



**6913**

**RF POWER SENSOR**

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**Instruction Manual**

RF POWER SENSOR

H 6913

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Printed in the UK

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## PRELIMINARIES




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- Contents
- Notes and Cautions

## CHAPTERS

- 1 General information
- 2 Installation
- 3 Operation
- 4 Technical description
- 5 Maintenance
- 6 Replaceable parts
- 7 Servicing diagrams

## HAZARD WARNING SYMBOLS

The following symbols appear on the equipment.

<i>Symbol</i>	<i>Type of hazard</i>	<i>Reference in manual</i>	<i>Page (iii)</i>
	Static sensitive component		
	Incorrect dismantling will cause irreparable damage to the unit, see Chap. 5 Dismantling procedure para. before attempting this.		
	This unit has a precision 3.5 mm connector fitted.		

### Note...

Each page bears the date of the original issue or the code number and date of the latest amendment (Am. 1, Am.2 etc.).

Any changes subsequent to the latest amendment state of the manual are included on inserted sheets coded C1, C2, etc.

# NOTES AND CAUTIONS


## ELECTRICAL SAFETY PRECAUTIONS

This accessory, when used with the 6950 or 6960 RF Power Meter, is protected in accordance with IEC Safety Class I. It has been designed and tested according to IEC Publication 148 'Safety Requirements for Electronic Measuring Apparatus', and has been supplied in a safe condition.

## MEASUREMENT PRECAUTIONS

This sensor contains a sensitive detector. Because of this the r.f. connector must be properly terminated to prevent stray radiation being detected and displayed on the power meter. It is also important to allow thermal stability to be obtained before zeroing or operating the power meter.

## CAUTION : STATIC SENSITIVE COMPONENTS

Components identified with the symbol  on the circuit diagrams and/or parts lists are static sensitive devices. The presence of such devices is also indicated in the equipment by orange discs, flags or labels bearing the same symbol. Certain handling precautions must be observed to prevent these components being permanently damaged by static charges or fast surges.

(1) If a printed board containing static sensitive components (as indicated by a warning disc or flag) is removed, it must be temporarily stored in a conductive plastic bag.

(2) If a static sensitive component is to be removed or re-placed the following anti-static equipment must be used.

A work bench with an earthed conductive surface.

Metallic tools earthed either permanently or by repeated discharges.

A low-voltage earthed soldering iron.

An earthed wrist strap and a conductive earthed seat cover for the operator, whose outer clothing must not be of man-made fibre.

- (3) As a general precaution, avoid touching the leads of a static sensitive component. When handling a new one, leave it in its conducting mount until it is required for use.

**WARNING : HANDLING HAZARDS**

*Whilst every endeavour has been made to remove sharp points and edges care should be taken, particularly when servicing the equipment, to avoid minor cuts.*

**WARNING : TOXIC HAZARD**

*Many of the electronic components used in this equipment employ resins and other chemicals which give off toxic fumes on incineration. Appropriate precautions should therefore be taken in the disposal of these items.*

**⚠ CAUTION : PRECISION CONNECTOR**

The precision 3.5 mm connector fitted to this sensor may be damaged by mating with connectors that do not conform to the dimensions of Fig. 1.

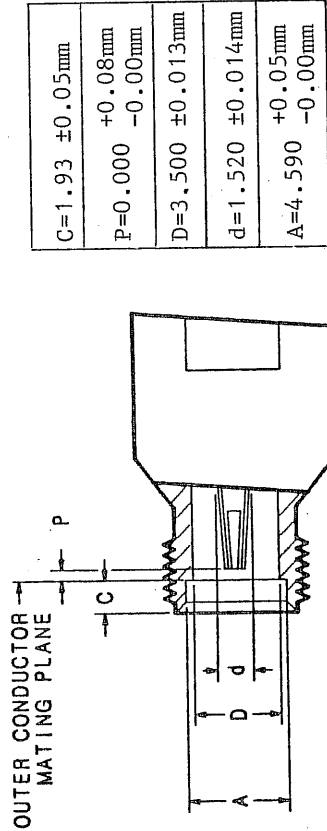


Fig. 1 Mating dimensions of female 3.5 mm connector

Chapter 1

**GENERAL INFORMATION**

**CONTENTS**

Para. 1 Features  
4 Performance data  
5 Accessories

Fig. 1 RF Power Sensor type 6913 ... .. Page 1

**FEATURES**

1. The RF Power Sensor 6913 is for use with analog RF Power Meter type 6950 and microprocessor RF Power Meter type 6960 to measure r.f. power from 50 MHz to 26.5 GHz over a 50 dB dynamic range from -30 dBm (1 µW) to +20 dBm (100 mW).
2. Each sensor has an individual label showing calibration factor graph and linearity factor. The linearity factor is a power linearity correction figure that can be used to enhance power accuracy. In Power Meter 6950 compensation is preset, but can be individually set in Power Meter 6960 to provide greater accuracy.

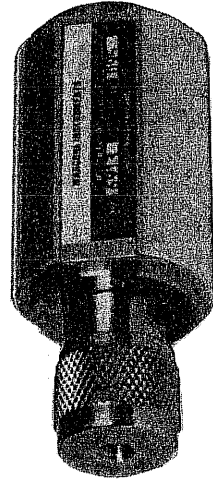


Fig. 1 RF Power Sensor type 6913

3. Each r.f. sensor provides high level signals to the power meter so that the possibility of r.f. susceptibility is virtually eliminated.

## ACCESSORIES

5. N-type male/SMA female adapter 6913/050

## PERFORMANCE DATA

### *Characteristic* *Performance*

4. Power range : -30 dBm (1  $\mu$ W) to +20 dBm (100 mW).

Maximum r.f. input : +24.8 dBm (300 mW) average.  
Peak power 15 W for 2  $\mu$ s.

Frequency range : 10 MHz to 26.5 GHz.

VSWR :  
 10 MHz - 40 MHz : 1.4  
 40 MHz - 100 MHz : 1.15  
 100 MHz - 2 GHz : 1.10  
 2 GHz - 12.4 GHz : 1.15  
 12.4 GHz - 18 GHz : 1.20  
 18 GHz - 26.5 GHz : 1.25

Linearity factor : Provided with sensor.\*  
Accuracy  $\pm 0.5\%$  at 25°C.

Calibration factor : Provided with sensor.

Drift : <10 nW (typical, 1 h after 24 h warm-up at constant temperature).

RF connector : Precision 3.5 mm male, 50  $\Omega$ .

Output connector : Multiway. Mates with sensor cable assembly (supplied with power meter).

Size : 82 mm long (including connectors),  
33.5 mm dia.

Weight : 140 g.

\*Linearity factor is preset in 6950 and selectable in 6960.

Chapter 2

## INSTALLATION

## UNPACKING AND REPACKING

1. Retain the packing materials and the packing instruction note (if included) in case it is necessary to reship the sensor.
2. If the sensor is to be returned for servicing attach a label indicating the service required, type number, serial number and your return address.
3. If the original container or materials are not available use a strong double-wall carton packed with shock absorbing material around all sides of the sensor to hold it firmly.

Chapter 3

**OPERATION**

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- 1 With Power Meter type 6950
- 6 With Power Meter type 6960

With Power Meter type 6950

1. Connect the power sensor to the SENSOR INPUT socket using the sensor cable assembly supplied with the instrument. With no power applied to the sensor adjust the ZERO control on the most sensitive range (range switch fully anti-clockwise) for zero reading on the meter.\* The rear panel RESPONSE-TIME potentiometer may be adjusted to reduce the noise, helping to set the zero. It may be easier to start on a less sensitive range as the ZERO adjustment has considerable effect.
2. Connect the sensor to the POWER REFERENCE output of the 6950 Power Meter using the N-type to SMA adaptor. Set the RANGE switch to 0 dBm. Set the CAL FACTOR to 100%. Turn on the POWER REFERENCE on the rear panel and adjust the front panel GAIN control for a full scale meter reading.
3. Turn off the POWER REFERENCE and disconnect the sensor from the output.
4. Determine the CAL FACTOR for the measurement frequency from the calibration curve on the power sensor or the calibration certificate provided. Set the CAL FACTOR accordingly.
5. The power meter can now be used for measuring r.f. power.\* For full instructions and uncertainty calculations refer to the 6950 Operating Manual, Chap. 3.

**\*CAUTION**

Before setting up or making measurements allow time for thermal stabilization.

# TECHNICAL DESCRIPTION

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3	RF sensor	2
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	Amplifier	

Fig.

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2	Simplified diagram of amplifier	...

### OVERALL CIRCUIT DESCRIPTION - see Fig. 1

1. The RF SENSOR gives a small d.c. output voltage when power is applied. This d.c. voltage is converted to an a.c. signal by the SIGNAL CHOPPER. The chopped signal is fed to the AMPLIFIER which is divided into two parts, the first part being the power sensor and the other in the power meter. The signal is then processed by the power meter to give a power reading. A Zener diode in the power sensor provides sensor type information for the power meter.

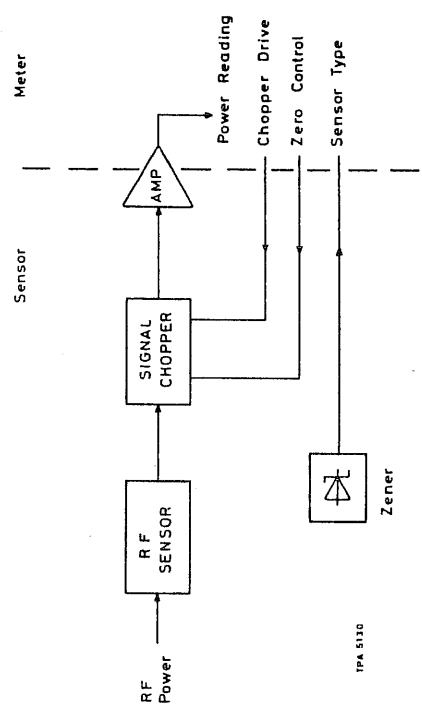


Fig. 1 Block diagram of r.f. power sensor

6. Connect the power sensor to the SENSOR INPUT socket using the sensor cable assembly supplied with the instrument. Determine the linearity factor of the sensor from the calibration label on the sensor or the calibration certificate provided. Enter this into the 6960 using the LINEARITY FACTOR function.

7. With no power applied to the sensor press AUTO ZERO. When this routine is complete, connect the sensor to the POWER REFERENCE of the 6960 using the N-type to SMA adaptor. Press AUTO CAL. The instrument will now read 0 dBm with the POWER REF turned on assuming the 6960 CAL FACTOR is set to 100%.

8. Turn off the POWER REF and disconnect the sensor from the POWER REFERENCE output.

9. Determine the CAL FACTOR for the measurement frequency from the calibration curve on the power sensor or the calibration certificate provided. Use the CAL FACTOR function to enter this on the 6960.

10. The power meter can now be used for measuring r.f. power.\* For full instructions and uncertainty calculations refer to the 6960 Operating Manual, Vol. 1, Chap. 3.

#### \* CAUTION

Before setting up or making measurements allow time for thermal stabilization.



DETAILED DESCRIPTION (Cet. diagram : Chap. 7, Fig. 1)

RF sensor

2. The r.f. sensor consists of a monolithic semi-conductor thermocouple element. This element provides a good 50  $\Omega$  match to the r.f. power and an output voltage proportional to the r.f. power.

Signal chopper

3. The signal chopper consists of two field-effect transistors which act as a sampling gate. The sampling rate is controlled by a 925 Hz square wave signal from the power meter. The output of the signal chopper is a 925 Hz square wave with amplitude proportional to the r.f. input power.

4. A zero control signal from the power meter is introduced at the input of the signal chopper. This allows the power meter to cancel any residual output that occurs with no r.f. power applied.

Amplifier

5. The amplifier is divided between the power sensor and the power meter. A simplified circuit is shown in Fig. 2.

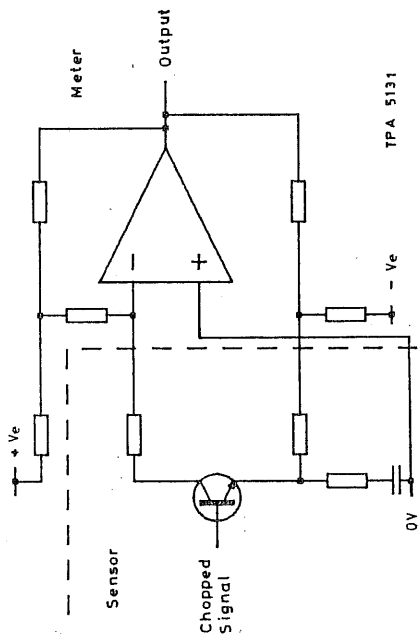


Fig. 2 Simplified diagram of amplifier

6. The amplifier has a gain of approximately 1000 and a band-pass characteristic centred at the sampling rate of 925 Hz. For a full description of the amplifier refer to the 6950 or 6960 Service Manuals.

7. A Zener diode is mounted in the sensor to provide head select information for the power meters. For 6913 type sensor head a 5.6 V diode is used.

# MAINTENANCE

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6	Testing the chopper assembly	
7	Dismantling	
12	Reassembly	
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## TEST EQUIPMENT

1.	<u>Description</u>	<u>Specification</u>
	6950 or 6960 Power Meter (with sensor cable)	
	Digital voltmeter	Resolution : 10 $\mu$ V, : 1 $\Omega$ .
	Power supply	Capable of producing $\pm 5$ V d.c.
	10 k $\Omega$ resistor	
	Oscilloscope	Bandwidth : >20 kHz. Sensitivity : Better than 50 mV/div.

## PRECAUTIONS $\Delta$

2. To avoid possible damage to the sensor exercise extreme care when measuring across or close to the gold wires of the r.f. assembly. They are of a delicate construction and can easily be damaged. All probes must be free of dirt and grease as this can impair the performance of the sensor.

It is particularly vulnerable in the vicinity of the gold wires and clamp assembly.

### INITIAL TESTING

3. Connect the sensor to a known working power meter type 6960 or 6950 using a known working sensor cable. Attempt to zero and calibrate the sensor as described in Chap. 3. Should either fail proceed as follows.

### ACCESS - see Fig. 1

4. Remove the sensor cable from the 12 pin connector on the sensor. Remove the rear plate screws 1 and 2. Remove the rear plate and slide the casing from the sensor.

### FAULT FINDING

5. Reconnect the sensor cable and power meter. Connect the input to the 1 mW 50 MHz reference output of the power meter. Switch on the reference and carry out the following procedure.

- (1) Carefully measure the voltage across the gold pads on the FET chopper assembly.
- (2) If this is 100  $\mu$ V or greater the r.f. assembly is functioning correctly. Test the chopper assembly as described in para. 6.
- (3) If the voltage is less than 100  $\mu$ V remove the sensor from the 1 mW reference. Remove the beam clamp, first loosen the clamp screw (3) then remove the beam clamp fixing screws (4) and (5). Remove the beam clamp and carefully lift the gold wires of the r.f. assembly clear of the gold pads.
- (4) Reconnect the sensor to the 1 mW reference and carefully measure the voltage across the gold wires. If this is less than 100  $\mu$ V the r.f. assembly is faulty and must be replaced.

### TESTING THE CHOPPER ASSEMBLY

6. Disconnect sensor from the 1 mW reference and remove sensor cable. Remove the beam clamp as described in para. 5 (step 3). Connect together sockets B, G and H of the 12 pin connector to turn both chopper f.e.t.'s on then carry out the following procedure:-

- (1) Measure the resistance between the two gold pads on the chopper assembly. This should be approximately 100 - 200  $\Omega$ .
- (2) Connect the +ve output of a 5 V d.c. power supply to socket B.

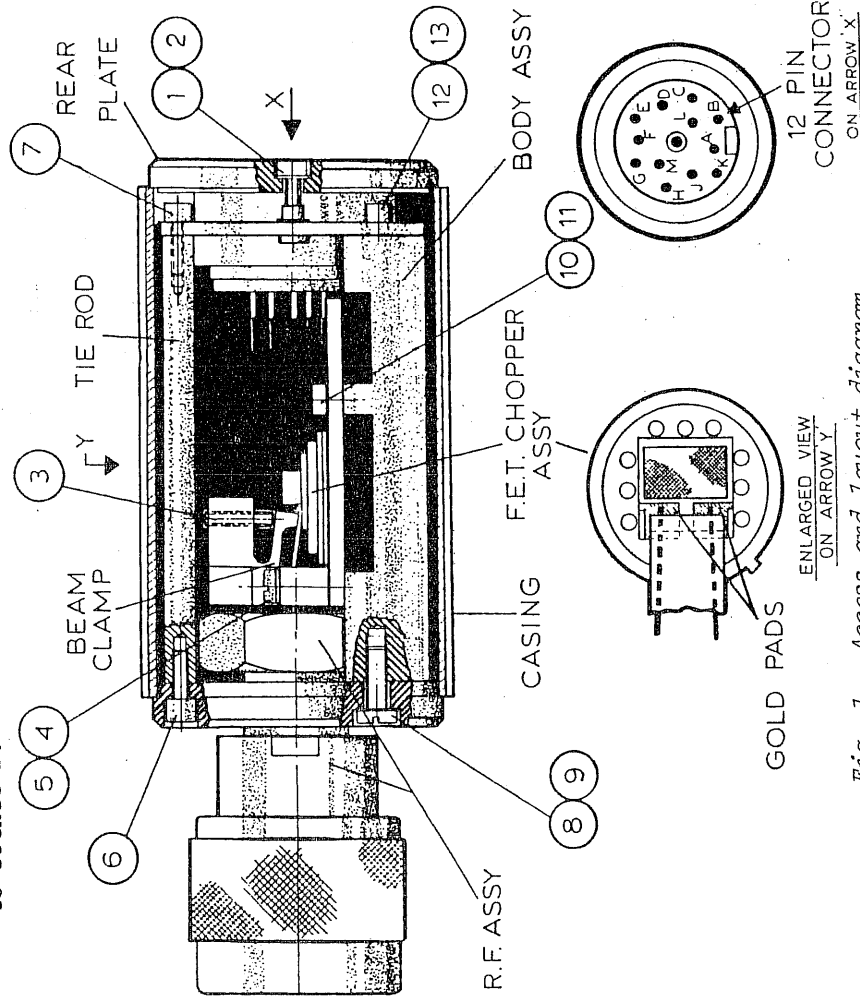


Fig. 1 Access and layout diagram

(3) Connect socket G to socket B and apply -5 V to socket H. This will turn off the parallel f.e.t. of the chopper. The resistance measured between the gold pads should now be greater than 10 kΩ.

(4) Connect socket H to socket B and apply -5 V to socket G. This will turn off the series f.e.t. of the chopper. The resistance measured across the gold pads should be greater than 10 kΩ.

Dismantling    Δ

7. To avoid damage to the internally connected gold wires dismantling must be carried out in the following order:-

Remove the rear plate screws (1) and (2).  
Remove the rear plate and slide the casing off the sensor.

8. Loosen the clamp screw (3) then remove the beam clamp fixing screws (4) and (5). Carefully remove the beam clamp.

9. Remove the tie rod by undoing screws (6) and (7).

Δ 10. Carefully remove the r.f. assembly fixing screws (8) and (9). Separate the r.f. assembly from the body assembly without damaging the gold wires.

11. Remove the circuit board fixing screws (10) and (11).  
Remove the body flange screws (12) and (13).  
The circuit board and 12 pin connector are now free.

Reassembly

12. The circuit board and 12 pin connector are fixed to the body by replacing the body flange fixing screws (12) and (13) and the circuit board screws (10) and (11).

13. Carefully offer up the r.f. assembly to the body without damaging the gold wires. Fit the fixing screws (8) and (9).

14. Carefully line up the gold wires over the middle of the gold pads on the chopper assembly.

15. Ensure that the clamp screw (3) is not in contact with the lower part of the plastic clamp and fit the beam clamp in position using the fixing screws (4) and (5).

16. Tighten the clamp screw (3) to firmly clamp the gold wires - a torque of 2 cNm is recommended.

17. Connect the partly assembled sensor to a power meter and check that it is functioning correctly as described in para. 3.

18. Fit the tie rod in position using screws (6) and (7).

19. Fit the casing and rear plate followed by the rear plate screws (1) and (2).

Chapter 6

REPLACEABLE PARTS

CONTENTS

Para.

1	Abbreviations
2	Component values
4	Ordering
5	Components

ABBREVIATIONS

1. The components are listed in alphanumerical order of the complete circuit reference using abbreviations from the following list :

- C : capacitor
- Carb : carbon
- Cer : ceramic
- D : semiconductor diode
- Elec : electrolytic
- FS : fuse
- IC : integrated circuit (package)
- L : inductor
- LP : lamp
- Max : maximum
- ME : meter
- Met : metal
- Mic : mica
- Min : minimum
- Ox : oxide
- Pl : plug
- Plas : plastic
- R : resistor
- S : switch
- SK : socket
- T : transformer
- Tant : tantalum

- TP : terminal
- TR : transistor
- Var : variable
- W : watts at 70°C
- WW : wirewound
- + : value selected during test; nominal value listed
- ∅ : feedthrough component
- ⚠ : static sensitive component

**COMPONENT VALUES**

2. One or more of the components fitted in this instrument may differ from those listed in this chapter for any of the following reasons :

- (a) Components indicated by a † have their values selected during test to achieve particular performance limits.
  - (b) Owing to supply difficulties, components of different value or type may be substituted provided the overall performance of the instrument is maintained.
  - (c) As part of a policy of continuous development, components may be changed in value or type to obtain detail improvements in performance.
3. When there is a difference between the component fitted and the one listed, always use as a replacement the same type and value as found in the instrument.

**ORDERING**

4. When ordering replacements, address the order to the Technical Services Department of our Microwave Products Division (address on rear cover) or nearest agent and specify the following for each component required :

- (1) Type and serial number of equipment.
- (2) Circuit reference.
- (3) Description.
- (4) Part number.

**COMPONENTS**

5.

*Circuit ref.*

*Description*

*Manufacturer/  
Part No.*

Power sensor, complete assy. 6913-001  
 3.5 mm r.f. assy. replacement kit 6913-008  
 Body assy. 6910-002  
 Spare mechanical parts kit 6910-011

Body assy. (6910-002)

SK1 Connector assy. 6910-052  
 Amplifier p.c.b. assy. 6910-003

C1	Cer 0.01μF 20% 100V	ITT B111 MZ5U
C2	Tant 4.7μF 20% 50V	STC 39479A
C3	Tant 4.7μF 20% 6.3V	SPRAGUE 499D
C4	Tant 1μF 20% 35V	26486-209F
C5	Chip 100pF 10% 100V	STC 0805 FX7R
C6	Chip 100pF 10% 100V	STC 0805 FX7R
C7	Tant 2.2μF 20% 50V	STC 52310X
D1	Zener BZX79C5V6	28371-417X
R1	RES MF 348kΩ 0.5% 1/8W	HOLCO H8
R2	RES MO 330Ω 2% 1/8W	CORNING NK3
R3	RES MO 2.2kΩ 2% 1/8W	CORNING NK3
R4	RES MO 10kΩ 2% 1/8W	CORNING NK3
R5	RES WW 100Ω 2% 1/8W	6910-043
TR1	FET Chopper assy. ⚠	6910-004
	TRANS BC414	Motorola

Circuit ref.

Description

Manufacturer/  
Part No.

Spare Mechanical Parts kit (6913-011)

	Beam clamp	6910-048
	Casing	6910-018
	Rear plate	6910-019
	Tie rod	6910-028
	Label warning	2121-615
	Spare screws kit	6910-012
1,2,6,7 10,11,12,13	M1.6 x 5LG SCREW CAP HD ZN PLT (8 off)	
8,9	M2 x 6LG SCREW PAN HD ZN PLT (2 off)	
4,5	M1.6 x 10LG SCREW CH HD ZN PLT (2 off)	
3	M3 x 8LG SCREW SET ZN PLT (1 off)	
1,2,6,7	M1.6 WASHER (4 off)	
8,9	M2 WASHER CRINKLE (2 off)	
4,5	M1.6 WASHER PLAIN (2 off)	

Chapter 7

CIRCUIT DIAGRAM

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Fig.

- 1a Amplifier p.c.b. layout ...
- 1 Circuit diagram ...

Component values

1. The letter in the component value code replaces the decimal point and indicates the multiplier and unit as follows:-

Resistors : Code letter R = ohms, k = kilohms ( $10^3$ ),  
M = megohms ( $10^6$ ).

Capacitors : Code letter m = millifarads ( $10^{-3}$ ),  
 $\mu$  = microfarads ( $10^{-6}$ ),  
n = nanofarads ( $10^{-9}$ ),  
p = picofarads ( $10^{-12}$ ).

Inductors : Code letter H = henrys, m = millihenrys ( $10^{-3}$ ),  
 $\mu$  = microhenrys ( $10^{-6}$ ),  
n = nanohenrys ( $10^{-9}$ ).

\* SIC : value selected during test, nominal value shown.

2. Components are marked normally with two, three or four figures according to the accuracy limit  $\pm 10\%$ ,  $\pm 1\%$  or  $\pm 0.1\%$ . Because a value  $4m7$  could be interpreted as 4.7 milliohms, millifarads or millihenrys, each value on circuit diagrams is placed near to its related symbol.

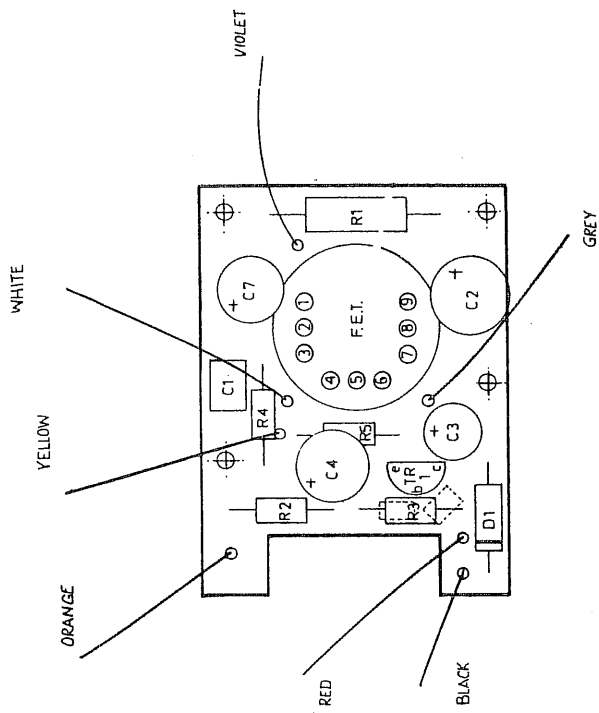
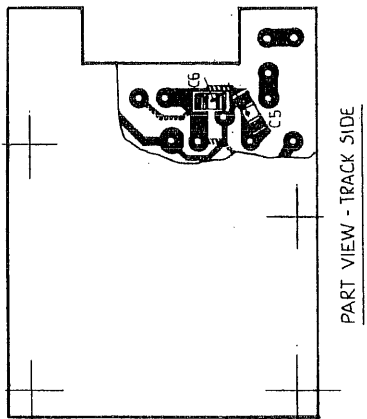


Fig. 1a Amplifier p.c.b. layout



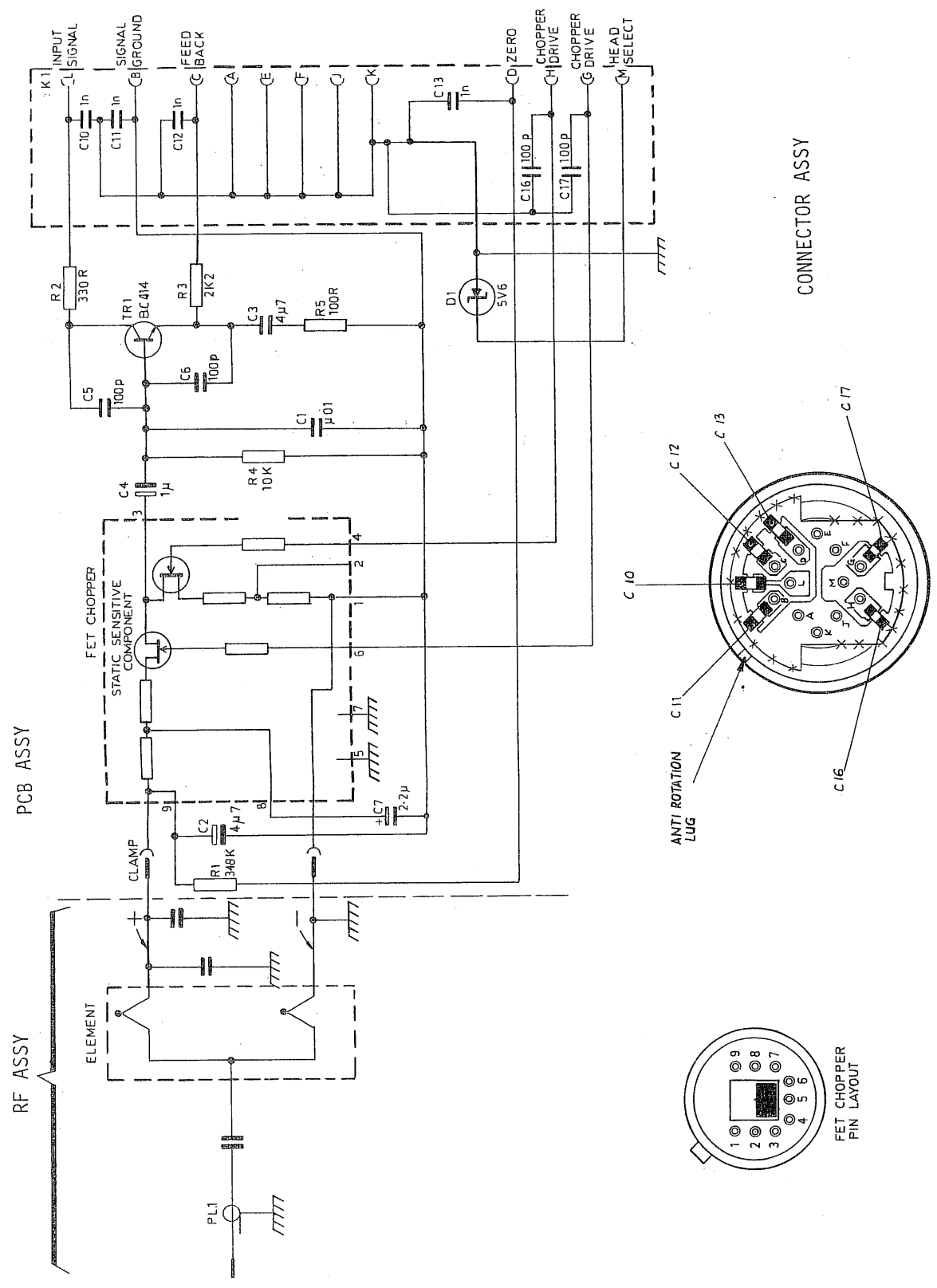


Fig. 1 Circuit diagram

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