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RA. 329

MILITARY TRANSISTORIZED

H.F. COMMUNICATIONS RECEIVER

(5820 - 99 - 193 - 4312)

SYSTEM MAINTENANCE MANUAL

RACAL

COMMUNICATIONS LIMITED

BRACKNELL

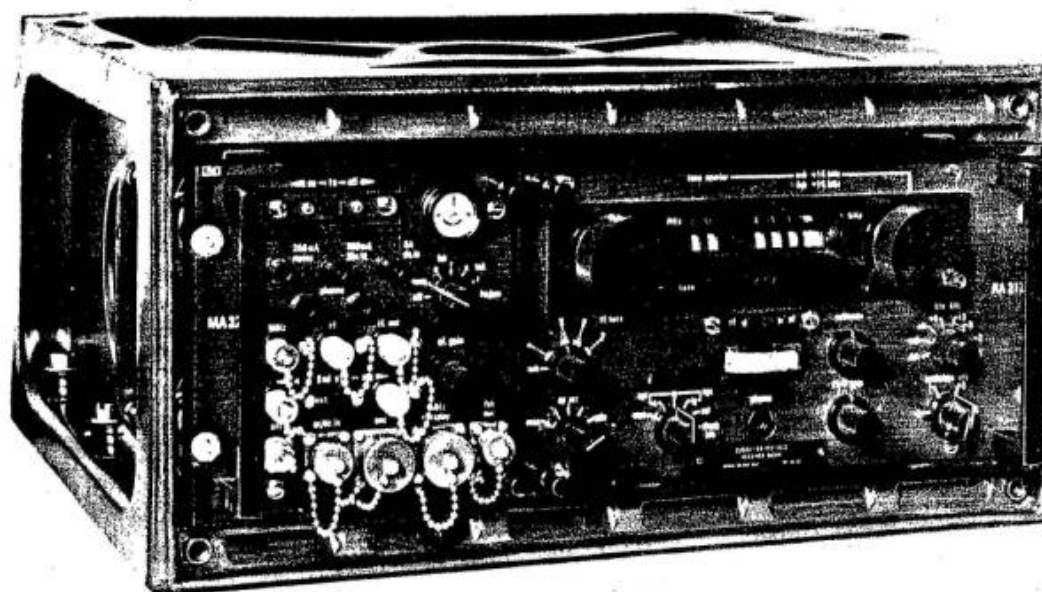
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MILITARY TRANSISTORIZED H.F. COMMUNICATIONS RECEIVER
TYPE RA.329B
(Z1/5820-99-193-4312)

RA. 329B MAINTENANCE MANUAL

CONTENTS

TECHNICAL SPECIFICATION

PART 1	RA. 329B SYSTEM
PART 2	RA. 217D MAINTENANCE
PART 3	MA. 323 MAINTENANCE

A detailed Contents List will be found at the beginning of each of the above parts.

TECHNICAL SPECIFICATION - RA. 329B

Frequency Range	1 to 30 MHz.
Modes of Reception	S.S.B. (U.S.B. or L.S.B.), D.S.B., M.C.W., C.W., F.S.K., Ph.M., F.M.
Tuning	Digital presentation in units of 1 kHz with interpolation calibration at 200 Hz intervals.
Calibration Accuracy	Better than ± 1 kHz referred to nearest 100 kHz calibration point.
Calibration	A 100 kHz signal, derived from the 1 MHz crystal oscillator provides check points at 100 kHz intervals.
Frequency Stability	After two hours from switch-on: ± 50 Hz over an eight hour period at constant ambient temperature and humidity.
Antenna Input	Nominal 75 Ω impedance unbalanced into a wideband circuit, or tuned in five automatic- ally selected bands:- (i) 1 to 2 MHz. (iv) 8 to 16 MHz. (ii) 2 to 4 MHz. (v) 16 to 30 MHz. (iii) 4 to 8 MHz.
Sensitivity	With tuned antenna input, and measured in a 3 kHz bandwidth, sensitivity figures are typically: CW/SSB. 1 μ V (emf) for 15dB signal-to- noise ratio. MCW/DSB. (30% modulated at 400 Hz). 3 μ V (emf) for 15dB signal-to-noise ratio.
Selectivity	Four alternative I. F. bandwidths are selected by means of a front panel switch with nominal 3dB bandwidths: 1. 13 kHz. 2. 3 kHz. 3. 1 kHz. 4. 0.2 kHz.

Cross Modulation

For a wanted signal level up to 1 mV and with appropriate use of the antenna attenuator an interfering signal, 20 kHz removed and modulated 30% at a level of 45 dB above that of the wanted signal will, in general, produce a cross modulation of less than 3% in the tuned input mode.

Intermodulation

To produce an equivalent 1 μ V input, the level of two equal unwanted signals greater than 10% removed from the wanted frequency must be at least 80 dB above 1 μ V in the tuned input mode.

Blocking

For level of wanted signal up to 1 mV, and with appropriate use of the antenna attenuator, an interfering signal 20 kHz removed, must be 56 dB above the level of the wanted signal to reduce its output by 3 dB in the tuned input mode.

Spurious Response to External Signals

To produce a response equivalent to 1 μ V signal, an external signal must, in general, be greater than 60 dB above 1 μ V.

Spurious Responses Internally Generated

Not greater than 3 dB above noise level in a 3 kHz bandwidth.

Noise Factor

Typically 10 dB.

I. F. Output (A. G. C. ON)

100 kHz: 270 mV across 75 Ω (nominal).

Automatic Gain Control

a) Time Constants (nominal)

	<u>Charge</u>	<u>Discharge</u>
Short	10 mS	20 mS
Medium	50 mS	250 mS
Long	50 mS	4 Sec.

b) Output change (nominal)

An increase in input of 85 dB above 2 μ V will produce a change in output level not greater than 4 dB.

B.F.O.

- a) Fixed offsets of +6, +3, 0, -3, and -6 kHz each variable by ± 3 kHz with respect to i.f. centre frequency.
- b) Fixed: ± 1.5 kHz (U.S.B. / L.S.B.) crystal controlled.

A.F. Output

- a) Headphone output: 10 mW into 600 Ω
- b) Line output 1 mW into 600 Ω
- c) 50 mW internal loudspeaker.

Overall A.F. Distortion

Less than 5%.

Overall A.F. Response

With a selectivity bandpass of 13 kHz the audio frequency output level from 100 Hz to 6000 Hz will not vary more than 4 dB from peak response.

Meter Indication RA. 217D

- a) R.F. Levels.
- b) A.F. level to line.

Meter Indication MA. 323

- a) F.S.K. demodulator: centre zero for mark/space Balance.

F.S.K. Demodulation

- a) Centred on 2550 Hz.
- b) Frequency shift: 85 to 850 Hz.
- c) Speed 50 up to 150 bauds.
- d) Relay output: dry contact polar relay with spark-suppressed contacts giving Space, Tongue, Mark connections. Contact rating 500V, 100 mA.
- e) Bias adjustment: $\pm 10\%$ by preset potentiometer.
- f) Bias distortion: less than 3% (nominal).
- g) Carrier fail detector holds relay on space or mark in absence of adequate signal.

F.M. / Ph. M. Demodulation

- a) Linear range: ± 10 Hz.
- b) Distortion (± 4 kHz deviation): less than 3% (nominal).
- c) Frequency response: within 3 dB 100 to 4000 Hz.

Power Supply

By appropriate connections to the front panel plug AC/DC IN, operation from the following power sources is obtainable:-

- a) 100-125V a.c. 45-400 Hz single phase.
- b) 200-250V a.c. 45-400 Hz single phase.
- c) 9-30 V d.c. floating input.

Power Consumption

15 VA approximately.

Controls

Receiver portion: (RA. 217D).

- a) Meter Switch: A. F. level/carrier level.
- b) Frequency Readout: in-line.
- c) MHz Tuning.
- d) kHz Tuning.
- e) System Switch.
- f) B. F. O. Variable and Detector Mode Selector.
- g) R. F. /I. F. Gain Control.
- h) R. F. Tuning/W. B. Control.
- i) Tuning Locks.
- j) Calibrate-Fine Tune.
- k) I. F. Bandwidth.
- l) Antenna Attenuator.
- m) Phone Socket.

F. S. K. Demodulator and A. F. Amplifier portion (MA. 323):

- a) Mode Switch.
- b) A. F. Gain.
- c) Loudspeaker ON/OFF Switch.
- d) Second V. F. O. IN/OUT Selector.

External Connections (Front Panel MA. 323)

- a) Phone Sockets: two in parallel 10 mW in 600Ω.
- b) Coaxial Socket BNC 1 MHz Input.
- c) Coaxial Socket BNC Adaptor connection.
- d) Coaxial Socket BNC 100 kHz I. F.
- e) Coaxial Socket BNC 2nd V. F. O. In.
- f) Coaxial Socket BNC 2nd V. F. O. Out.
- g) Coaxial Socket BNC Antenna.
- h) Power Supply Input Plug: Thorn 6-way.
- i) Ancillary Socket: Thorn 19-way.
- j) MHz Display Plug: Thorn 19-way.
- k) FSK Output Plug: Thorn 4-way.
- l) A. C. Power Supply Fuse: 250 mA.
- m) 16V H. T. Fuse: 500 mA.
- n) D. C. Power Supply Fuse: 3A.

Dimensions

- a) In transit case with lid.

10½ in. high x 20 in. wide x 19½ in. deep.
(27 cm) (51 cm) (49.5 cm)

- b) For standard 19 in. rack mounting.

7 in. high x 19 in. wide x 15 in. deep.
(17.5 cm) (48.3 cm) (38 cm)

Weight

- a) Including transit case with lid:
70 lb. (31 kg) approximately.

- b) For rack mounting:
50 lb. (22 kg) approximately.

Environmental Conditions

Operating temperature: -5°C to +55°C.

Storage temperature: -40°C to +70°C.

Humidity: 95% R.H. at +40°C.

The receiver is designed to meet certain of the requirements of British Defence Specification DEF. 133, Class L2, which include vibration and bump tests, and others appropriate to this class of equipment.

PART I

PART ONE
RA. 329B SYSTEM

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NOTE: Refer to Part 2 of the Manual for RA. 217D
Components and Part 3 for MA. 323.

PART ONE

RA. 329B SYSTEM

ILLUSTRATIONS

Frontispiece: Military Transistorized Communications Receiver RA. 329B

Fig. 1. Simplified Block Diagram: RA. 329B

Fig. 2. RA. 329B: Interconnections Between Units
(Fig. 1 and Fig. 2 are at rear of Part 1)

Fig. 2.1. Test Extension Leads for RA. 329.
(Fig. 2.1 is at the end of Chapter 2)

CHAPTER 1

GENERAL INFORMATION

GENERAL DESCRIPTION

1. It is assumed that the user is familiar with the general description contained in Part One Chapter One of the RA.329 System Operating Manual.

HANDBOOK NOTES

2. This Maintenance Manual consists of three parts, which are intended for use as follows:

Part One

This contains general information on connections, fuses etc. together with a System check and fault location guidance. The System check is intended only to establish that the receiving terminal is serviceable. If it is necessary to make any adjustment or repair, the user must refer to the more detailed procedures described in Part Two (RA.217) or Part Three (MA.323).

Part Two

This contains a detailed technical description of the RA.217D receiver, together with test and alignment procedures, dismantling instructions and component lists.

Part Three

This contains the same type of detailed information as Part 2, but refers specifically to the F.S.K. Demodulating and Terminating Unit MA.323.

FUSELINKS

3. These are mounted on the front of the MA.323. The correct type of fuselink must be fitted, as follows:

Fuselinks

<u>Identification</u>	<u>Rating</u>	<u>Replacement</u>
FS1 : D.C. Input	3 amp	Bulgin F300/3.0A
FS2 : A.C. Input	250 mA	Beswick TDC 134 anti-surge
FS3 : -16V	500 mA	Belling Lee L562

POWER SUPPLY

4. (a) AC 100 to 125 volts or 200 to 250 volts, 45 to 400 Hertz single phase.
(b) DC 9 to 30 volts positive or negative earth.

EXTERNAL CONNECTIONS

5. The following information is also contained in Chapter 2 of the RA.329 System Operating Manual. It should be noted that each receiver is supplied with a complete set of the connectors which mate with outlets on the MA.323.

Power Supply Cables

6. Two cables are supplied with each equipment; a three-core cable for use with an a.c. supply and a two-core cable for a d.c. supply. These cables are each fitted to a suitable connector for attachment to the plug AC/DC IN on the front of the MA.323. Wiring connections are as follows:

AC INPUT CABLE

<u>Pin</u>	<u>Wire Colour</u>	<u>Function</u>	
A	Red	Line	A. C.
B	Black (or Blue)	Neutral	A. C.
C	Green	Earth	A. C.

D.C. INPUT CABLE

D	Red	Positive	D. C.
E	Black (or Blue)	Negative	D. C.

Antenna and Phones

7. Connect the antenna to the ANT socket using 75 ohm coaxial feeder and BNC plug Type 5930-99-580-9636. (Transradio type BN1/7). The high impedance (600 ohm) headphones may be inserted in any of the three jacks. The phones Jackplug is an Igranic P50.

Teleprinter Connection

8. The teleprinter is connected to the F.S.K. OUT plug using a free socket type Thorn PT06W-8-4SA.

9. F.S.K. OUT Plug

The pins have standard MTS configuration and the cable should be connected as follows:

Pin A	Mark	Red
Pin B	Tongue	Green
Pin C	Space	Blue
Pin D	Earth	

Power for the teleprinter must be derived from an external telegraph power supply unit.

Ancillary (ANC) Connections

10. NOTE: The free plug and accessory set for connection to the ANC socket are Thorn PT06E-14-19P.

Pin

A	Test Point No. 1 on FSK unit.
B	Test Point No. 2 on FSK unit.
C	Test Point No. 3 on FSK unit.
D	+ 24V unregulated output.
E	- 24V unregulated output.
F	- 16V regulated D.C. Output.
G	Earth.
H	1 mW Audio out.
J	Screen to H.
K	Standby battery input 9-30V, +ve.
L	Standby battery input 9-30V, -ve.
M	Audio output from FM demodulator.
N	HT LF.
P	HT RF (for linking to pin N for operation below 1 MHz).
R	AGC LF.
S	AGC RF. (For linking to pin R for operation below 1 MHz).
T	A.G.C. Diversity.
V	AM Detector Output. (Approximately 200 mV into open circuit).

MHz Display Outlet

11. This 19-way outlet may be connected to an external readout unit to give a visual readout of the receiver MHz frequency. The readout connections at PL4 are as follows:-

<u>PL4 Pins</u>	<u>Digit</u>	<u>PL4 Pins</u>	<u>Digit</u>
A	1	H	8
B	2	J	9
C	3	K	0
D	4	L	00
E	5	M	20
F	6	N	10
G	7	P	Common

Coaxial Sockets

12. All coaxial outlets are 75 ohm unless otherwise stated. The free plugs for external connections are BNC 75Ω (Transradio Type BN1/7. British NATO 5935-99-580-9636).

Test Extension Leads Type CA.495

13. The extension leads enable either the RA.217D or the MA.323 to function outside the frame assembly, thus facilitating tests and adjustments. The set of leads can be obtained from the Service Department of Racal Communications Ltd., by quoting the Type Reference CA.495 and specifying for use with the RA.329B. One complete set of leads serves to extend either the MA.323 or the RA.217D.

Test Lead Assembly

14. To assist those customers who wish to assemble their own extension leads the list of parts and a schematic diagram is given in Chapter 2 (Test and Maintenance Equipment).

TABLE 1

MA.323 OUTLETS : CONCISE DATA

NOTE: The following data applies to a receiver which is serviceable and correctly adjusted. Audio and I. F. outputs assume that the correct input levels and control settings are used.

<u>Facility</u>	<u>Frequency</u>	<u>MA.323 Connection</u>	<u>Impedance or Termination</u>	<u>Level (Nominal)</u>
A. C. Power Supply	45-400 Hz	AC/DC IN		100-125 200-250
D. C. Power Supply	DC	AC/DC IN		9-30V

TABLE 1/CONTD.

<u>Facility</u>	<u>Frequency</u>	<u>MA. 323 Connection</u>	<u>Impedance or Termination</u>	<u>Level (Nominal)</u>
Internal-16V	DC	ANC pin F		16V \pm 0.5V
INT 2nd V. F. O.	3.6 to 4.6 MHz	2nd V. F. O. OUT	75 Ω	50 mV
100 kHz I. F.	100 kHz	I. F. OUT	75 Ω	270 mV
A. M. Det.	Audio	ANC pin V	None	200 mV
FM/PhM.	Audio	ANC pin M	2k Ω	50 mV
Line Audio	Audio	ANC pin H	600 Ω	1 mW
Phones Audio	Audio	Phones outlet (three)	600 Ω	10 mW
A. G. C. (RF)*	DC	ANC pin S	None	4 V \pm 0.25V
A. G. C. (DIV)*	DC	ANC pin T	None	9.5V \pm 1.0V
1 MHz	1 MHz	1 MHz	75 source	100mV e. m. f. from external source.
Reference Input				
Ext. 2nd V. F. O. or Synthesizer	3.6 to 4.6 MHz	2nd V. F. O. IN	75 source	100mV e. m. f. from external source.

* NOTE: Refer to Chapter 3 paragraph 9 for A. G. C. measurement

CHAPTER 2

TEST AND MAINTENANCE EQUIPMENT

NOTE: The following items of test equipment are required for the whole range of tests on the RA. 329B System, including the RA. 217D receiver and the MA. 323 unit. The items used in a particular range of tests are listed in each part of the Manual.

R. F. Signal Generator

Frequency Range	10 kHz to 70 MHz
Output Impedance	75 ohms
A. M. Modulation distortion	less than 10%
Example:	Marconi TF144H, with 50 to 75 ohms adaptor and 20 dB pad.

Multimeter AC/DC

Sensitivity	20 000 ohms/volt
Range	0 to 300 volts
Accuracy	2% of full scale
Example	AVO Model 8

Electronic Voltmeter (RF Voltmeter)

D. C. Input impedance	Not less than 1 megohm
Range (0 dB = 0. 775 volts)	Minus 50 dB to plus 10 dB
Frequency Range	Up to 70 MHz
Example	Airmec Type 301

Electronic Voltmeter (L. F.)

D. C. Input Impedance	Not less than 1 megohm
Range (0 dB = 0. 775 volts)	Minus 50 dB to plus 10 dB
Example	Advac VM77

Digital Frequency Meter (Counter) With Active Probe

Frequency Range	D. C. to 70 MHz
Accuracy	Internal reference frequency 1 part in 10^6 plus or minus 1 count.
Example	Racal Type SA550 with the high sensitivity, high impedance active probe unit Type SA. 544.

Output Power Meter

Frequency Range	100 Hz to 6000 Hz
Input Impedance	600 ohms and 3 ohms
Example	Marconi TF. 893A

Noise Generator

Output Impedance	75 ohms
Example	Marconi TF. 1106

Oscilloscope

Frequency Range	0 to 30 MHz
Example	Tektronix 545A

Audio Frequency Generator

Frequency Range	100 Hz to 15 kHz
Example	Advance Type J2

F.M. Signal Generator

Internal Modulation	1000 Hz
External Modulation Facility	100 - 6000 Hz
Frequency Outputs	1.6 MHz: 3.5 MHz
Deviation	± 4 kHz
Output Levels	1 μ V: 10 mV
Output Impedance	75 ohms
Example	Marconi 995A/2M

Telegraph Distortion Measuring Set (T. D. M. S.)

See NOTE below:

Data Rate	50 bauds
Example	Plessey Type SEBV

NOTE: This T. D. M. S. is used as a Message Generator. It may be noted that the Racal Telegraph (F. S. K.) Test Generator Type CA. 496 incorporates a simplified message generator which is adequate for testing without the use of the T. D. M. S. referred to above.

Teleprinter and Power Supply

Speed	50 bauds
Example	Creed Type 28

Telegraph (F.S.K.) Test Generator

Output Frequency	100 kHz, adjustable
Output Levels	5 mV to 300 mV
Shift	0 to 1000 Hz
Data Rate	50 to 150 Bauds
Internal Square-wave modulation.	
Facility for external modulation.	
Example	Racal Type CA.496

Telephone Headset

Not less than 600 ohms impedance.

Terminating Resistors

27 Ω	$\frac{1}{4}$ watt
47 Ω	$\frac{1}{4}$ watt
75 Ω	$\frac{1}{4}$ watt
330 Ω	$\frac{1}{4}$ watt
680 Ω	$\frac{1}{4}$ watt
2.2k Ω	$\frac{1}{4}$ watt

Tools

Spanner 9/16 inch A.F. (for removing cover from Transit case)
Spanner 1/4 inch A.F. (for coaxial connectors).

Screwdrivers : various

Soldering iron

The following tools are supplied with the RA.217 receiver, mounted in clips on the chassis.

Double-ended trimming tool for the R.F. Unit.

Single ended general purpose trimming tool.

Two hexagonal wrenches (Allen keys).

Test Extension Leads Type CA.495

One set of four leads can be assembled from the following items:
Refer to Fig. 2.1 at the end of this chapter for interconnections.

24-Way Extension (Two required)

<u>Item</u>	<u>Quantity</u>	<u>Manufacturers Type</u>	<u>Racal Part No.</u>
Sockets	2	Cannon DDMF24W7S	911719
Coaxial inserts	14	Cannon DM53742-5001	907076
Shrouds	4	Cannon DD51216-1	914475
Plugs	2	Cannon DDMF24W7P	911721
Coaxial inserts	14	Cannon DM53740-5001	908341

5-Way Assembly

<u>Item</u>	<u>Quantity</u>	<u>Manufacturers Type</u>	<u>Racal Part No.</u>
Socket	1	Cannon DBMF5W5S	911722
Coaxial inserts	5	Cannon DM53742-5001	907076
Shrouds	2	Cannon DB24659	914476
Plug	1	Cannon DBMF5W5P	914477
Coaxial inserts	5	Cannon DM53740-5001	908341

NOTE: In the 5-way extension only the coaxial connections A1 and A2 are essential and some financial saving is achieved by fitting only these two inserts.

Coaxial Cable

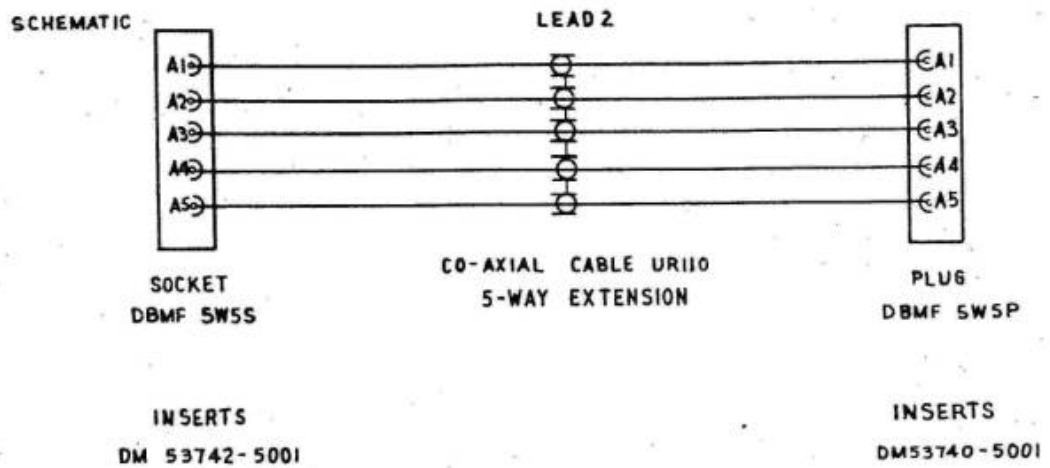
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Antenna Extension

Mini-Quick Connector	Radiall R15.000	912050
Mini-Quick Connector	Radiall R15.550	912049
Coaxial cable 75Ω		

HEAT SHUNT

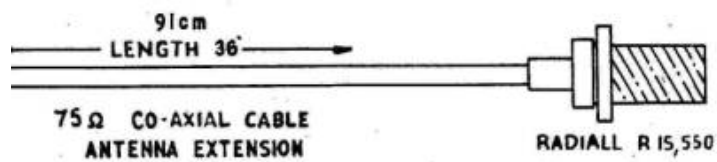
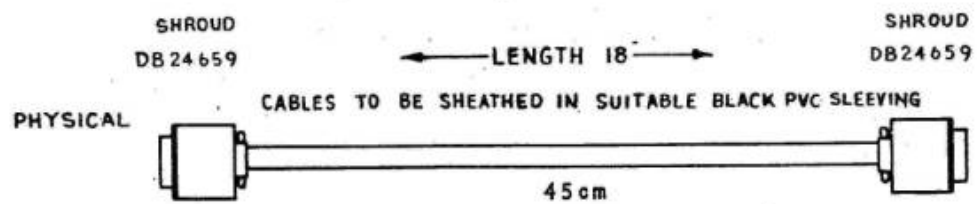
Required when soldering certain types of coil assembly to the printed circuit boards. Refer to the next page for details.



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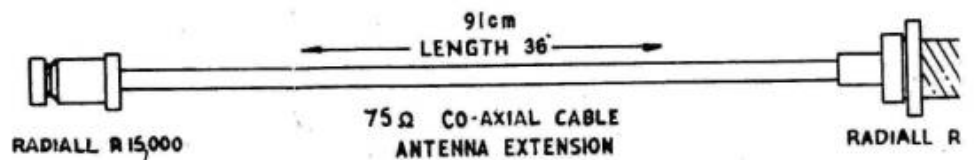
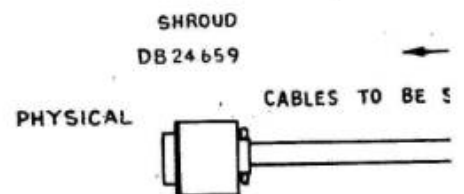
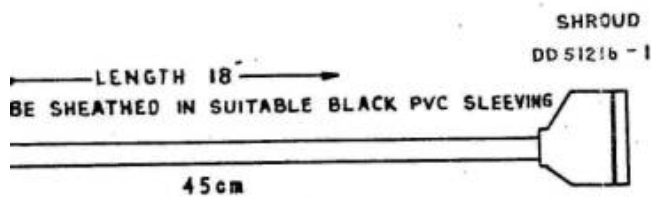
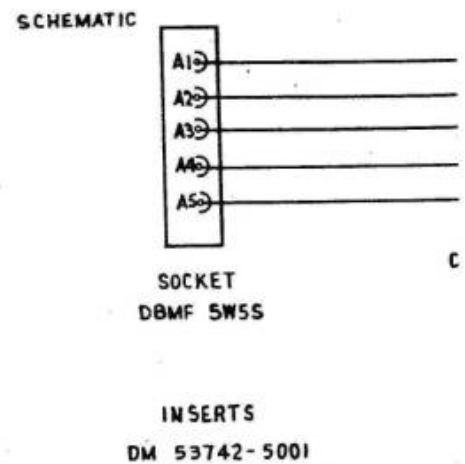
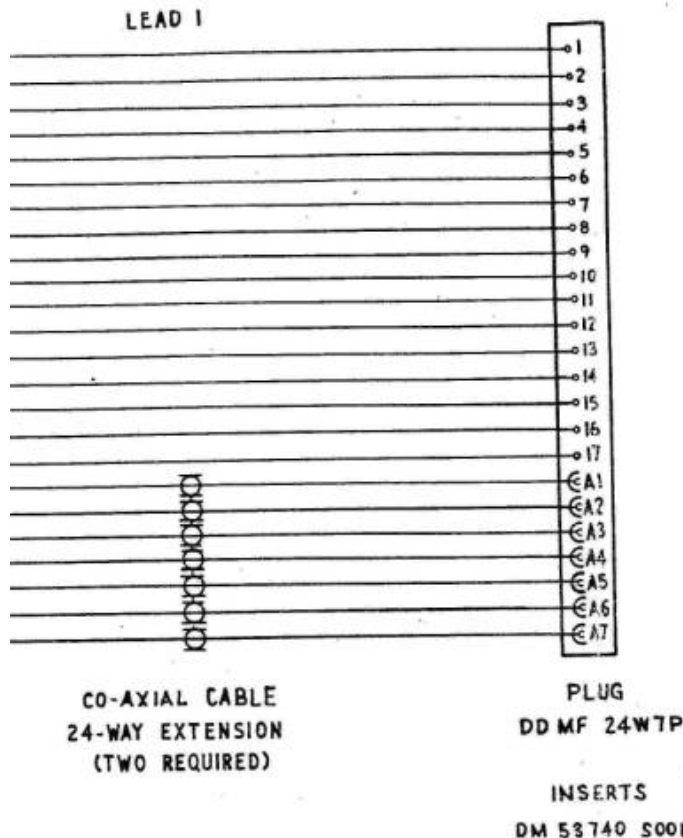
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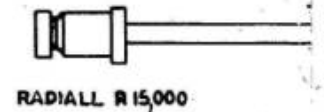
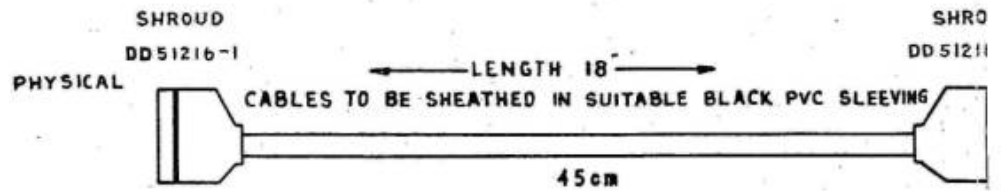
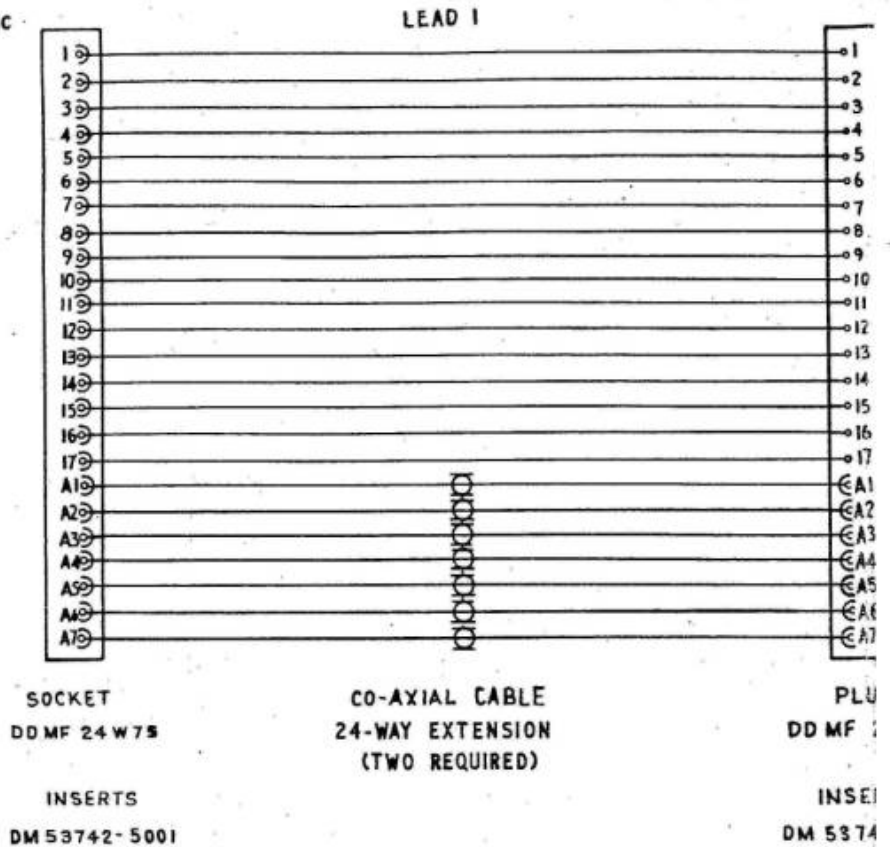
sion Leads for RA.329

Fig. 2.1



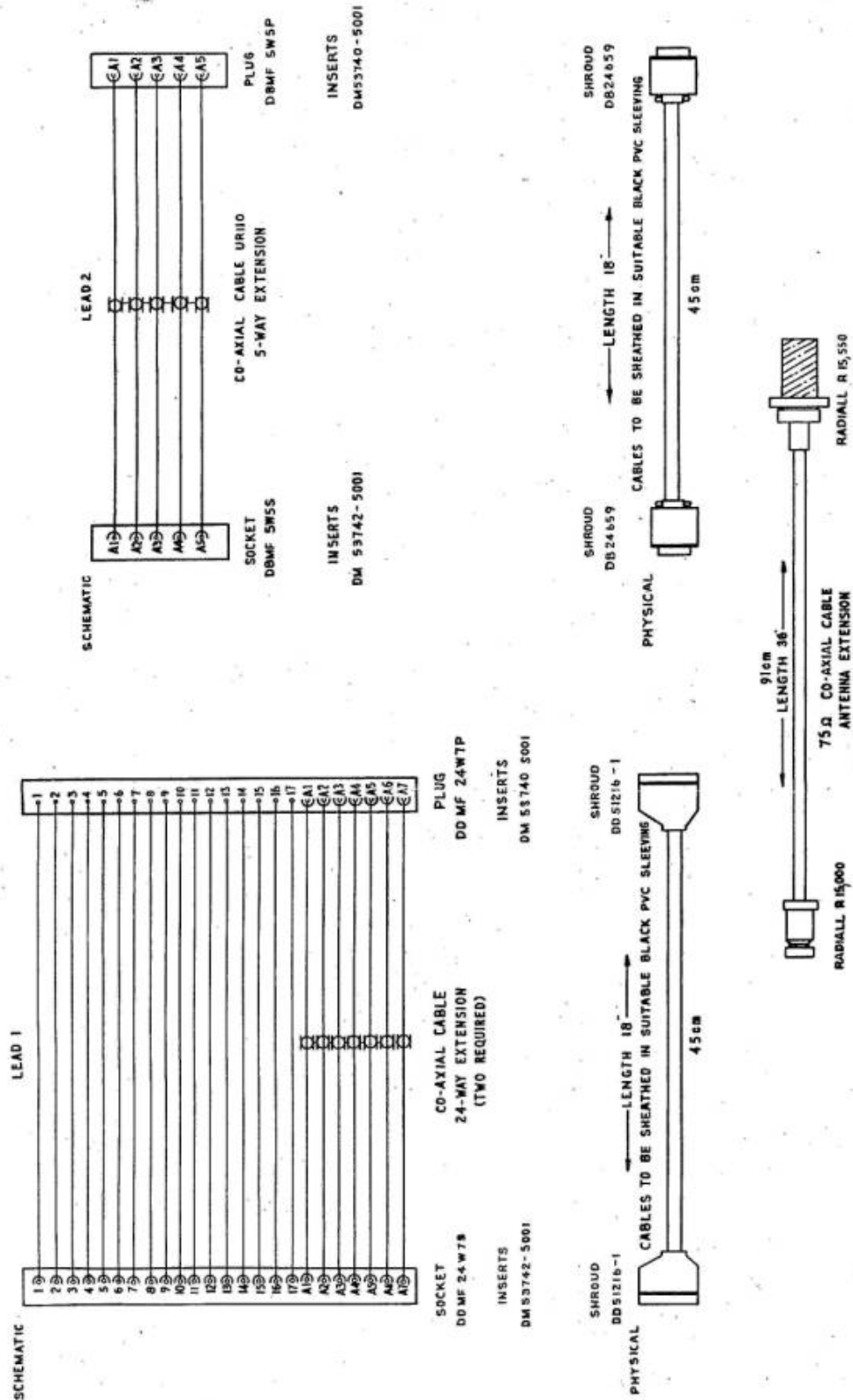
Test Extension Leads for RA.329

SCHEMATIC



CA. 495	2828/3
1	

Test Extel



CHAPTER 3

SYSTEM CHECK

INTRODUCTION

1. This chapter provides a serviceability check without removing the receiver from the carrying case. For a more detailed performance check on the RA. 217D receiver unit reference should be made to Part 2 of this manual, and to Part 3 for details of the MA. 323 unit. Reference should be made to Part 2 and Part 3 if adjustments are considered to be necessary.

TEST EQUIPMENT REQUIRED

NOTE: Refer to the previous chapter for the specification details of the following items of test equipment.

2. (a) D. C. Voltmeter (Multimeter)
D. C. Voltage 0 to 25 volts.
- (b) Signal Generator. 10 kHz to 30 MHz.
- (c) Electronic Voltmeter (LF).
- (d) Electronic Voltmeter (HF).
- (e) Output Power Meter.
- (f) Terminating Resistor. 75 ohms.
- (g) F. M. Signal Generator.
- (h) Teleprinter and Power Supply.

POWER SELECTOR SETTING

3. Before connecting the external power supply check that the ac/dc selector switch at the rear of the RA. 217D is set to the correct position. The switch settings are:

125 - - - - - For operation from 100 - 125 volts a. c.
250 - - - - - For operation from 200 - 250 volts a. c.
D. C. - - - - - For operation from 9 - 30 volts d. c.

Refer to the next paragraph for access instructions.

ACCESS TO THE POWER SELECTOR SWITCH

4. (1) Remove the four corner bolts at the front of the RA. 329 assembly.
- (2) Pull the RA. 329 assembly forward and withdraw from the carrying case.
- (3) Slacken the three screws and clips on the upper edge of the rear panel, pull the top cover forward and remove.
- (4) Release the six captive screws in the rear panel and remove the panel for access to the Power Selector switch.
- (5) Replace the panel and top cover. Replace the receiver in the carrying case.

POWER CONNECTION

5. Connect the outlet 'AC/DC IN' on the MA. 323 to the external power source using the 3-core cable for an a. c. supply, or the 2-core cable for a d. c. supply.

MECHANICAL CHECK

6. (1) Check all controls for smooth action. Note that the MHz tuning control will have an irregular feel because it is switching the range coils in the r. f. unit, and also each discrete megahertz setting is a stepped function.
- (2) Set the MHz and kHz tuning locks of the RA. 217D to the downward position and check that the controls are locked

BRIEF SYSTEM CHECK

NOTE 1: For a more detailed check on the RA. 217D receiver refer to Chapter 3 in Part 2 of this manual.

NOTE 2: The function switch on the RA. 217D is referred to as the "System" switch and on the MA. 323 as the "Mode" switch.

CAUTION:

To minimise the risk of short circuits when making test connections it is recommended that the Mode switch on the MA.323 be set to OFF while making connections. This instruction will not be repeated.

7. (1) Refer to paragraph 4 and ensure that the Power Selector switch has been correctly set. Connect up the external power supply (para. 5).

-16 Volt Check

8. (1) Set the d.c. voltmeter to the 25 volt range and connect the -ve lead to pin P of the ANC socket. The +ve lead to chassis. Check that the RA.217D MHz tuning control is not set to '00'.
- (2) Set the Mode switch to TUNE and check that the voltmeter indicates -16 volts ± 0.5 volts. If adjustment is required refer to Part 2 Chapter 3 paragraph 5.
- (3) Set the MHz tuning to '00' and check that the voltmeter indication is removed.
- (4) To check the H. T. microswitch, transfer the -ve lead of the voltmeter to pin N of the ANC socket and check that the indication obtained in operation (2) is present on this pin. Rotate the MHz tuning away from '00' and the voltmeter indication should become zero.
- (5) Transfer the -ve lead of the voltmeter to pin F of the ANC socket. An indication of -16 volts ± 0.5 volts should be obtained.
- (6) Remove the voltmeter.

A. G. C. Check

9. (1) Set the d.c. voltmeter to the 10 volt range and connect the -ve lead to pin S of the ANC socket. The +ve lead to chassis.
- (2) Set the RA. 217D meter switch to RF and check that the MHz tuning control is not set to 00.
- (3) Set the RF/IF GAIN fully clockwise.

- (4) Set the Mode switch to TUNE.
- (5) Set the System switch to the positions AGC 'L', 'M' and 'S' in turn. At each setting the voltmeter should indicate -4 volts $\pm 0.25V$.
- (6) To check the A. G. C. microswitch set the MHz tuning control to '00' and check that the voltmeter reading at pin S becomes zero.
- (7) Transfer the voltmeter -ve lead to pin R of the ANC socket and check that the reading obtained in operation (5) is present on this pin. Move the MHz tuning away from '00' and the voltmeter reading should be removed.
- (8) Disconnect the d. c. voltmeter.

General Receiver Check

10. (1) Connect the headphones to a PHONES socket on the MA. 323.
- (2) Set the signal generator to 3.5 MHz, 15 microvolts e. m. f., modulated 30% at 400 Hertz, and connect the output to the ANTENNA socket on the MA. 323.
- (3) Set the controls of the RA. 217D as follows:
 - (a) RF/IF GAIN fully clockwise (maximum)
 - (b) MHz control to 03 and adjust for maximum noise in the phones, then lock the control
 - (c) kHz control to 500
 - (d) R. F. TUNE fully anti-clockwise (WB)
 - (e) AE ATT to MIN.
 - (f) B. F. O. kHz switch to OFF
 - (g) Bandwidth kHz to 3
 - (h) AF GAIN to mid-position
 - (i) CALIBRATE control to mid-position.
- (4) Set the System switch to CAL and the Mode switch to TUNE.

- (5) Adjust the kHz tuning control around the 500 indication until a beat note is heard. If necessary, calibrate the scale by setting the kHz tuning to exactly 500 and adjust the CALIBRATE control to obtain a zero beat note.
- (6) Set the System switch to CHECK B. F. O. and alter the kHz tuning by approximately 10 kHz. Move the BFO kHz control through the positions L. S. B., U. S. B. and +6 to -6. Check that an appropriate beat note occurs at each change of setting.
- (7) Set the System switch to MAN.
- (8) Re-set the kHz tuning to 500 and, if necessary, adjust the signal generator frequency to give a clear signal in the phones.
- (9) Connect a 600 ohm power meter to pins H and J of the ANC socket and check that an indication of 1mW is obtained. If line level adjustment is necessary refer to Part 2 Chapter 3 paragraph 12.
- (10) Set the RA. 217D Meter switch to A. F. and check that the meter indicates the audio line level of 1mW +2 dB.
- (11) Disconnect the power meter.
- (12) Set the RA. 217D METER switch to RF.
- (13) Set the output of the signal generator to C. W. and an e. m. f. of exactly 1 microvolt.
- (14) Set the System switch to AGC 'M' and adjust the R. F. TUNE control for a maximum indication on the RA. 217D meter. The meter should indicate 1 microvolt. It may be necessary to adjust the meter zero-setting potentiometer, RV4, to obtain this indication. Refer to Part 2 Chapter 3 paragraph 6 operation (19) for zero setting instructions.
- (15) Set the d. c. voltmeter to the 10 volt range and connect the -ve lead to pin S of the ANC socket. The +ve lead to chassis.

- (16) Increase the signal generator output in steps of 10 dB up to +40 dB. Check that the a.g.c. voltage indicated on the voltmeter becomes less negative at each 10 dB step and the RA. 217D meter indicates within ± 20 dB of the appropriate r.f. level.
- (17) Re-set the signal generator output e.m.f. to 1 microvolt.
- (18) To check the Diversity A.G.C. output, connect the -ve lead of the d.c. voltmeter to pin T of the ANC socket. The +ve lead to chassis.
- (19) Ensure that the receiver is tuned to the signal generator frequency. Set the System switch to AGC "M" and check that a reading of -9.5 volts ± 1 volt is indicated on the voltmeter. Remove the d.c. voltmeter. Set the signal generator to 400 Hz 30% modulation.
- (20) To check the DET audio output, set the System switch to MAN. Set the L.F. electronic voltmeter to the 300 mV range and connect to pin V of the ANC socket. Check that the receiver is tuned and the RF/IF GAIN fully clockwise. A reading of not less than 200 millivolts should be obtained. Remove the electronic voltmeter.
- (21) Terminate the coaxial socket 'I.F. OUTPUT' with a 75 ohm resistor. Connect the electronic voltmeter across the termination. An indication of not less than 230 millivolts should be obtained.

2nd V.F.O. Input and Output

11. (1) The 2nd V.F.O. switch on the MA. 323 must be set to indicate OUT.
- (2) Terminate the socket 2nd V.F.O. OUT with a 75 ohm resistor.
- (3) Connect the electronic voltmeter across the termination. The indication should be not less than 50 millivolts.
- (4) Remove the locking plate from the 2nd V.F.O. switch and set the switch to the alternative position (IN).

- (5) Set the signal generator to 4.1 MHz C. W., 100 millivolts e.m.f. and connect the output to the socket 2nd V.F. O. IN.
- (6) The electronic voltmeter connected across the terminated 2nd V.F. O. OUT socket should indicate not less than 50 millivolts into 75 ohms.
- (7) Disconnect the test equipment and 75 ohm termination.
- (8) Set the 2nd V.F. O. switch to the OUT positions and replace the switch locking plate and caps.

F.S.K. Test

12. Test procedures utilizing telegraph test equipment are given in Part 3 of this manual. The following test uses a signal generator and multimeter, which will be supplemented by a reception test if a teleprinter and power supply are available.
13.
 - (1) Set the signal generator to 3.5 MHz C. W., output e.m.f. 1 microvolt. Connect the generator output to the ANTENNA socket.
 - (2) Set the Mode switch to F.S.K. (N).
 - (3) Set the RA.329 controls as follows:
 - (a) System switch to AGC (M).
 - (b) MHz control to 03 and maximum noise.
 - (c) KHz tuning control to 500.
 - (d) RF/IF GAIN fully clockwise.
 - (e) AF GAIN to mid-position.
 - (f) BANDWIDTH kHz to 1 kHz.
 - (g) AE ATT to MIN.
 - (h) RF TUNE to resonance.
 - (j) BFO kHz to +3.
 - (k) Meter switch to RF.
 - (4) Tune the receiver (including RF TUNE) to the signal generator frequency, so that the MA 323 meter gives a central (zero) indication.

- (5) Set the multimeter to measure continuity and connect between pin A (Mark) and pin B (Tongue) of the FSK OUT plug on the MA. 323.
- (6) To check the f.s.k. relay circuit shift the tuning of the signal generator approximately 500 Hz above the 3.5 MHz setting. At the same time note that the MA. 323 meter deflects to one side. This indicates that functioning is satisfactory up to the discriminator output in the F.S. Tone Converter board of the MA. 323.
- (7) Note whether the multimeter is indicating a closed or open loop between Mark and Tongue.
- (8) Observe the MA. 323 meter indication and slowly shift the signal generator frequency to a frequency approximately 500 Hz below the 3.5 MHz setting. The MA. 323 meter indication should deflect to the opposite side in sympathy. At the same time the multimeter will indicate a change of state on the loop between pins A and B.
- (9) At the FSK OUT plug transfer the multimeter lead from pin A to pin C (Space) Check that the loop condition noted in (7) has now appeared between pins C and B.
- (10) Shift the signal generator frequency back to 3.5 MHz +500 Hz and note that the multimeter indicates a change of state while doing so.
- (11) Remove the signal generator and multimeter.
- (12) Connect the antenna to the ANTENNA socket and tune the receiver to a reliable f.s.k. transmission. Under reasonably quiet conditions the f.s.k. relay should be heard chattering.
- (13) If a teleprinter and power supply are available, connect up and make a print-out check on a reliable transmission.

F.M. Sensitivity Check

NOTE: An F.M. Signal Generator is required for this test.

14.
 - (1) Connect the output of the F.M. signal generator to the ANTENNA socket.
 - (2) Connect the 600 ohm power meter to a PHONES outlet on the MA.323.
 - (3) Set the F.M. signal generator to :-
 - (a) An internal Modulation of 1000 Hz.
 - (b) Deviation to '0' kHz.
 - (c) Frequency to 3.5 MHz.
 - (d) Output level to 1 microvolt e.m.f.
 - (4) Set the RA.329 controls as follows:
 - (a) Mode switch to FM/PM.
 - (b) RF/IF GAIN to fully clockwise.
 - (c) AF GAIN to fully clockwise.
 - (d) AE ATT to MIN.
 - (e) BANDWIDTH kHz to 13.
 - (f) BFO kHz to OFF.
 - (g) System switch to AGC (M).
 - (h) MHz tuning to 03 and set carefully to the centre of its free movement.
 - (j) kHz tuning to 500.
 - (k) RF TUNE to resonance.
 - (5) Tune the receiver (including RF TUNE) to the input carrier frequency, such that a minimum noise output indication is obtained on the power meter.
 - (6) Set the F.M. signal generator to 4 kHz deviation. Adjust the receiver RF TUNE control for maximum output on the power meter, which should be not less than 10 milliwatts.

- (7) Connect an electronic voltmeter to pin M of the ANC socket. The electronic voltmeter should indicate not less than 70 millivolts.
- (8) Disconnect all test equipment.

CHAPTER 4

GENERAL FAULT LOCATION

INTRODUCTION

1. The fault location advice in this chapter assumes that only basic test equipment is available (multimeter and electronic voltmeter) the object being to locate an elementary fault, or to isolate a fault to a limited area of the receiver assembly. Paragraphs 2 to 13 deal with a fault in the RA. 217D indicated by nil audio in the phones. The final paragraph deals with faults in the f. s. k. section. More detailed test procedures for the RA. 217D are contained in Part 2 of the manual, and for the MA. 323 in Part 3.

PRELIMINARY CHECKS

2. If the receiver is newly installed check the following items:
 - (a) Voltage selector switch correctly set. (Chapter 3 para. 4)
 - (b) 2nd V. F. O. switch set to OUT (front panel).
 - (c) Power connections and fuses.
 - (d) Antenna connected.

INITIAL FAULT LOCATION

Controls

3. Set the receiver as follows and check for signal or noise.
 - (1) MA. 323 Mode switch to TUNE.
 - (2) RA. 217 System switch to MAN.
 - (3) B. F. O. switch to OFF.
 - (4) Meter switch to R. F.
 - (5) A. F. GAIN to maximum (clockwise).
 - (6) R. F. / I. F. GAIN to maximum (clockwise).
 - (7) Bandwidth switch to 3 kHz.
 - (8) AE ATT control to the MINIMUM position (MIN).
 - (9) R. F. TUNE control to resonance with tuned frequency.
 - (10) Ensure that the MHz tuning control is not set to '00'.

Basic Diagnosis

4. The most useful indication in elementary fault diagnosis is receiver noise, or 'mush'. The controls should be set as listed in paragraph 3 and the receiver tuned over a suitable portion of the h.f. band. At each step of the MHz tuning control make a fine adjustment and listen for a rise in receiver noise level. If no noise can be heard, check that the phones are serviceable and listen at the loudspeaker as well as at the phones jack socket. Note the RA.217D meter reading. If a reading is obtained, reduce the R.F./I.F. GAIN and the meter should deflect to the right. This indicates that the h.t. supply and a.g.c. line are normal.

POWER CHECK

5. If the receiver appears dead (no noise or meter reading) and the dial lights are not illuminated, check the -16 volts fuse and the appropriate power input fuse. Check for -16V, relative to chassis, at Pin F of the ANC socket.

GENERAL RECEIVER CHECK

6. (1) Set the receiver controls according to paragraph 3.
- (2) Set the System switch to CHECK B.F.O. and rotate the B.F.O. switch through all settings. Select +6 to -6 and rotate the B.F.O. variable control. Listen for the b.f.o. heterodyne whistle and observe the receiver meter indications. These indications can be used for diagnosis as indicated in the following Table.

TABLE 1

"CHECK B.F.O. INDICATIONS"

<u>Meter Indication</u> <u>Observed</u>		<u>B.F.O. Whistle</u> <u>Audible</u>	<u>Diagnosis</u>
(a)	Yes	Yes	RA.217D is serviceable from 3rd Mixer input through to audio output. Also 1 MHz is functioning.
(b)	Yes	No	Fault probably in detector board or audio amplifier board of the I.F. Module.

1 MHz Check

12. Set the System switch to CAL and tune the kHz control to the 100 kHz calibration check frequencies. If the calibration whistle is heard at each point it indicates that the 1 MHz oscillator is functioning. If no calibration whistles are heard, turn the System switch to CHECK B.F.O. and set the B.F.O. switch to +6, +3, -3 and -6 kHz in turn. If, again, no heterodyne whistles are heard, it indicates a faulty 1 MHz crystal oscillator. Check that the crystal is correctly fitted in the upper deck of the 37.5 MHz Generator Module in the RA. 217D.

A. G. C. FAULT

13. If the receiver operates satisfactorily with manual r.f. gain control (System switch to MAN) but overloads on strong signals in the a.g.c. settings of the System Switch check as follows:

- (1) Tune the receiver to a strong signal. Set the System switch to AGC 'M' and the Meter switch to R.F. If the meter indicates a reading appreciably greater than 1 microvolt the a.g.c. board in the I.F. Module is serviceable. If no reading is obtained the fault is probably in the I.F. Module.
- (2) If the meter reading is satisfactory, connect the test meter negative lead to pin S of the ANC socket (positive lead to chassis). As the receiver is tuned through a powerful signal the a.g.c. level should change from -4V (no signal) to approximately 0 volts (strong signal). If no reading is obtained check the microswitch SC adjacent to the MHz tuning shaft. (Fig. 18). The bottom tag of the microswitch should show the a.g.c. level in all operating modes; the centre tag in all settings of the MHz control except '00' and the top tag only in the '00' setting of the MHz tuning control.

NOTE: The levels quoted in para. 13 cannot be given exactly because the level of a strong signal is not defined.

DETAILED RECEIVER CHECK

Refer to Chapter 5 in Part 2 of the manual.

- | | | | |
|-----|----|----|--|
| (c) | No | No | Possible areas of fault are: |
| | | | (a) 1 MHz reference. Refer to para. 12. |
| | | | (b) 1st i. f. amplifier and main i. f. amplifier boards of I. F. Module. |
| | | | (c) Transistor stage VT3 in 3rd Mixer. |

7. If both whistle and meter readings are obtained in CHECK B. F. O. position, set the System switch to CAL. If no calibration whistles are obtained as the kHz tuning is rotated, it suggests a fault in the 2nd V. F. O. or the mixer stage of the 3rd Mixer.

8. If the CHECK B. F. O. and CAL tests are satisfactory, set the controls as listed in paragraph 3 and make a front end check as follows:-

FRONT END CHECK: RA. 217D

9. Set the B. F. O. switch to OFF. Listen intently and slowly rotate the MHz tuning control. If a very slight rise in noise level can be heard as the MHz tuning passes through each resonant point it suggests that the 37.5 MHz loop is functioning and therefore the fault is more likely to be in the antenna circuit, R. F. Module or 1st Mixer. Make the check in the WB setting of the R. F. TUNE control as well as in the tuned antenna condition (adjust R. F. TUNE control). Thoroughly check all front end connections as follows:-

- (1) Check Antenna.
- (2) Check the connections between the R. F. Module and 1st Mixer (on the side of the R. F. Module).

10. If, when tuning the MHz control as described in the previous paragraph, no noise can be heard, the 1st V. F. O. or its connections may be faulty. Check connections from 1st V. F. O. to 1st Mixer and 37.5 MHz Generator respectively at the brackets on the left side of the main chassis. (Viewed from the front. Refer to Fig. 18 in the RA. 217D section).

R. F. H. T. Check

11. At the ANC socket connect pin P (HT. RF.) to Pin N (HT. LF.). If the receiver then functions correctly the microswitch SD should be checked. Make a voltage check at the microswitch (centre tag, violet lead). (Fig. 18 RA. 217D).

MA. 323 FAULTS

14. The following guide assumes that audio reception at the receiver phones outlet is satisfactory. For detailed test procedures refer to Chapter 3 in Part 3 of this manual.

<u>Symptom</u>	<u>Possible Cause and Action</u>
Complete Failure on both F. S. K. and T. S. K. settings of Mode switch.	<ol style="list-style-type: none">(1) Observe the meter on the MA. 323. If no deflection obtainable check the power supply.(2) If power supply is correct check the Mode switch connections and ensure that the Bandpass Filter Unit FLA is firm in socket. Check that base pins are clean.(3) A fault may exist in Tone Converter board prior to the discriminator output or in buffer amplifier of the product detector board.
Failure on F. S. K. but satisfactory on T. S. K.	<ol style="list-style-type: none">(1) Check the 100 kHz i. f. at the socket "I. F. OUT". If no output, the fault may be in the i. f. converter of the receiver or in the connections at the rear of the i. f. unit. (Plug 2 pin A2).(2) Check the f. s. k. contacts of the Mode switch.(3) Possible fault in the oscillator and mixer section of the product detector board.
Failure on both F. S. K. and T. S. K. but meter indications are normal.	<ol style="list-style-type: none">(1) Maladjustment of Carrier Fail Level setting. Refer to Part 3 Chapter 3 for setting-up instructions.(2) Check that the F. S. K. relay is secure in its socket. Check that pins are clean.(3) A fault may exist in the Carrier Fail circuit which gives a permanent 'hold' condition to the relay drive stage. Disconnect the strap on the Tone Connector board as a check.

Symptom

No Audio Output from FM.
Transmission. Receiver otherwise
serviceable.

Possible Cause and Action

- (4) A fault may exist in the relay drive
stages of the Tone Converter board.

Check with electronic voltmeter at
pin M of the ANC socket for 50mV
into a 2k Ω termination. If satisfac-
tory suspect the Mode switch. If no
output refer to the Discriminator
Check in Part 3 of this manual,
Chapter 3 para. 15.

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
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LIST OF COMPONENTS

RA. 329B

MA. 322 FRAME ASSEMBLY

(NATO NO. 5820-99-193-4534)

Connectors

NOTE: The Cannon multi-way connectors are listed without coaxial inserts. The inserts can be renewed separately.

SKT1	24-way connector	911719	Cannon DDMF24W7S
SKT2	24-way connector	911719	Cannon DDMF24W7S
SKT3	5-way connector	911722	Cannon DBMF5W5S
Coaxial inserts for SKT1 - SKT3		908600	Cannon DM53743-5001
PL1	24-way connector	911721	Cannon DDMF24W7P
PL2	24-way connector	911721	Cannon DDMF24W7P
PL3	Antenna: Mini-Quick series	912049	Radiall R15.550
Coaxial inserts for PL1 and PL2		907080	Cannon DM53741-5001

H.F. RECEIVER TYPE RA. 217D

Parts List Reference DA.28100/D: NATO NO. 5820-99-193-4536

Refer to Part 2 of this Manual for parts information.

DEMODULATION AND TERMINATING UNIT TYPE MA. 323

Parts List Reference DA. 39375: NATO NO. 5820-99-193-4535

Refer to Part 3 of this Manual for parts information.

ORDERS FOR SPARE PARTS

In order to expedite handling of spare part orders,
please quote:-

- (1) Type and serial number of equipment.
- (2) Circuit reference, description, Racal part number, and manufacturer of part required.
- (3) Quantity required.

NOTE: If the equipment is designed on a modular basis, please include the type and description of the module for which the replacement part is required.

NOTES ON COMPONENT CHANGES AND ADDITIONS

[illegible]

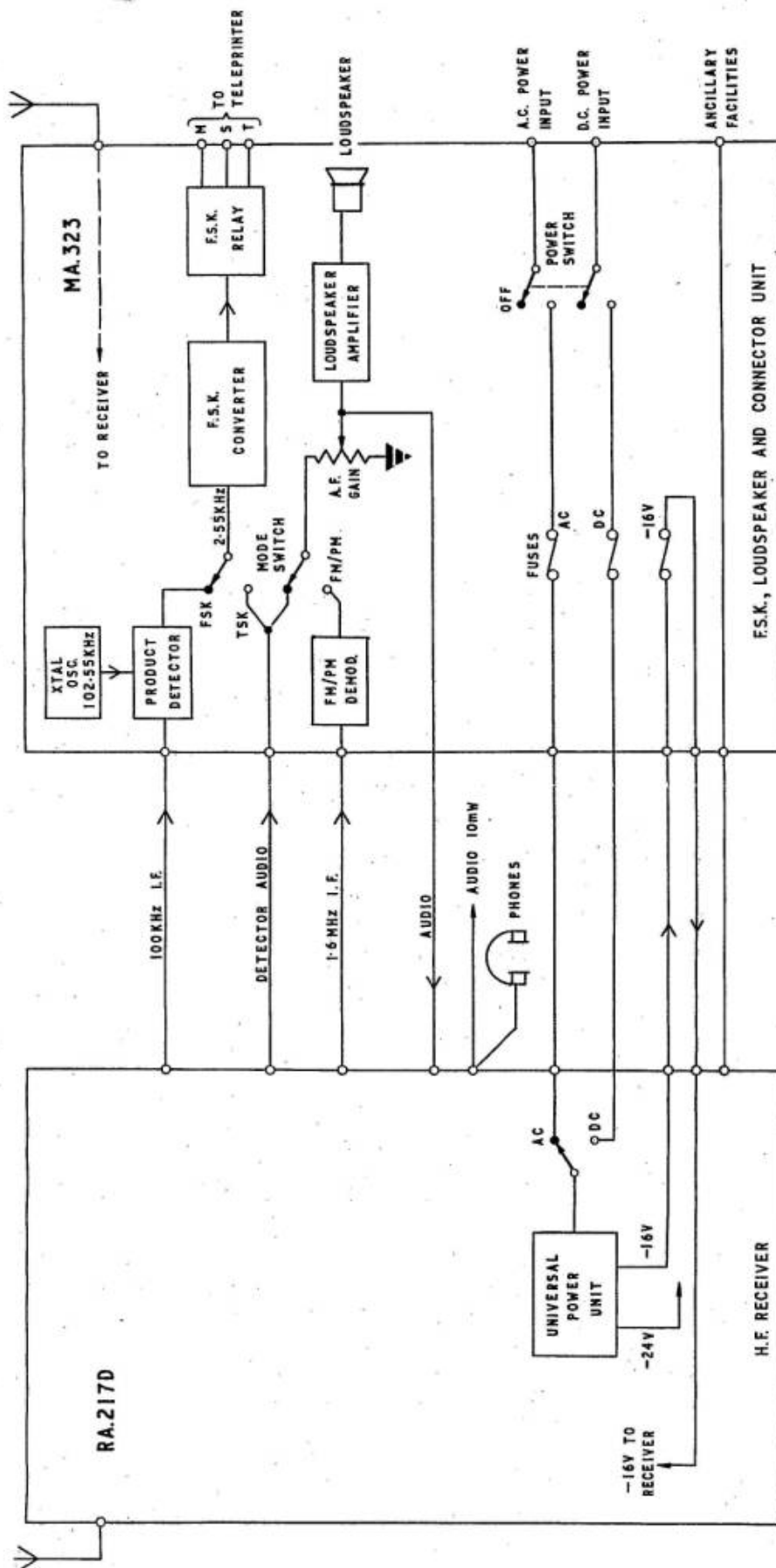
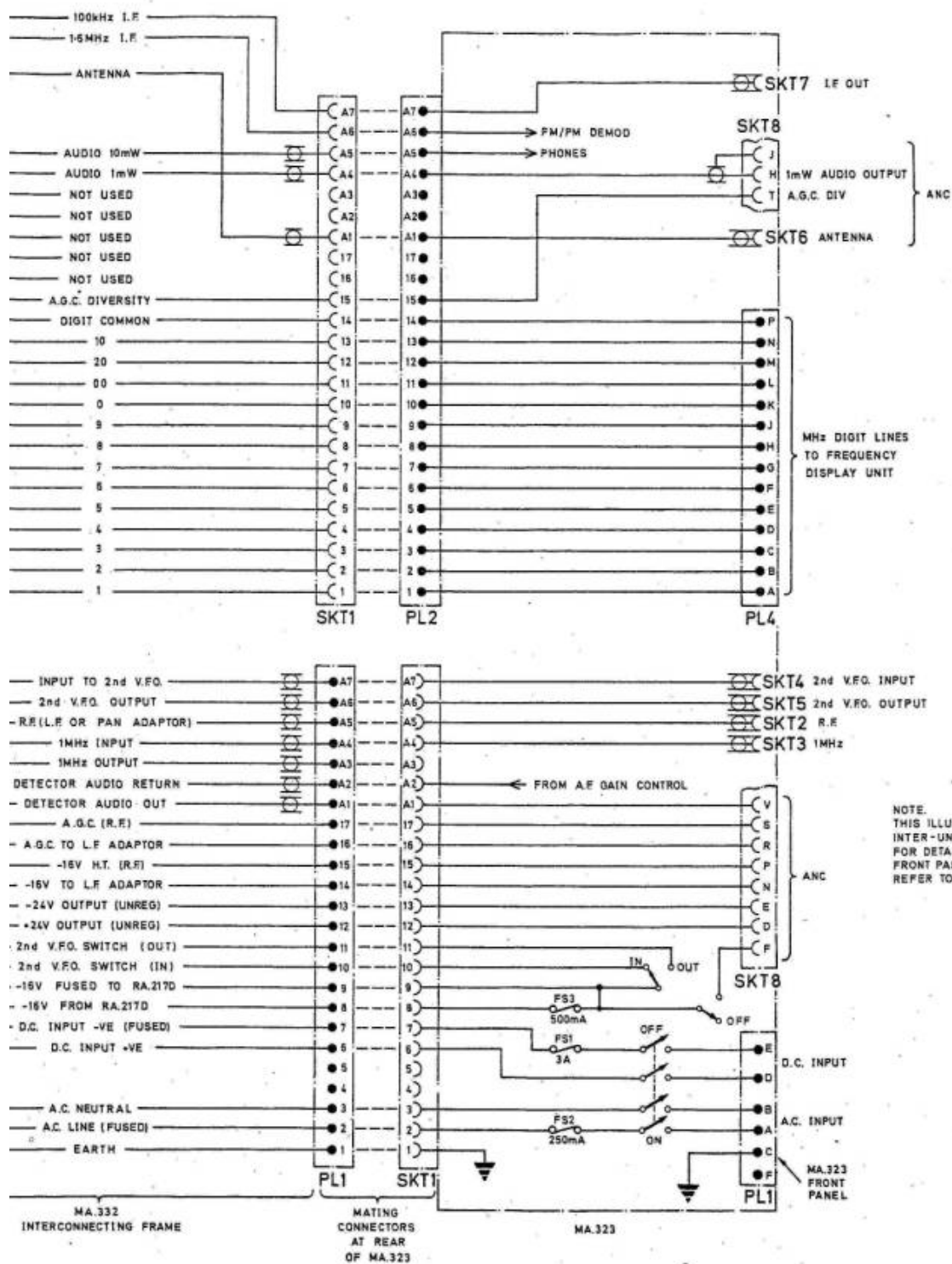


Fig. I
(Part 1)

Simplified Block Diagram : RA.329B

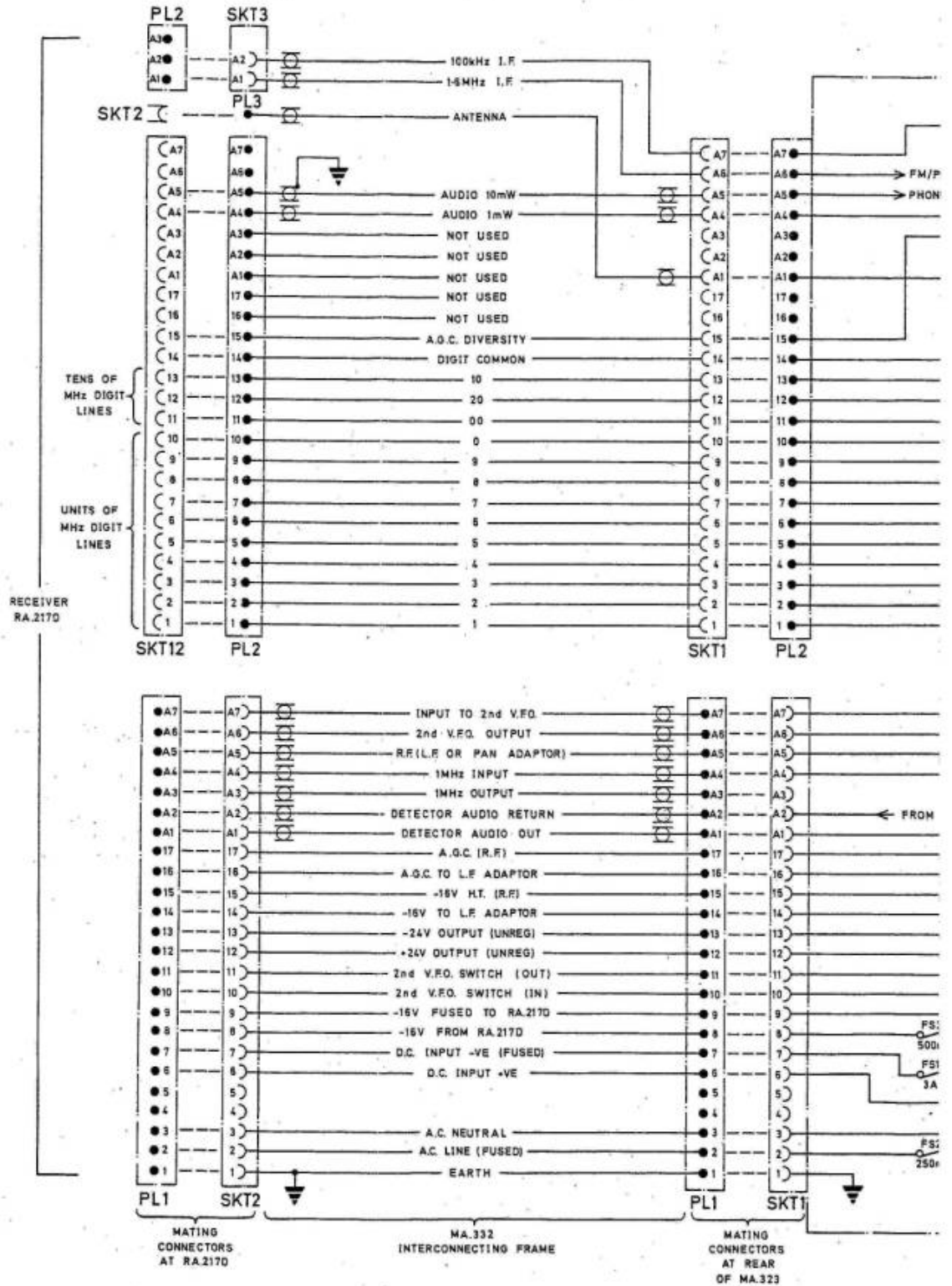


RA.329B: Interconnections Between Units



RA.329B:Interconnections Between Units

Fig. 2
(Part 1)



282B/2

RA.329B:Interconnections Between