

Technical Manual
For
HF SSB Radiotelephone
Type GRC-102

MILCOM
ELECTRONICS

**TECHNICAL MANUAL
FOR
HF SSB RADIOTELEPHONE TYPE GRC-102**

Contents

CHAPTER 1	GRC-102 TRANSCEIVER
CHAPTER 2	MAIN FRAME
CHAPTER 3	RECITER
CHAPTER 4	FREQUENCY PROCESSING UNIT
CHAPTER 5	HARMONIC FILTER
CHAPTER 6	CONTROL LOGIC
CHAPTER 7	POWER AMPLIFIER
CHAPTER 8	POWER SUPPLY
CHAPTER 9	EXTENDED (AUDIO) CONTROL UNIT (ECU)

CHAPTER 1
GRC-102 TRANSCEIVER

Contents

	Paragraph
GENERAL DESCRIPTION	1
Operating Modes	4
Intercom Facilities	5
Monitoring	6
Antennas	7
SPECIFICATION	9
CONSTRUCTION	10
POWER SUPPLIES	13
INSTALLATION	15
Location	17
Primary Power Connections	21
Accessory Connections	24
Antenna Systems	28
Noise Suppression in Mobile Stations	37
OPERATING INSTRUCTIONS	42
Normal (Synthesised) Mode	43
Frequency Agile (Hopping) Mode	46
Remote Control	49
Extended Control	50
Intercom Facility	51

Tables

	Table No.
Specifications	1
GRC-102 Assemblies	2
Control and Indicators	3

Illustrations**Figure No.**

Transceiver : General View	1
Installation Details : Mobile Station	2
Accessory Connections	3
Single Frequency Half Wave Dipole	4
Single Frequency Centre Fed Inverted V	5
Multiple Frequency Centre Fed Inverted V	6
Mobile Station : Wire Antenna With Counterpoise	7
Mobile Station : Whip Antenna + ATU	8

GENERAL DESCRIPTION

1. The GRC-102 is a rugged, reliable, integrated Transceiver equipment capable of providing HF SSB communications in the 1.6MHz to 30MHz frequency range.
2. Synthesised frequency control is available through two optional units designated SR-102 and KY102.

(a) **Synthesiser SR-102**

The SR-102 enables the radio to operate on 28 400 channels. These channels have increments of 1kHz. A VFO facility is incorporated which permits the frequency of any selected channel to be varied over $\pm 500\text{Hz}$.

(b) **Frequency Processor Unit KY102**

The Frequency Processor Unit which is capable of providing all the facilities available with the Synthesiser includes a microprocessor system which enables the operating frequency to be varied in a pseudo-random manner. The bandwidth within which 'frequency-hopping' occurs is preselected. The rate of hopping and frequency selection is controlled by the microprocessor. The frequency hopping sequence is determined by a 6-digit code applied to the microprocessor.

3. Communication between GRC-102 Transceivers incorporating KY102 Frequency Processing Units and other equipments having compatible 'frequency hopping' facilities, and which are operating in the hopping mode, is only possible when identical codes are applied to the frequency processors and the microprocessor systems are running in synchronism. KY102 Frequency Processing Units are therefore fitted into GRC-102 Transceivers comprising a radio network to provide 'secure' communications. Synchronisation of microprocessor systems is achieved through a simple operating procedure.

OPERATING MODES

4. The operating modes available are:

(a) **KEY (CW) (always in transmit condition)**

The Transceiver is permanently switched to transmit. The system operates in a suppressed carrier mode until it is keyed, when an internally generated 1kHz SSB tone is transmitted. This tone may be monitored at the Transceiver loudspeaker or by means of a Front Panel connected handset or phone unit. The sideband employed, upper or lower, is selected at the USB/LSB switch.

(b) **BK IN KEY (break in CW)**

The Transceiver is in the receive mode until the CW key is depressed, when the system is switched to transmit. The equipment then operates in a similar manner to that previously described for CW, ie. a 1kHz tone is transmitted whilst the CW key is depressed. The system however returns to the receive mode after a 1s break in keying operations. The sideband employed is selected at the USB/LSB switch.

(c) **SSB**

The Transceiver is switched between the transmit and receive modes by operations of the local handset p.t.t. switch to transmit and receive SSB signals. The sideband employed is selected at the USB/LSB switch.

(d) AM

The Transceiver operates as described for (c) to transmit and receive AM compatible signals.

This mode is not available when operating the Transceiver in a frequency hopping network. Should a Frequency Processing Unit FUNCTION switch be set to FAM (and synchronisation within a network achieved) when the AM mode has been selected, AM is inhibited and the Transceiver operates in the SSB mode.

(e) TUNE

When the TUNE mode is selected the TUNE INITIATE circuit is taken to 0V and a tuning sequence commences. The Transceiver operates in the transmit mode to generate a nominal 25W output from the internal 1kHz tone oscillator. This is used in an external antenna tuning unit.

(f) REMOTE

A remote operator controls the Transceiver functions listed below by means of a remote control system comprising Remote Control Units Type RC102/1 and RC102/2.

- (i) Selection of SSB and AM operational modes
- (ii) LSB or USB selections
- (iii) Frequency selection
- (iv) Initiation of tuning sequences
- (v) PTT switching

The following controls are not accessible to the remote operator:

- (vi) SQUELCH
- (vii) VFO
- (viii) INTERCOM
- (ix) METER

Should the Transceiver incorporate an FPU, frequency agile mode functions are not available to the remote operator.

INTERCOM FACILITIES

5. In some radiotelephone station applications provision is made for the extended control of audio transmission and reception functions through an Extended (Audio) Control Unit. Intercom facilities are then required between the local and remote operators. These facilities, described in the following paragraphs, are made available by the INTERCOM switch.

(a) LOCAL

The GRC-102 is controlled by the local operator. The receiver audio output is switched via the INTERCOM switch to the intercom audio amplifier, the output of which is transformer coupled to an ECU. The remote operator may then switch his unit to OPERATE to monitor all traffic. The remote operator is also able to call the operator of the GRC-102 by depressing his PTT switch. The transceiver 'bleep tone' generator is then initiated and the front panel INTERCOM lamp is illuminated.

(b) CALL

When the 'CALL' position is selected a 1kHz tone generated in the intercom circuits is received in the ECU in both the STAND BY and OPERATING modes.

(c) INTERCOM

The local and remote operators are able to communicate through the intercom HMT, audio amplifier and Reciter L/S without interrupting normal traffic.

(d) EXTN

The remote operator controls the GRC-102 in SSB and, where applicable, AM modes when operating with audio signals only.

MONITORING**Front Panel Meter**

6. Control panel monitoring is provided by means of a meter and a METER input switch. When the GRC-102 is in the receive mode the switch is rendered inoperative and the meter automatically functions as an 'S' meter to provide an indication of received signal strength. The following functions are selected for monitoring when the Transceiver is in the transmit mode, ie. p.t.t. operated. The METER switch is spring loaded to FORWARD.

(a) Supply

The meter indicates the state of the power supply.

The meter should read 3/4 full scale deflection (+24V) and not flick down to more than half scale with modulation. The reading must remain in the GREEN band.

(b) Forward

The meter indicates the forward power fed to the antenna system.

The meter should flick up to approximately 3/4 full scale deflection with speech modulation on S.S.B.

(c) Reflected

The meter indicates the power reflected by the antenna.

The meter should remain near zero with speech modulation on S.S.B.

Fault Indications

7. Fault indications are provided by front panel OUT OF TUNE and FREQ ERROR indicators and a bleep tone.

(a) Out Of Tune

(i) The indicator flashes if the VSWR on the PA is too high.

(ii) The indicator is only continuously illuminated when the GRC-102 is operating with an Antenna Tuning Unit Type URA-602.

The conditions that cause the indicator to be illuminated are:

Interrupted power supply

Frequency changes greater than 10kHz

WHEN THE INDICATOR IS ILLUMINATED A TUNE SEQUENCE MUST BE INITIATED

THE LAMP IS THEN EXTINGUISHED

(b) Freq Error

The FREQ ERROR indicator is illuminated when a frequency selection is not admissible, ie, out of the GRC-102 frequency range.

(c) Bleep-Tone

Two bleep-tone warnings are generated, continuous and interrupted, the function of which are:

(i) **Continuous**

A continuous tone is generated and the INTERCOM lamp is illuminated when the GRC-102 is called from an extended control position.

(ii) **Interrupted**

An interrupted tone is generated if the power supply falls below a predetermined level or if it fails completely. The low-voltage warning is generated continuously and the power failure warning is momentary.

ANTENNAS

7. The GRC-102 was designed to operate with a load impedance of 50 ohms. An internal filter unit enables tuned 50/75 ohm antennas such as dipoles, log periodics etc. to be connected directly to the Transceiver.

Antenna Tuning Unit Type URA-602

8. If a non-resonant antenna, or an antenna having an insufficient bandwidth, is used, eg. whip or capacity top, an URA-602 Antenna Tuning Unit may be used. The URA-602 which is available as an extra, is an automatic, high-speed, digital coupler which transforms the antenna impedance to 50 ohms and tunes out the reactance.

SPECIFICATION

9. Nominal electrical and physical specifications are given in Table 1.

CONSTRUCTION

10. The GRC-102 which is a modular construction, comprises the assemblies listed in Table 2.

11. All the units with the exception of the Synthesiser are mounted on the Main Chassis. The Synthesiser unit fitted is located in the Reciter; being introduced through a rectangular slot in the Reciter front panel.

12. The Main Chassis assembly carries the major wiring cable forms and provides interconnections between sub-assemblies. (Refer to Chapter 2 Figure 2: System Block Diagram). External connections are made via connectors on the Reciter front panel, the Power Supply Unit and the Main Chassis as illustrated.

POWER SUPPLIES

13. The Transceiver primary power requirements (+24V d.c. and +12V d.c.) are derived from an 230V/115V, 50Hz/60Hz source for normal (fixed station) operation and/or from a +24V battery under emergency conditions. The circuit was designed to enable the battery, which is trickle charged during normal operation, to automatically provide power at a.c. failure.

14. For mobile installations a +24V battery is used.

INSTALLATION

CAUTION

Do not attempt to operate the GRC-102 until all installation operations have been completed as the unit may be damaged by improper power sources.

- 15.
15. Installation consists of mounting the GRC-102 in a suitable location, providing an antenna and making connections for various ancillary equipments. Refer to Fig. 2 for details of mobile installation space requirements.
16. If an URA-602 Antenna Tuning Unit is to be used the technical manual for that unit should be consulted for information relating to the installation of non-resonant antennas.

LOCATION

17. Instructions relating to fixed and mobile applications are given.

Fixed Station

18. When installing the following points should be noted.
 - (a) The GRC-102 should be placed on a table or a desk in a position convenient to the antenna lead in.
 - (b) If a lead-acid battery is used, and this battery is to be re-charged in situ, the battery and charging equipment must be well ventilated. The GRC-102 must be sited where it is free from acid fumes.
 - (c) Power, antenna and audio leads must be kept as far apart as possible.
 - (d) An earthing switch should be fitted so that the antenna can be connected directly to earth when the radio is not in use.
 - (e) In areas susceptible to thunder storms lightning arresters should be fitted to the antenna. If gas-filled r.f. spark-gap arresters are used the d.c. striking voltage must be sufficiently high to prevent flash-over during normal operation. A striking voltage of 2000V is recommended.
19. When selecting a site for a fixed station the following aspects relating to the location of the associated antenna must be considered.
 - (a) Antenna system coaxial feeder cables should be kept as short as possible (less than 60m).
 - (b) Radio signals may be absorbed by localised obstructions such as hills, trees, metal buildings and telephone or power lines.
Optimum propagation is achieved from the top of a hill over level ground or water.
 - (c) Interference fields arising from nearby power lines, radar transmitters, neon or flashing signs, or electrical motors should be avoided.
 - (d) Longwire and vertical whip antennas require an adjacent good electrical ground connection. This is best provided by moist ground.

Mobile Station

20. When the GRC-102 is incorporated into a mobile station the transceiver is normally operated with a whip antenna. This necessitates the inclusion of an URA-602 Antenna Tuning Unit into the system. Refer to the URA-602 technical handbook for installation details.

PRIMARY POWER CONNECTIONS

21. The primary power is derived from a 230/115V, 50/60Hz and/or 24V d.c. (battery source). Instructions for the connection of both a.c. and d.c. are given.

AC Power Supply

22. The Power Supply Unit Operates from either 115V, 50/60Hz, or 230V, 50/60Hz. The voltage selector, located at the rear of the GRC-102 must be set to the value of the local a.c. supply. The value of the fuse fitted in the PSU (at the rear of the GRC-102) for 115V and 230V operation is as follows:
- | | | |
|------|---|-----|
| 115V | : | 10A |
| 230V | : | 5A |

DC Power Supply

23. The battery leads supplied with the GRC-102 are of optimum length and diameter. If alternative cables are used the total resistance of both conductors must not exceed $0,007\Omega$ and must not produce a voltage drop greater than 0,25V at 35A. Connect these leads to the plug at the rear of the GRC-102. The other ends of the leads are connected to the battery, care being taken to observe correct polarity. The +ve lead should be fuse protected (20A) adjacent to the battery.

ACCESSORY CONNECTIONS

24. Refer to Figure 3.
25. Microphone, handset, headset and key units are connected to the GRC-102 via the two front panel AUDIO sockets. The connections provided by these sockets, which are wired in parallel, are:

PIN A	:	MIC
PIN B	:	PTT
PIN C	:	COMMON
PIN D	:	PHONES
PIN E	:	KEY
PIN F	:	Not Used
PIN G	:	Not Used
PIN H	:	Not Used

Headset units incorporating jack plug terminations may also be connected to the transceiver using the control panel PHONES socket.

26. The intercom handset is connected at the front panel INTERCOM socket. The connections provided are:

PIN A	:	MIC (INTERCOM)
PIN C	:	COMMON (INTERCOM)
PIN D	:	PHONES (INTERCOM)

The ECU used in extended control applications, located at a distance of up to 1,5km, is connected to two screw terminals on the rear panel of the transceiver via twisted telephone wires. FSK units are also connected using the INTERCOM socket. The connections are as follows:

PIN G	:	FSK RX
PIN H	:	FSK TX

27. Remote control and antenna units are also connected to the GRC-102 via rear panel sockets. Refer to the relevant technical handbooks for details.

ANTENNA SYSTEMS

General Information

28. The antenna used depends, to a large extent, upon the application in which the radio is to be employed.
29. The GRC-102 is designed to provide optimum performance when connected to a broad-band antenna (or antenna system) having a 50Ω impedance and operates quite satisfactory with caged dipoles, or log periodics, etc. In this instance the antenna feeder is connected directly to the rear panel ANTENNA socket. If an antenna having any impedance other than 50Ω is to be used, eg. whip, long or short wire, a URA-602 Antenna Tuning Unit must be included in the system. The antenna is then connected to the URA-602 which is, in turn, connected to the radio.
30. Resonant antennas such as dipoles operate over a very narrow frequency band. Consequently antenna lengths are normally set to suit a specific frequency, although multiple frequency arrays may be assembled. This antenna is more efficient than a whip or short-wire antenna.
31. Broad-band antennas can provide operation over most of the HF band and are suitable for use with stations having a limited space for erection of antenna arrays.
32. Horizontal antennas are, generally, better suited for long-distance, sky-wave propagation than vertical or whip antennas. When they are used they should be sited so that the line of the antenna is approximately at 90° to the direction of the receiving station.

Precautions

33. When installing an antenna the following rules should be observed:
- A nominal antenna height of 13m is used.
 - The antenna must be properly insulated at all supporting points.
 - All connections should be soldered.
 - Periodic checks must be made of the installation to see if insulators are broken, supports have collapsed, joints have corroded, etc.

It is also important to remember that the ground (or counterpoise) used with an antenna system is as much a part of the system as the antenna itself.

Suitable Antenna Systems

34. Figures 4, 5 and 6 illustrate antenna systems that may be used for fixed station applications.
35. Figures 7 and 8 illustrate antenna systems that may be used for mobile station applications.
36. The physical length of half-wave dipoles may be calculated for fixed frequency working, using the following formula

$$\text{Length in metres} = \frac{142,6}{\text{Frequency (MHz)}}$$

NOISE SUPPRESSION IN MOBILE STATIONS

37. The ability of a mobile radio station operator to receive weak signals can be seriously impaired by 'noise' generated within the vehicle. Some methods of eliminating noise, which may be categorised as radiated noise or power supply noise, are discussed in the following paragraphs.

38. Noise may be identified as follows:

- (1) Switch off the vehicle motor and disconnect the antenna.
If noise is present it is due to ripple or voltage transients on the power supply.
- (2) Connect the antenna but do not start the vehicle motor.
If noise is introduced it is due to radiation from sources other than the vehicle motor.
- (3) Start the vehicle motor.
If noise is introduced it is due to radiation from the motor electrical system.

Radiated Noise

39. **Ignition noise.** This is a sharp staccato noise and the frequency at which it occurs varies with engine speed. This type of noise can be generated by spark plugs, distributors, coils and arcing in high voltage wiring. The following steps should eliminate such noise.

- (1) If the vehicle does not have resistor plugs they should be fitted.
- (2) If the vehicle does not have a resistance lead from the coil to the centre of the distributor, install a plug-in resistor of the type made for this purpose.
- (3) If resistance wiring is used, check that breaks have not occurred in the conductor path. If arcing occurs, due to breaking, replace the lead.
- (4) Check the distributor points and condenser. Ensure they are in good condition.
- (5) Check the timing and adjustment of distributor points.
- (6) Clean dirt and grease from spark plug insulators. Check that the spark plugs are in good working order.
- (7) Install a $0,5\mu\text{F}$ coaxial bypass capacitor between the ignition coil battery lead and ground.
- (8) Make sure that the ignition coil case has a clean connection to the engine block.

40. **Generator/Alternator noise.** This is characterised as a high pitched noise which varies in frequency with engine speed. This may be eliminated as follows:

- (1) Bypass the generator armature terminal to ground using a $0,5\mu\text{F}$ feedthrough capacitor having a current rating compatible with the vehicle charging system. The capacitor should be mounted on the generator case. Maintain the lead from the armature to the capacitor as short as possible.

CAUTION

Do not by-pass the generator field terminal as this may result in damage to the voltage regulator contacts.

- (2) If the vehicle electrical supply is provided by an alternator install a special-to-type coaxial by-pass capacitor. Follow the manufacturers instructions.
- (3) Install a 5Ω resistor in series with a $0,002\mu\text{F}$ capacitor between the voltage regulator field terminal and ground.
- (4) By-pass the regulator battery and armature leads to ground using $0,1\mu\text{F}$ ceramic disc capacitors.

Power Supply Noise.

41. The following precautions should be taken to minimise this noise.

- (1) Battery leads should be connected directly to battery posts.
- (2) The power cable should be routed as far as possible away from high voltage wiring.

- (3) The power cable should be of heavy gauge wire and as short as possible.
- (4) The battery should be kept in good condition.

OPERATING INSTRUCTIONS

42. Instructions relating to NORMAL (SYNTHESISER) and FREQUENCY AGILE (HOPPING) modes are given together with remote control, extended control and use of the intercom facility. All operator controls and indicators are located on the Reciter and Synthesiser front panels. These are described in Table 3.

CAUTION

Before attempting to operate the set, thoroughly read and understand these instructions.

NORMAL (SYNTHESISED) MODE

43. The procedures detailed below have been subdivided for use when operating with resonant (50Ω) and non-resonant antennas, and with extended and remote control.

Using Resonant (50Ω) Antenna Connected Directly To GRC-102.

44. Proceed as follows:

(1) Set the front panel controls as follows:

POWER	-	OFF
INTERCOM	-	LOCAL
SPEAKER	-	RECEIVE
Meter	-	FORWARD (spring loaded)
Mode	-	KEY, BK IN CW, SSB or AM (as required)
USB/LSB	-	as required
RF ATTENUATOR	-	0dB
SQUELCH	-	OFF
RF GAIN	-	fully clockwise
AUDIO	-	centre position
FREQUENCY	-	as required
VFO	-	OFF

(2) Connect the GRC-102 to a suitable supply.

- (a) WHEN CONNECTING AC CHECK THAT SELECTOR SWITCH IS TO THE CORRECT SETTING, IE. 115V or 230V.
- (b) WHEN CONNECTING DC CHECK THAT THE VOLTAGE AND POLARITY IS CORRECT.

(3) Connect a microphone or telephone handset to one of the two front panel AUDIO input sockets.

(4) Set the POWER switch to ON.

- (5) Adjust the AUDIO control to obtain a comfortable listening level.

The GRC-102 is now ready to operate in the mode selected.

Using Non-Resonant Antenna Connected To The Radio Via URA-602 Antenna Tuning Unit

45. Proceed as follows:

- (1) Set the front panel controls as detailed in Paragraph 44 (1).
- (2) Perform the operations detailed in Paragraph 44, Steps (2) and (3).
- (3) Set the POWER switch to ON.
Note the OUT OF TUNE indicator.
This should be illuminated.
- (4) Set the MODE switch to TUNE and hold in this position until the indicator is extinguished.
When this occurs return the MODE switch to the required mode.
Note This action must be taken whenever the OUT OF TUNE indicator is illuminated.
The GRC-102 is now ready to operate in the mode selected.

FREQUENCY AGILE (HOPPING) MODE

46. The additional procedures required to operate the radio in hopping modes are given in the following paragraphs:

47. **Frequency Agile (Hopping) Mode – Slave**

- (1) Set FUNCTION switch to RESET and then to FAM.
- (2) Observe that orange ON LED illuminates.
- (3) Select required operating frequency on FREQUENCY selection switches.
- (4) Select required code on CODE switches.
- (5) Wait for the green SYNC LED to illuminate.
This occurs when the Synthesiser has been synchronised by a sync signal transmitted from the master.

48. **Frequency Agile (Hopping) Mode – Master**

- (1) Set FUNCTION switch to RESET and then to FAM.
- (2) Observe that orange ON LED illuminates.
- (3) Select required operating frequency on FREQUENCY selection switches.
- (4) Select required code on CODE switches.
- (5) Momentarily select the SYNC position of the FUNCTION switch and observe the green SYNC LED.
When this illuminates the Synthesiser frequency is hopping and all slave stations in the net are frequency hopping in synchronism.

NOTE: If it is required to revert to the NORMAL mode of operation from the HOPPING mode but to remain synchronised with the remainder of the net, set the FUNCTION switch to the OFF position. The green SYNC LED then remains illuminated but the orange ON LED is extinguished. (The only method of taking the micro-processor out of its hopping sequence is to return the FUNCTION switch of the RESET position).

REMOTE CONTROL

49. (i) Set the MODE switch to REMOTE

The Transceiver functions listed below are now available to a remote operator via Remote Control Units Type RC102/1 and RC102/2.

- (ii) Selection of SSB and AM operational modes
- (iii) LSB or USB selection
- (iv) Frequency selection
- (v) Initiation of URA-602 antenna tuning sequences
- (vi) PTT switching

Refer to the RCU handbook for operating instructions.

NOTE Should the Transceiver incorporate an FPU, frequency agile mode (FAM) functions are not available to a remote operator.

EXTENDED CONTROL

50. Extended control of the radio may be exercised through an Extended Control Unit. The procedure used with a transceiver ready for operation is as follows:

- (1) Set the SPEAKER switch to INTERCOM.
- (2) Set the INTERCOM switch to EXTN.
- (3) Set the ECU switch to REMOTE.

The ECU operator is now able to listen to received signals.

To transmit the ECU operator depresses his handset p.t.t. switch and speaks into the microphone.

The local operator is able to monitor radio traffic.

INTERCOM FACILITY

51. Intercom facilities between the local (Transceiver) operator and the remote (ECU) operator are available as follows:

- (1) Set the SPEAKER switch to INTERCOM.
- (2) Set the INTERCOM switch to CALL.
An audio signal, nominally 1 kHz is generated to alert the remote operator.
- (3) Set the INTERCOM switch to INTERCOM.
Wait for the remote operator to reply.

Note : When the remote operator receives a call signal he switches his OPERATE/STANDBY switch to OPERATE, presses his HMT p.t.t. switch and speaks into the handset microphone.

This should be heard on both the loudspeaker and the intercom HMT handset.

Communication between the local and remote positions may be maintained through the INTERCOM handsets without interrupting signal traffic flow.

- (4) Set the INTERCOM switch to LOCAL and the SPEAKER switch to RECEIVE.

Note : The local operator can now be called from the ECU. When the remote operator's p.t.t. switch is depressed a 'bleep-tone' is generated at the radio and the red indicator adjacent to the SPEAKER switch is illuminated.

TABLE 1 SPECIFICATIONS

GENERAL

Frequency Range : 1,6MHz to 29,999MHz in 1kHz steps with full interpolation (VFO) facility

Operating Modes : J3E - SSB Telephony (USB/LSB)
 A2A - CW Telegraphy
 A3E - AM Telephony

Environment

(a) Temperature : -10°C to $+55^{\circ}\text{C}$
 (b) Relative : 95%
 (c) Storage Temperature : -40°C to $+70^{\circ}\text{C}$

Note The GRC-102 is not damaged by moisture resulting from dewing. The operation of the radio may, however, be impaired. It is therefore recommended that it should be thoroughly dried before operational use or testing.

Power Supplies

(a) AC : 200V to 250V, 45Hz to 60Hz : 100V to 125V, 45Hz to 60Hz
 (b) DC : +24V d.c.

Antenna Impedance : 50Ω nominal (unbalanced)

Dimensions

Height : 178mm
 Depth : 400mm
 Width : 425mm

TRANSMITTER

Power Output (into 50Ω)

SSB : 100W PEP $\pm 1\text{dB}$ broadband
 CW : 100W $\pm 1\text{dB}$ broadband
 AM : 25W $\pm 1\text{dB}$ broadband

Harmonic Emission : 2nd harmonic -50dB relative to maximum power output

Spurious Emission : Spurious emissions separated from the carrier by more than 20kHz are attenuated by at least -40dB relative to maximum available output power.

Carrier Suppression : -40dB relative to maximum available output power

Unwanted Sideband Suppression : -40dB relative to maximum available output power at 1kHz

Intermodulation Products (Outband) : 3rd order products better than -32dB relative to one of two tones (600Hz and 2kHz) on a two tone test at rated output power

Transmitter Noise : -40dB relative to maximum available output power when switched to local and -ve ground.

- Microphone Sensitivity** : 2mV p.d. to 8mV p.d. for maximum available power output -5W
- Speech Processing** : On a 2-tone test (850Hz and 1000Hz) with a 30mV p.d. audio frequency input, the output power is more than 70% of the power output with a 30mV p.d. single tone input.
- Power Required (230V a.c.)** : SSB, CW full power output - typically 1,5A.

RECEIVER

- Sensitivity**
SSB and CW : 3 μ V e.m.f. RF input from a 50 Ω source (with VOLUME control to maximum) results in the following:
 (i) Into LOUDSPEAKER (6 Ω)
 Minimum 1W
 (ii) Into HEADPHONES (300 Ω)
 Minimum 2mW
 A maximum of 10% distortion is permissible.
- Automatic Gain Control**
SSB and CW : 3 μ V e.m.f. to 1mV e.m.f. input - less than 3dB change in audio output
AM : 10 μ V e.m.f. to 100mV e.m.f. input, 30% modulated by 1 kHz, from a 50 Ω source - less than 6dB change in audio output. At temp. limits - less than 10dB change in audio output
- Selectivity**
SSB and CW : 2,2kHz minimum at -6dB relative to 1kHz
 4kHz maximum at -40dB relative to 1kHz
AM : 5kHz minimum at -6dB relative to 1kHz
 24kHz maximum at -40dB relative to 1kHz
- Audio Frequency Response (SSB)**
Lower Limit : 350Hz \pm 100Hz at -6dB relative to 1kHz
Upper Limit : determined by bandwidth which is added to lower limit
- Signal-to-Noise Ratio**
SSB : 1 μ V e.m.f. from a 50 Ω source for 10dB (S + N) / N minimum
AM : 5 μ V, 30% modulated from a 50 Ω source for 10dB (S + N) / N minimum
- Spurious Signal Attenuation**
Image Rejection SSB, AM : -80dB
IF Rejection : -80dB
Spurious Rejection : SSB -70dB
 (Single tone test external) : AM -70dB
Intermodulation Outband (with 0dB attenuation) : SSB -70dB below 1 μ V reference.
Intermodulation Inband : With a RF input less than 1mV e.m.f. and an audio output less than 1mV into 300 Ω the inband intermodulation products are less than -26dB

Reciprocal Mixing : SSB 70dB below 1 μ V reference
(20kHz off carrier)

Power Required : Typically 200mA.
(230V a.c.)

SR102 SYNTHESISER

Frequency Stability : Locked (TCXO) – within 2 p.p.m. of frequency
(Ageing excluded)

Interpolate (5MHz) crystal – within 300Hz of selected frequency

Interpolation (VFO)

Tx and Rx simultaneously : Range \pm 500Hz minimum
Channel frequency : to be within \pm 45° of mechanical centre

KY102 FREQUENCY PROCESSING UNIT

As above plus the following

Frequency Setting : 1,6MHz plus frequency dispersion width, to 30MHz
(In Hopping mode)

Frequency Dispersion Width : According to customer requirements.

Dwell Time plus Settling Time : 200ms
(Internally Programmable)

Code Setting : 10⁶ combinations via a 6-digit front panel selector

Interpolate (VFO) : Functional in RESET and OFF positions of FUNCTION switch only

TABLE 2		GRC-102 ASSEMBLIES	
Module	Sub-Assemblies		
RECITER	Reciter p.c.b. Balanced Modulator Intercom Decoding Logic PCB Loudspeaker Switch PCB Low Pass Filter RF Attenuator PCB Decoupling PCB		
SYNTHESISER (2 options available) SR102 KY102	Synthesizer p.c.b. Integrator Diode p.c.b. Decoupling p.c.b. Synthesizer p.c.b. Integrator Generator p.c.b. Code Switch p.c.b. Frequency Switch p.c.b. Decoupling p.c.b.s		
POWER AMPLIFIER	Power Amplifier p.c.b.		
MAIN CHASSIS/AAMTU	Harmonic Filter PCB Control Logic PCB Interface PCB ECU Decoupling PCB		
POWER SUPPLY	Mains Decoupling PCB Switch Mode PCB Capacitor Interconnection PCB		

TABLE 3: CONTROLS AND INDICATORS		
Location	Control/Indicator	Function
RECITER CONTROL PANEL	MODE	<p>Selects operating modes as follows:</p> <p>(a) REMOTE</p> <p>The following functions are controlled by remote operator.</p> <ul style="list-style-type: none"> (i) Selection of SSB and AM modes (ii) LSB or USB selection (iii) Frequency selection (iv) Initiation of ATU tuning (v) PTT switching <p>(b) KEY</p> <p>The radio is held in a suppressed carrier transmit mode until it is keyed, when a 1kHz SSB tone is transmitted.</p> <p>NOTE..... If the 'key-down' condition is maintained for any length of time forced air cooling of the P.A. stages is required.</p> <p>(c) BK IN CW</p> <p>The radio operates in the receive mode until the CW key is operated when it is switched to transmit. The Transceiver returns to receive 1s after keying operations are terminated.</p> <p>(d) AM</p> <p>AM is inhibited in radios fitted with KY102 Synthesiser when operating in the hopping mode.</p> <p>(e) SSB</p> <p>USB or LSB selected at sideband selector.</p> <p>(f) TUNE</p> <p>The radio is switched to transmit, generating a 25W, 1kHz SSB output for use during ATU tuning sequences.</p>
	INTERCOM	<p>This switch is used when operating in conjunction a Extended Control system to select the intercom facilities described below:</p>

TABLE 3 (Cont.)		
Location	Control/Indicator	Function
		<p>(a) LOCAL</p> <p>The radio operator controls the Transceiver. The remote operator is able to monitor all traffic.</p>
		<p>(b) CALL</p> <p>1kHz call tone, generated in the radio is received at the extended control position.</p>
		<p>(c) INTERCOM</p> <p>The local and remote operators are able to communicate without interrupting normal radio traffic.</p>
		<p>(d) EXTN</p> <p>The remote operator is able to use the radio when it is operating in audio transmission modes. The local operator monitors all traffic.</p>
	SPEAKER	<p>The three positions of this switch, when used in conjunction with the INTERCOM control, provide the local operator with loudspeaker monitoring facilities as follows:</p>
		<p>(a) RECEIVE</p> <p>Incoming signals are monitored in the normal manner. Remote transmissions are monitored using an intercom handset.</p>
		<p>(b) OFF</p> <p>The loudspeaker is switched 'off'. Handset and headphones are still operative.</p>
		<p>(c) INTERCOM</p> <p>Extended Control System audio is monitored. The radio output is to the local H.M.T.</p>
	RF ATTENUATOR	<p>Received r.f. signal input attenuation levels of -30dB, -20dB, -10dB, 0dB are available. Attenuation is used when receiving strong signals.</p>

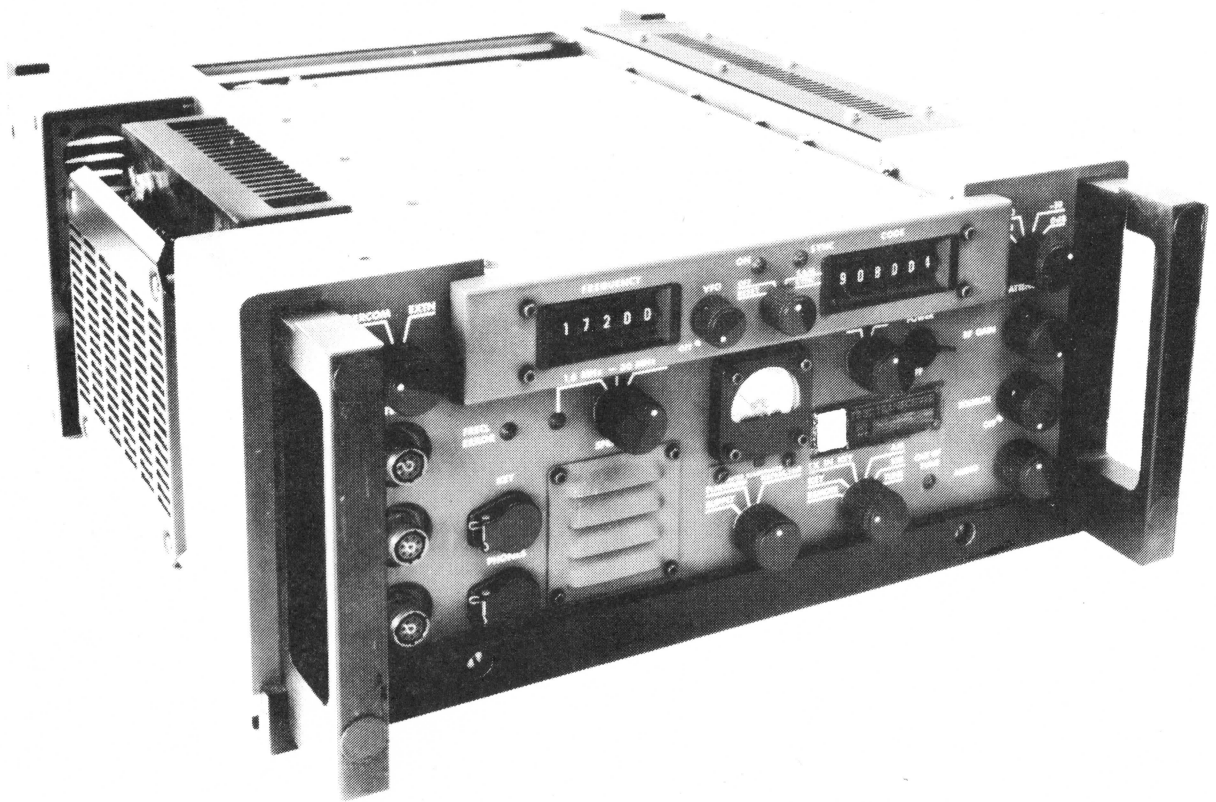
TABLE 3 (Cont.)		
Location	Control/Indicator	Function
	USB/LSB	Switches to select the required sideband.
	RF GAIN	Set depending on received signal strength.
	AUDIO	Adjusted to set the level of the audio output.
	SQUELCH	This control is operated to remove background noise in the absence of received signals. The squelch threshold is determined by the amount the control is rotated away from the switched OUT position. There is a degree of hysteresis.
	POWER	Switches the input power supply (a.c. or d.c.)
	METER	<p>When operating in the transmit mode the three positions of this switch connect the front panel meter to provide monitoring facilities as described below:</p> <p>(a) SUPPLY</p> <p>This position is spring-loaded to return the switch to FORWARD. The meter reading is an indication of the state of the power supply.</p> <p>(b) FORWARD</p> <p>Forward Power During SSB speech the needle should flick up to the GREEN sector</p> <p>(c) REFLECTED</p> <p>Reflected Power The meter should indicate near zero during SSB speech.</p> <p>When the GRC-102 is operating in the receive mode the switch is inoperative and the meter automatically becomes an 'S' meter, indicating receive signal strength. The scale reads dB's above microvolt.</p>
	METER ILLUMINATION	Slide switch under meter
	INTERCOM LAMP	Illuminated when INTERCOM switch is to LOCAL to indicate that the remote operator is calling. A continuous audio tone is also sounded.

TABLE 3 (Cont.)

Location	Control/Indicator	Function
	<p>FREQ. ERROR</p> <p>OUT OF TUNE</p>	<p>Illuminated when the selected frequency is not admissible, ie. below 1,6MHz.</p> <p>Indication provided depends on the GRC-102 operational condition.</p> <p>(a) Without URA-602 connected</p> <p>Flashes if V.S.W.R. to too high</p> <p>(b) With URA-602 connected</p> <p>(i) Flashes if V.S.W.R. is too high</p> <p>(ii) Is continuously illuminated under the following conditions Frequency change > 10Hz Power to GRC-102 is interrupted On initial switch on.</p>
<p>SYNTHESISER</p>	<p>FREQUENCY</p> <p>VFO</p> <p>* CODE (SETTING)</p> <p>* FUNCTION</p>	<p>Frequency selections are made using five switches which from left to right, are used to select frequency digits as follows:</p> <p>(a) x 10MHz (b) x 1 MHz (c) x 100MHz (d) x 10MHz (e) x 1 kHz</p> <p>The digit selected is displayed through a window on the switch.</p> <p>This switch and potentiometer combined enables the selected frequency to be varied by ± 500Hz when operating in the NORMAL mode.</p> <p>Six thumbwheel switches select the crypto code that defines the specific pseudo random frequency (hopping) sequence.</p> <p>This is a four position switch.</p> <p>(a) RESET</p> <p>The Synthesiser operates as a normal (non-hopping) synthesiser, ie. the CODE selectors are inoperative.</p>

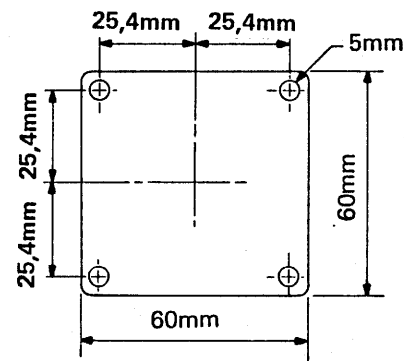
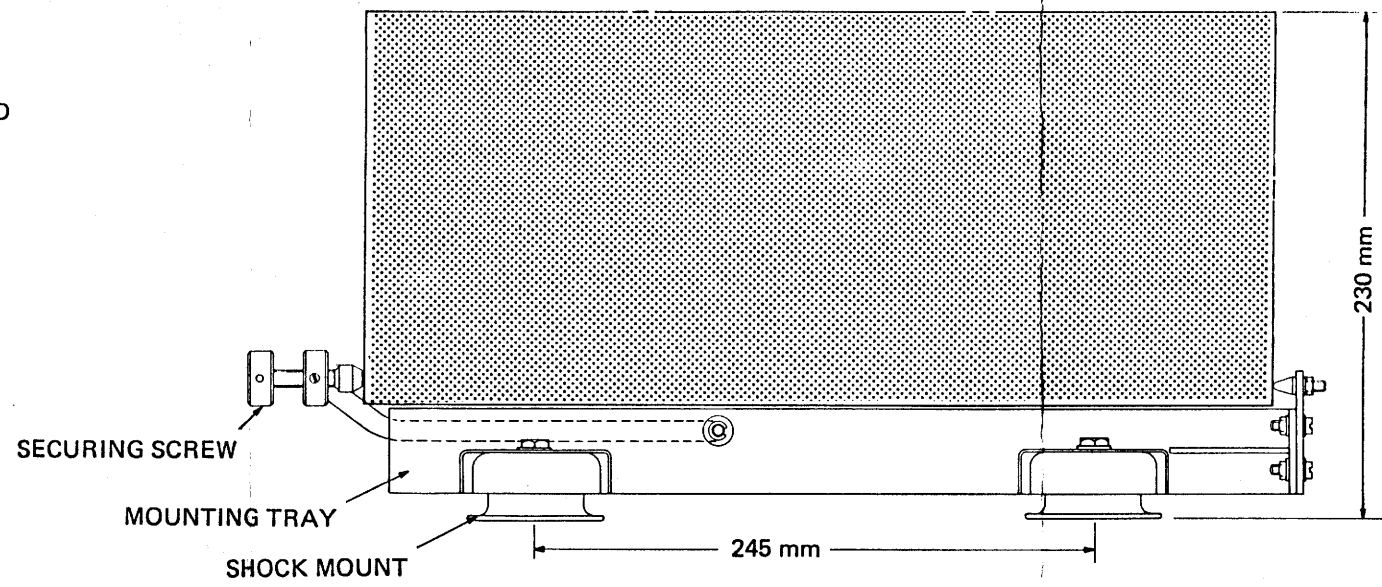
TABLE 3 (Cont)		
Location	Control/Indicator	Function
		<p>(b) OFF</p> <p>The Synthesiser operates in a similar manner as when RESET is selected except that the microprocessor is running and executing instructions, ie. the synthesiser is operating as a normal synthesiser but the microprocessor can be running in synchronism with a hopping link.</p> <p>(c) FAM</p> <p>When FAM is selected the orange ON LED is illuminated and the VFO control becomes inoperative. If FAM is selected immediately after OFF the micro-processor enters a SYNC recognition routine. The green SYNC LED is illuminated and frequency hopping under the control of the microprocessor takes place as soon as a sync signal from the master station is detected. Subsequent operations of the FREQUENCY switches then have no effect on the HOPPING mode of operation.</p> <p>(d) SYNC</p> <p>The switch is spring biased away from the SYNC position to the FAM position. Momentary selection of the SYNC mode causes a short synchronisation pulse train to be transmitted. On completion of this pulse train the SYNC LED is illuminated, indicating that the synthesiser is frequency hopping under control of the micro-processor control system.</p> <p>Controls marked * are included in KY102 Frequency Processor Units only.</p>



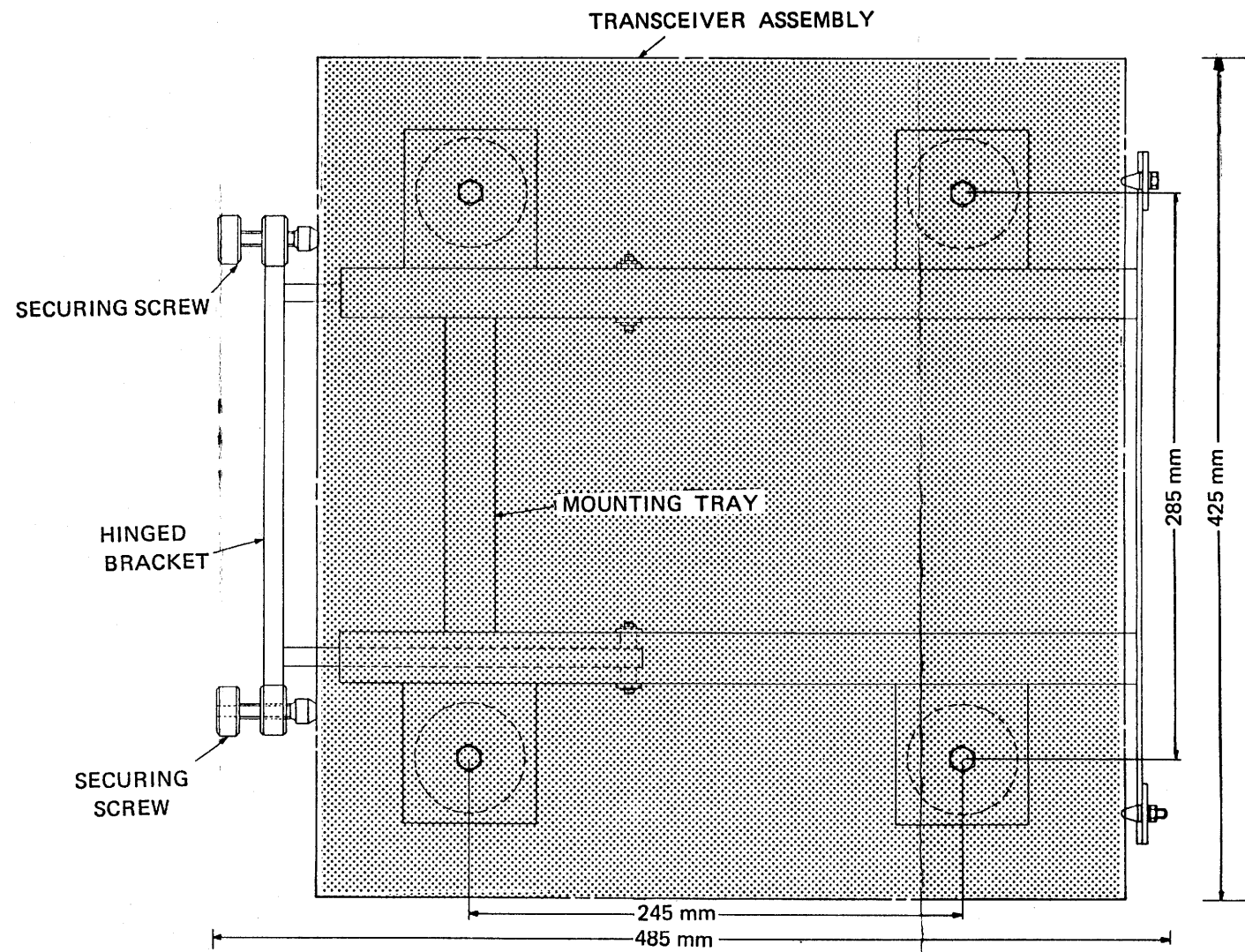


TRANSCEIVER GENERAL VIEW

NOTE FOR EFFICIENT VENTILATION OF THE TRANSCEIVER IT IS RECOMMENDED THAT A MINIMUM SPACE OF 250mm BE LEFT ABOVE THE ASSEMBLY.

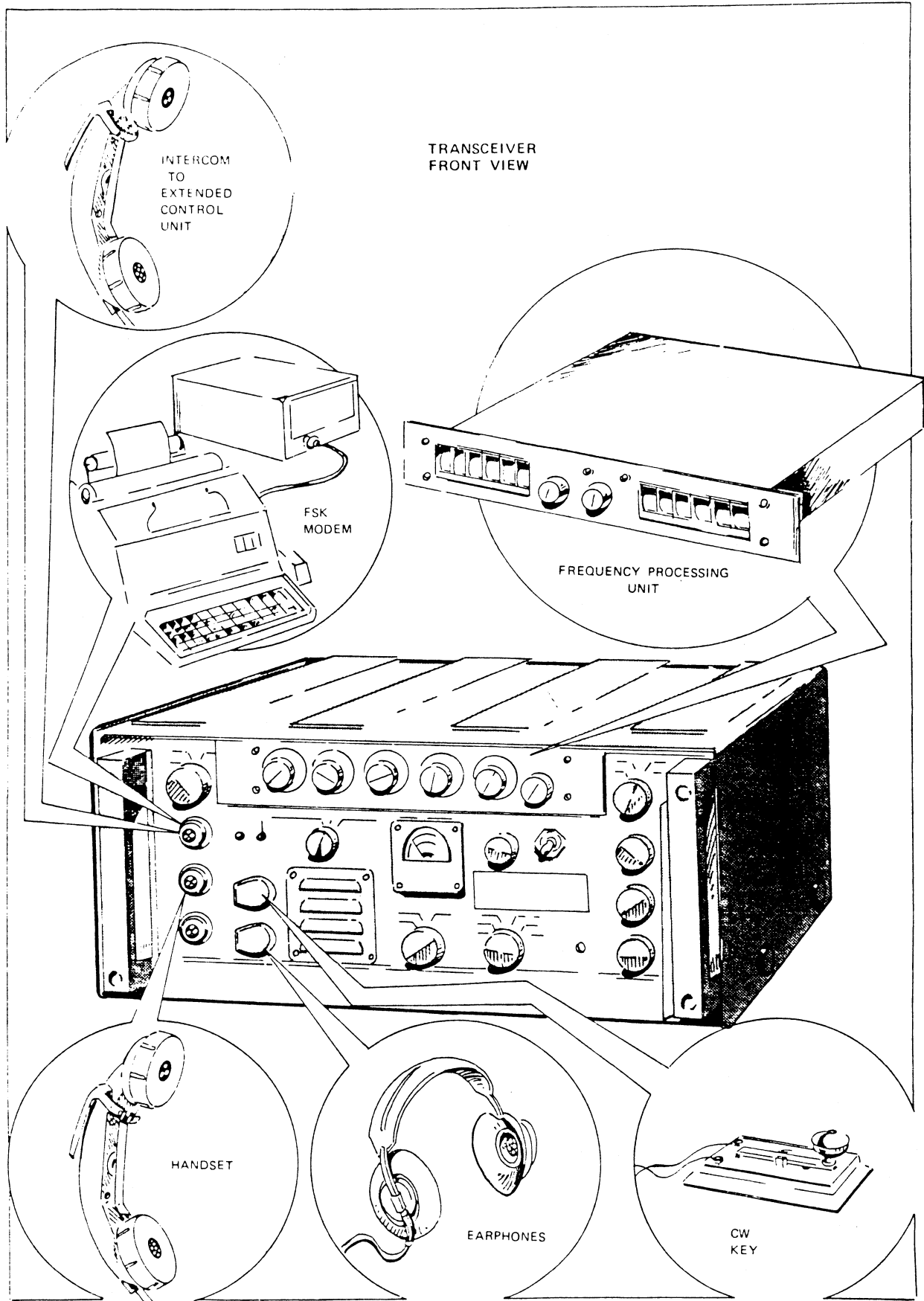


Detail of Shockmount Base

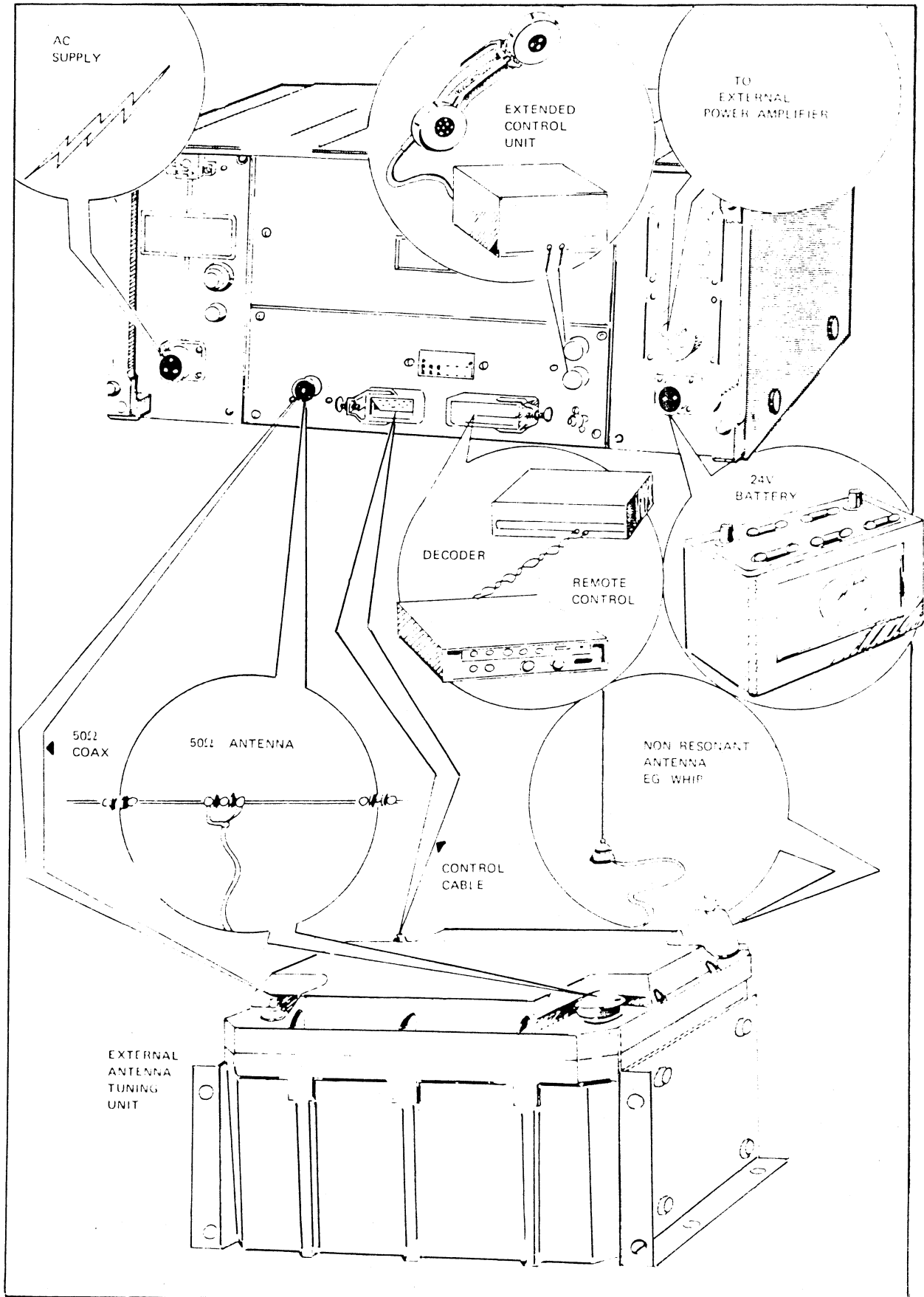


INSTALLATION DETAILS

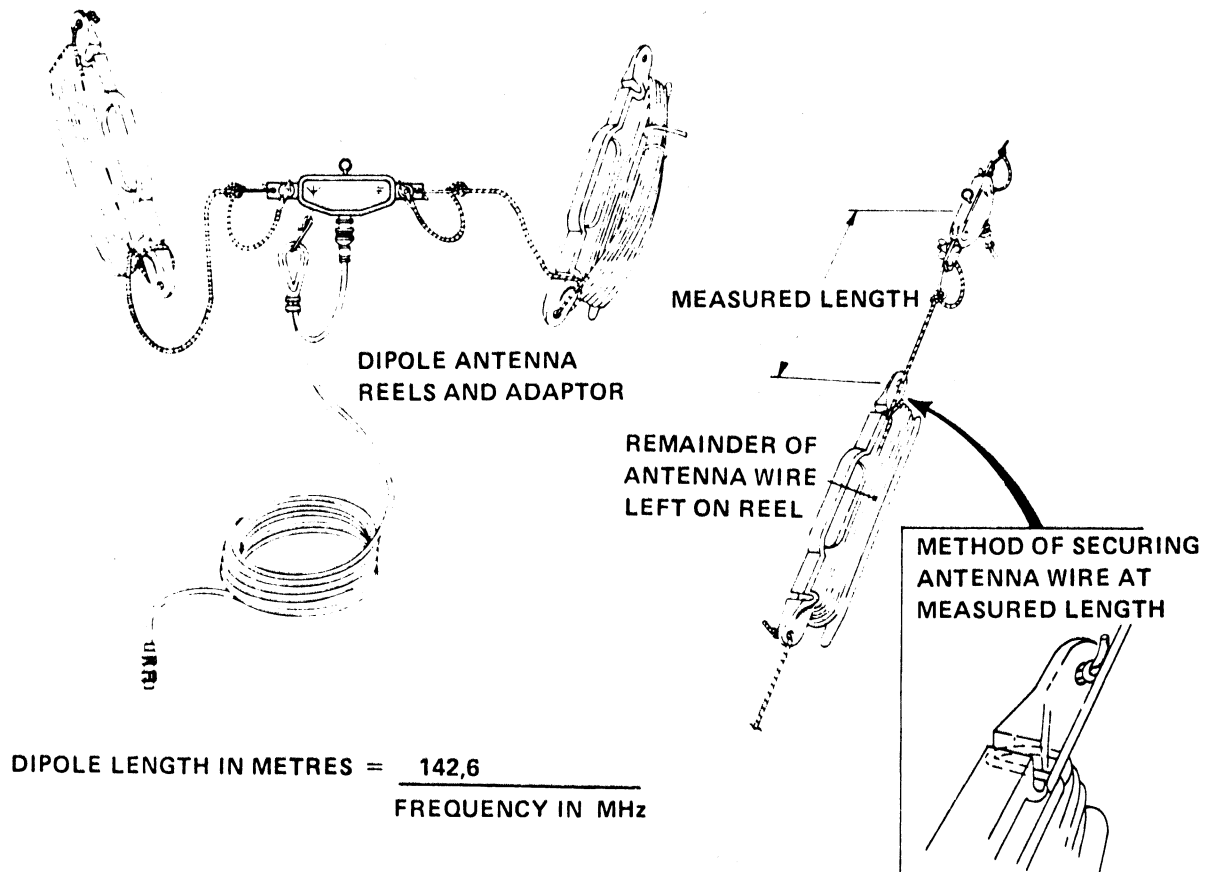
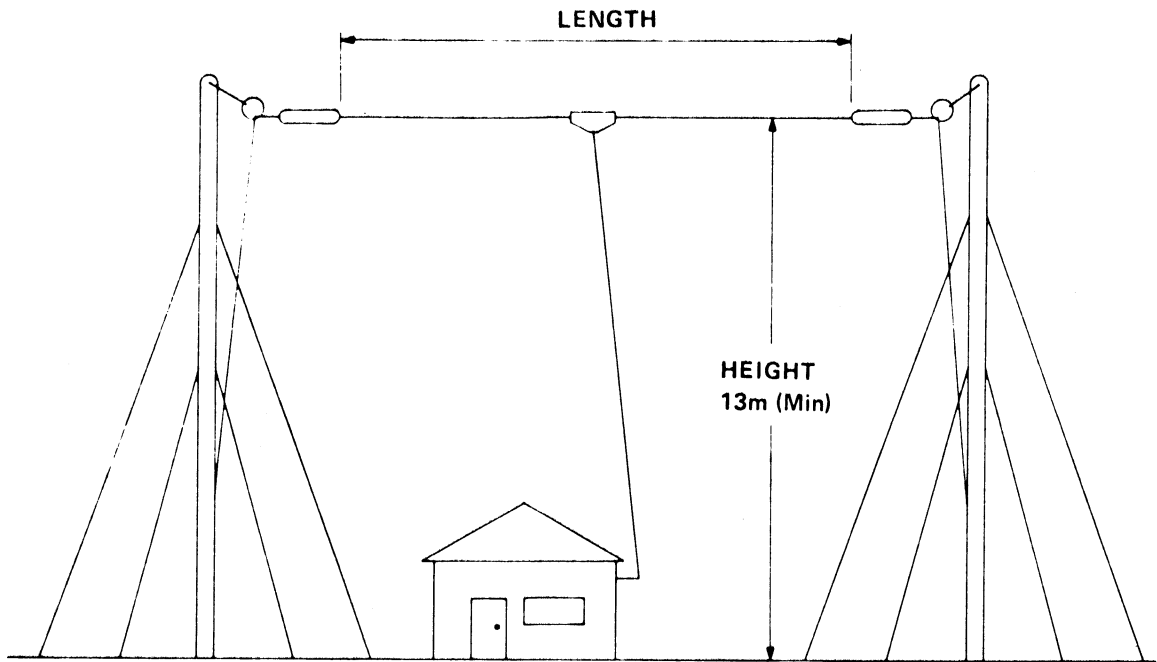
Mobile Station



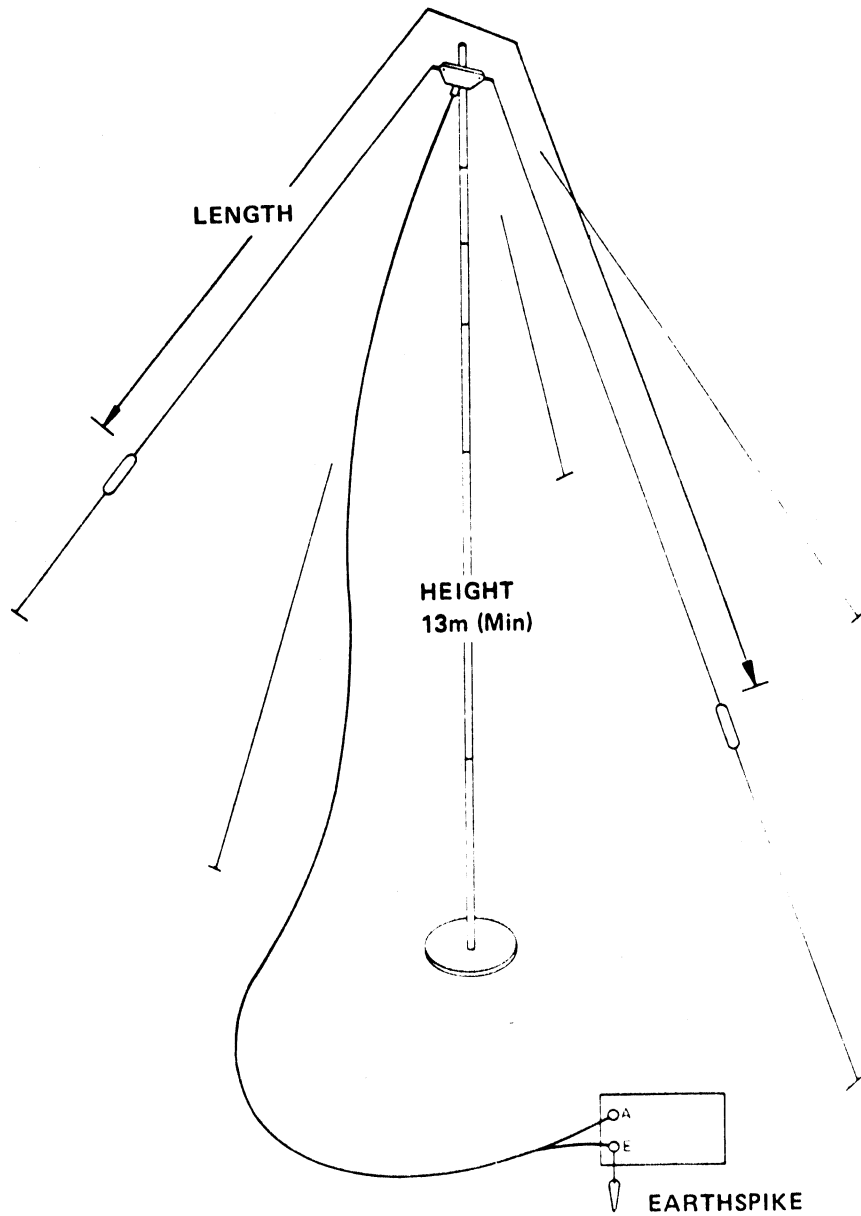
ACCESSORY CONNECTIONS



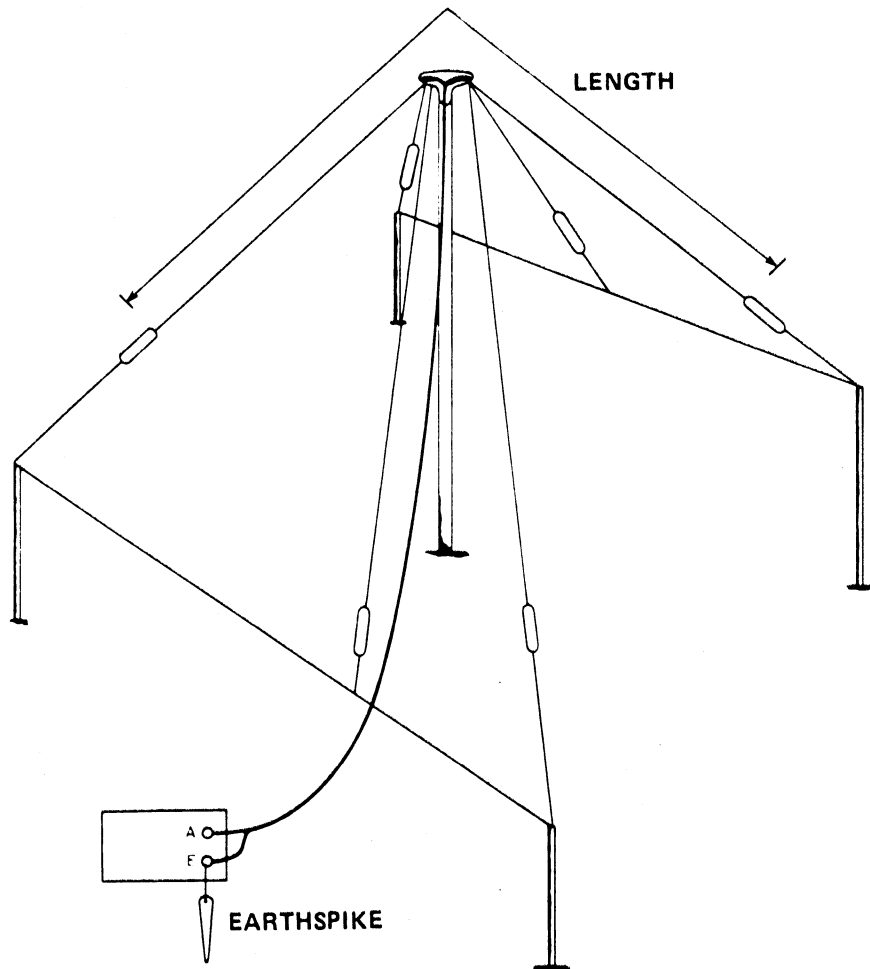
ACCESSORY CONNECTIONS



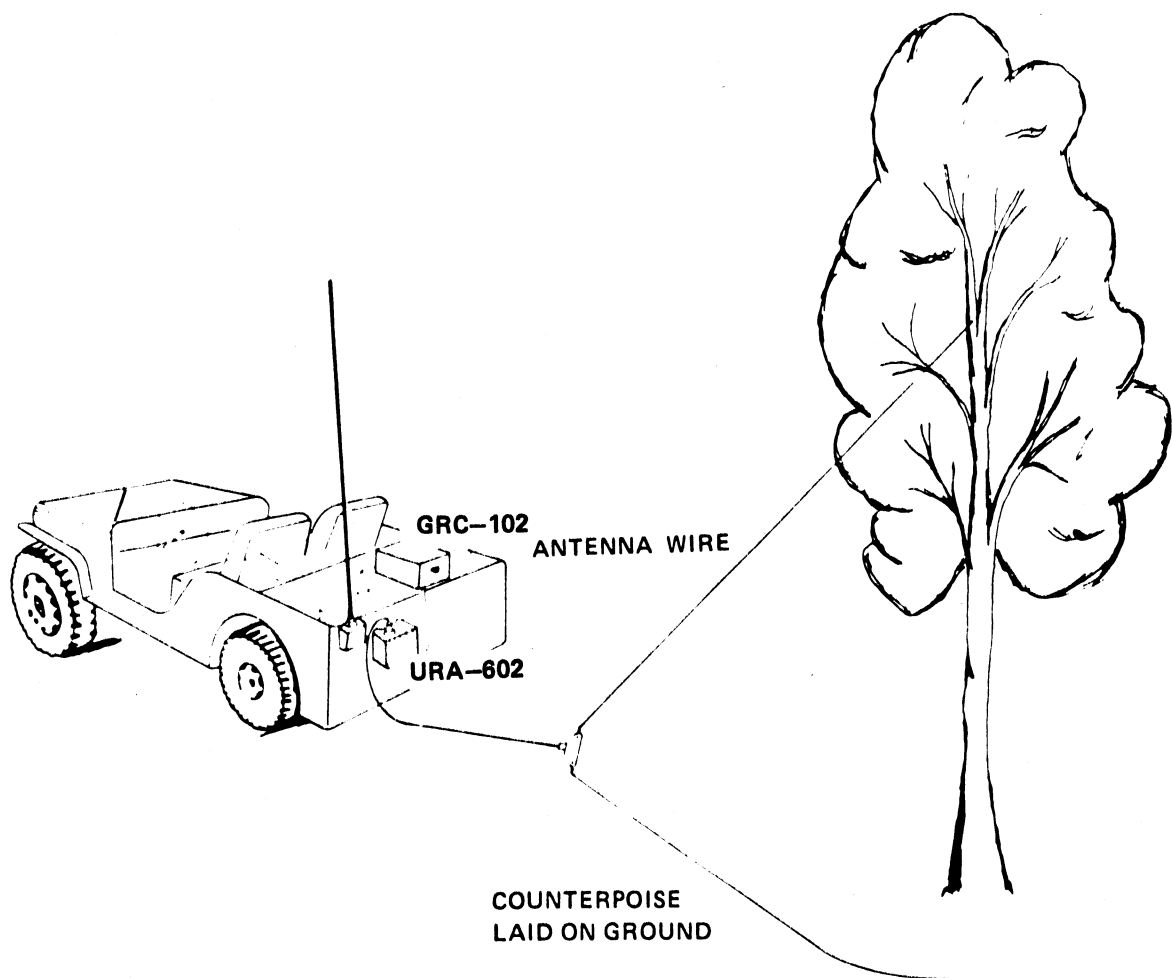
SINGLE FREQUENCY HALF WAVE DIPOLE



SINGLE FREQUENCY CENTRE FED INVERTED V

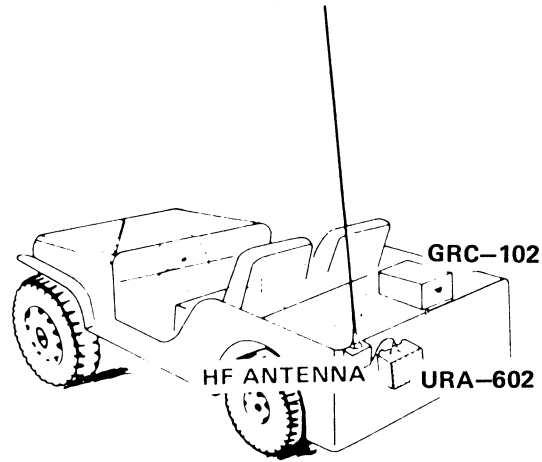


MULTIPLE FREQUENCY CENTRE FED INVERTED V

**NOTE**

The antenna wire, which should be raised to as near vertical as possible, is identified at the adaptor by the antenna symbol (Y).
The wire marked \perp provides the counterpoise.

MOBILE STATION : WIRE ANTENNA WITH COUNTERPOISE



INSTALLATION

Suitable covering should be supplied to protect the GRC-102 from direct sun and rain.

NOTE : The wire connecting the URA-602 to the base of the whip must be kept as short as possible and well clear of metal work. It must have approved insulation (P.T.F.E. or polyethylene). The R.F. voltages present can be very high. This section of the installation should be well clear of the fuel filler cap. The whip insulator base must have low capacity and be capable of withstanding 5kV.

MOBILE STATION : WHIP ANTENNA + ATU