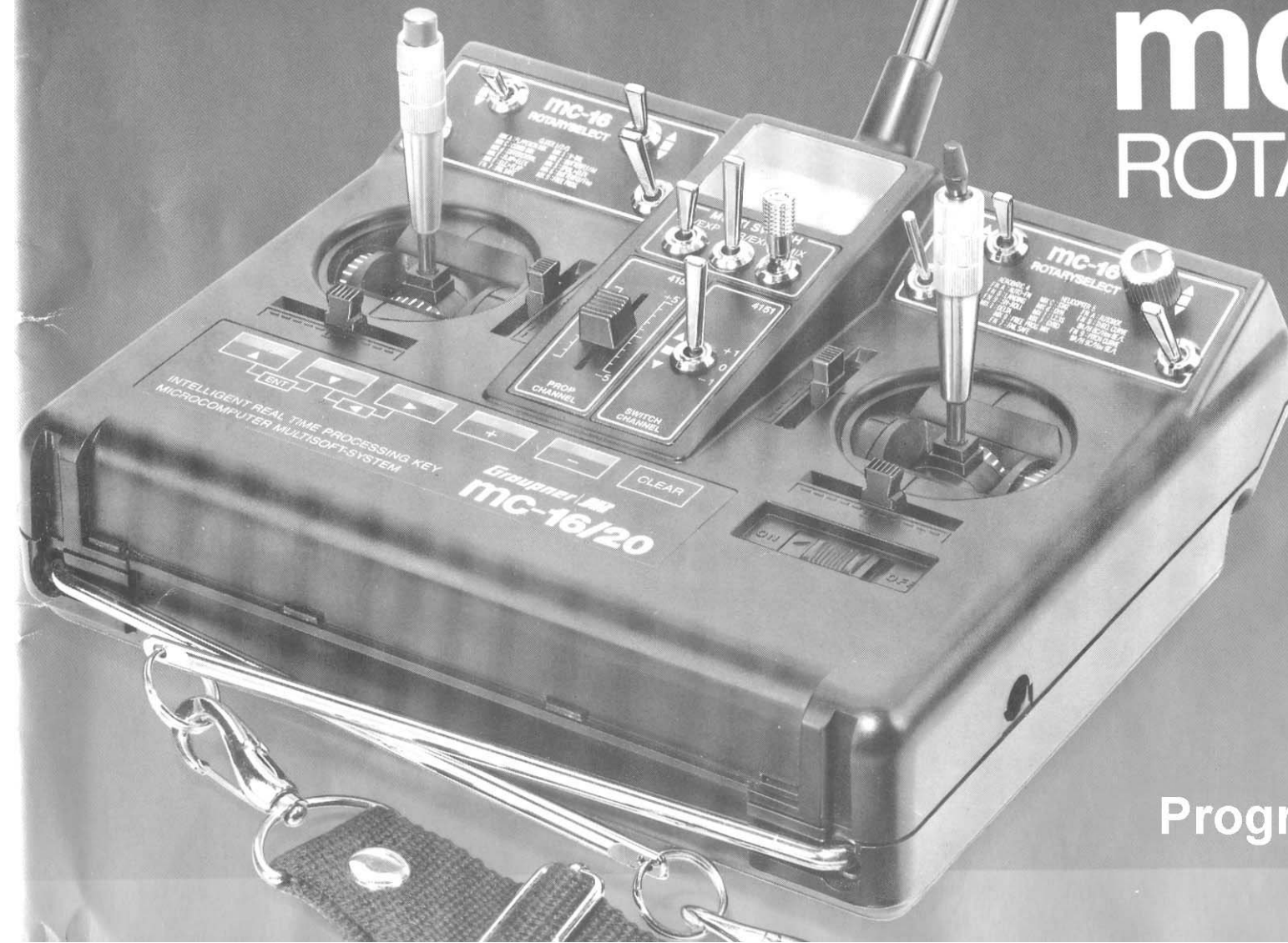


mc-16/20
Graupner JR
REMOTE CONTROL

mc-16/20 ROTARYSELECT



Programming Handbook

Contents

General Instructions

mc-16/20 Computer System 3 – 5	
Basic Installation Instructions	6 – 9
Connecting External Elements	10
Installing Modules	11
Compatibility	12
Starting Out	12
Multi-Data Terminal	13

System Usage (Fixed-Wing & Helicopter Models)

Software Structure	14
Switching On, System Menu Block Diagram	14
Modulation Mode	15
Model Type	15
Control Mode	15
Throttle Direction	16
Model Name	16
NAUTIC Program	16
Initialise Data (Reset Model)	17
Model Select	17
Receiver Connections	17

Operating System

General Instructions	18
Switching On, Menu Block Diagram	19

Fixed-Wing Models

<u>Menu Selection:</u>	
Dual-Rate	20
Exponential	20
Exponential / Dual-Rate	20
Servo Reverse	21
Servo Neutral	21
Servo Throw	21
Description of Mixers	22
Freely Programmable Mixers	22
Stopwatch and Alarm Timer	23 – 24
Fail Safe Memory, Receiver Battery Fail Safe	24 – 25
Examples of Prepared Programs	26 – 27

STANDARD “FL”

Description, Connection Diagram	28
Menu Block Diagram	29
Diagram of Adjustments	30 – 31
Combi-Mix (Aileron → Rudder)	32
Mixer, Flap → Elevator	32
Mixer, Elevator → Flap	32
Control Programmes (V-Tail, Delta)	33

UNIFLY “UN”

Description, Connection Diagram	34
Menu Block Diagram	35
Diagram of Adjustments	36 – 37
Mixer, Flap → Flaperon	38
Combi-Mix (Aileron → Rudder)	38
Differential Mixer	38 – 39
Mixer, Flap → Elevator	39
Mixer, Elevator → Flap	39
V-Tail Mixer	40
Mixer, Spoiler → Elevator	40

F3B / Butterfly “Fb”

Description, Connection Diagram	42
Menu Block Diagram	43
Diagram of Adjustments	44 – 45
Mixer, Flap → Flaperon	46
Differential Mixer	46
Combi-Mix (Aileron → Rudder)	47
Mixer, Flap → Elevator	47
Mixer, Elevator → Flap	47
V-Tail Mixer	48
Butterfly Mixer as a landing aid	49 – 50

AEROBATIC “AC”

Description, Connection Diagram	52
Menu Block Diagram	53
Diagram of Adjustments	54 – 55
Automatic Flight Manoeuvre (Snap Roll)	56
Dual-Rate / Exponential auto-coupling	56 – 57
Automatic Landing	57 – 58
Combi-Mix (Aileron → Rudder)	58
Mixer, Elevator → Flap	58
Control Programmes (V-Tail, Delta)	59

Helicopter “HE”

General Organisation of the Helicopter Model	60 – 61
Description, Connection Diagram	62
Menu Block Diagram	63
Diagram of Adjustments	64 – 65
Adjustment Instructions:	66
Swashplate Type	67
Servo Reverse	68
Servo Neutral	68
Servo Throw	68
Throttle – Collective Pitch Curve, Basic Explanation	69
Throttle – Collective Pitch Curve, Practical Process	70 – 71
Throttle Curve	72 – 73
Collective Pitch Curve	74 – 75
Autorotation	76
Static Torque Compensation	77
Dynamic Torque Compensation	77
Gyro Gain (Gyro Control)	78 – 79
Freely Programmable Mixers	80
Dual-Rate / Exponential	81
Stopwatch and Alarm Timer	82
Fail Safe Memory, Receiver Battery Fail Safe	83

NAUTIC

Multi Proportional Functions	84 – 85
Expert Switching Functions	86 – 87
Combination Multi Prop. & Expert Module	88 – 89

Appendix

Display Error Messages	90
Switches, Modules	91 – 92
Receivers	93
Transmitter Accessories	94 – 95
Teacher / Pupil	96
Final Notes	97
Quartz Crystals, Frequency Flags	98
Technical Data	99
General Equipment Approvals	100
Approval Documents	101 – 103

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 instructions 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 Åh (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 / 300mAh¹⁾

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.

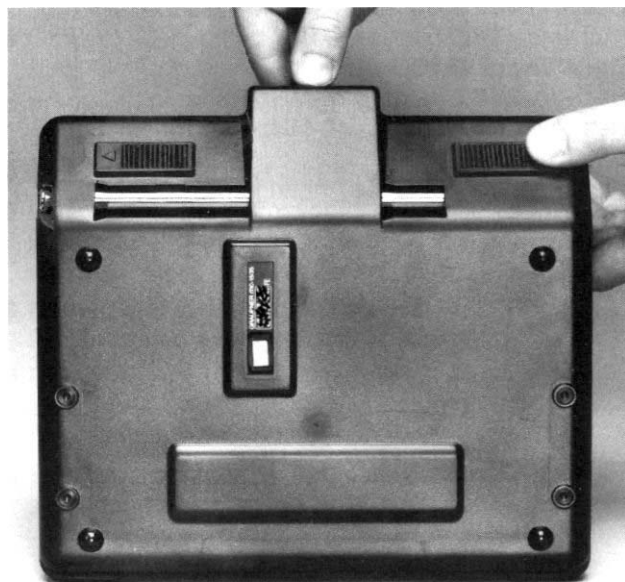
Further accessories – see the appendix and Graupner main catalogue.

Operating Instructions

Opening the Transmitter case

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

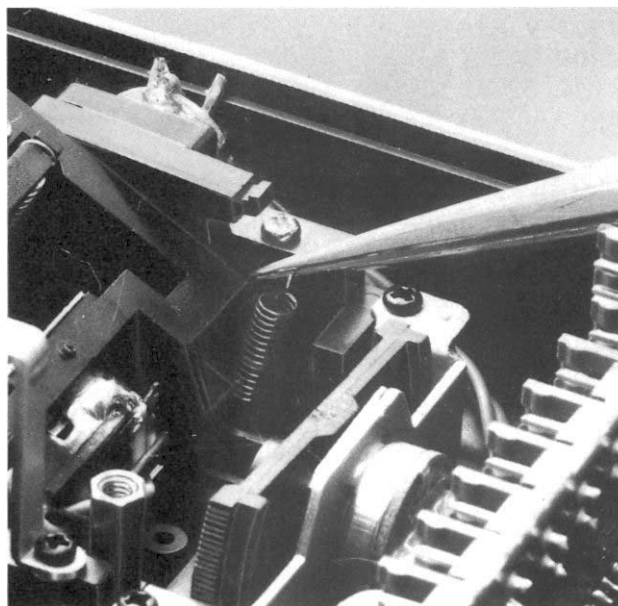
Before opening the Transmitter ensure the power switch is OFF. The sliding catches are moved against the direction of arrow (inward) until they hit the stop, then case back can be opened. To close, insert the case back into the housing at the lower edge. Push it closed and then slide both catches in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

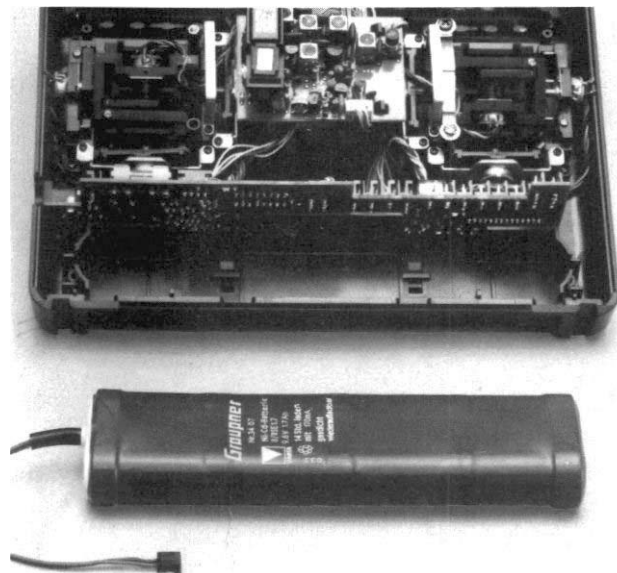
Different battery types are available to be selected. Into the battery mounting for the receiver, insert four AA cells of 1.2v and between 500 and 600mAh. Instead of the battery mounting, or in addition, a 4.8v battery with miniature plug can be used, see page 5.

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 be 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.

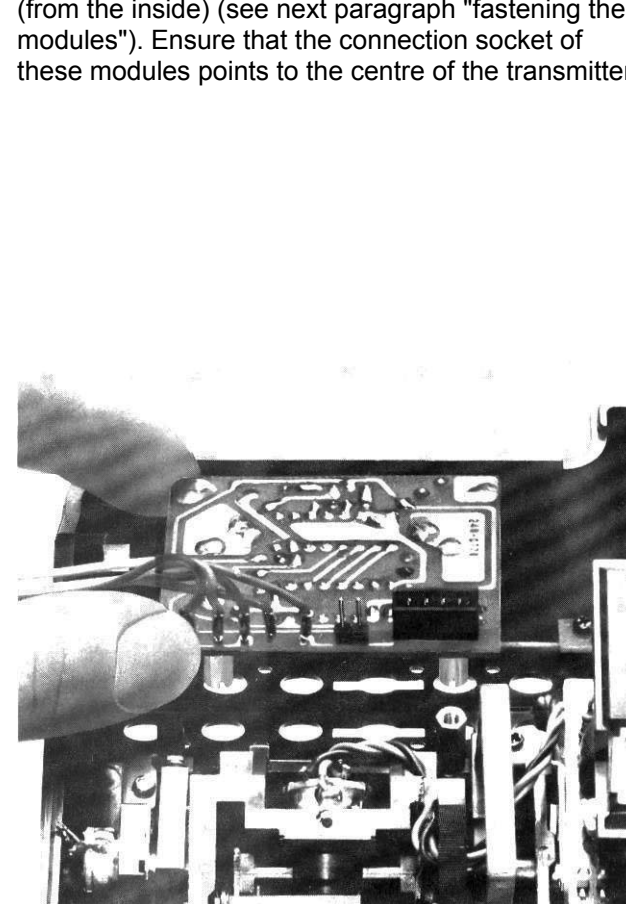
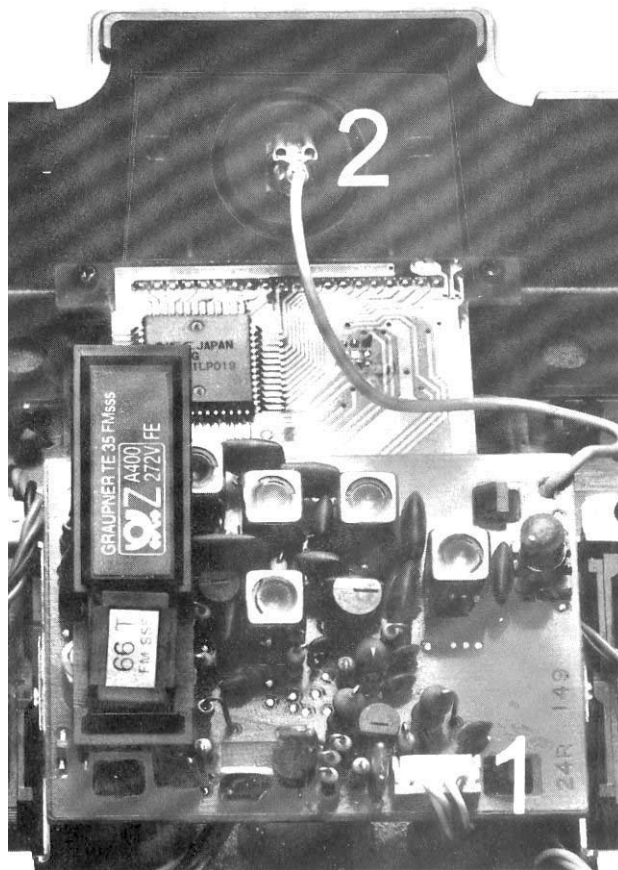
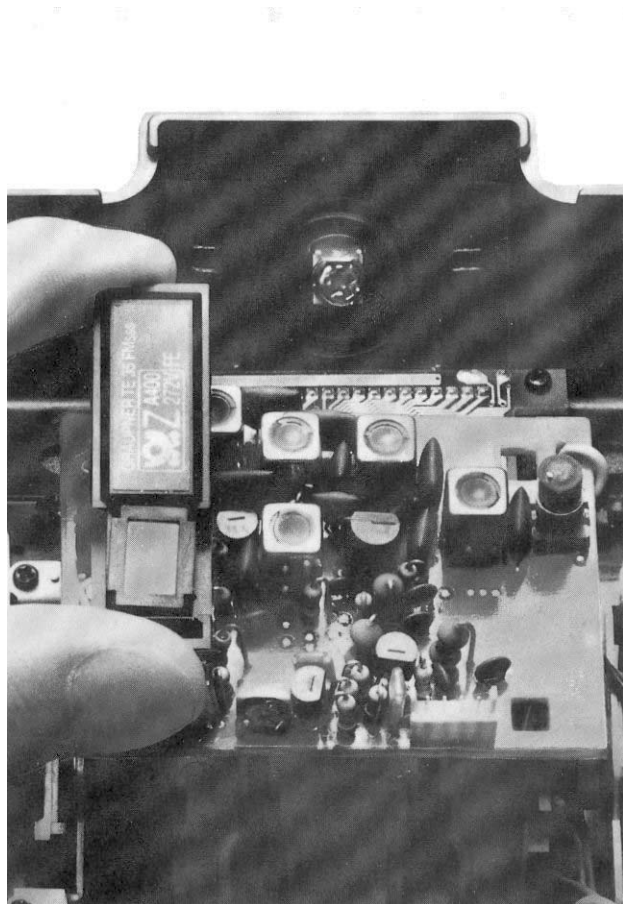
Changes of the HF channels: The channel is determined by the crystal. Only crystals of the correct type and the appropriate frequency band may be used (see page 98).

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

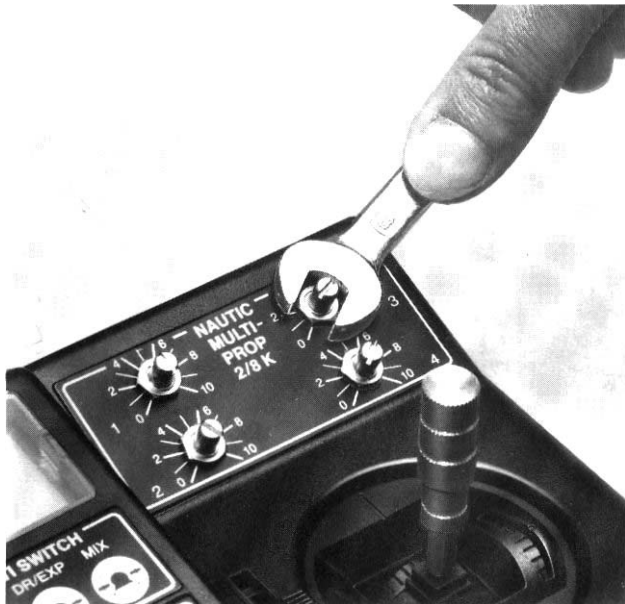
The Transmitter case is pre-drilled for the installation of the modules, like NAUTIC, Proportional and Switch Module. The blanking caps in the holes of the case can be removed pushing them outward with an appropriate object. To complete the assembly of the Proportional and Switch modules, Part. No. 4152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

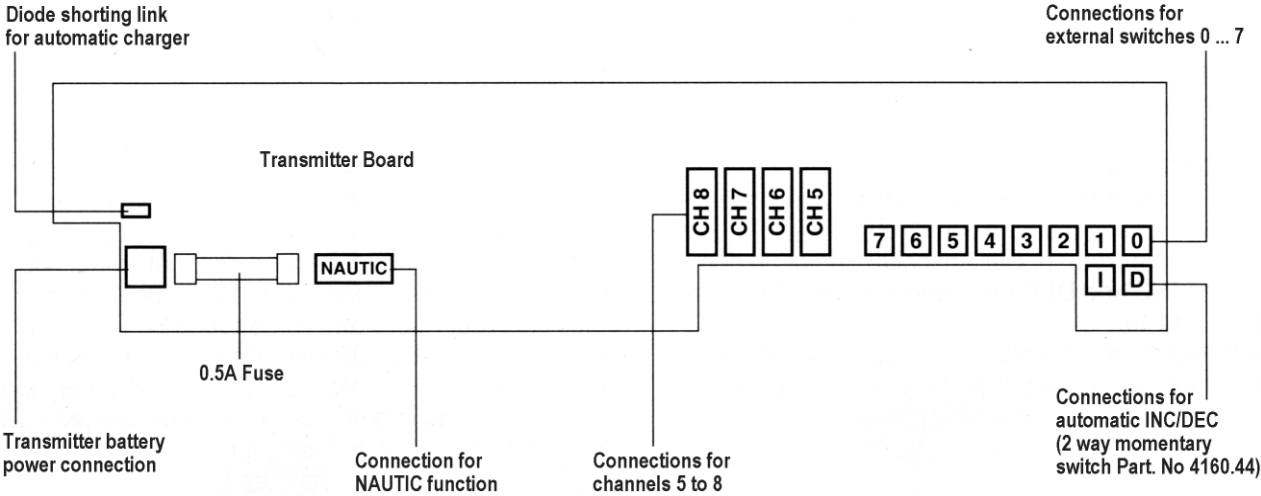


Assembly of the Transmitter Carriers

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"	Unify "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)				Aut rotation
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

