Modification to be performed on the Neco Drive Unit (35DE4) in order to fit it to a new generation autopilot.

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The Neco drive 35DE4 is a DC motor whose static magnetic field is produced by two split-shunt Coils; the direction of rotation is selected by energising either field Coil, holding constant the polarity of the supply to the Armature. In principle the Neco motor can be driven by any properly designed circuit made with high power transistors or relays but most common commercial autopilot outputs are not designed to do it so that a proper interface is needed. If the original Neco system is in good condition, the best way to control the motor is by taking advantage of a large part of the circuitry already provided by Neco (see Figure 1), namely the Switchline Conversion Unit Type 100 SCU (SCU hereafter), the Power Amplifier Type 250 PA (PA hereafter) and the Motor Suppression Box 250 MSB (MSB hereafter). The PA is the principal active circuit that takes care of supplying the current to one of the Fields at a time (depending on the required direction of rotation), powering the Armature when rotation is needed and powering the Clutch Armature all the time the autopilot is in Auto Mode. Just a few technicalities: while the Clutch is simply powered through a relay inside the SCU, the Armature and the two Fields are powered by high power transistors inside the PA. The latter transistors are wisely[1] driven by a complex circuit inside the PA and they are controlled by two lines coming directly from the Neco Control Unit that pass unaffected through the SCU (terminals 4 and 5 of both left and right 10-terminal blocks) and enter the left side of PA (terminal 5, "Port", and 6, "Stbd" of the 16-terminal block). Actually the two above control lines need to be closed through contacts 6 and 7 of the 16-terminal block at the right side of PA whence they are lead to the Rudder Feedback Unit and affected by limit switches. Please notice that all new generation autopilots are provided with their own Rudder Feedback Units and limit switches are not used anymore; the present modification takes care of this particular. For what concerns the rudder control lines, the output of any new generation autopilot is basically identical to the output of the Neco Control Unit. Therefore the two main rudder control lines ca be connected directly to the output of the new autopilot, namely to the output called MOTOR or RELAY or SOLENOID, depending on the model. Conversely, the clutch output of modern autopilots generally does not match the Neco Clutch circuit[2]; the latter issue is dealt with an additional interfacing relay in order to minimize the interventions to the original Neco units[3].

Summarizing: there are a number of simple interventions to be performed at the input (left) side of the SCU and at the output (right) side of the PA. The Rudder Reference Unit is discarded along with the Neco Control Unit and its Compass. Nothing must be changed in the link cables between the SCU and the PA, in particular the power lines coming directly from the main panel of the boat. Moreover a simple relay interface must be constructed.
All particulars are explained in what follows.

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[1] Actually the circuitry inside the PA takes care also of applying an electromagnetic break to the motor as soon as the right rudder angle is reached. This should be accounted for in case the original Neco PA is substituted by a different circuit.
[2] The Neco Control Unit activates the Clutch by closing a switch; most modern autopilots activate the Clutch by providing 12/24V on their "Clutch" output.
[3] In principle this could be done with some modifications inside the SCU.

1) **Switchline Conversion Unit Type 100 SCU, Figure 2**.

On the input (left) side of the SCU the Cable N.2, (8-Core from the Neco Control Unit) should be taken away altogether and the terminals 1, 2, 3, 4, 5, 6, 7 and 8 of the 10-terminal block connector freed.
A new cable with two differently coloured wires, with cross-section 1.5mm^2, should be fitted to terminals 4 and 5. The cable must be long enough to reach the MOTOR output terminals of the new Course Computer. Cable N.4 (3-core from Control Head) should be kept as it is and will serve to control the Clutch. It cannot be attached directly to the Clutch output of the new Course Computer but it needs an interfacing relay possibly fitted in a small waterproof box. This part will be dealt later.
As already mentioned the right part of the SCU, including Cable N.5 (8-core to Power Amp.) and Cable N.6 (2-core to Power Amp.) all connected to a 10-terminal block, should not be modified.

2) **Power Amplifier Type 250 PA, Figure 3**.

All cables entering the PA from the left (16-terminal block) are to be left unchanged. In particular there are two cables arriving from the SCU (Cable N.5 and Cable N.6) which, although not fully used, are still necessary and two cables from the boat main panel switchboard (Cable N.7 and Cable N.8) which are necessary to power the electronics and the motor. They are already provided by fuses and are switched on internally whenever the Course Computer in charge activates the Clutch.
On the right side of the PA (16-terminal block), only Cable N.12 (8-core) should be disconnected freeing the screw terminals 1, 2, 3, 4, 5, 6, and 7. This cable goes to the Neco Rudder Feedback Unit which is not used anymore. Depending on the new Course Computer to be fitted there are two possibilities on this part. If the new Course Computer is set to control a Reversing Motor (either mechanical or hydraulic) right after detaching the Cable N.12, two short links of electric cable should be fitted: one between terminals 5 and 6, and one between terminals 4 and 7. If the new Course Computer is set to control Solenoids then a 2-core cable similar to the one that was previously set up between the SCU and the Course Computer (1.5mm^2 and different colours) should be connected to terminals 6 and 7. The latter cable will go to the Course Computer outputs labelled “Solenoid Return” with no importance on polarity. In both cases all terminals previously connected to Cable N.12 that were not cited should be left empty.
Cable N.9, Cable N.10 and Cable N.11, all 2-core cables, go towards the Motor Suppression Box and eventually to the Motor; they are all needed and should be left in place.

3) **Additional relay needed to control the clutch, Figure 5**.

This is the only part that actually needs to be made from scratch. It must be a good reliable DC relay (typically 24V/30A switching specification but 30A are not really necessary[4]), activated at 12V or 24V depending on the new Course Computer[5]. Possible choices are Omron G8P-1C4P or Tyco Electronics VF4-11F13 or Potter Brumfeld T90N1D42 but any good automotive relay may work; the minimum requirement configuration is SPST NO (Single Pole, Single Throw, Normally Open). It is important that all connectors are isolated from ground and the absorption of the coil is as little as possible (approx 100mA). Find a proper way to accommodate the relay possibly in a small water resistant box with one 4-terminal block or two 2-terminal blocks. The two coil terminals (Clutch +) and Clutch -) must be connected to the autopilot Course Computer Clutch Output while the two switched terminals are to be connected to the SCU as drawn in Figure 4: to terminals 9 and 10 of the input (left) 10-terminal block. Be sure to use only the Common Terminal and the Normally Open Contact of the relay if it is not SPST-NO (check its datasheet). Polarity is not relevant in any of the pairs of connection of this relay (9 and 10 can be interchanged and the + and – can go in either of the Clutch outputs of the Course Computer).

Conclusion

To summarize (Figures 6 and 7), at the end of the modification there should be two new 2-core cables (N.2 and N.4) going from the SCU to the new Course Computer and, only if the latter is set for Solenoids, a third new 2-core cable (cable N.12) going from the PA to the Course Computer. Along Cable N.4 there should be the relay.
In case the Course Computer is set for a Reversing Motor, there is no Cable N.12 but there must be two new jumpers on the right connector inside the PA.

The new autopilot must be installed following its own manual; in particular besides the Course Computer it will be provided by a Display/Control Unit, a Compass and a Rudder Feedback all to be mounted following the manufacturer's instructions, in the proper places and with the provided cables. During the commissioning procedure provided by the Owner's Manual it may happen that the direction of rotation of the motor is reversed and the rudder is applied in the wrong direction; if the inversion of the turning direction cannot be performed through the software of the Course Computer, it can be made by simply inverting the two wires of cable N.2 at the Course Computer output (Motor).

[4] If in the future the Neco motor is substituted by an actuator that needs solenoids, a 30A relay will be indeed required.
[5] Some Course Computers powered at 24V provide 12V for the clutch. This is a particular that should be found in the specifications of the autopilot. Please notice that using a relay will draw a negligible amount of current from the Course Computer ensuring that whatever power absorption requirement is fulfilled.

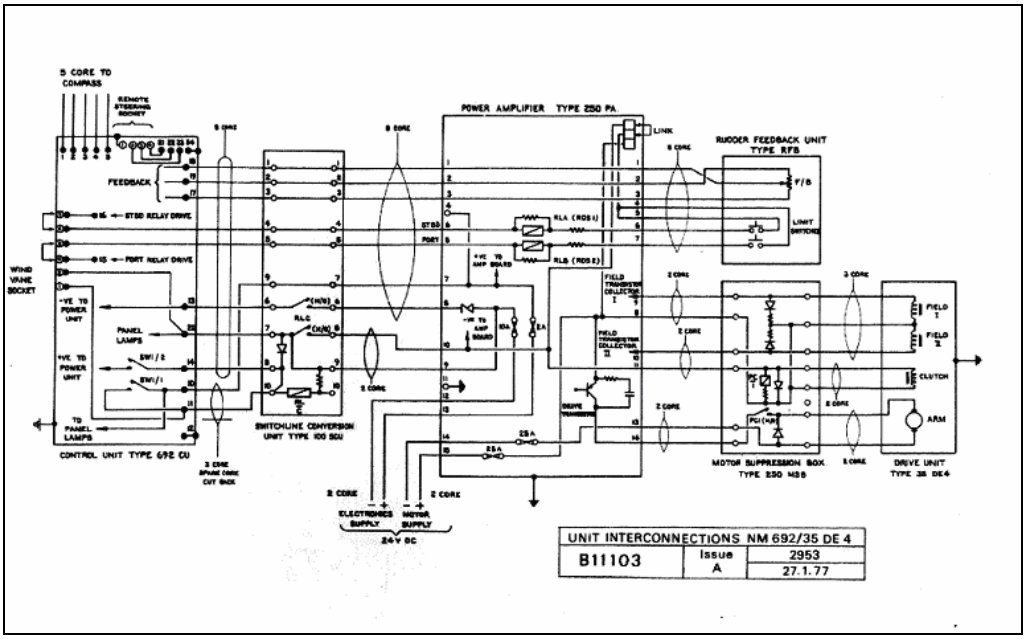


Figure 1. Original block scheme (extracted from the Neco Manual) of the circuitry that controls the Neco Type 35DE4 Drive. The Clutch is always activated during Auto Mode while the Armature and one Field is activated whenever the motor is required to turn. The Armature is powered with fixed polarity while the motor turning direction depends on which of the two Fields is activated.

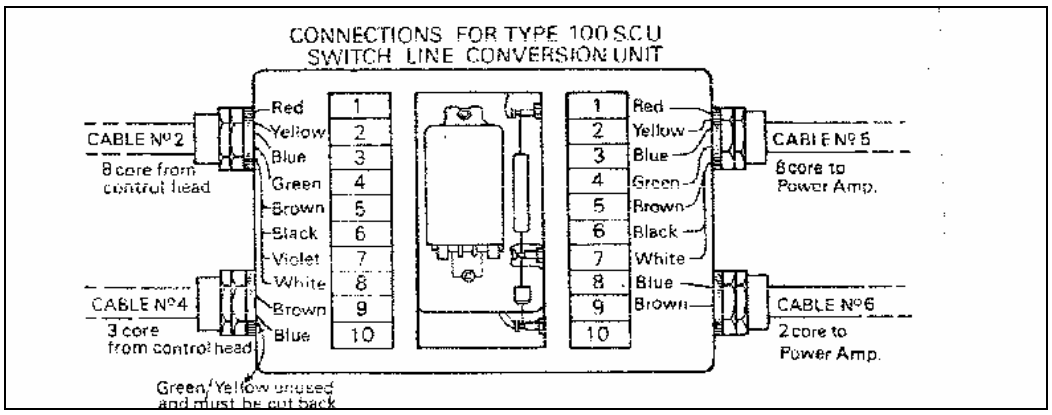


Figure 2. Picture of the open Neco Switchline Conversion Unit. Left: the input 10-terminal block. Right: the output 10-terminal block. (Extracted from the Neco Manual).

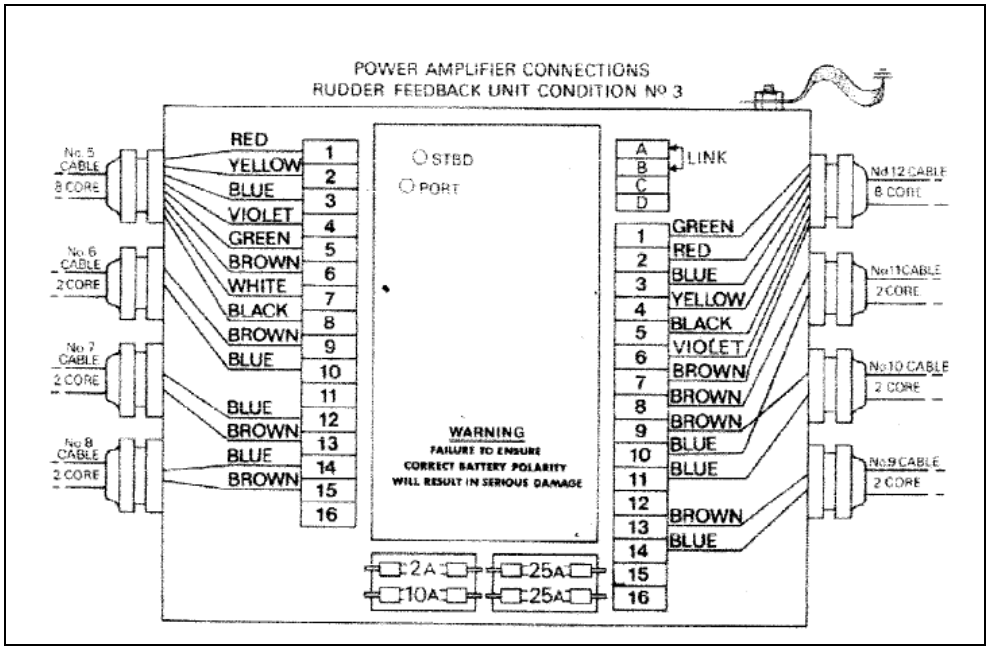


Figure 3. Picture of the open Neco Power Amplifier Unit. Left: the input 16-terminal block. Right: the output 16-terminal block. (extracted from the Neco Manual).

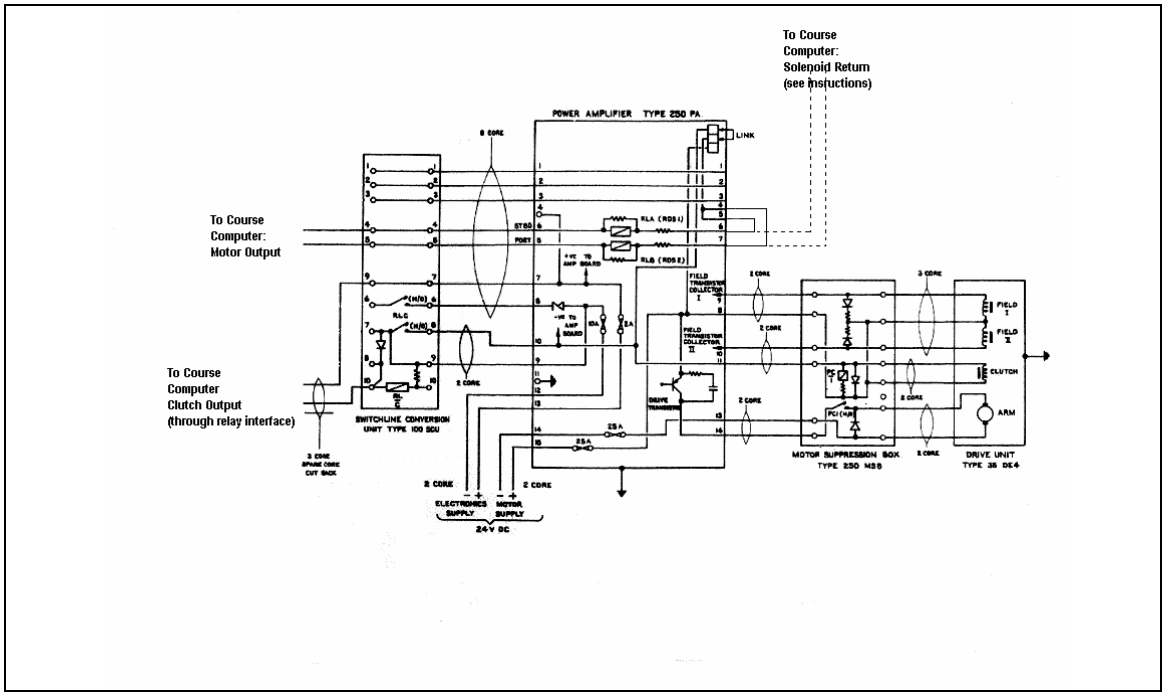


Figure 4. Modified block scheme.

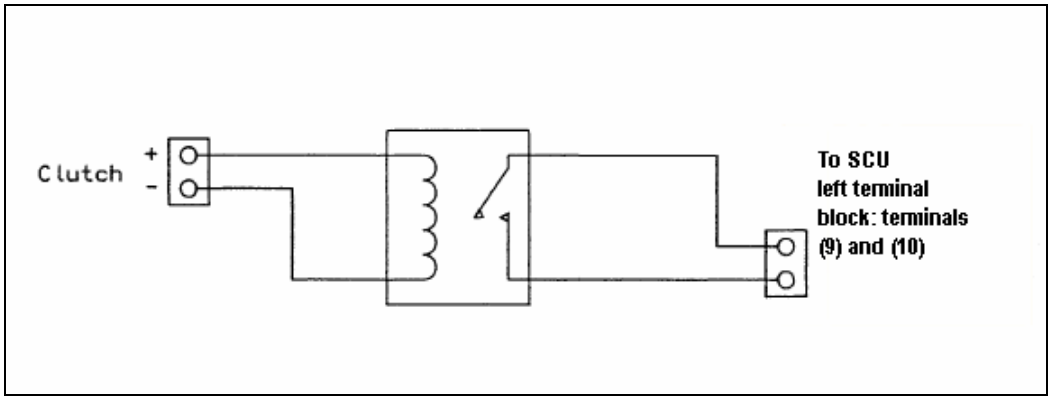


Figure 5. Relay interface for the Clutch.

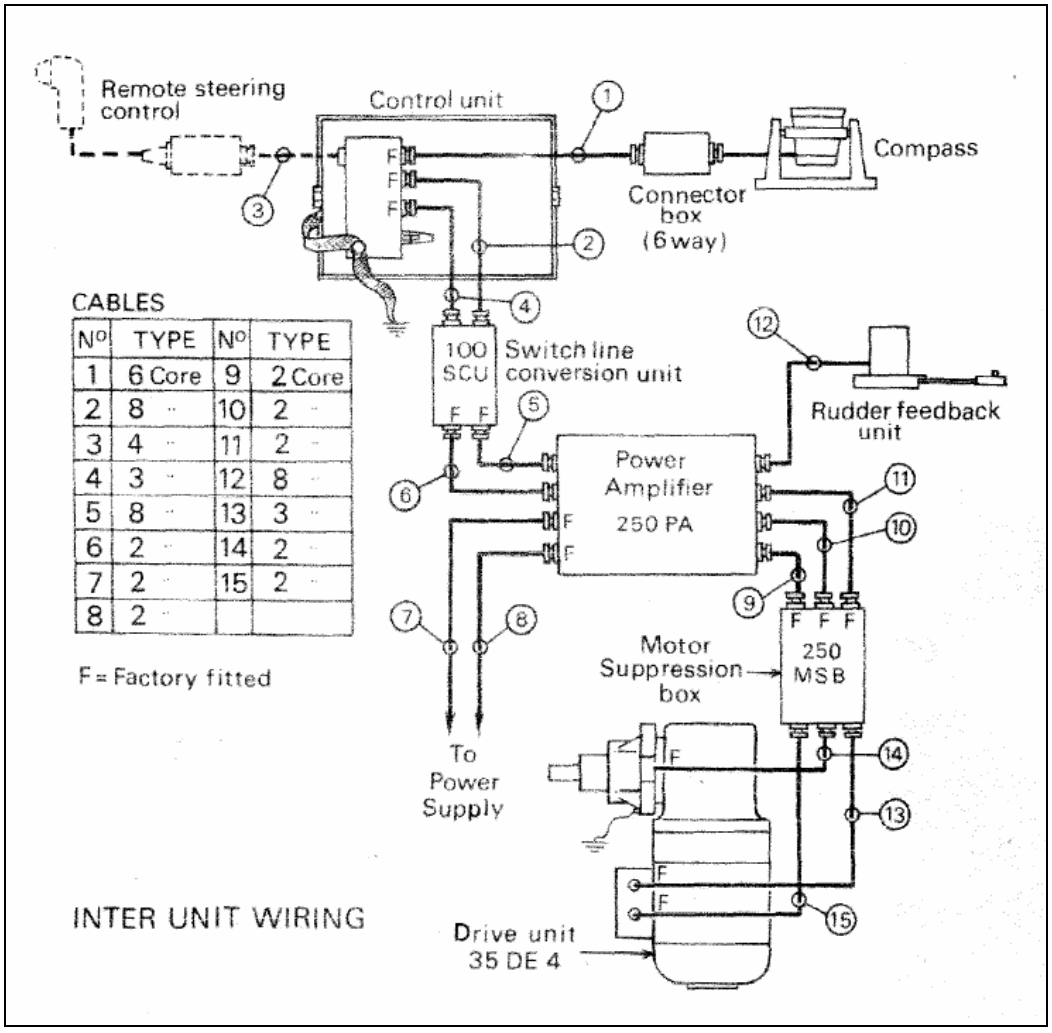
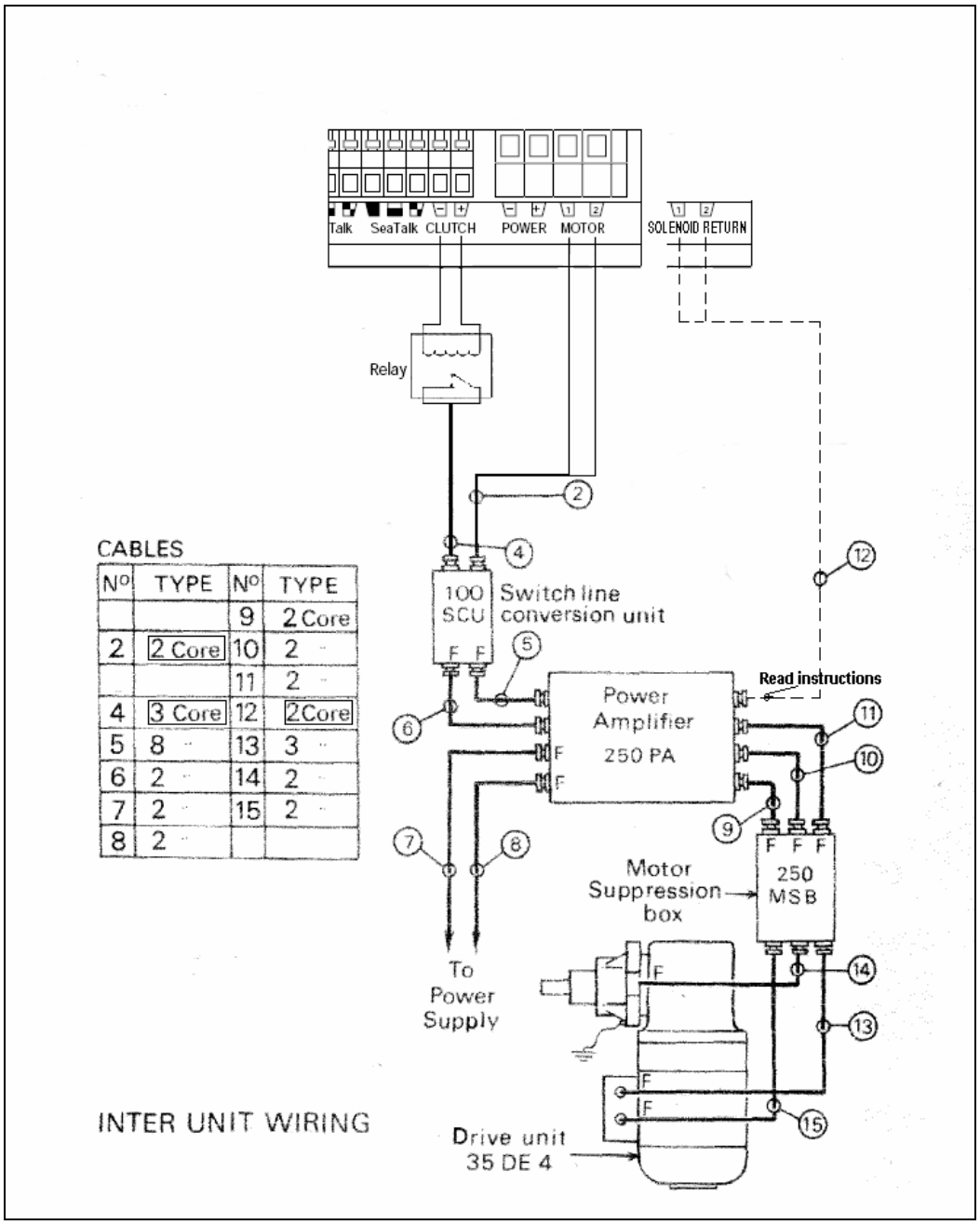


Figure 6. Original Neco Inter Unit wiring before modification (extracted from the Neco Manual).



N°	TYPE	N°	TYPE
		9	2 Core
2	2 Core	10	2 "
		11	2 "
4	3 Core	12	2 Core
5	8 "	13	3 "
6	2 "	14	2 "
7	2 "	15	2 "
8	2 "		

Figure 7. Inter Unit wiring after modification. The cables that need modification are boxed in the table. Cable N.4 is marked as 3-core because it is so in the original setup; actually only 2 cores are needed.