Sailor

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INSTRUKTIONSBOG FOR
SAILOR C2149 GMDSS ALARM UNIT

INSTRUCTION BOOK FOR
SAILOR C2149 GMDSS ALARM UNIT

INSTRUKTIONSBUCH FÜR
SAILOR C2149 GMDSS ALARM UNIT

INSTRUCTIONS POUR
SAILOR C2149 GMDSS ALARM UNIT

INSTRUCCIONES PARA
SAILOR C2149 GMDSS ALARM UNIT

A/S S. P. RADIO · AALBORG · DENMARK

CONTENTS

C2149 A

CONTENTS

C2149 GRØN

1. INTRODUCTION

1.1. GENERAL DESCRIPTION GMDSS SYSTEM

C2149 is a part of the GMDSS system.

C2149 is the remote alarm unit.

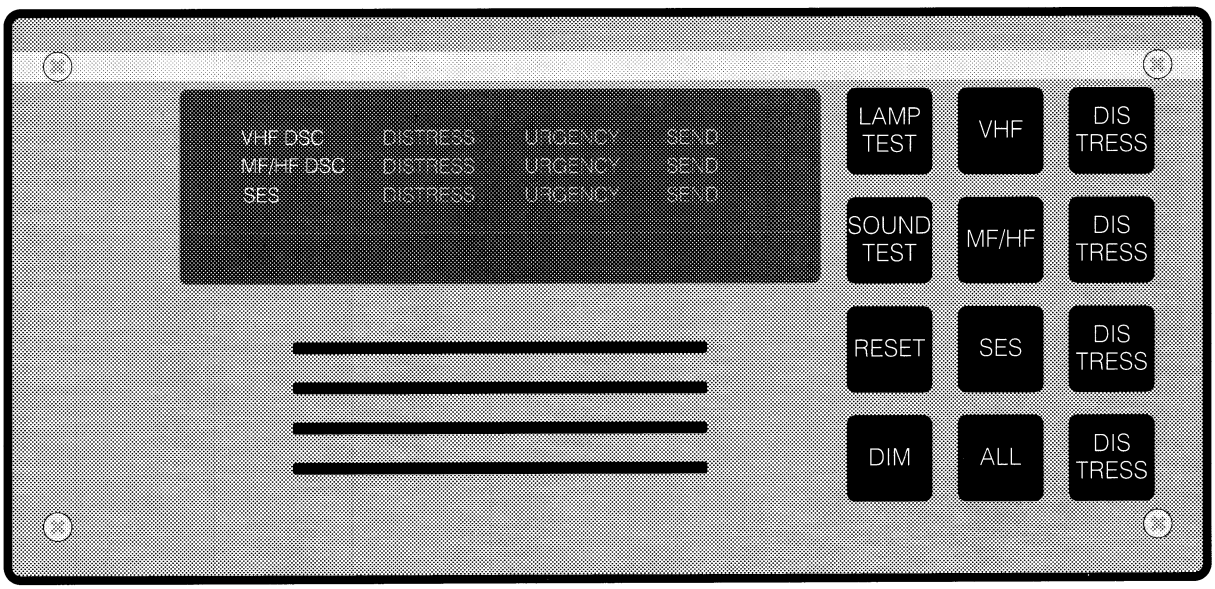
C2149 will display all incoming distress calls from MF/HF DSC watchkeeping receiver, VHF DSC receiver and Inmarsat-C Satellite (SES) receiver. (SES) Ship Earth Station.

C2149 is the remote alarm unit from which you can initiate a distress call on MF/HF, VHF and Inmarsat-C.

C2149 can be supplied from both the primary and secondary battery supply.

C2149 has inputs for both primary and secondary VHF DSC.

C2149 has input for satellite navigator (NMEA183).



1.2. TECHNICAL DATA

Primary Voltages:	24 volt DC -10% +30% (21.6-32V)
Secundary Voltages:	24 volt DC -10% +30% (21.6-32V)
Power Consumption:	Standby: 125 mA Max: 500 mA
Operating Temperature Range:	-15°C to +55°C
Storage Temperature Range:	-25°C to +75°C
Weight:	1.8 kg
Dimensions:	Height: 98 mm Width: 225 mm Depth: 122 mm

C2149 A

CONTENTS

2. INSTALLATION MECHANICAL

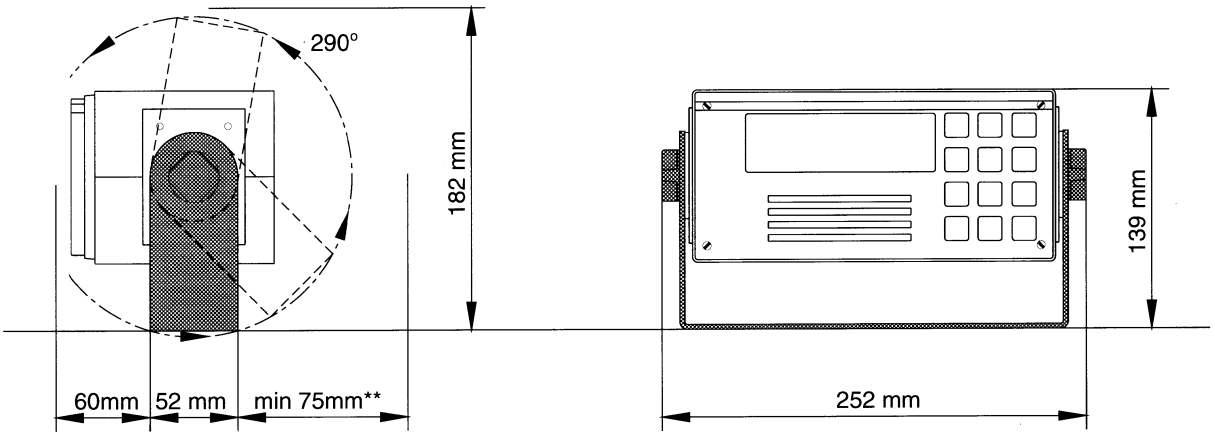
2.1. MOUNTING POSSIBILITIES

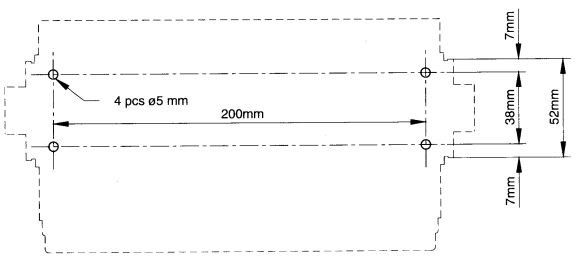
The DSC C2149 cabinet is designed in a module called a mini 1/4 box. For this module we can supply a wide variety of installation brackets etc. which will be described below. We have made a drawing including dimensions and drilling plan for each type and we kindly ask you to look at the drawing for the type in question.

H2077 MULTI-PURPOSE MOUNTING BRACKET
This mounting bracket is as standard delivered together with C2149. It permits a wide variety of installation possibilities such as tabletop, bulkhead or deckhead. It is easy to remove the set by unscrewing the two buttons of H2077.

H2077

C2149 A
4-0-27577 4-0-27578





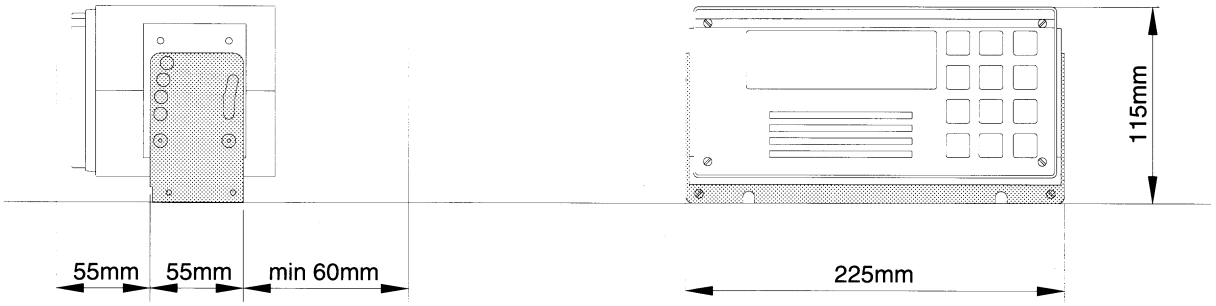
Weight:

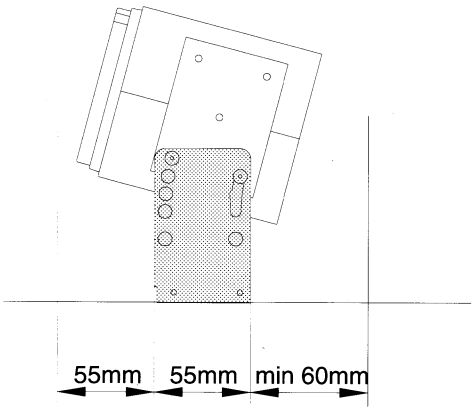
Mounting kit H2077:	0.4 kg
DSC C2149:	1.8 kg

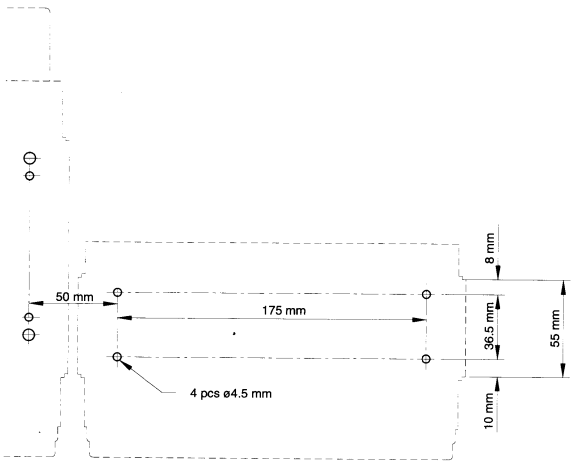
H2067 MOUNTING BRACKET FOR TABLETOP, BULKEHAD OR DECKHEAD MOUNTING FOR MINI 1/4 BOX

This mounting bracket is used when C2149 is to be mounted next to other units in the Compact 2000 programme mounted in H2055 mounting brackets. For example when installing the C2149 next to the VHF RT2048 it is possible to tilt both units in the same angle.

H2067







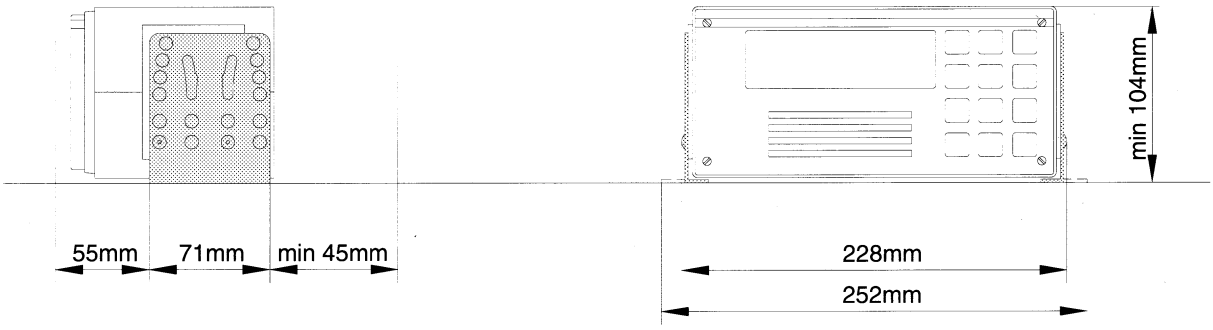
Weight:

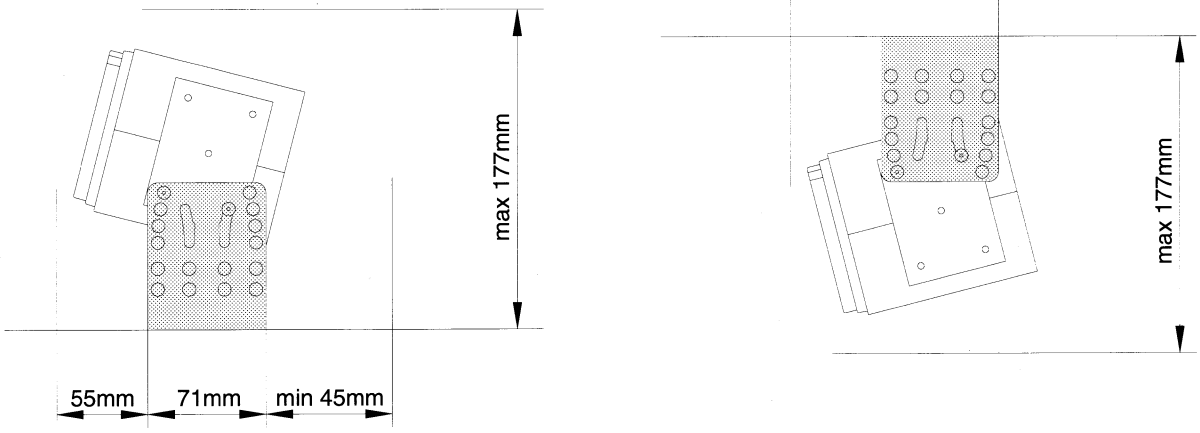
Mounting kit H2067:	0.5 kg
DSC C2149:	1.8 kg

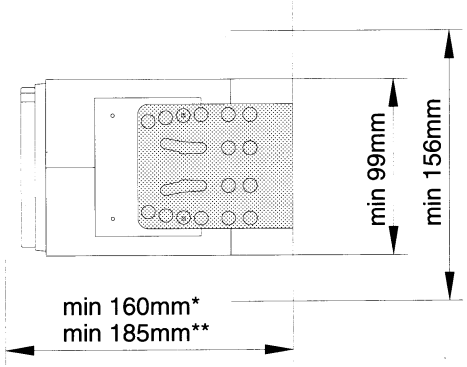
H2057 ANGLE HINGES FOR TABLETOP, BULKHEAD OR DECKHEAD MOUNTING FOR MINI 1/4 BOX

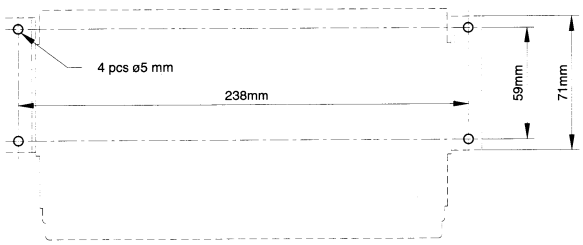
H2057 is designed for stationary installation. It offers a lot of mounting possibilities using the different holes in the angle hinges when tilting the DSC.

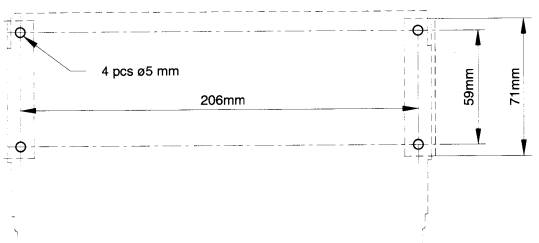
H2057











C2149
4-0-27569 4-0-27571
4-0-27572 4-0-27573
4-0-27574 4-0-27575

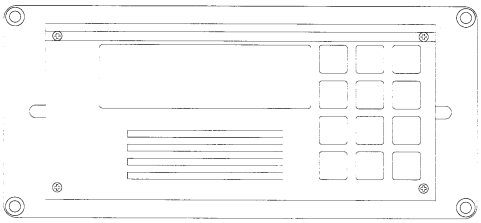
Weight:
Mounting kit H2057: 0.4 kg
DSC C2149: 1.8 kg

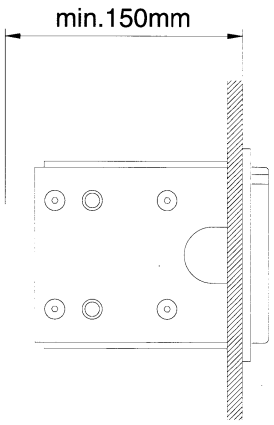
2.1. MOUNTING POSSIBILITIES cont.:

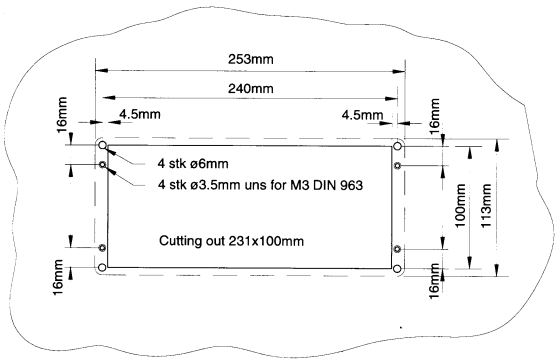
H2063 CONSOLE MOUNTING KIT FOR 1/4 BOX

This mounting kit is used for console flush mounting of 1/4 box and mini 1/4 box.
Free distance must be kept to allow free air circulation, ambient temperature max. 40oC.

H2063

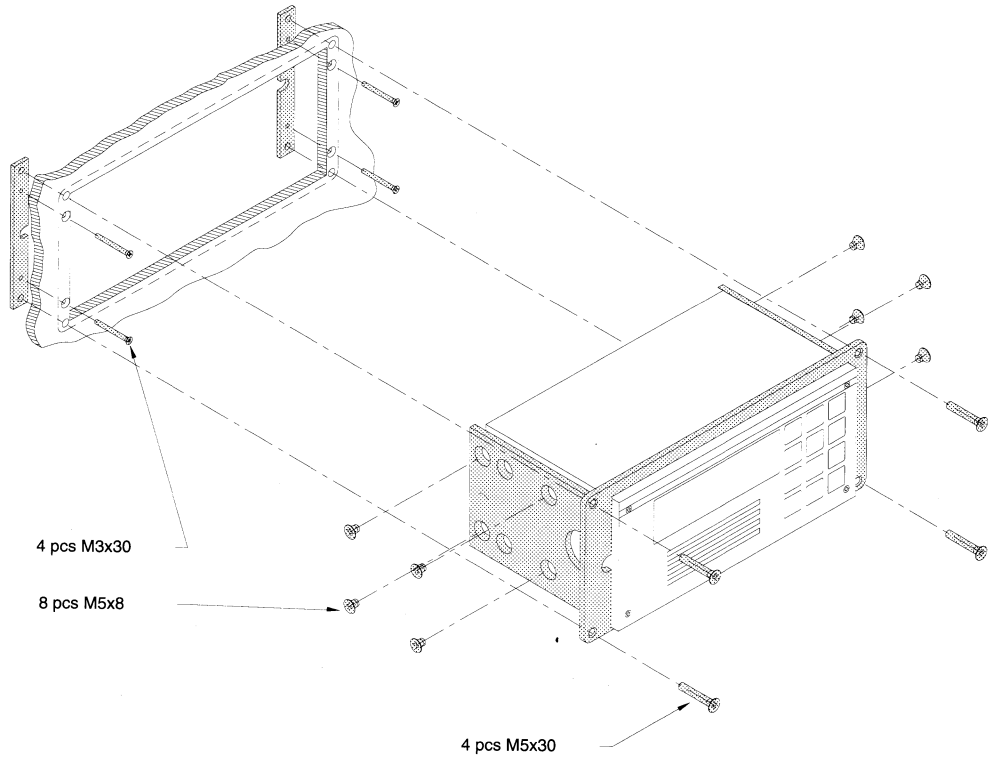




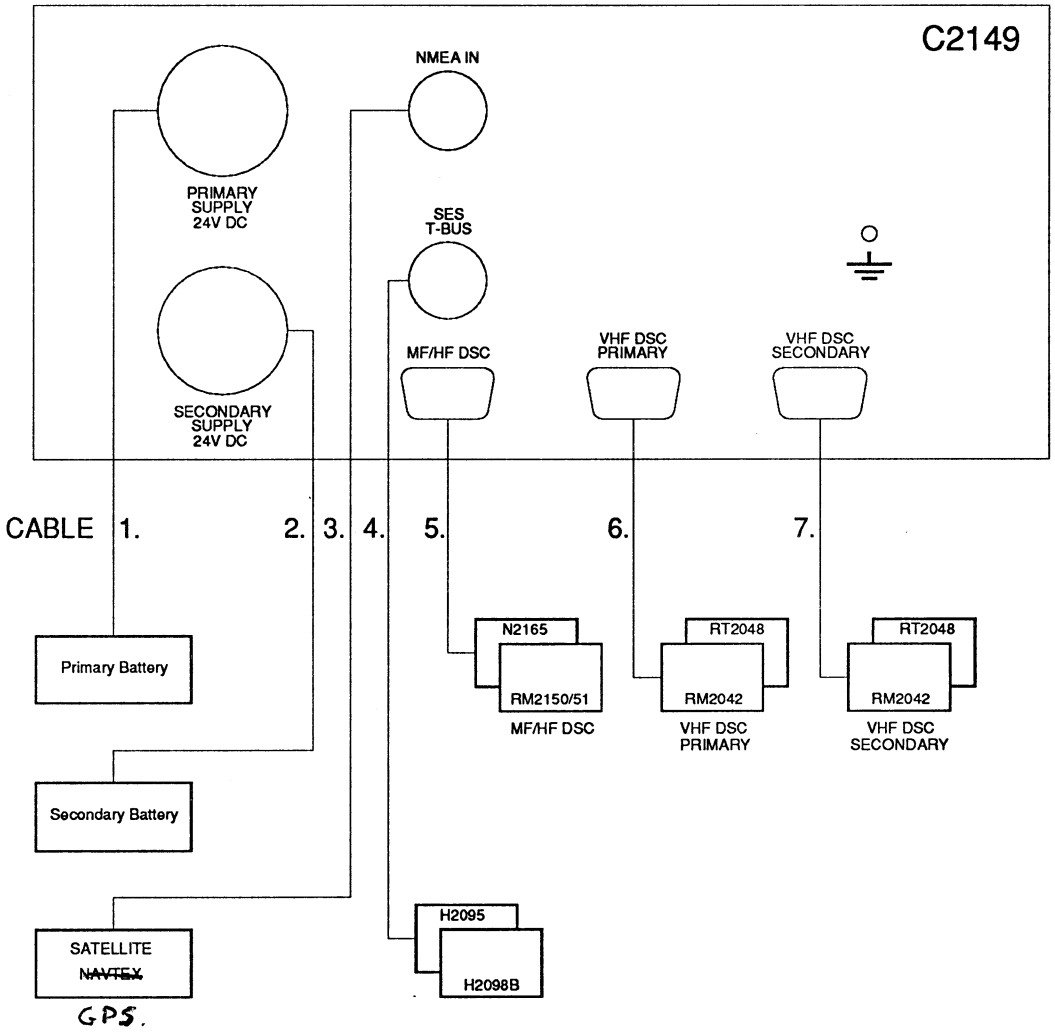


Weight:

Mounting kit H2063:	1.0 kg
DSC C2149:	1.8 kg



2.2. CABLE SPECIFICATIONS FOR CUSTOMER SUPPLIED CABLES



CABLE NO. 1 AND 2

Cable between GMDSS ALARM UNIT C2149 and Primary or Secondary Battery. Cable specification: SP nr. 503.758			
C2149	PRIMARY BATTERY		
PRIMARY OR SECONDARY SUPPLY 24V	BATTERY TERMINAL	COLOUR	SIGNAL
2			Ext. Alarm
3	+ batt	RED	+ batt
5	- batt	BLACK	- batt
6			Ext. Alarm

CABLE NO. 3

Cable between GMDSS ALARM UNIT C2149 and SAT.NAV. (G.P.S.) NMEA183 Cable specification: COAX RG58 SP nr. 77.509			
C2149	G.P.S.		
NMEA IN	OUT	COLOUR	SIGNAL
GROUND	GROUND		GROUND
Inner Conductor			Data in

CABLE NO. 4

Cable between GMDSS ALARM UNIT C2149 and Inmarsat-C (SES) H2095. Cable specification: COAX RG58 SP nr. 77.509			
C2149	H2095		
SES T-BUS	T-BUS	COLOUR	SIGNAL
GROUND	GROUND		GROUND
Inner Conductor			Data in/out

CABLE NO. 5

Cable between GMDSS ALARM UNIT C2149 and Power Supply N2165 for the MF/HF DSC RM2150. Cable specification: 8 * 0.22 mm SP nr. 77.118			
C2149	N2165		
MF/HF DSC	ST5	COLOUR	SIGNAL
1	NC		GROUND
2	2	RED	ALARM OUT
3	1	BLACK	ALARM IN
5	3	GREEN	GROUND
9	4	WHITE	+ 9 Volt

CABLE NO. 6 and 7.

Cable between GMDSS ALARM UNIT C2149 and VHF DSC RM2042. Cable specification: 8 * 0.22 mm SP nr. 77.118			
C2149	RM2042		
VHF DSC PRIMARY or SECONDARY	PC/C2149	COLOUR	SIGNAL
1	NC		Ground
2	3	RED	Data to C2149
3	2	BLACK	Data to RM2042
5	5	GREEN	- Batt
9	9	WHITE	+ 5 Volt

2.3 BUS SETTING IN H2095A TRANSCEIVER

The Bus port X5 on the backpanel of the H2095 or H2095A Transceiver can be used for either:

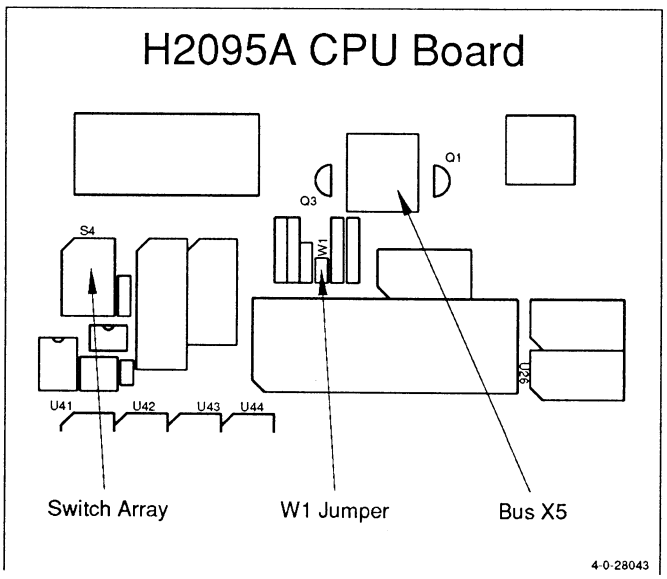
Bus communication, when connecting to the C2149 GMDSS remote alarm, or the H1602A, or the GPS TT-3012A.

NMEA 0183 communication, when connecting to a commercial available navigator device.

Changing to Bus communication.

If the H2095 or H2095A will be used with a C2149 GMDSS remote alarm using the Bus standard, you must do the following to ensure proper operation:

1. Turn off the H2095 or the H2095A.
2. Place the H2095/H2095A upside-down, remove all 9 screws so that the bottom cover can be removed.
3. Locate the switch array in the corner of the H2095/H2095A CPU board, and set switch 1 in the ON position. This selects Bus operation.
4. The jumper W1 beside the Bus connector must be inserted for the H2095/H2095A to be able to transmit on the Bus.



The part of the H2095/H2095A CPU Board Part No. TT-37-100524, where the Switch array and the Bus connector are located.

CONTENTS

3 SERVICE

3.1 MAINTENANCE

If C2149 has been installed in a proper way the maintenance can be reduced to an overhaul at each visit of the service staff. Then inspect the set, the cables, and plugs for mechanical damages, salt deposits, corrosion, and any foreign material. Owing to its traditional structure, the C2149 has a long lifetime, but it must always be carefully checked at intervals not exceeding 12 months - dependent on the conditions under which the set is working. The set must be brought to the service workshop to be tested.

3.2 ALIGNMENT INSTRUCTIONS

INTRODUCTION
The measuring values indicated in chapter 5. CIRCUIT DESCRIPTION AND SCHEMATIC DIAGRAMS are typical values and as indicated it will be necessary to use instruments in absolute conformity with the below list:

3.3 PROPOSAL FOR NECESSARY MEASURING INSTRUMENTS

Electronic Multimeter type PM2505	PHILIPS
Digitizing Oscilloscope type 2430/40	TEKTRONIC
Power Supply 21-32 Volt, 0.5A	
Power Supply 5-9 Volt, 10mA	

3.4 TROUBLE SHOOTING

3.4.1 Keyboard (Module 1)
None.

3.4.2 Display (Module2)
None.

3.4.3 Microprocessor (Module 3)

Check all incoming and outgoing voltages.

A. Supply voltages. Measured with voltmeter.

Incoming:	PLUG	PIN	Meas. ref.
GND	P2	18,20	
CHASSIS	P2	14	
+5 volt	P2	17	GND
+15 volt	P2	16	GND

Outgoing	PLUG	PIN	Meas. ref.
+6- +15 volt	J1	1	GND
+15 volt	J2	1	GND

Internal generated	Meas.point	Meas. ref.
+6.5 volt +-1 volt	Cathode D6	CHASSIS
-6.5 volt +-1 volt	Anode D7	CHASSIS

The upper side off the jumper (P1) can be used as GND.

VHF DSC (PRIMARY) RM2042
Switch ON the VHF DSC (PRIMARY) RM2042 and press **RESET** on the KEYBOARD.
After 10 sec. a pulse train 4 msec. long, can be seen on the oscilloscope at U13 pin 19 and U13 pin 3. Starting and ending at a high level (5 volt).
Test that P2 pin 12 (VHF P ON) is low < 2.0 volt.

VHF DSC (SECONDARY)
Switch OFF the VHF DSC (PRIMARY) RM2042 and switch ON the VHF DSC (SECONDARY) RM2042, press **RESET** on the KEYBOARD. After 10 sec. a pulse train 4 msec. long, can be seen on the oscilloscope at U12 pin 19 and U12 pin 3. Starting and ending at a high level (5 volt).
Test that P2 pin 11 (VHF S ON) is low < 2.0 volt.

MF/HF DSC RM2150/51
Switch ON the MF/HF DSC RM2150/51 and press **RESET** on the KEYBOARD. After 10 sec. a pulse train 800 msec. long, can be seen on the oscilloscope at U9 pin 29, starting and ending at a low level (0 volt). One sec. later a pulse train 800 msec. long, can be seen at U9 pin 17, starting and ending at a high level (5 volt). Test that P2 pin 10 (HF ON) is low < 2.0 volt.

SES H2095
Switch ON the SES H2095. The signal on U9 pin 12 is an endless stream of data. This is because the H2095 is polling for answer every 500 msec. When a pulse occur on U9 pin 9, the C2149 is transmitting data to the H2095 (SES). Test that P2 pin 13 (SES ON) is low < 2.0 volt.

Satellite Navigator
Switch ON the Satellite Navigator (NMEA 183). The signal on U12 pin 3 (P2 pin 2) is an endless stream of data. This is because the navigator is sending many types of data.

Sound signal
Press **SOUND TEST** on the KEYBOARD. The signal on U9 pin 15 consists of 4 pulses. Each pulse is 140 msec long and contains the frequentcy 2.1 kHZ.

Data and Clock for the Display driver
The serial bus occupied 3 bit of port 6 on the microprocessor.
U9 pin 25 is data, U9 pin 26 is clock and U9 pin 27 is select.

Press **DIM** on the KEYBOARD, 16 data bits can be seen simultaneously with 16 clock bits, subsequently by the select pulse.

3.4.4 Interface (Module 3)

Check all incoming and outgoing voltages.

A. Supply voltages. Measured with voltmeter.

Incoming PLUG	PIN	Meas ref. PIN		
+ 21.6-32 volt	P2	2	P2	5
+ 21.6-32 volt	P3	2	P3	5
+ 5 volt	J1	9	J1	5
+ 5 volt	J2	9	J2	5
+ 9 volt	J5	9	J5	5
-12 volt	J4	Conductor	Chassis	

Check the input current: (75mA- 160 mA)

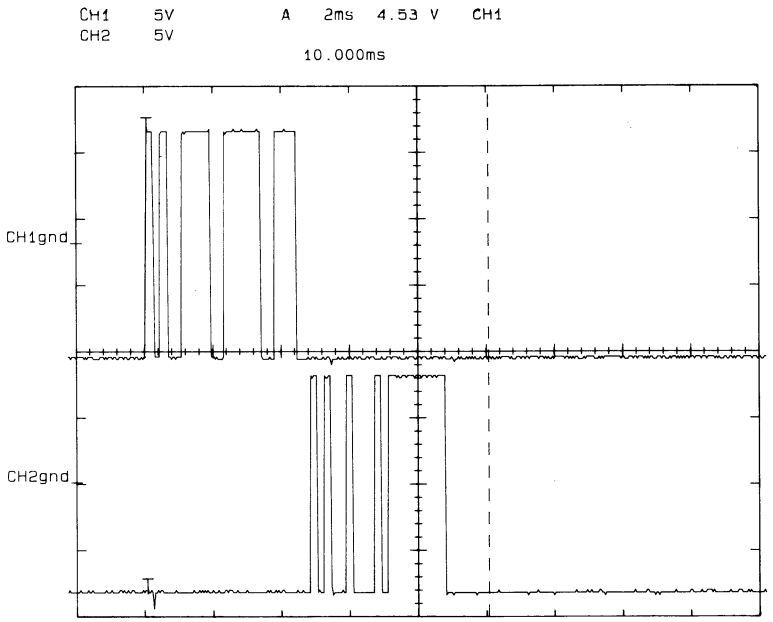
Outgoing:	PLUG	PIN	Meas. ref.
GND	P1	18,20	
CHASSIS	P1	14	
+5 volt	P1	17	GND
+15 volt	P1	16	GND

The Anode off D3 (upper right) can be used as GND.

Incoming and Outgoing signals to other units in the GMDSS system.

VHF DSC (PRIMARY) RM2042
Switch ON the VHF DSC (PRIMARY) RM2042 and press **RESET** on the KEYBOARD.
After 10 secs., the following signal can be seen on the oscilloscope.

CH1 connected to J1 pin 3 Meas. ref J1 pin 5
CH2 connected to J1 pin 2 Meas. ref J1 pin 5
5 Volt/div and 2 msek/div.



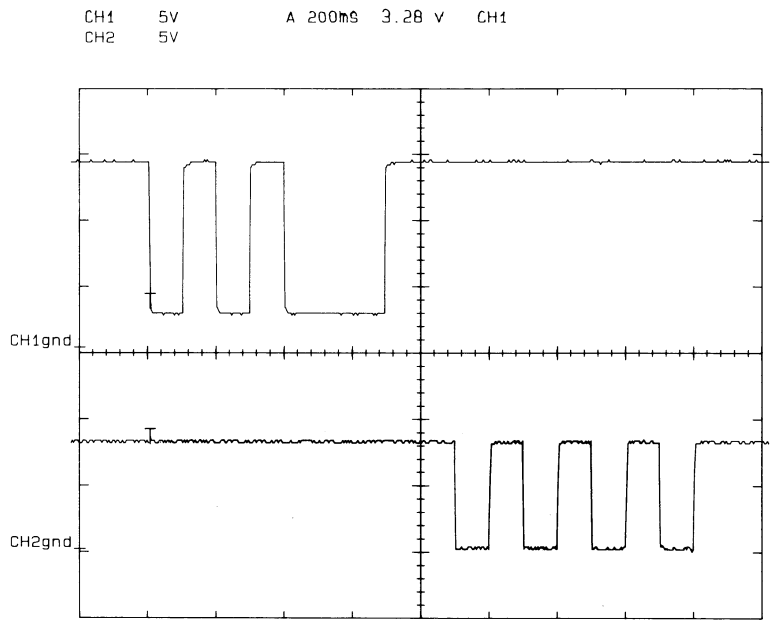
PLOT 1.

VHF DSC (SECONDARY) RM2042
Switch OFF the VHF DSC (PRIMARY) RM2042 and switch ON the VHF DSC (SECONDARY) RM2042, press **RESET** on the KEYBOARD.

After 10 secs., the same as PLOT 1 can be seen.

MF/HF DSC RM2150/51
Switch ON the MF/HF DSC RM2150/51 and press **RESET** on the KEYBOARD.
After 10 secs., the following signal can be seen on the oscilloscope.

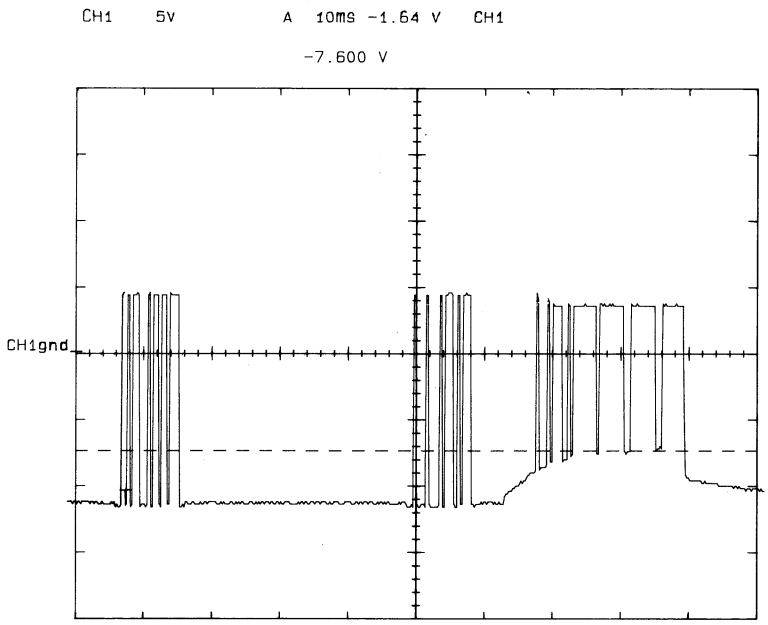
CH1 connected to J5 pin 3 Meas. ref J5 pin 5
CH2 connected to J5 pin 2 Meas. ref J5 pin 5
5 Volt/div and 200 msek/div.



PLOT 2.

SES H2095
Switch ON the SES H2095. The following signal can be seen on the oscilloscope.

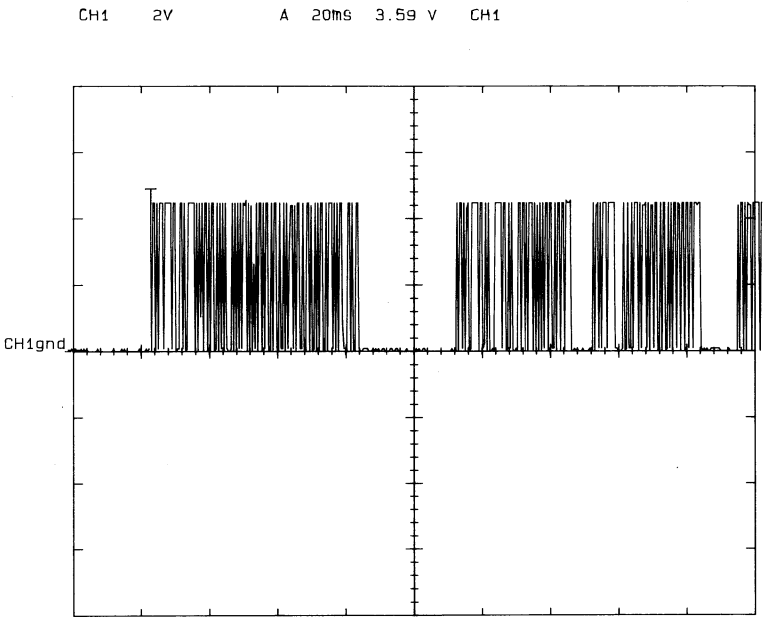
CH1 connected to J4.
5 Volt/div and 10 msek/div.



PLOT 3.

SAT NAVTEX G.P.S. NMEA183
The following signal can be seen on the oscilloscope typical.

CH1 connected to J3.
2 Volt/div and 20 msek/div.



PLOT 4.

Incoming and Outgoing signals to the Microprocessor (Module 3) in the ALARM UNIT C2149.

The PLUG P1 is the connection between the Interface (Module 4) and the Microprocessor (Module 3). All ---signals are described in section 3.4.

3.5 PERFORMANCE CHECK.

Follow the SERVICE TROUBLE SHOOTING chapter 3.3 and 3.4.

3.6 ADJUSTMENT PROCEDURE.

None

3.7 NECESSARY ADJUSTMENT AFTER REPAIR.

None

3.8 FUNCTION CHECK.

3.8.1 DISPLAY.

Press **LAMP TEST** on the KEYBOARD.
Check that all lamps in the display is blinking 3 times.

3.8.2 SOUND TEST.

Press **SOUND TEST** on the KEYBOARD.
Check that the alarm sound is laud and clear.

3.8.3 COMMUNICATION TO OTHER UNITS.

Switch ON the VHF DSC PRIMARY, and switch OFF the VHF DSC SECONDARY. Press **RESET** on the KEYBOARD. Check that the display lamp VHF DSC is on, after 10 secs.

Switch OFF the VHF DSC PRIMARY, and switch ON the VHF DSC SECONDARY. Press **RESET** on the KEYBOARD. Check that the display lamp VHF DSC is ON, after 10 secs.

Switch ON the MF/HF DSC. Press **RESET** on the KEYBOARD.
After 10 secs. Check that the display lamp MF/HF DSC is flashing, and after 2 sec. the display lamp is ON constantly.

Switch ON the SES.
Check that the display lamp SES is ON after maximum 42 sec.

3.8.4 DIMMER.

Press **DIM** on the KEYBOARD 5 times.
Check that the light in the display can be increased, and be switch OFF.

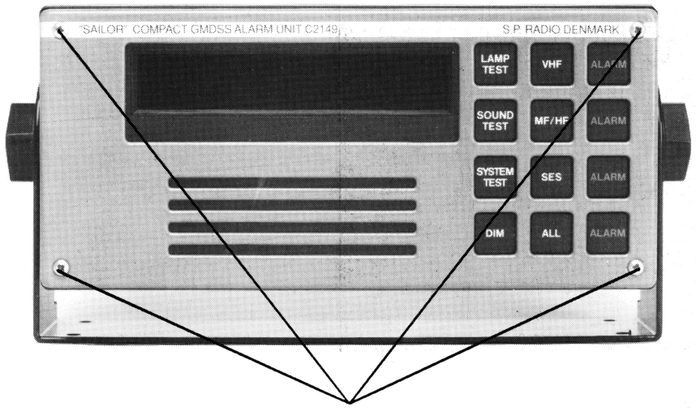
3.9 SERVICE PROGRAMS.

None

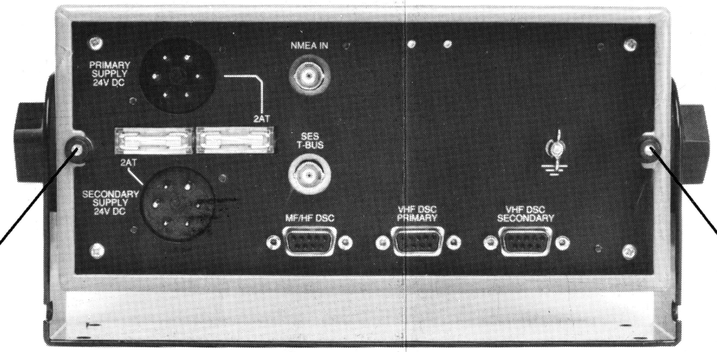
CONTENTS

4. MECHANICAL DESCRIPTION

4.1 MECHANICAL DISASSEMBLING AND UNITS LOCATION

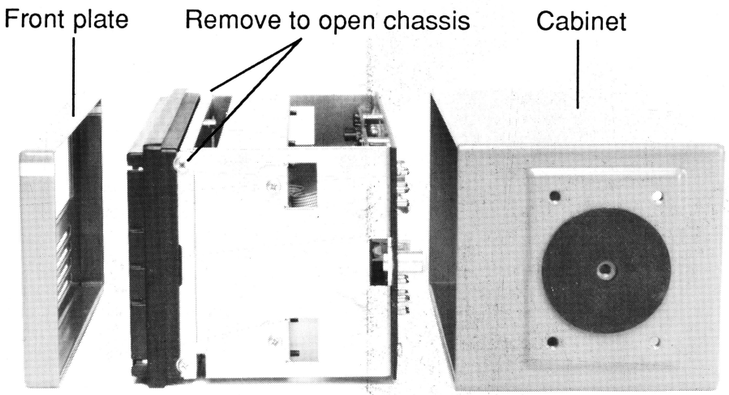


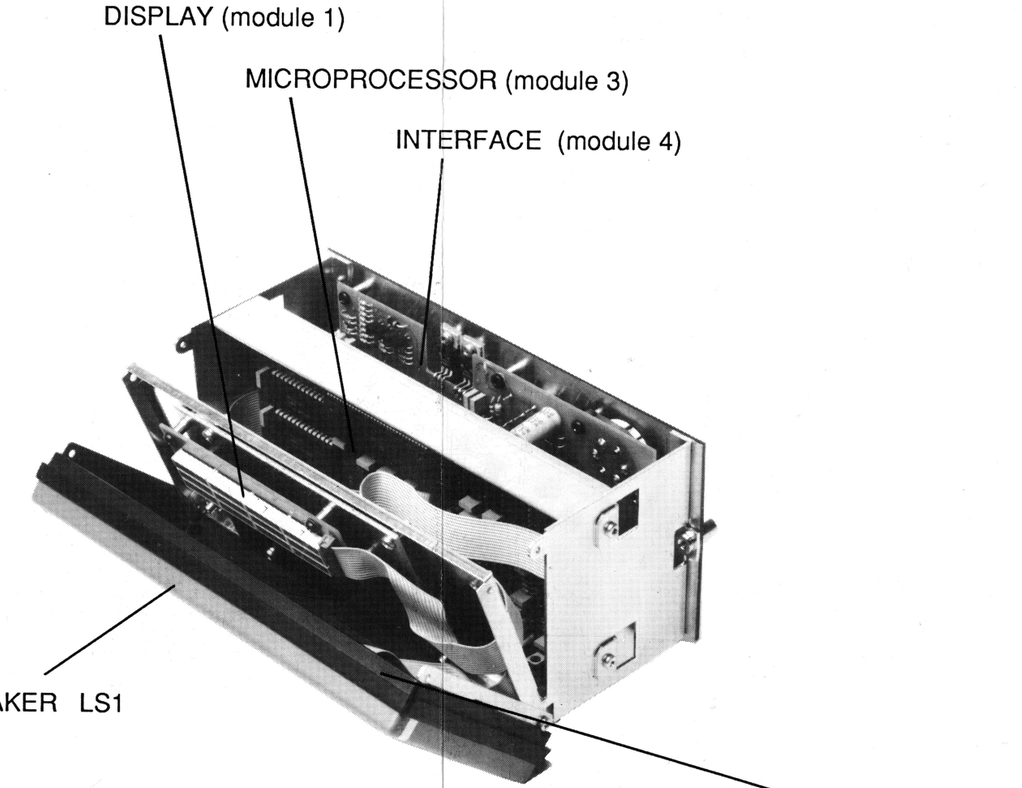
Remove to disassemble the front plate



Remove
to disassemble C2149

Remove
to disassemble C2149

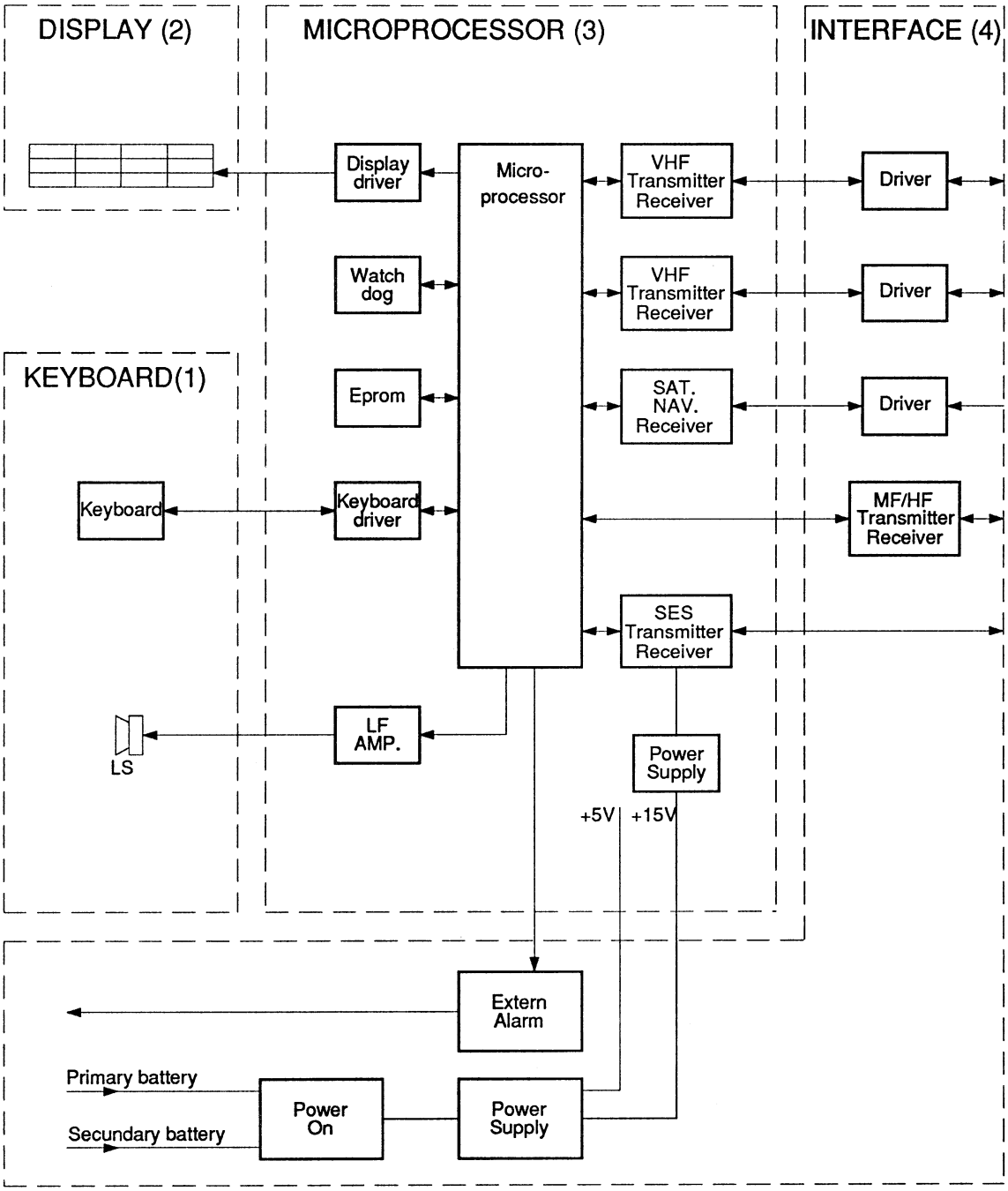




CONTENTS

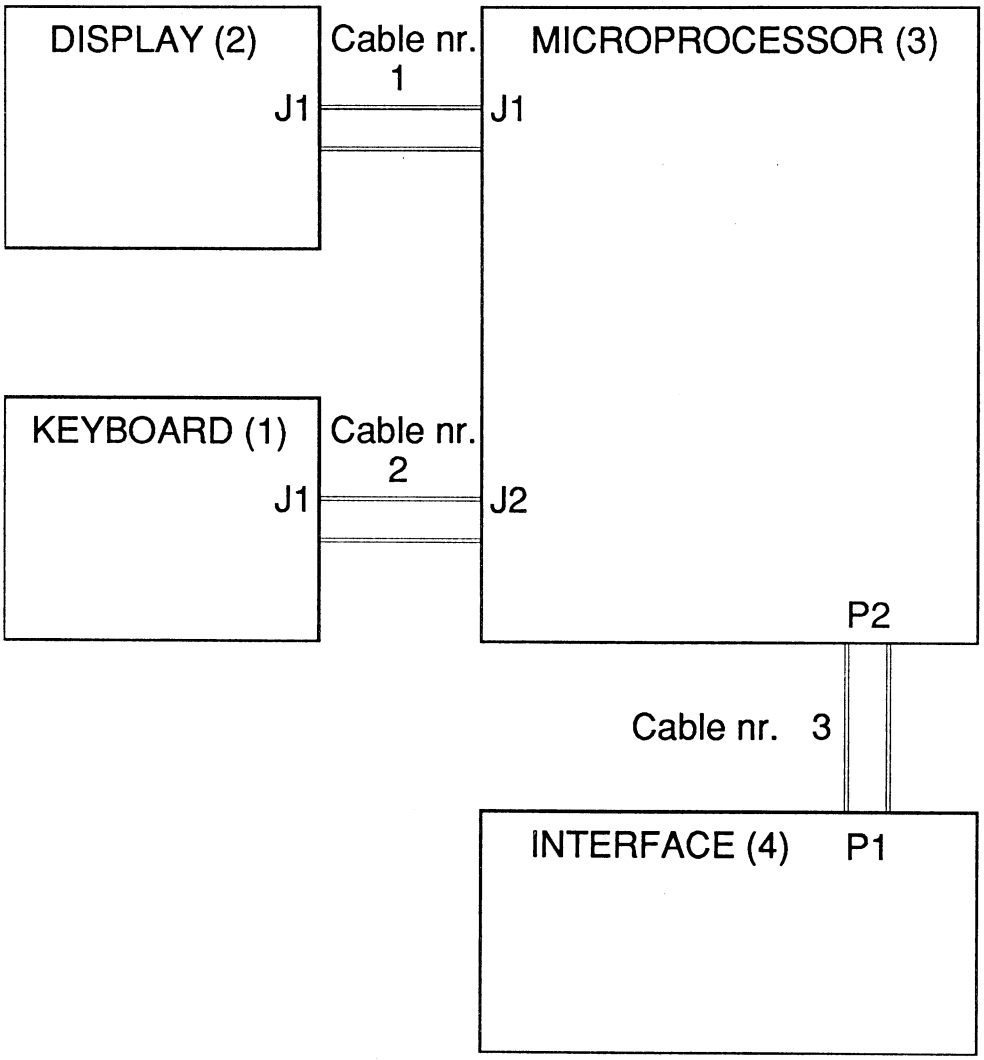
5. CIRCUIT DESCRIPTION AND SCHEMATIC DIAGRAMS

The schematic block diagram.



5. CIRCUIT DESCRIPTION AND SCHEMATIC DIAGRAMS cont.:

The cable connection between units.



The cable connection between units.

INTERNAL FLAT CABLE

Flat cable nr. 1
Between Display (2) and Microprocessor (3). The cable is a part of the Display module (2). SP No. 627052

PIN	SIGNAL
1	6-15 VOLT
2	VHF DSC ON
3	VHF DISTRESS
4	VHF URGENCY
5	VHF SEND
6	MF/HF DSC ON
7	MF/HF DISTRESS
8	MF/HF URGENCY
9	MF/HF SEND
10	SES ON
11	SES DISTRESS
12	SES URGENCY
13	SES SEND
14	GND

Flat cable No. 2
Between Keyboard (1) and Microprocessor (3)

SP No. 56.057

PIN	SIGNAL
1	15 VOLT
2	Y1 IN
3	Y2 IN
4	Y3 IN
5	Y4 IN
6	X1 OUT
7	X2 OUT
8	X3 OUT
9	KEY LIGHT
10	GND
11	NC
12	NC
13	LS
14	LS

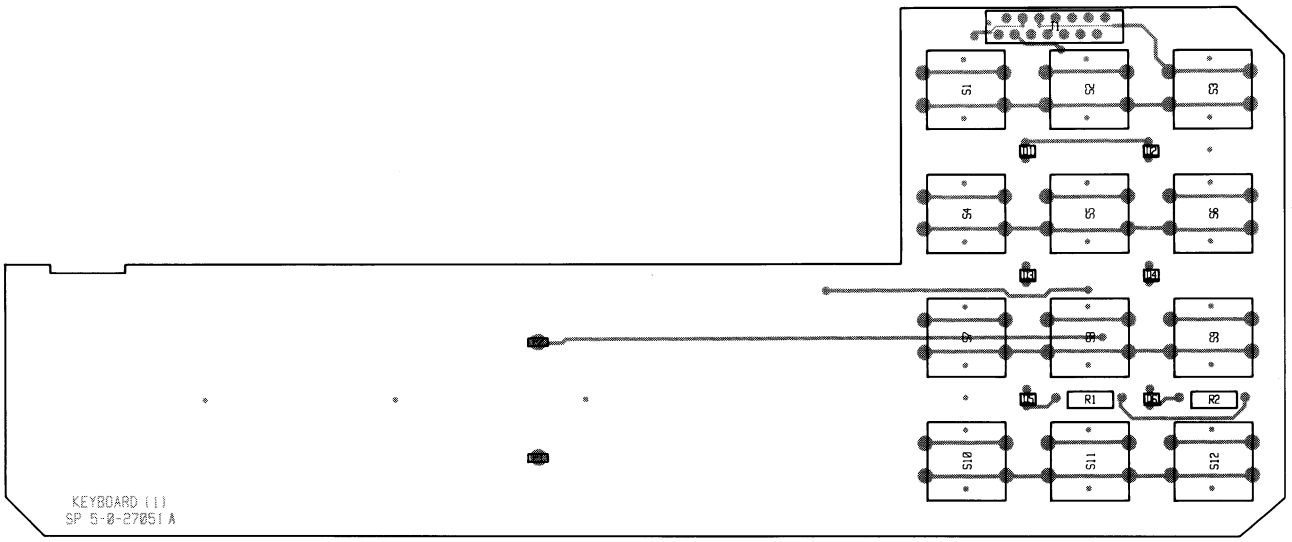
Flat cable No. 3
Between Interface (4) and Microprocessor (3).

SP No. 56.059

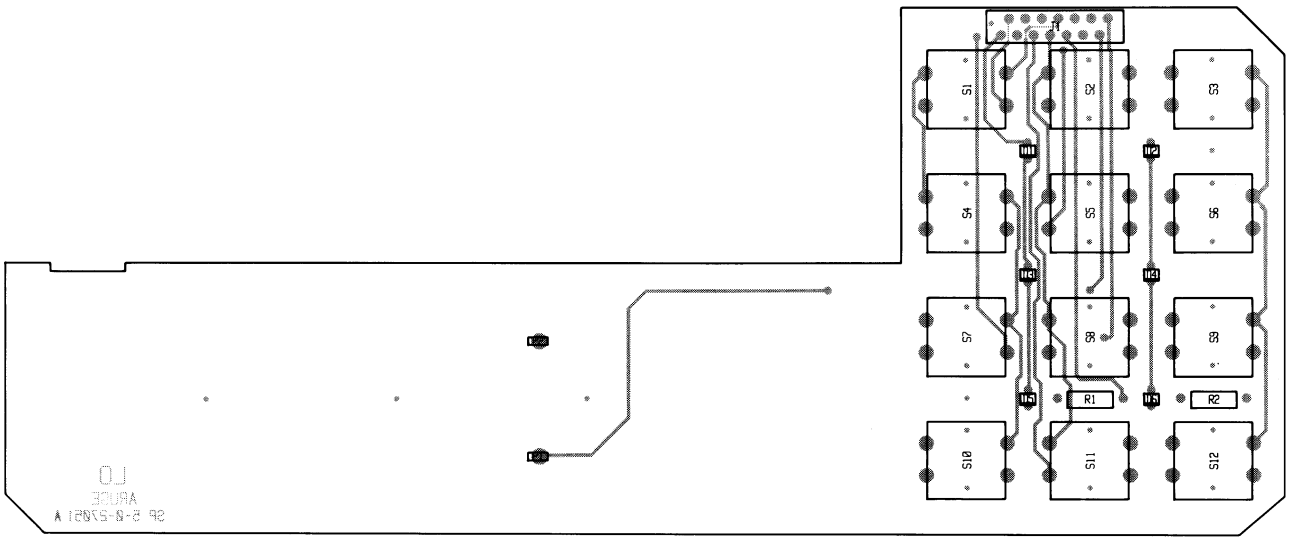
PIN	SIGNAL
1	T-BUS IN/OUT
2	NMEA183 IN
3	MF/HF IN
4	MF/HF OUT
5	EXTERNAL ALARM
6	VHF S OUT
7	VHF S IN
8	VHF P OUT
9	VHF P IN
10	MF/HF ON
11	VHF S ON
12	VHF P ON
13	SES ON
14	T-BUS GROUND
15	NC
16	+15 VOLT
17	+5 VOLT
18	GND
19	NC
20	GND

COMPONENT LOCATION KEYBOARD MODULE 1

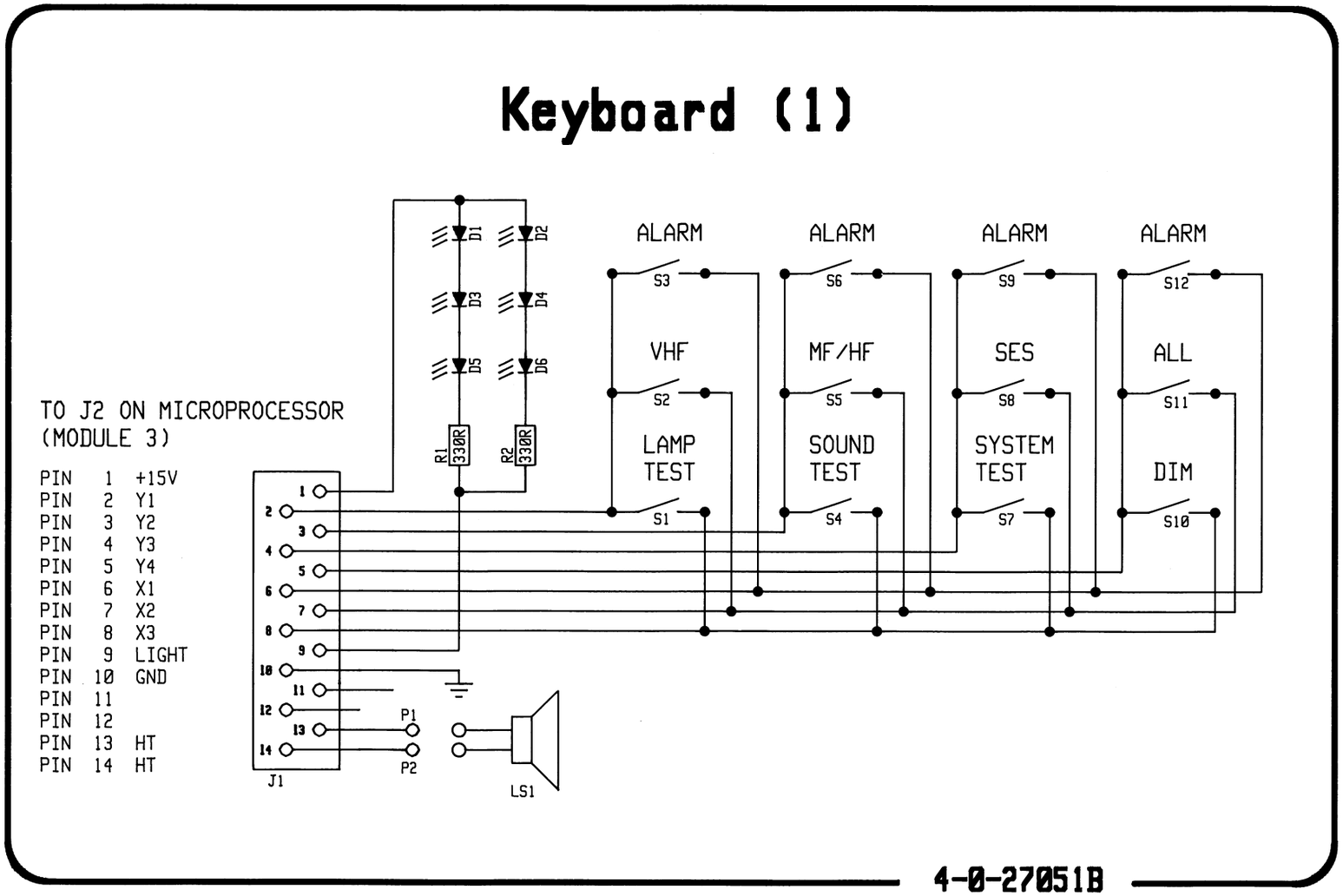
5.1. COMPONENT LOCATION KEYBOARD (MODULE 1)



Seen from component side with upper side tracks.

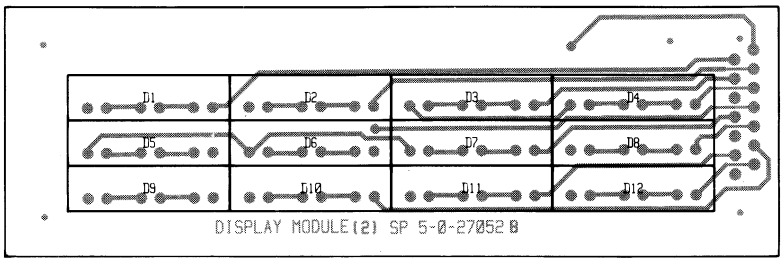


Seen from component side with lower side tracks.

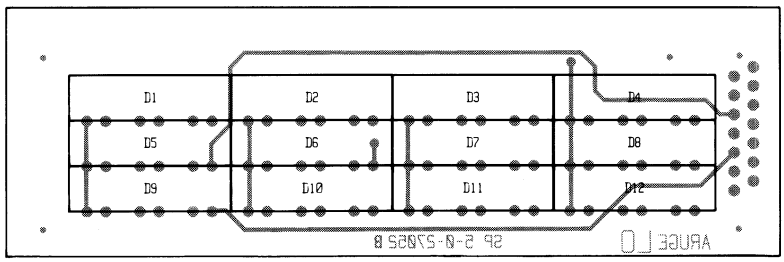


C2149 4-0-27051B

5.2. COMPONENT LOCATION DISPLAY (MODULE 2)



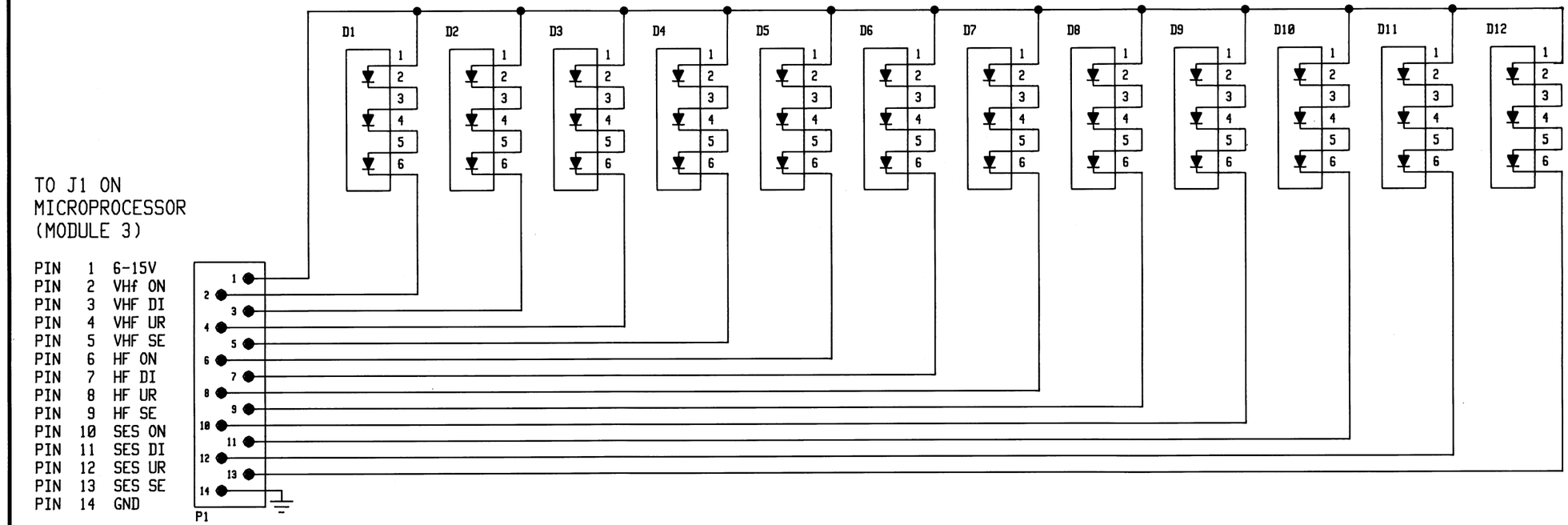
Seen from component side with upper side tracks.



Seen from component side with lower side tracks.

C2149 4-0-27052A

Display module (2)



5-0-27052A

5.3 Microprocessor (Module 3)

Functional description.

The Microprocessor (Module 3) has the following main function:

- **RECEIVE AND SEND DISTRESS**
- communication with the Standard C Terminal (SES)
- and galvanic isolation to the SES.
- communication with the MF/HF DSC
- communication with the VHF DSC
- receiving data from the Satellite Navigator G.P.S
- control the display
- read the keyboard
- make the acoustic alarm signal

These functions are implemented partially in hardware and partially in software.
The software to GMDSS ALARM UNIT C2149 is C1100x SP nr. 727497. (x= , ,A,B,C,D,E,..)

The Microprocessor (module 3) hardware is separated in a number of circuits, referring to the diagram:
- microcomputer
- clock oscillator
- watch dog
- power supply to the SES driver
- communication bus driver and receiver (T-BUS).
- display driver
- light dimmer
- LF amplifier
- usart's for serial communication
- chip select

MICROCOMPUTER
The purpose of the Microcomputer bloc is to run the program properly. It consists of the following:

- An 8 bit Hitachi microprocessor, U9
- An EPROM, carrying the program, U8
- Chip select circuit for the EPROM U6.4
- A Watch Dog U10.
- Jumpers P3

CLOCK OSCILLATOR AND A BINARY COUNTER
The clock frequent is generated of the crystal (4.9152 Mhz) X1, C21, C22, and U14.3 and U14.2. The binary counter U20 convert the clock frequent into two lower frequent (76.8 Khz, 38.4 Khz) used for Baud Rate.

WATCH DOG
The MAX 690 (U10) has the following purposes:

- Ensure a proper Reset for the microprocessor when
- the +5Volt is stable.
- Watch Dog.

During normal operation the microprocessor resets the watch dog at known locations in the program. If the microprocessor stays too long time in an unintentional loop, the Watch Dog will not be reset.
The Watch Dog will then activate the Reset pin on the microprocessor.
This may happen if the microprocessor is waiting for an event that never comes (failure in hardware) or noise has disturbed the program execution.

Jumper	Inserted	Out
1	NC	NC
2	Do not insert.	
3	Do not insert.	
4	NC	
5	Do not insert. For self test use.	Normal operation.

Jumper 1 is the Jumper placed in the right side.

The upper part of jumper 1-5 can be used as GND for measurements in the Microprocessor (module 3).

POWER SUPPLY FOR THE SES DRIVER
The power supply make a galvanic isolation between the SES GROUND and the C2149 GND, it deliver the voltages app. +/- 6.5 volt.
R28 and C12 make the switch frequent of app. 83.0 Khz.

T-BUS DRIVER & RECEIVER
The communication to the SES is a time multiplexed data bus. The SES is the Master and a number of Slaves may be connected to the T-Bus. The Driver output is normally in high impedance state except when transmitting on the T-Bus. The Driver consists of two gates, U6/1 & U6/2 (74HC132), two opto coupler OC1.1 & OC1.2 (for galvanic isolation) and two complementary output transistors Q2 (BC640), Q3 (BC639). D4 and D5 is placed to protect the T-BUS driver/receiver. The Driver is connected to the Microprocessor U9, pin 13 (Port 2, bit 4, Transmit Data), and pin 10 (Port 2, bit 1, Driver Enable. The Receiver consists of a opto coupler OC2.1 which is used for galvanic isolation. The Receiver is connected to the Microprocessor U9, pin12 (Port 2, bit 3, Receive Data). As the levels on the T-Bus approximately matches to the RS232C Standard, it is possible to connect a RS232C to the T-Bus.

DISPLAY DRIVER
This driver activates all LAMPS (LED diodes) on the Display (Module 1).
It consists of two serial to parallel shift register U2, U5 (74HC595) and two darlington drivers, located in U1 and U4 (MC1413). R1, R2 and R3 reduce the current in the Display.

LIGHT DIMMER
The functions of this circuit is to control the LIGHT in the Display at four levels. The level of the Light is selected from the microprocessor via the shift register U5, (High level pin 15), (High Middle level pin 1), (Low Middle level pin 2) and (Low level none). The signal from U5 is divided by R9,R10,R7 and added with the signal from R8. Applied to the non-inverting input of the op-amp. The op-amp. U3/2 has a gain of app.2 . The output voltage is buffed by the output transistors Q1.

KEYBOARD DRIVER.

The keyboard (Module 1) has been built up as a 3*4 matrix of whits all 12 keys are used. The keyboard is scanned every 10 msec. by means of 3 ports from the microprocessor, and received trough U17 on the data bus.

LF AMPLIFIER

The U16 (TDA7052) LF Amplifier deliver app 1 WATT to the 8 ohm's LS on the Keyboard (Module 2). The signal is deliver from U9 pin 15, and divided trough R27,C27 and R26,C26.

USART'S FOR SERIAL COMMUNICATION

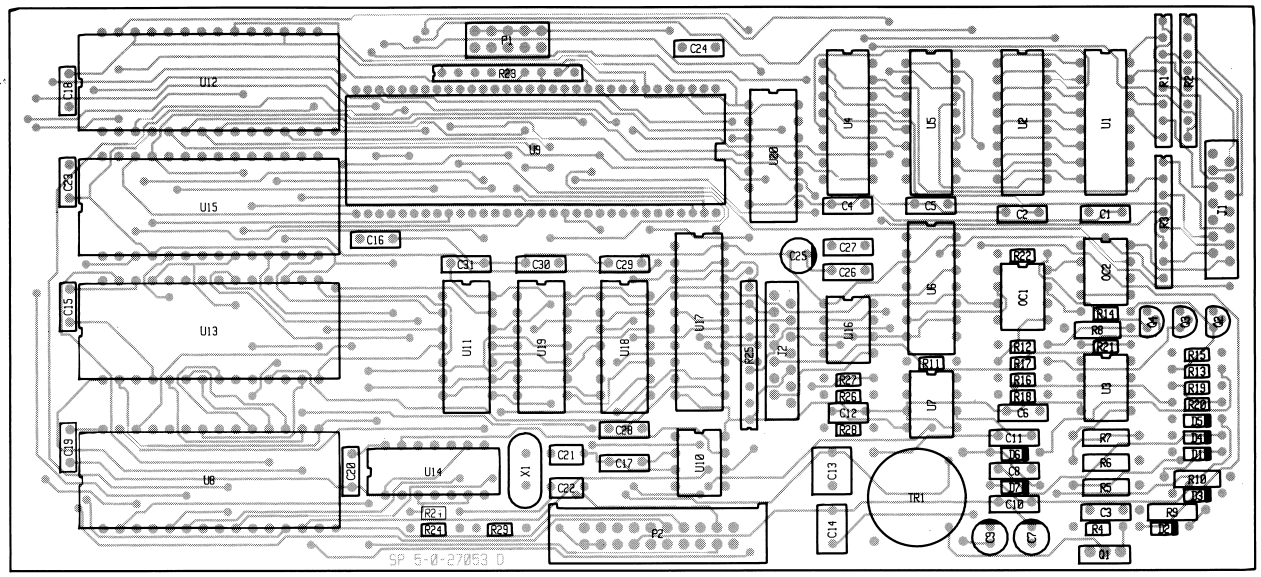
The Usart's U12, U13 and U15 is used for serial communication with the G.P.S (nmea183) and two VHF DSC. The TXready and RXready outputs are added trough a logical OR circuit, consist of U11.2, U14.5 and U11.1. This output is used as input to the processor.

CHIP SELECT CIRCUIT

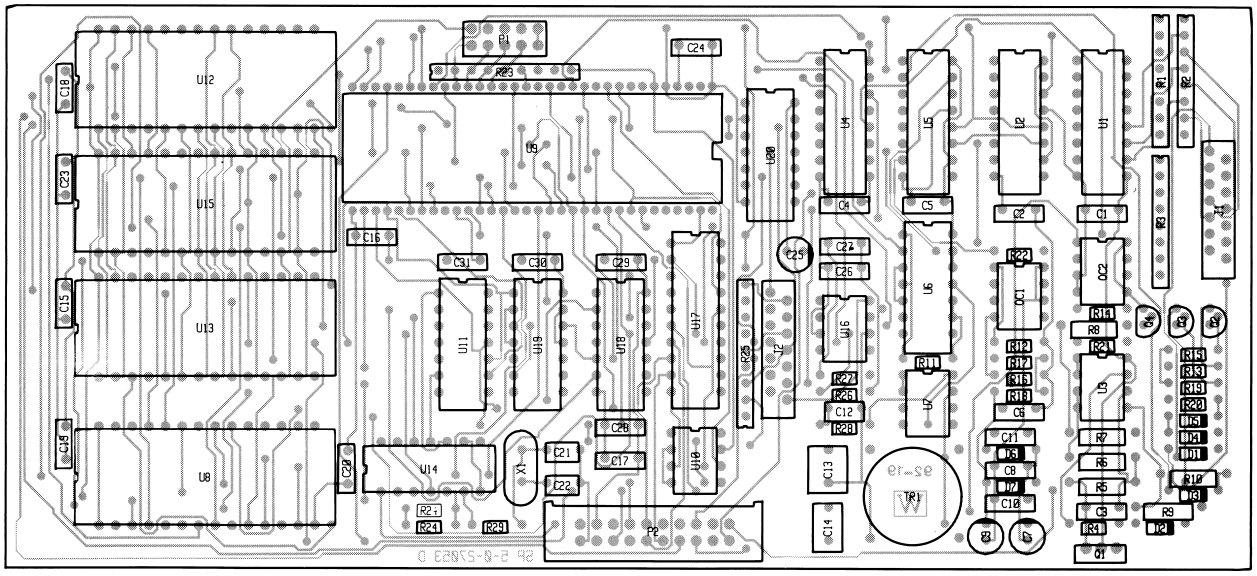
The four chip select circuits is used for:

1.	Keyboard and supply	U17	U18.1 and U11.3
2.	Secondary VHF DSC	U15	U18.2 and U19.1
3.	Primary VHF DSC	U13	U19.3 and U18.3
4.	G.P.S. (NMEA183)	U12	U19.2 and U18.4

5.3. COMPONENT LOCATION MICROPROCESSOR (MODULE 3)

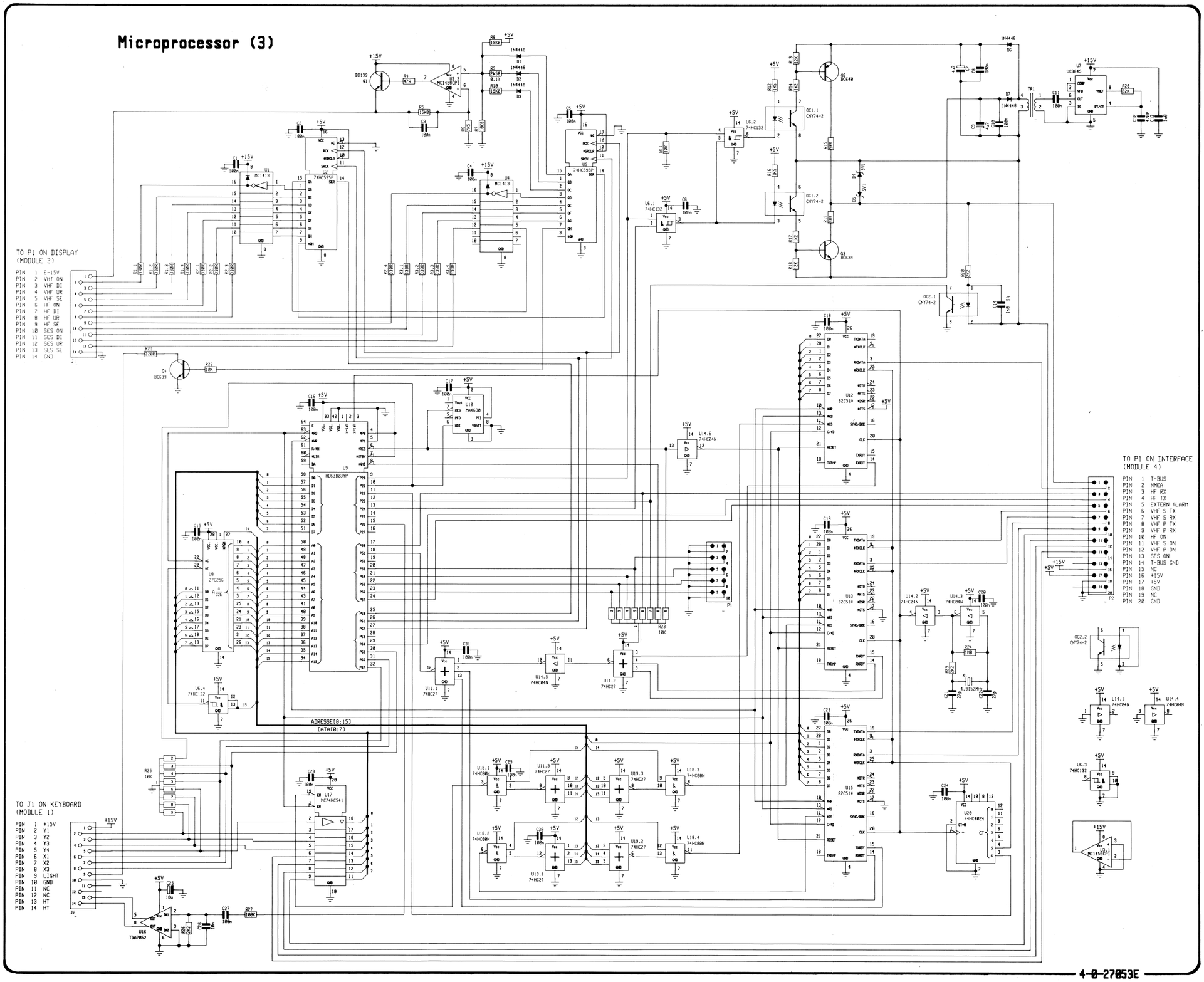


Seen from component side with upper side tracks.



Seen from component side with lower side tracks.

5.3. MICROPROCESSOR (MODULE 3)



C2149 4-0-27053E

MICROPROCESSOR MODULE 3

5.4 Interface (Module 4)

The main function of the Interface (Module 4) is to make the galvanic isolation between the Battery minus and the ground of all the connected units. This function is separated in a number of circuits, referring to the diagrams.

- primary and secondary supply
- switch ON circuit
- internal power supply
- extern alarm
- MF/HF DSC transmitter/receiver
- NMEA interface
- VHF DSC driver (transmitter/receiver)

PRIMARY AND SECONDARY SUPPLY
The voltages from the Primary Battery is OR'ed to the voltages from the Secondary battery trough D3,D4,F1,F2,D6,D7 and D8, in order to deliver a stable supply to the C2149. The diodes D3 and D4 secure that there is no connection between the two Ship batteries. If the Voltage from one of the batteries or the difference between the batteries becomes grater than 40 volts the thyrister D26 goes on and stays on until the Fuse blow. This is done en order to protect the C2149.

SWITCH ON CIRCUIT
The switch on circuit secure that the C2149 is switch ON if one or more, of the connected units is switch on.
The relay RE2 is activated from transistor Q4 trough R40. Q4 is sourced from one of the opto couplers OC2.1, OC3.2, OC4.2 or OC5.2, trough D12, D13, D14 or D15. The diodes D16,D17,D18 and D19 secure that the current is app. 0 Amp. when the C2149 is switch off. The transistor Q5,Q6,Q7 and Q8 reduce the off voltages down to 5 volt in order to protect the CPU unit.

INTERNAL SUPPLY
The C2149 is supplied from the ship battery 24 volt (20-32volt) and converted into 2 internal supplies in U2 (15 volt) and U3 (5 volt).

EXTERNAL ALARM
The relay RE1 can be used to drive an external alarm indicator. RE1 is soused direct from the CPU pin 24 trough Q3.

MF/HF DSC INTERFACE
The serial communication between the C2149 and the MF/HF DSC RM2150/51 is a slow asynchronous transmitter-receiver (10 Baud).

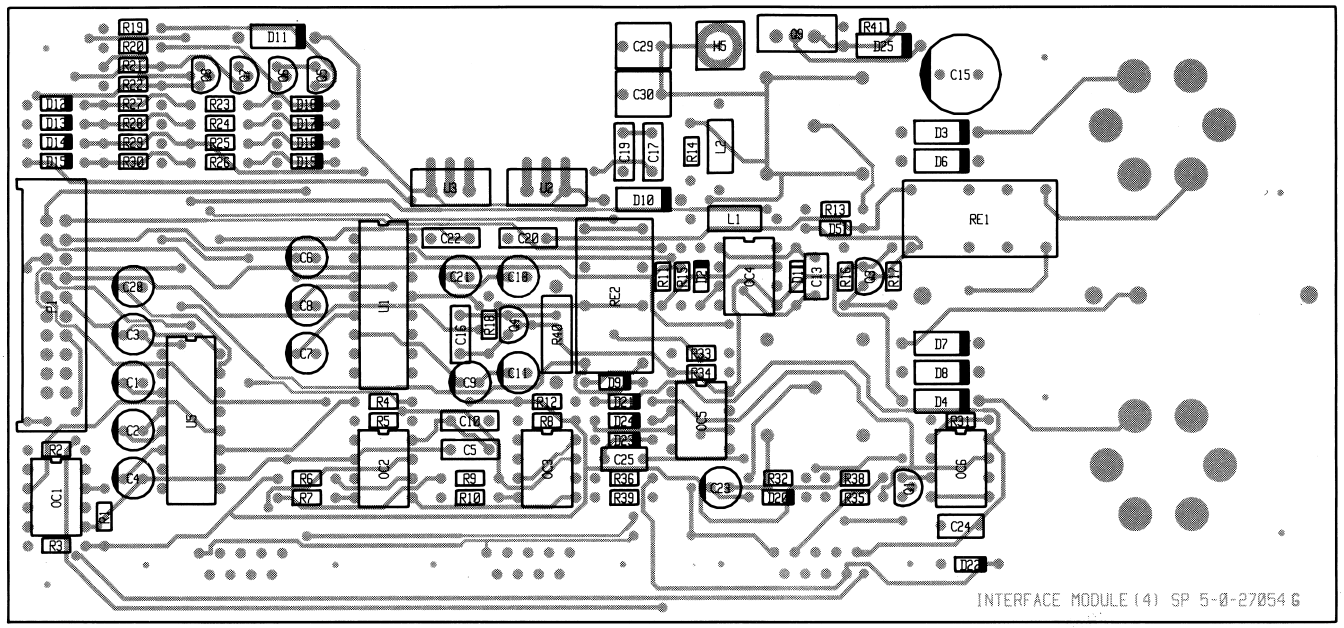
Transmitter
The open collector output, Collector of OC6.1 is pulled up by the RM2150/51. The Opto coupler OC6.1 is controlled from the CPU pin 29 trough Q1. D21, D22, C24 and R35 is for protection propose.

Receiver.
The open collector output from the RM2150/51 is used sa drive for the opto coupler OC5.1. R36 reduce the current in the opto coupler. D23, D24, R38 and C25 is for protection propose. The receiver is supplied from the N2165 with +9 volt.

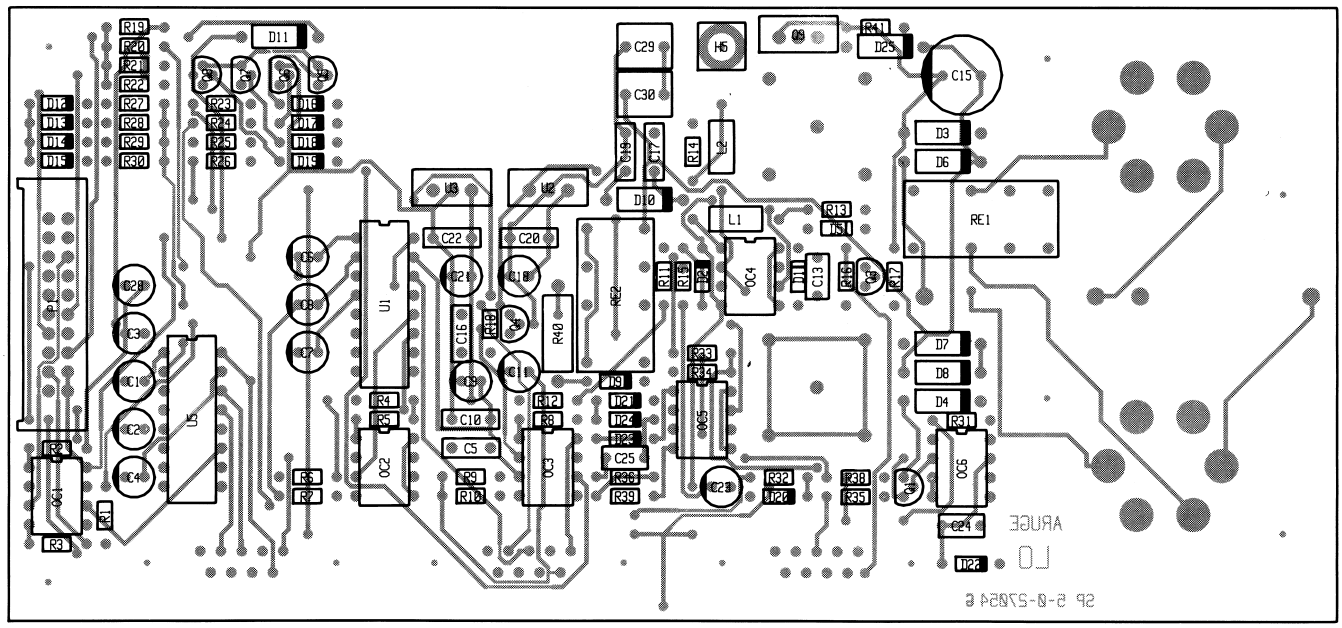
G.P.S NMEA183 INTERFACE
The opto coupler OC4.1 is for galvanic isolation, and C13, D1, L1, L2, R13 and R14 is for protection the opto coupler.

VHF DSC INTERFACE
The primary and secondary VHF DSC interface are identical, and only the Primary interface is explain. The RS232 receiver-transmitter driver U5 is supplied direct from the VHF DSC RM2042. C5 and C28 is placed to stabilize the +5 volt supply, and C1, C2, C3, C4 and C5 is placed to stabilize the internal generated voltages + 7.5 volt and -7.5 volt. The opto coupler OC1.1 and OC1.2 is for galvanic isolation.

5.4. COMPONENT LOCATION INTERFACE (MODULE 4)



Seen from component side with upper side tracks.



Seen from component side with lower side tracks.

C2149 4-0-27054G

Interface (4)

TO VHF DSC SECONDARY

PIN 1 CHASSIS
PIN 2 RS232 INPUT
PIN 3 RS232 OUTPUT
PIN 4 NC
PIN 5 -BATT
PIN 6 NC
PIN 7 NC
PIN 8 NC
PIN 9 +5VP

TO VHF DSC PRIMARY

PIN 1 CHASSIS
PIN 2 RS232 INPUT
PIN 3 RS232 OUTPUT
PIN 4 NC
PIN 5 -BATT
PIN 6 NC
PIN 7 NC
PIN 8 NC
PIN 9 +5VS

NMEA IN

TO SES T-BUS

TO P2 ON MICROPROCESSOR (MODULE 3)

PIN 1 T-BUS
PIN 2 NMEA
PIN 3 HF RX
PIN 4 HF TX
PIN 5 EXT. ALARM
PIN 6 VHF S TX
PIN 7 VHF S RX
PIN 8 VHF P TX
PIN 9 VHF P RX
PIN 10 HF ON
PIN 11 VHF S ON
PIN 12 VHF P ON
PIN 13 SES ON
PIN 14 CHASSIS
PIN 15 NC
PIN 16 +15V
PIN 17 +5V
PIN 18 GND
PIN 19 NC
PIN 20 GND

TO MF/HF DSC

PIN 1 CHASSIS
PIN 2 INPUT
PIN 3 OUTPUT
PIN 4 NC
PIN 5 GROUND
PIN 6 NC
PIN 7 NC
PIN 8 NC
PIN 9 +9V

PRIMARY SUPPLY 24V DC

SECONDARY SUPPLY 24V DC

4-0-27054G
24.03.92

CONTENTS

C2149 GRØN

POSITION	DESCRIPTION		MANUFACTOR	TYPE	S.P.NUMBER
	GMDSS ALARM UNIT C2149		ESPERA	GMDSS ALARM UNIT C2149 SAILOR GREEN	802149
VARIOUS	MINI 1/4 BOX CABINET	SAILOR GREEN		225435 GRØN RILSAN ALUMINIUM	141.751
VARIOUS	FRONTPLATE C2149	SAILOR GREEN		227059 LAK	143.561
VARIOUS	POWER CABLE WITH PLUG		ESPERA	503758 POWERKABEL	503758
VARIOUS	OPERATION MANUAL	C2149 ENGLISH	HESTBECH & CO.		B2149GB
VARIOUS	SERVICE AND SALES AGENTS	ADRESSES WORLD WIDE	S.P.RADIO A/S		F1000GB
VARIOUS	MANUAL C2149 ENGLISH		S.P.RADIO A/S		M2149GB

POSITION	DESCRIPTION		MANUFACTOR	TYPE	S.P.NUMBER
	BASE UNIT C2149 STD.		S.P.RADIO A/S		702149
VARIOUS	KEYBOARD FOIL C2149		ESPERA	1-0-27224 / 9-3-27224A VÆRKTØJ 1-0-24036E	227224
VARIOUS	HOLE PLUG, M5, BLACK		A.SANDER	TG.0-3-24252	48.549
VARIOUS	COVER FOR ALLEN SCREW		SANDER PLAST	0-3-25350A	48.699
VARIOUS	INTERCONNECTION CABLE	14 POLES L=305mm	S.P.RADIO	3-0-27479	527479
VARIOUS	INTERCONNECTION CABLE	20 POLES L=470mm	S.P.RADIO	3-0-27481	527481
-1	KEYBOARD MODULE (1)	C2149	S.P. RADIO A/S	5-0-27051A	627051
-2	DISPLAY MODULE (2)	C2149	S.P.RADIO A/S	5-0-27052B	627052
-3	CPU UNIT MODULE (3)	C2149	S.P.RADIO A/S	5-0-27053D	627053
-4	INTERFACE UNIT MODULE (4)	C2149	S.P.RADIO A/S	5-0-27054G	627054
LS1-1	LOUDSPEAKER	8 OHMS 1W Ø45mm	PEITONE	45S02A4	46.053
U2-4	VOLTAGE REGULATOR	FIXED 15V/1A	MOTOROLA	MC7815CT	31.090
U3-4	VOLTAGE REGULATOR	FIXED 5V/1A	MOTOROLA	MC7805CT	31.250

POSITION	DESCRIPTION		MANUFACTOR	TYPE	S.P.NUMBER
	KEYBOARD MODULE (1)	C2149	S.P. RADIO A/S	5-0-27051A	627051
-1	KEYBOARD MODULE (1)			5-0-27051A / 1-0-27051	52.071
D1-1	DIODE LIGHT EMITTING	SUB MINIATURE YELLOW	H.P.	HLMP-7019	25.649
D2-1	DIODE LIGHT EMITTING	SUB MINIATURE YELLOW	H.P.	HLMP-7019	25.649
D3-1	DIODE LIGHT EMITTING	SUB MINIATURE YELLOW	H.P.	HLMP-7019	25.649
D4-1	DIODE LIGHT EMITTING	SUB MINIATURE YELLOW	H.P.	HLMP-7019	25.649
D5-1	DIODE LIGHT EMITTING	SUB MINIATURE YELLOW	H.P.	HLMP-7019	25.649
D6-1	DIODE LIGHT EMITTING	SUB MINIATURE YELLOW	H.P.	HLMP-7019	25.649
J1-1	SOCKET	2x7 POLES	AMP	1-215079-4	78.196
P1-1	SOLDER LUG	PCB VERSION	VOGT AG	01015/Bz-Sn	82.005
P2-1	SOLDER LUG	PCB VERSION	VOGT AG	01015/Bz-Sn	82.005
R1-1	RESISTOR MF	330 OHM 5% 0.4W	PHILIPS	2322 161 53331	01.187
R2-1	RESISTOR MF	330 OHM 5% 0.4W	PHILIPS	2322 161 53331	01.187
S1-1	SWITCH KEYBOARD	12x12mm	ALPS	SKHCAD (KHC 10904)	43.601
S2-1	SWITCH KEYBOARD	12x12mm	ALPS	SKHCAD (KHC 10904)	43.601
S3-1	SWITCH KEYBOARD	12x12mm	ALPS	SKHCAD (KHC 10904)	43.601
S4-1	SWITCH KEYBOARD	12x12mm	ALPS	SKHCAD (KHC 10904)	43.601
S5-1	SWITCH KEYBOARD	12x12mm	ALPS	SKHCAD (KHC 10904)	43.601
S6-1	SWITCH KEYBOARD	12x12mm	ALPS	SKHCAD (KHC 10904)	43.601
S7-1	SWITCH KEYBOARD	12x12mm	ALPS	SKHCAD (KHC 10904)	43.601
S8-1	SWITCH KEYBOARD	12x12mm	ALPS	SKHCAD (KHC 10904)	43.601
S9-1	SWITCH KEYBOARD	12x12mm	ALPS	SKHCAD (KHC 10904)	43.601
S10-1	SWITCH KEYBOARD	12x12mm	ALPS	SKHCAD (KHC 10904)	43.601
S11-1	SWITCH KEYBOARD	12x12mm	ALPS	SKHCAD (KHC 10904)	43.601
S12-1	SWITCH KEYBOARD	12x12mm	ALPS	SKHCAD (KHC 10904)	43.601

POSITION	DESCRIPTION		MANUFACTOR	TYPE	S.P.NUMBER
	DISPLAY MODULE (2)	C2149	S.P.RADIO A/S	5-0-27052B	627052
-2	DISPLAY MODULE (2)			5-0-27052B / 1-0-27052A	52.072
D1-2	LIGHT BAR	RED 4.5x20mm	ROHM	LD701VR	25.700
D2-2	LIGHT BAR	RED 4.5x20mm	ROHM	LD701VR	25.700
D3-2	LIGHT BAR	RED 4.5x20mm	ROHM	LD701VR	25.700
D4-2	LIGHT BAR	RED 4.5x20mm	ROHM	LD701VR	25.700
D5-2	LIGHT BAR	RED 4.5x20mm	ROHM	LD701VR	25.700
D6-2	LIGHT BAR	RED 4.5x20mm	ROHM	LD701VR	25.700
D7-2	LIGHT BAR	RED 4.5x20mm	ROHM	LD701VR	25.700
D8-2	LIGHT BAR	RED 4.5x20mm	ROHM	LD701VR	25.700
D9-2	LIGHT BAR	RED 4.5x20mm	ROHM	LD701VR	25.700
D10-2	LIGHT BAR	RED 4.5x20mm	ROHM	LD701VR	25.700
D11-2	LIGHT BAR	RED 4.5x20mm	ROHM	LD701VR	25.700
D12-2	LIGHT BAR	RED 4.5x20mm	ROHM	LD701VR	25.700
P1-2	INTERCONNECTION CABLE	14 POLES L=350mm	S.P.RADIO	3-0-27480	527480

POSITION	DESCRIPTION		MANUFACTOR	TYPE	S.P.NUMBER
	CPU UNIT MODULE (3)	C2149	S.P.RADIO A/S	5-0-27053D	627053
-3	CPU UNIT MODULE (3)			5-0-27053D / 1-0-27053	52.073
C1-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C2-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C3-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C4-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C5-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C6-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C7-3	CAPACITOR ELECTROLYTIC	4.7uF 20% 50VDC	ERO	EKI 00 AA 147 H M9	14.510
C8-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C9-3	CAPACITOR ELECTROLYTIC	4.7uF 20% 50VDC	ERO	EKI 00 AA 147 H M9	14.510
C10-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C11-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C12-3	CAPACITOR CERAMIC	470pF 10% 500VDC	NKE	DT35-0465 758L 471BK 500V FLAT PACK	16.095
C13-3	CAPACITOR MKT	1uF 5% 63VDC	PHILIPS	2222 370 79105	11.190
C14-3	CAPACITOR POLYPROPYLENE	1nF 5% 10VDC	ERO	KP 1830-210/01-4-GW	13.398
C15-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C16-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C17-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C18-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C19-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C20-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C21-3	CAPACITOR CERAMIC	27pF 5% N150 50VDC	NKE	DT 350 758S PH 270 J 50V FLAT PACK	15.076
C22-3	CAPACITOR CERAMIC	27pF 5% N150 50VDC	NKE	DT 350 758S PH 270 J 50V FLAT PACK	15.076
C23-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C24-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C25-3	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C26-3	CAPACITOR MKT	10nF 5% 63VDC	PHILIPS	2222 370 89103	11.134
C27-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C28-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C29-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C30-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C31-3	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
D1-3	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.146
D2-3	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.146
D3-3	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.146
D4-3	DIODE ZENER	9V1 5% 0.4W	PHILIPS	BZX79C9V1	26.546
D5-3	DIODE ZENER	5.1V 5% 0.4W	PHILIPS	BZX79C5V1	26.527
D6-3	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.146

POSITION	DESCRIPTION		MANUFACTOR	TYPE	S.P.NUMBER
D7-3	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.146
J1-3	SOCKET	2x7 POLES	AMP	1-215079-4	78.196
J2-3	SOCKET	2x7 POLES	AMP	1-215079-4	78.196
OC1-3	OPTO COUPLER	CNY74-2	TELEFUNKEN	CNY74-2	32.529
OC2-3	OPTO COUPLER	CNY74-2	TELEFUNKEN	CNY74-2	32.529
P1-3	MULTIPLUG	1/10" DIL SQ PINS 5x2 POL	AMP	826656-5	78.321
P2-3	PLUG	2x10 POLES	3M	3592-6002 / 7620-6002 JL	78.250
Q1-3	TRANSISTOR AF	POWER NPN BD139 SOT-32	PHILIPS	BD139	29.060
Q2-3	TRANSISTOR	BC640	PHILIPS	BC640	28.124
Q3-3	TRANSISTOR AF	NPN BC639 TO-92	PHILIPS	BC639	28.120
Q4-3	TRANSISTOR AF	NPN BC639 TO-92	PHILIPS	BC639	28.120
R1-3	RESISTOR ARRAY	4x330 OHM 5% 1/4W	MURATA	RG SD 4 Y 331J	08.608
R2-3	RESISTOR ARRAY	4x330 OHM 5% 1/4W	MURATA	RG SD 4 Y 331J	08.608
R3-3	RESISTOR ARRAY	4x330 OHM 5% 1/4W	MURATA	RG SD 4 Y 331J	08.608
R4-3	RESISTOR MF	47 OHM 5% 0.33W	PHILIPS	2322 180 73479	02.440
R5-3	RESISTOR MF	15k0 OHM 1% 0.6W	PHILIPS	2322 156 11503	03.429
R6-3	RESISTOR MF	7k50 OHM 1% 0.6W	* PHILIPS	2322 156 17502	03.448
R7-3	RESISTOR MF	10k0 OHM 1% 0.6W	* PHILIPS	2322 156 11003	03.427
R8-3	RESISTOR MF	15k0 OHM 1% 0.6W	PHILIPS	2322 156 11503	03.429
R9-3	RESISTOR MF PRECISION	2k58 OHM 0.1% 75mW	DRALORIC	SMA 0207S-TK25-2k58-0.1% KARTON	06.120
R10-3	RESISTOR MF	15k0 OHM 1% 0.6W	PHILIPS	2322 156 11503	03.429
R11-3	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R12-3	RESISTOR MF	1k5 OHM 5% 0.33W	PHILIPS	2322 180 73152	02.476
R13-3	RESISTOR MF	12k OHM 5% 0.33W	PHILIPS	2322 180 73123	02.498
R14-3	RESISTOR MF	1k2 OHM 5% 0.33W	PHILIPS	2322 180 73122	02.474
R15-3	RESISTOR MF	5.6 OHM 5% 0.33W	PHILIPS	2322 180 73568	02.418
R16-3	RESISTOR MF	1k5 OHM 5% 0.33W	PHILIPS	2322 180 73152	02.476
R17-3	RESISTOR MF	1k2 OHM 5% 0.33W	PHILIPS	2322 180 73122	02.474
R18-3	RESISTOR MF	12k OHM 5% 0.33W	PHILIPS	2322 180 73123	02.498
R19-3	RESISTOR MF	5.6 OHM 5% 0.33W	PHILIPS	2322 180 73568	02.418
R20-3	RESISTOR MF	2k2 OHM 5% 0.33W	PHILIPS	2322 180 73222	02.480
R21-3	RESISTOR MF	220 OHM 5% 0.33W	PHILIPS	2322 180 73221	02.456
R22-3	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R23-3	RESISTOR ARRAY	8x10k OHM 5% 1/8W	PANASONIC	EXB-F9E-103 J	06.630
R24-3	RESISTOR MF	1M OHM 5% 0.33W	PHILIPS	2322 180 73105	02.544
R25-3	RESISTOR ARRAY	8x10k OHM 5% 1/8W	PANASONIC	EXB-F9E-103 J	06.630
R26-3	RESISTOR MF	2k2 OHM 5% 0.33W	PHILIPS	2322 180 73222	02.480
R27-3	RESISTOR MF	100k OHM 5% 0.33W	PHILIPS	2322 180 73104	02.520
R28-3	RESISTOR MF	22k OHM 5% 0.33W	PHILIPS	2322 180 73223	02.504
R29-3	RESISTOR MF	2k2 OHM 5% 0.33W	PHILIPS	2322 180 73222	02.480
TR1-3	BALUN FOR C2149	TL574	S.P.RADIO	6-0-27236	400574
U1-3	DARLINGTON DRIVERS	HIGH CURRENT/VOLTAGE	TEXAS	ULN2003A	31.077
U2-3	INTEGRATED CIRCUIT	8 BIT SHIFT REG.SERIAL IO	NATIONAL	MM74HC595N	34.502

POSITION	DESCRIPTION		MANUFACTOR	TYPE	S.P.NUMBER
U3-3	INTEGRATED CIRCUIT	DUAL OPERATIONAL AMP.	TEXAS	MC1458P	31.215
U4-3	DARLINGTON DRIVERS	HIGH CURRENT/VOLTAGE	TEXAS	ULN2003A	31.077
U5-3	INTEGRATED CIRCUIT	8 BIT SHIFT REG.SERIAL IO	NATIONAL	MM74HC595N	34.502
U6-3	NAND SCHMIDT TRIGGER	74HC132	TEXAS	74HC132	34.521
U7-3	PWM CONTROLLER	CURRENT MODE, UC3845N	UNITRODE	UC3845N (2845N)	31.176
U8-3	PROGRAMMED PROM U8-3	C2149	S.P. RADIO A/S	0-0-27497 / C1100F- 4D8E	727497
U9-3	MASTER PROCESSOR UNIT	8 BIT SERIAL INTERFACE	HITACHI	HD63B03YP	32.575
U10-3	uC SUPERVISORY CIRCUIT	MAX 690	MAXIM	MAX 690 CPA (EJA-MJA)	32.585
U11-3	INTEGRATED CIRCUIT	TRIPLE 3-INPUT NOR GATE	TEXAS	SN74HC27N	34.516
U12-3	UNIVERSAL SYNCHRON. ASYN-	CHRON. RECEIVER/TRANSMITT	OKI	MSM82C51A-2RS	32.572
U13-3	UNIVERSAL SYNCHRON. ASYN-	CHRON. RECEIVER/TRANSMITT	OKI	MSM82C51A-2RS	32.572
U14-3	INTEGRATED CIRCUIT	HEX INVERTERS	TEXAS	SN74HC04N	34.520
U15-3	UNIVERSAL SYNCHRON. ASYN-	CHRON. RECEIVER/TRANSMITT	OKI	MSM82C51A-2RS	32.572
U16-3	AF POWER AMPLIFIER	DIL 8 1W BTL.	PHILIPS	TDA7052	31.432
U17-3	INTEGRATED CIRCUIT	OCTAL BUFF.& LINE DRIVERS	TEXAS	SN74HC541N	34.510
U18-3	INTEGRATED CIRCUIT	QUAD 2-INPUT NAND GATE	TEXAS	SN74HC00N	34.515
U19-3	INTEGRATED CIRCUIT	TRIPLE 3-INPUT NOR GATE	TEXAS	SN74HC27N	34.516
U20-3	COUNTER 7 STATE BIN.RIPP.	74HC4024	TEXAS	SN74HC4024	34.555
X1-3	CRYSTAL	4.9152 MHz HC-49/U	NDK	LN-P-0001;4.9152MHz Cload = 20pF	39.769

C2149 92/19

POSITION	DESCRIPTION		MANUFACTOR	TYPE	S.P.NUMBER
	INTERFACE UNIT MODULE (4)	C2149	S.P.RADIO A/S	5-0-27054G	627054
VARIOUS	FUSE COVER	5x20mm FUSE SIZE	ELU	199016	48.716
VARIOUS	FUSE HOLDER	1 POLE 5x20mm PCB VERSION	ELU	199015	78.398
-4	INTERFACE UNIT MODULE (4)			5-0-27054G / 1-0-27054A	52.074
C1-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C2-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C3-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C4-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C5-4	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C6-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C7-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C8-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C9-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C10-4	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C11-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C13-4	CAPACITOR CERAMIC	470pF 10% 500VDC	NKE	DT35-0465 758L 471BK 500V FLAT PACK	16.095
C15-4	CAPACITOR ELECTROLYTIC	100uF -20/+50% 63VDC	ERO	EKM 05 DE 310 J 05	14.620
C16-4	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C17-4	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C18-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C19-4	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C20-4	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C21-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C22-4	CAPACITOR MKT	0.1uF 10% 63VDC	PHILIPS	2222 370 78104	11.136
C23-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C24-4	CAPACITOR CERAMIC	470pF 10% 500VDC	NKE	DT35-0465 758L 471BK 500V FLAT PACK	16.095
C25-4	CAPACITOR CERAMIC	470pF 10% 500VDC	NKE	DT35-0465 758L 471BK 500V FLAT PACK	16.095
C28-4	CAPACITOR ELECTROLYTIC	10uF 20% 35VDC	ERO	EKI 00 AA 210 F M9	14.512
C29-4	CAPACITOR MKT	1uF 10% 63VDC	PHILIPS	2222 370 78105	11.137
C30-4	CAPACITOR MKT	1uF 10% 63VDC	PHILIPS	2222 370 78105	11.137
D1-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D2-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D3-4	DIODE RECTIFIER	1N4002 100V/1A	THOMSON	1N4002 (03/04/05/06/07)	25.100
D4-4	DIODE RECTIFIER	1N4002 100V/1A	THOMSON	1N4002 (03/04/05/06/07)	25.100
D5-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D6-4	DIODE RECTIFIER	1N4002 100V/1A	THOMSON	1N4002 (03/04/05/06/07)	25.100
D7-4	DIODE RECTIFIER	1N4002 100V/1A	THOMSON	1N4002 (03/04/05/06/07)	25.100
D8-4	DIODE ZENER	5V1 5% 2W	THOMSON	BZV47C5V1	26.727
D9-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147

POSITION	DESCRIPTION		MANUFACTOR	TYPE	S.P.NUMBER
D10-4	DIODE RECTIFIER	1N4002 100V/1A	THOMSON	1N4002 (03/04/05/06/07)	25.100
D11-4	DIODE RECTIFIER	1N4002 100V/1A	THOMSON	1N4002 (03/04/05/06/07)	25.100
D12-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D13-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D14-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D15-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D16-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D17-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D18-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D19-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D20-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D21-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D22-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D23-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D24-4	DIODE HIGH SPEED	1N4448	PHILIPS	1N4448	25.147
D25-4	DIODE ZENER	39V BZV47C39	THOMSON-CSF	BZV47C39	26.763
D26-4	THYRISTOR	BT151-500R	PHILIPS	BT151-500R	29.912
F1-4	FUSE	2AT 250V 5x20mm	ELU	179 120 2AT	45.508
F2-4	FUSE	2AT 250V 5x20mm	ELU	179 120 2AT	45.508
J1-4	SOCKET SUB D 9 POLES	PCB VERSION 2x 4-40 NUT	NS TECH	DMS-9SBTS-"E"	78.164
J2-4	SOCKET SUB D 9 POLES	PCB VERSION 2x 4-40 NUT	NS TECH	DMS-9SBTS-"E"	78.164
J3-4	SOCKET BNC	PCB VERSION	ROSENBERGER	51K102-400 A4	78.444
J4-4	SOCKET BNC	PCB VERSION	ROSENBERGER	51K102-400 A4	78.444
J5-4	SOCKET SUB D 9 POLES	PCB VERSION 2x 4-40 NUT	NS TECH	DMS-9SBTS-"E"	78.164
L1-4	CHOKE FIXED	8u2H 10%	FASTRON	MICC-8R2K-02	20.358
L2-4	CHOKE FIXED	8u2H 10%	FASTRON	MICC-8R2K-02	20.358
OC1-4	OPTO COUPLER	CNY74-2	TELEFUNKEN	CNY74-2	32.529
OC2-4	OPTO COUPLER	CNY74-2	TELEFUNKEN	CNY74-2	32.529
OC3-4	OPTO COUPLER	CNY74-2	TELEFUNKEN	CNY74-2	32.529
OC4-4	OPTO COUPLER	CNY74-2	TELEFUNKEN	CNY74-2	32.529
OC5-4	OPTO COUPLER	CNY74-2	TELEFUNKEN	CNY74-2	32.529
OC6-4	OPTO COUPLER	CNY74-2	TELEFUNKEN	CNY74-2	32.529
P1-4	PLUG	2x10 POLES	3M	3592-6002 / 7620-6002 JL	78.250
P2-4	PLUG	6 POLES	HIRSCHMANN	973 887-100 UDEN FRÆSNING I BEN	78.315
P3-4	PLUG	6 POLES	HIRSCHMANN	973 887-100 UDEN FRÆSNING I BEN	78.315
Q1-4	TRANSISTOR AF	NPN BC639 TO-92	PHILIPS	BC639	28.120
Q3-4	TRANSISTOR AF	NPN BC639 TO-92	PHILIPS	BC639	28.120
Q4-4	TRANSISTOR	BC640	PHILIPS	BC640	28.124
Q5-4	TRANSISTOR AF	BC558B	PHILIPS	BC558B	28.100
Q6-4	TRANSISTOR AF	BC558B	PHILIPS	BC558B	28.100
Q7-4	TRANSISTOR AF	BC558B	PHILIPS	BC558B	28.100
Q8-4	TRANSISTOR AF	BC558B	PHILIPS	BC558B	28.100

POSITION	DESCRIPTION		MANUFACTOR	TYPE	S.P.NUMBER
R1-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R2-4	RESISTOR MF	2k2 OHM 5% 0.33W	PHILIPS	2322 180 73222	02.480
R3-3	RESISTOR MF	2k2 OHM 5% 0.33W	PHILIPS	2322 180 73222	02.480
R4-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R5-4	RESISTOR MF	2k2 OHM 5% 0.33W	PHILIPS	2322 180 73222	02.480
R6-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R7-4	RESISTOR MF	2k2 OHM 5% 0.33W	PHILIPS	2322 180 73222	02.480
R8-4	RESISTOR MF	2k2 OHM 5% 0.33W	PHILIPS	2322 180 73222	02.480
R9-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R10-4	RESISTOR MF	2k2 OHM 5% 0.33W	PHILIPS	2322 180 73222	02.480
R11-4	RESISTOR MF	100k OHM 5% 0.33W	PHILIPS	2322 180 73104	02.520
R12-4	RESISTOR MF	3k3 OHM 5% 0.33W	PHILIPS	2322 180 73332	02.484
R13-4	RESISTOR MF	330 OHM 5% 0.33W	PHILIPS	2322 180 73331	02.460
R14-4	RESISTOR MF	330 OHM 5% 0.33W	PHILIPS	2322 180 73331	02.460
R15-4	RESISTOR MF	4k7 OHM 5% 0.33W	PHILIPS	2322 180 73472	02.488
R16-4	RESISTOR MF	5k1 OHM 5% 0.33W	PHILIPS	2322 180 73512	02.489
R17-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R18-4	RESISTOR MF	680 OHM 5% 0.33W	PHILIPS	2322 180 73681	02.468
R19-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R20-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R21-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R22-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R23-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R24-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R25-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R26-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R27-4	RESISTOR MF	100k OHM 5% 0.33W	PHILIPS	2322 180 73104	02.520
R28-4	RESISTOR MF	100k OHM 5% 0.33W	PHILIPS	2322 180 73104	02.520
R29-4	RESISTOR MF	100k OHM 5% 0.33W	PHILIPS	2322 180 73104	02.520
R30-4	RESISTOR MF	100k OHM 5% 0.33W	PHILIPS	2322 180 73104	02.520
R31-4	RESISTOR MF	1kO OHM 5% 0.33W	PHILIPS	2322 180 73102	02.472
R32-4	RESISTOR MF	100 OHM 5% 0.33W	PHILIPS	2322 180 73101	02.448
R33-4	RESISTOR MF	5k1 OHM 5% 0.33W	PHILIPS	2322 180 73512	02.489
R34-4	RESISTOR MF	10k OHM 5% 0.33W	PHILIPS	2322 180 73103	02.496
R35-4	RESISTOR MF	47 OHM 5% 0.33W	PHILIPS	2322 180 73479	02.440
R36-4	RESISTOR MF	2k2 OHM 5% 0.33W	PHILIPS	2322 180 73222	02.480
R38-4	RESISTOR MF	470 OHM 5% 0.33W	PHILIPS	2322 180 73471	02.464
R39-4	RESISTOR MF	4k7 OHM 5% 0.33W	PHILIPS	2322 180 73472	02.488
R40-4	RESISTOR PMF	120 OHM 5% 2W	PHILIPS	2322 191 31201	04.178
R41-4	RESISTOR MF	100 OHM 5% 0.33W	PHILIPS	2322 180 73101	02.448
RE1-4	RELAY	12VDC DPDT 1.25A	MEISEI	M1B-12-H	21.295
RE2-4	RELAY	12VDC DPDT 1.25A	MEISEI	M1B-12-H	21.295
U1-4	RS232 DRIVER/RECEIVER	SINGLE SUPPLY, CMOS	ANALOG DEVICES	AD232JN	32.757
U2-4	VOLTAGE REGULATOR	FIXED 15V/1A	MOTOROLA	MC7815CT	31.090

POSITION	DESCRIPTION		MANUFACTOR	TYPE	S.P.NUMBER
U3-4	VOLTAGE REGULATOR	FIXED 5V/1A	MOTOROLA	MC7805CT	31.250
U5-4	RS232 DRIVER/RECEIVER	SINGLE SUPPLY, CMOS	ANALOG DEVICES	AD232JN	32.757