexpected rain. Full freedom of movement, for the operation of the transmitter, is ensured.
The cover is made from high-quality, smoke coloured, transparent plastic.
To fit the rain cover it is simply pushed between the transmitter and the tray and engaged at the transmitter mounting points. It can just as simply be removed whenever required.



PROFI Transmitter Cover II
Part No. **3087** (for Transmitter Tray 3082)

With the transmitter desk Saver II, from high-quality transparent plastic, both the transmitter and the hands are protected against influences of the weather such as rains and snow. Also with low temperatures outside and an icy wind the hand protections make sensitive control possible. The transmitter tray cover is simply pushed onto the tray and engaged at the transmitter tray mounting points. Just as simply it can be also be removed again at any time.

Teach – Pupil System with Fibre-Optic Cable



Opto-electrical Teach-Pupil System with Fibre-optic cable
Part No. **3290**

The teacher and pupil transmitters may be operated only in the PPM mode.

For connection between transmitter types D 14, FM 414, FM 4014, FM 6014, FM 6014 / PCM 18, mc-14, mc-15, mc-16, mc-16/20, mc-17, mc-18 and mc-20.

With this option and operation of the integrated momentary switch allows all control functions of the teacher's transmitter to be transferred to the pupil's transmitter.

It is necessary that the pupil's transmitter contains all the same programming, mixing and coupling functions as the teacher's transmitter as this data is not transferred.

For the installation of the teacher-pupil training system in teacher transmitter, it is required to drill a further hole into the right or left facia plate using a 6 mm drill. Please you make sure that no metal debris enters the inside the transmitter – there is a **risk of short circuits!**

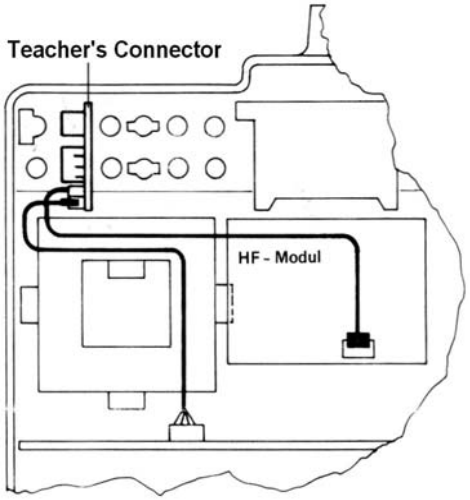
Function Notes
Switch the transmitters into PPM mode.

Plug M of the teacher-pupil cable into teacher's transmitter, and insert plug S into the pupil's transmitter. Both the teacher and pupil transmitters, must be equipped with suitable transmitter battery.
The HF radiation takes place from the teacher's transmitter and an appropriate crystal must be the installed. The pupil's transmitter needs no HF module

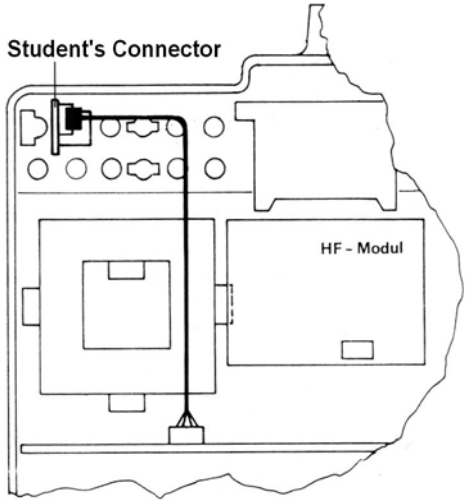
The change-over of control from teacher to pupil takes place by the teacher holding the momentary switch on his transmitter. The teacher need only release the switch to regain control of the model, resume normal flight attitude before handing control back to the pupil again.

Replacement Parts
Part No **3290.4** Fibre-optic cable for teacher-pupil system.

Module for additional pupil transmitters
Part No. 3290.3



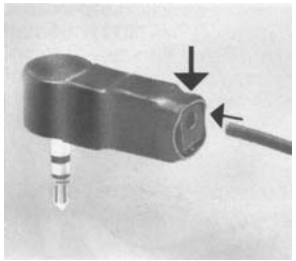
Installation in the Teacher's Transmitter
After installation of the teacher printed circuit board in teacher transmitter (board with switch and socket).
Disconnect the plug on the transmitter board from the HF Module and plug this into the socket on the teacher PCB.
Connect the lead soldered to the teacher PCB to the HF Module.



Installation in the Pupil's Transmitter
After installation of the board, unplug the HF Module lead at the transmitter board and connect the lead from the module in it's place.

Troubleshooting:

- The interface is not correctly connected to the HF Module.
- Pupil's transmitters is not switched on.
- Pupil's transmitters is not in PPM mode.
- The fibre-optic cable is damaged.
- The optical cable has worked loose from one of the sockets. In this case release the clamping device in the plug by pressing down as shown and push the fibre-optic cable back in.



Supplementary Information

Use of the Remote Control System

Treat your remote control equipment carefully to ensure that it is always reliable and ready for use.
Switch on the transmitter first, only then switch on the receiver.
Switch off the receiver first and only then switch off the transmitter.
If this sequence is not observed, i.e. the receiver is switched on first with transmitter switched off, the receiver can affected by other signals and unpredictable results can occur. The servos may jitter applying a high load to the battery and cause it to discharge quicker than expected.
If you notice the movement of the servos becoming slower, the receiver battery is discharging and it should charged or a new battery fitted.
Extended the transmitter antenna fully before commencing to fly.
In the direction the antenna points only a small field strength is generated. It is therefore wrong to point the antenna towards the model for best reception.
With simultaneous use of remote control sets on adjacent channels the pilots should stand together in a loose group.
Plots not standing in the group endanger both their and other models.

Polarised Connectors

The plugs of the servos and the power supplies are polarized can be inserted into the receiver one way round. This is achieved by one side having a bevelled edge and the receiver sockets being shaped accordingly.

Installation of Receivers

The receiver be mounted in foam rubber to protect it from impacts. It should also be fitted behind a strong frame and/or in vehicles or ship models protected from dust and water splashes.
The receiver should not be fitted directly the fuselage, chassis or hull, since otherwise engine vibrations, impacts or landing shocks will transfer directly to it.
The receiver should be installed in such a way that the antenna, servo and power leads are not under tensions or otherwise stressed.

Receiver Antenna

The receiver antenna is connected directly to the case. The length is approx. 100 cm.
The antenna should be routed as straight as possible and as far from electric motors, servos, metallic linkages or power cables.
For flying models the antenna should be routed out of the fuselage by the shortest possible route and attached to the vertical fin (you should use some strain relief!).
If the antenna should be longer than the distance to the vertical fin, let it continue as trailing antenna or route it to the wing tip edge of the horizontal stabilise. Each such bend in the antenna brings a loss of range.
With ships the position of the receiver should be such that the receiver and the antenna as far from drive electric motors, power cables and metal parts.
A blade antenna with a free length or 80 – 100 cm is preferred for ship models over every other antenna type.
With model cars, blade antennas work satisfactorily. Here shortened antennas can be used as the operating range is relatively short.

Power Supply

The power supply for the receiver comes from a rechargeable NiCd 4.8V battery (see page 5 or the main GRAUPNER catalogue). The battery should be wrapped in foam and securely mounted to a strong frame. The cables should be loosely routed making sure that they remain so during any movement of the battery.
The battery can be connected directly to the receiver or by a switch harness.

Examination before Starting

You should check for correct function and range before each use. Switch on the transmitter then the receiver. Remove the transmitter antenna. Check at an appropriate distance from the model that all the controls function perfectly and move in the correct direction.
This check should also be done motor running (an assistant can hold the model.

Installation of Control Linkages

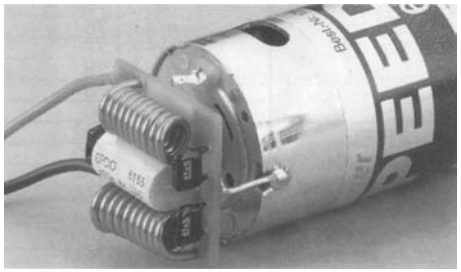
The installation should be done so that the linkages run freely and are low-friction. Linkages and controls that are difficult to operate absorb battery power, reduce the actual working time and unfavourably affect the control position accuracy.
Particularly important is that all control horns can move through their full travel and are not mechanically limited. Taking account of these criteria, the linkages and hinges in the model should be checked. Of particular importance is the motor throttle linkage. The "full power" position must be determined by the stick position and definitely not by the mechanical limits of carburettor. As the model maybe at full throttle for considerable periods the additional drain of a stalled servo would discharge the battery faster than expected. Likewise the idle setting must be achieved by the stick position and not mechanically by limits of the carburettor.

Suppression of Electric Motors

Even high quality electric motors produce sparks at the interface between the brushes and the commutator. Depending on the electric motor, these sparks can cause interference with the radio signal. Therefore, in models with electric drive, the motor must be carefully suppressed. Radio noise filter suppressors reduce these malfunctions to a great extent and are allow the radio system to operate normally. Radio noise filters are to be installed as close as possible to the motor (see figure). Each electric motor should be fitted with it's own radio noise filter. When using suppression filters consideration should be made of the manual of the respective electric motor. Interference suppression should be checked before use of the model, to ensure sufficient range between transmitter and receiver is available.

Suppression Filter

Part No. **3361** 18A
Part No. **3362** 36A
Pre-built Units. Simply soldered between the electric motor and the power cables (see figure). The range of the remote control system is better when using optimal interference suppression and the safety of operation of the model is increased.
The filter absorbs the noise spikes created by electric motors and therefore protects electronic speed controllers.
Electric RC car models with mechanical speed controllers have only basic filtering from the factory. When subsequently fitting an electronic speed controller the motor must then be adequately suppressed.



Servo Extension Lead Suppression.

Part No. **1040**
A servo lead suppression is needed when using long servo leads as the filters in the receiver are insufficient. A filter should be fitted next to the receiver. In critical cases a second filter at the servo can be fitted.
Length approx. 200 mm, weight approx. 3g

Servo Plug

Servo plugs are removed from the receiver socket by pulling about 5-10 cm away from the plug inline with the pin connections.

Battery Capacity & Period of Use

This applies to all battery source: At low temperatures the capacity decreases considerably, therefore the periods of use in cold weather are shorter. The available battery power must be checked more frequently.

Quartz Crystals, Frequency Pennants

Frequency Band	Permitted uses	Channel No.	Transmitter Frequency MHz	FMsss-Quarze Transmitter Part No.	FMsss-Quarze Receiver Part No.	Präzisions-Quarze Transmitter Part No.	Präzisions-Quarze Receiver Part No.	DS Doppelsuper-Quarze Part No.	Flagge Part No.	Permitted in these Countries (without guarantee) (D) (B) (A) (DK) (F) (I) (L) (N) (NL) (S) (CH)
35 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	**.182**	**.182**	**.182**	**.182**	**.182**	**.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**	
40 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	**.54**	**.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**	

Technical Data

Technical Data – Computer Transmitter **mc**-16/20	
Transmission System	FM/FMsss switchable to PCM with single chip micro computer system
HF System	Changeable module for 10 kHz channel spacing 35 or 40 MHz frequency
Quartz FMsss Crystals	35 MHz band, channels 61 – 80 and 182 to 191 40 MHz band, channels 50 – 59 and 81 to 92
Channel Spacing	10 kHz
Control Channel max.	16
Control Channel Basic	8 channel proportional, all electronic trims
Channel Expansion	8 channel proportional or switched
Channel Signal Timing	1.5 ms ± 0.5 ms, including trims
Control Signal Steps	512 step with single chip micro computer system
Antenna	Telescopic, 10 section, approx. 1470 mm long
Battery Voltage	9.6 to 12V
Current Drain, ca.	75mA (without HF module)
Weight with Battery, ca.	1000 g
Dimensions, ca.	215 x 192 x 75 mm

Technical Data – HF Transmitter Module	
Part No. – HF Module	4824.35 for 35 MHz band 4824.40 for 40 MHz band
Emission Classes	F1D, F3D
Power requirement with basic equipment	2W
Channel Spacing	10 kHz
Battery Voltage	9.6 to 12V
Current Drain, ca.	150mA
Temperature Range	–15 to +55°C
Dimensions, ca.	65 x 47 x 55 mm
Weight, ca.	35 g

Receiver Type	C 12 FM 12 Ch SUPERHET	C 16 FM 16 Ch SUPERHET	C 18 FM 18 Ch SUPERHET	C 19 FM 19 Ch SUPERHET	**mc**-18 18 Ch PCM	**mc**-20 20 Ch PCM	DS 18 FM 18 Ch PPM	DS 20 **mc** 20 Ch PCM
Receiver for 35 MHz band for 40 MHz band	Part No. 3175 Part No. 4075	Part No. 3867 Part No. 4067	Part No. 3868 Part No. 3869	Part No. 3179 Part No. 4074	Part No. 3171 Part No. 4071	Part No. 3176 Part No. 4076	Part No. 3220 Part No. 4041	Part No. 3222 Part No. 4042
Battery Voltage	4.8 – 6V	4.8 – 6V	4.8 – 6V	4.8 – 6V	4.8 – 6V	4.8 – 6V	4.8 – 6V	4.8 – 6V
Current Drain, ca.	10 mA	10 mA	10 mA	12 mA	19 mA	17 mA	35 mA	19 mA
Channel Spacing	10 kHz	10 kHz	10 kHz	10 kHz	10 kHz	10 kHz	10 kHz	10 kHz
Sensitivity, ca.	10µV	10µV	10µV	10µV	10µV	10µV	5µV	5µV
Servos outputs	6	8	9	9	9	10	9	10
Temperature Range, ca.	–15 to +55°C	–15 to +55°C	–15 to +55°C	–15 to +55°C	–15 to +55°C	–15 to +55°C	–15 to +55°C	–15 to +55°C
Antenna Length, ca. (mm)	1000	1000	1000	1000	1000	1000	1000	1000
Dimensions, ca. (mm)	53 x 36 x 15	62 x 36 x 21	51 x 36 x 21	51 x 36 x 16	51 x 36 x 21	53 x 38 x 21	53 x 38 x 21	53 x 38 x 21
Weight, ca. (g)	29	45	45	35	38	45	45	45

General Permissions

Transmitter and Receiver for the 27 and 40 MHz bands are registered and can be used without charge.

General permission for a Radio concerning the remote control of models

(Version dated 15.4.1987)

1. Establishing and operating radio communication systems for remote control flight , ships and other vehicle models for sport purposes with a Federal Post Office permission character and the additional marking "MF" or a Federal Post Office certification number (FTZ-Series test number) of the identification letter row "MF..." is hereby generally approved on 27.6.1966 due to §§ the 1 and 2 of the law over telecommunication installations in the version of the proclamation on 17.3.1977, changed by the law, for the area of application of this law.

2. For this permission, following conditions apply:

a) the radio communication systems for the remote control of models must carry a Federal Post Office permission character valid and intended for this device type and the additional "MF" marking or a Federal Post Office certification number (FTZ-Series test number) for the identification letter row "MF..." and

b) may only be equipped for those following specified frequencies:

(Frequency "First Choice")

13.560 MHz	40.665 MHz
26.995 MHz	40.675 MHz
27.045 MHz	40.685 MHz
27.095 MHz	40.695 MHz
27.145 MHz	
27.195 MHz	
27.255 MHz	

or

(Frequency "Second Choice")

27.005 MHz	40.715 MHz 1)
27.015 MHz	40.725 MHz
27.025 MHz	40.735 MHz
27.035 MHz	40.765 MHz
27.055 MHz	40.775 MHz
27.065 MHz	40.785 MHz
27.075 MHz	40.815 MHz
27.085 MHz	40.825 MHz
27.105 MHz	40.835 MHz
27.115 MHz	40.865 MHz
27.125 MHz	40.875 MHz
27.135 MHz	40.885 MHz
	40.915 MHz
	40.925 MHz
	40.935 MHz
	40.965 MHz
	40.975 MHz
	40.985 MHz 1)

c) Other telecommunication installations, which serve public purposes, and radio communication systems, those on frequencies outside of the frequency ranges

13.553 – 13.567 MHz
26.957 – 27.283 MHz
40.66 – 41.00 MHz

Maybe operated but not distributed.

d) Radio communication systems for the remote control of models may not be changed electrically and/or mechanically.

e) Connecting of a radio communication system for the remote control of models with other telecommunication installations is inadmissible.

3. Pertinent traffic instructions, liability instructions and-accident prevention instructions for remote-controlled models remain unchanged.

4. Terms of the permission. This "general permission" is given under the following terms, the component of permission are:

a) The aforementioned operating frequencies are for the joint use of high frequency devices and radio communication systems of different kinds! The owner of a radio communication system and the owner of permission do not therefore enjoy, for its radio communication system for the remote control of models, any protection from disturbances by high frequency devices, by other radio communication systems, which are operated in the frequency ranges mentioned, or by other radio communication systems, which are duly operated.

b) All parts of the radio communication system are to be kept in the correct working condition. Failures are to be eliminated immediately.

c) For the examination of the equipment, which is contained within this permission, for the use to be held ready or operated, the owner and owner of this permission have approved the Federal Post Office to enter properties and/or areas, on and/or in which radio communication systems for the remote control of models are, to permit at the normal business hours or to obtain this power. The nominated officer of the Federal Post Office thereby can request information to be given about these equipments.

d) Nominees of the Federal Post Office and Police can demand an inspection of the radio communication systems, falling under this general permission, be permitted

e) The owner of such a radio communication system and owner of this permission are obligated to follow each change or addition of permission immediately and to bear any necessary costs.

f) The Request of the Federal Post Office to cease use of a set of radio communication system for the remote control of models must be followed by the owner and owner of this permission without delay. If it requires, the Federal Post Office, can remove the radio communication system, or parts from it is, to be kept under closer supervision during the suspension of service arranged.

g) If this permission expires, then the arrangement over the removal of the radio communication system of the Federal Post Office is to be obeyed.

5. This "general permission" can be rescinded altogether or, for individual radio communication systems for the remote control of models, also for an individual user by the responsible local regional directorate.

A revocation is permissible in particular if the terms of the permission are not kept. Instead of recalling a permission, the Federal Post Office can arrange that due to offences against the terms the radio communication systems are to be put out of operation. Only on adherence to the terms again may operation be allowed.

The Federal Post Office can supplement or change the conditions and terms of this permission at any time.

1) The frequencies between 40,700 MHz and 41,000 MHz may not be used for flight models.

Auxiliary information for manufacturers, trading companies, salesmen and purchasers

1. Radio communication systems for the remote control of models do not require detailed special permission, if the individual equipment is recognizable and entitlement proven by a Federal Post Office permission character and the additional marking "MF" and/or a Federal Post Office certification number (FTZ-series test number) to the identification letter row "MF..." carries. Permission fees are not raised.

2. Only on radio communication systems for the remote control of models which comply with the central office for permissions in the telecommunication system and/or are examined and certified electrical and mechanical designs by the telecommunication technically engineering central office may carry the Federal Post Office permission character with the additional marking "MF" and/or a Federal Post Office certification number (FTZ–series test number) of the identification letter row "MF..." assigned on their case.

3. A Federal Post Office permission character and the additional marking "MF" can only be assigned to a company if a design of this series is presented to the central office for telecommunication system approvals, 6600 Saarbrucken, for examination, and the examination demonstrates that the design corresponds to the appropriate technical regulations (FTZ guideline 17 R 2012) for radio communication systems for the remote control of models.

The applicant must commit themselves, in relation to the Federal Post Office, to

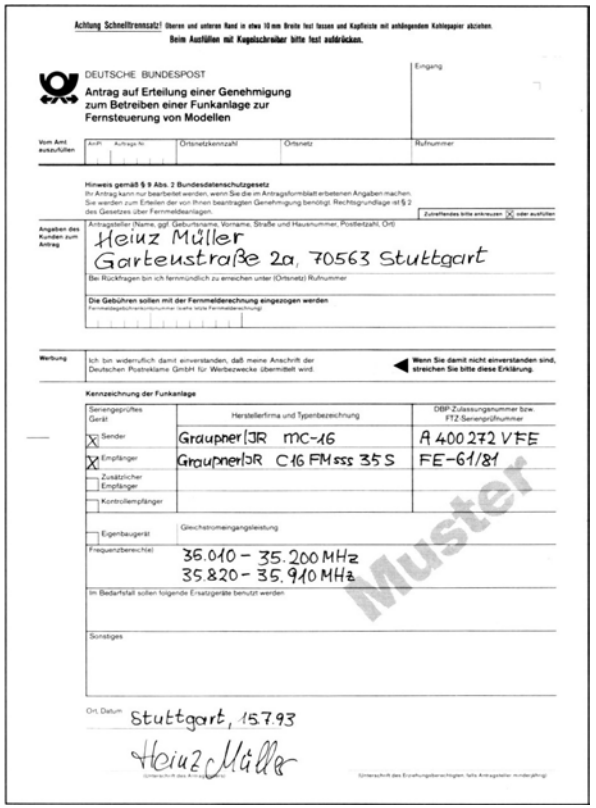
a) That only such examined and certified designs that comply (electrically and mechanically) are marked with the assigned Federal Post Office permission character and the additional marking "MF".

b) To attach to all equipment which can be brought under this Federal Post Office permission character in traffic, a reproduction of this "general permission".

4. It is recommended to the purchaser of a radio communication system, for the remote control of models, to request in his own interest a reproduction of this "general permission" from the salesman or previous owner of the equipment.

Sample licence request form for transmitters and receivers in the 35 MHz Band

You are responsible for registering transmitters and receivers for the 35-MHz-Band at the telecommunication office of the Federal Post Office. The fee for an operating permit that is valid for 10 years permit is currently DM 50. The request form is attached to the transmitter.



Achtung Schnelltrennstelle! Oberen und unteren Rand in etwa 10 mm Breite fest lassen und Kopfleiste mit anhängendem Kohlepapier abziehen.
Beim Ausfüllen mit Kugelschreiber bitte fest aufdrücken.

DEUTSCHE BUNDESPOST

Antrag auf Erteilung einer Genehmigung zum Betreiben einer Funkanlage zur Fernsteuerung von Modellen

Eingang

Vom Amt auszufüllen | Amt | Antrags-Nr. | Ortsnetzkennzahl | Ortsnetz | Rufnummer

Hinweis gemäß § 9 Abs. 2 Bundesdatenschutzgesetz
Ihr Antrag kann nur bearbeitet werden, wenn Sie die im Antragsformblatt erbetenen Angaben machen. Sie werden zum Erteilen der von Ihnen beantragten Genehmigung benötigt. Rechtsgrundlage ist § 2 des Gesetzes über Fernmeldeanlagen.

Zutreffendes bitte ankreuzen X oder ausfüllen

Angaben des Kunden zum Antrag

Antragsteller (Name, ggf. Geburtsname, Vorname, Straße und Hausnummer, Postleitzahl, Ort)

Heinz Müller
Gartenstraße 2a, 70563 Stuttgart

Bei Rückfragen bin ich fernmündlich zu erreichen unter (Ortsnetz) Rufnummer

Die Gebühren sollen mit der Fernmelderechnung eingezogen werden
Fernmeldegebührenkontonummer (siehe letzte Fernmelderechnung)

Werbung

Ich bin widerruflich damit einverstanden, daß meine Anschrift der Deutschen Postreklame GmbH für Werbezwecke übermittelt wird.

Wenn Sie damit nicht einverstanden sind, streichen Sie bitte diese Erklärung.

Kennzeichnung der Funkanlage

Serienge-prüftes Gerät	Herstellerfirma und Typenbezeichnung	DBP-Zulassungsnummer bzw. FTZ-Serienprüfnummer
X Sender	Graupner JR MC-16	A 400 272 VFE
X Empfänger	Graupner JR C16 FM sss 35 S	FE-61/81
Zusätzlicher Empfänger		
Kontrollempfänger		

Eigenbaugerät | Gleichstromeingangsleistung

Frequenzbereich(e)
36.010 – 35.200 MHz
35.820 – 35.910 MHz

Im Bedarfsfall sollen folgende Ersatzgeräte benutzt werden

Sonstiges

Muster

Ort, Datum: Stuttgart, 15.7.93

Heinz Müller

Unterschrift des Antragstellers | Unterschrift des Erziehungsberechtigten, falls Antragsteller minderjährig

Customer Approvals
for Transmitter mc-16/20

35 MHz

GRAUPNER / JR mc-16

Approval Number
A 400272 V FE

BUNDESAMT FÜR ZULASSUNGEN IN DER TELEKOMMUNIKATION

ZULASSUNGSURKUNDE

Zulassungsnummer: A400272V

Zus. Kennzeichen: FE

Objektbezeichnung: Graupner/JR mc 16

Zulassungsinhaber: Johannes Graupner
Henriettenstr. 94-96
D-7312 Kirchheim/Teck

Zulassungsart: Allgemeinzulassung

Objektart: Funkanlage zur Fernsteuerung von Flug-Modellen

Die Zulassungsurkunde mit Ausstellungsdatum 18. Juli 1989 wird hiermit ungültig.

Das Zulassungsobjekt erfüllt die technische Vorschrift der Richtlinie FTZ 17 R 2012, Ausgabe März 1985.

Saarbrücken, den 13.01.93

Im Auftrag

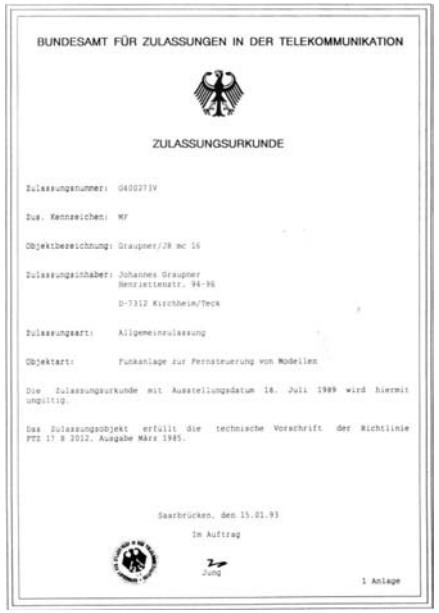
Jung

1 Anlage

40 MHz

GRAUPNER / JR mc-16

Approval Number
G 400273 V MF



BUNDESAMT FÜR ZULASSUNGEN IN DER TELEKOMMUNIKATION

ZULASSUNGSURKUNDE

Zulassungsnummer: G400273V

Zus. Kennzeichen: MF

Objektbezeichnung: Graupner/JR mc 16

Zulassungsinhaber: Johannes Graupner
Henriettenstr. 94-96
D-7312 Kirchheim/Teck

Zulassungsart: Allgemeinzulassung

Objektart: Funkanlage zur Fernsteuerung von Modellen

Die Zulassungsurkunde mit Ausstellungsdatum 18. Juli 1989 wird hiermit ungültig.

Das Zulassungsobjekt erfüllt die technische Vorschrift der Richtlinie FTZ 17 R 2012, Ausgabe März 1985.

Saarbrücken, den 15.01.93

Im Auftrag

Jung

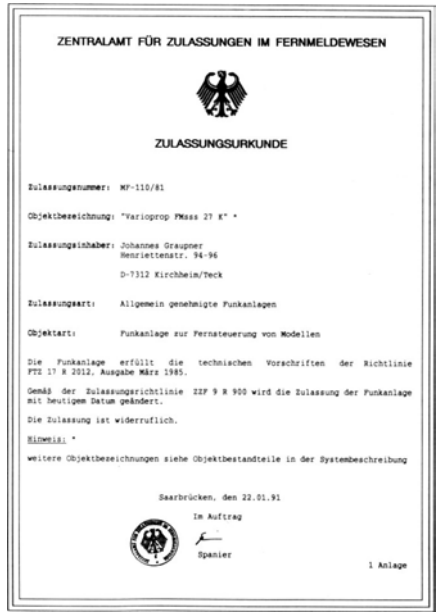
1 Anlage

for FM and PCM Receivers

35 MHz

C 16 FMsss 35 S
C 18 FMsss 35 S
mc-18 35 S
mc-20 35 S

Approval Number
FE-61/81



ZENTRALAMT FÜR ZULASSUNGEN IM FERNMELDEWESEN

ZULASSUNGSURKUNDE

Zulassungsnummer: MF-110/81

Objektbezeichnung: "Varioprop FMsss 27 K" *

Zulassungsinhaber: Johannes Graupner
Henriettenstr. 94-96
D-7312 Kirchheim/Teck

Zulassungsart: Allgemein genehmigte Funkanlagen

Objektart: Funkanlage zur Fernsteuerung von Modellen

Die Funkanlage erfüllt die technischen Vorschriften der Richtlinie FTZ 17 R 2012, Ausgabe März 1985.

Gemäß der Zulassungsrichtlinie ZZF 9 R 900 wird die Zulassung der Funkanlage mit heutigem Datum geändert.

Die Zulassung ist widerruflich.

Hinweis: *

weitere Objektbezeichnungen siehe Objektbestandteile in der Systembeschreibung

Saarbrücken, den 22.01.91

Im Auftrag

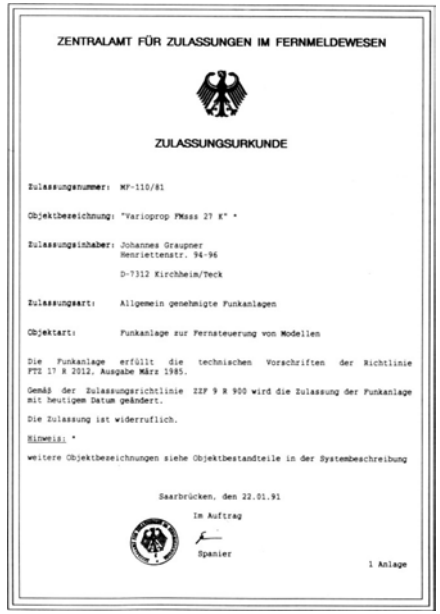
Spanier

1 Anlage

40 MHz

C 16 FMsss 40 S
C 18 FMsss 40 S
mc-18 40 S
mc-20 40 S

Approval Number
MF-110/81



ZENTRALAMT FÜR ZULASSUNGEN IM FERNMELDEWESEN

ZULASSUNGSURKUNDE

Zulassungsnummer: MF-110/81

Objektbezeichnung: "Varioprop FMsss 27 K" *

Zulassungsinhaber: Johannes Graupner
Henriettenstr. 94-96
D-7312 Kirchheim/Teck

Zulassungsart: Allgemein genehmigte Funkanlagen

Objektart: Funkanlage zur Fernsteuerung von Modellen

Die Funkanlage erfüllt die technischen Vorschriften der Richtlinie FTZ 17 R 2012, Ausgabe März 1985.

Gemäß der Zulassungsrichtlinie ZZF 9 R 900 wird die Zulassung der Funkanlage mit heutigem Datum geändert.

Die Zulassung ist widerruflich.

Hinweis: *

weitere Objektbezeichnungen siehe Objektbestandteile in der Systembeschreibung

Saarbrücken, den 22.01.91

Im Auftrag

Spanier

1 Anlage

Customer Approvals for FM Receivers

35 MHz

C 12 FM 35 S

Approval Number
A 012804 B FE

BUNDESAMT FÜR ZULASSUNGEN IN DER TELEKOMMUNIKATION

ZULASSUNGSURKUNDE

Zulassungsnummer: A0128048

Zus. Kennzeichen: FE

Objektbezeichnung: "C 12 FM 35 S"

Zulassungsinhaber: Johannes Graupner
Henriettenstr. 94-96
D-7312 Kirchheim/Teck

Zulassungsart: Allgemeinzulassung

Objektart: Funkanlage zur Fernsteuerung von Flug-Modellen

Das Zulassungsobjekt erfüllt die technische Vorschrift der Richtlinie FTZ 17 R 2012, Ausgabe März 1985.

Die Zulassungsurkunde mit Ausstellungsdatum 04.06.1991 wird hiermit ungültig.

Saarbrücken, den 17.12.92

Im Auftrag

Jung

1 Anlage

40 MHz

C 12 FM 35 S

Approval Number
G 012803 B MF

ZENTRALAMT FÜR ZULASSUNGEN IM FERNMELDEWESEN

ZULASSUNGSURKUNDE

Zulassungsnummer: G0128038

Zus. Kennzeichen: MF

Objektbezeichnung: C 12 FM 40 S, C 12 FM 27 S,

Zulassungsinhaber: Johannes Graupner
Henriettenstr. 94-96
D-7312 Kirchheim/Teck

Zulassungsart: Allgemein genehmigte Funkanlagen

Objektart: Funkanlage zur Fernsteuerung von Modellen

Die Funkanlage erfüllt die technischen Vorschriften der Richtlinie FTZ 17 R 2012, Ausgabe März 1985.

Gemäß der Zulassungsrichtlinie ZZF 9 R 900 wird die Funkanlage mit Wirkung vom 04. Juni 1991 zugelassen.

Die Zulassung ist widerruflich.

Saarbrücken, den 11.02.92

Im Auftrag

Jung

1 Anlage

35 MHz

C 19 FM 35 S

Approval Number
A 106898 D FE

BUNDESAMT FÜR ZULASSUNGEN IN DER TELEKOMMUNIKATION

ZULASSUNGSURKUNDE

Zulassungsnummer: A106898D

Zus. Kennzeichen: FE

Objektbezeichnung: C 19 FM 35 S

Zulassungsinhaber: Johannes Graupner
Henriettenstr. 94-96
D-7312 Kirchheim/Teck

Zulassungsart: Allgemeinzulassung

Objektart: Funkanlage zur Fernsteuerung von Flug-Modellen

Das Zulassungsobjekt erfüllt die technische Vorschrift der Richtlinie FTZ 17 R 2012, Ausgabe März 1985.

Saarbrücken, den 21.05.93

Im Auftrag

Jung

1 Anlage

40 MHz

C 19 FM 40 S

Approval Number
G 106897 D MF

BUNDESAMT FÜR ZULASSUNGEN IN DER TELEKOMMUNIKATION

ZULASSUNGSURKUNDE

Zulassungsnummer: G1068970

Zus. Kennzeichen: MF

Objektbezeichnung: C 19 FM 40 S

Zulassungsinhaber: Johannes Graupner
Henriettenstr. 94-96
D-7312 Kirchheim/Teck

Zulassungsart: Allgemeinzulassung

Objektart: Funkanlage zur Fernsteuerung von Modellen

Das Zulassungsobjekt erfüllt die technische Vorschrift der Richtlinie FTZ 17 R 2012, Ausgabe März 1985.

Saarbrücken, den 21.05.93

Im Auftrag

Jung

1 Anlage

Customer Approvals
for PCM Receivers and Dual-Conversion Superhet

35 MHz

mc-12 PCM 35 S

Approval Number
A 103692 C FE

BUNDESAMT FÜR ZULASSUNGEN IN DER TELEKOMMUNIKATION

ZULASSUNGSURKUNDE

Zulassungsnummer: A103692C

Zus. Kennzeichen: FE

Objektbezeichnung: mc-12 PCM 35 S

Zulassungsinhaber: Johannes Graupner
Henriettenstr. 94-96
D-7312 Kirchheim/Teck

Zulassungsart: Allgemeinzulassung

Objektart: Funkanlage zur Fernsteuerung von Flug-Modellen

Saarbrücken, den 14.07.92

Im Auftrag

Jung

1 Anlage

35 MHz

DS 18 FM 35
DS 20 mc-35

Approval Number
A 400090 A FE

BUNDESAMT FÜR ZULASSUNGEN IN DER TELEKOMMUNIKATION

ZULASSUNGSURKUNDE

Zulassungsnummer: A400090A

Zus. Kennzeichen: FE

Objektbezeichnung: "DS 20 mc-35" oder "DS 18 FM 35 MHz"

Zulassungsinhaber: Johannes Graupner
Henriettenstr. 94-96
D-7312 Kirchheim/Teck

Zulassungsart: Allgemeinzulassung

Objektart: Funkanlage zur Fernsteuerung von Flug-Modellen

Das Zulassungsobjekt erfüllt die technische Vorschrift der Richtlinie FTZ 17 R 2012, Ausgabe März 1985.

Die Zulassungsurkunde mit Ausstellungsdatum 03.07.1991 wird hiermit ungültig.

Saarbrücken, den 17.12.92

Im Auftrag

Jung

1 Anlage

40 MHz

mc-12 PCM 40 S

Approval Number
G 103691 C MF

BUNDESAMT FÜR ZULASSUNGEN IN DER TELEKOMMUNIKATION

ZULASSUNGSURKUNDE

Zulassungsnummer: G103691C

Zus. Kennzeichen: MF

Objektbezeichnung: mc-12 PCM 40 S

Zulassungsinhaber: Johannes Graupner
Henriettenstr. 94-96
D-7312 Kirchheim/Teck

Zulassungsart: Allgemein genehmigte Funkanlagen

Objektart: Funkanlage zur Fernsteuerung von Modellen

Saarbrücken, den 14.07.92

Im Auftrag

Jung

1 Anlage

40 MHz

DS 18 FM 40
DS 20 mc-40

Approval Number
G 400091 A MF

ZENTRALAMT FÜR ZULASSUNGEN IM FERNMELDEWESEN

ZULASSUNGSURKUNDE

Zulassungsnummer: G400091A

Zus. Kennzeichen: MF

Objektbezeichnung: "DS 20 mc-40" oder "DS 18 FM 40 MHz"

Zulassungsinhaber: Johannes Graupner
Henriettenstr. 94-96
D-7312 Kirchheim/Teck

Zulassungsart: Allgemein genehmigte Funkanlagen

Objektart: Funkanlage zur Fernsteuerung von Modellen

Die Funkanlage erfüllt die technischen Vorschriften der Richtlinie FTZ 17 R 2012, Ausgabe März 1985.

Gemäß der Zulassungsrichtlinie 22F 9 R 900 wird die Zulassung der Funkanlage mit heutigem Datum geändert.

Die Zulassung ist widerruflich.

Saarbrücken, den 03.07.91

Im Auftrag

Spanier

1 Anlage

JOHNANNES GRAUPNER
POSTFACH 1242
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