50W VHF Tank Radio

VRM 5080C and VRM 5080S

Technical Manual

Racal-Tacticom Limited

P.O. Box 112, 472 Basingstoke Road, Reading, Berks. RG2 0QF
Tel. Reading (0734) 875181 Telex: 848011 Grams: Tacticom Reading
Prepared by Group Technical Handbooks Department, Racal Group Services Limited

RACAL
The Electronics Group

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PART 1

GENERAL DESCRIPTION

CHAPTER 1

GENERAL DESCRIPTION

ROLE

1. The VRM 5080C and VRM 5080S equipments are VHF FM transceivers designed for installation in armoured or soft-skin military vehicles.

DESCRIPTION

2. The VRM 5080C (comprising the MA.4169 Transceiver and the MA.4168 Keyboard Unit) and the VRM 5080S (comprising the MA.4169 Transceiver, the MA.4168 Keyboard Unit and the ST.719582 16 kbit/sec Encryption Module) have identical front panel layouts (Fig. 1) and are distinguished by the plate on the equipment front panel located beneath the HARNESS and POWER connectors.

VERSIONS

VRM 5080C

3. The VRM 5080C equipment is of modular construction and designed to operate in clear mode (normal FM or wideband signals) in the frequency range of 30 to 76 MHz. Of the 1841 available channels, any ten can be programmed into a memory via the keyboard to permit rapid change of channel. Nine of the channels (numbers 1 to 9) are protected against accidental corruption.

4. On each of the nine protected channels, (1 to 9), transmission and reception can be performed on the same frequency or on differing frequencies. In the case of channel 0, only single frequency working is possible.

5. Remote operation (including intercommunication and call facilities) is provided for transmission and reception of clear signals by a remote operator via a 2-wire line up to 3 km in length.

6. An automatic rebroadcast facility permits re-transmission of clear speech signals.

7. Where the equipment has to be installed in an inaccessible position, the keyboard unit may be removed from the transceiver and connected via the audio or audio/data connector to permit control of the equipment at a distance of up to 10 m.

8. The unit provides control of either the BCC 543 Automatic Antenna Matching and Tuning Unit or the BCC 587B Antenna Matching Unit.

9. The VRM 5080C may be powered directly from a 24 V DC power supply or, where the equipment is to be used in a 12 V system, via the MA.4913 12/24 V power supply unit.

10. Where it is required to communicate in secure mode using a VRM 5080C, an MA.4261 External Encryption Unit may be connected to the system by means of the audio/data socket.

VRM 5080S

11. The VRM 5080S equipment is identical to the VRM 5080C above except that it further incorporates an ST.719582 16 kbit/sec Encryption Module to permit secure mode operation in addition to the standard clear mode operation.

12. In secure mode the input signal (audio only) is encrypted and transmitted as a 16 kbit/sec data stream. The encrypted signal resembles white noise unless received on an equipment fitted with a correctly coded decryption facility.

13. During reception with secure mode selected, the VRM 5080S automatically selects clear or secure operation as necessary and decrypts secure signals into clear form.

14. When transmitting or receiving secure signals, an interrupted pip tone is heard.

15. When connected for remote operation, the VRM 5080S permits transmission and reception of either clear speech or 16 kbit/sec data signals by a remote operator via a 2-wire line up to 3 km in length.

16. When incorporated in an automatic rebroadcast system, the VRM 5080S allows the re-transmission of clear or secure signals.

LIST OF ASSOCIATED PUBLICATIONS

17.

User Handbook for VRM 5080C and VRM 5080S 50 W VHF Programmable Transceiver	Ref. TH 1513
Technical Manual for MA.4260 16 kbit/sec Encryption Module (Racal Mobilcal Ref. ST 719582)	Ref. TH 1425
Technical Manual for MA.4261 16 kbit/sec Encryption Unit	Ref. TH 2238
Technical Manual for BCC 543 Automatic Antenna Matching and Tuning Unit	Ref. WOH 7221
Technical Manual for BCC 587B Antenna Matching Unit	Ref. TH 2254
Technical Manual for MA.4913 12/24 V Power Supply Unit	Ref. TH 3159
Technical Manual for MA.4073 VHF Programmer	Ref. TH 2090
Technical Manual for MA.4083 Fill Gun	Ref. TH 2477
User Handbook for BCC 400A Harness	Ref. WOH 8278/1
User Handbook for BCC 600 Harness	Ref. TH 2277

TECHNICAL SPECIFICATION

GENERAL

Frequency Range	30-76 MHz
Channels	Any 10 from 1841 (9 protected)
Channel Spacing	25 kHz
Operating Mode	F3 (narrowband FM) one or two frequency simplex.
Frequency Stability	±5 ppm including 1 year ageing
Supply	24 V DC nominal (limits 20-32 V)

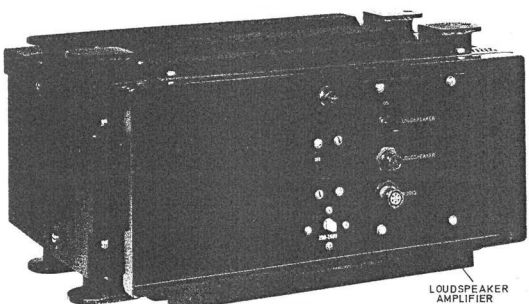
TRANSMITTER

RF Power Output (into 50 Ω Load)	High 50 W +2, -1 dB (25-32 V) supply Medium 10 W ±2 dB Low 3 mW ±4 dB
Peak Deviation	5 kHz nominal (10 kHz wide deviation)
Pilot Tone	148.8 Hz, 1.6 kHz deviation (3.0 kHz wide deviation)
AF Response:	
Clear and Secure	300 Hz to 3 kHz
Wideband	30 Hz to 10 kHz
Modulation Distortion	Less than 10% at 3 kHz deviation measured on AF bandwidth.
Spurious Emissions Harmonically Related Others	 Below - 40 dB Below - 120 dB relative to 50 W at more than 5% from the carrier measured in 18 kHz bandwidth.
Current Consumption	High Power 8.0 A Medium Power 5.5 A max. Low Power 1.5 A max.

RECEIVER

Sensitivity	Better than 15 dB SINAD for 1 µV e.m.f. with 5 kHz deviation @ 1 kHz
Image Rejection	Greater than 90 dB below nominal sensitivity
IF Rejection	Greater than 100 dB below nominal sensitivity

Adjacent Channel Rejection	Greater than 70 dB below nominal sensitivity
Spurious Responses (except f/2)	Greater than 90 dB below nominal sensitivity
Audio outputs:	
Local Handset Harness	Variable 5 mW max into 300 Ω 100 mW +3, -1 dB into 300 Ω for 5 kHz deviation
Remote	5 mW into 300 Ω from 150 Ω source
AF Response:	
Clear and Secure	300 Hz to 3 kHz
Wideband	30 Hz to 8 kHz
Sidetone	0 dB nominal relative to receive audio
Distortion (clear)	Less than 10% at 10 kHz deviation.
Squelch	Carrier to noise or pilot tone operated and 16 kbit/sec with encryption fitted.
Current Consumption	800 mA max depending on display brightness.
SYSTEMS	
Operates with	BCC 543 AAMTU BCC587B AMU bandswitched end fed whip
Close proximity working	Two VRM 5080 systems can be operated simultaneously when the frequency spacing is at least 5% and the antennas 2 m apart when using BCC 543 AAMTUs.
Extended Keyboard	Operates over a distance of up to 10 metres.



MA.4177
POWER UNIT

THE MA.4178 IS IDENTICAL TO THE MA.4177 EXCEPT THAT THE LOUDSPEAKER AMPLIFIER IS REPLACED BY A BLANKING PLATE.

CHAPTER 2

OPERATING INSTRUCTIONS

CONTENTS

Para.		Page
1	OPERATING INSTRUCTIONS	2-1
2	DISPLAY FACILITIES	2-1
	EQUIPMENT FACILITIES	2-2
4	Off/Gain/Erase Switch	2-2
5	Display Brightness	2-2
6.	Channel Selection	2-2
9	MODE OF OPERATION	2-2
	INPUT CONTROL MODES	2-4
22	Local	2-4
25	Remote	2-4
28	Setting-Up for Remote Operation	2-4
29	Intercom	2-4
33	Setting-Up for Intercom	2-5
34	Automatic Rebroadcast	2-5
40	Setting-Up for Automatic Rebroadcast	2-5
41	Squelch Selection	2-6
42	Transmitter Power	2-7
43	Test Facility	2-7
45	E (Display Character)	2-7
46	Error Message	2-7
47	PROGRAM STORE CONTENTS	2-8
49	FREQUENCY SELECTION	2-8
50	Channel Loading using the Equipment Keyboard	2-8
53	Channel Loading using the MA.4073 VHF Programmer or the MA.4083 Fill Gun	2-9
54	OPERATION MODE SELECTION	2-10
55	Programming of Operation Mode using the Equipment Keyboard	2-10
56	ENCRYPTION AND DECRYPTION	2-10
58	Encryption Code Loading using the Equipment Keyboard	2-10
64	Encryption Code Loading using the MA.4073 VHF Programmer or the MA.4083 Fill Gun	2-12
65	Correction of Program Store Contents	2-12

CHAPTER 2

OPERATING INSTRUCTIONS

OPERATING INSTRUCTIONS (Refer to Fig. 1)

1. (1) Switch on the equipment. Set the Off/Gain/Erase switch clockwise. Refer to para. 4.

   (2) Select display brilliance. Depress [LAMPS] to obtain required display brilliance. Refer to para. 5.

   (3) Select channel. Depress [CHAN] and the numerical pushbutton of the required channel. Refer to para. 6.

   (4) Select mode of operation. Depress [CLEAR], [CLEAR WIDE] or [SEC] (secure) as required. Refer to para. 9.

   (5) Select input control mode. Depress [LOCAL], [REM] (remote) or [AUTO REBRO] (automatic rebroadcast) as required. Refer to para. 22.

   (6) Select squelch. Carrier squelch is selected automatically. For alternative squelch modes refer to para. 41.

   (7) Select transmitter power. Depress [HIGH], [MED] (medium) or [LOW] as required. Refer to para. 42.

   (8) Communicate. To transmit, depress pressel and speak into microphone. Sidetone is heard during transmission.

   (9) Adjust volume. Refer to para. 4.

   NOTE: Antenna matching is performed automatically on selection of a new transmission frequency. When used with the BCC 543 AAMTU, initial matching is performed into the dummy load within the AAMTU. Fine tuning of the AAMTU into the antenna is performed on initial operation of the pressel switch. The transmit sidetone may be inhibited during the matching process.

DISPLAY FACILITIES

2. The equipment display is a 16 digit alphanumeric display. The normal display format provides control, frequency and test information. An explanation of the normal display format is given in Fig. 2. For a more detailed description of the functions, the operator should refer to the appropriate paragraphs.

3. When programming frequency, mode of operation or encryption codes, the normal display format is replaced by the appropriate programming format. The programming formats are discussed in paras. 49, 54 and 56.

EQUIPMENT FACILITIES

Off/Gain/Erase Switch

4. The switch in the top right hand corner of the front panel has seven positions. The switch has an equipment off position and provides four audio output levels to the audio/data and audio sockets. Additionally, the fully-clockwise position provides a medium volume level with squelch held open whilst the fully anti-clockwise position labelled Z erases all the frequency and encryption code information stored in the memory. The erase position is protected by a mechanical interlock in order to prevent accidental erasure. In order to overcome the mechanical interlock, the interlock lever on the front of the switch should be pivotted outwards thereby permitting the switch to be set to the Z position.

Display Brightness

5. The readout from the alphanumeric display can be varied through three levels of brightness and off by successive operation of the [LAMPS] key.

Channel Selection

6. Channel 0 to 9 may be programmed to any of the 1841 channels in the frequency range 30 to 76 MHz. Channels 1 to 9 are protected against accidental corruption and in normal operation the channel frequencies should not be re-programmed. Where it is required to operate on a frequency other than one of the nine protected channels, channel 0 should be programmed as follows:

7. Depress [CHAN], [0] and key in the required frequency in kHz in the form XXXYZ (where, within the frequency range 30 to 76 MHz, X = any number 0-9, Y = 0, 2, 5, 7 and Z = 0, 5. The last digit is displayed automatically by the equipment to give the correct 25 kHz channel spacing).

NOTES:

(1) If an error is made when keying-in the frequency, the operator should continue depressing the numeric keys. After making the fifth keypress, a new frequency may be entered (over-writing the original selection).

(2) As the data store is non-volatile, the store contents is not lost when the equipment is switched off.

8. Where it is necessary to re-program channels 1-9, the operator should refer to para. 49.

MODE OF OPERATION

9. The VRM 5080C equipment can process clear traffic only (normal FM or wideband signals).

10. The equipment is primarily designed to operate with 5 kHz deviation signals (25 kHz channel spacing). Normal deviation is selected by depressing the CLEAR key. If, however, it is required to operate the equipment using 10 kHz frequency deviation signals (50 kHz channel spacing), the CLEAR WIDE key should be depressed. The CLEAR WIDE key affects the transmitter only and when selected the second digit of the alphanumeric display is set to w. The receiver accepts both normal and wide deviation signals without switching.

11. The VRM 5080S (or VRM 5080C plus MA.4261 External Encryption Unit) has an additional encryption facility permitting the processing of secure traffic (audio input encrypted as a 16 kbit/sec data stream).

12. Using the equipment keyboard, each of the ten channels can be pre-programmed to clear normal deviation or secure operation. It is not possible, however, to pre-program a channel for clear wide deviation operation.

13. Where the transmission mode has been pre-programmed, the fifteenth digit of the alphanumeric display is set to the appropriate C or S character as each channel is selected.

14. Following selection of a pre-programmed channel, the transmission mode may be changed by means of a CLEAR, CLEAR WIDE or SEC key. On subsequently returning to this channel however, the mode will revert to the pre-programmed state.

15. The transmission mode for a given channel returns to the non-programmed state when a new frequency is loaded into that channel.

16. Where the transmission mode has not been pre-programmed for a given channel, the equipment retains the transmission mode of the previously selected channel, unless changed by means of a CLEAR, CLEAR WIDE or SEC key.

17. When secure mode is selected the receiver detects whether the received signal is clear or encrypted and processes the signal automatically.

18. Where the transmission mode has been set to secure and a clear signal is received, the fifteenth and sixteenth digits of the alphanumeric display are set to S and C repsectively.

19. Where a clear transmission mode has been selected and the operator hears 16 kbit/sec narrowband filtered noise, he should depress SEC. If the operator is receiving secure signals and has the correct encryption code entered, he will hear the decoded signal. If however, the incorrect code is loaded and the operator is receiving 16 kbit/sec data signals, he will hear very heavily filtered noise.

20. When transmitting or receiving secure traffic, an interrupted pip tone will be heard on the operators headset.

21. Where it is required to program the mode of operation using the equipment keyboard, the operator should refer to para. 54.

INPUT CONTROL MODES

Local

22. This is the normal method of operation when operating from the front panel and is selected by depressing the [LOCAL] key. On selection, the eleventh digit of the alphanumeric display is set to L.

23. In local operation carrier squelch is used and voice communication is made by means of the local operator's handset connected to the audio or audio/data socket or via the vehicle radio harness connected to the harness socket.

24. Where it is required to transmit wideband signals, the data source should be connected to the audio/data or harness socket.

Remote

25. Remote operation is selected by depressing the [REM] (remote) key. On selection, the eleventh digit of the alphanumeric display is set to R.

26. In remote operation the equipment may be controlled by both remote and local operators. By connecting D10 twin cable to the line terminals, a remote operator with a remote control handset can transmit and receive clear speech from a distance of up to 3 km. Alternatively, when connected to an auxiliary data source via D10 cable the VRM 5080S can transmit and receive 16 kbit/sec data signals from a distance of up to 3 km.

27. If required, two VRM 5080 equipments can be connected together via the line terminal in a similar manner to that used for intercom and automatic rebroadcast (paras. 29 and 34 respectively). If two VRM 5080S equipments are used, the remote operation can be in either clear or secure speech.

Setting-Up for Remote Operation

28. (1) Set-up the equipment for operation as detailed in the preceding paragraphs.

(2) Connect D10 twin cable to the + and - terminals on the equipment front panel.

(3) Run out the cable to the remote site and connect it to the terminals of the appropriate remote control handset, auxiliary data source or second VRM 5080. If, on operating the equipment, a continuous tone is heard, the cable connections at one end of the line should be reversed.

Intercom

29. Intercom is selected by depressing the [INTERCOM] key. On selection, the eleventh digit of the alphanumeric display is set to I.

30. When intercom is selected, the local and remote operators may communicate with each other without transmitting.

31. If the key is held down, a 2 kHz steady tone is transmitted down the line to alert the remote operator. The eleventh digit of the alphanumeric display is set to C. (A corresponding facility is provided by the call button fitted to the remote control handset.)

32. If required, two VRM 5080 equipments can be connected together via the line terminals in a similar manner to that used for remote and automatic rebroadcast (paras. 25 and 34 respectively). If two VRM 5080S equipments are used, the intercom can be in either clear or secure speech.

Setting-Up for Intercom

33. The setting-up procedure for intercom is identical to that detailed in para. 28.

Automatic Rebroadcast

34. Automatic rebroadcast is selected by depressing the AUTO REBRO key. On selection, the eleventh digit of the alphanumeric display is set to A.

35. The VRM 5080 equipments can be used in automatic rebroadcast mode, either using the remote line terminals or via a harness system.

36. In either application, the rebroadcast network consists of four or more units operated in pairs. Each equipment pair operates on a different frequency. The pairs are interconnected to form a rebroadcast chain using landline links of up to 3 km in length.

37. Typical rebroadcast systems are shown in Figs. 3 and 4. 'A' and 'B' are operated as an equipment pair as are 'C' and 'D'. A frequency separation of not less than 5% should be used by the two pairs A-B and C-D.

38. A signal received by set 'B' automatically switches set 'C' to the transmit condition allowing the signal from set 'A' to be received by set 'D'. A similar action occurs when set 'D' transmits to set 'A'.

39. The 'A' and 'D' sets can be units other than VRM 5080 but 150 Hz pilot tone must be embodied for automatic operation.

NOTE: Tone Squelch is automatically provided when AUTO REBRO is selected.

Setting-Up for Automatic Rebroadcast

40. Considering the typical rebroadcast systems shown in Figs. 3 and 4.

(1) Connect sets 'B' and 'C' together either using up to 3 km of D10 twin cable connected to the line terminals or the vehicle radio harness. If, on operating a line connected system, a continuous tone is heard, the connections at one end of the line should be reversed.

(2) Set-up equipment pair 'A' - 'B' to operate as a normal voice link in local mode.

(3) Set-up equipment pair 'C' - 'D' to operate as a normal voice link in the local mode. Refer to Note 1.

(4) Select AUTO REBRO on sets 'B' and 'C' and advise operators, by means of a handset plugged into the socket of either set, that the rebroadcast link is established. Transmission and reception will now be carried out in both directions using the automatic voice switching circuits of the 'B' and 'C' sets.

(5) If required a 'break-in' facility can be provided for set 'B' or 'C' by connecting a handset to either the audio/data or audio connector. (Where the automatic rebroadcast link is operating in secure mode, the correct encryption code must be loaded in the 'break-in' equipment.)

NOTES:

(1) For optimum performance the equipment pairs should have a frequency separation of not less than 5% and an antenna separation of not less than 2 metres.

(2) Where an automatic rebroadcast link is set-up using the vehicle harness the switches on the harness control box must be set accordingly.

(3) The automatic rebroadcast link may operate in clear mode using VRM 5080C units and clear or secure mode using VRM 5080S units.

(4) When using VRM 5080S equipments, the complete net must be set-up and operated in clear or secure mode. If the VRM 5080S net is to be operated in secure mode, sets 'B' and 'C' (refer to Figs. 3 and 4) do not need to be programmed with the encryption codes in use unless the net is to be monitored at set 'B' or 'C'. In this case, the net should be set-up in clear mode before switching to secure mode for operation.

(5) Where it is required to transmit along the automatic rebroadcast link in one direction only e.g. set 'A' transmit, set 'D' receive, the rebroadcast link should be established in the normal manner after which REM should be selected on set C.

Squelch Selection

41. Carrier squelch is selected automatically. If the tone squelch facility is required, depress AUTO REBRO (automatic rebroadcast). Squelch override is obtained by turning the Off/Gain/Erase switch fully clockwise or by depressing and holding down the TEST key.

Transmitter Power

42. Three power levels are selectable by the keys labelled:

[HIGH] 50 W nominal

[MED] 10 W nominal

[LOW] 3 mW nominal

The selected levels are indicated by the thirteenth digit of the alphanumeric display by the letters H, M or L.

Test Facility

43. If the [TEST] key is depressed and held down, the eleventh, thirteenth and fifteenth digits of the alphanumeric display change to the form of 0, 1, 2 or 3 horizontal bars to provide a measure of the quantities detailed below: (The value displayed corresponds to the condition at the instant that [TEST] is depressed.)

digit 11: Transmitter power (pressel down) or Received signal strength (pressel up)

digit 13: Output voltage level from power supply unit

digit 15: Power amplifier heat sink temperature

In the case of the eleventh and thirteenth digits, 1 horizontal bar corresponds to a low level, 2 bars a medium level and 3 bars a high level. In the case of the fifteenth digit, one horizontal bar is illuminated when the temperature exceeds 85°C. When the temperature exceeds 105°C two bars are illuminated and, where high power is selected, the equipment will automatically override the selection and set the transmitter power to medium. Three bars are illuminated when the temperature exceeds 125°C. In this case the equipment should be switched off immediately and allowed to cool.

44. When the [TEST] key is held down, the squelch is held open.

E (Display Character)

45. When either the harness or the audio/data socket is programmed wideband, the fifteenth digit of the alphanumeric display (normally displaying S or C depending upon the selected mode) will be set to E to indicate that an external data device is connected. The E character is incorporated to remind the operator that the VRM 5080S cannot encrypt data and that the key selection may be invalid. Refer to para. 46.

Error Message

46. A two-tone audio warning will be heard on the operator's handset under any of the following conditions:

(1) An out-of-range frequency is selected. (In this case the equipment ignores the new frequency and re-writes the old frequency.)

(2) A parity error is detected on the serial control system. (In this case the equipment will blank the alphanumeric display.)

(3) When secure mode is selected and an external data device is connected to either harness or audio/data connectors. Refer to para. 45.

The audio warning may be cancelled by any valid instruction to the equipment.

PROGRAM STORE CONTENTS

47. The information contained in the program store (channel frequencies, encryption codes and modes of operation) will not require up-dating in normal use.

48. The following sections detail the procedure where it is necessary to re-program the data store.

NOTE: When the Off/Gain/Erase switch is turned fully anti-clockwise to the Z position, all frequency, encryption code and programmed mode of operation information is erased. The switch position is protected by a mechanical interlock in order to prevent accidental erasure. In order to overcome the mechanical interlock, the interlock lever on the front of the switch should be pivotted outwards thereby permitting the switch to be set to the Z position.

FREQUENCY SELECTION

49. Two methods of channel programming can be used:

(1) Channel loading using the Equipment Keyboard.

(2) Channel loading using the MA.4073 VHF Programmer or the MA.4083 Fill Gun.

Channel Loading using the Equipment Keyboard

50. The following procedure details the reprogramming sequence for channels 1 to 9.

(1) Depress [CHAN] (channel).

(2) Depress the numerical pushbutton corresponding to the required channel and confirm that the first digit of the alphanumeric display is set to the channel number.

(3) Depress [PROG] (program) and confirm that the right hand half of the 16 digit alphanumeric display is as shown.

F _ R X _ T X _

(4) Key in the required frequency in the form XXXYZ (where, within the frequency range 30 to 76 MHz, X = any number 0-9, Y = 0, 2, 5, 7 and Z = 0, 5. The last digit is selected automatically by the equipment to give the correct 25 kHz channel spacing). The selected frequency is displayed by digits 3 to 7 of the alphanumeric display. If required, a new frequency may be entered (over-writing the original selection) after making a fifth keypress of the numeric keys. The above sequence gives single frequency operation. If two frequency operation is required, the above sequence programs the transmission frequency and, in order to program the receiving frequency, the following items should be performed.

(5) Depress [PROG] (program) and confirm that the right hand half of the alphanumeric display is as shown.

F _ R X _ _ _ _

(6) Key in the required frequency in kHz as detailed in item (4).

51. The following procedure details the programming sequence for channel 0.

(1) Depress [CHAN] (channel).

(2) Depress [0] and confirm that the first digit of the alphanumeric display is set to 0.

(3) Key in the required frequency in kHz in the form XXXYZ (where, within the frequency range 30 to 76 MHz, X = any number 0-9, Y = 0, 2, 5, 7 and Z = 0, 5. The last digit is selected automatically by the equipment to give the correct 25 kHz channel spacing). The selected frequency is displayed by digits 3 to 7 of the alphanumeric display. If required, a new frequency may be entered (over-writing the original selection) after making a fifth keypress of the numeric keys. Single channel operation only is possible with channel 0.

52. Once programmed, the contents of any of the stored channels 0 to 9 may be recalled by pressing [CHAN] and the numerical pushbutton corresponding to the required channel. As the data store is non-volatile, the store contents is not lost when the power supplies are switched off.

Channel Loading using the MA 4073 VHF Programmer or the MA 4083 Fill Gun

53. The following procedure details the reprogramming sequence for channels 0 to 9.

(1) Connect the VHF Programmer or Fill Gun via the connecting lead to the audio/data or audio socket on the VRM 5080.

(2) In the case of the Fill Gun, the green ON lamp and the red NR (not ready) lamp will be illuminated. The ON lamp indicates that the Fill Gun is receiving DC power from the VRM 5080 and the NR lamp indicates that the Fill Gun is loading program into the store. When the NR lamp is extinguished, the VRM 5080 is programmed and the Fill Gun may be disconnected.

(3) In the case of the VHF Programmer, the operator is advised to consult the MA 4073 VHF Programmer Technical Manual.

NOTE: The above procedure also loads encryption codes. Refer to para. 64.

OPERATION MODE SELECTION

54. Using the equipment keyboard, each of the ten channels can be pre-programmed to clear normal deviation or secure operation. It is not possible, however, to pre-program a channel for clear wide deviation operation.

Programming of Operation Mode using the Equipment Keyboard

55. (1) Depress CHAN (channel).

(2) Depress the numerical pushbutton corresponding to the required channel and confirm that the first digit of the alphanumeric display is set to the channel number.

(3) Depress the appropriate CLEAR or SEC key and whilst holding it down press and release PROG (program). The programmed mode will be displayed by the appropriate C or S character in the fifteenth digit of the alphanumeric display.

ENCRYPTION AND DECRYPTION

56. The codes required for encryption comprise 40 octal characters, 20 of which are common to all 10 channels (channel common characters) whilst the remaining 20 can be programmed differently for each channel (channel variable characters).

57. The encryption codes can be loaded into the VRM 5080S by one of two methods:

(1) Encryption code loading using the Equipment Keyboard.

(2) Encryption code loading using the MA 4073 VHF Programmer or the MA 4083 Fill Gun.

Encryption Code Loading using the Equipment Keyboard

58. If it is intended that the channel variable characters are to be different for each channel, the programming sequence of paras. 60, 61 and 62 must be used.

59. However, if it is intended that the 40 character encryption codes are to be the same for each of the 10 channels, the programming sequence of paras. 60 and 63 should be used to remove the necessity to program each of the channels separately.

60. The channel common characters are entered using the following sequence:

(1) Depress SEC and confirm that the fifteenth digit of the alphanumeric display is set to S.

(2) Depress PROG (program) and confirm that the right hand half of the 16 digit alphanumeric display is as shown:

S _ C O M _ 1 _

(3) Using the numerical pushbuttons 0 to 7, insert the first block of 5 octal characters noting that the block is entered in digits 3 to 7 of the alphanumeric display.

NOTE: If an error is made when keying-in the 5 octal characters, the operator should continue depressing numerical pushbuttons 0 to 7 to complete a 5 character block after which further keypresses will over-write the original entry and permit insertion of the correct 5 character block.

(4) Depress PROG (program) and confirm that the 15th digit of the alphanumeric display is set to 2.

(5) Insert the second block of octal characters as detailed in item 3.

(6) Repeat items (4) and (5) in order to enter the third and fourth blocks of characters observing that, at the start of each block, the fifteenth digit of the display is set to 3 and 4 respectively.

61. The channel variable characters for a given channel are entered using the following sequence:

(1) Depress SEC and confirm that the fifteenth digit of the alphanumeric display is set to S.

(2) Depress the numerical pushbutton corresponding to the required channel and confirm that the first digit of the alphanumeric display is set to the channel number.

(3) Depress PROG (program) and confirm that the right hand half of the 16 digit alphanumeric is as shown:

S _ _ _ _ _ 1 _

(4) Using the numerical pushbuttons 0 to 7, insert the first block of 5 octal characters noting that the block is entered in digits 3 to 7 of the alphanumeric display. Refer to the note in para. 60 item 3 above.

(5) Depress PROG (program) and confirm that the fifteenth digit of the alphanumeric display is set to 2.

(6) Insert the second block of octal characters as detailed in item (4).

(7) Repeat items (5) and (6) in order to enter the third and fourth blocks of characters observing that, at the start of each block, the fifteenth digit of the alphanumeric display is set to 3 and 4 respectively.

62. The channel variable characters for the remainder of the channels are entered by repeating para. 61 for each of the channels in turn.

63. The following sequence is adopted where the channel variable characters are to be the same for each channel (after performing para. 60 above).

(1) Depress PROG (program) and confirm that the right hand side of the 16 digit alphanumeric display is as shown:

S_ALL_1_

(2) Using the numerical pushbuttons 0 to 7, insert the first block of 5 octal characters noting that the block is entered in digits 3 to 7 of the alphanumeric display. Refer to the note in paragraph 60 item (3) above.

(3) Depress PROG (program) and confirm that the fifteenth digit of the alphanumeric display is set to 2.

(4) Insert the second block of octal characters as detailed in item (2).

(5) Repeat items (3) and (4) in order to enter the third and fourth blocks of characters observing that, at the start of each block, the fifteenth digit of the display is set to 3 and 4 respectively.

(6) Depress PROG (confirming that the right hand half of the display is as shown:

S(ALL)__)

and, whilst holding the key down, depress SEC (noting that the brackets in the tenth and fourteenth digits disappear) to transfer the 20 channel variable characters into each of the ten channels. The transfer may be made at any time: not only following entry of the data.

Encryption Code Loading using the MA 4073 VHF Programmer or the MA 4083 Fill Gun

64. When using the MA 4073 Programmer or the MA 4083 Fill Gun to load the encryption codes, the loading operation is performed at the same time as the programming of the channel frequencies the procedure for which is detailed in para. 53.

Correction of Program Store Contents

65. If the operator makes an incorrect selection when programming para. 63, he must return to para. 60 and step through the sequence using the SEC and PROG keys as appropriate. Throughout the program stepping operation, the data will remain unaltered unless the operator overwrites a 5 character block using the numerical pushbuttons.

NOTE: For security reasons, no encryption code recall facility is provided on the keyboard display.

In all other cases the program store contents may be overwritten by returning to the start of the given section, stepping through the sequence and updating the contents as mentioned above.

CHAPTER 3

INSTALLATION

CONTENTS

Para.		Page
1	INTRODUCTION	3-1
2	INSTALLATION NOTES	3-1
4	OPERATIONAL COMPATIBILITY	3-2
7	VRM 5080 EQUIPMENT RANGE	3-2

CHAPTER 3

INSTALLATION

INTRODUCTION

1. The installation notes given below and typical system diagrams in Fig. 5 are intended as a guide. For more specific information, the operator should refer to the system handbook written for the particular installation.

INSTALLATION NOTES (Refer to Fig. 1)

2. (1) Fit the equipment into its mounting rack and secure with the two retaining screws.

(2) Insert the power connector in the +24 - socket.

(3) Connect the r.f. output from the ANT/ATU connector to the r.f. input connector on the ATU and the ATU control output lines from the ATU connector to the control input on the ATU. Where no ATU is fitted to the system, the ANT/ATU connector should be connected directly to the antenna.

(4) Connect the vehicle radio harness to the harness connector.

(5) Connect the local operator's handset or headset to the audio connector or the vehicle radio harness.

(6) Where the remote control facility is required, connect the 2 wire line to the + and - terminals.

(7) If the remote keyboard facility is required, the keyboard unit should be removed from the transceiver and the cover plate removed from the keyboard unit mounting box (by withdrawing the four 4 mm hexagon socket head cap screws in each case). The keyboard unit should be fitted to the keyboard unit mounting box (ensuring correct contact alignment) and the cover plate fitted to the transceiver. The keyboard unit data input/output line should be connected to the transceiver audio or audio/data sockets. Refer to Fig. 6.

(8) If the external encryption or auxiliary data facility is required, connect the data input/output line to the audio/data connector.

3. Where it is required to use Remote, Intercom or Automatic Rebroadcast modes, the operator should also refer to the appropriate setting-up notes in Chapter 2, paras. 28, 33 and 40 respectively.

OPERATIONAL COMPATIBILITY

4. The VRM 5080 equipments will work with other VRM 5080 equipments of the same variant without limitation. VRM 5080 equipment of different variants are compatible provided that operation is restricted to clear mode.

5. The VRM 5080 will operate with any other type of VHF/FM transceiver in the frequency range of 30 to 76 MHz. Table 1 provides information on operational compatibility with other Racal Transceivers and lists frequency range, channel spacing and modes.

6. A PRM 4090C VHF Transceiver may be programmed with frequency information using a VRM 5080C or VRM 5080S. Similarly a PRM 4090S may be programmed with both frequency and encryption code information using a VRM 5080S. It is not possible, however, to program a VRM 5080 variant using a PRM 4090 equipment.

VRM 5080 EQUIPMENT RANGE

7. The range of major and ancillary equipment is listed in Table 2.

CHAPTER 4

PREVENTIVE MAINTENANCE

CONTENTS

Para.		Page
1	GENERAL	4-1

CHAPTER 4

PREVENTIVE MAINTENANCE

GENERAL

1. No equipment can be expected to work properly unless it is kept in first class condition by regular maintenance conscientiously carried out. This is the responsibility of the operator who is in direct charge of the equipment and NOT of the workshop repair staff.

2. The tasks in the case of the VRM 5080 are simple and few in number as detailed below. They are performed daily when the set is in use and periodically when in store. The VRM 5080 is a fully sealed radio and is NOT to be opened by the operator.

ROUTINE CHECK LIST

	Item to be Checked	Procedure
1.	Completeness	Check that the equipment is complete with accessories
2.	Exterior surfaces	Remove dust, dirt and moisture from equipment surfaces
3.	Controls	Check that controls work smoothly, are tight on their shafts, and do not bind.
4.	Sockets	Check that sockets are tightly secured to the front panel.
5.	Handset	Inspect for cuts in cable and secure connections to plug.
6.	Transmitter/Receiver	Perform steps in Operational Checks in Chapter 5.

CHAPTER 5

CORRECTIVE MAINTENANCE AND FUNCTIONAL CHECKS

CONTENTS

Para.		Page
1	GENERAL	5-1
2	CONFIDENCE CHECKS	5-1
3	OPERATIONAL CHECKS	5-2

CHAPTER 5

CORRECTIVE MAINTENANCE AND FUNCTIONAL CHECKS

GENERAL

1. The procedure outlined is to be followed when checking the VRM 5080 and accessories. The checks are to be performed as part of preventive maintenance (Refer to Chapter 4) or in the event of equipment failure and are designed to enable an operator to quickly confirm that the unit is functioning correctly or to localise the fault if it is not. The following points should be observed at all times:

   (1) The operator is not to open sealed equipment under any circumstances.

   (2) The equipment will not normally be removed from its parent installation in order to perform maintenance.

   (3) The operator is to take remedial action where this is stated to be specifically within his capability.

   (4) The operator is not to make adjustments or replace items unless he can make a confirmatory test.

CONFIDENCE CHECKS

2. The following confidence checks provide a rapid indication of equipment operation:

   (1) Using the equipment test facility as detailed in Chapter 2, para. 43, the following quantities can be monitored:

      (a) transmitter output power

      (b) received signal strength

      (c) power supply voltage

      (d) power amplifier heatsink temperature

   (2) Confirm that the 9th digit of the alphanumeric display is set to T (transmit) or R (receive) depending upon handset pressel position.

   (3) On depressing headset pressel, confirm that the transmit sidetone can be heard on the operator's headset.

   (4) Set the Off/Gain/Erase switch to the fully clockwise position and confirm that when in receive mode, a hiss can be heard in the operator's headset.

OPERATIONAL CHECKS

3. (1) The operational checks given in Tables 3 to 8 should be performed using a second, tested, VRM 5080 unit to allow transmission and reception in various modes to be checked. (A network of four stations is necessary to carry out the Auto Rebroadcast checks in Table 9.)

(2) Both units should be programmed with the same frequencies using single frequency and two-frequency channels.

(3) If an encryption unit is fitted, the channels of both units should be programmed with identical codes. If it is required to check the equipments for data transmission and reception, data units should be connected to both transceivers.

CHAPTER 6

MECHANICAL DESCRIPTION AND DISMANTLING

CONTENTS

Para.		Page
1	INTRODUCTION	6-1
2	MA 4168 KEYBOARD MODULE	6-1
4	MA 4169 TRANSCEIVER	6-1
5	MODULE REMOVAL	6-1

CHAPTER 6

MECHANICAL DESCRIPTION AND DISMANTLING

INTRODUCTION

1. The VRM 5080 equipment comprises an MA 4168 Keyboard Module and an MA 4169 Transceiver.

MA 4168 KEYBOARD MODULE (Refer to Fig. 7)

2. The MA 4168 is a self contained module providing keypad and display facilities for the equipment. The keyboard module is usually fitted directly into the recess in the equipment front panel. Alternatively, where it is required to install the equipment in an inaccessible position, the keyboard module may be fitted in a keyboard unit mounting box to provide a remote keyboard facility at a distance of up to 10 metres as described in Part 1, Chaper 3, para. 2(7).

3. The construction of the keyboard module is given in Part 3, Chapter 1, para. 4.

MA 4169 TRANSCEIVER (Refer to Fig. 8)

4. The MA 4169 Transceiver is of modular construction. The equipment casing consists of the following:

   (1) Front panel casting containing the equipment input/output connectors, Off/Gain/Erase switch, antenna change-over relay, volume control resistor network, main on/off power relay and power supply decoupling. A recess is provided in the equipment front panel to house the MA 4168 Keyboard Module.

   (2) Heatsink casting containing the power amplifier module.

   (3) Equipment casing containing the receiver, transmit oscillator, audio, central control, synthesiser and comsec (VRM 5080S version only) modules. In the VRM 5080C version of the equipment, the position of the comsec module is left vacant. A VRM 5080C equipment may be upgraded to a VRM 5080S simply by inserting a comsec module in the appropriate location, if this is done, however, the identification plate on the front panel should be reversed.

MODULE REMOVAL

5. Where it is required to remove a given module (not the PA module) from the Transceiver, the following procedure should be adopted:

   (1) Lay the equipment on its right-hand side (when viewed from the equipment front panel).

(2) Withdraw the four 5 mm hexagon socket head cap screws which secure the front panel to the equipment casing and swing the front panel clear by pivotting it about the flexible printed circuit board and coaxial leads as shown in Fig. 9.

(3) Withdraw the four 5 mm hexagon socket head cap screws which secure the heatsink casting to the rear of the equipment casing and swing the heatsink casting clear by pivotting it about the flexible printed circuit and coaxial leads as shown in Fig. 10.

(4) Withdraw the two M4 crosshead captive screws which secure the module retaining bar to the equipment casing and remove the bar.

(5) Withdraw the two M5 crosshead captive screws which secure the required module to the motherboard mounting frame.

(6) Extract the module from the rear of the equipment.

(7) The module replacement procedure is the straight reversal of the dismantling procedure above. When refitting the module, however, ensure that the module is inserted the correct way up so that the two halves of the connector mate. Ensure that the module retaining bar is correctly positioned. When refitting the front panel and heatsink casting, confirm that the 'O' ring gaskets are correctly located in the annular slots.

6. Where it is required to remove the power amplifier module from the Transceiver, the following procedure should be adopted:

(1) Lay the equipment on its right hand side (when viewed from the equipment front panel).

(2) Withdraw the four 5 mm hexagon socket head cap screws which secure the heatsink casting to the rear of the equipment casing and swing the heatsink casting clear by pivotting it about the flexible printed circuit and coaxial leads as shown in Fig. 10.

(3) Disconnect the flexible printed circuit connector and the two coax connectors and lift the module clear.

(4) The power amplifier module replacement procedure is the straight reversal of the dismantling procedure above. When reconnecting the coax connectors ensure that the output from the transmit oscillator module is connected to the socket furthest from the flexible printed circuit connector. When refitting the heatsink casting, confirm that the 'O' ring gasket is correctly located in the annular slot.

CHAPTER 7

PRINCIPLES OF OPERATION

CONTENTS

Para.		Page
1	INTRODUCTION	7-1
4	AUDIO MODULE	7-1
9	KEYBOARD MODULE	7-2
11	CENTRAL CONTROL MODULE	7-2
18	SYNTHESISER MODULE	7-2
21	RECEIVER MODULE	7-3
25	TRANSMIT OSCILLATOR MODULE	7-3
28	POWER AMPLIFIER MODULE	7-3
32	ENCRYPTION MODULE	7-4

ILLUSTRATIONS

Fig. No.	
7.1	Block Diagram: VRM 5080S

CHAPTER 7

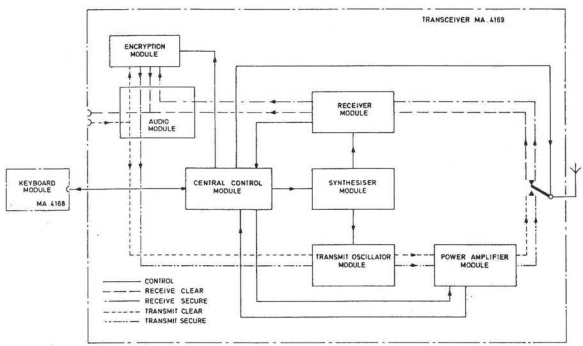
PRINCIPLES OF OPERATION

INTRODUCTION

1. The VRM 5080 50 W VHF Transceiver is a modular equipment shown in block diagram form in Fig. 7.1.

2. The function of each module is described below.

3. Reference should be made to Part 1, Chapter 1 and Chapter 1 of each of the parts describing the modules (Parts 2 to 9).



Block Diagram: VRM 5080S Fig.7.1

AUDIO MODULE

4. The audio module accepts narrowband signals from the remote lines and audio, audio/data and harness inputs, wideband signals from the audio/data and harness inputs and 16 kbit/sec data from the remote lines (VRM 5080S only).

The signals are amplified and filtered as appropriate and fed to the transmit oscillator module via either the encryption module (assuming the encryption facility is fitted and secure transmission is selected) or after being summed with a 150 Hz tone.

A proportion of the input signal is also fed back to the operator to provide sidetone.

5. The audio module also accepts the discriminator output from the receiver module and, after performing the required narrowband/wideband switching and filtering, provides outputs to the remote lines and audio, audio/data and harness connectors.

6. The audio module interfaces with the associated BCC 543 AAMTU/BCC 587B AMU ensuring the correct antenna re-tuning sequence when a new transmit frequency is selected.

7. The module generates a two frequency error tone and a 2 kHz call tone.

8. Pulse width modulated control data is transmitted along a bi-directional highway interconnecting the audio, audio/data, harness and central control input/output.

   Access to the highway is controlled by the audio module using four bi-directional ports which ensure that when data is received via a given port and fed onto the highway the remaining ports re-transmit the data to their respective input/outputs thus providing a common distribution of all control data.

KEYBOARD MODULE

9. The keyboard module is a self contained unit which is normally fitted into a recess in the front panel casting. (Alternatively the keyboard may be fitted in a mounting box permitting remote operation over a distance of up to 10 metres.)

10. The keyboard module has a 24 key keypad permitting entry of frequency, mode and programming data. This data is encoded as a pulse-width modulated serial data signal and transmitted along a bi-directional highway to the central control module.

    Frequency, mode and test data stored in the central control is similarly encoded and transmitted along the serial data highway to the keyboard module. The received data is checked and, if satisfactory, displayed on the 16 digit alphanumeric display.

CENTRAL CONTROL MODULE

11. The central control module retains all frequency, mode and test data in a non-volatile store. (Encryption codes are also stored where an encryption module is fitted.)

12. The central control module receives pulse width modulated frequency, mode and encryption data from the keyboard module. The incoming data is subjected to various checks and, where the checks are satisfactory, the data is entered into store.

13. Data stored in the central control module is similarly encoded and transmitted along the serial data highway to the keyboard module.

14. The module receives test data signals from the power amplifier and receiver modules.

15. The module transmits a serial frequency input to the synthesiser, a serial data mode input to the audio module and encryption codes to the comsec module.

16. The central control also outputs high/low bandswitch outputs to the synthesiser and power amplifier modules and an output to the transmit oscillator module to sub-divide the high and low bands.

17. On selecting a new transmit frequency, the central control module initiates a new ATU tuning sequence.

SYNTHESISER MODULE

18. The synthesiser module generates the receiver local oscillator and transmit oscillator input signals and the tuning voltage for the receiver hyperabrupt varactor tuned circuits.

19. The operational frequency range is covered using two oscillators: the low band oscillator covering 40.7 to 60.275 MHz (30.0 to 49.575 MHz plus 10.7 MHz IF offset) and the high band oscillator covering 60.3 to 86.7 MHz (49.6 to 76.0 MHz plus 10.7 MHz IF offset). The oscillator frequency is compared with the serial data frequency word from the central control and the resulting difference signal is fed back to the oscillators to form a closed loop.

20. The 10.7 MHz component is removed from the oscillator output when the pressel is operated.

RECEIVER MODULE

21. The receiver input signal from the antenna change over relay is fed via a front-end protection circuit. The protection circuit prevents overloading and frequency drift of the receiver or damage from large signals and also switches off the receiver when the equipment is set to transmit.

22. The output from the protection circuit is switched to either the low frequency tuning block (covering 30.0 to 49.575 MHz) or the high frequency tuning block (covering 49.6 to 76.0 MHz). Tuning is performed by using the synthesiser tuning voltage to vary the capacitance of the hyperabrupt varactor diodes.

23. The outputs from the tuning blocks are switched and fed to a double balanced mixer. The mixer output is filtered and limited prior to feeding to the discriminator circuit.

24. The discriminator provides an audio output and squelch control to the audio module and received signal level detector output to the central control module.

TRANSMIT OSCILLATOR MODULE

25. The transmit oscillator module applies phase modulation to the phase-locked synthesiser output and provides approximately 400 mW of RF drive to the power amplifier module.

26. The operational frequency range is covered using two oscillators (the low band oscillator covering 30.0 to 49.575 MHz and the high band oscillator covering 49.6 to 76.0 MHz). The oscillator output frequency is compared with the reference output from the synthesiser and the difference signal is fed back to the oscillator to form a closed loop and slave the transmit oscillator to the synthesiser output frequency.

27. The modulation output from the audio module is integrated and used to phase modulate the transmit oscillator output.

POWER AMPLIFIER MODULE

28. The power amplifier module is housed in the heatsink casting at the rear of the equipment. The module consists of the power amplifier and power supply/filter boards.

29. The power amplifier input signal from the transmit oscillator is switched by low, medium and high power control signals from the central control module.

When low power is selected, the input signal bypasses the driver and output stages to give a nominal output of 3 mW.

When medium or high power is selected, the input signal is fed via the driver and output stages. The medium and high power output levels of 10 W and 50 W respectively are set by switching the supply line to +8.5 volts or +22 volts.

30. The power amplifier output is low pass filtered and fed via the antenna change over relay to the antenna.

31. The power supply/filter board comprises the power amplifier regulator, the 17 volt regulator, the 22 volt regulator, the 5 volt regulator, the high band/low band low pass filter, ATU logic and attenuator circuits and temperature, transmit power and voltage level detector circuits.

ENCRYPTION MODULE

32. The encryption module is fitted only to VRM 5080S equipments. The module permits the encryption of analogue signals (speech) into secure data prior to transmission and decryption by the receiving equipment.

33. The encryption codes are retained in the central control. Encryption codes are stored only where an encryption module is fitted.

34. Where it is required to transmit secure traffic using a VRM 5080C, an external encryption unit may be used. In this case, the encryption codes are stored in the encryption unit itself.

CHAPTER 8

FRONT PANEL ASSEMBLY AND EQUIPMENT INTERCONNECTIONS

CONTENTS

Para.		Page
1	INTRODUCTION	8-1
2	FRONT PANEL INTERCONNECTIONS	8-1
3	SUPPLY LINE SWITCHING AND FILTERING	8-1
6	ANTENNA CHANGE-OVER RELAY	8-2
8	VOLUME CONTROL RESISTOR NETWORK	8-2
10	ERASE FACILITY	8-2
11	EQUIPMENT INTERCONNECTIONS	8-3
12	DETAILS OF INTERCONNECTION DATA	8-8

CHAPTER 8

FRONT PANEL ASSEMBLY AND EQUIPMENT INTERCONNECTIONS

INTRODUCTION (Refer to Fig. 11)

1. The front panel assembly houses the MA 4168 Keyboard Module and interconnects the equipment to its system by means of the following connectors:

   (1) ATU control socket, SK1

   (2) ATU RF socket, SK2

   (3) Remote lines connectors, SK3, SK4

   (4) HARNESS socket, SK5

   (5) AUDIO socket, SK6

   (6) AUDIO/DATA socket, SK7

   (7) Supply plug, PL1

   (8) Earth stud.

   In addition, the front panel assembly performs switching and filtering of the supply voltage lines, switching of the antenna change-over relay, houses the volume control resistor network and provides an erase facility to corrupt the contents of the central control random access memory (encryption codes, frequencies and modes).

FRONT PANEL INTERCONNECTIONS

2. The front panel assembly interconnections are shown in Fig. 12.

SUPPLY LINE SWITCHING AND FILTERING

3. The equipment switch-on sequence is initiated by either of the following:

   (1) Move the Off/Gain/Erase switch clockwise from the OFF position thereby energising RLB via diode D2, D4, D5, D7 or D10 on the volume control board. (The circuit is completed through the earth stud and metal mounting tray to the vehicle earth.)

   When the relay is energised, RLB1 switches PL1 pin B to pins 7, 8, 9, 10, 11 and 40 of the flexible printed circuit connector and RLB2 switches PL1 pin A to pins 1, 2, 3, 4, 5 and 6 of the flexible printed circuit connector.

(1) If pin K of the harness connector, SK5 is set low, RLB is energised via D1 and the 0 volt and 24 volt lines are switched as above.

NOTE: If the equipment supply polarity is reversed, diodes D1, D2, D4, D5, D7, D10 will be reverse-biased, RLB will not be energised and the equipment will not switch on. If the supply is not -ve earthed to chassis the equipment will not switch on.

4. Resistor R1 ensures that when the equipment is powered by the MA 4913 12/24 V power supply unit, the initial current drain through RLB and R1 is sufficient to switch on the MA 4913.

5. Filtering of the supply voltage lines is performed by C35, L4, C36, L3, C37, L2, C32. Diode, D3 protects the equipment from high voltage transients on the supply lines.

ANTENNA CHANGE-OVER RELAY

6. The antenna change-over relay is controlled by a Darlington pair transmit/receive switch located in the audio module.

When the equipment is set to receive (i.e. no pressel input), pin 37 of the flexible printed circuit connector is set high holding RLA in the de-energised state and connecting the antenna via RLA1 to the receiver antenna connector, SK8. Whilst the equipment is receiving, the transmitter output, SK9 is connected to chassis by RLA2.

When pin 37 is set low, RLA is energised and the antenna is switched via RLA1 to SK9. The receiver input is switched to chassis RLA2.

7. The T/R relay line is filtered by L5, C3, L1, C20.

VOLUME CONTROL RESISTOR NETWORK

8. The volume control resistor network comprises R2, R3, R4, R5. The volume varies inversely with the amount of resistance switched into the network between pin 62 and chassis.

9. When the Off/Gain/Erase switch is set fully clockwise, the circuit provides a medium volume level via D5, R5 and a squelch override input to the audio module by forward biasing D11.

ERASE FACILITY

10. When the Off/Gain/Erase switch is set fully anti-clockwise (the Z position), pin 58 is set low and the supply rail to the central control module random access memories is set to 0 V thereby corrupting the RAM contents.

NOTE: The erase position is protected by a mechanical interlock in order to prevent accidental erasure. In order to overcome the mechanical interlock, the interlock lever on the front of the switch should be pivoted outwards thereby permitting the switch to be set to the Z position.

EQUIPMENT INTERCONNECTIONS

11. The MA 4169 interconnection diagram showing the connections between each of the transceiver modules is shown in Fig. 13.

The interconnection data is also given in tabular form in Part 1, pages 8-4 to 8.7. Details of the abbreviated signal data listed in these tables is given on pages 8-8 to 8-13.

The equipment motherboard is shown in Figs. 14 and 15.

Motherboard 2 Signal	Front Panel 1	Power Amplifier 3	Receiver 4	Oscillator 5	Audio Logic 6	Central Control 7	Synthesiser 8	CONSEC 9
+V I/P	1,2,3,4,5,6	27 to 32						
O V	7,8,9,10,11	4,6,7,9,25,26	11,12,41,42 51,52,55,60	61, 31,32	61,62,31,32	61,62,31,32	61,62,31,32	
K/B DATA	59				46	11,42		
OC Vol	62				45			
FP NOISE	57				21			
I/P A/D	56				27			
I/P E A/D	53,55				25			
22 V	51,54	5						
O/P A/D	52				19			
PTT5	50				17			
phone A/D	47				15			
mic A	45				13			
mic E A	46,48				11			
phones A	43				9			
PTT1	41				7			
R/L +	42				5			
R/L -	39				3			
T/R RELAY	37				39			
ZEROISE	58					12		
I/P H	27				16			
I/P E H	28				14			
N/W	29				12			
PTT4	30				10			
TRb	31				8			
I CLEAR	33				6			
CNT DATA	34				4			
REM ON								

Motherboard 2 Signal	Front Panel 1	Power Amplifier 3	Receiver 4	Oscillator 5	Audio Logic 6	Central Control 7	Synthesiser 8	COMSEC 9
M1/CTS	35				2			
O/P H	36				1			
CLOCK	19				52	51,52	51	9A
SILENT	25				24	23		
24 V ATU	23,24	3						
FM D	20				50	49,50	49	
PTT3	21				18			
FE	18					54	53	
17VFP	13	24						
17VM/B (T)	12	23	43,44	29,30	29,30	29,30	29,30	20A,20B
17V$\overline{H}$ (T)	70	1	33	39				
17VH (T)	69	2	15,16	57				
M1 (T)	67		29		43,44	43		
DISC O/P (T)	66		37		35			
LK Tx (T)	64			34	33			
LK SYN (T)	17				34		33	
ME (T)	15				42	41		
OV$\overline{H}$ (T)	14	15				58	70	
T (T)	16		35		37,38	37,38	37,38	
VTX (T)	63			27				
5 V (T)	68	8	13,14	59,60		59,60	59,60	5A,5B
M3 (T)	38				28			21A
ITxOSC	60			41,42	41			
SE (T)	71					44		13A
SD (T)	72					46		12A
VT SYN-RX(T)	65		31				41,42	
INIT TUNE		13				66		

Motherboard 2 Signal	Front Panel 1	Power Amplifier 3	Receiver 4	Oscillator 5	Audio Logic 6	Central Control 7	Synthesiser 8	COMSEC 9
ATU TUNE		10			68	65		
I Tx PA		12			71			
HP		11			69			
TLP		14			72			
V MSB		22				68		
V LSB		17				69		
TEMP MSB		21				70		
TEMP LSB		18				71		
TX MSB		16				67		
TX LSB		19				72		
TW		20			70			
RxSYN			54				20	
RxSYN SC			53				19	
IFSG(T)			39,40					
Rx LSB			25			47		
Rx MSB			27			45		
20 V				56			55	
TxSYN				71			72	
TxSYN SC				72			71	
Tx BAND				54		53		
8 V (T)				25				
MOD				64	64			
MOD SC				63	63			
CINS					58	57		
S/TC					20	19		
SIN						64		28

Motherboard 2 Signal	Front Panel 1	Power Amplifier 3	Receiver 4	Oscillator 5	Audio Logic 6	Central Control 7	Synthesiser 8	COMSEC 9
E DISP					49	48		
CNT D E					22	21		
ERROR					67	63		
150 Hz					26		25	
DIN					36			17A
TS					40			15A
C MOD					57			6A
AF OUT					23			23A
S MOD					65			3B
S MOD Sc					66			3A

DETAILS OF INTERCONNECTION DATA

12. +V I/P	Supply Voltage Input	Filtered supply from pin A of power supply socket.
0 V	Ground	Connected to chassis.
K/B Data	Keyboard data	Bidirectional serial data line to audio module and front panel mounted keyboard.
DC Vol	DC Volume Control	Voltage level used to control handset audio level.
FP Noise	Front Panel Noise	Logic signal controlling squelch override from front panel.
I/P A/D	Input Audio/Data	Mic audio or data from pin A of audio/data socket.
I/PE A/D	Input Earth Audio/Data	Ground reference for input signal and programming input from pin B of audio/data socket.
22 V	22 V Regulated Supply	Supply output to pin C of audio/data and audio sockets.
O/P A/D	Output Audio/Data	Audio or data output to pin D of audio/data socket.
PTT5	Press-to-talk 5	Earth for transmit and serial control data to pin F of audio/data socket.
Phone A/D	Phone Audio/Data	Phones output and squelch/clear to send connected to pin G of audio/data socket.
MIC A	Microphone Audio	Microphone input from Pin A of audio socket.
Mic E A	Mic. Earth Audio	Ground reference for mic signal from pin B of audio socket.

Phone A	Phone Audio	Audio output to pins D and G of audio socket.
PTT 1	Press-to-talk 1	Earth for transmit and serial control data to pin F of audio/data socket.
R/L+	Remote Line Positive	Remote line audio and signalling output.
R/L-	Remote Line Negative	Remote line audio output and ground reference.
T/R Relay	Transmit/receive relay	Earthed on transmit to operate changeover relay.
Zeroise		Earthed by front panel switch to erase data stored in central control.
I/P H	Input Harness	Mic. audio or data from Pin A of harness socket.
I/PE H	Input Earth Harness	Ground reference for mic signal from pin B of harness socket.
N/W	Narrow/Wideband	Earth for wideband audio (also output when crypto fitted) from pin C of harness socket.
PTT 4	Press-to-talk 4	Earth for transmit to pin D of harness socket.
Trb	Transmit Rebroadcast	Earthed by radio to operate slave transmitter PTT in rebroadcast pin E of harness socket.
I Clear	Inhibit Clear Sets	Used in secure systems to inhibit clear transmitters. Pin H of harness socket.
CNT Data	Control Data	Serial control data I/O pin S of harness socket.

REM ON	Remote On/Off	Earth to switch on remotely pin O or harness socket.
MI/CTS	Carrier Squelch/Clear to send	Low indicates received signal or transmitter working. Earth to override squelch remotely. Pin L of harness socket.
O/P H	Output Harness	Audio/Data output to pin M of harness socket.
Clock		Clock used to transfer data on internal data system. Pin A of ATU socket.
Silent	Silent Tune	Low output switches BCC 543 to silent tune. Pin B of ATU socket.
24 V ATU		Switched supply output to ATU pin C of ATU socket.
FMD	Frequency Mode Data	Data line carrying frequency and Mode data words. Pin D of ATU socket.
PTT 3	Press-to-talk 3	Keyline, earth to switch radio to 'Tune Power' transmit. Pin F of ATU socket.
FE	Frequency Enable	Framing pulse indicating frequency word. Pin G of ATU socket.
17 V FP	17 volt supply to Front Panel	17 V connected to keyboard top stud and harness pin K.
17 V M/B (T)	17 Volt supply on Motherboard.	Test signal (brought out to FP connector)
17 V H (T)	18 volts lowband switched	" "
17 V H (T)	17 volt highband switched	" "
M1 (T)	Carrier Squelch	" "

Disc O/P (T)	Discriminator Output	Test Signal (brought out to FP connector)
LK Tx (T)	Lock Transmitter Oscillator	" "
LK SYN (T)	Lock Synthesizer	" "
ME	Mode enable	" " Mode word framing pulse
OVH	Bandswitching	" "
VTX (T)	Tx oscillator varactor voltage	" "
5 V (T)	5 V Supply	" "
M3 (T)	16 Kb squelch	" "
I Tx Osc (T)	Inhibit Tx Oscillator	" "
SE (T)	Secure Enable	" " Secure code framing pulse
SD (T)	Secure Data	" " Secure code data
VT SYN-Rx(T)	Synthesizer varactor voltage	" "
INIT TUNE	Initiate Tune	
ATU TUNE		
I Tx PA	Inhibit Tx Power Amplifier	
HP	High Power Select	
TLP	Low Power Select	
V MSB	Voltage most significant bit	
V LSB	Voltage Least " "	
Temp MSB	Temperature Most " "	

Temp LSB	Temperature Least Significant bit	
Tx MSB	Power Most Significant Bit	
Tx LSB	Power least " "	
Tw	Transmit working	Indicators on HP or MP, RF Power is preset.
Rx Syn	Receiver local oscillator	Coaxial connection on motherboard
Rx Syn Sc	Screen	
IF SG (T)	IF Signal Level	DC level varies with RF level
Rx LSB	Receive signal LSB	
Rx MSB	Receive signal MSB	
20 V	20 V Supply	Generated in synthesizer
Tx Syn	Transmit Oscillator reference	Coaxial connection on motherboard
Tx Syn Sc	Screen	
Tx BAND	Transmit Bandswitch	Switches Tx oscillator sub-bands
8 V (T)	8 V supply	On Tx oscillator
MOD	Modulation	Screened track on motherboard
MOD Sc	Modulation Screen	
C In S	Clear in Secure	Indicates clear message received when secure selected.
S/Tc	Sidetone Control	Indicates Tw, Lk, Syn, Lk, Tx are all preset

SIN	Secure Module In	Secure module earths line to central control.
E Disp	External data device display	
CNT D E	Control Data Enable	Permits audio module to drive data onto a PTT line which is earthed via 1.5 kΩ resistor.
Error		Sets error tone warning.
150 Hz	Squelch Tone	From synthesizer.
D In	Data In	16 kb/s data into secure module.
C Mod	Clear Modulation	Clear audio into secure module.
TS	Transmit Secure	Switches secure module to transmit.
AF Out	Audio Output	Clear audio out of secure module.
S Mod	Secure Modulation	16 kb/s data out of secure module.
S Mod Sc	Screen	screened track on motherboard.