

**A precision Power Meter with comprehensive GPIB facilities for ATE requirements and standard bench applications**



- **Extensive frequency coverage: 30 kHz to 46 GHz**
- **Wide dynamic range: -70 dBm (100 pW) to +44 dBm (25 W)**
- **Fast response on GPIB of 25 ms**
- **Auto averaging with manual override**
- **Both 50  $\Omega$  and 75  $\Omega$  sensors**
- **Low sensor VSWR reduces measurement uncertainty**
- **Sensor linearity correction for improved accuracy**
- **Maximum hold facility**
- **Optional DC operation**
- **Non-volatile memory**

The 6960B RF Power Meter is a high accuracy instrument which together with its associated power sensors provides measurements at frequencies from 30 kHz up to 46 GHz over a wide range of power levels. Its numeric keyboard enables easy manual control while full GPIB implementation with SRQ mask and trigger modes make it the logical choice for fast ATE systems.

#### **Meter Accuracy**

The 6960B features an instrumentation accuracy of better than  $\pm 0.5\%$  in linear mode and  $\pm 0.02$  dB in logarithmic mode. A special auto zero circuit digitally stores the zero offset for each of the five ranges, thus reducing zero carry over errors to  $\pm 0.03\%$  and providing a zero accuracy of  $\pm 1\%$  of FSD on the most sensitive range for any sensor type.

#### **High Accuracy**

All power sensors are provided with detailed

calibration data to 0.01% resolution. In addition to Calibration Factor data, each sensor is individually calibrated for linearity. When entered into the power meter, this data reduces linearity errors to less than  $\pm 0.5\%$  even on the highest range.

#### **Precision Calibration Attenuators**

The 6920 series of high sensitivity power sensors are supplied with a precision 30 dB attenuator for calibrating to the internal power reference. These attenuators have an accuracy of  $\pm 0.05$  dB at 50 MHz to provide high calibration accuracy.

#### **Duty Cycle Correction**

Although the 6960B is a true average power measuring instrument, it may still be used for pulsed power measurements. The duty cycle of the signal to be measured may be entered in the range 100 to 0.001%. The power meter calculates the peak power by dividing the measured average power by the duty cycle.

#### **Relative Measurements**

The dB REL key enables the measurement of high powers by entering the calibrated value of an attenuator or coupler directly as a negative number. Positive relative values to account for amplifier gains can also be entered. The dB offset facility may be used with linear units so that transmitter output powers can be displayed in Watts.

#### **Two Power-Up Modes**

The instrument is provided with two power-up modes. For production line testing, or applications in power monitoring at unattended sites, power-up mode 2 returns the instrument to its previous settings after switch-off or a power failure. Power-up mode 1 sets all the instrument functions to default values.

#### **Two Proportional Voltage Outputs**

Two analog voltage outputs proportional to RF input power are provided on the rear panel. The Recorder Output offers the full 50 dB dynamic range of the instrument in the dB mode at 1 volt/decade for wide range power measurements. In the Watts mode this output provides 0 to 5 V linear voltage proportional to the RF input power.

The fast Levelling Output provides 1 V per range for effective power levelling of sweepers or signal sources. The calibration and linearity correction data from the sensor are traded off for a fast response. For semi-automated testing, a rear panel BLANKING output is provided to turn off a source or

sweep generator during AUTO ZERO operation of the meter.

### Ease of Use

With its conventional calculator style keyboard, changing parameters is both precise and obvious to the new user. Displayed units may be either linear (mW) or logarithmic (dBm). Applications which require circuit adjustments to optimise output or tune for a null are conveniently achieved with the analog meter. Automatic signal averaging is provided as auto ranging. The power meter selects the most appropriate amount of averaging in conjunction with the range in use.

### External DC Operation

For operation in remote locations and for certain military applications an optional external DC supply input is available. Any voltage within the range 11 to 32 volts can be accepted, operation from a vehicle DC supply is thus possible.

### Optimum Noise Operation

For applications needing a fast response on a sensitive range, the user can trade off resolution for speed by entering a lower average number. The 6960B accepts average numbers between 1 and 256, so optimum noise reduction or required response time are always available.

### Non-Volatile Memory

Nine non-volatile stores are available for storing complete instrument settings.

### Maximum Hold

Long term drift measurements are easily made with the 'maximum hold' facility which enables the maximum value of a changing signal to be retained.

### Automatic Sensor Recognition

The power meter contains a special sensor recognition circuit so that the correct scaling is selected automatically when the power sensor is connected.

### GPIB Operation

6960B has been specifically designed with the requirements of the ATE system designer in mind. The GPIB interface has been optimized both in terms of hardware and software allowing greater speed in measurements with selectable resolution. Up to 40 readings per second are possible. The GPIB program codes feature simple mnemonics, requiring either a single digit number entry with no terminator or floating point entry requiring a terminator.

### Six Trigger Modes

Specific GPIB program codes include TR-trigger mode. This sets the trigger mode or starts a measurement after a hold condition. Up to six trigger modes are available from the 6960B, from free running fast to an immediate trigger with settling time then hold.

### SRQ Response

To the system user, the SRQ response is always important and in the 6960B the SRQs have been arranged to form a mask with each SRQ option having a binary weighting: 1 on end of measurement, 2 on error, 4 on end of GPIB operation. SRQ option 4 is useful to inform the controller that the requested GPIB operation such as Autozero has been executed.

### Self-Test

Self-test is initiated when the instrument is switched on and the validity of the information in the non-volatile memory is automatically checked. The LCD alpha-numerics and annunciators can also be verified using a coded key press.

### Reliability

The 6960 series has a proven record of high reliability. Data from service records show its actual mean time between failures (MTBF) to exceed 120,000 hours. Conservative component ratings, liquid crystal display and switch mode power supply for low internal heat generation, contribute to this excellent reliability. Consequently, a two year warranty is offered as standard with an optional third year warranty available at the time of initial order.

### Fast and Easy Servicing

To make servicing easy and fast, careful thought has led to a simple arrangement of components and adjustments. Selective key switch operations can access the filter and digital to analog converters to check their operation, eliminating the need for a range calibrator. The only test equipment required to assist servicing is a counter-timer, digital voltmeter and screwdriver.

### Low Cost of Ownership

Due to the modular design with good accessibility, mean time to repair (MTTR) is just 20 minutes thus keeping the cost of ownership low for the entire life of the instrument.

## Specification

### FREQUENCY RANGE

30 kHz to 46 GHz depending on sensor used.

### POWER RANGE

-70 dBm (100 pW) to +44 dBm (25 W) depending on sensor used.

### POWER REFERENCE

0 dBm (1 mW), 50 MHz, Type N female precision connector, 50  $\Omega$ .  
Adapters are supplied for other connectors with the power sensor.

### Uncertainty

$\pm 0.7\%$  traceable to National Standards.

### Accuracy

$\pm 1.2\%$  worst case for one year.

### DISPLAY

Four digit LCD.  
Over-range, Remote, Peak, Under-range, dB, dBm, dB REL, nW to kW, Zero.

### INSTRUMENTATION ACCURACY

Watts mode	dBm mode	dB REL mode
$\pm 0.5\%$	$\pm 0.02$ dB.	$\pm 0.02$ dB.

### ZERO

**Set**  $\pm 1\%$  of FSD on most sensitive range.

**Carryover**  $\pm 0.03\%$  of FSD (when zeroed on most sensitive range).

**Drift**  $\pm 0.1\%$  of FSD ( $\pm 2\%$  6920 series) on range 1 (most sensitive) over 1 hour at constant temperature after 24 hour stabilization.  
Decrease by factor 10 for each higher range.

### NOISE

Less than 1% of FSD (2% for 6920 series) for most sensitive range with an average factor greater than 19.

## OUTPUTS (BNC socket)

### Fast levelling

0 to 1 V each range, 1 k $\Omega$  impedance, excludes correction for Cal Factor, Linearity Factor and Average Number. (For external levelling of RF source.)

### Recorder

$\pm 1\%$ .  
dB mode: 1 V/decade, 7 V maximum on range 5.  
Watts mode: 5 V linear.  
Fully corrected for Cal Factor, Linearity Factor and Average Number (For plots of the full 50 dB dynamic range).

### Blanking

Maximum voltage: 25 V Maximum current: 50 mA, open collector, short circuit for blank.

## RESPONSE TIME

**Range 1 (most sensitive)** 1 s, selectable.

**Ranges 2 to 5** 250 ms (display update), selectable 25 ms using GPIB.

## GENERAL

### GPIB INTERFACE

GPIB unit built into instrument if option 001 is ordered.  
All front panel functions are remotely programmable except for test modes.

### KEY FUNCTIONS

#### Units

Selects either linear (mW) or logarithmic (dBm) units with toggle action.

#### dB Rel

Displays current offset which may be entered in range -99 to +99 dB.

#### Store & Recall

Stores up to 9 complete instrument settings for any set-up condition (eg Cal Factors at different frequencies); store 0 contains instrument settings prior to last power down.

#### Max Hold

Retains maximum reading of changing signal. When enabled, units annunciators flash.

#### Range

Displays current range in use; 'Au' denotes auto ranging, 'Hd' indicates held range. Any range may be selected and held at any time.

### Averaging

Enables any integer number in the range 1 to 256 to be set. In Auto Averaging mode the following response times are obtained:

Range	Average No.	Response Time
5	1	0.25 s
4	1	0.25 s
3	4	1 s
2	20	5 s
1	50	12.5 s

### Power Up

Displays power-up mode currently in use. In power-up mode 1, instrument assumes default settings. Power-up mode 2 reinstates the settings in use at power down.

### Linearity Factor

Provides data entry for individual sensor linearity data to improve accuracy.

### Duty Cycle

Enables entry of duty cycle of pulsed signal in range 100% to

0.001%. The 6960B calculates the peak value of the pulsed signal from the average power measured by the sensor.  
'Peak' annunciator displayed when duty cycle <100%.

### Calibration Factor

Allows entry of sensor calibration factor in range 100% to 0.001 %.

### Local

Returns instrument to 'local' front panel operation when remotely addressed unless 'local lock out' is employed. In manual operation, displays current GPIB address.

### Auto Zero

Initiates zero routines to store zero offset for each of the 5 ranges.

### Auto Cal

Initiates self-calibration routine after connection of sensor to Power Reference.

### Power Ref

Toggles internal 0 dBm (50 MHz) power reference on and off.

### Resolution

Resolution may be changed by altering the Average Number in the following format:-

Range	Resolution (dB)	0.1	0.01	0.001
		Average Number		
5 (highest power)		1	4	4
4		1	1	4
3		1	1	4
2		1	4	20
1 (lowest power)		4	20	50

## ENVIRONMENTAL

### Operating Temperature

0°C to 55°C.

### Storage Temperature

-40°C to +70°C.

### Storage Humidity

Up to 95% relative humidity at 35°C.

### Altitude

Up to 2500 m (pressurized freight at 27 kPa differential, i.e. 3.9 lb/in<sup>2</sup>).

## ELECTROMAGNETIC COMPATIBILITY

Conforms with the protection requirements of the EEC Council Directive 89/336/EEC. Conforms with the limits specified in the following standards:  
IEC/EN61326-1 : 1997, RF Emission Class B, Immunity Table 1, Performance Criteria B

## SAFETY

Conforms with the requirements of EEC Council Directive 73/23/EEC and Standard IEC/EN 61010-1 : 1993  
Complies with IEC 348 , HD 401 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

## POWER REQUIREMENTS

### AC supply

Switchable voltage ranges: 105 to 120 V  $\pm 10\%$ , 210 to 240 V  $\pm 10\%$ , 45 to 440 Hz. 25 VA maximum. 15 VA typical.

### DC supply (option 004 only)

**Input voltage** Operates from 11 V to 32 V DC.

The instrument resets below 11 V. Input fuse 3.15 A time-lag.

**Power consumption** Less than 15 W.

## DIMENSIONS AND WEIGHT (over projections)

Height	Width	Depth	Weight
108 mm	256 mm	369 mm	3.3 kg
88 mm	216 mm	excluding feet and handles.	

## Versions and Accessories

When ordering please quote the full ordering number information.

### Ordering Numbers

#### Versions

6960B RF Power Meter

#### Options (Options must be specified at the time of ordering)

Option 001 GPIB.  
Option 002 Rear sensor input.  
Option 003 Storage pouch mounted on top of instrument.  
Option 004 External DC operation.

#### Supplied with

46882/124 AC Supply Lead.  
46882/123 Instruction Manual H6960B (Vol. 1).  
43138/663 Summary Card.  
43138/663 1.5 m Power Sensor Cable  
43138/154 DC Supply Lead (Option 004 only)

#### Accessories

54417/002 Waveguide 22 to 2.92 mm coax transition.  
43138/664 3 m Power Sensor Cable.  
43138/665 10 m Power Sensor Cable.  
43138/666 25 m Power Sensor Cable.  
43138/667 50 m Power Sensor Cable.  
46884/501 Rack Mounting Kit (Double Unit –3U High).  
46884/500 Rack Mounting Kit (Single Unit –2U High).  
54124/022 Stowage Cover.  
46881/365 GPIB Manual H54811-010.  
46882/125 Service Manual (H6960B Vol. 2).

#### POWER SENSORS - STANDARD

56910/900 10 MHz to 20 GHz (-30 dBm to +20 dBm) Type N.  
56911/900 10 MHz to 20 GHz (-30 dBm to +20 dBm) APC 7.  
56912/900 30 kHz to 4.2 GHz (-30 dBm to +20 dBm) Type N.  
56913/900 10 MHz to 26.5 GHz (-30 dBm to +20 dBm) MPC 3.5.  
56914/001 10 MHz to 40 GHz (-30 dBm to +20 dBm) 2.92 mm.  
56914/002 10 MHz to 40 GHz (-30 dBm to +20 dBm) 2.92 mm  
plus waveguide 22 coax transition and calibration table.  
56914/003 10 MHz to 46 GHz (-30 dBm to +20 dBm) 2.92 mm.  
56919/900 75 Ω 30 kHz to 3 GHz (-30 dBm to +20 dBm) Type N

#### POWER SENSORS - LOW POWER

56920/900 10 MHz to 20 GHz (-70 dBm to -20 dBm) Type N.  
56923/900 10 MHz to 26.5 GHz (-70 dBm to -20 dBm) MPC 3.5  
56924/001 10 MHz to 40 GHz (-70 dBm to -20 dBm) 2.92 mm.  
56924/002 10 MHz to 40 GHz (-70 dBm to -20 dBm) 2.92 mm  
plus waveguide 22 coax transition and calibration table  
56924/003 10 MHz to 46 GHz. (-70 dBm to -20 dBm) 2.92 mm.

#### POWER SENSORS - HIGH POWER

56930/900 10 MHz to 18 GHz (-15 dBm to +35 dBm) Type N.  
56932/900 30 kHz to 4.2 GHz (-15 dBm to +35 dBm) Type N.  
56934/001 10 MHz to 40 GHz (-15 dBm to +30 dBm) 2.92 mm  
56934/002 10 MHz to 40 GHz (-15 dBm to +30 dBm) 2.92 mm  
plus waveguide 22 coax transition and calibration table  
56934/003 10 MHz to 46 GHz (-15 dBm to +30 dBm) 2.92 mm  
56930/002 10 MHz to 18 GHz (-5 dBm to +44 dBm) Type N  
56932/002 30 kHz to 4.2 GHz (-5 dBm to +44 dBm) Type N

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