

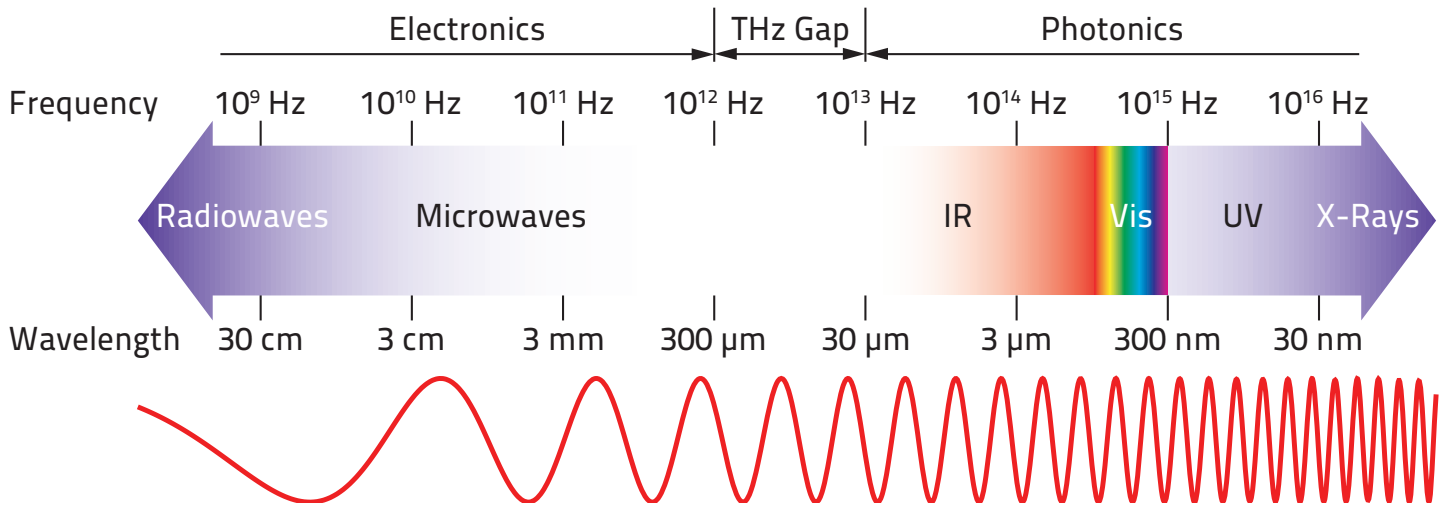
# PRESENTATION

## WHAT IS TERAHERTZ RADIATION?

The THz portion of the electromagnetic spectrum fills the gap between the far infrared and the microwaves. More precisely, it is nestled between the high-frequency edge of the microwave band, 300 gigahertz ( $3 \times 10^{11}$  Hz), and the long-wavelength edge of far-infrared light, 3000 GHz ( $3 \times 10^{12}$  Hz or 3 THz). In wavelengths, this range corresponds to 0.1 mm (or 100  $\mu\text{m}$ ) infrared to 1.0 mm microwave. The THz band is set in the region where electromagnetic physics can best be described by its wave-like characteristics (microwave) and its particle-like characteristics (infrared).<sup>a</sup>

<sup>a</sup> Source: Wikipedia

**Figure 1. The electromagnetic spectrum showing the THz gap** from 100  $\mu\text{m}$  to 1000  $\mu\text{m}$  or 3 THz to 0.3 THz



## WHAT IS IT USED FOR?

THz radiation is interesting because of the way it interacts with matter:

- It can penetrate things like wood, plastics, clothing, and other materials.
- It is also absorbed by water, or a material that contains water, like human skin.
- It is non-ionizing and therefore not harmful to humans like X-rays can be.

One of the first uses is the "full body scan" used at airports. It also has uses in medical applications for early detection of cancer cells.

## HOW IS IT MEASURED?

THz sources come in many varieties, including those with CW or Pulsed outputs. They range in power from nW to mW and in energy from nJ to mJ. Like most electromagnetic sources, they must be characterized for performance and/or control.

Older THz detection methods include:

- Goly Cells
- Micro-bolometers
- Pyroelectric detector and electrical devices like photo-acoustic and Schottky diode detectors

## WHY ARE GENTEC-EO PRODUCTS BETTER?

- **Goly Cells** used to be the detector of choice, but they are costly and often very large.
- **Pyroelectric Detectors** (like the ones used in our THz Detectors) used to have lower performances, but recent advances placed them on the same technical level as Goly Cells, and even higher. Pyroelectric Detectors in THz measuring show several benefits to the user:
  - Broadband thermal response from 0.1 to 3000  $\mu\text{m}$
  - Can be used at room temperature with high sensitivity (measure nW of power and nJ of energy)
  - Wider power range (from nW to mW)
  - Lower cost

# PRESENTATION

## OVERVIEW OF THE DIFFERENT MODELS

We have a unique line of sensors and meters for the terahertz region. You can choose either a standalone device with on-board electronics or go with our T-Rad meter and a separate sensor. We also have small terahertz detectors that come as discrete pyroelectric units for integration.



See page 106

### THZ-I-BNC

- THz Detectors with Integrated Analog (BNC) Module (no need for a monitor)
- Wide Dynamic Range from nW to mW
- BNC output:
  - Battery or AC Powered (for use with an oscilloscope)
  - Very Low Noise Level (0.4 nW for THZ2I-BL-BNC)

### INTEGRATED BNC MODULE



See page 108

### THZ-B SENSORS WITH T-RAD-USB OR APM MODULES

- Large Choice of Apertures:
  - 1.5 mm, 5 mm and 9 mm  $\emptyset$
- High Voltage responsivity:
  - Up to 500 kV/W with the THZ9B-MT-BNC
- High Average Powers:
  - Up to 200 mW with the 5 and 9 mm probes
- Choice between Digital or Analog Modules:
  - Digital (T-Rad-USB), Analog (APM). See below.

#### T-RAD-USB

The T-Rad-USB Lock-In Amplifier Module is a small shielded box that houses a microprocessor, 12-bit ADC and USB connector. It is powered by the USB connection and also includes an analog output and trigger input BNC to sync it to the chopper frequency. It comes with our incredibly powerful Software and LabView Drivers.

#### APM

The APM provides battery or AC power to our THZ-B sensors. It includes a power On/Off switch and a BNC output connector. To get accurate and fast readings, just plug the THZ-B probe into the APM, and the APM BNC output into your oscilloscope.



See page 112

### QS-THZ

- Hybrid Pyroelectric Detectors
- Small T05/T08 Packages
- Available in 5 Sizes: 1.5, 2, 3, 5 and 9 mm  $\emptyset$  Apertures
- Wide Dynamic Range from nW to mW
- QS-I-TEST Test Box Available

### DISCRETE PYROELECTRIC DETECTORS SMALL T05/T08 PACKAGES

# THZ-I-BNC

THz Detector, Integrated Analog Module



## KEY FEATURES

- 1 Measure Sources from 0.1 to 30 THz**  
Broadband, room temperature operation, easier to use and less expensive than a Golay cell
- 2 Wide Dynamic Range from nW to mW**  
With state of the art pyroelectric sensors, measure down to 50 nW with 1 nW resolution
- 3 Integrated Analog Module**  
Plug the device directly to your oscilloscope
- 4 Battery or AC Powered**  
Includes 9V Battery and AC Power Eliminator
- 5 Calibrated Devices**  
All THz detectors are calibrated in the 0.25 to 15  $\mu$ m (20 THz) region

## AVAILABLE MODELS



THZ2I-BL-BNC  
(2 mm-Organic Black)

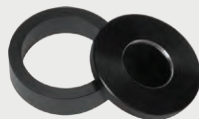


THZ5I-MT-BNC  
(5 mm-Metallic)

## ACCESSORIES



Stand with Delrin Post  
(Model Number: 200428)



Removable IR Windows  
(Various types available)



SDC-5000 Digital  
Optical Chopper



Pelican Carrying Case

## SEE ALSO

TECHNICAL DRAWINGS	114
LIST OF ALL ACCESSORIES	174

MONITORS  
ENERGY DETECTORS  
POWER DETECTORS  
PHOTO DETECTORS  
THZ DETECTORS  
OEM DETECTORS  
CALORIMETERS  
SPECIAL PRODUCTS  
BEAM DIAGNOSTICS

# THZ-I-BNC

## SPECIFICATIONS



Approved or in the process of being approved\*

MODELS	THZ21-BL-BNC	THZ51-MT-BNC
MAX AVERAGE POWER	200 mW	200 mW
EFFECTIVE APERTURE	2 mm Ø	5 mm Ø
INTEGRATED MODULE	Analog (BNC)	Analog (BNC)

MEASUREMENT CAPABILITY		
Spectral Range		
Frequency	0.1 - 30 THz	0.1 - 30 THz
Wavelength	3000 - 10 µm	3000 - 10 µm
Max Measurable Power	200 mW	200 mW
Noise Equivalent Power	0.4 nW [4.0 x 10 <sup>-10</sup> W/(Hz) <sup>2</sup> ]	1.0 nW [1.0 x 10 <sup>-9</sup> W/(Hz) <sup>2</sup> ]
Rise Time (0-100%)	≤ 0.2s	≤ 0.2s
Sensitivity (Typical)	140 kV/W	70 kV/W
Calibration Uncertainty	± 4%	± 4%
DAMAGE THRESHOLDS		
Maximum Average Power Density (1064 nm)	50 mW/cm <sup>2</sup>	50 mW/cm <sup>2</sup>
PHYSICAL CHARACTERISTICS		
Effective Aperture	2 mm Ø	5 mm Ø
Sensor	Pyroelectric	Pyroelectric
Absorber	BL	MT
Analog Output	0-10 V	0-10 V
Dimensions	81.3Ø X 99.3D mm	81.3Ø X 99.3D mm
Weight	500 g	500 g
ORDERING INFORMATION		
Full Product Name	THZ21-BL-BNC	THZ51-MT-BNC
Product Number	201701	201702

Specifications are subject to change without notice

\* For details, contact your Gentec-EO representative

# THZ-B

THz Detectors for T-Rad-USB Module

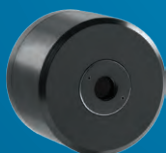


T-Rad-USB Module

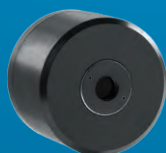
## KEY FEATURES

- 1 Measure Sources from 0.1 to 30 THz**  
Broadband, room temperature operation, easier to use and less expensive than a Golay cell
- 2 Wide Dynamic Range from nW to mW**  
With state of the art pyroelectric sensors, measure down to 50 nW with 1 nW resolution
- 3 Use with T-Rad THz Digital or Analog Power Modules**  
Each head can be connected to an oscilloscope using the analog power module (APM) or directly to a PC with the digital power module (T-Rad-USB)
- 4 Large Area Sensors Available**  
5 mm and 9 mm diameter pyroelectric sensors make optical alignment easier
- 5 Calibrated Devices**  
All THz detectors are calibrated in the 0.25 to 15  $\mu\text{m}$  (20 THz) region
- 6 User-Friendly Software with Many Features (When used with T-Rad-USB)**
  - Strip Chart, Histogram and Full Statistics
  - Controls and Power display always visible
  - Tuning Needle display includes min/max indicators
  - Data Logging for long term testing

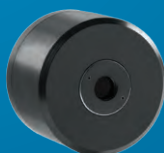
## AVAILABLE MODELS



THZ1.5B-MT  
(1.5mm-Metallic)



THZ5B-MT  
(5mm-Metallic)

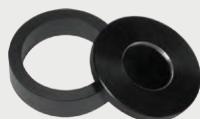


THZ9B-MT  
(9mm-Metallic)

## ACCESSORIES



Stand with Delrin Post  
(Model Number: 200428)



Removable IR Windows  
(Various types available)



SDC-5000 Digital  
Optical Chopper



APM Analog Power Supply  
(Model Number: 201495)



Pelican Carrying Case

## SEE ALSO

TECHNICAL DRAWINGS  
COMPATIBLE MODULES  
T-RAD-USB 114



LIST OF ALL ACCESSORIES 174

WATCH THE DEMONSTRATION VIDEO AVAILABLE  
ON OUR WEBSITE AT [www.gentec-eo.com](http://www.gentec-eo.com)

MONITORS

ENERGY DETECTORS

POWER DETECTORS

PHOTO DETECTORS

THZ DETECTORS

OEM DETECTORS

CALORIMETERS

SPECIAL PRODUCTS

BEAM DIAGNOSTICS

# THZ-B

## SPECIFICATIONS



Approved or in the process of being approved\*

MODELS	THZ1.5B-MT	THZ5B-MT	THZ9B-MT
MAX AVERAGE POWER	20 mW	200 mW	200 mW
EFFECTIVE APERTURE	1.5 mm Ø	5 mm Ø	9 mm Ø
COMPATIBLE MODULE(S)	APM and T-Rad-USB	APM and T-Rad-USB	APM and T-Rad-USB

MEASUREMENT CAPABILITY	With APM	With T-Rad-USB	With APM	With T-Rad-USB	With APM	With T-Rad-USB
	Spectral Range					
Frequency	0.1 - 30 THz		0.1 - 30 THz		0.1 - 30 THz	
Wavelength	3000 - 10 µm		3000 - 10 µm		3000 - 10 µm	
Max Measurable Power	1.4 µW	20 mW	14 µW	200 mW	500 µW	200 mW
Noise Equivalent Power (NEP)	$2.0 \times 10^{-10} \text{ W}/(\text{Hz})^{1/2}$	2 nW	$1.0 \times 10^{-9} \text{ W}/(\text{Hz})^{1/2}$	5 nW	$3.0 \times 10^{-9} \text{ W}/(\text{Hz})^{1/2}$	10 nW
Rise Time (0-95%)	≤ 0.2s		≤ 0.2s		≤ 0.2s	
Sensitivity (Typical)	700 kV/W	N/A	70 kV/W	N/A	20 kV/W	N/A
DAMAGE THRESHOLDS						
Max Average Power Density (@ 1064 nm)	10 mW/cm <sup>2</sup>		10 mW/cm <sup>2</sup>		10 mW/cm <sup>2</sup>	
PHYSICAL CHARACTERISTICS						
Effective Aperture	1.5 mm Ø		5 mm Ø		9 mm Ø	
Sensor	Pyroelectric		Pyroelectric		Pyroelectric	
Absorber	MT		MT		MT	
Dimensions	66.0Ø x 46.5D mm		66.0Ø x 46.5D mm		66.0Ø x 46.5D mm	
Weight	227 g		227 g		227 g	
ORDERING INFORMATION						
Full Product Name	THZ1.5B-MT-BNC	THZ1.5B-MT-USB	THZ5B-MT-BNC	THZ5B-MT-USB	THZ9B-MT-BNC	THZ9B-MT-USB
Product Number	201757	201747	201746	201750	201755	201751

Specifications are subject to change without notice

\* For details, contact your Gentec-EO representative

# THZ-B

MONITORS  
ENERGY DETECTORS  
POWER DETECTORS  
PHOTO DETECTORS  
THZ DETECTORS  
OEM DETECTORS  
CALORIMETERS  
SPECIAL PRODUCTS  
BEAM DIAGNOSTICS



T-Rad-USB  
(Front View)



T-Rad-USB  
(Rear View)



## T-RAD-USB

The T-RAD-USB is a microprocessor-based digital radiometer that includes a 12-bit ADC and unique DSP Lock-In Software. It is powered by a USB connection, which also acts as a Virtual COM port. When a THZ-B Terahertz Pyro-electric detector is plugged into the T-Rad-USB module, the module reads the content of the head's EEPROM, which identifies the detector and provides calibration and wavelength correction data. The LabView Software supplied with the device makes it very easy to set up the radiometer, measure a THz or broadband source and record data. The software is compatible with Windows XP, VISTA and 7.

## SPECIFICATIONS & FEATURES

- Compatible Detector Heads
- Full Scale Ranges
- Power On Light
- Detector Input
- Analog Output
- Computer Connection
- Trigger Input (TTL)

T-Rad-USB

THZ-B

200 nW - 20 mW \*

Green

Lemo Connector

BNC Connector - 0 to 3.6 V

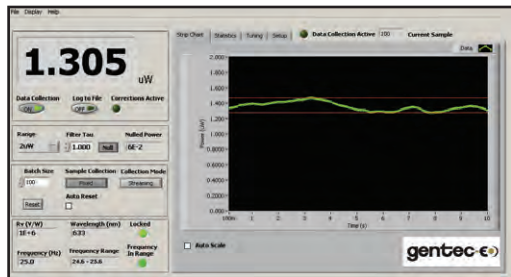
USB (Virtual COM Port)

BNC Connector

\* Actual ranges vary based on the THZ-B detector selected

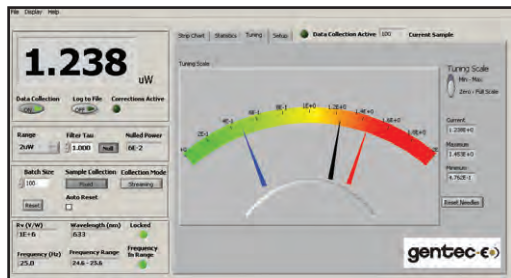
## INSTRUMENT CONTROL AND STRIP CHART

Instrument controls and the radiant power measurement are always visible, making it easy to change the radiometer settings, no matter which display tab is selected. Instrument controls include: Range, Filter Tau, Batch Size, Data Collection Mode, Reset Options, and a Null button for background cancellation. In addition, there are more set up and operation status indicators including: detector Rv, Wavelength, Frequency (actual), Locked and Frequency in Range lights. The Strip Chart displays the Radiant Power measurement in Watts, either continuously or by the batch. Select full scale, auto scale or use our manual scaling option.



## INSTRUMENT CONTROL AND TUNING NEEDLE

The "TUNE" tab selects the very useful "Tuning Needle" display. This is a simulated analog meter whose speed is determined by the "filter tau" setting. It is expected to be used during the set-up of a radiometer with a source. The "tau" value is usually set to a small value when aligning the probe to the source (i.e. when peaking the reading). There a button control to select "full scale", "min-max" or "reset". In the "min-max" mode, the indicators are "blue" for the minimum power and "red" for the maximum power.



# THZ-B

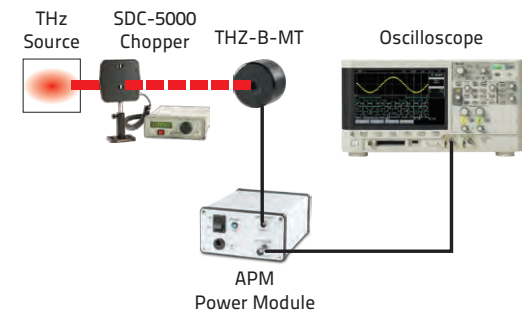
## INSTRUMENT CONTROL AND STATISTICS

In the "Statistics" tab there are 4 large windows that contain the statistics for the selected batch, including: Minimum, Maximum, Standard Deviation and Mean, expressed in Engineering Notation. Standard Deviation can be displayed in Watts or as a % that is user-selectable. There is also a window that shows the bandwidth of the Digital Band Pass Filter based on the user selected "Filter Tau" (0.100 to 100 seconds). A lower time constant is helpful when setting up, and a longer one when making measurements, especially on the lower ranges of the instrument.



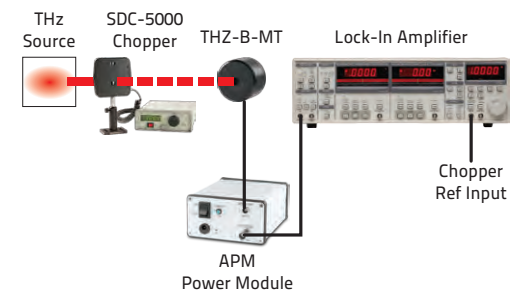
## THZ-B-BNC DETECTOR AND OSCILLOSCOPE

Here is a basic analog set up that would be useful if the optical power of the source was about 5  $\mu$ W or greater. The output of the THZ5B-MT-BNC detector would be approximately 600 mV @ 5 Hz chopping frequency, giving plenty of signal for an oscilloscope. Simply read the voltage output and divide by the Rv factor (V/W) of the detector to measure the intensity of the source in Watts. Also consider applying a wavelength correction factor under certain circumstances.



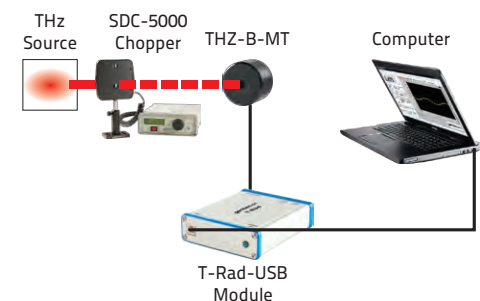
## THZ-B-BNC DETECTOR AND LOCK-IN AMPLIFIER

This is another analog set-up option that we recommended it if you have to measure very low power levels (i.e. less than 5  $\mu$ W) where the signal may be buried in the broadband noise. The voltage output of the analog THZ-B detector, powered by our APM, is routed to the Lock-In Amplifier input, and the Sync Output of our SDC-5000 Chopper is connected to the reference input. The Lock-In Amplifier will lock on the chopping frequency and you can dial in a long integrating time and measure a very low RMS voltage. The voltage divided by our Voltage Responsivity (V/W) equals the power of the source.



## THZ-B-USB DETECTOR AND T-RAD-USB

Although analog solutions are available, for simplicity, convenience and sensitivity, we recommend you choose our THZ-B-USB detectors and the T-Rad-USB Digital Radiometer. Our unique DSP Lock-In Amplifier software provides a function much like the Analog Lock-In, but is so much easier to use. It also addresses thermal drift of the sensor and allows you to display the power measurement and complete statistics directly in digital and graphic formats. Set the range, null the background, set the filter tau (bandwidth) and make the measurement. It's that easy!



MONITORS  
ENERGY DETECTORS  
POWER DETECTORS  
PHOTO DETECTORS  
THZ DETECTORS  
OEM DETECTORS  
CALORIMETERS  
SPECIAL PRODUCTS  
BEAM DIAGNOSTICS

# QS-THZ

Hybrid THz Detectors



## KEY FEATURES

- 1 Measure Sources from 0.1 to 30 THz**  
Broadband, room temperature operation, easier to use and less expensive than a Golay cell
- 2 Wide Dynamic Range from nW to mW**  
With state of the art pyroelectric sensors, measure down to 50 nW with 1 nW resolution
- 3 Easy to Integrate Format**  
TO5 and TO8 packages make the QS-THZ detectors small and easy to integrate in an existing system
- 4 Several Detector Sizes**  
Sensors with apertures of 2 x 2 mm and 5 and 9 mm  $\varnothing$  available
- 5 Calibrated Devices**  
All THz detectors are calibrated in the 0.25 to 15  $\mu$ m (20 THz) region
- 6 Test Box Available**  
Can be used with our QS-I-TEST test box which provides mounting and power supply

## AVAILABLE MODELS

- QS2-THZ-BL 2 x 2 mm, Discrete Pyroelectric Sensor with Organic Black Coating in TO5 Packaging
- QS5-THZ-MT 5 mm  $\varnothing$ , Discrete Pyroelectric Sensor with Metallic Coating in TO5 Packaging
- QS9-THZ-BL 9 mm  $\varnothing$ , Discrete Pyroelectric Sensor with Organic Black Coating in TO8 Packaging

## ACCESSORIES



QS-I-Test  
Evaluation Test Box



Permanent IR Windows  
(Various types available)



SDC-5000 Digital  
Optical Chopper



Pelican Carrying Case

## SEE ALSO

TECHNICAL DRAWINGS	114
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MONITORS  
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POWER DETECTORS  
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THZ DETECTORS  
OEM DETECTORS  
CALORIMETERS  
SPECIAL PRODUCTS  
BEAM DIAGNOSTICS

# QS-THZ

## SPECIFICATIONS



Approved or in the process of being approved\*

MODELS	QS2-THZ-BL	QS5-THZ-MT	QS9-THZ-BL
VOLTAGE RESPONSIVITY	140 kV/W	70 kV/W	30 kV/W
EFFECTIVE APERTURE	2 x 2 mm	5 mm Ø	9 mm Ø
PACKAGE	T05	T05	T08

MEASUREMENT CAPABILITY			
Spectral Range			
Frequency	0.1 - 30 THz	0.1 - 30 THz	0.1 - 30 THz
Wavelength	3000 - 10 µm	3000 - 10 µm	3000 - 10 µm
Max Power Density	50 mW/cm <sup>2</sup>	50 mW/cm <sup>2</sup>	50 mW/cm <sup>2</sup>
Noise Equivalent Power	4.0 x 10 <sup>-10</sup> W/(Hz) <sup>½</sup>	1.0 x 10 <sup>-9</sup> W/(Hz) <sup>½</sup>	3.0 x 10 <sup>-9</sup> W/(Hz) <sup>½</sup>
Detectivity <sup>a</sup>	5.10 <sup>9</sup> cm(Hz) <sup>½</sup> / W	4.10 <sup>9</sup> cm(Hz) <sup>½</sup> / W	2.7.10 <sup>9</sup> cm(Hz) <sup>½</sup> / W
Voltage Responsivity <sup>a</sup>	140 kV/W	70 kV/W	30 kV/W
PHYSICAL CHARACTERISTICS			
Effective Aperture	2 x 2 mm	5 mm Ø	9 mm Ø
Package	T05	T05	T08
Sensor	Pyroelectric	Pyroelectric	Pyroelectric
Absorber	BL	MT	BL
Dimensions	3.6Ø x 7.5D mm	3.6Ø x 7.5D mm	3.6Ø x 7.5D mm
Weight	45 g	45 g	45 g
ORDERING INFORMATION			
Full Product Name	QS2-THZ-BL	QS5-THZ-MT	QS9-THZ-BL
Product Number	201691	201692	201690

a: 630 nm, 5 Hz

Specifications are subject to change without notice

## QS-I-TEST EVALUATION TEST BOX



Batteries  
R<sub>f</sub> Resistors  
C<sub>f</sub> Compensating  
Package  
Optical Mount  
Front Bezel

### QS-I-TEST

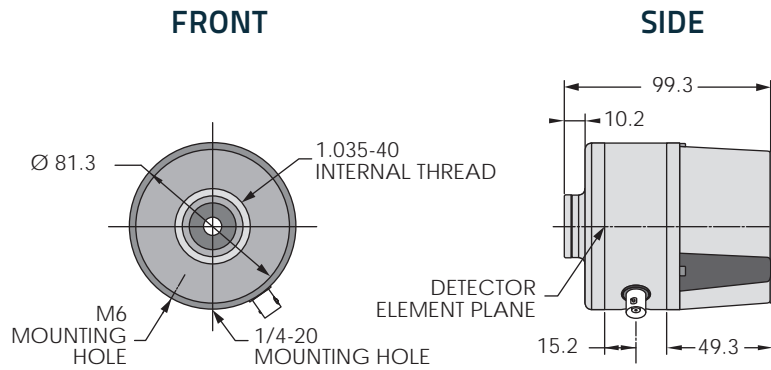
+9V/ -9V  
10<sup>5</sup> - 10<sup>10</sup> Ω  
YES  
101.6H x 127W x 58.4D  
¼-20 Threaded  
SM1 (1.035-40)

\* For details, contact your Gentec-EO representative

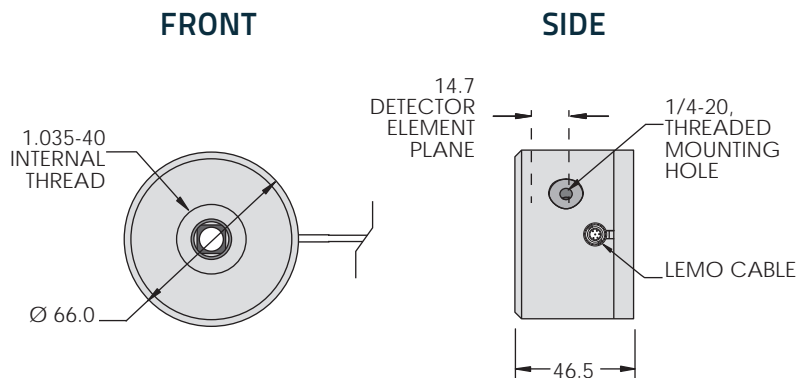
# TECHNICAL DRAWINGS

MONITORS ENERGY DETECTORS POWER DETECTORS PHOTO DETECTORS THZ DETECTORS OEM DETECTORS CALORIMETERS SPECIAL PRODUCTS BEAM DIAGNOSTICS

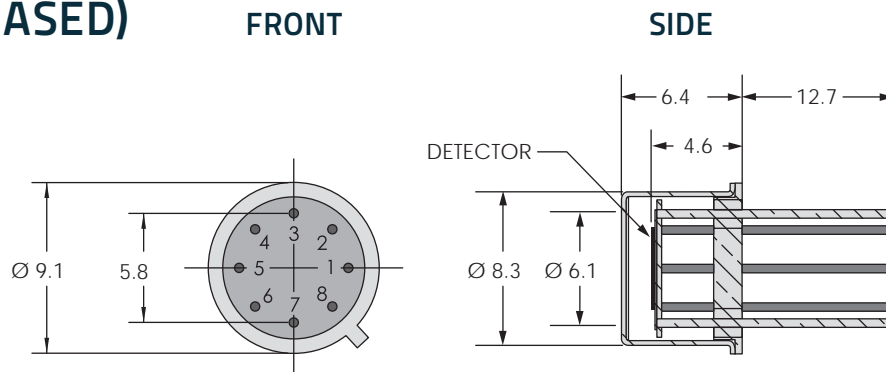
## THZ-I-BNC



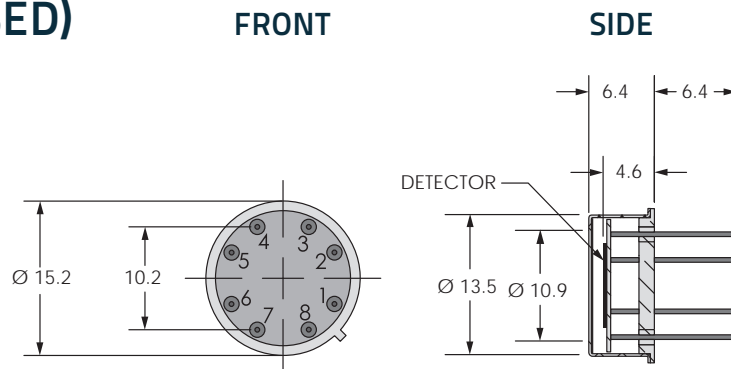
## THZ-B



## QS-THZ (T05-BASED)



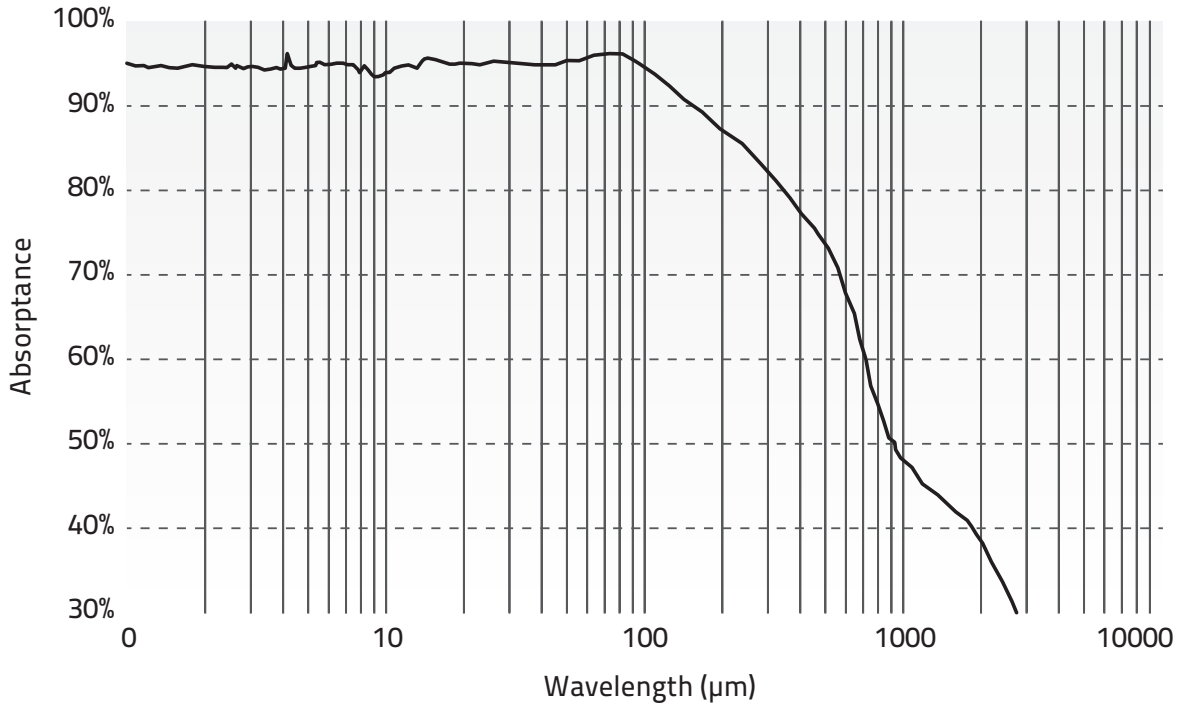
## QS-THZ (T08-BASED)



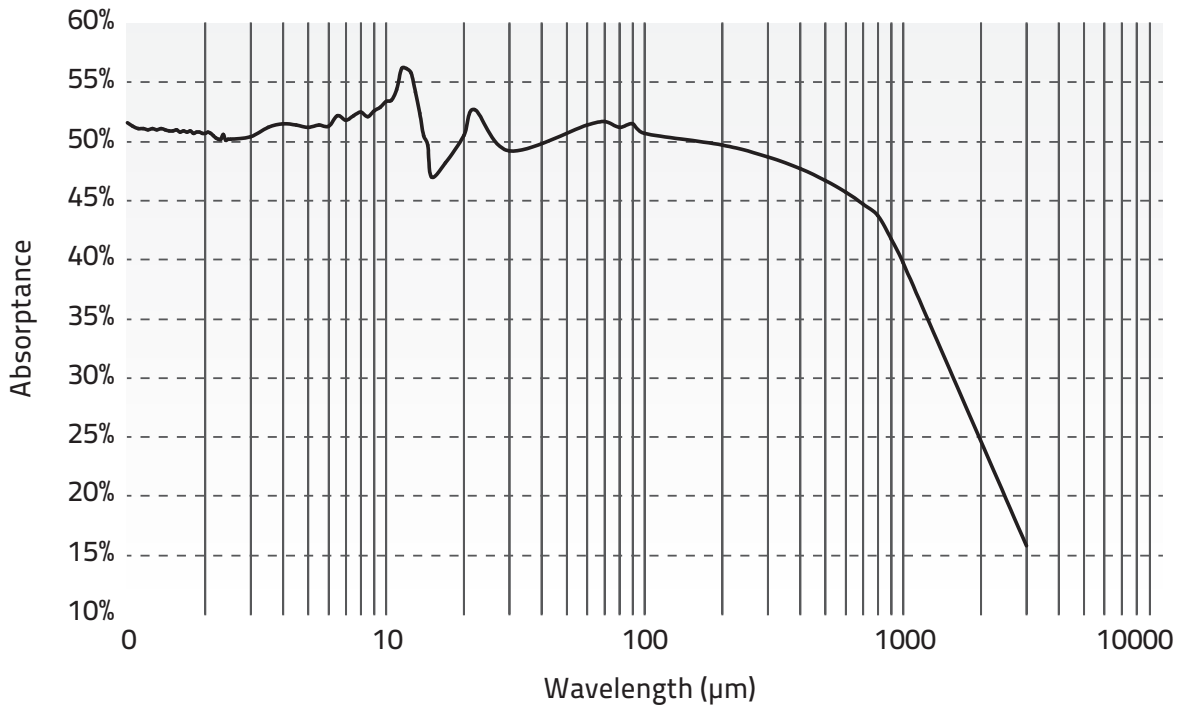
All dimensions in mm

# ABSORPTION CURVES

THZ-BL



THZ-MT



All dimensions in mm