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SCIENTECH®



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

Serial Number_____

P/N 10190H
5205

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DETECTOR CALIBRATION DATA

Calorimeter # 1:

Model No: _____

Serial No: _____

Calibration Wavelength _____nm or µm

Output Sensitivity (S): _____V/W

Time Constant (1/e): _____sec.

Calibration Temp: _____°C

Sub. Heater Resistance (R_c): _____ohms

Sub. Heater Voltage (V_h): _____volts

Sub. Heater Wattage (W_h) _____watts

Calorimeter # 2:

Model No: _____

Serial No: _____

Calibration Wavelength: _____nm or µm

Output Sensitivity (S): _____V/W

Time Constant (1/e): _____sec.

Calibration Temp: _____°C

Sub. Heater Resistance (R_c): _____ohms

Sub. Heater Voltage (V_h): _____volts

Sub. Heater Wattage (W_h): _____watts

Pyroelectric Detector # 1:

Model No: _____

Serial No: _____

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

Thank you for choosing a Scientech laser power and energy meter. Scientech, an ISO 9000 registered company, and employees are pleased to provide you with a product designed for years of reliable service. Please read this manual completely before using your indicator. This information will enable you to fully utilize the equipment and should be located nearby for reference. The indicator is intended to be used only in the manner outlined in this manual. Misuse of the equipment may cause product failure.

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

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ASTRAL™ CALORIMETER SPECIFICATIONS

Model	AC 2500	AC 25HD	ACX 25HD	AC 2501	ACX 2501	AC 25UV	AC 2504
Type Absorber	Surface	Surface	Surface	Volume	Volume	Volume	Volume
Max Beam Diameter	25 mm	25 mm	8 mm	25 mm	8 mm	25 mm	25 mm
Spectral Response	.25-35 µm	.19-12 µm	.4-2 µm	.266-1.2 µm	.4-1.2 µm	.19-.36 µm	.85-4.2 µm
Average Power (max)	10 W						
Average Power (min)*	1 mW						
Noise Level	10 µW or µJ						
Power Density (max)	200 W/cm²	1.5 kW/cm²	12 kW/cm²	Note 1	Note 2	Note 3	Note 4
Peak Power Density (max)	1 MW/cm²	100 MW/cm²	800 MW/cm²	Note 5	8.5 GW/cm²	Note 6	Note 7
Single Pulse Energy (max)	10 J						
Energy Density (max)	Note 8	Note 9	Note 10	Note 11	Note 12	Note 13	Note 14
Precision	< 1%						
Accuracy	3%						
Response Time	3 sec (if attached to a Scientech indicator and indicator is in watts mode)						
Dimensions DxL (in.) (cm)	3.75 x 2.2 9.53 x 5.6	3.75 x 2.2 9.53 x 5.6	3.75 x 3.82 9.53 x 9.7	3.75 x 2.2 9.53 x 5.6	3.75 x 3.82 9.53 x 9.7	3.75 x 2.2 9.53 x 5.6	3.75 x 2.2 9.53 x 5.6
Weight (lbs) (kgs)	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	H310, H310D, H410, H410D, S310, S310D, D200PC, D200C						
Model	AC 5000	AC 50HD	ACX 50HD	AC 5001	ACX 5001	AC 50UV	AC 5004
Type Absorber	Surface	Surface	Surface	Volume	Volume	Volume	Volume
Max Beam Diameter	50 mm	50 mm	16 mm	50 mm	16 mm	50 mm	50 mm
Spectral Response	.25-35 µm	.19-12 µm	.4-2 µm	.266-1.2 µm	.4-1.2 µm	.19-.36 µm	.85-4.2 µm
Average Power (max)	30 W						
Average Power (min)	100 mW						
Noise Level	1 mW or mJ						
Power Density (max)	200 W/cm²	1.5 kW/cm²	12 kW/cm²	Note 1	Note 2	Note 3	Note 4
Peak Power Density (max)	1 MW/cm²	100 MW/cm²	800 MW/cm²	Note 5	8.5 GW/cm²	Note 6	Note 7
Single Pulse Energy (max)	30 J						
Energy Density (max)	Note 8	Note 9	Note 10	Note 11	Note 12	Note 13	Note 14
Precision	< 1%						
Accuracy	3%						
Response Time	3 sec (if attached to a Scientech indicator operating in watts mode)						
Dimensions DxL (in.) (cm)	4.75 x 2.3 12.07 x 5.8	4.75 x 2.3 12.07 x 5.8	4.75 x 3.92 12.07 x 9.96	4.75 x 2.3 12.07 x 5.8	4.75 x 3.92 12.07 x 9.96	4.75 x 2.3 12.07 x 5.8	4.75 x 2.3 12.07 x 5.8
Weight (lbs) (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	H310, H310D, H410, H410D, S310, S310D, D200PC, D200C						

*Calorimeter installed in an Isoperibol enclosure

Note 1: AC 2501, AC 5001 — 30 W/cm² @ 1064nm, 23 W/cm² @ 532nm, 8.5 W/cm² @ 355nm, 175mW/cm² @ 266nm

Note 2: ACX 2501, ACX 5001 — Note 1 specs x 8 for 400nm to 1.2um

Note 3: AC 25UV, AC 50UV — 50 W/cm² @ 355nm

Note 4: AC 2504, AC 5004 — 35W/cm² @ 1064nm

Note 5: AC 2501, AC 5001 — 100GW/cm² @ 1064nm, 78GW/cm² @ 532nm, 29GW/cm² @ 355nm, 580MW/cm² @ 266nm

Note 6: AC 25UV, AC 50UV — For repetitive pulses; 101MW/cm² @ 355nm
For single pulses; 305GW/cm² @ 355nm

Note 7: AC 2504, AC 5004 — 125GW/cm² @ 1064nm

Note 8: AC 2500, AC 5000 — Max J/cm² = 1000 x (pulse width)$^{1/2}$ to a maximum of 200 J/cm².

Note 9: AC 25HD, AC 50HD — Max J/cm² = 4500 x (pulse width)$^{1/2}$ to a maximum of 14 J/cm².

Note 10: ACX 25HD, ACX 50HD — Max J/cm² = 36,000 x (pulse width)$^{1/2}$ to a maximum of 42.5 J/cm².

Note 11: AC 2501, AC 5001 — For repetitive pulses: 4.1 J/cm² @ 1064nm, 3.2 J/cm² @ 532nm, 1.2 J/cm² @ 355nm, 24mJ/cm² @ 266nm
For single pulses: 8 J/cm² @ 1064nm, 6.2 J/cm² @ 532nm, 2.3 J/cm² @ 355nm, 46mJ/cm² @ 266nm

Note 12: ACX 2501, ACX 5001 — Note 11 specs x 8 for 400nm to 1.2um

Note 13: AC 25UV, AC 50UV — For repetitive pulses; 1.1J/cm² @ 355nm
For single pulses; 40J/cm² @ 355nm

Note 14: AC 2504, AC 5004 — For repetitive pulses; 4.8J/cm² @ 1064nm
For single pulses; 10J/cm² @ 1064nm

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VECTOR ™ PYROELECTRIC DETECTOR SPECIFICATIONS

Model	PHF 02	PHF 05	PHF 09	P 05	P 09
Active Diameter	2 mm	5 mm	9 mm	5 mm	9 mm
Voltage Response				3.0 V/mJ	0.8 V/mJ
S,I	15 V/mJ	2.5 V/mJ	1 V/mJ		
L	0.15 V/mJ	0.025 V/mJ	0.01 V/mJ		
Electrical Decay Time				2.0 msec	2.0 msec
(RC Time Constant)					
S	0.05 msec	0.05 msec	0.05 msec		
I	0.5 msec	0.5 msec	0.5 msec		
L	2.5 msec	2.5 msec	2.5 msec		
Noise Equivalent Energy				15 nJ	35 nJ
S, I	3 nJ	15 nJ	35 nJ		
L	150 nJ	750 nJ	3500 nJ		
Rep Rate (max)				400 pps	200 pps
S	4000 pps	4000 pps	4000 pps		
I	400 pps	400 pps	400 pps		
L	80 pps	80 pps	80 pps		
Pulse Width (max)				50 µsec	100 µsec
(For Calibrated Response)					
S	5 µsec	5 µsec	5 µsec		
I	50 µsec	50 µsec	50 µsec		
L	250 µsec	250 µsec	250 µsec		
Voltage Output (max.)	4.5 V				
Average Power (max)	1 W	2 W	2 W	2 W	2 W
Accuracy	7%	7%	7%	5%	5%
Indicator Compatibility	S310, S310D, D200PC, D200P				

Model	P 25	PHF 25	PHD 25	PHDX 25	PHDX25UV	SP 25	SPHF 25	SPHD 25
Max Beam Diameter	25 mm	25 mm	25 mm	7 mm	7mm	25 mm	25 mm	25 mm
Spectral Response	UV to mid-IR			.4-2um	UV to mid-IR			
Average Power (max)	5 W *	5 W *	5 W *	5 W *	5 W *	5 W *	5 W *	5 W *
Noise Equivalent Energy	4 µJ							
Energy Density (max)	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
Rep Rate (max)	100 pps	400 pps	40 pps	40 pps	40 pps	100 pps	400 pps	40 pps
Pulse Duration (max)	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 (in.)	2.4dia x 2.3L	2.4dia x 2.3L	2.4dia x 2.3L	2.4dia x 3.9L	2.4D x 3.9L	2.3x2.3x0.6	2.3x2.3x0.6	2.3x2.3x0.6
(cm)	6.1dia x 5.8L	6.1dia x 5.8L	6.1dia x 5.8L	6.1dia x 9.9L	6.1D x 9.9L	5.8x5.8x1.4	5.8x5.8x1.4	5.8x5.8x1.4
Weight (lbs)	0.9	0.9	0.9	1.1	1.1	0.3	0.3	0.3
(kgs)	0.41	0.41	0.41	0.5	0.5	0.14	0.14	0.14
Indicator Compatibility	H310, H310D, H410, H410D, S310, S310D, D200PC, D200P							

Model	P 50	PHF 50	PHD 50	PHDX 50	PHDX50UV	SP 50	SPHF 50	SPHD 50
Max Beam Diameter	50 mm	50 mm	50 mm	15 mm	15 mm	50 mm	50 mm	50 mm
Spectral Response	UV to mid-IR			.4-2um	UV to mid-IR			
Average Power (max)	10 W *	10 W *	10 W *	10 W *	10 W *	10 W *	10 W *	10 W *
Noise Equivalent Energy	16 µJ							
Energy Density (max)	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							
Rep Rate (max)	50 pps	400 pps	20 pps	20 pps	20 pps	50 pps	400 pps	20 pps
Pulse Duration (max)	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 (in.)	3.5dia x 2.3L	3.5dia x 2.3L	3.5dia x 2.3L	3.5dia x 3.9L	3.5dia x 3.9L	3x3x0.6	3x3x0.6	3x3x0.6
(cm)	8.8dia x 5.8L	8.8dia x 5.8L	8.8dia x 5.8L	8.8dia x 9.9L	8.8dia x 9.9L	7.6x7.6x1.5	7.6x7.6x1.5	7.6x7.6x1.5
Weight (lbs)	1.5	1.5	1.5	1.7	1.7	0.4	0.4	0.4
(kgs)	0.68	0.68	0.68	0.77	0.77	0.18	0.18	0.18
Indicator Compatibility	H310, H310D, H410, H410D, S310, S310D, D200PC, D200P							

*Full illumination of the sensor

^Beam centered on absorber

Note 1: Max $J/cm^2 = 316 \times (\text{pulse width})^{1/2}$

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

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

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

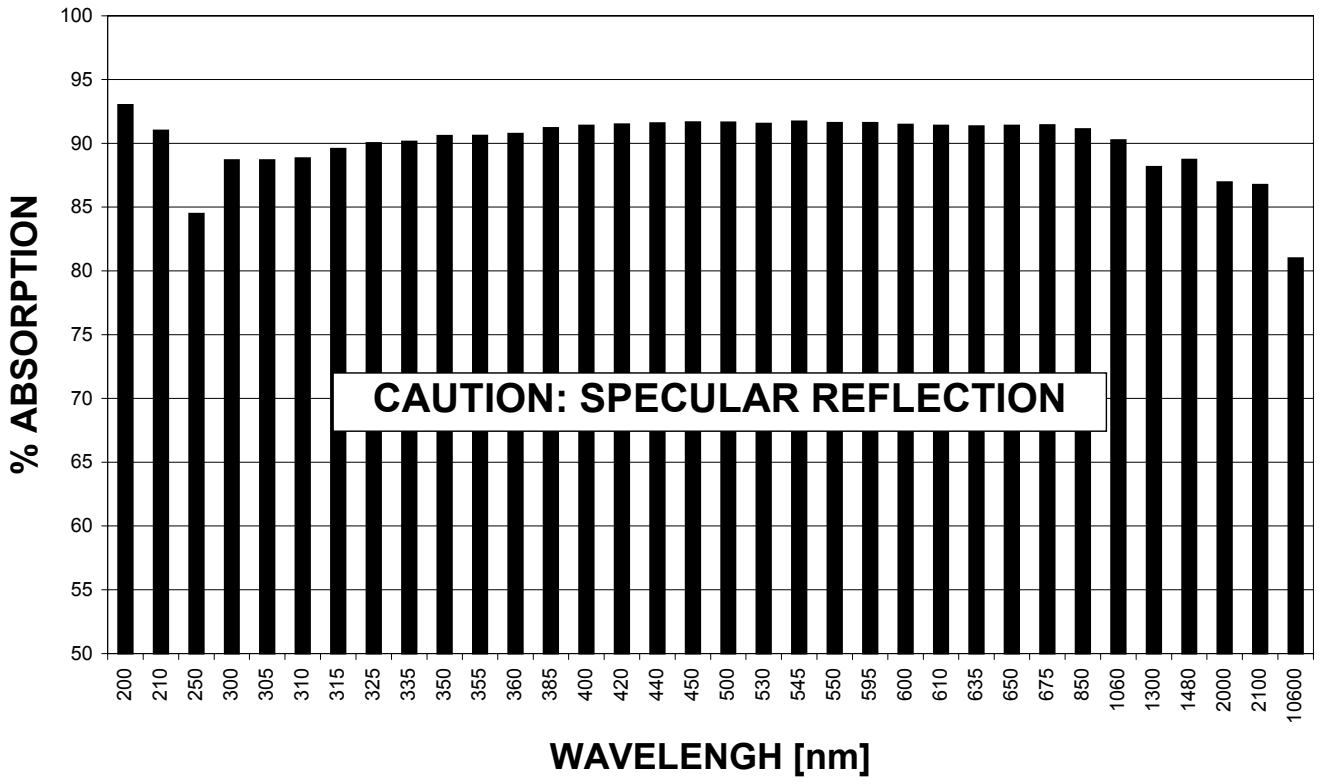
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ULTRA™ CALORIMETER SPECIFICATIONS

Model	UC 150	UC 150HD	UC 150HD40	UC 150UV
Type Absorber	Surface	Surface	Surface	Volume
Max Beam Size	25 mm dia.	25 mm dia.	40 mm x 40 mm	25 mm dia.
Spectral Response	.25-35 µm	.19-12 µm	.19-12 µm	.19-.36 µm
Average Power (max)	150 W			
Average Power (min)	10 W			
Noise Level	0.1 W			
Power Density (max)	200 W/cm²	1.5 kW/cm²	1.5 kW/cm²	50 W/cm²
Peak Power Density (max)	1 MW/cm²	100 MW/cm²	100 MW/cm²	1 GW/cm²
Energy Density (max)	1 J/cm²*	14 J/cm²**	14 J/cm²**	15 J/cm²
Precision	< 1%			
Accuracy	5%			
Response Time	Sensor dependent			
Dimensions (in.) (cm)	4.9H x 3.4 x 4.0D 12.5H x 8.6W x 10.2D			
Weight (lbs) (kgs)	2.7 1.2			
Indicator Compatibility	S310, S310D			

*Laser pulse duration of 1 µsec
**Laser pulse duration of 10 µsec

ABSORPTION OF HD ABSORBER vs WAVELENGTH



NOTE: Please exercise caution when using HD detectors. They exhibit spectral reflection of between 7% and 33%, of the input power, back out of the aperture. Please refer to the preceding bar graph to determine the reflectance for the wavelength you are measuring. These detectors should be treated as a partial mirror or any other type of reflective optic and the appropriate caution level observed, especially at the CO_2 wavelength.

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MODEL S310 SPECIFICATIONS

Model	S310	S310D
Display	4 digit LCD with selectable analog meter movement	4 digit LCD
Ranges (Watts & Joules Full Scale) (When connected to 25 mm calorimeter)	10.00 m (Watts only), 100.0 m, 1.000, 10.00 and AUTO (Watts only)	
Ranges (Watts & Joules Full Scale) (When connected to 50 mm calorimeter)	300.0 m, 3.000, 30.00 and AUTO (Watts only)	
Ranges (Watts & Joules Full Scale) (When connected to pyroelectric sensor)	3.000 m, 30.00 m, 300.0 m, 3.000, 30.00, AUTO With HR Detectors > 3.000 µ*, 30.00 µ*, 300.0 µ, 3.000 m, 30.00 m, AUTO	
Range (Watts Full Scale) (When connected to Ultra calorimeter)	150.0	
Maximum Rep. Rate with Calorimeters (Joules Mode)	Calorimeter Dependent (1 pulse every 60 to 90 sec.)	
Maximum Rep. Rate for Collecting Data in Statistics Mode with Pyroelectric Sensor	750 pps	
Response Time - Watts Mode (When connected to calorimeter)	Calorimeter Dependent 3 to 10 seconds	
Dimensions (H X W X D) (inches) (cm)	4.68 X 8.83 X 7.83 11.89 X 22.43 X 19.89	
Power Requirement	120 Volt, 60 Hz ± 10% or 220 Volt, 50 Hz ± 10%	
Operating Temperature	5° C to 40° C	

*__Not__ available in long pulse setting on PHF02, PHF05, and PHF09

CE Mark Certification: All of the detectors listed in this manual have been certified for the european CE mark *except* the following:

1. All of the Ultra™ Series calorimeters: Model UC150, UC150UV, UC150HD, UC150HD40.
2. All of the Vector Series slim profile pyroelectric detectors: Models: SP25, SPHF25, SPHD25, SP25YAG, SP25UV, SP25AL, SP50, SPHF50, SP50YAG, SP50UV, SP50AL.

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ENVIRONMENTAL REQUIREMENTS

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

UNPACKING AND SETUP

The meter, detectors, and accessories are shipped in custom packing materials. All packing materials should be saved for future damage free shipments. Before making any connections, verify that the power (VAC) requirement shown on the power entry module is compatible with the actual AC power outlet to which the indicator will be connected. *insert into the fuse holder. Plug the fuse holder back into the power entry module.* ***The power requirement of the instrument is easily changed by removing the fuse holder and voltage selector which is the center portion of the power entry module. To remove, insert a screwdriver into the right side of the fuse holder and pry out. Slide the voltage selector out, flip over and re-insert into the fuse holder. Plug the fuse holder back into the power entry module.***

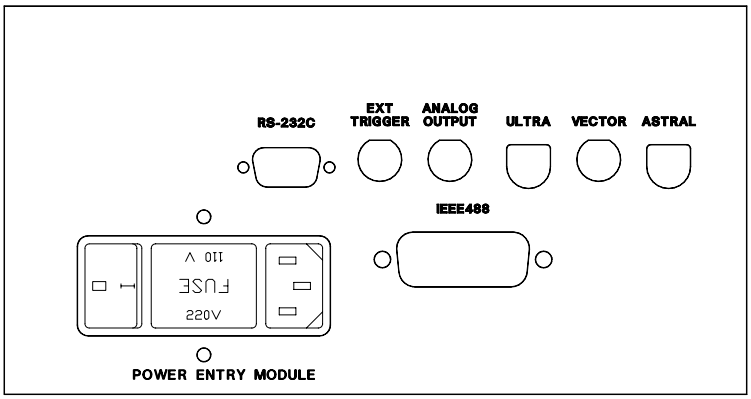
Analog Needle Zero Adjust (S310 only)

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.

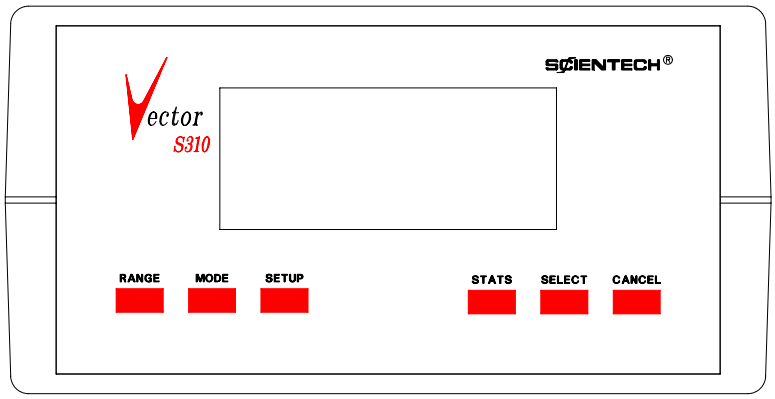
Connecting Detectors

Refer to the following drawing of the S310 rear panel. A 3 meter mini-DIN type cable with "D" shaped connectors comes with Astral and Ultra calorimeters. A 3 meter BNC type cable comes with Vector pyroelectric detectors. The input jacks on the rear panel of the S310 are labeled "Ultra", "Vector", and "Astral" for hook up of these three types of detectors. **Note:** ***Only one detector should be plugged in at any time***. Note that the flat side of the DIN type cables should be oriented up when plugging in to the S310. Also included with each detector is a 1/2" diameter mounting post for installing the detector to your working surface. An optional mounting base, Scientech Model 301-019, is also available for holding the detector/post assembly upright. Astral calorimeters are sensitive to all types of thermal input. Due to handling of the calorimeter during setup and possible environmental temperature differences, thermal gradients may exist in the calorimeter. Several minutes before usage may be required to allow the calorimeter to reach thermal equilibrium. **Note:** ***When using a 25 mm Astral calororimeter for measuring average power levels below 30 mW and single pulse energy levels below 30 mJ, a Scientech Model 36-0203A, Isoperibol Enclosure, is required. The isoperibol enclosure should not be used at average power levels above 30 mW, and single pulse energy levels above 100 mJ because unwanted heat build up will occur.***

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S310 Rear Panel



S310 Front Panel

Turn On Sequence

The S310 cycles through a self-calibration sequence whenever it is turned on. The display will show all segments until completion of the self-calibration period which takes about 25 seconds. At the end of this sequence the unit will revert to its operational state in its last used configuration.

FRONT PANEL CONTROLS

Count Up (Range) Count Down (Mode)

The RANGE and MODE buttons are used to change the numeric entry in the display when in statistics mode, average energy mode, and calibration and setup modes. The 4 digit LCD allows numeric entry from .0001 to 9999. The decimal place floats to the right as you hold down the RANGE button to achieve larger values (less resolution) and to the left as you hold down the MODE button to achieve smaller values (greater resolution).

Setup

The SETUP button controls the process by which you configure the instrument and later recall the configuration to be used, viewed, and/or changed. Pushing the CANCEL button at any time will terminate this process with no changes. The large display will show the current value entered. The range digits will show a two character mnemonic for the current parameter. Briefly pressing the SELECT button always advances the configuration to the next step. Holding down the SELECT button places the S310 in its

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operational state and implements any changes to the group configuration made up to this point. There are four setup groups which can be configured and recalled by pressing the SETUP button.

To choose one of four setup groups press the SETUP button. The setup group last used (1, 2, 3, or 4) will appear in the display. To move to the next group press the SETUP button again. To select a setup group press the SELECT button when the desired group appears in the display. If the SELECT button is not pushed within a few seconds, the group number displayed will be activated (return to the current configuration for operation). The default settings for the groups are 1: Astral Calorimeter, 2: Pyroelectric detector, 3: HR Pyroelectric detector, 4: Ultra Calorimeter.

To observe each element of the current settings in the group press the SELECT button after each setting. To change settings, press the SETUP button until the desired setting appears, then press the SELECT button.

Group Configuration for Astral™ Calorimeters

1. Select the desired setup group to configure by pressing the SETUP button repeatedly until the desired group number appears then press the SELECT button.

2. Press the SETUP button until the calorimeter annunciator “CAL” appears in the display. Press the SELECT button to activate the calorimeter configuration program.

3. The "tc" (time constant) annunciator now appears in the display. Press the count up (RANGE) and count down (MODE) buttons to change the number in the display to match the time constant number listed on the serial tag of your calorimeter. Press the SELECT button to enter the time constant value to memory.
4. The "SP" (speed) annunciator now appears in the display. Press the count up (RANGE) button to speed up or count down (MODE) button to slow down the response time of the meter. Press the SELECT button when the desired number appears in the display. The following settings can be fine tuned to your preference of speed versus overshoot. We recommend these initial settings:

AC2500, AC25HD, ACX25HD	103.0
AC2501, ACX2501, AC25UV, AC2504	136.0
AC5000, AC50HD, ACX50HD	100.0
AC5001, ACX5001, AC50UV, AC5004	120.0

5. The "Cd" (calorimeter delay) annunciator now appears in the display. The calorimeter delay feature prohibits the display of energy if a pulse is fired before the entered time (1 to 255 seconds) elapses. The calorimeter must reach environmental thermal equilibrium before a subsequent pulse is fired or low energy measurements will occur. To set the time delay between pulses use the count up (RANGE) and count down buttons (MODE) buttons to enter the time in seconds. Press the SELECT button after the time has been entered. The following time delays are recommended:

AC2500, AC25HD	60 seconds
AC2501, AC25HD, AC2504	60 seconds
AC5000, AC50HD	90 seconds
AC5001, AC50UV, AC5004	90 seconds

6. The "At" (attenuation) annunciator now appears in the display. If no attenuator is being used in conjunction with the calorimeter, the attenuation factor in the display must be set at 1.000 since this value is a display multiplier. Attenuation multipliers from .0001 to 9999 can be entered into the displayed value. Use the count up (RANGE), count down (MODE) buttons to change the attenuation factor. Press the SELECT button to enter the attenuation factor to memory.

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

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

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

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

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

Group Configuration for Vector™ Pyroelectric Detectors

1. Select the desired group to be configured.

2. Press the SETUP button until the "PYro" annunciator appears. Immediately press the SELECT button to select the pyroelectric detector configuration program. Either the "V/J" annunciator or the "V/mJ" annunciator and a detector sensitivity number will appear in the display.

3. Press the SETUP button to toggle between the V/J and V/mJ entries. The output sensitivity of the pyroelectric detector in V/J or V/mJ is listed on the serial tag of your detector. Use the count up (RANGE) and count down (MODE) buttons to enter the V/J or V/mJ value. Press the SELECT button to enter the value to memory. Do not push the SELECT button before entering the sensitivity number or the next setup stage will be entered.

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

5. The "AUTO, SET CAL" annunciators now appear in the display ***(only if watts mode was selected prior to group configuration)***. This is the transfer calibration function. This allows you to adjust the output sensitivity of the pyroelectric detector while in operation enabling you to match the average power reading of the S310 to that of the NIST certified detector. Typically a beam splitter is used with the detector to be calibrated in one beam path and the NIST certified detector in the other beam path. While using the S310 with the detector to be calibrated and the NIST standard in an optical calibration, use the count up (RANGE), count down (MODE) buttons, which change the V/J or V/mJ settings, to make the

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displayed value of the S310 power reading the same as the NIST standard. Press the SELECT button when the readings match.

6. The "At" (attenuation) annunciator now appears in the display. If no attenuator or correction factor is to be applied to the displayed value, the setting should be 1.000. If a multiplier is to be applied to the displayed value, use the count up (RANGE), count down (MODE) buttons to enter the multiplier value. Press the SELECT button to enter the value to memory.

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

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

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

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

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

Group Configuration of Ultra™ Series 150 Watt Detectors

1. Select the desired group to be configured.

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

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

4. The "At" (attenuation) annunciator now appears in the display. If no attenuator is being used in conjunction with the detector, the attenuation factor in the display must be set at 1.000 since this value is a display multiplier. Attenuation multipliers from .0001 to 9999 can be entered into the displayed value. Use the count up (RANGE), count down (MODE) buttons to change the attenuation factor. Press the SELECT button to enter the attenuation factor to memory.

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

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

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

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

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

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Range

The RANGE button is used to select the range most appropriate for the power or energy level to be measured. On the S310 only, held down the RANGE button to toggle the analog meter on or off. The appropriate ranges will be automatically determined by the type of detector which has been programmed into the group which has been selected.

1. Press the range button each time to move to the next range. Not pushing the RANGE button when the desired range appears in the display automatically activates the range after a few seconds and returns the S310 to its operational state.

2. To turn the analog meter on or off, press and hold the RANGE button, then release after the meter appears or disappears (S310 only).

Mode

The MODE button allows selection of the type of measurement to be made and units of measure to be displayed; scientific notation or µ, m annunciators. The different measurement modes available are:

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

When configured for a calorimeter: Power (W), Energy (J).

When configured for Ultra detector: Power (W) only.

1. Briefly press the MODE button each time a different mode setting is wanted. Not pushing the MODE button when the desired mode appears in the display automatically activates that mode after a few seconds and returns the S310 to its operational state.

2. To select scientific notation or µ and m annunciators, press and hold the MODE button and release when the desired configuration appears.

Stats

Note: ***When using the PHF09 pyroelectric detector in the long pulse setting, a manual range must be selected when running statistics.*** The STATS button provides statistical analysis of a series of energy readings (pulses). The average energy, minimum energy, maximum energy, standard deviation, and coefficient of variation are automatically calculated after each run. Runs of up to 1000 pulses (pulse population) can be entered.

1. To enter into statistics mode press the STATS button. If you are using a pyroelectric detector, the joules mode and range selected prior to statistics mode are automatically activated. The pulse population previously selected along with the STATS annunciator and flashing SET annunciator appear in the display.

2. Press the count up (RANGE) and/or count down (MODE) buttons to change the display to the desired number of energy readings to be collected. You may select up to 1000 energy measurements for the pulse population. Press the SELECT button to enter the pulse population to memory. The "STATS" annunciator will flash indicating the S310 is ready to start a new run.

3. Press the SELECT button to begin collecting new data. The S310 will automatically stop when the pulse population has been collected.

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4. The STATS button must be pressed to recall each data point: the number of pulses collected, the average energy (AVG), minimum energy (MIN), maximum energy (MAX), standard deviation (SIGMA), and coefficient of variation (CV%). After recalling the data, the flashing STATS annunciator indicates the S310 is ready for a new run.

5. Press the SELECT button to begin a new run, or the CANCEL button to exit statistics mode.

Each time a new run begins, data from the previous run is lost. If statistical data is to be automatically registered, it must be done so through the digital interface.

Select

The SELECT button activates a particular mode or function. Holding down the SELECT button will revert the S310 to its operational state during group setup. Any changes made during group setup prior to holding down the SELECT button will be implemented.

Cancel

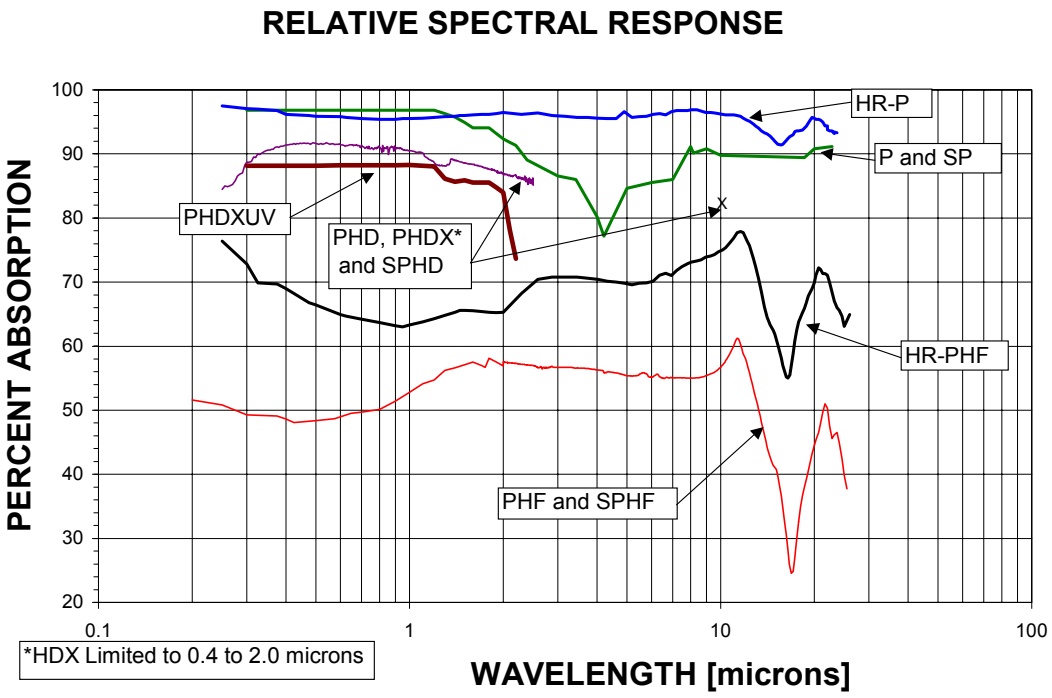
The CANCEL button reverts the S310 to its operational state during group setup. Any changes made during group setup prior to pressing the CANCEL button will ***not*** be implemented. ***Pressing the CANCEL button is the exit out of statistics mode and also is used to zero the display when using a calorimeter in watts mode.***

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OPERATING PROCEDURES

USING THE S310 WITH VECTOR™ PYROELECTRIC DETECTORS

Pyroelectric detector models P25, P50, SP25, SP50, P05, and P09 are coated with a special black absorbing material which provides a very flat spectral response over a broad wavelength band. Models PHF25, PHF50, SPHF25, SPHF50, PHF02, PHF05, and PHF09 have a partially absorbing, partially reflecting chromium coating. The relative spectral responses of these detectors are given below.



Before using your Vector joulemeter system, please review the energy density formulas given in the chart on page 2. 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 HD type detectors***. Fire the beam at the test slide before using the detector to be sure you are operating under safe conditions.

Configure One of the Four Groups for the Pyroelectric Detector to be Used (See Page 7).

Energy Mode

Press the MODE button (repeatedly, if need be) until the "J" annunciator appears in the display. Press the SELECT button or simply wait a few seconds and the joules mode will automatically be activated. Press the range button (repeatedly, if need be) to select desired range. 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.***

The energy level of the laser pulses will be displayed on the front panel LCD. The update rate of the display is 20 Hz. Statistics mode can collect data at repetition rates of up to 300 Hz.

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Average Energy Mode

The average energy mode displays a running average of a selected number of pulses from 2 to 9999. Enter into the average energy mode by pressing the MODE button until the "J AVG" annunciator appears in the display. Press the SELECT button or simply wait a few seconds and the range in the display will automatically be activated. The number of pulses to be averaged will appear in the display. To change the number, press the RANGE (count up) and/or MODE (count down) buttons. When the desired number of pulses to be averaged appears in the display, press the SELECT button. The maximum repetition rate is 300 Hz.

Average Power Mode

The average power mode displays the average power (watts) of repetitively pulsed lasers (minimum rep rate of 10 pps). Select the appropriate range for the average power level to be measured. To enter into the average power mode press the MODE button repeatedly until the "W AVG" annunciator appears. Press the SELECT button or simply wait a few seconds and the S310 will automatically enter into its operational state in the average power mode. The maximum repetition rate is 300 Hz

Statistics Mode

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. If you select AUTO range, the first few pulses of a run may be missed (not counted) if the S310 has to internally change ranges. Therefore, if you want the first pulse to be counted, do not select AUTO range. 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 press the STATS button. The number of pulses in the last run will appear in the display. Use the RANGE (count up) and MODE (count down) buttons to change the display to the desired number of pulses (up to 1000). Press the SELECT button to enter the pulse population to memory. Press the SELECT button to begin the run. The indicator will automatically stop once the data has been collected. Pressing the STATS button recalls the data to the display. The STATS button must be pressed for each event. Once all of the data has been recalled, pressing the SELECT button starts a new run. Pressing the CANCEL button returns the indicator to the mode of operation in effect prior to statistics mode.

External Trigger

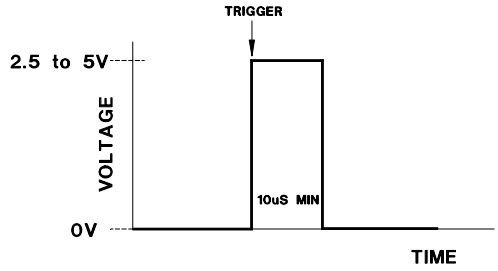
The automatic trigger threshold of the S310 is 7 % of full scale. Energy values below 7% of full scale on any range will not be displayed unless an external trigger is used. The external trigger input is located on the rear panel of the S310. The external trigger pulse needs to have the following characteristics:

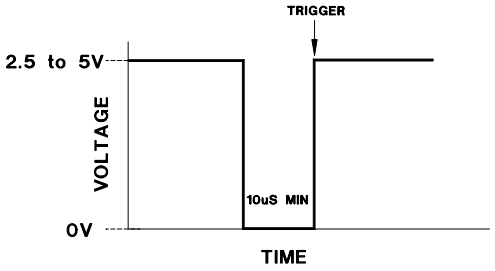
1. 2.5 volts min. to 5 volts max.
2. A minimum pulse width of 10 µsec. to a maximum of the laser pulse repetition rate.
3. A maximum rise/fall time of 500 nsec.

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

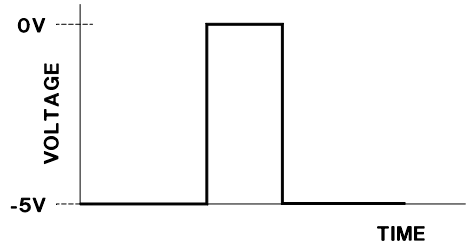
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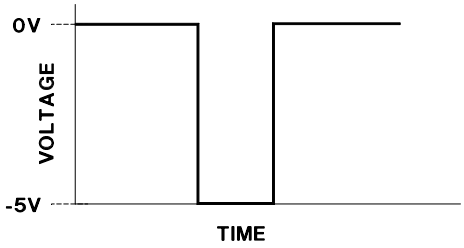
Viable external triggers:





The following pulses will not trigger the S310:





A laser pulse must be delivered 1 to 3 msec. (depending on the detector type) after an external trigger occurs or the meter will reset.

Pyroelectric Detector Operation With Oscilloscope

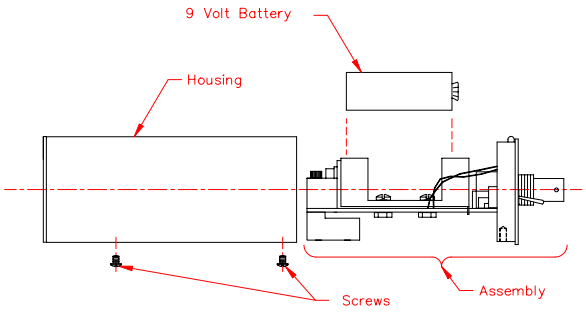
The pyroelectric detectors may be connected directly to a 1 MΩ input oscilloscope or a 50 ohm input if the detectors are the HR type (PHF02, PHF05, PHF09, P05 or P09). The peak voltage of the detector divided by the V/J or V/mJ output sensitivity = energy (joules or millijoules).

HR Battery Installation

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

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

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Battery Installation

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

Set Electrical Time Constants for Model PHF02, PHF05 and PHF09

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

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

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

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

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

USING THE S310 WITH ASTRAL™ SERIES CALORIMETERS

Be sure the calorimeter is appropriate for the laser measurements you intend on making. Please familiarize yourself with the operating specifications which are given on page 1 of this manual.

Configure One of the Four Groups for the Astral Calorimeter to be Used (See Page 6) .

Energy Mode (J)

Press the RANGE button to select the desired range. ***Note: AUTO range does not exist in energy mode***. You must select a manual range. Press the MODE button until the "J" annunciator appears in the display. Press

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the SELECT button or simply wait a few seconds and the energy mode will automatically be selected. The system is now ready to measure the energy level of individual pulses.

With the calorimeter delay entered, the S310 will display the "trig" annunciator and the single pulse energy after the first pulse is delivered. The "trig" annunciator will then disappear after the calorimeter delay time has elapsed prompting you to fire another pulse. Do not fire another pulse until the annunciator disappears. If you do, the S310 resets the time delay and ignores the sequential pulse altogether.

Power Mode (W)

The speed-up circuit (differentiator) in watts mode is controlled by software and must be adjusted to accommodate the type of calorimeter being used. The response time is adjusted in the group configuration as described in the SETUP section above (see page 5). ***The speed-up circuit is not active in AUTO range***. Press the RANGE button to select the desired range. Select the watts mode by pressing the MODE button repeatedly until the "W AVG" annunciator appears. The system is now ready to measure the power of a repetitively pulsed or CW laser.

Statistics Mode

The statistics mode will collect data on a pulse population of up to 1000 pulses. At your prompting, the indicator will display number of pulses delivered, average energy, minimum energy, maximum energy, standard deviation, and coefficient of variation. See STATS section for details.

USING THE S310 WITH ULTRA™ SERIES DETECTORS

Be sure the Ultra detector is appropriate for the laser measurements you intend on making. Please familiarize yourself with the operating specifications which are given on page 3 of this manual.

Configure One of the Four Groups for the Ultra Detector to be Used (See Page 8).

The S310 has only a single range and mode when used with the Ultra detector and is ready to take measurements once the system has been configured.
The speed up circuit is controlled by software and can be adjusted to your preference - see page 8.

Analog Output

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

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

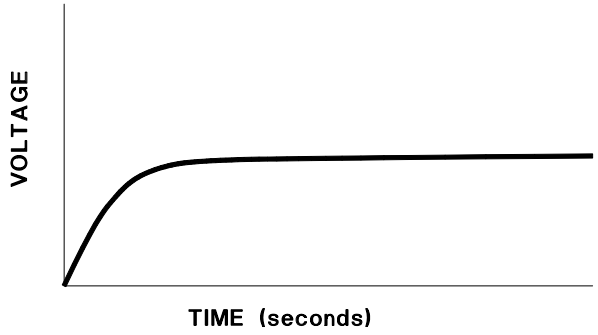
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Again, this can be determined by noting the peak voltage value on the analog output, and the joules reading on the S310 display.

With a pyroelectric detector connected to the S310, determine the relationship between the peak voltage value and the energy (joules) or power (watts) reading on the S310 display in the same manner.

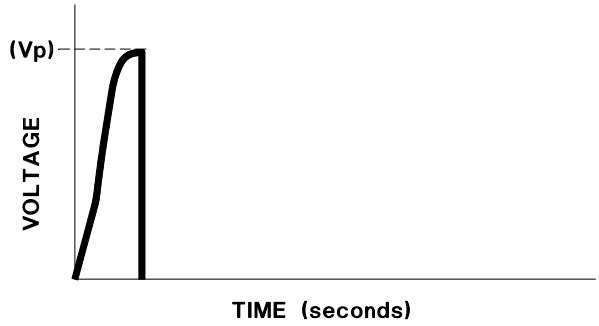
The analog output with the various detectors and operating modes should appear as follows:

1. Calorimeter Watts Mode



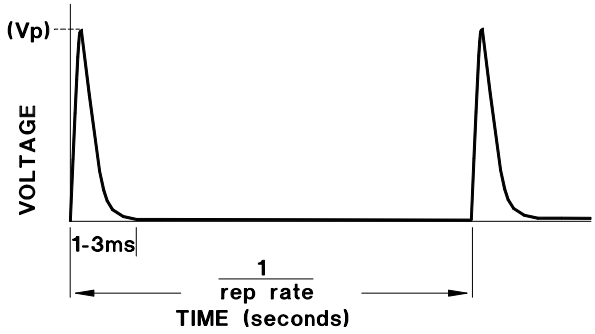
Compare voltage to wattreading displayed on the S310 to determine V/W constant to use when looking at the analog output

2. Calorimeter Joules Mode



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

3. Pyroelectric Watts and Joules Modes



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

Determination of Power and Energy from the Analog Output Assuming 3 V Full Scale

Calorimeters

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

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

where:

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

0.5 V/W	for 25 mm models
0.1667 V/W	for 50 mm models

R = indicator range multiplier as follows:

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

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

$$W = V/S$$

where:

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

Pyroelectric Detector

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

$$W = Vpk/S$$

where:

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

$$J = Vpk/S$$

where:

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

Ultra Calorimeter

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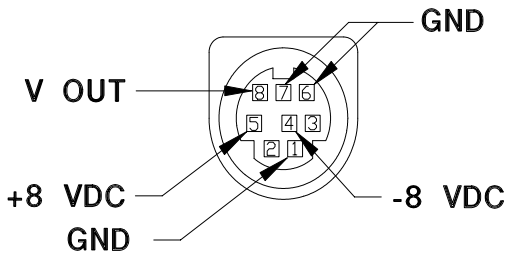
The analog output voltage is approximately 3 volts full scale. With an Ultra calorimeter the digital display will read up to 300 watts, even though the Ultra Calorimeter is only rated for 150 watts. To calculate power from the analog output voltage use the following equation.

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

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

CALORIMETER OPERATION

Astral calorimeters are powered up by the indicators. To use an Astral calorimeter alone with a volt meter or chart recorder, you must apply +/-8VDC to the mini DIN connector as shown below.



Calibration Using Electric Substitution Heating

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.

1. Remove the screws holding the calorimeter's ID tag and remove the plate to expose the circuit board.

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

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

4. 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.

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

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

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

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

Operation of Astral Calorimeters with a Digital Volt Meter

The calorimeters may be used with any digital volt meter (DVM) capable of reading 5 volts full scale. The voltage output of the calorimeter is available on pins 6 and 8 as shown above.

1. Connect the output of the calorimeter to the DVM using the adapter cable.

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2. Select the DC volts mode.

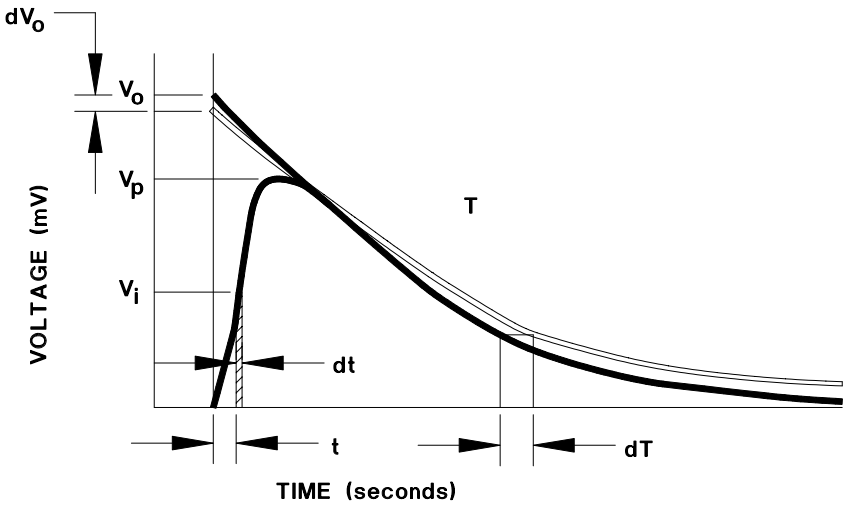
3. Direct the laser beam on to the absorbing surface of the calorimeter.

4. 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 which is 0.5 V/W for 25 mm and 0.167 V/W for the 50 mm calorimeters.

Operation of Astral Calorimeters with an Analog Chart Recorder

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



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

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

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

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

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

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

1. Numerical Integration

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

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

The error caused by this procedure is:

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

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

2. Initial Voltage Interpolation

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

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

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

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

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

3. 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.

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Damage Considerations

1. Surface Absorbers

Surface absorbing calorimeters have been found to safely withstand 200 W/cm^2. This heat input is diffused across the thermopile surface so that the local surface temperature is acceptable. Experience has indicated the damage threshold for a single pulse to be 1 joule/cm^2 in a 1 microsecond gaussian pulse. For the recommended operatings limits please review the energy density formulas given in the chart on page 1.

Heat is produced in the thin pigment layer on the thermopile directly heating the thermopile. Lateral diffusion of heat across the thermopile is quite effective so that the hot side of the thermopile does not have gross hot spots. The structure of the thermoelectric junctions is such that each shares the heat flow in parallel and sums the thermoelectric potential in series. Thus the response is linear with the total heat flow and independent of heat distribution. The thermopile conductance is about 0.2 watts per degree Celsius and the maximum recommended power of 10 watts raises the average temperature of the absorbing surface about 50° C above ambient.

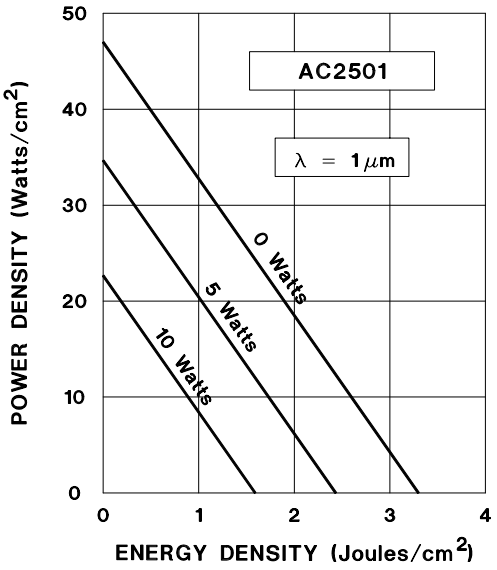
2. Volume Absorbers

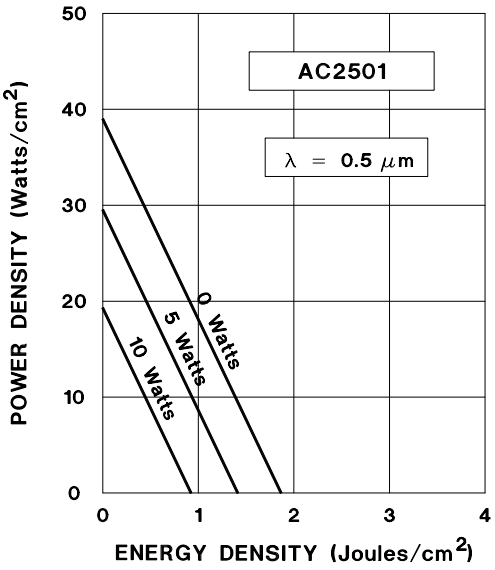
See the detector specification chart for maximum pulse energy densities. The surface temperature will rise to 100°C for the briefest instant at these fluency levels. The initial exponential temperature variation with penetration would rapidly decay as the heat flows through the absorber to the thermopile surface which remained at ambient temperature during the laser pulse.

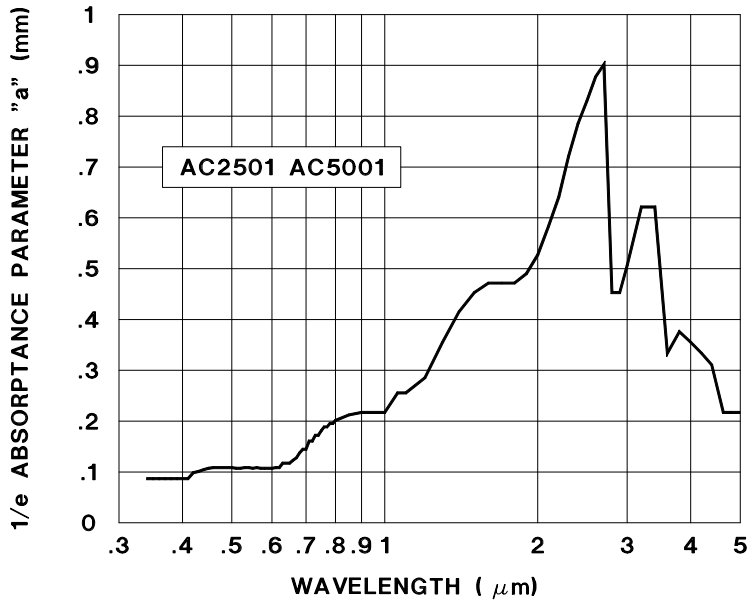
If a CW laser beam is being absorbed, a considerably different situation occurs. The continuous supply of laser power produces steady state temperature distribution from front to back and across the absorber. The absorption region is small compared to the absorber thickness so the temperature drop is substantially linear front to back. Because the absorber (glass) is a poor conductor of heat, the same laser power density will produce a much higher surface temperature than it would produce on the surface absorber. Furthermore, the glass will confine the heat laterally while the surface absorber does not. The maximum power density for the volume absorber is nearly one tenth that of the surface absorber.

If a repetitively pulsed laser is supplying a steady power input the situation is even more complicated. Superimposed upon the average linear temperature drop is the pulse by pulse instantaneous temperature rise. If we ask how these various parameters of the laser input can vary we obtain a family of curves for the same glass absorber. (See figures below). For ACX2501, ACX5001 multiply the Power Density and the Energy Density by 8.

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The variation of absorptance with wavelength is depicted above. The parameter "a" is the depth of penetration 1/e reduction in laser intensity.

REMOTE INTERFACE LANGUAGE

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

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

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

RS-232 Specifications

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

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

example:

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

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

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

Remote Interface Language Common Commands and Queries

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

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

Commands in this group are available from both interfaces:

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

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

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

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

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

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

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

SND?
The SND? query causes the instrument to send the next reading to the remote interface.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ATTEN?
Returns the attenuation factor for the current detector.

ZERO
This command zeros the power baseline for a calorimeter.

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

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

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

CSPEED_<dec num>

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Sets the watts mode display response speed for calorimeters and Ultra Series detectors.

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

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

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

IEEE488 Specific Commands

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

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

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

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

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

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

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

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

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

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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 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. 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, then pack that box in a larger box with at least four inches of packing material. Scientech does not assume responsibility for underpacked items.

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

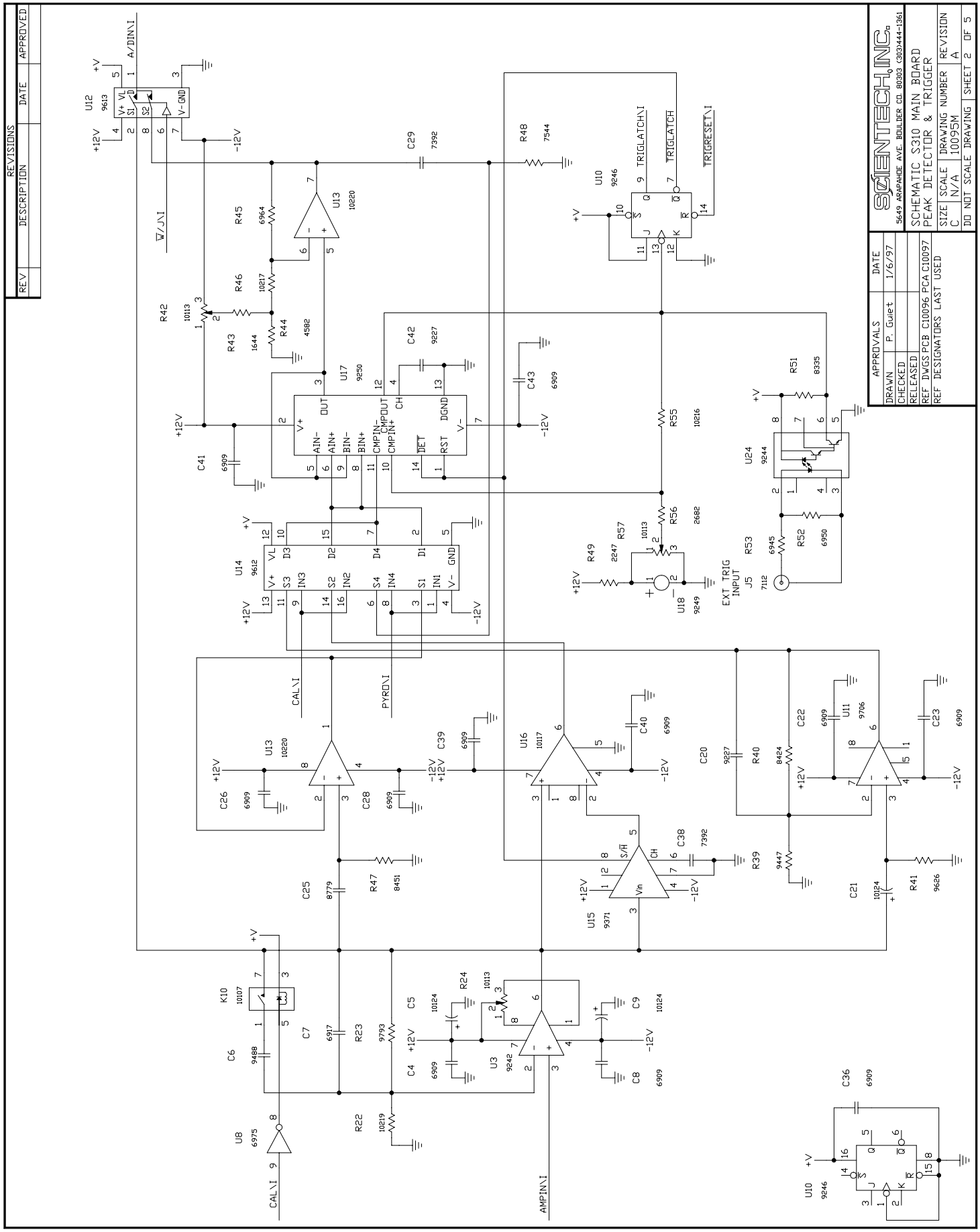
Normally, products are repaired and shipped within 5 working days after their arrival at the product service facility. This is an average time and could vary depending on the workload.

Shipping Address:

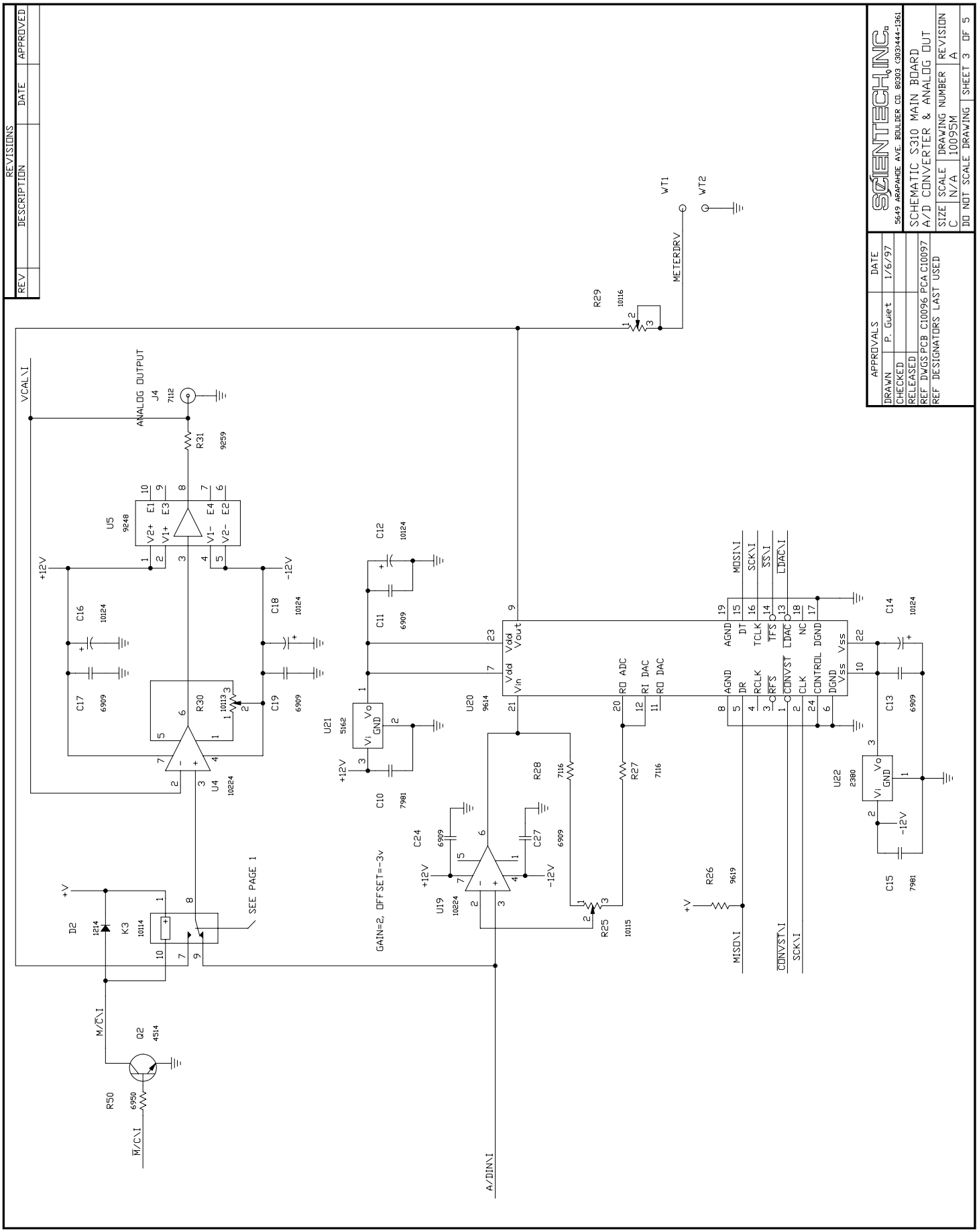
Scientech, Inc.
Product Service Department
5649 Arapahoe Ave.
Boulder, Colorado 80303
U.S.A.

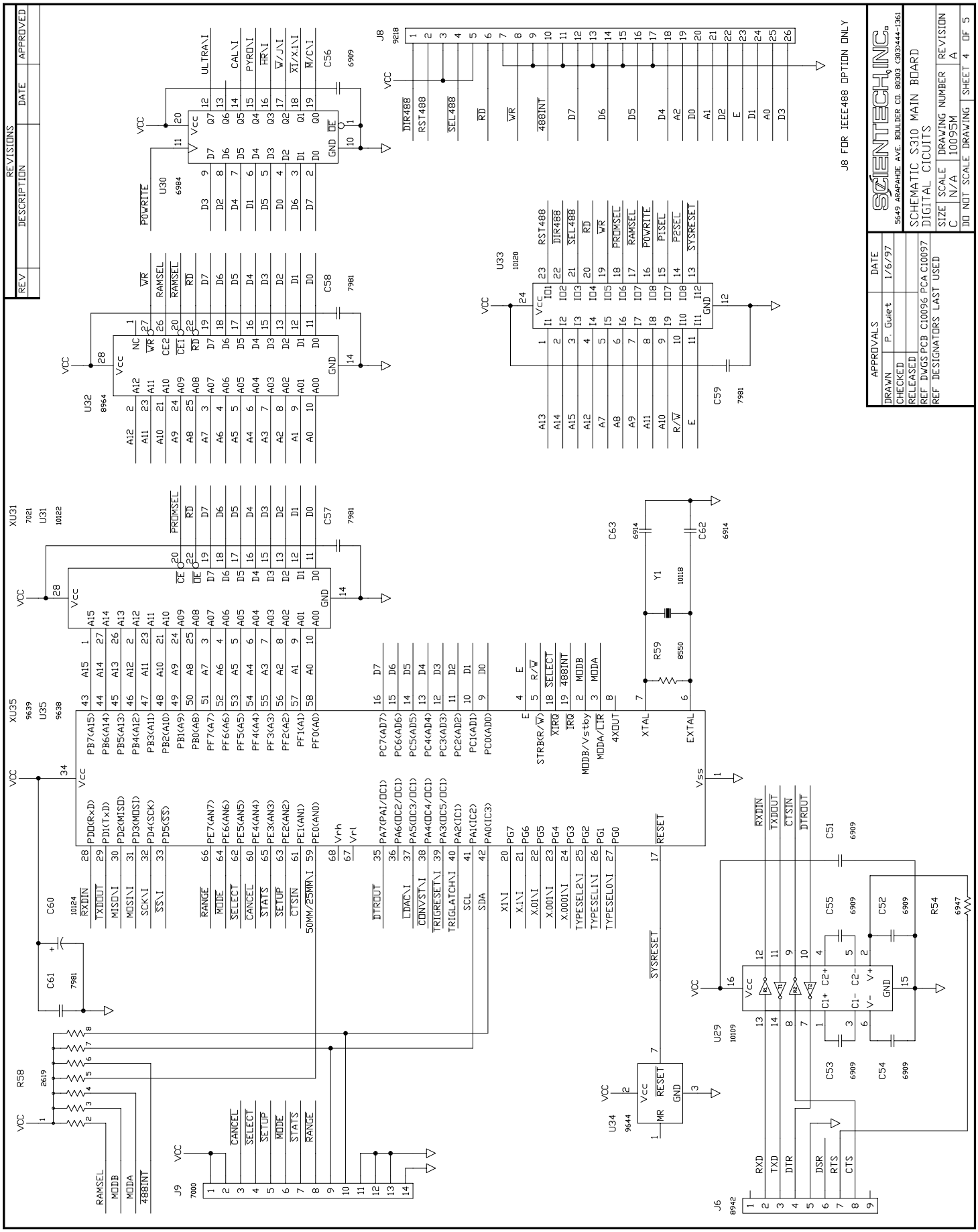
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SCHEMATICS

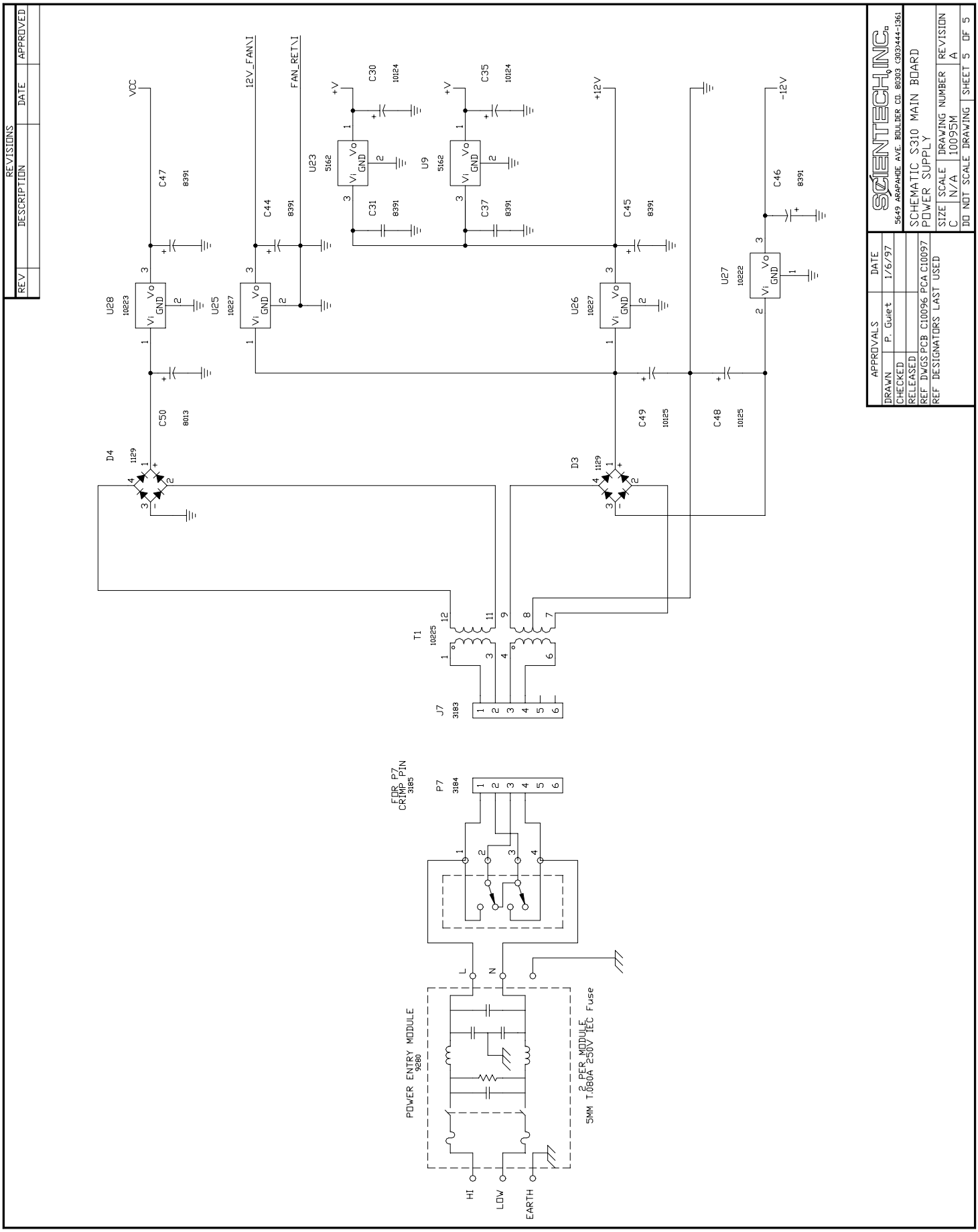


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DESCRIPTION
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SCIENTECH, INC.
5649 ARAPAHOE AVE. BOULDER CO. 80303 (303)444-1361
SCHEMATIC S310 MAIN BOARD
A/D CONVERTER & ANALOG OUT
APPROVALS
DRAWN
P. Guiet
1/6/97
CHECKED
RELEASED
REF DWGS PCB C10096 PCA C10097
REF DESIGNATORS LAST USED
SIZE
C
SCALE
N/A
DRAWING NUMBER
10095M
REVISION
A
DO NOT SCALE DRAWING
SHEET 3 OF 5
VCAL\
ANALOG OUTPUT
J4
7112
R31
9259
U5
9248
V2+
V1+
V1-
V2-
E1
E3
E4
E2
+12V
-12V
C16
10124
C17
6909
C18
10124
C19
6909
R30
10113
U4
10224
C12
10124
C11
6909
U21
5162
Vi
Vo
GND
+12V
C10
7981
U20
9614
Vdd
Vout
Vin
RI ADC
RI DAC
RO DAC
R28
7116
R27
7116
C24
6909
C27
6909
U19
10224
-12V
R25
10115
GAIN=2, OFFSET=-3v
SEE PAGE 1
+V
D2
1214
K3
10114
M/C\I
Q2
4514
R50
6950
M/C\I
A/DIN\I
R29
10116
J1
WT1
METERDRV
WT2
MOSI\I
SCK\I
SS\I
LDAC\I
AGND
DT
TCLK
TFS
DR
RCLK
RFS
CONVST
LDAC
CLK
CONTROL
NC
DGND
Vss
DGND
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MISO\I
CONVST\I
SCK\I



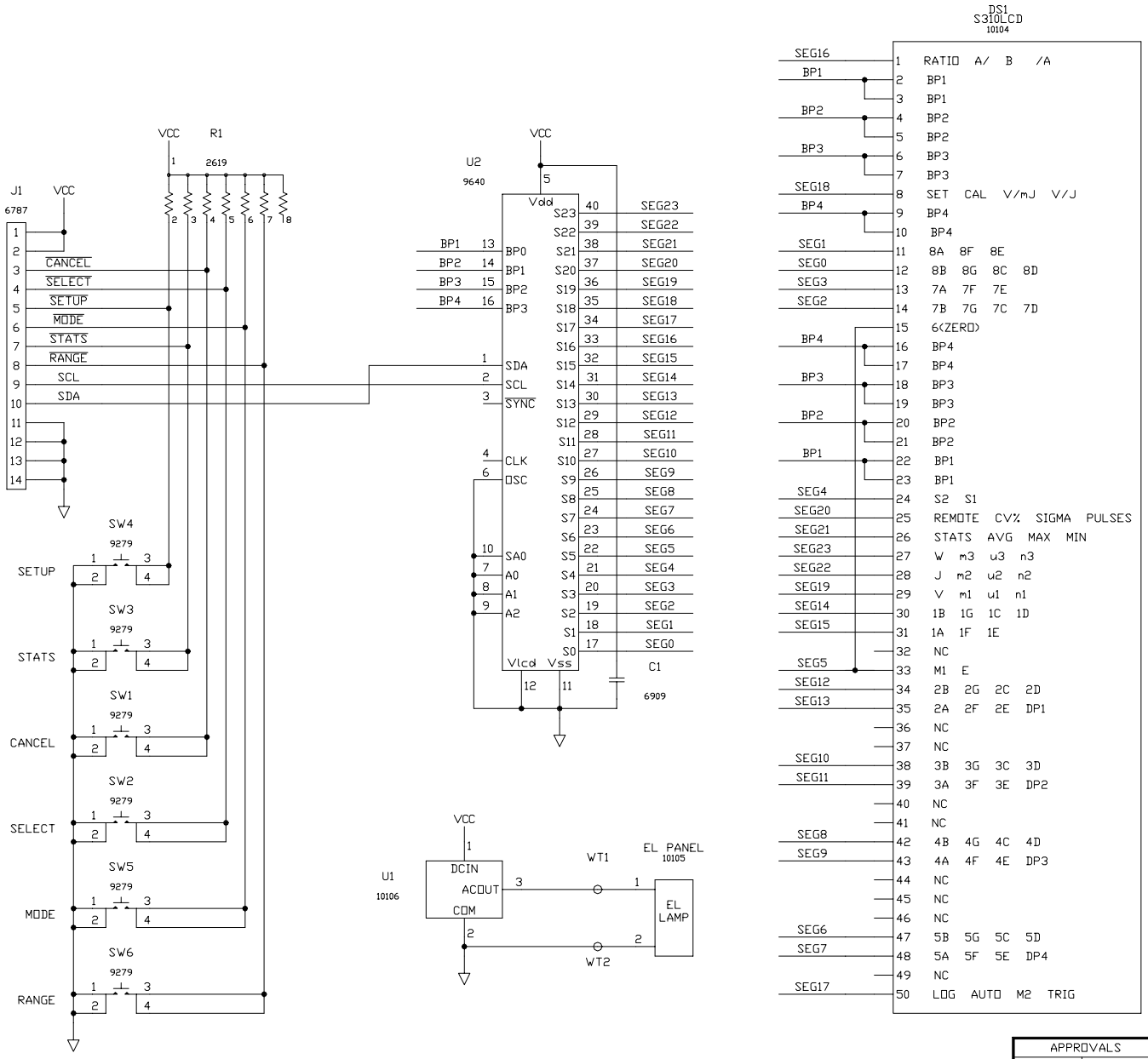
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DRAWN	P. Guiet	1/6/97
CHECKED		
RELEASED		
REF DWGS PCB C10099 PCA C10100		
REF DESIGNATORS LAST USED C1,DS1,J1,R1,SW6,U2		

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SCHEMATIC S310 DISPLAY BOARD

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