SCIENTECH

Vector™ Series

Models S310 & S310D

Laser Power and Energy Meters

Operating Manual

Thank you for choosing a Scientech Vector™ calorimeter detector. Scientech's employees are pleased to provide you with a product designed for years of reliable and accurate service. Please read this operating manual before using your detector and power meter. This reference information will allow you to fully understand the capabilities of the product. The detector is intended to be used only in the manner outlined in this manual. Operation not within specifications for the product may cause product damage.

Table of Contents

Detector Operating Parameters 3
Environmental Requirements 4
CE Mark Certification 4
Vector™ S310 Power Meter Specifications 4
Unpacking 6
Quick Setup 6
Group Settings 9
To Select a Group 9
Group Settings for Vector™ Calorimeters 9
Group Settings for Vector™ Pyroelectric Detectors 12
Operating Procedures 14
Using the S310 with Vector™ Pyroelectric Detectors 14
9. External Trigger 20
To Perform a Transfer Calibration 20
HR Battery Installation 20
Set Electrical Time Constants for Model PHF02, PHF05 and PHF09 21
Correcting Pyroelectric Detector Operating Parameters for Use at Different Wavelengths 21
Using S310 with Vector™ Series Calorimeters 22
Correcting FX Calorimeter Operating Parameters for Use at Different Wavelengths 27
Analog Output 28
Calibration of Vector™ Calorimeters Using Electric Substitution Heaters 30
Calibration of Large Aperture Calorimeters Using Electric Substitution Heating 31
Calibration with an Interface Module and S310 Power Meter 32
Calibration without an Interface Module and S310 Power Meter 32
Detector Operation Without a Power Meter 34
Pyroelectric Detector Operation without Power Meter 34
Vector ™ Calorimeter Operation without Power Meter 34
Operation of Vector™ Calorimeters with a Digital Volt Meter 35
Operation of Vector™ Calorimeters with an Analog Recorder 35
Calorimeter Response: 35
Numerical Integration: 36
Initial Voltage Interpolation: 36
Peak Voltage Estimate: 37
Remote Interface Language 37
Scientech Calibration Service 45
Limited Warranty 45
Return Material Procedure 45
Disposal of Electronic Equipment 46
Schematics 47

DETECTOR OPERATING PARAMETERS

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.

Power Meter Serial Number_____

Calorimeter 1:		**Calorimeter 2:**	
Model No:	_____	Model No:	_____
Serial No:	_____	Serial No:	_____
Group No:	_____	Group No:	_____
Calibration Wavelength or µm	_____nm or µm	Calibration Wavelength:	_____nm
Output Sensitivity (S):	_____V/W	Output Sensitivity (S):	_____V/W
Time Constant (1/e):	_____sec.	Time Constant (1/e):	_____sec.
Calibration Temp:	_____°C	Calibration Temp:	_____°C
Calibration Humidity:	_____%R.H.	Calibration Humidity:	_____% R.H.
Sub. Heater Resistance (R_c):	_____ohms	Sub. Heater Resistance (R_c):	_____ohms
Sub. Heater Voltage (V_h):	_____volts	Sub. Heater Voltage (V_h):	_____volts
Sub. Heater Wattage (W_h)	_____watts	Sub. Heater Wattage (W_h):	_____watts

Pyroelectric Detector 1:

Model No: _____
Serial No: _____
Group No: _____
Calibration Wavelength: _____nm or µm
Output Sensitivity:[1] _____V/J or _____V/mJ S_____ I_____ L_____
Output Sensitivity:[1] _____V/J (Scope)
Calibration Temp: _____°C Calibration Humidity: _____%R.H.

Pyroelectric Detector 2:

Model No: _____
Serial No: _____
Group No: _____
Calibration Wavelength: _____nm or µm
Output Sensitivity:[1] _____V/J or _____V/mJ S_____ I_____ L_____
Output Sensitivity: V/J (Scope)
Calibration Temp: _____°C Calibration Humidity: _____%R.H.

The V/J is used to calibrate the power meter to a known NIST traceable standard. This is the value the meter must use.
The V/J (Scope) is the "true" Volts per Joule as seen at an oscilloscope.

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 over voltages 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.

CE Mark Certification

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

VECTOR™ S310 POWER METER SPECIFICATIONS

The Models S310 and S310D are identical to each other in every respect except the analog meter. The S310 has both analog and digital displays. The S310D has only a digital display. All references to the S310 are intended to include the S310D except where noted. Also, the words "indicator" and "meter" are synonymous. Specifications are summarized in Table 1.

Table 1. S310 Power Meter Specifications

Model	S310	S310D
Display	4 Digit backlight LCD with analog indicator	4 Digit backlight, LCD
Operating Modes, Power or Energy	Pyroelectric: energy, average energy, power, statistics Calorimeter: energy, power, calibration	Pyroelectric: energy, avg energy, power, statistics Calorimeter: energy, power, calibration
Pyroelectric Statistics Mode	Pulses collected, avg energy, min energy, max energy, standard deviation, coefficient of variation	Pulses collected, average energy, min energy, max energy, standard deviation, coefficient of variation
Calorimeter max repetition rate, power mode	Unlimited	Unlimited
Calorimeter max repetition rate, energy mode	1 pulse every 60 to 90 sec, calorimeter dependent	1 pulse every 60 to 90 sec, calorimeter dependent
For 25mm Calorimeters: Power Full Scale Ranges Energy Full Scale Ranges	 10mW, 100mW, 1W, 10W, Auto 10mJ, 100mJ, 1J, 10J	 10mW, 100mW, 1W, 10W, Auto 10mJ, 100mJ, 1J, 10J
For 50mm Calorimeters: Power Full Scale Ranges Energy Full Scale Ranges	 300mW, 3W, 30W, Auto 300mJ, 3J, 30J	 300mW, 3W, 30W, Auto 300mJ, 3J, 30J
For Pyroelectric Detectors: Power Full Scale Ranges Energy Full Scale Ranges	 3mW, 30mW, 300mW, 3W, 30W, Auto 3mJ, 30mJ, 300mJ, 3J, 30J, Auto	 3mW, 30mW, 300mW, 3W, 30W, Auto 3mJ, 30mJ, 300mJ, 3J, 30J, Auto
For HR Pyroelectric Detectors	Not supported	3 µJ, 30 µJ, 300 µJ, 3 mJ, 30 mJ, Auto
For 100mm Calorimeter: Use Interface Module, PN 10735 Use Interface Module, PN 10748	 300mW, 3W, 30W, Auto or 300mJ, 3J, 30J 500mW, 5W, 50W, Auto or 1.5mJ, 15J, 150J	 300mW, 3W, 30W, Auto or 300mJ, 3J, 30J 500mW, 5W, 50W, Auto or 1.5mJ, 15J, 150J
For 200mm Calorimeter: Use Interface Module, PN 10747 Use Interface Module, PN 10769	 300mW, 3W, 30W, Auto or 300mJ, 3J, 30J 1W, 10W, 100W, Auto or 3J, 30J, 300J	 300mW, 3W, 30W, Auto or 300mJ, 3J, 30J 1W, 10W, 100W, Auto or 3J, 30J, 300J
Power Requirements	120 Volts, 60 Hz ± 10 % or 220 Volts, 50 Hz ± 10 %	120 Volts, 60 Hz ± 10 % or 220 Volts, 50 Hz ± 10 %
Dimensions D x L, inches cm	8.25 x 4.0 x 1.5 20.96 x 10.16 x 3.81	4.7 x 8.8 x 7.8 11.9 x 22.5 x 19.9
Other Specs:	LabVIEW™ drivers, Selectable attenuation correction, IEEE 488 interface option	LabVIEW™ drivers, Selectable attenuation correction, IEEE 488 interface option

UNPACKING

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

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

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

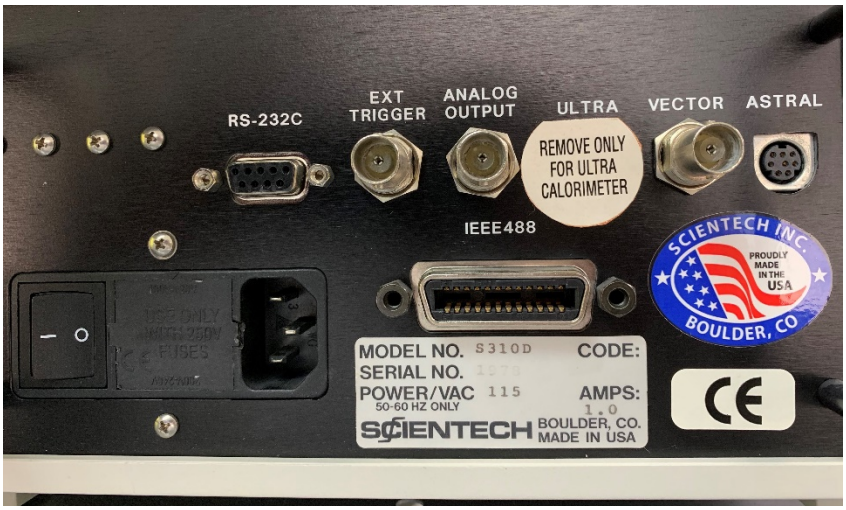


Figure 1. S310 Rear Panel

QUICK SETUP

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

1. Power On the Meter

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

Press the ON switch located in the rear panel of the meter. The S310 will immediately turn on with its operational state based on the last used detector Group Setting. For information on Group Settings, refer

to the Group Settings section. If you purchased the S310 with one detector, this detector's Group settings will be active and you are ready to take measurements.

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

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

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

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

Refer to Figure 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.

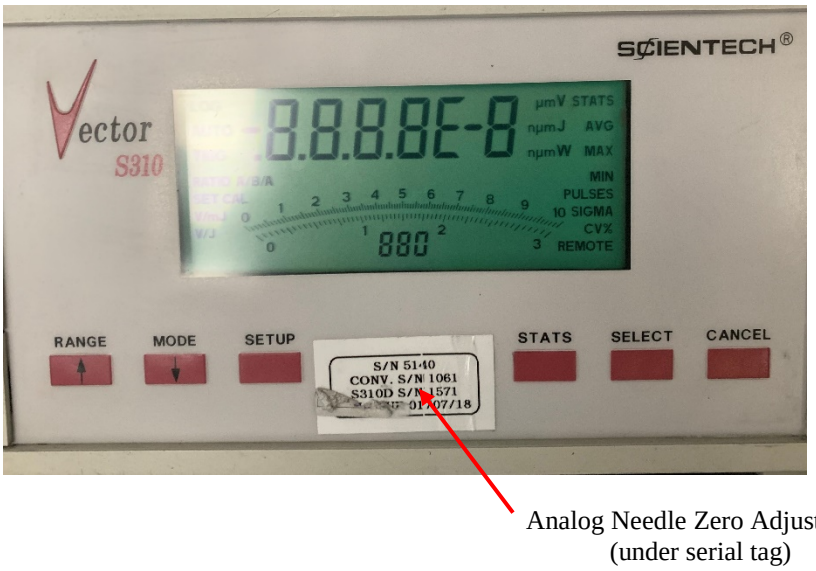


Figure 2. S310 Front Panel

4. Connect a Detector

Do not connect more than one detector to the power meter at any time.

Refer to the drawing of the S310 rear panel in Figure 1. A 3-meter mini-DIN type cable with "D" shaped connectors comes with Vector calorimeters, including the large aperture calorimeters. A 3-meter BNC type cable comes with Vector pyroelectric detectors and Vector HR pyroelectric detectors. To connect the Vector detectors, the input connectors on the rear panel of the S310 are labeled as follows:

"**Ultra**" for Ultra Detectors (no longer manufactured)

"**Vector**" **for all Vector Pyroelectric detectors**

"**Astral**" **for all Vector calorimeters, including the large aperture calorimeters**

Note that the flat side of the DIN type cables should be oriented up when plugging into the S310. Detectors have a 1/2" diameter mounting post hole for installing a detector post. Mounting bases and posts are available for purchase at Scientech to attach the detector to a working surface.

5. Select a Range

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

6. Select a Mode

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

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

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

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

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

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

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

8. **Take your measurement**

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

GROUP SETTINGS

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

Group #1 – Vector Calorimeters or Large Aperture Calorimeters

Group #2 – Vector Pyroelectric Detectors

Group #3 – Vector HR Pyroelectric Detectors

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

To Select a Group

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

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

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

Group Settings for Vector™ Calorimeters

The factory default Group for Vector 8mm, 25mm, 16mm, 50mm or large aperture calorimeters is Group #1.

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

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

To review, change, or setup a Group Setting for Vector calorimeters, proceed as follows:

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

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

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

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

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

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

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

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

AC2500, AC25HD, ACX25HD	103.0
AC2501, ACX2501, AC25UV, AC2504, AC25FX, ACX25FX	136.0
AC5000, AC50HD ACX50HD, AC50FX, ACX50FX	100.0
AC5001, ACX5001, AC50UV, AC5004,	120.0
360401 with interface module	150.0
380401, 380402, 384UV5 with interface module	245.0
360801 with interface module	170.0
380801, 380802, 388UV5 with interface module	280.0

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

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

AC2500, AC25FX, ACX25FX, AC25HD, ACX25HD	60 seconds
AC2501, AC25UV, AC2504	60 seconds
AC5000, AC50FX, ACX50FX, AC50HD, ACX50HD	90 seconds
AC5001, AC50UV, AC5004	90 seconds
360401 with interface module	105 seconds
380401, 380402, 384UV5 with interface module	180 seconds
360801 with interface module	125 seconds
380801, 380802, 388UV5 with interface module	200 seconds

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

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

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

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

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

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

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

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

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

Group Settings for Vector™ Pyroelectric Detectors

Note: The factory default Group for Vector Pyroelectric Detectors is Group #2.

Note: The factory default Group for Vector HR Pyroelectric Detectors is Group #3.

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

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

Note: If you want to use the transfer calibration function, you must select the watts mode prior to entering the Group configuration program.

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

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

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

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

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

E. Either the "V/J" annunciator or the "V/mJ" annunciator and a detector sensitivity number will appear in the display. V/J is used for standard pyroelectric detectors. V/mJ is used only for HR pyroelectric detectors. Press the SETUP button to toggle between the V/J and V/mJ entries. The output sensitivity of the pyroelectric detector in V/J or V/mJ is listed on the serial tag of your detector. Use the count up (RANGE) and count down (MODE) buttons to enter the V/J or V/mJ value. Press the SELECT button to enter the value to memory. Do not push the SELECT button

before entering the sensitivity number as this takes you to the next setup step without the proper sensitivity number.

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

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

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

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

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

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

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

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

1200, 2400, 9600, and 19,200. When the preferred baud rate appears in the display press the SELECT button.

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

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

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

OPERATING PROCEDURES

Using the S310 with Vector™ Pyroelectric Detectors

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

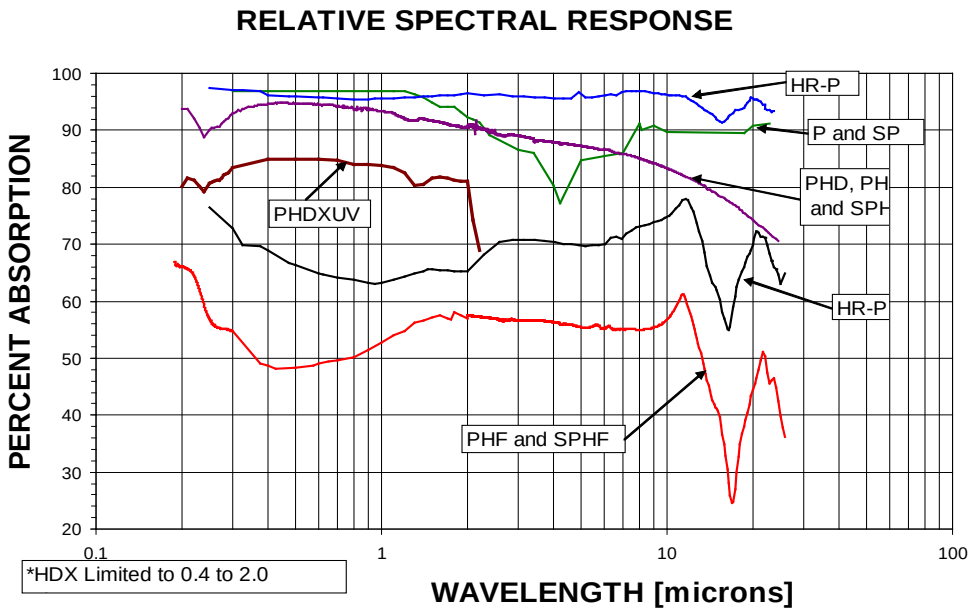


Figure 3. Pyroelectric Spectral Response

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.

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

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

1. To Turn On the Meter

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

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

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

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

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

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

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

4. To Connect a Pyroelectric Detector

Note: Only one detector should be plugged in at any time.
Refer to the drawing of the S310 rear panel in Figure 2. A 3 meter BNC type cable comes with Vector pyroelectric detectors and Vector HR pyroelectric detectors. One of the input connectors on the rear panel of the S310 is labeled "Vector" for hook up of the pyroelectric detectors.

5. To Select a Group

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

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

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

6. To Select a Range

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

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

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

Table 2. S310 Ranges for Pyroelectric

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

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

7. To Select a Mode

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

A. To Measure Energy (J):

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

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

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

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

B. To Measure Average Energy (J AVG)

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

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

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

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

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

C. To Measure Average Power (W AVG)

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

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

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

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

iii. The average power will be displayed.

D. To Measure Volts (V)

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

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

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

iii. The volts per pulse will be displayed.

8. To Measure a Statistical Run of Energy Pulses

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

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

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

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

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

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

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

To enter into the statistics mode:

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

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

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

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

B. Press the STATS button to recall the data to the display. The STATS button must be pressed each time to recall each of the following statistical calculations:

Number of pulses collected

Average energy (AVG)

Minimum energy (MIN)

Maximum energy (MAX)

Standard deviation (SIGMA)

Coefficient of variation (CV%)

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

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

9. External Trigger

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

To Perform a Transfer Calibration

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

HR Battery Installation

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

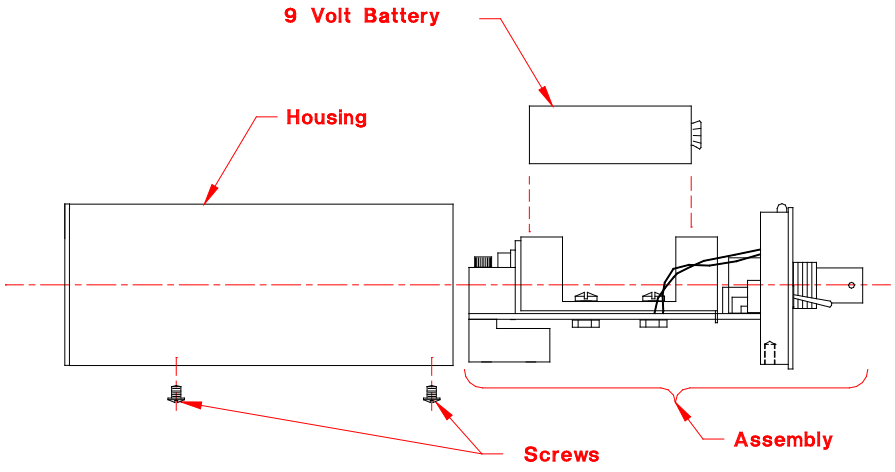


Figure 4. HR Detector Battery Access

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

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

Set Electrical Time Constants for Model PHF02, PHF05 and PHF09

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

S (Short Pulses):	Select for pulse durations of 5 µsec. or less. Repetition rates up to 4 kHz can be measured.
I (Intermediate Pulses):	Select for pulse durations of 50 µsec. or less. Repetition rates of up to 400 Hz can be measured.
L (Long Pulses):	Select for pulse durations of 250 µsec. or less. Repetition rates of up to 80 Hz can be measured.

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

Correcting Pyroelectric Detector Operating Parameters for Use at Different Wavelengths

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:

$$\left[\frac{\text{absorption rate of new wavelength}}{\text{absorption rate of calibration wavelength}}\right] \times \text{output sensitivity (V/J)} = \left[\begin{array}{l}\text{output sensitivity for new}\\ \text{wavelength from serial tag}\end{array}\right]$$

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

Using S310 with Vector™ Series 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.

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

Vector™ 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 calorimeter for measuring average power levels below 30mW and single pulse energy levels below 30mJ, a Scientech Model 360203A isoperibol™ Enclosure is highly recommended. The isoperibol enclosure should not be used at average power levels above 30mW, and single pulse energy levels above 100mJ because heat build-up will occur.

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

1. To Turn-On the Meter

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

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

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

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

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

Refer to Figure 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 a calorimeter.

4. To Connect a Calorimeter

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

Refer to the drawing of the S310 rear panel in Figure 1. A 3 meter mini-DIN type cable with "D" shaped connectors comes with Vector calorimeters. For large aperture calorimeters, the interconnect cables for both the calorimeter and power meter are hardwired to the interface module. One of input connectors on the rear panel of the S310 is labeled "*Astral*" for the connection of Vector *(previously called Astral*) calorimeters and including the large aperture (100 & 200mm apertures) calorimeters. Note that the flat side of the DIN type cables should be oriented up when plugging in to the S310.

5. To Select a Group

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

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

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

6. To Select a Range

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

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

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

Table 3. S310 Ranges for Vector™ Calorimeters

Model	Vector 25mm		Vector 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 50W or 150J.

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

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

7. To Select a Mode

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

A. To Measure Average Power (W AVG):

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

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

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

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

iii. Press the CANCEL button to zero the display.

iv. The average power will be displayed.

A. To Measure Energy (J)

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

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

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

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

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

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

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

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

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

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

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

To enter into the statistics mode:

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

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

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

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

E. Press the STATS button to recall the data to the display. The STATS button must be pressed to recall each of the following statistical calculations:

Number of pulses collected

Average energy (AVG)

Minimum energy (MIN)

Maximum energy (MAX)

Standard deviation (SIGMA)

Coefficient of variation (CV%)

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

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

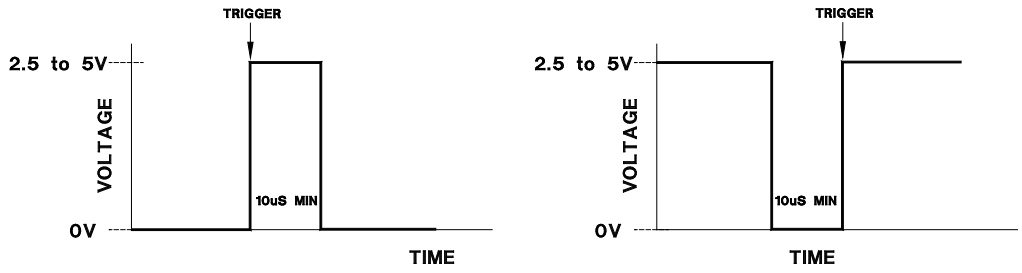
9. External Trigger

The external trigger input is located on the rear panel of the S310 as shown in Figure 1. The external trigger function is designed to ensure the entire pulse energy of a single pulse is captured by the S310 power meter. An external trigger "awakens" the S310's circuitry so that it is ready for the arrival of the laser pulse. The external trigger pulse must have the following characteristics:

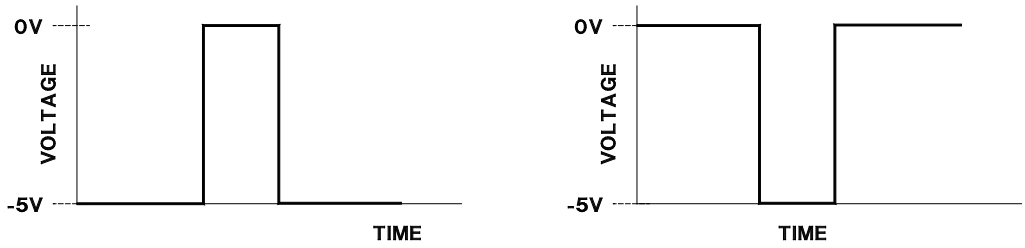
1. 2.5 volts min. to 5 volts max.
2. A minimum pulse width of 10 µsec. to a maximum of the laser pulse repetition rate.
3. A maximum rise/fall time of 500 nsec.
4. Delivered 1 to 3 milliseconds prior to the laser pulse.

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

The following are viable external triggers.



The following pulses will not trigger the S310.



Correcting FX Calorimeter Operating Parameters for Use at Different Wavelengths

Note: FX calorimeters are no longer available for sale. This information is provided for users who previously purchased FX calorimeters to understand how they operate with Vector power meters.

Note: Due to variability in the manufacturing process the absorption characteristics of the FX 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. FX and FXX 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 FX or FXX calorimeter is used at a wavelength other than the calibration wavelength, the power meter's displayed value can be adjusted to compensate for the absorption rate at the new wavelength by using an attenuation factor. The attenuation factor is calculated as follows:

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

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

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

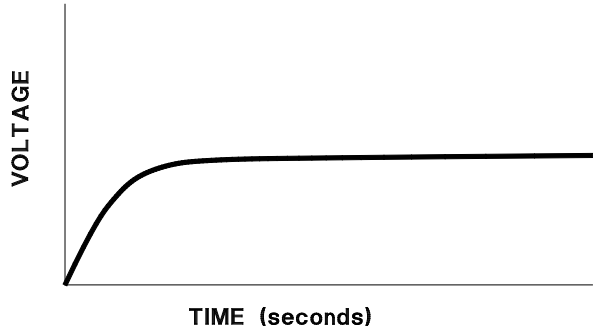
Analog Output

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

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

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

A. Calorimeter Watts Mode



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

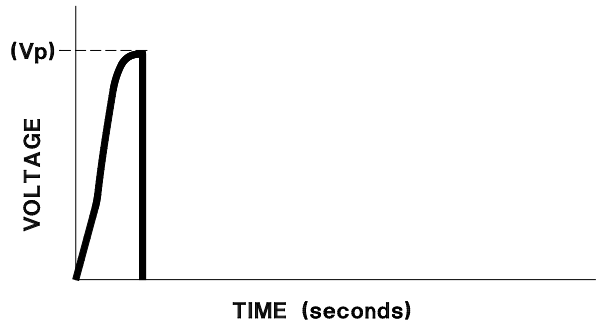
In power (watts) mode, the analog output is nominally 3 V full scale for each range. Therefore, to calculate watts from the analog output voltage:

W = V/S

where:

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

B. Calorimeter Joules Mode



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

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

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

where:

Vpk = peak voltage from the analog output

TC = calorimeter time constant from the calorimeter serial tag

S = calorimeter output sensitivity as follows:

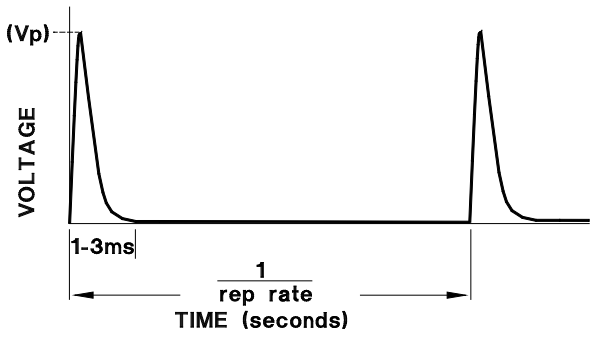
0.5 V/W	for 25 mm models
0.1667 V/W	for 50 mm models and large aperture calorimeters

R = power meter 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

C. Pyroelectric Watts and Joules Modes

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



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

W = Vpk/S

where:

Vpk = peak voltage from the analog output

S = analog output sensitivity (V/W) ≈ 3 V/range (W)
(for example, on the 3mW 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)

CALIBRATION OF VECTOR™ CALORIMETERS USING ELECTRIC SUBSTITUTION HEATERS

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

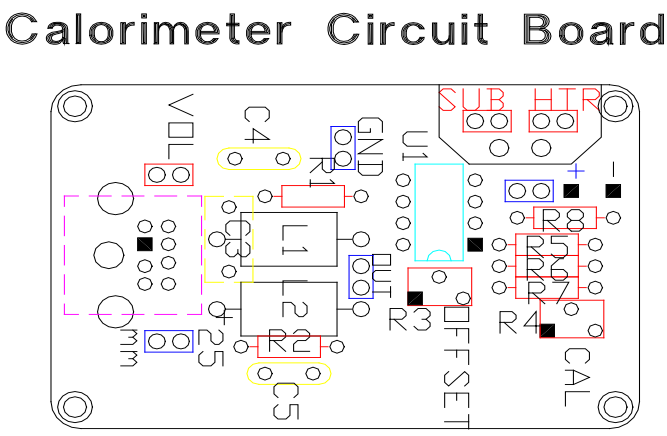


Figure 5. Calorimeter Circuit Board

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

B. Connect the calorimeter to the power meter, 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 power meter 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 power meter.

CALIBRATION OF LARGE APERTURE CALORIMETERS USING ELECTRIC SUBSTITUTION HEATING

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

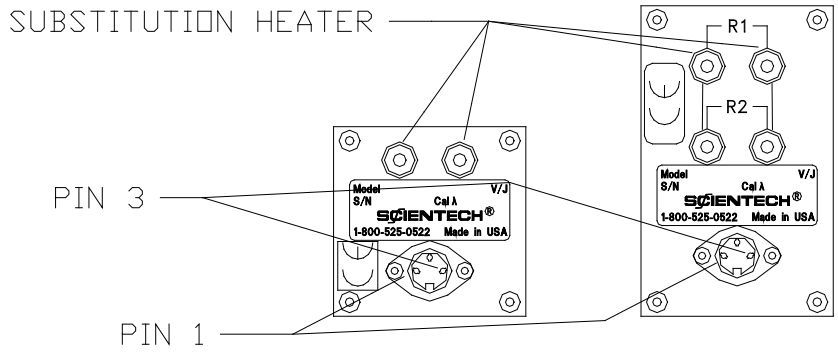


Figure 6. Large Calorimeter Connector Panel

Calibration with an Interface Module and S310 Power Meter

A. Connect a DVM to the white jacks of the calorimeter. Refer to Figure 6.

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

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

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

C. Remove the DVM. Connect a power supply to the white jacks and connect the DVM to monitor the power supply.

D. Set up the power meter in the Watts Mode and the 30W range.

E. Remove the screws holding the interface module's ID tag and remove the plate to expose the circuit board. Refer to Figure 5.

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

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

Calibration without an Interface Module and S310 Power Meter

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

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

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

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

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

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

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

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:

$$\mathbf{S = V_c/W}$$

where:

S = calorimeter's output sensitivity

V_c = voltage output from the calorimeter in mV

W = desired laser power output.

The measured sensitivity should be ± 3 % of the calorimeter's original sensitivity value.

DETECTOR OPERATION WITHOUT A POWER METER

Pyroelectric Detector Operation without Power Meter

A. Standard and SP Models

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

B. HR Models

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

Vector ™ Calorimeter Operation without Power Meter

A. Cable Requirements

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

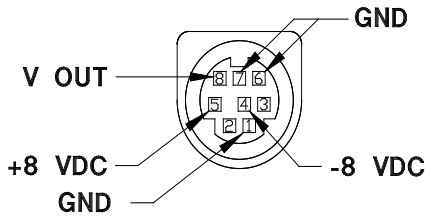


Figure 7. Calorimeter mini DIN Connector

When large aperture calorimeters are used without an power meter their interface module is not used. The output of the calorimeter is connected directly to the DVM or chart recorder. Large aperture calorimeters do not require any power. The voltage output is on pin 1 of the DIN connector and should be connected to the positive side of the DVM or chart recorder. Ground is on pin 3 and should be connected to the negative side. Pin 2 is not used. Refer to Figure 6.

Operation of Vector™ Calorimeters with a Digital Volt Meter

Note: Whenever a large aperture calorimeter is used without a power meter the interface module is not required.

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

A. Select the DC volts mode.

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

C. When the display of the DVM has stabilized (about 2 minutes), calculate the laser power using the formula:

W = V/S

where:

W = Laser power in watts
V = Voltage reading of the DVM in volts

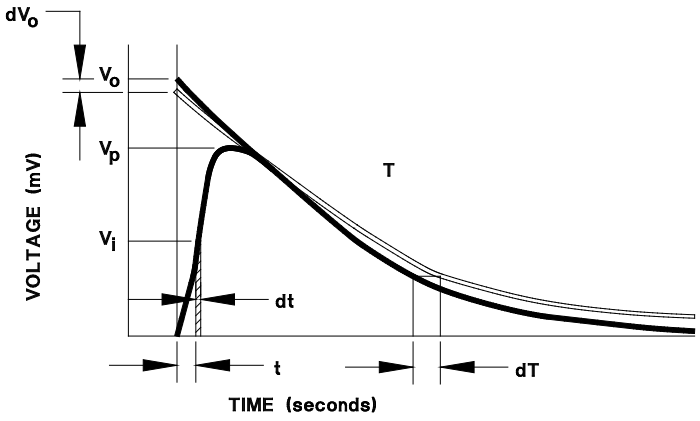
S = Sensitivity of the calorimeter from page 2.

Operation of Vector™ Calorimeters with an Analog Recorder

Note: Whenever a large aperture calorimeter is used without a power meter the interface module is not used.

Calorimeter Response:

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



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

$W = V/S$, $W_i = V_i/S$
V = Chart recorder voltage level in mV
S = Calorimeter sensitivity in mV/W

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

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

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

Numerical Integration:
Finding the area under the curve in figure 7 is the equivalent procedure for determining pulse energy.

Choose an appropriate time interval, dt, and perform the summation:

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

The error caused by this procedure is:

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

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

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

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

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

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

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

Peak Voltage Estimate:

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

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

$$F = E/V_p$$

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

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

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

REMOTE INTERFACE LANGUAGE

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

A. RS-232 Connector

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

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

B. RS-232 Specifications

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

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

C. 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.

D. Remote Interface Language Common Commands and Queries

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

The commands which work in both interfaces are presented first, followed by the password protected commands peculiar to the IEEE488 interface, followed finally by the archaic commands. In the descriptions which follow, the command (or query) will be presented first, followed optionally by one or more arguments, separated by commas. When the vertical bar "|" is used in an argument, it denotes the word "or", and signifies that one and only one of the items separated by bars may be inserted into the

space of the argument. For example, the command: XXXA|B,C has two arguments, the first of which may be `A' or `B', and the second of which is the letter `C'. Where a space character is required by the syntax, it is represented with an underline character.

Commands in this group are available from both interfaces:

*IDN?

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

*SAV_<dec num>

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

SENS_PYRO|CAL|PHR|ULTRA

Sets the detector type.

SENS?

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

SND?

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

RPT?

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

COL _<dec num>

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

accessed with the queries mean?, max?, sigma?, and cv?. The individual data points may be dumped with the dump? query.

RANGE_<dec num>|auto

Sets the range to the decimal number supplied, or to the closest legal range allowed for the current detector and configuration. If the word auto is supplied, this command activates the auto-range feature if it is supported for the current detector and configuration.

RANGE?

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

Table 4. S310 Range Selection Using Remote Interface Language

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

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

MEAN?

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

MIN?

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

MAX?

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

SIGMA?

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

CV?

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

PULSES?

Returns the number of pulses collected in the last run.

DUMP?

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

BAUD_<dec num>

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

PARITY EVEN|ODD|NONE

Sets the parity of the RS232 interface to even parity, odd parity, or no parity, as specified.

HANDS XON|CTS|NONE

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

IO RS232|IEEE

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

*RST

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

METER ON|OFF

Activates or deactivates the analog meter.

MODE VOLTS|ENERGY|AVGE|AVGP

If the specified mode is valid for the detector in use, the software changes mode to the one specified.

MODE?

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

*TST?

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

*OPC?

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

*WAI

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

CLR

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

*RCL_<dec num>

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

COUNT_<dec num>

Sets the number of pulses making up each average in average energy mode.

COUNT?

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

CALIB_<dec num>

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

CALIB?

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

ATTEN_<dec num>

Sets an attenuation factor for the current detector.

ATTEN?

Returns the attenuation factor for the current detector.

ZERO

This command zeros the power baseline for a calorimeter.

PSWD_<dec num>

Enables password protection commands if the password is entered correctly.

PSPEED HF|BL

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

PSPEED?

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

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

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

CDELAY_<dec num>

Sets the "Calorimeter Delay" function of the meter.

CDELAY?

Returns the "Calorimeter Delay" function of the meter.

E. 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.

SCIENTECH CALIBRATION SERVICE

Scientech recommends that a complete calibration be performed annually to verify system accuracy. Please visit Scientech's website at **www.scientechinc.com** to obtain an RMA (returned material authorization) number and complete the form noting that you are requesting calibration of your detector. You may also contact our Product Service Department at (800)525-0522 or (303)444-1361 or Fax (303)444-9229 or email inst@scientechinc.com. Be prepared to provide model number, serial number along with contact information. to arrange for a NIST traceable, factory calibration. Scientech calibrates the detector with its power meter for the same price.

LIMITED WARRANTY

Scientech warrants and represents that the laser power measurement product will be free from defects in design, materials and workmanship and conform with applicable Scientech product specifications for a period of three (3) years. The product warranty period begins on the date of shipment from Scientech. Scientech warrants that its products shall conform to applicable Scientech specifications and drawings and will meet all the functional and performance requirements when properly installed, operated, and maintained in accordance with Scientech's operating manual. Warranty does not extend to any Scientech products that have been subjected to misuse, abuse, or accidents, or improper installation, maintenance or applications, repaired by unauthorized personnel, or Products in which the tamper proof sticker has been removed or broken.

During the warranty period, Scientech will repair, or at its option replace at no charge, components that prove to be defective. The product must be returned, shipping prepaid, to Scientech's authorized repair facility. Products repaired by Scientech's authorized repair personnel/facilities will be warranted against defects in the repaired component and workmanship for a period of 365 days from the date of shipment of the repaired Product.

RETURN MATERIAL PROCEDURE

Should it become necessary to return any product to Scientech for any reason including calibration, please visit Scientech's website at **www.scientechinc.com** to obtain an RMA (returned material authorization) number and complete the form. You may also contact our Product Service Department at (800)525-0522 or (303)444-1361 or Fax (303)444-9229 or email inst@scientechinc.com. Be prepared to provide model number, serial number, and a description of the problem along with contact information. Frequently we can provide self-help information which will eliminate the need for returning the product.

If product 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 products damaged during shipping and shipping damage will not be treated as a warranty repair. Please include a point of contact, email address, and phone number of the person we should contact regarding repair questions.

Normally, products are repaired and shipped within five (5) business days following receipt of the product at the authorized service facility. The repair turn-around time could vary depending on the workload.

Shipping Address: Scientech, Inc.

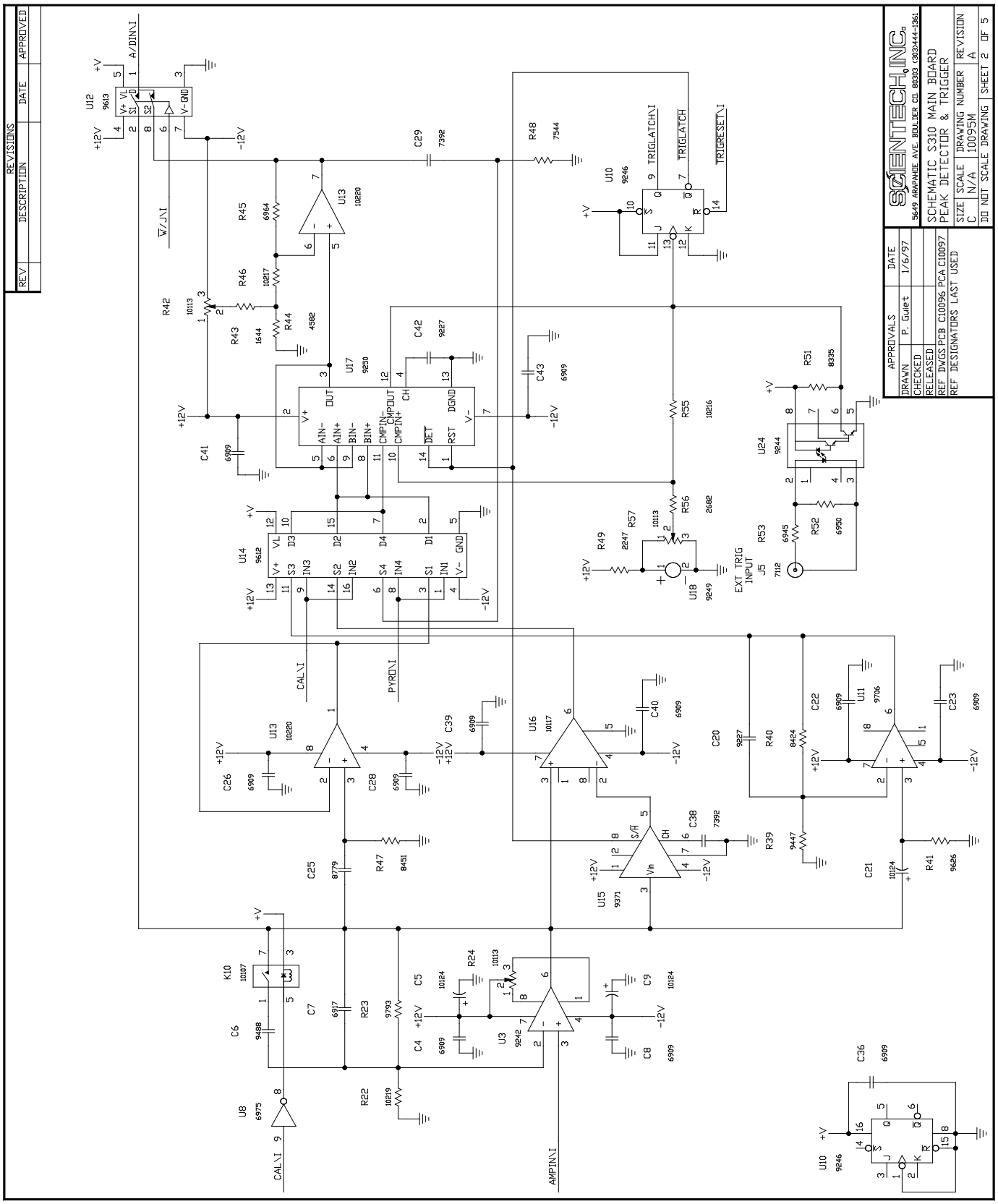
Product Service Department
5649 Arapahoe Ave.
Boulder, Colorado 80303 U.S.A.

DISPOSAL OF ELECTRONIC EQUIPMENT

Scientech 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 cannot 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.

SCHEMATICS


REVISIONS
REV
DESCRIPTION
DATE
APPROVED
SCIENTECH INC.
5649 ARAPAHOE AVE. BOULDER CO. 80303 (303)444-1361
SCHEMATIC S310 MAIN BOARD
PEAK DETECTOR & TRIGGER
SIZE C
SCALE N/A
DRAWING NUMBER 10095M
REVISION A
DO NOT SCALE DRAWING
SHEET 2 OF 5
APPROVALS
DATE
DRAWN P. Gulett 1/6/97
CHECKED
RELEASED
REF DWGS PCB C10096 PCA C10097
REF DESIGNATORS LAST USED
+12V
-12V
+V
W/JN1
A/DINN1
CAL1
PYRON1
AMPINN1
TRIGLATCHN1
TRIGLATCH
TRIGRESETN1
EXT TRIG INPUT
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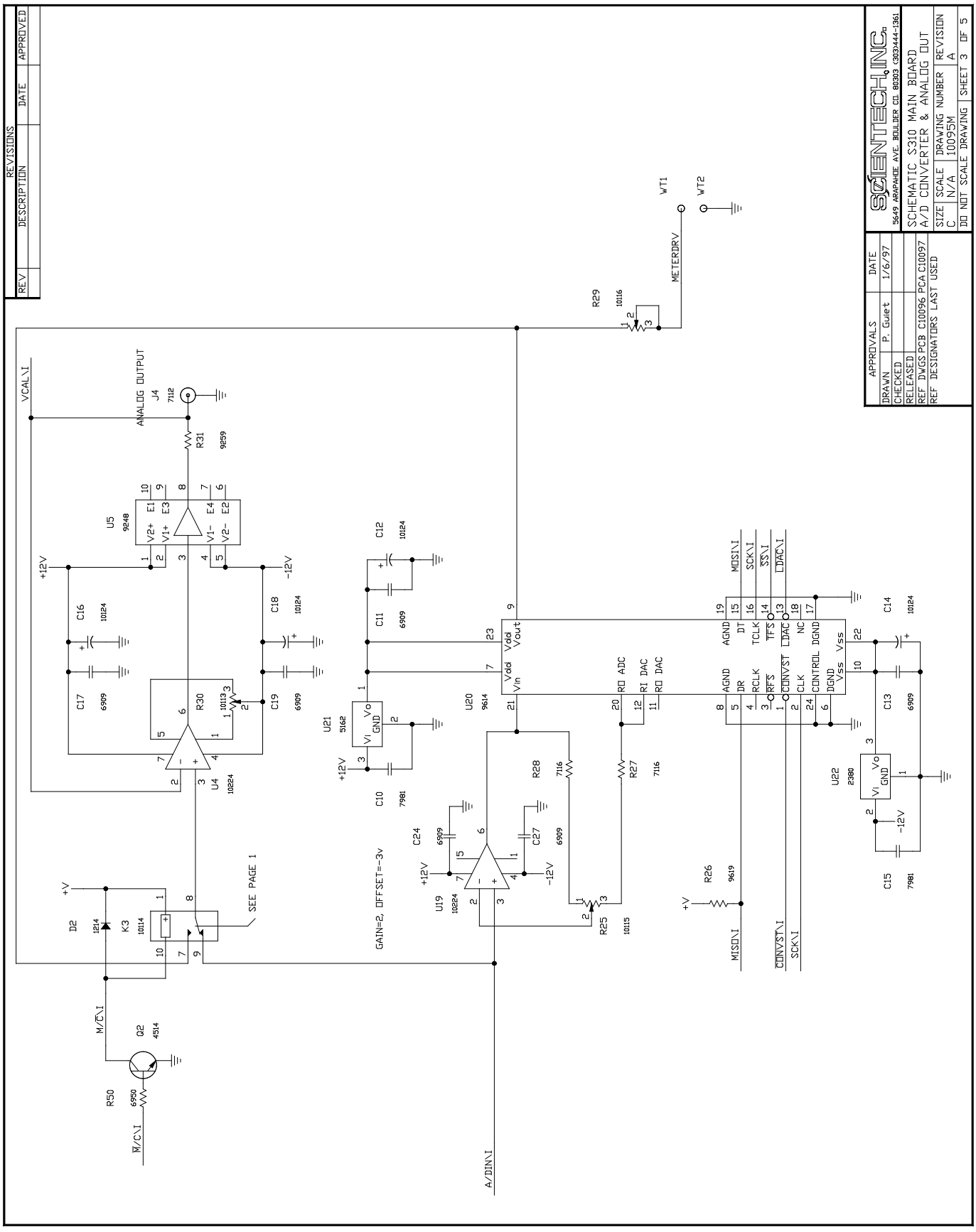
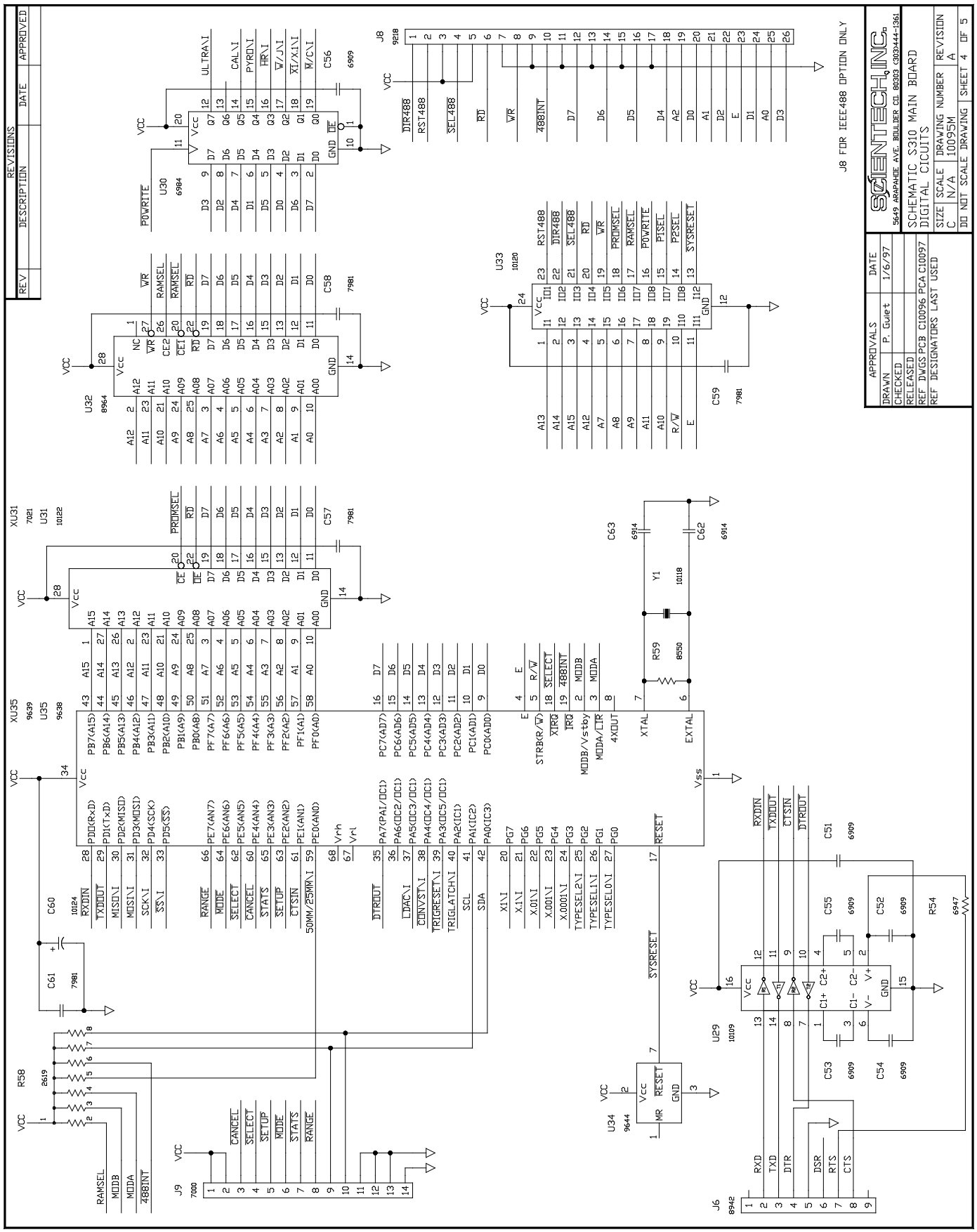
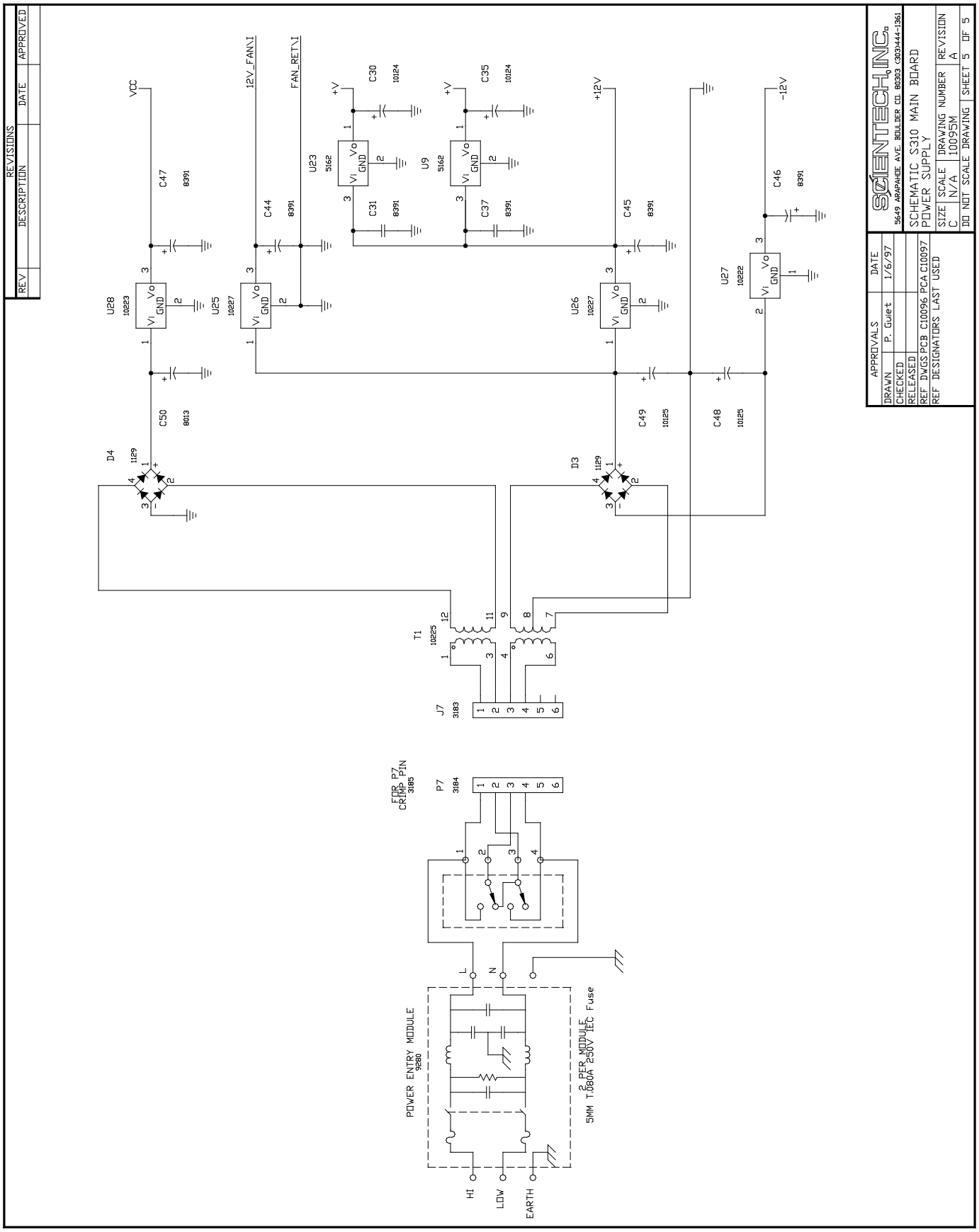
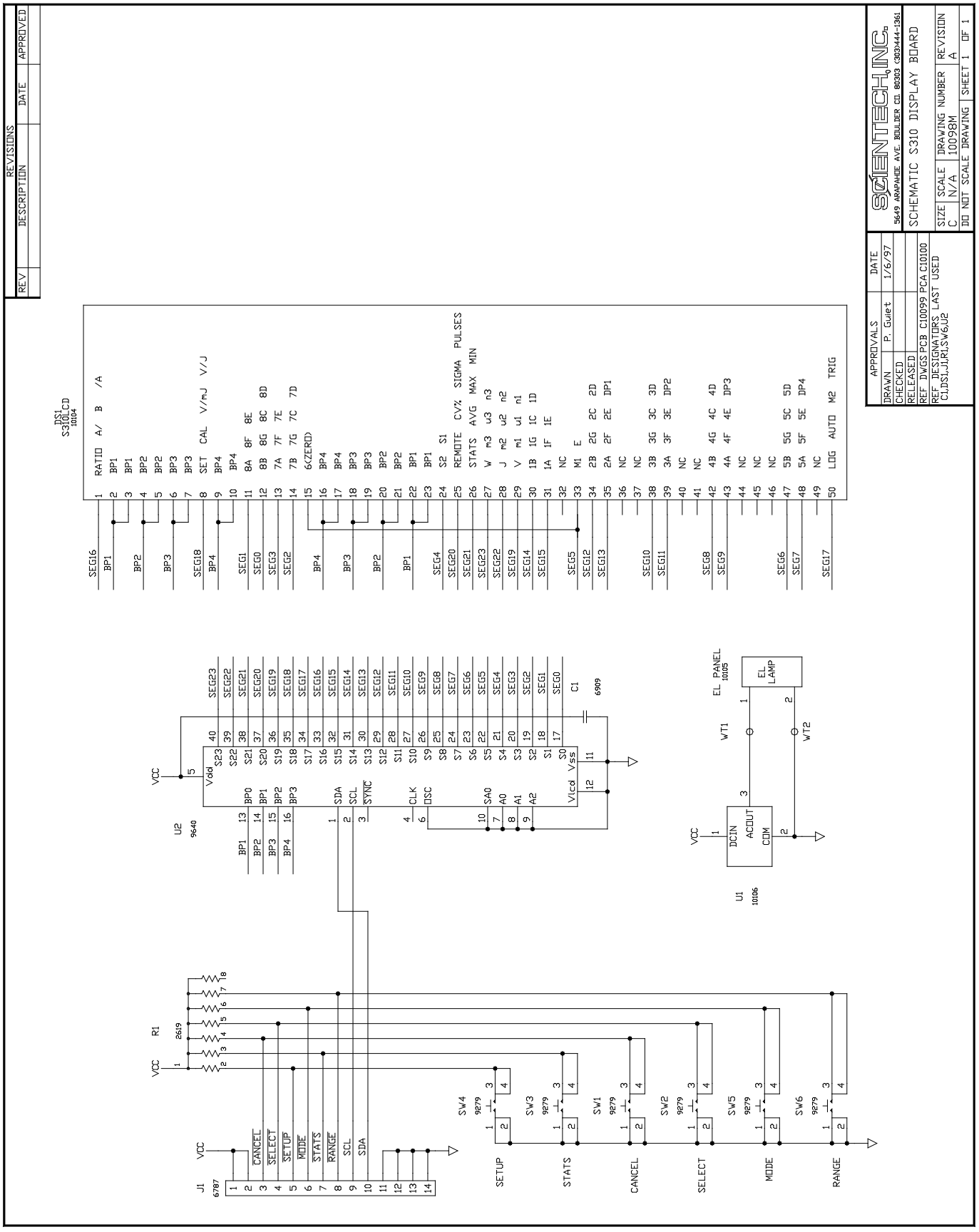

REVISIONS
REV
DESCRIPTION
DATE
APPROVED
SCITECH INC
5649 ARAPAHOE AVE. BOULDER CO. 80303 (303)444-1361
APPROVALS
DATE
DRAWN
P. Guiet
1/6/97
CHECKED
RELEASED
REF DWGS PCB C10096 PCA C10097
REF DESIGNATORS LAST USED
SCHEMATIC S310 MAIN BOARD
A/D CONVERTER & ANALOG OUT
SIZE C
SCALE N/A
DRAWING NUMBER 10095M
REVISION A
DO NOT SCALE DRAWING
SHEET 3 OF 5
VCAL\I
ANALOG OUTPUT
J4
7112
R31
9259
U5
9248
+12V
-12V
C16
10124
C17
6909
C18
10124
C19
6909
R30
10113
U4
10224
C12
10124
C11
6909
U21
5162
C10
7981
U20
9614
R28
7116
R27
7116
R25
10115
C24
6909
C27
6909
U19
10224
R29
10116
METERDRV
WT1
WT2
MDSI\I
SCK\I
SS\I
LDAC\I
TCLK
TFS
RFS
CONVST
CLK
CNTROL
AGND
DT
DR
RCLK
NC
DGND
Vss
RI ADC
RI DAC
C14
10124
C13
6909
U22
2380
C15
7981
R26
9619
MISDI\I
CONVST\I
SCK\I
A/DIN\I
GAIN=2, OFFSET=-3v
SEE PAGE 1
D2
1214
K3
10114
M/C\I
Q2
4514
R50
6950
M/C\I
+V


REVISIONS
REV
DESCRIPTION
DATE
APPROVED
SCHEMATIC S310 MAIN BOARD
DIGITAL CIRCUITS
SIZE C
SCALE N/A
DRAWING NUMBER 10095M
REVISION A
SHEET 4 OF 5
DO NOT SCALE DRAWING
APPROVALS
DRAWN P. Guiet 1/6/97
CHECKED
RELEASED
REF DWGS PCB C10096 PCA C10097
REF DESIGNATORS LAST USED
SCITECH INC
5649 ARAPAHOE AVE. BOULDER CO. 80303 (303)444-1361
J8 FOR IEEE488 OPTION ONLY
VCC
GND
RAMSEL
MODB
MODA
488INT
RXDIN
TXDOUT
MISO\I
MOSI\I
SCK\I
SS\I
RANGE
MODE
SELECT
CANCEL
STATS
SETUP
CTSIN
50MM/25MM\I
DTROUT
LDAC\I
CONVST\I
TRIGRESET\I
TRIGLATCH\I
SCL
SDA
X1\I
X1\I
X.01\I
X.001\I
X.0001\I
TYPESEL2\I
TYPESEL1\I
TYPESEL0\I
SYSRESET
RESET
XTAL
EXTAL
STRBR/W
XIRQ
IRQ
MODB/Vstby
MODA/LIR
4XOUT
R/W
SELECT
PRDMSEL
POWRITE
ULTRA\I
CAL\I
PYRO\I
HR\I
W/A\I
X1/X1\I
M/C\I
DIR488
RST488
SEL488
RD
WR
488INT
D7
D6
D5
D4
A2
D0
A1
D2
E
D1
A0
D3
RS232
RXD
TXD
DTR
DSR
RTS
CTS
RXDIN
TXDOUT
CTSIN
DTROUT


REVISIONS
REV
DESCRIPTION
DATE
APPROVED
VCC
12V_FANI
FAN_RETI
+V
+12V
-12V
C47
C44
C30
C35
C45
C46
C31
C37
C50
C49
C48
U28
U25
U23
U9
U26
U27
D4
D3
T1
J7
P7
FOR P7
CRIMP PIN
POWER ENTRY MODULE
2 PER MODULE
5MM T.080A 250V IEC Fuse
HI
LOW
EARTH
L
N
SCIENTECHINC
5649 ARAPAHOE AVE. BOULDER CO. 80303 (303)444-1361
APPROVALS
DRAWN
P. Guiet
1/6/97
CHECKED
RELEASED
REF DWGS PCB C10096 PCA C10097
REF DESIGNATORS LAST USED
SCHEMATIC S310 MAIN BOARD
POWER SUPPLY
SIZE C
SCALE N/A
DRAWING NUMBER 10095M
REVISION A
DO NOT SCALE DRAWING
SHEET 5 OF 5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REV
DESCRIPTION
DATE
APPROVED
DS1
S310LCD
10104
SEG16
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SEG1
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SEG3
SEG2
SEG4
SEG20
SEG21
SEG23
SEG22
SEG5
SEG12
SEG13
SEG10
SEG11
SEG8
SEG9
SEG6
SEG7
SEG17
RATIO
SET
CAL
V/mJ
V/J
REMOTE
CV%
SIGMA
PULSES
STATS
AVG
MAX
MIN
M1
E
AUTO
M2
TRIG
LOG
U2
9640
VCC
Vdd
Vss
Vlcd
CLK
OSC
SDA
SCL
SYNC
SA0
A0
A1
A2
C1
6909
R1
2619
J1
6787
CANCEL
SELECT
SETUP
MODE
STATS
RANGE
SW1
SW2
SW3
SW4
SW5
SW6
9279
U1
10106
DCIN
ACOUT
CDM
EL PANEL
10105
EL LAMP
WT1
WT2
APPROVALS
DATE
DRAWN
P. Guiet
1/6/97
CHECKED
RELEASED
REF DWGS PCB C10099 PCA C10100
REF DESIGNATORS LAST USED
C1,DS1,J1,R1,SW6,U2
SCIENTECH INC.
5649 ARAPAHOE AVE. BOULDER CO. 80303 (303)444-1361
SCHEMATIC S310 DISPLAY BOARD
SIZE
C
SCALE
N/A
DRAWING NUMBER
10098M
REVISION
A
DO NOT SCALE DRAWING
SHEET 1 OF 1