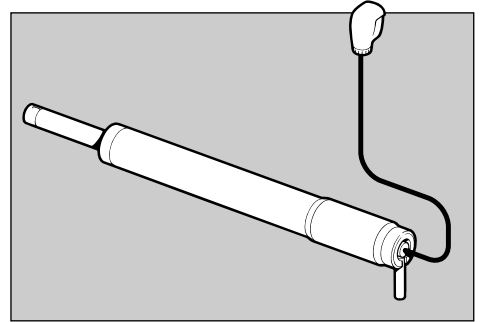
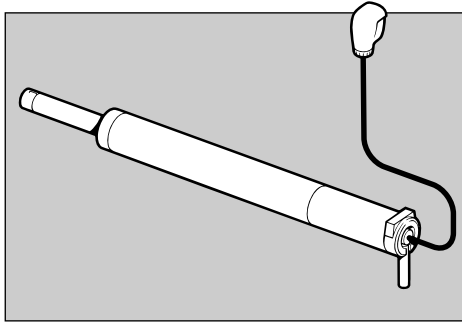
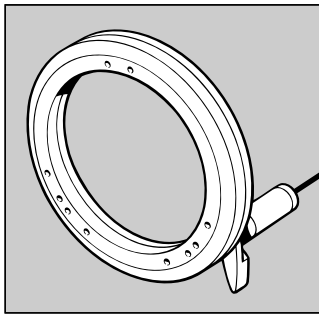
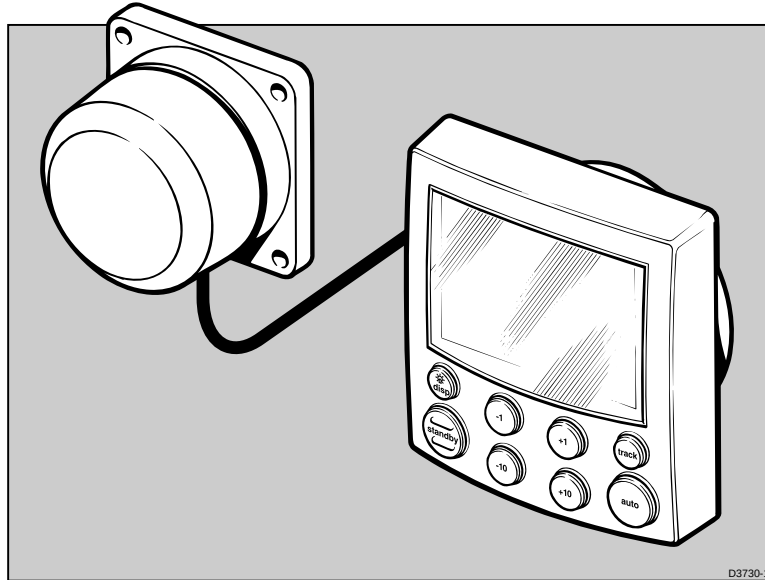




## ST4000+ Autopilots Service Manual

For use on

Z326, Wheel Autopilot

Z327, Tiller Autopilot

Z332, Tiller GP Autopilot

## Warning

### CE Marking of Equipment/Replacement Parts

If the Autohelm equipment under repair, test, calibration, installation or setting to work carries the European CE mark, only parts and components supplied or approved for such use by Raytheon should be used in order to maintain compliance with the relevant CE requirements.

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# Chapter 1. ST4000+ Control Head

## 1.1 PCB Changes

When a PCB is changed, it may be necessary to set the new PCB to the required pilot type, ST4000+ Wheel, ST4000+ Tiller or ST4000+ Tiller GP

1. If the instrument is disassembled, fit the reflector, diffuser, elastomers, LCD and surround to the PCB
2. Apply 12V power to the instrument/PCB assembly
3. Press and hold STDBY for 14 seconds until CAL ? is displayed
4. Momentarily press +1 and -1 together to gain access to extended calibration (dealer set - up)
5. Advance from the CAL LOCK page to the pilot type page by pressing DISP
6. Use the +1 and -1 buttons to set the pilot type as required, 4000 WHL (wheel) or 4000 TILL (tiller)
7. Press STDBY to exit extended calibration
8. Switch off the power supply. Do not disconnect
9. When the pilot is fully powered down, switch the power on again
10. Check that the required pilot type is momentarily displayed before STANDBY is entered. If not, repeat the set - up procedure. In the case of a second failure, change the PCB.

## 1.2 Disassembly/Assembly

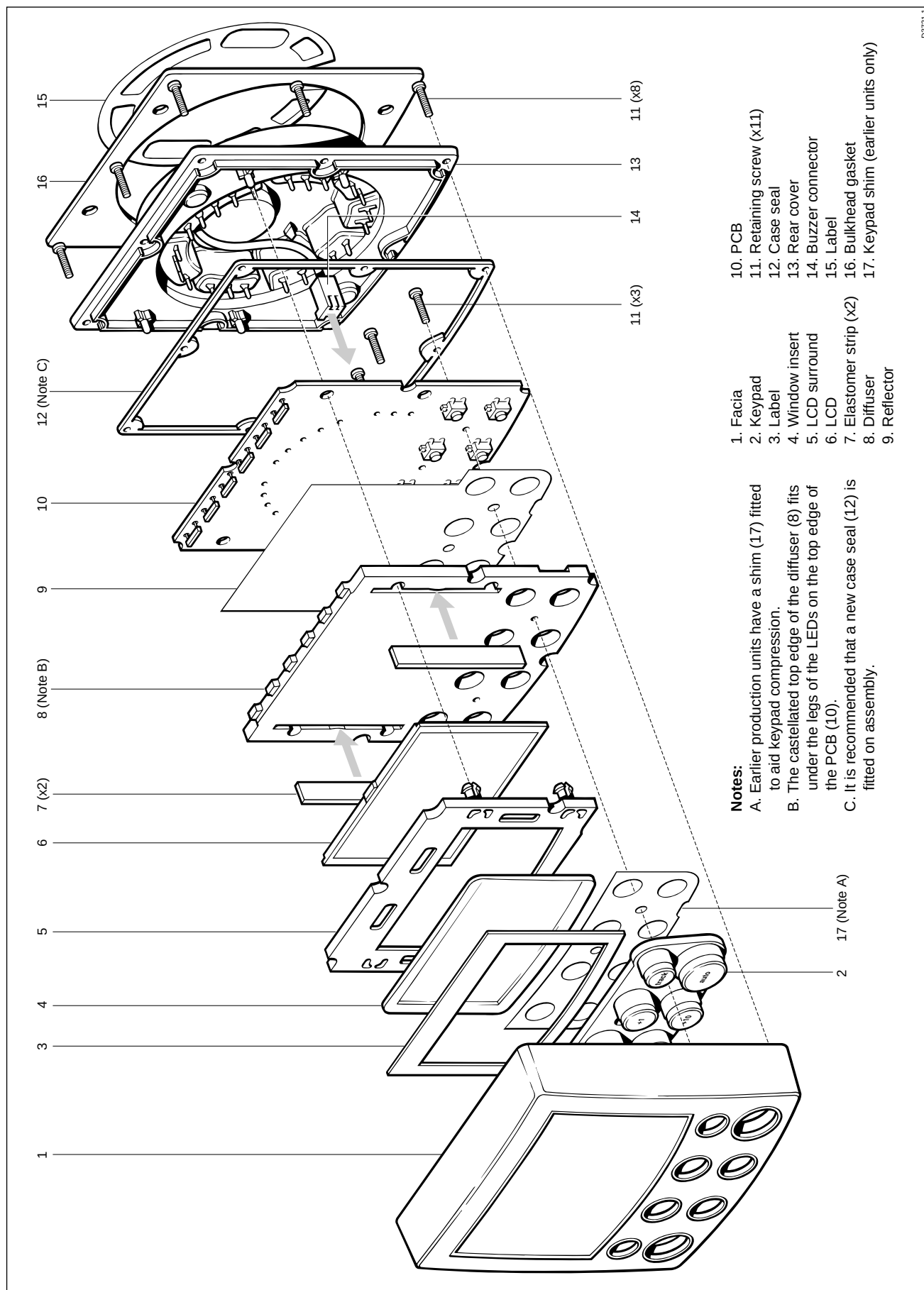


Figure 1: ST4000+ Control Head exploded view

## ST4000+ Control Head spare parts list

The **item** numbers refer to Figure 1: ST4000+ Control Head exploded view

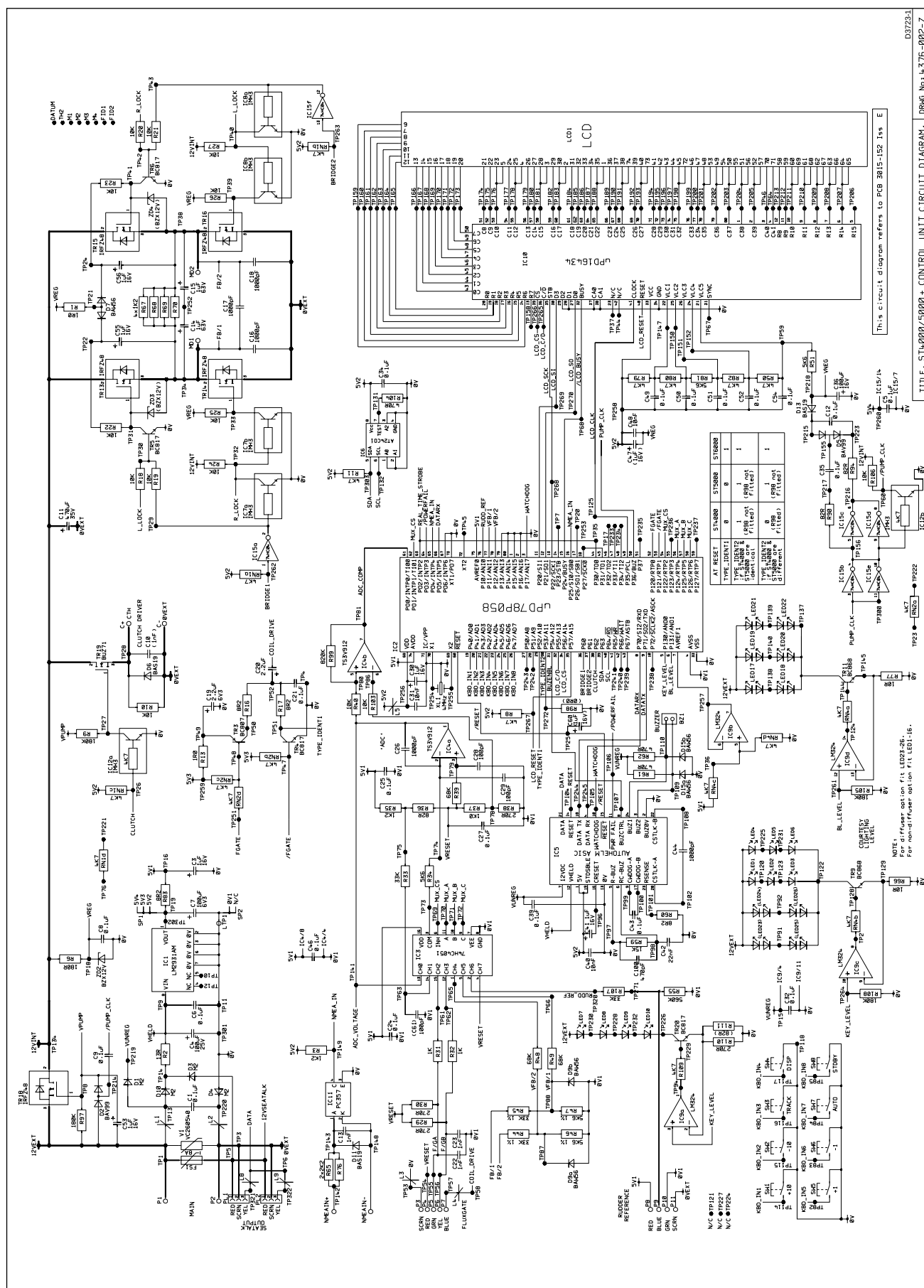
| Item | Spare Description                                   | Part No. | Comments                                                                                                        |
|------|-----------------------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------|
| 1    | Facia                                               | W115     |                                                                                                                 |
| 2    | Keypad                                              | Q219     |                                                                                                                 |
| 3    | Display kit, <i>including</i><br>Label (selection)  | Q220     | Fit ST4000+ label                                                                                               |
| 4    | Window insert                                       |          |                                                                                                                 |
| 5    | LCD surround                                        |          |                                                                                                                 |
| 6    | LCD                                                 |          |                                                                                                                 |
| 7    | Elastomer (x2)                                      |          |                                                                                                                 |
| 8    | Diffuser kit, <i>including</i><br>Diffuser          | W117     |                                                                                                                 |
| 9    | Reflector                                           |          |                                                                                                                 |
| 10   | PCB                                                 | Q221     | ST4000+/ST5000+ PCB                                                                                             |
| 11   | Fixing kit, <i>including</i><br>Screw (x11)         | W120     |                                                                                                                 |
| 12   | Case seal                                           | W118     |                                                                                                                 |
| 13   | Back cover assembly, <i>including</i><br>Back cover | W119     | <i>Comes fitted with,</i><br>Gortex filter,<br>Sleeving,<br>Buzzer and<br>Buzzer connector<br>Fit ST4000+ label |
| 14   |                                                     |          |                                                                                                                 |
| 15   | Label (selection)                                   |          |                                                                                                                 |
| 16   | Bulkhead gasket                                     | W125     |                                                                                                                 |
|      | Sun cover                                           | D340     | Not illustrated                                                                                                 |

## 1.3 PCB Details

### Input/Output Signals (refer to Figure 2. Circuit Diagram)

| Pin No.  | Signal                  | Description                                                                                                                |
|----------|-------------------------|----------------------------------------------------------------------------------------------------------------------------|
| PL1/1    | +12V                    | Nominal 12V dc                                                                                                             |
| PL1/2    | 0V in                   | 0V                                                                                                                         |
| PL1/3    | SeaTalk                 | Intermittent streams of (nominal) 12V pulses                                                                               |
| PL2/1    | +12V                    | Nominal 12V dc                                                                                                             |
| PL2/2    | 0V in                   | 0V                                                                                                                         |
| PL2/3    | SeaTalk                 | Intermittent streams of (nominal) 12V pulses                                                                               |
| P1       | +12V                    | Nominal 12V dc                                                                                                             |
| P2       | 0V in                   | 0V                                                                                                                         |
| P3       | SCRN                    | 0V                                                                                                                         |
| P4       | Bias                    | Nominal 2.5V dc (VRESET)                                                                                                   |
| P5       | F/GA                    | +2.5V dc                                                                                                                   |
| P6       | F/GB                    | +2.5V dc                                                                                                                   |
| P7       | Coil drive              | AC signal, 17 cycles at 7.9kHz, driven twice every 1/16 second                                                             |
| P8       | Rudder reference supply | Nominal 5V supply to rudder reference                                                                                      |
| P9       | Rudder reference        | 0 to 5V dc (nominal) rudder reference output                                                                               |
| P10      | Rudder reference 0V     | 0V                                                                                                                         |
| P11      | SCRN                    | 0V                                                                                                                         |
| C+       | Clutch                  | +12V if Autopilot engaged; otherwise 0V                                                                                    |
| C–       | Clutch 0V               | 0V                                                                                                                         |
| MD1      | MD1                     | When Autopilot engaged and depending on direction of drive, intermittent variable length pulses, nominal 12V; otherwise 0V |
| MD2      | MD2                     | When Autopilot engaged and depending on direction of drive, intermittent variable length pulses, nominal 12V; otherwise 0V |
| NMEA in+ | NMEA+                   | Intermittent streams of (nominal) 12V pulses                                                                               |
| NMEA in– | NMEA–                   | 0V                                                                                                                         |





## PCB Layout

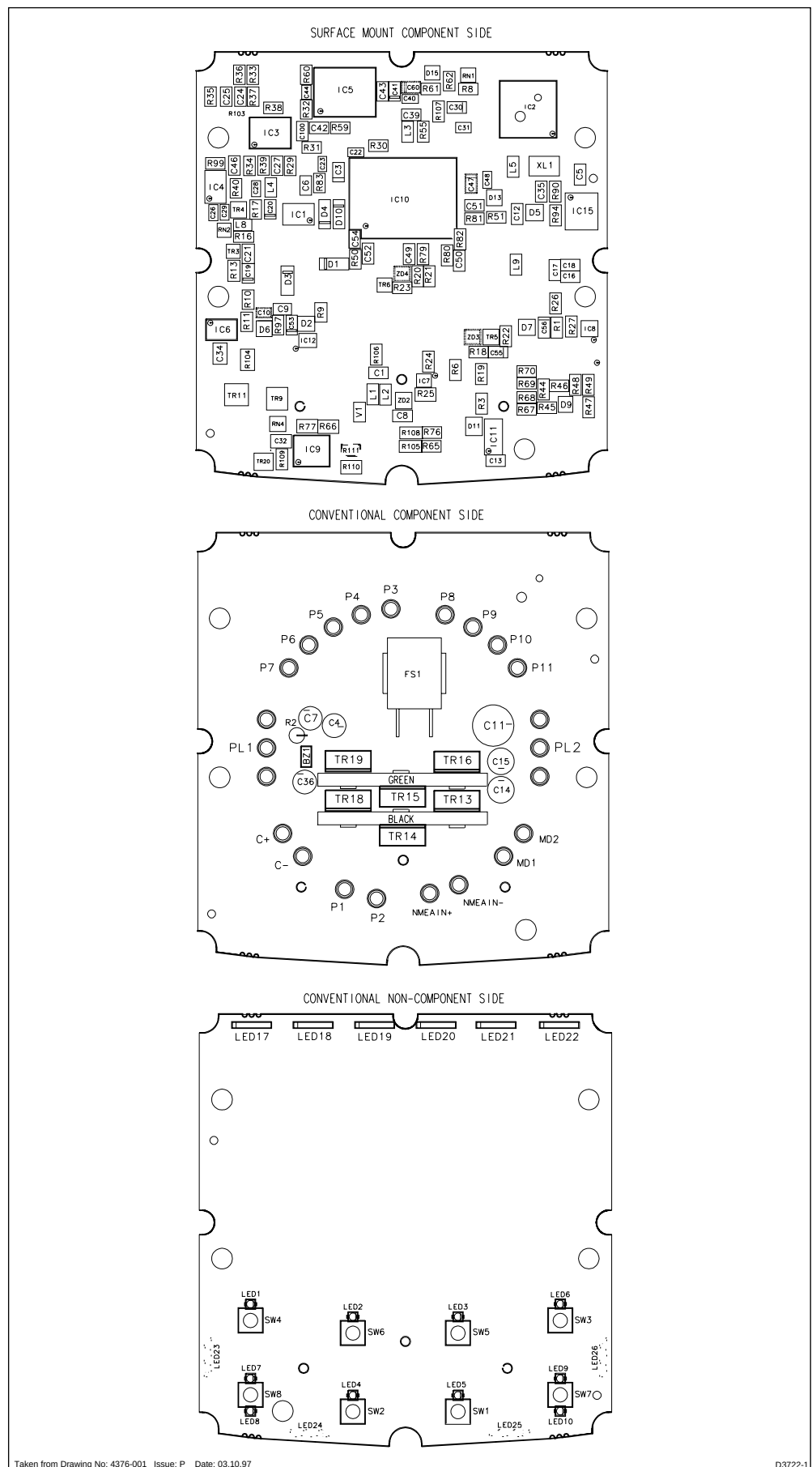


Figure 3: PCB Component Layout

**PCB Component list**

## SURFACE MOUNT COMPONENT SIDE

|              |                                                |                                                      |
|--------------|------------------------------------------------|------------------------------------------------------|
| 9103270R     | RESISTOR WCR 1206 270R 1% 0.125W               | R110                                                 |
| 9600L1       | SOLID CHIP INDUCTOR                            | L1-5,8,9                                             |
| 9600RES4M0   | RESONATOR 4MHz                                 | XL1                                                  |
| 9108VC260540 | VARIABLE VC260540                              | V1                                                   |
| 940074HC04   | IC HEX INVERTING BUFFER 74HC04                 | IC15                                                 |
| 9400PC317    | IC OPTO ISOLATOR PC357 S016                    | IC11                                                 |
| 940016434    | IC LCD DRIVER uPD16434                         | IC10                                                 |
| 9400LM324    | IC QUAD OPAMP LM324                            | IC9                                                  |
| 95001MH3     | TRANSISTOR ARRAY 1MH3AT110 SOT36               | IC7,8,12                                             |
| 940024C01A   | IC CMOS EPROM AT24C01                          | IC6                                                  |
| 9401RLA80    | IC RAYTHEON ASIC                               | IC5                                                  |
| 9400TS3V912  | IC TS3V912                                     | IC4                                                  |
| 940074HC4051 | IC 74HC4051                                    | IC3                                                  |
| 940078P058   | IC MICROPROCESSOR uPD78P058 80PIN QFP          | IC2                                                  |
| 9400LM2931AM | IC REGULATOR LM2931AM 5V S08                   | IC1                                                  |
| 9501BC868    | TRANSISTOR SOT89 BC868 NPN                     | TR9,11                                               |
| 9500BC807    | TRANSISTOR SOT23 BC807 PNP                     | TR3                                                  |
| 9500BC817    | TRANSISTOR SOT23 BC817 NPN                     | TR4-6,20                                             |
| 930522N      | CAPACITOR X7R 22nF 5% 50V 1206                 | C42                                                  |
| 9302100P     | CAPACITOR COG 100pF 10% 50V 0805               | C28,29                                               |
| 93102U2      | CAPACITOR TANT 2.2uF 20% 6V3 TANTA             | C19,20                                               |
| 93041000P    | CAPACITOR X7R 1000pF 10% 50V 0805              | (C10),13,16-18,22,23,44                              |
| 93091U       | CAPACITOR TANT 1uF 10% 16V TANTA               | C3,30,41,(47),53,55,56,(60)                          |
| 93040U01     | CAPACITOR X7R 0.01uF 10% 50V 0805              | C31,40,48                                            |
| 93001000P    | CAPACITOR COG 1000pF 10% 50V 0805              | C26                                                  |
| 93070U1      | CAPACITOR X7R 0.1uF 20% 50V 1206               | C1,5,6,8,9,12,21,24,25,27,32,34,35,39,43,46,49-52,54 |
| 9317470P     | CAPACITOR COG 470pF 20% 50V 1206               | C100                                                 |
| 9203BZX12V   | DIODE ZENER BZX84C12V SOT23                    | ZD2,(3,4)                                            |
| 9200BAS19    | DIODE BAS19 SOT23                              | D6,11,13                                             |
| 9200BAW56    | DIODE BAW56 SOT23                              | D7,9,15                                              |
| 9200M2SYM    | DIODE M2-SYM 10A 100V                          | D1,3,4,10                                            |
| 9200BAV99    | DIODE BAV99 SOT23                              | D2,5                                                 |
| 91124K7      | RESISTOR NETWORK 4K7                           | RN1,2,4                                              |
| 9103180K     | RESISTOR WCR 1206 180K 1% 0.125W               | R9,97,105,108                                        |
| 9106820K     | RESISTOR WCR 1206 820K 5% 0.125W               | R99                                                  |
| 910310R      | RESISTOR WCR 1206 10R 1% 0.125W                | R66,77                                               |
| 9106470R     | RESISTOR WCR 1206 470R 5% 0.125W               | R61,62,104                                           |
| 910315K      | RESISTOR WCR 1206 15K 1% 0.125W                | R59                                                  |
| 9103560K     | RESISTOR WCR 1206 560K 1% 0.125W               | R55                                                  |
| 910368K      | RESISTOR WCR 1206 68K 1% 0.125W                | R39,48,49                                            |
| 910382R      | RESISTOR WCR 1206 82R 1% 0.125W                | R36,90,94,(111)                                      |
| 91031K2      | RESISTOR WCR 1206 1K2 1% 0.125W                | R3,35,67-70                                          |
| 91035K6      | RESISTOR WCR 1206 5K6 1% 0.125W                | R34,46,47,51,81                                      |
| 910333K      | RESISTOR WCR 1206 33K 1% 0.125W                | R33,44,45,107                                        |
| 91031K0      | RESISTOR WCR 1206 1K0 1% 0.125W                | R31,32,37                                            |
| 9103270R     | RESISTOR WCR 1206 270R 1% 0.125W               | R29,30,38                                            |
| 91064K7      | RESISTOR WCR 1206 4K7 5% 0.125W                | R8,11,50,79,80,82,109                                |
| 9106180R     | RESISTOR WCR 1206 180R 5% 0.125W               | R6                                                   |
| 91062K2      | RESISTOR WCR 1206 2K2 5% 0.125W                | R65,76                                               |
| 91061R0      | RESISTOR WCR 1206 1R 5% 0.125W                 | R1,13                                                |
| 91068R2      | RESISTOR WCR 1206 8R2 5% 0.125W                | R16,17,60,83                                         |
| 910610K      | RESISTOR WCR 1206 10K 5% 0.125W                | R10,18-27,40,103,106                                 |
| 3015-152     | PCB ST60 ST4/5/6000 CONTROL UNIT AND AUTOPILOT |                                                      |

## CONVENTIONAL COMPONENT SIDE

|            |                                      |                                         |
|------------|--------------------------------------|-----------------------------------------|
| 3036-141   | HEATSINK                             |                                         |
| 15277      | INSULATOR KOOL PAD                   |                                         |
| 15014      | INSULATING BUSH                      |                                         |
| 26008      | RIVSCREW                             |                                         |
| 15047      | PAD DOUBLE SIDED ADHESIVE            |                                         |
| 3030-035-B | SOLDER BUCKETS                       | PL1,2,P1-11,MD1,2,C+,C-,NMEA1N+,NMEA1N- |
| 15289      | FUSE 8A POLY                         | FS1                                     |
| 07266      | HEADER MOLEX 2WAY                    | BZ1                                     |
| 03074      | CAPACITOR ELEC 100uF 16V +/-20%      | C36                                     |
| 03062      | CAPACITOR ELEC 100uF 6V3 20%         | C7                                      |
| 03050      | CAPACITOR ELEC 1uF 63V 20%           | C14,15                                  |
| 03069      | CAPACITOR ELEC 470uF 35V 20%         | C11                                     |
| 03100      | CAPACITOR ELEC LOW IMP 100uF 25V 20% | C4                                      |
| 05040      | TRANSISTOR FET 1RFZ48N 60V T0220     | TR13-16,18                              |
| 05048      | TRANSISTOR BUZ71                     | TR19                                    |
| 01183      | RESISTOR 13R 5% 0.4W SFR25           | R2                                      |

## CONVENTIONAL NON-COMPONENT SIDE

|       |                 |                  |
|-------|-----------------|------------------|
| 15165 | LED 202         | LED17-22,(23-26) |
| 02050 | LED HLMP6505    | LED1-6           |
| 02076 | LED HLMPQ102    | LED7-10          |
| 06030 | SWITCHES ALPMIN | SW1-8            |

Taken from Drawing No: 4376-001 Issue: P Date: 03.10.97

D3724-1



## Chapter 2. Fluxgate Compass Transducer

### 2.1 Functional test

Disconnect the Fluxgate from the Autopilot and check continuity as follows:

| Cable colour   | Connector pin number | Resistance   |
|----------------|----------------------|--------------|
| Screen to blue | 2/4                  | < 10 ohms    |
| Red to green   | 3/5                  | < 5 ohms     |
| Red to yellow  | 3/6                  | < 5 ohms     |
| Red to screen  | 3/2                  | Open circuit |

### 2.2 Magnetic deviation

The Fluxgate Compass requires careful siting if optimum Autopilot performance is to be achieved. The SeaTalk electronics is able to correct the compass for most deviating magnetic fields present when the linearisation procedure is carried out. Any further deviation, introduced after linearisation, will introduce an error between the Fluxgate and the ship's compass. This can be removed by carrying out the linearisation again. If the displayed deviation is greater than  $\pm 15$  degrees the Fluxgate should be resited.

**Note:** The linearisation procedure should always be carried out if the Fluxgate has been exchanged, removed or moved from its original mounting position.

2.3 Disassembly/assembly

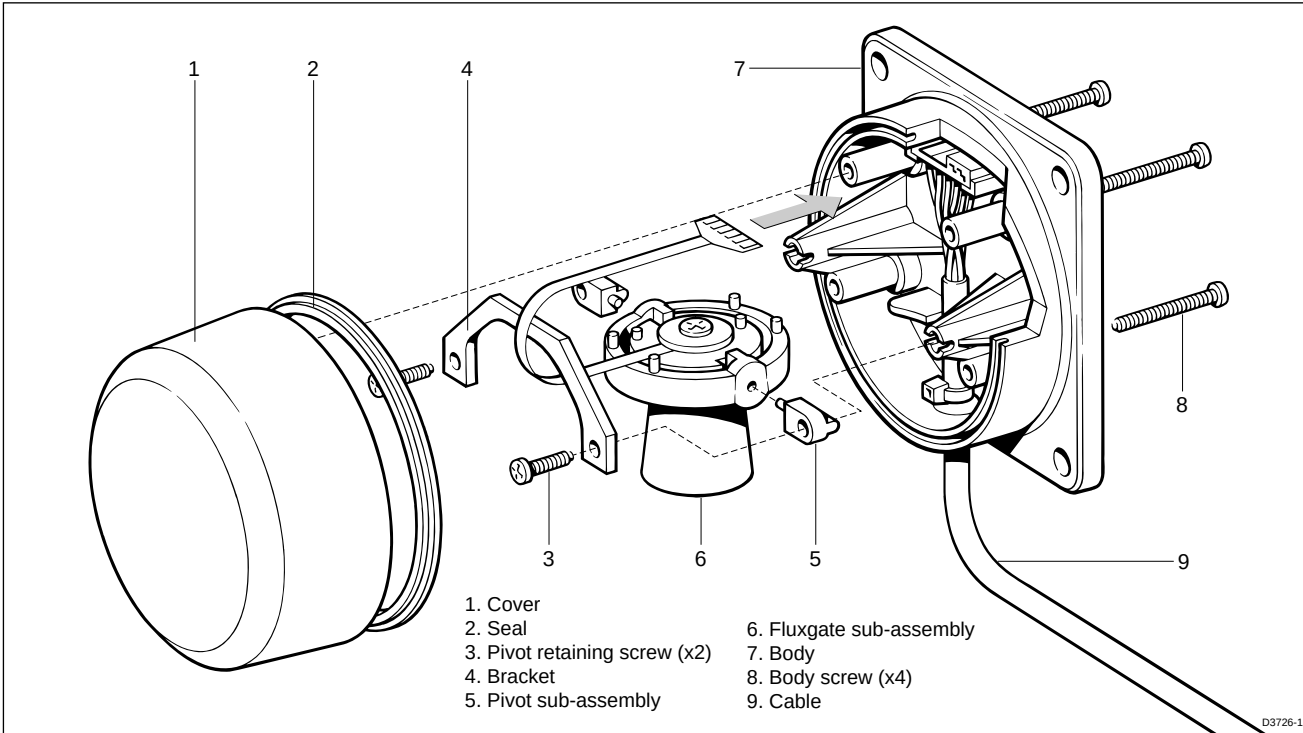


Figure 4. Fluxgate Compass exploded view

Fluxgate Compass spare parts list

The **item** numbers refer to Figure 4: Fluxgate Compass exploded view

| Item | Spare Description                                                  | Part No. | Comments |
|------|--------------------------------------------------------------------|----------|----------|
| 3    | Compass base kit, <i>including</i><br>Pivot retaining screw (x2)   | M096     |          |
| 4    | Bracket                                                            |          |          |
| 5    | Fluxgate sub-assembly, <i>including</i><br>Pivot sub-assembly (x2) | M022     |          |
| 6    | Fluxgate sub-assembly                                              |          |          |

## Chapter 3. Wheel Drive Actuator

### 3.1 Wheel Drive Actuator test

Carry out the passive and active tests detailed in Figure 6.

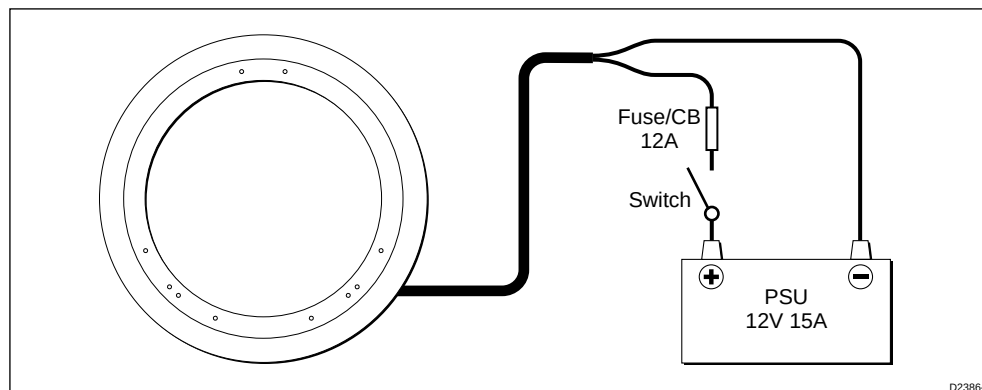


Figure 5. Wheel Drive Actuator test connections

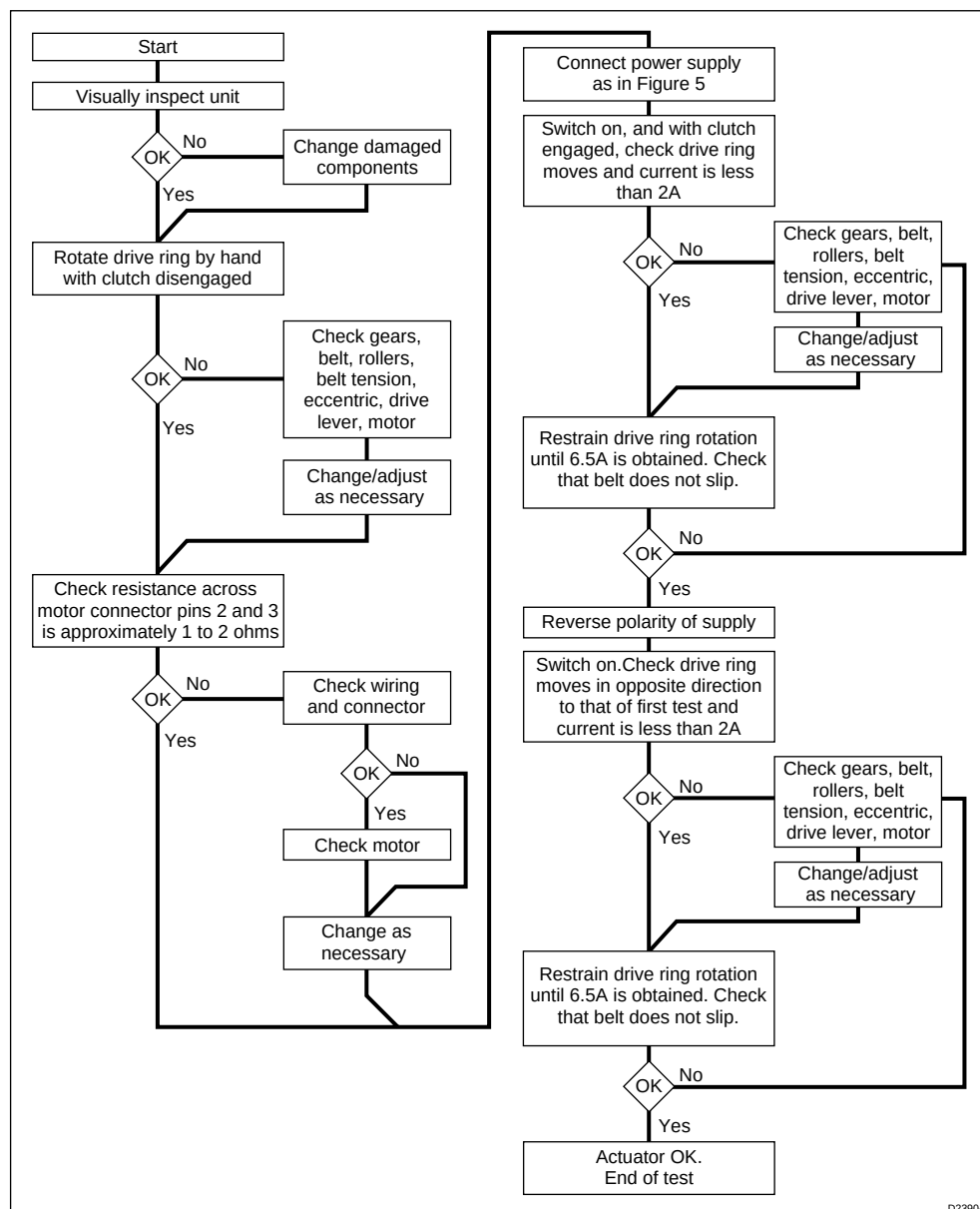


Figure 6. Wheel Drive Actuator test flowchart

## 3.2 Disassembly/assembly

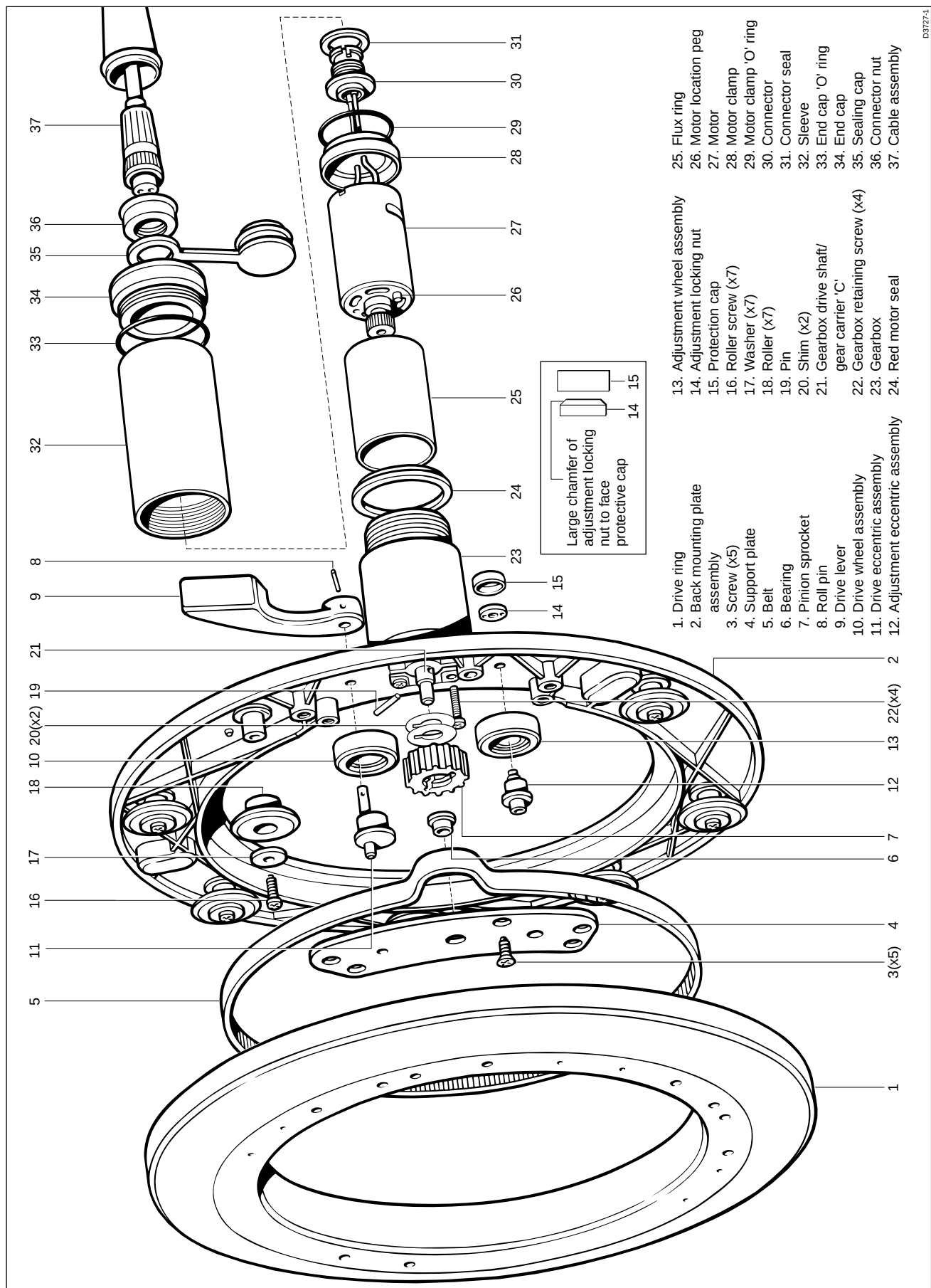


Figure 7. Wheel Drive Actuator exploded view



## Wheel Drive Actuator spare parts list

The **item** numbers refer to Figure 7: Wheel Drive Actuator exploded view

| Item | Spare Description                                          | Part No. | Comments                                                 |
|------|------------------------------------------------------------|----------|----------------------------------------------------------|
| 1    | Drive ring                                                 | N031     |                                                          |
| 2    | Back mounting plate assembly                               | N013     | <i>Comes fitted with, pre-assembled gearbox, item 23</i> |
| 5    | Belt                                                       | D169     |                                                          |
|      | Pinion kit, <i>including</i>                               | N014     |                                                          |
| 7    | Pinion sprocket                                            |          |                                                          |
| 15   | Protection cap                                             |          |                                                          |
| 19   | Pin                                                        |          |                                                          |
| 20   | Shim (x2)                                                  |          |                                                          |
|      | Drive lever kit, <i>including</i>                          | N011     |                                                          |
| 8    | Roll pin                                                   |          |                                                          |
| 9    | Drive lever                                                |          |                                                          |
| 11   | Drive eccentric assembly                                   | N024     |                                                          |
|      | Gearbox drive shaft/gear carrier 'C' kit, <i>including</i> | N026     |                                                          |
| 21   | Gearbox drive shaft/gear carrier 'C'                       |          | See Figure 8, item 3                                     |
| —    | Planet gear (x12)                                          |          | See Figure 8, item 4                                     |
| —    | Shim                                                       |          | See Figure 8, item 2                                     |
| —    | 'O' ring                                                   |          | See Figure 8, item 1                                     |
| 27   | Motor                                                      | N012     |                                                          |
|      | Wiring kit, <i>including</i>                               | Q106     |                                                          |
| 28   | Motor clamp                                                |          |                                                          |
| 29   | Motor clamp 'O' ring                                       |          |                                                          |
| 30   | Connector                                                  |          |                                                          |
| 31   | Connector seal                                             |          |                                                          |
| 33   | End cap 'O' ring                                           |          |                                                          |
| 34   | End cap                                                    |          |                                                          |
| 35   | Sealing cap                                                |          |                                                          |
| 36   | Connector nut                                              |          |                                                          |
| 37   | Cable assembly                                             |          |                                                          |

## Disassembly

### ***Belt removal***

Refer to Figure 7. Wheel Drive Actuator exploded view.

1. Insert a wide flat, non-metallic blade into the gap between the drive ring (1) and the back mounting plate (2). Gently lever the blade to force the drive ring (1) off the rollers (18) of the back mounting plate (2). Repeat this action in three to four places around the drive ring (1) in order to remove.
2. Unscrew and remove the five screws (3). Detach the support plate (4) from the back mounting plate (2).
3. Remove the belt (5).

### ***Pinion sprocket removal***

Refer to Figure 7. Wheel Drive Actuator exploded view.

1. Perform actions as described in *Belt removal*.
2. Lift the pinion sprocket (7) off the gearbox drive shaft/gear carrier 'C' (21).

### ***Drive lever and eccentric removal***

Refer to Figure 7. Wheel drive actuator exploded view.

1. Perform actions as described in *Pinion sprocket removal*.
2. Place a block with a suitable clearance hole under the drive lever/shaft (9) to provide support and prevent the shaft bending when the roll pin is driven out.
3. Drive out the roll pin (8).
4. Pull the drive lever (9) off the drive eccentric shaft (11).
5. Lift the drive eccentric assembly (11) and drive wheel assembly (10) off the back mounting plate (2).

### ***Motor removal***

Refer to Figure 7. Wheel Drive Actuator exploded view.

1. Unscrew and remove the connector nut (36).
2. Remove the sealing cap (35).
3. Grip the gearbox (23), unscrew and remove the sleeve (32) ensuring the connector does not rotate.
4. Withdraw motor (27)/location peg (26) disengaging it from the gearbox (23). Slide off the flux ring (25).

**Note:** Although given separate item numbers, the gearbox (23) is an integral part of the back mounting plate assembly (2) and the location peg (26) is part of the motor (27).

5. Desolder connector wires from the motor tags.

### ***Gearbox removal***

Refer to Figure 7. Wheel Drive Actuator exploded view.

1. Perform actions as described in *Pinion sprocket removal*, and 1, 2, 3 and 4 in *Motor removal*.
2. Unscrew and remove the four gearbox retaining screws (22).
3. Separate the gearbox ( 23) from the back mounting plate assembly (2) leaving the gearbox drive shaft/gear carrier 'C' (21) in place.
4. Support the gearbox drive shaft/gear carrier 'C' (21) and drive out the pin (19).
5. Withdraw the gearbox drive shaft/gear carrier 'C' (21) from the back mounting plate assembly (2).

### ***Gearbox disassembly***

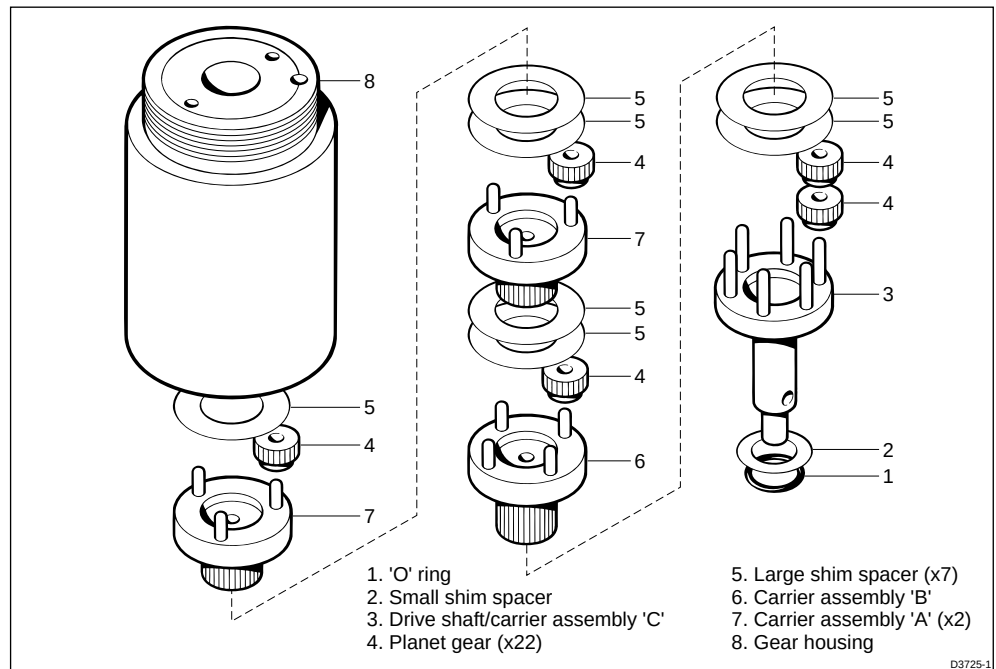


Figure 8. Gearbox exploded view

## **Assembly**

In all cases, assembly is a straight reversal of the steps described in *Disassembly*.

### **Gearbox assembly**

Refer to Figure 7. Wheel Drive Actuator exploded view.

1. Rebuild gearbox. Refer to Figure 8. Gearbox exploded view
2. Fix the gearbox (23) to the back mounting plate assembly (2) using the four gearbox retaining screws (22).
3. Slide the two shims (20) over the gearbox drive shaft/gear carrier 'C' (21) and hard up against the back mounting plate assembly (2).
4. Support the gearbox drive shaft/gear carrier 'C' (21) and refit the pin (19).

**Note:** If the original pin (19) is bent or damaged a replacement pin can be obtained from pinion kit, part no. N014.

### **Motor assembly**

Refer to Figure 7. Wheel Drive Actuator exploded view.

1. Fit the red motor seal (24) over the threaded end of the gearbox (23).
2. Insert the connector wires through the motor clamp (28), and solder the connector wires to the motor tags – red lead to the tag with a red spot, black lead to the other motor tag.
3. Slide flux ring (25) on the motor (27) and fit onto the gearbox (23) ensuring that the motor drive gear is fully engaged with the gear train and the motor location peg (26) is engaged correctly into the gearbox (23).
4. Fit the 'O' ring (29) onto the motor clamp (28).
5. Place the connector seal (31) over the connector (30).
6. Screw the sleeve (32) with fitted 'O' ring (33) and end cap (34) onto the gearbox (23).
7. Place the sealing cap (35) over the connector (36) and secure with the connector nut (37).

### **Adjustment eccentric assembly**

Refer to Figure 7. Wheel Drive Actuator exploded view.

1. Assemble the adjustment wheel assembly (13), adjustment eccentric assembly (12), adjustment lock nut (14) with its chamfered edge facing outwards, and protection cap (15) to the back mounting plate assembly (2).

**Note:** Ensure that the drive lever (9) is in the slack (declutched) position and the adjustment eccentric assembly (12) is in its lowest position, so that the belt (5) is at its slackest.

### ***Drive lever and eccentric assembly***

Refer to Figure 7. Wheel Drive Actuator exploded view.

1. Assemble the drive eccentric assembly (11) and drive wheel assembly (10) to the back mounting plate assembly (2).
2. Slide the drive lever (9) onto the drive eccentric assembly (11). Support the drive lever (9) and insert the roll pin (8).

**Note:** Always use a new roll pin (8) on refit.

### ***Pinion sprocket and belt assembly***

Refer to Figure 7. Wheel Drive Actuator exploded view.

1. Slot the pinion sprocket (7) over the gearbox drive shaft (21) and pin (19).
2. With the drive lever (9) in its slack (declutched) position and the adjustment eccentric assembly (12) is in its lowest position fit the belt (5) around the pinion sprocket (7), drive wheel assembly (10) and adjustment wheel assembly (13).
3. Position the support plate (4) with fitted bearing (6) onto the gearbox drive shaft (21), drive eccentric assembly (11), adjustment eccentric assembly (12) and over the screw pillars. Insert the five screws (3) and secure the support plate (4).

**Note:** Take care not to cut new threads in the screw pillars when securing the support plate (4).

### ***Drive ring closure***

Refer to Figure 7. Wheel Drive Actuator exploded view.

1. Rest the drive ring (1) over the rollers (18).
2. Locate the rollers (18) nearest the gearbox (23) into the groove of the drive ring (1). Push down and around the drive ring (1) to progressively snap the drive ring (1) over the remaining rollers (18).
3. Spin the drive ring (1) in both directions, two or three times, too ensure the assembly is fully seated and free running.

### 3.3 Setting Belt Tension

The purpose of the belt tensioning procedure is to ensure that:

1. The belt is sufficiently tight to transmit the normal maximum drive torques.
2. The belt is not over-tightened, as this will increase the backdrive load to a level where it can be felt on the vessel's wheel.

#### Tools required:

4000 Drive unit torque fixture

Service tool number - T033

4000 Drive unit torque adjuster

Service tool number - T032

Motor drive box and ammeter

#### Motor drive box

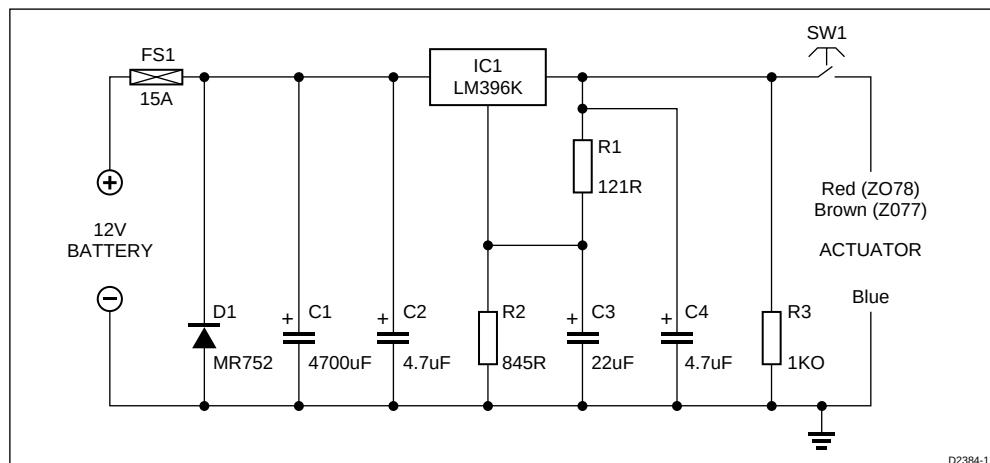


Figure 9. Motor drive box circuit diagram

**Motor drive box parts**

| Component | Description |                              |
|-----------|-------------|------------------------------|
| R1        | Resistor    | 121R 0.1% metal film         |
| R2        | Resistor    | 845R 0.1% metal film         |
| R3        | Resistor    | 1k0 0.5W                     |
| C1        | Capacitor   | 4700uF 20% electrolytic 25V  |
| C2        | Capacitor   | 4.7uF 10% solid tantalum 35V |
| C3        | Capacitor   | 22uF 10% solid tantalum 35V  |
| C4        | Capacitor   | 4.7uF 10% solid tantalum 35V |
| D1        | Diode       | MR 752                       |
| IC1       | LM396K      | High power 10A regulator     |
| F1        | Fuse        | 15A quick blow               |
|           | Fuseholder  | 1.1/4 inch                   |
| SW1       | Switch      | Single pole single throw     |
|           | TO3         | Insulating kit               |
|           | Diecast box |                              |

**Procedure**

1. Screw the drive ring clamp to the front ring. Use the group of two holes on their own, not two holes in a group of four. Screw the torque restraint pin into the back mounting plate
2. Connect the motor to the motor drive box, using an in - line ammeter (0 - 10 amps) to measure current
3. Connect the motor drive box to a 12V battery. The drive box provides a regulated 10.5V supply to the motor
4. Engage the drive unit clutch
5. Use the eccentric adjuster to loosen (anti - clockwise) the locking nut and allow the eccentric to move to the minimum tension position
6. Switch on the drive to the motor and, using a 1.5mm Allen key, rotate the eccentric anticlockwise (as viewed from above) to increase belt tension until the belt just stops slipping (motor stalled)
7. Check that the motor current is approximately 6.5 amps
8. Tighten the locking nut, apply Loctite to retain the setting and switch off the motor drive.





## Chapter 4. Tiller Drive Actuator

### 4.1 Tiller Drive Actuator test

Carry out the passive and active tests detailed in Figure 11. Tiller Drive Actuator test flowchart.

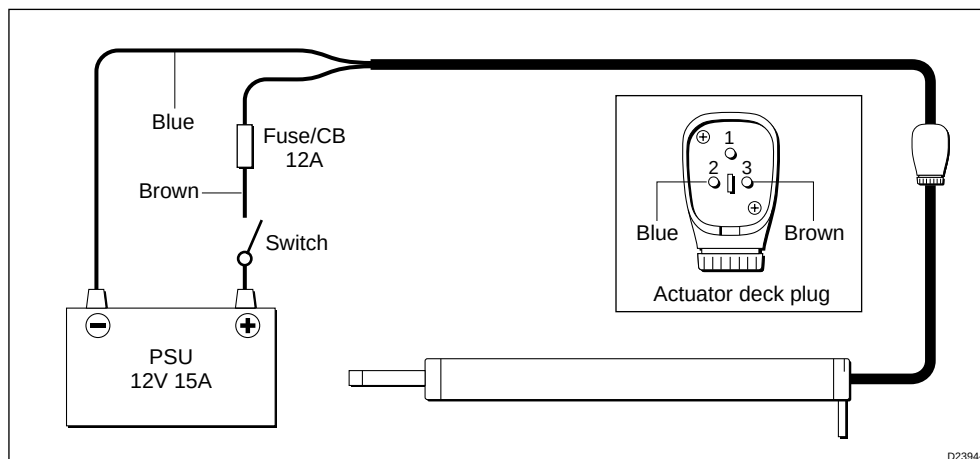


Figure 10. Tiller Drive Actuator test connections

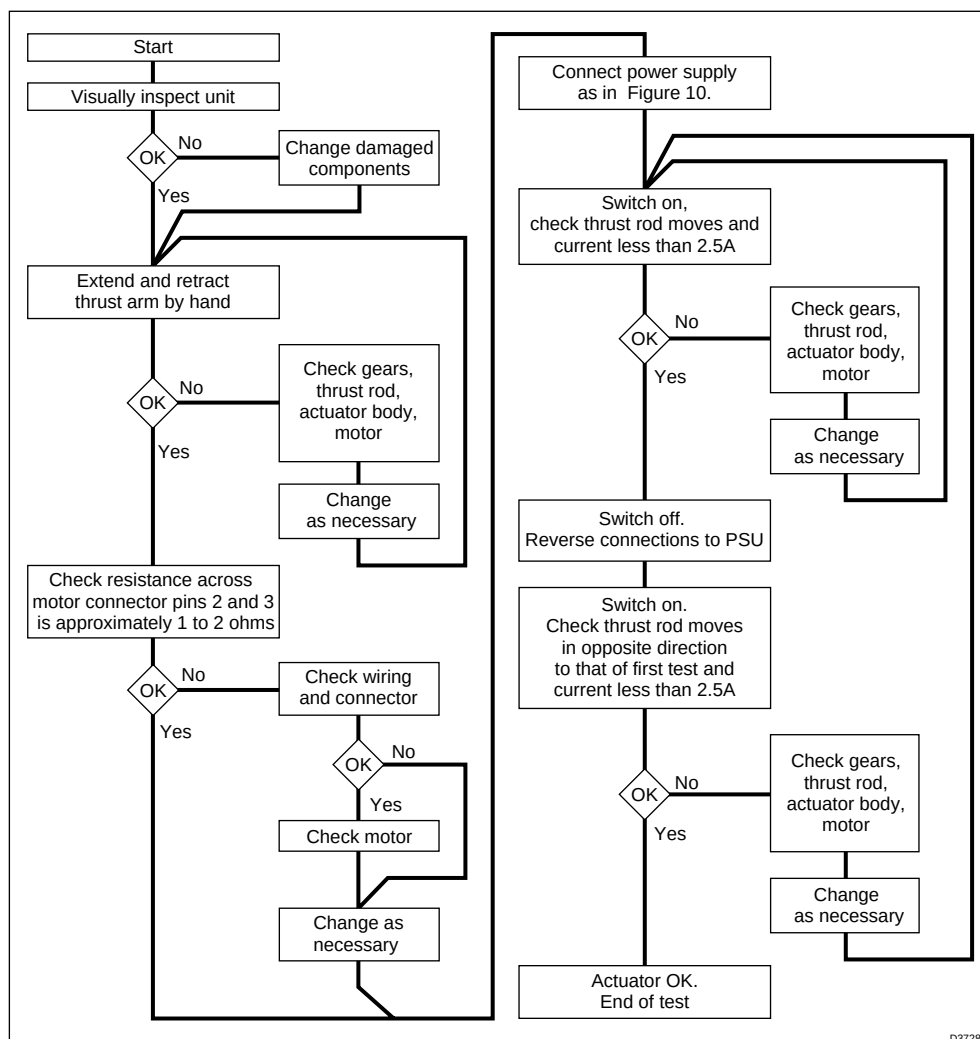


Figure 11. Tiller Drive Actuator test flowchart

## 4.2 Disassembly/assembly

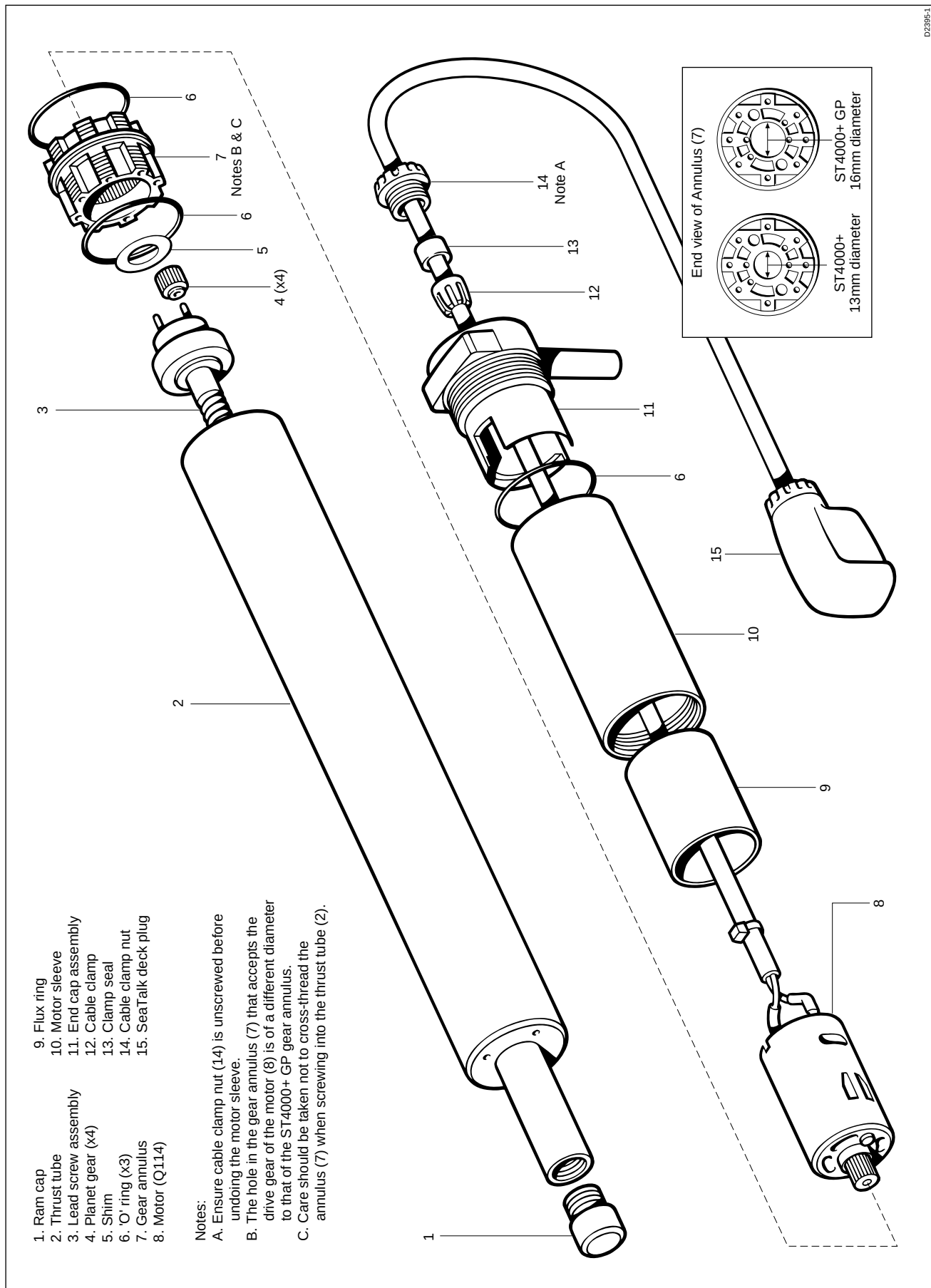


Figure 12. Tiller Drive Actuator exploded view

## Tiller Drive Actuator spare parts list

The **item** numbers refer to Figure 12: Tiller Drive Actuator exploded view

| Item | Spare Description | Part No. | Comments            |
|------|-------------------|----------|---------------------|
|      | Drive module      | Q047     | Complete drive unit |
| 8    | Motor             | Q114     |                     |
| 11   | End cap assembly  | W014     |                     |

## Tiller Drive Actuator GP conversion kit (W003)

This GP conversion kit (W003) gives the option of converting the ST4000+ which has the power to helm boats of up to 6,500 kg (14,300 lbs) displacement, to the ST4000+ GP which would push the limit up to 9,000 kg (20,000 lbs) displacement.

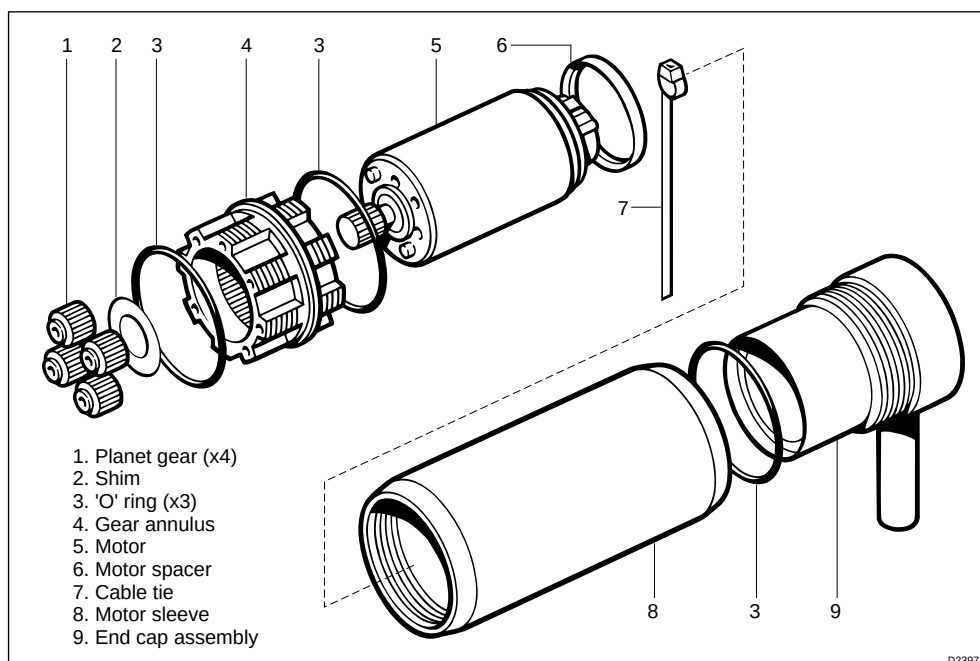


Figure 13. Tiller Drive Actuator GP conversion kit (W003)



## Chapter 5. Tiller Drive Actuator GP

### 5.1 Tiller Drive Actuator GP test

Carry out the passive and active tests detailed in Figure 15. Tiller Drive Actuator GP test flowchart.

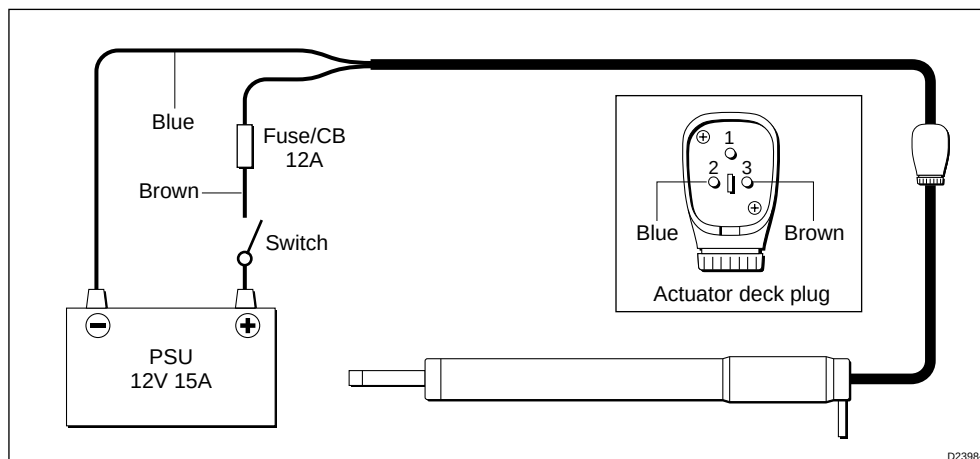


Figure 14. Tiller Drive Actuator GP test connections

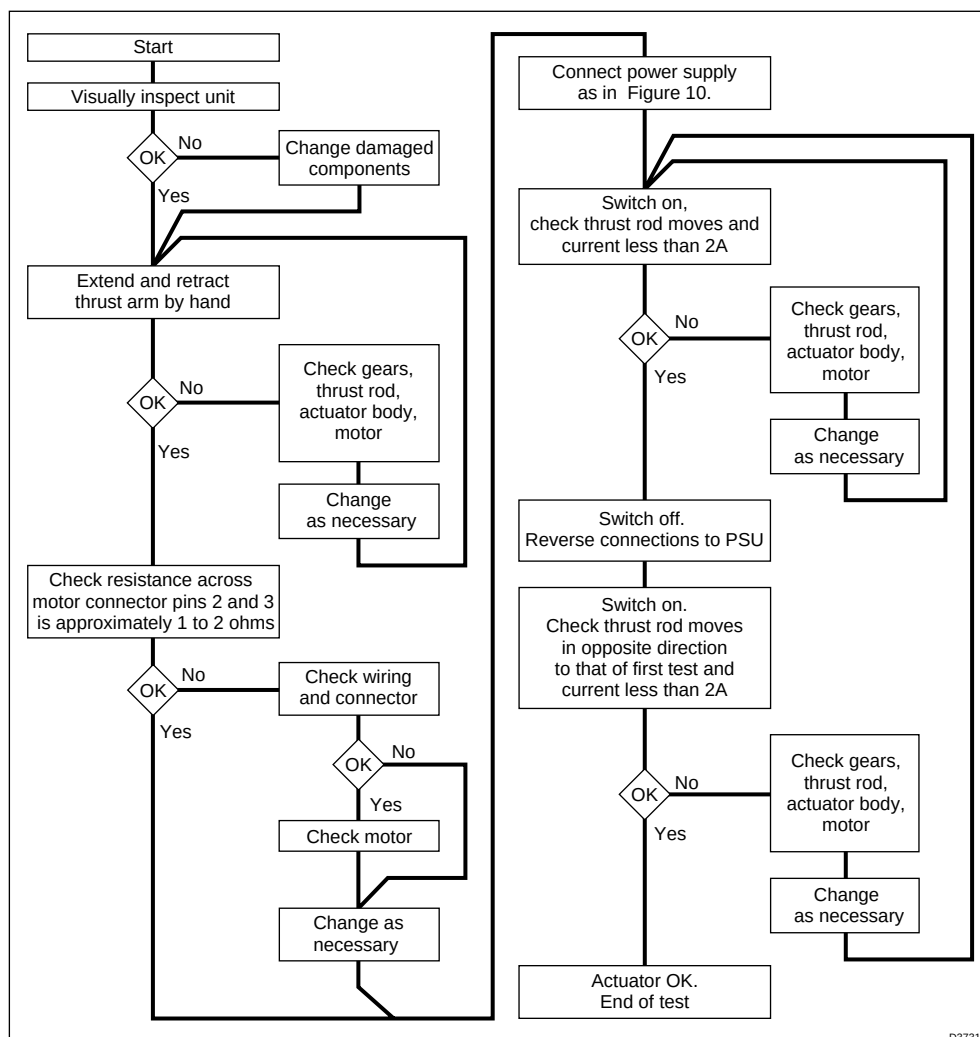


Figure 15. Tiller Drive Actuator GP test flowchart

## 5.2 Disassembly/assembly

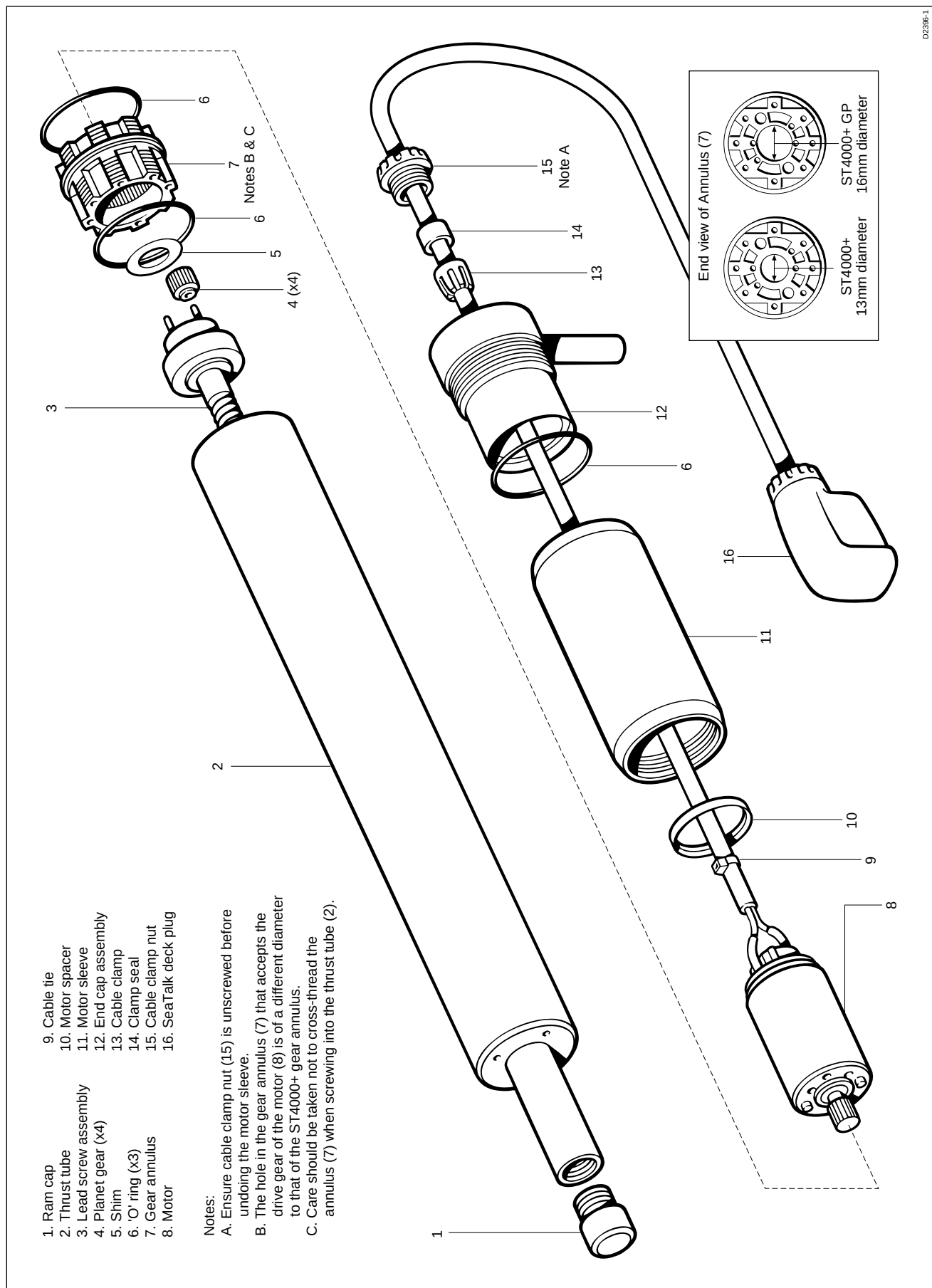


Figure 16. Tiller Drive Actuator GP exploded view

**Tiller Drive Actuator GP spare parts list**

The **item** numbers refer to Figure 16: Tiller drive actuator GP exploded view

| <b>Item</b> | <b>Spare Description</b>         | <b>Part No.</b> | <b>Comments</b>                                                            |
|-------------|----------------------------------|-----------------|----------------------------------------------------------------------------|
|             | Drive module                     | Q086            | Complete drive unit                                                        |
|             | ST4000+ GP kit, <i>including</i> | W003            | Serves as an upgrade conversion kit for the ST4000+ tiller drive actuator. |
| 4           | Planet gear (x4)                 |                 |                                                                            |
| 5           | Shim                             |                 |                                                                            |
| 6           | 'O' ring (x3)                    |                 |                                                                            |
| 7           | Annulus                          |                 |                                                                            |
| 8           | Motor                            |                 |                                                                            |
| 9           | Cable tie                        |                 |                                                                            |
| 10          | Motor spacer                     |                 |                                                                            |
| 11          | Motor sleeve                     |                 |                                                                            |
| 12          | End cap assembly                 |                 |                                                                            |







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