

3 SYSTEM DESCRIPTION

3.1 General

The Compact HF SSB Programme 2000 includes all facilities that forms a modern maritime short wave radio station.

The equipment consists of a number of separate units, which can be interconnected to give a sophisticated and highly advanced maritime communication system. The divided structure gives a very flexible system, which can be fitted to fulfil all needs and wishes of the customers. This gives a very cost efficient system, because the customer only pays for the facilities he actually needs.

3.2 Simplex Radiotelephone Standard System

The system is built up around four units, which form the standard system for simplex radiotelephony. These four units are pointed out on the block diagram by a surrounding broken line.

The standard system is delivered in three different versions, with the following power levels: 250W, 600W and 1200W. The power level is only depending on the size of the transmitter and aerial coupler, which means that the Receiver/Exciter Unit RE2100 is common for all versions of the system.

The standard system is fully controlled from the Receiver/Exciter Unit RE2100. This unit is provided with a high quality push-button keyboard, and a display where keyed operations are instantly confirmed.

The standard system can be extended by optional equipment to fulfil almost any requirement. This optional equipments is described below.

3.3 Duplex Radiotelephone

The standard system can be extended to duplex operation by means of the Duplex Receiver R2120. This unit has its own antenna for reception and is fully controlled from the Receiver/Exciter Unit RE2100.

3.4 Telegraphy

The standard system can be extended to telegraphy operation by means of the Duplex/Telegraphy Receiver R2120T, which is a special version of the Duplex Receiver. This version includes a very narrow intermediate filter and a BFO circuit (Beat Frequency Oscillator).

Furthermore, to obtain the facility of telegraphy, the system must also include the CW Unit H2185. This unit includes a Side Tone Oscillator, power supply for Duplex/Telegraphy Receiver R2120T and connectors for the Morse Key and Headset.

3.5 Remote Control

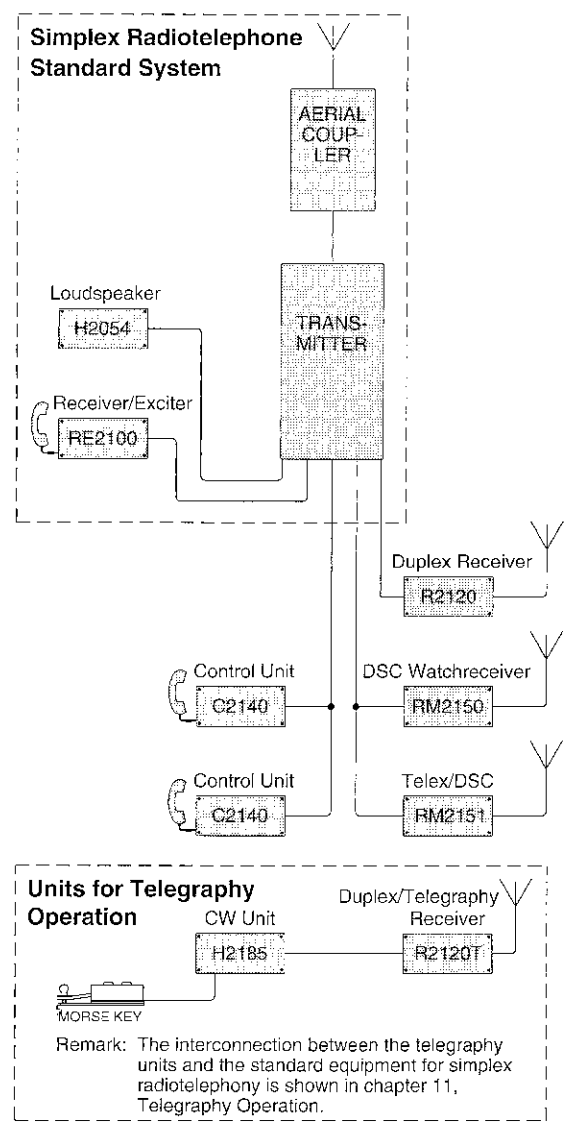
The Standard Simplex/Duplex system can be remote controlled by the Control Unit C2140, which can be placed up to 100 meters away from the Transmitter. The system can handle up to five Control Units C2140, depending on the number of other optional units.

Furthermore, it is possible to use the Control Unit C2140 as an intercom, which means that a conversation can take place between two Control Units C2140 or between a Control Unit C2140 and the Receiver/Exciter Unit RE2100.

3.6 DSC/Telex

The standard system can be extended with the DSC Watchreceiver RM2150 and/or the Telex/DSC RM2151.

The operation of these two units and the principle of DSC (Digital Selective Calls) are described in the separate operator manual: "OPERATOR MANUAL DSC HF SSB RM2150/RM2151".



1 GENERAL INFORMATION

The HF SSB R2120 is an all solid state constructed microcomputer controlled SSB short wave telephony duplex receiver.

The HF SSB R2120 covers the frequency range from 100 kHz to 30 MHz.

The HF SSB R2120 is a remote controlled receiver, with working mode J3E, upper or lower sideband.

The HF SSB R2120 is an integrated part of RE2100, and this system can operate in both simplex semi-duplex and duplex.

The HF SSB R2120 will automatically switch to duplex operation, when duplex is possible.

The HF SSB R2120 can as option work as a remote controlled Telegraphy or Telex receiver.

The HF SSB R2120 will automatically switch to duplex operation on all ITU channels in the bands from 2 MHz to 25 MHz.

The HF SSB R2120 can as an integrated part of RE2100, work as duplex receiver on 100 quick select frequency pairs.

The HF SSB R2120 has clarifier function ± 150 Hz in 10 Hz steps.

The HF SSB R2120 is fully synthesized and has a high stability reference oscillator (TCXO).

The HF SSB R2120 has a special serial input (SP-BUS) enabling R2120 to communicate with other units.

1.1 INTRODUCTION

This instruction book consists of:

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|------------|---|
| Section 1. | This section give a general description down to unit level. |
| Section 2. | This section is the installation chapter, which give you some hints about installing the equipment. |
| Section 3. | Is the service chapter, which give you information, about performance or function check and information about the service programmes. |
| Section 4. | Is mechanical information. |
| Section 5. | In this section you will find the circuit descriptions. |
| Section 6. | Contains the parts lists. |

1.2 DESCRIPTION OF THE HF SSB PROGRAMME

The The HF SSB programme is designed to meet all requirements within HF radio communication.

The The HF SSB programme consists of one main control unit and three transmitters with different power levels (250W, 600W, 1200W PEP).

To obtain maximum performance, the systems are designed with aerial couplers, which can be mounted outdoors. All the aerial couplers have automatic tuning.

Each of these three systems can be extended with:

- remote control units C2140.
- telex/DSC scanning receiver with built-in modem RM2151.
- DSC MF/HF watchkeeping receiver with built-in modem RM2150
- duplex receiver R2120

The system may be supplied from 24V DC or 110/220V AC power source.

For the system, the following three battery chargers are available:

- 30 amp battery charger N2174
- 3 × 30 amp battery charger 2 × N2174
- 60 amp battery charger N2174 Dual

These battery chargers can be used to charge maintenance free lead-acid batteries and Nickel Cadmium batteries.

The 600W PEP and 1200W PEP transmitters and power supplies consist of the following units:

- 1) TX control unit, consisting of output filter, power supply, and audio amplifier for RE2100 and the TX-processor.
- 2) Power amplifier unit, consisting of a 600W power amplifier.
- 3) Combiner unit, consisting of power splitter and power combiner.
- 4) 24V DC power unit, consisting of a 24V DC to 28V and 42V DC switch mode power supply, which supplies the power amplifier unit.
- 5) 110/220V AC power supply unit, consisting of a 110/220V AC to 28V DC and 42V DC thyristor controlled power supply, which supplies the power amplifier unit.

1.3 TECHNICAL DATA**SYSTEMS SPECIFICATION.**

- Performance specifications:** In compliance with ETSI, CEPT; FTZ and FCC.
- Modes of operation:** SSB (J3E) upper and lower sideband.
- * Option Telegraphy (A1A) and Telex (J2B).
- Remote control:** SP-BUS is an interrupt command/response data bus. Type NRS, baud rate 4800, Format E81.
- * Option Interface to RS 232C, with interface unit H2186.
- Frequency control:** By SP-BUS in steps of 10 Hz.
- Mode control:** By SP-BUS all modes can be selected.
- Clarifier/BFO control:** Clarifier is controlled by SP-BUS in SSB (J3E) mode.
- * Option The BFO is controlled by SP-BUS in Telegraphy (A1A) mode.
- Power failure control:** All set up data will be restored when power supply return.

RECEIVER SPECIFICATIONS.

- Receive System:** Double conversion super heterodyne 1st IF 70 MHz. 2nd IF 10,73 MHz.
- Frequency Range:** 100 kHz to 29999,9 kHz.
- Clarifier Range:** +/- 150 Hz in 10 Hz step.
- *Option **BFO Range:** +/- 1500 Hz in 4 Hz step.
- Antenna impedance:** 50 ohm
- Frequency Stability:** Better than 0.39 ppm.
- IF selectivity:** SSB:
Pass band ripple better than 2,5 dB.
6 dB bandwidth at 350 Hz to 2700 Hz.
60 dB bandwidth at -625 Hz to 3975 Hz.
- *Option Telex/Telegraphy:
Pass band ripple better than 1 dB.
3 dB bandwidth at +/-150 Hz to +/- 350 Hz.
60 dB bandwidth at +/- 750 Hz.
- Sensitivity:** SSB:
calling sensitivity: 20 dB SINAD
100 kHz to 385 kHz 10 dB/μV.
385 kHz to 29999,9 kHz 5 dB/μV.
(CEPT method of test.)
- *Option Telex/Telegraphy:
calling sensitivity: 20 dB SINAD

100 kHz to 385 kHz 2 dB/μV.
 385 kHz to 29999,9 kHz -3 dB/μV.

**Adjacent Channel
 Selectivity:**

SSB:
 48 dB at + 4,0 kHz and - 1,0 kHz.
 60 dB at + 5,0 kHz and - 2,0 kHz.
 71 dB at + 8,0 kHz and - 5,0 kHz.
 (CEPT method of test)

*Option Telex/Telegraphy:
 45 dB at +/- 500 Hz.

**Automatic
 gain control:**

SSB:
 Less than 2 dB variation of detector output level for 90 dB input signal variation
 (0 dB/μV to 90 dB/μV).
 Fast attack time and slow decay time.

*Option Telex/Telegraphy:
 Less than 2 dB variation of detector output level for 90 dB input signal variation
 (0 dB/μV to 90 dB/μV).
 Fast attack time and slow decay time.

**Manual
 gain control:**

SSB:
 Dynamic range better than 100 dB.

*Option Telex/Telegraphy:
 Dynamic range better than 100 dB.

Blocking:

SSB:
 With wanted signal level at 60dB/μV.
 Better than 120 dB/μV for unwanted signals more than 20 kHz away from the
 wanted signal.
 With wanted signal level at sensitivity level.
 Better than 100 dB for unwanted signals more than 20 kHz away from the
 wanted signal.
 (CEPT method of test).

*Option Telex/Telegraphy:
 Better than 55 dB for unwanted signals in the band 1 kHz to 3 kHz away from
 the wanted signal.
 Better than 75 dB for unwanted signals more than 3 kHz away from the wanted
 signal.

***Option Co-channel rejection:**

Telex/Telegraphy:
 Less than 3 dB.
 (CEPT method of test).

Intermodulation:

SSB:
 IP3 better than 8 dBm.
 (CEPT method of test).

*Option Telex/Telegraphy:
 IP3 better than 8 dBm.
 (CEPT method of test).

Spurious rejection:	SSB: IF: Better than 85 dB. Image: Better than 100 dB. Others: Better than 80 dB. (CEPT method of test).
*Option	Telex/Telegraphy: IF: Better than 85 dB. Image: Better than 100 dB. Others: Better than 80 dB. (CEPT method of test).
Spurious Emission:	SSB: Better than 1nW at antenna connector.
*Option	Telex/Telegraphy: Better than 1nW at antenna connector.
Audio Power:	SSB: 0 dBm into 600 ohm.
*Option	Telex/Telegraphy: 0 dBm into 600 ohm.

GENERAL.

DC power source:	+18 V DC +/-5%, 0.3 Amp. -18 V DC +/-5%, 0.1 Amp. +9 V DC +/-5%, 0.3 Amp.
Ambient temperature:	-15°C to 55°C operating. -20°C to 70°C storage.
Relative humidity:	95% non-condensing.
Vibration:	IEC, CEPT and MPT 1204.
Dimension:	H x W x D, 98mm x 210mm x 300mm.
Weight:	3.7 Kg.
Option:	Telex/Telegraphy: Telex and or Telegraphy can be supplied as an option. The type number will then be changed to R2120-T.

1.4 CONTROLS

The HF SSB R2120 is a remote controlled receiver, and contains therefor no control buttons.

In the compact 2000 system, R2120 is fully controlled by the controls at the front panel of the RE2100.

To activate the duplex receiver from RE2100 three conditions have to be fulfilled.

- Channel mode has to be chosen
- The separation between the chosen TX and RX frequency has to be greater than 280 kHz.
(all the ITU channels fulfil this condition).
- The transmitter has to be keyed.

This means that when the display at RE2100 show the RX and TX frequency the system works in simplex mode, even if the transmitter is keyed.

When the system works in simplex mode the receiver inside RE2100 is used, and when the system works in duplex mode the receiver inside R2120 is used.

For further information about operation of R2120 please use the OPERATORS MANUAL FOR RE2100.

This unit contains input protection circuit, input filters, mixer and 70 MHz IF filter.

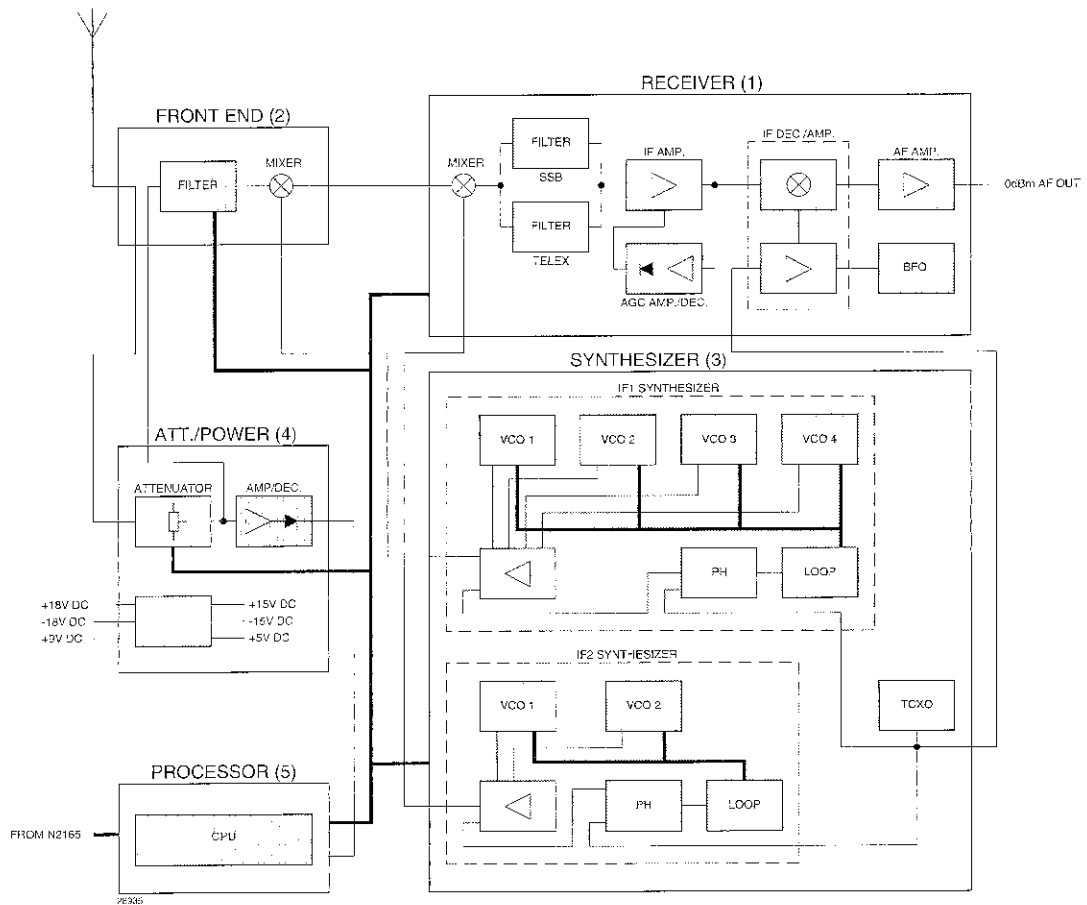
The input filter is a mixture of lowpass, highpass and bandpass filter to obtain max. performance in the entire band from 100 kHz to 30 MHz.

The mixer is a FET mixer with a high level LO-injection to give the mixer good large signal quality. The mixer is followed by a 70 MHz bilitic quartz filter with a bandwidth of 15 kHz.

1.5 PRINCIPLE OF OPERATION AND BLOCK DIAGRAM.

The HF SSB R2120 is a remote controlled receiver for the The Compact HF SSB Programme 2000. It contains following circuits.

PRINCIPLE OF OPERATION.



The receiver is a high performance double conversion receiver, where the first IF signal is 70 MHz and the second IF signal is 10.7 MHz. The receiver can work as a remote controlled telephony duplex receiver, or as a remote controlled Telex/Telegraphy receiver.

Dependent of the commands received at the SP-BUS, the receiver will automatically be set to the wanted mode of operation.

In telephony duplex mode, the RF signal path from the antenna is, through the duplex attenuator, which is set as explained below, to the first mixer where the RF signal is converted to a 70 MHz IF signal. The 70 MHz IF signal is filtered and then fed to the second mixer, which converts the signal to the 10.7 MHz second IF. This IF signal is fed through the SSB filter and the IF amplifier, to the detector. The detector is supplied with an injection signal, which is the TCXO signal. This injection signal is used for conversion of the second IF signal to an AF signal. The resulting AF signal is filtered and fed through the 0 dBm amplifier to the output terminal.

In Telex/Telegraphy the RF signal path from the antenna is, through the duplex attenuator, which is set to 0 dB attenuation, to the first mixer where the RF signal is converted to a 70 MHz IF signal. The 70 MHz IF signal is filtered and then fed to the second mixer, which converts the signal to the 10.7 MHz second IF. This IF signal is fed through the Telex/Telegraphy filter and the IF amplifier, to the detector. The detector is supplied with an injection signal, which is the TCXO signal in Telex, and the BFO oscillator signal in Telegraphy. The injection signal is used for conversion of the second IF signal to an AF signal. The resulting AF signal is filtered and fed through the 0 dBm amplifier to the output terminal.

When the conditions for a duplex telephone conversation is fulfilled R2120 is activated by a duplex command from the RE2100. The transmitter will then be activated with a tune signal, and the microprocessor in R2120 will activate the RF attenuator to fully 55 dB attenuation. The attenuation will then be adjusted in steps of 5 dB to less attenuation, until the RF detector change level. The setting of the RF attenuator will be fixed at this level until the receiver frequency is changed. The adjustment of the RF attenuator takes approximately 100 msec, after which the transmitter stops sending of tune tones and the receiver is then ready for use for duplex conversation.

DUPLEX PROCESSOR MODUL (5).

This modul operates as interface between the user (RE2100 keyboard and display) and the duplex receiver. It fed control signals to all modules using the internal serial bus (SPI). The PCB holds the memory and the user defined memory in the EEPROM, so even when the supply voltage is removed, the content of the memory is preserved. The duplex receiver communicate with RE2100 by the external serial bus (SP-BUS).

SYNTHESIZER MODUL (3).

This modul contains all frequency generating parts.

There is only one reference oscillator which is a temperature compensated crystal oscillator (TCXO) with a frequency of 10.73 Mhz.

The receiver is using two LO-signals. These signals are generated in two separate PLL's, one having output frequencies from 70 MHz to 100 MHz and the other having output frequencies of 59.27 MHz and 80.73 MHz.

The synthesizer which covers from 70 to 100 MHz is a fractional synthesizer with a resolution of 10 Hz. The other synthesizer is a conventional synthesizer. It has two output frequencies, one for lower sideband 80.73 MHz and another for upper sideband 59.27 MHz.

RECEIVER FRONT END MODUL (2).

This unit contains input protection circuit, input filters, mixer and 70 MHz IF filter.

The input filter is a mixture of lowpass, highpass and bandpass filter to obtain max. performance in the entire band from 100 kHz to 30 MHz.

The mixer is a FET mixer with a high level LO-injection to give the mixer good large signal quality. The mixer is followed by a 70 MHz bilitic quartz filter with a bandwidth of 15 kHz.

RECEIVER MODUL (1).

This unit contains all necessary circuits to convert a 70 MHz IF signal to an audio signal.

The 70 MHz signal from the Front End PCB is fed to the second mixer which converts the 70 MHz signal to the 2nd IF signal at 10.7 MHz. From the mixer this signal is fed to a high order monolithic quartz filter, one for SSB and optionally one for TELEX/TELEGRAPHY. The type of filter is selected from the microprocessor.

From the filter the signal is fed to the 10.73 MHz IF amplifier. The gain of this amplifier is regulated from the AGC amplifier. The regulated IF amplifier is followed by a ceramic filter to reduce the wideband noise. From the ceramic filter the signal is fed to the demodulator, which can operate as an SSB/TELEX detector or as TELEGRAPHY detector, controlled from the microprocessor. The injection signal to the detector is the TCXO reference signal in SSB/Telex mode and the BFO signal in Telegraphy mode. The offset of the BFO oscillator is controlled by the microprocessor through a digital to analog converter. The detector is followed by a low frequency filter circuit, which has cutoff frequencies at 350 Hz and 3000 Hz. From the low frequency filter the signal is amplified in two AF amplifiers, one for the microtelephone earpiece and one for the 0 dBm output.

DUPLEX ATTENUATOR/POWER MODUL (4).

This unit contains two separate circuits, an RF power attenuator with a signal strength detector, and a DC voltage regulator for the internal supply voltages.

From the antenna, the RF signal is fed through an attenuator and then to the front end filters and mixer. The attenuator consists of four attenuators of 5 dB, 10 dB, 20 dB and 20 dB. The setting of this attenuator is controlled by the microprocessor at the processor modul. The information of the attenuator setting is given to the microprocessor by the Signal strength detector placed in connection with the attenuator. The input DC voltages from N2165, T2131 or T2135 is +/-18 V and 9 V. These voltages passes through three series regulators to produce the necessary supply voltages to R2120.

1 GENERAL INFORMATION

BLOCK DIAGRAM.

