

Circuit Description - AXIS RT1200

Introduction.

The AXIS RT1200 consists of two PCB assemblies. The main RF PCB assembly, Navico part No. E02957, contains all the transmitter and receiver circuitry, including the synthesiser, modulator and audio power amplifiers. The control PCB assembly, Navico part No. E02960, contains the microprocessor, user controls, the LCD display and external interfaces.

E02957 Rx/Tx PCB Assembly.

The circuitry on this assembly is shown on drawing No. E02955.

Receiver. RF from the antenna socket passes through the low pass PA filter to a quarter wave match/switch L5, L6 and pin diode D1. In transmit D1 is on to protect the receiver. There then follows an optional attenuator and power splitter, not used on the RT1200. In this model C214 is a 1nF coupling capacitor. L7, L8 and the associated capacitors form a bandpass filter before the R.F. pre-amp, TR1. L9, L10 and L11 form a further bandpass section before the mixer. The RF signal is fed to the source of TR2 and the local oscillator fed to Gate 1. Low side injection is used, i.e. the LO is 21.4 MHz below the receive frequency. L13 forms the drain load before matching through C25 and C26 to the 4 pole crystal filter, XTAL1 and XTAL2. The output of the filter is coupled by L14, C28 and C29 to the integrated IF amplifier/demodulator IC1. This uses a second local oscillator at 21.855MHz giving a second IF of 455kHz. XTAL4 is a 6 pole ceramic filter completing the necessary bandwidth definition. Quadrature coil L16 provides the demodulation.

Audio from pin 9 of IC1 is de-emphasised by R20 and C3, buffered by TR120 before distribution to the various audio stages on the control PCB. The audio from pin 9 is also passed through a very high gain amplifier, within IC1, configured as a band pass filter to detector D2 to provide a voltage proportional to the received signal strength. This level also goes to the control panel to provide squelch control. The AF signal is returned from the control panel after the volume and squelch controls to two audio power amplifiers in Bridge mode. The speaker output is switched at the external speaker socket to mute the internal speaker when an external speaker is connected.

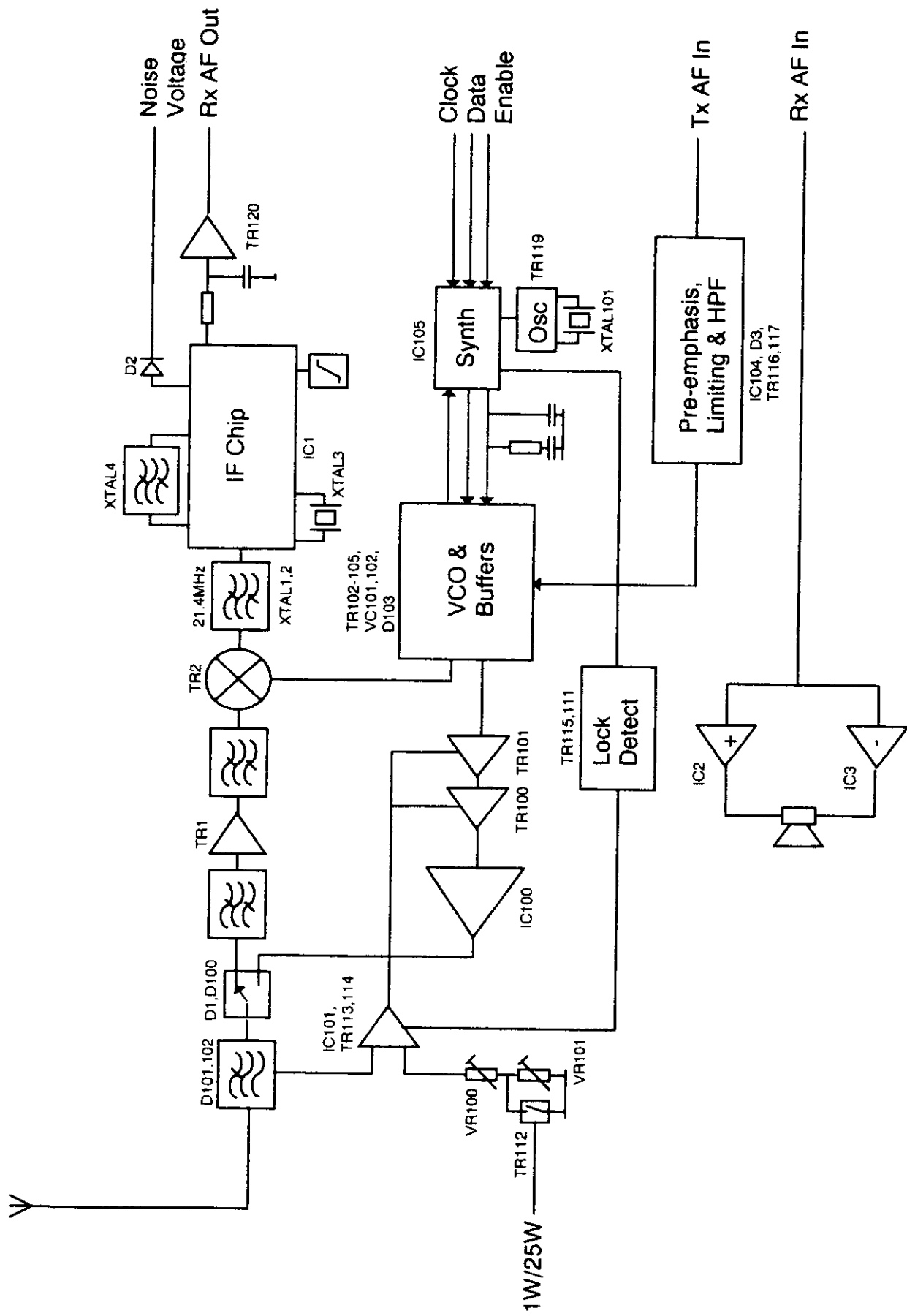
Transmitter. From the LO switch/buffer TR102, the transmit signal is amplified by controlled transistors TR101 and TR100, to drive the hybrid PA module IC100. This device is capable of generating the required 25Watts. The output is switched through PIN diode D100 before passing through the PA filter L1 to L4. L4 of this filter, with diodes D101 and D102 forms a simple forward and reverse power detector to provide power control and transmitter status indication on the front panel display. The power control signal is fed to differential amplifier IC101 along with the reference power signal from VR100 and VR101, used to set the hi and low powers. The output of this amplifier forms a regulated supply with TR113 and TR114 to supply the PA drivers TR100 and TR101. Note that the

reference input and supply for TR114 is fed from TR111 which is only turned on after the synthesiser is in lock.

Local Oscillator / Synthesiser. The main LO consists of TR105 connected as a Colpitts oscillator. Tuning is by L113 and varactor VC102. Band switching between Rx and Tx is by PIN diode D103. The output of this oscillator is buffered by a cascade pair formed by TR104 and TR103 in receive, and TR102 and TR104 in Transmit, the supply to TR102 and TR103 being switched between the two modes. The output is also buffered by TR119 to the input of the synthesiser, IC105. The reference frequency at 9.6MHz is generated by TR119 and controlled by XTAL101. C200, C115 and R157 form the main loop filter with additional suppression of the reference frequency given by R179 and C204. The synthesiser is controlled from the control panel via a 3 wire serial interface.

Modulator. Audio from the control panel is amplified by IC104a. The gain of this stage is configured by R173 and C169 to give the signal pre-emphasis. The output of this stage is peak detected by D3 and detector TR116 to provide a gain control signal to TR117, to provide limiting of high level input signals. Temperature compensation of the limiter is provided by thermistor TH1. IC104b forms a high pass filter to meet the 14db/octave roll-off above 6kHz. The final output is fed to the modulation diode VC101 via gain control VR102, which is set to a maximum of 5kHz deviation.

Power Regulation and Switching. The 12Volt supply is switched on the front panel then feeds the audio amplifiers and regulators. The R.F. power module takes power before the switch to minimise voltage drops. Reverse polarity protection is provided by D104 and D105. A regulated 8V supply is provided by IC103 and 5V from IC107. The supply for receive and transmit circuits are switched by TR106 and TR110, controlled from the synthesiser via TR107 to TR109. IC105 controls the switching of PIN diode D103, ensuring that there is a suitably high reverse bias across it in the OFF condition.



E02955 Rx - Tx Circuitry Block Diagram

E02960 Control PCB Assembly.

The circuitry for this assembly is shown on drawing number E02958.

All the functions of the radio are controlled from this assembly by the microprocessor IC1. This microprocessor has its own clock controlled by XTAL1 at 4.096MHz. Reset generator IC5 ensures that the microprocessor starts up correctly, and resets under low voltage conditions. This microprocessor has an integral LCD interface driving the front panel display, LCD1. External controls consist of five push buttons, S1 to S5, rotary channel change switch CS1, and squelch control VR2. The level of illumination on the LCD and keypad is controlled by TR2 driving LED's LED1, LED5-9.

Configuration data and channel information is contained in the non volatile memory IC4. This interfaces to IC1 via a 4 wire serial interface shared with the synthesiser data to the Rx/Tx PCB assembly. Separate chip enables ensure that the data is routed correctly.

Volume control VR1 controls the level of audio in the loudspeaker. Amplifier IC4a boosts the level delivered to the handset earpiece. Individual mutes of the speaker and handset audio are provided by TR1 and TR3 respectively, under control of the micro. This reads the voltages on the squelch control and noise input from the Rx/Tx PCB and mutes the audio as appropriate. Additionally the state of the handset on the cradle is detected from SKT1 to mute the speaker when the handset is off cradle (optional).

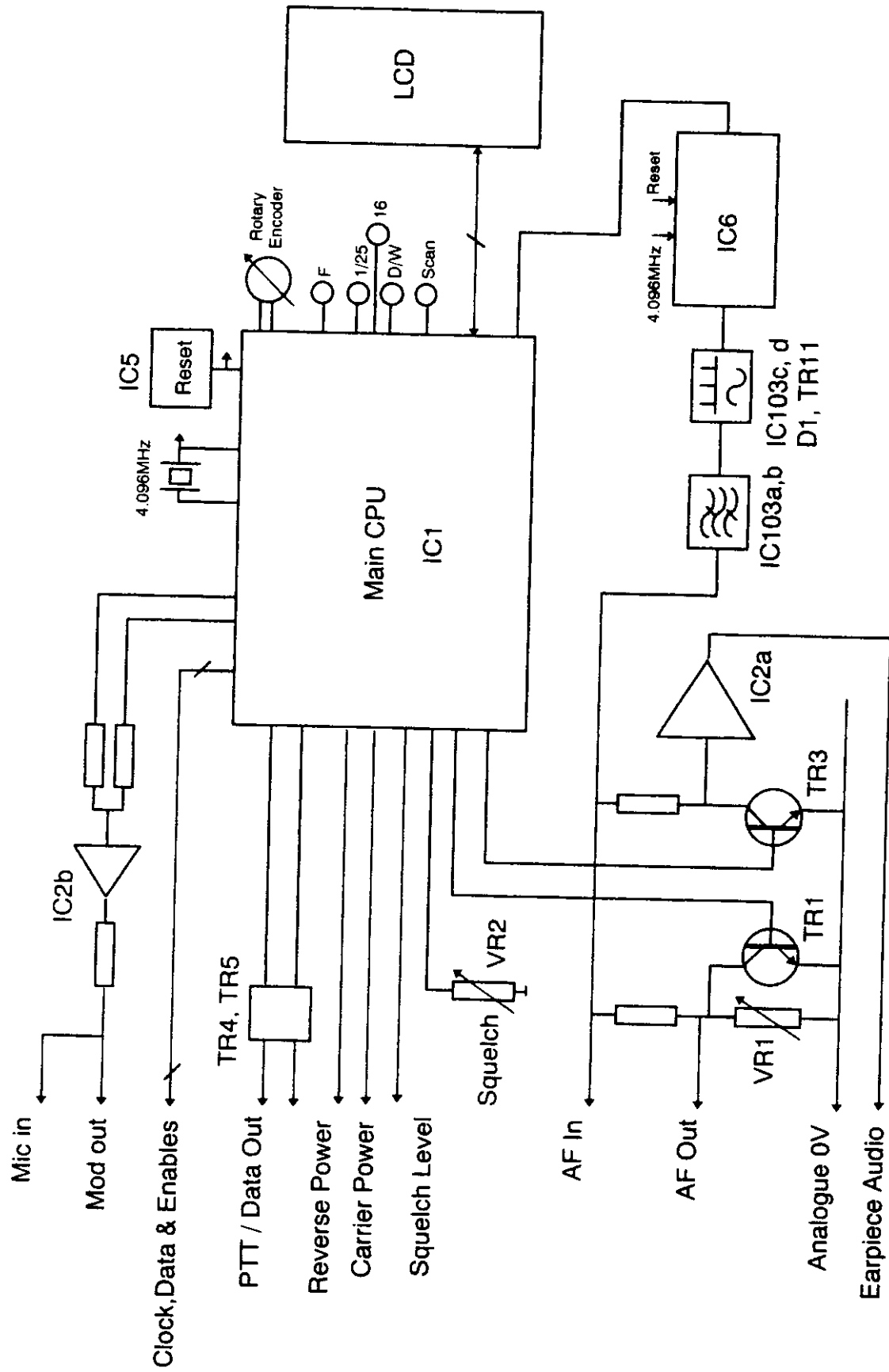
The handset interface is via connector SKT1. The microphone input is biased for use with Electret microphones and may be muted by TR6. The 12V output is current limited by TR7 and TR8. The cradle and PTT lines are additionally used for external data connections to a PC or third party accessories.

Additionally optional interfaces are provided for external programming and remote control (TR4 and TR5), ATIS generation (IC2b) and detection (IC3, IC6 and TR11) and alarm generation (TR9).

The ATIS signal is generated by the microprocessor, IC1, which produces a 2 bit (3 level) approximation of a sine wave at the correct frequency and baud rate. The two outputs are summed by R27, R43 and R30 before filtering by IC2b which forms a second order low pass filter. The output is then attenuated by R31 and R32 before summing into the microphone audio. Note that the microphone is muted by TR6 during transmission of the ATIS signal. The MMSI is held in the non volatile memory IC4 along with a control flag to enable ATIS generation.

The inclusion of IC6 allows the ATIS signal to be muted during reception. The received audio is filtered by IC3a and IC3b which are followed by a zero crossing detector formed by IC3c, IC3d, D1 and TR11. This signal is sent to a second microprocessor, IC6, which measures the period of each half cycle of the incoming signal. By counting the number of periods which might be an ATIS signal the micro can decide that ATIS is being received. When this decision is made, after about 10ms, IC6 sets an output to inform IC1 to mute the audio for

300ms. IC6 derives its clock from the main micro IC1 and the reset from IC5 via inverter TR10.



E02958 Circuit Block Diagram

Notes on completing the Axis RT Radio Configuration Form

There are many different options available for AXIS RT series radios. In order to help our Sales and Manufacturing functions deliver the correctly configured and labelled products to you, please complete and sign the enclosed form. **Note:** We need one form for each version or option that you require.

Section 1.

The first box should be self explanatory. The second box allows the choice of scan modes. Scan 16 alternate is the mode required in Scandinavia where channel 16 is scanned between each alternate channel. The normal output power of the AXIS RT radiotelephones is 25W. Please indicate if your requirement is different. The third box selects the channel configuration at power on. Where allowed the alternative (second) mode may be selected by holding depressed the Function (Lights) key when turning the radio on. This gives access to a default table of channels for USA or International mode. Not that if ATIS has been enabled in the primary mode it will be disabled when the secondary mode is selected.

Section 2.

Alternative start up and priority channels may be programmed in. Please specify if different to Channel 16.

Section 3.

To help us keep track of National variations in the standard channel plan (as specified in appendix 18 of the Radio Regulations) please complete this table carefully. Tick boxes - tick appropriate box if channel is required and if 1W and / or Rx only are required. [Normal International requirement allows all channels except 00, 29, 37, 70, 75, 76 and 89. Channels 15 and 17 are 1W only.]

Section 4.

Some countries have specific National channels. AXIS RT series radiotelephones can indicate these with a two digit legend. The available legends are:-

First digit 0 - 9, L, F, P, M, R and blank.

Second digit 0 - 9, L, F, R, Π, - and blank.

Please specify the legend and the associated frequency and attributes.

Section 5.

There are 10 private channels available in AXIS RT radios for individual customer requirements. If you require a permanent channel not covered by the international or Auxiliary channel tables please specify. Specify *either* Rx and Tx frequency *or* Channel No. and Simplex / Duplex. Additionally tick the '1W only' box if required.

Section 6.

Please indicate hardware options required and whether a fist mike or handset is to be supplied with the radio. Note that if ATIS is enabled and the second mode is selected by the user no ATIS identifier will be sent.

Section 7.

We need you to supply us with your National type approval reference number and where known the type approval specification number. Alternatively, if it is intended to sell AXIS RT in a country known to accept type approval from another country, that information should be supplied. Failure to supply this information will result in radios being supplied, labelled as unapproved.

Note: If there are any special labelling requirements for your Axis radios please detail them on a separate sheet.

Warning: This document should be signed by a senior member of your company. Please note that this will be used as the reference document. Any errors in completing the form which require Navico to rework radios due to wrong information may incur a charge.

Navico Axis RT Radiotelephone Configuration Form

Distributors Name	Various
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Country(s) for Intended Sale	USA
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1. Radio Type - Tick one box only. Use copies of forms for each radio variant.

Model	
RT1200	✓
RT1400	
RT1600	

Non-Scan	
Scan	✓
Scan 16 Alternate	

Max Power Output	
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(normally 25W)

Operating Mode		
First Mode	Second Mode	
As per Configuration	Disabled	
As per Configuration	USA	
As per Configuration	International	✓

2. Enter alternative channel if required.

Start-up Channel	16	✓
Priority / Dual Watch Channel	16	✓

3. Tick as required

No.	✓	Rx(only)	1W(only)	No.	✓	Rx(only)	1W(only)	No.	✓	Rx(only)	1W(only)
				20	✓			69	✓		
01	✓			21	✓						
02				22	✓			71	✓		
03	✓			23	✓			72	✓		
04				24	✓			73	✓		
05	✓			25	✓			74	✓		
06	✓			26	✓						
07	✓			27	✓						
08	✓			28	✓			77	✓		
09	✓							78	✓		
10	✓							79	✓		
11	✓			60				80	✓		
12	✓			61	✓			81	✓		
13	✓			62				82	✓		
14	✓			63	✓			83	✓		
15	✓		✓	64	✓			84	✓		
16	✓			65	✓			85	✓		
17	✓		✓	66	✓			86	✓		
18	✓			67	✓			87	✓		
19	✓			68	✓			88	✓		

Navico Axis RT Radiotelephone Configuration Form

4. Auxiliary Channels

Legend	Channel (Tx) Frequency	Simplex / Duplex	1W only	Rx only

5. Standard Private Channels as required.

No.	Rx Frequency	Tx Frequency	Channel No.	Simplex / Duplex	1Watt Only
P0					
P1					
P2					
P3					
P4					
P5					
P6					
P7					
P8					
P9					

6. Select hardware options

ATIS (with Killer)	☐
Class F integral DSC	☐

Fist Mike	☒
Telephone Handset	☒

I understand that the integral class F DSC option does not conform fully to IMO and ITU-R requirements.

7. Please enter the following information

Type Approved To

CFR 47 part 80

Type Approval No.

TBD

Does the above information fully meet National and International Regulations?



	Sign	Print	Date
Completed By	D C Sheekey		23/10/98

For office use only

Order Code		Bar Code No.		EAN / UPC
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