SCIENTECH®

100mm and 200mm Calorimeters

Setup and Operating Procedures

PN11434C

Thank you for choosing a Scientech large aperture calorimeter. Scientech, an ISO 9001 registered company, and our employees are pleased to provide you with a product designed for years of reliable service. Please read this manual completely before using your calorimeter. This information will enable you to fully utilize the equipment and should be located nearby for reference. The calorimeter is intended to be used only in the manner outlined in this manual. Misuse of the equipment may cause product failure.

The words "calorimeter" and "detector" are synonymous as used in this manual.

Table of Contents:

CALORIMETER OPERATING PARAMETERS:

Calorimeter 1:

Model No:	_____
Serial No:	_____
Calibration Wavelength	_____nm
Output Sensitivity (S):	_____V/W
Time Constant (1/e):	_____sec.
Calibration Temp:	_____°C
Sub. Heater Resistance (R_c):	_____ohms
Sub. Heater Voltage (V_h):	_____volts
Sub. Heater Wattage (W_h)	_____watts

LARGE APERTURE CALORIMETER SPECIFICATIONS:

Model	**360401**	**380401**	**380402**	**384UV5**	**360801**	**380801**	**380802**	**384UV5**
Type of Absorber	Surface	Volume	Volume	Volume	Surface	Volume*	Volume	Volume
Aperture Diameter	100mm				200mm			
Minimum Beam Diameter	5cm				7.5cm			
Spectral Response	.25 - 35µm	.266 - 1.2µm	9 -11µm	.193 - .36µm	.25 - 35µm	.266 - 1.2µm	9 -11µm	.193 - .36µm
Maximum Average Power	50W with full illumination of absorbing surface				100W with full illumination of absorbing surface			
Minimum Average Power	150mW				700mW			
Noise Level	1.5mJ - mW				7mJ - mW			
Maximum Power Density	200W/cm²	See Note 1	4W/cm²	Note 2	200W/cm²	See Note 3	4W/cm²	Note 2
Maximum Peak Power Density	1MW/cm²	See Note 4	100MW/cm²	See Note 5	1MW/cm²	See Note 6	100MW/cm²	See Note 5
Maximum Single Pulse Energy	150J				300J			
Maximum Energy Density	Note 7	Note 8	4J/cm^2	Note 9	Note 7	Note 10	4J/cm^2	Note 9
Precision	< 1%							
Accuracy	5%							
Response Time	5 sec when connected to a Scientech Indicator in Watts Mode							
Dimensions DxL - inches/cm	6.00 x 8.00/15.24 x 20.32				9.00 x 10.00/22.86 x 25.40			
Weight - pounds/kgs	6/2.72				16.27/7.26			
Indicator Compatibility	H410, H410D, S310, S310D							

* This is a segmented absorber

Note 1: 380401 — 27W/cm^2 @ 1064 nm, 21W/cm^2 @ 532 nm, 7.7W/cm^2 @ 355 nm, 158mW/cm^2 @ 266nm

Note 2: 384UV5, 388UV5 — 50W/cm^2 @ 355nm

Note 3: 380801 — 13.5W/cm^2 @ 1064 nm, 10.5W/cm^2 @ 532 nm, 3.85W/cm^2 @ 355 nm, 79mW/cm^2 @ 266nm

Note 4: 380401 — 90GW/cm^2 @ 1064 nm, 71GW/cm^2 @ 532 nm, 27GW/cm^2 @ 355 nm, 530MW/cm^2 @ 266nm

Note 5: 384UV5, 388UV5 — Repetitive pulses: 101MW/cm^2 @ 355nm
Single pulses: 3.5GW/cm^2 @ 355nm

Note 6: 380801 — 45GW/cm^2 @ 1064 nm, 35.5GW/cm^2 @ 532 nm, 13.5GW/cm^2 @ 355 nm, 265MW/cm^2 @ 266nm

Note 7: 360401, 360801 — Max J/cm^2 = 1000 x (pulse width)$^{1/2}$ to a maximum of 200J/cm^2

Note 8: 380401 — Repetitive pulses:
3.7J/cm^2 @ 1064nm, 2.9J/cm^2 @ 532nm, 1J/cm^2 @ 355nm, 20mJ/cm^2 @ 266nm
Single pulses:
7J/cm^2 @ 1064nm, 5.6J/cm^2 @ 532nm, 2.1J/cm^2 @ 355nm, 41mJ/cm^2 @ 266nm

Note 9: 384UV5, 388UV5 — Repetitive pulses: 1.1J/cm^2 @ 355nm
Single pulses: 40J/cm2 @ 355nm

Note 10: 38-0801 — Repetitive pulses:
1.85J/cm^2 @ 1064nm, 1.45J/cm^2 @ 532nm, 0.5J/cm^2 @ 355nm, 10mJ/cm^2 @ 266nm
Single pulses:
3.5J/cm^2 @ 1064nm, 2.8J/cm^2 @ 532nm, 1.05J/cm^2 @ 355nm, 20.5mJ/cm^2 @ 266nm

CE MARK CERTIFICATION:

All of the calorimeters listed in this manual have been certified for the European CE mark.

ENVIRONMENTAL REQUIREMENTS:

This product is intended for indoor use at altitudes up to 2000 meters, Pollution Degree 2 in accordance with IEC 664 and transient overvoltages according to Installation Categories (Overvoltage Categories) II. Note that each of the above detectors will not pass the IEC 801 Publication, Part 3, Radiated Electromagnetic Field Requirements. The system, meter and detector, is designed to measure radiation within the test's radiation band. The detectors were held outside the radiated electromagnetic field during this test. It is up to the user to be aware of RF fields present during measurements and their effects if any on those measurements.

UNPACKING AND SET UP:

The calorimeter and accessories are shipped in custom packing materials. All packing materials should be saved for future damage free shipments.

A ¾" diameter mounting post is included. Screw the post into the mounting hole in the body of the calorimeter. Mount the post to your optical bench or working surface.

If you are using a Scientech indicator, connect the calorimeter to the interface module and the interface module to the indicator. Follow the detailed set up instructions that are in the indicator's instruction manual. If you are not using a Scientech indicator operating requirements are contained in this manual.

Note: Large aperture calorimeters are sensitive to all types of thermal input. Due to the handling of the calorimeter during setup and possible environmental temperature differences, thermal gradients may exist in the calorimeter. Allow the calorimeter to sit undisturbed for several minutes to, reach thermal equilibrium, before using.

CABLE REQUIREMENTS:

Refer to Figure 1. The output of the calorimeter is connected directly to the DVM or chart recorder. Large aperture calorimeters do not require any power. The voltage output is on pin 1 of the DIN connector and should be connected to the positive side of the DVM or chart recorder. Ground is on pin 3 and should be connected to the negative side. Pin 2 is not used.

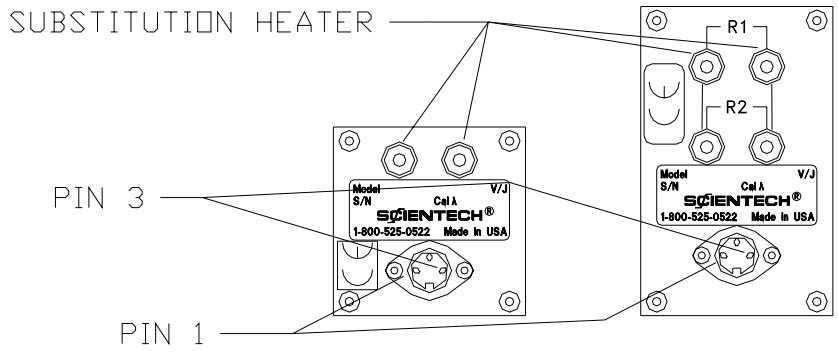


Figure 1 – 100mm and 200mm connectors

CALORIMETER OPERATION WITHOUT AN INDICATOR:

Note: Whenever a large aperture calorimeter is used without an indicator the interface module, which is required to connect the calorimeter to the indicator, is not used.

Operation of Large Aperture Calorimeters with a Digital Volt Meter:

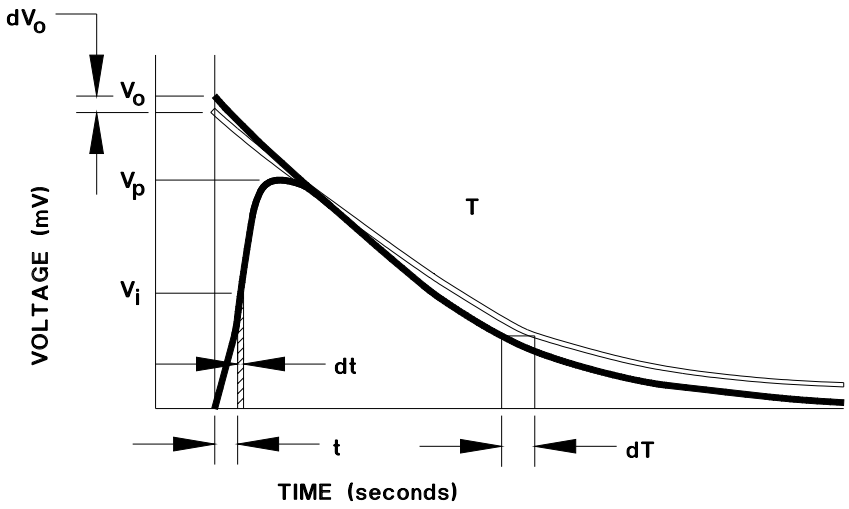
The calorimeters may be used with any digital volt meter (DVM) capable of reading 5 volts full scale.

A. Refer to Figure 1. Connect the output of the calorimeter to the DVM.
B. Select the DC volts mode.
C. Direct the laser beam on to the absorbing surface of the calorimeter.
D. When the display of the DVM has stabilized (about 2 minutes), calculate the laser power using the formula: W = V/S
   where:
   W = Laser power in watts
   V = Voltage reading of the DVM in volts
   S = Sensitivity of the calorimeter from page 2.

Operation of Large Aperture Calorimeters with an Analog Chart Recorder:

Calorimeter Response:

The response of a calorimeter to a single pulse input as displayed by a chart recorder appears below.



The output voltage from a chart recorder can be converted to wattage at any time by:

$$W = V/S,\ W_i = V_i/S$$

V = Chart recorder voltage level in mV
S = Calorimeter sensitivity in mV/W

The total energy (E) in the pulse can be found by integrating the instantaneous wattage over time:

$$E = \int_0^{\infty} W(t)\, dt$$

The following methods may be used to compute the total integrated energy:

Numerical Integration:

Finding the area under the curve in figure 7 is the equivalent procedure for determining pulse energy. Choose an appropriate time interval, dt, and perform the summation:

$$E = \sum_{I=1}^{N} W_i x dt = (dt/S) \sum_{i=1}^{N} V_i$$

The error caused by this procedure is:

$$dE = (dt/S) \sum_{i=1}^{N} dV_i$$

The error, in theory, is only dependent upon the value of $\sum dV_i$, that is the cumulative random error of V_i. This number should approach zero if data is carefully taken. The accuracy is also increased if the time interval, dt, is minimized. Numerical integration can yield accurate results, but is a tedious task.

Initial Voltage Interpolation:

A method used to eliminate the tedious numerical integration task is to project the thermal decay envelope on to the voltage axis, determine the 1/e decay time constant T, and estimate the total energy value (E):

$E = (V_o/S) \times T$

The change from thermal absorption to thermal transport phenomena near the peak causes difficulty in accurately projecting the envelope on to the voltage axis introducing an error, dV_o. Further, the determination of the time constant T, introduces another error, dT. The total error is the sum of the two errors.

$dE = (V_o/S)dT + (T/S)dV_o$

The difficulty in eliminating the potential error makes this method typically less accurate than numerical integration, but much faster in application.

Peak Voltage Estimate:

The peak voltage method requires using an independent determination of total energy and referencing it back to the peak voltage value, V_p.

For a given pulse, use the numerical integration method to obtain E. Note the peak voltage, V_p. Compute the value, F

$F = E/V_p$

For the next pulse compute the total energy: $E = F \times V_p$

The error in using this method yields: $dE = FdV_p + V_pdF$

The accuracy of this measurement depends upon the error in the original calibration, dF, and the error in the peak voltage dV_p. A careful numerical integration yields a value for dF near zero. The value of dV_p can be minimized by maintaining the geometry of the system (i.e. beam intensity, beam profile, wavelength and environment) during operation to be the same as during calibration. Under controlled circumstances, the peak method accuracy usually falls between the numerical integration and initial voltage interpolation methods.

Calibration of Large Aperture Calorimeters:

A. Refer to Figure 1. Connect a DVM to the white jacks of the calorimeter.
B. Measure the resistance of the substitution heater making sure to subtract the resistance of the patch cables from the total resistance measurement.
   Note: When measuring the substitution heater resistance of a 200 mm calorimeter, R1 and R2 must be connected together in series.
   Compare this resistance to R_C in the calibration data in the front of the manual. The two should agree within 2%. If not, contact Scientech.
C. Calculate the voltage equivalent to laser power using the following formula:
   $V = (R_c \times C \times W)^{1/2}$
   where:
   V = voltage applied to the heater coil
   R_c = substitution heater resistance from step B
   C = Cal coefficient

360401 = 1.018	360801 = 1.000
380401 = 0.974	380801 = 1.008
380402 = 1.024	380802 = 1.008
384UV5 = 1.021	388UV5 = 1.002

   W = desired laser power in watts
D. Connect the DVM to the calorimeter's DIN connector.
E. Apply the calculated voltage (V) to the electrical substitution heater.

F. Record the voltage reading of the DVM (V_c).
G. Calculate the calorimeter's output sensitivity (S) as follows:

$$S = V_c/W$$

where:

S = calorimeter's output sensitivity
V_c = voltage output from the calorimeter in mV
W = desired laser power output.

The measured sensitivity should be ± 3 % of the calorimeters original sensitivity value.

FACTORY RECALIBRATION:

Scientech recommends that a complete calibration be performed annually to verify system accuracy. Please contact our Product Service Department at (800)525-0522 or (303)444-1361 or Fax (303)444-9229 or email inst@scientech-inc.com to arrange for a NIST traceable, factory calibration.

LIMITED WARRANTY:

All Scientech Laser Power and Energy Measurement Systems are warranted against defects in materials and workmanship for two (2) years from date of delivery. During the warranty period, Scientech will repair, or at its option replace at no charge, components that prove to be defective. The equipment must be returned, shipping prepaid, to Scientech's product service facility. This limited warranty does not apply if the equipment is damaged by accident or misuse or as a result of service or modification by other than a Scientech service facility. The foregoing warranty is in lieu of all other warranties expressed or implied including but not limited to any implied warranty of merchantability, fitness, or adequacy for any special incidental or consequential damages whether in contract, tort, or otherwise.

RETURNED GOODS PROCEDURE:

Should it become necessary to return any item to Scientech for any reason, please contact our Product Service Department at (800)525-0522 or (303)444-1361 or Fax (303)444-9229 or email inst@scientech-inc.com. When you call, please be ready to provide model number, serial number, and a description of the problem. Frequently we can provide self-help information which will eliminate the need for returning the unit(s).

If equipment return is required, please pack the items in the original box and packing material. As an alternate, place the equipment in a snug-fitting box, and then pack that box in a larger box with at least four inches of packing material. Scientech does not assume responsibility for under packed items.

Please include the name and phone number of the person we should contact regarding repair questions.

Normally, products are repaired and shipped within 5 working days after their arrival at the product service facility. This is an average time and could vary depending on the workload.

Shipping Address:

Scientech, Inc.
Product Service Department
5649 Arapahoe Ave.
Boulder, Colorado 80303
U.S.A.

DISPOSAL OF ELECTRICAL AND ELECTRONIC EQUIPMENT:

Scientech, Inc. recommends the following for disposal of electrical and electronic equipment:

1. The best option is to reuse the equipment in its entirety.
2. Where the equipment can not be reused in its entirety, priority should be given to reuse of its subassemblies and components.
3. Where reuse is not appropriate, electrical and electronic equipment, including batteries, should be recycled according to local ordinances. It should never be mixed with municipal waste.