

INSTRUCTION MANUAL

9240 SERIES

RF VOLTMETER

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Boonton 9240 Series RF Voltmeter

INSTRUCTION MANUAL, 9240 SERIES RF VOLTMETER

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P/N 98406900B

This manual covers instrument serial numbers: 11001 and higher.

Boonton 9240 Series RF Voltmeter

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation and maintenance of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Boonton Electronics assumes no liability for the customer's failure to comply with these requirements.

THE INSTRUMENT MUST BE GROUNDED

To minimize shock hazard the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a NEMA three conductor, three prong power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to a two-contact adapter with the (green) grounding wire firmly connected to an electrical ground in the power outlet.

DO NOT OPERATE THE INSTRUMENT IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with the power cable connected. Under certain conditions dangerous voltages may exist even though the power cable was removed, therefore; always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Do not install substitute parts or perform any unauthorized modifications on the instrument. Return the instrument to Boonton Electronics for repair to ensure that the safety features are maintained.

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SAFETY SYMBOLS



This safety requirement symbol (located on the rear panel) has been adopted by the International Electro-technical Commission, Document 66 (Central Office) 3, Paragraph 5.3, which directs that an instrument be so labeled if, for the correct use of the instrument, it is necessary to refer to the instruction manual. In this case it is recommended that reference be made to the instruction manual when connecting the instrument to the proper power source. Verify that the correct fuse is installed for the power available.



The CAUTION symbol denotes a hazard. It calls attention to an operational procedure, practice or instruction that, if not followed, could result in damage to or destruction of part or all of the instrument and accessories. Do not proceed beyond a CAUTION symbol until its conditions are fully understood and met.



The NOTE symbol is used to mark information which should be read. This information can be very useful to the operating in dealing with the subject covered in this section.



The HINT symbol is used to identify additional comments which are outside of the normal format of the manual, however can give the user additional information about the subject.

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1. General Information

This instruction manual provides general information, installation and operating instructions for the Model 9240 Series of RF Voltmeters. The 9240 Series includes single channel Model 9241 and dual channel Model 9242. The terms 9240 and Model 9240 used throughout this manual refer to both configurations unless otherwise noted.

1.1 Organization

The manual is organized into seven sections and three Appendices, as follows:

Section 1 - General Information presents summary descriptions of the instrument and its principal features, accessories and options. Also included are specifications for the instrument.

Section 2 - Installation provides instructions for unpacking the instrument, setting it up for operation, connecting power and signal cables, and initial power-up.

Section 3 - Getting Started describes the controls and indicators and the initialization of operating parameters. Several practice exercises are provided to familiarize you with essential setup and control procedures.

Section 4 - Operation describes the display menus and procedures for operating the instrument locally from the front panel.

Section 5 - Remote Operation explains the command set and procedures for operating the instrument remotely over GPIB bus.

Section 6 - Maintenance includes procedures for installing software and verifying fault-free operation.

Section 7 - Appendix A - Error Messages defines the messages that are displayed when errors occur.

Section 8 - Appendix B - Warranty and Repair Policy states the policies governing the return and replacement of modules and instruments during and after the warranty period.

Boonton 9240 Series RF Voltmeter

1.2 Description

The Model 9240 is a DSP (digital signal processor) based RF Voltmeter capable of measuring RF voltage levels from 200 microvolts to 300 volts (probe dependent) over a frequency range from 10 Hz to 2.5 GHz (probe dependent). The voltage levels can be displayed in V, mV, dBV or dBmV. When the measured voltage is across a known impedance (5 ohms and 2500 ohms), the calculated power can be displayed in dBm or dBW.

1.3 Features

- *Software.* A 32-bit Digital Signal Processor running control software provides display, I/O and system memory functions for the instrument. Software updates are easily made using either the GPIB or RS232 interfaces.
- *Alphanumeric Display.* The alphanumeric LCD provides clear, unambiguous readouts of the instrument's setup and measurement values. Simultaneous display of both channels is available in dual channel mode. A bar graph provides a display of the channel's measured value for nulling and peaking applications.



Figure 1-1. 9240 Series RF Voltmeter

Boonton 9240 Series RF Voltmeter

- *Dual Independent Channels.* When equipped with the optional second measurement channel, the instrument can display two CW signals simultaneously. Each channel is calibrated and all channel parameters are channel-independent.
- *Selectable Ranging.* Any of eight measurement ranges, or autoranging, can be selected during instrument setup. The selection will be held until it is changed, or until the instrument is turned off. When measuring signals with levels that fall within a narrow range, selecting one specific instrument range may reduce measurement time. Autoranging is useful if the RF signal level is unknown, or if RF signals with widely varying levels are to be measured.
- *Selectable Filtering.* Measurement speed and display stability can be optimized through the use of selectable filtering. Filter times can be adjusted up to 20 seconds maximum in 50 millisecond increments.
- *Zeroing.* Automatic zeroing (nulling of offsets for the voltage probe and input channel) is done independently on each range to eliminate zero carryovers.
- *Wide Frequency Range.* The calibrated frequency range of the instrument is determined by the probe model used. The 952001B standard RF Probe provides calibrated measurements from 10 kHz to 1.2 GHz with usable indications beyond 4 GHz. The optional 952016 low frequency RF Probe provides calibrated response from 10 Hz to 100 MHz.
- *Calibration Storage.* Shaping and calibration data for each probe is contained in EEPROM within its 951090 Sensor Data Adapter. When the probe with its Data Adapter is plugged into the 9240 RF Voltmeter, the shaping and calibration data is downloaded and applied to the measurement automatically. It is not necessary to enter any data manually. Existing voltage probes can be used with the 9240 by loading a blank Data Adapter with calibration data. No further calibration of the probe is needed.
- *Voltage Range.* The 9240 uses three internal hardware ranges to achieve a dynamic range of 90 dB. The input levels can range from less than 200 microvolts to 10 volts. Display resolution is selectable to 0.001 dB. Using the appropriate 100:1 Voltage Divider accessory, the voltage range can be extended to 300 Volts. For the 952001 RF Probe, use adapter Model 952005 to extend the voltage range to 300 V over a frequency range of 50 kHz to 700 MHz. For the purpose of compatibility with previous models and preexisting calibration procedures, the input range is divided into 8 virtual ranges which correspond to previous practice.
- *True RMS Response.* The waveform response of the RF voltage probe is true RMS for voltages below 30 mV. This characteristic provides accurate measurements for all types of waveforms with levels up to 30 mV or 3 V with the appropriate 100:1 Voltage Divider. The waveform response of the probe gradually changes to a peak detecting response above 30 mV. Computer generated shaping allows the instrument to display RMS readings above 30 mV. This is valid for nearly sinusoidal waveforms. For modulated signals, accurate results can be obtained at high levels if the modulation envelope is relatively flat, (e.g. FM, QPSK). For other modulation types (e.g. Am, Pulse, CDMA), accurate results can be obtained below 30 mV. The equivalent peak sinewave voltage can be displayed. It is 1.414 times the RMS voltage and 3.01 dB greater than the reading in decibel units.
- *Low Noise.* The 9240 has been designed and constructed to minimize noise from all sources. A line filter and RF tight enclosure reject outside interference. The probe cables are a special low noise design; vigorous flexing causes only minor disturbances, even on low level measurements. Non-microphonic probes are used to lessen probe sensitivity to shock and vibration.

Boonton 9240 Series RF Voltmeter

- *Simple Instrument Setup and Operation.* The front panel conductive rubber keypad provides access to menus which control instrument operation. The MENU key selects channel, setup and diagnostic menus. The <SENSOR> key selects sensor related function. The <AVG> key selects filter time averaging controls. Setting the filter time to zero will select the auto-filter mode. This selects an appropriate filter time without operator intervention. The <REF LEVEL> key is used for making relative measurements in dBr or percent. The values for these parameters are displayed and can be adjusted by using the arrow and enter keys.
- *One key press operations.* To provide for ease of use operation of the instrument functions that are used often, they can be performed with a single push of a button. Common operations such as Zeroing the channel calibration and setting a Reference Level can be done simply by pressing the <Zero> and <REF Level> key respectively.

Zero – When measuring low level signals it is important to zero the channel prior to measuring the signal. When the Active Channel is measuring levels below approximately -50 dBm, depressing the <Zero> key will use the measured reading as the zero offset. This allows for fast zeroing of the channel so that the needed measurement can be performed faster.

The Zero sub-menu can be displayed by first pressing the Menu key followed by the <Zero> key. From there the user chooses the channel to perform a zeroing operation on.

REF Level – Often relative measurements are required especially when measuring system gains and losses. One key press of the <Ref Level> key makes this job easier and faster to perform. Simply connect the active channel's sensor to the input signal of the system under test. Press the <Ref Level> key and the reference level is set! Next, connect the sensor to the system output and read the gain or loss directly from the reference level measurement.

The REF Level sub-menu can be displayed by first pressing the <Menu> key followed by the <REF Level> key. From there the user may LOAD or SET the reference level on either channel.

- *Chart Recorder Output.* A 0 to 10 volt dc output, proportional to the measurement values is available for application to a chart recorder. The Recorder Output is selectable to track either channel 1, channel 2 or the active channel. The Chart Recorder Output is a BNC connector located on the rear panel.
- *Flexible Remote Control.* All instrument functions except power on/off can be controlled remotely via the standard GPIB bus interface or RS232 connection. Setup of interface parameters is menu driven; front panel indicators keep the user informed of bus activity. Remote control programming is performed using industry-standard SCPI programming syntax. The 9230 emulation mode is provided for users that prefer back compatibility with legacy Boonton products such as the 9230 series line of RF Voltmeters.
- *Stored Configurations.* For applications in which the same instrument configurations are used repeatedly, up to 10 complete setups can be stored and recalled.
- *HIGH/LOW Limit Alarms.* The ALARM function provides a means to monitor the power level in each channel independently. When the ALARM is "ON" (enabled) the level on the channel is continuously compared with the HI and LO Limit values. The 9240 sets indicator flags (up and down arrows) on the channel display when the limit values are exceeded. There are 4 status bits in the Operation Condition register byte which, when unmasked, can be used to request service over the IEEE-488 interface bus when the selected alarm condition occurs. Note that choosing overlapping limit conditions is not an error, but may result in confusing alarm indications.

Boonton 9240 Series RF Voltmeter

1.4 Accessories

Optional 9240 accessories that can be ordered from Boonton Electronics. A Sensor Data Adapter for each channel installed along with the AC power cord is supplied with the instrument. One or more Boonton 952000 series RF Voltage Probes is required and must be ordered separately. Probes are available with accessory kits and are sold separately. Additional available accessories are summarized in Table 1-1.

Table 1-1 Accessories for the 9240 Series

Selection	Part Number	Description
Standard	95109101A	Data Adapter with 5 ft (1.27 m) cable
	56810400A	Line Cord (US)
	98601300x*	Manual CD, Boonton Measurement Instruments (CD-ROM) (x* - denotes revision level)
Optional	952063	Standard RF Probe Kit, 10 kHz to 1.2 GHz Includes: 952001 RF Probe 95200201B 50 Ohm BNC(F) Adapter 95200401A Probe tip 95200501A 100:1 Voltage Divider 41-2A Probe Cable, 5 ft (1.5m)
	952064	Low Frequency Probe Kit, 10 Hz to 100 MHz Includes: 952016 Low Frequency RF Probe 95200201B 50 Ohm BNC(F) Adapter 95200401A Probe tip 95205801A 100:1 Voltage Divider
	95201102A	50 Ohm Accessory Kit for 952001B RF Probe Includes: 95200301A 50 Ohm Type N Tee Adapter. 95200801B Unterminated BNC Adapter (Female) 95201301A Accessory Case 95202801A Model 91-15A 50 Ohm Termination
	95201202A	75 Ohm Accessory Kit for 952001B RF Probe Includes: 95200701A 75 Ohm Tee Adapter 95200801B Unterminated BNC Adapter (Female) 95201301A Accessory Case 95202901A Model 91-15A/1 75 Ohm Termination
	95202801A	Model 91-15A 50 Ohm Termination
	95202901A	Model 91-15A/1 75 Ohm Termination
	95200301A	50 Ohm Type N Tee Adapter
	95200501A	Model 91-7C 100:1 Voltage Divider
	95200601B	75 Ohm BNC Adapter for use up to 500 MHz
	95200701A	75 Ohm Type N Tee Adapter
	95200801B	Unterminated BNC Adapter (Female)

Boonton 9240 Series RF Voltmeter

Table 1-1 Accessories for the 9240 Series (*continued*)

Selection	Part Number	Description
Optional		
	545504000	Fuse, 0.5A 250V
	95401501A	Rack Mounting Kit
	95403001A	Rack Mounting Kit (Brackets only)
	95403003A	Rack Mounting Kit (Brackets with handles)
	95109102A	Data Adapter with 10 ft (2.54 m) cable
	95109103A	Data Adapter with 20 ft (5.05 m) cable
	95109104A	Data Adapter with 50 ft (12.7 m) cable
	95109105A	Data Adapter with 100 ft (25.4 m) cable
	95109001A	Voltage Probe Data Adapter – with connector for 41-2A cable
	41-2A	Voltage Probe Cable – 5ft (1.27 m)
	41-2A/10	Voltage Probe Cable – 10ft (2.54 m)
	41-2A/20	Voltage Probe Cable – 20ft (5.05 m)
	41-2A/50	Voltage Probe Cable – 50ft (12.7 m)
	41-2A/100	Voltage Probe Cable – 100ft (25.4 m)
	95004701A	F/F Adapter, 41-2A (for connecting Model 41-2A cables end to end)
	95004901A	Bulkhead Connector F/F, 41-2A (for connecting Model 41-2A cables end to end)
	95201301A	Accessory Case
	98406900A	Instruction Manual 9240 Series, <i>English</i> (Printed w/binder)
Probes		
	952001	RF Probe - 10 kHz to 1.2 GHz
	952016	Low Frequency RF Probe - 10 Hz to 100 MHz

1.5 Models, Options and Configurations

Model 9241. One measurement channel; channel input connector located on the front panel.

Model 9242. Two measurement channels; channel input connectors located on the front panel.

Opt -01. Rear Panel Channel input(s).

Opt -30. Warranty option: Extend factory warranty to 3 years

Option designations are appended to the instrument's base model number. For example, Model 9242-01 would be a two-channel instrument with channel input connectors all on the rear panel.

Specials. Custom configurations have –S/*n* appended to the model number, where *n* is a unique number.

Boonton 9240 Series RF Voltmeter

1.6 Specifications

Performance specifications for the 9240 Series are listed in Table 1-2.

Table 1-2 9240 Series Performance Specifications
(Specifications are subject to change without notice)

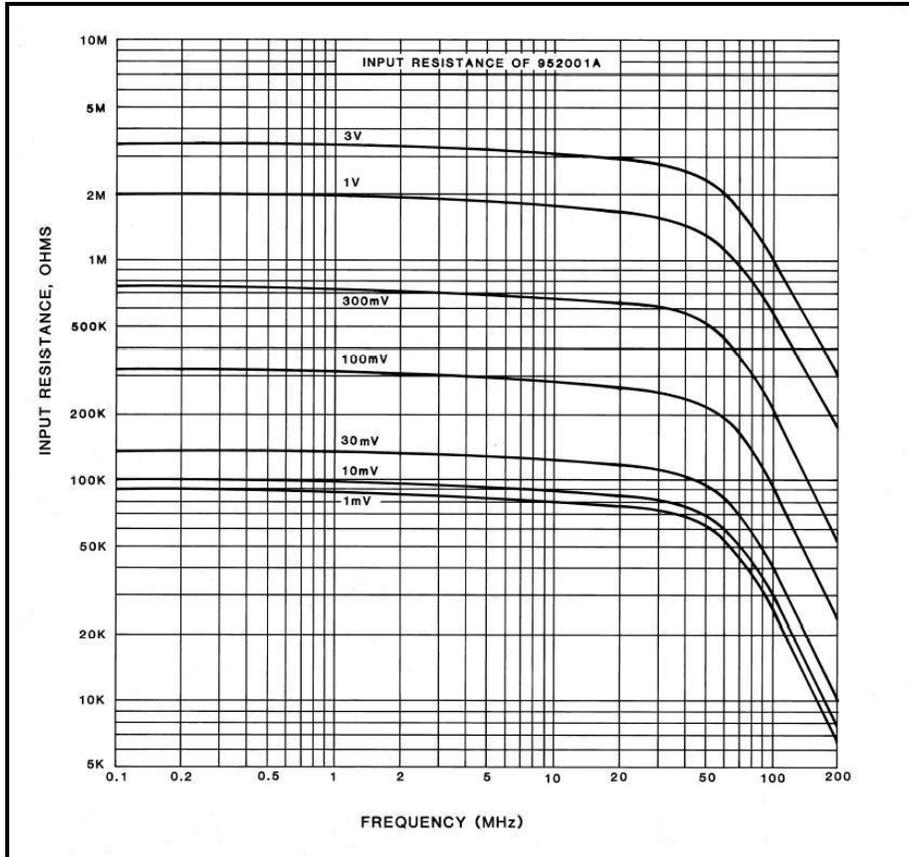
VOLTAGE PROBE INPUTS

Frequency Range:	10 Hz to 1.2 GHz ¹	(¹ Voltage Probe dependant)
Voltage Range:	200 μ V to 10V	
Dynamic Range:	90 dB	
Waveform response:	RMS to 30mV, calibrated in RMS of a sinewave above 30mV (RMS to 3V and 700MHz with 100:1 divider)	
Crest Factor:	Direct Input: Level	300uV 1mV 3mV 10mV 30mV
	CF	140 42 14 4.2 1.4
	With Divider: Level	30mV 100mV 300mV 1V 3V
	CF	140 42 14 4.2 1.4
Input Impedance:	Refer to Figure 1-2	
Maximum AC Input:	10V	
Maximum DC Input:	200V	

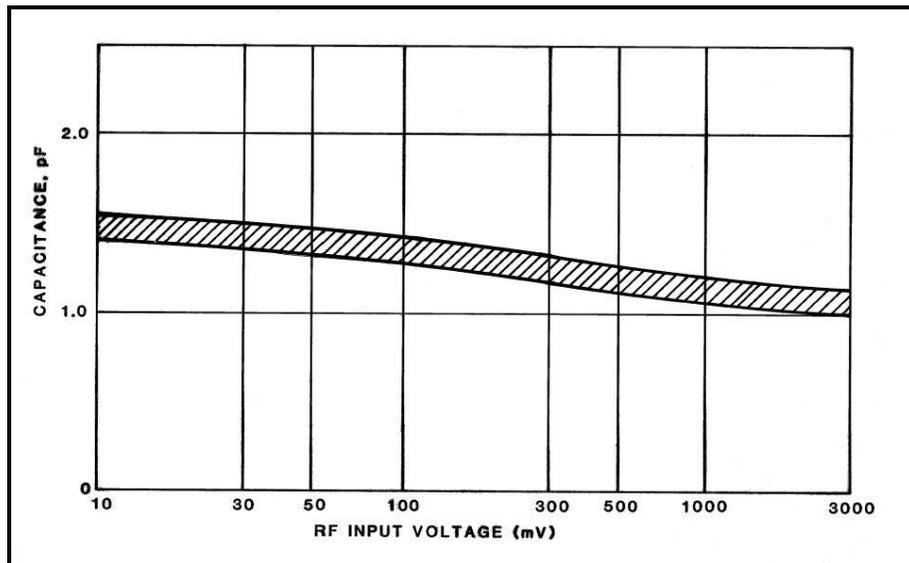
FEATURES

Display:	Menu-driven 20 character x 4 line LCD
Display Units:	VOLTS, dBV, dBmV, dB μ V, WATTS, dBW, dBm ² , dBr, % (² 0dBm = 1mW calculated from V^2/Z_0 where the reference impedance $Z_0 = 50 \Omega$)
Z ₀ Impedance:	Any selected reference value from 5 to 2500 Ω
Peak Display:	1.414 times Voltage display or 3.01 dB added to dB display
Display Resolution:	0.001 dB or 5 digits (in Volts mode)
Display Offset:	-99.99 dB to +99.99 dB in 0.01 dB steps
Limiting:	Individual high and low limit thresholds, -99.99 dB to +99.99 dB
Ranging:	Manual (8 ranges) or autoranging
Filtering:	Filter times to 20.00 seconds in 0.05 second increments
Zeroing:	Automatic function; calculates, stores, and applies zero corrections to each range
Reference Level:	-99.99 dB to +99.99 dB in 0.01 dB steps for dBr measurements may be express in % in linear mode.
Recorder Ouput:	For linear voltage readout, 10V full scale proportional to indicated voltage over each decade. Ranging occurs at 10% of full scale. For decibel readouts, scale factor is 1V per 10dB change over the entire dynamic range.

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INPUT RESISTANCE VS. FREQUENCY,
MODEL 952001B RF PROBE



INPUT CAPACITANCE VS. INPUT VOLTAGE,
MODEL 952001B RF PROBE

Figure 1-2. Input Impedance

Boonton 9240 Series RF Voltmeter

Table 1-2 9240 Series Performance Specifications (*continued*)

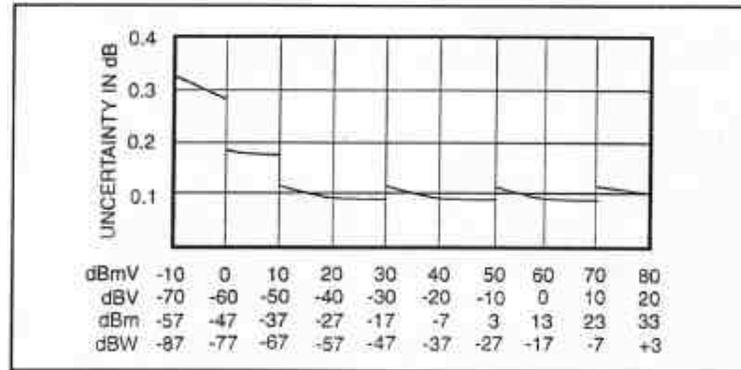
MEASUREMENT SYSTEM

Voltage Probe Inputs: One or two measurement channels.
 Measurement Technique: 24 bit Sigma-delta A/D converter per channel.

ACCURACY

Basic Uncertainty:
 3 mV – 10 V 1% rdg \pm 1 count
 1 mV – 3 mV 2% rdg \pm 2 counts
 0.2 mV – 1mV 3% rdg \pm 3 counts

For dBv, dBmv, dBm, dBW



Model 9240 Uncertainty vs. Input Level
 For dBV, dBmV, dBm and dBW

Frequency Effect: Model 952001B Probe with Model 952002 50Ω BNC Adapter or Model 952003 Tee Adapter.

Frequency	mV	dBV, dBmV, dBm, dBW
1 MHz (cal freq)	0	0
10 kHz – 100 MHz	1% rdg	0.09 dB
100 MHz – 1 GHz	3% rdg	0.27 dB
1 GHz – 1.2 GHz	7% rdg	0.63 dB

SWR: 1.05 to 300 MHz, 1.10 to 1 GHz, 1.15 to 1.2 GHz

Model 952001B Probe with Model 952005 100:1 Divider.

Frequency	mV	dBV, dBmV, dBm, dBW
1 MHz (cal freq)	0	0
300 kHz – 30 MHz	1% rdg	0.09 dB
100 kHz – 350 MHz	3% rdg	0.27 dB
50 kHz – 700 MHz	7.5% rdg	0.68 dB

Boonton 9240 Series RF Voltmeter

Table 1-2 9240 Series Performance Specifications (*continued*)

Frequency Effect:

Model 952016 Low Frequency Probe with Model 952002 50Ω BNC Adapter.

Frequency	mV	dBV, dBmV, dBm, dBW
1 MHz (cal freq)	0	0
50 Hz - 20 MHz	1% rdg	0.09 dB
20 Hz - 50 Hz	2% rdg	0.17 dB
10 Hz - 100 MHz	5% rdg	0.45 dB

SWR: 1.05 to 100 MHz

Model 952016 Low Frequency Probe with Model 952058 100:1 Divider.

Frequency	mV	dBV, dBmV, dBm, dBW
1 MHz (cal freq)	0	0
1MHz - 20 MHz	5% rdg	0.45 dB
50 Hz - 1 MHz	3.5% rdg	0.31 dB
20 Hz - 50 Hz	4.5% rdg	0.40 dB
10 Hz - 20 Hz	7.5% rdg	0.68 dB

Model 952001B Probe with Model 952006 75Ω BNC Adapter.

Frequency	mV	dBV, dBmV, dBm, dBW
1 MHz (cal freq)	0	0
10 kHz - 100 mHz	1% rdg	0.09 dB
100MHz - 300 MHz	3% rdg	0.27 dB
300 MHz -500 MHz	6% rdg	0.54 dB

SWR: 1.05 to 150 MHz, 1.10 to 300 MHz, 1.20 to 500 MHz

Model 952001B Probe with Model 952007 75Ω Tee Adapter.

Frequency	mV	dBV, dBmV, dBm, dBW
1 MHz (cal freq)	0	0
10 kHz - 100 MHz	1% rdg	0.09 dB
100 MHz - 700 MHz	3% rdg	0.27 dB
700 MHz - 1 GHz	7% rdg	0.63 dB

SWR: 1.05 to 150 MHz, 1.10 to 750 MHz, 1.25 to 1 GHz

Temperature Effect:

Model 952001B Voltage Probe at 10 kHz to 1.2 GHz.

Temp °C	mV		dBV, dBmV, dBm, dBW	
	Inst	Probe	Inst	Probe
21 – 25	0	0	0	0
18 – 30	0	1% rdg	0	0.09 dB
10 - 40	1% rdg	3% rdg	0.09 dB	0.26 dB
0 - 55	2% rdg	7% rdg	0.18 dB	0.63 dB

Boonton 9240 Series RF Voltmeter

Table 1-2 9240 Series Performance Specifications (*continued*)

EXTERNAL INTERFACES

Remote Control:	Complies with IEEE-488.1 and SCPI version 1993.
GPIB:	Implements AH1, SH1, T6, LE0, SR1, RL1, PP0, DC1, DT1, C0, and E1.
RS232:	Type-D connector, 9 pins.
Inputs:	Front or Rear panel sensor connector; rear panel IEEE-488 connector and RS-232 connector.
Outputs:	Front panel or optional Rear panel CAL OUT connector, 50 MHz, 100 mW max; rear panel recorder BNC connector, 9.09 kilohm impedance, 0 to 10 volts into 1 megohm (may be operated into 1 kilohm for 1V fs).

PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

Case Dimensions:	8.26W x 3.48H x 13.5D inches (21.0 x 8.9 x 34.3 cm), Half-rack width, 2U height
Weight:	5 lbs (2.3kg)
Power Requirements:	90 to 260 VAC, 47 to 63 Hz 90 to 135 VAC, 47 to 400Hz 15 Watts, 25 VA
Operating Temperature ² :	0 to 55 °C
Storage Temperature ² :	-30 to +60 °C
Humidity ² :	95% maximum, non-condensing
Altitude ² :	Operation up to 15,000 feet
Shock ² :	Withstands ±30G, in X, Y, and Z axes
Vibration ² :	Withstands 2G

(² as per MIL-PRF-28800F)

OTHER CHARACTERISTICS

Display:	Dot matrix 80 character LCD module (4 lines by 20 characters)
Keyboard:	11 Key conductive rubber
Processor:	32-bit Digital Signal Processor
Panel setup storage:	Can save and recall 10 complete “user” setups.

Boonton 9240 Series RF Voltmeter

Table 1-2 9240 Series Performance Specifications (*continued*)

REGULATORY CHARACTERISTICS

CE Mark:	Full compliance with the following European Union directives and standards:
Safety:	Low Voltage Directive 2006/95/EC IEC 61010 – 1 : 2001 (2 nd Edition); EN 61010 – 1 : 2001 (2 nd Edition)
EMC:	Electromagnetic Compatibility Directive 2004/108/EC IEC 61000-3-2: 2000 Limits for harmonic current emissions IEC 61000-3-3: 2002 Limitation of voltage changes, voltage fluctuations and flicker IEC 61000-4-2: 2001 Electrostatic discharge immunity test IEC 61000-4-3: 2002 Radiated, radio-frequency, electromagnetic field immunity test IEC 61000-4-4: 2004 Electrical fast transient/burst immunity test IEC 61000-4-5: 2001 Surge immunity test IEC 61000-4-6: 2003 Immunity to conducted disturbances, induced by radio frequency fields. IEC 61000-4-11: 2004 Voltage dips, short interruptions and voltage variations immunity test EN 61326-1: 2006 Electrical equipment for measurement, control and laboratory use – EMC requirements - Part 1: General requirements
RoHS:	RoHS Directive 2002/95/EC
Construction:	Manufactured to the intent of MIL-T28800E, Type III, Class 5, Style E

2. Installation

This section contains unpacking and repacking instructions, power requirements, connection descriptions and preliminary checkout procedures.

2.1 Unpacking & Repacking

The 9240 Series is shipped complete and is ready to use upon receipt. Figure 2-1 shows you the various pieces included in the packaging and the order in which they are loaded into the container. Actual details may vary from the illustration.

Note



Save the packing material and container to ship the instrument, if necessary. If the original materials (or suitable substitute) are not available, contact Boonton Electronics to purchase replacements. Store materials in a dry environment. Refer to the Physical and Environmental Specifications in Table 1-2 for further information.

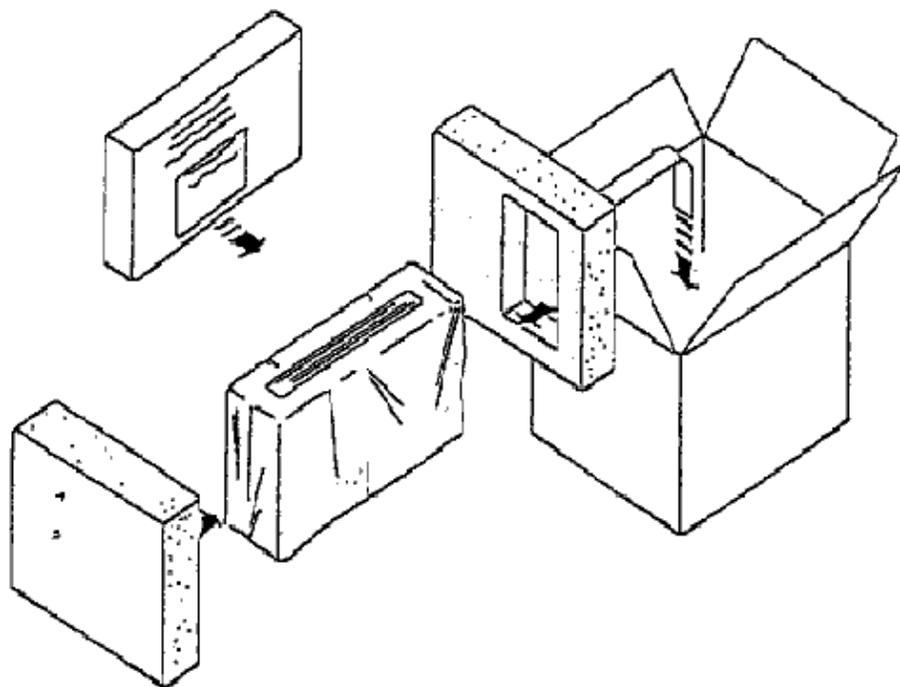


Figure 2-1. Packaging Diagram

Boonton 9240 Series RF Voltmeter

Table 2-1 9240 Series Packing List

INSTRUMENT (See also Table 1-1)

9240 Series RF Voltmeter
Line Cord
Boonton Instruction Manual CD

PROBE(S) (packaged separately)

Voltage Probe(s)
Data Adapter/Cable(s)

For bench-top use, choose a clear, uncluttered area. Ensure that there is at least 2" of clearance at the exhaust vents on the side panels. Pull-down feet are located on the bottom of the instrument. Rack mounting instructions are provided with the optional rack mount kit.

2.2 Power Requirements

The 9240 Series is equipped with a switching power supply that provides automatic operation from a 90 to 260 volt, 47 to 63 Hz, single-phase, AC power source. Maximum power consumption is 15W and 25VA. For metric fuse sizes, use the metric fuse kit supplied. Connect the power cord supplied with the instrument to the power receptacle on the rear panel. See Figure 3-2.

Caution



Before connecting the instrument to the power source, make certain that a 0.5-ampere time delay fuse (type T) is installed in the fuse holder on the rear panel.

Before removing the instrument cover for any reason, position the input module power switch to off (0 = OFF; 1 = ON) and disconnect the power cord.

2.3 Connections

Probe(s)

Connect the RF Voltage Probe that covers the frequency range of the measurement to the CHANNEL 1 connector on the front (Standard) or rear (Optional) panel, as follows. Connect the probe to the supplied Data Adapter/Cable combo. Connect the Data Adapter to the CHANNEL 1 Input, holding the red mark on the adapter connector up. For two-channel measurements, use the same procedures to connect the second probe to the CHANNEL 2 input.

Recorder

If a recorder is to be used to record measurement data, connect the recorder to the recorder BEC connector on the rear panel. Output impedance is 9.06 kilohms, and the output voltage range is 0 to 10 volts dc.

Remote

If the instrument is to be operated remotely using the GPIB (IEEE-488) bus, connect the instrument to the bus using the rear panel GPIB connector and appropriate cable. For RS-232 control, the rear panel 9 pin RS-232 connector should be used. In most cases, it will be necessary to configure the interface used via the *Menu > SETUP > IEEE* or *Menu > SETUP > RS232* menus.

Boonton 9240 Series RF Voltmeter

2.4 Preliminary Check

The following preliminary check verifies that the instrument is operational and has the correct software installed. It should be performed before the instrument is placed into service. To perform the preliminary check, proceed as follows:

1. Connect the AC (mains) power cord to a suitable AC power source; 90 to 264 volts AC, 47 to 63 Hz, with a capacity in excess of 75 W. The power supply will automatically adjust to voltages within this range.
2. Attach the probe Data Adapter(s) to the front panel CHANNEL connector(s).
3. Set the POWER switch to the ON (1) position.
4. Verify that "BOONTON ELECTRONICS, 9242 RF Voltmeter, Rev. XXXXXXXX" is momentarily displayed where XXXXXXXX represents the revision code. (Note: Model number 9241 display for single channel instruments.) While the sign-on screen is displayed the phrase " A WIRELESS TELECOM GROUP COMPANY" is scrolled along the second line.

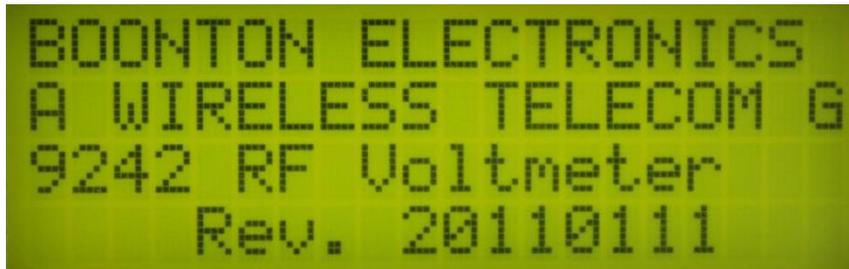


Figure 2-2. Typical Power-On Display

5. Verify that the measurement display showing "CH 1" only for Model 9241 or "CH 1" and "CH 2" for Model 9242. Other data on the display will depend upon previous settings.
6. Press the <MENU> key and select DIAGNOSTICS with the down arrow key. Press <ENTER>. Verify the following sub-menu:

```
RTN
SELFTEST  <
SWITCHES
RECORDER
```

7. Press <Enter> to execute the self-test. The items tested are as follows:

```
PROCESSOR
SRAM MEMORY
EEPROM
```

Each test will display the OK message if passed. When the test is completed the menu will reappear.

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8. Use the <Down Arrow> key to move the "<" cursor to SWITCHES and press <ENTER>. Press each front panel key, avoiding <MENU> until last. Each key press will result in an identifying message; <MENU> will exit the test and return to the MENU.
9. Use the <Down Arrow> key to select RECORDER and press <ENTER>. This test will sequentially send a DC voltage in 1 volt steps to the recorder output BNC connector on the rear panel. The test will continue until <MENU> is pressed. Use a DC voltmeter to verify correct operation.
10. Press <MENU> to return to the measurement display.
11. Press the <Sensor> key and verify that the RF Voltage Probe serial number(s) appear under the channel heading(s). An active channel with no sensor installed will report a table number.
12. Press the <AVG> key and verify that the filter time and number of samples appear for each active channel.
13. Press the <Menu> key followed by the <Zero/Cal> key and select ZERO function for the active channel. Verify the ZERO operation completes successfully.
14. Repeat steps 13 for channel 2 if installed.
15. Connect a GPIB controller to the Model 9240. Verify that the instrument can be addressed to Listen at its IEEE bus address, and set to Remote. The display must show the correct status on the bottom line of the display. For message passing, the line terminators for the controller and the Model 9240 must be compatible for both Listen and Talk. Use <Menu> <SETUP> <IEEE> to set address and terminators for the 9240. Address the Model 9240 to Listen/Remote and send the command "*IDN?" EOL. Then address the Model 9240 to Talk (controller to listen) and verify that the correct identification string is returned. For example using SCPI emulation the ID string returned would be as follows;

BOONTON ELECTRONICS, 9242, 11002, 20110111
16. Connect a dumb terminal or PC serial terminal to the Model 9240. Use a null modem if the terminal is wired as DCE. For message communication to take place, the parameters of the serial connection and message strings must agree between the terminal and the Model 9240. Use <Menu> <SETUP> <RS-232> to set parameters for the 9240. Send the command or "*IDN?" EOL and verify that the correct identification string is returned.

3. Getting Started

This chapter will introduce the user to the 9240 Series. The chapter will identify objects on the front and rear panels, identify display organization, list the initial configuration of the instrument after reset, and provide practice exercises for front panel operation. For additional information you should see **Chapter 4 "Operation."**

3.1 Organization

Subsection 3.2 Operating Controls, Indicators and Connections identifies the control features and connections on the front and rear panels.

Subsection 3.3 Operation identifies the front panel keys, their functions and the menu structure while describing the various display modes.

3.2 Operating Controls, Indicators and Connections

Figures 3-1 and 3-2 illustrate the controls, indicators and connectors on the front and rear panels, respectively, of the standard instrument. Refer to Table 3-1 for a description of each of the illustrated items. Connectors indicated by an asterisk (*) may be front or rear-mounted, depending on the option selected. The function and operation of all controls, indicators and connectors are the same on the standard and optional models.

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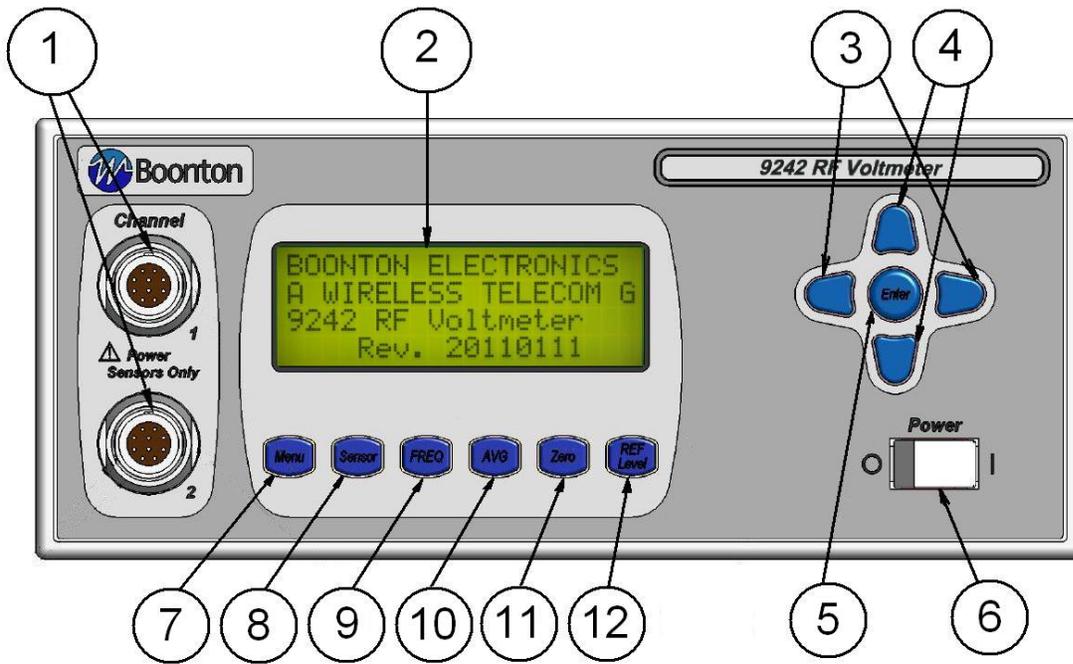


Figure 3-1. Standard 9240 Series RF Voltmeter - Front Panel

Table 3-1 Operating Controls, Indicators and Connections

Reference #	Front	Rear	Nomenclature	Function
1	1		Channel Inputs	One or two Channel inputs are located on the front, or optionally on the rear panel of the instrument. These are 10-pin precision connectors designed to accept only Boonton RF Voltage Probes.
				<p>Caution Do not attempt to connect anything other than a Boonton Voltage Probe and Data Adapter to the Channel inputs! The Channel inputs are not measurement terminals and cannot be used for other than the intended purpose.</p>
2			Display Screen	LCD readout of the measurements and user interface for editing of the instrument's operating parameters.

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Table 3-1 Operating Controls, Indicators and Connections *(continued)*

Reference #	Front Rear	Nomenclature	Function
3		◀ and ▶ Keys	In entry mode, pressing ◀ advances the cursor to the left. In the measurement mode of operation pressing the ◀ key sets the Active channel to Linear measurement units (Volts, %). In entry mode, pressing ▶ advances the cursor to the right. In the measurement mode of operation pressing the ▶ key sets the Active channel to Log measurement units (dBm, dBr).
4		▲ and ▼ Keys	Used for incrementing or decrementing numeric parameters, selecting from lists, or scrolling through multi-line displays. In the measurement mode of operation pressing the ▲ key moves the Active Channel cursor up on the display. For example if the active channel is set to 2, pressing the ▲ key will cause channel 1 to be the active channel. Pressing the ▼ key moves the Active Channel cursor down on the display. If the active channel is set to 1, pressing the ▼ key will cause channel 2 to be the active channel.
5		Enter Key	In entry mode, initiates the procedure to change a parameter. In parameter entry mode, terminates the current command and changes the parameter to the last displayed value. In the measurement mode, display the active channels CHANNEL menu.
6		Power Switch	Turns the instrument off and on.
7		<Menu> Key	Displays and allows editing of the instrument's operating parameters. Returns instrument to local mode when operating in the bus remote mode. Escapes back to measurement screen from any menu.
8		<Sensor> Key	Displays the serial number of the installed probes and allows for editing of the Voltage Probe parameters.
9		<FREQ> Key	Selects the operating frequency display. NOTE: The probes are not provided with frequency calibration factors. Changing this parameter has no affect on the measurement.
10		<AVG> Key	Selects the filter averaging display for the measurement value.
11		<Zero > Key	One Key Press Operation. When measuring low level signals it is important to zero the channel prior to measuring the signal. When the Active Channel is measuring levels below approximately -50 dBm, depressing the <Zero > key will use the measured reading as the zero offset. This allows for fast zeroing of the most sensitive range of the channel so that the needed measurement can be performed faster.

The Zero menu can be displayed by first pressing the <Menu> key followed by the <Zero > key. From there the user chooses the the channel to perform a Zero operation on.

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Table 3-1 Operating Controls, Indicators and Connections *(continued)*

Reference #	Front Rear	Nomenclature	Function
12		<REF Level> Key	<p>Often relative measurements are required especially when measuring system gains and losses. One key press of the Ref/Level key makes this easier and faster to perform. Simply connect the active channel's probe to the input signal of the system under test. Press the Ref/Level key and the reference level is set! Next connect the probe to the system output and read the gain or loss directly from the reference level measurement.</p> <p>The REF Level menu can be displayed by first pressing the <Menu> key followed by the <REF Level> key. From there the user may LOAD or SET the reference level on either channel.</p>
13		Recorder	Provides a DC voltage proportional to the measured values for use by an external recorder.
14		RS232	9-pin D-sub connector for connecting the voltmeter to the remote control Serial Bus. Communication parameters can be configured through the <SETUP <RS232> menu.
15		GPIB	24-pin GPIB (IEEE-488) connector for connecting the voltmeter to the remote control General Purpose Instrument Bus. GPIB parameters can be configured through the <SETUP <IEEE> menu.
16		AC Line Input	A multi-function power input module is used to house the AC line input, main power switch, and safety fuse. The module accepts a standard AC line cord, included with the voltmeter. The power switch is used to shut off main instrument power. The safety fuse may also be accessed once the line cord is removed. The instrument's power supply accepts 90 to 264VAC, so no line voltage selection switch is necessary.



Caution

Replace fuse only with specified type and rating:
0.5 A-T (time delay type), 250VAC

Boonton 9240 Series RF Voltmeter

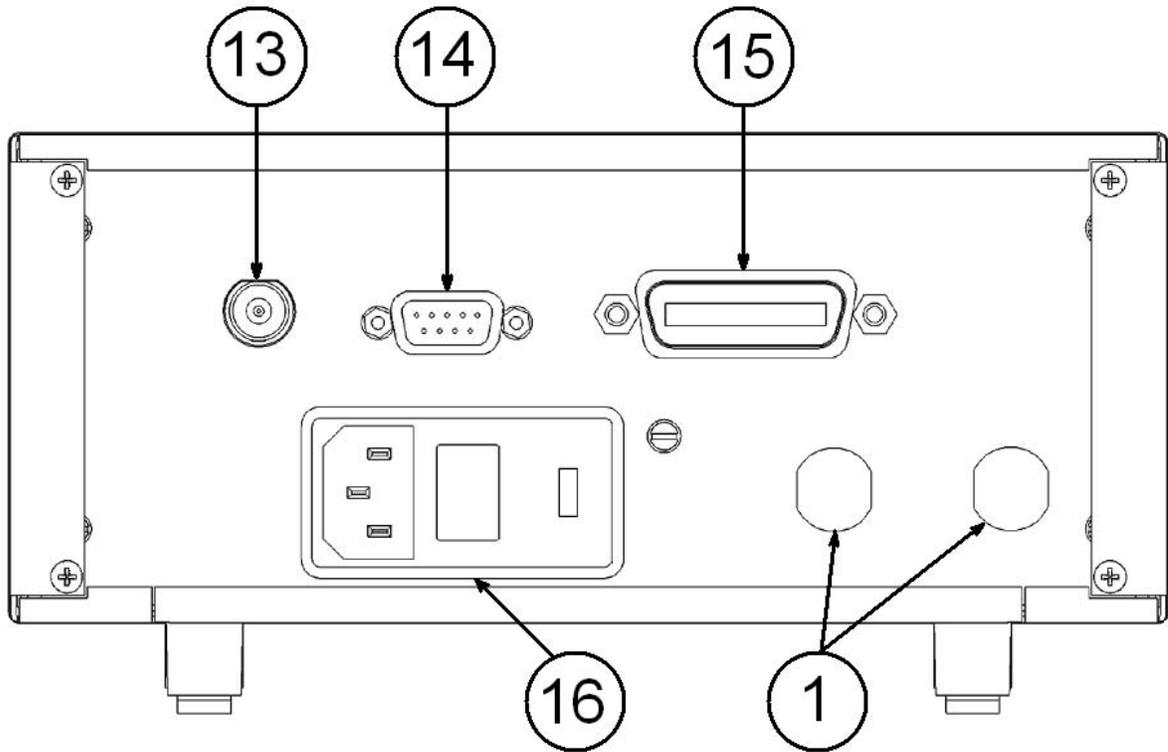
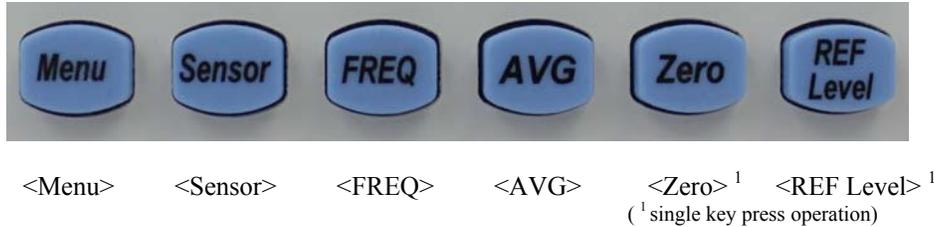


Figure 3-2. 9240 Series - Rear Panel
(Shown without optional rear panel connectors not installed)

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3.3 Operation

The Model 9240 can be configured for operation via the six switches on the front panel;



Pressing a key will bring the instrument to the next submenu. A flow chart of the instrument's command structure is shown in figure 3-5. The <Menu> key serves as an ESCAPE key to cancel the current operation from any point and return to the measurement screen.

To change a value, use the arrow keys to position the cursor to the desired parameter. Press the <Enter> key and then use the up/down arrow keys to scroll through the parameter list. When a number is to be entered, use the left/right arrow keys to position the cursor under the number that is to be changed, then use the up/down arrow keys to increment/decrement the number. Holding the up/down arrow key will initiate repeat mode to allow rapid movement through the selection.

Within a submenu, the \wedge \vee indicators are displayed in the upper right portion of the display when the current screen has additional information that can be obtained by scrolling with the up/down arrow keys. Three conditions are possible:

1. \wedge Use the up arrow key to scroll the screen upward for additional information.
2. \vee Use the down arrow key to scroll the screen downward for additional information.
3. \wedge \vee Use the up/down arrow keys to scroll the screen upward/downward for additional information.

Additional features introduced in the 9240 are the 'single key press operation' for the <Zero> and <REF Level> keys. See section 3.3.5 and 3.3.6 for further details. Also the arrow keys and the <Enter> key have special functions while measurements are displayed.

Arrow keys group. Selection of the Active Channel and the channel's measurement units may be accomplished by use of the arrow keys while in the measurement mode of operation.

Up Arrow key. Moves the Active Channel cursor up on the display. For example if the active channel is set to 2, pressing the <Up Arrow> key will cause channel 1 to be the active channel.

Down Arrow key. Moves the Active Channel cursor down on the display. For example if the active channel is set to 1, pressing the <Down Arrow> key will cause channel 2 to be the active channel.

Left Arrow key. Pressing this key sets the Active Channel to Linear measurement units (Volts, %).

Right Arrow key. Pressing this key sets the Active Channel to Log measurement units (dBm, dBr).

Enter key. When in the measurement mode of operation pressing the <Enter> key causes the instrument to drop down into the **CHANNELS** menu using the Active Channel as a pointer to the associated channels menu. This provides faster settings of channel parameters such as units, resolution, duty cycle, offset, range, alarm setting and limits.

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DUAL CHANNEL

^A C	M	M	M	M	M	L	±	D	D	D	D	D	D	U	U	U	U	^P _K	Δ
				(B	A	R		G	R	A	P	H)					
^A C	M	M	M	M	M	L	±	D	D	D	D	D	D	U	U	U	U	^P _K	Δ
				(	B	A	R		G	R	A	P	H)					

SINGLE CHANNEL

^A C	M	M	M	M	M	L	±	D	D	D	D	D	D	U	U	U	U	^P _K	Δ
				(	B	A	R		G	R	A	P	H)					

KEY: D = 0 through 9 or a decimal point
 L = \wedge , \vee (alarm mode)
 Ω (indicating power measurement relative Z_0)
 M M M M M = CH1, CH2, CH1+2, CH1/2
 U U U U = V, mV, nW, uW, mW, kW, MW, dBm, dBW, dBuV, dBmV, dBV, dBr, %
^AC = Active Channel pointer

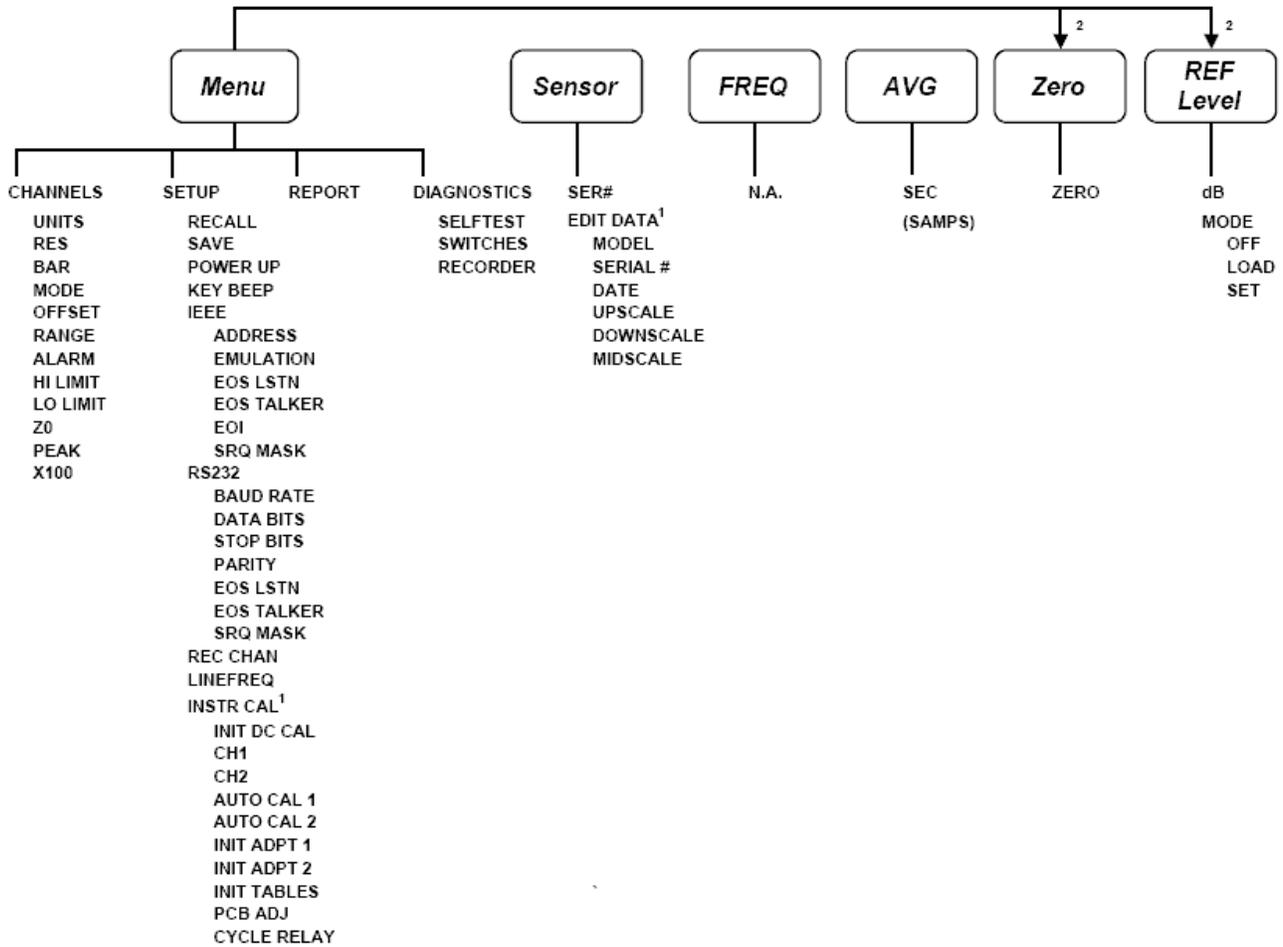
Figure 3-3. Measurement Display, Local Mode

^A C	M	M	M	M	M	L	±	D	D	D	D	D	D	U	U	U	U	^P _K	Δ
				(	B	A	R		G	R	A	P	H)					
^A C	M	M	M	M	M	L	±	D	D	D	D	D	D	U	U	U	U	^P _K	Δ
	R	E	M			L	S	N			T	L	K			S	R	Q	

KEY: REM = Remote mode enabled
 LSN = Listener addressed
 TLK = Talker addressed
 SRQ = Service Request activated

Figure 3-4. Measurement Display, Remote Mode

Boonton 9240 Series RF Voltmeter



¹ This function requires an access code to execute

² This key is an action key in the measurement mode and requires pressing the Menu key prior to pressing this keys to access the sub-menu.

Figure 3-5. Model 9240, Command Set

Last Menu Operation. In keeping with minimum key strokes to perform a function repeatedly, the control program can remember the last menu the user was at prior to returning to the measurement display. In doing this submenu functions can be quickly selected and parameters changed getting the user back to the measurement display faster.

For example, suppose the user steps through a series of voltage levels while manually changing ranges. Pressing the <Enter> key in the measurement mode brings up the Active CHANNEL Menu. To hold a measurement range press the <Down Arrow> key until the cursor is pointing RANGE. Pressing <Enter> allows this parameter to be set to the desired range. In this example the voltage measured will vary from -35 dBm to -25 dBm ($Z_0 = 50$) in 1 dB steps. So the initial range setting is set to range 2 then pressing <Enter> sets the range. Pressing the <Menu> key at this time returns to the measurement display. As the voltage is increased it reaches the overrange limit and the “-HIGH-“ message is displayed. At this point pressing the <Enter> key returns the user to the previous CHANNEL Menu item, in this case RANGE. The user can now edit the range parameter and return quickly to the measurement display, simplifying the ease of use.

In this example multiple key strokes were eliminated from previous instrument implementations cutting down time on instrument configuration providing the user expedient results.

Once in a submenu, the previous menu can always be reached by depressing the <Up Arrow> until RTN or escape to the parent menu using the <Left Arrow> key. If the user exits out to the measurement screen by this method, pressing the <Menu> key will bring up the top level menu.

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3.3.1 Menu Key.

The instrument's, CHANNELS, SETUP, REPORT and DIAGNOSTIC functions are accessed when the <Menu> key is pressed (see Figure 3-6). Using the up/down arrow keys, the cursor can be positioned to select from the four submenus.

Channel Menu. An example of the display for the Channels menu is shown in Figure 3-7. Although the figure shows twelve lines, the instrument can only display four at a time. Therefore, it will be necessary to use the up/down arrow keys to sequence through the commands. When viewing the commands, the instrument will retain the first line as a header and use the next three lines to scroll through the remaining commands.

Table 3-2 gives a description of the commands available from the Channels menu. The associated parameters, and factory default settings are also given.

Setup Menu. An example of the display for the Setup menu is shown in Figure 3-8. It will be necessary to use the up/down arrow keys to sequence through the commands since there are more than four lines of information to be displayed. When sequencing through the list, the instrument will retain the first line as a header and use the next three lines to scroll through the command list.

R	T	N																	
C	H	A	N	N	E	L	S												
S	E	T	U	P															
R	E	P	O	R	T														
D	I	A	G	N	O	S	T	I	C	S									

Figure 3-6. Main Menu Display

R	T	N							C	H	#		V	O	L	T			
U	N	I	T	S					>	V	O	L	T	S					
R	E	S							X	X	X	X	X						
B	A	R							O	N									
M	O	D	E																
R	A	N	G	E					A	U	T	O							
A	L	A	R	M					O	F	F								
H	I		L	I	M	I	T		9	9	.	9	9						
L	O		L	I	M	I	T		-	9	9	.	9	9					
Z	0								5	0	.	0	0						
P	E	A	K						O	F	F								
X	1	0	0						O	F	F								

Figure 3-7. Channels Menu Display

Boonton 9240 Series RF Voltmeter

Table 3-2 CHANNEL MENU Functions

Function	Description	Parameters	Defaults
RTN	Returns the instrument to the previous menu.	n/a	
UNITS	Units used for measurement display.	dBm, WATTS	dBm
RES	Display resolution	X.X, X.XX, X.XXX dBm or/ XXX, XXXX, XXXXX Watts	X.XX
BAR	Enables the bar graph on the measurement display.	ON, OFF	ON
MODE	Sets the display mode for channel 2; only available when two channels are installed. The units for sum and ratio modes track the units selected for channel 2.	CH2, CH1+2, CH1/2 OFF	CH2
RANGE	Selects and holds the instrument's measurement range. If repetitive measurements are to be made over a narrow range of levels, selecting the appropriate instrument range may speed measurements.	AUTO, 0,1,2,3,4,5,7	AUTO
ALARM	Enables alarm mode; the v or ^ symbol is displayed before the channel mode designator on the measurement display to indicate when the upper or lower threshold limit is Exceeded.	ON, OFF	OFF
HI LIMIT	Upper threshold limit for the alarm function.	-99.99 to 99.99	99.99
LO LIMIT	Lower threshold limit for the alarm function.	-99.99 to 99.99	-99.99
ZØ	Characteristic impedance used to calculate power.	5 to 2500 Ohms	50 Ohms
PEAK	Displays sinewave peak instead of RMS. Equal to a factor of 1.414 or +3dB.	ON, OFF	OFF
X100	Used with 100:1 divider accessory	ON, OFF	OFF

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R	T	N																
R	E	C	A	L	L					>	1							
S	A	V	E								2							
P	O	W	E	R		U	P					D	E	F	A	U	L	T
K	E	Y		B	E	E	P					O	F	F				
I	E	E	E															
R	S	2	3	2														
R	E	C		C	H	A	N					C	H	1				
L	I	N	E	F	R	E	Q											
I	N	S	T	R		C	A	L										

Figure 3-8. Setup Menu Display

Table 3-3 SETUP MENU Functions

Function	Description	Parameters	Defaults
RTN	Returns the instrument to the previous menu.	n/a	
RECALL	Recalls one of ten user defined instrument configurations or the factory setup.	DEFAULT, 1-10, SANITIZE ¹	DEFAULT
¹ SANITIZE initializes all program locations to DEFAULT settings			
SAVE	Saves the current instrument configuration to one of ten non-volatile memory locations.	1-10	1
POWER-UP	Instructs the instrument to power-up to the specified configuration.	DEFAULT, 1-10	DEFAULT
KEY BEEP	Turns on/off the key beep.	ON, OFF	OFF
IEEE	Brings the instrument to the IEEE menu.	see table 3-5	n/a
RS232	Brings the instrument to the RS-232 menu.	see table 3-6	n/a
LINEFREQ	Select line (mains) frequency.	50Hz, 60Hz	n/a
INSTR CAL	Refer to Service Manual.	n/a	n/a

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IEEE Menu. The IEEE submenu is used to configure the Model 9240 for communications over the GPIB. An example of the menu is shown in Figure 3-9 and the description of the commands, parameters and factory defaults is given in Table 3-4.

R	T	N																		
A	D	D	R	E	S	S					>	1	3							
E	M	U	L	A	T	I	O	N				S	C	P	I					
E	O	S		L	S	T	N					C	R	L	F					
E	O	S		T	A	L	K	E	R			C	R	L	F					
E	O	I										O	N							
S	R	Q		M	A	S	K					0								

Figure 3-9. IEEE Menu Display

Table 3-4 IEEE MENU Functions

Function	Description	Parameters	Defaults
RTN	Returns the instrument to the previous menu.	n/a	
ADDRESS	GPIB address assigned to the instrument.	0 to 30	n/a
EMULATION	GPIB emulation mode.	SCPI, 437B, 438A, 4230	SCPI
EOS LSTN	End of string indicator for received messages.	LF, CR, CRLF, NONE Where: LF = Line Feed CR = Carriage Return CRLF = Carriage Return and Line Feed	LF
EOS TALKER	End of string character sent with transmitted messages.	LF, CR, CRLF, NONE	LF
EOI	Enables/disables the end or identify hardware control line.	ON, OFF	OFF
SRQ MASK	Service request interrupt mask. See Section 5.5.1 *STB? for bit descriptions.	0 to 255 Where: 255 enables all interrupts	0

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RS232 Menu. The RS232 menu is used to configure the Model 9240 for serial communications over the RS-232 bus. An example of the submenu is shown in Figure 3-10 and an explanation of the commands, parameters and factory defaults is given in Table 3-5.

R	T	N																	
B	A	U	D		R	A	T	E		>	3	8	4	0	0				
D	A	T	A		B	I	T	S			8								
S	T	O	P		B	I	T	S			1								
P	A	R	I	T	Y						N	O	N	E					
E	O	S		L	S	T	N				L	F							
E	O	S		T	A	L	K	E	R		C	R	L	F					
S	R	Q		M	A	S	K				0								

Figure 3-10. RS232 Menu Display

Table 3-5 RS232 MENU Functions

Function	Description	Parameters	Defaults
RTN	Returns the instrument to the previous menu.	n/a	
BAUD RATE	Rate at which data is transferred over the bus.	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200	38400
DATA BITS	Number of data bits in a message.	7, 8	8
STOP BITS	Number of stop bits in a message.	1, 2	1
PARITY	Parity bit mode in a message.	ODD, EVEN, NONE	NONE
EOS LSTN	End of string indicator for received messages.	LF, CR, CRLF, NONE Where: LF = Line Feed CR = Carriage Return CRLF = Carriage Return and Line Feed	LF
EOS TALKER	End of string character sent with transmitted messages.	LF, CR, CRLF, NONE	CRLF
SRQ MASK	Service request interrupt mask. See Table 4-7 for bit descriptions.	0 to 255 Where: 255 enables all interrupts	0

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REPORT Display. The REPORT menu item displays the versions of the firmware and FPGA image installed in the instrument. The SCPI specification compliance version is also displayed in this report. This display is for informational purposes only and does not support any editing of the data. The REPORT display is shown in Figure 3-11.

											V	E	R	S	I	O	N		
F	I	R	M	W	A	R	E				2	0	1	0	0	7	1	1	
F	P	G	A								1	.	1	8					
S	C	P	I								1	9	9	0					

Figure 3-11. Report Display

Diagnostics Menu. The Model 9240 can be directed to perform self-tests from the diagnostics menu. The Diagnostics menu is shown in Figure 3-12 and a description of each command is given in Table 3-6.

R	T	N																	
S	E	L	F	T	E	S	T				<								
S	W	I	T	C	H	E	S												
R	E	C	O	R	D	E	R												

Figure 3-12. Diagnostics Display

Table 3-6 DIAGNOSTICS MENU Functions

Function	Description	Parameters	Defaults
RTN	Returns the instrument to the previous menu.	n/a	n/a
SELF TEST	Instructs the instrument to perform internal diagnostics and the display test.	n/a	n/a
SWITCHES	Interactive test to verify proper operation of the front panel switches.	n/a	n/a
RECORDER	The recorder output DAC is exercised through its full range from 0 to 10 V.D.C. in 1V steps continuously until the <Menu> key is depressed.	n/a	n/a

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3.3.2 Sensor Key.

Pressing the <Sensor> key brings the instrument to the Sensor menu and facilitates viewing and editing of the voltage probe's parameters. An access code is required to enter the editing mode (refer to Figure 3-14). A sample display of the Sensor menu is shown in Figure 3-13.

The instrument is capable of using sensor calibration data from either the sensor data adapters or from any one of four internal tables. The sensor calibration data contained within the sensor data adapter is only accessible to the installed channel. For example, Channel 1 can use the sensor calibration data from any of the internal tables or the sensor data adapter 1. Similarly, Channel 2 can use the sensor calibration data from any of the internal tables or the sensor data adapter 2.

Referring to Figure 3-13, the cursor can be positioned to three fields. The two fields below the 'CH1' and 'CH2' indicate the serial number of the sensor whose calibration data is selected for channels 1 and 2 respectively. The instrument uses this data for the linearity and high frequency correction data and automatically applies the correction to the measured value.

					C	H	1					C	H	2			
S	E	R	#	>	2	9	3	9	1			3	3	3	7	2	
E	D	I	T		D	A	T	A		2	9	3	9	1			

Figure 3-13. Sensor Display Menu

To change the current selection for channel 1, use the arrow keys to move to the SER# command line and position the cursor below the 'CH1' field. Press the <Enter> key and use the up/down arrow keys to scroll through the parameter list. The parameter list typically consists of serial numbers for each voltage probe. Scroll through the list until the desired serial number is displayed and press <Enter> to accept. Move the cursor below the 'CH2' field and follow the same procedure used to change the table for channel 2.

The instrument detects the presence of the Data Adapter and automatically down-loads the sensor calibration data. This occurs when the power to the unit is first applied or after plugging the Data Adapter into the instrument. The voltage probe and corresponding Data Adapter have matching serial numbers for maintaining them as a matched pair.

EDIT DATA ACCESS CODE

The access code to enter the Edit Data menu is as follows:

Press the front panel switches in the following order:

<FREQ> <AVG> <AVG> <FREQ> <Sensor> <Enter>

Figure 3-14. Access Code

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R	T	N																
M	O	D	E	L							>	5	1	0	7	5		
S	E	R	I	A	L		#					2	9	3	9	1		
D	A	T	E									0	8		2	3		1 0
U	P	S	C	A	L	E						0	:	5	0	0	0	
D	O	W	N	S	C	A	L	E				0	:	0	0	0	0	
M	I	D	S	C	A	L	E					0	:	0	0	0	0	

Figure 3-14. Sensor Edit Data Menu Display

The parameter list will show TBLn (where n = 1, 2, 3, 4) when a serial number has not been entered for the corresponding internal table. For example, TBL3 will be displayed if the serial number has not been previously entered for internal table 3. In addition, the parameter list will show ADPTn (where n = 1, 2) if a serial number has not been entered for the table contained within the sensor data adapter. For example, ADPT2 is displayed when the serial number has not been previously entered for sensor data adapter 2.

To edit the voltage probe calibration data, move the cursor to the EDIT DATA function and press <Enter>. Scroll through the voltage probe serial numbers until the desired selection is displayed. Press <Enter> to proceed. Enter the access code to edit or depress the <Menu> key to escape. (See Figure 3-14.)

Sensor Edit Data Menu. An example of the Edit Data menu is shown in Figure 3-14. Table 3-7 contains a description of the commands and associated parameters.

Table 3-7 Sensor Edit Data Menu Functions

Function	Description	Parameters	Defaults
RTN	Returns the instrument to the	n/a	n/a
MODEL	Voltage probe model number	0 to 99999	0
SERIAL #	Voltage probe serial number	0 to 99999	0
DATE	Calibration date	MM/DD/YY Where: MM = 01 to 12 DD = 01 to 31 YY = 00 to 99	01/01/01
UPSCALE	Upscale linearity factors	Range : Factor [0 to 6] : [0 to 9999]	5000
DOWNSCALE	Downscale linearity factors	Range : Factor [0 to 6] : [-999 to 999]	0
MIDSCALE	Midscale linearity factors	Range : Factor [0 to 6] : [-999 to 999]	0

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Linearity Factors. Eight upscale, downscale and midscale linearity factors are assigned to each voltage probe. These values can be viewed or edited by moving the cursor to the UPSCALE, DOWNSCALE or MISCALE command and pressing the <Enter> key. The instrument will sequence through the linearity factors by pressing the up/down arrow keys. If a value is to be edited, scroll to the desired linearity factor, use the right arrow key to move the cursor to the first digit in value field and then use the up/down arrow keys to increment/decrement the number. Set the remaining digits in the same manner. If another value needs to be changed, move the cursor back to the range field and use the up/down arrow keys to display the next value to be modified. Press the <Enter> key when all of the changes have been entered.

Save. Exiting the EDIT DATA menu displays the confirmation menu as shown in Figure 3-15. Move the cursor to YES to save the edited parameters or NO to leave the data unchanged.

	S	T	O	R	E		S	E	N	S	O	R		D	A	T	A		
			A	R	E		Y	O	U		S	U	R	E	?				
					Y	E	S			>	N	O							

Figure 3-15. Save Display

3.3.3 FREQ Key.

This key provides for the setting of the measured frequency so that frequency calibration factors can be applied to the measurement. However, the Boonton series of voltage probes do NOT provide this functionality hence making this a null function.

The operating frequency may be set by first pressing the <FREQ> key. The instrument will advance to the Frequency menu as shown in Figure 3-16. The frequency for Channel 1 is entered by positioning the cursor to the value field under the CH1 heading and pressing the <Enter> key. A value between 0.01 GHz and 100 GHz can be entered. The power on default is 0.05 GHz. Once the frequency is entered, the corresponding Cal Factor is displayed in dB beneath the frequency. Since no calibration factors are provided dashes will appear in the dBCF field.

F	R	E	Q	U	E	N	C	Y											
					C	H	1						C	H	2				
G	H	z		>	0	0	0	.	0	5			0	0	0	.	0	5	
d	B	C	F		-	-	-	.	-	-			-	-	-	.	-	-	

Figure 3-16. Frequency Display

3.3.4 AVG Key.

The averaging time may be adjusted to optimize measurement speed and display stability. Averaging time, in seconds, can be adjusted in 0.05 increments to a maximum of 20.00 seconds. The length of the filter in number of samples is shown on the display.

To adjust the averaging time, press the <AVG> key and the instrument will display the screen as shown in Figure 3-17. Position the cursor under the desired channel heading and press the <Enter> key. Use the arrow keys to set the desired value and then press <Enter> to accept. Entering 00.00 selects the auto filtering Mode. This menu can be accessed to show the filter setting in the auto mode.

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T	I	M	E																
					C	H	1						C	H	2				
S	E	C		>	1	0	.	5	0				0	0	.	0	8		
S	A	M	P	S				2	1	0							1	6	

Figure 3-17. Averaging Time Display

3.3.5 Zero Key (single key press operation).

Zeroing should be performed when the unit is first warmed-up, a sensor has been changed or the instrument has drifted a significant amount with respect to the signal level being measured. For large signals (measurements taken on range 4, 5, 6 or 7), this may be done once every several hours. For small signals, (measurements taken on range 0, 1, 2, or 3), zeroing should be done before each measurement for optimum results. When zeroing is performed, the instrument calculates and stores zero corrections for each range, and applies the corrections to subsequent measurements.

Assigning the <Zero> key as a single key press operation allows for a fast zeroing of the lowest hardware range to avoid the longer zeroing process. When the Active Channel is measuring levels below approximately -50 dBm, and if the measurement is settled, that is, if the filter is full, pressing the <Zero> key will take the displayed measurement as the zero reference. This allows for faster and more accurate measurements of low level signals. If the measurement is not settled the complete zeroing process of all ranges is performed.

The Zero menu is displayed by first pressing the <Menu> key followed by the <Zero> key. From there the user chooses the channel to perform the Zero operation on. The Zero menu invokes the command line as shown in Figure 3-18.

											C	H	1		C	H	2		
					Z	E	R	O			<								

Figure 3-18. Zero and Calibration Display

Table 3-8 Zero Menu Functions

Function	Description	Parameters	Defaults
ZERO	Performs zeroing of all hardware ranges of the selected channel.	n/a	n/a

3.3.6 REL Level Key (single key press operation).

Often relative measurements are required especially when measuring system gains and losses. One key press of the <Ref/Level> key makes this job easier and faster to perform. Simply connect the active channel's sensor to the input signal of the system under test. Press the <Ref/Level> key and the reference level is set! Next connect the sensor to the system output and read the gain or loss directly from the reference level measurement.

The REF Level menu is displayed by first pressing the <Menu> key followed by the <REF Level> key. From there the user may SET (entering a value) or LOAD (use the current channel measurement) the reference level on either channel.

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Press the <REF Level> key to enter a value or to use the current channel measurement for the reference level. The measurement units will automatically change to dBr for logarithmic units or % for linear units for subsequent measurements. An example of the instrument's display is shown in Figure 3-19.

R	E	F	E	R	E	N	C	E		L	E	V	E	L				
					C	H	1						C	H	2			
d	B			>	+	0	0	.	0	0			+	2	5	.	0	0
M	O	D	E		L	O	A	D					S	E	T			

Figure 3-19. Zero and Calibration Display

Table 3-9 Reference Level Menu Functions

Function	Description	Parameters	Defaults
dBm	Reference level value in Preset mode.	-99.99 to 99.99 dBm	0
MODE	Reference level mode. "LOAD" makes the current channel measurement as the reference level. The Set mode is used to select the entered reference level. The Off mode disables the reference level adjustment.	LOAD, SET, OFF	OFF

To set a reference level, depress the <REF Level> key to display the REFERENCE LEVEL menu. Move the cursor to the reference value for the appropriate channel. (Channel 1 is default.) Depress the <Enter> key to initiate the editing process. Use the arrow keys to edit the reference value in dBm. Once the desired value has been selected, depress the <Enter> key to leave the editing function. To use this value as the reference, depress the <Down> arrow key to MODE, depress the <Enter> key for mode selection and using the <Up> or <Down> arrow keys, select SET. Depressing the <Enter> key will place the appropriate channel to the "dBr" mode of operation using the set value as the reference.

The instrument can also load the current measured value as the reference level. To do this, depress the <REF Level> key to display the REFERENCE LEVEL sub-menu. Navigate the cursor using the arrow keys to the MODE selection of the desired channel. Depress the <Enter> key for mode selection and using the <Up> or <Down> arrow keys, select LOAD. Depressing the <Enter> key will place the appropriate channel to the dBr mode of operation using the measured value as the reference level.

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4. Operation

This section provides detailed background information on various aspects of operation of the Model 9240. It is assumed that the reader is familiar with the basic operating procedures covered in Section 3. This section covers the following topics: Voltmeter Probe calibration, Zeroing, Filtering, Noise, Dynamic range, Measurement time, Chart recorder operation and Waveform sensitivity.

4.1 Zeroing the Instrument

For greatest accuracy, especially on the more sensitive ranges, the instrument must be zeroed. To eliminate the need for tedious and often inaccurate manual zeroing, the instrument incorporates an automatic zeroing capability. When automatic zeroing is initiated, the microprocessor reads, averages and stores zero corrections for each measurement range of the instrument and applies the proper zero correction for the range in use for all subsequent measurements. Zero corrections are most important on the more sensitive ranges of the instrument. During instrument warm-up periods and during use in environments with varying ambient temperatures, the instrument should be zeroed frequently if measurements are being made on the lower ranges. To zero the instrument, proceed as follows:



Never press the ZERO key with a signal applied to the probe. To do so will result in erroneous zero corrections and inaccurate subsequent measurements. If the input exceeds normal zero offsets, an error message will be displayed when automatic zeroing is initiated; remove the input signal and rezero the instrument.

1. **Remove All Input Signal to the Probe.** This can be done by unscrewing the probe tip until the tip just breaks contact with the internal connection, leaving the metal shell engaged with the probe body threads. Alternatively, the probe tip can be removed and a Model 952002 50 Ω adapter connected in its place.

2. **Press the ZERO key.** The automatic zeroing cycle takes approximately 9 seconds; the microprocessor computes and stores zero corrections during this period. When zeroing is complete, the instrument display typically shows -99.99 in all dB modes, indicating input underrange. In the mV mode, the underrange indication does not appear; the instrument display shows the "zero condition". This is composed of residual noise and offsets and, ideally, should show + and - excursions of similar amplitude less than 100 μ V.

4.2 Making Measurements

Once the instrument has been programmed and zeroed, it is ready for voltage or dB level measurements. Merely connect the probe to the source whose voltage or dB level is to be measured; the measured level will be displayed directly.

4.3 Overload Limits

1. The Model 952001B RF Probe supplied with the instrument is overload protected to 10 volts AC and 200 volts DC. Exceeding these limits may result in permanent damage.

2. The Model 952002 50 Ω BNC Adapter supplied with the instrument should not be subjected to continuous overload of more than 10 volts (DC + RMS AC) in order to avoid excessive heating of the terminating resistor.

3. Where voltages above the specified overload limits are likely to be encountered, use the Model 952005 100:1 Voltage Divider. Maximum rating of the voltage divider is 1000 volts (DC + peak AC).

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The terminated Model 952009 RF Probe should not be subjected to continuous overload of more than 4 volts (DC + RMS AC) in order to avoid excessive heating of the terminating resistor. Exceeding these limits may result in permanent damage.

4.4 Connection Recommendations

1. The Model 952001B probe is equipped with a detachable tip and ground lead. For measurement of signals below approximately 100 MHz, this tip provides a convenient means for making both signal and ground connections.
2. For frequencies above 100 MHz, the probe tip should not be used because the series impedances of the connection will affect the voltage level at the probe and cause an error in measurement. For high impedance voltage measurements, connection should be made directly to the center contact of the RF probe, with the ground connection kept as short as possible. For matched impedance measurements, one of the various terminated adapters, tee adapter or Model 952009 Probe should be used. Refer to Figure 4-1.

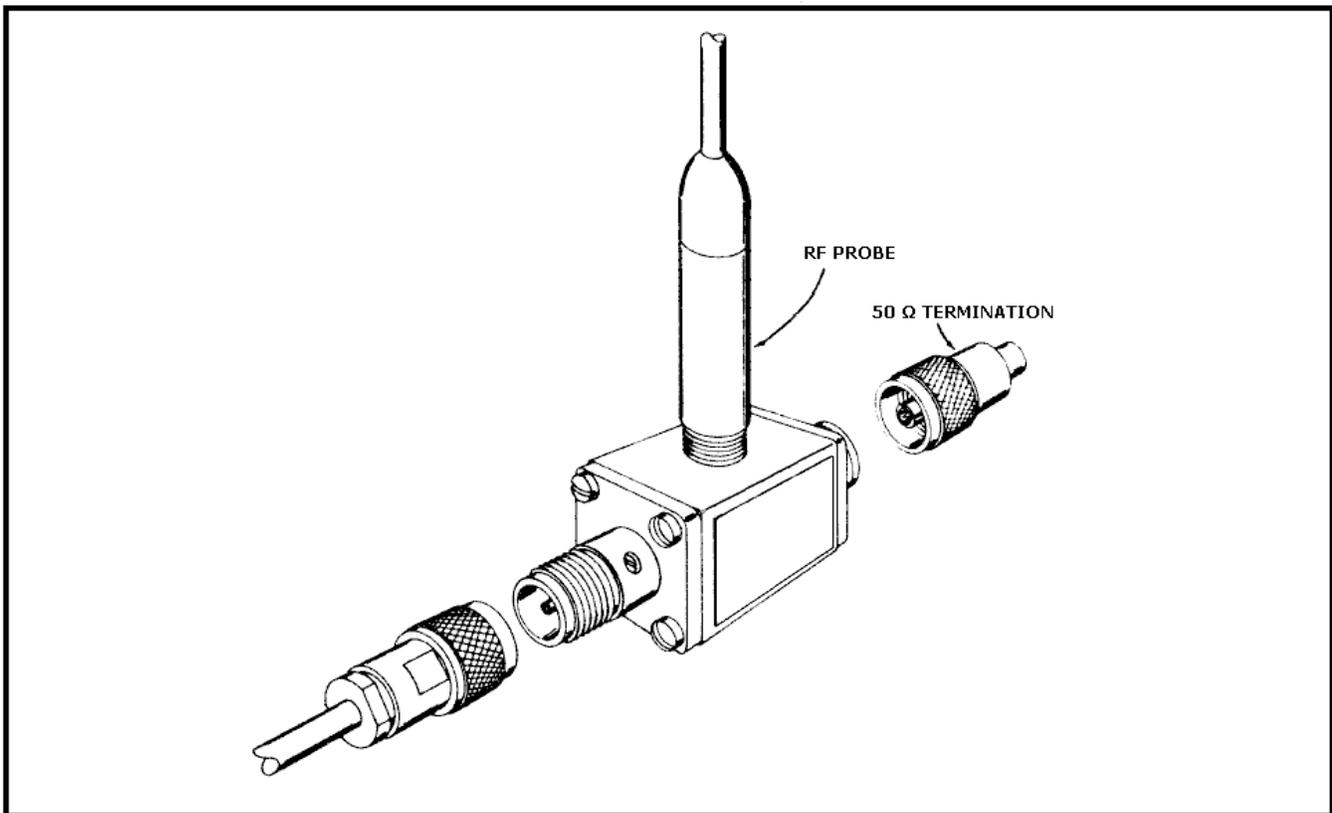


Figure 4-1. Attachment of Model 952003 to (Type N) Tee adapter to Model 952001B Probe And Model 952014 50 Ohm Termination

4.5 Low Level Measurements

The instrument will provide reliable, repeatable measurements of signal levels as low as 200 microvolts. Useful indications extend down to $50 \mu V$. Zeroing of the instrument is essential when using the lower ranges in order to achieve the specified accuracy. Zeroing is also strongly recommended for all ranges up to 30 millivolts. Refer to Section 4.1 for the zeroing procedure.

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4.6 Temperature Effects

1. The accuracy specifications for the instrument apply over a temperature range of 0° C to 50° C. Outside these limits, operation of the instrument is possible, but appreciable inaccuracies can be expected; however, no permanent change in probe characteristics will result from any reasonably high or low temperature exposure.
2. It should be noted that inaccuracies of measurement resulting from temperature effects may occur when measuring with the probe in the vicinity of heat sources such as resistors, heat sinks and so forth.
3. When making low level measurements (below approximately 2 millivolts), it is important to make sure that the probe has attained a uniform temperature throughout its body. A temperature gradient between the inside and outside of the probe can generate a small thermal voltage that may add to the DC output of the detector diodes.

4.7 Hum, Noise and Spurious Pickup

When measuring low level signals, precautions should always be taken to avoid the possibility of measurement errors resulting from hum, noise or stray RF pickup. Although all low frequency hum and noise are attenuated at the input, unwanted high level signals could still possibly cause error. In some cases it may be necessary to provide extra shielding around the probe connection to reduce stray pickup. Some typical sources of spurious radiation are dielectric heating units, diathermic machines and transmitters.

4.8 Recorder Output

The DC output provided at the rear panel RECORDER connector may be used to drive an XY recorder for swept measurements, or a strip chart recorder for monitoring applications. Refer to Section 2.3.

4.9 Correction Curve for Model 952003 50 Ohm Type N Tee Adapter

When using the optional Model 952003 Tee Adapter, the input voltage to the adapter is indicated directly on the instrument. To obtain the correct output voltage from the adapter, subtract the correction shown in Figure 4-2 from the input voltage, in dB, indicated on the instrument. Corrections are not required if the Model 952003 is terminated with 50 Ω .

4.10 Correction Curve for Model 952007 75 Ohm Type N Tee Adapter

When using the optional Model 952007 Tee Adapter, the input voltage to the adapter is indicated directly on the instrument. To obtain the correct output voltage from the adapter, subtract the correction shown in Figure 4-2 from the input voltage, in dB, indicated on the instrument. Corrections are not required if the Model 952007 is terminated with 75 Ω .

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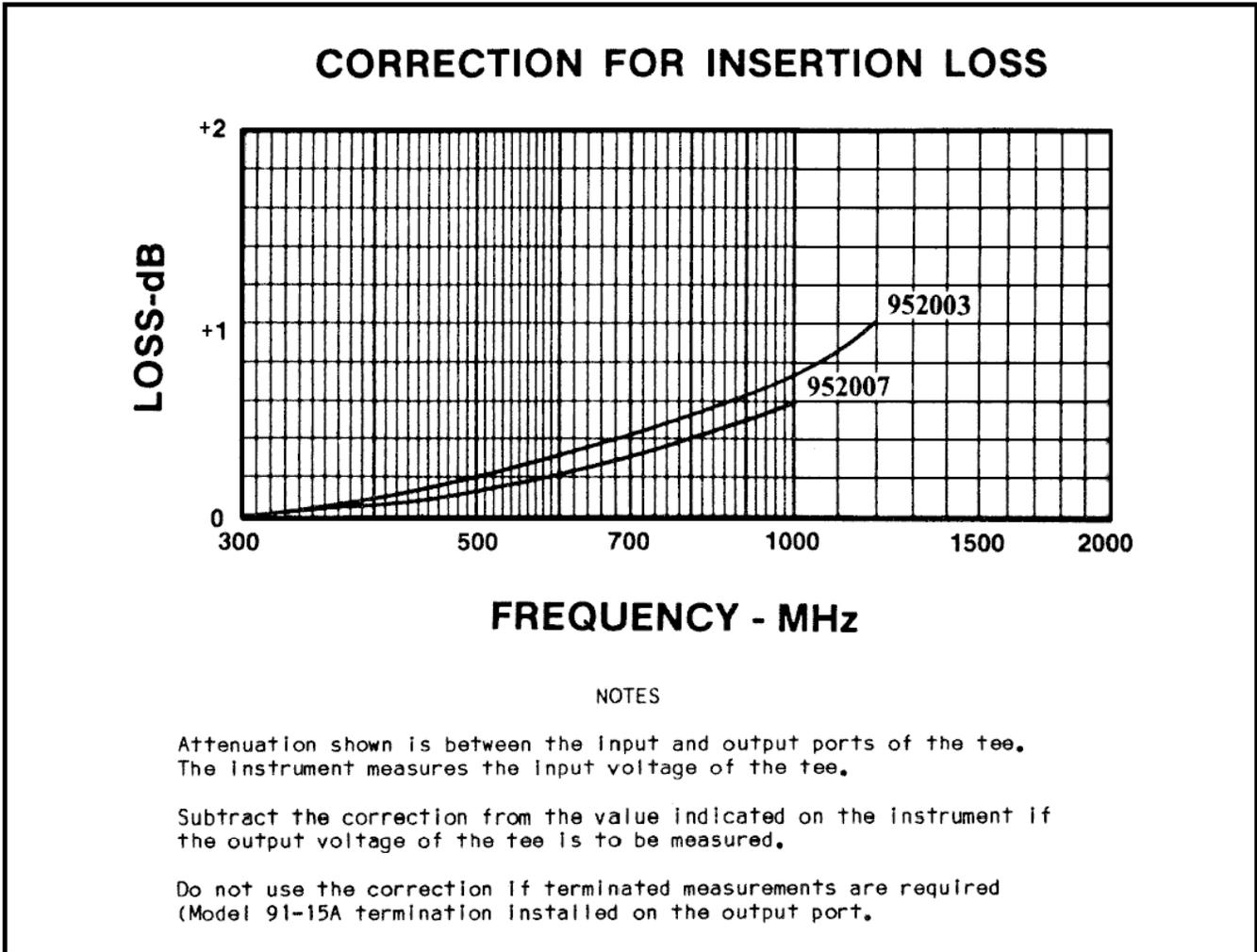


Figure 3-4. Correction Curves for Models 952003 and 952007 Type N tee Adapters.

4.11 RF Power Measurements

The Z_0 function in the CHANNELS sub-menu enables the user to set a characteristic impedance to be used for power calculations. The default value is 50 ohms; however, values from 5 to 2500 ohms may be used. This value is used only in association with the dBm and dBW units. The power level is calculated using the expression:

$$P = V^2/Z_0 \quad \text{where} \quad \begin{array}{l} V \text{ is in volts} \\ Z_0 \text{ is in ohms} \\ P \text{ is in watts} \end{array}$$

For dBm units, the result is the ratio in decibels of the calculated power to 1 milliwatt (0 dBm = 1 milliwatt). For dBW units, the result is the ratio in decibels of the calculated power to 1 watt (0 dBW = 1 watt). This capability is useful for determining the power dissipated in a nonstandard load impedance or in a load which is not part of a coaxial transmission line. The accuracy of this method depends upon the ability to measure the effective voltage across the load. The RF Probe enables the user to reach components mounted on circuit boards.

5. Remote Operation

5.1 GPIB Configuration

The 9240 GPIB interface is configured using the *Menu > SETUP > IEEE* menu. The primary listen/talk address (MLTA) can be set to any value from 1 to 30 inclusive. The value assigned must be unique to each GPIB device. Secondary address is not implemented.

To inform the instrument that a message has been completed, the bus controller must end all messages with a terminating character and/or EOI control signal. The Model 9240 can be programmed for several combinations of terminating characters as required by the controller employed. Selection of terminating characters is accomplished via the *Menu > SETUP > IEEE* menu. There the instrument can be programmed for individual end of string characters in both listener and talker modes as well as independently enabling the end or initiate control signal.

5.2 RS-232 Configuration

RS-232 interface is also available on the Model 9240. The command set and data transfer protocol are nearly identical to those for IEEE. The *Menu > SETUP > RS232* commands are used to configure the RS-232 interface to comply with the terminal in use. Setting the end-of-string character and SRQ Mask is accomplished by using the EOS Talker/Listener and SRQ Mask commands respectively.

Entering the Remote Mode. The Model 9240 enters the remote mode when the ASCII "SI" character (hexadecimal 0F/CTRL O) is received. In the remote state, the front panel keyboard is disabled, except for the <Menu> key which serves as the return to local function. The display will show the REM indicator on the last line and enable the TLK, LSN and SRQ as appropriate.

Returning to Local Mode. The instrument will return to the local state when; a) The <Menu> key is pressed or b) The ASCII "SO" character (hexadecimal 0E/CTRL N) is received.

Note

The instrument must be placed in the remote state for it to respond to data messages. It is not possible to store data in the local state for execution in the remote state.



Talk Operations. The Model 9240 can be requested to talk in two ways. The "??" mnemonic is available for requesting data via the RS-232 port. Immediately after receiving this mnemonic, the instrument responds by transmitting data based on the current talk mode. For example, the following interactive sequence causes the Model 9240 to transmit the measurement with the associated units (4230 IEEE Emulation mode):

Terminal Sends	Model 9240 Response
O (CTRL O/hexadecimal 0F)	REM displayed on bottom line, indicating remote operation.
DB TM1 ??<ENTER>	Set measurement to dBm, set the talk mode to 1 (talk measurement with units). Data returned: "0,-3.00 dBm" - indicating no error at -3 dBm.

Note

<ENTER> means transmit end-of-string as defined via the *Menu > SETUP > RS232 > EOS LSTN* parameter (typically CR).



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Additionally, the ASCII "DC2" character (hexadecimal 12/CTRL R) will cause the instrument to immediately transmit data based on the current talk mode. Continuing the above example:

Terminal Sends	Model 9240 Response
TM0 <ENTER>	Set the talk mode to send Floating Point Measurements.
R (CTRL R/hexadecimal 12)	Talk the error flag and the measurement in floating point notation. Data returned: "0,-3.00" - indicating no error and the power is -3 dBm.

The rules for number and data strings are the same as for the IEEE-488 interface. Number formats are free form and data strings are case insensitive.

5.3 SCPI Language

The 9240 Series instruments may be remotely controlled using commands that follow the industry-standard SCPI programming conventions. The default language is:

```
SYSTem:LANGuage SCPI
```

All of the functions of the 9240 Series are accessible remotely via SCPI commands.

5.3.1 SCPI Structure

The SCPI instrument model defines a hierarchical command structure based on "command nodes". Each node may contain commands or names of a next-level command node. Each command is formed of a series of keywords joined together, and delimited by a colon ":" character. The command begins with a colon at the "root node", and traverses downwards through the command tree to form a specific command. This structure is very similar to a DOS file system, where the file system begins at the root level ("."), and each directory (SCPI subsystem) may contain a list of files (SCPI commands) and lower-level directories. To execute an individual command, the entire command name ("path") must generally be specified, although there are several shortcuts available to reduce the command string length.

SCPI subsystems or command groups are usually aligned with instrument functions, and the standard provides a number of pre-defined subsystems that can be used for most instrument types. For example, the top level SENSE subsystem groups commands that are related to sensing signals (detection, amplification, digitization, linearization), while the OUTPUT subsystem contains commands that control output functions of the instrument such as voltage output or controlling an RF reference output.

5.3.2 Long and Short Form Keywords

Each command or subsystem may be represented by either its full keyword, or a short form of that keyword. The short form is typically the first several characters of the full name, although this is not necessarily the case. The short form of each keyword is identified in this manual by the keyword characters shown in UPPERCASE, while the long form will be shown in mixed case. For example, the short form of "CALCulate" is "calc", while the long form is "calculate". Long form and short form commands may be used interchangeably, but only the exact forms are permitted – intermediate length commands will not be recognized. Sending "CALCUL" will cause an error.

Note that not all keywords have long forms – in this case, the entire keyword will be shown in uppercase.

While uppercase and lowercase text is used to identify keywords, SCPI is generally case-insensitive, so it is acceptable to send uppercase, lowercase or mixed case keywords to the instrument. The only exception is when a command accepts a literal string argument. In this case, quotes may be used to delimit a string of user-defined case.

5.3.3 Subsystem Numeric Suffixes

Certain subsystems, such as the SENSE or CALCulate subsystems in the 9240 Series, often exist as more than one instance (often called a "channel" in an instrument). In this case, an optional numeric suffix may be used to define the channel. If this

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suffix is not present, the default channel is assumed. For example, SENSE or SENSE1 defines operation affecting the instrument's "Channel 1" measurement path, while SENSE2 commands will apply to channel 2.

5.3.4 Colon Keyword Separators

The colon (":") character is used similar to the way a slash or backslash is used in a filesystem. Prefixing a command string with a colon resets parsing at the root command level, and a colon must separate each keyword in the command. Beginning a new line always resets parsing to the root level, so the leading colon is optional if the command is the first command on a line.

5.3.5 Command Arguments and Queries

Many commands require arguments. In this case, the entire command string is sent, followed by the argument. A space is used to separate the command from the argument. For example, "SENSE:CORREction:DCYCLE 25.0" sets duty cycle correction to a value of 25.0. Arguments may be numeric, or alphanumeric. If a command requires more than one numeric argument, the arguments must be sent as a comma delimited list.

To read the current value of a particular parameter, the Query Form of its command may be used. A command query is formed by appending a question-mark ("?") suffix to the command instead of an argument list. There should not be any whitespace between the command and the suffix. For example, "SENSE:CORREction:DCYCLE?" queries the duty cycle correction parameter, and causes the instrument to return its current value.

5.3.6 Semicolon Command Separators

The semicolon (";") character is used to separate multiple commands on a single line. However, the parsing path is affected when more than one command is combined on a line. As noted previously, the first command of a line is always referenced to the root level whether or not the command is prefixed by a colon. However, for the second and succeeding commands, the parsing level is NOT reset to the root level, but rather referenced from the current node. This allows the parser to remain at the current node, and execute other commands from that node without resending the entire node string. For example, the following multi-command strings are equivalent:

:CALCulate:LIMit:LOWer -10.0; CALCulate:LIMit:UPPer 13.0;	(two full-path commands)
:CALCulate:LIMit:LOWer -10.0; UPPer 13.0;	(second command referenced to CORREction node)
CALCulate:LIMit:LOWer -10.0; UPPer 13.0;	(leading colon omitted from first command)

If a command does not belong to the same subsystem as the preceding command on the same line, then its full path must be specified, including the colon prefix.

5.3.7 Command Terminators

All SCPI command strings transmitted to the instrument must be terminated. For commands sent via the GPIB bus, any character with the IEEE488 EOI (End-Or-Identify) control line asserted may be used as a terminator. This may be the last letter of the command, query or argument. Optionally, a CR (ASCII 13) and/or LF (ASCII 10) may be included.

For commands sent via the RS-232 interface a CR and/or LF must be included to match the desired protocol.

When the terminating condition is met, the SCPI path is first reset to the root level, and the received message is then passed to the SCPI parser for evaluation.

5.3.8 9240 Series SCPI Implementation

The SCPI Model of the 9240 provides a single or dual SENSE sub-system to handle probe input and a matching single or dual CALCulate sub-system to process the data obtained from the probes into useful results. The CALibration sub-system is used

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to zero the measurement channel. Channel dependent commands end with a number to indicate the desired channel as follows:

Examples:

:CALCulate:STATe ON	Turn on measurement channel 1 (default channel number)
:CALCulate1:STATe ON	Turn on measurement channel 1 (specified channel number)
:CALC:STAT ON	Turn on measurement channel 1 (short form, default chan #)
:CALC1:STAT ON	Turn on measurement channel 1 (short form, specified chan #)
:CALCulate:STATe?	Query the state of measurement channel 1 (default chan #)
:CALC:STAT?	Query the state of channel 1 (short form, default chan #)
:CALCulate1:STATe?	Query the state of measurement channel 1 (specified chan #)
:CALC1:STAT?	Query the state of channel 1 (short form, specified chan #)
:SENSe:FILTer:TIME 5.0	Set channel 1 averaging time to 5 seconds.

In the discussion and tables below, the following notation will be used:

Command name long and short form:	SYSTem
Optional command name in brackets:	SYSTem:ERRor[:NEXT]?
Command with channel dependence:	CALCulate[1|2]:STATe OFF
Default channel 1:	CALibration:ZERO
Explicit channel 1:	CALibration1:ZERO
Select channel 2:	CALibration2:ZERO
Short Form:	CAL2:ZERO
Command which takes numeric argument:	SENSe1:AVERAge <numeric value>
Same command; query:	SENSe1:AVERAge?
Command with literal text argument:	CALCulate1:UNITs <character data>
Command with no query form:	*CLS
Command with query form only:	FETCh1:CW:VOLTage?

SYNTAX NOTES

Square brackets [] are used to enclose the list of valid channels for a command, or a list of command options separated by the vertical separator bar | character. This character is for syntax only, and is not to be entered as part of the command. By default, if no channel number is specified, Channel 1 is selected.

A literal argument denoted by <character data> indicates a word or series of characters, which must exactly match one of the choices for the command. An argument denoted by <numeric value> requires a string which, when converted to a number, is within the range of valid arguments. Numerical values can generally be in any common form including decimal and scientific notation. <Boolean> indicates an argument which must be either true or false. Boolean arguments are represented by the values 0 or OFF for false, and 1 or ON for true. Queries of Boolean parameters always return 0 or 1.

Curly braces { } are used to enclose two or more possible choices for a mandatory entry, separated by the comma character. One of the enclosed options MUST be inserted into the command, and the braces are not to be entered as part of the command.

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5.4 Basic Measurement Information

The easiest way to obtain a reading is by use of the MEASure command. This command initiates one complete measurement sequence which includes a default configuration. Examples are:

MEAS1:POWER? To return the average power of channel 1, or
MEAS1:VOLTAGE? To return the average voltage of channel 1.

For finer control over the measurement, individual configuration and function commands should be used. Readings are obtained using the FETCH[]? command for current data or the READ[]? command for fresh data.

Readings are in fundamental units as set by the CALCulate[1|2]:UNIT command. Each reading is preceded by a condition code, which has the following meaning:

- 1 Measurement is STOPPED. Value returned is not updated.
- 0 Error return. Measurement is not valid.
- 1 Normal return. No error.
- 2 An Under-range condition exists.
- 3 An Over-range condition exists.

With the INITiate:CONTinuous OFF condition, a single measurement cycle is started by use of the INITiate[:IMMEDIATE] command, where bracketed commands are optional. Multiple triggered measurement cycles are enabled by INITiate:CONTinuous ON.

5.4.1 Service Request

Service requests provide a means to signal the host that a particular event or group of events have occurred in the instrument. Service requests are controlled by the Status Byte Register and the Service Request Enable Register. The Service Request Enable Register is a bit mask that determines which summary bits of the Status Byte Register can cause a request for service to be sent to the Controller. The summary bits of the Status Byte are the MAV, or Message Available bit, and three bits from event driven registers. The first of these is the Standard Event Status Register. The bits of this register are set and latched by specific events within the instrument and cleared when the register is read. The remaining two registers are the Operation Status Register and the Questionable Status Register. These two registers are similar to the Standard Event Status Register but have the additional capability to detect changes in the individual bits of the associated register's condition register. The bits are not only selected by a mask register, but a change in a selected bit, either a high to low, low to high or either transition, can be specified by transition mask registers.

The Status Byte is read by the *STB? command. The bit enable mask is set by the *SRE command and read by the *SRE? query. The Standard Event Status Register is read by the *ESR? Command and the bit enable mask is set by the *ESE command or read by the *ESE? Command.

The Operation Status Register is read by the STATus:OPERation:CONDition? command. The transition masks are set by the STATus:OPERation:NTransition and STATus:OPERation:PTransition commands. The bit enable mask is set by the STATus:OPERation:ENABLE command and read by the STATus:OPERation:ENABLE? query. The Operation Event Register is read by the STATus:OPERation:EVENT? query.

The Questionable Event Status Register has the same structure as the Operation Status Register. Refer to the command descriptions that follow for detailed information.

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5.5 SCPI Command Reference

This section contains a list of all SCPI remote commands accepted by the 9240 Series. The list is grouped by SCPI subsystem or IEEE488.2 function, and includes a detailed description of each command.

5.5.1 IEEE 488.2 Commands

The purpose of IEEE488.2 commands is to provide management and data communication instructions for the system by defining a set of “*” commands (an asterisk followed by a three character code). These commands allow device control and status monitoring, and are the basis for some of the commands of the SCPI STATus subsystem (see Section 5.5.12).

*CLS

Description: Clear Status command. This command resets the SCPI status registers (Questionable Status and Operation Status), the error queue, the IEEE488.2 Status Byte (STB) and Standard Event Status (ESR) registers, and the measurement.

Syntax: *CLS

Argument: None

*ESE

Description: Set or return the Standard Event Status Enable Register. The mask value in this register is used to enable bits of the Standard Event Status Register that are or'ed together to form the ESB summary bit in the instrument Status Byte. When a mask bit is set, and the corresponding ESR bit goes true, an SRQ will be generated, provided the Event Status Summary bit (ESB, bit 5) is enabled in the SRE register. No SRQ can be generated for that condition if the mask bit is cleared. To clear the entire Standard Event Status Enable Register, send *ESE = 0. See the *ESR command for bit assignments. This register is not cleared by *CLS, *RST or DCLR.

Syntax: *ESE <numeric value>

Argument: <numeric value> = 0 to 255

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*ESR?

Description: Return the current value of the Standard Event Status Register, then clear the register. This register has bits assigned to a number of possible events or conditions of the instrument. When the event occurs, the corresponding bit is latched. The register value is read using this command. Individual bits may be enabled or disabled for SRQ generation using the ESE mask (see *ESE command). The following table shows the bit assignments in the Standard Event Status Register:

Bit	Value	Definition
0	1	Operation Complete Flag 1 = all current operations have completed execution.
1	2	Not used
2	4	Not used
3	8	Device Dependent Error 1 = the instrument encountered a device dependent error.
4	16	Not used always returns 0
5	32	Command Error 1 = a remote interface command error exists.
6	64	Not used always returns 0
7	128	Not used always returns 0

Syntax: *ESR?

Returns: Current Value of Event Status Register (0 to 255)

*IDN?

Description: Return the instrument identification string. This string contains the manufacturer, model number, serial number and firmware version number.

Syntax: *IDN?

Returns: < Mfgr, Model#, Serial#, Version# >

*OPC

Description: Clears the OPC (Operation Complete) status flag. This command is issued before the command to be checked for completion. After this, the flag may be queried by *OPC? until a value of one is returned, indicating the command has completed. Note that the query is not a true query - a value of zero will never be returned.

Syntax: *OPC

Argument: None

*OPC?

Description: This command examines the OPC (Operation Complete) status flag and returns a "1" if all pending operations are complete. If pending operations are not yet complete, it does not return.

Syntax: *OPC?

Returns: Always returns 1 to indicate operations complete. Otherwise, does not return.

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*OPT?

Description: Return the status of Channel 1 and Channel 2 followed by a list of installed options.

Syntax: *OPT?

Returns: <f1, f2, f3, f4, opt1, opt2, ...> : f1 – Chan 1 installed?, f2 – Chan1 sensor present?, f3 – Chan 2 installed?, f4 – Chan 2 sensor present?, opt1, opt2, etc. (option list may be empty).

*RST

Description: Set the instrument to a known “default” configuration. Set measurements to STOP. Set the sensor temperature offset flag to FALSE, set the SCPI file over-write permission to FALSE, turn the internal Calibrator output OFF and clear the error queues. System communication parameters are not changed. Instrument measurement functions are set their default values (See Table 3-3, **Initialized Parameters**).

Syntax: *RST

Argument: None

*SRE

Description: Set or return the mask value in the Service Request Enable Register. This value is used to enable particular bits for generating a service request (SRQ) over the GPIB when certain conditions exist in the Status Byte register. When a mask bit in the SRE Register is set, and the corresponding STB register bit goes true, an SRQ will be generated. No SRQ can be generated for that condition if the mask bit is clear. The bits in the Status Byte register are generally summary bits, which are the logical OR of the enabled bits from other registers. See the *STB command for bit assignments.

Syntax: *SRE <numeric value>

Argument: <numeric value> = 0 to 255

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*STB?

Description: Return the current value of the Status Byte register. This register has bits assigned to a number of possible events or conditions of the instrument. The register value may be read using this command, or may be used to generate a service request (SRQ) over the GPIB when certain conditions exist. Individual bits may be enabled or disabled for SRQ generation using the SRE mask (see *SRE command). Note that the bits in the Status Byte register are generally summary bits, which are the logical OR of the enabled bits from other registers. The following table shows the bit assignments in the Status Byte register:

Bit	Value	Definition	
0	1	Not used	
1	2	Not used	
2	4	Error/Event queue status	1 = there is at least one event in the error queue.
3	8	QUEStionable Status Summary	1 = an enabled QUEStionable condition is true.
4	16	Message AAvailable flag bit	1 = an output message is ready to transmit.
5	32	Event Status Summary	1 = an enabled Event Status condition is true.
6	64	MSS Summary Status	1 = at least one other Status Byte bit is true.
7	128	OPERation Status Summary	1 = an enabled OPERation condition is true.

Syntax: *STB?

Returns: Current Value of Status Byte register (0 to 255)

*TRG

Description: Simulate the bus trigger command. This command has the same effect as the GPIB command GET (Group Execute Trigger), except it must be parsed and decoded before the action takes place. There is no query form of this command.

Syntax: *TRG

Argument: None

*TST?

Description: Self-test query. This command initiates a self-test of the instrument, and returns a result code when complete. The result is zero for no errors, or a signed, 16-bit number if any errors are detected.

Syntax: *TST

Returns: Error Code

*WAI

Description: Wait command. This command insures sequential, non-overlapped execution. The 9240 always operates in non-overlapped, sequential mode, therefore this command is accepted as valid, but takes no action.

Syntax: *WAI

Argument: None

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5.5.2 CALCulate Subsystem

The CALCulate group of the command subsystem is used to configure post acquisition data processing. Functions in the CALCulate subsystem are used to configure the measurement mode and control which portions of the acquired measurement data is used and how it is processed to yield a finished measurement. In addition to measurement mode, CALCulate is used to define mathematical operations, measurement units, and limit monitoring. The numeric suffix of the CALCulate program mnemonic in the CALCulate commands refers to a processing and display “channel”, that is CALCulate1 and CALCulate2 represent the voltmeter’s Channel 1 and Channel 2 functions. The CALCulate commands generally DO NOT affect the data acquisition portion of the measurement (see the SENSE subsystem, Section 5.5.11). In a signal-flow block diagram, the CALCulate block operations will follow those of the SENSE block. Note that CALCulate2 commands will generate an error if used with a single channel Model 9241.

CALCulate:LIMit:CLEar[:IMMediate]

Description: Clear all latched alarms for the selected channel.
Syntax: CALCulate[1|2]:CLEar[:IMMediate]
Argument: None

CALCulate:LIMit:FAIL?

Description: Returns the status of all limit alarms for the specified channel in five flags. The first flag is the logical sum of the remaining four. They are: low-limit active, high-limit active, low-limit latched and high-limit latched. Active means that the limit is exceeded when the command is executed; Latched means that the limit has been exceeded since the last limit clear command.
Syntax: CALCulate[1|2]:LIMit:FAIL? <Boolean1>, ... <Boolean5>
Returns: <Boolean1> = summary, <Boolean2> = low-limit active, <Boolean3> = high limit active, <Boolean4> = low-limit latched, <Boolean5> = high-limit latched

CALCulate:LIMit:LOWer[:POWER]

Description: Set or return the lower limit power level for the selected channel. This limit is used for level alarms. When the measured average power is below the lower limit, a down arrow ▼ will appear on the display to the left of the measured value, and flag bits are set in the alarm register which may be accessed using CALCulate:LIMit:FAIL? query and CALCulate:LIMit:CLEAR commands.
Syntax: CALCulate[1|2]:LIMit:LOWer[:POWER] <numeric value>
Argument: <numeric value> = -99.99 to +99.99 dBm

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CALCulate:LIMit:UPPer[:POWer]

Description: Set or return the upper limit power level for the selected channel. This limit is used for level alarms. When the measured average power is above the upper limit, an up arrow ▲ will appear on the display to the left of the measured value and flag bits are set in the alarm register which may be accessed using CALCulate:LIMit:FAIL? query and CALCulate:LIMit:CLEAR commands.

Syntax: CALCulate[1|2]:LIMit:UPPer[:POWer] <numeric value>

Argument: <numeric value> = -99.99 to +99.99 dBm

CALCulate:LIMit:LOWer:STATe

Description: Set or return the lower limit alarm system state for the selected channel. When the lower alarm is enabled (ON), the measured average power is compared to the preset lower power limit, and the error flag is set if out of range. When OFF, no action occurs if the power is out of range.

Syntax: CALCulate[1|2]:LIMit:LOWer:STATe <Boolean>

Argument: <Boolean> = { 0, 1, OFF, ON }

CALCulate:LIMit:UPPer:STATe

Description: Set or return the upper limit alarm system state for the selected channel. When the upper alarm is enabled (ON), the measured average power is compared to the preset upper power limit, and the error flag is set if out of range. When OFF, no action occurs if the power is out of range.

Syntax: CALCulate[1|2]:LIMit:UPPer:STATe <Boolean>

Argument: <Boolean> = { 0, 1, OFF, ON }

CALCulate:LIMit[:BOTH]:STATe

Description: Set or return the combined upper and lower limit alarm system state for the selected channel. When alarms are enabled (ON), the measured average power is compared to the preset upper and lower limits, and the error flags are set if out of range. When OFF, no action occurs if the power is out of range. A query returns 1 if either the upper or lower limit alarm is enabled. A query forces both upper and lower ON if either is enabled.

Syntax: CALCulate[1|2]:LIMit[:BOTH]:STATe <Boolean>

Argument: <Boolean> = { 0, 1, OFF, ON }

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CALCulate:MATH:ARGA

Description: Set or return the first argument to be used for channel math operations.

Syntax: CALCulate:MATH:ARGA <character data>

Argument: <character data> = { CH1, CH2 }

CALCulate:MATH:ARGB

Description: Set or return the second argument to be used for channel math operations.

Syntax: CALCulate:MATH:ARGB <character data>

Argument: <character data> = { CH1, CH2 }

CALCulate:MATH:DATA?

Description: Returns the channel math result.

Syntax: CALCulate:MATH:DATA?

CALCulate:MATH:OPERator

Description: Set or return the channel math operator.

Syntax: CALCulate:MATH:OPERator <character data>

Argument: <character data> = { CH_SUM, CH_DIFF, CH_RAT }

CALCulate:MODE

Description: Set or return the system remote measurement mode. These measurement modes are only available under bus control. NORMAL is the default mode of operation at approximately 20 readings per second. FAST returns data at over 200 readings per second. FILTERed will only return data when the filter is full. FILTERed works best when INITiate:CONTinuous is OFF and a trigger is issued. In this case the measurement will not be returned until the filter is full. When the instrument is returned to local the MODE defaults to NORMAL.

Syntax: CALCulate:MODE <character data>

Argument: <character data> = { NORMAL, FAST, FILTERed }

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CALCulate:REFerence:COLLect

Description: For the selected channel, make the current power the reference level for ratiometric measurements, replacing the previous reference level.

Syntax: CALCulate[1|2]:REFerence:COLLect

Argument: None

CALCulate:REFerence:DATA

Description: For the selected channel, set the power level specified by the argument as the reference level for ratiometric measurements, replacing the previous reference level.

Syntax: CALCulate[1|2]:REFerence:DATA <numeric value>

Argument: <numeric value> = -99.99 dBm to +99.99 dBm

CALCulate:REFerence:STATe

Description: For the selected channel, sets or returns the state of the ratiometric measurement mode. The ratiometric mode causes the reading to be expressed relative to a user specified value. The resulting reading will have units of dBr (dB relative) or percentage depending upon the type of units in use. When the ratiometric mode is disabled, the reading will be restored to express a power or voltage level.

Syntax: CALCulate[1|2]:REFerence:STATe <Boolean>

Argument: <Boolean> = { 0, 1, OFF, ON }, accepts all, returns OFF, ON

CALCulate:STATe

Description: Set or return the measurement state of the selected channel. When ON, the channel performs measurements; when OFF, the channel is disabled and no measurements are performed.

Syntax: CALCulate[1|2]:STATe <Boolean>

Argument: <Boolean> = { 0, 1, OFF, ON }, accepts all, returns OFF, ON

Restrictions: Only pertains to channel 2 of the 9242. Channel 1 cannot be individually disabled. 1 is accepted as the default argument but no action is taken.

CALCulate:UNITs

Description: Set or return units for the selected channel. For voltage probes, watts is calculated with reference to the impedance specified by Z0. Note that for ratiometric results, logarithmic units will always return dBr (dB relative) while linear units return percent.

Syntax: CALCulate[1|2]:UNITs <character data>

Argument: <character data> = {DBW, DBMW, WATTS, VOLTS, DBV, DBMV, DBUV}

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5.5.3 CALibration Subsystem

The CALibration group of commands is used to control automatic zero offset to the RF Voltage probe and the channel to which it is connected. Zero offset adjustment can be performed at any time if no RF signal is applied to the probe.

The numeric suffix of the CALibration commands refers to a measurement channel, that is CALibration1 and CALibration2 refer to CH1 and CH2 input channels, respectively.

Note that CALibration2 commands will generate an error if used with a single channel Model 9241. Also note that although CALibration commands do not accept any arguments, all have a query form, which returns a status code upon completion of the zero process. This allows the user to determine when the process has completed, and whether or not it was successful.

CALibration:ZERO

- Description: Performs a zero offset null adjustment. The sensor does not need to be connected to any calibrator for zeroing – the procedure is often performed in-system. However, this command will turn off the internal calibrator prior to zeroing to avoid the need to perform this step explicitly.
- Syntax: CALibration[1|2]:ZERO[?]
- Returns: 0 if successful, 1 otherwise (using query form only)

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5.5.4 DISPlay Subsystem

The DISPlay group of commands is used to control the selection and presentation of measurements.

DISPlay:ACTive[?]

Description: Set or return the active channel for talk commands.
Syntax: DISPlay:ACTive <numeric value>
Argument: <numeric value> = 1 to 2

DISPlay:CLEar

Description: Clear all data buffers for CH1 and CH2. Clears averaging filters to empty. Does NOT clear errors.
Syntax: DISPlay:CLEar

DISPlay:LIN:RESolution

Description: Set or return the display resolution for linear voltage readings. The number of significant digits displayed is equal to the argument. This command also sets the resolution of measurements returned in remote mode.
Syntax: DISPlay[1|2]:LIN:RESolution <numeric value>
Argument: <numeric value> = 3 to 5

DISPlay:LOG:RESolution

Description: Set or return the display resolution for logarithmic voltage readings. The number of decimal places displayed is equal to the argument. This command also sets the resolution of measurements returned in remote mode.
Syntax: DISPlay[1|2]:LOG:RESolution <numeric value>
Argument: <numeric value> = 1 to 3

DISPlay:LABel:MODE

Description: Turns on/off the user message display mode enabling the user to place text messages on the front panel display.
Syntax: DISPlay:LABel:MODE <Boolean>
Argument: <Boolean> = { 0, 1, OFF, ON }

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DISPlay:LABel:TEXTA

Description: Displays a text message of up to 20 characters in the first label field when Display Label Mode is enabled.

Syntax: DISPlay:LABel:TEXTA <alphanumeric value>

Argument: <alphanumeric value> = A to Z, a to z, 0 to 9, ! @ # \$ % ^ & * () _ - + = { } [] ? / < > : .

DISPlay:LABel:TEXTB

Description: Displays a text message of up to 20 characters in the second label field when Display Label Mode is enabled.

Syntax: DISPlay:LABel:TEXTB <alphanumeric value>

Argument: <alphanumeric value> = A to Z, a to z, 0 to 9 ! @ # \$ % ^ & * () _ - + = { } [] ? / < > : .

DISPlay:LABel:TEXTC

Description: Displays a text message of up to 20 characters in the third label field when Display Label Mode is enabled.

Syntax: DISPlay:LABel:TEXTC <alphanumeric value>

Argument: <alphanumeric value> = A to Z, a to z, 0 to 9 ! @ # \$ % ^ & * () _ - + = { } [] ? / < > : .

DISPlay:LABel:TEXTD

Description: Displays a text message of up to 20 characters in the fourth label field when Display Label Mode is enabled.

Syntax: DISPlay:LABel:TEXTD <alphanumeric value>

Argument: <alphanumeric value> = A to Z, a to z, 0 to 9 ! @ # \$ % ^ & * () _ - + = { } [] ? / < > : .

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5.5.5 FETCh Queries

The FETCh? group of queries is used to return specific measurement data from a measurement cycle that has been INITiated and is complete or free-running. FETCh? performs the data output portion of the measurement. FETCh? does not start a new measurement, so a series of FETCh? queries may be used to return more than one set of processed measurements from a complete set of acquired data. FETCh? usually returns the current value of measurements, and should be used anytime free running data acquisition is taking place (INITiate:CONTinuous ON). If FETCh? is used for single measurements (INITiate:CONTinuous OFF), no data will be returned until a measurement has been INITiated and is complete.

FETCh:CW:VOLTage?

Description: Return current average amplitude reading in channel units.
Syntax: FETCh[1|2]:CW:VOLTage?
Returns: CC, average voltage
Where CC is the measurement condition code.

FETCh:KEY?

Description: Return the key code of the last key depressed; e.g. MENU = 1.
Syntax: FETCh:KEY?
Returns: key code

Key	Code
Menu	1
Sensor	2
FREQ	4
AVG	8
Zero/Cal	16
REF Level	32
Up Arrow	64
Left Arrow	128
Enter	256
Right Arrow	512
Down Arrow	1024

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5.5.6 INITiate and ABORt Commands

The purpose of the INITiate group of commands is to start and control the process of data acquisition once a measurement has been configured. Depending on settings, the 9240 RF Voltmeter may be commanded to begin either a single measurement (INITiate:CONTInuous OFF) which stops when complete, or enter a “free-run” mode where data acquisition occurs continuously (INITiate:CONTInuous ON). The ABORt command terminates any operation in progress and prepares the instrument for an INITiate command.

ABORt

Description: Terminates any measurement in progress and resets the state of the trigger system. Note that ABORt will leave the measurement in a stopped condition with all current measurements cleared, and forces INITiate:CONTInuous to OFF.

Syntax: ABORt

Argument: None

INITiate:CONTInuous

Description: Set or return the data acquisition mode for single or free-run measurements. If INITiate:CONTInuous is set to ON, the 9240 immediately begins taking measurements. If set to OFF, the measurement will begin as soon as the INITiate command is issued, and will stop once the measurement criteria (averaging, filtering or sample count) has been satisfied. Note that INITiate:IMMEDIATE and READ commands are invalid when INITiate:CONTInuous is set to ON; however, by convention this situation does not result in a SCPI error.

Syntax: INITiate:CONTInuous <Boolean>

Argument: <Boolean> = { 0, 1, OFF, ON }

INITiate[:IMMEDIATE[:ALL]]

Description: Starts a single measurement cycle when INITiate:CONTInuous is set to OFF. The measurement will complete once the voltage has been integrated for the full FILTER time. No reading will be returned until the measurement is complete. This command is not valid when INITiate:CONTInuous is ON, however, by convention this situation does not result in a SCPI error.

Syntax: INITiate[:IMMEDIATE[:ALL]]

Argument: None

Restrictions: INITiate:CONTInuous must be OFF

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5.5.7 MEASure Queries

The MEASure group of commands is used to acquire data using a set of high level instructions. They are structured to allow the user to trade off fine control of the measurement process for easy operability. MEASure? provides a complete capability where the voltmeter is configured, a measurement taken, and results returned in one operation. The instrument is set to a basic, predefined measurement state with little user intervention necessary or possible. Sometimes, more precise control of measurement is required. In these cases, MEASure? should not be used. Rather, a sequence of configuration commands, generally from the CALCulate and SENSE groups should be used to set up the instrument for the measurement, then READ? or FETCH? commands are used to return the desired measurement data in a specific format.

MEASure:POWer?

Description: Return a power measurement in dBm using a default instrument configuration. The instrument remains stopped after a measurement.

Syntax: Measure[1|2]:POWer?

Returns: CC, Power in dBm
Where CC is the measurement condition code.

MEASure:VOLTagE?

Description: Return average voltage using a default instrument configuration in volts units. Instrument remains stopped after a measurement.

Syntax: MEASure[1|2]:VOLTagE?

Returns: CC, Average voltage in linear volts
Where CC is the measurement condition code.

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5.5.8 MEMory Subsystem

The MEMory group of commands is used to save and recall instrument operating configurations. Up to ten configurations may be saved.

MEMory:SNSR:CWRG?

Description: Return sensor AC cal data.
Syntax: MEMory:SNSR[1|2]:CWRG?
Argument: None, query only.

MEMory:SNSR:INFO?

Description: Return the sensor ID and parameter data.
Syntax: MEMory:SNSR[1|2]:INFO?
Argument: None

MEMory:SYS:LOAD

Description: Recall a previously stored configuration of an instrument setup.
Syntax: MEMory:SYS:LOAD <filename>
Argument: Alphanumeric filename, "USER0" thru "USER10"

MEMory:SYS:STORe

Description: Save the configuration of the current instrument setup.
Syntax: MEMory:SYS:STORe <filename>
Argument: Alphanumeric filename, "USER1" thru "USER10"

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5.5.9 OUTPUT Subsystem

The OUTPUT group of commands is used to control various outputs of the 9240. These outputs include the Recorder Output. OUTPUT commands for the Recorder Output include setting the DC output to the MAXimum or MINimum level or can be forced to any level in between. Also the Recorder Output can be assigned to either channel 1 or 2.

OUTPUT:RECORDER:FORCE

Description: Command sets the output voltage to the argument. Query returns the output voltage previously set by FORCE or causes error -221 "Settings conflict" if the Recorder Output has been assigned to a channel.

Syntax: OUTPUT:RECORDER:FORCE <numeric value>

Argument: <numeric value> = 0.000 to + 10.000 V

OUTPUT:RECORDER:MAX

Description: Set or return the recorder output maximum, or full scale (+10.0V) voltage reference level.

Syntax: OUTPUT:RECORDER:MAX

Argument: none

OUTPUT:RECORDER:MIN

Description: Set or return the recorder output minimum, or downscale (0.0V) voltage reference level.

Syntax: OUTPUT:RECORDER:MIN

Argument: none

OUTPUT:RECORDER:SOURCE

Description: Set or return the source channel for the Recorder Output.

Syntax: OUTPUT:RECORDER:SOURCE <character data>

Argument: <character data> = CH1, CH2, ACTIVE

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5.5.10 READ Queries

The purpose of the READ? group of queries is to initiate a measurement cycle, acquire data, and return specific measurement data. READ? performs the initiation, data acquisition, postprocessing, and data output portions of the measurement. READ? is equivalent to ABORting any operation in progress, INITiating a new measurement, then FETChing the data when it is ready. READ? generally does not return data unless acquisition is complete. Since READ? INITiates a new measurement every time it is issued, READ? queries should not be used for free running data acquisition (INITiate:CONTinuous ON) - in this case, use FETCh queries instead. The measurement is generally considered complete when the integration filter (see SENSE:FILTer) is filled.

READ:CW:VOLTage?

Description: Return current average amplitude reading in channel units.
Syntax: READ[1|2]:CW:VOLTage?
Returns: CC, Average voltage (volts, dBm)
Where CC is the measurement condition code.

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5.5.11 SENSE Subsystem

The purpose of the SENSE command subsystem is to directly configure device specific settings used to make measurements, generally parameters related to the RF voltage probe and signal processing. The SENSE commands are used to configure the voltmeter for acquiring data. SENSE enables you to change measurement parameters such as filtering or averaging. The numeric suffix of the SENSE program mnemonic in the SENSE commands refers to a hardware measurement “channel”, that is SENSE1 and SENSE2 represent the instrument’s SENSOR 1 and SENSOR 2 signal paths, respectively. The SENSE commands generally DO NOT affect the data processing and display portion of the measurement (see the CALCulate subsystem, Section 5.5.2). Note that SENSE2 commands will generate an error if used with a single channel 9240 Series instrument.

SENSE:FILTer:STATe

Description: Set or return the current setting of the integration filter on the selected channel. OFF provides no filtering, and can be used at high signal levels when absolute minimum settling time is required. ON allows a user-specified integration time, from 50 milliseconds to 20 seconds (see SENSE:FILTer:TIME command). Note that setting the filter time will force the state to ON. AUTO uses a variable amount of filtering, which is set automatically by the voltmeter based on the current signal level to a value that gives a good compromise between measurement noise and settling time at most levels.

Syntax: SENSE[1|2]:FILTer:STATe <character data>

Argument: <character data> = {OFF, ON, AUTO}

SENSE:FILTer:TIME

Description: Set or return the current length of the integration filter on the selected channel. If the filter state is set to AUTO, querying the time will return -0.01, and if set to OFF, a time query will return 0.00. Note that setting the filter time will force the state to ON.

Syntax: SENSE[1|2]:FILTer:TIME <numeric value>

Argument: <numeric value> = 0.05 to 20.00 seconds in 50 millisecond increments

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5.5.12 STATus Commands

The STATus command subsystem enables you to control the SCPI defined status reporting structures. The user may examine the status or control status reporting of the voltmeter by accessing the Device, Operation and Questionable status groups.

STATus:DEVIce:CONDition?

Description: Return the current value of the Device Condition register. The following table shows the bit assignments in the register. These bits are updated by the instrument in real time, and can change in response to changes in the instrument's operating condition.

<u>Bit</u>	<u>Value</u>	<u>Definition</u>	
0	1	Not used	always returns 0.
1	2	Channel 1 Connected	1 = A sensor or probe is connected to channel 1.
2	4	Channel 2 Connected	1 = A sensor or probe is connected to channel 2.
3	8	Channel 1 Error	1 = Channel 1 is reporting an error.
4	16	Channel 2 Error	1 = Channel 2 is reporting an error.
5	32	Shape Cal 1	1 = Channel 1 is using a CW shape cal table.
6	64	Shape Cal 2	1 = Channel 2 is using a CW shape cal table.
7	128	Not used	always returns 0.
8	256	Not used	always returns 0.
9	512	Not used	always returns 0.
10	1024	Not used	always returns 0.
11	2048	Not used	always returns 0.
12	4096	Not used	always returns 0.
13	8192	Key Press	1 = A key has been pressed.
14	16384	Not used	always returns 0.
15	32768	Not used	always returns 0.

Syntax: STATus:DEVIce:CONDition?

Returns: 16-bit register value (0 to 65535)

STATus:DEVIce:ENABLE

Description: Sets or returns the Device Enable register, which contains the bit mask that defines which true conditions in the Device Status Event register will be reported in the Device Summary bit of the instrument Status Byte. If any bit is 1 in the Device Enable register and its corresponding Device Event bit is true, the Device Status summary bit will be set.

Syntax: STATus:DEVIce:ENABLE <numeric value>

Argument: <numeric value> = 0 to 65535

Returns: 16-bit register value (0 to 65535)

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STATus:DEvice:EVENT?

Description: Returns the current contents of the Device Event register then resets the register value to 0. The Device Event register contains the latched events from the Device Condition register as specified by the Device status group's positive and negative transition filters.

Syntax: STATus:DEvice:EVENT?

Returns: 16-bit register value (0 to 65535)

STATus:DEvice:NTRansition

Description: Set or return the value of the negative transition filter bitmask for the Device status group. Setting a bit in the negative transition filter causes a 1 to 0 (negative) transition in the corresponding bit of the Device Condition register to cause a 1 to be written in the associated bit of the Device Event register.

Syntax: STATus:DEvice:NTRansition <numeric value>

Argument: <numeric value> = 0 to 65535

Returns: 16-bit register value (0 to 65535)

STATus:DEvice:PTRansition

Description: Set or return the value of the positive transition filter bitmask for the Device status group. Setting a bit in the positive transition filter causes a 0 to 1 (positive) transition in the corresponding bit of the Device Condition register to cause a 1 to be written in the associated bit of the Device Event register.

Syntax: STATus:DEvice:PTRansition <numeric value>

Argument: <numeric value> = 0 to 65535

Returns: 16-bit register value (0 to 65535)

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STATus:OPERation:CONDition?

Description: Return the current value of the Operation Condition register. The following table shows the bit assignments in the register. These bits are updated by the instrument in real time, and can change in response to changes in the instrument's operating condition.

Bit	Value	Definition	
0	1	Zeroing	1 = probe zeroing in progress.
1	2	Settling	1 = averaging filter is not full.
2	4	Ranging	1 = range change in progress.
3	8	Not used	always returns 0.
4	16	Measuring	1 = measurement in progress.
5	32	Triggering	1 = Trigger mode enabled waiting for a trigger.
6	64	Not used	always returns 0.
7	128	Not used	always returns 0.
8	256	Alarm 1	1 = Channel 1 is in an alarm condition.
9	512	Alarm 2	1 = Channel 2 is in an alarm condition.
10	1024	Alarm Latch 1	1 = Channel 1 alarm is latched.
11	2048	Alarm Latch 2	1 = Channel 2 alarm is latched.
12	4096	Not used	always returns 0
13	8192	Not used	always returns 0.
14	16384	Not used	always returns 0.
15	32768	Not used	always returns 0.

Syntax: STATus:OPERation:CONDition?

Returns: 16-bit register value (0 to 65535)

STATus:OPERation:ENABLE

Description: Sets or returns the Operation Enable register, which contains the bit mask that defines which true conditions in the Operation Status Event register will be reported in the Operation Summary bit of the instrument Status Byte. If any bit is 1 in the Operation Enable register and its corresponding Operation Event bit is true, the Operation Status summary bit will be set.

Syntax: STATus:OPERation:ENABLE <numeric value>

Argument: <numeric value> = 0 to 65535

Returns: 16-bit register value (0 to 65535)

STATus:OPERation:EVENT?

Description: Returns the current contents of the Operation Event register then resets the register value to 0. The Operation Event register contains the latched events from the Operation Condition register as specified by the Operation status group's positive and negative transition filters.

Syntax: STATus:OPERation:EVENT?

Returns: 16-bit register value (0 to 65535)

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STATus:OPERation:NTRansition

Description: Set or return the value of the negative transition filter bitmask for the Operation status group. Setting a bit in the negative transition filter causes a 1 to 0 (negative) transition in the corresponding bit of the Operation Condition register to cause a 1 to be written in the associated bit of the Operation Event register.

Syntax: STATus:OPERation:NTRansition <numeric value>

Argument: <numeric value> = 0 to 65535

Returns: 16-bit register value (0 to 65535)

STATus:OPERation:PTRansition

Description: Set or return the value of the positive transition filter bitmask for the Operation status group. Setting a bit in the positive transition filter causes a 0 to 1 (positive) transition in the corresponding bit of the Operation Condition register to cause a 1 to be written in the associated bit of the Operation Event register.

Syntax: STATus:OPERation:PTRansition <numeric value>

Argument: <numeric value> = 0 to 65535

Returns: 16-bit register value (0 to 65535)

STATus:PRESet

Description: Sets SCPI enable registers and transition filters to the default state. The Operational Enable and Questionable Enable mask registers are both cleared so an SRQ will not be generated for these conditions. All bits for the device and questionable calibration registers are enabled. All positive transition filters are enabled and all negative transition filters are cleared.

Syntax: STATus:PRESet

Argument: None

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STATus:QUEStionable:CONDition?

Description: Return the current value of the Questionable Condition register. The following table shows the bit assignments in the register. These bits are updated by the instrument in real time, and can change in response to changes in the instrument's operating condition.

Bit	Value	Definition	
0	1	Not used	always 0.
1	2	Not used	always 0.
2	4	Not used	always 0.
3	8	Voltage	1 = a voltage measurement may be invalid.
4	16	Not used	always 0.
5	32	Not used	always 0.
6	64	Not used	always 0.
7	128	Not used	always 0.
8	256	Calibration	1 = probe requires zeroing
9	512	Not used	always 0.
10	1024	Not used	always 0.
11	2048	Not used	always 0.
12	4096	Not used	always 0.
13	8192	Not used	always 0.
14	16384	Not used	always 0.
15	32768	Not used	always 0.

Syntax: STATus:QUEStionable:CONDition?

Returns: 16-bit register value (0 to 65535)

STATus:QUEStionable:ENABLE

Description: Sets or returns the Questionable Enable register, which contains the bit mask that defines which true conditions in the Questionable Status Event register will be reported in the Questionable Summary bit of the instrument Status Byte. If any bit is 1 in the Questionable Enable register and its corresponding Questionable Event bit is true, the Questionable Status summary bit will be set.

Syntax: STATus:QUEStionable:ENABLE <numeric value>

Argument: <numeric value> = 0 to 65535

Returns: 16-bit register value (0 to 65535)

STATus:QUEStionable:EVENT?

Description: Returns the current contents of the Questionable Event register then resets the register value to 0. The Questionable Event register contains the latched events from the Questionable Condition register as specified by the Questionable status group's positive and negative transition filters.

Syntax: STATus:QUEStionable:EVENT?

Returns: 16-bit register value (0 to 65535)

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STATus:QUEStionable:NTRansition

Description: Set or return the value of the negative transition filter bit mask for the Questionable status group. Setting a bit in the negative transition filter causes a 1 to 0 (negative) transition in the corresponding bit of the Questionable Condition register to cause a 1 to be written in the associated bit of the Questionable Event register.

Syntax: STATus:QUEStionable:NTRansition <numeric value>

Argument: <numeric value> = 0 to 65535

Returns: 16-bit register value (0 to 65535)

STATus:QUEStionable:PTRansition

Description: Set or return the value of the positive transition filter bit mask for the Questionable status group. Setting a bit in the positive transition filter causes a 0 to 1 (positive) transition in the corresponding bit of the Questionable Condition register to cause a 1 to be written in the associated bit of the Questionable Event register.

Syntax: STATus:QUEStionable:PTRansition <numeric value>

Argument: <numeric value> = 0 to 65535

Returns: 16-bit register value (0 to 65535)

STATus:QUEStionable:CALibration:CONDition?

Description: Return the current value of the Questionable Calibration Condition register. This register is used to notify the user of questionable quality with respect to calibration. The following table shows the bit assignments in the register. These bits are updated by the instrument in real time, and can change in response to changes in the instrument's operating condition.

Bit	Value	Definition
0	1	Not Used
1	2	Not used
2	4	Sens1 Default Shape 1 = Channel 1 using default shape table.
3	8	Sens2 Default Shape 1 = Channel 2 using default shape table.

Syntax: STATus:QUEStionable:CALibration:CONDition?

Returns: 16-bit register value (0 to 65535)

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STATUS:QUESTIONABLE:CALIBRATION:ENABLE

Description: Sets or returns the Questionable Calibration Enable register, which contains the bit mask that defines which true conditions in the Questionable Calibration Event register will be reported in the Questionable Calibration Summary bit of the Questionable Condition register. If any bit is 1 in the Questionable Calibration Enable register and its corresponding Questionable Calibration Event bit is true, the Questionable Calibration summary bit will be set.

Syntax: STATUS:QUESTIONABLE:CALIBRATION:ENABLE <numeric value>

Argument: <numeric value> = 0 to 65535

Returns: 16-bit register value (0 to 65535)

STATUS:QUESTIONABLE:CALIBRATION:EVENT?

Description: Returns the current contents of the Questionable Calibration Event register then resets the register value to 0. The Questionable Calibration Event register contains the latched events from the Questionable Calibration Condition register as specified by the Questionable Calibration status group's positive and negative transition filters.

Syntax: STATUS:QUESTIONABLE:CALIBRATION:EVENT?

Returns: 16-bit register value (0 to 65535)

STATUS:QUESTIONABLE:CALIBRATION:NTRANSITION

Description: Set or return the value of the negative transition filter bit mask for the Questionable Calibration status group. Setting a bit in the negative transition filter causes a 1 to 0 (negative) transition in the corresponding bit of the Questionable Calibration Condition register to cause a 1 to be written in the associated bit of the Questionable Calibration Event register.

Syntax: STATUS:QUESTIONABLE:CALIBRATION:NTRANSITION <numeric value>

Argument: <numeric value> = 0 to 65535

Returns: 16-bit register value (0 to 65535)

STATUS:QUESTIONABLE:CALIBRATION:PTRANSITION

Description: Set or return the value of the positive transition filter bit mask for the Questionable Calibration status group. Setting a bit in the positive transition filter causes a 0 to 1 (positive) transition in the corresponding bit of the Questionable Calibration Condition register to cause a 1 to be written in the associated bit of the Questionable Calibration Event register.

Syntax: STATUS:QUESTIONABLE:CALIBRATION:PTRANSITION <numeric value>

Argument: <numeric value> = 0 to 65535

Returns: 16-bit register value (0 to 65535)

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5.5.13 SYSTem Subsystem

The SYSTem group of commands is used to control system-level functions not directly related to instrument measurement performance. SYSTem commands are used to return error codes or messages from the voltmeter error queue, control hardware features and configure communication parameters for the GPIB.

SYSTem:BEEP[:ENABle]

Description: Set or return the status of the audible keyboard beeper.
Syntax: SYSTem:BEEP[:ENABle] <Boolean>
Argument: <Boolean> = { 0, 1, OFF, ON }

SYSTem:BEEP:IMMediate

Description: Causes the system to emit an audible beep. Command only; does not respond to a query.
Syntax: SYSTem:BEEP:IMMediate
Argument: None

SYSTem:COMMunicate:GPIB:ADDRess

Description: Set or return the GPIB bus address.
Syntax: SYSTem:COMMunicate:GPIB:ADDRess <numeric value>
Argument: <numeric value> = 1 to 30

SYSTem:COMMunicate:GPIB:EOI

Description: Set or return the status of the GPIB EOI .
Syntax: SYSTem:COMMunicate:GPIB:EOI <Boolean>
Argument: <Boolean> = { 0, 1, OFF, ON }

SYSTem:COMMunicate:GPIB:LISTen

Description: Set or return the GPIB Listen end-of-string terminator .
Syntax: SYSTem:COMMunicate:GPIB:LISTen <character data>
Argument: <character data> = {LF, CR, CRLF, EOIONLY}

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SYSTem:COMMunicate:GPIB:TALK

Description: Set or return the GPIB Talk end-of-string terminator .
Syntax: SYSTem:COMMunicate:GPIB:TALK <character data>
Argument: <character data> = {LF, CR, CRLF, EOIONLY}

SYSTem:COMMunicate:SERial:BAUD

Description: Set or return the RS232 baud rate.
Syntax: SYSTem:COMMunicate:SERial:BAUD <numeric value>
Argument: <numeric value> = 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

SYSTem:COMMunicate:SERial:BITS

Description: Set or return the RS232 serial word length (Data Bits).
Syntax: SYSTem:COMMunicate:SERial:BITS <numeric value>
Argument: <numeric value> = 7, 8

SYSTem:COMMunicate:SERial:PARity

Description: Set or return the RS232 parity.
Syntax: SYSTem:COMMunicate:SERial:PARity < character data >
Argument: <character data> = ODD, EVEN, NONE

SYSTem:COMMunicate:SERial:SBITS

Description: Set or return the number of RS232 serial stop bits.
Syntax: SYSTem:COMMunicate:SERial:SBITS <numeric value>
Argument: <numeric value> = 1, 2

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SYSTem:ERRor[:NEXT]?

Description: Returns the next queued error code number followed by a quoted ASCII text string describing the error. Note that errors are stored in a “first-in-first-out” queue, so if more than one error has occurred, repeating this command will report the errors in the sequence they happened. The action of reading an error removes that error from the queue, so once the most recent error has been read, further queries will report a code of zero, and “No Error”. See Appendix A for detailed descriptions of the error codes that may be returned.

Syntax: SYSTem:ERRor[:NEXT]?

Returns: <numeric error code>, “QUOTED ERROR DESCRIPTION”

SYSTem:ERRor:CODE?

Description: Returns the next queued error code number. Note that errors are stored in a “first-in-first-out” queue, so if more than one error has occurred, repeating this command will report the error codes in the sequence they happened. The action of reading an error removes that error from the queue, so once the most recent error has been read, any more queries will report a code of zero. See Appendix A for a more detailed description of the error codes that may be returned.

Syntax: SYSTem:ERRor:CODE?

Returns: <numeric error code>

SYSTem:ERRor:COUNT?

Description: Returns the number of errors that currently exist in the error queue. A value of 0 means that there are no errors in the queue. Therefore, either no errors have occurred, or all errors have been read. See Appendix A for a more detailed description of the error codes that may be returned.

Syntax: SYSTem:ERRor:COUNT?

Returns: <numeric error code>

SYSTem:PRESet

Description: Set 9240 default parameters. Equivalent to SETUP > RECALL > DEFAULT. See Tables 3-2, 3-3 and 3-4 for a list of the default values for each parameter.

Syntax: SYSTem:PRESet

Argument: None

SYSTem:VERSion?

Description: Return the SCPI version compliance claimed.

Syntax: SYSTem:VERSion?

Returns: <character data> = Version Code as <year.version> YYYY.V (will return 1999.0)

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5.5.14 INSTRument:VERSion Commands

INSTRument:VERSion group of commands is used to query the firmware and FPGA revision codes. The firmware code follows a “YYYYMMDD” format. The FPGA revision format has a major and minor representation in the form of “MM.mm” where “MM” is the major revision number and “mm” in the minor revision number.

INSTRument:VERSion:FIRMware?

Description: Returns the firmware revision code.
Syntax: INSTRument:VERSion:FIRMware?
Returns: YYYYMMDD

INSTRument:VERSion:FPGA?

Description: Returns the FPGA revision code.
Syntax: INSTRument:VERSion:FPGA?
Returns: MM.mm

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5.5.15 SCPI Command Summary

Table 5-1. SCPI COMMAND SUMMARY

*CLS	Clear Status Command
*ESE	Set/get Standard Event Status Enable
*ESR?	Standard Event Status Register Query
*IDN	Identification Query
*OPC	Operation Complete Command
*OPC?	Operation Complete Query
*OPT?	Return the instrument options
*RST	Reset Command
*SRE	Set/get Service Request Enable
*STB?	Read Status Byte Query
*TRG	Simulate Group Execute Trigger
*TST?	Self-Test Query
ABORT	Immediately set measurement trigger system to idle
CALCulate[1|2]:LIMit:CLEar[:IMMediate]	Clear all latched limit alarms
CALCulate[1|2]:LIMit:FAIL?	Return the status of all alarms. <Boolean> = {summary, LL, UL, LLL, ULL}
CALCulate[1|2]:LIMit:LOWer[:POWer]	Set/return lower limit power level. < numeric value > = -99.99 to +99.99 dBm
CALCulate[1|2]:LIMit[:BOTH]:STATe	Set or return the combined upper and lower limit alarm system state for the selected channel.
CALCulate[1|2]:LIMit:LOWer:STATe	Set/return lower limit alarms. <Boolean> = 0, 1, OFF, ON
CALCulate[1|2]:LIMit:UPPer:STATe	Set/return upper limit alarms. <Boolean> = 0, 1, OFF, ON
CALCulate[1|2]:LIMit:UPPer[:POWer]	Set/return upper limit power level. < numeric value > = -99.99 to +99.99 dBm
CALCulate:MATH:ARGA	Set or return the first argument to be used for channel math operations.

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Table 5-1. SCPI COMMAND SUMMARY (continued)

CALCulate:MATH:ARGB	Set or return the second argument to be used for channel math operations.
CALCulate:MATH:DATA?	Returns the channel math result.
CALCulate:MATH:OPERator	Set or return the channel math operator.
CALCulate:MODE	Set/return remote measurement mode <character data> = NORMal, FAST, FILTered
CALCulate[1|2]:REfERENCE:COLLect	Set the current reading to be the ratiometric measurement reference level.
CALCulate[1|2]:REfERENCE:DATA	Set or return the ratiometric measurement reference level in dBm. <numeric value> = -99.99 to +99.99 dBm
CALCulate[1|2]:REfERENCE:STATe	Set or return the ratiometric measurement mode state. <Boolean> = 0, 1, OFF, ON
CALCulate[1|2]:STATe	Enable currently selected channel allowing measurements to be made. <Boolean> = 0, 1, OFF, ON
CALCulate[1|2]:UNITs	Change channel units. <character value> = DBM, Watts, Volts, DBV, DBMV, DBUV
CALibration[1|2]:ZERO	Start zero process.
DISPlay:ACTive	Set/return the active channel for talk commands.
DISPlay:CLear	Clear measurement data and display.
DISPlay:LIN:RESolution	Set number of significant digits for linear displays and remote return values. <numeric value> = 3 to 5
DISPlay:LOG:RESolution	Set number of decimal places for log displays and remote return values. <numeric value> = 1 to 3
DISPlay:LABel:MODE	Enables/disables the user message display. <Boolean> = 0, 1, OFF, ON
DISPlay:Label:TEXTA	Displays a text message in the first label field. <alphanumeric value> = A to Z, a to z, 0 to 9 !@# \$ % ^ & * () _ - + = { } [] ? / < > : .
DISPlay:Label:TEXTB	Displays a text message in the second label field. <alphanumeric value> = A to Z, a to z, 0 to 9 !@# \$ % ^ & * () _ - + = { } [] ? / < > : .
DISPlay:Label:TEXTC	Displays a text message in the third label field. <alphanumeric value> = A to Z, a to z, 0 to 9 !@# \$ % ^ & * () _ - + = { } [] ? / < > : .

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Table 5-1. SCPI COMMAND SUMMARY (continued)

DISPlay:Label:TEXTD	Displays a text message in the fourth label field. <alphanumeric value> = A to Z, a to z, 0 to 9 !@# \$ % ^ & * () _ - + = { } [] ? / < > : .
FETCh[1|2]:CW:VOLTage?	Return current average reading in voltage units
FETCh:KEY?	Return code of last key depressed
INITiate:CONTInuous	Set/return state of mode which triggers meas cycles continuously. <Boolean> = 0, 1, OFF, ON
INITiate[:IMMEDIATE[:ALL]]	Set mode which starts a measurement cycle when trigger event occurs
MEASure[1|2]:POWER?	Return the average voltage measurement in dBm
MEASure[1|2]:VOLTage?	Return the average voltage measurement in volts.
MEMory[1|2]:SNSR:CWRG?	Return sensor AC cal data.
MEMory[1|2]:SNSR:INFO?	Return the sensor ID and parameter data.
MEMory:SYST:LOAD	Load saved instrument setup by filename. <character data> = "USER0" ... "USER10".
MEMory:SYST:STORE	Save instrument setup by filename. <character data> = "USER1" ... "USER10".
OUTPut:REcorder:FORCe	Command sets the Recorder Output voltage to the argument. <numeric value> = 0.0 to + 10.0 V
OUTPut:REcorder:MAX	Set or return the Recorder Output maximum, or full scale (+10.0V) voltage reference level.
OUTPut:REcorder:MIN	Set or return the Recorder Output minimum, or downscale (0.0V) voltage reference level
OUTPut:REcorder:SOURce	Set or return the source channel for the Recorder Output. <character data> = CH1, CH2, ACTIVE
READ[1|2]:CW:VOLTage?	Return new average reading in voltage units.
SENSe[1|2]:FILTer:STATe	Set/return filter state. <character data> = OFF, AUTO, ON
SENSe[1|2]:FILTer:TIME	Set or return the current length of the integration filter on the selected channel. <numeric value> = 0.05 to 20.00 seconds
STATus:DEvice:CONDition?	Return value of Device Condition Register
STATus:DEvice:ENABLE	Set/return value of Device Enable Mask
STATus:DEvice:EVENT?	Return value of Device Event Register

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5-1. SCPI COMMAND SUMMARY (continued)

STATus:DEvice:NTRansition	Set/return the Negative Transition filter
STATus:DEvice:PTRansition	Set/return the Positive Transition filter
STATus:OPERation:CONDition?	Return value of Operation Condition Register
STATus:OPERation:ENABLE	Set/return value of Operation Enable Mask
STATus:OPERation:EVENT?	Return value of Operation Event Register
STATus:OPERation:NTRansition	Set/return the Negative Transition filter
STATus:OPERation:PTRansition	Set/return the Positive Transition filter
STATus:PRESet	Set device dependent SCPI registers to default states
STATus:QUEStionable:CONDition?	Return value of Questionable Condition Register
STATus:QUEStionable:ENABLE	Set/return value of Questionable Enable Mask
STATus:QUEStionable:EVENT?	Return value of Questionable Event Register
STATus:QUEStionable:NTRansition	Set/return the negative transition filter
STATus:QUEStionable:PTRansition	Set/return the positive transition filter
STATus:QUEStionable:CALibration:CONDition?	Return value of the questionable calibration condition register
STATus:QUEStionable:CALibration:ENABLE	Set/return value of the questionable calibration enable mask
STATus:QUEStionable:CALibration:EVENT?	Return value of the questionable calibration event register
STATus:QUEStionable:CALibration:NTRansition	Set/return the negative transition filter
STATus:QUEStionable:CALibration:PTRansition	Set/return the positive transition filter
SYSTem:BEEP[:ENABLE]	Set/return keypad audible beeper status. <Boolean> = 0, 1, OFF, ON
SYSTem:BEEP:IMMediate	Causes a beep to be emitted. No argument. No return.
SYSTem:COMMunicate:GPIB:ADDRess	Set or return the GPIB bus address. <numeric value> = 1 to 30
SYSTem:COMMunicate:GPIB:EOI	Set/return the status of the GPIB EOI. <Boolean> = 0, 1, OFF, ON
SYSTem:COMMunicate:GPIB:LISTen	Set/return the GPIB Listen end-of-string terminator. <character data> = LF, CR, CRLF, EOIONLY
SYSTem:COMMunicate:GPIB:TALK	Set/return the GPIB Talk end-of-string terminator. <character data> = LF, CR, CRLF, EOIONLY

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Table 5-1. SCPI COMMAND SUMMARY (continued)

SYSTem:COMMunicate:SERial:BAUD	Set/return the RS232 baud rate. <numeric value> = 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
SYSTem:COMMunicate:SERial:BITS	Set/return the RS232 serial Data Bits. <numeric value> = 7,8
SYSTem:COMMunicate:SERial:PARity	Set/return the RS232 Parity. <character data> = ODD, EVEN, NONE
SYSTem:COMMunicate:SERial:SBITS	Set/return the RS232 serial Stop Bits. <numeric value> = 1,2
SYSTem:ERRor[:NEXT]?	Return system error code and description
SYSTem:ERRor:CODE?	Return system error code
SYSTem:ERRor:COUNT?	Return the number of errors in the queue
SYSTem:PRESet	Set instrument to default conditions.
SYSTem:VERSion?	Return SCPI version compliance. <numeric value> = yyyy.v
INSTrument:VERSion:FIRMware?	Returns the firmware revision code. <numeric value> = yyyyymmdd
INSTrument:VERSion:FPGA?	Returns the FPGA revision code. <numeric value> = MM.mm

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5.5.16 9230 Emulation GPIB Commands

Table 5-2. 4230 EMULATION GPIB COMMANDS

Code	Description	Comment
AM	Measure A-B	
AR	Measure A/B	
BD	Measure B - A	
BR	Measure B/A	
BN	4230A Native mode	
CH	Channel select 1 - 2	
CL	Clear	
DB	dBm select	
DF	Display off	
DN	Display on	
DR	dBr select	
DU	Display user message	
FA	Auto filter	
FL	Filter time select	0 to 20.00 in 0.05 steps
?ID	Talk instrument ID	
*IDN?	Talk instrument ID ¹	
LH	High limit	-99.99 to 99.99 in 0.01 steps
LL	Low limit	-99.99 to 99.99 in 0.01 steps
LM0	Disable limits checking function	
LM1	Enable limits checking function	
LR	Load reference	
PK0	Disable peak readout.	
PK1	Peak sinewave voltage (x.1414 or +3dB)	
VOLT	Volts units select (μ V, mV)	
MF	Measure filtered	
MFD	Measure Fast Dual Channels	
MFS	Measure fast single channel	
MN	Measure normal, free run	
MS	Measure settled	
PW	Watts select	
RA	Autorange	
RB	Recorder bottom	

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Table 5-2. 4230 EMULATION GPIB COMMANDS (continued)

Code	Description	Comments
RC	Recall instrument configuration	1 - 10
RE	Resolution	1 - 3
RN	Recorder normal	
RS	Range select	0 - 6
RT	Recorder top	
SCPI	Set remote programming language to SCPI	
VSI	Send linearity data to instrument	
SM	Service request (SRQ) mask	0 - 255
VSO	Get linearity data from instrument	
SR	Set dBr reference	-99.99 to 99.99 in 0.01 steps
SS	Sensor select	1 - 6
ST	Store instrument configuration	1 - 10
TF	Trigger filtered	
TFD	Trigger fast dual channels	
TFS	Trigger fast single channel	
TN	Trigger normal	
TM	Talk mode	0 - 6
TR	Bus trigger	
TS	Trigger settled	
ZR	Instrument zero	
Z0	Set characteristic impedance 5-2500 ohms	
XT0	X100 Divider not used	
XT1	x100 divider installed	

1 The * must be included as part of the GPIB command string.

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6. Maintenance

This section presents procedures for maintaining the 9240 Series.

6.1 Safety

Although the 9240 Series has been designed in accordance with international safety standards, general safety precautions must be observed during all phases of operation and maintenance. Failure to comply with the precautions listed in the **Safety Summary** located in the front of this manual could result in serious injury or death. Service and adjustments should be performed only by qualified service personnel.

6.2 Cleaning

Painted surfaces can be cleaned with a commercial spray-type window cleaner or a mild detergent and water solution.

CAUTION



Avoid using chemical cleaning agents which can damage painted or plastic surfaces.

6.3 Inspection

If a 9240 Series instrument malfunctions, perform a visual inspection of the instrument. Inspect for signs of damage caused by excessive shock, vibration or overheating. Inspect for broken wires, loose electrical connections, or accumulations of dust or other foreign matter.

Correct any problems you discover and conduct a performance test to verify that the instrument is operational. If the malfunction persists or the instrument fails the performance verification, contact Boonton Electronics for service.

6.4 Firmware Upgrade

Operating Firmware has been loaded into the 9240 Series instrument at the factory. The Firmware will be updated from time to time to correct errors and add new features. Users can upgrade their firmware by downloading a special Firmware Upgrade file from the Boonton Electronics webpage, www.boonton.com.

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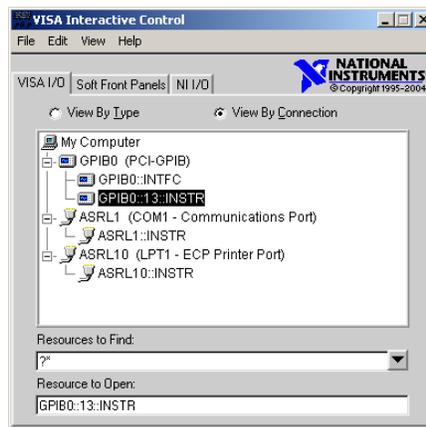
6.5 Firmware Upgrade Instructions

Requirements

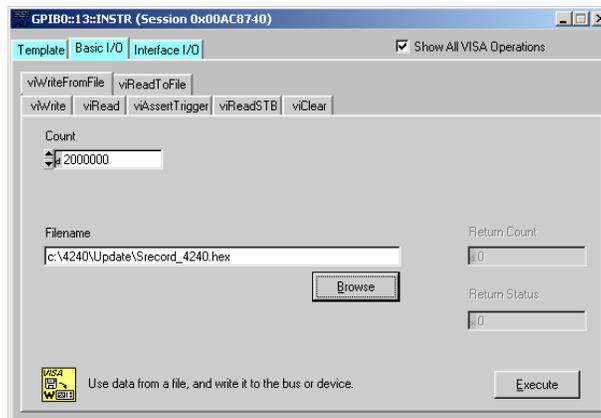
The Firmware Update file is a text file in S-record format. Any utility that can send a text file over the GPIB interface could be used, however, it is recommended that National Instruments VISA Interactive Controller (VIC) utility that is available with installation of their VISA (Virtual Instrument Software Architecture) product be used as this has been tried and tested. Please refer to the specific vendor's website for license and download details.

Procedure

1. Save the file "Srecord_9240.hex" to your hard drive in a folder such as "C:\9240\Update"
2. On the 9240 configure the following IEEE parameters as shown;
EMULATION 4230
EOS LSTN LF
3. Start the VISA Interactive Controller utility



4. Double click on the 9240 Resource (in this example 'GPIB0::13::INSTR') to open a VISA Session. Ensure that the 'Show All VISA Operations' box is checked. Then click the 'Basic I/O' tab and then the 'viWriteFromFile' tab on that form.
5. Set the count to 2000000 then either Browse for or enter the Filename.



6. Click the 'Execute' button to send the file to the instrument.

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7. During this time the 9240 will display "FIRMWARE DOWNLOAD". The download takes approximate 45 seconds to completely transfer.
 8. When the End-Of-File is reached the message "PROGRAMMING FLASH" will be displayed on the 9240. Flash programming takes approximately 5 seconds to complete.
 9. When programming is complete the instrument returns to the measurement display.
 10. At this time cycle the power to the instrument to run the new firmware.
 11. Note the 'Rev.' number should indicate the latest revision. For example: 20110111.
-

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7. Appendix A SCPI Error Messages

7.1 SCPI Error Messages

NO.	MESSAGE	DESCRIPTION
0	"No Error"	
-100	"Command Error"	
-101	"SubCmd not found"	
-102	"Syntax error"	
-103	"Too many qry"	
-108	"Parameter not allowed"	
-109	"Missing parameter"	
-113	"Undefined header"	
-115	"Channel out of range"	
-121	"Invalid argument"	
-131	"Invalid suffix"	
-200	"Execution error"	
-213	"Init ignored"	
-221	"Settings conflict"	
-222	"Data out of range"	
-224	"Illegal parameter value"	
-240	"Hardware Error"	
-241	"Error hardware missing"	
-242	"CH2 Not Responding"	Channel 2 is not responding to instrument control.
-243	"CH1 Not Responding"	Channel 1 is not responding to instrument control.
-244	"No channel responding"	CH1 and CH2 do not respond to instrument control.

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NO.	MESSAGE	DESCRIPTION
-245	"Sensor Disconnected."	
-246	"Sensor voltage error"	
-248	"Keyboard error"	
-249	"FPGA download err"	
-263	"MFS Init"	
-264	"Flash init"	
-266	"Mem restore"	
-280	"Program error"	
-295	"Command not in language."	
-296	"Data out of range, set to limit."	
-297	"Command not supported."	
-313	"Cal mem lost"	
-340	"Calibration failed"	
-350	"Error queue overflow"	
-360	"Communication Error"	
-362	"Snsr2 Page Blank"	
-363	"Snsr1 Page Blank"	
-364	"Sensor access fault"	
-371	"Err CH2 Data Adapter Data"	Checksum failure of the Channel 2 Data Adapter EEPROM.
-372	"Err CH1 Data Adapter Data"	Checksum failure of the Channel 1 Data Adapter EEPROM .
-373	"Measurement Error"	
-375	"Cmd not accepted"	
-376	"I2C Timeout"	Software has timed-out while communicating over the I2C bus.
-377	"No I2C Ack"	Missing Acknowledge signal while assessing the I2C bus.
-397	"Err CW signal."	

8. Appendix B Warranty & Repair

Repair Policy

9240 Series Instrument.

If the Boonton 9240 Series RF Voltmeter is not operating correctly and requires service, contact the Boonton Electronics Service Department for return authorization. You will be provided with an RMA number and shipping instructions. Customers outside the USA should contact the authorized Boonton distributor for your area. The entire instrument must be returned in its original packing container. If the original container is not available, Boonton Electronics will ship a replacement container and you will be billed for the container cost and shipping charges. See section 2.1 of this manual for packing instructions.

Boonton Voltage Probes.

Damaged or defective voltage probes are repaired as separate accessories. Note that probes which have failed due to overloading, improper mating, or connecting to an out-of-tolerance connector are not considered defective and will not be covered by the Boonton Warranty. If repair is needed, contact the Boonton Electronics Service Department for return authorization. You will be provided with an RMA number and shipping instructions. Customers outside the USA should contact the authorized Boonton distributor for your area. Only the defective probe should be returned to Boonton, not the entire instrument. The probe must be returned in its original packing container. If the original container is not available, Boonton Electronics will ship a replacement container and you will be billed for the container cost and shipping charges. If a new sensor is ordered, note that it does not include a sensor cable - this item must be ordered separately.

Contacting Boonton.

Customers in the United States having questions or equipment problems may contact Boonton Electronics directly during business hours (8 AM to 5 PM Eastern) by phoning (973) 386-9696. FAX messages may be sent at any time to (973) 386-9191. E-mail inquiries should be sent to service@boonton.com. International customers should contact their authorized Boonton Electronics representative for assistance. A current list of authorized US and international representatives is available on the Boonton website at www.boonton.com.

Limited Warranty

Boonton Electronics warrants its products to the original Purchaser to be free from defects in material and workmanship and to operate within applicable specifications for a period of one year from date of shipment for instruments, probes, power sensors and accessories. Boonton Electronics further warrants that its instruments will perform within all current specifications under normal use and service for one year from date of shipment. These warranties do not cover active devices that have given normal service, sealed assemblies which have been opened, or any item which has been repaired or altered without Boonton's authorization.

Boonton's warranties are limited to either the repair or replacement, at Boonton's option, of any product found to be defective under the terms of these warranties.

There will be no charge for parts and labor during the warranty period. The Purchaser shall prepay inbound shipping charges to Boonton or its designated service facility and shall return the product in its original or an equivalent shipping container. Boonton or its designated service facility shall pay shipping charges to return the product to the Purchaser for domestic shipping addresses. For addresses outside the United States, the Purchaser is responsible for prepaying all shipping charges, duties and taxes (both inbound and outbound).

At Boonton's option, an extended Warranty period may be available for an additional charge. If an extended warranty option has been purchased, the extended period is substituted for the 1 year period above. Note that the extended warranty does not extend the instrument's calibration interval past 12 months. The instrument must be maintained in a calibrated state throughout the warranty period to be eligible for warranty service to remedy "out of spec" operation.

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THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Boonton will not be liable for any incidental damages or for any consequential damages, as defined in Section 2-715 of the Uniform Commercial Code, in connection with products covered by the foregoing warranties.

END OF 9240 SERIES MANUAL