

SCIENTECH®



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

Serial Number _____

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: _____ $^{\circ}\text{C}$
 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: _____ $^{\circ}\text{C}$
 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: _____ $^{\circ}\text{C}$

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: _____ $^{\circ}\text{C}$

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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	5°C to 40°C	
Power Requirement	120 Volts, 60 Hz \pm 10 % or 220 Volts, 50 Hz \pm 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 CO₂ wavelength.

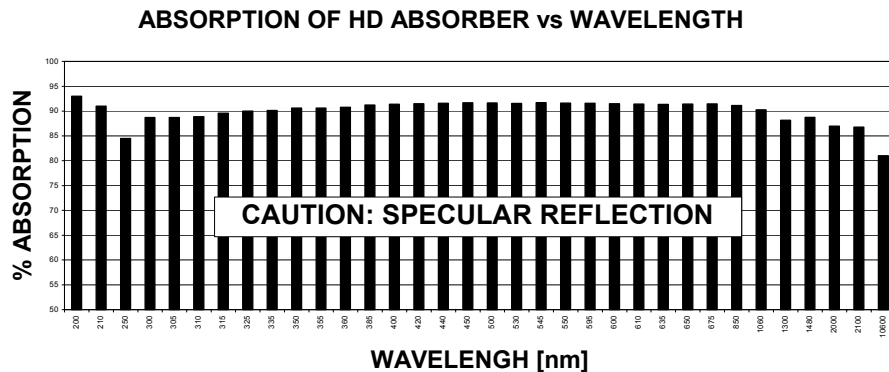


Figure 1

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 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/cm² = 4500 x (pulse width)^{1/2} to a maximum of 1.4 J/cm².
Maximum pulse width of the pyroelectric detector must be observed.
- Note 3: HDX models Max J/cm² = 36,000 x (pulse width)^{1/2} to a maximum of 12.6 J/cm².
Maximum pulse width of the pyroelectric detector must be observed.
- Note 4: HDXUV models Max J/cm² = 18,000 x (pulse width)^{1/2} to a maximum of 5.6 J/cm².
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				1.5 μJ	3.5 μJ
S, I	0.3 μJ	1.5 μJ	3.5 μJ		
L	15 μJ	75 μJ	350 μJ		
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 $\text{J}/\text{cm}^2 = 316 \times (\text{pulse width})^{1/2}$				
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/cm ²	1.5 kW/cm ²	12 kW/cm ²	Note 1	Note 2	Note 3	Note 4
Maximum Peak Power Density	1 MW/cm ²	100 MW/cm ²	800 MW/cm ²	Note 5	8.5 GW/cm ²	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/cm ²	1.5 kW/cm ²	12 kW/cm ²	Note 1	Note 2	Note 3	Note 4
Maximum Peak Power Density	1 MW/cm ²	100 MW/cm ²	800 MW/cm ²	Note 5	8.5 GW/cm ²	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/cm² @ 1064nm, 23W/cm² @ 532nm, 8.5W/cm² @ 355nm, 175mW/cm² @ 266nm
- Note 2: ACX2501, ACX5001 Note 1 specs x 8 for 400nm to 1.2 μm
- Note 3: AC25UV, AC50UV 50W/cm² @ 355nm
- Note 4: AC2504, AC5004 35W/cm² @1064nm
- Note 5: AC2501, AC5001 100GW/cm² @ 1064nm, 78GW/cm² @532nm, 29GW/cm² @ 355nm, 580MW/cm² @266nm
- Note 6: AC25UV, AC50UV Repetitive pulses: 101MW/cm² @ 355nm
Single pulses: 3.5GW/cm² @ 355nm
- Note 7: AC2504, AC5004 125GW/cm² @ 1064nm
- Note 8: AC2500, AC5000 Max J/cm² = 1,000 x (pulse width)^{1/2} to a maximum of 200J/cm².
- Note 9: AC25HD, AC50HD Max J/cm² = 4,500 x (pulse width)^{1/2} to a maximum of 14J/cm².
- Note 10: ACX25HD, ACX50HD Max J/cm² = 36,000 x (pulse width)^{1/2} to a maximum of 42.5J/cm².
- Note 11: AC2501, AC5001 Repetitive pulses: 4.1J/cm²@1064nm, 3.2J/cm²@532nm, 1.2J/cm²@355nm, 24mJ/cm²@266nm
Single pulses: 8J/cm²@1064nm, 6.2J/cm²@532nm, 2.3J/cm²@355nm, 46mJ/cm²@266nm
- Note 12: ACX2501, ACX5001 Note 11 specs x 8 for 400nm to 1.2 μm
- Note 13: AC25UV, AC50UV Repetitive pulses: 1.1J/cm² @ 355nm
Single pulses: 40J/cm² @ 355nm
- Note 14: AC2504, AC5004 Repetitive pulses: 4.8J/cm² @ 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
Maximum Beam Diameter	100mm				200mm			
Minimum Beam Diameter	5cm				7.5cm			
Spectral Response	.25 - 35 μ m	.266 - 1.2 μ m	9 - 11 μ m	.193 - .36 μ m	.25 - 35 μ m	.266 - 1.2 μ m	9 - 11 μ m	.193 - .36 μ m
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/cm ²	See Note 1	4W/cm ²	Note 2	200W/cm ²	See Note 3	4W/cm ²	Note 2
Maximum Peak Power Density	1MW/cm ²	See Note 4	100MW/cm ²	See Note 5	1MW/cm ²	See Note 6	100MW/cm ²	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 @ 265 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/cm ² @ 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 %			
Response 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/cm² = 1000 x (pulse width)^{1/2} to a maximum of 200J/cm²

Note 2: UC150HD, UC150HD40

Maximum J/cm² = 4500 x (pulse width)^{1/2} to a maximum of 14J/cm²

Note 3: UC150UV

Repetitive pulses: 1.1J/cm² @ 355nm

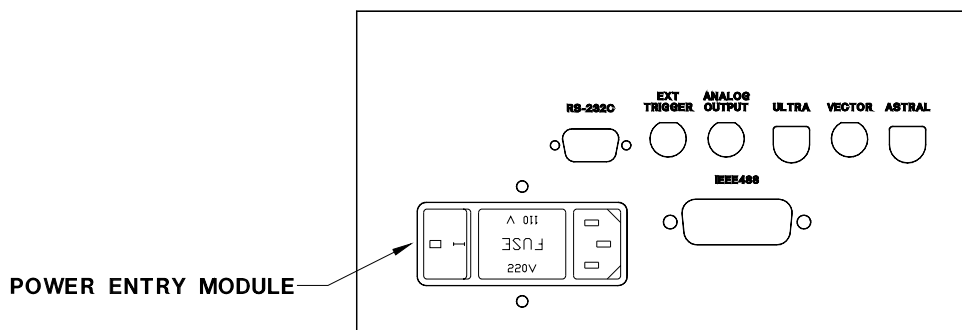
Single pulses: 40J/cm² @ 355nm

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.

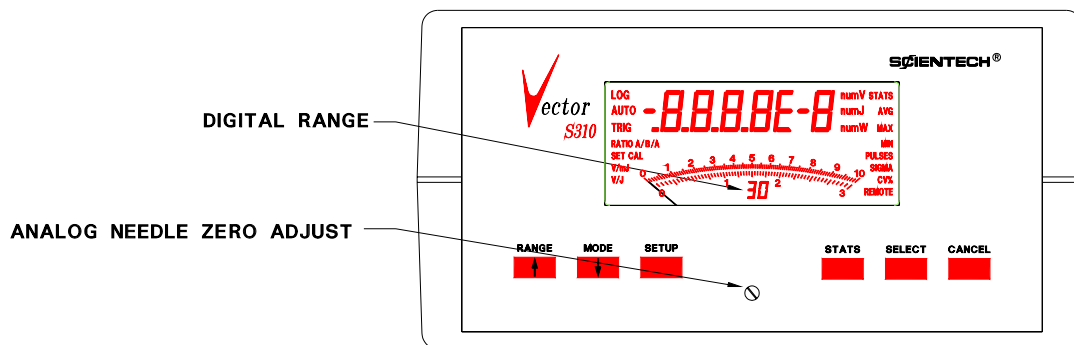
If you purchased more than one detector with the S310, you must choose the Group setting for the detector you are connecting to the S310 in step 4. The Group Setting for each detector purchased with your S310 is shown on page 2. To select a Group Setting, press the SETUP button repeatedly until the desired 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.

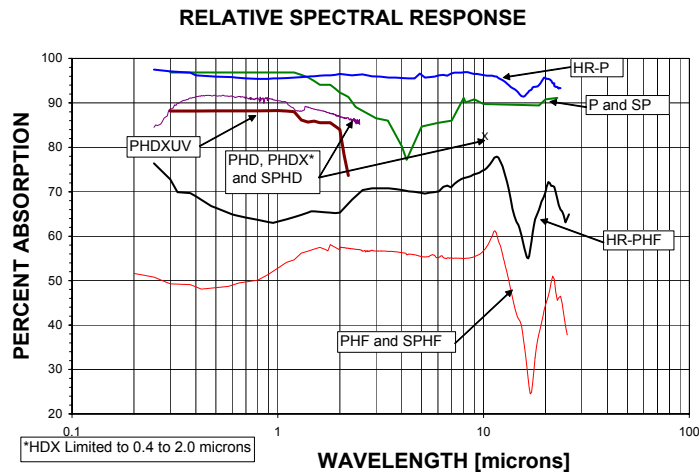
Use the count up (RANGE), count down (MODE) buttons to change the attenuation factor. Press the SELECT button to enter the attenuation factor to memory.

- 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 through 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.

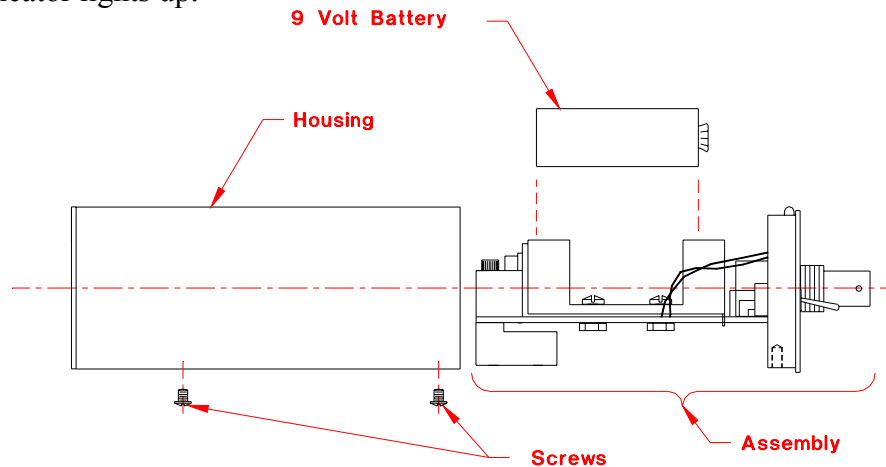


Figure 4

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 CO₂.

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 μ sec. or less. Repetition rates up to 4 kHz can be measured. |
| I (Intermediate Pulses): | Select for pulse durations of 50 μ sec. or less. Repetition rates of up to 400 Hz can be measured. |
| L (Long Pulses): | Select for pulse durations of 250 μ sec. 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:

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:

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

This new output sensitivity can be used in step 5 below or when using the pyroelectric detector without a H410 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**	
	Power	Energy	Power	Energy	Power	Energy	Power	Energy
Range	10mW	10mJ	300mW	300mJ	300mW	300mJ	300mW	300mJ
	100mW	100mJ	3W	3J	3W	3J	3W	3J
	1W	1J	30W	30J	30W	30J	30W	30J
	10W	10J	AUTO		AUTO		AUTO	
	AUTO							

* 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. 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 through 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.

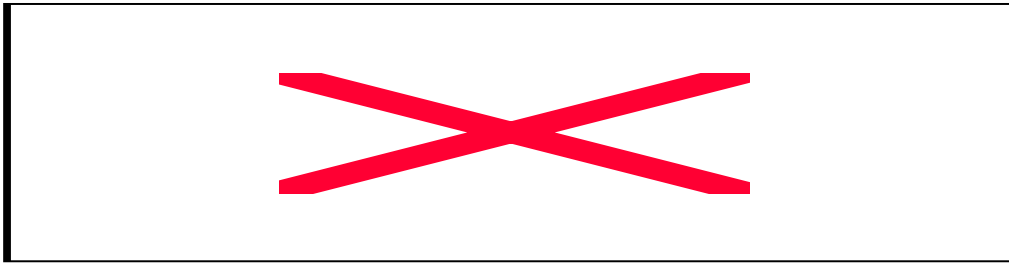
9. External Trigger:

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:

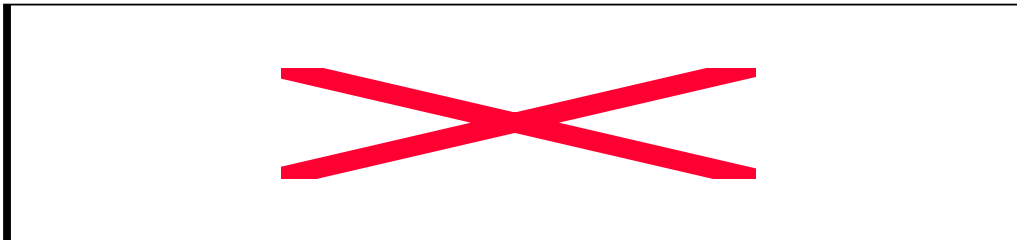
1. 2.5 volts min. to 5 volts max.
2. A minimum pulse width of 10 μ sec. to a maximum of the laser pulse repetition rate.
3. A maximum rise/fall time of 500 nsec.
4. Delivered 1 to 3 milliseconds prior to the laser pulse.

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:

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:

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

The attenuation factor can be entered into the H410 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:

Sciencetech 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:

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

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

The attenuation factor can be entered into the H410 as described in the Group Settings section.

ANALOG OUTPUT:

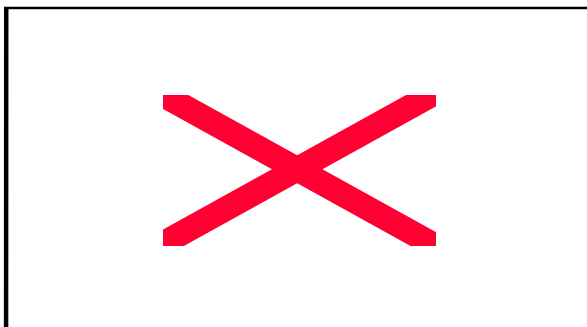
The analog output is an uncalibrated output accessible via the 50 ohm terminated BNC connector located on the indicator's rear panel (see Figure 1). Although the analog output voltage level is uncalibrated, it is representative of the power and energy readings displayed on the S310. The analog output 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:

$$W = V/S$$

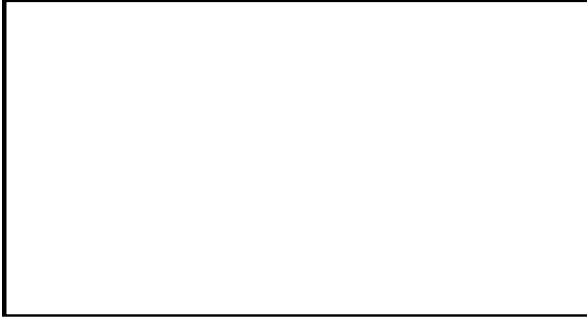
where:

V = analog output voltage (V)

S = analog output sensitivity (V/W) ≈ 3 V/range (W)

(for example, on the 10 mW range, $S \approx 3 \text{ V}/.010 \text{ W} = 300 \text{ V/W}$)

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.

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

where:

V_{pk} = 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

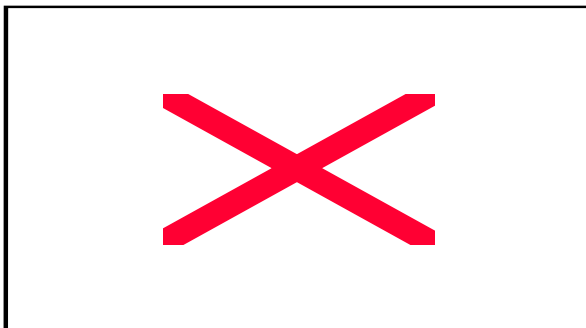
100.0 for the 1 or 3 range

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:

$$W = V_{pk}/S$$

where:

V_{pk} = peak voltage from the analog output
 S = analog output sensitivity (V/W) ≈ 3 V/range (W)
 (for example, on the 3 mW range, $S \approx 3 \text{ V}/.003 \text{ W} = 1000 \text{ V/W}$)

$$J = V_{pk}/S$$

where:

V_{pk} = peak voltage from the analog output
 S = analog output sensitivity (V/J) ≈ 3 V/range (J)
 (for example, on the 3 mJ range, $S \approx 3 \text{ V}/.003 \text{ J} = 1000 \text{ V/J}$)

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.

Calorimeter Circuit Board

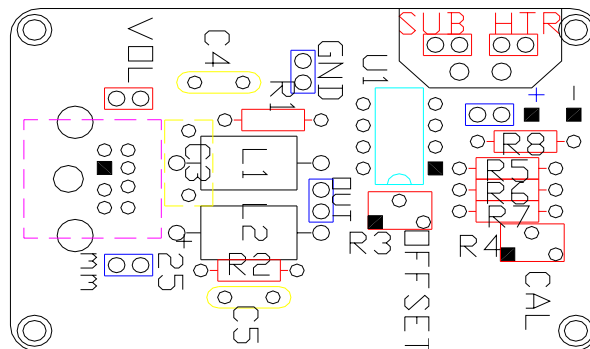


Figure 5

- 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.

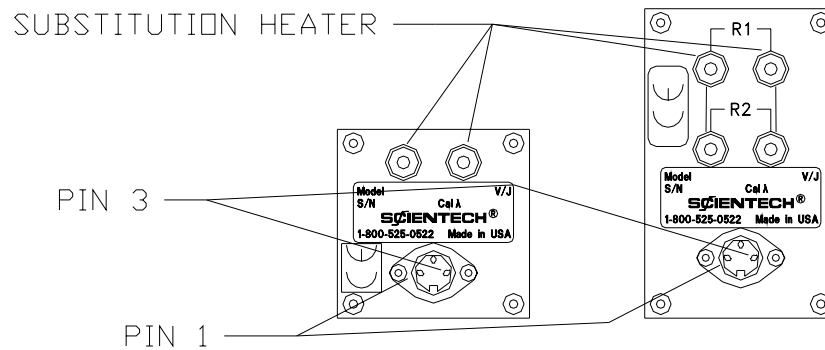


Figure 6

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 on 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 $\pm 3\%$ 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 $1M\Omega$ input oscilloscope. The peak voltage shown on the oscilloscope can be divided by the V/J output sensitivity of the detector to calculate energy.

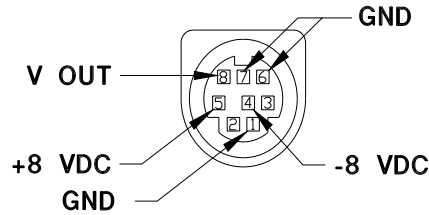
HR Models:

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.



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.

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

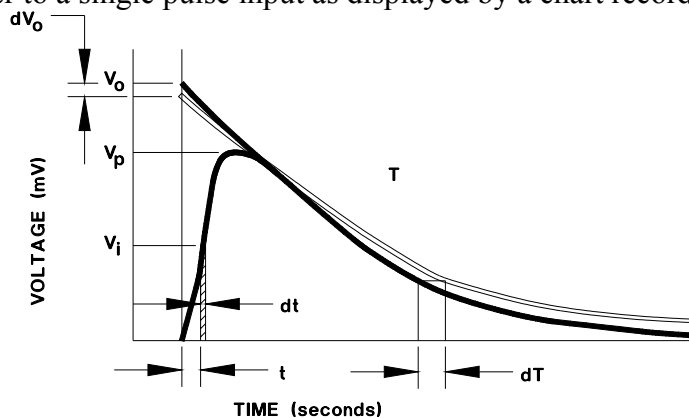
$$W = V/S \quad \text{where:} \quad \begin{array}{l} W = \text{Laser power in watts} \\ V = \text{Voltage reading of the DVM in volts} \\ S = \text{Sensitivity of the calorimeter from page 2.} \end{array}$$

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:

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

The error caused by this procedure is:

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

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

Initial Voltage Interpolation:

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

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

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

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

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

Peak Voltage Estimate:

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

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

$$F = E/V_p$$

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

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

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
U.S.A.

HD CALORIMETER AND PYROELECTRIC ABSORPTION VS. WAVELENGTH:

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

Wavelength μm	Absorption %
0.200	93.00
0.210	91.00
0.220	88.00
0.230	85.00
0.240	82.00
0.250	84.48
0.255	85.03
0.260	84.90
0.265	85.08
0.270	85.26
0.275	85.84
0.280	86.56
0.285	86.86
0.290	87.06
0.295	88.28
0.300	88.68
0.305	88.68
0.310	88.84
0.315	89.57
0.320	89.42
0.325	90.01
0.330	89.91
0.335	90.14
0.340	90.31
0.345	90.52
0.350	90.59
0.355	90.60
0.360	90.76
0.365	90.75
0.370	91.03
0.375	91.10
0.380	91.06
0.385	91.20
0.390	91.20
0.395	91.29
0.400	91.39
0.405	91.41
0.410	91.44
0.415	91.54
0.420	91.49
0.425	91.64
0.430	91.54
0.435	91.66
0.440	91.58
0.445	91.67
0.450	91.66
0.455	91.68
0.460	91.69
0.465	91.64
0.470	91.67
0.475	91.61

Wavelength μm	Absorption %
0.480	91.54
0.485	91.63
0.490	91.74
0.495	91.67
0.500	91.63
0.505	91.57
0.510	91.52
0.515	91.57
0.520	91.63
0.525	91.54
0.530	91.55
0.535	91.63
0.540	91.74
0.545	91.71
0.550	91.60
0.555	91.53
0.560	91.56
0.565	91.58
0.570	91.57
0.575	91.46
0.580	91.52
0.585	91.49
0.590	91.51
0.595	91.59
0.600	91.46
0.605	91.41
0.610	91.40
0.615	91.31
0.620	91.20
0.625	91.31
0.630	91.29
0.635	91.33
0.640	91.41
0.645	91.46
0.650	91.40
0.655	91.47
0.660	91.28
0.665	91.38
0.670	91.36
0.675	91.43
0.680	91.28
0.685	91.32
0.690	91.30
0.695	90.99
0.700	91.37
0.705	91.16
0.710	91.08
0.715	91.02
0.720	90.88
0.725	90.96
0.730	91.16

Wavelength μm	Absorption %
0.735	90.77
0.740	91.22
0.745	90.79
0.750	90.80
0.755	90.99
0.760	90.90
0.765	90.67
0.770	90.83
0.775	90.99
0.780	90.82
0.785	91.05
0.790	90.92
0.795	91.19
0.800	91.12
0.805	90.92
0.810	90.73
0.815	90.24
0.820	91.32
0.825	90.40
0.830	91.00
0.835	90.93
0.840	90.82
0.845	91.15
0.850	91.10
0.855	89.92
0.860	90.44
0.865	91.04
0.870	91.04
0.875	91.21
0.880	91.03
0.885	91.10
0.890	90.47
0.895	91.19
0.900	90.70
0.905	90.96
0.910	90.87
0.915	90.97
0.920	90.91
0.925	90.89
0.930	90.82
0.935	90.95
0.940	90.80
0.945	90.83
0.950	90.66
0.955	90.64
0.960	90.67
0.965	90.60
0.970	90.57
0.975	90.60
0.980	90.57
0.985	90.59

Wavelength µm	Absorption %
0.990	90.51
0.995	90.52
1.000	90.49
1.005	90.48
1.010	90.49
1.015	90.50
1.020	90.45
1.025	90.44
1.030	90.44
1.035	90.39
1.040	90.37
1.045	90.30
1.050	90.29
1.055	90.25
1.060	90.25
1.065	90.27
1.070	90.31
1.075	90.31
1.080	90.28
1.085	90.30
1.090	90.28
1.095	90.20
1.100	90.12
1.105	90.10
1.110	90.08
1.115	89.75
1.120	89.62
1.125	89.54
1.130	89.51
1.135	89.43
1.140	89.39
1.145	89.29
1.150	89.21
1.155	89.13
1.160	89.11
1.165	89.05
1.170	88.99
1.175	88.98
1.180	88.91
1.185	88.91
1.190	88.90
1.195	88.79
1.200	88.62
1.205	88.54
1.210	88.42
1.215	88.36
1.220	88.35
1.225	88.29
1.230	88.29
1.235	88.22
1.240	88.23
1.245	88.19
1.250	88.23

Wavelength µm	Absorption %
1.255	88.20
1.260	88.20
1.265	88.21
1.270	88.26
1.275	88.15
1.280	88.12
1.285	88.16
1.290	88.19
1.295	88.13
1.300	88.15
1.305	88.11
1.310	88.14
1.315	88.20
1.320	88.32
1.325	88.32
1.330	88.35
1.335	88.30
1.340	88.34
1.345	88.46
1.350	88.71
1.355	89.17
1.360	89.19
1.365	89.22
1.370	89.22
1.375	89.12
1.380	89.08
1.385	89.11
1.390	89.11
1.395	89.02
1.400	88.97
1.405	88.99
1.410	89.04
1.415	88.96
1.420	88.91
1.425	88.92
1.430	88.95
1.435	88.91
1.440	88.84
1.445	88.82
1.450	88.74
1.455	88.74
1.460	88.79
1.465	88.74
1.470	88.71
1.475	88.72
1.480	88.72
1.485	88.67
1.490	88.61
1.495	88.61
1.500	88.61
1.505	88.66
1.510	88.61
1.515	88.59

Wavelength µm	Absorption %
1.520	88.50
1.525	88.52
1.530	88.51
1.535	88.49
1.540	88.48
1.545	88.44
1.550	88.44
1.555	88.40
1.560	88.40
1.565	88.44
1.570	88.44
1.575	88.40
1.580	88.38
1.585	88.43
1.590	88.40
1.595	88.35
1.600	88.33
1.605	88.35
1.610	88.38
1.615	88.28
1.620	88.24
1.625	88.23
1.630	88.23
1.635	88.25
1.640	88.22
1.645	88.24
1.650	88.19
1.655	88.20
1.660	88.24
1.665	88.16
1.670	88.20
1.675	88.12
1.680	88.05
1.685	88.06
1.690	88.11
1.695	88.07
1.700	88.06
1.705	88.00
1.710	87.99
1.715	87.91
1.720	87.99
1.725	87.94
1.730	87.89
1.735	87.80
1.740	87.83
1.745	87.88
1.750	87.85
1.755	87.82
1.760	87.79
1.765	87.73
1.770	87.75
1.775	87.72
1.780	87.77

Wavelength μm	Absorption %
1.785	87.73
1.790	87.64
1.795	87.62
1.800	87.66
1.805	87.64
1.810	87.59
1.815	87.58
1.820	87.56
1.825	87.58
1.830	87.67
1.835	87.49
1.840	87.58
1.845	87.52
1.850	87.62
1.855	87.50
1.860	87.56
1.865	87.48
1.870	87.52
1.875	87.42
1.880	87.44
1.885	87.38
1.890	87.38
1.895	87.32
1.900	87.29
1.905	87.18
1.910	87.11
1.915	87.41
1.920	87.06
1.925	87.10
1.930	87.08
1.935	87.06
1.940	87.13
1.945	87.02
1.950	86.97
1.955	87.06
1.960	87.07
1.965	87.20
1.970	87.04
1.975	87.12
1.980	87.10
1.985	86.91
1.990	86.98
1.995	86.92
2.000	86.96
2.005	86.81
2.010	86.85
2.015	86.75
2.020	86.90
2.025	86.89
2.030	86.82
2.035	86.79
2.040	86.77
2.045	86.78

Wavelength μm	Absorption %
2.050	86.86
2.055	86.83
2.060	86.72
2.065	86.71
2.070	86.71
2.075	86.60
2.080	86.63
2.085	86.62
2.090	86.69
2.095	86.66
2.100	86.74
2.105	86.58
2.110	86.48
2.115	86.59
2.120	86.59
2.125	86.62
2.130	86.60
2.135	86.57
2.140	86.59
2.145	86.46
2.150	86.62
2.155	86.58
2.160	86.56
2.165	86.66
2.170	86.67
2.175	86.65
2.180	86.65
2.185	86.69
2.190	86.71
2.195	86.63
2.200	86.65
2.205	86.44
2.210	86.42
2.215	86.30
2.220	86.30
2.225	86.17
2.230	86.33
2.235	86.38
2.240	86.38
2.245	86.15
2.250	86.39
2.255	86.25
2.260	86.17
2.265	86.13
2.270	86.39
2.275	86.22
2.280	86.28
2.285	86.20
2.290	86.32
2.295	85.99
2.300	86.31
2.305	86.17
2.310	86.09

Wavelength μm	Absorption %
2.315	86.25
2.320	86.07
2.325	86.04
2.330	86.01
2.335	85.97
2.340	85.96
2.345	86.54
2.350	85.94
2.355	86.02
2.360	86.01
2.365	85.68
2.370	85.87
2.375	86.30
2.380	85.77
2.385	85.68
2.390	85.97
2.395	85.99
2.400	85.26
2.405	85.40
2.410	85.84
2.415	85.64
2.420	86.09
2.425	85.77
2.430	86.26
2.435	85.72
2.440	85.41
2.445	86.02
2.450	85.92
2.455	85.46
2.460	85.77
2.465	85.96
2.470	85.87
2.475	85.29
2.480	86.08
2.485	85.59
2.490	86.26
2.495	85.54
2.500	85.12
10.600	82.10

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	51.600	2.087	57.426	2.273	57.191	2.496	56.996
0.250	50.800	2.090	57.412	2.277	57.168	2.501	56.989
0.300	49.300	2.094	57.416	2.281	57.167	2.506	56.966
0.375	49.100	2.097	57.419	2.285	57.171	2.511	56.943
0.400	48.600	2.100	57.401	2.289	57.178	2.516	56.931
0.425	48.100	2.104	57.406	2.293	57.185	2.520	56.935
0.500	48.400	2.107	57.423	2.297	57.174	2.525	56.934
0.575	48.700	2.111	57.407	2.301	57.151	2.530	56.912
0.600	49.000	2.114	57.390	2.306	57.137	2.535	56.891
0.650	49.500	2.117	57.385	2.310	57.136	2.540	56.878
0.700	49.700	2.121	57.389	2.314	57.136	2.545	56.849
0.800	50.100	2.124	57.398	2.318	57.135	2.550	56.849
0.900	51.400	2.128	57.398	2.322	57.143	2.555	56.829
1.000	52.800	2.131	57.391	2.326	57.146	2.560	56.736
1.100	54.100	2.135	57.374	2.330	57.139	2.565	56.709
1.200	54.700	2.138	57.369	2.335	57.135	2.570	56.720
1.300	56.200	2.142	57.367	2.339	57.134	2.575	56.694
1.400	56.600	2.145	57.342	2.343	57.121	2.581	56.670
1.500	57.100	2.149	57.329	2.347	57.098	2.586	56.643
1.600	57.500	2.153	57.332	2.352	57.093	2.591	56.618
1.700	57.000	2.156	57.343	2.356	57.104	2.596	56.638
1.750	56.700	2.160	57.349	2.360	57.103	2.601	56.636
1.800	58.100	2.163	57.337	2.364	57.103	2.607	56.637
1.900	57.500	2.167	57.322	2.369	57.102	2.612	56.655
2.000	56.900	2.171	57.301	2.373	57.093	2.617	56.663
2.003	57.515	2.174	57.288	2.377	57.078	2.622	56.693
2.006	57.552	2.178	57.305	2.382	57.068	2.628	56.685
2.009	57.559	2.182	57.328	2.386	57.081	2.633	56.741
2.012	57.544	2.185	57.331	2.390	57.088	2.638	56.809
2.016	57.514	2.189	57.323	2.395	57.073	2.644	56.797
2.019	57.475	2.193	57.309	2.399	57.057	2.649	56.773
2.022	57.479	2.196	57.295	2.404	57.049	2.655	56.728
2.025	57.521	2.200	57.296	2.408	57.047	2.660	56.601
2.028	57.533	2.204	57.283	2.413	57.038	2.665	56.448
2.031	57.502	2.208	57.276	2.417	57.029	2.671	56.440
2.034	57.473	2.211	57.286	2.422	57.038	2.676	56.534
2.038	57.452	2.215	57.278	2.426	57.044	2.682	56.641
2.041	57.439	2.219	57.259	2.431	57.033	2.687	56.675
2.044	57.443	2.223	57.254	2.435	57.019	2.693	56.668
2.047	57.473	2.226	57.255	2.440	57.002	2.699	56.712
2.051	57.489	2.230	57.236	2.445	56.998	2.704	56.696
2.054	57.475	2.234	57.221	2.449	57.011	2.710	56.646
2.057	57.468	2.238	57.230	2.454	57.018	2.716	56.586
2.060	57.447	2.242	57.225	2.458	57.022	2.721	56.571
2.064	57.420	2.246	57.189	2.463	57.019	2.727	56.691
2.067	57.439	2.250	57.173	2.468	57.008	2.733	56.653
2.070	57.443	2.254	57.201	2.472	56.994	2.739	56.565
2.073	57.411	2.257	57.230	2.477	56.971	2.744	56.663
2.077	57.408	2.261	57.225	2.482	56.964	2.750	56.668
2.080	57.410	2.265	57.222	2.487	56.978	2.756	56.595
2.083	57.420	2.269	57.220	2.491	56.990	2.762	56.572

Wavelength µm	Absorption %
2.768	56.594
2.774	56.654
2.780	56.646
2.786	56.642
2.792	56.693
2.798	56.666
2.804	56.648
2.810	56.698
2.816	56.705
2.822	56.709
2.828	56.715
2.834	56.707
2.840	56.726
2.847	56.746
2.853	56.776
2.859	56.837
2.866	56.876
2.872	56.864
2.878	56.821
2.885	56.772
2.891	56.729
2.897	56.699
2.904	56.694
2.910	56.697
2.917	56.688
2.924	56.684
2.930	56.689
2.937	56.687
2.943	56.686
2.950	56.688
2.957	56.685
2.964	56.680
2.970	56.680
2.977	56.683
2.984	56.679
2.991	56.674
2.998	56.676
3.005	56.679
3.012	56.675
3.019	56.666
3.026	56.657
3.033	56.656
3.040	56.657
3.047	56.657
3.054	56.665
3.062	56.665
3.069	56.655
3.076	56.657
3.083	56.667
3.091	56.672
3.098	56.665
3.105	56.657
3.113	56.664

Wavelength µm	Absorption %
3.120	56.676
3.128	56.676
3.135	56.676
3.143	56.681
3.151	56.677
3.158	56.672
3.166	56.674
3.174	56.680
3.182	56.685
3.189	56.684
3.197	56.677
3.205	56.674
3.213	56.671
3.221	56.666
3.229	56.671
3.237	56.677
3.245	56.673
3.253	56.669
3.262	56.665
3.270	56.665
3.278	56.665
3.286	56.661
3.295	56.661
3.303	56.663
3.312	56.664
3.320	56.664
3.328	56.661
3.337	56.656
3.346	56.652
3.354	56.646
3.363	56.632
3.372	56.620
3.381	56.616
3.389	56.610
3.398	56.594
3.407	56.580
3.416	56.571
3.425	56.572
3.434	56.583
3.443	56.592
3.452	56.596
3.462	56.596
3.471	56.595
3.480	56.591
3.490	56.580
3.499	56.567
3.508	56.567
3.518	56.581
3.528	56.592
3.537	56.593
3.547	56.593
3.557	56.591
3.566	56.584

Wavelength µm	Absorption %
3.576	56.576
3.586	56.571
3.596	56.569
3.606	56.570
3.616	56.568
3.626	56.562
3.636	56.559
3.646	56.555
3.657	56.545
3.667	56.533
3.677	56.528
3.688	56.528
3.698	56.526
3.709	56.518
3.720	56.509
3.730	56.501
3.741	56.494
3.752	56.489
3.763	56.482
3.774	56.476
3.785	56.470
3.796	56.460
3.807	56.447
3.818	56.436
3.829	56.428
3.841	56.421
3.852	56.415
3.864	56.407
3.875	56.403
3.887	56.399
3.898	56.388
3.910	56.376
3.922	56.366
3.934	56.356
3.946	56.348
3.958	56.339
3.970	56.330
3.982	56.320
3.994	56.311
4.007	56.303
4.019	56.293
4.032	56.284
4.044	56.277
4.057	56.271
4.070	56.263
4.082	56.252
4.095	56.243
4.108	56.234
4.121	56.222
4.134	56.211
4.148	56.204
4.161	56.195
4.174	56.182

Wavelength µm	Absorption %
4.188	56.144
4.201	56.033
4.215	55.869
4.229	55.802
4.242	55.877
4.256	55.901
4.270	55.841
4.284	55.837
4.299	55.897
4.313	55.952
4.327	55.986
4.342	56.001
4.356	55.997
4.371	55.985
4.386	55.971
4.401	55.958
4.416	55.948
4.431	55.939
4.446	55.929
4.461	55.917
4.477	55.904
4.492	55.895
4.508	55.890
4.523	55.882
4.539	55.870
4.555	55.861
4.571	55.851
4.587	55.840
4.604	55.830
4.620	55.820
4.636	55.809
4.653	55.799
4.670	55.784
4.687	55.767
4.704	55.750
4.721	55.732
4.738	55.712
4.755	55.688
4.773	55.662
4.791	55.638
4.808	55.612
4.826	55.584
4.844	55.562
4.862	55.541
4.881	55.519
4.899	55.500
4.918	55.480
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4.974	55.431
4.993	55.408
5.013	55.389
5.032	55.389

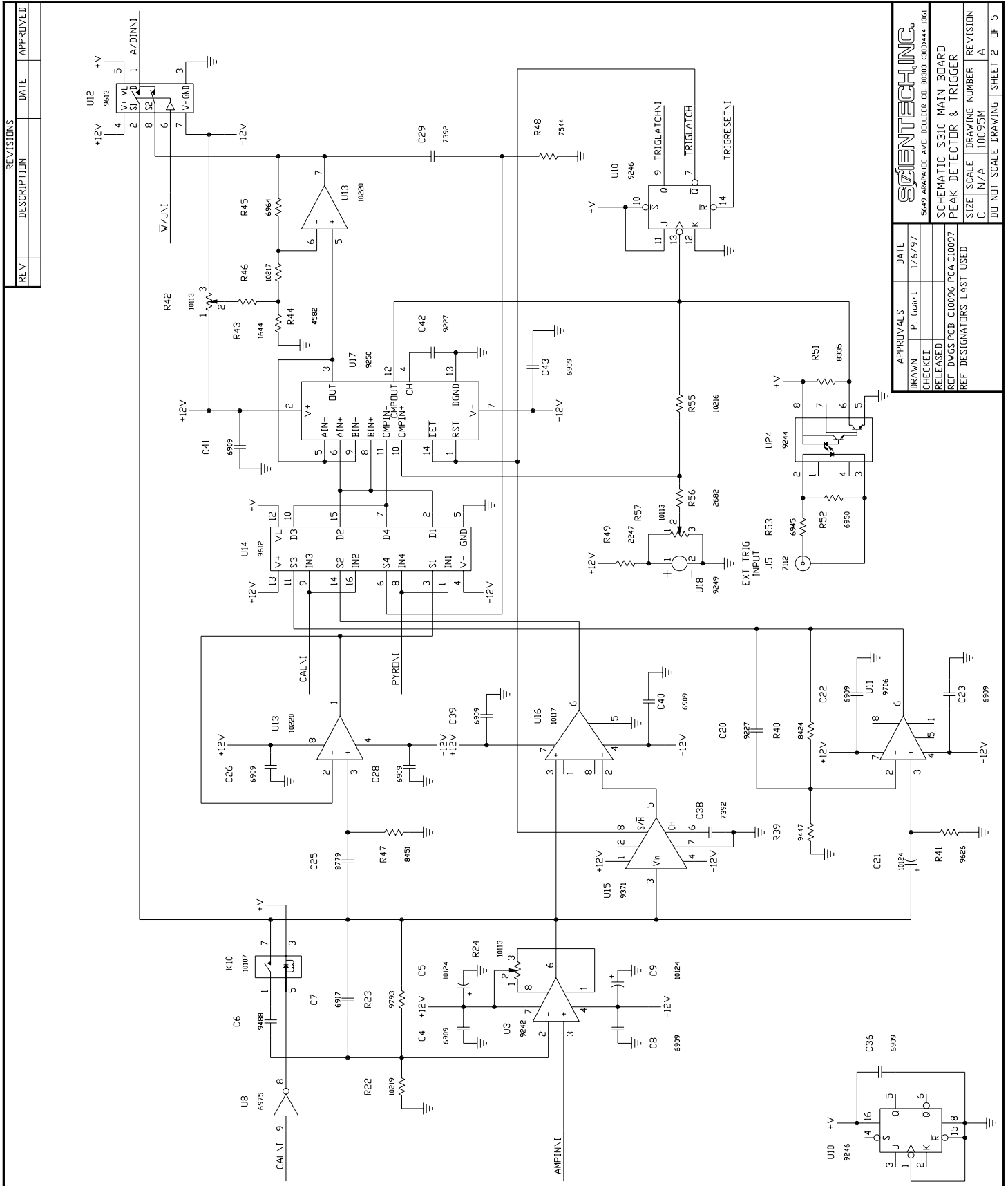
Wavelength μm	Absorption %
5.052	55.378
5.071	55.361
5.091	55.360
5.111	55.352
5.131	55.337
5.152	55.346
5.172	55.341
5.193	55.313
5.214	55.318
5.235	55.342
5.256	55.343
5.278	55.345
5.299	55.368
5.321	55.353
5.343	55.344
5.365	55.401
5.387	55.409
5.410	55.405
5.432	55.445
5.455	55.491
5.478	55.581
5.501	55.665
5.525	55.691
5.548	55.700
5.572	55.763
5.596	55.826
5.620	55.815
5.645	55.847
5.669	55.875
5.694	55.823
5.719	55.752
5.745	55.712
5.770	55.716
5.796	55.627
5.822	55.484
5.848	55.326
5.875	55.200
5.901	55.188
5.928	55.153
5.956	55.159
5.983	55.230
6.011	55.190
6.039	55.111
6.067	55.210
6.095	55.326
6.124	55.382
6.153	55.424
6.183	55.502
6.212	55.580
6.242	55.600
6.272	55.593
6.303	55.509
6.333	55.387

Wavelength μm	Absorption %
6.365	55.240
6.396	55.111
6.428	55.106
6.460	55.039
6.492	55.030
6.525	55.049
6.557	54.976
6.591	54.958
6.624	55.015
6.658	55.094
6.693	55.155
6.727	55.160
6.762	55.100
6.798	55.045
6.834	55.010
6.870	55.074
6.906	55.117
6.943	55.075
6.981	55.042
7.018	55.024
7.057	55.062
7.095	55.055
7.134	55.010
7.174	55.042
7.214	55.071
7.254	55.058
7.295	55.047
7.336	55.066
7.378	55.080
7.420	55.052
7.462	55.042
7.506	55.053
7.549	55.041
7.593	55.042
7.638	55.055
7.683	55.051
7.729	55.038
7.775	55.032
7.822	55.027
7.870	55.021
7.918	55.018
7.966	55.016
8.015	55.013
8.065	55.010
8.116	55.013
8.167	55.022
8.218	55.029
8.271	55.032
8.324	55.041
8.378	55.056
8.432	55.065
8.487	55.077
8.543	55.096

Wavelength μm	Absorption %
8.600	55.119
8.657	55.151
8.715	55.183
8.774	55.216
8.834	55.253
8.894	55.292
8.956	55.343
9.018	55.403
9.081	55.462
9.145	55.520
9.210	55.581
9.276	55.641
9.343	55.701
9.410	55.772
9.479	55.849
9.549	55.931
9.620	56.027
9.691	56.141
9.764	56.262
9.838	56.393
9.913	56.544
9.990	56.711
10.067	56.885
10.146	57.065
10.226	57.264
10.307	57.489
10.390	57.740
10.473	58.013
10.559	58.301
10.645	58.621
10.733	58.973
10.823	59.327
10.914	59.674
11.006	60.048
11.100	60.512
11.196	60.976
11.294	61.227
11.393	61.171
11.494	60.830
11.596	60.291
11.701	59.605
11.807	58.914
11.916	58.408
12.026	57.969
12.139	57.388
12.253	56.654
12.370	55.856
12.489	55.044
12.611	54.230
12.734	53.420
12.860	52.603
12.989	51.767
13.120	50.912

Wavelength μm	Absorption %
13.254	50.028
13.391	49.105
13.531	48.136
13.673	47.138
13.819	46.140
13.968	45.150
14.120	44.205
14.275	43.355
14.434	42.615
14.596	41.947
14.762	41.404
14.932	41.115
15.106	40.710
15.284	39.712
15.466	38.254
15.652	36.607
15.843	34.810
16.039	32.791
16.240	30.540
16.446	28.176
16.657	25.938
16.873	24.525
17.095	24.855
17.324	26.997
17.558	29.907
17.799	32.631
18.046	34.907
18.301	36.682
18.563	38.001
18.832	39.192
19.109	40.501
19.395	41.883
19.689	43.268
19.992	44.500
20.305	45.515
20.628	46.556
20.961	47.950
21.305	49.687
21.661	51.005
22.028	50.312
22.409	47.489
22.802	45.586
23.210	46.163
23.633	46.509
24.071	44.911
24.526	42.487
24.998	39.856
25.489	37.772
26.000	36.255

SCHEMATICS:

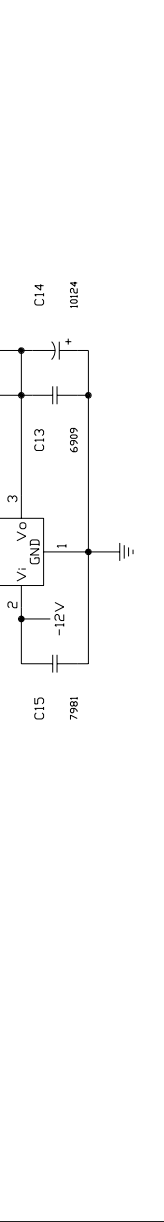


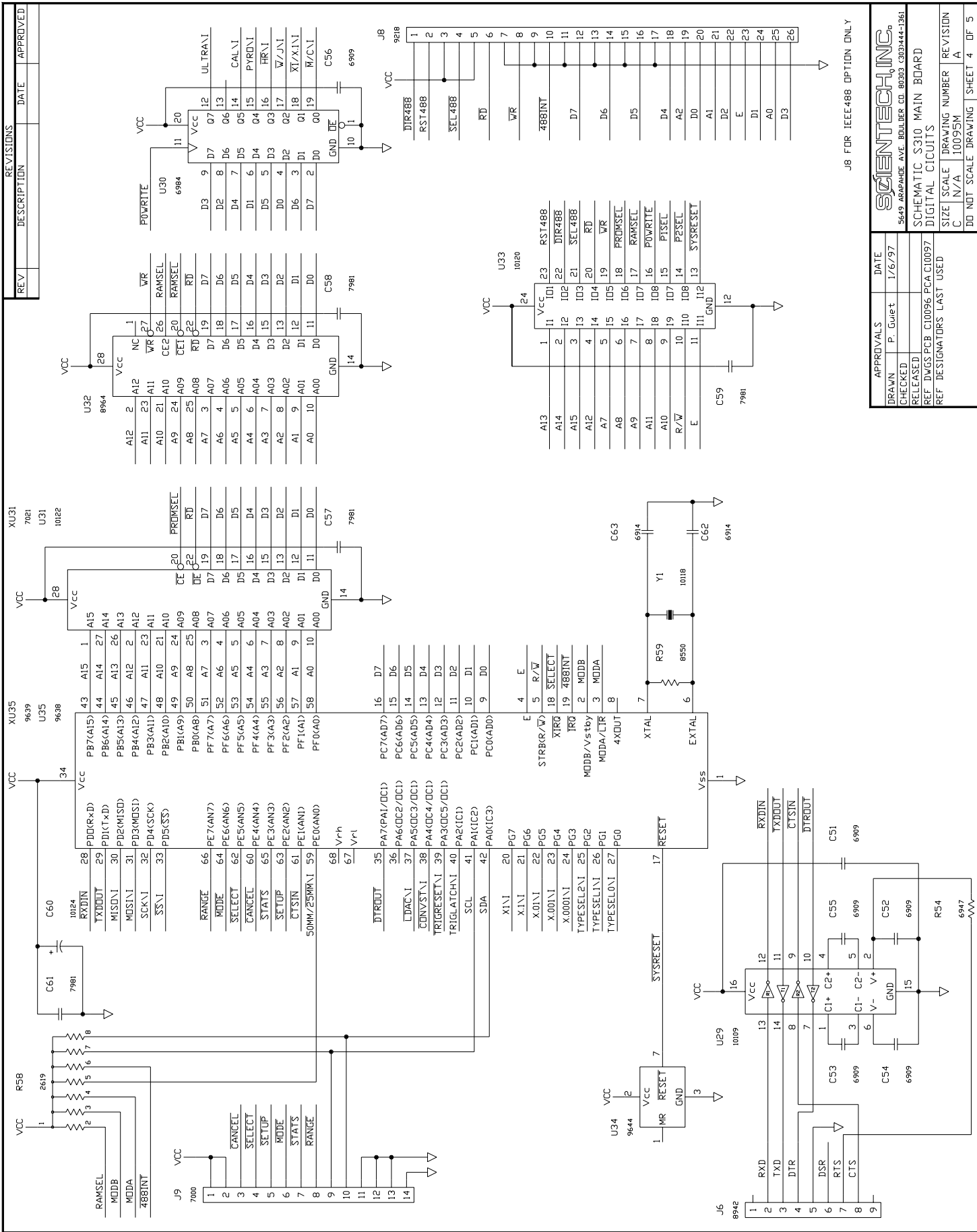
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REV	DESCRIPTION	DATE	APPROVED

APPROVALS		DATE
DRAWN	P. Guet	1/6/97
CHECKED		
RELEASED		
REF DWGS PCB C10096 PCA C10097		
REF DESIGNATORS LAST USED		
SIZE	SCALE	DRAWING NUMBER
C	N/A	10095M
DO NOT SCALE DRAWING		SHEET 3 OF 5





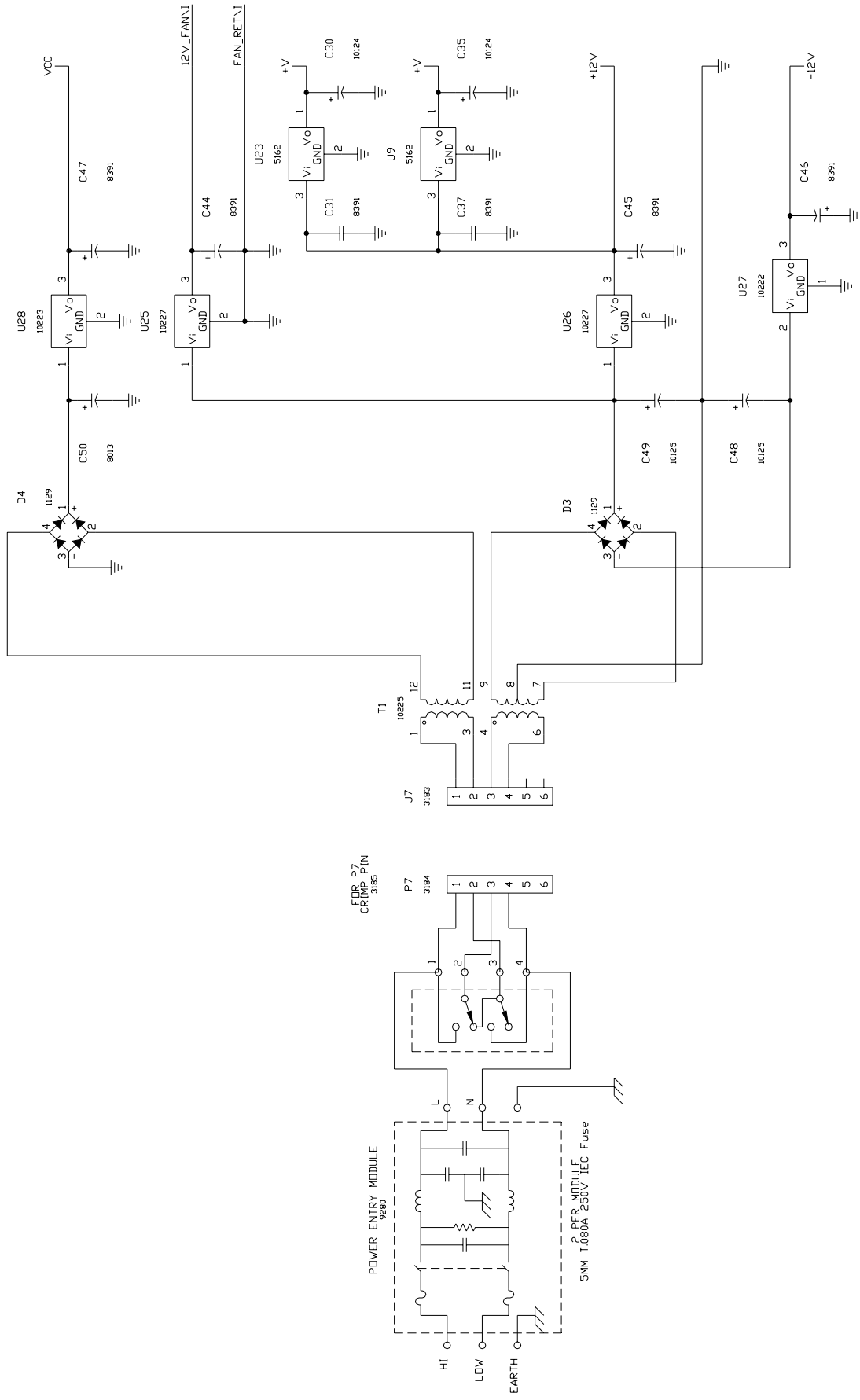
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