

SCIENTECH®



Models H410 & H410D
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 H410 and H410D are identical to each other in every respect except the analog meter. The H410 has both an analog and digital display. The H410D has only a digital readout. All references to the H410 are intended to include the H410D 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: _____
 Calibration Wavelength: _____ nm
 Output Sensitivity (S): _____ V/W
 Time Constant (1/e): _____ sec.
 Calibration Temp: _____ °C
 Sub. Heater Resistance (R_C): _____ ohms
 Sub. Heater Voltage (V_h): _____ volts
 Sub. Heater Wattage (W_h): _____ watts

Calorimeter 2:

Model No: _____
 Serial No: _____
 Calibration Wavelength: _____ nm
 Output Sensitivity (S): _____ V/W
 Time Constant (1/e): _____ sec.
 Calibration Temp: _____ °C
 Sub. Heater Resistance (R_C): _____ ohms
 Sub. Heater Voltage (V_h): _____ volts
 Sub. Heater Wattage (W_h): _____ watts

Pyroelectric Detector 1:

Model No: _____
 Serial No: _____
 Calibration Wavelength: _____ nm or μm
 Output Sensitivity: _____ V/J or _____ V/mJ S _____ I _____ L _____
 Calibration Temp: _____ °C

Pyroelectric Detector 2:

Model No: _____
 Serial No: _____
 Calibration Wavelength: _____ nm or μm
 Output Sensitivity: _____ V/J or _____ V/mJ S _____ I _____ L _____
 Calibration Temp: _____ °C

Photodiode Detector 1:

Model No: _____
 Serial No: _____
 Calibration wavelength: _____ nm or μm
 Output Sensitivity: _____ V/W
 Calibration Temp: _____ °C

Photodiode Detector 2:

Model No: _____
 Serial No: _____
 Calibration Wavelength: _____ nm or μm
 Output Sensitivity: _____ V/W
 Calibration Temp: _____ °C

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CE MARK CERTIFICATION:

The H410 indicator and all of the detectors listed in this manual have been certified for the European CE mark.

ENVIRONMENTAL REQUIREMENTS:

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

VECTOR™ H410 INDICATOR SPECIFICATIONS:

Model	H410	H410D
Display	4digit 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, AUTO	
Full Scale Ranges with Photodiode Detector - Watts only	30.00 μ , 300.0 μ , 3.000 m, 30.00 m, AUTO	
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	300 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	
Operating Temperature	5°C to 40°C	
Power Requirement	4 ea. Rechargeable Batteries	
AC Charger Input Requirements	120 Volts, 60 Hz \pm 10 % or 220 Volts, 50 Hz \pm 10 %	
Dimensions H x W x D - inches/cm	8.25 x 4.0 x 1.5/20.96 x 10.16 x 3.81	
Weight - pounds/kgs	1.23/0.56	

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.

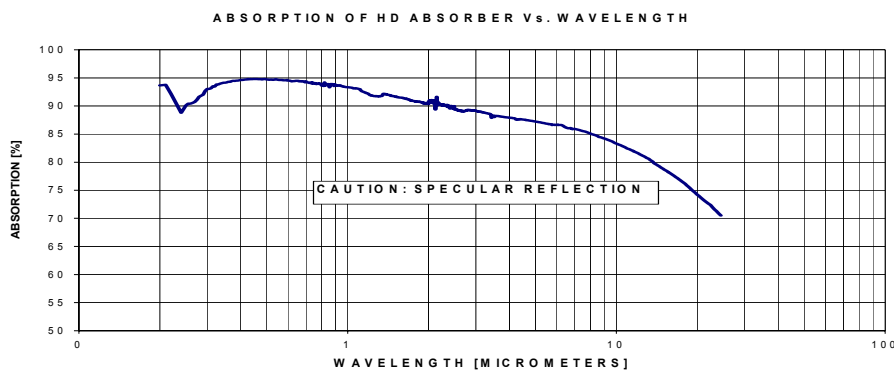


Figure 1

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 pyroelectric detector.

VECTOR™ PYROELECTRIC DETECTOR SPECIFICATIONS:

Model	P 25	PHF 25	PHD 25	PHDX 25	PHDX25UV	SP 25	SPHF 25	SPHD 25
Aperture Diameter	25.4 mm	25.4 mm	25.4 mm	7mm	7mm	25.4 mm	25.4 mm	25.4 mm
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	50.8 mm	50.8 mm	50.8 mm	15 mm	15 mm	50.8 mm	50.8 mm	50.8 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.

ASTRAL™ CALORIMETER SPECIFICATIONS:

Model	AC2500	AC25HD	ACX25HD	AC2501	ACX2501	AC25UV	AC2504
Type of Absorber	Surface	Surface	Surface	Volume	Volume	Volume	Volume
Aperture Diameter	25.4 mm	25.4 mm	8 mm	25.4 mm	8 mm	25.4 mm	25.4 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
Aperture Diameter	50.8 mm	50.8 mm	16 mm	50.8 mm	16 mm	50.8 mm	50.8 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 1.2μm
- 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 1.2μm
- 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
Aperture Diameter	100mm				200mm			
Minimum Beam Diameter	5cm				7.5cm			
Spectral Response	.25 - 35µm	.266 - 1.2µm	9 - 11µm	.193 - .36µm	.25 - 35µm	.266 - 1.2µm	9 - 11µm	.193 - .36µm
Maximum Average Power	50W with full illumination of absorbing surface				100W with full illumination of absorbing surface			
Minimum Average Power	150mW				700mW			
Noise Level	1.5mJ - mW				7mJ - mW			
Maximum Power Density	200W/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 @ 355 nm, 265MW/cm ² @ 266nm
Note 7: 360401, 360801	Max J/cm ² = 1000 x (pulse width) ^{1/2} to a maximum of 200J/cm ²
Note 8: 380401	Repetitive pulses: 3.7J/cm ² @ 1064nm, 2.9J/cm ² @ 532nm, 1J/cm ² @ 355nm, 20mJ/cm ² @ 266nm Single pulses: 7J/cm ² @ 1064nm, 5.6J/cm ² @ 532nm, 2.1J/cm ² @ 355nm, 41mJ/cm ² @ 266nm
Note 9: 384UV5, 388UV5	Repetitive pulses: 1.1J/cm ² @ 355nm Single pulses: 40J/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

ASTRAL™ PHOTODIODE DETECTOR SPECIFICATIONS:

Model	AP30	AP30UV
Type of Absorber	Silicon	
Aperture Diameter	7.9 mm	
Spectral Response	400 nm - 1.1 µm	200 nm - 1.1 µm
Maximum Power	30 mW	2 mW
Minimum Power	100 nW	
Maximum Power Density	170 mW/cm ²	5 mW/cm ²
Noise Level	1 nW	
Accuracy	± 5 %	
Response Time	1 second	
Dimensions D x L - inches/cm	2.5 x 1.1/6.35 x 2.79	
Weight - pounds/kgs	0.25/0.114	
Indicator Compatibility	H410, H410D	

UNPACKING:

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

If using the AC battery charger, verify that the electrical outlet is compatible with the charger. When using a charger, the H410 will operate with or without batteries installed. However, if batteries are installed, they must have a minimum charge of approximately 1 hour before the H410 will turn on, even if the AC battery charger is used.

The H410 also runs off of four AA rechargeable batteries, which provide approximately 6 hours of usage before requiring recharge. To recharge the batteries connect the charger to the indicator and the appropriate electrical outlet. Allow 16 to 20 hours for a full charge.

CHANGING OR INSTALLING BATTERIES:

Warning: Use only Ni-MH or NI-Cad rechargeable batteries. If non-rechargeable batteries are used with the battery charger the batteries may burst and cause damage to you or the indicator.

Note: Dispose of used batteries according to local regulations.

To install batteries refer to Figure 3 and proceed as follows:

1. Loosen the screw holding the battery compartment cover.
2. Remove the old batteries if necessary.
3. Observing the polarity, install the new batteries.
4. Replace the cover and charge the batteries for 16 to 20 hours.

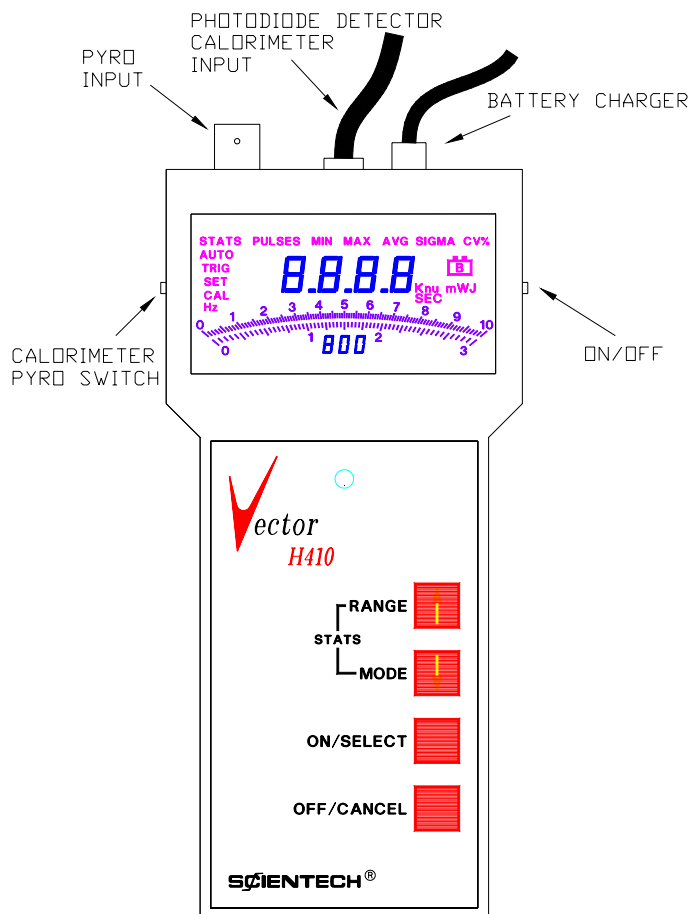


Figure 2

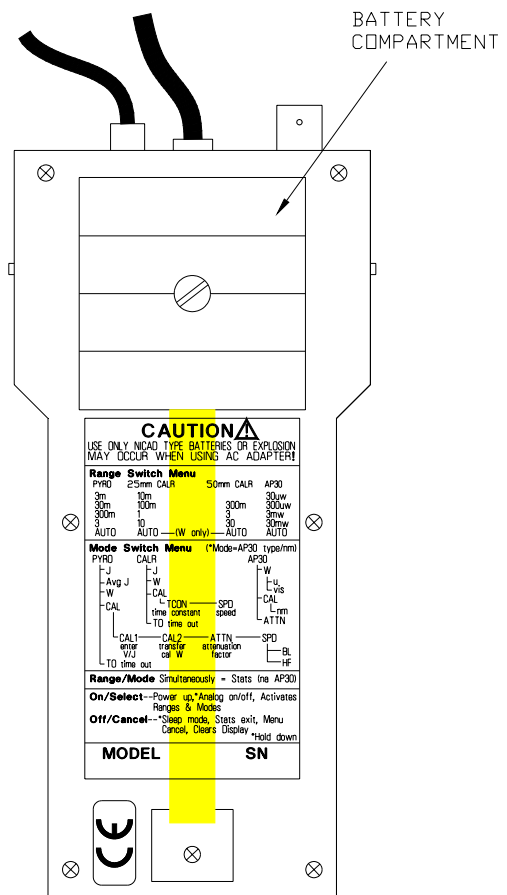


Figure 3

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 H410 should be turned on and warmed up for 30 minutes.

Slide the ON/OFF switch, located on the upper right side of the H410, to the ON position. The indicator will immediately turn on in the operational state last used. If you purchased the H410 with one detector, this detector's operating parameters will be in the indicator's memory and you are ready to take measurements.

If you purchased more than one detector with the H410, you must make sure the operating parameters for the detector you plan to use are in the indicator's memory. For detailed instructions please refer to the Operating Procedure section for that type of detector.

2. Turn the Analog Needle On or Off (does not apply to the H410D):

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

3. Zero the Analog Needle (does not apply to the H410D):

Refer to Figure 2. 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.

4. Connect a Detector:

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

Refer Figure 2. Slide the CAL/PYRO switch, located on the upper left side of the H410, into the CAL (up) position for use with Astral and Large Aperture calorimeters and Astral photodiode detectors or into the PYRO (down) position for use with Vector pyroelectric detectors.

A 3 meter mini-DIN type cable with "D" shaped connectors comes with Astral and Large Aperture calorimeters and Astral photodiode detectors. A 3 meter BNC type cable comes with Vector pyroelectric detectors. Plug in the detector's cable into the appropriate connector on the H410. 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:

Press the RANGE button, the analog scale (if active) will disappear, then the H410 will begin cycling through the ranges available for the detector you have connected. Press the ON/SELECT button when the range you desire appears in the display.

6. Select a Mode:

The MODE button allows selection of the type of measurement to be made (watts, joules, etc). The different modes available are:

When configured for a pyroelectric detector: **Energy (J)**, **Avg. Energy (J AVG)**, **Power (W)**, Configuration (CAL) and Time Out (tO).

When configured for a calorimeter: **Energy (J)**, **Power (W)**, Configuration (CAL), Time Out (tO) and Calorimeter Delay (cd).

When configured for a photodiode detector: **Power (W)**, Configuration (CAL) and Attenuation (ATTN).

The preceding list of modes in bold type represents the measurement modes of the H410. These modes are discussed in this Quick Setup section. The modes in normal type allow you to customize the H410's set up for different detectors and are discussed in detail in the Operating Procedure section for each detector.

Press the MODE button to start the menu cycle. Press the ON/SELECT button when the measurement mode you desire appears in the display.

7. Zero the display:

If you have chosen the calorimeter Power (W) mode or are using a photodiode detector you must zero the display by pressing the CANCEL button before any measurements are taken. It is not necessary to zero the display in any other mode of operation, but if you choose to do so no errors will be introduced.

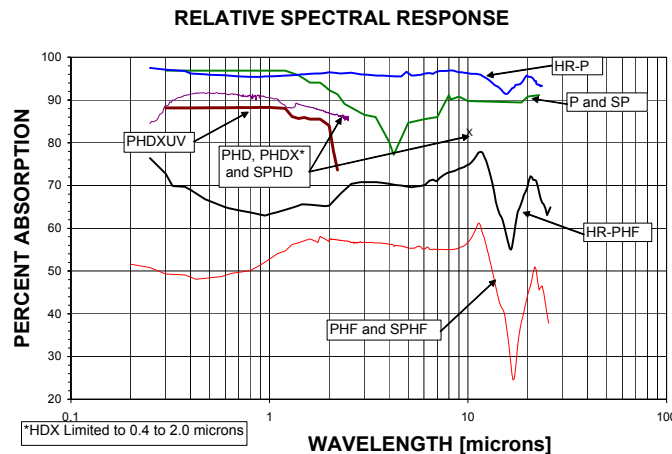
8. Take your measurement:

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

OPERATING PROCEDURES:

USING THE H410 WITH VECTOR™ PYROELECTRIC DETECTORS:

Pyroelectric detector models P25, P50, SP25 and SP50 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 and SPHF50 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 trigger threshold of the H410 is 7 % of full scale.

1. To Turn On the Meter:

Note: For the most accurate measurements possible, the H410 should be turned on and warmed up for 30 minutes.

Slide the ON/OFF switch, located on the upper right side of the H410, to the ON position. The indicator will immediately turn on in the operational state last used. If you purchased the H410 with one detector, this detector's operating parameters will be in the indicator's memory and you are ready to take measurements.

If you purchased more than one detector with the H410, you must make sure the operating parameters for the detector you plan to use are in the indicator's memory. For detailed instructions please refer to the operating parameters listed on page 2 and the following procedure.

2. Turn the Analog Needle On or Off (does not apply to the H410D):

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

3. Zero the Analog Needle (does not apply to the H410D):

Refer to Figure 2. 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.

4. To Connect a Pyroelectric Detector:

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

Refer to Figure 2. Slide the CAL/PYRO switch, located on the upper left side of the H410, to the PYRO (down) position. A 3 meter BNC type cable comes with Vector pyroelectric detectors. Connect the cable to the indicator's BNC connector.

5. To Configure the H410 for a Pyroelectric Detector:

Note: Some of the menu selections are skipped in this section. They are discussed in detail in later sections.

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

The operating parameters for the pyroelectric detector you are going to use must be entered into the H410's memory. First the output sensitivity of the detector's crystal is entered, then the speed, based of the detector's type of absorbing surface is entered.

To enter into the configuration mode:

- A. Press the MODE button. A menu cycle of J, AVG J, W, CAL and tO will begin.
- B. Press the ON/SELECT button when "CAL" appears. A menu cycle of CAL 1, CAL 2, Attn and SPd will begin.
- C. Press the ON/SELECT button when "CAL 1" appears. The current V/J output sensitivity will be displayed and the "SET CAL" annunciator will flash.
- D. Use the RANGE (count up) button to increase the value or the MODE (count down) to decrease the value to enter the V/J value listed on the pyroelectric detector's serial tag.
- E. Press the ON/SELECT button to exit this menu. The indicator will return to the last operational state.
- F. Press the MODE button to return to the menu in step A.
- G. Press the ON/SELECT button when "CAL" appears. A menu cycle of CAL 1, CAL 2, Attn and SPd will begin.

H. Press the ON/SELECT button when “SPd” appears. Choose between “hF” for high frequency absorbers and “bL” for black coated absorbers according to the following chart.

Type of Absorber	Pyroelectric Detector Model Type	Speed Selection
Black Coated	P, SP, PHD and SPHD	bL
High Frequency	PHF and SPHF	hF

I. Press the ON/SELECT button to select the appropriate “SPd” setting. The indicator will return to the last operational state.

J. Press and hold the OFF/CANCEL button until the display blanks to save the settings.

K. Press the ON/SELECT button to turn the H410 back on.

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.

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

A. Press the RANGE button. The analog scale (if active) will disappear and AUTO, 3m, 30m, 300m and 3 will cycle through the display.

B. To select a range, press the ON/SELECT button when the range you desire appears in the display. The H410 will return to the last operational state.

C. Press and hold the OFF/CANCEL button until the display blanks to save the setting.

D. Press the ON/SELECT button to turn the H410 back on.

7. To Select a Measurement Mode:

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

Available measurement modes are: Energy (J), Avg. Energy (J AVG) and Power (W).

A. To Measure Energy (J):

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

The energy mode displays the energy of each pulse of a repetitively pulsed laser or a single pulse.

- i. Press the MODE button to start the menu cycle of J, AVG J, W, CAL and tO.
- ii. Press the ON/SELECT button when the J annunciator appears on the display.
- iii. The energy level of each laser pulse will be displayed on the LCD.
- iv. Press and hold the OFF/CANCEL button until the display blanks to save the setting.
- v. Press the ON/SELECT button to turn the H410 back on.

B. To Measure Average Energy (J AVG):

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

The average energy mode displays an average of a selectable number of pulses from 2 to 9999.

- i. Press the MODE button to start the menu cycle of J, AVG J, W, CAL and tO.
- ii. Press the ON/SELECT button when the AVG J annunciators appear on the display. The number of pulses to be averaged will now appear in the display.
- iii. To change the number of pulses to be averaged, press the RANGE (count up) and/or MODE (count down) buttons until the desired number of pulses to be averaged appears in the display.
- iv. Press the ON/SELECT button to select the pulse population. The average energy of the number of pulses you selected will be displayed after the number of pulses entered in step iii is received by the pyroelectric detector. This is not a running average, but is the average for the pulse population selected in step iii. 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.
- v. Press and hold the OFF/CANCEL until the display blanks to save the setting.
- vi. Press the ON/SELECT button to turn the H410 back on.

C. To Measure Average Power (W):

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.

The average power mode displays the average power of repetitively pulsed lasers.

- i. Press the MODE button to start the menu cycle of J, AVG J, W, CAL and tO.
- ii. Press the ON/SELECT button when the W annunciator appears on the display.
- iii. The average power will be displayed.
- iv. Press and hold the OFF/CANCEL until the display blanks to save the setting.
- v. Press the ON/SELECT button to turn the H410 back on.

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: Each time a new stats run begins, data from the previous run is lost.

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

Note: Statistics mode can collect data at repetition rates of up to 300 Hz depending on the detector model.

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

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 RANGE and MODE buttons simultaneously. The number of pulses in the last statistics run and a flashing SET annunciator 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. The display will blank and a flashing STATS annunciator will appear.
- D. Press the MODE button to begin the run. The STATS annunciator will stop flashing. The indicator will automatically stop once the data has been collected.
- E. Press the ON/SELECT button to recall the data to the display one item at a time. Each time the ON/SELECT button is pressed the following statistical calculations will be sequentially displayed:
 - Number of pulses collected
 - Average energy (AVG)
 - Minimum energy (MIN)
 - Maximum energy (MAX)
 - Standard deviation (SIGMA)
 - Coefficient of variation (CV%)
- F. Press the ON/SELECT button one more time to return to step D for a new stats run. The flashing STATS annunciator indicates that the H410 is ready for a new run. Each time a new run begins the data from the previous run is lost.
- G. Press the OFF/CANCEL button to return the indicator to the mode of operation in effect prior to statistics mode.
- H. Press and hold the OFF/CANCEL until the display blanks to save the setting.
- I. Press the ON/SELECT button to turn the H410 back on.

9. To Perform a Transfer Calibration:

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

You can transfer a calibration from a calorimeter to a Vector pyroelectric detector using the Transfer Calibration function of the H410. This function allows adjustment of the output sensitivity of your Vector pyroelectric detector in combination with your H410 meter in order to match the average power reading from the H410 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.

To enter into the transfer calibration mode:

- A. Press the MODE button to start a menu cycle of J, AVG J, W, CAL and tO.

- B. Press the ON/SELECT button when the CAL annunciator appears. A second menu cycle of CAL 1, CAL 2, Attn and SPd will start.
- C. Press the ON/SELECT button when the CAL 2 annunciator appears. The average power (W) mode will automatically be selected and SET CAL will flash.
- D. Direct the laser beam through the calibrated beam splitter onto both the pyroelectric detector and the calorimeter transfer standard.
- E. Adjust the power reading of the H410 by using the RANGE (count up) and MODE (count down) buttons to agree with the transfer standard.
- F. Press the ON/SELECT button. The indicator is now calibrated and will return to the last operational state.
- G. Press and hold the OFF/CANCEL until the display blanks to save the setting.
- H. Press the ON/SELECT button to turn the H410 back on.

10. Attenuation Factors:

Note: You must enter an attenuation factor of 1.0 when not using an attenuator.

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

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.

To enter into the attenuation factor mode:

- A. Press the MODE button to start a menu cycle of J, AVG J, W, CAL and tO.
- B. Press the ON/SELECT button when the CAL annunciator appears. A second menu cycle of CAL 1, CAL 2, Attn and SPd will start.
- C. Press the ON/SELECT button when the Attn annunciator appears. The current attenuation factor will be displayed and SET will flash.
- D. Press the RANGE (count up) and MODE (count down) buttons to change the attenuation factor to the desired value. Values of 0.01 to 99.99 may be selected.
- E. Press the ON/SELECT button. The attenuation factor is now active and the indicator will return to the last operational state.
- F. Press and hold the OFF/CANCEL until the display blanks to save the setting.
- G. Press the ON/SELECT button to turn the H410 back on.

11. Time Out:

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

Note: The time out default setting is 10 minutes.

The time out feature conserves battery power by putting the H410 to sleep if there is no input from a detector after a selected period of time. To awaken the H410 once it is in the sleep mode press the ON/SELECT button.

To enter into the time out mode:

- A. Press the MODE button to start a menu cycle of J, AVG J, W, CAL and tO.
- B. Press the ON/SELECT button when the tO annunciator appears. The current time out setting will be displayed and SET will flash.
- C. Press the RANGE (count up) and MODE (count down) buttons to change the desired number of minutes, from 1 to 9999.
- D. Press the ON/SELECT button. The time out setting is now active and the indicator will return to the last operational state.
- E. Press and hold the OFF/CANCEL until the display blanks to save the setting.
- E. Press the ON/SELECT button to turn the H410 back on.

CORRECTING PYROELECTRIC DETECTOR OPERATING PARAMETERS FOR USE AT DIFFERENT WAVELENGTHS:

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

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

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

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

This new output sensitivity can be entered into the H410 as described in Group Settings or when using the pyroelectric detector without a H410 indicator as discussed later in this manual.

USING THE H410 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: 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 H410 should be turned on and warmed up for 30 minutes.

Slide the ON/OFF switch, located on the upper right side of the H410, to the ON position. The indicator will immediately turn on in the operational state last used. If you purchased the H410 with one detector, this detector's operating parameters will be in the indicator's memory and you are ready to take measurements.

If you purchased more than one detector with the H410, you must make sure the operating parameters for the detector you plan to use are in the indicator's memory. For detailed instructions please refer to the operating parameters listed on page 2 and the following procedure.

2. Turn the Analog Needle On or Off (does not apply to the H410D):

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

3. Zero the Analog Needle (does not apply to the H410D):

Refer to Figure 2. 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.

4. To Connect a Calorimeter:

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

Refer to Figure 2. Slide the CAL/PYRO switch, located on the upper left side of the H410, to the CAL (up) position. A 3 meter mini DIN type cable comes with Astral calorimeters. For large aperture calorimeters the interconnect cables for both the calorimeter and the indicator are hard wired to the interface module. Connect the cable(s) to the detector and the indicator's mini DIN connector.

5. To Configure the H410 for a Calorimeter:

Note: Some of the menu selections are skipped in this section. They are discussed in detail in later sections.

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

The operating parameters for the calorimeter you are going to use must be entered into the H410's memory.

To enter into the configuration mode:

- A. Press the MODE button. A menu cycle of J, W, CAL, tO and cd will begin.
- B. Press the ON/SELECT button when “CAL” appears. A menu cycle of tCon, SPd and Attn will begin.
- C. Press the ON/SELECT button when “tCon” appears. The current time constant value will be displayed and the “SET CAL” annunciator will flash. The time constant is a measure of the length of time the calorimeter takes to respond to a laser beam.

Use the RANGE (count up) button to increase the value or the MODE (count down) to decrease the value. Enter the time constant value listed on the serial tag of your Astral calorimeter or interface module for large aperture calorimeters.

- D. Press the ON/SELECT button. The time constant is now active and the indicator will return to the last operational state.
- E. Press the MODE button to return to the menu in step A.
- F. Press the ON/SELECT button when “CAL” appears. A menu cycle of tCon, SPd and Attn will begin.
- G. Press the ON/SELECT button when “SPd” appears. The current speed up value will be displayed and the “SET CAL” annunciator will flash. The speed up 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.

Use the RANGE (count up) button to increase the value or the MODE (count down) to decrease the value. Enter the appropriate speed value from the following table.

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

- H. Press the ON/SELECT button. The speed setting is now active and the indicator will return to the operational state last used.
- I. Press the MODE button. A menu cycle of J, W, CAL, tO and cd will begin.
- J. Press the ON/SELECT button when the cd annunciator is displayed. The current calorimeter delay setting is displayed and the SET annunciator flashes. 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

Note: Make sure the calorimeter delay is less than the time out setting you will make in section 10.

K. Press and hold the OFF/CANCEL button until the display blanks to save the settings.

L. Press the ON/SELECT button to turn the H410 back on.

6. To Select a Range:

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

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

A. Press the RANGE button. The analog scale (if active) will disappear and the available ranges will cycle through the display. The ranges available for calorimeters are in the following table:

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

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

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

B. To select a range, press the ON/SELECT button when the range you desire appears in the display. The selected range will be activated and the H410 will return to the last operational state.

C. Press and hold the OFF/CANCEL button until the display blanks to save the settings.

D. Press the ON/SELECT button to turn the H410 back on.

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 Measurement Mode:

The modes available for the calorimeters are: Energy (J) and Power (W).

A. To Measure Energy (J):

Note: Calorimeters can only measure single shot energy pulses with the time between pulses dependent on the calorimeter delay setting from section 5J. With the calorimeter delay entered, the H410 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 "trig" annunciator disappears. If you do, the H410 resets the time delay and ignores the sequential pulse altogether.

Note: Make sure the calorimeter delay, set in section 5J, is shorter than the time out set in section 10. If not the H410 will go into sleep mode before the pulse energy is displayed.

- i. Press the MODE button. A menu cycle of J, W, CAL, tO and cd will begin.
- ii. Press the ON/SELECT button when the J annunciator appears and the joules mode will be activated.
- iii. The energy level of each laser pulse will be displayed.

B. To Measure Power (W):

Note: 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. A menu cycle of J, W, CAL, tO and cd will begin.
- ii. Press the ON/SELECT button when the W annunciator appears and the watts mode will be activated.
- iii. Press the CANCEL button to zero the display.
- iv. The power will be displayed.

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 from section 5J). With the calorimeter delay entered, the H410 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 "trig" annunciator disappears. If you do, the H410 resets the time delay and ignores the sequential pulse altogether.

Note: Make sure the calorimeter delay, set in section 5J, is shorter than the time out set in section 10. If not the H410 will go into sleep mode before the pulse energy is displayed.

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.

Note: To exit the statistical mode at any time, press the OFF/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 RANGE and MODE buttons simultaneously. The number of pulses in the last statistics run will appear in the display and the SET annunciator will flash.
- 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 ON/SELECT button to enter the pulse population to memory. The display will blank and the STATS annunciator will flash.
- D. Press the MODE button to begin the run. The STATS annunciator will stop flashing and the indicator will automatically stop once the data has been collected.
- E. Press the ON/SELECT button to recall the data to the display one item at a time. Each time the ON/SELECT button is pressed the following statistical calculations will be sequentially displayed:
 - Number of pulses collected
 - Average energy (AVG)
 - Minimum energy (MIN)
 - Maximum energy (MAX)
 - Standard deviation (SIGMA)
 - Coefficient of variation (CV%)
- F. Press the ON/SELECT button one more time to return to step D to begin a new stats run. The flashing STATS annunciator indicates that the H410 is ready for a new run. Each time a new run begins the data from the previous run is lost.
- G. Press the OFF/CANCEL button to return the indicator to the mode of operation in effect prior to statistics mode.
- H. Press and hold the OFF/CANCEL button until the display blanks to save the settings.
- I. Press the ON/SELECT button to turn the H410 back on.

9. Attenuation Factors:

Note: You must enter an attenuation factor of 1.0 when not using an attenuator.

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

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.

To enter into the attenuation factor mode:

- A. Press the MODE button to start a menu cycle of J, W, CAL and tO and cd.
- B. Press the ON/SELECT button when the CAL annunciator appears. A second menu cycle of tCon, SPd and Attn will start.
- C. Press the ON/SELECT button when the Attn annunciator appears. The current attenuation factor will be displayed and SET will flash.
- D. Press the RANGE (count up) and MODE (count down) buttons to change the attenuation factor to the desired value. Values of 0.01 to 99.99 may be selected.

- E. Press the ON/SELECT button. The attenuation factor is now active and the indicator will return to the last operational state.
- F. Press and hold the OFF/CANCEL until the display blanks to save the setting.
- G. Press the ON/SELECT button to turn the H410 back on.

Attenuation factors can also be used to enable the H410 to display the correct reading when HD and HDX calorimeters are used with wavelengths other than their calibration wavelength. See the discussion at the beginning of this section for details.

10. Time Out:

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

Note: The time out default is 10 minutes.

The time out feature conserves battery power by putting the H410 to sleep if there is no input from a detector after a selected period of time. To awaken the H410 once it is in the sleep mode press the ON/SELECT button.

To enter into the time out mode:

- A. Press the MODE button to start a menu cycle of J, W, CAL, tO and cd.
- B. Press the ON/SELECT button when the tO annunciator appears. The current time out setting will be displayed and SET will flash.
- C. Press the RANGE (count up) and MODE (count down) buttons to change the desired number of minutes, from 1 to 9999.
- D. Press the ON/SELECT button. The time out setting is now active and the indicator will return to the last operational state.
- E. Press and hold the OFF/CANCEL until the display blanks to save the setting.
- F. Press the ON/SELECT button to turn the H410 back on.

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

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

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

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

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

The attenuation factor can be entered into the H410 as described in step 9.

USING THE H410 WITH ASTRAL™ PHOTODIODE DETECTORS:

Be sure the photodiode detector is appropriate for the laser measurements you plan to make. Please familiarize yourself with the detector's operation specifications before you use it.

Note: Photodiode detectors can only be used to measure continuous wave lasers.

1. To Turn On the Meter:

Note: For the most accurate measurements possible, the H410 should be turned on and warmed up for 30 minutes.

Slide the ON/OFF switch, located on the upper right side of the H410, to the ON position. The indicator will immediately turn on in the operational state last used. If you purchased the H410 with one detector, this detector's operating parameters will be in the indicator's memory and you are ready to take measurements.

If you purchased more than one detector with the H410, you must make sure the operating parameters for the detector you plan to use are in the indicator's memory. For detailed instructions please refer to the operating parameters listed on page 2 and the following procedure.

2. Turn the Analog Needle On or Off (does not apply to the H410D):

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

3. Zero the Analog Needle (does not apply to the H410D):

Refer to Figure 2. 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.

4. To Connect a Photodiode Detector:

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

Refer to Figure 2. Slide the CAL/PYRO switch, located on the upper left side of the H410, to the CAL (up) position. A 3 meter mini DIN type cable comes with Astral photodiode detectors. Connect the cable to the indicator's mini DIN connector.

5. To Configure the H410 for a Photodiode Detector:

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

To enter into the configuration mode:

- A. Press the MODE button. A menu cycle of W, CAL and Attn will begin.
- B. Press the ON/SELECT button when W appears. A menu cycle of U and UIS will begin. Choose U (ultraviolet) for the model AP30UV or UIS (visible) for the model AP30.
- C. Press the ON/SELECT button when the appropriate option is in the display. The H410 is now configured for the chosen photodiode detector and will return to the last operational state.
- D. Press and hold the OFF/CANCEL until the display blanks to save the setting.
- E. Press the ON/SELECT button to turn the H410 back on.

6. To Select a Wavelength:

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

To enter into the wavelength selection mode:

- A. Press the MODE button. A menu cycle of W, CAL and Attn will begin.
- B. Press the ON/SELECT button when CAL appears. The current wavelength is displayed and the SET annunciator is flashing.
- C. Use the RANGE (count up) and MODE (count down) buttons to change the display (in 1 nm increments) to the desired wavelength. The available wavelengths are as follows:
 - 200 nm to 1100 nm for Model AP30UV
 - 400 nm to 1100 nm for Model AP30
- D. Press the ON/SELECT button. The new wavelength setting is now active and the H410 will return to the last operational state.
- E. Press and hold the OFF/CANCEL until the display blanks to save the setting.
- F. Press the ON/SELECT button to turn the H410 back on.

7. To Select a Range:

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

- A. Press the RANGE button. The analog scale (if active) will disappear and AUTO, 30 μ W, 300 μ W, 3mW and 30mW will cycle through the display.
- B. Press the ON/SELECT button when the range you desire appears in the display. The selected range is activated and the H410 will return to the last operational state.
- C. Press and hold the OFF/CANCEL button until the display blanks to save the setting.
- D. Press the ON/SELECT button to turn the H410 back on.

8. To Zero the Display:

- A. Press the CANCEL button before the photodiode is lased.

9. Attenuation Factors:

Note: You must enter an attenuation factor of 1.0 when not using an attenuator.

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

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.

To enter into the attenuation factor mode:

- A. Press the MODE button to start a menu cycle of W, CAL and Attn.
- B. Press the ON/SELECT button when the Attn annunciator appears. The current attenuation factor will be displayed and SET will flash.
- C. Press the RANGE (count up) and MODE (count down) buttons to change the attenuation factor to the desired value. Values of 0.01 to 99.99 may be selected.
- D. Press the ON/SELECT button. The attenuation factor is now active and the indicator will return to the last operational state.
- E. Press and hold the OFF/CANCEL until the display blanks to save the setting.
- F. Press the ON/SELECT button to turn the H410 back on.

10. Time Out:

Note: You must save all settings by pressing and holding the OFF/CANCEL button until the display blanks. If the H410 is turned off, by using the ON/OFF slide switch, before settings are saved they will be lost.

Note: The time out default is 10 minutes.

The time out feature conserves battery power by putting the H410 to sleep if there is no input from a detector after a selected period of time. To awaken the H410 once it is in the sleep mode press the ON/SELECT button.

To enter into the time out mode:

- A. Press the MODE button to start a menu cycle of J, AVG J, W, CAL and tO.
- B. Press the ON/SELECT button when the tO annunciator appears. The current time out setting will be displayed and SET will flash.
- C. Press the RANGE (count up) and MODE (count down) buttons to change the desired number of minutes, from 1 to 9999.
- D. Press the ON/SELECT button. The time out setting is now active and the indicator will return to the last operational state.
- E. Press and hold the OFF/CANCEL until the display blanks to save the setting.
- F. Press the ON/SELECT button to turn the H410 back on.

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

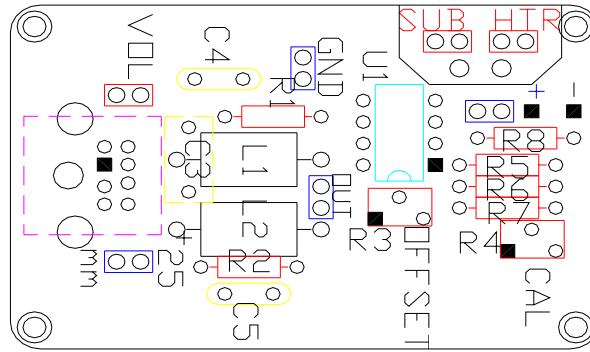


Figure 4

- A. Remove the screws holding the calorimeter's ID tag and remove the plate to expose the circuit board as shown in Figure 4.
- 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.

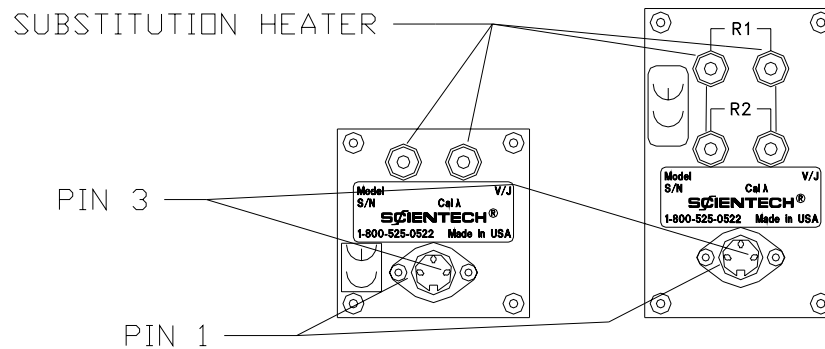


Figure 5

Calibration with an Interface Module and H410 Indicator:

- 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 of a 200 mm calorimeter, R1 and R2 must be connected together in series.
Compare this resistance to R_C in the calibration data in the front of the manual. The two should agree within 2%. If not, contact Scientech.
- C. 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 4.
- 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 H410 Indicator:

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

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 5.

- A. Connect a DVM to the white jacks of the calorimeter. Refer to Figure 4.
- B. Measure the resistance of the substitution heater making sure to subtract the resistance of the patch cables from the total resistance measurement.

Note: When measuring the substitution heater resistance of a 200 mm calorimeter, R1 and R2 must be connected together in series.

Compare this resistance to R_c in the calibration data in the front of the manual. The two should agree within 2%. If not, contact Scientech.

- C. Calculate the voltage equivalent to laser power using the following formula:

$$V = (R_c \times C \times W)^{1/2}$$

where:

V = voltage applied to the heater coil

R_c = substitution heater resistance from step B

C = Cal coefficient 360401 = 1.018 360801 = 1.000

 380401 = 0.974 380801 = 1.008

 380402 = 1.024 380802 = 1.008

 384UV5 = 1.021 388UV5 = 1.002

W = desired laser power in watts

- D. Connect the DVM to the calorimeter's DIN connector.
- E. Apply the calculated voltage (V) to the electrical substitution heater.
- F. Record the voltage reading of the DVM (V_c).
- G. Calculate the calorimeter's output sensitivity (S) as follows:

$$S = V_c/W$$

where:

S = calorimeter's output sensitivity

V_c = voltage output from the calorimeter in mV

W = desired laser power output.

The measured sensitivity should be $\pm 3\%$ of the calorimeters original sensitivity value.

DETECTOR OPERATION WITHOUT AN INDICATOR:

Pyroelectric Detectors:

Standard and SP Models:

Pyroelectric detectors can be operated with a 1M Ω input oscilloscope. The peak voltage shown on the oscilloscope can be divided by the V/J 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 6. The voltage output of the calorimeter, from pin 8, should be connected to the positive side of the DVM or chart recorder. All 3 of the grounds should be tied together at the negative side. Pins 2 and 3 are not used.

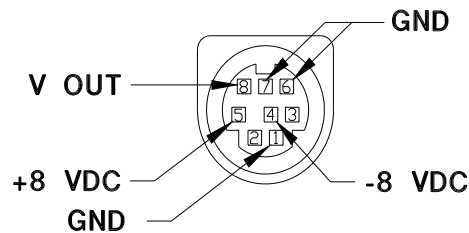


Figure 6

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 5.

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.

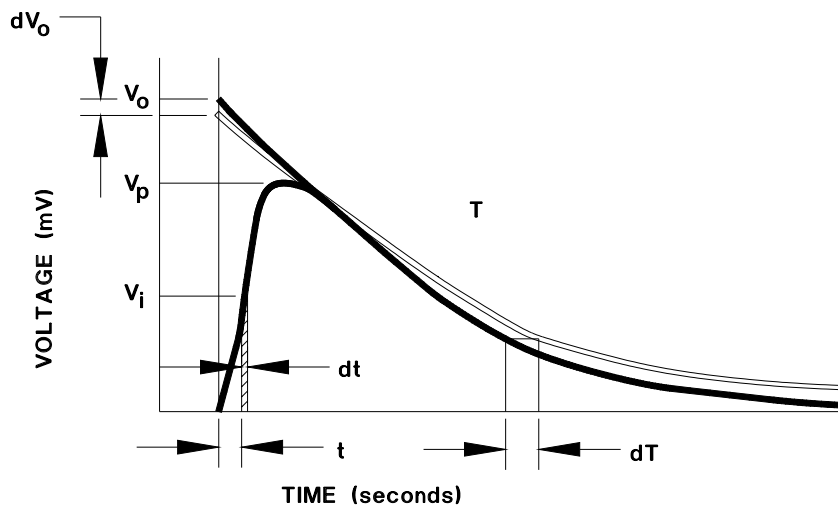
- A. Connect the output of the calorimeter to the DVM.
- B. Select the DC volts mode.
- C. Direct the laser beam on to the absorbing surface of the calorimeter.
- D. When the display of the DVM has stabilized (about 2 minutes), calculate the laser power using the formula: $W = V/S$
where:
W = Laser power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

Operation of Astral™ and Large Aperture 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):

$$E = (V_0/S) \times T$$

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_0 . Further, the determination of the time constant T, introduces another error, dT . The total error is the sum of the two errors.

$$dE = (V_0/S)dT + (T/S)dV_0$$

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.

Astral™ Photodiode Detectors:

Scientech does not recommend that Astral photodiode detectors be used without a H410 indicator. The crystals used in the detectors are wavelength dependent and the absorption characteristics vary from batch to batch as they are manufactured. The H410 indicator's software contains the correction factors necessary to get accurate readings.

Cable Requirements:

Astral photodiode detectors are powered up by the indicators. To use an Astral photodiode detector without a Scientech indicator you must construct a cable as described on page 30 and shown in Figure 6.

Operation of Astral™ Photodiode Detectors with a Digital Volt Meter:

The detectors may be used with any digital volt meter (DVM) capable of reading 5 volts full scale only at the 632 nm wavelength. For use at any wavelength other than 632 nm you must contact Scientech to determine the correct sensitivity for that wavelength.

- A. Connect the output of the detector to the DVM.
- B. Select the DC volts mode.
- C. Direct the laser beam on to the absorbing surface of the detector.
- D. When the display of the DVM has stabilized calculate the laser power using the formula: $W = V/S$

where:

W = Laser power in watts

V = Voltage reading of the DVM in volts

S = Sensitivity of the calorimeter from page 2.

FACTORY RECALIBRATION:

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

LIMITED WARRANTY:

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

RETURNED GOODS PROCEDURE:

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

If equipment return is required, please pack the items in the original box and packing material. As an alternate, place the equipment in a snug-fitting box, and then pack that box in a larger box with at least four inches of packing material. Scientech does not assume responsibility for under packed items. Please include the name and phone number of the person we should contact regarding repair questions.

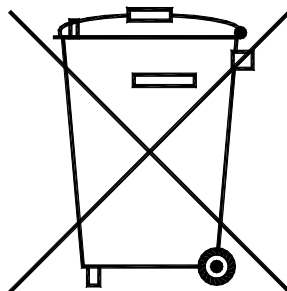
Normally, products are repaired and shipped within 5 working days after their arrival at the product service facility. This is an average time and could vary depending on the workload.

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

DISPOSAL OF ELECTRICAL AND ELECTRONIC EQUIPMENT:

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

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



HD CALORIMETER AND PYROELECTRIC ABSORPTION VS. WAVELENGTH:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

P MODEL PYROELECTRIC DETECTOR ABSORPTION VS. WAVELENGTH:

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

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

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

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

HF MODEL PYROELECTRIC DETECTOR ABSORPTION VS. WAVELENGTH:

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

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

Wavelength μm	Absorption %
2.067	60.27
2.070	60.28
2.073	60.24
2.077	60.24
2.080	60.24
2.083	60.25
2.087	60.26
2.09	60.25
2.094	60.25
2.097	60.25
2.100	60.23
2.104	60.24
2.107	60.26
2.111	60.24
2.114	60.22
2.117	60.22
2.121	60.22
2.124	60.23
2.128	60.23
2.131	60.22
2.135	60.21
2.138	60.20
2.142	60.20
2.145	60.17
2.149	60.16
2.153	60.16
2.156	60.17
2.160	60.18
2.163	60.17
2.167	60.15
2.171	60.13
2.174	60.12
2.178	60.13
2.182	60.16
2.185	60.16
2.189	60.15
2.193	60.14
2.196	60.12
2.200	60.12
2.204	60.11
2.208	60.10
2.211	60.11
2.215	60.11
2.219	60.09
2.223	60.08
2.226	60.08
2.230	60.06
2.234	60.05
2.238	60.06
2.242	60.05
2.246	60.01
2.250	60.00
2.254	60.02

Wavelength μm	Absorption %
2.257	60.06
2.261	60.05
2.265	60.05
2.269	60.05
2.273	60.01
2.277	59.99
2.281	59.99
2.285	59.99
2.289	60.00
2.293	60.01
2.297	60.00
2.301	59.97
2.306	59.96
2.310	59.96
2.314	59.96
2.318	59.96
2.322	59.96
2.326	59.97
2.330	59.96
2.335	59.96
2.339	59.95
2.343	59.94
2.347	59.92
2.352	59.91
2.356	59.92
2.360	59.92
2.364	59.92
2.369	59.92
2.373	59.91
2.377	59.90
2.382	59.89
2.386	59.90
2.390	59.91
2.395	59.89
2.399	59.87
2.404	59.87
2.408	59.86
2.413	59.85
2.417	59.84
2.422	59.85
2.426	59.86
2.431	59.85
2.435	59.83
2.440	59.82
2.445	59.81
2.449	59.82
2.454	59.83
2.458	59.84
2.463	59.83
2.468	59.82
2.472	59.81
2.477	59.78
2.482	59.78

Wavelength μm	Absorption %
2.487	59.79
2.491	59.80
2.496	59.81
2.501	59.80
2.506	59.78
2.511	59.75
2.516	59.74
2.520	59.75
2.525	59.74
2.530	59.72
2.535	59.70
2.540	59.69
2.545	59.65
2.550	59.65
2.555	59.63
2.560	59.54
2.565	59.51
2.570	59.52
2.575	59.49
2.581	59.47
2.586	59.44
2.591	59.41
2.596	59.43
2.601	59.43
2.607	59.43
2.612	59.45
2.617	59.46
2.622	59.49
2.628	59.48
2.633	59.54
2.638	59.61
2.644	59.60
2.649	59.58
2.655	59.53
2.660	59.40
2.665	59.23
2.671	59.23
2.676	59.32
2.682	59.44
2.687	59.47
2.693	59.46
2.699	59.51
2.704	59.49
2.710	59.44
2.716	59.38
2.721	59.36
2.727	59.49
2.733	59.45
2.739	59.36
2.744	59.46
2.750	59.47
2.756	59.39
2.762	59.36

Wavelength μm	Absorption %
2.768	59.39
2.774	59.45
2.780	59.44
2.786	59.44
2.792	59.49
2.798	59.46
2.804	59.44
2.810	59.50
2.816	59.50
2.822	59.51
2.828	59.51
2.834	59.51
2.840	59.53
2.847	59.55
2.853	59.58
2.859	59.64
2.866	59.68
2.872	59.67
2.878	59.63
2.885	59.57
2.891	59.53
2.897	59.50
2.904	59.49
2.910	59.50
2.917	59.49
2.924	59.48
2.930	59.49
2.937	59.49
2.943	59.48
2.950	59.49
2.957	59.48
2.964	59.48
2.970	59.48
2.977	59.48
2.984	59.48
2.991	59.47
2.998	59.47
3.005	59.48
3.012	59.47
3.019	59.46
3.026	59.45
3.033	59.45
3.040	59.45
3.047	59.45
3.054	59.46
3.062	59.46
3.069	59.45
3.076	59.45
3.083	59.46
3.091	59.47
3.098	59.46
3.105	59.45
3.113	59.46

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

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

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

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

Wavelength μm	Absorption %
6.365	57.97
6.396	57.83
6.428	57.83
6.460	57.76
6.492	57.75
6.525	57.77
6.557	57.69
6.591	57.67
6.624	57.73
6.658	57.81
6.693	57.88
6.727	57.88
6.762	57.82
6.798	57.76
6.834	57.73
6.870	57.79
6.906	57.84
6.943	57.79
6.981	57.76
7.018	57.74
7.057	57.78
7.095	57.77
7.134	57.73
7.174	57.76
7.214	57.79
7.254	57.78
7.295	57.76
7.336	57.78
7.378	57.80
7.420	57.77
7.462	57.76
7.506	57.77
7.549	57.76
7.593	57.76
7.638	57.77
7.683	57.77
7.729	57.76
7.775	57.75
7.822	57.74

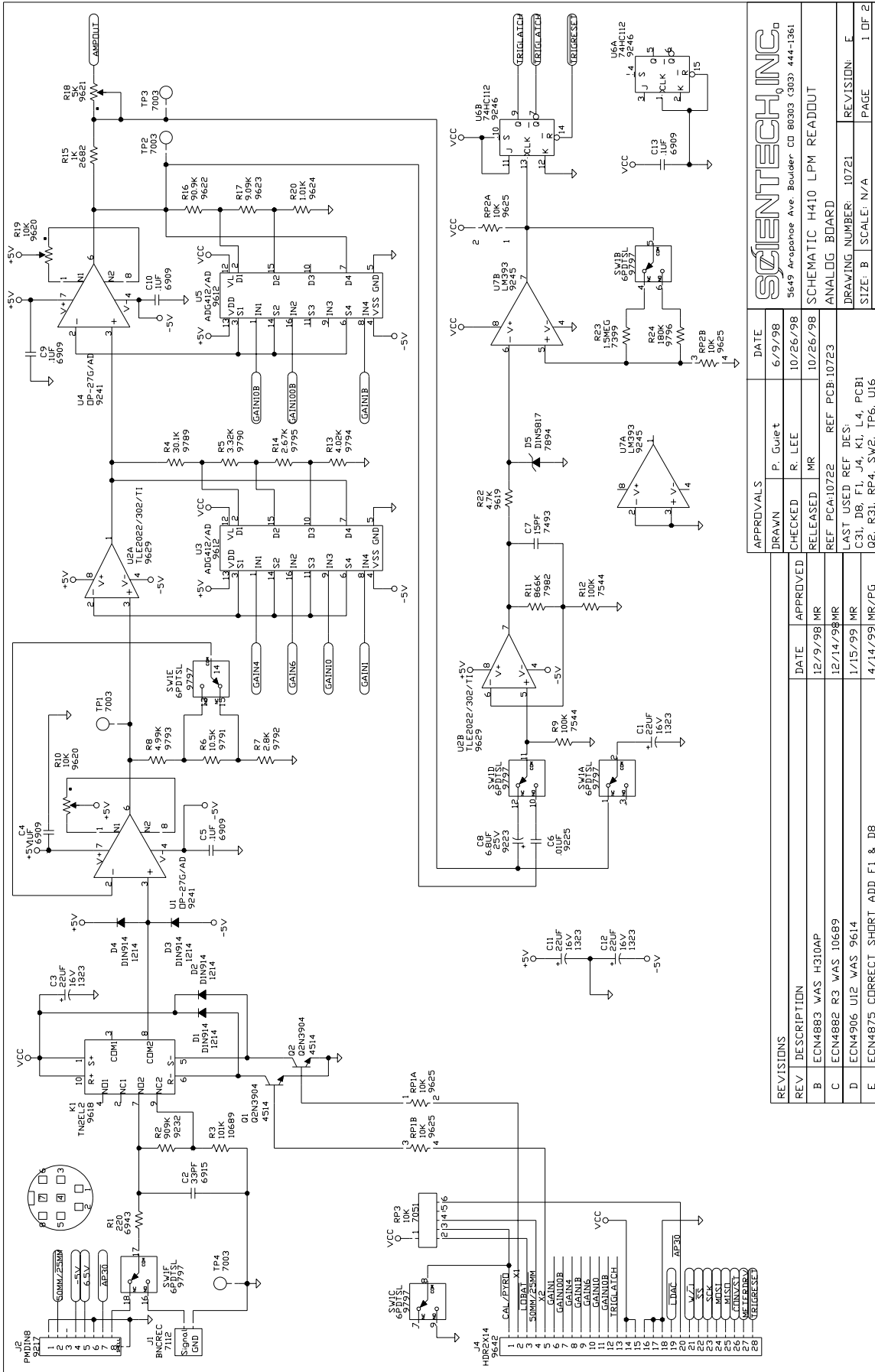
Wavelength μm	Absorption %
7.870	57.74
7.918	57.73
7.966	57.73
8.015	57.73
8.065	57.73
8.116	57.73
8.167	57.74
8.218	57.74
8.271	57.75
8.324	57.76
8.378	57.77
8.432	57.78
8.487	57.80
8.543	57.82
8.600	57.84
8.657	57.87
8.715	57.91
8.774	57.94
8.834	57.98
8.894	58.02
8.956	58.07
9.018	58.14
9.081	58.20
9.145	58.26
9.210	58.32
9.276	58.39
9.343	58.45
9.410	58.52
9.479	58.61
9.549	58.69
9.620	58.79
9.691	58.91
9.764	59.04
9.838	59.18
9.913	59.34
9.990	59.51
10.07	59.69
10.15	59.88
10.23	60.09

Wavelength μm	Absorption %
10.31	60.33
10.39	60.59
10.47	60.88
10.56	61.18
10.65	61.51
10.73	61.88
10.82	62.26
10.91	62.62
11.01	63.01
11.10	63.50
11.20	63.99
11.29	64.25
11.39	64.19
11.49	63.83
11.60	63.27
11.70	62.55
11.81	61.82
11.92	61.29
12.03	60.83
12.14	60.22
12.25	59.45
12.37	58.61
12.49	57.76
12.61	56.91
12.73	56.06
12.86	55.20
12.99	54.32
13.12	53.42
13.25	52.50
13.39	51.53
13.53	50.51
13.67	49.46
13.82	48.42
13.97	47.38
14.12	46.39
14.28	45.49
14.43	44.72
14.60	44.02
14.76	43.45

Wavelength μm	Absorption %
14.93	43.14
15.11	42.72
15.28	41.67
15.47	40.14
15.65	38.41
15.84	36.53
16.04	34.41
16.24	32.05
16.45	29.57
16.66	27.22
16.87	25.74
17.10	26.08
17.32	28.33
17.56	31.38
17.80	34.24
18.05	36.63
18.30	38.49
18.56	39.88
18.83	41.13
19.11	42.50
19.40	43.95
19.69	45.40
19.99	46.70
20.31	47.76
20.63	48.85
20.96	50.32
21.31	52.14
21.66	53.52
22.03	52.80
22.41	49.83
22.80	47.84
23.21	48.44
23.63	48.80
24.07	47.13
24.53	44.58
25.00	41.82
25.49	39.64
26.00	38.04

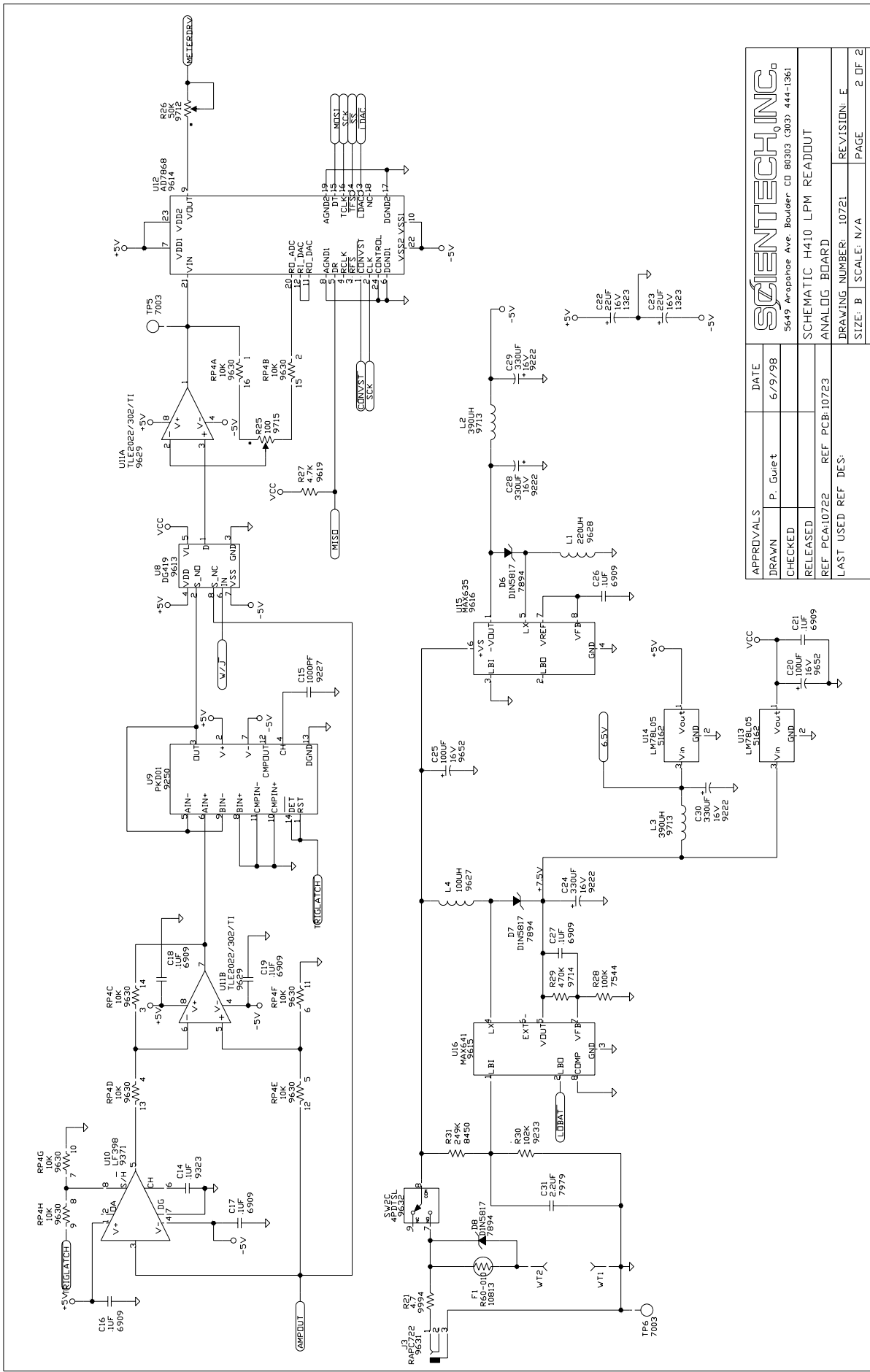
Note: Due to variability in the manufacturing process the absorption in the UV region varies. Calibration at 266nm is recommended if the detector is to be used in the UV region.

SCHEMATICS:

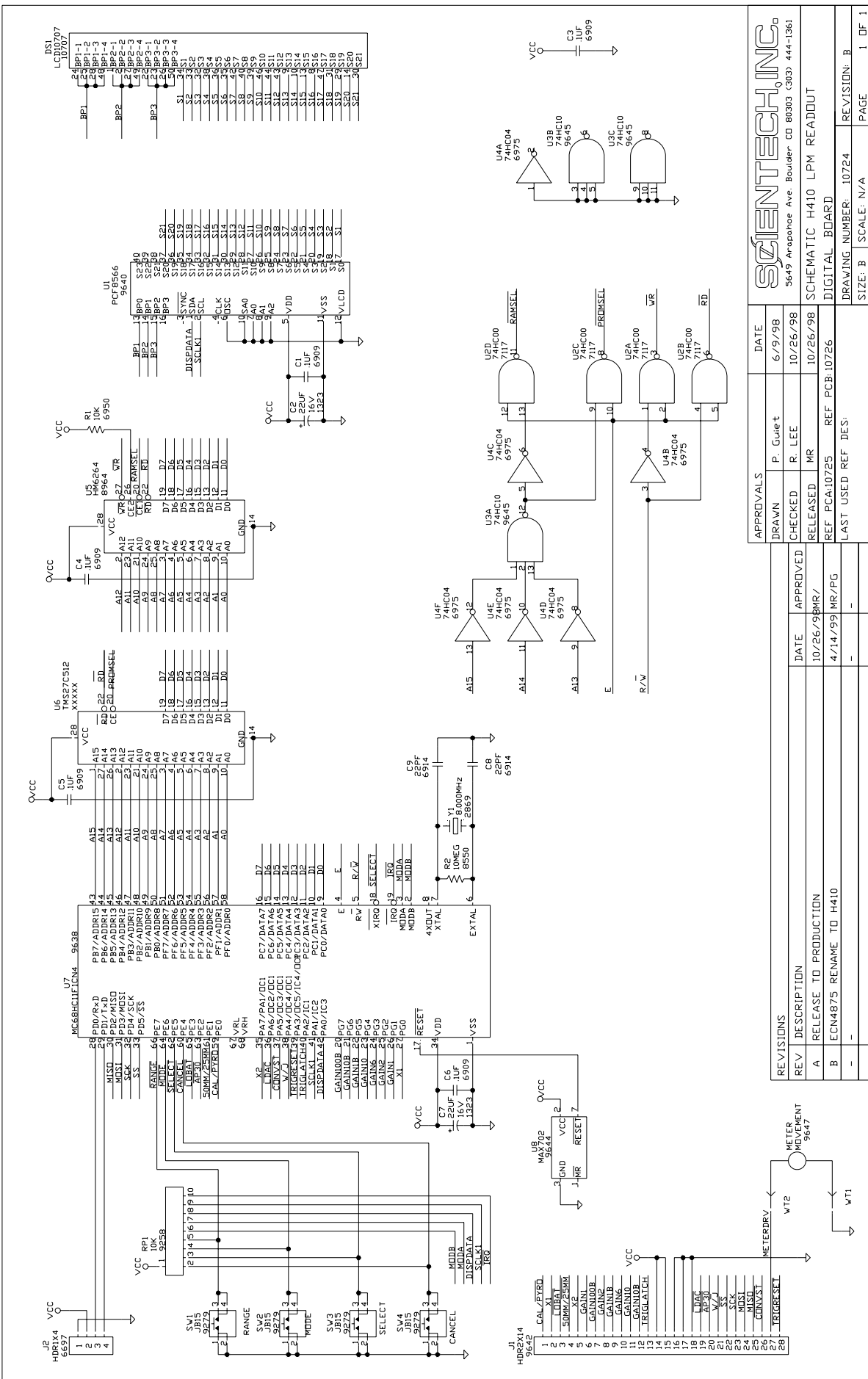


SCIENTECH INC		DATE	
APPROVALS	P. Guent	6/9/98	
DRAWN	R. Lee	10/26/98	
CHECKED	MR	10/26/98	
RELEASED	MR	10/26/98	
REF. PCA-10722	REF. PCB-10723		
SCHEMATIC H410 LPM READOUT			
5649 Arapahoe Ave. Boulder CO 80303 (303) 444-1361			
DRAWING NUMBER: 10721			
SCALE: N/A			
REVISION: E			
PAGE 1 OF 2			

REV	DESCRIPTION	DATE	APPROVED
B	ECN4883 WAS H310AP	12/9/98	MR
C	ECN4882 R3 WAS 10689	1/15/99	MR
D	ECN4906 U12 WAS 9614	4/14/99	MR/PG
E	ECN4875 CORRECT SHORT ADD F1 & D8		



SCIENTECH INC.	
APPROVALS	DATE
DRAWN P. Gulet	6/9/98
CHECKED	
RELEASED	
REF PCA:10722	REF PCB:10723
LAST USED REF DES:	
SCHEMATIC H410 LPM READOUT	
ANALOG BOARD	
DRAWING NUMBER: 10721	REVISION: E
SIZE: B	PAGE: N/A
	2 OF 2



APPROVALS		DATE
DRAWN	P. Guinet	6/9/98
CHECKED	R. LEE	10/26/98
RELEASED	MR	10/26/98
REF	PCAI:10725	REF PCB:10726
LAST USED REF DES:		
REV	DESCRIPTION	DATE
A	RELEASE TO PRODUCTION	10/26/98MR/PG
B	ECN4875 RENAME TO H410	-
-	-	-
-	-	-

REV	DESCRIPTION	DATE	APPROVED
A	RELEASE TO PRODUCTION	10/26/98MR/PG	
B	ECN4875 RENAME TO H410	-	
-	-	-	
-	-	-	

REVISIONS	DATE
6/9/98	
10/26/98	
10/26/98	
10/26/98	

SCHEMATIC H410 LPM READOUT
DIGITAL BOARD
DRAWING NUMBER: 10724
REVISION: B
SIZE: B
SCALE: N/A
PAGE
1
DF 1

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