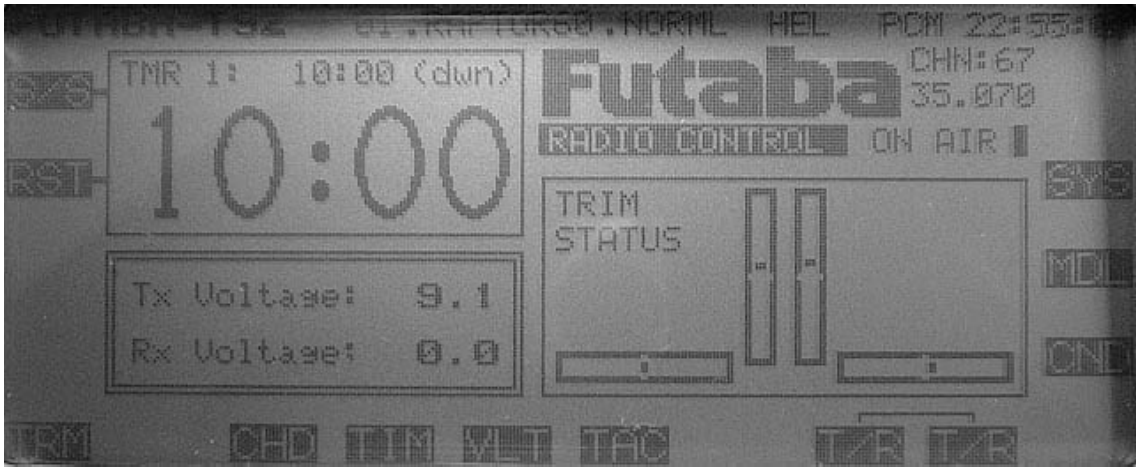
Last updated: 7-Sep-05, 11:12:16 PM

Tweaking the Futaba 9Z

Please note:

This page may take a while to load due to the large amount of photographs.



Most Futaba radios have a formerly secret service menu implemented into their firmware. This menu was designed for transmitter testing and servicing, but also allows a degree of radio customization.

One of the greatest features available through the service menu is the ability to customize the toggle switches (switch A through to switch H). In fact any combination is possible including the ability to swap switches such as Idle-Up and Thro-Hold or any other pair. This also makes possible the installation of 3-position switches to any 9Z radio allowing an identical switch configuration with the latest 9Z WC2.

In fact there are only 3 things that differentiate a WC2 from its predecessor WC

a. The new blue colour, and stronger switch bases
b. Switches A,B and D now offer a middle (third) position
c. A slightly improved firmware that offers the so-called "accelerated frame rate around centre", which improves the response of the fourth digital servo in 4-servo CCPM implementations.

Thus if you are not flying 4-point CCPM helicopters fitted with digital servos this simple switch conversion could really give you all the benefits of the new WC2 system. Not to mention that the stronger switch bases, blue stick and stickers are available from Futaba service centres. Isn't it time to give your radio a new look?

The 9Z has numerous other service menu functions which allow quick testing of the radio's electronic and mechanical components such as sticks, knobs, slides, switches, trims, voltmeter and tachometer. Additionally, one could also see the firmware version, the radio's total usage time and most importantly, retrieve the password which is commonly forgotten.

I have received a number of emails from people who bought a second-hand 9Z transmitter and were seeking advice on how to convert from stick mode 1 to 2 or the opposite. The physical conversion is relatively simple for someone who can carefully unplug a few cables and lift one of the PCBs (*). However, once the physical alternations are made it is necessary to recalibrate the sticks due to elevator and throttle having different amount of travel. If such calibration in not performed the unwanted effects include increased elevator servo throw (beyond the radio's specifications) and throttle/pitch curve points 1,2,12,13 becoming unreachable. Again the service menu will allow you to perform such a task (**).

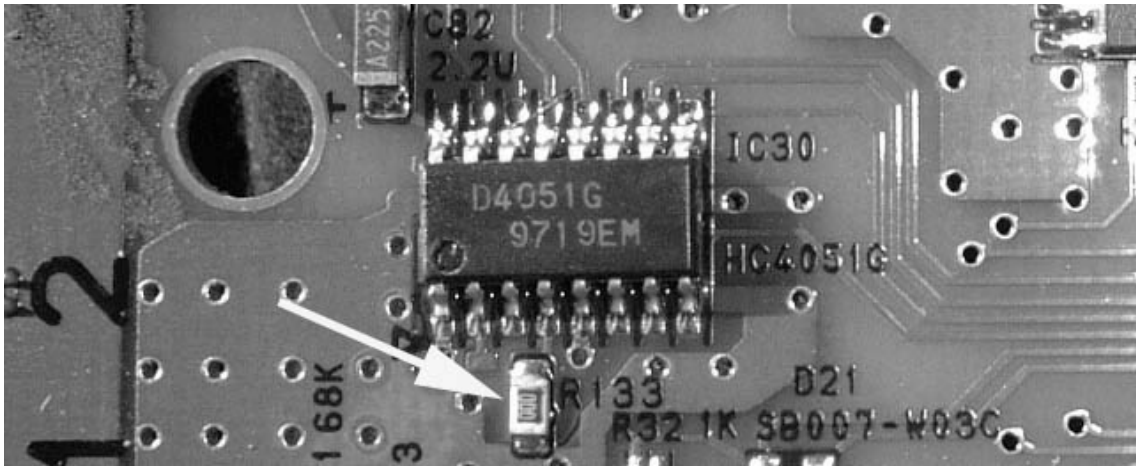
Calibration is not only required when a stick mode conversion is performed. In the short time that I have owned a 9Z I noticed that slight drifts have developed to the neutral positions due to normal wear of the joystick potentiometers. Factory calibration may also be lost when the lithium back-up battery is replaced.

Non-calibrated stick neutral positions may cause various unwanted effects such as small aileron, elevator or rudder servo movement upon activation of Dual Rates (D/R). This undoubtedly changes in the aircrafts trimming upon activation of D/R and becomes more obvious at low values of D/R.

If you are unsure to whether your transmitter's sticks are correctly calibrated or not, you can perform this simple test.

1. Start by selecting a blank (freshly reset) airplane program.
2. Go to the ATV menu
3. Hold both sticks fully up and fully right while switching between AIL, ELE, THR and RUD. If the pointer below the graph moves even a little while you are switching channels you radio needs calibration.
4. Repeat step 3 but now holding both sticks fully down and fully left.
5. Finally, repeat step 3 with both sticks cantered (including throttle axis).

People often ask how to convert the default transmitter program from airplane to helicopter (or vice versa) or how to change the default stick mode between 1 and 2. Such conversion requires the replacement of a resistor (R133) and once done a complete hardware reset is required for the changes to take effect. Such reset erases all stick calibration values, thus we again need access to the service menu to recalibrate the radio. The picture below will help you identify the part that needs to be replaced. If you cannot find a replacement SMD resistor (package type 0805) you can use any standard size resistor. Also you may use a piece of wire instead of a zero-ohm resistor.



No.Resistor (open circuit) = stick mode 1, T9ZHP (heli)
68K (labelled 683) = stick mode 2, T9ZHP (heli)

18K (labelled 183)	= stick mode 1, T9ZAP (air)
Short (labelled 000)	= stick mode 2, T9ZAP (air)

Added 16 Jan 2005: As described above a complete hardware reset is needed for the new stick mode to come into effect. A complete hardware reset may also be needed if the voltmeter calibration is accidentally damaged. In such case the hardware reset will load the factory default calibration values. The accuracy of the voltmeter will increase if the calibration is performed fully as described below however in most cases the factory default values fall very close.

The complete hardware reset is performed by shorting two pads on the 9Z processor circuit board. These can be reached via two small holes at the bottom of the battery compartment, thus disassembly of the transmitter is not necessary. The pads need to be shorted for a couple of seconds using a piece of wire. A paperclip works well. On the next power on the transmitter will display a warning message. Powering the transmitter off and back on will clear this. Following a hardware reset the joysticks will need to be recalibrated as described below. Note that the hardware reset erases all data from the transmitter including model programs, thus a copy needs to be made to a CAMPac, UltraPAC or equivalent storage card.

Added 8 June 2003: I know that it is hard sometimes to buy SMD parts at small quantities. Thus I ordered some of each of the above resistors. If you are planning to make a conversion you will most likely need an UltraPAC to recalibrate the transmitter. When placing your order for the UltraPAC please let me know that you require resistors and I will include them in your order free of charge.

Below you will find detailed explanation of each of the service menu screens. Access to the service menu can be obtained using our UltraPAC. See the products page for details.

If you have any questions regarding these modifications or issues not discussed here please do not hesitate to contact me. Remember, when any alteration is performed to your radio system, regardless of how minor, you are strongly advised to carry out a full check of the controls prior to operating each of your models.

Finally, if you would like to see a personal message from the developers of 9Z go to the voltmeter screen and press [L] and [M] simultaneously. Once the first message appears you may press [L] and [M] again which brings a second message up.

Happy flying!

-Angelos

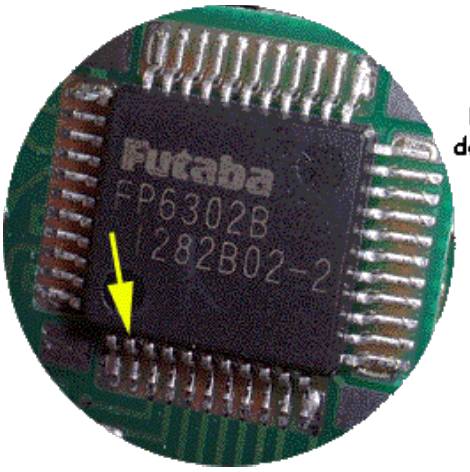
(*) Physical conversion of the stick mode requires disassembly of the transmitter which includes

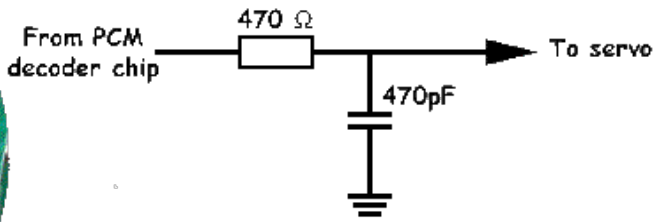
temporary removal of one circuit board. However, once access to the rear of the joysticks is possible, conversion can be performed fairly easy. People often mistaken and swap the two joysticks around. This is not required and in fact will cause confusion as the stick positions will no longer correspond to the trims and to what is shown on the screen of the transmitter. If you take a careful look at the joystick mechanics you will notice that the throttle axis has a spring too which is retained extended by a plastic tab to prevent automatic centring of the throttle. There are also two limiters that reduce its full through. All that is required for the stick mode conversion is to remove the tab and the two limiters and install them at the other joystick. At this point you have two options. The first one involves the replacement of R133 (see above) which will result in a perfect conversion where your radio will function as if it was manufactured for this new stick mode. Your second option is to proceed without replacing R133. However, you will still need to calibrate the sticks as J2 and J3 now have different through than before. Additionally, since R133 is not replaced the transmitter is not aware of the new stick layout, thus every time you create a new model program (or reset a model program) you will have to go to FNC menu and manually define how the sticks and trims are coupled with the output servo channels.

(**) Futaba distributors in USA found a quick way to resolve this issue without revealing the service menu. They recommend a full hardware reset. Such reset erases all calibration parameters and loads some default values. These default values are approximate values for any newly manufactured transmitter and they represent calibration values of both elevator and throttle being of short stick travel. This procedure will resolve the problem of throttle/pitch curve points being unreachable, however the increased elevator servo throw will remain. The reset will also wipe the factory calibration of the voltmeters, in which case the voltmeters will continue to function but they may have reduced accuracy. Loss of neutral point calibration may also affect the aircraft's trimming upon activation of Dual Rates as discussed above.

Added 15 Dec 2002: Great news! Last night I discovered that my 9Z-WC in fact transmits a 10th channel! Channel 10 is non-proportional just like channel 9 and is permanently assigned to switch-D. The signal for channel 10 is produced by the PCM decoder chip (FR6302B) and available inside the receiver (pointed by the yellow arrow below). It can be accessible externally with an easy and inexpensive modification. All you need is a 470 Ohm resistor, a 470pF capacitor and a servo socket. Have a look at the DIY page to see how I did it on my FP-R129DP receiver.

So why didn't Futaba call it 10Z?





Added 29 Dec 2002: The "accelerated frame rate" feature of the latest 9Z WC2 has been broadly discussed at various internet newsgroups, yet very little information was given out by Futaba of what it really is. People often debate to whether it has notable effect to their flying. Some say that it is essential for 4-point CCPM helicopters with digital servos, some say that they see no difference at all and finally some point out that their flying skills aren't probably good enough to see any difference but perhaps the proz can! The so called by some problem is caused when using the latest digital servos which respond much faster. For the CCPM swashplate to move smoothly it requires accurate coordination of the motion of all servos involved. If any of the servos is not updated with positioning information in time the corresponding side of the swashplate will seem to lag. This small lag was always there in the 9Z radios but it has now become more obvious with the new digital servos. Simply, traditional servos like the S9202 wouldn't even seem to start moving within the time it takes to update all remaining servos.

The servo positioning information is obviously tunnelled over the radio link. In the past I though that Futaba had a way of updating certain channels more frequently though their PCM1024 protocol while penalising secondary channels of less importance like Ch5, Ch7 and Ch8. I have know discovered enough about the PCM protocol to know that this is not the case since channel allocations within each PCM frame are not interchangeable. This leaves only one possibility; that the 9Z WC2 computes the servo positions faster. Most likely the 9Z's processor cannot compute all mixes and CCPM servo positions within the time it takes to transmit one frame. As a result some of the servo positions will have to be transmitted in the next frame approximately 28msec later. This is where the lag arises. If they could however do the maths just a bit faster it would be possible to transmit all CCPM channels in time.

Based on information that I have collected from various sources including Futaba's website I have a very good idea of what "accelerated frame rate" really does. The

most important hint is that "accelerated frame rate" only works "near centre" and for one quarter of stick travel. Let's assume that 9Z uses "signed integers" for the maths. As we all know it is a 1024 step system. Thus -511 would correspond to a stick being fully left, 0 to centre and +511 fully right. For one quarter of the full stick travel at the centre the possible values would be in the range -127 to 127 which can be represented by 8bits rather than the 10bits required for the full stick travel. It is much faster to do calculations on 8bit numbers than 10bit. It could take less than haft the time! Thus what seems to happen inside the 9Z WC2 is:

1. The 9Z reads the stick positions and determines if aileron and elevator are within -127 to +127.
2. If this is true, it quickly works out a result based on 8bit numbers. There is no loss of resolution as these 8bits only correspond to one quarter of stick travel rather than full travel which of course requires 10bits (see below)
3. If however the stick position is outside the -127 to +127 range, the 9Z would use the older and slower 10bit algorithms to do the calculations. Obviously, there is no improvement in this case.

I haven't seen any references of "accelerated frame rate" improving any other controls in airplanes, helicopters or gliders rather than CCPM. CCPM is probably the most computationally demanding mix and thus the only one requiring this fix.

This is just my opinion but it does make sense. Oh well… at least it makes sense to me!

T9Z Service Menu

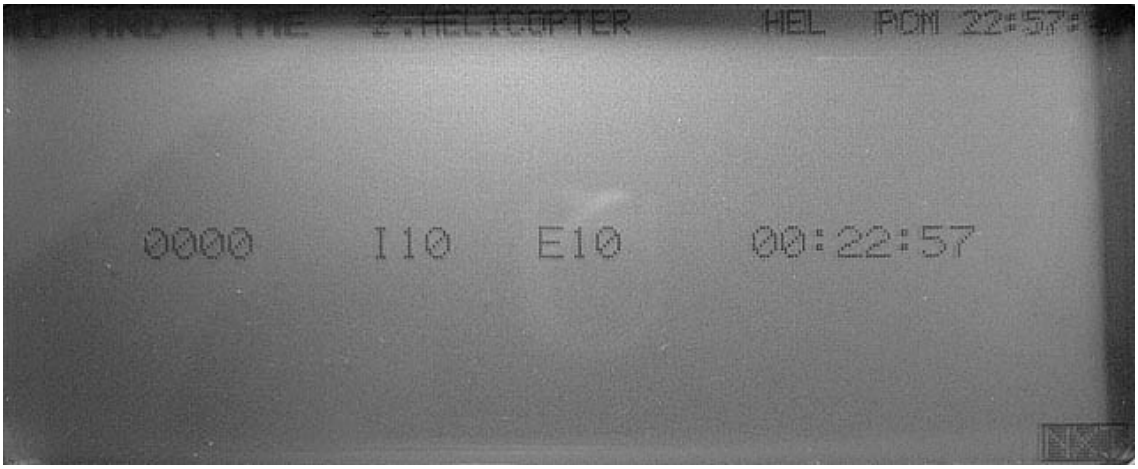
Service Menu Main Screen

2.HELICOPTER = Stick Mode 2, helicopter version (T9ZHP)

[A] takes you to "ID AND TIME" and "SWITCH TYPE" screens

[B] takes you to every other screen

ID AND TIME



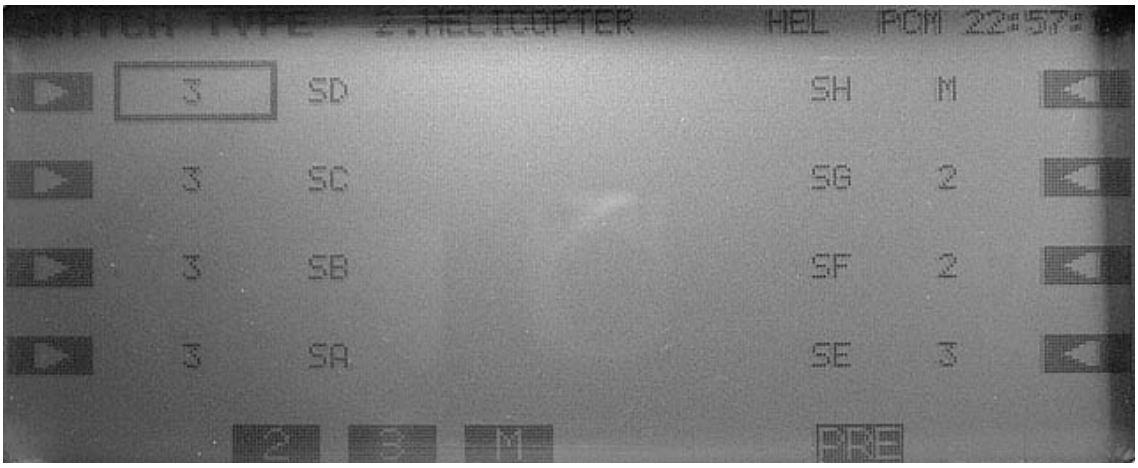
0000 = ID number (password)

I10 = internal firmware version 1.0

E10 = external ROM contains firmware version 1.0

00:22:57 = Total usage time (hours x100 : hours : minutes)

SWITCH TYPE



This screen allows customization of the switch configuration. Obviously physical replacement of the switch is also required. All types of switches have the same number of contacts and identical footprint which makes direct replacement possible.

Select the switch you wish to modify, then choose between [2], [3] or [M]

2 = 2-position switch

3 = 3-position switch

M = momentary switch

SA - SH = Switch A – Switch H

SWITCH REV

Calibration process for the toggle switches:

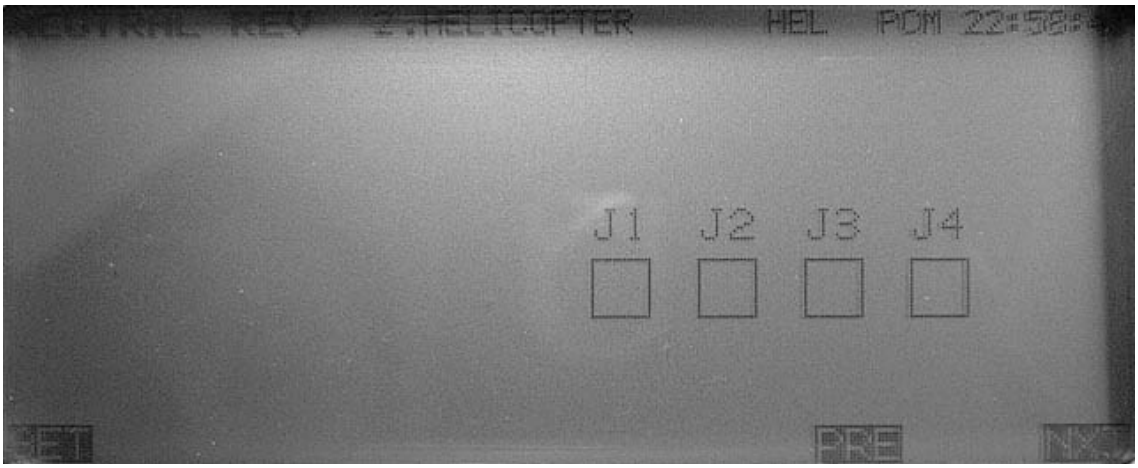
Press [SET], toggle switch A, press [SET]

(Do not calibrate the middle position of switch A – if such position exists on your radio)

Confirmation of successful calibration:

Both boxes should become black.

NEUTRAL REV



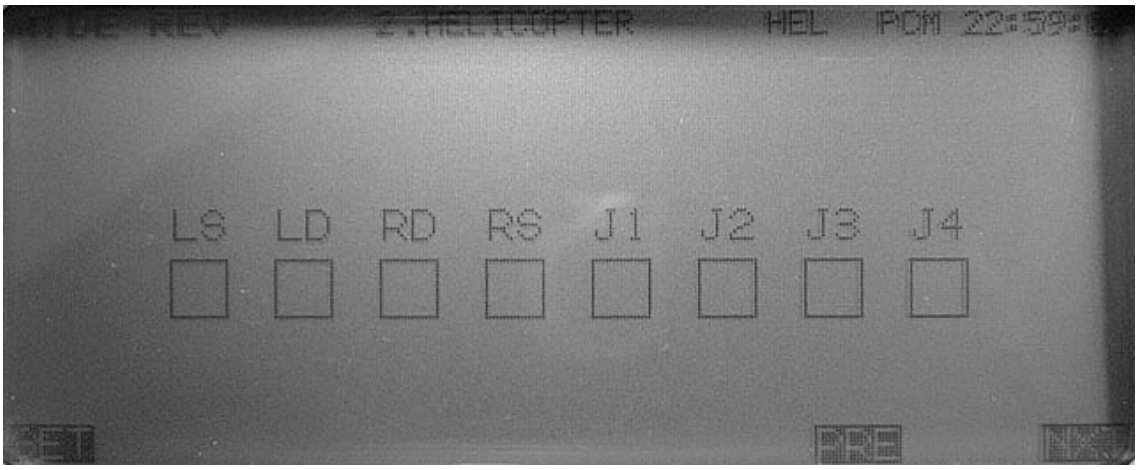
Neutral calibration process for the joysticks:

Set all sticks to neutral (centre) including throttle, Press [SET]

Confirmation of successful calibration:

All four boxes should become black.

WIDE REV



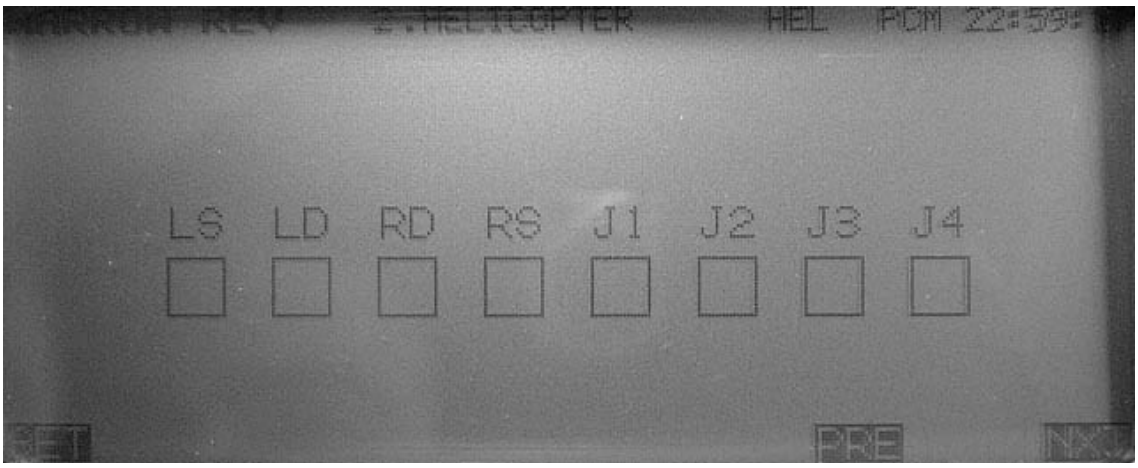
Move both sticks fully right and fully down, set knobs fully clockwise and sliders fully down. Press [SET]

Confirmation of successful calibration:

All eight boxes should become black.

Note: These controls can be calibrated individually. Any control that we do not wish to calibrate must remain at the centre of its range.

NARROW REV



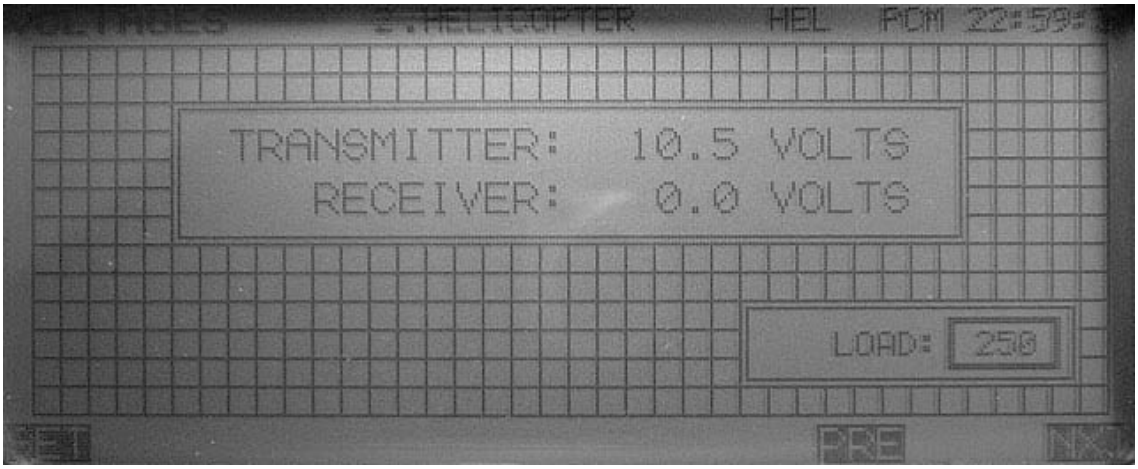
Move both sticks fully left and fully up, set knobs fully anticlockwise and sliders fully up. Press [SET]

Confirmation of successful calibration:

All eight boxes should become black.

Note: These controls can be calibrated individually. Any control that we do not wish to calibrate must remain at the centre of its range.

VOLTAGES (calibration)



Voltmeter calibration procedure:

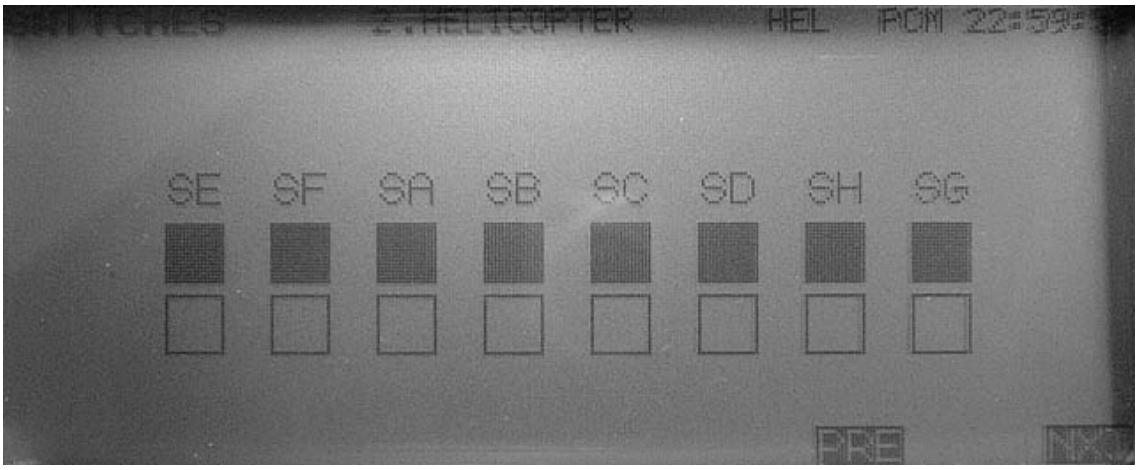
Two calibrated power supplies are required.

Set the battery voltage to 8.5±0.2V and the receiver voltage input (DIN connector, Pin.6) to 5±0.2V. Press [SET]

Confirmation of successful calibration:

None at this stage. However, voltage check is available at later screens.

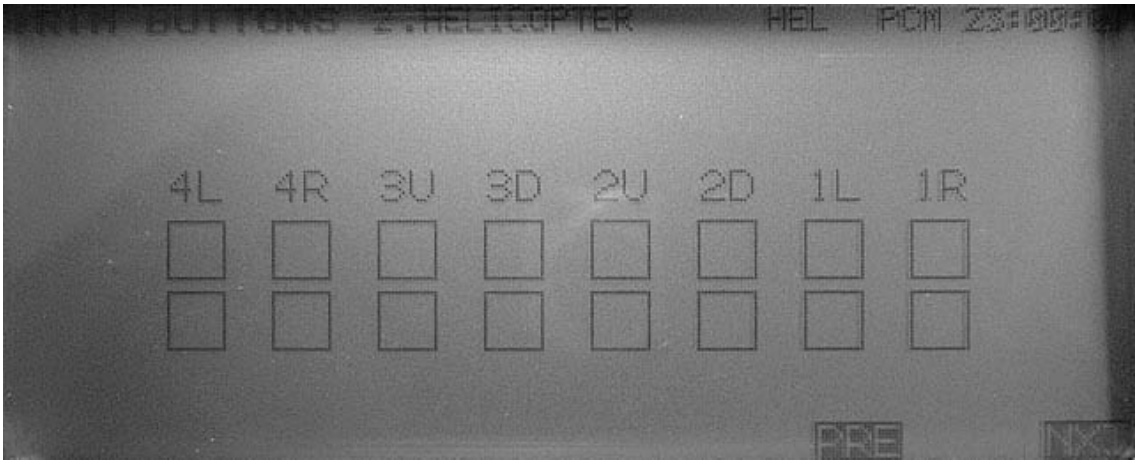
SWITCHES



Toggle switch check. Move switches to all position.

All boxes should become black.

TRIM BUTTONS

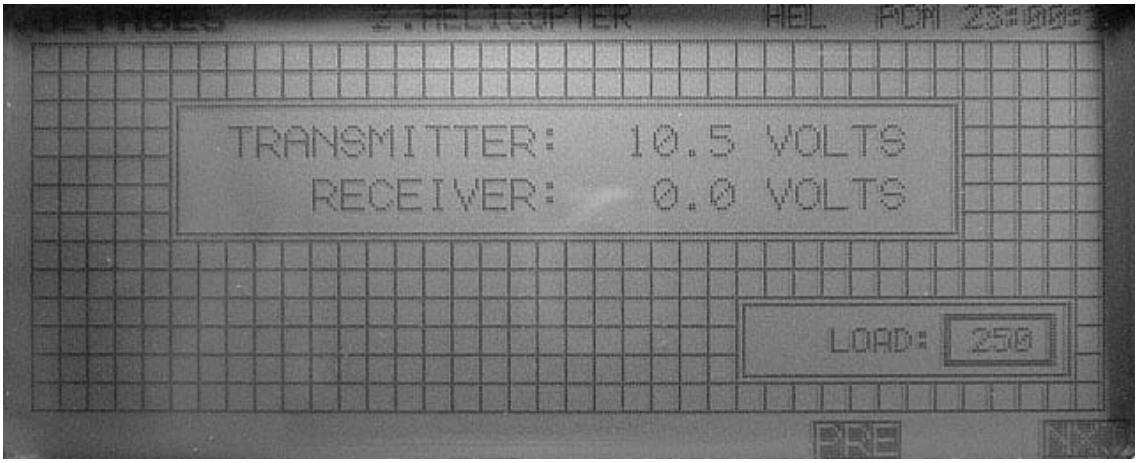


Operate the trims and confirm that the corresponding box is turned black.

Top line corresponds to normal trim.

Bottom line corresponds to fast trim (harder press of the switch).

VOLTAGES (check)

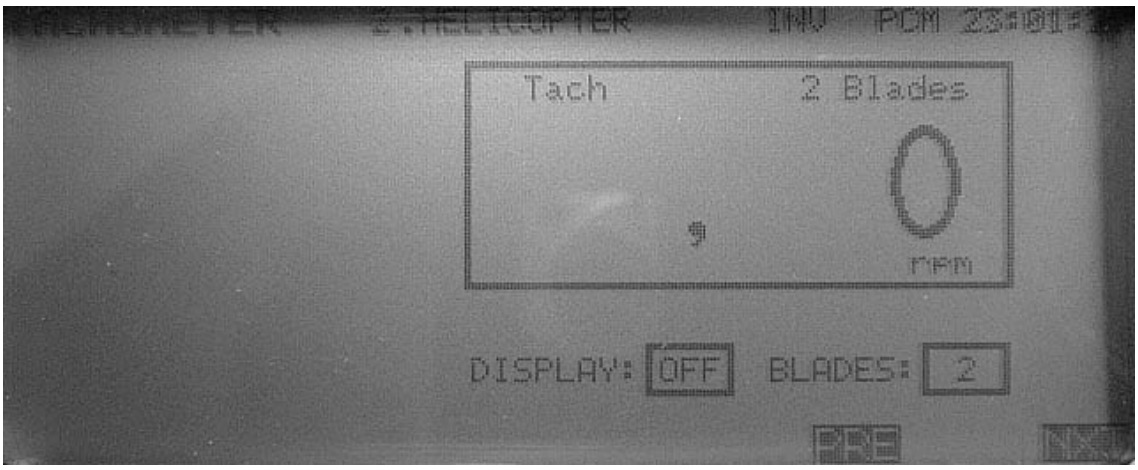


Two calibrated power supplies are required.

Set the battery voltage to 8.5V and the receiver voltage input (DIN connector, Pin.6) to 5V

Confirm that displayed voltages are within ±0.2V of power supply voltage.

TACHOMETER



Check tachometer operation.

Procedure: Position tachometer sensor near a fluorescent light tube or TV screen (not computer monitor).

Reading should be:

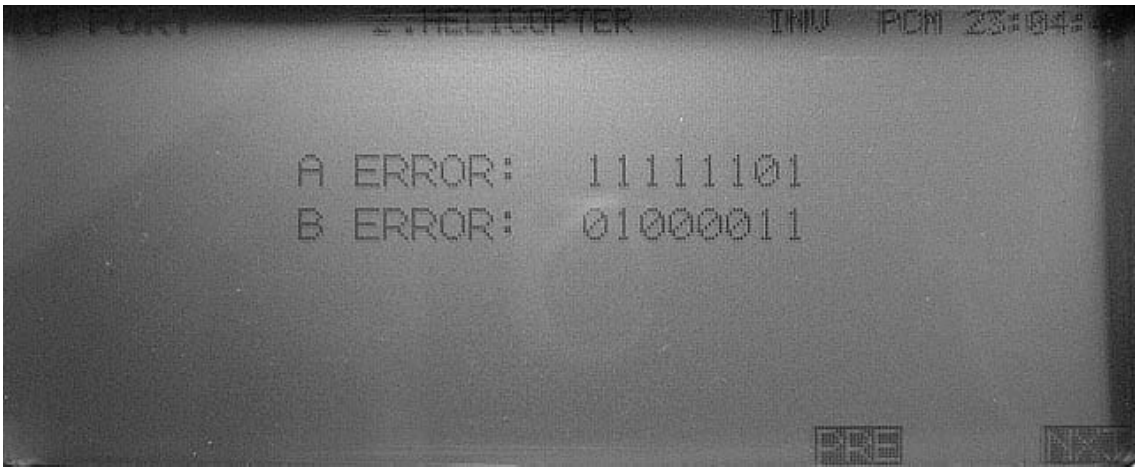
3000 ± 20rpm fluorescent light at 50Hz (Europe)

3600 ± 20rpm fluorescent light at 60Hz (USA)

1500rpm ± 10rpm PAL TV (Europe)

1800rpm ± 10rpm NTSC TV (USA)

IO PORT



This is a hardware test that requires some technical knowledge. Here is what these numbers represent:

LSB at right.

bit7 = PLL connector, RFCONT pin

bit6 = PLL connector, CLOCK pin

bit5 = PLL connector, DATA pin

bit4 = PLL connector, LE pin

bit3 = CAMPac connector, Pin.2

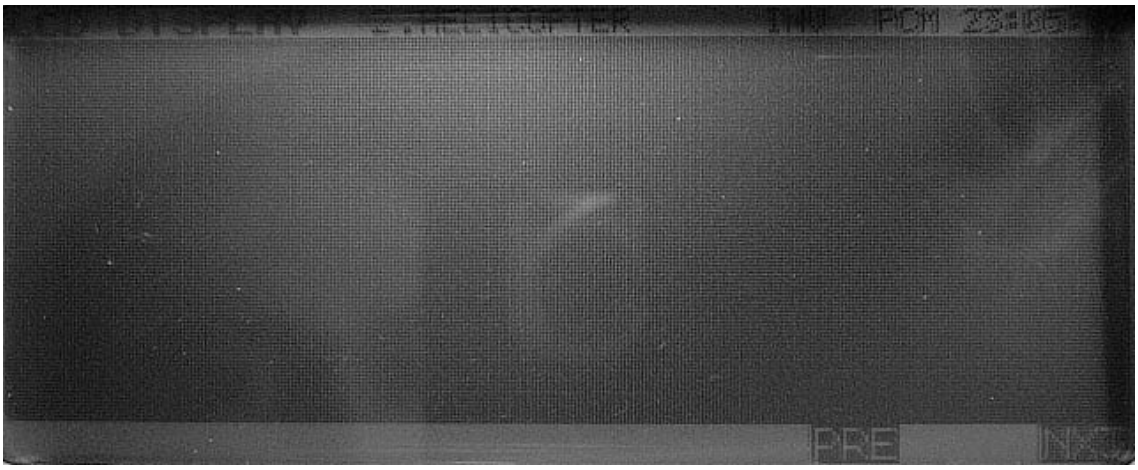
bit2 = CAMPac connector, Pin.3

bit1 = DIN connector, Pin.3

bit0 = RF module connector, METER pin

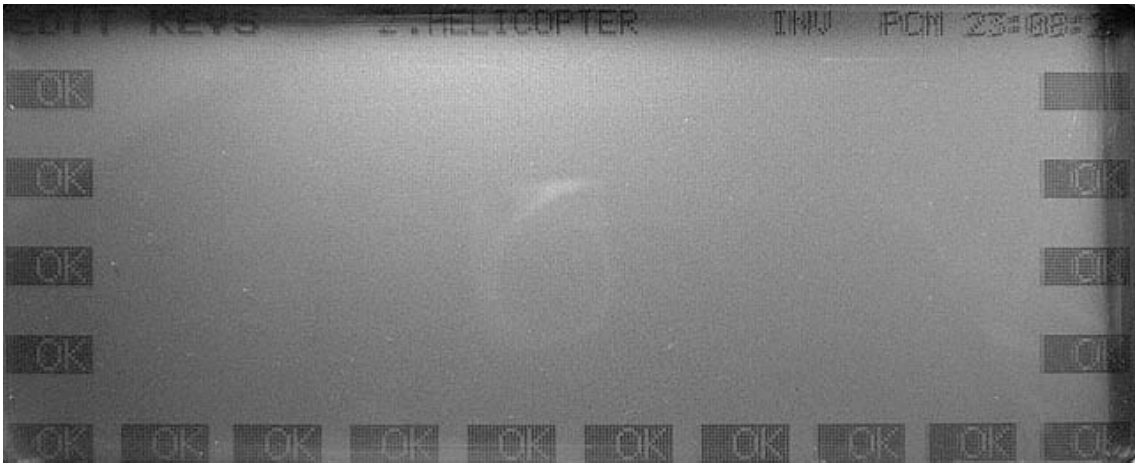
All pins are configured as inputs for this test although some function as outputs during normal operation. A ERROR indicates the state of these pins when this screen is entered. If the state of these pins change A ERROR is not updated. However B ERROR shows '1' for any of these pins that transitioned from high to low.

LCD DISPLAY



The big dark section blinks on/off. Confirm there are no "dead pixels" (white dots) in this area.

EDIT KEYS



Press all keys from A to R. The corresponding box displays [OK].

Once all keys are pressed you will be prompted to exit the service menu or return to the previous screen.