

SmartPilot S1 & S1G

Service Manual

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Important Information

Safety notices

CAUTION: Electrostatic discharge

The S1(G) course computer contains electrostatic sensitive components. Always observe the appropriate precautions when handling, shipping and storing this product. Failure to do so could result in permanent damage to the equipment.

CE marking of equipment/replacement parts

If the Raymarine 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 Raymarine should be used in order to maintain compliance with the relevant CE requirements.

Incorporation, use or attachment, by any means, of parts or components not supplied or not approved for such use by Raymarine or, if supplied or approved for use by Raymarine, not properly fitted in accordance with instructions published, provided or recommended by Raymarine, may cause the equipment to malfunction and in particular, to become unsafe or to no longer meet the relevant CE requirements. In these circumstances, Raymarine excludes liability to the fullest extent permissible in law for any loss or damage including any liability for its contribution to such loss or damage by its negligent acts or omissions.

EMC conformance

All Raymarine equipment and accessories are designed to the best industry standards for use in the recreational marine environment.

The design and manufacture of Raymarine equipment and accessories conform to the appropriate Electromagnetic Compatibility (EMC) standards, but correct installation is required to ensure that performance is not compromised.

Waste Electrical and Electronic (WEEE) Directive



The WEEE Directive requires the recycling of waste electrical and electronic equipment. Whilst the WEEE Directive does not apply to some of Raymarine's products, we support its requirements as part of our environmental policy and we ask you to be aware of how you should dispose of this product. The crossed out wheeled bin symbol found on our products signifies that it should not be disposed of in general waste or landfill. Please contact your local dealer, national distributor or Raymarine Technical Services for information on product disposal.

Technical accuracy

The technical information contained within this Service Manual, to the best of our knowledge, was correct at the time of writing. However, Raymarine cannot accept liability for any inaccuracies or omissions it may contain.

In addition Raymarine's policy of continuous product improvement may change specifications without notice. As a result Raymarine cannot accept any liability for any differences between the product and the manual.

Warranty

This unit contains no serviceable parts, if the unit has failed replace PCB or rate gyro as necessary.

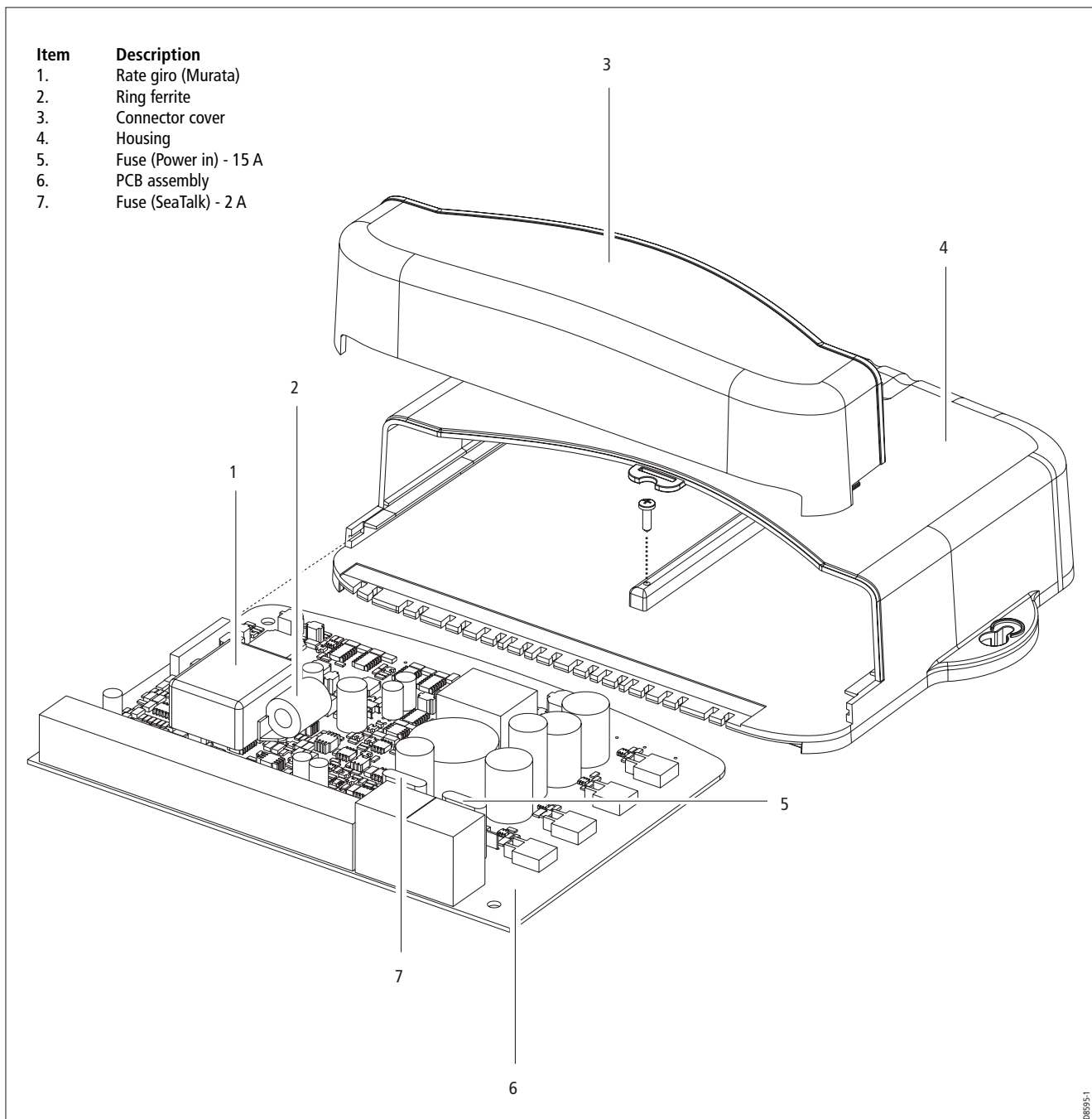
Introduction

This manual describes the service and maintenance procedures for the Raymarine type S1 and S1G Course Computer.

General description

The Course Computer processes information from the sensors in the autopilot system so it can steer the boat using the drive unit. The Course Computer assembly consists of a plastic case, a printed circuit board (PCB). The PCB carries a microprocessor, electronic circuitry to control the drive unit, a power amplifier for the drive motor and a connector block for all inputs and outputs.

Type S1G assembly drawing



Spares

Item	Spare /Accessory	Part Number	Comments
3	Connector cover		
4	Housing		
5	Fuse 15 A		
7	Fuse 2 A		
6	PCB		less gyro
1	Gyro	A18069	Kionix - from Aug. 2005 (Revision E PCBs)

Functional tests

Introduction

This section describes how to complete basic functional tests on the Course Computer aiding fault diagnosis.

Equipment and tools

- ST6001/2 Control Head
- Rudder Reference
- Fluxgate Compass
- C/E Series unit
- DVM (Digital Volt Meter)
- 12V dc 10A PSU (Power Supply Unit)
- Type 1 pump
- A conventional 330 Ohm resistor, rated at 1 Watt

Initial inspection checks

Before applying power to the Course Computer carry out following visual inspections:

1. Remove the connector cover, the PCB retaining screw and slide the PCB out of the case.
1. Check that the two fuses, F1 (15A), F2 (2A) are the correct rating and not blown.
2. Visually inspect the PCB for any obvious signs of component damage or blackening, paying particular attention to the FETs and main power components.
3. Check that capacitor C43 polarity is correct (see Tech Update TU228 on page 14)
4. Check that resistance value of R18 matches the requirement of the gyro fitted (see Tech Update 332 on page 16)

Rate gyro connection

The plug is designed to fit one way into the socket. Check the plug is correctly inserted and fully seated.

Detailed diagnosis

Before starting testing ensure that the following are connected to the Course Computer:

- Fluxgate compass
- Rudder reference
- Control Head
- 330 Ohm resistive load to the clutch terminals
- C/E Series display connected via NMEA 1 (do not connect the C/E Series unit via SeaTalk)

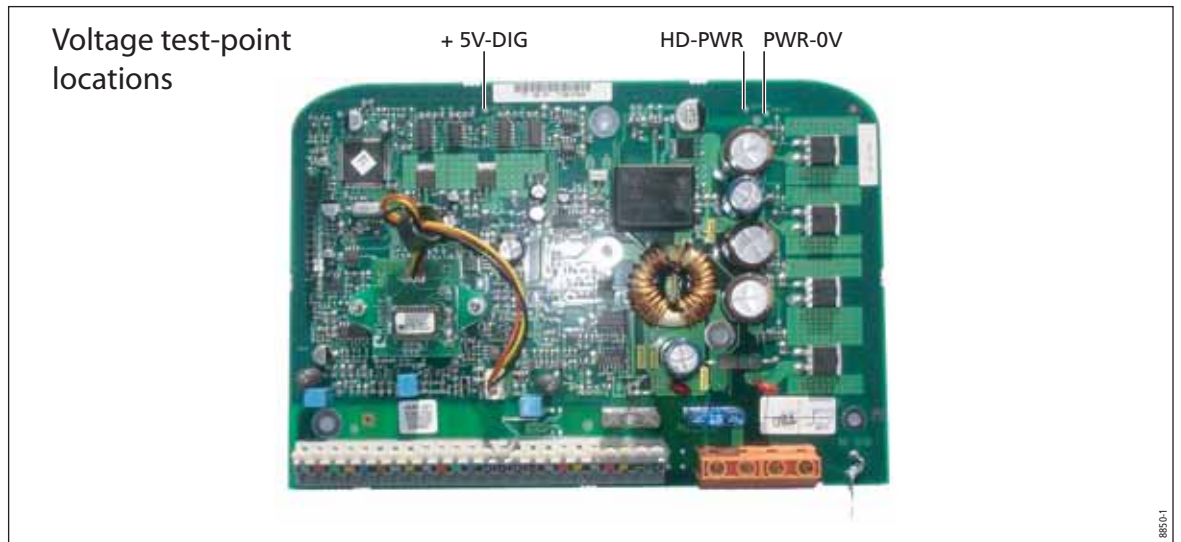
Unless otherwise stated, the following tests should be carried out with 12V applied to the Course Computer.

If the unit fails any of the following diagnostic checks (except Step 3), return the PCB to Raymarine and obtain a service exchange unit. Component level replacement must only be carried out by the factory.

Step 1 - Power checks

Check the voltages at the following locations are correct:

Test point	Voltage
+5V-DIG	4.9 V - 5.1 V
HD-PWR	11.95 V - 12.05 V
PWR-0V	0 V



Step 2 - System checks

1. Check that the display shows a compass heading (the actual heading displayed is unimportant at this stage) and that a rudder angle bar is displayed. This confirms that the Seatalk communications are functioning correctly.

Note: From October 2005 revision E PCBs have Verado software installed. This software does not require an external rudder reference device. In standby mode the rudder reference bar will not be displayed.

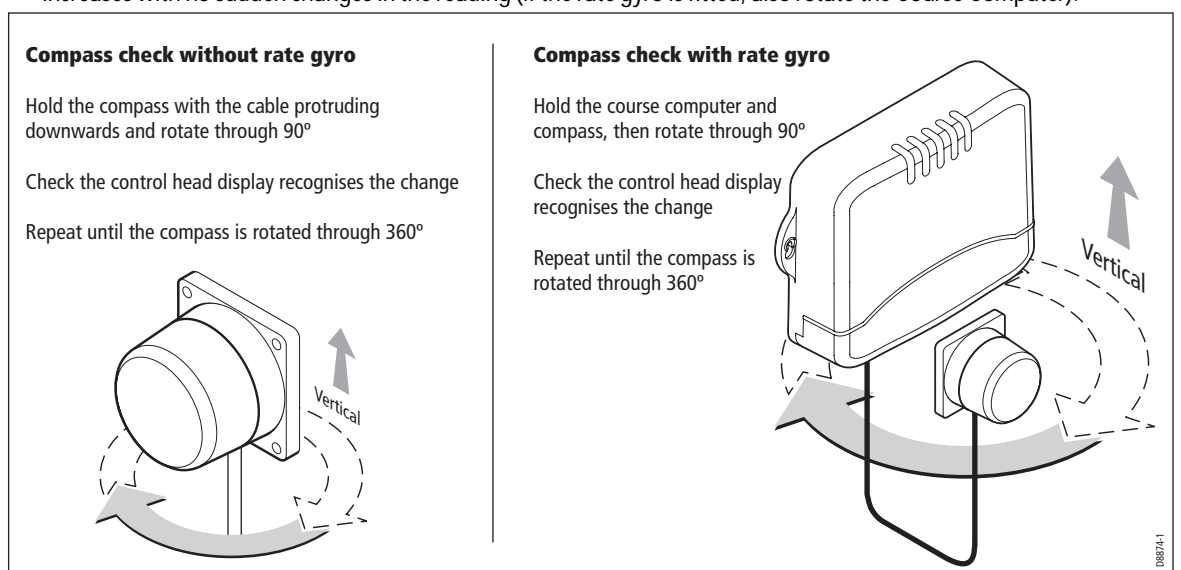
Step 3 - Rate gyro

1. Using a DVM, measure the voltage at the rate gyro terminals (black and yellow leads). If the rate gyro is serviceable, the nominal reading is $2.5\text{ V} \pm 0.1\text{ V}$.
2. With the multi meter still connected, turn the Course Computer slowly, first clockwise, then anticlockwise.
3. If the rate gyro unit is functioning correctly, the voltage should increase (from 2.5V) as the Course Computer is turned in one direction and decrease (from 2.5V) as it is turned in the opposite direction.

If the signal levels are unstable or outside tolerances, replace the gyro (Refer to Tech Update TU232).

Step 4 - Compass

1. With the compass unit connected to the Course Computer, rotate the compass through 90° as shown below.
2. Slowly rotate the compass clockwise through 360° . As the compass is turned, check that the displayed heading increases with no sudden changes in the reading (If the rate gyro is fitted, also rotate the Course Computer).



Note: *Ensure that you hold the compass with the cable protruding downwards.*

Step 5 - Rudder Reference

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.*

Step 6 - Clutch (Auto)

1. Ensure that the rudder reference is in the central position.
2. Press **AUTO**
3. Measure voltage at clutch terminals (12 V nominal), then proceed to Step 7.

Step 7- Clutch (Standby)

1. Press **STANDBY**
2. Measure voltage at clutch terminals. If the voltage is 0 V, proceed to Step 8

Step 8- H-Bridge

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).

Step 9 - 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 unit matches that of the Autopilot.

Step 10 - 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.
-

Disassembly and reassembly

CAUTION: Electrostatic Discharge (ESD)

This product contains components that can be damaged by electrostatic discharge.

If the cover is removed, any work on the product must be carried out at a properly equipped anti-static station by personnel wearing anti-static straps.

Tools required

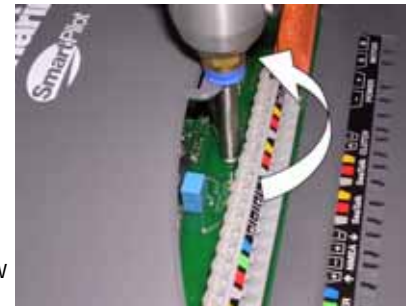
To assemble/disassemble the Course Computer you will need:

- 3 mm Allen key
- cross-head screwdriver

Disassembly/reassembly



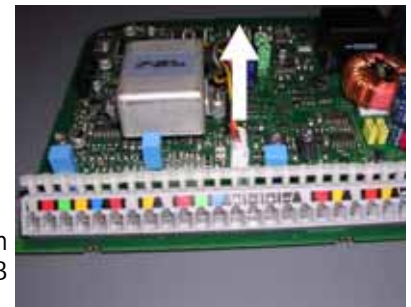
Remove the connector cover



Remove the PCB retaining screw



Slide out the PCB



Unplug the rate gyro connector from the PCB



Remove the gyro retaining screws on the rear of the PCB (retain the screws and plastic pillars)

Software

Software history

Version	Change
3.04	Fixes loss of calibration items

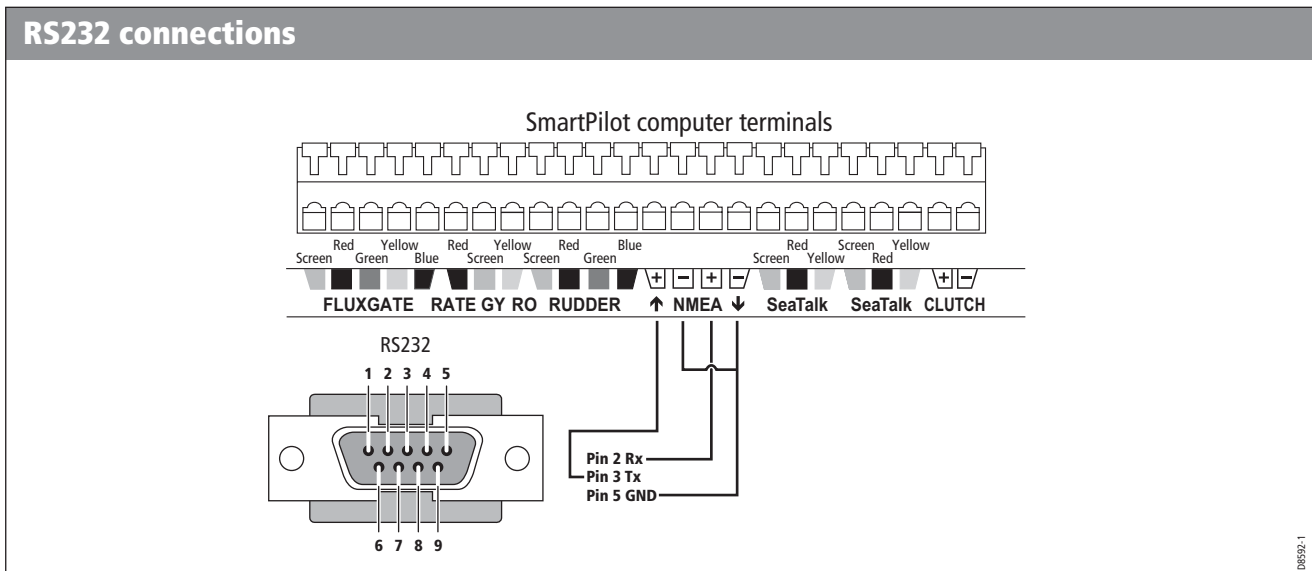
Software upgrade

The Type S1(G) Course Computer has the ability to implement software upgrades via the NMEA port connected to a PC running Windows 9x or NT 4.0. This section describes the upgrade procedure.

A PC or laptop with an RS232 port is required, together with a custom serial download cable.

The laptop software comprises three files plus the downloadable file.

Note: *It is very important that during the actual file transfer that power is not removed from the Course Computer. If power is lost, only a partial transfer will take place and will render the unit inoperable. In this case the unit will have to be returned to Raymarine.*



Download procedure

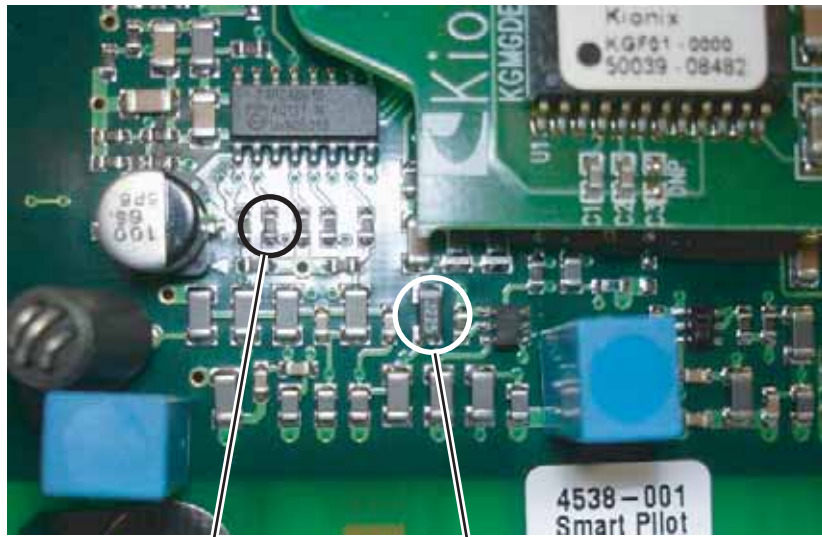
1. Power Off the Course Computer and connect a cable as shown to the PC's serial port.
2. From the PC, run the programme **SWDL 4 Windows.exe**.
3. From the menu select **File>Open CC115K1.INI** if using com port 1 **or CC115K2.INI** if using com port 2.
4. Power Up the Course Computer. You should now see RED and BLACK messages on the scrolling down the screen.

Product history

Technical updates

Update	Title
TU228	Fluxgate Compass Circuit Fault
TU232	Introduction of new "Kionix" Rate Gyro module

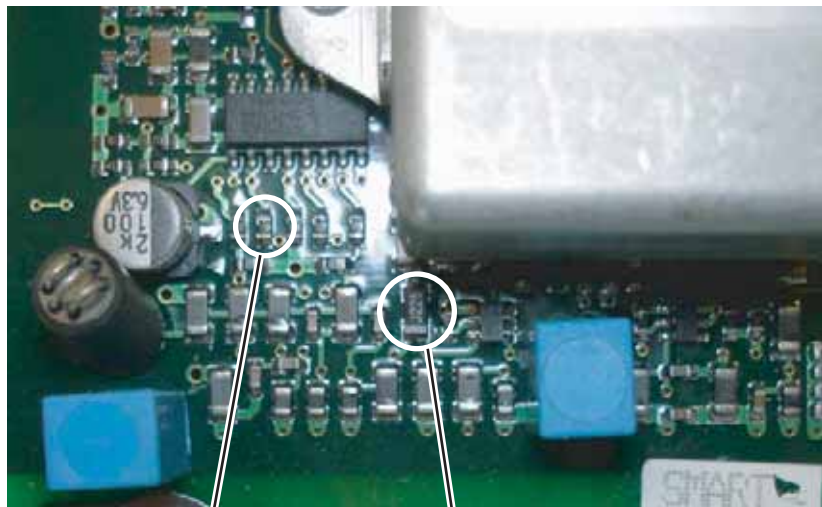
PCB 3015-286 issue E (Aug 05)



Ref: Tech note TU232
resistor value 113k (Kionix gyro)

Ref: Tech note TU228
capacitor correctly orientated

PCB 3015-286 issue A to E



Ref: Tech note TU232
resistor value 110k (Murata gyro)

Ref: Tech note TU228
capacitor incorrectly orientated

Technical Update

Issue Number: TU228

Page 1 of 2

Date: 1st August 2005Author: **Bob Sims**

Product Description: SmartPilot S1 & S1G Course Computers, Corepacks & Systems

Serial Number(s): All

Subject: Fluxgate Compass Circuit Fault

Please be advised that infield feedback has highlighted a potential fluxgate compass circuit fault, which can affect current S1 and S1G SmartPilot course computers.

The fault will cause the compass heading to drift, jump segments or show large inaccuracies.

The fault is associated with the wrongly reverse placement of the fluxgate drive AC coupling capacitor C43. The fault does not affect all S1 Course Computers and is only triggered when the tolerance of the capacitor is at the limits of its value specification.

The following service procedure should be taken to rectify faulty units:

- Follow procedure over.
- Remove PCB from Course Computer Case
- Locate C43 Capacitor
- Unsolder & remove from PCB
- Replace and re-solder in reverse (see diagrams)
- Replace PCB into case
- 15mins labour per unit can be claimed against warranty
- For onboard service follow the normal warranty claims procedure

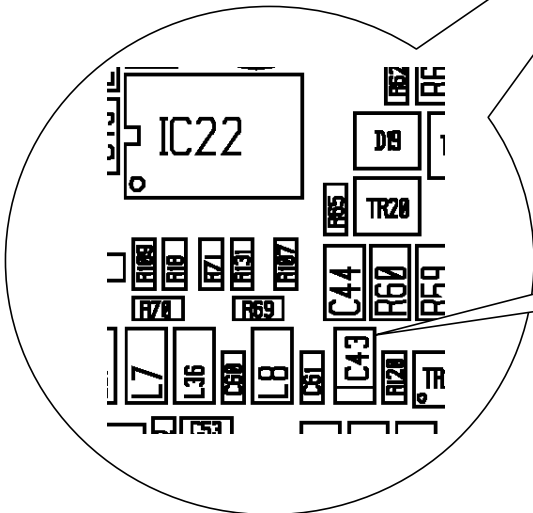
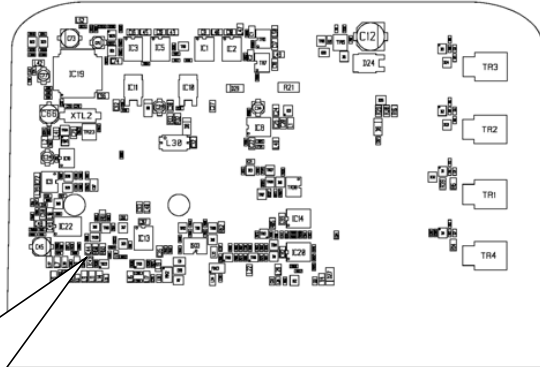
For further information contact Raymarine's Technical Services Department.

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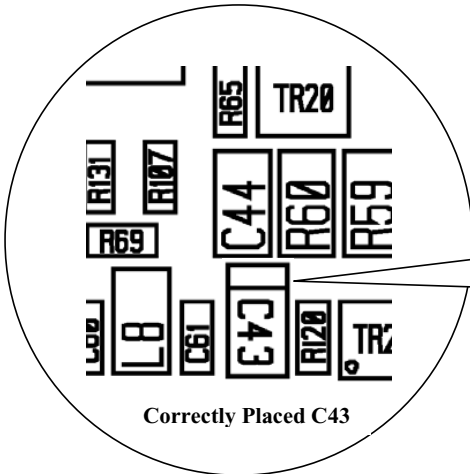
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Service Details and Procedures



**C43 Polarised Capacitor 2.2uF 6.3v
Wrongly Placed on PCB!**



Correctly Placed C43

Service Procedure:

- Remove PCB from plastic casing
- Locate C43 Capacitor
- Unsolder & Remove from PCB
- Replace & re-solder in reverse

Technical Update

Issue Number: TU232

Page 1 of 2

Date: 19th September 2005

Author: Bob Sims

Product Description:	SmartPilot S1G, S2G, S3G
Serial Number(s):	S1G – E12115 – 0850001 S2G – E12091 – 0850001 S3G – E12092 – 0850054 S3G IPS – E12177 - 0850003
Subject:	Introduction of new “Kionix” Rate Gyro module

Due to obsolescence of the earlier Murata type Gyro, a new Rate Gyro module (Kionix) has now been introduced into production SmartPilot Course Computers. The list above indicates start serial numbers.

Improved high speed Performance:

The introduction of the Kionix Gyro will in some cases improve the high speed steering performance of vessels fitted with the G version pilots.

Service Requirements - Course Computer back compatibility:

The application of the new Kionix gyro requires a modification to early Course Computer PCB's by way of a change of resistor values. (See diagrams).

Resistor & Gyro Consignment:

S1G:

Surface mount Resistor (R18) fitted:

Murata Gyro – R18 = 100k (0603)

Kionix Gyro – R18 = 113k (0603)

S2G / S3G:

Surface Mount Resistors (R145 & R147) fitted:

Murata Gyro – R145 & R147 = 10k (0805)

Kionix Gyro – R145 & R147 = 11.3k (0805)

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|-------------------------------------|-------------------------|
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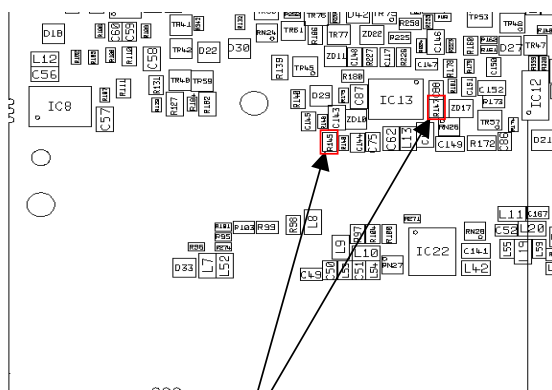
Kionix Gyro (new)



Murata Gyro (early)



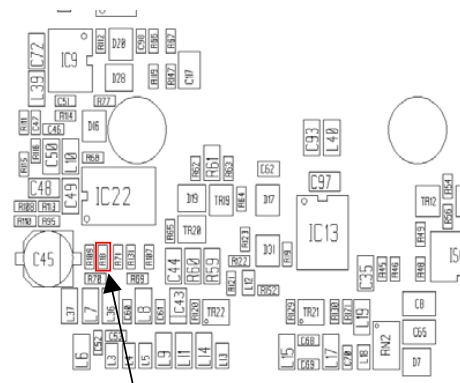
S2G & S3G SmartPilot PCB



NOTES:

S2G & S3G
Change R145 and R147
Murata Gyro 10K (0805)
Kionix Gyro 11.3K (0805)

S1G SmartPilot PCB



S1G Pilot
Change R18
Murata Gyro 100k (0603)
Kionix Gyro 113k (0603)

Gyro assembly onto PCB:

The new Kionix Gyro is mounted onto the PCB in the same orientation as the Murata Gyro. With the Course Computer upright (connector strip at the bottom), the Gyro should be secured to the PCB with the Gyro loom & connector uppermost.

Replacing faulty Murata Gyro with new Kionix Gyro on early Course Computer PCB:

S1G - Replace R18 with 113K Resistor, secure and connect Gyro as above.

S2G/S3G/150G/400G - Replace R145 & R147 with 11.3K Resistor, secure and connect Gyro as above.

Replacing faulty Course Computer PCB with new modified PCB and retaining early Murata Gyro:

S1G – Replace PCB and change R18 with 100K Resistor secure and connect Gyro as above.

S2G/S3G/150G/400G – Replace PCB and change R145 & R147 with 10K Resistor, secure and connect Gyro as above.

Service Spares:

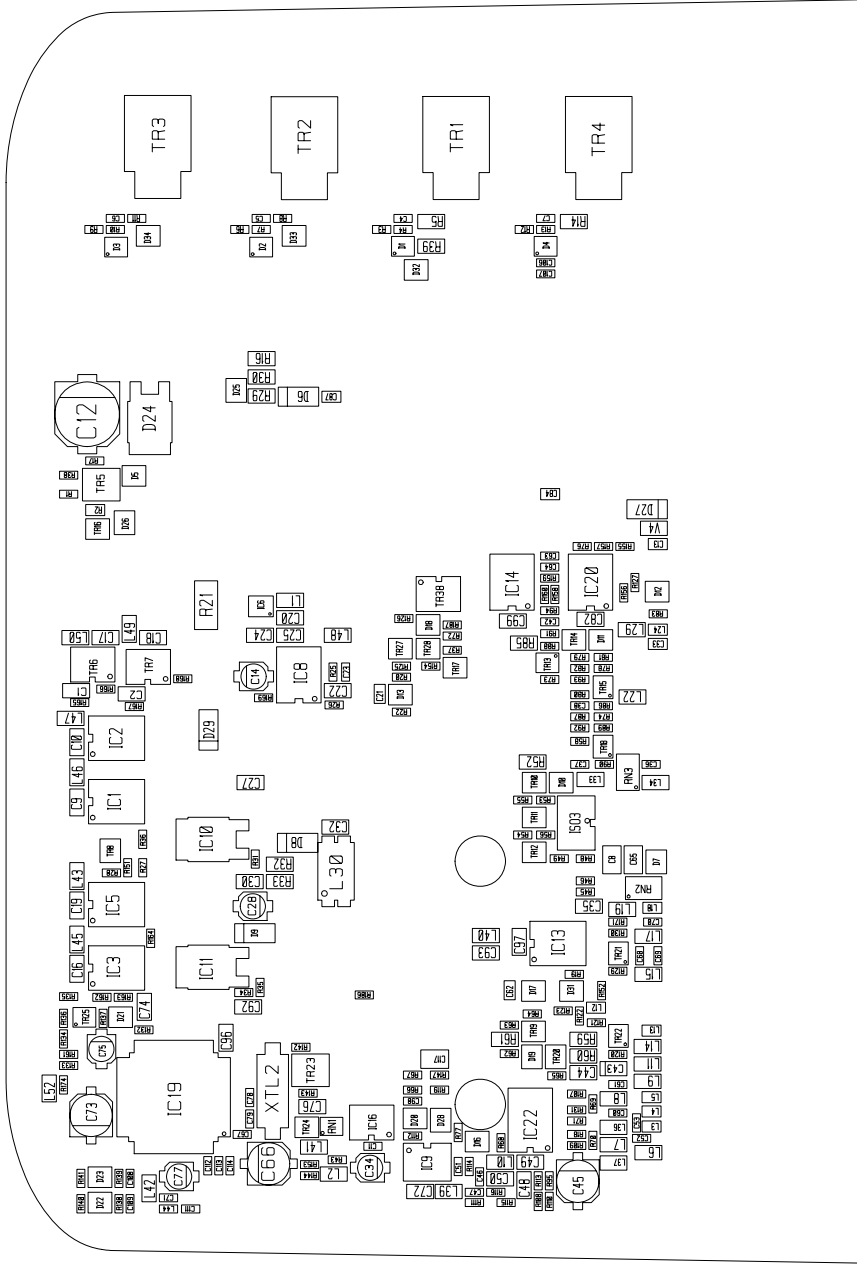
Gyro service spares will be supplied with the appropriate resistors, therefore it is strongly recommended to check resistor values against the Gyro type when servicing the Course Computer.

Diagrams

Drawing Number	Title
4538001G - SHT 1	Mini Course Computer (surface mount component side)
4538001G - SHT 2	Mini Course Computer (conventional component side)
4538002Q - SHT 1	Mini Course Computer PSU/H - Bridge
4538002Q - SHT 2	Mini Course Computer NMEA/SeaTalk
4538002Q - SHT 3	Mini Course Computer Fluxgate/Rate Gyro
4538002Q - SHT 4	Mini Course Computer Micro

PCB 3015-286

SURFACE MOUNT COMPONENT SIDE



MODIFICATION/AMENDMENT	
ISS	DATE COMMENTS
A	28.01.03 First Issue
B	27.05.03 Updated Issue
C	03.07.03 Updated to bring in line with sheet2.
D	02.07.03 Added Note for Ck polarity.
E	04.08.03 Deleted Note.
F	30.06.04 Deleted C95 (No fit) M-04-005
G	29.07.05 C43 rotated 180° to correct polarity. M-05-005



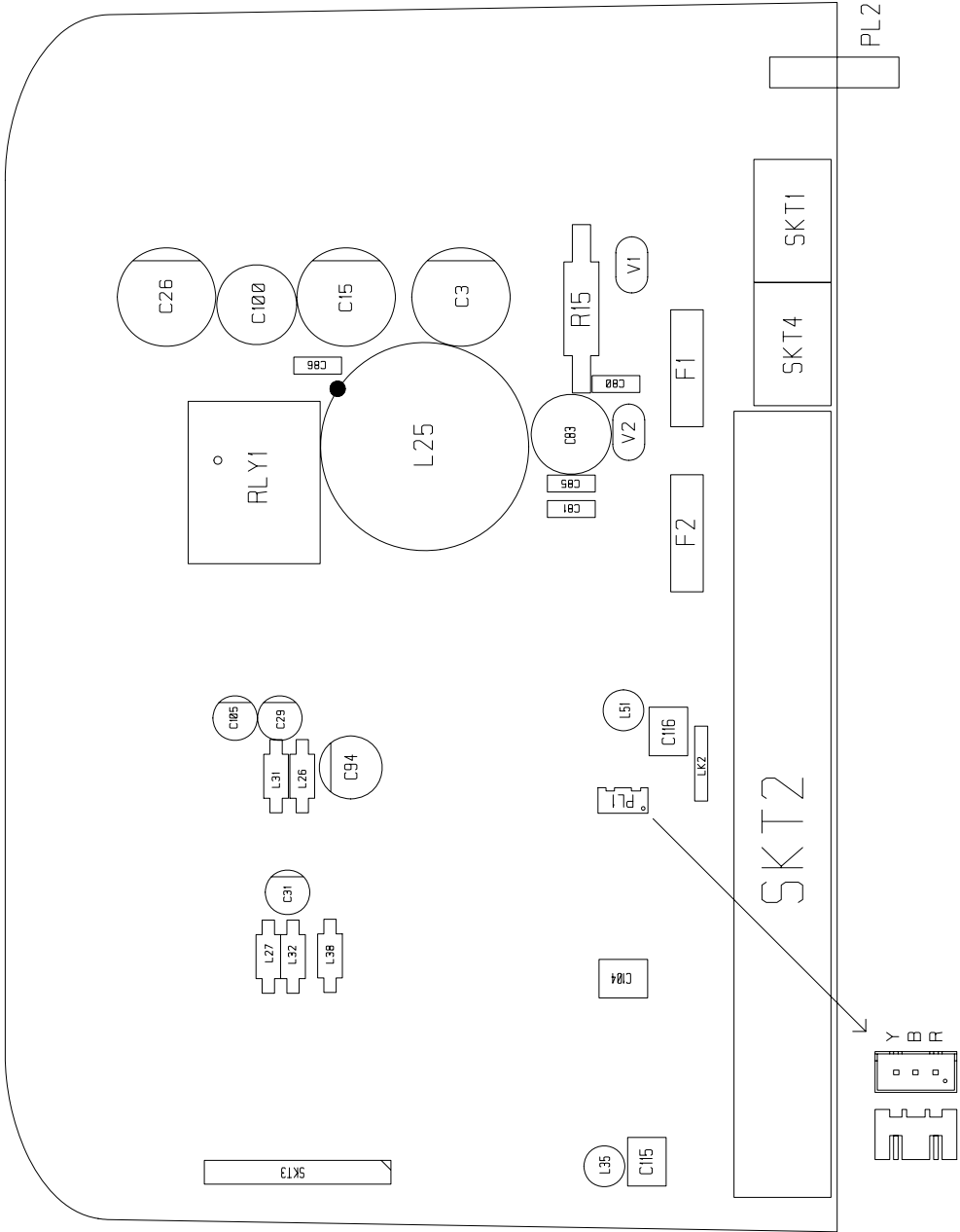
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PROJ D538	TITLE .MINI COURSE COMPUTER	SHEET 1 OF 2	DRWS No:- 4538-001	

PCB 3015-286

CONVENTIONAL COMPONENT SIDE



MODIFICATION/AMENDMENT	
ISS	DATE
A	28.01.03
B	27.05.03
C	03.07.03
D	10.07.03
E	04.08.03
F	30.05.04
G	29.07.05

COMMENTS
First Issue
Updated Issue
Deleted L23 & Added LK2.
Upssued to bring in line with sheet 1.
Upssued to bring in line with sheet 1.
Upssued to bring in line with sheet 1. M-04-005
Upssued to bring in line with sheet 1. M-05-006

CHKD MW	DATE 28.01.03
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DRAWN SWJ	SCALE 1:1
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REMOVE ALL BURRS AND SHARP EDGES UNLESS OTHERWISE STATED	SHEET 2 OF 2
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DO NOT SCALE	TITLE . MINI COURSE COMPUTER
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PROJ D538	DRWG No :- 4538-001
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Raymarine
ONBOARD

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Parts list

Reference	Description
C1,C2,C96	CAPACITOR Y5V 1206 1uF 50V
C3,C15,C26	CAP. 680uF, 50V RADIAL
C4,C5,C6,C7	CAPACITOR 2.2nF 0603
C8,C65	CAPACITOR 220pF 25V -20/+50%
C9,C10,C16,C17,C18,C19,C20,C22,C24,C25,C27,C30, C32,C35,C44,C48,C49,C50,C72,C74,C76,C82,C92,C93	CAPACITOR 0.1uF, 1206
C11	CAP. 10nF XR7
C12	CAPACITOR 470uF 10V +/-20%
C13,C62	CAPACITOR 0.01uF, X7R
C14,C28,C34,C75,C77	CAPACITOR 10uF, 16VDC ELECT
C21	CAPACITOR 1000pF, 0805
C29,C31,C105	CAP 100uF 25V +/- 20%
C33,C84,C87	CAPACITOR 470pf 100v +/-5% 0805
C36,C37,C38,C51,C52,C53,C60,C61,C63,C67	CAPACITOR 1nF 0603
C42,C64	CAPACITOR 100nF, 0603
C43	CAPACITOR 2.2uF
C45,C66,C73	CAPACITOR 100uF ELECT. 6.3VDC
C46,C47,C108,C98,C109,C111,C112,C113,C114,C23	CAP. SM,100pF,50V,5%,0603
C68,C69,C70,C71,C106,C107	CAPACITOR 1nF 0603
C78	CAPACITOR 47pF COG
C79	CAP. SM,68pF,50V,5%,0603
C80,C81,C85,C86	CAP. 100NF 100V
C83,C100	CAPACITOR 220uF ELECT 50V 20%
C94	CAP ELECT 470uF 25V RADIAL
C97,C99	CAPACITOR 0.1uF, 1206
C115,C104,C116	CAP 1uF 63V PEST
C117	CAP. SM 2.2nF 25V 1206
D1,D2,D3,D4	TRIPLE DIODE ARRAY - ISOLATED
D5,D7,D10,D12,D16,D25	DIODE SOT23 BAS19
D6,D27,D29,D8,D9	DIODE RECTIFIER 1A / 100V
D11,D17,D21	BAV99 DIODE
D13,D20,D22,D23,D26,D28	5V1 ZENER
D18,D32,D33,D34	BZX84C18 ZENER DIODE
D19	BAW56LT1 DIODE
D24	SCHOTTKY RECTIFIER(30WQ03FN)
D31	5V1 ZENER
F1,F2	AUTOMOTIVE FUSE CLIP
IC1	QUAD 2 INPUT NAND
IC2	QUAD AND GATE - SN74HC08D R
IC3	QUAD NOR 74HC02
IC5	SCHMITT TRIGGER IC
IC6	CURRENT SENSE AMP.(MAX4173)
IC8,IC14	QUAD COMPARATOR
IC9	TLC27M2CD
IC10,IC11	VOLT. REG. - LM317MDT
IC13,IC20	QUAD OP-AMP LM324
IC16	RESET CONTROLLER S24O22 +2KMEM
IC19	FLASH MICRO(uPD70F3079)
IC22	IC 74HC4051
ISO3	OPTO SWITCH - HCPL-0701
L1,L2,L6,L7,L8,L9,L10,L11,L14,L15,L17	CHIP INDUCTOR
L13,L18,L24	CHIP FERRITE BEAD BLM21 SERIES
L19,L22,L29,L33,L34,L36,L37,L39,L40,L41,L42,L43,L45,L 46	CHIP INDUCTOR
L25	COMM. MODE CHOKE(10AMP)
L26,L27,L31,L32,L38	INDUCTOR - EC24-100K
L3,L4,L5,L12	CHIP FERRITE BEAD BLM21 SERIES
L30	INDUCTOR 5A COMMON MODE
L35,L51	FERRITE(294666631)

Reference	Description
L44	CHIP INDUCTOR(BLM18AG121SN1D)
L47,L48,L49,L50,L52	CHIP INDUCTOR
LK2	24 SWG WIRE LINKS BANDLIER
PL1	PCB CONNECTOR(DBC 2 2.5 3 T)
PL2	RF GROUND TAG
R1,R3,R6,R8,R9,R11,R12,R120,R129	RESISTOR 22R 1% 0.063W 0603
R2	RESISTOR 8R2+ -5% 0805 0.1W
R4,R13,R115	RESISTOR - 82 OHMS 1% 0603
R5,R14,R39	RESISTOR 10R, 1206
R7,R10	RES. 100R, 1%, 0.063W, 0603
R15	RES. 330R(ROX3S 330R)
R18	RES 113K 1% 0603
R19	RES. 270R, 1%, 0.063W, 0603
R20,R27	RESISTOR 47K,1% 0.063W 0603
R21,	CHIP RESISTOR - LR2512
R22,R90,R92,R93	RESISTOR 39K,1% 0.063W 0603
R25,R160,R171	RESISTOR 1M,1% 0.063W
R26,R94,R131,R137	RES. 100K, 1%, 0.063W, 0603
R28,R36,R37,R72,R154,R187	RESISTOR 47K,1% 0.063W 0603
R31	RESISTOR 180R 1% 0.063W
R32,R33	RESISTOR 470R, 1206
R34	RES. 820R, 1%, 0.63W, 0603
R35,R69,R70,R113	RES. 270R, 1%, 0.063W, 0603
R38,R73	RESISTOR 2.2K,1% 0.063W 0603
R43	RESISTOR - 680 OHMS 1% 0603
R45,R49,R152	ZERO OHM LINK, 0603 PACKAGE
R46,R54,R55,R89,R134,R135,R144,R153	RESISTOR 4.7K,1% 0.063W 0603
R48,R116	RESISTOR - 1K2 1% 0603
R52,R16,R29,R30	RESISTOR 47R, 1206
R53,R62,R63,R64,R65,R112	RESISTOR 1.5K,1% 0.063W 0603
R56,R58,R71,R77	RESISTOR 10K,1% 0.063W 0603
R59,R60,R85	RESISTOR 8R2, 1206
R61	RESISTOR 1R0, 1206 0.25W
R66,R67,R68,R140,R141	RESISTOR 33K,0.063W,0603
R74,R78,R79	RESISTOR 2.2K,1% 0.063W 0603
R76,R86,R122	RES. 22K,1%,0.063W,0603
R80,R81,R95,R125,R126,R136,R142,R143,R147,R151, R162,R163,R164,R165	RESISTOR 10K,1% 0.063W 0603
R82	RES. 390R, 1%, 0.063W, 0603
R87,R121,R130	RESISTOR 15K 1% 0.063W 0603
R88,R107,R108,R109,R123	RESISTOR 1.0K,1% 0.063W 0603
R91,R110,R111,R156,R157	RESISTOR 68K,1% 0.063W 0603
R114,R138,R139	RESISTOR - 5K6 1% 0603
R119	RESISTOR - 820K 1% 0603
R127,R132,R133,R155,R161,R174	RESISTOR 1.0K,1% 0.063W 0603
R158,R17	RESISTOR 4.7K,1% 0.063W 0603
R166,R167,R168,R169,R186,R159	RESISTOR 10K,1% 0.063W 0603
RLY1	CLOSED FRAME RELAY(V23076A)
RN1	RESISTOR NETWORK
RN2,RN3	RES. NETWORK 2K2(MNR34)
SKT1,SKT4	POWER CONNECTOR(10A)
SKT2	WAGO CONNECTOR BLOCK(24 WAY)
SKT3	1 x 12 WAY HEADER - AMP
TR1,TR2,TR3,TR4	SM FET(IRFZ48NS)
TR5	EC868
TR6,TR7	HALF-BRIDGE DRIVER
TR8,TR11,TR12,TR16,TR17,TR20,TR24,TR27	BC817
TR10,TR19,TR28	BC807
TR13,TR18,TR25	DIGITAL TRANSISTOR ARRAY
TR14	2N7002 MOSFET
TR15	DUAL TRANSISTOR ARRAY

Reference	Description
TR21,TR22	DUAL TRANSISTOR ARRAY
TR23	SWITCHING MOSFET(N-CHANNEL)
TR38	MOSFET(IRF7406TR) - POWER FET
V1,V2	VARISTOR TYPE GE V22ZT1
XTL2	14.0MHz CRYSTAL(HC49/4HSMX)
	AUTOMOTIVE FUSE - 15 AMP
	AUTOMOTIVE FUSE - 2 AMP
	SMARTPILOT SM ASSY
