PRESENTATION

OVERVIEW OF THE DIFFERENT PRODUCTS

Gentec Electro-Optics specializes in the measurement of laser radiation, in all its forms. This is why we have developped very specialized products over the years, that were first aimed at customized applications, but that became standardized products as the demand grew stronger.

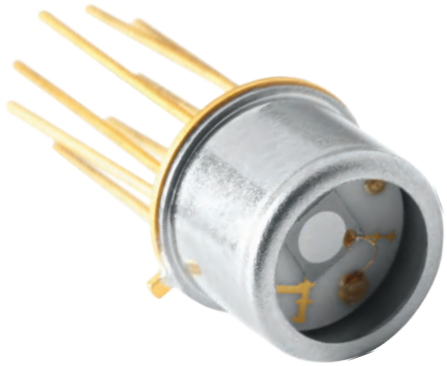
See page 130

MACH Series

ULTRAFAST JOULEMETERS

- High Speed Digital Joulemeters: Measures EVERY PULSE at up to 200 kHz
- Capture and Store up to 4 Million Pulses at the Maximum Repetition Rate
- Track Missing Pulses and Pulses below Threshold
- Wide Energy Range: Measure from pJ to mJ
- Spectral Range from 0.35 to 2.5 µm
- Sensors include Si, InGaAs and Pyroelectric
- Easy USB 2.0 Connection
- Includes Powerful LabView Software with Diagnostic Features

THE FASTEST ENERGY METERS ON THE MARKET:
MEASURE EVERY PULSE AT UP TO 200 KHZ



See pages 136 to 144

QS Series

DISCRETE PYROS

- TO5/TO8 Discrete or Hybrid Pyroelectric Detectors
- Available in 5 Sizes: 1, 2, 3, 5 and 9 mm Ø Apertures
- 5 Families of products to choose from
- Test Box Available for Hybrid Detectors

DISCRETE OR HYBRID PYROS
SMALL TO5/TO8 PACKAGES

See page 146

TRAP

OPTICAL TRAP DETECTORS

- Optical TRAP Detectors in 2 formats:
  - Integrated USB Module
  - Standard Head with Separate Preamplifier
- High Quantum efficiency (QE) >>99%
- Spatial Uniformity Better than 0.02%
- Low Calibration Uncertainty <0.5% from 400 to 980 nm
- For Low Divergence or Collimated Beams
- Heads Optimized for both CW or Pulsed Lasers
- Use these TRAP Detectors As Golden Calibration Standards

TO BE USED AS GOLDEN
CALIBRATION STANDARDS

PRESENTATION

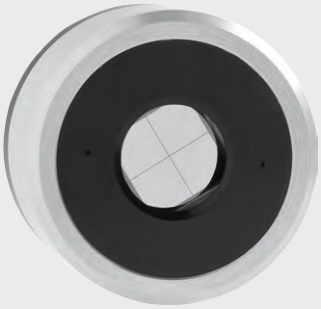
See page 148

QUAD

POSITION SENSING DETECTORS

- Position Sensing QUADrant Pyroelectric Detectors
- Available for both Power (QUAD-P) and Energy (QUAD-E) Measurements
- Measure, Track and Align your Beam in Real Time
- For Wavelengths from UV to IR and even THz
- Large Apertures up to 20 x 20 mm

POSITION SENSING QUADRANT DETECTORS

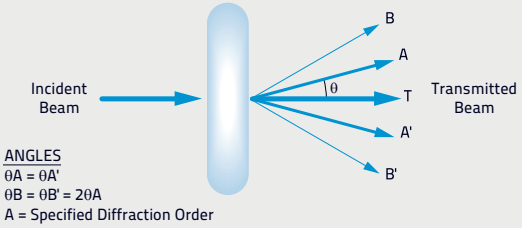


See page 152

HBS

DIFFRACTIVE OPTICS

- HBS - Holographic Beam Samplers, used for Sampling and Attenuation
- Perfect for ON-LINE Monitoring
- Keep the spatial profile intact
- Environment Insensitive
- Very High Damage Threshold



MACH SERIES

130 & 200 kHz Energy Meters

KEY FEATURES

1 Up to 200 kHz Pulse-to-Pulse
- 130kHz with Mach 5 Module and M5 Detectors
- 200 kHz with Mach 6 Module and M6 Detectors

2 Capture and Store up to 4 million Pulses
Store 40 seconds of data at 100 kHz

3 Track Missing Pulses and Pulses Below Threshold
Know how many pulses were missed or that didn't make the energy threshold with this unique pulse feature

4 Several Heads to Choose From
Silicon, InGaAs and Pyroelectric heads for a broad wavelength and energy range

5 Analog Module Available
Use our fast M5/M6 Detectors with the APM and an oscilloscope for fast analog energy measurements

6 Full-Speed USB 2.0 Connection
Ensures high data rate transfer and fast operation

7 User-Friendly Software with Many Diagnostic Features
- Live Mode, Strip Chart, Histogram and Statistics displays
- FFT display of pulse energy data for temporal diagnostics
- Life Test Mode to automate laser testing

AVAILABLE MODELS

- M5/M6-6-Si 6 mm Ø, Silicon Sensor (0.35-1.1 µm)
- M5/M6-6-Si-L 6 mm Ø, Silicon Sensor (0.35-1.1 µm), Low Noise Level
- M5/M6-6-In 6 mm Ø, InGaAs Sensor (1.0-1.6 µm)
- M5/M6-6-In-L 6 mm Ø, InGaAs Sensor (1.0-1.6 µm), Low Noise Level
- M5/M6-6-PY 6 mm Ø, Pyroelectric Sensor with Metallic Coating (0.35-2.5 µm)
- M5/M6-12.5-PY 12.5 mm Ø, Pyroelectric Sensor with Metallic Coating (0.35-2.5 µm)

All M5/M6 heads need to be used with the Mach 5/Mach 6 Energy Meters (respectively)

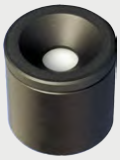
ACCESSORIES


Stand with Delrin Post
(Model Number: 200428)


Additional 9V Power Supply
(Model Number: 200960)


USB Cable
(Model Number: 100776)


APM Analog Power Supply
(Model Number: 201495)


MT-UV-QED
Relative Measurements in UV


Pelican Carrying Case

SEE ALSO

TECHNICAL DRAWINGS 50
COMPATIBLE MODULES
MACH 5/ MACH 6  APM 
LIST OF ALL ACCESSORIES 174

APPLICATION NOTES:

PULSE-TO PULSE MEASUREMENTS AT 130 KHZ
121D-201923

MEASUREMENT LIMITS USING JOULEMETERS
121D-201932

WATCH THE DEMONSTRATION VIDEO AVAILABLE ON OUR WEBSITE AT www.gentec-eo.com

MACH SERIES

SPECIFICATIONS

Approved or in the process of being approved*

MODELS (MACH 5/6)	M5-6-Si/ M6-6-Si	M5-6-Si-L/ M6-6-Si-L	M5-6-In/ M6-6-In	M5-6-In-L/ M6-6-In-L	M5-6-PY/ M6-6-PY	M5-12.5-PY/ M6-12.5-PY
MAX ENERGY	200 µJ	2 µJ	200 µJ	2 µJ	20 mJ	200 mJ
MAX AVERAGE POWER	5 W	5 W	5 W	5 W	5 W	25 W
MAX REP RATE (MACH 5/6)	130 000 Hz/ 200 000 Hz	130 000 Hz/ 200 000 Hz	130 000 Hz/ 200 000 Hz	130 000 Hz/ 200 000 Hz	130 000 Hz/ 200 000 Hz	130 000 Hz/ 200 000 Hz
EFFECTIVE APERTURE	6 mm Ø	6 mm Ø	6 mm Ø	6 mm Ø	6 mm Ø	12.5 mm Ø
MEASUREMENT CAPABILITY	With Mach 5/6	With Mach 5/6	With Mach 5/6	With Mach 5/6	With Mach 5/6	With Mach 5/6
Spectral Range	0.35 - 1.1 µm	0.35 - 1.1 µm	1.0 - 1.6 µm	1.0 - 1.6 µm	0.35 - 2.5 µm	0.35 - 2.5 µm
Max Measurable Energy [a]	200 µJ	2 µJ	200 µJ	2 µJ	20 mJ	200 mJ
Noise Equivalent Energy	2 nJ	20 pJ	2 nJ	20 pJ	0.2 µJ	2 µJ
Rise Time (0-100%)	150 ns	150 ns	150 ns	150 ns	150 ns	150 ns
Max Repetition Rate	130 000 Hz/ 200 000 Hz	130 000 Hz/ 200 000 Hz	130 000 Hz/ 200 000 Hz	130 000 Hz/ 200 000 Hz	130 000 Hz/ 200 000 Hz	130 000 Hz/ 200 000 Hz
Max Pulse Width	100 nsec	100 nsec	100 nsec	100 nsec	100 nsec	100 nsec
Calibration Uncertainty	± 4%	± 4%	± 4%	± 4%	± 4%	± 4%
Repeatability	± 1%	± 1%	± 1%	± 1%	± 1%	± 1%
DAMAGE THRESHOLDS						
Max Avg Power (60 seconds)	5 W	5 W	5 W	5 W	5 W	25 W
Max Probe Energy (@ 1064 nm)	200 µJ	2 µJ	200 µJ	2 µJ	20 mJ	200 mJ
PHYSICAL CHARACTERISTICS						
Effective Aperture	6 mm Ø	6 mm Ø	6 mm Ø	6 mm Ø	6 mm Ø	12.5 mm Ø
Sensor	Silicon	Silicon	InGaAs	InGaAs	Pyroelectric	Pyroelectric
Absorber	WA	WA	WA	WA	WA	WA
Dimensions	38.1 Ø x 58.4D mm	38.1 Ø x 58.4D mm	38.1 Ø x 58.4D mm	38.1 Ø x 58.4D mm	38.1 Ø x 58.4D mm	76H x 111W x 76D
Weight (Head only)	150 g	150 g	150 g	150 g	150 g	N/A
ORDERING INFORMATION						
Full Product Name (Mach 5)	M5-6-Si	M5-6-Si-L	M5-6-In	M5-6-In-L	M5-6-PY	M5-12.5-PY
Product Number	201551	201553	201545	201546	201547	201549
Full Product Name (Mach 6)	M6-6-Si	M6-6-Si-L	M6-6-In	M6-6-In-L	M6-6-PY	M6-12.5-PY
Product Number	202115	202116	202117	202118	202119	202120
Modules			Mach 5: 201557 / Mach 6: 202090			

Specifications are subject to change without notice

a. Maximum pulse energy reading will vary with wavelength and probe voltage responsivity (Rv). For more details, please read Application Note 121D-201932 and contact us at info@gentec-eo.com

* For details, contact your Gentec-EO representative

MACH SERIES

MACH 5 / MACH 6 JOULEMETERS

Measure every pulse at up to 130 kHz with MACH 5 and 200 kHz with MACH 6. Measure with 12-bit digital accuracy and capture up to 4 million pulses in real time. Our MACH 5 and MACH 6 Joulemeters are the only instruments in the world that perform at this speed, and with this precision. They are designed to support our full complement of fast energy probes that include Silicon, InGaAs and Pyroelectric Detectors. Measure from pJ to mJ and from 0.35 to 2.5 µm. Using the M5-Si detector and the MT-UV-QED accessory, you can make relative measurements at 266 nm.

MACH 5 / 6 (Front View)

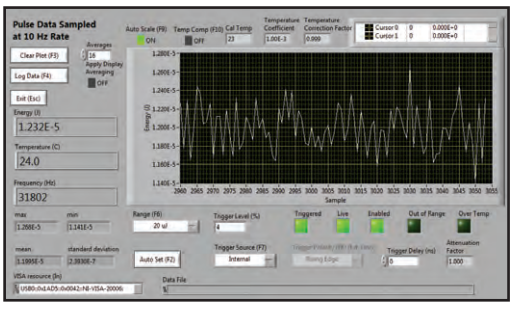
MACH 5 / 6 (Rear View)

SPECIFICATIONS & FEATURES

	MACH 5	MACH 6
Compatible Detector Heads	M5	M6
Maximum Repetition Rate	130,000 Hz	200,000 Hz
Analog Output	0-3 V	0-3 V
External Trigger (TTL)	Optically Coupled	Optically Coupled
Internal Trigger	2-20 %	2-20 %
Trigger Delay (User-Selectable)	38-3825 ns	38-3825 ns
Energy Resolution	1/2000	1/2000
Computer Input Connector	USB2.0	USB2.0

INSTRUMENT CONTROL SCREEN

Our powerful LabView Application Software includes many unique control and diagnostic features. The Instrument Control Screen, shown on the left, is used to set up the operation of the MACH 5/6, including range, trigger, wavelength, and more. In addition, it is used to set a pulse batch size and to ARM the instrument, which starts the data collection. It also gives you access to features like "Autoset", "Call Live Mode", "Run Life Test", "Save Instrument Setup" and the like. These features can be accessed by clicking directly on the feature or pushing the associated function key.



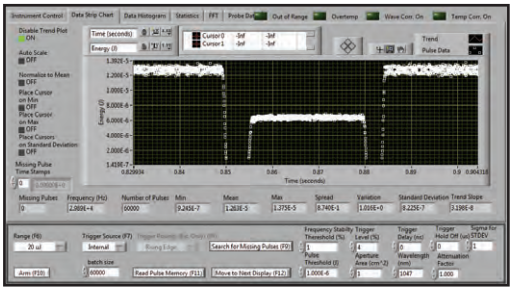
LIVE MODE DISPLAY

The Live mode can be accessed from the Instrument Control Screen, or by simply pressing the "F4" function key on your PC. This mode of operation is intended to act like your typical slower Digital Joulemeter, as it samples the laser pulses at a 10 Hz rate. It provides you with an energy strip chart, live energy reading, statistics and repetition rate. It is a very useful mode when setting up the Mach 5/6 with your laser. You can select "Auto Set", where the instrument runs through the ranges and trigger levels until it finds the correct range, or set them manually. When setup is complete, you will exit this screen and return to the "Control" screen where you will select a Batch Size, Arm the instrument and start taking pulse energy data.

MACH SERIES

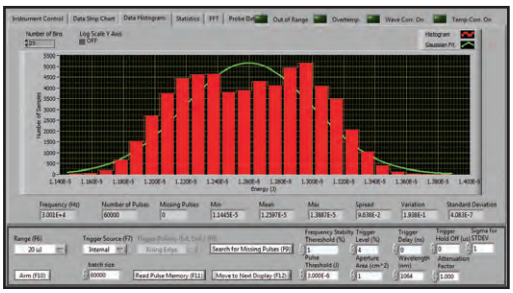
STRIP CHART

The Strip Chart Display provides a quick graphical look at the pulse data batch just collected. The data can be displayed in full scale or in auto scale mode. You can also zoom-in on a portion of the data, like shown in the screen on the right. An ND0.3 filter has been dropped through the beam and you can see the effects on the pulse data collected. You can fit trend and min/max lines to the data. Just below the chart, you will find a complete set of statistics for the batch. At the top of this screen you will see tabs that will take you to the Histogram, Statistics, and FFT (Fast Fourier Transform) displays.



HISTOGRAM

Interested in viewing the statistical distribution of the pulse energy data set? The Histogram screen does this for you and fits a "best Gaussian curve" to the data. It displays complete statistical calculations along the bottom of the graph, along with pulse frequency. Just below the statistics, you will find instrument controls, like range and trigger. You are also given the ability to adjust trigger delay and hold off as needed.

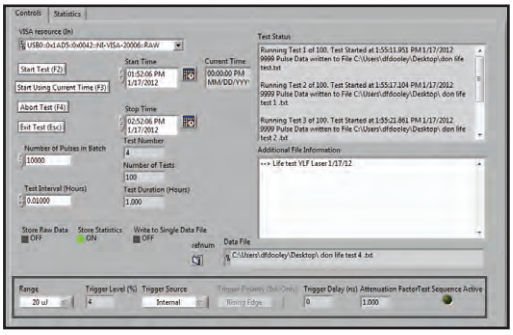


STATISTICS

The Statistics Display offers a very complete set of useful energy readings and calculated statistics. These include: minimum, maximum, average (mean), standard deviation, spread and variation. Some other very handy features include: windows displaying, Average Frequency, Pulse Jitter, Pulses Below Trigger and Pulses Below Threshold (a level set by you). In the screen on the right, you can see that there were 12 pulses below an energy threshold of 3 µW, and 147 missing pulses (or pulses below trigger).

LIFE TEST MODE

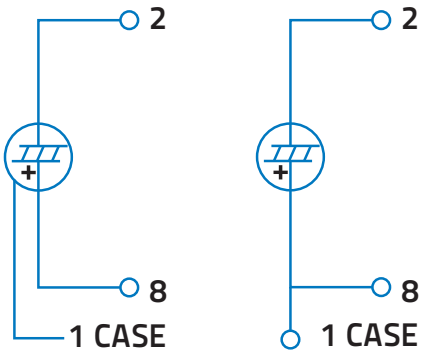
Would you like to run a life test on your high repetition rate pulsed laser? How about a periodic test vs. an environmental change like temperature? We have included a great feature to accomplish this. In the Life Test screen, we give you the ability to select the statistics you want, a start time and date, a stop time and date, the number of pulses and a test interval. You simply identify a file, a place to put the data, and then click on start and walk away! When you come back, you have a data set that tracked the performance of your laser over time, temperature, shock, vibration or anything you chose.



DISCRETE PYROS

PYROELECTRIC THERMAL DETECTORS

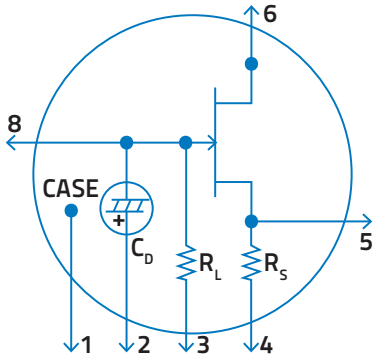
Our pyroelectric detectors are a class of room temperature thermal detectors that produce a current output that is directly proportional to the rate of change of temperature when exposed to a source of radiation. They are best described by an AC current source, capacitor and resistor. Their current output is governed by the equation ***I = p(T)·A·dT/dt***, where I is current, ***p(T)*** is the Pyro Coefficient, ***A*** is the area as defined by the front electrode, and ***dT/dt*** is the rate of temperature change of the pyro crystal. The advantages of a pyroelectric detector over other IR detectors are: room temperature operation, broad spectral response, high sensitivity (D*) and fast response (sub-nsec into 50 Ω).



QS-L (left) and QS-H (right) Pin-Outs

QS-L AND QS-H DISCRETE PYROS

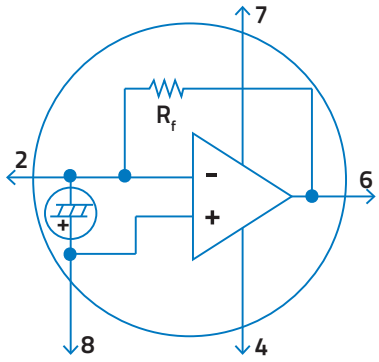
Our passive Discrete Pyroelectric Detectors range from 1 to 9 mm in diameter and are provided in two configurations: high sensitivity or high average power. They present a pyroelectric detector element covered with our metallic coating (MT) and are packaged in a miniature TO-5 or TO-8 can. The diagram shown left identifies the Pin-out for both types of detectors. Available as an option is our organic black coating (BL), which increases the optical absorption and helps flatten the spectral response. We also offer a number of permanent IR Windows that can be added to the TO can. These discrete pyro detectors are ideal for pulsed laser applications.



QS-VL Pin-Out

QS-VL VOLTAGE MODE HYBRID PYROS

Pyroelectric Detectors are high impedance (>10^{13} Ω) devices that require use in an impedance converting circuit when trying to achieve the highest sensitivity (high D*). Our QS-VL Series detectors include our pyroelectric element mated to an ultra-low noise FET in a source follower circuit. These are in turn packaged in a miniature TO-5 or TO-8 can. The equivalent circuit and Pin-out for this series are shown at the left. They are also available is sizes ranging from 1 to 9 mm diameter. These models are ideal for analytical instrumentation applications like Broadband IR Radiometers, Optical Pyrometer, and/or FTIR Spectrometers.



QS-IF and QS-IL Pin-Out

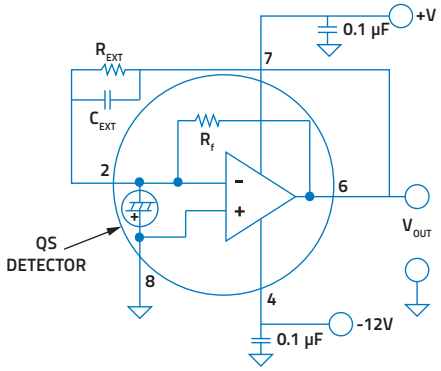
QS-IF AND QS-IL CURRENT MODE HYBRID PYROS

These detectors offer high gain (>105 V/W) and/or high bandwidth (>10 MHz). In this configuration, the pyroelectric detector element is combined to a low noise operational amplifier. The QS-IL models are designed for high performance at low to medium frequencies, while the QS-IF models offer good performance at medium to high frequencies. These detectors are very easy to use. Simply supply the +/- 10 to 15 V to power the operational amplifier and add an external resistor, if required, to adjust the bandwidth and you are ready to measure pulsed, modulated or chopped sources, from nJ to m J and nW to W. These detectors also make great candidates for any variety of broadband analytical instruments or laser measurement products.

DISCRETE PYROS

VOLTAGE OUTPUT VS. FREQUENCY

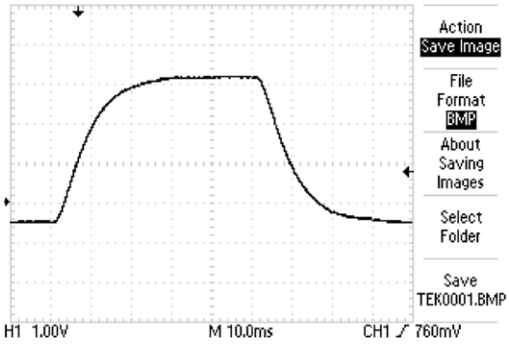
Our QS-VL and QS-IL Hybrid Detectors are designed to maximize voltage output at low frequencies and therefore include load and feedback resistors in the 100 GΩ to 300 GΩ range. They are also designed into 8-pin TO packages that allow the addition of an "external resistor" to lower the output and increase the bandwidth. The circuit diagram at the right shows a typical hook up for our QS5-IL detector (with our MT coating), using external resistors and capacitors. Our QS-IF series, on the other hand, are designed for high bandwidth applications and therefore include a smaller feedback resistor of 100 MΩ. For expert help on designing a detector circuit please contact us info@gentec-eo.com.



QS-IF and QS-IL Circuitry

OPERATION IN POWER MEASUREMENT MODE

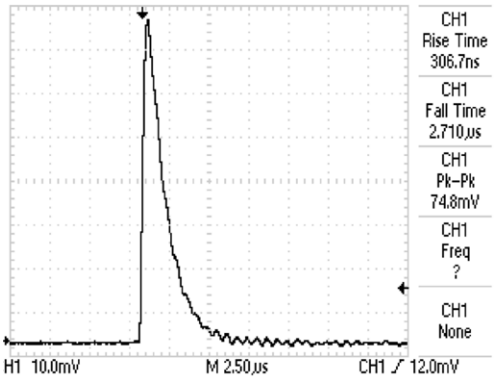
When using our QS-IL Hybrid Detector to measure the Power (in Watts) of your CW or High Rep Rate source (Quasi-CW), you will need to employ an optical chopper. The diagram at the right shows the typical voltage output of a QS5-IL when used with our QS-I-TEST evaluation test box. Note that the voltage output is an approximate "square wave" whose rise and fall times are governed by the RC time constant of the circuit. The optical power is directly proportional to the peak voltage minus the baseline voltage. We calibrate these devices when operating in this mode.



Typical QS-IL Voltage Output in Power Measurement Mode

OPERATION IN ENERGY MEASUREMENT MODE

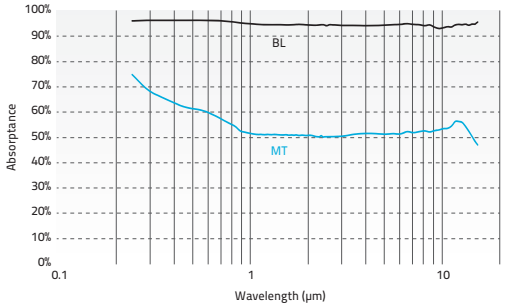
Our Pyroelectric Detectors are an ideal choice when measuring the performance of your pulsed laser in the range of nJ to mJ, across the full spectrum! The scope trace at the right represents the typical output from a QS9-IL, when used with our QS-I-TEST set up as an integrating Joulemeter. Note the fast rise to a peak and then slower decay governed by the RC time constant selected for the integrating circuit. In this configuration you can measure absolute pulse energy, rep rate, and pulse-to-pulse stability. The maximum pulse width of your source is determined by the RC time constant you select and there is no limit as to how short the pulse can be!



Typical QS-IL Voltage Output in Energy Measurement Mode

BROAD SPECTRAL RESPONSE

Unlike photoconductive and photovoltaic detectors, our Pyroelectric Thermal Detectors are not limited to a small part of the electromagnetic spectrum. They are truly broad spectrum detectors, sensitive from 0.1 µm to 3000 µm (EUV, FAR IR, and THz). Any and all radiation absorbed by our coatings or pyro crystal will result in a measurable signal. The two plots at the right show the relative spectral response of detectors with MT and BL coatings. Note that the well documented, NIST traceable calibrated portion of these curves runs from 0.25 µm to 15 µm. There are currently no traceable optical standards for measurements > 15 µm.



Absorption Curves of QS Pyroelectric Detectors

T 418.651.8003 1888 5GENTEC F 418.651.1174 www.gentec-eo.com info@gentec-eo.com

QS-L

Discrete Pyro Detectors, Low Noise Level

KEY FEATURES

1 Broad Spectral Response
From 0.1 to 100 µm

2 Optimum Current Output
To maximize the detector's thermal time constant

3 Easy to Integrate Format
TO5 and TO8 packages make the QS detectors small and easy to integrate in an existing system

4 Large Area Sensors
5 mm and 9 mm diameter pyroelectric sensors make optical alignment easier

5 Several IR Windows in Option

- Quartz: 0.2 – 3.5 µm
- Barium Fluoride: 0.2 – 17.5 µm
- Sapphire: 0.1 – 7.0 µm
- Silicon: 1.2 – 9.0 µm and 22 – 100 µm
- AR Germanium: 1.8 – 23 µm (10.6 µm peak)

AVAILABLE MODELS

- QS1-L 1 mm Ø, TO5 Packaging
- QS2-L 2 mm Ø, TO5 Packaging
- QS3-L 3 mm Ø, TO5 Packaging
- QS5-L 5 mm Ø, TO5 Packaging
- QS9-L 9 mm Ø, TO8 Packaging

ACCESSORIES

Permanent IR Windows
(Various types available)

Pelican Carrying Case

SEE ALSO

TECHNICAL DRAWINGS 114
LIST OF ALL ACCESSORIES 174

APPLICATION NOTES
QS DETECTORS PIN-OUTS & DESCRIPTIONS
121D-201931

QS-L
SPECIFICATIONS

Approved or in the process of being approved*

MODELS	QS1-L	QS2-L	QS3-L	QS5-L	QS9-L
CURRENT RESPONSIVITY	1 µA/W	0.5 µA/W	0.5 µA/W	0.25 µA/W	0.25 µA/W
EFFECTIVE APERTURE	1 mm Ø	2 mm Ø	3 mm Ø	5 mm Ø	9 mm Ø
PACKAGE	TO5	TO5	TO5	TO5	TO8

MEASUREMENT CAPABILITY					
Spectral Range	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm
Max Average Power	50 mW	50 mW	50 mW	50 mW	50 mW
Capacitance (at 1000 Hz)	15 pF	22 pF	60 pF	90 pF	250 pF
Current Responsivity (at 630 nm)	1 µA/W	0.5 µA/W	0.5 µA/W	0.25 µA/W	0.25 µA/W
Thermal Frequency (3 dB)	3.5 Hz	1.6 Hz	0.8 Hz	0.5 Hz	0.25 Hz
Temperature Coefficient	0.2%/°C	0.2%/°C	0.2%/°C	0.2%/°C	0.2%/°C
PHYSICAL CHARACTERISTICS					
Effective Aperture	1 mm Ø	2 mm Ø	3 mm Ø	5 mm Ø	9 mm Ø
Package	TO5	TO5	TO5	TO5	TO8
Sensor	Pyroelectric	Pyroelectric	Pyroelectric	Pyroelectric	Pyroelectric
Absorber	MT	MT	MT	MT	MT
Dimensions	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	13.6Ø x 6.4D mm
Weight	1.0 g	1.0 g	1.0 g	1.0 g	1.5 g
ORDERING INFORMATION					
Full Product Name	QS1-L	QS2-L	QS3-L	QS5-L	QS9-L
Product Number	201657	201659	201662	201664	201666

Specifications are subject to change without notice

* For details, contact your Gentec-EO representative

T 418.651.8003 1888 5GENTEC F 418.651.1174 www.gentec-eo.com info@gentec-eo.com

QS-H

Discrete Pyro Detectors, High Average Power

KEY FEATURES

1 Broad Spectral Response
From 0.1 to 100 µm

2 Handles Higher Average Powers
Thanks to a maximized heat dissipation design

3 Easy to Integrate Format
TO5 and TO8 packages make the QS detectors small and easy to integrate in an existing system

4 Large Area Sensors
5 mm and 9 mm diameter pyroelectric sensors make optical alignment easier

5 Several IR Windows in Option

- Quartz: 0.2 – 3.5 µm
- Barium Fluoride: 0.2 – 17.5 µm
- Sapphire: 0.1 – 7.0 µm
- Silicon: 1.2 – 9.0 µm and 22 – 100 µm
- AR Germanium: 1.8 – 23 µm (10.6 µm peak)

AVAILABLE MODELS

- QS1-H 1 mm Ø, TO5 Packaging
- QS2-H 2 mm Ø, TO5 Packaging
- QS3-H 3 mm Ø, TO5 Packaging
- QS5-H 5 mm Ø, TO5 Packaging
- QS9-H 9 mm Ø, TO8 Packaging

ACCESSORIES

Permanent IR Windows
(Various types available)

Pelican Carrying Case

SEE ALSO

TECHNICAL DRAWINGS 114
LIST OF ALL ACCESSORIES 174

APPLICATION NOTES
QS DETECTORS PIN-OUTS & DESCRIPTIONS
121D-201931

QS-H
SPECIFICATIONS

Approved or in the process of being approved*

MODELS	QS1-H	QS2-H	QS3-H	QS5-H	QS9-H
MAX AVERAGE POWER	500 mW	500 mW	500 mW	500 mW	500 mW
EFFECTIVE APERTURE	1 mm Ø	2 mm Ø	3 mm Ø	5 mm Ø	9 mm Ø
PACKAGE	TO5	TO5	TO5	TO5	TO8

MEASUREMENT CAPABILITY					
Spectral Range	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm
Max Average Power	500 mW	500 mW	500 mW	500 mW	500 mW
Capacitance (at 1000 Hz)	3 pF	12 pF	30 pF	90 pF	250 pF
Current Responsivity (at 630 nm)	0.25 µA/W	0.25 µA/W	0.25 µA/W	0.25 µA/W	0.25 µA/W
Thermal Frequency (3 dB)	5 Hz	5 Hz	5 Hz	5 Hz	5 Hz
Temperature Coefficient	0.2%/°C	0.2%/°C	0.2%/°C	0.2%/°C	0.2%/°C
PHYSICAL CHARACTERISTICS					
Effective Aperture	1 mm Ø	2 mm Ø	3 mm Ø	5 mm Ø	9 mm Ø
Package	TO5	TO5	TO5	TO5	TO8
Sensor	Pyroelectric	Pyroelectric	Pyroelectric	Pyroelectric	Pyroelectric
Absorber	MT	MT	MT	MT	MT
Dimensions	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	13.6Ø x 6.4D mm
Weight	1.0 g	1.0 g	1.0 g	1.0 g	1.5 g
ORDERING INFORMATION					
Full Product Name	QS1-H	QS2-H	QS3-H	QS5-H	QS9-H
Product Number	201658	201661	201663	201665	201667

Specifications are subject to change without notice

* For details, contact your Gentec-EO representative

T 418.651.8003 1888 5GENTEC F 418.651.1174 www.gentec-eo.com info@gentec-eo.com

QS-VL

Hybrid Pyro Detectors, Voltage Mode, Low Noise Level

KEY FEATURES

1 Low Noise Level in Voltage Mode
Ultra low noise Field-Effect Transistor (FET) and GΩ resistor for unparalleled performance from 1 Hz to 1 KHz

2 High Voltage Response
Up to 900 V/W

3 Easy to Integrate Format
TO5 and TO8 packages make the QS detectors small and easy to integrate in an existing system

4 Large Area Sensors
5 mm and 9 mm diameter pyroelectric sensors make optical alignment easier

5 Several IR Windows in Option

- Quartz: 0.2 – 3.5 µm
- Barium Fluoride: 0.2 – 17.5 µm
- Sapphire: 0.1 – 7.0 µm
- Silicon: 1.2 – 9.0 µm and 22 – 100 µm
- AR Germanium: 1.8 – 23 µm (10.6 µm peak)

AVAILABLE MODELS

- QS1-VL 1 mm Ø, TO5 Packaging
- QS2-VL 2 mm Ø, TO5 Packaging
- QS3-VL 3 mm Ø, TO5 Packaging
- QS5-VL 5 mm Ø, TO5 Packaging
- QS9-VL 9 mm Ø, TO8 Packaging

ACCESSORIES

QS-V-TEST
(Test Box in Voltage Mode)

Permanent IR Windows
(Various types available)

Pelican Carrying Case

SEE ALSO

TECHNICAL DRAWINGS 114
LIST OF ALL ACCESSORIES 174

APPLICATION NOTES

HOW THEY WORK: QS-I-TEST & QS-V-TEST
121D-201927

QS DETECTORS PIN-OUTS & DESCRIPTIONS
121D-201931

QS-VL
SPECIFICATIONS

Approved or in the process of being approved*

MODELS	QS1-VL	QS2-VL	QS3-VL	QS5-VL	QS9-VL
VOLTAGE RESPONSIVITY	900 V/W	200 V/W	90 V/W	25 V/W	15 V/W
CURRENT RESPONSIVITY	1 µA/W	0.5 µA/W	0.5 µA/W	0.25 µA/W	0.25 µA/W
EFFECTIVE APERTURE	1 mm Ø	2 mm Ø	3 mm Ø	5 mm Ø	9 mm Ø
PACKAGE	TO5	TO5	TO5	TO5	TO8

MEASUREMENT CAPABILITY					
Spectral Range	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm
Max Average Power	50 mW	50 mW	50 mW	50 mW	50 mW
Noise Equivalent Power [a]	$3x10^{-10}$ W/(Hz)^{½}	$6x10^{-10}$ W/(Hz)^{½}	$1x10^{-9}$ W/(Hz)^{½}	$2x10^{-9}$ W/(Hz)^{½}	$5x10^{-9}$ W/(Hz)^{½}
Detectivity [a]	$2.9x10^{8}$ cm(Hz)^{½} /W	$3.0x10^{8}$ cm(Hz)^{½} /W	$2.7x10^{8}$ cm(Hz)^{½} /W	$2.2x10^{8}$ cm(Hz)^{½} /W	$1.6x10^{8}$ cm(Hz)^{½} /W
Capacitance (at 1000 Hz)	15 pF	22 pF	60 pF	90 pF	250 pF
Current Responsivity (at 630 nm)	1 µA/W	0.5 µA/W	0.5 µA/W	0.25 µA/W	0.25 µA/W
Voltage Responsivity [b]	900 V/W	200 V/W	90 V/W	25 V/W	15 V/W
Thermal Frequency (3 dB)	3.5 Hz	1.6 Hz	0.8 Hz	0.5 Hz	2.5 Hz
Load Resistor	300 GΩ	300 GΩ	100 GΩ	100 GΩ	100 GΩ
Supply Voltage	+9 to +15 V	+9 to +15 V	+9 to +15 V	+9 to +15 V	+9 to +15 V
PHYSICAL CHARACTERISTICS					
Effective Aperture	1 mm Ø	2 mm Ø	3 mm Ø	5 mm Ø	9 mm Ø
Package	TO5	TO5	TO5	TO5	TO8
Sensor	Pyroelectric	Pyroelectric	Pyroelectric	Pyroelectric	Pyroelectric
Absorber	MT	MT	MT	MT	MT
Dimensions	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	13.6Ø x 6.4D mm
Weight	1.0 g	1.0 g	1.0 g	1.0 g	1.5 g
ORDERING INFORMATION					
Full Product Name	QS1-VL	QS2-VL	QS3-VL	QS5-VL	QS9-VL
Product Number	201673	201674	201676	201677	201678

a: 630 nm, 15 Hz, 1 Hz Bandwidth
b: 630 nm, 15 Hz

Specifications are subject to change without notice

QS-V-TEST EVALUATION TEST BOX

	QS-V-TEST
Batteries	+9V
R_L Resistors	10^{5} - 10^{10} Ω
C_f Compensating	NO
Package	101.6H x 127W x 58.4D
Optical Mount	¼-20 Threaded
Front Bezel	SM1 (1.035-40)

* For details, contact your Gentec-EO representative

QS-IF

Hybrid Pyro Detectors, Current Mode, Fast Response

KEY FEATURES

1 High Frequency Response
From 1 KHz to 20 MHz

2 Fast Response in Current Mode
The QS-IF take full advantage of the pyroelectric detectors' fast response times

3 Easy to Integrate Format
TO5 and TO8 packages make the QS detectors small and easy to integrate in an existing system

4 Large Area Sensors
5 mm and 9 mm diameter pyroelectric sensors make optical alignment easier

5 Several IR Windows in Option

- Quartz: 0.2 – 3.5 µm
- Barium Fluoride: 0.2 – 17.5 µm
- Sapphire: 0.1 – 7.0 µm
- Silicon: 1.2 – 9.0 µm and 22 – 100 µm
- AR Germanium: 1.8 – 23 µm (10.6 µm peak)

AVAILABLE MODELS

- QS1-IF 1 mm Ø, TO5 Packaging
- QS2-IF 2 mm Ø, TO5 Packaging
- QS3-IF 3 mm Ø, TO5 Packaging
- QS5-IF 5 mm Ø, TO5 Packaging
- QS9-IF 9 mm Ø, TO8 Packaging

ACCESSORIES

QS-I-TEST
(Test Box in Current Mode)

Permanent IR Windows
(Various types available)

Pelican Carrying Case

SEE ALSO

TECHNICAL DRAWINGS 114
LIST OF ALL ACCESSORIES 174

APPLICATION NOTES:
COMPENSATING CURRENT MODE AMPLIFICATION USING QS-I-TEST 121D-201925

THERMAL SATURATION IN HYBRID PYROELECTRIC DETECTORS 121D-201926

HOW THEY WORK: QS-I-TEST & QS-V-TEST 121D-201927

QS DETECTORS PIN-OUTS & DESCRIPTIONS 121D-201931

QS-IF
SPECIFICATIONS

Approved or in the process of being approved*

MODELS	QS1-IF	QS2-IF	QS3-IF	QS5-IF	QS9-IF
VOLTAGE RESPONSIVITY	100 V/W	50 V/W	50 V/W	25 V/W	25 V/W
CURRENT RESPONSIVITY	1 µA/W	0.5 µA/W	0.5 µA/W	0.25 µA/W	0.25 µA/W
EFFECTIVE APERTURE	1 mm Ø	2 mm Ø	3 mm Ø	5 mm Ø	9 mm Ø
PACKAGE	TO5	TO5	TO5	TO5	TO8

MEASUREMENT CAPABILITY					
Spectral Range	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm
Max Average Power	50 mW	50 mW	50 mW	50 mW	50 mW
Noise Equivalent Power [a]	$5x10^{-8}$ W/(Hz)^{½}	$8x10^{-8}$ W/(Hz)^{½}	$8x10^{-8}$ W/(Hz)^{½}	$1.6x10^{-7}$ W/(Hz)^{½}	$1.6x10^{-7}$ W/(Hz)^{½}
Detectivity [a]	$1.8x10^{6}$ cm(Hz)^{½} /W	$2.2x10^{6}$ cm(Hz)^{½} /W	$3.3x10^{6}$ cm(Hz)^{½} /W	$2.8x10^{6}$ cm(Hz)^{½} /W	$5.0x10^{6}$ cm(Hz)^{½} /W
Capacitance (at 1000 Hz)	15 pF	22 pF	60 pF	90 pF	250 pF
Current Responsivity (at 630 nm)	1 µA/W	0.5 µA/W	0.5 µA/W	0.25 µA/W	0.25 µA/W
Voltage Responsivity [b]	100 V/W	50 V/W	50 V/W	25 V/W	25 V/W
Thermal Frequency (3 dB)	3.5 Hz	1.6 Hz	0.8 Hz	0.5 Hz	0.25 Hz
Feedback Resistor	100 MΩ	100 MΩ	100 MΩ	100 MΩ	100 MΩ
Supply Voltage	± 12 V	± 12 V	± 12 V	± 12 V	± 12 V
PHYSICAL CHARACTERISTICS					
Effective Aperture	1 mm Ø	2 mm Ø	3 mm Ø	5 mm Ø	9 mm Ø
Package	TO5	TO5	TO5	TO5	TO8
Sensor	Pyroelectric	Pyroelectric	Pyroelectric	Pyroelectric	Pyroelectric
Absorber	MT	MT	MT	MT	MT
Dimensions	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	13.6Ø x 6.4D mm
Weight	1.0 g	1.0 g	1.0 g	1.0 g	1.5 g
ORDERING INFORMATION					
Full Product Name	QS1-IF	QS2-IF	QS3-IF	QS5-IF	QS9-IF
Product Number	201679	201680	201681	201682	201683

a: 630 nm, 15 Hz, 1 Hz Bandwidth
b: 630 nm, 15 Hz

Specifications are subject to change without notice

QS-I-TEST EVALUATION TEST BOX

	QS-I-TEST
Batteries	+9V/-9V
R_f Resistors	10^{5} - 10^{10} Ω
C_f Compensating	YES
Package	101.6H x 127W x 58.4D
Optical Mount	¼-20 Threaded
Front Bezel	SM1 (1.035-40)

* For details, contact your Gentec-EO representative

QS-IL

Hybrid Pyro Detectors, Current Mode, Low Noise Level

KEY FEATURES

1 High Voltage Response in Current Mode
This family of pyro detectors offers a 10^{11} Ω chip resistor that results in an incredible 50 000 V/W voltage response

2 Low Noise Level
The high voltage response allows to detect signals down in the nW range!

3 Easy to Integrate Format
TO5 and TO8 packages make the QS detectors small and easy to integrate in an existing system

4 Large Area Sensors
5 mm and 9 mm diameter pyroelectric sensors make optical alignment easier

5 Several IR Windows in Option
- Quartz: 0.2 – 3.5 µm
- Barium Fluoride: 0.2 – 17.5 µm
- Sapphire: 0.1 – 7.0 µm
- Silicon: 1.2 – 9.0 µm and 22 – 100 µm
- AR Germanium: 1.8 – 23 µm (10.6 µm peak)

AVAILABLE MODELS

- QS1-IL 1 mm Ø, TO5 Packaging
- QS2-IL 2 mm Ø, TO5 Packaging
- QS3-IL 3 mm Ø, TO5 Packaging
- QS5-IL 5 mm Ø, TO5 Packaging
- QS9-IL 9 mm Ø, TO8 Packaging

ACCESSORIES

QS-I-TEST
(Test Box in Current Mode)

Permanent IR Windows
(Various types available)

Pelican Carrying Case

SEE ALSO

TECHNICAL DRAWINGS 114
LIST OF ALL ACCESSORIES 174

APPLICATION NOTES
COMPENSATING CURRENT MODE AMPLIFICATION USING QS-I-TEST 121D-201925
THERMAL SATURATION IN HYBRID PYROELECTRIC DETECTORS 121D-201926
HOW THEY WORK: QS-I-TEST & QS-V-TEST 121D-201927
HIGHEST PERFORMANCE WITH QS DETECTORS 121D-201928
QS DETECTORS PIN-OUTS & DESCRIPTIONS 121D-201931

QS-IL
SPECIFICATIONS

Approved or in the process of being approved*

MODELS	QS1-IL	QS2-IL	QS3-IL	QS5-IL	QS9-IL
VOLTAGE RESPONSIVITY	50 kV/W	25 kV/W	25 kV/W	13 kV/W	13 kV/W
CURRENT RESPONSIVITY	1 µA/W	0.5 µA/W	0.5 µA/W	0.25 µA/W	0.25 µA/W
EFFECTIVE APERTURE	1 mm Ø	2 mm Ø	3 mm Ø	5 mm Ø	9 mm Ø
PACKAGE	TO5	TO5	TO5	TO5	TO8
MEASUREMENT CAPABILITY					
Spectral Range	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm	0.1 - 1000 µm
Max Average Power	50 mW	50 mW	50 mW	50 mW	50 mW
Noise Equivalent Power [a]	$8x10^{-10}$ W/(Hz)^{½}	$2x10^{-9}$ W/(Hz)^{½}	$2x10^{-9}$ W/(Hz)^{½}	$6x10^{-9}$ W/(Hz)^{½}	$6x10^{-9}$ W/(Hz)^{½}
Detectivity [a]	$1.1x10^{8}$ cm(Hz)^{½} /W	$9.0x10^{7}$ cm(Hz)^{½} /W	$1.3x10^{8}$ cm(Hz)^{½} /W	$7.0x10^{7}$ cm(Hz)^{½} /W	$1.3x10^{8}$ cm(Hz)^{½} /W
Capacitance (at 1000 Hz)	15 pF	22 pF	60 pF	90 pF	250 pF
Current Responsivity (at 630 nm)	1 µA/W	0.5 µA/W	0.5 µA/W	0.25 µA/W	0.25 µA/W
Voltage Responsivity [b]	50 kV/W	25 kV/W	25 kV/W	13 kV/W	13 kV/W
Thermal Frequency (3 dB)	3.5 Hz	1.6 Hz	0.8 Hz	0.5 Hz	0.25 Hz
Feedback Resistor	100 GΩ	100 GΩ	100 GΩ	100 GΩ	100 GΩ
Supply Voltage	± 5 to ± 12 V	± 5 to ± 12 V	± 5 to ± 12 V	± 5 to ± 12 V	± 5 to ± 12 V
PHYSICAL CHARACTERISTICS					
Effective Aperture	1 mm Ø	2 mm Ø	3 mm Ø	5 mm Ø	9 mm Ø
Package	TO5	TO5	TO5	TO5	TO8
Sensor	Pyroelectric	Pyroelectric	Pyroelectric	Pyroelectric	Pyroelectric
Absorber	MT	MT	MT	MT	MT
Dimensions	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	8.3Ø x 6.4D mm	13.6Ø x 6.4D mm
Weight	1.0 g	1.0 g	1.0 g	1.0 g	1.5 g
ORDERING INFORMATION					
Full Product Name	QS1-IL	QS2-IL	QS3-IL	QS5-IL	QS9-IL
Product Number	201684	201685	201686	201687	201688

a: 630 nm, 15 Hz, 1 Hz Bandwidth
b: 630 nm, 15 Hz

Specifications are subject to change without notice

QS-I-TEST EVALUATION TEST BOX

	QS-I-TEST
Batteries	+9V/-9V
R_f Resistors	10^{5} - 10^{10} Ω
C_f Compensating	YES
Package	101.6H x 127W x 58.4D
Optical Mount	¼-20 Threaded
Front Bezel	SM1 (1.035-40)

* For details, contact your Gentec-EO representative

TRAP

Optical Trap Detectors

KEY FEATURES

1. **Don't Lose Your Photons Anymore**
   Highest Efficiency Detectors in the Photonics World, Quantum efficiency (QE) >>99 %
2. **Have your own Golden Calibration Standard**
   The high QE makes it an excellent, standalone, calibration transfer standard
3. **Incredible Spatial Uniformity**
   The spatial uniformity is better than 0.02 %
4. **Low Calibration Uncertainty <0.5 %**
   From 480 to 970 nm
5. **For Low Divergence or Collimated Beams**
   Devices optimized for both types of lasers
6. **Measure power from pW to mW**
   When used with the TRAP-PREAMP amplifier that provides a direct digital readout

AVAILABLE MODELS

TRAP7-Si-C
(For Collimated Beams)

TRAP7-Si-D
(For Divergent Beams)

ACCESSORIES

Stand with Delrin Post
(Model Number: 200428)

TRAP-PREAMP

TRAP-PREAMP
Low Noise, High Gain Amplifier

Pelican Carrying Case

SEE ALSO

TRAP
SPECIFICATIONS

Approved or in the process of being approved*

MODELS	TRAP7-Si-C-BNC	TRAP7-Si-D-BNC
MAX AVERAGE POWER	2 mW	2 mW
EFFECTIVE APERTURE	7 mm Ø	7 mm Ø
COMPATIBLE MODULE(S)	TRAP-PREAMP	TRAP-PREAMP
MEASUREMENT CAPABILITY		
Spectral Range (Calibrated)	0.2 - 0.98 µm	0.2 - 0.98 µm
Max Measurable Power	2 mW	2 mW
Noise Equivalent Power	100 pW	100 pW
Sensitivity	0.505 A/W	0.505 A/W
Theoretical Uncertainty		
0.22 - 0.4 µm	< 4.5%	< 4.5%
0.401 - 0.98 µm	< 2%	< 2%
Quantum Efficiency (400nm to 950nm)	> 99%	> 99%
Spatial Uniformity	< 0.02%	< 0.02%
DAMAGE THRESHOLDS		
Max Average Power Density	1 mW/cm^2	1 mW/cm^2
PHYSICAL CHARACTERISTICS		
Effective Aperture	7 mm Ø	7 mm Ø
Sensor	Silicon	Silicon
Source Type	Collimated	Divergent
Field of view	< ± 10°	< ± 14°
Dimensions	69.1Ø X 30.0D mm	66.8H X 67.3W X 27.4D mm
Weight	227 g	227 g
ORDERING INFORMATION		
Full Product Name	TRAP7-Si-C-BNC	TRAP7-Si-D-BNC
Product Number	201738	201740

Specifications are subject to change without notice

* For details, contact your Gentec-EO representative

T 418.651.8003 1888 5GENTEC F 418.651.1174 www.gentec-eo.com info@gentec-eo.com

QUAD

Position Sensing Power & Energy Detectors

KEY FEATURES

1. **Measure, Track and Align**
   With µm resolution in real time!
2. **4-Channel Detectors**
   Unique pyrolectric QUADrant detector technology handles high peak power without saturation
3. **For CW, Pulsed and High Rep Rate Lasers**
   - QUAD-E: Energy per pulse from µJ to mJ
   - QUAD-P: Powers from µW to mW
4. **From UV to FIR and THz**
   Broadband detectors cover the full spectrum, from UV to Sub-Millimeter wavelengths
5. **Large Area Sensors**
   9 mm and 20 mm square detectors
6. **Fast USB 2.0 Connection**
   Ensures full speed tracking
7. **Includes Application Software**
   Complete LabView Application Software included, with many features

AVAILABLE MODELS

QUAD-9-MT-E	QUAD-20-MT-E	QUAD-9-MT-P	QUAD-20-MT-P
(9 x 9 mm-For Energy)	(20 x 20 mm-For Energy)	(9 x 9 mm-For Power)	(20 x 20 mm-For Power)

ACCESSORIES

Stand with Delrin Post
(Model Number: 200428)

Additional 9V Power Supply
(Model Number: 200960)

USB Cable
(Model Number: 100776)

SDC-5000 Digital
Optical Chopper (for -P)

Pelican Carrying Case

SEE ALSO

TECHNICAL DRAWINGS 160
LIST OF ALL ACCESSORIES 174

APPLICATION NOTES
LASER POSITION SENSING DETECTORS AND MONITOR
121D-201930

WATCH THE DEMONSTRATION VIDEO AVAILABLE ON OUR WEBSITE AT www.gentec-eo.com

QUAD
SPECIFICATIONS

Approved or in the process of being approved*

MODELS	QUAD-9-MT-E / QUAD-9-MT-P	QUAD-20-MT-E / QUAD-20-MT-P
MAX ENERGY / AVG POWER	20 mJ / 200 mW	20 mJ / 200 mW
MAX POSITION RESOLUTION	1 µm / 10 µm	1 µm / 10 µm
EFFECTIVE APERTURE	9 x 9 mm	20 x 20 mm

MEASUREMENT CAPABILITY		
Spectral Range	0.1 - 3000 µm	0.1 - 3000 µm
For -E (Energy sensors)		
Max Measurable Energy	20 mJ/Channel	20 mJ/Channel
Noise Equivalent Energy	0.5 µJ	1.0 µJ
Rise Time (0-100%)	150 µs	150 µs
Max Repetition Rate	1000 Hz	1000 Hz
Max Pulse Width	2.5 µsec	2.5 µsec
Sensitivity	1000 V/J	1000 V/J
For -P (Power sensors)		
Max Measurable Power	200 mW	200 mW
Noise Equivalent Power	1 µW	2 µW
Rise Time (0-100%)	< 0.02 s	< 0.02 s
Max Chopping Frequency	50 Hz	50 Hz
Sensitivity	2000 V/W	2000 V/W
Calibration Uncertainty	± 4%	± 4%
Minimum Position Resolution With QUAD-4Track Monitor	-E: 1 µm -P: 10 µm	-E: 1 µm -P: 10 µm

DAMAGE THRESHOLDS		
Max Average Power Density (@ 1.064 µm)	100 mW/cm²	100 mW/cm²
Max Energy Density (@ 1.064 µm 10 ns)	50 mJ/cm²	50 mJ/cm²

PHYSICAL CHARACTERISTICS		
Effective Aperture	9 x 9 mm	20 x 20 mm
Sensor	Pyroelectric	Pyroelectric
Absorber	MT	MT
Dimensions	63.5Ø X 40.6D mm	63.5Ø X 40.6D mm
Weight	181 g	181 g

ORDERING INFORMATION				
Full Product Name (Detectors)	QUAD-9-MT-E	QUAD-9-MT-P	QUAD-20-MT-E	QUAD-20-MT-P
Product Number	201774	201776	201775	201777
Full Product Name (Module)	QUAD-4Track			
Product Number	201517			

Specifications are subject to change without notice

* For details, contact your Gentec-EO representative

T 418.651.8003 1888 5GENTEC F 418.651.1174 www.gentec-eo.com info@gentec-eo.com

QUAD

QUAD-4TRACK

The QUAD-4Track is a Laser Position Sensing system designed to support our unique Pyroelectric Quadrant Detectors, QUAD-P and QUAD-E. It is a 4-channel microprocessor-based system that measures the voltage output of each QUAD element and does the math necessary to provide a measurement of the X and Y displacement of a laser beam or image. It is fast and can be used to track, align and/or measure movement in real time, with a resolution of just a few microns!

QUAD-4Track (Front View)

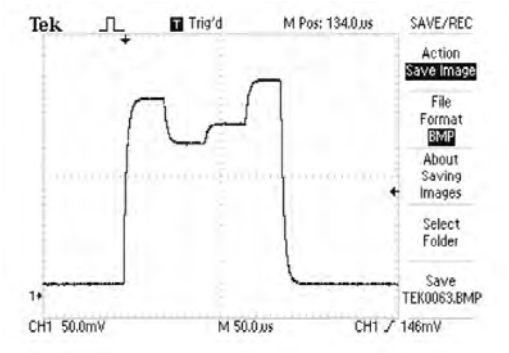
QUAD-4Track (Rear View)

SPECIFICATIONS & FEATURES

Number of Channels	4
Full Scale Ranges (4 Decades) (E / P)	
Joulemeter Mode (with QUAD-E)	20 µJ to 20 mJ
Radiometer Mode (with QUAD-P)	200 µW to 200 mW
USB Connection to Computer	YES (USB 2.0 Full Speed)
Power Supply	9VDC
Power On Light	YES
Detector Input	DB-25 Connector
Detector Analog Output	BNC Connector (0-2 V)
Trigger Input (TTL)	BNC Connector with LED Indicator

QUAD DETECTORS

Our large area Pyroelectric Quadrant Detectors provide unique advantages over other position sensing detectors like Silicon quads or lateral effect photodiodes. They are fast, handle high peak power of pulsed lasers without saturation and respond to lasers across the spectrum, from UV to Far IR and even THz. The QUAD-E is intended for use with pulsed sources at up to 1000 Hz, while the QUAD-P is designed for CW and High Repetition Rate (Quasi CW) sources. Both types of detectors can also be used as standalone units, in an analog mode, for incorporation into your own system application. We can provide a Lemo pigtail cable for this purpose.



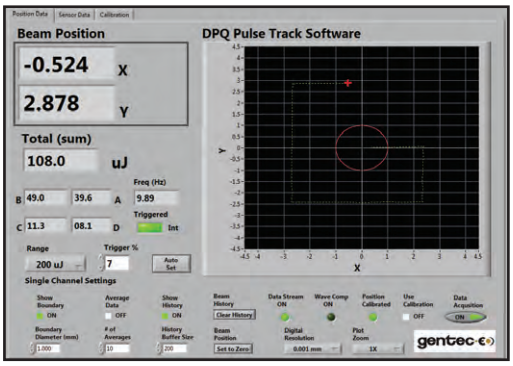
ANALOG OUTPUT

The analog output of the QUAD-4Track provides voltage that is directly proportional to the pulse energy or laser power irradiating each QUAD element. When the four voltage outputs are equal, the beam is centered on the QUAD detector. This provides a very useful tool when setting up our QUAD probes with your source for optical alignment.

QUAD

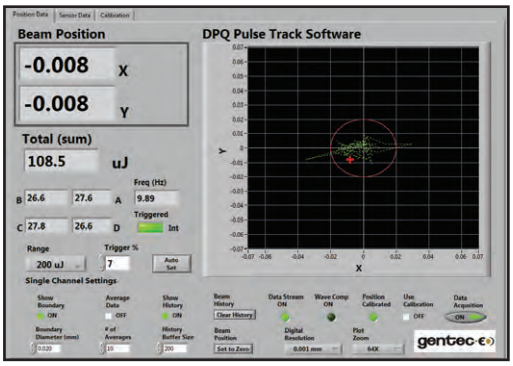
MEASUREMENT SCREEN

QUAD-4Track includes powerful, stand alone, LabView Software which is used to control the instrument, process the data, and display X and Y position. It also displays the energy or power of your source and repetition rate. The large graphic in this screen shows the position of the centroid of the beam and tracks its movement in real time. The software includes many handy features like: set boundary, zoom (2X to 128X), set resolution, data logging, and many more. The green line represents the tracking history.



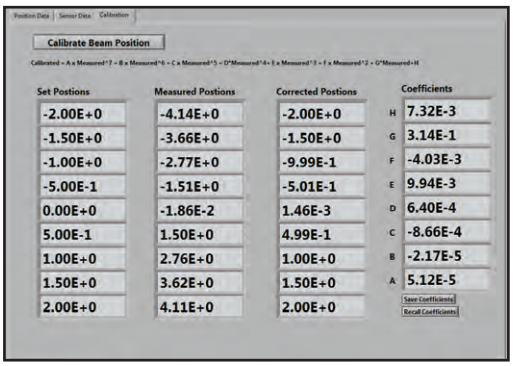
TRACKING THE BEAM OVER TIME

In the measurement screen shown on the right, we are are tracking the beam stability of a pulsed Nd:YLF laser at 10 Hz. Thje resoltuion was set at 0.001 nm, the boundary is at 20 µm (red circle), and the zoom feature is at 64X. The total energy is 108.5 µJ, the final position of the laser is at -8 µm in X and -8 µm in Y. The green tracking line shows the movement of the laser about the zero position over a few hundred pulses.



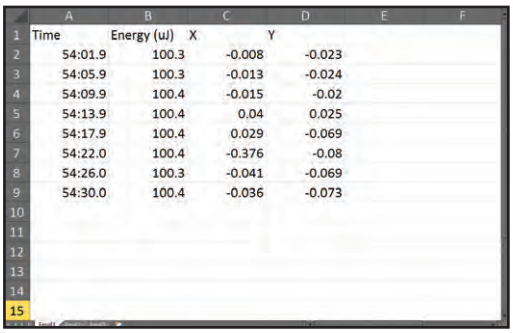
POSITION CALIBRATION SCREEN

We've developed a unique position calibration routine which allows you to calibrate our QUAD-4Track system when working with a uniformly round laser beam. It requires the use of a micrometer-driven linear stage (1-axis only). As you can see from the calibration screen on the right, the procedure involves zeroing the instrument, moving the QUAD probe to nine discrete positions (+2.000 to – 2.000 mm) and then capturing the QUAD readings. It then determines correction coefficients (last column) and applies them to the raw data to arrive at "corrected positions". The QUAD probe is now calibrated!



DATA LOGGING

Another very handy feature is "data logging". This allows you to set up the QUAD-4Track to follow the displacement, energy and/or power of your laser over several minutes, hours or even days. Need to measure the "beam steering" of your laser as it warms up? This is how you do it! Need to measure the beam displacement vs laser repetition rate or energy level? Data logging will help you measure it!



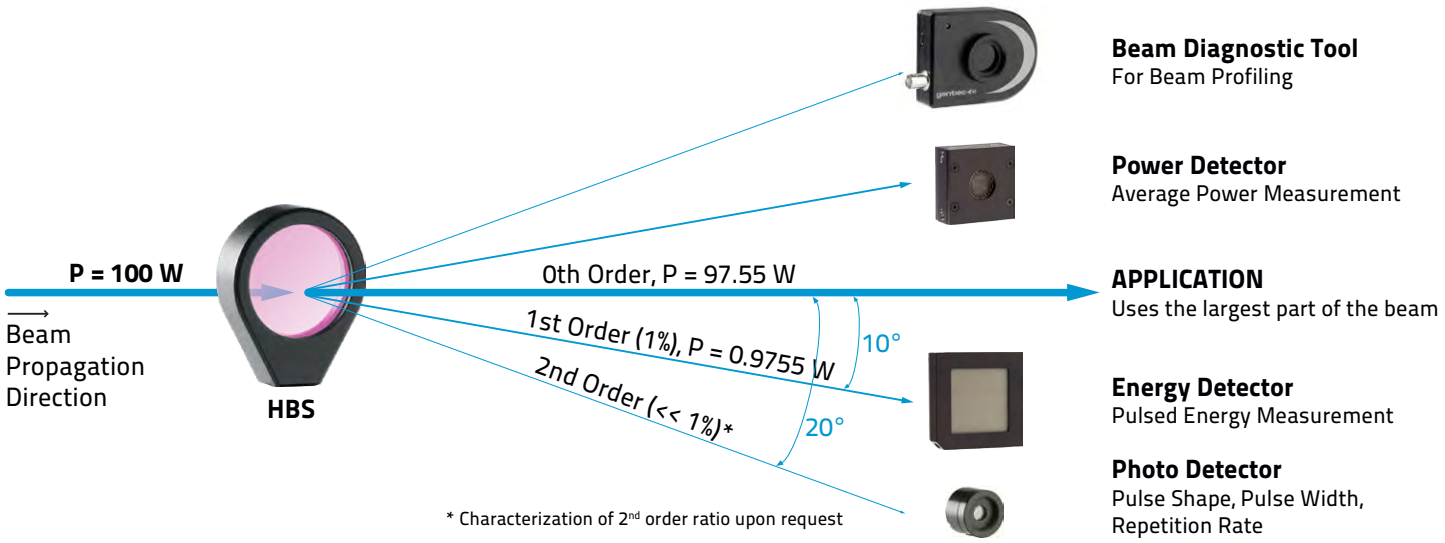
	A	B	C	D
1	Time	Energy (uJ)	X	Y
2	54:01.9	100.3	-0.008	-0.023
3	54:05.9	100.3	-0.013	-0.024
4	54:09.9	100.4	-0.015	-0.02
5	54:13.9	100.4	0.04	0.025
6	54:17.9	100.4	0.029	-0.069
7	54:22.0	100.4	-0.376	-0.08
8	54:26.0	100.3	-0.041	-0.069
9	54:30.0	100.4	-0.036	-0.073

DIFFRACTIVE OPTICS

OVERVIEW

What if you need to measure the performance of the beam in real-time while your application is online? You cannot insert or remove optical components or interrupt the beam either. How do you do that? One way is to divert a small fraction of the beam that is an exact replica of the main beam. Sampling is also a solution if the beam is too "hot" for your diagnostic instruments to handle. In either case, almost all of the main beam is available to do its job.

Figure 1. Example HBS Application
Pulsed ND:YAG, 1064 nm, 1J @ 100 Hz (100 W)



SAMPLING

One approach is to use something like a moveable mirror to sample in time. The beam is interrupted and diverted for small slices of time. A big disadvantage though is that the time sampler provides average values so it is not well suited for real-time operation, especially with pulsed lasers. The other way is to continuously divert a tiny fraction of the beam to another angle while the main beam passes through, along its original line. However it is done, the sample needs to be a low power replica of the main beam.

REAL-TIME BEAM SAMPLING

The components or methods suitable for real-time beam sampling are summarized in Table 1. The particular requirements of an application will narrow down the list of acceptable methods. All of these methods provide a decent replica of the main beam in the sampled beam and all can withstand reasonably high power. If it is important that the polarization of the sample be the same as the beam, then the Mirror and the Frustrated Total Internal Reflection are not good choices due to mixing of the horizontal and vertical polarizations. Low sampling fraction is very good. This means that most of the beam passes on to the application with a tiny percentage being diverted. The Mirror and Hole Matrix remove much more energy from the beam than the other components which is a problem for many applications.

DIFFRACTIVE OPTICS

ISSUES IN BEAM SAMPLING

Table 1. Comparison of Real-Time Sampling Methods

Table 1. Comparison of Real-Time Sampling Methods

	Spatial Profile Available	Polarization Insensitive	Low Sampling Fraction	Sustain High Power	V bration Insensitive	Environment Insensitive	Cartesian Main Beam	Small Unusable Losses	Commercial Product Available
Reflective Samplers									
Wedge: Low-Reflective dielectric coatings on both faces (Rmin)	✓	✓	✓	✓				✓	✓
Mirror: Leakage from high reflectivity mirror (Rmax)	✓			✓	✓		✓	✓	✓
Refractive Samplers									
Cascaded Wedges	✓	✓	✓	✓		✓			
Frustrated Total Internal Reflection (FTIR): Adjustable gap between two prisms	✓		✓	✓			✓	✓	
Transmission Samplers									
Hole matrix: Periodic array of holes machined in highly reflective mirror or transparent substrate	✓	✓		✓	✓		✓	✓	
Holographic: Relief hologram etched on transparent substrate	✓	✓	✓	✓	✓	✓	✓	✓	✓

ENVIRONMENTAL ISSUES

If the relative position of the beam on the sampler is critical, vibration will have a disruptive effect. The methods employing refraction to some degree (eg. prisms and wedges) are highly sensitive to vibration. This includes vibration in the beam as well as the sampler. You will prefer other choices in rough environments or for laser beams that do not have great pointing stability. Changing temperature and humidity can be a problem for all but the Holographic sampler and Cascaded Wedges. This is an important consideration for industrial environments.

APPLICATION ISSUES

Cartesian main beam: if it is important that the main beam continue either parallel or perpendicular to the incident beam, you would have to rule out the Cascaded Wedges or the Wedge. The need for that depends on the design of the optical train. The other problem for the Cascaded Wedges is its unusable losses. Compared to the other methods, a significant fraction of the energy that is diverted from the main beam is not useful for sampling and must be dissipated. That can be substantial in high power applications. From the table you can see that the holographic sampler is suited to the widest range of applications.

T 418.651.8003 1888 5GENTEC F 418.651.1174 www.gentec-eo.com info@gentec-eo.com

HBS

355 nm, 532 nm and 1064 nm, 1 % and 0.05 %

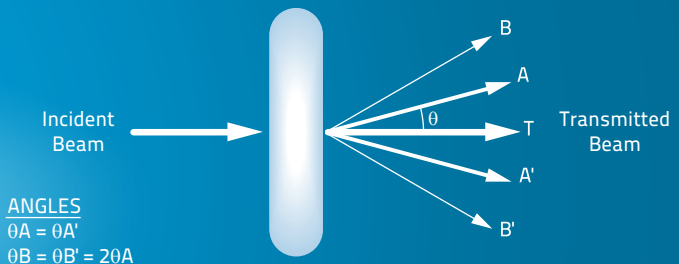
KEY FEATURES

1 On-Line Monitoring
Do real-time sampling of your laser and measure your profile while working

2 Spatial Profile Preserved
The HBS will not create artefacts in your measurements or in your main beam

3 Environment Insensitive
The ONLY sampling component that is insensitive to ALL environmental variations, including polarization

4 Very High Damage Threshold
Can be as high as fused silica itself



ANGLES
θA = θA'
θB = θB' = 2θA
A = Specified Diffraction Order

AVAILABLE MODELS

HBS-355-100-1C-10 (355 nm-1%-Coated)	HBS-532-100-1C-10 (532 nm-1%-Coated)	HBS-532-100-1U-10 (532 nm-1%-Uncoated)	HBS-1064-100-1C-10 (1064 nm-1%-Coated)	HBS-1064-100-1U-10 (1064 nm-1%-Uncoated)	HBS-1064-2000-1C-10 (1064 nm-0.05%-Coated)

ACCESSORIES

Stand with Steel Post
(Model Number: 200160)

1 inch Mount
(Model Number: 101543)

Pelican Carrying Case

SEE ALSO

LIST OF ALL ACCESSORIES 174

HBS

SPECIFICATIONS

MODELS	STANDARD HBS	CUSTOM CAPABILITIES
1ST ORDER RATIO	0.05 % or 1 %	0.05 % to 10 %
WAVELENGTHS	355, 532 & 1064 nm	250 to 2100 nm
DIAMETER	1 inch	Up to 2 inches

MEASUREMENT CAPABILITY		
Wavelengths	355, 532 & 1064 nm	250 to 2100 nm
Substrate		
Shape	Slight wedge 1/2°	With or without edge
Contour	Flat	Flat
Thickness	1/8"	Up to 1/4"
Diameter	1"	Up to 2.5"
Coatings	V-AR (both sides or uncoated)	V-AR (both sides or uncoated)
Type of Grating	Sinusoidal	Sinusoidal or Binary
Typical Calibration Accuracy (1st order)	±3 %	±2 %
1st Order Ratio	Depends on Wavelength	Depends on Wavelength
355 nm	1 %	0.2 to 5 %
532 nm	1 %	0.05 to 10 %
1064 nm	1 % and 0.05 %	0.05 to 10 %
1st Order Angle	Depends on Wavelength	Depends on Wavelength
355 nm	10°	Up to 13°
532 nm	10°	Up to 20°
1064 nm	10°	Up to 20°
Total Insertion Loss (V-AR)	0.3 % per side (typical)	0.2 % to 2 % per side
Total Insertion Loss (Uncoated)	4 % per surface	4 % per surface

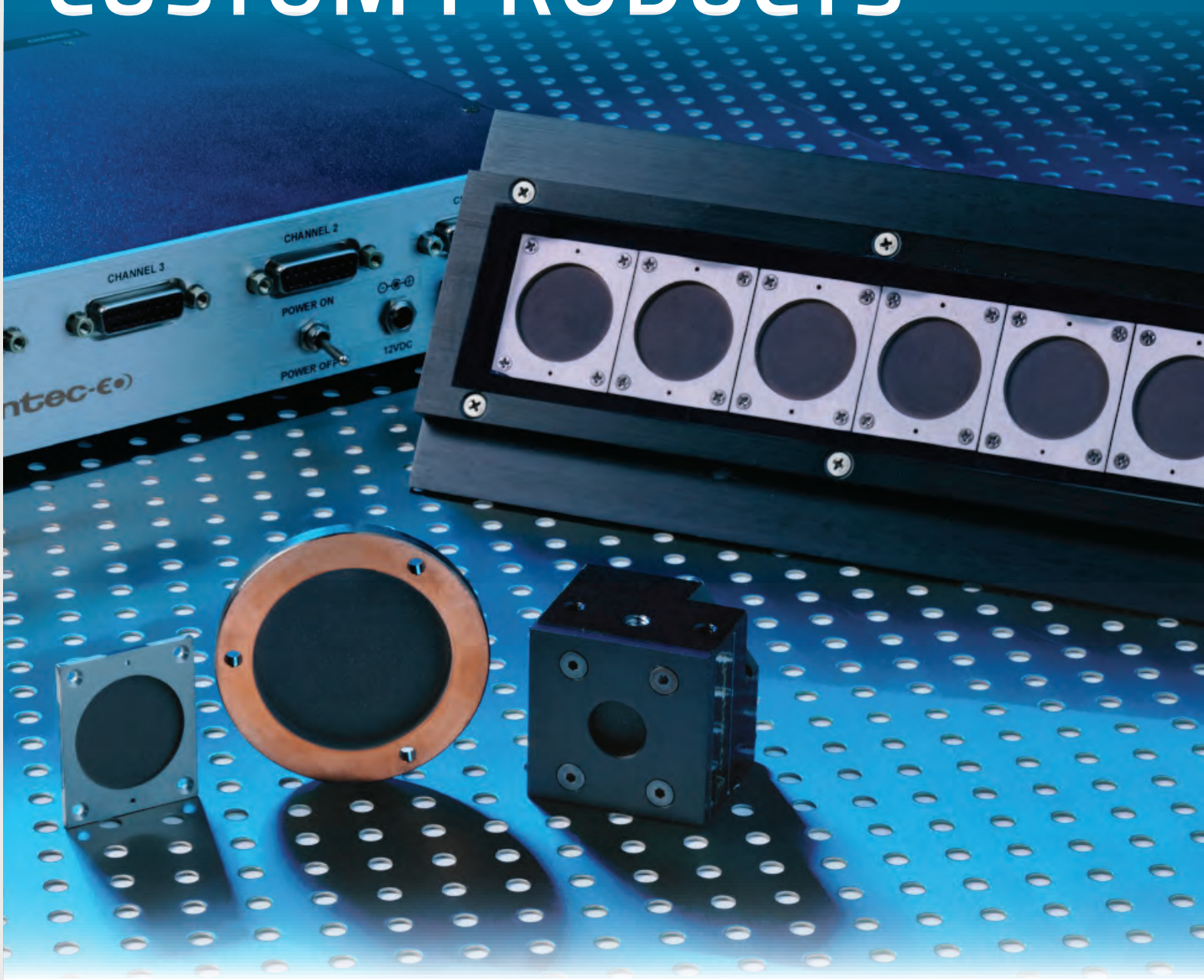
DAMAGE THRESHOLDS		
Maximum Energy Density (1064 nm, uncoated)	Up to 86 J/cm²	Up to 86 J/cm²
Maximum Power Density (1064 nm, V-AR)	Up to 2 MW/cm²	Up to 2 MW/cm²

STANDARD HBS MODELS	Wavelenght	1st Order Ratio	Coating	Max En. Dens.	Max Power Dens.	Product Number
HBS-355-100-1C-10	355 nm	1 %	V-AR 355	5 J/cm²	0.5 MW/cm²	23799
HBS-532-100-1C-10	532 nm	1 %	V-AR 532	10 J/cm²	1 MW/cm²	20731
HBS-532-100-1U-10	532 nm	1 %	None	58 J/cm²	N/A	21262
HBS-1064-100-1C-10	1064 nm	1 %	V-AR 1064	20 J/cm²	2 MW/cm²	20733
HBS-1064-100-1U-10	1064 nm	1 %	None	86 J/cm²	N/A	21263
HBS-1064-2000-1C-10	1064 nm	0.05 %	V-AR 1064	20 J/cm²	2 MW/cm²	23977

Specifications are subject to change without notice

T 418.651.8003 1888 5GENTEC F 418.651.1174 www.gentec-eo.com info@gentec-eo.com

CUSTOM PRODUCTS



After 40 years of experience in the Laser Beam Measurement business, we have developped many customized solutions, sometimes for very unusual applications! This section is only a small portion of the projects we have accomplished for our customers, so do not hesitate to contact us with any special need you may have. We are always striving to find the perfect solution for your application!

CUSTOM PRODUCTS

LARGE SIZE HIGH POWER DETECTORS

Our unique power detector technology offers FULL FLEXIBILITY on both POWER and SIZE:

- Very High Average Powers (Up to 30 kW, more on request)
- NO Limitations on Aperture Size and Shape
- High Damage Thresholds
- Direct USB Output to PC
- CO2, YAG, Fiber Laser, Diode Arrays, etc.

MULTI-KW CAPABILITIES
LARGEST APERTURES ON THE MARKET

6-ELEMENT DETECTOR BAR

Custom detector integration that monitors multiple lasers in a system. This detector bar included six independent power sensors, covered by protection windows with anti-reflective coating, presence sensors, on-board signal conditioning and acquisition to instantly measure power and communicate with the system through industrial serial protocol.

- 6 elements on one board
- Instantaneous power measurement of all 6 elements
- Detector elements protected by windows with AR coating

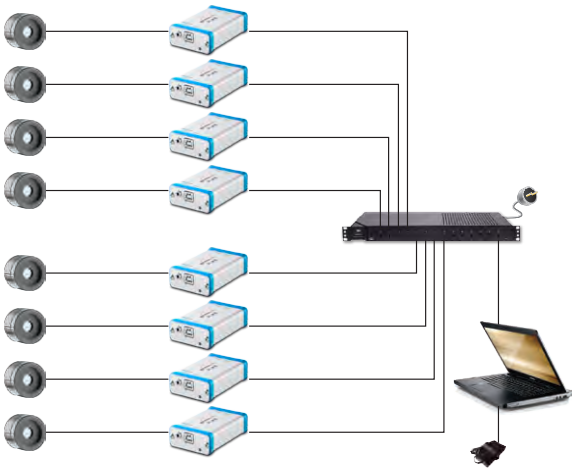
TEMPERATURE-CONTROLLED POWER METERS

- **Temperature Controlled Power Sensors and Controller**: Each head is composed of a low noise detector, thermistor, TE cooler and heat sink to compensate for any temperature change
- **The Ultimate Choice in Measurement Stability**: Temperature control down to 0.05°C from 20 to 30°C gives a temperature coefficient <0.01 %, thus a voltage output stable to 0.01 %

2 Sizes Available for the TP Sensors:

- TP5-BL: 5 mm Ø pyroelectric sensor with organic black coating
- TP9-BL: 9 mm Ø pyroelectric sensor with organic black coating

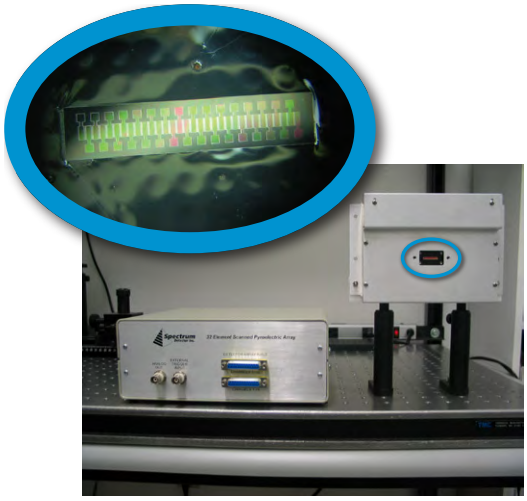
CUSTOM PRODUCTS



OCTOLINK

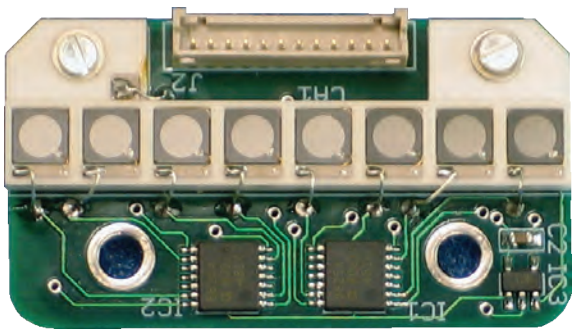
OCTOLINK is our new multichannel software that was specifically designed for the simultaneous measurement of a large set of power detectors. As its name indicates, OCTOLINK allows the measurement of up to 8 devices simultaneously, all on a combined control screen. Furthermore, this tool offers full flexibility on the functionalities, allowing to control, compare and collect data of multiple detectors in a simple but effective manner. The channels can be user-set, allowing a transparent integration in the existing systems. Pass-fail feature and complete data logging make OCTOLINK an ideal and inexpensive solution for long term power monitoring.

MEASURE 8 DETECTORS SIMULTANEOUSLY
USER-SETTABLE INTERFACE



32-CHANNEL THZ PYROELECTRIC ARRAY

The SDX-1105 is a 32-element Pyroelectric Array combined to a 32-channel multiplexing electronics that was designed for a THz Spectrometer Application. The system was designed to be able to measure a few nanojoules of energy from a pulsed THz source in the 0.1 to 20 THz region. As the Pyroelectric detectors are based on a thermal effect, the same device can be used with pulsed lasers from the DUV to FIR. The detector elements of the array are 1 mm tall by 0.5 mm wide and spaced on 0.5 mm centers.



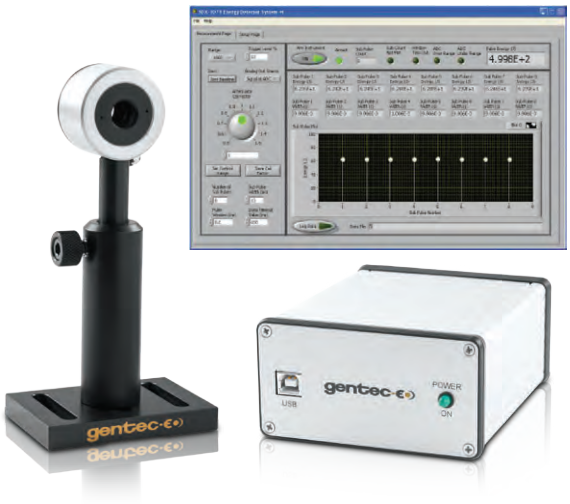
8-CHANNEL ARRAY FOR THZ TOMOGRAPHY

The 8 element Pyroelectric Array and electronics were designed for a Fiber Laser-based, multi-beam, THz Tomography project which was a joint venture between the Universities of Manchester, Southampton and Leeds in the UK.

The goal was to produce a high performance, low noise level, discrete array, capable of measuring 10 nW per channel in the 0.5 to 2 THz range.

8-CHANNEL PYROELECTRIC ARRAY
0.5 TO 2 THz RANGE
10 nW PER CHANNEL

CUSTOM PRODUCTS

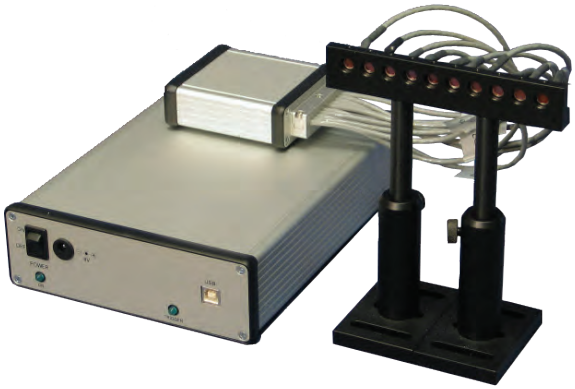


PULSE BURST ENERGY METER

This pulse burts energy meter was developed for Candela Corporation for a new 2-Color Medical Laser System that required measuring the power in multiple pulses and displaying total and sub-pulse energy and pulse width of a laser running in a burst mode.

It was designed to measure a single pulse or up to eight pulses in a burst. The spectral range was 0.5 µm to 3.0 µm.

MEASURES INDIVIDUAL PULSE ENERGIES IN A PULSE BURST



10-CHANNEL ENERGY METER

This Energy Meter was designed for use with Mid-IR and Far-IR lasers and could be used in pairs to create a 20-Channel Digital Joulemeter. The energy sensors were based on fast Pyroelectric Detectors outfitted with KRS5 windows. The microprocessor instrument featured a full speed USB2.0 output, LabView application software and USB Drivers. It also included a multiplexed analog output for use with an oscilloscope that allowed viewing of the relative energy of each channel.

COMBINES 10 ENERGY MEASUREMENTS IN ONE APPLICATION

"HOLLOW" DETECTOR

This special calorimeter demonstrates the extent of Gentec-EO's customization capabilities. This product fulfills the requirements for the newest lasers for high energetic beam experimentation.

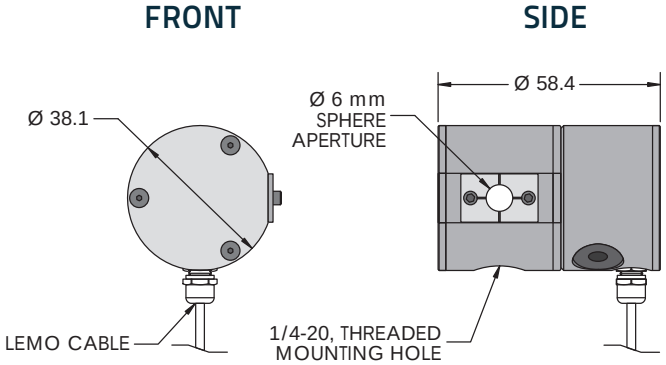
- High energy at low repetition rate for continuous measurement
- Femtosecond pulse
- Very large diameter with different shapes & sizes available
- Offers the flexibility to measure both power or energy
- Center hole option for let through an electron beam

SHORT PULSES, HIGH ENERGIES VARIOUS SHAPES & SIZES

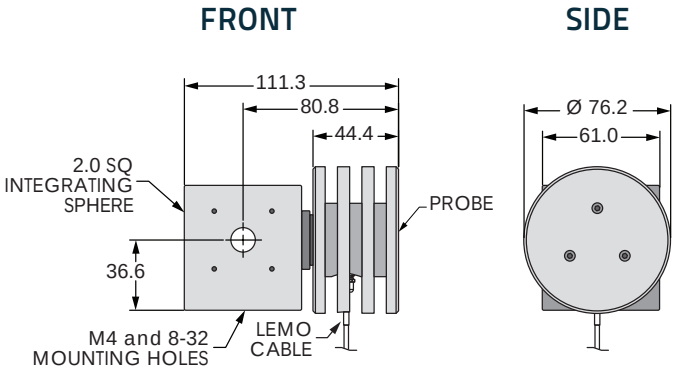
T 418.651.8003 1888 5GENTEC F 418.651.1174 www.gentec-eo.com info@gentec-eo.com

TECHNICAL DRAWINGS

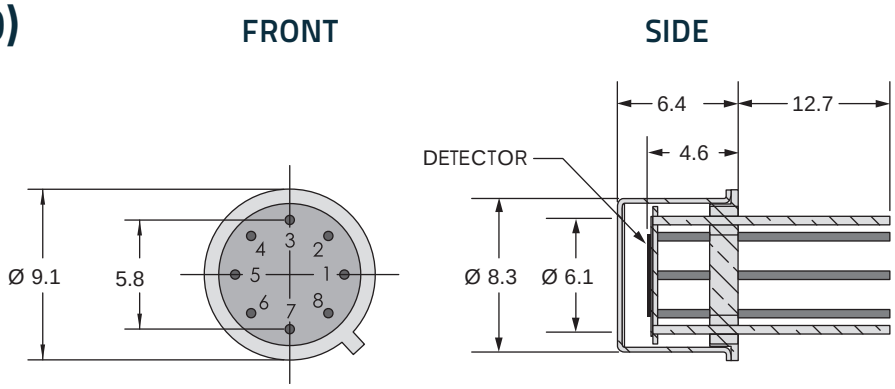
M5/M6 (6 mm Ø)



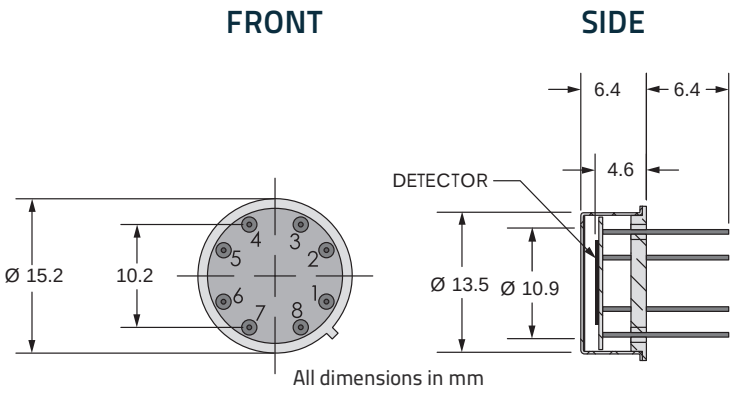
M5/M6 (12.5 mm Ø)



QS (TO5-BASED)



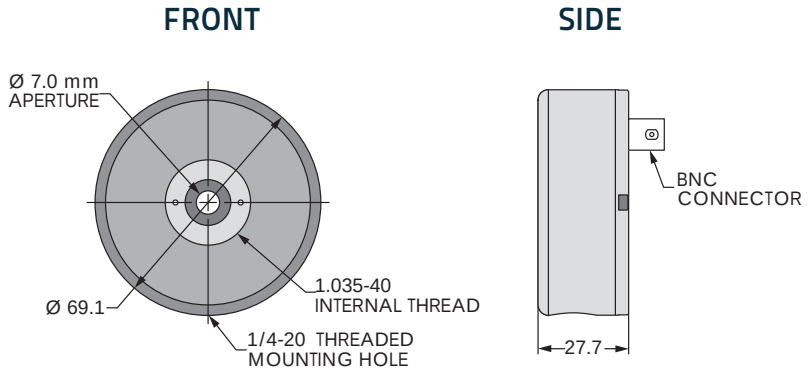
QS (TO8-BASED)



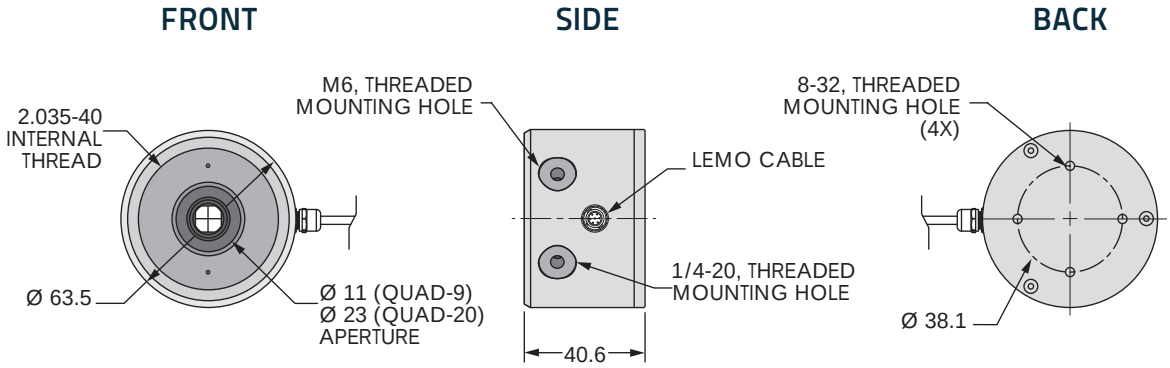
All dimensions in mm

ABSORPTION CURVES

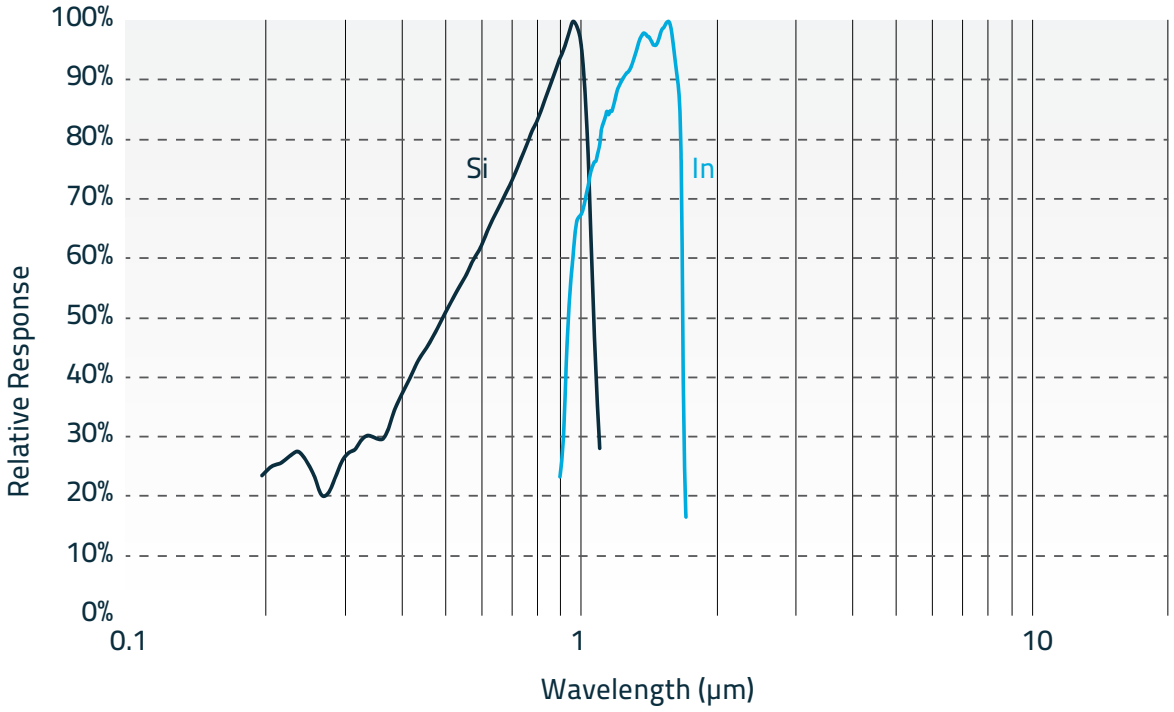
TRAP



QUAD



M5/M6-Si & M5/M6-In



All dimensions in mm