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SYNCAL

TRA. 921
H.F. S.S.B. Manpack Transmitter-Receiver

Technical Manual

RACAL
THE ELECTRONICS GROUP

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TYPE TRA.921

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TRA. 921 H. F. S. S. B.

TRANSMITTER - RECEIVER

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PART 1 H.F. S.S.B. TRANSMITTER-RECEIVER

TYPE TRA. 921.

CONTENTS

ILLUSTRATIONS

Illustrations for the Synthesizer are in Part 3.
All other illustrations are at the end of Part 2.

TECHNICAL SPECIFICATION

GENERAL

Frequency Range	2 to 8 MHz
Channels	6000 Channels in 1 kHz steps derived from single high stability crystal selected by four in-line switches. Maximum synthesizer locking time is less than one second.
Operating Modes	U. S. B. Suppressed Carrier (VOICE U. S. B.) L. S. B. Suppressed Carrier (VOICE L. S. B.) A. M. (A3)(VOICE A. M.) C. W. (U. S. B. keyed tone). (KEY U. S. B.) C. W. (L. S. B. keyed tone). (KEY L. S. B.)
Frequency Stability	Over the temperature range of 0°C to 40°C the frequency change will be less than 30 Hz relative to the frequency at 25°C.
Temperature Range	Operating - 10°C to + 55°C. Storage - 40°C to + 70°C.
Power Supply	Internal Battery:- 18 volt 3.5 AH nickel-cadmium rechargeable battery, Type MA. 928. Vehicle Operation:- 12/24 volt D. C. Power Unit type MA. 926. Static Operation:- 100-125/200-250 volt 45 to 60 Hz Power Unit Type MA. 927.
Antennas	8 ft. (2.4 m) Whip, Long Wire or Dipole.
Antenna Tuning	Single-control tuning. Inbuilt ATU tunes above antennas for both transmit and receive.

Sealing	Transmitter-Receiver case sealed and fitted with desiccator. Battery container may be removed without breaking main seal.
Front Panel Controls and Facilities	(a) Four frequency Selection Switches
	(b) Function Switch Selecting: OFF VOICE AM KEY LSB VOICE LSB VOICE USB KEY USB TUNE
	(c) Antenna Tuning Control
	(d) Gain Control
	(e) High/Low Power Switch
	(f) Meter monitoring battery voltage (on a.m., c.w. and s.s.b. modes) and antenna current (on Tune).
	(g) Whip Antenna Socket
	(h) Two 50 ohm sockets for dipole antenna (i) 2-4 MHz. (ii) 4-8 MHz.
	(j) Ground terminal
	(k) Two ancillary sockets for handset, head-set or morse key or loudspeaker amplifier/power supply unit or battery charging unit.
Weight:	Basic TRA. 921 unit 10 lb. (4.5 kg). Operational manpack with handset, whip antenna, nickel cadmium battery and haversack 22¼ lb. (10 kg) approx.
Dimensions	Width: 12.5/16 in. (13.2 cm.) Height: 4.3/8 in. (11.1 cm.) Depth: 15.1/2 in. (39.4 cm.)
Ancillaries	Full details of ancillaries will be found in 'Racal HF SSB Manpack Ancillaries' Brochure. A list of ancillaries is given in Appendix No. 1.

TRANSMITTER

Power Output	High Level	Low Level
VOICE (SSB)	20 watts p.e.p. nominal	5 watts p.e.p. nominal
KEY	15 watts nominal	3.5 watts nominal
VOICE (A.M.)	5 watts carrier	1.5 watts carrier

NOTE 1: The minimum output power for SSB and KEY operation in the 'High' position, under all conditions of channel frequency, sideband selection and operating temperature (-10°C to +55°C), is better than 1.5 dB below the nominal output.

NOTE 2: 'Key' output refers to normal keyed c.w. operation. The TRA.921 is not suitable for use as a 'beacon' under continuous key-down conditions in the 'High' power position.

Harmonic Emmissions	No harmonic will exceed -40 dB relative to full p.e.p. in 50 ohms load.
Spurious Emissions	Typically better than -40 dB relative to full p.e.p. in 50 ohms load.
Carrier Suppression	-40 dB relative to full p.e.p. output.
Unwanted Sideband Suppression	-40 dB relative to full p.e.p. output at 1 kHz.
Intermodulation Distortion	-25 dB relative to full p.e.p. output.
Power Consumption	1.5A for s.s.b. average speech.

RECEIVER

Sensitivity	1 microvolt (p.d.) r.f. input will give 2 mW a.f. output with a signal to noise ratio of not less than 15 dB.
Selectivity	SSB 6 dB bandwidth 2.2 kHz typical 40 dB bandwidth 5.0 kHz typical A.M. 6 dB bandwidth 7 kHz typical 55 dB bandwidth 25 kHz typical
Image Rejection	Better than 60 dB.
Spurious Responses	All spurious responses attenuated by at least 40 dB.
A.F. Power Output	4 mW nominal.

Distortion	5% maximum at 2 mW.
A. G. C.	The a.f. output will change less than 6 dB for an r.f. signal input variation of 80 dB.
Power Consumption	Approximately 170 mA.

NOTE: The above mentioned performance figures are measured with a power supply of not less than 18 volts.

CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

1. The 'Syncal' Type TRA. 921 manpack provides transmission and reception facilities in the frequency range of 2 to 8 MHz. Six thousand channels are available, spaced at 1 kHz intervals throughout the frequency range. The transmitter provides a high power output of approximately 20 watts p.e.p. or a low power output of approximately 5 watts p.e.p: the selection of high or low power output is made at a switch fitted to the front panel.

2. The manpack provides single sideband (upper and lower) and double sideband (a.m.) telephony operation. In addition c.w. telegraphy facilities are provided by means of a keyed tone on the upper or the lower sideband.

3. The casing and front panel is moulded in high impact plastic, allowing the equipment to withstand severe handling. The manpack is fully waterproofed, allowing it to be totally immersed without damage. A dessicator is fitted to the front panel, and can be changed without dismantling the equipment. The element of the dessicator can be re-activated by means of a hot-air blower after removal from the set.

4. Sockets are fitted to the front panel to allow the connection of ancillary equipment, including antennas. A wide range of ancillary equipment is available, as listed in Appendix No. 1.

5. The power supply is normally provided by an 18V nickel-cadmium battery fitted in a case which is joined to the main case. The battery can be re-charged in situ, via a front panel socket, or can be changed without disturbing the waterproof sealing of the main case. For certain applications an external power supply can be used in place of the battery.

6. The total weight of the complete packset, including the haversack, battery, whip antenna and handset, is approximately $22\frac{1}{4}$ lb (10 kg).

COMPOSITION OF 'SYNCAL' MANPACK TYPE TRA. 921

7. A 'Syncal' Manpack Type TRA. 921 consists of two main units in addition to the battery. The two units are the Transceiver Unit Type MA. 924 and the Synthesizer Type MA. 920. Part 1 of this handbook gives

information on the complete manpack, Part 2 covers the Transceiver Unit and Part 3 the Synthesizer. Illustrations for the Synthesizer will be found in Part 3, other illustrations are at the end of Part 2.

Transceiver Unit MA. 924

8. This unit includes the control panel on which are mounted all the operating controls and external connector points. (see fig. 1 of Part 2). These latter points include the three antenna sockets, one for the whip antenna and two for the dipole or end-fed antennas. These two sockets are used to cover the frequency range in two steps of 2 - 4 and 4 - 8 MHz.

9. The two AUDIO sockets on the front panel are connected in parallel, permitting the connection of various combinations of handset, headset etc. Examples of these may be a loudspeaker amplifier and a handset, a handset (used by a second operator) and a headset (used by first operator for monitoring), or a headset and a morse key. The sockets are also used to connect the various combined loudspeaker amplifiers and power units or battery charging unit to the manpack.

10. The majority of the transmitter/receiver circuit is contained on a single fibreglass printed circuit board, giving easy access to all components. The printed circuit board is held in a chassis assembly mounted on hinges which are fitted at the rear of the control panel. Screening of the circuit against unwanted external pick-up is provided by the fitting of screening covers over the two faces of the chassis assembly.

Battery

11. The battery power pack is attached to the upper section of the unit by two retaining screws, which, when screwed firmly home, ensure a watertight seal between the two sections. The nickel cadmium re-chargeable battery has a capacity of 3.5 ampere-hours.

12. Metering of the battery voltage is carried out at the control panel meter, in conjunction with the mode selector switch. When set to any one of the Voice or Key positions, the switch connects the meter across the battery. A reading of less than half scale deflection under transmit conditions, with HIGH or LOW power selected, (dependent upon the power output to be used) indicates that the battery needs recharging.

13. The contact arrangement between the battery and the main unit is so designed that, provided the battery is inserted with the terminals outward, incorrect connection is impossible (see fig. 4 of Part 2).

Synthesizer MA. 920

14. The Synthesizer is housed in a light alloy casting that bolts to brackets at the rear of the front panel. The four frequency selection controls are fitted to the front panel of the manpack.

PRINCIPLES OF OPERATION

Transceiver Unit

15. Microphone inputs are made to the a. f. amplifier and then to the clipper, (see simplified block diagram fig. 5 of Part 2). The a. f. input modulates a 10. 7 MHz frequency and the resultant i. f. signal is amplified and fed to one of the three filters, u. s. b., a. m. or l. s. b., dependent upon mode selected. The filtered signal is then mixed with the channel oscillator frequency, fed through a low pass filter, and amplified in the driver and p. a. stages prior to being fed to the antenna via the a. t. u.

16. The power output of the transmitter can be HIGH or LOW, dependent upon the setting of the POWER switch.

17. Received r. f. signals are fed via the a. t. u., a protection circuit and a low pass filter, to the r. f. mixer, where the signals are mixed with the channel oscillator frequency to provide the i. f. of 10. 7 MHz. The i. f. is fed via the appropriate filter, dependent upon mode selected, then to the i. f. amplifier. The amplified signal is detected and the resultant a. f. is amplified prior to being fed to the output connector.

18. An a. g. c. circuit, operating upon the r. f. and i. f. stages, is provided and maintains a sensibly constant a. f. output level for wide variations of r. f. input level.

Synthesizer

19. The main oscillator, which covers the range 12. 7 to 18. 7 MHz, is approximately tuned by a corase bias selected by the front panel MHz control and applied to the oscillator via a summing amplifier. The fine tuning of the main oscillator is completed by a control loop which comprises a mixer and programmed divider feeding into frequency and phase comparators.

20. The setting of the front panel MHz switch selects the required coarse bias and also one of six crystal oscillators in the 12-17 MHz Generator. The output of the 12-17 MHz Generator is mixed with the output of the main oscillator and applied to a programmed divider whose division ratio is determined by the setting of the 'kHz' controls. The output of the divider is exactly 1 kHz when the output frequency is correct.

21. The phase and frequency comparators provide an error output when a difference exists between the 1 kHz signal from the reference frequency generator and the signal from the programmed divider. The error output causes the summing amplifier to adjust the frequency of the main oscillator until the output frequency is correct. The frequency comparator brings the synthesizer into correct tune after a frequency change; it is then held 'in lock' by the phase comparator.

22. The channel frequency and the 10.7 MHz frequency are of the same order of accuracy as the 5 MHz crystal which controls the outputs from the reference frequency generator.

CHAPTER 2

PREPARATION

1. Unpack the equipment from the transit case and remove the manpack from its haversack.

2. Carefully inspect the equipment for any transit damage.

3. Unscrew the two retaining screws in the base of the container and detach the battery power pack.

4. Check that the 7 amp. fuse is serviceable and that a spare fuse is fitted. Insert the battery with the battery terminals pointing outwards from the case. Refit the battery pack and screw the retaining screws firmly home, to ensure a waterproof seal between the pack and the main case.

NOTE: Do not overtighten since this may damage the seal.

5. Set the MODE SELECTOR switch on the control panel to a position other than OFF or TUNE and read the level indicated. A fully charged battery is indicated by a reading of three-quarters scale deflection.

6. Replace the manpack in the haversack and tighten the haversack frame retaining screws into the threaded inserts which are located behind two of the eyelet holes in the bottom of the haversack. The remaining eyelet holes provide for haversack drainage.

7. Check the Humidity Indicator. If it has changed to a pink colour, the desiccator insert should be removed and re-activated, or replaced with a new insert.

CHAPTER 3

OPERATION

CONTROLS AND CONNECTIONS

1. The controls and sockets fitted to the front panel of the manpack are listed below.

(a)	FREQUENCY SELECTION CONTROLS	The four control switches are used to select the required frequency.
(b)	MODE SELECTOR SWITCH	The seven position rotary switch is used to select the mode of operation of the equipment. The positions of the switch are OFF, VOICE A. M., KEY L. S. B., VOICE L. S. B. VOICE U. S. B., KEY U. S. B. and TUNE.
(c)	GAIN	This potentiometer controls the receiver a. f. gain.
(d)	TUNE	This control operates an a. t. u. which matches the transmitter and receiver to the antenna.
(e)	HIGH/LOW POWER SWITCH	This switch controls the output level of the transmitter.
(f)	METER	The meter indicates the battery voltage when the mode selector switch is at a VOICE or KEY position. The meter indicates antenna current when TUNE is selected.
(g)	AUDIO SOCKETS	These two sockets are connected in parallel, and allow ancillary equipment (such as a headset, morse key, external power supply or battery charging equipment etc.) to be connected to the manpack.

(h)	WHIP SOCKET	This socket allows a whip antenna to be connected to the manpack.
(j)	2-4 MHz and 4-8 MHz 50Ω SOCKETS	These sockets allow an antenna (other then a whip) to be connected to the manpack.
(k)	GROUND TERMINAL	This terminal allows a grounding spike to be connected to the manpack.

ANCILLARY EQUIPMENT OF OTHER MANUFACTURES

2. Care should be exercised when using ancillary equipment made by other manufacturers. As an example, certain morse keys which look identical with Racal products have different pin connections. These keys will not normally cause damage to the manpack, but will prevent telegraphy working taking place.

CONNECTION OF ANTENNA

3. Connect the required antenna. For man-portable working the whip antenna is used, while static operation permits the use of either a dipole or long wire antenna. Enhanced performance of the equipment will be obtained by the use of the latter antenna types.

Whip Antenna

4. (1) Assemble the sectional whip antenna and insert the antenna plug into the WHIP antenna socket on the control panel.

(2) Where a flexible connector is provided, plug the flexible connector into the WHIP antenna socket, and the antenna plug into the free end of the flexible connector.

NOTE: The whip antenna is easily assembled by laying the antenna along the ground in a straight line, with the antenna plug away from the user. Holding the thinest section of the antenna, draw the centre wire tight, until the sections become interlocked.

End-Fed Antenna

5. (1) Erect the antenna, using a mast or tree etc.

(2) Connect the antenna plug into the WHIP antenna socket.

(3) Drive the earthing spike into the ground and connect the ground lead to the ground terminal on the control panel.

Dipole Antenna

6. (1) Adjust the length of the antenna as required, by reference to the 0.5 MHz markings provided on the antenna.

(2) Erect the antenna horizontally with the line of the antenna running at right angles to the desired direction of transmission/reception.

(3) Connect the coaxial feeder plug into the relevant 50Ω coaxial socket on the control panel. The two sockets are clearly marked for the two frequency ranges covered.

(4) Drive the earthing spike into the ground and connect the ground lead to the ground terminal on the control panel.

BATTERY ECONOMY

7. The equipment should, whenever possible, be used with LOW POWER selected to give the maximum operating time between battery changing or charging. The TUNE condition should only be selected for the time necessary to carry out tuning, to avoid excessive battery drain.

VOICE AM/VOICE LSB AND USB OPERATION

8. (1) Connect the handset to either of the AUDIO sockets.

(2) Set the HIGH/LOW Power switch to the appropriate position.

(3) Set the frequency selection controls to their appropriate position.

(4) Set the Mode Selector switch to TUNE.

(5) Adjust the TUNE control for a maximum reading on the meter.

(6) Set the Mode Selector switch to the appropriate position i.e. VOICE AM/VOICE LSB or USB.

(7) Adjust the GAIN control to give the desired a.f. level.

(8) To transmit, press the handset switch.

TELEGRAPHY OPERATION

9. (1) Connect the headset into one AUDIO socket and the morse key into the other.

(2) Set the HIGH/LOW Power switch to the appropriate position.

(3) Set the frequency selection control switches to their appropriate positions.

(4) Set the mode selector switch to TUNE.

(5) Adjust the TUNE control for a maximum reading on the meter.

(6) Set the mode selector switch to either KEY LSB or KEY USB.

(7) Adjust the gain control to give the desired a.f. level.

(8) To transmit, operate the morse key. The transmit condition is maintained for approximately half a second after the key is re-leased.

BATTERY POWER CHECK

10. (1) Select HIGH or LOW power, in accordance with output power required during transmission.

(2) Set the mode selector switch to TUNE.

(3) Adjust the TUNE control for a maximum reading on the meter.

(4) Set the system switch to either KEY L.S.B. or KEY U.S.B. and operate the morse key, observing the meter, or select VOICE U.S.B. or VOICE L.S.B. and whistle loudly into the microphone. If the reading falls appreciably, then the battery is nearing a discharged condition. If the reading falls below half scale deflection the battery should be re-charged or changed.

PART 2

TRANSCEIVER UNIT TYPE MA.924

REF: 410
ISSUE B

PART 2 - TRANSCEIVER UNIT TYPE MA.924

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CONTENTS - PART 2 (Continued)

CONTENTS - PART 2 (Continued)

ILLUSTRATIONS

CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

1. The Transceiver Unit Type MA.924 consists of the front panel with controls (except those controls which form part of the synthesizer or 49 channel crystal oscillator), the a.t.u. and all circuitry other than that associated with the synthesizer or 49 channel crystal oscillator. The majority of the circuit components are fitted to a printed circuit board which is housed in a light alloy box. The box is hinged to the rear of the front panel. A general view of the equipment is given in Fig. 4.

PRINCIPLES OF OPERATION (Fig. 2)

Transmission -Voice U.S.B. and L.S.B.

2. Microphone inputs are made, via an r.f. filtering stage, to an audio pre-amplifier VT39 and VT40. The output of the pre-amplifier is fed to a symmetrical compressor D26a and D26b which compresses the peaks of the a.f. signal if a pre-determined level is exceeded.

3. The signal from the compressor is fed via an amplifier VT37 to the balanced modulator stage T14, D24a and D24b. A 10.7 MHz signal is also injected into the balanced modulator via buffer amplifier VT36, providing a double sideband suppressed carrier i.f. signal centred on 10.7 MHz at the output.

4. A sidetone signal is also fed from the compressor stage to the receiver.

5. The i.f. signal is amplified by VT34 and VT33 and fed to the sideband filter via the diode switch D10. The gain of VT34 is controlled at high or low level by the VT35 gate.

6. Either the upper or lower sideband filter will be in use, dependant upon mode selected; the following description (up to para. 10) assumes that VOICE U.S.B. mode is selected.

7. A positive voltage is supplied to diodes D28, D30, D34 and D36 in u.s.b. mode, opening the upper sideband channel and allowing the signal to be fed via filter FL4. This filter has a pass band of 10.6995 to 10.6975 MHz and thus accepts the lower sideband of the i.f. signal.

NOTE: Frequency relationships are discussed in paras. 29 to 31.

8. The signal from the u.s.b. filter is fed via D28 and D30 the a.m. filter FL3 and diode D6 to the mixer T13, VT31, VT32, where it is mixed with the channel oscillator signal (12.7 - 18.7 MHz), supplied by the synthesizer or 49 channel crystal oscillator via filter FL2 and diode switch D3. The difference frequency (2 to 8 MHz plus u.s.b. modulation) is selected by the filter FL6.

9. The output of the filter is fed to the pre-driver amplifier VT30 and VT28, and from there to the push-pull driver stage VT26 and VT27. The bias of the driver stage is adjusted for HIGH or LOW power by the control gate VT29, which is, in turn, controlled by relay RLB.

10. The output of the driver is fed to the p.a. stage VT24 and VT25, where it is coupled, via T7, T8, and the relay contacts RLA-1, to the manually tuned a.t.u. L1, C1/C2 and C3. The matching of the a.t.u. in high or low power is controlled by RLB-1.

11. The transmitter operates in a similar manner in l.s.b. mode except that the sideband filter FL5 is brought into use (by D29, D31, D35 and D37) instead of filter FL4 (see para. 7).

Transmission - Key U.S.B. and L.S.B.

12. In keying modes a 1000 Hz tone from the VT41 tone oscillator stage is used as the modulating signal for the selected sideband. When the external key is closed the oscillator is brought into operation, and the 1000 Hz tone is injected into the audio circuit, after the compressor stage. The remainder of the transmitter circuits then operate as for u.s.b. or l.s.b. voice modes.

13. When the key is released the transmit relay RLA (and relay RLB if HIGH power is selected) are held in the 'operated' position for a short time. This ensures that the receiver is muted during normal keying breaks.

Transmission - Voice A.M.

14. In this mode the microphone input aduio pre-amplifier and audio compressor stages operate as described in para. 2. The input to VT37 is controlled by a level adjusting gate D25 and RV8, which reduces the a.f. level to a suitable value. The reduction in level is necessary for two reasons:

(1) As a carrier and both sidebands are transmitted in this mode, the a.f. level must be reduced to ensure that the output stages are not overdriven.

(2) As only the a.m. (7 kHz) filter is in circuit the filter losses will be lower than in s.s.b. modes.

15. The reduced a.f. level is fed to the modulator T14, D24a and D24b via the amplifier VT37. The modulator unbalancing circuit incorporating RV6 is brought into use in this mode.

16. During s.s.b. working the modulator produces sum and difference frequencies (para. 3) but the i.f. centre frequency (10.7 MHz) is suppressed as the modulator is balanced. In a.m. mode the modulator is unbalanced, allowing the stage to produce the sum and difference frequencies and the i.f. frequency, resulting in a true a.m. signal.

17. The a.m. signal is fed to the a.m. filter FL3 via the VT34 and VT33 stages, the D10 diode switch (para. 5) and the D32 and D33 switching stage. The signal from filter FL3 is then fed to the mixer, pre-driver, driver and p.a. stages as described in paras. 8 to 10.

Transmission - High and Low Power Output

18. Relay RLB is de-energized when low power is selected and energized when high power selected. Relay contacts RLB-1 adjust the coupling of the p.a. stage to the a.t.u. to suit the output power level; contacts RLB-2 adjust the gain of the i.f. amplifier and the bias of the driver stage.

Reception - U.S.B. and L.S.B. Modes

19. Voice and key modes are identical as far as the receiver circuits are concerned, as the keyed tones are demodulated and amplified in the same manner as a.f. signals.

20. The incoming r.f. signal is fed via the a.t.u. and the de-energized contacts of relay RLA-1, to the protection diodes D1a and D1b, which prevent damage to the receiver as the result of overloading. The signal is then fed, via a low pass filter FL1, to the mixer and i.f. amplifier stage T1, VT1, VT2 and T3, which mixes the signal with the channel oscillator signal (obtained from the synthesizer or 49 channel oscillator via filter FL2 and diode switch D2) producing an i.f. signal based on 10.7 MHz.

21. The i.f. signal is fed, via the diode switch D5 and the 7 kHz filter FL3, to the sideband filters. The filter FL4 is brought into circuit by diode switches D28, D30, D34 and D36 when U.S.B. VOICE or U.S.B. KEY is selected. If an l.s.b. mode is selected switches D29, D31, D35 and D37 will bring filter FL5 into circuit.

22. The signal from the selected filter is fed to the i.f. amplifier stages VT13, VT14 and VT15, and then to the product detector stage VT17. A 10.7 MHz input from the synthesizer or 49 channel crystal oscillator is also applied to this stage, and the difference frequency of the two signals is extracted. This difference signal is the required audio modulation carried by the sideband. The a.f. is amplified by the audio pre-amplifier stage VT19 and fed to the manual gain control RV2 via a level limiting stage D14a, D14b,

D15a, D15b, which is a symmetrical clipping circuit that prevents overloading of the audio power amplifier circuits which follow.

23. The output from the audio power amplifier stage is fed to the audio sockets on the front panel of the unit. The audio power amplifier is also connected to the sidetone circuit from the compressor stage (para. 3) and a sample of the a.f. signal fed to the transmitter (which may be voice or keyed tone) is heard in the receiver circuits during transmission.

Reception - Voice A.M. Mode

24. The circuit from the antenna to the mixer and amplifier is the same as that used for u.s.b. and l.s.b. working (para. 20). From the mixer and amplifier stage the i.f. signal is fed via diode switch D5 to filter FL3, which allows the carrier complete with both sidebands to be fed to the i.f. amplifier VT13, VT14 and VT15, via diode switches D32, D33 and D7.

25. During reception in VOICE A.M. mode the 10.7 MHz signal from the synthesizer or 49 channel crystal oscillator is muted and the product detector VT17 acts as a normal a.m. detector, separating the a.f. content from the i.f. The audio pre-amplifier VT19, limiter and audio power amplifier stages function as described in paras. 22 and 23.

Receiver - A.G.C. Circuit

26. A.g.c. voltages are derived from two sources, the VT17 detector stage and the VT19 a.f. amplifier stage. When a.m. working is selected and modulation is absent the VT19 stage is inoperative, and the detector stage controls the gain of the receiver. The a.g.c. voltage is derived from the carrier signal, which is continuous during a.m. reception.

27. In u.s.b., l.s.b. or a.m. mode with modulation present, the a.g.c. voltage is derived from the VT19 amplifier stage and takes precedence in controlling the gain of the receiver. The circuit embodies a time delay so that the a.g.c. potential is maintained during normal breaks in the received signal, thus preventing noise being heard between words or keyed tones.

28. The a.g.c. voltage is rectified and amplified in the VT16, VT18 stage to generate a voltage which is applied to the VT13 and VT14 i.f. amplifier stages and the mixer stage, thereby maintaining a constant a.f. output from the receiver over a wide range of input signal levels.

Frequency Relationships - Transmission

29. Frequency relationships are illustrated easiest by an actual example, i.e. a 500 Hz audio note transmitter at 4 MHz. This gives the following, for u.s.b. and l.s.b. channels.

30. U.S.B. Channel. A.F. in, 500 Hz, mixed at balanced modulator to give 10.7005 MHz (10.7 MHz + 500 Hz) and 10.6995 MHz (10.7 MHz - 500 Hz). The lower frequency 10.6995 MHz is selected by filter FL4, and is mixed with the channel frequency, which, when 4 MHz is selected, will be 10.7 + 4 HMz, i.e. 14.7 MHz. The mixer provides sum and difference frequencies of 25.3995 and 4.0005 MHz. The sum frequency is rejected by filter FL6, and the difference frequency, 4.0005 MHz, is transmitted.

31. L.S.B. Channel. In this case the higher frequency from the balanced modulator, 10.7005 MHz, is selected by filter FL5 and mixed with 14.7 MHz. The difference frequency, in this case 3.9995 MHz, is selected by filter FL6 and provides the transmitted frequency.

Frequency Relationships - Reception

32. Again a 500 Hz note at 4 MHz received frequency will be considered. The 4 MHz signal with modulation (i.e. 4.0005 MHz for u.s.b.) is received at the antenna, and converted in the mixer stage to an i.f. signal of 10.6995 MHz by mixing with a channel frequency of 14.7 MHz and selecting the difference frequency. This frequency is fed to the appropriate filter which, in the case of u.s.b., selects the signal of 10.6995 MHz.

33. The signal is mixed in the product detector with a 10.7 MHz frequency, and the difference frequency, 500 Hz, is the required a.f. output.

34. The l.s.b. channel is similar to the u.s.b. except that the filter selects a frequency above 10.7 MHz i.e. in the case of a 500 Hz audio tone, 10.7005 MHz.

Tuning

35. Tuning is carried out by selecting TUNE at the MODE switch, adjusting the selection controls of the synthesizer or 49 channel crystal oscillator so that the required frequency or channel is indicated on the dials, then adjusting the TUNE control to give maximum reading, after which the mode switch is set to OFF or to the required mode. During the short time that the synthesizer is tuning pulsed tones are supplied to the audio amplifier, and these tones are heard in the a.f. circuits, along with the 1 kHz tone (para. 37). When a 49 channel crystal oscillator is used only the 1 kHz tone is heard.

36. When the TUNE condition is selected the p.t.t. relay RLA, and the High Power relay RLB (if HIGH is selected) are energized, giving the Transmit condition. The microphone input and amplifier, and the audio compressor stage are disconnected in this condition.

37. The 1000 Hz Oscillator VT41 is permanently switched on when TUNE is selected, providing a tone which is fed, via the sidetone circuit, to the audio power amplifier. This tuning tone indicates that the TUNE position is selected.

The VT38 muting gate is set to the mute condition when TUNE is selected, preventing an audio or tone input being fed to the transmitter.

38. The 'unbalancing gate', set by RV6, is in operation during tuning, unbalancing the modulator as for a.m. working (paras. 15 and 16), thus providing a 10.7 MHz unmodulated signal. This signal is then fed to the a.m. filter, mixer pre-driver and p.a. stages as given in para. 17.

39. The a.t.u. is manually tuned by the front panel TUNE control. In the TUNE condition of the mode switch a sample of the r.f. current supplied to the antenna is detected and rectified by the T6, D18 stage, to form a positive d.c. signal whose amplitude is proportional to the antenna current. The d.c. signal is fed to the meter, which is used as a tuning indicator.

Power Supplies (Fig. 3)

40. Power is supplied by an 18V battery, or by an external power supply. A diode D17 is fitted to prevent damage due to a reversed polarity or incorrect supply connection. The diode passes sufficient reverse current to blow the fuse in the case of a wrong connection.

41. The battery voltage is fed via the mode switch to the various stages, relay and metering circuits when a mode is selected. A stabiliser circuit provides a 9V stabilised supply to certain stages. The metering circuit reads the battery voltage in all positions except TUNE (see para. 39) and OFF. The remainder of the power supplies are self evident.

CHAPTER 2

CIRCUIT DESCRIPTION

TRANSMITTER CIRCUITS (Fig.7)

Input Pre-Amplifier and Speech Compressor

1. Microphone inputs appear between pins A and D of SKT4 or 5 and are fed, via isolating resistors R154 to R157 and r.f. decoupling capacitors, to the input pre-amplifier VT39 and VT40. The amplifier stages are d.c. coupled and the gain is adjusted during manufacture or maintenance, by the pre-set potentiometer RV10 in the feed-back loop.

2. The speech compressor consists of two diodes D26a and D26b which symmetrically clip the peaks of audio signals when the 'knee' voltage of the diodes is exceeded.

Amplifier VT37, Level Control Gate and Muting Gate

3. Transistor VT37 forms an amplifier which accepts the a.f. signal from the speech compressor. Interposed between the speech compressor and the amplifier is a level control gate D25, RV8, and a muting gate. The level control is brought into operation during A.M. VOICE working, by a positive potential from switch SA1F which drives diode D25 into conduction, causing a part of the audio signal to be fed to earth via RV8. The reduced a.f. level is necessary to give the correct sideband to carrier level during this mode of working.

4. The muting gate VT38 is set to the conducting condition during the selection of TUNE, by a positive potential from switch SA1. In the TUNE condition the audio input to the modulator is not required, and is therefore fed directly to earth via VT38.

Modulator, Unbalancing Gate and Buffer Amplifier VT36

5. The modulator T14, D24a and D24b acts as a balanced modulator for s.s.b. working and an unbalanced modulator during A.M. VOICE and TUNE conditions. When the modulator is balanced the 10.7 MHz centre frequency is suppressed and the output consists of two sidebands centred about 10.7 MHz. When the stage is unbalanced the output consists of a 10.7 MHz signal with sidebands, i.e. a true a.m. signal.

6. Consider the case when there is no a.f. input and the modulator is in its balanced condition. The 10.7 MHz signal from the synthesizer or 49 channel oscillator is applied via the buffer amplifier VT36, to the primary of T14. The induced signal in the secondary of T14 will cause a current flow in the loop D24a, D24b, R125, R126 and RV7, producing a d.c. voltage across RV7. The capacitors C113 and C114 balance out the capacitance of the two diodes.

7. The modulator is set up during manufacture or maintenance so that the output at the wiper of RV7 is zero when no a.f. input is present. The modulator is then in its balanced condition. The injection of an a.f. signal (at the centre tap of T14 secondary) causes an output to be provided which consists of the two sidebands of the 10.7 MHz sub carrier signal, with the centre (10.7 MHz) frequency suppressed.

8. During a.m. working the 10.7 MHz signal and its sidebands are required. The unbalancing gate is brought into use by a positive potential fed to potentiometer RV6, which supplies a part of the potential to the two diodes of the modulator via the centre tap of T14. This unbalances the modulator providing a 10.7 MHz signal at its output when no a.f. input is present. When an i.f. input is applied a true a.m. signal results.

9. During tuning the 10.7 MHz signal only is required and this produces a signal at the required carrier frequency which is used to tune the equipment. A positive potential applied to RV6 unbalances the modulator as described in the previous paragraph. The a.f. input is muted (para. 4), therefore the output is a 10.7 MHz signal which is mixed, as described later, to form a continuous carrier.

I.F. Amplifiers VT34 and VT33

10. The output of the modulator is amplified by VT34, which is tuned to the i.f. by L14, C103 and C104. The gain of the stage can be controlled at a high or low level as described in para. 19. The output of VT34 is fed to a further i.f. amplifier VT33, whose gain is preset by potentiometer RV4, and then to the filtering and switching stages.

Filtering and Switching Stages

11. During transmission the switching diode D10 is set to the conducting condition (see para. 43), allowing the signal from VT33 to be fed to the appropriate filter via transformer T4. If an u.s.b. mode is selected, diode switches D36, D34, D30 and D28 are set to the conducting condition, allowing the signal to be fed through filter FL4 to filter FL3. If a l.s.b. mode is selected, switches D37, D35, D31 and D29 are set to conduct providing a path to filter FL3 via filter FL5. The appropriate filter FL4 or FL5 is therefore selected, filter FL3 having little effect upon the signal as its passband is larger than that of either of the other two filters.

12. When A.M. VOICE is selected switches D33 and D32 are set to conduct allowing the i.f. signals to be fed directly to filter FL3. The output of filter FL3 is fed, via diode switch D6, to the mixer T13, VT31, VT32.

Mixer T13, VT31, VT32 and Filter FL6

13. The T13, VT31, VT32 mixer accepts the i.f. signal and the appropriate channel oscillator frequency via diode switch D3, which is set to the conducting condition during transmission (see para. 43). The output of the mixer is filtered providing a modulated signal at channel output frequency.

14. The modulated i.f. signal is fed to the primary of T13. The centre tap of the secondary is fed with the channel oscillator signal and sum and difference signals are generated by the mixer VT31 and VT32. The potentiometer RV3 is preset to give the correct balance condition i.e. to prevent the channel oscillator frequency appearing at the output. The output of the amplifier is fed, via transformer T12, to the low pass filter FL6, which removes the sum frequency and passes the required difference frequency to the pre-driver stage.

Pre-Driver and Driver Stages

15. The pre-driver stage consists of VT30 and VT28, a d.c. coupled wideband stage embodying feedback via R89. The output of VT28 is coupled, via T11, to the wideband driver stage VT26 and VT27. The transformer T11 is damped by resistors R86 and R83 to give the required bandwidths. The diodes D23a and D23b provide the bias supply to the two transistors. The bias voltage is adjusted for HIGH or LOW power output by the bias control gate VT29, as given in para. 18. The driver stage is a push-pull amplifier stage, and is coupled to the p.a. stage via transformers T9 and T10, which are damped by R76, R77, R78 and R79.

P.A. Stage

16. The p.a. stage is a wideband push-pull amplifier, formed by transistors VT24 and VT25. Base bias for the transistors is provided by the network consisting of R68 to R71 and diode D22. The bias is taken from the 9V stabilized supply; the remainder of the p.a. stage is supplied from the 18V unstabilized supply. Feedback is supplied via R61, R62, C78 and R63, R64, C79; in addition frequency compensation is provided by R65, C80 and R66, C81. Transformers T7 and T8 couple the output of the p.a. to the a.t.u.; stabilizing networks R57, R58, C75 and R59, R60, C76 are fitted in the output circuit.

A.T.U.

17. The output of the p.a. is fed via relay contacts RLB-1 (see para. 21) and RLA-1 (in transmit condition) to the a.t.u. L1. This is a manually tuned inductor which is matched, in conjunction with C1 and C2, or C3, for use with a dipole or end-fed antenna, or is directly matched with a whip antenna. The r.f. signal to the a.t.u. is fed via the antenna current detector T6, which is described in para. 40.

High and Low Power Selection

18. Switch SB controls the selection of HIGH or LOW transmitted power, via relay RLB which gives high power when it is energized. Relay contacts RLB-2 control the Bias Adjusting Gate VT29 and the Gain Control Gate VT35, by applying a positive voltage to the two stages when high power is required.

19. Gain Control Gate VT35. The i.f. amplifier VT34 (see para. 10) embodies the Gain Control Gate VT35 in its emitter circuit, to allow the gain of the amplifier to be increased when high power is selected. This is achieved by applying a positive potential to the base of VT35, and driving it into conduction. The conducting transistor places C107 in parallel with R116; the capacitor has a very low impedance at i.f. therefore the resistor R116 is effectively short circuited to a.c. signals, and the current swing, and consequently the gain, of VT34 is increased.

20. Bias Adjusting Gate VT29. The base bias for the driver amplifier VT26, VT27 is derived from the voltage drop across D23a and D23b. In the LOW power condition the bias is fed from the 9V supply via resistor R84. When relay contacts RLB-2 are closed a positive potential is fed to the base of VT29, which drives this transistor into saturation. This brings resistor R90 into circuit, in parallel with R84, increasing the current supply to the driver stage and increasing the bias voltage to VT26 and VT27 to handle the increased drive level.

21. Matching of A.T.U. Relay contacts RLB-1 connect the secondary of T7 in series with the secondary of T8 for high power operation, thus ensuring optimum matching of the a.t.u. to the power amplifier.

RECEIVER CIRCUITS (Fig. 7)

A.T.U., Protection Circuit and Filter FL1

22. The antenna input is fed, via the a.t.u., to a protection circuit consisting of diodes D1a and D1b. If signals are received whose amplitude is above the 'knee' voltage of the diodes, the signals are clipped, preventing damage due to overloading of the receiver circuits. The filter FL1 ensures that signals above 8 MHz (e.g. the channel oscillator of i.f. signals) cannot be fed to the antenna system.

Diode Switches D3, D5 and Mixer VT1, VT2

23. The input from the filter FL1 is fed, via T1, to a mixer stage VT1, VT2, D4a, D4b. This stage is also supplied with the channel frequency via filter FL2 and diode switch D2, which is conducting during reception (see para. 43). The mixer works in a similar manner to the mixer VT31, VT32 (para. 13) providing sum and difference frequencies. The balance of the mixer is set by RV1. The difference signal, which is the i.f. signal carrying modulation, is selected by T3 and fed via conducting diode switch D5, to the filtering and switching stages. An a.g.c. potential is applied to the stage,

as described in para. 30.

Filtering and Switching Stages

24. These stages and associated switches operate in the same manner as during transmission (see para. 11) except that the signal flow is in the opposite direction.

Diode Switch D7 and I.F. Amplifiers VT13 and VT14

25. The i.f. signal from the filter stages is fed to the i.f. amplifiers via diode switch D7, which is conducting during reception. VT13 and VT14 are two tuned stages which amplify the i.f. signal and feed it to a third stage VT15. An a.g.c. voltage is applied to the i.f. amplifiers, as described in para. 30.

I.F. Amplifier VT15 and Detector VT17

26. The load for the amplifier VT15 is formed by transformer T5, which couples the stage to the detector, VT17. During s.s.b. working a 10.7 MHz signal is applied to the secondary of T5 via C39, so the base of VT17 is fed with two signals, a suppressed carried 10.7 MHz s.s.b. signal and an unmodulated 10.7 MHz signal. Mixing takes place in VT17, due to the arrangement of bias, and the resultant difference signal is fed, via C46, to the audio stages. This difference is the required a.f. intelligence. The i.f. and 10.7 MHz signals are suppressed by L11 and associated filtering components.

27. During a.m. reception the unmodulated 10.7 MHz signal is muted at source via switch wafer SA1B, therefore only the modulated 10.7 MHz a.m. signal is applied to VT17 which acts as a normal detector and extracts the a.f. intelligence.

Audio Pre-Amplifier and Level Limiter

28. Transistor VT19 is an audio amplifier, the output of which is limited by diodes D14a, D14b, D15a and D15b. The diodes conduct if a predetermined audio level is exceeded, feeding part of the a.f. signal to earth and preventing large transients in the a.f. output.

Manual Gain Control and Audio Power Amplifier

29. The a.f. gain level to the audio power amplifier is controlled by RV2, the manual GAIN control fitted to the front panel. Transistor VT20 is a driver for the symmetrical, transformerless, output stage VT21, VT22, which provides the required a.f. level from the receiver.

A.G.C.

30. The a.g.c. amplifier consists of transistors VT16 and VT18 and is fed with input signals from the VT17 and VT19 stages. Considering the input from the VT17 stage first, this is rectified by D11 to form a positive voltage which is applied to the base of VT18. The magnitude of the positive voltage is dependent upon input signal level to VT17.

31. The positive voltage at VT18 base produces a reduction in voltage at the output of VT16 which reduces the positive bias applied to the controlled stages (VT1 and VT2, VT13, VT14) and reduces the gain of the stages. Thus an increase in the detector output reduces the i.f. gain so that the receiver output is maintained at a sensibly constant level.

32. During s.s.b. reception, or a.m. reception when modulation is present, the input to the a.g.c. amplifier is taken from the a.f. stage VT19. A time delay circuit is included to prevent noise being heard between words or keyed tones. During a.m. reception when modulation is not present the input is taken from VT17, and is due to the carrier signal.

33. The audio signal is fed via R43 and C49 to the voltage doubler D12 and D13, where it is rectified to form a positive voltage at the base of VT18, which operates as given in para. 31. C45 is charged during a.g.c. operation and, since the charge can only leak away slowly, via VT18 and associated circuit, the a.g.c. voltage is maintained for a short while after the audio input ceases.

34. The two inputs to the a.g.c. amplifier are both in operation during reception, and the applied a.g.c. voltage is due to the largest of the two inputs under the particular operating conditions.

MODE P.T.~~T. AND~~ KEYING CIRCUITS (Figs. 7 and ~~10~~) 3

35. The appropriate diode switches for the u.s.b., l.s.b. and a.m. filters are set to the conducting condition by a positive voltage from the mode switch, thus selecting the appropriate filter to suit the required mode. When a VOICE mode is selected a power supply is fed to the input pre-amplifier of the transmitter, ~~allowing mic~~ inputs to be made. In KEY modes the pre-amplifier is switched off and a power supply is fed to the tone oscillator VT41.

Tone Oscillator VT41

36. The tone oscillator is a Colpitts circuit whose frequency is determined by the pre-set inductor L15, C129 and C130. The amplitude of signal from the oscillator is pre-set by potentiometer RV9. The diode D27 limits the positive voltage applied to the emitter of VT41 during key-up conditions.

P.T.T. Circuits

37. The P.T.T. (Press to Transmit) circuit is brought into operation by connecting pins C and D of an audio socket together, via an external switch. This action causes relay RLA to be energized if LOW power is selected or both relays RLA and RLB to be selected if HIGH power is in use. Relay contacts RLA-1 change-over the a.t.u. circuit from the receiver to the transmitter circuits; contacts RLA-2 change-over power supplies. The operation of the HIGH-LOW power relay RLB is given in para. 18.

Keying Circuits

38. When a keying mode is selected power is supplied to the 1 kHz tone oscillator via switch SA2B, and relays RLA and RLB are connected to the external key circuit at pins E and D of the audio sockets. When the key is depressed the tone oscillator circuit is completed, providing a 1000 Hz tone to the transmit circuits, and the relay(s) circuit(s) is (are) completed giving the conditions described in the previous paragraph. In this case the time delay circuits, C83, R75 for relay RLA and C82, R80 for relay RLB, are also brought into circuit. When the key is released the capacitors must discharge via the resistors before the relay(s) can de-energize, thus maintaining the transmit condition during normal keying spaces.

TUNING CIRCUITS

39. When TUNE is selected, relay RLA and relay RLB (if HIGH power is in use) are energized giving the transmit condition. The modulator 'unbalancing gate' is brought into circuit as described in para. 8, and carrier signal, at the selected frequency, is fed to the a.t.u. via T6 and an Antenna Current Detector D18 and D19. The 'A.M.' condition of the filter and switching stages is selected by switch SA1F, in the same manner as given in para. 12.

Antenna Current Detector

40. The r.f. current to the a.t.u. is coupled by the current transformer T6 to its load resistor R55. The voltage across R55 is rectified by diode D18 which, in conjunction with a load resistor R56 and the meter circuit, forms a d.c. circuit whose current flow is proportional to r.f. current. Diode D19 protects the meter; C77 is a smoothing capacitor.

Metering Circuit

41. The d.c. current developed by the detector is fed to the meter via switch wafer SA3F (figs. 3 and 7) to give an indication of antenna current during tuning.

Tuning Tone

42. The 1 kHz oscillator is in operation during tuning to provide a tone in the receiver a.f. circuits. This tone is not fed to the transmitter circuits as it is muted by VT38 when TUNE is selected (see para. 4). When a synthesizer is used pulsed 'out of lock' tones are also fed to the receiver a.f. circuits during the short time that the synthesizer is tuning. The pulsed tones are not provided when a 49 channel crystal oscillator is in use.

DIODE SWITCHES (Fig. 7)

43. The diode switches control the flow of r.f. and i.f. signals, by presenting a low impedance (conducting condition) or a high impedance (non-conducting condition) to the signals in accordance with d.c. control voltages. The diode switches D2 and D3 will be described as typical examples.

44. During reception a positive voltage is applied to D2, via R5. This causes a d.c. current flow through D2 to earth via T2 secondary. Because the diode is conducting it offers a low impedance to the channel oscillator signal from FL2 and this is fed via T2 and the diode to the receiver circuits. When the positive voltage is removed the diode does not conduct presenting a high impedance to the channel oscillator thus preventing the signal reaching the receiver.

45. The diode D3 works in a similar manner to D2, controlling the supply of the channel oscillator signal to the transmitter.

46. The diodes do not rectify or alter the r.f. signal (apart from a small attenuation) as the applied d.c. level is greater than the peak to peak swing of the r.f., and the diodes are conducting during the whole of the r.f. cycle.

POWER SUPPLIES

47. Power supplies are taken from an 18V battery within the unit, or from an external source connected to pins B and D of an audio socket (see fig. 7). The supply is stabilized at 9 volts by D16 and VT23.

Stabilizer VT23

48. The Zener diode D16 provides, in conjunction with R50, a constant reference voltage at the base of the series current regulator VT23, which acts as an emitter follower. This transistor, in conjunction with R53, ensures that a stabilized 9V supply is maintained. Capacitor C65 prevents surges affecting the reference voltage.

Stabilizer VT23

49. The Zener diode D16 provides, in conjunction with R50, a constant reference voltage at the base of the series current regulator VT23, which acts as an emitter follower. This transistor, in conjunction with R53, ensures that a stabilized 9V supply is maintained. Capacitor C65 prevents surges affecting the reference voltage.

CHAPTER 3

MAINTENANCE

INTRODUCTION

1. This chapter covers maintenance procedures and tests on the complete Manpack and on the Transceiver Unit MA.924. Maintenance information on the Synthesizer MA.920 or the 49 channel Crystal Oscillator MA.923 is given in Part 3 Chapter 3 of this handbook. Each procedure can be carried out in isolation from the remainder of the procedures, unless otherwise indicated.

TEST EQUIPMENT

2. The following test equipment is required to carry out the procedures given in this chapter.

(1) Test Set (including power supply). The Racal Type CA.470B is suitable.

(2) Multimeter, Electronic, R.F., having d.c. ranges and r.f. ranges which can be used up to 25 MHz. The Marconi Type TF2604 is suitable.

(3) Multimeter, Electronic, A.F., having a range of up to 10 mV at 20 Hz to 100 kHz. The advance Type 77C is suitable.

(4) Audio Power Output Meter, having a range of 10 Hz to 100 kHz at an input impedance to 300Ω and ranges of 1 mW to 10 mW. The Marconi Type TF893 is suitable.

(5) R.F. Signal Generator having a range of 1 to 20 MHz at 50Ω output impedance, which can be modulated up to 30% at 1000 Hz. The Marconi Type TF.144H is suitable.

(6) A.F. Two Tone Signal Generator, having outputs of 20 to 3000 Hz at 600Ω impedance, with an output level of 1 mV to 1V. The Dymar Type 745 is suitable.

(7) Digital Frequency Counter having a range of up to 20 MHz at 50 mV r.m.s. input. The Racal type 9022 is suitable.

(8) Oscilloscope having a frequency range of d.c. to 20 MHz and a sensitivity of 50 mV/cm. The Advance OS2000 is suitable.

(9) A.F. Signal Generator having a frequency range berween 20 Hz and 20 kHz at 600Ω impedance. The advance J2 is suitable.

(10) R.F. Wattmeter covering the range of 2 to 8 MHz at 50Ω input impedance and capable of dissipating 25W. The Marconi Type TF.2503 is suitable.

NOTE: The wattmeter is not required when the CA.470B Test Set is used.

(11) Multimeter, General Purpose. The Avometer Model 8 is suitab

(12) Power Supply capable of continuously providing 3A at 18V d.c.

NOTE: The power supply is not required when a CA.470B test set is used.

Use of Test Set CA.470B

3. The Test Set CA.470B simplifies maintenance operations. It consists of the following circuits.

(1) A power supply with overload protection, allowing a manpack to be driven from 100 to 125V or 200 to 250V 45 to 60 Hz mains, without risk of damage due to internal short circuits etc.

(2) A 50Ω dummy load incorporating a wattmeter, allowing easy measurements of output power.

(3) Connecting points for a.f. inputs and outputs and a frequency counter or oscilloscope.

(4) Transmit/Receive and Key switching.

4. The power supply circuit within the test set will 'trip out' if excess current is drawn, removing the power supply. The POWER switch must be set to the OFF AND RESET position, then returned to the ON position to re-establish the power supply.

5. The following paragraphs are written on the assumption that a test set is available. If a test set is not available it will be necessary to use a six pole plug connected to an audio socket SKT4 or SKT5, to provide power supplies, audio inputs and outputs, keying signals and p.t.t. signals. A metered dummy load will be required to measure output powers.

CHANNEL FREQUENCY SELECTION

5A. As previously stated, the SYNCAL utilises a synthesizer with controls which are marked in frequency, and the COMCAL utilises a 49 channel crystal oscillator, with controls marked in channel numbers. It is important to note that the channel frequency of the oscillator is not the crystal frequency, but is 10.7 MHz below crystal frequency.

INITIAL PROCEDURE

6. (1) Set the mode switch to the OFF position.

(2) Remove the manpack from its haversack and remove the battery.

(3) Remove the transmitter - receiver from its case.

(4) Remove the outer cover from the transceiver unit.

(5) Set the POWER switch on the test set to OFF and the TRANS/REC switch to REC. Connect the six pole plug of the test set to the audio socket on the front panel of the transmitter-receiver.

(6) Check all controls (including TUNE control) for smooth action. Check plugs and sockets for correct mating.

(7) Switch on power at the CA.470B Test Set, and select VOICE A.M., KEY L.S.B., VOICE L.S.B., VOICE U.S.B. and KEY U. S.B. in turn on the manpack mode switch and check that the meter indicates approximately 0.8 scale deflection. Select OFF at the mode switch.

VOLTAGE STABILIZER CHECK

7. (1) Connect a multimeter, set to the 25V d.c. range, across the 10.7 MHz mute connection (pin 2 on the synthesizer, or 49 channel crystal oscillator) and earth.

(2) Select VOICE A.M. and check that a reading between 8.5V and 10.5V is given.

(3) Select OFF at the mode switch and remove the multimeter.

RECEIVER

A.F. Power Output Check

8. (1) Connect an audio power meter, set to the 10 mW range at an input impedance of 300Ω to terminals A.F. and EARTH of the Test Set.

(2) Connect the 600Ω output of the A.F. Signal Generator and an AF valve voltmeter to the point TP6 and earth.

(3) Connect an oscilloscope across the aduio power meter.

(4) Select any mode (other than TUNE), set the GAIN control to maximum and the audio generator to provide a 1 kHz signal at minimum output. Increase the audio generator level until clipping can be seen to start, denoted on the oscilloscope by a flattening of the peaks of the signal.

(5) Check that the audio power meter indicates between 10 to 20 mW.

(6) Set the mode switch to OFF and remove test equipment.

A.F. Amplifier Sensitivity and Bandwidth Check

9. (1) Carry out operations (1) and (2) of the preceding paragraph.

(2) Select any mode (other than TUNE), and adjust the audio generator to 1 kHz, at an output level sufficient to provide an indication on the power meter of 4 mW, with the GAIN control set to maximum. The input from the audio generator should be betweem 6 amd 10 mV.

(3) Reduce the frequency of the signal without disturbing its output level setting, until the power output has dropped to 1 mW. The audio generator frequency should be between 90 and 150 Hz.

(4) Increase the audio generator frequency without disturbing its output level until the power output has again dropped to 1 mW. The frequency should be between 5 and 10 kHz.

(5) Set the mode switch to OFF and disconnect test equipment from TP6.

I.F. Amplifier Alignment

10. (1) Connect an audio power meter to the A.F. and EARTH terminals of the test set. Set the meter to the 10 mW range at 300Ω input.

(2) Connect an r.f. signal generator to test point TP4 and earth.

(3) Select A.M. VOICE and adjust the signal generator to provide an output of 20µV e.m.f. at 10.7 MHz, modulated by a tone of 1 kHz to a depth of 30%.

(4) Adjust the cores of L10 and L9, in that order, to give maximum indication on the audio power meter.

(5) Repeat operation (4) until optimum conditions are obtained, then set the mode switch to OFF.

(6) Lock the cores of L10 and L9 using a compound such as Silicone Coil Retaining Compound Part No. 915906.

Channel Oscillator and 10.7 MHz Input Level Checks

11. (1) Connect an electronic voltmeter, set to the 300 mV r.f. range, to test point TP1 and earth.

(2) Set the synthesizer controls to 4·000 MHz, or the channel oscillator controls to nearest frequency, select VOICE L.S.B. and check that the electronic voltmeter indicates 150mV minimum when a synthesizer is used, or 175mV minimum when a channel oscillator is used.

(3) Connect the electronic voltmeter to test point TP5 and check that an indication of 100 mV minimum is given. Set the mode switch to OFF and remove test equipment.

Mixer Balancing

12. (1) Set the synthesizer controls to 2.000 MHz or the channel oscillator controls to nearest frequency. Connect a signal generator to the 2-4 MHz antenna socket, and tune the generator to provide an output at the selected frequency, at an output level of 2 µV e.m.f. Connect an audio power meter to the A.F. and EARTH terminals of the test set, and adjust the power meter to the 10 mW range at 300Ω input.

(2) Select VOICE U.S.B. and with the GAIN control at maximum adjust the TUNE control and signal generator frequency to give maximum output on the audio power meter.

(3) Switch the signal generator carrier off, adjust RV1 for minimum reading on the power meter.

(4) Restore the signal generator carrier and adjust RV13 to give 2 mW on the power meter.

(5) Set the mode switch to OFF and remove test equipment.

Sensitivity Check

13. (1) Connect an a.f. power meter, set to the 10 mW range at an input impedance of 300Ω to terminals A.F. and EARTH of the test set.

(2) Connect an r.f. signal generator to the 2 - 4 MHz 50Ω antenna socket on the manpack.

(3) Set the synthesizer controls to 2.000 MHz, or the channel oscillator controls to nearest frequency.

(4) Adjust the output of the signal generator to channel frequency plus 1 kHz, unmodulated, at a level of 2µV e.m.f.

(5) Select VOICE U.S.B., set the gain control to maximum, and adjust the TUNE control for maximum output.

(6) Check that the a.f. power meter indicates an output of at least 2 mW.

(7) Retune the signal generator output frequency. Select VOICE L.S.B. and check that a minimum a.f. power meter reading of 2 mW is obtained.

(8) Repeat operations (4) to (7) with the synthesizer controls set to 8 MHz, or the channel oscillator controls set to nearest frequency.

(9) Set the mode switch to OFF. Remove test equipment unless further checks are to be carried out.

Signal to Noise Ratio Check

14. (1) Carry out operations (1) to (5) of the preceding paragraph. Note the a.f. power output.

(2) Mute the signal generator output and check that the power meter indicates at least 15 dB below the previous level.

(3) Repeat the previous operations with the mode switch set to VOICE L.S.B.

(4) Repeat operation (3) with the synthesizer controls set to 8 MHz, or the channel oscillator controls set to nearest frequency, and VOICE U.S.B. selected.

(5) Repeat operation (4) with the VOICE L.S.B. selected.

(6) Set the mode switch to OFF. Remove test equipment unless further checks are to be carried out.

Overall Frequency Response

15. (1) Carry out operations (1) to (5) of para. 13. Connect a digital frequency counter across the a.f. power meter. Adjust the GAIN control to give a power output of 2 mW.

(2) Increase the generator output to 4 μV e.m.f. Gradually increase the frequency of the signal generator until the power output returns to 2 mW.

(3) Check that the frequency indicated on the counter is between 2.5 and 2.5 kHz.

(4) Reset the signal generator to the original frequency, then slowly decrease frequency until the power output drops to 2 mW.

(5) Check that the frequency indicated on the counter is between 100 Hz and 500 Hz.

(6) Repeat the above procedures with VOICE L.S.B. selected.

(7) Set the mode switch to OFF. Remove test equipment unless further checks are to be carried out.

A.G.C. Response Check

16. (1) Carry out operations (1) to (5) of para. 13. Adjust the GAIN control to give 1 mW output.

(2) Increase the signal generator output by 10dB (i.e. to 6 μV e.m.f.) and check that the power output increases to 4 mW maximum.

(3) Increase the signal generator output by a further 90 dB (i.e. to 200 mV e.m.f.) and check that the power output increases to 6 mW maximum.

(4) Set the mode switch to OFF. Remove test equipment unless further checks are to be carried out.

Spurious Response

17. (1) Connect an a.f. power meter, set to the 10 mW range at an input impedance of 300Ω to terminals A.F. and EARTH of the test set.

(2) Connect an r.f. signal generator to the 4-8 MHz 50Ω antenna socket of the manpack.

(3) Set the synthesizer controls to 5.352 MHz or the channel oscillator controls to the nearest frequency.

(4) Adjust the output of the generator to the channel frequency and its output to 2 μV emf.

(5) Select VOICE L.S.B. and adjust the tune controls for maximum output.

(6) Set the gain control to give 2 mW output.

(7) Set the synthesizer controls to 7.999 MHz or the channel oscillator controls to the nearest frequency.

(8) Check that the increase in output level of the signal generator is at least 40 dB above 2 μV to obtain a reading of 2 mW as before, retuning the generator slightly to obtain maximum output.

(9) Adjust the output of the generator to the channel frequency and its output to 2 μV emf.

(10) Adjust the TUNE control for maximum output and set the GAIN control to give 2 mW output.

(11) Re-tune the signal generator to the image frequency of 29.401 MHz and increase the output level until the a.f. power meter again indicates 2 mW.

(12) Ensure that the signal generator output level necessary to achieve 2 mW output is at least 60 dB above 2 μV, i.e. an output level of 2 mV.

(13) Reduce the generator frequency to the i.f. of 10.701 MHz and adjust its output level to obtain an output level of 2 mW.

(14) Ensure that the signal generator output level necessary to achieve 2 mW output is at least 40dB above 2 μV i.e. an output level of 200 μV.

(15) Set the mode switch to OFF and disconnect all test equipment except the CA.470 test set.

TRANSMITTER

Setting of A.F. Amplifier and Speech Clipper Check

18. (1) Connect a link between test point TP8 and earth.

(2) Connect the 600Ω output of the two tone audio generator to MOD and EARTH terminals of the test set. Adjust the generator to provide an 1000 Hz tone at an output level of 6 mV e.m.f.

(3) Connect an electronic voltmeter and an oscilloscope to test point TP9 and earth.

(4) Select HIGH power and VOICE L.S.B. at the mode switch and TRANSMIT at the test set.

(5) Adjust RV10 until an a.f. output of 100 mV is indicated on the electronic voltmeter.

(6) Increase the audio generator output by 10dB (i.e. to 20 mV) and check that the waveform shown on the oscilloscope is compressed.

(7) Set the mode switch to OFF and remove test equipment unless the check given in the next paragraph is to be carried out.

A.F. ~~A.M.~~ Amplifier Response Check

19. (1) With the equipment in the condition given at the end of the previous check, decrease the audio generator output to 6 mV.

(2) Increase the frequency of the audio generator until the indicated output on the electronic voltmeter drops to 50 mV. Check that the frequency of the aduio generator is between 10 and 30 kHz.

(3) Reset the audio generator to 1000 Hz, then decrease frequency until the indicated output again drops to 50 mV. Check that the frequency of the audio generator is between 75 and 150 Hz.

(4) Set the mode switch to OFF and disconnect test equipment except test set and audio oscillator.

Tone Oscillator Check

20. (1) Connect an electronic voltmeter and digital frequency meter to test point TP9 and earth. Set RV9 fully clockwise, set the mode switch to KEY L.S.B. and depress the KEY push button on the test set.

(2) Adjust L15 to give a reading of 1000 Hz on the frequency meter.

(3) Disconnect frequency meter and connect an oscilloscope in its place. Depress the KEY push button and adjust the oscilloscope to display the 1000 Hz note.

(4) Select TUNE and check that the oscilloscope display is muted.

(5) Set the mode switch to OFF, remove oscilloscope and electronic voltmeter from TP9.

NOTE: RV9 must be set to give the required level as in para. 28 (output power setting) after carrying out the above procedure.

Channel Oscillator Output Level Check

21. (1) Connect an electronic voltmeter, set to the 300 mV r.f. range, between test point TP2 and earth.

(2) Select VOICE L.S.B. and TRANSMIT, and check that the electronic voltmeter indicates a level greater than 200 mV, with the synthesizer controls set, in turn, to 2.000, 4.000, and 7.999 MHz, or the channel oscillator controls set to each usable channel in turn.

(3) Set the mode switch to OFF and remove electronic voltmeter.

Balanced Modulator Setting and I.F. Amplifier Alignment

22. (1) Set the synthesizer controls to 4.000 MHz, or the channel oscillator to the nearest frequency. Select the ~~10 W~~ 50W position of the meter on the test set, and connect the test set r.f. connector to the 2-4 MHz 50Ω output socket of the manpack. Connect an oscilloscope to the COUNTER socket of the test set.

(2) Select VOICE L.S.B., TRANSMIT and HIGH power, and adjust the TUNE control for maximum output, modulating the signal as given in para. 18(2).

~~NOTE: Ensure that the meter of the test set is now overloaded, use the 50 W setting if necessary.~~

(3) Adjust RV4 to give an output of approximately 10 W.

(4) Adjust L14 to give maximum output and seal the core using a suitable compound such as Rocol Silicone Coil Retaining Compound MS.2241.

(5) Disconnect the a.f. input and adjust the sensitivity of the oscilloscope to maximum.

(6) Adjust RV7 and C113 to give minimum indication on the oscilloscope.

NOTE: RV4 must be set to give the required I.F. gain as in para. 24 after carrying out the above procedure.

Sideband Filter Output Matching

23. (1) Carry out operations (1) and (2) of the preceeding paragraph.

(2) Note the output level on the power meter.

(3) Select VOICE U.S.B. mode and again note the output level on the meter. If the readings differ adjust RV11 and RV12 as necessary to give identical readings with one of the potentiometer settings remaining fully clockwise.

(4) Switch the mode switch to OFF.

Channel Mixer Balancing and I.F. Amplifier Gain Setting

24. (1) Connect the 600Ω output of an audio generator to the MOD and EARTH terminals of the test set. Set the output to 1100 Hz, at 6 mV.

(2) Select VOICE L.S.B., TRANSMIT and HIGH power, and set the synthesizer controls to 4.00 MHz or the channel oscillator to the nearest frequency. Adjust TUNE control for maximum output.

(3) Adjust RV3 to give maximum power output.

(4) Adjust RV4 to give a power output of 17 W.

(5) Set the mode switch to OFF.

Two-Tone Output Level Tests

25. (1) Connect an oscilloscope to the COUNTER socket on the test set. Connect an electronic voltmeter, set to the 100V range, to the rear of the 2-4 MHz 50Ω output socket.

(2) Set the synthesizer controls to 4 MHz or the channel oscillator to the nearest frequency.

(3) Connect the 600Ω output of a two-tone audio generator to the MOD and EARTH terminals of the test set. Set the output to 1100 Hz and 1800 Hz, each at a level of 5 mV.

(4) Select VOICE L.S.B., TRANSMIT and HIGH power, and check that the two tone test pattern is slightly compressed, due to the action of the speech compressor.

(5) If necessary, slightly adjust the TUNE control for maximum reading on the electronic voltmeter. The reading should not be less than 32V. Set the mode switch to OFF and remove test gear.

Setting of Carrier Re-Insertion Level (A.M. Voice and Tune)

26. (1) Connect an audio generator to the MOD and EARTH terminals of the test set. Connect an oscilloscope to the COUNTER socket of the test set.

(2) Set the synthesizer controls to 4.000 MHz, or the channel oscillator to the nearest frequency, select VOICE A.M., HIGH power and TRANSMIT. Adjust TUNE control for maximum output.

(3) Adjust RV6 to provide a power output of 7 W, with no audio input.

(4) Select LOW power and check that a power output of 1 to 2 W is given.

(5) Tune the audio generator to provide an 1000 Hz input at 50 mV. Select HIGH power and adjust RV8 until the signal, as displayed on the oscilloscope, is 100% modulated.

(6) Select TUNE and check that a power output of 7 W is obtained.

(7) Set the mode switch to OFF, and remove test equipment.

Measurement of Carrier Suppression

27. (1) Remove the audio generator input to the test set, and open circuit the MOD and EARTH terminals.

(2) Connect an oscilloscope to the rear of the 2-4 MHz 50Ω output socket.

(3) Set the synthesizer to 4.000 MHz, or the channel oscillator to the nearest frequency, select TUNE and HIGH power. Adjust the TUNE control for maximum output.

(4) Select VOICE L.S.B. and check that the peak-to-peak voltage indicated on the oscilloscope is not greater than 800 mV.

(5) Select VOICE U.S.B. and repeat operation (4).

(6) Set the mode switch to OFF and remove oscilloscope.

Setting of Output Power-Keying Modes

28. (1) Set the meter switch to the 50 W position. Set the synthesizer controls to 4.000 MHz, or the channel oscillator to the nearest frequency, select KEY L.S.B. mode, and adjust the TUNE control for maximum output with KEY push button depressed.

(2) Adjust RV9, again with KEY push button depressed, to give an output power of 23 W.

(3) Select KEY L.S.B., depress key, and check that the power output is within 22-24W.

(4) Set the synthesizer controls to 2.000 MHz, or the channel oscillator to the nearest frequency, select KEY L.S.B. mode, tune the equipment and check that, with key depressed, an output between 12 and 23 W is obtained.

(5) Repeat operation (4) with the synthesizer controls set to 4.000 MHz, or the channel oscillator set to the nearest frequency, and the output connection connected to the 4-8 MHz socket.

(6) Repeat operation (5) with the synthesizer controls set to 7.999 MHz, or the channel oscillator set to the nearest frequency.

(7) Set the mode switch to OFF, unless the check given in the next paragraph is to be carried out.

Sidetone Check

29. This check should be carried out after the procedure in the preceding paragraph has been carried out.

(1) With the equipment in the condition given at the end of the preceding paragraph connect an electronic voltmeter, set to the 1V range, to the A.F. and EARTH terminals of the test set.

(2) Select KEY U.S.B., press the KEY push button, and check that an audio output of between 150 and 300 mV is indicated.

(3) Select KEY L.S.B. and repeat operation (2).

(4) Select TUNE and check that an audio output of between 150 and 300 mV is indicated.

(5) Set the mode switch to OFF and remove all test equipment.

CHAPTER 4

FAULT FINDING

INTRODUCTION

1. The information given in this chapter will, in the majority of cases, allow the fault to be localised to a stage or ancillary component with the minimum use of test equipment. When the faulty stage is determined, the faulty component can be found by checking static voltages at individual components. A table of typical voltages is given at the end of this chapter.

INITIAL PROCEDURE

2. It is advisable to commence fault finding with a battery voltage check, or, if available, to operate the equipment from the test set CA.470. The test set can be used to indicate r.f. power output.

3. The next operation should be to check the ancillary equipment such as headsets, p.t.t. switches, keys and antenna, as this equipment can receive severe handling under operational conditions. The easiest method of checking is by substituting equipment known to be functional in place of the suspect item.

4. A final check prior to internal investigation can be made by checking ancillary equipment connected in turn to both of the two audio sockets on the front panel of the manpack.

FAULT LOCATION PROCEDURE

5. If the foregoing procedure does not locate a fault then the internal circuitry of the unit must be suspected. Prior to removing the equipment from its case a deductive procedure should be adopted on the following lines.

6. Check whether the fault is in the transmit or receive circuits, or in both. If the fault is in only one circuit the common stages can be eliminated. A study of the block diagram fig. 2, will show that, amongst others, this will eliminate the channel frequency input, the antenna circuit, the power supply and, if a mode other than VOICE A.M. is chosen, the 10.7 MHz frequency input (this input is absent in VOICE A.M. reception). The u.s.b., l.s.b. and a.m. filters and switches can also be eliminated.

7. If, say, reception only is possible, the transmitter should be checked in all modes. The inability to transmit in any mode will eliminate the input pre-amplifier and the speech compressor circuit of the transmitter, as these are not in use

during keying modes. The operation of both relays (in HIGH power) should be checked.

8. The output of the tone oscillator can be heard in the a.f. circuits during tuning, this provides a simple method of checking the tone oscillator and the receiver a.f. circuits.

9. Further transmitter checks could consist of checking whether an output is given during tuning, using the test set; if for example an output was available during tuning but not at any other time, the VT37 buffer stage would need checking, followed by the modulator D24a, D24b (which is unlikely to be faulty in this particular instance) and the 'Unbalancing Gate' incorporating RV6 (which would cause a failure during VOICE A.M. working).

10. The above procedure is not intended to be exhaustive, but to illustrate how, with a few simple tests carried out without dismantling the equipment, it may be possible to determine the stage or stages that are faulty.

11. The faulty stages can now be checked by taking voltage measurements at the appropriate points listed in the Table, or by injecting a signal at the input of the suspect stage. If a signal is injected, the signal level should not be excessive.

STATIC VOLTAGE CHECKS

12. The voltages given in the following table are typical values, and were measured with an Avometer Model 8 multimeter (20 kΩ per volt) under the condition stated, with no input signal and an 18V power supply. All readings are positive with respect to ground.

TABLE OF STATIC VOLTAGES

Test Point	D.C. Voltage		Condition
VT1 collector	7.9	)	
VT1 emitter	1.0	)	
VT1 base	1.6	)	
VT2 collector	7.9	)	RECEIVE, VOICE L.S.B.
VT2 emitter	1.0	)	
VT2 base	1.6	)	
R5/D2 junction	0.7	)	
D5/L2 junction	7.0	)	
D5/L2 junction	8.2		TRANSMIT, VOICE L.S.B., HIGH POWER
VT4/VT6 base	0.9		RECEIVE OR TRANSMIT, VOICE L.S.B.
VT10/VT12 base	0.9		RECEIVE OR TRANSMIT, VOICE L.S.B.
VT3/VT5 base	0.9		RECEIVE OR TRANSMIT, VOICE U.S.B.
VT9/VT11 base	0.9		RECEIVE OR TRANSMIT, VOICE U.S.B.
VT7/VT8 base	0.9		RECEIVE OR TRANSMIT, VOICE A.M.
T4/R15 junction	4.2		RECEIVE , VOICE L.S.B.
T4/R15 junction	6.8		TRANSMIT, VOICE L.S.B., HIGH POWER
VT13 collector	8.9	)	
R20/R21 junction	1.3	)	
R25/26 junction	1.3	)	
VT14 collector	9.0	)	
VT15 collector	8.7	)	
VT15 emitter	1.4	)	
VT16 emitter	8.4	)	
VT17 collector	7.5	)	
VT17 emitter	0.2	)	
VT19 collector	4.4	)	
VT19 emitter	0.9	)	RECEIVE, VOICE L.S.B.
VT20 base	0.9	)	
VT21 collector	8.8	)	
VT21 emitter	4.0	)	
~~VT21 base~~	4.6	)	
VT22 collector	0.3	)	
VT22 emitter	4.0	)	
VT22 base	3.4	)	
VT23 collector	18.0	)	
VT23 emitter	9.3	)	
VT23 base	9.8	)	

TABLE OF STATIC VOLTAGES (CONTINUED)

Test Point	D.C. Voltage	Condition
VT24 collector	19.0)	
VT24 base	0.6)	
VT25 collector	19.0)	
VT25 base	0.6)	
D3/R67 junction	0.7)	
VT26 collector	19.0)	
VT26 emitter	0.6)	TRANSMIT, VOICE L.S.B. HIGH POWER
VT27 collector	19.0)	
VT27 emitter	0.6)	
VT28 collector	7.1)	
VT28 emitter	1.4)	
VT28 base	2.0)	
VT29 collector	1.3	TRANSMIT, VOICE L.S.B., HIGH POWER
VT29 collector	9.1	TRANSMIT, VOICE L.S.B., LOW POWER
VT29 emitter	1.3	TRANSMIT, VOICE L.S.B., HIGH POWER
VT29 emitter	1.0	TRANSMIT, VOICE L.S.B., LOW POWER
VT29 base	1.9	TRANSMIT, VOICE L.S.B., HIGH POWER
VT29 base	0	TRANSMIT, VOICE L.S.B., LOW POWER
VT30 emitter	0.3)	
VT30 base	1.1)	
VT31 collector	6.8)	
VT31 emitter	0.6)	
VT31 base	1.1)	
VT32 collector	6.8)	
VT32 emitter	0.6)	TRANSMIT, VOICE L.S.B., HIGH POWER
VT32 base	1.2)	
VT33 collector	6.0)	
VT33 emitter	3.2)	
VT34 collector	8.6)	
VT34 emitter	1.9)	
VT35 base	0.8)	
VT35 base	0	TRANSMIT, VOICE L.S.B., LOW POWER
VT36 collector	8.9)	
VT36 emitter	1.5)	TRANSMIT, VOICE L.S.B., HIGH POWER
VT37 collector	9.1)	
VT37 emitter	3.0)	
VT38 collector	0)	TUNE, LOW POWER
VT38 base	0.6)	

TABLE OF STATIC VOLTAGES (CONTINUED)

Test Point	D.C. Voltage	Condition
RV8/D25 junction	0.6	TRANSMIT, VOICE A.M., LOW POWER
VT39 collector	4.4)	TRANSMIT, VOICE L.S.B., HIGH POWER
VT39 emitter	0.6)	
VT39 base	1.2)	
VT40 base	0.6)	
VT41 collector	8.3)	TUNE, LOW POWER
VT41 emitter	4.8)	
VT41 base	5.1)	
R153/D27 junction	0.7)	

DYNAMIC VOLTAGE CHECKS

13. The voltages given in the following table are typical values and were measured using an electronic voltmeter, under the conditions stated, with no signal input.

Test Point	R.F. Voltage	Condition
TP1	250 mV	RECEIVE, VOICE L.S.B.
TP2	370 mV	TRANSMIT, VOICE L.S.B., HIGH POWER
TP3	85 mV	TRANSMIT, KEY L.S.B., HIGH POWER
TP5	215 mV	RECEIVE, VOICE L.S.B.
TP7	100 mV	TRANSMIT, KEY L.S.B., HIGH POWER
TP8	420 mV	TRANSMIT, KEY L.S.B., HIGH POWER
TP9	115 mV	TRANSMIT, KEY L.S.B., HIGH POWER

CHAPTER 5

DISMANTLING AND RE-ASSEMBLY

INTRODUCTION

1. Dismantling and re-assembly procedures are, in general, self-evident. The following instructions should be noted to prevent damage to the equipment during these procedures.

WARNING: DO NOT APPLY GREASE OR ANY FORM OF SEALING COMPOUND TO THE SEAL RETAINING GROOVES OR THE RUBBER SEALING RINGS WHEN RE-ASSEMBLING THIS EQUIPMENT.

Front Panel/Main Case Assembly

2. Under no circumstances should grease or any other sealing compound be used on the plastic cases or front panels for sealing purposes as this may induce stress cracks.

Battery Box

3. The sealing rings of the retaining screws on the battery case should be lightly lubricated. Under normal operating conditions the grease applied to these rings during manufacture will last the life of the equipment. In the event of the replacement of the rings, the recommended lubricant is silicone grease Part No.917814.

Pressure Testing

4. During manufacture a sealing test at an internal pressure of 2 psi (0.9 kg/cm^2) is carried out, it is normally necessary to repeat this test. If however a pressure test is required internal pressures greater than 10 psi (4.5 kg/cm^2) must be avoided to prevent distortion of the main case.

REMOVAL FROM, AND REPLACEMENT INTO HAVERSACK

5. Remove antenna, headsets etc. from the unit. Loosen the two screws in the bottom of the haversack and remove the manpack from the haversack. Replacement is self-evident.

REMOVAL AND REPLACEMENT OF BATTERY PACK

6. After removal from the haversack the two screws in the base of the battery

container can be loosened and the container removed. Prior to replacement the seal at the underside of the case must be examined for damage and renewed, if necessary.

NOTE: The battery can be charged, via an audio socket, without removing it from the manpack.

REMOVAL AND REPLACEMENT OF MAIN UNIT

7. Remove sixteen screws from the underside of the front panel and slide out the main unit until access can be gained to the terminal block to which the power supply connectors are screwed. Remove connectors and remove main unit.

8. Prior to replacement of main unit check the seal at the underside of the front panel for damage, and renew if necessary. Re-connect power supplies, slide the main unit into the case and replace sixteen securing screws.

NOTE: Do not over tighten screws. The torque wrench type BA 700449 should be used.

OPERATIONS ON MAIN UNIT

9. The transceiver and synthesizer or 49 channel crystal oscillator units are housed in light alloy cases. Removal of the covers from the case is self evident, and only the outer covers need to be removed unless components are to be changed. The transceiver case is hinged, and can be swung away from the synthesizer or oscillator case when a clamp, at the base of the unit is unscrewed and the a.t.u. plug removed. Care must be taken to ensure that the hinged panel does not cause damage by being allowed to swing freely.

RELAYS

10. The two relays are plug-in units and can easily be changed after a clamp has been removed.

KNOBS

11. It is not necessary to remove knobs unless a switch or variable component has to be changed. The knob is removed by first removing the cap at the top of the knob, then loosening the collet screw.

ORDERS FOR SPARE PARTS

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

(1) Type and serial number of equipment.

(2) Circuit reference, description, Racal part number.

(3) Quantity required.

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

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part No.

CHAPTER 6

LIST OF COMPONENTS

(MA.924)

Resistors

	ohms		watts		
R1	100	Carbon film	1/3	±10	914938
R2	6.8k	Carbon film	1/3	±10	914947
R3	18k	Carbon film	1/3	±10	915153
R4	150	Carbon film	1/3	±10	914939
R5	2.2k	Carbon film	1/3	±10	914944
R6	120	Carbon film	1/3	±10	915132
R7	220	Carbon film	1/3	±10	914940
R8	390	Carbon film	1/3	±10	915145
R9	1k	Carbon film	1/3	±10	914943
R10	1k	Carbon film	1/3	±10	914943
R11	1k	Carbon film	1/3	±10	914943
R12	1k	Carbon film	1/3	±10	914943
R13	1k	Carbon film	1/3	±10	914943
R14	1k	Carbon film	1/3	±10	914943
R15	1k	Carbon film	1/3	±10	914943
R16	220	Carbon film	1/3	±10	914940
R17	10k	Carbon film	1/3	±10	911914
R18	3.3k	Carbon film	1/3	±10	914945
R19	220	Carbon film	1/3	±10	914940
R20	150	Carbon film	1/3	±10	914939
R21	1k	Carbon film	1/3	±10	914943
R22	10k	Carbon film	1/3	±10	911914
R23	3.3k	Carbon film	1/3	±10	914945
R24	220	Carbon film	1/3	±10	914940
R25	NOT USED				
R26	1k	Carbon film	1/3	±10	914943
R27	10k	Carbon film	1/3	±10	911914
R28	3.3k	Carbon film	1/3	±10	914945
R29	220	Carbon film	1/3	±10	914940
R30	1k	Carbon film	1/3	±10	914943

Alternative values of R26 may be 680Ω Racal Part Number 914942
470Ω Racal Part Number 914941

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part No.
Resistors (contd)					
	ohms		watts		
R31	150	Carbon film	1/3	±10	914939
R32	10k	Carbon film	1/3	±10	911914
R33	100k	Carbon film	1/3	±10	915112
R34	10k	Carbon film	1/3	±10	911914
R35	3.3k	Carbon film	1/3	±10	914945
R36	12k	Carbon film	1/3	±10	915151
R37	150	Carbon film	1/3	±10	914939
R38	560	Carbon film	1/3	±10	915146
R39	47k	Carbon film	1/3	±10	914950
R40	82k	Carbon film	1/3	±10	915154
R41	5.6k	Carbon film	1/3	±10	915150
R42	1k	Carbon film	1/3	±10	914943
R43	12k	Carbon film	1/3	±10	915151
R44	15k	Carbon film	1/3	±10	915152
R45	2.7k	Carbon film	1/3	±10	915148
R46	560	Carbon film	1/3	±10	915146
R47	4.7k	Carbon film	1/3	±10	914946
R48	3.9k	Carbon film	1/3	±10	915149;
R49	1.2k	Carbon film	1/3	±10	915108
R50	680	Carbon film	1/3	=10	914942
R51	100k	Composition	1/10	±10	902532
R52	120	Carbon film	1/3	±10	915132
R53	10Ω	Composition	1/3	±10	902411
R54	150	Carbon film	1/3	±10	914939
R55	100	Carbon film	1/3	±10	914938
R56	5.6k	Carbon film	1/3	±10	915150
R57	39	Composition	1/4	±10	902418
R58	39	Composition	1/4	±10	902418
R59	39	Composition	1/4	±10	902418
R60	39	Composition	1/4	±10	902418
R61	820	Carbon film	1/3	±10	915144
R62	820	Carbon film	1/3	±10	915144
R63	820	Carbon film	1/3	±10	915144
R64	820	Carbon film	1/3	±10	915144
R65	18	Carbon film	1/3	±10	915138

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part No.
Resistors (contd)					
	ohms		watts		
R66	18	Carbon film	1/3	±10	915138
R67	2.2k	Carbon film	1/3	±10	914944
R68	100	Carbon film	1/3	±10	914938
R69	100	Carbon film	1/3	±10	914938
R70	100	Carbon film	1/3	±10	914938
R71	100	Carbon film	1/3	±10	914938
R72	3	Wirewound	1½	±10	915155
R73	22	Carbon film	1/3	±10	915139
R74	22	Carbon film	1/3	±10	915139
R75	220	Carbon film	1/3	±10	914940
R76	68	Carbon film	1/3	±10	915135
R77	68	Carbon film	1/3	±10	915135
R78	1.2k	Carbon film	1/3	±10	915108
R79	1.2k	Carbon film	1/3	±10	915108
R80	220	Carbon film	1/3	±10	914940
R81	12	Carbon film	1/3	±10	915136
R82	12	Carbon film	1/3	±10	915136
R83	1k	Carbon film	1/3	±10	914943
R84	10k	Carbon film	1/3	±10	911914
R85	47	Carbon film	1/3	±10	914937
R86	820	Carbon film	1/3	±10	915144
R87	39	Carbon film	1/3	±10	915120
R88	560	Carbon film	1/3	±10	915146
R89	2.2k	Carbon film	1/3	±10	914944
R90	3.3k	Carbon film	1/3	±10	914945
R91	33	Carbon film	1/3	±10	915140
R92	1k	Carbon film	1/3	±10	914943
R93	33k	Carbon film	1/3	±10	915111
R94	56	Carbon film	1/3	±10	915134
R95	180	Carbon film	1/3	±10	915143
R96	220	Carbon film	1/3	±10	914940
R97	1k	Carbon film	1/3	±10	914943
R98	15	Carbon film	1/3	±10	915137
R99	15	Carbon film	1/3	±10	915137
R100	4.7k	Carbon film	1/3	±10	914946

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part No.
Resistors (contd)					
	ohms		watts		
R101	NOT USED				
R102	1k	Carbon film	1/3	±10	914943
R103	560	Carbon film	1/3	±10	915146
R104	220	Carbon film	1/3	±10	914940
R105	NOT USED				
R106	47	Carbon film	1/3	±10	914937
R10	820	Carbon film	1/3	±10	915144
R108	820	Carbon film	1/3	±10	915144
R109	10	Carbon film	1/3	±10	914936
R110	1k	Carbon film	1/3	±10	914943
R111	820	Carbon film	1/3	±10	915144
R112	3.3k	Carbon film	1/3	±10	914945
R113	220	Carbon film	1/3	±10	914940
R114	390	Carbon film	1/3	±10	915145
R115	150	Carbon film	1/3	±10	914939
R116	180	Carbon film	1/3	±10	915143
R117	6.8k	Carbon film	1/3	±10	914947
R118	3.3k	Carbon film	1/3	±10	914945
R119	2.2k	Carbon film	1/3	±10	914944
R120	NOT USED				
R121	100k	Carbon film	1/3	±10	915112
R122	15k	Carbon film	1/3	±10	915152
R123	NOT USED				
R124	820	Carbon film	1/3	±10	915144
R125	100	Carbon film	1/3	±10	914938
R126	100	Carbon film	1/3	±10	914938
R127	220	Carbon film	1/3	±10	914940
R128	220	Carbon film	1/3	±10	914940
R129	1k	Carbon film	1/3	±10	914943
R130	10k	Carbon film	1/3	±10	911914
R131	3.5k	Carbon film	1/3	±10	914945
R132	220	Carbon film	1/3	±10	914940
R133	2.7k	Carbon film	1/3	±10	915148
R134	47k	Carbon film	1/3	±10	914950
R135	33k	Carbon film	1/3	±10	915111

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part No.
Resistors (contd)					
	ohms		watts		
R136	47k	Carbon film	1/3	±10	914950
R137	33k	Carbon film	1/3	±10	915111
R138	100k	Carbon film	1/3	±10	915112
R139	47k	Carbon film	1/3	±10	914950
R140	15k	Carbon film	1/3	±10	915152
R141	100k	Carbon film	1/3	±10	915112
R142	1.5k	Carbon film	1/3	±10	915109
R143	220	Carbon film	1/3	±10	914940
R144	2.7k	Carbon film	1/3	±10	915148
R145	47	Carbon film	1/3	±10	914937
R146	330	Carbon film	1/3	±10	915107
R147	2.2k	Carbon film	1/3	±10	914944
R148	220	Carbon film	1/3	±10	914940
R149	680	Carbon film	1/3	±10	914942
R150	12k	Carbon film	1/3	±10	915151
R151	33k	Carbon film	1/3	±10	915111
R152	12k	Carbon film	1/3	±10	915151
R153	1k	Carbon film	1/3	±10	914943
R154	1.5k	Carbon film	1/3	±10	915109
R155	1.5k	Carbon film	1/3	±10	915109
R156	1.5k	Carbon film	1/3	±10	915109
R157	1.5k	Carbon film	1/3	±10	915109
R158	1k	Carbon film	1/3	±10	914943
R159	Not Used				
R160	Not Used				
Potentiometers					
	ohms				
RV1	100	Linear, preset			919513
RV2	5k	[redacted]			711054
RV3	220	Linear, preset			919518
RV4	100	Linear, preset			919513
RV5	NOT USED				

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part No.
Potentiometers (contd)					
	ohms				
RV6	4.7k	Linear, preset			919511
RV7	470	Linear, preset			919514
RV8	1k	Linear, preset			919516
RV9	100k	Linear, preset			919512
RV10	4.7k	Linear, preset			919511
RV11	100	Linear, preset			919513
RV12	100	Linear, preset			919513
RV13	4.7k	Linear, preset			919511
Capacitors					
	F		Volts		
C1	33p	Ceramic	4k	±5	915127
C2	33p	Ceramic	4k	±5	915127
C3	33p	Ceramic	4k	±5	915127
C4	.01μ	Ceramic	63	±20	916187
C5	.01μ	Ceramic	63	±20	915173
C6	.01μ	Ceramic	63	±20	915173
C7	.01μ	Ceramic	63	±20	916187
C8	.01μ	Ceramic	63	±20	916187
C9	.01μ	Ceramic	63	±20	915173
C10	NOT USED				
C11	68p	Polystyrene	30	±2½	908321
C12	150p	Polystyrene	30	±2½	908331
C13	.01μ	Ceramic	63	±20	915173
C14	4.7μ	Electrolytic	35	±20	914026
C15	.01μ	Ceramic	63	±20	915173
C16	NOT USED				
C17	NOT USED				
C18	.01μ	Ceramic	63	±20	916187
C19	.01μ	Ceramic	63	±20	916187
C20	.01μ	Ceramic	63	±20	915173
C21	.01μ	Ceramic	63	±20	915173
C22	.01μ	Ceramic	63	±20	916187
C23	.01μ	Ceramic	63	±20	916187
C24	.01μ	Ceramic	63	±20	916187
C25	150p	Polystyrene		±5	916514

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part No.
Capacitors (contd)					
	F		Volts		
C26	470p	Polystyrene		±20	916870
C27	.01μ	Ceramic	63	±20	915173
C28	.01μ	Ceramic	63	±20	916187
C29	.01μ	Ceramic	63	±20	916187
C30	.01μ	Ceramic	63	±20	916187
C31	150p	Polystyrene		±5	916514
C32	470p	Polystyrene		±20	916870
C33	.01μ	Ceramic	63	±20	915173
C34	.01μ	Ceramic	63	±20	916187
C35	.01μ	Ceramic	63	±20	916187
C36	270p	Polystyrene	30	±2½	913452
C37	.01μ	Ceramic	63	±20	915173
C38	.01μ	Ceramic	63	±20	916187
C39	.01μ	Ceramic	63	±20	916187
C40	.01μ	Ceramic	63	±20	916187
C41	.47±	Electrolytic	35	±20	915168
C42	.01μ	Ceramic	63	±20	916187
C43	.01μ	Ceramic	63	±20	916187
C44	22μ	Electrolytic	15	±20	915169
C45	.47μ	Electrolytic	35	±20	915168
C46	4.7μ	Electrolytic	35	±20	914026
C47	150p	Polystyrene	30	±2½	908331
C48	100μ	Electrolytic	3	±20	915170
C49	.22μ	Polycarbonate		±20	917205
C50	.01μ	Ceramic	63	±20	916187
C51	4.7μ	Electrolytic	35	±20	914026
C52	.01μ	Ceramic	63	±20	916187
C53	.01μ	Ceramic	63	±20	916187
C54	4.7μ	Electrolytic	35	±20	914026
C55	.47μ	Electrolytic	35	±20	915168
C56	.01μ	Ceramic	63	±20	916187
C57	.01μ	Ceramic	63	±20	916187
C58	150p	Polystyrene	30	±2½	908331
C59	.01μ	Ceramic	63	±20	916187
C60	22μ	Electrolytic	15	±20	915169

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part No.
Capacitors (contd)	F		Volts		
C61	.001μ	Polystyrene	30	±2½	908583
C62	4.7μ	Electrolytic	35	±20	914026
C63	100μ	Electrolytic	3	±20	915170
C64	NOT USED				
C65	22μ	Electrolytic	15	±20	915169
C66	22μ	Electrolytic	15	±20	915169
C67	4.7μ	Electrolytic	35	±20	914026
C68	~~250μ~~ 220μ	Electrolytic	25	+50-10	~~910911~~ 921536
C69	.1 μ	Ceramic		+40-20	906675
C70	.1 μ	Ceramic		+40-20	906675
C71	.1 μ	Ceramic		+40-20	906675
C72	.1 μ	Ceramic		+40-20	906675
C73	.1 μ	Ceramic		+40-20	906675
C74	.1 μ	Ceramic		+40-20	906675
C75	560p	Ceramic	500	±10	915128
C76	560p	Ceramic	500	±10	915128
C77	.01μ	Ceramic	~~63~~ 250v	~~±20~~ +40 -20	~~900067~~ 916187
C78	.01μ	Ceramic	63	±20	915173
C79	.01μ	Ceramic	63	±20	915173
C80	.0015 μ	Ceramic	500	±20	911850
C81	.0015 μ	Ceramic	500	±20	911850
C82	250 μ	Electrolytic	25	+50-10	910911
C83	250 μ	Electrolytic	25	+50-10	910911
C84	.01 μ	Ceramic	63	±20	915173
C85	.01 μ	Ceramic	63	±20	916187
C86	.01 μ	Ceramic	63	±20	915173
C87	.01 μ	Ceramic	63	±20	915173
C88	NOT USED				
C89	~~470p~~	~~Polystyrene~~	~~30~~	~~±2½~~	~~908317~~
C90	.01 μ	Ceramic	63	±20	916187
C91	.01 μ	Ceramic	63	±20	915173
C92	.01 μ	Ceramic	63	±20	915173
C93	.01 μ	Ceramic	63	±20	915173
C94	.01 μ	Ceramic	63	±20	915173
C95	NOT USED				

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part No.
Capacitors (contd)					
	F		Volts		
C96	.01 μ	Ceramic	63	±20	916187
C97	.01 μ	Ceramic	63	±20	916187
C98	.01 μ	Ceramic	63	±20	915173
C99	.01 μ	Ceramic	63	±20	916187
C100	.01 μ	Ceramic	63	±20	916187
C101	.01 μ	Ceramic	63	±20	915173
C102	.01 μ	Ceramic	63	±20	915173
C103	470p	Polystyrene		±20	916870
C104	150p	Polystyrene		±5	916514
C105	22 μ	Electrolytic	35	±20	915169
C106	.01 μ	Ceramic	63	±20	915173
C107	.01 μ	Ceramic	63	±20	915173
C108	.01 μ	Ceramic	63	±20	915173
C109	.01 μ	Ceramic	63	±20	916187
C110	.01 μ	Ceramic	63	±20	916187
C111	NOT USED				
C112	.01 μ	Ceramic	63	±20	916187
C113	2.10p	Var.ceramic			918716
C114	2.7p	Ceramic	500	±0.5	909889
C115	.47 μ	Electrolytic	35	±20	915168
C116	.01 μ	Ceramic	63	±20	915173
C117	.01 μ	Ceramic	63	±20	916187
C118	.01 μ	Ceramic	63	±20	916187
C119	.01 μ	Ceramic	63	±20	916187
C120	.01 μ	Ceramic	63	±20	916187
C121	4.7 μ	Electrolytic	35	±20	914026
C122	.001 μ	Polystyrene	30	±2½	908583
C123	4.7 μ	Electrolytic	35	±20	914026
C124	4.7 μ	Electrolytic	35	±20	914026
C125	4.7 μ	Electrolytic	35	±20	914026
C126	.01 μ	Ceramic	63	±20	916187
C127	4.7 μ	Electrolytic	35	±20	914026
C128	22 μ	Electrolytic	15	±20	915169
C129	.47 μ	Polycarbonate		±10	915172
C130	.47 μ	Polycarbonate		±10	915172

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part No.
Capacitors (Contd)					
	F		Volts		
C131	.01 μ	Ceramic	63	±20	916187
C132	.001 μ	Polystyrene	30	±2½	908583
C133	.002 μ	Polystyrene	30	±2½	915167
C134	4.7 μ	Electrolytic	35	±20	914026
C135	4.7 μ	Electrolytic	35	±20	914026
C136	.01 μ	Ceramic	63	±20	916187
C137	.47 μ	Electrolytic	35	±20	915168
C138	4.7 μ	Electrolytic	35	±20	914026
C139	.01 μ	Ceramic	63	±20	916187
C140	.01 μ	Ceramic	63	±20	916187
C141	.01 μ	Ceramic	63	±20	916187
C142	.01 μ	Ceramic	63	±20	916187
C143	.01 μ	Ceramic	63	±20	916187
C144	.01 μ	Ceramic	63	±20	916187
Inductors					
	H				
L1					BT 710023
L2	NOT USED				
L3	330 μ	Choke, sub miniature		±10	911593
L4	330 μ	Choke, sub miniature		±10	911593
L5	330 μ	Choke, sub miniature		±10	911593
L6	330 μ	Choke, sub miniature		±10	911593
L7	330 μ	Choke, sub miniature		±10	911593
L8	68μ	Choke			915848
L9					CT 710024
L10					CT 710024
L11	330 μ	Choke, sub miniature		±10	911593
L12	330 μ	Choke, sub miniature		±10	911593
L13	330 μ	Choke, sub miniature		±10	911593
L14					CT 710024
L15					CT 710025
L16	330 μ	Choke, sub miniature		±10	911593

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part No.
Transformers					
T1					BT 710034
T2					BT 710029
T3					BT 710030
T4					BT 710027
T5					BT 710028
T6					CT 710008
T7					CT 710035
T8					CT 710035
T9					BT 710026
T10					BT 710026
T11					BT 710032
T12					BT 710034
T13					BT 710033
T14					BT 710032
Switches					
SA		Rotary			BD 700219
SB		Lever			900265
Transistors					
VT1		SX 407 or T1 407K			915117
VT2		SX 407 or T1 407K			915117
VT3	NOT USED				
VT4	NOT USED				
VT5	NOT USED				
VT6	NOT USED				
VT7	NOT USED				
VT8	NOT USED				
VT9	NOT USED				
VT10	NOT USED				
VT11	NOT USED				
VT12	NOT USED				
VT13		SX 407 or T1 407K			915117
VT14		2N 4996			916493
VT15		2N 4996			916493

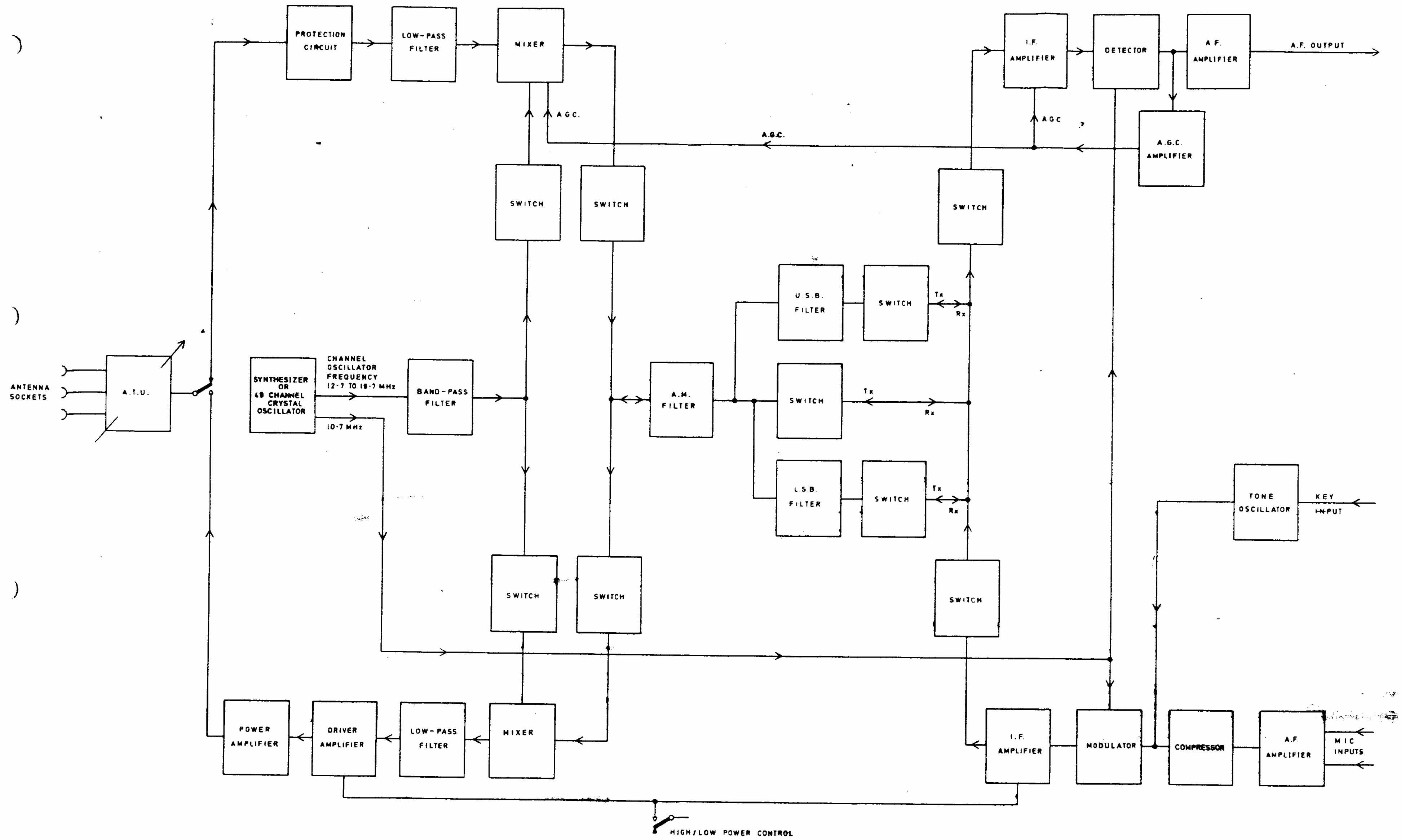
Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part No.
Transistors (contd)					
VT16		SX 3711 or 2N 3711K			915119
VT17		2N 4996			916493
VT18		SX 3711 or 2N 3711K			915119
VT19		SX 3711 or 2N 3711K			915119
VT20		SX 3711 or 2N 3711K			915119
VT21		2N 5450			915133
VT22		2N5448			915118
VT23		2N 3054			911951
VT24*		U 14630/3			915130
VT25*		U 14630/3			915130
VT26		BSX61			916632
VT27		BSX61			916632
VT28		BSX61			916632
VT29		SX3711 or 2N3711K			915119
VT30		SX407 or T1 407K			915117
VT31		SX407 or T1 407K			915117
VT32		SX407 or T1 407K			915117
VT33		SX407 or T1 407K			915117
VT34		SX407 or T1 407K			915117
VT35		SX407 or T1 407K			915117
VT36		SX407 or T1 407K			915117
VT37		SX3711 or 2N 3711K			915119
VT38		SX3711 or 2N 3711K			915119
VT39		SX3711 or 2N 3711K			915119
VT40		SX3711 or 2N 3711K			915119
VT41		SX3711 or 2N 3711K			915119

* VT24 and VT25 must be replaced as a matched pair by selecting devices with identical colour code spots. The colour may be red, green, brown or black.

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part No.
Diodes					
D1a/b		1N4149			914898
D2		1N4149			914898
D3		1N419			914898
D4a/b		BAV10			918130
D5		1N4149			914898
D6		1N4149			914898
D7		1N4149			914898
D8		1N4149			914898
D9		1N4149			914898
D10		1N4149			914898
D11		1N4149			914898
D12		1N4149			914898
D13		1N4149			914898
D14a/b		1N4149			914898
D15a/b		1N4149			914898
D16		1S2100A			909902
D17		BZY93-C27R			918084
D18		1N4149			914898
D19		0A91			900071
D20		1N4149			914898
D21		1N4149			914898
D22		10D1			909879
D23a/b		1N4149			914898
D24a/b		BAV10			918130
D25a		1N4149			914898
D26a/b		1N4149			914898
D27		1N4149			914898
D28		BA182			921781
D29		BA182			921781
D30		BA182			921781
D31		BA182			921781
D32		BA182			921781

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part No.
D33		BA182			921781
D34		BA182			921781
D35		BA182			921781
D36		BA182			921781
D37		BA182			921781
Plugs and Sockets					
PL1					906391
PL2					906391
PL6					916884
SKT1					905449
SKT2					905449
SKT3					BD 70007
SKT4					909908
SKT5					909908
SKT6					916885
Relays					
RLA					909880
RLB					909880
Fuses					
FS2		Size 00 350 mA			907842
Miscellaneous					
ME1		Meter			AR711005
		Terminal (ground)			901399
		Dessicator, black			909909
TB1		Terminal Block, 2 way			906882
		Knob (Gain and Tune)			915125
		Knob (Mode Switch)			915126
FL1		Filter			AR 711041
FL2		Filter			BR 711046
FL3		Filter			AR 711050
FL4		Filter			BR 711031
FL5		Filter			BR 711030
FL6		Filter			AR 711041

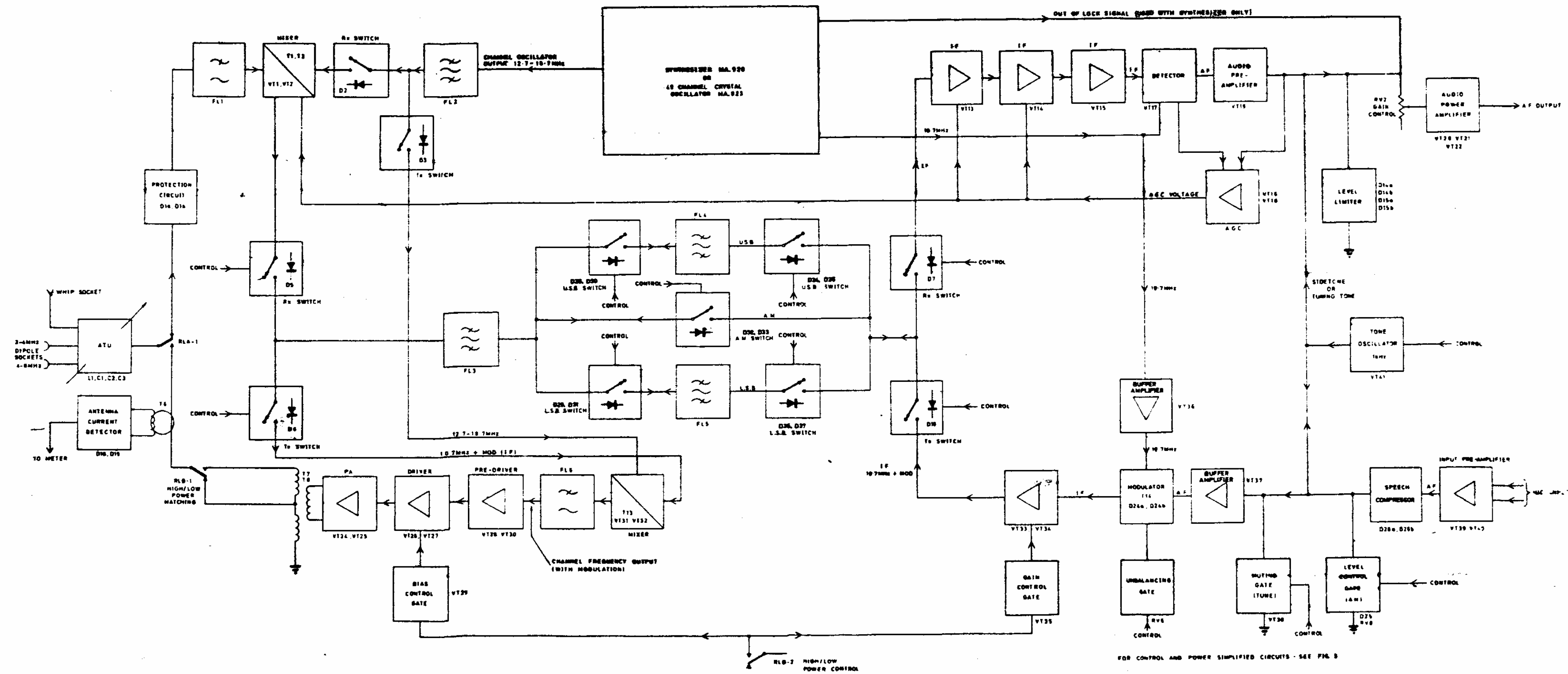
Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part No.
		Heat sink			915176
		Mounting pad for transistors			915177
		Mounting pad for transistors (T05)			909933
		Socket (test points)			915179
		Fuse Holder, Size 00			900412
		Socket for relay			909881
		Clamp for relays			AD 700414



H610/1-2 Part 2

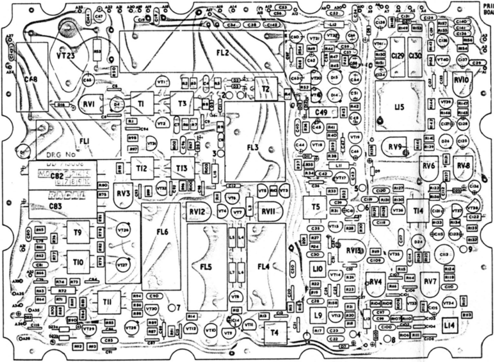
Simplified Block Diagram: Transceiver MA.924

Fig.1



Block Diagram : Transceiver MA.924

Fig. 2

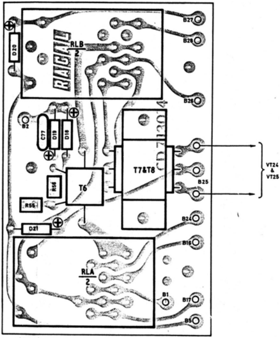


PRINTED CIRCUIT BOARD No. 1

DD713008/3	DD713008/	DA.700316/1
6	7 2	7 8

M410/6 2
Part 2

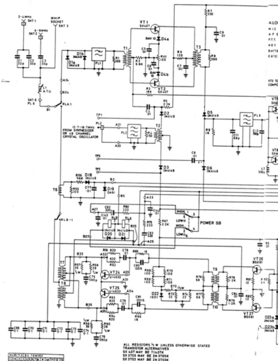
Component Layout: P.C. Boards Transceiver MA.924



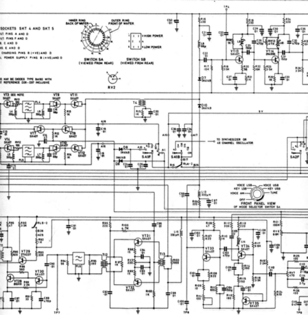
PRINTED CIRCUIT BOARD No. 2

CD713014/2	CD713014/1
2	1

Fig. 6



ALL RESISTORS ½ W UNLESS OTHERWISE STATED
TRANSISTOR ALTERNATIVES
SX 407 MAY BE TI407K
SX 3705 MAY BE 2N 3705K
SX 3703 MAY BE 2N 3703K
SX 3711 MAY BE 2N 3711K



Circuit : Transceiver MA.924

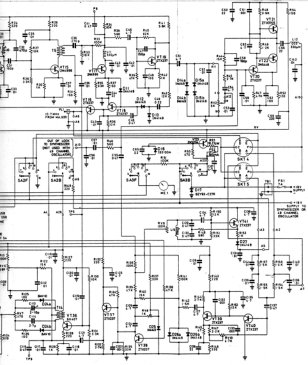


Fig.7

53. VT42 and VT43 are separate amplifiers driven by VT44. The output via VT43 is fed to the mixer in the tuning loop (Fig. 5) and that via VT42 drives the main output buffer VT45/VT46 and also the oscillator a.g.c. circuit.

54. Oscillator A.G.C. The amplitude in each oscillator circuit is controlled by the conductivity of VT41. If the amplitude of the oscillatory feedback into the emitters of VT39/VT40 tends to increase, a lower impedance is automatically developed by a -ve bias applied to VT41, which drains the excess current sufficiently to stabilise the oscillator gain. The a.g.c. bias on the base of VT41 is derived from the main output via peak detector D53, which charges C74 negatively in proportion to the output amplitude.

SUMMING AMPLIFIER Fig. 6

55. The summing amplifier is designed to maintain a linear relationship between oscillator frequency and changes of input current. The input to the summing amplifier is a combination of the coarse bias selected by the MHz switch (Fig. 3) and the error information from the phase and frequency comparators; the output is fed to the junctions of the varactors in the main oscillators. A varactor is most sensitive at low junction voltages, and less gain is then required from the summing amplifier. On the other hand. an increased voltage applied to the varactors will increase the main oscillator frequency, but due to the lower sensitivity of the varactors at higher voltages, it is necessary for the summing amplifier to provide higher gain to maintain tuning linearity.

56. The summing amplifier comprises transistors VT35 and VT36. and VT37. The tuning information is in the form of currents flowing into a virtual earth at the base of VT35. The overall gain of the summing amplifier varies according to the output level at pin 84 and is determined almost entirely by the impedance of the nonlinear feedback network D46, D47, R72 and R74. If the impedance of the feedback path is high, the gain is high. If the feedback impedance is reduced, the overall gain is correspondingly lower. The main feedback path is via R74 to the base of VT35 with a parallel path via D47/D46/R72.

57. At higher frequency settings the feedback path is via R74 alone. At the lower frequency settings of the MHz switch, the coarse bias is increased, and the resulting -ve voltage at the collector of VT37 will cause D47 and D46 to conduct, thereby lowering the resistance of the feedback path and reducing the amplifier gain, as required. The output from VT37 is fed to the oscillator tuning circuits via the low-pass filter formed by R75 with R76, C59 and C65. The diodes D55/D56 and D57/58 provide a path of lower resistance to abrupt changes of voltage, thus ensuring that the oscillator rapidly approaches the correct frequency whenever the MHz tuning switch is operated.

CHAPTER 3

TEST AND MAINTENANCE EQUIPMENT

Power Supply

NOTE: For testing purposes the MA. 920 can be powered from the Manpack battery or from a suitable 18 volt source such as the Test Set Type CA. 470. The load is approximately 100 mA irrespective of the supply voltage. If, however, the covers are removed and the boards hinged outwards (see Chapter 6) for testing, there is a considerable risk of accidental short-circuits to chassis which could damage the series regulator transistor in the power section. Such damage can be prevented by the use of a 30-volt d.c. power source connected to the MA. 920 via a 120 ohm resistor rated at 1½ watts or higher. The voltage on the +18V terminal must not exceed 25 volts.

Power Unit

Test Set CA. 470 or a dual 30V d.c. power supply unit with 120 ohm, 1½ watt wirewound resistor. (See NOTE above).

Multimeter — 20 000 ohms per volt.

Example:	AVO 8.

Digital Frequency Meter

Frequency:	100 Hz to 20 MHz with resolution to one Herz.
Sensitivity:	100 mV r.m.s.
Input:	High impedance, or a high impedance active probe must be available.
Example:	Racal Type 806.

Electronic Voltmeter (not essential if suitable oscilloscope available).

A. C. Input Impedance:	Not less than 1 megohm.
Frequency Range:	Up to 20 MHz.
Measurement Range:	10 mV to 250 mV.
Example:	Airmec 301.

Oscilloscope (not essential if electronic voltmeter is available, but is useful for fault location).

Bandwidth:	20 MHz or better.
Sensitivity:	100 mV/cm when used with high impedance probe.

Cambion Trimming Tool	Type 2375-4.
Screwdriver	1/16 inch (1.6 mm) shaft
Terminating Resistor	50 ohm, ± 10% ¼ watt.

CHAPTER 4

ADJUSTMENTS

NOTE: The setting-up procedures in this chapter are intended for use in an overhaul schedule. Do not make random adjustments in an attempt to improve performance. Under normal conditions of serviceability the only adjustment likely to need attention is the trimmer of the 5 MHz reference oscillator. If a fault condition is suspected refer to the next Chapter.

CAUTION: The two printed circuit boards will remain attached to the synthesizer unit with normal interconnections. Care must be taken to prevent short-circuits between any part of the board and the chassis. To reduce the risk of damage from accidental short-circuits, it is recommended that the Manpack battery supply should be disconnected from the synthesizer and a 30-volt d.c. supply be connected through a 120 ohm $1\frac{1}{2}$ watt resistor in series with the 18V terminal.

IDENTIFICATION OF BOARDS AND DISMANTLING

1. When the synthesizer unit and the trans/receiver unit are in their normal positions the PM1 (or PM2) board is on the outer side adjacent to the Manpack container and the PM3 board is on the opposite side, adjacent to the tran/receiver unit. For dismantling instructions refer to Chapter 6.

ACCESS TO ADJUSTMENTS

2. After removing the synthesizer covers the potentiometer adjustments are accessible via holes in each board without further dismantling. Coil trimming can be done only from the component (inner) side of each board. The access to the trimmer capacitor of the reference frequency oscillator is via a hole in the main frame.

POWER UNIT ADJUSTMENTS (PM3 Board)

Equipment Required

3. 30 volt d.c. Power Unit with 120Ω $1\frac{1}{2}$ watt resistor.
Multimeter 20 000 ohms per volt.

Procedure

4. (1) Connect up the d.c power supply to terminal 1 (+ve) and the earth tag (0 volts).

(2) Connect the multimeter +ve lead to pin 72 on the PM3 board, the -ve lead to chassis. Switch on the power supply and check that the multimeter indicates approximately 18 volts. (The synthesizer will function satisfactorily from supply voltages within the range 13.3V to 25V but the nominal 18V input is desirable for setting up).

(3) Transfer the +ve lead of the multimeter to pin 64 and check for an indication of 13 volts plus or minus 100 mV. If necessary adjust potentiometer RV3 to obtain the correct level.

(4) Transfer the +ve lead of the multimeter to pin 65 and check for an indication of 8 volts plus or minus 100 mV. If necessary adjust potentiometer RV1 to obtain the required level.

(5) Transfer the +ve lead of the multimeter to pin 66 and check for an indication of 4 volts plus or minus 100 mV. If necessary adjust potentiometer RV2 to obtain the required level.

(6) Switch off the power supply and disconnect the testmeter.

REFERENCE FREQUENCY OSCILLATOR (PM1 or PM2 Board)

CAUTION: Normal production of the MA. 920 is fitted with the discrete component oscillator (PM2 board). Alternatively sealed 5 MHz Oscillator unit can be provide (PM1 board). If a sealed unit is fitted the user should adjust only if absolutely necessary and replace the unit if a large frequency error exists.

NOTE: The most satisfactory check on the frequency reference is to measure the 10.7 MHz frequency at the outlet SKT1. The limits at this point are 10.7000 000 plus or minus 40 Hz within the temperature range 0°C to 40°C. If possible checks and adjustment should be made at an ambient temperature of approximately 25°C (77°F). It is essential that the synthesizer covers are screwed into position during this test.

Equipment Required

5. Digital Frequency Meter.
Screwdriver with 1/16 inch (1.6mm) shaft.

Adjustment of Discrete Component Reference Oscillator (PM2 Board)

6. (1) Disconnect the 10.7 MHz outlet, SKT1, from the trans/receiver and connect a digital frequency meter to this outlet.

(2) Switch on and allow the synthesizer to run for a few minutes. Check that the digital frequency meter indicates within the limits 10 700 000 plus or minus 40 Hz.

(3) If necessary, adjust the oscillator trimmer (C42 in Fig. 2) via the hole in the main frame to obtain an indication as close to 10 700 000 Herz as possible. This adjustment must be done with the synthesizer covers screwed into position.

(4) Disconnect the test equipment and reconnect the 10.7 MHz output lead.

Adjustment of Sealed 5 MHz Oscillator Unit (PM1 Board)

7. (1) Check the 10.7 MHz frequency as instructed in operations (1) and (2) of the previous paragraph.

(2) Insert the 1/16" Screwdriver into the aperture in the oscillator unit, via the hole in the synthesizer main frame, and very carefully adjust the variable capacitor for an indication as close to 10 700 000 Herz as possible.

(3) Disconnect the test equipment. Re-connect the 10.7 MHz output lead.

MAIN OSCILLATORS SETTING-UP (PM3 Board)

Equipment Required

8. 30 volt d.c. Power Unit with 120Ω $1\frac{1}{2}$ watt resistor.
Digital Frequency Meter.
Multimeter.
Electronic Voltmeter.
Variable d.c. supply 1 volt to 11 volts.
50 ohm $\frac{1}{4}$ watt terminating resistor.
Shorting link.
Cambion Trimming tool

Procedure

9. (1) Check that the power supply is switched off and disconnect the coaxial lead from the OUTPUT socket (SKT2).

(2) Terminate the OUTPUT socket with a 50 ohm resistor to chassis.

(3) On the PM3 board fix a temporary link from pin 83 to chassis (earth) in order to turn off VT37.

(4) Connect the +ve side of an 11 volt d.c. supply to pin 85. The -ve side to chassis. Check with the multimeter that this supply is 11 volts plus or minus 100 mV.

(5) Connect a digital frequency meter to the synthesizer OUTPUT socket (SKT2).

(6) Set the synthesizer MHz switch to position 3 and check that the digital frequency meter indicates 16.2 MHz plus or minus 20 kHz. If necessary adjust transformer T8 to obtain this reading. To do this, slacken the locking nut on T8 assembly (6BA spanner) and adjust the core using the slotted end of the Cambion trimming tool. Finally re-tighten the locking nut.

(7) Move the MHz switch to positions 2 and 4 and check that the frequency indication does not change.

(8) Set the MHz switch to position 6 and check that the digital frequency meter indicates 19.2 MHz plus or minus 20 kHz. If necessary, adjust transformer T9 to obtain this reading. The method of adjustment is described in (6) above.

(9) Move the MHz switch to positions 5 and 7 and check that the frequency indication does not change.

(10) Reduce the level of the d.c. source connected to pin 85 from 11 volts to 1 volt ± 100 mV. Check that the frequency at the OUTPUT socket is less than 12.400 MHz on the lower range (MHz switch set to 2, 3 or 4) and less than 15.400 MHz on the higher range (MHz switch set to 5, 6 or 7).

(11) Set the MHz control to position '3' and adjust the level of the d.c. source connected to pin 85 so that the frequency at the OUTPUT socket is 14.2 MHz plus or minus 200 kHz. With the electronic voltmeter check that the level is 200 mV plus or minus 5 mV. If necessary adjust RV5 to obtain this reading.

(12) Set the MHz control to position '6'. Check that the frequency at the OUTPUT socket is 17.2 MHz plus or minus 200 kHz and the output level 200 mV plug or minus 5 mV. If necessary adjust RV6 to obtain this reading.

(13) Remove the temporary link from between pin 83 and chassis fitted in (3).

(14) Remove the 50 ohm termination from the OUTPUT socket and disconnect the test equipment.

10.7 MHz OUTPUT (PM1 or PM2 Board)

10. (1) To check the 10.7 MHz generator the 10.7 outlet on the case must be driving a 50 ohm load, either the trans/receiver, an electronic voltmeter or a 50 ohm resistor connected to chassis.

(2) Switch on the synthesizer and check that the level at the 10.7 MHz outlet is not less than 100 mV r.m.s. or 280 mV peak-to-peak if using an oscilloscope.

(3) If necessary adjust the core of transformer T2 on the PM1/PM2 board to obtain a peak response. (Use the screwdriver end of the Cambion tool).

(4) Connect a digital frequency meter to SKT1 and check that the frequency is 10 700 000 plus or minus 32 Herz.

(5) If the frequency is not correct the reference frequency oscillator unit may require adjustment. Refer to paragraphs 6 or 7.

(6) Switch off and disconnect the 50 ohm load (if fitted) and the test equipment.

PHASE COMPARATOR OUTPUT (PM1 or PM2 Board)

NOTE: This test describes the adjustment of potentiometer RV1 on the PM1 or PM2 board. This adjustment should normally be required only if an M.O.S.T. or a component has been changed in the area of VT54 or VT56.

Equipment Required

11. Oscilloscope.
Multimeter.

Procedure

12. (1) Switch on the power supply and connect the oscilloscope probe to pin 54 on the PM1 (or PM2) board (collectors of VT50/51) observe the slightly distorted triangular waveform and check that the amplitude is 8 volts plus or minus 1 volt, peak-to-peak. The mean d.c. voltage should be 6.7V plus or minus 0.6V.

(2) Disconnect the link between pins 32 and 33.

(3) Connect the +ve lead of the multimeter to pin 36 (emitter of VT58), -ve lead to chassis.

(4) Adjust potentiometer RV1 to obtain an indication of 4.8 volts plus or minus 100 mV on the multimeter. If the voltage is too high a resistor of 1.5 kΩ ± 5%(R155) should be connected between pins 46 and 47 in place of the link.

(5) Finally, switch off and re-connect the link between pins 32 and 33.

CHAPTER 5

TESTING AND FAULT FINDING

INTRODUCTION

1. This chapter provides a series of tests which will assist fault location. The first part, headed "Overall Unit Tests" can be performed with the covers in position and will quickly establish the serviceability of the synthesizer. The second part headed "Board Tests" will assist in locating a fault to a particular board or part of a board. It is assumed that the user has a thorough knowledge of the circuit principles. The data in this chapter conforms to the specification standard of the synthesizer. It is assumed that tests will not be carried out in extreme conditions of either heat or cold.

NOTE: Do not remove the covers from the synthesizer unit.

EQUIPMENT REQUIRED

2. Digital Frequency Meter (20)MHz with high impedance input).
Electronic Voltmeter (frequency range up to 20 MHz).
50 ohm ¼ watt terminating resistor.
Universal Test Meter (Multimeter)
Headphones.

OVERALL UNIT TESTS

MAIN OUTPUT CHECK

3. (1) Disconnect the lead from the OUTPUT socket on the synthesizer case, and terminate this outlet with the 50 ohm resistor.

(2) Set the synthesizer controls to 3.500.

(3) Connect a digital frequency meter across the 50 ohm termination at the OUTPUT socket.

(4) Switch on and check that the digital frequency meter indicates a frequency 10.7 MHz higher than the settings of the synthesizer controls, within a tolerance of 3 parts in 10^6. In this example the output frequency should be 14 200 000 plus or minus 42 Hz. This checks the lower frequency oscillator output.

(5) Disconnect the digital frequency meter and connect an electronic voltmeter in its place. Check that the output level is 200mV ± 10 mV.

NOTE: A lower output level will cause some reduction in transmitter output power. Refer to Chapter 4 for information on the adjustment of oscillator output voltage.

(6) To check the high frequency oscillator set the synthesizer controls to 6.500 and check that the output level is 200 mV ± 10 mV (See also NOTE above).

(7) Disconnect the electronic voltmeter and connect the digital frequency meter in its place. Check that the output frequency is 17 200 000 plus or minus 51 Hz.

(8) Select various settings of the synthesizer MHz and kHz controls and check that the digital frequency meter indicates a frequency 10.7 MHz higher than the control settings in each case.

(9) Disconnect the test equipment and remove the 50 ohm load resistor.

10.7 MHz OUTPUT CHECK

4. (1) Disconnect the coaxial lead from the 10.7 MHz outlet SKT1. Terminate this outlet with the 50 ohm resistor.

(2) Measure the frequency at the 10.7 MHz outlet which should be 10 700 000 plus or minus 32 Hz.

(3) Check the voltage across the 50 ohm termination which should be in the range 100 to 200 mV.

(4) Refer to Chapter 4 for adjustment information.

(5) Do not remove the 50 ohm termination until the Mute test is completed.

10.7 MUTE

5. (1) If the synthesizer is connected to the trans/receiver the mute operation can be checked by switching the Manpack Mode switch through its various settings. The 10.7 MHz output level measured across the 50 ohm termination at the 10.7 socket (see para. 4) should fall to less than 10 mV whenever the Mode switch is set to A.M.

(2) If the trans-receiver is not connected, the following method of activating the mute may be used:-

(i) Disconnect the lead from the MUTE terminal on the synthesizer.

(ii) With a jumper lead briefly connect the MUTE terminal to the adjacent 18 volt terminal. At the same time note the electronic voltmeter reading across the terminated 10.7 MHz outlet. This should fall to less than 10 mV as the jumper lead is connected.

NOTE: Ideally this test should be made by connecting a +ve 9 volt d.c. supply to the disconnected MUTE terminal, but the +18V connection is a convenient alternative.

(3) Disconnect the test equipment. Remove the 50 ohm termination.

(4) Re-connect the lead to the MUTE terminal (if it has been disconnected).

OUT OF LOCK INDICATION

NOTE: For this test the headphones should be connected to the synthesizer between the out-of-lock (O. L. I.) terminal and the chassis, or an oscilloscope may be used. If the synthesizer is connected in the Manpack the normal phones outlet should be used.

6. (1) Make the synthesizer go out-of-lock by setting the MHz control midway between two adjacent settings.

(2) Switch on and listen for the interrupted 1 kHz out-of-lock tone, or connect an oscilloscope to the out-of-lock terminal and observe the 1 kHz waveform.

(3) Set the MHz control correctly so that the synthesizer is in lock. Connect the +ve lead of a multimeter to the out-of-lock terminal.

(4) Set the multimeter to the 25 volt d.c. range (do not use a lower range because the circuit resistance is 22 kΩ).

(5) Set the synthesizer kHz x 100 control to position '5'. Provided the unit is correctly locked, the multimeter should then indicate between 4.0 and 5.0 volts.

(6) Check that with the unit "in lock", the out of lock tone disappears.

BOARD TESTS

CAUTION: For board testing the covers must be removed with a consequent risk of accidental short circuits while testing. The use of a 30 volt d.c. power supply connected via a 120Ω $1\frac{1}{2}$ watt resistor is strongly advised to avoid the risk of damage to the series regulator transistor in the power section.

GENERAL DIAGNOSIS

PM1 (or PM2) Board Diagsosis

7. (a) Reference Frequencies Generator Fault

A fault in this section may cause the main oscillator output frequency to be very low. In this case there will be no out-of-lock tone, only a clicking sound in the phones. Check the 10.7 MHz at the 10.7 MHz outlet (SKT1) and check the 1 kHz reference at pin 32 on the PM1 board.

(b) 12-17 MHz Generator Fault

If the unit works correctly except in one position of the MHz switch, check the 12-17 MHz generator. A fault in the generator affecting all switch positions can be found only by testing, but will normally cause the frequency to too high.

(c) 10.7 MHz Generator Fault

The 10.7 MHz output is not used in the synthesizer, but can be used to check the accuracy of the 5 MHz reference. Refer to Chapter 4.

(d) Frequency Comparator Fault

No distinct fault indications, but a tendency to lock on the wrong frequency indicates a frequency comparator fault.

(e) Phase Comparator

A fault in the Phase Comparator will cause the main oscillator output frequency to be unstable. (Hunting around the correct frequency but failing to lock).

PM3 Board Diagnosis

8. (a) Main Oscillator and Summing Amplifier

If the synthesizer is satisfactory in positions 2 to 4 of the MHz switch but not in 5 to 7 - or vice versa - it is probably a main oscillator fault. If the frequency from both main oscillators is seriously in error, or does not change with movements of the MHz switch, check the summing amplifier section and coarse bias. Also check the links to pins 86, 87. It is possible for these links to be disturbed by careless re-fitting of the boards.

(b) Mixer Fault

Main oscillator frequencies will be high because the frequency comparator will see an apparently low frequency output from the programmed divider and will attempt to correct this. (Similar symptoms to complete failure of 12-17 MHz Generator).

(c) Programmed Divider

The most likely indications are that the main oscillator frequency is too high or is locking on to the wrong frequency.

(d) Power Supply

A power supply fault may cause a complete failure of the synthesizer indicated by no outputs from SKT1 (10.7 MHz) or main oscillators OUTPUT (SKT2) and no out-of-lock tones.

TESTING PM1 (or PM2) BOARD

NOTE: To avoid repetition of tests described elsewhere the user will be referred to Chapter 4 where appropriate.

Equipment Required

9. 30 volt d.c. power supply with 120Ω $1\frac{1}{2}$ watt resistor.
Digital Frequency Meter with high impedance input or with active high impedance probe.
Electronic Voltmeter.
Oscilloscope with 10 MΩ probe.
Multimeter.
50 ohm $\frac{1}{4}$ watt resistor.
Soldering iron.

Board Tests

10. (1) The boards should remain in the unit with covers removed, but with all interconnections as normal. Unscrew the board under test but do not undo any connections. When folding the board outwards take great care to prevent contact between the track and any metal work. Place a sheet of thick paper or polythene beneath the board.

(2) Disconnect the Manpack power supply from the synthesizer and connect the +ve side of the 30 volt d.c. power supply in series with a 120 ohm $1\frac{1}{2}$ watt resistor to the 18 volt terminal. Connect the 0 volt terminal to the -ve side of the supply.

(3) Check that all the wire links on the board are connected, and in good order as follows:

Pins 20/21, 30/31, 32/33, 35/36, 43/44
(43/44 may have a resistor link).

(4) Check the supply voltages coming from the other board using a multimeter. (Note the different polarity on pin 34) 0 volt pins are 17 and 23.

Supply Voltages

Pin	D.C. Voltage Relative to 0 volt
15	+ 13.0v ± 100 mV
18	+ 8.0v ± 100 mV
16	+ 4.0v ± 100 mV
34	- 5.3v ± 1V

(5) To check the 5 MHz reference, disconnect the link between pins 20 and 21. Connect the digital frequency meter (high impedance input) to pin 20 (Fig. 2). The frequency should be 5 MHz plus or minus 15 Hz. If adjustment is necessary refer to Chapter 4 paragraph 6 or 7.

(6) Re-connect the link between pins 20 and 21.

(7) Reduce the sensitivity of the digital frequency meter to between 0.5 and 1.0 volt. Measure the frequency at pin 32 (Fig. 4) which should be 1 kHz plus or minus 1 Hz. An oscilloscope should display a square wave of approximately 2 volts amplitude peak-to-peak, at this pin.

(8) Repeat test (7) at pin 41 (Fig. 4).

(9) To check the 10.7 MHz generator and Mute facility refer paragraphs 4 and 5 in this chapter.

(10) If satisfactory, the above tests fully check the reference frequencies generator.

12-17 MHz Generator

11. (1) Connect the oscilloscope probe to the case (collector) of transistor VT11 (Fig. 9, Fig. 3). The waveform amplitude should be approximately 2 volts peak-to-peak.

(2) Connect the digital frequency meter (high impedance input essential) and in each setting of the synthesizer MHz switch check the frequency to a tolerance of plus or minus 50 Hz as follows:

TABLE 1

MHz Switch Setting	Frequency at VT11
2	12.0)
3	13.0)
4	14.0) All ± 50 Hz
5	15.0)
6	16.0)
7	17.0)

Disconnect the frequency meter and oscilloscope.

(3) Test point pins 11 and 48 (Refer to Fig. 3, collector of VT6 and junction of R60/T1) should be checked with the multimeter (10v d.c. range) in each setting of the MHz switch. This may provide useful information if a fault condition exists.
Pin 11 (a.g.c.) should normally read higher than 1 volt. The level at pin 48 is satisfactory if it is between 0.25V and 5V.

(4) If the synthesizer is faulty on only one setting of the MHz switch, refer to Fig. 3 and check the switch wiring. Check that the relevant channel wire (pins 1 to 6) is at 0 volts. Try by-passing the appropriate diode D9 to D14. If necessary check resistor R11-R19 for correct resistance.

Phase Comparator Check (Fig. 9 Fig. 4)

12. (1) With an oscilloscope check at pin 54 (collectors of VT50/VT51). Observe a 1 kHz slightly distorted triangular waveform with an amplitude of 8V plus or minus 1V peak-to-peak. The mean d.c. voltage should be 6.7V plus or minus 0.6V.

(2) The setting-up of RV1 is described in Chapter 4 paragraph 12. If necessary refer to those instructions.

Frequency Comparator Checks (Fig. 9 Fig. 4)

NOTE: Three methods are available depending upon the test equipment available. The principle in each case is to check the operation with an input frequency which is in turn higher, lower and equal to the reference input. The methods are:

12. (a) <u>Alternative Connection Method</u>

This requires no specialised test equipment but has the slight disadvantage that the out of lock indication is checked only on the higher frequency side.

(b) <u>Pulse Generator Method</u>

This is a very satisfactory method provided that a suitable pulse generator is available.

(c) <u>Variable Voltage Method</u>

This method provides a complete check on the phase lock loop by manual variation of the main oscillator frequency. Its disadvantages are the need for a regulated variable d.c. supply and the necessary assumption that the mixer and programmed divider are working correctly.

<u>Alternative Connection Method (Frequency Comparator Check)</u>

13. (1) Disconnect the links between pins 30/31 and 41/42 on the PM1 board, thus removing both inputs from the frequency comparator (Fig. 1).

(2) Connect a jumper wire from pin 31 to pin 41, thus feeding the 1 kHz reference in lieu of the programmed divider signal. This simulates the condition 'programmed input high'.

(3) Connect the +ve lead of the multimeter (25V d.c. range) to pin 51 and 53 in turn (-ve lead to chassis). Check that the voltages are 13V and 8V ± 0.5V respectively (see Table 2 below, Input High).

(4) Retain the jumper wire linking pins 31 and 41 and re-connect the link between pins 41/42, thus feeding the 1 kHz reference to both inputs (Inputs equal).

(5) Connect the +ve lead of the multimeter (10V d.c. range) to pins 51 and 53 in turn and check that voltages are 8V and 8V respectively (see Table 2 Input Equal).

(6) Remove the jumper wire from pin 31 and 41 thus simulating input low. Again check the voltages at pins 51 and 53 which should be 8V and 4V respectively (Table 2 Input Low).

TABLE 2

Frequency Comparator Measurements

Pins Linked	Input State	Pin 51	Pin 53	Limits
31/31	High	13V	8V	±0.5V
31/41 41/42	Equal	8V	8V	±0.5V
41/42	Low	8V	4V	±0.5V

(7) Finally, reconnect the link between pins 30 and 31.

Pulse Generator Method (Frequency Comparator Check)

NOTE: The measurements in Table 2 above also apply to a pulse generator test provided the input signals in each mode differ by more than 200 Hz.

14. (1) The pulse generator output should be a square wave variable in frequency from 500 Hz to 2000 Hz. The amplitude should be approximately 3 volts peak-to-peak with rise and fall times of less than 200 nanoseconds.

(2) Disconnect the link between pins 30 and 31 and connect the pulse generator output to pin 31 with its earth lead to pin 29.

(3) Set the pulse generator to the following frequency settings in turn. Refer to Table 2 in the previous paragraph and check the voltage measurements according to each input state as follows:

Frequency	Input State in Table 2
Greater than 1200 Hz	High
Exactly 1000 Hz	Equal
Less than 800 Hz	Low

(4) Check that the out-of-lock indication is obtained with the 'High' and 'Low' inputs.

(5) Finally, disconnect the test equipment and re-connect the link between pins 30 and 31.

Variable Voltage Method (Frequency Comparator Check)

NOTE: For this test the 12-17 MHz generator, main oscillator, mixer and programmed divider must be working correctly. A variable d.c. voltage source (0 to 11 volts) may be used or alternatively a 10 kΩ potentiometer connected between the +18V and EARTH terminals on the case can provide a suitable voltage. Check that the voltage taken from the potentiometer slider does not exceed 12 volts.

15. (1) Set the Synthesizer kHz controls to 300.

(2) On the PM3 board link pin 83 directly to earth. This prevents excessive current in VT37 (Fig. 6).

(3) On the PM3 board connect a regulated d.c. voltage source to pin 85 (+ve) and pin 82 (-ve). The applied voltage must not at any time exceed 12 volts.

(4) With the d.c. voltage source set to approximately 10 volts check the voltage at pins 51 and 53 on the PM1 board in accordance with Table 2 in paragraph 13 (Input State High). At the same time an out of lock indication should be obtained.

(5) Reduce the d.c. voltage source to 1 volt and repeat the measurements of (4) which should be in accordance with Input State Low. Check that an out-of-lock indication is obtained.

(6) Slowly vary the d.c. voltage source from 1 volt through to 10 volts and check that the out-of-lock tone output goes through the sequence of 'on' - 'off' - 'on'. The phones or oscilloscope can be connected between the out-of-lock terminal and chassis. An oscilloscope will disply a 1 kHz waveform, approximately triangular (with some interference superimposed) with an amplitude between 0.5V and 1.0V peak-to-peak.

PM3 BOARD TESTS

CAUTION: The advice previously given concerning the use of a 30V d.c. power supply connected via a 120 ohm 1½ watt resistor should be noted.

Power Supply

16. (1) Check that correct d.c. voltages are present on the following pins of the PM3 board:

Pin 64	+ 13V ± 100 mV
Pin 65	+ 8V ± 100 mV
Pin 66	+ 4V ± 100 mV

If voltages are not correct refer to Chapter 4 for adjustment instructions.

(2) Measure the voltage on pin 70 which should be +10V plus or minus 1.5V. This monitors the current in the 8-volt line by measuring the volts drop across resistor R47. (Fig. 5).

(3) Measure the voltage on pin 71 which should be +5 volts plus or minus 0.5V. This monitors the current in R48 for the 4-volt line. (Fig. 5).

Main Oscillator Setting-Up

17. This is described in Chapter 4.

Main Oscillators Output Check

18. Refer to paragraph 3 in this chapter.

Mixer and Programmed Divider Check

NOTE 1 : The 12-17 MHz generator in the PM1 board should be working correctly for this test. If it is not, a signal generator (12 MHz) will be required. This 12 MHz can be injected at pin 1 on the PM3, but first disconnect the coaxial lead from pins 1 and 2 because this lead carries 8V d.c.

NOTE 2 : The following procedures refer to the later production versions fitted with binary coded KHz switches.

19. (1) With both the PM1 and PM3 boards connected, set the synthesizer controls to 2.500. The two frequencies entering the mixer should now be 12.0 MHz and 13.2 MHz.

NOTE: If the 12-17 MHz generator is not working disconnect the coaxial inner and outer from pins 1 and 2 on the PM3 board. Connect a signal generator output to pin 1 on the PM3 board (Fig. 5). Set the signal generator to 12 MHz c.w. 70 mV r.m.s.

(2) Connect a digital frequency meter to the main oscillator OUTPUT socket and check that the frequency indication is 13 200 000 approximately The actual reading depends upon the accuracy of the signal generator frequency.

(3) Check the frequency at pin 7 of the PM3 board. This should be 1 kHz. An oscilloscope connected to pin 7 will display the 1 kHz waveform which should have the following approximate parameters.

Up for 800 microseconds.
Down for 200 microseconds.
Amplitude 3 volts peak-to-peak.

(4) If the above waveform is not obtained, check the integrated-circuit elements LG1, LG2 and LG3. Check for an input at pin 8 on the element and an output at pins 5 and 12. The output waveform is typically 3 volts peak-to-peak and should not be less than 2V p-p.

(5) If an integrated-circuit element is faulty a recognizable square waveform will be obtained at pin 8 of the faulty element but nil output at the output pins 5, 12 etc.

(6) With a multimeter measure the voltage on pin 10 which should be -ve 5.3V plus or minus 1.0V. This is the negative bias for the phase comparator.

(7) Measure the voltage at pin 9 which should be +8 volts relative to chassis. This is the binary 0 volt reference applied to the kHz control switches.

kHz Switching Faults

20. (1) A faulty contact in one of the kHz control switches may be the cause of an erratic change of the kilohertz frequency of the main oscillator. This frequency can be measured at the OUTPUT socket, using a digital frequency meter. For example if one of the kHz, switches, when rotated from 0 to 9, causes the corresponding digits in the main oscillator output frequency to have an erratic sequence such as 1-2-3-4-8-6-7-8-9, then the binary levels at the pins on the relevant integrated circuit LG1, LG2 or LG3 should be checked. Refer to the Switch Sequence tables on page 2-13, bearing in mind that '0' reference is +8 volts and the '1' level is approximately +13V.

(2) If an output reading of "600" is obtained in every combination of switch settings it suggests a break in the '0' reference line between pin 9 on the Programmed Divider and the common lead to tag 10 on the switches. It may be noted that the disconnection of a single wire to a kilohertz switch will normally cause an erroneous digit indication in several positions of that switch.

POWER UNIT FAULTS

21. Series Regulator Fault

(1) If the series transistor VT27 (Refer to Fig. 5) is open-circuit, current can continue to flow through the parallel resistor R56. The effect is that the 4 volt, 8 volt and 13 volt lines will all show low-voltage readings. The extent of the reduced voltage on these lines would depend upon the battery voltage. If the battery supply is only 15 volts, then the fall in voltage levels resulting from this fault would be substantial (certainly more than 50 percent). With an 18 volt battery the drop would be slightly less.

Broken Connections

(1) The voltage regulation system depends upon a correct balance of currents in the 4V, 8V and 13V lines. It is essential that the 4 volt line carries a slightly higher current than the other two. A broken connection could upset this balance, but the actual effect depends upon where the break occurs. The test points at pins 70 and 71 on the PM3 board provide a check on the correct balance in the voltage regulator circuit. The following voltages should be measured on the PM3 board with a good quality testmeter.

(i) First check that the voltage at pin 64 is 13 volts ± 0.1V relative to chassis. If this reading is not correct check the adjustment of RV3 (Chapter 4 para. 4).

(ii) Assuming that pin 64 is at 13 volts, check that pins 70 and 71 show the following readings relative to chassis.

Pin 70	between 8.5V and 11.5V
Pin 71	between 4.5 V and 5. 5V.

VOLTAGE MEASUREMENTS

22. Typical Voltage readings are given on the following pages. These were taken on a good quality 20 000 ohms per volt instrument and are provided as a general guide to serviceability.

TABLE OF STATIC VOLTAGE MEASUREMENTS

NOTES 1: All measurements are relative to chassis (0 volt)

2: All readings are positive (+) unless otherwise indicated

3: These readings are provided as a guide and do not represent a specification. Variations of ±10% may be expected. The measurements were made with an AVO Type 8 (20 kΩ/volt) multimeter using the 10V or 25V range, as appropriate.

4: The Frequency selecting switches of the manpack may be in any in-lock position except where specific instructions are given.

PM2 (or PM1) BOARD

Test Point	D.C. Volts	
VT1e	9.5	MHz Switch set to 2
	10.8	MHz Switch set to 3
	12.5	MHz Switch set to 4
	10.0	MHz Switch set to 5
	11.2	MHz Switch set to 6
	12.7	MHz Switch set to 7

Test Point	D.C. Volts	Test Point	D.C. Volts
VT5 b	5.6	VT14 b	7.1
e	5.0	VT18 e	6.2 (PM2 only)
c	7.7	VT20 e	5.5
VT9 e	0.2	VT21 c	5.0
c	1.2	Pin 11 between	1V and 5V
VT11 e	1.6	Pin 9 between	0.5V and 5V
b	2.3	VT22 c	4.9
VT16 e	4.6	VT23 c	4.8
c	5.7	VT24 e	4.8
VT15 b	6.4	VT24 c	7.8
c	7.2	VT26 c	4.4

Test Point	D.C. Volts	Test Point	D.C. Volts
VT27 e	5.1	VT51 e	1.0
c	8.0	b	1.2
VT40 e	4.5	VT52 b	1.2
c	6.5	c	1.3
VT41 e	5.2	VT53 e	5.0
b	5.9	b	4.7
VT43 e	8.0	c	-1.8
b	8.7		
VT44 e	4.0	Pin 40	8.0
b	3.8	VT63c	2.0
VT48 c	0.2	VT66c	2.0
VT49 c	4.0	Pin 51, 53	8.0
VT50 e	11.5	Pin 34	-5.3
b	10.3	Pin 54	6.8
c	6.8		

	In Lock	Out of Lock	(Set MHz switch between positions)
VT73 c	0.2	0.7	
VT75 c	3.6	0.8	
VT76 c	0.1	1.7	
VT77 e	0.1	1.3	

PM3 BOARD

(See Next Page)

PM3 BOARD

Test Point	D.C. Volts	Test Point	D.C. Volts
Pin 70	10.0	VT39 b	4.0 } MHz SW in positions 5, 6 and 7.
71	5.0	VT40 b	3.1 }
VT1 e	3.4	VT44 e	0.5
VT5 e	8.0	c	4.1
b	8.7	VT42 e	4.4
c	9.3	b	5.1
VT6 c	10.5	c	7.5
VT8 c	12.8	Pin 83	7.9
VT9 c	8.3	Junction D54-R99	4.5
VT10 c	12.0	Pin 91	3.1
VT12 c	9.1	VT43 e	4.5
VT11 e	11.3	b	5.2
VT13 c	2.7	c	8.0
VT14 e	4.0	VT46 e	1.0
VT39 b	3.1 } MHz Sw in positions	b	1.7
VT40 b	4.0 } 2, 3, 4	c	5.0
VT41 e	3.7	VT45 b	5.7

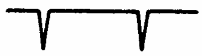
TABLE OF TYPICAL WAVEFORMS

PM2 (or PM1) Board

Pin 12 Sinusoidal 12-17 MHz 300 mV p.p.

VT11 c Sinusoidal 12-17 MHz 2.4 V p.p.

VT2 c  p.r.f. = 1 MHz, width = 30 nS, amplitude = 3V.

VT3 c  p.r.f. = 1 MHz, width = 30 nS, amplitude = 4V.

Pin 10  p.r.f. = 1 MHz, width = 20 nS amplitude = 13V.

Note VT2c, VT3c, Pin 10 need fast scope, - 80 MHz or higher.

VT15 c Normally shows a complex waveform of 12-17 MHz together with feedback from mixer, therefore it is not a useful one to observe.

NOTE To check frequency of 12-17 MHz generator, connect oscilloscope probe to VT11 collector and connect probe output to digital frequency meter input. (Racal 806R).

VT18 e Sinusoidal 5 MHz 300 mV p.p. (PM2 only)

VT20 c Sinusoidal 5 MHz 2 V p.p. (PM2 only)

Pin 20 PM2 (a) with no link to pin 21: same as VT20 c

(b) with link to pin 21:....1.6 V p.p.

PM1 with link connected:.... 1V p.p.

VT22 c  5 MHz 3.5 p.p.

		p.m.f.	width	amplitude
VT25 c		1 MHz	= 100 nS	= 3.5V
D24 a	Waveform as VT25C	1 MHz	= 80 nS	= 2.2V

		p.m.f.	width	amplitude
VT28 c	Waveform as VT25 c	= 200 kHz,	= 800 nS	= 3.7V
D26 a	Waveform as VT25 c	= 200 kHz	= 700 nS	= 2.5V
VT31 c	Waveform as VT25 c	= 50 kHz	= 3 µS	= 3.7V
D28 a	Waveform as VT25 c	= 50 kHz	= 3 µS	= 2.5V
VT34 c	Waveform as VT25 c	= 10 kHz	= 12 µS	= 3.7V
D30 a	Waveform as VT25 c	= 10 kHz	= 12 µS	= 2.6V
VT37 c	Waveform as VT25 c	= 2 kHz	= 70 µS	= 3.5V
D32 a	Waveform as VT25 c	= 2 kHz	= 70 µS	= 2.3V

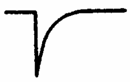
LG1 pin 2  p.r.f. = 2 kHz, width = 70 µS
amplitude = 1.7V

LG1 pin 10  square 1 kHz amplitude = 2.4V

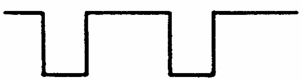
LG1 pin 6 Same as pin 10 but inverted.

Pin 24 With 50 Ω load fitted; 150 mV r.m.s., sinusoidal, 10.7 MHz

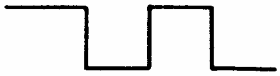
VT40 c With 50 Ω load fitted on pin 24; 4V p.p., sinusoidal, 10.7 MHz

VT45 c  p.r.f. = 50 kHz, width 50 nS
amplitude = 3.6V

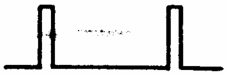
VT46 c  p.r.f. = 50 kHz, width 80 nS
amplitude = 3.6V

Pin 30  p.r.f. 1 kHz (in lock) width 200 µS
amplitude 3.1V

VT48 c  p.r.f. 1kHz (in lock) width 1 µS
amplitude 2.6V

VT49 e  1 kHz square wave amplitude = 2.4V

VT49 c  p.r.f. 1 kHz (in lock) width 1 μS amplitude = 3.7V

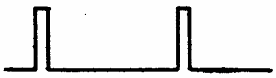
VT53 c or D36 k  p.r.f. 1 kHz (in lock) width 1.2 μS amplitude = 13V

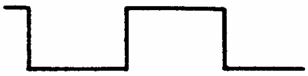
Pin 32 Square wave 1 kHz 2V p.p.

Pin 54 (VT51 c)  1 kHz, triangular 8V p.p.

VT60 c  p.r.f. 1 kHz (in lock) width 200 μS amplitude = 3.4V

VT61 c  p.r.f. 1 kHz width 2 μS amplitude 2.7V

VT62 c  p.r.f. 1 kHz (always) width 2 μS amplitude 2.7V

VT63 c  p.r.f. 1 kHz (in lock) up-down ratio variable amplitude 3.4V

VT66 c  p.r.f. 1 kHz (in lock) up-down ratio variable amplitude 3.4V inverse of VT63 c.

VT63 c 66 c out of lock gives a blurred "changing" waveform

VT64 c
(a) in lock. no signal (3.8V DC)
(b) out of lock - frequency high width 2 μS amplitude 3.5V, p.r.f. depends on error frequency, but may be very low.
(c) out of lock - frequency high, no signal (3.8V DC).

VT65 c — As VT64 c except that it gives output if frequency is low, not otherwise.

VT69 c — out of lock - frequency high

amplitude = 4.0V

Waveform depends on nature of error frequency.
Down for about 3 mS, up for variable period (may jitter)

in lock, or frequency low

DC. 12.8V

VT70 c as VT69c except waveform occurs with frequency low
height = 3.6V

in lock or frequency high, DC = 7.8

VT75 — out of lock amplitude 3.7V

jittery frequency, normally down for about 100 mS.
The in-lock amplitude is 3.5V DC .

pin 45 — in lock . DC voltage from output of frequency comparator (actual voltage depends on frequency setting) normally between 1V and 9V

out of lock jittery waveform with 1 kHz triangular wave about 10.5V p.p. plus spikes. Best listened to on headphones, (can put phones directly onto pin 45 or OLIterminal on casting - no capacitor needed).

Table of Typical Waveforms

PM3 Board

VT1 c — Sinusoidal 4V p.p. frequency = that of main oscillator 12.7 to 18.7 MHz but with some distortion.

Pin 3 — Low level sine wave plus other (higher) frequencies superimposed. Typical level = 200 mV p.p. frequency = 700-1699 kHz depending on frequency setting.

VT5 c

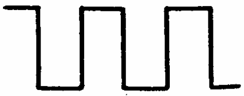
700-1699 kHz 1.4V p.p.

VT6 c

700-1699 kHz
3.7 V p.p. fall time = 30 nS

LG1 pin 6 — square wave 350-850 kHz 2.8 V p.p.

LG1 pin 12



square wave 70-170 kHz 3.0V p.p.
1 up to 4 down

LG2 pin 6 — square wave 35-85 kHz 3.0V p.p.

LG2 pin 12

7-17 kHz 3.0V p.p. 1 up to 4 down

LG3 pin 5 and pin 12 — Waveforms dependent on 100 kHz switch setting 3.0 V p.p. Note all above waveforms on LG1, 2, 3, may have variable level "tops" to wave forms.

LG1, 2 or 3, pin 1 or Pin 13 or VT8 c

1 kHz p.r.f. (in lock)
300 nS width
4.2 V p.p. amplitude

VT9 c

p.r.f. 1 kHz in lock
Amplitude = 0.7 p.p.
width = 300 μS

Pin 7  in lock p.r.f. = 1kHz
down for 200 μS
Amplitude = 3.2V

D22 a — square wave 350-850 kHz 6V p.p.

Remaining waveforms are all sinusoidal at frequency of main oscillator 12.7-18.7 MHz

VT44 c	500 mV p.p.	
VT43 c	1.5V p.p.	
VT42 c	1.8V p.p.	
VT45 c	1.6V p.p.	assuming 50 Ω lead connected to output.
Pin 98	700 mV p.p.	
T8 pin 1	300 mV p.p.	
T9 pin 3	300 mV p.p.	

CHAPTER 6

DISMANTLING AND RE-ASSEMBLY

NOTE: The term 'Manpack' is used to denote the complete assembly of transmitter/receiver together with the Synthesizer Unit.

ACCESS TO THE SYNTHESIZER

1. (1) Remove the complete Manpack unit from its case (refer to the Manpack section of the handbook).

   (2) Place the unit with the front panel face downwards on the bench.

   (3) Remove the antenna flying lead (red plug) from its socket beside the A.T.U.

   (4) At the rear of the unit free the two metal straps (one screw from each) which hold the two chassis together. Grip the two chassis while freeing the straps to prevent the T/R chassis from falling.

   (5) Hinge the trans/receiver chassis downwards to a horizontal position.

   (6) The side covers of the synthesizer unit can now be removed for making tests and adjustments.

   (7) To re-assemble follow the above instructions in the opposite sense and sequence.

ACCESS TO THE PRINTED CIRCUIT BOARDS

2. Board PM1 (or PM2) is on the outward side of the synthesizer; board PM3 is on the inward side facing the trans/receiver unit.

   (1) Release the screws which secure the side covers to the synthesizer and remove the cover (or covers).

   (2) Release the screws which secure the board to be tested and hinge the board outwards to reveal the components. To avoid the risk of short circuits between the board track and frame metalwork, place a sheet of thick polythene or similar beneath the board and lower the board down on to it.

CAUTION: When re-fitting the boards, ensure that the power is off and carefully avoid trapping any leads between the board and chassis.

REMOVAL OF THE SYNTHESIZER UNIT

3. (1) Refer to paragraph 1 and carry out instructions (1) to (4).

(2) Remove the escutcheon panel from the Synthesizer front panel (4 screws).

(3) From each switch knob on the synthesizer ease off the plastic cap which reveals a slotted hexagon ($\frac{1}{4}$ inch AF) screw. Remove the screw from each knob.

(4) Pull off the control knobs and unscrew the lock-nuts from each shaft.

(5) Remove the dessicator unit which is mounted between the synthesizer panel and the meter. The dessicator can be unscrewed from the front.

(6) Remove three screws from each of the two brackets which secure the synthesizer frame to the Manpack.

(7) Hold the synthesizer unit in position and place the Manpack assembly in a horizontal position.

(8) Draw the synthesizer unit away from the front panel sufficient to allow the two r.f. leads and the soldered leads to be disconnected from the synthesizer terminals.

(9) Remove the synthesizer unit.

(10) Replace the dessicator in the front panel.

(11) To re-assemble, follow the above instructions in the opposite sense and sequence.

CHAPTER 7

LIST OF COMPONENTS

CONTENTS

NOTE: Component values are quoted as follows:

Resistors		Capacitors	
No suffix	= ohms	No suffix	= microfarads
Suffix 'k'	= Kilohms	Suffix 'p'	= picofarads
Suffix 'M'	= Megohms		

ALTERNATIVES

It will be found in some cases that due to the requirement for standardisation, or the availability of an improved type of component, that an item shown in the components list may differ from the information shown in the circuit illustration. Generally the information in the Components List is more up-to-date. The following table gives the items which are most likely to be affected.

Alternative Component Types

Components List Item	Alternative
Diode: Type 1N4149	Type 1N4148
15 µF Tantalum capacitor	10 µF Tantalum Kemet K10 E10

Transistor: The type U14603/1 is shown in circuit diagrams and component lists. The recommended replacement is the Motorola 2N4126 or the Transitron (U.K.) TES014

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

FOREWORD: The list of components is in three divisions. Page 7-1 contains items not mounted on a board. Pages 7-2 to 7-14 contain the common component list for the PM1 and PM2 boards. Pages 7-15 to 7-24 contain the component list for the PM3 board.

SYNTHESIZER MAIN ASSEMBLY ITEMS

Synthesizer Assembly Type MA 920 (complete) MDA.75428

Chassis Components

Capacitors

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
1C1	.01	Ceramic	25	-25+50	911845	Erie 831T/25
1C2	.01	Ceramic	25	-25+50	911845	Erie 831T/25
1C3	0.1	Polycarbonate	100	20	914173	S.T.C. PMA M100

Switches

Cct. Ref.	Description	Racal Part No.
SW1	MHz selection	MBSW75779
SW2	KHz x 100 selection	MBSW75780
SW3	KHz x 10 selection	MBSW75781
SW4	KHz x 1 selection	MBSW75781

Switch Knobs

Description	Racal Part No.
Knob for MHz switch	711059
Knobs for KHz switches	711058

Connectors

Cct. Ref.	Description	Racal Part No.	Manufacturer
SKT1	10.7 MHz output	906878	Belling Lee L1403/CS/AP
SKT2	Main Osc. output	906878	Belling Lee L1403/CS/AP

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

PM1 and PM2 BOARDS

Printed Circuit Board Assembly Type PM1 (complete) MDA75388/B
Printed Circuit Board Assembly Type PM2 (complete) MDA75388/A

COMPONENTS ON PM1 and PM2 BOARDS

Resistors

Cct. Ref.	Value ohms	Description	Rat watts	Tol %	Racal Part No.	Manufacturer
R1	100k	Metal film	1		915872	Erg EEO-1-FCO
R2	178k	Metal film	1		915873	Erg EEO-1-FCo
R3	680k	Metal Oxide	2		914951	Electrosil TR5
R4	33.2k	Metal film	1		914961	Erg EEO-1-FCO
R5	115k	Metal film	1		915878	Erg EEO-1-FCO
R6	226k	Metal film	1		915880	Erg EEO-1-FCO
R7	3.32k	Metal film	1		914967	Erg EEO-1-FCO
R8	910k	Metal Oxide	2		915881	Electrosil TR5
R9	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R10	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R11	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R12	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R13	470	Carbon	0.3	10	914941	Dubilier U.B.T.
R14	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R15	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R16	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R17	470	Carbon	0.3	10	914941	Dubilier U.B.T.
R18	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R19	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R20	680	Carbon	0.3	10	914942	Dubilier U.B.T.
R21	3.3k	Carbon	0.3	10	919945	Dubilier U.B.T.
R22	470	Carbon	0.3	10	914941	Dubilier U.B.T.
R23	220	Carbon	0.3	10	914940	Dubilier U.B.T.
R24	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R25	470	Carbon	0.3	10	914941	Dubilier U.B.T.
R26	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R27	22k	Carbon	0.3	10	914949	Dubilier U.B T.
R28	6.8k	Carbon	0.3	10	914947	Dubilier U.B.T.
R29	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R30	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R31	4.7k	Metal oxide	5		900989	Electrosil TR4
R32	4.7k	Metal oxide	5		900989	Electrosil TR4
R33	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R34	1k	Carbon	0.3	10	914943	Dubilier U.B T.
R35	47	Carbon	0.3	10	914937	Dubilier U.B.T.

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

PM1/PM2 (continued)

Resistors (contd)

Cct. Ref.	Value	Description	Rat watts	Tol %	Racal Part No.	Manufacturer
R36	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R37	47k	Carbon	0.3	10	914950	Dubilier U.B.T.
R38	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R39	150	Carbon	0.3	10	914939	Dubilier U.B.T.
R40	10	Carbon	0.3	10	914936	Dubilier U.B.T.
R41	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R42	47k	Carbon	0.3	10	914950	Dubilier U.B.T.
R43	6.8k	Carbon	0.3	10	914947	Dubilier U.B.T.
R44	470	Carbon	0.3	10	914941	Dubilier U.B T.
R45	6.8k	Carbon	0.3	10	914947	Dubilier U.B T.
R46	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R47	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R48	100k	Metal Oxide		5	908293	Electrosil TR4
R49	15k	Metal Oxide		5	908280	Electrosil TR4
R50	NOT USED					
R51	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R52	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R53	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R54	6.8k	Carbon	0.3	10	914947	Dubilier U.B T.
R55	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R56	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R57	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R58	150	Carbon	0.3	10	914939	Dubilier U.B.T.
R59	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R60	10k	Carbon	0.3	10	914948	Dubilier U.B.T.
R61	NOT USED					
R62	NOT USED					
R63	NOT USED					
R64	NOT USED					
R65	10k	Carbon	0.3	10	914948	Dubilier U.B.T.
R66	22k	Carbon	0.3	10	914949	Dubilier U.B.T
R67	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R68	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R69	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R70	680	Carbon	0.3	10	914942	Dubilier U.B.T.
R71	10k	Metal Oxide		5	900986	Electrosil TR4
R72	4.7k	Metal Oxide		5	900989	Electrosil TR4
R73	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R74	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R75	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.

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

PM1/PM2 (continued)

Resistors (contd)

Cct. Ref.	Value	Description	Rat watt	Tol %	Racal Part No.	Manufacturer
R76	47k	Carbon	0.3	10	914950	Dubilier U.B.T.
R77	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R78	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R79	12.4k	Metal film		1	914963	Erg EEO-1-FC2
R80	2.2k	Carbon	0.3	10	914944	Dubilier U.B T.
R81	1k	Carbon	0.3	10	914943	Dubilier U.B T.
R82	13k	Metal film		1	914738	Erg EEO-1-FC2
R83	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R84	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R85	47	Carbon	0.3	10	914937	Dubilier U.B T.
R86	11k	Metal film		1	914962	Erg EEO-1-FC2
R87	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R88	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R89	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R90	13k	Metal film		1	914738	Erg EEO-1-FC2
R91	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R92	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R93	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R94	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R95	14.3k	Metal film		1	914964	Erg EEO-1-FC2
R96	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R97	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R98	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R99	NOT USED					
R100	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R101	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R102	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R103	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R104	470	Carbon	0.3	10	914941	Dubilier U.B.T.
R105	470	Carbon	0.3	10	914941	Dubilier U.B.T.
R106	6.8k	Carbon	0.3	10	914947	Dubilier U.B.T.
R107	6.8k	Carbon	0.3	10	914947	Dubilier U.B.T.
R108	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R109	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R110	470	Carbon	0.3	10	914941	Dubilier U.B.T.
R111	680	Carbon	0.3	10	914942	Dubilier U.B.T.
R112	220	Carbon	0.3	10	914940	Dubilier U.B.T.
R113	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R114	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R115	47k	Carbon	0.3	10	914950	Dubilier U.B.T.

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
PM1/PM2 (continued)						
Resistors (contd)			watts			
R116	150	Carbon	0.3	10	914939	Dubilier U.B.T.
R117	10k	Carbon	0.3	10	914948	Dubilier U.B.T.
R118	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R119	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R120	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R121	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R122	NOT USED					
R123	NOT USED					
R124	NOT USED					
R125	NOT USED					
R126	NOT USED					
R127	NOT USED					
R128	NOT USED					
R129	NOT USED					
R130	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R131	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R132	NOT USED					
R133	15k	Metal Oxide		5	908280	Electrosil TR4
R134	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R135	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R136	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R137	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R138	5.6k	Metal Oxide		5	908273	Electrosil TR4
R139	33k	Metal Oxide		5	908291	Electrosil TR4
R140	27k	Metal Oxide		5	908295	Electrosil TR4
R141	22k	Metal Oxide		5	908273	Electrosil TR4
R142	5.6k	Metal Oxide		5	908273	Electrosil TR4
R143	330	Carbon	0.3	10	915107	Dubilier U.B.T.
R144	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R145	330	Carbon	0.3	10	915107	Dubilier U.B.T.
R146	5.6k	Metal Oxide		5	908273	Electrosil TR4
R147	33k	Metal Oxide		5	908291	Electrosil TR4
R148	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R149	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R150	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R151	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R152	47k	Carbon	0.3	10	914950	Dubilier U.B.T.
R153	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R154	100k	Metal Oxide		5	908293	Electrosil TR4
R155	Selected by test					

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

PM1/PM2 (continued)

Resistors (contd)			watts			
R156	15k	Metal Oxide		5	908280	Electrosil TR4
R157	1k	Metal Oxide		5	908267	Electrosil TR4
R158	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R159	6.8k	Carbon	0.3	10	914947	Dubilier U.B.T.
R160	150	Carbon	0.3	10	914939	Dubilier U.B.T.
R161	7.15k	Metal film		1	914952	Erg EEO-1-FCC
R162	NOT USED					
R163	22k	Carbon	0.1	10	902524	Erie 15
R164	NOT USED					
R165	47k	Carbon	0.3	10	914950	Dubilier U.B.T.
R166	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R167	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R168	NOT USED					
R169	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R170	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R171	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R172	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R173	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R174	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R175	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R176	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R177	47k	Carbon	0.3	10	914950	Dubilier U.B.T.
R178	47k	Carbon	0.3	10	914950	Dubilier U.B.T.
R179	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R180	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R181	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R182	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R183	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R184	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R185	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R186	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R187	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R188	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R189	150	Carbon	0.3	10	914939	Dubilier U.B.T.
R190	47k	Carbon	0.3	10	914950	Dubilier U.B.T.
R191	47k	Carbon	0.3	10	914950	Dubilier U.B.T.
R192	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R193	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R194	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R195	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
PM1/PM2 (continued)						
Resistors (contd)			watts			
R196	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R197	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R198	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R199	150	Carbon	0.3	10	914939	Dubilier U.B.T.
R200	220	Carbon	0.3	10	914940	Dubilier U.B.T.
R201	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R202	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R203	3.9k	Carbon		5	900990	Electrosil TR4
R204	3.9k	Carbon		5	900990	Electrosil TR4
R205	10k	Carbon	0.3	10	914948	Dubilier U.B.T.
R206	10k	Carbon	0.3	10	914948	Dubilier U.B.T.
R207	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R208	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R209	10k	Carbon	0.3	10	914948	Dubilier U.B.T.
R210	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R211	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R212	10k	Carbon	0.3	10	914948	Dubilier U.B.T.
R213	6.8k	Carbon	0.3	10	914947	Dubilier U.B.T.
R214	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R215	470	Carbon	0.3	10	914941	Dubilier U.B.T.
R216	100	Carbon	0.3	10	914938	Dubilier U.B.T.
Potentiometer						
RV1	2.2k					Egen 522 (preferred) or Morganite 62H
Capacitors						
C1	0.1	Polycarbonate	100	20	914173	S.T.C. PMA M100
C2	33p	Ceramic		10	914909	Erie 831/N750
C3	22p	Ceramic		10	914931	Erie 831/N750
C4	33p	Ceramic		10	914909	Erie 831/N750
C5	4.7	Tantalum	20	20	914914	U.C. Kemet 4R7E20

Cct. Ref.	Value	Description	Rat volts	Tol %	Racal Part No.	Manufacturer

PM1/PM2 (continued)

Capacitors (contd)

Cct. Ref.	Value	Description	Rat volts	Tol %	Racal Part No.	Manufacturer
C6	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C7	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C8	220p	Ceramic		10	914916	Erie 831 /N4200
C9	100p	Ceramic		10	911904	Erie 831 /N3300
C10	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C11	4.7	Tantalum	20	20	914914	U.C. Kemet 4R7E20
C12	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C13	.01	Ceramic	25	-25+30	911845	Erie 831T/25
C14	4.7	Tantalum	20	20	914914	U.C. Kemet 4R7E20
C15	NOT USED					
C16	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C17	220p	Ceramic		10	914916	Erie 831/N4200
C18	4.7	Tantalum	20	20	914914	U.C. Kemet 4R7E20
C19	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C20	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C21	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C22	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C23	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C24	220p	Ceramic		10	914916	Erie 831 /N4200
C25	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C26	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C27	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C28	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C29	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C30	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C31	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C32	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C33	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C34	NOT USED					
C35	NOT USED					
C36	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C37	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C38	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C39	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C40	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C41	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C42	12p	Trimmer			914905	Erie Type 565-013
C43 *		(Selected on test		½pF		Erie Style 831 NPO
C44 *		(see NOTE		10	914931	Erie Style 831 N750
C45	.01	Ceramic	25	-25+50	911845	Erie 831T/25

NOTE:- The values of C43 and C44 are selected by factory test.
Nominal values are C43, 4.7p and C44, 22p.

Cct. Ref.	Value	Description	Rat volts	Tol %	Racal Part No.	Manufacturer

PM1/PM2 (continued)

Capacitors (contd)

Cct. Ref.	Value	Description	Rat volts	Tol %	Racal Part No.	Manufacturer
C46	470p	Silver Mica	50	5	915187	J & M C5E
C47	100p	Silver Mica	50	5	915186	J & M C5E
C48	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C49	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C50	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C51	220p	Ceramic		10	914916	Erie 831/N4200
C52	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C53	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C54	10p	Ceramic		10	914912	Erie 831/NPO
C55	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C56	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C57	100p	Silver Mica	50	2	915183	J & M C5E
C58	10p	Ceramic		10	914912	Erie 831/NPO
C59	470p	Silver Mica	50	2	915184	J & M C5E
C60	15	Tantalum	10	20	915188	U.C.Kemet K15E10
C61	10p	Ceramic		10	914912	Erie 831/NPO
C62	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C63	.0022	Silver Mica		2	915185	J & M C12E
C64	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C65	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C66	10p	Ceramic		10	914912	Erie 831 NPO
C67	.01	Polycarbonate		2	914933	S.T.C. PMA.G100
C68	NOT USED					
C69	33	Tantalum	10	20	901100	U.C. Kemet K33J10S
C70	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C71	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C72	33p	Ceramic		10	914909	Erie 831/N750
C73	.047	Polycarbonate		2	914934	S.T.C. PMA G100
C74	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C75	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C76	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C77	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C78	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C79	NOT USED					
C80	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C81	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C82	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C83	100p	Silver Mica	50	2	915183	J & M C5E
C84	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C85	.01	Ceramic	25	-25+50	911845	Erie 831T/25

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
PM1/PM2 (continued)			volts			
Capacitors (contd)						
C86	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C87	100p	Ceramic		10	911904	Erie 831/N3300
C88	220p	Ceramic		10	914916	Erie 831/N4200
C89	100p	Ceramic		10	911904	Erie 831/N3300
C90	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C91	33p	Ceramic		10	914909	Erie 831/N750
C92	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C93	22p	Ceramic		10	914931	Erie 831/N750
C94	NOT USED					
C95	NOT USED					
C96	100p	Ceramic		10	911904	Erie 831/N3300
C97	15	Tantalum	10	20	915188	U.C.Kemet K15E10
C98	15	Tantalum	10	20	915188	U.C.Kemet K15E10
C99	4.7	Tantalum	20	20	914914	U.C.Kemet K15E10
C100	0.1	Polycarbonate		20	914173	S.T.C. PMA M100
C101	.01	Polycarbonate		5	914913	S.T.C. PMA J100
C102	0.1	Polycarbonate		20	914173	S.T.C. PMA M100
C103	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C104	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C105	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C106	4.7	Tantalum	20	20	914914	U.C. Kemet KR7E20
C107	33p	Ceramic		10	914909	Erie 831/N750
C108	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C109	.01	Polycarbonate		5	914913	S.T.C. PMA J100
C110	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C111	NOT USED					
C112	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C113	NOT USED					
C114	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C115	100p	Ceramic		10	911904	Erie 831/N3300
C116	100p	Ceramic		10	911904	Erie 831/N3300
C117	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C118	33p	Ceramic		10	914909	Erie 831/N750
C119	33p	Ceramic		10	914909	Erie 831/N750
C120	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C121	15	Tantalum	10	20	915188	U C. Kemet K15E10
C122	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C123	220p	Ceramic		10	914916	Erie 831/N4200
C124	220p	Ceramic		10	914916	Erie 831/N4200
C125	22p	Ceramic		10	914931	Erie 831/N750

Cct. Ref.	Value	Description	Rat volts	Tol %	Racal Part No.	Manufacturer

PM1/PM2 (continued)

Capacitors (contd)

Cct. Ref.	Value	Description	Rat volts	Tol %	Racal Part No.	Manufacturer
C126	22p	Ceramic		10	914931	Erie 831/N750
C127	0.1	Polycarbonate		20	914173	S.T.C. PMA M100
C128	0.1	Polycarbonate		20	914173	S.T.C. PMA M100
C129	100p	Ceramic		10	911904	Erie 831/N3300
C130	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C131	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C132	100	Ceramic		10	911904	Erie 831/N3300
C133	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C134	4.7	Tantalum	20	20	914914	U C. Kemet K4R7E20
C135	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C136	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C137	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C138	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C139	15	Tantalum	10	20	915188	U C Kemet K15E10
C140	0.1	Ceramic	12	20	21-1552	Centralab DA482

Inductors and Transformers

Cct. Ref.	Value	Description	Racal Part No.	Manufacturer
L1	68µ	Choke	915848	Delavan 1537-68
L2	68µ	Choke	915848	Delavan 1537-68
L3	68µ	Choke	915848	Delavan 1537-68
L4 and L5 NOT USED				
L6	68µ	Choke	915848	Delavan 1537-68
T1		Transformer	MBT.75382	
T2		Transformer	MCT.75381	

Integrated Circuits

Cct. Ref.	Description	Racal Part No.	Manufacturer
IC1	Dual in-line clocked flip-flop	914935	Motorola MC822P

Transistors

Cct. Ref.	Racal Part No.	Manufacturer
VT1	912678	Motorola 2N4126
VT2	915232	Fairchild U14603/1
VT3	906842	S.T.C. 2N2369
VT4	915232	Fairchild U14603/1
VT5	906842	S.T C. 2N2369

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

PM1/PM2 (continued)

Transistors (contd)

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
VT6					914900	Mullard BC109
VT7					914908	Mullard BSX82
VT8					906842	S.T.C. 2N2369
VT9					906842	S.T.C. 2N2369
VT10					914900	Mullard BC109
VT11					906842	S.T.C. 2N2369
VT12					915232	Fairchild U14603/1
VT13					915232	Fairchild U14603/1
VT14					915232	Fairchild U14603/1
VT15					906842	S.T.C. 2N2369
VT16					906842	S.T.C. 2N2369
VT17	NOT USED					
VT18					906842	S.T.C. 2N2369
VT19					906842	S.T.C. 2N2369
VT20					906842	S.T.C. 2N2369
VT21					906842	S.T.C. 2N2369
VT22					906842	S.T.C. 2N2369
VT23					906842	S.T.C. 2N2369
VT24					906842	S.T.C. 2N2369
VT25					906842	S.T.C. 2N2369
VT26					906842	S.T.C. 2N2369
VT27					906842	S.T.C. 2N2369
VT28					906842	S.T.C. 2N2369
VT29					906842	S.T.C. 2N2369
VT30					906842	S.T.C. 2N2369
VT31					906842	S.T.C. 2N2369
VT32					906842	S.T.C. 2N2369
VT33					906842	S.T.C. 2N2369
VT34					906842	S.T.C. 2N2369
VT35					906842	S.T.C. 2N2369
VT36					906842	S.T.C. 2N2369
VT37					906842	S.T.C. 2N2369
VT38	NOT USED					
VT39	NOT USED					
VT40					906842	S.T.C. 2N2369
VT41					906842	S.T.C. 2N2369
VT42					906842	S.T.C. 2N2369
VT43					914900	Mullard BC109
VT44					914900	Mullard BC109
VT45					906842	S.T.C. 2N2369

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
PM1/PM2 (continued)						
Transistors (contd)						
VT46					915232	Fairchild U14603/1
VT47	NOT USED					
VT48					906842	S.T.C. 2N2369
VT49					906842	S.T.C. 2N2369
VT50					915232	Fairchild U14603/1
VT51					914900	Mullard BC109
VT52					914900	Mullard BC109
VT53					915232	Fairchild U14603/1
VT54					914907	U.C. 2N4392
VT55					914908	Mullard BSX82
VT56					914900	Mullard BC109
VT57					914900	Mullard BC109
VT58					915232	Fairchild U14603/1
VT59	NOT USED					
VT60					906842	S.T.C. 2N2369
VT61					906842	S.T.C. 2N2369
VT62					906842	S.T.C. 2N2369
VT63					906842	S.T.C. 2N2369
VT64					906842	S.T.C. 2N2369
VT65					906842	S.T.C. 2N2369
VT66					906842	S.T.C. 2N2369
VT67					906842	S.T.C. 2N2369
VT68					906842	S.T.C. 2N2369
VT69					906842	S.T.C. 2N2369
VT70					906842	S.T.C. 2N2369
VT71					915232	Fairchild U14603/1
VT72					914900	Mullard BC109
VT73					906842	S.T.C. 2N2369
VT74					906842	S.T.C. 2N2369
VT75					906842	S.T.C. 2N2369
VT76					914900	Mullard BC109
VT77					914900	Mullard BC109
Diodes						
D1		Silicon			914898	S.T.C. 1N4149
D2		Silicon			914898	S.T.C. 1N4149
D3		Silicon			914898	S.T.C. 1N4149
D4		Silicon			914898	S.T.C. 1N4149
D5		Silicon			914898	S.T.C. 1N4149

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
<u>PM1/PM2</u> <u>(continued)</u>						
<u>Diodes</u> (<u>contd</u>)						
D6		Silicon			914898	S.T.C. 1N4149
D7		Silicon			914898	S.T.C. 1N4149
D8		Silicon			914898	S.T.C. 1N4149
D9		Silicon			914898	S.T.C. 1N4149
D10		Silicon			914898	S.T.C. 1N4149
D11		Silicon			914898	S.T.C. 1N4149
D12		Silicon			914898	S.T.C. 1N4149
D13		Silicon			914898	S.T.C. 1N4149
D14		Silicon			914898	S.T.C. 1N4149
D15		Voltage Var.Capcitance				Motorola MV1638
D16		Voltage Var.Capacitance				Motorola MV1638
D17		Silicon			914898	S.T.C. 1N4149
D18		Silicon			914898	S.T.C. 1N4149
D19	NOT USED					
D20		Silicon			914898	S.T.C. 1N4149
D21		Silicon			914898	S.T.C. 1N4149
D22		Silicon			914898	S.T.C. 1N4149
D23		Silicon			914898	S.T.C. 1N4149
D24		Silicon			914898	S.T.C. 1N4149
D25		Silicon			914898	S.T.C. 1N4149
D26		Silicon			914898	S.T.C. 1N4149
D27		Silicon			914898	S.T.C. 1N4149
D28		Silicon			914898	S.T.C. 1N4149
D29		Silicon			914898	S.T.C. 1N4149
D30		Silicon			914898	S.T.C. 1N4149
D31		Silicon			914898	S.T.C. 1N4149
D32		Silicon			914898	S.T.C. 1N4149
D33		Silicon			914898	S.T.C. 1N4149
D34	NOT USED					
D35	NOT USED					
D36		Silicon			914898	S.T.C. 1N4149
D37		Silicon			914898	S.T.C. 1N4149
D38	NOT USED					
D39	NOT USED					
D40		Silicon			914898	S.T.C. 1N4149
D41		Silicon			914898	S.T.C. 1N4149
D42		Silicon			914898	S.T.C. 1N4149
D43		Silicon			914898	S.T.C. 1N4149
D44		Silicon			914898	S.T.C. 1N4149
D45		Silicon			914898	S.T.C. 1N4149

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
PM1/PM2 (continued)						
Diodes (contd)						
D46		Silicon			914898	S.T.C. 1N4149
D47		Silicon			914898	S.T.C. 1N4149
D48		Silicon			914898	S.T.C. 1N4149
Crystals						
XL1		12 MHz			MCD 75400/A	
XL2		13 MHz			MCD 75400/B	
XL3		14 MHz			MCD 75400/C	
XL4		15 MHz			MCD 75400/D	
XL5		16 MHz			MCD 75400/E	
XL6		17 MHz			MCD 75400/F	
XL7		5 MHz (PM2 Board only)			MCD 75402	
XL8		10.6993 MHz			MCD 75401	
XL9		10.6993 MHz			MCD 75401	
Frequency Reference Oscillator Unit (PM1 Board only)						
TCXO		5 MHz Oscillator Unit			MBD 75426	

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

PM3 BOARD

Printed Circuit Board Assembly Type PM3 (complete) MDA75359

COMPONENTS ON PM3 BOARD

Resistors	ohms		watts			
R1	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R2	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R3	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R4	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R5	150	Carbon	0.3	10	914939	Dubilier U.B.T.
R6	NOT USED					
R7	NOT USED					
R8	NOT USED					
R9	NOT USED					
R10	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R11	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R12	10k	Carbon	0.3	10	914948	Dubilier U.B.T.
R13	10k	Carbon	0.3	10	914948	Dubilier U.B.T.
R14	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R15	220	Carbon	0.3	10	914940	Dubilier U.B.T.
R16	10	Carbon	0.3	10	914936	Dubilier U.B.T.
R17	10	Carbon	0.3	10	914936	Dubilier U.B.T.
R18	10	Carbon	0.3	10	914936	Dubilier U.B.T.
R19	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R20	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R21	NOT USED					
R22	10k	Carbon	0.3	10	914948	Dubilier U.B.T.
R23	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R24	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R25	22k	Metal Oxide		5	908269	Electrosil TR4
R26	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R27	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R28	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R29	33k	Metal Oxide		5	908291	Electrosil TR4
R30	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R31	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R32	10k	Carbon	0.3	10	914948	Dubilier U.B.T.
R33	22k	Carbon	0.3	10	914949	Dubilier U.B.T.
R34	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R35	NOT USED					

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
PM3 (continued)						
Resistors (contd)	ohms		watts			
R36	NOT USED					
R37	NOT USED					
R38	NOT USED					
R39	NOT USED					
R40	22.1k	Metal film		1	914956	Erg EEO-1-FCO
R41	16.5k	Metal film		1	914954	Erg EEO-1-FCO
R42	17.4k	Metal film		1	914955	Erg EEO-1-FCO
R43	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R44	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R45	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R46	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R47	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R48	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R49	220	Composition	0.1	10	See Note	Erie 15
R50	7.15k	Metal film		1	914966	Erg EEO-1-FCO

NOTE: The value of R49 is selected by test. Normal value is 220Ω.

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
R51	7.87k	Metal film		1	914953	Erg EEO-1-FCO
R52	6.8k	Carbon	0.3	10	914947	Dubilier U.B.T.
R53	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R54	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R55	6.8k	Carbon	0.3	10	914947	Dubilier U.B.T.
R56	150	Wirewound	2.5	10	915248	Welwyn WW W21
R57	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R58	6.8k	Carbon	0.3	10	914947	Dubilier U.B.T.
R59	NOT USED					
R60	NOT USED					
R61	NOT USED					
R62	NOT USED					
R63	NOT USED					
R64	NOT USED					
R65	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R66	22k	Metal Oxide		5	908269	Electrosil TR4
R67	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R68	3.3k	Carbon	0.3	10	914945	Dubilier U.B.T.
R69	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R70	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.

NOTE: R66 is selected on test. The nominal value is 22k.

PM3 (continued)

Resistors (Contd)

Cct. Ref.	Value ohms	Description	Rat watts	Tol %	Racal Part No.	Manufacturer
R71	NOT USED					
R72	10k	Metal Oxide		5	900986	Electrosil TR4
R73	NOT USED					
R74	10k	Metal Oxide		5	900986	Electrosil TR4
R75	10k	Metal Oxide		5	900986	Electrosil TR4
R76	680	Metal Oxide		5	908390	Electrosil TR4
R77	NOT USED					
R78	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R79	NOT USED					
R80	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R81	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R82	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R83	220	Carbon	0.3	10	914940	Dubilier U.B.T.
R84	22k	Metal Oxide	0.25	5		Electrosil TR4.
R85	22k	Metal Oxide	0.25	5		Electrosil TR4.
R86	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R87	220	Carbon	0.3	10	914940	Dubilier U.B.T.
R88	47k	Carbon	0.3	10	914950	Dubilier U.B.T.
R89	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R90	NOT USED					
R91	1k	Carbon	0.3	10	914943	Dubilier U.B.T.
R92	680	Carbon	0.3	10	914942	Dubilier U.B.T.
R93	680	Carbon	0.3	10	914942	Dubilier U.B.T.
R94	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R95	470	Carbon	0.3	10	914941	Dubilier U.B.T.
R96	4.7k	Carbon	0.3	10	914946	Dubilier U.B.T.
R97	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R98	6.8k	Carbon	0.3	10	914947	Dubilier U.B.T.
R99	150	Carbon	0.3	10	914939	Dubilier U.B.T.
R100	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R101	220	Carbon	0.3	10	914940	Dubilier U.B.T.
R102	150	Carbon	0.3	10	914939	Dubilier U.B.T.
R103	47	Carbon	0.3	10	914937	Dubilier U.B.T.
R104	100	Carbon	0.3	10	914938	Dubilier U.B.T.
R105	47	Carbon	0.3	10	914937	Dubilier U.B.T.

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

PM3 (continued)

Resistors (contd)

	ohms		watts			
R106	1k	Carbon	0.3	10	914943	Dubilier U.B T.
R107	2.2k	Carbon	0.3	10	914944	Dubilier U.B.T.
R108	1k	Carbon	0.3	10	914943	Dubilier U.B T.

Potentiometers

RV1	2.2k				915674	Egen 522
RV2	2.2k				915674	Egen 522
RV3	2.2k				915674	Egen 522
RV4	NOT USED					
RV5	2.2k				915674	Egen 522
RV6	2.2k				915674	Egen 522

NOTE:- The Morganite Type 62H may be fitted as an alternative if the Egen Type 522 is not available.

Capacitors

			Volts			
C1	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C2	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C3	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C4	100p	Ceramic		10	911904	Erie 831/N3300
C5	100p	Ceramic		10	911904	Erie 831/N3300

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

PM3 (continued)

Capacitors (contd)

Cct. Ref.	Value	Description	Rat volts	Tol %	Racal Part No.	Manufacturer
C6	NOT USED					
C7	NOT USED					
C8	NOT USED					
C9	NOT USED					
C10	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C11	220p	Ceramic		10	914916	Erie 831/N4200
C12	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C13	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C14	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C15	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C16	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C17	4.7	Tantalum	20	20	914914	U.C. Kemet K15E10
C18	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C19	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C20	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C21	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C22	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C23	33	Tantalum	10	20	901100	U.C. Kemet K33J10S
C24	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C25	100p	Ceramic		10	911904	Erie 831N330
C26	.01	Ceramic			911845	Erie 831T/25
C27	33p	Ceramic		10	914909	Erie 831N750
C28	33p	Ceramic		10	914909	Erie 831N750
C29	10p	Ceramic		10	914912	Erie 831NPO
C30	.01	Polycarbonate		5	914913	S.T.C. PMA J100
C31	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C32	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C33	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C34	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C35	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C36	NOT USED					
C37	NOT USED					
C38	NOT USED					
C39	NOT USED					
C40	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C41	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C42	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C43	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C44	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C45	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
PM3 (continued)						
Capacitors (contd)			volts			
C46	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C47	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C48	6.8	Tantalum	35	20	910129	U.C. Kemet K6R8J35S
C49	0.1	Polycarbonate	100	±20	914173	S.T.C.PMA M100
C50	NOT USED					
C51 to C55	NOT USED					
C56	NOT USED					
C57	NOT USED					
C58	NOT USED					
C59	1.0	Tantalum	35	20	913509	U.C. Kemet K1J35KS
C60	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C61	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C62	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C63	NOT USED					
C64	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C65	22	Tantalum	15	10	907481	U.C. Kemet K22J15KS
C66	15	Tantalum	10	20	915188	U C. Kemet K15E10
C67	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C68	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C69	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C70	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C71	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C72	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C73	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C74	100p	Ceramic		10	911904	Erie 831/N3300
C75	15	Tantalum	10	20	915188	U.C. Kemet K15E10
C76	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C77	0.1	Tantalum	35	20	915443	U.C. Kemet KR1E35
C78	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C79	10p	Ceramic		10	914912	Erie 831/NPO
C80	10p	Ceramic		10	914912	Erie 831/NPO
C81	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C82	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C83	4.7	Tantalum	20	20	914914	U.C. Kemet K4R7E20
C84	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C85	33p	Ceramic		10	914909	Erie 831/N750
C86	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C87	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C88	NOT USED					
C89	NOT USED					
C90	NOT USED					

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
PM3 (continued)						
Capacitors (contd)			volts			
C91	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C92	NOT USED					
C93	.01	Ceramic	25	-25+50	911845	Erie 831T/25
C94	.01	Ceramic	25	-25+50	911845	Erie 831T/25
Inductors and Transformers						
	μH					
L1	1.0	Choke			915849	Delavan 1537-12
L2	NOT USED					
L3	NOT USED					
L4	68	Choke			915848	Delavan 1537-68
L5	NOT USED					
L6	NOT USED					
L7	NOT USED					
L8	NOT USED					
L9	NOT USED					
L10	15	Choke			915850	Delavan 1537-40
L11 to L15		NOT USED				
L16	NOT USED					
L17	68	Choke			915848	Delavan 1537-68
L18	68	Choke			915848	Delavan 1537-68
Transformers						
T1		Wideband transformer			MBT75382	
T2		Wideband transformer			MBT75382	
T3		Wideband transformer			MBT75382	
T4	NOT USED					
T5		Wideband transformer			MBT75385/2	
T6		Wideband transformer			MBT75382	
T7		Wideband transformer			MBT75382	
T8		Coil assembly			MCT75782	
T9		Coil assembly			MCT75783	

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

PM5 (continued)

Integrated Circuits

LG1		Dual in-line decade counter			914917	Signetics N8280A
LG2		Dual in-line decade counter			914917	Signetics N8280A
LG3		Dual in-line binary counter			914918	Signetics N8281A

Transistors

VT1		Silicon n.p.n.			906842	S.T.C. 2N2369
VT2		Silicon n.p.n.			906842	S.T.C. 2N2369
VT3	NOT USED					
VT4	NOT USED					
VT5		Silicon n.p.n.			906842	S.T.C. 2N2369
VT6		Silicon n.p.n.			906842	S.T.C. 2N2369
VT7	NOT USED					
VT8		Silicon n.p.n.			906842	S.T.C. 2N2369
VT9		Silicon n.p.n.			906842	S.T.C. 2N2369
VT10		Silicon n.p.n.			906842	S.T.C. 2N2369
VT11		Silicon n.p.n.			906842	S.T.C. 2N2369
VT12		Silicon n.p.n.			906842	S.T.C. 2N2369
VT13		Silicon n.p.n.			906842	S.T.C. 2N2369
VT14		Silicon n.p.n.			906842	S.T.C. 2N2369
VT15	NOT USED					
VT16-VT19 NOT USED						
VT20		Silicon n.p.n.			914900	Mullard BC109
VT21		Silicon n.p.n.			914900	Mullard BC109
VT22		Silicon n.p.n.			914900	Mullard BC109
VT23		Silicon n.p.n.			914900	Mullard BC109
VT24		Silicon n.p.n.			915232	Fairchild U14603/1
VT25		Silicon p.n.p.			915232	Fairchild U14603/1
VT26		Silicon n.p.n.			914900	Mullard BC109
VT27		Silicon p.n.p.			915267	Mullard BFX29
VT28		Silicon n.p.n.			914900	Mullard BC109
VT29	NOT USED					
VT30	NOT USED					

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

PM3 (continued)

Transistors (contd)

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
VT31-VT34	NOT USED					
VT35		Silicon p.n.p.			915232	Fairchild U14603/1
VT36		Silicon p.n.p.			915232	Fairchild U14603/1
VT37		Silicon n.p.n.			914900	Mullard BC109
VT38	NOT USED					
VT39		Silicon p.n.p.			915232	Fairchild U14603/1
VT40		Silicon p.n.p.			915232	Fairchild U14603/1
VT41		Silicon p.n.p.			915232	Fairchild U14603/1
VT42		Silicon n.p.n.			906842	S.T.C. 2N2369
VT43		Silicon n.p.n.			906842	S.T C. 2N2369
VT44		Silicon n.p.n.			906842	S.T C. 2N2369
VT45		Silicon n.p.n.			906842	S.T.C. 2N2369
VT46		Silicon n.p.n.			906842	S.T.C. 2N2369

Diodes

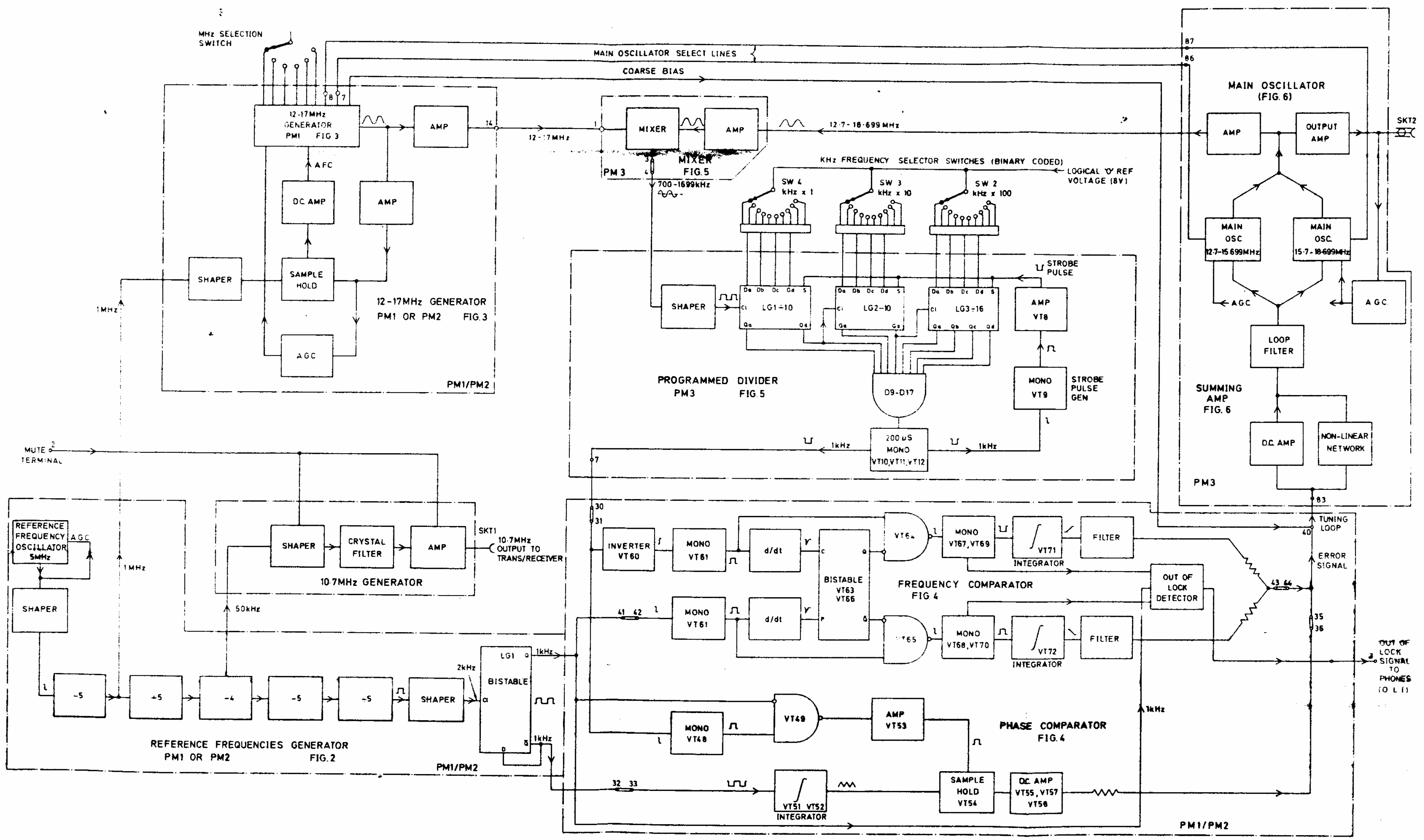
Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
D1		Silicon			914898	S.T.C. 1N4149
D2		Silicon			914898	S.T.C. 1N4149
D3		Silicon			914898	S.T.C. 1N4149
D4		Silicon			914898	S.T.C. 1N4149
D5	NOT USED					
D6	NOT USED					
D7	NOT USED					
D8		Silicon			914898	S.T.C. 1N4149
D9		Silicon			914898	S.T C. 1N4149
D10		Silicon			914898	S.T.C. 1N4149
D11		Silicon			914898	S.T.C. 1N4149
D12		Silicon			914898	S.T.C. 1N4149
D13		Silicon			914898	S.T.C. 1N4149
D14		Silicon			914898	S.T.C. 1N4149
D15		Silicon			914898	S.T.C. 1N4149
D16		Silicon			914898	S.T.C. 1N4149
D17		Silicon			914898	S.T.C. 1N4149
D18	NOT USED					
D19	NOT USED					
D20		Silicon			914898	S.T.C. 1N4149
D21		Silicon			914898	S.T.C. 1N4149
D22		Silicon			914898	S.T.C. 1N4149
D23		Silicon			914898	S.T.C. 1N4149
D24		Silicon			914898	S.T.C. 1N4149
D25	NOT USED					

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

PM3 (continued)

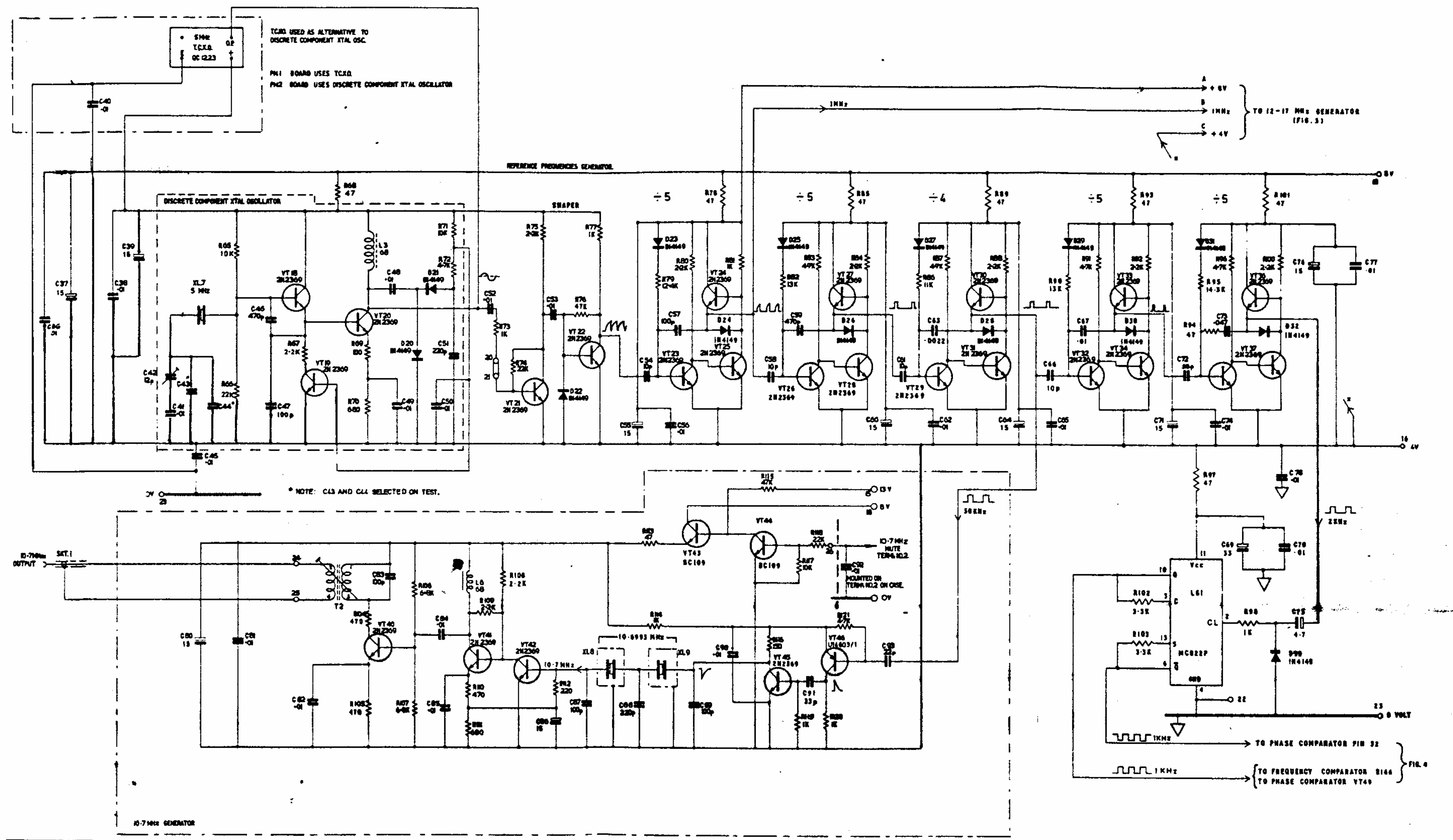
Diodes (contd)

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part No.	Manufacturer
D26-D29	NOT USED					
D30		Zener: 5.6V			912747	Mullard BZY88-C5V6
D31		Zener: 5.6V			912747	Mullard BZY88-C5V6
D32		Zener: 5.6V			912747	Mullard BZY88-C5V6
D33		Silicon			914898	S.T.C. 1N4149
D34		Silicon			914898	S.T.C. 1N4149
D35		Zener: 6.2V			911682	Mullard BZY88-C6V2
D36		Silicon			914898	S.T.C. 1N4149
D37		Zener: 6.8V			914064	Mullard BZY88-C6V8
D38		Zener: 9.1V			914899	Mullard BZY88-C9V1
D39					911460	Texas 1N4002
D40	NOT USED					
D41-D44	NOT USED					
D45		Silicon			914898	S.T.C. 1N4149
D46		Silicon			914898	S.T.C. 1N4149
D47		Silicon			914898	S.T.C. 1N4149
D48		Voltage-Var.Capacitance:		±10%		Motorola MV1650
D49		Voltage-Var.Capacitance:		±10%		Motorola MV1650
D50		Voltage-Var.Capacitance:		±10%		Motorola MV1650
D51		Voltage-Var.Capacitance:		±10%		Motorola MV1650
D52		Silicon			914898	S.T.C. 1N4149
D53		Silicon			914898	S.T.C. 1N4149
D54		Silicon			914898	S.T.C. 1N4149
D55		Silicon			914898	S.T.C. 1N4149
D56		Silicon			914898	S.T.C. 1N4149
D57		Silicon			914898	S.T.C. 1N4149
D58		Silicon			914898	S.T.C. 1N4149



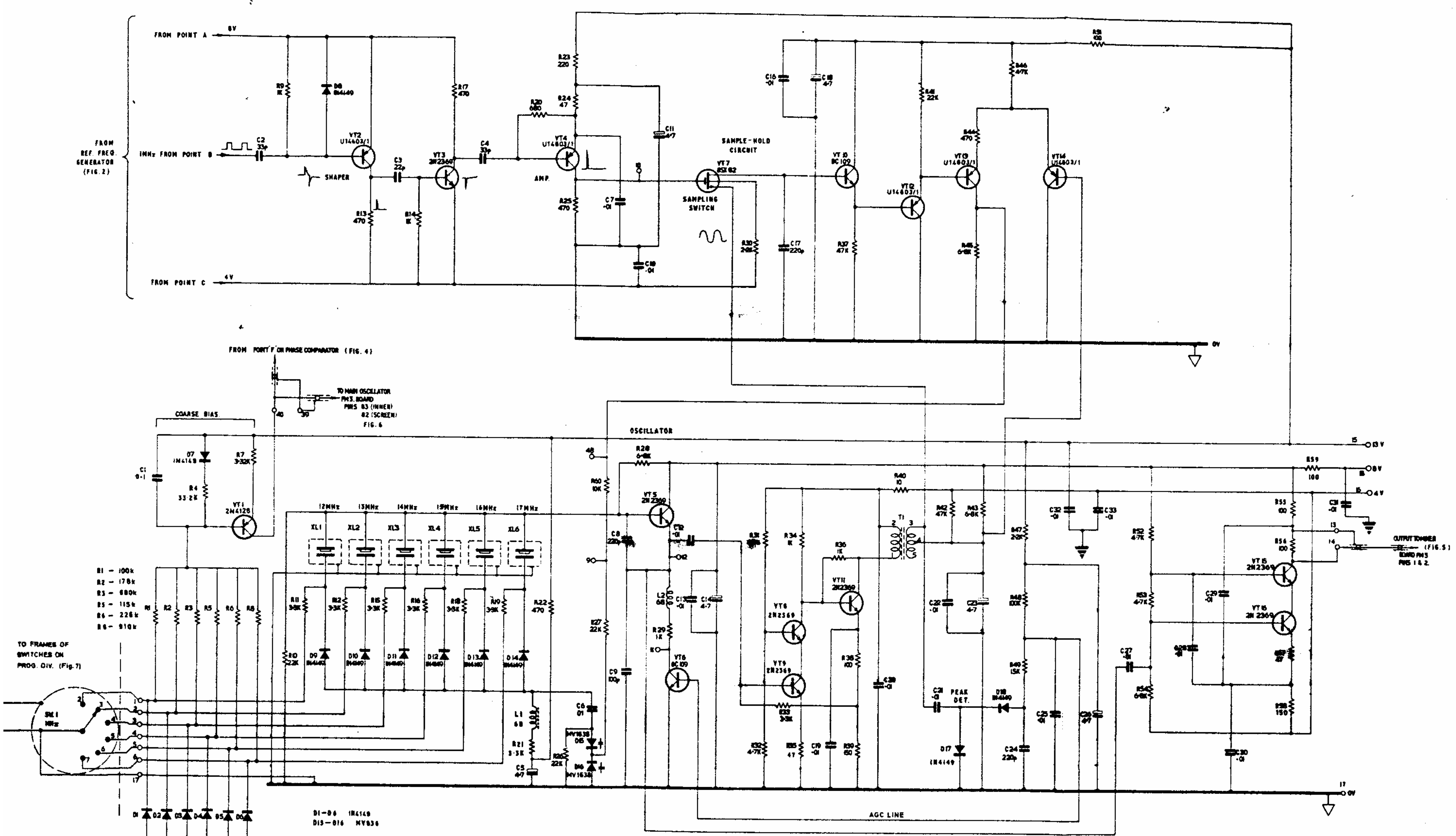
Block Diagram : Synthesizer Type MA.920

Fig. 1



Circuit: Reference Frequencies Generator and 10·7MHz Generator
(PM1 OR PM2 BOARD)

Fig. 2

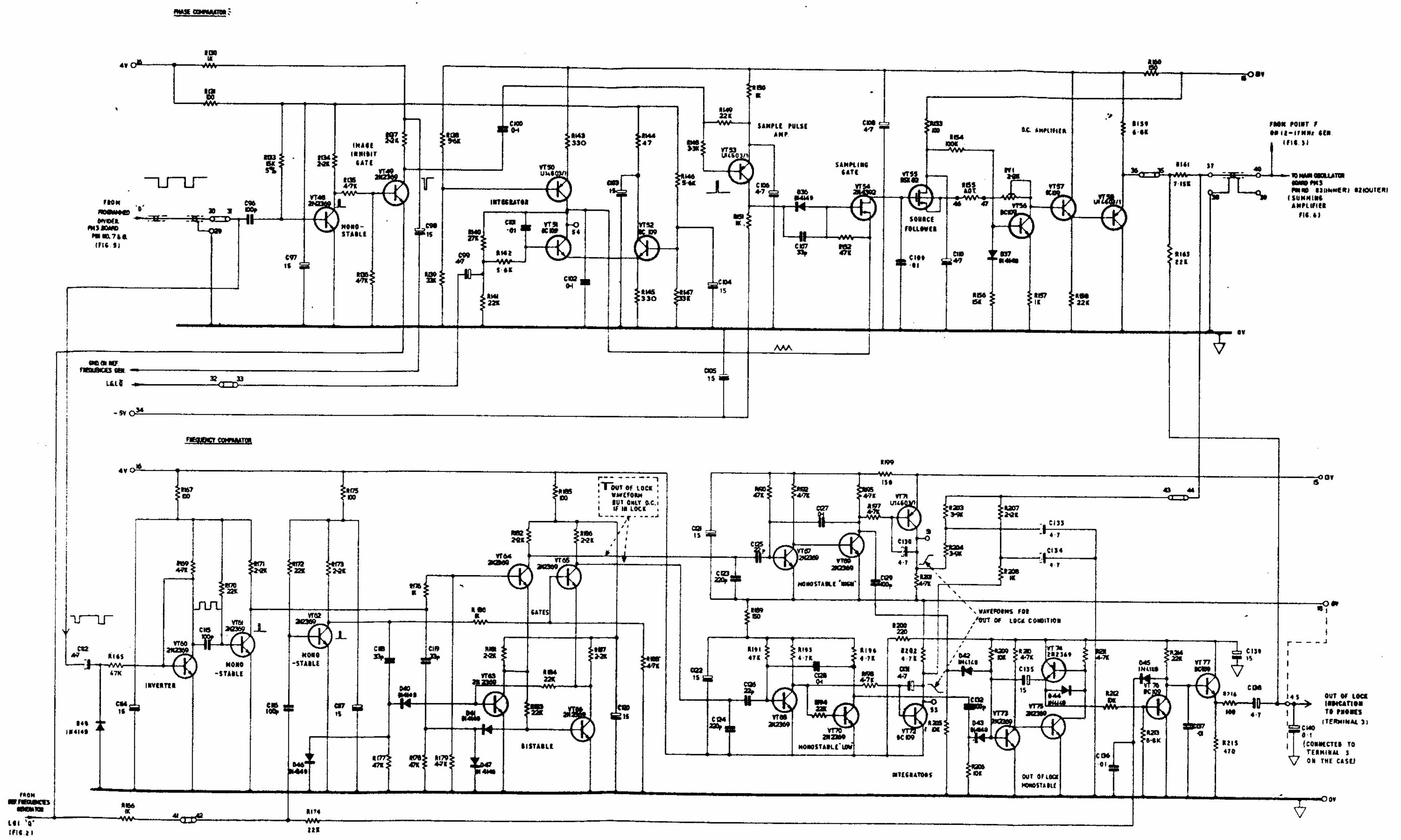


MDC 75291/1	315/3
1 2 3 4 5	

Circuit: 12-17MHz Generator

(PM1 OR PM2 BOARD)

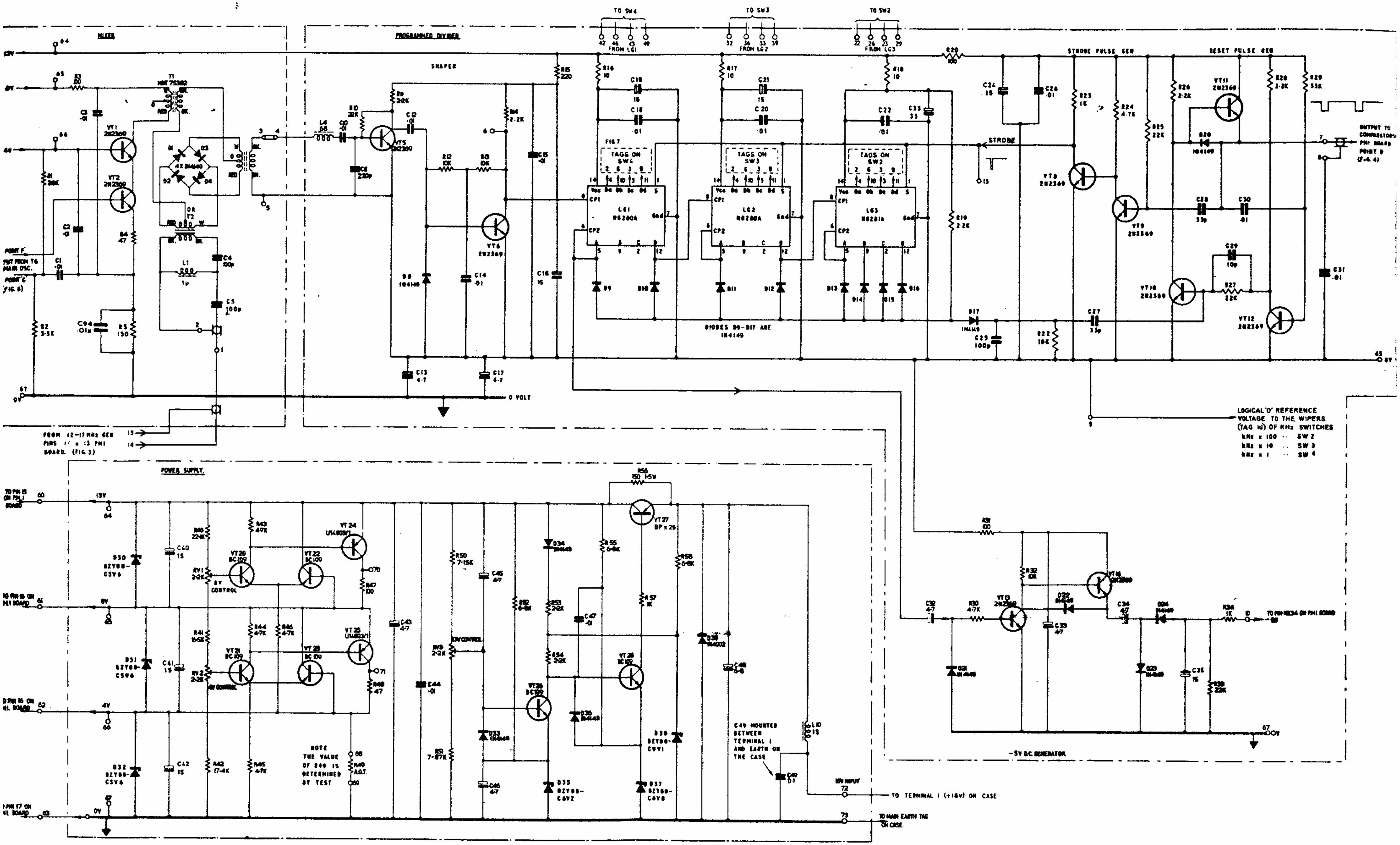
Fig. 3



NBC 75291/3 515/4
1 2 4 5

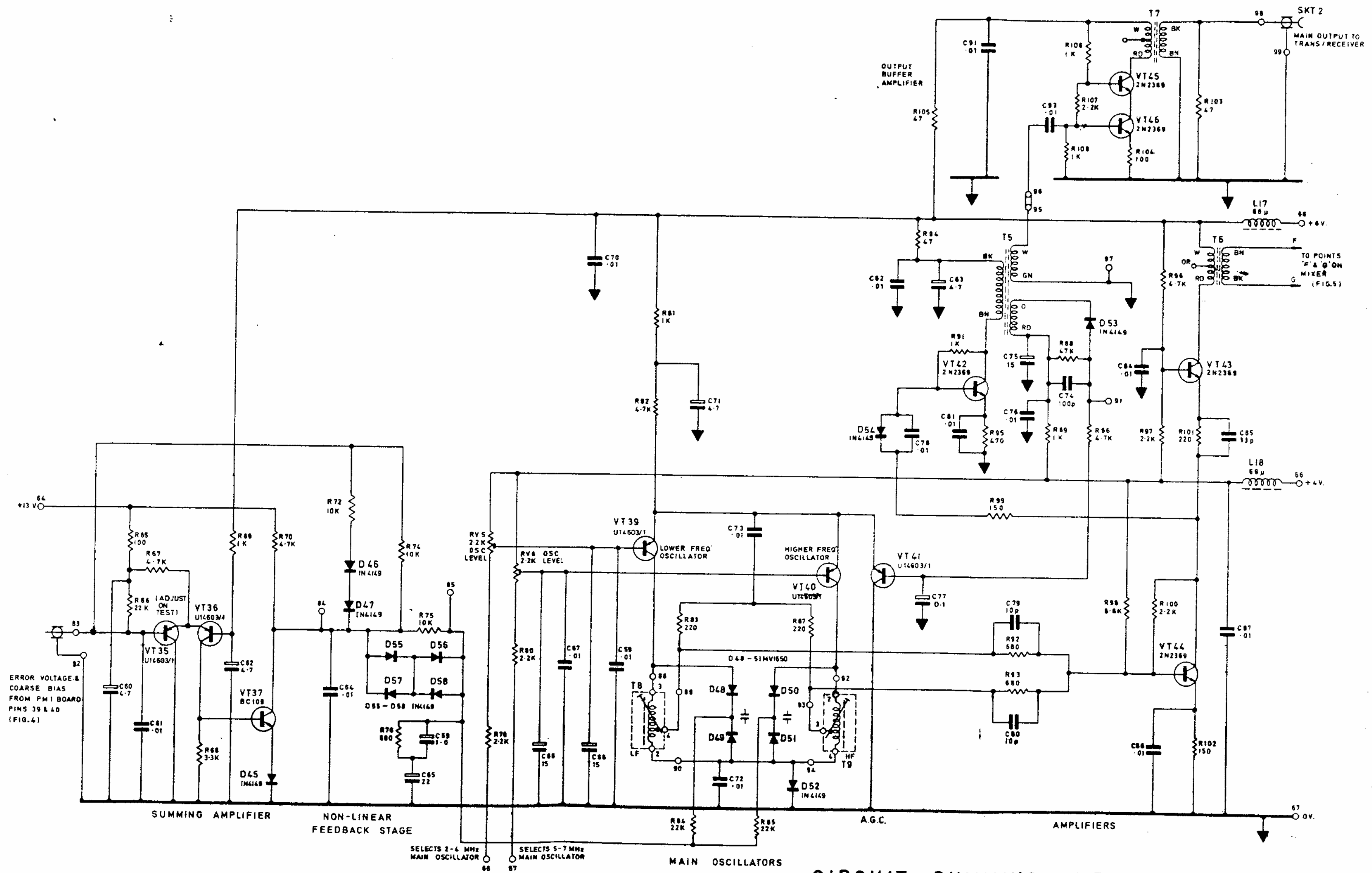
Circuit: Phase and Frequency Comparators
(PM1 OR PM2 BOARD)

Fig. 4



Circuit: Mixer, Programmed Divider and Power Supply
(PM3 Board)

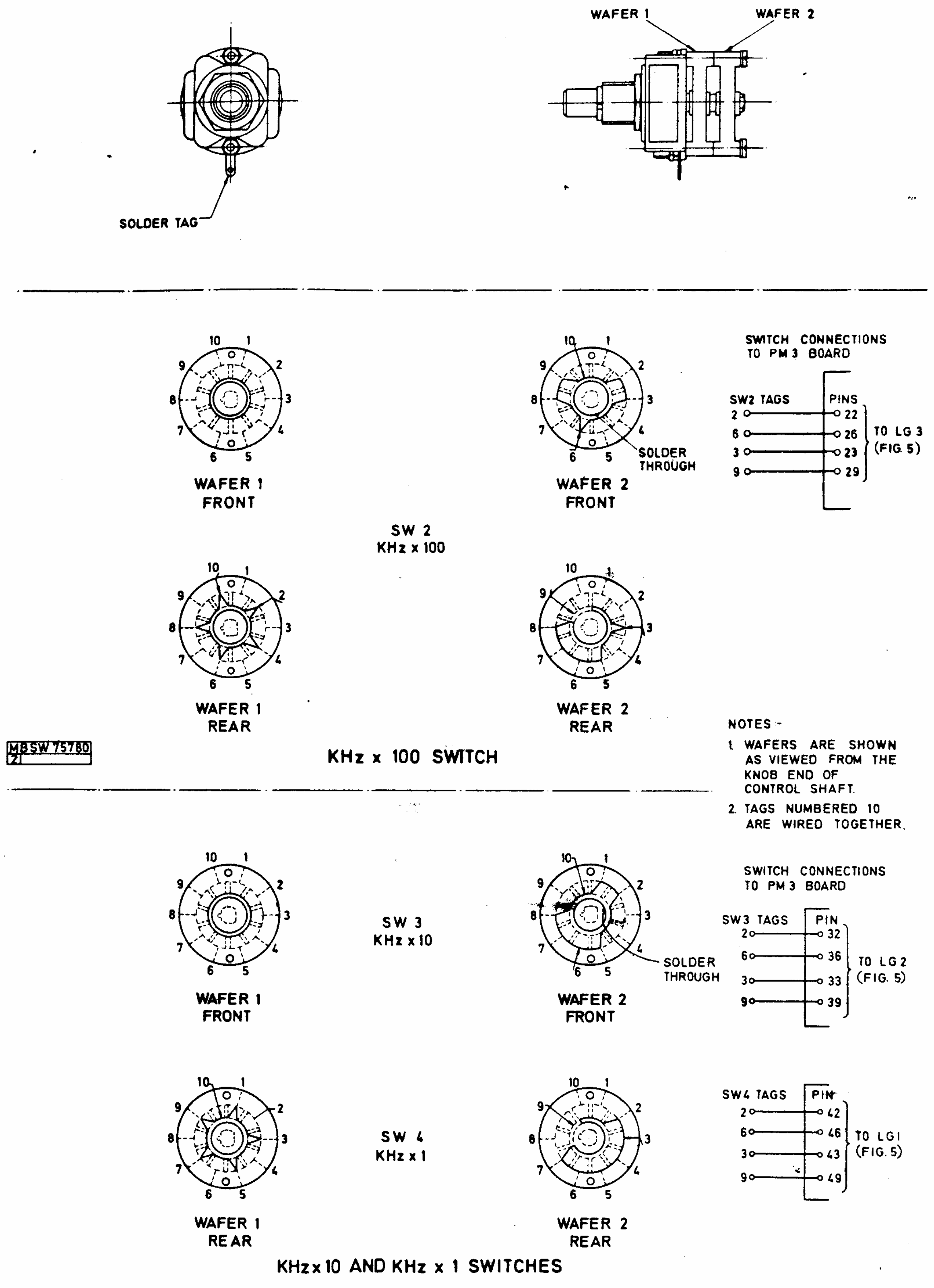
Fig. 5



MOC 75292/E/315/6

CIRCUIT: SUMMING AMPLIFIER & MAIN OSCILLATORS (PM3 BOARD)

FIG. 6

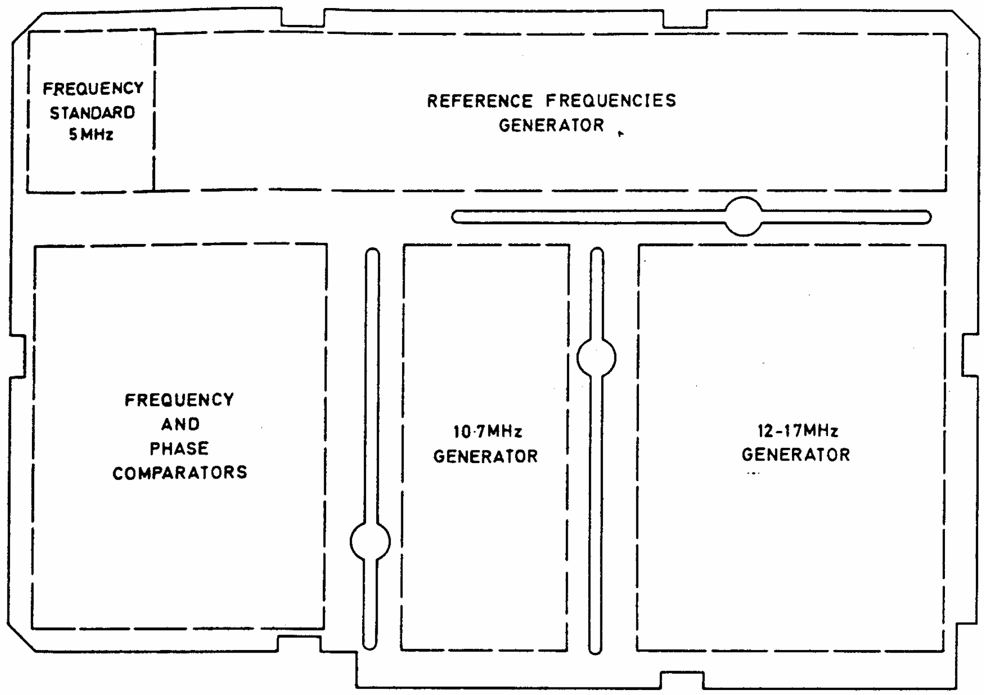


MBSW 75780 2

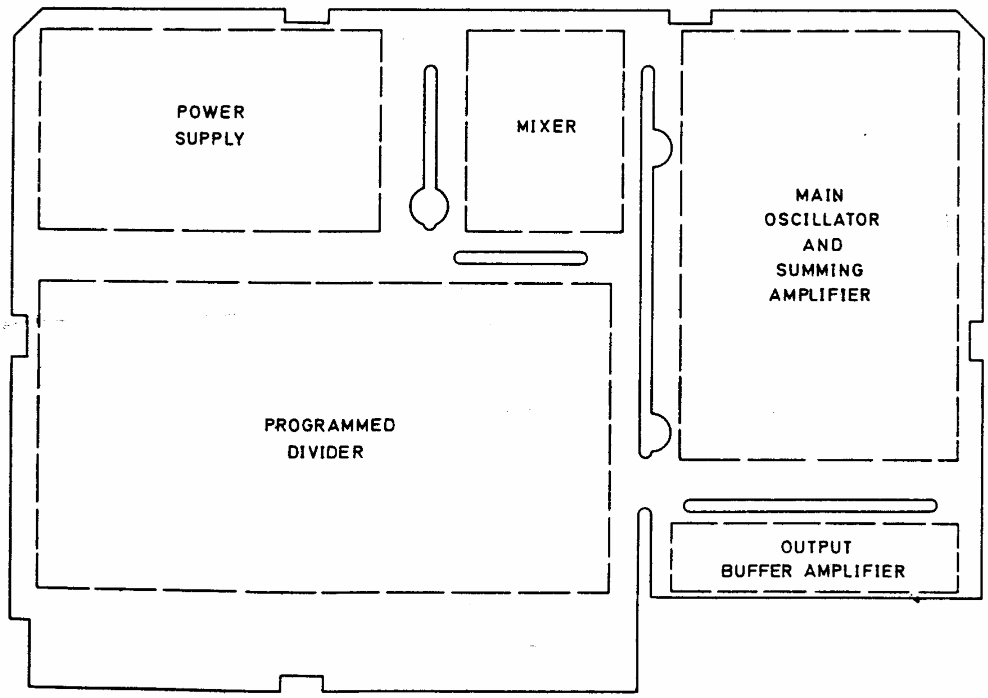
MBSW 75781 315/7 2

Binary Coded KHz Switches

Fig. 7



PM1 OR PM2 BOARD

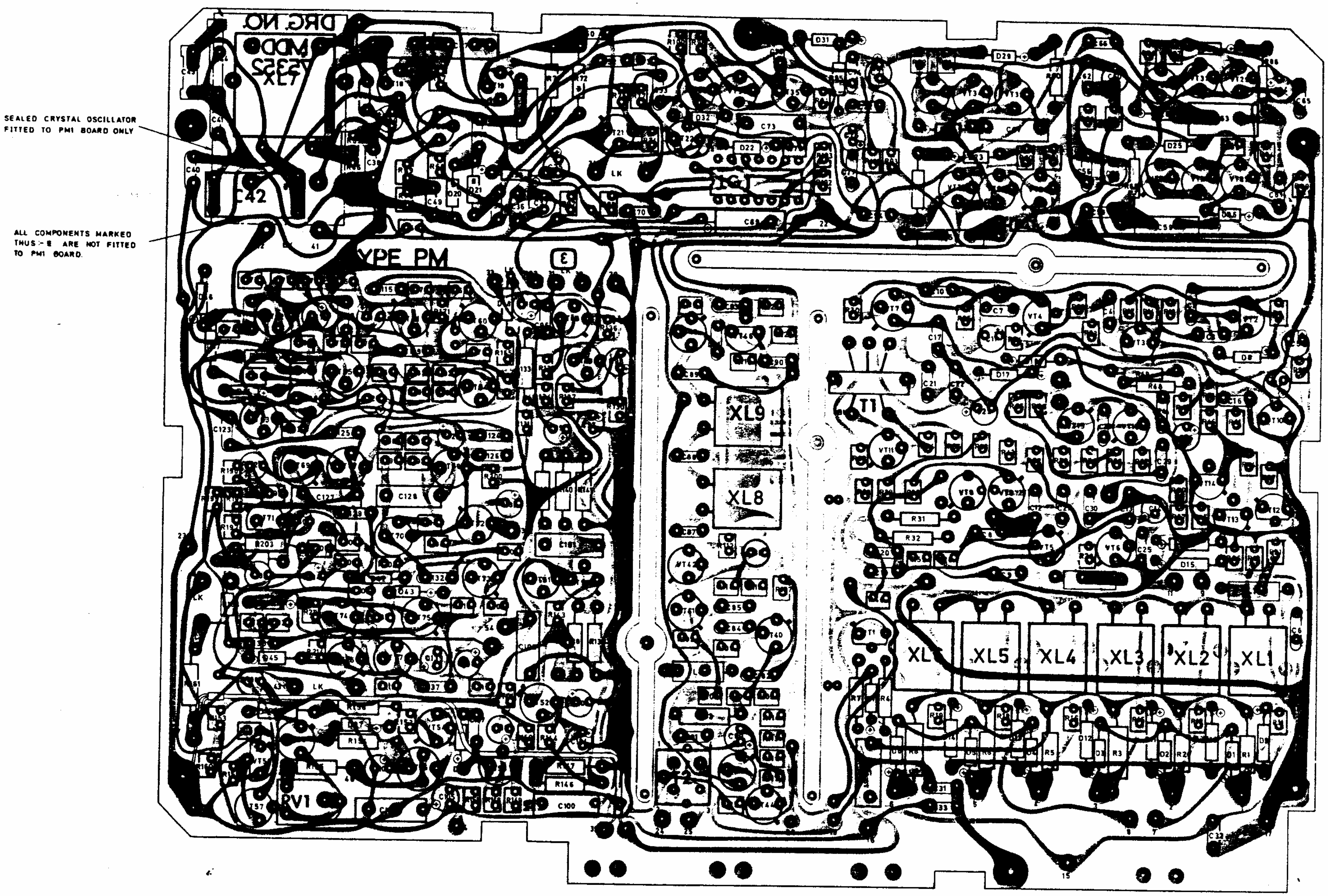


PM3 BOARD

H315/8

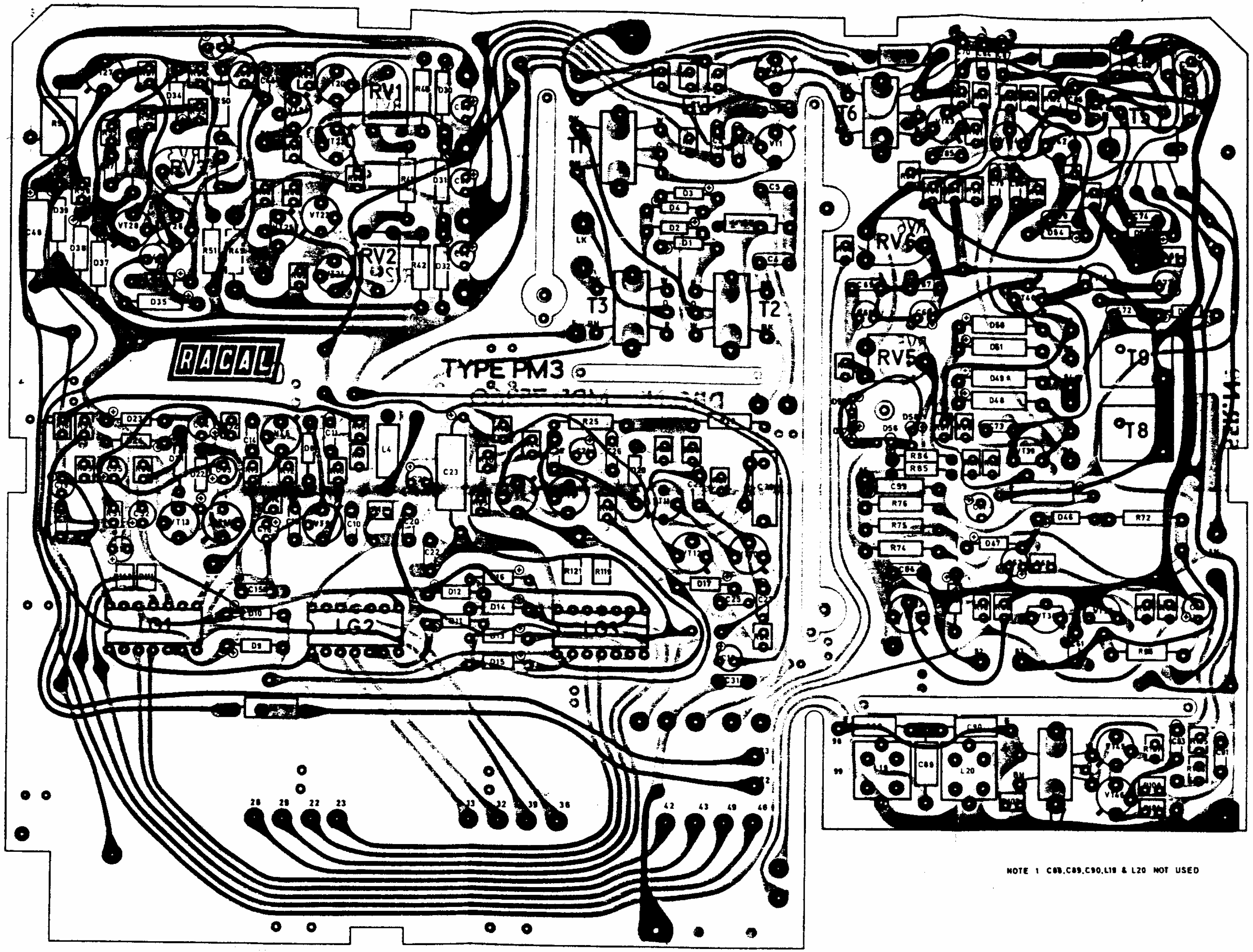
Key Diagram of Board Layouts

Fig. 8



Component Layout : PM1 or PM2 Board

Fig. 9



NOTE 1 C88,C89,C90,L19 & L20 NOT USED

H315/10 H315/10 H315/10

Component Layout : PM3 Board

Fig. 10