

Keysight 423B and 8470B Detectors

Notices

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CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Certification

Keysight Technologies certifies that this product met its published specifications at the time of shipment from the factory. Keysight Technologies further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (NIST, formerly NBS), to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Assistance







Product maintenance agreements and other customer assistance agreements are available for Keysight Technologies products.

For assistance, call your local Keysight Technologies Sales and Service Office.



Any adjustment, maintenance, or repair of this product must be performed by qualified personnel. Contact your customer engineer through your local Keysight Sales and Service Center.

Safety Symbols

The following symbols on the instrument and in the documentation indicate precautions which must be taken to maintain safe operation of the instrument.

	When you see this symbol on your instrument, you should refer to the instrument's instruction manual for important information.		This symbol indicates hazardous voltages.
	The laser radiation symbol is marked on products that have a laser output.		This symbol indicates that the instrument requires alternating current (ac) input.
	This symbol indicates that the power line switch is ON.		This symbol indicates that the power line switch is OFF or in STANDBY position.

Regulatory Markings

	The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.		The CSA mark is a registered trademark of the Canadian Standards Association.
ISM 1-A	This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4).	ICES/NMB-001	ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.

Waste Electrical and Electronic Equipment (WEEE) Directive

This instrument complies with the WEEE Directive marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

Product category:

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.



Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit <http://about.keysight.com/en/companyinfo/environment/takeback.shtml> for more information.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/detectors
(product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
(worldwide contact information for repair and service)

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Description

The Keysight Technologies 423B and 8470B detectors are 50 Ω (nominal) Schottky diode devices designed for measurement use in coaxial systems.

Features

- The instruments convert the RF power levels applied to the 50 Ω input connector into proportional values of dc voltage.
- The instruments measure relative power up to 200 mW and have a BNC female connector for the output jack which allows the detected output to be connected to a SWR meter.
- The output voltage polarity is negative, unless Option 003 is selected.
- The frequency range of the 423B is 10 MHz to 12.4 GHz.
- The frequency range of the 8470B is 10 MHz to 18 GHz.
- AM modulation can be detected up to about 1 MHz.

Options

The 423B and 8470B detectors are available with the following non-exclusive options.

Option 001: Matched pair of detectors

Option 002: Furnished with matched load resistor for optimum square law characteristics

Option 003: Positive polarity output

Option 012: Furnished with stainless steel type-N male connectors (8470B only)

Connectors

- The mating RF input connectors used with the 423B and 8470B Option 012 must be type-N female connectors which comply with U.S. military standard MIL-C-39012.
- The 8470B (standard) RF input connector must be an 7-mm connector.
- The mating output connector for the 423B and 8470B must be a BNC male.

Installation

Initial inspection

- 1** Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. Procedures for checking electrical performance are given under “**Performance Tests**” on page 17.
- 2** If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, contact the nearest Keysight Technologies office. Any adjustment, maintenance, or repair of this product must be performed by qualified personnel. Contact your customer engineer through your local Keysight Sales and Service Center. Refer to “**Sales and Technical Support**” on page 4. Keysight Technologies will arrange for repair or replacement of the damaged or defective equipment. Keep the shipping materials for the carrier's inspection.
- 3** If you are returning the instrument for service, repackaging the instrument requires original shipping containers and materials or their equivalents. Keysight can provide packaging materials identical to the original materials. Any adjustment, maintenance, or repair of this product must be performed by qualified personnel. Contact your customer engineer through your local Keysight Sales and Service Center. Refer to “**Sales and Technical Support**” on page 4. Attach a tag indicating the type of service required, return address, model number and serial number. Mark the container **FRAGILE** to insure careful handling. In any correspondence, refer to the instrument by model number and serial number.

Storage and shipment

The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

- | | |
|----------------------|-----------------------------|
| a Temperature | -54 to +85 °C |
| b Altitude | < 7620 meters (25,000 feet) |
| c Humidity | < 95% relative |
| d Shock | 100 G for 11 ms |
| e Vibration | 20 G from 80 to 2000 Hz |

Table 1 Specifications

Characteristic	Value
Frequency range^[a]	
423B	10 MHz to 12.4 GHz
8470B	10 MHz to 18 GHz
Frequency response^{[b][c]}	
423B and 8470B	
Octave flatness	±0.2 dB over any octave 10 MHz to 8 GHz
Broadband flatness	±0.3 dB 10 MHz to 12.4 GHz
8470B only:	
Broadband flatness	±0.5 dB 10 MHz to 15 GHz ±0.6 dB 10 MHz to 18 GHz
SWR^{[d][e]} (Max)	
423B and 8470B	10 MHz to 4 GHz, 1.15 4 GHz to 12.4 GHz, 1.3
8470B only	12.4 GHz to 15 GHz, 1.3 15.0 GHz to 18 GHz, 1.7
Maximum operating input power	200 mW, peak or average
Maximum short term input power	1 watt (typical) peak or average for < 1 minute
Sensitivity^{[c][d][f]}	
High level	< 0.35 mW produces 100 mV output
Low level	> 0.5 mVdc/μW CW
Input impedance	50 Ω (nominal)
Output impedance	1 to 2 kΩ (typically 1.3 kΩ) shunted by 35 to 65 pF (typically 50 pF)
Output polarity	Negative (refer to options for positive polarity units)
Detector element	Supplied
Bias	Not required
Noise	< 50 μVpp with CW applied to produce 100 mV output
Options	
423B and 8470B	
Option 002	Furnished with matched load resistor for optimum square law characteristics of 25 °C, within ±0.5 dB from square law over a range of at least 30 dB up to 10 mV peak output, working into an external load > 8 kΩ. Sensitivity typically is greater than 0.1 mV/μW when load resistor is used
Option 003	Positive polarity output
423B	
Option 001	Matched detector pair. Frequency response characteristics (exclusive of basic sensitivity) track within ±0.2 dB from 10 MHz to 12.4 GHz at -30 dBm
8470B:	
Option 001	Matched detector pair. Frequency response characteristics (exclusive of basic sensitivity) track within ±0.2 dB from 10 MHz to 12.5 GHz; ±0.3 dB from 12.4 GHz to 18 GHz at -30 dBm.
Option 012	Furnished with stainless steel type-N male connector

Table 1 Specifications (continued)

Characteristic	Value
Environmental	
423B	
Operating temperature	0 °C to +55 °C
Humidity	< 95% relative
Vibration	20 G from 80 to 2000 Hz
Shock	100 G for 11 ms
Altitude	< 4570 meters (15,000 feet)
8470B	
Operating temperature	-20°C to +85 °C
Humidity	< 95% relative
Vibration	20 G from 80 to 2000 Hz
Shock	100 G for 11 ms
Altitude	< 4570 meters (15,000 feet)
General	
Weight	
423B and 8470B	Net 114 g (4 oz.)
Dimensions	
423B	63 mm long, 20 mm diameter (2.47 in. long, 0.78 in. diameter)
8470B	64 mm long, 19 mm diameter (2.50 in. long, 0.75 in. diameter)

[a] RF may leak through the output connector below 1 GHz. It can be reduced, if objectionable, with a suitable low pass filter.

[b] Measured at -30 dBm. Flatness is the peak-to-valley range of the response.

[c] External load resistance >50 k Ω

[d] Specifications given for +25 °C unless otherwise noted.

[e] Measurement made at -20 dBm.

[f] Sensitivity decreases with increasing temperature, typically: 0.5 dB from -20 to +25 °C; 0.5 dB from +25 to +40 °C; 1 dB from +40 to +55 °C; 1.25 dB from +55 to +75 °C; 1 dB from +75 to +85 °C.

Operating Information

The detector can be used as a demodulator to obtain a pulse envelope which can then be observed on an oscilloscope. It can also be used as a general purpose detector.

CAUTION

Static discharge can damage the detector element. A 100 pF capacitor (1.2 m [4 ft] of coax cable) charged to 14 volts stores .1 erg, the maximum pulse rating of the detector element.

- Connect cables to test equipment and discharge the center conductor before connecting to the detector.
 - **DO NOT NEEDLESSLY HANDLE THE DETECTOR ELEMENT USED IN CRYSTAL DETECTOR.** Static electricity which builds up on a person, especially on a cold dry day, must never be allowed to discharge through the detector.
 - Avoid exposed leads to or from the detector, since these are often touched accidentally.
-

The power applied to the detector can be either modulated or continuous wave (CW). If modulated at a 1000 Hz rate, an SWR meter can be used as an indicator. For CW detection, a dc milliammeter or millivoltmeter can be used as the indicator.

NOTE

When using the detector with an oscilloscope, and the waveshapes to be observed have rise times of less than 5 μ s, the coaxial cable connecting oscilloscope and detector should be as short as possible and shunted with a resistor.

Ideally, this resistor should be 50 Ω to terminate the coaxial cable properly. However, with 50 Ω resistance, the output video pulse may be too small to drive some oscilloscopes. Therefore, the cable should be shunted with the smallest value of resistance that will obtain suitable deflection on the oscilloscope; typically the value will lie between 50 Ω and 2 k Ω . The larger the resistance the more degradation of rise time.

Operator's check

Peak power measurement

The procedure for peak power measurement involves calibration of an oscilloscope which, in turn, is used to calibrate a CW generator. The output of the calibrated CW generator is measured with a power meter; the peak power of a pulse is thereby measured. The procedure is as follows:

- 1 Connect equipment as shown in **Figure 1**, step A. Observe the pulse on a decoupled oscilloscope. Using a marking pencil, mark on the graticule the base-to-peak amplitude of the pulse envelope.
- 2 Replace the pulse source with a CW generator. While observing the oscilloscope trace, adjust the amplitude of CW generator output to make detector's output equal to that of pulse generator, as indicated by markings on the graticule (step A).
- 3 Leave the CW generator at setting obtained in step B. Disconnect the detector from CW generator.
- 4 Connect the output of CW generator to the power meter (step C). Measure the adjusted levels (set in step B) of the CW generator output. The peak power of the pulse envelope observed in step A is equal to the output power of the CW generator.

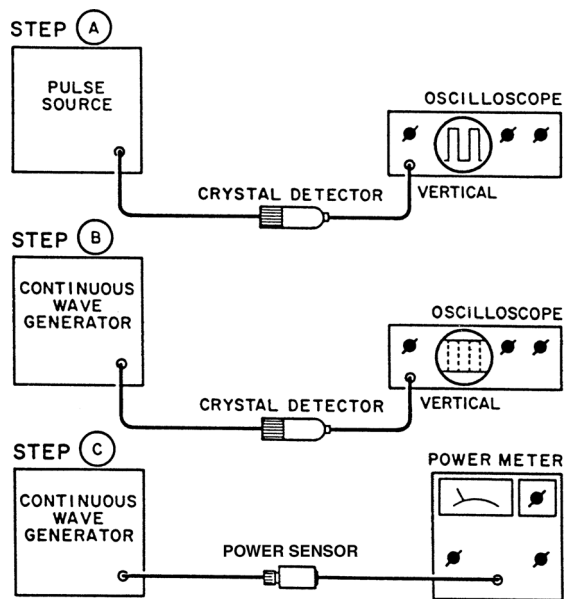


Figure 1 Peak power measurement

Reflectometer application

For information about reflectometer systems and measurements refer to Keysight Technologies Application Note Index. Copies are available upon request.

Harmony frequency comparison measurement application

The detector can be used as a mixer in harmonic-frequency comparison measurements. Refer to Keysight Technologies Application Note Index for further information.

Performance Tests

Methods for testing detector specifications are given below. Refer to the manuals of the equipment involved for operating instructions.

NOTE

Multiple mismatch errors caused by attenuator SWR, power meter SWR, and detector SWR should be taken into account, as well as the accuracy of the indicator used to measure the detector's output.

Frequency response test

- 1 Using signal sources covering 10 MHz to 18 GHz with a 10 dB isolating attenuator and a power meter, connect the power sensor to the attenuator. Adjust the RF power level to -20 dBm input to the power sensor.
- 2 Without changing the RF power level of signal source, disconnect the power sensor.
- 3 Connect the detector to the attenuator. Measure the dc voltage output and record the measurement.
- 4 Change the frequency of the signal source and repeat steps 1 through 3.
- 5 Since the detector follows a square-law response at this power level, its output is proportional to power ($P_{dB} = 10 \log V_o$). Total variation of detector readings should meet specifications for all frequencies of interest across the band.

Higher level sensitivity test

- 1 Using signal sources covering 10 MHz to 18 GHz and a dc voltmeter or oscilloscope as the indicator, connect the detector to the signal source. Adjust the RF power level for a 100 mV detected output from the detector, using a CW signal.
- 2 Disconnect the detector from the signal source and measure the RF output level. The RF output level should be ≤ 0.35 mW.
- 3 Repeat steps 1 and 2 for all frequencies of interest across the band.

Low level sensitivity test

- 1 Using a signal source (covering 10 MHz to 18 GHz), a 10 dB attenuator, and a power meter, connect the attenuator to the signal source and power sensor to the attenuator. Adjust the RF power level for -20 dBm output from the attenuator. Verify the ambient temperature.
- 2 Disconnect the power sensor from the attenuator and connect the detector. Measure the dc voltage output from the detector. The output should be >5.0 mV at 25°C . Between 20°C and 30°C , the sensitivity slope is typically -0.04 dB/ $^\circ\text{C}$.

Match test (SWR)

- 1 To verify the detector's SWR specifications, use any system whose measurement accuracies for SWR (residual SWR) are known.

Service

The 423B and 8470B does not have internal adjustments and should not be opened; it should only be repaired by service-trained personnel. Should it become necessary to return the 423B and 8470B for repair or service, contact your nearest Keysight Sales and Service Center. Refer to “[Sales and Technical Support](#)” on page 4 of this manual.



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