SCIENTECH®

Models S310 & S310D Laser Power and Energy Meters Setup and Operating Procedures

Serial Number_____

P/N 10190M

Thank you for choosing a Scientech laser power and energy meter. 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 indicator. This information will enable you to fully utilize the equipment and should be located nearby for reference. The indicator is intended to be used only in the manner outlined in this manual. Misuse of the equipment may cause product failure.

Note: The Models S310 and S310D are identical to each other in every respect except the analog meter. The S310 has both analog and digital displays. The S310D has only a digital display. All references to the S310 are intended to include the S310D except where noted. Also the words "indicator" and "meter" are synonymous.

DETECTOR OPERATING PARAMETERS:

Note: All detectors are calibrated at a specific wavelength and the detector's operating parameters are derived for that wavelength. This information is recorded below and on the detector's serial tag. When a detector is used at a wavelength other than the calibration wavelength some of the operating parameters may need to be adjusted. For specific instructions please refer to the Operating Procedures section for the type of detector you are using.

Calorimeter 1:

Model No:	_____	
Serial No:	_____	
Group No:	_____	
Calibration Wavelength	_____	nm or µm
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

Calorimeter 2:

Model No:	_____	
Serial No:	_____	
Group No:	_____	
Calibration Wavelength:	_____	nm or µm
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

Pyroelectric Detector 1:

Model No:	_____	
Serial No:	_____	
Group No:	_____	
Calibration Wavelength:	_____	nm or µm
Output Sensitivity:	_____	V/J or _____ V/mJ S_____ I_____ L_____
Calibration Temp:	_____	°C

Pyroelectric Detector 2:

Model No:	_____	
Serial No:	_____	
Group No:	_____	
Calibration Wavelength:	_____	nm or µm
Output Sensitivity:	_____	V/J or _____ V/mJ S_____ I_____ L_____
Calibration Temp:	_____	°C

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CE MARK CERTIFICATION:

All of the detectors listed in this manual have been certified for the European CE mark *except* for the Ultra™ Series Calorimeters. The Series consists of the models UC150, UC150UV, UC150HD, UC150HD40.

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.

VECTOR™ S310 INDICATOR SPECIFICATIONS:

Model	S310	S310D
Display	4 Digit LCD with Selectable Analog Meter Movement	4 Digit LCD
Full Scale Ranges with Astral 25mm Calorimeter	10.00 m, 100.0 m, 1.000, 10.00, AUTO (Watts only)	
Full Scale Ranges with Astral 50mm Calorimeter	300.0 m, 3.000, 30.00, AUTO (Watts only)	
Full Scale Ranges with Vector Pyroelectric Detector	3.000 m, 30.00 m, 300.0 m, 3.000, 30.00, AUTO	
Full Scale Ranges with Vector HR Pyroelectric Detector	3.000 µ*, 30.00 µ*, 300.0 µ, 3.000 m, 30.00 m, AUTO	
Full Scale Ranges with Ultra Calorimeter	150.0 Watts	
Maximum Repetition Rate with Calorimeter in Joules Mode	Calorimeter Dependent - 1 pulse every 60 to 90 seconds	
Maximum Repetition Rate with Calorimeter in Watts Mode	Unlimited	
Maximum Repetition Rate for Collecting Data in Statistics Mode with a Pyroelectric Detector	750 pps	
Response Time with Calorimeter in Joules Mode	Calorimeter Dependent - 1 to 3 seconds	
Response Time with Calorimeter in Watts Mode	Calorimeter Dependent - 3 to 10 seconds	
Response Time with Ultra Calorimeter	40 seconds	
Operation Temperature	5ºC to 40ºC	
Power Requirement	120 Volts, 60 Hz ± 10 % or 220 Volts, 50 Hz ± 10 %	
Dimensions H x W x D - inches/cm	4.68 x 8.83 x 7.83/11.89 x 22.43 x 19.89	
Weight - pounds/kgs	5/2.2	

* 3.000 µ and 30.00 µ ranges not available for long pulse setting with PHF02, PHF05 or PHF09 HR Pyroelectric detectors

ABSORPTION OF HD ABSORBING MATERIAL:

Warning: You must exercise caution when using HD detectors. They exhibit spectral reflection of between 7% and 18%, of the input power, back out of the aperture. Please refer to Figure 1 to determine the reflectance for the wavelength you are measuring. These detectors should be treated as a partial mirror or any other type of reflective optic and the appropriate caution level observed, especially at the CO_2 wavelength.

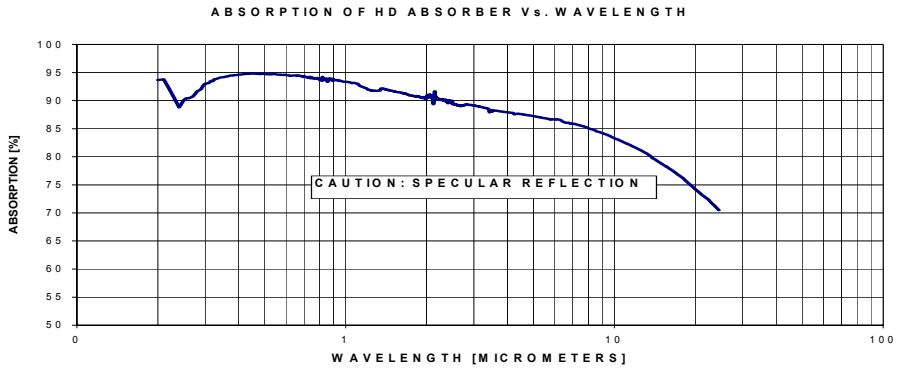


Figure 1

Note: HD detectors might show "beam" marks on the absorbing surface. These marks are characteristic of the material and do not affect the performance of the detector. Do not rub off or remove the marks. Polishing or cleaning the absorbing surface might change the performance of the pyroelectric detector.

VECTOR™ PYROELECTRIC DETECTOR SPECIFICATIONS:

Model	**P 25**	**PHF 25**	**PHD 25**	**PHDX 25**	**PHDX25UV**	**SP 25**	**SPHF 25**	**SPHD 25**
Maximum Beam Diameter	25mm	25mm	25mm	7mm	7mm	25mm	25mm	25mm
Spectral Response	.193-26µm		.193-10.6µm	.4-2µm	.193-2µm	.193-26µm		.193-10.6µm
Maximum Average Power	5 W with full illumination of the detector							
Minimum Energy	7% of selected range							
Noise Equivalent Energy	4 µJ							
Maximum Energy Density	Note 1		Note 2	Note 3	Note 4	Note 1		Note 2
Accuracy	5%	5%	8%^	8%^	8%^	5%	5%	8%^
Output Sensitivity	8 V/J	8 V/J	2 V/J	2 V/J	2 V/J	8 V/J	8 V/J	2 V/J
Maximum Repetition Rate	100 pps	400 pps	40 pps	40 pps	40 pps	100 pps	400 pps	40 pps
Maximum Pulse Duration	0.2 msec	0.045 msec	0.2 msec	0.2 msec	0.2 msec	0.2 msec	0.045 msec	0.2 msec
Dimensions D x L - inches	2.4 x 2.3	2.4 x 2.3	2.4 x 2.3	2.4 x 3.9	2.4 x 3.9	2.3x2.3x0.6	2.3x2.3x0.6	2.3x2.3x0.6
cm	6.1 x 5.8	6.1 x 5.8	6.1 x 5.8	6.1 x 9.9	6.1 x 9.9	5.8x5.8x1.4	5.8x5.8x1.4	5.8x5.8x1.4
Weight - pounds/kgs	0.9/1.4	0.9/1.4	0.9/1.4	1.1/0.5	1.1/0.5	0.3/0.14	0.3/0.14	0.3/0.14
Indicator Compatibility	H410, H410D, S310, S310D, D200PC, D200P							

Model	**P 50**	**PHF 50**	**PHD 50**	**PHDX 50**	**PHDX50UV**	**SP 50**	**SPHF 50**	**SPHD 50**
Maximum Beam Diameter	50 mm	50 mm	50 mm	15 mm	15 mm	50 mm	50 mm	50 mm
Spectral Response	.193-26µm		.193-10.6µm	.4-2µm	.193-2µm	.193-26µm		.193-10.6µm
Maximum Average Power	10 W with full illumination of the detector							
Minimum Energy	7% of selected range							
Noise Equivalent Energy	16 µJ							
Maximum Energy Density	Note 1		Note 2	Note 3	Note 4	Note 1		Note 2
Accuracy	5%	5%	8%^	8%^	8%^	5%	5%	8%^
Output Sensitivity	2 V/J							
Maximum Repetition Rate	50 pps	400 pps	20 pps	20 pps	20 pps	50 pps	400 pps	20 pps
Maximum Pulse Duration	0.4 msec	0.045 msec	0.4 msec	0.4 msec	0.4 msec	0.4 msec	0.045 msec	0.4 msec
Dimensions D x L - inches	3.5 x 2.3	3.5 x 2.3	3.5 x 2.3	3.5 x 3.9	3.5 x 3.9	3x3x0.6	3x3x0.6	3x3x0.6
cm	8.8 x 5.8	8.8 x 5.8	8.8 x 5.8	8.8 x 9.9	8.8 x 9.9	7.6x7.6x1.5	7.6x7.6x1.5	7.6x7.6x1.5
Weight - pounds/kgs	1.5/0.68	1.5/0.68	1.5/0.68	1.7/0.77	1.7/0.77	0.4/0.18	0.4/0.18	0.4/0.18
Indicator Compatibility	H410, H410D, S310, S310D, D200PC, D200P							

^Beam centered on absorber

Note 1: Max J/cm2 =316 x (pulse width)1/2

Note 2: HD models — Max J/cm^2 = 4500 x (pulse width)$^{1/2}$ to a maximum of 1.4 J/cm^2. Maximum pulse width of the pyroelectric detector must be observed.

Note 3: HDX models — Max J/cm^2 = 36,000 x (pulse width)$^{1/2}$ to a maximum of 12.6 J/cm^2. Maximum pulse width of the pyroelectric detector must be observed.

Note 4: HDXUV models — Max J/cm^2 = 18,000 x (pulse width)$^{1/2}$ to a maximum of 5.6 J/cm^2. Maximum pulse width of the pyroelectric detector must be observed.

VECTOR ™ HR PYROELECTRIC DETECTOR SPECIFICATIONS:

Model	PHF 02	PHF 05	PHF 09	P 05	P 09
Active Diameter	2 mm	5 mm	9 mm	5 mm	9 mm
Spectral Response	.193 - 26 µm				
Voltage Response				3.0 V/mJ	0.8 V/mJ
S, I	15 V/mJ	2.5 V/mJ	1 V/mJ		
L	0.15 V/mJ	0.025 V/mJ	0.01 V/mJ		
Electrical Decay Time (RC Time Constant)				2.0 msec	2.0 msec
S	0.05 msec	0.05 msec	0.05 msec		
I	0.5 msec	0.5 msec	0.5 msec		
L	2.5 msec	2.5 msec	2.5 msec		
Noise Equivalent Energy				15 nJ	35 nJ
S, I	3 nJ	15 nJ	35 nJ		
L	150 nJ	750 nJ	3500 nJ		
Minimum Energy				1.5µJ	3.5µJ
S, I	0.3µJ	1.5µJ	3.5µJ		
L	15µJ	75µJ	350µJ		
Rep Rate (max)				400 pps	200 pps
S	4000 pps	4000 pps	4000 pps		
I	400 pps	400 pps	400 pps		
L	80 pps	80 pps	80 pps		
Maximum Pulse Width (For Calibrated Response)				50 µsec	100 µsec
S	5 µsec	5 µsec	5 µsec		
I	50 µsec	50 µsec	50 µsec		
L	250 µsec	250 µsec	250 µsec		
Maximum Voltage Output	4.5 V				
Maximum Average Power	1 W	2 W	2 W	2 W	2 W
Accuracy	7%	7%	7%	5%	5%
Maximum Energy Density	Max $J/cm^2 = 316 \times (\text{pulse width})^{1/2}$				
Dimensions D x L - inches/cm	1.75 x 4.24/ 4.45 x 10.8				
Weight - pounds/kgs	0.5/0.21				
Indicator Compatibility	S310, S310D, D200PC, D200P				

ASTRAL™ CALORIMETER SPECIFICATIONS:

Model	**AC2500**	**AC25HD**	**ACX25HD**	**AC2501**	**ACX2501**	**AC25UV**	**AC2504**
Type of Absorber	Surface	Surface	Surface	Volume	Volume	Volume	Volume
Maximum Beam Diameter	25 mm	25 mm	8 mm	25 mm	8 mm	25 mm	25 mm
Spectral Response	.25-35 µm	.193-12 µm	.4-2 µm	.266-1.2 µm	.4-1.2 µm	.193-.36 µm	.85-4.2 µm
Average Power Maximum	10 W						
Average Power Minimum	1 mW when installed in an Isoperibol Enclosure						
Noise Level	10 µW or µJ						
Maximum Power Density	200 W/cm²	1.5 kW/cm²	12 kW/cm²	Note 1	Note 2	Note 3	Note 4
Maximum Peak Power Density	1 MW/cm²	100 MW/cm²	800 MW/cm²	Note 5	8.5 GW/cm²	Note 6	Note 7
Maximum Single Pulse Energy	10 J						
Maximum Energy Density	Note 8	Note 9	Note 10	Note 11	Note 12	Note 13	Note 14
Precision	< 1 %						
Accuracy	± 3 %						
Response Time	3 sec when connected to a Scientech Indicator in Watts Mode						
Dimensions DxL - inches	3.75 x 2.2	3.75 x 2.2	3.75 x 3.82	3.75 x 2.2	3.75 x 3.82	3.75 x 2.2	3.75 x 2.2
cm	9.53 x 5.6	9.53 x 5.6	9.53 x 9.7	9.53 x 5.6	9.53 x 9.7	9.53 x 5.6	9.53 x 5.6
Weight - pounds/kg	1.5/0.68	1.5/0.68	1.7/0.77	1.5/0.68	1.7/0.77	1.5/0.68	1.5/0.68
Indicator Compatibility	H410, H410D, S310, S310D, D200PC, D200C						

Model	**AC5000**	**AC50HD**	**ACX50HD**	**AC5001**	**ACX5001**	**AC50UV**	**AC5004**
Type Absorber	Surface	Surface	Surface	Volume	Volume	Volume	Volume
Maximum Beam Diameter	50 mm	50 mm	16 mm	50 mm	16 mm	50 mm	50 mm
Spectral Response	.25-35 µm	.193-12 µm	.4-2 µm	.266-1.2 µm	.4-1.2 µm	.193-.36 µm	.85-4.2 µm
Average Power Maximum	30 W						
Average Power Minimum	40 mW						
Noise Level	400 µW or µJ						
Maximum Power Density	200 W/cm²	1.5 kW/cm²	12 kW/cm²	Note 1	Note 2	Note 3	Note 4
Maximum Peak Power Density	1 MW/cm²	100 MW/cm²	800 MW/cm²	Note 5	8.5 GW/cm²	Note 6	Note 7
Maximum Single Pulse Energy	30 J						
Maximum Energy Density	Note 8	Note 9	Note 10	Note 11	Note 12	Note 13	Note 14
Precision	< 1 %						
Accuracy	± 3 %						
Response Time	3 sec when connected to a Scientech Indicator in Watts Mode						
Dimensions DxL - inches	4.75 x 2.3	4.75 x 2.3	4.75 x 3.92	4.75 x 2.3	4.75 x 3.92	4.75 x 2.3	4.75 x 2.3
cm	12.07 x 5.8	12.07 x 5.8	12.07 x 9.96	12.07 x 5.8	12.07 x 9.96	12.07 x 5.8	12.07 x 5.8
Weight pounds/kgs	2.9/1.3	2.9/1.3	3.1/1.4	2.9/1.3	3.1/1.4	2.9/1.3	2.9/1.3
Indicator Compatibility	H410, H410D, S310, S310D, D200PC, D200C						

Note 1: AC2501, AC5001 — 30W/cm^2 @ 1064nm, 23W/cm^2 @ 532nm, 8.5W/cm^2 @ 355nm, 175mW/cm^2 @ 266nm

Note 2: ACX2501, ACX5001 — Note 1 specs x 8 for 400nm to 1.2µm

Note 3: AC25UV, AC50UV — 50W/cm^2 @ 355nm

Note 4: AC2504, AC5004 — 35W/cm^2 @1064nm

Note 5: AC2501, AC5001 — 100GW/cm^2 @ 1064nm, 78GW/cm^2 @532nm, 29GW/cm^2 @ 355nm, 580MW/cm^2 @266nm

Note 6: AC25UV, AC50UV — Repetitive pulses: 101MW/cm^2 @ 355nm
Single pulses: 3.5GW/cm2 @ 355nm

Note 7: AC2504, AC5004 — 125GW/cm^2 @ 1064nm

Note 8: AC2500, AC5000 — Max J/cm^2 = 1,000 x (pulse width)$^{1/2}$ to a maximum of 200J/cm^2.

Note 9: AC25HD, AC50HD — Max J/cm^2 = 4,500 x (pulse width)$^{1/2}$ to a maximum of 14J/cm^2.

Note 10: ACX25HD, ACX50HD — Max J/cm^2 = 36,000 x (pulse width)$^{1/2}$ to a maximum of 42.5J/cm^2.

Note 11: AC2501, AC5001 — Repetitive pulses: 4.1J/cm^2@1064nm, 3.2J/cm^2@532nm, 1.2J/cm^2@355nm, 24mJ/cm^2@266nm
Single pulses: 8J/cm^2@1064nm, 6.2J/cm^2@532nm, 2.3J/cm^2@355nm, 46mJ/cm^2@266nm

Note 12: ACX2501, ACX5001 — Note 11 specs x 8 for 400nm to 1.2µm

Note 13: AC25UV, AC50UV — Repetitive pulses: 1.1J/cm^2 @ 355nm
Single pulses: 40J/cm2 @ 355nm

Note 14: AC2504, AC5004 — Repetitive pulses: 4.8J/cm^2 @ 1064nm
Single pulses: 10J/cm2 @ 1064nm

LARGE APERTURE (100MM & 200MM) 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

ULTRA™ CALORIMETER SPECIFICATIONS:

Model	UC150	UC150HD	UC150HD40	UC150UV
Type of Absorber	Surface	Surface	Surface	Volume
Maximum Beam Diameter	25mm	25mm	40mm x 40mm	25mm
Spectral Response	.25 - 35µm	.193 - 12µm	.193 - 12µm	.193 - .36µm
Maximum Average Power	150Watts			
Minimum Average Power	10Watts			
Noise Level	0.1Watts			
Maximum Power Density	200W/cm^2	1.5kW/cm^2	1.5kW/cm^2	50W/cm^2 @ 355nm
Maximum Peak Power Density	1MW/cm^2	100MW/cm^2	100MW/cm^2	101MW/cm^2 @ 355nm
Maximum Energy Density	Note 1	Note 2	Note 2	Note 3
Precision	< 1 %			
Accuracy	± 5 %			
Pesponse Time	40 seconds when connected to a Scienetch Indicator			
Dimensions H x W x D - inches/cm	4.9 x 3.4 x 4.0/12.5 x 8.6 x 10.2			
Weight - pounds/kgs	2.7/1.2			
Indicator Compatibility	S310, S310D			

Note 1: UC150 Maximum J/cm^2 = 1000 x (pulse width)$^{1/2}$ to a maximum of 200J/cm^2

Note 2: UC150HD, UC150HD40 Maximum J/cm^2 = 4500 x (pulse width)$^{1/2}$ to a maximum of 14J/cm^2

Note 3: UC150UV Repetitive pulses: 1.1J/cm^2 @ 355nm

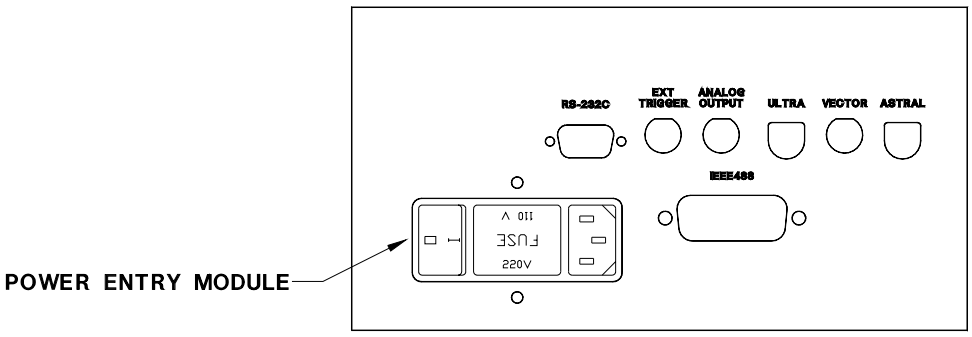
Single pulses: 40J/cm^2 @ 355nm

UNPACKING:

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

Before making any connections, verify that the power (VAC) requirement shown on the power entry module is compatible with the actual AC power outlet to which the indicator will be connected. To change the indicator's voltage, proceed as follows:

1. Refer to Figure 2. Locate the power entry module and the fuseholder in the center of the module.
2. Remove the fuseholder by inserting a slotted screwdriver in the slot on the right side and prying it out.
3. Slide the voltage selector out, flip it over and re-insert it into the fuseholder.
4. Re-insert the fuseholder into the power entry module.



S310 Rear Panel – Figure 2

QUICK SETUP:

Note: For detailed instructions for each type of detector, refer to the Operating Procedures section.

1. Turn On the Meter:

Note: For the most accurate measurements possible, the S310 should be turned on and warmed up for 30 minutes.

Note: For information on Group Settings, refer to the Group Settings section.

Press the ON switch located in the rear panel of the meter. The S310 will immediately turn on with its operational state based on the last used detector Group Setting. If you purchased the S310 with one detector, this detector's Group settings will be active and you are ready to take measurements.

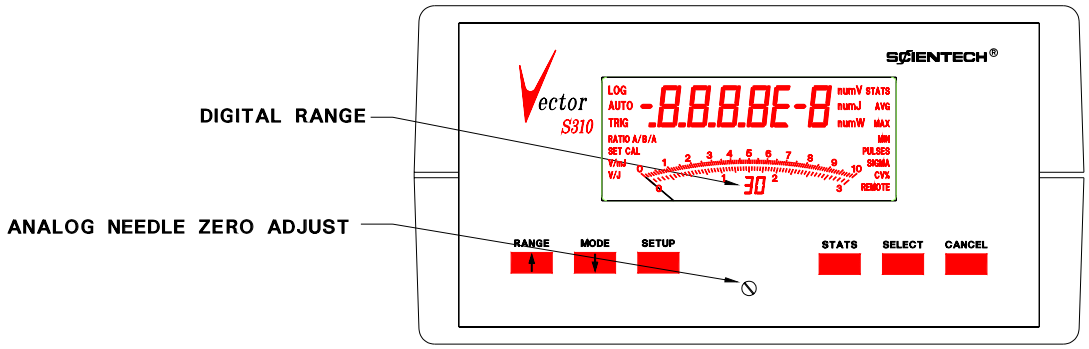
If you purchased more than one detector with the S310, you must choose the Group setting for the detector you are connecting to the S310 in step 4. The Group Setting for each detector purchased with your S310 is shown on page 2. To select a Group Setting, press the SETUP button repeatedly until the desire Group number appears in the display. Wait 3 seconds and that Group will be automatically selected and made active.

2. Turn the Analog Needle On or Off (does not apply to the S310D):

To turn the analog meter on or off, press and keep holding down the RANGE button. Then release the button after the meter appears or disappears.

3. Zero the Analog Needle (does not apply to the S310D):

Refer to Figure 3. The black slotted button located just below the display allows screwdriver adjustment to set the analog needle to zero. This adjustment should be made before connecting the detector.



S310 Front Panel – Figure 3

4. Connect a Detector:

Note: Only one detector should be plugged in at any time.

Refer to the drawing of the S310 rear panel in Figure 1. A 3 meter mini-DIN type cable with "D" shaped connectors comes with Astral, Large Aperture and Ultra calorimeters. A 3 meter BNC type cable comes with Vector pyroelectric detectors and Vector HR pyroelectric detectors. The input jacks on the rear panel of the S310 are labeled "Ultra", "Vector", and "Astral (including large aperture calorimeters)" for hook up of these three types of detectors. Note that the flat side of the DIN type cables should be oriented up when plugging into the S310. Also included with each detector is a 1/2" diameter mounting post for installing the detector to your working surface. An optional mounting base, Scientech Model 301-019, is also available for holding the detector/post assembly upright.

5. Select a Range:

On the first press of the RANGE button, the analog scale (if active) will disappear. Then briefly press the RANGE button each time another range is desired. Press the SELECT button when the range you desire appears in the display (failure to press the SELECT button within 3 seconds will activate the range shown in the display and return the S310 to its operation state).

6. Select a Mode:

The MODE button allows selection of the type of measurement to be made (watts, joules, etc). It also gives access to the scientific notation unit of measure. The different measurement modes available are:

When configured for a pyroelectric detector: Energy (J), Avg. Energy (J AVG), Power (W AVG), and Volts (V).
When configured for a calorimeter: Power (W AVG), Energy (J).
When configured for Ultra detector: Power (W) only.

Briefly press the MODE button each time a different mode setting is wanted. Press the SELECT button when the mode you desire appears in the display (failure to press the SELECT button within 3 seconds will activate the mode shown in the display and return the S310 to its operation state).

To select the scientific notation annunciator, press and hold down the MODE button and only release when the annunciator appears. To exit the scientific notation mode, press and hold down the MODE button again.

7. Zero the Display (only for calorimeters with Watts mode selected):

Press the CANCEL button to zero the display when using a calorimeter in watts mode.

8. Take your measurement:

Direct the laser beam onto the absorbing surface of the detector.

GROUP SETTINGS:

The operating parameters for the detectors used with the S310 indicator must be stored in the indicator's memory. This information is stored in Group Settings. The typical configuration of the Group Settings is as follows:

Group #1 – Astral Calorimeters or Large Aperture Calorimeters
Group #2 – Vector Pyroelectric Detectors
Group #3 – Vector HR Pyroelectric Detectors
Group #4 – Ultra Calorimeters

However, the Group Settings may be configured differently depending on what detectors are used with the indicator. The operating parameters and group number for the detectors purchased with the S310 Indicator are recorded on page 2 of this manual.

1. To Select a Group:

A. Press the SETUP button. The Group Setting last used will appear in the display.

B. To move to the next Group, press SETUP button again.

C. To select a Group, press the SELECT button when the Group you desire appears in the display (failure to press the SELECT button within 3 seconds will activate the Group shown in the display and return the S310 to its operational state).

2. Group Settings for Astral™ or Large Aperture Calorimeters:

Note: The factory default Group for Astral or Large Aperture Calorimeters is Group #1.

Note: Pressing the CANCEL button at any time during this process will terminate this process with no changes made.

Note: Holding down the SELECT button for 3 seconds at any time during this process will save any changes made up to that point and return the S310 to its operational state for the Group selected.

To review, change, or setup a Group Setting for Astral or Large Aperture calorimeters, proceed as follows:

A. Press the SETUP button. The Group Setting last used will appear in the display.

B. To move to the next Group, press SETUP button again.

C. To select a Group, press the SELECT button when the Group you desire appears in the display (failure to press the SELECT button within 3 seconds will activate the Group shown in the display and return the S310 to its operational state).

D. Press the SETUP button until the calorimeter annunciator "CAL" appears in the display. Press the SELECT button to activate the calorimeter configuration program.

E. The "tc" (time constant) annunciator now appears in the display. The time constant is a measure of the length of time the calorimeter takes to respond to a laser beam.

Press the count up (RANGE) and count down (MODE) buttons to change the number in the display to match the time constant number listed on the serial tag of your Astral calorimeter or interface module for large aperture calorimeters. Press the SELECT button to enter the time constant value to memory.

F. The "SP" (speed) annunciator now appears in the display. The speed setting allows you to control the indicator's display rate. The best value will cause a slight overshoot then a quick settling on the final value. Too high of a setting will cause the display to overshoot then slowly drift back down to the final value. A slow setting will cause the display to slowly count up to the final value.

Press the count up (RANGE) button to speed up or count down (MODE) button to slow down the response time of the meter. Press the SELECT button when the desired number appears in the display. The following settings can be fine tuned to your preference of speed versus overshoot. We recommend these initial settings:

AC2500, AC25HD, ACX25HD	103.0
AC2501, ACX2501, AC25UV, AC2504	136.0
AC5000, AC50HD, ACX50HD	100.0
AC5001, ACX5001, AC50UV, AC5004	120.0
360401 with interface module	150.0
380401, 380402, 384UV5 with interface module	245.0
360801 with interface module	170.0
380801, 380802, 388UV5 with interface module	280.0

G. The "Cd" (calorimeter delay) annunciator now appears in the display. The calorimeter delay feature prohibits the display of energy if a pulse is fired before the entered time (1 to 255 seconds) elapses. The calorimeter must reach environmental thermal equilibrium before a subsequent pulse is fired or low energy measurements will occur.

To set the time delay between pulses use the count up (RANGE) and count down buttons (MODE) buttons to enter the time in seconds. Press the SELECT button after the time has been entered to save the setting. The following time delays are recommended:

AC2500, AC25HD	60 seconds
AC2501, AC25HD, AC2504	60 seconds
AC5000, AC50HD	90 seconds
AC5001, AC50UV, AC5004	90 seconds
360401 with interface module	105 seconds
380401, 380402, 384UV5 with interface module	180 seconds
360801 with interface module	125 seconds
380801, 380802, 388UV5 with interface module	200 seconds

H. The "At" (attenuation) annunciator now appears in the display. If no attenuator is being used in conjunction with the calorimeter, the attenuation factor in the display must be set at 1.000 since this value is a display multiplier. Attenuation multipliers from .0001 to 9999 can be entered into the displayed value.

The attenuation factors of optics can be entered into the S310 so the displayed value will automatically compensate for the amount of attenuation. For example, assume a beam splitter is being used that transmits 75% and reflects 25% of the beam. If the S310 is set up to measure the reflected beam the attenuation could be set up as follows:

- An attenuation factor of 1 would display the value of the reflected beam.
- An attenuation factor of 3 would display the value of the transmitted beam.
- An attenuation factor of 4 would display the value of the source.

Use the count up (RANGE), count down (MODE) buttons to change the attenuation factor. Press the SELECT button to enter the attenuation factor to memory.

I. If The S310 has the optional IEEE488 interface, the REMOTE annunciator will appear along with the digital interface previously selected; r232 (RS232) or IEEE (IEEE488). Press the SETUP button to toggle the interface between r232 (RS232) and IEEE (IEEE488). Press the SELECT button when the desired interface appears in the display.

J. If the optional IEEE488 interface was not installed, the "br" (baud rate) annunciator for setting up the RS232 interface appears in the display along with the baud rate previously selected. To change the baud rate press SETUP button until the desired baud rate appears in the display. One of the following baud rates can be selected: 300, 1200, 2400, 9600, and 19,200. When the preferred baud rate appears in the display press the SELECT button.

K. The "PA" (parity) annunciator now appears in the display. Press the SETUP button to select none, even, or odd parity. Press the SELECT button to enter the parity of choice to memory

L. The "HS" (handshake) annunciator now appears in the display. Press the SETUP button until your choice of none (nOnE), on/off (onoF), or clear to send (CtS) appears in the display. Press the SELECT button when your choice is displayed to enter the handshake to memory.

M. If IEEE488 has been selected, the "bA" (bus address) annunciator appears with the default bus address. Bus addresses from 0 to 30 may be selected by pressing the count up (RANGE) count down (MODE) buttons followed by the SELECT button. Once the remote interface has been setup, the group annunciator will appear. Press the SELECT button or simply wait a few seconds and the group will automatically be selected for operation.

3. Group Settings for Vector™ Pyroelectric Detectors and Vector™ HR Pyroelectric Detectors:

Note: The factory default Group for Vector Pyroelectric Detectors is Group #2.
Note: The factory default Group for Vector HR Pyroelectric Detectors is Group #3.
Note: Pressing the CANCEL button at any time during this process will terminate this process with no changes made.
Note: Holding down the SELECT button for 3 seconds at any time during this process will save any changes made up to that point and return the S310 to its operational state for the Group selected.
Note: If you want to use the transfer calibration function, you must select the watts mode prior to entering the Group configuration program.

To review, change, or setup a Group Setting for Vector Pyroelectric or Vector HR Pyroelectric detectors, proceed as follows:

A. Press the SETUP button. The Group Setting last used will appear in the display.

B. To move to the next Group, press SETUP button again.

C. To select a Group, press the SELECT button when the Group you desire appears in the display (failure to press the SELECT button within 3 seconds will activate the Group shown in the display and return the S310 to its operational state).

D. Press the SETUP button until the "PYro" annunciator appears. Immediately press the SELECT button to select the pyroelectric detector configuration program.

E. Either the "V/J" annunciator or the "V/mJ" annunciator and a detector sensitivity number will appear in the display. V/J is used for standard pyroelectric detectors. V/mJ is used only for HR pyroelectric detectors. Press the SETUP button to toggle between the V/J and V/mJ entries. The output sensitivity of the pyroelectric detector in V/J or V/mJ is listed on the serial tag of your detector. Use the count up (RANGE) and count down (MODE) buttons to enter the V/J or V/mJ value. Press the SELECT button to enter the value to memory. Do not push the SELECT button before entering the sensitivity number as this takes you to the next setup step without the proper sensitivity number.

F. The "SP" (speed) annunciator now appears in the display. Press the SETUP button to toggle between bL (black or HD coated detectors) or hF (high frequency) detector. If the detector Model No. includes the letters “HF”, press the SELECT button when the hF annunciator appears in the display. If the detector’s surface is black (does not have the letters “HF” in the Model No.) press the SELECT button when the "bL" annunciator appears in the display.

G. The "AUTO, SET CAL" annunciators now appear in the display ***(only if watts mode was selected prior to group configuration)***. This is the Transfer Calibration function. The Transfer Calibration function is designed to transfer the calibration from a NIST certified calorimeter to a Vector pyroelectric detector. This function allows you to adjust the output sensitivity of your Vector pyroelectric detector in combination with your S310 meter (in the average power mode) in order to match the average power reading of a NIST certified system. Typically a 50/50 beam splitter is used with the Vector pyroelectric detector to be calibrated in one beam path and the NIST certified calorimeter in the other beam path. You are to adjust the output sensitivity of the pyroelectric detector while it is operating by using the count up (RANGE), count down (MODE) buttons, which change the V/J or V/mJ settings, to make the displayed value of the S310 power reading the same as the NIST standard. Press the SELECT button when the readings match.

H. The "At" (attenuation) annunciator now appears in the display. This allows you to enter a value from 0.0001 to 9999 which will become a multiplier of the actual displayed value. If no attenuator or correction factor is to be used in conjunction with the pyroelectric detector then the attenuation factor must be set to 1.000.

The attenuation factors of optics can be entered into the H410 so the displayed value will automatically compensate for the amount of attenuation. For example, assume a beam splitter is being used that transmits 75% and reflects 25% of the beam. If the H410 is set up to measure the reflected beam the attenuation could be set up as follows:

- An attenuation factor of 1 would display the value of the reflected beam.
- An attenuation factor of 3 would display the value of the transmitted beam.
- An attenuation factor of 4 would display the value of the source.

Use the count up (RANGE), count down (MODE) buttons to enter the attenuation value. Press the SELECT button to enter the value to memory.

I. The REMOTE annunciator now appears along with the digital interface previously selected; r232 (RS232) or IEEE (IEEE488). Press the SETUP button to change the interface between r232 (RS232) and IEEE (IEEE488). Press the SELECT button when the desired interface appears in the display.

J. If RS232 has been selected, the "br" (baud rate) annunciator appears in the display along with the baud rate previously selected. To change the baud rate press the SETUP button repeatedly until the desired baud rate appears in the display. One of the following baud rates can be selected: 300, 1200, 2400, 9600, and 19,200. When the preferred baud rate appears in the display press the SELECT button.

K. The "PA" (parity) annunciator now appears in the display. Press the SETUP button to select none, even, or odd parity. Press the SELECT button to enter the parity choice to memory

L. The "HS" (handshake) annunciator now appears in the display. Press the SETUP button until your choice of none (nOnE), on/off (onoF), or clear to send (CtS) appears in the display. Press the SELECT button when your choice is displayed to enter the handshake to memory.

M. If IEEE488 has been selected, the "bA" (bus address) annunciator appears with the default bus address. Bus addresses from 0 to 30 may be selected by pressing the count up (RANGE) count down (MODE) buttons followed by the SELECT button. Once the remote interface has been setup, the group annunciator will appear. Press the SELECT button or simply wait a few seconds and the group will automatically be selected for operation.

4. Group Setting for Ultra™ Series 150 Watt Detectors:

Note: The factory default Group for Ultra Detectors is Group #4.

Note: Pressing the CANCEL button at any time during this process will terminate this process with no changes made.

Note: Holding down the SELECT button for 3 seconds at any time during this process will save any changes made up to that point and return the S310 to its operational state for the Group selected.

To review, change, or setup a Group Setting for Ultra Series detectors, proceed as follows:

A. Press the SETUP button. The Group Setting last used will appear in the display.

B. To move to the next Group, press SETUP button again.

C. To select a Group, press the SELECT button when the Group you desire appears in the display (failure to press the SELECT button within 3 seconds will activate the Group shown in the display and return the S310 to its operational state).

D. Press the SETUP button until the "ULtr" annunciator appears in the display. Immediately press the SELECT button to select the Ultra detector configuration program.

E. The "SET CAL" (calibration) annunciator now appears in the display. Press the count up (RANGE) and count down (MODE) buttons to select the calibration constant (mV/W) value listed on the serial tag of your Ultra detector. Press the SELECT button to enter the calibration constant value to memory.

F. The "SP" (speed) annunciator now appears in the display. Press the count up (RANGE) button to speed up or count down (MODE) button to slow down the response time of the meter. Press the SELECT button when the desired number appears in the display. We recommend initially setting the speed to 0.3. Press the SELECT button to enter the speed setting to memory.

G. The "At" (attenuation) annunciator now appears in the display. If no attenuator is being used in conjunction with the detector, the attenuation factor in the display must be set at 1.000 since this value is a display multiplier. Attenuation multipliers from .0001 to 9999 can be entered into the displayed value.

The attenuation factors of optics can be entered into the H410 so the displayed value will automatically compensate for the amount of attenuation. For example, assume a beam splitter is being used that transmits 75% and reflects 25% of the beam. If the H410 is set up to measure the reflected beam the attenuation could be set up as follows:

- An attenuation factor of 1 would display the value of the reflected beam.
- An attenuation factor of 3 would display the value of the transmitted beam.
- An attenuation factor of 4 would display the value of the source.

Use the count up (RANGE), count down (MODE) buttons to change the attenuation factor. Press the SELECT button to enter the attenuation factor to memory.

H. The REMOTE annunciator now appears along with the digital interface previously selected; r232 (RS232) or IEEE (IEEE488). Press the SETUP button to change the interface between r232 (RS232) and IEEE (IEEE488). Press the SELECT button when the desired interface appears in the display.

I. If RS232 has been selected, the "br" (baud rate) annunciator appears in the display along with the baud rate previously selected. To change the baud rate press SETUP button until the desired baud rate appears in the display. One of the following baud rates can be selected: 300, 1200, 2400, 9600, and 19,200. When the preferred baud rate appears in the display press the SELECT button.

J. The "PA" (parity) annunciator now appears in the display. Press the SETUP button to select none, even, or odd parity. Press the SELECT button to enter the parity choice to memory

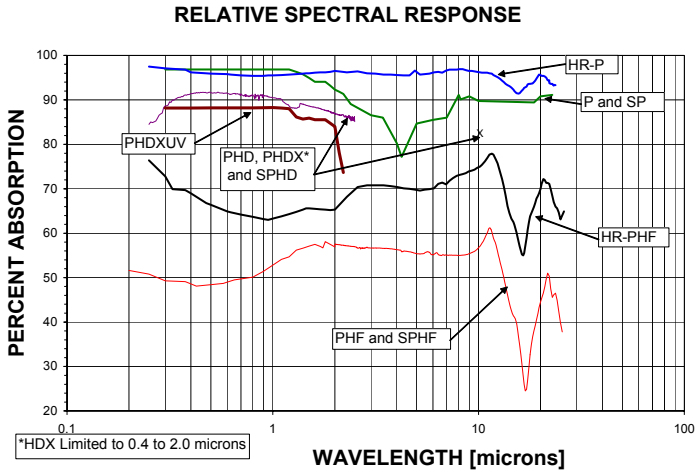
K. The "HS" (handshake) annunciator now appears in the display. Press the SETUP button until your choice of none (nOnE), on/off (onoF), or clear to send (CtS) appears in the display. Press the SELECT button when your choice is displayed to enter the handshake to memory.

L. If IEEE488 has been selected, the "bA" annunciator appears with the default bus address. Bus addresses from 0 to 30 may be selected by pressing the count up (RANGE) count down (MODE) buttons followed by the SELECT button. Once the remote interface has been setup, the group annunciator will appear. Press the SELECT button or simply wait a few seconds and the group will automatically be selected for operation.

OPERATING PROCEDURES:

USING THE S310 WITH VECTOR™ PYROELECTRIC DETECTORS:

Pyroelectric detector models P25, P50, SP25, SP50, P05, and P09 are coated with a special black absorbing material which provides a very flat spectral response over a broad wavelength band. Pyroelectric detector models PHD25, PHDX25, PHDX25UV, PHD50, PHDX50, PHDX50UV, SPHD25, and SPHD50 are coated with a special high damage absorbing material which provides absorption over a broad wavelength band. Models PHF25, PHF50, SPHF25, SPHF50, PHF02, PHF05, and PHF09 have a partially absorbing, partially reflecting chromium coating. The relative spectral responses of these detectors are shown in the following graph. Please be aware of the absorption differences between the detector's calibration wavelength and your operational wavelength. Detailed absorption information is contained in the charts at the end of this manual.



Before using your Vector joulemeter system, please review the energy density formulas given in the chart at the front of this manual. Familiarize yourself with all of the specifications of the detector models which you are using. A damage test slide is provided with each P and PHF type detectors, ***but not with PHD type detectors***. Fire the beam at the test slide before using the detector to be sure you are operating under safe conditions.

Note: The default Group Setting for Vector Pyroelectric Detectors is Group #2. The default Group Setting for Vector HR Pyroelectric Detectors is Group #3. Either select Group #2, #3, or configure another Group for pyroelectric detectors and select that Group. For Group configuration, refer to the Group Settings section.

Note: The automatic trigger threshold of the S310 is 7 % of full scale.

1. To Turn On the Meter:

Note: For the most accurate measurements possible, the S310 should be turned on and warmed up for 30 minutes.

Press the ON switch located in the rear panel of the meter. The S310 will immediately turn on with its operational state based on the last used detector Group Setting. If you purchased the S310 with one detector, this detector's Group settings will be active and you are ready to take measurements.

If you purchased more than one detector with the S310, you must choose the Group setting for the detector you are connecting to the S310 as described in step 4. The Group Setting for each detector purchased with your S310 is shown on page 2.

2. To Turn the Analog Needle On or Off (does not apply to the S310D):

To turn the analog meter on or off, press and keep holding the RANGE button down. Then release after the meter appears or disappears.

3. To Zero the Analog Needle (does not apply to the S310D):

Refer to Figure 3. The black slotted button located just below the display allows screwdriver adjustment to set the analog needle to zero. This adjustment should be made before connecting a pyroelectric detector.

4. To Connect a Pyroelectric Detector:

Note: Only one detector should be plugged in at any time.

Refer to the drawing of the S310 rear panel in Figure 2. A 3 meter BNC type cable comes with Vector pyroelectric detectors and Vector HR pyroelectric detectors. One of the input connectors on the rear panel of the S310 is labeled "Vector" for hook up of the pyroelectric detectors.

5. To Select a Group:

A. Press the SETUP button. The Group Setting last used will appear in the display.

B. To move to the next Group, press SETUP button again.

C. To select the appropriate Group, press the SELECT button when the Group you desire appears in the display (failure to press the SELECT button within 3 seconds will activate the Group shown in the display and return the S310 to its operational state).

6. To Select a Range:

Note: AUTO range may be selected if the energy levels of repetitive pulses are to be measured. ***However, do not select AUTO range if you want to measure single pulse energy or pulses running at repetition rates lower than 10 Hz.***

A. Press the RANGE button. On the first press of the RANGE button, the analog scale (if active) will disappear. Then briefly press the RANGE button each time another range is desired.

B. To select a range, press the SELECT button when the range you desire appears in the display (failure to press the SELECT button within 3 seconds will activate the range shown in the display and return the S310 to its operational state). The ranges available for pyroelectric detectors are in the following table.

Model	Standard or SP		PHF02 - L		PHF02 – S or I		PHF05 – L		PHF05 – S or I	
Mode	Power	Energy	Power	Energy	Power	Energy	Power	Energy	Power	Energy
Ranges	3mW	3mJ	30.00µW	30.00µJ	3.000µW	3.000µJ	300.0µW	300.0µJ	3.000µW	3.000µJ
	30mW	30mJ	3.000µW	3.000µJ	30.00µW	30.00µJ	3.000mW	3.000mJ	30.00µW	30.00µJ
	300mW	300mJ	3.000mW	3.000mJ	300.0µW	300.0µJ	30.00mW	30.00mJ	300.0µW	300.0µJ
	3W	3J	30.00mW	30.00mJ	3.000mW	3.000mJ	AUTO	AUTO	3.000mW	3.000mJ
	AUTO	AUTO	AUTO	AUTO	30.00mW	30.00mJ			30.00mW	30.00mJ
					AUTO	AUTO			AUTO	AUTO

Model	PHF09 – L		PHF09 – S or I		P05		P09	
Mode	Power	Energy	Power	Energy	Power	Energy	Power	Energy
Ranges	3.000mW	3.000mJ	30.00µW	30.00µJ	3.000µW	3.000µJ	3.000µW	3.000µJ
	30.00mW	30.00mJ	300.0µW	300.0µJ	30.00µW	30.00µJ	30.00µW	30.00µJ
	AUTO	AUTO	3.000mW	3.000mJ	300.0µW	300.0µJ	300.0µW	300.0µJ
			30.00mW	30.00mJ	3.000mW	3.000mJ	3.000mW	3.000mJ
			AUTO	AUTO	30.00mW	30.00mJ	30.00mW	30.00mJ
					AUTO	AUTO	AUTO	AUTO

7. To Select a Mode:

Available pyroelectric modes are: Energy (J), Avg. Energy (J AVG), Average Power (W AVG), and Volts (V).

A. To Measure Energy (J):

Note: The update rate of the display is 20Hz.

i. Press the MODE button (repeatedly, if necessary) until the "J" annunciator appears in the display.

ii. Press the SELECT button (or wait 3 seconds) and the joules mode will automatically be activated.

iii. The energy level of each laser pulse will be displayed on the LCD.

B. To Measure Average Energy (J AVG):

Note: The maximum repetition rate for average energy is 300HZ.

i. Press the MODE button (repeatedly, if necessary) until the "J AVG" annunciator appears in the display.

ii. Press the SELECT button (or wait 3 seconds) and the average joules mode will be automatically activated. The number of pulses to be averaged will now appear in the display. You may select the number of pulses to average from 2 to 9999.

iii. To change the number of pulses to be averaged, press the RANGE (count up) and/or MODE (count down) buttons. When the desired number of pulses to be averaged appears in the display, press the SELECT button.

iv. The average energy of the number of pulses you selected will be displayed after the number of pulses entered in step ii is received by the pyroelectric detector. This is not a running average, but is the average for the pulse population selected in step ii. Nothing is displayed until the full pulse population is delivered. This average is displayed until another full population of pulses is delivered at which time the display is updated with the average for that population of pulses.

C. To Measure Average Power (W AVG):

Note: The maximum repetition rate for average power is 300HZ. The minimum repetition rate for average power is 10Hz.

Note: The average power mode displays the average power (watts) of repetitively pulsed lasers. Pyroelectric detectors will not work with continuous wave lasers.

i. Press the MODE button repeatedly until the "W AVG" annunciator appears.

ii. Press the SELECT button (or wait 3 seconds) and the S310 will automatically enter into its operational state in the average power mode.

iii. The average power will be displayed.

D. To Measure Volts (V):

Note: The maximum repetition rate for volts is 300HZ.

i. Press the MODE button repeatedly until the "V" annunciator appears.

ii. Press the SELECT button (or simply wait 3 seconds) and the S310 will automatically enter into its operational state in the volts mode.

iii. The volts per pulse will be displayed.

8. To Measure a Statistical Run of Energy Pulses:

Note: Do not use AUTO range when making a statistical run.

Note: Do not go from the Average Power Mode to Stats since the range will be too high. Select the range manually.

Note: When using the PHF09 pyroelectric detector in the long pulse setting, a manual range must be selected when running statistics.

Note: Each time a new stats run begins, data from the previous run is lost. If statistical data is to be saved, it must be done though the digital interface.

Note: To exit the statistical mode at any time, press the CANCEL button.

Note: Statistics mode can collect data at repetition rates of up to 750 Hz depending on the detector model.

The statistics mode will collect data on a pulse population of up to 1000 pulses. At your prompting, the indicator will display the number of pulses delivered, average energy, minimum energy, maximum energy, standard deviation, and coefficient of variation. When the statistics mode is selected, the energy mode is automatically activated regardless of the mode previously selected. Select the appropriate range for the pulse energy level to be measured. It is very important to select the most appropriate range. If you have selected a manual range and the laser pulse(s) has overflowed the maximum energy of the range, OF will be displayed when the data is recalled. You should then select a higher range.

To enter into the statistics mode:

A. Press the STATS button. The number of pulses in the last statistics run will appear in the display.

B. Use the RANGE (count up) and MODE (count down) buttons to change the display to the desired number of pulses to include in the statistics run (up to 1000).

C. Press the SELECT button to enter the pulse population to memory.

D. Press the SELECT button to begin the run. The indicator will automatically stop once the data has been collected.

E. Press the STATS button to recall the data to the display. The STATS button must be pressed each time to recall each of the following statistical calculations:
   - Number of pulses collected
   - Average energy (AVG)
   - Minimum energy (MIN)
   - Maximum energy (MAX)
   - Standard deviation (SIGMA)
   - Coefficient of variation (CV%)

F. After recalling the statistical information, the flashing STATS annunciator indicates that the S310 is ready for a new run.

G. Press the SELECT button to start a new run (each time a new run begins, data from the previous run is lost) or press the CANCEL button to return the indicator to the mode of operation in effect prior to statistics mode.

9. External Trigger:

The automatic trigger threshold of the S310 is 7 % of full scale. The external trigger function is designed for single pulse energy measurement with a calorimeter. It does not improve the trigger circuit of the S310 with pyroelectric detectors.

10. To Perform a Transfer Calibration:

You can transfer a calibration from a calorimeter to a Vector pyroelectric detector using the Transfer Calibration function of the S310. To do this, please refer to the Group Settings for Vector Pyroelectric Detectors, paragraph #G. You must follow the Group Settings steps to get into the Transfer Calibration function. This function allows you to adjust the output sensitivity of your Vector pyroelectric detector in combination with your S310 meter in order to match the average power reading from the S310 to that of a NIST certified system. Typically a 50/50 beam splitter is used with the Vector pyroelectric detector to be calibrated in one beam path and the NIST certified calorimeter in the other beam path.

11. HR Battery Installation:

A 9 volt alkaline battery comes installed with all **HR** Series detectors. Always select the OFF position of the power switch when the detector is not in use to spare the lifetime of the battery. Replace the battery when the low battery LED indicator lights up.

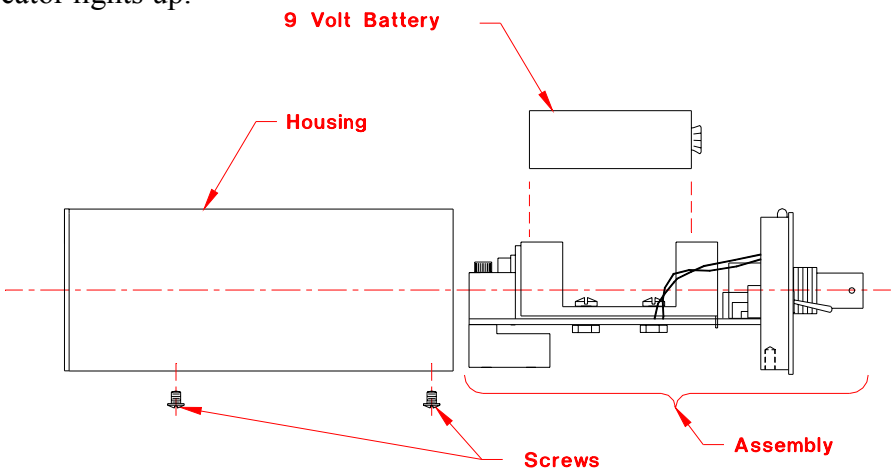


Figure 4

Refer to Figure 4. Remove the two slotted 4-40 binder head screws located on the underside of the detector. Pull off the outer housing to expose the battery. Remove the used battery from the battery holder and snap in the new battery. Slide the outer housing back in to place and secure with the screws.

Do not touch the delicate pyroelectric crystals in the **HR** Series detectors. They should only be cleaned with a stream of clean air, nitrogen or CO_2.

12. Set Electrical Time Constants for Model PHF02, PHF05 and PHF09:

The pulse width switch, located on the rear of the PHF02, PHF05, and PHF09 detectors, selects one of three electrical time constants and should be set as follows:

S (Short Pulses): Select for pulse durations of 5 µsec. or less. Repetition rates up to 4 kHZ can be measured.

I (Intermediate Pulses): Select for pulse durations of 50 µsec. or less. Repetition rates of up to 400 HZ can be measured.

L (Long Pulses): Select for pulse durations of 250 µsec. or less. Repetition rates of up to 80 HZ can be measured.

There are no pulse width settings on the P05 and P09 detectors which utilize a highly absorbing material on the crystal. The pulse duration considerations merely function in the determination of damage thresholds. Repetition rates up to 100 HZ using the P05 and 50 HZ using the P09 can be measured.

CORRECTING PYROELECTRIC DETECTOR OPERATING PARAMETERS FOR USE AT DIFFERENT WAVELENGTHS:

NOTE: Due to variability in the manufacturing process the absorption characteristics of the HD and P model detectors can vary in the UV region (190 to 400nm). Scientech recommends optical calibration at 266nm if the detector is to be used in the UV region instead of relying on an absorption rate in the chart at the end of this manual.

All pyroelectric detectors are calibrated at a specific wavelength and the detector's output sensitivity is derived for that wavelength. The output sensitivity and calibration wavelength is recorded in the Operating Parameters section at the front of the manual and on the detector's serial tag. When a pyroelectric detector is used at a wavelength other than the calibration wavelength, its output sensitivity can be adjusted to compensate for the absorption rate at the new wavelength. The new output sensitivity is calculated as follows:

1. Find the absorption rate from the chart at the end of this manual for the calibration wavelength of your pyroelectric detector.
2. Find the absorption rate for the wavelength where you will be working.
3. Determine the new output sensitivity using the following formula:

$$\frac{\text{absorption rate of new wavelength}}{\text{absorption rate of the calibration wavelength}} \times \text{output sensitivity (V/J)} = \text{output sensitivity for new wavelength from serial tag}$$

This new output sensitivity can be entered into the S310 as described in Group Settings or when using the pyroelectric detector without a S310 indicator as discussed later in this manual.

USING THE S310 WITH ASTRAL™ SERIES OR LARGE APERTURE CALORIMETERS

The calorimeter selected needs to be the appropriate model for the planned laser measurements. Please familiarize yourself with the operating specifications which are given in the front of this manual.

Note: The default Group Setting for calorimeters is Group #1. Either select Group #1 or configure another Group for calorimeters and select that Group.

Note: Astral and 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.

Note: When using a 25mm Astral calorimeter for measuring average power levels below 30mW and single pulse energy levels below 30mJ, a Scientech Model 36-0203A, Isoperibol Enclosure, is highly recommended. The isoperibol enclosure should not be used at average power levels above 30mW, and single pulse energy levels above 100mJ because heat build up will occur.

Note: Large Aperture calorimeters and the Interface Modules that they are calibrated with are matched sets and must be used together.

1. To Turn On the Meter:

Note: For the most accurate measurements possible, the S310 should be turned on and warmed up for 30 minutes.

Press the ON switch located in the rear panel of the meter. The S310 will immediately turn on with its operational state based on the last used detector Group Setting. If you purchased the S310 with one detector, this detector's Group settings will be active and you are ready to take measurements. If you purchased more than one detector with the S310, you must chose the Group setting for the detector you are connecting to the S310 as described in step 4. The Group Setting for each detector purchased with your S310 is shown on page 2.

2. To Turn the Analog Needle On or Off (does not apply to the S310D):

To turn the analog meter on or off, press and keep holding the RANGE button down. Then release after the meter appears or disappears.

3. To Zero the Analog Needle (does not apply to the S310D):

Refer to Figure 3. The black slotted button located just below the display allows screwdriver adjustment to set the analog needle to zero. This adjustment should be made before connecting a calorimeter.

4. To Connect a Calorimeter:

Note: Only one detector should be plugged in at any time.

Refer to the drawing of the S310 rear panel in Figure 2. A 3 meter mini-DIN type cable with "D" shaped connectors comes with Astral calorimeters. For large aperture calorimeters, the interconnect cables for both the calorimeter and indicator are hardwired to the interface module. One of input connectors on the rear panel of the S310 is labeled "Astral" for hook up of the Astral and Large Aperture calorimeters. Note that the flat side of the DIN type cables should be oriented up when plugging in to the S310.

5. To Select a Group:

A. Press the SETUP button. The Group Setting last used will appear in the display.

B. To move to the next Group, press SETUP button again.

C. To select the appropriate Group, press the SELECT button when the Group you desire appears in the display (failure to press the SELECT button within 3 seconds will activate the Group shown in the display and return the S310 to its operational state).

6. To Select a Range:

Note: AUTO range is not available in the energy mode for calorimeters

A. Press the RANGE button. On the first press of the RANGE button, the analog scale (if active) will disappear. Then briefly press the RANGE button each time another range is desired.

B. To select a range, press the SELECT button when the range you desire appears in the display (failure to press the SELECT button within 3 seconds will activate the range shown in the display and return the S310 to its operational state). The ranges available for calorimeters are in the following table:

Model	Astral 25mm		Astral 50mm		Large Aperture 100mm with PN10735 Interface Module*		Large Aperture 200mm with PN10747 Interface Module**	
Mode	Power	Energy	Power	Energy	Power	Energy	Power	Energy
Range	10mW 100mW 1W 10W AUTO	10mJ 100mJ 1J 10J	300mW 3W 30W AUTO	300mJ 3J 30J	300mW 3W 30W AUTO	300mJ 3J 30J	300mW 3W 30W AUTO	300mJ 3J 30J

* With a PN10748 – 10X attenuator, the actual power or energy is 10 times the displayed value up to 50 W or 150J.

** With a PN10769 – 10X attenuator, the actual power or energy is 10 times the displayed value up to 100 W or 300 J.

Note: When using PN10748 or PN10769, 10X attenuators, you may want to use an attenuation factor of 10 so the displayed reading on the S310 is correct. However the range designation may be incorrect if the power or energy reading exceeds the upper limit of the range. See the Group Settings section for details.

7. To Select a Mode:

The modes available for the calorimeters are: Average Power (W AVG) or Energy (J).

A. To Measure Average Power (W AVG):

Note: The speed-up circuit (differentiator) in watts mode is controlled by software and was adjusted at the factory to accommodate the type of calorimeter being used. You can change the speed-up setting to your preference. For changing a Group setting, refer to the Group Setting discussion in the previous section on Group Settings for Astral or Large Aperture Calorimeters. ***The speed-up circuit is not active in AUTO range***.

Note: The average power mode displays the average power (watts) of repetitively pulsed lasers or continuous wave lasers.

i. Press the MODE button repeatedly until the "W AVG" annunciator appears.
ii. Press the SELECT button (or simply wait 3 seconds) and the S310 will automatically enter into its operational state in the average power mode.
iii. Press the CANCEL button to zero the display.
iv. The average power will be displayed.

B. To Measure Energy (J):

Note: Calorimeters can only measure single shot energy pulses (time between pulses is dependent on the calorimeter delay "CD" setting in the Group Setting for calorimeters [see previous section on Group Settings for Astral or Large Aperture Calorimeters]). With the calorimeter delay entered, the S310 will display the "trig" annunciator and the single pulse energy after the first pulse is delivered. The "trig" annunciator will then disappear after the calorimeter delay time has elapsed prompting you to fire another pulse. Do not fire another pulse until the annunciator disappears. If you do, the S310 resets the time delay and ignores the sequential pulse altogether.

i. Press the MODE button (repeatedly, if necessary) until the "J" annunciator appears in the display.
ii. Press the SELECT button (or simply wait 3 seconds) and the joules mode will automatically be activated.
iii. The energy level of each laser pulse will be displayed on the LCD.

8. To Measure a Statistical Run of Single Shot Energy Pulses:

Note: Calorimeters can only measure single shot energy pulses (time between pulses is dependent on the calorimeter delay "CD" setting in the Group Setting for calorimeters [see previous section on Group Settings for Astral or Large Aperture Calorimeters]). With the calorimeter delay entered, the S310 will display the "trig" annunciator and the single pulse energy after the first pulse is delivered. The "trig" annunciator will then disappear after the calorimeter delay time has elapsed prompting you to fire another pulse. Do not fire another pulse until the annunciator disappears. If you do, the S310 resets the time delay and ignores the sequential pulse altogether.

Note: Do not use AUTO range when making a statistical run.

Note: Do not go from the Average Power Mode to Stats since the range will be too high. Select the range manually.

Note: Each time a new stats run begins, data from the previous run is lost. If statistical data is to be saved, it must be done though the digital interface.

Note: To exit the statistical mode at any time, press the CANCEL button.

The statistics mode will collect data on a pulse population of up to 1000 pulses. At your prompting, the indicator will display the number of pulses delivered, average energy, minimum energy, maximum energy, standard deviation, and coefficient of variation. When the statistics mode is selected, the energy mode is automatically activated regardless of the mode previously selected. Select the appropriate range for the pulse energy level to be measured. It is very important to select the most appropriate range. If you have selected a manual range and the laser pulse(s) has overflowed the maximum energy of the range, OF will be displayed when the data is recalled. You should then select a higher range.

To enter into the statistics mode:

A. Press the STATS button. The number of pulses in the last statistics run will appear in the display.

B. Use the RANGE (count up) and MODE (count down) buttons to change the display to the desired number of pulses to include in the statistics run (up to 1000).

C. Press the SELECT button to enter the pulse population to memory.

D. Press the SELECT button to begin the run. The indicator will automatically stop once the data has been collected.

E. Press the STATS button to recall the data to the display. The STATS button must be pressed to recall each of the following statistical calculations:
   - Number of pulses collected
   - Average energy (AVG)
   - Minimum energy (MIN)
   - Maximum energy (MAX)
   - Standard deviation (SIGMA)
   - Coefficient of variation (CV%)

F. After recalling the statistical information, the flashing STATS annunciator indicates that the S310 is ready for a new run.

G. Press the SELECT button to start a new run (each time a new run begins, data from the previous run is lost) or press the CANCEL button to return the indicator to the mode of operation in effect prior to statistics mode.

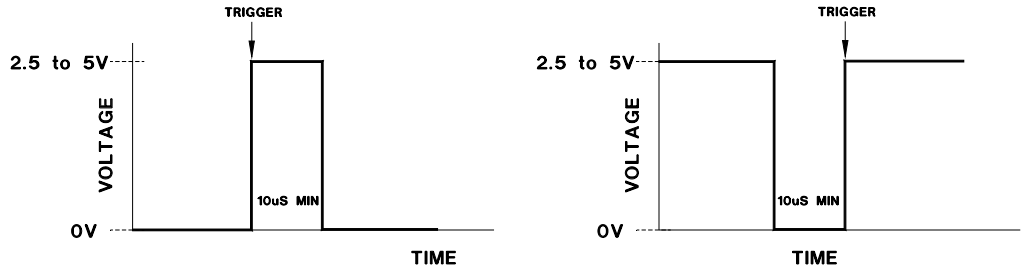
9. External Trigger:

The external trigger input is located on the rear panel of the S310 as shown in Figure 2. The external trigger function is designed to ensure the entire pulse energy of a single pulse is captured by the S310 indicator. An external trigger "awakens" the S310's circuitry so that it is ready for the arrival of the laser pulse. The external trigger pulse must have the following characteristics:

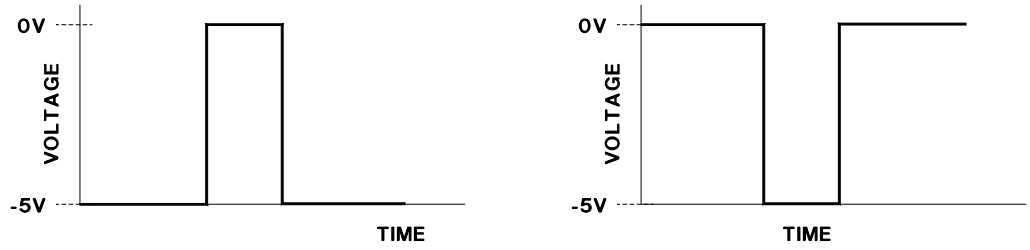
1. 2.5 volts min. to 5 volts max.
2. A minimum pulse width of 10 µsec. to a maximum of the laser pulse repetition rate.
3. A maximum rise/fall time of 500 nsec.
4. Delivered 1 to 3 milliseconds prior to the laser pulse.

The trigger is generated on the rising edge of the incoming pulse.

The following are viable external triggers.



The following pulses will not trigger the S310.



CORRECTING ASTRAL™ SERIES HD CALORIMETERS OPERATING PARAMETERS FOR USE AT DIFFERENT WAVELENGTHS:

NOTE: Due to variability in the manufacturing process the absorption characteristics of the HD and P model detectors can vary in the UV region (190 to 400nm). Scientech recommends optical calibration at 266nm if the detector is to be used in the UV region instead of relying on an absorption rate in the chart at the end of this manual.

Scientech calorimeters in general have a flat response to all wavelengths within their specified spectral response. HD and HDX calorimeters are an exception to that rule and are calibrated at a specific wavelength by adjusting the calorimeter's gain circuitry for that wavelength. The calibration wavelength is recorded in the Operating Parameters section at the front of the manual and on the detector's serial tag. When a HD or HDX calorimeter is used at a wavelength other than the calibration wavelength, the indicator's displayed value can be adjusted to compensate for the absorption rate at the new wavelength by using an attenuation factor. The attenuation factor is calculated as follows:

1. Find the absorption rate from the chart at the end of this manual for the calibration wavelength of your calorimeter.
2. Find the absorption rate for the wavelength where you will be working.
3. Determine the attenuation factor using the following formula:

$$\frac{\text{absorption rate of calibration wavelength}}{\text{absorption rate of the new wavelength}} = \text{attenuation factor}$$

The attenuation factor can be entered into the S310 as described in the Group Setting section.

USING THE S310 WITH ULTRA™ SERIES DETECTORS:

The Ultra detector selected needs to be the appropriate model for the planned laser measurements. Please familiarize yourself with the operating specifications which are given in the front of this manual.

Note: The default Group Setting for Ultra Detectors is Group #4. Either select Group #4 or configure another Group for Ultra Detectors and select that Group.

1. To Turn On the Meter:

Note: For the most accurate measurements possible, the S310 should be turned on and warmed up for 30 minutes.

Press the ON switch located in the rear panel of the meter. The S310 will immediately turn on with its operational state based on the last used detector Group Setting. If you purchased the S310 with one detector, this detector's Group settings will be active and you are ready to take measurements. If you purchased more than one detector with the S310, you must chose the Group setting for the detector you are connecting to the S310 as described in step 4. The Group Setting for each detector purchased with your S310 is shown on page 2.

2. To Turn the Analog Needle On or Off (does not apply to the S310D):

To turn the analog meter on or off, press and keep holding the RANGE button down. Then release after the meter appears or disappears.

3. To Zero the Analog Needle (does not apply to the S310D):

Refer to Figure 3. The black slotted button located just below the display allows screwdriver adjustment to set the analog needle to zero. This adjustment should be made before connecting an Ultra detector.

4. To Connect an Ultra Detector:

Note: Only one detector should be plugged in at any time.

Refer to the drawing of the S310 rear panel in Figure 2. A 3 meter mini-DIN type cable with "D" shaped connectors comes with Ultra detectors. One of input jacks on the rear panel of the S310 is labeled "Ultra" for hook up of the Ultra detectors. Note that the flat side of the DIN type cables should be oriented up when plugging in to the S310.

5. To Select a Group:

A. Press the SETUP button. The Group Setting last used will appear in the display.

B. To move to the next Group, press SETUP button again.

C. To select the appropriate Group, press the SELECT button when the Group you desire appears in the display (failure to press the SELECT button within 3 seconds will activate the Group shown in the display and return the S310 to its operational state).

6. To Select a Range:

The S310 has only one range (150.0) when used with the Ultra detector.

7. To Select a Mode:

The S310 has only one mode (watts) when used with the Ultra detector and will display the average power of repetitively pulsed lasers or continuous wave lasers.

8. To Measure Average Power (W):

Place the beam on the absorbing surface of your Ultra detector and the display will read in watts.

CORRECTING ULTRA SERIES HD CALORIMETERS OPERATING PARAMETERS FOR USE AT DIFFERENT WAVELENGTHS:

NOTE: Due to variability in the manufacturing process the absorption characteristics of the HD and P model detectors can vary in the UV region (190 to 400nm). Scientech recommends optical calibration at 266nm if the detector is to be used in the UV region instead of relying on an absorption rate in the chart at the end of this manual.

Scientech calorimeters in general have a flat response to all wavelengths within their specified spectral response. HD calorimeters are an exception to that rule and are calibrated at a specific wavelength by adjusting the calorimeter's gain circuitry for that wavelength. The calibration wavelength is recorded in the Operating Parameters section at the front of the manual and on the detector's serial tag. When a HD calorimeter is used at a wavelength other than the calibration wavelength, the indicator's displayed value can be adjusted to compensate for the absorption rate at the new wavelength by using an attenuation factor. The attenuation factor is calculated as follows:

1. Find the absorption rate from the chart at the end of this manual for the calibration wavelength of your calorimeter.
2. Find the absorption rate for the wavelength where you will be working.
3. Determine the attenuation factor using the following formula:

$$\frac{\text{absorption rate of calibration wavelength}}{\text{absorption rate of the new wavelength}} = \text{attenuation factor}$$

The attenuation factor can be entered into the S310 as described in the Group Settings section.

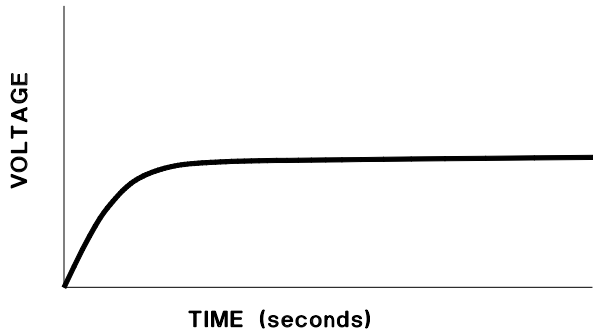
ANALOG OUTPUT:

The analog output is an uncalibrated output accessible via the 50 ohm terminated BNC connector located on the indicator's rear panel (see Figure 1). Although the analog output voltage level is uncalibrated, it is representative of the power and energy readings displayed on the S310. The analog output voltage level is approximately 3 volts full scale. For high accuracy, you must determine the relationship between the analog output voltage level and the power and energy readings on the S310 display.

With a calorimeter connected to the S310 in watts mode, the analog output voltage readings will rise to a steady level when power is applied to the calorimeter. After the voltage readings become stable, note the analog output voltage reading and the watt reading on the S310 display. All subsequent voltage readings will have the same V/W values. In the joules mode, the voltage will rise to a peak value relatively quickly (seconds) followed by a rapid return to baseline. The peak voltage is representative of the joules value. Again, this can be determined by noting the peak voltage value on the analog output, and the joules reading on the S310 display.

With a pyroelectric detector connected to the S310, determine the relationship between the peak voltage value and the energy (joules) or power (watts) reading on the S310 display in the same manner.
The analog output with the various detectors and operating modes should appear as follows:

1. Calorimeter Watts Mode:



Compare voltage to the watt reading displayed on the S310 to determine V/W constant to use when looking at the analog output.

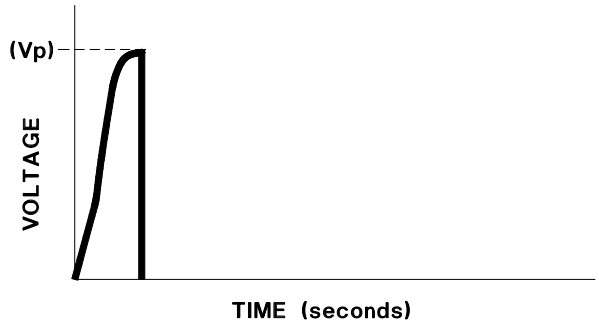
In power (watts) mode, the analog output is nominally 3 V full scale for each range. Therefore, to calculate watts from the analog output voltage:

$$W = V/S$$

where:

V = analog output voltage (V)
S = analog output sensitivity (V/W) ≈ 3 V/range (W)
(for example, on the 10 mW range, S ≈ 3 V/.010 W = 300 V/W)

2. Calorimeter Joules Mode:



Compare the peak voltage to the energy (joules) reading displayed on the S310 to determine V/J constant to use when looking at the analog output.

In the energy (joules) mode the analog output is an amplified voltage signal proportional to the voltage generated by the calorimeter thermopile. To calculate energy (joules) from the analog output use the following equation.

$$J = \frac{0.3(Vpk)(TC)}{(S)(R)}$$

where:

Vpk = peak voltage from the analog output
TC = the calorimeter time constant from the calorimeter serial tag
S = the calorimeter output sensitivity as follows:

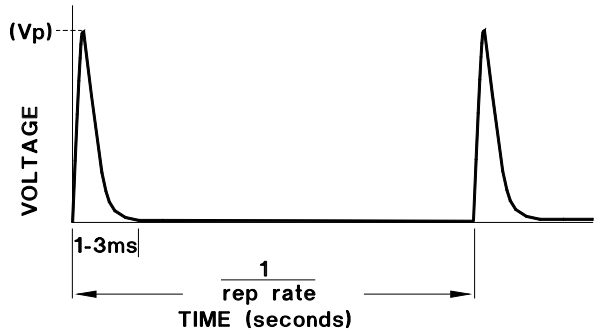
0.5 V/W	for 25 mm models
0.1667 V/W	for 50 mm models and large aperture calorimeters

R = indicator range multiplier as follows:

10.0	for the 10 or 30 range
100.0	for the 1 or 3 range
1,000.0	for the .1 or .3 range
10,000.0	for the .01 or .03 range

3. Pyroelectric Watts and Joules Modes:

Compare peak voltage to energy (joules) or power (watts) reading displayed on the S310 to determine V/J or V/W constant to use when looking at the analog output.



In power (watts) and energy (joules) mode, the peak voltage of a laser pulse is directly proportional to the power energy level:

$$W = Vpk/S$$

where:

Vpk = peak voltage from the analog output
S = analog output sensitivity (V/W) ≈ 3 V/range (W)
(for example, on the 3 mW range, S ≈ 3 V/.003 W = 1000 V/W)

$$J = Vpk/S$$

where:

Vpk = peak voltage from the analog output
S = analog output sensitivity (V/J) ≈ 3 V/range (J)
(for example, on the 3 mJ range, S ≈ 3 V/.003 J = 1000 V/J)

4. Ultra™ Calorimeter:

The analog output voltage is approximately 3 volts full scale. With an Ultra calorimeter the digital display will read up to 300 watts, even though the Ultra Calorimeter is only rated for 150 watts. To calculate power from the analog output voltage use the following equation.

$$W = \frac{V}{[0.0332(S)] - [3 \times 10^{-5}]}$$

Where: V = analog output voltage (V)
S = Ultra sensitivity (mV/W)

CALIBRATION OF ASTRAL™ CALORIMETERS USING ELECTRIC SUBSTITUTION HEATING:

For Astral calorimeters the electric substitution heating option must be ordered and installed at the factory when the calorimeter is purchased. It can not be retrofitted to a calorimeter at a later time. To calibrate using electric substitution heating proceed as follows.

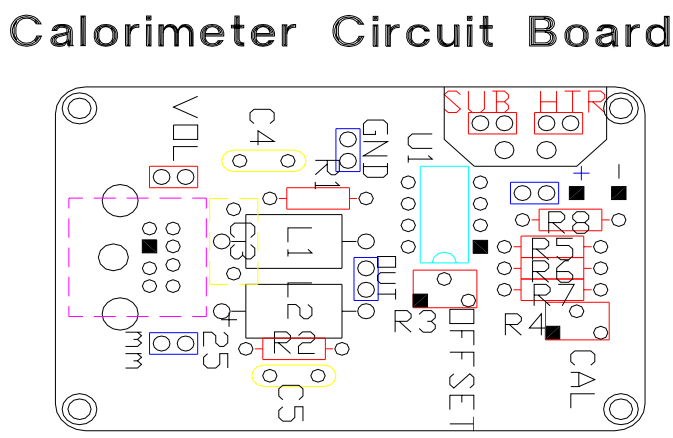


Figure 5

A. Remove the screws holding the calorimeter's ID tag and remove the plate to expose the circuit board as shown in Figure 5.

B. Connect the calorimeter to the indicator, turn on the power and let the system equilibrate.

C. Connect a DVM to the test points labeled SUB and HTR on the calorimeter circuit board.

D. Measure the resistance of the substitution heater making sure to subtract the resistance of the patch cables from the total resistance measurement. 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.

E. Remove the DVM. Connect a power supply to the SUB and HTR test points and connect the DVM to monitor the power supply.

F. Set up the indicator in the Watts Mode and the 10W range for 25 mm calorimeters or the 3W range for 50 mm calorimeters.

G. Apply V_h volts, stated in the calibration data you received with the calorimeter, to the substitution heater.

H. If needed, adjust the calibration trim pot, R4 on the calorimeter circuit board, until W_h Watts, from the calibration data, is displayed by the indicator.

CALIBRATION OF LARGE APERTURE CALORIMETERS USING ELECTRIC SUBSTITUTION HEATING:

Electrical substitution heating is a standard feature of large aperture calorimeters.

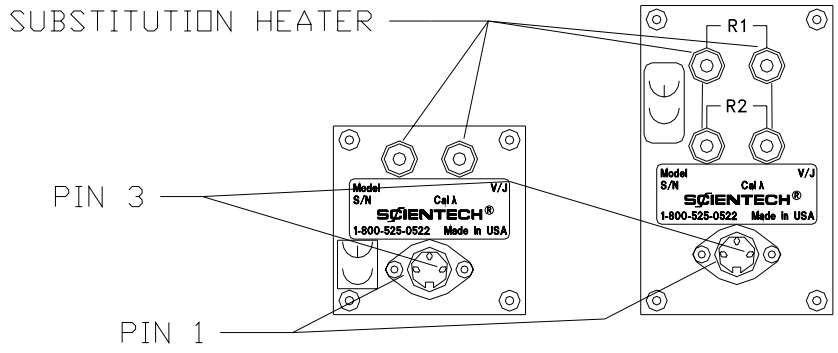


Figure 6

Calibration with an Interface Module and S310 Indicator:

A. Connect a DVM to the white jacks of the calorimeter. Refer to Figure 6.
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 or 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. Remove the DVM. Connect a power supply to the white jacks and connect the DVM to monitor the power supply.
D. Set up the indicator in the Watts Mode and the 30W range.
E. Remove the screws holding the interface module's ID tag and remove the plate to expose the circuit board. Refer to Figure 5.
F. Apply V_h volts, stated in the calibration data you received with the calorimeter, to the substitution heater.
G. If needed, adjust the calibration trim pot, R4 on the calorimeter circuit board, until W_h Watts, from the calibration data, is displayed by the indicator.

Calibration without an Interface Module and S310 Indicator:

For this procedure you will need to make an adapter cable to go from the calorimeter's DIN connector to the DVM. The voltage output is on pin 1 of the DIN connector and should be connected to the positive side of the DVM. Ground is on pin 3 and should be connected to the negative side. Pin 2 is not used. Refer to Figure 6.

A. Connect a DVM to the white jacks of the calorimeter. Refer to Figure 5.
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 or 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.

DETECTOR OPERATION WITHOUT AN INDICATOR:

Pyroelectric Detectors:

Standard and SP Models:

Standard and SP model pyroelectric detectors can be operated with a 1MΩ input oscilloscope. The peak voltage shown on the oscilloscope can be divided by the V/J output sensitivity of the detector to calculate energy.

HR Models:

HR pyroelectric detectors can be operated with a 50Ω input oscilloscope. The peak voltage shown on the oscilloscope can be divided by the V/mJ output sensitivity of the detector to calculate energy.

Astral ™ and Large Aperture Calorimeters:

Cable Requirements:

Astral calorimeters are powered up by the indicators. To use an Astral calorimeter without a Scientech indicator, but with a volt meter or chart recorder, you must apply +/-8VDC to the mini DIN connector as shown in Figure 7. The voltage output of the calorimeter, from pin 8, should be connected to the positive side of the DVM or chart recorder. All 3 of the grounds should be tied together at the negative side. Pins 2 and 3 are not used.

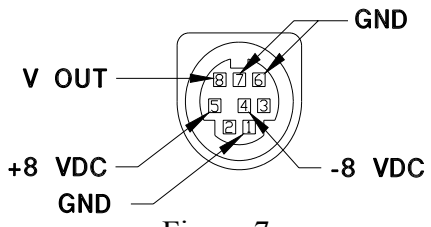


Figure 7

When large aperture calorimeters are used without an indicator their interface module is not used. 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. Refer to Figure 6.

Operation of Astral™ and Large Aperture Calorimeters with a Digital Volt Meter:

Note: Whenever a large aperture calorimeter is used without an indicator the interface module is not used .

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

A. Select the DC volts mode.
B. Direct the laser beam on to the absorbing surface of the calorimeter.
C. When the display of the DVM has stabilized (about 2 minutes), calculate the laser power using the formula:

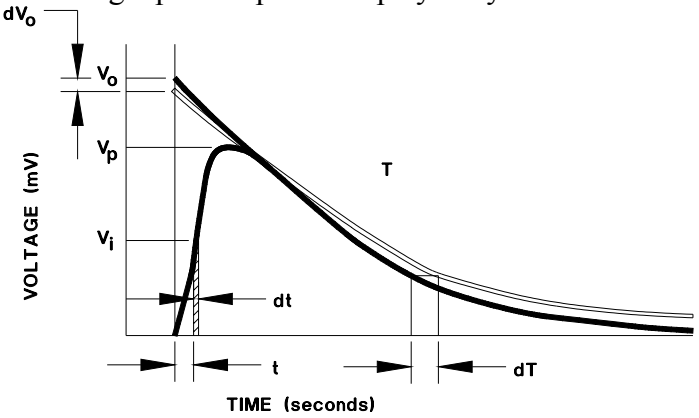
W = V/S where: W = Laser power in watts
V = Voltage reading of the DVM in volts
S = Sensitivity of the calorimeter from page 2.

Operation of Astral™ Calorimeters with an Analog Chart Recorder:

Note: Whenever a large aperture calorimeter is used without an indicator the interface module is not used.

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:

$$dE = (dt/S) \Sigma\, dV_i \quad (i=1 \text{ to } N)$$

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.

Remote Interface Language:

The remote interface language for the S310 is compatible with Std-IEEE488.2 and it also works with the RS-232 remote interface.

1. RS-232 Connector:

The RS-232 connector is a 9 pin subminiature connector on the instrument rear panel. The pin out and pin descriptions are shown below:

Pin 1	Unused
Pin 2	Data In (RXD)
Pin 3	Data Out (TXD)
Pin 4	DTR (is generated)
Pin 5	Ground
Pin 6	DSR (is ignored)
Pin 7	RTS (is marking)
Pin 8	CTS (is evaluated if requested)
Pin 9	Unused

2. RS-232 Specifications:

Type:	EIA-RS232C
Method:	Half-duplex, Asynchronous
Transmission:	Bi-directional
Format:	300, 1200, 2400, 9600, 19200 baud rate selectable
Data bits:	7
Parity bit:	Even, Odd, or None
Stop bit:	1
Code:	ASCII
Total no. of bits:	10

* The start bit counts for the first bit. Therefore, if you choose no parity you must have 2 stop bits.

3. Remote Interface Language Syntax:

Remote interface messages consist of zero or more commands or queries, separated by semicolons and terminated by a linefeed (IEEE488) or a carriage return (RS232). A command or query consists of a command or query header followed by zero or more arguments separated by commas. Messages must be less than 75 characters.

Example:

cmd1 arg1;cmd2arg1,arg2;...cmdN arg1

The queries RPT?, SND?, COL?, and *OPC?, and the commands COL and *OPC are intended to be placed as the last command in the message. Placing them elsewhere will not result in harm to the instrument, but it may produce results which seem unusual.

Queries which have not finished will be aborted by the receipt of additional commands or queries. This will result in Query Errors in the IEEE488 interface. If a RPT?, COL?, or SND? query is immediately followed by another command, it is likely that no data will be transmitted. If COL is followed by another command, statistics gathering will be halted unless the command *WAI appears between the two commands.

4. Remote Interface Language Common Commands and Queries:

Most commands and queries may be used with either the RS232 interface or the IEEE488 interface. Some commands, however, work only with the IEEE488 interface. Some commands require that a password has been entered. A few commands are archaic, but were left in because no harm was done, and they may be needed again if multi-channel units are constructed again.

The commands which work in both interfaces are presented first, followed by the password protected commands peculiar to the IEEE488 interface, followed finally by the archaic commands. In the descriptions which follow, the command (or query) will be presented first, followed optionally by one or more arguments, separated by commas. When the vertical bar "|" is used in an argument, it denotes the word "or", and signifies that one and only one of the items separated by bars may be inserted into the space of the argument. For example, the command: XXXA|B,C has two arguments, the first of which may be `A' or `B', and the second of which is the letter `C'. Where a space character is required by the syntax, it is represented with an underline character.

Commands in this group are available from both interfaces:

*IDN?
This query takes no arguments, and returns a comma separated collection of four strings, describing respectively the manufacturer of the instrument (Scientech, Inc.), the model number (S310), the serial number, and the firmware version number.

*SAV_<dec num>
This is the IEEE488.2 common command for saving the instrument setup. The number may be an integer from 1 through 4. When used from either remote interface, it saves the current configuration to the numbered save area. The next time the instrument is powered up or the *RST command is issued with the same save area as the default, or the RCL command is executed for the same save area, the configuration will be restored to the values saved.

SENS_PYRO|CAL|PHR|ULTRA
Sets the detector type.

SENS?
Returns the detector type (PYRO|CAL|PHR|ULTRA).

SND?
The SND? query causes the instrument to send the next reading to the remote interface. When using a calorimeter in the joules mode, the SND? query must be sent to the S310 before the calorimeter is pulsed by the laser.

RPT?
This query causes the remote interface to begin sending a sequence of comma-separated readings. A new reading is sent each time one is taken by the instrument. This activity will continue until the remote interface is interrupted by a new command or query, or the instrument is turned off.

COL _<dec num>
This command causes the instrument in energy mode to begin collecting readings for statistical analysis indicated by the response COLLECTING... This command continues until <dec num> data points are collected, or until it is interrupted by another command. If it is interrupted, no statistics are computed. If it terminates normally, a carriage return and line feed occurs, and it computes values for the mean, max, standard deviation, and coefficient of variation of the data points collected. Those values may then be accessed with the queries mean?, max?, sigma?, and cv?. The individual data points may be dumped with the dump? query.

RANGE_<dec num>|auto
Sets the range to the decimal number supplied, or to the closest legal range allowed for the current detector and configuration. If the word auto is supplied, this command activates the autorange feature if it is supported for the current detector and configuration.

RANGE?
The RANGE query returns the decimal number between 1 and the maximum range of the instrument. The meaning of the number varies, depending upon the type of detector, and the configuration of the instrument. (Generally speaking, there are 5 ranges, though not all of them are used for every detector).

Range	Cal 25 mm	Cal 50 mm	Ultra	Pyro 25/50 mm	PHR 2, 5, 9 mm Long Mode
1	1.000 m	300.0 m	150.0	3.000 m	300.0 µ
2	10.00 m	300.0 m	150.0	30.00 m	300.0 µ
3	100.0 m	300.0 m	150.0	300.0 m	300.0 µ
4	1.000	3.000	150.0	3.000	3.000 m
5	10.00	30.00	150.0	30.00	30.00 m

Range	PHR 2 mm Short/Int Mode	PHR 5 mm Short/Int Mode	PHR 9 mm Short/Int Mode	PHR 5 mm Painted	PHR 9 mm Painted
1	3.000 µ	3.000 µ	3.000 µ	3.000 µ	3.000 µ
2	30.00 µ	30.00 µ	30.00 µ	30.00 µ	30.00 µ
3	300.0 µ	300.0 µ	300.0 µ	300.0 µ	300.0 µ
4	300.0 µ	3.000 m	3.000 m	3.000 m	3.000 m
5	300.0 µ	30.00 m	30.00 m	3.000 m	30.00 m

MEAN?
If statistics have been collected from the front panel, or by the COL or COL? commands, this command returns the mean value of the collection. If no statistics have been collected, it returns to zero.

MIN?
If statistics have been collected from the front panel, or by the COL or COL? commands, this command returns the minimum value of the collection. If no statistics have been collected, it returns to zero.

MAX?
If statistics have been collected from the front panel, or by the COL or COL? commands, this command returns the maximum value of the collection. If no statistics have been collected, it returns to zero.

SIGMA?
If statistics have been collected from the front panel, or by the COL or COL? commands, this command returns the standard deviation of the collection. If no statistics have been collected it returns zero.

CV?
If statistics have been collected from the front panel, or by the COL or COL? commands, this command returns the coefficient of variation of the collection. If no statistics have been collected it returns zero.

PULSES?
Returns the number of pulses collected in the last run.

DUMP?
If statistics have been collected from the front panel, or by the COL or COL? commands, this command returns all of the data values in the collection. If no statistics have been collected, it does nothing.

BAUD_<dec num>
If the <dec num> takes any of the values 300, 1200, 2400, 9600, or 19200; or any of their abbreviations 3, 12, 24, 96, 192, this command sets the RS232 baud rate to the corresponding value.

PARITY EVEN|ODD|NONE
Sets the parity of the RS232 interface to even parity, odd parity, or no parity, as specified.

HANDS XON|CTS|NONE
Sets the handshake method of the RS232 interface to XON/XOFF,CTS, or NONE as specified.

IO RS232|IEEE
On units with both IEEE and RS232 interfaces, this command makes the named interface the SAVED active interface. The next time the instrument is powered up, or its configuration is restored from the configuration save set active when this command was issued, the specified interface becomes the active remote interface.

*RST
This is the IEEE488.2 common command by the same name. When executed from the RS232 interface, it has the effect of restoring the saved instrument configuration from the current save area. It has the additional function in the IEEE488 interface of forcing the interface into the OCIS state and the OQIS state.

METER ON|OFF
Activates or deactivates the analog meter.
MODE VOLTS|ENERGY|AVGE|AVGP
If the specified mode is valid for the detector in use, the software changes mode to the one specified.

MODE?
Returns the instrument's operating mode. The possible responses are VOLTS, ENERGY, AVGE, and AVGP.

*TST?
This is the IEEE488.2 common query. From either interface, it causes ROM checksum, and non-destructive RAM test to be run. If the tests succeed, this query returns zero. If the ROM test fails, a 1 is returned. If the RAM test fails, a 2 is returned.

*OPC?
This is the IEEE488.2 common query. From either interface, it waits until no overlapping command is in progress, and then it returns a 1.

*WAI
This is the IEEE488.2 common command. From either interface, it causes the command processor to wait until any overlapping command is finished before continuing to process commands.

CLR
This command halts RPT?, SND?, or COL? commands in progress. It also terminates statistics gathering started by the COL command. This command is issued internally whenever a carriage return that is not preceded by a command is typed into the RS232 interface. When the IEEE488 interface receives a linefeed terminated message with no commands, it too generates the CLR command.

*RCL_<dec num>
This is the IEEE488.2 common command. It takes the single numeric argument [1-4], and restores the instrument configuration to that configuration stored in the corresponding save area. It also places the IEEE interface into the OCIS and OQIS states.

COUNT_<dec num>
Sets the number of pulses making up each average in average energy mode.

COUNT?
Returns the number of pulses making up each average in average energy mode.

CALIB_<dec num>
Sets the calibration constant (Volts/Joule) for a pyro detector, (Volt/Watt) for an Ultra Series detector or the time constant for a calorimeter. Note: This command is context sensitive; the detector type must be set by the SENS command before this command is executed.

CALIB?
Returns the constant for a pyro detector, or the time constant for a calorimeter. Note: This command is context sensitive; the returned value depends on the detector type set by the SENS command.

ATTEN_<dec num>
Sets an attenuation factor for the current detector.

ATTEN?
Returns the attenuation factor for the current detector.

ZERO
This command zeros the power baseline for a calorimeter.

PSWD_<dec num>
Enables password protection commands if the password is entered correctly.

PSPEED HF|BL
Sets the electronic response speed according to the repetition rate capability of the pyroelectric detector type - a "black" coated absorbing crystal, or uncoated "high frequency" absorbing crystal.

PSPEED?
Returns the pyro speed, possible responses are BL and HF.

CSPEED_<dec num>
Sets the watts mode display response speed for calorimeters and Ultra Series detectors.

CSPEED?
Returns the watts mode display response speed for calorimeters and Ultra Series detectors.

CDELAY_<dec num>
Sets the "Calorimeter Delay" function of the meter.

CDELAY?
Returns the "Calorimeter Delay" function of the meter.

5. IEEE488 Specific Commands:

These commands may be used only from the IEEE488.2 interface. They are all members of the collection of the so-called "common Commands" described in the IEEE488.2 standard.

*CLS
Clears the Standard Event Status Register and forces the device into Operation Complete Command Idle state.

*ESR?
Returns a decimal number which is the value of the Standard Event Status Register. Reading the register clears it.

*ESE_<dec num>
Sets the bits of the Standard Event Status Enable Register to the binary representation of the decimal integer supplied.

*ESE?
Returns a decimal number representing the contents of the Standard Event Status Enable Register.

*SRE_<dec num>
Sets the bits of the Standard Request Enable Register to the binary representation of the decimal integer supplied.

*SRE?
Returns a decimal number which represents the contents of the Service Request Enable Register.

*OPC
Sets the "Operation Complete" event bit in the Standard Event Status Enable Register when pending device operations have been completed.

*STB?
Returns a decimal number which is the value of the IEEE488.1 status byte and the Master Summary Status message.

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.

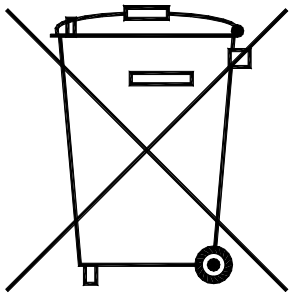
Shipping Address:

Scientech, Inc.
Product Service Department
5649 Arapahoe Ave.
Boulder, Colorado 80303 USA

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.
4. Waste electrical and electronic equipment should never be mixed with municipal waste.



HD CALORIMETER AND PYROELECTRIC ABSORPTION VS. WAVELENGTH:

Use this table for all HD calorimeters and HD pyroelectric detectors.

Wavelength µm	Absorption %	Wavelength µm	Absorption %	Wavelength µm	Absorption %	Wavelength µm	Absorption %
0.200	93.66	0.480	94.71	0.735	93.99	0.990	93.34
0.210	93.78	0.485	94.75	0.740	94.21	0.995	93.35
0.220	92.18	0.490	94.80	0.745	93.98	1.000	93.34
0.230	90.44	0.495	94.76	0.750	93.98	1.005	93.33
0.240	88.79	0.500	94.73	0.755	94.08	1.010	93.33
0.250	90.07	0.505	94.70	0.760	94.04	1.015	93.33
0.255	90.42	0.510	94.67	0.765	93.89	1.020	93.29
0.260	90.41	0.515	94.68	0.770	93.94	1.025	93.28
0.265	90.56	0.520	94.70	0.775	94.01	1.030	93.28
0.270	90.71	0.525	94.66	0.780	93.91	1.035	93.25
0.275	91.13	0.530	94.66	0.785	94.03	1.040	93.23
0.280	91.63	0.535	94.70	0.790	93.96	1.045	93.17
0.285	91.85	0.540	94.75	0.795	93.89	1.050	93.14
0.290	92.01	0.545	94.73	0.800	93.64	1.055	93.12
0.295	92.73	0.550	94.66	0.805	93.65	1.060	93.12
0.300	93.02	0.555	94.63	0.810	93.67	1.065	93.14
0.305	93.04	0.560	94.64	0.815	93.53	1.070	93.17
0.310	93.15	0.565	94.64	0.820	94.21	1.075	93.16
0.315	93.53	0.570	94.62	0.825	93.61	1.080	93.13
0.320	93.45	0.575	94.56	0.830	93.81	1.085	93.12
0.325	93.82	0.580	94.59	0.835	93.83	1.090	93.09
0.330	93.83	0.585	94.56	0.840	93.83	1.095	93.06
0.335	93.96	0.590	94.56	0.845	93.93	1.100	93.03
0.340	94.07	0.595	94.61	0.850	93.84	1.105	93.01
0.345	94.14	0.600	94.55	0.855	93.31	1.110	93.00
0.350	94.15	0.605	94.51	0.860	93.65	1.115	92.83
0.355	94.19	0.610	94.50	0.865	93.90	1.120	92.76
0.360	94.31	0.615	94.45	0.870	93.84	1.125	92.67
0.365	94.30	0.620	94.38	0.875	93.92	1.130	92.60
0.370	94.44	0.625	94.44	0.880	93.81	1.135	92.57
0.375	94.48	0.630	94.42	0.885	93.85	1.140	92.56
0.380	94.46	0.635	94.44	0.890	93.54	1.145	92.51
0.385	94.53	0.640	94.48	0.895	93.88	1.150	92.47
0.390	94.53	0.645	94.50	0.900	93.60	1.155	92.43
0.395	94.57	0.650	94.46	0.905	93.70	1.160	92.42
0.400	94.62	0.655	94.49	0.910	93.62	1.165	92.37
0.405	94.63	0.660	94.39	0.915	93.68	1.170	92.32
0.410	94.65	0.665	94.43	0.920	93.66	1.175	92.30
0.415	94.72	0.670	94.41	0.925	93.64	1.180	92.24
0.420	94.70	0.675	94.44	0.930	93.60	1.185	92.23
0.425	94.78	0.680	94.36	0.935	93.67	1.190	92.21
0.430	94.74	0.685	94.37	0.940	93.59	1.195	92.16
0.435	94.80	0.690	94.36	0.945	93.60	1.200	92.08
0.440	94.76	0.695	94.19	0.950	93.50	1.205	92.02
0.445	94.80	0.700	94.37	0.955	93.49	1.210	91.94
0.450	94.79	0.705	94.25	0.960	93.51	1.215	91.91
0.455	94.79	0.710	94.20	0.965	93.45	1.220	91.92
0.460	94.79	0.715	94.16	0.970	93.42	1.225	91.88
0.465	94.76	0.720	94.08	0.975	93.40	1.230	91.87
0.470	94.78	0.725	94.11	0.980	93.35	1.235	91.82
0.475	94.75	0.730	94.21	0.985	93.37	1.240	91.81

Wavelength µm	Absorption %
1.245	91.78
1.250	91.79
1.255	91.76
1.260	91.75
1.265	91.76
1.270	91.79
1.275	91.75
1.280	91.74
1.285	91.74
1.290	91.74
1.295	91.71
1.300	91.72
1.305	91.70
1.310	91.70
1.315	91.73
1.320	91.78
1.325	91.78
1.330	91.79
1.335	91.76
1.340	91.77
1.345	91.82
1.350	91.94
1.355	92.17
1.360	92.17
1.365	92.17
1.370	92.15
1.375	92.12
1.380	92.12
1.385	92.12
1.390	92.10
1.395	92.04
1.400	91.99
1.405	92.00
1.410	92.02
1.415	91.98
1.420	91.95
1.425	91.95
1.430	91.96
1.435	91.94
1.440	91.91
1.445	91.86
1.450	91.77
1.455	91.77
1.460	91.80
1.465	91.79
1.470	91.79
1.475	91.77
1.480	91.75
1.485	91.73
1.490	91.69
1.495	91.69
1.500	91.68
1.505	91.71

Wavelength µm	Absorption %
1.510	91.70
1.515	91.66
1.520	91.58
1.525	91.59
1.530	91.59
1.535	91.58
1.540	91.57
1.545	91.53
1.550	91.52
1.555	91.50
1.560	91.49
1.565	91.51
1.570	91.50
1.575	91.49
1.580	91.49
1.585	91.50
1.590	91.47
1.595	91.45
1.600	91.44
1.605	91.44
1.610	91.43
1.615	91.36
1.620	91.32
1.625	91.33
1.630	91.34
1.635	91.34
1.640	91.31
1.645	91.29
1.650	91.24
1.655	91.26
1.660	91.30
1.665	91.24
1.670	91.24
1.675	91.20
1.680	91.15
1.685	91.16
1.690	91.18
1.695	91.13
1.700	91.09
1.705	91.04
1.710	91.03
1.715	90.97
1.720	90.99
1.725	90.96
1.730	90.92
1.735	90.89
1.740	90.92
1.745	90.92
1.750	90.89
1.755	90.89
1.760	90.89
1.765	90.86
1.770	90.87

Wavelength µm	Absorption %
1.775	90.84
1.780	90.86
1.785	90.83
1.790	90.78
1.795	90.77
1.800	90.80
1.805	90.79
1.810	90.77
1.815	90.76
1.820	90.75
1.825	90.76
1.830	90.81
1.835	90.71
1.840	90.74
1.845	90.71
1.850	90.77
1.855	90.71
1.860	90.74
1.865	90.70
1.870	90.73
1.875	90.67
1.880	90.67
1.885	90.64
1.890	90.64
1.895	90.61
1.900	90.59
1.905	90.53
1.910	90.48
1.915	90.63
1.920	90.45
1.925	90.48
1.930	90.48
1.935	90.48
1.940	90.52
1.945	90.45
1.950	90.41
1.955	90.47
1.960	90.50
1.965	90.56
1.970	90.47
1.975	90.49
1.980	90.46
1.985	90.36
1.990	90.39
1.995	90.36
2.000	90.39
2.001	90.68
2.004	90.79
2.005	90.49
2.007	90.53
2.010	90.56
2.013	90.54
2.015	90.52

Wavelength µm	Absorption %
2.016	90.87
2.019	91.03
2.020	90.69
2.022	90.68
2.025	90.67
2.026	90.99
2.029	90.92
2.030	90.60
2.032	90.61
2.035	90.63
2.038	90.66
2.040	90.69
2.041	90.70
2.045	90.70
2.048	90.69
2.050	90.68
2.051	91.03
2.054	91.07
2.055	90.70
2.058	90.67
2.060	90.63
2.061	91.02
2.064	91.03
2.065	90.64
2.068	90.64
2.070	90.63
2.071	91.01
2.074	90.96
2.075	90.55
2.077	90.55
2.080	90.54
2.081	90.91
2.084	90.76
2.085	90.43
2.088	90.47
2.090	90.51
2.091	90.87
2.094	90.90
2.095	90.53
2.098	90.57
2.100	90.61
2.101	90.99
2.104	90.90
2.105	90.50
2.108	90.45
2.110	90.40
2.111	90.41
2.115	90.43
2.118	90.80
2.120	89.36
2.125	90.44
2.122	90.44
2.125	90.60

Wavelength µm	Absorption %
2.129	90.76
2.130	90.41
2.132	90.05
2.135	90.41
2.136	90.43
2.139	90.84
2.140	90.48
2.143	90.46
2.145	91.65
2.146	90.04
2.150	90.45
2.153	90.44
2.155	90.42
2.157	90.39
2.160	90.36
2.161	90.69
2.164	90.76
2.165	90.43
2.168	90.44
2.170	90.44
2.171	90.41
2.175	90.38
2.179	90.38
2.180	90.37
2.182	90.40
2.185	90.44
2.186	90.42
2.190	90.41
2.193	90.39
2.195	90.37
2.197	90.38
2.200	90.39
2.201	90.34
2.205	90.29
2.208	90.33
2.210	90.36
2.212	90.33
2.215	90.29
2.216	90.27
2.220	90.26
2.224	90.21
2.225	90.16
2.227	90.20
2.230	90.24
2.231	90.24
2.235	90.25
2.239	90.22
2.240	90.19
2.243	90.14
2.245	90.08
2.247	90.17
2.250	90.25
2.251	90.21

Wavelength µm	Absorption %
2.255	90.17
2.258	90.14
2.260	90.11
2.262	90.12
2.265	90.13
2.270	90.24
2.274	90.20
2.275	90.17
2.278	90.17
2.280	90.17
2.282	90.14
2.285	90.11
2.286	90.15
2.290	90.19
2.294	90.11
2.295	90.03
2.298	90.10
2.300	90.18
2.303	90.14
2.305	90.10
2.307	90.08
2.310	90.07
2.311	90.09
2.315	90.10
2.319	90.07
2.320	90.04
2.323	90.03
2.325	90.02
2.327	90.00
2.330	89.98
2.332	89.97
2.335	89.95
2.336	89.94
2.340	89.93
2.344	90.08
2.345	90.23
2.348	90.08
2.350	89.93
2.353	89.96
2.355	89.99
2.357	89.98
2.360	89.98
2.361	89.88
2.365	89.79
2.366	89.82
2.370	89.85
2.374	89.98
2.375	90.10
2.379	89.97
2.380	89.84
2.383	89.82
2.385	89.79
2.387	89.86

Wavelength µm	Absorption %
2.390	89.92
2.392	89.92
2.395	89.91
2.396	89.72
2.400	89.53
2.401	89.57
2.405	89.61
2.410	89.84
2.414	89.79
2.415	89.73
2.419	89.85
2.420	89.96
2.423	89.88
2.425	89.79
2.428	89.91
2.430	90.03
2.432	89.89
2.435	89.75
2.437	89.68
2.440	89.61
2.441	89.78
2.445	89.95
2.446	89.90
2.450	89.86
2.451	89.73
2.455	89.59
2.460	89.75
2.465	89.83
2.469	89.81
2.470	89.80
2.474	89.66
2.475	89.51
2.479	89.72
2.480	89.92
2.483	89.79
2.485	89.66
2.488	89.82
2.490	89.98
2.493	89.79
2.495	89.59
2.498	89.49
2.500	89.38
2.503	89.38
2.507	89.38
2.512	89.35
2.517	89.37
2.522	89.39
2.527	89.41
2.532	89.43
2.537	89.36
2.542	89.34
2.547	89.27
2.552	89.24

Wavelength µm	Absorption %
2.557	89.30
2.562	89.25
2.567	89.23
2.572	89.29
2.577	89.25
2.582	89.28
2.588	89.26
2.593	89.20
2.598	89.18
2.603	89.18
2.608	89.13
2.614	89.11
2.619	89.12
2.624	89.16
2.630	89.10
2.635	89.10
2.640	89.13
2.646	89.20
2.651	89.21
2.656	89.11
2.662	89.06
2.667	89.03
2.673	88.98
2.678	89.03
2.684	89.06
2.690	89.10
2.695	89.05
2.701	89.09
2.706	89.10
2.712	89.05
2.718	89.06
2.723	89.05
2.729	89.09
2.735	89.09
2.741	89.13
2.747	89.19
2.752	89.19
2.758	89.16
2.764	89.20
2.770	89.23
2.776	89.23
2.782	89.24
2.788	89.30
2.794	89.32
2.800	89.27
2.806	89.27
2.812	89.26
2.818	89.25
2.824	89.27
2.830	89.26
2.837	89.24
2.843	89.29
2.849	89.31

Wavelength µm	Absorption %
2.855	89.26
2.862	89.24
2.868	89.25
2.874	89.23
2.881	89.24
2.887	89.26
2.894	89.24
2.900	89.19
2.907	89.22
2.913	89.20
2.920	89.22
2.926	89.24
2.933	89.20
2.940	89.21
2.946	89.17
2.953	89.17
2.960	89.17
2.966	89.17
2.973	89.15
2.980	89.12
2.987	89.14
2.994	89.17
3.001	89.14
3.008	89.11
3.015	89.09
3.022	89.08
3.029	89.08
3.036	89.06
3.043	89.07
3.050	89.06
3.057	89.04
3.065	89.03
3.072	89.02
3.079	89.01
3.087	89.00
3.094	89.01
3.101	89.00
3.109	88.99
3.116	88.99
3.124	88.95
3.131	88.93
3.139	88.97
3.146	88.96
3.154	88.92
3.162	88.89
3.170	88.88
3.177	88.86
3.185	88.85
3.193	88.86
3.201	88.85
3.209	88.83
3.217	88.82
3.225	88.80

Wavelength µm	Absorption %
3.233	88.79
3.241	88.75
3.249	88.75
3.257	88.76
3.265	88.75
3.274	88.74
3.282	88.73
3.290	88.72
3.299	88.71
3.307	88.69
3.315	88.68
3.324	88.67
3.333	88.65
3.341	88.65
3.350	88.63
3.358	88.62
3.367	88.61
3.376	88.59
3.385	88.57
3.394	88.55
3.402	88.51
3.411	88.35
3.420	88.05
3.429	87.89
3.439	88.03
3.448	88.18
3.457	88.23
3.466	88.26
3.475	88.29
3.485	88.30
3.494	88.28
3.504	88.11
3.513	88.01
3.523	88.11
3.532	88.19
3.542	88.23
3.552	88.26
3.561	88.24
3.571	88.21
3.581	88.22
3.591	88.22
3.601	88.22
3.611	88.21
3.621	88.21
3.631	88.20
3.641	88.20
3.652	88.19
3.662	88.18
3.672	88.17
3.683	88.15
3.693	88.14
3.704	88.13
3.714	88.11

Wavelength µm	Absorption %
3.725	88.11
3.736	88.10
3.747	88.09
3.758	88.07
3.768	88.07
3.779	88.07
3.790	88.06
3.802	88.05
3.813	88.04
3.824	88.02
3.835	88.03
3.847	88.02
3.858	88.00
3.870	87.99
3.881	87.99
3.893	87.98
3.905	87.97
3.916	87.96
3.928	87.96
3.940	87.96
3.952	87.95
3.964	87.94
3.977	87.93
3.989	87.90
4.001	87.90
4.013	87.90
4.026	87.88
4.038	87.89
4.051	87.89
4.064	87.90
4.077	87.88
4.089	87.85
4.102	87.85
4.115	87.85
4.129	87.83
4.142	87.82
4.155	87.82
4.168	87.82
4.182	87.80
4.195	87.77
4.209	87.70
4.223	87.60
4.236	87.56
4.250	87.60
4.264	87.60
4.278	87.57
4.293	87.58
4.307	87.61
4.321	87.64
4.336	87.65
4.350	87.66
4.365	87.67
4.380	87.67

Wavelength µm	Absorption %
4.394	87.66
4.409	87.64
4.424	87.63
4.440	87.62
4.455	87.61
4.470	87.61
4.486	87.59
4.501	87.58
4.517	87.56
4.533	87.55
4.549	87.55
4.565	87.54
4.581	87.51
4.597	87.49
4.613	87.50
4.630	87.49
4.646	87.48
4.663	87.46
4.680	87.45
4.697	87.44
4.714	87.43
4.731	87.41
4.749	87.40
4.766	87.39
4.784	87.38
4.801	87.37
4.819	87.36
4.837	87.35
4.855	87.34
4.873	87.32
4.892	87.31
4.910	87.30
4.929	87.29
4.948	87.27
4.967	87.25
4.986	87.24
5.005	87.22
5.025	87.20
5.044	87.20
5.064	87.18
5.084	87.16
5.104	87.14
5.124	87.13
5.144	87.10
5.165	87.10
5.185	87.09
5.206	87.08
5.227	87.07
5.248	87.05
5.270	87.03
5.291	87.01
5.313	87.00
5.335	86.98

Wavelength µm	Absorption %	Wavelength µm	Absorption %	Wavelength µm	Absorption %	Wavelength µm	Absorption %
5.357	86.95	6.682	86.05	8.879	84.32	13.09	80.67
5.379	86.95	6.717	86.06	8.940	84.27	13.23	80.54
5.401	86.94	6.752	86.07	9.002	84.22	13.36	80.36
5.424	86.90	6.787	86.00	9.065	84.17	13.50	80.24
5.447	86.89	6.823	85.91	9.129	84.11	13.65	80.08
5.470	86.86	6.859	85.86	9.194	84.06	13.79	79.83
5.493	86.86	6.895	85.91	9.260	84.00	13.94	79.67
5.516	86.86	6.932	85.93	9.326	83.95	14.09	79.57
5.540	86.83	6.970	85.92	9.394	83.90	14.25	79.42
5.564	86.80	7.007	85.91	9.462	83.83	14.40	79.29
5.588	86.78	7.045	85.87	9.532	83.78	14.57	79.14
5.612	86.79	7.084	85.86	9.603	83.72	14.73	78.98
5.636	86.77	7.123	85.84	9.674	83.64	14.90	78.81
5.661	86.76	7.162	85.79	9.747	83.55	15.07	78.66
5.686	86.76	7.202	85.77	9.821	83.46	15.25	78.54
5.711	86.74	7.242	85.74	9.896	83.38	15.43	78.39
5.736	86.68	7.283	85.70	9.972	83.32	15.62	78.23
5.762	86.59	7.324	85.66	10.05	83.26	15.81	78.05
5.787	86.62	7.366	85.63	10.13	83.19	16.00	77.89
5.813	86.66	7.408	85.61	10.21	83.13	16.20	77.73
5.839	86.66	7.450	85.56	10.29	83.06	16.41	77.54
5.866	86.64	7.493	85.52	10.37	82.99	16.62	77.36
5.893	86.61	7.537	85.50	10.45	82.90	16.84	77.17
5.919	86.63	7.581	85.48	10.54	82.82	17.06	76.95
5.947	86.63	7.626	85.46	10.60	82.79	17.29	76.77
5.974	86.64	7.671	85.42	10.63	82.76	17.52	76.57
6.002	86.67	7.716	85.36	10.71	82.69	17.76	76.38
6.030	86.66	7.763	85.32	10.80	82.61	18.01	76.15
6.058	86.60	7.809	85.28	10.89	82.51	18.26	75.87
6.086	86.62	7.857	85.24	10.99	82.42	18.52	75.62
6.115	86.64	7.905	85.18	11.08	82.35	18.79	75.36
6.144	86.63	7.953	85.13	11.18	82.29	19.06	75.07
6.173	86.62	8.002	85.09	11.27	82.21	19.35	74.81
6.203	86.62	8.052	85.02	11.37	82.13	19.64	74.56
6.232	86.61	8.102	84.97	11.47	82.06	19.94	74.25
6.263	86.58	8.153	84.94	11.58	81.94	20.26	73.99
6.293	86.54	8.205	84.91	11.68	81.86	20.58	73.73
6.324	86.47	8.257	84.86	11.79	81.79	20.91	73.41
6.355	86.39	8.310	84.82	11.89	81.69	21.25	73.14
6.386	86.34	8.364	84.77	12.00	81.60	21.61	72.90
6.418	86.26	8.418	84.73	12.12	81.50	21.97	72.65
6.450	86.23	8.473	84.69	12.23	81.40	22.35	72.37
6.482	86.15	8.529	84.60	12.35	81.29	22.74	71.98
6.514	86.12	8.585	84.50	12.47	81.21	23.15	71.60
6.547	86.10	8.642	84.47	12.59	81.10	23.57	71.31
6.580	86.05	8.700	84.45	12.71	80.98	24.01	70.85
6.614	86.03	8.759	84.41	12.84	80.85	24.46	70.50
6.648	86.03	8.819	84.37	12.96	80.74		

Note: Due to variability in the manufacturing process the absorption in the UV region varies.
Calibration at 266nm is recommended if the detector is to be used in the UV region.

P MODEL PYROELECTRIC DETECTOR ABSORPTION VS. WAVELENGTH:

Use this table for standard and slim profile painted (P) model pyroelectric detectors.

Wavelength μm	Absorption %
0.30	96.850
0.40	96.850
0.50	96.850
0.60	96.850
0.70	96.850
0.80	96.850
0.90	96.850
1.00	96.850
1.10	96.850
1.20	96.850
1.30	96.309
1.40	95.768

Wavelength μm	Absorption %
1.50	94.931
1.60	94.094
1.70	94.094
1.80	94.094
1.90	93.209
2.00	92.323
2.00	92.323
2.10	91.831
2.20	91.339
2.39	89.092
3.00	86.542
3.42	86.032

Wavelength μm	Absorption %
4.00	80.251
4.22	77.191
5.00	84.672
6.00	85.522
7.00	86.032
8.00	91.133
8.17	90.113
9.00	90.793
10.00	89.772
18.61	89.432
20.00	90.793
22.80	91.133

HF Model Pyroelectric Detector Absorption vs. Wavelength:

Use this table for standard and slim profile high frequency (HF) model pyroelectric detectors.

Wavelength µm	Absorption %	Wavelength µm	Absorption %	Wavelength µm	Absorption %	Wavelength µm	Absorption %
0.200	58.05	0.68	51.99	1.19	57.51	1.70	59.91
0.210	57.59	0.69	52.06	1.20	57.58	1.71	59.78
0.220	58.33	0.70	52.17	1.21	57.75	1.72	59.65
0.230	57.76	0.71	52.23	1.22	57.93	1.73	59.60
0.240	57.18	0.72	52.29	1.23	58.09	1.74	59.65
0.250	56.55	0.73	52.36	1.24	58.27	1.75	59.70
0.260	56.08	0.74	52.45	1.25	58.40	1.76	59.84
0.270	55.63	0.75	52.48	1.26	58.51	1.77	59.93
0.280	55.35	0.76	52.51	1.27	58.66	1.78	60.09
0.290	55.07	0.77	52.54	1.28	58.81	1.79	60.26
0.300	54.79	0.78	52.66	1.29	58.91	1.80	60.49
0.310	54.56	0.79	52.61	1.30	59.04	1.81	60.49
0.320	54.21	0.80	51.81	1.31	59.14	1.82	60.48
0.330	53.91	0.81	52.05	1.32	59.22	1.83	60.47
0.340	53.74	0.82	52.29	1.33	59.32	1.84	60.44
0.350	53.03	0.83	52.23	1.34	59.36	1.85	60.38
0.360	52.95	0.84	52.73	1.35	59.44	1.86	60.40
0.370	52.62	0.85	53.33	1.36	59.48	1.87	60.41
0.375	52.42	0.86	53.37	1.37	59.53	1.88	60.39
0.380	52.21	0.87	53.53	1.38	59.60	1.89	60.35
0.390	51.81	0.88	53.69	1.39	59.63	1.90	60.39
0.400	51.25	0.89	53.82	1.40	59.64	1.91	60.32
0.410	50.94	0.90	53.97	1.41	59.72	1.92	60.34
0.420	50.77	0.91	54.12	1.42	59.75	1.93	60.26
0.425	50.65	0.92	54.26	1.43	59.81	1.94	60.10
0.430	50.52	0.93	54.34	1.44	59.87	1.95	60.00
0.440	50.36	0.94	54.53	1.45	59.92	1.96	59.95
0.450	50.18	0.95	54.59	1.46	59.92	1.97	59.98
0.460	49.96	0.96	54.70	1.47	59.99	1.98	59.88
0.470	49.87	0.97	54.74	1.48	60.00	1.99	59.84
0.480	49.83	0.98	54.88	1.49	60.02	2.000	59.87
0.490	49.73	0.99	55.04	1.50	60.06	2.003	60.35
0.500	49.68	1.00	55.16	1.51	60.11	2.006	60.39
0.510	49.64	1.01	55.34	1.52	60.11	2.009	60.40
0.520	49.65	1.02	55.51	1.53	60.16	2.012	60.38
0.530	49.70	1.03	55.68	1.54	60.13	2.016	60.35
0.540	49.83	1.04	55.84	1.55	60.10	2.019	60.31
0.550	49.86	1.05	56.01	1.56	60.22	2.022	60.32
0.560	49.95	1.06	56.14	1.57	60.26	2.025	60.36
0.570	50.08	1.07	56.33	1.58	60.28	2.028	60.37
0.575	50.17	1.08	56.49	1.59	60.32	2.031	60.34
0.580	50.25	1.09	56.62	1.60	60.36	2.034	60.31
0.590	50.47	1.10	56.77	1.61	60.34	2.038	60.29
0.600	50.70	1.11	56.87	1.62	60.30	2.041	60.27
0.610	50.91	1.12	56.99	1.63	60.25	2.044	60.28
0.620	51.08	1.13	57.10	1.64	60.20	2.047	60.31
0.630	51.27	1.14	57.19	1.65	60.18	2.051	60.33
0.640	51.44	1.15	57.29	1.66	60.18	2.054	60.31
0.650	51.64	1.16	57.36	1.67	60.22	2.057	60.30
0.660	51.78	1.17	57.40	1.68	60.14	2.060	60.28
0.670	51.86	1.18	57.47	1.69	60.06	2.064	60.25

Wavelength µm	Absorption %	Wavelength µm	Absorption %	Wavelength µm	Absorption %	Wavelength µm	Absorption %
2.067	60.27	2.257	60.06	2.487	59.79	2.768	59.39
2.070	60.28	2.261	60.05	2.491	59.80	2.774	59.45
2.073	60.24	2.265	60.05	2.496	59.81	2.780	59.44
2.077	60.24	2.269	60.05	2.501	59.80	2.786	59.44
2.080	60.24	2.273	60.01	2.506	59.78	2.792	59.49
2.083	60.25	2.277	59.99	2.511	59.75	2.798	59.46
2.087	60.26	2.281	59.99	2.516	59.74	2.804	59.44
2.09	60.25	2.285	59.99	2.520	59.75	2.810	59.50
2.094	60.25	2.289	60.00	2.525	59.74	2.816	59.50
2.097	60.25	2.293	60.01	2.530	59.72	2.822	59.51
2.100	60.23	2.297	60.00	2.535	59.70	2.828	59.51
2.104	60.24	2.301	59.97	2.540	59.69	2.834	59.51
2.107	60.26	2.306	59.96	2.545	59.65	2.840	59.53
2.111	60.24	2.310	59.96	2.550	59.65	2.847	59.55
2.114	60.22	2.314	59.96	2.555	59.63	2.853	59.58
2.117	60.22	2.318	59.96	2.560	59.54	2.859	59.64
2.121	60.22	2.322	59.96	2.565	59.51	2.866	59.68
2.124	60.23	2.326	59.97	2.570	59.52	2.872	59.67
2.128	60.23	2.330	59.96	2.575	59.49	2.878	59.63
2.131	60.22	2.335	59.96	2.581	59.47	2.885	59.57
2.135	60.21	2.339	59.95	2.586	59.44	2.891	59.53
2.138	60.20	2.343	59.94	2.591	59.41	2.897	59.50
2.142	60.20	2.347	59.92	2.596	59.43	2.904	59.49
2.145	60.17	2.352	59.91	2.601	59.43	2.910	59.50
2.149	60.16	2.356	59.92	2.607	59.43	2.917	59.49
2.153	60.16	2.360	59.92	2.612	59.45	2.924	59.48
2.156	60.17	2.364	59.92	2.617	59.46	2.930	59.49
2.160	60.18	2.369	59.92	2.622	59.49	2.937	59.49
2.163	60.17	2.373	59.91	2.628	59.48	2.943	59.48
2.167	60.15	2.377	59.90	2.633	59.54	2.950	59.49
2.171	60.13	2.382	59.89	2.638	59.61	2.957	59.48
2.174	60.12	2.386	59.90	2.644	59.60	2.964	59.48
2.178	60.13	2.390	59.91	2.649	59.58	2.970	59.48
2.182	60.16	2.395	59.89	2.655	59.53	2.977	59.48
2.185	60.16	2.399	59.87	2.660	59.40	2.984	59.48
2.189	60.15	2.404	59.87	2.665	59.23	2.991	59.47
2.193	60.14	2.408	59.86	2.671	59.23	2.998	59.47
2.196	60.12	2.413	59.85	2.676	59.32	3.005	59.48
2.200	60.12	2.417	59.84	2.682	59.44	3.012	59.47
2.204	60.11	2.422	59.85	2.687	59.47	3.019	59.46
2.208	60.10	2.426	59.86	2.693	59.46	3.026	59.45
2.211	60.11	2.431	59.85	2.699	59.51	3.033	59.45
2.215	60.11	2.435	59.83	2.704	59.49	3.040	59.45
2.219	60.09	2.440	59.82	2.710	59.44	3.047	59.45
2.223	60.08	2.445	59.81	2.716	59.38	3.054	59.46
2.226	60.08	2.449	59.82	2.721	59.36	3.062	59.46
2.230	60.06	2.454	59.83	2.727	59.49	3.069	59.45
2.234	60.05	2.458	59.84	2.733	59.45	3.076	59.45
2.238	60.06	2.463	59.83	2.739	59.36	3.083	59.46
2.242	60.05	2.468	59.82	2.744	59.46	3.091	59.47
2.246	60.01	2.472	59.81	2.750	59.47	3.098	59.46
2.250	60.00	2.477	59.78	2.756	59.39	3.105	59.45
2.254	60.02	2.482	59.78	2.762	59.36	3.113	59.46

Wavelength µm	Absorption %
3.120	59.47
3.128	59.47
3.135	59.47
3.143	59.48
3.151	59.47
3.158	59.47
3.166	59.47
3.174	59.48
3.182	59.48
3.189	59.48
3.197	59.47
3.205	59.47
3.213	59.47
3.221	59.46
3.229	59.47
3.237	59.48
3.245	59.47
3.253	59.47
3.262	59.46
3.270	59.46
3.278	59.46
3.286	59.46
3.295	59.46
3.303	59.46
3.312	59.46
3.320	59.46
3.328	59.46
3.337	59.45
3.346	59.45
3.354	59.44
3.363	59.43
3.372	59.41
3.381	59.41
3.389	59.40
3.398	59.39
3.407	59.37
3.416	59.36
3.425	59.37
3.434	59.38
3.443	59.39
3.452	59.39
3.462	59.39
3.471	59.39
3.480	59.38
3.490	59.37
3.499	59.36
3.508	59.36
3.518	59.37
3.528	59.39
3.537	59.39
3.547	59.39
3.557	59.38
3.566	59.38

Wavelength µm	Absorption %
3.576	59.37
3.586	59.36
3.596	59.36
3.606	59.36
3.616	59.36
3.626	59.35
3.636	59.35
3.646	59.35
3.657	59.34
3.667	59.32
3.677	59.32
3.688	59.32
3.698	59.32
3.709	59.31
3.720	59.30
3.730	59.29
3.741	59.28
3.752	59.28
3.763	59.27
3.774	59.26
3.785	59.26
3.796	59.25
3.807	59.23
3.818	59.22
3.829	59.21
3.841	59.21
3.852	59.20
3.864	59.19
3.875	59.19
3.887	59.18
3.898	59.17
3.910	59.16
3.922	59.15
3.934	59.14
3.946	59.13
3.958	59.12
3.970	59.11
3.982	59.10
3.994	59.09
4.007	59.08
4.019	59.07
4.032	59.06
4.044	59.05
4.057	59.05
4.070	59.04
4.082	59.03
4.095	59.02
4.108	59.01
4.121	59.00
4.134	58.99
4.148	58.98
4.161	58.97
4.174	58.96

Wavelength µm	Absorption %
4.188	58.92
4.201	58.80
4.215	58.63
4.229	58.56
4.242	58.64
4.256	58.66
4.270	58.60
4.284	58.59
4.299	58.66
4.313	58.71
4.327	58.75
4.342	58.77
4.356	58.76
4.371	58.75
4.386	58.73
4.401	58.72
4.416	58.71
4.431	58.70
4.446	58.69
4.461	58.68
4.477	58.66
4.492	58.65
4.508	58.65
4.523	58.64
4.539	58.63
4.555	58.62
4.571	58.61
4.587	58.60
4.604	58.59
4.620	58.57
4.636	58.56
4.653	58.55
4.670	58.54
4.687	58.52
4.704	58.50
4.721	58.48
4.738	58.46
4.755	58.44
4.773	58.41
4.791	58.38
4.808	58.36
4.826	58.33
4.844	58.30
4.862	58.28
4.881	58.26
4.899	58.24
4.918	58.22
4.936	58.20
4.955	58.18
4.974	58.17
4.993	58.14
5.013	58.12
5.032	58.12

Wavelength µm	Absorption %
5.052	58.11
5.071	58.09
5.091	58.09
5.111	58.08
5.131	58.07
5.152	58.08
5.172	58.07
5.193	58.04
5.214	58.05
5.235	58.07
5.256	58.08
5.278	58.08
5.299	58.10
5.321	58.08
5.343	58.08
5.365	58.14
5.387	58.14
5.410	58.14
5.432	58.18
5.455	58.23
5.478	58.33
5.501	58.41
5.525	58.44
5.548	58.45
5.572	58.52
5.596	58.58
5.620	58.57
5.645	58.60
5.669	58.63
5.694	58.58
5.719	58.50
5.745	58.46
5.770	58.47
5.796	58.37
5.822	58.22
5.848	58.06
5.875	57.92
5.901	57.91
5.928	57.88
5.956	57.88
5.983	57.96
6.011	57.91
6.039	57.83
6.067	57.94
6.095	58.06
6.124	58.12
6.153	58.16
6.183	58.24
6.212	58.32
6.242	58.35
6.272	58.34
6.303	58.25
6.333	58.12

Wavelength µm	Absorption %	Wavelength µm	Absorption %	Wavelength µm	Absorption %	Wavelength µm	Absorption %
6.365	57.97	7.870	57.74	10.31	60.33	14.93	43.14
6.396	57.83	7.918	57.73	10.39	60.59	15.11	42.72
6.428	57.83	7.966	57.73	10.47	60.88	15.28	41.67
6.460	57.76	8.015	57.73	10.56	61.18	15.47	40.14
6.492	57.75	8.065	57.73	10.65	61.51	15.65	38.41
6.525	57.77	8.116	57.73	10.73	61.88	15.84	36.53
6.557	57.69	8.167	57.74	10.82	62.26	16.04	34.41
6.591	57.67	8.218	57.74	10.91	62.62	16.24	32.05
6.624	57.73	8.271	57.75	11.01	63.01	16.45	29.57
6.658	57.81	8.324	57.76	11.10	63.50	16.66	27.22
6.693	57.88	8.378	57.77	11.20	63.99	16.87	25.74
6.727	57.88	8.432	57.78	11.29	64.25	17.10	26.08
6.762	57.82	8.487	57.80	11.39	64.19	17.32	28.33
6.798	57.76	8.543	57.82	11.49	63.83	17.56	31.38
6.834	57.73	8.600	57.84	11.60	63.27	17.80	34.24
6.870	57.79	8.657	57.87	11.70	62.55	18.05	36.63
6.906	57.84	8.715	57.91	11.81	61.82	18.30	38.49
6.943	57.79	8.774	57.94	11.92	61.29	18.56	39.88
6.981	57.76	8.834	57.98	12.03	60.83	18.83	41.13
7.018	57.74	8.894	58.02	12.14	60.22	19.11	42.50
7.057	57.78	8.956	58.07	12.25	59.45	19.40	43.95
7.095	57.77	9.018	58.14	12.37	58.61	19.69	45.40
7.134	57.73	9.081	58.20	12.49	57.76	19.99	46.70
7.174	57.76	9.145	58.26	12.61	56.91	20.31	47.76
7.214	57.79	9.210	58.32	12.73	56.06	20.63	48.85
7.254	57.78	9.276	58.39	12.86	55.20	20.96	50.32
7.295	57.76	9.343	58.45	12.99	54.32	21.31	52.14
7.336	57.78	9.410	58.52	13.12	53.42	21.66	53.52
7.378	57.80	9.479	58.61	13.25	52.50	22.03	52.80
7.420	57.77	9.549	58.69	13.39	51.53	22.41	49.83
7.462	57.76	9.620	58.79	13.53	50.51	22.80	47.84
7.506	57.77	9.691	58.91	13.67	49.46	23.21	48.44
7.549	57.76	9.764	59.04	13.82	48.42	23.63	48.80
7.593	57.76	9.838	59.18	13.97	47.38	24.07	47.13
7.638	57.77	9.913	59.34	14.12	46.39	24.53	44.58
7.683	57.77	9.990	59.51	14.28	45.49	25.00	41.82
7.729	57.76	10.07	59.69	14.43	44.72	25.49	39.64
7.775	57.75	10.15	59.88	14.60	44.02	26.00	38.04
7.822	57.74	10.23	60.09	14.76	43.45		

Note: Due to variability in the manufacturing process the absorption in the UV region varies.
Calibration at 266nm is recommended if the detector is to be used in the UV region.

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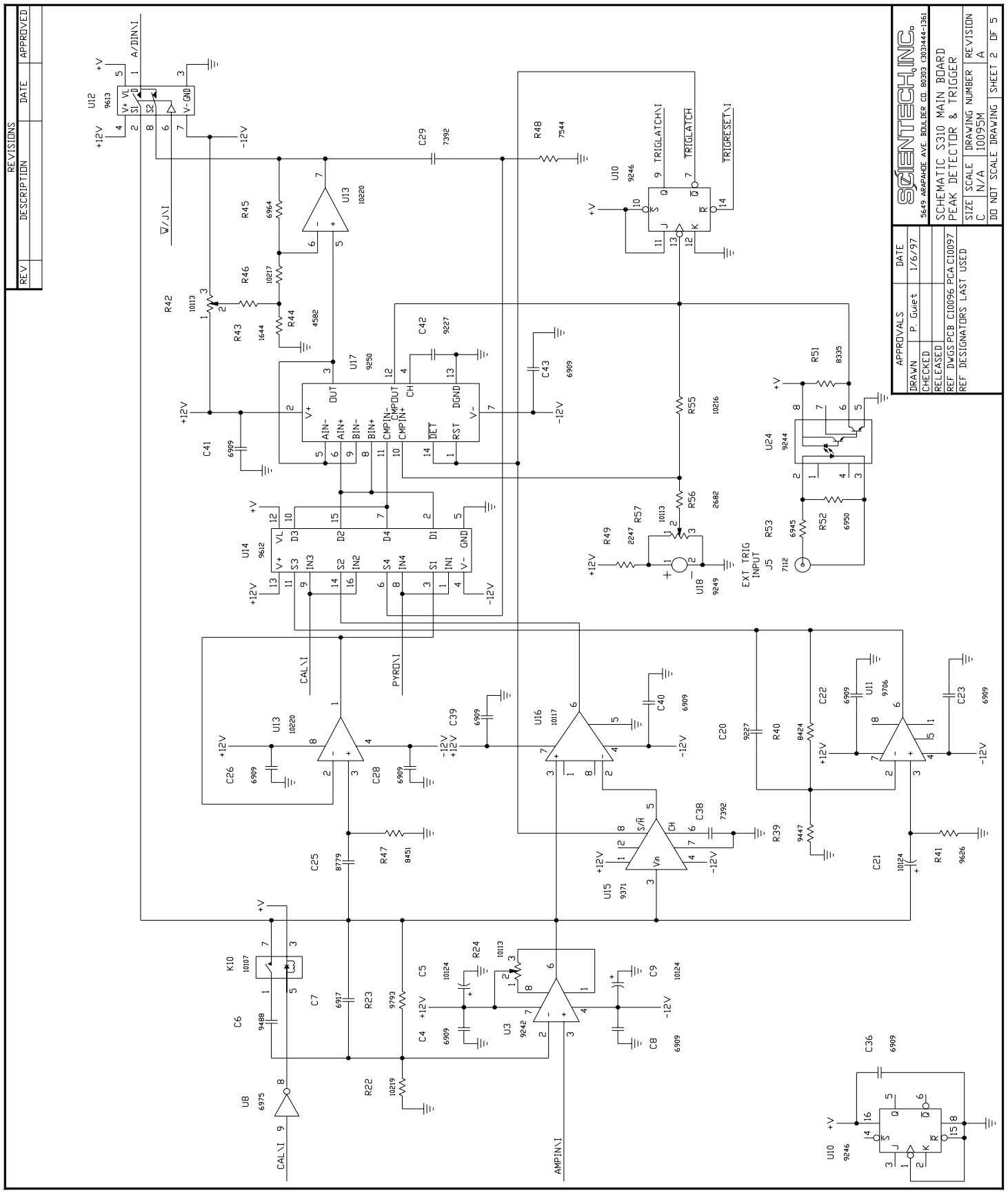
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DATE
APPROVED
SCIENTECH INC
5649 ARAPAHOE AVE. BOULDER CO. 80303 (303)444-1361
APPROVALS
DATE
DRAWN P. Guiet 1/6/97
CHECKED
RELEASED
REF DWGS PCB C10096 PCA C10097
REF DESIGNATORS LAST USED
SCHEMATIC S310 MAIN BOARD
PEAK DETECTOR & TRIGGER
SIZE C
SCALE N/A
DRAWING NUMBER 10095M
REVISION A
DO NOT SCALE DRAWING
SHEET 2 OF 5
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A/DIN\I
+12V
-12V
+V
C29
R48
U13
R45
R46
R42
R43
R44
U17
C42
C43
C41
U10
TRIGLATCH\I
TRIGLATCH
TRIGRESET\I
R55
R56
R57
R49
R51
R52
R53
U24
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U18
U14
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C39
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C26
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R40
C22
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R39
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C25
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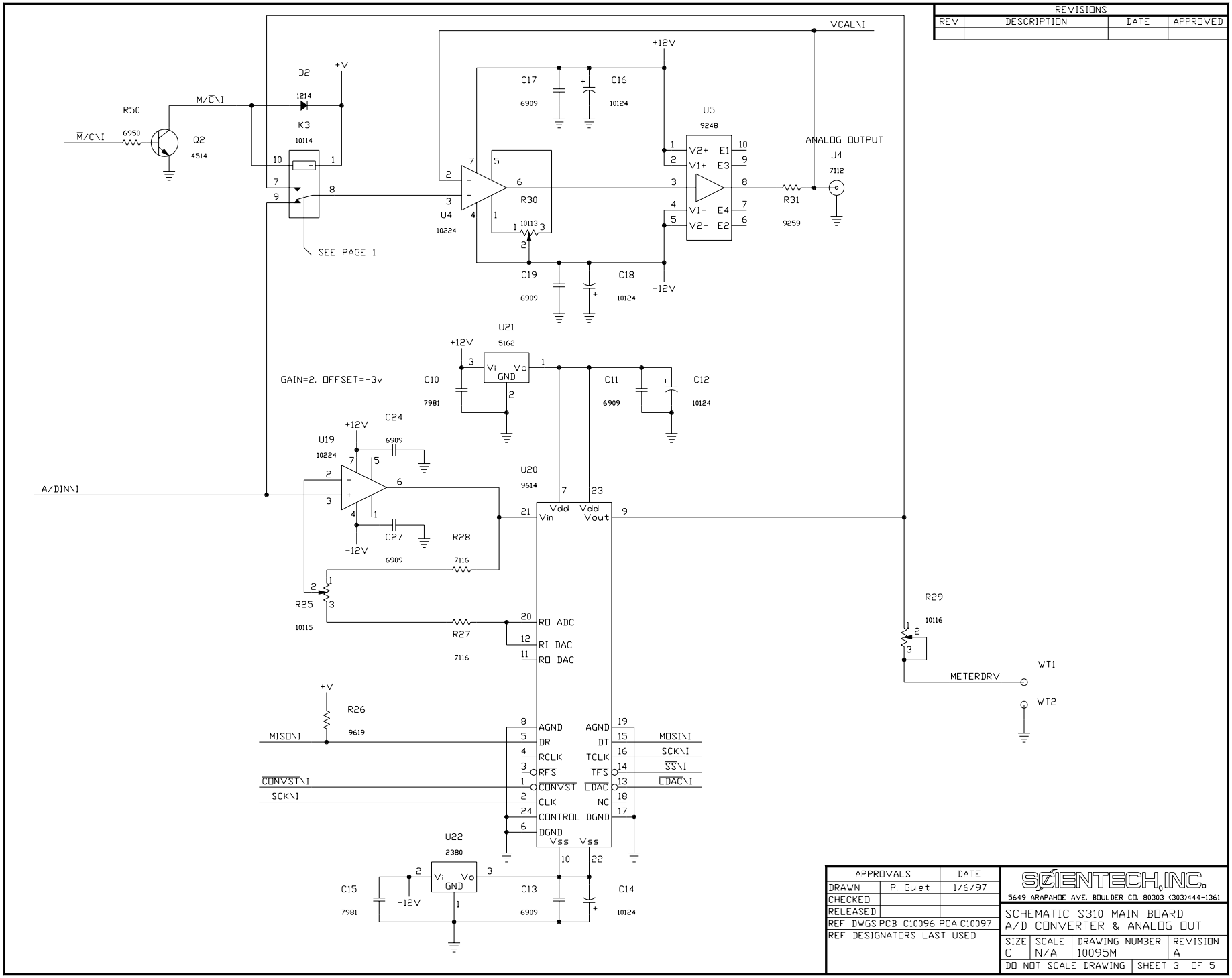
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K3
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C16
10124
U5
9248
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R30
U4
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10113
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9259
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C18
10124
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U21
5162
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C11
6909
C12
10124
C24
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U19
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U20
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C27
6909
R28
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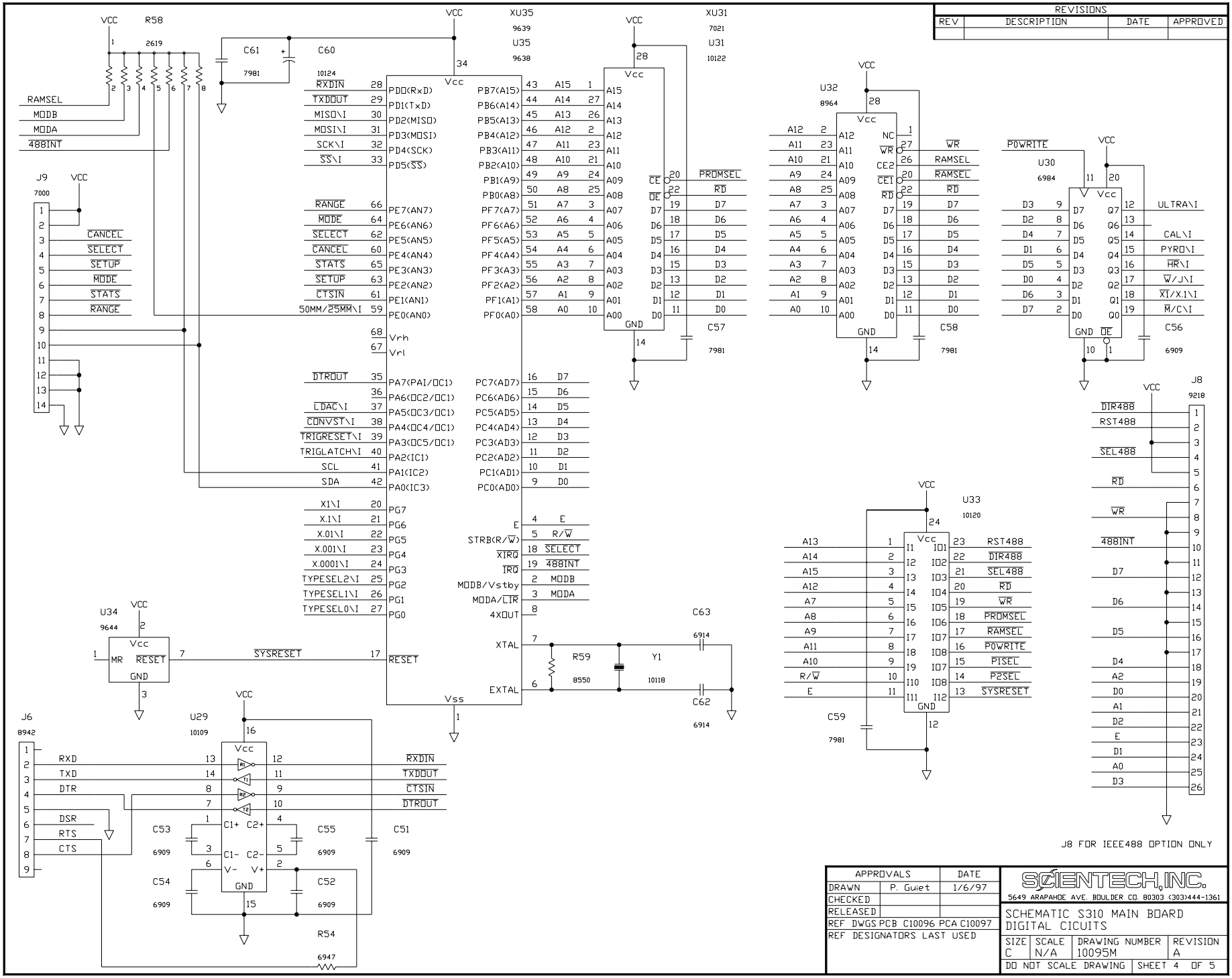
R25
10115
R27
7116
R29
10116
METERDRV
WT1
WT2
R26
9619
MISO\I
CONVST\I
SCK\I
MOSI\I
SCK\I
SS\I
LDAC\I
U22
2380
C15
7981
C13
6909
C14
10124
APPROVALS | DATE
DRAWN | P. Guiet | 1/6/97
CHECKED
RELEASED
REF DWGS PCB C10096 PCA C10097
REF DESIGNATORS LAST USED
SCIENTECH, INC.
5649 ARAPAHOE AVE. BOULDER CO. 80303 (303)444-1361
SCHEMATIC S310 MAIN BOARD
A/D CONVERTER & ANALOG OUT
SIZE C | SCALE N/A | DRAWING NUMBER 10095M | REVISION A
DO NOT SCALE DRAWING | SHEET 3 OF 5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Vcc
GND
RXDIN
TXDOUT
MISO\I
MOSI\I
SCK\I
SS\I
RANGE
MODE
SELECT
CANCEL
STATS
SETUP
CTSIN
50MM/25MM\I
Vrh
Vrl
DTROUT
LDAC\I
CONVST\I
TRIGRESET\I
TRIGLATCH\I
SCL
SDA
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RAMSEL
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DIR488
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APPROVALS | DATE
DRAWN | P. Guiet | 1/6/97
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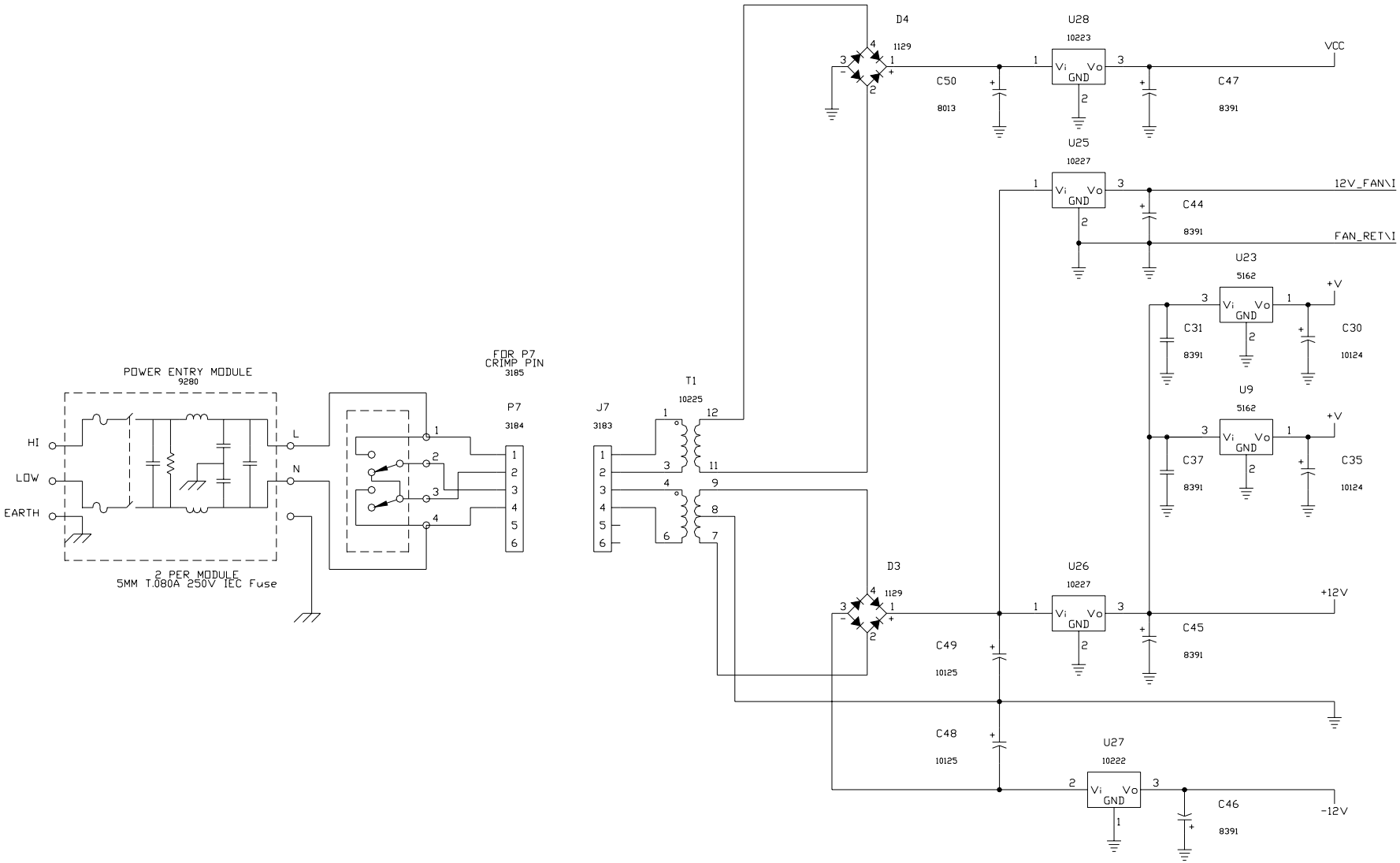
RELEASED
REF DWGS PCB C10096 PCA C10097
REF DESIGNATORS LAST USED
SCIENTECH, INC.
5649 ARAPAHOE AVE. BOULDER CO. 80303 (303)444-1361
SCHEMATIC S310 MAIN BOARD
DIGITAL CICUITS
SIZE C | SCALE N/A | DRAWING NUMBER 10095M | REVISION A
DO NOT SCALE DRAWING | SHEET 4 OF 5

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



APPROVALS		DATE
DRAWN	P. Guiet	1/6/97
CHECKED		
RELEASED		
REF DWGS PCB C10096 PCA C10097		
REF DESIGNATORS LAST USED		

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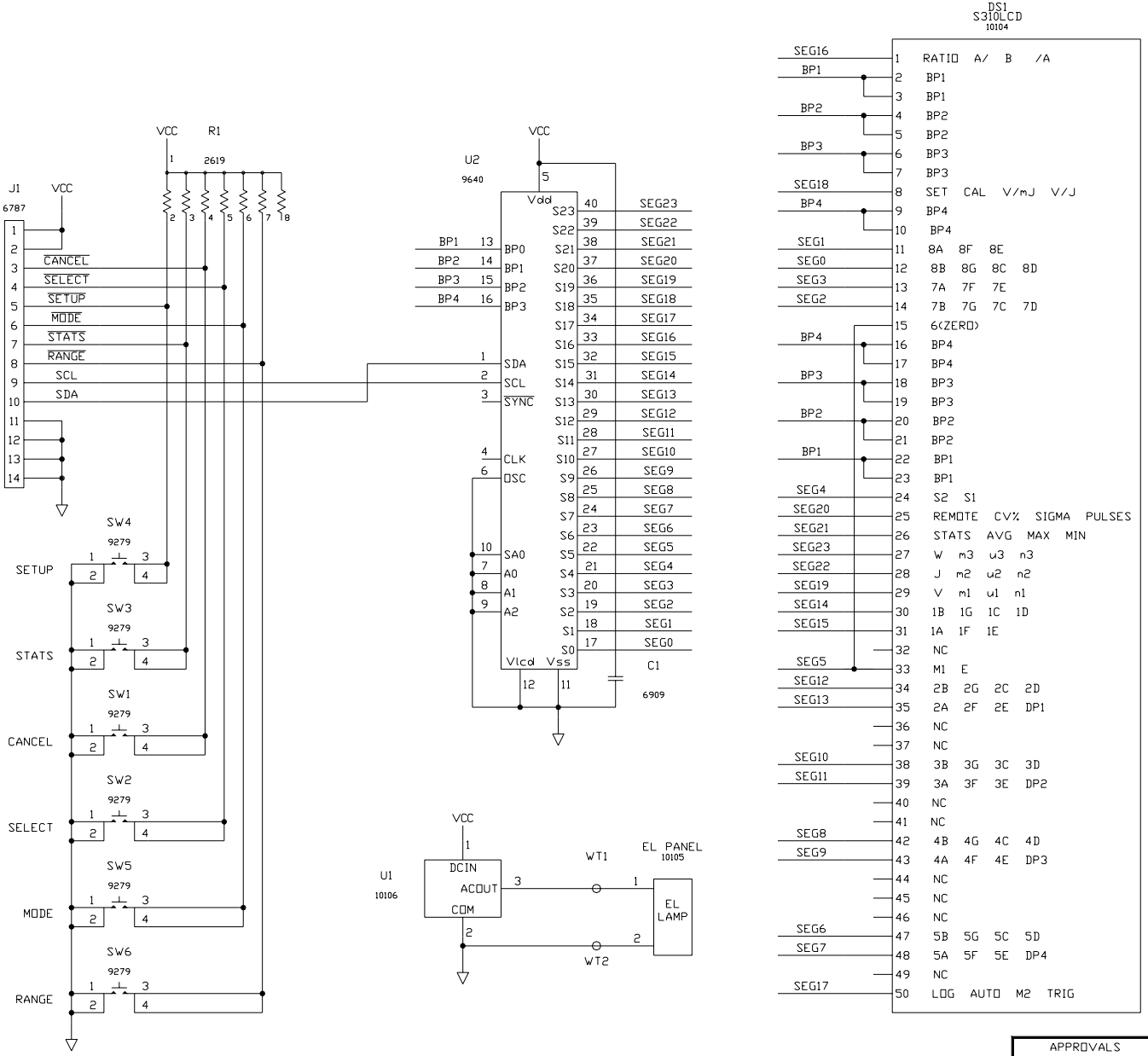
SCHEMATIC S310 MAIN BOARD
POWER SUPPLY

SIZE	SCALE	DRAWING NUMBER	REVISION
C	N/A	10095M	A
DO NOT SCALE DRAWING		SHEET 5 OF 5	

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



APPROVALS		DATE
DRAWN	P. Guiet	1/6/97
CHECKED		
RELEASED		
REF DWGS PCB C10099 PCA C10100		
REF DESIGNATORS LAST USED C1,DS1,J1,R1,SW6,U2		

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SCHEMATIC S310 DISPLAY BOARD

SIZE	SCALE	DRAWING NUMBER	REVISION
C	N/A	10098M	A
DO NOT SCALE DRAWING		SHEET 1 OF 1	