Procedure to check the functionality of the Neco 17DR8/35DR8 Drive Unit (Relay Box and Motor Assembly), the Compass and the cables.

Part 1 of this note relating to tests for faultfinding is divided into two sub-sections. Part 1a requires to physically work on the Drive Unit (DU hereafter) which, sometimes can be pretty uncomfortable; Part 1b, instead, requires working on the large rear connector of the Control Unit (CU hereafter), depicted in Figure 1., which, although critical due to the smallness of the contacts to be reached by the probe, most of the times is placed in a much more comfortable position. In case the Drive Unit is very difficult to reach, my advice is to start from the tests described in Part 1b; if all tests are ok, you do not need to proceed because the tests of Part 1a will be redundant and, if any problem persists, it can certainly be ascribed to the Control Unit. If, on the contrary, some tests of Part 1b fail, you should go back and proceed with Part 1a to pinpoint the problem and possibly solve it with the aid of what is explained in other parts of this note.
You may want to read all the notes before starting the tests in any case because, for historical reasons, Part 1a was written first, more extensively and with clearer explanations on the technical details.
Other parts are not always provided in the printout of this note because they are still under construction; in case: Part 2 contains instructions on how to change specific components, Part 3 contains helpful pictures and schematics and Part 4 contains the list of all commercially available electronic components and indications on how to get them.

PART 1a, Drive Unit and Relay Box.

If the Drive Unit is still electrically linked to both the Control Unit (one 8-core cable and one 3-core cable, usually both black) and to the main power supply (two 2-core cables), please skip this paragraph and go to the following marked with (α).
In case the Drive Unit is disconnected from the rest of the system, you must give power to it; this is accomplished by feeding the battery positive to terminals 2 an 4 of the large 16-way brown terminal block (here it is assumed that the Relay Box was already opened and you are familiar with its innards; if not, please continue reading because you will find a good description of the 16-way block in the following paragraphs, see also Figure 2.) and the battery negative to terminals 1 and 3. Just to be sure, you can check the following: the terminals, which must be connected to the battery positive pole, continue inward with red cables while the negative terminals continue inward with black cables. This kind of color-coding is a standard practice.

(α) If presently the battery power reaches the Drive Unit, turn temporarily OFF the power that comes directly from the central switchboard of the boat to the Neco. From now on, to simplify we will call it just "power line".

If the Drive Unit is not electrically linked to the rest of the Neco system, ignore this paragraph and go to the next marked with (β). If it is linked via the two black cables, unplug the large connector located on the rear of the CU; this is indeed the best thing to do but if it is too complicate, just set to OFF the switch located on the front panel of the CU. It must be clarified that if the rear connector of the CU is left in its place, the resistance measurements of the feedback potentiometer will not be meaningful; for this reason it is strongly advised to disconnect it or, if not possible, to disconnect inside the Drive Unit at least two of the wires coming from outside and ending at terminals 14, 15,

and 16 (before disconnecting the latter cables, take a note of their positions in order to be able to restore them correctly).

(β) Open the Relay Box. Probably you will need a hex wrench set in inches.

Turn ON the power line. Nothing should happen; the clutch should not engage, the relays should not show any sign of life and neither the motor.

The first things to check are the fuses that must be in good order; there are four fuses: two large (size 31.75mm x 6.35mm; rated 25A at 12V or 15A at 24V) and two small (size 20mm x 5.2mm, rated 2A and 5A, respectively).

Between the two large fuses there must be the supply voltage of the boat either before and after the fuses- the positive is connected to the fuse reached by a red wire; same situation between the small fuses. If the smaller fuses are properly mounted, the 5A fuse is mounted on the positive line, the one reached by a red wire. If any of the fuses has blown, it should be replaced with an identical one, if any of the fuses blows with the CU disconnected, the problem lies positively within the Relay Box and should be immediately identified and fixed.

1) Test of the relays.
Push gently the moving contact of a relay (the two relays are assembled base-to-base; the moving contacts are placed on their top) one at a time. The engine should make noise and turn idle. Notice: it turns idle, because the clutch is not engaged in this test. If the relays are clearly pitted or damaged, they must be replaced.
At this point, you should locate the 16-way terminal block on the side where four black cables enter the Relay Box, Figure 2. Inside the Relay Box, looking at the terminal block from the point of view of the relays, the terminal number 1 is the one at the extreme right (in the picture: top right) where, in general, a blue wire comes from outside and a black wire leaves inward. Please note that the colors given in parenthesis below relate to the incoming cables; they provide some indication but they do not always correspond to the right colors; in case of dissimilarity the terminal number is the truly important indication.

2) Check that the relays respond to a command arriving from the Control Unit.
Put the rudder in the central position - this is an important point because there are “end switches” that may intervene if the rudder is too far off from the central position. If the Drive Unit was disconnected from the rudder system, putting the rudder in the central position does not help: go directly to test Nr. 5 (feedback potentiometer) and come back to this point after placing the potentiometer in its middle position by turning by hand the output chain sprocket on the side of the motor.

With a small piece of wire, short-circuit terminal 9 (white) and terminal 12 (brown or green). One of the relay should click and the engine turn idle. With the same piece of wire short terminal 9 (white) to terminal 13 (green or brown). Same effect: it activates the other relay and the engine idles. If one of these two attempts fails, you should try moving the rudder (or chain sprocket) to a different position in order to override the end switches, if this is the problem. Notice that the clutch is still not engaged so the only expected effect is the clicking of a relay and the noise of the engine idling. If this test fails, there is a problem in the line going from the terminal block to the relay excitation coil passing through the end switches. It could be i) the wire connections, ii) the end switches, iii) the relay coil, or iv) the diode across the relay coil.

3) Test of the clutch.

With a small piece of wire, make a jumper between terminal 5 (brown) to and terminal 7 (blue). As you connect the two terminals you should hear a loud "clack", the clutch engages and the steering wheel (or the sprocket wheel) freezes. Take off the jumper in order to free the clutch for next test. Notice that the clutch may stay engaged for a while after the electrical connection was taken off; moving the sprocket (or the rudder wheel) should free the clutch. If the test fails, there is a problem in i) the wire connections or ii) in the clutch itself. In the second case, the fixing needs an intervention from a professional.

4) Test of the feedback potentiometer.
With an electronic tester as ohmmeter measure the resistance between terminal 14 (yellow) and terminal 16 (blue). There should be approximately 500 ohm. Then measure the resistance between terminals 14 (yellow) and 15 (red); there should be a resistance between 0 and 500 ohms that varies continuously depending on the position of the rudder (or of the output sprocket wheel placed at the side of the motor). If the resistance does not change smoothly, there are problems: the potentiometer needs cleaning or replacing. Perform the same measurement between terminals 15 (red) and 16 (blue): resistance between 0 and 500 ohms depending on the position of the rudder. Notice that the two last resistance values are complementary; for any position of the rudder their sum should be approximately 500 Ohm. Put the rudder (or the sprocket wheel) in the middle position where the two resistances are approximately the same, equal to 250 Ohm, and leave it there. Mark with a felt pen the position of the sprocket wheel in order to keep a reference of the central position of the potentiometer.
Regarding this point, it must be noticed that if there is a remote Rudder Feedback Unit close to the rudder quadrant (like in a hydraulic steering system, for example), the feedback potentiometer object of this test is placed right there. In this case one should check the resistances as the rudder blade moves; if the output sprocket wheel turns but the rudder, for any reason, does not move, the resistance will not vary at all.

5) Test that power is sent to the CU.
With an electronic tester set on volt, measure the voltage between the terminals 11 (black) and 9 (white). There should be 12V with the positive on terminal 9. If the boat voltage is 24V or 32V, there should be strictly not more than 19V. If the voltage is not as prescribed, there is a problem either in the electrical connections or in the Zener diode, which needs replacing.

6) Test for checking the health of the motor.
Engage the clutch like in test Nr 3) (put a jumper between 5 and 7) and leave it engaged. Push the upper relay contacts, one at a time for not too long. The motor should turn in both direction and the sprocket wheel along with it. Please try to notice carefully if the motor seems to have a different sound or RPM in the two directions of rotation; it may be the sign of something wrong that needs to be fixed. After this test, place again the sprocket wheel in its middle (central rudder) position, free the clutch by taking off the jumper between 5 and 7 and switch off the power line. Any noticeable malfunctioning in this test is ascribable to the motor only; if someone messed up the connections of the 6 wires coming from the motor, a fixing is possible and described later. Please notice that the motor brushes, if not inexpertly messed up, hardly need replacing after many years of intense use.

If the above tests were all positive, the Drive Unit from the large 16-way terminal block inward is fine.

PART 1b. Cables between the Control Unit, the Drive Unit and the Compass.

The next tests will be performed on the big connector placed on the back of the Control Unit (picture attached). To disconnect it you need to undo two retaining screws and pull it. It is very important that the power line from the boat main switchboard to the autopilot is active. The Control Unit will be disconnected so its front panel switch will be not influent.
First with "good eyes" find the numbers identifying the pins of the connector; it may be tricky but there are indeed numbers. Please be particularly careful because the pins are very close and you should avoid short-circuiting inadvertently nearby pins.

1) Measure the voltage between pin 13 (negative) and pin 14 (positive). 12V or more are expected.

2) Short-circuit pin 14 and pin 15; a relay should click and the motor turn but NOT the rudder or the sprocket wheel (the clutch is not engaged). (Please read also what is written at point 2 of Part 1a)

3) Short-circuit pin 14 and pin 16; the result should be as in 2 of this Part) but for the other relay.

4) Short-circuit pin 10 and pin 11; the clutch should engage (Point 3. of Part 1a).

5) Measure the resistance between 17 and 18. Rudder feedback potentiometer; anything between 0 and 500 Ohm is expected (please read carefully Point 4. of Part 1a regarding the possibility of the presence of a remote Rudder Feedback Unit).

6) Measure the resistance between 19 and 18. As point 5 of this Part.

7) Measure the resistance between 1 and 2. Compass excitation coil; a few Ohms are expected.

8) Measure the resistance between 3 and 4. Compass sensor coil; a few Ohms.

9) Measure the resistance between 3 and 5. Compass sensor coil; a few Ohm.

End of the tests regarding the Motor, the Relay Box, the Rudder Feedback, the Compass and the cables. If all tests were ok, the problem lies within the Control Unit.

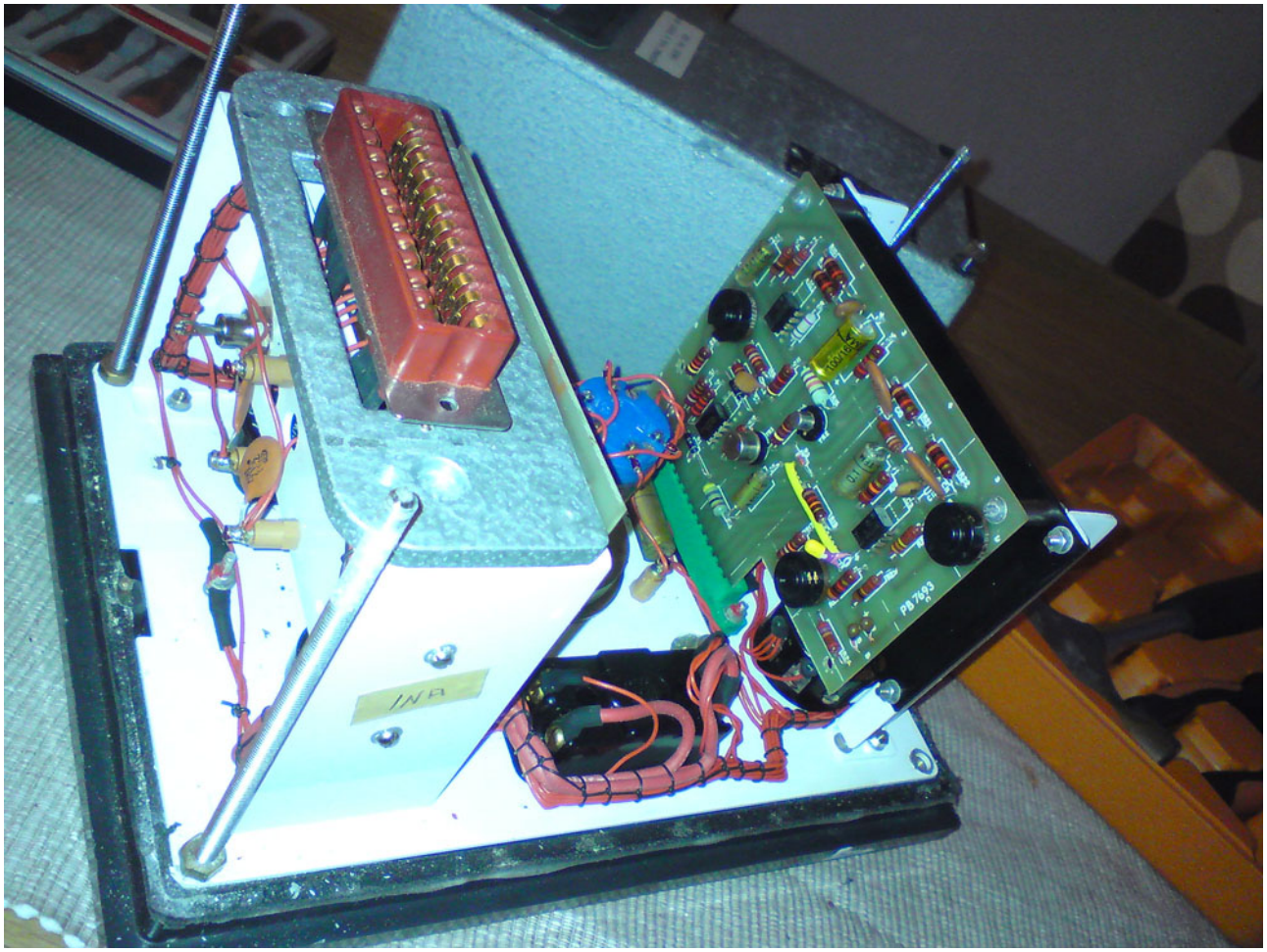
How to fix the Control Unit

The first thing to do is open it.
After undoing the large connector placed in the back of the CU from where 3 thick cables exit, put the CU on a table face down; the fasteners to undo are: four visible nuts at the corner of the rear side, two visible slotted screws and one hidden slotted screw around the connector. The latter is placed under the rubber foam in the middle.

Once you have undone these 7 items, the CU can be opened; sometimes it is glued or stuck but with some patience it will open.

Once open, the first thing to check is whether the CU is a Single Board or a Double Board model. Just compare your unit with the enclosed pictures. The Double Board models are the oldest; if it is a Single Board model, it is important to assess the version because there exist several and they have small but important differences in the electronic design and components.

Double Board Control Unit



Double Board:
Circuit diagram TIS 1060
Internal wiring TIS 1053

Single Board

Circuit diagram
B10971 (Rudder 10k, external condenser)
B11596 (Rudder 1k, external condenser)
TIS 1185 (Mk III) (Rudder 1k, internal condenser)

Internal wiring
TIS 1187 (Mk III)

PCB Assembly
B10953
B11597
TIS1186 (Mk III)

Figure 1. Connector on the cables reaching the rear of the Control Unit

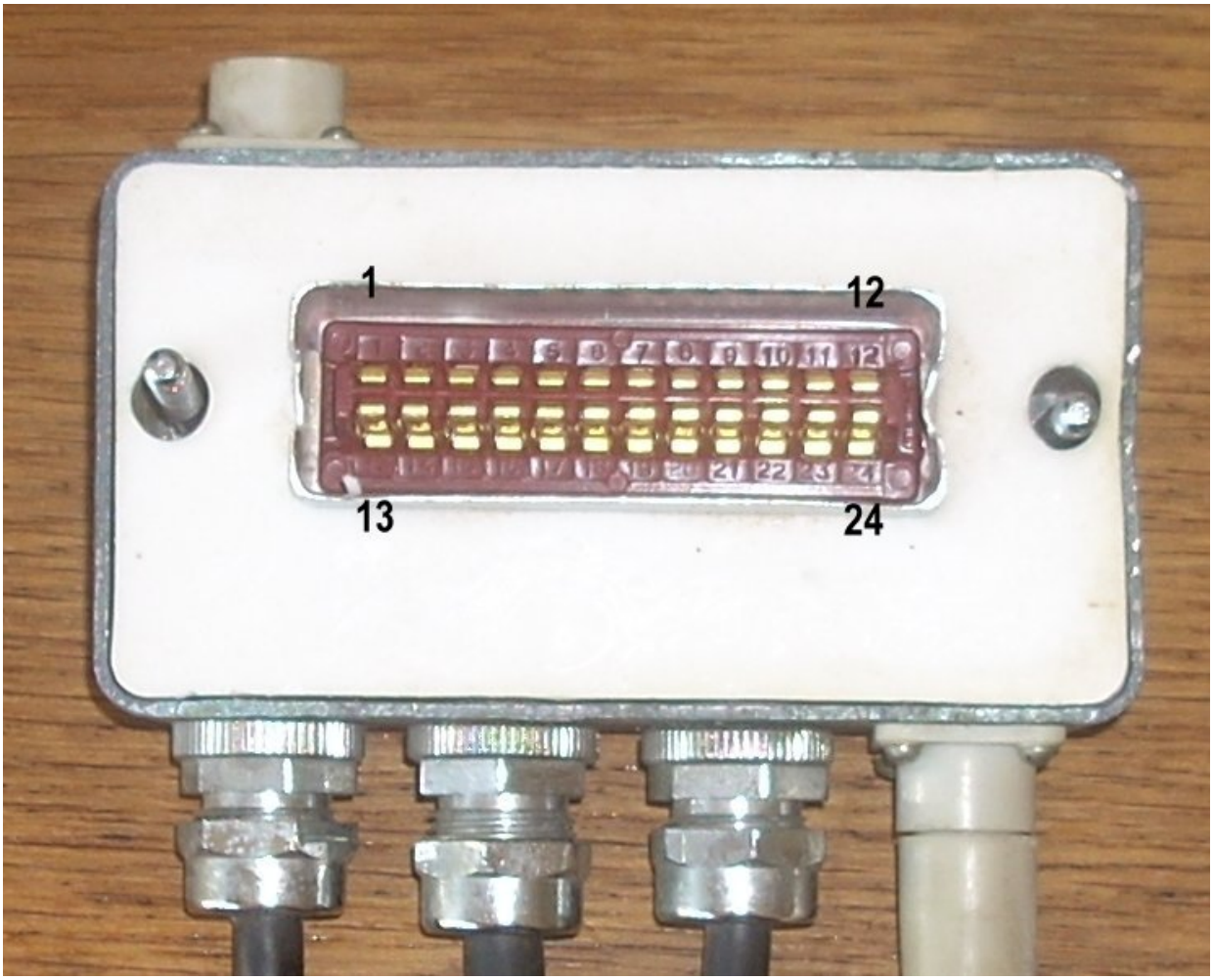
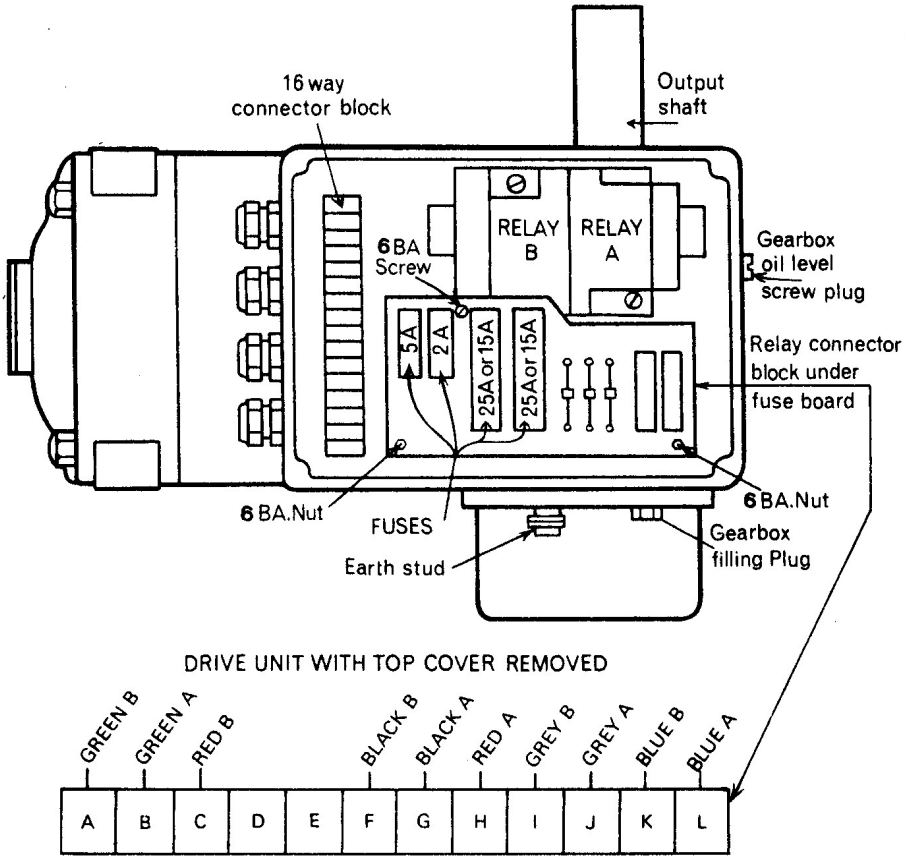
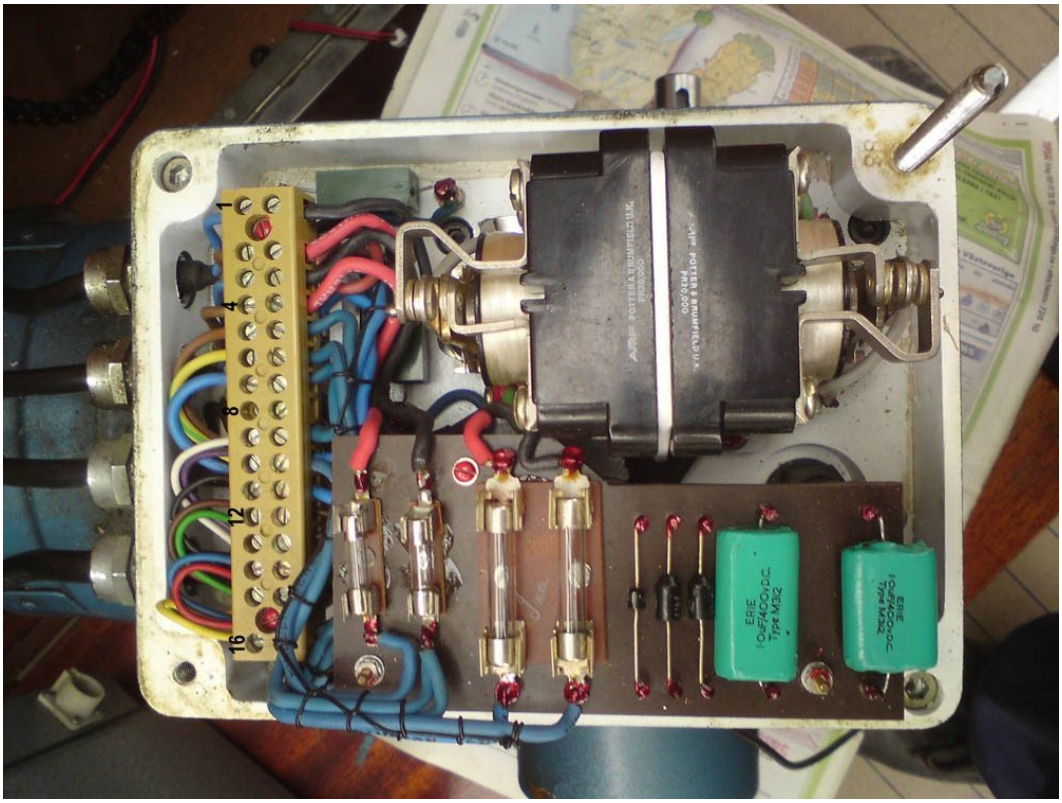


Figure 2. Relay Box





How to replace the relays

Needed tools.
Soldering iron with accessories, pliers, screwdrivers and, maybe, an electronic tester.

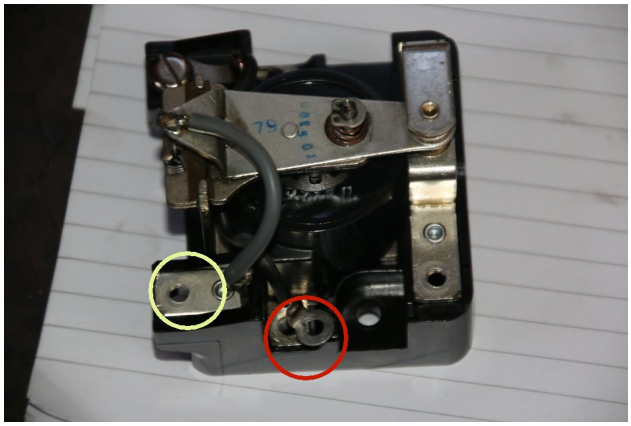
1) the Central contact of the new relays (Figure 3., white circle) is in a slightly different place. The thing to be careful of is that as the new contact will be close to the bottom of the box, the wire attached to it should NOT come in contact with the aluminium of the box itself.

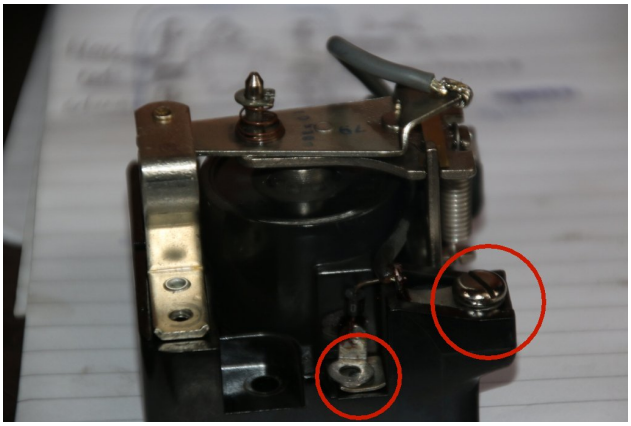
2) the coil contacts (red circles) are also slightly displaced but the main problem is to restore the small diode that goes from one contact to the other. Take it out of the old relays but keep in mind its polarity. First: the two diode wires are usually too short and one of them must be extended and insulated. Second: the diode must be placed in a slightly different place because the relay is made differently; be careful that the diode DOES NOT interfere with the moving contact. Third: the polarity of the diode is VERY important so it should be kept as in the original way with regards to the two wires arriving to the coil (they should be one red and the other black).
In case you lose record of how the diodes were connected, you must be able to look at the diodes and identify the white band on their plastic case; they are small and the search might not be easy for dirt or age but a white band must be there. If it is not there you should check with an ohmmeter the diode polarity but this is even more tricky because you should also know the polarity of your ohmmeter! Anyhow, if you find the white band you will also know that the wire closest to it is the cathode, i.e. the negative side in the conducting mode. As the diode in this setup must be reverse polarized, the cathode (white band side, negative) must be connected to the red wire (positive).

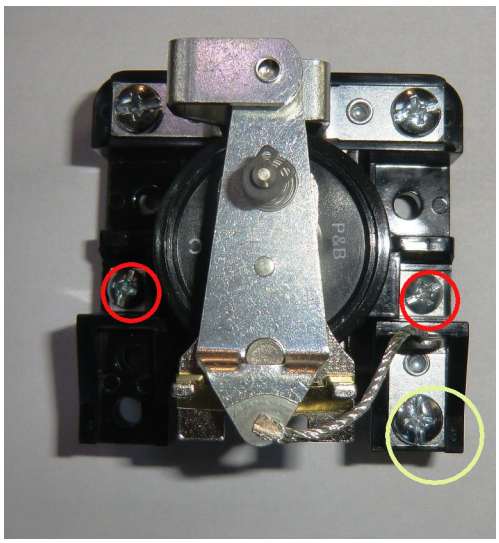
3) The other two contacts are the same in the new and old relays; no problem regarding them. Be careful that the position of the wires should be maintained as in the old relays; this is very important.

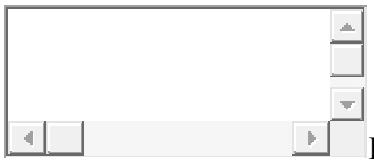
4) There is a last thing that regards the mounting of the relay assembly. While the old relays can be first mounted on their bracket and then the latter can be fixed in its place with its screws, in the case of the new relays the only way to mount them is by first screwing the bracket in its position on the bottom of the box and then mount the two relays with the two screws that unite them. It may be a bit tricky but it is feasible.

Figure 3. Relay









How to replace the potentiometer of the Rudder Feedback

Needed tools:
Soldering iron with accessories, pliers, metric and imperial hex wrench sets with very small size keys, screwdrivers, hacksaw for steel, a small vise, CRC, an electronic tester.

Procedure.

First, if not already placed in a very comfortable position to work with, the motor assembly (Drive Unit) should be dismounted and laid on a workbench.

How to remove the motor:

1) put the rudder in the middle position and secure it (there is no need to turn on anything)
2) release the sprocket pinion from the chain or whatever links the Drive Unit to the rudder system trying to move the least possible the pinion from its position. Possibly mark the position of the pinion in its mid-rudder position.
3) open the box of the relay placed over the motor.
4) disconnect the four cables that enter the Relay Box keeping a record of the way the wires were connected.

When the engine is on the table: 1) Free the cable coming out of the Rudder Feedback and entering the Relay Box from below by undoing 5 wires from the main 16-way terminal block and 2 wires from a 12-way terminal block placed under the brown Vetronite board with the fuses. The latter can be gently lifted after unscrewing three nuts/screws without disturbing the maze of wires. Just be sure to carefully mark the position of all the cables before disconnecting them. 2) Pull the black cable from below after loosening the retaining nut of the gland. 3) Open the lid of the Rudder Feedback box placed on the side of the motor, opposite to the sprocket pinion. 4) Undo the two screws holding the plate of the Rudder Feedback assembly. Now you can remove the plate trying not to let turn the potentiometer with its gear. At this point the sprocket pinion where the chain was and previously blocked has no more reason to be blocked in its central position.

Before proceeding study well the Rudder Feedback assembly. There is a potentiometer with three wires and with its turning shaft presumably set in the middle position. To the shaft of the potentiometer are attached (in addition to a helical gear) two cams acting on two microswitches. By rotating the shaft in one direction away from the middle position a microswitch is activated at some point (it clicks), by rotating in the other direction the other microswitch is activated. It is a good idea to write down these facts describing carefully the directions of rotation and which switches are activated at about which angle. All this will be very helpful in re-assembling. Take note also of the exact position and colors of the three wires going to the potentiometer terminals and also of the positions and colors of the 2 + 2 wires going to the switches; if everything goes smoothly, there will be no need to disturb the latter's but it is better to keep record of everything.
At this point, having recorded all, the position of the shaft can be changed at will and you can proceed to the disassembling of the potentiometer;

1) unsolder the three wires to the potentiometer
2) loosen the grub screws that hold the cams
3) loosen the grub screw that holds the helical gear
4) loosen the nut that holds the body of the potentiometer to the plate

5) free the potentiometer.

The new potentiometer should be modified in order to make it identical to the old; in particular, the shaft must be probably shortened. Having done this, it is possible to go through all the previous steps backward with the following annotations.

1) while the position of the worm gear about the shaft (angular position) is not important (note: its longitudinal position along the shaft is indeed important), the angular positions of the cams is very important. After having fixed well the body of the potentiometer to the holding plate with its nut and before tightening the grub screws of the cams, with an ohmmeter (but also with your fingers) position the shaft of the potentiometer in its middle position and make sure that the microswitches are activated as in the old potentiometer. This means tightening the grub screws of the cams after having positioned them properly. I insist that this is one of the most critical points that need attention. I also recommend to place the pot shaft midway before engaging the helical gear in the worm screw and after the latter action, lock (as in the beginning) the sprocket pinion coming out of the opposite side of the gearbox so as not to move the potentiometer until the engine is repositioned in the boat.
2) It depends on the new potentiometer but in some cases the size of the body is slightly larger than the original so that it sticks out by a fraction of a millimeter beyond the supporting plate. It is not a serious problem but it should be considered when re-fixing the plate on the side of the gearbox; in fact, in this case it is necessary to insert two thin and possibly wide shims or washers between the plate and the side of the gearbox in correspondence with the two screws to avoid that the potentiometer position is modified by the push of the gearbox side. This requires a bit of skills but having the engine on the table should make the work pretty easy. Obviously in repositioning the plate on the side of the gearbox, first you will fix without tightening the screw which has a circular hole and then the one that has a slotted hole. Then you will gently rotate the plate until the helical gear rests firmly but not too hard on the worm that comes out from the side of the engine and tighten the two screws.

Another part likely to be critical regards the loosening the grub screws of the cams and of the gear in disassembling the Rudder Feedback.
The essential thing is to use the right size tools and avoid shortcuts. Unfortunately, it is not possible to indicate here which is the right Allen key to use because Normand Electric Company (Neco) used different types at different times; it is important to have all size available, both metric and in fractions of an inch, and try the best fit. Obviously, in case of problems, using CRC or equivalent may be of help but, in some bad cases, you may even need to apply heat: a lighter with a small flame will do.
I have records of particularly "bad" cases in which it was required even to dismantle the microswitches but at the end it was always possible to undo the grub screws with minimal damage. The main advice is: "be very patient and insist but never force beyond the breaking point." Just consider that grub screws with such tiny internal hex keys are extremely delicate. Luckily enough there are quite often also very simple cases.

Once repositioned the Drive Unit at its site, before linking it to the steering system, you must perform the alignment procedure described in the original manual.

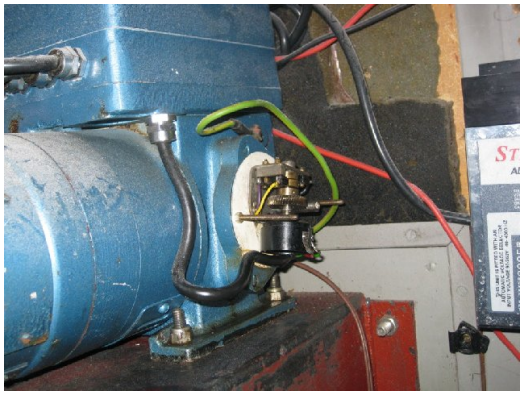
Here a few notes are added.

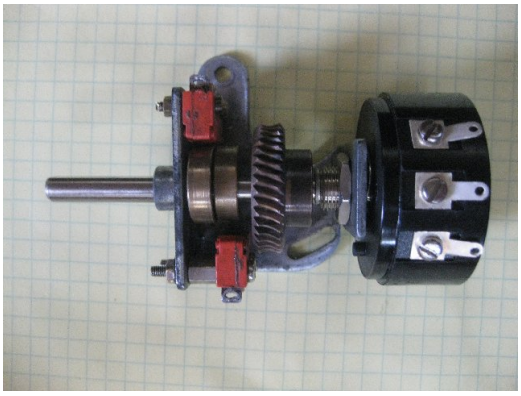
After placing the Drive Unit in its place and after connecting all cables, you need to first release the sprocket pinion that was blocked as recommended above.

Only at this point it is ready for the alignment must be done by having disconnected at least two wires of different colors in the Junction Box compass. The manual suggests disconnect all the wires but actually it is enough to disconnect any two of those connected (needless to disconnect what is not connected, if by chance there is one -sometimes the black! that does not count ...) Following the instructions of the manual, before turning on the autopilot having engaged the engine in the wheelhouse may not happen anything. Do not be alarmed now because this should mean only that the potentiometer is already exactly halfway, equivalent to "wheel in the middle" (or so I hope for you!). To be sure you must turn off the autopilot, manually rotate the pinion of one turn and switch on the pilot again. The engine should activate and return the pinion to the starting point. You can repeat rotating the pinion in the opposite direction; activating the Neco should always return the pinion to the central position within a small acceptable error. At this point, following the instructions, having locked the wheel "in the center position" and the pinion also in the center position you can proceed and re-engage the motor to the steering system (put on the chain or engage the appropriate gear), being careful not to move the relative position of the rudder and of the pinion. If one takes a little care in avoiding to hurt his/her fingers, the Neco CU can be left ON because this ensures that the pinion does not move; in certain cases, however, in order to engage the chain, it is easier to have the pinion free.

Very important: before the alignment procedure all the knobs on the front of Neco apart from the course setter, must be positioned as explained in the manual. TRIM center, RUDDER all the way clockwise, SENSITIVITY all the way clockwise. The large knob (Course Setter) instead has no effect when the Compass is disconnected. I insist on this point because I myself sometimes forget of the knobs and must perform the alignment again. After aligning the Neco and having re-engaged the sprocket pinion to the rudder system, remember reconnect the cables inside the Junction Box of the Compass and this should be performed with the CU in OFF.

Figure 3. Rudder Feedback Potentiometer in Drive Unit.





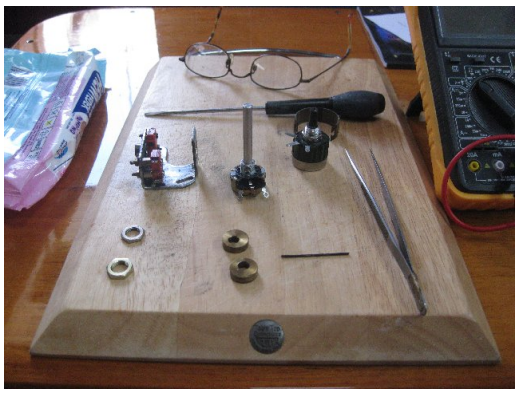


Figure 5. Original figures taken from the Neco manuals

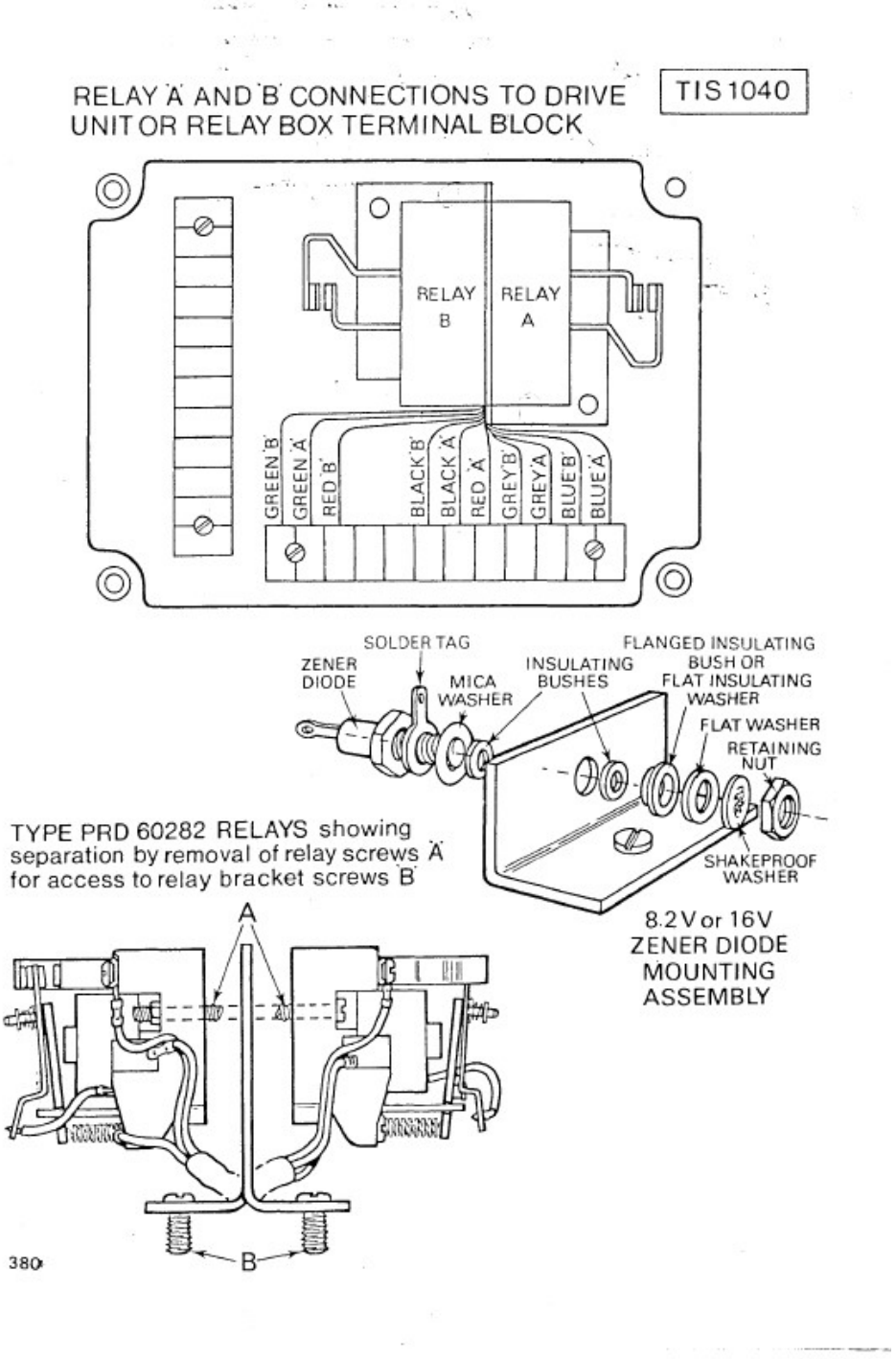
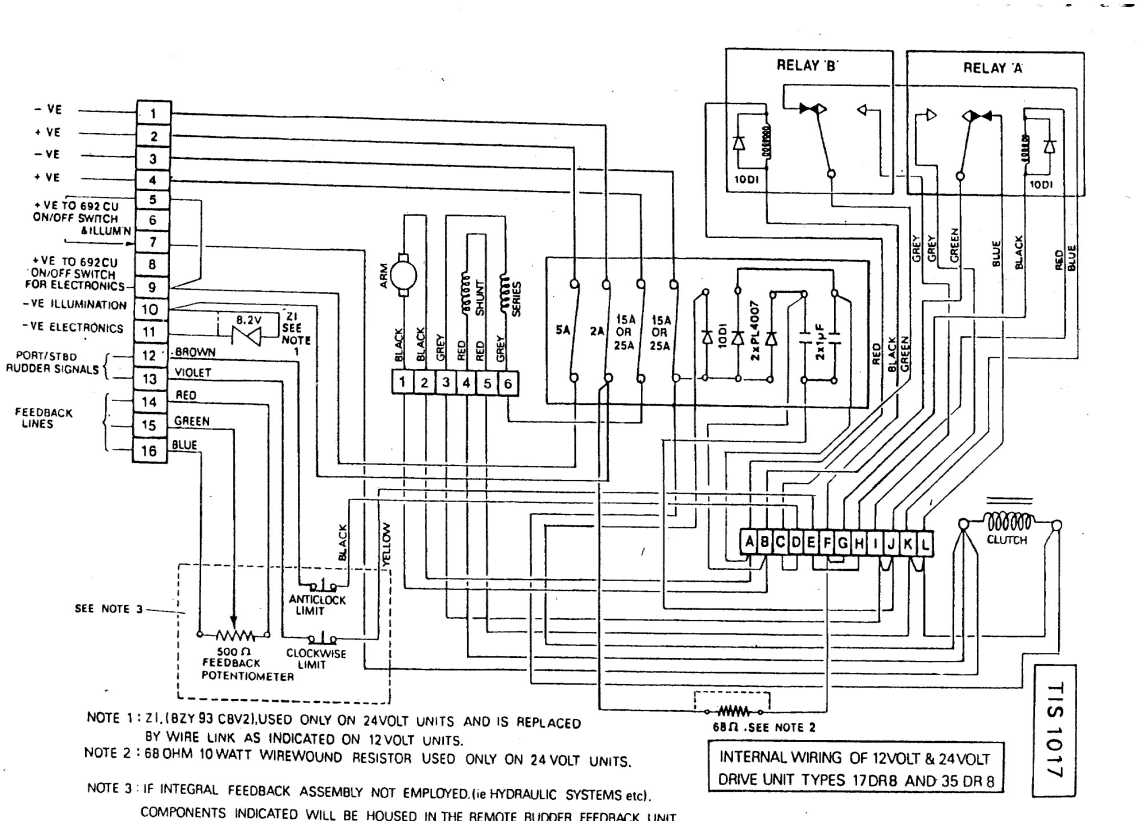


Figure 6. Electrical schematics of the Relay Box (12 & 24 Volt)



The autopilot steers correctly only on some definite courses.

This kind of symptom can be given only by two causes:
1) a defective compass.
2) a false contact between the brushes and the rotor of the synchro or a partly broken coil within the synchro itself.

Case 1), compass.
Useless to say that there should not be any disturbing magnetic body closer to the compass than, say, 50-100 cm.
Check visually that the compass is ok and turn it full 360 degrees to see if the inner part is doing its job, i.e. follow smoothly the magnetic north.
Measure the resistance of the inner coils: a mono-phase one (the exciting coil) connected to a white and a red wire. A three-phase one (the receiver coil) connected a yellow (or orange), a green, and a blue wire. All above wires belong to a 5-core "tinsel cable" ending in a junction box nearby.
The resistance between any two wires belonging to the same coil should be approximately 4 Ohm; no continuity between the two coils is expected.
The resistances can be measured either at the junction box or directly at the large connector the fits the back of the Control Unit. Pins 1 and 2: mono-phase coil; pins 3, 4 and 5: three-phase coil. In making the measurement at the junction box, be sure that the named connector is detached from the CU.

Case 2), Synchro.
Measure the resistance between r1 and r2 as you turn the Course knob; it should be a few hundred Ohms and steady. Measure the resistance between s1 and s2, then between s2 and s3 and finally between s1 and s3. The measurements on sx can be freely performed as far as the large back connector is unplugged while the measurements on rx must be performed after either unscrewing one of the cables reaching the synchro top or unplugging the internal Printed Circuit Board of the Control Unit (in case of a Double Board unit, unplug the B board, the one farthest from the large back connector).
The resistances should be all the same.

The autopilot is dead.

The first thing to check is if the power reaches the Drive Unit and the motor can be indeed be activated by pushing on the relays. If yes, then it is likely that the Control Unit either is not powered or something inside failed.
The symptom can be ascribed to the following causes:
1) defective power lines from the boat switchboard to the Drive Unit. There are two independent lines, one for the motor (a "dirty" line) and one for the electronics (a "clean" line). It is very important to maintain this configuration because the motor produces e.m. noise and lowering of the voltage which may disrupt the correct functioning of the electronics.
2) blown fuses inside the Drive Unit
3) burnt Zener diode inside the Drive Unit
4) missing or defective yellow/grey dummy plug placed in the large connector on the back of the Control Unit
5) burnt Zener diode inside the CU
6) short-circuited condenser inside the CU
7) broken voltage regulator (CU)

The autopilot can correct the course only on one direction.

Defective final transistor inside the CU.

As soon as the autopilot is switched on, the rudder turns hard-over to one side.

1) Defective feedback potentiometer
2) Interrupted monophase coil of the synchro.

Gearbox oil

Quoted from the NM692 manual:
"...the gearbox should be filled with lubricating oil (Castrol MAGNA) or equivalent SAE 20 best quality gear oil by unscrewing the small plug on the end of the gearbox and removing the filling plug fitted to the gearbox. Fill the gearbox until oil flows from the oil level plug, replacing plugs."

Technical characteristics

Motor.
Series Coil resistance: ≈ 0 Ohm
Shunt Coil resistance: ≈ 8 Ohm
Armature Coil resistance: ≈ 1.2 Ohm
Clutch Coil resistance: ≈ 11 Ohm

Compass.
It is made of two independent circuits as long as dc currents are concerned.

1) White-Red: 4 Ohm
2) Orange (or Yellow)-Blue-Green: 4 Ohm between any pair.
3) Infinite resistance between any two wires belonging to the two independent circuits.

Follows a partial list of components and possible replacements

Zener diodes
BZY 93 C8V2
BZY 93 C16

Noise suppressing diodes
10D1 can be substituted by STTH208 or equivalent.
http://www.mouser.it/ProductDetail/STMicroelectronics/STTH208/?qs=sGAEpiMZZMtvcUztdGSumJS725njxsbLoeZvehNmL9U=
PL4007 can be substituted by 1N4007 or equivalent
http://www.mouser.it/ProductDetail/ON-Semiconductor/1N4007G/?qs=sGAEpiMZZMtqO%252bWUGLBzeDbi29SPb2By

RELAYS
PRD-5DY0-12
http://www.mouser.it/ProductDetail/TE-Connectivity/PRD-5DY0-12/?qs=%2fha2pyFadugicUG%252bGoh95%2fdicab5LpEZcazFwD6UMG4%3d
http://www.digikey.com/product-detail/en/PRD-5DY0-12/PB493-ND/365927

Feedback potentiometer:
500 Ohm wire wound, high precision, linear response, shaft diameter 6.3mm (1/4”), shaft length at least 4 cm.
http://it.rs-online.com/web/p/potenziometri/0812803/

Set of Allen keys: one in imperial sizes down to 0.05", and one in metric sizes down to 1.5mm.
http://it.rs-online.com/web/p/chiavi-a-brugola-e-kit/1995195/

Note 1: the links point to the Italian store of a worldwide internet provider; the important item is the code of the product which is the same in all stores.
Note 2: the RS retailer is not particularly cheap so you are welcome to use cheaper equivalent products. The only important factor is that both keys and the potentiometer are of excellent quality.