mi Sanders

A GEC-MARCONI ELECTRONICS COMPANY

6058B

SIGNAL SOURCE

INSTRUCTION MANUAL

MARCONI INSTRUMENTS LTD
SANDERS DIVISION STEVENAGE

INSTRUCTION MANUAL

for

SIGNAL SOURCE

TYPE 6058B

mi Sanders

Technical Publications

MARCONI INSTRUMENTS LIMITED
SANDERS DIVISION
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Fig. 1 M.I. Sanders Signal Source Type 6058B

1.1 SPECIFICATION

FREQUENCY	
Range	8.0 to 12.5 GHz in one continuous band
Scale Accuracy	±1%
Stability (Typical) (After one hour warm up in stable environment)	
Short Term (5 min)	0.003% (Allowing settling time of 15 min after frequency change)
Long Term (1 hour)	0.008%
Line stability	0.001% per 10V change in range 200 to 260V
With Temperature	0.006%/°C in range 10 to 50°C

Pulling (Typical) (Frequency pull due to mismatch of 50:1)	
at 8.0 GHz	0.09%
at 10.0 GHz	0.06%
at 12.0 GHz	0.09%
Output Power	Not less than 20 mW in 50Ω
Attenuator	Internally and externally fully variable over at least 15 dB
Impedance	50Ω
Output Connector	Precision stainless steel female 'N' Type
SIGNAL PURITY	
Harmonic Content	Not greater than −20 dB relative to fundamental
Residual F.M.	Typically 10 p.p.m.
Amplitude Modulation	
Internal	15 dB depth modulation, variable over at least 100 Hz either side of a nominal 1 kHz squarewave.
External	Up to 17 dB depth for a 100 mA input. Rise time being faster than 5 μs.
Output Levelling	Compatible with levelling amplifier Type 6587, to level output within 0.1 dB (excluding detector and coupler variations).
Power Requirements	
Supply Voltage	100 to 120 or 200 to 260V 50 to 60 Hz.
Input Power	20 VA
Dimensions	Height: 98 mm (3.7/8 in) Width: 203 mm (8 in) Depth: 286 mm (11.1/4 in) Weight: 4.0 kg
Accessories	A wide range of precision coaxial components is available for use with this instrument.

1.2 INTRODUCTION

The M.I. Sanders Signal Source Type 6058B is one in a range of solid state replacements for low power triode and klystron oscillators.

This model employs a Gunn effect device operating in a fundamental mode coaxial cavity. The cavity is tuned by means of a non-contacting short circuit plunger which is driven by a linearising cam and linked through a gear train to the front panel FREQUENCY control. The output frequency is displayed on a four digit mechanical counter. The effects of load variations on the oscillator are minimised by the incorporation of a miniature ferrite isolator.

Adjustment of the r.f. power level is accomplished by means of an electrically variable P.I.N. diode attenuator, which may be operated by the use of the front panel LEVEL control. The r.f. power can also be modulated internally by a 900 to 1100 Hz (or 2.9 to 3.1 kHz) squarewave applied to the P.I.N. diode unit.

The P.I.N. diode is also accessible via a BNC socket on the front panel, for use with a variety of external modulation signals. For example, the attenuator may be employed to level the r.f. output if an error signal is fed back from an external coupler and detector system.

The attenuation range available using the LEVEL control is greater than 15 dB. With this control set to MAX and an Ext input of 100 mA then attenuation of greater than 17.0 dB is available.

A facility which increases the usefulness of the source is the output voltage which is proportional to frequency. The relevant output connector is mounted on the rear panel of the unit and is labelled S2 on Fig.14. This voltage, which is approximately a 10V change over the frequency range, can be applied to the X traverse input of an X–Y recorder to enable broadband or manual swept-frequency measurements to be carried out.

Residual f.m. is of the order of 0.001% for the unit and is comparable with that of a conventional triode or klystron microwave source. Harmonic frequency components in the output of the unit are kept to a level of at least 20 dB below that of the fundamental, typically −30 dB, by the use of multi-section low-pass filter in the output line of the oscillator.

The oscillator is completely self-contained with its own built-in integrated circuit power unit suitable for operation from a.c. mains supplies of 110 or 230V.

1.3 INSTALLATION

Before connecting to the mains supply check that the rear panel voltage switch is set to the appropriate value and that the correct fuse (250 mA) is fitted.

The unit can be mounted in any position, but care should be taken to allow air to circulate freely over the rear panel.

Chapter 2

Operation

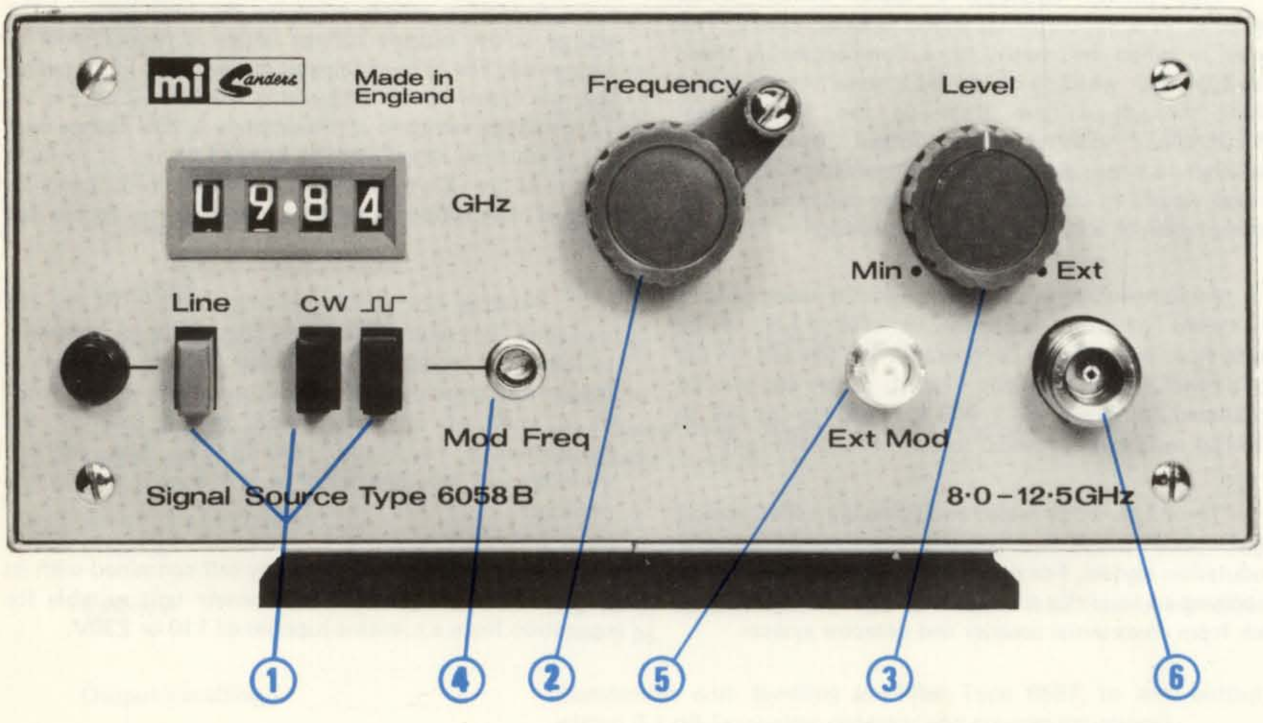


Fig. 2 Control Panel

2.1 OPERATING INSTRUCTIONS

The Type 6058B Signal Source can be operated in the following modes:

a) As c.w. source of microwave power.

b) As 900 to 1100 Hz or 2.9 to 3.1 kHz internally modulated squarewave source.

c) As externally modulated source with a rise time faster than 5 μs.

The control functions of the unit are shown in Fig.2.

1. FUNCTION SWITCH

For c.w. output push LINE and C.W. buttons.

For squarewave modulated output push LINE and ⊔⊓ buttons.

The panel lamp indicates a.c. power in each case.

2. FREQUENCY CONTROL

Set the desired frequency as indicated on the front panel counter.

3. R.F. LEVEL CONTROL

This can be used to set the r.f. output level. The minimum r.f. output is obtained when the control is set fully counterclockwise.

4. MODULATING FREQUENCY CONTROL

This control is used to set the internal modulation frequency between 900 to 1100 Hz or 2.9 to 3.1 kHz depending on the internal connection.

5. EXTERNAL MODULATION INPUT

The front panel BNC socket allows access to the internal P.I.N. diode attenuator, directly, when the

LEVEL switch is set to EXT. For maximum attenuation an input of 100 mA is required. Details of the attenuator performance are given by Fig.5.

6. R.F. OUTPUT

The r.f. output is connected via a miniature ferrite isolator, P.I.N. diode modulator and low-pass filter to the front panel 'N' type connector. In addition there is a rear panel BNC connector which provides an output voltage directly proportional to frequency. (Typically a 10V change over the full r.f. frequency range.) This can be used to drive the X axis of an X–Y recorder when making broadband measurements.

2.2 OUTPUT LEVELLING

The 6058B Signal Source produces an output in excess of 20 mW over the range 8.0 to 12.5 GHz. Typical variation of output power with frequency is shown in Fig.3.

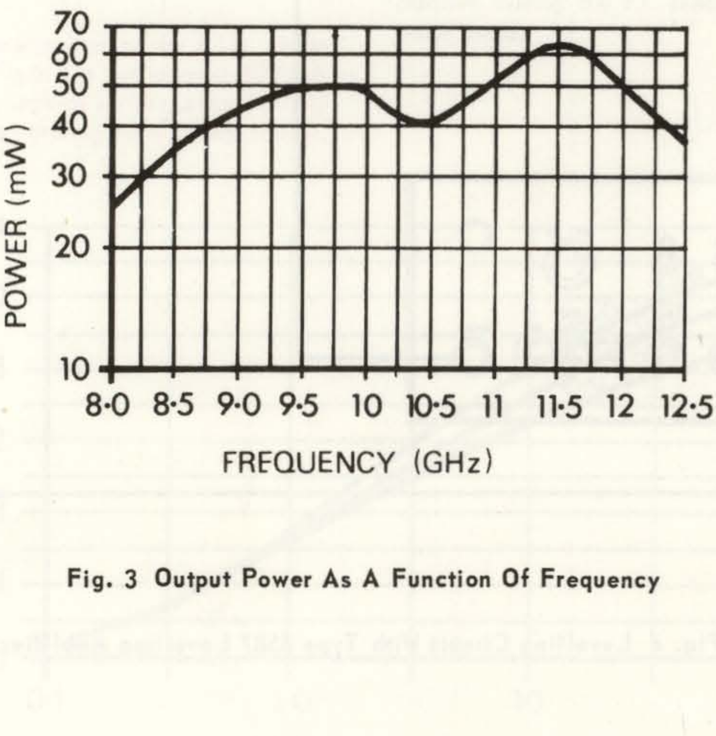


Fig. 3 Output Power As A Function Of Frequency

The power output can be levelled to 20 mW over the range using the internal modulator. The circuit required is shown in Fig.4.

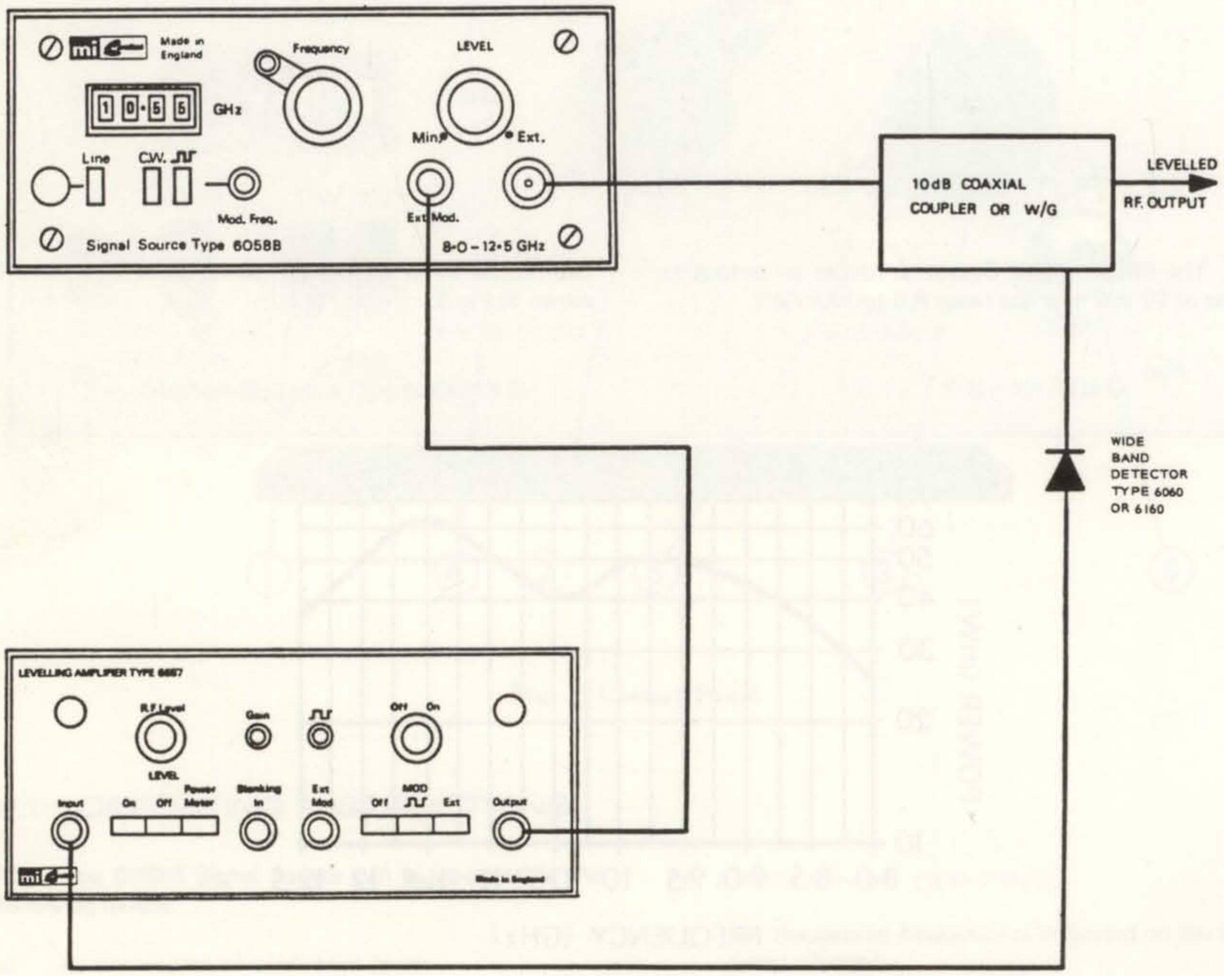


Fig. 4 Levelling Circuit With Type 6587 Levelling Amplifier

2.3 BROADBAND MEASUREMENTS

The Signal Source 6058A, can be used in conjunction with an X–Y recorder to provide a permanent record of broadband measurements. When used in this mode the source is operated in a similar way to the Microwave Sweeper Type 6600A with the rear panel BNC socket providing the sweep voltage. Reflectometer and insertion loss measurements can be made in the usual way see Figs.A1 and B1. The output voltage is zero at 8 GHz and approximately 10V at 12.5 GHz. As it is intended for high impedance input circuits (100 kΩ) heavier loading than this will degrade the linearity. This output can also be used in conjunction with network analyser systems.

Maximum accuracy will be achieved if the FREQUENCY control is always rotated in the same direction during the sweep. This will avoid errors due to residual backlash in the system.

2.4 EXTERNAL MODULATION

The front panel 'Ext. Mod.' socket provides direct access to the P.I.N. diode attenuator. This attenuator requires a positively increasing current to increase its attenuation, i.e. to decrease the r.f. output. When using the external modulation facility of this unit the LEVEL control is turned fully clockwise, i.e. maximum r.f. output and then any positive signal applied to the 'Ext. Mod.' socket will reduce the r.f. output. To adjust the maximum level of the r.f. output turn the LEVEL control counterclockwise until the required level is reached.

The logarithmic characteristic of the P.I.N. diode attenuator is shown by Fig.5. Do not exceed 100 mA input current. If necessary include series resistor (470Ω) to limit input current when driving from voltage source.

The frequency response of the modulator is limited by the rise time of the input circuitry. The rise time when driven from a high impedance source is less than 5 μs. Faster rise times can be achieved by driving the diode with shaped pulses. The basic requirement for achieving faster rise times is to remove the charge stored in the P.I.N. diode junction capacitance by applying higher potentials at the leading and trailing edges of the applied pulse. In the case of short pulses of r.f. power it is usual to arrange that the P.I.N. diode is biased slightly positive during the r.f. pulse in order to improve the pulse shape.

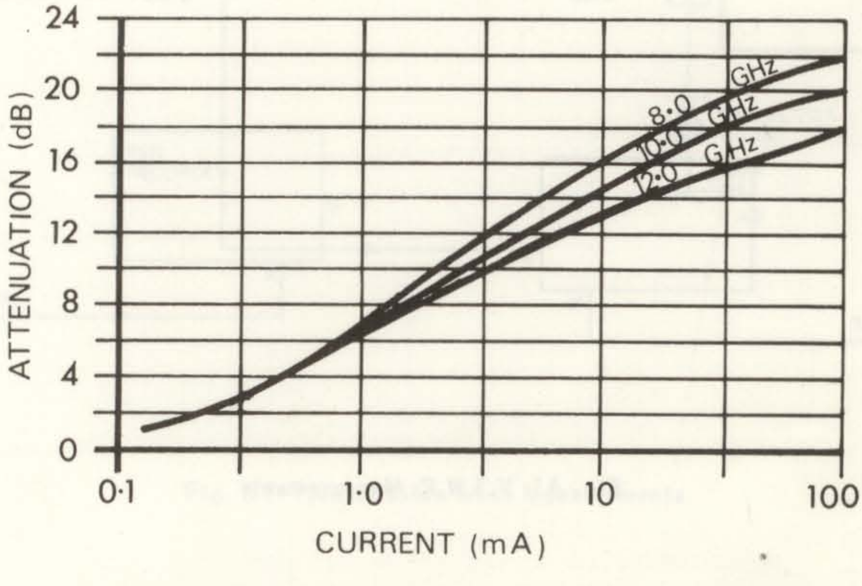


Fig. 5 Typical Modulator Performance

The P.I.N. diode attenuator represents a severe mismatch above about 3 dB attenuation with a result that some frequency pulling must be expected. This pulling has been reduced to approximately 0.1% by the use of an internally fitted miniature ferrite isolator.

In applications where it is necessary to achieve even better frequency stability with a varying load, about 10 dB of attenuation should be introduced by the front panel LEVEL control. This will reduce the pulling to an insignificant level. Alternatively another isolator or large value attenuator may be put in series with the r.f. signal.

2.5 TYPICAL APPLICATIONS

A. Manual Swept Frequency Measurements of V.S.W.R.

A. Manual Sweep Frequency Measurements of V.S.W.R. Using the equipment as shown in Fig.A1 a permanent record of test results can be obtained over the complete frequency range of the instrument. If greater sensitivity is required a Ratiometer can be connected and used with the signal source operated in the squarewave modulated mode.

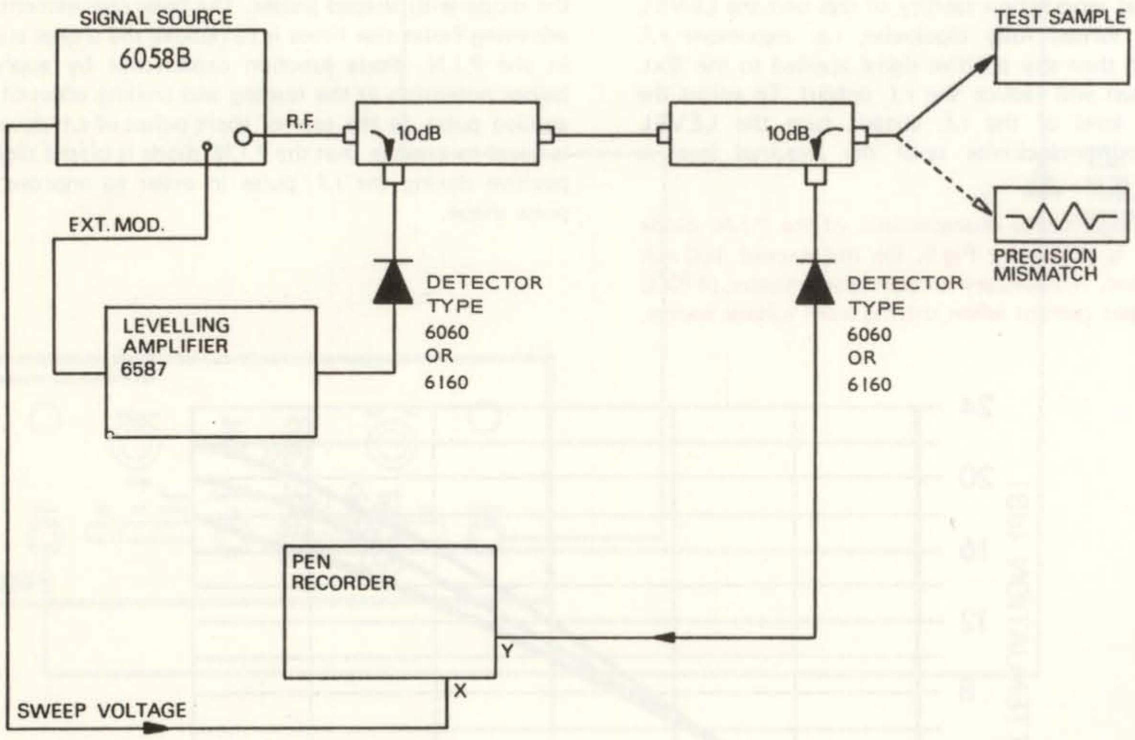


Fig. A1 V.S.W.R. Measurements

B. Broadband Transmission Loss Measurement

B. Manual Swept Frequency Measurement of Transmission Loss. Using the equipment as shown in Fig.B1 it is possible to make transmission loss measurement over the complete frequency range of the signal source. The signal source is suitable for carrying out the same measurements in a waveguide system although coaxial systems are shown in the example.

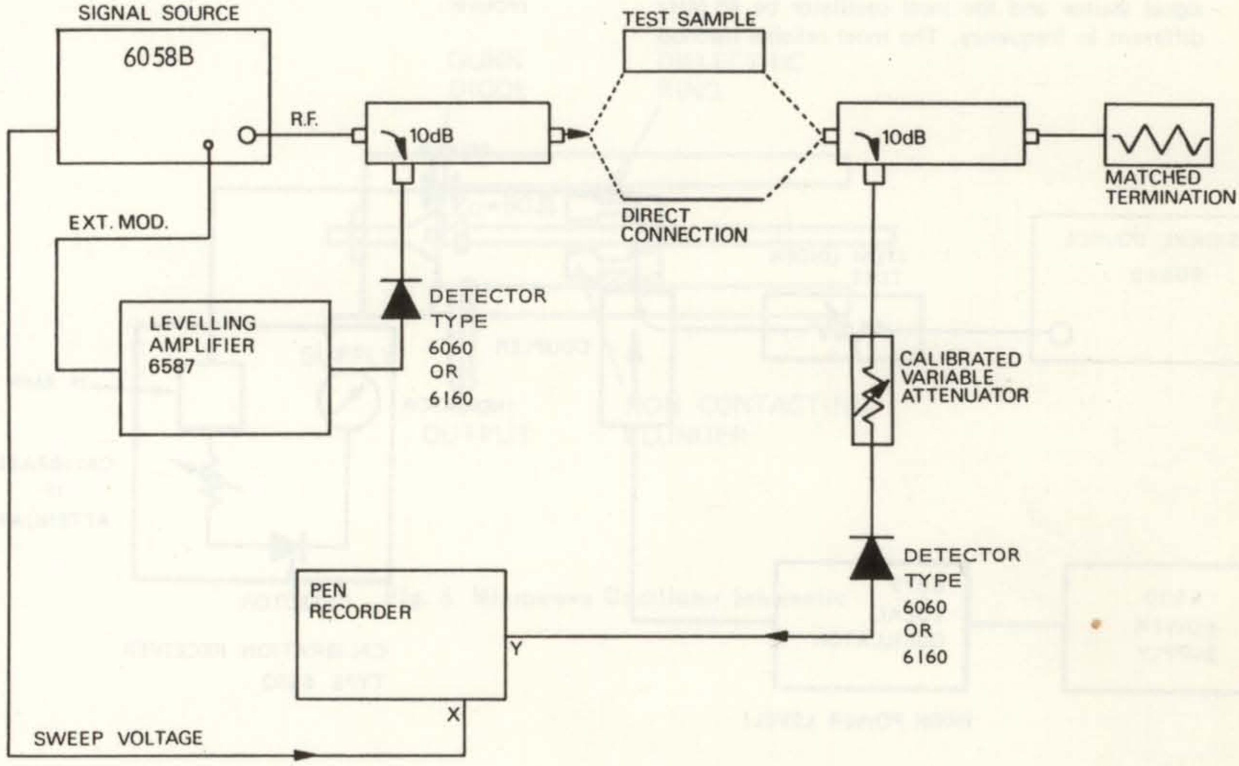


Fig. B1 Transmission Loss Measurements

C. Superheterodyne System For High Attenuation Measurement

C. Superheterodyne System for High Attenuation Measurement. Using the equipment as shown in Fig.C1 attenuations of 80 dB can be measured. The system requires that the signals from the signal source and the local oscillator be 45 MHz different in frequency. The most reliable method of setting up is to set the local oscillator to the required frequency for the test and then adjust the output frequency of the signal source until a maximum reading is achieved on the calibration receiver.

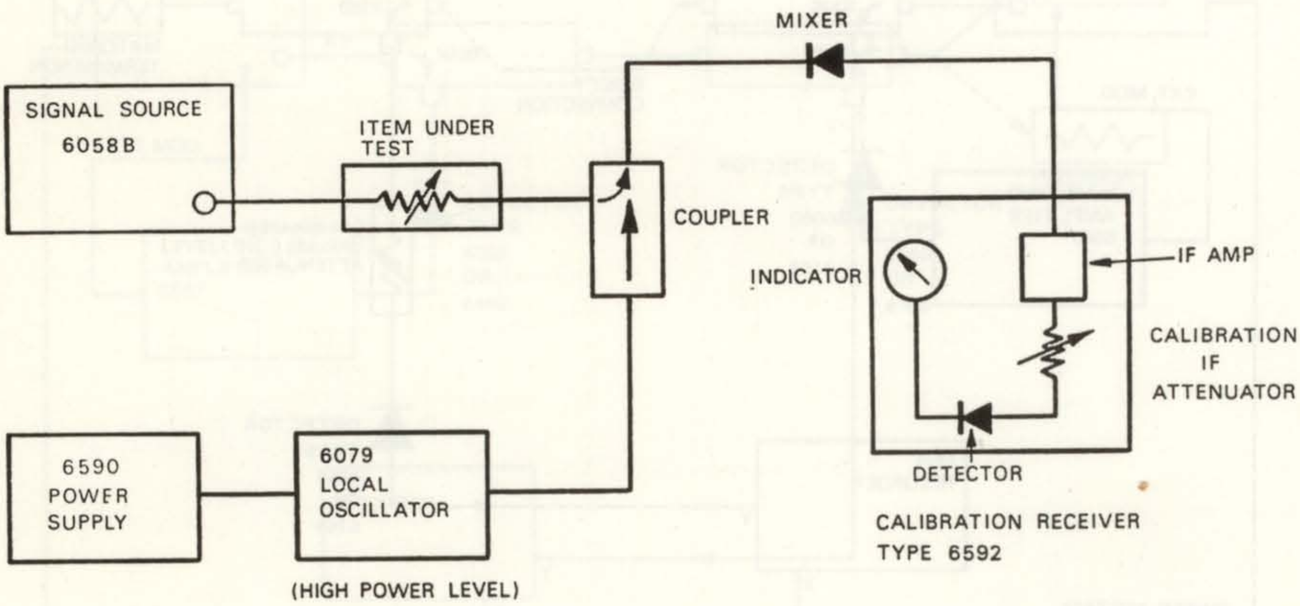


Fig. C1 High Attenuation Measurement

NOTE: With item under test removed power level from 6058B should be 20 dB below level of local oscillator, i.e. with 10 dB coupler, 10 dB down.

Chapter 3

Technical description

3.1 MICROWAVE OSCILLATOR

The microwave generator consists of a Gunn effect device operating in a fundamental mode coaxial cavity; the resonant frequency of which is varied by means of a non-contacting short circuit plunger driven by a cam. By using a suitable cam profile a linear relationship between the angular position of the cam spindle and r.f. output frequency can be acheived, this allows a direct frequency reading to be displayed on the front panel digital counter.

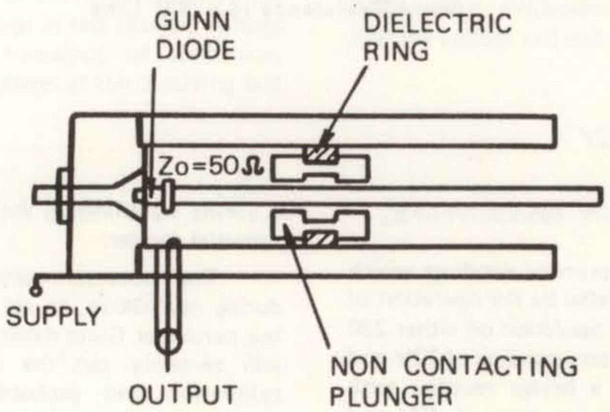


Fig. 6 Microwave Oscillator Schematic

3.2 P.I.N. DIODE ATTENUATOR

The P.I.N. diode attenuator unit mounted in the 50Ω output line is used to control the output signal level.

The operation of this unit depends on the fundamental factor that the shunt resistance of the diode is a function of the current passing through it. Reference to Fig.7 shows the relationship between insertion loss and shunt resistance in a 50Ω line.

The maximum attenuation which can be introduced depends on the parasitic resistance of the diode. In this case the residual resistance is about 1Ω corresponding to about 30 dB attenuation for 100 mA forward bias current.

This is modified somewhat due to the compensating elements used to keep the diode impedance resistive. The main consequence of these elements is to cause the attenuation to vary with frequency.

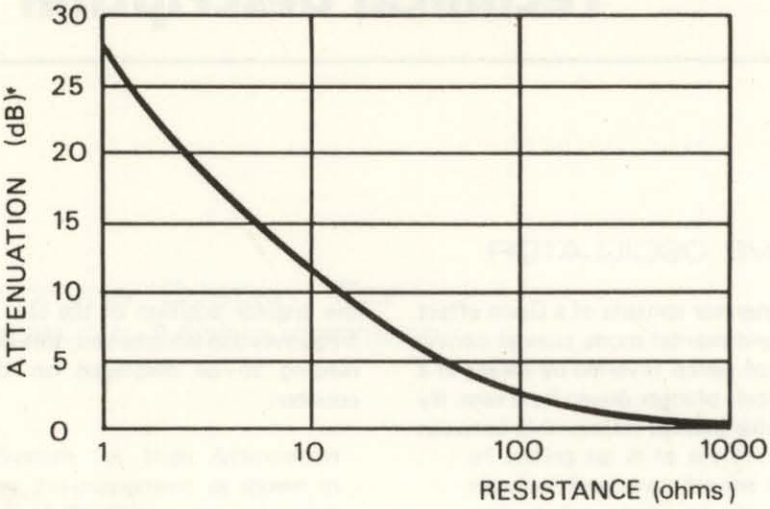


Fig. 7 Insertion Loss as a Function of Shunt Resistance in a 500 Line

3.3 POWER SUPPLY

TRANSFORMER, PRIMARY SMOOTHING

Transformer T1 has two primary windings which can be connected in series or parallel by the operation of switch S1 on the rear panel, for operation on either 230 or 110V a.c. supply. The secondary consists of 22V and 15V supplies each employing a bridge rectifier with capacitive smoothing to provide a.c. lines of 29V and 20V respectively.

GUNN DIODE BIAS SUPPLY

The variable voltage supply for biasing the Gunn diode is derived from an integrated circuit stabilized power supply.

The reference voltage for the control-integrated circuit IC–4 is derived from the hybrid integrated circuit, IC–1, this contains a constant current supply and a temperature compensated zener diode. The output of IC–1, is reduced by the potential divider consisting of R2 and R3, the output of which is decoupled by C4. Current amplification of the output of IC–4 is provided for by TR4. The Gunn diode bias voltage is determined by the ratio of the potential divider consisting of R17, RV5 and RV6 with the voltage tracking over the frequency range controlled by the setting of RV2A. As IC–4 has a very high gain the voltage at the inverting input, pin 2, is always maintained within a few millivolts of the reference voltage, pin 3. Hence the output voltage is varied by changing the dividing ratio of the output potential divider.

The potentiometers RV5 and RV6 are preset during calibration, to set the required level of bias for the particular Gunn diode, and any adjustment after this will certainly put the instrument out of frequency calibration and probably prevent the diode from oscillating at certain frequencies.

SHORT CIRCUIT PROTECTION

When the voltage across R16 is increased, by excess output current flowing, to the V_{BE} of TR3, that transistor conducts and grounds the base voltage of TR4, hence reducing the output voltage to zero. Removal of the short circuit will result in the resumption of normal operation.

OVER VOLTAGE PROTECTION

This is a basic crowbar circuit, where RV7 determines the voltage at which CRS1 clamps down. The circuit is set to operate at the maximum Gunn diode voltage rating, and when the voltage between the positive end of C8 and the wiper of RV7 equals the zener voltage plus V_{BE} of TR7, that transistor will conduct and cause an IR drop across R22, which in turn fires CRS1, thus shorting out the power supply. Hence the power supply is shut down by the action of R16/TR3 previously described.

MODULATOR POWER SUPPLY

This consists of two independent supplies, IC–3 with its constant reference voltage derived from D10 and R4 with TR2 as a current amplifier, provides a stabilized positive voltage. Likewise IC–2, D9, R1 and TR1 provide an equivalent negative voltage. The mark/space ratio of the squarewave is varied by RV4 which controls the negative rail voltage.

MULTIVIBRATOR CIRCUIT

The free-running multivibrator again employs an integrated circuit. This has two states, one in which the output is at its positive saturation level, the other is the corresponding negative saturation state. The necessary feedback to ensure saturation is supplied by R14, R12 and R13 whereas the switching frequency is determined by C7, RV1 and either R10 or R11. Variation in the value of RV1 results in a change in the charged voltage of C7 hence affecting the frequency of oscillation. Switching occurs when the voltage at the inverting and non-inverting inputs are equal and remains so until C7 charges or discharges to a state determined by R2 and R3 then again switching occurs and process repeats itself. Diodes D11 and D12 protect IC–5 against input breakdown.

The multivibrator produces a squarewave having good rise and fall times and excellent frequency stability.

The output has a mark/space ratio of approximately 1:1 and a repetition frequency of either 1 kHz or 3 kHz depending on whether R10 or R11 is connected to terminal 'K'. The ratio is adjusted by varying RV4 so that the voltage across C5 is the same as that across C6 (approximately 12V).

Internal r.f. level control is achieved by biasing the P.I.N. diode modulator with current derived from the positive voltage rail and set by the value of RV3.

Chapter 4	Maintenance

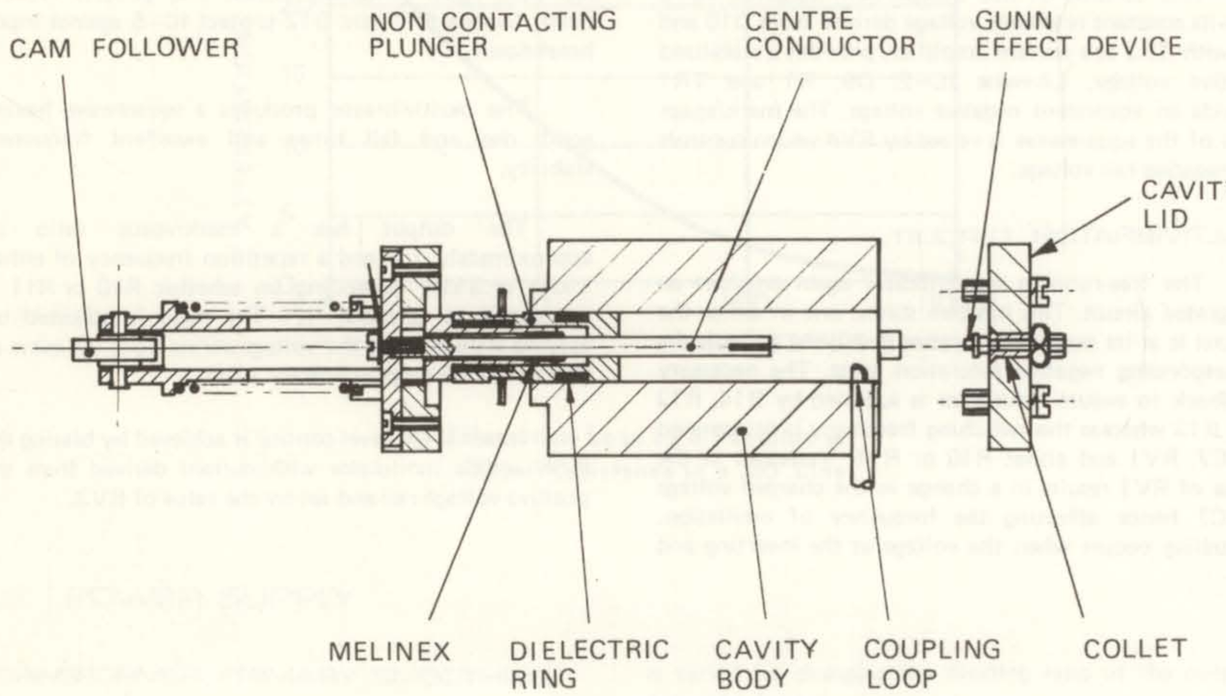


Fig. 8 Cavity Assembly

4.1 POWER SUPPLY

No special techniques are required to service the power supply. Chapter 5 lists the replaceable parts. It should be noted, however, that it will be necessary to recalibrate the unit if any components associated with the Gunn effect device bias circuit are changed. If recalibration is attempted the value of the Gunn effect device bias voltage should NEVER exceed 13V. This voltage should be measured across C8 with the voltmeter, Selectest Super 50.

4.2 MICROWAVE UNITS

In the Signal Source there are only two elements in the Microwave Unit which are likely to require replacement. They are the P.I.N. diode and the Gunn effect device.

P.I.N. DIODE REPLACEMENT

The P.I.N. diode attenuator will have an indefinite lifetime provided that the 'Ext. Mod.' input is not overloaded. In the event of the diode failing it is recommended that a new replacement module be fitted in view of the complex procedure involved in replacing the actual P.I.N. diode.

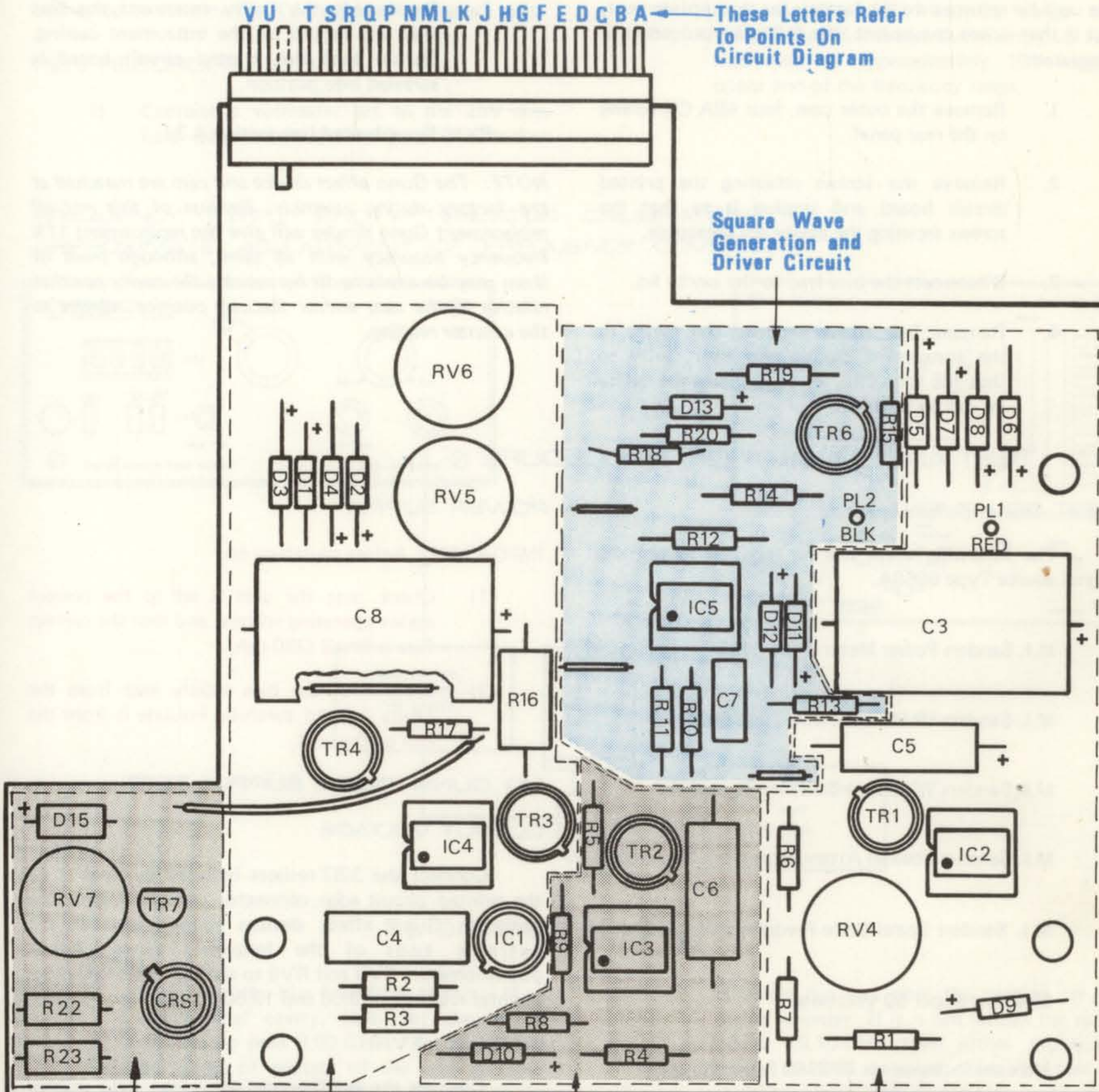


Fig.9 Printed Circuit Board

GUNN EFFECT DEVICE REPLACEMENT

The Gunn effect device should not require replacement under normal operating conditions, as it cannot be damaged by external mismatching of the r.f. connector. If, however, it should fail for any reason, it is possible to replace the diode and carry out the necessary recalibration. However, it is strongly recommended that the unit be returned to the factory for this replacement, but if that is not convenient, the following procedure is suggested:

1. Remove the outer case, four 4BA CH screws on the rear panel.
2. Remove the screws retaining the printed circuit board and unplug it so that the screws securing the cavity are accessible.
3. Disconnect the bias lead to the cavity lid.
4. Remove four screws securing the cavity to the instrument casting and turn cavity so that the four 6BA screws securing the cavity lid can be removed.
5. Carefully remove the cavity lid and slacken off the collet tensioning nut (4BA) so that the Gunn effect device may be removed.
6. Insert the replacement Gunn effect device ensuring that it is correctly seated in the collet before retightening the tensioning nut.
7. Reassemble the cavity reconnect the bias lead and mount on the instrument casting. Ensure that the printed circuit board is screwed into position.
8. Recalibrated (see section 4.3.)

NOTE: The Gunn effect device and cam are matched at the factory during assembly. Because of this not all replacement Gunn diodes will give the replacement ±1% frequency accuracy with all cams, although most of them may be made to fit by moving the cavity position relative to the cam and/or the cam position relative to the counter reading.

4.3 TEST AND INSPECTION PROCEDURE

TEST EQUIPMENT

The following units will be required to test the signal source Type 6058A.

M.I. Sanders Power Meter Type 6460

M.I. Sanders tft Head 10 mW Type 6420

M.I. Sanders Wideband Detector Type 6060

M.I. Sanders Coaxial Attenuators from Series 6535

M.I. Sanders Spiral Scale Frequency Meter 6049/2

Selectest Super 50 Voltmeter

Marconi Instruments TF2150 Power Supply

Marconi Instruments TF2210 Oscilloscope

Spectrum Analyser

X–Y Pen Recorder, e.g. Bryans 20021

32Ω ±5% 5W Resistor, e.g. Welwyn.

POWER SUPPLY

IMPORTANT Before switching on:

1) Check that the unit is set to the correct mains operating voltage, and that the correct fuse is fitted (250 mA).
2) Disconnect the bias supply lead from the cavity lid and carefully insulate it from the rest of the unit.

(A) GUNN DIODE SUPPLY TEST

OUTPUT VOLTAGE

Connect the 32Ω resistor between terminal M on the printed circuit edge connector and earth. Note the optimum Gunn effect devices requirements at the extreme ends of the frequency range. Adjust potentiometers RV5 and RV6 to achieve these values for counter readings of 8.00 and 12.50 GHz.

RIPPLE LEVEL

Connect the oscilloscope across the 32Ω resistor and verify that the ripple is less than 1.0 mV peak to peak.

(B) POSITIVE 12 VOLT POWER SUPPLY TEST

Measure voltage across C6, check that it is in range 10 to 13V.

(C) NEGATIVE 12 VOLT POWER SUPPLY TEST

Measure voltage across C5, adjust RV4 until same voltage as that measured across C6 is obtained.

SQUARE WAVE MODULATION

Connect the oscilloscope between the P.I.N. diode modulator feed-through capacitor terminal E and earth, and check that there is a squarewave when the FUNCTION switch, S2, is set to $\sqcup\sqcap$. Vary RV1 and check that the modulation frequency can be adjusted from 900 to 1100 Hz or from 2.9 to 3.1 kHz if R11 is connected to terminal K. RV4 adjusts mark/space ratio.

PEN RECORDER OUTPUT

1) Connect a voltmeter set to the 25V d.c. f.s.d. range across the rear panel BNC socket with the negative connected to the outer (earth) and the positive terminal to the centre conductor.

2) With the Signal Source set at the lowest end of its frequency range the voltmeter should read approximately 1V.

3) On traversing the frequency range this voltage should increase consistently up to a maximum of approximately 10V at the upper end of the frequency range.

FREQUENCY, OUTPUT AND ATTENUATOR CALIBRATION

APPROXIMATE ADJUSTMENT OF FREQUENCY COVERAGE

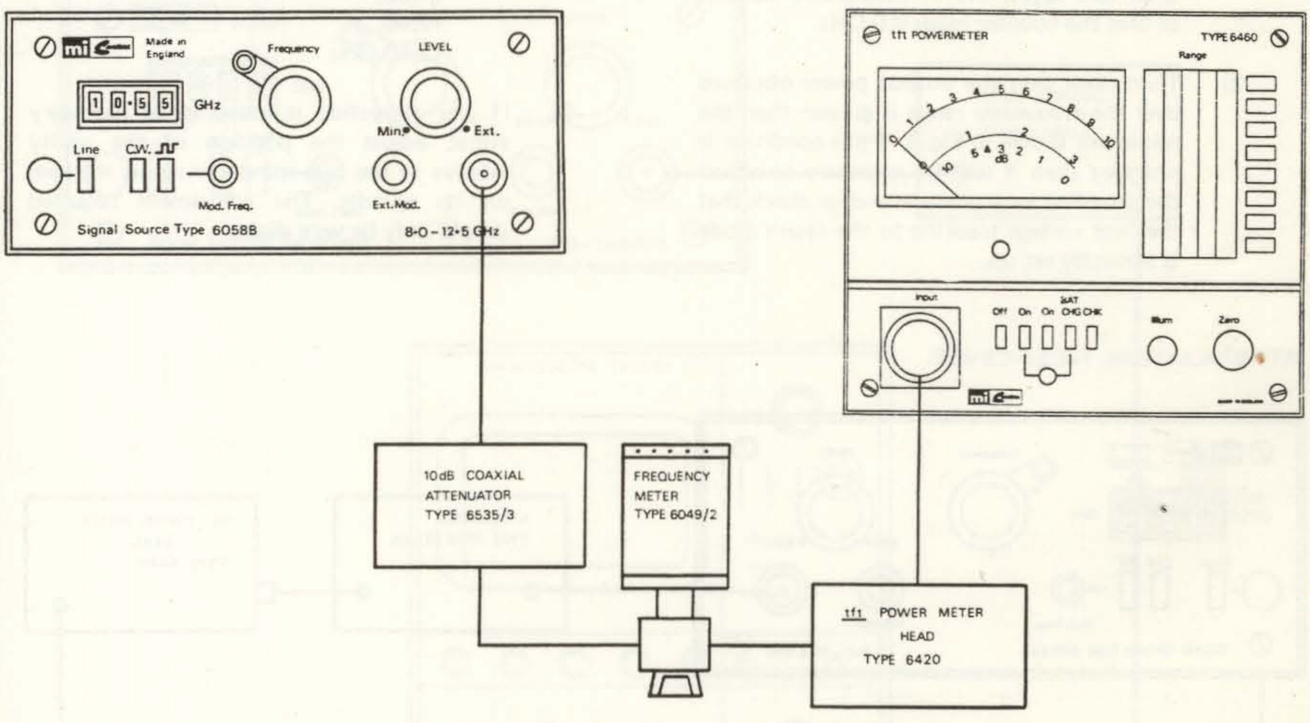


Fig. 10 Frequency Calibration Circuit

1) Reconnect the bias lead from terminal M to the coaxial cavity, then set the digital counter to read 8.00 GHz. For this setting the point of contact of the cam follower bearing should be roughly at the start of the cam law. It may be necessary to move the cavity relative to the cam spindle or alternatively to rotate the cam on its eccentric centre bush.

2) Connect up the system shown in Fig. 10 using the equipment shown in the Table. Set the wavemeter to 10.00 GHz and the powermeter to the 10 mW f.s.d. range.

3) Adjust the FREQUENCY control until the powermeter registers the wavemeter resonant dip and note the reading on the digital counter. If it is not within the range 10.00 ±0.10 GHz then either move the cavity towards or away from the cam to raise or lower the frequency, until it is within the specified tolerance.

4) Now adjust the FREQUENCY control so that the counter reads 12.50 GHz and find the actual output frequency using the wavemeter. The output frequency should be within ±0.12 GHz of the counter display, if this is not the case then there are three main parameters which will influence the output frequency.

a) The cavity position relative to the cam spindle.

b) The penetration of the coupling loop.

c) The angular position of the cam.

One or more of these parameters may be used to correct the output frequency at the upper end of the frequency range.

NOTE: Refer to the 8.00 and 10.00 GHz frequencies to ensure that they have not been influenced unduly.

ADJUSTMENT OF r.f. POWER LEVEL

With the system connected as shown in Fig.11:

1) Set the LEVEL control to the EXT. position, switch the FUNCTION switch to C.W. and adjust the FREQUENCY control so that the counter reads 8.0 GHz.

2) Then note that the output power obtained over the frequency range is greater than the minimum shown in Fig.3. If this condition is not met then it will be necessary to adjust the coupling loop position and/or check that the bias voltage tracking to the Gunn diode is correctly set up.

NOTES:

a) Any appreciable adjustment of the coupling loop position will alter the output frequency of the oscillator.

b) If any bias voltage adjustment is made it is essential that the frequency range be slowly traversed to ensure that the bias voltage on the Gunn diode NEVER exceeds 13V.

ACCURATE FREQUENCY CALIBRATION

1) With the system connected up as shown in Fig.11, check that the actual output frequency is within ±1% of the wavemeter reading at the following frequencies:

8.00,
9.00,
10.00,
11.00,
12.00,
12.50 GHz

2) If any correction is found to be necessary either adjust the position of the cavity relative to the cam spindle or rotate the cam on its spindle. The adjustment required should only be very slight.

ATTENUATOR RESPONSE

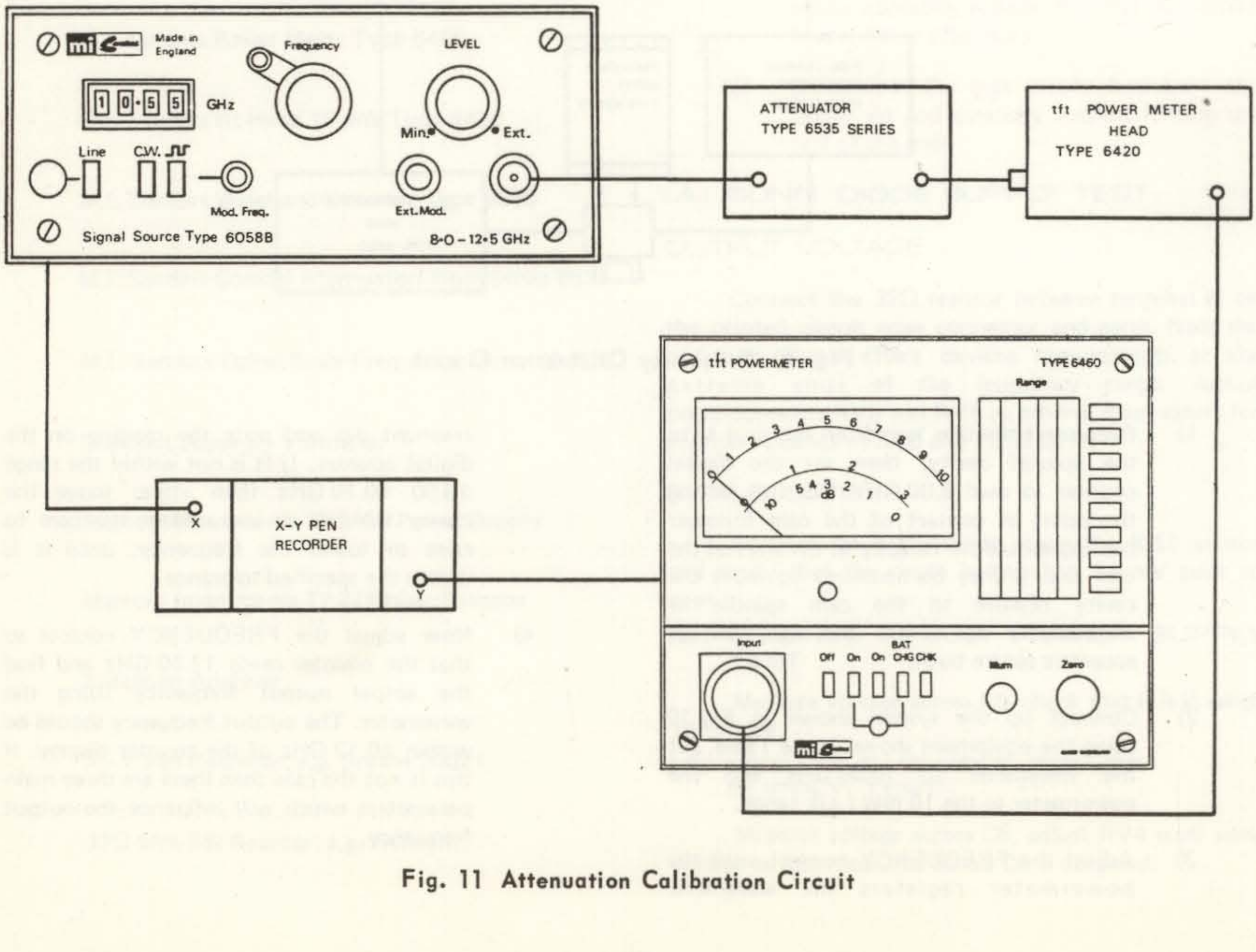


Fig. 11 Attenuation Calibration Circuit

1) Using the system shown in Fig.11 with the pen recorder output of the Signal Source connected to the X-input of the pen recorder adjust the Y sensitivity to correspond to f.s.d. on the microwave powermeter.

2) With the LEVEL control set to EXT. make an output power plot of the oscillator.

3) Now repeat the plot with 15 dB removed from the attenuator and the LEVEL control set to MIN.

4) This trace should be below the original at all points in the frequency range 8.00 to 12.50 GHz.

5) Switch off the Signal Source and set the LEVEL control to EXT., then connect a power supply (with its current limit set to 100 mA) to the 'Ext. Mod.' connector on the front panel. Connect the positive terminal to the outer, earth, and the negative terminal to the centre contact.

6) Set the FUNCTION switch to C.W. and repeat the power plot with the P.I.N. diode biased at 100 mA and a further 2 dB of attenuation removed from the attenuator. This plot should be below the one made in 2 at all frequencies in the 8.00 to 12.50 GHz range.

INTERNAL MODULATION

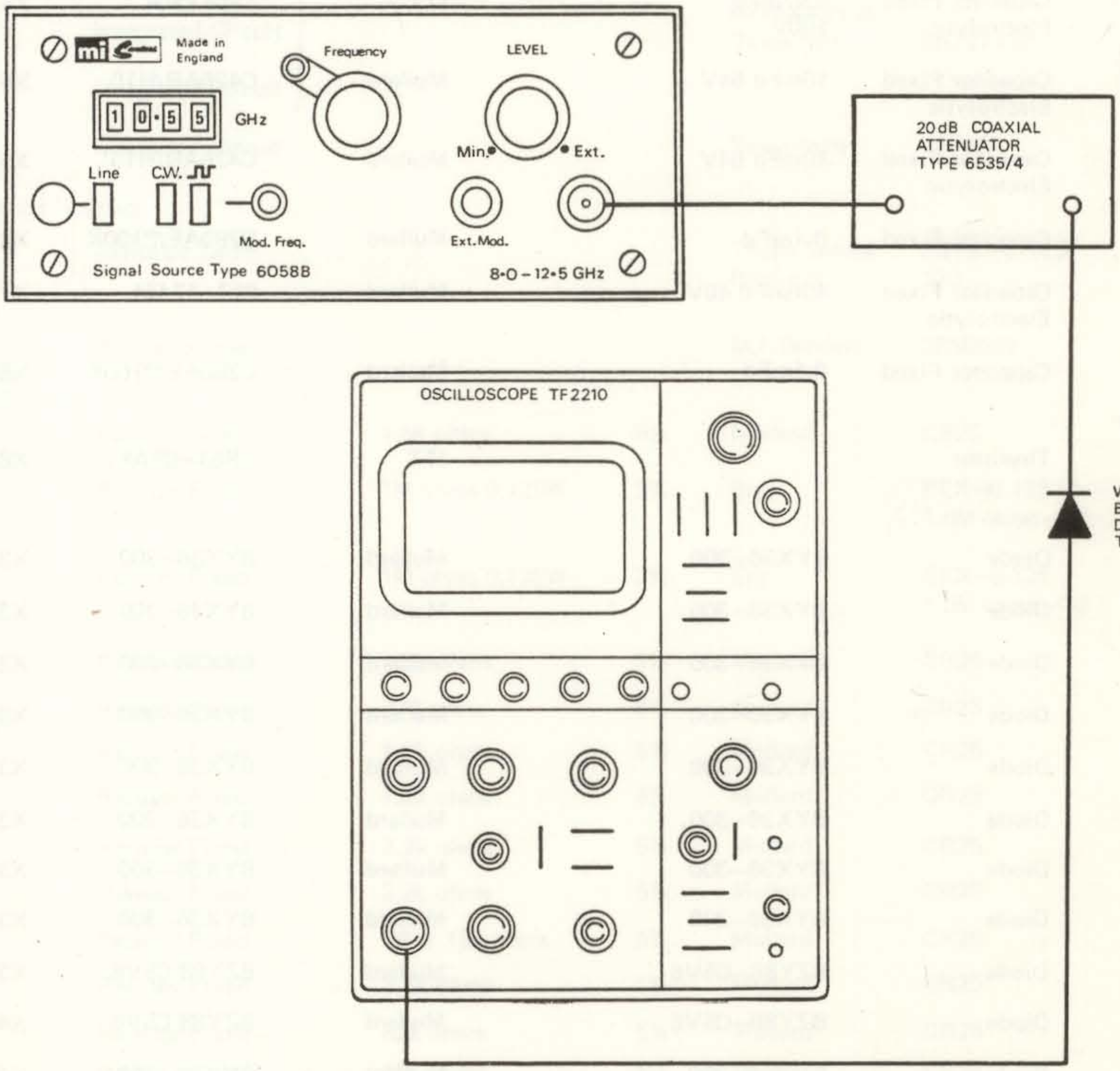


Fig. 12 Modulation Circuit

1) Set up the system shown in Fig.12.

2) Monitor the squarewave modulated output and check that the r.f. 'off' level is less than 3% of the level of the maximum r.f. output using the waveform displayed on the oscilloscope.

3) Check that the frequency can be varied from 900 to 1100 Hz (or 2.9 to 3.1 kHz if R11 is connected to terminal K).

Chapter 5

Replaceable parts

REFERENCE	DESCRIPTION	RATING	TOL.	MANFG.	PART No.	CIRCUIT DIAGRAM GRID REF.
Capacitors						
C1 (a) (b) & (c)	Capacitor Suppressor	0.1 +0.005 +0.005mFd 1000V		Radio Spares	Suppr. Capr.	X1 – Y2
C2	Capacitor Fixed	4700mFd 40V		Mullard	071–17472	X3 – Y4
C3	Capacitor Fixed Electrolytic	400mFd 40V		Mullard	017–17471	X3 – Y1
C4	Capacitor Fixed Electrolytic	0.47mFd 100V		ITT	Type PMA	X4 – Y4
C5	Capacitor Fixed Electrolytic	10mFd 64V		Mullard	C426AR/H10	X5 – Y1
C6	Capacitor Fixed Electrolytic	10mFd 64V		Mullard	C426AR/H10	X5 – Y3
C7	Capacitor Fixed	0.1mFd		Mullard	C280AE/P100K	X6 – Y2
C8	Capacitor Fixed Electrolytic	400mFd 40V		Mullard	017–17471	X7 – Y4
C10	Capacitor Fixed	0.1mFd		Mullard	C280AE/P100K	X8 – Y4
Thyristor						
CRS1	Thyristor			ITT	CR51–05AF	X8 – Y4
Diodes						
D1	Diode	BYX36–300		Mullard	BYX36–300	X3 – Y5
D2	Diode	BYX36–300		Mullard	BYX36–300	X3 – Y5
D3	Diode	BYX36–300		Mullard	BYX36–300	X3 – Y5
D4	Diode	BYX36–300		Mullard	BYX36–300	X3 – Y5
D5	Diode	BYX36–300		Mullard	BYX36–300	X3 – Y2
D6	Diode	BYX36–300		Mullard	BYX36–300	X3 – Y2
D7	Diode	BYX36–300		Mullard	BYX36–300	X3 – Y1
D8	Diode	BYX36–300		Mullard	BYX36–300	X3 – Y1
D9	Diode	BZY88–C5V6		Mullard	BZY88 C5V6	X3 – Y1
D10	Diode	BZY88–C5V6		Mullard	BZY88 C5V6	X4 – Y3
D11	Diode	BYX36–300		Mullard	BYX36–300	X6 – Y2
D12	Diode	BYX36–300		Mullard	BYX36–300	X6 – Y2
D13	Diode	BYX36–300		Mullard	BYX36–300	X9 – Y3
D14	Diode	IN914, OA91, or OA47				X8 – Y2
D15	Diode	BZY88–C8V2		Mullard	BYZ88 C8V2	X7 – Y5

REFERENCE	DESCRIPTION	RATING	TOL.	MANFG.	PART No.	CIRCUIT DIAGRAM GRID REF.
Fuse						
FS1	Fuse, 20mm x 5mm Glass	250mA		M.I. Sanders		X1 – Y1
	Fuse Holder			R.S. Comps.		
Integrated Circuits						
IC1	Integrated Circuit			Dage(GB)Ltd.	DVRM 6.4 A5OP	X4 – Y5
IC2	Integrated Circuit			National Semi-conductors or Texas Inst.	LM741CN SN72741P	X4 – Y1
IC3	Integrated Circuit					X4 – Y3
IC4	Integrated Circuit					X5 – Y5
IC5	Integrated Circuit			Texas Instr.	72709P	X6 – Y2
Indicator Lamp						
ILP1	Indicator Lamp			Thorn Special Products	SGF9/A/RED/110	X2 – Y4
Plug						
PL1	Appliance Inlet			M.I. Sanders	3850069	X1 – Y1
Resistors						
R1	Resistor Fixed	1.5k ohms	5%	Mullard	CR25	X3 – Y2
R2	Resistor Fixed	1M ohms 0.125W	2%	Erg.	EEX–0.125 1.0M ohms–G2	X4 – Y4
R3	Resistor Fixed	1M ohms 0.125W	2%	Erg.	EEX–0.125 1.0M ohms–G2	X4 – Y4
R4	Resistor Fixed	1.5k ohms	5%	Mullard	CR25	X4 – Y3
R5	Resistor Fixed	270 ohms	5%	Mullard	CR25	X5 – Y3
R6	Resistor Fixed	1.5k ohms	5%	Mullard	CR25	X5 – Y1
R7	Resistor Fixed	1.5k ohms	5%	Mullard	CR25	X5 – Y1
R8	Resistor Fixed	2.2k ohms	5%	Mullard	CR25	X5 – Y4
R9	Resistor Fixed	2.2k ohms	5%	Mullard	CR25	X5 – Y3
R10	Resistor Fixed	12 or 15k ohms	5%	Mullard	CR25	X5 – Y2
R11	Resistor Fixed	3.3k ohms	5%	Mullard	CR25	X5 – Y2
R12	Resistor Fixed	82k ohms	5%	Mullard	CR25	X7 – Y2
R13	Resistor Fixed	15k ohms	5%	Mullard	CR25	X7 – Y2
R14	Resistor Fixed	56 ohms	5%	Mullard	CR25	X7 – Y2
R15	Resistor Fixed	390 ohms	5%	Mullard	CR25	X7 – Y2
R16	Resistor Fixed	1.0 ohms 3.5W	2%	C.G.S.	PM3.5	X7 – Y5
R17	Resistor Fixed	390 ohms 2.5W	5%	Radio Spares	VIT2W5	X7 – Y5

REFERENCE	DESCRIPTION	RATING	TOL.	MANFG.	PART No.	CIRCUIT DIAGRAM GRID REF.
R18	Resistor Fixed	1k ohms	5%	Mullard	CR25	X8 – Y2
R19	Resistor Fixed	390 ohms	5%	Mullard	CR25	X8 – Y2
R20	Resistor Fixed	390 ohms	5%	Mullard	CR25	X9 – Y3
R21	Resistor Fixed	1k ohms	5%	Mullard	CR25	X9 – Y3
R22	Resistor Fixed	1.5k ohms	5%	Mullard	CR25	X7 – Y4
R23	Resistor Fixed	1.5k ohms	5%	Mullard	CR25	X8 – Y4
Resistors Variable						
RV1	Resistor Variable	10 ohms 1/4W Linear		Morganite	Type U	X6 – Y3
RV2 A	Resistor Variable	500 ohms Linear		Reliance Controls Ltd.		X7 – Y4
RV2 B	Resistor Variable	10k ohms Linear		Reliance Controls Ltd.		X9 – Y3
RV3	Resistor Variable	25k ohms Log		Plessey	Type E	X9 – Y4
RV4	Resistor Variable	2.2k ohms Linear		Plessey	MPD.PC	X5 – Y1
RV5	Resistor Variable	220 ohms Linear		Plessey	WMP.PC	X7 – Y4
RV6	Resistor Variable	2.2k ohms Linear		Plessey	WMP.PC	X8 – Y4
RV7	Resistor Variable	2.2k ohms Linear		Plessey		X7 – Y4
Switches						
S1	Switch, Slide	Dp. Dt.		E.M.I.	T/11040/004	X1 – Y3
S2	Switch, Assy.			M.I. Sanders	2627059 (S2/a) (S2/b) (S2/c)	X1 – Y2 X8 – Y2 X7 – Y3
Sockets						
SK1	Socket Fixed	BNC		Greenpar	GE35063	X9 – Y2
SK2	Socket Fixed	BNC		Greenpar	GE35063	X9 – Y3
SK3	'N' Type Socket Cable Assembly			M.I. Sanders	2565006	X11 – Y4
SK4	Socket and nut			Pye Conn.	M7SN A/D C/H	X3 – Y5 X7 – Y1
SK5	Socket and cap			Harwin	W3000 RED	X7 – Y1
SK6	Socket and cap			Harwin	W3000 BLACK	X7 – Y1
Transformer						
T1	Mains Transformer			M.I. Sanders	3510T541	X2 – Y5
Transistors						
TR1	Transistor	BFY51		Mullard	BYF51	X4 – Y1
TR2	Transistor	BFY51		Mullard	BYF51	X5 – Y3
TR3	Transistor	BFY51		Mullard	BFY51	X6 – Y5
TR4	Transistor	BFY51		Mullard	BFY51	X6 – Y5

REFERENCE	DESCRIPTION	RATING	TOL.	MANFG.	PART No.	CIRCUIT DIAGRAM GRID REF.
TR5	Transistor, with Mica Washer	2N3055		Mullard	2N3055	X7 – Y5
TR6	Transistor	BFY51		Mullard	BFY51	X8 – Y2
TR7	Transistor	2N3702		Texas Inst.	2N3702	X7 – Y4
Miscellaneous						
	Crank Knob			M.I. Sanders	2564060	——
	Gunn Effect Device			M.I. Sanders	2565030	X9 – Y5
	Isolator			M.I. Sanders	2565008	X9 – Y5
	Pin Diode Modulator			M.I. Sanders	2565005	X10 – Y4

ORDERING Send your order for replacement parts to our Service Division. Specify the following information for each part required:

1) Type and serial number of instrument
2) Circuit reference
3) Description

for TECHNICAL SERVICES DEPARTMENT ADDRESS
(see back cover)

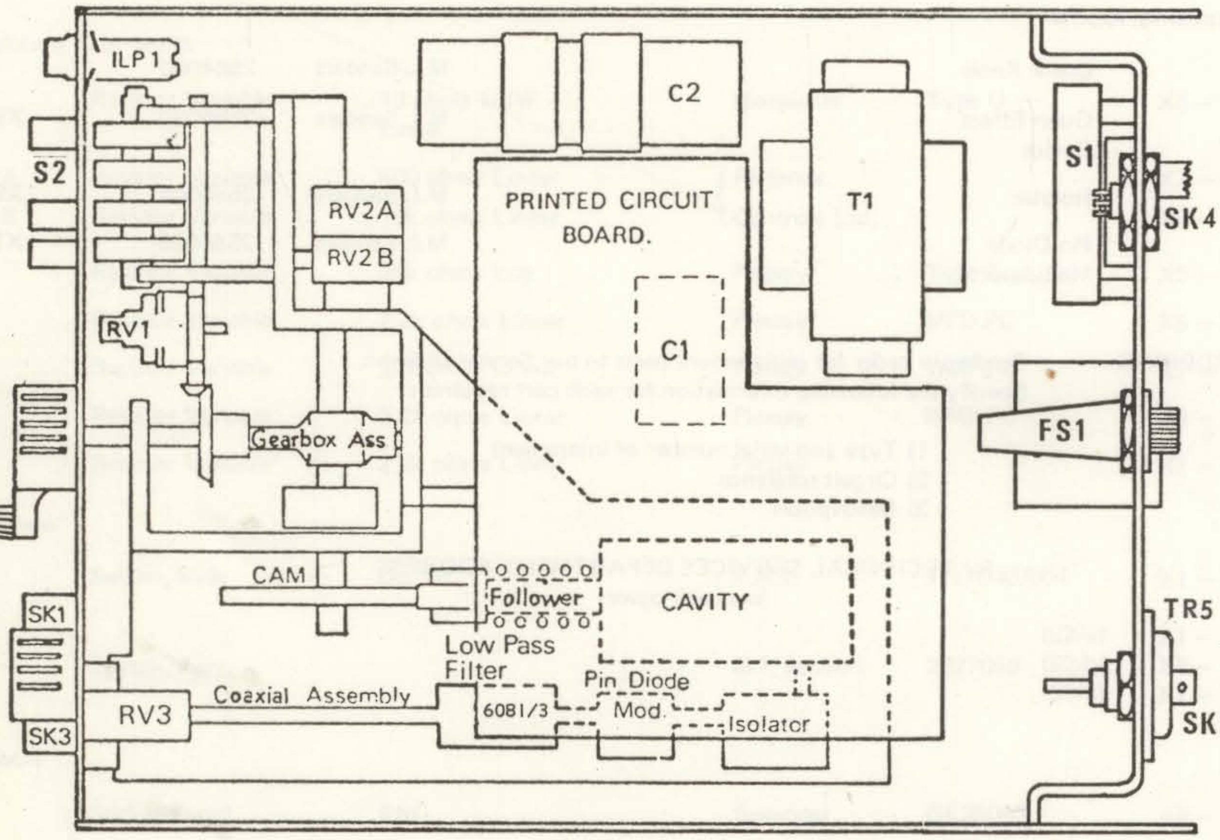
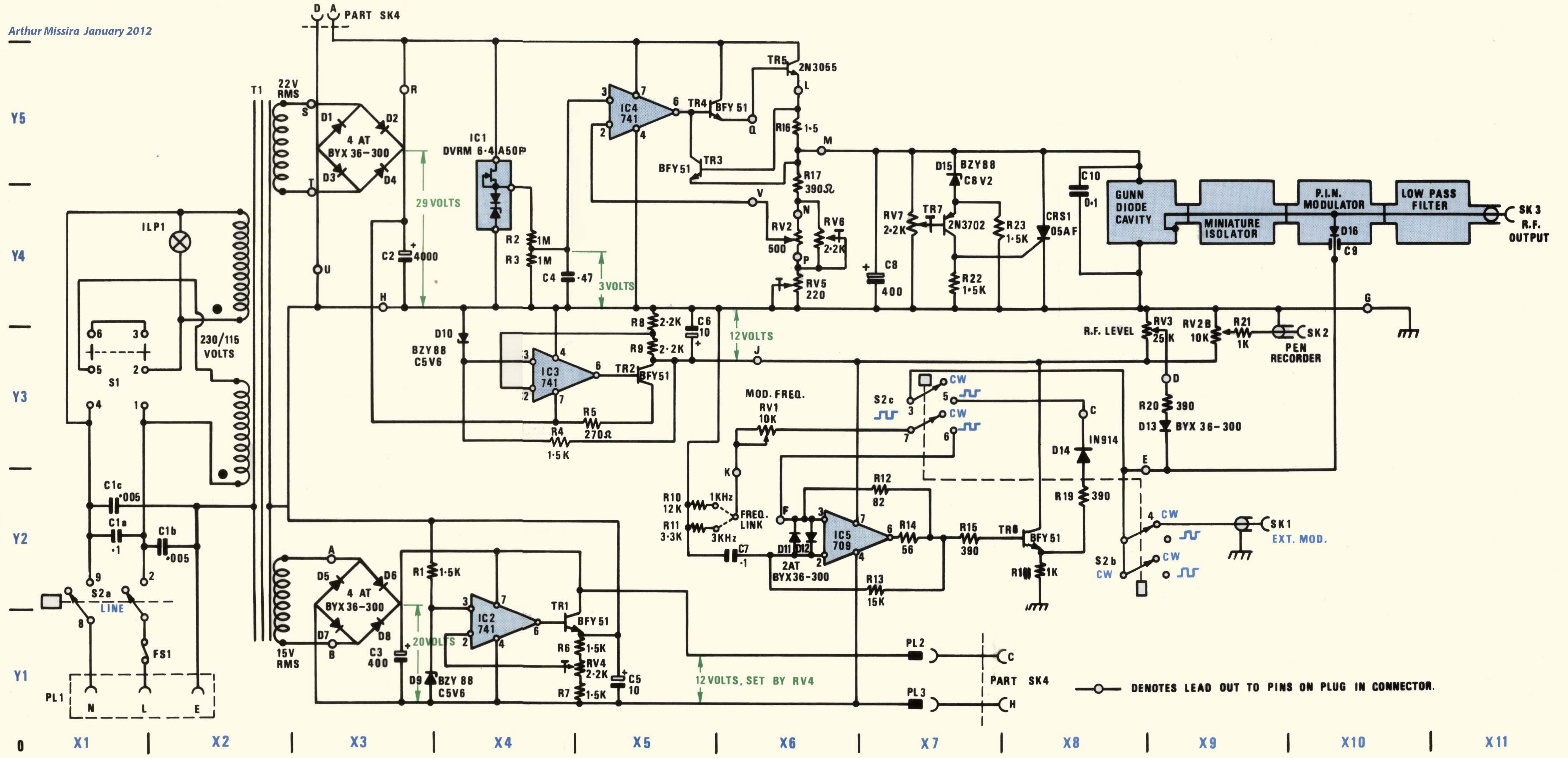


Fig. 13 Component Layout

Arthur Missira January 2012



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