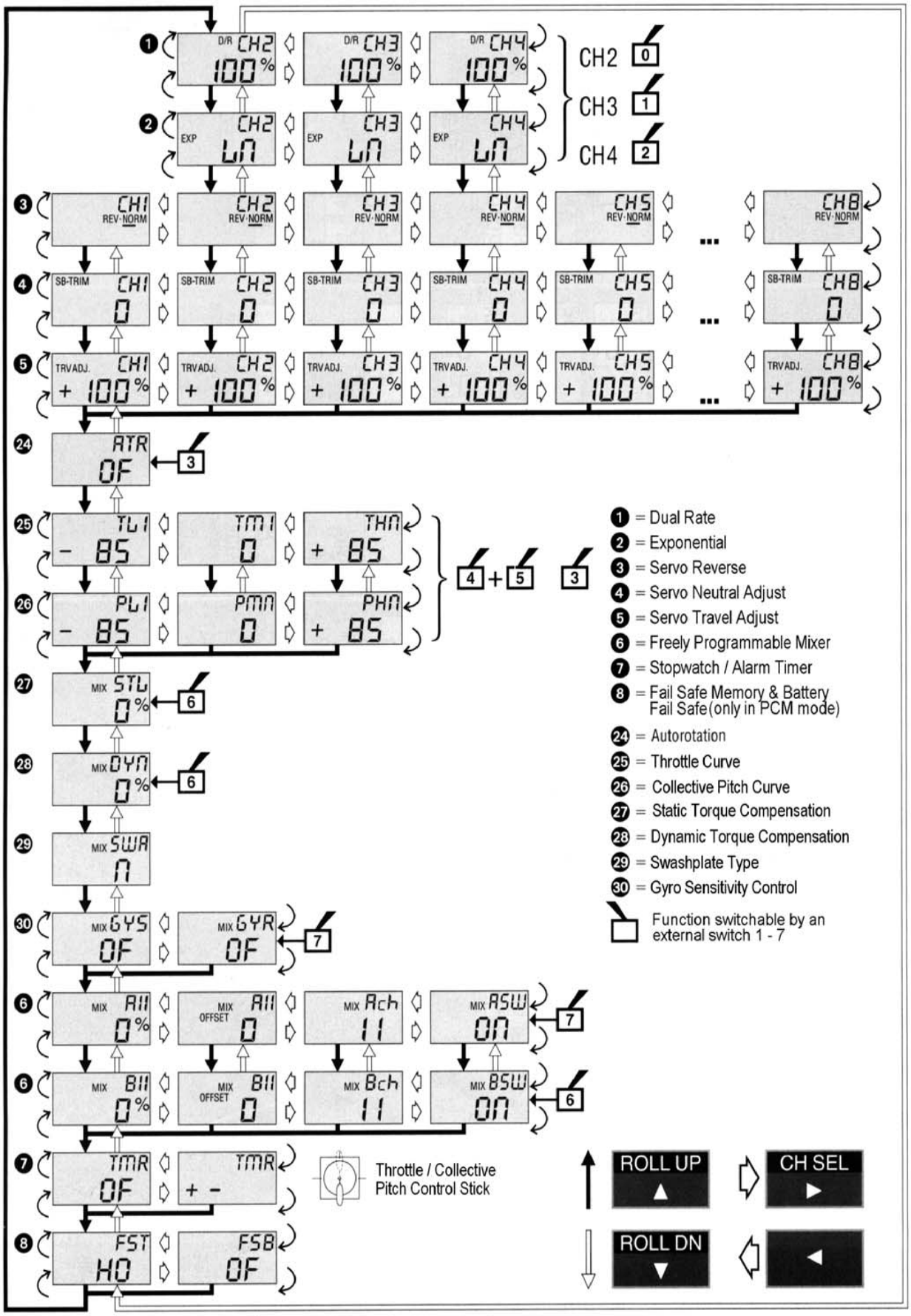
Block Diagram HELICOPTER "HE"



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)

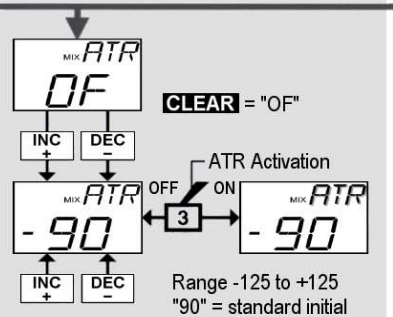
❶-❺, ❼, ❽

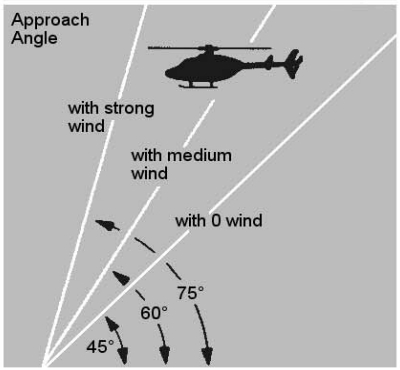
Adjustments ❶-❼, ❽ are available for all model types

- 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

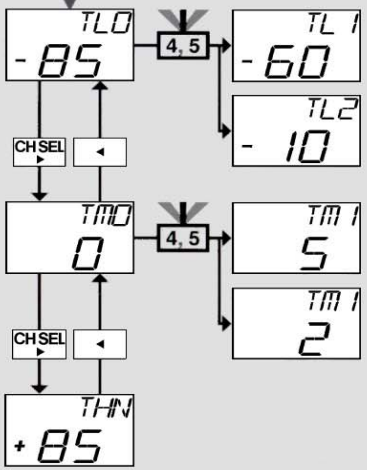
Autorotation
The functions throttle and collective pitch are separated, with the throttle servo taking a preset position. For autorotation an external switch connected to socket 3 is necessary. **CLEAR** deactivates the functions ("OF"), to prevent inadvertent change over to ATR. With ATR activated the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



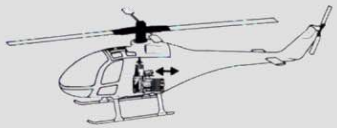


❷❺ TL/M/H ...

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).

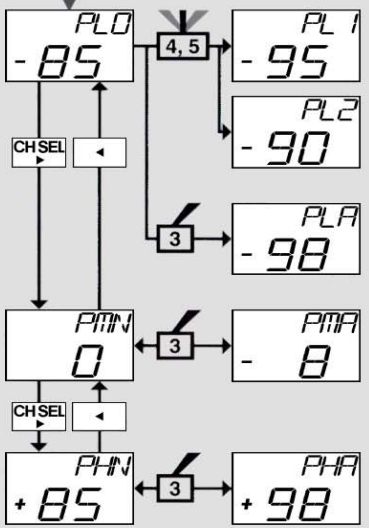


Select the desired value with **INC** or **DEC**. Range -125 to +125



❷❻ PL/M/H ...

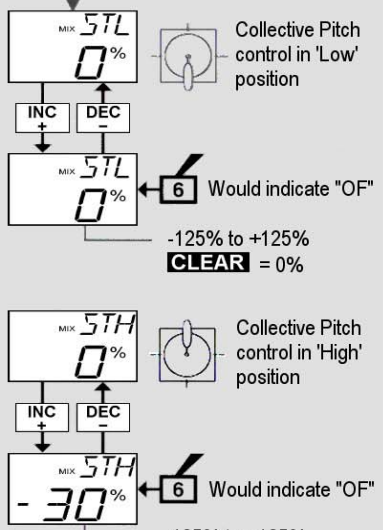
Collective Pitch Curves (Pitch Low / Hover / High)
Three different collective pitch curves can be set and switched between during the flight. The maximum collective pitch (PHN) and hover pitch (PMN) are fixed together for all three curves; a separate value can be set for for pitch minimum (PL0,1,2). 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

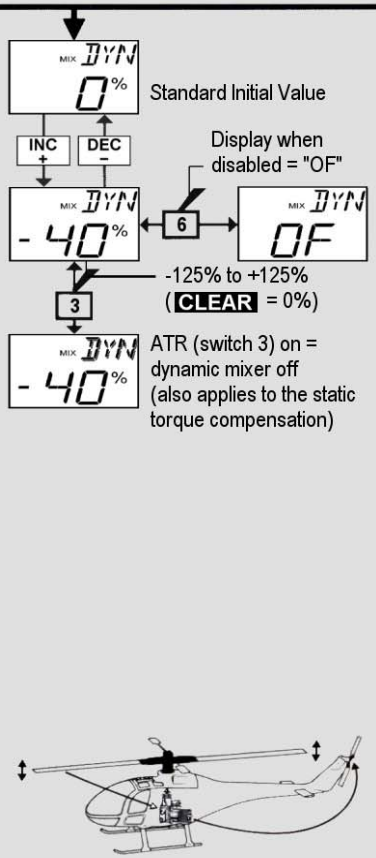
Static Torque Compensation
Using **INC** / **DEC** the low (STL) and high collective pitch (STH) static torque mix for Pitch ➡ Tail Rotor pitch. The position of the tail rotor Servos depends on the maximum and minimum pitch values set here. The mix direction must be selected according to the direction 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.



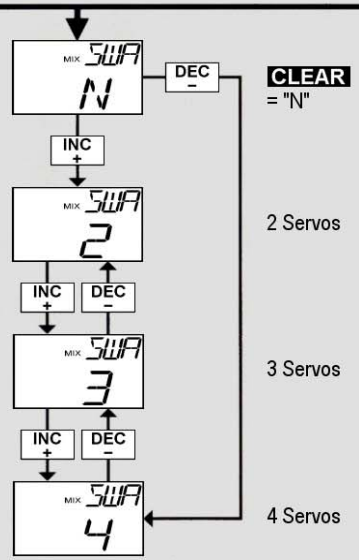
All mixer data can be set to 0, i.e. switched off using the CLEAR key. Display "OF" = the external mixer is switched off.

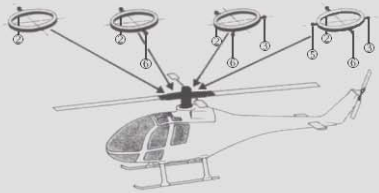
㉘ MIX DYN

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").



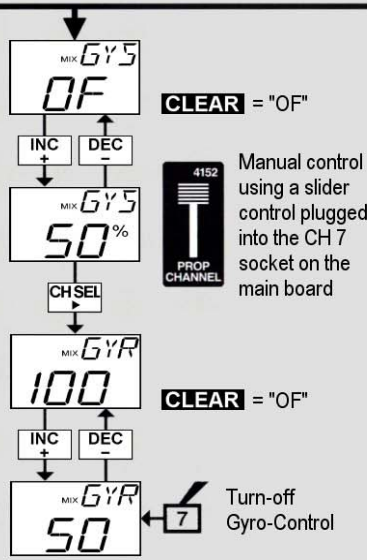
㉙ MIX SWA





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.

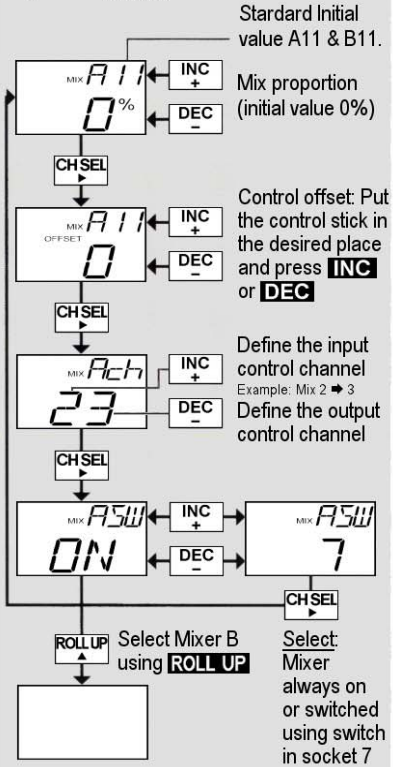


Gyro effect is presettable within a range of 50 to 100% of tail rotor control stick deflection

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.

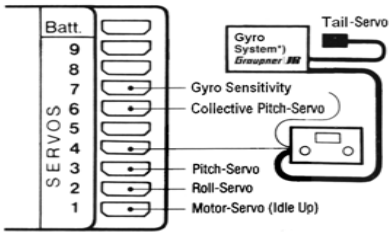
Mixer	External Switch
B	Socket 6
A	Socket 7



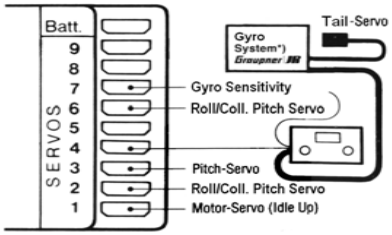
Connections to the receiver (Ch 1 to 8)

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

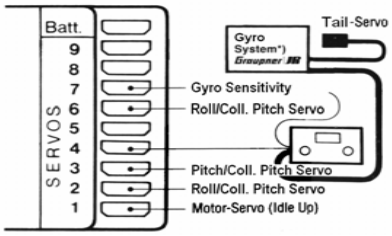
Swashplate Type N



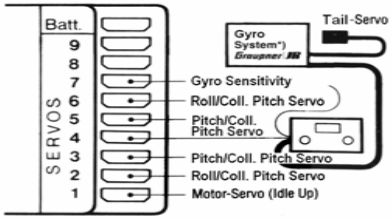
Swashplate Type 2



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).

SWASHPLATE TYPE

Swashplate Mixer
(access via Set-Up Menu)

Four different programs exist for the control of the swashplate:

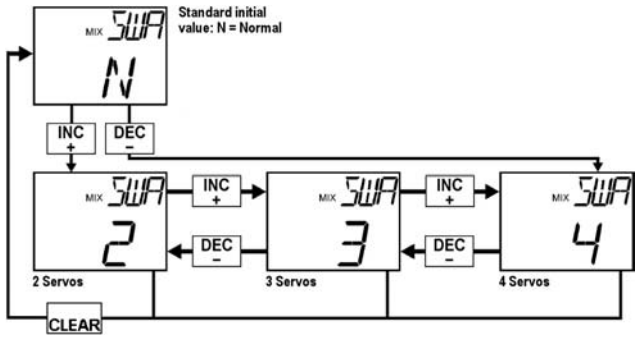
"N" (Normal) The swashplate is tilted for roll by a servo; the collective pitch control is by a separate servo. Type "N" also includes those helicopters with mechanic mixers to achieve the collective and cyclic blade control.

"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).

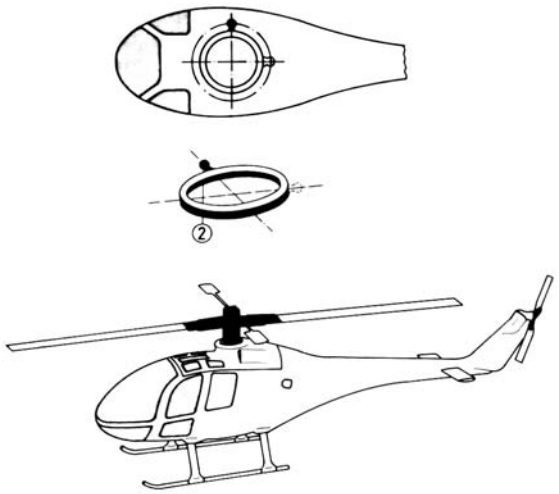
"3" Symmetrical three point control of the swashplate using three coupling points at 120°, to which a fore & aft pitch / collective pitch servo (in front or at the rear) and two roll / collective pitch servos (laterally on the left and right) are connected. For collective pitch all three servos move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

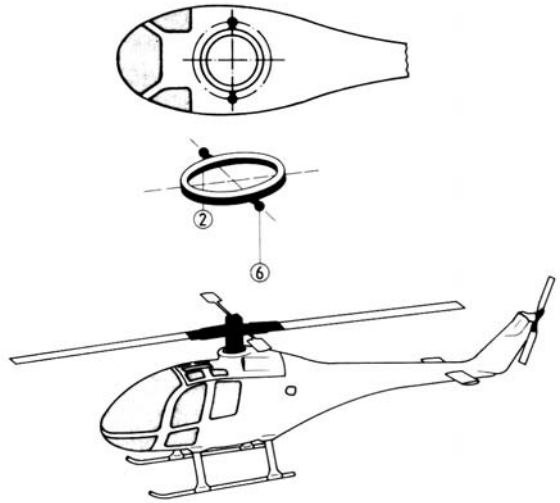
The selection of the code is achieve using the INC / DEC buttons.



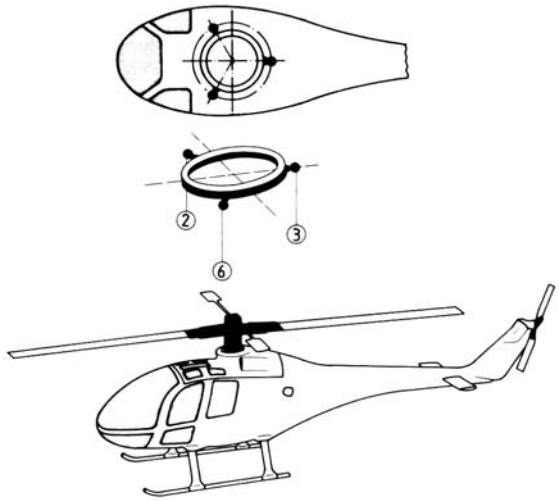
Program »N«
1 Servo



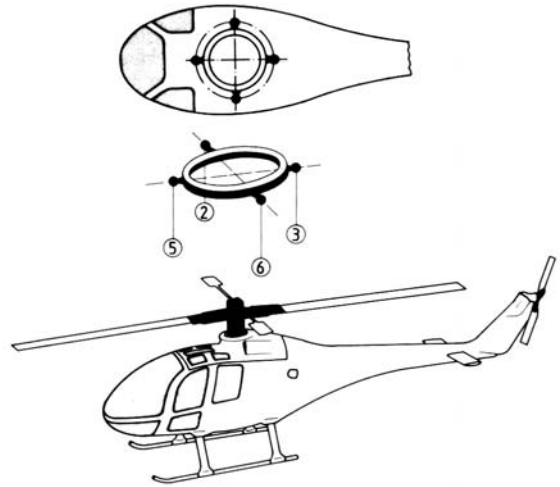
Program »2«
2 Roll servos



Program »3«
2 Roll servos and 1 Pitch servo



Program »4«
2 Roll servos and 2 Pitch servos

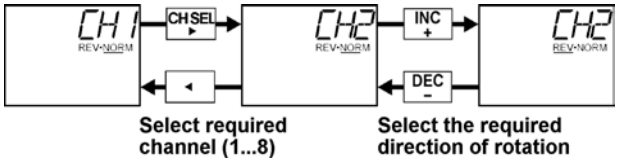


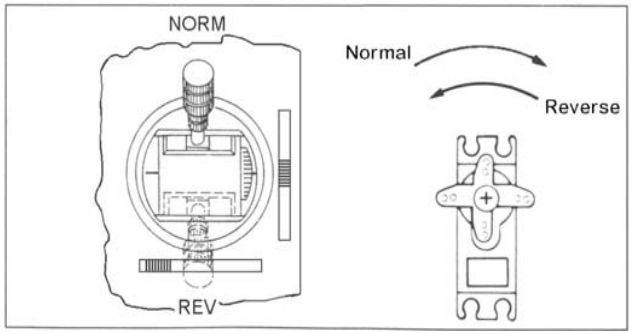
SERVO REVERSE

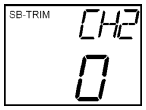
Reversing the Rotation of the Servos
(access via Set-Up Menu)

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.



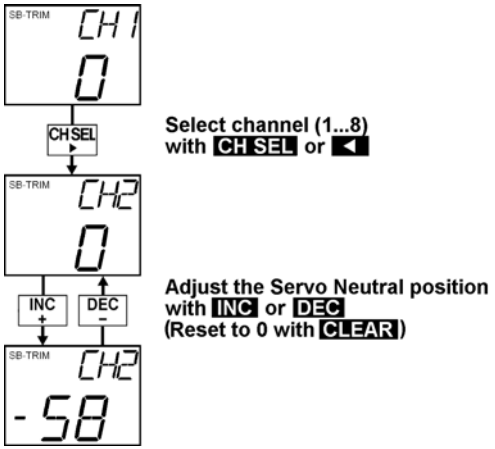


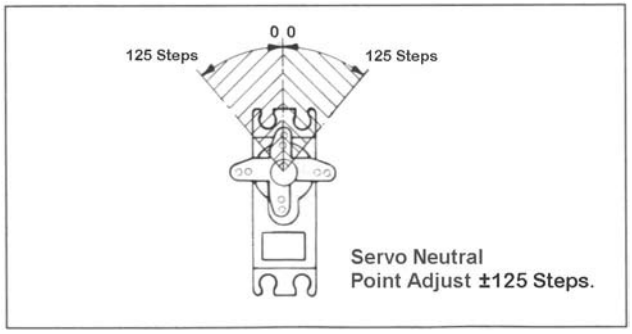


SERVO NEUTRAL POSITION

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.

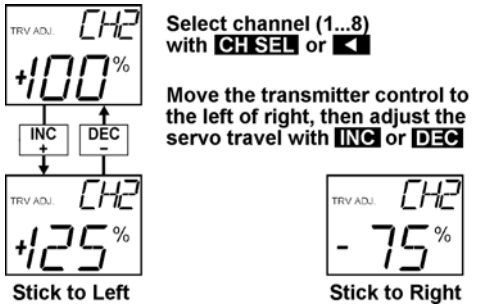


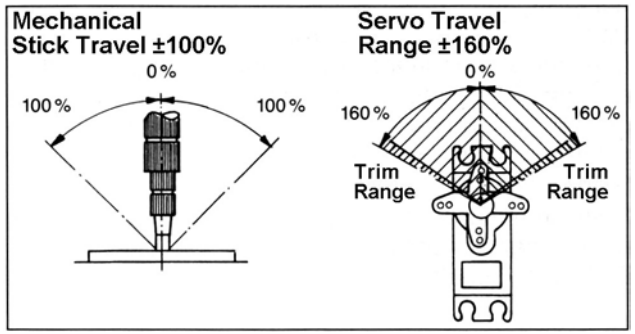


SERVO TRAVEL

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.

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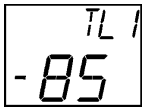

Throttle Curve

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.