9054 & 9055 VHF/UHF Calibrators

Technical Manual

2.10.72-200

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G0RSQ

26th January 2015

9054 & 9055
V.H.F./U.H.F.
Calibrators

Technical Manual

RACAL
THE ELECTRONICS GROUP

RACAL INSTRUMENTS LIMITED

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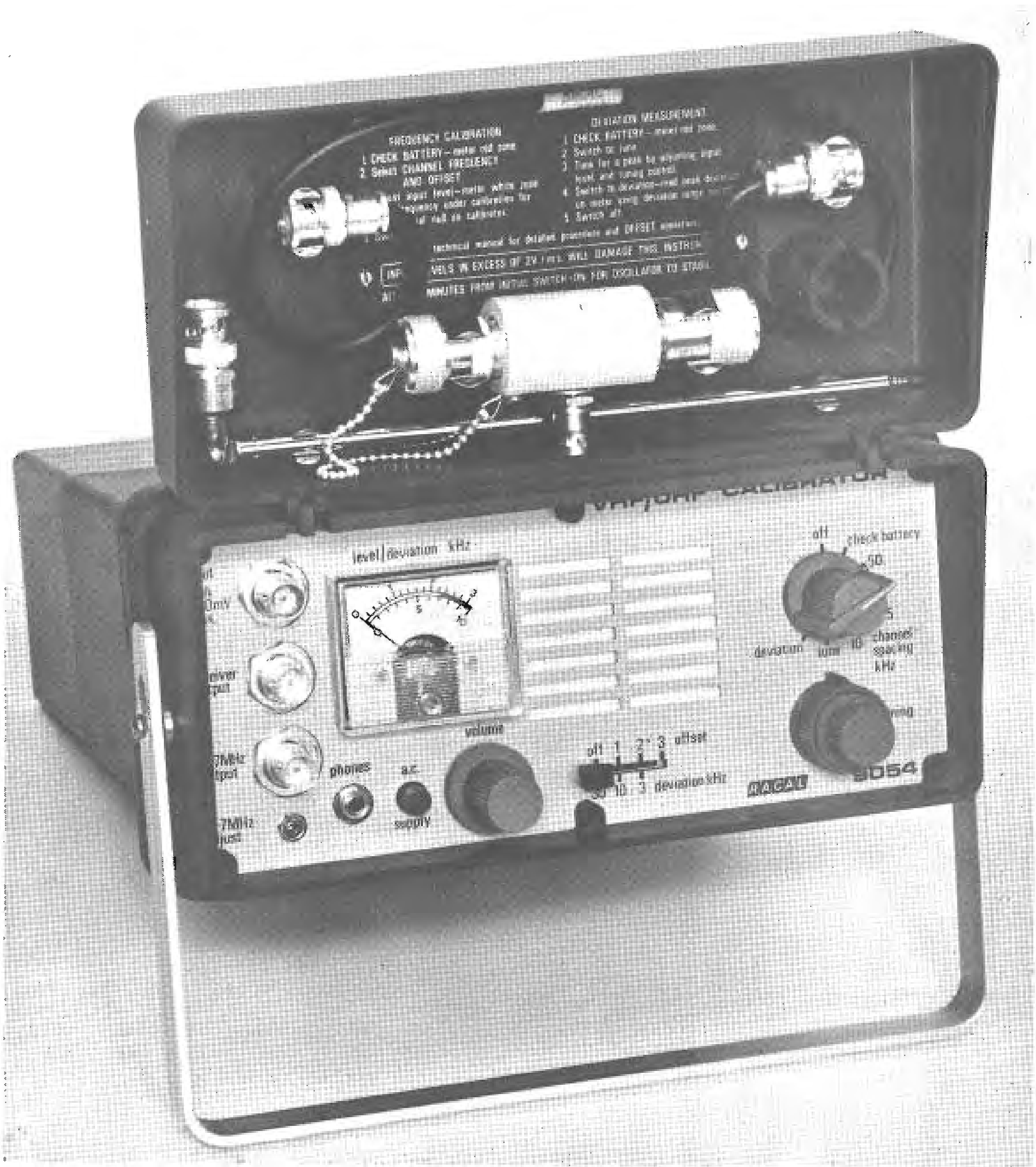

V.H.F./U.H.F. Calibrator Type 9054

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SECTION 1

TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATION

TYPES 9054 & 9055

1 INPUT CHARACTERISTICS

Frequency Range: (a) "Calibration" mode: 100kHz to 512MHz.

(b) Peak Deviation Measurement: Up to ±30 kHz of F.M. transmissions from 20MHz to 512MHz.

Input Impedance: 50 ohms nominal.

Input Coupling: Capacitive.

Input Connection: 50 ohm BNC coaxial socket.

Maximum Input Level: 250mV r.m.s.

Damage Overload: 2V r.m.s.

Sensitivity: (2/3 Scale Deflection) Nominally 50mV in both Calibration and Deviation Measurement modes.

Channel Spacings:

9054
10kHz
12.5kHz
25kHz
50kHz

9055	
10kHz	25kHz
12.5kHz	30kHz
15kHz	50kHz
20kHz	60kHz

2 FREQUENCY STABILITY

Function of Temperature: $\pm$ 5 parts in 10^9 per degree C.

Function of Supply Voltage: $\pm$ 2 parts in 10^7 over battery life or permissible supply voltage variation.

Average Ageing Rate: $\pm$ 2 parts in 10^8 per day.

Warm-Up Accuracy: Better than 1 part in 10^6 after 1 min. Better than 1 part in 10^7 after 3 mins.

3 FREQUENCY OFFSETS

The Offset frequencies, together with the maximum errors introduced across the frequency bands are tabulated in Table 1 (9054) and Table 2 (9055).

Deviation Accuracy

(As a percentage of meter full-scale deflection)

(a)

Range	Mains or 12.5V Battery Operation at + 20°C
3 kHz	± 10%
10 kHz	± 5%
30 kHz	± 5%

(b) Function of accuracy versus battery voltage (V_B)

$$\frac{\Delta \text{ Accuracy}}{12.5 - V_B} = -2\% \text{ per volt}$$

(where V_B is 10.5 to 15.0 volts)

(c) Function of accuracy versus operating temperature (T)

$$\frac{\Delta \text{ Accuracy}}{20 - T} = -0.15\% \text{ per } ^\circ\text{C}.$$

(where T is - 10°C to + 55°C).

NOTE: Unless using headphones accurate deviation measurements may only be taken with VOLUME control turned to MINIMUM.

5. OUTPUT CHARACTERISTICS

Receiver Calibration:

(a) Output Connection: 50 ohm BNC socket.

(b) Coupling: Capacitive.

(c) Pulse Repetition Rate: 9054: 10, 12.5, 25 and 50kHz.
9055: 10, 12.5, 15, 20, 25, 30, 50 and 60kHz.

(d) Pulse Amplitude: Greater than 1 volt peak into 50 ohms.

(e) Pulse Width: Less than 2n Sec at 10% of amplitude.

(f) Frequency Spectrum: Contains harmonics of channel spacing frequency up to 512MHz where amplitude of any individual harmonic is greater than 10μV.

N.B. Channel spacing frequency is slightly modified on offset working, as shown in Tables 1 and 2 on previous page.

Storage Temperature Range

With battery pack: -25° to $+40^{\circ}C$.
With mains pack: -25° to $+55^{\circ}C$.

10 ACCESSORIES SUPPLIED

Telescopic Antenna
50 ohm Coupling Unit
Coaxial Cable Assembly
Extender Lead Assembly
P.C.B. Extraction Levers.

11 OPTIONS

07 Battery Pack (less batteries)
08 A.C. Power Pack) See NOTE.
)

NOTE: Either option 07 or 08 is required for operation of the instrument.

12 ACCESSORIES AVAILABLE

(To special order)

A5: Extender Board Assembly: 19-0501
A6: 10 dB, 50 ohms Attenuator:
A7: Headphones: 23-9061.

SECTION 2

DESCRIPTION

OPERATION & MAINTENANCE

CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

1.1 V.H.F./U.H.F. Calibrators Type 9054 and 9055 are lightweight portable instruments providing convenient, rapid and accurate calibration of mobile or fixed-station radiotelephone transmitter/receivers. The instruments are available in either battery or mains-powered versions, the battery pack and the mains unit being available as options so that a battery-operated instrument can easily be converted to mains operation or vice versa.

FACILITIES

1.2 The facilities offered by the 9054 and 9055 are as follows:-

(a) Frequency calibration of v.h.f./u.h.f. transmitters and receivers over the range 100kHz to 512MHz.

(b) Peak frequency deviation measurement up to $\pm$ 30kHz of frequency modulated transmissions from 20MHz to 512MHz.

1.3 The signal is introduced into the instrument by either a telescopic antenna or a coupling unit and coaxial lead which are stowed within the front cover of the instrument; an Attenuator unit (option) is available for use in conditions of high signal level. Indication to the operator is by meter and loudspeaker. A 'Phones' outlet is provided for the lightweight headphones which are an optional extra.

FREQUENCY CALIBRATION PRINCIPLE

1.4 The Racal Calibrators employ a unique frequency comparison principle to provide a simple calibration procedure which is designed specifically for use with v.h.f./u.h.f. mobile radio telephone equipment in which the allocated operating frequencies are harmonically related to the channel spacings.

1.5 The instrument generates sampling pulses which occur at the channel spacing frequency. These are applied, together with the incoming transmitter 'carrier' signal to a frequency comparison circuit. If the two frequencies are in exact harmonic relationship a d.c. output results, indicating that the transmitter frequency is correct. However, any 'error' in the transmitter frequency produces an a.c. (audio) output from the comparator which is heard in the loudspeaker and also produces a meter deflection. The operator simply has to tune the transmitter to obtain an audio null and minimum deflection on the meter, thus calibrating the transmitter to better than one part in 10^6. The limited tuning range of v.h.f. transmitters combined with a selection of different channel spacing frequencies eliminates the possibility of tuning a transmitter to an incorrect harmonic indication. Provision is made for "offset" operation as described in the next paragraph.

Mid-Band V.H.F. Operation

1.6 Certain authorities allocate "mid-band" channels between the harmonically related channels. These are catered for in the Racal Calibrators by an "Offset" switch which 'pulls' the internal crystal reference oscillator by the prescribed amount. Tables 4 and 5 in Chapter 2 indicate the bands where 'Offset' operation may be encountered, and the appropriate switch setting.

DIFFERENCES BETWEEN TYPES 9054 and 9055

1.7 The two instruments are identical except for the following:-

(a) Frequency Offset. In the 9054 two offset positions can be selected by the front panel control whereas the 9055 has three Offset positions.

(b) Channel Spacing. The 9055 provides the more extensive selection of channel spacings, as indicated by the engravings at the Function switch.

(c) Frequency Standard Oscillator. Both instruments contain a Racal plug-in fast-warm-up oscillator which provides operational readiness within 3 minutes of switching on from cold condition. The 9054 utilizes the 5MHz type 843 oscillator unit whereas the 9055 is fitted with the 6MHz Type 841 unit. In the event of an oscillator defect the customer is recommended to fit a replacement unit and return the defective oscillator to Racal Instruments Ltd. or authorized agent.

CONSTRUCTION

1.8 The instruments are of simple and robust construction, utilising printed circuit boards and solid state devices. The case in which the unit is housed is made from injection moulded A.B.S. and is divided into three sections, which are illustrated in Fig.2.6 at the end of Chapter 4.

1.9 The front panel is protected by a hinged hood (cover) in which are mounted the accessories such as antenna and coupling unit. The right hand side of the hinged hood is shaped so that it cannot be closed unless the Function switch is at OFF. The instrument circuitry is mounted on a chassis which is secured to the rear of the front panel.

1.10 The centre section provides a protective case for the main chassis and via an 8-way socket in the base provides the connections between the power unit (either mains or battery version) and the electronic circuits of the main chassis assembly. The Extender Cable in the Accessories Kit is available to connect the plug and socket of the two sections of the instrument to facilitate servicing on the main chassis with centre housing removed. The rear section contains the appropriate power unit for mains or battery operation.

POWER PACK

Mains Powered Version

1.11 The heavy components of the mains power unit are mounted on a metal base-plate and the lighter components on the Electronic Smoothing Assembly 19-0114. Pins 1 to 4 on the transformer input permit selection of either a 220V (nominal) or 110V (nominal) a.c. supply, 45 to 400Hz. It is essential that the appropriate connections are made prior to operation from an a.c. supply. Refer to Chapter 2, paragraph 2.1. The mains input fuses are accessible at the back of the case, together with the mains input connector.

Battery Powered Version

1.12 The battery power supply assembly used with the instrument contains a battery pack, which consists of nine dry cells (of the I.E.C. BS'R20' or A.S.A.'D' Size) connected in series. Typically, the endurance provided by Type HP2 cells, for example, is a total of approximately 40 hours service at an ambient temperature of +29^{o}C falling to approximately 20 hours at 0^{o}C.

1.13 A foam rubber moulding holds the cells firmly in position, and springs on the bottom make electrical contact with one end of each cell; the other end of the cells engage with contacts on the adjacent section of the case. The negative supply of the battery pack is routed via a spring loaded plunger, while the positive terminal engages its contact directly. The battery polarity is indicated on the case. The unit is protected from possible damage due to wrongly made connections by a diode D20 and a 1.5A fuse (FS3). (Fig.4.12 and 4.13).

OPTIONS

1.14 Optional items of equipment are offered so that a mains powered type may be converted into a battery powered type and vice versa. Earphones are offered as an optional accessory for both types, also a 10dB, 50 ohms Attenuator unit for connection in series with either the telescopic antenna or the coupling unit when signal level is too high for accurate deviation measurement. A complete list of options is contained in the Technical Specification.

CHAPTER 2

PREPARATION AND OPERATING

INSTRUMENTS WITH A.C. POWER SUPPLY

CAUTION: DISCONNECT A.C. SUPPLY BEFORE MAKING CHECKS ON THE POWER PACK.

2.1 (1) Check that the input fuses on the back of the unit are of correct rating for the local supply, as follows:

110V (nominal) 1A
220V (nominal) ....0.5A.

(2) Remove the two drawbolts and detach the power pack from the centre section of the instrument.

(3) Check that the connections between the power input plug and pins 1 to 4 on the transformer input are correct for the local a.c. supply voltage, as follows:

(a) 110V (nominal) applied to pins 1 and 2 ... link 1 to 3 and 2 to 4.
(b) 220V (nominal) applied to pins 1 and 4 ... link 2 to 3.

(4) Reassemble. When refitting the Power Pack note that the drawbolt holes are offset to the lower side of the case, thus preventing incorrect assembly.

INSTRUMENTS WITH BATTERY SUPPLY

2.2 (a) Check that correct batteries are fitted according to instructions on battery pack case.

(b) Open the front cover and select CHECK BATTERY. The meter reading should read in the red sector. Failure to reach the red sector indicates that new cells must be fitted and a satisfactory reading obtained before using the instrument.

NOTE: The battery fuse is mounted inside the battery pack, wired to the output socket.

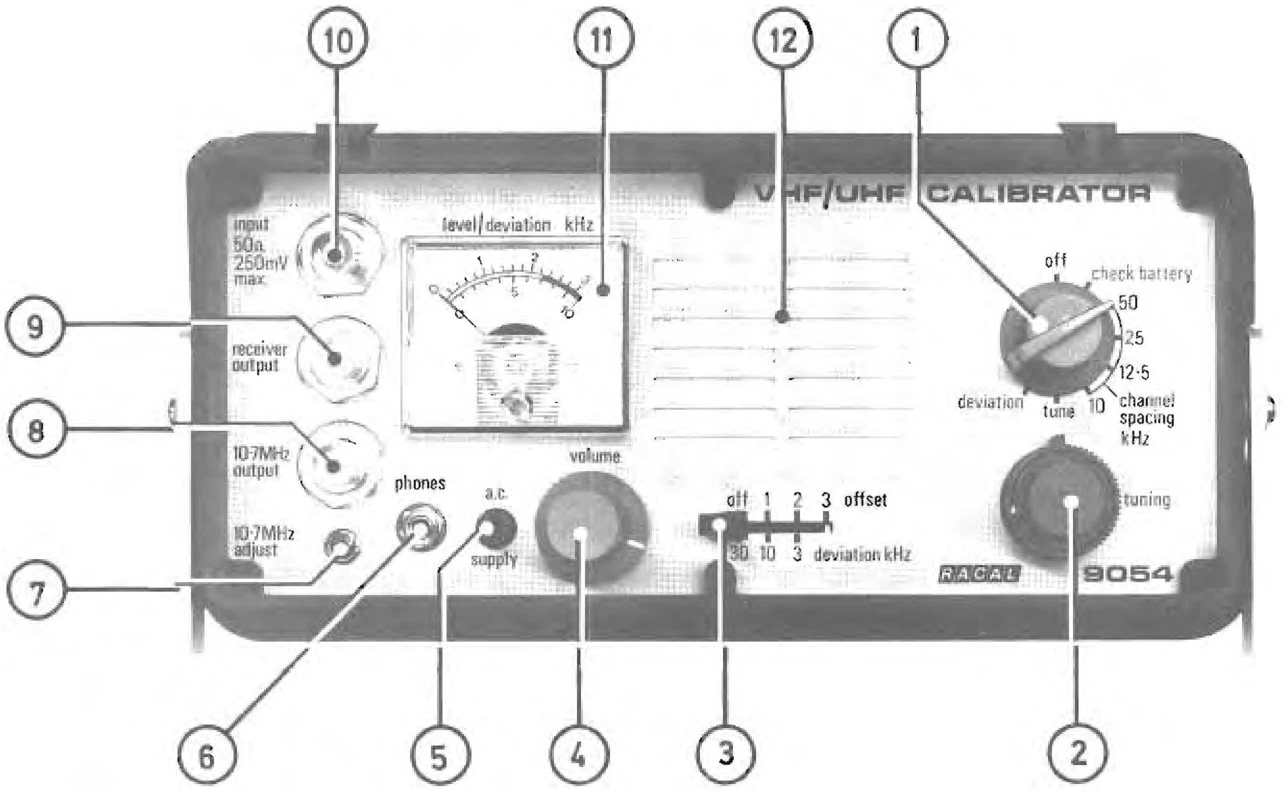
ANTENNA

2.3 Open the front cover and connect the telescopic antenna to the INPUT socket at the top left-hand corner of the front panel. Normally, suitable positioning of the instrument and antenna will ensure a satisfactory signal level at the input, but with higher-powered F.M. transmitters, it may be necessary to connect the 10dB Attenuator unit (optional accessory) between the telescopic antenna and the Input socket to prevent excessive meter deflection in the deviation measurement procedure.

CAUTION: For correct operation when calibrating, the signal voltage at the INPUT should not exceed 250mV r.m.s. THE INPUT MUST NEVER BE ALLOWED TO EXCEED 2V r.m.s. OTHERWISE THE DIODES IN THE COMPARISON BRIDGE MAY BE DAMAGED.

COUPLING UNIT

2.4 If the transmitter is feeding into a dummy antenna, or is radiating at very low power, the coupling unit may be used. This unit should be connected in series with the transmitter output and dummy antenna, using the end connections which provide a straight-through circuit. Connection to the instrument is made from the BNC socket on the side of the unit, using the coaxial cable provided. The coupling may be adjusted by loosening the locknut on the BNC socket and screwing the socket in or out, as required. If necessary, the optional 10dB Attenuator may be connected between the BNC socket and the coaxial cable.



FRONT PANEL CONTROLS Fig. 2.1

(Refer to description in Table 3)

TABLE 3

OPERATING CONTROLS AND CONNECTIONS

(1)	Function Switch	(a) OFF: all d.c. power to main assembly is off, but on a.c. operated models the power pack continues to function. (b) CHECK BATTERY: provides voltage check on battery powered instruments under normal load conditions. (c) CHANNEL SPACING positions: these provide "channel spacing" selection for transmitter carrier and receiver calibration. (d) TUNE and DEVIATION: these are used in F.M. deviation measurement.
(2)	TUNING	Tunes the v.f.o. in F.M. deviation measurement procedure.
(3)	OFFSET/DEVIATION Switch	(a) The upper (black) markings refer to 'Offset' selection, for use when calibrating equipment which operates on certain 'mid-band' frequencies. (See Tables 4 and 5 on page 2-5). For normal (non-offset) operation the switch must be at OFF. (b) The lower (blue) markings refer to deviation frequency ranges in F.M. measurement.
(4)	VOLUME	Provides control of the audio level in phones or speaker.
(5)	A.C. SUPPLY indicator	Indicator lamp: illuminates when external power is connected in a.c. powered instruments.
(6)	PHONES	Outlet for headphones, (the phones impedance must be higher than eight ohms). When phones are plugged in the loudspeaker is automatically disconnected.
(7)	10.7MHz ADJUST	Provides fine frequency adjustment of 10.7MHz output.
(8)	10.7MHz OUTPUT Socket	10.7MHz Crystal oscillator output for receiver calibration.

(9)	RECEIVER OUTPUT Socket	Provides a harmonic spectrum of the selected "channel spacing" frequency, for use in receiver calibration.
(10)	INPUT socket	Connection for input signal to the Calibrator. Maximum input levels (approximate) for satisfactory operation are:- Calibration: 250mV r.m.s. Deviation measurement: 80mV r.m.s. The absolute (never exceed) maximum is 2V r.m.s.
(11)	Meter	(a) The red portion of the scale indicates acceptable battery condition when switched to CHECK BATTERY. This switch position will also give a meter reading with mains powered instruments. (b) The numbered scale markings are applicable only to deviation measurement and should be interpreted in relation to the setting of the OFFSET/DEVIATION switch (30, 10 or 3).
(12)	Loudspeaker	Provides audio indication for both calibration and deviation procedures. Is automatically disconnected when the phones are plugged into the PHONES socket.

NOTES ON 'CHANNEL SPACING' SELECTION

2.5 (a) The transmitter frequency must be a multiple of the channel spacing selected. This is the normal (non-offset) condition in which the OFFSET/DEVIATION switch must be set to OFF.

(b) The channel spacing setting must be such that the frequency adjustment of the unit under test will not permit tuning to the adjacent channel. Therefore, when tuning a transmitter which has a wide tuning range always use the highest of the suitable channel spacing frequencies. For example, if the carrier frequency is divisible by 12.5, 25 and 50 then the 50kHz position should be used to provide the widest spacing between spectral lines.

(c) In any frequency range where it is necessary to employ OFFSET 1, 2 or 3, use only the 12.5kHz channel spacing position in the 9054 Calibrator and the 15kHz position in the 9055 Calibrator. Table 4 and Table 5 below, show the bands where "offset" operation may be encountered.

TABLE 4

OFFSET SWITCH SETTINGS: TYPE 9054

Input Frequency Bands (MHz)	Switch Settings		Maximum errors at extremities of bands
	Channel Spacing kHz	Offset	
105-108	12.5	1	$\pm 8.5 \times 10^{-7}$
138-141	12.5	2	$\pm 5 \times 10^{-7}$

TABLE 5

OFFSET SWITCH SETTINGS: TYPE 9055

Input Frequency Bands (MHz)	Switch Settings		Maximum errors at extremities of bands
	Channel Spacing kHz	Offset	
150.80-152.810	15	1	$\pm 2 \times 10^{-7}$
150.870-154.520	15	2	$\pm 2 \times 10^{-7}$
154.540-154.600	15	3	Negligible

OPERATING PROCEDURES

TRANSMITTER CARRIER CALIBRATION

2.6 (1) It is assumed that the instrument is ready for use (see paragraphs 2.1 to 2.3) and that the transmitter has had an adequate warm-up period.

CAUTION: It is important that the transmitted carrier wave is unmodulated during the calibration procedure.

(2) Refer to the Notes in paragraph 2.5 and select the appropriate Channel Spacing position.

(3) Set the OFFSET/DEVIATION switch to OFF, unless calibrating a 'mid-band' frequency, in which case refer to Table 4 (9054) or Table 5 (9055) on the previous page.

(4) Ensure that a meter reading of not less than half-scale is obtained with the transmitter off tune. This can normally be arranged by suitable positioning of the instrument and/or antenna.

CAUTION: An excessive input level may cause the calibrator to become inoperative because of capture of the audio circuitry by the r.f. signal. This occurrence can be avoided by:

(a) keeping the instrument 5 to 10 feet (2 to 3 metres) away from radiating antennas or,

(b) by employing the through-line coupling unit and terminating the transmitter in a dummy load, or

(c) by fitting the optional 10dB Attenuator.

(5) Set the volume control to a suitable level* and tune the transmitter to reduce the frequency of the signal heard in the instrument speaker or headphones. When the transmitter is nearly on tune, the level meter will change from a steady reading to a pulsating one. The transmitter must be further tuned until the level meter indicates a minimum frequency beat. Thus the transmitter is correctly tuned when the audio output from the calibrator is at a minimum frequency, and the level meter indicates a minimum beat frequency. Ideally zero beat indication should be obtained on the level meter, but in practice transmitter instability usually prevents this.

* NOTE: With battery-powered instruments a high setting of the VOLUME control will increase power consumption and reduce battery life, therefore a moderate volume level is recommended.

FREQUENCY DEVIATION MEASUREMENT

NOTE: It is assumed that the instrument is ready for use (see paragraphs 2.1 to 2.3) and that the transmitter has had an adequate warm-up period.

2.7 (1) For satisfactory deviation measurement the input to the instrument should not exceed 80mV r.m.s. This can normally be ensured by transmitting at lowest power and by placing the Calibrator 10 to 15 feet (3 to 5 metres) away from the radiating antenna. With higher powered transmitters it may be desirable to use the Coupling Unit or the optional 10dB Attenuator unit as described in paragraphs 2.3 and 2.4.

(2) On the Calibrator set the Function switch to TUNE and the OFFSET/DEVIATION switch to the "30" position.

(3) With the transmitter switched on, vary the TUNING control on the Calibrator to obtain the point of maximum deflection on the meter. If the meter reading goes to full-scale deflection, the level of the input signal must be reduced sufficiently to allow the point of maximum deflection to be seen.

(4) Set the FUNCTION switch to DEVIATION and modulate the transmitter with an audio tone in the range 200Hz to 3kHz. For this purpose it is usually sufficient to whistle into the microphone, at the same time observing the reading on the Calibrator meter.

(5) If the modulation reading is very low, move the OFFSET/DEVIATION switch to a position which gives satisfactory meter deflection. In Deviation measurement the loudspeaker may be used to check that modulation level is satisfactory, but when taking the meter reading it is essential that the loudspeaker output be turned off by setting the VOLUME control to minimum.

(6) Note the peak deviation reading on the meter, interpreting the scale markings according to the setting of the OFFSET/DEVIATION switch (blue marking) as follows:

(a) On setting '3' read meter upper scale markings direct.

(b) On setting '30' read upper scale times 10.

(c) On setting '10' read lower scale direct.

RECEIVER CALIBRATION

NOTE: If a high degree of accuracy is required in this operation reference may be made to the 10.7MHz adjustment in (5) below.

2.8 (1) Set the Function switch to the appropriate Channel spacing position for the receiver frequency required. (See Notes in para.2.5).

(2) Loosely couple the RECEIVER OUTPUT socket to the Antenna socket of the receiver. (Use may be made of the Telescopic Antenna). Direct connection should be avoided due to possible overloading of a sensitive receiver, leading to incorrect calibration due to spurious signals. Use only sufficient coupling to obtain the indication described in (4) below.

(3) Loosely couple a lead from the 10.7 MHz O/P on the Calibrator to the I.F. section of the receiver under test.

(4) Listen on the phones or loudspeaker of the receiver and adjust the trimmer of the receiver crystal controlled local oscillator to obtain a zero beat frequency.

(5) If required, the nominal 10.7 MHz crystal frequency can be very accurately adjusted in the field via the pre-set control '10.7 MHz ADJUST' as follows:

(a) Connect the 10.7 MHz OUTPUT to the Calibrator INPUT socket via a coaxial link.

(b) Set the OFFSET/DEVIATION switch to OFF and the Function switch to "25kHz" Channel Spacing. (This ensures a suitable scale reading).

(c) Adjust the 10.7 MHz ADJUST control (screwdriver) until an audio heterodyne note is heard in the loudspeaker, and bring this audio tone to the lowest possible frequency with at the same time a minimum frequency indication on the meter, in exactly the same way as calibrating a transmitter.

OFFICIAL REQUIREMENTS

2.9 The type 9054 and 9055 Frequency Calibrators will satisfy the requirements of certain government regulations for the 'netting' of transmitters provided that the following procedure is adhered to:-

(1) Procedure:

(a) Be sure that adequate warm-up time has been allowed for the type of equipment being calibrated. A minimum of 5 minutes is recommended.

(b) If the frequency of the signal under test is very close to a zero beat, and if no sound is heard from the Calibrator loudspeaker, "rock" the transmitter trimmer to ensure that the calibrator is actually receiving and measuring the signal under test and that the instrument is working properly.

(2) Test Records

Local requirements for official recording of test details should be verified by the user.

CHAPTER 3

TECHNICAL DESCRIPTION

BASIC PRINCIPLES

Frequency Calibration Principle

3.1 The instruments operate on a frequency comparison principle, which indicates whether or not the output frequency of the transmitter under test is an exact harmonic of an accurate frequency, equal to the channel spacing frequency, which is generated in the instrument. The two frequencies are mixed to give an audio output, the frequency of which is the difference between the transmitter signal and the nearest harmonic of the instrument frequency.

3.2 Offset Tuning. The instruments can calibrate not only carrier frequencies which are an exact multiple of the channel spacing frequencies, but also carriers in which an effective offset condition is present, as described in para.2.5 of the previous chapter. By moving the OFFSET/DEVIATION switch to positions 1, 2 or 3 appropriate reference voltages are applied to the oscillator which increase or decrease the reference frequency by the required amount. Tables 1 and 2 in the Technical Specification tabulate the amount of offset, the corresponding shift in oscillator frequency and the maximum error at the high and low extremities of each band due to the shift in reference frequency.

Frequency Comparison Principle

3.3 As previously explained, the instrument generates an accurate frequency which it compares with the transmitter signal, the difference between these two frequencies being used to indicate whether the transmitter signal is an exact harmonic of the instrument reference signal. The comparison system uses a sampling technique which is described below.

Sampling Gate

3.4 Figure 2.2a below illustrates a simplified sampling gate. A diode is reversed-biased by a fixed potential (eB) and applied at e_p is the narrow sampling pulse of sufficient amplitude and correct polarity to cause the diode to conduct. The unknown frequency (e_s) is applied to the other electrode of the diode.

3.5 When the diode conducts, a charge is applied to capacitor C, this charge being dependent on the amplitude of the input signal coincident with the sampling pulse. When the diode ceases to conduct the charge on capacitor C leaks away via resistor R_L so that the output pulse is considerably longer than the sampling pulse.

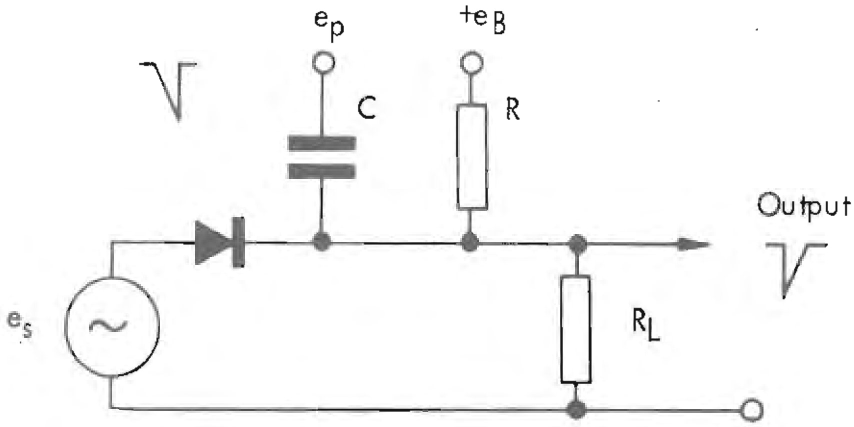


Fig. 2.2a Principle of the Sampling System

3.6 If the pulse repetition rate is an exact sub-multiple of the unknown frequency, a constant charge flows each time the diode conducts and the average is therefore a constant ("on tune" condition) as illustrated in Fig.2.2b. If the two frequencies are not harmonically related the output pulses are modulated with a low frequency beat as shown in Fig.2.2c, the frequency being the difference between the unknown and nearest harmonic of the pulse repetition rate, ("off tune" condition). Therefore a zero beat note is obtained whenever the input frequency is an exact harmonic of the pulse repetition rate.

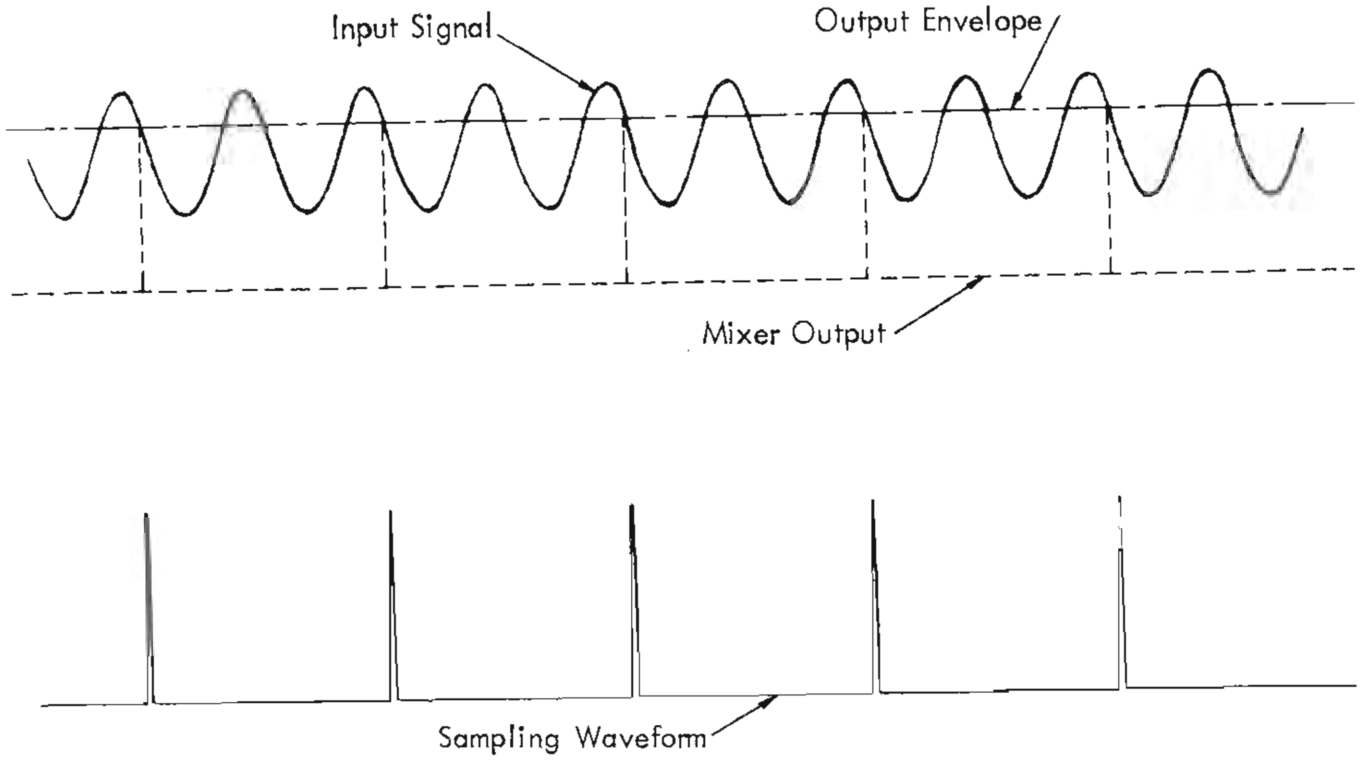
3.7 This principle can be used to tune any v.h.f. transmitter which has a transmission frequency harmonically related to any of the channel spacing frequencies provided, and may be extended, by using the technique of shifting the reference frequency, to transmitters operating on frequencies which are not an exact multiple of the channel spacing frequency. Table 6 shows the range of channel spacings provided for in the instruments:-

TABLE 6

CHANNEL SPACING FREQUENCIES

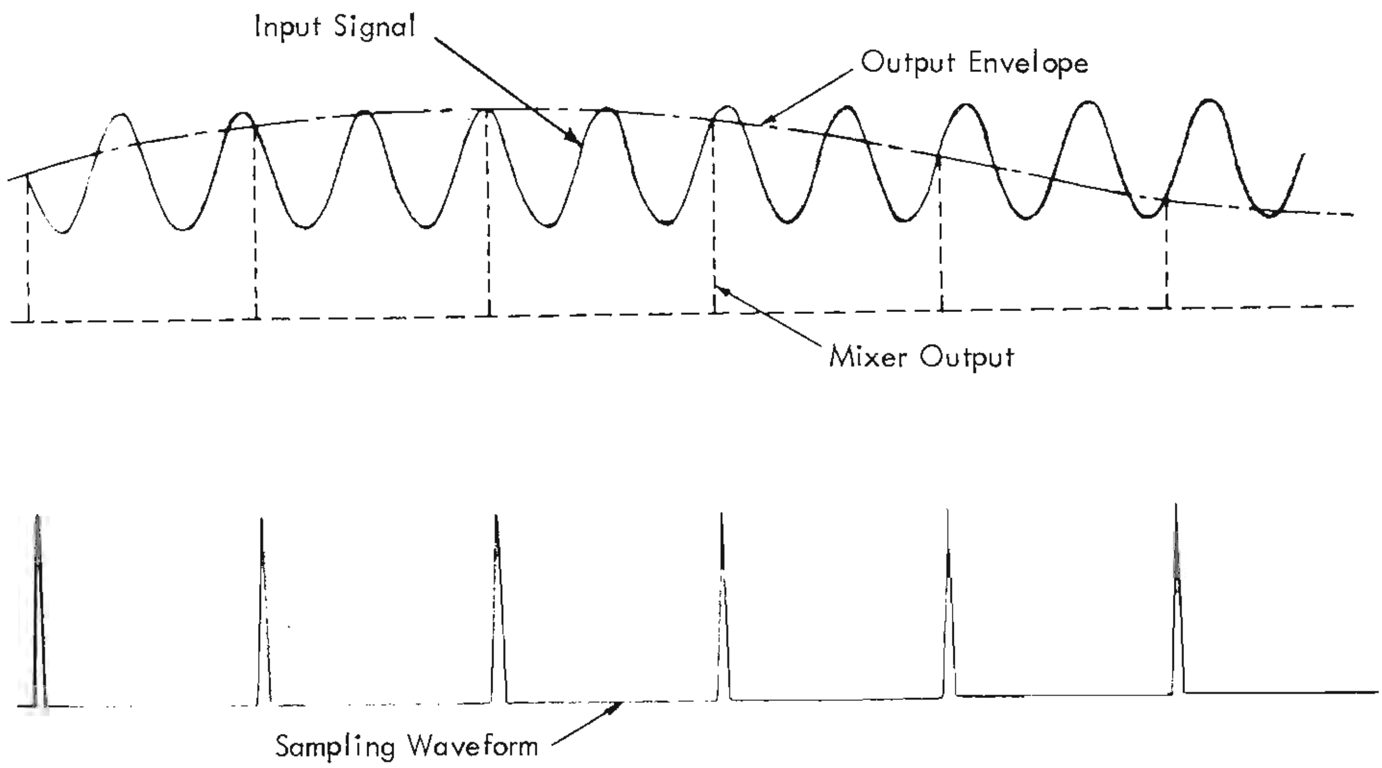
Type 9054	Type 9055	
10kHz	10kHz	25kHz
12.5kHz	12.5kHz	30kHz
25kHz	15kHz	50kHz
50kHz	20kHz	60kHz

3.8 Thus for a transmitter with 12.5kHz channel spacing the instrument generates sampling pulses at a 12.5kHz rate. Modern transmitter design practice is such that the available tuning range allows only the correct frequency to be set. Thus in Fig. 2.2a by substituting the transmitter for e_s and the 12.5kHz instrument pulses for e_p and monitoring the audio output, the transmitter can be correctly tuned. Correct tuning would be indicated when the monitored audio frequency reaches zero.



Sampling Waveforms in 'TUNE' Condition

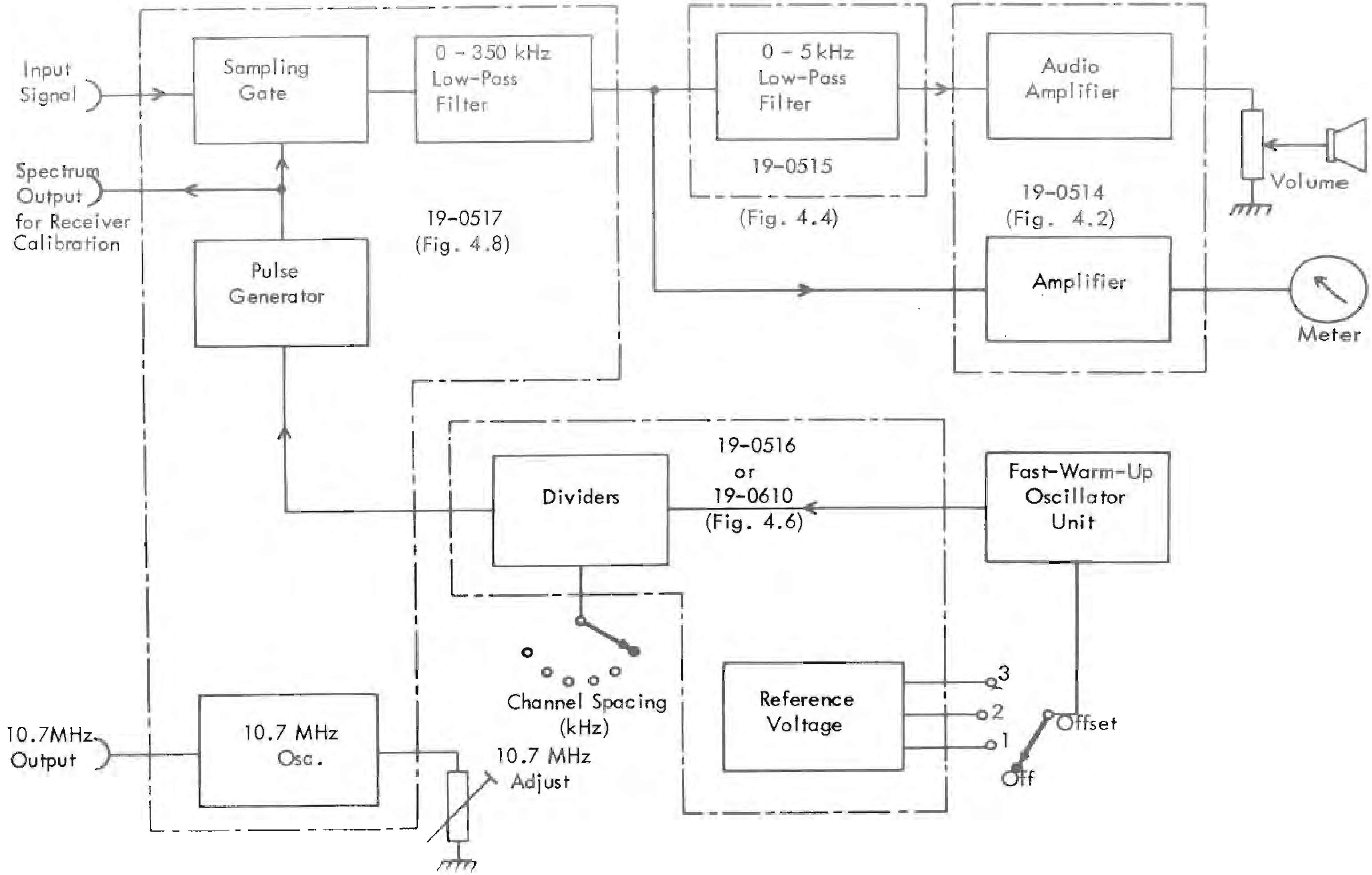
Fig. 2.2b



Sampling Waveforms in 'OFF-TUNE' Condition

Fig. 2.2c

Fig. 2.3



Simplified Block Diagram: Calibration Function

Fig. 2.3

3.9 If the transmitter channel spacing were 25kHz, it might be possible to detune the transmitter by more than 12.5kHz; thus if instrument pulses at a frequency of 12.5kHz were used, more than one harmonic relationship would be possible, and the transmitter might be tuned to an incorrect frequency. For this reason the instrument pulse frequency is increased to 25kHz for tuning transmitters with 25kHz channel spacing and 50kHz for transmitters with 50kHz channel spacing. Thus to avoid the risk of "false" tuning it is essential to select the correct channel spacing on the Function switch when carrying out calibration. Fig.2.3 shows a simplified block diagram of a Calibrator such as the Type 9055, the 9054 being similar except that it has fewer channel frequencies.

Sampling Pulse Generation

3.10 The output from the fast warm-up oscillator is applied to the divider assembly which, under the control of the Function switch, produces the required range of channel spacing frequencies (sampling rates). From the divider the selected sampling rate signal is fed to the pulse generator which shapes the sampling rate signal into very narrow (less than 2 nanosecond) pulses which are applied to the Sampling Gate.

Audio Output and Meter Indication

3.11 The Sampling Gate output is filtered and amplified to extract the beat frequency which is fed to the loudspeaker (or headphones if used). The gate output is also fed via a peak detector to the meter which registers a deflection. When the input (transmitter) frequency is an exact multiple of the sampling pulse frequency the audio indication falls into the silent (zero beat) zone but the meter continues to indicate, and by tuning for a very low beat frequency, permits very fine adjustment of the transmitter frequency, virtually to the accuracy of the crystal reference; in this case better than 1 part in 10^6.

Receiver Calibration

3.12 This facility is available for receivers which use a 10.7 MHz intermediate frequency (i.f.) and functions by the interaction of the following signals in the receiver mixer stage:-

(a) A substitute "carrier" frequency obtained from the RECEIVER OUTPUT socket on the Calibrator and applied to the receiver antenna socket.

(b) The normal signal supplied internally by the receiver local oscillator (v.f.o.).

(c) A nominal 10.7MHz crystal reference obtained from the Calibrator which may be applied by loosely coupling a lead from the 10.7MHz OUTPUT to the i.f. section of the receiver.

If the frequency of the mixer output due to signals (a) and (b) does not coincide with the frequency of (c), a beat note will be heard. The receiver local oscillator should then be adjusted to obtain an audio null. The simple check procedure for the 10.7MHz crystal frequency, given on page 2-8, will ensure very precise receiver calibration when operating in extreme temperature conditions.

3.13 The RECEIVER OUTPUT socket offers a wide frequency spectrum obtained from the Sample Pulse Generator. Provided that the Function switch has been set to the correct channel spacing frequency this spectrum will contain the correct r.f. signal for receiver calibration. The choice of channel spacing frequency is determined by the same considerations as for transmitter calibration. (para.2.5).

Principle of F.M. Deviation Measurement

3.14 For F.M. deviation measurement the incoming modulated signal is mixed with an internal reference signal of 1.5MHz ±75kHz which is derived from a stable variable frequency oscillator (v.f.o.). The output from the comparison (sampler) stage is adjusted to approximately 150kHz by manual tuning of the v.f.o. to obtain a peak reading on the meter. This intermediate frequency signal which contains the f.m. waveform is then fed into a frequency discriminator the output from which is peak detected and the information presented on the meter in the form of peak frequency deviation.

CIRCUIT DESCRIPTIONS

Circuit Differences: 9054 & 9055

3.15 The instruments contain a number of assemblies, most of which are 'plug-in' for ease of servicing. The 9054 and 9055 are so similar to each other that a common technical description can apply to both instruments, the only significant differences being as follows:-

(a) Fast warm-up Oscillator Unit: the 9054 uses the 5MHz Type 843 and the 9055 the 6MHz Type 841.

(b) Divider and Reference Voltage Assembly: in the 9055 additional components are fitted to cater for the greater number of channels provided for in that instrument. (Fig.4.6).

(c) There are some differences in the switch connections due to the different number of channels (Fig.4.12, Fig.4.13).

SAMPLE PULSE GENERATION

Divider and Reference Voltage Assembly: 19-0516 and 19-0610

3.16 Referring to Fig.4.6 the sinusoidal reference waveform from the fast warm-up oscillator is received at Pin 16 on the Divider and Reference Voltage Assembly and fed into amplifier Q1 via C2. The positive half cycles of the a.c. voltage developed across L1 turn on Q3, which grounds the emitter of Q2 via R7 and thus switches on the regenerative divider formed by Q2 and its associated components, which provides division by 5. The charge on C3 maintains R7 at ground potential during the negative half cycles of the oscillator signal which allow Q3 to turn off. Thus Q3 ensures a complete shut-down of the regenerative divider upon failure of the oscillator signal, thereby preventing the generation of incorrect sampling frequencies. Note that the values of C4 and C5 differ in the 9055 due to the higher oscillator frequency.

3.17 The divided signal is amplified in Q4 and fed to the transistor pump formed by Q5, C7, D1 and C9, where a staircase voltage is developed across C9. The regenerative pair Q6/Q7 form a voltage comparator which discharges C9 after two steps of the staircase voltage and resets the transistor pump. The resulting pulse output from Q7 is at one half the frequency of the input to Q4.

3.18 The output from Q7 is fed to two more pump dividers, Q9/Q10/Q11 and Q13/Q14/Q15 with their associated components, which are arranged to provide a choice of division ratios by the connection of suitable capacitor combinations. The required division ratio is selected according to the "channel spacing" position of the Function switch which selects the appropriate value of pump storage capacitance in each circuit. Referring to Fig.4.6 it is seen that the additional "switched" capacitance is provided by C12, C17, C18, C19 and C20. Of these, C12 and C19 are fitted only to the 9055 Calibrator to provide the additional channel spacing facilities on that instrument. The relationship between pump storage capacitors and division ratio for both 9054 and 9055 instruments is as follows:-

DIVIDER CIRCUIT SWITCHING

Pump Storage Capacitor in Circuit	Divider Stage	Division Ratio 9054 and 9055
C13	Q9, Q10, Q11	÷ 5
C12/13		÷ 6 (9055 only)
C21	Q13, Q14, Q15	÷ 2
C21/C20		÷ 4
C21/C19		÷ 6 (9055 only)
C21/C18		÷ 8
C21/C17		÷ 10

3.19 The output from the divider circuits is fed via amplifier Q16 and pin 5 to the Sampler Assembly. (Fig.4.8), which is discussed under "Frequency Comparison". The circuitry in the lower left of Fig.4.6 is concerned with the 'Offset' facility and is discussed in a later paragraph.

TABLE 7

FREQUENCY DIVISION DATA

Divider and Reference Voltage Assemblies 19-0516 and 19-0610

Divider Stage Transistors	Division Ratio	Output Frequency		Channel Spacing		Storage Capacitors in Circuit
		9054	9055	9054	9055	
Q2	5	1.0MHz	1.2MHz			
Q4/5/6/7	2	500kHz	600kHz			
Q9/10/11	5	100kHz	120kHz			C13
	6		100kHz			C12, C13
Q13/14/15	2	50kHz	60kHz		60	C21
			50kHz	50	50	C12, C21
	4	25kHz	30kHz	25	30	C20, C21
			25kHz		25	C12, C20, C21
	6		20kHz		20	C21, C19
	8	12.5kHz	15kHz	12.5	15	C21, C18
			12.5kHz		12.5	C12, C21, C18
	10	10kHz	10kHz	10	10	C12, C21, C17

FREQUENCY COMPARISON

Sampler and 10.7MHz Assembly: 19-0517 (Fig. 4.8)

NOTE: The 10.7MHz oscillator circuit on this Assembly is for the purpose of receiver alignment and has no part in the frequency comparison function.

3.20 Inputs. The Sampling Bridge is supplied simultaneously with the transmitter signal and the pulse generator signal, but these differ in character according to the function selected. The transmitter signal which enters the Sampling Bridge via C1 is unmodulated for the "calibration" process, but f.m. modulated for deviation measurement. The sampling rate signal in transformer T1 is obtained from the pulse generator D3, but the drive to the pulse generator is either the channel spacing frequency from the divider (on 'Calibration' mode) or the v.f.o. signal (on TUNE and DEVIATION) according to the input to the gate Q7-Q9.

3.21 When switched to a 'channel spacing' position the divided reference signal is fed via the inverter Q9 and the 'gate' Q8 to the pulse generator Q5/Q6/D3. The circuit around Q5 and Q6 forms a differentiating network to sharpen the edges of the pulse, this being followed by D3, a 'step recovery' diode which produces current pulses in the 1:1 ratio transformer T1, these pulses being fed to the Sampling Bridge formed by D1, D2, R7 and R8. The Sampling Bridge, which is the heart of the calibrator system, receives negative pulses via C6 and positive pulses via C5 together with the transmitter signal via C1. The principles of the sampling system have been discussed earlier in this chapter, but Fig. 2.4 below extends the discussion to the balanced bridge similar to that in the circuit of Fig.4.8.

3.22 Referring to Fig.2.4 it can be seen that the charge on C depends upon the frequency relationship between e_s and e_p. The charge flowing into C is the algebraic sum of the charges that are due to both pulses. The charge level is modulated as before, except that pulses which correspond with positive half cycles of e_s charge C in one direction while pulses corresponding with negative half cycles charge C in the opposite direction. Thus when e_p and e_s are not harmonically related, an a.c. envelope about ground is developed across C. Conversely when e_s and e_p are harmonically related a d.c. output envelope is developed at C which may be either positive or negative or zero, depending upon which point of e_s corresponds with e_p.

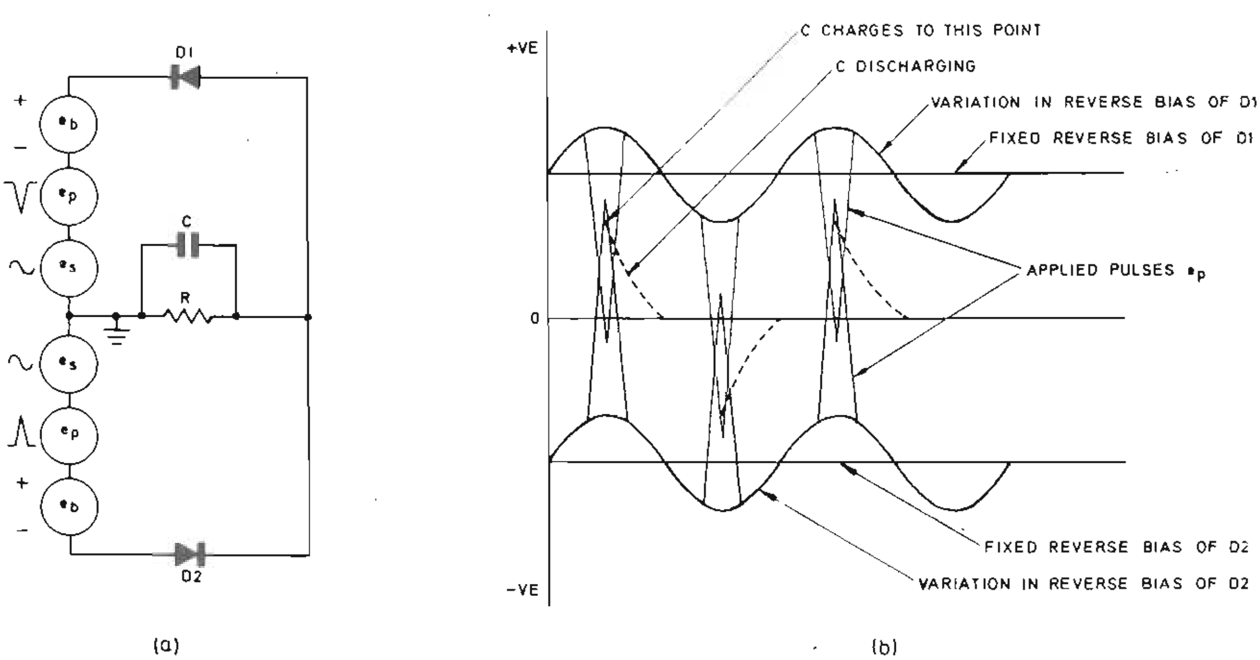


Fig. 2.4 Principle of the Balanced Comparison Bridge

3.23 The circuit diagram of the Assembly (Fig.4.8) shows the similarity between the bridge and the circuit of Fig.2.4. Diodes D1 and D2 are shosen for their high speed switching capability and low capacitance. Reverse bias is provided from the voltage stabilizer circuits via R3 and R5 whilst R12 enables the biasing of D1 and D2 to be balanced; pulse inputs fed via capacitors C5 and C6 overcome this reverse bias. The input signal is applied via the instrument antenna socket and R1 maintains the input impedance at approximately 50 ohms. The envelope output to C7 will be a.c. when the transmitter is off tune, and d.c. when it is on tune.

3.24 From the Sampling Bridge amplitude modulated pulses are fed to the amplifier Q1 and thence to a 350kHz Low-Pass Filter formed by Q2, Q3, Q4 and associated components, the output being taken via pin 1 to the Function switch, which arranges appropriate filtering according to the function selected.

Loudspeaker and Meter Drive Assembly: 19-0514

3.25 The loudspeaker amplifier is IC1 together with associated circuitry. Transistor Q7 with zener diode D2 stabilizes the power supply to the amplifier and output limiting is provided by diodes D3/D5 and D4/D6. The clipping action of these diodes gives a more penetrating quality to the audio tone, with improved loudspeaker efficiency at the very low frequencies close to the null. The circuit Q1 to Q6 is concerned with meter drive and receives its input at pin 1 from the 350kHz L.P. Filter whenever the Function switch is in the 'Channel Spacing' positions. Amplification is provided by Q1 to Q6, with adjustment by R8 being required in the maintenance procedure. Note that Q1 is provided with a regulated 6.8V collector supply. Transistors Q5 and Q6 act as a unity-gain inverting amplifier and hence the voltage appearing across the peak detector diode D1 is twice that due to the output of Q4. The detector output, which is proportional to the peak value of the input voltage, is fed to the front panel meter. During the calibration procedure, when the transmitter is almost on tune, variation in the pulse level causes a pulsating indication on the meter, this pulsing rate falling almost to zero when the transmitter is exactly on tune.

F.M. DEVIATION MEASUREMENT (Fig.2.5)

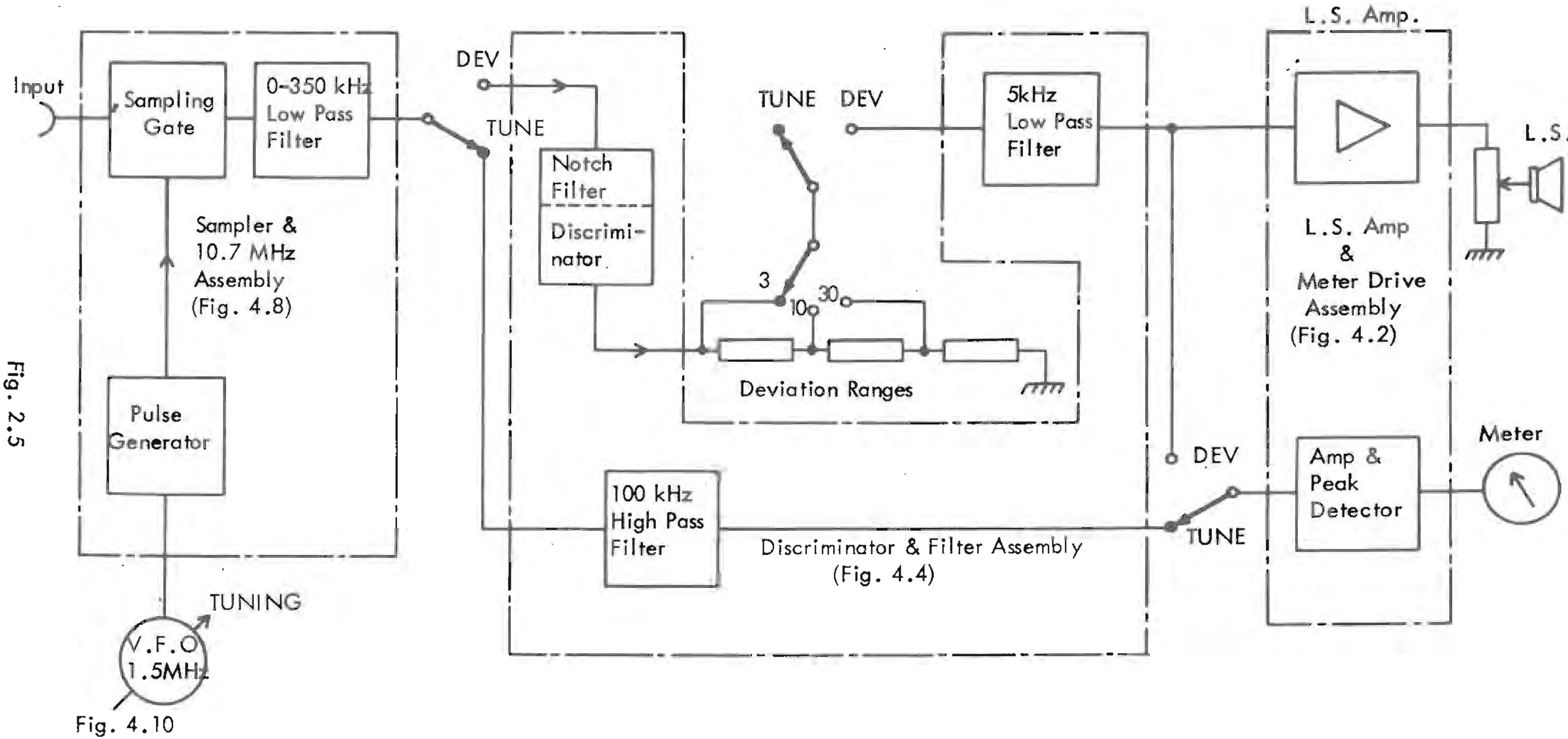
3.26 In F.M. deviation measurement the Pulse Generator, the external input signal and the Sampling Bridge function in a manner similar to that described for frequency calibration except that the pulse generator is fed from the v.f.o. instead of from the divided crystal reference.

"Tune" Mode

3.27 The first step in the procedure is to set the Function switch to TUNE which has the following effects as shown in Fig.2.5:-

(a) The 100kHz high-pass filter (Fig.4.4) is connected in series with the 350kHz low-pass filter.

(b) The discriminator stage and the 5kHz low-pass filter are not connected.



Simplified Block Diagram
Frequency Deviation Measurement

Fig. 2.5

9054/9055

(c) The nominal 1.5 MHz V.F.O. is switched on.

The v.f.o. output drives the pulse generator in the Sampler Assembly and by adjustment of the front panel TUNING control a maximum reading is obtained on the meter.

3.28 In the TUNE mode the output from the Sampling Bridge passes through the 350kHz L-P Filter (Fig.4.8) and via the Function switch to the 100kHz High-Pass Filter (pin 2 Fig.4.4). The combination of these two filters provides, in effect, a pass band extending from 100kHz to 350kHz, the output being fed to the peak detector and the amplified output displayed on the meter. Thus maximum meter reading is obtained when the output from the sampling bridge is between 100kHz and 350kHz.

Deviation Mode and Discriminator Circuit (Fig.4.4)

3.29 When the Function switch is set to the DEVIATION position the sampling bridge output via the 350kHz L-P Filter is fed through a notch filter, R15-R17 and C12-C14 (Fig.4.4) which removes any signal at the v.f.o. frequency, then to an amplifier Q5, Q6, Q7, Q8 and a pulse shaper Q9. The shaped pulses are then fed into a "pump type" discriminator which consists of C25, Q10, D1 and C26. The charge stored on C26 is linearly dependent on the pulse repetition rate.

3.30 The output from the discriminator is fed through the buffer stage Q11, then from pin 13 to the OFFSET/DEVIATION switch which introduces attenuation in three steps to provide the three deviation ranges of 3, 10 and 30kHz. From the OFFSET/ DEVIATION switch the signal is fed via the 5kHz low-pass filter to the peak detector and loudspeaker amplifier. The meter indicates true peak f.m. deviation and the audio tone can be heard in the loudspeaker (or headphones).

V.F.O. and Reference Voltage Assembly: 19-0518 (Fig.4.10)

3.31 This Assembly contains two distinct circuits, as follows:-

(a) The 1.5MHz (nominal) variable frequency oscillator Q1, whose function has already been described, together with associated amplifiers Q4, Q5 and Q6. This circuit operates only in the TUNE and DEVIATION modes.

(b) The 6.8V reference voltage circuit Q3 and Q4. The 6.8V reference is supplied to the following circuits where a very stable supply is important, they are:-

(i) The discriminator stages (Fig.4.4).

(ii) The tuning circuit of the 10.7MHz oscillator (Fig.4.8).

(iii) The first stage of the meter drive amplifier (Fig.4.2).

The above points could be significant in fault location.

REFERENCE FREQUENCY SOURCE

3.32 The highly accurate source for the channel spacing frequencies (sampling rates) is a Racal Fast Warm-Up Oscillator, a Type 843 operating at 5MHz is fitted in the 9054 and a Type 841 operating at 6MHz in the 9055. To permit calibration of certain mid-band frequencies the oscillator frequency can be shifted (offset) by a fixed amount by the application of an accurate preset voltage to the oscillator varactor diode tuning.

Offset Voltage

3.33 The preset "offset" voltage is provided by the stabilizer circuit Q17 and associated potentiometers R47, R48 and R50 in the Divider and Reference Voltage Assembly (Fig.4.6) and connected to the oscillator by the OFFSET/DEVIATION switch in the OFFSET positions. Tables 1 and 2 in the Technical Specification tabulate the extent of the frequency offset, and the associated error factors at the extreme ends of the bands.

Oscillator Servicing

3.34 A serviceability check for the frequency standard oscillator is given in Chapter 4. However, the repair and calibration of these precision units requires specialised equipment of equivalent or higher accuracy, and since the oscillator is a plug-in unit designed for easy replacement, it is recommended that such servicing and re-calibration be entrusted to Racal Instruments Ltd., or authorized agent. The fitting of a replacement unit will ensure minimum 'down-time' on the instrument.

CHAPTER 4

MAINTENANCE

INTRODUCTION

4.1 This chapter contains functional tests, and adjustment procedures, which will assist in maintaining satisfactory performance and serve as an aid to general fault diagnosis. Except for specific power supply checks, the tests apply to both battery and a.c. powered versions. In some tests, however, the data differs between types 9054 and 9055 and the user should observe the appropriate instructions. It is important that the tests are carried out in the sequence given in this chapter.

4.2 If desired, recalibration of the instrument may be entrusted to the Service Department of Racal Instruments Ltd., or authorised agents, and this is strongly recommended in the case of the frequency standard oscillator unit, the accuracy of which is vital to instrument performance.

DISMANTLING

4.3 (1) Remove the six screws from the flange of the Front Panel Assembly.

(2) Undo and remove the two drawbolts from the rear of the instrument.

(3) Carefully detach the power pack and centre section from the Front Panel Assembly.

(4) When re-assembling note that the two drawbolts apertures are offset from the centre to prevent incorrect assembly of the power pack to the centre section.

FUSELINK DATA

4.4

Ref:	Function:	Rating:	Part No.:
FS1 } FS2 }	A.C. Power Input	0.5A (220V) 1A (110V)	23-0004 23-0006
FS3	D.C. Fuse	1.5A	23-0007

NOTE: FS1 and FS2 are accessible externally at the rear of the instrument. Access to FS3 is obtained by removing the power pack.

TABLE 8

TEST EQUIPMENT

TEST EQUIPMENT	SPECIFICATION	SUITABLE MODEL
Multimeter	20 000 ohm/volt. AC/DC 0-250V D.C. 2% f.s.d.	AVO Model 8
V.H.F. Signal Generator with F.M.	Range: 10MHz - 460MHz Output: 1mV - 100mV into 50 ohms	Marconi TF2008 or TF 1066B
Modulation Meter (used to check the F.M. signal Generator)	Range: 3MHz - > 500MHz Deviation 0-100kHz	Racal-Airmec 409
H.F. Signal Generator	Range: 30kHz - 15MHz Output: 1mV - 300mV	Racal-Airmec 201A or 399
Oscilloscope (general purpose)	Bandwidth: d.c. to > 10MHz Sensitivity: approx. 50mV/cm	Tektronix 453
H.F. Millivoltmeter	0 to > 500MHz 1mV to 300mV	Racal-Airmec 301A
Universal Counter-Timer	Range: 10Hz - 10MHz Sensitivity: 50mV a.c. input and 500mV d.c. input with ± 5V offset control.	Racal Type 9036 or Type 9835.
D.C. Power Supply (see para.4.5)	9 to 20V d.c., 500mA	Farnell L30BT
ACCESSORIES		
Coaxial lead. 3ft (1 metre)	50 ohms with BNC connector at each end.	
'T' Piece	50 ohms BNC with 50 ohms terminating pad.	
Headphones	High impedance	Racal Part No.23-9061
Extender Lead	Supplied with the instrument	
Extender Board Assembly	Available from Racal Insts.	Racal Accessory A5.

USE OF VARIABLE D.C. SUPPLY

4.5 Generally, the tests in this chapter may be carried out using the instrument's normal power supply (see para's. 4.6 and 4.7). In paragraphs 4.17 and 4.18, however, a variable d.c. supply is called for, and this should be connected as follows:

(1) Remove the power pack.

(2) Connect a 10V to 15V variable d.c. supply to the plug PL2 on the main chassis as follows:

(a) The +12V (nominal) output from the d.c. supply unit to pins 3 and 7 on plug PL2.

(b) The 0V connection from the d.c. supply unit to pins 1 and 5 on plug PL2.

If the d.c. supply unit is to be used for the complete test procedure, the supply level should be set to +12.5V unless otherwise stated.

POWER SUPPLY CHECK

Battery Powered Instruments

4.6 Switch to CHECK BATTERY and ensure that the meter indication is not lower than the centre of the red area of the scale (nominal 12.5 volts). If the reading is near the lower end of the red area new batteries must be fitted before carrying out any tests.

Mains (A.C.) Powered Instruments

4.7 (1) Detach the Mains Pack and centre section of the instrument case from the Front Panel Assembly.

(2) Using the extender lead connect socket SK2 on the Mains Pack to the plug PL2 on the Main Chassis Assembly.

(3) Ensure that the Mains Pack input links are correct for the local supply voltage. (Chapter 2 para.2.1).

(4) Check that the Function switch is at OFF. Connect the instrument to the mains supply, and note that the power indicator lamp is illuminated.

(5) On the plug PL2 at the rear of the main chassis, check that the voltage on the linked pins 3 and 7 relative to 0V (chassis) is between +12V and +15V.

REFERENCE FREQUENCY INITIAL CHECK

4.8 (1) Set the Function switch to "50kHz" and allow the instrument to warm up for not less than 3 minutes.

(2) Set the OFFSET switch to OFF.

(3) Connect an oscilloscope between pin 16 and 0V on the edge connector of the Divider and Ref. Voltage Assembly. (This is more accessible than pin 1 on the oscillator holder).

(4) Check for the following oscillator frequency:-

Type 9054 . . . . 5 MHz approx.) Refer to para.4.13 for detailed
Type 9055 . . . . 6 MHz approx.) tests.

(5) Remove test equipment.

SAMPLING BRIDGE BALANCE

4.9 (1) Set the Function switch to the '10kHz' Channel Spacing position.

(2) On the Sampler and 10.7 MHz Assembly (19-0517) adjust potentiometer R12 (see Fig.2.7) for a minimum reading on the instrument meter.

DEVIATION MEASUREMENTS

4.10 Equipment required: V.H.F. Signal Generator with F.M.

Procedure

(1) Set Function switch to TUNE.

(2) From the F.M. Signal Generator apply the following F.M. signal to the Input socket:-

Frequency 100MHz.
10kHz deviation (±3%) at 1kHz modulating frequency.
Generator output level 50mV into 50 ohms.

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

(4) Adjust the output level of the signal generator to bring the meter reading to the beginning of the red sector, at the same time checking the adjustment of the TUNING control (see operation (3)) to maintain maximum meter reading, thus compensating any frequency shift in the signal generator.

(5) At the input check with the electronic voltmeter that the signal generator output level does not exceed 50mV into 50 ohms.

(6) Set the Function switch to DEVIATION and the DEVIATION switch to the "10kHz" position. Check that a clear audio tone is heard. If using the loudspeaker turn the VOLUME control to minimum whilst carrying out operation (7).

(7) Adjust the potentiometer R8 on p.c.b. 19-0514 (refer to Fig.2.7 at end of this chapter), for a meter reading of 10kHz.

(8) Operate the VOLUME control and check that a variation in level occurs in the audio tone from the loudspeaker.

(9) Set the Function switch to TUNE.

(10) Set the F.M. Signal Generator to 20MHz with 3kHz Deviation and 1kHz Modulation.

(11) With the signal generator signal applied, adjust the TUNING control for a maximum meter reading.

(12) Set the Function switch to DEVIATION and the DEVIATION switch to 3kHz. Check that the meter reads 3kHz ± 300Hz.

(13) Repeat operations (9) to (12) at a frequency of 20MHz and with 1kHz modulation but with DEVIATION settings as in Table 9 below:-

TABLE 9

Deviation Check

Signal Generation Deviation Settings	OFFSET/DEVIATION switch position	TOLERANCE
5kHz	10kHz	± 500Hz
12kHz	30kHz	± 1.5kHz
20kHz	30kHz	± 1.5kHz

(14) Repeat operations (9) to (13) and Table 9 at the following input frequencies:-

(a) 100MHz.

(b) 460MHz.

Check that the deviation measured is within the limits specified in operation (12) Table 9.

SENSITIVITY CHECK

4.11 Equipment Required: V.H.F. Signal Generator 300kHz - 460MHz.

Procedure

(1) Set the Function switch to:-

50kHz on Type 9054
60kHz on Type 9055

(2) From the V.H.F. signal generator apply a signal of 300.5kHz, CW, to the Input socket.

(3) Increase the signal level until the instrument meter indicates full-scale deflection. At this point check that the signal generator output does not exceed 50mV r.m.s. into 50 ohms. Also note that an audio tone is heard from the loudspeaker.

(4) Rotate the Function switch through all the "Channel Spacing" positions down to "10kHz" and check that the meter reading remains in the red sector.

(5) Set the Function switch to "50kHz".

(6) Apply an input signal of 460MHz, CW, from the signal generator.

(7) Check that the meter indicates in the red sector with an input signal level not exceeding 50mV r.m.s. It will be necessary to fine tune the signal generator to achieve a maximum reading.

CHANNEL SPACING CHECK

4.12 Equipment required: H.F. Signal Generator.

Procedure

(1) Set the signal generator to the frequencies given in Table 10 or 11 below, with an output level of approximately 50mV r.m.s. into 50 ohms.

(2) Apply the signal to the Input socket and listen on the loudspeaker for a 'beat frequency' of 500Hz for each applied frequency and Channel Spacing in Table 10 (Type 9054) or Table 11 (Type 9055).

NOTE 1: '0' indicates that a constant 500Hz beat note should be heard.
'X' indicates an 'off-tune' condition. A beat note may, or may not, be heard, but will in any case differ markedly from 500Hz.

NOTE 2: If satisfactory results are not obtained when carrying out the tests in Table 10 or 11 refer to the divider alignment check in para. 4.17.

TABLE 10

Channel Spacing Check: Type 9054

FUNCTION SWITCH SETTING (kHz)	SIGNAL GENERATOR FREQUENCY (kHz)			
	37.0	40.5	50.5	75.5
10	X	0	0	X
12.5	0	X	0	0
25	X	X	0	0
50	X	X	0	X

O = "On Tune" : 500 Hz beat note.

X = "Off Tune": refer to NOTE 1 on previous page.

TABLE 11

Channel Spacing Check: Type 9055

FUNCTION SWITCH SETTING (kHz)	SIGNAL GENERATOR FREQUENCY (kHz)					
	30.5	37.0	40.5	50.5	60.5	75.5
10	0	X	0	0	0	X
12.5	X	0	X	0	X	0
15	0	X	X	X	0	0
20	X	X	0	X	0	X
25	X	X	X	0	X	0
30	0	X	X	X	0	X
50	X	X	X	0	X	X
60	X	X	X	X	0	X

FREQUENCY STANDARD CALIBRATION AND OFFSET ADJUSTMENT

Oscillator Frequency Calibration

CAUTION: Allow a warm-up period of at least 5 minutes before making any oscillator adjustments.

4.13 Equipment required: (a) Oscilloscope.

(b) 1MHz Frequency Standard.

Procedure

(1) Set the Function switch to "50kHz" and the OFFSET/DEVIATION switch to OFF.

(2) Connect the oscilloscope to pin 16 and 0V on the edge connector socket of the Divider and Ref. Voltage Assembly.

(3) Trigger the oscilloscope externally from an external frequency standard which has an accuracy of not less than $\pm$ 2 parts in 10^8.

(4) Adjust the oscillator "Fine" tuning control via the aperture in the oscillator case (see Fig.2.7) to display a near stationary trace of 5MHz (Type 9054) or 6MHz (Type 9055). Check that less than one cycle of the displayed waveform passes a fixed mark on the oscilloscope tube in 10 seconds; this will indicate that the accuracy is within $\pm$ 2 parts in 10^8.

(5) If, in the previous operation, the 5MHz (or 6MHz) frequency cannot be tuned by the 'Fine' tuning control, or if obtainable only with the control very close to either extremity of its adjustment, proceed as follows:

(i) Set the oscillator "Fine" tuning control to its central position.

(ii) Adjust the adjacent 'Coarse' tuning control as close as possible to 5MHz (Type 9054) or 6MHz (Type 9055).

(iii) Repeat the 'Fine' tuning operation as in (4) above.

Offset Frequency Adjustment

4.14 Equipment required: Digital Frequency Meter (counter).

Procedure

(1) After a five-minute warm-up period connect a digital counter to pin 16 on the Divider and Reference Voltage Assembly, and to 0V (chassis).

(2) Refer to Table 12 (Type 9054) or Table 13 (Type 9055) and check the oscillator frequency in each position of the OFFSET switch. If necessary adjust

the potentiometers on the Divider and Reference Voltage Assembly to obtain the required offset frequencies according to the appropriate Table.

TABLE 12

Offset Frequency Adjustment: Type 9054

OFFSET SWITCH SET	FREQUENCY (Hz) ($\pm$ 1 digit)	ADJUSTMENT
OFF	5.000.000	on osc. unit
1	5.000.293.4	R50 } On Assembly 19-0610
2	5.000.224.1	R48 } On Assembly 19-0610

TABLE 13

Offset Frequency Adjustment: Type 9055

OFFSET SWITCH SET	FREQUENCY (Hz) ($\pm$ 1 digit)	ADJUSTMENT
OFF	6.000.000	On osc. unit
1	6.000.197.8	R50 } On Assembly 19-0516
2	6.000.195.2	R48 } On Assembly 19-0516
3	5.999.806.0	R47 } On Assembly 19-0516

10.7MHz OUTPUT CHECK

NOTE: A simple check on the 10.7MHz frequency, without use of instruments, is given in para.2.8.

4.15 Equipment required: Digital Frequency Meter
Electronic Millivoltmeter
'T' piece and 50 ohm termination.

Procedure

(1) Connect the 50 ohm input electronic voltmeter to the 10.7MHz OUTPUT socket using a BNC-to-BNC coaxial lead.

(2) Check that the output is 50mV $\pm$ 10mV.

(3) Disconnect the electronic voltmeter, fit a 'T' piece and 50 ohm termination to the coaxial lead, and connect a digital frequency meter.

(4) Check that the output frequency is 10.7MHz ± 10Hz. If necessary adjust the "10.7MHz ADJUST" control via the front panel aperture to obtain this readout.

"RECEIVER OUTPUT" CHECK

4.16 Equipment required: Electronic Millivoltmeter.

Procedure

(1) Connect the 50 ohm electronic millivoltmeter to the "RECEIVER OUTPUT" socket, using the BNC-to-BNC coaxial lead.

(2) Check that the output reading is not less than 5mV r.m.s.

(3) Rotate the Function switch to the remaining "CHANNEL SPACING" positions in sequence and check that the millivoltmeter readings increase progressively until at the "50kHz" position the reading is approximately 20mV r.m.s.

SUPPLEMENTARY ALIGNMENT PROCEDURES

DIVIDER AND REFERENCE VOLTAGE ASSEMBLY (19-0516 or 19-0610)

4.17 Equipment required: (a) Oscilloscope
(b) Digital Universal Counter.

Procedure

(1) Mount the p.c.b. Assembly in the instrument on an Extender Board.

(2) Set the Function switch to the '50kHz' Channel Spacing.

(3) Using an oscilloscope check for an approximately sinusoidal waveform at the junction of R10/R11. If necessary adjust the core of L2 to lock the displayed waveform.

(4) Compare the frequency at C2 with that at R10/R11 and verify that division by five is obtained, as follows:-

9054		9055	
C2	R10/R11	C2	R10/R11
5MHz	1MHz	6MHz	1.2MHz

(5) Short-circuit resistor R1 and check that all signals at R10/R11 cease. Remove the short circuit across R1.

(6) Disconnect the p.c.b. Assembly from the extender board and fit the Assembly into the instrument.

(7) Connect a digital Universal Counter between pin 5 (output) of the 19-0516/19-0610 edge connector and chassis (0V).

(8) Set the Counter to "Frequency" measurement and "0.1 second" gate time.

(9) Set the Counter input offset control to "-5V" and select "D.C." operation.

(10) Set the instrument Function switch to the highest frequency channel spacing position and check that the frequency displayed on the counter corresponds with the selected channel spacing frequency.

(11) With a variable d.c. supply connected (see para.4.5) vary the power supply voltage over the range 10V to 15V and check that the counter reading does not change.

(12) Repeat operations (10) and (11) in all the remaining "Channel Spacing" positions of the Function switch.

(13) Set the Function switch to OFF and disconnect the test equipment.

<u>V.F.O. and Voltage Stabilizer Assembly 19-0518</u>

4.18 <u>Voltage Stabilizer Check</u>

(1) Set the Function Switch to the 10kHz channel.

(2) With a multimeter measure the voltage between pin 3 on the p.c.b. edge connector and chassis (0V). The reading should be between 6.1 and 7.6V.

(3) With a variable d.c. power supply connected (see para.4.5) vary the supply over the range 10V to 15V and check that the reading in (2) does not vary by more than ± 0.1V.

4.19 <u>V.F.O. Check</u> (19-0518)

(1) Set the Function switch to TUNE.

(2) Connect the oscilloscope between pin 5 of the p.c.b. and chassis (0V).

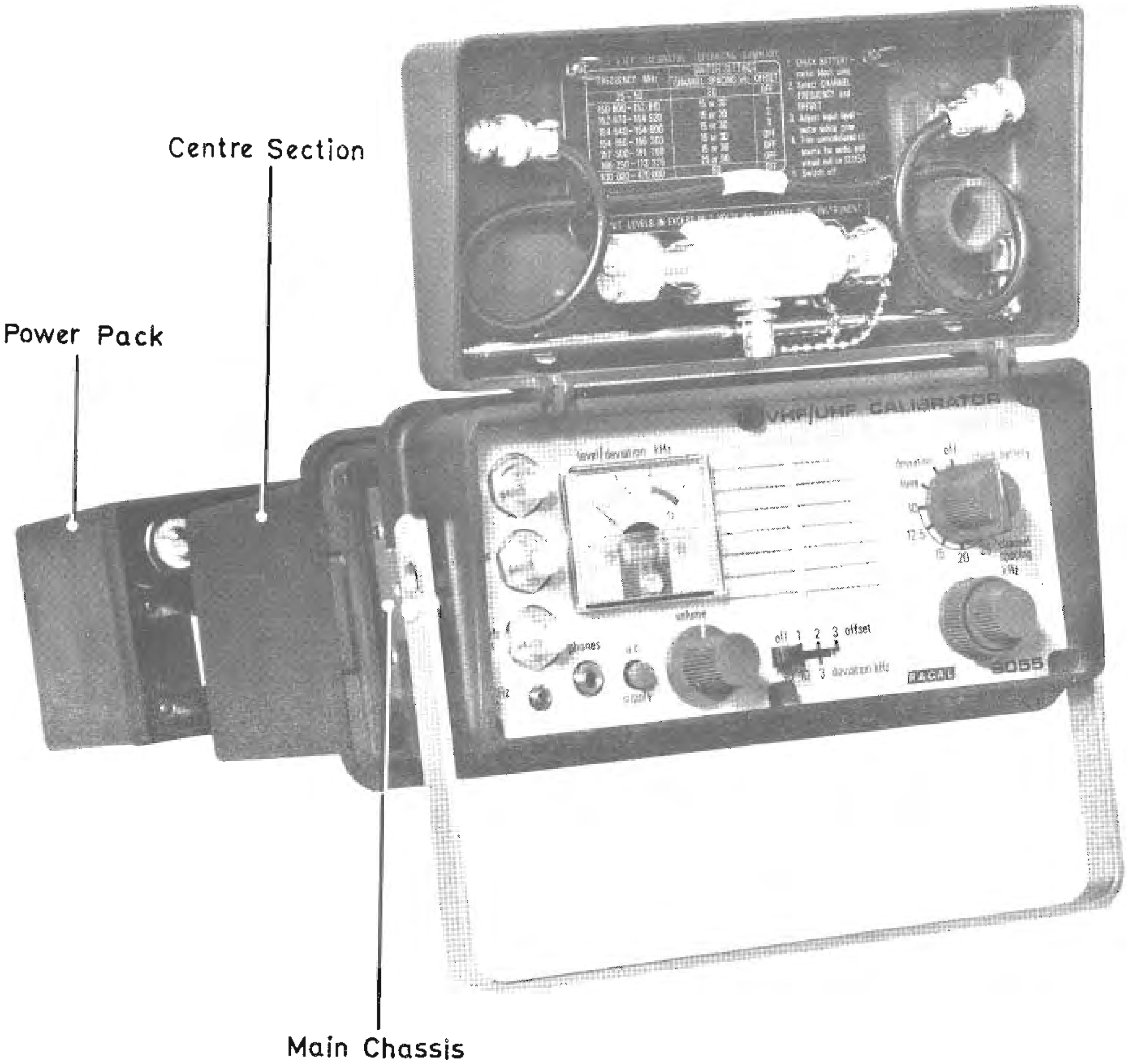
(3) Verify that the output waveform is approximately sinusoidal with frequency and amplitude approximately 1.5MHz and 5V peak-to-peak.

(4) Set the Function switch to DEVIATION and check that the output in (3) is maintained.

(5) Rotate the Function switch through all the 'Channel Spacing' positions and check that no signal exists.

(6) Disconnect the oscilloscope and connect the same pin 5 and 0V to the A.C. input of the Universal Counter.

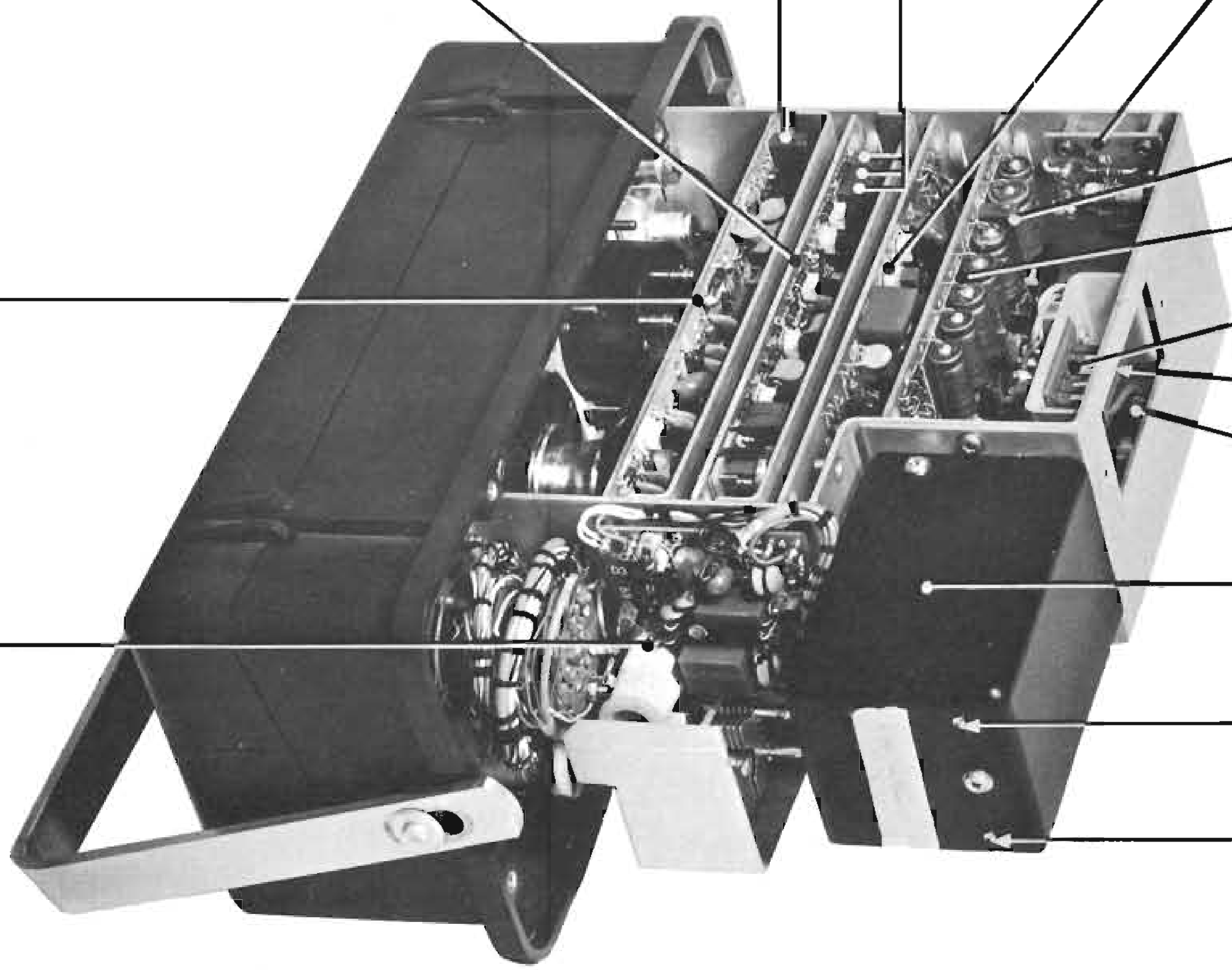
(7) Set the Function switch to TUNE and rotate the TUNING control, at the same time checking that the V.F.O. nominal 1.5MHz output is capable of variation by ± 75kHz approximately. (From 1.425MHz to 1.575MHz on the Counter).



WOH2047

Type 9055: Service View

Fig. 2·6



NOTE: R47 Fitted in 9055 only.

WOH2047
A

Service View (Main Chassis) Types 9054 & 9055

Fig. 2·7

SECTION 3

PARTS LIST

ORDERING OF SPARE PARTS LIST

1. To be assured of satisfactory service when ordering replacement parts, the customer is requested to include the following information.

   (a) Instrument type and serial number.

   (b) The type reference of the Assembly in which the particular item is located (for example, "19-0514").

   (c) The Racal Part number and circuit reference of each item being ordered.

   It should be noted that a minimum charge of £5 sterling is applicable to all orders.

2. The name of the manufacturer (Vendor) quoted in the right-hand column of the Parts List is for general information only. Racal Instruments Limited, reserves the right to supply an equivalent or improved part by another manufacturer, if necessary.

CHAPTER 5

PARTS LIST

CONTENTS

NOTES

Replacement Resistors

The Erie Type 15 composition resistor which has 0.4 inch (10mm) lead spacing may be replaced by the Mullard Type CR16 carbon film type. In cases where the printed circuit board has resistor mounting holes with 0.5 inch (12.5mm) spacing, the recommended replacement resistor is the Mullard CR25, 330mW, carbon film type. The Mullard CR25 may also replace those $\frac{1}{4}$ watt, 5% metal oxide resistors which have 0.5 inch hole spacing.

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
	CASE ASSEMBLY: 11-0152					
23-0007	Fuselink	1.5A			FS3	(Bulgin F270 (Beswick TDC13 or (Bussman (USA) GMA
23-3050	Socket 8-way				SK3	McMurdo RS8
	MAINS PACK ASSEMBLY: 11-0156					
19-0114	Electronic Supply Assembly (See parts list 19-0114)					Racal Insts.
17-4011	Transformer Assembly				T3	Racal Insts.
21-0560	Electrolytic	25V		3,300μ	C34, C35	Mullard 071-16332
23-0004	Fuselink	0.5A(220V)			FS1, FS2	Bulgin F270
23-006	Fuselink	1A (110V)				Bulgin F270
23-3036	Receptacle-Male 3 pin-mains connector				PL2	Bulgin P429
10-2018	Power Lead Assembly					Racal Insts.
	SWITCH ASSEMBLY: 11-0699					
	Switch					
23-4018	Switch Edge: OFFSET/DEVIATION				SB	N.S.F. MLA.8
	Resistors					
20-4018	Metal Oxide	¼	2	10k	IR1, IR3	Erie M04
20-4061	Metal Oxide	½	2	6.8k	IR2	Erie M04
20-4071	Metal Oxide	¼	2	3.3k	IR4	Erie M04
	FRONT MOUNTING PANEL ASSEMBLIES: 11-0711 (9054) AND 11-0715 (9055)					
	(Main Chassis)					
	Resistors					
20-6602	Variable "Volume"			1k	R5	Plessey MHI 404/8/02652
20-6019	Variable "10.7MHz Adjust"			10k	R6	Electrosil MT.21.P
	Capacitors					
21-0509	Electrolytic	25V		250μ	C36	Waycom Printilyt 1
21-6025	"Tuning"			0-50p	C37	Jackson C.804

Oscillators

In Model 9054 the Racal Oscillator 843 is fitted as standard and the type 9413 oscillator is available as alternative. In model 9055 the oscillator 841 is standard with Type 9411 as alternative.

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
	11-0711 and 11-0715 (continued)					
	Diode					
22-1602	Silicon, 100V, 1A				D20	I.T.T. IN 4002
	Miscellaneous					
	Oscillator Type 843: 5MHz (Type 9054 only)					Racal Insts.
	Oscillator Type 841: 6MHz (Type 9055 only)					Racal Insts.
11-0699	Switch Assembly SB (See separate parts list)					Racal Insts.
17-0048	Switch SA (Function switch 9054)					Racal Insts.
17-0049	Switch SA (Function switch 9055)					Racal Insts.
23-1016	Lamp Holder					Bulgin D972/11100/Red
23-3051	Plug 8-way				PL2	McMurdo RP8
23-3074	Valve Base B7G p.c.b. mounting					Carr. Fastener
23-3143	Jack Socket				JK1	Rendar MJ.PS.600
23-5124	Edge Connector					Carr. Fastener
23-9060	Loudspeaker				LS1	Impecton Hokutone
26-3007	Lamp				LP1	Thorn Bendix L1343
	ELECTRONIC SUPPLY ASSEMBLY: 19-0114					
	Resistors	Volts				
20-3151	Metal Oxide	½	5	150	R55	Erie M05
20-0472	Composition	1/10	10	4.7k	R76	Erie 15
	Diodes and Transistor					
22-1602	Silicon				D17, D18	I.T.T. IN.4002
20-1006	Silicon				D19	M.C.P. MGD72
22-6011	Silicon:npn				Q20	Fairchild S40250

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer

LOUDSPEAKER AND METER DRIVE ASSEMBLY: 19-0514 (Issue 4)

Resistors

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
20-2561	Carbon Film	1/3	5	560	R1, R13, R19, R23, R24, R26	Mullard CR25
20-2392	Carbon Film	1/3	5	3.9k	R2	Mullard CR25
20-2101	Carbon Film	1/3	5	100	R3	Mullard CR25
20-2332	Carbon Film	1/3	5	3.3k	R4, R16	Mullard CR25
20-2103	Carbon Film	1/3	5	10k	R5, R12, R25, R27	Mullard CR25
20-2102	Carbon Film	1/3	5	1k	R6	Mullard CR25
20-2222	Carbon Film	1/3	5	2.2k	R7	Mullard CR25
20-7002	Variable	3/4		1k	R8	Morganite 82.150ppm
20-2152	Carbon Film	1/3	5	1.5k	R9	Mullard CR25
20-2562	Carbon Film	1/3	5	5.6k	R10, R14, R17, R20	Mullard CR25
20-2100	Carbon Film	1/3	5	10	R11	Mullard CR25
20-2223	Carbon Film	1/3	5	22k	R15, R18	Mullard CR25
20-2273	Carbon Film	1/3	5	27k	R21	Mullard CR25
20-2220	Carbon Film	1/3	5	22	R22	Mullard CR25

Capacitors

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
21-0573	Electrolytic	10V	-10+50	200μ	C1	Mullard C426/AR/D200
21-0574	Electrolytic	10V	-10+50	125μ	C2, C3, C5, C6, C7, C15	Mullard C426/AR/D125
21-1537	Ceramic		25	2700p	C4	Erie 831.K7004
21-1032	Tantalum	15V	10	1μ	C8	Union Carbide K1J15
21-1002	Tantalum	20V	20	10μ	C10, C11, C12, C14	I.T.T. TAG.10/25
21-0542	Electrolytic	16V	-10+50	125μ	C9	Mullard C426/AR/E125
21-1616	Ceramic	12V	10	0.1μ	C13	Murata DD.600.BC12

Diodes

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
22-0001	Germanium				D1	Hughes HD.1870
22-1813	Voltage Reg.	8.2V			D2	Mullard BZY88-C8V2
22-1029	Silicon				D3, D4, D5, D6	I.T.T. 1N4149

Transistors

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
22-6041	Silicon: npn				Q1, Q2, Q3, Q5	Mullard BC109
22-6010	Silicon: pnp				Q4, Q6	Motorola 2N.4126
22-6044	Silicon: npn				Q7	Mullard BFY51

Integrated Circuit

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
22-4119	Amplifier					Motorola MFC 6000

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer

DISCRIMINATOR AND FILTER ASSEMBLY: 19-0515

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
	Resistors					
20-2332	Metal Oxide	¼	5	3.3k	R1, R2, R6	Erie M04
20-0473	Composition	1/10	10	47k	R3, R4	Erie 15
20-0332	Composition	1/10	10	3.3k	R5, R12, R20	Erie 15
20-0101	Composition	1/10	10	100	R7, R14, R33	Erie 15
20-0392	Composition	1/10	10	3.9k	R8, R13	Erie 15
20-2472	Metal Oxide	¼	5	4.7k	R9	Erie M04
20-2223	Metal Oxide	¼	5	22k	R10, R11	Erie M04
20-2221	Metal Oxide	¼	5	220	R15, R16	Erie M04
20-2560	Metal Oxide	¼	5	56	R17	Erie M04
20-0103	Composition	1/10	10	10k	R18, R19, R22, R29	Erie 15
20-0273	Composition	1/10	10	27k	R21	Erie 15
20-0152	Composition	1/10	10	1.5k	R23	Erie 15
20-2100	Metal Oxide	1/3	5	10	R24, R31	Mullard CR25
20-0102	Composition	1/10	10	1k	R25, R26, R30, R32	Erie 15
20-0470	Composition	1/10	10	47	R27, R41	Erie 15
20-0223	Composition	1/10	10	22k	R28	Erie 15
20-0104	Composition	1/10	10	100k	R34, R39	Erie 15
20-0222	Composition	1/10	10	2.2k	R35	Erie 15
20-2473	Metal Oxide	¼	5	47k	R36	Erie M04
20-0472	Composition	1/10	10	4.7k	R37, R38	Erie 15
20-0272	Composition	1/10	10	2.7k	R40	Erie 15
	Capacitors					
21-1002	Tantalum	25V	20	10µ	C1, C3, C10, C19, C22, C29, C30	I.T.T. TAG 10/25
21-3549	Polystyrene	30V	5	.0168µ	C2	Suflex HS.0.0168/5-10/30
21-3547	Polystyrene	30V	5	3900p	C4	Suflex HS.3900/5-10/30
21-3548	Polystyrene	30V	5	8200p	C5	Suflex HS.8200/5-10/30
21-1616	Ceramic	12V	20	0.1µ	C6, C9, C15, C16, C18, C20, C23, C24, C27, C28	Murata D.D.600.BC.12
21-2646	Silver Mica	350V	2	180p	C7, C8	Lemco MS.611/M
21-1546	Ceramic	18V	+50-25	.022µ	C11	Erie 831/T/18V
21-2598	Silver Mica	350V	2	680p	C12, C13, C14	Lemco MS.611/M/R/G
21-1528	Ceramic		10	470p	C17, C21	Erie 831
21-2644	Silver Mica	350V	20	100p	C25	Lemco MS.611/M
21-2587	Silver Mica	350V	2	470p	C26	Lemco MS.611/M/R/G
21-1003	Tantalum	10v	20	15µ	C31, C32	I.T.T. TAG 15/10

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer

19-0515 (continued)

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
	Diode					
22-1029	Silicon				D1	1N4149
	Transistors					
22-6009	Silicon: npn				Q1, Q3	Fairchild 2N.4124
22-6010	Silicon: pnp				Q2, Q4	Fairchild 2N.4126
22-6041	Silicon: npn				Q5, Q11	Mullard BC.109
22-6017	Silicon: npn				Q6, Q8, Q9, Q10	Mullard 2N.2369
22-6058	Silicon: npn				Q7	Transitron TES.014
	Inductor					
23-7057	Inductor Assembly		150μH		L1	Racal Insts.

DIVIDER AND VOLTAGE REFERENCE ASSEMBLY: 19-0516

(Fitted on Type 9055)

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
	Resistors	Watts				
20-0222	Composition	1/10	10	2.2k	R1, R7, R18, R19, R31, R32, R40	Erie 15
20-0153	Composition	1/10	10	15k	R2	Erie 15
20-0151	Composition	1/10	10	150	R3	Erie 15
20-0103	Composition	1/10	10	10k	R4, R8	Erie 15
20-0332	Composition	1/10	10	3.3k	R5	Erie 15
20-0102	Composition	1/10	10	1k	R6, R11, R12, R14, R24, R35, R36	Erie 15
20-2101	Metal Oxide	1/4	5	100	R9	Erie M04
20-0472	Composition	1/10	10	4.7k	R10, R17, R30	Erie 15
20-0271	Composition	1/10	10	270	R13	Erie 15
20-2821	Metal Oxide	¼	5	820	R15, R28, R37	Erie M04
20-2472	Metal Oxide	¼	5	4.7k	R16, R29, R38	Erie M04
20-0330	Composition	1/10	10	33	R20, R33	Erie 15
20-0100	Composition	1/10	10	10	R21, R23, R25, R26, R27	Erie 15
20-0471	Composition	1/10	10	470	R22, R34	Erie 15
20-0681	Composition	1/10	10	680	R39	Erie 15
20-2220	Metal Oxide	¼	5	22	R41	Erie M04
20-2182	Metal Oxide	¼	5	1.8k	R42, R43	Erie M04
20-2392	Metal Oxide	¼	5	3.9k	R44	Erie M04
20-2391	Metal Oxide	¼	5	390	R45	Erie M04

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
			19-0516 (Continued)			
	Resistors	Watt				
20-2103	Metal Oxide	1/4	5	10k	R46, R49, R51	Erie M04
20-7004	Variable	3/4		10k	R47, R48, R50	Morganite 82, 150 ppm
	Capacitors					
21-1002	Tantalum	25V	20	10μ	C1, C8, C14, C22 C24	I.T.T. TAG 10/25
21-1545	Ceramic	25V	+50-25	0.01μ	C2, C3, C6, C10, C15	Erie 831/T/25V
21-2587	Silver Mica	350V	2	470p	C4, C13	I.T.T. 454-LWA-73
21-2592	Silver Mica	350V	2	150p	C5	I.T.T. 454-LWA-73
21-2586	Silver Mica	350V	2	220p	C12	I.T.T. 454-LWA-73
21-2585	Silver Mica	350V	2	124p	C7	I.T.T. 454-LWA-73
21-2584	Silver Mica	350V	2	98p	C9	I.T.T. 454-LWA-73
21-2645	Silver Mica	350V	2	120p	C11	Lemco MS 611 M
21-2588	Silver Mica	350V	2	1000p	C16, C21	I.T.T. 454-LWA-74
21-2648	Silver Mica	350V	2	9200p	C17	Lemco MS 611/M
21-2591	Silver Mica	350V	1	6800p	C18	I.T.T. 454-LWA-76
21-2590	Silver Mica	350V	2	4150p	C19	I.T.T. 454-LWA-75
21-1616	Ceramic	12V		0.1μ	C23	Murata D.D.600.BC.12
	Diodes					
22-1029	Silicon				D1-D10	Texas IN 4149
22-1810	Voltage Regulator	6.2V	5	400mW	D11	Mullard BZY 88-C5V6
	Transistors					
22-6010	Silicon: pnp				Q1, Q4, Q6, Q8, Q10, Q12, Q14, Q17	Fairchild 2N.4126
22-6009	Silicon: npn				Q2, Q3, Q5, Q7, Q9, Q11, Q13, Q15, Q16	Fairchild 2N.4124
	Inductor					
23-7058	Wirewound		10%	33μH	L1	Cambion 3640/57/2
17-4035	Variable				L2	Racal Insts.

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer

SAMPLER AND 10MHz ASSEMBLY: 19-0517

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
	Resistors	Watts				
20-2510	Metal Oxide	¼	5	51	R1,R34	Erie M04
20-2101	Metal Oxide	¼	5	100	R2	Erie M04
20-2472	Metal Oxide	¼	5	4.7k	R3,R4,R5,R6, R7,R8,R15,R16	Erie M04
20-2561	Metal Oxide	¼	5	560	R9,R28	Erie M04
20-0106	Composition	1/10	10	10M	R10,R11	Erie 15
20-7002	Variable	¾		1k	R12	Morganite 82, 150 ppm
20-2222	Metal Oxide	¼	5	2.2k	R13, R47	Erie M04
20-2102	Metal Oxide	¼	5	1k	R14,R42	Erie M04
20-2332	Metal Oxide	¼	5	3.3k	R17,R18,R20	Erie M04
20-2392	Metal Oxide	¼	5	3.9k	R19,R22	Erie M04
20-0470	Composition	1/10	10	47	R25, R40 R48,R54	Erie 15
20-0271	Composition	1/10	10	270	R23, R46	Erie 15
20-0102	Composition	1/10	10	1k	R24,R35,R50	Erie 15
20-0101	Composition	1/10	10	100	R26,R27,R29	Erie 15
20-2122	Metal Oxide	¼	5	1.2k	R30	Erie M04
20-2470	Metal Oxide	¼	5	47	R31	Erie M04
20-2181	Metal Oxide	¼	5	180	R32	Erie M04
20-2560	Metal Oxide	¼	5	56	R33	Erie M04
20-0332	Composition	1/10	10	3.3k	R36	Erie 15
20-0103	Composition	1/10	10	10k	R37,R38	Erie 15
20-0104	Composition	1/10	10	100k	R39	Erie 15
20-0152	Composition	1/10	10	1.5k	R41,R49	Erie 15
20-2823	Metal Oxide	¼	5	82k	R43	Electrosil TR4
20-2223	Metal Oxide	¼	5	22k	R44,R45	Erie M04
20-0223	Composition	1/10	10	22k	R51,R52	Erie 15
20-2271	Metal Oxide	¼	5	270	R53	Erie M04
20-2221	Carbon Film	¼	5	220	R21	Mullard CR25
	Capacitors					
21-1616	Ceramic	12V		0.1μ	C1,C29,C33	Murata DD.600.BC12
21-1002	Tantalum	25V	20	10μ	C2,C8,C12,C15, C17,C19,C21, C23,C25	I.T.T. TAG 10/25
21-1532	Ceramic		20	1000p	C3,C4,C30,C34	Erie 831.K350081
21-1508	Ceramic		10	10p	C5,C6,C20,C22	Erie 831.NPO
21-5501	Polycarbonate	100V	20	0.1μ	C7	I.T.T. PMA 0.1.M100
21-1525	Ceramic		10	270p	C9,C10,C14,C16	Erie 831.N4700
21-1518	Ceramic		10	68p	C11	Erie 831.N2200
21-1545	Ceramic	25V	+50-25	.01μ	C18	Erie 831/T/25V

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer

19-0517 (continued)

Capacitors

21-2640	Silver Mica	350V	2	12p	C26	Lemco MS/611M
21-2589	Silver Mica	200V	2	2,200p	C27	Lemco MS.611/M/R/G
21-2586	Silver Mica		2	220p	C28	Lemco MS.611/M/R/G
21-1536	Ceramic		25	2,200p	C31	Erie 831.K7004
21-1000	Tantalum	16V	20	3.3μ	C32	I.T.T. TAG 3.3/16

Diodes

22-1033	Hot Carrier: matched pair				D1, D2	H-Packard HP.5082.2912
22-1045	Step Recovery Diode				D3	H-Packard HP.5082.0180
22-1029	Silicon				D4, D7	I.T.T. IN 4149
22-1038	Silicon: varicap				D6	Motorola MV1634

Transistors

22-6101	N Channel FET (Pinch off -1.5V to -3.0V)				Q1	Siliconex W.300A
22-6009	Silicon: npn				Q2, Q3, Q10, Q11, Q12, Q13	Fairchild 2N.4124
22-6010	Silicon: pnp				Q4	Fairchild 2N.4126
22-6058	Silicon: pnp				Q5	Transitron TES.014
22-6017	Silicon: npn				Q6, Q7, Q8, Q9	Mullard 2N.2369

Miscellaneous

17-2019	Crystal 10.7MHz				XL1	Racal Insts.
17-4036	Transformer Assembly				T1	Racal Insts.
23-8000	Ferrite Bead				FX1	Mullard FX1242

V.F.O. and VOLTAGE STABILIZER ASSEMBLY: 19-0518

Resistors

20-2152	Metal Oxide	¼	5	1.5k	R1	Erie M04
20-2561	Metal Oxide	¼	5	560	R2	Erie M04
20-2681	Composition	1/10	10	680	R3	Erie 15
20-0223	Composition	1/10	10	22k	R4	Erie 15
20-0103	Composition	1/10	10	10k	R5, R11	Erie 15
20-2821	Metal Oxide	¼	5	820	R6	Erie M04

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
			19-0518 (continued)			
	Resistors					
20-0152	Composition	1/10	10	1.5k	R7, R14	Erie 15
20-2182	Metal Oxide	¼	5	1.8k	R8	Erie M04
20-2271	Metal Oxide	¼	5	270	R9	Erie M04
20-0333	Composition	1/10	10	33k	R10	Erie 15
20-0222	Composition	1/10	10	2.2k	R12	Erie 15
20-0101	Composition	1/10	10	100	R13	Erie 15
20-0221	Composition	1/10	10	220	R15	Erie 15
20-0681	Composition	1/10	10	680	R16	Erie 15
20-0471	Composition	1/10	10	470	R17	Erie 15
20-0560	Composition	1/10	10	56	R18	Erie 15
20-0122	Composition	1/10	10	1.2k	R19	Erie 15
	Capacitors					
21-2643	Silver Mica	350V	2	68p	C2	Lemco MS 611/M
21-1616	Ceramic	12V	20	0.1µ	C6, C9, C10, C11	Murata DD.600.BC.12
21-2647	Silver Mica	350V	2	2700p	C4, C5	Lemco MS 611/M
21-1545	Ceramic	25V	+50-25	.01µ	C8, C12	Erie 831/T/25V
21-1002	Tantalum	25V	20	10µ	C13	I.T.T. TAG 10/25
	Diodes					
22-1814	Voltage Regulator: 9.1V				D1	Mullard BZY 88-C9V1
22-1029	Silicon				D2	I.T.T. IN.4149
22-1809	Voltage Regulator: 5.6V				D3	Mullard BZY 88-C5V6
22-1810	Voltage Regulator: 6.2V				D4	Mullard BZY 88-C6V2
	Transistors					
22-6041	Silicon: npn				Q1	Mullard BC109
22-6017	Silicon: npn				Q2, Q3	Mullard 2N 2369
22-6009	Silicon: npn				Q4, Q5	Fairchild 2N.4124
22-6010	Silicon: pnp				Q6	Fairchild 2N.4126
	Inductors					
17-3063	Coil Assembly				L1	Racal Insts.

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer

CHECK BATTERY ASSEMBLY: 19-0519

Resistors

Part No.	Description	Rat.	Tol. %	Value	Component References	Manufacturer
20-4052	Metal Oxide	$\frac{1}{4}$	1	150k	R1	Erie M04
20-4650	Metal Oxide	1	5	180	R2	Erie M06
20-3390	Metal Oxide	$\frac{1}{2}$	5	39	R3	Erie M05

DIVIDER AND REFERENCE VOLTAGE ASSEMBLY: 19-0610

(Fitted in Type 9054)

Components fitted in Assembly 19-0610 are the same as those in Assembly 19-0516 except for the following:

Resistors

R21, R26, R46 and R47 are not fitted in the 19-0610.
R42 is 3.9k, Part No. 20-2392 Erie M04
R49 is 5.6k, Part No. 20-2562 Erie M04

Capacitors

C12 and C19 are not fitted in the 19-0610.
C4 is 680p, Part No. 21-2598. Silver Mica 2%. I.T.T. 454-LWA-74
C5 is 220p, Part No. 21-2586. Silver Mica 2%. I.T.T. 454-LWA-73

SECTION 4

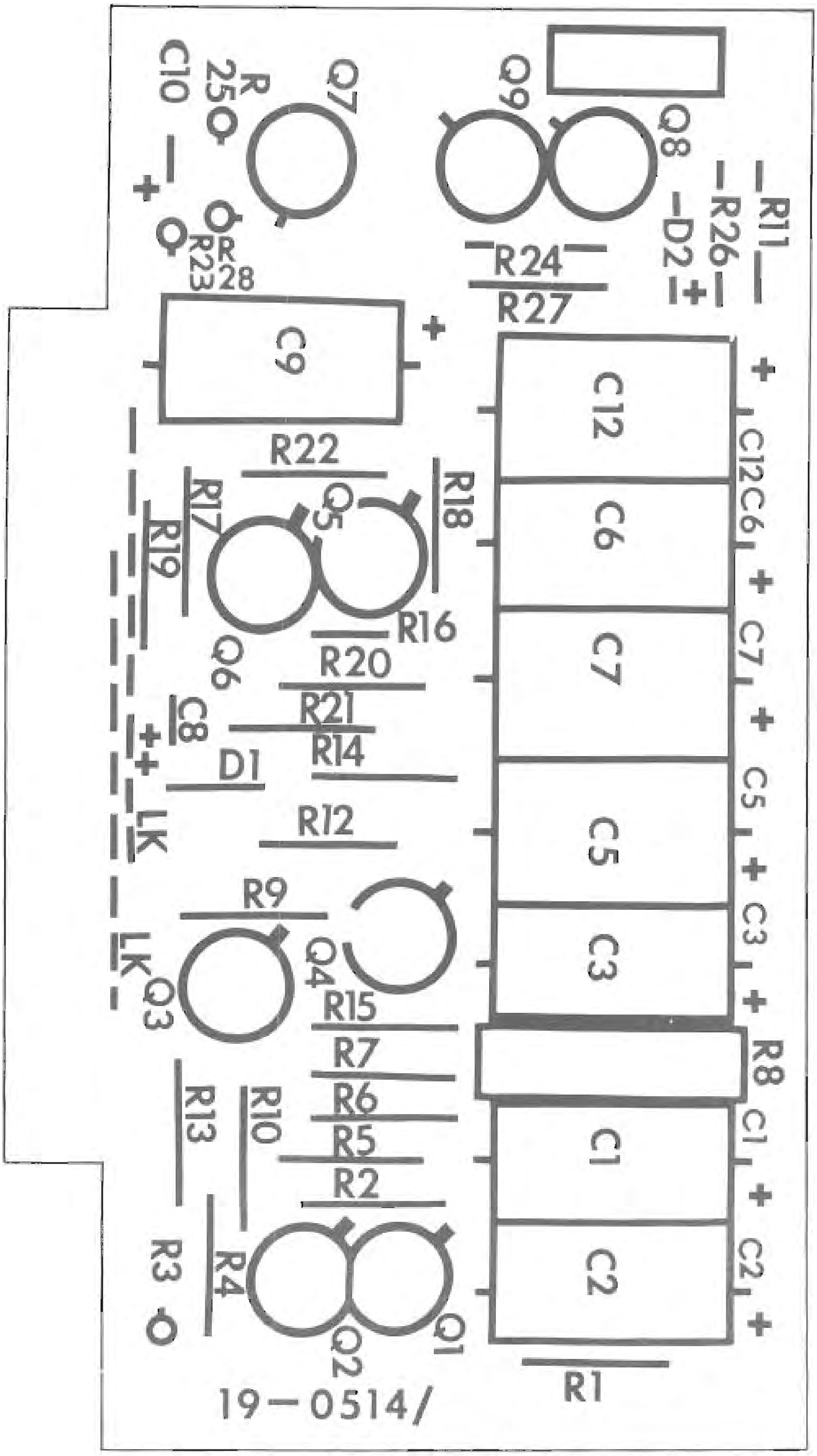
CIRCUIT DIAGRAMS

AND

LAYOUTS

SECTION 4

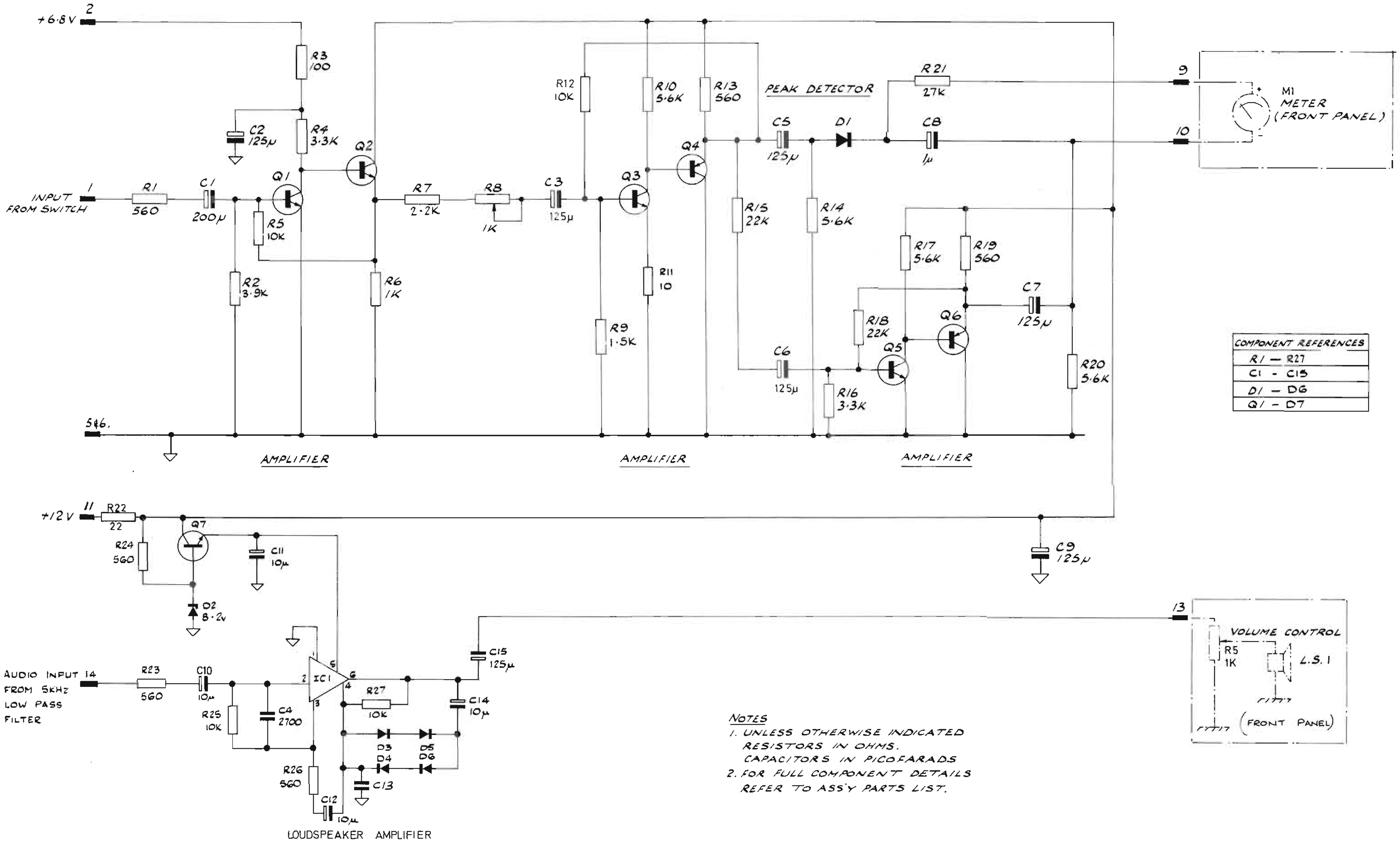
LIST OF CIRCUIT DIAGRAMS AND LAYOUTS



Layout: Meter Drive and Loudspeaker Assembly
19–0514

Fig. 4·1

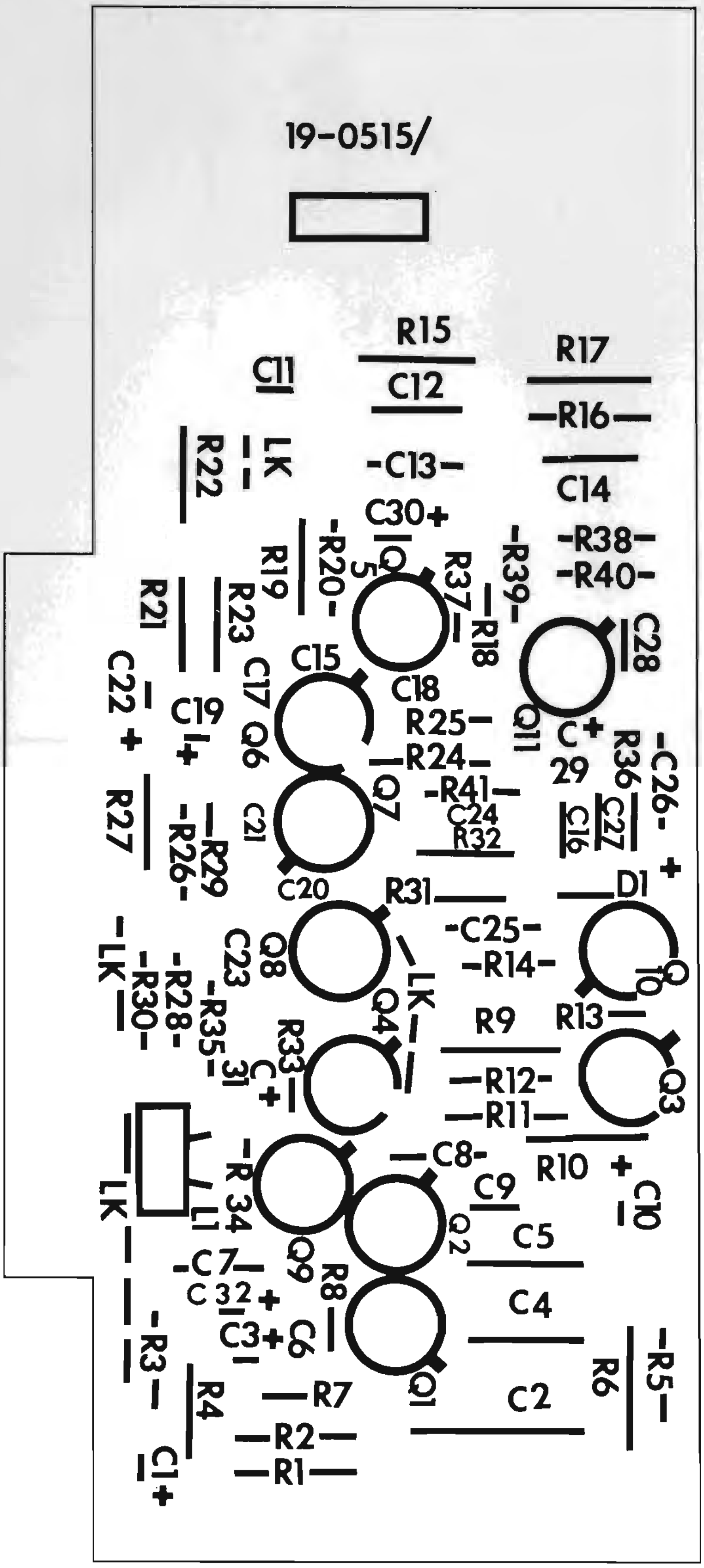
WOH 2047 | 19-0514 | 1



WOH2047	19-0514
4 5	

Circuit: Meter Drive & Loudspeaker Amplifier 19-0514

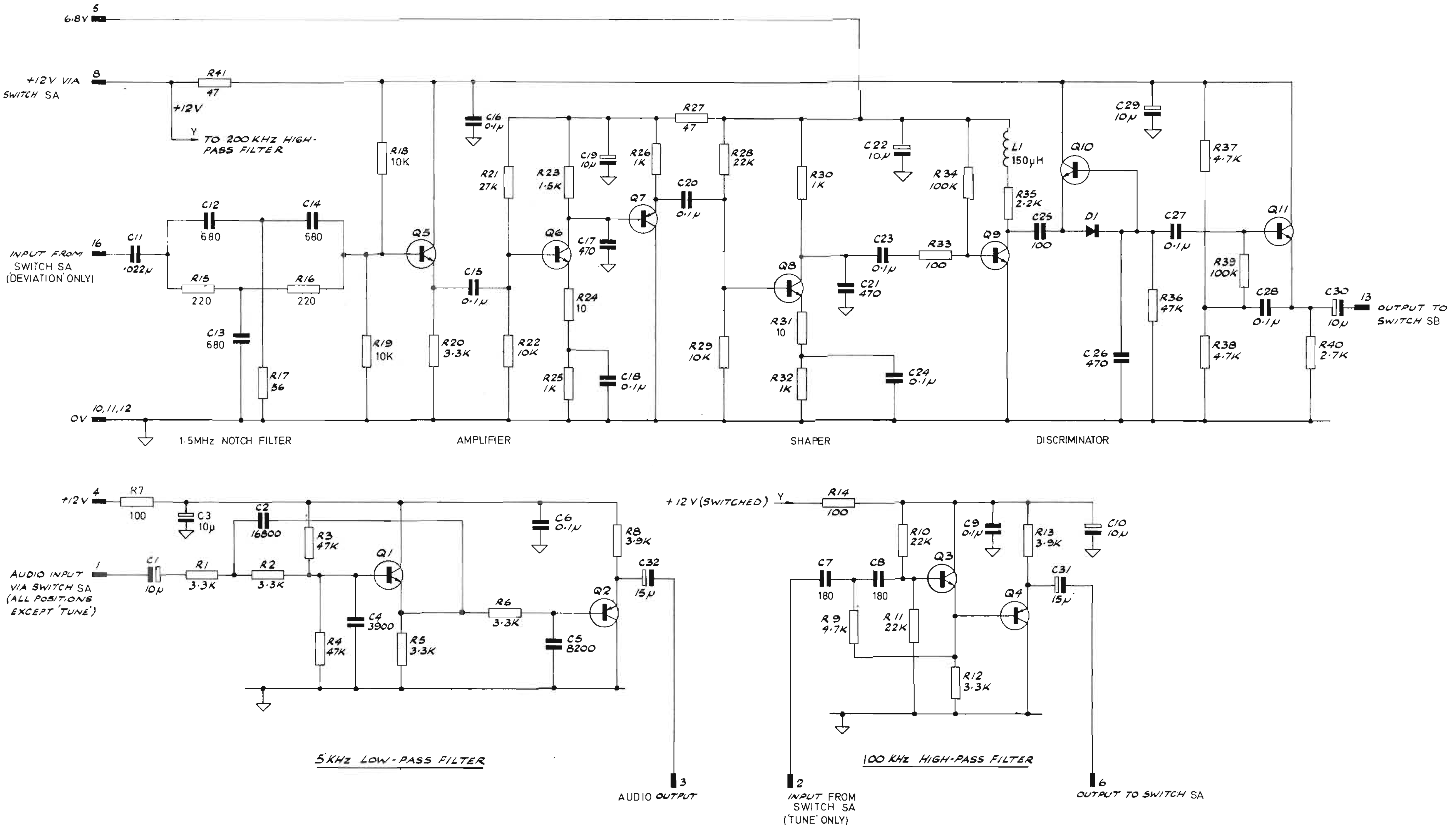
19-0514 Fig. 4·2



Layout : Discriminator and Filter Assembly
19-0515

Fig. 4·3

WOH 2047	19-0515
1	

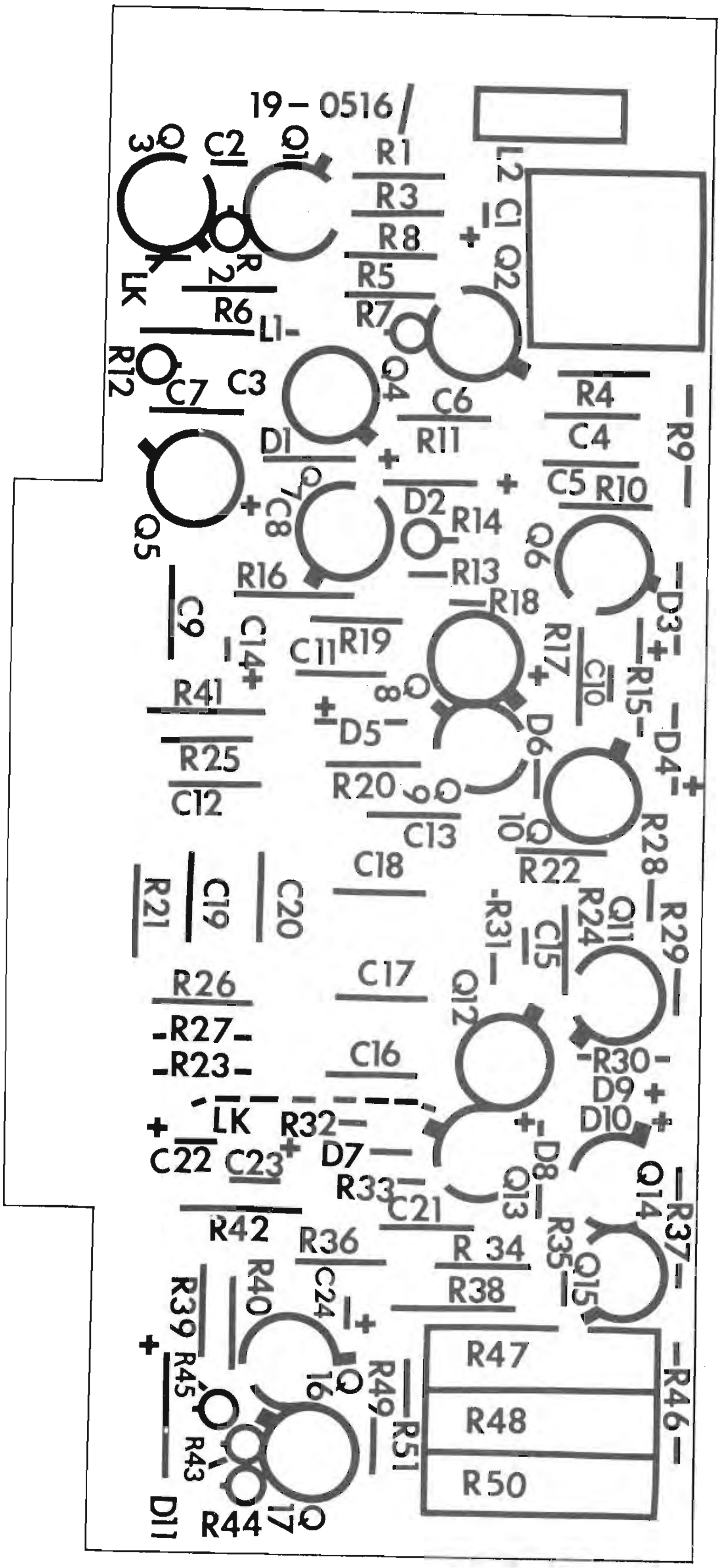


WOH2047 19-515 1 2

Circuit : Discriminator & Filter Assembly 19-0515

19-0515

Fig. 4·4

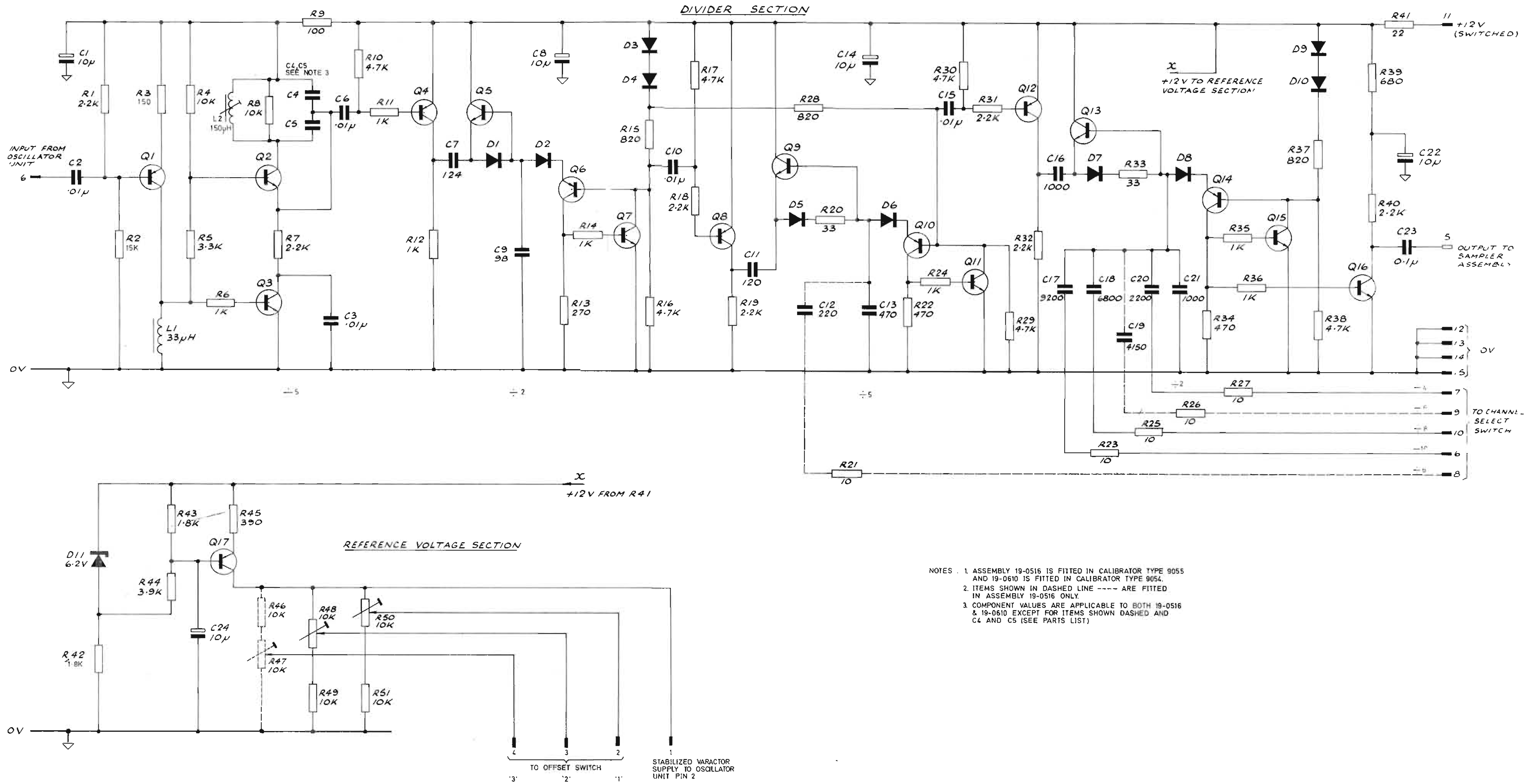


NOTE : THE FOLLOWING ARE NOT FITTED IN P.C.B. 19-0610 (CALIBRATOR 9054) R21, R26, R46, R47, C9, C12

19-0516
1
19 0610
1
WOH2047

Layout : Divider and Reference Voltage Assemblies
19-0516 & 19-0610

Fig 4·5



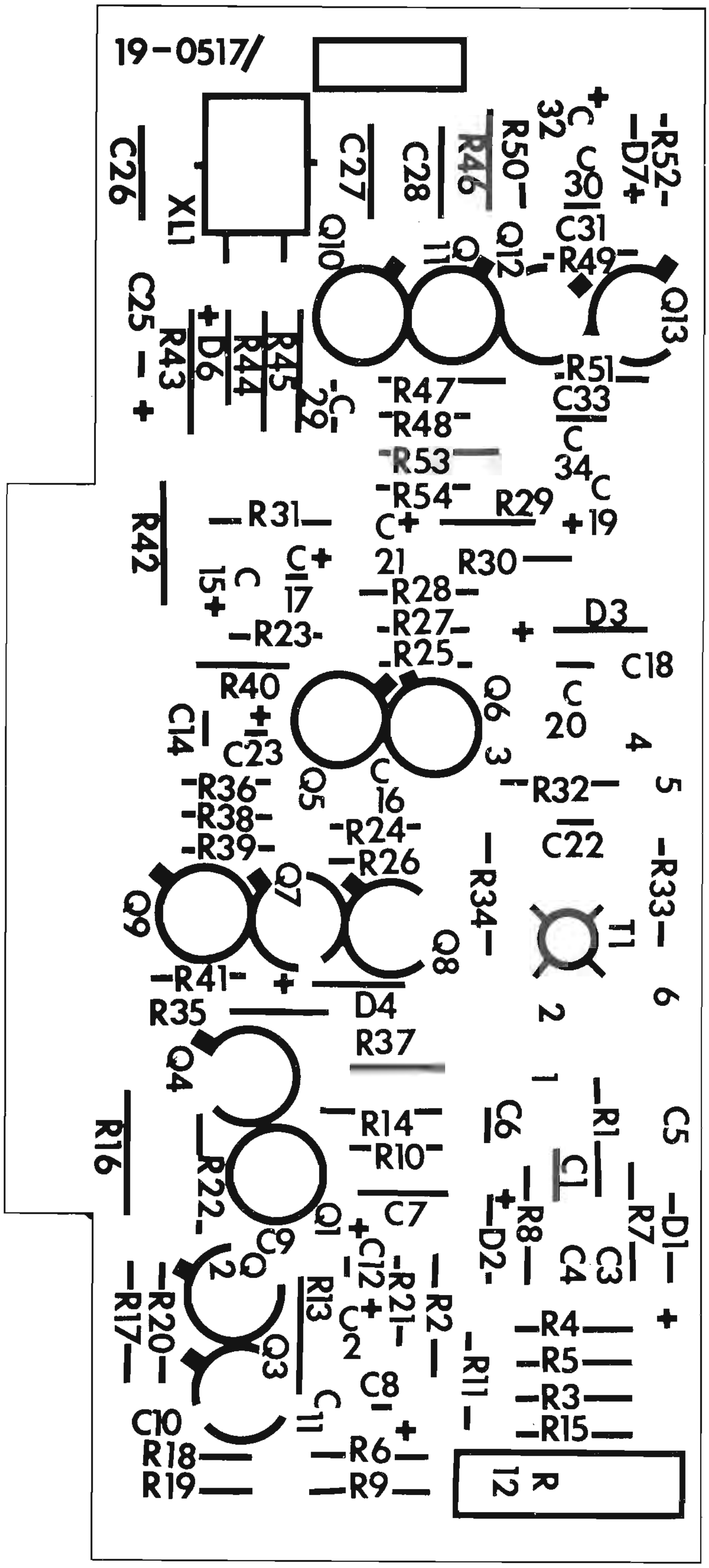
NOTES.
1. ASSEMBLY 19-0516 IS FITTED IN CALIBRATOR TYPE 9055 AND 19-0610 IS FITTED IN CALIBRATOR TYPE 9054.
2. ITEMS SHOWN IN DASHED LINE ---- ARE FITTED IN ASSEMBLY 19-0516 ONLY.
3. COMPONENT VALUES ARE APPLICABLE TO BOTH 19-0516 & 19-0610 EXCEPT FOR ITEMS SHOWN DASHED AND C4 AND C5 (SEE PARTS LIST)

WOH2047 | 19-0516
WOH2047 | 19-0610

Circuit : Divider & Reference Voltage Assemblies 19-0516 & 19-0610

19-0516
19-0610

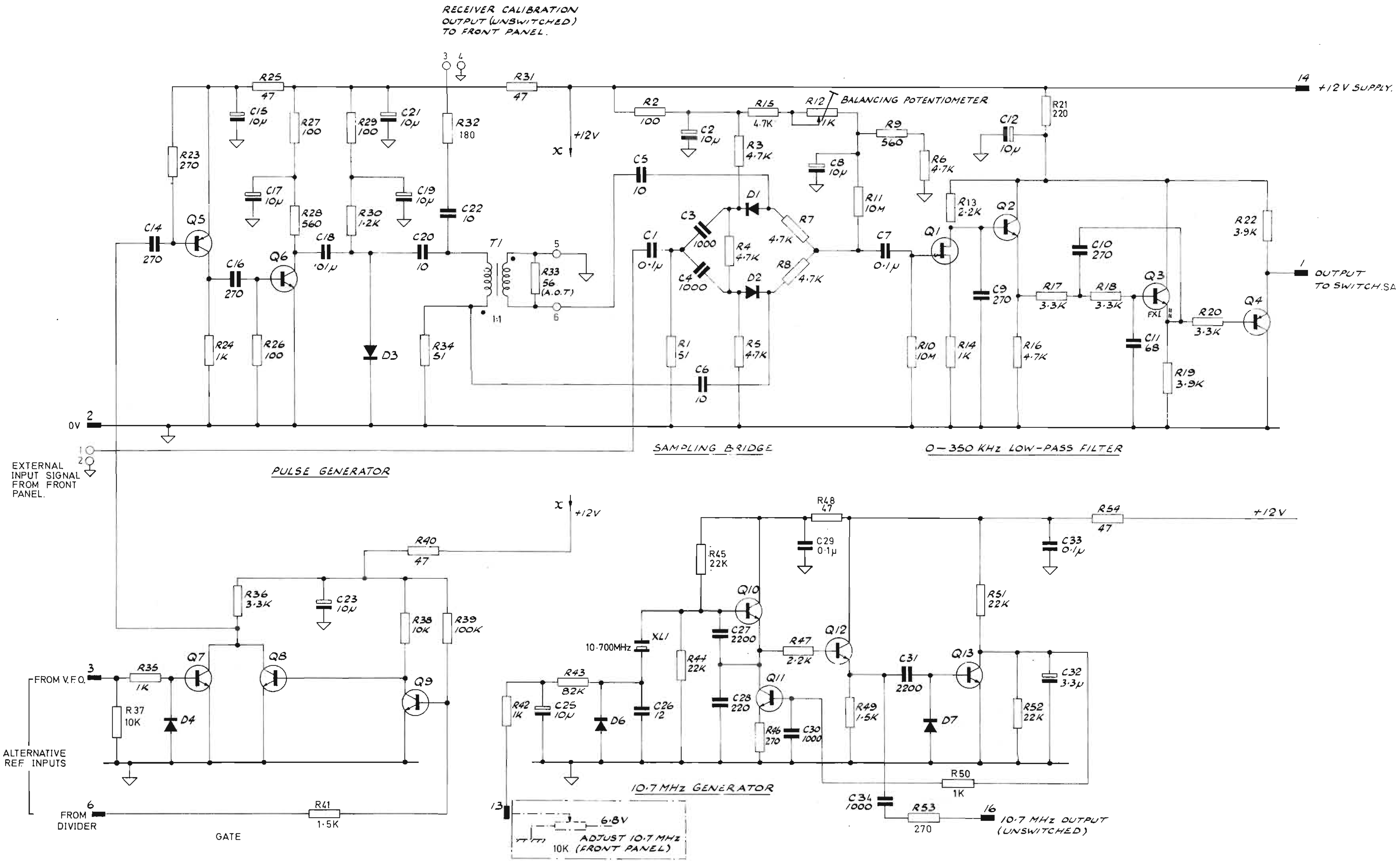
Fig. 4.6



Layout : Sampler and 10·7MHz Assembly
19-0517

Fig. 4·7

WOH2047	19-0517
1	

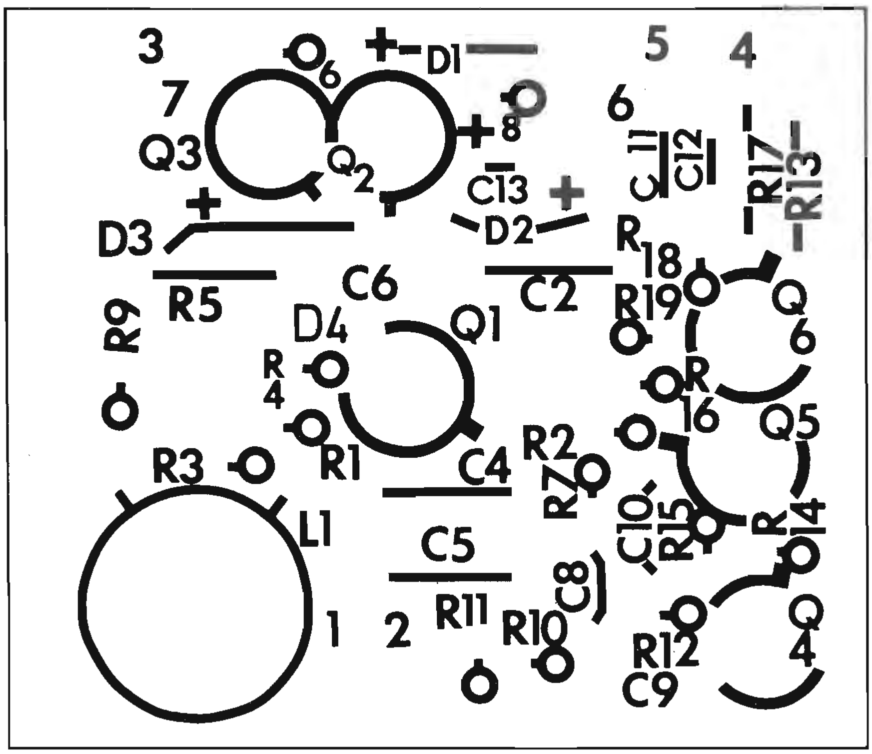


WOH2047 19-0517

Circuit: Sampler & 10·7MHz Assembly 19-0517

19-0517

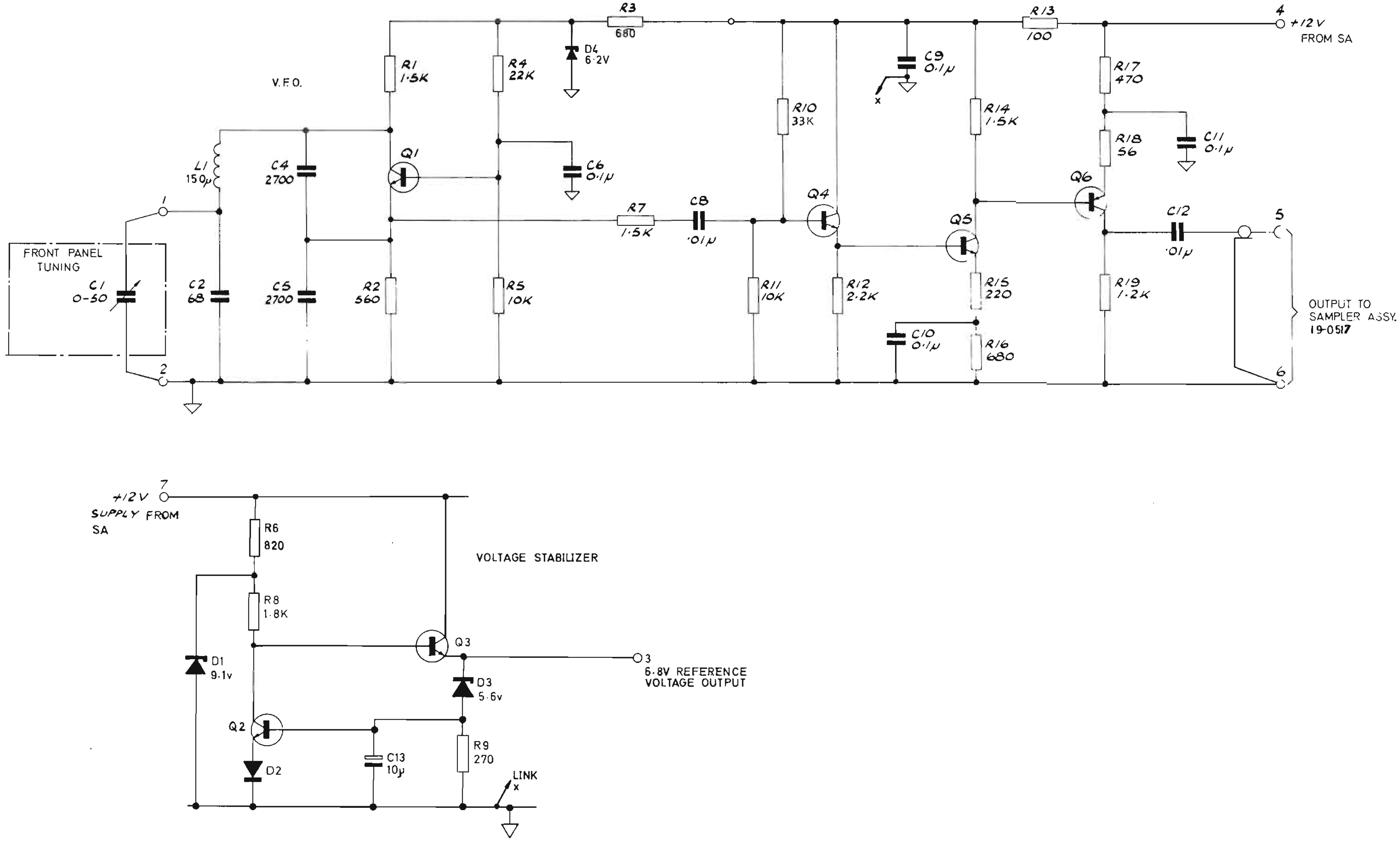
Fig. 4·8



Layout : V.F.O. and Voltage Stabilizer Assembly
19-0518

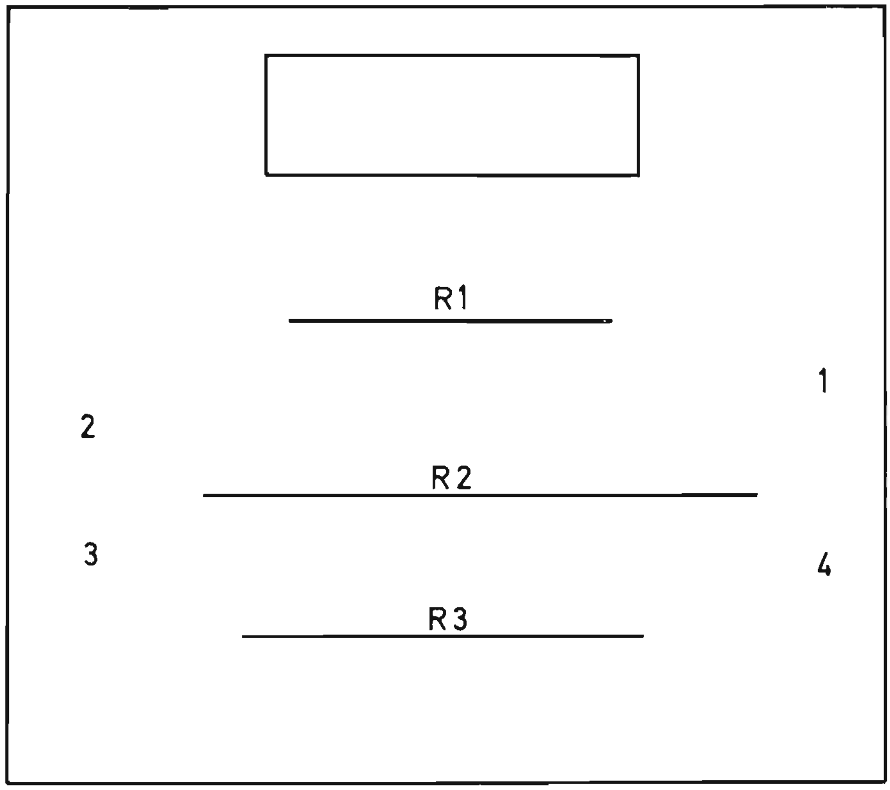
Fig. 4-9

WOH2047 | 19-0518
2



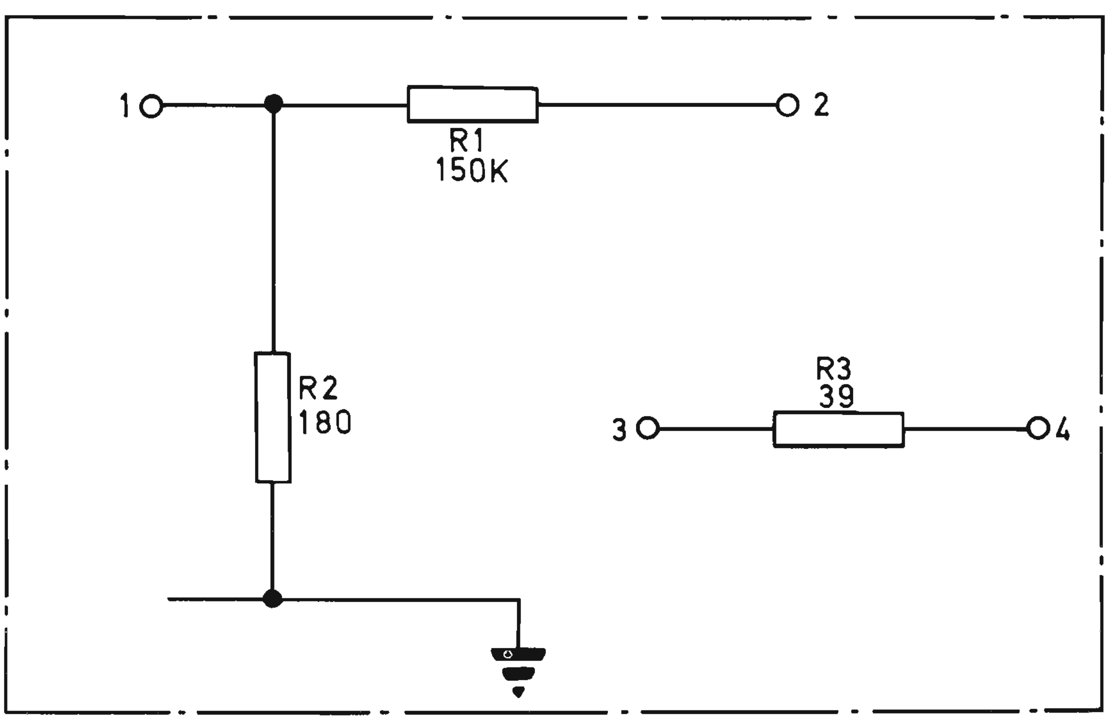
Circuit : V.F.O. & Reference Voltage Assembly 19-0518

Fig. 4·10



18-0519
1

Layout



19-0519
1

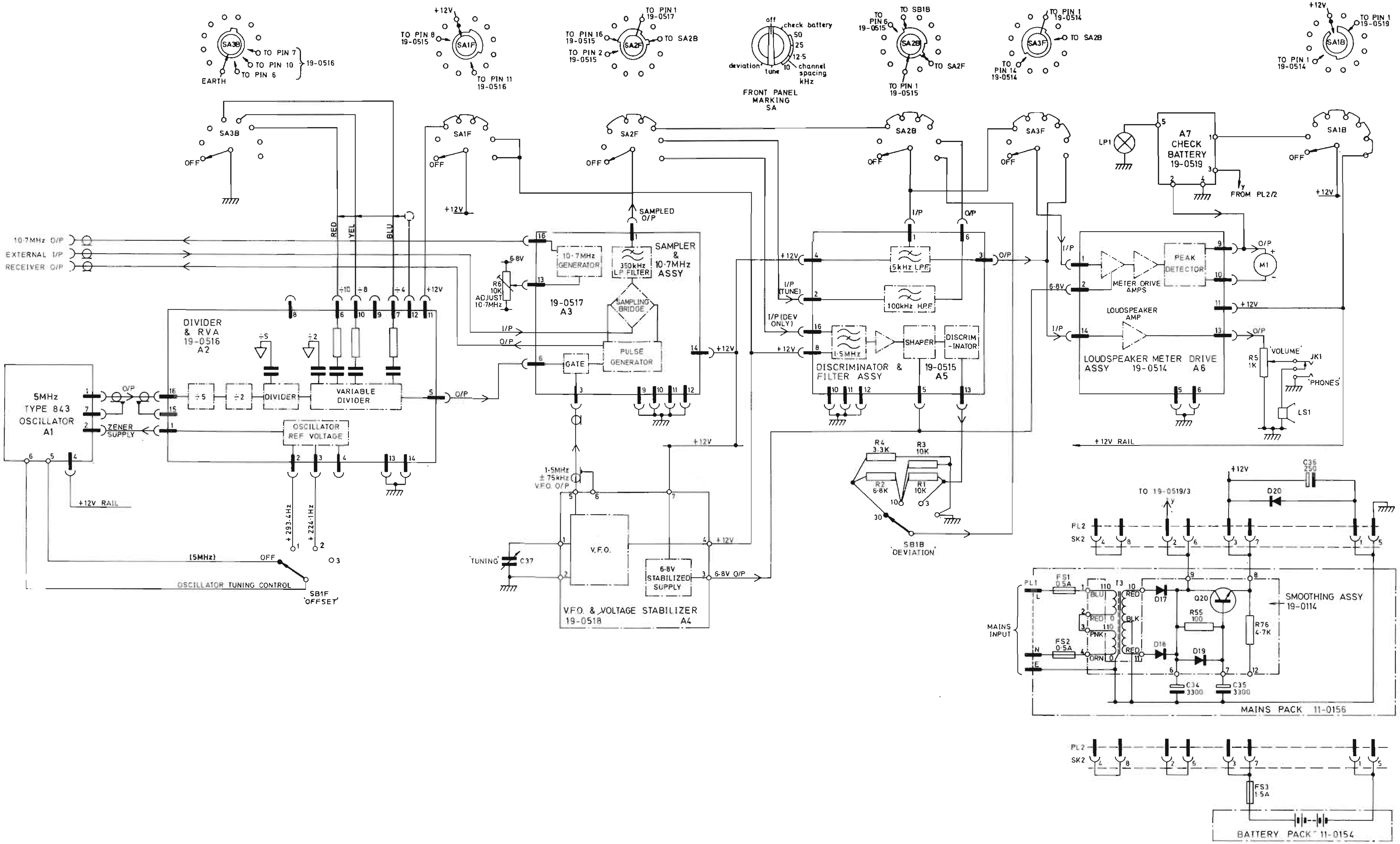
Circuit

Circuit and Layout

WOH2047

Check Battery Assembly 19-0519

Fig. 4.11

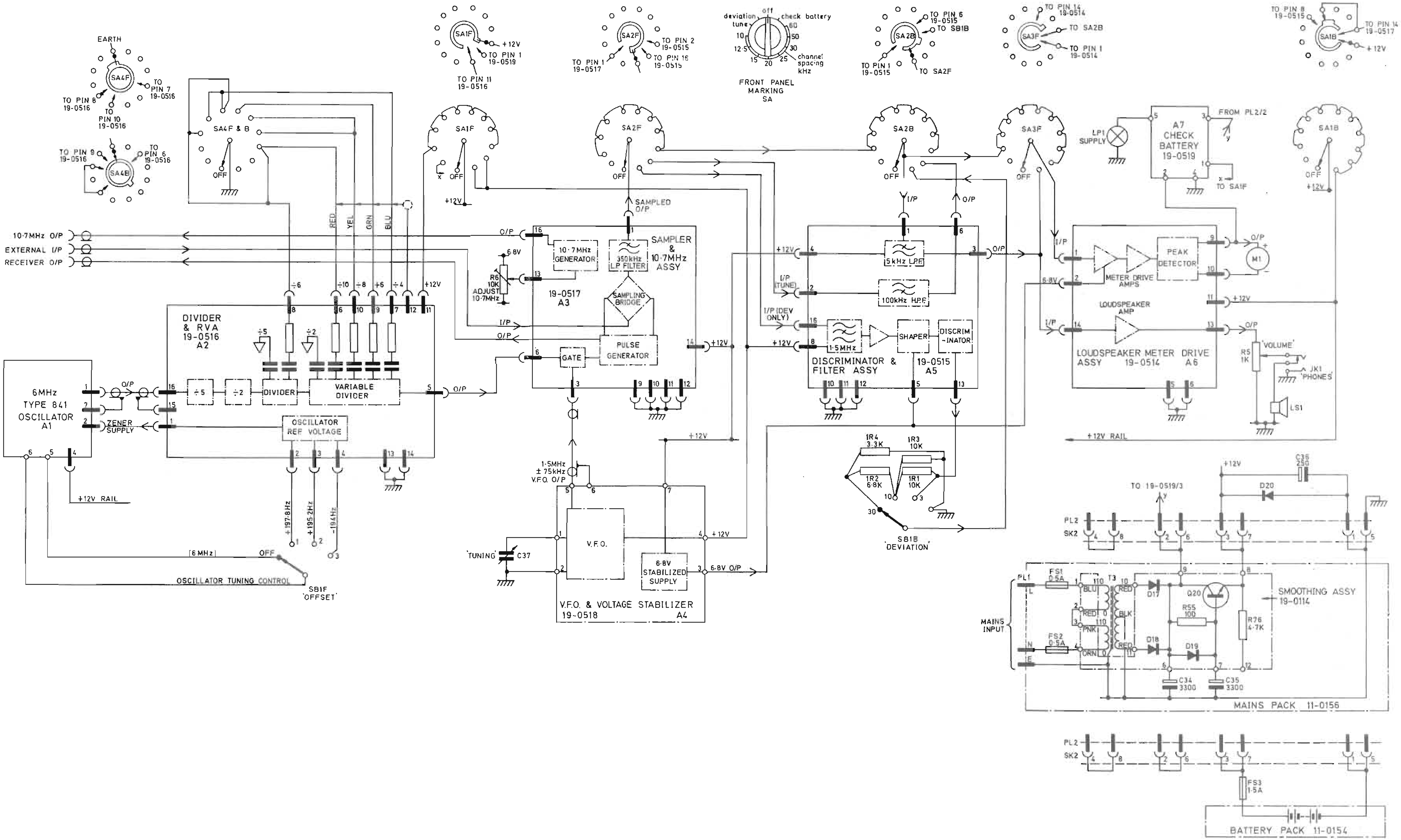


WOH2047 | 9054 | 1

Block Interconnection Diagram : Type 9054

9054

Fig. 4·12



WOH 2047 | 9055 | 1

Block Interconnection Diagram : Type 9055

9055

Fig. 4·13

SECTION 5

APPENDICES

AND

CHANGE INFORMATION

V.H.F. & U.H.F. CALIBRATORS 9054/9055

AMENDMENTS

CIRCUIT DIAGRAMS

Fig. 4.4 Discriminator and Filter Assembly 19-0515

(1) A Ferrite Bead (reference X1) is fitted to the emitter of Q1 and also (X2) to the emitter of Q3.

(2) R23 is changed to 2.7 kΩ

(3) R30 is changed to 2.2kΩ

(4) R34 is changed to 15kΩ

(5) C31 is changed to .01μF

(6) The supply end of R3 is disconnected from +12V and connected instead to the 6.8V rail. (edge connector pin 5).

Fig. 4.8 Sampler and 10.7 MHz Assembly 19-0517

(1) A Ferrite Bead (reference X1) is fitted to the emitter of Q2 also to the emitter of Q3 (X2) and collector of Q3 (X3).

(2) R11 is changed to 4.7MΩ

(3) C8 is changed to 0.1μF

(4) An additional capacitor (C35, tantalum, 10μ) is fitted, positive to the junction R21/C12 and negative to the junction C8/R11.

Parts List

Page 5-5

(1) Under Resistors change R23 to 2.7k, Part No. 20-0272
(2) Add R34, 15k, Part No. 20-2153, ¼W, 5% Carbon Film
(3) Under "Capacitors" delete C31 from Part No. 21-1003
(4) Insert new details, C31, as follows:-
"21-1545 Ceramic 25V +50 -25% .01μ C31 Erie 831/T/25V"

Page 5-6

Insert Ferrite Bead details under "Inductor" as follows:-
"23-8000 Ferrite Bead X1, X2, Mullard FX1242"

Page 5-8

(1) Delete R11 from Part No.20-0106 and add new line as follows:-
"20-1560 Carbon Film ¼W 10% 4.7M R11 Mullard CR25

(2) Under "Capacitors" amend as follows:-
(i) Add "C8" to Part No. 21-1616
(ii) Delete "C8" from Part No. 21-1002 and add "C35".

Page 5-9

Under "Miscellaneous" add the following:-
"23-8000 Ferrite Bead X1,X2 Mullard FX1242

General

(1) On Tech.Spec. page (4) item 6 under "Battery Operation" add the words "Leakproof batteries should be used"
(2) Chapter 1 page 1-3 para.1.12 add the words "Leakproof batteries should be used".