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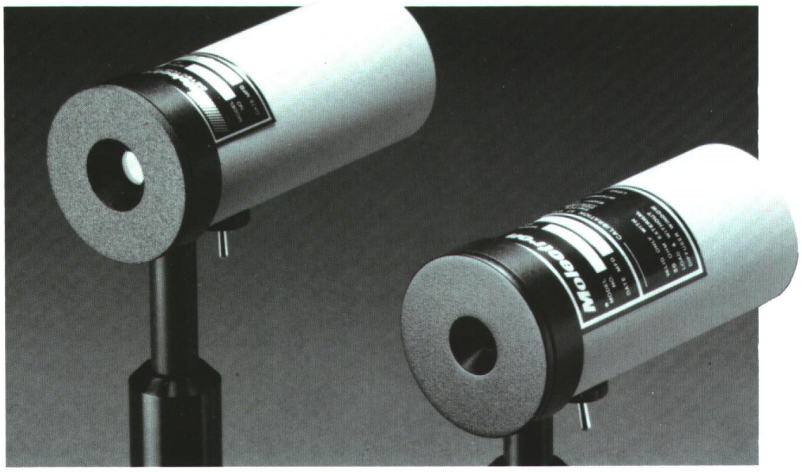
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Features

J3/J4/J3S Series Pyroelectric/Silicon Joulemeter

- **Wide dynamic range fJ to J**
- **High rep rate to 20 kHz**
- **Large area to 1 cm²**
- **NIST traceable CAL in V/mJ and V/nJ**
- **Spectral range UV, VIS, Far IR**
- **Excellent EMI shielding**
- **Use directly with oscilloscope**



Applications

- *Pulsed laser energy*
- *Pulse to pulse stability*
- *Laser setup and field service*
- *Pulsed laser spectroscopy*
- *Flashlamp test and calibration*
- *Laser safety*
- *OEM energy monitor*

Use with these pulsed lasers

- *Excimer/Dye*
- *CuVa*
- *Nitrogen*
- *Pulsed Dye*
- *Nd:YAG/Dye*
- *Diode Pumped Nd:YAG*
- *Nd:YLF*
- *HF/DF*
- *CO_2*
- *Far IR*
- *Free Electron*
- *TiSa*
- *Holmium*

Description

The J3/J4/J3S series are high sensitivity Joulemeters combining a Pyroelectric or Silicon detector with a fast transistor amplifier circuit. These energy probes are optimized for linear integration of short optical pulses from subpicosecond to submillisecond at up to 4000 pps.

In all models the incoming optical pulse generates a corresponding signal current in the detector, which is then integrated by the preamplifier. This results in a voltage output from the Joulemeter probe that is directly proportional to the energy in the optical pulse. Each probe is calibrated against a known pulse energy which is NIST traceable.

All models are packaged in a cylindrical housing which provides EMI shielding, as well as an easy way of mounting optical accessories on the Joulemeter. It also contains a 9 volt battery supplying noise free power to the preamplifier.

The J3 and J3S Joulemeters are designed for use with your standard oscilloscope, boxcar integrator and our JD1000, JD2000 and OM4001 Joulemeter instruments. The J4 probes are for use with our JD500 Joulemeter Display as well.

J3 Series

The **J3-02, J3-05** and **J3-09** Joulemeters include a 2, 5 or 9 mm diameter Pyroelectric detector that offers broad spectral response from 0.01 to 1000 microns. A three position switch allows you to select the integration time constant and voltage output that are best for your pulsed source. Measure energy levels from nJ to mJ and pulse widths from ps to 250 µs. The J3 series are ideal for pulsed flashlamps, diode pumped Nd:YAG and tunable dye lasers (i.e., N_2/Dye, YAG/Dye and Excimer/Dye).

J4 Series

The **J4-05** and **J4-09** are similar to the J3 series and include a 5 mm or 9 mm diameter Pyroelectric detector. In these models, however, the detectors include a black absorbing coating which flattens their spectral response from the UV to Far IR. Therefore, they are ideal for absolute spectral measurements of tunable optical sources and in addition, the black coating

J3/J4/J3S Series Pyroelectric/Silicon Joulemeter

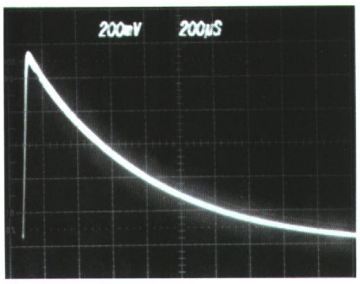


Figure 1. Typical voltage output of J3-02, J3-05 and J3-09.

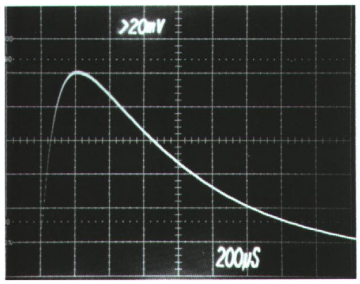


Figure 2. Typical voltage output of J4-05 and J4-09.

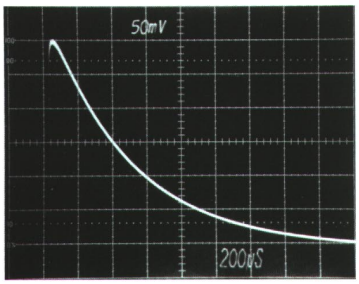


Figure 3. Typical voltage output of J3S-10

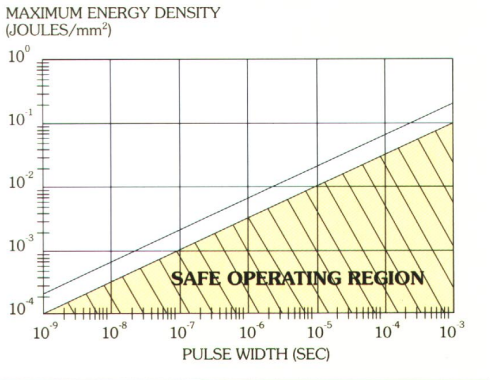


Figure 4. Energy density damage threshold (see Damage Threshold section.)

is less sensitive to pulsed laser damage (see fig. 4). The J4-05 and J4-09 have fixed voltage output and RC time constant and are limited to measurements up to 400 and 200 pps, respectively.

J3S Series

The **J3S-10** Joulemeter includes a 11 mm diameter Silicon detector with UV grade quartz window for spectral response from 0.2 to 1.1 µm. A three position switch allows you to select the integration time constant and voltage output that is best for your pulsed source. These are extremely sensitive Joulemeters capable of measuring energy levels from fJ to µJ and pulse widths from fs to µs.

The J3S series products are calibrated at 1.064 µm only. They can be used for relative measurements at other wavelengths between 0.2 to 1.1 µm. For absolute measurements at other wavelengths, however, the user must calibrate the J3S using the laser source of interest and a broadband, flat response device like our J4-05 or J4-09 Pyroelectric Joulemeter. Contact our Applications Engineering department for further details.

Operation

In the J3 and J4 series Joulemeter, the optical pulse energy is absorbed by the Pyroelectric detector and converted into heat, which then generates a measureable signal current (thermal effect). However, in the J3S series the photons of the optical pulse interact with the molecules of the Silicon detector, thus generating a signal current (photon effect).

In both cases this signal is then electrically integrated by the equivalent capacitance of the amplifier and yields a pulsed voltage output that is directly proportional to the actual optical pulse energy. The voltage output rises sharply to a peak and then decays exponentially in a period determined by the Joulemeters' electrical time constant (see figs. 1, 2, and 3).

Each Joulemeter probe is calibrated in V/mJ or V/nJ at 1064 nm against a NIST traceable pulse energy standard. Optional calibration wavelengths for models J3 and J4 Pyroelectric Joulemeters are 532 nm, 355 nm and 248 nm.

Damage Threshold

Our J3 and J4 series Pyroelectric Joulemeters can be damaged if they are exposed to excessive laser pulse energy (high peak power density). It is, therefore, important that you determine the energy density of your pulsed laser source before using the Joulemeter. Make sure that it does not exceed the "safe" values shown in fig. 4 for a given pulse width. If it appears to be greater than the safe level, you may consider using the appropriate attenuation accessory (see Accessories).

The damage mechanism is ablation of the front coating. For the J3-02, J3-05 and J3-09 this ablation is permanent and irreversible. The J4-05 and J4-09 have an organic black coating which damages more slowly and may not affect accuracy immediately; however, if too much of the black is removed, so that the front metallic electrode is exposed, the voltage output of the Joulemeter can be affected. These probes may be returned for recoating periodically (i.e., every 6 months).

With the J3S series Silicon Joulemeters, the issue is not physical damage but detector saturation; so we recommend that the maximum average power not exceed 50 µW.

In the case of Pyroelectric Joulemeters, we highly recommend that you use our **damage test slides** to test the laser beam for excessive energy prior to irradiating the Joulemeter. A damage test slide is provided with each J3 and J4 Series Joulemeter.

Specifications

Accurate Energy Measurements

To assure accurate, repeatable pulse energy measurements, we recommend you consider the following:

1. Calculate the maximum pulse energy and make sure it does not exceed the specified limits (see fig. 4).
2. Place a damage test slide in your laser beam, where the Joulemeter is to be used, to verify that there is no damage. Leave it in several minutes if possible. Use the chrome end for J3 probes and black end for J4 probes.
3. Take care to align your laser on the Joulemeter detector element.
4. If using the Joulemeter with a focused beam, never place the probe at the focal point, always in front or behind so that it is defocused.
5. Always use a 50 ohm termination with the J3, J4, J3S series probes. This prevents electronic ringing due to impedance mismatch.
6. Consult our Specification table for the maximum pulse width and rep rate for your specific Joulemeter. Make sure that you operate within these limits.
7. When using the J3 or J3S series Joulemeters, be sure to consult the Spectral Response curves (see fig. 6) for the appropriate voltage responsivity factor. The J4 series probes are spectrally flat and should be used as the standard.
8. For the most accurate energy readings, always use these Joulemeter probes with our peak reading Voltmeter/Joulemeter instruments.

J3-SERIES ***J3S-SERIES***	**J3-02 (Typ)**	**J3-05 (Typ)**	**J3-09 (Typ)**	**J3S-10 (Typ)**	**UNITS J3S in parentheses**	**CONDITIONS**
Voltage Responsivity						
1k,I	15	2.5	1	1.0	V/mJ (V/nJ)	λ = 1.064 μm
L	0.15	0.025	0.01	0.01	V/mJ (V/nJ)	R_L = 50Ω
Electrical Decay Time (RC Time Constant)						
1k	0.05	0.05	0.05	0.05	msec	
I	0.5	0.5	0.5	0.5	msec	
L	2.5	2.5	2.5	2.5	msec	
Noise Equivalent Energy						
1k,I	3.0	15	35	20.0	nJ(fJ)	BW = 10kHz
L	150	750	3500	2000	nJ(fJ)	λ = 1.064 μm
Maximum Rep Rate						with...
1k	20 k	20 k	20 k	20 k	pps	oscilloscope
	1200	1200	1200	1200	pps	EPM1000/2000
I	400	400	400	400	pps	
L	80	80	80	80	pps	
Maximum Pulse Width (for calibrated response)						
1k	5	5	5	5	μsec	10% RC
I	50	20	20	50	μsec	10% RC
L	250	250	250	250	μsec	10% RC
Linearity	0.2	0.2	0.2	0.2	%	V_0<2V
Max. Voltage Output	4.5	4.5	4.5	4.5	V	R_L = 50Ω
Max. Avergage Power	1	2	2	50	W (μW)	
Calibration Uncertainty						
0.19 to 20.0 μm	±7	±7	±7		%	
0.19 to 1.10 μm	±5	±5	±5	±10	%	

J4-SERIES	**J4-05 (Typ)**	**J4-09 (Typ)**	**UNITS**	**CONDITIONS**
Voltage Responsivity	3.0	0.8	V/mJ	λ = 1.064 μm R_L = 50Ω
Electrical Decay Time (RC Time Constant)	2.0	2.0	msec	
Noise Equivalent Energy	15	35	nJ	BW = 10kHz λ = 1.064 μm
Maximum Rep Rate	400	200	pps	R_L = 50Ω
Maximum Pulse Width (for calibrated response)	50	100	μsec	
Linearity	0.2	0.2	%	V_0<2V
Max. Voltage Output	4.5	4.5	V	R_L = 50Ω
Max. Avergage Power	2	2	W	
Calibration Uncertainty 0.19 to 20.0 μm	±5	±5	%	

J3/J4/J3S Series
Pyroelectric/Silicon Joulemeter

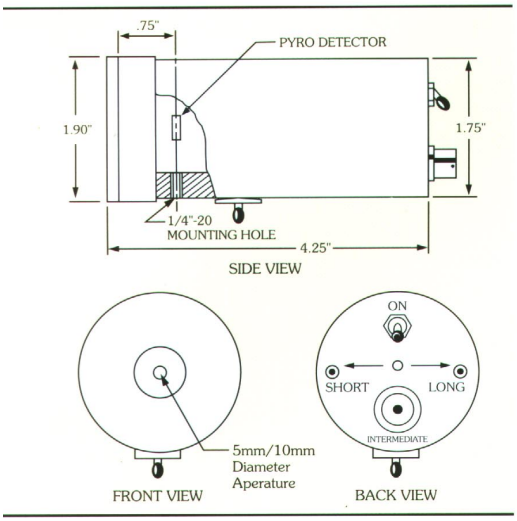


Figure 5. Mechanical detail of J3 and J3S. J4 is very similar.

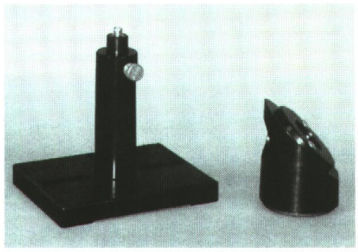


Figure 6. Accessories for J3, J4 and J3S include PSS post and stand (one included with each probe) and JS25Q Quartz beamsplitter.

Options

There are several options that may be of interest to you. These are intended to help solve your energy measurement problems. They are as follows:

DC Power – At your request, we can replace the internal battery and on/off switch with a power cable, allowing you to power the amplifier from an external DC voltage supply.

Calibration – In addition to our standard calibration, we are happy to offer NIST traceable calibration at several other wavelengths including 532 nm, 355 nm and 248 nm. Please contact our Applications Engineering department for technical details.

Custom OEM Joulemeters – If you need a small Joulemeter for a system application, talk to us about our special J9-119A. It consists of a 5 mm diameter detector on a small (0.5 x 2.0 inch) preamplifier circuit board and includes power and signal cables. Its performance is similar to the J3-05.

Call our Sales Engineers to discuss your specific needs.

Accessories

We offer a variety of optical accessories for these Joulemeter probes. They are as follows:

DW9 – 9 mm dia. UV 0.2 to 3.0 μm Quartz Diffuser.

JS25Q – 25 mm dia. 8% UV Quartz Beamsplitter which mounts onto the J3, J4, and J3S Joulemeter.

JW25 – 25 mm dia. Wedged UV Quartz Beamsplitter with bench mount holder.

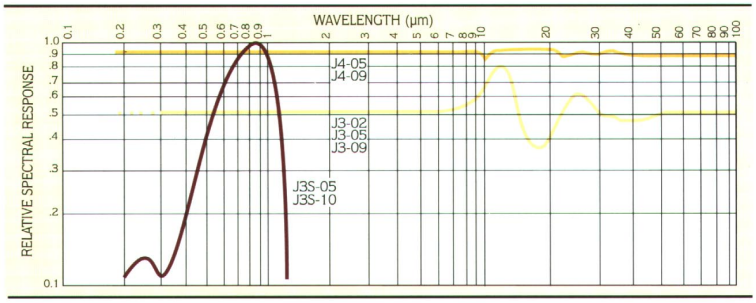


Figure 7. Relative spectral response of J3, J4 and J3S. (Dashed line indicates uncalibrated portion of spectral curve.)

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