Model 1835-C Multi-Function Optical Meter



OPERATOR'S MANUAL

Newport

Model 1835-C
Multi-Function Optical Meter

Warranty

Newport Corporation warrants this product to be free from defects in material and workmanship for a period of 1 year from the date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at Newport's option.

To exercise this warranty, write or call your local Newport representative, or contact Newport headquarters in Irvine, California. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made and the instrument returned, transportation prepaid. Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

Limitation of Warranty

This warranty does not apply to defects resulting from modification or misuse of any product or part. This warranty also does not apply to fuses, batteries, or damage from battery leakage.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. Newport Corporation shall not be liable for any indirect, special, or consequential damages.

Statement of Calibration

This instrument has been inspected and tested in accordance with specifications published by Newport Corporation.

The accuracy and calibration of this instrument and photodetector (where applicable) is traceable to the National Institute for Standards and Technology through equipment which is calibrated at planned intervals by comparison to the certified standards maintained at Newport Corporation.

Copyright 1993, Newport Corporation
Part No. 20061-01, Rev. D
IN-05931 (02-00)



EC DECLARATION OF CONFORMITY

Model 1835-C

We declare that the accompanying product, identified with the "CE" mark, meets the intent of the Electromagnetic Compatability Directive, 89/336/EEC and Low Voltage Directive 73/23/EEC.

Compliance was demonstrated to the following specifications:

EN50081-1 EMISSIONS:

Radiated and conducted emissions per EN55011, Group 1, Class A

EN50082-1 IMMUNITY:

Electrostatic Discharge per IEC 1000-4-2, severity level 3
Radiated Emission Immunity per IEC 1000-4-3, severity level 2
Fast Burst Transients per IEC 1000-4-4, severity level 3
Surge Immunity per IEC 1000 4-5, severity level 3

IEC SAFETY:

Safety requirements for electrical equipment specified in IEC 1010-1.

Alain Danielo

VP European Operations
Zone Industrielle
45340 Beaune-la-Rolande, France

Jeff Cannon

General Manager-Precision Systems
1791 Deere Avenue
Irvine, Ca. USA

Table of Contents

Warranty ii
EC Declaration of Conformity iii
List of Figures vii
List of Tables viii
Safety Symbols and Terms ix
Definitions x
Specifications xi

Section 1 – General Information

1.1 System Overview 1
1.2 Scope of this manual 2
1.3 Unpacking and Inspection 2
1.4 Preparation for Use 2
1.5 Optional Accessories and Services 2

Section 2 – System Operation

2.1 Introduction 3
2.2 Display 3
2.3 Top Level Key Functions 5
2.3.1 ⏻, Power 6
2.3.2 SHIFT 6
2.3.3 DISP ☼, Display Brightness 6
2.3.4 FILTER, Signal Filtering 6
2.3.5 ZERO, Offset Subtraction 7
2.3.6 AUTO, Automatic Gain Ranging 7
2.3.7 STO REF, Store Reference Value 7
2.3.8 ATTN, Attenuator 8
2.3.9 λ, Wavelength 8
2.3.10 RANGE, Signal Range 8
2.3.11 R/S, Run-Stop 8
2.3.12 MODE, Measurement Mode 9
2.3.13 UNITS, Display Units 10
2.3.14 STATS, Moving Statistics 10
2.3.15 EXT, External Trigger 11
2.3.16 MENU 11
2.3.17 ENTER 11
2.3.18 ESC, Escape 11
2.3.19 ▲, ▼, ◀, ▶ Adjust 11
2.4 Menu Level Functions 12
2.4.1 Menu Access and Movement 12
2.4.2 Data Store 14

2.4.3 Meter Configuration 15
2.4.4 Auto Cal 16
2.4.5 User Calibration 17
2.4.6 DC Sampling 17
2.4.7 Trigger Output 18
2.4.8 Trigger Input 19
2.4.9 Bar Graph 19
2.4.10 Tone 20
2.4.11 Detector Switch Position 20
2.4.12 Remote Setup 20
2.4.13 General Information Functions 20
2.5 Connecting AC Power 21
2.6 Detector Connection and Setup 22
2.7 Power Up 22
2.8 Performing Basic Measurements 23
2.8.1 Making a DC Power Measurement 23
2.8.2 Making a Peak-to-Peak Power Measurement 23
2.8.3 Making a Pulse Energy Measurement 24
2.8.4 Making a Signal Integration Measurement 24
2.8.5 Measuring a Laser Pulse Energy with a Thermopile Detector 24
2.8.6 Using the Model 1835-C as an Exposure Controller 26

Section 3 – Principles of Operation

3.1 Introduction 27
3.2 Analog Signal Flow 27
3.3 Digitized Signal Flow 28
3.4 Typical Detector Signals 30
3.5 Thermopile Detector Signals 30
3.6 Pulse Energy Detector Signals 31
3.7 Peak-to-Peak (Photodiode) Detector Signals 32
3.8 Integration of Detector Signals 33
3.9 Analog Output 34
3.10 Measurement Considerations 34
3.10.1 Detector Calibration and Accuracy 34
3.10.2 Quantum Detector Temperature Effects 35
3.10.3 Thermopile Detector Temperature Effects 35
3.10.4 Energy Detector Temperature Effects 35
3.10.5 Ambient and Stray Light 35
3.10.6 Common Measurement Errors 36

Section 4 – Computer Interfacing

4.1 General Guidelines 37
4.2 Computer Interface Terminology 37
4.3 Entering Remote Computer Interface Mode 39
4.4 RS-232C Communication 39
4.4.1 Setting Baud Rate and Echo Mode from the Keypad. 40
4.4.2 Setting Baud Rate and Echo Mode from a Remote Interface .. 40

4.5 RS-232C XON/XOFF Handshaking Protocol 41
4.6 GPIB Communication 41
4.6.1 Setting the GPIB Address 42

Section 5 – Remote Command Reference

5.1 Model 1835-C Remote Interface Commands 43
5.2 Device Independent Commands 45
5.3 Device Dependent Commands 54

Section 6 – Maintenance, Test and Troubleshooting

6.1 Maintenance Procedures 82
6.2 Power Up Self Test 82
6.3 Troubleshooting Guide 82

Section 7 – Factory Service

7.1 Introduction 85
7.2 Obtaining Service 85
Service Form 87

Appendices

A Syntax and Definitions 89
B Error Messages 93
C Status Reporting System 96
D Sample Programs 100

List of Figures

1. Model 1835-C Controller and Accessories 1
2a. Model 1835-C VFD Display 3
2b. Description of Model 1835-C Display Regions 4
3. Front Panel Key Pad 5
4. Decimal Point Indication of Menu Hierarchy Position 12
5. Rear Panel Power Supply Voltage Switches in Positions L, R 21
6. Connecting a Detector with its Calibration Module 22
7. Model 1835-C Detector Calibration Module Input Port 22
8. Measuring Laser Pulse Energy via a Thermopile in INTG Mode 25
9. Model 1835-C Analog Signal Flow Diagram 27
10. Model 1835-C Digitized Signal Flow Block Diagram 28
11. Thermopile Signals 30
12. Energy Detector Signal from a Single Optical Pulse 31
13. Negative Baseline Drift Voltage to a Pulse Train 31
14. Time Varying Signal Measurements 32
15. Integrated Energy Via a Trapezoid Approximation 33
16. Measuring Laser Pulse Energy with a Thermopile 34
17. RS 232 Cable Connections 40

List of Tables

Table 1. Model 1835-C Display Annunciators 4
Table 2. Model 1835-C Top Level Key Functions and Associated Remote Commands 5
Table 3. Newport Detector Families and Available Measurement Modes 9
Table 4. Model 1835-C Measurement Modes 9
Table 5. Valid Display Units Available to Detector Families by MODE 10
Table 6. Displayed Unit Abbreviations versus Actual Measurement Units 10
Table 7. Menu Level Key Functions and Parameters 13
Table 8. Data Store Operations 14
Table 9. Configuration Parameters and Default Conditions 15
Table 10. Meter Configuration Operations 16
Table 11. User Calibration Operations 17
Table 12. SAMPLE PREC States and Limits 18
Table 13. DC SAMPLING Operations 18
Table 14. TRIGGER OUT Operations 19
Table 15. EXT TRIGGER IN Operations 19
Table 16. BAR GRAPH Operations 19
Table 17. TONE Operations 20
Table 18. DET SWITCH POS Operations 20
Table 19. REMOTE SETUP Operations 20
Table 20. GENERAL INFO Operations 21
Table 21. Power Supply Voltage Switch Positions 21
Table 22. Analog Signal Flow Paths 28
Table 23 Common Measurement Errors 36
Table 24 Model 1835-C IEEE-488.1 Capabilities Summary 41
Table 25 Device Independent Status Commands 43
Table 26 Device Dependent Commands ..... 44 - 45
Table 27. Symptom/Fault Troubleshooting Guide ..... 83 - 84

Safety Symbols and Terms

The following safety terms are used in this manual:

The **WARNING** heading in this manual explains dangers that could result in personal injury or death.

The **CAUTION** heading in this manual explains hazards that could damage the instrument.

In addition, a **NOTES** heading gives information to the user that may be beneficial in the use of this instrument.

GENERAL WARNINGS AND CAUTIONS

The following general warnings and cautions are applicable to this instrument:

WARNING

This instrument is intended for use by qualified personnel who recognize shock hazards or laser hazards and are familiar with safety precautions required to avoid possible injury. Read the instruction manual thoroughly before using, to become familiar with the instrument's operations and capabilities.

WARNING

The American National Safety Institute (ANSI) states that a shock hazard exists when probes or sensors are exposed to voltage levels greater then 42VDC or 42V peak AC. Do not exceed 42V between any portion of the Model 1835-C (or any attached detector or probe) and earth ground or a shock hazard will result.

CAUTION

There are no user serviceable parts inside the Model 1835-C. Work performed by persons not authorized by Newport may void the warranty. For instructions on obtaining warranty repair or service please refer to Section 5 of this manual.

Definitions

A	amps
AC	alternating current
ADC	analog-to-digital converter
BAT	battery option
BIC	biconic fiber connector
BNC	standard coaxial connector type
°C	degrees Centigrade
DC	direct current
°F	degrees Fahrenheit
Hz	hertz (cycles per second)
I-V	current-to-voltage converter
kHz	kilohertz
kΩ	kiloOhms
mA	milliamps
mV	millivolts
nA	nanoamps
nF	nanofarads
nm	nanometers
P-P	peak-to-peak
RH	relative humidity
S/N	serial number
µA	microamps
µS	microsecond
V	volts
W	watts

Specifications

Physical Specifications:

Dimensions:	4.2 × 8.8 × 13.9 in (107 × 224 × 353 mm)
Weight:	8 lb, 3 oz. (3.7 kg)
Enclosure:	Metal case, painted
Connectors:	8-Pin Sub Mini DIN CAL MODULE Input; BNC Analog Output, Trigger Output and Trigger Input; 9 Pin D-Sub RS-232, 24 Conductor GPIB
Power:	100/120/220/240 VAC ± 10%, 50/60 Hz
Display:	5.5 digit annunciated VFD
Display Update Rate:	10 Hz
Gain Ranges:	Up to 7 decades (Detector and MODE dependent)
Operating Environment:	0°C – 40°C; < 70% RH noncondensing
Storage Environment:	-20°C – 60°C; < 90% RH noncondensing
Compatible Detectors:	Low-Power (Semiconductor) Family High-Power (Thermopile) Family Energy (Pyroelectric) Family

Electrical Specifications:

DC Current Measurement (Low-Power, Semiconductor Photodiode CAL MODULE)

Signal Range:[1,2]	0	1	2	3	4	5	6
Full-Scale Current:	2.51 nA	25.1 nA	251 nA	2.51 µA	25.1 µA	251 µA	2.50 mA
A/D Resolution: (20,000 Count Precision)	126 FA	1.26 pA	12.6 pA	126 pA	1.26 nA	12.6 nA	126 nA
Display Noise Floor: (Input Open, Filter Off)	≤ 8 LSD	≤ 1 LSD	≤ 1 LSD	≤ 1 LSD	≤ 1 LSD	≤ 1 LSD	≤ 1 LSD
Full-Scale Accuracy:[3] (Typical)	± 0.1%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%
Full-Scale Accuracy:[3] (Worst-Case)	±0.48%	.30%	.30%	.30%	.30%	.30%	.30%

Peak-Peak Current Measurement (Low-Power, Semiconductor Photodiode CAL MODULE)

Signal Range:[1, 2]	0	1	2	3	4	5	6	7	8
Full Scale (P-P) Current:	253 nA	797 nA	2.52 µA	7.97 µA	25.1 µA	79.3 µA	251 µA	793 µA	2.51 mA
A/D Resolution:	61.7 pA	195 pA	616 pA	1.95 nA	6.13 nA	19.4 nA	61.3 nA	194 nA	613 nA
Full-Scale Accuracy:[3] (Typical)	±1%	±1%	±1%	±1%	±1%	±1%	±1%	±1%	±1%
Full-Scale Accuracy:[3] (Worst Case)	±2%	±2%	±2%	±2%	±2%	±2%	±2%	±2%	±2%
Bandwidth (3db):	(5 Hz - 1 KHz)			(5 Hz - 10 KHz)			(5 Hz - 47 KHz)		
Frequency Range for ±2% (Typ) Accuracy:	(50 Hz - 100 Hz)			(50 Hz - 1.4 KHz)			(50 Hz - 7 KHz)		

Trigger Level: 4% of full scale (fixed) above ground.

D.C. Voltage Measurement (Thermopile CAL MODULE)

Signal Range:[1, 2]	0	1	2	3
Full Scale Voltage: (20,000 Count Precision)	2.49 mV	24.9 mV	249 mV	2.49 V
Resolution: (20,000 Count Precision)	125 nV	1.25 µV	12.5 µV	125 µV
Display Noise Floor: (Input Shorted)	≤ 8 LSD	≤ 1 LSD	≤ 1 LSD	≤ 1 LSD
Full Scale Accuracy (Typ.):[3]	± .3%	± .2%	± .1%	± .05%
Full Scale Accuracy: (Worst Case)	± .56%	± .36%	± .18%	± .1%
Bandwidth (3db):	5 Hz	5 Hz	5 Hz	5 Hz

[1] Listed signal ranges specify meter capability. Available signal ranges are detector dependent.

[2] Maximum measurable signal is detector dependent. See description of detector saturation message “SA”, page 83.

[3] After 60 min warm-up, followed by execution of AUTOCAL command. See Section 2.4.4.

Pulse Voltage Measurement (Energy, Pyroelectric CAL MODULE)

Signal Range:[1]	0	1	2	3	4	5	6	7	8	9
Full Scale[2] Voltage:	789 µV	2.50 mV	7.89 mV	25.0 mV	78.9 mV	250 mV	789 mV	2.50 V	7.91 V	25.0 V
A/D Resolution:	193 nV	610 nV	1.93 µV	6.10 µV	19.3 µV	61.0 µV	193 µV	610 µV	1.93 mV	6.10 mV
Full-Scale Accuracy:[3] (Typical)	±1%	±1%	±1%	±1%	±1%	±1%	±1%	±1%	±1%	±1%
Full-Scale Accuracy:[3] (Worst Case)	± 2%	± 2%	± 2%	± 2%	± 2%	± 2%	± 2%	± 2%	± 2%	± 2%

Maximum Pulse Repetition Rate: 2 kHz

Trigger Level: 8% of Full Scale[1] (fixed)

[1] Listed signal ranges specify meter capability. Available signal ranges are detector dependent.

[2] Full scale voltage is measured relative to baseline voltage.

[3] After 60 min warm-up, followed by AUTOCAL command. See Section 2.4.4.

Analog Output

Full Scale Voltage: 0 - 2.5V into 50Ω

Accuracy: ± 2.5%

Detector Signals and Calculations:

S	Represents the most recent signal value obtained from the A/D converter. It may represent amps or volts and may be analog and or digitally filtered.
S_d	Represents the value stored as a reference signal for subsequent use in signal offset, i.e. ZERO calculations. S_d=0 when ZERO is off.
$S - S_d$	Represents the most recent net signal value. This is the value that is displayed when units are set to Amps or Volts. Note that S_d = 0 when ZERO is off.
$\frac{(S - S_d)}{R_\lambda}$	Measurement calculation when the display units are Watts or Joules. R_λ is the detector responsivity associated with the current wavelength setting.
$10\log\left(\frac{(S - S_d)/R_\lambda}{1\text{mW}}\right)$	Measurement calculation when the display units are ten times the (base ten) logarithm of the ratio of the measured power to 1 mW, i.e. dBm.
$\frac{(S - S_d)/R_\lambda}{\text{STO-REF}}$	Measurement calculation when the display units are the ratio of measured power to the value stored by the STO-REF function.
$10\log\left(\frac{(S - S_d)/R_\lambda}{\text{STO-REF}}\right)$	Measurement calculation when the display units are ten times the (base ten) logarithm of the ratio of measured power to the value stored by the STO-REF function.

Section 1
General Information

1.1 System Overview

The Model 1835-C Multi-Function Optical Meter is a high performance instrument with a wealth of measurement and triggering features designed to provide measurement sensitivity, flexibility and speed. In spite of its power, Model 1835-C is also designed to provide simple operation with direct panel access to basic features and a shallow menu for access to advanced features.

Great flexibility exists within the command structure of the Model 1835-C so that even complex measurements can be set up quickly and easily. The 1835-C can react to or provide triggering, act as an exposure or noise meter, or data log up to 2,500 measurements!

The Model 1835-C is compatible with all of Newport's Low-Power, High-Power and Energy detector families. A family tree of the 1835-C, compatible detectors and accessories is shown in Figure 1 below.

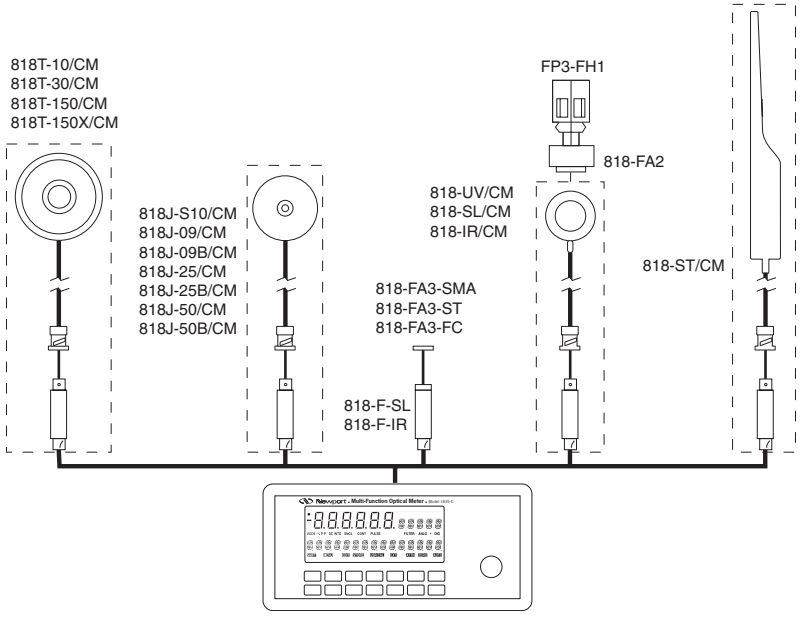


Figure 1. Model 1835-C Controller and Accessories

The Model 1835-C connects to detectors through a calibration module containing information unique to the detector being used. Calibration modules are ordered with a detector at the time of purchase and are labeled with the detector's model number and serial number. Detectors with calibration modules have a "/CM" appended to their model number.

EXAMPLE: 818-SL (no calib. module) 818-SL/CM (with calibration module)

1.2 Scope of this manual

Please carefully read this instruction manual before using the Model 1835-C Multi-Function Optical Meter. Be especially careful to observe the warnings and cautions throughout this manual. If any operating instructions are **not** clear, contact Newport Corporation.

This instruction manual contains the necessary information for operation and maintenance of the Newport Model 1835-C Multi-Function Optical Meter as well as information for troubleshooting and obtaining service if necessary. This information is divided into the following sections:

Section 1	General Information and Functional Description
Section 2	System Operation
Section 3	Principles of Operation
Section 4	Computer Interfacing
Section 5	Computer Command Reference
Section 6	Maintenance and Troubleshooting
Section 7	Factory Service
Appendix A	Syntax and Definitions
Appendix B	Error Messages
Appendix C	Status Reporting System

1.3 Unpacking and Inspection

All Model 1835-C Multi-Function Optical Meters are carefully assembled, tested and inspected before shipment. Upon receiving this instrument, check for any obvious signs of physical damage that might have occurred during shipment. Report any such damage to the shipping agent immediately. Retain the original packing materials in case reshipment becomes necessary.

1.4 Preparation for Use

The Model 1835-C Multi-Function Optical Meter should have some operations performed *before* measurements are made. These include:

Connecting AC Power (Section 2.5)

Detector Connection and Setup (Section 2.6)

1.5 Optional Accessories and Services

The Newport Catalog presents up to date information on the detectors, detector accessories and detector calibration services available for use with the Model 1835-C Multi-Function Optical Meter. Refer to Figure 1 for where a given detector or accessory fits within the Model 1835-C family tree.

Section 2
System Operation

2.1 Introduction

The Model 1835-C is designed to provide quick operation and to avoid a steep learning curve. This section starts by giving a brief listing of display, key pad and menu command features. Much of the Model 1835-C's operation will be obvious after these descriptions. The manual then explains each key operation and menu command in detail. Reference each of these detailed explanations as required when getting started.

2.2 Display

The Model 1835-C incorporates a vacuum fluorescent display, VFD, which can be clearly observed with most laser goggles and at high angles of incidence. Figure 2 illustrates and identifies the primary regions and annunciators within the Model 1835-C's display.

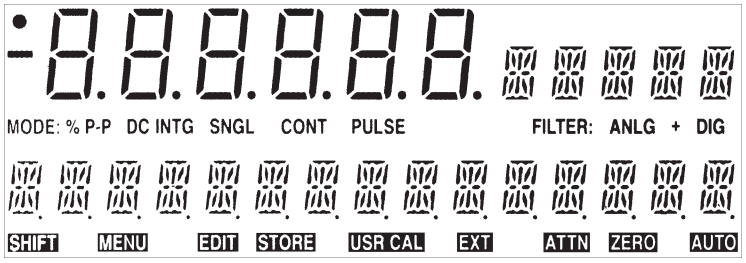


Figure 2a. Model 1835-C VFD Display

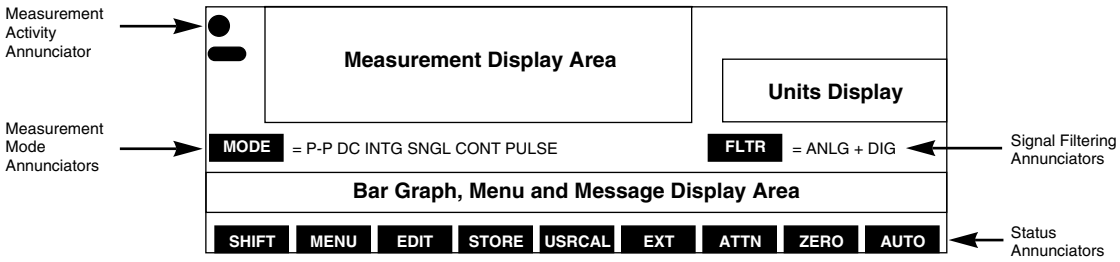


Figure 2b. Description of Model 1835-C Display Regions —

Table 1. Model 1835-C Display Annunciators

Annunciator	Comment
●	Blinking indicates that the meter is making measurements.
DC	Meter is set to make DC signal measurements.
INTG	Meter is set to make INTEGRATED signal measurements.
P-P	Meter is set to make Peak-to-Peak signal measurements.
SNGL	Meter will make only one measurement per front panel or external trigger.
CONT	Meter will continuously make measurements until stopped.
PULSE	Meter is set to make pulse energy measurements.
ANLG	Analog signal filtering is on.
DIG	Digital signal filtering is on.
SHIFT	Indicates that the next key press will execute a blue key function.
MENU	Meter and display are in menu mode. Measurement is stopped.
STORE	Meter is logging measurements into memory, i.e. data logging.
USRCAL	User (versus calibration module) has supplied the detector responsivity in use.
EXT	External trigger input is enabled.
AUTO	Automatic signal gain ranging is on.
ZERO	Background signal subtraction, (zeroing), is on.
ATTN	The responsivity in use includes the affect of the detector's attenuator.

2.3 Top Level Key Functions

Operating controls for the Model 1835-C are found on both the front and rear panels of the Model 1835-C. For measurement operation, only the front panel controls are used. Rear panel controls are used for AC line power setup, Section 2.5.

The front panel key pad of the Model 1835-C, Figure 3, provides quick access to measurement functions and menu access to advanced features and setup parameters. Table 2 and Sections 2.3.1 through 2.3.12 list and describe each top level key function. Menu level key functions are discussed in Section 2.4.

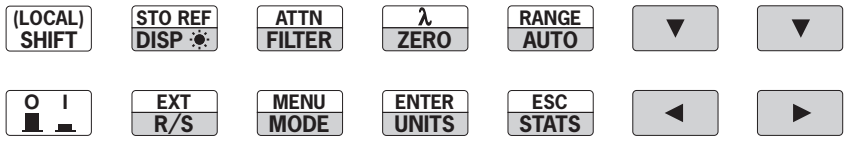


Figure 3. Front Panel Key Pad

Table 2. Top Level Key Functions and Associated Remote Commands

Keypad	Remote Commands	Description
O I	None	Turn the Model 1835-C on and off.
SHIFT	None	Enable the blue key functions.
DISP ☼	DISP, DISP?	Cycle display brightness: OFF, LOW, NORM and HIGH.
FILTER	FILTER, FILTER?	Cycle signal filtering: OFF, ANLG, DIG and ANLG+DIG.
ZERO	ZERO, ZERO?, STOZERO, ZEROVAL?	Zero the display via offset subtraction.
AUTO	AUTO, AUTO?	Turn automatic gain ranging on and off.
STO REF	STOREF, STOREF?	Store last reading for future dB and REL measurements.
ATTN	ATTN, ATTN?	Set responsivity to detector or detector-with-attenuator.
λ	LAMBDA, LAMBDA?	Display and edit the calibration wavelength in use.
RANGE	RANGE, RANGE?	Display signal gain range in use.
R/S	RUN, STOP	Starts and stops signal acquisition.
MODE	MODE, MODE?	Cycle meter between allowed measurement modes.
UNITS	UNITS, UNITS?	Cycle display measurement units between those allowed.
STATS	STSIZE, STSIZE?, STMAX? STMIN?, STMXMN? STMEAN STSDEV?	Display statistics.: Max, Min, Max-Min, Mean and Std. Dev.

EXT	EXT	Enable or disable external triggering.
MENU	None	Enter or exit MENU command mode.
ENTER	None	Select next lower menu level or enter edit mode.
ESC	None	Escape to next higher menu level or escape edit mode.
▼, ▲	None	Adjust gain range or parameter values or move through a list.
◀, ▶	None	Zooms bargraph in or out. When in Edit mode, selects the digit to be edited by the ▼, ▲ keys.

2.3.1 ⏻, Power

The ⏻ key toggles the Model 1835-C on and off. To turn the meter on, depress the ⏻ key in until it clicks and stays in its depressed position. To turn the meter off, press the key again until it clicks and rebounds to its original length.

2.3.2 SHIFT

When SHIFT is pressed, the SHIFT display annunciator lights and the blue key functions (such as STOREF) are enabled. The next key press will cause that blue function to be executed and the "shift status" to disable. If a no blue function is the next pressed, then the 'shift status' reverts to disabled.

2.3.3 DISP ☼, Display Brightness

This key cycles the display and the backlit key pad through: OFF, LOW, NORM and HIGH brightness levels. This allows a user to operate in a dark environment without light pollution from the display, (except for one dim scanning decimal point and the measurement activity annunciator).

When the display is OFF, the R/S key may be used to manually trigger measurements. Any other key press returns the display to the LOW brightness state while ignoring the key function.

2.3.4 FILTER, Signal Filtering

Press this key to cycle input signal filtering between: OFF, ANLG, DIG, ANLG+DIG. This function provides methods of lowering the noise observed in the measurement data and the analog output.

When the ANLG annunciator is lit, a 5Hz low pass filter lowers the noise floor by attenuating high frequency signal components. ANLG filtering is not available to High Power detectors, Energy detectors or any P-P modes.

When the DIG display annunciator is lit, measurements pass through a moving 10-sample averaging buffer before being further processed, stored or communicated to the display or computer interfaces. With DIG on, all observable values represent digitally averaged results relative to the original A/D conversions. This averaging is independent of the subsequent processing available through the STATS buffer, Section 2.3.14.

2.3.5 ZERO, Offset Subtraction

This key turns offset subtraction on and off. When turned on, the ZERO annunciator lights and the last signal reading is saved as S_d and subtracted from all subsequent signal readings S. This causes subsequent signal calculations (and the display) to use the value $S-S_d$ instead S.

Offset subtraction allows one to remove the effects of ambient DC signals, by zeroing the display before making a measurement. A second ZERO key press turns off the ZERO annunciator and stops offset subtraction.

2.3.6 AUTO, Automatic Gain Ranging

The AUTO key toggles automatic signal ranging on and off. When on, the AUTO annunciator lights and the signal range (amplifier gain) is adjusted to utilize maximum analog-to-digital converter resolution. When AUTO is turned off, the AUTO annunciator is turned off and the signal range is left in its current state.

Signal range can be manually controlled by the ▼, ▲ arrow keys. Pressing an ▼, ▲ arrow key when AUTO is on (and STATS, MENU and λ are off), turns AUTO off and executes the manual range change. See RANGE, Section 2.3.10.

Signal range changes will not often coincide with observable changes to the display value as the display is scaled by the detector responsivity and so must adjust independently. Signal range gains will occur in 1 decade steps when auto ranging and 1 or ½ decade steps (depending on MODE) when manual ranging.

When auto ranging in CONT PULSE mode, the arrival rate of pulses must be above 1 Hz. In P-P CONT mode, the arrival rate of peaks must be above 50 Hz.

AUTO gain ranging is not allowed in SNGL measurement modes. When exiting a SNGL measurement MODE, AUTO will turn back on if it was on when the SNGL measurement mode was entered. (See MODE, Section 2.3 12)

2.3.7 STO REF, Store Reference Value

STO REF causes the last measurement D to be stored as D_{ref} for subsequent use in relative measurement calculations. When units are relative, REL, the displayed value is the ratio $D/D_{ref.}$ When units are logarithmic relative, dB, the displayed value is the function $10 \log (D/D_{ref})$. D_{ref} is always a power reading stored in the units of Watts.

Press STO REF to cause a new D_{ref} to overwrite the existing D_{ref} value and show this new D_{ref} in the message display area. D_{ref} will be displayed until overridden by an ESC, λ, RANGE or MENU keypress. STO REF can be pressed at any time.

NOTE

When not using remote interface operation and when displaying relative dB or REL measurements, the message display area will show the STO REF value used in the calculation.

2.3.8 ATTN, Attenuator

The ATTN key toggles the responsivity value, R_λ, between the value for the detector alone and the value for the detector-with-attenuator. When ATTN is on, the ATTN annunciator is lit and the responsivity of the detector-with-attenuator is used. When ATTN is off, the annunciator is off and the detector-alone responsivity is used. If the detector does not have an attenuator, or if USR CAL is on (Section 2.4.5) the ATTN key has no effect.

2.3.9 λ, Wavelength

A detector calibration module contains responsivity data for its assigned detector at discrete wavelengths. By telling the meter which wavelength is being measured, the correct responsivity value is used in calculating the measured power or energy. When a wavelength falls between two calibration points, linear interpolation is used to approximate the true responsivity value.

Press the λ key to display the measurement wavelength in the message display area. Press ENTER to light the EDIT annunciator and cause the last digit of the wavelength to blink. Press ▼, ▲ to adjust the blinking digit up or down and ◀, ▶ to change which digit blinks. Press the ENTER a second time to accept the new wavelength and exit the wavelength edit/display mode. Press λ or ESC to exit without changing the wavelength.

2.3.10 RANGE, Signal Range

RANGE key allows the user to view the amplifier signal range. Signal ranges step in 1 or ½ decade gain increments (MODE dependent) as the RANGE is changed in order to utilize maximum resolution from the meter's analog-to-digital converters. The available signal ranges are detector and mode dependent.

Press RANGE to display the signal range number in the message display area. If AUTO is on, then the signal range number will change if the detector signal varies more than a decade in magnitude. Signal range changes can occur without an effect on the displayed measurement value. Press RANGE a second time to exit the signal range display mode.

Press the ▼, ▲ arrow keys to increase or decrease the signal range. If AUTO is on, pressing the ▼, ▲ arrow keys will disable AUTO and cause the signal range to change. Manual ranging is useful when working with external analog recording equipments.

NOTE

Pressing the ▼, ▲ arrow keys will disable AUTO ranging and change the signal range even when the signal range is not being displayed via the RANGE key.

2.3.11 R/S, Run-Stop

The R/S run-stop key provides front panel control over data acquisition. When in SNGL measurement mode, each R/S key press causes one reading to be taken. In CONT measurement mode, each R/S key press toggles continuous data acquisition on and off.

The activity annunciator (Figure 2b) flashes to indicate that readings are being taken. A steady glow indicates that the meter is armed and waiting for a pulse or P-P waveform to arrive. The indicator is off when data acquisition has been stopped.

2.3.12 MODE, Measurement Mode

The Model 1835-C provides a number of measurement modes for acquiring data. At power on, the meter checks the detector's calibration module to determine which measurement modes the detector supports. Table 3 describes the measurement modes available for each family of detector.

Table 3. Newport Detector Families and Available Measurement Modes

	Low-Power	High-Power	Energy
DC CONT	**X**	**X**	
DC SNGL	x	x	
INTG	x	x	
P-P CONT	x		
P-P SNGL	x		
CONT PULSE			**X**
SNGL PULSE			x

X marks the default mode for the detector family

Press the MODE key repeatedly until the desired mode is indicated in the mode annunciator area of the display, see Table 4. When selecting a new mode, the display units will change to appropriate default units if they are not compatible with the new measurement mode, Section 2.3.13.

Table 4. Model 1835-C Measurement Modes

Mode	Description
DC CONT	Measurement occurs at a programmable sample rate, Section 2.4.6.
DC SNGL	A measurement is taken every time the meter receives a trigger up to a 1000Hz. rate. (AUTO is disabled in SNGL mode.)
INTG	Measurements occur at 500Hz and are trapezoidally integrated to get an energy result. An R/S key press or external trigger sets the display to 0.0000 and sampling starts. A second R/S keypress or external trigger terminates integration.
P-P CONT	Acquisition is driven by the arrival of high-low peak pairs. A measurement is processed for every high-low peak pair up to a frequency of 1000 Hz. Above 1000 Hz, pair captures experience a minimum 1 ms separation.
P-P SNGL	A trigger[1] arms the meter to capture the next high-low peak pair. Triggers can occur at a rate of up to 1000 Hz. (AUTO is disabled in SNGL mode.)
CONT PULSE	The meter captures every energy pulse up to a frequency of 1000 Hz. Above 1000 Hz, pulse acquisitions experience a minimum 1 ms separation.
SNGL PULSE	A trigger[1] arms the meter to capture the next energy pulse. Triggers can occur at a rate of up to 1000 Hz. (AUTO is disabled in SNGL mode.)

[1] "Trigger" refers to a command to start or stop signal acquisition. Trigger sources are the R/S key, the external trigger input and remote interface commands.

2.3.13 UNITS, Display Units

Measurements can be displayed in various units. The set of units available at any given time is determined by the detector type and the measurement mode. Press the UNITS key repeatedly to cycle the display units through the set of available units. Table 5 describes the sets of available units for each detector family as a function of the measurement mode.

Table 5. Valid Display Units Available to Detector Families by MODE.

FAMILY	MODE	V	A	W	W/cm^2	J	J/cm^2	Erg	Erg/cm^2	dBm	dB	REL
Low-Power	DC CONT		x	**X**	x					x	x	x
Low-Power	DC SNGL		x	**X**	x					x	x	x
Low-Power	INTG					**X**	x	x	x			
Low-Power	P-P CONT		x	**X**	x					x	x	x
Low-Power	P-P SNGL		x	**X**	x					x	x	x
High-Power	DC CONT	x		X	x					x	x	x
High-Power	DC SNGL	x		X	x					x	x	x
High-Power	INTG					**X**	x	x	x			
Energy	CONT PULSE	x				**X**	x	x	x			x
Energy	SNGL PULSE	x				**X**	x	x	x			x

X denotes the default units for the detector family in the given measurement mode.

Some display units are abbreviated. Table 6 lists displayed units versus actual measurement units. Display units are limited to four characters in order to provide for display engineering prefixes such as: p, n, µ, m and k. (pico, nano, micro, milli and kilo respectively).

Table 6. Displayed Unit Abbreviations Versus Actual Measurement Units.

Actual Units	V	A	W	J	Erg	W/cm^2	J/cm^2	Erg/cm^2	dBm	dB	REL
Displayed Units	V	A	W	J	ERG	W/cm	J/cm	E/cm	dBm	dB	E±dd

2.3.14 STATS, Moving Statistics

The STATS key causes a list of statistical results from the stats buffer to be displayed in the message display area. The stats buffer is a moving data window containing the most recent measurements to a depth 1 ″ N ″ 100. The default value is N = 10. Display occurs without disrupting data acquisition or storage and results are continuously updated.

Press the STATS key to enter the stats display list. The first statistic displayed will be the stats buffer depth N. Press the ▲, ▼ adjust keys to move through the list. The following statistics are available: N, MAX, MIN, MAX-MIN, MEAN and STD DEV.

When the STATS buffer depth, N, is displayed, it can be adjusted by pressing ENTER and using the ▲, ▼ keys to set a new value for N. Press the ENTER key to adopt the new value for N and escape the edit mode. The STATS buffer is cleared whenever a new stats buffer depth N, or MODE or UNITS is established. Press the STATS key a second time to exit the stats display mode.

2.3.15 EXT, External Trigger

EXT enables and disables the triggering of data acquisition through the rear panel trigger input BNC connector. The meter can be configured to be triggered by either a rising or falling edge TTL signal. See Section 2.4.8.

Press EXT to light the EXT annunciator and enable the external trigger input. The Model 1835-C will still respond to triggers from the R/S key even when the EXT trigger is enabled. Press the EXT key a second time to turn off the annunciator and disable the external trigger input.

2.3.16 MENU

The MENU key provides access to advanced features and parameters. Press the MENU key to stop all data acquisition, light the MENU annunciator, and display the first item of the top level menu list. Press the MENU key a second time to immediately exit the menu. Menu structure and functions are presented in Section 2.4.

The menu consists of a series of lists and parameter values. Most parameter values can be edited to configure the meter. Lists are moved through via the ▼, ▲ keys. To move to a lower level list, press the ENTER key. To escape a lower level list, press the ESC key.

In the menu, all key functions are ignored except for the MENU, ENTER, ESC and the ▼, ▲ keys. Each key will act without having to initially press SHIFT. Pressing SHIFT will toggle the SHIFT annunciator, but it will not effect anything else when in MENU mode.

To edit a displayed parameter press ENTER. This enables the edit mode and causes the parameter (or a digit) to blink. Press the ▼, ▲ keys to adjust the parameter through its allowed list or to count the blinking digit up and down. When adjusting a numerical value, the ◀, ▶ keys can be used to change which decimal digit blinks. Press ENTER to adopt the new value and escape the editing mode. Press ESC to leave the editing mode without adopting the new value.

2.3.17 ENTER

ENTER allows one to move lower into the menu when in menu mode, to enter editing mode when an editable parameter is being displayed and to adopt a new parameter value after it has been edited. Editable parameters can be found both in and out of the menu mode. If ENTER is pressed when a non-editable parameter is being displayed, the key press is ignored.

2.3.18 ESC, Escape

ESC allows one to escape to the next higher level when in menu mode and to escape editing mode when editing a parameter value without adopting any changes to the parameter. At the top level of the menu, the ESC key causes one to escape menu mode. The ESC key also allows one to escape various other display modes such as STATS or wavelength display or amplifier signal gain range display modes. When there is nothing to escape from, the ESC key is ignored.

2.3.19 ▼, ▲, ◀, ▶ Adjust

The ▼, ▲, ◀, ▶ keys allow one to adjust various parameter states and values. In normal operation, the ▼, ▲ keys turn AUTO off and adjust the amplifier signal gain. In any other mode, the ▼, ▲ keys cause one to move

through a list or to adjust a blinking digit. The ◀,▶ keys zoom the bargraph (◀ in,▶ out) and in edit mode, select which digit of a numerical value will blink.

2.4 Menu Level Functions

Menu functions provide control over parameter values and methods of making measurements, The menu consists of a number of lists and parameter values. Table 7 presents a quick summary of the hierarchy of the menu functions and parameters.

2.4.1 Menu Access and Movement

To access the menu press MENU. The MENU annunciator will light and data acquisition will stop.

Menu labels and parameter values are displayed in the message display area. The first, second and third leftmost decimal points within this area indicate a current position at the top, second, third or fourth level of the menu hierarchy, Figure 4. Table 7 presents the menu functions and their hierarchy.

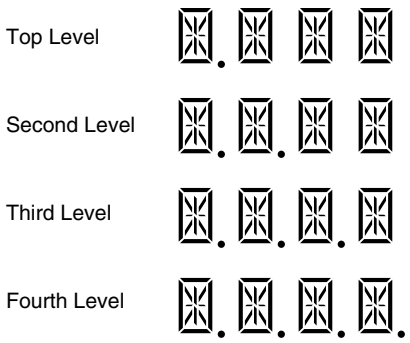


Figure 4. Decimal Point Indication of Menu Hierarchy Position

In the menu, valid keys are limited to those needed to perform operations to move through the menu or edit a parameter value. In the menu, it is not necessary to hit the SHIFT key to invoke the action of the menu keys: MENU, ENTER, ESC or .▼,▲,◀,▶ . The SHIFT key will toggle the SHIFT annunciator, but with no effect on subsequent pressings of other keys. Once in the menu, the rules for moving through the menu are as follows:

i. Press ENTER to move to the next level down or to enter the edit mode if a editable parameter is being displayed and to accept a parameter value in its currently displayed state and exit edit mode.

ii. Press ESC to move to the next level up or to escape the menu when at the top level or to exit edit mode without changing the parameter value being edited.

iii. Press MENU to immediately escape the menu regardless of current level within the menu.

iv. Use the ▼,▲ keys to move up or down through a menu list on a given level. Also use these keys to adjust a parameter or decimal value when in edit mode.

v. Use the ◀,▶ keys to select the digit being adjusted when in edit mode.

Table 7. Menu Level Key Functions and Parameters

Top Level		Second Level		Third Level
DATA STORE	<- ->	DATA STORE OFF	<- ->	DATA STORE ***ON, OFF***
		CLR DATA BUFFER (or DATA BUFFER CLR)		
		SLIDE BUFFER	<- ->	***SLIDE, FIX*** BUFFER
		D_BUF SIZE dddd	<- ->	D_BUF_SIZE ***dddd***
		VIEW DATA	<- ->	***dddd*** OF dddd
SAVE CONFIG	<- ->	SAVE TO ***d***		
RECALL CONFIG	<- ->	RCL ***DEFAULT, d***		
AUTO CAL				
DET SWITCH POS	<- ->	SWITCH POS ***S, I, L***		
USER CALIB	<- ->	USR CAL OFF	<- ->	USR CAL ***ON, OFF***
		USR RESP	<- ->	***d.dddE±d*** A/W†
		PRESENT RESP	<- ->	d.dddE±d A/W †
DC SAMPLING	<- ->	SAMPLE PREC	<- ->	PREC= ***20000, 4096*** CNT
		SAMPLE FREQ	<- ->	FREQ = ***ddd.ddd*** HZ
TRIGGER OUT	<- ->	TRIG ON CMPLT	<- ->	TRIG ***ON CMPLT***, TRIG ***AT FREQ*** , TRIG ***ON LEVEL***, TRIG ***ON INTG***, TRIG ***OUT OFF***
		TRIG POLARITY	<- ->	TRIG ACTIVE ***LO, HI***
		TRIGGER FREQ	<- ->	FREQ= ***dddd.ddd*** HZ
		TRIGGER LEVEL	<- ->	LVL= ***±d.ddd E±dd*** W
		TRIGGER INTG	<- ->	INTG= ***±d.ddd E±dd*** J
EXT TRIGGER IN	<- ->	***FALLING , RISING*** EDGE		
BAR GRAPH ON	<- ->	BAR GRAPH ***ON, OFF***		
TONE OFF	<- ->	TONE ***ON, OFF***		
REMOTE SETUP	<- ->	GPIB ADDR dd	<- ->	GPIB ADDR ***dd***
		BAUD RATE 9600	<- ->	BAUD RATE ***1200, 2400, 4800, 9600, 19.2K***
		RS-232 ECHO OFF	<- ->	RS-232 ECHO ***ON, OFF***
GENERAL INFO	<- ->	MODEL 1835-C		
		SW VERSION d.d		
		DETECTOR INFO	<- ->	MODEL xxxxxx
				DET SN ddddd
				ATTN SN ddddd
				CAL ddMONyyyy

† *Units may be in A/W, V/W or V/J.*

Items in ***bold italics*** type are editable states or decimal values. Decimals are denoted by ***d.*** Move vertically via the ▲,▼ keys. Move horizontally via ENTER and ESC.

2.4.2 Data Store

The Model 1835-C allows a user to save up to 2500 measurements in an internal buffer for subsequent viewing or transmission over a computer interface. Data is maintained on power down, but lost when a new configuration is loaded, Section 2.4.3, or when the buffer is cleared via the CLR DATA BUFFER command or when data with new units is being stored.

The data store buffer operates in two ways: SLIDE or FIX. In SLIDE configuration, the buffer slides along storing the most recent measurements up to the size of the buffer. Beyond this, as data enters the buffer, the oldest data is pushed out and lost. In FIX configuration, data storing continues until the data buffer is full. After this, data acquisition stops and no additional data can be stored without first clearing the buffer via the CLR DATA BUFFER command. DATA BUFFER CLR is displayed when the buffer is empty.

The size of the buffer is set by the D_BUF_SIZE ***dddd*** menu function. Edit the value ***dddd*** to establish the number of data points that the buffer will hold before dropping old data or stopping data storage.

Data storing is enabled by the user via the DATA STORE menu function. Edit the ***ON, OFF*** condition to enable or disable data storing and the associated STORE annunciator.

When in CONT mode, data acquisition and storage is resumed immediately upon exiting the menu if acquisition was active as the menu was entered. When acquisition was not active when the menu was entered, or when in SNGL or INTG mode, data acquisition and storage requires an initiating R/S key press, external trigger or a remote RUN command after exiting the menu.

Buffer data can be viewed via the VIEW DATA menu command. Data are displayed in the measurement area while the message area displays the position within the buffer: ***dddd*** of dddd. Use the ▲, ▼ keys to move through the buffer data. The value ***dddd*** = 0001 is the first, i.e. the oldest datum.

NOTE

When DATA STORE is off, CONT acquisition mode behavior defaults to the condition where data acquisition is begun without the requirement of a starting trigger. SNGL acquisition modes always require a trigger for each acquisition.

Table 8. Data Store Operations

Menu Operation	Keypad Commands	Associated Remote Commands
DATA STORE **ON, OFF**	Edit ***ON, OFF*** status.	DSE, DSE?
DATA BUFFER CLR or CLR DATA BUFFER	If CLR DATA BUFFER, press ENTER to clear buffer.	DSCLR
SLIDE, FIX BUFFER	Edit ***SLIDE, FIX*** BUFFER	DSBUF DSBUF?
D_BUF_SIZE dddd	Edit D_BUF_SIZE ***dddd***	DSSZ, DSSZ?
VIEW DATA	Press ENTER and use ▲, ▼ keys.	DS?, DSCNT?, DSUNITS?

2.4.3 Meter Configuration

The Model 1835-C provides a method to save the configuration of the meter and to recall that configuration for later use even if the meter has been turned off. This is accomplished through configuration buffers maintained in non-volatile memory. Configuration buffers are numbered 0 to 9 with buffer 0 being a DEFAULT buffer which can only be recalled but not saved to. The reset state of all the buffers except the default buffer is empty. Empty buffers cannot be recalled.

A recalled configuration becomes the current configuration of the meter. Any changes to the current configuration must be saved via SAVE CONFIG or they will be lost when a new configuration is recalled.

The meter will not recall a configuration that is not compatible with the detector calibration module currently plugged into the meter. Configurations using the same model of detector are compatible while configurations using different models of detectors are incompatible.

The default configuration of the meter depends upon the detector family. The list of configuration parameters stored in a configuration buffer as well as their default values versus detector family are listed in Table 9 below:

Table 9. Configuration Parameters and Default Conditions

Parameter	Detector Family	Default Condition
MODE	Low-Power, High-Power Energy	DC CONT CONT PULSE
UNITS	Low-Power, High-Power Energy	W J
λ, Lambda		Lowest available
PRESENT RESP		PRESENT RESP
USR CAL		OFF
ATTN		OFF
FILTER		OFF
DC SAMPLE PREC	Low-Power, High-Power	20,000 CNT
DC SAMPLE FREQ		25 Hz
AUTO		ON
RANGE		0
ZERO		0.000
Zero Value		0
Reference Value		0.001
STATS Buffer Size		10
DET SWITCH POS	Energy	I, (Intermediate)
DATA STORE		OFF
DATA STORE BUFFER		SLIDE
D_BUF_SIZE		100

Parameter	Detector Family	Default Condition
Data Store Units		Same as UNITS
EXT		OFF
EXT TRIG IN		FALLING
TRIGGER OUT		TRIG ON CMPLT
TRIG OUT POL		TRIG ACTIVE LO
TRIG OUT FREQ		FREQ = 30 Hz
TRIG LEVEL	Low-Power, High-Power, Energy	LVL = 0.001 W LVL = 0.001 J
TRIG INTG LVL	Low-Power, High-Power	INTG = 0.001 J
BAR GRAPH		ON
TONE		OFF
GPIB ADDR		05
BAUD RATE		9600
RS-232 ECHO		OFF

These parameters adopt the following default values at power up and are not affected by recalling a configuration or by setting the configuration to default.

Local Lockout	OFF
Display Brightness	NORMAL

Table 10. below lists the menu commands effecting the saving and recalling of meter configurations.

Table 10. Meter Configuration Operations

Menu Operation	Keypad Commands	Associated Remote Commands
SAVE CONFIG	Adjust SAVE TO ***d***, and ENTER	*SAV
RECALL CONFIG	Adjust RECALL ***d***, and ENTER	*RCL, *RST

2.4.4 AUTO CAL

The AUTO CAL command causes the 1835-C to perform A/D conversions of amplifier offset voltages (zero errors) arising from aging and temperature effects. These conversions are then used in subtracting the appropriate error voltage from each reading during normal operation. The 1835-C automatically performs this procedure every time it powers up (or is reset). To achieve stable reading at the specified accuracy, AUTO CAL should be executed after a minimum 60 minute warm-up period from power-up.

Executing AUTO CAL with High Power (Thermopile) detectors:

1. With the detector connected to the 1835-C, remove the detector from the radiation source and allow a minimum of 60 seconds for the detector surface temperature to stabilize.

2. Press ENTER when AUTO CAL is displayed. The display message area will display "ONE MOMENT", followed by a buzzer sound indicating that AUTO CAL is complete.

Executing AUTO CAL with Low Power (Photodiode) or Energy detectors:

Simply press ENTER when AUTO CAL is displayed. The display message area will display "ONE MOMENT", followed by a buzzer sound indicating that AUTO CAL is complete. Low Power and Energy detectors do no have to be connected to the 1835-C or removed from the radiation source to effectively execute AUTO CAL.

2.4.5 User Calibration

The Model 1835-C allows one to create a detector responsivity which overrides the responsivities obtained from the detector's calibration module. This allows one to account for the effects of additional optics and filters in the measurement path.

When USR CAL is on, the USR CAL annunciator is lit and the meter adopts the responsivity value displayed by the editable USR RESP value. Use the PRESENT RESP function to display the current calibration module responsivity.

The USR RESP units are the same as the PRESENT RESP units. Table 11 lists the possible user calibration operations.

Table 11. User Calibration Operations

Menu Operation	Keypad Commands	Associated Remote Commands
USR CALIB **ON, OFF**	Edit USR CALIB ***ON, OFF***	USRCAL, USRCAL?
USR RESP	Edit ***d.dddE±dd*** A/W*	USRRESP, USERRESP?
PRESENT RESP	ENTER to view d.dddE±dd A/W*	RESP?

*Units of A/W, V/W or V/J may be displayed. These units are not editable.

2.4.6 DC Sampling

The Model 1835-C incorporates two analog-to-digital, (A/D) converters, one with 20,000 count resolution and a second with 4096 count resolution. The user may select which A/D will be used during DC CONT and DC SNGL acquisition modes. All other modes use the 4096 count A/D. The 20,000 count A/D converter, can operate at sample rates up to 25 Hz. The 4,096 count A/D converter, can operate at sample rates up to 1000 Hz.

The SAMPLE PREC menu command, Table 12, selects which analog-to-digital converter is used. Sampling frequency can be adjusted within the limits imposed by the SAMPLE PREC state, see Table 13. When the SAMPLE PREC state changes, the sampling frequency defaults to 25 Hz if the existing SAMPLE FREQ is incompatible with the new SAMPLE PREC state.

Table 12. SAMPLE PREC States and Limits.

SAMPLE PREC	A/D Accuracy	Sample Frequency Range
20000 CNT	20,000 counts	0.001 Hz to 25.0 Hz
4096 CNT	4,096 counts	0.001 Hz to 1000.0 Hz

Table 13. DC SAMPLING Operations.

Menu Function	Keypad Commands	Associated Remote Commands
SAMPLE PREC	Edit PREC= ***20,000, 4096*** CNT	SPREC, SPREC?
SAMPLE FREQ	Edit FREQ= ***ddd.ddd*** HZ	SFREQ, SFREQ?

2.4.7 Trigger Output

The Model 1835-C's rear panel TTL trigger output allows it to coordinate activities among other instruments. The trigger output can operate in several ways: conversion complete, periodic output, comparator output and integrating comparator output. In addition, the polarity of the trigger output can be specified.

In TRIG ON CMPLT mode, a pulse is output after each reading has been acquired and completely processed. It indicates that the 1835-C is ready to take another reading. The width of this pulse is at least 8 µS.

In TRIG AT FREQ mode, a pulse is output at a user defined frequency or rate. Each pulse width is at least 8 µS and the programmable frequency range of the pulses is 0.001 Hz to 1000.0 Hz.

In TRIG ON LEVEL mode, each measurement is compared to a programmable trigger level. The units of the trigger level always equal Watts for power detectors or Joules for energy detectors. If a measurement is less than the specified value, then the trigger output is inactive. If the measurement exceeds the specified value then the trigger output becomes active. The TRIG ON LEVEL output is a shift in level rather than a pulse.

In TRIG ON INTG mode, continuous measurements from a power detector are integrated and compared against a programmable value. The units of the programmable value are Joules. If the calculated integral is less than the specified value, then the trigger output is active. If the calculated integral exceeds the specified value, then the integration stops and the trigger output becomes inactive. The TRIG ON INTG trigger is a shift in level rather than a pulse.

The polarity of the trigger output is programmable as active high or active low. If the polarity is active high then the output will idle low. If the polarity is active low then the line will idle high.

Table 14. TRIGGER OUT Operations.

Menu Function	Keypad Commands	Associated Remote Commands
TRIGGER OUT	Edit ***TRIG ON CMPLT*** ***TRIG AT FREQ*** ***TRIG ON LEVEL*** ***TRIG ON INTG*** ***TRIG OUT OFF***	TRIGOUT, TRIGOUT?
TRIG POLARITY	Edit ACTIVE ***HI, LO***	TRIGOUTPOL, TRIGOUTPOL?
TRIGGER FREQ	Edit FREQ= ***ddd.ddd*** Hz	TRIGOUTFREQ, TRIGOUTFREQ?
TRIGGER LEVEL	Edit LVL= ***d.dddE±dd*** W*	TRIGOUTLVL, TRIGOUTLVL?
TRIGGER INTG	Edit INTG= ***d.dddE±dd*** J	TRIGOUTINTG, TRIGOUTINTG?

*Displayed units may be W or J depending upon the detector in use.

2.4.8 Trigger Input

The Model 1835-C's rear panel TTL external trigger input can be enabled or disabled, Section 2.3.15, and have its edge polarity set. The edge polarity is accessed via the EXT TRIGGER IN menu function and can be set to rising or falling edge triggering.

The external trigger (and R/S key) acts like an acquisition trigger when in SNGL modes and acts like a toggled acquisition gate when in CONT modes. In Peak-to-Peak or Pulse acquisition modes the external trigger (and R/S key) act as single or continuous acquisition enabled rather than forcing an acquisition to occur at the moment the trigger (or keypress) occurs.

The external trigger pulse width must be ≥200 ns. In DC SNGL mode, the delay from the trigger input going active to the start of the A/D conversion is <80 µs. In SNGL PULSE and P-P SNGL modes, the delay from the trigger input going active to the meter becoming armed to capture the next PULSE or P-P pair is <70 µs.

Table 15. EXT TRIGGER IN Operations.

Menu Function	Keypad Commands	Associated Remote Commands
EXT TRIGGER IN	Edit ***RISING,*** ***FALLING*** EDGE	EXTEDGE, EXTEDGE?, EXT, EXT?

2.4.9 Bar Graph

A high resolution analog bar graph is provided for visual feedback when performing optical alignment tasks. This bar graph uses the message display area and moves from left to right with increasing display value, and reaches full scale when the digital display reaches full scale.

The ◀ , ▶ keys can be used to zoom the bargraph in and out. Press the ◀ to zoom the bargraph into a 10x magnification which auto-centers with each subsequent ◀ press. Press ▶ to zoom out to normal 1x magnification.

Table 16. BARGRAPH Operations.

Menu Function	Keypad Commands	Associated Remote Commands
BAR GRAPH	Edit BARGRAPH ***ON, OFF***	BARGRAPH, BARGRAPH?

2.4.10 Tone

The 1835-C has a speaker that can emit a short tone or tick to indicate when a peak or pulse is detected in P-P or PULSE measurement modes. The audible output is enabled or disabled via the TONE menu function. TONE is not available in INTG measurement mode.

Table 17. TONE Operations.

Menu Function	Keypad Commands	Associated Remote Commands
TONE	Edit TONE ***ON, OFF***	TONE, TONE?

2.4.11 Detector Switch Position

Some Newport Energy detectors have a switch that sets an electronic decay time constant to optimize operation for various pulse repetition rates. As this adjustment effects the responsivity of the detector, the Model 1835-C must be informed of the detector's switch setting. The available detector switch settings are: SHORT, INTERMEDIATE and LONG. The 1835-C accounts for the switch setting through the DET SWITCH POS function.

Table 18. DET SWITCH POS Operations.

Menu Function	Keypad Commands	Associated Remote Commands
DET SWITCH POS	Edit SWITCH POS ***S, I, L***	DETSW DETSW?

2.4.12 Remote Setup

The Model 1835-C provides both RS-232 and IEEE-488 computer interfaces as standard features. Each interface requires that certain parameters be set. Remote interface setup and commands are discussed in Section 2.5 Computer Interfacing.

Table 19. REMOTE SETUP Operations.

Menu Function	Keypad Commands	Associated Remote Commands
GPIB ADDR dd	Edit GPIB ADDR ***dd***	None
BAUD RATE dddd	Edit BAUD RATE ***1200, 2400, 4800, 9600, 19.2K***	None
RS-232 ECHO ON, OFF	Edit RS-232 ECHO ***ON, OFF***	ECHO, ECHO?

2.4.13 General Information Functions

General information about the Model 1835-C and any attached detector can be found using the GENERAL INFO menu functions. These functions display the Model 1835-C software version, the detector's model number, serial number, associated attenuator serial number and calibration date.

Table 20. GENERAL INFO Operations.

Menu Function	Keypad Commands	Associated Remote Commands
SW VERSION d.d	For viewing only.	*IDN?
MODEL cccccccc	For viewing only.	DETMODEL?
DET SN ddddd	For viewing only.	DETSN?
ATTN SN ddddd	For viewing only.	ATTNSN?
CAL ddMonyyyy	For viewing only.	CALDATE?

2.5 Connecting AC Power

The Model 1835-C can be configured to operate with line voltages over the following ranges: 90-264 VAC, 50-60 Hz. Before turning the meter on, configure it to local voltage using the following procedure:

i. Configure the Model 1835-C's power supply voltage selection switches to match the nominal local voltage. See Figure 5 and Table 21.

ii. Plug an AC line power cord to the rear of the Model 1835-C and then connect the cord with AC power.

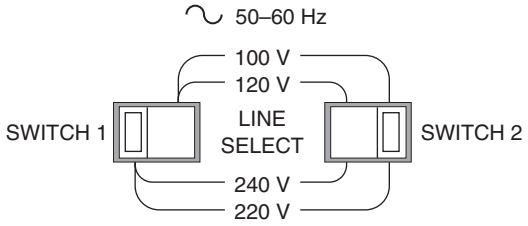


Figure 5. Rear Panel Power Supply Voltage Switches in Positions with Switch 1 set to Left and Switch 2 set to Right

Table 21. Power Supply Voltage Switch Positions.

Switch 1 Position	Switch 2 Position	Nominal Local Voltage
Right	Right	100 VAC
Right	Left	120 VAC
Left	Right	220 VAC
Left	Left	240 VAC

WARNING

This product is equipped with a 3 wire grounding type plug. Any interruption of the grounding connection can create an electric shock hazard. If you are unable to insert the plug into your wall plug receptacle, contact your electrician to perform the necessary alterations to assure that the green (green-yellow) wire is attached to earth ground.

2.6 Detector Connection and Setup

Connect the detector to its calibration module as shown, Figure 6. The detector's model and serial numbers should match the model and serial numbers found on the calibration module. Insert the calibration module into the front panel input port of the Model 1835-C. An alignment pin forces the proper orientation of the calibration module.

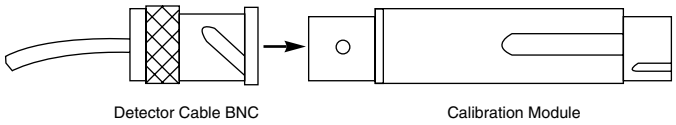


Figure 6. Connecting a Detector with its Calibration Module

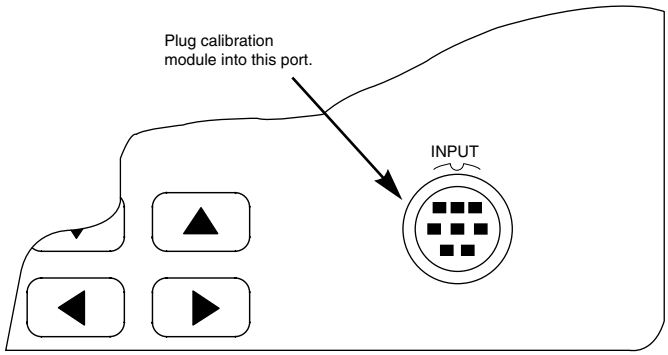


Figure 7. Model 1835-C Detector Calibration Module Input Port

NOTE

If the detector being connected is a battery powered Newport Energy Detector then be sure to configure the DET SWITCH POS menu function to match the position of the switch on the detector, see Section 2.4.11. The 1835-C defaults to the intermediate switch position, I.

2.7 Power Up

Turn on the Model 1835-C by depressing the front panel key until it clicks in and remains in its depressed position. The Model 1835-C will perform a power up self test, Section 6.2 and then configure itself to its last operating state. If the last operating state is not compatible with the current detector, the 1835-C adopts the default configuration appropriate to this new detector. If the meter does not pass its self test or fails to respond to front panel key commands, refer to Section 6, Maintenance and Troubleshooting.

2.8 Performing Basic Measurements

Basic measurement techniques for using the Model 1835-C are covered in the following sections. Refer to Table 2, Table 3 and Table 7 (pages 5, 9, and 13 respectively) for a review of the Model 1835-C's functions and capabilities. The following instructions assume familiarity with the meters functions. They also include steps to incorporate background correction and assume that the experimental setup underfills and does not saturate or damage the detector.

2.8.1 Making DC Power Measurements

The following process describes the procedure for making basic optical power measurements while properly removing the influence of ambient light and other drift effects.

i. Plug in a Newport Low-Power or High-Power detector via its associated calibration module and then turn the meter on. Set MODE to DC CONT, set AUTO on and set the measurement wavelength to the desired value.

ii. When using a Newport High-Power (thermopile) detector, execute AUTO CAL per Section 2.4.4.

iii. Cover or otherwise block the source that you will be measuring and then turn ZERO on.

iv. Uncover the source so that it illuminates the detector and note the display value. This reading is the optical power observed by the detector due to the source.

The process as detailed assumes that the ambient signal is not changing between when you zero the display and when you make your measurement. Remember, if you can see your detector as you move around, then your detector can see you as a changing ambient DC signal!

2.8.2 Making Peak-to-Peak Power Measurements

The following process describes the procedure for making basic optical peak-to-peak power measurements.

i. Plug in a Newport Low-Power detector via its associated calibration module and then turn the meter on. Set MODE to P-P CONT, set AUTO on and set the measurement wavelength to the desired value.

ii. Illuminate the detector and note the display value. This reading is the peak-to-peak optical power observed by the detector.

2.8.3 Making Pulse Energy Measurements

The following process describes the procedure for making basic optical pulse energy measurements.

i. Plug in a Newport Energy detector via its associated calibration module and then turn the meter on. Set MODE to CONT PULSE, set AUTO on and also set the measurement wavelength to the desired value.

ii. Illuminate the detector and note the display value as the meter measures each laser pulse. These readings represent the energies of the incident laser pulses. The meter will display the last pulse energy measured until a new pulse arrives.

2.8.4 Making a Signal Integration Measurement

The following process describes the procedure for making a basic signal integration measurement while properly removing influence of ambient light and other drift effects. The Model 1835-C begins and ends integration via the arrival of a trigger signal such as is received from the R/S key.

i. Plug in a Newport Low-Power or High-Power detector via its associated calibration module and then turn the meter on. Set MODE to DC CONT, set AUTO on and also set the measurement wavelength to the desired value.

ii. When using a Newport High-Power (thermopile) detector, execute AUTO CAL per Section 2.4.4.

iii. Cover or otherwise block the source that you will be measuring, turn ZERO on and then set the MODE to INTG. As you enter the INTG mode, the meter will begin to acquire and integrate data. The display value may reflect the integration of noise due to ambient temperature fluctuations (thermopile) or light fluctuations (photodiode).

iv. Uncover or trigger the source. The display value should now reflect detector signal integration process by continuously increasing.

v. Press the R/S key to stop the integration and freeze the display value at the final integration value.

NOTE

The process as described above assumes that ambient signals are not changing between when you zero the display and when you make your measurement.

2.8.5 Measuring a Laser Pulse Energy with a Thermopile Detector

This application makes use of the Model 1835-C's INTG mode. When an optical pulse with energy $E(\lambda)$, is incident on a thermopile, a voltage signal arises as the heat pulse flows out to the cooling fins. The integrated signal resulting from this heat pulse is a measure of the optical pulse energy, Figure 8.

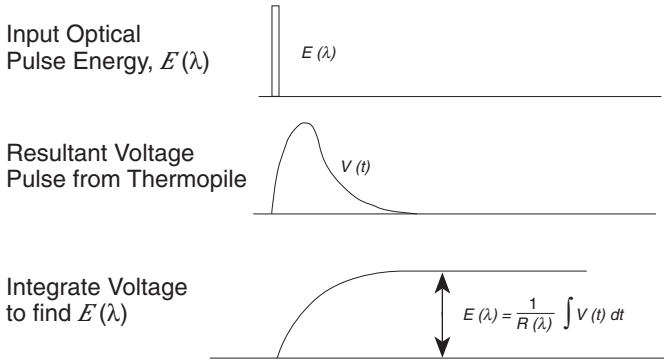


Figure 8. Measuring Laser Pulse Energy via a Thermopile in INTG Mode

A recommended procedure is:

i. Plug in a Newport High-Power detector via its associated calibration module and then turn the meter on. Set MODE to DC CONT, set AUTO on, set the measurement wavelength to the desired value and then execute AUTO CAL per Section 2.4.4. Now set ZERO on and then MODE to INTG.

ii. Press the R/S key to begin the integration. Before the optical pulse arrives, the display may reflect the integral of detector noise due to ambient temperature fluctuations.

iii. Trigger the laser pulse and watch the display increase at a much faster rate due to the detector signal from the heat flow.

iv. When the display increase begins to slow down and again reflect integration of the detectors noise component, press the R/S key a second time to stop the integration. The final display value represents the pulse energy.

NOTE

If the integrated result of the pulse signal is much larger than the integral of the detector's noise component, the display will show a steady reading after the pulse. If the integrated result of the pulse is not much larger, then error in the measurement will arise due to the uncertainty generated by integration of the noise component terms.

NOTE

The time constant of a thermopile detector determines the amount of time that one should expect to wait when making an integrated energy measurement of an optical pulse. Typically, an accurate value will be arrived at 5 time constants after the arrival of the optical pulse. Newport High-Power detector time constants are listed in the Newport Catalog and in each detector's manual.

2.8.6 Using the Model 1835-C as an Exposure Controller

This application uses the INTG measurement mode along with triggering features to configure the Model 1835-C as an exposure meter-controller. Use the following setup and procedure:

i. Connect a BNC cable between the Model 1835-C's trigger input and trigger output BNC connectors. Using a T-connector, connect the trigger output BNC to your shutter's external control BNC.

ii. Configure the trigger output to TRIG AT INTG and set the energy level at which you wish the exposure to stop, see Section 2.4.7. Adjust the polarity of the trigger output to open the shutter when the trigger output is active.

iii. Set the meter to INTG mode with AUTO on and then press the R/S key to begin the integration and open the exposure controlling shutter.

iv. The display value will increase until the INTG trigger output threshold is crossed. At the threshold, integration will stop and the trigger output will close the shutter. The display now shows the final integration value from the exposure.

NOTE

One can also configure the Model 1835-C as an exposure timer-controller by configuring the trigger output as TRIG AT FREQ and setting the trigger frequency appropriately.

Section 3
Principles of Operation

3.1 Introduction

The Model 1835-C's electronics adapt to a number of signal measurement tasks: DC current or voltage, AC peak-to-peak current or pulse voltage, or integrated DC current or voltage signals. This versatility is required to handle the various signals that Newport's **Low-Power**, **High-Power** and **Energy** detector families generate. These detector families are based on semiconductor, thermopile and pyroelectric detectors respectively.

Detector data is introduced to the Model 1835-C by way of a calibration module specific to the detector in use. At power up (and RESET), the 1835-C uploads information about the detector from the calibration module which describes the set of operating states available to the detector. A user then selects among the available operating states when using the meter. Front panel control and the operating states of the Model 1835-C are discussed in Sections 2.3 and 2.4.

3.2 Analog Signal Flow

Detector signals can follow many different paths through the Model 1835-C input amplifier chain. A block diagram of analog signal flow is shown in Figure 9. The actual flow path depends upon the detector type and the mode of measurement.

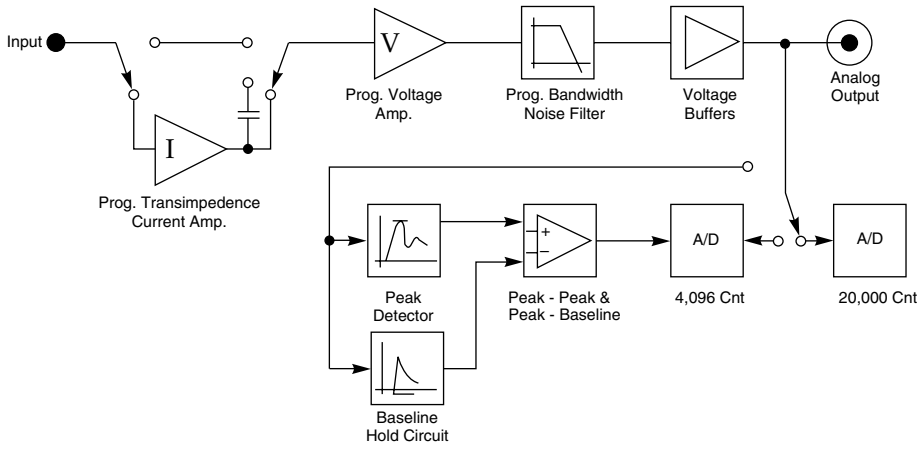


Figure 9. Model 1835-C Analog Signal Flow Diagram

The analog signal flow path is primarily determined by the responsivity units of the detector. The numerator of these units indicates how the meter must be configured in order to obtain a calibrated optical measurement. Analog signal flow is independent of whether SNGL or CONT measurements are made. Responsivity units and signal flows for the various detector families is listed in Table 22.

Table 22. Analog Signal Flow Paths.

Detector Family	Resp. Units	Mode	Amplifier Path	Peak-Peak	A/D Converter
Low-Power	A / W	DC	I	No	20,000 or 4,096
Low-Power	A / W	P-P	I , AC coupled	Yes	4,096
Low-Power	A / W	INTG	I	No	4,096
High-Power	V / W	DC	V only	No	20,000 or 4,096
High-Power	V / W	INTG	V only	No	4,096
Energy	V / J	PULSE	V only	Yes	4,096

3.3 Digitized Signal Flow

Signals that are captured by one of the analog-to-digital converters are further processed as illustrated in the signal flow block diagram of Figure 10. Raw signals are acquired by the analog-to-digital converters and have the units of current or voltage depending upon how the input amplifier chain was configured. These digitized signals move through a number of process steps which may or may not alter the digitized value depending upon the operating state of the meter. Each of these possible processing steps is discussed in their order of occurrence.

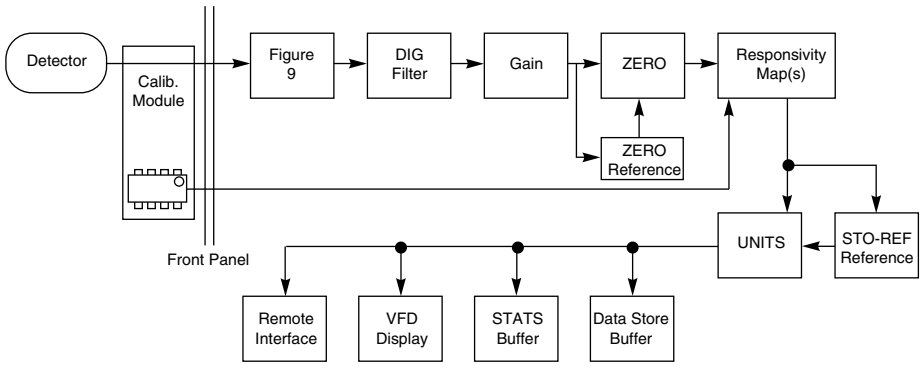


Figure 10. Model 1835-C Digitized Signal Flow Block Diagram

Digital Filter

If the digital filter annunciator DIG is on, Section 2.3.4, the filter output is the average of the most recent 10 digitized values. When less than 10 values are have been acquired since the last reset of the digital filter, the output is the average of all the values received. The digital filter is reset when the Model 1835-C is turned on, and whenever the UNITS or the range changes or when the MODE key is pressed.

NOTE

When using the digital filter in SNGL acquisition mode , each measurement is the average of the last 10 acquisitions independent of how old any of the measurements are.

Gain

Gain processing accounts for the signal gain of the input amplifiers. The output is the product of the digitized value and the amplifier gain.

Zero Offset

Zero offset is active whenever the ZERO annunciator is lit, Section 2.3.5. The zero offset output is equal to the input value less the zero reference value, $S\text{-}S_o$.

Responsivity Map(s)

This process scales the input value in accordance with current calibration wavelength and the responsivity map downloaded from the detector calibration module. The output of this process, i.e. the measurement value, is the digitized input value divided by the responsivity associated with the current calibration wavelength or the user defined calibration value. Different responsivities are used depending upon if the attenuator, ATTN, annunciator is lit, Section 2.3.8.

Units Correction

Units correction adjusts a measurement value to account for the display units selected. When the display units are equal to the detector signal units, i.e. equal to the numerator of the responsivity units, Table 22, the measurement value is not adjusted. Otherwise the digitized value is adjusted to account for detector responsivity and/or additional unit conversions such as Joules-to-Ergs or W-to-W/cm^2.

NOTE

Per area unit conversions such as W-to-W/cm^2 divide the measurement value by the active area of the detector. This calculation assumes that the entire active area of the detector is uniformly illuminated. Per area measurements where the entire detector active area is not uniformly lit are not accurate. The user must insure that these conditions are met before utilizing per area units.

Data Store Buffer

Units correction adjusts a measurement value to account for the display units selected. When the display units are equal to the detector signal units, i.e. equal to the numerator of the responsivity units, Table 22.

3.4 Typical Detector Signals

The flexibility of the Model 1835-C analog signal flow is required in order that it may properly measure the signals that various types of detectors make. Basic optical power or energy measurements are related to a measured detector signal, S, in the following way:

$$P \text{ or } E = \frac{S}{R_\lambda}$$

Where: R_λ = Detector responsivity at λ.

S = Detector signal

Semiconductor (Newport Low-Power) detectors, provide a current signal. The 1835-C is capable of 100 fA resolution in order to provide the highest sensitivity performance with these detectors.

Thermopile (Newport High-Power) detectors, provide a small voltage signal. The 1835-C is capable of 125 nV resolution in order to reach the sensitivity limits of thermopile detectors.

Pyroelectric (Newport Energy) detectors, deliver a peak voltage signal, $S = V_{pk}$. The 1835-C is capable of capturing 2 µsec rise time voltage spikes so that it may operated with the fastest of these detectors.

3.5 Thermopile Detector Signals

Thermopile detectors respond with a voltage signal that slowly to changes in incident optical power. The time constant of most thermopile detectors is on the order of 1 to 10 seconds.

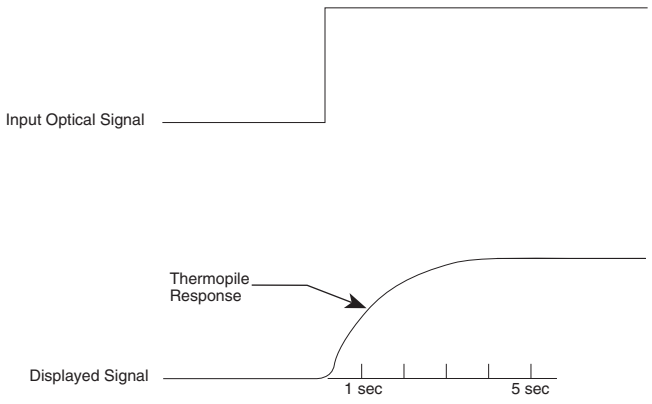


Figure 11. Thermopile Signals exhibit 1 to 10 second time constants.

3.6 Pulse Energy Detector Signals

A Newport Energy detector will respond to a single radiant energy pulse with a voltage pulse at its BNC output. This pulse exhibits a sharp voltage rise to a peak followed by a slower voltage decay which "undershoots" zero volts before settling back to zero volts. When a detector is operated within its proper limits, the voltage difference from immediately before the sharp rise to the peak is linearly proportional to the radiant energy.

If a second pulse arrives before the "undershoot" rises back to zero volts, the voltage rise from this pulse will start from an initial negative value. At sufficient energy pulse repetition rates, a negative "baseline" voltage will develop from which the voltage rise must now be measured to achieve accurate energy readings. The 1835-C contains baseline capture circuitry which maintain its accuracy specifications over rep-rates ranging from single pulse to 2 kHz.

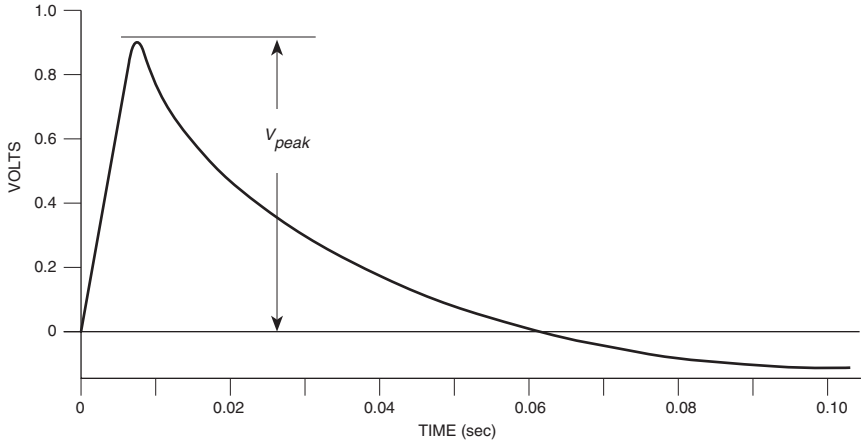


Figure 12. Typical Newport Energy Detector Signal Waveform — An energy detector signal sharply rises to a peak value and then decays going somewhat negative before finally returning to zero. The energy in the radiant pulse is proportional to the height of the peak measured from immediately before the sharp rise.

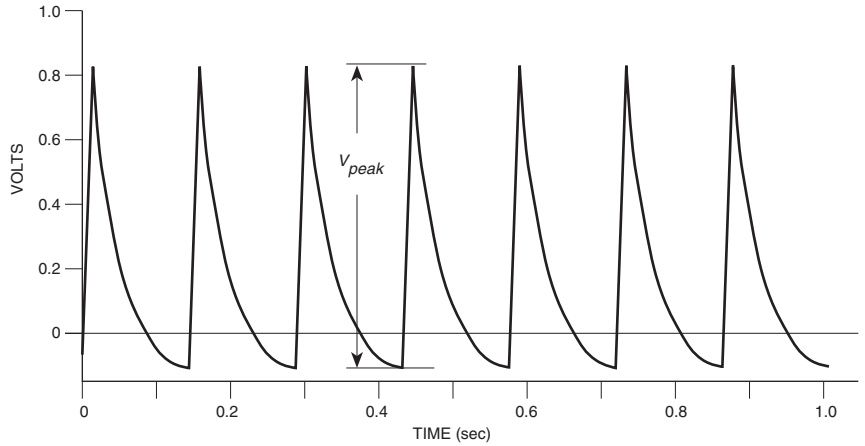


Figure 13. Negative Baseline Voltage Due to a Pulse Train — If a laser pulse arrives before the previous Energy detector signal has fully decayed, the detector signal rises from the present decay point of the previous signal.

3.7 Peak-to-Peak (Photodiode) Detector Signals

The Model 1835-C allows one to make peak-to-peak measurements of time varying signals from semiconductor photodiode detectors. Since optical power is a zero bounded positive quantity, signals from a detector observing such modulated light will similarly be zero bounded positive signals. To make a peak-to-peak measurement, the Model 1835-C must be able to capture both the maximum and minimum values of a detector signal. This is accomplished by AC coupling the incoming detector signal so that the original minimum value shows up as a negative peak.

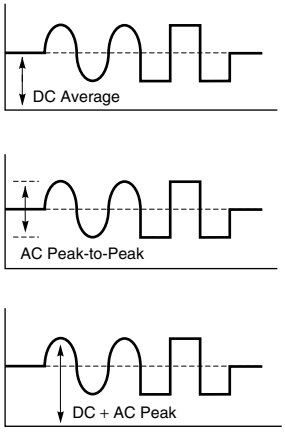


Figure 14. Time Varying Signal Measurements — Many different measurements can be made on different portions of a time varying signal. The most common are: DC power, peak power, and peak-to-peak power.

The Model 1835-C can only measure periodic AC peak-to-peak signals within the frequency range: 50 – 7,000 Hz. Above 7,000 Hz, bandwidth limitations significantly effect the accuracy of the peak-to-peak measurement. Below 50 Hz, the AC coupling attenuates signals and measurement accuracy. However, low frequency measurements can be quantified in DC CONT measurement mode, see note below.

NOTE

Peak-to-peak measurements of frequencies below 50 Hz can be accomplished by observing the MAX-MIN value of the STATS buffer in DC CONT measurement mode, Sections 2.3.12 and 2.3.14. To do so, disable the analog filter, adjust the sample rate, Section 2.4.6 and the STATS buffer depth, Section 2.3.14, so that the actual maximum and minimum values will be captured by the stream of DC measurements.

3.8 Integration of Detector Signals

The Model 1835-C provides for making measurements that integrate incoming power detector signals to obtain an energy via the INTG mode, Section 2.3.12. In INTG mode, the display units indicate Joules since energy is the time integral of power:

$$E(\lambda) = \int_{t_0}^{t_1} P(\lambda)\, dt = \int_{t_0}^{t_1} \frac{S(t)}{R(\lambda)}\, dt$$

As the detector signal actually consists of a stream of digitized values, the integral becomes a numerical approximation using the trapezoid method, Figure 15. In order to maintain the highest accuracy for this numerical process, the sample rate is set at its maximum value of 500 Hz.

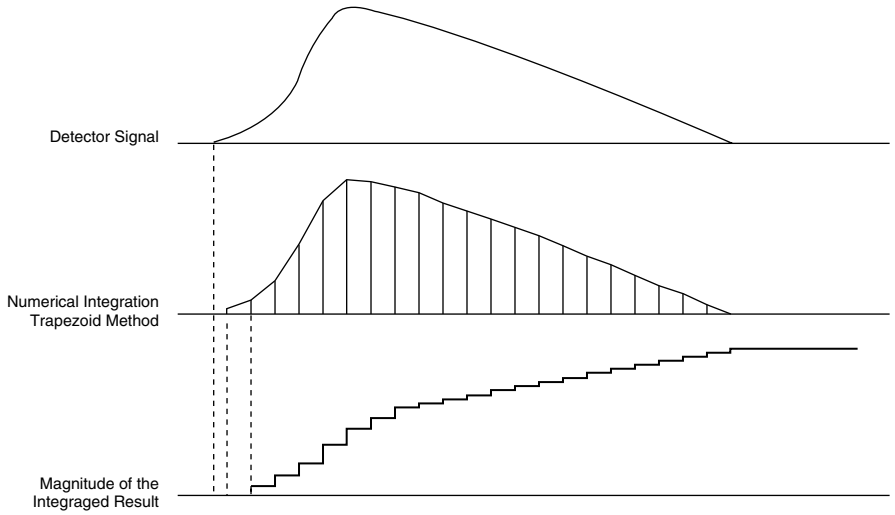


Figure 15. Integrated Energy Via a Trapezoid Approximation — The INTG measurement mode performs a discrete integration at a 500 Hz sample rate.

Two common applications are natural extensions of the INTG measurement mode:

1. Pulse laser energy measurement using with a thermopile detector, Section 3.5

2. Energy from exposure over a period of time (dosage), Section 3.6.

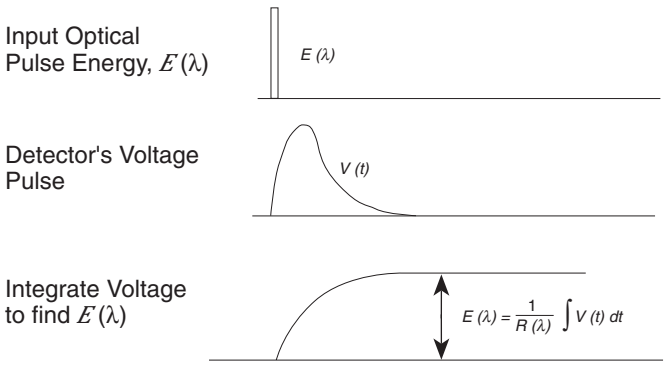


Figure 16. Measuring Laser Pulse Energy with a Thermopile — Thermopiles are often used to measure pulsed laser energy by integrating the response of the detector to the pulse.

3.9 Analog Output

The Model 1835-C provides a 0 to 2.5 volt, into 50Ω, BNC analog output for signal monitoring. The analog output is the actual amplified detector signal and is uncorrected for the effects of the detector's responsivity, AUTO CAL, and ZERO.

3.10 Measurement Considerations

This section describes detector characteristics, optical and electrical considerations, and environmental influences on optical measurements. In general, measurement accuracy is limited by the calibration accuracy of the detector calibration. Accurate measurements however, are also dependent upon proper set-up, controlling temperature and illumination conditions and understanding the factors that affect optical measurements.

3.10.1 Detector Calibration and Accuracy

Newport Corporation calibrates its detectors using secondary standards directly traceable to the United States National Institute of Science and Technology (NIST) or to Great Britain's National Physical Laboratory, (NPL). The details and accuracy of the calibration procedure vary with each detector model but a detailed description of the calibration results is supplied with each individually calibrated detector.

In general, detector calibration accuracy varies from 2% to 5% in absolute terms and varies with wavelength. Each detector will also have some variation in response over its surface. Therefore, for the most reproducible measurements, light should illuminate the detector as uniformly as possible over as large an area as practical.

CAUTION

Avoid focusing a light source onto the detector surface. Inaccurate readings and possible detector damage may result. Consult the detector manual for saturation or damage thresholds.

NIST traceability requires that detectors be recalibrated on one year intervals. As individual detector responses change with time, especially in the ultraviolet, recalibration is necessary to assure confidence in the accuracy of the measurement. For the most reproducible measurements, the same detector should always be used for measurements which are to be directly compared.

3.10.2 Quantum Detector Temperature Effects

Semiconductor, Newport Low-Power detectors, are affected by temperature. At long wavelengths, quantum detectors typically lose sensitivity with increasing temperature. Additionally, detector dark current increases exponentially with temperature.

Observed dark current is often dominated by the interaction between the detector and a meter's amplifier and is typically larger than the theoretical dark current limit. Silicon detectors are inherently quieter than germanium detectors due to their higher internal resistance and lower capacitance. The noise or drift in the dark current sets a lower bound on the measurement resolution which can be achieved with any given detector. Cooling a detector significantly lowers its dark current and dark current noise.

The observed dark currents can also be zeroed at any moment via the ZERO function. Since dark currents drift with temperature, the ZERO should be adjusted just prior to taking any measurements. If the detector temperature is constant, sensitivity changes and dark current drifts are significantly reduced.

3.10.3 Thermopile Detector Temperature Effects

Thermopile, Newport High-Power detectors, are significantly affected by temperature fluctuations arising from air flow disturbances. As the detector is a temperature measuring device, air flow disturbances set a practical lower limit on the power that a detector can measure. In order to get the most out of any thermopile detector, be careful to shield the detector from air flow disturbances. Common sources of disturbance are: air conditioners and people walking past.

3.10.4 Energy Detector Temperature Effects

Pyroelectric, Newport Energy detectors, are AC coupled devices and thus are not susceptible to temperature induced DC signal offsets or noise floor changes. One generally does not need to take much precaution with pyroelectric detectors except to make sure that their damage threshold is not exceeded.

3.10.5 Ambient and Stray Light

Ambient and stray light striking the detector should be considered when making a measurement. Ambient light can be distinguished from dark current (or the detector/meter noise floor) by either turning off or blocking the source and covering the detector face with opaque material such as a piece of black rubber.

Using the human hand to cover the detector is not advised because it emits a significant amount of infrared radiation and radiates a temperature significantly different from ambient. With the detector covered, a reading of the dark current may be made. Next, remove the material which is covering the detector and take another reading. The difference is the ambient light level.

NOTE

Changes in ambient light levels can occur from such factors as turning room lights on or off, or by moving people or equipment. Remember, if you can see your detector element, then your detector can see the light bouncing off you.

The effects of ambient light are greatly reduced when using a fiber-connectorized signal input to the detector. If free-space beam measurements are desired, using an attenuator will often improve the signal to ambient signal noise level. Wavelength-specific filters, such as optical cutoff, bandpass, or spike filters can be used if the signal wavelength spectrum permits. Other techniques to reduce stray light include using apertures, placing the detector in a box or other housing to shield the surface from light (or air currents) and turning off room and other polluting light sources.

3.10.6 Common Measurement Errors

The most common sources of optical measurement error are listed in Table 23 below. Other common errors are discussed in the preceding subsections of Section 3.10 Measurement Consideration.

Table 23. Common Measurement Errors

Type of Error	What should be done?
Radiometry	Check that all of the light is actually hitting the detector.
Ambient Light	Check that any ambient light was ZEROed before the measurement was made.
Wavelength Calibration	Check that the Calibration Factor for the measurement wavelength is properly set.
Detector Saturation or Damage	Check that the optical power density remains below the detector's saturation or damage threshold.

NOTE

The Model 1835-C will indicate when a detector is being operated above its saturation or damage threshold by displaying "SA" in the measurement display area. Be aware that detectors often experience local saturation or damage without ever exceeding an overall saturation or damage threshold.

This only applies to semiconductor photodiodes and thermopiles used above maximum intermittent power.

Detector damage can still arise even when "SA" is not displayed. Be sure to follow your detector manual's user guidelines.

Section 4
Computer Interfacing

4.1 General Guidelines

The 1835-C has two computer interface ports: GPIB and RS-232C. The GPIB port conforms with the IEEE Standard 488.1 hardware standard and the IEEE 488.2 software standard. The protocol for the RS-232C port conforms as much as possible to the IEEE 488.2 software standard.

As specified by the IEEE 488.2 standard, there are two command types; device independent commands and device dependent commands. The device independent commands have the same meaning to all devices and are defined as part of the IEEE 488.2 standard. All device independent commands start with an asterisk (*). Device dependent commands do not start with an asterisk and have meanings unique to the Model 1835-C.

A query is a command that invokes a response from the meter. All queries are terminated by a question mark (?). It is recommended that when a query is made, that the response to that query be read before other commands are issued. When a query is made to the GPIB interface, the MAV bit in the status byte should be checked by means of a serial poll to make sure that the data is available before the reading the response. (See Appendix C.4 Status Byte)

4.2 Computer Interface Terminology

Listed below are key abbreviations and concepts used in the command reference section of this manual.

<...> Delimiting Punctuation

For the purposes of this manual, any string enclosed by <....> is considered to be a command, a string or a numerical argument. The punctuation <....> is used to symbolize the typographic limits of the command, string or argument in question.

<EOI> End or Identify

An IEEE 488.1 signal sometimes sent with the end-of-string character.

<IST> Individual Status

This status is generated by the status byte and parallel poll enable register. It is used in responding to parallel polls.

<CR> Carriage Return

The ASCII encoded byte 13 in decimal. (0D hex)

<LF> Line Feed

The ASCII encoded byte 10 in decimal. (0A hex)

<NL> New Line

Defined in the IEEE 488.2 standard as the ASCII encoded byte 10 in decimal. (0A hex)

<END> End of Message

Indicates the concurrent transmission of <EOI> with the a <NL> data byte.

(;) Semicolons

Used to separate commands within a single transmission (concatenation).

<number> Numerical Types

Numerical parameters are passed and returned as the actual ASCII characters in the string representation of the number. See the appendix for a detailed description of <number>.

<string> String Types

See the appendix for a detailed description of <string>

RS-232C Command Termination

When a command is received from the RS-232C port, either a <CR> or a <LF> is treated as the command terminator.

GPIB Command Termination

When a command is received from the GPIB port, either an <EOI> with a data byte, <NL>, or <CR> is treated as the command terminator. The recommended form of termination is an <EOI> sent with a <NL> denoted as <END> in this manual.

RS-232C Response Termination

In RS-232C echo mode responses are terminated by a <CR><LF> sequence. In RS-232C normal mode the <NL> character terminates the response.

GPIB Response Termination

All responses from the 1835-C GPIB port are terminated by an <END> sequence. Which is the concurrent transmission of <EOI> with a <NL> data byte.

4.3 Entering Remote Computer Interface Mode

When a command or query is received by the GPIB or RS-232 interface ports, the 1835-C automatically goes into remote interface mode. The message area on the display will indicate which remote port received the command.

While in remote mode, the keypad is disabled except for the power and <(LOCAL)> key. To get out of remote mode press the <(LOCAL)> key. If the 1835-C is in local lockout then the LLO remote command must be used to disable local lockout before you will be able to return to keypad control. The message area of the display will indicate when the keypad is in local lock out state.

4.4 RS-232C Communication

Before communicating with the 1835-C through the RS-232 port, proper cable connections must be made. Figure 16 shows the cable connections for communicating with the RS-232C port on the 1835-C.

Once cable connections are made, the baud rate and echo mode need to be set. Valid baud rates are 19.2K, 9600, 4800, 2400, and 1200. The parity, data bits, and stop bits are fixed at no parity, 8 data bits, and 1 stop bit.

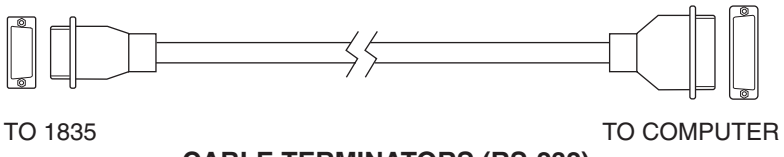
RS-232C Parameters

Baud Rate	19.2K, 9600, 4800, 2400, or 1200
Parity	none
Data bits	8
Stop bits	1

When the echo mode is enabled the 1835-C generates a '> ' prompt for every new line and all characters sent to the 1835-C are echoed back over the interface. Error messages are reported over the interface immediately. As the user is entering commands the line may be edited by using the backspace key (sending an ASCII decimal 08 code) or by using the DEL key (sending an ASCII decimal 127 code).

In echo mode the RS-232C port is interactive and especially useful when a dumb terminal type of device is used to communicate with the 1835-C.

When echo mode is disabled (normal mode) the 1835-C does not generate a prompt or echo characters back over the interface. Error messages must be accessed by using the *ERR? query. This is the default state of the echo mode.



TO 1835 TO COMPUTER

CABLE TERMINATORS (RS-232)
9 pin to 25 pin

9 PIN PIN NO.	CODE	DESCRIPTION	25 PIN PIN NO.
1	DCD	CARRIER DETECT	8
2	RXD	RECEIVE DATA	3
3	TXD	TRANSMIT DATA	2
4	DTR	DATA TERM. READY	20
5	GND	SIGNAL GROUND	7
6	DSR	DATA SET READY	6
7	RTS	REQUEST TO SEND	4
8	CTS	CLEAR TO SEND	5
9	RI	RING IND.	22



TO 1835 TO COMPUTER

CABLE TERMINATORS (RS-232)
9 pin to 9 pin

9 PIN PIN NO.	CODE	DESCRIPTION	9 PIN PIN NO.
1	DCD	CARRIER DETECT	1
2	RXD	RECEIVE DATA	2
3	TXD	TRANSMIT DATA	3
4	DTR	DATA TERM. READY	4
5	GND	SIGNAL GROUND	5
6	DSR	DATA SET READY	6
7	RTS	REQUEST TO SEND	7
8	CTS	CLEAR TO SEND	8
9	RI	RING IND.	9

Figure 17. RS-232 Cable Connections

4.4.1 Setting Baud Rate and Echo Mode From The Keypad

The baud rate and echo mode are set from within the menu structure. To set the baud rate select the BAUD RATE option from the REMOTE SETUP menu. To set the echo mode select the ECHO MODE option from the REMOTE SETUP menu. (See Section 2.4.12)

4.4.2 Setting Baud Rate and Echo Mode From A Remote Interface

The baud rate cannot be set from the remote interface. To set the echo mode use the ECHO command. Use the ECHO? to see if the echo mode is enabled or disabled. (See Section 2.4.12)

4.5 RS-232C XON/XOFF Handshaking Protocol

The 1835-C uses the XON/XOFF handshaking protocol. When the 1835-C's RS-232 input buffer is nearly full the 1835-C will send an XOFF (ASCII encoded 19 decimal) character to the remote computer. The XOFF character informs the remote computer that it needs to suspend transmission until it receives the XON character from the 1835-C. When the buffer empties sufficiently the 1835-C will send an XON (ASCII encoded 17 decimal) to signal the remote computer that it can resume transmission.

The 1835-C will also respond to XOFF and XON characters sent to it from the remote computer. When the 1835-C receives an XOFF character it will suspend all transmission of characters to the remote computer until the XON character is received.

4.6 GPIB Communication

A variety of third party GPIB communication hardware and software, such as plug-in GPIB computer boards and Lab View software from National Instruments exists. The 1835-C should work with any of these as long as they adhere to the IEEE 488.1 standard. This manual assumes the user is familiar with one of these third party hardware/software packages. The table below summarizes the IEEE 488.1 capabilities supported by the 1835-C.

Table 24. Model 1835-C IEEE 488.1 Capabilities Summary

Description	Command	Level of Capability
Source Handshake	SH1	complete capability
Acceptor Handshake	AH1	complete capability
Talker	T6	basic talker, serial poll, unaddress if MLA
Extended Talker	TE0	no capability
Listener	L4	basic listener, unaddress if MTA
Extended Listener	LE0	no capability
Service Request	SR1	complete capability
Remote Local	RL0	*no capability
Parallel Poll	PP1	remote configuration
Device Clear	DC1	complete capability
Device Trigger	DT0	no capability
Controller	C0	no capability

NOTE

* In order to better handle the RS-232C interface the 1835-C automatically goes into remote mode when a command is received from either of the remote computer interfaces. The LLO command is used to enable or disable the local lockout state.

4.6.1 Setting The GPIB Address

Before communicating with the 1835-C GPIB port the 1835-C GPIB address must be set. The address can be between 0 and 30. The address can only be set from the keypad and is accessed through the menu structure. To set the GPIB address select the REMOTE SETUP->GPIB ADDRESS option in the menu. The Model 1835-C GPIB is factory set to 5. (See Section 2.4.12)

Section 5
Command Reference

5.1 Model 1835-C Remote Interface Commands

The Model 1835-C remote commands can be divided into two groupings:

i. Device Independent Commands, Section 5.2

ii. Device Dependent Commands., Section 5.3

Table 25 lists the Device Independent Commands supported by the 1835-C while Table 26 lists the Device Dependent Commands supported the 1835-C. Following these tables are the detailed presentations of each command and their syntax and an example of their use.

Table 25. Device Independent Status Commands

Command	Command Name
*CAL?	Calibration Query
*CLS	Clear Status
*ERR?	Error Query
*ESE	Event Status Enable
*ESE?	Event Status Enable Query
*ESR?	Event Status Register Query
*IDN?	Identification Query
*IST?	Individual Status Query
*OPC	Signal When Operation Complete
*OPC?	Operation Complete Query
*PRE	Parallel Poll Enable
*PRE?	Parallel Poll Enable Query
*RCL	Recall Device Configuration
*RST	Software Reset
*SAV	Save Device Configuration
*SRE	Service Request Enable
*SRE?	Service Request Enable Query
*STB?	Status Byte
*TST?	System Test
*WAI	Wait To Continue

Table 26. Device Dependent Commands

Command	Command Name
ATTN	Attenuator Calibration Data Enable
ATTN?	Attenuator Calibration Data Enable Query
ATTNSN?	Attenuator Serial Number Query
AUTO	Auto Ranging Enable
AUTO?	Auto Ranging Enable Query
BARGRAPH	Bar Graph Enable
BARGRAPH?	Bar Graph Enable Query
CALDATE?	Calibration Date Query
DETMODEL?	Detector Mode Query
DETSN?	Detector Serial Number Query
DETSW	Detector Switch Select
DETSW?	Detector Switch Query
DISP	Display Brightness Select
DISP?	Display Brightness Query
DS?	Data Store Value Query
DSBUF	Data Store Buffer Behavior Select
DSBUF?	Data Store Buffer Behavior Query
DSCLR	Data Store Clear
DSCNT?	Data Store Value Count Query
DSE	Data Store Enable
DSE?	Data Store Enable Query
DSSIZE	Data Store Buffer Size Select
DSSIZE?	Data Store Buffer Size Query
DSUNITS?	Data Store Units Query
ECHO	RS-232 Echo Mode Enable
ECHO?	RS-232 Echo Mode Enable Query
EVENT?	Device Event Register Query
EVENTEN	Device Event Enable Register
EVENTEN?	Device Event Enable Register Query
EXT	External Trigger Enable
EXT?	External Trigger Enable Query
EXTEDGE	External Trigger Edge Select
EXTEDGE?	External Trigger Edge Query
FILTER	Filter Select
FILTER?	Filter Query
LAMBDA	Lambda Select
LAMBDA?	Lambda Query
LLO	Local Lockout Enable
LLO?	Local Lockout Enable Query
MODE	Acquisition Mode Select
MODE?	Acquisition Mode Query
R?	Read Measurement Query
RANGE	Manual Range Level Select
RANGE?	Manual Range Level Query
REFVAL	Reference Value Select
REFVAL?	Reference Value Query
RESP?	Responsivity Query
RUN	Start Acquisition
RWS?	Read Measurement with Status Query
SFREQ	DC Sample Frequency Select
SFREQ?	DC Sample Frequency Query
SPREC	DC Sample Type Select
SPREC?	DC Sample Type Query
STMAX?	Statistics Buffer Maximum Value Query

STMEAN?	Statistics Buffer Mean Value Query
STMIN?	Statistics Buffer Minimum Value Query
STMXMN?	Statistics Buffer Maximum-Minimum Value Query
STSDEV?	Statistics Buffer Standard Deviation Query
STSIZE	Statistics Buffer Size Select
STSIZE?	Statistics Buffer Size Query
STOP	Stop Acquisition
STOREF	Store Reference Reading
STOZERO	Store Zero Signal
TONE	Tone Enable
TONE?	Tone Enable Query
TRIGOUT	Trigger Out Mode Select
TRIGOUT?	Trigger Out Mode Query
TRIGOUTFREQ	Trigger Out Frequency Select
TRIGOUTFREQ?	Trigger Out Frequency Query
TRIGOUTINTG	Trigger Out Integration Level Select
TRIGOUTINTG?	Trigger Out Integration Level Query
TRIGOUTLVL	Trigger Out Level Select
TRIGOUTLVL?	Trigger Out Level Query
TRIGOUTPOL	Trigger Out Polarity Select
TRIGOUTPOL?	Trigger Out Polarity Query
UNITS	Units Select
UNITS?	Units Query
USRCAL	User Calibration Enable
USRCAL?	User Calibration Enable Query
USRRESP	User Responsivity Factor Select
USRRESP?	User Responsivity Factor Query
ZERO	Signal Zeroing Enable
ZERO?	Signal Zeroing Enable Query
ZEROVAL?	Zero Signal Query

5.2 Device Independent Commands

*CAL?
Calibration Query

Syntax: *CAL?

Parameters: None

Function:

This routing performs an auto calibration sequence that measures the amplifier offsets at all gain settings. These measurements are stored and subtracted from subsequent measurements. Acquisition is suspended during auto calibration and no other remote commands will be processed until the auto calibration sequence is complete.

Returns: <number>

<number> represents the integer 0. This return value is generated when autocalibration is complete.

Related Commands: None

*CLS
Clear Status

Syntax: *CLS

Parameters: None

Function:

This command clears the Standard Event Status register, device event register, and the error queue. As a result of this command the status byte is cleared except for the message available bit (bit 4). Because this command does not clear the input and output buffers the MAV bit will not be affected.

The *CLS command also cancels any outstanding *OPC and OPC? commands.

Related Commands: *ESR?, EVENT?, *IST?, *STB?

*ERR?
Error Query

Syntax: *ERR?

Parameters: None

Function:

Returns (and removes) oldest error message from the error queue. The error message is made up of an error code and a text description of the error (see the appendix B). A maximum of 10 errors can be stored in the queue. If no errors are stored in the queue, a message to that effect will be returned.

Errors that occur due to commands and queries sent from the RS-232 interface will be stored in the queue only if the echo mode is disabled. When the echo mode is enabled the error messages are automatically returned to the user when the error occurs. See Appendix B for a description of the error messages.

The command *CLS will clear the error queue.

Returns: <errno>,<description>

<errno> is of type <number> and represents a negative integer error code. <description> is of type <string> in double quote format, and describes the error. See the appendix for a list of possible error messages.

Related Commands: *CLS, *STB?

*ESE
Event Status Enable

Syntax: *ESE <mask>

Parameters:

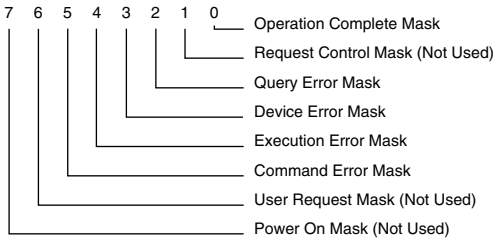
<mask> is an integer in the range 0 to 255 inclusive. <mask> is written to the Event Status Enable register.

Function:

The Event Status Enable register is AND'ed with the Event Status register. If any bit is set in the result of this AND'ing operation the ESB bit (bit 5) of the Status Byte will be set. The Status Byte can be used in conjunction with the Service Request Enable register to generate a service request.

The Event Status Enable register is an 8 bit, bit mapped register. Any bit set to 1 in the Event Status Enable Register allows the corresponding bit in the Event Status Register to set the ESB bit (bit 5) in the Status Byte. Any bit set to 0 disables the corresponding bit in the Event Status Register from setting the ESB bit. The Event Status Enable register is set to 0 upon power-up. See Appendix C for a detailed description of the Event Status Register.

The significance of each bit in the Event Status Enable register is shown below:



Event Status Enable Register

Related Commands: *CLS, *ESE?, *ESR?, EVENT?, EVENTEN, EVENTEN?, *IST?, *PRE, *PRE?, *SRE, *SRE?, *STB?

*ESE?
Event Status Enable Query

Syntax: *ESE?

Parameters: None

Function:

This query returns the contents of the Event Status Enable register. See the *ESE command for a description of the Event Status Enable register. See Appendix C for a detailed description of the Event Status Register.

Returns: <mask>

<mask> is of type <number> and represents an unsigned integer in the range 0 to 255.

Related Commands: *CLS, *ESE, *ESR?, EVENT?, EVENTEN, EVENTEN?, *IST?, *PRE, *PRE?, *SRE, *SRE?, *STB?

*ESR?
Event Status Register Query

Syntax: *ESR?

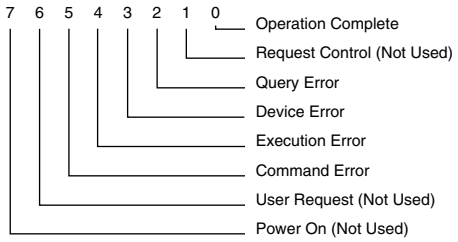
Parameters: None

Function:

This query returns the contents of the Event Status Register and clears the Event Status Register except for bit 3. bit 3 is determined by the state of the Device Event and Device Event Enable registers. The *CLS command will also set this register to 0.

The Event Status register is AND'ed with the Event Status Enable register. If any bit is set in the result of this AND'ing operation the ESB bit (bit 5) of the Status Byte will be set. The Status Byte can be used in conjunction with the Service Request Enable register to generate a service request. See Appendix C for a detailed explanation of the Event Status Register.

The Event Status Register is an 8 bit, bit mapped register, with each bit signifying a different condition. The bits are listed below, most significant bit first:



Standard Event Status Register

Returns: <value>

<value> is of type <number> and represents an unsigned integer in the range 0 to 255.

Related Commands: *CLS, *ESE, *ESE?, EVENT, EVENTEN, EVENTEN?, *IST?, *PRE, *PRE?, *SRE, *SRE?, *STB?

*IDN?
Identification Query

Syntax: *IDN?

Parameters: None

Function:

This query causes the 1835-C to return device identification information. The information returned is manufacturer, model, serial number, and firmware version.

Returns: <manufacturer>,<model>,<serial>,<version>

<manufacturer> is of type <string> using the no quotes format. The 1835-C always returns Newport Corp..

<model> is of type <string> using the no quotes format.

<serial> is of type <string> using the no quotes format. This is always a '0'.

<version> is of type <string> using the no quotes format. This text identifies the internal firmware version of the 1835-C. This text consists of two sections, separated by two underscores. The first section is the revision level, and the second is the revision date.

Related Commands: None

*IST?
Individual Status Query

Syntax: *IST?

Parameters: None

Function:

This query returns the current state of the IEEE 488.1 <IST> local message. The <IST> message is generated by the parallel poll status system. If any bit is set in the Status Byte and it's corresponding bit is set in the Parallel Poll Enable register, then the <IST> message is set true (a value of 1). Otherwise the <IST> message is set false (a value of 0).

When a parallel poll is conducted with the 1835-C configured to respond to it, the <IST> message is compared to the <S BIT> (sense bit). If they are the same then the configured data line will be driven true in response to the parallel poll.

Both the <S BIT> and the data line driven during a parallel poll can be selected by the IEEE 488.1 parallel poll remote configuration command.

Returns: <sbit>

<sbit> is of type <number> which represents the integer 0 or 1.

Related Commands: *PRE, *PRE?, *STB?

*OPC
Signal When Operation Complete

Syntax: *OPC

Parameters: None

Function:

This command provides a means of synchronizing operations between the 1835-C and the host. This command sets the Operation Complete bit (bit 0) of the Event Status register to 1 when all pending operations have completed. This bit will remain 1 until cleared by the *CLS command or the *ESR? query.

This command can be used in conjunction with the *ESE and *SRE commands to cause a Service Request on the GPIB bus when all pending operations are complete.

Once the *OPC command is received, it will not set the operation complete bit to 1 while any of the following operations are in progress:

Single acquisition in progress
Data store enabled with fixed data store buffer
The meter is ranging

Related Commands: *ESE, *ESE?, *ESR?, *OPC?, *SRE, *SRE?, *STB?, *WAI

*OPC?
Operation Complete Query

Syntax: *OPC?

Parameters: None

Function:

This query provides a means of synchronizing operations between the 1835-C and the host. This command generates a response when all pending operations have completed.

When all pending operations are complete, this query will cause the Message Available bit (bit 4) of the Status Byte to be set because of the response generated. By enabling bit 4 of the Service Request Enable register (see *SRE), the *OPC? query can be used to cause a Service Request on the GPIB bus when all pending operations are complete.

Once the *OPC? query is received, the response will not be generated while any of the following operations are in progress:

Single acquisition in progress
Data store enabled with fixed data store buffer
The meter is ranging

The *CLS or *RST commands, as well as a GPIB interface device clear, will cancel the operation complete query.

Returns: 1

The response is generated when all pending operations are complete.

Related Commands: *OPC, *SRE, *SRE?, *STB?, *WAI

*PRE
Parallel Poll Enable

Syntax: *PRE <mask>

Parameters:

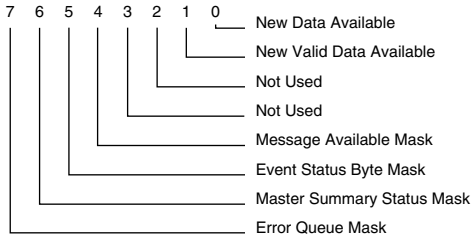
<mask> is an integer in the range 0 to 255 inclusive. The value of this number is written into the Parallel Poll Enable register.

Function:

This command sets the Parallel Poll Enable register bits. The Parallel Poll Enable register is used in conjunction with the Status Byte to generate the IST (Individual Status) message. See Appendix C for a detailed description of the Event Status Register.

The Parallel Poll Enable Register is set to 0 at power-on.

The Parallel Poll Enable Register is an 8-bit, bit mapped register, with each bit signifying a different condition. The bits and their significance are detailed below:



Parallel Poll Enable Register

Related Commands: *IST, *PRE?, *STB?

*PRE?
Parallel Poll Enable Query

Syntax: *PRE?

Parameters: None

Function:

This query returns the contents of the Parallel Poll Enable register. See the *PRE command for a description of the Parallel Poll Enable register. See Appendix C for a detailed description of the Event Status Register.

Returns: <mask>

<mask> is of type <number> and represents an unsigned integer in the range 0 to 255.

Related Commands: *IST, *PRE, *STB?

*RCL
Recall Meter Configuration

Syntax: *RCL <config>

Parameters:

<config> is of type <number> which rounds to an integer in the range 0 to 9. This number specifies a configuration storage buffer. The number 0 stands for the default configuration buffer.

Function:

This command configures the meter to a configuration previously stored in non-volatile memory (see *SAV), or to the default configuration for the attached detector.

This command will fail if the requested configuration is incompatible with the detector attached to the meter or empty. The parameters affected by this command are those listed in Table 9.

Returns: None

Related Commands: *RST, *SAV

*RST
Reset

Syntax: *RST

Parameters: None

Function:

This sets the meter to the default configuration, see Table 9, for the detector attached to it. It also cancels any outstanding *OPC or *OPC? commands.

Related Commands: *RCL, *SAV

*SAV
Save Meter Configuration

Syntax: *SAV <config>

Parameters:

<config> is of type <number> which rounds to an integer in the range 1 to 9. This number specifies a configuration storage buffer.

Function:

This command saves the configuration of the meter to the configuration specified by the parameter. The parameters saved by this command are those listed in Table 9.

Related Commands: *RCL, *RST

*SRE
Service Request Enable

Syntax: *SRE <mask>

Parameters:

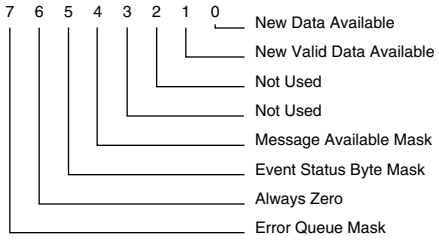
<mask> is an integer in the range 0 to 255 inclusive. The value of this number is written into the Service Request Enable register.

Function:

The Service Request Enabled Register is used in conjunction with the Status Byte to generate service requests on the GPIB bus. See Appendix C for a detailed description of the Event Status Register.

If a bit is set in the Service Request Enable register and it's corresponding bit is set in the Status Byte Register, then a service request will be generated once for the for the given event. When service is being requested, bit 6 is set in the byte returned by a serial poll of the 1835-C.

The Service Request Enable Register is an 8-bit, bit mapped register, with each bit signifying a different condition. The bits are listed below, most significant bit first:



Service Request Enable Register

Related Commands: *SRE?, *STB?

*SRE?
Service Request Enable Query

Syntax: *SRE?

Parameters: None

Function:

This query returns the contents of the Service Request Enable register. See the *SRE command for a description of the Service Request Enabled register. See Appendix C for a detailed description of the Event Status Register.

Returns: <mask>

<mask> is an integer in the range 0 to 255 inclusive, except that bit 6 is always a zero.

Related Commands: *SRE, *STB?

*STB?
Status Byte Query

Syntax: *STB?

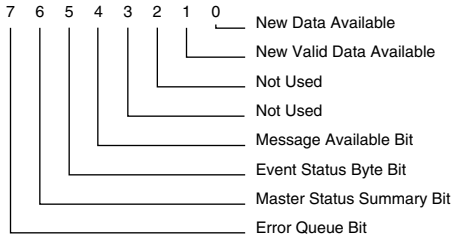
Parameters: None

Function:

This query returns the contents of the Status Byte which records current system conditions. Appendix C describes the Status Byte in detail.

If a bit is set in the Status Byte Register and it's corresponding bit is set in the Service Request Enable Register, then a service request will be generated once for the given event. When service is being requested, bit 6 is set in the byte returned by a serial poll of the 1835-C.

The Status Byte Register is an 8-bit, bit mapped register, with each bit signifying a different condition. When a bit is set, or has a value of one, then the condition is true. The bits are listed below, most significant bit first:



Status Byte Register.

Note that the *CLS common command clears most of the bits in the Status Byte.

Returns: <value>

<value> is an integer in the range 0 to 255 inclusive.

Related Commands: *CLS, *SRE, *SRE?

*TST?
Self Test Query

Syntax: *TST?

Parameters: None

Function:

As defined in the IEEE 488.2 standard, the *TST? command causes the device to return a result of a self-test, indicating whether or not the unit completed the self-test without any errors. The self test is only administered upon reset or power up. The query does not initiate the self test and only returns a 0 indicating that the system passed its earlier self test.

Returns: 0

Related Commands: None

*WAI
Wait to continue

Syntax: *WAI

Parameters: None

Function:

The *WAI command causes the device to wait until all pending operations are complete before processing any commands waiting in the input queue. Care should be taken when using this command since it is possible to overflow the input queue by continuing to write commands to the 1835-C while the *WAI command is in effect.

Note that the *WAI command will essentially "lock out" the remote interfaces until all pending operations are complete. The *OPC command and *OPC? query differ from *WAI in this area, as they allow other commands to be processed while they are waiting for pending operations to complete.

Once the *WAI command is received, it will be in effect while any of the following operations are in progress:

Single acquisition in progress
Data store in progress with fixed data store buffer
The meter is ranging

The *WAI command can only be canceled by a GPIB interface device clear or by turning the meter off and on.

Related Commands: *OPC, *OPC?

5.3 Device Dependent Commands

ATTN
Attenuator Calibration Data Enable

Syntax: ATTN <state>

Parameters:

The parameter <state> is either 0 or 1. If <state> is 0, then detector responsivity data is used to calculate readings. If <state> is 1, then the detector + attenuator responsivity data is used to calculate readings.

Function:

This command enables or disables the use of attenuator responsivity data. If enabled, responsivity data collected with the attenuator attached to the detector is used in data calculations. If disabled, responsivity data collected with the detector alone is used in data calculations.

This command will generate an error if the attached detector does not support an attenuator.

Related Commands: ATTN?, ATTNSN?, LAMBDA, LAMBDA?, RESP?, USRCAL, USRCAL?, USRRESP, USRRESP?

ATTN?
Attenuator Calibration Data Enable Query

Syntax: ATTN?

Parameters: None

Function:

This query returns a value showing whether or not attenuator responsivity data is currently being used.

Returns: <state>

<state> is of type <number> which represents the integer 0 if detector responsivity data is being used or 1 if detector + attenuator responsivity data is being used.

Related Commands: ATTN?, ATTNSN?, LAMBDA, LAMBDA?, RESP?, USRCAL, USRCAL?, USRRESP, USRRESP?

ATTNSN?
Attenuator Serial Number Query

Syntax: ATTNSN?

Parameters: None

Function:

This query returns the serial number of the attenuator that was calibrated with the attached detector.

When using an attenuator this serial number must match the serial number of the attenuator being used or data calculations will be inaccurate.

Returns: <attnSN>

<attnSN> is of type <string> in the double quote format. If no attenuator serial number is available, the query returns an empty double quoted string, "".

Related Commands: CALDATE?, DETMODEL?, DETSN?

AUTO
Auto Ranging Enable

Syntax: AUTO <state>

Parameters:

The parameter <state> is either 0 or 1. If <state> is 0 then manual ranging is enabled. If <state> is 1 then auto ranging is enabled.

Function:

This command enables or disables auto ranging. If enabled and in a continuous acquisition mode, a signal range is automatically selected to suit the input signal. If disabled, the meter needs to be manually ranged.

Related Commands: AUTO?, RANGE, RANGE?

AUTO?
Auto Ranging Enable Query

Syntax: AUTO?

Parameters: None

Function:

This query returns a value showing whether the meter is in auto ranging feature is enabled or disabled.

Returns: <state>

<state> is of type <number> which represents the integer 0 if auto ranging is disabled or 1 if auto ranging is enabled. If enabled, the meter will auto range when in continuous acquisition modes.

Related Commands: AUTO, RANGE, RANGE?

BARGRAPH
Bar Graph Enable

Syntax: BARGRAPH <state>

Parameters:

The parameter <state> is either 0 or 1. If <state> is 0 then the bargraph is disabled. If <state> is 1 then the bargraph is enabled.

Function:

This command enables or disables the bargraph feature. If enabled, the bargraph will be displayed when the units of measurement are not ratio type of units and the meter is not in INTG mode.

Related Commands: BARGRAPH?, TONE, TONE?

BARGRAPH?
Bar Graph Enable Query

Syntax: BARGRAPH?

Parameters: None

Function:

This query returns a value showing whether the bargraph is enabled or disabled. Note: The bargraph is not displayed while in either GPIB or RS-232 mode regardless of enabled status.

Returns: <state>

<state> is of type <number> which represents the integer 0 if the bar graph is disabled and 1 if the bar graph is enabled.

Related Commands: BARGRAPH, TONE, TONE?

CALDATE?
Calibration Date Query

Syntax: CALDATE?

Parameters: None

Function:

This query returns the calibration date of the detector as read from the memory module attached to the 1835-C.

Returns: <model>

<model> is of type <string> in the double quote format.

Related Commands: ATTNSN?, DETMODEL?, DETSN?

DETMODEL?
Detector Model Query

Syntax: DETMODEL?

Parameters: None

Function:

This query returns the model number of the detector that belongs to the memory module attached to the 1835-C.

Returns: <model>

<model> is of type <string> in the double quote format.

Related Commands: ATTNSN?, CALDATE?, DETSN?

DETSN?
Detector Serial Number Query

Syntax: DETSN?

Parameter: None

Function:

This query returns the serial number of the detector that the memory module belongs to. This serial number must match the serial number of the detector attached to the 1835-C.

Returns: <detSN>

<detSN> is of type <string> in the double quote format.

Related Commands: ATTNSN?, CALDATE?, DETMODEL?

DETSW
Detector Switch Setting

Syntax: DETSW <setting>

Parameter:

<setting> is of type <string> in a double quoted format. The possible values of <setting> are "S" for short, "I" for intermediate, and "L" for long.

Function:

The 818J-S10 and the 818J-09 have a switch setting for short, intermediate and long energy pulse measurement. This command must be used to inform the 1835-C what the switch is set to when using these detectors.

If the attached detector doesn't support a switch then this command will cause an execution error.

Related Commands: DETSW?

DETSW?
Detector Switch Setting Query

Syntax: DETSW?

Parameter: None

Function:

This query returns the switch setting assumed by the 1835-C. This setting must match the actual switch setting on the detector or readings will be inaccurate.

Returns: <setting>

<setting> is of type <string> in the double quote format. The possible values of <setting> are "S" for short, "I" for intermediate, and "L" for long. If the attached detector doesn't support a switch the return value will be "N/A".

Related Commands: DETSW

DISP
Display Brightness

Syntax: DISP <level>

Parameters:

The parameter <level> is of type <number> which rounds to an integer in the range 0 to 2. 0 corresponds to off, 1 to dim, 2 to normal, and 3 to bright.

Function:

This command sets the brightness of the display to a desired level. The valid levels are off, dim, normal, and bright.

Returns: None

Related Commands: DISP?

DISP?
Display Brightness Query

Syntax: DISP?

Parameters: None

Function:

This query returns the brightness level of the display.

Returns: <level>

<level> is of type <number> where 0 corresponds to off, 1 to dim, 2 to normal, and 3 to bright.

Related Commands: DISP

DS?
Data Store Value Query

Syntax: DS? <number>

Parameters:

The parameter <number> rounds to an integer and represents the data store value that is being queried. The range of <number> is 1 to n; where n is the number of values stored in the data store buffer (see DSCNT?). A parameter of 1 represents the oldest data value in the data store, 2 the second oldest and so on.

Function:

This query is used to query an individual data value from the data store buffer. If the parameter is out of range then an execution error message will be generated and nothing will be returned. It is recommend to use the DSCNT? query to determine how many values have been stored in the data buffer.

Returns: <status>,<number>

<status> is an integer that represents the status of the returned value. <status> will be 0 for ok, 1 for over range, 2 for detector saturated, 3 for data error and 4 for ranging.

<number> is a floating point number in the exponential format.

Related Commands: DSCLR, DSCNT?, DSE, DSE?, DSSIZE, DSSIZE?, DSUNITS?, DSBUF, DSBUF?

DSBUF
Data Store Buffer Behavior Select

Syntax: DSBUF <state>

Parameters:

The parameter <state> is of type <number> which rounds to an integer in the range -32768 to 32767. If the number rounds to 0 then data store FIXED BUFFER behavior is enabled. Otherwise, data store SLIDE BUFFER behavior is enabled.

Function:

This command selects data store FIXED BUFFER or SLIDE BUFFER behavior.

Related Commands: DS?, DSCLR, DSCNT?, DSE, DSE?, DSSIZE, DSSIZE?, DSUNITS?, DSBUF?

DSBUF?
Data Store Buffer Behavior Query

Syntax: DSBUF?

Parameters: None

Function:

This query returns a value showing whether data store FIXED BUFFER or SLIDE BUFFER behavior is enabled.

Returns: <state>

<state> is of type <number> and represents an integer 0, if FIXED BUFFER behavior is enabled, or 1, if data store SLIDE BUFFER behavior is enabled.

Related Commands: DS?, DSCLR, DSCNT?, DSE, DSE?, DSSIZE, DSSIZE?, DSUNITS?, DSBUF

DSCLR
Data Store Clear

Syntax: DSCLR

Parameters: None

Function:

This command is used to clear the data store buffer.

Related Commands: DS?, DSCNT?, DSE, DSE?, DSSIZE, DSSIZE?, DSUNITS?, DSBUF, DSBUF?

DSCNT?
Data Store Value Count Query

Syntax: DSCNT? <number>

Parameters: None

Function:

This query returns the number of data values stored in the data store buffer.

Returns: <count>

<count> is of type <number> and represents an integer in the range of 1 to the size of the data store buffer.

Related Commands: DS?, DSCLR, DSE, DSE?, DSSIZE, DSSIZE?, DSUNITS?, DSBUF, DSBUF?

DSE
Data Store Enable

Syntax: DSE <state>

Parameters:

The parameter <state> is a <number> which is either 0 or 1. If the number is 0, data storing is disabled. If the number is 1, data storing is enabled.

Function:

This command enables or disables data storing.

Note that data storing can not be enabled when the data store buffer is full and FIXED BUFFER behavior is enabled. The user must first either clear the data store buffer or enable SLIDE BUFFER behavior and then enable data storing.

Related Commands: DS?, DSCLR, DSCNT?, DSE?, DSSIZE, DSSIZE?, DSUNITS?, DSBUF, DSBUF?

DSE?
Data Store Enable Query

Syntax: DSE?

Parameters: None

Function:

This query returns a value showing whether or not data storing is enabled or disabled.

Returns: <state>

<state> is of type <number> and represents an integer 0, if data storing is disabled, or 1, if data storing is enabled.

Related Commands: DS?, DSCLR, DSCNT?, DSE, DSSIZE, DSSIZE?, DSUNITS?, DSBUF, DSBUF?

DSSIZE
Data Store Buffer Size Select

Syntax: DSSIZE <size>

Parameters:

The parameter <size> is of type <number> which rounds to an integer in the range 1 to 2500. The parameter represents the size of the data buffer to be used for data storing.

Function:

This command sets the size of the buffer used for data storing. Note that the data buffer is cleared automatically when this command is used and all previously stored data will be gone.

Related Commands: DS?, DSCLR, DSCNT?, DSE, DSE?, DSSIZE?, DSUNITS?, DSBUF, DSBUF?

DSSIZE?
Data Store Buffer Size Query

Syntax: DSSIZE?

Parameters: None

Function:

This query returns the data store buffer size.

Returns: <size>

<size> is of type <number> and represents an integer of the range 1 to 2500.

Related Commands: DS?, DSCLR, DSCNT?, DSE, DSE?, DSSIZE, DSUNITS?, DSBUF, DSBUF?

DSUNITS?
Data Store Buffer Units Query

Syntax: DSUNITS?

Parameters: None

Function:

This query returns the units of the data stored in the data store buffer.

Returns: <units>

<units> is of type <string> in the double quote format.

The possible values of units are: “A”, “V”, “W”, “W/CM”, “dBm”, “dB”, “REL”, “J”, “J/CM”, “Erg”, or “E/CM” depending on the detector and acquisition mode.

Related Commands: DS?, DSCLR, DSCNT?, DSE, DSE?, DSSIZE, DSSIZE?, DSBUF, DSBUF?

ECHO
RS-232 Echo Mode Enable

Syntax: ECHO <enable>

Parameters:

The parameter <state> is either 0 or 1. If <state> is 0 then RS-232 echo mode is disabled. If <state> is 1 then RS-232 echo mode is enabled.

Function:

This command enables or disables the echo mode for RS-232 communication.

Related Commands: ECHO?

ECHO?
RS-232 Echo Mode Enable Query

Syntax: ECHO?

Parameters: None

Function:

This query returns a value showing whether the RS-232 echo mode is enabled or disabled.

Returns: <state>

<state> is of type <number> that represents the integer 0, if the echo mode is disabled, or 1, if the echo mode is enabled.

Related Commands: ECHO

EVENT?
Device Event Register Query

Syntax: EVENT?

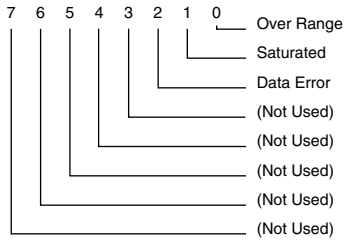
Parameters: None

Function:

This query returns the contents of the Device Event register and sets the Device Event register to 0. The *CLS command will also set this register to 0.

The Device Event register is AND'ed with the Device Event Enable register. If any bit is set in the result of this AND'ing operation then Device Error bit (bit 3) in the Standard Event Status register will be set.

The Device Event register is an 8 bit, bit mapped register, with each bit signifying a different condition. The bits are listed below, most significant bit first:



Device Event Register

Returns: <event>

<event> is an integer in the range from 0 to 255 inclusive.

Related Commands: *ESE, *ESE?, *ESR?, EVENTEN, EVENTEN?,

EVENTEN
Device Event Enable Register

Syntax: EVENTEN <mask>

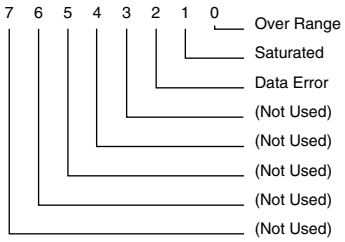
Parameters:

<mask> is an integer in the range 0 to 255 inclusive. The value of this number is written into the Device Event Enable register.

Function:

The Device Event Enable register is AND'ed with the Device Event register. If any bit is set in the result of this AND'ing operation then Device Error bit (bit 3) in the Standard Event Status register will be set.

The Device Event Enable register is an 8 bit, bit mapped register. Any bit set to 1 in the Device Event Enable register allows the corresponding bit in the Device Event register to set the Device Error bit (bit 3) in the Standard Event Status register. Any bit set to 0 disables the corresponding bit in the Device Event register from setting the Device Error it.



Device Event Register

Related Commands: EVENT?, EVENTEN?, *ESE, *ESE?, *ESR?

EVENTEN?
Device Event Enable Register Query

Syntax: EVENTEN?

Parameters: None

Function:

This query returns the contents of the Device Event Enable register. See the EVENTEN command for a description of the Device Event Enable register.

Returns: <mask>

<mask> is of type <number> and represents an unsigned decimal integer in the range from 0 to 255.

Related Commands: EVENT?, EVENTEN, *ESE, *ESE?, *ESR?

EXT
External Trigger Enable

Syntax: EXT <enable>

Parameters:

The parameter <state> is either 0 or 1. If <state> is 0 then the external trigger is disabled. If <state> is 1 then the external trigger is enabled.

Function:

This command enables or disables the external trigger input on the back panel.

Related Commands: EXT?, EXTEDGE, EXTEDGE?

EXT?
External Trigger Enable Query

Syntax: EXT?

Parameters: None

Function:

This query returns a value showing whether the external trigger input enabled or disabled.

Returns: <state>

<state> is of type <number> that represents the integer 0, if the external trigger input is disabled, or 1, if the external trigger is enabled.

Related Commands: EXT, EXTEDGE, EXTEDGE?

EXTEDGE
External Trigger Edge Select

Syntax: EXTEDGE <edge>

Parameters:

The parameter <edge> is either 0 or 1. If <edge> is 0 then the external trigger is defined as a falling edge. If <edge> is 1 then the external trigger is defined as a rising edge.

Function:

This command defines whether the external trigger input on the back panel is falling edge or rising edge active.

Related Commands: EXT, EXT?, EXTEDGE

EXTEDGE?
External Trigger Edge Query

Syntax: EXTEDGE?

Parameters: None

Function:

This query returns a value showing which external trigger edge is the active edge.

Returns: <edge>

<edge> is of type <number> and represents the 0, if the external trigger is defined as a falling edge, or 1, if the external trigger is defined as a rising edge.

Related Commands: EXT, EXT?, EXTEDGE

FILTER
Filter Select

Syntax: FILTER <filter>

Parameters:

The parameter <filter> is an integer in the range 0 to 3 inclusive. 0 corresponds to no filtering, 1 to analog filter only, 2 to digital averaging filter only, and 3 to analog and digital filters combined.

Function:

This command selects a filter combination to be used to condition readings taken from the detector. The choices are to have no filter at all, an analog filter, digital averaging filter, and both the analog and digital filters. The digital filter processes every signal reading by averaging it with the last 9 readings taken.

All detectors signals are filtered to some extent even without the analog filter feature. By enabling the analog filter the signal is filtered by a 5 Hz low pass instead of the standard filter. The analog filter feature only applies to Low Power detectors when not in P-P mode. For High Power and Energy detectors, the analog filter feature is not available.

If an attempt is made to enable the analog filter for a detector that does not support it, an execution error will occur.

Related Commands: FILTER?

FILTER?
Filter Query

Syntax: FILTER?

Parameters: None

Function:

This query returns a value that represents the filter combination currently being used to condition readings.

Returns: <filter>

<filter> is of type <number> in a range of 0 to 3 with 0 corresponding to no filter, 1 to analog filter only, 2 to digital averaging filter only, and 3 to analog and digital filters combined.

This query will always return a 0 or 2 for High Power and Energy detectors because the use of the analog filter is not allowed with these types of detectors.

Related Commands: FILTER

LAMBDA
Lambda Select

Syntax: LAMBDA <wavelength>

Parameters:

The parameter <wavelength> is of type <number> which rounds to an integer with a range that depends on the detector being used. The units of <wavelength> is nanometers and should correspond to the wavelength of the light source being measured.

Function:

This command is used to specify the wavelength of light being measured. This will insure that the proper responsivity calibration point will be used when the 1835-C calculates measurement values.

Related Commands: ATTN, ATTN?, LAMBDA?, RESP?, USRCAL, USRCAL?, USRRESP, USRRESP?

LAMBDA?
Lambda Query

Syntax: LAMBDA?

Parameters: None

Function:

This query returns the wavelength that corresponds to the responsivity calibration point currently being used by the 1835-C in measurement calculation.

Returns: <wavelength>

<wavelength> is of type <number> and represents an integer. The units of <wavelength> is nanometers.

Related Commands: ATTN, ATTN?, LAMBDA, RESP?, USRCAL, USRCAL?, USRRESP, USRRESP?

LLO
Local Lockout Enable

Syntax: LLO <state>

Parameters:

The parameter <state> is either 0 or 1. If <state> is 0 then local lock-out is disabled. If <state> is 1 then local lock-out is enabled.

Function:

This command enables or disables the local lockout.

Returns: None

Related Commands: LLO?

LLO?
Local Lockout Enable Query

Syntax: LLO?

Parameters: None

Function:

The query returns the state of the local lockout.

Returns: <state>

<state> is of type <number> and represents the integer 0, if local lockout is disabled, or 1, if local lockout is enabled.

Related Commands: LLO

MODE
Acquisition Mode Select

Syntax: MODE <mode>

Parameters:

The parameter <mode> is of type <string>. Its range depends on the detector attached to the meter. The valid values for this parameter are listed below.

“DCSNGL”	specifies DC single mode
“DCCONT”	specifies DC continuous mode
“INTG”	specifies integration mode
“PPSNGL”	specifies P-P single mode
“PPCONT”	specifies P-P continuous mode
“SNGLPULSE”	specifies single pulse mode
“CONTPULSE”	specifies continuous pulse mode

Function:

This command sets the mode to be used to acquiring subsequent readings.

Note that the current units may be changed if they are not compatible with the new mode.

Related Commands: MODE?, UNITS, UNITS?

MODE?
Acquisition Mode Query

Syntax: MODE?

Parameters: None

Function:

This query returns the acquisition mode currently being used by the meter.

Returns: <mode>

<mode> is of type <string> in the double quote format.

Related Commands: MODE, UNITS, UNITS?

R?
Read Query

Syntax: R?

Parameters: None

Function:

This query returns the last valid measurement taken. The units of this measurement are the units defined at the time the reading was made. Because it is possible to make this query faster than measurements are actually being taken, the values returned by successive queries may be multiple reports of a single measurements.

To ensure that fresh data is being read the NVDA(new valid data available) bit in the Status Byte can be checked either by issuing a serial poll or by using the *STB? command. A serial poll is recommended if the GPIB interface is being used. The NVDA bit will be 1 if the last valid measurement has not been read. The bit is set to 0 immediately after this query, or the RWS? query, is executed and will stay 0 until a new valid reading is taken by the meter. A valid reading is a reading that would return a status of 0 using the RWS? query.

Returns: <number>

<number> is a floating point number in the exponential format.

Related Commands: *STB?, MODE, MODE?, RWS?, UNITS, UNITS?

RANGE
Signal Range Select

Syntax: RANGE <range>

Parameters:

The parameter <range> is of type <number>. A value of 0 represents the smallest signal range available for the current configuration of the meter.

Function:

This command is used to select a new manual signal range. This command will disable the auto ranging feature.

Related Commands: AUTO, AUTO?, RANGE?

RANGE?
Signal Range Query

Syntax: RANGE?

Parameters: None

Function:

This query returns a value that represents the current signal range setting being used whether the meter is auto ranging or in manual ranging mode.

Returns: <range>

<range> is of type <number> and represents the gain level currently being used for either auto or manual ranging. A value of 0 represents the smallest signal range.

Related Commands: AUTO, AUTO?, RANGE

REFVAL
Reference Value Select

Syntax: REFVAL <val>

Parameters:

The parameter <val> is of type <number>.

Function:

This command provides a means of directly storing a reference value to be used in linear and logarithmic (dB) relative measurements. The units of this value are watts for Low Power and High Power detectors and joules for Energy detectors.

Related Commands: REFVAL?, STOREF

REFVAL?
Reference Value Query

Syntax: REFVAL?

Parameters: None

Function:

This query returns the last stored reference value. This value will be in watts for Low-Power and High-Power detectors and joules for Energy detectors.

Returns: <refval>

<refval> is of type <number> in exponential notation.

Related Commands: REFVAL, STOREF

RESP?
Responsivity Query

Syntax: RESP?

Parameters: None

Function:

This query returns the responsivity value currently being used by the 1835-C in measurement calculation.

Returns: <val>

<val> is of type <number> and represents a floating point number. The units of the responsivity <val> depends upon the type of detector family of the detector in use. See Table 22 for a listing of responsivity units by detector family.

Related Commands: ATTN, ATTN?, LAMBDA, LAMBDA?, USRCAL, USRCAL?, USRRESP, USRRESP?

RUN
Start Acquisition

Syntax: RUN

Parameters: None

Function:

This command initiates the acquisition of data in the currently defined acquisition mode. In single type acquisition modes the RUN command will cause one reading to be acquired. In continuous type acquisition modes the RUN command will initiate the continuous acquisition of readings. The STOP command will terminate acquisition.

Related Commands: STOP

RWS?
Read With Status Query

Syntax: RWS?

Parameters: None

Function:

This query returns the last measurement taken. The units of this measurement are the units defined at the time the reading was made. Because it is possible to make this query faster than measurements are actually being taken, the values returned by successive queries may be multiple reports of the same measurement.

To ensure that fresh data is being read the NDA(new data available) bit in the Status Byte can be checked either by issuing a serial poll or by using the *STB? command. A serial poll is recommended if the GPIB interface is being used. The NDA bit will be 1 if the last measurement data has not been read.

The bit is set to 0 immediately after this query, or the R? query, is executed and will stay 0 until a new reading is taken by the meter. This query will also set the NVDA bit to 0.

Returns: <status>,<number>

<status> is an integer that represents the status of the returned value. <status> will be 0 for ok, 1 for over range, 2 for saturated and 3 for data error, and 4 for ranging.

<number> is a floating point number in the exponential format.

Related Commands: *STB?, MODE, MODE?, R?, UNITS, UNITS?

SFREQ
DC Sample Frequency Select

Syntax: SFREQ <freq>

Parameters:

The parameter <freq> is of type <number>. The range of this number depends on the current DC sample precision (see SPREC). If the precision is 20000 then the range is 0.001 to 25Hz. If the precision is 4096 then the range is 0.001 to 1000Hz.

Function:

This command determines how often a signal is sampled when in DC continuous mode.

Related Commands: SFREQ?, SPREC, SPREC?

SFREQ?
DC Sample Frequency Query

Syntax: SFREQ?

Parameters: None

Function:

This query returns the sample rate used for continuous DC acquisition.

Returns: <freq>

<freq> is of type <number> in exponent notation with units of hertz or samples per second.

Related Commands: SFREQ, SPREC, SPREC?

SPREC
DC Sample Precision Select

Syntax: SPREC <prec>

Parameters:

The parameter <prec> is of type <number> and with acceptable values of 20000 or 4096.

Function:

The 1835-C has a 20,000 count high precision A/D and a 4,096 count A/D. This command determines which of these A/Ds will be used to acquire samples during DC single and DC continuous acquisition modes. This command affects the available range of DC sample frequencies.

Note that the 4,096 count A/D is used during all other acquisition modes.

Related Commands: SFREQ, SFREQ?, SPREC?

SPREC?
DC Sample Precision Query

Syntax: SPREC?

Parameters: None

Function:

This query returns a string that indicates whether the 20,000 count A/D or the 4,096 count A/D will be used during DC CONT or DC SNGL acquisition modes.

Returns: <prec>

<prec> is of type <number>. It will be 20000 if the 20,000 count A/D is select and 4096 if the 4,096 count A/D is selected.

Related Commands: SFREQ, SFREQ?, SPREC?

STMAX?
Statistics Buffer Maximum Value Query

Syntax: STMAX?

Parameters: None

Function:

This query returns the maximum value in the statistics buffer.

Returns: <max>

<max> is of type <number> in exponent notation.

Related Commands: STMEAN?, STMIN?, STMXMN?, STSDEV?, STSIZE, STSIZE?,

STMEAN?
Statistics Buffer Mean Value Query

Syntax: STMEAN?

Parameters: None

Function:

This query returns the mean or average of all the values in the statistics buffer.

Returns: <mean>

<mean> is of type <number> in exponent notation.

Related Commands: STMAX?, STMIN?, STSDEV?, STMXMN?, STSIZE, STSIZE?

STMIN?
Statistics Buffer Minimum Value Query

Syntax: STMIN?

Parameters: None

Function:

This query returns the minimum value in the statistics buffer.

Returns: <min>

<min> is of type <number> in exponent notation.

Related Commands: STMAX?, STMEAN?, STSDEV?, STMXMN?, STSIZE, STSIZE?

STMXMN?
Statistics Buffer Max-Min Query

Syntax: STMXMN?

Parameters: None

Function:

This query returns the difference between the maximum and minimum readings in the statistics buffer.

Returns: <mxmn>

<mxmn> is of type <number> in exponent notation.

Related Commands: STMAX?, STMEAN?, STMIN?, STMXMN, STSIZE, STSIZE?

STSDEV?
Statistics Buffer Standard Deviation Query

Syntax: STSDEV?

Parameters: None

Function:

This query returns the standard deviation of the readings in the statistics buffer.

Returns: <stddev>

<stddev> is of type <number> in exponent notation.

Related Commands: STMAX?, STMEAN?, STMIN?, STMXMN, STSIZE, STSIZE?

STSIZE
Statistics Buffer Size Select

Syntax: STSIZE <size>

Parameters:

The parameter <size> is of type <number> which rounds to an integer in the range of 0 to 100. The parameter represents the size of the statistics buffer.

Function:

This command sets the size of the buffer used for calculating real-time statistics. The contents of this buffer are updated every time a reading is taken. The statistics buffer is cleared automatically when this command is issued or when the acquisition mode or units are changed.

If the buffer size is set to 0 then the statistics are disabled and no statistical information will be maintained.

Related Commands: STMAX?, STMEAN?, STMIN, STSIZE?, STSDEV?

STSIZE?
Statistics Buffer Size Query

Syntax: STSIZE?

Parameters: None

Function:

This query returns the statistics buffer size.

Returns: <size>

<size> is of type <number> and represents an integer in the range 0 to 100.

Related Commands: STMAX?, STMEAN?, STMIN, STMSMN?, STSDEV?, STSIZE

STOP
Stop Acquisition

Syntax: STOP

Parameters: None

Function:

This command terminates any acquisition of data currently in progress. If the meter is not acquiring data then this command has no effect.

Related Commands: RUN

STOREF
Store Reference Reading

Syntax: STOREF

Parameters: None

Function:

This command takes the latest reading and stores it as a reference reading to be used when making relative linear and dB measurements. The units of the reference reading defaults to Watts for Low-Power and High-Power detectors and Joules for Energy detectors.

Related Commands: REFVAL, REFVAL?

STOZERO
Store Zero Signal

Syntax: STOZERO

Parameters: None

Function:

This command takes the latest reading and stores it as a zero signal reference value to be used when zeroing is enabled. The units of the zero reference defaults to Amperes for Low-Power detectors and Volts for High-Power and Energy detectors.

Related Commands: ZERO, ZERO?, ZEROVAL?

TONE
Tone Enable

Syntax: TONE <state>

Parameters:

The parameter <state> is <number> which can be 0 or 1. If the number is 0 then the tone is disabled. If the number is 1, then tone is enabled.

Function:

This command enables or disables a tone feature that emits a short audible "tick" when a peak or pulse is detected in peak-to-peak or pulse acquisition modes.

This command will cause an error if the detector does not support peak-to-peak or pulse acquisition modes.

Related Commands: TONE?

TONE?
Tone Enable Query

Syntax: TONE?

Parameters: None

Function:

This query returns a value indicating whether the tone feature is not available, enabled or disabled.

Returns: <state>

<state> is a <number> which can be -1, 0 or 1. If -1 then the tone feature is not available for the detector in use. If 0 then the tone feature is disabled. If 1 then the tone feature is enabled.

Related Commands: TONE

TRIGOUT
Trigger Out Mode Select

Syntax: TRIGOUT <mode>

Parameters:

The parameter <mode> is of type <string>. The valid values for this parameter are listed below.

"CMPLT"	specifies conversion complete mode
"FREQ"	specifies frequency mode
"LVL"	specifies level comparator mode
"INTG"	specifies integration level mode
"OFF"	specifies off mode

Function:

This command determines in which mode the trigger out output on the backpanel will operate.

Certain modes require additional parameters to be set.

Related Commands: TRIGOUT, TRIGOUT?, TRIGOUTFREQ, TRIGOUTFREQ?, TRIGOUTINTG, TRIGOUTINTG?, TRIGOUTLVL, TRIGOUTLVL?, TRIGOUTPOL, TRIGOUTPOL?

TRIGOUT?
Trigger Out Mode Query

Syntax: TRIGOUT?

Parameters: None

Function:

This query returns the current mode of the trigger out output.

Returns: <mode>

<mode> is of type <string> in the double quote format.

Related Commands: TRIGOUT, TRIGOUTFREQ, TRIGOUTFREQ?, TRIGOUTINTG, TRIGOUTINTG?, TRIGOUTLVL, TRIGOUTLVL?, TRIGOUTPOL, TRIGOUTPOL?

TRIGOUTFREQ
Trigger Out Frequency Select

Syntax: TRIGOUTFREQ <freq>

Parameters:

The parameter <freq> is of type <number>. The range of this number is 0.001 to 1000Hz.

Function:

This command is used to set the frequency at which a pulse is output, on the trigger out, in trigger out frequency mode.

Related Commands: TRIGOUT, TRIGOUT?, TRIGOUTFREQ?, TRIGOUTINTG, TRIGOUTINTG?, TRIGOUTLVL, TRIGOUTLVL?, TRIGOUTPOL, TRIGOUTPOL?

TRIGOUTFREQ?
Trigger Out Frequency Query

Syntax: TRIGOUTFREQ?

Parameters: None

Function:

This query returns the trigger out pulse frequency used during trigger out frequency mode.

Returns: <freq>

<freq> is of type <number> in exponent notation with units of hertz.

Related Commands: TRIGOUT, TRIGOUT?, TRIGOUTFREQ, TRIGOUTINTG, TRIGOUTINTG?, TRIGOUTLVL, TRIGOUTLVL?, TRIGOUTPOL, TRIGOUTPOL?

TRIGOUTINTG
Trigger Out Integration Level Select

Syntax: TRIGOUTINTG <level>

Parameters:

The parameter <level> is of type <number> which specifies an integration energy level in joules.

Function:

This command is used to set the integration energy level at which the trigger out will become inactive if using the trigger out in integration mode.

Related Commands: TRIGOUT, TRIGOUT?, TRIGOUTFREQ, TRIGOUTFREQ?, TRIGOUTINTG, TRIGOUTLVL, TRIGOUTLVL?, TRIGOUTPOL, TRIGOUTPOL?

TRIGOUTINTG?
Trigger Out Integration Level Query

Syntax: TRIGOUTINTG?

Parameters: None

Function:

This query returns the trigger out integration energy level at which the trigger out will become inactive if using the trigger out in integration acquisition mode.

Returns: <level>

<level> is of type <number> in exponent notation with units of joules.

Related Commands: TRIGOUT, TRIGOUT?, TRIGOUTFREQ, TRIGOUTFREQ?, TRIGOUTINTG, TRIGOUTLVL, TRIGOUTLVL?, TRIGOUTPOL, TRIGOUTPOL?

TRIGOUTLVL
Trigger Out Level Select

Syntax: TRIGOUTLVL <level>

Parameters:

The parameter <level> is of type <number>. The units of this parameter are Watts for Low-Power and High-Power detectors and Joules for Energy detectors.

Function:

This command is used to set the level used by the trigger out level comparator mode. When the power, or energy level is at or above this level the trigger out will go to its active state.

Related Commands: TRIGOUT, TRIGOUT?, TRIGOUTFREQ, TRIGOUTFREQ?, TRIGOUTINTG, TRIGOUTINTG?, TRIGOUTLVL?, TRIGOUTPOL, TRIGOUTPOL?

TRIGOUTLVL?
Trigger Out Level Query

Syntax: TRIGOUTLVL?

Parameters: None

Function:

This query returns the trigger out level used by the trigger out level comparator mode.

Returns: <level>

<level> is of type <number> in exponent notation with units of Watts for Low-Power and High-Power detectors and Joules for Energy detectors.

Related Commands: TRIGOUT, TRIGOUT?, TRIGOUTFREQ, TRIGOUTFREQ?, TRIGOUTINTG, TRIGOUTINTG?, TRIGOUTLVL, TRIGOUTPOL, TRIGOUTPOL?

TRIGOUTPOL
Trigger Out Polarity Select

Syntax: TRIGOUTPOL <state>

Parameters:

The parameter <state> is a <number> which can be 0 or 1. If the number rounds to 0, then the polarity will be active low. If the number is 1, then the polarity will be active high.

Function:

This command is used to set the polarity of the trigger out output to either active low or active high.

Related Commands: TRIGOUT, TRIGOUT?, TRIGOUTFREQ, TRIGOUTFREQ?, TRIGOUTINTG, TRIGOUTINTG?, TRIGOUTLVL, TRIGOUTLVL?, TRIGOUTPOL?

TRIGOUTPOL?
Trigger Out Polarity Query

Syntax: TRIGOUTPOL?

Parameters: None

Function:

This query returns a value that indicates whether the trigger out polarity is active high or active low.

Returns: <state>

<state> is of type <number> and represents the integer 0, if the polarity is active low, or 1, if the polarity is active high.

Related Commands: TRIGOUT, TRIGOUT?, TRIGOUTFREQ, TRIGOUTFREQ?, TRIGOUTINTG, TRIGOUTINTG?, TRIGOUTLVL, TRIGOUTLVL?, TRIGOUTPOL

UNITS
Units Select

Syntax: UNITS <units>

Parameters:

<units> is of type <string>. All possible values of units are listed below:

"V"	specifies volts
"A"	specifies amps
"W"	specifies watts
"W/cm"	specifies watts/cm^2
"dBm"	specifies dBm
"dB"	specifies dB
"REL"	specifies linear ratio

"J"	specifies joules
"J/cm"	specifies joules/cm^2
"ERG"	specifies ergs
"E/cm"	specifies ergs/cm^2

A subset of these units will be valid for particular detector and acquisition mode.

Function:

Sets the units to be used for subsequent measurements. Once the units have been set, all new readings are given in the new units.

Related Commands: MODE, MODE?, UNITS?

UNITS?
Units Query

Syntax: UNITS?

Parameters: None

Function:

This query returns the units of readings currently being taken.

Returns: <units>

<units> is of type <string> in the double quote format.

The possible values of units are: "A", "V", "W", "W/cm", "dBm", "dB", "REL", "J", "J/cm", "ERG", or "E/CM" depending on the detector and acquisition mode.

Related Commands: MODE, MODE?, UNITS

USRCAL
User Calibration Enable

Syntax: USRCAL <state>

Parameters:

The parameter <state> is a <number> which can be 0 or 1. If the number is 0, then user calibration is disabled. If the number is 1, then user calibration is enabled.

Function:

This command enables or disables the use of a user defined calibration point.

Related Commands: ATTN, ATTN?, LAMBDA, LAMBDA?, RESP?, USRCAL?, USRRESP, USRRESP?

USRCAL?
User Calibration Enable Query

Syntax: USRCAL?

Parameters: None

Function:

This query returns a value showing whether or not user calibration is enabled or disabled.

Returns: <state>

<state> is of type <number> and represents an integer 0, if user calibration is disabled, or 1, if user calibration is enabled.

Related Commands: ATTN, ATTN?, LAMBDA, LAMBDA?, RESP?, USRCAL, USRRESP, USRRESP?

USRRESP
User Responsivity Factor Select

Syntax: USRRESP <val>

Parameters:

The parameter <val> is of type <number>. The units of this parameter match the responsivity units of the detector in use.

Function:

This command is used to define a responsivity factor that will be used by the 1835-C in measurement calculation when user calibration is enabled.

Related Commands: ATTN, ATTN?, LAMBDA, LAMBDA?, RESP?, USRCAL, USRCAL?, USRRESP?

USRRESP?
User Responsivity Factor Query

Syntax: USRRESP?

Parameters: None

Function:

This query returns the user defined responsivity factor that will be used by the 1835-C in measurement calculation when user calibration is enabled.

Returns: <val>

<val> is of type <number> and represents a floating point number. The units of <val> match the responsivity units of detector in use.

Related Commands: ATTN, ATTN?, LAMBDA, LAMBDA?, RESP?, USRCAL, USRCAL?, USRRESP

ZERO
Signal Zeroing Enable Query

Syntax: ZERO <state>

Parameters:

The parameter <state> is a <number> which can be 0 or 1. If the number is 0, then readings are not adjusted by the stored zero reference. If the number is 1, then readings are adjusted by the stored zero reference.

Function:

This command enables or disables the zeroing feature. Zeroing causes the stored zero reference (see STOZERO command) to be subtracted from incoming signal readings before the incoming signal is used in measurement calculations.

Related Commands: STOZERO, ZERO?, ZEROVAL

ZERO?
Signal Zeroing Enable Query

Syntax: ZERO?

Parameters: None

Function:

This query returns a value showing whether or not zeroing is enabled or disabled.

Returns: <state>

<state> is of type <number> and represents the integer 0, if zeroing is enabled, or 1, if zeroing is disabled.

Related Commands: STOZERO, ZERO, ZEROVAL

ZEROVAL?
Zero Signal Query

Syntax: ZEROVAL?

Parameters: None

Function:

This query returns the current value being used for zeroing.

Returns: <zeroval>

<zeroval> is of type <number> in exponential notation. The units of this value are the numerator of the detector's responsivity, i.e. amps for Low Power detectors and volts for High Power and Energy detectors.

Related Commands: STOZERO, ZERO, ZERO?

Section 6
Maintenance, Test and Troubleshooting

6.1 Maintenance Procedures

In cleaning the body of this instrument, use only a mild soap and water solution on a damp cloth.

CAUTION

Do not use acetone or other organic solvents (other than alcohol) on the Model 1835-C Multi-Function Optical Meter. Organic solvents attack the paint.

6.2 Power Up Self Test

The Model 1835-C executes a system self test after every power up or reset and indicates on the display whether the self test has been passed. If the self test is not passed the display will indicate one of the following error messages:

"CAL MODULE ERROR"
"REGISTER ERROR"
"INTG A/D ERROR"
"SA A/D/ ERROR"
"KEYPAD ERROR"

If "CAL MODULE ERROR" appears, check to see that the module is properly inserted.

Should any other message appear, call Newport Corporation's Customer Service Department.

6.3 Troubleshooting Guide

The following troubleshooting guide is intended to isolate and solve problems with the power meter so that, to the greatest extent possible, the return of the power meter/detector system to Newport will be unnecessary. For the

problems that cannot be resolved with information in this manual, or for other situations that are not covered in this section, please see Section 7 for details on returning your entire system to Newport for service.

Table 27. Symptom/Fault Troubleshooting Guide

Symptom	**Possible Fault/Correction**
Blank display.	Power switch OFF. Turn switch ON.
	Power cord connection is absent. Check power cord connection.
Display shows "OL"	Indicates that the signal is too large for the selected signal range. Select a higher RANGE or use an attenuator if one is available.
Display shows "SA"	Indicates that the signal exceeds the detector saturation or damage threshold. Select a detector with higher power or energy handling capability or use an attenuator if one is available.
Display shows "-----"	Indicates that the meter is in the middle of a range change or that the current units don't match the units of the last reading.
Any of the following messages:	
"REGISTER ERROR" "INTG A/D ERROR" "SA A/D ERROR" "KEYPAD ERROR"	Call Newport Corporation's Customer Service Department and arrange to return the unit for repair.
The display shows:	
"CAL MODULE ERROR" and "MISSING OR BAD"	Make sure the CAL MODULE is seated correctly and reset the meter. Try a second CAL MODULE, if one is available, to localize the problem to the first CAL MODULE.
	If the first CAL MODULE does not work after proper seating and reset, but the second CAL MODULE works, call Newport Customer Service and arrange for a repair of the first CAL MODULE.
	If neither the first or second CAL MODULE works, call Newport Customer Service and arrange for a meter repair. Be sure to also return the first CAL MODULE if you cannot otherwise determine that it is working.
The display shows:	
"CAL MODULE ERROR" and "CHECKSUM ERROR"	Call Newport Customer Service and arrange to return the meter for repair.

The display shows:	
"BATTERY FAILURE"	Call Newport Customer Service and arrange to return the meter for battery replacement.
RS-232 communication does not seem to work	Check the RS-232 cable connection and cable pinouts, Figure 17. Make sure that the device talking to the meter is setup for 8 data bits, no parity, and 1 stop bit. Also check the echo mode state.
No listener error when attempting GPIB communications	Check the GPIB cable connections and the GPIB address.
Display value does not change.	Press the R/S key.
Reading is different than expected.	See Table 23 Common Measurement Errors. Section 3.10.6.

Section 7
Factory Service

7.1 Introduction

This section contains information regarding obtaining factory service for the Model 1835-C Multi-Function Optical Meter. The user should not attempt any maintenance or service of this instrument and/or accessories beyond the procedures given in Section 6: Maintenance, Test and Troubleshooting. Any problems which cannot be resolved using the guidelines listed in Section 6 should be referred to Newport Corporation factory service personnel. Contact Newport Corporation or your Newport representative for assistance.

The Model 1835-C contains no user serviceable parts. Its calibration accuracy is warranted for a period of 1 year. After 1 year, the unit should be returned to Newport Corporation for recalibration and NIST traceability recertification.

7.2 Obtaining Service

To obtain information concerning factory service, contact Newport Corporation or your Newport representative. Please have the following information available:

1. Instrument model number (On front panel)
2. Instrument serial number (On rear panel)
3. Description of the problem.

If the instrument is to be returned to Newport Corporation, you will be given a Return Number, which you should reference in your shipping documents.

Please fill out the service form, located on page 87, and have the information ready when contacting Newport Corporation. Return the completed service form with the instrument.

Service Form

Newport Corporation
U.S.A. Office: 949/863-3144
FAX: 949/253-1800

Name _____ RETURN AUTHORIZATION # _____

Company _____ (Please obtain prior to return of item)

Address _____

Country _____ Date _____

P.O. Number _____ Phone Number _____

Item(s) Being Returned:

Model # _____ Serial # _____

Description _____

Reason for return of goods (please list any specific problems) _____

_____

List all control settings and describe problem _____

_____

_____

_____(Attach additional sheets as necessary).

Show a block diagram of your measurement system including all instruments connected (whether power is turned on or not). Describe signal source. If source is a laser, describe output mode, peak power, pulse width, repetition rate and energy density.

Where is the Measurement Being Performed?

(factory, controlled laboratory, out-of-doors, etc.) _____

What power line voltage is used? _____ Variation? _____

Frequency? _____ Ambient Temperature? _____

Variation? _____ °F. Rel. Humidity? _____ Other? _____

Any additional information. (If special modifications have been made by the user, please describe below).

_____

_____

_____

_____

Appendix A
Syntax and Definitions

A.1 Definition of <*string*>

The IEEE 488.2 standard defines two type of string data. These strings are either single or double quoted. For convenience, the 1835-C also recognizes an unquoted string with certain restrictions as detailed below. Any of these forms may be used where a <*string*> parameter is required.

1. <*string*>, using double quotes. **"this is a string"**
2. <*string*>, using single quotes. **'this is a string'**
3. <*string*>, using no quotes. **thisisastring**

A description of each type of <*string*> follows:

1. <*string*> defined using double quotes.

   A double quote indicates that a string follows, and the string is terminated by another double quote. A double quote may be embedded within the string by using two double quotes together:

   Example: "this string contains a "" double quote"

   All characters within the two outer double quotes are considered part of the string. It is an error if the string does not terminate with a double quote. The string cannot contain the <CR>(ascii decimal 13), <LF>(ascii decimal 10), or End Of Identify characters.

2. *string*> defined using single quotes.

   This form is similar to double quoted string. A single quote indicates that a string follows, and the string is terminated by another single quote. A single quote may be embedded within the string by using two single quotes together:

   Example: 'this string contains a '' single quote'

   All characters within the two outer single quotes are considered part of the string. It is an error if the string does not terminate with a single quote. The string cannot contain the <CR>(ascii decimal 13), <LF>(ascii decimal 10), or End Of Identify characters.

3. <*string*> defined using no quotes.

   All strings using this format must start with an alphabetic character (A through Z, a through z). All other characters must be either alphabetic, digit (0 through 9) or the '_' character. Any other character will deliminate the string.

Some examples are shown below:

Sent:	this is a string	
Interpreted:	this	(1st string)
	is	(2nd string)
	a	(3rd string)
	string	(4th string)
Sent:	this,isastring	
Interpreted:	this	(1st string)
	,	(separator character)
	isastring	(2nd string)
Sent:	w/cm	
Interpreted:	w	(1st string)
	ERROR	(unrecognized character)
	cm	(2nd string)

A.2 Definition of <number>

The IEEE 488.2 standard defines four different types of numeric data. The 1835-C recognizes all four types as *number*>, thus any format may be used.

1. <*number*> defined as floating point.
2. <*number*> defined as binary.
3. <*number*> defined as octal.
4. <*number*> defined as hexadecimal.

Where necessary, integers are converted to floating point numbers. In all cases, a number is terminated by any of the below characters:

, ; <NL> <EOI> <SPACE>

Any non-valid characters detected in any number received are considered an error in format, and an error condition will be generated in the system. There are no differences between the 1835-C and IEEE-488.2 standard for number definition.

A description of each type of <*number*> follows:

1. <*number*> defined as floating point.

   Any of the following characters, as the first character of an ASCII sequence, indicates that a number is being defined:

   + – . 0 1 2 3 4 5 6 7 8 9

   A floating point number is defined as follows:

   1. Optional + – sign. This defines the sign of the number. If missing, positive is assumed.
   2. Optional 0 - 9 digits. These digits define the integer portion of the mantissa.
   3. Optional . decimal point. This defines the end of the integer portion of the mantissa, and indicates that the fractional portion of the mantissa follows.

4. Optional 0 - 9 digits. These digits define the fractional portion of the mantissa.

5. Optional exponent indicator, an ASCII 'E' or 'e', followed by a '+' or '–' (optional), followed by decimal digits.

Examples:

the numbers below all represent the value "1.2"

1.2

1.2e0

+01.2E+00000

120E-2

.12e1

the numbers below all represent the value "–1.2"

–1.2

–1.2e+00

–0001.2e+0

–120e-2

.12E1

2. <number> defined as binary.

The 1835-C recognizes unsigned binary numbers in the range of 0 to 65535, decimal, or 0 to 1111111111111111 binary. Binary numbers are represented using only the digits 0 and 1. A binary number has the following format:

#B<*binary*>

Where

#B = mandatory binary number header

<*binary*> = binary digits (0's or 1's)

Example:

All numbers below represent the decimal value 129.

#B10000001

#b010000001

#b10000001

3. <*number*> defined as octal.

   The 1835-C recognizes unsigned octal numbers in the range 0 to 65535 decimal, or 0 to 177777 octal. Octal numbers are represented using digits from 0 to 7. An octal number has the following format:

   #Q<*octal*>

   Where

   #Q = mandatory octal number header

   <*octal*> = octal digits (0 to 7)

   Example:

   All numbers below represent the decimal value 129.

   #Q201

   #q0201

   #q201

4. <number> defined as hexadecimal.

   The 1835-C recognizes unsigned hexadecimal numbers in the range 0 to 65535 decimal, or 0 to FFFF hexadecimal). Hexadecimal numbers are represented using the digits 0 - 9 and the characters A - F. A hexadecimal number has the following format:

   #H<*hexadecimal*>

   Where

   #H = mandatory octal number header

   <*hexadecimal*> = hexadecimal digits (0 - 9 and A - F)

   Example:

   All numbers below represent the decimal value 127.

   #H7f

   #H007F

   #h7f

Appendix B
Error Messages

The IEEE 488.2 standard defines certain bits in the status registers as error condition flags. When an error occurs, one of the error bits is set in the status registers. The bit enable masks and the service request enable allow the 1835-C to alert the remote controller that an error has occurred. The standard allows error numbers that range from -100 to -499.

When using the RS-232C port the RS-232 Echo Mode controls when errors are returned. When the Echo Mode is enabled the errors are returned immediately. When the Echo Mode is disabled the errors are not returned immediately and the *ERR? command must be used to retrieve the errors.

B.1 Command Errors

Command Errors are associated with the conversion of the data received into the commands and their parameters (parsing). Incorrect syntax, incorrect parameters, and improper command format will generate these errors. Any command error will cause the Command Error bit (bit 5) in the Standard Event Status Byte to be set.

-102,"Syntax error"

Occurs when an error in command structure or parameter type is detected. Some typical causes are:

Using a number as a command mnemonic.
Using the wrong parameter type.
Using ASCII characters outside of a string constant that are not defined by the command language syntax.
Missing or too many parameters.

The above list in not exhaustive but does give the basic idea of what to look for.

-110,"Command header error"

This error is generated when the system parser detects an invalid character in a command header.

-113, "Undefined Header"

This error is generated when the 1835-C does not recognize a command header.

-121,"Invalid character in number"

This error indicates that a numeric parameter contains an invalid character or a character in the wrong place. The only characters allowed in a number are:

0-9 e E . + –

When using the binary number format, the only characters allowed are:

0 1

When using the octal number format, the only characters allowed are:

0 1 2 3 4 5 6 7

When using the hexadecimal number format, the only characters allowed are:

0-9 A-F a-f

-150,"String data error"

This error is generated when the system parser detects an error in string type data.

-151,"Invalid string data"

Usually caused by an error in string termination. The IEEE 488.2 standard defines all quoted strings as having a closing quote. If the closing quote is missing, usually due to a <NL> character being embedded in the string, this error will be generated.

-191,"Out of string space"

Generated when the system parser runs out of space for commands and parameters. It may occur if commands are not terminated correctly.

-192,"Out of token space"

Occurs when the system parser detects more command elements (headers and parameters) than it can handle. It may also occur if commands are not terminated correctly.

B.2 Execution Errors

Execution Errors are associated with the interpretation of the converted commands and parameters received. Incorrect parameter values and numerical range errors are types of execution errors. Any execution error will cause the Execution Error bit (bit 4) in the Standard Event Status Byte to be set.

-220,"Parameter error"

This is a general parameter error. If this error occurs the parameter may be invalid or inappropriate.

-222,"Data out of range"

This error will occur if a parameter is out of a valid range or not in the set of valid parameters for a given command.

-286, "Configuration not compatible"

This error will occur if an attempt is made to recall a system configuration that is not compatible with the detector currently attached to the meter.

-287, "Configuration not available"

This error will occur if an attempt is made to recall a system configuration that has not been saved to and is therefore not available.

-288, "Command not available"

This error will occur if an attempt is made to use a command that is not available for the detector in use.

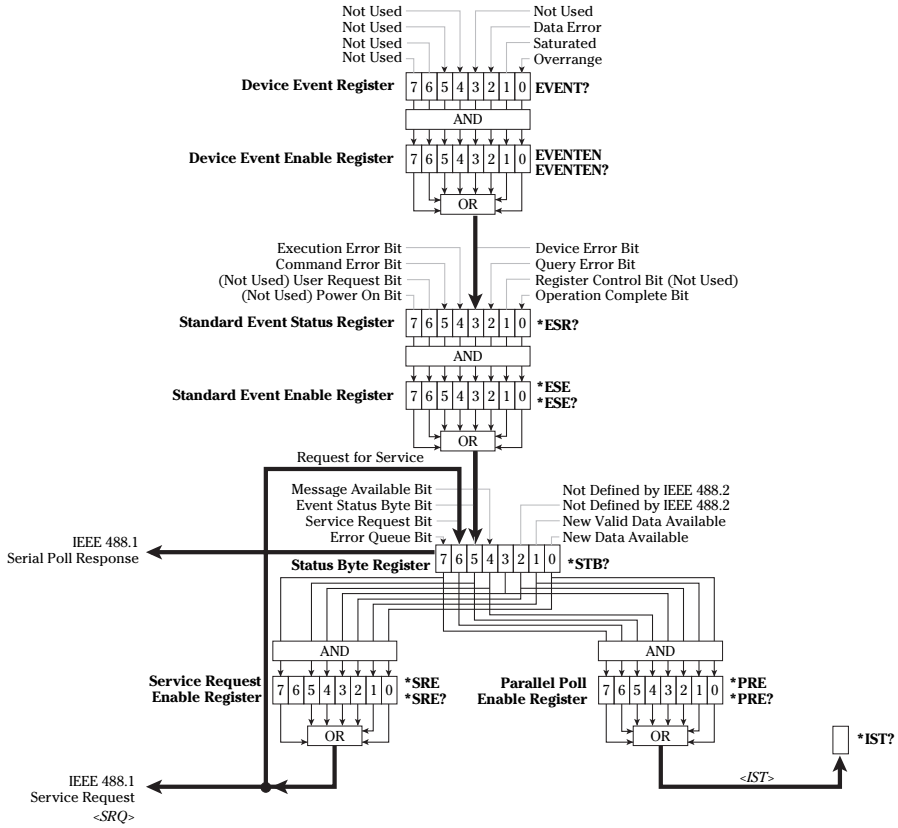
B.3 Device Errors

Device Errors are associated with some system condition that affects the operation of the meter. Errors associate with data reading will set the appropriate bit but will not generate an error message to avoid jamming the error queue or the interface

Appendix C
Status Reporting System

On this page is a graphical representation of the status reporting system for the GPIB and RS-232 port communications. Following, is a detailed description of each register and how the bits are set and reset. The interactions between registers is discussed as well as the generation of a GPIB Service Requests.

C.1 Status Reporting System Flowchart



C.2 Device Event Register

The Device Event Register is used to record device errors associated with some system condition that affects the operation of the meter. When a bit is set (has a value of one) then the condition is true. The bit remains set until cleared by the EVENT? query or *CLS command.

The Device Event Enable Register is used to define the conditions that will set the Device Error bit in the Standard Event Status register. If a bit is set in the Device Event Register and its corresponding bit is set in the Device Event Enable Register, then the Device Error bit in the Standard Event register will be set.

The Device Event Enable Register is configured by using the EVENTEN command.

The Device Event Register is described below. The register is bit mapped, with each bit representing the described condition. The bits are listed most significant bit first.

Device Event Register

bit 7-bit 3: Not Currently Used.

bit 2: Data Error

A one in this bit indicates that a data error occurred during reading calculations. These errors will include such conditions as divide by zero or taking the log of a negative number.

bit 1: Saturated

Many detectors contain information in their CAL MODULE that indicates when the detector saturates or is otherwise over driven. A one in this bit indicates that a reading was taken at or above this saturation level.

bit 0: Overrange Error

A one in this bit indicates that an overrange condition occurs when taking a reading.

C.3 Standard Event Status Register

The Standard Event Status Register is used to record general system event conditions for the status reporting system. The register is bit mapped, meaning that each condition is represented by a bit. When a bit is set (has a value of 1), then the condition is true. The bit remains set until cleared by the *ESR? query or the *CLS command.

The Standard Event Enable Register is used to define the conditions that will set the Event Status Byte bit (bit 5) in the Status Byte. If a bit is set in the Standard Event Status register and its corresponding bit is set in the Standard Event Enable Register, then the Event Status Byte bit (bit 5) in the Standard Event Register will be set.

The Standard Event Enable Register is configured by using the *ESE common command.

Each of the bits in the Standard Event Status Register is described below.

Standard Event Status Register

bit 7: Power On Not used by the 1835-C.

bit 6: User Request Not used by the 1835-C.

bit 5: Command Error

A 1 in this bit indicates that the 1835-C has received a remote command that generated a command error.

bit 4: Execution Error

A 1 in this bit indicates that the 1835-C has received a remote command that generated an execution error.

bit 3: Device Error

A 1 in this bit indicates that an unmasked device error has occurred.

bit 2: Query Error

A 1 in this bit indicates that a query error has occurred.

bit 1: Request Control This bit is always 0.

bit 0: Operation Complete

This bit is controlled by the *OPC command. If the *OPC command is in effect, then this bit will be set to 1 when all pending operations have completed. To operate correctly, this bit should be cleared by the *CLS command or *ESR? query before the *OPC command is issued again.

C.4 Status Byte

The Status Byte register is used to record a summary of current system conditions for the status reporting system. It is returned to the controller when a serial poll of the 1835-C is conducted or when the *STB? query is issued. The register is bit mapped, meaning that each condition is represented by a bit. When a bit is set, or has a value of 1, then the condition is true. The bits are cleared based on the conditions described for each bit.

The Service Request Enable register is used to define the conditions that will generate a IEEE 488.1 <SRQ>. When an event occurs that causes a bit to be set in the Status Byte register and its' corresponding bit is set in the Service Request Enable register, then a <SRQ> will be generated when that bit is set.

The Service Request Enable Register is configured by using the *SRE common command.

The Parallel Poll Enable Register is used with the Status Byte to generate the <IST> message. If any bit is set in the Status Byte and it's corresponding bit is set in the Parallel Poll Enable Register, then the <IST> message is set true (a value of one). Otherwise the <IST> message is set false (a value of zero).

When a parallel poll is conducted with the 1835-C configured to respond to it, the <IST> message is compared to the <S BIT> (sense bit). If they are the same then the configured data line will be driven true in response to the parallel poll.

Both the <S BIT> and the data line driven during a parallel poll can be selected by the IEEE 488.1 parallel poll remote configuration command.

The Parallel Poll Enable Register is configured by using the *PRE command.

The Status Byte Register is described below.

Status Byte

bit 7: Error Queue

A one in this bit indicates that the error queue is not empty (see the *ERR? query). The *CLS command will empty the error queue and, as a result, this bit.

bit 6: Service Request/Master Summary Status

When the status byte is read by means of a serial poll, this bit is set when the 1835-C is requesting service.

When the status byte is read by means of the *STB? query, this bit will be set if any bit in the status byte is set and its corresponding bit is set in Service Request Enable Register.

bit 5: Event Status Byte

The Event Status Byte bit is set when a bit in the Standard Event Status register is set and its corresponding bit in the Standard Event Enable register is set. The *CLS command or *ESR? query will clear the Standard Event Status register and, as a result, this bit.

bit 4: Message Available

The Message Available MAV bit becomes set when any message is ready to be transmitted over the GPIB interface (not the RS-232 interface). Once the message is sent, the MAV bit is cleared. A GPIB device clear command will clear the output queue and, as a result, this bit.

NOTE: After a query is issued over the GPIB interface this bit should be checked by means of a serial poll before attempting to read the query response.

bit 3: Not used

bit 2: Not used

bit 1: New Valid Data Available

The New Valid Data Available NVDA bit becomes set when a new reading has been taken by the 1835-C that is not overrange, did not saturate the detector, did not cause a data error and was not taken while ranging. It is cleared by the R? or RWS? queries.

bit 0: New Data Available

The New Data Available NDA bit becomes set when a new reading has been taken by the 1835-C. It is cleared by the R? or RWS? queries.

Appendix D
Sample Programs

D.1 Example Program: RS-232C Communication

```
10 '********************* Program Header ***************************
20 'NEWPORT CORPORATION
30 '1835-C to RS232 Communication Program - an example program
40 '
50 'This program is designed to show you how to write a simple
60 'program that will write commands and read query responses to and
70 'from the 1835-C Multi-Function Optical Meter via the RS-232 port on the
80 'Rear Panel and the RS-232 port on an IBM PC/AT or compatible.  The
90 'Program was written in MICROSOFT GWBASIC on an IBM AT compatible.
100 '
110 'Written By: Darwin D. Smith
120 '    Date: April 28, 1993
130 '************************ End of Header ************************
1000 'Beginning of program
1010    'Open COM port with the following specifications:
1020    'COM port 1, 9600 baudrate, no parity, 8 data bits & 1 stop bit
1030    OPEN "COM2:9600,N,8,1" FOR RANDOM AS #1
1040    GOSUB 2000                      'Draw header on the screen
1050    GOSUB 3000                      'Process user input
1060    CLOSE #1                        'Close the COM file
1070 END 'End of program
1080 '
2000 'Main.Screen: Draw the main screen.
2010   CLS
2020   LOCATE 1, 20: PRINT "N E W P O R T   C O R P O R A T I O N"
2030   LOCATE 2, 20: PRINT "1835-C to RS-232 Communication Program"
2040   LOCATE 3, 20: PRINT "         q or Q to Quit"
2050 RETURN
2060 '
3000 'Enter.User.Commands: Get and interpret the user's commands.
3010   WHILE (1)   'Get and process user input until Q or q is input.
3020     RS232OUT$ = ""                'Clear RS232out$ string
3030     LINE INPUT RS232OUT$          'Get the user input
3040     IF RS232OUT$ = "Q" OR RS232OUT$ = "q" THEN RETURN ELSE GOSUB 4000
3050     'Assume strings ending with "?" are queries
3060     IF INSTR(RS232OUT$, "?") = 0 THEN GOTO 3090
3070       GOSUB 5000
3080     'END IF
3090   WEND
3100 RETURN
3110 '
4000 'Write.RS232.String: Write the string RS232OUT$ to the RS232 port
4010   PRINT #1, RS232OUT$    'PRINT # appends <CR><LF> to the string
4020 RETURN
4030 '
5000 'Read.RS232.String: Read a string from the 1835-C RS232 port.
5010 'Characters are read one at a time until a <LF> character is
5020 'read or 8 seconds elapse between consecutive character reads.
5030 'At the end of the routine the string read is in RS232IN$.
5040   BUFFER$ = CHR$(0)           'Initialize buffer$ to NULL character
5050   RS232IN$ = ""
5060   TIMEOUT.ERROR% = 0          'Initiate to no timeout error
5070   ON TIMER(8) GOSUB 6000      'Set timer for a 1 second time out
5080   TIMER ON                    'Turn on timer
5090   'While port doesn't timeout and string deliminator <LF> not
```

```
5100   'read, continue trying to read input on COM port.
5110   WHILE TIMEOUT.ERROR% = 0 AND BUFFER$ <> CHR$(10)
5120     IF LOC(1) = 0 THEN GOTO 5170
5130       TIMER OFF
5140       BUFFER$ = INPUT$(1, #1)
5150       RS232IN$ = RS232IN$ + BUFFER$
5160       TIMER ON
5170     'END IF
5180   WEND
5190   TIMER OFF
5200   IF TIMEOUT.ERROR% = 0 THEN GOTO 5230
5210     PRINT "Timed out when reading RS-232 port."
5220     TIMEOUT.ERROR% = 0
5230   'ELSE
5240     PRINT RS232IN$;
5250   'END IF
5260 RETURN
5270 '
6000 'timeout: Set TIMEOUT.ERROR% flag.  Called if t seconds, as
6010 'defined by ON TIMER(t), in the Read.RS232.String, has elapsed
6020 'between TIMER ON AND TIMER OFF.
6030   TIMEOUT.ERROR% = 1
6040 RETURN
10000 END 'End of Program Listing
```

D.2 Example Program: IEEE-488 Communication

```
'********************** Program Header ******************************
'NEWPORT CORPORATION
'1835-C to IEEE-488 Communication Program - an example program
'
'The following program is designed to be an example of how to write a simple
'program that will write commands and read query responses to and from
'the 1835-C Multi-Function Optical Meter via the IEEE-488 port.
'
'This program was written on an IBM AT compatible using QuickBASIC 4.5
'  and software routines included with the GPIB board.
'The GPIB board used was:  National Instruments GPIB-PC2A board
'                         Newport Corporation pn LA-PC-488-2A-5
'The interface cable was:  Newport Corporation pn LA-CABLE-2M488
'
'NOTE: Before running this program follow National Instrument's instructions
'      for hardware and software installation.  This program uses the GPIB
'      configuration device named DEV5 which uses GPIB address 5 by default.
'      All routines that begin with the letters "IB" are defined in the
'      National Instruments library.
'
'Written By: Darwin D. Smith
'      Date: April 28, 1993
'************************ End of Header ***********************************
'Beginning of program
'$INCLUDE: 'E:\b45\QBDECL4.BAS'          'Use your own path here.
'Beginning of program
    IEEEout$ = "DEV5"                    'Use this name or assign a new one
   CALL IBFIND(IEEEout$, device.number%) 'Setup the device.number% variable
                                         'used in GPIB-PC routine calls.
    IF device.number% < 0 THEN
      PRINT "Unable to find "; IEEEout$; " device."
      STOP
    END IF
    GOSUB Main.Screen                    'Draw header on the screen
    GOSUB Enter.User.Commands            'Process user input
END  'End of program

'Main.Screen: Draw the main screen.
Main.Screen:
  CLS
  LOCATE 1, 22: PRINT "N E W P O R T   C O R P O R A T I O N"
  LOCATE 2, 19: PRINT "1835-C to IEEE-488 Communication Program"
  LOCATE 3, 19: PRINT "          Q or q to Quit"
RETURN

'Enter.User.Commands: Get and interpret the user's commands.
Enter.User.Commands:
  DO    'Get and process user input until Q, or QUIT input.
    IEEEout$ = ""                        'Clear IEEEout$ string
    LINE INPUT IEEEout$                  'Get the user input
    IEEEout$ = UCASE$(IEEEout$)          'Convert input to upper case
    SELECT CASE IEEEout$
      CASE "Q", "QUIT"                     'Exit on Q
        RETURN
      CASE "IBCLR"                       'Allow a device clear
        CALL IBCLR(device.number%)
      CASE "IBRSP"                       'Allow a serial poll
        CALL IBRSP(device.number%, poll%)
        PRINT poll%
      CASE ELSE
        GOSUB Write.IEEE.String          'Write user input to IEEE port
        IF INSTR(IEEEout$, "?") <> 0 THEN 'If command was a query
          GOSUB Read.IEEE.String         '  Read input data on IEEE port
        END IF
    END SELECT
  LOOP WHILE 1 = 1
RETURN
```

```
'Write.IEEE.String: Write the string IEEEout$ out to the IEEE port.
Write.IEEE.String:
  IEEEout$ = IEEEout$ + CHR$(10)          'Append a <LF> to IEEEout$
  CALL IBWRT(device.number%, IEEEout$)    'Write IEEEout$ to IEEE-488 port
RETURN

'Read.IEEE.String: Read a string from the PMC200P IEEE port.  The string
'  read from the IEEE-488 port is printed on the screen.  If the MAV bit
'  in the status byte doesn't go high after 8 seconds then this routine
'  will timeout.  Otherwise the query response is in IEEEin$
Read.IEEE.String:
  timeout.error% = 0                      'Initiate to no timeout error
  poll% = 0
  IEEEin$ = SPACE$(255)                   'Initiate IEEEin$ to 255 spaces
  ON TIMER(8) GOSUB timeout

  'wait for MAV bit in the status byte to be set or a timeout to occur
  TIMER ON
  WHILE ((poll% AND &H10) = 0) AND (timeout.error% = 0)
    CALL IBRSP(device.number%, poll%)
  WEND
  TIMER OFF

  IF (timeout.error% = 1) THEN
    PRINT "IEEE-488 port timed out when trying to read input."
  ELSE
    CALL IBRD(device.number%, IEEEin$)    'Read IEEE-488 port
    IEEEin$ = RTRIM$(IEEEin$)             'Trim trailing spaces
    PRINT IEEEin$;                        'Print the query response
  END IF
RETURN

'timeout: Set timeout.error% flag.  This routine is called if t seconds,
'as defined by the ON TIMER(t) function call, has elapsed between TIMER ON
'and TIMER OFF.
timeout:
  timeout.error% = 1
RETURN

END  'End of Program Listing
```

Newport Corporation

Worldwide Headquarters

1791 Deere Avenue

Irvine, CA 92606

(In U.S.): 800-222-6440

Tel: 949-863-3144

Fax: 949-253-1680

Internet: sales@newport.com

Newport®

Visit Newport Online at: **www.newport.com**

ISO 9001
FM 27207

Newport Corporation, Irvine, California, has been certified compliant with ISO 9001 by the British Standards Institution.

P/N 20061-01, Rev. D
IN-05931 (02-00)
Printed in the USA