

PRC 319 radio operating instructions

Apply 24VDC, Turn it on, Switch to 'LP' or 'HP', Mode to Voice..
The frequencies entered with 6 digits: 100000 = 10000.0 KHz, 050000
= 5000.0 KHz.

To listen to 14,200.0 KHz put an antenna on the BNC connector.

Press 'R 1'

Then press '1 4 2 0 0 0'

Then press 'Store'

Then press 'R 1' again

Then Press 'Change'

That puts the radio on 14,200.0 KHz and 14200.0 KHz into Receive
memory #1.

Repeat the same process for transmitting.

To set the transmitter, Press 'T 1', enter the Tx frequency 142000,
Press Store, Press 'T1' then Press Change.

Push the 'T/R in use' button before transmitting to check that the
TX freq is the same as the RX freq. If you did it right you will see
both frequencies that you just entered. "A1" Means 'R1' (Receive
memory number 1), "t1" means 'T1' (Transmit memory number 1).

If you have a TURF press 'R' then 'TURF Tune', then 'T' then 'TURF
Tune'.

If the antenna is correctly tuned, the LCD display will no longer
say 'Tune'.

The 'TURF Tune' button does not work without the BA1303...

When finished turn to 'Standby', (If you turn it 'Off' you will lose
all memory frequencies, you have to change batteries fast too or the
memory will dump).

Test

Turn the radio power switch to "Batt Chk". The off-load voltage
should be displayed.

Receiver Test:

Turn the power switch to "Test" and mode switch to "CW" or voice.
Press the R key, followed by the "Test" key on the keyboard and wait
approx 5 seconds.

If the test has passed, "Bite Pass" will be displayed on the LCD.

Transmitter Test:

Set the power switch to "Test" and the mode switch to CW or voice.
Press the T key followed by the "Test" key on the keyboard.

If the test has passed, "Bite Pass" will be displayed on the LCD.

Modem Test:

Set the power switch to "Test" and the mode switch to one of the 3
data positions.

Press the Test key on the keyboard.

Alternating mark & space tones will be heard in the earphones, and
the far left hand side digit on the LCD will alternate between 0 &
1.

Failure of the modem test is indicated if the display remains fixed
at 0 or 1.

Warning & error messages:

These are always displayed on the lower line of the LCD.

PHAS - Frequency synthesizer phase lock lost
PRot - RF overload warning - protection circuit activated
tunE - Antenna tuning warning - TURF not correctly tuned
BAAtt - Low battery warning
SuPP - Power supply warning
Bite Fail 1 - Phasing module malfunction (Rx test)
Bite Fail 2 - RF head module malfunction (Rx Test)

TURF tuning:

After you have entered valid Tx & Rx frequencies, you can then initiate the antenna tuning by pressing the "Tune TURF" button. You must do this for each Tx & Rx frequency seperately. The "Tune" indicator in the LCD will disappear if the TURF is working ok & has tuned correctly.

Test sequence for the EMU

Turn the EMU 'ON'

You will see

F 000

P 000

Turn unit to 'Test', This is the BITE Test.

Push 'SEL TX', Then '1'

You will see :

t

1001

Push 000000 (This is the callsign for a Broadcast transmission).

Then Push 'NEXT GRP'

You will see:

t 001 000000

1002

Then type in message '123456'

Then push 'NEXT GRP'

You will see:

t 002 123456

1 003

Then Push 'EOM'

You will see:

t 003

1 004 = =

Now Push 'TX', you should see a black triangle under the 'S' meaning it is sending.

Now Push 'SEL Rx' then '0' , The left black triangle should be there indicating a received message.

You should see :

F 001 000000

0 002 123456

If it says 'Fail', It failed. Try again.

CATEGORY 1

PURPOSE AND PLANNING INFORMATION

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CHAPTER 1.1

TRANSMITTER/RECEIVER 319

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CHAPTER 1.1TRANSMITTER/RECEIVER 319RPOSE

The RT 319 is a small, lightweight, microprocessor controlled, high frequency (h.f.) transmitter/receiver with an operating frequency range 1.5 MHz to 40 MHz in steps of 100 Hz. The operating frequency used on transmit may be different from that used on receive (two frequency simplex system). Single sideband (s.s.b.) is employed for both voice and data communications, while continuous wave (c.w.) is used for morse transmission and reception. Data communications can be made in conjunction with either the digital message handling device (DMHD) or the electronic message unit (EMU) Mk 1. Up to 10 operating frequencies can be stored in random access memory (RAM) and displayed on the liquid crystal display. Warning signals and results from built-in-test-equipment (BITE) can also be displayed.

IDENTITY

Manufacturer	: MEL, Crawley, West Sussex
Manufacturers identification	: Transmitter-receiver RT 319
MEL type number	: BA 1302
MEL drawing series	: 9571 113 0200
NATO stock number	: 5820-99-734-7835

DESIGN AND PERFORMANCE DATACommunication Range

** Patrols on the move	: 20 km
Patrols at the halt	: 2,000 km
To static base station	: 5,000 km
To aircraft in flight	: 1,000 km

Frequency Data

Frequency range	: 1.5 MHz to 40 MHz
Frequency steps	: 100 Hz (min)
Channel storage	: 10 channels
Accuracy	: 5 in 10 ⁷
Indicated frequency standard	: Suppressed carrier (CCIR)

Transmitter

5 R.F. output power	: 50 W peak envelope power (p.e.p.) at high power (H.P.); 5 W p.e.p. at low power (L.P.)
Intermodulation (two tone)	: At least 25 dB below either wanted tone
Level control	: Automatic
Modulation sensitivity	: Inputs of 0.4 mV to 40 mV e.m.f. into 300Ω (voice), or 65 mV peak-to-peak into 300Ω (DMHD) are required to give the full specified output at H.P. or L.P. as selected

Sideband suppression : Greater than 46 dB down on wanted output
 Carrier suppression : Greater than 40 dB down on wanted output
 Speech processing : 5 dB peak-to-mean ratio
 Protection : Any mismatch with short circuit or open circuit antenna

Receiver

6 Signal and noise/noise ratio : 10 dB for 0.5 μ V e.m.f. (voice), ^{1 μ V} e.m.f.
 18 dB for 0.5 μ V e.m.f. (c.w.) ^{worst} case

A.F. output : Greater than 0.4 mW into 150 Ω for 1 μ V e.m.f. input (gain control at maximum)

Automatic gain control range : 2 μ V to 100 mV e.m.f. inputs produce not greater than 5 dB output variations

Selectivity : Voice, 300 Hz to 3050 Hz (6 dB)
~~3000~~ 3000 Hz to 7000 Hz (60 dB)
 C.W., 850 Hz to 1150 Hz (6 dB)
 0 Hz to 2000 Hz (60 dB)
 Data, 75 bauds \pm 200 Hz (50 dB)
 150 bauds \pm 320 Hz (50 dB)
 300 bauds \pm 540 Hz (50 dB)

Spurious responses : Greater than 80 dB relative to 1 μ V, greater than 55 dB for third harmonic response and greater than 60 dB for other harmonic responses.

Protection : No damage when subjected to field strengths up to 10 v/m

Modem

7 Transmission standard : STANAG 4202
 Data rate : 75, 150 and 300 bauds

4 Ah Battery Life

8 1:9 transmit/receive ratio : 8 hours approximately
 (voice or cw)
 Burst data transmission : 100 hours approximately
 (1:100 : 70 transmit/receive/
 standby ratio)

PHYSICAL DATADimensions and Weight

9 For the dimensions and weight of the transmitter/receiver refer to Table 1.1.1.

Note Dimensions include all protrusions ie switches, sockets, flanges etc.

Table 1.1.1 Dimensions and Weight

Item	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
Transmitter/ receiver RT 319	200	210	103	3.4

Environmental

- 10 Storage temperature : -46°C to +70°C
 Operating temperature : -31°C to +55°C
 Humidity : 95% at 40°C
 Immersion : To a depth of 2 m for 5 minutes
 Shock : Withstands freefall of 0.75 m onto
 concrete
 Low pressure : Operating altitude up to 3000 m. Air
 transportation up to 12000 m.

SERVICES REQUIRED

Power Supply

- 11 Battery : Secondary alkaline, 24 V 4.0 Ah, or
 secondary alkaline 24 V 1.2 Ah, or
 primary lithium 24 V

LOGISTIC REQUIREMENTS

- 12 To be issued

ASSOCIATED DOCUMENTATION

Handbooks

- 13 EMU Mk 1 User Unit Handbook AESP 5820-U-113
 Interim Base Station Handbook AESP 5820-U-114

Defence Standards

- 14 DEF STAN 59-98/2

CHAPTER 1.2.1

TUNING UNIT RADIO FREQUENCY

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CHAPTER 1.2.1

TUNING UNIT RADIO FREQUENCY

PURPOSE

- 1 The tuning unit radio frequency (TURF) is a microprocessor controlled unit used to tune and match various antennas to the RT 319. This is achieved by selecting a combination of series inductors, capacitors and switched-variable transformer windings, each component being switched into circuit by a relay. To enable rapid changeover between transmit and receive frequencies the relay settings for the last transmit and receive tuning sequences are stored in random access memory. Power required by the TURF is provided by the RT 319.
- 2 The TURF Extender, which contains additional inductors and relays, can be used in conjunction with the TURF to extend the tuning range.

IDENTITY

- 3 Manufacturer : MEL, Crawley, West Sussex
Manufacturer's reference : Tuning Unit Radio Frequency PRC 319
MEL type number : BA 1303
MEL drawing series : 9571 113 0300
NATO stock number : 5820-99-734-7836

DESIGN AND PERFORMANCE DATA

Tuning Time

- 4 Previously stored relay settings : Less than 35 ms
New relay settings : Less than 200 ms

Tuning

- 5 Antenna tuned : Voltage standing wave ratio (V.S.W.R.) normally less than 1.5:1, but depends on antenna and frequency used.
Antenna non tuned indication : V.S.W.R. greater than 5:1.

Storage Capacity

- 6 Receive status store : One set of relay selection signals obtained during last tune to receive sequence.
Transmit status store : One set of relay selection signals obtained during last tune to transmit sequence.

Frequency Range

- 7 Tuning frequency range : 1.5 MHz to 40 MHz, depending on which antenna is used.

Power Consumption

- 8 Tuning : Less than 15 W
 Non tuning : Less than 3 mW
 S/BY selected on RT 319 power switch : Less than 1 mA

PHYSICAL DATA

Dimensions and Weight

9 For dimensions and weight of the TURF refer to Table 1.2.1.1.

NOTE Dimensions include all protrusions, ie sockets, flanges etc.

Table 1.2.1.1 Dimensions and Weight

Item	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
Tuning Unit Radio Frequency	64	105	205	1.3

Environmental

- 10 Storage temperature : -46°C to +70°C
 Operating temperature : -31°C to +55°C
 Immersion : Sealed to withstand immersion in water to a depth of 2 m for 5 minutes.
 Shock : Withstands free fall of 0.75 m on to a hard flat surface.
 Low pressure (air transportation) : Withstands air pressure equivalent to 12,000 m altitude.
 Low pressure (operational) : Operates at air pressure equivalent to 3,000 m altitude.

SERVICES REQUIRED

Power Supply

- 11 Tuning : +24 V dc
 Non tuning : +6 V dc

LOGISITIC REQUIREMENTS

12 To be issued.

ASSOCIATED DOCUMENTATION

Handbooks

- 13 Electronic Message Unit AESP 5820-U-113
 Interim Base Station AESP 5820-U-114

standards

.4 DEF STAN 59-98/2

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TUNING UNIT RADIO FREQUENCY

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CHAPTER 1.2.1

TUNING UNIT RADIO FREQUENCY

PURPOSE

- 1 The tuning unit radio frequency (TURF) is a microprocessor controlled unit used to tune and match various antennas to the RT 319. This is achieved by selecting a combination of series inductors, capacitors and switched-variable transformer windings, each component being switched into circuit by a relay. To enable rapid changeover between transmit and receive frequencies the relay settings for the last transmit and receive tuning sequences are stored in random access memory. Power required by the TURF is provided by the RT 319.
- 2 The TURF Extender, which contains additional inductors and relays, can be used in conjunction with the TURF to extend the tuning range.

IDENTITY

- 3 Manufacturer : MEL, Crawley, West Sussex
Manufacturer's reference : Tuning Unit Radio Frequency PRC 319
MEL type number : BA 1303
MEL drawing series : 9571 113 0300
NATO stock number : 5820-99-734-7836

DESIGN AND PERFORMANCE DATA

Tuning Time

4. Previously stored relay settings : Less than 35 ms
New relay settings : Less than 200 ms

Tuning

- 5 Antenna tuned : Voltage standing wave ratio (V.S.W.R.) normally less than 1.5:1, but depends on antenna and frequency used.
Antenna non tuned indication : V.S.W.R. greater than 5:1.

Storage Capacity

- 6 Receive status store : One set of relay selection signals obtained during last tune to receive sequence.
Transmit status store : One set of relay selection signals obtained during last tune to transmit sequence.

Frequency Range

- 7 Tuning frequency range : 1.5 MHz to 40 MHz, depending on which antenna is used.

Power Consumption

- 8 Tuning : Less than 15 W
- Non tuning : Less than 3 mW
- S/BY selected on RT 319 power switch : Less than 1 mA

PHYSICAL DATA

Dimensions and Weight

9 For dimensions and weight of the TURF refer to Table 1.2.1.1.

NOTE Dimensions include all protrusions, ie sockets, flanges etc.

Table 1.2.1.1 Dimensions and Weight

Item	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
Tuning Unit Radio Frequency	64	105	205	1.3

Environmental

- 10 Storage temperature : -46°C to +70°C
- Operating temperature : -31°C to +55°C
- Immersion : Sealed to withstand immersion in water to a depth of 2 m for 5 minutes.
- Shock : Withstands free fall of 0.75 m on to a hard flat surface.
- Low pressure (air transportation) : Withstands air pressure equivalent to 12,000 m altitude.
- Low pressure (operational) : Operates at air pressure equivalent to 3,000 m altitude.

SERVICES REQUIRED

Power Supply

- 11 Tuning : +24 V dc
- Non tuning : +6 V dc

LOGISITIC REQUIREMENTS

12 To be issued.

ASSOCIATED DOCUMENTATION

Handbooks

- 13 Electronic Message Unit AESP 5820-U-113
- Interim Base Station AESP 5820-U-114

standards

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CHAPTER 1.2.2

TUNING UNIT RADIO FREQUENCY EXTENDER

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CHAPTER 1.2.2TUNING UNIT RADIO FREQUENCY EXTENDERPURPOSE

1 The tuning unit radio frequency (TURF) Extender is a small lightweight unit used to extend the tuning capabilities of the TURF (Chap 1.2.1). The addition of the Extender enables a whip antenna or long wire antenna to be tuned to frequencies down to 1.5 MHz. This is achieved by selecting into circuit any number of the three series inductors contained within the Extender, selection being made by relays under the control of the TURF. The power supply required by the Extender is also provided by the TURF.

IDENTITY

2 Manufacturer : MEL, Crawley, West Sussex
 Manufacturer's reference : Tuning Unit Radio Frequency
 Extender PRC 319
 MEL type number : BA 1305
 MEL drawing series : 9571 113 0500
 NATO stock number : 5820-99-734-7837

DESIGN AND PERFORMANCE DATA

3 The following design and performance data relates to a combined TURF (Chap 1.2.1) and TURF Extender.

Tuning Time

4 Tuning time : Less than 220 ms

Tuning

5 Antenna tuned : Voltage standing wave ratio (V.S.W.R.) normally less than 1.5:1 but depends on antenna and frequency used.

Antenna non tuned indication : V.S.W.R. greater than 5:1

Frequency Range

6 Tuning frequency range : 1.5 MHz to 40 MHz, depending on which antenna is in use.

Power Consumption

7 Tuning : Less than 28 W
 Non tuning : Less than 5 mW

PHYSICAL DATA

Dimensions and Weight

8 For dimensions and weight of the TURF Extender refer to Table 1.2.2.1.

NOTE: Dimensions include all protrusions, ie sockets, flanges etc.

Table 1.2.2.1 Dimensions and Weight

Item	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
Tuning Unit Radio Frequency Extender	49	90	212	0.5

Environmental

- 9 Storage temperature : -46°C to +70°C
 Operating temperature : -31°C to +55°C
 Immersion : Sealed to withstand immersion in water to a depth of 2 m for 5 minutes.
 Shock : Withstands free fall of 0.75 m on to a hard flat surface.
 Low pressure (air transportation) : Withstands air pressure equivalent to 12,000 m altitude.
 Low pressure (operational) : Operates at air pressure equivalent to 3,000 m altitude.

SERVICES REQUIRED

- 10 Power supply : +24 V dc

LOGISTIC REQUIREMENTS

- 11 To be issued.

ASSOCIATED DOCUMENTATION

Handbooks

- 12 Electronic Message Unit : AESP 5820-U-113
 Interim Base Station : AESP 5820-U-114

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CHAPTER 2.1

CONFIGURATION

INTRODUCTION

1 The multi-role capability of PRC 319 results from modular design, which enables different field station configurations to be set up or interchanged easily according to operational requirements. In the manpack role the constituent units connect directly together to form a complete, compact system. For static field stations the units may be separated and a variety of ancillary items may be used to suit the particular situation. The constituent units fall into five groups, namely:

- (a) Transmitter/Receiver
- (b) Antenna tuning units and antennas
- (c) Power sources
- (d) Data terminals
- (e) Ancillary items

The following paragraphs give a brief description of each of the above groups followed by the method of attachment of each item within the groups for both the manpack role and the static field stations.

BRIEF DESCRIPTION

Transmitter/Receiver

2 The transmitter/receiver RT 319 is a man-portable, microprocessor-controlled, high frequency (HF) transmitter/receiver capable of providing single sideband (s.s.b.) voice and data communications with a continuous wave (c.w.) facility available for morse transmission and reception. Communications are possible over a frequency range of 1.5 MHz to 40 MHz up to a distance of 20 km between patrols on the move. To enable single, dual or remote operator working, two audio sockets (1 and 2) are provided. Audio socket 2 can also interface with the digital message handling device (DMHD), while the power for the DMHD is provided by a power connector on the side of the RT 319. A data socket for connection to the electronic message unit (EMU) Mk 1 is available. Because switching between transmit and receive functions is carried out under the control of a microprocessor, up to ten operating frequencies (channels) can be stored in the transmitter/receiver memory. Access to the microprocessor is provided by a 20-key keyboard and six-position mode switch. Many of the circuits within the RT 319 are common to both transmit and receive functions. The microprocessor determines the operation of these circuits from the information fed in on the keyboard and mode switch. For unit operation refer to Chapter 2.4.

3 Provision is made for the tuning unit radio frequency (TURF) to be attached by screw fixings to the top of the transmitter/receiver, while toggle catches enable a 24 volt battery to be attached to the bottom of the

transmitter/receiver. Guides are provided on the left-hand side of the unit to allow the EMU to be slid into place and to connect directly with the data socket.

Antenna Tuning Units and Antennas

4 A tuning unit radio frequency (TURF) and TURF Extender are used to tune and match the antennas listed in Chapter 2.2 to the transmitter/receiver. The TURF is a microprocessor-controlled unit which carries out the tune and match sequence by switching into circuit a combination of series inductors, capacitors and switched-variable transformer windings. Selection of the components is made by relays, the last transmit and receive settings of which can be stored in the TURF memory. Initialisation of the tune sequence is performed by the RT 319 sending one of four tune up tone signals to the TURF. Interconnection between the transmitter/receiver and the TURF is made by a coaxial cable which carries the power supply, current radio frequency and instruction tones.

5 If a whip or long wire antenna is to be tuned to frequencies down to 1.5 MHz the TURF Extender, which contains a further three inductors and six relays, is used in conjunction with the TURF. Power supplies for both units are derived from the transmitter/receiver. The additional inductors are switched into circuit by relays controlled from the TURF. Interconnections between the TURF and the Extender are made via an antenna terminal (r.f. signal) and a 7-pin socket (power supply and relay control signals).

6 The TURF is fastened to the top of the RT 319 by two screw fixings, one at the front and one at the back. Attachment of the Extender to the top of the TURF is achieved by a screw fixing on the back and an earth strap on the front.

7 The many different antennas and associated accessories for use with the PRC 319 are listed in Table 2.2.1 of Chapter 2.2. The choice of antenna depends on the following factors:

- (a) The operational role.
- (b) The required communication range and frequency.
- (c) The physical operating conditions.

The normal antenna for use in the manpack role is the 2.4 m whip which is mounted to the antenna base attached to an earth spike located in the satchel.

Power Sources

8 The different batteries and associated ancillaries for use with the RT 319 are listed in Table 2.3.1 of Chapter 2.3. The battery is normally attached directly to the bottom of the transmitter/receiver by two spring-loaded toggle catches, but can be detached and used via the three-metre power cable. A further power cable allows the RT 319 to be supplied from a nominal 24 v d.c. source other than the batteries. The power supplies required by the TURF, TURF Extender, EMU and DMHD are all provided by the transmitter/receiver battery (the EMU also has its own internal primary battery for message preparation and reading remote from the radio).

9 The secondary batteries listed in Table 2.3.1 of Chapter 2.3 can be charged from either a hand-operated generator fitted between the RT 319 and the battery, or a solar charger whose charging cable plugs directly into the battery. In both cases operation of the radio is not impeded.

Data Terminals

10 Transmission and reception of data messages is carried out by the RT 319 in conjunction with either an electronic message unit (EMU) Mk 1 or a digital message handling device (DMHD).

11 The EMU is a small, hand-held microprocessor-controlled device which can operate at a baud rate of 75, 150 or 300 depending on the selection made on the RT 319 mode switch. A keyboard and display provide access to the microprocessor, and up to ten callsigns and two messages for transmission can be stored in the EMU memory. Only messages commencing with one of the stored callsigns are processed by the microprocessor. Received messages are stored in up to 77 'P' store locations and one 'F' store location. Indicators on the display warn of any fault condition or of a message waiting in store. Guides on the left-hand side of the front face of the radio allow the EMU to be slid into place to connect with the RT 319 data socket. The EMU can be detached and used remotely via a special cable to the radio data socket. During message preparing or viewing procedures the EMU can be disconnected from the radio and operated from its own internal battery. Further technical information and operating procedures can be found in AESP 5820-U-113.

12 The DMHD is an in-service item and is similar to the EMU with a keyboard and display. It is connected, via a special audio lead, to audio socket 2 on the right-hand side of the RT 319. The unit is powered from the DMHD power connector also located on the right-hand side of the radio.

Ancillary Items

13 Table 2.1.1 below lists the ancillary items available for use with the PRC 319 system.

Table 2.1.1 PRC 319 Ancillary Items

ITEM	DESCRIPTION	NATO STOCK NO.
1	Headset, Single Transducer	5965-99-622-5436
2	Key, Telegraph, Manual, Manpack (morse key)	5805-99-117-7542
3	Cable Assembly RF UR76 (20 m 2 off)	5820-99-620-5803
4	Cable Assembly RF UR76 (10 m)	5995-99-620-9817
5	Couplers BNC (2 off to enable items 3 and 4 to be joined together)	5935-99-999-7889
6	Satchel	5820-99-734-1696
7	Cable Assembly (85 mm) Radio-Turf	5995-99-734-7841
8	Cable Assembly - Radio-EMU Extension	5995-99-734-7839
9	Cable Assembly (80 mm) Turf-Turf Ext	5995-99-734-7840
10	Antenna Mount	5820-99-734-7842
11	Balum (Dipole Centre junction)	5820-99-734-7838

Items 1 and 2 are standard in-service items compatible with the RT 319. The three cable assemblies, items 3 and 4, and two couplers (item 5) enable remote use of the TURF at a distance of up to 50 metres from the transmitter/receiver. Items 7, 8 are used in the manpack role and are covered in Paras 17 and 18.

Carrying Satchel

14 The carrying satchel shown in Fig 2.1.2 is designed to carry all the constituent units and ancillary items of the PRC 319 system. The two bags, one either side of the main satchel, are attached by zip fasteners and can be removed easily. Fig 2.1.3 shows the bags removed and the front flap lowered, giving access to the inside of the satchel. Once placed within the satchel the PRC 319 system is secured by three retaining straps. Adjusters are provided for both the shoulder and waist straps as shown in Fig 2.1.4.

CONFIGURATION

Manpack Role

15 To operate the PRC 319 in the manpack role the constituent units are connected directly together to form a complete compact system (Fig 2.1.1.). The following paragraphs detail the method of attachment for each of the units.

16 Battery

- (1) Place the radio onto the battery ensuring that the protrusions on the bottom of the radio locate in the slots on the battery.
- (2) Fasten the two spring-loaded catches.

17 Tuning Unit Radio Frequency

- (1) Place the TURF on top of the transmitter/receiver and attach using the two screw fixings.
- (2) Connect 85mm cable assembly (item 7 Table 2.1.1) between the r.f. socket on the transmitter/receiver and the input socket on the TURF.

18 Tuning Unit Radio Frequency Extender

- (1) Place the TURF Extender on top of the TURF ensuring that the two protrusions on the bottom of the Extender locate in the slots on the top of the TURF.
- (2) Secure the extender using the screw fixing on the back and the earth strap on the front.
- (3) Connect 80 mm cable assembly (item 8 Table 2.1.1) between the 7-pin socket on the TURF and the 7-pin socket on the Extender.

19 Electronic Message Unit

- (1) Slide the EMU into place from the left of the radio so that the

oversize rear lid of the EMU locates in the guide slots in the radio case.

- (2) Push the unit fully home so that the spring-loaded retaining catch on the EMU engages in the slot in the striking plate on the radio.

20 Antennas. Connecting details for the antennas compatible with the PRC 319 can be found in Chap 2.2. The antennas are attached to the antenna terminal of either the TURF or the TURF Extender, depending on the operating frequency selected and the type of antenna in use. Connection from the TURF or TURF Extender to the antenna terminal is made to the antenna mount via a small length of "P11" Cable.

21 Ancillaries

- (1) Connect the single transducer headset (item 1 Table 2.1.1) to either audio socket 1 or audio socket 2 on the radio.

NOTE: If the morse key is to be connected to the radio the headset must be connected to audio socket 1.

- (2) Connect the morse key (item 2 Table 2.1.1) to audio socket 2 on the radio.

Static Field Station

22 In the static field station configuration the units comprising the PRC 319 can be connected either directly together, or remotely as shown in Figs 2.1.5 and 2.1.6.

23 To connect the EMU Mk 1 to the radio remotely, fit the male connector on cable assembly (item 9, Table 2.1.1) to the data socket on the radio case and fit the female connector on the cable to the data plug on the EMU Mk 1. Both cable connectors have bayonet fittings.

24 The TURF, and hence the TURF Extender, can also be connected to the radio remotely using a combination of items 3, 4 and 5 listed in Table 2.1.1. To connect the TURF to the radio select the cable assemblies needed to cover the distance between the TURF and the radio (10, 20, 30, 40 or 50 metres) and join them together using the BNC couplers (item 5) listed in Table 2.1.1. Fit one end of the assembled cable to the r.f. socket on the radio (Fig 2.1.1) and the other end to the input socket on the TURF (Fig 2.1.1).

25 To enable the batteries to be placed remote from the radio a three-metre power cable is used. A further power cable of 2.23 metres in length enables a nominal 24 v d.c. source, other than the batteries, to be used. Further details of the cables, including connecting procedures, are contained in Chap 2.3. For a list of the antennas compatible with PRC 319, and connecting details associated with them, refer to Chap 2.2.

26 To operate the radio in the data mode in conjunction with the DMHD connect the units as shown in Fig 2.1.6. Connect the DMHD power lead to the DMHD power socket on the radio and the DMHD audio lead to audio socket 2 also on the radio (Fig 2.1.1). If a Clansman rechargeable battery is being used connect the DMHD power lead to the battery charging socket.

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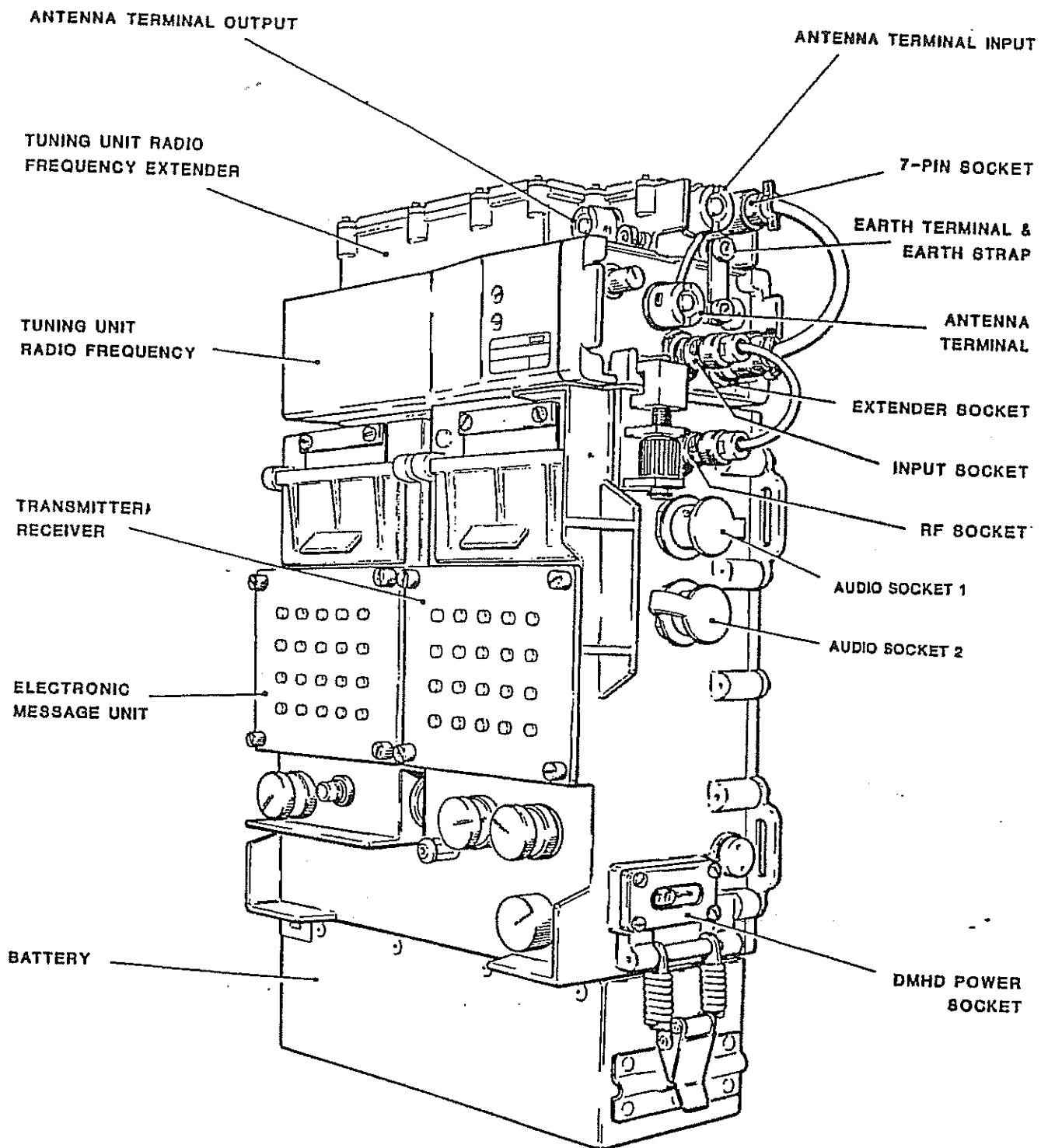


Fig 2.1.1 Manpack Configuration

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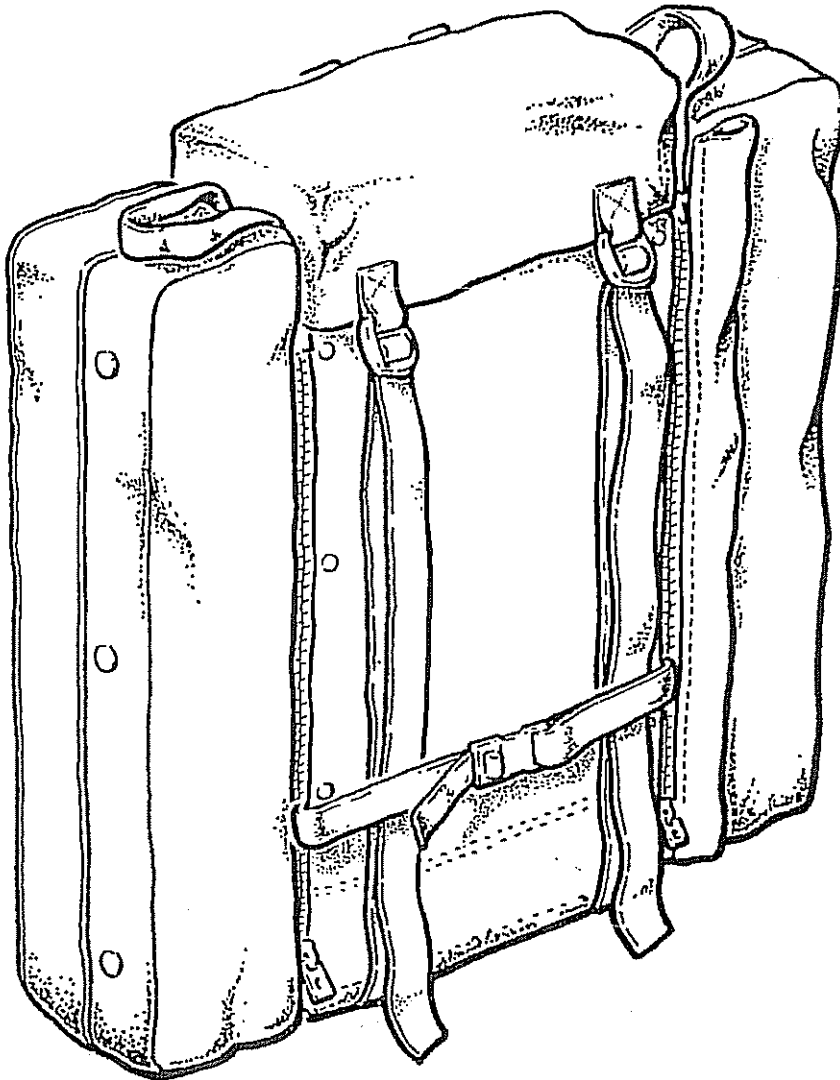


Fig 2.1.2 Carrying Satchel

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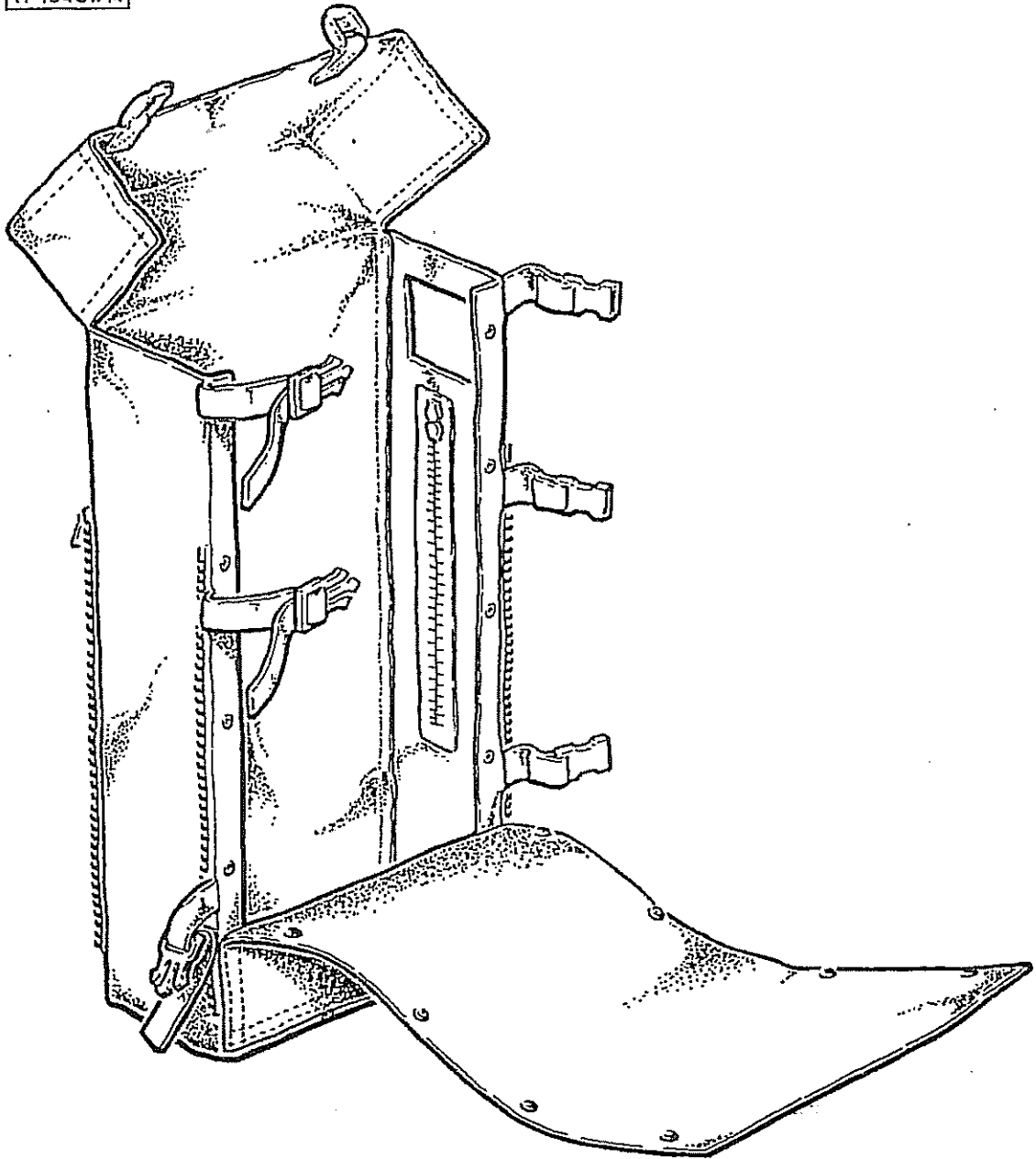


Fig 2.1.3 Carrying Satchel - Bags Removed and Flap Lowered

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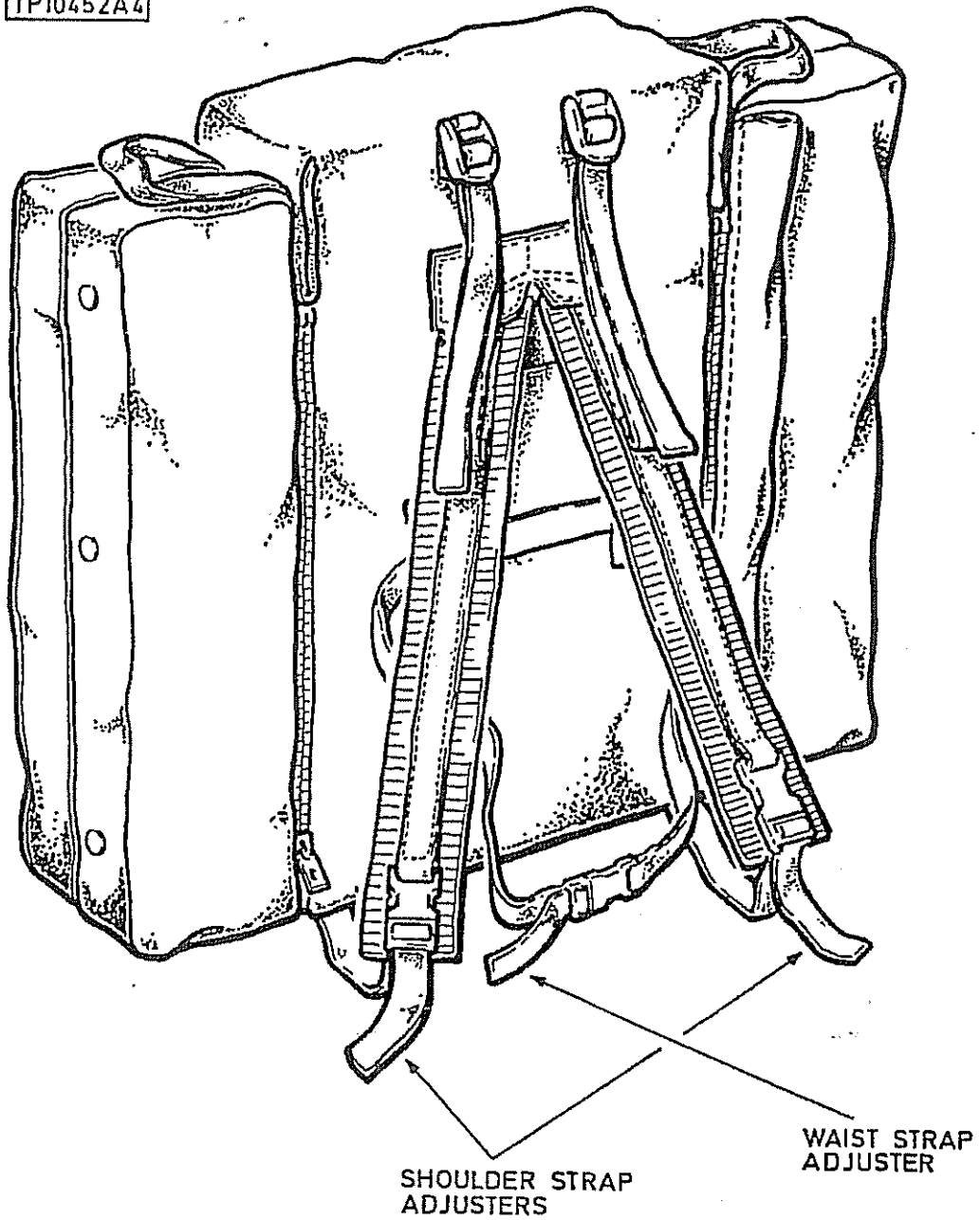


Fig 2.1.4 Satchel Strap Adjusters

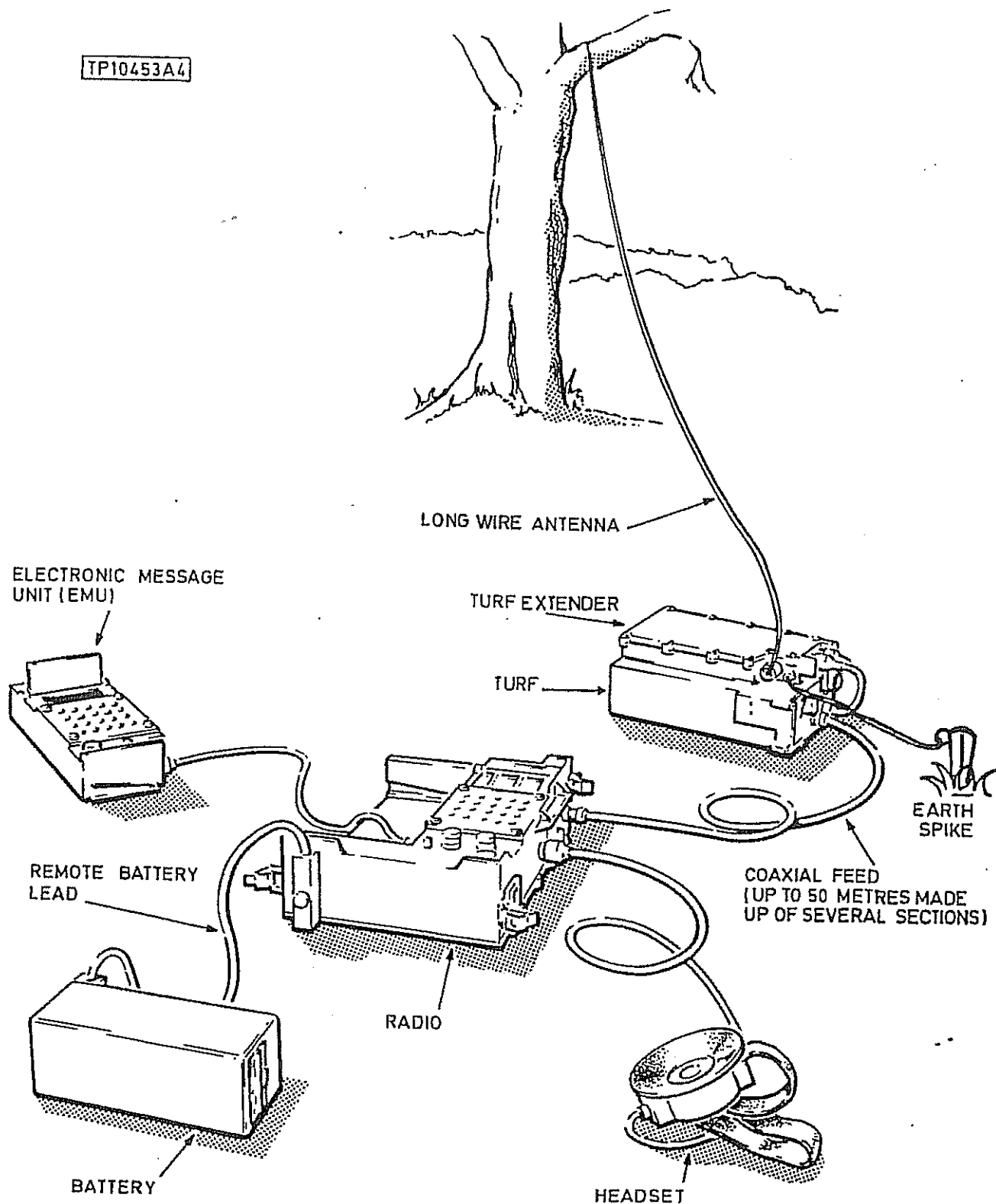


Fig 2.1.5 Possible Static Field Station Configuration

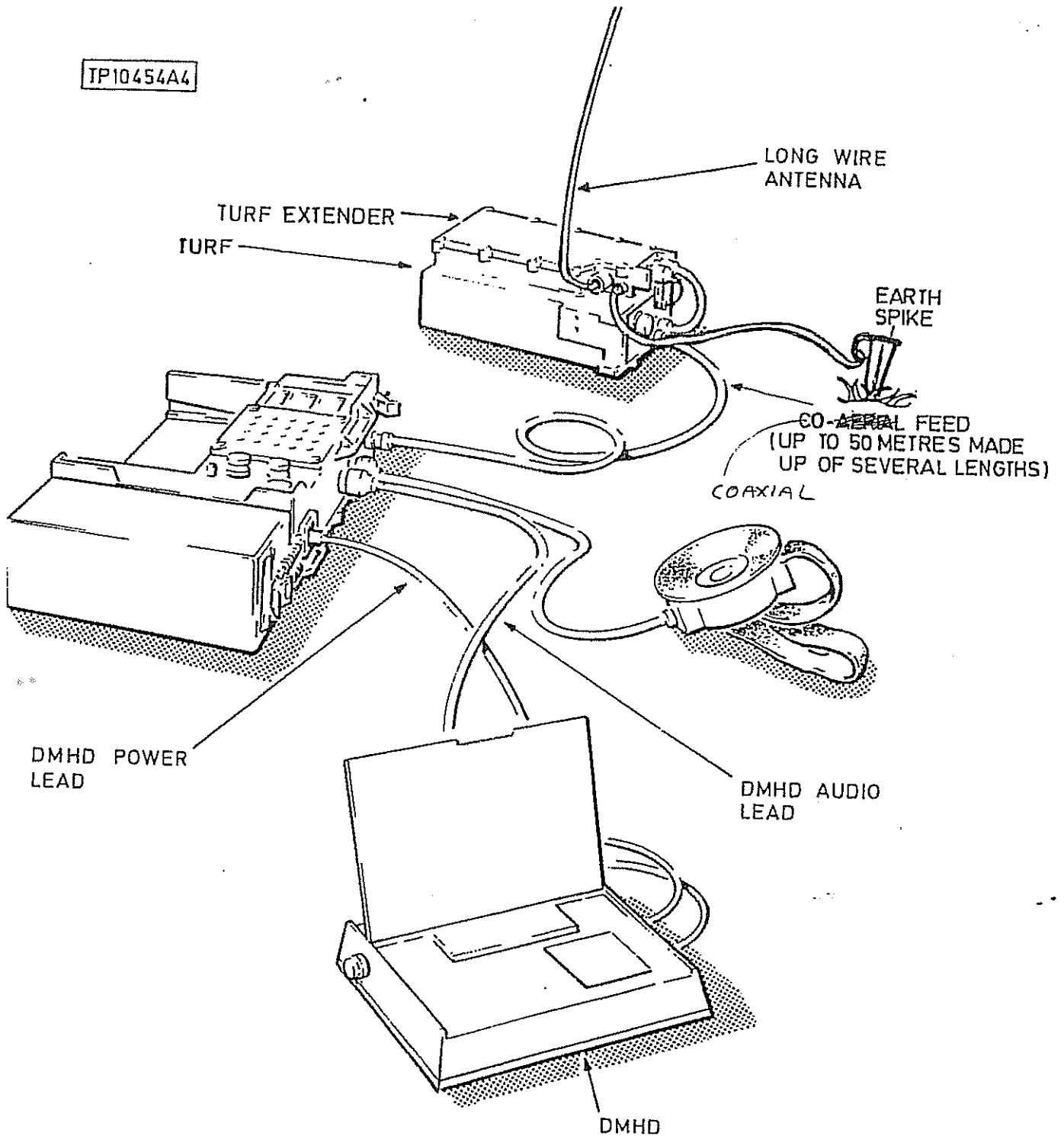


Fig 2.1.6 DMHD Connections

CHAPTER 2.2

ANTENNAS

Contents

Para

- 1 INTRODUCTION
- 4 Warnings

- DEPLOYMENT AND CONNECTION
- 5 2.4 m Whip
- 6 Wire Antennas
- 7 Wire type antenna complete with reel
- 8 5 m Wire type antenna
- 9 7 m Wire type antenna
- 10 Counterpoise
- 11 Covert, travelling wave
- 12 Dipole Antenna
- 13 Mast kit

- 14 TURF SWITCH SETTINGS

- 15 TUNING RANGES FOR ANTENNAS

Tables

Table

- 2.2.1 Antennas and Associated Accessories
- 2.2.2 Antenna Tuning Range

Page

- 2.2.3
- 2.2.6

CHAPTER 2.2ANTENNASINTRODUCTION

1 Many different antennas may be used with PRC 319, field station. The choice of antenna and method of deployment depends on a number of factors:

- (1) the operational rôle,
- (2) the required communication range and frequency,
- (3) the physical operating conditions.

2 Table 2.2.1 shows the available antennas and associated accessories. (Refer to Table 2.2.2 for their tuning range.)

Table 2.2.1 Antennas and Associated Accessories

Description	Reference
Antenna 2.4 m Whip	5820-99-621-9029
Antenna Wire type c/w reel 2 off	5820-99-117-7440
Antenna 7.0 m Wire	TBS
Antenna 5.0 m Wire	TBS
Antenna Covert, dipole	TBS
Antenna Covert, travelling wave	TBS
Antenna Counterpoise	5820-99-117-7438
TURF Co-axial adaptor	3513 172 3982
Dipole Balun Adaptor	5820-99-734-7838
Whip Antenna mount	TBS 5820-99-734-7842
Mast Kit	5820-99-621-9027

3 All antennas may be used without damage to the equipment, for both transmit and receive either directly from the PRC 319 or via the TURF or TURF with TURF EXTENDER. When an antenna is connected directly to the PRC 319 the Voltage Standing Wave Ratio (V.S.W.R.) at the operating frequency should be 1.5:1 (or better) into 50 ohms. If this is not the case the PRC 319 will reduce its transmitted power to protect the RF output stages. For best results in this application a dipole, suitably adjusted for the frequency, should be used. When a dipole antenna is connected via the TURF,

mismatches of up to 3:1 will be corrected by the TURF and full output power will be achieved.

4 Warnings:

- (a) High voltages may be generated at the antenna, so to avoid RF arcing which would impair communications, ensure that the RF connectors are kept clean and dry before setting to work.
- (b) When operating the set during transmit in a mobile role (on the move), take care not to touch any exposed metal parts on the equipment as RF burns could result.
- (c) When operating the set in a static role (at rest) it is recommended to ground it ~~as per~~ via an earth spike connected to the earth terminal on either the TURF or TURF Extender.

DEPLOYMENT AND CONNECTION

5 2.4 m Whip. This is the normal antenna for the PRC 319 when used in a 'manpack' role.

- (1) Connect the sections of the antenna together pulling the draw cord through each section as it is connected to the next. Tie off the cord after assembly to ensure that the antenna sections stay together.
- (2) Attach the antenna mounting base to the earth spike located in the satchel and mount the antenna to the base.
- (3) The electrical connection from the antenna to the TURF or TURF extender is made using small length of "P11" cable.

Wire Antennas ($\frac{1}{4}$ or $\frac{3}{4}$ wave end fed, tuned dipole, fixed length wire antenna)

6 A wire antenna provides effective RF radiation while being inconspicuous when deployed. The antenna can be end fed or centre fed, and its length should be adjusted to suit the operating frequency. Each wire antenna is used in conjunction with an earth spike or antenna counterpoise which is connected to the TURF earth terminal (or one connection of a dipole centre junction if used).

7 Wire type antenna complete with reel. This antenna used with the TURF enables an end fed configuration to be set up and adjusted for optimum match at the operating frequency. The wire length should be adjusted to just less than one-quarter wavelength (or alternatively just less than three-quarters of a wavelength) at the operating frequency.

8 5 m Wire type antenna. This end fed wire antenna covers the frequency range 4 MHz to 23 MHz when used with the TURF, and 1.5 MHz to 23 MHz when used with the TURF EXTENDER, see Table 2.2.2.

- 9 7 m Wire type antenna. This is similar to the 5 m Wire antenna and covers the frequency range 3.4 MHz to 17 MHz with the TURF, and 1.5 MHz to 17 MHz with the TURF and the TURF EXTENDER, see Table 2.2.2.

Counterpoise

- 10 In order to obtain an effective groundplane for the antenna, especially when the PRC319 is used with end fed wire antennas, an antenna counterpoise should be used. This consists of a length of cable, with one end connected to the PRC319 earth terminal and the other left trailing on the ground.

- 11 Covert, travelling wave. This is an end terminated antenna designed to be buried below ground. It must be used in conjunction with the TURF which may also be buried. This provides a high level of physical security, but radiated power will be reduced.

12 Dipole Antenna

This is formed by two wires, adjusted in length according to the operating frequency, and connected to the Balun (Dipole Centre function). A coaxial cable connects the centre junction to the TURF via the TURF coaxial adaptor, the TURF acting as a line flattener. Alternatively the coaxial feed may be connected directly to the RT connector on the RT 319. Under this condition there may be some additional loss due to line mismatch.

- 13 Mast kit. The mast kit provides a physically stable mount for end fed and dipole antennas.

TURF SWITCH SETTINGS

- 14 The TURF has one rotary switch with the following positions:

- (1) DIPOLE/END FED
- (2) 3.4 m - 8.0 m
- (3) ~~3.6 m.~~

TUNING RANGES FOR ANTENNAS

- 15 Table 2.2.2 shows the tuning ranges for the various antennas used with the TURF, and with the TURF plus TURF EXTENDER.

Table 2.2.2 Antenna Tuning Range

Antenna Type	Tuning Range		TURF SWITCH POSITION
	PRC319 + TURF	PRC319 + TURF + TURF EXTENDER	
2.4 m Whip	4.5 MHz - 40 MHz	1.5 MHz - 40 MHz	< 3.6 m
Wire Dipole @ 3:1 v.s.w.r. (using centre junction dipole)	1.5 MHz - 40 MHz	NOT USED	DIPOLE/END FED
5 m Wire	4.0 MHz - 23 MHz	1.5 MHz - 23 MHz	3.4 m - 8 m
7 m Wire	3.4 MHz - 17 MHz	1.5 MHz - 17 MHz	3.4 m - 8 m
End Fed Wire $\frac{1}{4}$ or $\frac{3}{4}$ nominal wavelength	1.5 MHz - 40 MHz	NOT USED	DIPOLE/END FED

CHAPTER 2.3

BATTERIES

Contents

Para

- 1 INTRODUCTION

- BATTERY CONNECTION
- 2 Direct Battery Connection
- 3 Indirect Battery Connection
- 4 Changing the Battery
- 5 External Supply Connection

- 6 CHARGING
- 7 Use of Hand-Operated Generator

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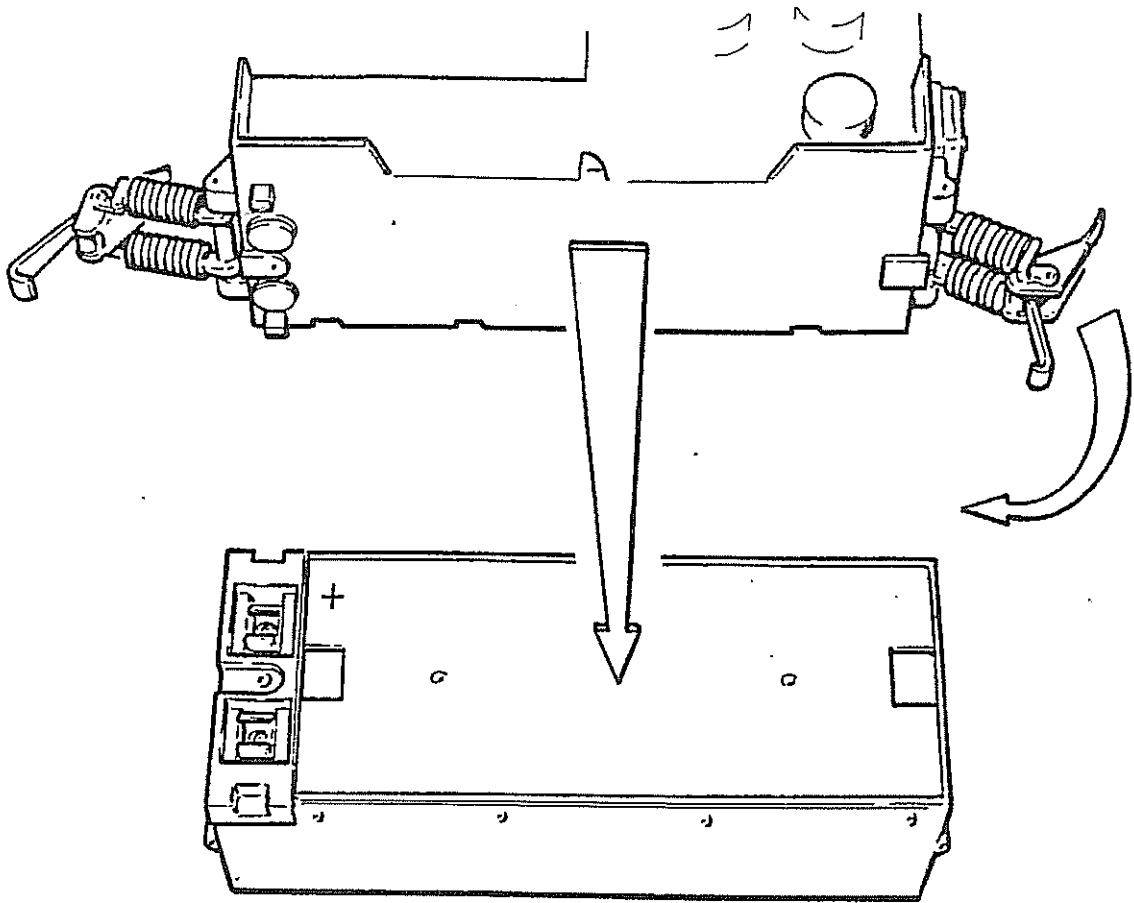


Fig 2.3.1 Direct battery connection

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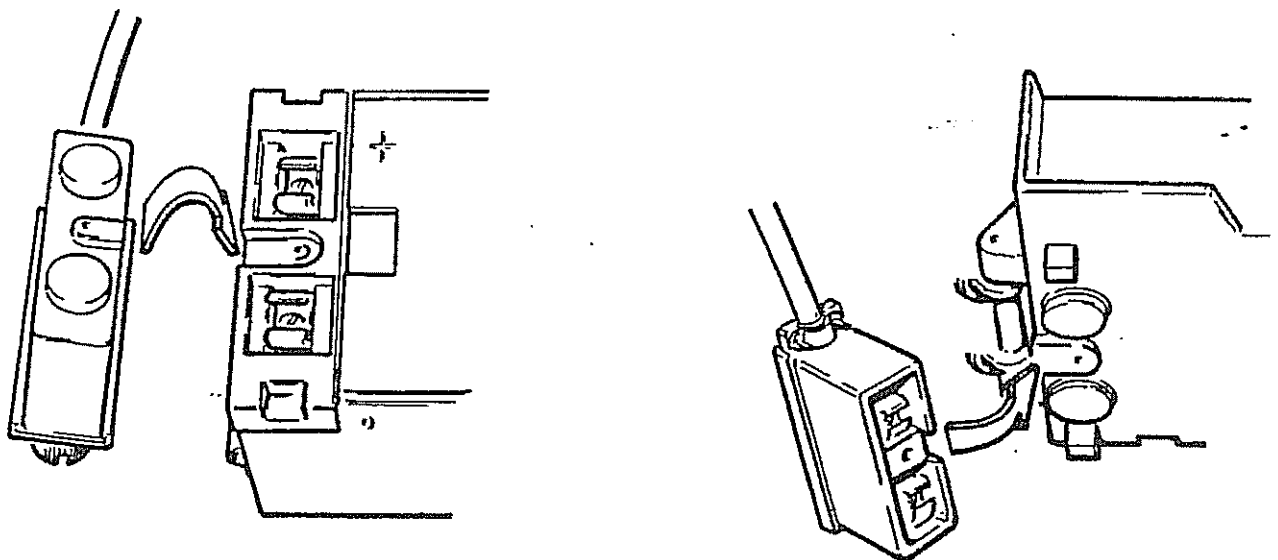


Fig 2.3.2 Indirect battery connection

CHAPTER 2.3

BATTERIES

INTRODUCTION

1 Batteries and associated power supply items specified for use with RT 319 are listed in Table 2.3.1 below. All are mechanically interchangeable so various connection arrangements are possible as described in the following paragraphs.

TABLE 2.3.1 BATTERIES AND POWER SUPPLY ANCILLARIES

Description	NSN or other reference
Battery, Secondary 24 V 4 Ah	6140-99-620-8057
Battery, Secondary 24 V 1.2 Ah	6140-99-620-8058
Battery, Primary Lithium	TBD
Generator, Electrical, Hand Operated	5820-99-114-3390
Cable Assembly, Power Electrical (2 conductor, 3 m)	5995-99-620-2113
Cable Assembly, Power Electrical (2 conductor, 2.23 m)	5995-99-117-7435

BATTERY CONNECTION

Direct Battery Connection

2 Normally the battery is attached directly on to the bottom of the RT 319 case by means of two spring-loaded toggle catches. Protrusions on the bottom of the radio locate in slots on the battery to position it accurately before the catches are fastened. The operation is most easily performed by placing the radio on to the battery as shown in Figure 2.3.1 (1.2 Ah rechargeable battery depicted).

Indirect Battery Connection

3 Any of the batteries can be connected to the RT 319 via the three-metre power cable 5995-99-620-2113. One end of the cable is fitted with a terminal block that has spring terminals similar to those on the battery. This is connected to the radio. The other end of the cable has pad terminals like those on the radio and is connected to the battery. The terminal blocks are physically designed so that they can only be connected at the correct end and with the correct polarity. They are secured with captive screws. Refer to Figure 2.3.2.

Changing the Battery

4 The RT 319 is designed to retain stored information, including channel number/frequency combinations and display illumination level, for a short period of time to enable the battery to be changed. The radio should be set to the standby condition for this operation (see Chapter 2.4).

Note: Unserviceable batteries are to be backloaded through RAOC channels for subsequent delivery to an authorised recycling plant.

External Supply Connection

5 Power cable 5995-99-117-7435 is specified to allow the possibility of supplying RT 319 from a nominal 24 V d.c. source other than the batteries listed in Table 2.3.1. One end of the cable is fitted with a terminal block with spring terminals. This is connected to the radio. The other end is fitted with 'crocodile' clips for connection, say, to a vehicle lead-acid battery. The brown lead should be connected to the positive supply terminal; the blue lead to the negative terminal. The cable incorporates a diode to protect the radio from reverse polarity in the event of incorrect connection at the supply.

CHARGING

6 Either of the secondary batteries will need to be recharged from time to time during long missions. The RT 319 displays a warning when battery voltage falls below 20 V (see Chapter 2.4) and at this time the battery should be changed and/or recharged. Operation of the radio can be continued during charging.

Use of Hand-Operated Generator

7 The hand-operated generator 5820-99-114-3390 is fitted between the RT 319 and the battery being charged. Before fitting the generator its operating handle needs to be reversed from the stowage position to the operating position (see Figure 2.3.3). The generator is secured to the RT 319 by the toggle catches that normally hold the battery. The battery is in turn secured by two similar catches on the generator. Once again, physical design ensures correct location and connection.

8 If the discharged battery is connected to the RT 319 via the power cable (Para 3), the generator can be fitted to the battery and the cable is then secured to the top of the generator. Whatever arrangement is used, disconnection and reconnection should be carried out with the RT 319 set to standby (Chapter 2.4) to prevent loss of stored information.

9 Having connected the generator, charging is carried out by steadily turning the operating handle at about 30 revolutions per minute. A light-emitting diode, indicates when the battery is being charged.

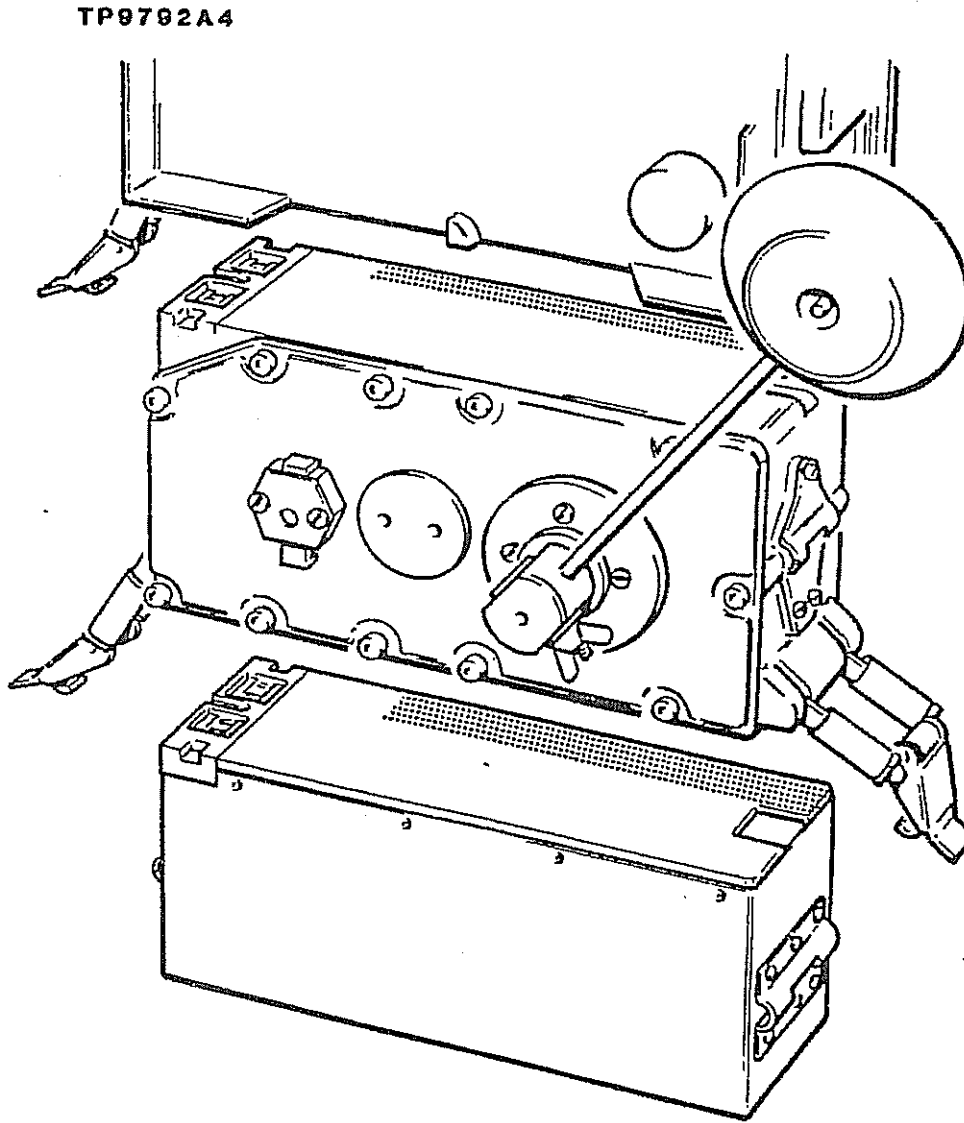


Fig 2.3.3 Hand-operated generator attachment

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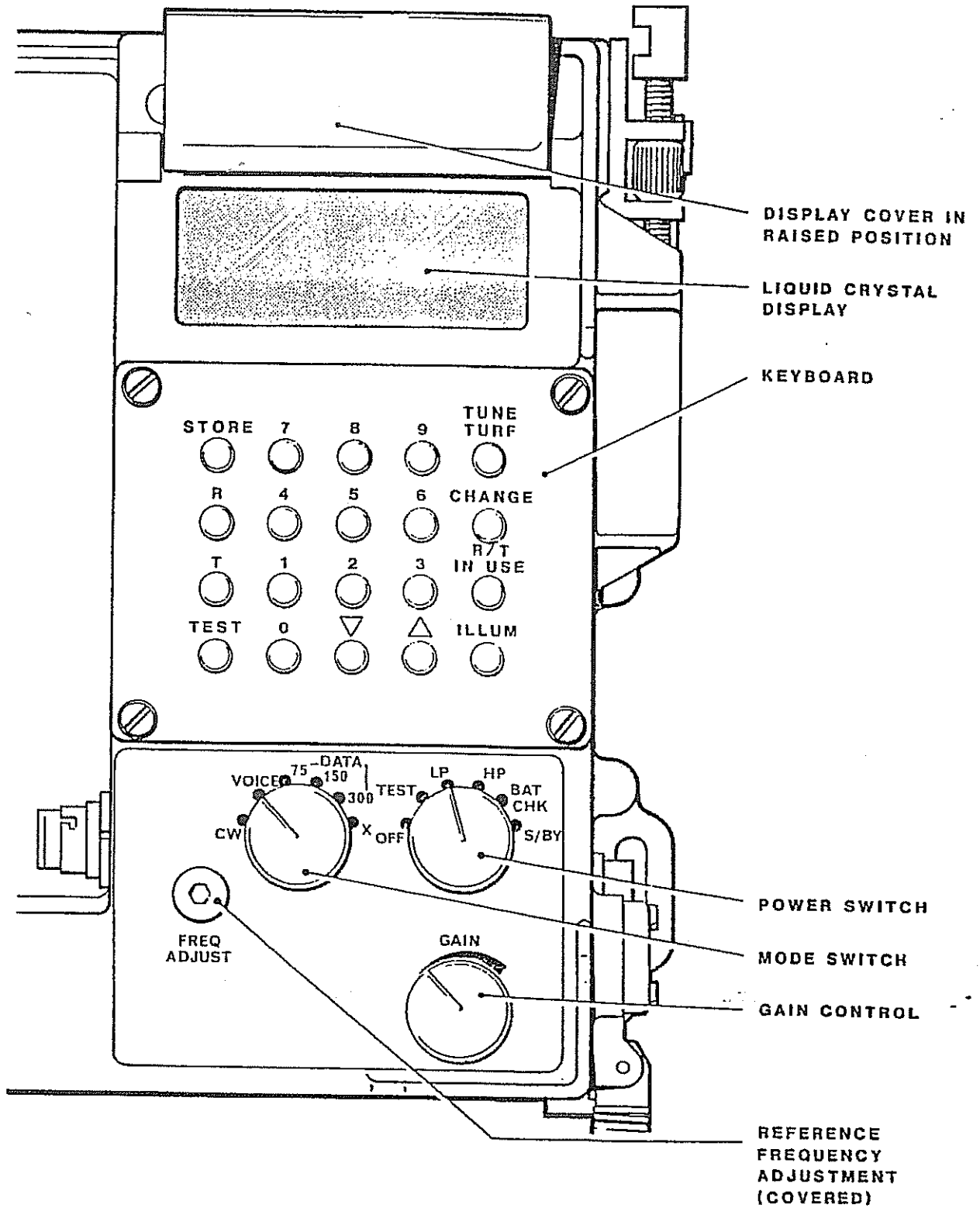


Fig 2.4.1 RT 319 Controls and Display

CHAPTER 2.4

CONTROL AND OPERATION

INTRODUCTION

- 1 All primary control operations for PRC 319 are carried out using the receiver-transmitter controls and display illustrated in Figure 2.4.1 opposite. On the basis that the station has been set up as described in Chapters 2.1 to 2.3, this chapter details the controls and indications available and provides operating sequences for all communication functions and for user tests.
- 2 Operating sequences involving associated equipments Electronic Message Unit (EMU) Mk 1 and Digital Message Handling Device (DMHD) contain cross references to publications dealing with these equipments, which are listed in Category 1.

CONTROLS & DISPLAY

Power Switch

- 3 The power switch is a six-position rotary switch used for controlling the operational status of RT 319 and that of associated equipments when connected. Switch positions are:
 - (a) OFF: Power is disconnected and all functions are inoperative. Switching to OFF erases the stored channel number and frequency data, and the display illumination level, and also switches off output power for the TURF 319, EMU Mk 1 and DMHD. To prevent this being done inadvertently, the power switch has to be set to TEST then pulled out before OFF is selected.

Note: If rechargeable battery 6140-99-620-8057 or -8058 is being used to power RT 319, the DMHD can be powered directly from the battery, in which case the power switch is bypassed.
 - (b) TEST: Enables built-in tests to be performed when the mode switch is appropriately set and certain keys on the keyboard are operated (see Para 38).
 - (c) LP: Selects low power operation (see Category 1).
 - (d) HP: Selects high power operation (see Category 1).
 - (e) BAT CHK: Enables battery voltage (to the nearest volt) to be displayed. When the power switch alone is set to BAT CHK, off load voltage is displayed. When the transmit pressel is operated, on load voltage is displayed after about 10 sec but no r.f. power is transmitted.

- (f) S/BY: Selects a standby state in which the RT 319 does not receive or transmit. However, memory functions continue to operate so that channel number, frequency data and display illumination information remain stored. Power output is also maintained to the TURF 319 and EMU Mk 1, when connected, so that memory functions in these equipments remain active. The power output for the DMHD is not available in standby (except direct from an appropriate battery, see Note after Sub-para (a)).

Mode Switch

4 The mode switch is a six-position rotary switch used for setting up the RT 319 for particular types of reception and transmission. Switch positions are CW (eg for morse); VOICE; DATA 75, 150 or 300 for operation with the EMU Mk 1; and X for operation with the DMHD. Numbers associated with the DATA positions are the data rates in bauds. The function of the switch is to select appropriate methods of modulation and demodulation and audio signal processing.

Gain Control

- 5 The function of the GAIN control differs according to the setting of the mode switch.
- (a) For c.w. operation, a.f. amplification for the audio output sockets and r.f. gain are both controlled, the latter by influencing the automatic gain control (a.g.c.) system.
 - (b) For voice operation, only the a.f. gain for the audio output sockets is controlled.
 - (c) For operation with the EMU Mk 1 (mode switch set to DATA 75, 150 or 300), a.f. amplification for the audio output sockets is controlled but the audio feed to the demodulator is not affected.
 - (d) For operation with the DMHD (mode switch set to X), a.f. amplification for one audio output socket 1 only is controlled. The output to audio socket 2, to which the DMHD is connected, is at a fixed gain optimised for the DMHD.

Frequency Adjustment

6 The FREQ ADJUST control is not for operator use but may be required very occasionally by the maintainer to adjust the frequency of the reference oscillator in the frequency synthesiser to counteract the effect of component ageing. The control is normally covered by a screw button cap.

Keyboard

7 The keyboard contains 20 keys in a four-by-five matrix. Numeral keys 0 to 9 are used for entering numeric data. The ten function keys have the following significance:

- (a) STORE: Used to write channel number and frequency into memory after entering the data by means of the R or T and numeral keys.
- (b) R: Indicates 'receive'. Used to begin a number of key sequences so that receiver functions are selected (see Operating Procedures for details).
- (c) T: Indicates 'transmit'. Used to begin a number of key sequences so that transmitter functions are selected (see Operating Procedures).
- (d) TEST: Used to start built-in tests after setting the power and mode switches appropriately and/or operating the R or T keys (see Paras 39 to 41).
- (e) TUNE TURF: Used to tune the TURF 319 after changing to a new frequency channel or, in conjunction with the R or T key, to re-tune the TURF 319 to the working frequency.
- (f) CHANGE: Used to carry out a frequency change after entering R or T and a new channel number.
- (g) R/T IN USE: Used to display the currently-selected channel number and frequency. Receive data is displayed on the first operation of the key, transmit data is displayed for five seconds on the second operation of the key.
- (h) ILLUM: Used to switch on the back lighting for the display (first operation) and to switch it off again (second operation). Lighting automatically switches off 10 seconds after the last keyboard entry.
- (j) \triangle and (k) ∇ : Used to increase or decrease the level of back lighting when ILLUM has been operated. The level is memorised and used when back lighting is switched on subsequently, provided the RT 319 has not been switched OFF at the power switch.

Liquid Crystal Display

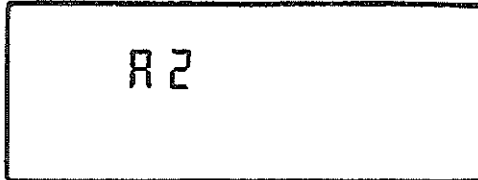
8 The liquid crystal display (LCD) ~~is a custom-built device that~~ presents alphanumeric data in two rows of four-plus-six characters. As well as numerals 0 to 9, which appear in the familiar seven-segment format, several alphabetic characters are used. These are A, B (same as 8), E, F, H, i, I (same as 1) L, n, o (as opposed to 0 - zero), P, r, R (same as A), S (same as 5), t and u. How the alphabetic characters are presented in the seven-segment format is shown in the Operating Procedures, where typical display indications are illustrated. The upper, middle and lower horizontal bars of some characters are also used in certain circumstances. No decimal points are used.

- 9 Channel number and frequency data appear in the upper row of characters. The channel number occupies the third and fourth characters of the left-hand, four-character group. Frequency is displayed in the six-character, right-hand group. The most-significant frequency digit represents tens of megahertz, appearing as 0 for frequencies below 10 MHz. Thus, the least-significant digit represents 100 Hz, ie the smallest increment of frequency that can be selected (see Category 1). The first and second characters in the left-hand group are used to display battery voltage, also the first character is used during built-in testing of the modem (see Operator Checks).
- 10 The lower four-character group is reserved for warning data and to indicate that built-in tests are in progress. Specific warnings are explained in the Operating Procedures and built-in testing is covered under Operator Checks.
- 11 The lower six-character group displays different information depending on the operational status of the radio:
- (a) When the radio is receiving, received signal strength is indicated by a row of horizontal bars.
 - (b) When the radio is transmitting, forward and reverse power are indicated by rows of horizontal bars, the upper bar being used for forward power, and the lower bar for reverse power. The setting of the power switch is taken into account so that maximum forward power is indicated by six bars irrespective of whether the transmitter is operating in high or low power mode.
 - (c) During built-in testing, results are displayed; either 'pass' or 'fail' plus a number indicating the area of failure. (See Paras 39 to 41).
- 12 A spring-loaded cover is provided to protect the display and to shield it in bright daylight conditions to assist reading.

OPERATING PROCEDURES

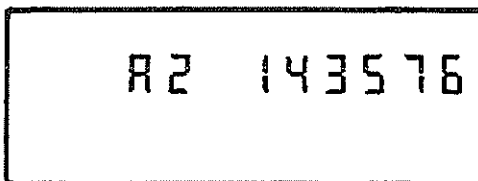
Storage of Channel Number/Frequency

- 13 When the RT 319 is first switched on up to ten receive and ten transmit frequencies can be stored for subsequent access. The frequencies remain stored provided the RT 319 is not switched OFF but is left on S/BY (standby). This procedure is also used for altering stored frequencies. To store a receive frequency proceed as follows:
- (1) Set the power switch to TEST, LP, HP or BAT CHK.
 - (2) Press the R key on the keyboard then enter a number in the range 0 to 9. This will be the channel number for future reference. The display indicates the selection made (channel 2 is shown as an example, with the power switch set to LP).



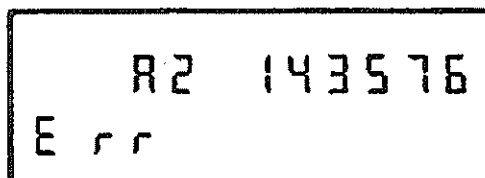
R2

- (3) Press appropriate numeral keys to enter the frequency starting with the tens of megahertz digit (zero if less than 10 MHz). Numbers appear on the display in the order in which they are entered and in their correct position, ie the group is filled from the left. For example, 14.3576 MHz is entered in the order 1, 4, 3, 5, 7, 6 and is indicated thus:



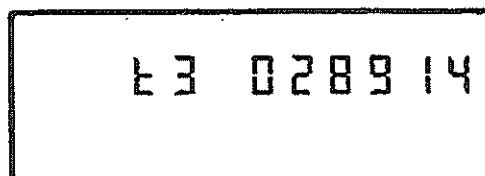
R2 143576

- (4) If an entry error is made and the mistake is not realised, the entire key sequence can be restarted by pressing the R key again. The display is blanked except for the R, so channel number and frequency must be re-entered. If an error is made when entering the frequency, this can be corrected by completing the entry, then entering an additional six (correct) frequency digits. When the first of these is displayed in the tens of megahertz position, the other frequency digits are blanked. The remaining five correct digits must then be entered in descending order as before.
- (5) When satisfied that the data is correct, press the STORE key to write the channel number/frequency combination into memory. If an invalid entry sequence has been used and has not been corrected, an error indication is displayed. The entry sequence must then be repeated from step (2).



R2 143576
E r r

14 To store a transmit frequency the procedure in para 13 is followed except that the T key is used to start the entry sequence (step (2)) or to restart it (step (4)). When the entry sequence is complete the display indicates as shown below (transmit channel 3, frequency 2.8914 MHz):



t3 028914

15 To display a stored frequency at any time press the R or T key as appropriate followed by the required channel number key. Channel number and frequency are displayed as shown in the examples above (Paras 13 and 14).

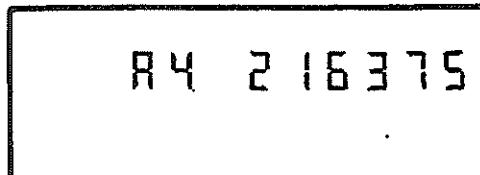
16 Stored frequencies can be altered as follows:

- (1) Press the R or T key as appropriate followed by the required channel number key. The channel number and currently-stored frequency are displayed.
- (2) Enter six new frequency digits. The first digit to be entered is displayed in the tens of megahertz position and the other frequency digits are blanked. The remaining five correct digits must then be entered in descending order.
- (3) When satisfied that the revised frequency is correct, press the STORE key to update the frequency store. As before, if an invalid entry sequence has been used, an error indication is displayed and the sequence must be repeated correctly.

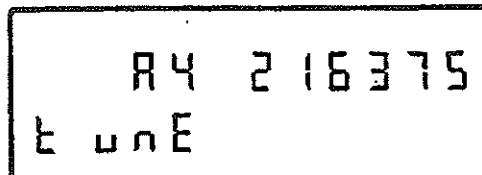
Selection of Receive and Transmit Frequencies in Use

17 On completion of the storage of frequency channels as required, one receive and one transmit frequency must be selected as the 'frequencies in use'. The same procedure can be used subsequently if it is necessary to change the frequencies in use. To select the receive frequency in use proceed as follows:

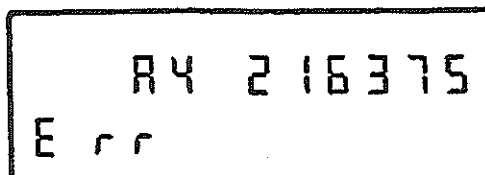
- (1) Press the R key and chosen channel number key. The stored channel number and frequency are displayed:



- (2) Press the CHANGE key. The display indicates that the TURF 319 needs to be tuned:

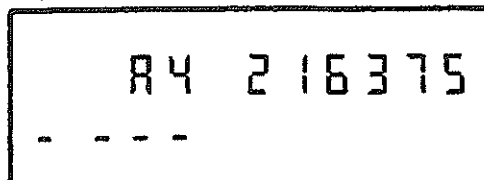


Note: If an invalid entry sequence has been used, the error indication is displayed and the sequence has to be repeated correctly.



- (3) Press the TUNE TURF key. When the antenna is correctly tuned, the 'tune' indication disappears.

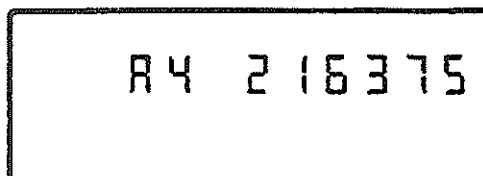
Note: If the radio is being used without the TURF 319, as described in Chapter 2.1, the display indicates this fact as shown below when CHANGE is pressed and tuning is not possible.



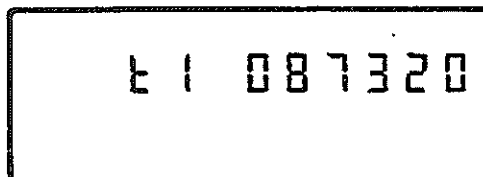
- 18 To select the transmit frequency in use press the T key and channel number key to display the stored transmit frequency. The CHANGE and TUNE TURF keys are then used as described above (para 17(2) and (3)).

- 19 When the frequencies in use have been selected their antenna tuning requirements are stored in the TURF 319 provided that the RT 319 is not switched OFF. The frequencies in use can be called to the display except when transmitting by pressing the R/T IN USE key. The receive frequency is displayed after the first operation of the key, and the transmit frequency is displayed for five seconds after the second operation of the key:

First
operation



Second
operation

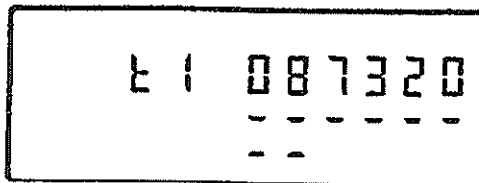


- 20 The TURF 319 can be returned to the frequencies in use by pressing the R or T key as appropriate followed by the TUNE TURF key.

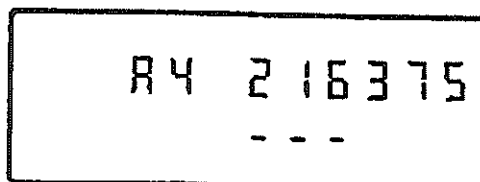
C.W. Communication

- 21 To set up the equipment for c.w. operation (morse), proceed as follows:
- (1) Connect the headset and morse key to the audio sockets on the side of the RT 319 (see Chapter 2.1).
 - (2) Set the mode switch to CW and the power switch to LP or HP as required.

- (3) Select the required frequencies in use and tune the TURF 319 as described in the preceding paragraphs (13 to 20).
- (4) To transmit, operate the morse key. When the key is pressed for the first time the RT 319 switches to the transmit mode. The transmit channel and frequency in use are displayed, and the TURF 319 is automatically set to the working frequency.
- (5) During transmission the display indicates forward and reverse power by rows of horizontal bars displayed below the frequency. The upper row indicates forward power and, with the antenna correctly tuned, consists of five or six bars. The lower row indicates reverse power with a good match no lower bar should be present.



- (6) The RT 319 remains in the transmit mode until the morse key is released for a period of about 1 sec, after which the RT 319 reverts to the receive mode.
- (7) Reversion to the receive mode causes the receive channel number and frequency in use to be displayed. During reception, received signal strength is indicated below the frequency as a row of horizontal bars:



- (8) Use the GAIN control as required during transmission or reception to adjust the audio signal level delivered to the headset.

Voice Communication

- 22 Voice communications make use of the single transducer headset as both a microphone and an earphone. Set up the equipment as follows:
 - (1) Connect the headset to one of the audio sockets on the side of the RT 319 (see Chapter 2.1).
 - (2) Set the mode switch to VOICE and the power switch to LP or HP as required.
 - (3) Select the required frequencies in use and tune the TURF 319.
 - (4) To transmit, operate the pressel on the headset. The RT 319 switches to the transmit mode. Transmit channel number, frequency

in use, forward and reverse power are indicated. The TURF 319 is automatically set to the working frequency.

- (5) When the transmit pressel is released the RT 319 reverts to the receive mode. Receive channel number and frequency in use are displayed and the TURF 319 is reset to the working receive frequency. During reception, received signal strength is indicated.
- (6) Use the GAIN control as necessary during reception to adjust the audio signal level delivered to the headset.

Data Communication Using the EMU Mk 1

23 The RT 319 may be set up to transmit and receive messages for the EMU Mk 1 as follows:

- (1) Connect the EMU to the RT 319 either directly or via the special cable (see Chapter 2.1 Table 2.1.1 item 9).
- (2) Connect the headset to one of the audio sockets on the side of the RT 319 (see Chapter 2.1).
- (3) Set the mode switch to the required DATA position; 75, 150 or 300. This selects the data rate at which messages will be received or transmitted.
- (4) Set the power switch to LP or HP as required.
- (5) Select the frequencies in use and tune the TURF 319. (Note. TURF tuning on transmit is not necessary since TURF tuning automatically takes place as part of the transmit sequence with EMU. See para 24 below).
- (6) Prepare and send messages using the EMU as described in AESP 5820-U-113-201.

24 Transmission can be initiated only by means of the transmit key (Tx) on the EMU keyboard. Pressels on any devices connected to the audio sockets are not operative with the mode switch in any DATA position. When the EMU transmit key is pressed the TURF 319 is automatically retuned to the transmit frequency and the display indicates transmit channel number and frequency. If optimum tuning is not achieved, the 'tune' indication appears, although transmission still takes place. At the end of the transmission the RT 319 reverts to the receive mode and receive channel number and frequency are displayed.

Communication Using the DMHD

25 Set up the RT 319 to transmit and receive messages for the DMHD as follows:

- (1) Connect the DMHD audio cable to the lower audio socket (audio 2) on the side of the RT 319 (see Chapter 2.1 and AESP 5895-C-200-201).
- (2) Connect the power cable for the DMHD either to the power socket on the RT 319, or to the charging socket on the battery if a Clansman

rechargeable battery 6140-99-620-8057 or -8058 is being used (see Chapter 2).

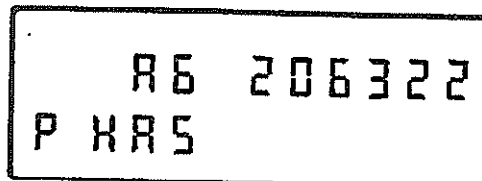
- (3) Connect the headset to the upper audio socket (audio 1) on the side of the RT 319 (see Chapter 2.1).
 - (4) Set the mode switch to X and the power switch to LP or HP as required.
 - (5) Select the frequencies in use and tune the TURF 319.
- 26 On the DMHD enter the message and then transmit. The transmit channel number and frequency in use are displayed and the TURF 319 is tuned. Forward and reverse power are displayed during transmission and sidetone is heard in the headset.
 - 27 At the end of transmission the RT 319 reverts to the receive mode and the display indicates the receive channel number and frequency in use. During reception signal strength is indicated and sidetone is heard in the headset. The GAIN control is used to adjust the level of the sidetone delivered to the headset.

WARNING INDICATIONS

- 28 Warning indications appear in the lower four-character group in the display. Their significance is explained below.

Frequency-control System Warning

- 29 If frequency synthesiser phase lock is lost, PHAS appears at the bottom of the display:

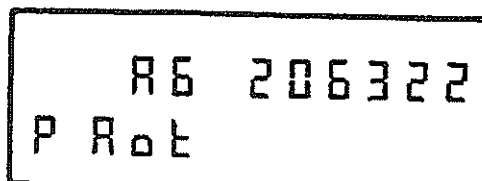


R6 206322
P HRS

This warning, when it appears, overrides all other warnings that may be present. Transmission is inhibited under this condition.

RF Overload Warning

- 30 The RT 319 is protected against high power close range transmissions. When the protection circuit is activated, P Aot appears at the bottom of the display:

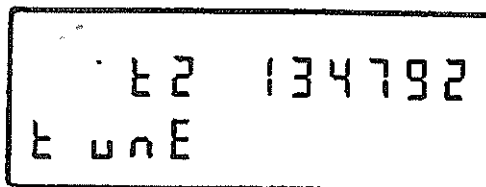


R6 206322
P Aot

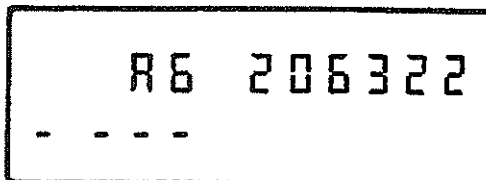
This warning inhibits transmission when displayed.

Antenna Tuning Warning

31 When the TURF 319 is not correctly tuned to the displayed frequency the 'tune' indication appears. Transmission is not inhibited under this condition.

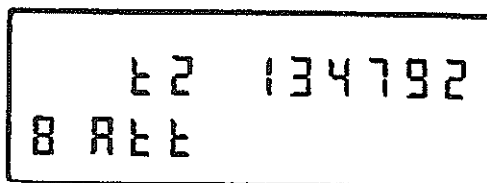


32 Four horizontal bars, appearing when a change to a different frequency in use is attempted, indicate that the TURF 319 is not connected and that antenna tuning is not possible.



Low Battery Power Warning

33 If battery voltage falls below 20 volts a flashing warning is displayed.



Should another warning be present when low voltage is detected, this and the 'battery' indication are displayed alternately. The 'battery' warning does not itself inhibit transmission.

34 Power supply warning^u On initial switch-on of the RT 319 a diagnostic test of the power supply unit is performed. If the -12 v and/or +6 v supply lines fail, SPP appears in the lower four-character group of the display and the RT 319 is deemed unserviceable.

DISPLAY ILLUMINATION

PICTURE OF ABOVE

35 In day or artificial light the liquid crystal display can be read due to light being reflected by the back of the display. In poor ambient light conditions and in darkness, back lighting can be switched on to illuminate the display as follows:

- (1) Press the ILLUM key on the keyboard. If back lighting has not been used previously since the RT 319 was switched on (power switch moved from the OFF position), the lowest of three levels of illumination is provided. If lighting has been used and the RT 319 has not been switched off, the previously-selected level of illumination is provided.

- (2) Adjust the level of illumination as required using the \triangle key to increase illumination and the ∇ key to decrease it. Two operations of the appropriate key change the level from lowest to highest or vice versa.

36 Operate the ILLUM key again to switch off back lighting. The selected level of illumination is remembered and reselected when back lighting is used again, provided the RT 319 is not switched OFF. If the ILLUM key is not used to switch off the back lighting, it is switched off automatically 10 seconds after the last key entry.

OPERATOR CHECKS

Battery Checks

37 To check battery voltage proceed as follows:

- (1) Set the power switch to BATT CHK. The off-load voltage is displayed (to the nearest volt):



2 483 018674

- (2) Connect the headset or morse key to one of the audio sockets on the side of the RT 319 (see Chapter 2.1).
- (3) Operate the pressel on the headset or press the morse key as appropriate and keep it depressed for about 10 sec to allow for the measurement to take place. On-load voltage to the nearest volt is displayed.



2 283 018674

Built-in Tests

38 Built-in tests are initiated by the operator as confidence checks or by the maintainer as a means of first-line fault finding. Three specific tests can be carried out.

39 Receiver Test. To initiate a receiver test proceed as follows:

- (1) Set the power switch to TEST.
- (2) Press the R key followed by the TEST key on the keyboard.
- (3) The display indicates that a built-in test has been carried out and passed as follows:

```
      R3 018674  
B, tE PASS
```

(4) Alternatively a built-in test failure is indicated by:

```
      R3 018674  
B, tE FAIL-1
```

or

```
      R3 018674  
B, tE FAIL-2
```

'FAIL-1' indicates a phasing module malfunction,
'FAIL-2' indicates an rf head module malfunction.

40 Transmitter Test. A transmitter built-in test is initiated by setting the power switch to TEST and pressing the T key followed by the TEST key on the keyboard. Display indications are the same as for receiver test.

41 Modem Test. To initiate a built-in test of the modem module that interfaces with the EMU, proceed as follows:

(1) Set the power switch to TEST and the mode switch to one of the DATA positions (75, 150 or 300).

(2) Press the TEST key on the keyboard.

(3) The built-in test indication is displayed and correct modem operation is indicated by the left-hand character in the upper four-character group alternating between 0 and 1, ie between:

```
0  R3 018674  
B, tE
```

and

```
1  R3 018674  
B, tE
```

(4) Failure of the modem test is indicated if the display remains fixed at 0 or 1.

CATEGORY 3
TECHNICAL DESCRIPTION

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CHAPTER 3.2.1	TUNING UNIT RADIO FREQUENCY	
CHAPTER 3.2.2	TUNING UNIT RADIO FREQUENCY EXTENDER	

CHAPTER 3.1

TRANSMITTER/RECEIVER 319

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CHAPTER 3.1TRANSMITTER/RECEIVER 319INTRODUCTION

1 The RT 319 transmitter-receiver is a small, lightweight, microprocessor controlled, high frequency transmitter-receiver containing the following eight sub-assemblies:

- (a) Display Processor
- (b) Phasing
- (c) Modem
- (d) Power Supply Unit (p.s.u.)
- (e) Synthesiser
- (f) Power Amplifier (p.a.) an integral part of the chassis rear lid
- (g) Radio Frequency Unit
- (h) Filter and Switching.

A microprocessor on the display processor assembly produces the control signals required throughout the unit, and a keyboard and two selector switches provide user access to the system. A frequency spectrum of 1.5 MHz to 40 MHz is provided by the synthesiser operating in five bands. The operating frequency used on transmit may be different from the frequency used on receive (two frequency simplex system). Tuning and bandswitching is achieved automatically. Adjustment of the temperature-controlled crystal oscillator (TCXO) frequency is provided via the FREQ ADJUST control on the front panel to correct for ageing effects. The synthesiser also provides a 4.8 MHz reference signal for use throughout the transmitter-receiver.

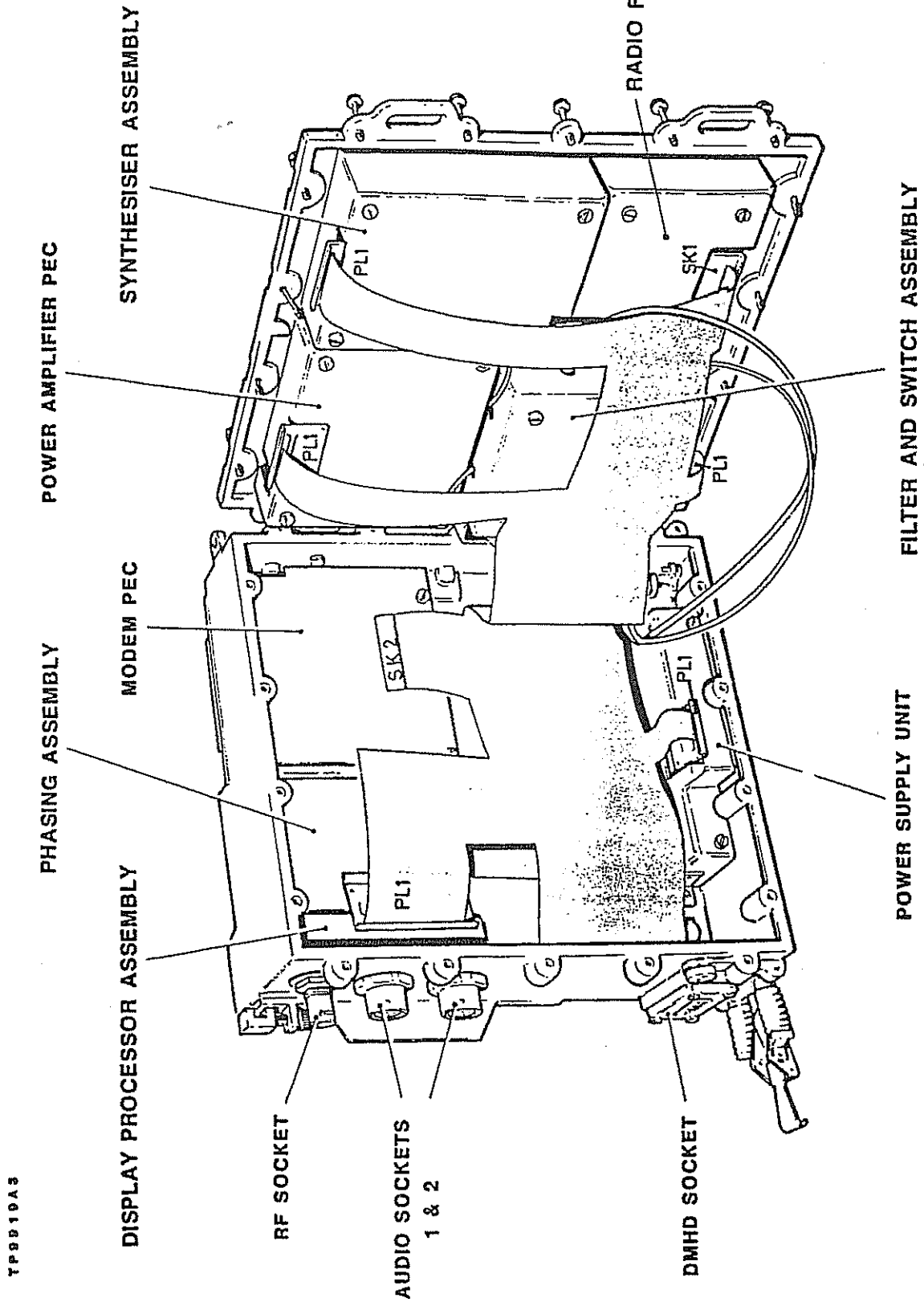
2 For transmission and reception single side band (s.s.b.) is used, and is generated by the phasing assembly and radio frequency unit using a combination of 'first method' and 'third method' generating techniques. This produces an upper sideband which can be used for either voice or data information. The transmitter-receiver can also communicate using continuous wave (c.w.) morse transmission. When the RT 319 is receiving, the phasing assembly determines the level of automatic gain control (a.g.c.) required.

3 In the transmit state the mean transmitted power level is increased by a speech processing circuit automatically switched in for voice operations only. The final level of signal produced by the power amplifier p.e.c. for transmission is determined by the display processor assembly. The power amplifier is protected against inadvertent mismatch at the output.

4 A modem provides the required interface between the electronic message unit (EMU) and RT 319, converting digital data to voice frequency tones, and vice versa. A built-in-test-equipment (BITE) loop check is available on the modem. All other BITE checks on the phasing assembly and radio frequency unit are carried out using reference signals produced by the display processor assembly.

5 The following power supplies required throughout the unit are provided by the power supply unit from a 24 volt d.c. input:

- (a) +12 V
- (b) +6 V



TP9910A3

Fig 3.1.1 RT 319 Physical Layout

- (c) +5 V
- (d) 0 V
- (e) -6 V
- (f) -12 V

PHYSICAL DESCRIPTION

- 6 The RT 319 comprises nine main items, the case assembly which is an aluminium alloy casting, and the eight sub-assemblies listed in Para 1. Fig 3.1.1 shows the location of the various items. The r.f. socket for connection to the tuning unit radio frequency (TURF), two audio connectors and a power connector for the digital message handling device (DMHD) are located on the right-hand side of the case. Mounted on the front face are the power switch, mode switch, gain control, frequency adjust, keyboard and display. The switch positions on the power switch are OFF, TEST, LP, HP, BAT CHK and S/BY, while the positions on the mode switch are CW, VOICE, DATA (75, 150 or 300) and X (for use with DMHD). A small shutter is provided for the protection of the liquid crystal display and associated window.
- 7 Provision is made for the TURF and 24 volt battery to be attached to the top and bottom respectively of the transmitter-receiver. Guides are provided on the left-hand side of the unit to allow the EMU to be slid into place and to connect with the data socket.
- 8 Apart from the keyboard, which can be removed from the front of the case, access to sub-assemblies is gained by removing the rear lid. The power amplifier p.e.c. uses this lid as a heat sink. The majority of interconnections between sub-assemblies are provided by a film wiring loom, while discrete wiring is used for some power and r.f. connections. When the unit is fully assembled it is hermetically sealed.

FUNCTIONAL DESCRIPTION

- 9 The following Paragraphs give a functional description of the RT 319 and are divided between the two operations, transmit and receive. A general description is given for each operation, followed by more detailed descriptions of its various component processes. The position of the mode switch affects different areas of the transmit and receive functions. Any circuits affected are dealt with at the relevant place in the description of transmit and receive.

Note: On the block diagrams that follow no terminal information is provided for either the film wiring to the display processor assembly or the r.f. and power inputs to the power amplifier p.e.c. This is because this particular wiring is connected directly to the track of the associated p.e.c.s.

Transmit

- 10 General description (Fig 3.1.2). With the RT 319 switched to Transmit, the operation of the circuit up to the modulator stage is determined by the position of the mode switch.

Note: No mention is made at this stage of the effects of selecting CW on the mode switch, as the c.w. input (DC MOD) is applied direct to the radio frequency unit and does not require either speech processing or modulation on the phasing assembly.

- 11 With the mode switch set to 'VOICE' the microphone signal is first amplified by the pre-amplifier on the phasing assembly, and then fed to a voice operated gain adjusting device (VOGAD). This provides a constant output level for a wide range of input levels, thus allowing for whisper operation. The VOGAD output is passed through an audio bandpass filter before being applied to a 90° phaser circuit. Two signals of identical amplitude and frequency, but with a 90° difference in phase (quadrature phase related), are produced and fed to the speech processing circuit to reduce the peak-to-mean power ratio and so increase the transmitter efficiency.
- 12 With the mode switch set to 'X', for operation with the DMHD, the transmitter operates as detailed above except that both the VOGAD and the speech processing circuits are bypassed. The output of the 90° phaser is fed direct to the modulator stage.
- 13 With the mode switch set to 'DATA' at 75, 150 or 300, the data from the EMU, after processing by the modem, is applied direct to the audio band-pass filter and then to the 90° phaser circuit. From there it is fed to the modulator stage, bypassing the speech processing circuit.
- 14 Each of the two audio outputs from either the speech processing circuit or the 90° phaser is fed to a pair of balanced modulators (M1, M3 and M2, M4). Each modulator is driven by a different output from a four-phase divider circuit. The phase relationships of the divider outputs are selected so that when the outputs of the modulators are combined in summing amplifiers A1 and A2, the upper sidebands of both channels are cancelled out leaving the 'folded' lower sidebands of each channel (Tx1 and Tx2) with a 90° phase difference between them. The 'foldover' effect is achieved by ensuring that the outputs from the four-phase divider have a frequency that lies in the centre of the audio band to be transmitted ie 1.7 kHz for voice (audio band 0.3 kHz to 3.1 kHz), 2.222 kHz for DMHD (frequencies 1.944 kHz and 2.5 kHz), 2.0 kHz for data (frequencies 1.575 kHz and 2.425 kHz).
- 15 Each of the s.s.b. signals Tx1 and Tx2 then passes to the radio frequency unit for further amplification. A 1.5 kHz low-pass filter removes the residual unwanted sideband generated by the modulators.
- 16 A balanced modulator in each channel provides modulation with the selected transmit frequency derived from the synthesiser assembly. Correct synthesiser output is obtained by accurate decoding of the data word supplied by the display processor assembly. The two balanced modulators, which are driven at the same frequency but with a 90° phase difference between them, produce outputs which consist of both upper and lower sidebands. The phase relationship of their outputs is such that when they are combined in the final mixer, the unwanted sidebands cancel each other out while the wanted ones are added to produce the required sideband signal.
- 17 The remainder of the circuit in the transmit line raises the transmit signal to the level selected by the display processor assembly. Control of the desired level is provided by a feedback line (a.l.c.) to the radio frequency unit amplifier where the initial amplification is performed. The output is filtered by the appropriate bandpass filter selected according to

the transmit frequency being used. The r.f. signal is then further amplified in the power amplifier p.e.c. and passed on to the voltage standing wave ratio (VSWR) detector which protects against inadvertent mismatch at the output. The VSWR detector output is fed back to an automatic level control generator where it is compared with a reference voltage from the display processor assembly. Any error is returned via the a.l.c. line to adjust the gain of the amplifier in the radio frequency unit thereby setting the level of the transmit signal.

18 Final filtering of the transmit signal is carried out by one of a set of four low-pass, high power filters. Once again, the filter is selected according to the transmit frequency being used.

19 Before being fed out to the TURF the final transmit signal is passed through a reverse-overload circuit to ensure that the transmit lines are protected against reverse r.f. power.

20 Speech processing (Fig 3.1.3). Speech processing is employed only in voice mode and is used primarily to reduce the peak-to-mean power ratio of the input signal and thus increase the mean radiated power.

21 The two a.f. signals from the 90° phaser circuit (Para 11) are fed to two balanced modulators. Each modulator is driven by a different output from a divide-by-four frequency divider. A 1.2 MHz signal from the synthesiser assembly is applied to the divider to produce two 300 kHz carrier signals with 90° phase difference. These signals are selected so that the 0° a.f. signal is combined with a 90° carrier signal, while the 90° a.f. signal is combined with a 0° carrier signal. The outputs from the modulators consist of both upper and lower sidebands. The phase relationship of these outputs is such that the lower unwanted sidebands cancel each other out while the upper sidebands are added to produce the required s.s.b. signal. A bandpass filter removes any unwanted modulator frequency components.

22 The outputs from the modulators are fed through a clipper circuit. Any unwanted harmonics are filtered out by a further 300 kHz bandpass filter.

23 Conversion of the signal back to audio frequency (a.f.) signals is carried out by two further demodulators, each fed with the same 300 kHz reference supplied to the previous modulators. Two operational amplifiers act as low-pass filters on the output line, allowing only the 0° and 90° audio frequency (baseband) elements to pass onto the next stage.

24 Transmit modulators (Fig 3.1.2). The transmit modulators on the phasing assembly are used in voice, DMHD and data modes. Voice mode is described in Para 25 to 28, and DMHD and data modes in Para 29. For c.w. transmissions a different modulation scheme is employed and is covered in Para 30.

25 In voice mode the two audio outputs from the speech processor circuit are applied to two balanced modulators (M1 and M2). Each modulator is also supplied with an audio tone of 1.7 kHz, the tones being quadrature phase related to each other. The modulators are balanced so as to remove the audio input and leave only the sidebands. The wanted sideband is 'folded', that is to say that it contains all the original information in a bandwidth of half the audio input.

- 26 This 'folded' effect is achieved by correct selection of the audio tone (f_0) so that it is centred on the bandwidth set by the 0.3 kHz to 3.1 kHz band pass filter (ie 1.7 kHz). For audio input frequencies (f) of 0.3 kHz to 1.7 kHz the lower sideband ($f_0 - f$) will be 1.4 kHz down to zero (Fig 3.1.4a). Audio input frequencies (f) of 1.7 kHz up to 3.1 kHz produce beat frequencies of zero up to 1.4 kHz (Fig 3.1.4b). The 'folded' effect occurs whenever both the above states occur together (Fig 3.1.4c).
- 27 The phase relationship of the sidebands produced by modulators M1 and M2 is such that the unwanted sideband is cancelled out and the 'folded' sideband (Tx1) is reinforced.
- 28 An identical circuit (M3 and M4) receives the same two audio inputs (f), and audio tones of 1.7 kHz which are still quadrature phase related but in antiphase to the 1.7 kHz tones applied to M1 and M2. The phase relationship of the sidebands produced by modulators M3 and M4 is such that the unwanted sideband is again cancelled out. The folded sideband (Tx2) is reinforced and, because of the phase relationship of the modulators' input is 90° out-of-phase with Tx1. Tx1 and Tx2 are passed on to the radio frequency unit for amplification and further filtering to remove the unwanted sideband.
- 29 Frequency offsetting for data operations. In DMHD mode, because only two audio frequencies (1.944 kHz and 2.5 kHz) are used, a central modulating audio tone of 2.222 kHz is required. As the smallest increment of synthesiser output is 100 Hz, a modulating tone of 2.2 kHz is used as a best approximation. In the data mode the two audio frequencies are 1.575 kHz and 2.425 kHz, so a central audio tone of 2 kHz is used.
- 30 C.W. modulation. In c.w. mode the phasing output signals are disabled. A d.c. voltage (DC-MOD) is applied by the Display Processor to the Radio Frequency Unit. This d.c. voltage is used to imbalance one of the R.F. mixers which causes it to produce the synthesiser frequency at its output. After further amplification and filtering this signal becomes the c.w. radio carrier.
- 31 Data transmission (Fig 3.1.2). Data transmissions are made in one of two ways, either with the DMHD or with the EMU. In the DMHD(x) mode the data tones are first amplified by a pre-amplifier on the phasing assembly and then fed to the audio bandpass filter and 90° phaser circuit previously detailed in Para 11. To avoid any tone distortions the outputs from the 90° phaser are switched to bypass the speech processor and connect directly to the transmit modulators. Switching is achieved by a serial data input from the display processor assembly. Data tones then follow the same path as for voice operations (Paras 14 to 19).
- 32 For operation with the EMU, tones are generated by the modem according to the value of the data input from the EMU. The output from the modem (Tx VF) is fed, via the audio bandpass filter, to the 90° phaser circuit, bypassing the pre-amplifier and VOGAD. The data tones then take the same path as for DMHD, passing unprocessed to the transmit modulators.
- 33 Sidetone (Fig 3.1.2). Sidetone output is taken from one of three stages depending on the position of the mode switch. If VOICE is selected, sidetone is taken from the output of an audio pre-amplifier. If X or DATA is selected the sidetone is taken from the output of the audio bandpass filter. The gain control sets the level of sidetone at audio socket one but has no

effect on the transmit level. On c.w. the sidetone level is fixed and is supplied by the display processor assembly as A.F. INJECTION. This signal is derived from the 4.8 MHz and is divided down to produce a tone of 1.2 kHz.

34 Sub-octave filters (Fig 3.1.2). R.F. filtering is included in the transmit drive to suppress out-of-band spurious signals. To cover the operating frequency range of 1.5 MHz to 40 MHz, eight bandpass filters are required, only one of which is used at any one time. Selection of the filter is carried out by the 'select filter' signal from the display processor assembly. This three-bit word is fed to the filter and switch assembly where it is decoded to set one of eight digital selection signals to logic 1. This selection signal enables the r.f. input to its associated filter, while inputs to the other seven filters are disabled.

35 Power amplifier and automatic level control (a.l.c.) (Fig 3.1.5). D.C. power for the power amplifier is taken direct from the battery to provide maximum overall efficiency. During receive operations, or with the power switch set to OFF, the p.a. is isolated by the receive/transmit relay on the filter and switch assembly.

36 The output from the sub-octave filter is fed to the single transistor class A pre-amplifier stage of the p.a. and then transformer coupled to the driver stage. This consists of a push-pull class B amplifier. The driver stage is transformer-coupled to the output stage (push-pull class B amplifier) which sets the transmitter power to a level determined by the automatic level control generator. Temperature sensing transistors within the bias control circuit automatically vary the bias of the driver and output stages for changes in temperature.

37 The signal from the output amplifier is fed to a VSWR detector. This protects against inadvertent mismatch at the output, and detects output power. As mentioned previously, the level of output power is set by the a.l.c. generator. The output from the VSWR and a reference voltage 'POWER SET' from the display processor assembly are both applied to the a.l.c. generator. Any error between these two signals is returned to the radio frequency unit output amplifier as a gain control signal, increasing or decreasing the power amplifier input as required. The level of the 'POWER SET' signal depends on the position of the power switch ie LP or HP.

38 To prevent saturation of the output transistors occurring at low battery voltage, a sample of the signal produced by the output stage is applied to the saturation detect circuit. This circuit feeds a signal to the a.l.c. generator, reducing the output power level, when the collector voltage of the output transistors falls below 5 volts. A temperature detector circuit also feeds the a.l.c. generator and is used to limit the maximum operating temperature of the power amplifier transistors. In the event of sustained data or c.w. transmissions the a.l.c. feedback line reduces the drive to the power amplifier and prevents overheating.

39 BIAS SET 1 and 2 signals are produced by the display processor assembly to set the bias control circuit. On transmit, the signals are set to logic zero for normal SSB operation. To test the battery (power switch set to BAT CHK) the BIAS SET 1 and 2 signals are both set HIGH on operation of the pressel and the stages are biased to draw 5 A from the battery supply.

40 Harmonic filters (Fig 3.1.2). Four filters on the filter and switch assembly provide harmonic filtering of the power amplifier output. The frequency bands of the filters are shown in Table 3.1.1. Selection of the appropriate filter is made by relays energised by the 'select filter' signal from the display processor assembly. This two-bit word is decoded to provide a one-out-of-four selection signal to energise the appropriate relay. During reception the relays are de-energised.

Table 3.1.1 Filter Frequency Band

FILTER	PASSBAND (MHz)
1	1.5 to 3.42
2	3.42 to 7.79
3	7.79 to 17.78
4	17.78 to 40.0

Receive

41 General description (Fig 3.1.6). The received signal from the antenna and TURF system is fed, via an input protection circuit (Para 89), to a set of eight sub-octave bandpass filters. Only one filter is selected at any one time dependent upon the receive frequency being used. Selection of the correct filter is achieved by decoding the 'select filter' signal from the display processor assembly.

42 Prior to the first mixers, the input level is increased by a wideband low-noise r.f. amplifier. An automatic gain signal is fed to the amplifier to prevent overloading when large input signals are present. A wideband power splitter divides the amplified r.f. signal into two components of equal amplitude and frequency. These signals are then applied to two channels with identical paths. The following description applies to either.

43 The r.f. signal is applied to an r.f. mixer which also receives an appropriate input from the synthesiser assembly. The frequency of this input is determined by data decoded on the display processor assembly and lies near the centre of the received frequency band. The resultant output from the mixers lies in a band of 0 to 1.5 kHz. Both mixers receive identical frequencies from the synthesiser but with a 90° phase difference between them. A 1.5 kHz low-pass filter improves the main receiver selectivity before the signal level is increased by a low noise amplifier. The resultant frequency signal is then fed to the next processing stage which is on the phasing assembly.

44 After further amplification, which takes into account a.g.c., selectivity is further enhanced by additional dual 1.5 kHz low-pass filters. The audio signals are then applied to the final demodulators in the receive line. This is achieved by feeding to the demodulators a mixer frequency at the centre of the 3 kHz audio band. The value of the frequency varies according to the mode selected (Para 49). The phase relationship of the outputs from the demodulators is such that, when they are combined in the audio amplifier, the lower sidebands cancel out allowing the upper sidebands to pass on to a 3 kHz filter where residual unwanted sidebands produced by the previous process are removed.

- 45 If the receiver is operating in the c.w. mode an additional 1 kHz bandpass filter is switched into the output line automatically. The audio output level is determined by a final amplifier, the gain of which is set by the gain control on the front panel.
- 46 Sub-octave filters. Front end R.F. filtering is included to suppress spurious harmonic responses. The sub-octave filters positioned at the receiver input are the same filters as those used during transmit (Para 34). Filter selection depends upon the receive frequency being used and is achieved by decoding the three-bit 'select filter' signal from the display processor assembly to enable one of the eight filters.
- 47 R.F. unit signal processing (Fig 3.1.6). The r.f. unit mixers are used to convert the r.f. signal down to a frequency band of 0 to 1.5 kHz by mixing the received input with a signal from the synthesiser assembly. By choosing an injection frequency that lies in the centre of the received bandwidth, the resulting output from the demodulator is 'folded over' so that the received information is contained in a band approximately half the width of the received band. For voice operation the synthesiser signal is 1.7 kHz above the received frequency, ie halfway between 0.3 kHz and 3.1 kHz. For data operations, the same frequency offsets as for transmission apply (Para 29) because of the fixed audio tones that are used. Thus, for EMU message reception, the synthesiser signal is 2 kHz above the received frequency (halfway between 1.575 kHz and 2.425 kHz) and for DMHD messages it is 2.22 kHz above the received frequency.
- 48 The synthesiser supplies the correct frequency of mixing signal by decoding the data word produced by the display processor assembly. A 90° phase difference exists between the two r.f. unit channels.
- 49 Phasing demodulation (Fig 3.1.6). The demodulating process in the phasing assembly is used to unfold and combine the two receive channel outputs from the radio frequency unit. Depending on the operating mode, a programmable divider on the display processor assembly reduces the 4.8 MHz reference signal to either 6.8 kHz, 8 kHz or 8.88 kHz (AF Demod). After passing this signal through the divide-by-four stage prior to the demodulators, one of the following mixer frequencies is produced:
- (a) 1.7 kHz - voice
 - (b) 2.0 kHz - data (EMU)
 - (c) 2.22 kHz - X (DMHD).
- With the relevant mixer frequency applied to the final balanced demodulators the two 'folded' audio inputs from the radio frequency unit are unfolded.
- 50 When both outputs from the demodulator are combined the lower sideband signals cancel out. The upper sideband signals are therefore allowed to pass on to the audio bandpass filter and gain-controlled amplifier.
- 51 Automatic gain control (Fig 3.1.6). A.G.C. prevents overloading in the presence of large input signals and operates in one of two ways depending on the position of the mode switch.
- 52 In all operating modes other than c.w. the a.g.c. voltage is obtained by sampling one of the twin channels prior to the 1.5 kHz dual low pass filter on the phasing assembly. The a.g.c. generator produces a voltage proportional to the size of the sample taken, and feeds it back to the input

amplifiers in the radio frequency unit and phasing assembly as controlled amplifier gain.

- 53 In c.w. mode the above sampling process is available, but can be manually overridden by the gain control on the front panel.

Overall Radio Control System (Fig 3.1.7)

54 Introduction. Overall control of the RT 319 is provided by a microprocessor on the display processor assembly. The 1.2 MHz clock pulse required to control the system is derived from the 4.8 MHz output of the TCXO on the synthesiser assembly. All control signals and communications from the microprocessor are fed via a data bus to the appropriate interface circuits. These are then used to control the radio assemblies.

55 All operational routines to be executed by the microprocessor are stored in read-only memory (ROM). Any other data or channel information entered via the keyboard is stored in random-access memory (RAM). The RAM data storage is maintained by a low voltage produced from the display processor assembly using the +6 V supply. When the power switch is switched to standby (S/BY) a small current from the main battery sustains this voltage on a capacitor. If the battery is removed, the stored data is held for four minutes by a supercap on the supply line to the RAM.

56 The following paragraphs describe the various processes associated with the control of the RT 319.

57 System initialisation. When the power switch is initially switched from OFF or STANDBY to any other position the processor resets the system to a start state and performs the initialisation process. This checks that the power supply is operating and that the RAM contents have not been corrupted (see Para 65). If the power supply has failed a SuPP warning is indicated on the display. Corruption of the RAM causes all bytes in the channel frequency store to be set to a predetermined value. The Liquid Crystal Display (LCD) is then blanked. After these initial checks the processor generates the data words for the phasing and synthesiser assemblies and configures the transmitter-receiver into the receive state. Initialisation is completed by passing control to the executive.

58 Executive. The executive facility selects the functions in the following order of precedence:

- (a) error condition display routine
- (b) keyboard entry interpreter
- (c) change channel processing
- (d) transmit/receive BITE
- (e) modem BITE
- (f) TURF tune
- (g) mode and power switch selection
- (h) low battery voltage checks
- (i) system display.

Warning displays and keyboard entries are given highest priority allowing the fastest possible response to errors and operator initiated tasks. Lowest priority is given to the display which reacts only when no other function has been initiated. The selected function takes control of the processor until

the task has been completed when the executive takes over and selects the next priority function.

59 Operator interface. Operator interface is provided by a keyboard containing twenty snap-dome switches arranged in five columns and four rows. The pressing of a switch is detected by monitoring each X and Y co-ordinate. In this way the number of connections made to the keyboard is reduced from twenty-one to nine. Information entered via the keyboard is placed into the keyboard buffer where, once the key sequence has been completed, it is checked for validity against known sequences. If the entry is correct the operation is actioned either directly or by the executive, while an incorrect entry causes the ERR message to be displayed. The keyboard allows the following operations to be actioned:

- (a) channel frequency entry
- (b) channel selection
- (c) tune TURF
- (d) BITE test
- (e) channel in use display
- (f) illumination setting and control.

60 System display. The liquid crystal display (LCD) uses a duplex electrical drive to reduce the number of connections. Whenever the RT 319 display information is updated a display software routine is executed so that the current channel, operating frequency, and signal conditions are all displayed. The received signal strength indication is produced by sampling the a.g.c. voltage from the phasing assembly, while the transmitter forward and reverse power indications are produced by sampling the output from the VSWR detector on the power amplifier p.e.c. These sampled values are converted by the microprocessor's analogue to digital converter (ADC) to allow the LCD segments to be set. Operation of the ADC function is explained in Para 64.

61 Background lighting for the display is provided by two light-emitting diodes (LEDs) and is switched on by pressing the 'ILLUM' key on the keyboard. The intensity of the light is adjustable through three different levels by operation of the '↑' and '↓' keys. This adjustment is selected by feeding a two-bit data word, generated by the processor, to a lighting logic circuit on the display processor assembly. The two-bit word is converted to an analogue signal which determines the current flowing in the LEDs. The lighting automatically switches off ten seconds after the last keyboard entry, or immediately after pressing the 'ILLUM' key.

62 Receive/transmit switching. The RT 319 switches from receive to transmit:

- (a) when the pressel on the headset is operated ('VOICE' mode)
- (b) when the morse key is pressed for the first time ('CW' mode)
- (c) when a request to send (RTS) signal is received from the EMU ('DATA' mode)
- (d) when the equivalent of a pressel signal is received from the DMHD ('X' mode).

The interrupt generated by the above conditions starts the receive to transmit switching sequence as follows:

- (a) T/R and T/R RELAY signals set to transmit state
- (b) d.c. power applied to TURF.
- (c) 28-bit data word (4 bits unused) applied to phasing assembly.
- (d) 28-bit data word (2 bits unused) applied to synthesiser assembly.
- (e) current channel number and frequency stored in display buffer
- (f) r.f. filters selected on the filter and switch assembly.
- (g) a.l.c. reference and amplifier bias signals applied to power amplifier p.e.c. are set.
- (h) 'Tune up transmit frequency' signal fed to TURF to initiate TURF tuning sequence.
- (i) T/R DELAY signal set to transmit state.
- (j) 'DC MOD' is applied to the Radio Frequency Unit (C.W. only).

If the TURF has not previously been tuned to the transmit or receive frequency currently in use a TUNE message appears on the display, indicating that operation of the TUNE TURF key is required.

63 Transmit/receive switching. The RT 319 switches from transmit to receive:

- (a) when the pressel on the headset is released ('VOICE' mode)
- (b) when the morse key is released and after a time delay of 750 ms ('CW' mode)
- (c) when the RTS signal from the EMU is removed ('DATA' mode)
- (d) when the equivalent of a pressel release signal is received from the DMHD ('X' mode)

The transmit to receive switching sequence then progresses as follows:

- (a) T/R and T/R DELAY signals set to receive state
- (b) 28-bit data word (4 bits unused) applied to phasing assembly
- (c) DC MOD signal cleared
- (d) RF filters selected on the filter and switch assembly
- (e) 28-bit data word (2 bits unused) applied to synthesiser assembly
- (f) current channel number and frequency stored in display buffer
- (g) 'Tune up receive frequency' signal fed to TURF to initiate TURF tuning sequence
- (h) T/R RELAY set to receive state.

64 System measurements. System measurements such as BITE tests, battery tests, and signal condition checks are performed by the analogue to digital (A to D) conversion function on the display processor assembly. The A to D conversion is achieved using a successive approximation algorithm in conjunction with a digital to analogue circuit and comparator. In this way a digital representation of the analogue input to be measured is produced.

65 Power down control. Three possible power down situations are possible in the RT 319, power switch set to STANDBY, thermal protection shutdown and power switch set to OFF. In the first two cases the processor initiates a checksum routine on the RAM and saves the result in store so that during system initialisation (Para 57) the RAM contents can be checked for corruption. The processor is then switched off and the system shut down. RAM data is held in storage by a voltage produced from the battery, Para 55.

66 In the third case, with the power switch set to OFF, the RAM is cleared by the microprocessor and all power is removed from the entire processor system.

Frequency Synthesiser (Fig 3.1.8)

67 General description. Frequencies for both transmission and reception of information are supplied by the synthesiser assembly. The operating frequency range of 1.5 MHz to 40 MHz is derived from a voltage controlled oscillator (v.c.o.) operating at four times the required frequency and feeding a divide-by-four counter/phase splitter. The range is divided into five bands as shown in Table 3.1.2.

Table 3.1.2 Band Ranges for Voltage Controlled Oscillator and R.F. Unit

BAND	V.C.O. RANGE (MHz)	OPERATING RANGE - R.F. HEAD (MHz)
1	6.0000 to 15.9996	1.5000 to 3.9999
2	16.0000 to 31.9996	4.0000 to 7.9999
3	32.0000 to 59.9996	8.0000 to 14.9999
4	60.0000 to 119.9996	15.0000 to 29.9999
5	120.0000 to 160.0000	30.0000 to 40.0000

68 When the required frequency has been selected on the keyboard, the display processor assembly produces a 26-bit serial word. Table 3.1.3 shows the representative value of each bit within this word. Band selection is determined by bits one to three, whilst the requested synthesiser frequency within that band is defined by bits 4 to 26. Bits 4 to 22 program the universal divider (UD) and bits 23 to 26 program the rate multiplier.

Table 3.1.3 Bit Representation

BITS	1-3	4-6	7-10	11-14	15-18	19-22	23-26
FREQ		10 MHz	1 MHz	100 kHz	10 kHz	1 kHz	100 Hz

Set Band

Applied to
Rate Multiplier

Applied to
Universal
Divider

69 Detailed description. The synthesiser assembly operates in one of two ways depending on the value of bits 23 to 26 of the serial word (100 Hz digit). The following description applies for a 100 Hz digit of zero.

70 The data word from the display processor assembly is read into a shift register where it is stored and processed for use within the synthesiser. Bits 4 to 22 are transferred as programming data to the UD in such a way that, when the v.c.o. is producing the correct frequency, the UD gives an output signal of 2 kHz. Because the v.c.o. output range is up to 160 MHz, whereas the UD has a maximum operating frequency range of 24 MHz, the output from the v.c.o. is applied via a pre-scaling divider. The pulsed output from the UD is fed via a phase modulator, to a phase comparator. A reference signal of 2 kHz, obtained by division of the 4.8 MHz output from

the temperature-compensated crystal oscillator (TCXO), is also fed to the phase comparator. If the two input signals are not of the same frequency the comparator produces two tuning voltages, PC1 and PC2, which are applied, via a filter, to the v.c.o. to drive the frequency in the direction required to achieve the demanded value. PC2 provides the coarse adjustment, PC1 the fine adjustment.

71 Also produced by the phase comparator is an 'out of lock' indication, generated if the synthesiser is unable to obtain phase lock due to malfunction. The indication is used by the display processor assembly to inhibit transmission.

72 If the demanded frequency contains a 100 Hz digit of other than zero, the operation of the synthesiser assembly is modified. This is necessary because a demanded frequency that includes sub-multiples of 1 kHz (ie sub-multiples of 4 kHz at the v.c.o. output) requires a non-integer value of divisor 'n' to enable the output from the UD to equal 2 kHz. Because it is not practical to make 'n' a non-integer, it is arranged that the average value of 'n' has the required value. This is done by switching the divisor of the pre-scaler/UD combination between 'n' and 'n + 1' for a certain proportion of comparison periods (a comparison period being 0.5 ms). Bits 23 to 26 of the data word are applied to the rate multiplier to produce a number of 'overflow' pulses equal to the decimal digit in the 100 Hz position. This means that, if the demanded frequency ends in 300 Hz then three 'overflow' pulses are generated in every ten comparison periods. These pulses are applied to the universal divider so that the divisor switches to 'n + 1' for every overflow pulse received.

73 Because the comparison periods now contain varying numbers of cycles there is a phase jitter on the 2 kHz signal from the UD. If this were allowed to reach the phase comparator it would produce a ripple on the tuning voltage fed back to the v.c.o. The shape of the jitter is represented in digital form by the 'residue' pulses from the rate multiplier. These pulses are converted to an analogue voltage by the digital to analogue (D-A) converter, the size and sense of the voltage being such that when it is applied to the phase modulator the phase jitter is cancelled out before it reaches the phase comparator.

74 As the amplitude of the jitter varies according to the frequency selected, the amplitude of the output from the D-A converter must also vary. This is achieved by the auto-null loop which performs a coherent detection of the jitter occurring at PC1, using the 'overflow' pulses from the rate multiplier as a reference signal. The output of the auto-null loop is applied to the D-A converter as a gain control and is automatically adjusted to minimise the jitter at PC1. Bits 4 to 10 of the data word are fed to the auto-null loop to control the signal levels.

Modem (Fig 3.1.9)

75 General description. The modem p.e.c. provides the interface between the transmitter-receiver and the EMU Mk 1. Digital data from the EMU is converted to two voice-frequency tones by controlled division of the 4.8 MHz reference signal from the TCXO. Conversion of voice-frequency tones to digital data is carried out by a filter-rectifier-assessor circuit.

76 The modem also provides the controlling clock pulses required by the EMU during data transfer. The frequency of the clock defines the data rate

and is obtained by division of the 4.8 MHz reference signal. The two-bit digital 'bandwidth select' signal from the display processor assembly is converted to three-bits by the data rate logic circuit. These then provide the programming input for a programmable divider so that one of three reference frequencies is produced, namely 600 Hz, 1.2 kHz or 2.4 kHz. A fixed divide-by-eight stage then reduces the references to the 75 Hz, 150 Hz or 300 Hz clock pulses required by the EMU.

77 When an all-zero bandwidth select signal is applied, the +12 V and -12 V power supplies to the modem are disabled, thus reducing the amount of power consumed. Operation of the modem is best explained as two individual systems, transmit and receive.

78 Transmit. Digital data received from the EMU is fed to a divide logic circuit to convert the single data input line to two lines having inverse logic values. These signals are applied to a programmable divider in such a way that one of two division ratios is selected. The 4.8 MHz reference signal supplied by the synthesiser assembly provides the basic input to the programmable divider.

79 Before any further action can be carried out a 'clear to send' (CTS) signal, produced by the display processor assembly, must be applied to the enable input of the divider. This allows frequencies of 9.45 kHz and 14.55 kHz to be produced for data input logic levels of one and zero respectively. A fixed divider, set to divide by 6, ensures a symmetrical waveform is produced and reduces the frequencies of the tones to the correct value for mark and space, ie 1575 Hz and 2425 Hz respectively.

80 Receive. During receive operations the two-tone a.f. signal from the phasing assembly is fed directly to the modem. It is first split into two identical channels, one for each tone, to protect against the attenuation of one tone. The following description applies to either channel.

81 The unwanted tone (ie that required by the other channel) and any unwanted signals are removed by a bandpass filter. The bandwidth of this is controlled by the two-bit 'bandwidth select' input from the display processor assembly and is dependent on the data rate selected (75, 150 or 300 baud). After filtering, the tone signal is full-wave rectified and passed through an active low-pass filter to remove harmonics of the sub-carrier frequency.

82 The resulting outputs from the two low-pass filters are amplified; the mark channel by a non-inverting amplifier and the space channel by an inverting amplifier. The outputs of these amplifiers are combined by an assessor which produces a raw data signal. This raw data is hard limited by a two-stage comparator-amplifier to provide a logic level signal to the EMU.

Power Supply System (Fig 3.1.10)

83 Power supplies required by the transmitter/receiver are produced by the power supply unit (p.s.u.) from a 24 V battery input. The voltages provided are:

- (a) +12 V
- (b) + 6 V
- (c) + 5 V
- (d) 0 V

- (e) -6 V
- (f) -12 V.

A separate battery feed is also taken to the power amplifier p.e.c. via a 15 A fuse and the receive/transmit relay in the filter and switch assembly. The positive line is applied to the p.s.u. via the 2A fuse and the power switch on the display processor assembly.

84 To protect the p.s.u. against the application of a reverse polarity input a forward-connected diode is positioned on the input line. A start up supply circuit then regulates the input so that a +11 V signal is applied to a switching regulator. This produces a 100 kHz square wave output which grounds the primary of transformer T1 via a field effect transistor (f.e.t.) and current limit circuit. Transformation and rectification of the square wave produces voltage levels which are filtered to provide the supplies required for use throughout the transmitter-receiver. To ensure that these supplies are stabilised a sample of the +6 V output is first divided down and then fed back to the switching regulator. This signal is compared with an internal reference voltage in the regulator so that the pulse width of the 100 kHz output is changed to regulate the supplies listed in Para 83. The switching regulator is then fed from the +12 volt output in lieu of the start up supply circuit.

85 A current limit circuit in series with the switching regulator feeds a proportional voltage back to the regulator. If this signal exceeds a predetermined level the regulator, and hence the p.s.u., cycles on and off until the overload is removed. A temperature above 75°C causes a thermal protection circuit to produce a logic '0' thermal shutdown warning (TSW) signal. This is fed to the display processor assembly to warn the microprocessor that the p.s.u. is about to shut down. 10 ms later a logic '1' signal is raised by the thermal protection circuit to switch off the regulator.

86 In the event of nuclear radiation being present the gamma radiation detector diodes conduct and provide the biasing to switch two transistor pairs arrayed as thyristors. All the output voltages are then routed through these transistors to the zero volts line, removing all supplies from the transmitter-receiver.

Protection Systems

- 87 Power supply unit d.c. supply (Fig 3.1.10). Protection of the p.s.u. d.c. supply is provided by the following circuits:
- (a) to protect the p.s.u. against the application of a reverse polarity supply voltage a forward-connected diode is positioned on the input line,
 - (b) the current limit circuit prevents the output current from rising above a predetermined level,
 - (c) the thermal protection circuit switches the regulator off whenever the temperature within the p.s.u. becomes excessive,
 - (d) if nuclear radiation is present the gamma radiation detector provides a path to the zero volt line for all the voltage outputs.

This in effect switches off the p.s.u., and hence the transmitter/receiver.

88 Transmitter mismatch (Fig 3.1.11). Transmitter mismatch protection is provided by the V.S.W.R. detector and a.l.c. loop. If a high V.S.W.R. appears at the power amplifier output the V.S.W.R. detector causes the a.l.c. generator output voltage to rise. This voltage is fed back to the transmit amplifier in the radio frequency unit to reduce its gain and hence the drive to the power amplifier input. In this way damage to the power amplifier output stage is prevented.

89 Reverse r.f. power (Fig 3.1.11). During receive operations protection against the application of reverse power is provided by a set of reverse polarity diodes within the filter and switch assembly. Any reverse power causes the diodes to become forward biased and so to provide a low impedance path to earth. Transmit operation is made inoperative by the 'Tx Inhibit' signal generated by the filter and switch assembly.

90 If high level reverse r.f. power is applied while the RT 319 is transmitting, the V.S.W.R. detector and a.l.c. loop operate as previously described in Para 88, and the output from both the V.S.W.R. detector and the a.l.c. generator rise. The transmit protect circuit compares this rise in voltage with a 2.5 V reference, producing a logic zero 'TX Protect' signal whenever the detected voltage rises above 5 volts. The effect of this is to revert the Tx/Rx relay to the receive position. The reverse r.f. power is then routed to earth via the diodes as described in the previous paragraph.

Built-In-Test-Equipment (Fig 3.1.12)

91 General principle. Built-in-test equipment (BITE) is provided within the PRC 319 to allow the operator to perform transmit and receive tests on the radio frequency unit and phasing assembly. A loop check on the modem is also available. All these tests are performed using the controls on the front panel in accordance with a prescribed check routine (see AESP 5820-F-303-201).

92 In addition to operator-initiated BITE the display processor assembly performs a basic internal self-test at switch on. This self-test checks that the d.c. supply is present and that the RAM contents have not been corrupted. Continuity checks on the transmit filters and power amplifier can be carried out by keying in an input on c.w. (DC MOD) and observing the forward and reverse power LCD indications. During these checks the circuit operates as for c.w. and voice transmissions (see Paras 30 and 17 to 19).

93 Detailed description. In the transmit tests an audio signal of 1 kHz (AF INJ) from the display processor assembly is fed to the phasing assembly pre-amplifier. 1 kHz is obtained by logic-controlled division of the 4.8 MHz reference signal. The audio input then follows the transmit path previously described in Paras 11 to 16. Testing of both the radio frequency unit and the phasing assembly is achieved by comparing their respective outputs with a reference level within the display processor assembly. If the signal level is sufficient, a 'PASS' indication is shown on the display. If a fail condition is indicated the possible area of the fault is also shown.

94 In the receive tests a 1.2 MHz signal (R.F. BITE) from the display processor assembly is applied to the radio frequency unit pre-amplifier where it follows the receive path previously described in Paras 42 to 44. Testing of the radio frequency unit and phasing assembly is achieved in the same manner as in the transmit tests, with a 'PASS' indication being displayed for an output of sufficient amplitude.

95 The modem loop test is initiated by the selection of a data rate and 'TEST' on the mode and power switches respectively. A 'BITE COMMAND' signal is then produced by the display processor assembly to 'ENABLE' both the BITE data generator and programmable divider (Fig 3.1.9 Modem : Block diagram). The digital output produced by the BITE data generator is applied at a low rate (approximately 1 Hz) to the divide logic and programmable divider to produce frequency tones for one and zero logic input levels (see Paras 78 and 79). The resultant tones are returned to the receive channel of the modem where the error circuit converts them back to digital data (see Paras 80 to 82). Correct generation of the tones is checked using the audible sidetone signals. Correct data output is checked by observing the slowly changing displayed data, which changes in sympathy with the sidetone.

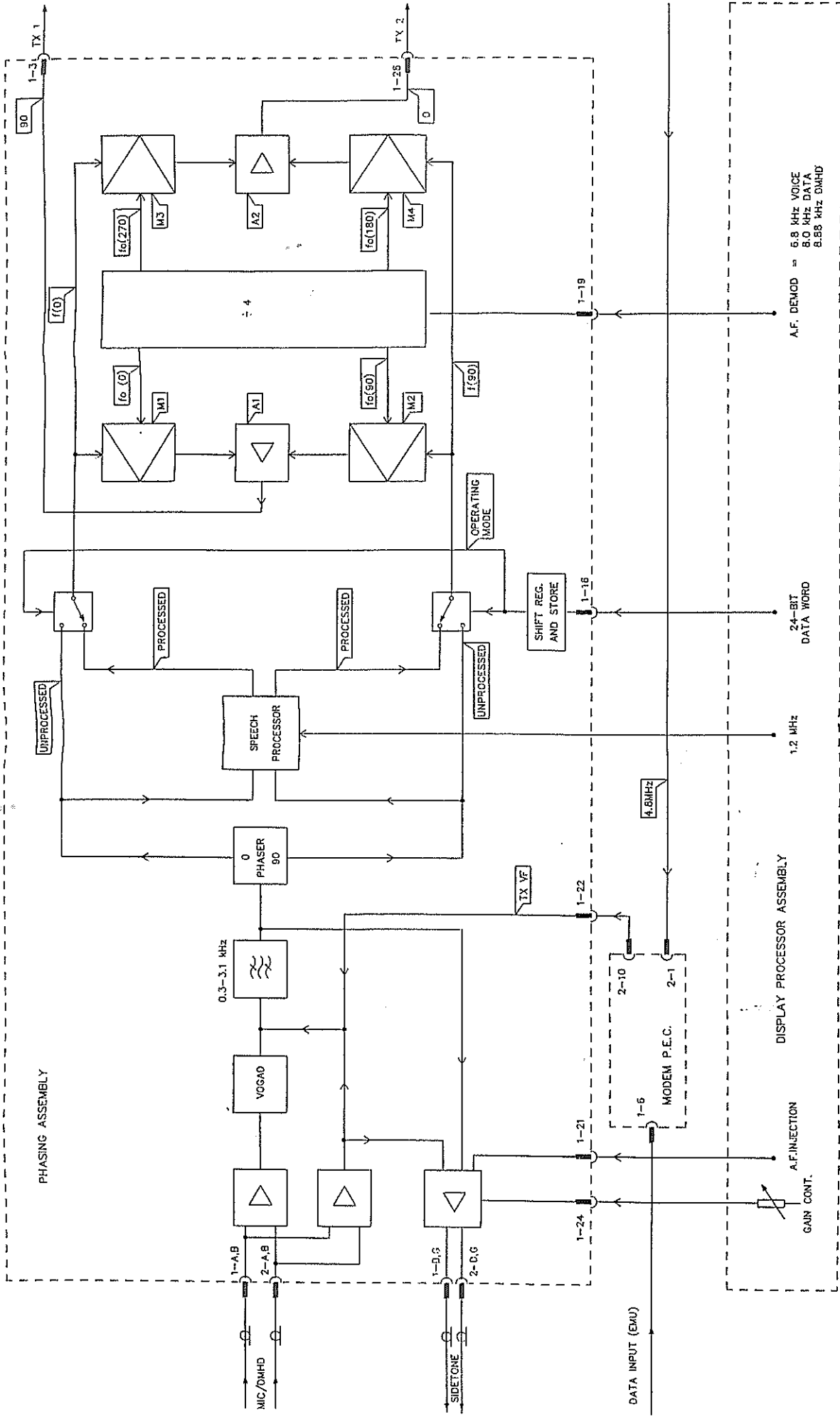


Fig 3.1.2

Fig 3.1.2 Transmit : Block Diagram (Sheet 1)

Fig 3.1.2



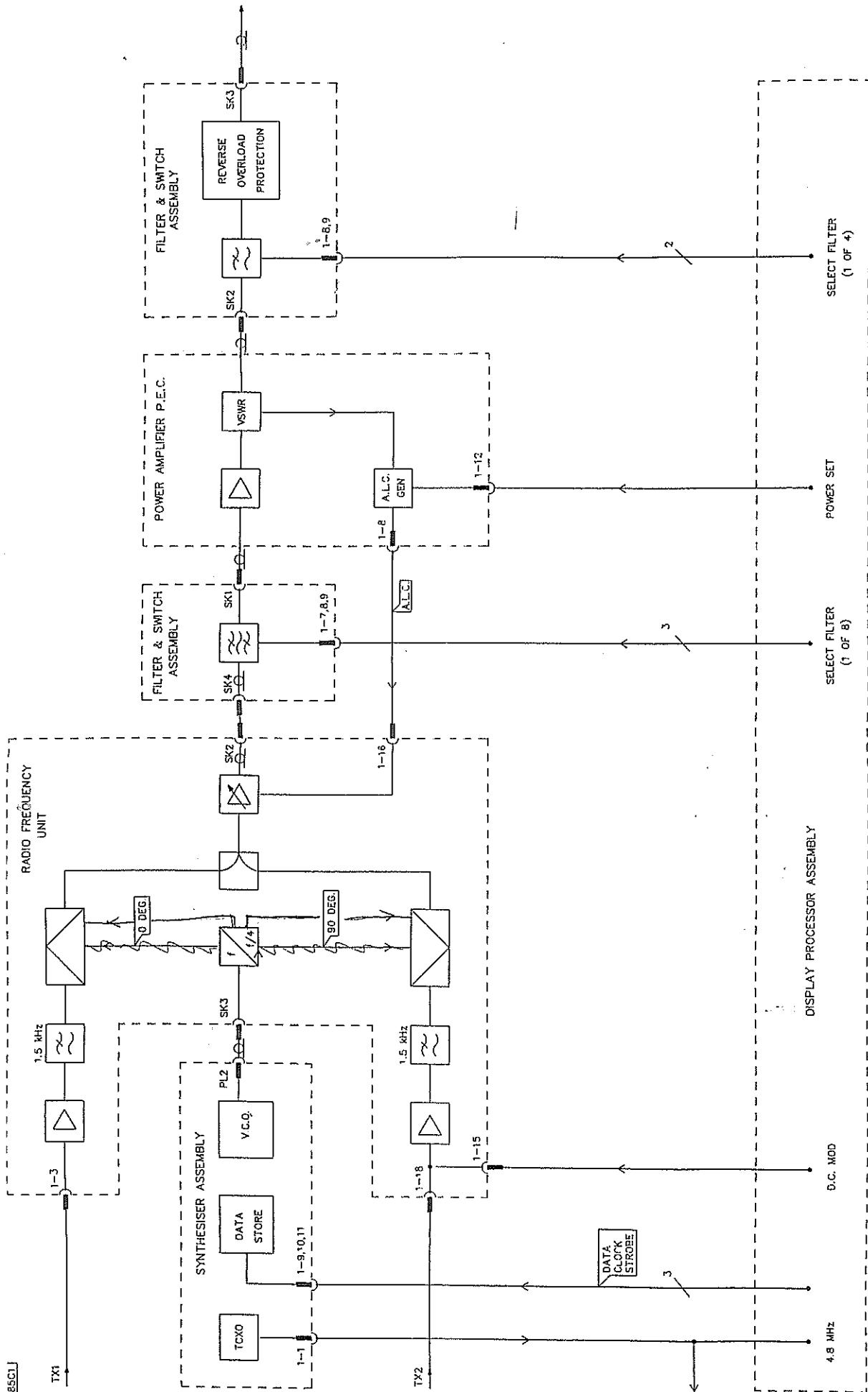
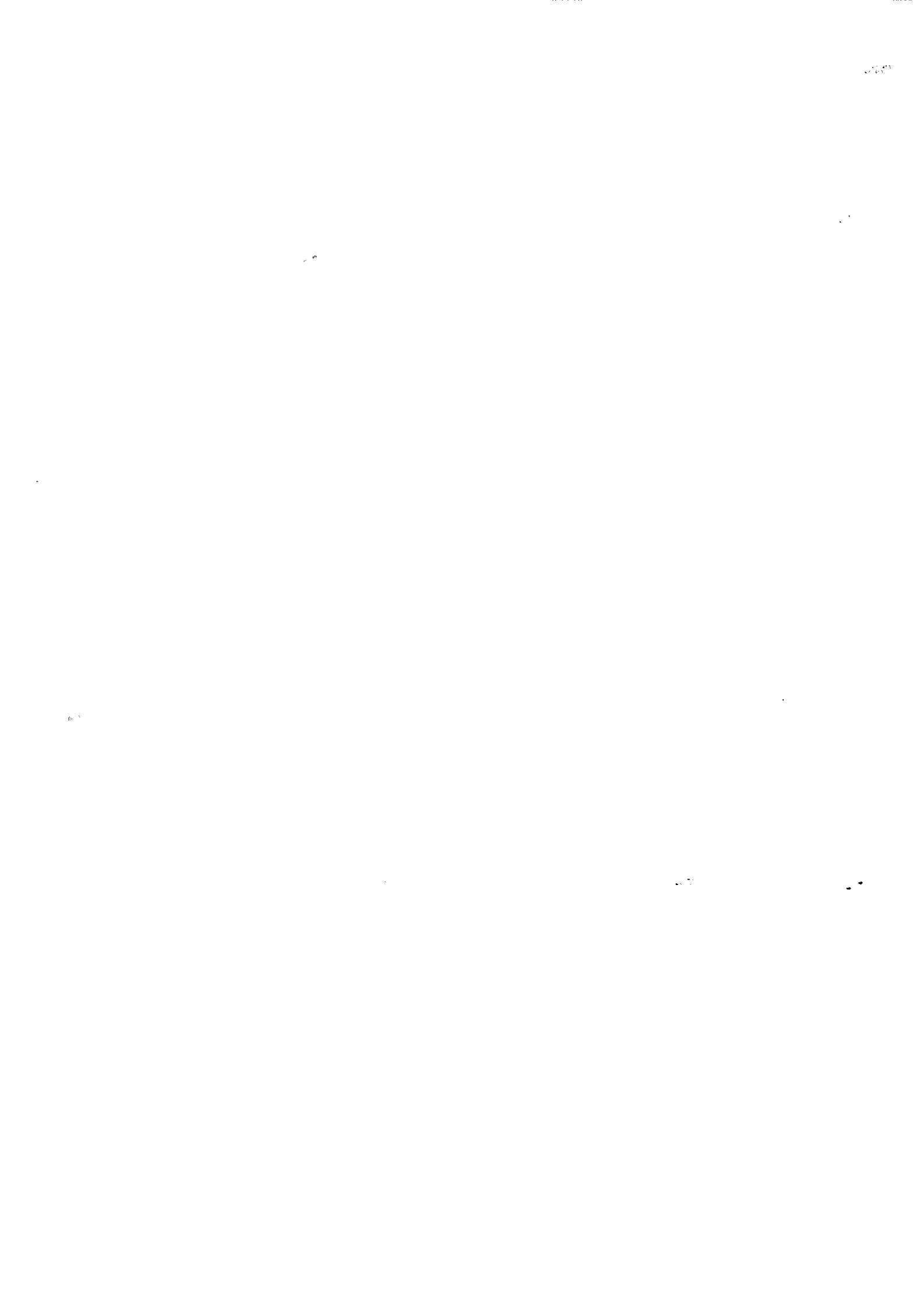
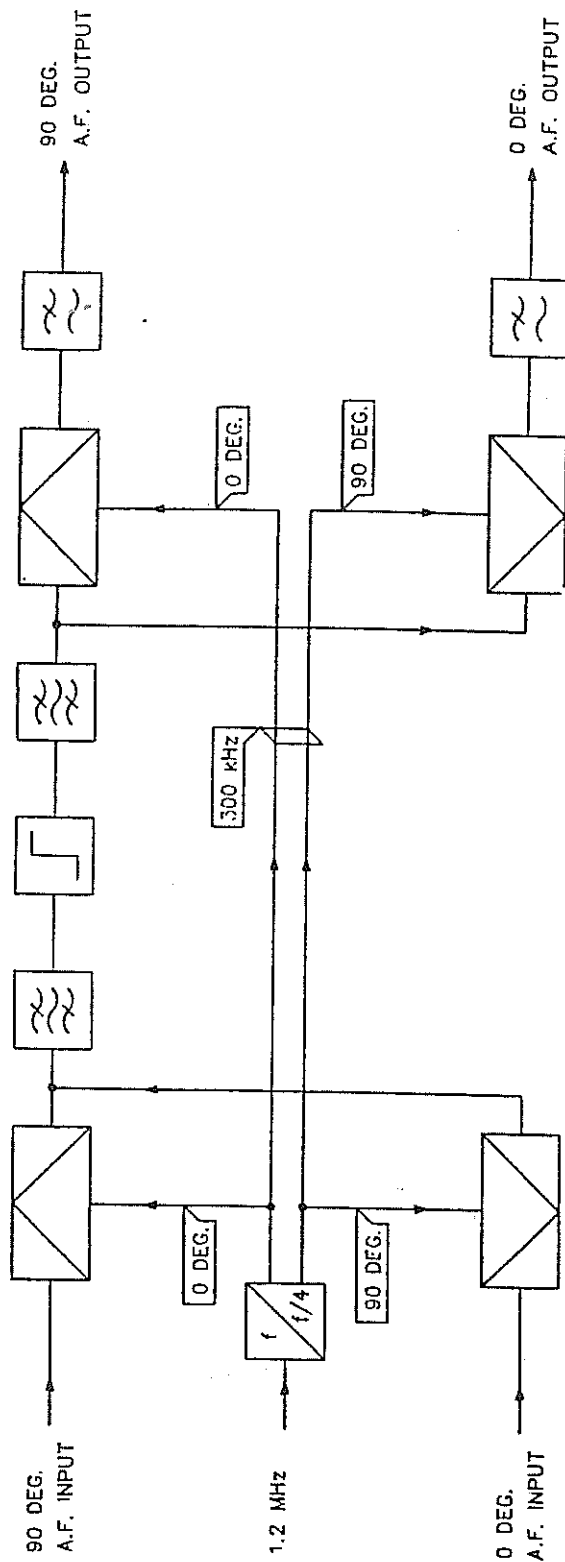


Fig 3.1.2

Fig 3.1.2 Transmit : Block Diagram (Sheet 2)

Fig 3.1.2

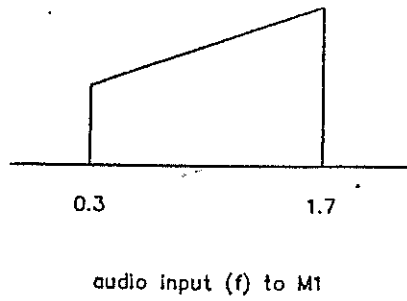




IP9875C

Fig 3.1.3 Speech Processing : Block Diagram

TP9876C



frequency (kHz)

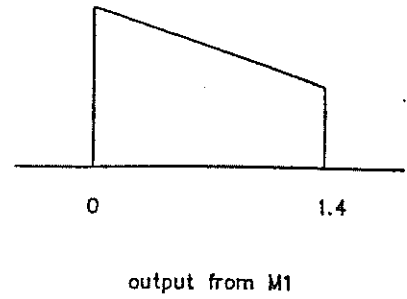
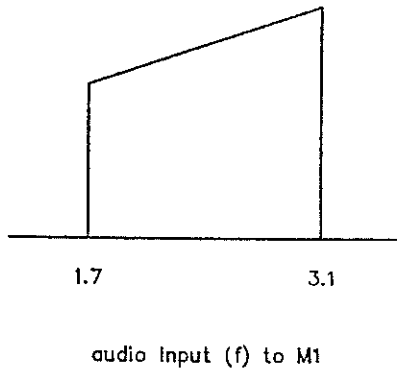


FIG 3.1.4a



frequency (kHz)

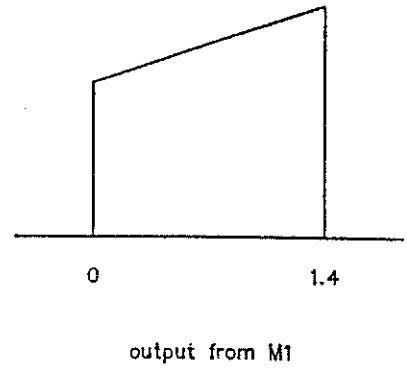
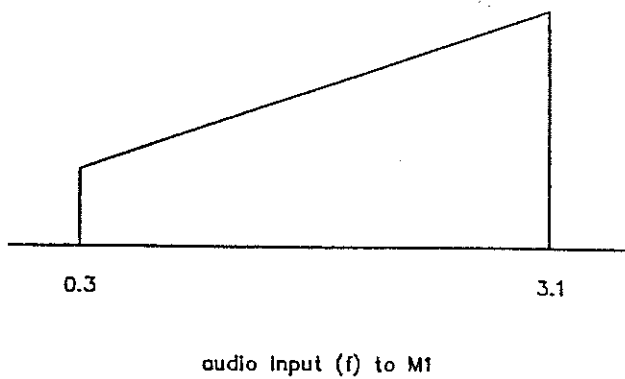


FIG 3.1.4b



frequency (kHz)

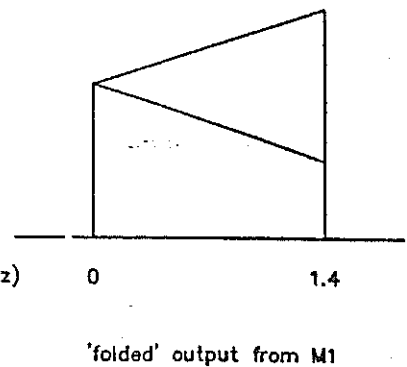


FIG 3.1.4c

Fig 3.1.4 Transmit Modulators Folded Effect

TP9778C

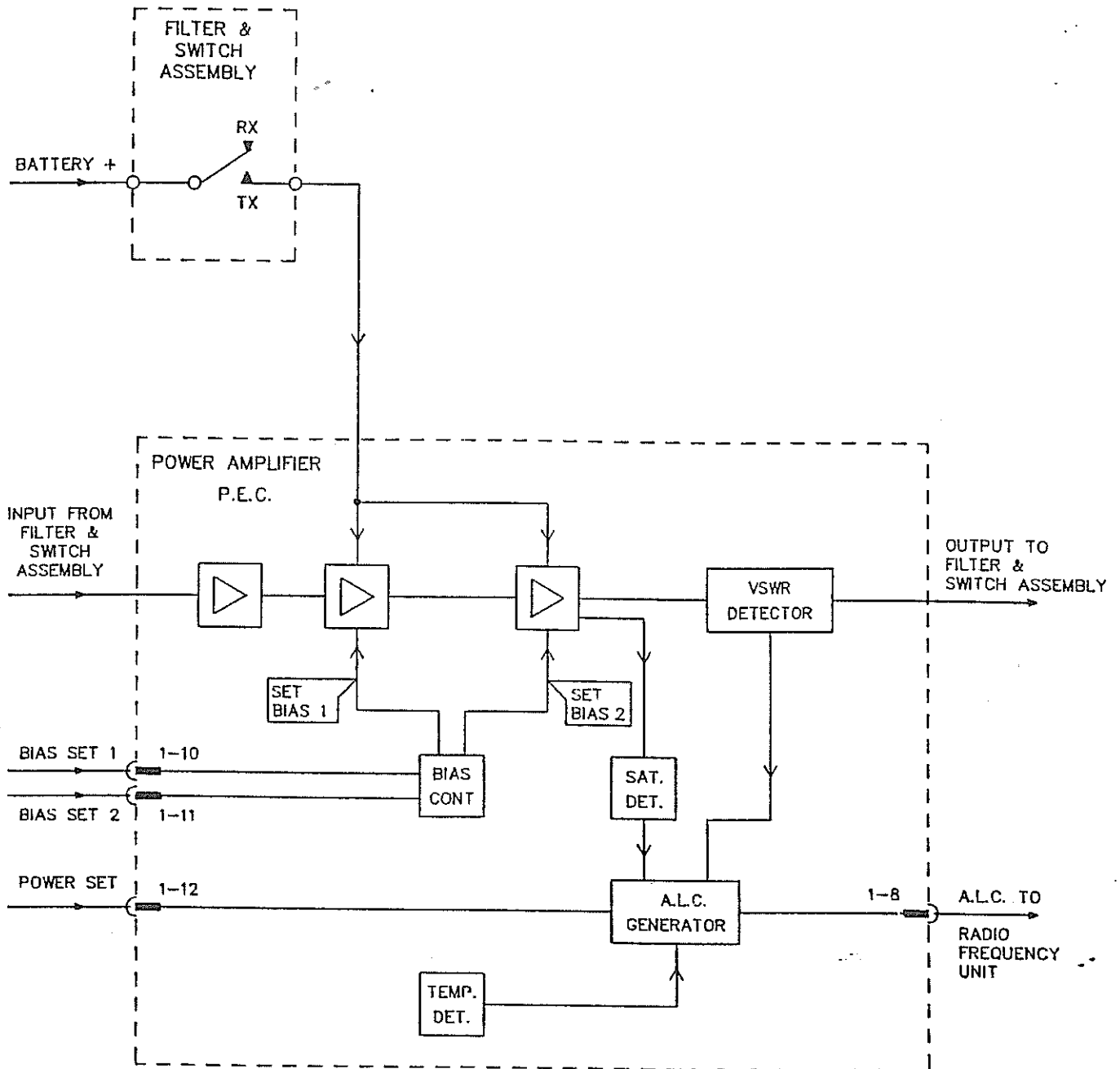


Fig 3.1.5 Power Amplifier and a.l.c. : Block Diagram

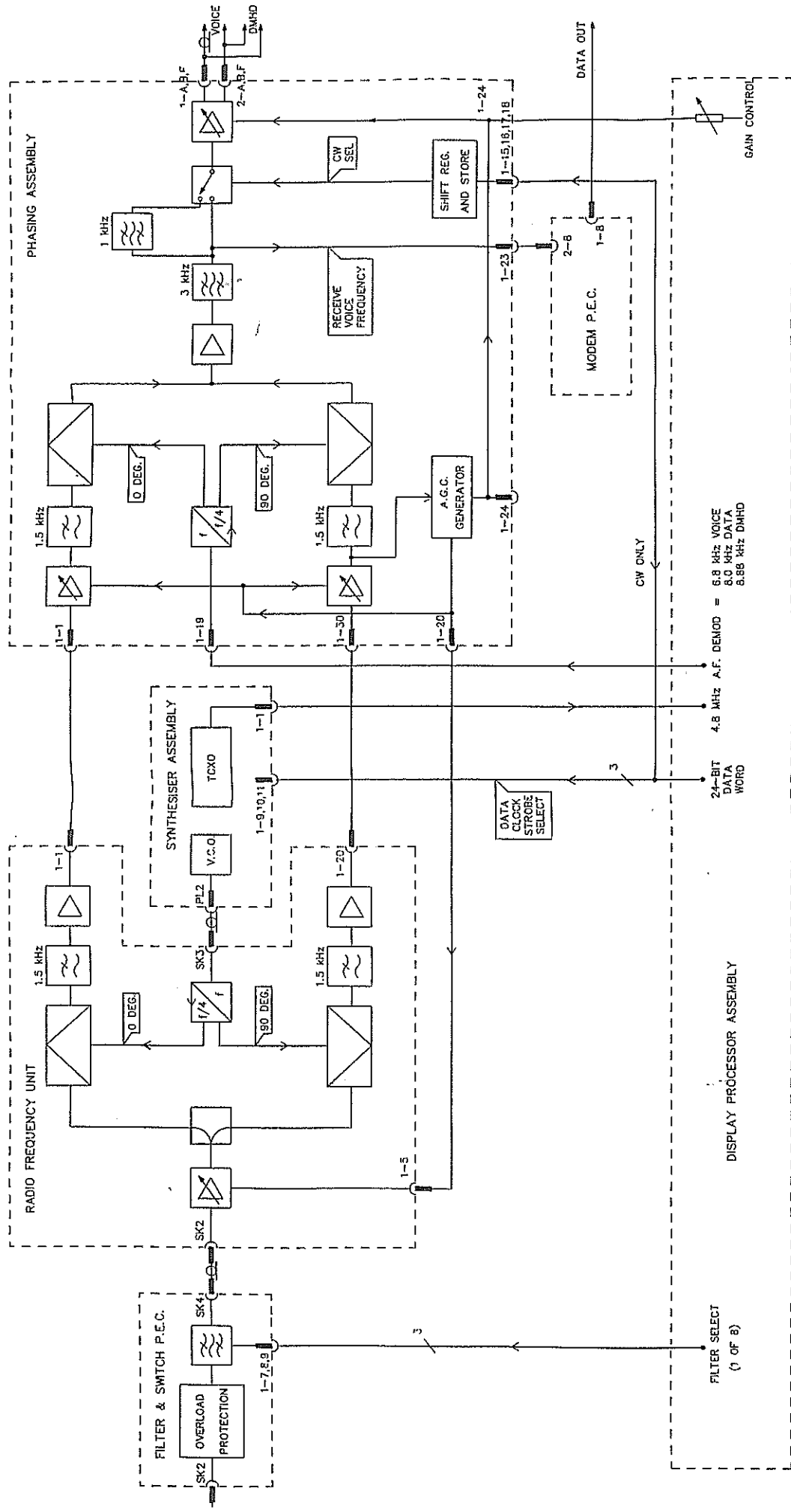


Fig 3.1.6

Fig 3.1.6 Receive : Block Diagram

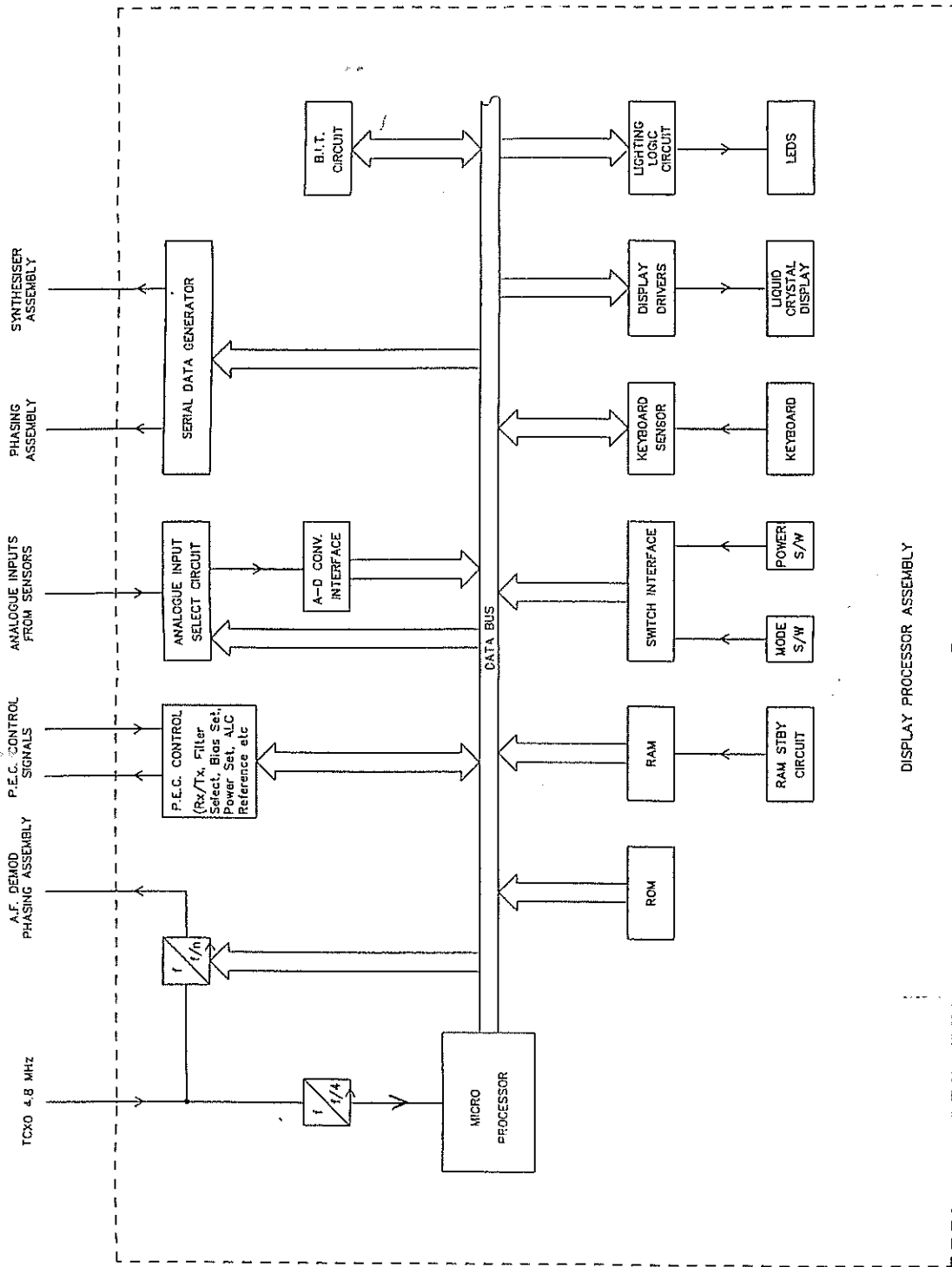
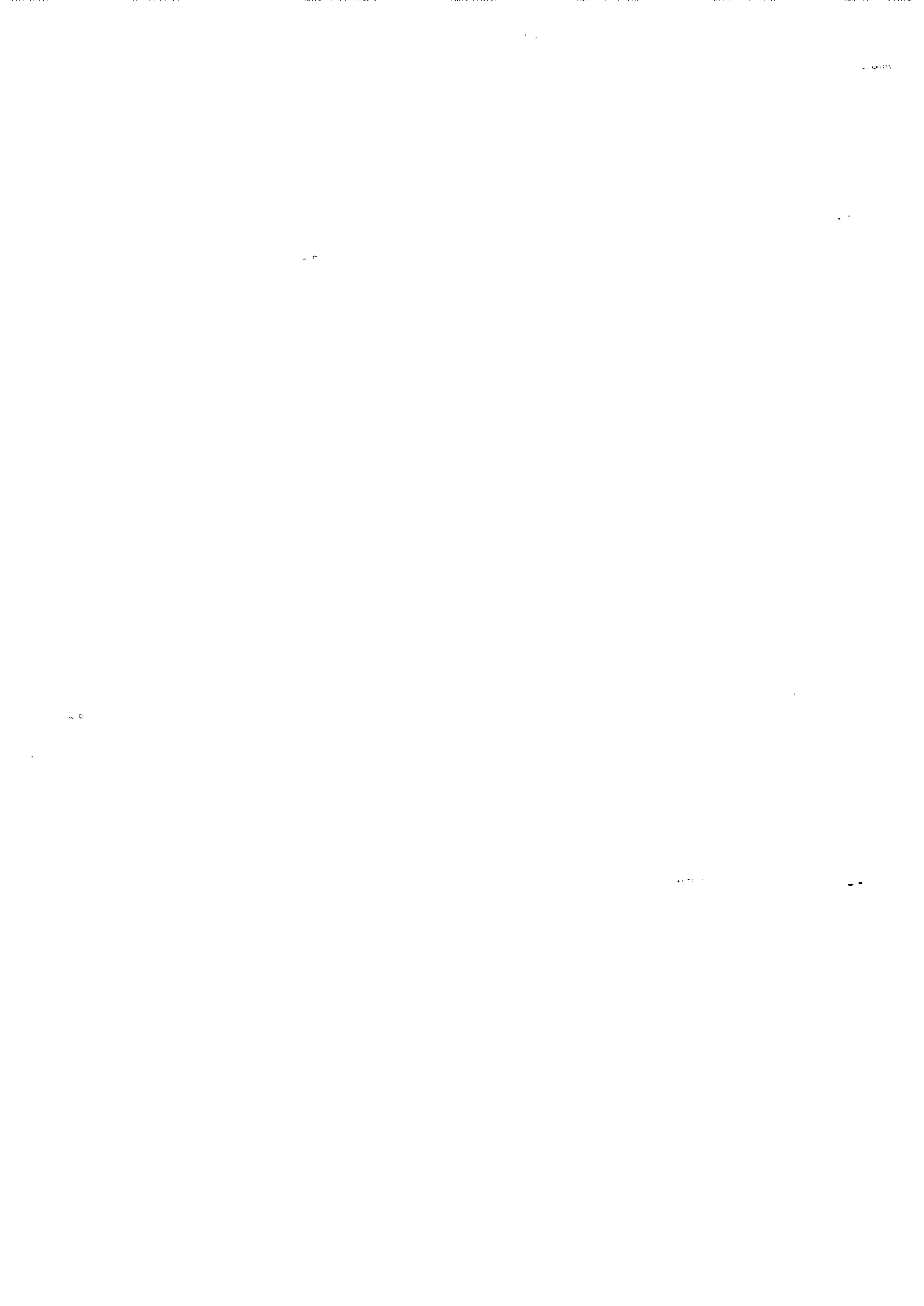


Fig 3.1.7

Overall Radio Control : Block Diagram



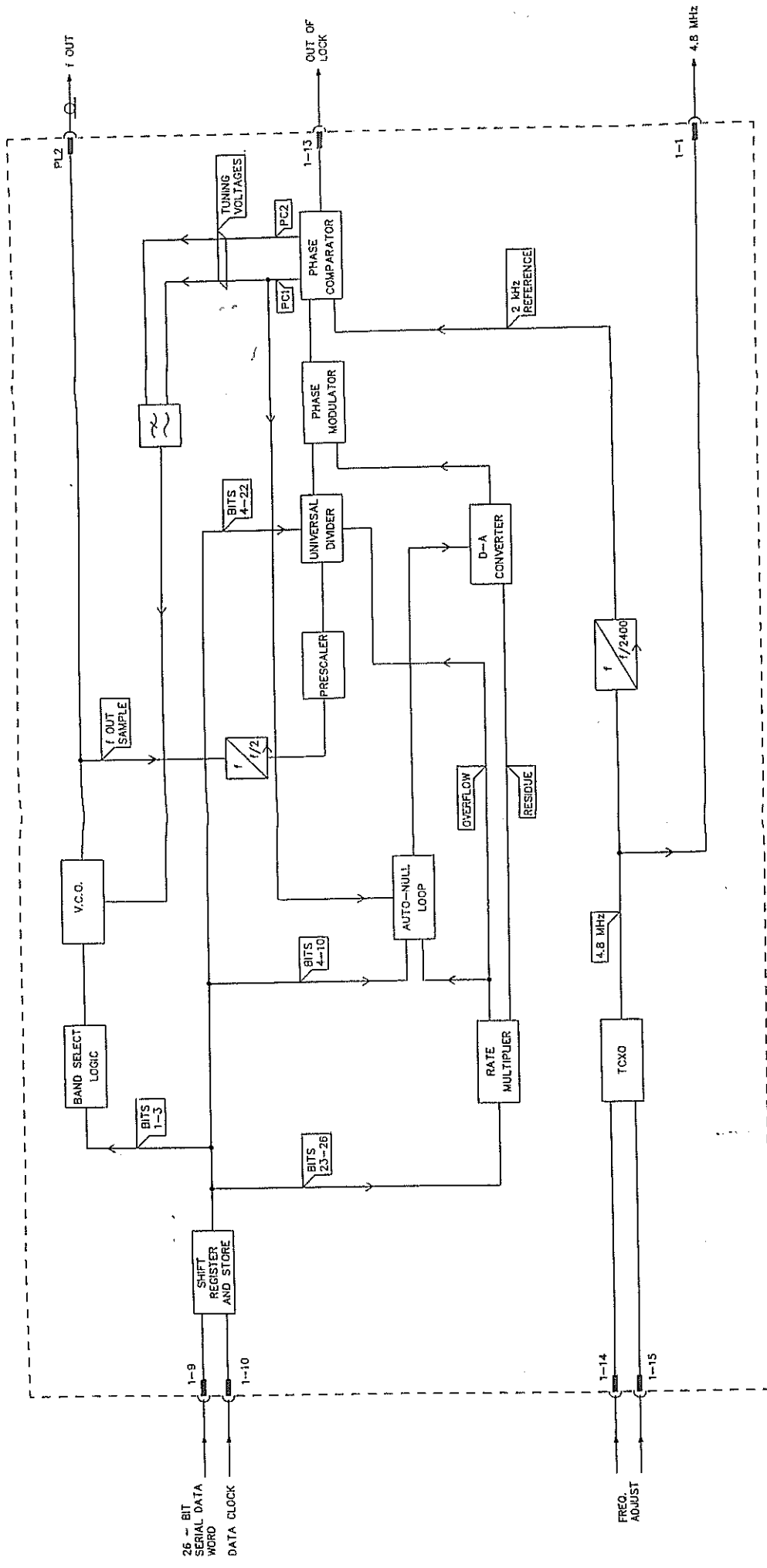


Fig 3.1.8

Synthesiser : Block Diagram

U.K RESTRICTED

Fig 3.1.8

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16

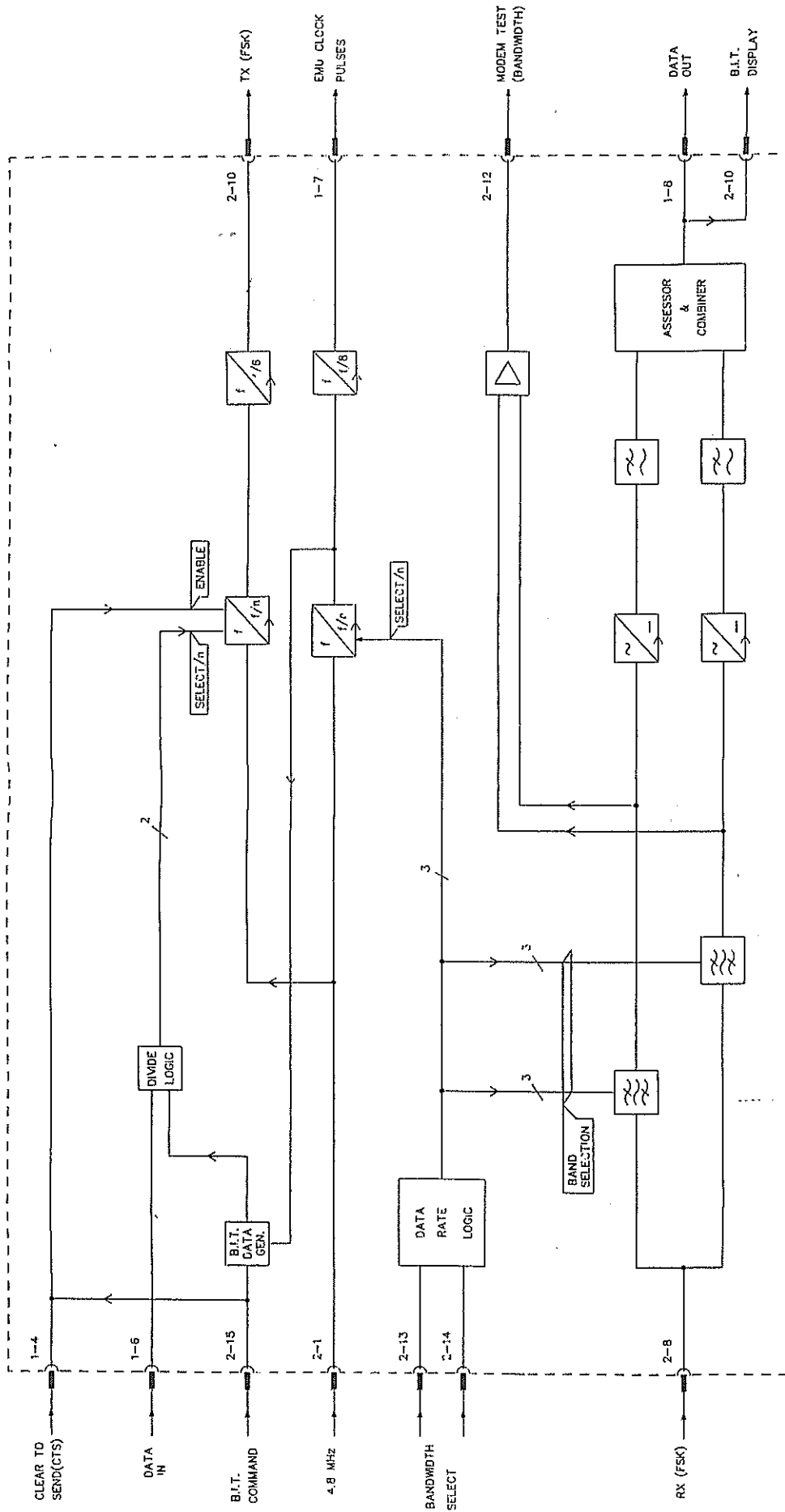


Fig 3.1.9

Modem : Block Diagram

U.K RESTRICTED

Fig 3.1.9

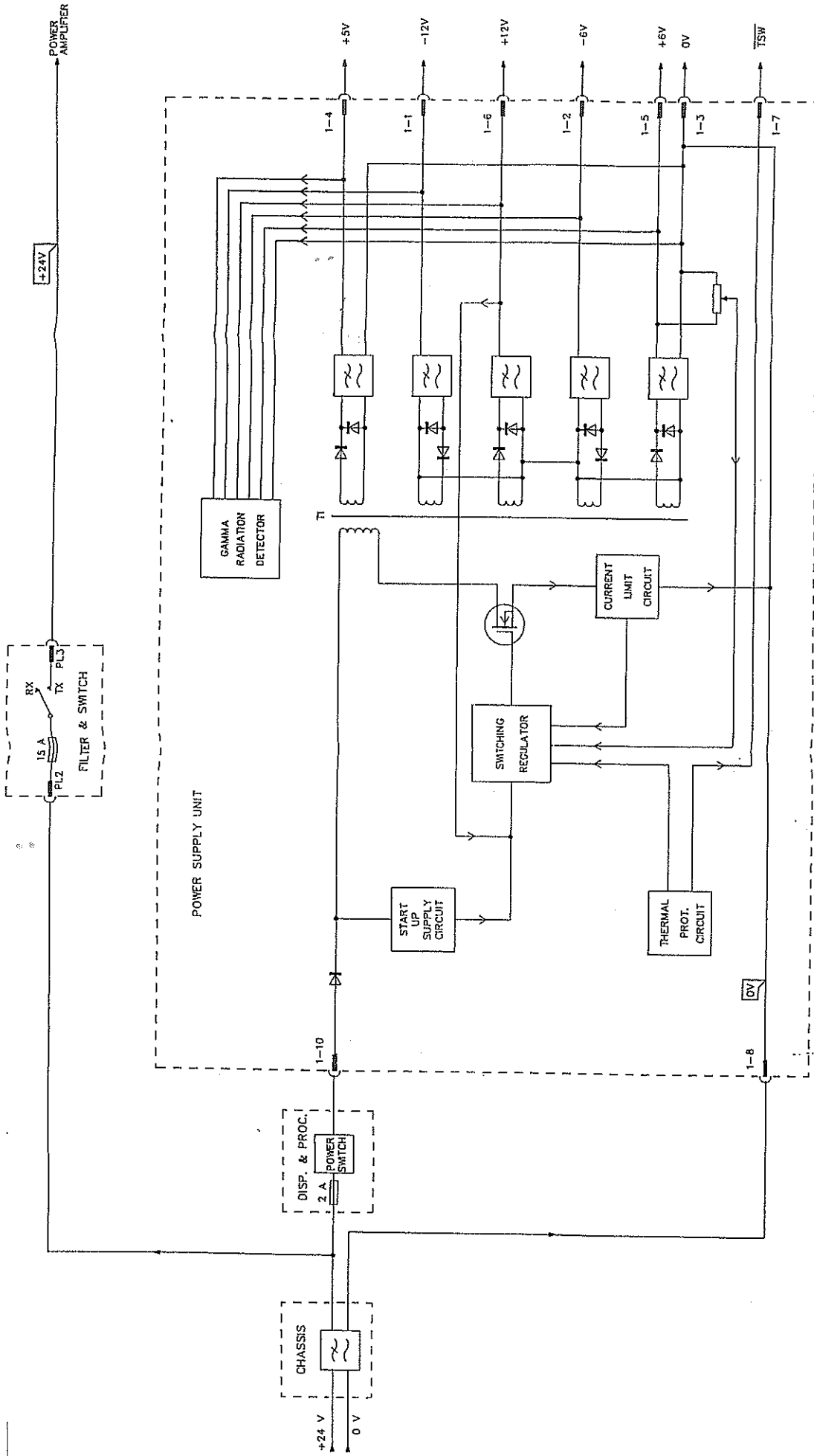


FIG 3.1.10 POWER SUPPLY : BLOCK DIAGRAM

Fig 3.1.10

Fig 3.1.10

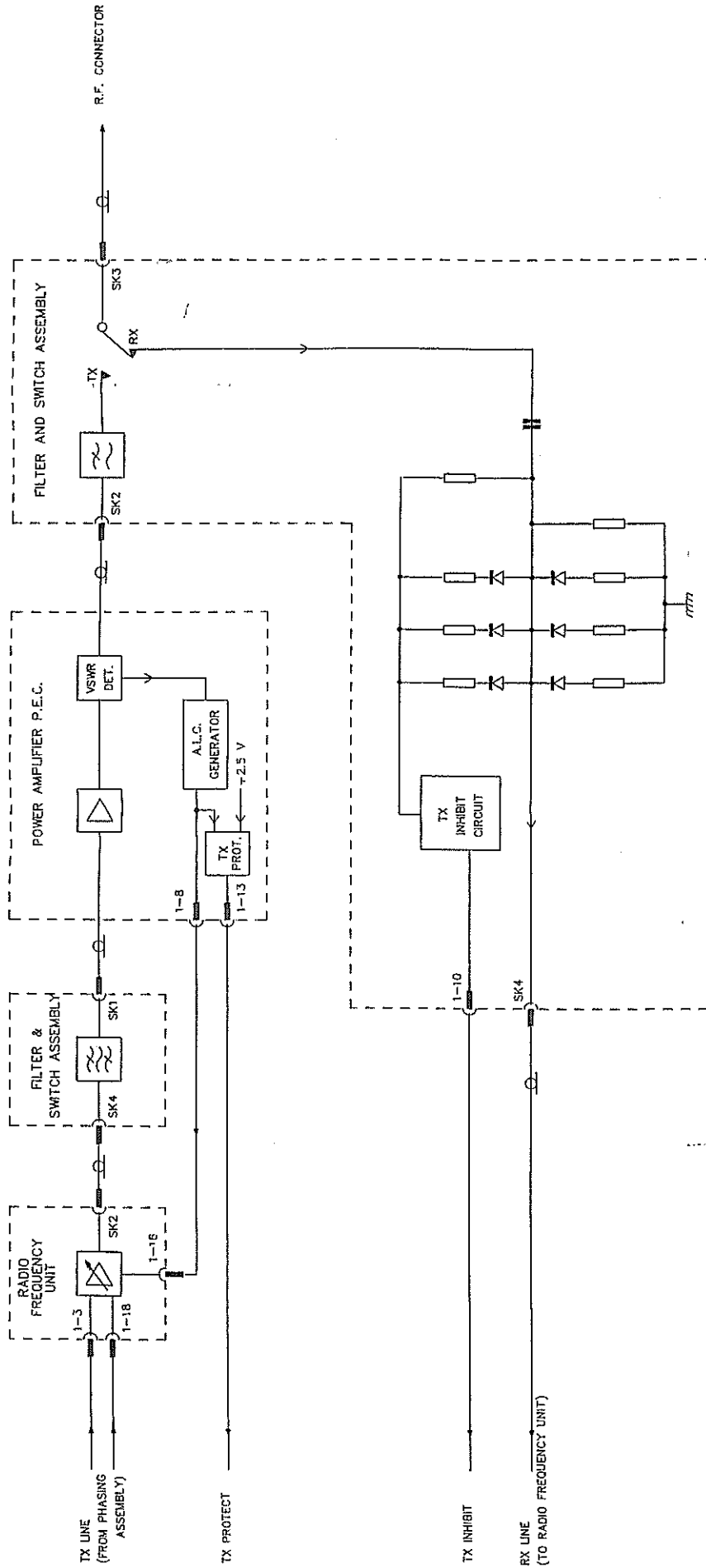
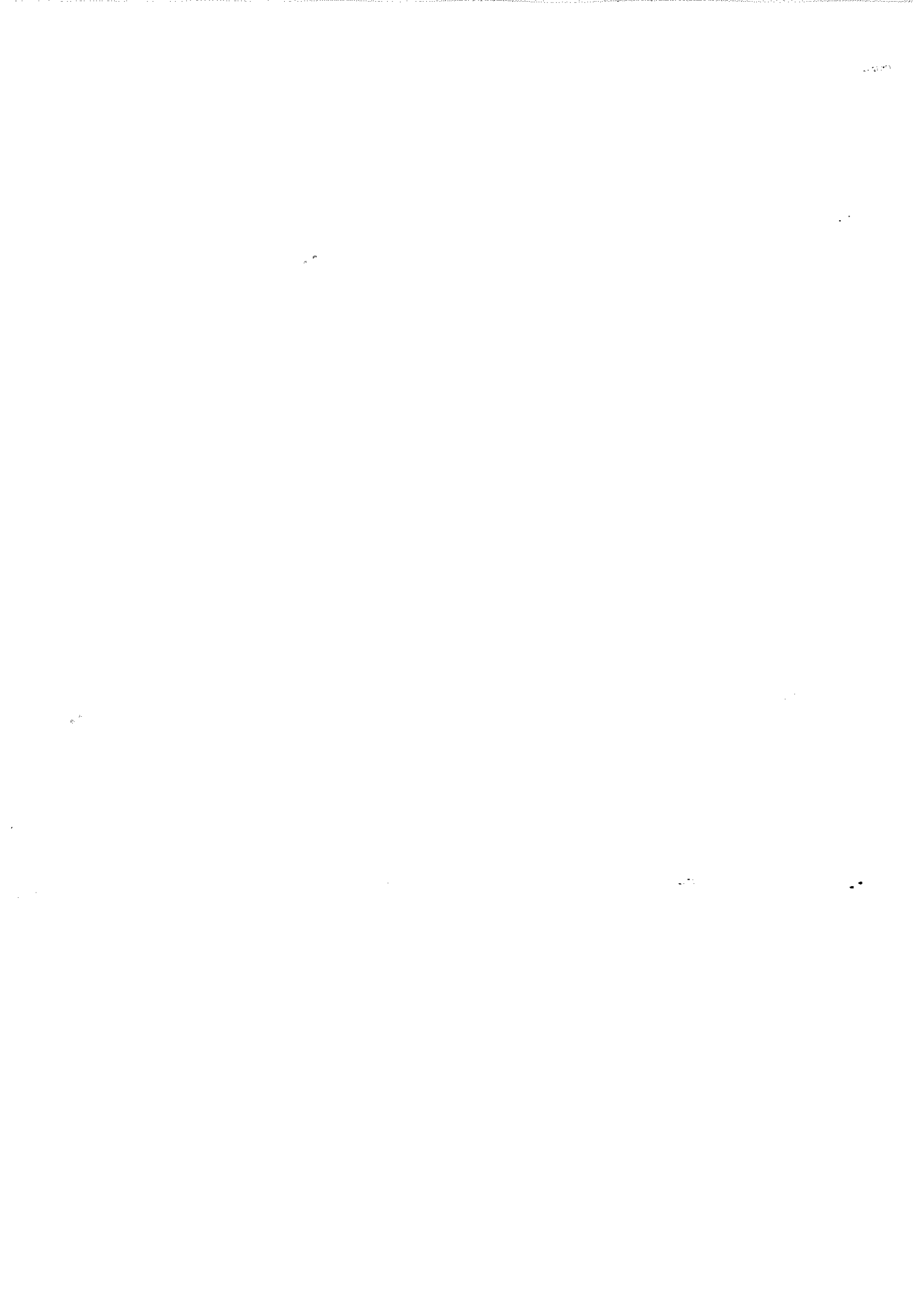


Fig 3.1.11 Protection systems : Block Diagram



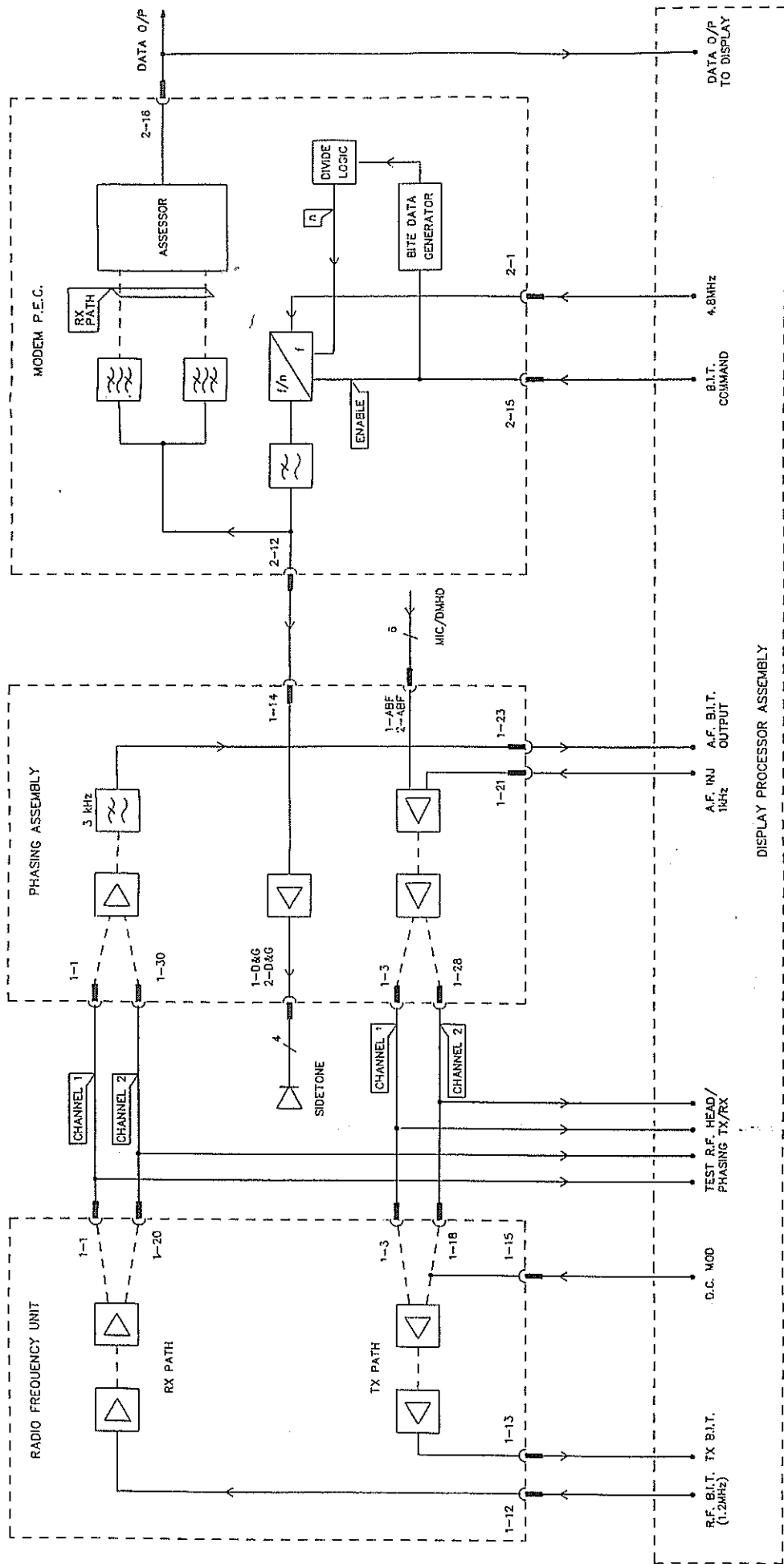
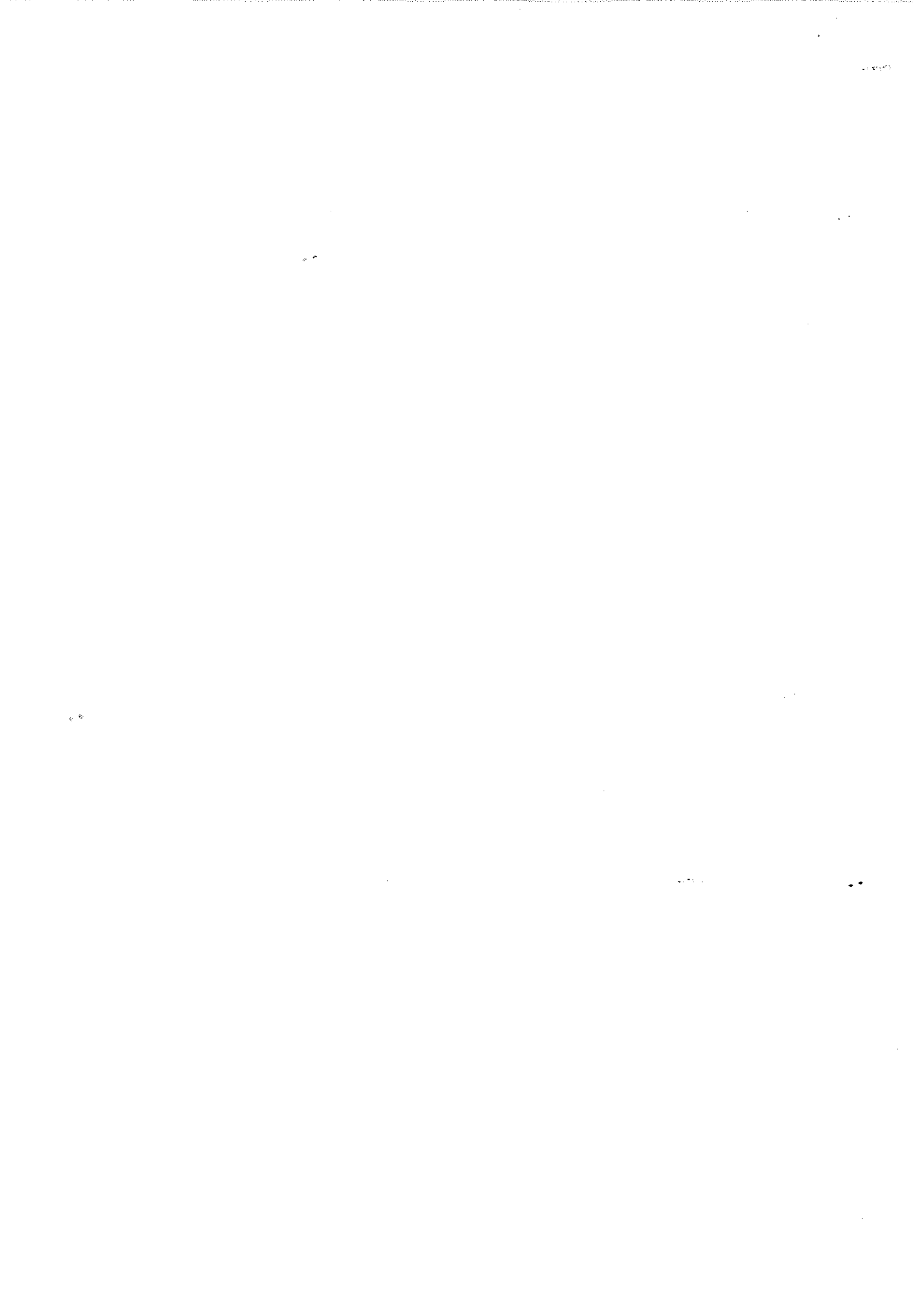


Fig 3.1.12

Fig 3.1.12 Built-In Test : Block Diagram

Fig 3.1.12



TP10068A3

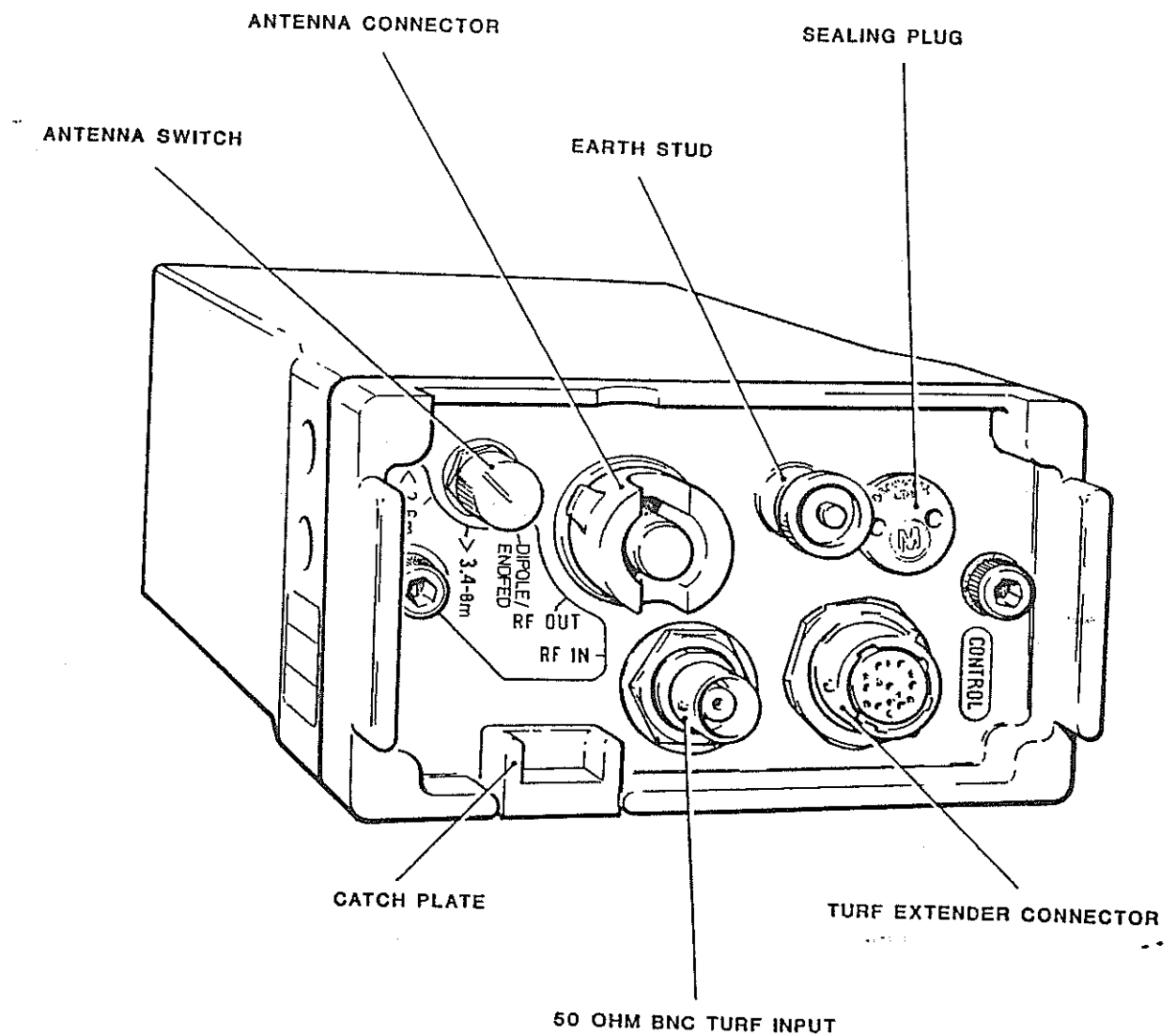


Fig 3.2.1.1 Tuning Unit Radio Frequency Physical Layout

CHAPTER 3.2.1

TECHNICAL DESCRIPTION

INTRODUCTION

1 The tuning unit radio frequency (TURF) is a microprocessor controlled unit used to tune and match various antennas to the transmitter/receiver 319. The unit comprises the following main items:

- (a) Case assembly
- (b) Tune p.e.c.
- (c) Control p.e.c.
- (d) Match p.e.c.

Connection to the transmitter/receiver is made via a coaxial cable which carries the TURF power supply, selected radio frequency (r.f.) signal and instruction tones.

2 A microprocessor on the control p.e.c. produces the control signals required throughout the unit and initiates a tuning sequence whenever a tune up tone signal is received from the transmitter/receiver. During the sequence a combination of series capacitors, inductors and switched-variable transformer windings on the tune and match p.e.c.s are selected by relays to improve the voltage standing wave ratio (VSWR). If on completion of the tuning sequence a VSWR of less than 5:1 (ideally less than 1.5:1) is achieved, an antenna tuned signal is passed to the transmitter/receiver and the relay settings are stored in random access memory (RAM). The TURF is then able to switch rapidly between transmit and receive tuned conditions. To improve the tuning capabilities of the system a TURF extender, containing three inductors in series, may be used in conjunction with the TURF (see Chapter 3.2.2).

3 The main power supply required by the TURF is provided by the transmitter/receiver and varies according to the operating state of the TURF. During the tuning sequence a supply of 24 volts dc is needed, while for all other conditions a supply of 6 volts dc maintains the TURF memory.

PHYSICAL DESCRIPTION

4 The location of the assemblies listed in Para 1 and the position of the connectors on the TURF are shown in Figs 3.2.1.1 and 3.2.1.2. The case assembly, an aluminium alloy casting, carries the following items on the front face:

- (a) 50 ohm BNC TURF input, to connect to transmitter/receiver
- (b) antenna connector
- (c) seven-pin TURF Extender connector
- (d) earth stud
- (e) three position rotary antenna switch
- (f) drying plug
- (g) screw fixing block.

To enable the TURF to be attached to the transmitter/receiver and the Extender to be attached to the TURF two further screw fixing blocks are provided on the rear of the unit. These blocks are designed to connect with

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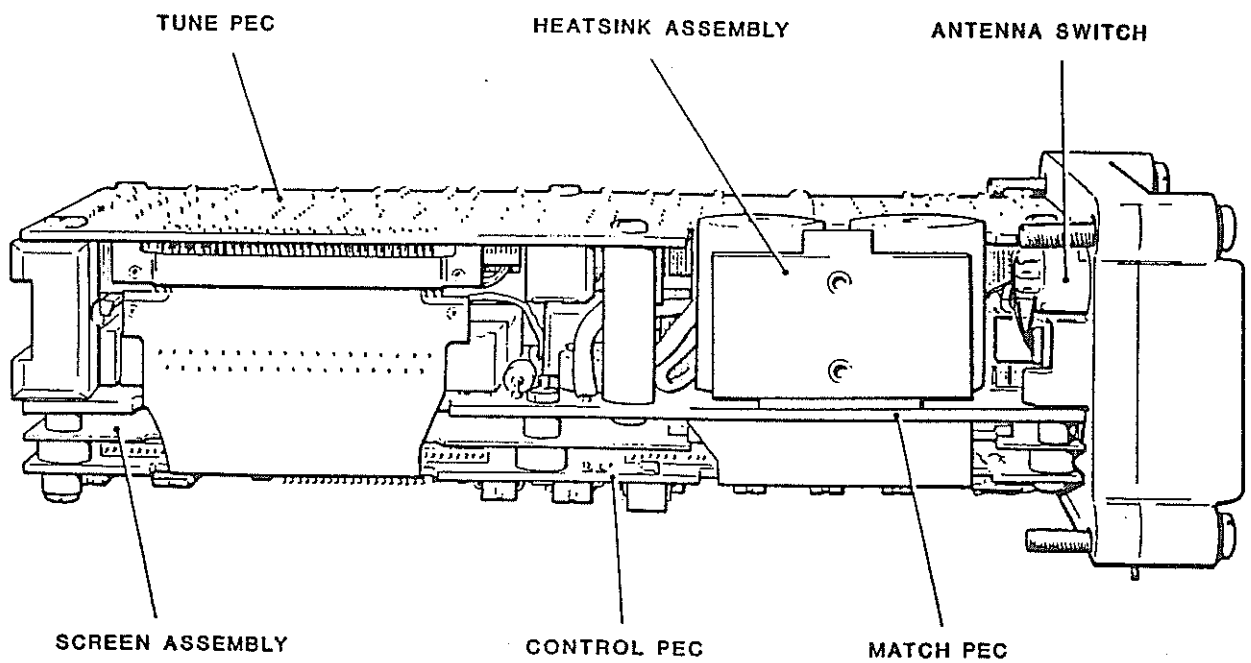


Fig 3.2.1.2 Tuning Unit Radio Frequency P.E.C.
and Sub-assembly Identification

the screw fixings on the transmitter/receiver and Extender. The antenna switch positions are DIPOLE/END FED, 3.4 - 8m and <3.6m.

5 The three p.e.c.s contained within the TURF are mounted horizontally one on top of each other separated by spacers. A metal screen protects the control p.e.c. against interference from the other two. Interconnections between the p.e.c.s, the Extender connector, and the antenna switch are made via film wiring, while discrete wiring is used for the r.f. connections. When the unit is fully assembled it is hermetically sealed.

FUNCTIONAL DESCRIPTION

6 The following paragraphs give a functional description of the TURF 319. The tuning sequence is covered first followed by the control required to achieve that sequence.

Tuning Strategy

7 It is necessary to tune and match the antenna to the transmitter/receiver to ensure that maximum power is transferred between the two. This process is carried out by a microprocessor under the control of various software routines. The antenna's reactance is matched by the selection of a number of series inductors and capacitors (tune), while the resistance of the antenna is matched by switched-variable transformer windings (match).

8 Selection of the inductors and capacitors is achieved using latching relays, each relay having set and reset select lines. 'Set' switches the component into circuit while 'reset' switches the component out of circuit. Selection of the components is made according to the phase difference between input voltage and input current, the radio frequency being used, and the type of antenna fitted. Each transformer winding is then switched into circuit and the VSWR measured. The winding giving the best result is selected, which completes the tune and match sequence.

Tuning Sequence (Fig 3.2.1.5)

9 To enable the tuning sequence to begin, the transmitter/receiver provides a +24 V d.c. supply to the TURF via SK1. The application of this supply produces a RESET interrupt to start the software at the initialisation routine (Para 18). During this routine the following two measurements are made and the results saved in memory for future use (Para 16). The microprocessor first determines which type of antenna is fitted by scanning the antenna switch. With 3.4 - 8m selected on the switch both pins one and two of the control p.e.c. SK4 are high (logic one). Selection of <3.6m or DIPOLE/END FED grounds pin one or pin two respectively (logic 0). The microprocessor can therefore identify the type of antenna in use by the logic signals presented at SK4. In some cases, to tune and match the antenna to the transmitter/receiver requires the use of a TURF Extender (Chap 3.2.2). The second measurement made by the initialisation routine must therefore ascertain whether the Extender is fitted or not. This is done by scanning pin F of the control p.e.c. SK1. With the Extender fitted pin F is grounded at PL1 and a zero volt signal is therefore presented to the control p.e.c. at SK1 pin F.

10 On completion of the initialisation, two status tones, one of 12 kHz and one of 19 kHz, are produced by the microprocessor and returned to the transmitter/receiver via SK1. The sequence of these tones informs the

transmitter/receiver whether or not the TURF extender is fitted as follows:

- (a) 12 kHz tone followed by 19 kHz tone means that the Turf Extender is not connected.
 - (b) 19 kHz tone followed by 12 kHz tone means that the Turf Extender is connected.
- 11 On receipt of the status tones the transmitter/receiver supplies one of the following four function tones to the TURF.
- (a) 12 kHz (Tune to transmit)
 - (b) 14 kHz (Tune to receive)
 - (c) 16.3 kHz (Go to transmit)
 - (d) 19 kHz (Go to receive)

This tone is fed to the match p.e.c. via SK1 and passes through a VSWR detector and the centre tap of a switched-variable transformer. Both these items have no effect at this stage but are covered later in the description (Para 14). The tone is then applied to the control p.e.c., via SK3/13, where its frequency is measured. This process is carried out by a phase-locked loop which consists of a phase comparator and a voltage controlled oscillator (v.c.o.). The output from the v.c.o. and the tone to be measured are both fed to the phase comparator. A voltage related to the result of the comparison is produced and returned to drive the v.c.o. output towards the frequency of the tone. By measuring this voltage the microprocessor can determine which function tone has been received and hence carry out the next process within the tuning sequence. The action taken by the microprocessor on receipt of a 'go to transmit' or 'go to receive' function tone is covered in Para 16. Receipt of a 'tune to transmit' or 'tune to receive' function tone causes the following sequence (Paras 12 to 15) to be initiated.

12 Following the transmission of the function tone, the transmitter/receiver feeds a signal to the TURF at the current operating radio frequency. This signal is applied to the control p.e.c. via the VSWR detector, switched variable transformer and connector CON 1. The signal frequency is measured by a timer in the RAM. To ensure that the radio frequency lies within the operating range of the timer a divide-by-sixteen stage is positioned on the input. A phase detector on the Match p.e.c. then measures the phase difference between the input r.f. voltage and input r.f. current and feeds either a 'phase +' (inductive antenna) or 'phase -' (capacitive antenna) control signal back to the RAM.

13 The microprocessor now selects one of a possible 96 different tuning algorithms contained within the RAM. The selection is made according to:

- (a) the type of antenna fitted (Para 9),
- (b) whether or not the TURF Extender is fitted (Para 9),
- (c) the current operating radio frequency (Para 12),
- (d) the sign of the phase difference between the input r.f. voltage and the input r.f. current (Para 12).

Once a tuning algorithm has been selected the microprocessor (i) generates a signal (Para 27) which switches off the r.f. input to the TURF, and (ii) produces the relay selection signals required to switch into or out of circuit the components detailed by the algorithm. The Extender 'IN' signal

also is produced if the inductors in the Extender are required to tune the antenna. These signals are then stored in either the transmit or the receive status stores depending on the frequency of the function tone originally received (Para 11). The tuning process is now deemed to be completed and the matching process can begin as follows.

14 The microprocessor first produces the signals required to switch RL1 on the match p.e.c. into circuit and RL2 to 8 out of circuit. The r.f. input is restored (Para 27), and a VSWR detector then measures the forward power of the r.f. signal being applied to the TURF followed by the reverse power. The ratio between the two is calculated within the microprocessor by dividing the forward power by the reverse power. The result is then saved and the process repeated for each transformer winding in turn. The winding giving the largest result (lowest VSWR) is selected into circuit and the relay selection signal required is again stored in either the transmit or the receive status stores depending on the frequency of the function tone originally received (Para 11).

15 On completion of the tune and match sequence the microprocessor informs the transmitter/receiver of the result of the sequence by producing one of the following reply tones and returning it via SK1:

- (a) 12 kHz - Antenna tuned,
- (b) 14 kHz - Antenna tuned but memory only partially preserved,
- (c) 16.3 kHz - Antenna tuned with no power restrictions when turf extender connected,
- (d) 19 kHz - Antenna not tuned, or function tone indeterminate.

16 Receipt of a 'Go to transmit' or 'Go to receive' function tone (Para 11) causes the microprocessor to switch off the r.f. input to the TURF, and to scan either the transmit status store or the receive status store and produce the relay selection signals from the information held there. In this way the components previously selected to tune and match the antenna are switched into circuit without the need to carry out the tune and match sequence. On completion of the relay switching, the r.f. input to the TURF is restored (see Para 27).

Overall TURF Control System - Software Function Family Tree (Fig 3.2.1.3)

17 Introduction. Overall control of the TURF is provided by a microprocessor on the control p.e.c. All communications between the microprocessor and the p.e.c.s are made via appropriate interface circuits. The software routines to be executed by the microprocessor are stored in EPROM and are shown in Fig 3.2.1.3. The following paragraphs describe the purpose and operation of each routine.

18 Initialisation. Following the application of power to the TURF a RESET interrupt is produced which starts the microprocessor software system at the initialisation routine. This routine initialises and verifies the TURF system and consists of the following four main actions:

- (a) the microprocessor input/output ports, system memory and system interrupts are all configured and initialised by the routine,
- (b) a validation check is carried out on the memory by means of checksums (Para 23). This determines whether the information held

in both the transmit status store and the receive status store has been preserved,

- (c) a check is made to see which type of antenna is fitted (Para 9),
- (d) a check is made to see if the TURF Extender is fitted (Para 9).

On completion of the above procedures the initialisation routine sets up the reply tone store so that the two status tones described in Para 19 are returned to the transmitter/receiver under the control of the terminate function.

19 Execute function. The execute function then measures the frequency of the function tone produced by the transmitter/receiver (Para 11) and compares it with the contents of the tone store. The appropriate action can then be taken on the result of this comparison, i.e. Tune to transmit, Tune to receive, Go to transmit, or Go to receive. If the audio tone is not one of the four recognised tones, a 19 kHz (function tone indeterminate) signal is returned to the transmitter/receiver and no further action is taken by the TURF.

20 An audio tone of 12 kHz (Tune to transmit) or 14 kHz (Tune to receive) causes the execute routine to pass control of the microprocessor to the tune and match function (Para 21). An audio tone of 16.3 kHz (Go to transmit) or 19 kHz (Go to receive) causes the execute function to look at the validation check previously carried out on the transmit status store and receive status store. Provided that the information held in the relevant store has been preserved, the execute function produces the signals required to operate the appropriate component selection relays. The reply tone store is then set up so that a 12 kHz 'antenna tuned' signal is returned to the transmitter/receiver on the command of the terminate function. Control of the microprocessor is then passed to the terminate function (Para 23). If for some reason the function cannot be completed, eg information held in memory corrupted, a 19 kHz audio tone is set up in the reply tone store.

21 Tune and match function. As stated previously in Para 20, receipt of a 12 kHz or 14 kHz function tone from the transmitter/receiver causes the tune and match function to take control of the microprocessor. Although this function is split into two routines, tune to transmit and tune to receive, the following description applies to both. The only difference being that the final component selection relay settings are saved in a different store location ie transmit status store or receive status store.

22 The first operation of the function is to produce the signals required to switch out of circuit all the tuning components and select the centre tap of the match transformer. The current operating r.f. frequency is then measured (Para 12), followed by a look at the outcome of the initialisation checks (Para 18(c) and (d)). Finally, the initial phase of antenna is noted according to the measurement made by the phase detector (Para 12). On receipt of these four measurements the tune and match function selects and performs the appropriate tuning algorithm, storing the final relay selection signals in the relevant store location and flagging that store location as preserved (Para 13). The sequence described in Para 14 is then performed by the tune and match routine with the relay selection signal producing the best VSWR reading, again being stored in the relevant store location. Providing a VSWR of less than 5:1 is achieved the reply tone store is set up so that a 12 kHz 'antenna tuned' signal is returned to the transmitter/receiver on the

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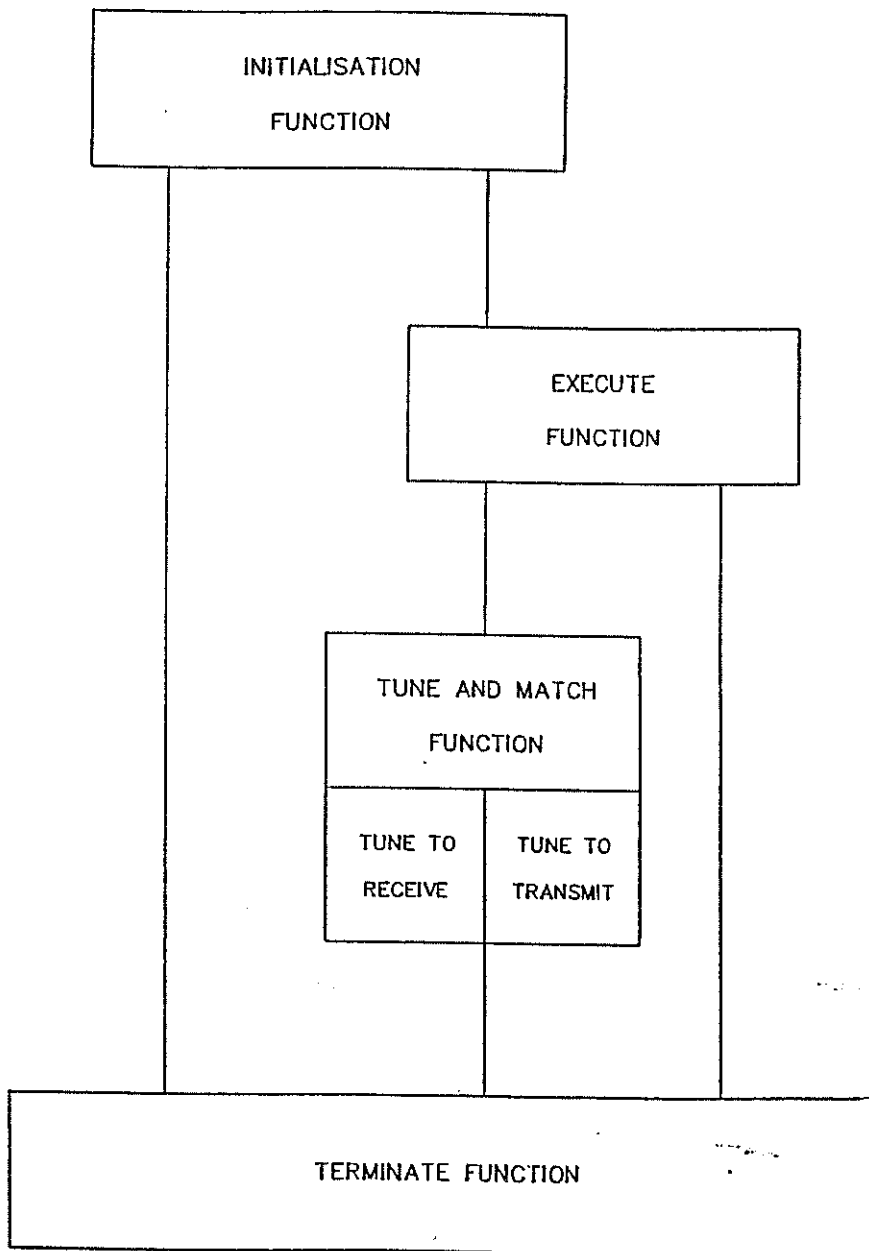


Fig 3.2.1.3 Software Function Family Tree

command of the terminate function. Control of the microprocessor is then passed to the terminate function. If a VSWR of greater than 5:1 is achieved the reply tone store is set up so that a 19 kHz audio tone is returned to the transmitter/receiver.

23 Terminate function. The first task of the terminate function is to determine whether the transmit status store and receive status store have been flagged as preserved (see previous para). If so, the terminate function adds a checksum byte and a balance byte to each store. These bytes enable the initialisation function to carry out a validation check of the memory on the next power up. The checksum byte is formed by adding the first seven bytes of the store, while the balance byte is the inverse of the checksum.

24 The reply tone store is then monitored and one of the reply tones listed in Para 15 is generated. Finally, the terminate function halts the software allowing the initialisation routine to take control of the microprocessor at the next power up.

Protection Circuits (Fig 3.2.1.4)

25 Electromagnetic pulses. The TURF r.f. components are protected against electromagnetic pulses (EMP) by one gas-filled surge arrestor connected to the antenna terminal and another contained within the front panel BNC connector. The control circuits on the control p.e.c. are protected against EMP by capacitive decoupling of the control lines to both the tune and the match p.e.c.s.

26 Nuclear radiation. In the event of nuclear radiation being present a gamma radiation detector diode within the nuclear protection circuit fires and provides a path to earth for the +24 V supply, effectively switching off the TURF.

27 Relay protection. The TURF component selection relays are protected from damage throughout the switching sequence by ensuring that r.f. power is removed from the TURF for this period (Para 13/14). The microprocessor switches an additional load into the TURF output, thus increasing the current drawn by the TURF. This increase in current causes the T/R to switch off the r.f. power, and the microprocessor then starts the relay switching sequence (and also disconnects the additional load). When the switching sequence is complete, the r.f. power is restored by the T/R.

Power Supplies (Fig 3.2.1.4)

28 General description. The main power supply required by the TURF is provided by the transmitter/receiver and switches between 24 V and 6 V according to the operating state of the TURF. During tuning or switching between stored transmit and receive relay settings, a +24 V supply is applied to SK1 to produce the following voltage levels required throughout the unit:

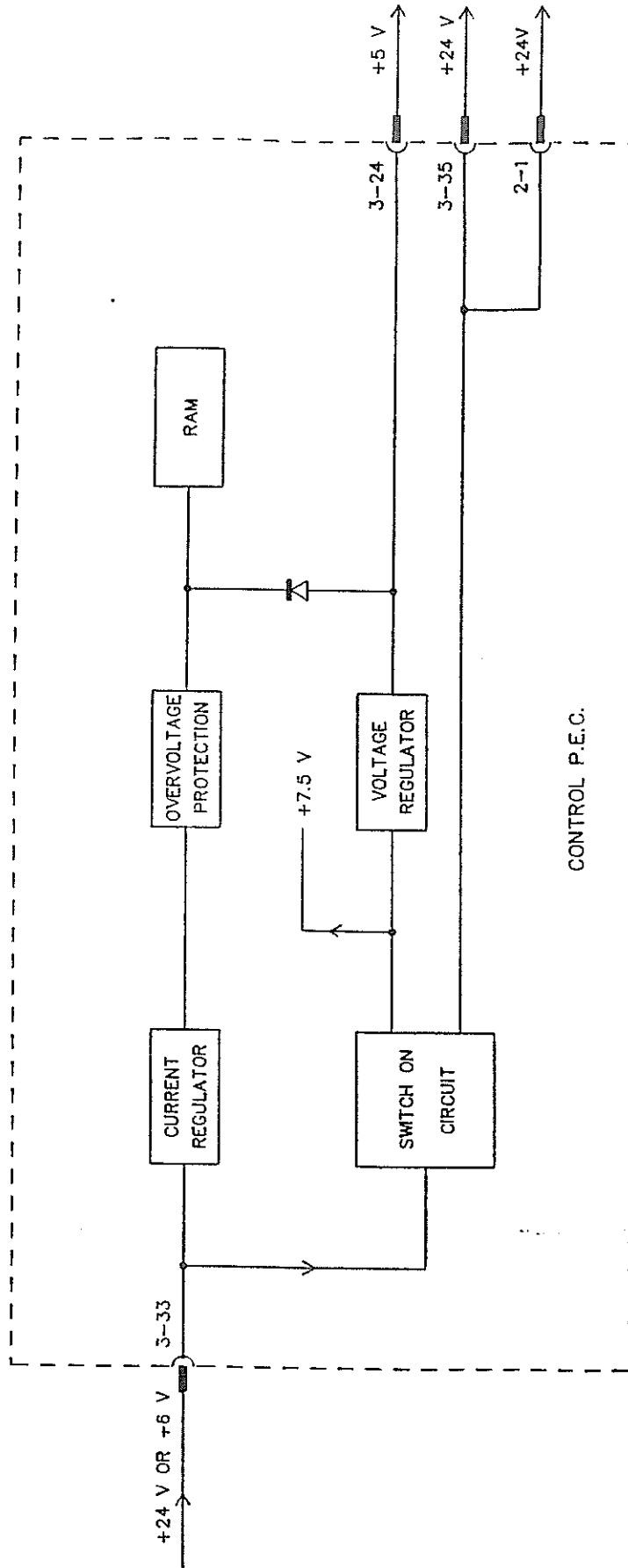
- (a) +24 V (Switched)
- (b) +7.5 V (control p.e.c. only)
- (c) +5 V

At all other times a +6 V supply is applied to SK1 to produce a trickle current to maintain the TURF memory. The power consumed by the TURF is therefore kept to a minimum during non operation.

29 Detailed description. The main power supply, +24 V or +6 V, is fed to the match p.e.c. via SK1 on the front panel as shown in Fig 3.2.1.5. On the match p.e.c. it passes through a VSWR detector (Para 14), switched-variable transformer windings (Para 14) and a nuclear protection circuit (Para 26). It is then applied to the control p.e.c. as shown in Fig 3.2.1.4.

30 With +6 V applied (non tuning) the switch-on circuit cannot operate because the biasing for the switch-on transistor is provided by a 13 V zener diode. This means that until the input voltage rises above +13 V the +24 V (switched), +7.5 V and +5 V supplies are all disabled. The current regulator however, produces a trickle current to maintain the information stored in RAM. To protect the RAM against high voltages an overvoltage protection circuit, consisting of a 5.1 V zener diode, is positioned on the output from the current regulator.

31 With +24 V applied (tuning) the switch-on circuit operates and allows this voltage to be made available to the control p.e.c. Further zener diodes and transistors contained within the switch-on circuit reduce the input voltage to +7.5 V for use on the control p.e.c. A voltage regulator then reduces this voltage to the + 5 V required by the TURF logic circuits. The +5 V is also applied to the RAM to maintain the memory during tuning operations.



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Fig 3.2.1.4 Power Supplies : Block Diagram

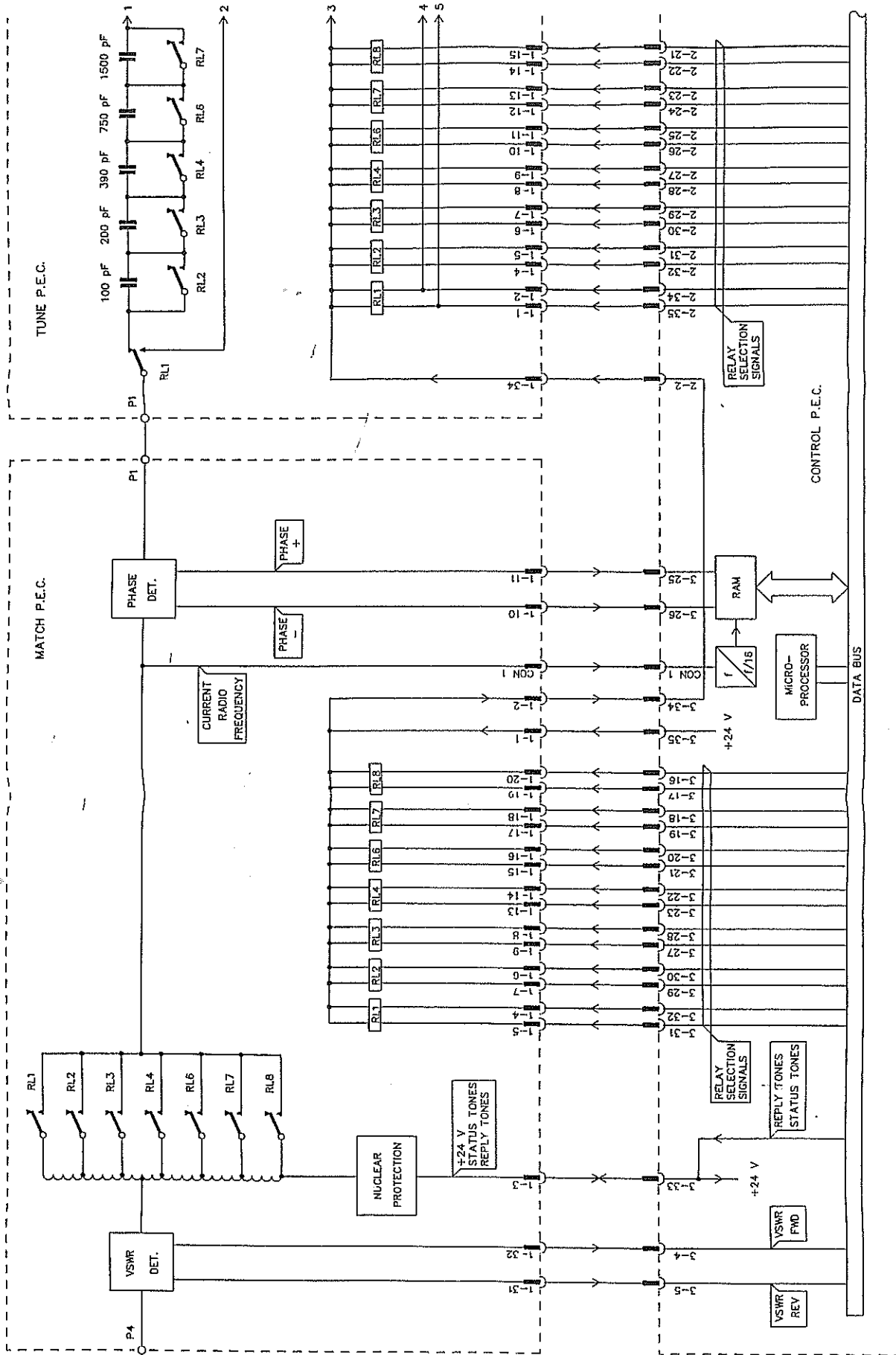


Fig 3.2.1.5

Fig 3.2.1.5 Tuning Unit Radio Frequency : Block Diagram (Sheet 1)

Fig 3.2.1.5

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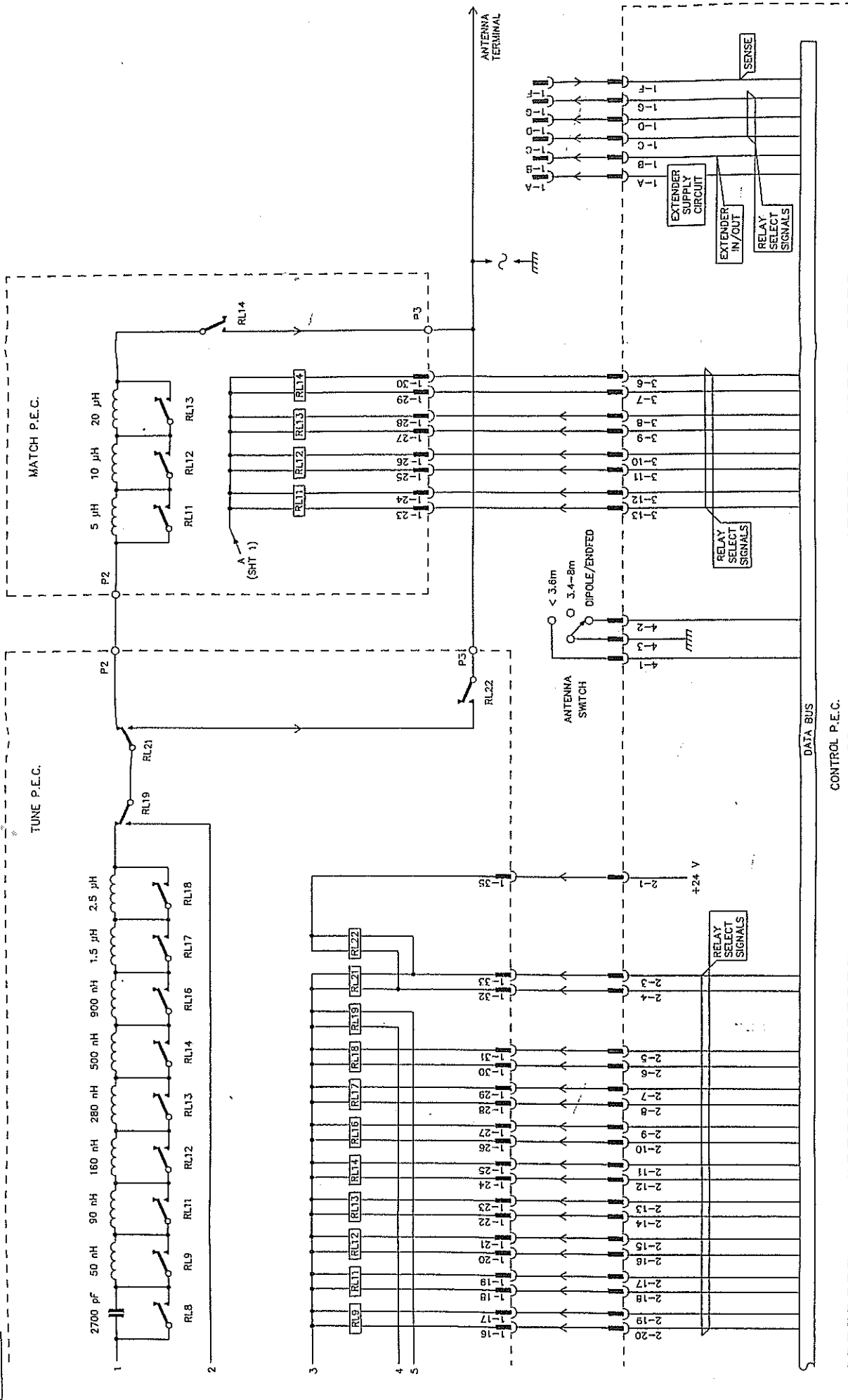


Fig 3.2.1.5

Fig 3.2.1.5 Tuning Unit Radio Frequency : Block Diagram (Sheet 2)

Fig 3.2.1.5

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CHAPTER 3.2.2

TUNING UNIT RADIO FREQUENCY EXTENDER

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- 2 PHYSICAL DESCRIPTION
- 3 FUNCTIONAL DESCRIPTION

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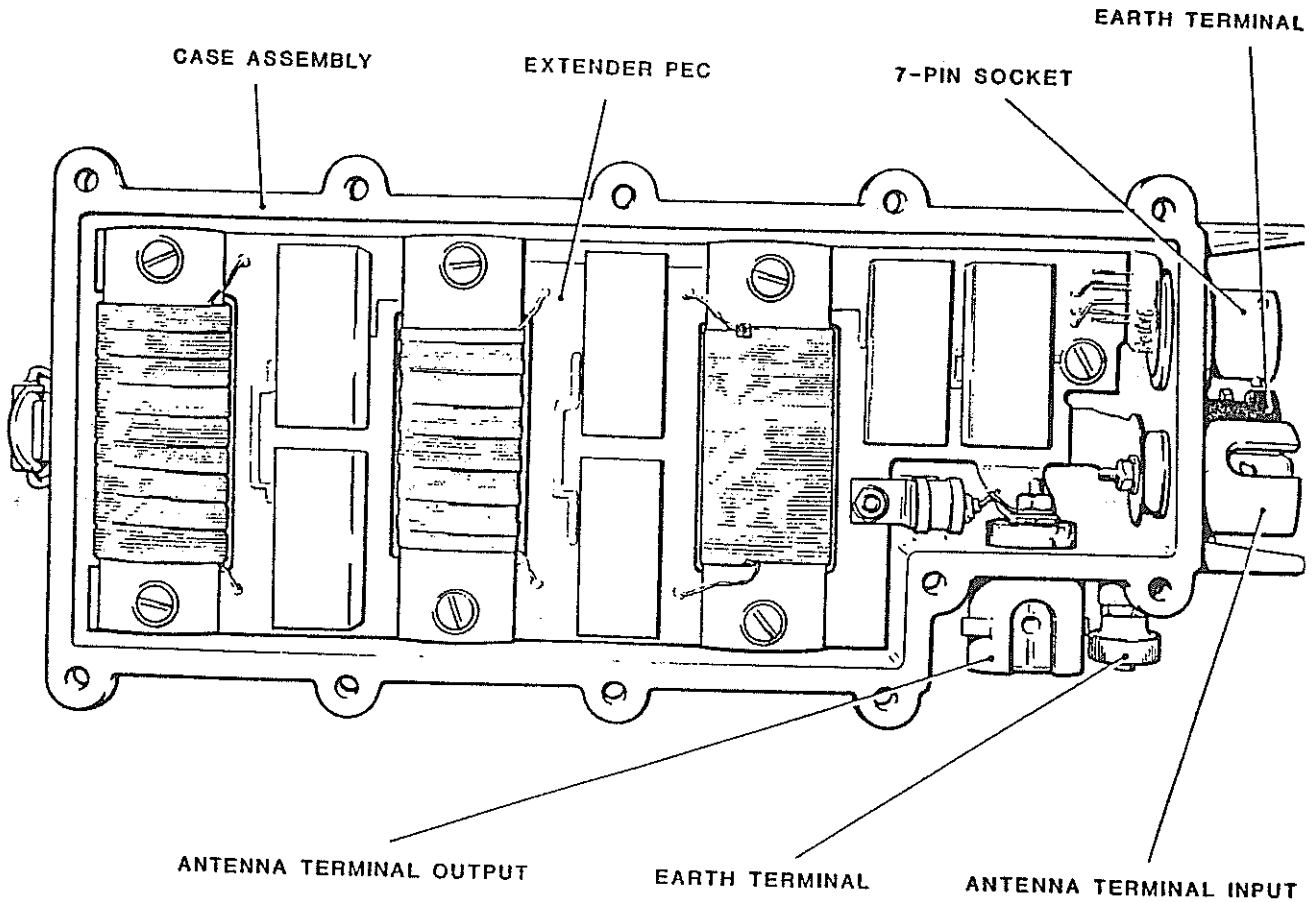


Fig 3.2.2.1 TURF Extender Physical Layout

CHAPTER 3.2.2

TECHNICAL DESCRIPTION

INTRODUCTION

1 The tuning unit radio frequency (TURF) Extender is a small lightweight unit used to extend the tuning capabilities of the TURF (Chap 3.2.1). Addition of the Extender enables a whip antenna or long wire antenna to be tuned to frequencies as low as 1.5 MHz. The unit comprises the following main items:

- (a) case assembly
- (b) Extender p.e.c.
- (c) 7-pin socket
- (d) antenna terminal input
- (e) antenna terminal output
- (f) two earth terminals.

The Extender p.e.c. carries the three inductors used to improve the tuning. Switching of the Extender into or out of circuit and selection of the inductors is achieved by relays under the control of the TURF. All the control signals and the +24 V supply for the Extender are provided by the TURF via the 7-pin socket.

PHYSICAL DESCRIPTION

2 Figure 3.2.2.1 shows the location of the assemblies listed in Para 1. The case assembly is an aluminium-alloy casting. The front face carries connectors (c) and (d) listed above and one of the earth terminals, while the left-hand face carries the antenna terminal output and the other earth terminal. On the rear of the unit is a screw fastener assembly which, along with the earth strap fastened to the front earth terminal, enables the Extender to be attached to the top of the TURF. Most of the interior of the TURF Extender is occupied by the extender p.e.c. on which are mounted the three inductors and six relays used by the TURF in the tuning sequence. Interconnections between the p.e.c. and the connectors are made via film wiring. When the unit is fully assembled it is hermetically sealed.

FUNCTIONAL DESCRIPTION (Fig 3.2.2.2)

3 During the tuning sequence carried out by the TURF (Chap 3.2.1) it is sometimes necessary to switch into circuit any number of the three inductors within the TURF Extender. The following paragraph describes the method of selection of these components.

4 The TURF first switches the Extender into circuit by providing a zero volts signal on SK1 pin B (Extender in/out). This zero volts allows the +24 volts supplied from the TURF on pin A to pass through the 'set' coil of relays one and six and the 'reset' coil of relay seven, causing the relays to be positioned as shown in Fig 3.2.2.2. The components can then be selected by the relay select signals on pins C, D and G. A zero volts signal on any of these pins allows the +24 volts on pin A to pass through the 'reset' coil of the relay on that line, switching the inductor in question into circuit. A +24 volts relay select signal on pins C, D or G passes through the 'set' coil of the relay to the earth on pin F, switching the inductor in question

out of circuit. When the Extender is not required to tune the antenna an 'Extender in/out' signal of +24 volts is supplied by the TURF on pin B. Relays one and six are reset and relay seven set, thus switching out of circuit all three inductors.

- 5 The Extender circuit is protected against electromagnetic pulses (EMP) by a surge arrestor positioned adjacent to the antenna output terminal.
- 6 With the TURF Extender in use, under certain conditions of low frequency and type of antenna used, high antenna voltage will exist. The TURF Extender is protected against this eventuality by the RT 319 reducing the high PEP.

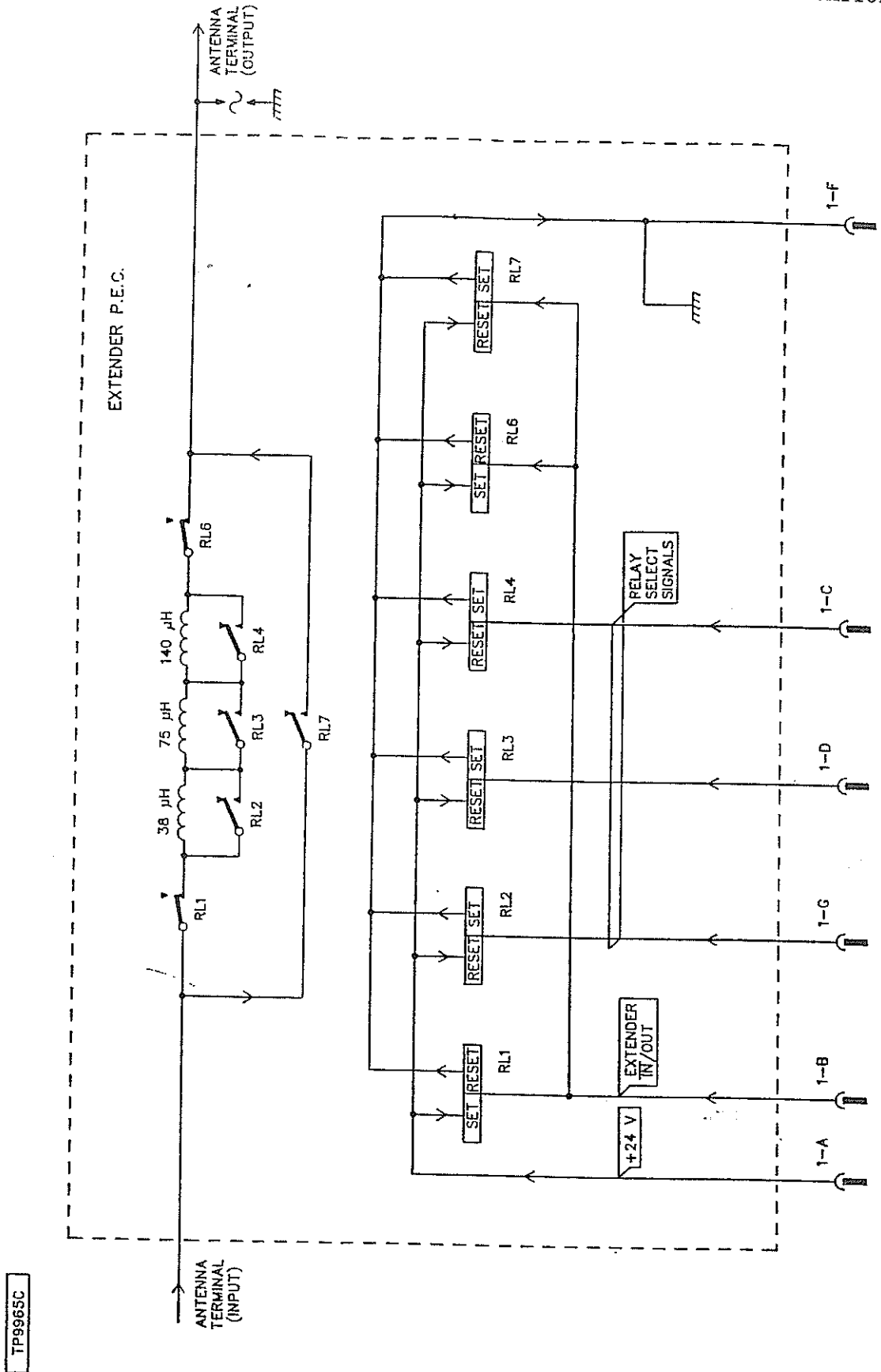


Fig 3.2.2.2 TURF Extender : Block Diagram



CATEGORY 5

MAINTENANCE INFORMATION AND INSTRUCTIONS

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* SUB-CATEGORY 5.1 -- FAULT DIAGNOSIS

SUB-CATEGORY 5.2 - REPAIR INSTRUCTIONS

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SUB-CATEGORY 5.1

FAULT DIAGNOSIS

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CHAPTER 5.1.2.2 - TUNING UNIT RADIO FREQUENCY EXTENDER

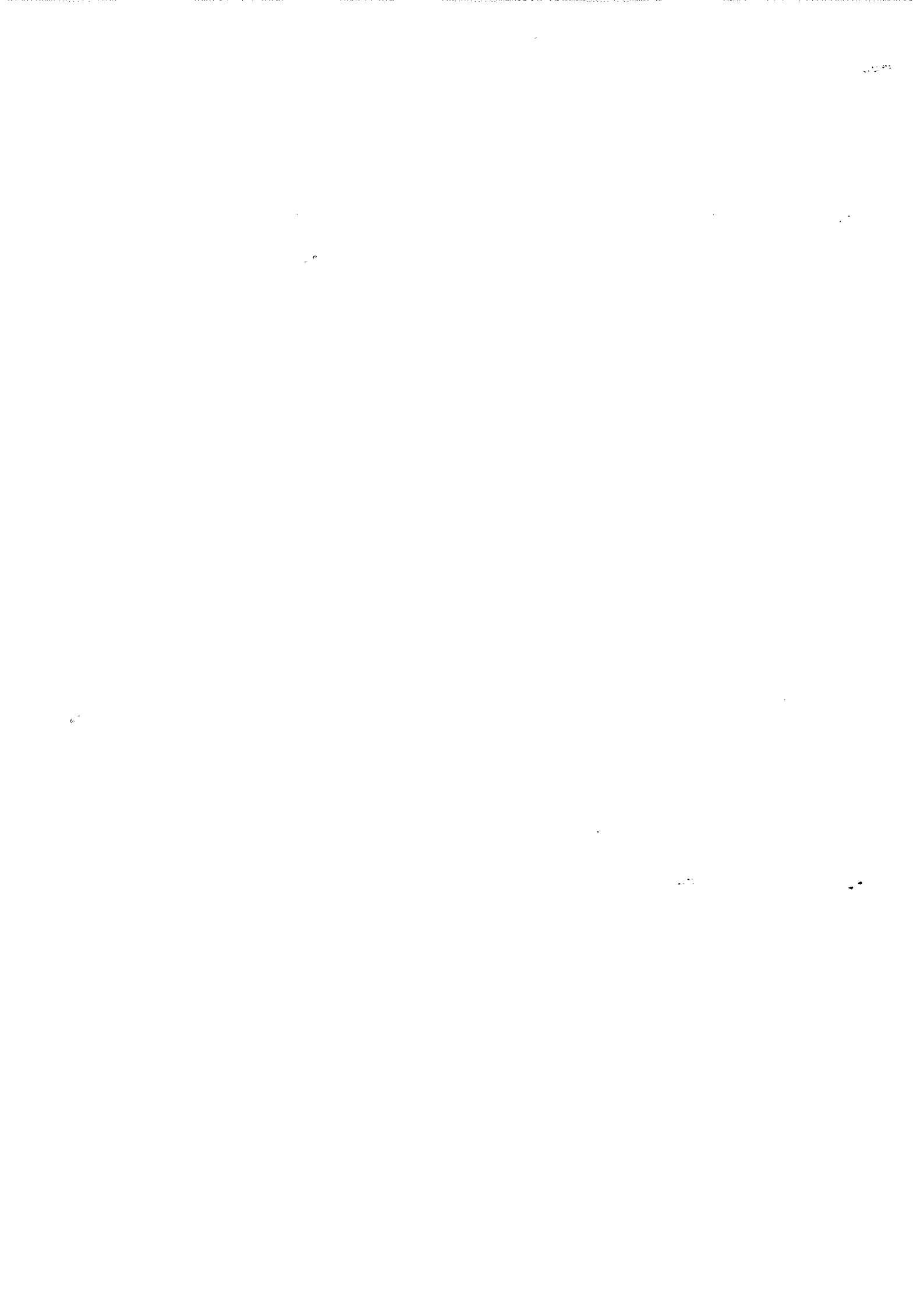
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TRANSMITTER/RECEIVER

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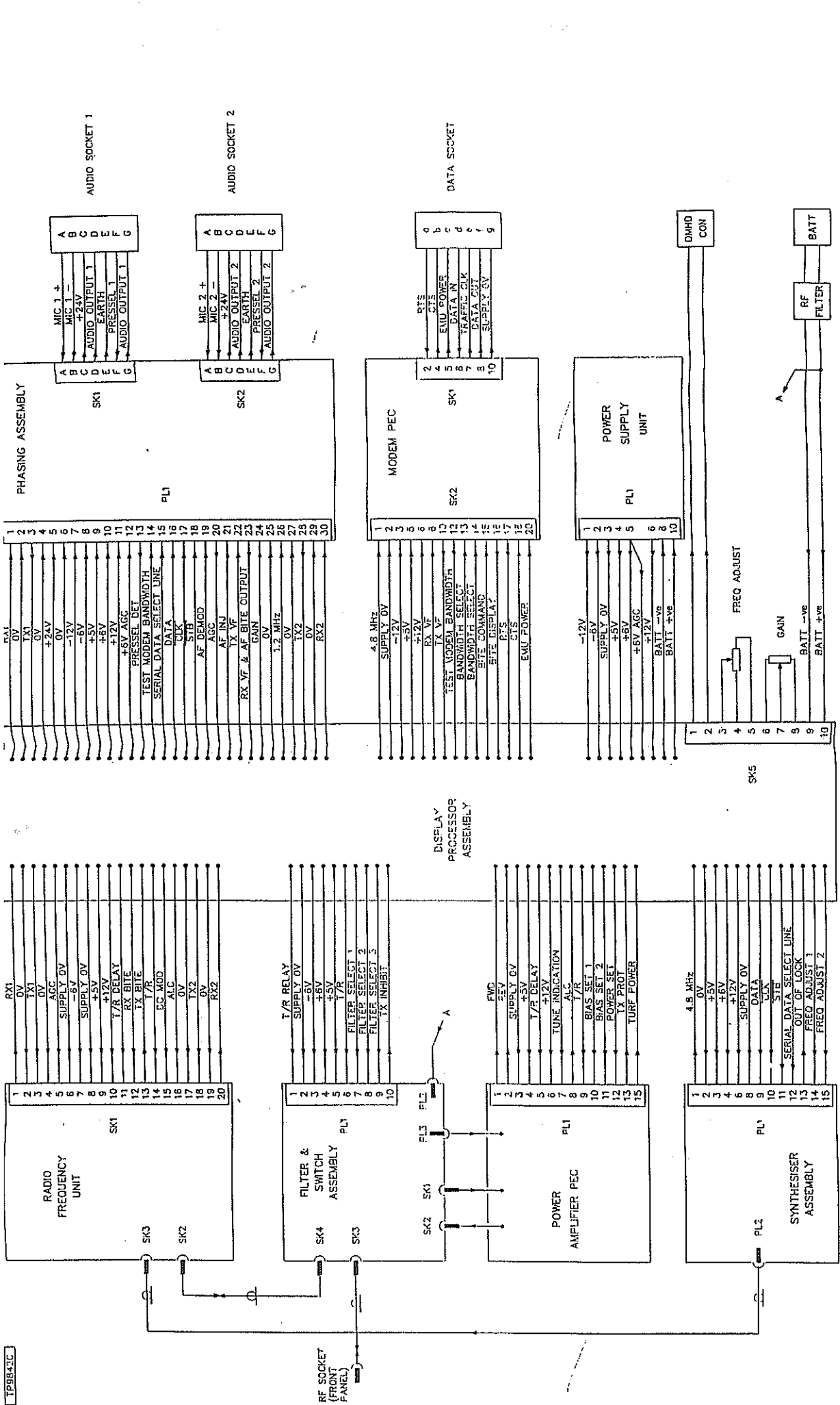
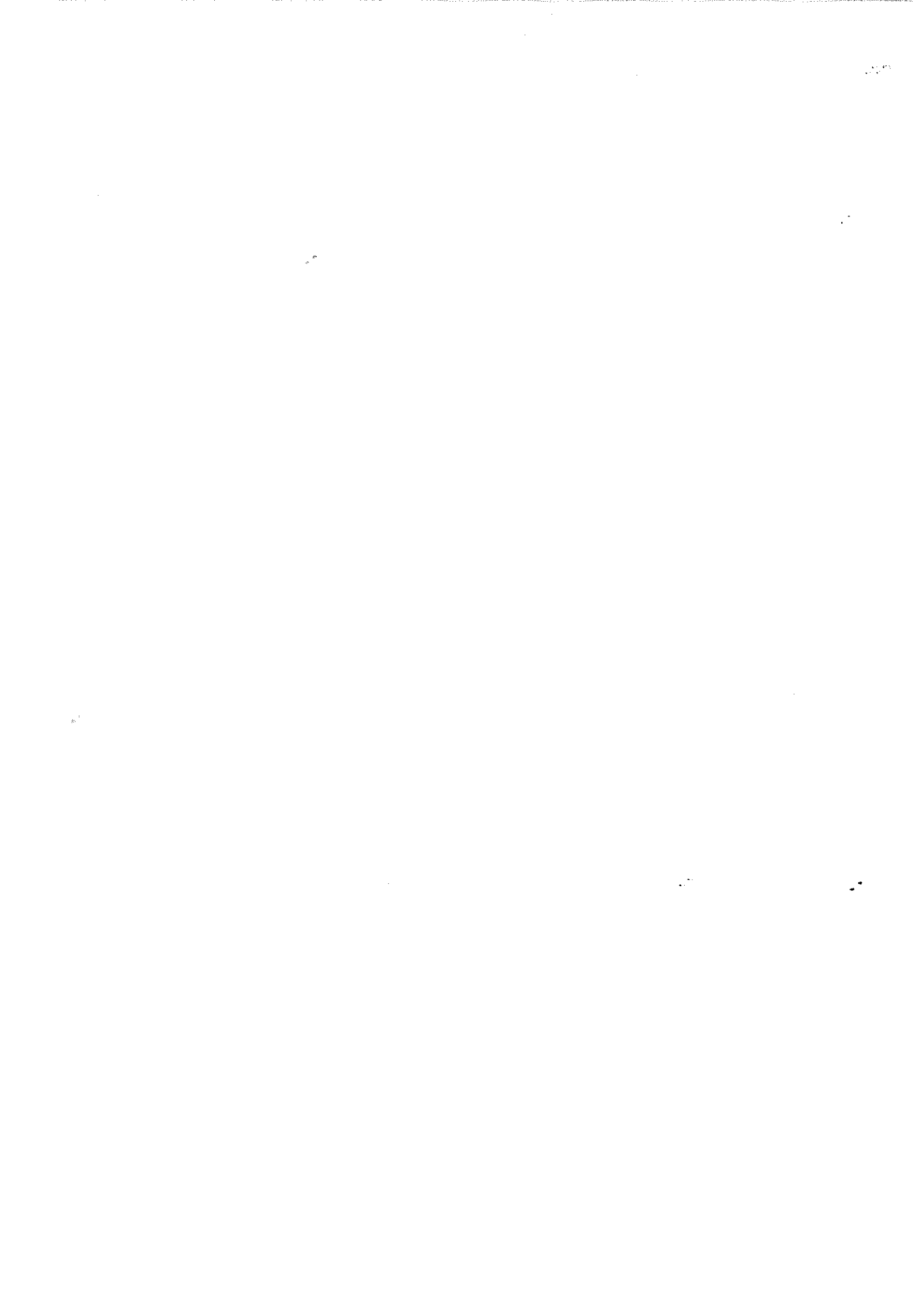


Fig 5.1.1.1

Fig 5.1.1.1

RT 319 Interconnecting Diagram



CHAPTER 5.1.2.1

TUNING UNIT RADIO FREQUENCY

Contents

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Interconnecting Diagram

CHAPTER 5.1.2.2

TUNING UNIT RADIO FREQUENCY EXTENDER

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SUB-CATEGORY 5.2

REPAIR INSTRUCTIONS

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CHAPTER 5.2.2.2 - TUNING UNIT RADIO FREQUENCY EXTENDER

CHAPTER 5.2.1

TRANSMITTER/RECEIVER

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4	Gain Control, Mode and Power Switch Knobs
5	Keyboard Assembly
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7	Synthesiser Assembly
8	Radio Frequency Unit
9	Filter and Switch Assembly
10	Power Amplifier P.E.C.
11	Modem P.E.C.
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14	Display Processor Assembly
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CHAPTER 5.2.1

TRANSMITTER/RECEIVER

SUB-ASSEMBLY AND P.E.C. REMOVAL AND REPLACEMENT

CAUTION: As this equipment contains devices which are sensitive to static electricity, maintenance should be carried out in accordance with the recommendations contained in DEF STAN 59-98/2.

Location and Identification of Parts

- 1 The location and identity of the assemblies and p.e.c.s of the RT 319 are shown in Fig 5.2.1.1 and Fig 5.2.1.2.

NOTE: The battery, engraved keyboard plate, gain control knob, mode knob and power knob can all be removed without breaking the equipment seal. On completion of any other dismantling operation the drying and sealing procedure detailed in Para 19 is to be carried out whenever possible.

Battery

- 2 To remove the battery proceed as follows:
 - (1) stand the transmitter/receiver on the battery,
 - (2) release two spring loaded toggle catches,
 - (3) lift the transmitter/receiver off the battery.
 - (4) Replace by reverse procedure ensuring correct alignment of battery connections.

Keyboard Engraved Plate Assembly

- 3 To remove the keyboard engraved plate assembly proceed as follows:
 - (1) remove four special screws to release the plate,
 - (2) remove plate.
 - (3) Replace by reverse procedure.

Gain Control, Mode and Power Switch Knobs

- 4 To remove either the gain control, mode, or power switch knobs proceed as follows:
 - (1) turn the knob/switch until the attaching screw is visible,
 - (2) using an allen key remove the M3 x 3 mm screw to release knob.
 - (3) Replace by reverse procedure.

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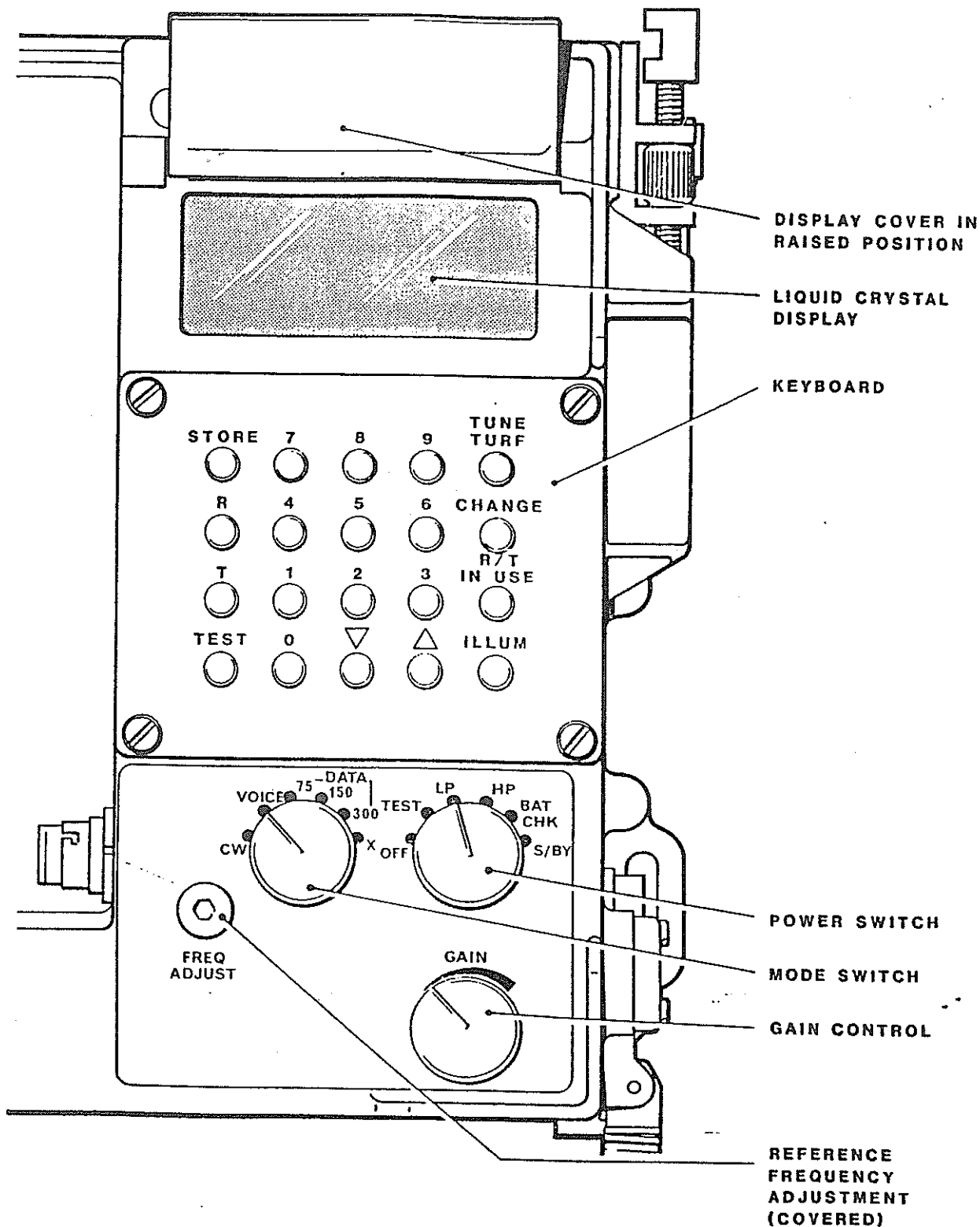
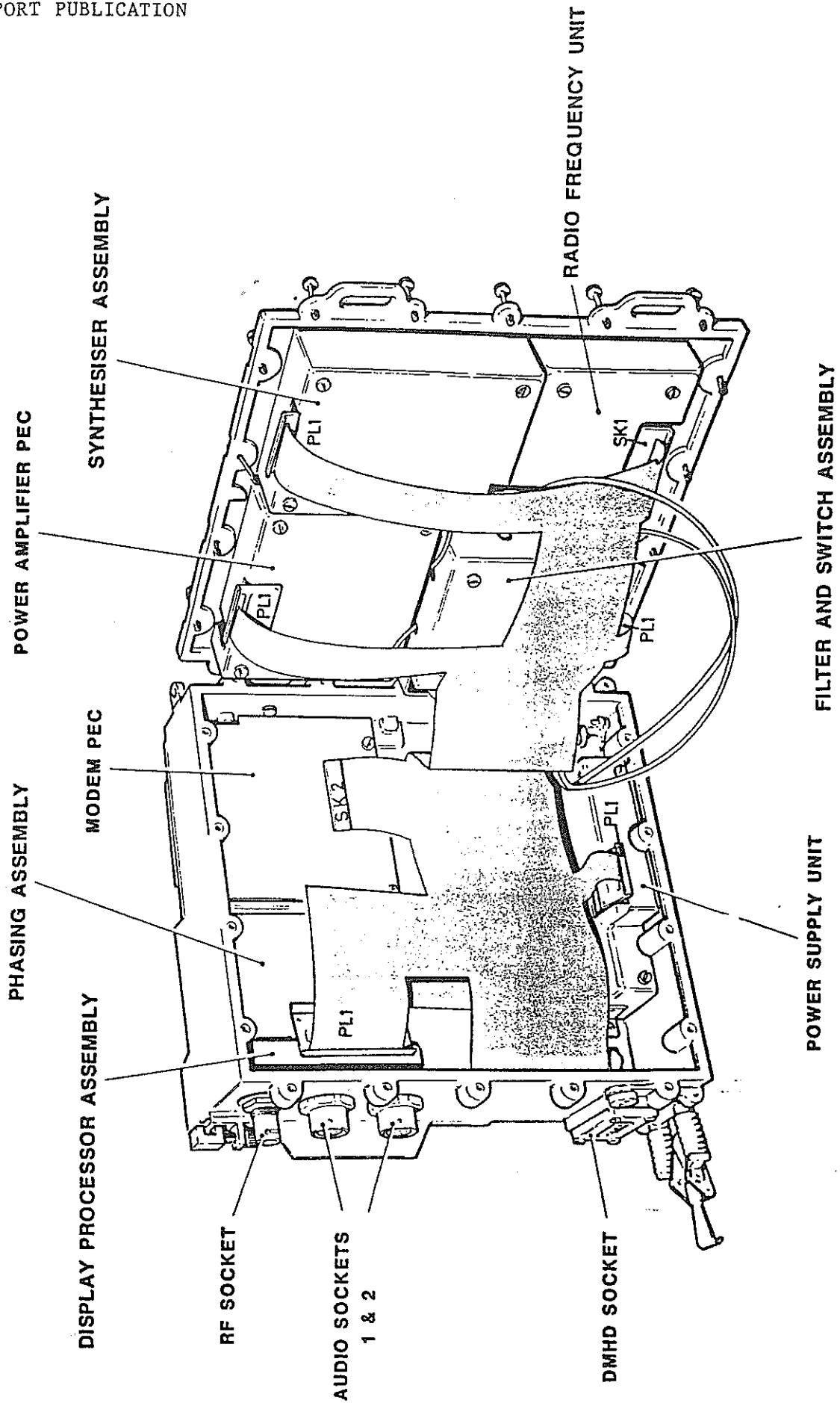


Fig 5.2.1.1 RT 319 Controls and Display



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Fig 5.2.1.2 RT 319 Sub-assembly and P.E.C. Identification

Keyboard Assembly

- 5 To remove the keyboard assembly refer to Fig 5.2.1.3 and proceed as follows:
- (1) carry out the procedure detailed in Para 3,
 - (2) remove eight M2.5 x 8 mm screws to free the keyboard assembly,
 - (3) remove keyboard assembly consisting of clamp, moulding, keyboard p.e.c. and gasket.
 - (4) Replace by reverse procedure,
 - (5) carry out the drying and sealing procedure detailed in Para 19.

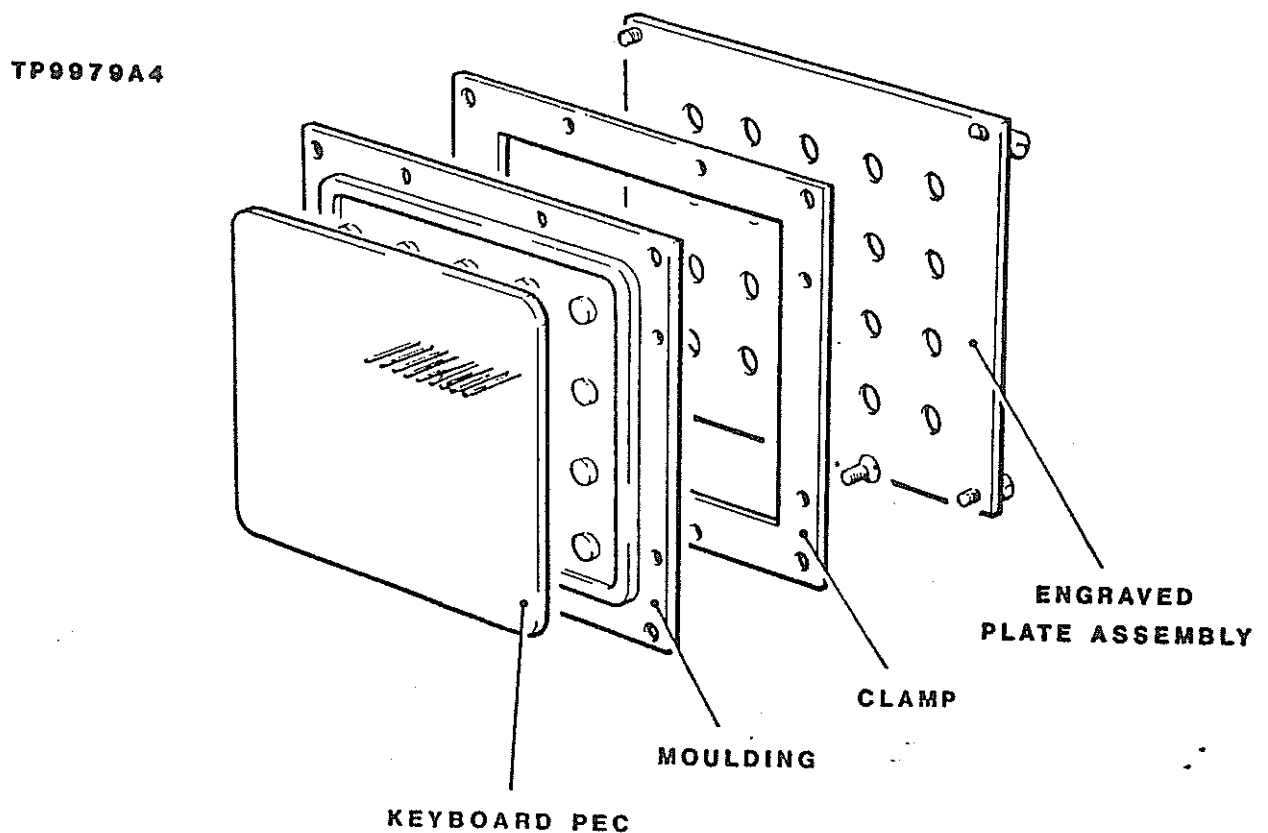


Fig 5.2.1.3 Keyboard Assembly Configuration

Rear Lid Assembly

- 6 To remove the rear lid assembly complete with p.e.c.s proceed as follows:
- (1) carry out the procedure detailed in Para 2,
 - (2) release the 18 captive screws to free the lid assembly,

- (3) remove rear lid assembly, complete with gasket, as far as flexible wiring loom will allow,
- (4) disconnect the flexible wiring connector PL1 from the synthesiser assembly,
- (5) disconnect the flexible wiring connector SK1 from the radio frequency unit,
- (6) disconnect the flexible wiring connector PL1 from the filter and switch assembly,
- (7) disconnect the flexible wiring connector PL1 from the power amplifier p.e.c.,
- (8) disconnect battery supply wire PL2 from the filter and switch assembly,
- (9) disconnect battery supply wire PL2 from the power amplifier p.e.c.
- (10) Replace by reverse procedure using a new gasket ensuring that the 18 fixing screws are tightened to a torque of between 0.38 Nm and 0.42 Nm,
- (11) carry out the drying and sealing procedure detailed in Para 19.

Synthesiser Assembly

- 7 To remove the synthesiser assembly from the rear lid assembly proceed as follows:
 - (1) carry out the procedure detailed in Para 6 (1) to (4),
 - (2) release the four captive screws securing the synthesiser assembly,
 - (3) disconnect the coaxial connector PL2 from the synthesiser assembly,
 - (4) remove the synthesiser assembly complete with cover,
 - (5) remove four captive screws to extract synthesiser assembly from its cover.
 - (6) Replace by reverse procedure, using a new gasket.
 - (7) carry out drying and sealing procedure detailed in Para 19.

Radio Frequency Unit

- 8 To remove the radio frequency unit from the rear lid assembly refer to Fig 5.2.1.4 and proceed as follows:
 - (1) carry out the procedure detailed in Para 6 (1) to (3),
 - (2) disconnect the flexible wiring connector SK1 from the radio frequency unit,

- (3) disconnect both coaxial connectors SK2 and SK3 from the radio frequency unit,
- (4) release the four captive screws securing the radio frequency unit,
- (5) remove the radio frequency unit top cover,
- (6) remove the radio frequency unit, eight spacers and the bottom cover from the rear lid assembly.
- (7) Replace by reverse procedure, using a new gasket,
- (8) carry out drying and sealing procedure detailed in Para 19.

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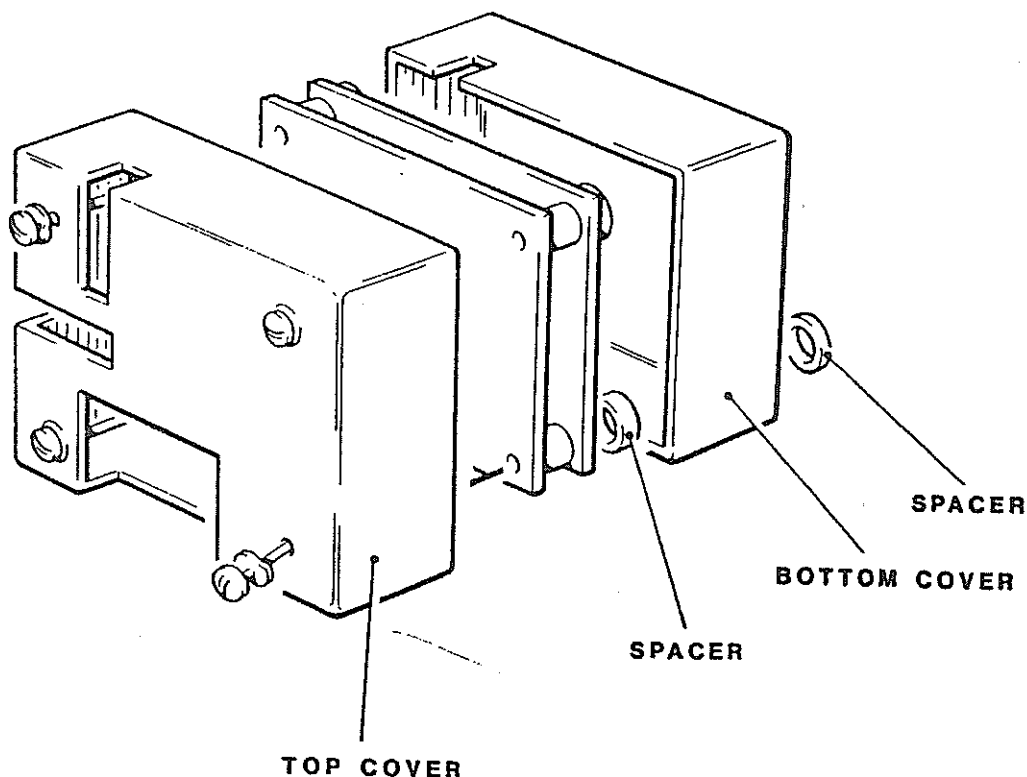


Fig 5.2.1.4 Radio Frequency Unit Configuration

Filter and Switch Assembly

- 9 To remove the filter and switch assembly from the rear lid assembly refer to Fig 5.2.1.5 and proceed as follows:
 - (1) carry out the procedure detailed in Para 6 (1) to (3),
 - (2) disconnect the flexible wiring connector PL1 from the filter and switch assembly,
 - (3) release the four captive screws securing the filter and switch assembly,
 - (4) disconnect all four coaxial sockets from the filter and switch assembly,

- (5) disconnect battery supply wires PL2 and PL3 from the filter and switch assembly,
- (6) remove the filter and switch assembly complete with both covers,
- (7) remove four captive screws to extract the filter and switch assembly from its covers.
- (8) Replace by reverse procedure, using a new gasket,
- (9) carry out drying and sealing procedure detailed in Para 19.

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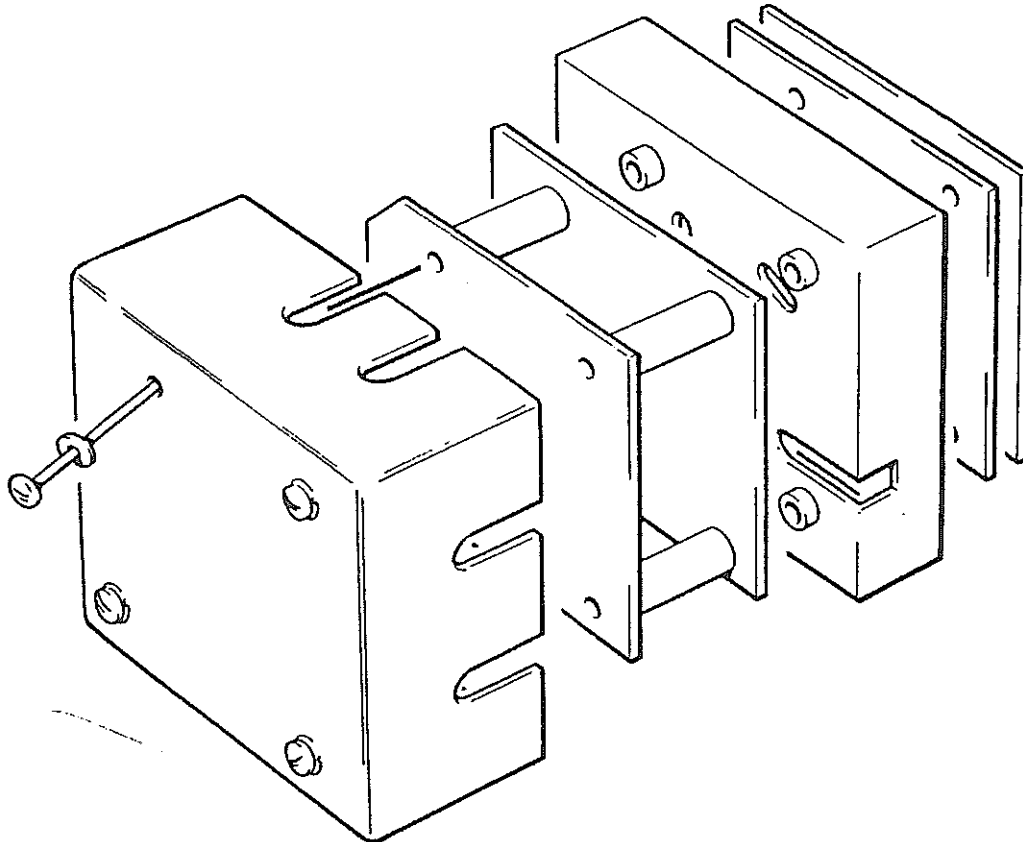


Fig 5.2.1.5 Filter and Switch Assembly Configuration

Power Amplifier P.E.C.

10 The power amplifier p.e.c. is an integral part of the rear lid assembly and cannot be removed from it. To remove the power amplifier p.e.c. complete with rear lid assembly proceed as follows:

- (1) carry out the procedure detailed in Para 6 (1) to (9),
- (2) carry out the procedure detailed in Para 7 (2) to (4),
- (3) carry out the procedure detailed in Para 8 (2) to (6),
- (4) carry out the procedure detailed in Para 9 (2) to (6).

(5) Replace by reverse procedure, using a new gasket

(6) carry out the drying and sealing procedure detailed in Para 19.

Modem P.E.C.

11 To remove the modem p.e.c. from the case assembly proceed as follows:

(1) carry out the procedure detailed in Para 6 (1) to (7),

(2) disconnect flexible wiring connector SK2 from the modem p.e.c.,

(3) remove the four screws and crinkle washers securing the modem p.e.c.,

(4) disconnect discrete wiring connector SK1 from the modem p.e.c.,

(5) remove the modem p.e.c.

(6) Replace by reverse procedure, using a new gasket,

(7) carry out drying and sealing procedure detailed in Para 19.

Power Supply Unit

12 To remove the power supply unit from the case assembly refer to Fig 5.2.1.6 and proceed as follows:

(1) carry out the procedure detailed in Para 6 (1) to (3),

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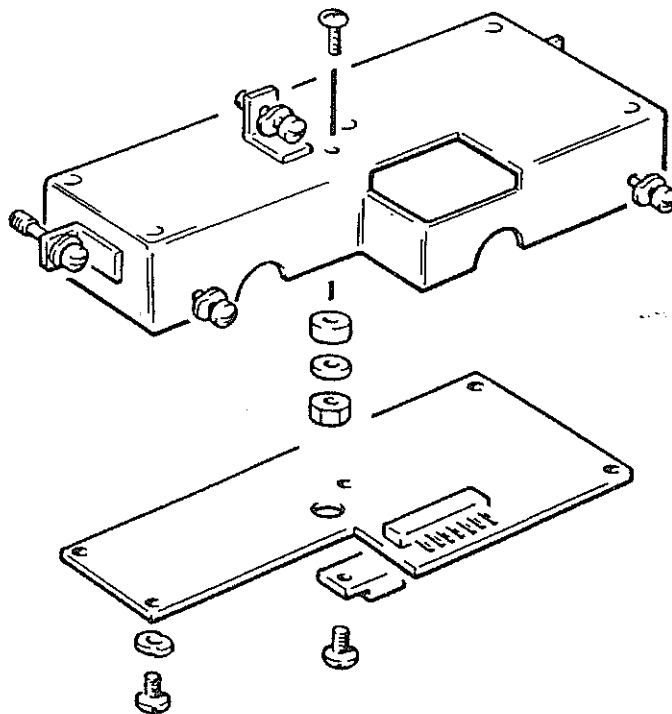


Fig 5.2.1.6 Power Supply Unit Configuration

- (2) disconnect the flexible wiring connector PL1 from the power supply unit,
- (3) remove the five screws and washers securing the power supply unit,
- (4) remove the power supply unit complete with cover,
- (5) remove the five M3 x 6 mm screws to extract the power supply unit from its cover.
- (6) Replace by reverse procedure, using a new gasket,
- (7) carry out drying and sealing procedure detailed in Para 19.

Phasing Assembly

- 13 To remove the phasing assembly from the case assembly refer to Fig 5.2.1.7 overleaf and proceed as follows:
- (1) carry out the procedure detailed in Para 6 (1) to (9),
 - (2) disconnect the flexible wiring connector SK2 from the modem p.e.c.,
 - (3) disconnect the flexible wiring connector PL1 from the power supply unit,
 - (4) disconnect the flexible wiring connector PL1 from the phasing assembly,
 - (5) because the following screws are different lengths, note the position of, and remove one M3 x 10 mm pan head screw with washer, one 'EPROM-1' screw with washer and two 'EPROM-2' screws with washers to release EPROM p.e.c.,
 - (6) release four captive screws securing the phasing assembly,
 - (7) remove nuts and washers securing audio sockets 1 and 2 to the chassis,
 - (8) extract audio sockets 1 and 2 from the case assembly as far as flexible wiring will allow,
 - (9) remove both phasing 1 and phasing 2 p.e.c.s complete with audio sockets 1 and 2.
 - (10) Replace by reverse procedure ensuring that the EPROM p.e.c. attaching screws are replaced in the positions noted in (5) above,
 - (11) carry out drying and sealing procedure detailed in Para 19.

Display Processor Assembly

- 14 To remove the display processor assembly from the case assembly proceed as follows:
- (1) carry out the procedure detailed in Para 3 (1) to (2),

- (2) carry out the procedure detailed in Para 4 (1) to (2) for mode and power switches only,
- (3) remove nuts and washers securing the mode and power switches to the case assembly,
- (4) carry out the procedure detailed in Para 5 (1) to (3),
- (5) carry out the procedure detailed in Para 13 (1) to (8),
- (6) disconnect discrete wiring connector SK5 from the display processor assembly,
- (7) remove the display processor assembly complete with display, flexible wiring loom, EPROM p.e.c. and mode and power switches.
- (8) Replace by reverse procedure, using a new gasket,
- (9) carry out drying and sealing procedure detailed in Para 19.

Audio Sockets 1 or 2

- 15 To remove either audio socket 1 or 2 from the case assembly proceed as follows:
- (1) carry out the procedure detailed in Para 14 (1) to (7),
 - (2) record the disposition of the flexible wiring connections to the audio socket and unsolder them,
 - (3) remove audio socket.
 - (4) Replace by reverse procedure, using a new gasket,
 - (5) carry out drying and sealing procedure detailed in Para 19.

Gain Control Potentiometer

- 16 To remove the gain control potentiometer from the case assembly proceed as follows:
- (1) carry out the procedure detailed in Para 4 (1) to (2) for the gain control knob only,
 - (2) carry out the procedure detailed in Para 6 (1) to (9),
 - (3) remove M8 nut and washer securing the gain control potentiometer to the case assembly,
 - (4) unsolder three wires from the gain control potentiometer. Connections are shown in Table 5.2.1.1 opposite,
 - (5) remove gain control potentiometer.
 - (6) Replace by reverse procedure, using a new gasket,
 - (7) carry out drying and sealing procedure detailed in Para 19.

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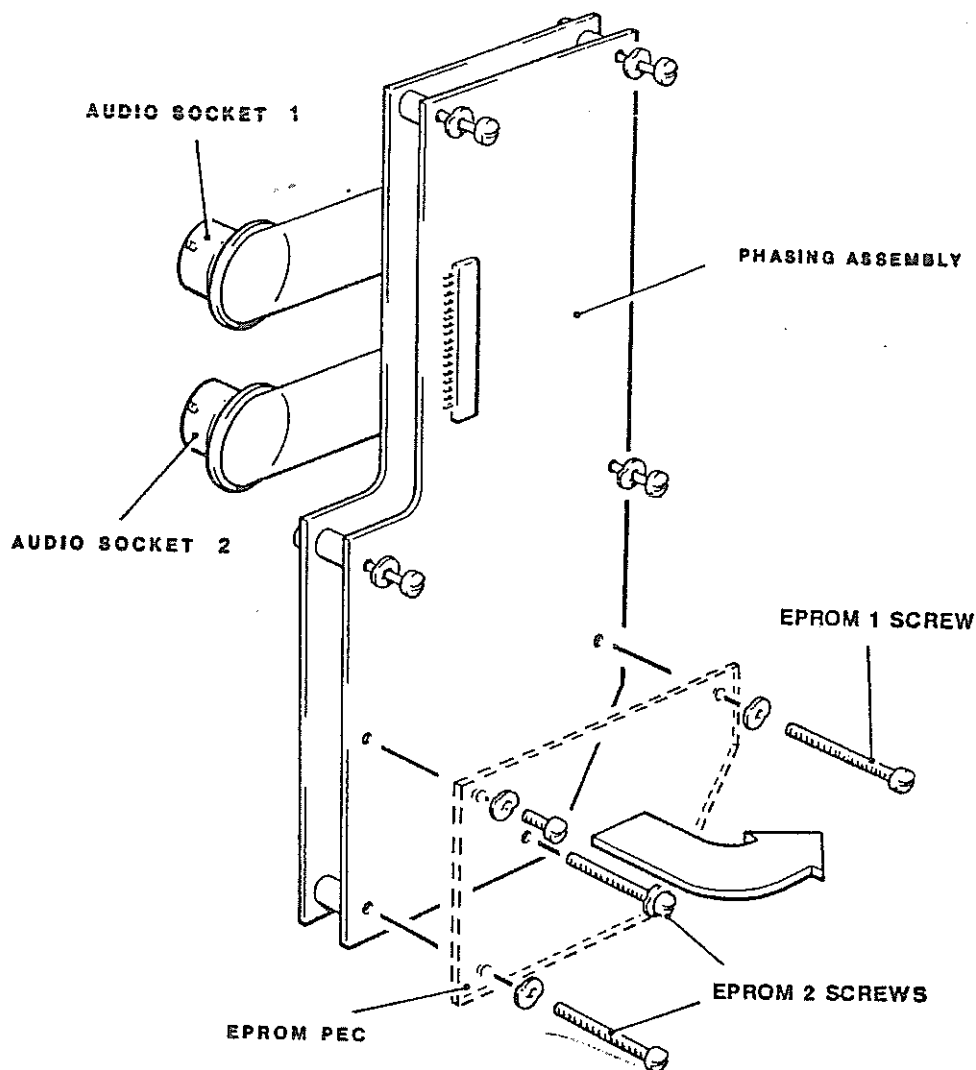


Fig 5.2.1.7 Phasing Assembly Configuration

Table 5.2.1.1 Gain Control Potentiometer Connections

Connection	No Off	Colour
a	1	Violet
b	1	Blue
c	1	Green

Frequency Adjustment Potentiometer

- 17 To remove the frequency adjustment potentiometer from the case assembly proceed as follows:
- (1) carry out the procedure detailed in Para 13 (1) to (9),
 - (2) remove special nut and socket screw securing the frequency adjustment potentiometer to the case assembly,
 - (3) unsolder three wires from the frequency adjustment potentiometer. Connections are shown in Table 5.2.1.2,
 - (4) remove frequency adjust potentiometer.
 - (5) Replace by reverse procedure, using a new gasket,
 - (6) carry out drying and sealing procedure detailed in Para 19.

Table 5.2.1.2 Frequency Adjustment Potentiometer Connections

Connection	No Off	Colour
1	1	Red
2	1	Orange
3	1	Yellow

Digital Message Handling Device (DMHD) Socket

- 18 To remove the DMHD socket from the case assembly proceed as follows:
- (1) remove four pan head screws and crinkle washers securing the DMHD socket to the case assembly,
 - (2) extract DMHD socket and rubber O-ring seal as far as wiring will allow,
 - (3) unsolder two wires from the DMHD socket. Connections are shown in Table 5.2.1.3,
 - (4) before replacing rubber O-ring seals lightly smear with XG271 grease.
 - (5) Replace by reverse procedure, using a new gasket,
 - (6) carry out drying and sealing procedure detailed in Para 19.

Table 5.2.1.3 DMHD Socket Connections

Connection	No Off	Colour
+ve	1	Black
-ve	1	Brown

Sealing and Drying Procedure

19 The following procedure is recommended:

- (1) Replace dessicator sachet.
- (2) Completely assemble the unit.
- (3) Test the sealing of the unit by applying air at a pressure of 0.3 bar. See specification in MVD 230-4018.
- (4) Dry the unit using the procedure detailed in MVD 230-3025

CHAPTER 5.2.2.1

TUNING UNIT RADIO FREQUENCY

Contents

Para

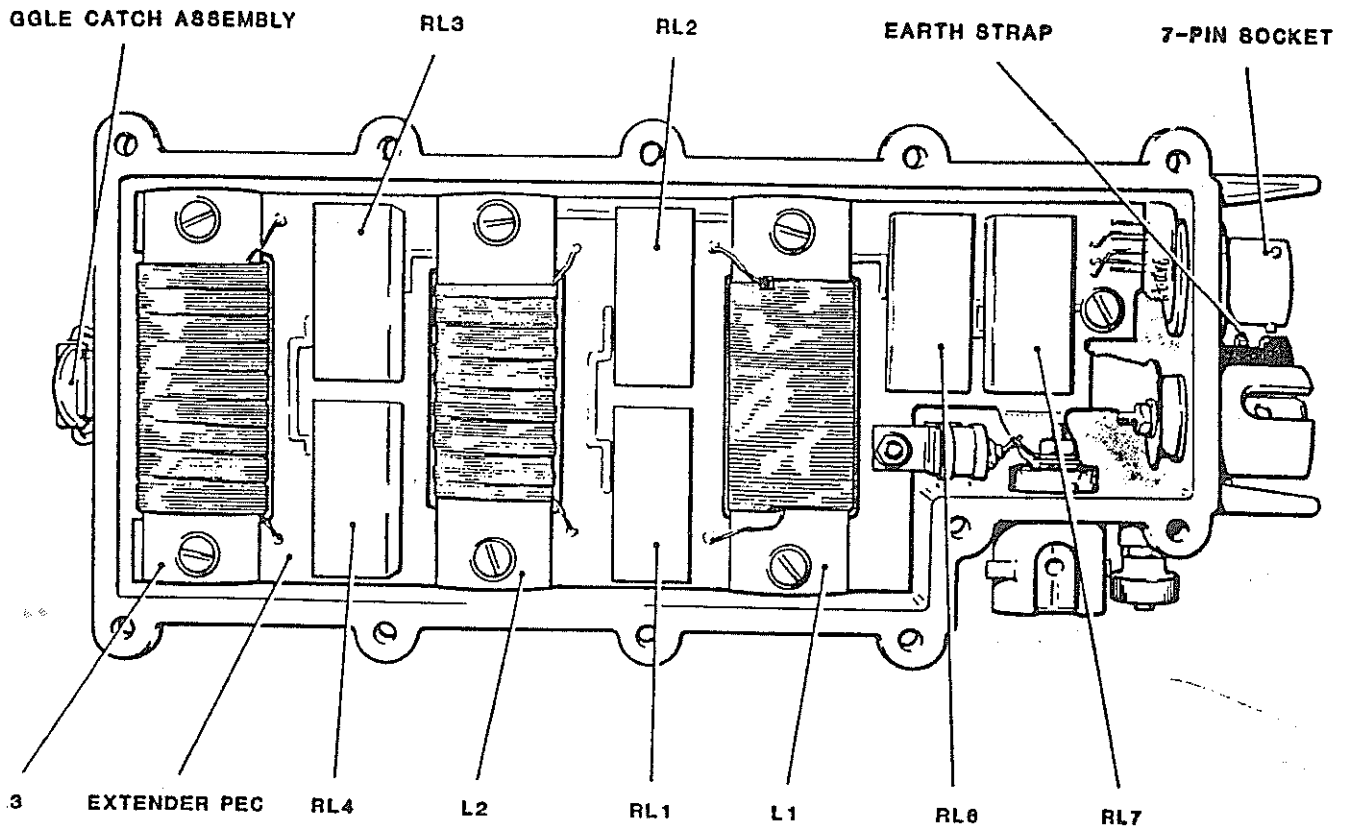
- SUB-ASSEMBLY AND P.E.C. REMOVAL AND REPLACEMENT
- 1 Location and Identification of Parts
 - 2 Antenna Switch Knob
 - 3 Earth Stud
 - 4 Case Sub-assembly
 - 5 Alignment Plate
 - 6 Control P.E.C.
 - 7 Screen Assembly
 - 8 Match P.E.C.
 - 9 Tune P.E.C.
 - 10 Heatsink Assembly
 - 11 Capacitors
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 - 13 Relays
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Replace with Fig 3.2.1.1

Fig 5.2.2.1.1 Tuning Unit Radio Frequency Physical Layout

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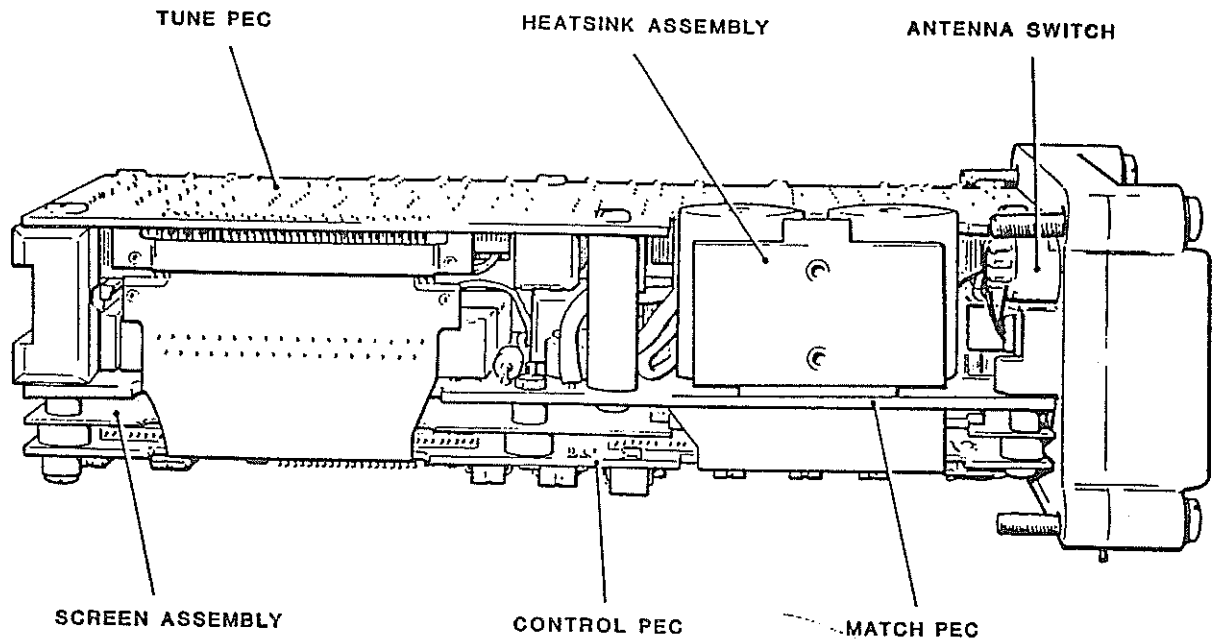


Fig 5.2.2.1.2 Tuning Unit Radio Frequency P.E.C
and Sub-assembly Identification

CHAPTER 5.2.2.1

TUNING UNIT RADIO FREQUENCY

SUB-ASSEMBLY AND P.E.C. REMOVAL AND REPLACEMENT

CAUTION: As this equipment contains devices which are sensitive to static electricity, maintenance should be carried out in accordance with the recommendations contained in DEF STAN 59-98/2.

Location and Identification of Parts

1 The location and identity of the assemblies and p.e.c.s of the tuning unit radio frequency (TURF) are shown in Figs 5.2.2.1.1 and 5.2.2.1.2.

NOTE: The antenna switch knob and earth stud can be removed without breaking the equipment seal. On completion of any other dismantling operation the drying and sealing procedure detailed in Para 17 is to be carried out whenever possible.

Antenna Switch Knob

2 To remove the antenna switch knob proceed as follows:

- (1) rotate antenna switch until the attaching screw is visible,
- (2) using an allen key remove the M3 x 3 mm screw to release knob.
- (3) Replace by reverse procedure.

Earth Stud

3 To remove the earth stud from the front panel proceed as follows:

- (1) remove the retaining ring from the end of the earth stud,
- (2) remove clamping nut from the earth stud,
- (3) unscrew and remove earth stud from the front panel.
- (4) Replace by reverse procedure.

Case Sub-assembly

4 To remove the case sub-assembly proceed as follows:

- (1) remove two screws and sealing washers from each side of the case sub-assembly,
- (2) release two captive screws on the front panel,
- (3) stand the unit on its front panel and carefully remove the case sub-assembly taking care not to damage the components on the control p.e.c.
- (4) Replace by reverse procedure, using a new gasket.

(5) carry out drying and sealing procedure detailed in Para 17.

Alignment Plate

- 5 To remove the alignment plate from the case sub-assembly proceed as follows:
- (1) carry out the procedure detailed in Para 4(1) to (3),
 - (2) unscrew and remove two plugs, complete with rubber seals, from the rear of the case sub-assembly,
 - (3) remove the alignment plate from the interior of the case sub-assembly.
 - (4) Replace by reverse procedure, using a new gasket,
 - (5) carry out drying and sealing procedure detailed in Para 17.

Control P.E.C.

- 6 To remove the control p.e.c. proceed as follows:
- (1) carry out the procedure detailed in Para 4(1) to (3),
 - (2) remove six pan head screws securing the control p.e.c.,
 - (3) disconnect flexible p.e.c.s from the front panel,
 - (4) hinge p.e.c. about flexible wiring to other p.e.c.s,
 - (5) disconnect flexible wiring SK2 from the tune p.e.c.,
 - (6) disconnect flexible wiring SK3 from the match p.e.c.,
 - (7) remove the control p.e.c. complete with flexible wiring.
 - (8) Replace by reverse procedure, using a new gasket,
 - (9) carry out drying and sealing procedure detailed in Para 17.

Screen Assembly

- 7 To remove the screen assembly proceed as follows:
- (1) carry out the procedure detailed in Para 6(1) to (5),
 - (2) remove the screen assembly.
 - (3) Replace by reverse procedure, using a new gasket,
 - (4) carry out drying and sealing procedure detailed in Para 17.

Match P.E.C.

- 8 To remove the match p.e.c. proceed as follows:

- (1) carry out the procedure detailed in Para 7(1) and (2),
- (2) remove one pan head screw securing the match p.e.c.,
- (3) note arrangement of, and unsolder four wires from the match p.e.c. connectors P1 to P4,
- (4) remove match p.e.c.
- (5) Replace by reverse procedure, using a new gasket,
- (6) carry out drying and sealing procedure detailed in Para 17.

Tune P.E.C.

- 9 To remove the tune p.e.c. proceed as follows:
- (1) carry out the procedure detailed in Para 8(1) to 8(3),
 - (2) remove six pan head screws securing the tune p.e.c.,
 - (3) remove the tune p.e.c.
 - (4) Replace by reverse procedure, using a new gasket
 - (5) carry out drying and sealing procedure detailed in Para 17.

Heatsink Assembly

- 10 To remove the heatsink assembly from the match p.e.c. proceed as follows:
- (1) carry out the procedure detailed in Para 9(1) to (5),
 - (2) note arrangement of, and unsolder the six wires from the heatsink assembly,
 - (3) unscrew the attachment wire from the heatsink assembly,
 - (4) remove heatsink assembly.
 - (5) Replace by reverse procedure, using a new gasket,
 - (6) carry out drying and sealing procedure detailed in Para 17.

Capacitors

- 11 To remove any one of the eight capacitors from the tune p.e.c. refer to Fig 5.2.2.1.3 for the location and proceed as follows:
- (1) carry out the procedure detailed in Para 9(1) to (5),
 - (2) unsolder and remove capacitor.
 - (3) Replace by reverse procedure, using a new gasket,
 - (4) carry out drying and sealing procedure detailed in Para 17.

Inductors

- 12 To remove any one of the eight inductors from the tune p.e.c. refer to Fig 5.2.2.1.3 for the location and proceed as follows:
- (1) carry out the procedure detailed in Para 9(1) to (5),
 - (2) unsolder and remove inductor,
 - (3) clean adhesive from p.e.c.
 - (4) Replace by reverse procedure, using adhesive to fasten inductor to p.e.c., and using a new gasket.
 - (5) carry out drying and sealing procedure detailed in Para 17.

Relays

- 13 To remove any one of the eighteen relays from the tune p.e.c., or one of the twelve from the match p.e.c., refer to Fig 5.2.2.1.3 or 5.2.2.1.4 for the location of the relay and proceed as follows:
- (1) carry out the procedure detailed in Para 8(1) to (4) or Para 9(1) to (3) depending on which p.e.c. the relay is on,
 - (2) unsolder and remove relay,
 - (3) clean solder/flux residue from p.e.c.
 - (4) Replace by reverse procedure, using a new gasket.
 - (5) carry out drying and sealing procedure detailed in Para 17.

Diodes

- 14 To remove either of the two diodes from the tune p.e.c. refer to Fig 5.2.2.1.3 for the location of the diode and proceed as follows:
- (1) carry out the procedure detailed in Para 9(1) to (5),
 - (2) unsolder and remove diode,
 - (3) clean solder/flux residue from p.e.c.
 - (4) Replace by reverse procedure, using a new gasket.
 - (5) carry out drying and sealing procedure detailed in Para 17.

Extender Connector

- 15 To remove the Extender connector from the case assembly proceed as follows:
- (1) carry out the procedure detailed in Para 7(1) and (2),
 - (2) remove nut securing Extender connector to the case assembly,

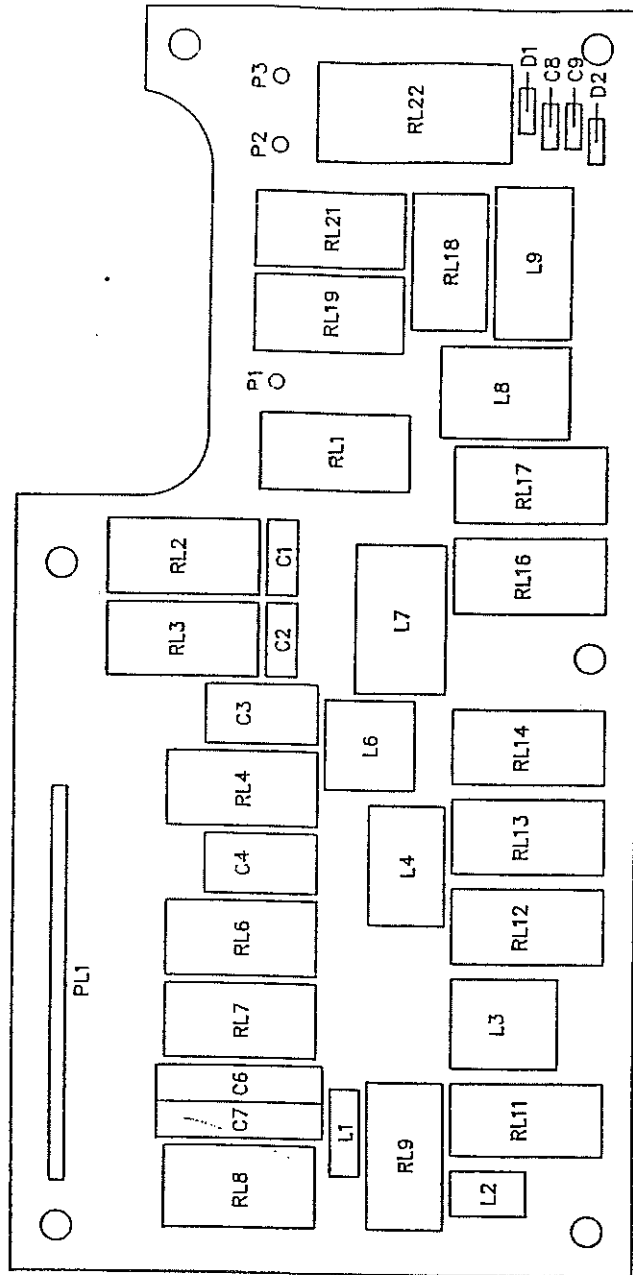
- (3) remove Extender connector complete with flexible wiring,
- (4) note arrangement of, and unsolder flexible wiring from the Extender connector.
- (5) Replace by reverse procedure, using a new gasket,
- (6) carry out drying and sealing procedure detailed in Para 17.

Antenna Switch

- 16 To remove the antenna switch from the case assembly proceed as follows:
- (1) carry out the procedure detailed in Para 2(1) and (2),
 - (2) carry out the procedure detailed in Para 4(1) to (3),
 - (3) remove nut securing antenna switch to the case assembly,
 - (4) remove antenna switch as far as flexible wiring will allow,
 - (5) note arrangement of, and unsolder flexible wiring from the antenna switch.
 - (6) Replace by reverse procedure, using a new gasket,
 - (7) carry out drying and sealing procedure detailed in Para 17.

Drying and Sealing Procedure

- 17 The following procedure is recommended:
- (1) Replace dessicator sachet.
 - (2) Completely assemble the unit.
 - (3) Test the sealing of the unit by applying air at a pressure of 0.3 bar. See specification in MVD 230-4018.
 - (4) Dry the unit using the procedure detailed in MVD 230-3025.



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Fig 5.2.2.1.3 Tune P.E.C Component Layout

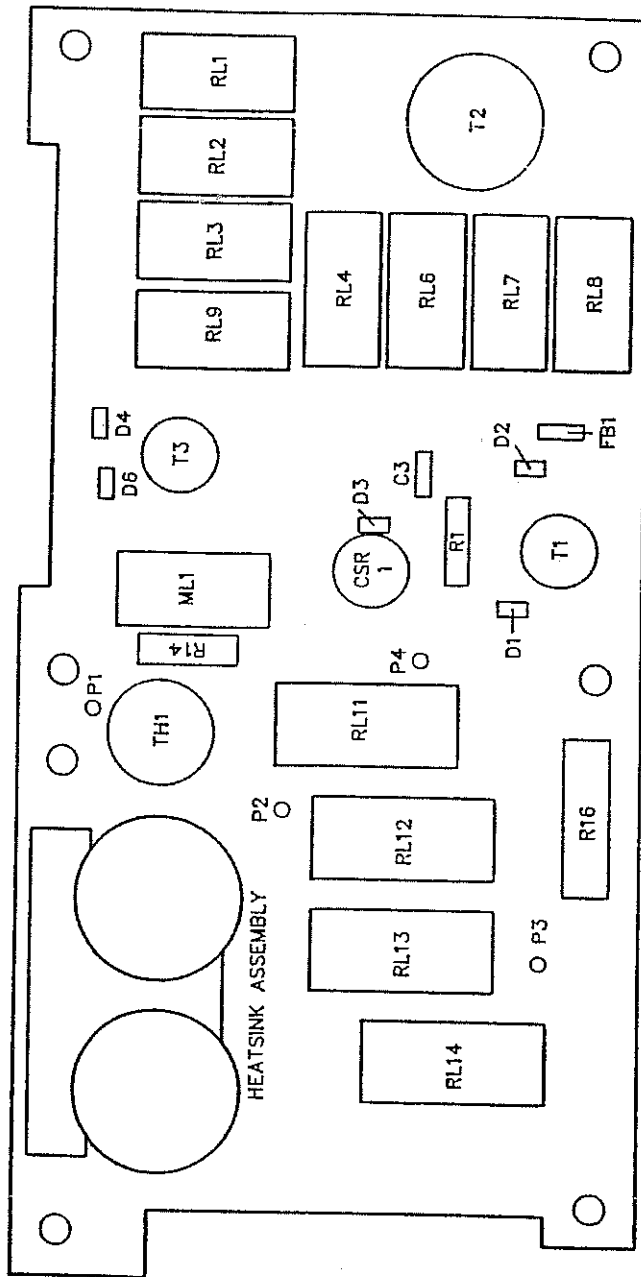


Fig 5.2.2.1.4 Match P.E.C. Component Layout

CHAPTER 5.2.2.2

TUNING UNIT RADIO FREQUENCY EXTENDER

Contents

Para

SUB-ASSEMBLY AND P.E.C. REMOVAL AND REPLACEMENT

- 1 Location and Identification of Parts
- 2 Earth Strap
- 3 Lid Assembly
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- 5 Inductor
- 6 Relay
- 7 7-Pin Socket
- 8 Drying and Sealing Procedure

Illustrations

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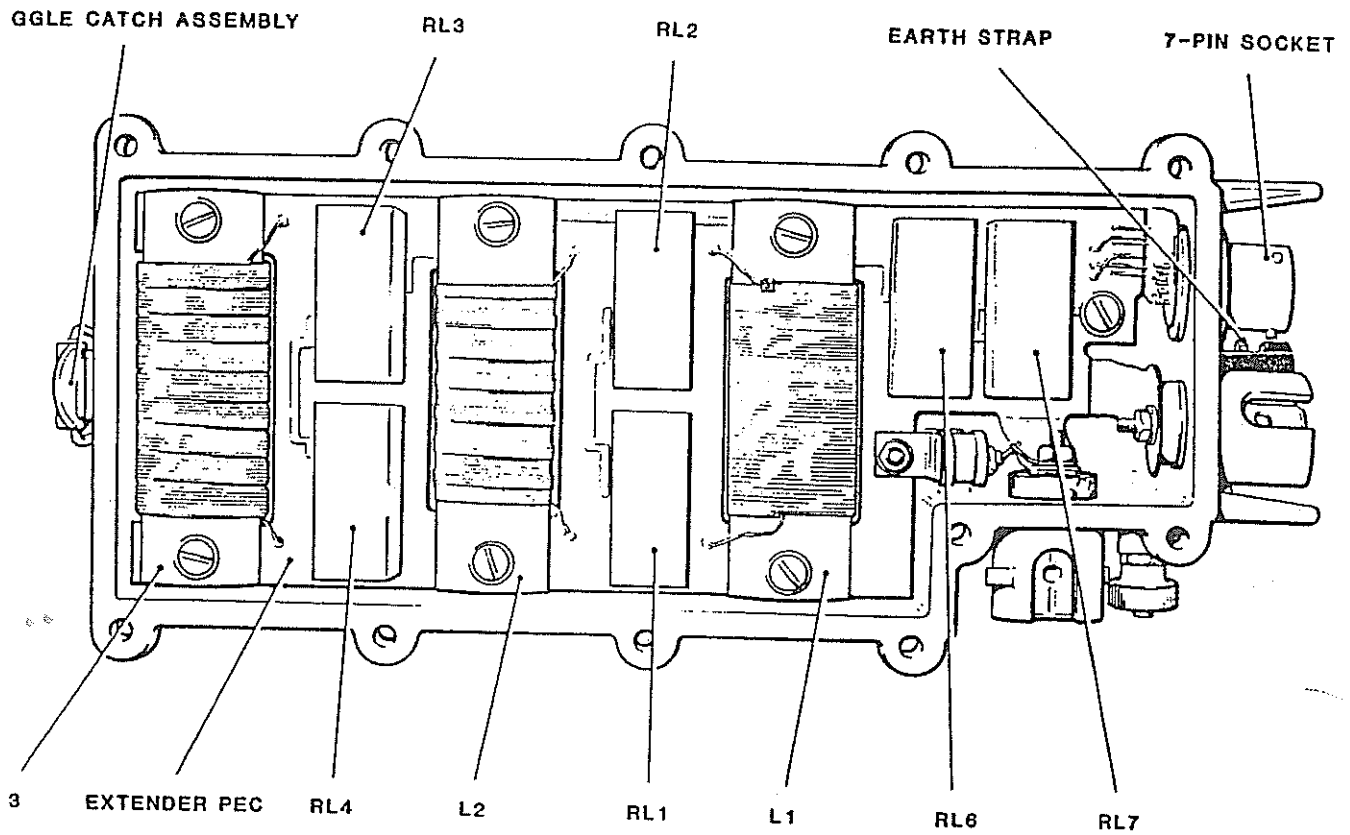


Fig 5.2.2.2.1 TURF Extender Component and Sub-assembly Identification

CHAPTER 5.2.2.2TUNING UNIT RADIO FREQUENCY EXTENDERSUB-ASSEMBLY AND P.E.C. REMOVAL AND REPLACEMENTLocation and Identification of Parts

- 1 The location and identity of the assemblies and p.e.c. of the tuning unit radio frequency (TURF) Extender are shown in Fig 5.2.2.2.1.

NOTE: The earth strap can be removed without breaking the equipment seal. On completion of any other dismantling operation the drying and sealing procedure detailed in Para 8 is to be carried out whenever possible.

Earth Strap

- 2 To remove the earth strap proceed as follows:
 - (1) remove the clamping nut from the earth stud,
 - (2) remove the earth strap from the earthstud.
 - (3) Replace by reverse procedure.

Lid Assembly

- 3 To remove the lid assembly proceed as follows:
 - (1) release the thirteen captive screws securing the lid assembly to the case assembly,
 - (2) remove the lid assembly complete with gasket.
 - (3) Replace by reverse procedure, using a new gasket, ensuring that the thirteen fixing screws are tightened to a torque of between 0.38 Nm and 0.42 Nm,
 - (4) carry out the drying and sealing procedure detailed in Para 8.

Extender P.E.C.

- 4 To remove the Extender p.e.c. proceed as follows:
 - (1) carry out the procedure detailed in Para 3(1) to (2),
 - (2) remove M3 nut, plain washer and crinkle washer securing the flexible wiring to the antenna terminal input,
 - (3) disconnect flexible wiring from the antenna terminal input,
 - (4) remove M3 nut, crinkle washer and solder tag securing the flexible wiring to the antenna terminal output,
 - (5) disconnect flexible wiring from the antenna terminal output,

- (6) remove M3 nut and crinkle washer securing the surge arrestor to the bracket assembly,
- (7) remove surge arrestor from the bracket assembly,
- (8) remove M3 x 8 mm pan head screw securing the bracket assembly to the case assembly,
- (9) remove nut securing the 7-pin socket to the case assembly,
- (10) withdraw 7-pin socket from the case assembly,
- (11) remove six M3 x 20 mm pan head screws and plain washers securing the Extender p.e.c. to the frame assembly,
- (12) release the captive screw securing the Extender p.e.c. to the case assembly,
- (13) remove Extender p.e.c. complete with flexible wiring and 7-pin socket.
- (14) Replace by reverse procedure,
- (15) carry out the drying and sealing procedure detailed in Para 8.

Inductor

- 5 To remove any one of the three inductors from the Extender p.e.c. proceed as follows:
 - (1) carry out the procedure detailed in Para 3 (1) to (2),
 - (2) refer to Fig 5.2.2.2.1 for the location of the inductor to be removed,
 - (3) unsolder the two connections on the Extender p.e.c.,
 - (4) remove two M3 x 20 mm pan head screw and plain washers securing the inductor to the Extender p.e.c.,
 - (5) remove the inductor.
 - (6) Replace by reverse procedure,
 - (7) carry out the drying and sealing procedure detailed in Para 8.

Relay

- 6 To remove any one of the six relays from the Extender p.e.c. proceed as follows:
 - (1) carry out the procedure detailed in Para 4 (1) to (13),
 - (2) refer to Fig 5.2.2.2.1 for the location of the relay to be unsoldered,
 - (3) unsolder the connections to the relay,

- (4) remove the relay.
- (5) clean all residue from P.E.C.,
- (6) Replace by reverse procedure,
- (7) carry out the drying and sealing procedure detailed in Para 8.

7-Pin Socket

7 To remove the 7-pin socket proceed as follows:

- (1) carry out the procedure detailed in Para 4 (1) to (13),
- (2) record the orientation of the flexible wiring and unsolder the seven connections,
- (3) disconnect the flexible wiring from the 7-pin socket.
- (4) Replace by reverse procedure,
- (5) carry out the drying and sealing procedure detailed in Para 8.

Drying and Sealing Procedure

8 The following procedure is recommended:

- (1) Replace dessicator sachet.
- (2) Completely assemble the unit.
- (3) Test the sealing of the unit by applying air at a pressure of 0.3 bar. See specification in MVD 230-4018.
- (4) Dry the unit using the procedure detailed in MVD 230-3025.