

# SAILOR 6000 MF/HF 150W/250W System

## SAILOR 6000 MF/HF 150W FCC System





# **Thrane & Thrane A/S**

**SAILOR 6000 MF/ HF 150W/250W System**

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**Installation manual**

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# 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 includes voice, DSC and a dedicated 2187.5 kHz DSC watch receiver, forming an ideal system for MF GMDSS installations.

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 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 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 Message Terminal is connected to the system through the CAN bus.

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, a 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, IEC and FCC, 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 0.35 ppm 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		
<b>Output power:</b>	Refer to sections concerning Receiver / Transmitter characteristics		
<b>Supply voltage:</b>	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		
<b>Power consumption:</b>		<b>150W:</b>	<b>250W:</b>
	Rx, 60 W (approx. at 24V DC)		
	Tx, SSB speech:	175W	300W
	Tx, SSB two-tone:	300W	550W
	Tx, DSC/TELEX:	310W	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
Loudspeaker	2.2	1.6

## 1.2.2 Receiver characteristics

<b>General:</b>	Complies with ETSI 300373 in the ITU marine bands.		
<b>Reception:</b>	<b>Mode</b>	<b>Rx/Tx antenna plug</b>	<b>DSC/Telex antenna plug</b>
	SSB/AM	X	
	DSC	X (Routine calls)	X (Distress calls)
	Telex		X
<b>Frequency range:</b>	150 kHz to 30 MHz		
<b>Frequency resolution:</b>	100 Hz by keyboard entry 10 Hz, 100 Hz or 1 kHz search/fine-tune facility is provided		
<b>Input impedance:</b>	Rx/Tx :	50 ohm	
	The Antenna is matched by the antenna amplifier in the Antenna Tuning Unit		
	DSC/Telex:	50 ohm	
	12V DC / 20 mA is available for eventual use of active antenna.		
<b>Sensitivity:</b>	Telephony(J3E):	below 11 dBµV for 20 dB Sinad	
	Broadcast (A3E):	below 25 dBµV for 20 dB Sinad	
	DSC/Telex (J2B):	below 0 dBµV	
<b>Intermodulation:</b>	Telephony (J3E):	Wanted Signal:	30 dBµV
	Intermodulation level:		above 80 dBµV
	Telex(J2B):	Wanted Signal:	30 dBµV
	Intermodulation level:		above 90 dBµV
	DSC (J2B):	Wanted Signal:	20 dBµV
	Intermodulation level:		above 80 dBµV
<b>Spurious rejection:</b>	above 70 dB		

**Audio output power:** Build-in loudspeaker  
 Optional loudspeaker output 6 W typical with less than 10 % distortion.  
 Output intended for 8 ohm loudspeaker.

### 1.2.3 Transmitter characteristics

**General:** Complies with ETSI 300373 and FCC or better in the ITU marine bands.  
 The Transmitter characteristics are with the Antenna Tuning Unit included.

**Frequency range:** The ITU marine bands in the frequency range 1605 kHz to 30 MHz

**Frequency resolution:** 100 Hz

**Output power:** 150 W 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 80 W when continuously keyed with duty cycle greater than 55% during 1 min. Automatic power recovery after 1 min.

DSC/Telex:  
 120 W ± 1.4 dB

250 W 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 100 W when continuously keyed with duty cycle greater than 55% during 1 min. Automatic power recovery after 1 min.

DSC/Telex:  
 160 W ± 1.4 dB

**Power reduction:** Low power: 20 W PEP

**Intermodulation:** below -31 dB/PEP

**Spurious Emission:** below -43 dB/PEP  
 below -60 dB/PEP (FCC)

**Hum and noise:** Less than - 40 dB/PEP

### 1.2.4 DSC Watch receiver characteristics

**General:** Complies with ETSI 300338 or better.

**Reception:** DSC/Telex antenna plug.

**Frequency range:** Scanning the following frequencies if upgraded to include 6 channel scanning DSC watch receiver:  
 2187.5 kHz, 4207.5 kHz, 6312.0 kHz, 8414.5 kHz, 12577.0 kHz, 16814.5 kHz

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

**Sensitivity:** DSC (J2B): below 0 dBµV

**Intermodulation:** DSC (J2B): Wanted Signal: 20 dBµV  
 Intermod. level: above 70 dBµV

**Spurious rejection:** above 70 dB

## 1.2.5 Antenna characteristics

<b>General:</b>	Complies with ETSI 300373 and FCC or better in the ITU marine bands
<b>Frequency range:</b>	1.6 MHz - 27 MHz
<b>Antenna requirements:</b>	8-18 m wire and/or whip antenna
<b>Antenna 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. 493-13, M. 541-9
	Ship's identity:	9-digit identity number
	Navigator interface:	According to IEC 61162-1 GLL, RMC, ZDA, GGA, GNS
<b>TELEX:</b>	Protocols:	ITU-R M. 625-3 (incl. M. 476-5), M. 490, M. 491-1, and 492-6 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: 6301/02/03:</b>	Width:	241 mm (9.5")
	Height:	107 mm (4.2")
	Depth:	99 mm (3.9")
	Weight:	0.82 kg (1.8 lbs)
<b>Transceiver Unit 6360/62/63:</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: 6381/82:</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

# 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.

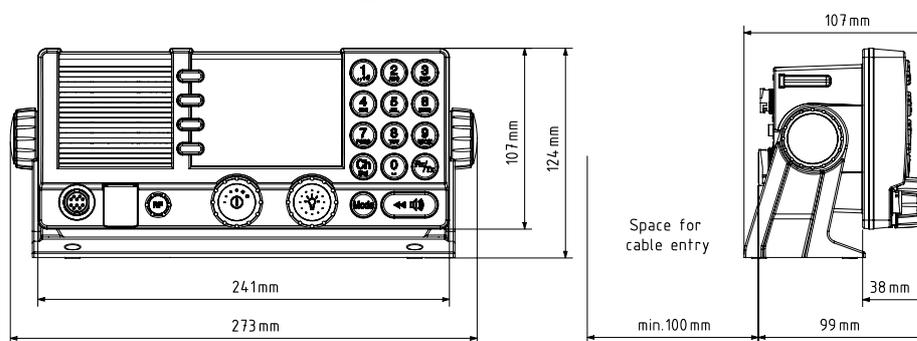
## 2.2 Mounting the units

### Mounting the Control Unit (CU)

One Unit shall be connected to the Transceiver Unit using the build-in local bus (CU-TU Bus). The CU may be mounted up to 100m from the Transceiver Unit using just a multicable 5 x 2 x 0.5 mm<sup>2</sup> screened.

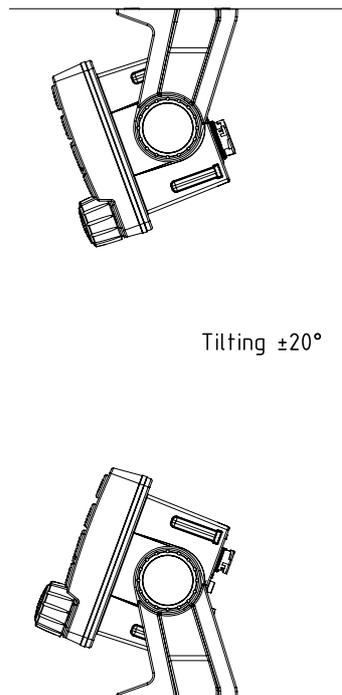
The Control Unit may be tabletop or bulkhead mounted.

### Control Units with mounting bracket



99-131868

### Mounting option

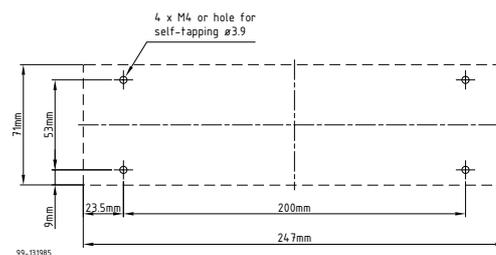


99-131944

#### Weight:

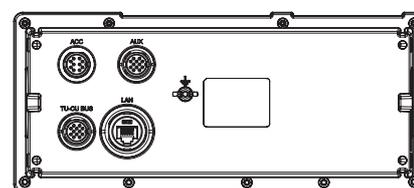
Control Unit	0.82 kg
Mounting Bracket	0.20 kg

### Drilling plan for bracket



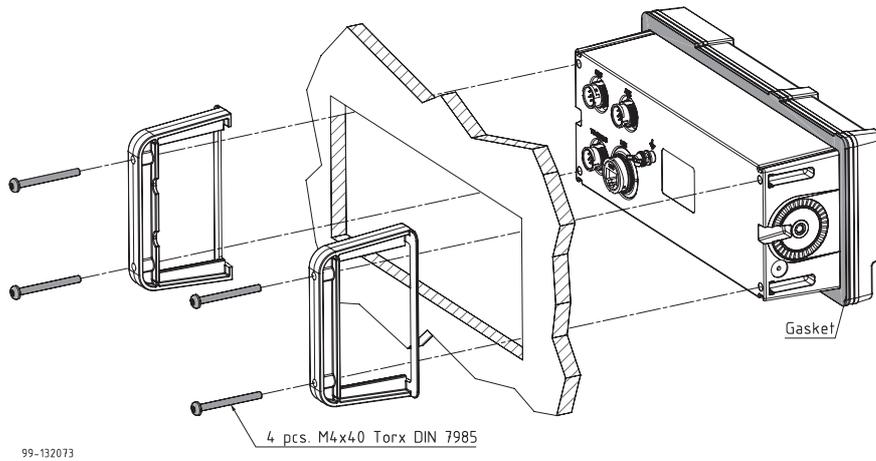
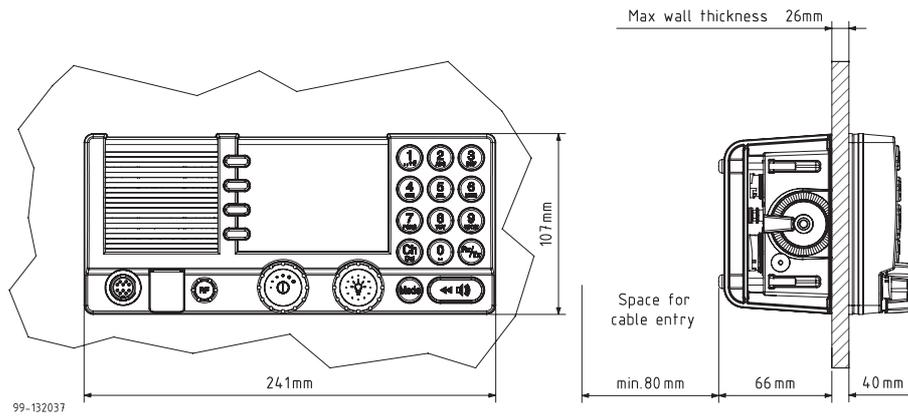
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### Control unit connector panel

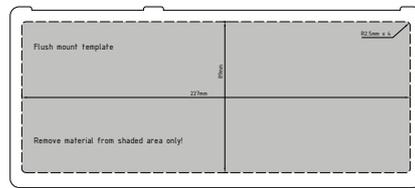


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### Control Units with flush mounting bracket



### Drilling plan



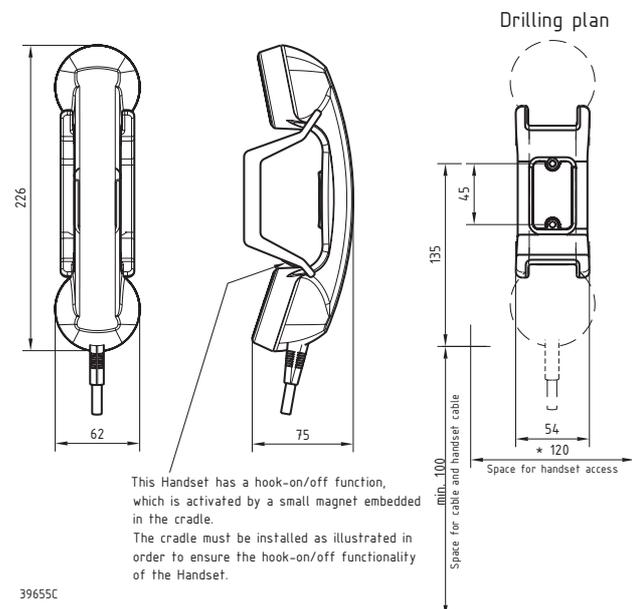
### Weight:

Flush mount bracket 0.04 kg

### WARNING:

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

### Handset for Control Unit



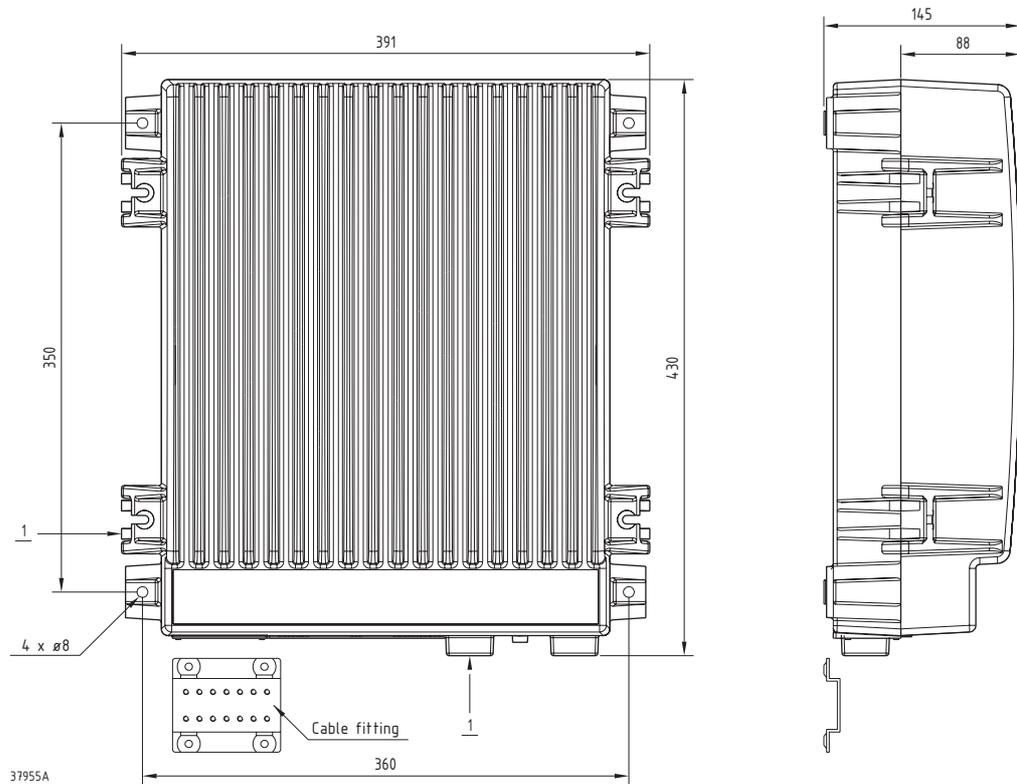
### Weight:

Handset for Control Unit 0.4 kg (0.02 lbs)

Dimensions are in mm

### Mounting the Transceiver Unit (TU)

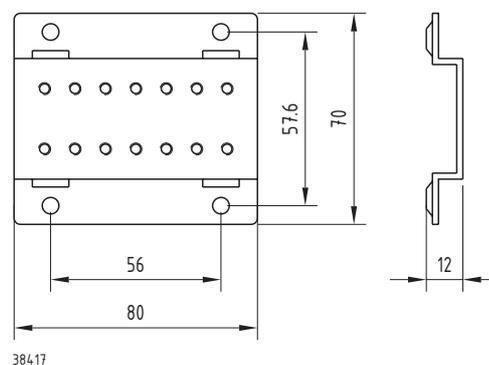
The Transceiver Unit should be installed in a dry place and consideration should be given to accessibility for servicing. It is important to provide sufficient airspace below, above and in front of the unit for adequate air circulation through the cooling fins. The drawing below shows the outer dimensions,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



1) Space for cable: min. 150 mm

Space for airflow and service: min. 500 mm

### Cable fitting

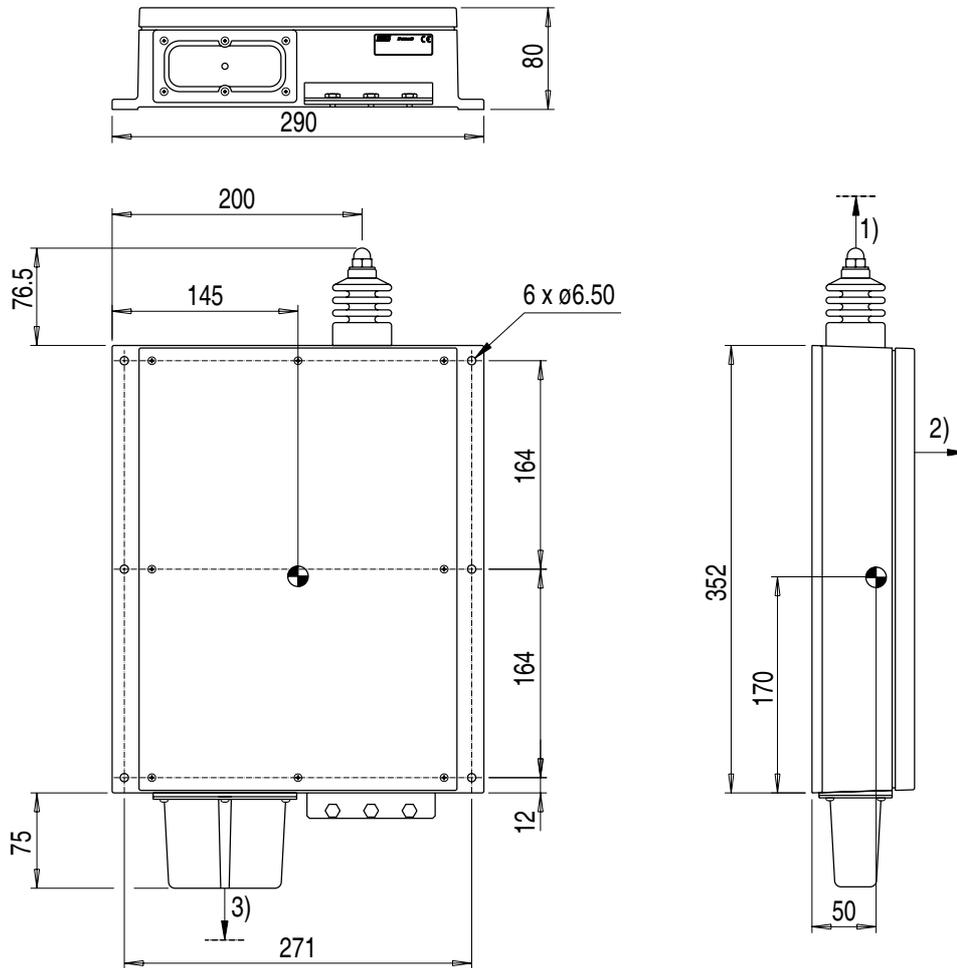


Dimensions are in mm

### Mounting the Antenna Tuning Unit (ATU)

The ATU may be mounted up to 100 metres from the Transceiver Unit using just one RG-213/U or better coaxial cable.

The ATU must be installed outside in a convenient position to have good access for sufficient length of feeder wire to meet the antenna connection point.



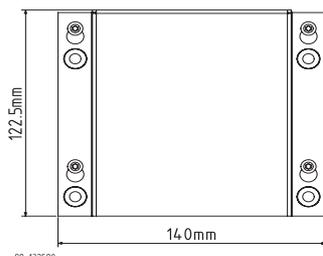
37978

- 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

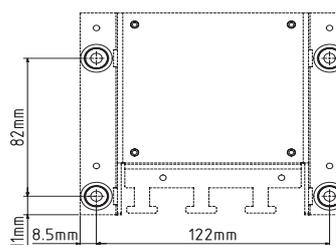
### SAILOR 6208 Control Unit Connection Box

The SAILOR 6208 is used to convert the small cable dimension from LTW plug to screw terminal with strain relief for connection to larger cable dimensions.

The box is used to connect the Transceiver Unit to Control Units and Message Terminal respectively. The box is fitted with optional 120 ohm CAN-BUS termination.



#### Drilling Plan



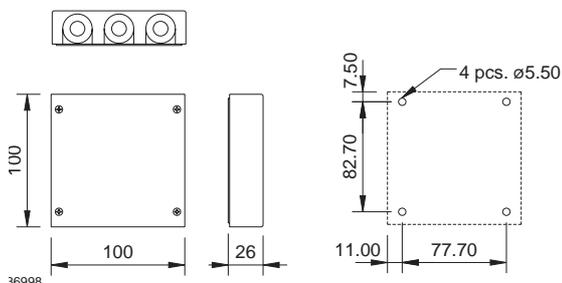
**Weight:**  
SAILOR 6208 0.5 kg.

### SAILOR 6209 Accessory Connection Box

The SAILOR 6209 is used to convert the small cable dimension from LTW plug to screw terminal with strain relief for connection larger cable dimensions.

The box is used to connect the Transceiver Unit and /or the Control Unit to peripheral equipment e.g. GPS, external loudspeaker etc.

#### Drilling Plan



**Weight:**  
SAILOR 6209 0.4 kg.

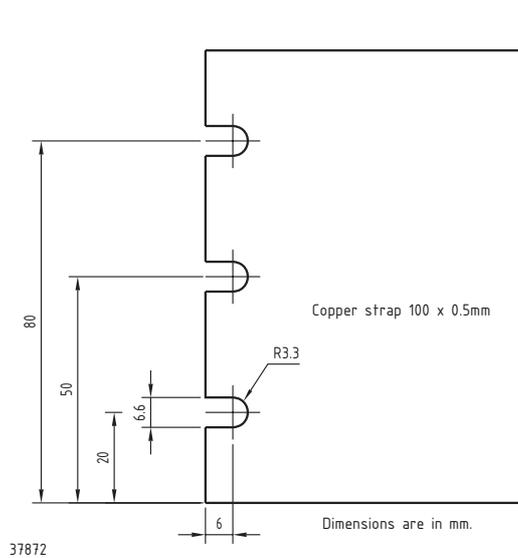
Dimensions are in mm

The SAILOR 6208 and the SAILOR 6209 may be ordered as accessory. Please find accessory list on the last page of this manual.

## 2.3 Ground connections

### Antenna Tuning Unit

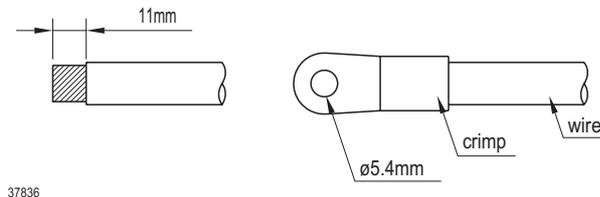
As the earth connection of a transmitter is a very important part of the antenna system, it is of the utmost importance to keep in mind that the earth connection of the Antenna Tuning Unit must have the lowest possible RF-impedance. Losses in the earth connection will result in a decrease in radiated 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.



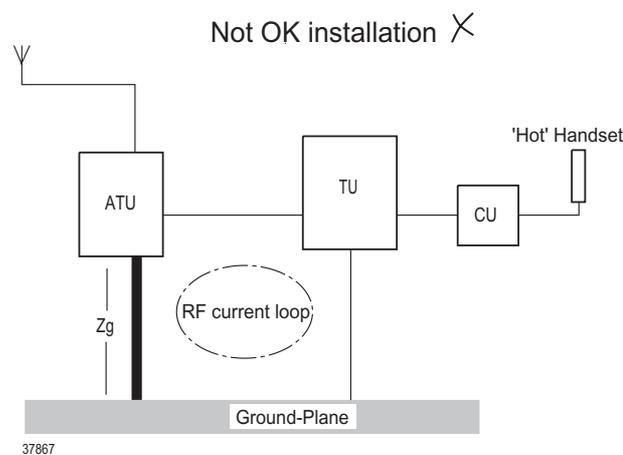
## 2.4 Grounding considerations

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

- The ground connection between the ATU and earth ground plane.
- 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 seldomly achieved, but interference problems will be reduced along with how close to this “ideal” the grounding of the installation is performed.

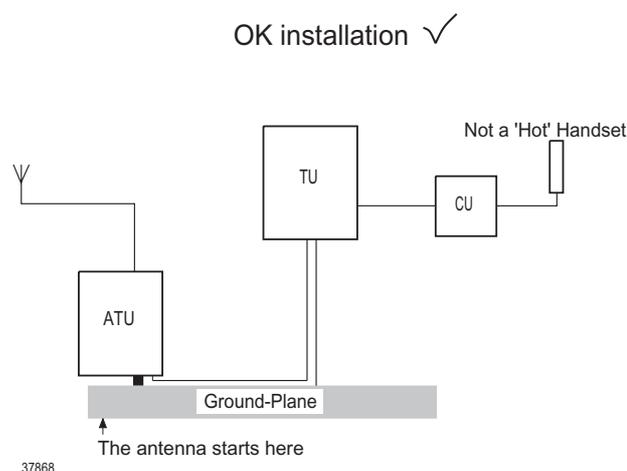
On some installations ground loops will cause problems. A ground loop is caused by more than one ground path for a given unit. This will introduce circulating RF currents which may cause malfunction of other equipment onboard the ship as well as a “hot” handset.



### Antenna start

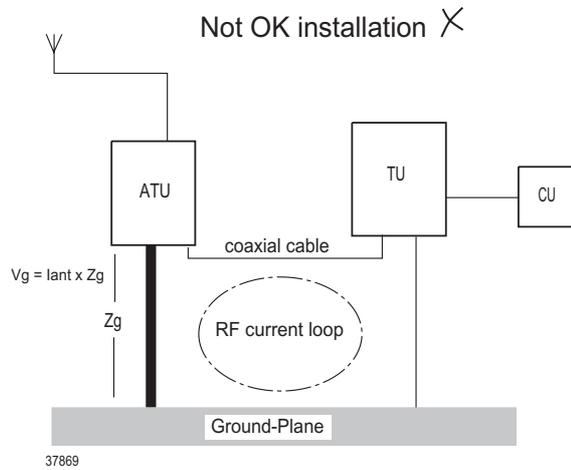
The vertical antenna always starts at its electrical ground-plane, whether or not it is physically mounted there. First determine the antenna’s electrical ground-plane, which is where the ATU must be mounted. Where possible always take the ATU to the ground, not the ground to the ATU.

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.



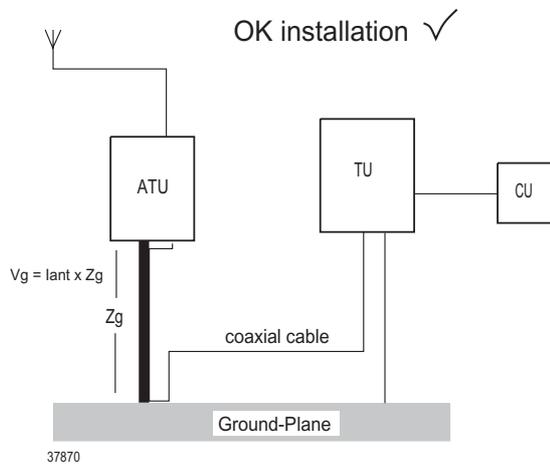
## RF ground loop

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.



## 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.



## 2.5 Antennas

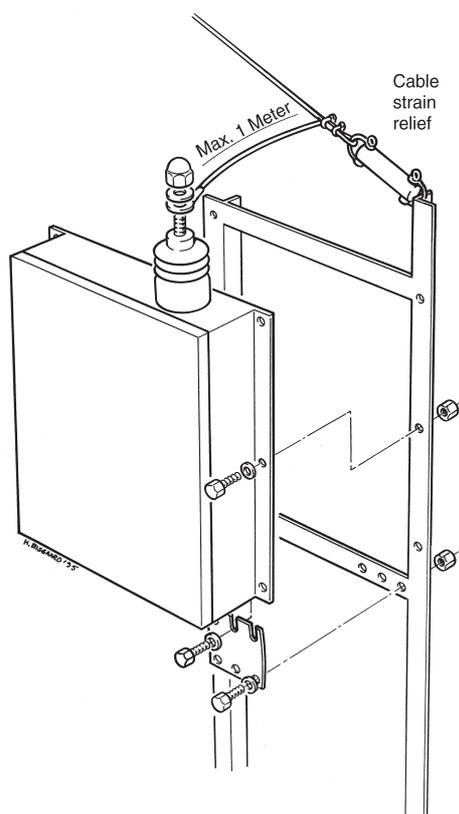
### Transceiver Antenna

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:

Install the ATU on an ATU Mounting Kit shown on page 2-10. The kit is stainless steel which can be bolted or welded to ship's hull to ensure good and solid connection in the radio system primary ground point.

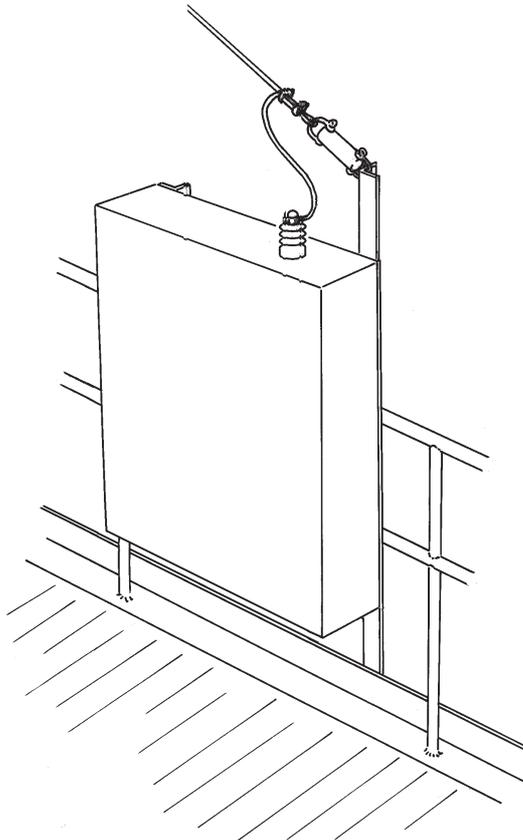
The mounting kit will at the same time ensure straight and flat mounting for the ATU cabinet and provide good airflow around the ATU for better heat dissipation.

On a wooden or fibreglass hull vessel:

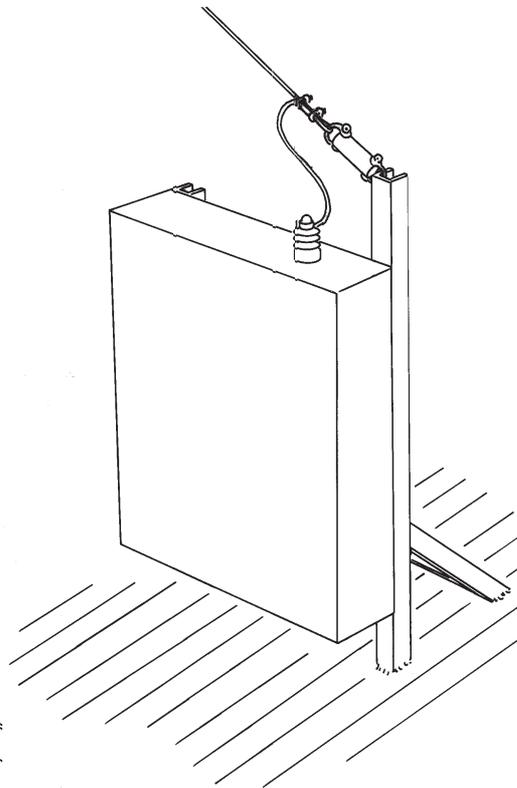
Install the ATU on an STU Mounting Kit shown on page 2-10. The kit is stainless steel which can be bolted to ship's hull and then provide a ground plane connection to ensure good and solid connection in the radio system primary ground point.

The ground plane should normally be provided in as wide surface as possible with shortest possible connection to ship's earth connection to the water surface.

Alternatively and in case of long ground connections the grounding should be arranged in a solid and shielded cable connection where sufficient cable square material to provide the connection and the shielding connected to ATU Mounting Kit and left open at earth connection side.



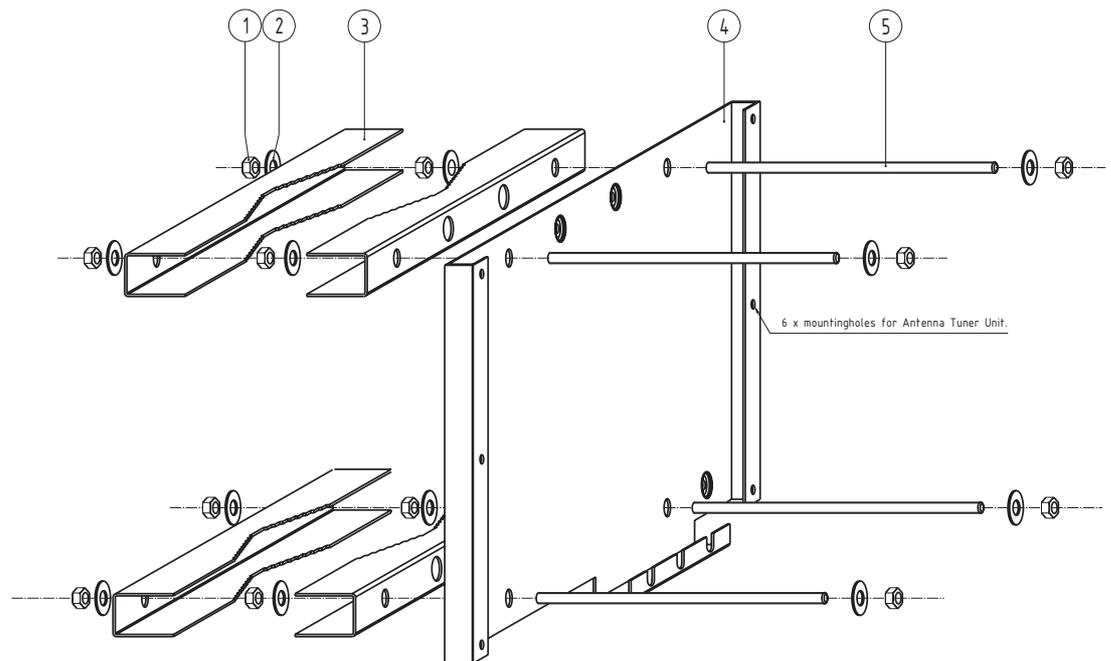
Antenna Tuning Unit bracket welded to the railing.



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.

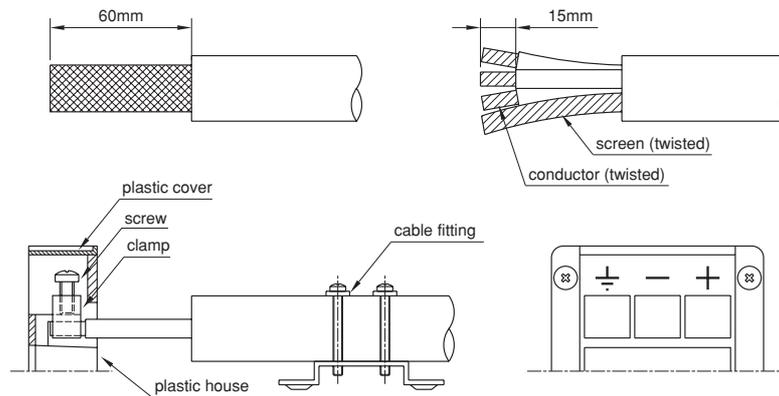
DC supply voltage for an active antenna is available at the DSC RX antenna connector. The supply voltage is +12V for supply currents up to 20 mA. The short circuit current is limited to 2 mA to allow passive antennas with matching transformers to be connected directly.

## 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 3 wire shielded power supply cable to meet international installation and EMC requirements. The safety ground wire is connected to the left terminal showing ground symbol and shielding connected to the cable fitting shown in page 2-3 must be well grounded to ships hull. 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** | Fusing must be provided in the supply leads.

Table below shows the necessary cable cross sections and external fuse ratings.

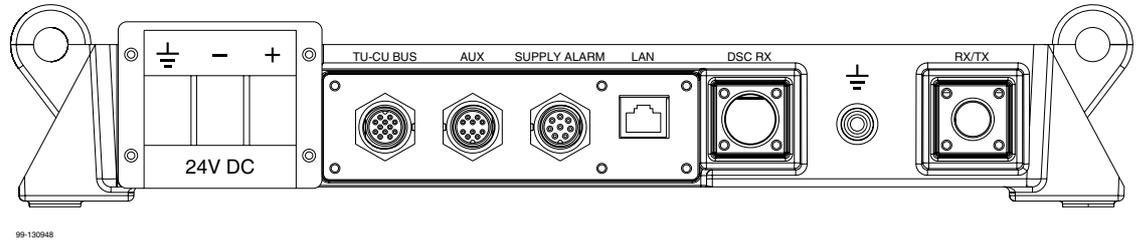


99-132996

Max. cable length to battery *	Recommended cable Screened multiwire	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

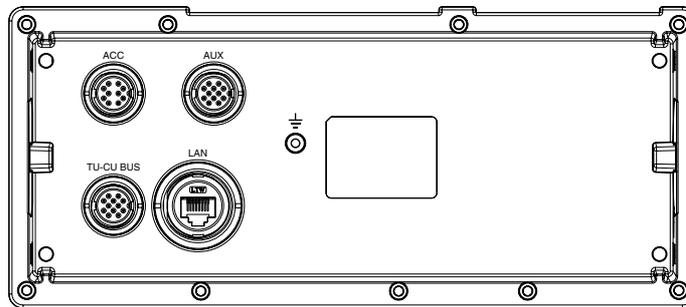
## 2.7 Interconnection of units

### Transceiver Unit connector panel



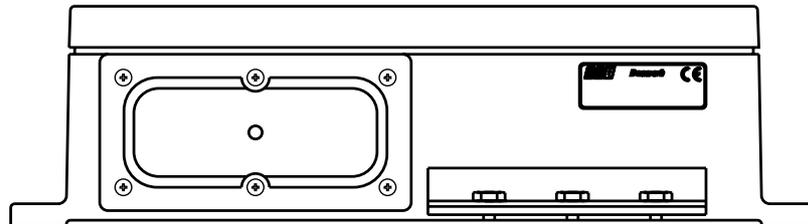
99-130948

### Control Unit connector panel

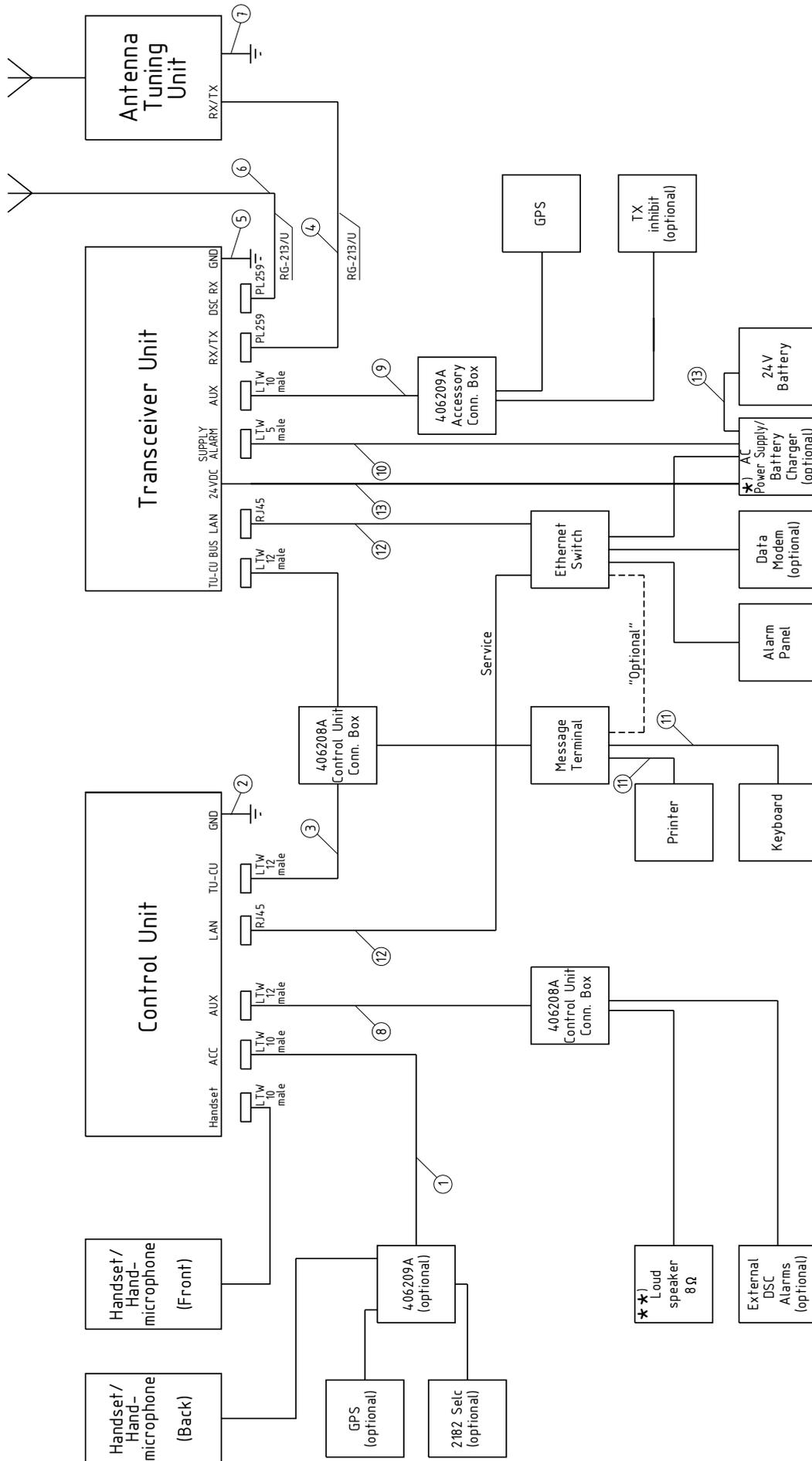


99-130950

### Antenna Tuning Unit connector panel



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★) 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 0.25mm<sup>2</sup> instead of 0.5mm<sup>2</sup>

**Cable 1: Control Unit - ACC**

Cable: 10 x LTW-UL2464 26AWG

Cable-connector: 10 way LTW

Control Unit 'ACC' 10 way LTW	Designation	Remarks	Color
1	NMEA+	NMEA position input	Brown
2	NMEA-	NMEA position input	Blue
3	2182 Selec	OC output. Low when 2182 kHz is selected	White
4	NC	No Connection	Green
5	MIC	Handset microphone	Yellow
6	EAR	Handset earpiece	Grey
7	HOOK_PTT	Hook and PTT	Pink
8	+12V DC	12V supply to handset	Red
9	GND	System ground	Black
10	GND	System ground	Orange

**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: 12 x LTW-UL2464 20AWG

Maximum cable length 100 m (6 m supplied)

For extended installations, use multicable 6x2x0.5mm<sup>2</sup> or better

Cable-connector: 12 way LTW

Control Unit 'TU-CU Bus' 12 way LTW	Transceiver Unit 'TU-CU Bus' 12 way LTW	Twisted pair	Designation	Remarks	Color
1	1	a	SHIELD	Screen connected to system ground	Brown
2	2	b	GND	System ground	Blue
3	3	b	+24V	Supply voltage for the Control Unit	White
4	4	c	CAN_Vcc	CAN supply (15V DC)	Green
5	5	d	CAN_H	CAN data H	Yellow
6	6	d	CAN_L	CAN data L	Grey
7	7	c	CAN_GND	CAN ground	Pink
8	8	a	SUPPLY_ON	Supply on signal to the Transceiver Unit. Active when connected to GND	Red
9	9	e	AUDIO_IN+	Balanced Audio IN	Black
10	10	e	AUDIO_IN-		Orange
11	11	f	AUDIO_OUT+	Balanced Audio OUT	Violet
12	12	f	AUDIO_OUT-		Cyan

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

Cable: 50 ohm coaxial cable RG213/U (or better) - part no. 77.508

Maximum cable length 100 m

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

Where the coaxial cable connection requires a PL259 UHF connector a Crimp type connector should be fitted - part no. 78.508

**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 (or better) - part no. 77.508

Maximum cable length 100 m

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

Where the coaxial cable connection requires a PL259 UHF connector a Crimp type connector should be fitted - part no. 78.508

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

Copper strap 100 x 0.5 mm

Refer to section 'Ground Connections'

**Cable 8: Control Unit - External DSC Alarms & External Speaker**

Cable: 12 x LTW-UL2464 20AWG

Maximum cable length 3 m

Cable-connector: 12 way LTW

Control Unit 'AUX' 12 way LTW	Designation	Cable no.	Remarks	Color
1	NC	10	No Connection	Brown
2	NC	11	No Connection	Blue
3	NC	11	No Connection	White
4	NC	9	No Connection	Green
5	OTHER ALARM	8	+ 5V output, when active	Yellow
6	NC	10	No Connection	Grey
7	DISTRESS ALARM	10	+ 5V output, when active	Pink
8	GND	9	System ground	Red
9	SPEAKER OUT	8	External speaker (max 6W in 8ohm)	Black
10	NC	10	No Connection	Orange
11	NC	11	No Connection	Violet
12	NC	12	No Connection	Cyan

**Cable 9: Transceiver Unit - AUX**

Cable: 10 x LTW-UL2464 26AWG

Maximum cable length 3 m

Cable-connector: 10 way LTW

Transceiver Unit 'AUX' 10 way LTW	Designation	Remarks	Color
1	NMEA_IN+	NMEA position input	Brown
2	NMEA_IN-	NMEA position input	Blue
3	GND	System ground	White
4	LINE_OUT	Single ended 600 ohms AF output Nominal 0 dBm in 600 ohm Refers to system ground (GND)	Green
5	LINE_IN	Single ended 600 ohms AF input Nominal level 0 dBm Refers to system ground (GND)	Yellow
6	TX_INHIBIT	Transmitter inhibit/RX mute input. Pulled up to +15 V Active when connected to GND	Grey
7	TX_KEYED	Low when TX keyed OC output, max. 50 mA, 12 V	Pink
8	12V_OUT	+12 V output Max. 50 mA	Red
9	EXT KEY	Transmitter key input. Pulled up to +15 V Active when connected to GND	Black
10	GND	System ground	Orange

**Cable 10: Transceiver Unit - Supply Alarm**

Cable: 5 x LTW-UL2464 24AWG

Cable-connector: 5 way LTW

Transceiver Unit 'SUPPLY ALARM' 5 way LTW	Designation	Remarks	Color
1	AC_ALR*	AC Alarm input. Alarm when connected to GND	Brown
2	GND	System ground	Blue
3	VBAT-	Voltage input for high/low battery voltage alarm	Black
4	VBAT+		White
5	NC	No Connection	Green/GND

**Cable 11: Message Terminal**

Cable: Shielded high quality USB

Maximum cable length 1 m

**Cable 12: Ethernet**

Cable: STP CAT-5E

Maximum cable length 100 m

**Cable 15: Transceiver Unit - 24V 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

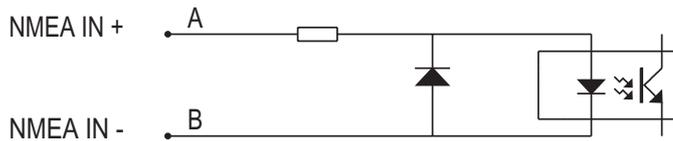
\* fused

## 2.8 Position and time information

### Connection of Navigation Equipment

Navigation equipment complying with the NMEA 0183/IEC 61162-1 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.

Supported sentences:

GLL (longitude, latitude, utc, status, mode)

GGA (longitude, latitude, utc, quality )

RMC (longitude, latitude, utc, status, mode)

GNS (longitude, latitude, utc, mode)

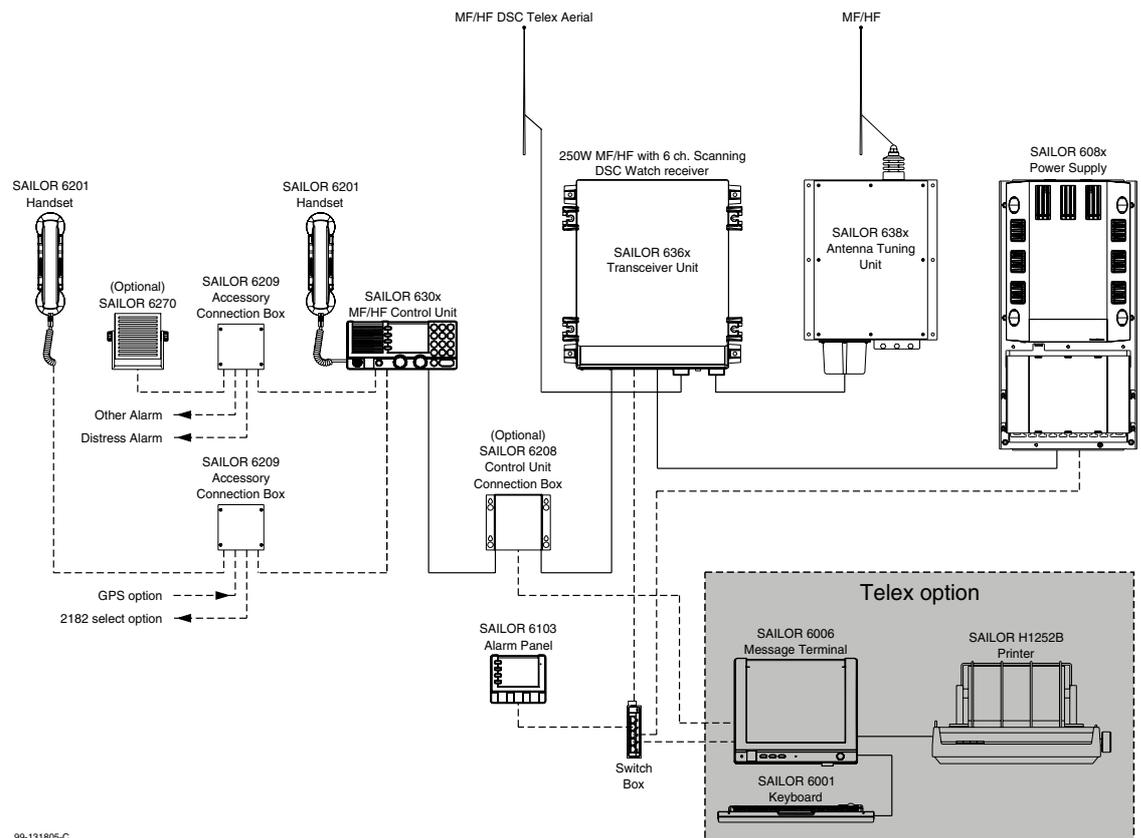
ZDA (utc, day, month, year)

Only the mentioned fields are used - the rest are discarded.

## 2.9 Telex operation

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.

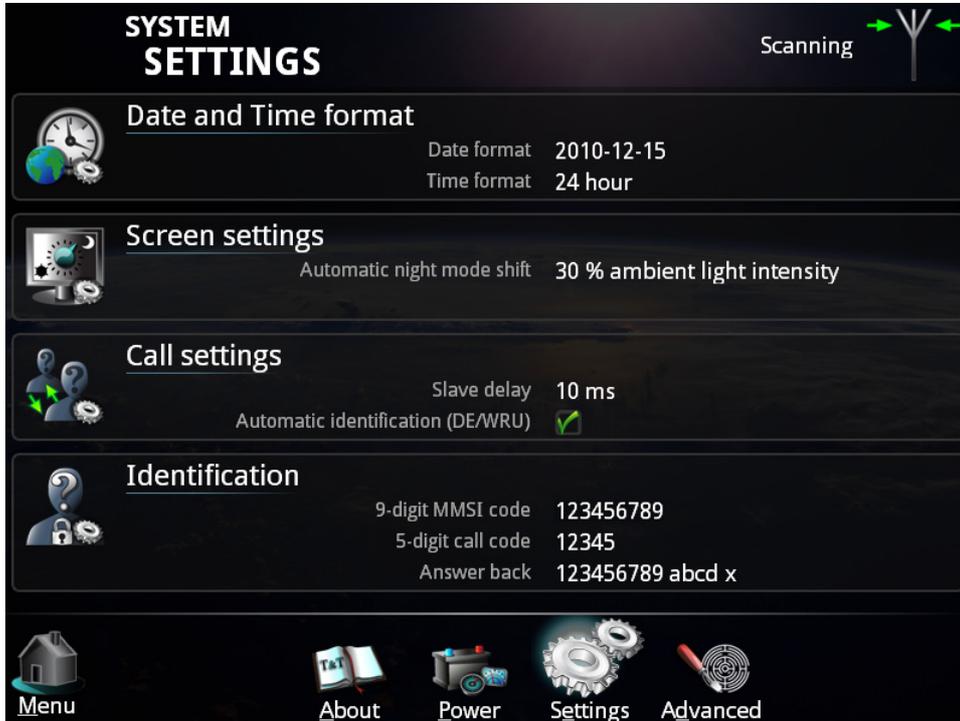


## 2.10 Programming Telex ID

### Answer back

To configure the answer back string in the SAILOR 6006, do as follows:

1. From the main menu on the SAILOR 6006 select System.
2. Select Settings at the bottom of the page. (Billed GUI\_System\_Settings.png)



3. Select Identification and type in the password 1234.
4. Type in the answer back string and select OK.

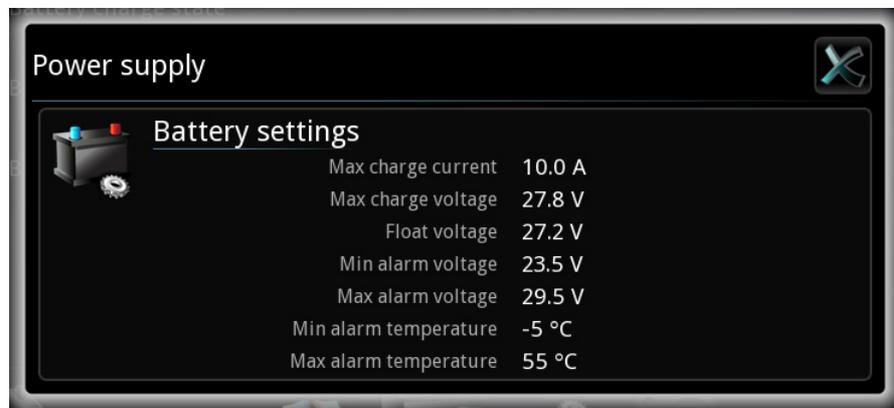


## 2.11 Power status

To see the status of the power source, select **System** > **Power**.



1. To see the power settings, select **Settings...**

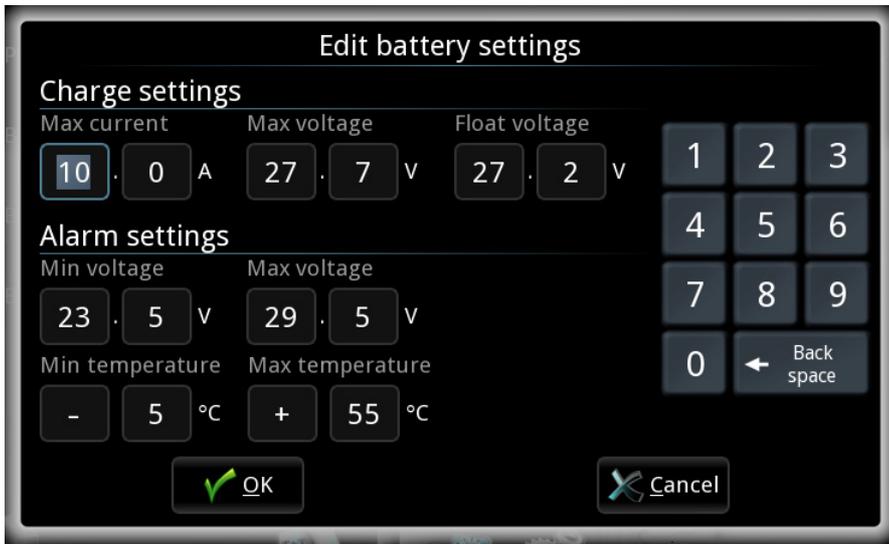


### Important

The default settings are suitable for most installations. Do not change these settings unless you have a special battery type or installation that requires different settings. Only skilled personnel should change the power settings.

- To change the power settings, select **Battery settings**.

**Note** | You must enter the password 1234 to access these settings.



- Change the settings as needed.

**Note** | The charge current depends mostly on the capacity of the battery (larger battery > higher charge current). It must be high enough to charge the battery from empty to required capacity in 10 hours (COMSAR/Circ.32).

- Select **OK** to apply the new settings.

## Technical description

### 3.1 Control Unit

The Control Unit consists of a main module 60-127962 and two sub modules: HMI module 60-127963 and the Intercon module 60-127964.

The main module consists of the digital part, i.e. the microprocessor, program FLASH, SDRAM, TU-CU Bus communication driver and Ethernet 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 module also controls the the graphical TFT color display (240x320 dots).

The HMI module contains a minor keyboard interface and encoders for volume and rotary knob.

The Intercon module contains the connectors for external interfaces.

### 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 60-127961

The Control/Intercon module performs the digital 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. The processor communicates with the CU via the CAN interface, with auxiliary equipment via an Ethernet interface and the ATU via a modem circuit. Internal communication is via the TU Bus. At power up the CPU boots the DSP.

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 DSP performs DSC modulator and dual DSC demodulator functions. The modulator output is through a transversal filter.

The DSP performs the analogue control and audio switching allows loop back test.

Audio circuits convert between unbalanced and balanced lines used by the TU-CU Bus.

### 3.4 Synth. and DSC WR module 60-131332

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 receive 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 remove 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 PA and Filters module 60-123937 (FCC)

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 receive 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 remove 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	-	2.3 MHz
2.3	-	3.05 MHz
3.05	-	4.5 MHz
4.5	-	8.8 MHz
8.8	-	16.81 MHz
16.81	-	19.0 MHz
19.0	-	30.0 MHz

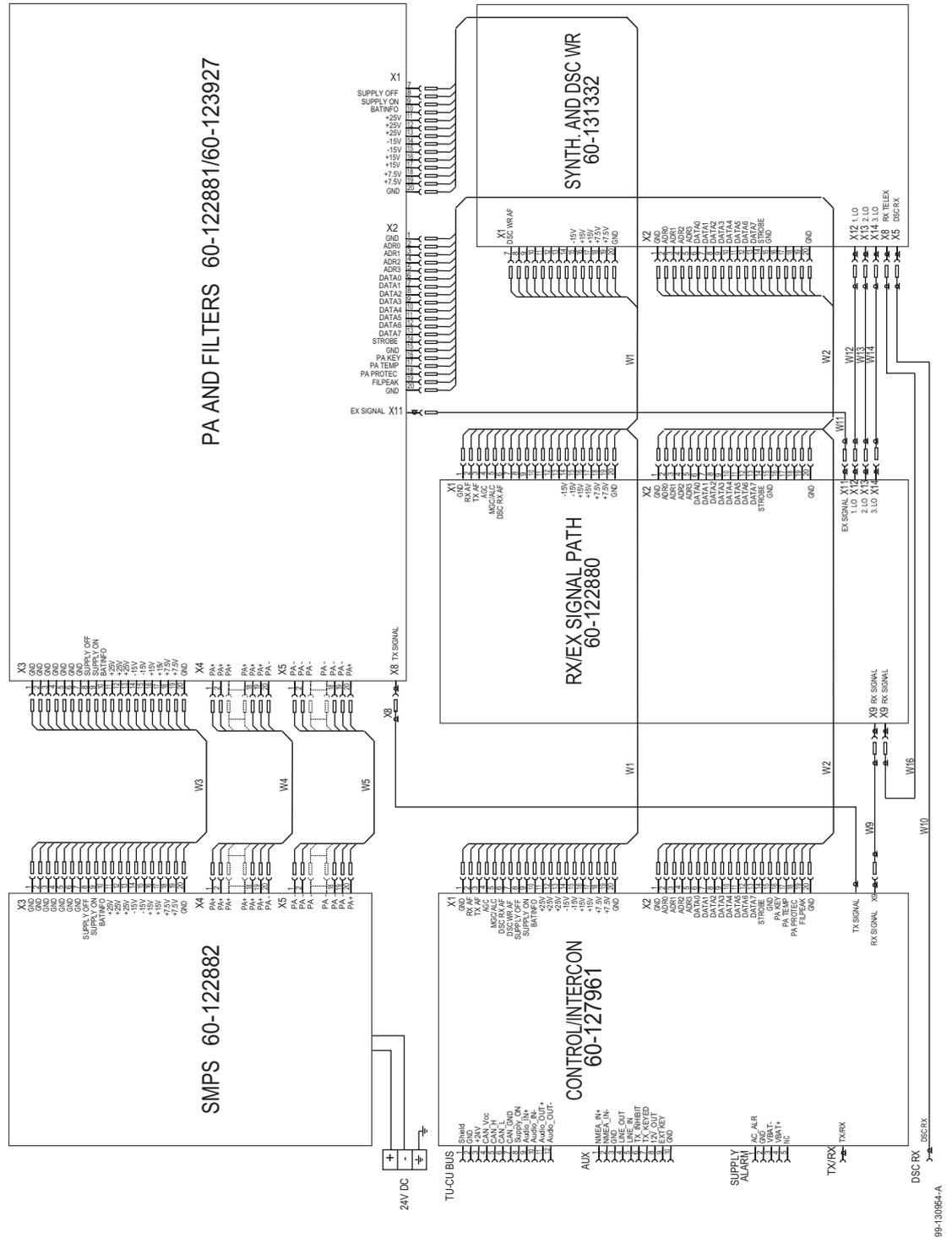
### 3.8 SMPS module 60-122882

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 TU-CU Bus 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 BATINFO detector circuit and fed to the Control/Intercon module for automatic RF output power adjustment.



### 3.10 Transceiver unit interconnection diagram



Technical description

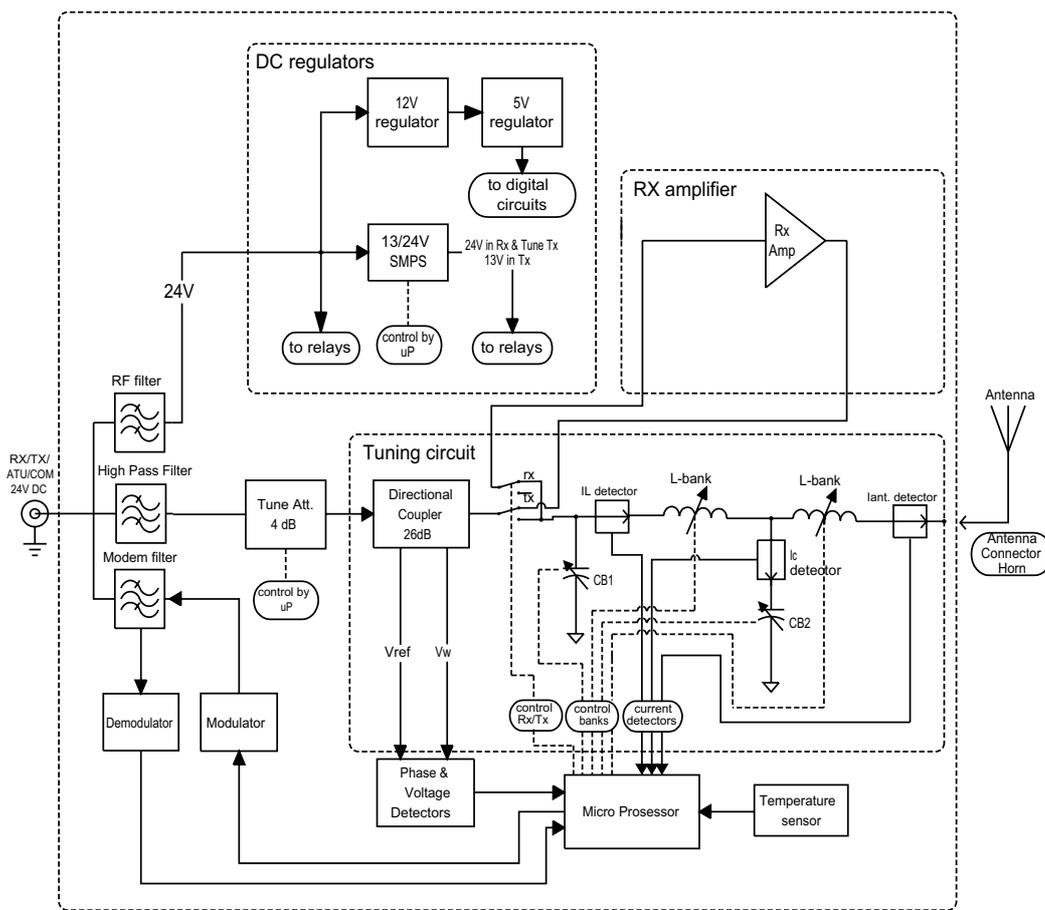
### 3.11 Antenna Tuning Unit

#### 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 p-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 is utilized, to improve the sensitivity of the system. It is possible to select the sensitivity in the steps OFF and NORMAL from the Control Unit.

### 3.12 Antenna Tuning Unit block diagram



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## 3.13 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.

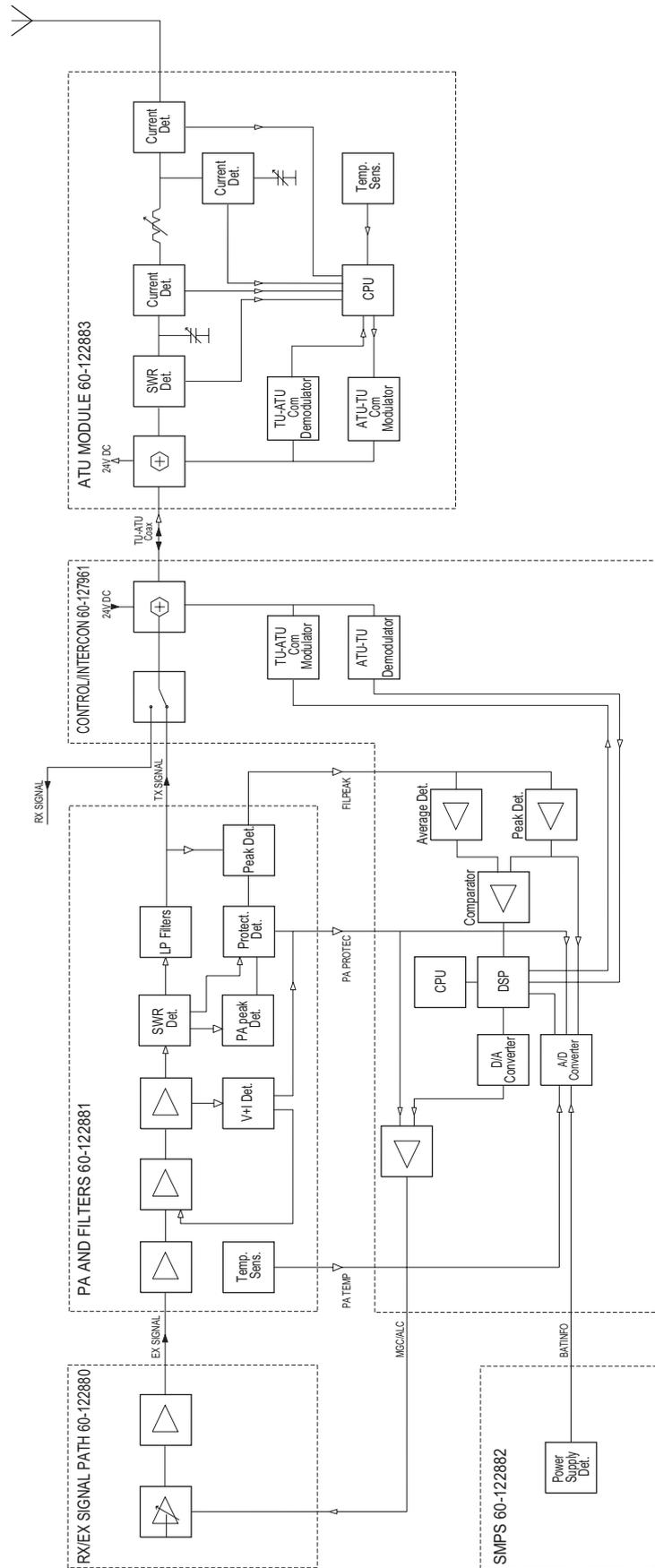
### Power Amplifier Protection

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 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.

### 3.14 Power control and protection system block diagram



99-1335/6

# Service

## 4.1 Software update

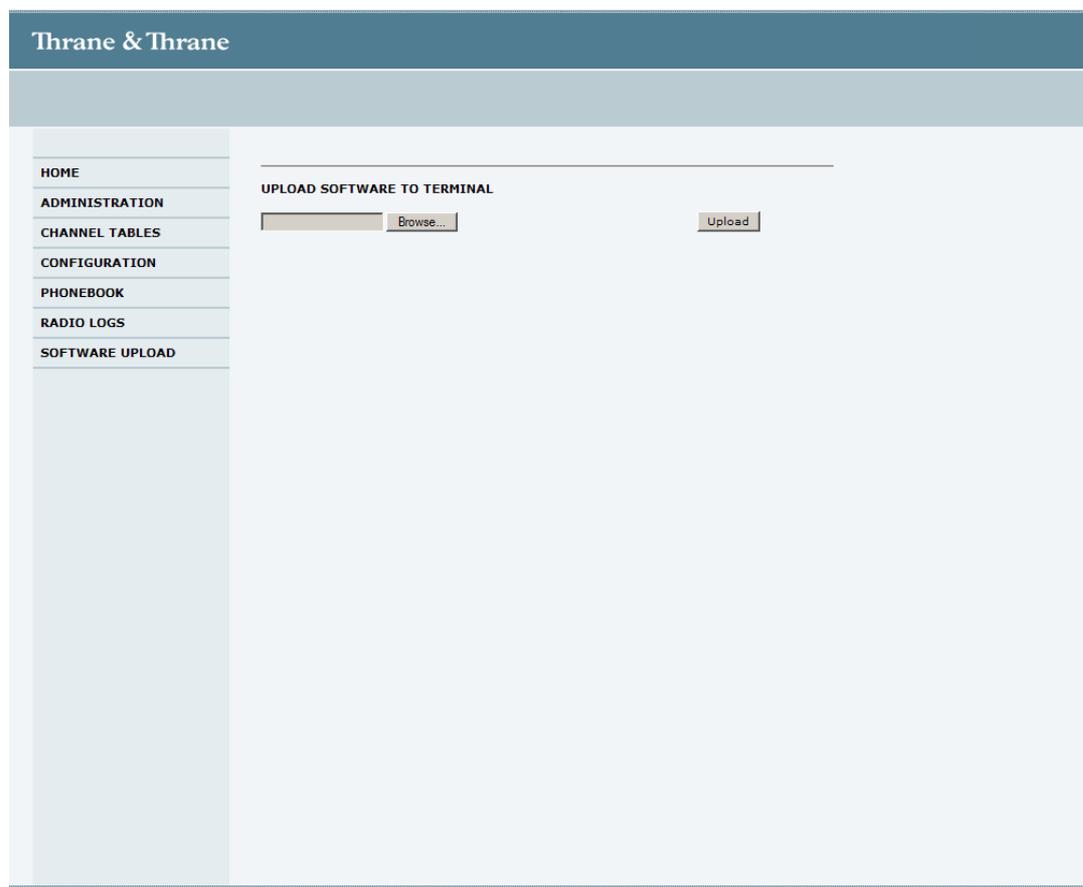
Below is a guide to upload software to the MF/HF transceiver unit. The sequence should be repeated for the Control Unit, if this unit should be updated as well.

1. Power off the MF/HF radio.
2. Attach a personal computer to the transceiver. Use crossed LAN cable directly or a straight LAN cable connected to the optional Moxa switch.
3. Turn on the MF/HF radio and wait for the radio being operational.
4. Open a Mozilla Firefox browser on the PC and enter the IP address of the transceiver unit (can be found under menu: Setup -> System Configuration-> IP Address).
5. Select '**Software Upload**' in the menu bar on to the left (see fig. down below).
6. Select the browse button and locate the file containing the firmware (can be found on the Thrane & Thrane Extranet).
7. Select the file and press the 'Upload' button.
8. Wait for the radio to reboot (this can take up to ten minutes).

### Important

#### WARNING!

Make sure you select the **correct file** and **do not power cycle the radio** during software upload. Failing to do so can render the radio system useless. Repair can only be done internally by Thrane & Thrane.

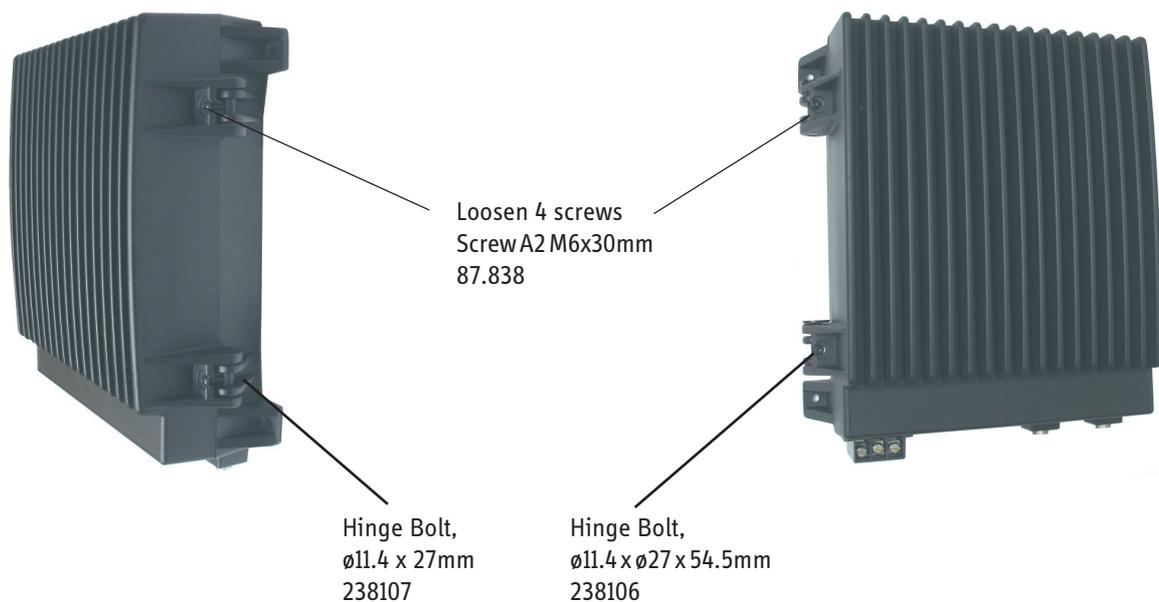




## Spare part exchange

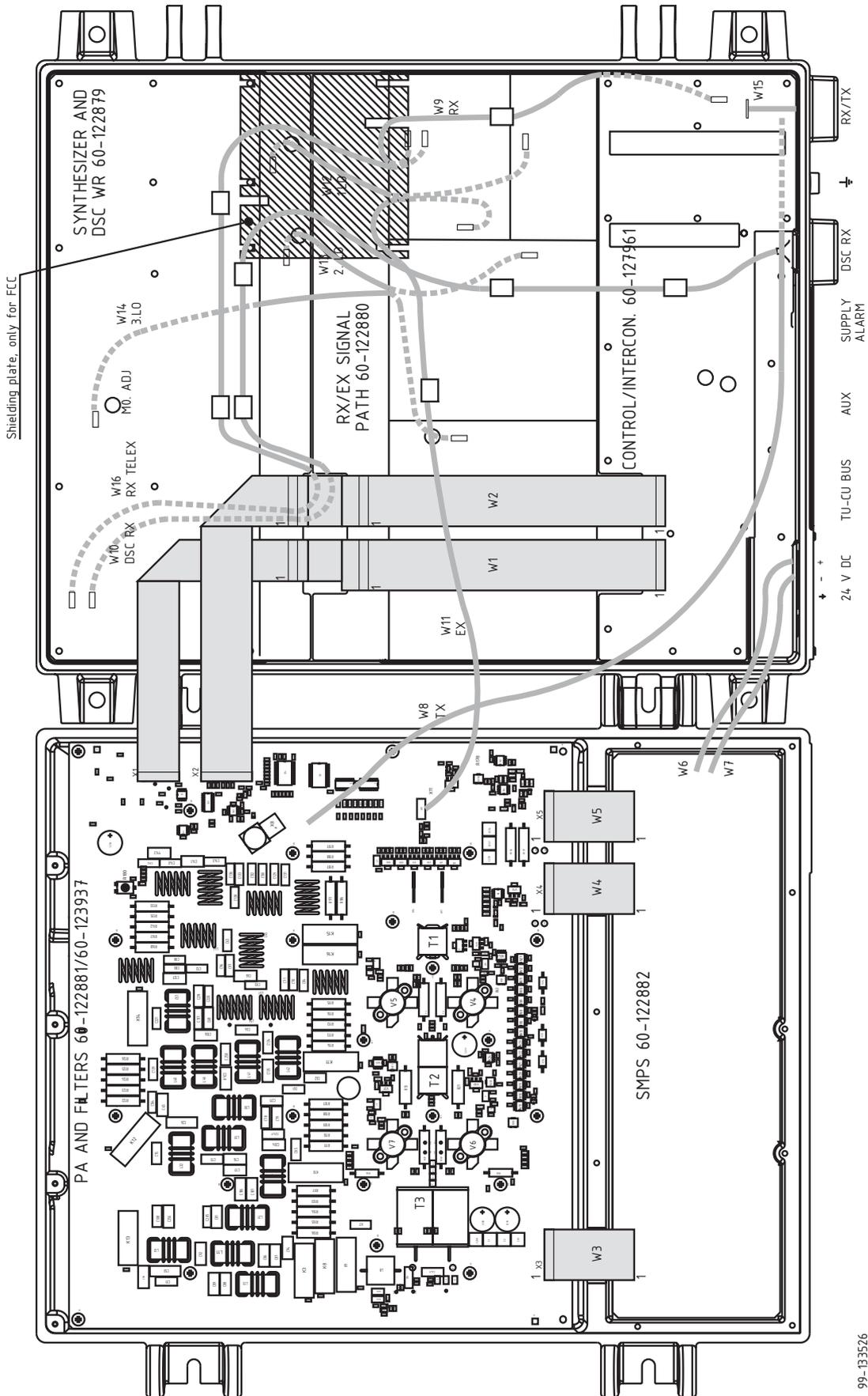
### 5.1 Disassembling the Transceiver Unit

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.



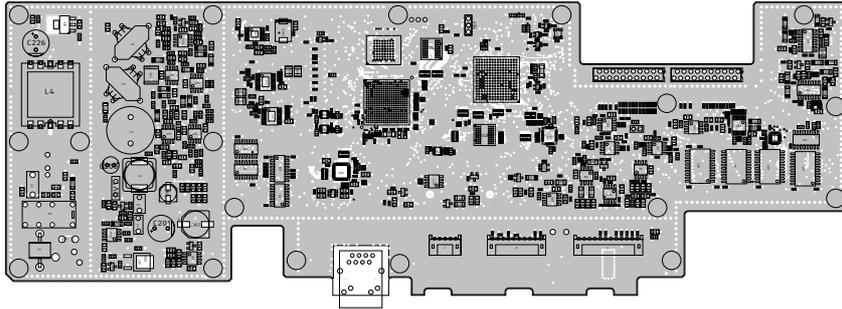
## 5.2 Transceiver Unit module location

The following modules are available as service parts.

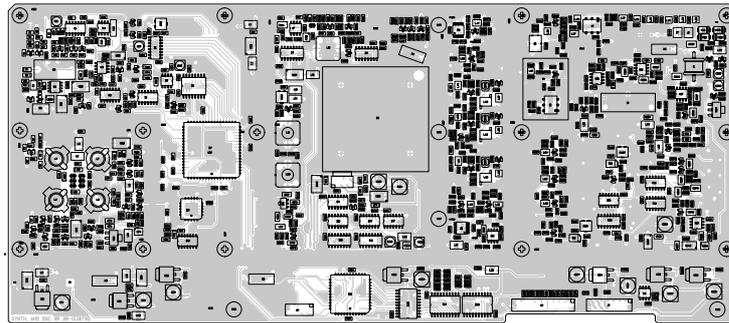


99-133526

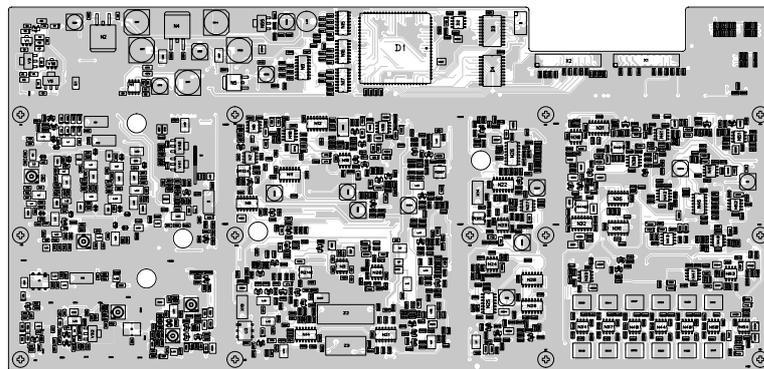
**Control / Intercon. module 60-127961**



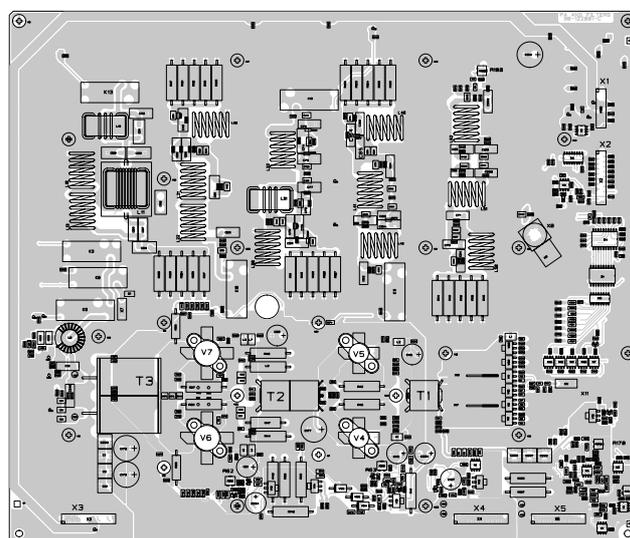
**Synthesizer and DSC WR module 60-122879**



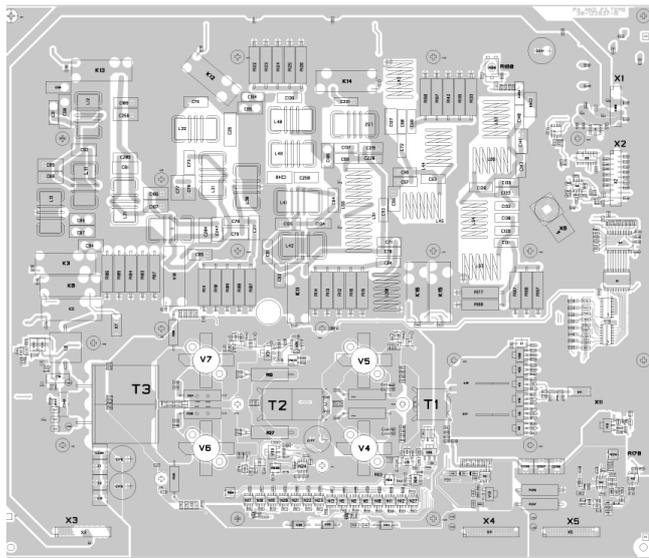
**RX/EX Signal path module 60-122880**



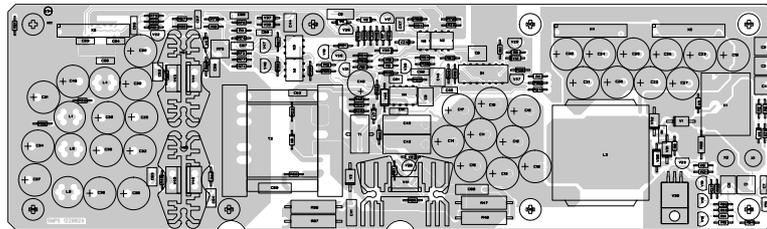
**PA and filters module 60-122881**



### PA and filters module 60-123937 (FCC)



### 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

Item	Part no.
SAILOR 6301 Control Unit Class A	406301A
SAILOR 6302 Control Unit Class E	406302A
SAILOR 6360 150W MF/HF Transceiver Unit DSC Class A	406360A
SAILOR 6361 150W MF/HF Transceiver Unit DSC Class A FCC	406361A
SAILOR 6362 150W MF/HF Transceiver Unit DSC Class E	406362A
SAILOR 6363 250W MF/HF Transceiver Unit DSC Class A	406363A
SAILOR 6381 150/250W Antenna Tuning Unit DSC Class A	406381A
SAILOR 6382 150/250W Antenna Tuning Unit DSC Class E	406382A
SAILOR 6006 Message Terminal	406006A
SAILOR 6001 Keyboard for Message Terminal	406001A
SAILOR 6103 Multi Alarm Panel	406103A
SAILOR 6080 Power Supply	406080A
SAILOR 6081 Power Supply & Charger	406081A
SAILOR 5083 Power Supply & Charger	405083A
SAILOR 6197 Ethernet Switch	406197A
SAILOR 6208 Control Unit Connection Box	406208A
SAILOR 6209 Accessory Connection Box	406209A
SAILOR 6270 External 8W Loudspeaker	406270A
Optional installation kit (3 x SAILOR 6080 + 1 x SAILOR 6081)	406081-004
ATU Mounting Kit:	
Mounting plate and fittings for mast	737589
Mounting plate	737588
Gasket kit for Antenna Tuning Unit	737822



**A**

AGC Automatic Gain Control

ALC Automatic Level Control

AM Amplitude Modulation

ATU Antenna Tuning Unit

**C**

CU Control Unit

CW Continuous Wave (modulation, used for morse communication)

**D**

DSC Digital Selective Call

**F**

FEC Forward Error Correction (Broadcast)

**H**

HF High Frequency

**J**

J2B DSC/Telex (modulation)

J3E SSB Telephony (modulation)

**L**

LSB Lower Side Band

**M**

MF Medium Frequency

MID Maritime Identification Digits

MMSI Maritime Mobile Service Identity

MSI Maritime Safety Information's

## **N**

NMEA National Marine Electronics Association

## **P**

PA Power Amplifier

PTT Push To Talk

## **R**

RTTY Radioteletype (Radio Telex)

RX Receive(r)

## **S**

Sitor SImplex Teletype Over Radio (Radio Telex)

SMPS Switch Mode Power Supply

SSB Single Side Band

## **T**

TU Transmitter Unit

TX Transmit(ter)

## **U**

USB Upper Side Band



98-120890-B