Marconi
Instruments

RF POWER SENSORS

6900 SERIES

Instruction Manual

CONTENTS

PREFACE

WARNINGS, CAUTIONS and NOTES

These terms have specific meanings in this manual:

WARNINGS contain information to prevent personal injury.
CAUTIONS contain information to prevent damage to the equipment.
Notes contain important general information.

HAZARD SYMBOLS

The meaning of symbols that appear on the equipment is as follows:-

Symbol	Type of hazard	Reference in manual
	Static sensitive component	Page iv
	Dismantling may cause irreparable damage to this unit	Chap. 5
	Precision connector	Page iv

SYMBOLS IN THE MANUAL

The meaning of symbols used in this manual is as follows:-

(1) Sequence of steps in a procedure.

• List of topics or items

CAPS Capitals are used to identify names of controls and panel markings.

[ ] Square brackets are used to distinguish push-button keys.

MANUAL AMENDMENT STATUS

Each page bears the date of the original issue or the date of the latest amendment. Any changes subsequent to the latest amendment state of the manual are included on inserted sheets coded C1, C2 etc.

OPERATING PRECAUTIONS

These sensors, when used with the 6950 or 6960 Series of RF Power Meters, the 6970 Power Meter or the 6200 Series of Microwave Test Sets, are protected in accordance with IEC Safety Class 1. They have been designed and tested according to IEC Publication 348 'Safety Requirements for Electronic Measuring Apparatus', and have been supplied in a safe condition.

CAUTION - AVOIDANCE OF MEASUREMENT ERRORS

To prevent stray radiation being detected and displayed on the power meter, the sensor should be properly terminated in 50 Ω (75 Ω for the 6919).

Before zeroing and operating the power meter, sufficient time should be allowed for the sensor to take up the ambient temperature of the measuring environment. Rapid temperature changes should be avoided while operating.

CAUTION - STATIC SENSITIVE COMPONENTS

These sensors contain static sensitive components which may be damaged by handling.

CAUTION - PRECISION CONNECTOR

All Marconi Instruments Power Sensors are fitted with precision connectors. Good connector care is essential to maintain the performance of the Power Sensor. The following guidelines must always be adhered to when making connections:

- The connector interfaces must be clean and free of any mechanical damage.
- The connector should be measured with a connector gauge to ensure they are within mechanical tolerance.
- Connections should be made by rotating the outer locking nut only, NEVER the body of the device.
- Always use a torque spanner with 3.5 mm and 2.92 mm connectors.

The Warranty does not cover connector damage due to mis-use or normal wear and tear.

WARNING - TOXIC HAZARD

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

WARNING - TEMPERATURE HAZARD

When a 6930 Series sensor is used for measuring high powers the device has a high operating surface temperature.

Chapter 1

GENERAL INFORMATION

CONTENTS

FEATURES

The 6900 Series of RF Power Sensors is used with Marconi Instruments RF Power Meters 6950 (analogue) and 6960 Series (digital), the 6970 RF Power Meter and the 6200 Series of Microwave Test Sets. Note, however, that the 6930 Series of sensors can be used with the 6960A and 6960B RF Power Meters, but cannot be used with the 6960 RF Power Meter. The sensors provide the meter with a chopped DC analogue of the RF power, and collectively they cover a power range from -70 dBm to +35 dBm (0.1 nW to 3 W) at frequencies from 30 kHz to 40 GHz.

Each sensor has an individual label showing a graph of 'calibration factor', and values of '50 MHz reference calibration factor' and 'linearity factor'. The calibration factor appropriate to the measurement frequency may be entered into both the 6950, 6960 Series and 6970 power meters to enhance accuracy. The linearity factor may also be entered into the 6960 and 6970 to compensate for non-linearity at higher powers (compensation is preset internally in the 6950). The 6200 Series of Microwave Test Sets allow entry and storage of all the calibration data supplied with the sensors.

A 'calibration record' giving linearity factor and calibration data to two decimal places is also provided with each sensor.

VSWR and uncertainty values are low across the entire frequency range of the sensor.

Each sensor has a multi-way output connector for connection to the power meter via the sensor cable that is supplied with the meter. The sensor provides high level signals to the power meter so that the possibility of significant RF interference during measurements is negligible. A high damage level threshold minimizes the possibility of damage to the RF unit. Damaged units are, however, field replaceable in most cases (see Chapter 5).

Its small, light, rugged construction allows the sensor to be used confidently in bench or field applications without the need for any mechanical support.

PERFORMANCE DATA

The specifications for the sensors are shown on the following pages.

	6920	6923	6924
POWER RANGE	-70 dBm to -20 dBm (0.1 nW to 10 µW)	-70 dBm to -20 dBm (0.1 nW to 10 µW)	-70 dBm to -20 dBm (0.1 nW to 10 µW)
MAX RF INPUT	+26 dBm (400 mW) CW +30 dBm (1 W) peak for 2 µs	+26 dBm (400 mW) CW +30 dBm (1 W) peak for 2 µs	+26 dBm (400 mW) CW +30 dBm (1 W) peak for 2 µs
FREQUENCY RANGE	10 MHz - 20 GHz	10 MHz - 26.5 GHz	10 MHz - 40 GHz
VSWR	1.4 - 1.2 10 MHz - 40 MHz 1.2 40 MHz - 10 GHz 1.35 10 GHz - 18 GHz 1.4 typical 18 GHz - 20 GHz	1.4 10 MHz - 40 MHz 1.15 40 MHz - 100 MHz 1.12 100 MHz - 2 GHz 1.17 2 GHz - 8 GHz 1.3 8 GHz - 18 GHz 1.5 18 GHz - 26.5 GHz	1.58 10 MHz - 40 MHz 1.15 40 MHz - 100 MHz 1.12 100 MHz - 2 GHz 1.33 2 GHz - 18 GHz 1.5 18 GHz - 33 GHz 1.95 33 GHz - 40 GHz 1.97 26.5 GHz - 40 GHz (-002 version)
DRIFT	20 µW (typical, 1 hr after 24 hr warm-up at constant temperature)	20 µW (typical, 1 hr after 24 hr warm-up at constant temperature)	20 µW (typical, 1 hr after 24 hr warm-up at constant temperature)
LINEARITY FACTOR	Provided with sensor	Provided with sensor	Provided with sensor
Accuracy	±1% at 25°C between -30 and -20 dBm Improves by a factor of 10 for each lower range	±1% at 25°C between -30 and -20 dBm Improves by a factor of 10 for each lower range	±1% at 25°C between -30 and -20 dBm Improves by a factor of 10 for each lower range
CALIBRATION FACTOR Accuracy	Uncertainty provided with sensor	Uncertainty provided with sensor	Uncertainty provided with sensor
Resolution	0.01%	0.01%	0.01%
RF CONNECTOR	Precision N-type, male, 50 Ω	MPC 3.5 mm, male, 50 Ω	MPC 2.92 mm, male, 50 Ω
SIZE & WEIGHT	104 mm long, 33.5 mm dia. 180 g	87 mm long, 33.5 mm dia. 180 g	88.5 mm long, 33.5 mm dia. 150 g

	6930	6932	6934
POWER RANGE	-15 dBm to +35 dBm (30 µW to 3 W)	-15 dBm to +35 dBm (30 µW to 3 W)	-15 dBm to +30 dBm (30 µW to 1 W)
MAX RF INPUT	+37 dBm (5 W) CW +50 dBm (100 W) peak for 2 µs	+37 dBm (5 W) CW +50 dBm (100 W) peak for 2 µs	+33 dBm (2 W) CW +45 dBm (32 W) peak for 2 µs
FREQUENCY RANGE	10 MHz - 18 GHz	30 kHz - 4.2 GHz	10 MHz - 40 GHz
VSWR	1.1 10 MHz - 2 GHz 1.18 2 GHz - 16 GHz 1.28 16 GHz - 18 GHz	1.1 30 kHz - 4.2 GHz	1.5 10 MHz - 40 MHz 1.12 40 MHz - 100 MHz 1.1 100 MHz - 2 GHz 1.15 2 GHz - 12.4 GHz 1.2 12.4 GHz - 18 GHz 1.25 18 GHz - 26.5 GHz 1.43 26.5 GHz - 40 GHz (1.55 for version -002)
DRIFT	10 µW (typical, 1 hr after 24 hr warm-up at constant temperature) after 24 hr warm-up at constant temperature	10 µW (typical, 1 hr after 24 hr warm-up at constant temperature) after 24 hr warm-up at constant temperature	10 µW (typical, 1 hr after 24 hr warm-up at constant temperature) after 24 hr warm-up at constant temperature
LINEARITY FACTOR	Provided with sensor	Provided with sensor	Provided with sensor
Accuracy	-2.5% to +3.5% with 6950 -1% to +2% with 6960A/B between +25 and +35 dBm Improves by a factor of 10 for each lower range	-2.5% to +3.5% with 6950 -1% to +2% with 6960A/B between +25 and +35 dBm Improves by a factor of 10 for each lower range	-1.5% to +3.5% with 6950 -1% to +3% with 6960A/B between +25 and +35 dBm Improves by a factor of 10 for each lower range
CALIBRATION FACTOR Accuracy	Uncertainty provided with sensor	Uncertainty provided with sensor	Uncertainty provided with sensor
Resolution	0.01%	0.01%	0.01%
RF CONNECTOR	Precision N-type, male, 50 Ω	Precision N-type, male, 50 Ω	MPC 2.92 mm, male, 50 Ω
SIZE & WEIGHT	93 mm long, 33.5 mm dia. 190 g	93 mm long, 33.5 mm dia. 190 g	87 mm long, 33.5 mm dia. 150 g

SUPPLIED ACCESSORIES

	Part No.
6913, 6914	
N-type male / SMA female adapter (to connect to 0 dBm power reference)	23443-822K
6919	
75 Ω to 50 Ω adapter (to connect to 0 dBm power reference)	23443-842W
6920	
30 dB precision attenuator - for use in calibration Attenuation: 30 dB ±0.05 dB at 50 MHz at 25°C	06920-023P
6923, 6924	
30 dB precision attenuator - for use in calibration Attenuation: 30 dB ±0.05 dB at 50 MHz at 25°C	06920-023P
N-type male / SMA female adapter to connect to 0 dBm power reference	23443-822K
6934	
N-type male / SMA female adapter	

The 001 versions of the 40 GHz power sensors (i.e. 56914-001, 56924-001 and 56934-001) are supplied with accessories as above. The 002 versions also include a waveguide 22 transformer and calibration table.

OPTIONAL ACCESSORIES

The following items are required when using the 6920 and 6930 series sensors with the 6950 RF Power Meter. They are available from the Service Unit (address on rear cover of this manual).

6920 Series	
Range scale (-65 to -20 dBm) for attaching magnetically to the 6950 range control.	06920-008L
6930 Series	
Range scale (-10 to +35 dBm) for attaching magnetically to the 6950 range control.	41179-028M

Chapter 2
INSTALLATION

UNPACKING AND REPACKING

Retain the packing materials and the packing instruction note (if included) in case it is necessary to reship the sensor.

If the sensor is to be returned for servicing attach a label indicating the service required, type number, serial number and your return address.

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.

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Chapter 3
OPERATION

CONTENTS

PREPARATION FOR USE

Note...

The 6930 Series power sensors can only be used with the 6950, 6960A/6960B and 6970 RF Power Meters, and also the 6200 Series of Microwave Test Sets. They cannot be used with the 6960 RF Power Meter.

Before making measurements, the power meter must be matched to the individual characteristics of the sensor. This entails the following procedures:

- Zeroing the meter.
- Calibration, that is, entering the sensor's calibration factor and linearity factor.

Note...

If the sensor has been stored at a temperature different from that of the measurement environment, allow sufficient time for thermal equilibrium to be established before zeroing or calibration. Avoid rapid temperature changes while operating.

WARNING

When using 6930 Series sensors, dissipation of the applied power can cause the sensor to have a high surface temperature. Take care when handling.

CAUTION

Avoid applying excessive torque when tightening RF connectors or damage may occur. Finger-tight is usually sufficient, especially for type N connectors. If a torque wrench is used for 3.5 mm and 2.92 mm connectors, set it to break at 1 Nm (8 lb in).

WITH 6950 POWER METER

Zeroing

(1) Connect the sensor to the SENSOR INPUT socket of the power meter using the sensor cable supplied with the power meter.

(2) With no power applied to the sensor, select the most sensitive range by turning the RANGE switch fully counter-clockwise.

(3) Adjust the ZERO control for zero reading on the meter, using the special tool provided with the power meter.

Hint...

It may be helpful in setting zero to adjust the RESPONSE TIME control on the rear panel to reduce noise. You may also find it easier to set zero first on a less sensitive range, as slight adjustments of the ZERO control have considerable effect on the most sensitive range.

Calibration

(1) Connect the sensor to the POWER REFERENCE output of the power meter.

Use the N-type to SMA adapter for 6913/6914/6934
Use the 75 Ω to 50 Ω adapter for 6919
Use the 30 dB pad for 6920
Use the 30 dB pad and N-type to SMA adapter for 6923/6924

(2) Attach the appropriate magnetic range scale to the skirt of the RANGE switch if required and set the switch to 0 dBm.

(3) Set the CAL FACTOR control to the value of the **reference calibration factor** given on the sensor label. Some sensors, e.g. the 6910, do not have this information on the label; in these cases the default value of 100% is assumed.

(4) On the rear panel, switch POWER REF to ON and the LIN F : 6%/8% switch to the setting which is nearest to the value of the **linearity factor** shown on the sensor label or its calibration data chart. (If the LIN F switch positions on your 6950 are designated 75 Ω and 50 Ω, these should be interpreted as 6% (75 Ω) and 8% (50 Ω) and the switch set accordingly as above.)

(5) Adjust the GAIN control for full-scale meter reading.

(6) Switch POWER REF off and disconnect the sensor from the POWER REFERENCE socket.

(7) Determine the **calibration factor** for the measurement frequency, whether from the graph on the sensor label or from its calibration data chart. Set the CAL FACTOR control to the same value.

The power meter can now be used for measuring RF power. For full instructions and uncertainty calculations, refer to the power meter Operating Manual, Chapter 3.

Linearity Factor Correction for 6920 Series Sensors

The linearity factor of 6920 Series sensors can vary from unit to unit. Since the 6950 has two preset linearity factor correction values, measurement errors will result when using 6920 Series sensors with a linearity factor that is significantly different from this value, and when the power level is above -30 dBm. If necessary, the displayed reading can be corrected to give a more accurate power measurement figure, as follows:

At -20 dBm, corrected reading = Displayed reading + Correction Factor
where Correction Factor = Sensor Lin Factor – 8%

For each 3 dB decrease in power level, this correction figure should be halved. At -30 dBm or lower the error will be negligible and the above correction is not necessary.

WITH 6960 SERIES POWER METER

Zeroing

(1) Connect the sensor to the SENSOR INPUT of the power meter, using the sensor cable supplied with the power meter.

(2) With no power applied to the sensor, press [AUTO ZERO]. Five dashes appear on the display, representing the power meter's five ranges. When the last of these disappears, all five ranges have been zeroed. This takes approximately 25 seconds.

Calibration

(1) Determine the **linearity factor**, either from the label on the sensor or from its calibration data chart. Press [LINEARITY FACTOR] and enter this value in the power meter.

(2) Connect the sensor to the POWER REFERENCE output of the power meter.

Use the N-type to SMA adapter for 6913/6914/6934
Use the 75 Ω to 50 Ω adapter for 6919
Use the 30 dB pad for 6920
Use the 30 dB pad and N-type to SMA adapter for 6923/6924

(3) Press [CAL FACTOR] and enter the value of the **reference calibration factor** given on the sensor label. Some sensors, e.g. the 6910, do not have this information on the label; in these cases the default value of 100% is assumed.

(4) Press [AUTO CAL]. Note that the POWER REFERENCE LED comes on and 'CAL' is displayed. The auto cal routine takes approximately 10 seconds for most sensors, the 6930 Series requiring about 45 seconds.

(5) When calibration is completed, you can check that it has been successful by pressing [POWER REF]. This switches the power reference signal on, and 0 dBm (1 mW) should be displayed.

(6) Press [POWER REF] again to switch off the power reference signal and disconnect the sensor from the POWER REFERENCE socket.

(7) Determine the **calibration factor** for the measurement frequency, either from the graph on the sensor label or from its calibration chart. Press [CAL FACTOR] and enter this value in the power meter.

The power meter can now be used for measuring RF power. For full instructions and uncertainty calculations, refer to the power meter Operating Manual, Chapter 3.

WITH 6970 POWER METER

Zeroing

(1) Press [ON/ENTER] to activate the instrument.

(2) Connect the sensor to the SENSOR INPUT of the power meter, using the sensor cable supplied with the power meter.

(3) With no power applied to the sensor, press [SHIFT] [ZERO]. The display will be cleared and the peaking meter bar will progress across the display during the zeroing sequence. On completion the instrument will be restored to normal operation.

Calibration

(1) Determine the **linearity factor**, either from the label on the sensor or from its calibration data chart. Press [LIN FACTOR] and enter this value in the power meter.

Note...

For the best measurement accuracy, the sensor should be calibrated against the optional integral power reference, immediately following a sensor zero, as described in steps (2) to (5). An external power reference may be used if the power reference option is not fitted.

(2) Connect the sensor to the POWER REF output of the power meter

Use the N-type to SMA adapter for 6913/6914/6934.
Use the 75 Ω to 50 Ω adapter for 6919.
Use the 30 dB pad for 6920.
Use the 30 dB pad and N-type to SMA adapter for 6923/6924.

(3) Press [CAL FACTOR] and enter the value of the **reference calibration factor** given on the sensor label. Some sensors, e.g. the 6910, do not have this information on the label; in these cases the default value of 100% is assumed.

(4) When calibration is completed, you can check that it has been successful by pressing [SHIFT] [PWR. REF]. This switches the power reference signal on, and 0 dBm (1 mW) should be displayed.

(5) Press [SHIFT] [PWR. REF] again to switch off the power reference signal and disconnect the sensor from the POWER REF socket.

(6) Determine the **calibration factor** for the measurement frequency, either from the graph on the sensor label or from its calibration chart. Press [CAL FACTOR] and enter this value in the power meter.

The power meter can now be used for measuring RF power. For full instructions and uncertainty calculations, refer to the power meter Operating Manual, Chapter 3.

WITH 6200 SERIES OF MICROWAVE TEST SETS

For calibration instructions, refer to Chapter 3 of the 6200 Operating Manual.

Chapter 4
TECHNICAL DESCRIPTION

CONTENTS

LIST OF FIGURES

OVERALL CIRCUIT DESCRIPTION

Refer to Fig. 4-1. The RF sensor gives a small DC output voltage when RF power is applied. This DC voltage is converted to an AC signal by the signal chopper. The chopped signal is fed to the amplifier which is divided into two parts, the first part being in 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.

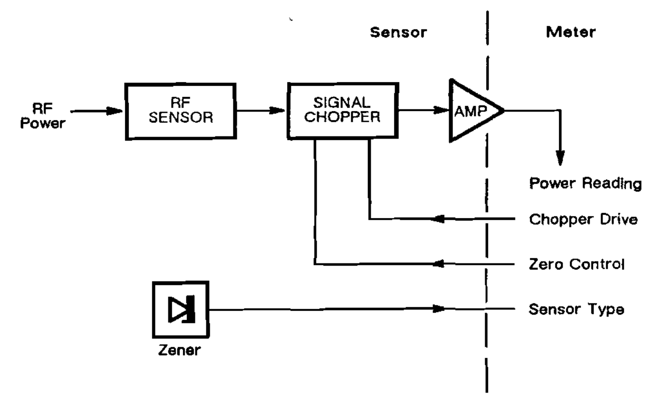

Fig. 4-1 Block Diagram of RF Power Sensor

DETAILED DESCRIPTION

Refer to Chapter 7 for the circuit diagram of the sensor.

RF Sensor

For the 6910 Series and 6930 Series sensors, the sensing element consists of a monolithic semiconductor thermocouple element. The 6920 Series uses a Schottky barrier diode. Both types of sensor provide an output voltage proportional to the RF power.

Signal chopper

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

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 RF power applied.

Amplifier

The amplifier is divided between the power sensor and the power meter. A simplified circuit is shown in Fig. 4-2.

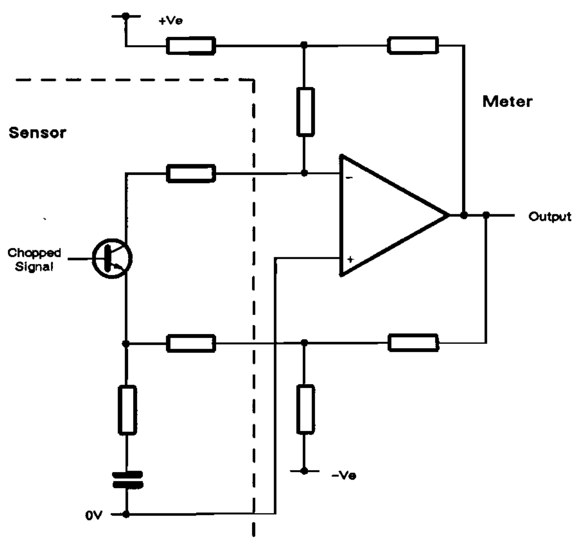

Fig. 4-2 Simplified Diagram of Amplifier

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 appropriate power meter Service Manual.

A Zener diode is mounted in the sensor to provide sensor type information for the power meters. The Zener voltage is detected by the power meter and indicates the type of sensor in use. This in turn defines the required scaling and linearity corrections that must be applied to give a true power reading.

Chapter 5
MAINTENANCE

CONTENTS

LIST OF FIGURES

6910 AND 6930 SERIES SENSORS

The following information does not apply to the 6914 and 6934 sensors. There is no provision for customer servicing of these sensors, and the complete unit must be returned to Marconi Instruments Service Division for repair (address at rear of manual).

CAUTIONS

- It is important that the dismantling and re-assembling detailed in this chapter is performed in the order specified. This is because the gold wires which connect the RF assembly to the body assembly (see Fig. 5-1) are extremely delicate and may easily be damaged if over-stressed. For this reason also, care should be taken when measuring voltages across or in the vicinity of the gold wires.
- Ensure that all parts are free from dirt, grease or moisture as these might impair the performance of the sensor.

TEST EQUIPMENT

Description	**Specification**
6950, 6960 Series Power Meter, 6970 Power Meter or 6200 Series MTS (with sensor lead)	
Digital voltmeter	Resolution: 1 µV and 1 Ω.
Power supply	Capable of providing ±5 V DC.
Allen key	1.5 mm

SERVICING POLICY AND MAINTENANCE INFORMATION

For customer-servicing purposes, the sensor is considered in two parts (see Fig. 5-1).

The RF assembly. This is not customer-serviceable, but calibrated replacement RF assemblies may be quickly and easily fitted by the customer. See later in this chapter for testing and replacement instructions.

The body assembly. This contains the PCB assembly on which the FET chopper and part of the amplifier are mounted. The procedure for testing the chopper is given later in this chapter.

The chopper is not customer-serviceable but is available as a replacement part. The parts list in Chap. 6 and circuit diagram in Chap. 7 detail those components of the amplifier which are contained in the sensor. The remainder of the amplifier circuitry is in the power meter and limited fault-finding information for this circuit is contained in the Service Manuals for these instruments.

The complete sensor may, of course, be returned to Marconi Instruments Service Division for repair and calibration (address at rear of manual).

FAULTY OPERATION

If the sensor is connected to a power meter and sensor lead which are known to be working, and either zeroing or calibration (as described in Chap. 3) cannot be successfully accomplished, then the sensor can be assumed to be faulty.

BASIC ACCESS

(1) Remove the sensor cable from the 12 pin connector on the sensor.

(2) Remove the rear plate retaining screws (item 1 and 2) using a 1.5 mm Allen key.

(3) Remove the rear plate and slide the casing from the sensor.

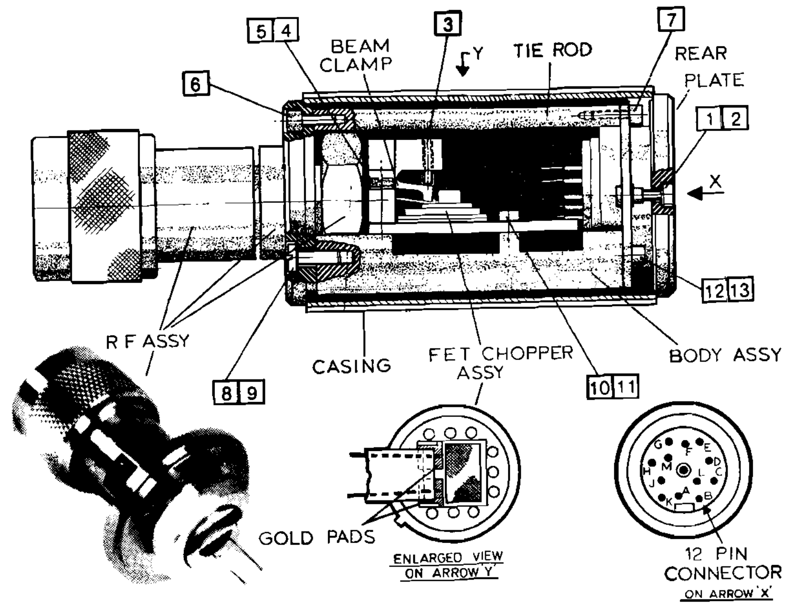

Fig. 5-1 Access and layout diagram - 6910 and 6930 Series Sensors

FAULT FINDING

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 signal.

Testing the RF Assembly

6910 Series sensors:

(1) Carefully measure the voltage across the gold pads on the FET chopper assembly (see inset, Fig. 5-1).

(2) If the voltage is 100 µV or greater, the RF assembly is functioning correctly. In this case, test the FET chopper assembly as described in the next section.

(3) If the voltage is less than 100 µV, remove the sensor from the 1 mW reference. Remove the tie rod by removing screws item 6 and item 7 with the Allen key.

Remove the beam clamp, by first loosening the clamp screw (item 3), then removing the beam clamp fixing screws (item 4 and 5). Remove the beam clamp and carefully lift the two gold wires from the RF assembly clear of the gold pads.

(4) Reconnect the sensor to the 1 mW reference signal and carefully measure the voltage across the gold wires. If the voltage is now greater than 100 µV, it can be concluded that there is a fault on the chopper/amplifier PCB or in the 12 pin connector. If the voltage is still less than 100 µV, the RF assembly is faulty and must be replaced as described in "Replacement of RF Assembly".

6930 Series sensors:

(1) Carefully measure the voltage across the gold pads on the FET chopper assembly (see inset, Fig. 5-1).

(2) If the voltage is 3 µV or greater, the RF assembly is functioning correctly. In this case, test the FET chopper assembly as described in the next section.

(3) If the voltage is less than 3 µV, remove the sensor from the 1 mW reference. Remove the tie rod by removing screws item 6 and item 7 with the Allen key.

Remove the beam clamp, by first loosening the clamp screw (item 3), then removing the beam clamp fixing screws (item 4 and 5). Remoye the beam clamp and carefully lift the two gold wires from the RF assembly clear of the gold pads.

(4) Reconnect the sensor to the 1 mW reference signal and carefully measure the voltage across the gold wires. If the voltage is now greater than 3 µV, it can be concluded that there is a fault on the chopper/amplifier PCB or in the 12 pin connector. If the voltage is still less than 3 µV, the RF assembly is faulty and must be replaced as described in "Replacement of RF Assembly".

Testing the FET Chopper Assembly

(1) Disconnect the sensor from the 1 mW reference and remove the sensor cable. Remove the beam clamp as described in step (3) of "Testing the RF Assembly".

(2) Connect together sockets B, G and H of the 12 pin connector (see Fig. 5-1 inset) to turn both of the chopper's FETs on.

(3) Measure the resistance between the two gold pads. This should be approximately 100 - 200 Ω.

(4) Disconnect the link between sockets B/G and socket H Apply -5 V to socket H. This will turn off the shunt FET of the chopper. The resistance measured across the gold pads should now be greater than 10 kΩ.

(5) Disconnect the link between sockets B and G. Connect socket H to socket B and apply -5 V to socket G. This will turn off the series FET of the chopper. The resistance measured across the gold pads should be greater than 10 kΩ.

If the applied signals are getting through to the FET chopper but any of the above measurements are not achieved than the assembly is faulty and should be replaced as described in "Access to Chopper/Amplifier PCB".

SERVICING

Replacement of RF Assembly

(1) Dismantle the sensor as described in "Testing the RF assembly", step (3).

(2) Carefully remove the two RF assembly fixing screws (item 8 and 9) using a screwdriver. Carefully separate the RF assembly from the body assembly without damaging the gold wires.

(3) Offer the replacement RF assembly to the body assembly so that the fixing screw holes in the RF assembly flange match with those in the body assembly. Be careful not to damage the gold wires.

(4) Fit the fixing screws, items 8 and 9. Align the gold wires centrally over the gold pads on the chopper assembly.

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

(6) Tighten the clamp screw (item 3) to firmly clamp the gold wires. The top of the clamp should just begin to bend upwards. If a torque screwdriver is available, tighten to 2 Ncm.

(7) Connect the partly assembled sensor to a power meter and check that zeroing and calibration can be successfully accomplished.

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

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

Access to Chopper/Amplifier PCB (PCB and 12 pin connector)

(1) Separate the RF assembly from the body assembly as described in steps (1) and (2) of "Replacement of RF Assembly".

(2) Remove the PCB fixing screws (items 10 and 11). Remove the 12 pin connector fixing screws (items 12 and 13). The PCB and 12 pin connector are now free of the body assembly.

(3) To replace the chopper/amplifier PCB and the 12 pin connector, reverse the above procedure.

6920 SENSORS

The following servicing information applies only to the 6920 sensor. There is no provision for customer servicing of the 6923 and 6924 sensors, and the complete unit must be returned to Marconi Instruments Service Division for repair (address at rear of manual).

CAUTIONS

To avoid possible damage or degradation in performance:

- Take care when attaching/detaching leads to/from the RF assembly.
- Do not link any points unless specifically instructed to.
- Ensure that all parts are free from dirt, grease or moisture.

TEST EQUIPMENT

Description	**Specification**
6950, 6960 Series Power Meter, 6970 Power Meter or 6200 Series MTS (with sensor lead)	
Digital voltmeter	Resolution: 1 mV.
Power supply	Capable of providing ±5 V DC.
Oscilloscope	Bandwidth: >20 kHz. Sensitivity: Better than 50 mV/div
10 kΩ resistor	
Allen key	1.5 mm.

SERVICING POLICY AND MAINTENANCE INFORMATION

For servicing purposes, the sensor is considered in two parts (see Fig. 5-2).

The RF assembly. This is not customer-serviceable, but calibrated replacement RF assemblies may be quickly and easily fitted by the customer. See later in this chapter for testing and replacement instructions.

The body assembly. This contains the PCB on which is mounted part of the amplifier circuit. The remainder of this circuit is in the power meter and limited fault-finding information is contained in the Service Manuals for these instruments. Access to the PCB is described later in this chapter.

The complete sensor may, of course, be returned to Marconi Instruments Service Division for repair and calibration (address at rear of manual).

FAULTY OPERATION

If the sensor is connected to a power meter and sensor lead which are known to be working, and either zeroing or calibration (as described in Chap. 3) cannot be successfully accomplished, then the sensor can be assumed to be faulty.

BASIC ACCESS

(1) Remove the sensor cable from the 12 pin connector on the sensor.

(2) Remove the rear plate retaining screws SC1 and SC2 using a 1.5 mm Allen key.

(3) Remove the rear plate and slide the casing from the sensor.

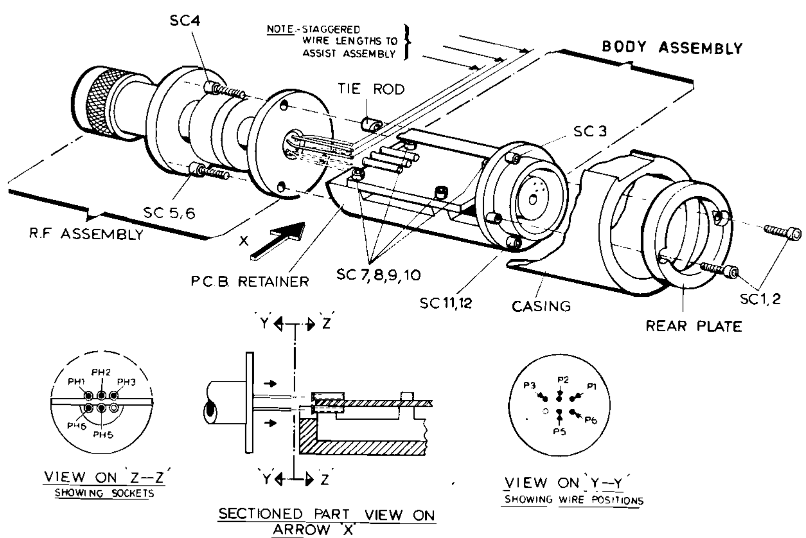

Fig. 5-2 Access and Layout Diagram - 6920 Sensor

FAULT FINDING

Testing the Body Assembly

(1) Reconnect the cable between the sensor and the power meter.

(2) Using the oscilloscope, check that the 925 Hz, 0 to -5 V square wave chopper drive signals are present on pin holders PH5 and PH6 (measure with respect to PCB retainer).

(3) If either signal is not present, then there is a fault in the body assembly (amplifier PCB or 12 pin connector).

Testing the RF Assembly

(1) Connect the sensor to the POWER REFERENCE output of the power meter. Switch the power reference on.

(2) Using the oscilloscope, carefully measure the voltage waveform between pin holder PH2 and the PCB retainer. This should be a 925 Hz, 0 to -200 mV (approximately) square wave. If not, a fault in the RF assembly is indicated. The remaining steps in this procedure will confirm or disprove this.

(3) Remove the RF assembly retaining screws SC4, 5 and 6 using the Allen key, and carefully pull the RF assembly away from the body assembly.

(4) Connect the RF assembly directly to the POWER REFERENCE output.

(5) Using the DC power supply, apply -5 V via a 10 kΩ resistor to pin P6 with the RF assembly chassis as earth (ground). Connect pin P5 to the chassis. Carefully attach a lead from the -ve terminal of the DVM to pin P1. Switch the POWER REFERENCE on and check that the reading is greater (more negative) than -200 mV. Reduce the DC supply to 0 V. The DVM reading should reduce to less than -60 mV.

(6) Switch the power reference off. Again using the DC power supply, apply -5 V via the 10 kΩ resistor to pin P5 with the RF assembly chassis as earth. Connect pin P6 to the chassis. Carefully attach a lead from the +ve terminal to pin P2. Switch the POWER REFERENCE on and check that the reading is greater (more negative) than -200 mV.

(7) If all of the measurements in steps (5) and (6) above are correct, then the RF assembly is not faulty. Check that corrections between RF assembly and body assembly are correct, and re-check that body assembly, sensor lead and power meter are functioning correctly. If any of the measurements in steps (5) and (6) are incorrect, then the RF assembly is faulty and must be replaced.

SERVICING

Replacement of RF Assembly

(1) Disconnect the RF assembly from the body assembly as described in "Basic Access" and "Testing the RF Assembly", step (3).

(2) In fitting the new RF assembly, ensure that the six pins protruding from the RF assembly are aligned correctly with the six pin holders in the body assembly. With the RF assembly on your right-hand side and the body assembly on your left (PCB uppermost), the longest pair of wires should be furthest away from you.

(3) Carefully insert the pins into the corresponding pin holders and check that the holes in the PCB retainer and tie rod correspond with those in the RF assembly flange. Gently push home.

(4) Replace screws SC4, 5 and 6. Note that SC4 (which connects to the tie rod) is narrower than the other two.

(5) Connect the partly assembled sensor to a power meter and check that it is functioning correctly

Access to Body Assembly (PCB and 12 pin connector)

(1) Disconnect the RF assembly from the body assembly as described in "Basic Access" and "Testing the RF Assembly", step (3).

(2) Remove SC7, 8 9 and 10 to detach the PCB from its retainer.

(3) Remove SC11 and 12 to detach the 12 pin connector from the PCB retainer. Remove SC3 to detach the tie rod from the 12 pin connector, if required.

(4) To replace PCB and 12 pin connector, reverse the above procedure.

Chapter 6

REPLACEABLE PARTS

CONTENTS

COMPONENT VALUES

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

- Components indicated by a * have their values selected during test to achieve particular performance limits.
- Owing to supply difficulties, components of different value or type may be substituted provided the overall performance of the equipment is maintained.
- As part of a policy of continuous development, components may be changed in value or type to obtain detail improvements in performance.

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

When ordering replacements, address the order to our Service Division (address on rear cover) or nearest agent and specify the following for each component required:

(1) Type and serial number of instrument.

(2) Circuit reference.

(3) Description.

(4) Part number.

Note...

The components on the Amplifier PCB are not recommended as replaceable parts but are listed for reference only.

6910

Circuit Ref.	Description	Part No.
	Calibrated replacement RF assembly	44991/008
	Body assembly (includes amplifier PCB and connector assembly SK1)	44990/986
Amplifier PCB		
C1	CAPACITOR CERAMIC 0.01µF 20% 100V	26383/536
C2	CAPACITOR TANTALUM 4.7µF 20% 50V	26486/220
C3	CAPACITOR TANTALUM 4.7µF 20% 6.3V	26486/217
C4	CAPACITOR TANTALUM 1µF 20% 35V	26486/209
C5	CAPACITOR CERAMIC 100pF 5% 50V	26386/824
C6	CAPACITOR CERAMIC 100pF 5% 50V	26386/824
C7	CAPACITOR TANTALUM 2.2µF 20% 50V	26486/212
D1	ZENER BZX79C5V6	28371/417
R1	RESISTOR METAL-FILM 348K 0.5% 1/4W	24753/388
R2	RESISTOR METAL-FILM 330R 2% 1/8W	24772/061
R3	RESISTOR METAL-FILM 2K2 2% 1/8W	24772/081
R4	RESISTOR METAL-FILM 10K 2% 1/8W	24772/097
R5	THERMISTOR POSITIVE-TC 100R	6910/061
TR1	TRANSISTOR BC550B	28455/309
	FET CHOPPER ASSEMBLY	6910/004

6911

Circuit Ref.	Description	Part No.
	Calibrated replacement RF assembly	44991/009
	Body assembly (includes amplifier PCB and connector assembly SK1)	44990/986
Amplifier PCB	As for 6910	

6912

Circuit Ref.	Description	Part No.
	Calibrated replacement RF assembly	44991/010
	Body assembly (includes amplifier PCB and connector assembly SK1)	44990/987
Amplifier PCB		
C1	CAPACITOR CERAMIC 0.01μF 20% 100V	26383/536
C2	CAPACITOR TANTALUM 4.7μF 20% 50V	26486/220
C3	CAPACITOR TANTALUM 4.7μF 20% 6.3V	26486/217
C4	CAPACITOR TANTALUM 1μF 20% 35V	26486/209
C5	CAPACITOR CERAMIC 100pF 5% 50V	26386/824
C6	CAPACITOR CERAMIC 100pF 5% 50V	26386/824
C7	CAPACITOR TANTALUM 2.2μF 20% 50V	26486/212
D1	ZENER BZX79C6V8	28371/550
R1	RESISTOR METAL-FILM 348K 0.5% 1/4W	24753/388
R2	RESISTOR METAL-FILM 330R 2% 1/8W	24772/061
R3	RESISTOR METAL-FILM 2K2 2% 1/8W	24772/081
R4	RESISTOR METAL-FILM 10K 2% 1/8W	24772/097
R5	THERMISTOR POSITIVE-TC 100R	6910/061
TR1	TRANSISTOR BC550B	28455/309
	FET CHOPPER ASSEMBLY	6910/004

6913

Circuit Ref.	Description	Part No.
	Calibrated replacement RF assembly	44991/011
	Body assembly (includes amplifier PCB and connector assembly SK1)	44990/986
Amplifier PCB	As for 6910	

6919

Circuit Ref.	Description	Part No.
	Calibrated replacement RF assembly	44991/012
	Body assembly (includes amplifier PCB and connector assembly SK1)	44990/988
Amplifier PCB		
C1	CAPACITOR CERAMIC 0.01μF 20% 100V	26383/536
C2	CAPACITOR TANTALUM 3.3μF 20% 50V	26486/003
C3	CAPACITOR TANTALUM 4.7μF 20% 6.3V	26486/217
C4	CAPACITOR TANTALUM 1μF 20% 35V	26486/209
C5	CAPACITOR CERAMIC 100pF 5% 50V	26386/824
C6	CAPACITOR CERAMIC 100pF 5% 50V	26386/824
C7	CAPACITOR TANTALUM 2.2μF 20% 50V	26486/212
D1	ZENER BZX79C6V8	28371/550
R1	RESISTOR METAL-FILM 523K 0.5% 1/4W	24753/220
R2	RESISTOR METAL-FILM 330R 2% 1/8W	24772/061
R3	RESISTOR METAL-FILM 2K2 2% 1/8W	24772/081
R4	RESISTOR METAL-FILM 10K 2% 1/8W	24772/097
R5	THERMISTOR POSITIVE-TC 100R	6910/061
TR1	TRANSISTOR BC550B	28455/309
	FET CHOPPER ASSEMBLY	6910/004

6920

Circuit Ref.	Description	Part No.
	Calibrated replacement RF assembly	44991/013
	Body assembly (includes amplifier PCB and connector assembly SK1)	44990/989
Amplifier PCB		
C3	CAPACITOR TANTALUM 1μF 20% 35V	26486/209
C4	CAPACITOR TANTALUM 4.7μF 20% 6.3V	26486/217
C5	CAPACITOR CERAMIC 10nF 20% 100V	26383/536
C6	CAPACITOR TANTALUM 10μF 20% 6.3V	26486/224
C7	CAPACITOR CERAMIC 47nF 10% 50V	26343/560
C9	CAPACITOR TANTALUM 220nF 20% 35V	26486/205
C14	CAPACITOR CERAMIC 100pF 5% 50V	26386/824
C15	CAPACITOR CERAMIC 100pF 5% 50V	26386/824
D2	ZENER BZX79C2V7	28371/202
R1	RESISTOR METAL-FILM 30K 2% 1/8W	24772/108
R2	RESISTOR METAL-FILM 330R 2% 1/8W	24772/061
R3	RESISTOR METAL-FILM 2K 2% 1/8W	24772/080
R4	RESISTOR METAL-FILM 10K 2% 1/8W	24772/097
R5	RESISTOR METAL-FILM 47R 2% 1/8WR	24772/041
R6	RESISTOR METAL-FILM 68R 2% 1/8WR	24772/045
TR1	TRANSISTOR BC550B	28455/309

6930

Circuit Ref.	Description	Part No.
	Calibrated replacement RF assembly	44991/014
	Body assembly (includes amplifier PCB and connector assembly SK1)	44990/990
Amplifier PCB		
C1	CAPACITOR CERAMIC 0.01μF 20% 100V	26383/536
C2	CAPACITOR TANTALUM 4.7μF 20% 50V	26486/220
C3	CAPACITOR TANTALUM 4.7μF 20% 6.3V	26486/217
C4	CAPACITOR TANTALUM 1μF 20% 35V	26486/209
C5	CAPACITOR CERAMIC 100pF 5% 50V	26386/824
C6	CAPACITOR CERAMIC 100pF 5% 50V	26386/824
C7	CAPACITOR TANTALUM 2.2μF 20% 50V	26486/212
D1	ZENER BZX79C8V2	28371/671
R1	RESISTOR METAL-FILM 348K 0.5% 1/4W	24753/388
R2	RESISTOR METAL-FILM 330R 2% 1/8W	24772/061
R3	RESISTOR METAL-FILM 2K2 2% 1/8W	24772/081
R4	RESISTOR METAL-FILM 10K 2% 1/8W	24772/097
R5	THERMISTOR POSITIVE-TC 100R	6910/061
TR1	TRANSISTOR BC550B	28455/309
	FET CHOPPER ASSEMBLY	6910/004

6932

Circuit Ref.	Description	Part No.
	Calibrated replacement RF assembly	44991/015
	Body assembly (includes amplifier PCB and connector assembly SK1)	44990/990
Amplifier PCB	As for 6930	

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Chapter 7
SERVICING DIAGRAMS

CONTENTS

LIST OF FIGURES

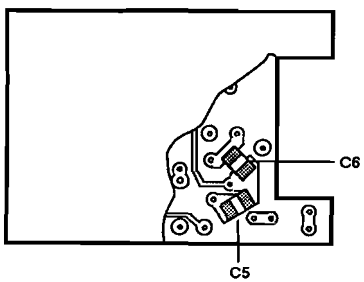
COMPONENT VALUES

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

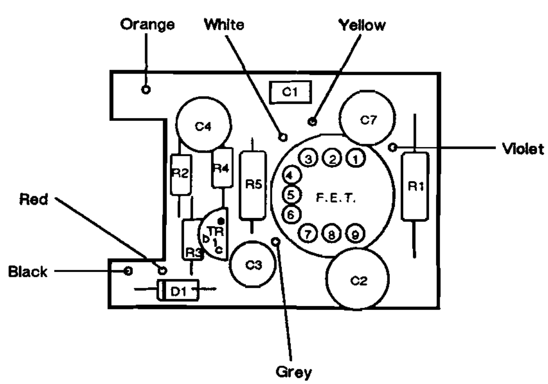
Resistors	:	Code letter R	=	ohms,
		k	=	kilohms (10^3),
		M	=	megohms (10^6).
Capacitors	:	Code letter m	=	millifarads (10^{-3}),
		μ	=	microfarads (10^{-6}),
		n	=	nanofarads (10^{-9}),
		p	=	picofarads (10^{-12}).
Inductors	:	Code letter H	=	henrys,
		m	=	millihenrys (10^{-3}),
		μ	=	microhenrys (10^{-6}),
		n	=	nanohenrys (10^{-9}).

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

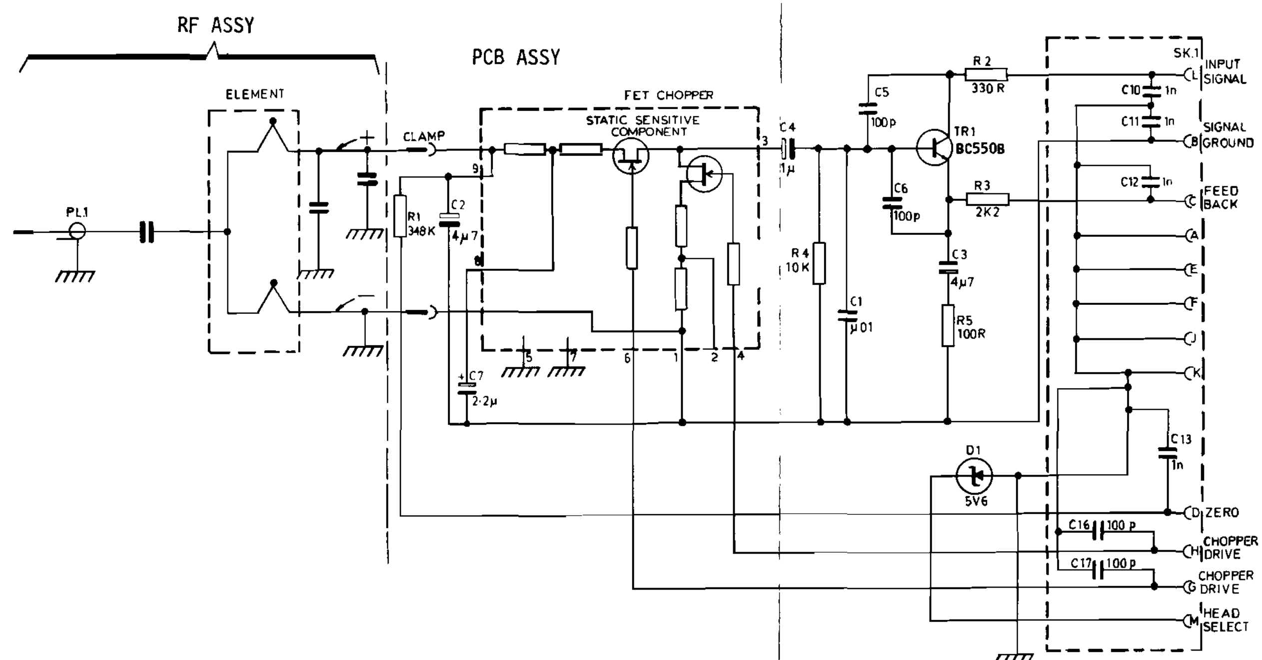
Components are marked normally with two, three or four figures according to the accuracy limit ±10%, ±1% or ±0.1%.

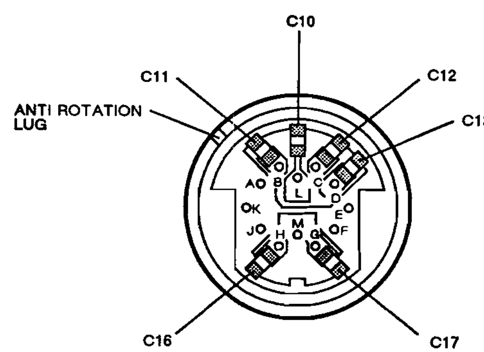


PART VIEW - TRACK SIDE

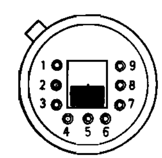


Amplifier p.c.b.



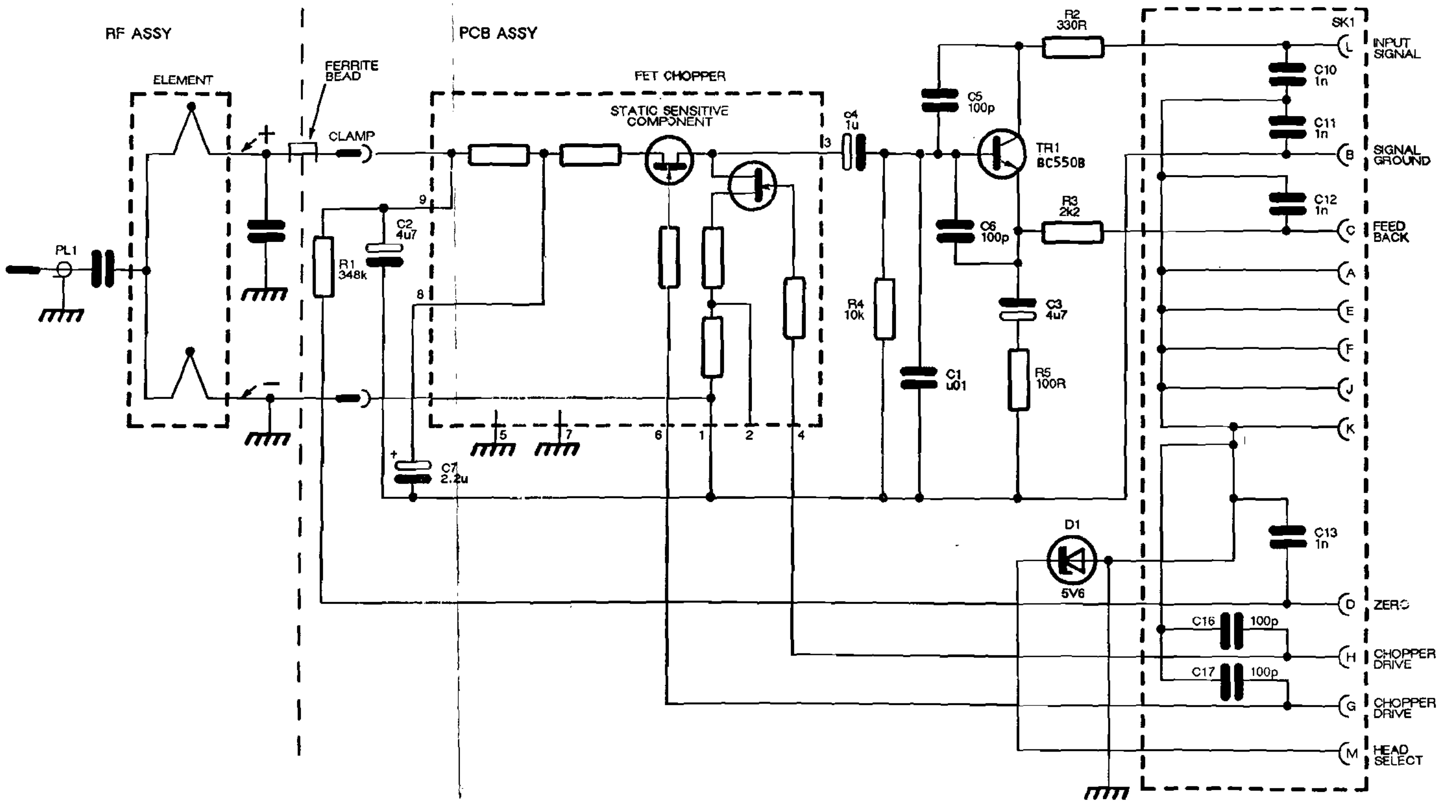


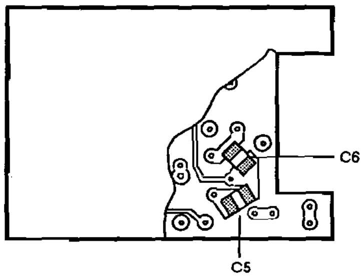
SK1 assembly



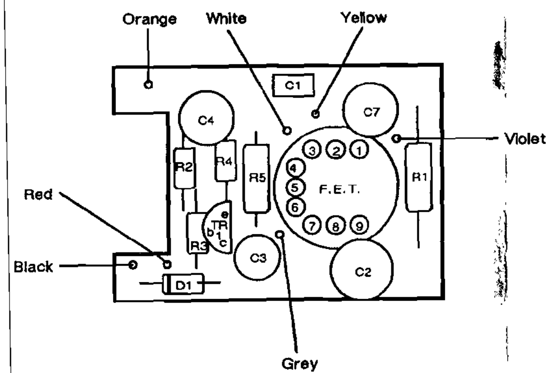
FET CHOPPER PIN LAYOUT

Fig. 7-1 Circuit diagram and component layout: 6913

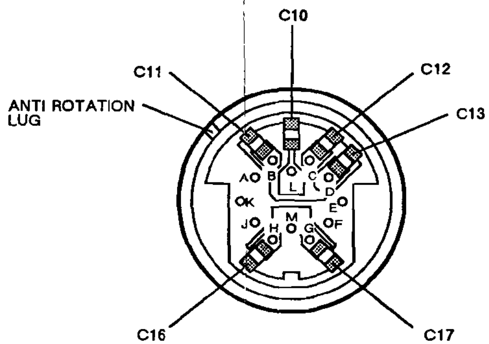




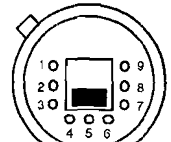
PART VIEW - TRACK SIDE



Amplifier p.c.b.



SK1 assembly



FET CHOPPER PIN LAYOUT

Fig. 7-2 'Circuit diagram and component layout : 6910/6911

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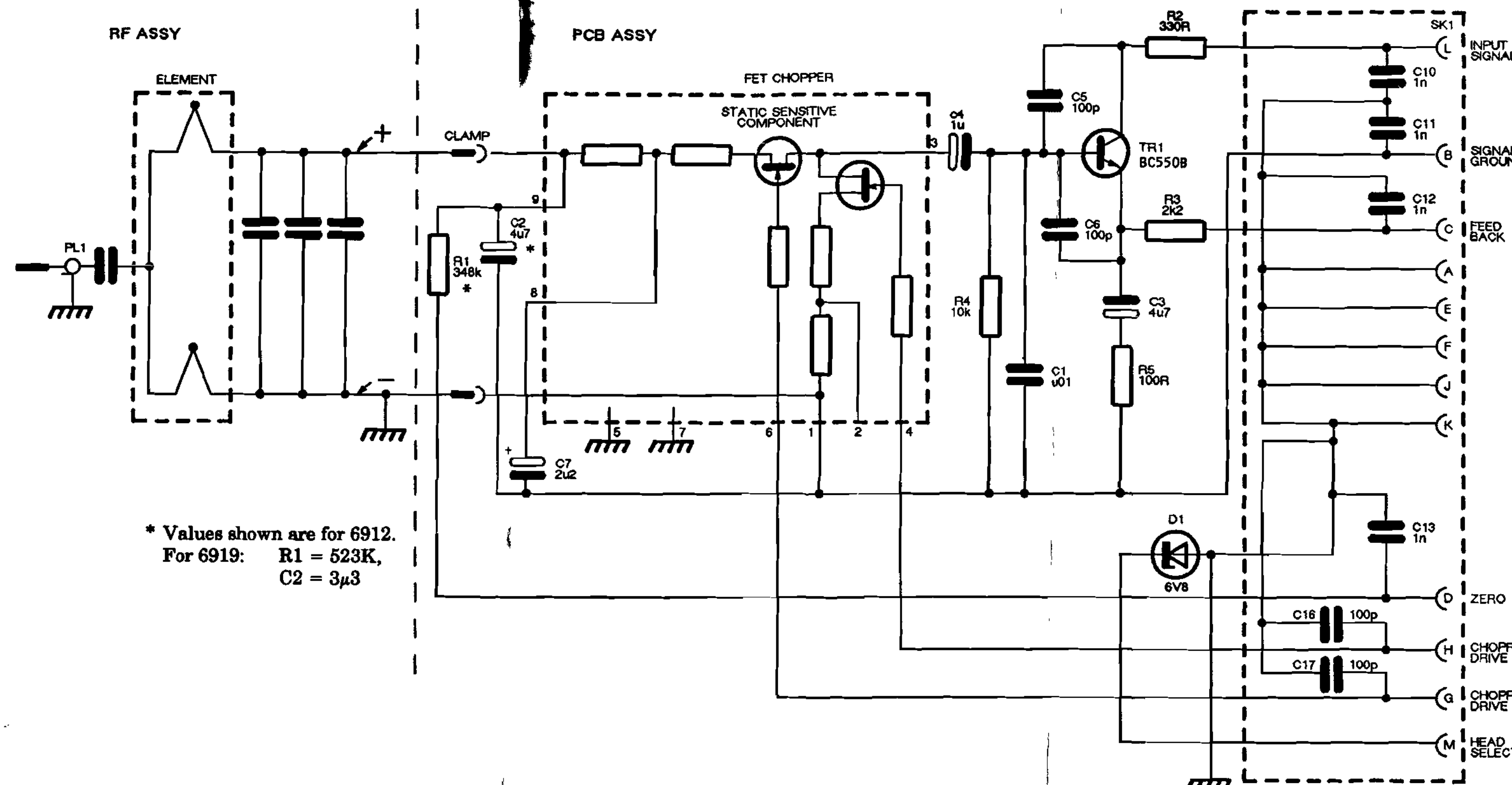
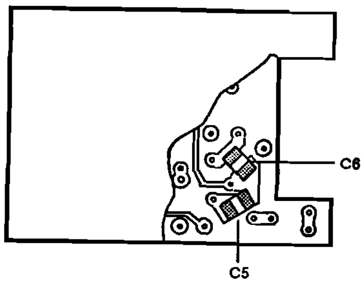
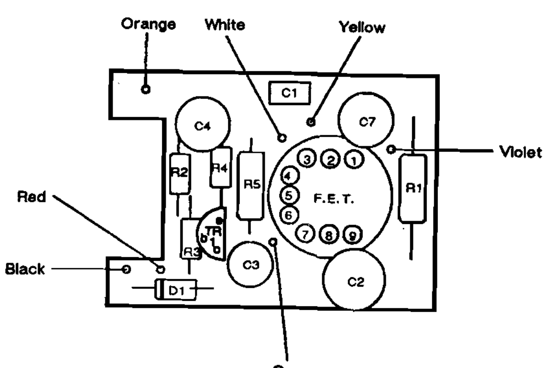


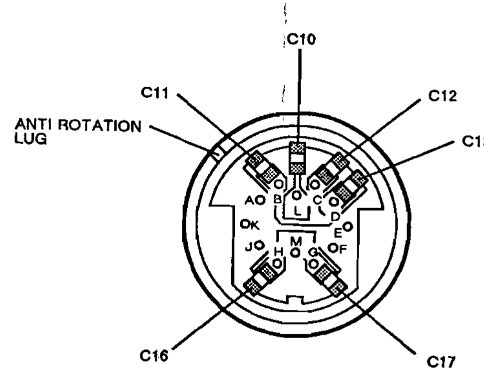
* Values shown are for 6912.
For 6919: R1 = 523K,
C2 = 3μ3



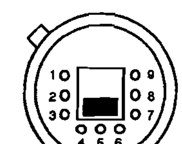
PART VIEW - TRACK SIDE



Amplifier p.c.b.



SK1 assembly



FET CHOPPER PIN LAYOUT

Fig. 7-3 Circuit diagram and component layout: 6912/6919

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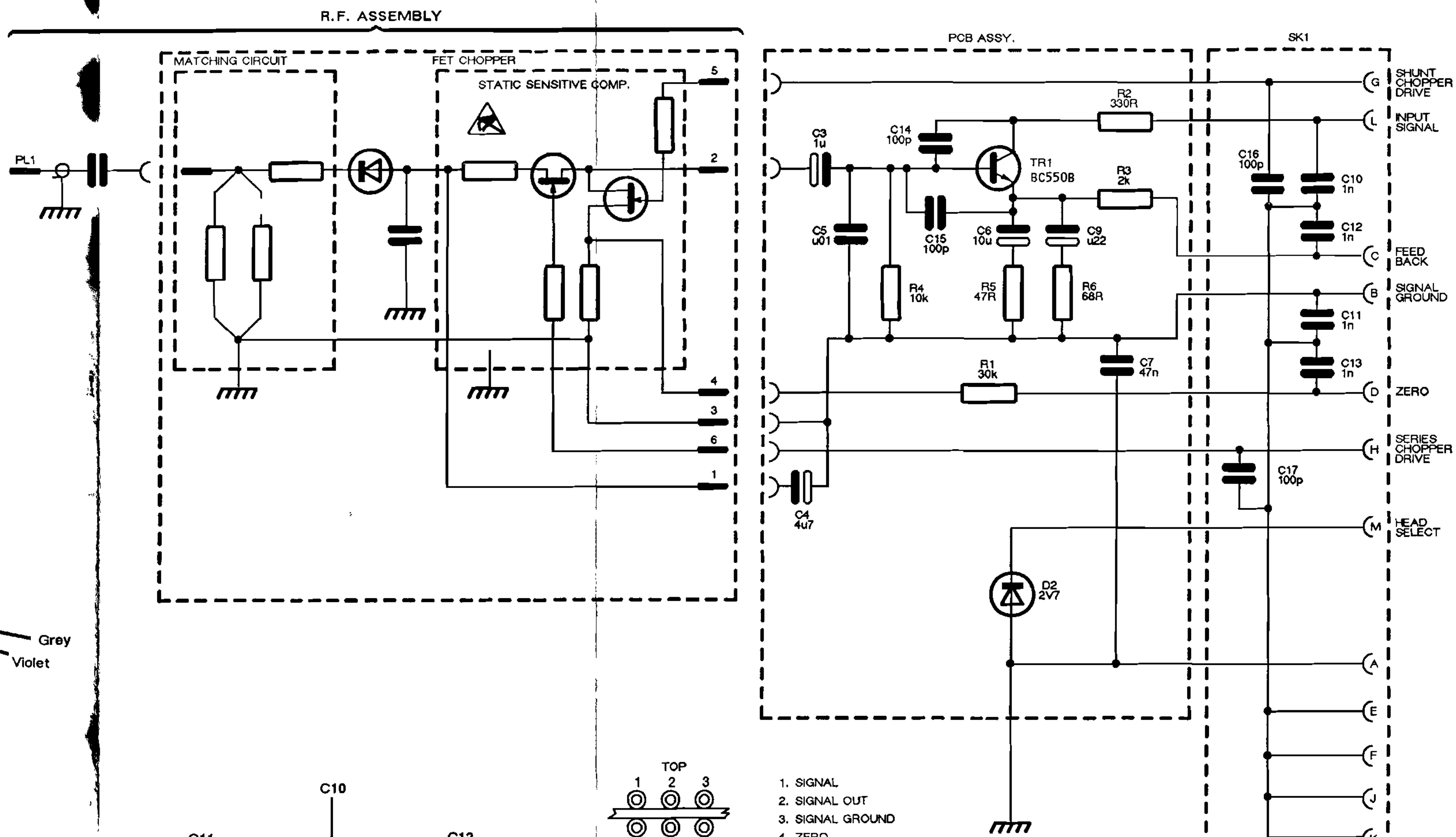
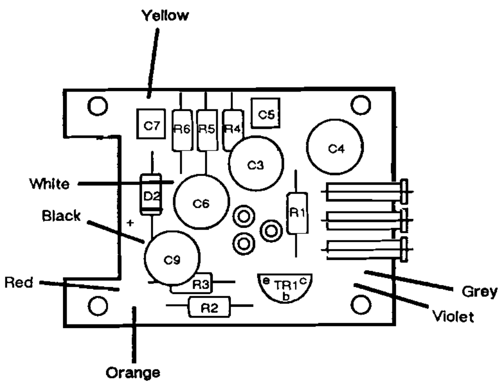
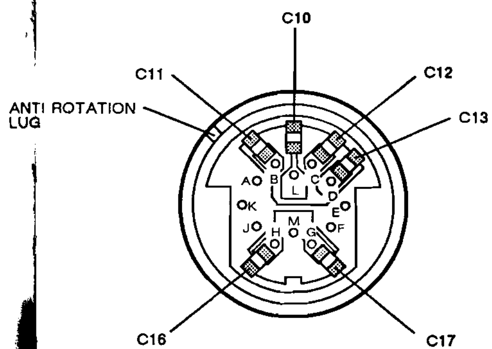




Amplifier p.c.b.



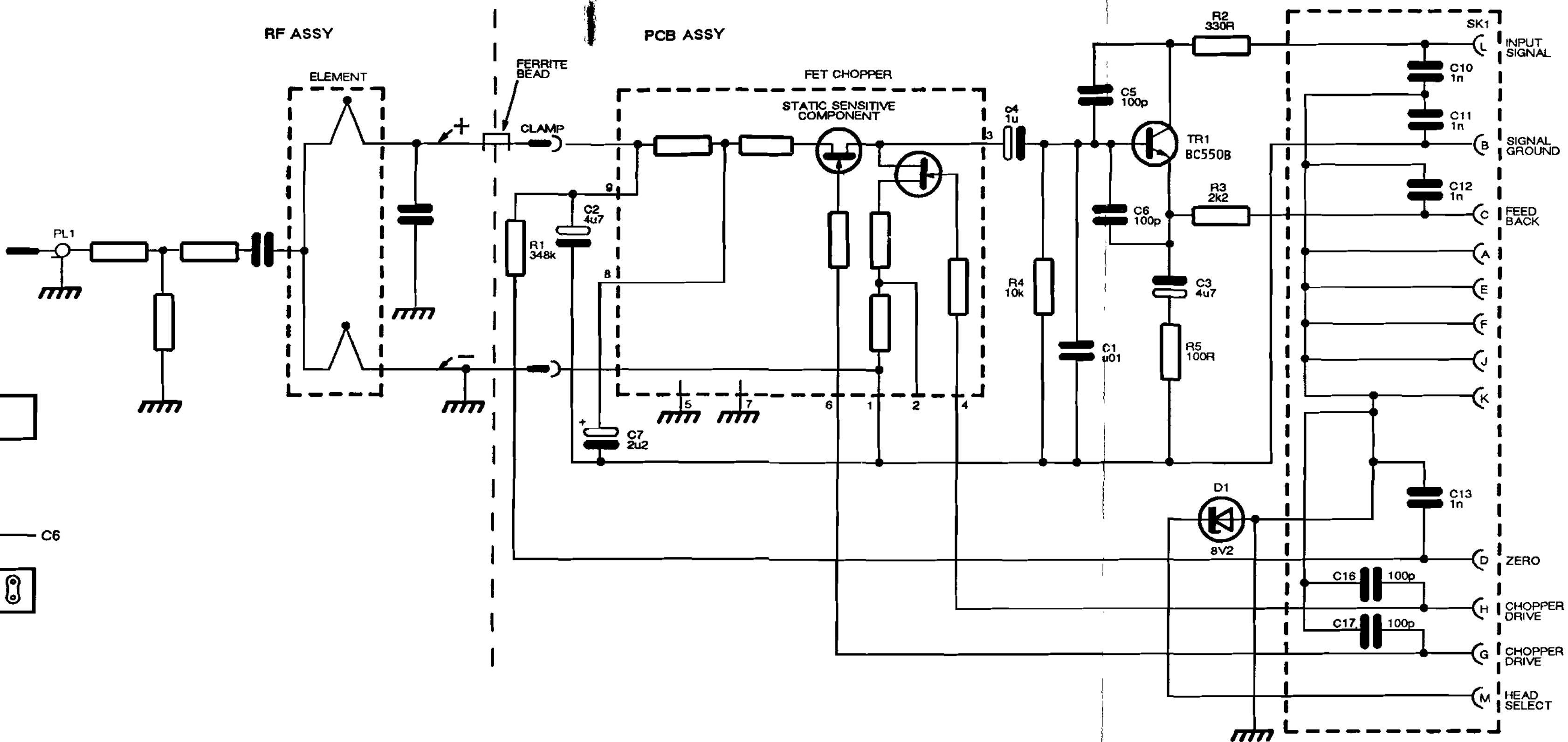
SK1 assembly

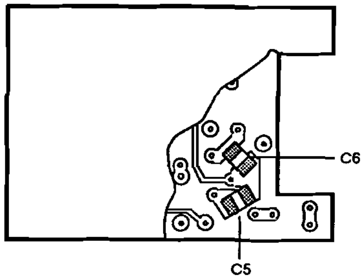
END VIEW OF PCB

1. SIGNAL
2. SIGNAL OUT
3. SIGNAL GROUND
4. ZERO
5. SHUNT CHOPPER DRIVE
6. SERIES CHOPPER DRIVE

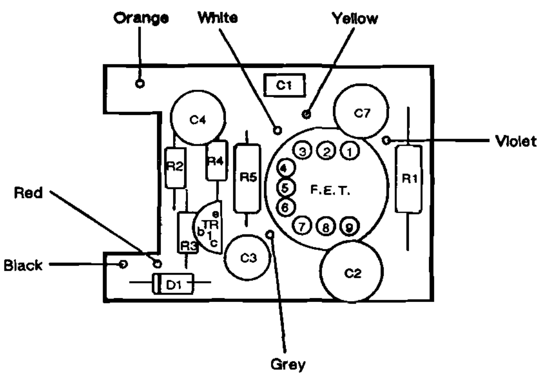
CONNECTIONS P.C.B. ASSEMBLY TO R.F. ASSEMBLY

Fig. 7-4 Circuit diagram and component layout: 6920

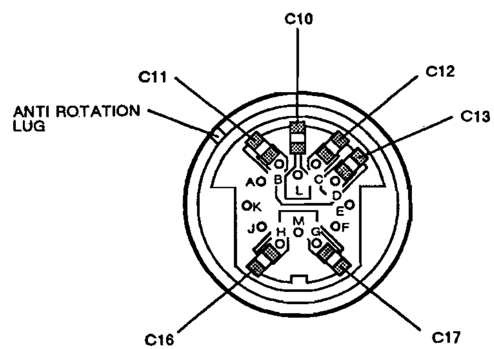




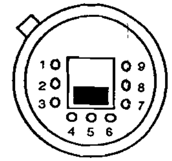
PART VIEW - TRACK SIDE



Amplifier p.c.b.

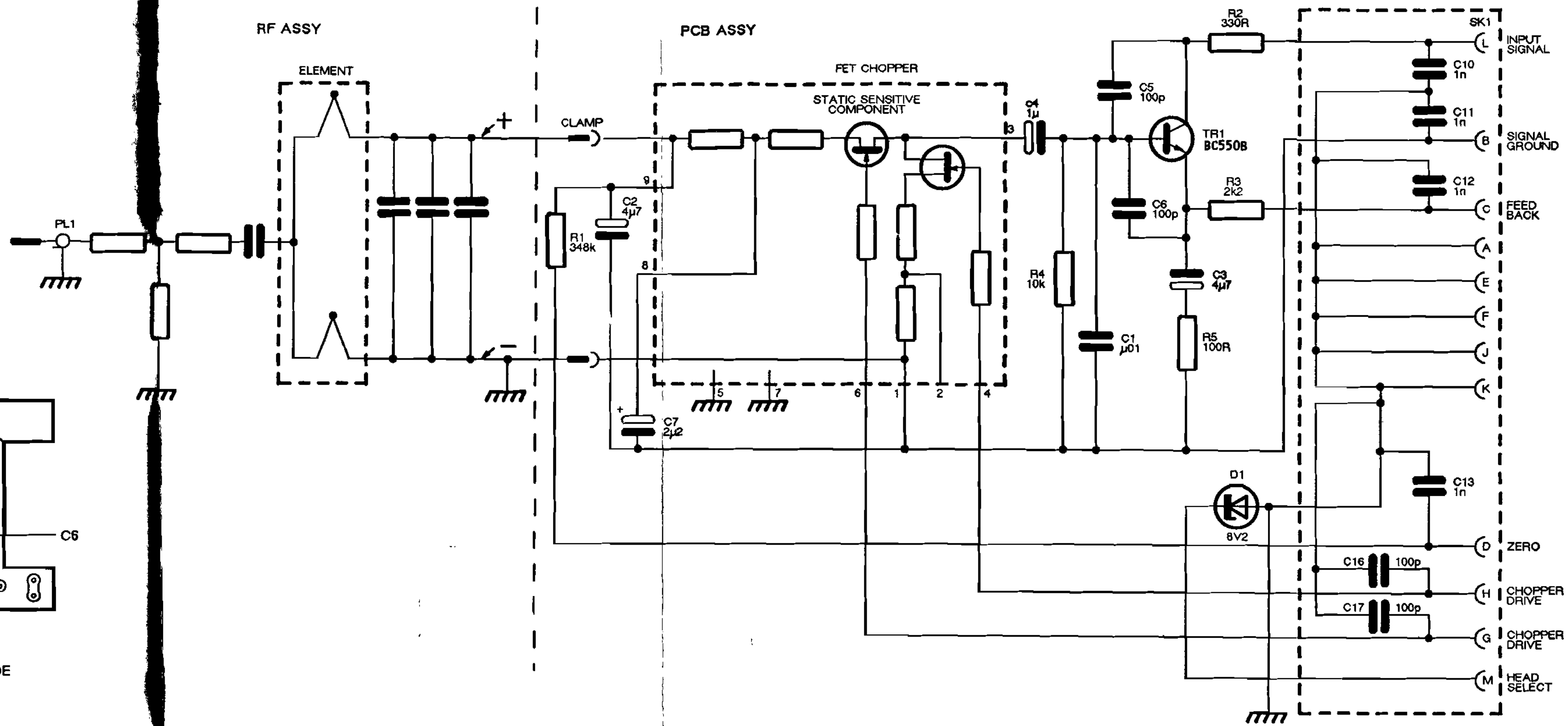


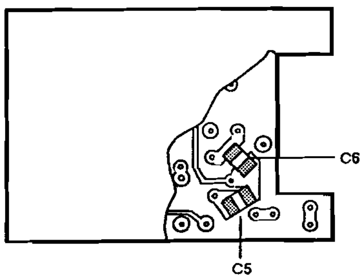
SK1 assembly



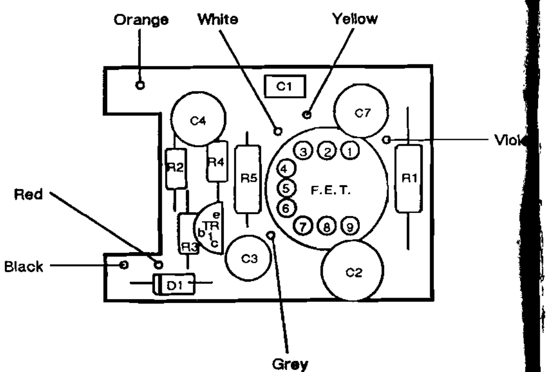
FET CHOPPER PIN LAYOUT

Fig. 7-5 Circuit diagram and component layout: 6930

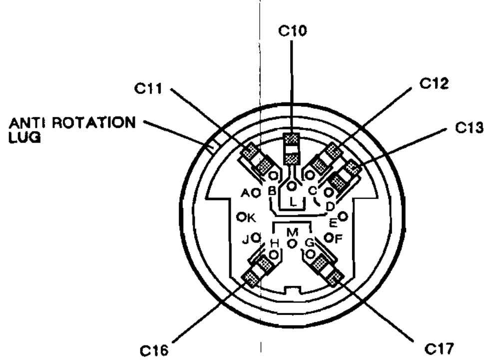




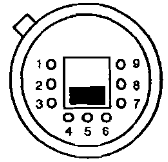
PART VIEW - TRACK SIDE



Amplifier p.c.b.



SK1 assembly



FET CHOPPER PIN LAYOUT

Fig. 7-6 Circuit diagram and component layout: 6932.

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