

SmartPilot Service Manual

SmartPilot X-5 Wheel & Tiller systems

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Introduction

Safety notices



WARNING: Electrical safety

Make sure you have switched off the power supply before you service this product.

About this manual

This manual is provided to assist authorized Raymarine Service Engineers when servicing the following Raymarine SmartPilot X systems.

- E12201 SPX-5 Wheel
- E12203 SPX-5 Tiller Plus
- E12204 SPX-5 Tiller GP

As much of the information in this book is commercially sensitive, it should not be disclosed to anyone other than Raymarine employees and authorized Raymarine service agents.

To the best of our knowledge, the information in this manual was correct when it was published. However, as details of product build, components etc can change at short notice, in pursuance of our policy of continuous product improvement, this manual may not always reflect the build state of the product being serviced, and so is provided on an 'information only' basis. If there is any doubt about the applicability of the information in this manual to the product being serviced, refer to the Raymarine Technical Support Department for clarification.

Raymarine cannot accept liability for any inaccuracies or omissions in this manual.

Product disposal



Waste Electrical and Electronic (WEEE) Directive

The European WEEE Directive requires that waste electrical and electronic equipment is recycled.

Products carrying the crossed out wheeled bin symbol (illustrated above) must not be disposed of in general waste or landfill, but in accordance with local regulations for such products.

Although the WEEE Directive does not apply to all Raymarine products, we support its policy and ask you to be aware of the correct method for disposing of such products.

Please contact your local dealer, national distributor or Raymarine Technical Services for information on product disposal.

Chapter 1: Testing & Diagnostics

Use this chapter to investigate faults in Raymarine SmartPilot X (SPX-5) Wheel, Tiller and GP Tiller systems.

1.1 Course computer

Requirement

Equipment and tools

- ST6001/2 Control Head
- Rudder Reference Transducer
- Fluxgate Compass
- C/E Series unit
- Digital Volt Meter (DVM)
- Ammeter with at least 10 A full scale deflection (fsd)
- 12V dc 10A PSU (*Power Supply Unit*)
- Type 1 pump

Initial inspection checks

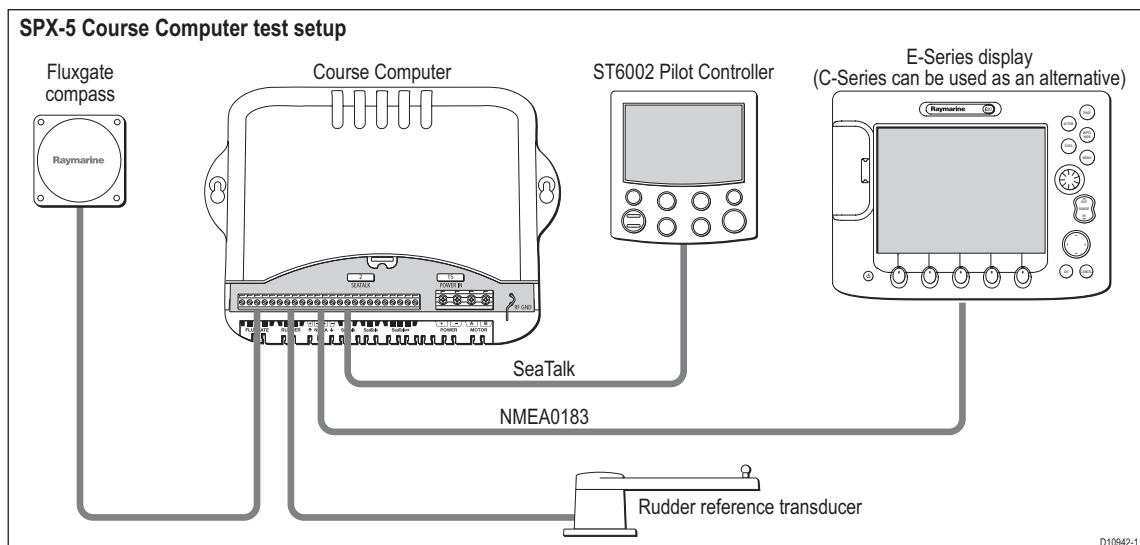
Carry out following visual inspection, **before applying power to the Course Computer**:

1. Remove the connector cover.
2. Remove and retain the PCB retaining screw and slide the PCB out of the case.
3. Check that the two fuses, F1 (15A), F2 (2A) are the correct rating and not blown.
4. Inspect the PCB for any obvious signs of component damage or overheating, paying particular attention to the FETs and main power components.

If the PCB appears to be satisfactory, replace and secure it in the case.

Test system

Ensure power is switched off, then connect the Course Computer to be tested to a known serviceable pilot Controller, Fluxgate Compass, Rudder Reference Transducer and either a Raymarine C- or E-series display. Refer to the relevant installation instructions as necessary.



Switch on power to the Course Computer and confirm that SeaTalk is functioning correctly by checking that the controller display shows:

- A compass heading (any value).
- A rudder angle bar.

Test procedures

Test the Course Computer by carrying out the following tests:

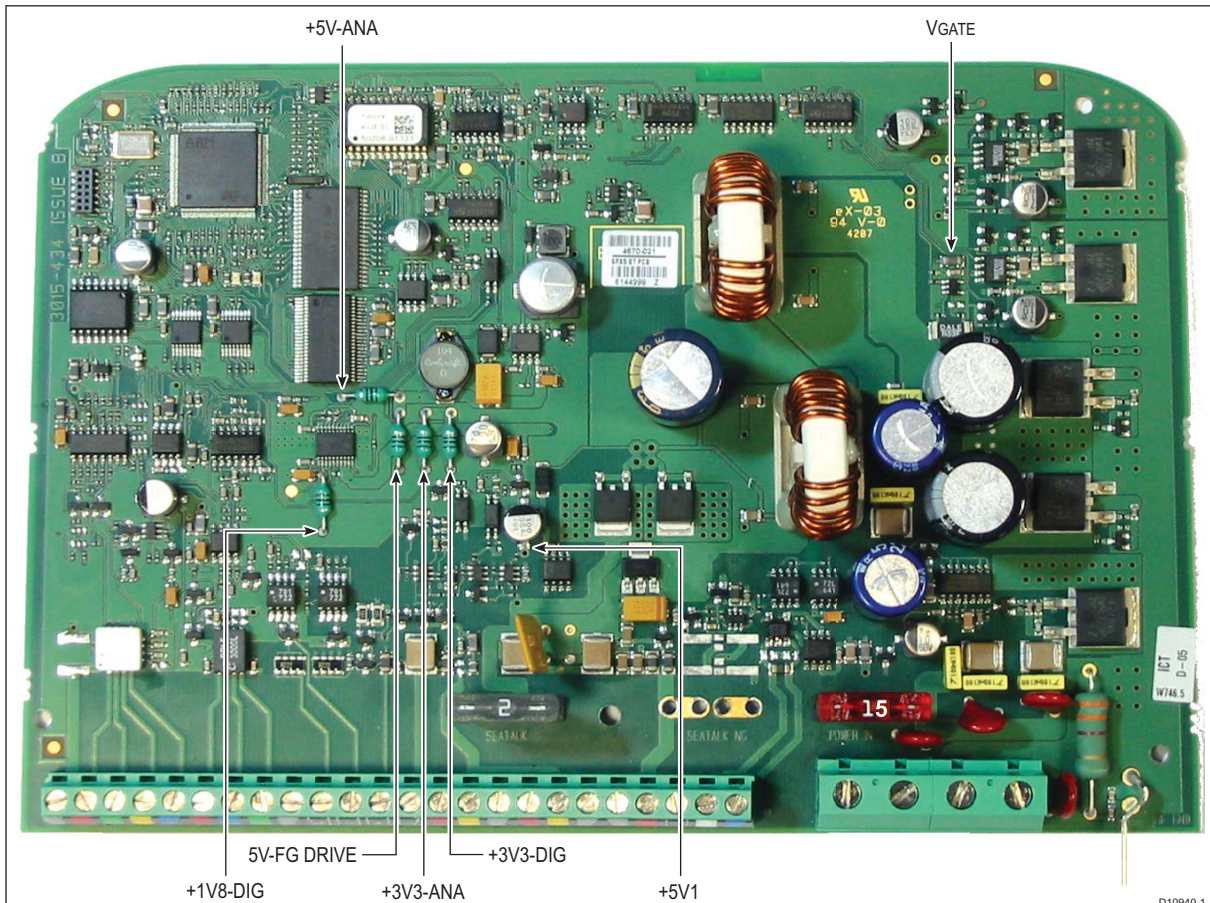
1. Power checks.
2. Rate gyro.
3. Compass
4. Rudder Reference.
5. H Bridge
6. NMEA.
7. EEPROM.

Detailed procedures for these tests are given below. If the Course Computer fails any test, return the PCB to Raymarine and obtain a service exchange unit. Component replacement must only be carried out by the factory.

Power checks

Check the voltages at the following locations are correct:

Test point	Function	Voltage
	+5V-ANA	4.8 V to 5.2 V
	5V-FG DRIVE	4.8 V to 5.2 V
	+3V3-ANA	3.2 V to 3.4 V
	+3V3-DIG	3.2 V to 3.4 V
	+1V8-DIG	1.7 V to 1.9 V
	+5V1	4.8 V to 5.2 V
	VGATE	10 V to 12.2 V

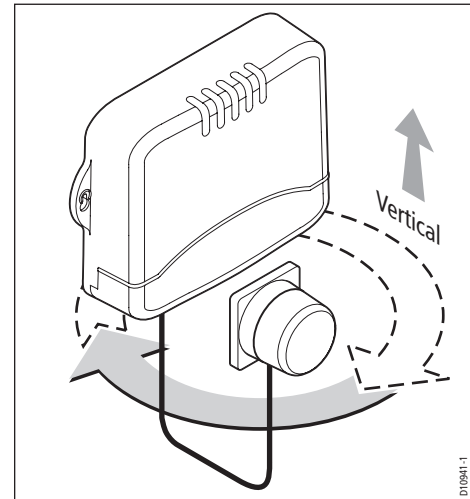


Rate gyro

1. Using a DVM, measure the voltage at the rate gyro output (LTP13). If the rate gyro is serviceable, the nominal reading is $2.5\text{ V} \pm 0.3\text{ V}$.
2. With the DVM still connected, turn the Course Computer slowly, first clockwise, then counterclockwise.
3. If the rate gyro is functioning correctly, the voltage should increase (from 2.5 V) as the Course Computer is turned in one direction and decrease (from 2.5 V) as it is turned in the opposite direction.

Compass

1. Position the compass so the cable is at the bottom, then slowly rotate the compass and Course Computer clockwise..
2. As they turn, check that the displayed heading reading on the associated control head increases steadily, with no sudden changes in the reading.
3. Continue rotating the compass and Course Computer and checking the heading reading, until a full 360° turn has been completed.



Rudder Reference (if fitted)

1. Check that the rudder offset value is set to zero. (To adjust, use the Dealer Calibration screens.)
2. Move the rudder reference into the central position.
3. Check that the rudder bar on the display is in the central position.
4. Move the rudder reference to the left and check that the rudder position bar on the display moves to the left.
5. Move the rudder reference to the right and check that the rudder position bar on the display moves to the right.

Note: If the rudder bar display moves the wrong way, turn off the power, reverse the red and green wires connected to the RUDDER inputs on the Course Computer, switch on the power and re-check.

H-Bridge

At the control head:

1. Press **auto**.
2. Press **+10** twice, the motor should spin.
3. Press **standby**, the motor should stop.
4. Press **auto**
5. Press **-10** twice, the motor should spin in the opposite direction
6. Measure HD-PWR whilst the motor is running (Check this against the table in Step 1).

NMEA

Receive

1. Enter a new waypoint into the C/E Series unit.
2. Perform a "Goto Waypoint" command on the C/E Series unit.
3. Verify that the waypoint information has been sent to the Course Computer by viewing the XTE, DTW and BTW data pages on the Control Unit.

Transmit

Check that the heading displayed on the C/E Series display is the same as displayed at the pilot controller.

EEPROM Test

This test checks that the calibration settings are being stored correctly.

1. Using the calibration screens, change the Drive Type to a different value.
2. Save the setting and exit calibration.
3. Remove and re-instate power to the Course Computer.
4. Verify that the new drive type is still active.

1.2 Fluxgate Compass

Correct operation of the Fluxgate Compass depends on correct linearization and setup, as described in the *SPX-5 Installation & Setup Guide*, to minimize magnetic deviation. If the Fluxgate Compass is changed or moved from its original mounting position, carry out the linearization again before using the Fluxgate Compass.

If the displayed deviation is greater than ± 15 degrees the Fluxgate should be re-sited.

If the problem remains, test the Fluxgate Compass as follows:

1. Ensure the SPX-5 system power is switched off.
2. Disconnect the Fluxgate Compass from the Course Computer, then check continuity as follows:

Check between (wire colors)	Correct resistance
Screen to blue	< 10 ohms
Red to green	< 5 ohms
Red to yellow	< 5 ohms
Red to screen	Open circuit

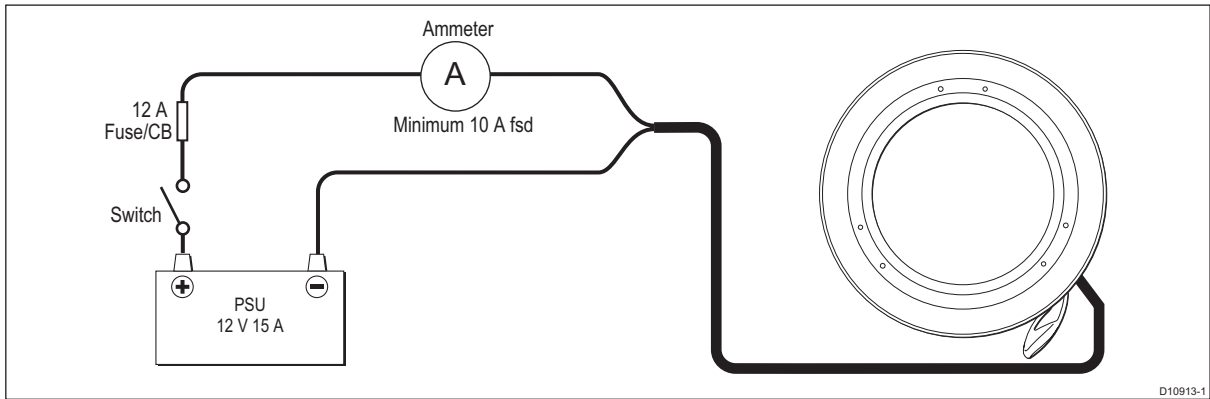
Repair

If you need to repair the Fluxgate Compass, refer to *Chapter 2: Servicing SPX-5 Products*.

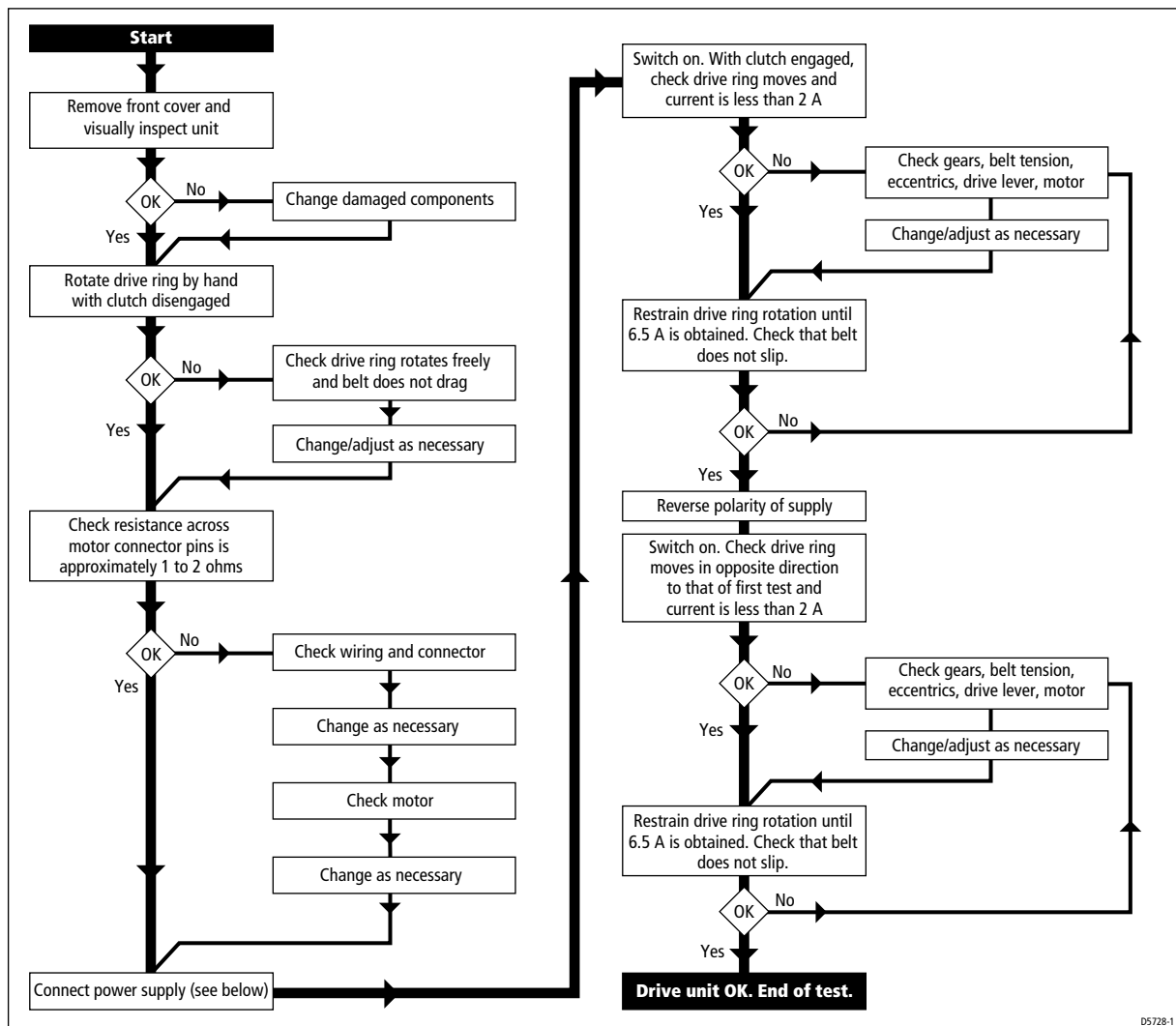
1.3 Wheel Drive

If a WheelDrive is not operating correctly, assemble a test rig and carry out a functional test, as described below.

Test rig



Functional test

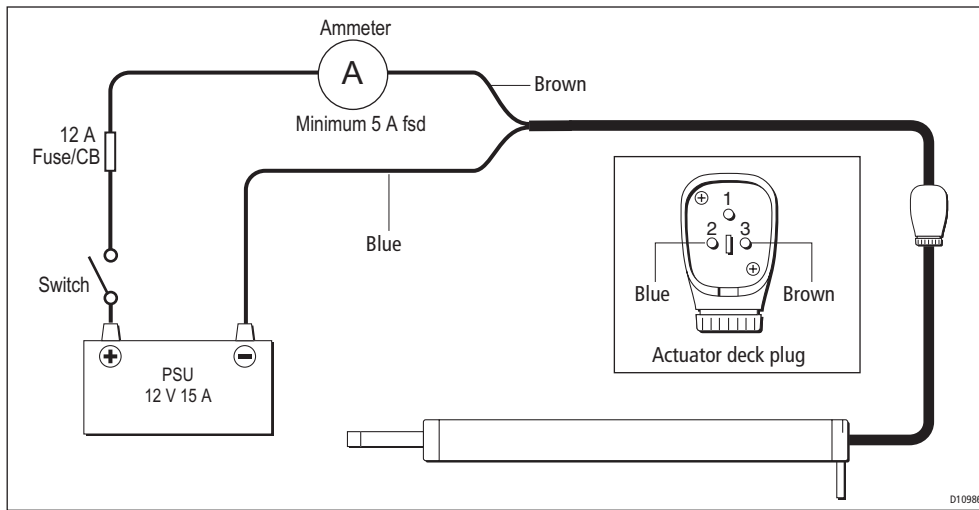


Repair

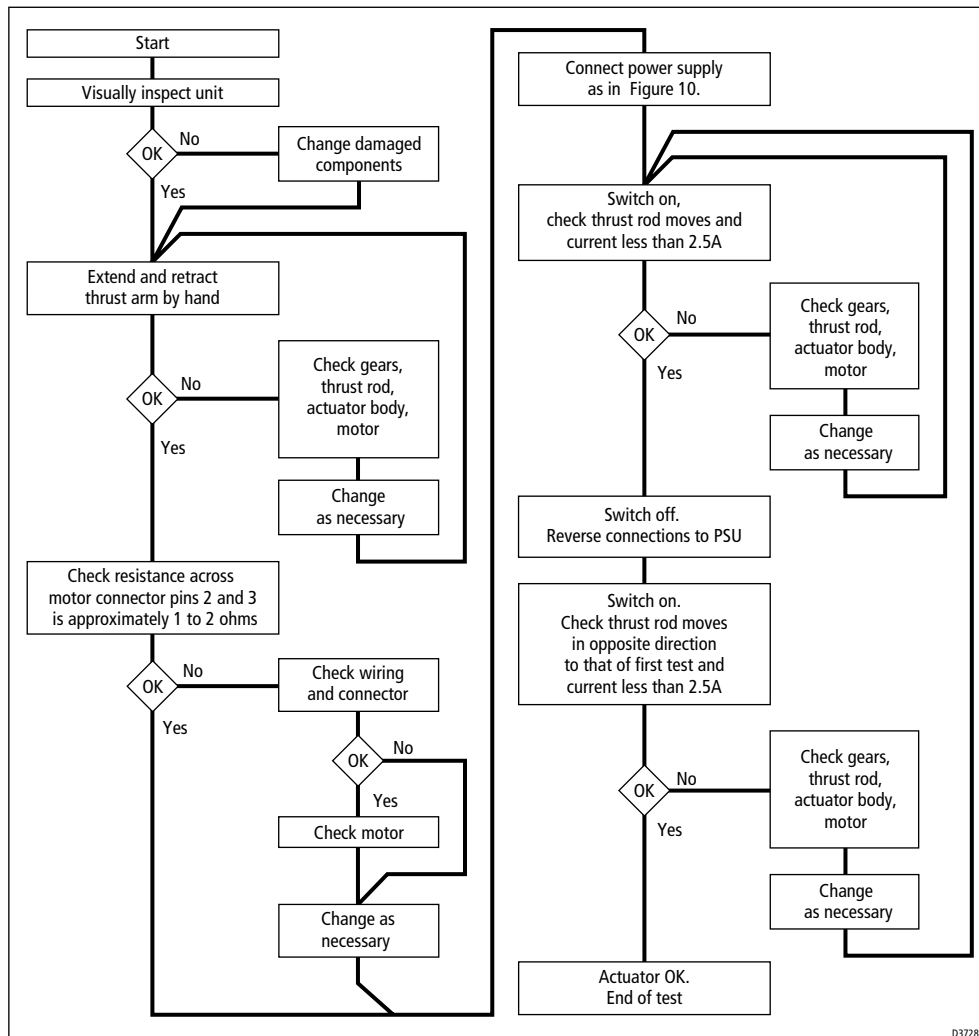
If you need to repair the Wheel Drive, refer to *Chapter 2: Servicing SPX-5 Products*.

1.4 Tiller Drive

Test rig



Functional test

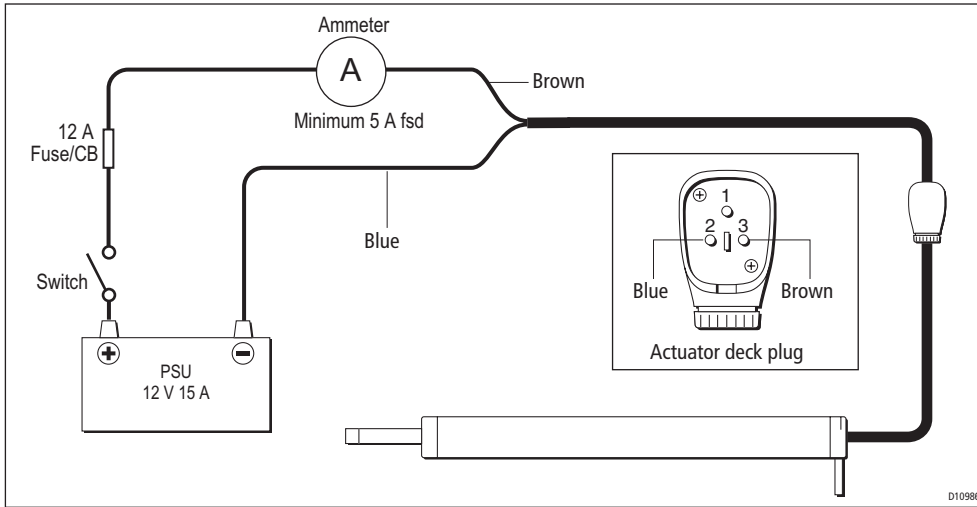


Repair

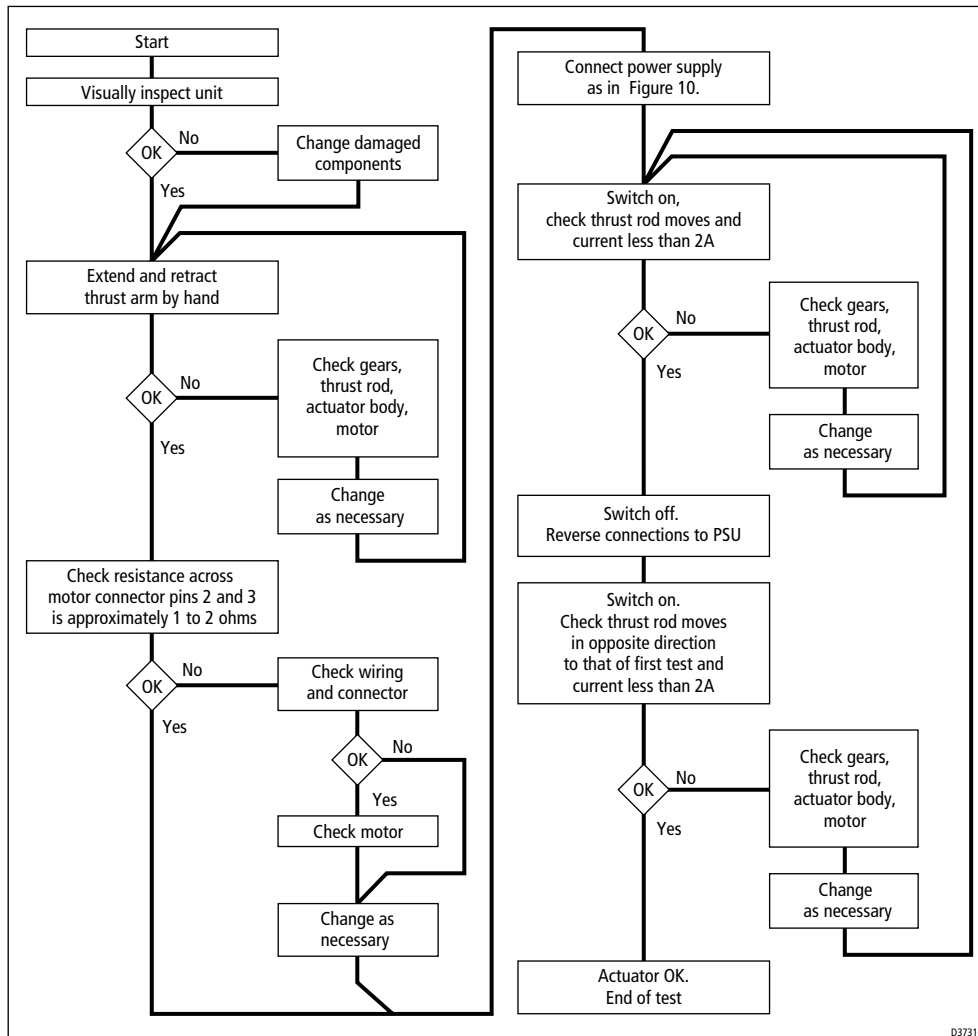
If you need to repair the Tiller Drive, refer to *Chapter 2: Servicing SPX-5 Products*.

1.5 GP Tiller Drive

Test rig



Functional test

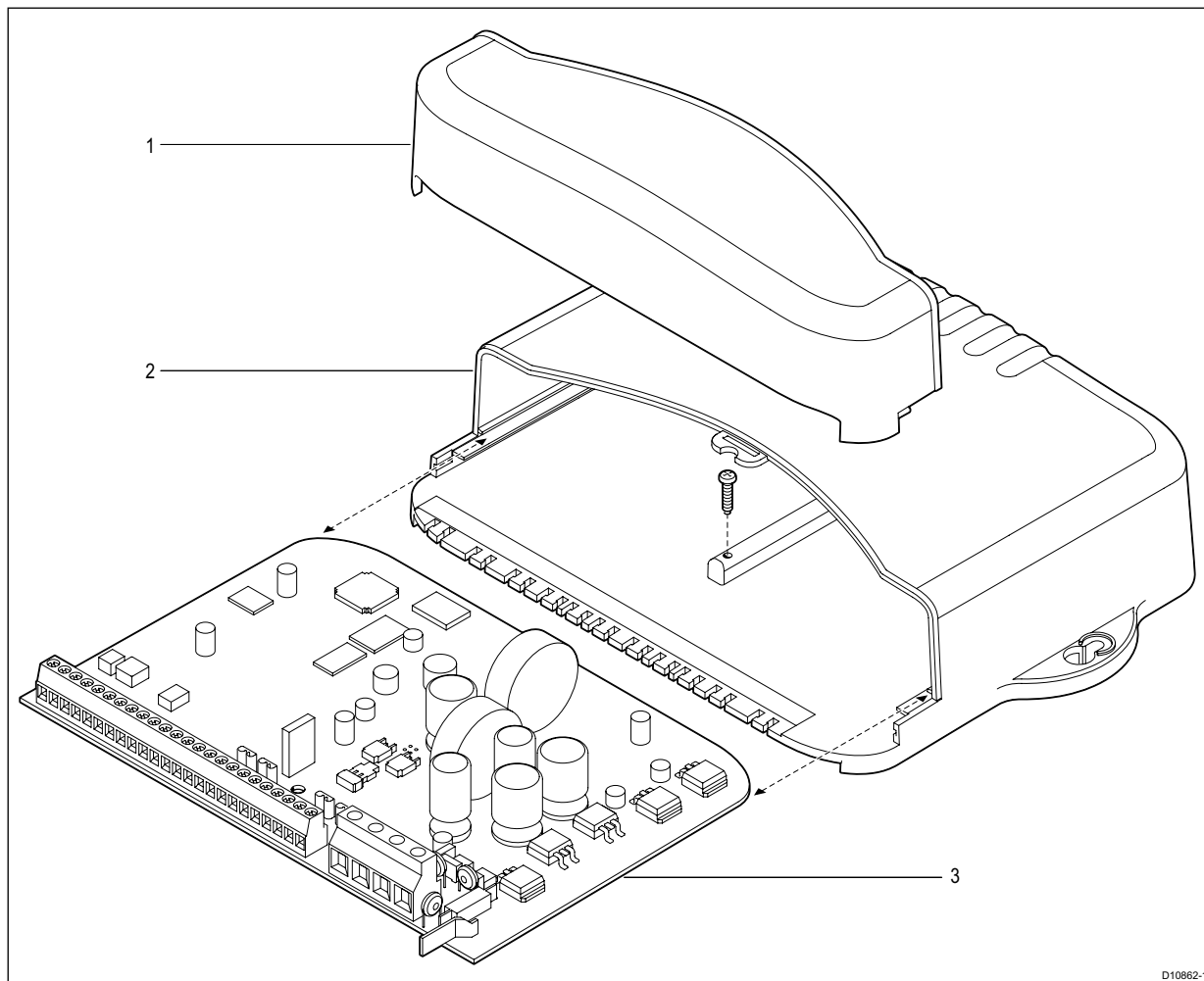


Repair

If you need to repair the GP Tiller Drive, refer to *Chapter 2: Servicing SPX-5 Products*.

Chapter 2: Servicing SPX-5 Products

2.1 Course Computer



Parts list

Item	Description	Part Number
-	SPX-5 Course Computer	R18151
1 & 2	SPX-5 Course Computer Case	R18152
3	SPX-5 Course Computer PCB	R18153

Disassembly

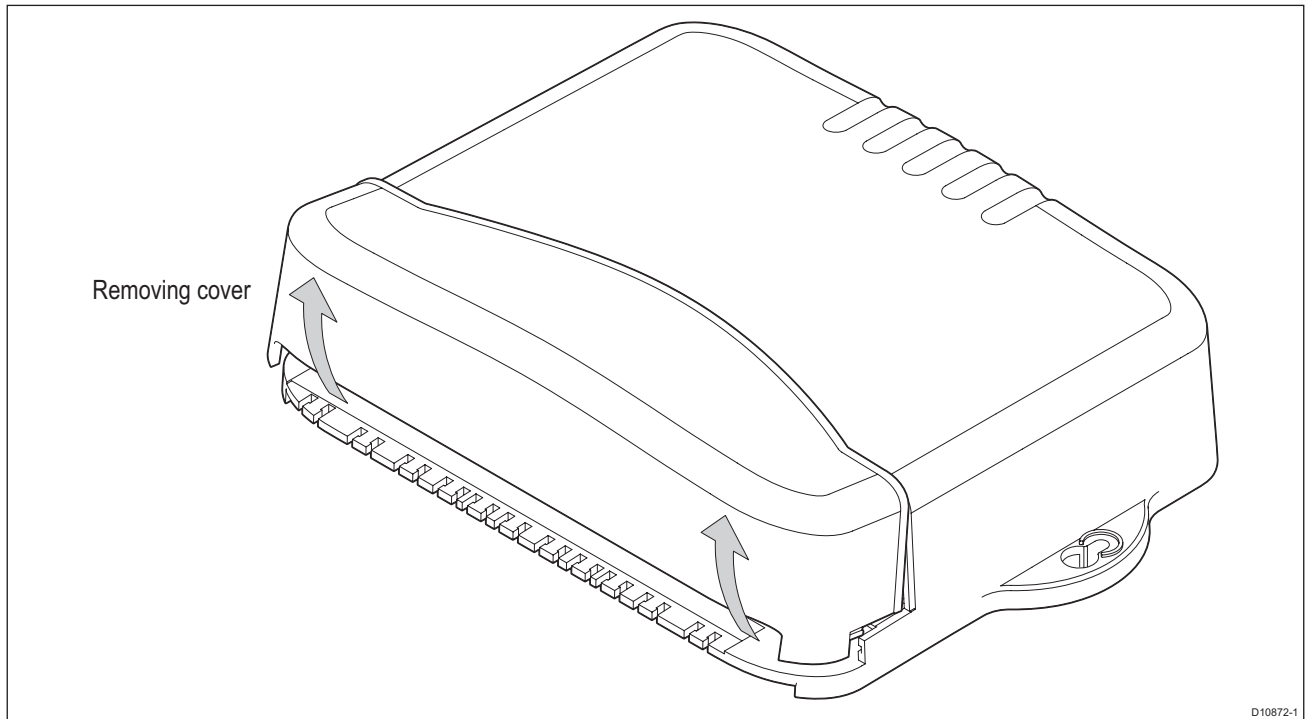


WARNING:

Before dismantling the course computer, ensure power has been disconnected from the unit.

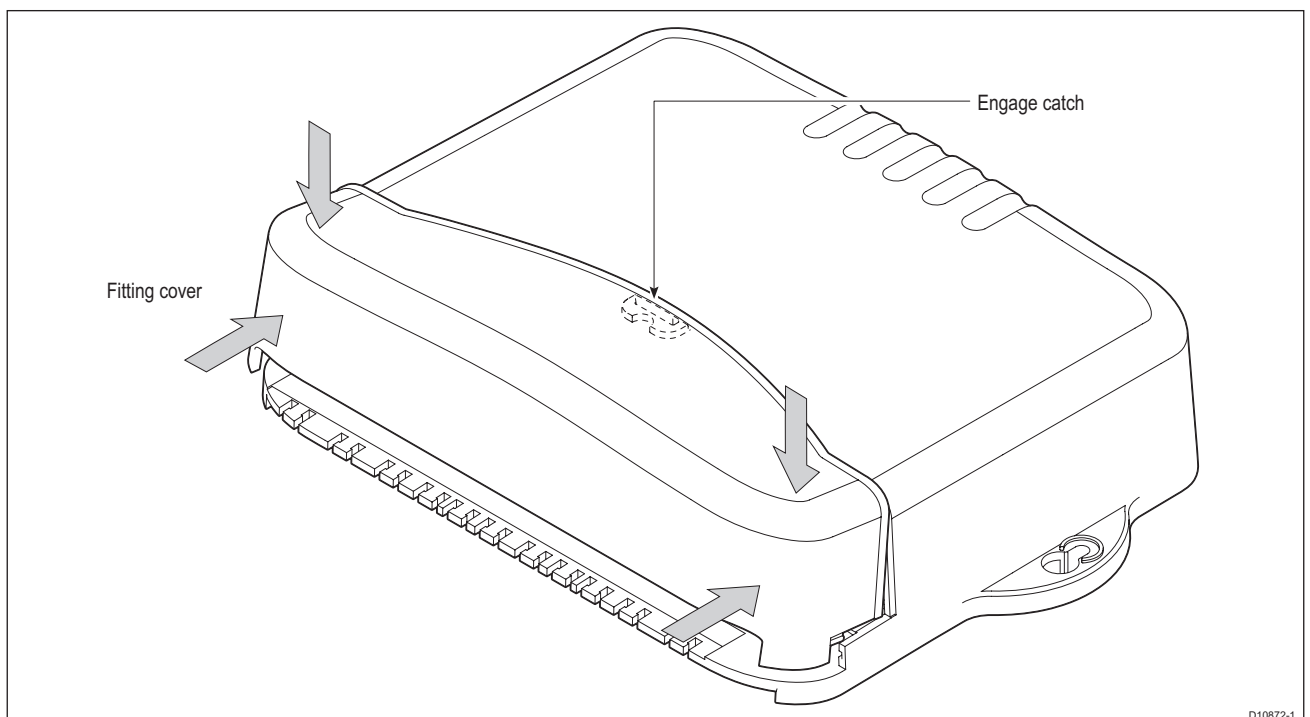
To disassemble the course computer;

1. Unclip the bottom of the lower cover and remove the cover.
2. If you want to remove the PCB
 - i. Remove and retain the PCB securing screw.
 - ii. Slide the PCB from the course computer.

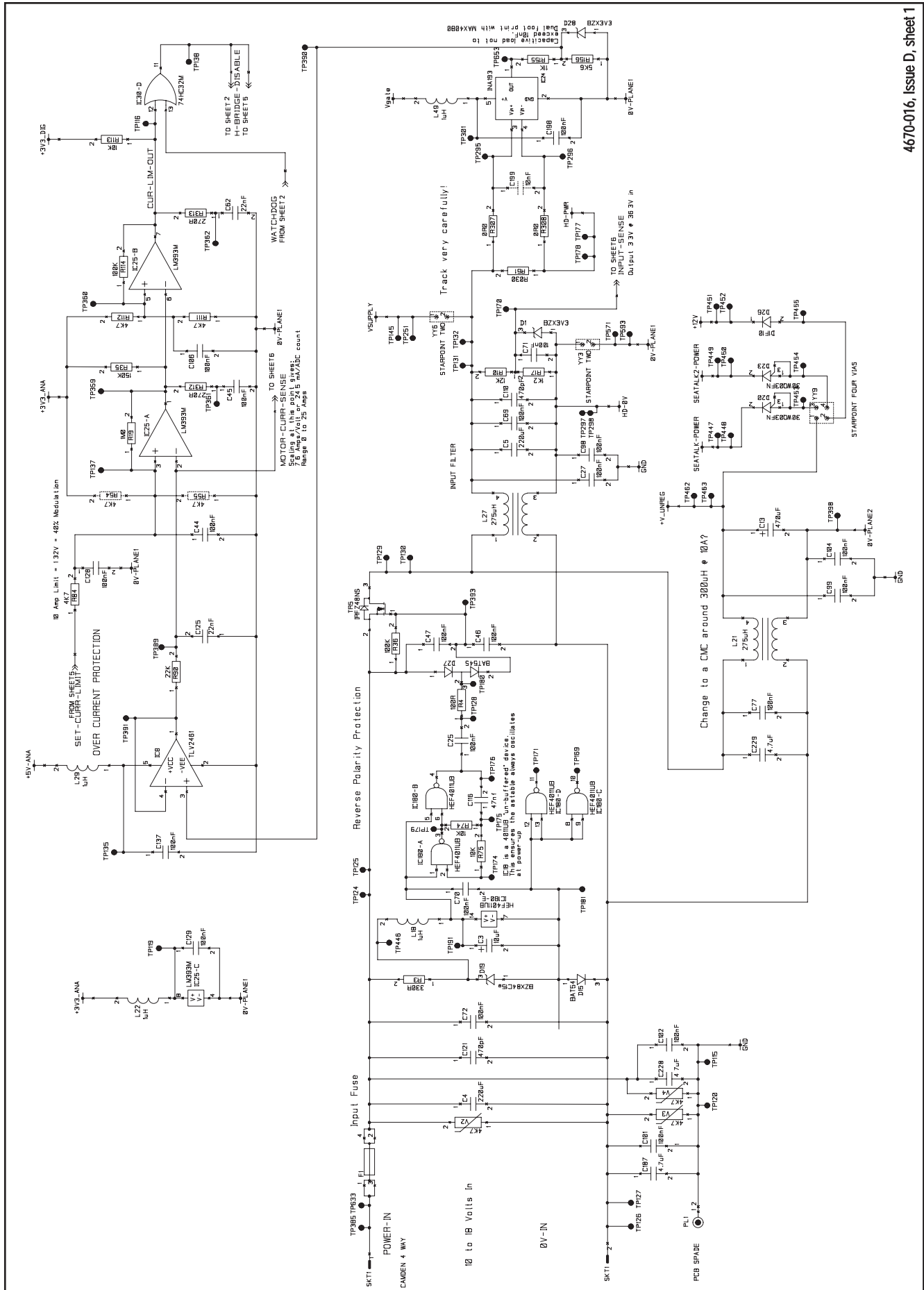


Reassembly

To reassemble the Course Computer, engage the catch at the top of the cover then press the lower part of the cover into the case, as shown in the following illustration. Ensure it is securely fitted.



PCB



4670-016, Issue D, sheet 1

Figure 2-1: SPX-5 Course Computer circuit diagram, sheet 1

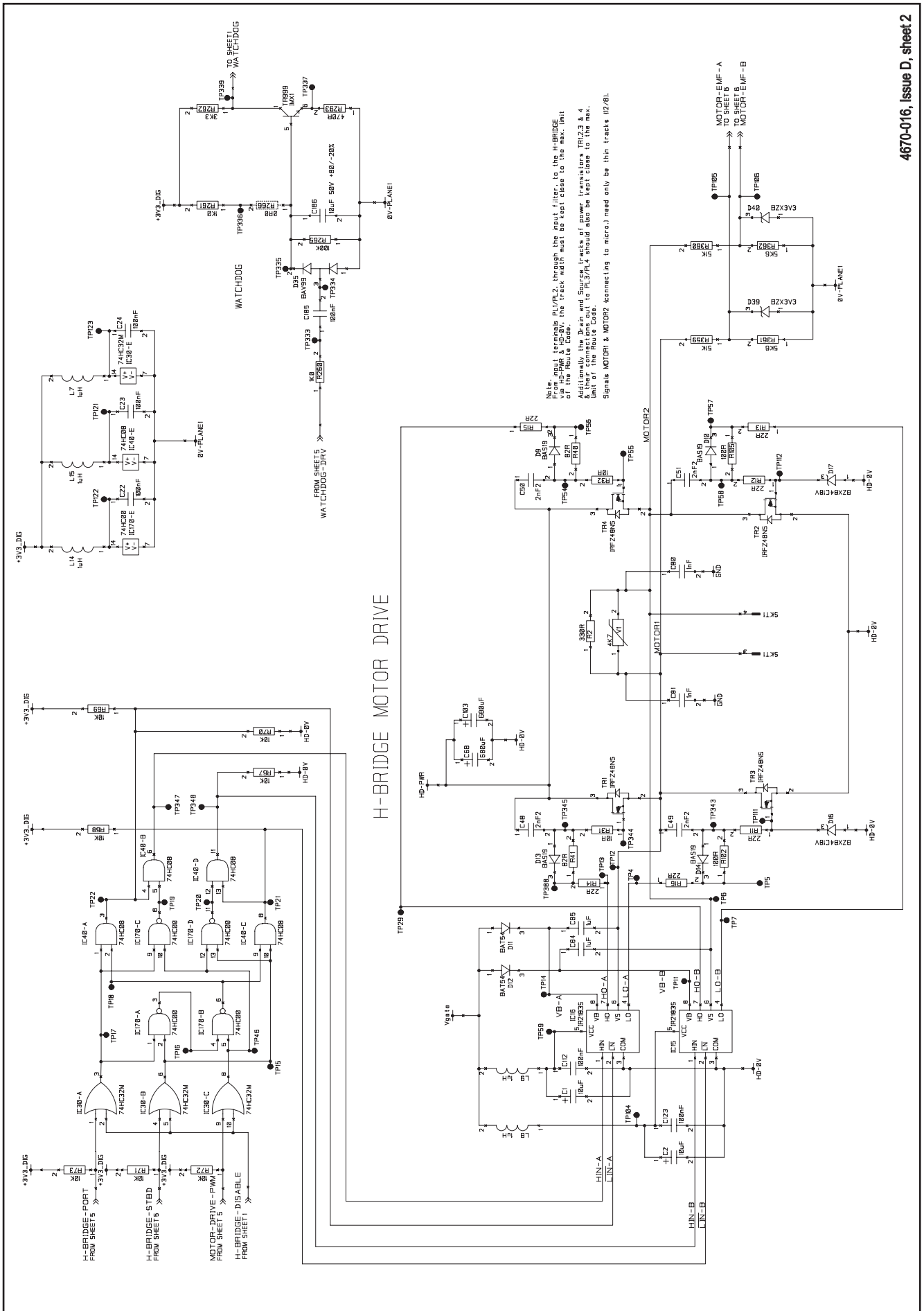


Figure 2-2: SPX-5 Course Computer circuit diagram, sheet 2

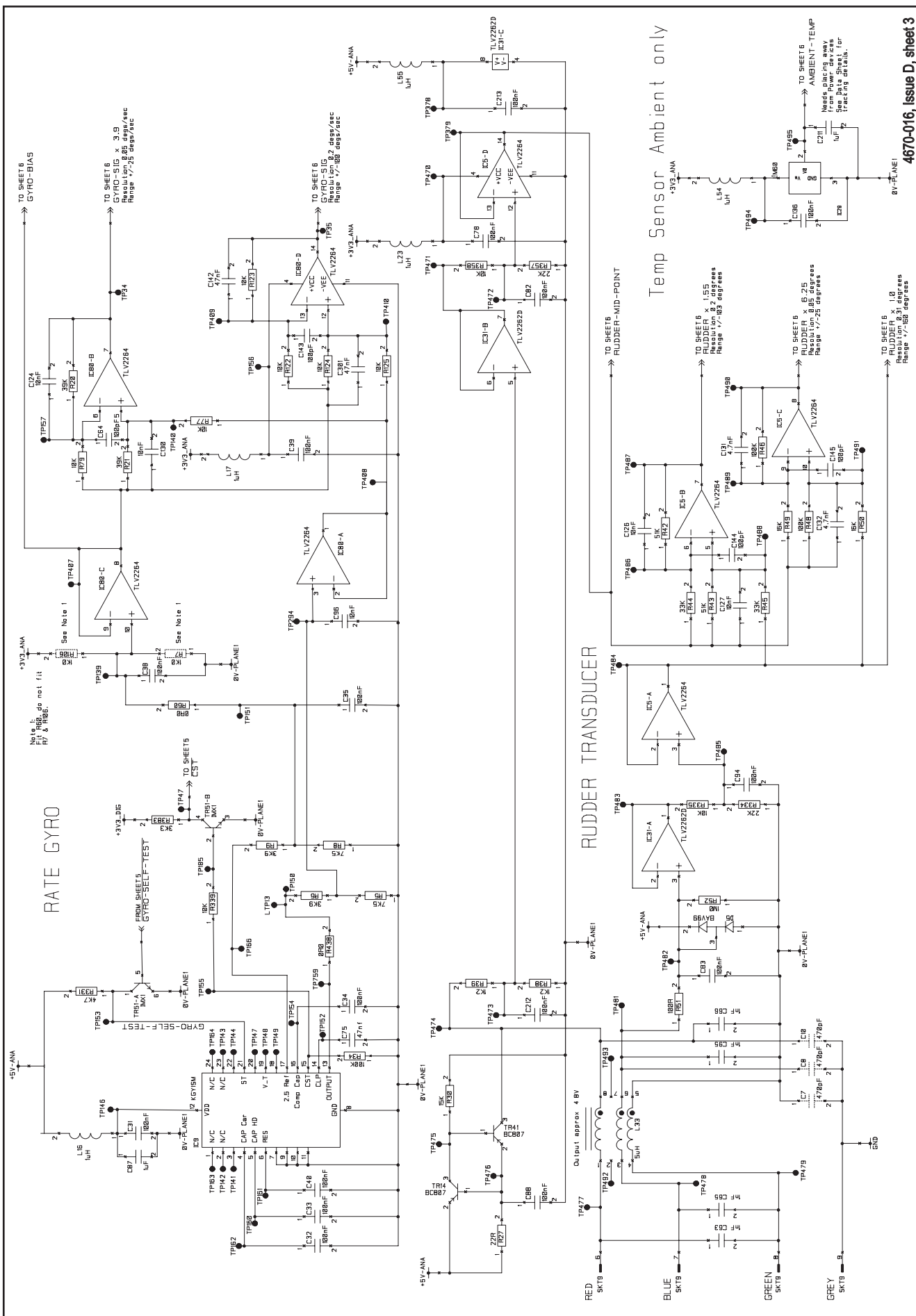


Figure 2-3: SPX-5 Course Computer circuit diagram, sheet 3

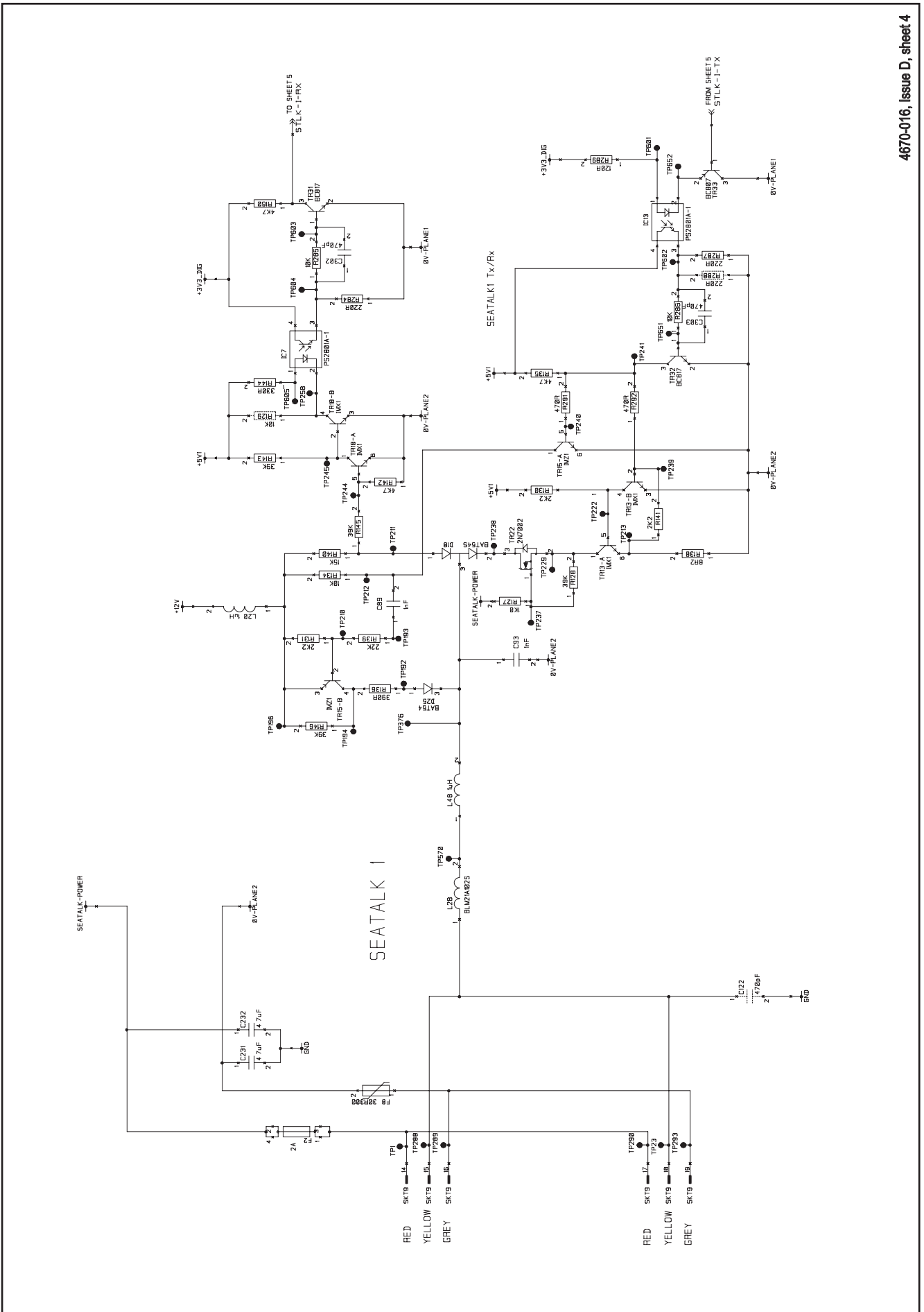


Figure 2-4: SPX-5 Course Computer circuit diagram, sheet 4

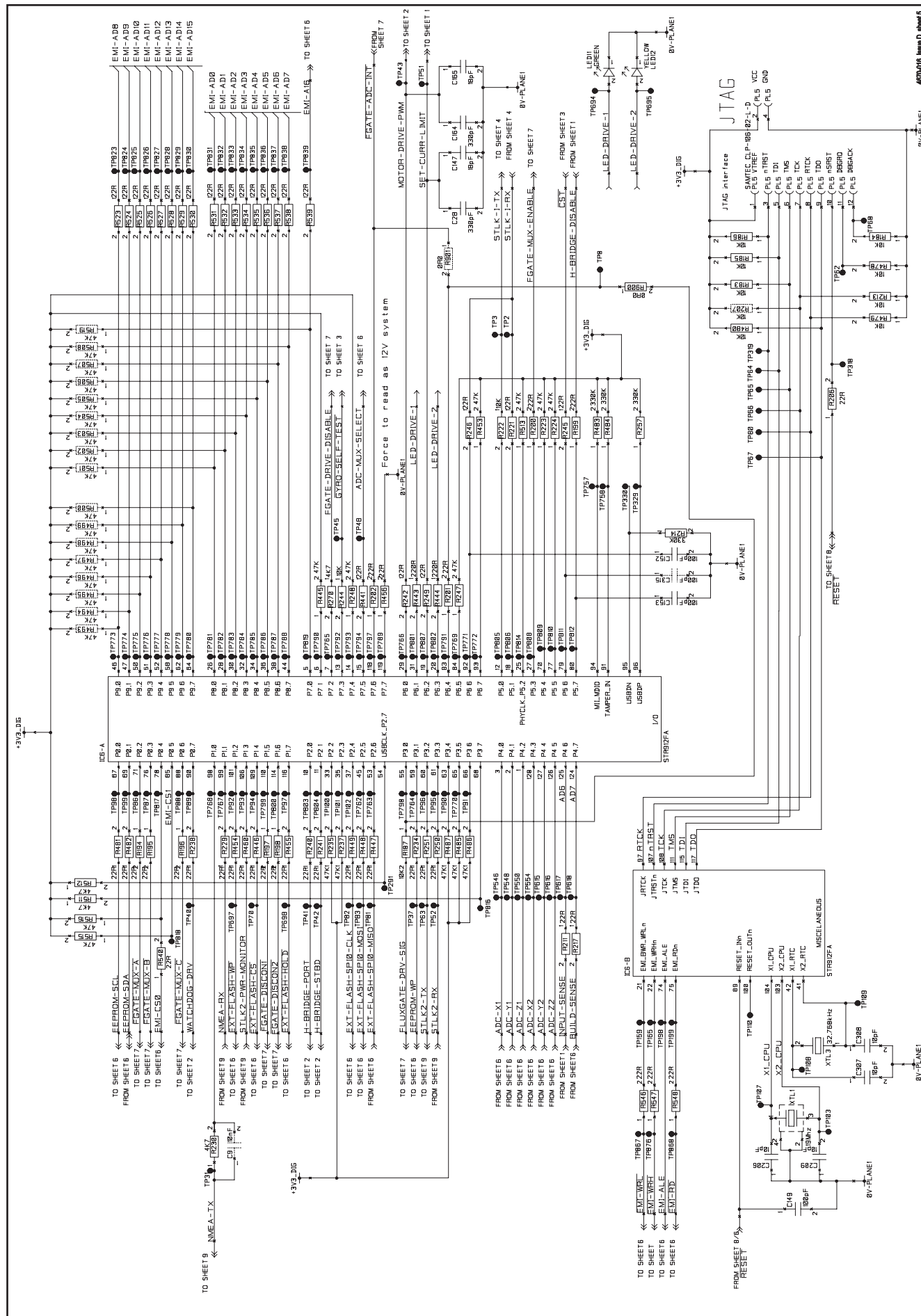


Figure 2-5: SPX-5 Course Computer circuit diagram, sheet 5

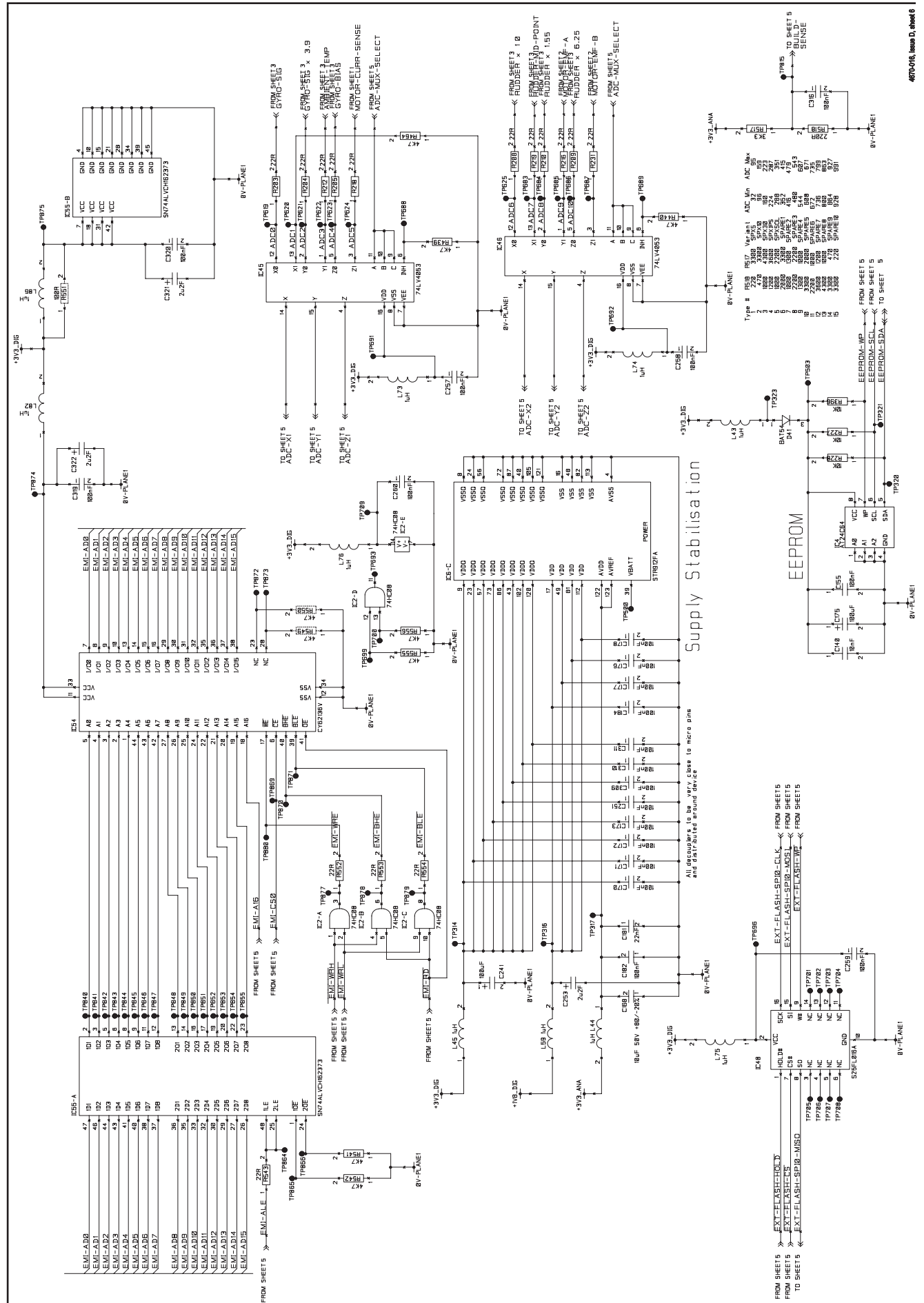


Figure 2-6: SPX-5 Course Computer circuit diagram, sheet 6

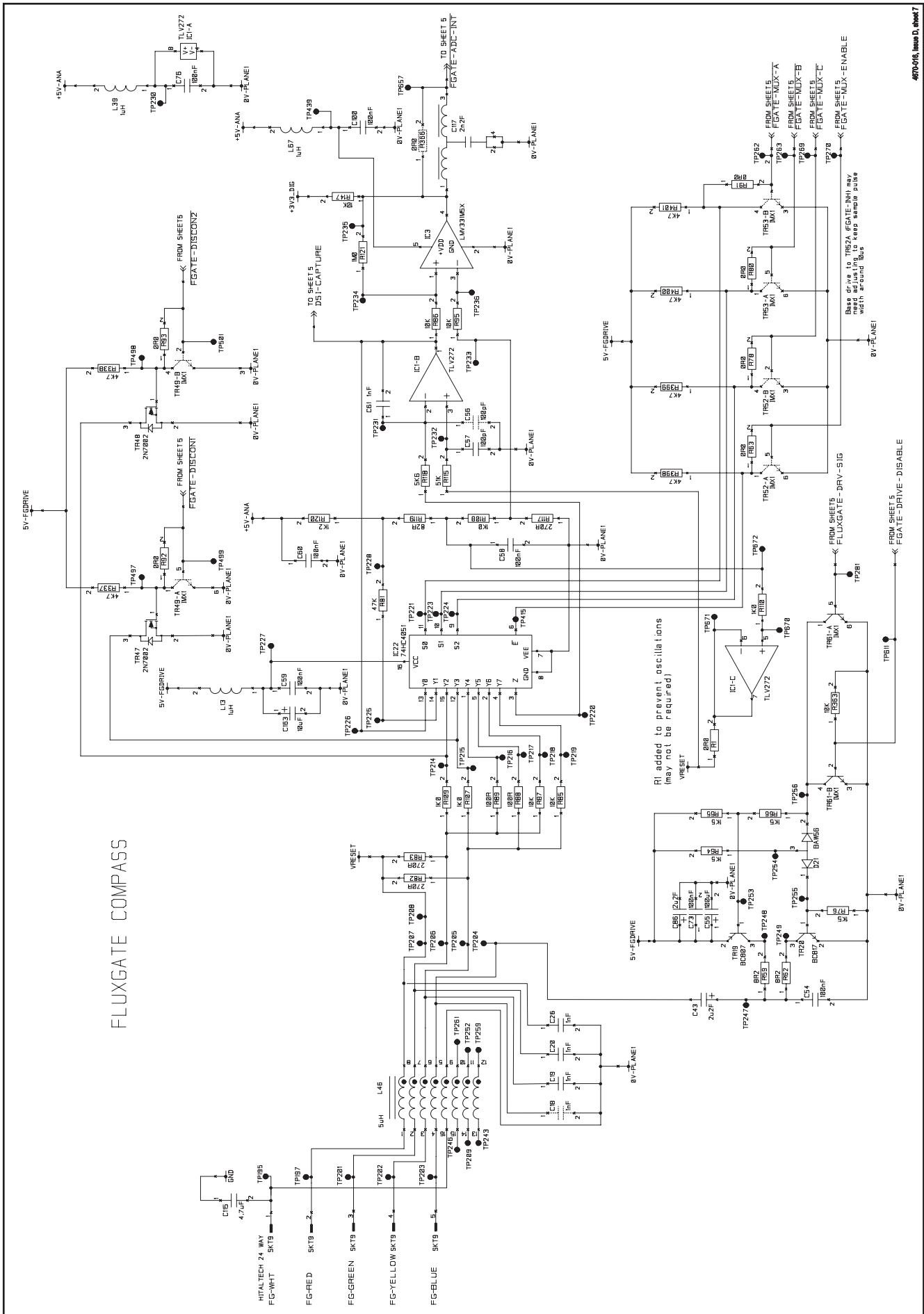
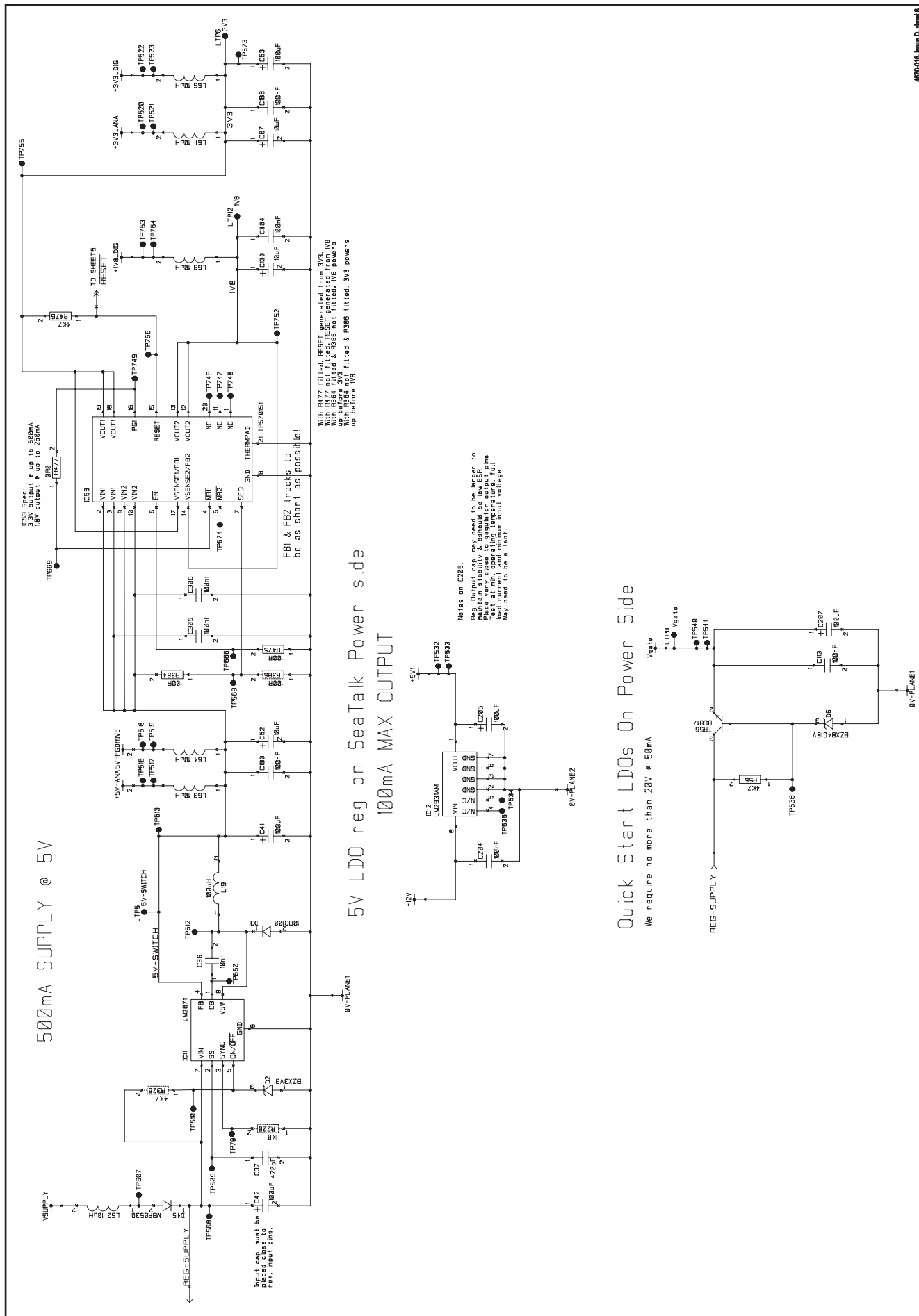


Figure 2-7: SPX-5 Course Computer circuit diagram, sheet 7



4870-016, Issue D, sheet 8

Figure 2-8: SPX-5 Course Computer circuit diagram, sheet 8

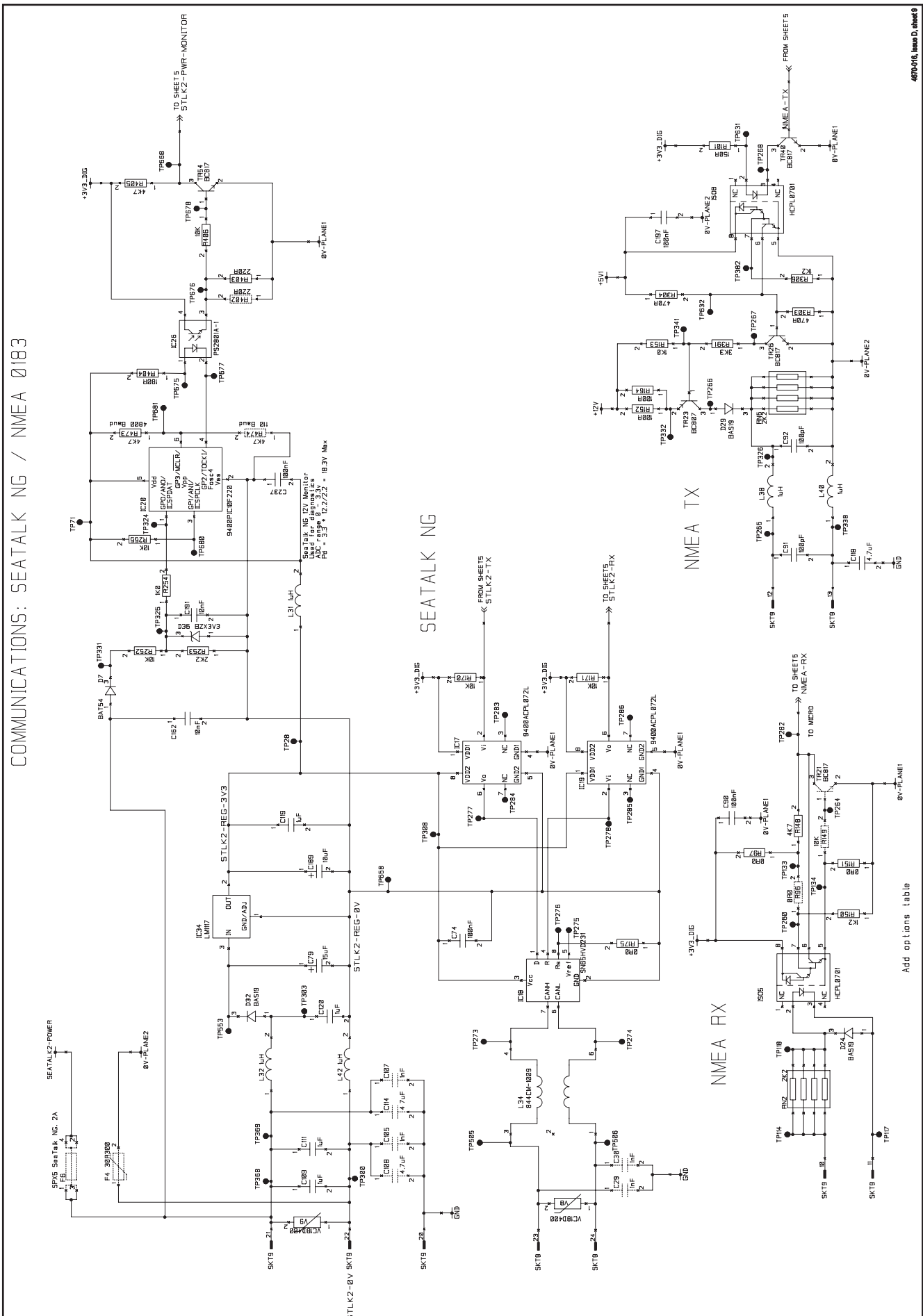
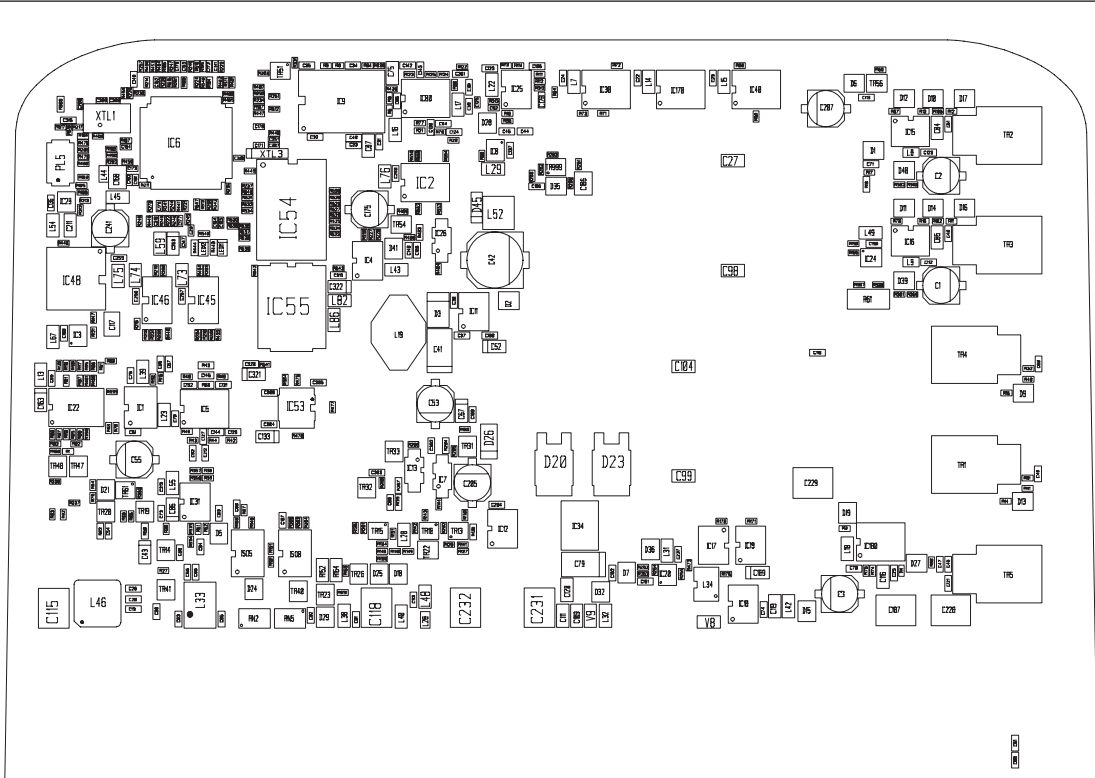
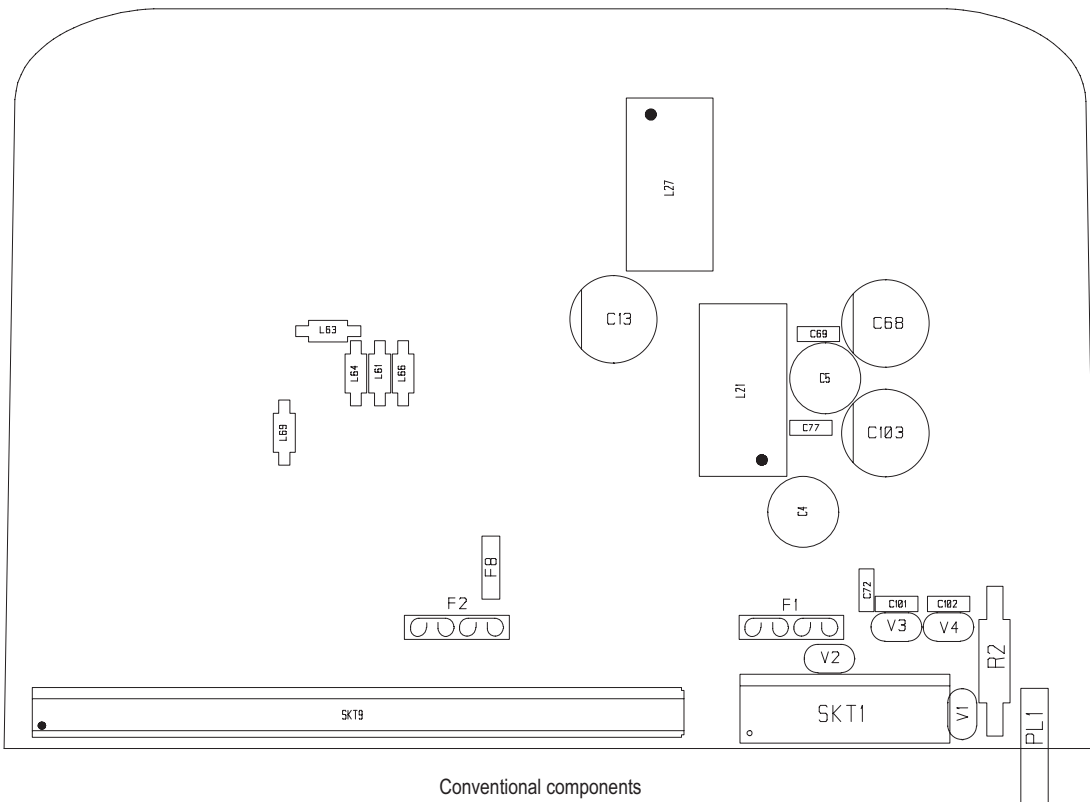


Figure 2-9: SPX-5 Course Computer circuit diagram, sheet 9

Components



Surface-mount components



Conventional components

PCB components list

4670-021 SPX-5 PCB ASSY Used in Wheel, Tiller, GP Tiller and Sport according to BOM 18/01/08)

Item	Part Number	Description
	3015-434-B	SPX-5 BARE BOARD (ST CHIP)
C1	93ZEHEXXX10U	CAP. 10uF 50V ELEC.
C2	93ZEHEXXX10U	CAP. 10uF 50V ELEC.
C3	93ZEHEXXX10U	CAP. 10uF 50V ELEC.
C4	03153	CAPACITOR 220uF ELECT 50V 20%
C5	03153	CAPACITOR 220uF ELECT 50V 20%
C13	03206	CAP ELECT 470uF 63V RADIAL
C19	93ADHBXX1N	CAPACITOR 1nF 0603
C20	93ADHBXX1N	CAPACITOR 1nF 0603
C22	93ADFB100N	CAP 100NF 25V 0603
C23	93ADFB100N	CAP 100NF 25V 0603
C24	93ADFB100N	CAP 100NF 25V 0603
C25	93ADFB100N	CAP 100NF 25V 0603
C26	93ADHBXX1N	CAPACITOR 1nF 0603
C27	93070U1	CAPACITOR 0.1uF, 1206
C28	93QCHA330P	CAP 330pF +/-5% 50V COG 0402
C31	93ADFB100N	CAP 100NF 25V 0603
C32	93ADFB100N	CAP 100NF 25V 0603
C33	93ADFB100N	CAP 100NF 25V 0603
C34	93ADFB100N	CAP 100NF 25V 0603
C35	93ADFB100N	CAP 100NF 25V 0603
C36	93ADHBXX10N	CAP. 10nF XR7
C37	93ACHAXX470P	CAPACITOR,470pF,50V,5%,0603
C38	93ADFB100N	CAP 100NF 25V 0603
C40	93ADFB100N	CAP 100NF 25V 0603
C41	9326100U	CAPACITOR 100uF 10V+-20% TANTA
C42	93ZEHEXX100U	CAP. 100uF, 50V, 20%, AL-ELEC
C43	93GDDC2U2	CAP TANT 2.2UF 10V 10%
C44	93ADFB100N	CAP 100NF 25V 0603
C45	93ADFB100N	CAP 100NF 25V 0603
C46	93ADFB100N	CAP 100NF 25V 0603
C47	93ADFB100N	CAP 100NF 25V 0603
C48	93ADHBXX2N2	CAPACITOR 2.2nF 0603
C49	93ADHBXX2N2	CAPACITOR 2.2nF 0603

Item	Part Number	Description
C50	93ADHBXX2N2	CAPACITOR 2.2nF 0603
C51	93ADHBXX2N2	CAPACITOR 2.2nF 0603
C52	93GDDCXXX10U	CAP 10UF TANT 10V 10%
C53	9324100U	CAPACITOR 100uF ELECT. 6.3VDC
C54	93ADFB100N	CAP 100NF 25V 0603
C55	93KEGEXX100U	CAPACITOR 100uF 35VOLT 20%
C57	93ACHAXX100P	CAP. SM,100pF,50V,5%,0603
C58	93ADFB100N	CAP 100NF 25V 0603
C59	93ADFB100N	CAP 100NF 25V 0603
C60	93ADFB100N	CAP 100NF 25V 0603
C61	93ADHBXX1N	CAPACITOR 1nF 0603
C62	93QDEB22N	CAP 22nF 16V X7R 0402 10%
C63	93ADHBXX1N	CAPACITOR 1nF 0603
C64	93ACHAXX100P	CAP. SM,100pF,50V,5%,0603
C65	93ADHBXX1N	CAPACITOR 1nF 0603
C66	93ADHBXX1N	CAPACITOR 1nF 0603
C67	93GDDCXXX10U	CAP 10UF TANT 10V 10%
C68	03132	CAPACITOR 680uF, 50V RADIAL
C69	03082	CAPACITOR 100NF 100V
C70	93ADFB100N	CAP 100NF 25V 0603
C71	93ADFB100N	CAP 100NF 25V 0603
C72	03082	CAPACITOR 100NF 100V
C73	93ADFB100N	CAP 100NF 25V 0603
C74	93ADFB100N	CAP 100NF 25V 0603
C75	93060U047	CAPACITOR 0.047uF
C76	93ADFB100N	CAP 100NF 25V 0603
C77	03082	CAPACITOR 100NF 100V
C78	93ADFB100N	CAP 100NF 25V 0603
C79	93JEGCXX15U	CAP 15uF 35V TANT. 20%
C80	93ADHBXX1N	CAPACITOR 1nF 0603
C81	93ADHBXX1N	CAPACITOR 1nF 0603
C82	93ADFB100N	CAP 100NF 25V 0603
C83	93ADFB100N	CAP 100NF 25V 0603
C84	93261U	CAPACITOR Y5V 1206 1uF 50V
C85	93261U	CAPACITOR Y5V 1206 1uF 50V
C86	93GDDC2U2	CAP TANT 2.2UF 10V 10%

Item	Part Number	Description
C87	93261U	CAPACITOR Y5V 1206 1uF 50V
C88	93ADFB100N	CAP 100NF 25V 0603
C89	93ADHBXX1N	CAPACITOR 1nF 0603
C90	93ADFB100N	CAP 100NF 25V 0603
C91	93ACHAXX100P	CAP. SM,100pF,50V,5%,0603
C92	93ACHAXX100P	CAP. SM,100pF,50V,5%,0603
C93	93ADHBXX1N	CAPACITOR 1nF 0603
C94	93ADFB100N	CAP 100NF 25V 0603
C95	93ADHBXX1N	CAPACITOR 1nF 0603
C96	93ADHBXX10N	CAP. 10nF XR7
C98	93070U1	CAPACITOR 0.1uF, 1206
C99	93070U1	CAPACITOR 0.1uF, 1206
C100	93ADFB100N	CAP 100NF 25V 0603
C101	03082	CAPACITOR 100NF 100V
C102	03082	CAPACITOR 100NF 100V
C103	03132	CAPACITOR 680uF, 50V RADIAL
C104	93070U1	CAPACITOR 0.1uF, 1206
C106	93ADFB100N	CAP 100NF 25V 0603
C109	93261U	CAPACITOR Y5V 1206 1uF 50V
C110	93ACHAXX470P	CAPACITOR,470pF,50V,5%,0603
C111	93261U	CAPACITOR Y5V 1206 1uF 50V
C112	93ADFB100N	CAP 100NF 25V 0603
C113	93ADFB100N	CAP 100NF 25V 0603
C115	93FDJBXXX4U7	CAPACITOR 4.7MFD 100V
C116	93060U047	CAPACITOR 0.047uF
C117	93ZHFGXXX2N2	CAP. SM 2.2nF 25V 1206
C118	93FDJBXXX4U7	CAPACITOR 4.7MFD 100V
C119	93261U	CAPACITOR Y5V 1206 1uF 50V
C120	93261U	CAPACITOR Y5V 1206 1uF 50V
C121	93ACHAXX470P	CAPACITOR,470pF,50V,5%,0603
C123	93ADFB100N	CAP 100NF 25V 0603
C124	93ADHBXX10N	CAP. 10nF XR7
C125	93QDEB22N	CAP 22nF 16V X7R 0402 10%
C126	93ADHBXX10N	CAP. 10nF XR7
C127	93ADHBXX10N	CAP. 10nF XR7
C128	93ADFB100N	CAP 100NF 25V 0603

Item	Part Number	Description
C129	93ADFB100N	CAP 100NF 25V 0603
C130	93ADHBXX10N	CAP. 10nF XR7
C131	93ADHAXXX4N7	CAP X7R 4.7NF 50V 10% 0603
C132	93ADHAXXX4N7	CAP X7R 4.7NF 50V 10% 0603
C133	93GDDCXXX10U	CAP 10UF TANT 10V 10%
C136	93ADFB100N	CAP 100NF 25V 0603
C137	93ADFB100N	CAP 100NF 25V 0603
C140	93ADHBXX10N	CAP. 10nF XR7
C142	93ADEBXX47N	CAPACITOR 47nF, 0603
C143	93ACHAXX100P	CAP. SM,100pF,50V,5%,0603
C144	93ACHAXX100P	CAP. SM,100pF,50V,5%,0603
C145	93ACHAXX100P	CAP. SM,100pF,50V,5%,0603
C147	93QCHA18P	CAPACITOR 18pF,50V,0402
C149	93ACHAXX100P	CAP. SM,100pF,50V,5%,0603
C152	93QAHA100P	CAP (SM) 100PF 50V 1% 0402
C153	93QAHA100P	CAP (SM) 100PF 50V 1% 0402
C155	93ADFB100N	CAP 100NF 25V 0603
C162	93ADHBXX10N	CAP. 10nF XR7
C163	93GDDCXXX10U	CAP 10UF TANT 10V 10%
C164	93QCHA330P	CAP 330pF +/-5% 50V COG 0402
C165	93QCHA18P	CAPACITOR 18pF,50V,0402
C168	93DFHD10U	CAP CER 10uF 50V
C170	93QDDI100N	CAPACITOR 100NF (0402)
C171	93QDDI100N	CAPACITOR 100NF (0402)
C172	93QDDI100N	CAPACITOR 100NF (0402)
C173	93QDDI100N	CAPACITOR 100NF (0402)
C175	9324100U	CAPACITOR 100uF ELECT. 6.3VDC
C176	93QDDI100N	CAPACITOR 100NF (0402)
C177	93QDDI100N	CAPACITOR 100NF (0402)
C178	93QDDI100N	CAPACITOR 100NF (0402)
C181	93QDEB22N	CAP 22nF 16V X7R 0402 10%
C182	93QDDI100N	CAPACITOR 100NF (0402)
C184	93QDDI100N	CAPACITOR 100NF (0402)
C186	93DFHD10U	CAP CER 10uF 50V
C187	93FDJBXXX4U7	CAPACITOR 4.7MFD 100V
C188	93ADFB100N	CAP 100NF 25V 0603

Item	Part Number	Description
C189	93GDDCXXX10U	CAP 10UF TANT 10V 10%
C190	93ADFB100N	CAP 100NF 25V 0603
C191	93ADHBXX10N	CAP. 10nF XR7
C197	93ADFB100N	CAP 100NF 25V 0603
C198	93ADFB100N	CAP 100NF 25V 0603
C204	93ADFB100N	CAP 100NF 25V 0603
C205	93KEGEXX100U	CAPACITOR 100uF 35VOLT 20%
C206	93QCHA10P	CAP, 10PF 50V (0402)
C207	93KEGEXX100U	CAPACITOR 100uF 35VOLT 20%
C209	93QCHA10P	CAP, 10PF 50V (0402)
C211	93261U	CAPACITOR Y5V 1206 1uF 50V
C212	93ADFB100N	CAP 100NF 25V 0603
C213	93ADFB100N	CAP 100NF 25V 0603
C228	93FDJBXXX4U7	CAPACITOR 4.7MFD 100V
C229	93FDJBXXX4U7	CAPACITOR 4.7MFD 100V
C231	93FDJBXXX4U7	CAPACITOR 4.7MFD 100V
C232	93FDJBXXX4U7	CAPACITOR 4.7MFD 100V
C237	93ADFB100N	CAP 100NF 25V 0603
C241	9324100U	CAPACITOR 100uF ELECT. 6.3VDC
C251	93QDDI100N	CAPACITOR 100NF (0402)
C253	93GDDC2U2	CAP TANT 2.2UF 10V 10%
C257	93ADFB100N	CAP 100NF 25V 0603
C259	93ADFB100N	CAP 100NF 25V 0603
C260	93ADFB100N	CAP 100NF 25V 0603
C301	93ADEBXX47N	CAPACITOR 47nF, 0603
C302	93ACHAXX470P	CAPACITOR,470pF,50V,5%,0603
C303	93ACHAXX470P	CAPACITOR,470pF,50V,5%,0603
C304	93ADFB100N	CAP 100NF 25V 0603
C305	93ADFB100N	CAP 100NF 25V 0603
C306	93ADFB100N	CAP 100NF 25V 0603
C307	93QCHA10P	CAP, 10PF 50V (0402)
C308	93QCHA10P	CAP, 10PF 50V (0402)
C309	93QDDI100N	CAPACITOR 100NF (0402)
C310	93QDDI100N	CAPACITOR 100NF (0402)
C311	93QDDI100N	CAPACITOR 100NF (0402)
C316	93ADFB100N	CAP 100NF 25V 0603

Item	Part Number	Description
C319	93ADFB100N	CAP 100NF 25V 0603
C320	93ADFB100N	CAP 100NF 25V 0603
C321	93GDDC2U2	CAP TANT 2.2UF 10V 10%
C322	93GDDC2U2	CAP TANT 2.2UF 10V 10%
D1	9203BZX3V3	3V3 ZENER
D2	9203BZX3V3	3V3 ZENER
D3	920010BQ100	DIODE SCHOTTKY
D5	9200BAV99	BAV99 DIODE
D6	9203BZX18V	BZX84C18 ZENER DIODE
D7	9200BAT54	BAT54 SCHOTTKY DIODE
D9	9200BAS19	DIODE SOT23 BAS19
D10	9200BAS19	DIODE SOT23 BAS19
D11	9200BAT54	BAT54 SCHOTTKY DIODE
D12	9200BAT54	BAT54 SCHOTTKY DIODE
D13	9200BAS19	DIODE SOT23 BAS19
D14	9200BAS19	DIODE SOT23 BAS19
D15	9200BAT54	BAT54 SCHOTTKY DIODE
D16	9203BZX18V	BZX84C18 ZENER DIODE
D17	9203BZX18V	BZX84C18 ZENER DIODE
D18	9200BAT54S	DIODE - SCHOTTKY BARRIER
D19	9203BZX15V	ZENER DIODE BZX84-C15
D20	920030WQ03	SCHOTTKY RECTIFIER(30WQ03FN)
D21	9200BAW56	BAW56LT1 DIODE
D23	920030WQ03	SCHOTTKY RECTIFIER(30WQ03FN)
D24	9200BAS19	DIODE SOT23 BAS19
D25	9200BAT54	BAT54 SCHOTTKY DIODE
D26	9204D1F10	DIODE RECTIFIER 1A / 100V
D27	9200BAT54S	DIODE - SCHOTTKY BARRIER
D29	9200BAS19	DIODE SOT23 BAS19
D32	9200BAS19	DIODE SOT23 BAS19
D35	9200BAV99	BAV99 DIODE
D36	9203BZX3V3	3V3 ZENER
D39	9203BZX3V3	3V3 ZENER
D40	9203BZX3V3	3V3 ZENER
D41	9200BAT54	BAT54 SCHOTTKY DIODE
D45	9200MBR0530	DIODE SM SCHOTTKY MBR0530

Item	Part Number	Description
F1	15525	FUSE HOLDER
F2	15525	FUSE HOLDER
F8	15524	3A POLYFUSE
IC1	9400TLV272	AMPLIFIER
IC2	940074HC08	QUAD AND GATE - SN74HC08D R
IC3	9400LMV331	IC COMPARATOR 2.7V SOT23
IC4	9401AT24C64	IC EEPROM 24C64 SOIC-8
IC5	9400TLV2264	QUAD OP AMP
IC6	9401STR912FA	IC(SM) FLASH MICRO
IC7	9400PS2801A1	SINGLE PHOTOCOUPLE
IC8	9400TLV2461	OP AMP-LOW POWER
IC9	9400KGF01	KIONIX GYRO 24-SOIC
IC11	9400LM2671	5V REGULATOR SWITCH
IC12	9400LM2931AM	LM2931 REGULATOR
IC13	9400PS2801A1	SINGLE PHOTOCOUPLE
IC15	9400IR2183	HALF-BRIDGE DRIVER
IC16	9400IR2183	HALF-BRIDGE DRIVER
IC17	9400ACPL072L	IC HIGH SPEED OPTOCOUPLER
IC18	940065HVD231	HIGH SPEED CAN TRANSCEIVER
IC19	9400ACPL072L	IC HIGH SPEED OPTOCOUPLER
IC20	940110F220	PRE-PROGRAMMED PIC NGCC
IC22	940074HC4051	IC 74HC4051
IC24	9400INA193	AMPLIFIER SOT23-5
IC25	9400LM393M	*DUAL COMPARATOR LM393M
IC26	9400PS2801A1	SINGLE PHOTOCOUPLE
IC29	9400LM60	TEMP SENSOR
IC30	940074HC32M	QUAD OR MM74HC32M
IC31	9400TLV2262	DUAL OP AMP
IC34	9400LM1117	LIN.REGULATOR - LM1117MPX-3.3
IC40	940074HC08	QUAD AND GATE - SN74HC08D R
IC45	940074LV4053	IC TRIPLE 2 CHANNEL ANALOG
IC46	940074LV4053	IC TRIPLE 2 CHANNEL ANALOG
IC48	9400S25FL016A	IC (SM) FLASH SPI
IC53	9400TPS70151	IC(SM) REGULATOR 3.3/1.8V
IC54	9400CY62136	IC(SM) SRAM
IC55	940074162373	IC(SM) 16 BIT LOGIC

Item	Part Number	Description
IC80	9400TLV2264	QUAD OP AMP
IC170	940074HC00	QUAD 2 INPUT NAND
IC180	94004011U	QUAD UNBUFFERED NAND GATE
ISO5	9400HP0701	OPTO SWITCH - HCPL-0701
ISO8	9400HP0701	OPTO SWITCH - HCPL-0701
L7	9600L1	CHIP INDUCTOR
L8	9600MAG1U	INDUCTOR 1UH 0.92A 5% 0805
L9	9600MAG1U	INDUCTOR 1UH 0.92A 5% 0805
L13	9600L1	CHIP INDUCTOR
L14	9600L1	CHIP INDUCTOR
L15	9600L1	CHIP INDUCTOR
L16	9600L1	CHIP INDUCTOR
L17	9600L1	CHIP INDUCTOR
L18	9600L1	CHIP INDUCTOR
L19	9600COILC2	INDUCTOR 100uH 730mA
L20	9600L1	CHIP INDUCTOR
L21	15539	IND COMMD CHKE 13A 275UH
L22	9600L1	CHIP INDUCTOR
L23	9600L1	CHIP INDUCTOR
L27	15539	IND COMMD CHKE 13A 275UH
L28	9600FER2012	CHIP FERRITE BEAD BLM21 SERIES
L29	9600L1	CHIP INDUCTOR
L31	9600L1	CHIP INDUCTOR
L32	9600L1	CHIP INDUCTOR
L33	9600PDLF30	IND C M CHOKE 3 LINE 5UH 100MA
L34	9600TOKOCM1	COMMON MODE CHOKE
L38	9600L1	CHIP INDUCTOR
L39	9600L1	CHIP INDUCTOR
L40	9600L1	CHIP INDUCTOR
L42	9600L1	CHIP INDUCTOR
L43	9600L1	CHIP INDUCTOR
L44	9600MAG1U	INDUCTOR 1UH 0.92A 5% 0805
L45	9600L1	CHIP INDUCTOR
L46	9600CCDLF80	IND C M CHOKE 8 LINE 100MA 5UH
L48	9600L1	CHIP INDUCTOR
L49	9600L1	CHIP INDUCTOR

Item	Part Number	Description
L52	9600L29	INDUCTOR 10uH 1.19A 0.11R
L54	9600L1	CHIP INDUCTOR
L55	9600L1	CHIP INDUCTOR
L59	9600L1	CHIP INDUCTOR
L61	15375	INDUCTOR - EC24-100K
L63	15375	INDUCTOR - EC24-100K
L64	15375	INDUCTOR - EC24-100K
L66	15375	INDUCTOR - EC24-100K
L67	9600L1	CHIP INDUCTOR
L69	15375	INDUCTOR - EC24-100K
L73	9600L1	CHIP INDUCTOR
L74	9600L1	CHIP INDUCTOR
L75	9600L1	CHIP INDUCTOR
L76	9600L1	CHIP INDUCTOR
L82	9600L1	CHIP INDUCTOR
L86	9600L1	CHIP INDUCTOR
LED11	9207SML210	LED,SM0805,SML210MT(GREEN)
LED12	9207SML210Y	LED, SM0805, SMT210Y (YELLOW)
PL1	07440	RF GROUND TAG
PL5	9602SAMTEC12	12-WAY CONNECTOR
R1	91QAA0R0	RES 0R0 1% 0.063W
R2	01245	RES. 330R(ROX3S 330R)
R3	91QAA330R	RES 330R 0402
R4	91QAA100R	RES 100R 1% 0.063W 0402
R5	91QAA7K5	RES MFILM 7K5 1% 0.063W 0402
R6	91QAA3K9	RES 3K9 0402
R7	91QAA1K	RES 1K0 1% 0.063W 0402
R8	91QAA7K5	RES MFILM 7K5 1% 0.063W 0402
R9	91QAA3K9	RES 3K9 0402
R10	91AAAXXX12K	RESISTOR 12K 1% 0.063W 0603
R11	91QAA22R	RES 22R 1% 0402
R12	91QAA22R	RES 22R 1% 0402
R13	91QAA22R	RES 22R 1% 0402
R14	91QAA22R	RES 22R 1% 0402
R15	91QAA22R	RES 22R 1% 0402
R16	91QAA22R	RES 22R 1% 0402

Item	Part Number	Description
R17	91QAA1K2	RESMFILM 1K2 1% 0.063W 0402
R19	91QAA1M	RES MFILM 1M0 1% 0.063W 0402
R20	91QAA39K	RES 39K 1% 0.063W 0402
R21	91QAA39K	RES 39K 1% 0.063W 0402
R27	91QAA22R	RES 22R 1% 0402
R30	91QAAXXX15K	RES, 15K, 1%, 0402, 0.063W
R31	91QAA10R	RES MFILM 10R 1% 0.063W 0402
R32	91QAA10R	RES MFILM 10R 1% 0.063W 0402
R34	91QAA100K	RES 100K 1% 0.063W 0402
R35	91QAA150K	RES 150K 1% 0.063W 0402
R36	91QAA100K	RES 100K 1% 0.063W 0402
R38	91QAA1K2	RESMFILM 1K2 1% 0.063W 0402
R39	91QAA1K2	RESMFILM 1K2 1% 0.063W 0402
R40	91QAA82R	RES MFIL 82R 1%0.063W 0402
R41	91QAA82R	RES MFIL 82R 1%0.063W 0402
R42	91QAA51K	RES MFILM 51K 1% 0.063W 0402
R43	91QAA51K	RES MFILM 51K 1% 0.063W 0402
R44	91QAA33K	RES MFILM 33K 1% 0.063W 0402
R45	91QAA33K	RES MFILM 33K 1% 0.063W 0402
R46	91QAA100K	RES 100K 1% 0.063W 0402
R48	91QAA100K	RES 100K 1% 0.063W 0402
R49	91AAAXXX16K	RESISTOR 16K,1%,0.063W, 0603
R50	91AAAXXX16K	RESISTOR 16K,1%,0.063W, 0603
R51	91QAA100R	RES 100R 1% 0.063W 0402
R52	91QAA1M	RES MFILM 1M0 1% 0.063W 0402
R56	91QAA4K7	RESISTOR 4K7 0402 1%
R59	91AAAXXX8R2	RESISTOR 8R2 1% 0.063W
R60	91QAA0R0	RES 0R0 1% 0.063W
R61	91FCHXXR030	RESISTOR METAL FILM R030
R62	91AAAXXX8R2	RESISTOR 8R2 1% 0.063W
R63	91QAA0R0	RES 0R0 1% 0.063W
R64	91QAA1K5	RES 1K5 1% 0.063W 0402
R65	91QAA1K5	RES 1K5 1% 0.063W 0402
R66	91QAA1K5	RES 1K5 1% 0.063W 0402
R67	91QAA10K	RES 10K 1% 0.063W 0402
R68	91QAA10K	RES 10K 1% 0.063W 0402

Item	Part Number	Description
R69	91QAA10K	RES 10K 1% 0.063W 0402
R70	91QAA10K	RES 10K 1% 0.063W 0402
R71	91QAA10K	RES 10K 1% 0.063W 0402
R72	91QAA10K	RES 10K 1% 0.063W 0402
R73	91QAA10K	RES 10K 1% 0.063W 0402
R74	91QAA10K	RES 10K 1% 0.063W 0402
R75	91QAA10K	RES 10K 1% 0.063W 0402
R76	91QAA1K5	RES 1K5 1% 0.063W 0402
R77	91QAA10K	RES 10K 1% 0.063W 0402
R78	91QAA0R0	RES 0R0 1% 0.063W
R79	91QAA10K	RES 10K 1% 0.063W 0402
R80	91QAA0R0	RES 0R0 1% 0.063W
R81	91QAA47K	RES 47K 1% 0.063W 0402
R82	91QAA270R	RES 270R 1% 0.0625W 0402
R83	91QAA270R	RES 270R 1% 0.0625W 0402
R84	91QAA4K7	RESISTOR 4K7 0402 1%
R85	91QAA10K	RES 10K 1% 0.063W 0402
R86	91QAA10K	RES 10K 1% 0.063W 0402
R87	91QAA10K	RES 10K 1% 0.063W 0402
R88	91QAA100R	RES 100R 1% 0.063W 0402
R89	91QAA100R	RES 100R 1% 0.063W 0402
R90	91QAA8K2	RES, 8K2, 1%, 0.063W, 0402
R91	91QAA0R0	RES 0R0 1% 0.063W
R92	91QAA0R0	RES 0R0 1% 0.063W
R93	91QAA0R0	RES 0R0 1% 0.063W
R95	91QAA10K	RES 10K 1% 0.063W 0402
R97	91QAA0R0	RES 0R0 1% 0.063W
R101	91QAA150R	RES 0402 510R-1%
R102	91QAA100R	RES 100R 1% 0.063W 0402
R105	91QAA100R	RES 100R 1% 0.063W 0402
R106	91QAA1K	RES 1K0 1% 0.063W 0402
R107	91QAA1K	RES 1K0 1% 0.063W 0402
R108	91QAA1K	RES 1K0 1% 0.063W 0402
R109	91QAA1K	RES 1K0 1% 0.063W 0402
R110	91QAA1K	RES 1K0 1% 0.063W 0402
R111	91QAA4K7	RESISTOR 4K7 0402 1%

Item	Part Number	Description
R112	91QAA4K7	RESISTOR 4K7 0402 1%
R113	91QAA4K7	RESISTOR 4K7 0402 1%
R114	91QAA100K	RES 100K 1% 0.063W 0402
R115	91QAA51K	RES MFILM 51K 1% 0.063W 0402
R117	91QAA270R	RES 270R 1% 0.0625W 0402
R118	91QAA5K6	RES MFILM 5K6 1% 0.063W 0402
R119	91QAA82R	RES MFIL 82R 1%0.063W 0402
R120	91QAA1K2	RESMFILM 1K2 1% 0.063W 0402
R121	91QAA1M	RES MFILM 1M0 1% 0.063W 0402
R122	91QAA10K	RES 10K 1% 0.063W 0402
R123	91QAA10K	RES 10K 1% 0.063W 0402
R124	91QAA10K	RES 10K 1% 0.063W 0402
R125	91QAA10K	RES 10K 1% 0.063W 0402
R127	91QAA1K	RES 1K0 1% 0.063W 0402
R128	91QAA39K	RES 39K 1% 0.063W 0402
R130	91QAA2K2	RES 2K2 1% 0.063W 0402
R131	91QAA2K2	RES 2K2 1% 0.063W 0402
R134	91QAA10K	RES 10K 1% 0.063W 0402
R135	91QAA4K7	RESISTOR 4K7 0402 1%
R136	91QAA390R	RES MFILM 390R 1% 0.063W 0402
R138	91AAAXX8R2	RESISTOR 8R2 1% 0.063W
R139	91AAAXX22K	RES. 22K,1%,0.063W,0603
R140	91QAAXX15K	RES, 15K, 1%, 0402, 0.063W
R141	91QAA2K2	RES 2K2 1% 0.063W 0402
R142	91QAA4K7	RESISTOR 4K7 0402 1%
R143	91QAA39K	RES 39K 1% 0.063W 0402
R144	91QAA330R	RES 330R 0402
R145	91QAA39K	RES 39K 1% 0.063W 0402
R146	91QAA39K	RES 39K 1% 0.063W 0402
R147	91QAA10K	RES 10K 1% 0.063W 0402
R148	91QAA4K7	RESISTOR 4K7 0402 1%
R150	91QAA1K2	RESMFILM 1K2 1% 0.063W 0402
R151	91QAA0R0	RES 0R0 1% 0.063W
R152	9106100R	RESISTOR 100R, 5% 1206 0.1W
R153	91QAA1K	RES 1K0 1% 0.063W 0402
R155	91QAA22K	RES, 22K, 1%, 0.063W, 0402

Item	Part Number	Description
R156	91QAA5K6	RES MFILM 5K6 1% 0.063W 0402
R160	91QAA4K7	RESISTOR 4K7 0402 1%
R164	9106100R	RESISTOR 100R, 5% 1206 0.1W
R170	91QAA10K	RES 10K 1% 0.063W 0402
R171	91QAA10K	RES 10K 1% 0.063W 0402
R175	91QAA0R0	RES 0R0 1% 0.063W
R183	91QAA10K	RES 10K 1% 0.063W 0402
R184	91QAA10K	RES 10K 1% 0.063W 0402
R185	91QAA10K	RES 10K 1% 0.063W 0402
R186	91QAA10K	RES 10K 1% 0.063W 0402
R187	91QAA10K	RES 10K 1% 0.063W 0402
R194	91QAA22R	RES 22R 1% 0402
R195	91QAA22R	RES 22R 1% 0402
R196	91QAA22R	RES 22R 1% 0402
R197	91QAA22R	RES 22R 1% 0402
R198	91QAA22R	RES 22R 1% 0402
R199	91QAA22R	RES 22R 1% 0402
R200	91QAA22R	RES 22R 1% 0402
R201	91QAA22R	RES 22R 1% 0402
R202	91QAA22R	RES 22R 1% 0402
R203	91QAA22R	RES 22R 1% 0402
R204	91QAA22R	RES 22R 1% 0402
R205	91QAA22R	RES 22R 1% 0402
R206	91QAA22R	RES 22R 1% 0402
R208	91QAA22R	RES 22R 1% 0402
R209	91QAA22R	RES 22R 1% 0402
R210	91QAA22R	RES 22R 1% 0402
R211	91QAA22R	RES 22R 1% 0402
R212	91QAA22R	RES 22R 1% 0402
R213	91QAA10K	RES 10K 1% 0.063W 0402
R214	91QAA330K	RES MFILM 330K 1% 0.063W 0402
R216	91QAA22R	RES 22R 1% 0402
R217	91QAA22R	RES 22R 1% 0402
R218	91QAA22R	RES 22R 1% 0402
R219	91QAA22R	RES 22R 1% 0402
R221	91QAA22R	RES 22R 1% 0402

Item	Part Number	Description
R222	91QAA10K	RES 10K 1% 0.063W 0402
R223	91QAA47K	RES 47K 1% 0.063W 0402
R224	91QAA47K	RES 47K 1% 0.063W 0402
R227	91QAA10K	RES 10K 1% 0.063W 0402
R228	91QAA10K	RES 10K 1% 0.063W 0402
R229	91QAA22R	RES 22R 1% 0402
R230	91QAA4K7	RESISTOR 4K7 0402 1%
R231	91QAA22R	RES 22R 1% 0402
R234	91QAA22R	RES 22R 1% 0402
R235	91QAA47K	RES 47K 1% 0.063W 0402
R237	91QAA47K	RES 47K 1% 0.063W 0402
R238	91QAA22R	RES 22R 1% 0402
R240	91QAA22R	RES 22R 1% 0402
R241	91QAA22R	RES 22R 1% 0402
R242	91QAA22R	RES 22R 1% 0402
R244	91QAA10K	RES 10K 1% 0.063W 0402
R245	91QAA22R	RES 22R 1% 0402
R246	91QAA22R	RES 22R 1% 0402
R247	91QAA47K	RES 47K 1% 0.063W 0402
R248	91QAA47K	RES 47K 1% 0.063W 0402
R249	91QAA22R	RES 22R 1% 0402
R250	91QAA22R	RES 22R 1% 0402
R251	91QAA22R	RES 22R 1% 0402
R252	91QAA10K	RES 10K 1% 0.063W 0402
R253	91QAA2K2	RES 2K2 1% 0.063W 0402
R254	91QAA1K	RES 1K0 1% 0.063W 0402
R255	91QAA10K	RES 10K 1% 0.063W 0402
R257	91QAA330K	RES MFILM 330K 1% 0.063W 0402
R260	91QAA1K	RES 1K0 1% 0.063W 0402
R261	91QAA1K	RES 1K0 1% 0.063W 0402
R262	91QAA3K3	RES MFILM 3K3 1% 0.063W 0402
R265	91QAA100K	RES 100K 1% 0.063W 0402
R270	91QAA4K7	RESISTOR 4K7 0402 1%
R284	91AAAXX220R	RESISTOR 220R 1% 0.063W 0603
R285	91QAA10K	RES 10K 1% 0.063W 0402
R286	91QAA10K	RES 10K 1% 0.063W 0402

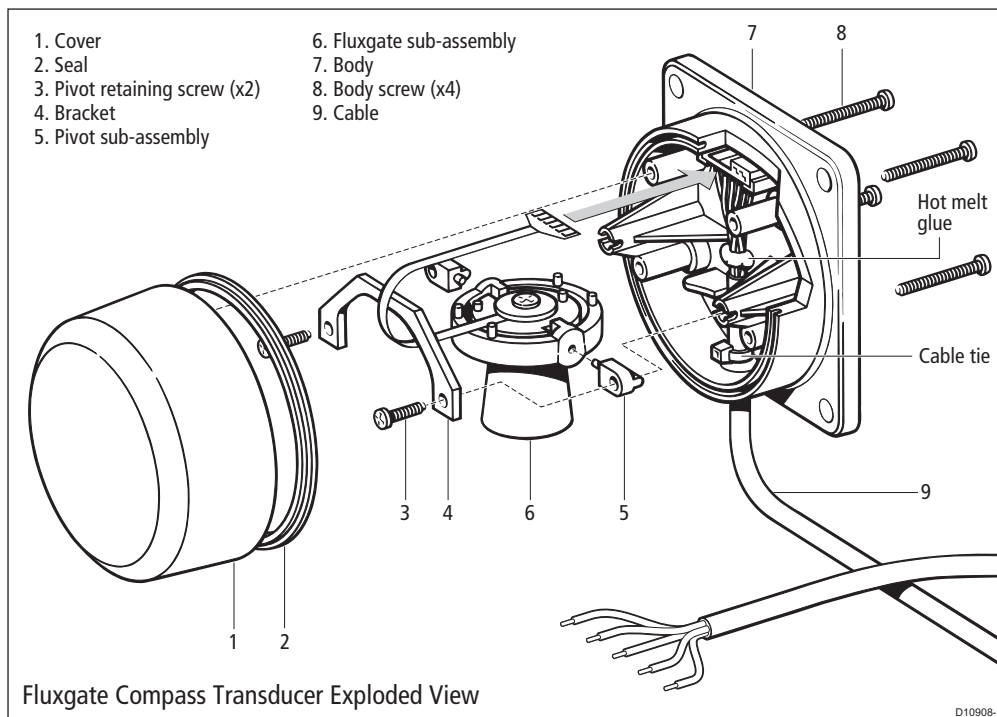
Item	Part Number	Description
R287	91AAAXX220R	RESISTOR 220R 1% 0.063W 0603
R289	91QAA120R	RES MFILM 120R 1% 0.063W 0402
R291	91QAA470R	RES 470R 1% 0.063W 0402
R292	91QAA470R	RES 470R 1% 0.063W 0402
R293	91QAA470R	RES 470R 1% 0.063W 0402
R303	91QAA470R	RES 470R 1% 0.063W 0402
R304	91QAA470R	RES 470R 1% 0.063W 0402
R306	91QAA1K2	RESMFILM 1K2 1% 0.063W 0402
R307	91QAA0R0	RES 0R0 1% 0.063W
R308	91QAA0R0	RES 0R0 1% 0.063W
R312	91QAA270R	RES 270R 1% 0.0625W 0402
R313	91QAA270R	RES 270R 1% 0.0625W 0402
R331	91QAA4K7	RESISTOR 4K7 0402 1%
R334	91QAA22K	RES, 22K, 1%, 0.063W, 0402
R335	91QAA10K	RES 10K 1% 0.063W 0402
R337	91QAA4K7	RESISTOR 4K7 0402 1%
R338	91QAA4K7	RESISTOR 4K7 0402 1%
R339	91QAA10K	RES 10K 1% 0.063W 0402
R357	91QAA22K	RES, 22K, 1%, 0.063W, 0402
R358	91QAA10K	RES 10K 1% 0.063W 0402
R359	91QAA51K	RES MFILM 51K 1% 0.063W 0402
R360	91QAA51K	RES MFILM 51K 1% 0.063W 0402
R361	91QAA5K6	RES MFILM 5K6 1% 0.063W 0402
R362	91QAA5K6	RES MFILM 5K6 1% 0.063W 0402
R363	91QAA10K	RES 10K 1% 0.063W 0402
R364	91QAA100R	RES 100R 1% 0.063W 0402
R383	91QAA3K3	RES MFILM 3K3 1% 0.063W 0402
R391	91QAA3K3	RES MFILM 3K3 1% 0.063W 0402
R396	91QAA10K	RES 10K 1% 0.063W 0402
R398	91QAA4K7	RESISTOR 4K7 0402 1%
R399	91QAA4K7	RESISTOR 4K7 0402 1%
R400	91QAA4K7	RESISTOR 4K7 0402 1%
R401	91QAA4K7	RESISTOR 4K7 0402 1%
R403	91AAAXX220R	RESISTOR 220R 1% 0.063W 0603
R404	91QAA180R	RESISTOR 180R 1% 0.063W 0402
R405	91QAA4K7	RESISTOR 4K7 0402 1%

Item	Part Number	Description
R406	91QAA10K	RES 10K 1% 0.063W 0402
R438	91QAA0R0	RES 0R0 1% 0.063W
R439	91QAA4K7	RESISTOR 4K7 0402 1%
R440	91QAA4K7	RESISTOR 4K7 0402 1%
R441	91QAA22R	RES 22R 1% 0402
R443	91AAAXX220R	RESISTOR 220R 1% 0.063W 0603
R444	91AAAXX220R	RESISTOR 220R 1% 0.063W 0603
R445	91QAA47K	RES 47K 1% 0.063W 0402
R446	91QAA22R	RES 22R 1% 0402
R447	91QAA22R	RES 22R 1% 0402
R448	91QAA22R	RES 22R 1% 0402
R449	91QAA22R	RES 22R 1% 0402
R453	91QAA47K	RES 47K 1% 0.063W 0402
R454	91QAA22R	RES 22R 1% 0402
R455	91QAA22R	RES 22R 1% 0402
R456	91QAA22R	RES 22R 1% 0402
R460	91QAA22R	RES 22R 1% 0402
R464	91QAA4K7	RESISTOR 4K7 0402 1%
R473	91QAA4K7	RESISTOR 4K7 0402 1%
R475	91QAA100R	RES 100R 1% 0.063W 0402
R476	91QAA4K7	RESISTOR 4K7 0402 1%
R477	91QAA0R0	RES 0R0 1% 0.063W
R478	91QAA10K	RES 10K 1% 0.063W 0402
R479	91QAA10K	RES 10K 1% 0.063W 0402
R480	91QAA10K	RES 10K 1% 0.063W 0402
R481	91QAA22R	RES 22R 1% 0402
R482	91QAA22R	RES 22R 1% 0402
R483	91QAA330K	RES MFILM 330K 1% 0.063W 0402
R484	91QAA330K	RES MFILM 330K 1% 0.063W 0402
R485	91QAA47K	RES 47K 1% 0.063W 0402
R486	91QAA47K	RES 47K 1% 0.063W 0402
R487	91QAA47K	RES 47K 1% 0.063W 0402
R511	91QAA4K7	RESISTOR 4K7 0402 1%
R512	91QAA4K7	RESISTOR 4K7 0402 1%
R513	91QAA47K	RES 47K 1% 0.063W 0402
R515	91QAA47K	RES 47K 1% 0.063W 0402

Item	Part Number	Description
R516	91QAA47K	RES 47K 1% 0.063W 0402
R517	91QAA3K3	RES MFILM 3K3 1% 0.063W 0402
R518	91QAA220R	RESISTOR 220R 1% 0.063W 0402
R523	91QAA22R	RES 22R 1% 0402
R524	91QAA22R	RES 22R 1% 0402
R525	91QAA22R	RES 22R 1% 0402
R526	91QAA22R	RES 22R 1% 0402
R527	91QAA22R	RES 22R 1% 0402
R528	91QAA22R	RES 22R 1% 0402
R529	91QAA22R	RES 22R 1% 0402
R530	91QAA22R	RES 22R 1% 0402
R531	91QAA22R	RES 22R 1% 0402
R532	91QAA22R	RES 22R 1% 0402
R533	91QAA22R	RES 22R 1% 0402
R534	91QAA22R	RES 22R 1% 0402
R535	91QAA22R	RES 22R 1% 0402
R536	91QAA22R	RES 22R 1% 0402
R537	91QAA22R	RES 22R 1% 0402
R538	91QAA22R	RES 22R 1% 0402
R539	91QAA22R	RES 22R 1% 0402
R540	91QAA22R	RES 22R 1% 0402
R541	91QAA4K7	RESISTOR 4K7 0402 1%
R542	91QAA4K7	RESISTOR 4K7 0402 1%
R543	91QAA22R	RES 22R 1% 0402
R546	91QAA22R	RES 22R 1% 0402
R547	91QAA22R	RES 22R 1% 0402
R548	91QAA22R	RES 22R 1% 0402
R552	91QAA22R	RES 22R 1% 0402
R553	91QAA22R	RES 22R 1% 0402
R554	91QAA22R	RES 22R 1% 0402
R555	91QAA4K7	RESISTOR 4K7 0402 1%
R556	91QAA4K7	RESISTOR 4K7 0402 1%
R900	91010R0	ZERO OHM LINK, 0603 PACKAGE
RN2	91122K2	RES. NETWORK 2K2(MNR34)
RN5	91122K2	RES. NETWORK 2K2(MNR34)
SKT1	07486	CONNECTOR 32A

Item	Part Number	Description
SKT9	07537	24WY TERMINAL BLOCK 5MM PITCH
TR1	9500IRFZ48	SM FET(IRFZ48NS)
TR2	9500IRFZ48	SM FET(IRFZ48NS)
TR3	9500IRFZ48	SM FET(IRFZ48NS)
TR4	9500IRFZ48	SM FET(IRFZ48NS)
TR5	9500IRFZ48	SM FET(IRFZ48NS)
TR13	9500IMX1	DIGITAL TRANSISTOR ARRAY
TR14	9500BC807	BC807
TR15	9500IMZ1	DUAL TRANSISTOR ARRAY
TR18	9500IMX1	DIGITAL TRANSISTOR ARRAY
TR19	9500BC807	BC807
TR20	9500BC817	BC817
TR22	95002N7002	2N7002 MOSFET
TR23	9500BC807	BC807
TR26	9500BC817	BC817
TR31	9500BC817	BC817
TR32	9500BC817	BC817
TR33	9500BC807	BC807
TR40	9500BC817	BC817
TR41	9500BC807	BC807
TR47	95002N7002	2N7002 MOSFET
TR48	95002N7002	2N7002 MOSFET
TR51	9500IMX1	DIGITAL TRANSISTOR ARRAY
TR54	9500BC817	BC817
TR56	9500BC817	BC817
TR61	9500IMX1	DIGITAL TRANSISTOR ARRAY
TR999	9500IMX1	DIGITAL TRANSISTOR ARRAY
V1	01051	VARISTOR TYPE GE V22ZT1
V2	01051	VARISTOR TYPE GE V22ZT1
V3	01051	VARISTOR TYPE GE V22ZT1
V4	01051	VARISTOR TYPE GE V22ZT1
V8	9108VC180400	TRANSIENT VOLTAGE SUPPRESSOR
V9	9108VC180400	TRANSIENT VOLTAGE SUPPRESSOR
XTL1	9601CR19	CRYSTAL 19MHZ
XTL3	9602CR32P768	CRYSTAL 32.768KHZ 7X1.4X1.5MM

2.2 Fluxgate Compass

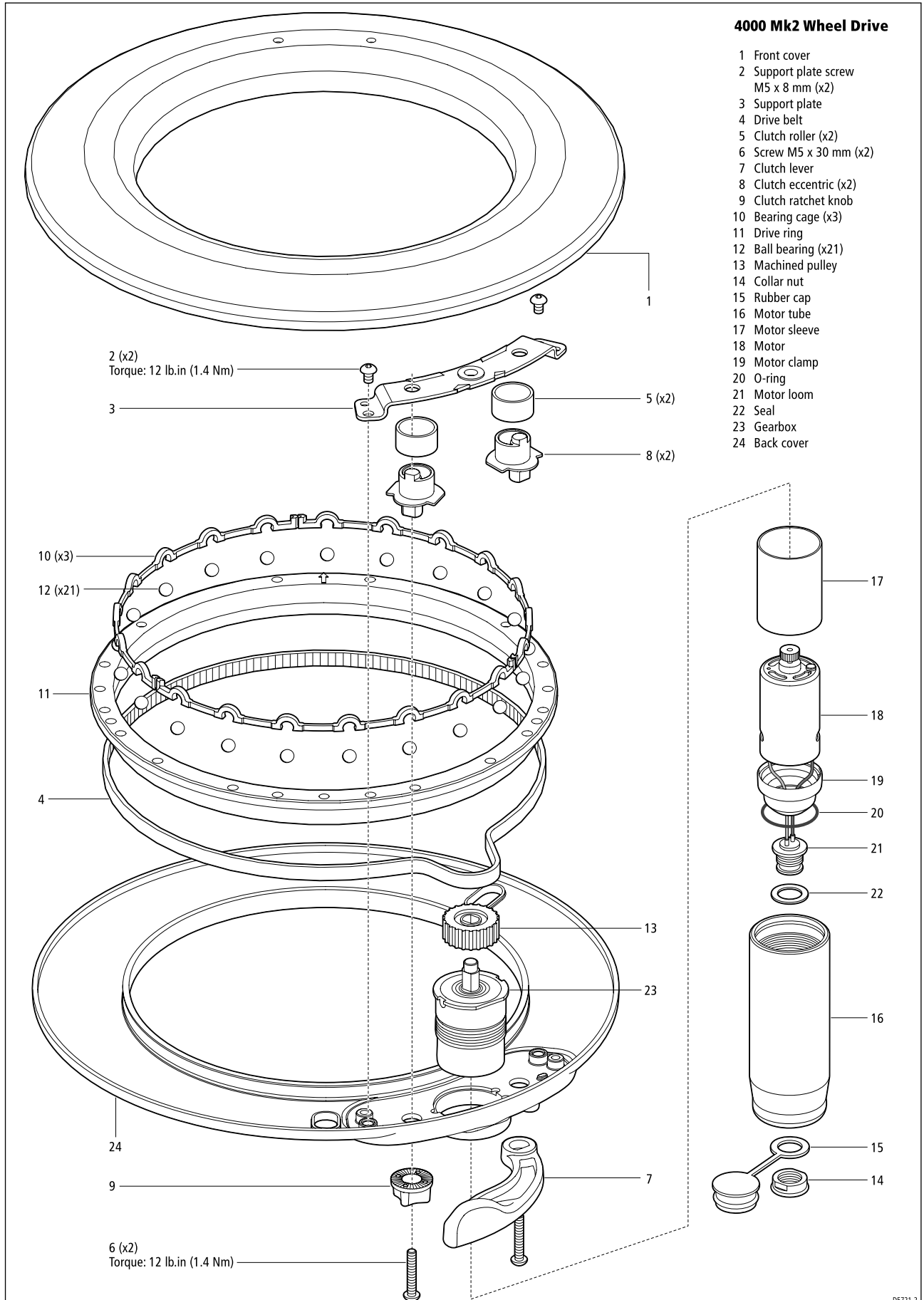


Fluxgate Compass spare parts

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

2.3 Wheel Drive

Exploded view



D5721-2

Parts list

Item	Spare/Accessory	Part No.	Comments
	Front cover	A18074	
1	Front cover		
	Drill bit		Not shown in exploded view
1	Front cover		
24	Back cover	A18075	
11	Drive ring	A18076	
	Clutch lever	A18077	
7	Clutch lever		
6	M5 x 30 mm screw		
	Clutch ratchet knob	A18078	
9	Ratchet knob		
6	M5 x 30 mm screw		
	Support plate	A18079	
3	Support plate		
2	M5 x 8 mm screw (x2)		
	Torque restraint (pedestal bracket)	A18080	
–	Torque restraint		Not shown in exploded view
–	No 10 x ¾ inch screw (x4)		Not shown in exploded view
–	4 mm drill bit		Not shown in exploded view
–	Wheel drive unit	A18081	Entire wheel drive assembly
4	Drive belt	A18083	
	Clutch kit	A18084	
8	Clutch eccentric		
5	Clutch roller		
6	M5 x 30 mm screw		
	Bearing kit	A18085	
12	Ball bearings (x21)		
10	Bearing cage (x3)		
18	Motor	A18086	
13	Machined pulley	A18087	
23	Gearbox	A18088	
	Single spoke clamp	A18089	
–	Spoke clamp		Not shown in exploded view
–	16 mm spoke clamp insert		Not shown in exploded view
–	12 mm spoke clamp insert		Not shown in exploded view
–	M5 x 16 mm screw		Not shown in exploded view
–	3 mm allen key		Not shown in exploded view
	Motor loom and seal kit	A18092	
14	Collar nut		
15	Rubber cap		
19	Motor clamp		
20	O-ring		
21	Loom plug assembly		
22	Gasket		
	Power cable		
	4.5 m (15 ft) cable with plug at one end and connector spades at the other	A18061	Not shown in exploded view

Disassembly

Note: *The numbered parts in the following instructions refer to the annotations on the exploded views. Remove the wheel drive from the wheel and release the clutch, then complete these steps:*

Support plate and drive belt

1. Remove the front cover (1) by pulling it away from the back cover.
2. Remove the support plate:
 - i. unscrew and remove the 2 support plate screws (2)
 - ii. lever the support plate (3) away from the back cover
3. Remove the drive belt:
 - i. lever the drive belt (4) up and over the machined pulley (13)
 - ii. remove the drive belt from the drive ring (11)

Clutch eccentrics, knob and lever

1. Remove the 2 clutch rollers (5) from the clutch eccentrics. Note that the clutch rollers are identical.
2. Remove the clutch lever:
 - i. unscrew and remove the clutch lever screw (6)
 - ii. pull the clutch lever (7) off the back cover
3. Remove the clutch lever eccentric (8).
4. Remove the clutch ratchet knob:
 - i. unscrew and remove the ratchet knob screw (6)
 - ii. pull the ratchet knob (9) off the back cover
5. Remove the clutch knob eccentric (8). Note: the clutch lever eccentric and clutch knob eccentric are identical.

Bearing cage and drive ring

1. Remove the 3 parts of the bearing cage (10) by inserting one end of the allen key into the joint between 2 parts of bearing cage (10), then levering one part of the cage up, so you can pull it out
2. Push all of the ball bearings together. The drive ring (11) will then be free to move.
3. Hold the drive unit horizontal, then lift off the drive ring (11).
4. Remove the 21 ball bearings (12), taking care to retain them for reassembly (e.g. in the inside of upturned front cover).
5. Lift off the machined pulley (13).

Motor and gearbox

1. Unscrew the plastic collar nut (14) by turning it anti-clockwise, then remove the rubber cap (15).
2. Unscrew the motor tube (16) by hand (turning it anti-clockwise) and then remove it.
3. Lift off the motor assembly, consisting of: motor sleeve (17), motor (18), motor clamp (19), O-ring (20), motor loom (21) and gasket (22).
4. Remove the gearbox (23) by pushing it out from the rear of the back cover (24).

Reassembly

CAUTION:

Do NOT use mineral-based solvents (e.g. WD40) to lubricate or clean the wheel drive as they will damage the material. The wheel drive is designed to run without lubrication.

Gearbox

1. Fit the gearbox (23) by inserting it from the inside of the back cover (24). Ensure that the locating slots on the gearbox are aligned with the lugs in the back cover.
2. Place the machined pulley (13) onto the gearbox shaft, with the recessed face on top.

Clutch eccentrics

1. Fit the 2 clutch eccentrics (8) with their flanges downwards, so that they are clear of the four pins on the back cover. Note: the 2 clutch eccentrics are identical.
2. Fit the 2 clutch rollers (5) over the clutch eccentrics. Note: the 2 clutch rollers are identical.

Drive ring and bearing cage

1. Place the drive ring (11) onto the back cover, with its lipped edge uppermost.
2. Place the 21 ball bearings (12) back into the ball groove.
3. Roughly distribute the ball bearings around the ball groove – this should secure the drive ring.
4. Fit the 3 parts of the bearing cage (10):
 - i. clip the first part of the bearing cage into the ball groove, capturing 7 ball bearings in the cage
 - ii. repeat for the other 2 parts of the bearing cage
 - iii. when you have fitted the 3 parts of the bearing cage, check that the drive ring is free to rotate

Drive belt and support plate

1. Fit the drive belt (4):
 - i. fit the belt around the drive ring
 - ii. rotate the clutch eccentrics to make the maximum amount of space between the machined pulley and the clutch eccentrics
 - iii. then fit the belt around the machined pulley
2. Fit the support plate (3):
 - i. fit the support plate over the clutch eccentrics and gearbox shaft, making sure the plate is pressed down fully
 - ii. insert and tighten the 2 screws (2): torque to 12 lb.in (1.4 Nm)

Clutch lever and ratchet knob

1. Fit the clutch lever (7):
 - i. place the clutch lever onto the eccentric spindle (it should be positioned between the two pips on the rear of the back cover)
 - ii. insert and tighten the clutch lever screw (6): torque to 12 lb.in (1.4 Nm)
 - iii. check that the lever engages and disengages the clutch
2. Fit the clutch ratchet knob (9):
 - i. place the clutch ratchet knob over the eccentric spindle
 - ii. insert and tighten the clutch ratchet knob screw (6): torque to 12 lb.in (1.4 Nm)
 - iii. you will need to **adjust the clutch** after reassembling the wheel drive (Section 3.4)

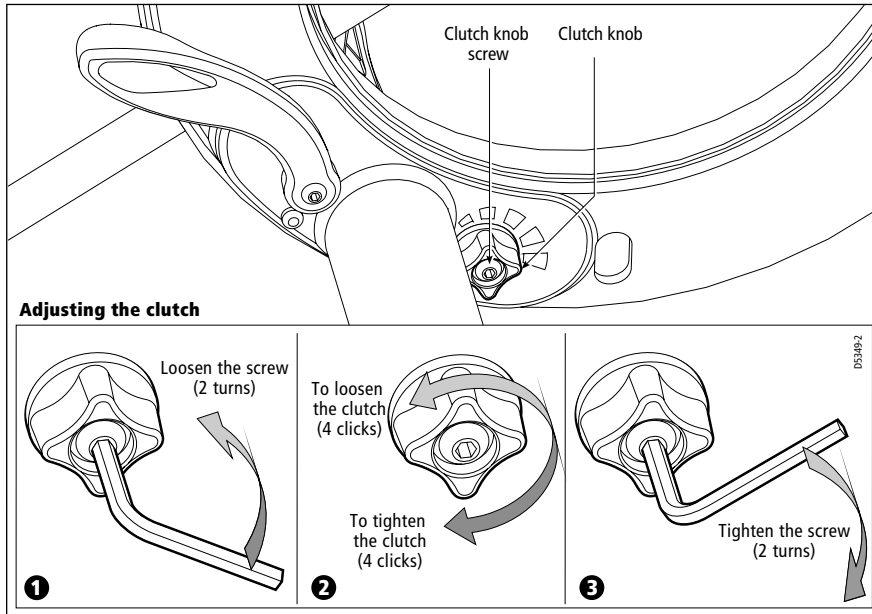
Motor assembly

1. Fit the motor assembly:
 - i. carefully insert the gear at the end of the motor (18) into the hole on the gearbox (23), making sure the teeth engage properly
 - ii. also make sure that the pin on the motor engages into one of the 2 holes on the top of the gearbox
 - iii. check that the O-ring seal (20) is still sitting on the motor clamp
2. Fit the motor tube (16) by placing it over the motor and hand-tightening it onto the back cover
3. Fit the rubber cap (15) and secure it with the plastic collar nut (14), making sure the lip on the collar nut is uppermost.

Front cover

Fit the front cover (1) by lining up the arrow on the front cover with the arrow on the drive ring, then pressing the cover into place

Adjusting the clutch



Clutch adjustment is required if either the clutch eccentrics have been removed, the ratchet knob has been replaced or the drive belt has been replaced.

When the clutch is correctly adjusted:

- the drive ring can rotate freely when the clutch is disengaged
- the drive belt does not slip when the clutch is engaged and the motor is driving

To adjust the clutch, make sure the clutch is disengaged. Then:

1. Use a 3 mm allen key to loosen the clutch knob screw about 2 turns counter-clockwise.
2. Turn the clutch knob either 4 clicks clockwise to tighten the clutch, or 4 clicks anti-clockwise to loosen the clutch.
3. Use the allen key to re-tighten the clutch knob screw.
4. Check that the wheel still moves freely with the clutch off.

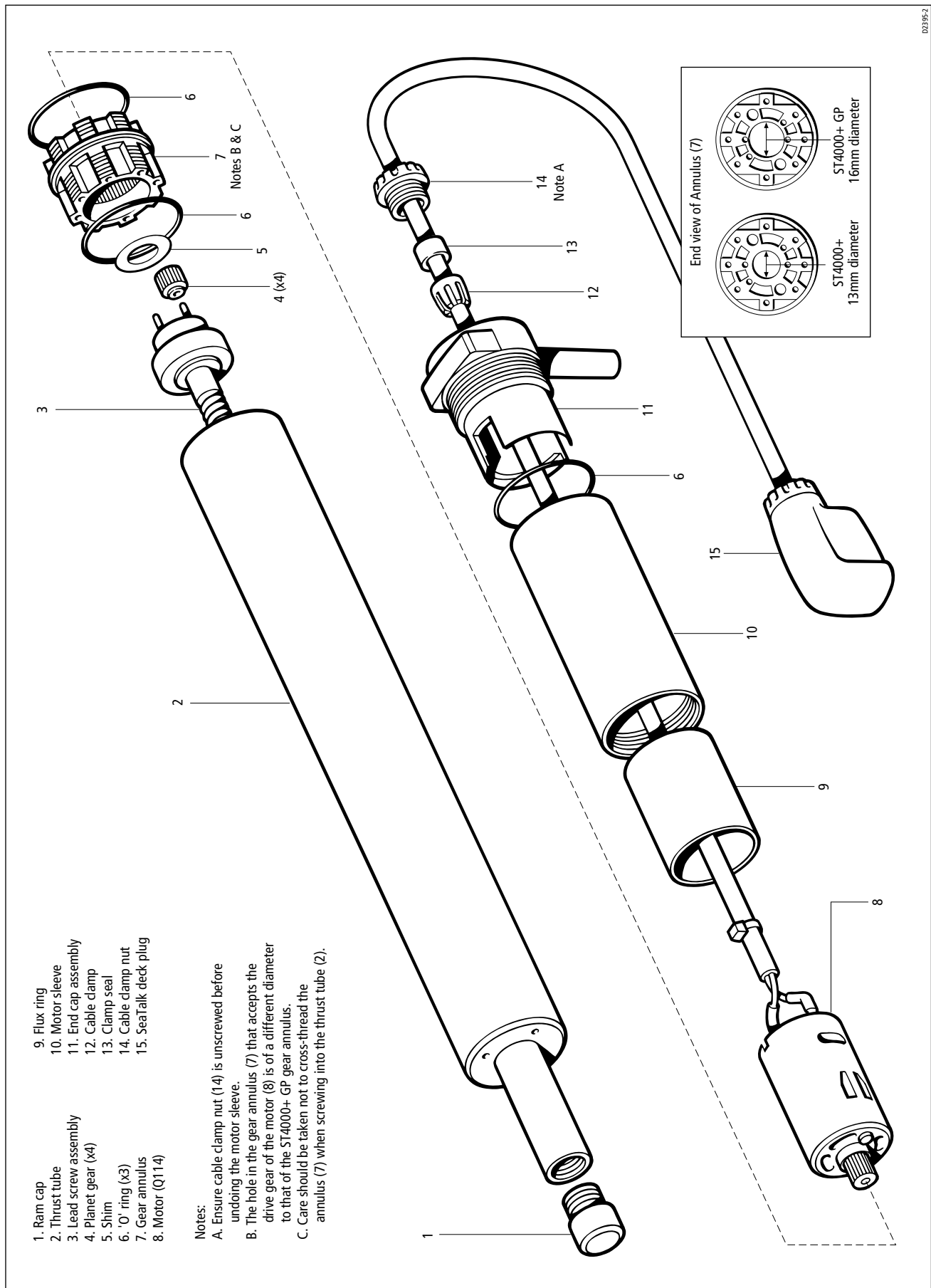
Note: *If the wheel does not move freely, reduce the clutch tension by turning the clutch knob 2 clicks anti-clockwise and check again*

5. Check the drive's operation with the clutch engaged.

This procedure is usually sufficient to correct a slipping or dragging drive belt. In some cases, however, you may need to repeat the procedure.

2.4 Tiller Drive Actuator

Exploded view



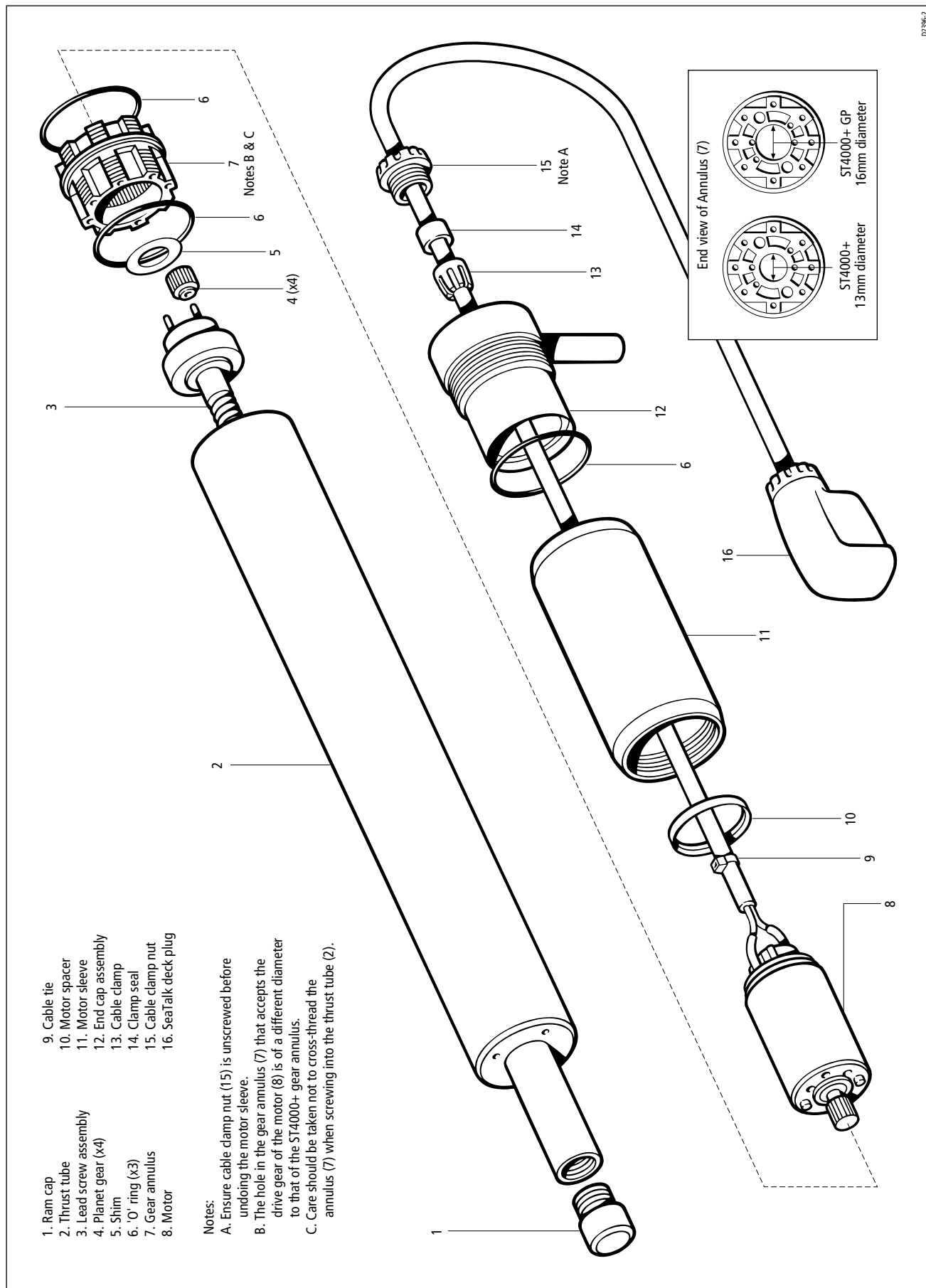
Tiller Drive Actuator spare parts list

The item numbers refer to the 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	

2.5 GP Tiller Drive Actuator

Exploded view



GP Tiller Drive parts list

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

Chapter 3: Software Upgrades

Use this chapter to upgrade software in Raymarine SmartPilot X-5 (SPX-5) systems.

You can download SPX-5 system software upgrades from the Raymarine web site at raymarine.com. This section describes how to download the software upgrade files, unzip them, transfer them to a CompactFlash memory card, then install the software in the SPX system. To do this, you need:

- A Raymarine SeaTalk system which includes a Raymarine E-Series Display.
- A personal computer (PC).
- A blank CompactFlash card
- A USB CompactFlash reader.

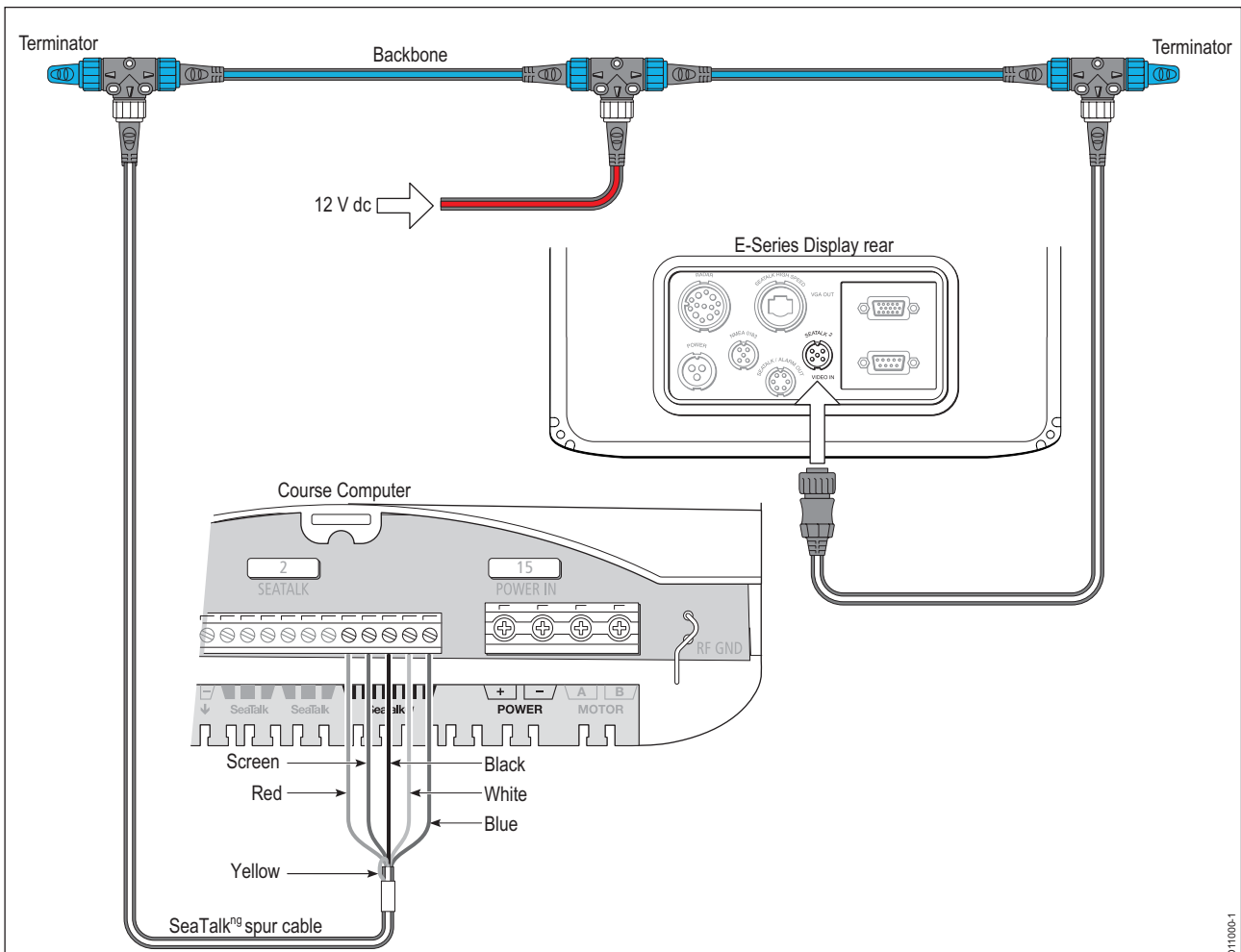
Carry out the procedures in sequence for:

- Getting started.
- Downloading software upgrades.
- Unpacking the upgrade files.
- Transferring the upgrade files.
- Installing the upgrade.

System requirement

When carrying out a software upgrade, you can use either

- An existing operational SeaTalk system to which the Raymarine E-Series Display and the relevant SPX Course Computer are both connected.
- or
- A discrete SeaTalk² or SeaTalk^{h9} terminated backbone from which the Raymarine E-Series Display and the relevant SPX Course Computer are spurred off, as in the following illustration.



Getting started

Prepare the CompactFlash for use as follows:

1. Plug the CompactFlash memory card into the CF card slot on the CompactFlash card reader. The card and reader are keyed so the CF card will only fit in the slot one way. Ensure it is correctly oriented.
2. Connect the CompactFlash card reader to a spare USB connector on your PC.
3. Your PC will recognize the card reader as a Removable Disk, and assign it a drive letter. Your computer may also display a window identifying the newly recognized removable disk. If such a window is displayed, the window's title bar will specify the removable disk drive letter, e.g. Removable Disk (E:).

Downloading software upgrades

Find and download the relevant software upgrade files as follows:

1. Go to Raymarine's web site at www.raymarine.com and click on the **Login or create an account** link, to display the log in and create an account page.
2. Using your login ID and password, log into your account.

Note: If you do not have a login ID, click on the **CREATE AN ACCOUNT** button, then follow the on-screen instructions.

3. When you have logged in, click on the **Customer Support** button at the top of the page.
4. Click on the link for **Software and Firmware Upgrades**, to go to the Raymarine.com technical support Knowledge Base.
5. Use the Knowledge Base to determine which upgrade you need.
6. Click on the relevant upgrade then follow the on-screen instructions to download the software upgrade file to your hard disk. Note the file name of the upgrade and the location to which you are saving it.
7. Log out of your Raymarine account.

Unpacking the upgrade files

To unpack your software upgrade:

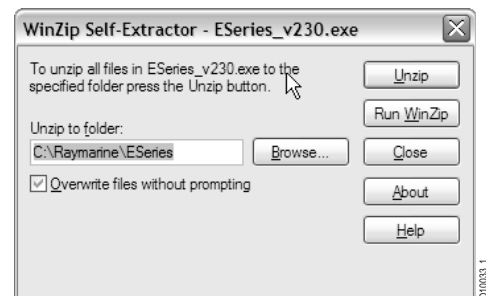
1. Locate the downloaded file on the PC.
2. Double-click the downloaded file, to open the WinZip self-extract application for that file.

Note: Do not change the default **Unzip to folder** field in this dialog.

3. Click on the **Unzip** button to unpack the upgrade files to your PC's hard drive.

By default the upgrade files unpack to:

C:\Raymarine\[Product Family]\[Software Version].



Transferring the upgrade files

Transfer the upgrade files to the CompactFlash card as follows:

1. Ensure the CompactFlash card reader is connected to your PC as described under *Getting started* above.
2. At your PC, open the directory described at step 3 under *Unpacking the upgrade files* above. This contains two files:
 - An autorun file, **autorun.dob**
 - The upgrade file which has the product name and software version as part of the filename, and a '**pkg**' extension.
3. Highlight both files then copy them (**Ctrl/C** in Windows).
4. Open the drive that was assigned to your CompactFlash reader in step 3 of *Getting started* above.
5. Paste both files (**Ctrl/V** in Windows) into the CompactFlash reader root directory.
6. Remove the CompactFlash memory card from your CompactFlash reader. The card is now ready for upgrading your SPX-5 system.

Installing the upgrade

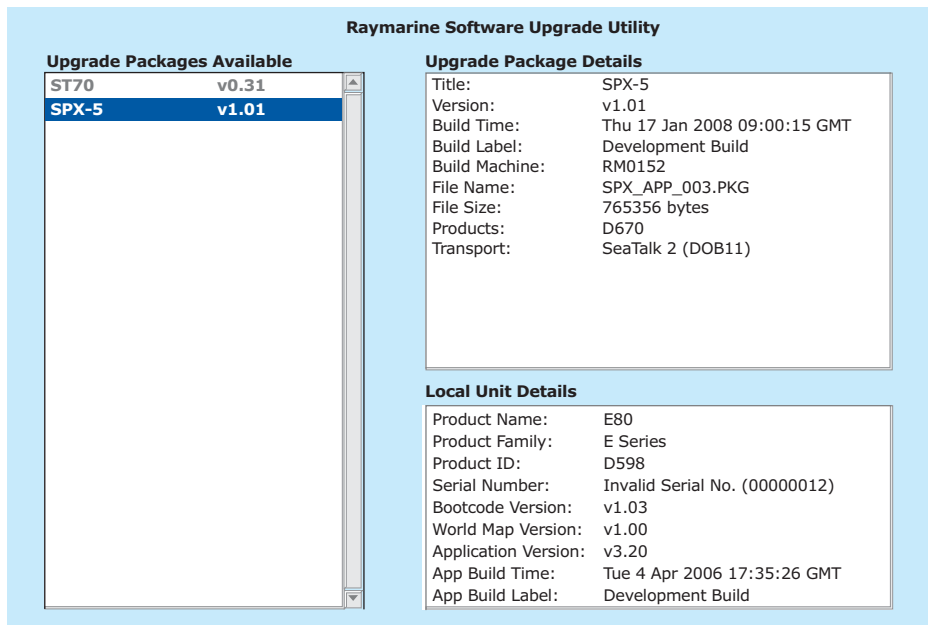


WARNING: Disruption to system operation

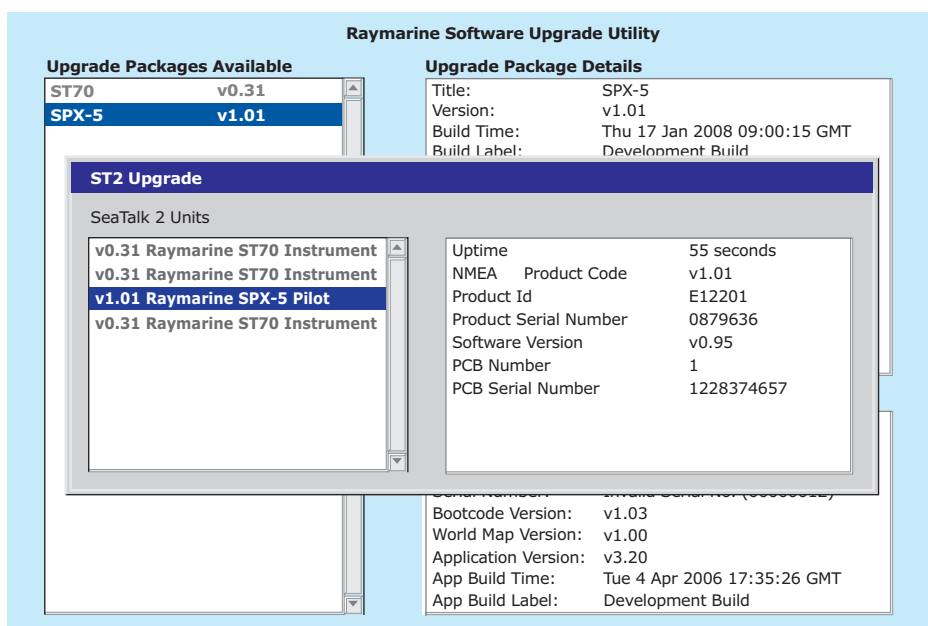
Do NOT attempt to install software in a system that is being used for navigation. The software installation process could result in unreliable data for the period of the upgrade process.

To install your SPX upgrade:

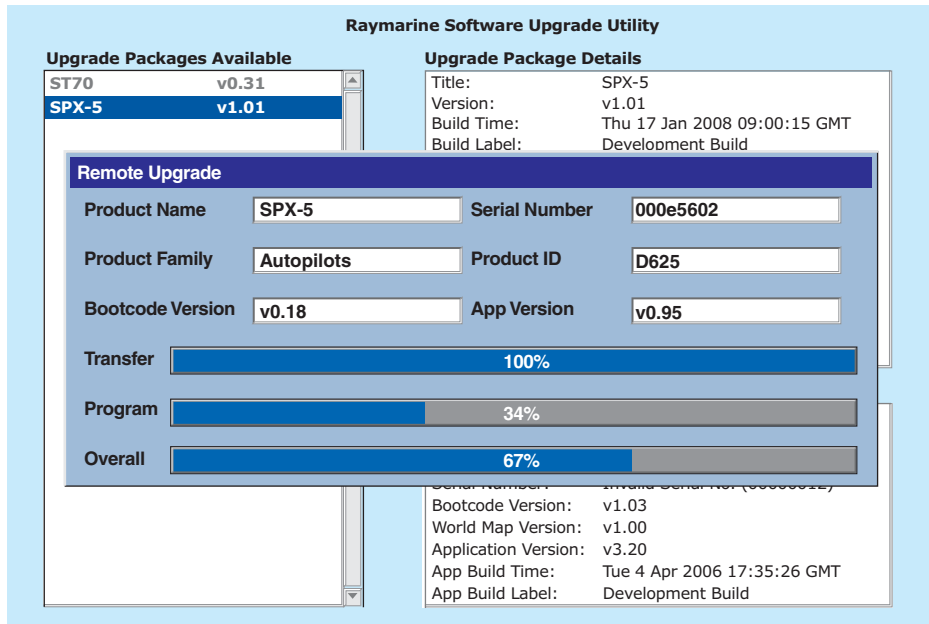
1. Choose a Raymarine E-Series Display to use for the upgrade procedure. This display must be connected to the same system as the SPX product you want to upgrade, and will be referred to as 'the display' throughout the rest of this procedure.
2. Switch off the power to the display. and, if a CompactFlash card is fitted, remove it.
3. Insert the CompactFlash card containing the software upgrade into the display card reader.
4. Switch on power to the display.
5. When the display is powered up, Software Upgrade Utility screen similar to the one below, is displayed.



6. In the **Upgrade Packages Available** column the software you transferred to the CompactFlash card should be highlighted. If it is not, use the directional track pad to highlight it.
7. Click on the **Upgrade Remote Unit** soft key.
8. Click on the **Upgrade Remote Unit on ST2** soft key, to display the ST2 Upgrade dialog box.



9. In the left-hand column, select the product you want to upgrade. The right-hand column shows the details of the selected product.
10. Click on the Upgrade Unit soft key. The upgrade process starts, with progress indicated by on-screen progress bars.



11. When the upgrade is complete remove the CompactFlash card from the card reader and disconnect the card reader.
12. Press the **Reboot** soft key. The instrument then restarts automatically using the new software.

Upgrading tips

If you experience any problems completing the installation of your software upgrade, switch off all products connected to the network, except for the power supply, the instrument you are upgrading and the display.

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Raymarine plc,
Anchorage Park,
Portsmouth, Hampshire PO3 5TD, United Kingdom.
Tel: +44 (0) 23 9269 3611.
Fax: +44 (0) 23 9269 4642

Raymarine Inc,
21 Manchester Street,
Merrimack,
New Hampshire 03054, USA.
Tel: +1 603.881.5200
Fax: +1 603.864.4756

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