Part 2. ST60 Analogue instruments

D4468-3
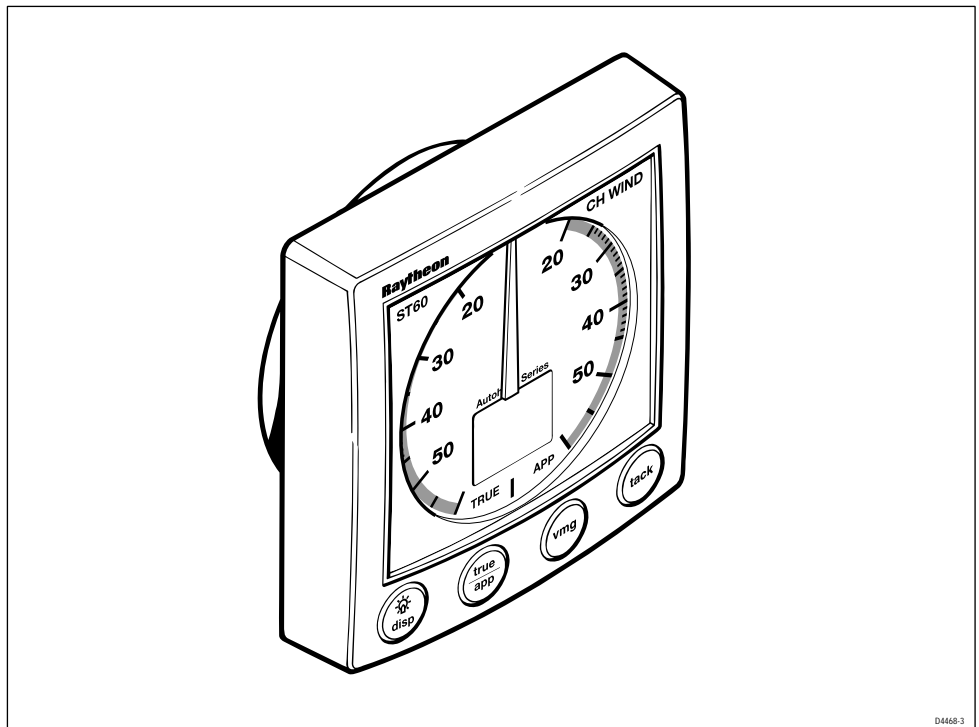
Contents

ST60 Analogue instrument exploded view

D449-1

15 (x8)
Torque 0.22Nm(2lbin)

15 (x3)   Torque 0.22Nm(2lbin)

14   15 (x3)
(x3)   Torque 0.22Nm(2lbin)

12. Case seal
13. Rear case
14. Washer (x3)
15. Screw (x11)
16. Label (rear case)
17. Gasket
18. Flush mount bezel
19. Screw (x4)
20. Flush mount seal
21. Rear bracket

1. Facia bezel
2. Keypad
3. Facia
4. Inner keypad
5. Shroud
6. Pointer
7. Display label
8. LCD analogue display
9. Diffuser
10. Reflector
11. PCB assembly

Note:
A. Display label (7) and Diffuser (9) fitted to the Rudder Angle Indicator do not have an LCD aperture.
B. LCD analogue display (8) is not fitted to a Rudder Angle Indicator.
C. It is recommended that a new case seal (12) is fitted on re-assembly.

17

16

13

12 (Note C)

11

10

9 (Note A)

8 (Note B)

7 (Note A)

5

4

3

2

1

6

Flush mounting

Assembly

2

18

21

20

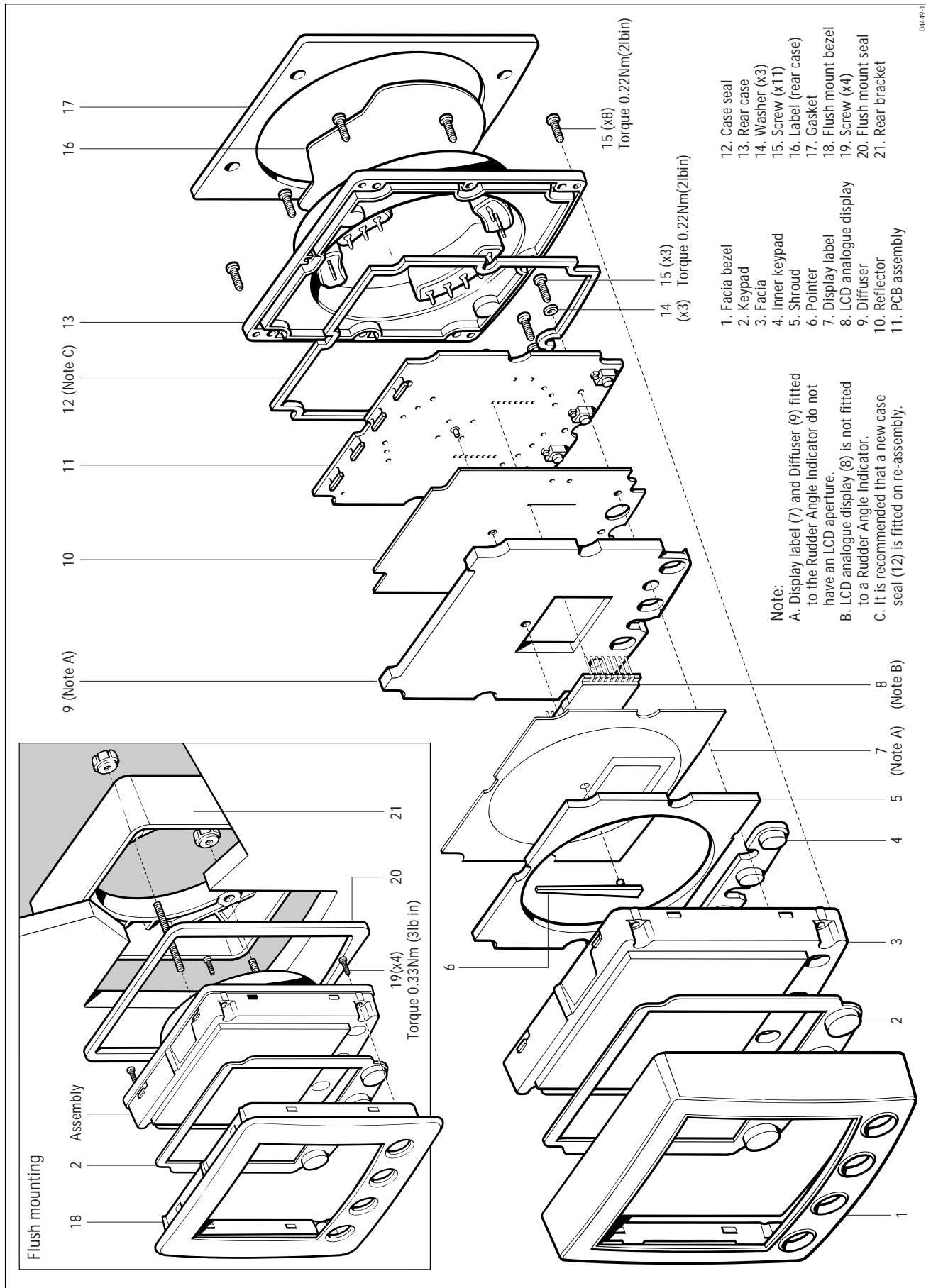19(x4)
Torque 0.33Nm (3lb in)

Figure 1: ST60 Wind, CH Wind, Compass and Rudder Angle Indicator Digital Instrument exploded view

Chapter 1. ST60 Wind instrument

Disassembly/reassembly

On reassembly (refer to Figure 1), it is important that the PCB assembly module is fixed to the facia (3) using a torque of 0.22Nm (2lb in). Similarly, fixing the rear case (13) to the facia (3) must also be torqued to 0.22Nm (2lb in).

Note: Failure to practice using the recommended torques may result in damage to the facia inserts.

It is also recommended a new case seal (12) is fitted on reassembly.

PCB identification

To aid identification of PCBs an identifying component has been included in the top left hand corner of the populated PCB.

WI: Wind and Clubhouse Wind
CH: CH Wind
CO: Compass
RU: Rudder Angle Indicator

D4492-1

A22005

Self-test procedure

The ST60 Wind instrument has built-in self-test functions to aid fault diagnosis.

To access self-test mode, press Key 1 and Key 4 together for 4 seconds. When the unit beeps, immediately press Key 3 and Key 4 together momentarily. The unit will enter self-test stage 1.

Self-test stage 1

A. The unit should display $5\,t$ followed by $t\,l$.

B. There will be a SeaTalk transmission to check the transmit/receive circuits.

C. The EEPROM is tested.

The following failure codes may be generated:

Message	Failure Mode	Action
$F0\,l$	SeaTalk Rx/Tx	Check for damaged bucket connectors/rear-case pins. Check SeaTalk interface components around TR3 and TR5.
$F02$	EEPROM failure	Replace EEPROM (IC8)

If there is no audible beep, generated by the key presses, check around TR2 and TR6 and the buzzer for damage. If the beep is quiet, check R79.

If all tests pass, P is shown on the display. Press Key 1 and Key 2 together momentarily to progress to self-test stage 2.

Self-test stage 2

A. The unit should display $t2$ for 1 second.

B. Illumination will change between level 0 and level 3 every second.

C. Any key press will cause audible beep.

D. The pointer will rotate continuously. This will highlight a problem if the pointer makes contact with the dial or window.

E. LCD segments will cycle through the following sequence:

No fail codes are generated since stage 2 is an audio/visual check. The following can, however, be used as a guide to isolate a problem:

Failure Mode	Action
Keypad Illumination failure (Dial illumination will also be degraded).	Check TR9, TR11, R78 and R91a. Check LEDs 1, 4, 7 and 8 for open circuit.
Keypad illumination OK but degraded Dial illumination.	Check TR10, TR11, R75 and R91b. Check LEDs 13 - 16 for open circuit.
No beep when key pressed.	Replace keyswitch.
LCD segment(s) missing completely.	Check LCD solder pins for poor/dry joints. Check IC3 for unsoldered pins.
Faint LCD segments.	Check LCD pins for shorts. Check IC3 for shorts.
Pointer not rotating or erratic movement.	Check motor winding continuity. Approximately 150 ohms between TP135 and TP136 and between TP142 and TP143.

When the pointer has completed at least one rotation, press Key 1 and Key 2 together momentarily to progress to self-test stage 3.

Self-test stage 3

This stage is to set up pointer offset and corrections. On entry the LCD will show $t3$ and then indicate the position to which the pointer should be positioned to adjust for pointer offset.

Momentary presses of Key 1 will rotate the pointer clockwise to align with the major graduations.

Should there be any misalignment repeatedly press Key 3 for anti-clockwise or Key 4 for clockwise adjustment until correct alignment is obtained on all major graduations.

On completion of correction adjustments press Key 1 and Key 2 together momentarily to progress to self-test stage 4.

A22005

Self-test stage 4

Note: This stage can be completed with either a Rotavecta transducer or Windvane transducer connected.

A.   The unit should display $t4$.

B.   Perform transducer operation as described below.

Rotavecta. Spin the rotavecta buckets. The display will show P for a pass or $F5$ for a failure.

Windvane. Spin the annemometer, then turn the vane in a complete circle. The display will show P for a pass, $F3$ for a failed windvane test or $F4$ for a failed annemometer test.

If the test fails, check the following ensuring the transducer is connected:

Check	Action

Rotavecta signal:
Turn rotavecta cups and check voltage at P13 switches between approximately 3V and 8V.
	• Constant current supply at P13 present.
	  Check around TR1 and IC4c.
	• 0V supply at P14 present.
	  Check L11 open circuit.
	• Check ROTAPRES (IC4 pin 14) is low.

Annemometer signal:
Turn annemometer and check voltage at P13 switches between approximately 2V and 8V.
	• Check L7 and R13 for open circuit.
	• 8V supply at P7.
	  Check L4, R84 for open circuit.
	• 0V supply at P11 present.
	  Check L8 for open circuit.
	• Check around IC4b.

Wind vane signal:
Slowly turn vane through 360°. Signal at SIN (P8) and COS (P4) should vary between approximately 2.2V and 5.8V.
	• 8V supply at P7 present.
	  Check L4, R84 for open circuit.
	• 0V supply at P11 present.
	  Check L8 for open circuit.

If the above is OK then the problem probably lies within the ADC circuit.	• Check L5,L6, R52, R82 for open circuit. • Check ADC circuit around IC5 and IC6.

To exit self-test and store pointer corrections press Key 1 and Key 2 together for 2 seconds.

If storage of pointer corrections is not required press Key 1 and Key 2 together momentarily to exit.

A22005

Useful PCB test points

TP7	Vcc 5V
TP10	0V
TP14	8V, transducer supply
TP80	Display illumination PWM
TP81	Key illumination PWM
TP191	SeaTalk receive
TP110	Integrator output (ADC)
TP119	ADC interupt
TP135	Motor drive Sin B
TP136	Motor drive Sin A
TP143	Motor drive Cos B
TP142	Motor drive Cos A

A22005

ST60 Wind spare parts list

The **item** numbers refer to

Figure 1: ST60 Analogue Instrument exploded view

Item	Spare/Accessory Description	Part No.	Comments
1	Facia bezel	A25001	
–	Suncover, standard	A25004	Not illustrated
2	Keypad, Wind	A28015	Pack of 5
	Facia with case seal, *including*	A28013	
3	Facia		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22Nm (2lb in)
	Inner keypad, *including*	A28022	
4	Inner keypad		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22Nm (2lb in)
5	Shroud, Wind	A28048	
6	Pointer	A28041	Pack of 5
7	Display label, Wind	A28043	Pack of 5
8	LCD, analogue display	A28025	
	PCB and dial assembly, Wind *including*	A28004	Assembled module consisting of items 6, 7, 8, 9, 10, 11.
6	Pointer		See A28041
7	Display label, Wind		See A28043
8	LCD, analogue display		See A28025
9	Diffuser		
10	Reflector		
11	PCB assembly		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22Nm (2lb in)
12	Case seal	A28027	Pack of 5
	Rear case assembly, *including*	A28014	
12	Case seal		See A28027
13	Rear case		
15	Screw (x8)		Torque to 0.22Nm (2lb in)
16	Label, Wind (rear case)	A28039	Pack of 5
17	Gasket	A28028	Pack of 5
18	Flush mount bezel	A25002	
	Flush mount kit, *including*	A25003	
–	Suncover, flush mount		Not illustrated
18	Flush mount bezel		See A25002
19	Screw (x4)		Torque to 0.33Nm (3lb in)
20	Flush mount seal		
21	Rear bracket		

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ST60 Wind PCB details

Input/Output signals

(refer to Figure 2. ST60 Wind circuit diagram)

Rear case connection	Signal	Description
A (Red)	12V EXT	Nominal 12V DC supply
B (Screen)	0V EXT	0V
C (Yellow)	DATA	Intermittent streams of (nominal) 12V pulses
D (Red)	12V EXT	Nominal 12V DC supply
E (Screen)	0V EXT	0V
F (Yellow)	DATA	Intermittent streams of (nominal) 12V pulses
G (Red)	8V	Vane supply
H (Green)	SIN	sin output
J (Blue)	COS	cos output
K (Yellow)	ANN	annemometer
L (White)	SCREEN	Transducer 0V return
N (Red)	ROTA+	Rotavecta current constant
P (Blue)	ROTA–	Rotavecta 0V

Rear case connections to ST60 Wind instrument   D4486-1
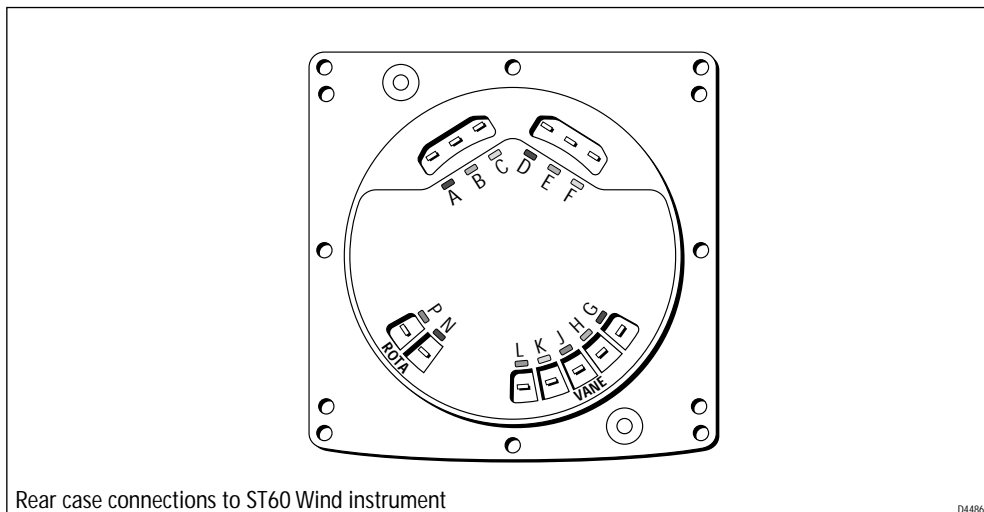
ST60 Wind circuit diagram

Figure 2. ST60 Wind circuit diagram

ST60 Wind PCB layout

A22005

SURFACE MOUNT
COMPONENT SIDE

CONVENTIONAL
COMPONENT SIDE

CONVENTIONAL
NON-COMPONENT SIDE

Taken from Drawing No: 4318-002 Issue: E Date: 26-10-98

D4471-1

ST60 Wind PCB component list

SURFACE MOUNT COMPONENT SIDE

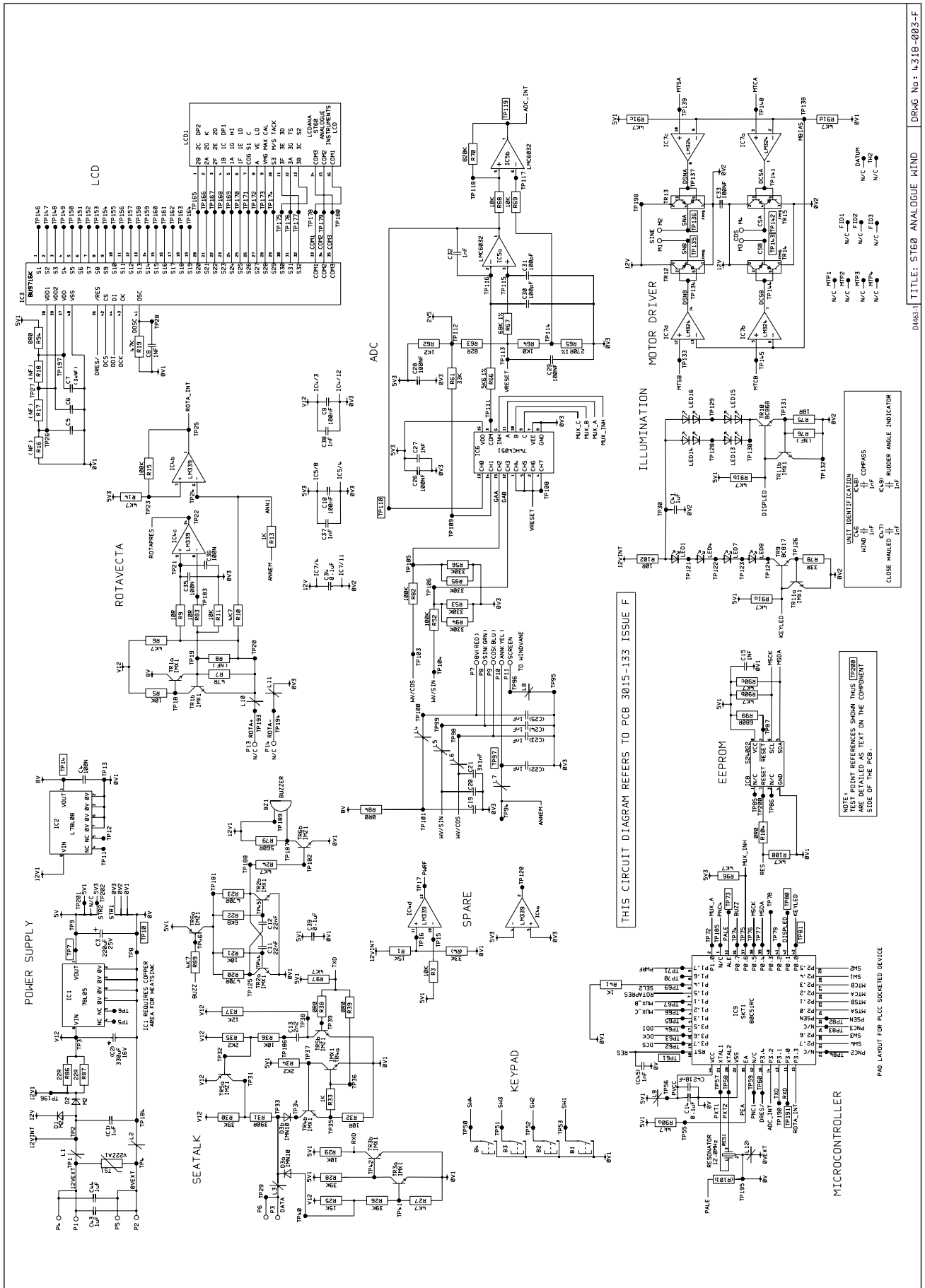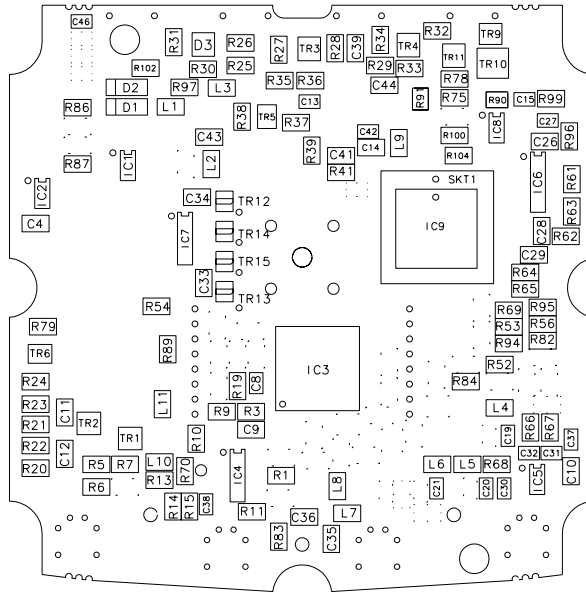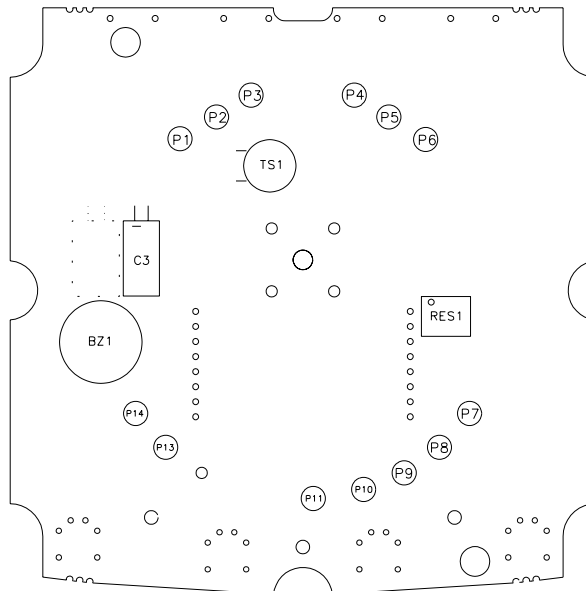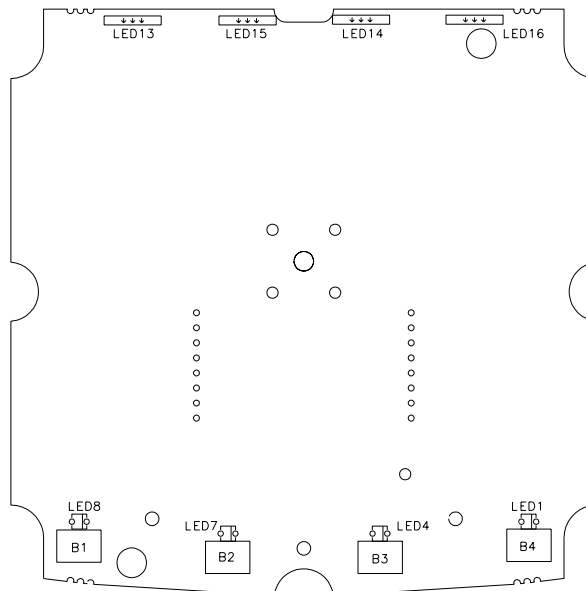|			
9600L1	11	SOLID CHIP INDUCTOR	L1-11
9600PLCC44	1	IC SOCKET PLCC44	SKT1
940087C51RCP	1	IC MICROPROCESSOR 87C51RC+	IC9
940024022	1	IC EEPROM & RESET CONTROLLER S24022	IC8
9400LM324	1	IC QUAD OPAMP LM324	IC7
940074HC4051	1	IC ANALOGUE SWITCH 74HC4051	IC6
9400LMC6032	1	IC DUAL OPAMP LMC6032	IC5
9400LM339	1	IC QUAD COMPARATOR LM339	IC4
9400BU9716K	1	IC LCD DRIVER BU9716K	IC3
9400LM78L08	1	IC REGULATOR L78L08 8V SO8	IC2
9400LM78L05	1	IC REGULATOR 78L05 5V SO8	IC1
9500FMY6	4	TRANSISTOR FMY6	TR12-15
9500IMZ1	2	TRANSISTOR ARRAY IMZ1 PNP	TR5,6
9500IMX1	5	TRANSISTOR ARRAY IMX1 NPN	TR1-4,11
9501BC868	1	TRANSISTOR SOT89 BC868 NPN	TR10
–	–	–	–
9500BC817	1	TRANSISTOR SOT23 BC817 NPN	TR9
–	–	–	–
93041000P	10	CAPACITOR X7R 1000pF 10% 50V 0805	C8,15,19-21,27,32,37,38,46
9302100P	2	CAPACITOR COG 100pF 10% 50V 0805	C30,31
93BDHXXX2N2	1	CAPACITOR X7R 2.2nF 10% 50V 1206	C13
930522N	2	CAPACITOR X7R 22nF 5% 50V 1206	C11,12
93040U01	1	CAPACITOR X7R 0.01uF 10% 50V 0805	C42
93070U1	12	CAPACITOR X7R 0.1uF 20% 50V 1206	C4,9,10,14,26,28,29, 33,34,35,36,39
93261U	3	CAPACITOR 1uF 20% 50V 1206	C41,43,44
9206IMN10	1	DIODE IMN10	D3
9200M2SYM	2	DIODE M2-SYM 10A 100V	D1,2
91124K7	2	RESISTOR NETWORK QUAD PACK 4K7	R90,91
9106680R	1	RESISTOR WCR 1206 680R 5% 0.125W	R99
91060R0	5	RESISTOR WCR 1206 0R0 0.125W	R38,39,54,84,104
91035K6	1	RESISTOR WCR 1206 5K6 1% 0.125W	R66
9103270R	1	RESISTOR WCR 1206 270R 1% 0.125W	R65
910368K	1	RESISTOR WCR 1206 68K 1% 0.125W	R67
9106820K	1	RESISTOR WCR 1206 820K 5% 0.125W	R70
910382R	1	RESISTOR WCR 1206 82R 1% 0.125W	R63
910618R	1	RESISTOR WCR 1206 18R 5% 0.125W	R75
9106390R	1	RESISTOR WCR 1206 390R 5% 0.125W	R31
910639K	3	RESISTOR WCR 1206 39K 5% 0.125W	R26,28,30
9103560R	1	RESISTOR WCR 1206 560R 1% 0.125W	R79
910647R	1	RESISTOR WCR 1206 47R 5% 0.125W	R7
910622R	2	RESISTOR WCR 1206 22R 5% 0.125W	R86,87
910633R	1	RESISTOR WCR 1206 33R 5% 0.125W	R78
910333K	1	RESISTOR WCR 1206 33K 1% 0.125W	R61
910610R	4	RESISTOR WCR 1206 10R 5% 0.125W	R9,32,83,102
9106470R	2	RESISTOR WCR 1206 470R 5% 0.125W	R20,23
9106100K	3	RESISTOR WCR 1206 100K 5% 0.125W	R15,52,82
91031K2	1	RESISTOR WCR 1206 1K2 1% 0.125W	R62
910647K	1	RESISTOR WCR 1206 47K 5% 0.125W	R19
91031K	4	RESISTOR WCR 1206 1K 1% 0.125W	R13,33,41,64
91036K8	1	RESISTOR WCR 1206 6K8 1% 0.125W	R22
91064K7	9	RESISTOR WCR 1206 4K7 5% 0.125W	R6,10,14,24,27,89,96,97,100
910615K	2	RESISTOR WCR 1206 15K 5% 0.125W	R1,25
91062K2	2	RESISTOR WCR 1206 2K2 5% 0.125W	R34,35
910612K	1	RESISTOR WCR 1206 12K 5% 0.125W	R37
9106330K	4	RESISTOR WCR 1206 330K 5% 0.125W	R53,56,94,95
910310K	8	RESISTOR WCR 1206 10K 1% 0.125W	R3,5,11,21,29,36,68,69
3015-133	1	PCB ST60 ANALOGUE	

CONVENTIONAL COMPONENT SIDE

3030-035-C	13	SOLDER BUCKETS	P1-11,13,14
01051	1	VARISTOR V22ZA1	TS1
15166	1	RESONATOR 12MHz	RES1
15136	1	BUZZER AT-17	BZ1
–	–	–	–
03075	1	CAPACITOR ELEC 220uF 25V	C3

CONVENTIONAL NON-COMPONENT SIDE

15165	4	LED 202 WHITE SIDE FIRING	LED13-16
02050	4	LED HLMP6505 GREEN	LED1,4,7,8
06030	4	SWITCH ALPMINI	B1-4

Taken from Drawing No: 4318-002 Issue: E Date: 26-10-98   D4472-1

A22005

A22005

Chapter 2. ST60 CH Wind instrument

Disassembly/reassembly

On reassembly (refer to Figure 1), it is important that the PCB assembly module is fixed to the facia (3) using a torque of 0.22Nm (2lb in). Similarly, fixing the rear case (13) to the facia (3) must also be torqued to 0.22Nm (2lb in).

Note: Failure to practice using the recommended torques may result in damage to the facia inserts.

It is also recommended a new case seal (12) is fitted on reassembly.

PCB identification

To aid identification of PCBs an identifying component has been included in the top left hand corner of the populated PCB.

WI: Wind and Clubhouse Wind
CH: CH Wind
CO: Compass
RU: Rudder Angle Indicator

Self-test procedure

The ST60 CH Wind instrument has built-in self-test functions to aid fault diagnosis.

To access self-test mode, press Key 1 and Key 4 together for 4 seconds. When the unit beeps, immediately press Key 3 and Key 4 together momentarily. The unit will enter self-test stage 1.

Self-test stage 1

A. The unit should display $5t$ followed by $t\,i$.

B. There will be a SeaTalk transmission to check the transmit/receive circuits.

C. The EEPROM is tested.

The following failure codes may be generated:

Message	Failure Mode	Action
F01	SeaTalk Rx/Tx	Check for damaged bucket connectors/rear-case pins. Check SeaTalk interface components around TR3 and TR5.
F02	EEPROM failure	Replace EEPROM (IC8)

If there is no audible beep, generated by the key presses, check around TR2 and TR6 and the buzzer for damage. If the beep is quiet, check R79.

If all tests pass, P is shown on the display. Press Key 1 and Key 2 together momentarily to progress to self-test stage 2.

Self-test stage 2

A. The unit should display T2 for 1 second.

B. Illumination will change between level 0 and level 3 every second.

C. Any key press will cause audible beep.

D. The pointer will rotate continuously. This will highlight a problem if the pointer makes contact the dial or window.

E. LCD segments will cycle through the following sequence:

No fail codes are generated since stage 2 is an audio/visual check. The following can, however, be used as a guide to isolate a problem:

Failure Mode	Action
Keypad Illumination failure (Dial illumination will also be degraded).	Check TR9, TR11, R78 and R91a. Check LEDs 1, 4, 7 and 8 for open circuit.
Keypad illumination OK but degraded Dial illumination.	Check TR10, TR11, R75 and R91b. Check LEDs 13 - 16 for open circuit.
No beep when key pressed.	Replace keyswitch.
LCD segment(s) missing completely.	Check LCD solder pins for poor/dry joints. Check IC3 for unsoldered pins.
Faint LCD segments.	Check LCD pins for shorts. Check IC3 for shorts.
Pointer not rotating or erratic movement.	Check motor winding continuity. Approximately 150 ohms between TP135 and TP136 and between TP142 and TP143.

When the pointer has completed at least one rotation, press Key 1 and Key 2 together momentarily to progress to self-test stage 3.

A22006

Self-test stage 3

This stage is to set up pointer offset and corrections. On entry the LCD will show $t3$ and then indicate the position to which the pointer should be positioned to adjust for pointer offset.

Momentary presses of Key 1 will rotate the pointer clockwise to align with the major graduations.

Should there be any misalignment repeatedly press Key 3 for anti-clockwise or Key 4 for clockwise adjustment until correct alignment is obtained on all major graduations.

On completion of correction adjustments press K1 and K2 together momentarily to exit self-test stage 3.

The unit will display $t4$ for 1 second and then P for pass.

To exit self-test and store pointer corrections press Key 1 and Key 2 together for 2 seconds.

If storage of pointer corrections is not required press Key 1 and Key 2 together momentarily to exit.

Useful PCB test points

TP7	Vcc 5V
TP10	0V
TP80	Display illumination PWM
TP81	Key illumination PWM
TP191	SeaTalk receive
TP135	Motor drive Sin B
TP136	Motor drive Sin A
TP143	Motor drive Cos B
TP142	Motor drive Cos A

A22006

A22006

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ST60 CH Wind spare parts list

The **item** numbers refer to

Figure 1: ST60 Analogue Instrument exploded view

Item	Spare/Accessory Description	Part No.	Comments
1	Facia bezel	A25001	
–	Suncover, standard	A25004	Not illustrated
2	Keypad, CH Wind	A28015	Pack of 5
	Facia with case seal, *including*	A28013	
3	Facia		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22 Nm (2lb in)
	Inner keypad, *including*	A28022	
4	Inner keypad		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22 Nm (2lb in)
5	Shroud, CH Wind	A28049	
6	Pointer	A28041	Pack of 5
7	Display label, CH Wind	A28044	Pack of 5
8	LCD, analogue display	A28025	
	PCB and dial assembly, CH Wind *including*	A28005	Assembled module consisting of items 6, 7, 8, 9, 10,11.
6	Pointer		See A28041
7	Display label, CH Wind		See A28044
8	LCD, analogue display		See A28025
9	Diffuser		
10	Reflector		
11	PCB assembly		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22 Nm (2lb in)
12	Case seal	A28027	Pack of 5
	Rear case assembly, *including*	A28014	
12	Case seal		See A28027
13	Rear case		
15	Screw (x8)		Torque to 0.22 Nm (2lb in)
16	Label, CH Wind (rear case)	A28040	Pack of 5
17	Gasket	A28028	Pack of 5
18	Flush mount bezel	A25002	
	Flush mount kit, *including*	A25003	
–	Suncover, flush mount		Not illustrated
18	Flush mount bezel		See A25002
19	Screw (x4)		Torque to 0.33 Nm (3lb in)
20	Flush mount seal		
21	Rear bracket		

A22006

ST60 CH Wind PCB details

Input/Output signals

(refer to Figure 3. ST60 CH Wind circuit diagram)

Rear case connection	Signal	Description
A (Red)	12V EXT	Nominal 12V DC supply
B (Screen)	0V EXT	0V
C (Yellow)	DATA	Intermittent streams of (nominal) 12V pulses
D (Red)	12V EXT	Nominal 12V DC supply
E (Screen)	0V EXT	0V
F (Yellow)	DATA	Intermittent streams of (nominal) 12V pulse

Rear case connections to ST60 CH Wind instrument

D4487-1

ST60 CH Wind circuit diagram
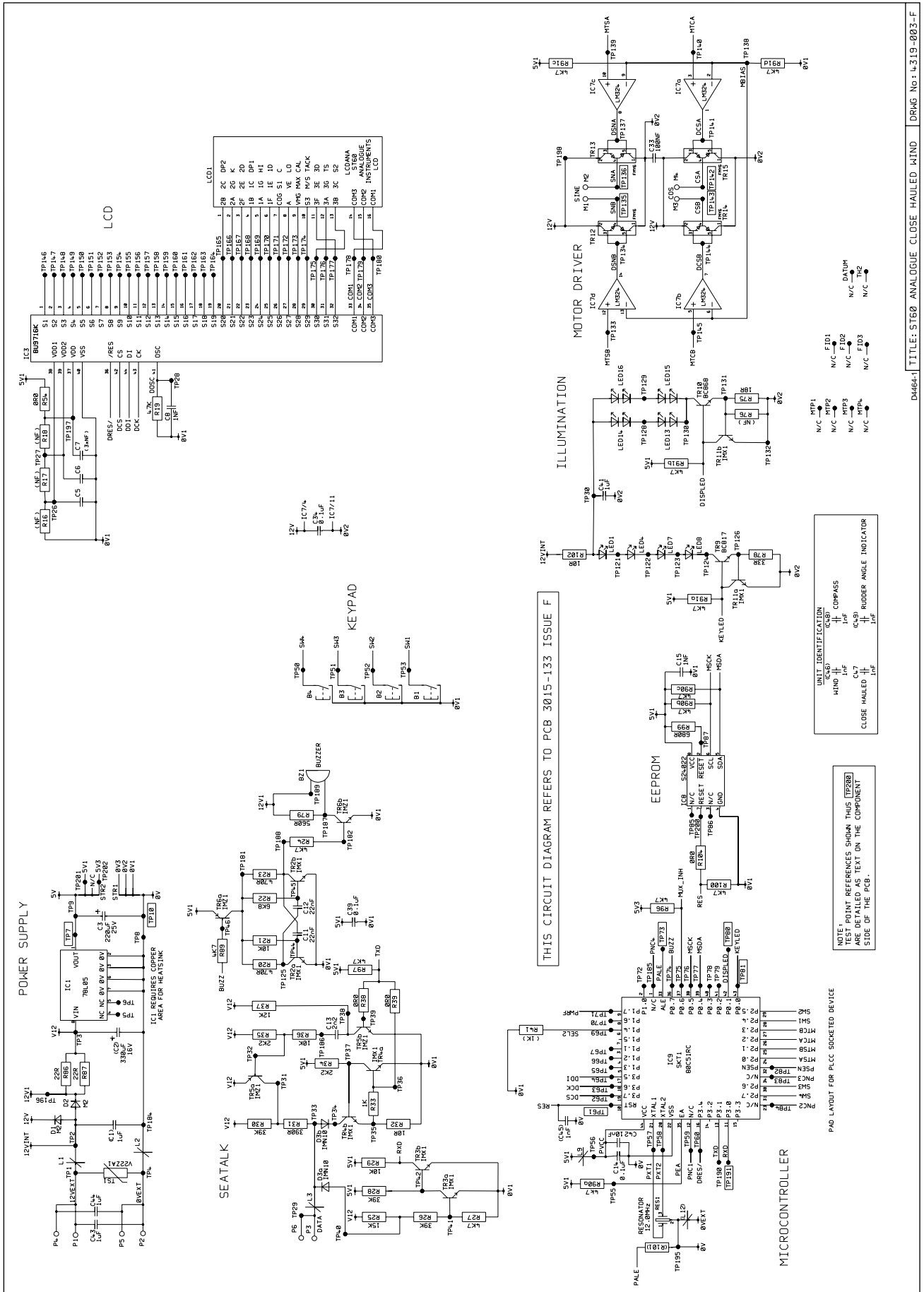
Figure 3. ST60 CH Wind circuit diagram

ST60 CH Wind PCB layout

SURFACE MOUNT
COMPONENT SIDE

CONVENTIONAL
COMPONENT SIDE

CONVENTIONAL
NON-COMPONENT SIDE
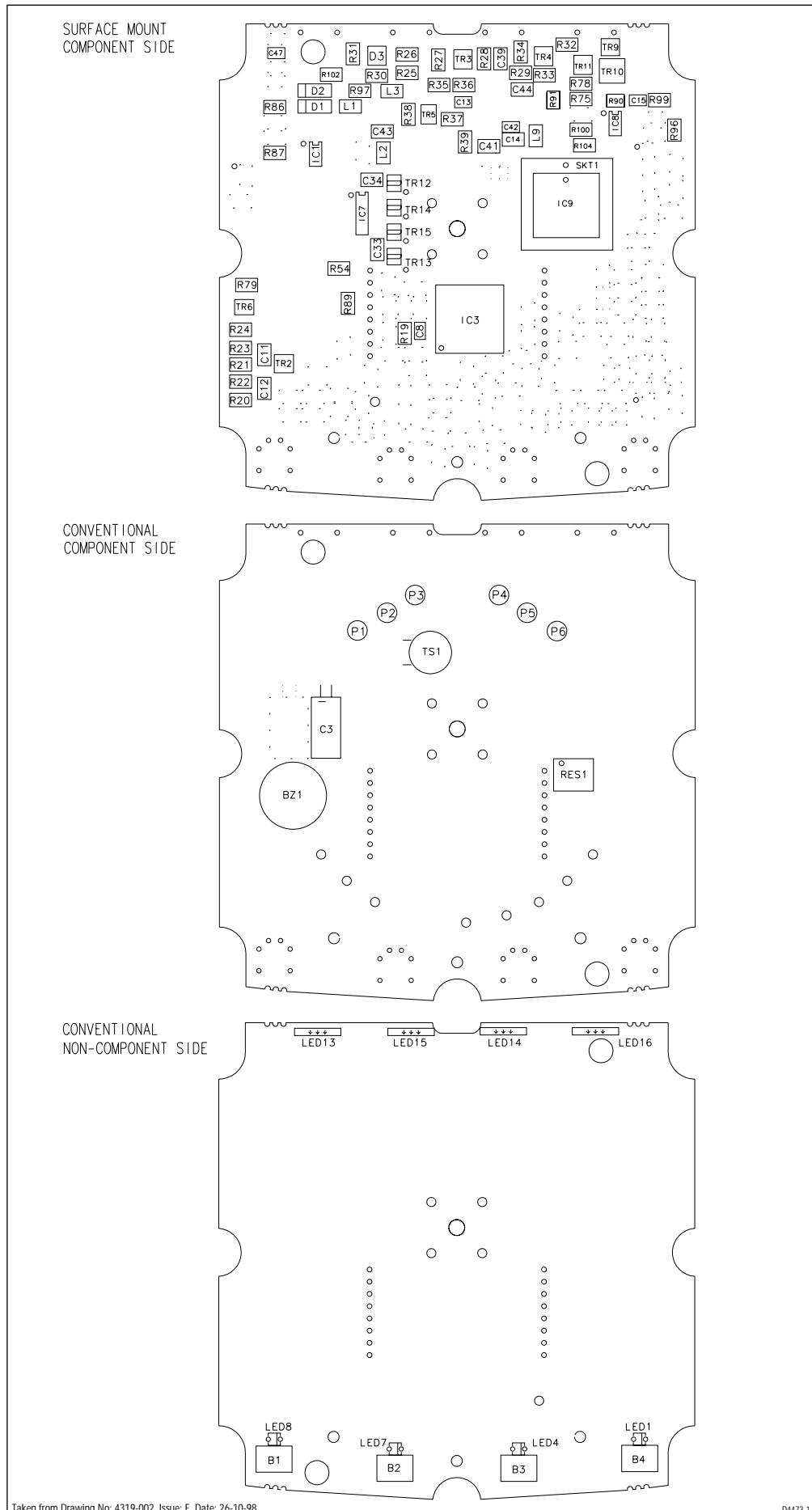
Taken from Drawing No: 4319-002 Issue: E Date: 26-10-98

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ST60 CH Wind PCB component list

SURFACE MOUNT COMPONENT SIDE

9600L1	4	SOLID CHIP INDUCTOR	L1-3,9
9600PLCC44	1	IC SOCKET PLCC44	SKT1
940087C51RCP	1	IC MICROPROCESSOR 87C51RC+	IC9
940024022	1	IC EEPROM & RESET CONTROLLER S24022	IC8
9400LM324	1	IC QUAD OPAMP LM324	IC7
-	-	-	-
-	-	-	-
-	-	-	-
9400BU9716K	1	IC LCD DRIVER BU9716K	IC3
-	-	-	-
9400LM78L05	1	IC REGULATOR 78L05 5V SO8	IC1
9500FMY6	4	TRANSISTOR FMY6	TR12-15
9500IMZ1	2	TRANSISTOR ARRAY IMZ1 PNP	TR5,6
9500IMX1	4	TRANSISTOR ARRAY IMX1 NPN	TR2-4,11
9501BC868	1	TRANSISTOR SOT89 BC868 NPN	TR10
-	-	-	-
9500BC817	1	TRANSISTOR SOT23 BC817 NPN	TR9
-	-	-	-
93041000P	3	CAPACITOR X7R 1000pF 10% 50V 0805	C8,15,47
93040U01	1	CAPACITOR X7R 0.01uF 10% 50V 0805	C42
93BDHXXX2N2	1	CAPACITOR X7R 2.2nF 10% 50V 1206	C13
930522N	2	CAPACITOR X7R 22nF 5% 50V 1206	C11,12
-	-	-	-
93070U1	4	CAPACITOR X7R 0.1uF 20% 50V 1206	C14,33,34,39
			-
93261U	3	CAPACITOR 1uF 20% 50V 1206	C41,43,44
9206IMN10	1	DIODE IMN10	D3
9200M2SYM	2	DIODE M2-SYM 10A 100V	D1,2
91124K7	2	RESISTOR NETWORK QUAD PACK 4K7	R90,91
91060R0	4	RESISTOR WCR 1206 0R0 0.125W	R38,39,54,104
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
9106390R	1	RESISTOR WCR 1206 390R 5% 0.125W	R31
910639K	3	RESISTOR WCR 1206 39K 5% 0.125W	R26,28,30
9103560R	1	RESISTOR WCR 1206 560R 1% 0.125W	R79
910633R	1	RESISTOR WCR 1206 33R 5% 0.125W	R78
910622R	2	RESISTOR WCR 1206 22R 5% 0.125W	R86,87
910618R	1	RESISTOR WCR 1206 18R 5% 0.125W	R75
-	-	-	-
910610R	2	RESISTOR WCR 1206 10R 5% 0.125W	R32,102
9106470R	2	RESISTOR WCR 1206 470R 5% 0.125W	R20,23
-	-	-	-
-	-	-	-
910647K	1	RESISTOR WCR 1206 47K 5% 0.125W	R19
91031K	1	RESISTOR WCR 1206 1K 1% 0.125W	R33
91036K8	1	RESISTOR WCR 1206 6K8 1% 0.125W	R22
91064K7	6	RESISTOR WCR 1206 4K7 5% 0.125W	R24,27,89,96,97,100
910615K	1	RESISTOR WCR 1206 15K 5% 0.125W	R25
91062K2	2	RESISTOR WCR 1206 2K2 5% 0.125W	R34,35
910612K	1	RESISTOR WCR 1206 12K 5% 0.125W	R37
9106680R	1	RESISTOR WCR 1206 680R 5% 0.125W	R99
910310K	3	RESISTOR WCR 1206 10K 1% 0.125W	R21,29,36
3015-133	1	PCB ST60 ANALOGUE	

CONVENTIONAL COMPONENT SIDE

3030-035-C	6	SOLDER BUCKETS	P1-6
01051	1	VARISTOR V22ZA1	TS1
15166	1	RESONATOR 12MHz	RES1
15136	1	BUZZER AT-17	BZ1
-	-	-	-
03075	1	CAPACITOR ELEC 220uF 25V	C3

CONVENTIONAL NON-COMPONENT SIDE

15165	4	LED 202 WHITE SIDE FIRING	LED13-16
02050	4	LED HLMP6505 GREEN	LED1,4,7,8
06030	4	SWITCH ALPMINI	B1-4

Taken from Drawing No: 4319-002 Issue: E Date: 26-10-98   D4474-1

A22006

A22006

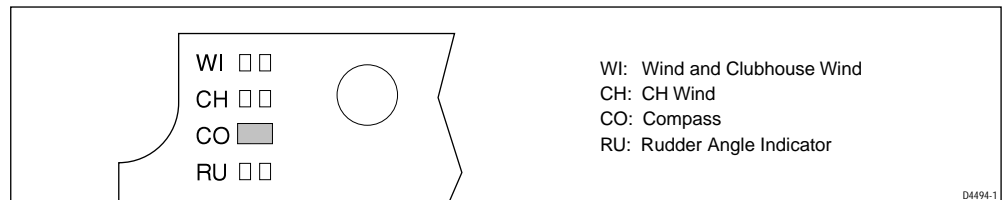# Chapter 3. ST60 Compass instrument

Disassembly/reassembly

On reassembly (refer to Figure1), it is important that the PCB assembly module is fixed to the facia (3) using a torque of 0.22Nm (2lb in). Similarly, fixing the rear case (13) to the facia (3) must also be torqued to 0.22Nm (2lb in).

Note: Failure to practice using the recommended torques may result in damage to the facia inserts.

It is also recommended a new case seal (12) is fitted on reassembly.

PCB identification

To aid identification of PCBs an identifying component has been included in the top left hand corner of the populated PCB.

WI: Wind and Clubhouse Wind
CH: CH Wind
CO: Compass
RU: Rudder Angle Indicator

Self-test procedure

The ST60 Compass instrument has built-in self-test functions to aid fault diagnosis.

To access self-test mode, press Key 1 and Key 4 together for 4 seconds. When the unit beeps, immediately press Key 3 and Key 4 together momentarily. The unit will enter self-test stage 1.

Self-test stage 1

A. The unit should display $5\,\mathrm{t}$ followed by $\mathrm{t}\,\mathrm{l}$.

B. There will be a SeaTalk transmission to check the transmit/receive circuits.

C. The EEPROM is tested.

The following failure codes may be generated:

Message	Failure Mode	Action
F01	SeaTalk Rx/Tx	Check for damaged bucket connectors/rear-case pins. Check SeaTalk interface components around TR3 and TR5.
F02	EEPROM failure	Replace EEPROM (IC8)

If there is no audible beep, generated by the key presses, check around TR2 and TR6 and the buzzer for damage. If the beep is quiet, check R79.

If all tests pass, P is shown on the display. Press Key 1 and Key 2 together momentarily to progress to self-test stage 2.

Self-test stage 2

A. The unit should display $t2$ for 1 second.

B. Illumination will change between level 0 and level 3 every second.

C. Any key press will cause audible beep.

D. The pointer will rotate continuously. This will highlight a problem if the pointer makes contact the dial or window.

E. LCD segments will cycle through the following sequence:

No fail codes are generated since stage 2 is an audio/visual check. The following can, however, be used as a guide to isolate a problem:

Failure Mode	Action
Keypad Illumination failure (Dial illumination will also be degraded).	Check TR9, TR11, R78 and R91a. Check LEDs 1, 4, 7 and 8 for open circuit.
Keypad illumination OK but degraded Dial illumination.	Check TR10, TR11, R75 and R91b. Check LEDs 13 - 16 for open circuit.
No beep when key pressed.	Replace keyswitch.
LCD segment(s) missing completely.	Check LCD solder pins for poor/dry joints. Check IC3 for unsoldered pins.
Faint LCD segments.	Check LCD pins for shorts. Check IC3 for shorts.
Pointer not rotating or erratic movement.	Check motor winding continuity. Approximately 150 ohms between TP135 and TP136 and between TP142 and TP143.

When the pointer has completed at least one rotation, press Key 1 and Key 2 together momentarily to progress to self-test stage 3.

Self-test stage 3

This stage is to set up pointer offset and corrections. On entry the LCD will show $t3$ and then indicate the position to which the pointer should be positioned to adjust for pointer offset.

Momentary presses of Key 1 will rotate the pointer clockwise to align with the major graduations.

Should there be any misalignment repeatedly press Key 3 for anti-clockwise or Key 4 for clockwise adjustment until correct alignment is obtained on all major graduations.

On completion of correction adjustments press Key 1 and Key 2 together momentarily to progress to self-test stage 4.

A22007

Self-test stage 4

Note: This stage to be completed with fluxgate transducer connected.

A. The unit should display ᵗᵘ.

B. Turn the fluxgate carefully through one rotation. The display will show P for a pass or F6 for a failure.

If the test fails, check the following with no transducer connected:

Check	Action
VREF (P7) – 2.5V	• Check R48, L4 for open circuit. • Check VRESET = 2.5V.
SCREEN (P11) – tied to 0V	• Check L8 for open circuit.
FGDRV – repetitive pulse train TP97 or P10.	• Check L7 for open circuit. • Check pulse train present either side of C17. • Check drive circuit components around TR7 and TR8.
If the above are OK then the problem probably lies within the ADC circuit.	• Check L5,L6, R52 and R82 for open circuit. • Check ADC circuit around IC5 and IC6.

To exit self-test and store pointer corrections press Key 1 and Key 2 together for 2 seconds.

If storage of pointer corrections is not required press Key 1 and Key 2 together momentarily to exit.

Useful PCB test points

TP7	Vcc 5V
TP10	0V
TP80	Display illumination PWM
TP81	Key illumination PWM
TP191	SeaTalk receive
TP110	Integrator output (ADC)
TP119	ADC interupt
TP135	Motor drive Sin B
TP136	Motor drive Sin A
TP143	Motor drive Cos B
TP142	Motor drive Cos A
TP97	Fluxgate

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ST60 Compass spare parts list

The **item** numbers refer to
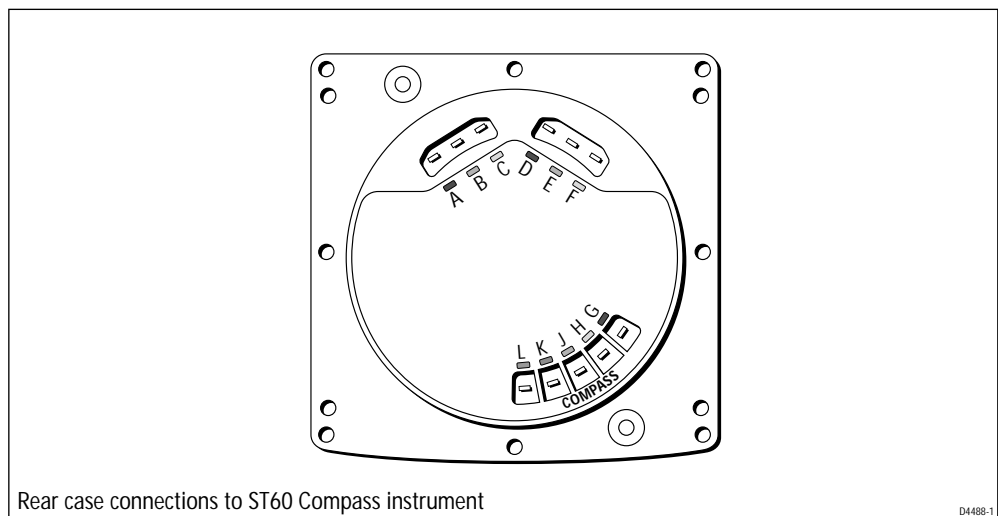
Figure 1: ST60 Analogue Instrument exploded view

Item	Spare/Accessory Description	Part No.	Comments
1	Facia bezel	A25001	
–	Suncover, standard	A25004	Not illustrated
2	Keypad, Compass	A28017	Pack of 5
	Facia with case seal, *including*	A28013	
3	Facia		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22Nm (2lb in)
	Inner keypad, *including*	A28022	
4	Inner keypad		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22Nm (2lb in)
5	Shroud, Compass	A28050	
6	Pointer	A28041	Pack of 5
7	Display label, Compass	A28047	Pack of 5
8	LCD, analogue display	A28025	
	PCB and dial assembly, Compass *including*	A28007	Assembled module consisting of items 6, 7, 8, 9, 10, 11.
6	Pointer		See A28041
7	Display label, Compass		See A28047
8	LCD, analogue display		See A28025
9	Diffuser		
10	Reflector		
11	PCB assembly		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22Nm (2lb in)
12	Case seal	A28027	Pack of 5
	Rear case assembly, *including*	A28014	
12	Case seal		See A28027
13	Rear case		
15	Screw (x8)		Torque to 0.22Nm (2lb in)
16	Label, Compass (rear case)	A28038	Pack of 5
17	Gasket	A28028	Pack of 5
18	Flush mount bezel	A25002	
	Flush mount kit, *including*	A25003	
–	Suncover, flush mount		Not illustrated
18	Flush mount bezel		See A25002
19	Screw (x4)		Torque to 0.33Nm (3lb in)
20	Flush mount seal		
21	Rear bracket		

A22007

ST60 Compass PCB details

Input/Output signals

(refer to Figure 4. ST60 Compass circuit diagram)

Rear case connection	Signal	Description
A (Red)	12V EXT	Nominal 12V DC supply
B (Screen)	0V EXT	0V
C (Yellow)	DATA	Intermittent streams of (nominal) 12V pulses
D (Red)	12V EXT	Nominal 12V DC supply
E (Screen)	0V EXT	0V
F (Yellow)	DATA	Intermittent streams of (nominal) 12V pulses
G (Red)	VREF	Fluxgate 2.5V
H (Yellow)	FGA	Sense A
J (Green)	FGB	Sense B
K (Blue)	FGDRV	Fluxgate drive
L (White)	Screen	Fluxgate 0V return
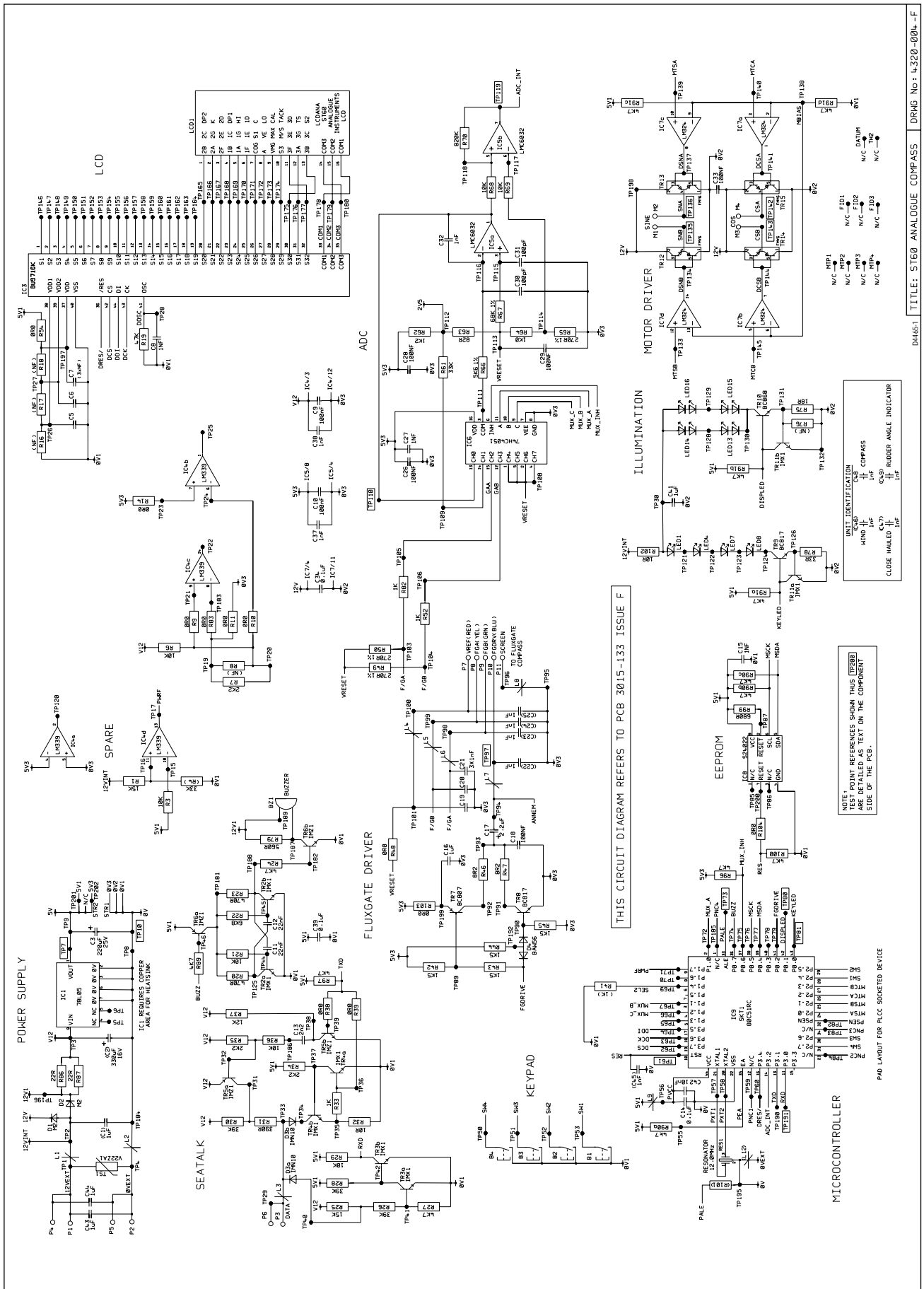
Rear case connections to ST60 Compass instrument

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ST60 Compass circuit diagram

Figure 4. ST60 Compass circuit diagram

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ST60 Compass PCB layout

SURFACE MOUNT
COMPONENT SIDE

CONVENTIONAL
COMPONENT SIDE

CONVENTIONAL
NON-COMPONENT SIDE
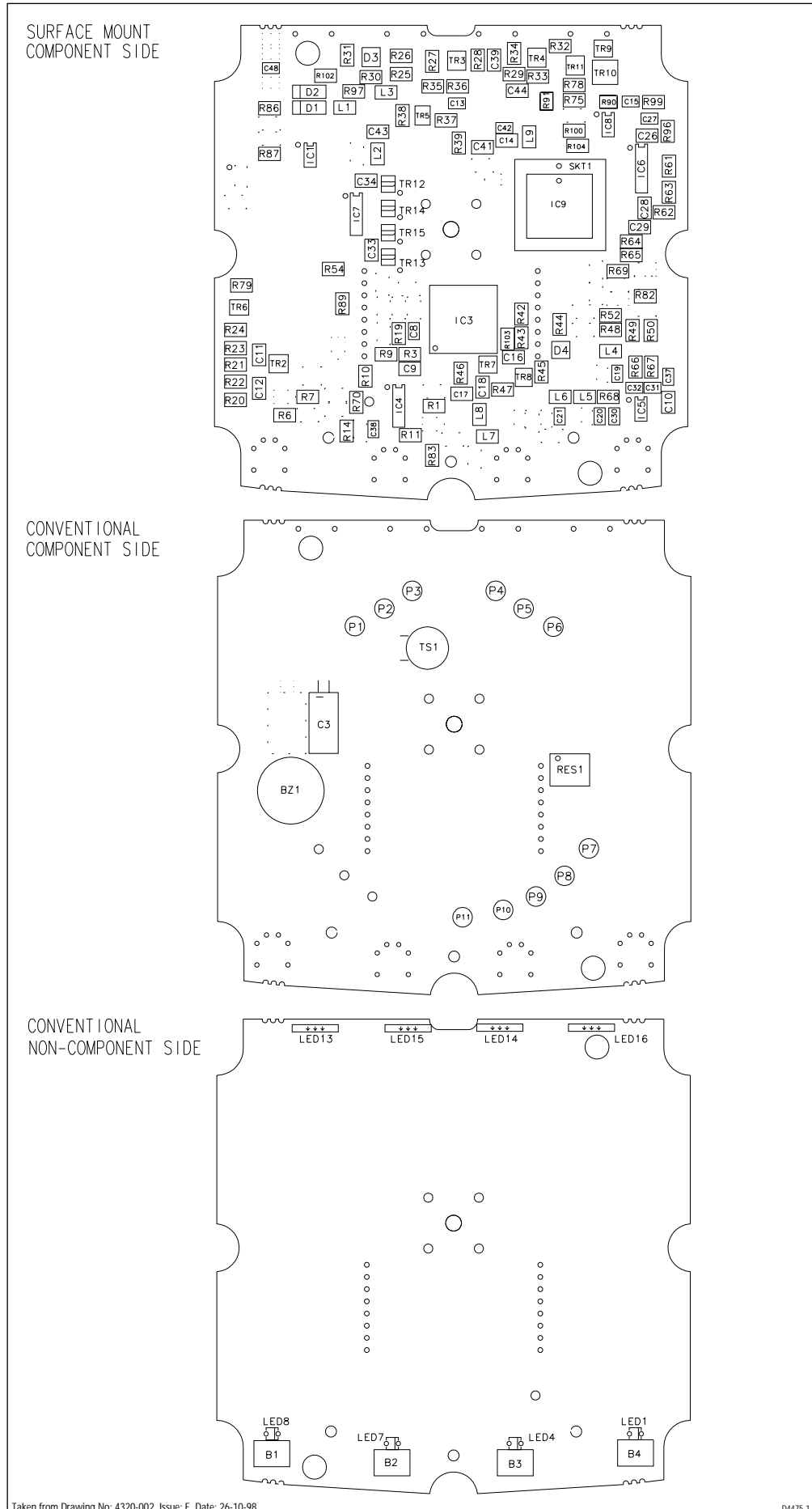
Taken from Drawing No: 4320-002 Issue: E Date: 26-10-98

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ST60 Compass PCB component list

SURFACE MOUNT COMPONENT SIDE

9600L1	9	SOLID CHIP INDUCTOR	L1-9
9600PLCC44	1	IC SOCKET PLCC44	SKT1
940087C51RCP	1	IC MICROPROCESSOR 87C51RC+	IC9
940024022	1	IC EEPROM & RESET CONTROLLER S24022	IC8
9400LM324	1	IC QUAD OPAMP LM324	IC7
940074HC4051	1	IC ANALOGUE SWITCH 74HC4051	IC6
9400LMC6032	1	IC DUAL OPAMP LMC6032	IC5
9400LM339	1	IC QUAD COMPARATOR LM339	IC4
9400BU9716K	1	IC LCD DRIVER BU9716K	IC3
–	–	–	–
9400LM78L05	1	IC REGULATOR 78L05 5V SO8	IC1
9500FMY6	4	TRANSISTOR FMY6	TR12-15
9500IMZ1	2	TRANSISTOR ARRAY IMZ1 PNP	TR5,6
9500IMX1	4	TRANSISTOR ARRAY IMX1 NPN	TR2-4,11
9501BC868	1	TRANSISTOR SOT89 BC868 NPN	TR10
9500BC807	1	TRANSISTOR SOT23 BC807 PNP	TR7
9500BC817	2	TRANSISTOR SOT23 BC817 NPN	TR8,9
93102U2	1	CAPACITOR TANT 2.2uF 20% 6V3 TANTA	C17
93041000P	10	CAPACITOR X7R 1000pF 10% 50V 0805	C8,15,19-21,27,32,37,38,48
9302100P	2	CAPACITOR COG 100pF 10% 50V 0805	C30,31
93BDHXXX2N2	1	CAPACITOR X7R 2.2nF 10% 50V 1206	C13
930522N	2	CAPACITOR X7R 22nF 5% 50V 1206	C11,12
93261U	4	CAPACITOR 1uF 20% 50V 1206	C16,41,43,44
93070U1	10	CAPACITOR X7R 0.1uF 20% 50V 1206	C9,10,14,18,26,28,29,33,34,39
93040U01	1	CAPACITOR X7R 0.01uF 10% 50V 0805	C42
9200BAW56	1	DIODE BAW56 SOT23	D4
9206IMN10	1	DIODE IMN10	D3
9200M2SYM	2	DIODE M2-SYM 10A 100V	D1,2
91124K7	2	RESISTOR NETWORK QUAD PACK 4K7	R90,91
91060R0	11	RESISTOR WCR 1206 0R0 0.125W	R9-11,14,38,39,48,54,83,103,104
91035K6	1	RESISTOR WCR 1206 5K6 1% 0.125W	R66
9103270R	3	RESISTOR WCR 1206 270R 1% 0.125W	R49,50,65
910368K	1	RESISTOR WCR 1206 68K 1% 0.125W	R67
9106820K	1	RESISTOR WCR 1206 820K 5% 0.125W	R70
910382R	1	RESISTOR WCR 1206 82R 1% 0.125W	R63
91061K5	4	RESISTOR WCR 1206 1K5 5% 0.125W	R42-45
9106390R	1	RESISTOR WCR 1206 390R 5% 0.125W	R31
910639K	3	RESISTOR WCR 1206 39K 5% 0.125W	R26,28,30
9103560R	1	RESISTOR WCR 1206 560R 1% 0.125W	R79
910618R	1	RESISTOR WCR 1206 18R 5% 0.125W	R75
910622R	2	RESISTOR WCR 1206 22R 5% 0.125W	R86,87
910633R	1	RESISTOR WCR 1206 33R 5% 0.125W	R78
910333K	1	RESISTOR WCR 1206 33K 1% 0.125W	R61
910610R	2	RESISTOR WCR 1206 10R 5% 0.125W	R32,102
9106470R	2	RESISTOR WCR 1206 470R 5% 0.125W	R20,23
9106680R	1	RESISTOR WCR 1206 680R 5% 0.125W	R99
91031K2	1	RESISTOR WCR 1206 1K2 1% 0.125W	R62
910647K	1	RESISTOR WCR 1206 47K 5% 0.125W	R19
91031K	4	RESISTOR WCR 1206 1K 1% 0.125W	R33,(41),52,64,82
91036K8	1	RESISTOR WCR 1206 6K8 1% 0.125W	R22
91064K7	6	RESISTOR WCR 1206 4K7 5% 0.125W	R24,27,89,96,97,100
910615K	2	RESISTOR WCR 1206 15K 5% 0.125W	R1,25
91062K2	3	RESISTOR WCR 1206 2K2 5% 0.125W	R7,34,35
910612K	1	RESISTOR WCR 1206 12K 5% 0.125W	R37
91068R2	2	RESISTOR WCR 1206 8R2 5% 0.125W	R46,47
910310K	7	RESISTOR WCR 1206 10K 1% 0.125W	R3,6,21,29,36,68,69
3015-133	1	PCB ST60 ANALOGUE	

CONVENTIONAL COMPONENT SIDE

3030-035-C	11	SOLDER BUCKETS	P1-11
01051	1	VARISTOR V22ZA1	TS1
15166	1	RESONATOR 12MHz	RES1
15136	1	BUZZER AT-17	BZ1
–	–	–	–
03075	1	CAPACITOR ELEC 220uF 25V	C3

CONVENTIONAL NON-COMPONENT SIDE

15165	4	LED 202 WHITE SIDE FIRING	LED13-16
02050	4	LED HLMP6505 GREEN	LED1,4,7,8
06030	4	SWITCH ALPMINI	B1-4

Taken from Drawing No: 4320-002 Issue: E Date: 26-10-98   D4476-1

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Chapter 4. ST60 Rudder Angle Indicator instrument

Disassembly/reassembly

On reassembly (refer to Figure 1), it is important that the PCB assembly module is fixed to the facia (3) using a torque of 0.22Nm (2lb in). Similarly, fixing the rear case (13) to the facia (3) must also be torqued to 0.22Nm (2lb in).

Note: Failure to practice using the recommended torques may result in damage to the facia inserts.

It is also recommended a new case seal (12) is fitted on reassembly.

PCB identification

To aid identification of PCBs an identifying component has been included in the top left hand corner of the populated PCB.

WI: Wind and Clubhouse Wind
CH: CH Wind
CO: Compass
RU: Rudder Angle Indicator

Self-test procedure

The ST60 Rudder Angle Indicator instrument has built-in self-test functions to aid fault diagnosis.

To access self-test mode, press Key 1 and Key 4 together for 4 seconds. When the unit beeps, immediately press Key 3 and Key 4 together momentarily. The unit will enter self-test stage 1.

Self-test stage 1

A. There will be a SeaTalk transmission to check the transmit/receive circuits.

B. The EEPROM is tested.

After 2 seconds a single beep will indicate a pass.

A double beep at this point indicates one of the tests has failed.

Failure Mode	Action
SeaTalk Rx/Tx	Check for damaged bucket connectors/rear-case pins. Check SeaTalk interface components around TR3 and TR5.
EEPROM failure	Replace EEPROM (IC8)

If there is no audible beep, generated by the key presses, check around TR2 and TR6 and the buzzer for damage. If the beep is quiet, check R79.

Press Key 1 and Key 2 together momentarily to progress to self-test stage 2.

A22008

Self-test stage 2

A. Illumination will change between level 0 and level 3 every second.

B. Any key press will cause audible beep.

C. The pointer will rotate continuously. This will highlight a problem if the pointer makes contact the dial or window.

No fail codes are generated since stage 2 is an audio/visual check. The following can, however, be used as a guide to isolate a problem:

Failure Mode	Action
Keypad Illumination failure (Dial illumination will also be degraded).	Check TR9, TR11, R78 and R91a. Check LEDs 1, 4, 7 and 8 for open circuit.
Keypad illumination OK but degraded Dial illumination.	Check TR10, TR11, R75 and R91b. Check LEDs 13 - 16 for open circuit.
No beep when key pressed.	Replace keyswitch.
Pointer not rotating or erratic movement.	Check motor winding continuity. Approximately 150 ohms between TP135 and TP136 and between TP142 and TP143.

When the pointer has completed at least one rotation, press Key 1 and Key 2 together momentarily to progress to self-test stage 3.

Self-test stage 3

This stage is to set up pointer offset and corrections. On entry the pointer will come to rest. Using Key 3 and Key 4 move the pointer to the top position.

Momentary presses of Key 1 will rotate the pointer clockwise to align with the major graduations.

Should there be any misalignment repeatedly press Key 3 for anti-clockwise or Key 4 for clockwise adjustment until correct alignment is obtained on all major graduations.

On completion of correction adjustments press Key 1 and Key 2 together momentarily to progress to self-test stage 4.

A22008

Self-test stage 4

Note: This stage to be completed with a Rudder Reference transducer connected.

Movement of the Rudder Reference transducer should be shown as movement by the pointer. If the pointer oscillates at the top of the dial then the Rudder Reference transducer has failed.

If the test fails, check the following ensuring the transducer is connected:

Check	Action
VRUD (P8) should vary either side of 2.5V as transducer is moved.	• 5V supply at P7 present. Check L4, R81 for open circuit. • 0V supply at P9 present. Check L15 for open circuit.
If the above is OK then the problem probably lies within the ADC circuit.	• Check L5, R52 for open circuit. • Check ADC circuit around IC5 and IC6.

To exit self-test and store pointer corrections press Key 1 and Key 2 together for 2 seconds.

If storage of pointer corrections is not required press Key 1 and Key 2 together momentarily to exit.

Useful PCB test points

TP7	Vcc 5V
TP10	0V
TP80	Display illumination PWM
TP81	Key illumination PWM
TP191	SeaTalk receive
TP110	Integrator output (ADC)
TP119	ADC interupt
TP135	Motor drive Sin B
TP136	Motor drive Sin A
TP143	Motor drive Cos B
TP142	Motor drive Cos A

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ST60 Rudder Angle Indicator spare parts list

The **item** numbers refer to

Figure 1: ST60 Analogue Instrument exploded view

Item	Spare/Accessory Description	Part No.	Comments
1	Facia bezel	A25001	
–	Suncover, standard	A25004	Not illustrated
2	Keypad, Rudder	A28016	Pack of 5
	Facia with case seal, *including*	A28013	
3	Facia		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22 Nm (2lb in)
	Inner keypad, *including*	A28022	
4	Inner keypad		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22 Nm (2lb in)
5	Shroud, Rudder	A28051	
6	Pointer	A28041	Pack of 5
7	Display label, Rudder	A28046	Pack of 5
	PCB and dial assembly, Rudder *including*	A28006	Assembled module consisting of items 6, 7, 9, 10, 11.
6	Pointer		See A28041
7	Display label, Rudder		See A28046
9	Diffuser		
10	Reflector		
11	PCB assembly		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22 Nm (2lb in)
12	Case seal	A28027	Pack of 5
	Rear case assembly, *including*	A28014	
12	Case seal		See A28027
13	Rear case		
15	Screw (x8)		Torque to 0.22 Nm (2lb in)
16	Label, Rudder (rear case)	A28037	Pack of 5
17	Gasket	A28028	Pack of 5
18	Flush mount bezel	A25002	
	Flush mount kit, *including*	A25003	
–	Suncover, flush mount		Not illustrated
18	Flush mount bezel		See A25002
19	Screw (x4)		Torque to 0.33 Nm (3lb in)
20	Flush mount seal		
21	Rear bracket		

A22008

ST60 Rudder Angle Indicator PCB details

Input/Output signals

(refer to Figure 5. ST60 Rudder Angle Indicator circuit diagram)

Rear case connection	Signal	Description
A (Red)	12V EXT	Nominal 12V DC supply
B (Screen)	0V EXT	0V
C (Yellow)	DATA	Intermittent streams of (nominal) 12V pulses
D (Red)	12V EXT	Nominal 12V DC supply
E (Screen)	0V EXT	0V
F (Yellow)	DATA	Intermittent streams of (nominal) 12V pulses
G (Red)	5V	Transducer +V supply
H (Blue)	VRUD	Transducer output
J (Green)	0V	Transducer 0V return
K (White)	Screen	Transducer screen

Rear case connections to ST60 Rudder instrument

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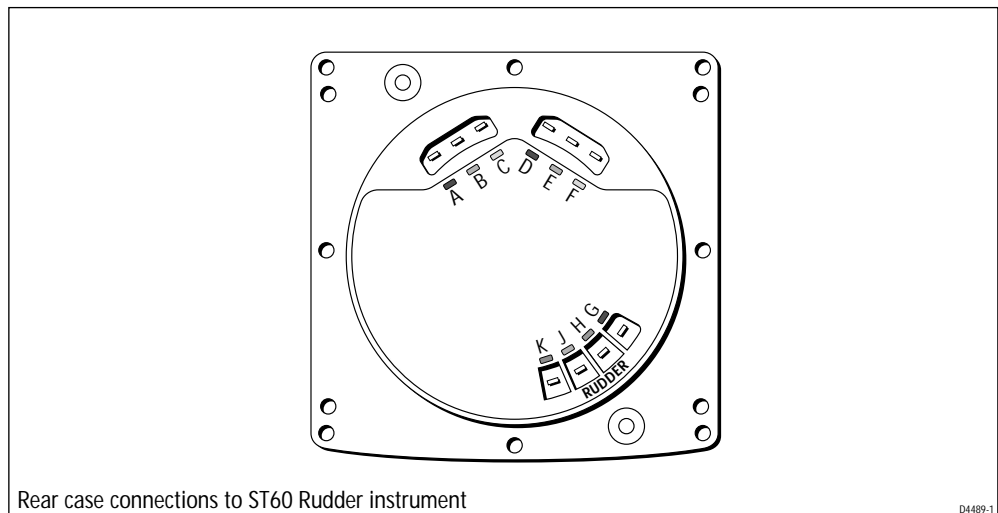
ST60 Rudder Angle Indicator circuit diagram
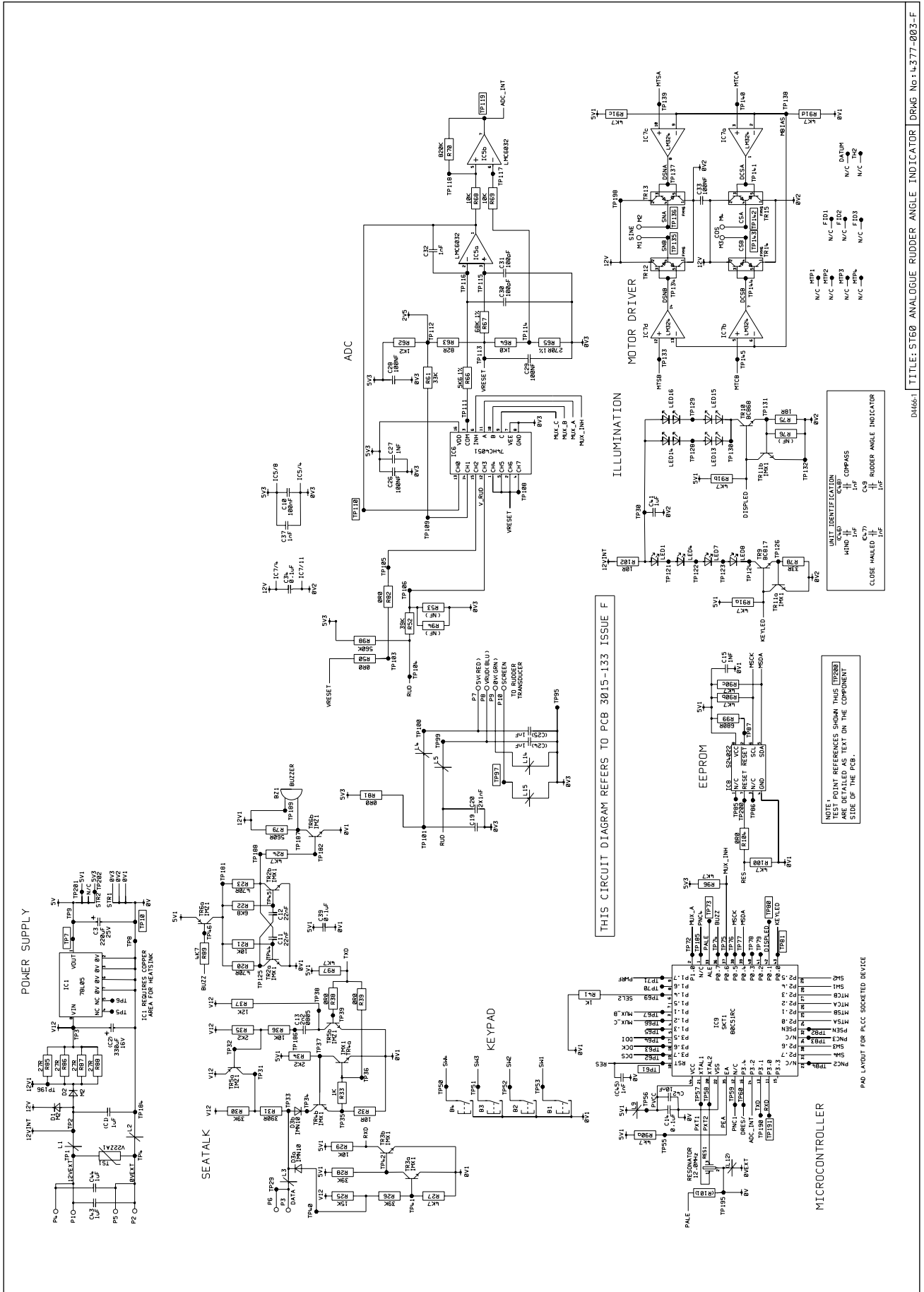
Figure 5. ST60 Rudder Angle Indicator circuit diagram

ST60 Rudder Angle Indicator PCB layout

SURFACE MOUNT
COMPONENT SIDE

CONVENTIONAL
COMPONENT SIDE

CONVENTIONAL
NON-COMPONENT SIDE
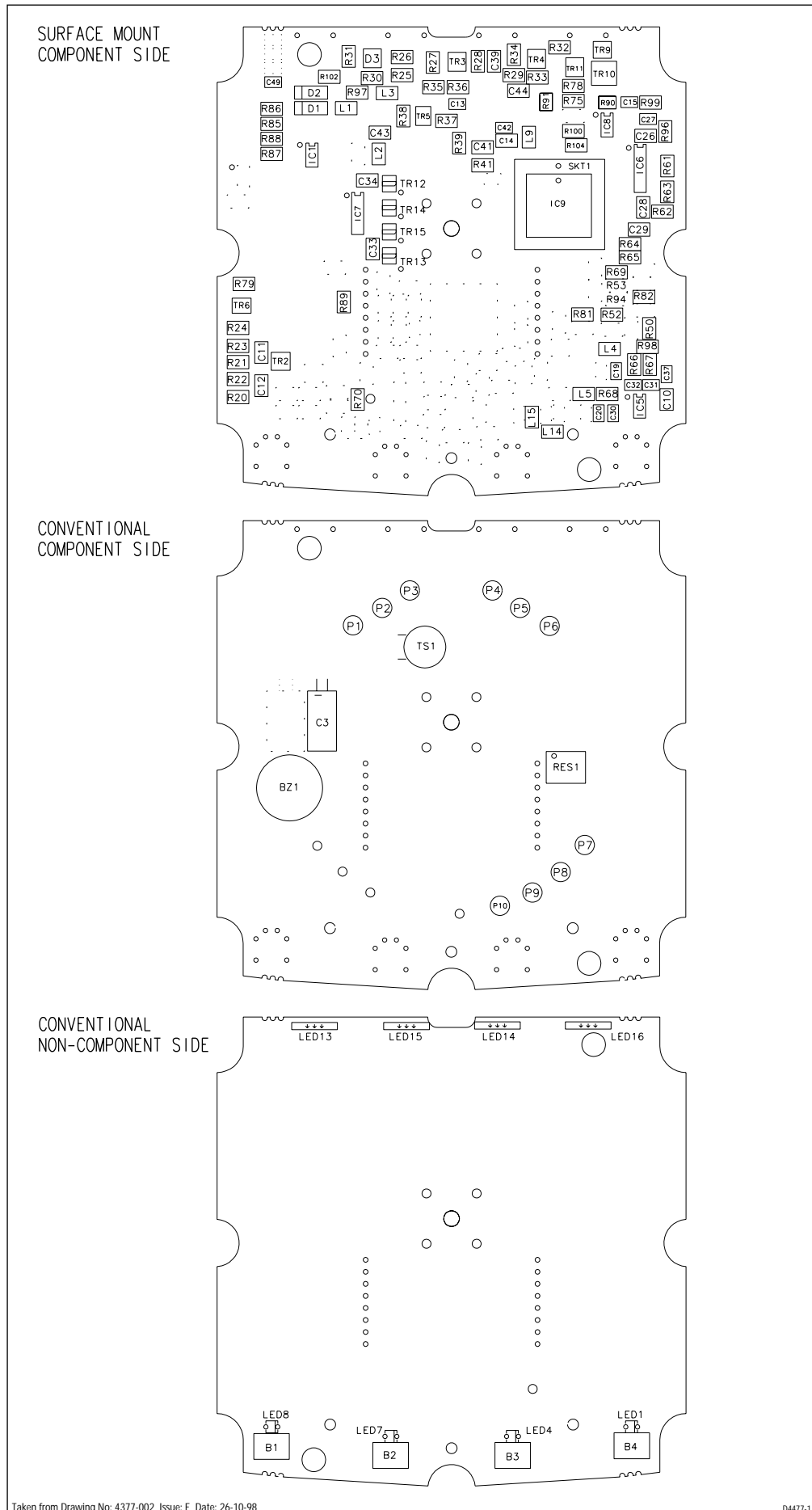
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Taken from Drawing No: 4377-002 Issue: E Date: 26-10-98

D4477-1

ST60 Rudder Angle Indicator component list

SURFACE MOUNT COMPONENT SIDE

9600L1	8	SOLID CHIP INDUCTOR	L1-5,9,14,15
9600PLCC44	1	IC SOCKET PLCC44	SKT1
940087C51RCP	1	IC MICROPROCESSOR 87C51RC+	IC9
940024022	1	IC EEPROM & RESET CONTROLLER S24022	IC8
9400LM324	1	IC QUAD OPAMP LM324	IC7
940074HC4051	1	IC ANALOGUE SWITCH 74HC4051	IC6
9400LMC6032	1	IC DUAL OPAMP LMC6032	IC5
-	-	-	-
-	-	-	-
-	-	-	-
9400LM78L05	1	IC REGULATOR 78L05 5V SO8	IC1
9500FMY6	4	TRANSISTOR FMY6	TR12-15
9500IMZ1	2	TRANSISTOR ARRAY IMZ1 PNP	TR5,6
9500IMX1	4	TRANSISTOR ARRAY IMX1 NPN	TR2-4,11
9501BC868	1	TRANSISTOR SOT89 BC868 NPN	TR10
-	-	-	-
9500BC817	1	TRANSISTOR SOT23 BC817 NPN	TR9
93261U	3	CAPACITOR 1uF 20% 50V 1206	C41,43,44
93041000P	7	CAPACITOR X7R 1000pF 10% 50V 0805	C15,19,20,27,32,37,49
9302100P	2	CAPACITOR COG 100pF 10% 50V 0805	C30,31
93BDHXXX2N2	1	CAPACITOR X7R 2.2nF 10% 50V 0805	C13
930522N	2	CAPACITOR X7R 22nF 5% 50V 1206	C11,12
93070U1	8	CAPACITOR X7R 0.1uF 20% 50V 1206	C10,14,26,28,29,33,34,39
			-
93040U01	1	CAPACITOR X7R 0.01uF 10% 50V 0805	C42
9206IMN10	1	DIODE IMN10	D3
9200M2SYM	2	DIODE M2-SYM 10A 100V	D1,2
91124K7	2	RESISTOR NETWORK QUAD PACK 4K7	R90,91
-	-	-	-
91060R0	6	RESISTOR WCR 1206 0R0 0.125W	R38,39,50,81,82,104
91035K6	1	RESISTOR WCR 1206 5K6 1% 0.125W	R66
9103270R	1	RESISTOR WCR 1206 270R 1% 0.125W	R65
910368K	1	RESISTOR WCR 1206 68K 1% 0.125W	R67
9106820K	1	RESISTOR WCR 1206 820K 5% 0.125W	R70
910382R	1	RESISTOR WCR 1206 82R 1% 0.125W	R63
-	-	-	-
9106390R	1	RESISTOR WCR 1206 390R 5% 0.125W	R31
910639K	4	RESISTOR WCR 1206 39K 5% 0.125W	R26,28,30,52
9103560R	1	RESISTOR WCR 1206 560R 1% 0.125W	R79
9106680R	1	RESISTOR WCR 1206 680R 5% 0.125W	R99
910633R	1	RESISTOR WCR 1206 33R 5% 0.125W	R78
910627R	4	RESISTOR WCR 1206 27R 5% 0.125W	R85-88
910333K	1	RESISTOR WCR 1206 33K 1% 0.125W	R61
910610R	2	RESISTOR WCR 1206 10R 5% 0.125W	R32,102
9106470R	2	RESISTOR WCR 1206 470R 5% 0.125W	R20,23
-	-	-	-
91031K2	1	RESISTOR WCR 1206 1K2 1% 0.125W	R62
910618R	1	RESISTOR WCR 1206 18R 5% 0.125W	R75
91031K	3	RESISTOR WCR 1206 1K 1% 0.125W	R33,41,64
91036K8	1	RESISTOR WCR 1206 6K8 1% 0.125W	R22
91064K7	6	RESISTOR WCR 1206 4K7 5% 0.125W	R24,27,89,96,97,100
910615K	1	RESISTOR WCR 1206 15K 5% 0.125W	R25
91062K2	2	RESISTOR WCR 1206 2K2 5% 0.125W	R34,35
910612K	1	RESISTOR WCR 1206 12K 5% 0.125W	R37
9103560K	1	RESISTOR WCR 1206 560K 1% 0.125W	R98
910310K	5	RESISTOR WCR 1206 10K 1% 0.125W	R21,29,36,68,69
3015-133	1	PCB ST60 ANALOGUE	

CONVENTIONAL COMPONENT SIDE

3030-035-C	10	SOLDER BUCKETS	P1-10
01051	1	VARISTOR V22ZA1	TS1
15166	1	RESONATOR 12MHz	RES1
15136	1	BUZZER AT-17	BZ1
-	-	-	-
03075	1	CAPACITOR ELEC 220uF 25V	C3

CONVENTIONAL NON-COMPONENT SIDE

15165	4	LED 202 WHITE SIDE FIRING	LED13-16
02050	4	LED HLMP6505 GREEN	LED1,4,7,8
06030	4	SWITCH ALPMINI	B1-4

Taken from Drawing No: 4377-002 Issue: E Date: 26-10-98   D4478-1

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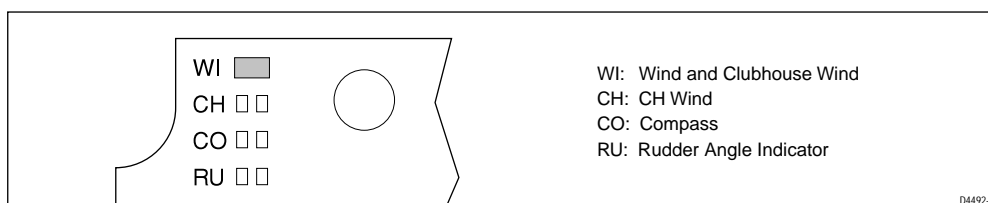# Chapter 5. ST60 Clubhouse Wind instrument

Disassembly/reassembly

On reassembly (refer to Figure 1), it is important that the PCB assembly module is fixed to the facia (3) using a torque of 0.22Nm (2lb in). Similarly, fixing the rear case (13) to the facia (3) must also be torqued to 0.22Nm (2lb in).

Note: Failure to practice using the recommended torques may result in damage to the facia inserts.

It is also recommended a new case seal (12) is fitted on reassembly.

PCB identification

To aid identification of PCBs an identifying component has been included in the top left hand corner of the populated PCB.

WI: Wind and Clubhouse Wind
CH: CH Wind
CO: Compass
RU: Rudder Angle Indicator

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Self-test procedure

The ST60 Wind instrument has built-in self-test functions to aid fault diagnosis.

To access self-test mode, press Key 1 and Key 4 together for 4 seconds. When the unit beeps, immediately press Key 3 and Key 4 together momentarily. The unit will enter self-test stage 1.

Self-test stage 1

A. The unit should display $5t$ followed by $t\,l$.

B. There will be a SeaTalk transmission to check the transmit/receive circuits.

C. The EEPROM is tested.
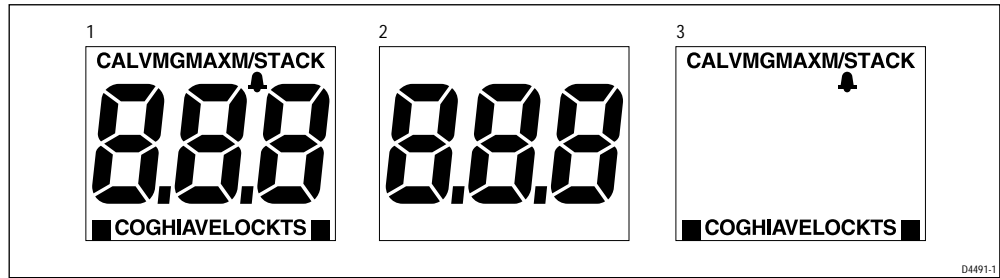
The following failure codes may be generated:

Message	Failure Mode	Action
FDl	SeaTalk Rx/Tx	Check for damaged bucket connectors/rear-case pins. Check SeaTalk interface components around TR3 and TR5.
$FD2$	EEPROM failure	Replace EEPROM (IC8)

If there is no audible beep, generated by the key presses, check around TR2 and TR6 and the buzzer for damage. If the beep is quiet, check R79.

If all tests pass, P is shown on the display. Press Key 1 and Key 2 together momentarily to progress to self-test stage 2.

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Self-test stage 2

A. The unit should display ⊢2 for 1 second.

B. Illumination will change between level 0 and level 3 every second.

C. Any key press will cause audible beep.

D. The pointer will rotate continuously. This will highlight a problem if the pointer makes contact the dial or window.

E. LCD segments will cycle through the following sequence:

No fail codes are generated since stage 2 is an audio/visual check. The following can, however, be used as a guide to isolate a problem:

Failure Mode	Action
Keypad Illumination failure (Dial illumination will also be degraded).	Check TR9, TR11, R78 and R91a. Check LEDs 1, 4, 7 and 8 for open circuit.
Keypad illumination OK but degraded Dial illumination.	Check TR10, TR11, R75 and R91b. Check LEDs 13 - 16 for open circuit.
No beep when key pressed.	Replace keyswitch.
LCD segment(s) missing completely.	Check LCD solder pins for poor/dry joints. Check IC3 for unsoldered pins.
Faint LCD segments.	Check LCD pins for shorts. Check IC3 for shorts.
Pointer not rotating or erratic movement.	Check motor winding continuity. Approximately 150 ohms between TP135 and TP136 and between TP142 and TP143.

When the pointer has completed at least one rotation, press Key 1 and Key 2 together momentarily to progress to self-test stage 3.

Self-test stage 3

This stage is to set up pointer offset and corrections. On entry the LCD will show ⊢3 and then indicate the position to which the pointer should be positioned to adjust for pointer offset.

Momentary presses of Key 1 will rotate the pointer clockwise to align with the major graduations.

Should there be any misalignment repeatedly press Key 3 for anti-clockwise or Key 4 for clockwise adjustment until correct alignment is obtained on all major graduations.

On completion of correction adjustments press Key 1 and Key 2 together momentarily to progress to self-test stage 4.

Self-test stage 4

Note: This stage can be completed with a Windvane transducer connected.

A. The unit should display `t4`.

B. Perform transducer operation as described below.

Spin the annemometer, then turn the vane in a complete circle. The display will show `P` for a pass, `F3` for a failed windvane test or `F4` for a failed annemometer test.

If the test fails, check the following ensuring the transducer is connected:

Check	Action

Annemometer signal:
Turn annemometer and check voltage at P13 switches between approximately 2V and 8V.
	• Check L7 and R13 for open circuit.
	• 8V supply at P7.
	  Check L4, R84 for open circuit.
	• 0V supply at P11 present.
	  Check L8 for open circuit.
	• Check around IC4b.

Wind vane signal:
Slowly turn vane through 360°. Signal at SIN (P8) and COS (P4) should vary between approximately 2.2V and 5.8V.
	• 8V supply at P7 present.
	  Check L4, R84 for open circuit.
	• 0V supply at P11 present.
	  Check L8 for open circuit.

If the above is OK then the problem probably lies within the ADC circuit.	• Check L5,L6, R52, R82 for open circuit. • Check ADC circuit around IC5 and IC6.

To exit self-test and store pointer corrections press Key 1 and Key 2 together for 2 seconds.

If storage of pointer corrections is not required press Key 1 and Key 2 together momentarily to exit.

Useful PCB test points

TP7	Vcc 5V
TP10	0V
TP14	8V, transducer supply
TP80	Display illumination PWM
TP81	Key illumination PWM
TP191	SeaTalk receive
TP110	Integrator output (ADC)
TP119	ADC interupt
TP135	Motor drive Sin B
TP136	Motor drive Sin A
TP143	Motor drive Cos B
TP142	Motor drive Cos A

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ST60 Clubhouse Wind spare parts list

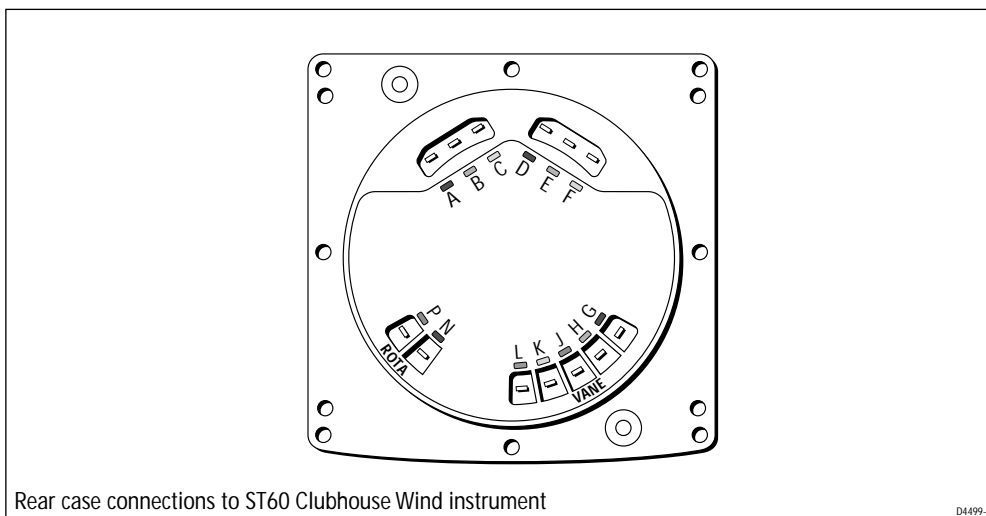The **item** numbers refer to

Figure 1: ST60 Analogue Instrument exploded view

Item	Spare/Accessory Description	Part No.	Comments
1	Facia bezel	A25001	
–	Suncover, standard	A25004	Not illustrated
2	Keypad, Rudder	A28016	Pack of 5
	Facia with case seal, *including*	A28013	
3	Facia		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22Nm (2lb in)
	Inner keypad, *including*	A28022	
4	Inner keypad		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22Nm (2lb in)
5	Shroud, Wind	A28048	As ST60 Wind
6	Pointer	A28041	Pack of 5
7	Display label, Clubhouse	A28045	Pack of 5
8	LCD, analogue display	A28025	
	PCB and dial assembly, Clubhouse *including*	A28008	Assembled module consisting of items 6, 7, 8, 9, 10, 11.
6	Pointer		See A28041
7	Display label, Clubhouse		See A28045
8	LCD, analogue display		See A28025
9	Diffuser		
10	Reflector		
11	PCB assembly		
12	Case seal		See A28027
14	Washer (x3)		
15	Screw (x11)		Torque to 0.22Nm (2lb in)
12	Case seal	A28027	Pack of 5
	Rear case assembly, *including*	A28014	
12	Case seal		See A28027
13	Rear case		
15	Screw (x8)		Torque to 0.22Nm (2lb in)
16	Label, Clubhouse (rear case)	A28039	Pack of 5
17	Gasket	A28028	Pack of 5
18	Flush mount bezel	A25002	
	Flush mount kit, *including*	A25003	
–	Suncover, flush mount		Not illustrated
18	Flush mount bezel		See A25002
19	Screw (x4)		Torque to 0.33Nm (3lb in)
20	Flush mount seal		
21	Rear bracket		

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ST60 Clubhouse Wind PCB details

Input/Output signals

(refer to Figure 6. ST60 Clubhouse Wind circuit diagram)

Rear case connection	Signal	Description
A (Red)	12V EXT	Nominal 12V DC supply
B (Screen)	0V EXT	0V
C (Yellow)	DATA	Intermittent streams of (nominal) 12V pulses
D (Red)	12V EXT	Nominal 12V DC supply
E (Screen)	0V EXT	0V
F (Yellow)	DATA	Intermittent streams of (nominal) 12V pulses
G (Red)	8V	Vane supply
H (Green)	SIN	sin output
J (Blue)	COS	cos output
K (Yellow)	ANN	Annemometer
L (White)	SCREEN	Transducer 0V return

Rear case connections to ST60 Clubhouse Wind instrument

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ST60 Clubhouse Wind circuit diagram

Figure 6. ST60 Clubhouse Wind circuit diagram

ST60 Clubhouse Wind PCB layout

SURFACE MOUNT
COMPONENT SIDE

CONVENTIONAL
COMPONENT SIDE

CONVENTIONAL
NON-COMPONENT SIDE
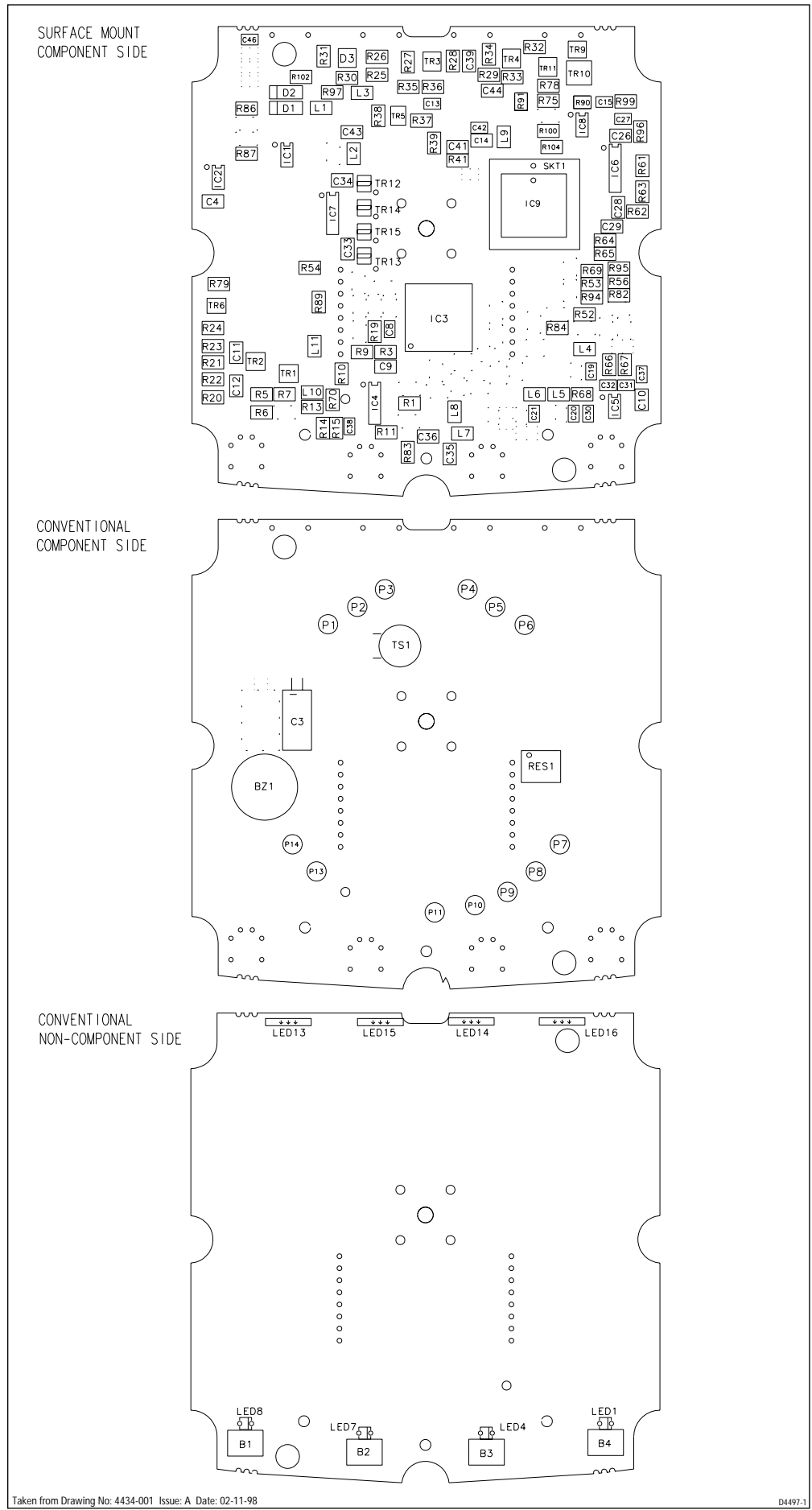
Taken from Drawing No: 4434-001 Issue: A Date: 02-11-98

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ST60 Clubhouse Wind PCB component list

SURFACE MOUNT COMPONENT SIDE

9600L1	11	SOLID CHIP INDUCTOR	L1-11
9600PLCC44	1	IC SOCKET PLCC44	SKT1
940087C51RCP	1	IC MICROPROCESSOR 87C51RC+	IC9
940024022	1	IC EEPROM & RESET CONTROLLER S24022	IC8
9400LM324	1	IC QUAD OPAMP LM324	IC7
940074HC4051	1	IC ANALOGUE SWITCH 74HC4051	IC6
9400LMC6032	1	IC DUAL OPAMP LMC6032	IC5
9400LM339	1	IC QUAD COMPARATOR LM339	IC4
9400BU9716K	1	IC LCD DRIVER BU9716K	IC3
9400LM78L08	1	IC REGULATOR L78L08 8V SO8	IC2
9400LM78L05	1	IC REGULATOR 78L05 5V SO8	IC1
9500FMY6	4	TRANSISTOR FMY6	TR12-15
9500IMZ1	2	TRANSISTOR ARRAY IMZ1 PNP	TR5,6
9500IMX1	5	TRANSISTOR ARRAY IMX1 NPN	TR1-4,11
9501BC868	1	TRANSISTOR SOT89 BC868 NPN	TR10
-	-	-	-
9500BC817	1	TRANSISTOR SOT23 BC817 NPN	TR9
-	-	-	-
93041000P	10	CAPACITOR X7R 1000pF 10% 50V 0805	C8,15,19-21,27,32,37,38,46
9302100P	2	CAPACITOR COG 100pF 10% 50V 0805	C30,31
93BDHXXX2N2	1	CAPACITOR X7R 2.2nF 10% 50V 1206	C13
930522N	2	CAPACITOR X7R 22nF 5% 50V 1206	C11,12
93040U01	1	CAPACITOR X7R 0.01uF 10% 50V 0805	C42
93070U1	12	CAPACITOR X7R 0.1uF 20% 50V 1206	C4,9,10,14,26,28,29, 33,34,35,36,39
93261U	3	CAPACITOR 1uF 20% 50V 1206	C41,43,44
9206IMN10	1	DIODE IMN10	D3
9200M2SYM	2	DIODE M2-SYM 10A 100V	D1,2
91124K7	2	RESISTOR NETWORK QUAD PACK 4K7	R90,91
9106680R	1	RESISTOR WCR 1206 680R 5% 0.125W	R99
91060R0	5	RESISTOR WCR 1206 0R0 0.125W	R38,39,54,84,104
91035K6	1	RESISTOR WCR 1206 5K6 1% 0.125W	R66
9103270R	1	RESISTOR WCR 1206 270R 1% 0.125W	R65
910368K	1	RESISTOR WCR 1206 68K 1% 0.125W	R67
9106820K	1	RESISTOR WCR 1206 820K 5% 0.125W	R70
910382R	1	RESISTOR WCR 1206 82R 1% 0.125W	R63
910618R	1	RESISTOR WCR 1206 18R 5% 0.125W	R75
9106390R	1	RESISTOR WCR 1206 390R 5% 0.125W	R31
910639K	3	RESISTOR WCR 1206 39K 5% 0.125W	R26,28,30
9103560R	1	RESISTOR WCR 1206 560R 1% 0.125W	R79
910647R	1	RESISTOR WCR 1206 47R 5% 0.125W	R7
910622R	2	RESISTOR WCR 1206 22R 5% 0.125W	R86,87
910633R	1	RESISTOR WCR 1206 33R 5% 0.125W	R78
910333K	1	RESISTOR WCR 1206 33K 1% 0.125W	R61
910610R	4	RESISTOR WCR 1206 10R 5% 0.125W	R9,32,83,102
9106470R	2	RESISTOR WCR 1206 470R 5% 0.125W	R20,23
9106100K	3	RESISTOR WCR 1206 100K 5% 0.125W	R15,52,82
91031K2	1	RESISTOR WCR 1206 1K2 1% 0.125W	R62
910647K	1	RESISTOR WCR 1206 47K 5% 0.125W	R19
91031K	4	RESISTOR WCR 1206 1K 1% 0.125W	R13,33,41,64
91036K8	1	RESISTOR WCR 1206 6K8 1% 0.125W	R22
91064K7	9	RESISTOR WCR 1206 4K7 5% 0.125W	R6,10,14,24,27,89,96,97,100
910615K	2	RESISTOR WCR 1206 15K 5% 0.125W	R1,25
91062K2	2	RESISTOR WCR 1206 2K2 5% 0.125W	R34,35
910612K	1	RESISTOR WCR 1206 12K 5% 0.125W	R37
9106330K	4	RESISTOR WCR 1206 330K 5% 0.125W	R53,56,94,95
910310K	8	RESISTOR WCR 1206 10K 1% 0.125W	R3,5,11,21,29,36,68,69
3015-133	1	PCB ST60 ANALOGUE	

CONVENTIONAL COMPONENT SIDE

3030-035-C	13	SOLDER BUCKETS	P1-11,13,14
01051	1	VARISTOR V22ZA1	TS1
15166	1	RESONATOR 12MHz	RES1
15136	1	BUZZER AT-17	BZ1
-	-	-	-
03075	1	CAPACITOR ELEC 220uF 25V	C3

CONVENTIONAL NON-COMPONENT SIDE

15165	4	LED 202 WHITE SIDE FIRING	LED13-16
02050	4	LED HLMP6505 GREEN	LED1,4,7,8
06030	4	SWITCH ALPMINI	B1-4

Taken from Drawing No: 4318-002 Issue: E Date: 26-10-98   D4498-1

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