

# SAILOR SYSTEM 5000 MF/HF 150/250W



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## 1 General information

### 1.1 Introduction

The 150W / 250W MF/HF transceiver with integrated DSC and telex is designed for maritime applications in voluntary as well as compulsorily fitted vessels. It offers simplex and semi-duplex SSB radiotelephone communication in the maritime mobile frequency bands between 1.6 and 30 MHz. The basic version of the transceiver include voice, DSC and a dedicated 2187,5kHz DSC watch receiver, forming an ideal system for MF GMDSS installations. The transceiver can easily be upgraded to include 6 channel scanning DSC watch receiver, and Telex operation to comply with MF/HF requirements in sea area A3. The upgrade is done by entering software license codes.

The equipment consists of a compact transceiver control unit, a fully remote controlled transceiver unit and an automatic antenna tuning unit.

The microprocessor controlled Antenna Tuning Unit automatically matches the impedance of antennas between 8 and 18 metres in length and requires no presetting at the installation. The typical tuning time is 1 s. It is designed for outdoor installation and may be located up to 100 metres from the Transceiver Unit.

The Transceiver Unit contains all receiver and transmitter circuits. The fully protected solid state 150W / 250W power amplifier cooled by natural convection matches a 50 ohm antenna system, but is normally used in connection with the Antenna Tuning Unit. The DSC/Telex modem contains two demodulators, one connected to the built-in watch receiver for continuous watch on the DSC distress frequency 2187.5 kHz, the other connected to the communication receiver which may be used to keep simultaneous watch on other DSC frequencies or may be used for telex communication.

The Control Unit is for operation of radiotelephone as well as DSC and telex functions. Use of the equipment is simple, logic and straight forward. DSC operation is based on the use of soft keys. Guiding texts are provided and the large display is able to show the contents of a complete call in one screen. For telex operation the keyboard, printer or data terminal can be connected directly to the control unit. The equipment is designed for operation from a 24 V battery. With the optional AC Power Supply unit installed the equipment may be supplied from 115/230 V AC main or emergency supplies with automatic switch-over to 24 V DC supply in the absence of AC supply voltage. Also optionally battery charger for AC is available in the product line.

The built-in test facilities and easy-to-replace module design of the equipment simplifies the service concept.

### 1.2 Technical data

#### 1.2.1 General

Complies with the relevant IMO performance standards for MF/HF GMDSS equipment, the ITU Radio Regulations, the ITU-R recommendations and the relevant performance specifications of ETSI and IEC, in the ITU marine bands.

<b>Operating modes:</b>	Simplex and semi-duplex SSB telephony (J3E), DSC (J2B), AM broadcast reception (A3E) and Telex (J2B).
<b>Frequency range:</b>	Refer to sections concerning specific characteristics.
<b>Frequency stability:</b>	better than 0.35ppm Warm-up time. Less than one minute. Ageing less than 0,1ppm/year.
<b>Normal operating temperature:</b>	from 0°C to +40°C.
<b>Extreme operating temperature:</b>	from -15°C to +55°C
<b>User-programmable channels:</b>	199 frequency pairs with mode (1-199)
<b>User-programmable stations:</b>	40 stations with name, MMSI and station channel

**Output power:** Refer to sections concerning Receiver / Transmitter characteristics

**Supply voltage:** Nominal 24V DC floating (-10 +30%)  
With optional external AC power supply:  
115/230V AC 50/60 Hz. Automatic change-over to DC in the absence of AC supply

**Power consumption:**

	<b>150W:</b>	<b>250W:</b>
Rx, 60W (approx. at 24V DC)		
Tx, SSB speech:	175W	300W
Tx, SSB two-tone:	300W	550W
Tx, DSC/TELEX:	420W	600W

**Compass safe distance:** Compass safe distance in accordance with ISO/R 694 are given below in metres.

<b>Unit</b>	<b>Standard</b>	<b>Steering</b>
	5.4°/H	18°/H
Control Unit	1.2	0.5
Transceiver Unit	0.4	0.2
Antenna Tuning Unit	0.3	0.1
Handset	0.3	0.2
Cradle	1.1	0.7
5070 Loudspeaker	2.2	1.6

## 1.2.2 Receiver characteristics

**General:** Complies with ETSI 300373 in the ITU marine bands.

**Reception:**

<b>Mode</b>	<b>Rx/Tx antenna plug</b>	<b>DSC/Telex antenna plug</b>
SSB/AM	X	
DSC	X	
Telex		X

**Frequency range:** 150 kHz to 30 MHz.

**Frequency resolution:** 100 Hz by keyboard entry.  
10 Hz, 100 Hz or 1 kHz search/fine-tune facility is provided.

**Input impedance:** Rx/Tx : 50 ohm  
The Antenna is matched by the antenna amplifier in the Aerial Coupler.

DSC/Telex: 50 ohm  
12V DC / 20 mA is available for eventual use of active antenna.

**Sensitivity:**

Telephony(J3E):	below 11 dB $\mu$ V for 20 dB Sinad
Broadcast (A3E):	below 25 dB $\mu$ V for 20 dB Sinad
DSC/Telex (J2B):	below 0 dB $\mu$ V

**Intermodulation:**

Telephony (J3E): Wanted Signal:	30 dB $\mu$ V
Intermodulation level:	above 80 dB $\mu$ V
Telex(J2B): Wanted Signal:	30 dB $\mu$ V
Intermodulation level:	above 90 dB $\mu$ V
DSC (J2B): Wanted Signal:	20 dB $\mu$ V
Intermodulation level:	above 80 dB $\mu$ V

**Spurious rejection:** above 70 dB

**Audio output power:** Build-in loudspeaker  
Optional loudspeaker output 4 W typical with less than 10 % distortion.  
Output intended for 8 ohm loudspeaker.

### 1.2.3 Transmitter characteristics

<b>General:</b>	Complies with ETSI 300373 or better in the ITU marine bands. The Transmitter characteristics are with the Aerial Coupler included.	
<b>Frequency range:</b>	The ITU marine bands in the frequency range 1605 kHz to 30 MHz	
<b>Frequency resolution:</b>	100 Hz.	
<b>Output power:</b>	<p>150W SSB: ± 1.4 dB into 50 ohm Antenna, voice for a duty cycle less than 55% and modulation rate greater than 3 baud. Reduction to 80W when continuously keyed with duty cycle greater than 55% during 1 min. Automatic power recovery after 1 min.</p> <p>DSC/Telex: 85W ± 1.4 dB</p> <p>250W SSB: ±1.4 dB into 50 ohm Antenna, voice for a duty cycle less than 55% and modulation rate greater than 3 baud. Reduction to 100W when continuously keyed with duty cycle greater than 55% during 1 min. Automatic power recovery after 1 min.</p> <p>DSC/Telex: 125W ± 1.4 dB</p>	
<b>Power reduction:</b>	Low power:	approx. 20 W PEP.
<b>Intermodulation:</b>		below -31 dB/PEP.
<b>Spurious Emission:</b>		below -43 dB/PEP.
<b>Hum and noise:</b>		Less than - 40 dB/PEP.

### 1.2.4 DSC Watch receiver characteristics

<b>General:</b>	Complies with ETSI 300338 or better.	
<b>Reception:</b>	DSC/Telex antenna plug.	
<b>Frequency range:</b>	Scanning the following frequencies: 2187,5 KHz, 4207,5 kHz, 6312,0 KHz, 8414,5 kHz, 12577,0 KHz, 16814,5 kHz.	
<b>Input impedance:</b>	DSC/Telex:	50 ohm. 12V DC / 20 mA is available for eventual use of active antenna.
<b>Sensitivity:</b>	DSC (J2B):	below 0 dBµV.
<b>Intermodulation:</b>	DSC (J2B):	Wanted Signal: 20 dBµV. Intermod. level: above 70 dBµV.
<b>Spurious rejection:</b>		above 70 dB.

### 1.2.5 Aerial coupler characteristics

<b>General:</b>	Complies with ETSI 300373 or better in the ITU marine bands.
<b>Frequency range:</b>	1.6 MHz - 27 MHz.
<b>Aerial requirements:</b>	8-18 m wire and/or whip aerial.
<b>Aerial tuning:</b>	Fully automatic with no presetting.
<b>Tuning speed:</b>	0.1 - 8 sec.
<b>Power capability:</b>	350W PEP into 50 ohm Antenna.
<b>Extreme operating temperature:</b>	from -25°C to +55°C.

### 1.2.6 DSC/Telex modem characteristics

<b>DSC:</b>	DSC Equipment class:	Class A.
	Protocols:	ITU-R M. 493.12, M. 541-6, and M. 1082.
	Ship's identity:	9-digit identity number.
	Navigator interface:	According to IEC 61162-1 GLL, RMC, ZDA, GGA.
<b>TELEX:</b>	Protocols:	ITU-R M. 625-2 (incl. M. 476-4), M. 490, M. 491-1, and 492-5 NBDP telex in ARQ, FEC and SELFEC modes.
	Ship's identity:	5- and/or 9-digit identity number.

### 1.2.7 Dimensions and weight

<b>Control Unit: CU5100/CU5110:</b>	Width:	200 mm (7,9")
	Height:	100 mm (3,9")
	Depth:	80 mm (3.1")
	Weight:	3.3 kg (7.3 lbs)
<b>Transceiver Unit TU5150/TU5155/TU5250:</b>	Width:	390 mm (15.3")
	Height:	445 mm (17.5")
	Depth:	127 mm (5")
	Weight:	19 kg (41.9 lbs)
<b>Antenna Tuning Unit: ATU5215:</b>	Width:	290 mm (11.4")
	Height:	500 mm (19.7")
	Depth:	80 mm (3.1")
	Weight:	3.3 kg (7.3 lbs)

<b>Equipment category:</b>	Control Unit:	Protected,
	Transceiver Unit:	Protected,
	Antenna Tuning Unit:	Exposed.



## 2 Installation

### 2.1 Description

Correct installation of the equipment is important for maximum performance and reliability. Antennas and earth connections must be installed with the greatest care using corrosion resistant materials. Cable routing shall be made so the cables are protected from physical damage. Sharp cable bends especially on coaxial cables must be avoided and a sufficient number of clips or straps should be used to secure the cables.

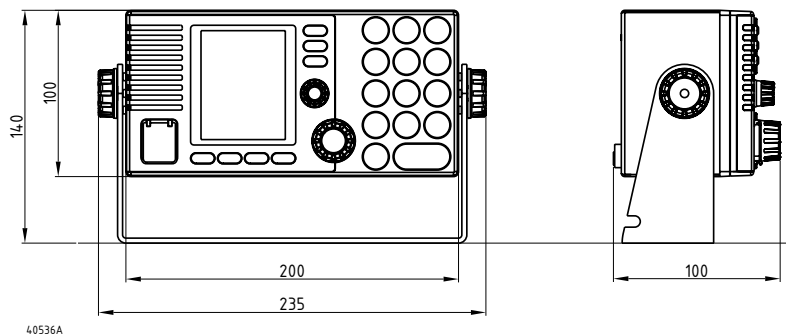
### 2.2 Mounting the units

#### Mounting the Control Unit (CU)

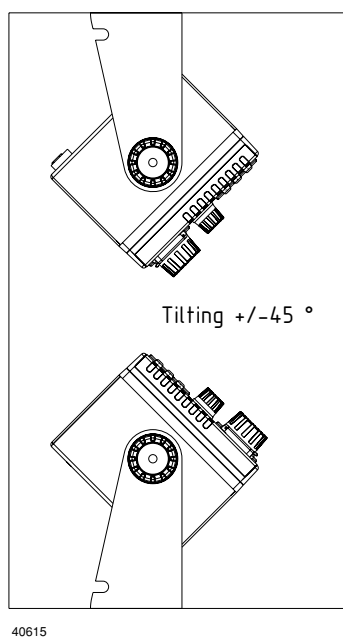
One Unit shall be connected to the Transceiver Unit using the build-in local area network (ScanBus). The CU may be mounted up to 100m from the Transceiver Unit using just one Multicable 5 x 2 x 0.5 mm<sup>2</sup> screened.

The Control Unit may be tabletop or bulkhead mounted.

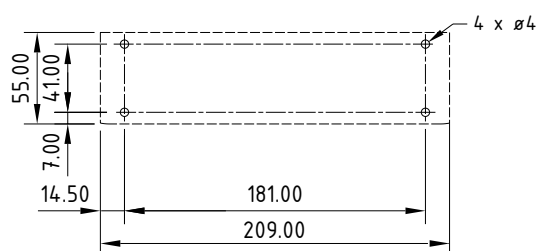
#### Control Units with mounting bracket



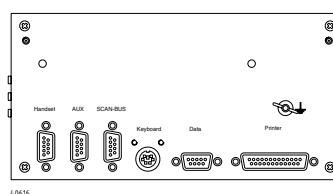
#### Mounting option



#### Drilling plan

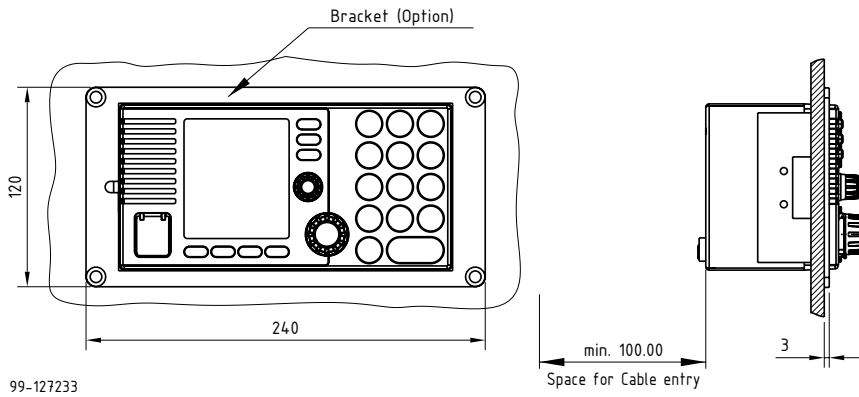


#### Control unit connector panel

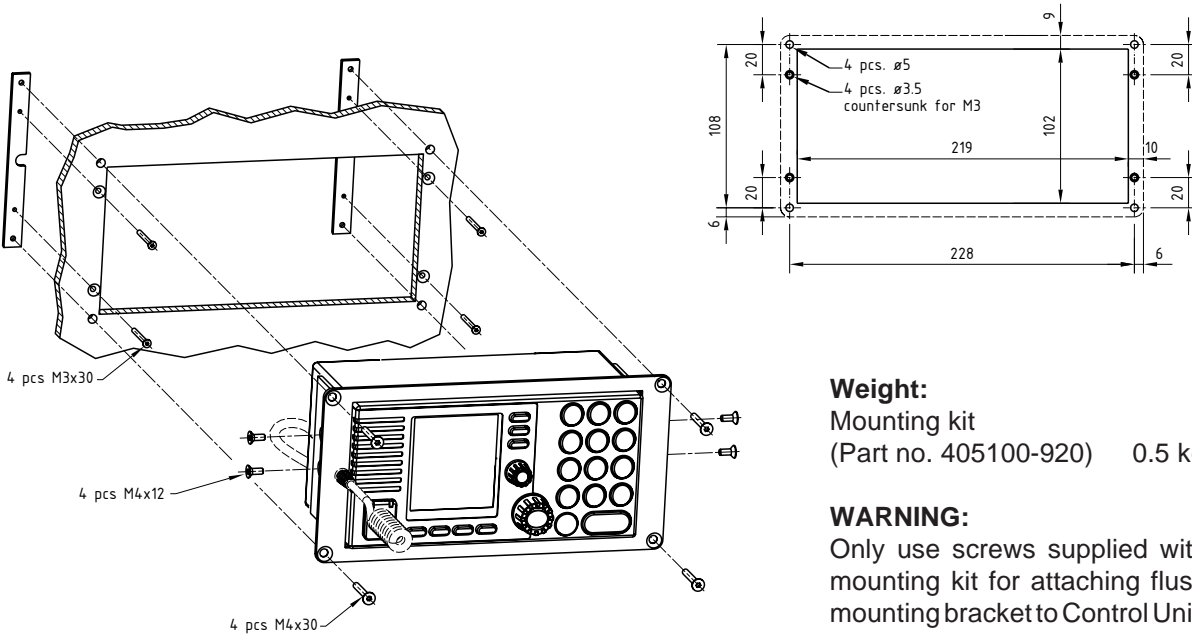


**Weight:**  
 Control Unit 1.4 kg.  
 Mounting Bracket 0.3 kg.

**Control Units with flush mounting bracket**



**Drilling plan**

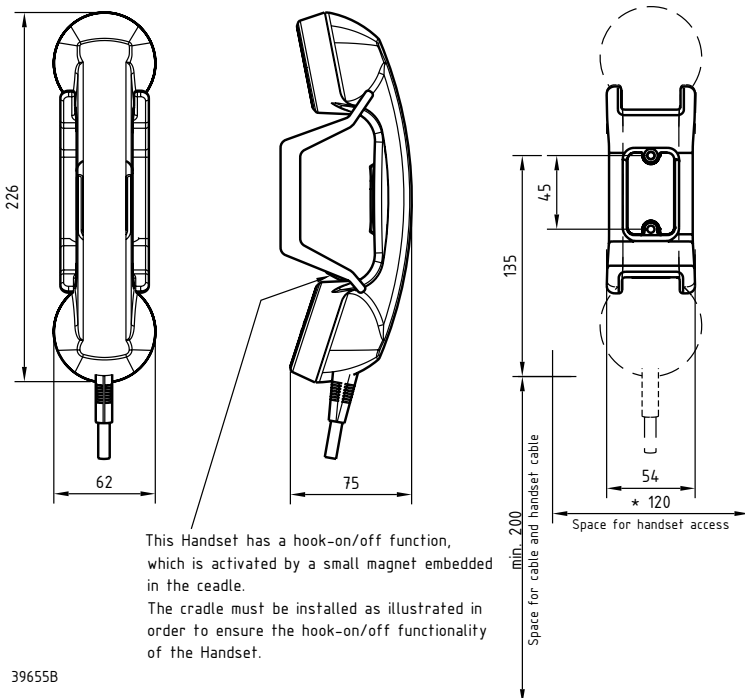


**Weight:**  
 Mounting kit  
 (Part no. 405100-920) 0.5 kg

**WARNING:**  
 Only use screws supplied with mounting kit for attaching flush mounting bracket to Control Unit.

**Handset for Control Unit**

**Drilling plan**

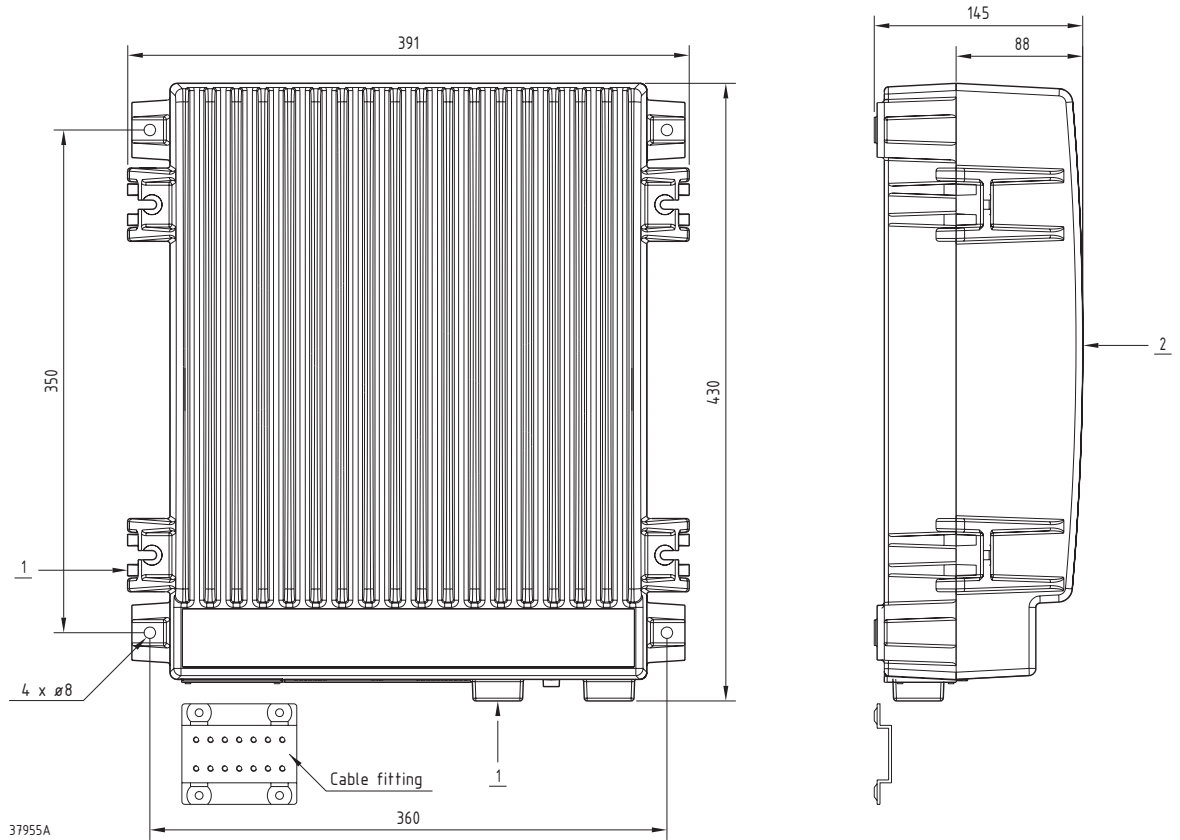


**Weight:**  
 Handset for Control Unit 0.4 kg

Dimensions are in mm

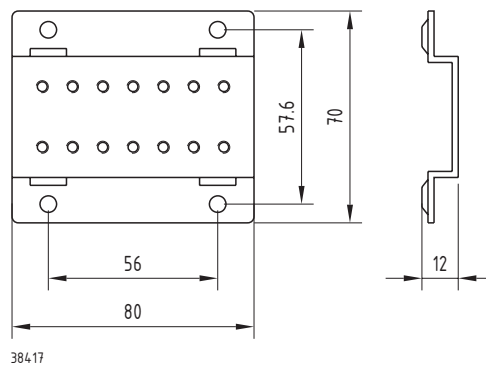
**Mounting the Transceiver Unit (TU)**

The Transceiver Unit should be installed in a dry place and consideration should be given to accessibility for servicing. It is important to provide sufficient airspace below, above and in front of the unit for adequate air circulation through the cooling fins. The drawing below shows the outer dimensions, mounting possibilities and the minimum distance to other objects, as well as a drilling plan.



- 1) Space for cable: min. 150 mm
- 2) Space for airflow and service: min. 500 mm

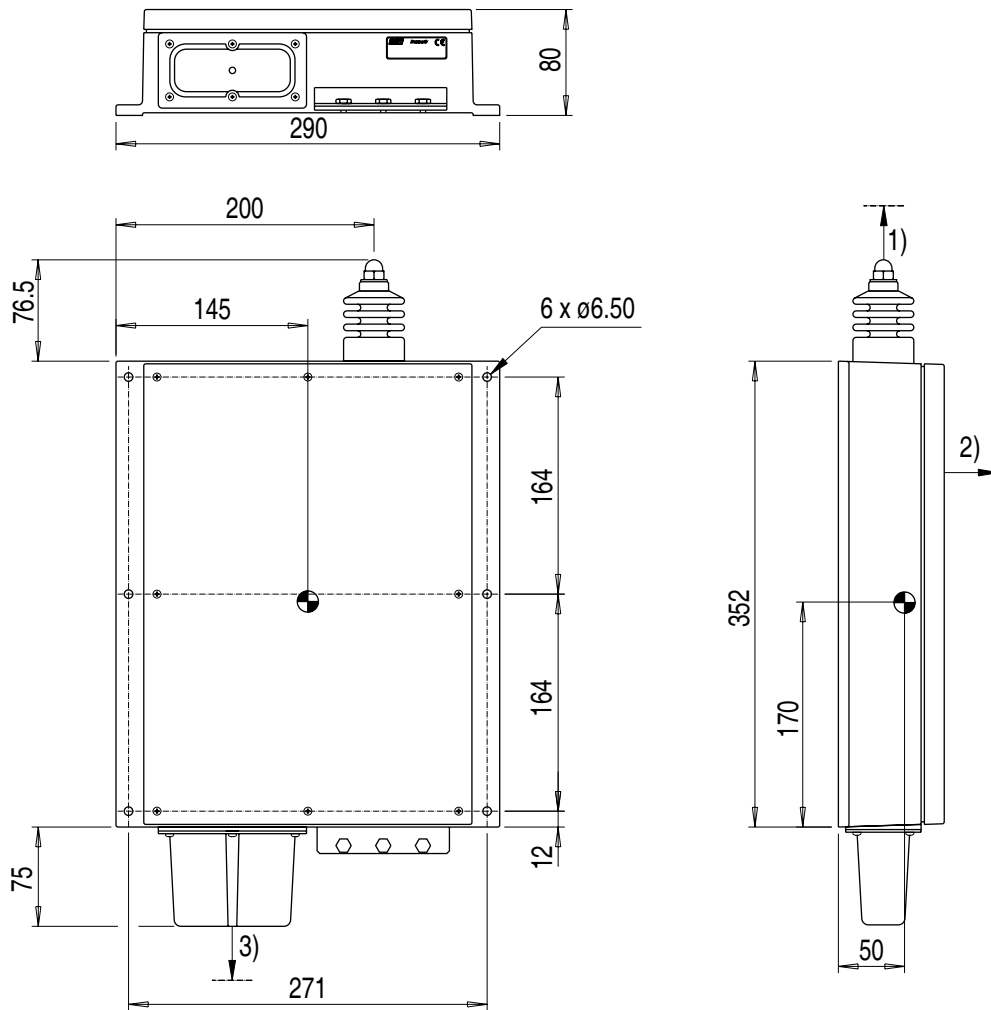
**Cable fitting**



Dimensions are in mm

**Mounting the Antenna Tuning Unit (ATU)**

The Antenna Tuning Unit may be mounted up to 100 metres from the Transceiver Unit using just one RG-213/U coaxial cable. The unit should be installed near the antenna feed point.



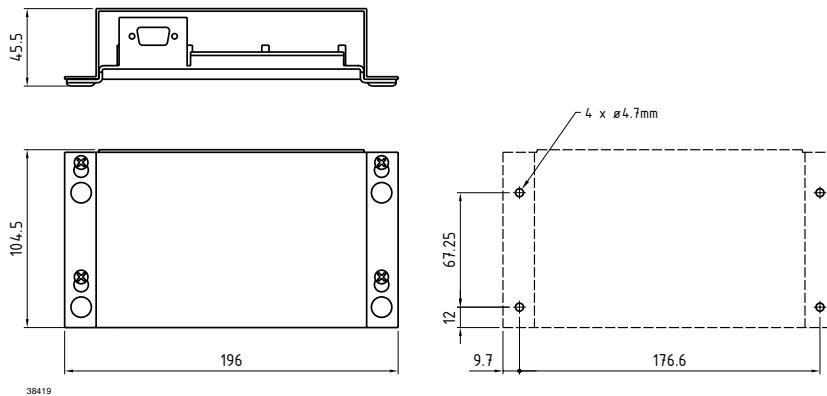
37978

- 1) Space to nearest overhang: min. 50 mm
  - 2) Space for service access: min. 500 mm
  - 3) Space for cable and service access: min. 200 mm
- Dimensions are in mm

**CB4616 Terminal Block Converter Box (accessory)**

CB4616 is used to convert the rather small DSUB-9 to a screw terminal with strain relief for large cables such as veritas cables. This box is delivered with a 1m DSUB-DSUB cable for connection to CU or TU.

**Drilling Plan**



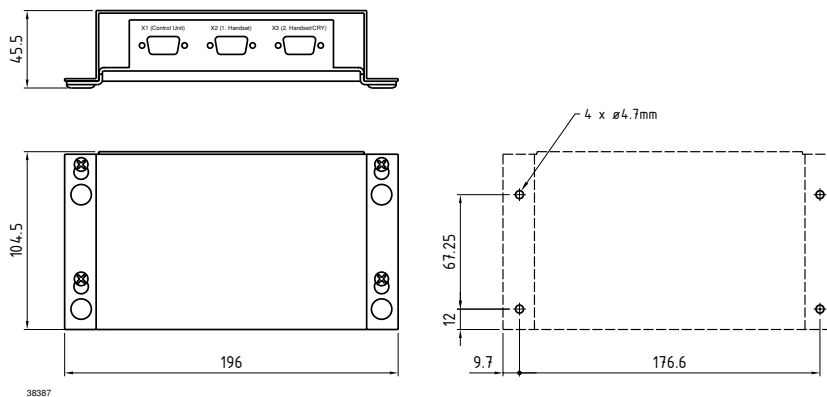
**Weight:**

CB4616 0.6 kg.

**CB4618 Handset Connection Box (accessory)**

CB4618 is used to connect the scrambler CRY2001 or to interface a secondary handset or the Heavy Duty Handset.

**Drilling Plan**



**Weight:**

CB4618 0.6 kg.

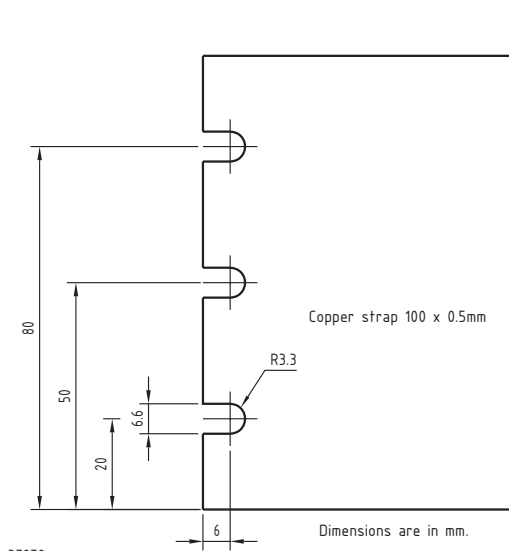
Dimensions are in mm

CB4616 and CB4618 may be ordered as accessory. Please find accessory list on the last page of this manual.

### 2.3 Ground connections

#### Antenna Tuning Unit

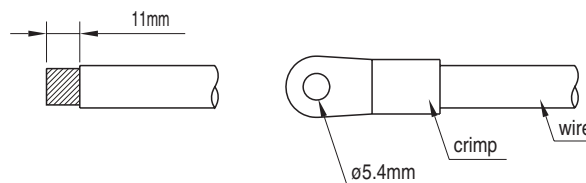
As the earth connection of a transmitter is a very important part of the antenna system, it is of the utmost importance to keep in mind that the earth connection of the Antenna Tuning Unit must have the lowest possible RF-impedance. Losses in the earth connection will result in a decrease in radiated power which means that the range of the transmitter will be reduced. In steel ships a 100 x 0.5 mm copper strap as short as possible is connected between the earth terminal at the bottom of the Antenna Tuning Unit and two or three 1/2" or M12 bolts welded to the superstructure. Vessels constructed of non-conducting materials must be equipped with a copper earth plate having a minimum area of 1 square metre mounted below the water line. From a copper earth bolt hard soldered to the earth plate a 100 x 0.5 mm copper strap is run, preferably uninterrupted to the earth terminal at the bottom of the Antenna Tuning Unit.



Should it be necessary to break the copper strap, for example to pass through a deck, two or three 1/2" or M12 bolts should be used for this feed through. On wooden ships having a superstructure of metal, this superstructure should also be effectively connected to the copper strap by using stainless steel bolts and preferably pieces of stainless steel strips between the metal parts. On fibre glass boats, such as yachts and sailing boats, it may be difficult to install a sufficiently good earth. Short copper straps are bolted to conducting parts on the engine, the keel and other conducting objects. Many copper straps can be glued to the inner surface of the hull below the water line to produce a large capacitance to the water. It is important that the total area of copper is large and that the distance between the copper surface and the water is as small as possible. The copper straps are connected directly to the ATU.

#### Transceiver Unit and Control Unit

The Transceiver Unit is preferably grounded separately to the ships metal in the shortest possible way. A 10 to 16mm sq. ground wire is connected to the ground terminal (cable clamp) at the bottom of the unit.



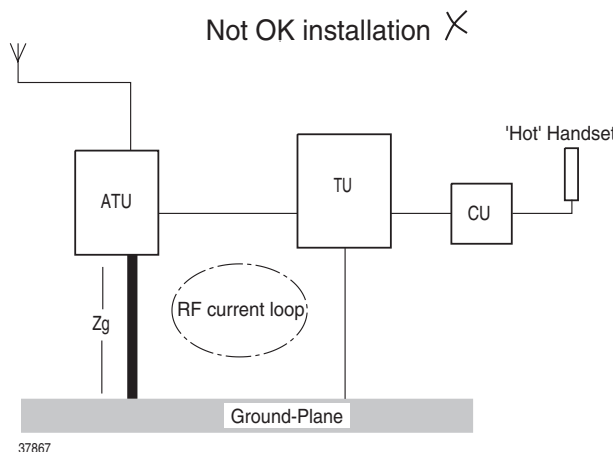
### 2.4 Grounding considerations

Proper system grounding is one of the most important installation details. Two areas of grounding must be considered:

- a) The ground connection between the ATU and earth ground plane.
- b) The ground connection of the TU and the externally connected equipment.

Each area requires separate considerations even though they are interrelated. Ideally the Control Unit, Transceiver Unit, Antenna Tuning Unit and the antenna ground-plane must have the same RF ground potential. Unfortunately this situation is seldom achieved, but interference problems will be reduced along with how close to this "ideal" the grounding of the installation is performed.

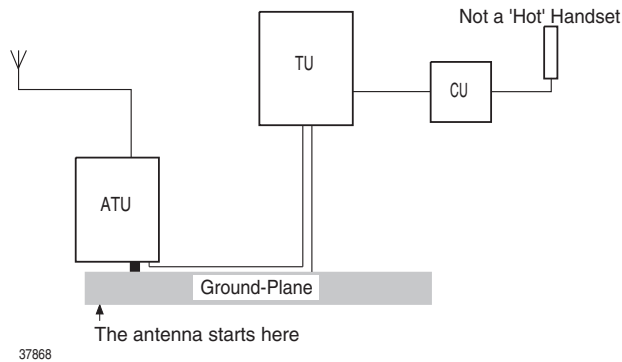
On some installations ground loops will cause problems. A ground loop is caused by more than one ground path for a given unit. This will introduce circulating RF currents which may cause malfunction of other equipment onboard the ship as well as a "hot" handset.



**Antenna start**

The vertical antenna always start at its electrical ground-plane, whether or not it is physically mounted there. First determine the antenna's electrical ground-plane, which is where the ATU must be mounted. Where possible always take the ATU to the ground, not the ground to the ATU. In case of a fibreglass boat, the ground-plane may well be at the hull grounding terminal. Then this is where the Antenna Tuning Unit should go and this is where the antenna actually starts.

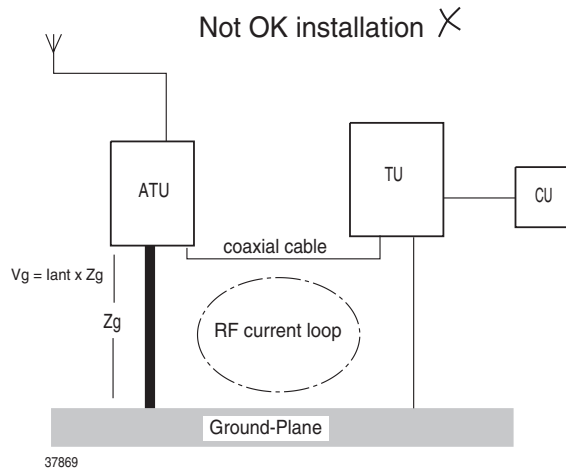
OK installation ✓



**RF ground loop**

It is not always possible or practical to mount the ATU using a very short strap to the actual ground-plane. In such a case the coaxial cable may be connected between units with different ground potentials causing RF loop-current to flow.

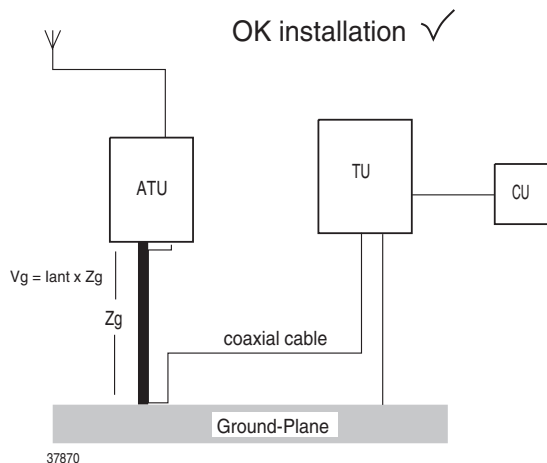
Not OK installation ✗



**Minimizing ground loops**

By routing the coax cable very close together with the ATU ground strap (secure good RF coupling between the two) all the way down to the ground-plane, there will be no RF ground loop left to generate the interference.

OK installation ✓



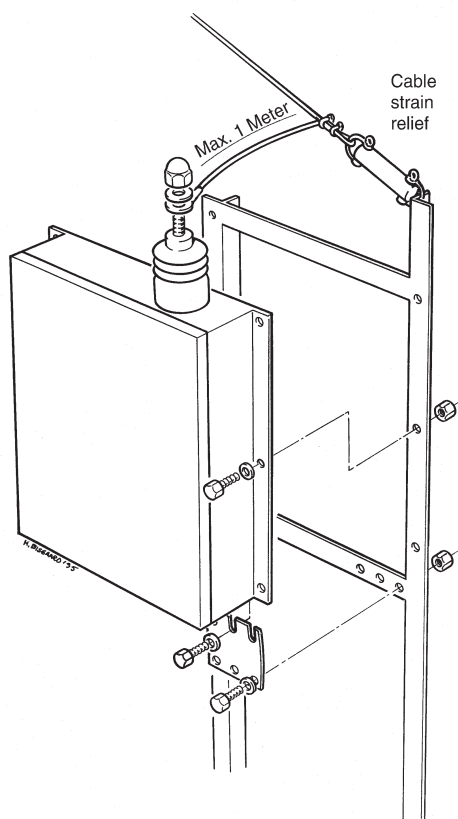
## 2.5 Antennas

### Transceiver Antenna

The equipment is used with common transmitting and receiving antenna. The antenna should be erected in the open, away from conducting object such as derricks etc. which may cause reduction of the radiated power. Insulators should be of the best type having low leakage even when wet. Stays, wires, steel masts etc. should be either effectively earthed or insulated. The antenna should also be kept as far away as possible from electrical equipment in order to minimize noise. Electrical installation such as cable braiding (screens) and instruments in the vicinity of the antenna should be earthed effectively, and the instruments in question should be fitted with noise-interference suppression devices, effective in the range 0.1 MHz to 30 MHz to avoid malfunction of these instruments. The Antenna Tuning Unit will tune on any frequency in the range 1.6 to 27 MHz to good whip and/or wire installations of 12 to 18 meters total electrical length. Shorter antennas, electrical length down to 8 meters can be used. Where possible long antennas should be installed to maximize the radiated power in the lower frequency bands.

In general a 12 meter antenna installation can be made using an 8 meter whip and 4.5 meter feeder or a 10 meter whip and 2.5 meter feeder. In both cases the whip should be mounted on a pole allowing for the feeder to be erected at an angle of no less than 60 degrees to create a vertical antenna system. Using horizontal feeders or feeders mounted at an angle below 45 degrees usually transform the antenna radiation resistance to a lower value reducing the radiated power. Furthermore, the total antenna system should be kept well away from conductive objects such as the mast. Usually a horizontal distance of more than 4 meters will create good results.

Note: If a whip antenna is used this should have an anti-corona ball as a top termination to prevent crackling noise in the receiver.

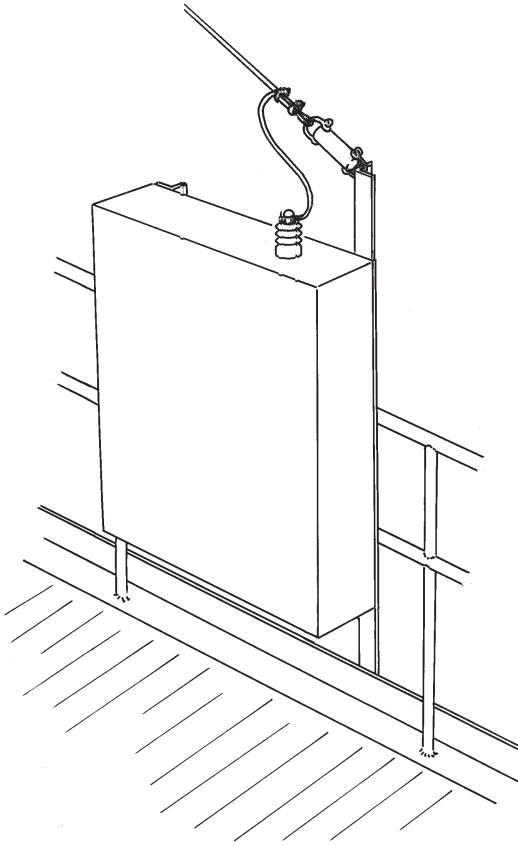


The antenna is terminated at the insulator at the top of the Antenna Tuning Unit. The insulator must be relieved from mechanical stress by using max. 1 metre flexible wire between the insulator and a support. To maximize the radiated power and avoid flash over keep distance to metal parts as long as possible. All wire junctions in the antenna system must be made with cable lugs of correct size according to the wire gauge. This will prevent bad connections due to corrosion. For further corrosion proofing grease may be applied to the cable joints.

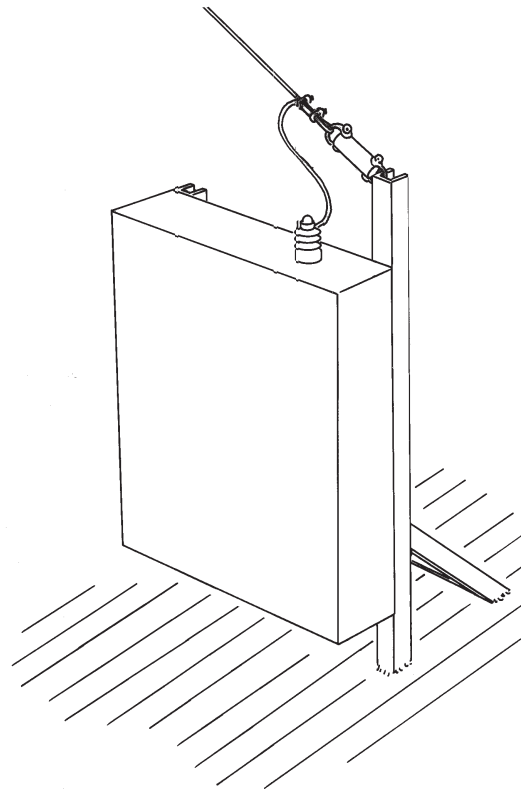


**Recommended ATU installation**

On a metal-hull vessel. Mount the Antenna Tuning Unit on a custom-built bracket made from iron angle bars (refer to figure on previous page).



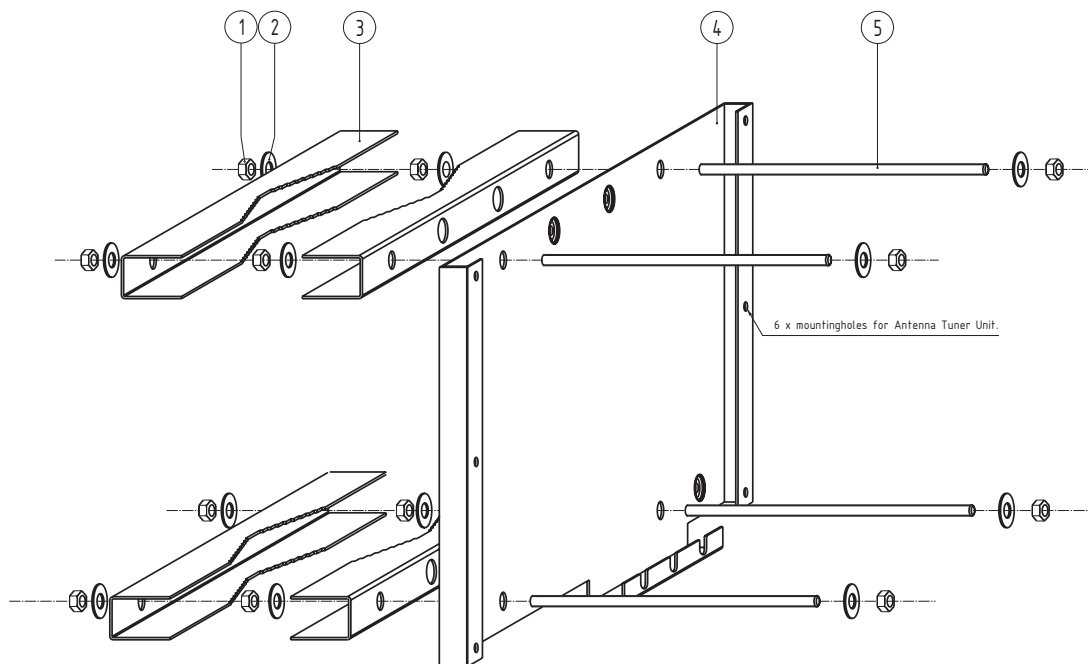
Antenna Tuning Unit bracket  
welded to the railing.



Antenna Tuning Unit bracket  
welded to the deck.

Optional an ATU Mounting Kit may be supplied as shown below. The kit exists in two versions:

- |   |  |                 |
|---|--|-----------------|
| 1 | Includes mounting plate and fittings for mast. | Part no. 737589 |
| 2 | Includes the mounting plate.                   | Part no. 737588 |
- 
- 1 For mounting the ATU directly on a mast, where the Mounting Plate and fittings for mast can form a sufficient earth connection on a steel mast welded to the superstructure.
  - 2 To get an even mounting surface on an uneven support.



- 1 Nut M10
- 2 Tooth lock washer M10
- 3 Fitting for mast
- 4 Mountingplate for ATU
- 5 Treadrod M10

### DSC watch receiver antenna

The DSC watch receiver antenna may be an active or a passive type.

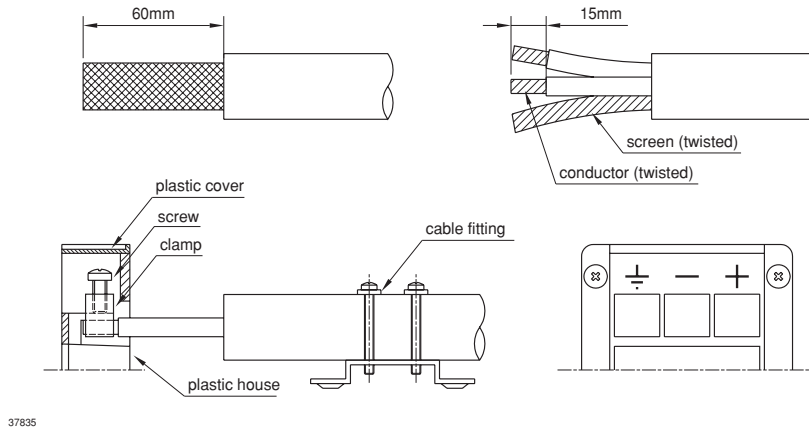
The antenna should be erected well in the clear and kept away as far as possible from electrical equipment in order to minimize noise. Electrical installation such as cable braiding and instruments in the vicinity of the antenna should be earthed effectively, and the instruments in question should be fitted with noise-interference suppression devices, effective in the range 0.1 to 30 MHz. The antenna feed-in should be coaxial cable.

In case of a passive antenna the feed-in should be as short as possible, especially in the case of short antennas. The recommended antenna length is 7-30 meters. If a long coax cable is necessary an impedance matching transformer should be inserted at the antenna or an active antenna should be used. DC supply voltage for an active antenna is available at the DSC RX antenna connector. The supply voltage is +12 V for supply currents up to 20 mA. The short circuit current is limited to 2 mA to allow passive antennas with matching transformers to be connected directly.

## 2.6 Power supply

The supply leads are connected to the supply terminal strip of the Transceiver Unit. The supply terminal strip is adapted for screened power supply cable to meet EMC requirements. The screen of the cable is connected to the left terminal.

The earth connection of the equipment will not cause the battery to be earthed. Maximum permissible peak voltage between the battery terminals and earth is 100 V. Note that fuses must be provided in the supply leads. Table below shows the necessary cable cross sections and external fuse ratings.

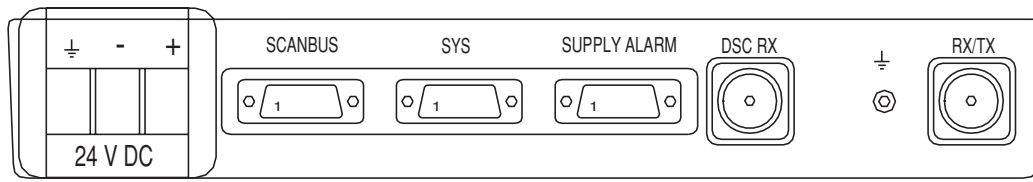


37835

Max. cable length to battery *	Recommended cable Screened multiwire	External fuses
5 m	2 x 10 mm <sup>2</sup>	40 A
8 m	2 x 16 mm <sup>2</sup>	50 A
12 m	2 x 25 mm <sup>2</sup>	63 A

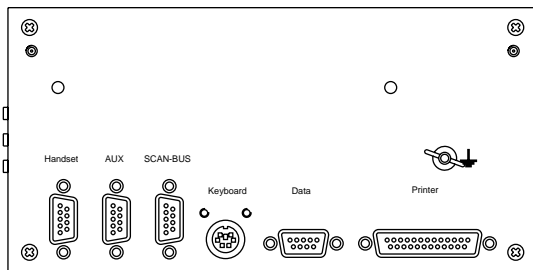
## 2.7 Interconnection of units

### Transceiver Unit connector panel



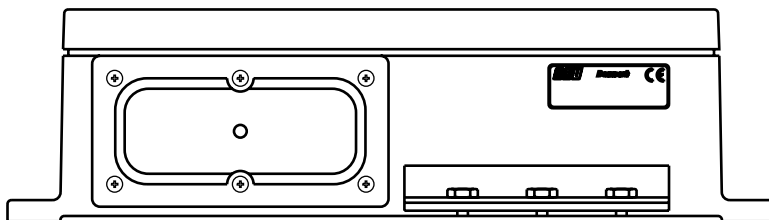
37849

### Control Unit connector panel

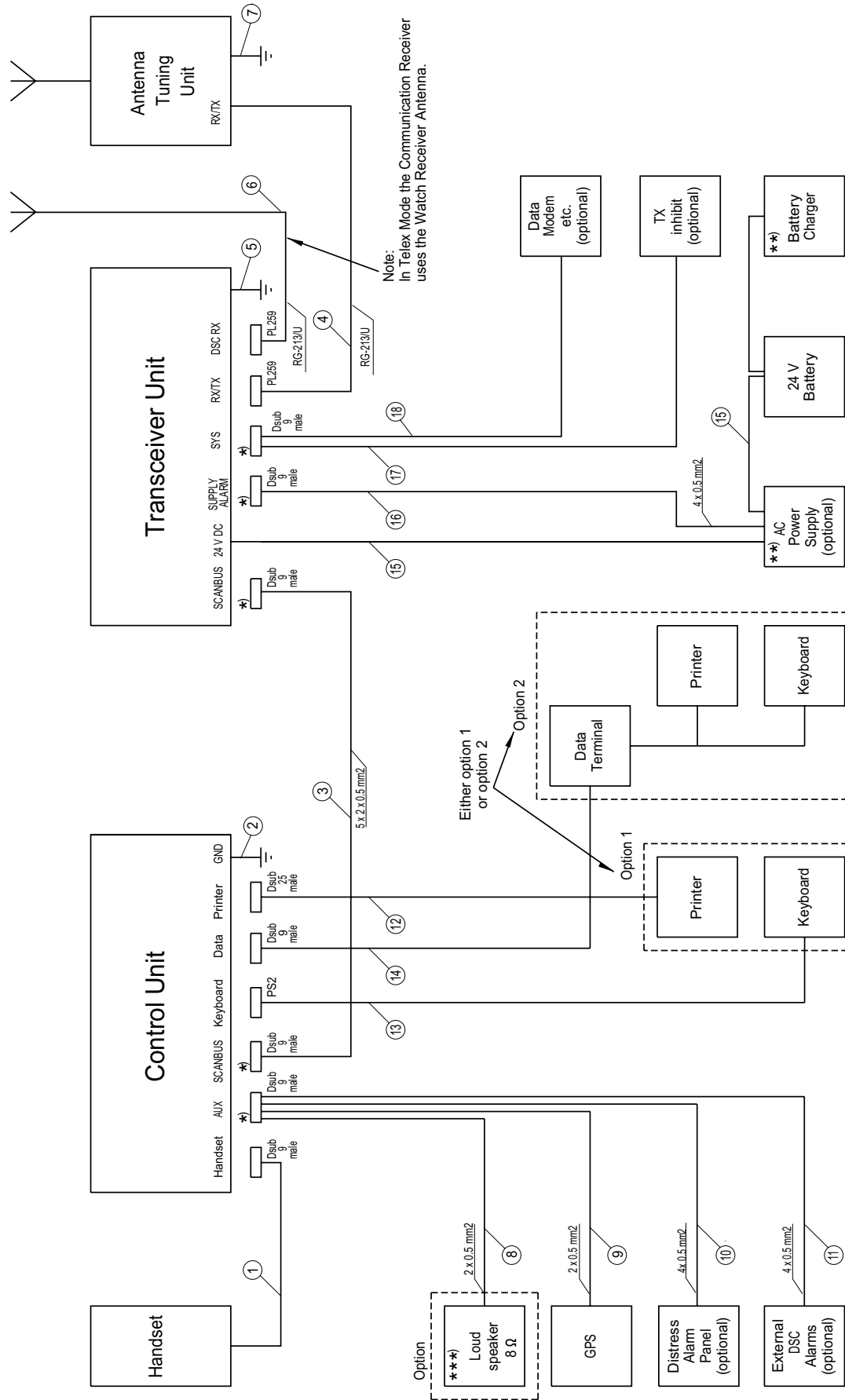


40616

### Antenna Tuning Unit connector panel



40631



\*) Please check the accessory list to find the optional DSUB to screw Terminal Converter Box CB4616.

\*\*) Please check the accessory list to find recommended power products.

\*\*\*) Please check the accessory list to find recommended loudspeaker.

Please note that for distance less than 25m the system will work with 0.25mm² instead of 0.5mm².

**Cable 1: Handset - Control Unit**

Cable: Supplied with handset

Cable-connector: 9 way Dsub male.

Control Unit 'HANDSET' Dsub 9	Designation	Remarks
1	TLF	Handset earpiece
2	GND	System ground
3	GND	System ground
4	MIC	Handset microphone
5	PTT	Transmit key
6	HOOK	Low when on hook
7	+8V	8 V supply to handset
8	nc	No connection
9	2182 SEL	OC output. Low when 2182 kHz is selected

**Cable 2: Control Unit - Ground**Recommended wire dimension: min. 2.5 mm<sup>2</sup>

Maximum length 0.2 m

**Cable 3: Control Unit - Transceiver Unit**Cable: Multicable 5 x 2 x 0.5 mm<sup>2</sup> screened

Maximum cable length 100 m

Cable-connector: 9 way Dsub male. Part no. 75100064

Twisted pairs	Control Unit	Transceiver	Designation	Remarks
	'SCANBUS' Dsub 9	'SCANBUS' Dsub 9		
	1	1	SUPPLY ON	Supply on signal to the Transceiver Unit. Active when connected to GND
1	2	2	DATA+	Data communication between units. CAN bus. Baud rate: 125 kbps
	3	3	DATA-	Spec.: ISO/DIS 11898.
2	4	4	AF +	TX AF modulation
	5	5	AF -	Vnom = 0.775 Vrms diff. Vmax = 12 Vpp diff.
	6	6	GND	System ground
	7	7	+24 V	Supply voltage for the Control Unit.
3	8	8	RXAF +	RXAF signal
	9	9	RXAF -	Vnom = 0.775 Vrms diff. Vmax = 12 Vpp diff.
	Shield	Shield	Screen	Screen connected to system ground

**Cable 4: Transceiver Unit - Antenna Tuning Unit**

Cable: 50 ohm coaxial cable RG213/U part no.: 77.508

Maximum cable length 100 m

Cable-connector: UHF connector PL259. Part no. 75100054

**Cable 5: Transceiver Unit - Ground**Recommended wire dimension: min. 10 mm<sup>2</sup>

Maximum length 0.2 m

**Cable 6: Transceiver Unit - DSC/TELEX RX Antenna**

Type: 50 ohm coaxial cable RG213/U part no.: 77.508

Maximum cable length 100 m

Cable-connector: UHF connector PL259. Part no. 75100054

**Cable 7: Antenna Tuning Unit - Ground**

Copper strap 100 x 0.5 mm  
Refer to section 'Ground Connections'

**Cable 8: Control Unit - External Speaker**

Cable: Multicable 2 x 0.5 mm<sup>2</sup> screened  
Maximum cable length 3m  
Control Unit 'AUX'. Refer to 'AUX' table.

**Cable 9: Control Unit - GPS**

Cable: Multicable 2 x 0.5 mm<sup>2</sup> screened  
Control Unit 'AUX'. Refer to 'AUX' table.  
Cable screen should be connected to the GPS chassis only and not be connected to system ground.

**Cable 10: Control Unit – Distress Alarm Panel**

Cable: Multicable 4 x 0.5 mm<sup>2</sup> screened  
Maximum cable length 100 m  
Control Unit 'AUX'. Refer to 'AUX' table.  
Cable-connector: 9 way Dsub male. Part no. 75100064

**Cable 11: Control Unit – External DSC Alarms**

Cable: Multicable 2 x 0.5 mm<sup>2</sup> screened  
Maximum cable length 3 m  
Control Unit 'AUX'. Refer to 'AUX' table.  
Cable-connector: 9 way Dsub male. Part no. 75100064

Control Unit	Designation	Cable no.:	Remarks	Alarm Panel
AUX Dsub 9				MF/HF x4 Dsub 9
1	SPARC-BUS+	10	To Distress Alarm Panel	3
2	DISTRESS ALARM	11	Standard HC-MOS output + 5V when active	
3	OTHER DSC ALARM	11		
4	NMEA IN-	9	NMEA position input	
5	GND	8	System ground	2
6	SPARC-BUS-	10	To Distress Alarm Panel	5
7	+24 V*	10	To Distress Alarm Panel	9
8	NMEA IN+	9	NMEA position input	
9	EXT_SP+	8	External speaker	
Shield	Screen		Screen connected to system ground	

\* Fused

**Cable 12: Control Unit – Printer**

Cable: Supplied with printer

Maximum cable length 10 m

Cable-connector: 25 way Dsub male. Part no. 75100066

Control Unit	Direction	Designation
'PRINTER' Dsub 25		
1	Output	LPT_STR
2	Output	LPT_D0
3	Output	LPT_D1
4	Output	LPT_D2
5	Output	LPT_D3
6	Output	LPT_D4
7	Output	LPT_D5
8	Output	LPT_D6
9	Output	LPT_D7
10	Input	LPT_ACK
11	Input	LPT_BUSY
12	Input	PAPER END
13	Input	LPT_SELECT
14	Output	AUTO LINE FEED
15	Input	LPT_ERROR
16	Output	LPT_INIT
17	Output	LPT_SELIN
18		GND
19		GND
20		GND
21		GND
22		GND
23		GND
24		GND
25		GND

**Cable 13: Control Unit – Keyboard**

Cable: Supplied with keyboard

Cable-connector: 6 pin PS2 mini DIN

Control Unit	Designation	Remarks
'KEYBOARD' Mini DIN(PS2)		
1	PC_KEYB_CLK	Keyboard clock
2	GND	System ground
3	PC_KEYB_DATA	Keyboard data
4	NC	No connection
5	+ 5 V	5V supply voltage to keyboard
6	NC	No connection



**Cable 14: Control Unit - Data / Service Interface**

Cable: Standard 9 wire serial cable for computer equipment

Cable-connector: 9 way Dsub male. Part no. 75100064

Control Unit	Designation	Remarks
Data Dsub 9		
1	nc	No connection
2	DATA OUT	RS232
3	DATA IN	RS232
4	DTR	RS232
5	GND	System ground
6	nc	No connection
7	nc	No connection
8	nc	No connection
9	nc	No connection
Shield	Screen	Screen connected to system

**Cable 15: Transceiver Unit – 24 V Battery**

Max. cable length to battery *	Cable type	External fuses
5 m	3 x 10 mm <sup>2</sup>	40 A
8 m	3 x 16 mm <sup>2</sup>	50 A
12 m	3 x 25 mm <sup>2</sup>	63 A

**Cable 16: Transceiver Unit – AC power supply**Cable: Multicable 4 x 0.5 mm<sup>2</sup> screened

Cable-connector: 9 way Dsub male. Part no. 75100064

Transceiver Unit 'SUPPLY ALARM' Dsub 9	Designation	Remarks
1		
2	nc	No connection
3	nc	No connection
4	/AC ALR	AC Alarm input. Alarm when connected to GND
5	GND	System ground
6	VBAT-	Voltage input for high/low battery voltage alarm
7	VBAT+	
8	nc	No connection
9	nc	No connection
Shield	Screen	Screen connected to system ground

**Cable 17: Transceiver Unit – TX Inhibit / RX Mute**Cable: Multicable 2 x 0.5 mm<sup>2</sup> screened

Maximum cable length 3 m

Transceiver Unit 'SYS' pins 4 and 5. Refer to 'SYS' table.

**Cable 18: Transceiver Unit – Data modem**Cable: Multicable 9 x 0.5 mm<sup>2</sup> screened

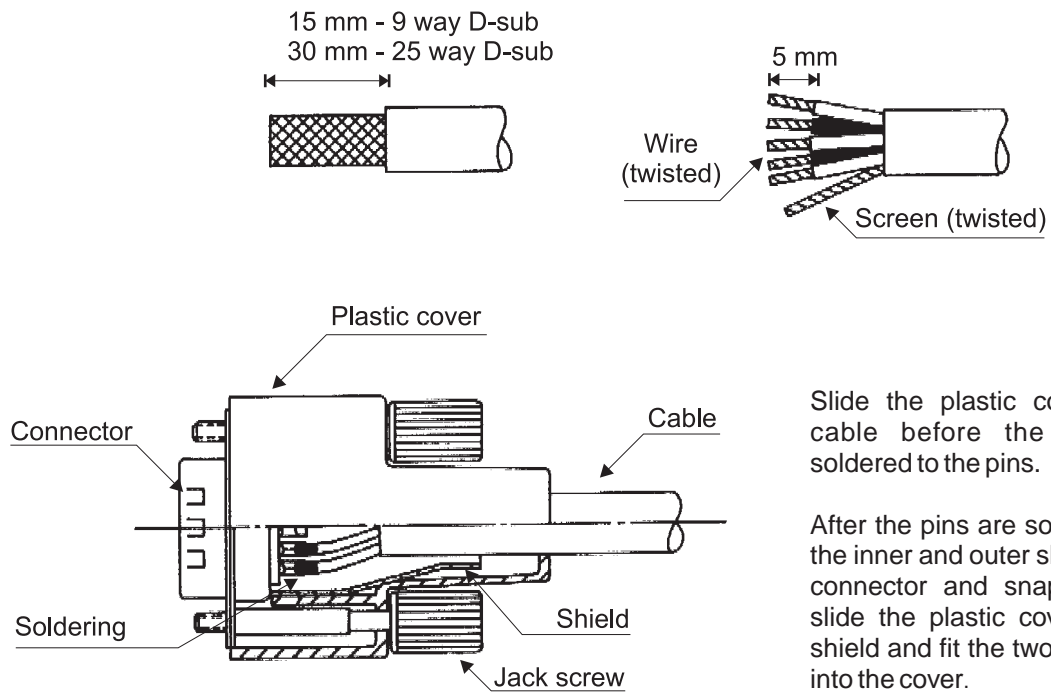
Maximum cable length 3 m

Cable-connector: 9 way Dsub male. Part no. 75100064

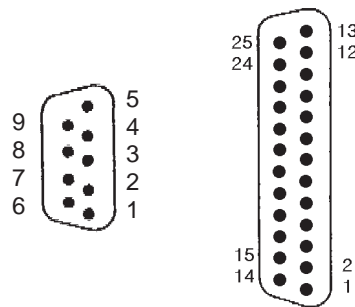
Transceiver Unit 'SYS' Dsub 9	Designation	Remarks
1	EXT KEY	Transmitter key input. Pulled up to +12 V Active when connected to GND
2	DATA OUT	RS-232 port for remote control of frequency, mode and power level. T+Bus protocol, baud rate 2400 bps
3	DATA IN	Also used for upload of software.
4	TX INHIBIT MAIN RX MUTE	Transmitter inhibit/RX mute input. Pulled up to +12 V Active when connected to GND
5	GND	System ground
6	LINE OUT	Single ended 600 ohms AF output 0 dBm in 600 ohms 1.55 Vrms when unloaded Refers to system ground (GND)
7	LINE IN	Single ended 600 ohms AF input Nominal level 0 dBm Accepts -15 dBm to +10 dBm Refers to system ground (GND)
8	TX KEYED	Low when TX keyed OC output, max. 50 mA, 32 V
9	+12 V	+12 V output Max. 100 mA, internally protected.
Shield	Screen	Screen connected to system ground

## 2.8 Connector mounting instructions

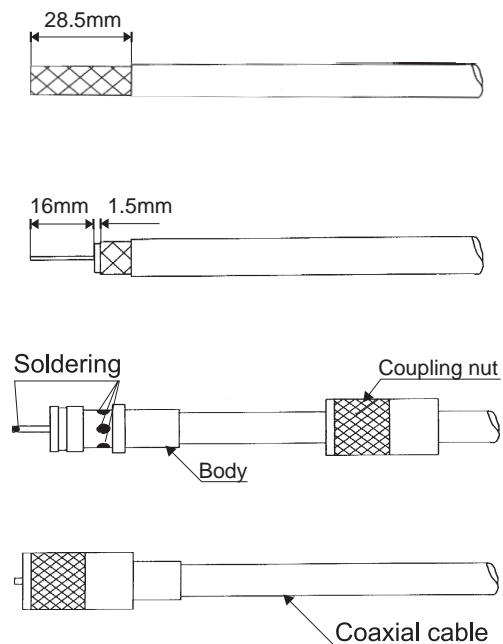
### 9 and 25 way D-sub



Contact arrangement  
(Viewed from solder side)



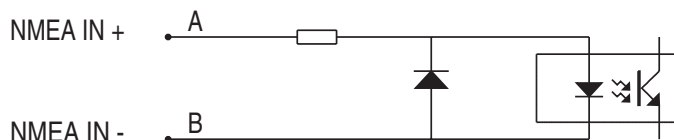
### PL 259



## 2.9 Position and time information

### Connection of Navigation Equipment

Navigation equipment complying with the NMEA 0183/IEC 1162 standard may be connected for automatic position and time updating. Connection is made to the 'NMEA' terminals of the Control Unit. The NMEA receive circuit consists of an optoisolator with a 470 ohms series resistor to insure current mode operation and a shunt diode to limit reverse bias as shown below. The circuit is isolated from ground.



The circuit operates with a minimum differential input voltage of 2 volts and takes less than 2 mA from the line at that voltage. The maximum voltage is 15 volts.

37871

Interconnection between devices may be by means of two-conductor shielded twisted-pair wire. Multiple listeners may be connected to a single talker. The receivers are connected in parallel. The shield should be connected to the navigator chassis and should **not** be connected at any listener. However the shield should be continuous (unbroken) between all listeners.

Following sentences are recognized by the equipment for extraction of position and associated time information: RMC, GLL, GGA. GLL sentences with and without time information is recognized, time information is extracted if present.

ZDA, RMC, GLL and GGA sentences are recognized by the equipment for extraction of UTC time information for automatic setting of the internal real time clock.

## 2.10 DSC programming

### Programming of DSC self-identification

The Maritime Mobile Service Identity (MMSI) assigned to the station must be stored in the DSC modem before it can be used on board the ship. The MMSI number will be requested each time the equipment is switched on until it has been stored.

Key in the MMSI number of the ship. Check the number carefully and select 'ENTER'. After the MMSI number has been entered it is necessary to restart the system to effect the change: Switch supply off and on. Check the MMSI number by pressing MENU key and select 'INFO & TEST', 'INFORMATION', 'MMSI' and read the number.

Once the MMSI number has been stored in the DSC modem, change of self-identification is only possible following a factory resetting.

### Programming of DSC group-identification

Six different group identities may be assigned to the station. Group call identity numbers always contain a leading zero. The group call identities must be stored in the DSC modem before it is able to respond to group calls.

Press MENU, select 'INFO & TEST', 'INFORMATION', 'MMSI', Press EDIT. Key in the group call identities and select 'OK'.

## 2.11 Battery alarm adjustment

Connect a voltmeter and an external power supply capable of delivering 1.0 A and adjustable up to 33 V DC to the VBAT- and VBAT+ input of the SUPPLY ALARM connector on the Transceiver Unit. Open the Transceiver Unit to gain access to the potentiometers on Control/Interconnection Module 122878.

### Low voltage alarm

1. Adjust the external power supply to the desired low voltage alarm level (22 – 24 V).
2. Watch the Alarm LED.
3. Now carefully turn the potentiometer marked 'Batt. low adj.' until the light in the Alarm LED just disappears.

Factory setting: 23.5 V

### High voltage alarm

1. Adjust the external power supply to the desired high voltage alarm level (27 – 32 V).
2. Watch the Alarm LED.
3. Now carefully turn the potentiometer marked 'Batt. high adj.' until the light in the Alarm LED just disappears.

Factory setting: 29.5 V

## 2.12 Options menu - setting up the system

To open the Options menu, press MENU, select 'SETUP' and select 'OPTIONS' in the 'SETUP' menu and enter the access code,1,2,3,4.

Menu	Submenu Level1	Submenu Level 2	Submenu Level 3 / Parameters	
OPTIONS	TX BANDS	EDIT Select band	Edit TX frequency band	
	CONFIGURATION	LSB MODE	Enable/disable	
		REMOTE MODE		
		BATT/ SUPPLY ALARM		
		ATU INSTALLED		
		RX MUTE MODE		
	DSC	TX INHIBIT MODE		
		AM TX MODE		
		PRINT DSC		
		LANGUAGE	Select language	
TX TEST	RX TEST	Enable/disable serial output of decoded DSC calls for test purposes		
	SEND DOTS	SEND DOTS	Send dot Pattern	
		SEND Y	Send Y frequency (1615 Hz)	
SEND B		Send B frequency (1785 Hz)		
FACTORY RESET		Turn off the radio!!!		
MMSI RESET		Turn off the radio!!!		

**Notes:**

**TX BANDS:** Up to 16 frequency bands can be defined. Transmission is inhibited on frequencies outside the defined bands.

Factory pre-programmed:	1605.0	-	4000.0	kHz
	4000.0	-	4438.0	kHz
	6200.0	-	6525.0	kHz
	8100.0	-	8815.0	kHz
	12230.0	-	13200.0	kHz
	16360.0	-	17410.0	kHz
	18780.0	-	18900.0	kHz
	19680.0	-	19800.0	kHz
	22000.0	-	22855.0	kHz
	25070.0	-	25210.0	kHz
	26100.0	-	26175.0	kHz

**CONFIGURATION:**

**LSB MODE:** When enabled selection of LSB (Lower Side Band) is possible with the MODE key on the front panel.

Note: LSB mode is normally not allowed for marine equipment.

Factory default setting: Disabled.

**REMOTE MODE:** When enabled selection of SSB REMOTE is possible with the MODE key on the front panel, allowing remote control via the SYS connector of frequency, mode and power level.

Factory default setting: Disabled.

**ATU INSTALLED:** When enabled supply voltage and control signals for the ATU is present at the TX/RX connector. When disabled a 50 ohms antenna or dummy load may be connected to TX/RX.

Factory default setting: Enabled.

**BATT /**

**SUPPLY ALARM:** When enabled the voltage at the VBAT input of the SUPPLY ALARM connector is monitored and an alarm is given by the Control Unit if the voltage is outside the set range.

Factory default setting: Disabled.

**RX MUTE /**

**TX INHIBIT:** Select RX mute or TX inhibit to select functionality of input pin (SYS con – pin 4 on transceiver). When RX mute is selected this input will mute the receiver when input is pulled low. When TX Inhibit is selected this input will prevent keying the transmitter when input is pulled low. Factory default setting: TX inhibit.

**AM TX MODE:** When AM TX is enabled it will be possible to transmit in AM mode with reduced power.

Note: AM TX mode is only allowed in connection with equipment type approved in accordance with FCC.

Factory default setting: Disabled.

**PRINT DSC:** When enabling this feature the DSC messages transmitted and received will be printed out on the attached printer. Note that these DSC message will still be stored in the DSC log.

**DSC:**

**LANGUAGE:** Factory default setting: English.

**RX TEST:** When enabled decoded call sequences are routed to the RS-232 port of the SYS connector. Baud rate: 2400 baud. Parity/data bits: Odd/8.

Factory default setting: Disabled.

**TX TEST:** For generation of continuous B or Y signal and dot pattern. DSC mode must be selected.

**FACTORY RESET:** Choosing this option will reset all user programmable settings to the factory default settings. MMSI will also be reset.

**MMSI RESET:** Choosing this option will only reset the MMSI number. Input new MMSI number after power up.

### 2.13 Factory resetting / MMSI resetting

Factory resetting and MMSI resetting is done on the Control Unit via the options menu.

To enter the options menu press MENU, select SETUP and finally select OPTIONS.

Then enter the access code 1-2-3-4.

#### Factory resetting

Select FACTORY RESET

The Control Unit will prompt for power off of the equipment.

When powered up again the System is in a state as described below.

The Factory Reset puts the System back to the default state originally set at the factory.

The chapters 2.10, 2.11 and 2.12 must therefore be repeated in order to restore the System settings before the Factory Reset.

The MMSI number must also be entered.

The Factory Reset removes configuration keys regarding **Telex Operation** and **6 ch scanning DSC Watch Receiver** if any of these keys were enabled.

Therefore it is necessary to carry out section 2.14 and 2.15, if the options have been installed before the factory reset.

#### MMSI resetting

Select MMSI RESET

The Control Unit will prompt for power off.

When powered up again the System is in a state as described below.

The MMSI reset only clears the MMSI number and when the system is powered up again the MMSI number is the only parameter which has to be reprogrammed.

**Note:** The System serial number is not affected by either the Factory Reset or the MMSI reset.

### 2.14 Enabling the 6 ch scanning DSC Watch Receiver

For the MF/HF product a *6 ch scanning DSC Watch Receiver* option is available. The option is enabled by entering a 10-digit pin code into the transceiver. The pin code is uniquely matched to the serial number of the transceiver.

Once in possession of the required pin code the 6 ch scanning option is enabled from the menu point *Watch Receiver* in the Config Status menu. To enter the *Config Status menu*, press MENU, select SETUP and finally select CONFIG STATUS. The 10-digit code is then entered from the control unit keypad.

For further information refer to the user manual.

When the pin code has been entered once, the feature remains permanently enabled.

Concerning setting up the scanning sequence refer to the user manual.

#### IMPORTANT:

Remember to write down the transceiver serial number and the corresponding 10-digit pin code in the table below.

The table content is needed in connection with Service/Maintenance, when the system has been *Factory Reset* or the Control/Intercon module 60-122879 has been replaced.

In conjunction with *Factory Reset* or replacement of Control/Intercon module 60-122879 the *6 ch scanning DSC Watch Receiver* option need to be enabled again as described above.

## 2.15 Enabling the Telex operation

For the MF/HF product a *Telex operation* option is available. The option is enabled by entering a 10-digit pin code into the transceiver. The pin code is uniquely matched to the serial number of the transceiver. Once in possession of the required pin code the Telex option is enabled from the menu point *Telex* in the Config Status menu. To enter the *Config Status menu*, press MENU, select SETUP and finally select CONFIG STATUS. The 10-digit code is entered from the control unit keypad.

For further information refer to the user manual.

When the pin code has been entered once, this feature remains permanently enabled.

### IMPORTANT:

Remember to write down the transceiver serial number and the corresponding 10-digit pin code in the table below.

The table content is needed in connection with service/maintenance, when the system has been *Factory Reset* or the Control/Intercon module 60-122879 has been replaced.

In conjunction with *Factory Reset* or replacement of Control/Intercon module 60-122879 the *Telex operation* option need to be enabled again as described above.

Serial number *:	
6 ch scanning DSC Watch Receiver pin code:	
Telex Operation pin code:	

\* Please find typelabel with serial number on transceiver side

## 2.16 Telex operation

For the MF/HF products a telex operation option is available. The telex operation option is enabled by entering of a pin-code (key) into the MF/HF transceiver. This pin code is uniquely matched to the serial number of the MF/HF transceiver, i.e. one specific pin code will enable the telex operation option in one specific MF/HF transceiver only.

Once in possession of the required pin code the telex operation option is enabled from the menu point *telex operation Code* in the System Setup menu. The 10-digit pin code is entered from the transceiver keypad.

When the pin code has been entered and the telex operation option enabled, the telex operation feature remains permanently available for selection.

For details on how to obtain the telex operation feature for your SAILOR CU5100 MF/HF transceiver, contact your local Thrane & Thrane representative.

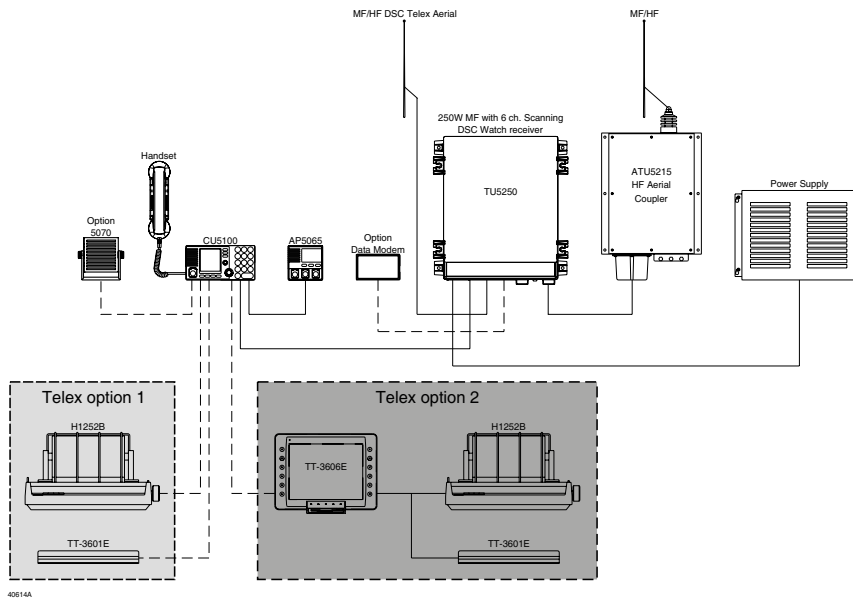
### 2.16.1 GMDSS Radiotelex terminal

The GMDSS Radiotelex Terminal is an option used for handling transmission/reception of telex messages over radio. The terminal consists of a printer and a keyboard, connected to the transceiver control unit which provides the interface to the DSC/telex modem located in the transceiver unit. The keyboard is equipped with an affixed template for function keys and indicator lamps.

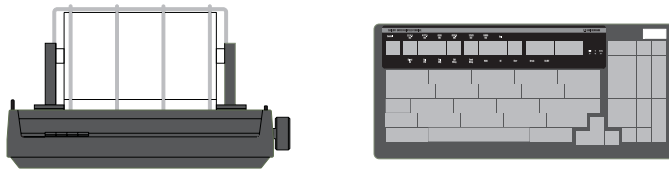
The GMDSS Radiotelex Terminal is designed in accordance with relevant IMO, ITU and ETSI recommendation/specifications and has been approved for shipboard installations to be operating within the Global Maritime Distress and Safety System.

It supports world-wide ship-to-ship, shore-to-ship and ship-to-shore communication by utilizing the radiotelex protocols described in ITU- Rec. 625 to overcome the deficiencies of the HF medium. In case of two-way communication an ARQ (Automatic Repetition reQuest) algorithm for error correction is thus used, and when sending to more than one station an FEC (Forward Error Correction) algorithm is used.





### 2.16.2 Simple telex operation



#### 2.16.2.1 Installation and Initial Set-up

##### Printer

The terminal uses an OKI Microline 280 parallel interface dot-matrix printer with roll paper stand, please refer to the operation guide delivered with the printer. The printer should be connected to the printer socket at the rear of the control unit by means of the parallel interface cable included with the printer. The printer is equipped with a special firmware which allows the paper to be scrolled up so the current line can be read in printing pauses, and scrolled back down when printing continues. The firmware version can be checked by performing a selftest: Disconnect the parallel interface cable. Press the LF (line-feed) and the Select button while switching the printer on. When light comes on in the indicator lamps, release the buttons. The printer version is now printed followed by a test print-out. The version must be: F/W 03.10 Also make sure the printer firmware is configured for radio telex. This is shown in the snapshot below, where "MEI E1" indicates configuration for radio telex.

```

ML280E1ite (MEI E1) F/W 03.10 42434401YR-04
CG 03.00
! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _ ` a b c d e f g h i j k l m n o
! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _ ` a b c d e f g h i j k l m n o p
" # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _ ` a b c d e f g h i j k l m n o p q
# $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _ ` a b c d e f g h i j k l m n o p q r
$ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _ ` a b c d e f g h i j k l m n o p q r s
% & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _ ` a b c d e f g h i j k l m n o p q r s t
    
```

##### Keyboard

The keyboard is a Cherry 1800 PC/AT compatible keyboard. The self-adhesive keyboard template delivered with the equipment must be mounted on the keyboard: Remove the protective paper. Carefully place the template around the function keys and indicator lamps so the latter are fully visible.

### Modem Set-up

Modem set-up mode is selected automatically when selecting telex mode on if no call codes are valid or if the answer back string is not valid. To change a valid set-up, a factory reset of the modem must be performed.

When entering telex mode after a factory reset the 5-digit call code, may then be entered. The MMSI number from the control unit will be printed, but cannot be changed. The answer back string allocated to the station may then be entered. To leave a setting unchanged just press '↵ Enter', otherwise key in a new setting and press '↵ Enter'. The next item is then printed. After the last item follows:

Accept settings (Y/N)?

The process may be repeated if 'N' is pressed; the modem set-up mode is left if 'Y' is pressed.

The answer back, which should be entered above is combined by the 5-digit call code or MMSI number, the abbreviated ID and an "x" e.g.:

12345 abcd x      or      123456789 abcd x

## 2.17 Final installation check

For operation of the equipment please refer to the User Manual.

Check the hardware configuration of the transceiver by selecting FUNC and the 'INFO & TEST', 'INFORMATION' 'HW VERSION' menu items, in particular check that the Antenna Tuning Unit is recognized, if installed.

Perform a Self Test of the transceiver by selecting FUNC and the 'INFO & TEST', 'CHECK', 'SELFTEST' menu items. The self test is performed automatically and is used for verification of all functions. Check the transmitter in all marine bands.

The Antenna Tuning Unit will tune automatically to the antenna first time the equipment is keyed on a new frequency or when the TUNE button is pressed. During the tune sequence and normal transmission all transmitter circuits are monitored to ensure safe operating conditions. If transmission conditions are bad ( bad antenna installation, high temperatures, etc. ) the transmitted power will be reduced to a safe limit. If the transmission condition is improved automatic recovery to full power takes place.

The protection can be investigated by selecting FUNC and the 'INFO & TEST', 'CHECK', 'TX PROTECTION' menu items. The displayed protection code(s) is described in the Service chapter of this manual. If a GPS is connected, check position and time in the DSC Status display.

If time is not contained in the NMEA sentences the time of position is indicated as —:—. In this case check if the GPS output setting can be changed to allow time information. Otherwise UTC time must be entered manually each time the transceiver is switched on.

Send a DSC test call to the appropriate coast station. The acknowledgement from the coast station is received by the 2187.5 kHz watch receiver if the call was sent on that frequency. If the call is sent on HF only the audio signal output from the 2187.5 kHz watch receiver should be checked by selecting FUNC and the 'INFO & TEST', 'MONITOR', 'WR AUDIO' menu items.

### 3 Technical description

#### 3.1 Control Unit

The Control Unit consists of a main module 60-122876 and a MMI module 60-122877.

The main module consists of the digital part, i.e. the microprocessor, program FLASH PROM, configuration FLASH PROM, RAM, ScanBus data communication driver, SPARC-Bus driver, Printer interface, Keyboard interface and data terminal interface.

The main module also consists of an analog part, i.e. the voltage regulators, the analog interface circuits and the analog output drivers (audio and light). The main module supports a build-in speaker and the connectivity of an external 8 ohm speaker.

The MMI module contains the graphical TFT color display (240x320 dots), the display controller, keyboard interface and encoders for volume and rotary knob.

#### 3.2 Transceiver Unit

Block diagram page 3-3, Interconnection diagram page 3-4.

The Transceiver Unit consists of five modules. Three modules located in the base part of the unit: a control and interconnection module, a receiver/exciter signal path module, and a synthesizer and DSC RX module including master oscillator, and two modules are located in the door part of the unit: a power amplifier module including filter bank and a switched mode power supply. The main wiring is by ribbon cables with Micro MaTch connectors. RF signals are routed in coaxial cables using Taico, MCX and BNC connectors.

#### 3.3 Control/Intercon module 60-122878

The Control/Intercon module performs the digital and analogue control of the transceiver functions requested by the Control Unit and contains interconnection circuits. The central part is the CPU. The program software is contained in Flash PROM. A separate Flash PROM holds the configuration parameters. The processor communicates with the CU via the CAN interface, with auxiliary equipment via an RS-232 interface and the ATU via a modem circuit. Internal communication is via the TU Bus. The transmitter is monitored via the PA Peak, Filter Peak and Filter Average detectors. An adjustable opto-isolated battery detector circuit monitors the battery voltage at the Supply Alarm connector and triggers an alarm when outside the set range. The CPU also performs DSC modulator and dual DSC demodulator functions. The modulator output is through a transversal filter. Audio switching allows loop back test. Audio circuits convert between unbalanced and balanced lines used by the ScanBus.

#### 3.4 Synth. and DSC WR module 60-122879

The Synthesiser part includes Master oscillator, dividers, 3.LO PLL and VCO, 2.LO filters and multiplier and 1.LO fractional N system as well as both 1. and 2. DSC LO PLL and VCO. The Master oscillator generates a 17.8176MHz reference signal which is distributed to the local Synthesizer LO sub-circuits. The appropriate frequencies for the MF/HF transceiver are then generated.

The DSC Watch receiver is built up as a Double Super Heterodyne Receiver using Intermediate frequencies of 30.155 MHz and 455 KHz.

After frequency conversion to 455 KHz the signal is fed to 455 KHz IF2 AGC amplifier before led to final detection / conversion to 1700 Hz.

The Signal is filtered out by 1700 Hz Audio filter and afterwards led to limiting amplifier thus creating the DSC output for further processing.

The Receiver Signal Path also includes antenna supply and receiver protection circuitry.

A RF splitter divides the DSC antenna signal between the Watch Receiver and the Main Receiver, which uses the signal in telex mode.

The Synthesizer used for the Watch Receiver consists of the following sub circuits:

- An integer type PLL is used for creating the DSC LO1 signal. The PLL resolution is 2 KHz and after division by 4 the final DSC LO1 resolution is 500 Hz. Three separate VCO's are used for covering the necessary frequency range. A 14.85 MHz TCXO is used for reference for the PLL.
- A doubler Circuit submitted to the 14,85 MHz reference signal is used for DSC LO2 signal thus creating 29.70 MHz.
- A 14.6144 MHz TCXO divided by 32 thus creating 456.7 KHz is used for DSC LO3 signal.

### 3.5 RX/EX signal path module 60-122880

The RX signal path includes protection, pre-selection, mixers, IF amplifiers, filter bank, demodulator, squelch and audio. The RX signal path has Automatic Gain Control. The RX signal path performs the handling of the received antenna signal and delivers an AF signal, via the Control/Intercon module where the AF signal is converted from an unbalanced to a balanced signal, to the Control Unit.

The RX signal path also includes a DSC receiver signal path, which uses the MF/HF signal path, until the last down conversion. DSC part includes a mixer, base band filter and hard limiter. During DSC reception, the DSC part overrules the normal MF/HF reception.

The EX signal path includes AF compressor, modulator, filter bank, mixers and EX output amplifiers. The EX signal path has Automatic Loop Control. The EX signal path generates the modulated RF signal, adjusted to correct level - ALC adjusted signal, to the Power Amplifier.

The RX/EX signal path is controlled by the Control/Intercon module and receives its injection signal from the Synth./DSC WR module.

### 3.6 PA and Filters module 60-122881

The PA and Filters module includes PA drivers, PA-stage, protection circuits, bias circuits, key circuit and five low-pass filters with relays and relay drivers. The PA and Filters receives the modulated RF input signal from the RX/EX Signal Path and delivers the amplified and filtered output signal to the TX/RX connector via a receive/transmit relay on the Control/Intercon module.

The low-pass filters removes the unwanted harmonic frequencies from the PA signal. The Filpeak and PAprotec outputs are monitoring signals for the Control/Intercon module. The driver and final power amplifier stages are galvanically isolated on input and output as they are supplied directly from the 24 V DC input. The selection of low-pass filter is controlled by the Control/Intercon module.

The PA filters cover the frequency ranges:

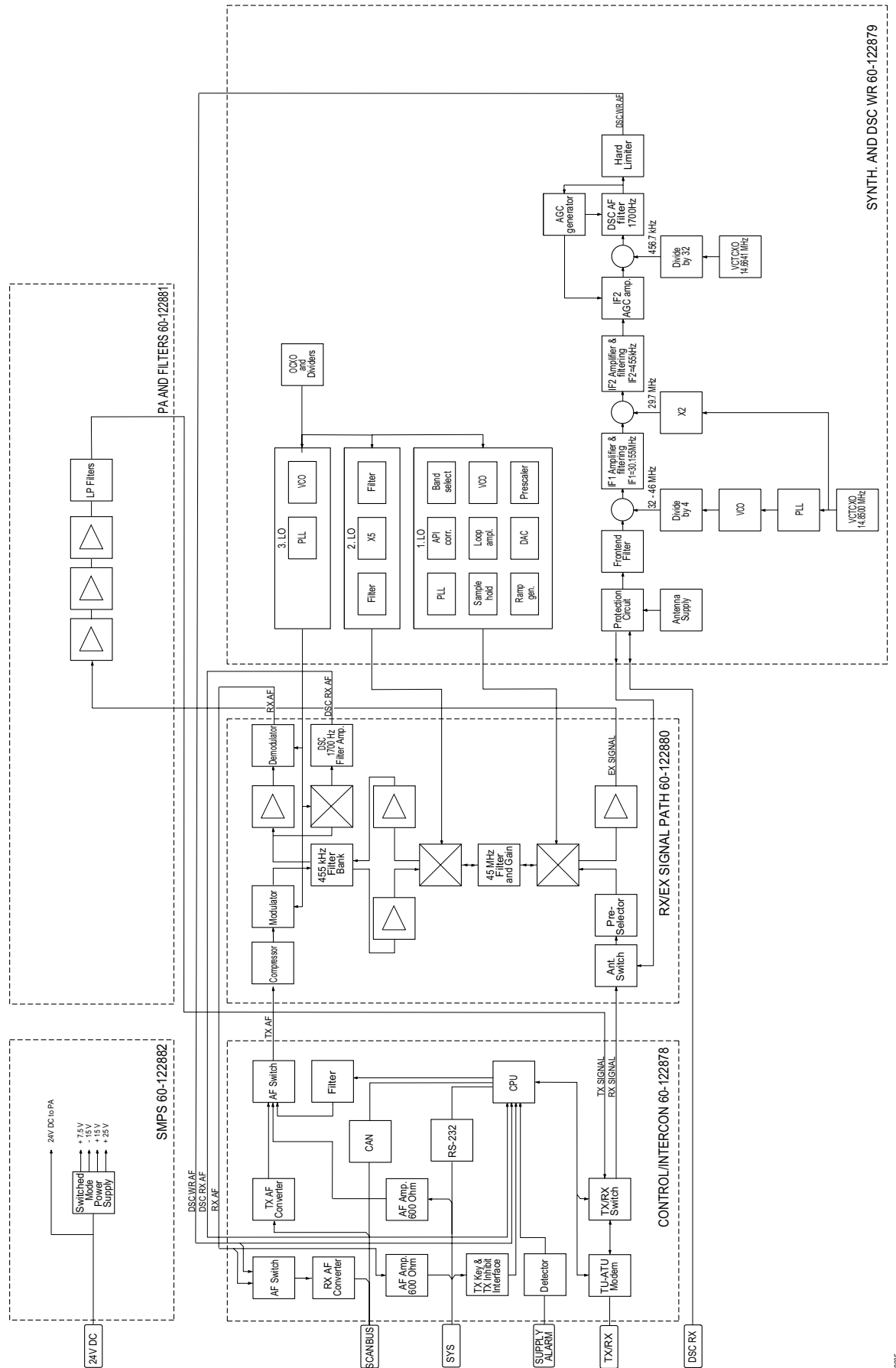
- 1.6 – 3.1 MHz
- 3.1 – 5.0 MHz
- 5.0 – 9.0 MHz
- 9.0 – 17.0 MHz
- 17.0 – 29.7 MHz

### 3.7 SMPS module 60-122882

The Switched Mode Power Supply supplies the low power circuits of the equipment with the various stabilized voltages required, and provides galvanic isolation from the supply source. The equipment is supplied from a 21.6 – 31.2 V DC power source. The module also carries the input filter and PA supply output which is not galvanically isolated.

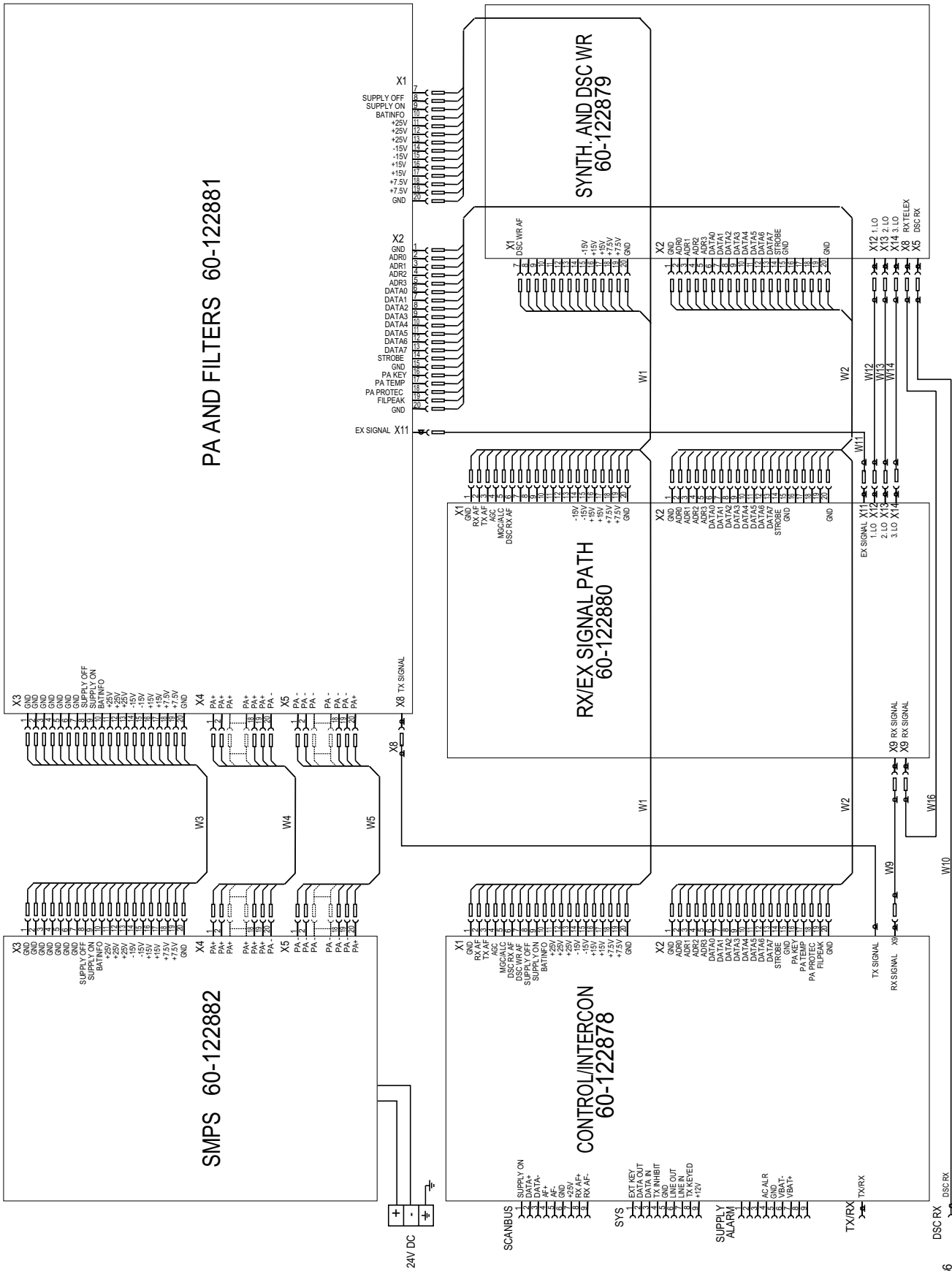
The power supply converts the incoming voltage to 7.5 V, +15 V, -15, and 25 V. The SMPS is switched on from the Control Unit via the Scanbus SUPPLY ON wire and switched off under software control via the SUPPLY ON/OFF connection from the Control/Intercon module. The DC supply voltage is sensed by a BAT INFO detector circuit and fed to the Control/Intercon module for automatic RF output power adjustment.

### 3.8 Transceiver unit block diagram



SYNTH. AND DSC WR 60-122879

### 3.9 Transceiver unit interconnection diagram



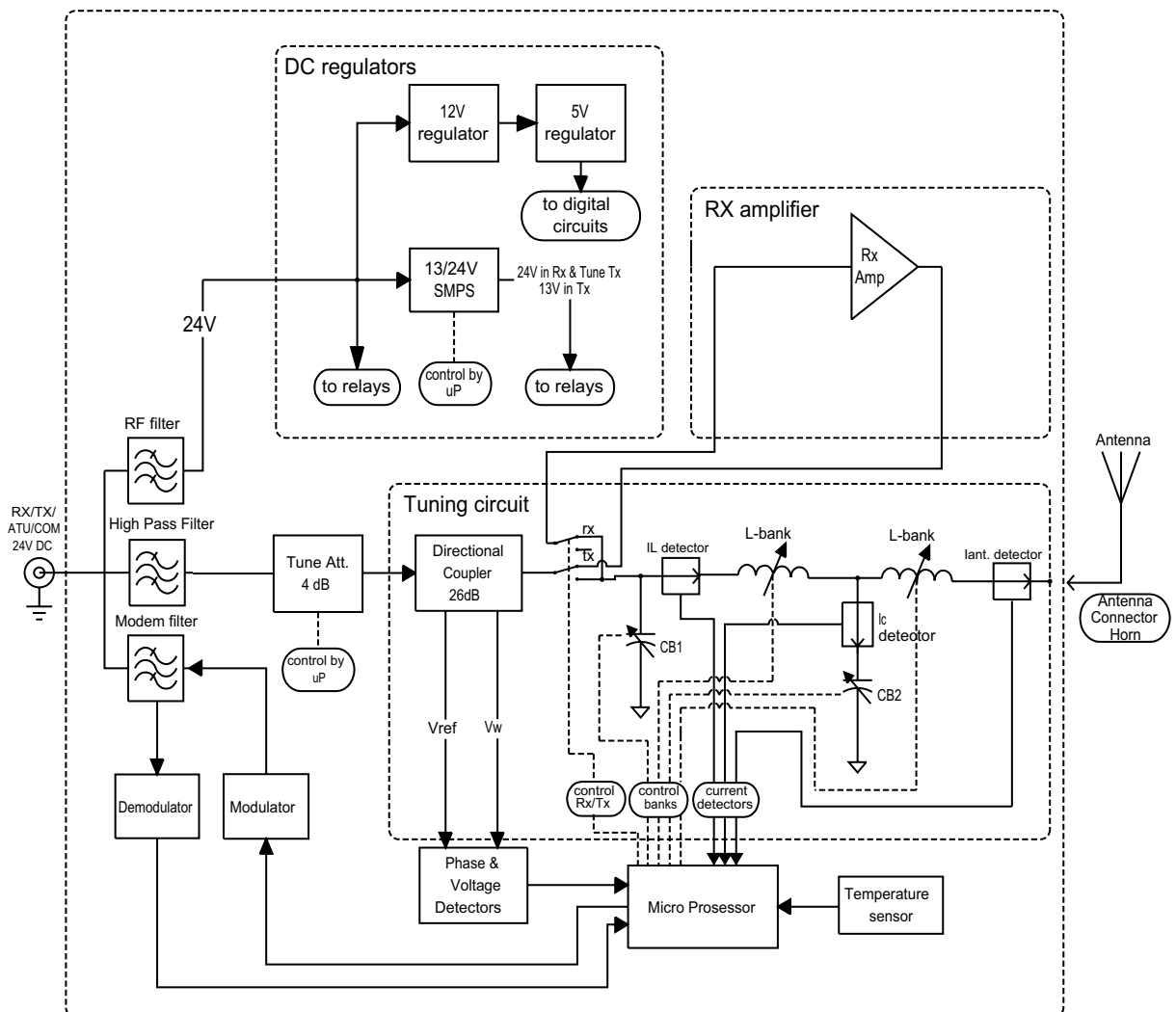
### 3.10 Antenna Tuning Unit

#### ATU module 60-122883

The ATU module comprises tuning network, measuring system and micro-controller circuits. The ATU module matches the impedance of the antenna to 50 ohm in order to gain the best possible SWR. The ATU module communicates tuning process and frequency information with the transceiver unit. The tuning network consists of Capacitor Bank 1, Capacitor Bank 2, and an Inductor Bank. With these it is possible to form either an L-network or a  $\pi$ -network. The capacitor banks and inductor bank are built up by binary related capacitors respectively binary related coils. The setting of capacitance and inductance is accomplished by relays. A current detector at the antenna output terminal is used for measuring the antenna current for display at the Control Unit. To prevent overload of the relays, current detectors are incorporated in the Inductor Bank and in Capacitor Bank 2 and information fed back to the transceiver unit to decrease the output power if maximum permissible current is exceeded. To prevent overheating a temperature sensor is incorporated which at excessive temperatures commands the transceiver to reduce the output power.

In receive mode an RX-Amplifier included in the Antenna Tuning Unit will be inserted, to improve the sensitivity of the system. It is possible to select the sensitivity in the steps OFF and NORMAL from the Control Unit.

### 3.11 Antenna Tuning Unit block diagram



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### 3.12 Power control and protection system

The Transceiver has an automatic power level system, which ensures that optimum power is delivered to the Antenna. The Tune Sequence, which is automatically initiated when keying the transmitter after a frequency change, makes the Tuning Network of the Antenna Tuning Unit tune to the best obtainable SWR. This is followed by an Automatic Level Control (ALC) adjustment according to the available power supply voltage, measuring the output current of the PA Filters (FILPEAK @ 10 Vp at full output), transmitting AM carrier, and setting the overall gain by the ALC voltage (MGC/ALC). It is now possible to transmit on full output power unless protection is activated or LOW POWER is selected. The output power is continuously monitored by the microprocessor, and is automatically adjusted during transmission to provide reliable communication .

#### Power Amplifier Protection

The protection of the power amplifier consists of V+I protection, SWR protection, and thermal protection. When PA PEAK, the output signal of the voltage detector at the output of the power amplifier is exceeding 10 V the output power is reduced to a safe level. If the ALC loop is at fault, disconnected or responding too slow and the PA PEAK is exceeding 10V, the gain will be reduced in the power amplifier, operating as a local and independent PA protection. The thermal protection consist of a temperature sensor on the power amplifier and an average detector on the Control/Intercon module reducing the output power when the duty cycle of the transmitted signal exceeds 50% for more than 60 seconds. The available power supply voltage is measured in the DC power supply and the information BAT INFO is transferred to the Control/Intercon module. If the supply voltage is dropping the microprocessor will adjust the output power to keep distortion below the limits.

#### Antenna Tuning Unit Protection

The ATU is protected by several detectors all monitored by the ATU's microprocessor, which calculates the SWR, temperature, maximum voltage and current. If these parameters are not below safe operating limits it requests for lower power.

#### Protection Codes

The current status of the power control and protection may be displayed in the form of Protection Codes by selecting MENU and the 'INFO & TEST', 'CHECK' and 'TX PROTECTION' menu items. The Protection Codes are described in the Service chapter of this manual.

It should be noted that protection may be in force even under normal conditions e.g. code nos. **25**, **44** and **48**:

No. 25 requests lower Pout relatively to increasing SWR at the Power amplifier.

@ SWR= 1.1 reduction will only be a few watt's

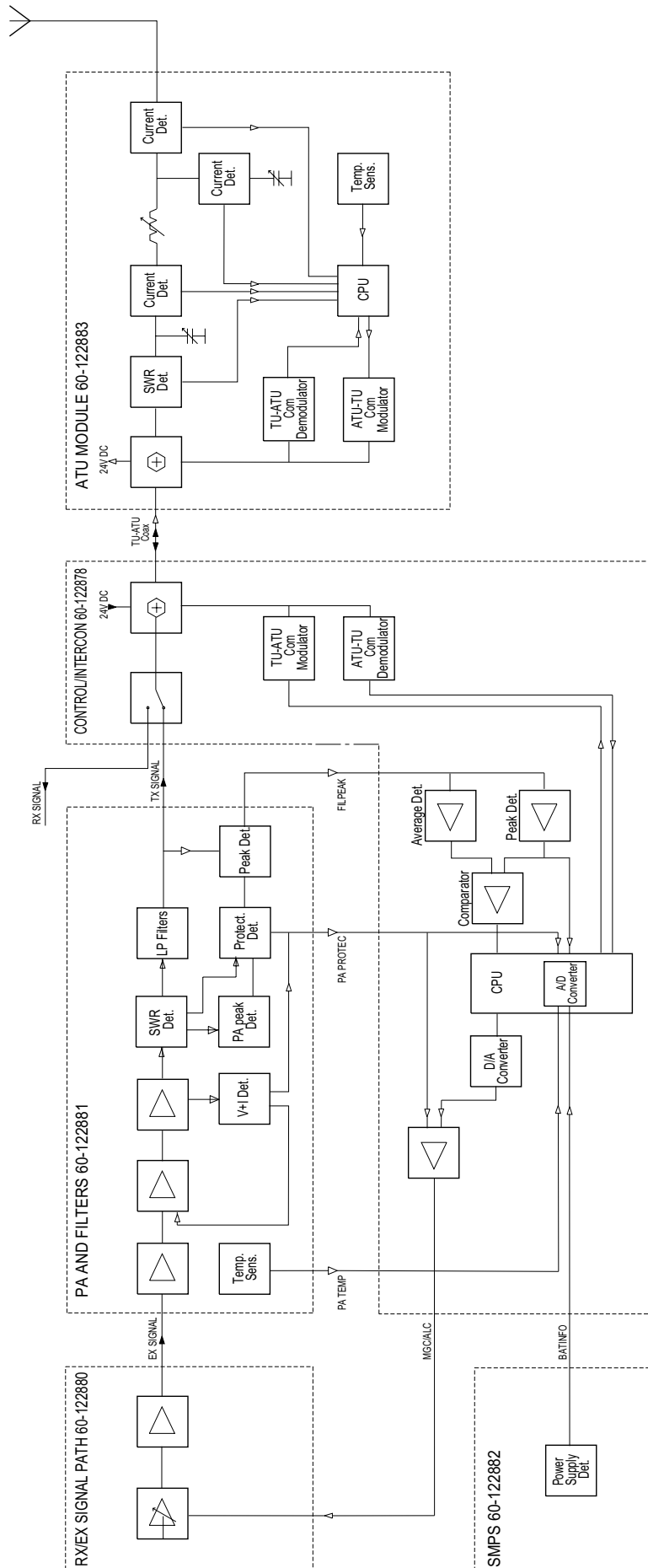
@ SWR= 2.0 reduction will be 2-3 dB

No. 44 and 48 requests lower Pout relatively to increasing V or I at ATU.

This is normal when transmitting on lower frequencies and short antennas ( $L \ll 1/4$  wavelength), and / or parallel capacitance present at the antenna, feeder, insulators, etc.



### 3.13 Power control and protection system



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## 4 Service

### 4.1 Preventive maintenance

Due to the modern design of the transceiver preventive maintenance can be reduced to a minimum provided the equipment is correctly installed. To ensure maximum performance and minimum repair trouble we recommend you to follow the below stated headlines for preventive maintenance.

1. The condition of the battery should be checked at frequent intervals. The battery must always be fully charged and should be topped up frequently with distilled water (liquid should be 5 to 10 mm above the plates).
2. Check the condition of antenna installation, ground connection and cables at regular intervals.
3. Keep antenna feed-through insulators clean and dry.
4. Ensure that no objects are obstructing the free airflow through the cooling fins of the Transceiver Unit and keep the units free of dust accumulation to prevent overheating.
5. For cleaning use a damp cloth. Sticky dirt may be removed using a cloth with a weak soap solution. Wipe off with a clean cloth.

### 4.2 Realignment of master oscillator

The master oscillator determines the exact transmit and receive frequencies of the equipment. All oscillators age very slowly with time, typically with the highest drift rate the first year, approaching zero drift after some years. Adjustment should be performed by a qualified technician with the necessary test equipment at his disposal.

1. Measuring Equipment:

Frequency Counter:	Frequency range 100 MHz
	Input impedance = 1 Mohm
	Sensitivity at least 0.2 Vrms
	Accuracy better than 0.01ppm

2. Preparations:

- 2.1 Switch on the power at least 30 minutes before adjustment.
- 2.2 Open the front of the Transceiver Unit.
- 2.3 Locate X13 on SYNTH.AND DSC WR module 60-122879 carrying the 2. Local Oscillator signal from the synthesizer to the RX/EX Signal Path. Connect the frequency counter probe to the inner conductor of the X13 socket on the synthesizer.
- 2.4 The ambient temperature should be within 10 to 30 deg. Celsius. Do not adjust the Master Oscillator shortly after long keying sequences of the transmitter. Be sure that thermal equilibrium has been reached before adjustment.

3. Realignment of Master Oscillator:

- 3.1 Locate the Master Oscillator adjustment hole in the metal cover over SYNTH.AND DSC WR module 60-122879. Use a small screwdriver to gently adjust the frequency.
- 3.2 Adjust the frequency as close as possible to 44.544 000 MHz.  
Adjustment tolerance +/-1Hz.
- 3.3 Remove the counter probe and refit the front of the Transceiver Unit.

### 4.3 Software update

Code and configuration software are placed in flash memory. Consequently it is not necessary to dismantle the units in order to update the software; a PC link must be used.

#### 4.3.1 Setup

In order to perform a software update, a PC with a communication program (e.g. Procomm Plus or HyperTerminal) and a communication cable are required.

If the Hyper Terminal program is used it is recommended to close and re-start the program if more than one file has to be downloaded. This should be done between each file download.

#### 4.3.2 PC

In the specific communication program, the Com port must be set to

Item	Value
Baudrate	38400
Parity	None
Data bits	8
Stop bits	1

Flow control must be set to: None

The communication protocol must be set to: X-Modem.

#### 4.3.3 Cable

The cable must be a 3-wire cable. Supplying more than 3-wire may damage the PC. The PC side of the cable must be a 9-pin (or 25-pin) female D-sub connector; the CU/TU side must be a 9-pin male D-sub connector. The cable may be supplied as accessory.

Designation	PC 'Com port'		CABLE	CU 'Data'	TU 'Sys'	Designation
	9-pin	25-pin		9-pin	9-pin	
Received Data	2	3		2	2	Data Out
Transmitted Data	3	2		3	3	Data In
Ground	5	7		5	5	Ground

#### 4.3.4 Procedure

The PC with the communication program and cabling must be ready before the CU/TU is switched on. The procedure is as follows.

- Download software from the web site or receive it from your distributor if necessary.
- Switch off PC and CU/TU
- Connect cable to unit to be updated
- Switch on PC
- Enter the communication program. Setup the Com port and select X-Modem protocol. Select the upload file (the new software version) and begin uploading.
- Switch on the CU/TU.

Upload will now begin. The result of the upload will be written on the PC when the upload is finished. If the upload was successful the CU/TU reboots automatically.

Any software update should always be followed by Factory Reset as described in section 2.13.

### 4.4 Trouble shooting

If a malfunction should occur in the transceiver, the following instructions should be followed in order to locate the module which is causing the malfunction:

1. Check the hardware configuration of the transceiver by selecting 'MENU' and the 'INFO & TEST', 'INFORMATION', 'VERSION' and 'HARDWARE' menu items, in particular check that the antenna tuning unit is recognized, if installed.
2. If the malfunction is related to transmission check the current status of the power and protection monitor. A description of the 'Protection codes' is included on the following pages.

3. If possible execute the built in self test. An 'Error code' for the failing module will be displayed. A description of the 'Error codes' is included in the Self Test section of this chapter.
4. If an execution of the self test failed, check that all cables and plugs are correctly connected, and that the supply voltage is correct. At this point the fuses should be checked.
5. The next step is to open the Transceiver Unit and :
  - a. Check the internal fuse, cables and plugs.
  - b. Check that the +5 V LED (Light Emitting Diode) V1 on the PA AND FILTERS module 60-122881 is constantly on; indicating that the Switch Mode Power Supply is on and producing +7.5 V DC.
6. If the above steps did not help, please contact your local service agent.  
A list of service agents is found on the Internet.

#### 4.5 Power protection

The Power and Protection system is monitoring the transmitter circuits during transmission and will automatically maximize the radiated power to safe limits. The current status of the Power and Protection monitor is presented in form of protection codes and may be requested at any time by selecting MENU and the 'INFO &TEST', 'CHECK', 'TX PROTECTION' menu items.

The display will show the Protection Code. More than one Protection Code may be set. Protection is automatically reset when the transmit conditions are normalized.

##### Protection Code Groups:

No.	Group
00	No protection set
10 - 17	TU power regulation problems. Perform a Self Test.
20 - 23	TU hardware protection.
40 - 51	ATU protection.

##### Protection Code explanation:

<b>0</b>	<b>No protection active !</b>
<b>10</b>	<b>Tune Power Low</b>
Measurement:	CONTROL/INTERCON module 60-122878 measures too low power output. Tune power < 20W.
Protection made:	ATU selects feed through setting after „TU Failure“ command. Power regulation inhibited
Possible cause:	TU - ATU coaxial cable open.
<b>11</b>	<b>Tune Power High</b>
Measurement:	CONTROL/INTERCON module 60-122878 measures too high power output. Tune power > 30W.
Protection made:	ATU selects feed through setting after „TU Failure“ command.
<b>12</b>	<b>ALC Power High</b>
Measurement:	CONTROL/INTERCON module 60-122878 measures too high power output. ALC power was too high.
Protection made:	Exciter level set to approx. +8dBm.

<b>13</b> Measurement: Protection made:	<b>Supply failure</b> Supply voltage higher than 33 V TX key inhibited. Note: It is necessary to press TUNE to reset the protection.
<b>14</b> Measurement: Protection made:	<b>ALC Power Low</b> CONTROL/INTERCON module 60-122878 measures too low power output. ALC power was too low. Exciter level set to approx. +8dBm.
<b>15</b> Measurement: Protection made:	<b>TU-ATU Failure</b> CONTROL/INTERCON module 60-122878 measures too high power output. ATU requests lower output power and TU has reached minimum. Automatic power regulation inhibited.
<b>16</b> Measurement: Protection made:	<b>Low Power High</b> CONTROL/INTERCON module 60-122878 measures too high power output. Low Power was too high. Power set as Low as possible.
<b>17</b> Measurement: Protection made:	<b>Full Power High</b> CONTROL/INTERCON module 60-122878 measures too high power output. Full Power was too high. Automatic power regulation inhibited.
<b>20</b> Measurement: Protection made: Possible cause:	<b>PA Temp</b> PA temperature too high. Output power decreased. Free airflow through the cooling fins of the Transceiver Unit impaired.
<b>21</b> Measurement: Protection made: Possible cause:	<b>PA SWR high</b> PA SWR was too high. Reflected power was detected. Output power decreased. TU - ATU coaxial cable or antenna.
<b>22</b> Measurement: Possible cause:	<b>High Average</b> Average power reduced to 100W. CW keyed for more than 1 minute.
<b>23</b> Measurement: Protection made: Possible cause:	<b>PA Hot</b> PA temperature continuously high. Key inhibit for 5 min. Free airflow through the cooling fins of the Transceiver Unit impaired.
<b>25</b> Measurement: Protection made: Possible cause:	<b>PA SWR</b> PA SWR was high. Output power reduced to safe limits. High SWR or change in antenna impedance.
<b>40</b> Measurement: Protection made: Possible cause:	<b>Not Tuned</b> ATU failed tuning the antenna. ATU selects feed through setting. Antenna installation.
<b>41</b> Measurement: Protection made: Possible cause:	<b>No Tune Power</b> ATU measured no tune power. ATU selects feed through setting. TU - ATU coaxial cable shorted.

<b>42</b>	<b>Bad SWR</b>
Measurement:	ATU measured SWR > 8 during Tune Procedure.
Protection made:	ATU selects feed through setting.
Possible cause:	Bad antenna impedance on the selected frequency.
<b>43</b>	<b>High SWR</b>
Measurement:	ATU measured SWR >3 but <8 during Tune Procedure.
Possible cause:	Poor antenna impedance on the selected frequency.
<b>44</b>	<b>V or I</b>
Measurement:	ATU measured that the maximum voltage or current rating is reached during ALC adjustment.
Possible cause:	A short antenna and a low frequency.
<b>45</b>	<b>Temp</b>
Measurement:	ATU requests for lower power during TX.
Possible cause:	Temperature inside ATU cabinet is too high.
<b>46</b>	<b>Bad SWR TX</b>
Measurement:	ATU measured SWR > 8 during transmission.
Possible cause:	Bad antenna impedance on the selected frequency.
<b>47</b>	<b>High SWR TX</b>
Measurement:	ATU measured SWR >3 but <8 during transmission.
Possible cause:	Poor antenna impedance on the selected frequency.
<b>48</b>	<b>V or I high TX</b>
Measurement:	ATU measured that the maximum voltage or current rating is reached during transmission.
Possible cause:	A short antenna and a low frequency.
<b>50</b>	<b>V or I high</b>
Measurement:	ATU measured that the maximum voltage or current rating is reached during ALC adjustment and the power had to be reduced more than 6 dB.
Possible cause:	A bad antenna and a low frequency.
<b>51</b>	<b>TU-ATU com bad</b>
Measurement:	TU - ATU communication is not operating.
Protection made:	Key inhibit.
Possible cause:	TU - ATU communication problem.

## 4.6 Selftest

### Introduction

The 'SELF TEST' BITE (Built-In Test Equipment) of the transceiver is used as a fault diagnosing tool for the service technician. It may also be used by the operator to obtain additional information on a problem when ordering service.

The 'SELF TEST' checks the vital functions of the Transceivers modules by performing and monitoring a sequence of operations. The program controls the analog and digital set ups necessary to perform each test step in the line of tests executed during the 'SELF TEST'. These set ups will result in a digital feed back from go/no-go analog check detectors, A/D converters or digital circuits.

### Self test description

The 'SELF TEST' is started by selecting MENU and the 'INFO &TEST', 'CHECK', 'SELFTTEST' menu items. All tests which does not involve transmission will automatically be performed successively until the last test has passed or an error condition has occurred. The test number and a name is displayed as the test proceeds.

After the last test the user has the option to continue with a test of the transmitter with power delivered to the antenna. The user selects the test frequency. Both receiver and transmitter are set to the test frequency which should be selected so as to cause minimal disturbance of others.

If stopped due to an error condition, an error code is displayed. Only one error code is given as a result of each test (the lowest number fitting). The user has the option to repeat the test or cancel.

It is also possible to select a single test step for service purposes. Tests may be repeated several times giving a technician the opportunity to make measurements. Note that test on an arbitrary test number may provide a false indication to where the problem is, as the self test assumes that all previous test steps have been performed and found OK.

Explanations to the 'Error codes' are listed on the following pages.

#### Test 1 - CU RAM

A write/read test is performed on the Random Access Memory in the Control Unit.

Error code	Conditions	Possible error sources
0101	CU RAM failure	CONTROL UNIT

#### Test 2 - CU CAN Controller

A test is performed on the CAN connection between CU and TU.

Error code	Conditions	Possible error sources
0201	No CAN connection	ScanBus cable or CONTROL UNIT or CONTROL/INTERCON 60-122878
0202	CAN connection lost	ScanBus cable or CONTROL UNIT or CONTROL/INTERCON 60-122878

#### Test 3 - TU RAM

A write/read test is performed on the Random Access Memory in the Transceiver Unit.

Error code	Conditions	Possible error sources
0301	TU RAM failure	CONTROL/INTERCON module 60-122878

#### Test 4 - SUPPLY VOLTAGES

+15 V and -15 V is checked. *(This test is not implemented initially).*

Error code	Conditions	Possible error sources
0401	+15 V missing	SMPS 60-122882 or cabling
0402	-15 V missing	SMPS 60-122882 or cabling

#### Test 5 - DSC MODEM

A loop-back test is made on the DSC modulator/demodulators.

Error code	Conditions	Possible error sources
0501	Demodulator 1 failure	CONTROL/INTERCON module 60-122878
0502	Demodulator 2 failure	CONTROL/INTERCON module 60-122878
0503	Modulator or demodulator 1 and demodulator 2 failure	CONTROL/INTERCON module 60-122878

#### Test 6 - MMSI

The CU checks that the MMSI has been programmed and that transfer to the modem has been successful.

Error code	Conditions	Possible error sources
0601	MMSI not programmed	Programming left out
0602	MMSI not transferred to TU	ScanBus cable or CONTROL UNIT or CONTROL/INTERCON 60-122878"

#### Test 7 - MASTER OSCILLATOR

The Master oscillator output is checked for signal.

Error code	Conditions	Possible error sources
0701	MO CHECK = No signal	SYNTH. AND DSC WR module 60-122879 or SMPS module 60-122882 or cabling



**Test 8 - 2. LO**

2. LO is checked for signal.

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
0801	2. LO CHECK = No signal	SYNTH. AND DSC WR module 60-122879

**Test 9 - 1. LO out of lock**

Tests if 1. LO gets out of lock by setting it to an out-of-band frequency to check that the microprocessor can control the synthesizer.

Settings:

Band: 45 – 52.5 MHz

1. LO: 75.00000 MHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
0901	1. LO CHECK = Lock	SYNTH. AND DSC WR module 60-122879

**Test 10 - 1. LO band 0 low border**

1. LO is checked for lock in band 0, low border.

Settings:

Band: 45 – 52.5 MHz

1. LO: 45.00000 MHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
1001	1. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

**Test 11 - 1. LO band 0 high border**

1. LO is checked for lock in band 0, high border.

Settings:

Band: 45 – 52.5 MHz

1. LO: 52.50000 MHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
1101	1. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

**Test 12 - 1. LO band 1 low border**

1. LO is checked for lock in band 1, low border.

Settings:

Band: 52.5 - 60 MHz

1. LO: 52.50000 MHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
1201	1. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

**Test 13 - 1. LO band 1 high border**

1. LO is checked for lock in band 1, high border.

Settings:

Band: 52.5 - 60 MHz

1. LO: 60.00000 MHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
1301	1. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

**Test 14 - 1. LO band 2 low border**

1. LO is checked for lock in band 2, low border.

Settings:

Band: 60 – 67.5 MHz

1. LO: 60.00000 MHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
1401	1. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

**Test 15 - 1. LO band 2 high border**

1. LO is checked for lock in band 2, high border.

Settings:

Band: 60 – 67.5 MHz

1. LO: 67.50000 MHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
1501	1. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

**Test 16 - 1. LO band 3 low border**

1. LO is checked for lock in band 3, low border.

Settings:

Band: 67.5 – 75 MHz

1. LO: 67.50000 MHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
1601	1. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

**Test 17 - 1. LO band 3 high border**

1. LO is checked for lock in band 3, high border.

Settings:

Band: 67.5 – 75 MHz

1. LO: 75.00000 MHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
1701	1. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

**Test 18 - 3. LO out of lock**

Tests if 3. LO gets out of lock by setting it to an out-of-band frequency to check that the microprocessor can control the synthesizer.

Settings:

3. LO: 400.00 kHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
1801	3. LO CHECK = Lock	SYNTH. AND DSC WR module 60-122879

**Test 19 - 3. LO low border**

3. LO is checked for lock at low border.

Settings:

3. LO: 452.50 kHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
1901	3. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

**Test 20 - 3. LO high border**

3. LO is checked for lock at high border.

Settings:

3. LO: 460.50 kHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
2001	3. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

**Test 21 - DSC LO1 out of lock**

DSC LO1 of the DSC watch receiver gets out of lock by setting it to an out-of-band frequency

Settings:

DSC LO1: 50.0000 MHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
2101	DSC LO1 CHECK = Lock	SYNTH. AND DSC WR module 60-122879

**Test 22 - DSC LO1 Low VCO locked**

DSC LO1 lower band VCO of the DSC Watch Receiver is checked for phase-lock.

Settings:

DSC LO1: 33.0000 MHz

Error code	Conditions	Possible error sources
2201	DSC 1. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

**Test 23 - DSC LO1 medium VCO locked**

DSC LO1 medium band VCO of the DSC Watch Receiver is checked for phase-lock.

Settings:

DSC LO1: 37.0000 MHz

Error code	Conditions	Possible error sources
2201	DSC 1. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

**Test 24 - DSC LO1 high VCO locked**

DSC LO1 upper band VCO of the DSC Watch Receiver is checked for phase-lock.

Settings:

DSC LO1: 33.0000 MHz

Error code	Conditions	Possible error sources
2201	DSC 1. LO CHECK = No lock	SYNTH. AND DSC WR module 60-122879

[Test 25 - reserved]

[Test 26 - reserved]

[Test 27 - reserved]

[Test 28 - reserved]

[Test 29 - reserved]

[Test 30 - reserved]

**Test 31 - RX SSB mode**

The receiver of the RX/EX Signal Path 60-122880 is checked in SSB mode. By choosing the proper synthesizer frequencies the signal passes the 45 MHz filter and is mixed to a 1 kHz tone in the audio part. The automatic gain control voltage and RX AF is checked.

Settings:

Band: 45 – 52.5 MHz

1. LO: 44.99900 MHz

3. LO: 456.00 kHz

Error code	Conditions	Possible error sources
3101	RX AF CHECK 515 = No signal	RX/EX SIGNAL PATH module 60-122880
3102	RX AF CHECK 510 = No signal	CONTROL/INTERCON module 60-122878
3103	No AGC voltage	RX/EX SIGNAL PATH module 60-122880 or CONTROL/INTERCON module 60-122878 or cabling

**Test 32 - RX AM mode**

The receiver of the RX/EX Signal Path 60-122880 is checked in AM mode. By choosing the proper synthesizer frequency the signal passes the 45 MHz filter and is mixed to generate an unmodulated carrier. The automatic gain control voltage and RX AF is checked.

Settings:

Band: 45 – 52.5 MHz

1. LO: 44.99900 MHz

Error code	Conditions	Possible error sources
3201	RX AF CHECK 515 = Signal	RX/EX SIGNAL PATH module 60-122880
3202	No AGC voltage	RX/EX SIGNAL PATH module 60-122880 or CONTROL/INTERCON module 60-122878

**Test 33 - RX DSC mode**

The receiver of the RX/EX Signal Path 60-122880 is checked in DSC mode. By choosing the proper synthesizer frequencies the signal passes the 45 MHz filter and is mixed to a 1.7 kHz tone in the audio part. RX AF is checked.

Settings:

Band: 45 – 52.5 MHz

1. LO: 44.99900 MHz

3. LO: 456.70 kHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
3301	DSC AF CHECK = No signal	RX/EX SIGNAL PATH module 60-122880
3302	RX AF CHECK 515 = No signal	RX/EX SIGNAL PATH module 60-122880
3303	RX AF CHECK 510 = No signal	CONTROL/INTERCON module 60-122878

**Test 34 - SQUELCH**

The squelch circuit of the RX/EX Signal Path 60-122880 is checked in SSB mode. By choosing the proper synthesizer frequencies the signal passes the 45 MHz filter and is mixed to a 500 Hz tone in the audio part. This makes the squelch open. Then a 2 kHz tone is generated making the squelch close. Squelch hold time is also checked.

Settings:

Band: 45 – 52.5 MHz

1. LO: 44.99900 MHz

a) 3. LO: 455.50 kHz (500Hz tone)

b) 3. LO: 457.00 kHz (2 kHz tone)

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
3401	RX AF CHECK 515 = No signal with 500 Hz tone.	RX/EX SIGNAL PATH module 60-122880
3402	RX AF CHECK 515 = Signal with 2 kHz tone.	RX/EX SIGNAL PATH module 60-122880
3403	Squelch hold time not ok.	RX/EX SIGNAL PATH module 60-122880

**Test 35 - RX AGC**

The gain control circuit of the RX/EX Signal Path 60-122880 is checked . By choosing the proper synthesizer frequency the signal passes the 45 MHz filter and is mixed to a 1 kHz tone in the audio part. By setting the MGC voltage to low sensitivity the RX AF Check should indicate no AF signal. By setting the MGC voltage to high sensitivity the RX AF Check should indicate AF signal present.

Settings:

Band: 45 – 52.5 MHz

1. LO: 44.99900 MHz

3. LO: 456.00 kHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
3501	RX AF CHECK 515 = Signal with MGC voltage at max.	RX/EX SIGNAL PATH module 60-122880 or CONTROL/INTERCON module 60-122878
3502	RX AF CHECK 515 = No signal with MGC voltage at min.	RX/EX SIGNAL PATH module 60-122880 or CONTROL/INTERCON module 60-122878

**Test 36 - RX ACG hang time**

The Automatic Gain Control Hang facility of the RX/EX Signal Path 60-122880 is checked. By choosing the proper synthesizer frequency the signal passes the 45 MHz filter and is mixed to a 1 kHz tone in the audio part. The hang function is examined in three steps:

- 1) Check normal AGC with 1 kHz tone
- 2) Check that AGC hangs with no signal
- 3) Check that AGC hang time has ended.

Settings:

Band: 45 – 52.5 MHz

1. LO: 44.99900 MHz

3. LO: 456.00 kHz

Band: 67.5 – 75 MHz

1. LO: 80.00000 MHz

3. LO: 456.00 kHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
3601	No AGC voltage with signal on	RX/EX SIGNAL PATH module 60-122880 or CONTROL/INTERCON module 60-122878
3602	Hang time too short	RX/EX SIGNAL PATH module 60-122880 or CONTROL/INTERCON module 60-122878
3603	Hang time too long	RX/EX SIGNAL PATH module 60-122880 or CONTROL/INTERCON module 60-122878

**Test 37 - EX SSB with no signal.**

The exciter of the RX/EX Signal Path 60-122880 is checked in SSB mode. PA and Filters 60-122881 is not keyed. The exciter is set to produce a 15 MHz SSB signal. No AF input signal. No RF should be detected at the exciter output.

Settings:

Band: 60 – 67.5 MHz

1. LO: 60.00000 MHz

3. LO: 456.50 kHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
3701	EX CHECK = Signal	RX/EX SIGNAL PATH module 60-122880
3702	TX AF CHECK = Signal	RX/EX SIGNAL PATH module 60-122880 or CONTROL/INTERCON module 60-122878

[Test 38 - reserved]

[Test 39 - reserved]

[Test 40 - reserved]

**Test 41 - EX TUNE CW**

The exciter of the RX/EX Signal Path 60-122880 is checked in Tune CW mode. PA and Filters 60-122881 is not keyed. The exciter is set to produce a 15 MHz carrier. No AF input signal. RF should be detected at the exciter output.

Settings:

Band: 60 – 67.5 MHz

1. LO: 60.00000 MHz

3. LO: 456.50 kHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
4101	EX CHECK = No signal	RX/EX SIGNAL PATH module 60-122880

**Test 42 - EX ALC**

The Automatic Level Control on the RX/EX Signal Path 60-122880 is checked. PA and Filters 60-122881 is not keyed. The exciter is set to produce a 15 MHz CW carrier. No AF input signal. Low and high ALC level. No RF should be detected at the exciter output with low ALC level. RF should be detected with high ALC level.

Settings:

Band: 60 – 67.5 MHz

1. LO: 60.00000 MHz

3. LO: 456.50 kHz

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
4201	EX CHECK = Signal with ALC low	RX/EX SIGNAL PATH module 60-122880 or CONTROL/INTERCON module 60-122878
4202	EX CHECK = No signal with ALC high	RX/EX SIGNAL PATH module 60-122880 or CONTROL/INTERCON module 60-122878

**Test 43 - ATU without RF power**

The ATU Module 60-122883 is checked without transmitting. The Transceiver Unit checks that an ATU is connected and is able to communicate with the TU. The ATU tests RAM, Vforward-, Vreflected-, 0 degrees-, 90 degrees-, and temperature- detectors.

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
4301	'ATU not installed' selected in FUNC menu.	Select CONTINUE to bypass test
4302	Communication failure	ATU or CONTROL/INTERCON module 60-122878 or coax cable
4303	ATU RAM error	ATU
4304	Vforward detector	ATU
4305	Vreflected detector	ATU
4306	0 degrees detector	ATU
4307	90 degrees detector	ATU
4308	Temperature sensor	ATU

[Test 44 - reserved]

[Test 45 - reserved]

**Test 46 - TX**

The user may enter a test frequency and listen for signals to ensure that the frequency is free, before the transmitter tests are carried out.

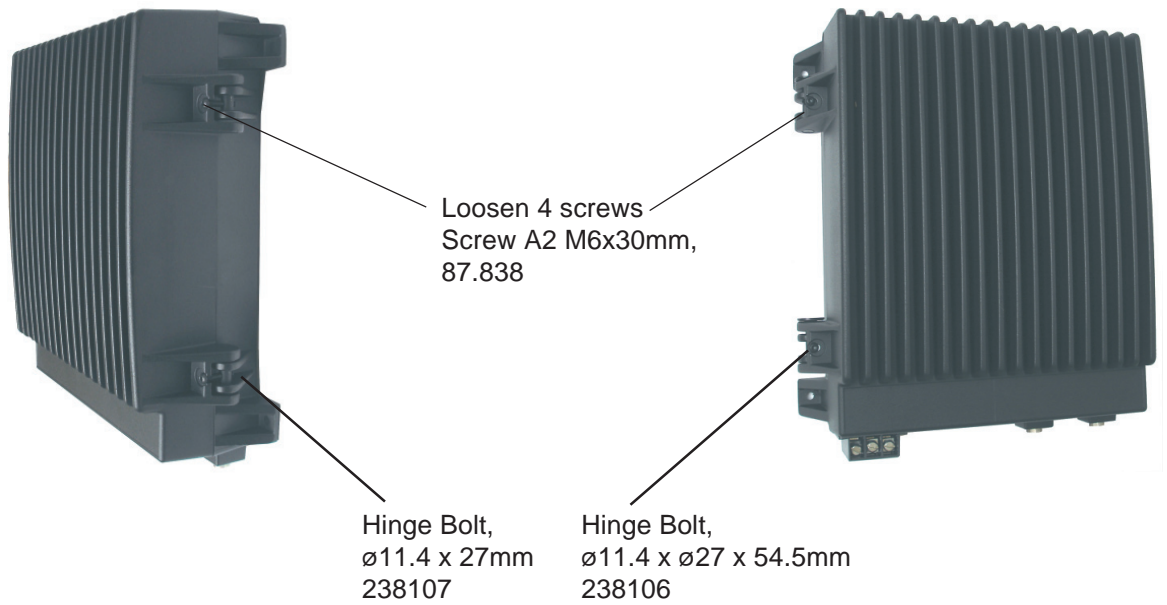
PA and Filters 60-122881 and ATU Module 60-122883 is checked. A full tune and ALC procedure is performed on a frequency chosen by the user. Then a transmission with full power is carried out for 10 seconds, followed by a transmission in low power mode also lasting 10 seconds.

<b>Error code</b>	<b>Conditions</b>	<b>Possible error sources</b>
4610	Tune power low	W1 or W2 or W8 or W11
4611	Tune power high	W1 or W2
4612	ALC power high	W1 or W2
4613	Supply failure	W1
4614	ALC power low	W1 or W2
4615	TU – ATU failure	Coax cable TU – ATU or Antenna installation or W15 or ATU
4616	Low power high	W1 or W2
4617	Full power high	W1 or W2
4620	PA temperature high	PA AND FILTERS module
4621	PA SWR high	Antenna installation or PA AND FILTERS module
4640	Not tuned	Antenna installation or ATU
4641	No tune power	CONTROL/INTERCON module 60-122878 or W15
or		Coax cable TU – ATU shorted or ATU
4642	Bad SWR	Antenna installation or ATU
4646	Bad SWR TX	Antenna installation or ATU

## 5 Spare part exchange

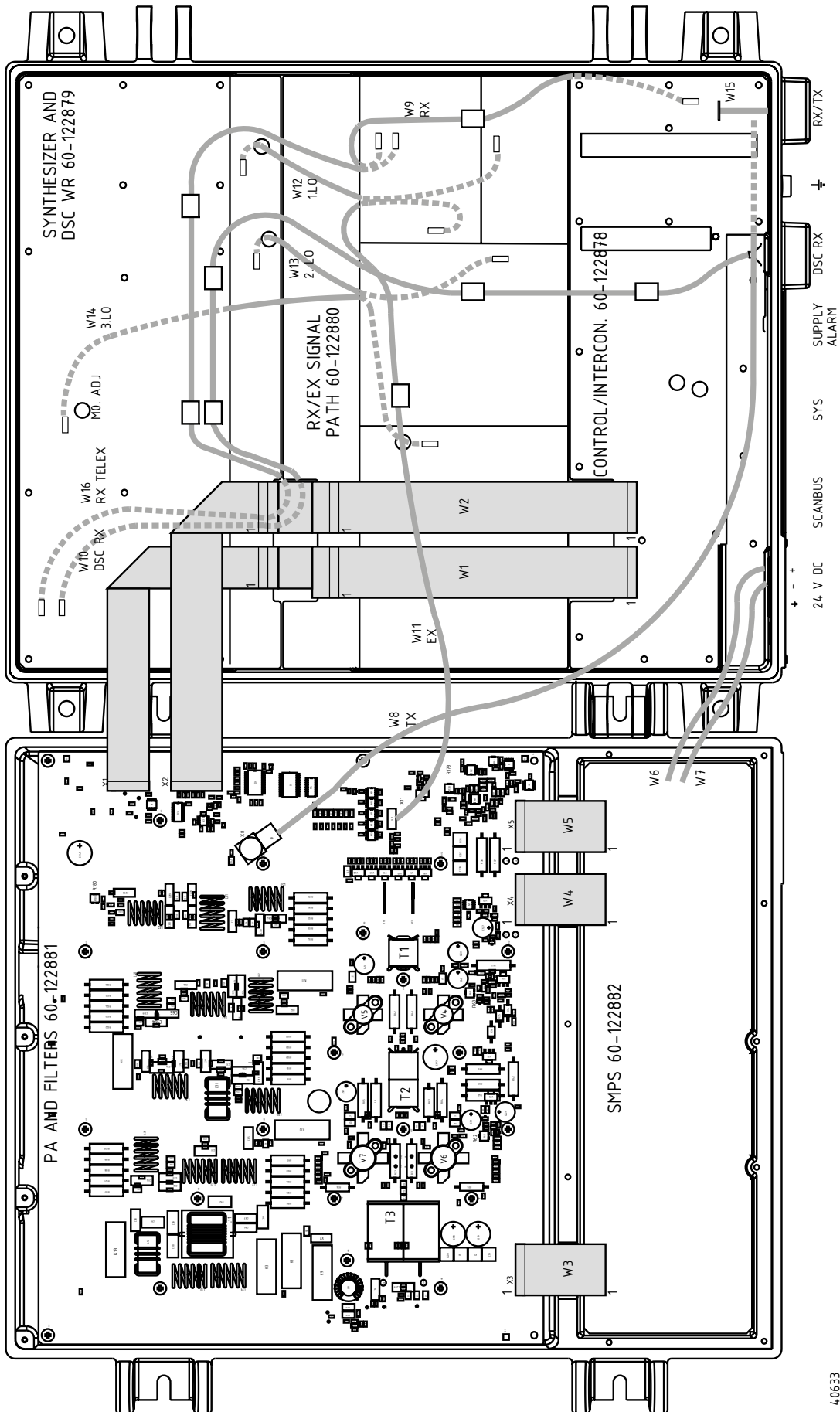
### 5.1 Disassembling the Transceiver Unit

To open the transceiver unit loosen the 4 screws (2 on each side) on the side of the cabinet. Move the screws to the side to unlock the TU. Now open the TU by pulling the front door towards you.



### 5.2 Transceiver Unit module location

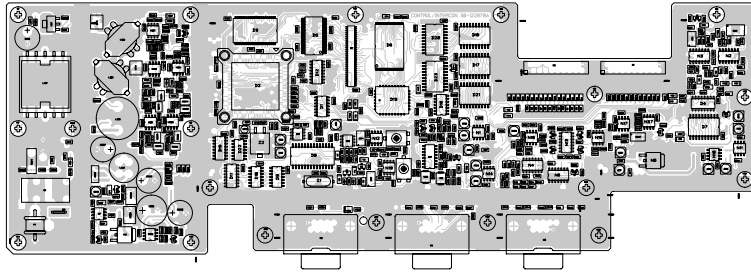
The following modules are available as service parts.



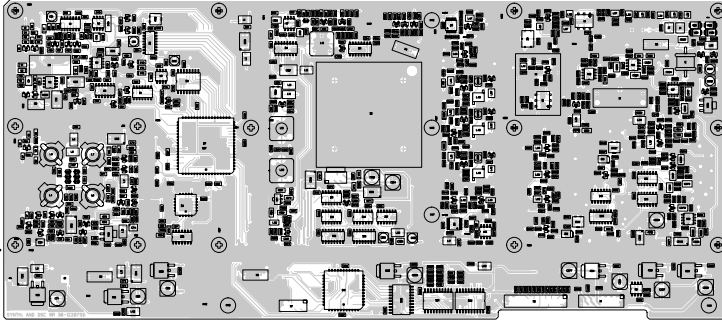
4,0633



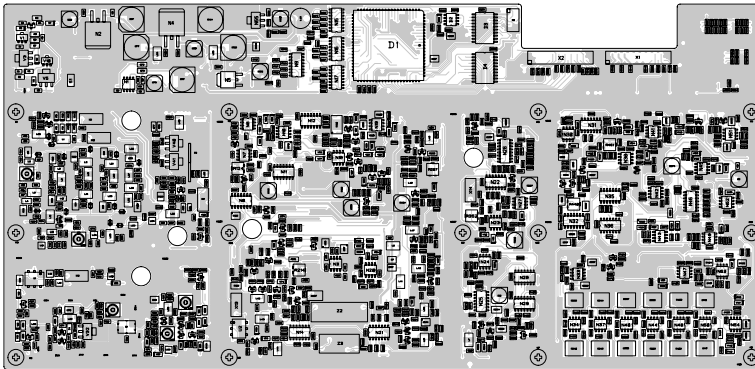
**Control / Intercon. module 60-122878**



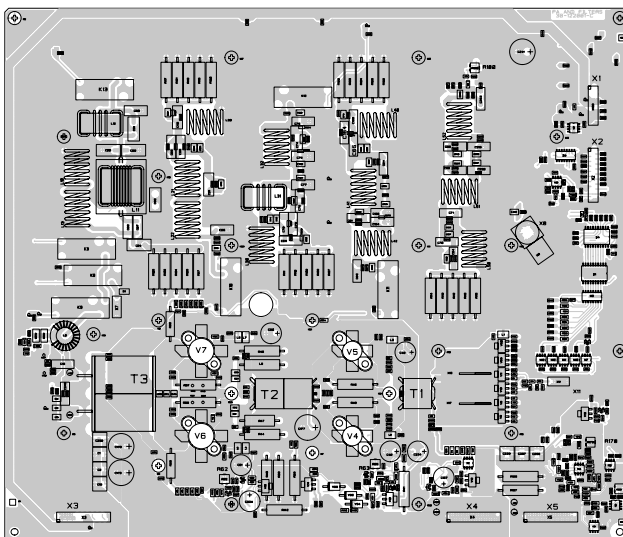
**Synthesizer and DSC WR module 60-122879**



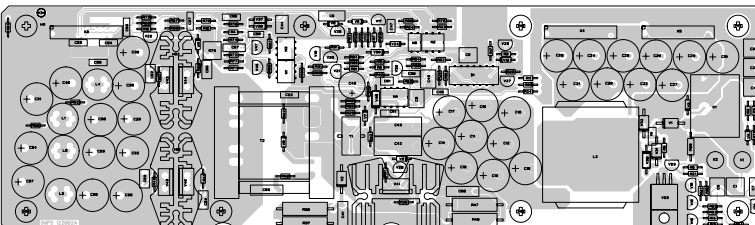
**RX/EX Signal path module 60-122880**



**PA and filters module 60-122881**



**SMPS module 60-122882**



**5.3 Required service tool**

For disassembling transceiver unit	Slotted screwdriver
For shield cover, print and cables	Torx screwdriver

**5.4 Accessory list**

<b>NAME</b>	<b>PART NO.</b>
5083 29A Power Supply	405083A
AC Power Supply	804655xx(*)
AC Power Supply Class E	8046650006
Battery Charger	804656xx(*)
Battery Charger Class E	8046660006
5070 External 8W speaker	405070
CB4616 SUBD-9 to Terminal Block Converter	804616 (*)
CB4618 Handset Connection Box	804618 (*)
3-wire Data download Cable	532506
ATU Mounting Kit:	
Mounting plate and fittings for mast.	737589
Mounting plate	737588
Gasket kit for Antenna Tuning Unit	737822

\* (Please find specific order numbers in User Manual)



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