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1830-C Optical Power Meter

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Warranty

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.

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EC DECLARATION OF CONFORMITY

Model 1830-C

We declare that the accompanying product, identified with the "CE" mark, meets the intent of the Electromagnetic Compatibility 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.

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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 than 42VDC or 42V peak AC. Do not exceed 42V between any portion of the Model 1830-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 1830-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 8 of this manual.

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Definitions

A	amps
ADC	analog-to-digital converter
BNC	standard coaxial connector type
degree C	degrees Centigrade
Hz	Hertz (cycles per second)
k	kilo (10^3)
kHz	kilohertz
kΩ	kilo-ohms
µ	micro (10^{-6})
m	milli (10^{-3})
mA	milliamps
mV	millivolts
n	nano (10^{-9})
nA	nanoamps
nm	nanometers
RH	relative humidity
S/N	serial number
µA	microamps
µs	microseconds
V	volts
W	watts

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Specifications

Dimensions:	3.7 x 7.5 x 9.0 in. (94 x 191 x 229 mm)
Weight:	5 lb (2.3 kg)
Enclosure:	Metal case, painted
Connectors:	Calibration Module: 8-Pin Sub Mini DIN Analog Output: BNC RS-232: 9 pin D-Sub GPIB: 24 Conductor D
Power :	100-120, 220-240 VAC ±10%, 50/60 Hz
Absolute Maximum Line Current Rating:	200 mA
Signal Ranges:	Up to 8 decades (dependent on detector type)
Display:	4.5 digit, annunciated, backlit, wide angle view LCD
Display Update Rate:	75 ms
Auto-Ranging Time:	200 ms (typical)
GPIB Bus Transfer Time:	10 ms (typical)
Operating Environment:	0 to +40 degree C; < 70% RH noncondensing
Storage Environment:	–20 to +60 degree C; < 90% RH noncondensing
Compatible Detectors:	Low-Power (Semiconductor) Family

Signal Range[1, 2]	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Full-Scale Current[3]	2 nA	20 nA	200 nA	2 µA	20 µA	200 µA	2 mA	5 mA
Gain	1000 M	100 M	10 M	1 M	100 k	10 k	1 k	100
Resolution	0.1 pA	1 pA	10 pA	100 pA	1 nA	10 nA	100 nA	1 µA
Analog Bandwidth[4]	45 Hz	45 Hz	2 kHz	2 kHz	10 kHz	30 kHz	10 kHz	30 kHz
Full-Scale Accuracy[5] (Typical)	0.2 %	0.2 %	0.2 %	0.2 %	0.2 %	0.2 %	0.2 %	0.2 %
Full-Scale Accuracy[5] (Worst Case)	0.4 %	0.4 %	0.4 %	0.4 %	0.4 %	0.4 %	0.4 %	0.4 %

[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" in Table 2.
[3]Full scale current may vary due to the Auto-Calibration compensation of amplifier DC offsets.
[4]Measured with a small signal input of 400 mVp-p.
[5]After 60 minute warm-up, followed by execution of an Auto-Calibration. See Section 2.5 and Section 6.2 ("O" Command).

Analog Output

Full-Scale Voltage:	2V into 1MΩ	
Full-Scale Accuracy:	±1%	
Maximum AC Noise: (open input)	Range 1:	<4 mV_{p-p}
	Ranges 2-8:	<1 mV_{p-p}

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Display Calculation	Display Unit	Comment
I/R	W	ZERO Disabled
$(I-I_z)/R$	W	ZERO Enabled
$10\log\left(\frac{I/R}{1mW}\right)$	dBm	ZERO Disabled
$10\log\left(\frac{(I-I_Z)/R}{1mW}\right)$	dBm	ZERO Enabled
$10\log\left(\frac{I}{I_{STOREF}}\right)$	dB	ZERO Disabled
$10\log\left(\frac{I-I_z}{I_{STOREF}-I_Z}\right)$	dB	ZERO Enabled
$\frac{I}{I_{STOREF}}$	REL	ZERO Disabled
$\left(\frac{I-I_z}{I_{STOREF}-I_Z}\right)$	REL	ZERO Enabled

Where I = detector current

I_z = detector background current defined when the ZERO key was pressed

R = responsivity of the detector (A/W)

I_{STOREF} = referenced detector current defined when the STOREF key was pressed

Table 1. Measurement Modes

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Section 1
General Information

1.1 System Overview

The 1830-C Optical Power Meter is a ±20,000 count A/D resolution, auto-ranging picoammeter. Measurements are displayed on a large 4 ½ digit liquid crystal display (LCD) and can also be taken remotely via the RS-232C port or the IEEE 488 GPIB bus. The 1830-C is designed to take continuous wave optical power measurements and is compatible with all of Newport's Low-Power Semiconductor photodetectors. A family tree of the 1830-C compatible detectors and accessories is shown in Figure 1 below.

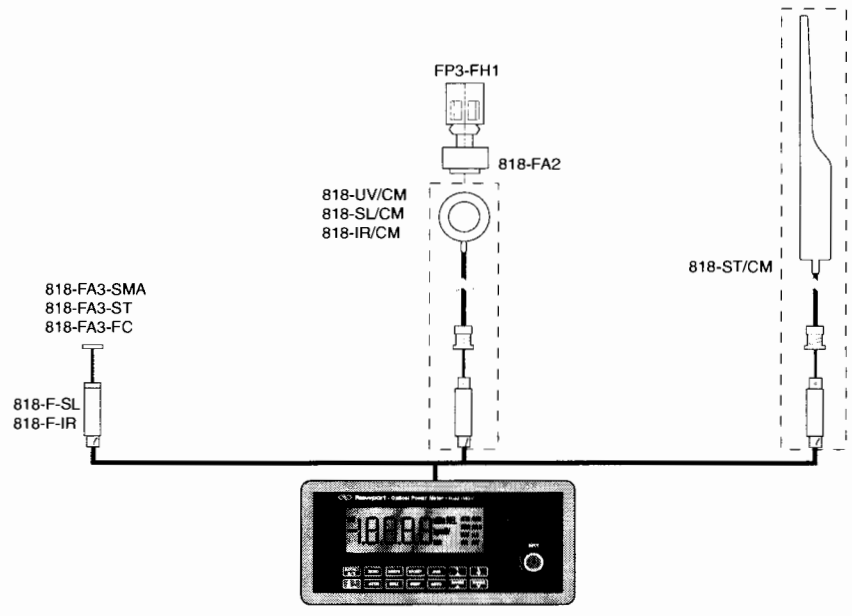


Figure 1. 1830-C Power Meter and Compatible Detectors

Detectors connect to the 1830-C through a calibration module, in which the responsivities and other information unique to the detectors is stored. Calibration modules are ordered with the detectors at the time of purchase and are labeled with the detectors' model number and serial number. Detectors with calibration modules have a "/CM" appended to their model number.

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

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1.2 Scope of this Manual

Please carefully read this instruction manual before using the 1830-C. Be especially careful to observe the warnings and cautions throughout this manual (see Safety Symbols and Terms). If any operating instructions are **not** clear, contact Newport Corporation.

This instruction manual contains the necessary information for operation and maintenance of the 1830-C, as well as information for troubleshooting and obtaining service if necessary. This information is divided into the following sections:

Section 1	General Information
Section 2	Initial Setup
Section 3	System Operation
Section 4	Performing Measurements
Section 5	Computer Interfacing
Section 6	Remote Command Set
Section 7	Troubleshooting and Maintenance
Section 8	Factory Service

1.3 Unpacking and Inspection

All 1830-C 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.

NOTE

Retain the original packing materials in case reshipment becomes necessary.

1.4 Preparation for Use

The 1830-C should have some basic operations performed before measurements are made. These include:

Setting the Line Voltage Selector Switch (Section 2.2)

Detector Connection and Setup (Section 2.3)

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Section 2
Initial Setup

2.1 Introduction

This section contains information on how to configure the 1830-C to your local line voltage and how to connect the detector and calibration module to the meter. It also includes a short discussion about the remote interface and the 1830-C's power-up and auto-calibration.

2.2 Setting the Line Voltage Selector Switch

The 1830-C can be configured to operate with line voltages of 100-120 VAC and 220-240 VAC, and line frequencies between 50-60 Hz. Before turning the meter on, configure it to the local voltage by setting the voltage selection switches on the 1830-C back panel to match the nominal local voltage. See Figure 2. Plug the AC line power cord to the rear of the 1830-C and then connect the cord to AC power.

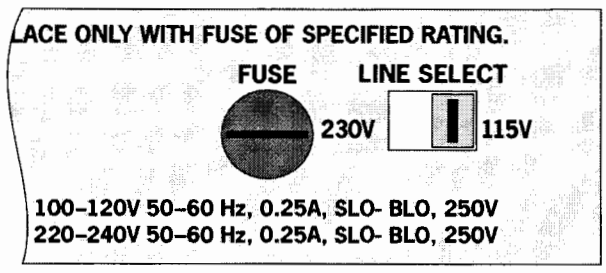


Figure 2. Line Voltage Selection Switch

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.

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2.3 Detector Connection and Setup

Connect the detector to its calibration module as shown in Figure 3. The detector's model and serial numbers must match the model and serial numbers found on the calibration module. Insert the calibration module, with its groove facing left, into the connector port on the front panel of the 1830-C, as shown in Figure 4. An alignment pin assures the proper orientation of the calibration module.

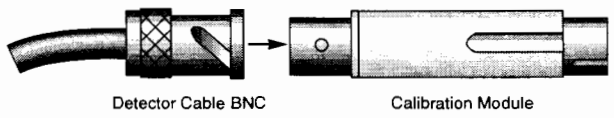


Figure 3. Connecting a Detector with its Calibration Module

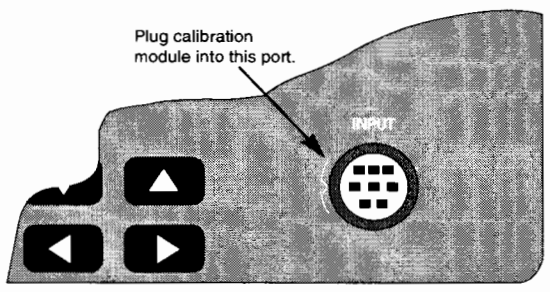


Figure 4. Calibration Module Connector Port

NOTE

Always power off the meter before removing or inserting the calibration module.

2.4 Configuring the Computer Interface

The RS-232C baud rate and the IEEE 488 GPIB address must be properly set via the back panel system switches if either interface is to be used. Please refer to Section 6 for detailed instructions.

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2.5 Power Up / Auto Calibration

Turn on the 1830-C by depressing the red power switch, located in the lower left-hand corner of the front panel, until it clicks and remains in its depressed position. At power-up, the 1830-C will perform the following sequence:

1) Momentarily display all the segments on the display

2) Display the software version number

3) Perform an Auto-Calibration, designated by displaying CAL on the display

4) Display the serial number of the detector/calibration module (If no calibration module is installed, the meter will display 000 as the serial number.)

5) Display the wavelength to which the meter is set (If no calibration module is installed, the meter will display 0257nm as the wavelength.)

The auto-calibration process involves measuring amplifier offset voltages which arise from aging and temperature effects. These offsets are then appropriately corrected for during normal operation. The 1830-C will automatically disconnect the input signal from the amplifier during the auto-calibration mode. To achieve stable readings at the specified accuracy, auto-calibration should be executed after a minimum 60 minute warm-up period. This can be done either by resetting the 1830-C with the RESET button on the back of the meter, or by sending the auto-calibration remote command, O.

NOTE

The 1830-C must be powered-up with the calibration module connected to the meter in order for the calibration data to be downloaded into the 1830-C. Always power off the meter before removing or inserting the calibration module.

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Section 3
System Operation

3.1 Introduction

This section contains the information needed to operate the 1830-C power meter, via the front panel key pad. The meanings of the display annunciators and the operation of all keys are discussed later in this section.

3.2 Digital Display

The 1830-C has a large 4-1/2 digit, back-lit liquid crystal display (LCD) which can be seen at large angles of view. Figure 5 illustrates the layout of the 1830-C's display. Table 2, on the following page, explains the meaning of the various annunciators and messages on the display.



Figure 5. The 1830-C Liquid Crystal Display

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Annunciator/Message	Comment
SN	This annunciator denotes *serial number* and is displayed at turn-on when the detector's serial number is displayed.
dBm	This annunciator specifies that either dB or dBm measurements are being displayed.
REL	This annunciator specifies that *relative* measurements are being displayed.
k μ m	Only one of the characters of this annunciator will light at any time to specify engineering prefixes of kilo, micro, nano, or milli. The "**m**" in this annunciator serves as both "**m**" and "**n**".
W	This annunciator specifies that measurements in units of *watts* are being displayed.
nm	This annunciator indicates *nanometer* whenever the wavelength is displayed.
ATTN	The responsivity in use includes the effect of the detector's OD3 attenuator.
AUTO	Automatic signal ranging is activated.
ZERO	Background signal subtraction (zeroing) is activated.
HOLD	No new readings will be displayed, nor be available on the remote interface bus.
REM	The meter has received a command/query either through the IEEE 488 or the RS-232C bus.
LLO	The meter has been set to local-lockout from the remote interface bus and will not respond to any front panel keys.
AVG: S M F	Either Slow, Medium, or Fast numerical averaging for the displayed measurement is activated.
OL	This message indicates that the input signal level exceeds the capability of the present signal range. Either use auto-ranging or increment the signal range until the OL message goes away.
SA	This message indicates that the input signal level exceeds the specified saturation current of the detector being used with the meter. This level is detector dependent.
CAL	This message indicates that the meter is currently performing an auto-calibration. The auto-calibration process involves measuring amplifier offset voltages. See Section 2.5 for more details.

Table 2. 1830-C Display Annunciators/Messages

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3.3 Front Panel Key Functions

The front panel key pad of the 1830-C, Figure 6, provides access to all the basic measurement functions. Table 3 and Sections 3.3.1 through 3.3.14 list and describe in detail each key function. For power-up default conditions, please see Table 4 at the end of this section.

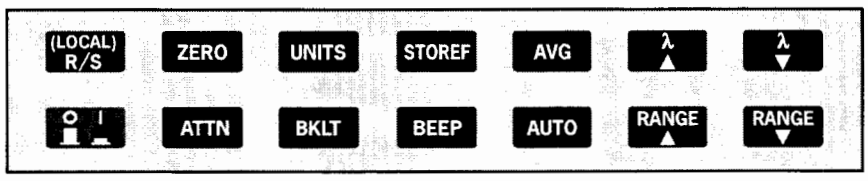


Figure 6. Front Panel Key Pad

Keypad	Remote Command	Description
(LOCAL)	L0	Enables local mode.
R/S	G0, G1	Run/Stop signal acquisition.
ZERO	Z0, Z1	Zero the display by subtracting the present reading from all subsequent readings.
UNITS	U1-U4	Cycles between the four available measurement units (Watt, dB, dBm, Relative).
STOREF	S	Stores last measurement for future dB or relative measurements.
AVG	F1-F3	Cycles between Slow, Medium, or Fast numerical averaging of readings that are within a certain percentage of each other.
λ ▲	W*nnnn*	Increments the calibration wavelength in use.
λ ▼	W*nnnn*	Decrements the calibration wavelength in use.
	None	Turns the meter on/off.
ATTN	A0, A1	Sets the responsivity value for either: 1) detector alone, or 2) detector and OD3 optical attenuator.
BKLT	K0, K1, K2	Cycles the display backlight brightness between Off, Medium, or High.
BEEP	B0, B1	Turns the variable frequency beeper on/off.
AUTO	R0, R1-R8	Turns the automatic signal ranging on/off.
RANGE ▲	Rx	Increments the signal range and disables the automatic signal ranging.
RANGE ▼	Rx	Decrements the signal range and disables the automatic signal ranging.

Table 3. 1830-C Key Functions and Associated Remote Commands

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3.3.1 (LOCAL) R/S Local Mode Run / Stop

This key serves two purposes:

1) When the meter receives a command through either the RS-232C or the IEEE 488 GPIB interface, the meter is automatically put into remote mode and the REM annunciator is displayed. Now all front panel keys are disabled except this (LOCAL) key which, when pressed, puts the meter back into the local mode. The meter can also be put in the local mode by sending the remote command, L0.

2) When the meter is in the local mode, pressing this key will toggle between run/stop acquisition modes. The HOLD annunciator is displayed when the meter is in the stop acquisition mode.

3.3.2 ZERO Offset Subtraction

This key turns the offset subtraction on and off. When turned on, the ZERO annunciator is displayed and the last measurement is saved as P_z and subtracted from all subsequent measurements P. This causes subsequent measurement calculations shown on the display and available on the remote interface to use the value ($P - P_z$) instead of P.

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.

3.3.3 UNITS Display Units

Measurements can be displayed in units of watts **W**, decibels **dB** or **dBm**, and relative **REL**. Pressing the UNITS key repeatedly cycles the display through these four units.

The **W** mode is a straightforward measurement which converts the current from the detector into a power reading via the responsivity of the detector at the set wavelength.

The **dB** mode uses the relationship dB = 10 * log(P / P_{ref}), where P is the most recent measurement and P_{ref} is the reference measurement. At power-up the reference for the **dB** mode is a level equivalent to 1mW. This can be changed by pressing STOREF, which makes the most recent measurement the new P_{ref}.

The **dBm** mode uses the relationship dBm = 10 * log(P / 1mW), where P is the most recent measurement.

The **REL** mode uses the relationship (P / P_{ref}), where P is the most recent measurement and P_{ref} is the reference measurement. At power-up the reference for the **REL** mode is a level equivalent to 1mW. This can be changed by pressing STOREF, which makes the most recent measurement the new P_{ref}.

When the engineering prefixes n, µ, m and k are displayed in the **REL** mode, they multiply the reading on the display by their appropriate weights. For example, a display of **1.8300µ** REL means $(P/P_{ref}) * 10^{-6}$.

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3.3.4 STOREF Store Reference Value

Pressing STOREF causes the most recent measurement P to be stored as P_{ref} for subsequent use in relative measurement calculations. When the units are **dB** and STOREF has been pressed, the displayed value is the function 10 * log(P/P_{ref}). When the units are **REL** and STOREF has been pressed, the displayed value is the ratio P/P_{ref}.

P_{ref} is always a power reading stored in the units of Watts. Pressing STOREF causes a new P_{ref} to overwrite the existing P_{ref} value.

3.3.5 AVG Numerical Averaging

Pressing AVG causes the numerical averaging feature to cycle through slow **S**, medium **M**, and fast **F** modes. The slow mode takes the last 16 measurements that are within ±9 counts of the oldest measurement and averages them for the displayed reading. The medium mode averages the last 4 measurements, and the fast mode does ***no*** averaging.

The averaging buffer is a sliding buffer that always maintains 16 or 4 measurements, depending on the mode. Initially the buffer is completely filled with the same measurement, and thereafter subsequent measurements replace the older measurements in the buffer. If, at any time, a single measurement is acquired that is not within ±9 counts of the oldest measurement, the averaging algorithm starts over, not retaining any of the previous measurements.

3.3.6 λ Wavelength Increment

Pressing this key once causes the wavelength to be displayed. If the key is pressed again or held down, the wavelength will increment or scroll, respectively.

The detector calibration module contains responsivity data at discrete wavelengths for its associated detector. By entering the wavelength which is being measured, the correct responsivity value is used by the 1830-C in calculating the measured power. When a wavelength falls between two calibration points, linear interpolation is used to approximate the true responsivity value.

Upon the initial power-up on a new calibration module, the meter defaults to the shortest wavelength available for that specific detector. *Whenever the calibration wavelength is changed, this new wavelength is written to the PROM in the calibration module and is used as the default wavelength at subsequent power-ups.*

NOTE:

If the detector and calibration module are changed to a different set, the power meter must be powered-up again to allow for the downloading of the new calibration data into the power meter. Always remember to power off the meter before removing or inserting the calibration module.

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3.3.7 λ▼ Wavelength Decrement

Same as λ▲ except that this key decrements the wavelength.

3.3.8 Power

This key turns the power to the 1830-C on and off. To turn the meter on, depress the key until it clicks. To turn the meter off, press the key again until it clicks and rebounds to its original position.

3.3.9 ATTN Optical Attenuator

This key selects whether the responsivity value for the detector-alone, or the value for the detector-with-attenuator is used. When the attenuator mode is on, the ATTN annunciator is lit and the responsivity value for the detector-with-attenuator is used. When the attenuator mode is off, the ATTN annunciator is off and the detector-alone responsivity value is used.

3.3.10 BKLT Backlight

This key cycles the brightness level of the LCD backlight between off, medium, and high.

3.3.11 BEEP Audible Beeper

This key turns the variable frequency beeper on and off. The frequency of this tone varies as a function of the optical power being measured. The real-time audible feedback is very helpful when trying to maximize optical through-put.

3.3.12 AUTO Automatic Signal Ranging

This key enables and disables the auto-range feature. When auto-range is enabled, the AUTO annunciator is displayed and the amplifier gain in the 1830-C will be automatically controlled to maximize the analog-to-digital converter resolution. When auto-range is disabled, the AUTO annunciator is turned off and the signal range is left in its present state. Signal ranging can be manually controlled by the RANGE(▲) and RANGE(▼) keys, as described below.

NOTE

The 1830-C has 8 signal ranges (R1-R8) which are one decade apart. The ranges available are detector dependent. For example, when using the 1830-C power meter with Newport's 818-IR, the lowest available range is R3. This is due to the fact that this germanium detector inherently has a large noise equivalent power (NEP).

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3.3.13 RANGE ▲ Manual Range Up

This key enables the user to manually decrease the amplifier gain by one decade, allowing the input of larger optical signals without saturating the amplifier. If the meter is in the auto-range mode just prior to pressing this key, the meter will be forced into the manual-range mode and the range will be incremented.

3.3.14 RANGE ▼ Manual Range Down

This key enables the user to manually increase the amplifier gain by one decade. If the meter is in the auto-range mode just prior to pressing this key, the meter will be forced into the manual-range mode and the range will be decremented.

3.4 Default Meter Configuration

Upon power-up or pressing the RESET button on the back of the meter, the 1830-C will configure itself as listed in Table 4.

Keypad Function	Default Power-Up Condition
(LOCAL)	Local
R/S	Signal Acquisition is on. (Run)
ZERO	ZERO is off.
UNITS	Watts
STOREF	1 mW
AVG	Medium Averaging
λ ▲	Lowest available, or last set wavelength
λ ▼	Lowest available, or last set wavelength
ATTN	ATTN is off. (Detector Alone)
BKLT	Medium Brightness
BEEP	BEEP is off
AUTO	Auto-Ranging enabled

Table 4. 1830-C Default Power-Up Conditions

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Section 4
Performing Measurements

4.1 Introduction

This section contains detailed information on how to make various optical power measurements with the 1830-C.

4.2 Photodetector Considerations

This section describes detector and attenuator characteristics, optical and electrical considerations, and environmental influences on optical measurements. In general, the accuracy of measurement with the 1830-C is limited by the calibration accuracy of the detector calibration. Making accurate measurements of optical power is however, also dependent upon properly setting up the 1830-C, controlling temperature and illumination conditions, and understanding the factors that affect power measurement.

4.2.1 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). 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 ranges from 2% to 7% in absolute terms and varies with wavelength. Each detector will have some variation in the response over different sections of its surface. Therefore, for the most reproducible measurements, light should illuminate the detector as uniformly as possible over 80% of the detector's active area.

CAUTION

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

NIST traceability requires that detectors be re-calibrated on one year intervals. As individual detector responses change with time, especially in the ultraviolet spectral range, re-calibration is necessary to assure confidence in the accuracy of the measurement. The same detector should always be used for measurements which are to be directly compared, in order to obtain reproducible results.

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4.2.2 Quantum Detector Temperature Effects

Semiconductor based photodiode detector characteristics (Newport Corporation **Low-Power** detectors) are significantly affected by temperature. At longer wavelengths, these quantum detectors typically lose sensitivity with increasing temperature. However the detector dark current increases exponentially with temperature. For silicon detectors, dark current is generally on the order of a few picoamps at room temperatures. With uncooled germanium detectors, however, this dark current is on the order of a nanoamp, or typically 1,000 to 10,000 times greater than silicon. These dark currents can be zeroed at any moment in time via the ZERO key on the 1830-C. Since dark currents drift with temperature, the ZERO should be adjusted just prior to taking any measurements. The noise or drift in the dark current sets a lower bound on the measurement resolution which can be achieved with any given detector.

If the detector temperature is constant, sensitivity changes and dark current drifts are significantly reduced. In addition, if the detector is cooled, the dark current and dark current noise will decrease. For the most accurate measurements, particularly with germanium detectors, the user can cool the detector to approximately 0 °C and control the temperature to within ± 1 °C.

4.2.3 Ambient and Stray Light

Ambient and stray light striking the detector will be measured by the 1830-C, and should be considered when making sensitive measurements. Ambient light can be distinguished from dark current (or the detector/meter noise floor) by turning off or blocking the source and covering the detector face with an opaque material such as a piece of black metal. Using the human hand to cover the detector is not advised because it emits a significant amount of infrared radiation, and because it 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.

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 (**Low-Power** detectors have an OD3 attenuator included) will reduce stray light and often improve the source signal to ambient signal noise level. Wavelength-specific filters, such as optical cutoff, bandpass, or spike filters can also 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 which is not coming from the source, and turning off room and other lights.

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 your shirt!

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4.3 Setting the Wavelength

In order to obtain accurate optical power measurements, it is necessary to set the calibration wavelength to the wavelength of the light incident upon the photodetector. This calibration wavelength is indicated in nanometers on the LCD display at power-up and whenever the λ▲/λ▼ keys are pressed. Upon power-up, the calibration wavelength used will be the last value entered into the meter (if this is the initial power-up on your calibration module, the wavelength will default to the shortest available wavelength).

To change the wavelength, do the following:

Determine the wavelength of the light being measured to the nearest nanometer. If the source is broadband, use either a value near the center wavelength of the light or the wavelength with greatest intensity. Pressing the λ▲/λ▼ keys will increase or decrease the calibration wavelength by 1nm. Wavelength will continue to change as long as the wavelength key is depressed.

NOTE

Different detectors are sensitive over different wavelength ranges. See the appropriate detector manual and calibration data to determine the range of wavelengths available for the detector being used. The responsivities stored in the calibration module span only the wavelength range appropriate for the detector and are specific to that detector.

4.4 Setting the Attenuator Mode

All Newport detectors are provided with calibrated optical attenuators. The responsivities for an attenuator/detector combination are stored in the calibration module. To measure optical powers above the saturation limit of the detector (see appropriate photodetector manual), use the optical attenuator that was shipped with your detector. When the attenuator mode is selected, the following occurs:

a. The ATTN annunciator is displayed.

b. The responsivity for the detector-with-attenuator is used in calculating the optical power being measured.

If the attenuator is subsequently removed, the ATTN key should be pressed to turn the attenuator mode off. All measurements will now be computed using the responsivity for the detector-alone.

NOTE

The transmission characteristics of each attenuator are slightly different; the user must therefore be careful to use ONLY the attenuator and detector pair with the same serial numbers for which the particular calibration module is calibrated.

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4.5.1 Power Measurements

The 1830-C's most basic measurement mode is in the units of Watts. Power measurements may be made with background correction, which is initiated by pressing the ZERO key. The following equation illustrates this relationship:

$$\text{Watt reading} = \text{Net Applied Power} = (I - I_z) / R$$

where

I = detector input current

I_z = detector background current defined when the ZERO key was pressed

R = responsivity of the detector (A/W) (or detector with attenuator)

a. Select the Watt measurement mode, auto-range, and a wavelength. Use manual ranging if you want manual control of the range; over-range is indicated by an OL message.

b. Block the light to be measured.

c. Initiate background correction by pressing the ZERO key. Display should read approximately zero, but will fluctuate depending upon the variations in the amount of light reaching the detector and the detector dark current fluctuations.

d. Illuminate the detector with the optical signal to be measured.

e. Take the reading from the display.

4.5.2 Logarithmic Measurements (dB and dBm)

The 1830-C can make logarithmic measurements referenced to any measured power level or to a 1 mW power level by changing the measurement units to **dB** or **dBm,** respectively.

NOTE

Log measurements should always be made on the lowest possible range (without over-ranging). Readings on high ranges will not allow optimum calculations of the logarithm. When in doubt, use auto-range.

NOTE

When using log measurements with background correction, the signal after the subtraction of the stored offset power level may be negative. In this case, OL will be displayed since the log of a negative number is not defined. This will be automatically cleared when the signal becomes positive.

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4.5.2.1 Logarithmic Measurements Using Reference Powers (dB)

The dB measurement mode displays the absolute value of 10 times the logarithm (base 10) of the input power, referenced to a power level which is selected by pressing the STOREF key. The following equation illustrates this relationship:

$$\text{dB reading} = 10 * \log [\text{Net Applied Power/Net Referenced Power(=STOREF)}]$$

$$= 10 * \log [((I - I_z)/R)/((I_{STOREF} - I_z)/R)]$$

where

I = detector input current

I_z = detector background current defined when the ZERO key was pressed

I_{STOREF} = referenced detector current defined when the STOREF key was pressed

R = responsivity of the detector (A/W) (or detector with attenuator)

To make dB measurements with background correction, proceed as follows:

a. Select the dB measurement mode, auto-range, and a wavelength.

b. Block the light to be measured.

c. Initiate background correction by pressing the ZERO key. Display should read approximately zero, but will fluctuate depending upon the variations in the amount of light reaching the detector and the detector dark current fluctuations.

d. Illuminate the detector with the optical signal to be used as the reference signal.

e. Press the STOREF key.

f. Illuminate the detector with the optical signal to be measured.

g. Take the reading from the display.

4.5.2.2 Logarithmic Measurements Using 1 mW Reference (dBm)

The dBm measurement mode displays the absolute value of 10 times the logarithm (base 10) of the input power, referenced to 1mW. The following equation illustrates this relationship:

$$\text{dBm reading} = 10 * \log [\text{Net Applied Power/1mW}]$$

$$= 10 * \log [((I - I_z)/R)/1\ \text{mW}]$$

where

I = detector input current

I_z = detector background current defined when the ZERO key was pressed

R = responsivity of the detector (A/W) (or detector with attenuator)

Using this 1mW reference power, the dBm reading span is from –90 dBm to +10 dBm (1 pW to 10 mW), when the detector responsivity equals 1.

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To make dBm measurements (relative to 1 mW optical power) with background correction, proceed as follows:

a. Select the dBm measurement mode, auto-range, and a wavelength.

b. Block the light to be measured.

c. Initiate background correction by pressing the ZERO key. Display should read approximately zero, but will fluctuate depending upon the variations in the amount of light reaching the detector and the detector dark current fluctuations.

d. Illuminate the detector with the optical signal to be measured.

e. Take the reading from the display.

4.5.3 Relative Measurements

The relative mode REL is selected by pressing the UNITS key until the **REL** annunciator turns on. The referenced power is selected at any time by pressing the STOREF key. The following equation illustrates this relationship:

$$\text{REL reading} = \frac{\text{Net Applied Power}}{\text{Net Referenced Power(=STOREF)}}$$

$$= ((I - I_z)/R)/((I_{STOREF} - I_z)/R)$$

where

I = detector input current

I_z = detector background current defined when the ZERO key was pressed

I_{STOREF} = referenced detector current defined when the STOREF key was pressed

R = responsivity of the detector (A/W) (or detector with attenuator)

To make relative measurements with background correction, proceed as follows:

a. Select the REL measurement mode, auto-range, and a wavelength.

b. Block the light to be measured.

c. Select background correction by pressing the ZERO key. Display should read approximately zero, but will fluctuate depending upon the variations in the amount of light reaching the detector and the detector dark current fluctuations.

d. Illuminate the detector with the optical signal to be used as the reference signal.

e. Press the **STOREF** key.

f. Illuminate the detector with the optical signal to be measured.

g. Take the reading from the display.

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4.6 Common Measurement Errors

The most common sources of optical power measurement errors are listed in Table 5 below.

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 ZERO'ed before the measurement was made.
Wavelength Calibration	Check that the proper wavelength has been set.
Detector Saturation	Check that the optical power density remains below the detector's saturation threshold.
Meter Configuration	Check that the 1830-C was powered-up with the calibration module properly connected. Check that the optical attenuator mode (ATTN annunciator) is properly enabled/disabled.

Table 5 — Common Measurement Errors

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Section 5
Computer Interfacing

5.1 Introduction

The 1830-C has two computer interface ports: GPIB and RS-232C. The GPIB interface conforms with the IEEE 488.1 hardware standard. All commands for the 1830-C are device dependent commands. In this manual, we interchangeably use either GPIB or IEEE 488 when referring to the IEEE 488 bus.

Please see the General Guidelines sections for using either the GPIB (Section 5.5.3) or RS-232C (Section 5.4.3) interfaces. These sections include important information on using these interfaces properly.

5.2 Computer Interface Terminology

Key abbreviations and concepts used in the command reference section of this manual are listed below:

<EOI> End or Identify

An IEEE488.1 signal sent with the end-of-string character.

<CR> Carriage Return

The ASCII decimal "13" byte.

<LF> Line Feed

An ASCII decimal "10" byte.

<NL> New Line

Defined in the IEEE 488 standard as the ASCII decimal "10" byte.

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<SRQ> Service Request

The 1830-C generates an <SRQ> to tell the GPIB controller that a serial poll is needed. Any device on the GPIB bus may assert the <SRQ> line. Bit 6 (decimal 64) will be high in the serial poll byte returned from a device requesting service. To determine if a device has generated an SRQ, an "AND" operation could be performed on the Status Byte :

IF ((*serial poll*) AND 64) = 64 THEN ⇒ device is requesting service, where *serial poll* is the integer returned from a GPIB serial poll.

Whitespace

Optional between commands and between parameters. Whitespace is any character with a binary value less than or equal to an ASCII space character (except the <NL> character).

Numerical types

Numerical parameters are passed and returned as the actual ASCII characters in the string representation of the number. The 1830-C accepts numeric values in decimal format only.

RS-232C Command Termination

Commands and queries sent to the 1830-C through the RS-232C port should be terminated with a <LF>.

All responses sent by the 1830-C are terminated with a <LF>.

GPIB Command Termination

Commands and queries sent to the 1830-C through the GPIB must be terminated with a <NL> <EOI> (<NL> is equivalent to an <LF>).

All responses sent by the 1830-C are terminated with a <NL> <EOI>.

5.3 Entering Remote Computer Interface Mode

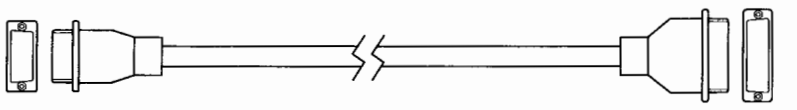
When a command or query is received by the GPIB or RS-232C interface ports, the 1830-C automatically goes into the remote interface mode. The REM annunciator on the 1830-C display will light up to indicate that the 1830-C is in remote interface mode.

When in remote mode, the 1830-C can be issued a "L1" command. The LLO annunciator on the 1830-C display will also light up to indicate that the 1830-C is in the local-lockout mode. This mode disables the 1830-C front panel keypad from affecting system operation. Locking out the front panel keys is useful in applications where the user does not want inadvertent key presses to affect his application setup. "L0" command disables the local-lockout feature. The local-lockout mode can also be disabled by powering-up the meter again, or by pressing the "RESET" button located at the back of the meter.

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5.4 RS-232C Communication

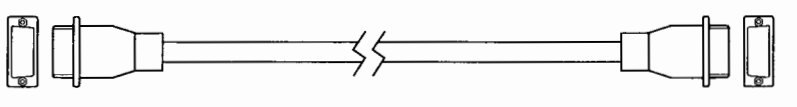
Before communicating with 1830-C through the RS-232C port, proper cable connections must be made. Figure 7 shows the cable connections for communicating with the RS-232C port on the 1830-C.



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 7. RS-232C Cable Connectors

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5.4.1 Setting the Baud Rate

Once cable connections are made, the baud rate for communication must be set. Valid baud rates are 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	9600, 4800, 2400, 1200
Parity	none
Data Bits	8
Stop Bits	1

Choose the appropriate baud rate by setting the rear panel system switches to the desired parameters, as shown in Figure 8.

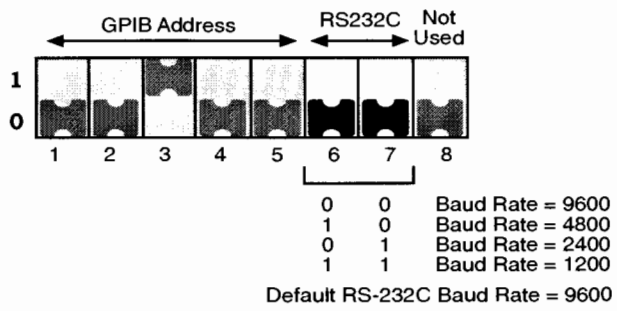


Figure 8. RS-232C Baud Rate Selector Switches

NOTE

Cycle the power off and on or press the "RESET" button located at back of the meter, whenever the 1830-C baud rate switch settings are changed.

5.4.2 RS-232C Command Termination:

Commands and queries sent to the 1830-C through the RS-232C port must be terminated by a <LF> (line feed).

All responses sent by the 1830-C are terminated with a <LF> (line feed).

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5.4.3 General Guidelines for Using the RS-232C Port

- The RS-232C port can communicate with a dumb terminal or a personal computer running any one of the many communications programs available. You may also control your 1830-C using a personal computer running high level programming languages such as Quick Basic or C and lab automation software such as LabWindows and LabVIEW.
- *When a dumb terminal type of device is used to communicate with the 1830-C via the RS-232C, the echo mode is especially useful.* When the "Echo Mode" for the RS-232C port is enabled, all characters sent to the 1830-C and error messages will be echoed. The 1830-C will generate a '>' prompt for every line. As the user enters 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).
- When the 1830-C is being controlled by a high level programming language, the echo mode should be disabled. When the "Echo" mode is disabled, the 1830-C does not generate a prompt or echo characters back to the interface.

NOTE:

The 1830-C's default mode for RS-232C communication is with echo disabled.

- Since the 1830-C's output buffer size is limited to ten bytes, it is recommended that when a query is made, the response to that query be read before other commands are issued.
- Only one command/query may be sent to the 1830-C per bus transaction.
- 1830-C system errors can be identified by reading the 1830-C's Status Byte Register. (See Appendix A)

5.5 GPIB Communication

A variety of third party GPIB communication hardware and software, such as plug-in GPIB computer boards and LabVIEW software from National Instruments are available. The 1830-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. We refer to GPIB and IEEE 488 interchangeably.

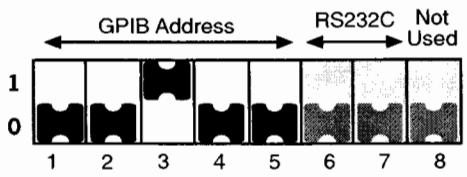
5.5.1 Setting the GPIB Address

The 1830-C GPIB interface port can be connected to the GPIB bus via a standard IEEE 488 cable. Before communicating with the 1830-C GPIB port, the 1830-C GPIB address must be set. Choose the appropriate 1830-C GPIB address by setting the rear panel system switches to the desired address, as shown in Figure 9.

NOTE

Cycle the power off and on or press the RESET button located at the back of the meter whenever the GPIB address is changed.

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GPIB Bus Address	SW 1	SW 2	SW 3	SW 4	SW 5	
1:	1	0	0	0	0	
2:	0	1	0	0	0	
3:	1	1	0	0	0	
4:	0	0	1	0	0	Default GPIB Address=4
5:	1	0	1	0	0	
6:	0	1	1	0	0	
7:	1	1	1	0	0	
8:	0	0	0	1	0	
9:	1	0	0	1	0	
10:	0	1	0	1	0	
11:	1	1	0	1	0	
12:	0	0	1	1	0	
13:	1	0	1	1	0	
14:	0	1	1	1	0	
15:	1	1	1	1	0	
16:	0	0	0	0	1	
17:	1	0	0	0	1	
18:	0	1	0	0	1	
19:	1	1	0	0	1	
20:	0	0	1	0	1	
21:	1	0	1	0	1	
22:	0	1	1	0	1	
23:	1	1	1	0	1	
24:	0	0	0	1	1	
25:	1	0	0	1	1	
26:	0	1	0	1	1	
27:	1	1	0	1	1	
28:	0	0	1	1	1	
29:	1	0	1	1	1	
30:	0	1	1	1	1	

Figure 9. GPIB Address Selector Switches

5.5.2 GPIB Command Termination:

Commands and queries sent to the 1830-C through the GPIB bus should be terminated by sending an <NL><EOI> (<NL> is equivalent to an <LF>).

All responses sent by the 1830-C are terminated with the concurrent transmission of a <NL><EOI>.

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5.5.3 General Guidelines for Using the GPIB Port

The GPIB port can communicate with computers and other devices that have GPIB ports that follow the IEEE 488.1 standards. Third party add-on boards and software can be used to allow a personal computer to communicate with the 1830-C through the IEEE 488 port. With these add-on boards and software, high-level language programs, can also be written to control the 1830-C through the IEEE 488 port. For those who wish to minimize the need for conventional "programming", Newport provides free instrument driver software for plug-in-and-run compatibility with LabWindows and LabVIEW. Call Newport for more information.

Some of the issues which should be kept in mind while developing the IEEE 488 software interface for the 1830-C, are as follows:

- A query is a command that invokes a response from the 1830-C. All queries are terminated with a question mark (?).
- Since the 1830-C's output buffer size is limited to ten bytes, it is recommended that the response to a query be read before other commands are issued.
- Before reading the response, the MAV bit in the status byte should be checked by means of a serial poll to make sure that the data is available. (See Appendix A, Status Reporting System)
- Only one command/query may be sent to the 1830-C per bus transaction.

5.5.4 Procedure for Reading Only New Measurements

When you want to retrieve only new measurements from the GPIB bus, use the following sequence of commands, serial polls, and queries:

1) Send the Command: **C**
   This will clear the status byte register.

2) Serial Poll the 1830-C until the Read Done bit goes high. (decimal 128)

3) Send the Query: **D?**
   This is a Data Query and responds with the last signal acquisition.

4) Serial Poll until the Message Available (MAV) bit goes high. (decimal 16)

5) Perform a GPIB read.

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Section 6
Remote Command Set

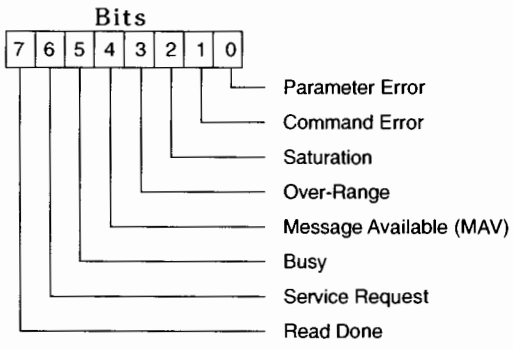
6.1 Summary of Command/Query Set

The following commands and queries are case insensitive. No spaces are allowed between the letter-command and the parameter or question mark (?). Only one command/query allowed per bus transaction.

Command	Description
A0	Attenuator off
A1	Attenuator on
A?	Attenuator query (returns: 0, 1)
B0	Beep off
B1	Beep on
B?	Beep query (returns: 0, 1)
C	Clear Status Byte Register
D?	Data Query
E0	Echo off
E1	Echo on
E?	Echo query (returns: 0, 1)
F1	Filter S (Slow)
F2	Filter M (Medium)
F3	Filter F (Fast)
F?	Filter query (returns : 1, 2, 3)
G0	Hold
G1	Go
G?	Go query (returns: 0, 1)
K0	Keypad/Display backlight off
K1	Set the Keypad/Display Backlight to medium intensity
K2	Set the Keypad/Display Backlight to high intensity
K?	Keypad/Display Backlight query (returns: 0, 1, 2)
L0	No local lockout
L1	Local lockout
L?	Local lockout query (returns: 0, 1)

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M	Service Request Enable Register (Mask)
M?	Service Request Enable Register Query
O	Auto-Calibration
Q?	Status Byte Register Query (returns: 0 – 255)



(See Appendix A for details)

R0	Auto Range
R1	Signal Range 1 (Highest signal range)
R2	Signal Range 2
R3	Signal Range 3
R4	Signal Range 4
R5	Signal Range 5
R6	Signal Range 6
R7	Signal Range 7
R8	Signal Range 8 (Lowest signal range)
R?	Signal Range query (returns: 1 – 8)
S	Store Reference
U1	Units W
U2	Units dB
U3	Units dBm
U4	Units REL
U?	Units Query (returns: 1, 2, 3, 4)
W*nnnn*	Set wavelength to *nnnn*
W?	Wavelength query (returns: *nnnn*)
Z0	Zero off
Z1	Zero on
Z?	Zero query (returns: 0, 1)

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An
Attenuator on/off

Function: Selects between the responsitivity values associated with the photodetector alone or for the photodetector-attenuator combination. These values are stored within the calibration module.

Syntax: A*n* or *an*

Parameter: *n* = 0 Use the calibration module's responsitivity values associated with the **photodetector-alone.**

n = 1 Use the calibration module's responsitivity values associated with the **photodetector-attenuator** combination.

Type: integer

Related Commands: A? – Attenuator query

A?
Attenuator query

Function: Reports whether the 1830-C is using the responsitivity associated with the photodetector-alone or the photodetector-attenuator combination.

Syntax: A? or a?

Returns: 0 photodetector-alone responsitivities are used.

1 photodetector-attenuator responsitivities are used.

Related Commands: A*n* – Selects the responsitivity associated with the photodetector-alone or photodetector-attenuator combination

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B*n*
Beeper on/off

Function: This command is used to turn the audio output on/off. The audio output frequency is proportional to the intensity of the input power signal.

Syntax: B*n*

Parameter: *n* = 0 beeper is off
n = 1 beeper is on

Type: integer

Related Commands: B?- Beeper query

B?
Beeper query

Function: This query informs the user whether the 1830-C's beeper is on or off.

Syntax: B? or b?

Parameter: none

Returns: 0 beeper is off.
1 beeper is on.

Related Commands: B*n* - Turn the beeper on/off.

C
Clear Status Byte Register

Function: This command is used to clear the status byte register. All bits, except the MAV bit, are set low by sending this command. The status byte register contents are described in Q? and Appendix A.

Syntax: C or c

Parameter: None

Related Commands: Q? - Status Byte Register query

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D?
Data query

Function: This query responds with the power level of the input signal.

Syntax: D? or d?

Parameter: none

Returns: The format of the returned data string is: ±d.ddddE ±dd.

Example: *Send: D?*
Resp: 0.0000E-09

Related Commands: A*n*, A? - Set/Query the Attenuator setting
R*n*, R? - Set/Query the Range setting
U*n*,U? - Set/Query the units of measurements

E*n*
Echo mode on/off (RS-232C interface only)

Function: This command is used to turn 1830-C's echo mode on/off. The echo mode applies to RS-232C communication only. In this mode all the characters that are received over the RS-232C are transmitted ("echoed") back to the user. This mode is useful when interfacing the 1830-C to a dumb terminal.

Syntax: E*n* or e*n*

Parameter: *n* = 0 Turn echo mode off
n = 1 Turn echo mode on

Type: integer

Related Commands: E? - Echo mode query

E?
Echo mode query

Function: This query informs the user whether the 1830-C's echo mode is on or off. When the echo mode is on, then all the characters that are received over the RS-232C are transmitted back to the user.

Syntax: E? or e?

Parameter: none

Returns: 0 echo mode is off.
1 echo mode is on.

Related Commands: E*n* - Turn the echo mode on/off.

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F*n*
Filter (same as averaging) Slow, Medium, Fast

Function: This command is used to set how many measurements are averaged for the displayed reading. When the slow speed filter is selected, the 1830-C displays the average of the last 16 measurements. When using the medium filter, the 1830-C displays the average of the last 4 measurements. The fast filter does no averaging.

Syntax: F*n* or f*n*

Parameter: *n* = 1 use the slow filter to average the last 16 measurements
n = 2 use the medium filter to average the last 4 measurements
n = 3 no averaging is performed

Type: integer

Related Commands: F? - Filter status query

F?
Filter (same as averaging) status query

Function: This query informs the user about the current settings for the filter parameter. The filter setting dictates how many measurements are averaged for the displayed reading. In the slow mode, the reading is the average of the last 16 measurements, while in the medium mode the reading is the average of the last 4 measurements. No averaging is done in the fast mode.

Syntax: F? or f?

Parameter: none

Returns: 1 The readings are being averaged in slow mode
2 The readings are being averaged in medium mode
3 The readings are not being averaged

Related Commands: F*n* - Set how many measurements are averaged for the displayed reading

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G*n*
Go on/off

Function: This command is used to enable/disable the 1830-C from taking new readings. During disable mode, no 1830-C parameters can be changed.

NOTE:

- "Run" and "Go " words are used interchangeably and they represent the same 1830-C function.
- "Stop" and "Hold" words are used interchangeably and they represent the same 1830-C function.

Syntax: G*n* or g*n*

Parameter: *n* = 0 1830-C is in Hold mode, i.e. does not take new readings
n = 1 1830-C is in Go mode, i.e. takes new readings

Type: integer

Related Commands: G? - Go query

G?
Go query

Function: This query informs the user whether the 1830-C is in the Run or Hold mode. If the meter is in the "Run" mode, the 1830-C will continue acquiring new measurements. In the "Hold" mode, it stops acquiring new measurements.

NOTE:

- "Run" and "Go " words are used interchangeably and they represent the same 1830-C function.
- "Stop" and "Hold" words are used interchangeably and they represent the same 1830-C function.

Syntax: G? or g?

Parameter: none

Returns:
0 1830-C is in Hold mode.
1 1830-C is in Run mode.

Related Commands: G*n* - Set 1830-C to either Run/Hold mode.

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Kn
Keypad/Display Backlight on/off

Function: This command is used to set the keypad/display backlight to various intensity levels. The backlight intensity levels may be set to off, medium, or high.

Syntax: K*n* or k*n*

Parameter: *n*=0 Turns the front panel backlight off
n=1 Turns the front panel backlight to medium intensity
n=2 Turns the front panel backlight to the highest intensity level

Type: integer

Related Commands: K? - Query the backlight intensity level

K?
Keypad/Display Backlight intensity level query

Function: This query responds with the current status of 1830-C's backlight intensity level. The backlight intensity level can be either off, medium, or high.

Syntax: K? or k?

Parameter: none

Returns: 0 Backlight is off
1 Backlight intensity is set to medium intensity level
2 Backlight intensity is set to the highest intensity level

Related Commands: K*n* - Set the Backlight intensity to off/medium/high.

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L*n*
Local lockout on/off

Function: This command is used to enable/disable the 1830-C's local-lockout function. When the local-lockout function is enabled, any front panel key presses would have no effect on system operation. The 1830-C's front panel display has a "LLO" annunciator, and it lights up when the local-lockout function is enabled.

This feature is useful when conducting an experiment and the user does not want inadvertent key presses to affect the system operation.

Syntax: L*n* or l*n*

Parameter: *n* = 0 Local-lockout is off
n = 1 Local-lockout is on

Type: integer

Related Commands: L? - Query the current status of local-lockout function

L?
Local lockout query

Function: This query informs the user whether 1830-C's local-lockout function is enabled/disabled. The local-lockout function, when enabled, locks out any front panel key presses from affecting the system operation. The 1830-C's front panel display has a "LLO" annunciator, and it lights up when the local-lockout function is enabled .

Syntax: L? or l?

Parameter: none

Returns: 0 Local-lockout function is disabled.
1 Local-lockout function is enabled.

Related Commands: L*n* - Enable/disable the 1830-C's local-lockout function.

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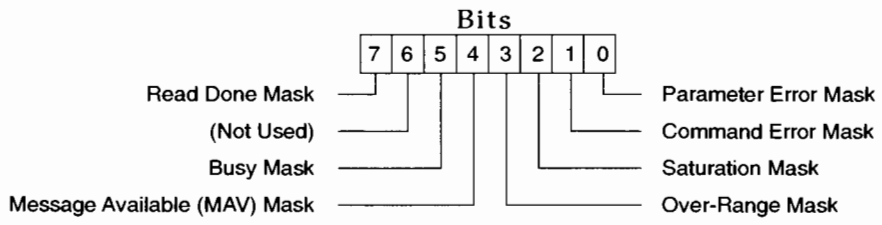
M*n*
Service Request Enable Register (Mask)

Function: The Service Request Enable Register is used to define the conditions that will generate an IEEE 488.1 service request, <SRQ>. This register performs a bit-wise AND'ing operation with the Status Byte Register.

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, an <SRQ> will be generated once for the given event. When the <SRQ> is asserted and a serial poll of the 1830-C is performed, bit 6 and the bit(s) that initiated the <SRQ> will be set high in the byte returned by the serial poll. A serial poll will clear the <SRQ> until it is again asserted by a new event in the Status Byte Register.

At power-up the default is M0, which means that the <SRQ> will not be asserted regardless of any bits that are set in the Status Byte Register.

See Appendix A for a detailed description of the Status Reporting System.



Syntax: M*n* or m*n*

Parameter: *n* = 0 - 255

Type: integer

Example:
M0 An <SRQ> will not be asserted.
M16 Only the MAV bit will assert an <SRQ>.
M255 Any bit in the Status Byte Register will assert an <SRQ>.

Related Commands:
M? Service Request Enable Register query
Q? Status Byte Register query

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M?
Service Request Enable Register query

Function: This query informs the user how the Service Request Enable Register is configured. See the M*n* command for a description of the Service Request Enable Register.

At power-up the default is M0, which means that the <SRQ> will not be asserted regardless of any bits that are set in the Status Byte Register.

See Appendix A for a detailed description of the Status Reporting System.

Syntax: M? or m?

Parameter: none

Returns: 000 - 255

Example: *Send:* M?
Resp: 000 An <SRQ> will not be asserted.

Send: M?
Resp: 016 Only the MAV bit will assert an <SRQ>

Send: M?
Resp: 255 Any bit in the Status Byte Register will assert an <SRQ>.

Related Commands: Mn Service Request Enable Register
Q? Status Byte Register query

O
Auto-Calibration

Function: This command is used to calibrate the 1830-C for future measurements. The auto-calibration process involves measuring amplifier offset voltages which arise from aging and temperature effects. These offsets are then appropriately corrected for during normal operation. The 1830-C will automatically disconnect the input signal from the amplifier during the auto-calibration mode. To achieve stable readings at the specified accuracy, auto-calibration should be executed after a minimum 60 minute warm-up period.

The status byte register can be used to monitor the completion of the auto-calibration process, because during the auto-calibration the BUSY bit remains high.

Syntax: O or o

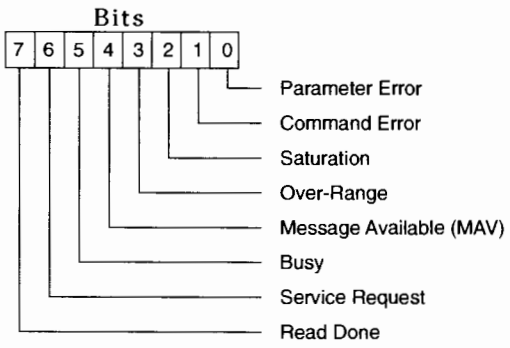
Parameter: None

Related Commands: Q? - Status Byte Register query

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Q?
Status Byte Register query

Function: Reports the value of 1830-C's status byte. This query informs the user about 1830-C's current system status. All bits in the status byte register, except the MAV bit, can be cleared using the clear status command, C. See Appendix A for a detailed description of each bit and the Status Reporting System.



(See Appendix A for details)

Syntax: Q? or q?

Parameter: none

Returns: 0 - 255

Example:

Send: Q?
Resp: 01 Parameter error

Send: Q?
Resp: 02 Command error

Send: Q?
Resp: 04 Input signal has saturated the photodetector

Send: Q?
Resp: 8 Input signal exceeds the max level for signal range

Send: Q?
Resp: 16 1830-C is ready with the response to a query

Send: Q?
Resp: 32 1830-C is busy auto-ranging or is in power-up state.

Send: Q?
Resp: 128 1830-C is ready with new power reading

Send: Q?
Resp: 144 A new power reading is available and MAV bit is high.

Related Commands: All commands & queries

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R*n*
Range setting

Function: This command is used to set the current signal range for the input signal.

The auto-ranging mode is enabled by sending a R0 command to the meter. In the auto-ranging mode, the meter automatically ranges between various signal ranges in response to input signal variations.

R1 command selects the lowest signal range for the input signal. R8 selects the highest signal range.

As each range is incremented by one, the signal gain decreases by a decade.

NOTE:

The lowest range for the geranium 818-IR detector is R3.

Syntax: R*n* or r*n*

Parameter:
n = 0 Auto-range
n = 1 Lowest manual signal range (highest amplifier gain)
: : :
n = 8 Highest manual signal range (lowest amplifier gain)

Type: integer

Example:
R0 *Selects auto-ranging for 1830-C .*
R1 *Selects the lowest signal range for 1830-C*
R8 *Selects the highest signal range for 1830-C*

Related Commands: R? - Range query

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R?
Range query

Function: This query informs the user about 1830-C's current signal range setting.

NOTE:

The lowest range for the geranium 818-IR detector is R3.

Syntax: R? or r?

Parameter: none

Returns:
1 indicates that the 1830-C is in the lowest signal range.
: : : :
8 indicates that the 1830-C is in the highest signal range.

Example:
Send: R?
Resp: 1 *1830-C is in the lowest signal range*

Send: R?
Resp: 8 *1830-C is in the highest signal range*

Related Commands: R*n* - Set the 1830-C signal range

S
Store reference

Function: Sets the current input signal power level as the power reference level for any future dB or relative measurements. Each time the S command is sent, the current input signal becomes the new reference level.

Syntax: S or s

Parameter: none

Related Commands: U - Set the units of display

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U*n*
Units

Function: This command is used to set the units of measurements. The units can be either Watts, dB, dBm or REL. The definitions for the units are given in Section 3.3.3.

Syntax: U*n* or u*n*

Parameter: *n* = 1 1830-C measurement unit is Watts
n = 2 1830-C measurement mode is in dB
n = 3 1830-C measurement mode is in dBm
n = 4 1830-C measurement mode is in REL

Type: integer

Example:
U1 Measure the input signal in Watts.
U2 Measure the input signal in dB

Related Commands: U? - Query the current 1830-C measurement units
S - Set the Reference signal power level
W*nnnn* - Set the wavelength of measurement

U?
Units query

Function: This query informs the user about 1830-C's current measurement units. The units can be either Watts, dB, dBm, or REL.

Syntax: U? or u?

Parameter: none

Returns:
1 1830-C current measurement unit is Watts.
2 1830-C current measurement mode is in dB
3 1830-C current measurement mode is in dBm
4 1830-C current measurement mode is in REL

Example:
Send: U?
Resp: 1 1830-C measurement units are Watts

Send: U?
Resp: 2 1830-C measurement units are dB

Related Commands: U*n* - Set the current 1830-C's measurement units
S - Set the Reference signal power level
W*nnnn* - Set the wavelength of measurement

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Wnnnn
Set wavelength to *nnnn*

Function: This command is used to set the wavelength of the input signal. 1830-C uses the responstivity value within the calibration module, corresponding to the wavelength selected, for it's calculations.

Syntax: W*nnnn* or w*nnnn*

Parameter: *nnnn* The wavelength of the input signal

Type: integer

Range: depends on the detector used

Example: W280 Set the wavelength to 280nm.

Related Commands: W? - Query the 1830-C's current wavelength setting

W?
Wavelength query

Function: This query informs the user about 1830-C's current wavelength setting.

Syntax: W? or w?

Parameter: none

Returns: *nnnn* Current wavelength in nm

Example: *Send*: W?
Resp: 633 Current wavelength is set to 633nm

Related Commands: W*nnnn* - Set the wavelength for measurement

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Zn
Zero on/off

Function: Turn the zero function on/off. Zero function is used for subtracting any background power levels from future measurements. When it is activated, the 1830-C uses the next power reading as it's background value, and it subtracts this value from any future power readings.

Syntax: *Zn* or *zn*

Parameter: *n* = 0 zero function is off
n = 1 zero function is on

Type: integer

Related Commands: Z? - Zero function query

Z?
Zero function query

Function: This query informs the user whether 1830-C's zero function is on/off. Zero function is used for subtracting the background power levels from any future measurements.

Syntax: Z? or z?

Parameter: none

Description:

Returns:
0 zero function is off.
1 zero function is on.

Related Commands: *Zn* - Turn the zero function on/off.

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Section 7
Troubleshooting and Maintenance

7.1 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 call Newport's Application Engineers for advice. If necessary, see Section 8 for details on returning your entire system to Newport for service.

Symptom	Possible Fault/Correction
Blank display.	Voltage selector switch not in the correct position or fuse blown. Press the RESET button.
Display shows 000 as the serial number at power-up.	No calibration module connected at power-up. Power off the meter, check that the module is properly inserted, and then power-up again.
Display shows "OL".	Indicates that the signal is too large for the selected signal range. Select a higher range, use auto-ranging, or use an attenuator if one is available.
Display shows "SA".	Indicates that the input signal level exceeds the specified saturation current of the detector being used with the meter. This level is detector dependent.
Reading is different than expected.	See Table 5 Common Measurement Errors, Section 4.6.
Reading never changes.	Calibration module not properly inserted at power-up. Meter not in the run mode - press the R/S key.
RS-232 communication does not seem to work.	Check the echo mode state, the string termination character, and the back panel baud rate switch settings. Check the RS-232 cable connection and cable pinouts on Figure 7. Make sure that the device talking to the meter is setup for 8 data bits, no parity, and 1 stop bit.

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Symptom	Possible Fault/Correction
GPIB communication errors	Check the GPIB address, the GPIB cable connections, and the string termination character.
A program does not compile in the QuickBASIC environment	For example: National Instruments IBCONF file had some other device name for DEV4 or the IBCONF file was not configured properly for the 1830-C. The QBIB.OBJ file was not compiled and linked with the QuickBASIC environment. To accomplish this step, follow the National Instruments manual commands: C:\QB45>link /q qbib.obj, qbib.qlb,, bqlb45.lib C:\QB45>qb /l qbib.qlb The pathname for the QBDECL.BAS should be modified per the user's computer system.
Your IEEE application software program program does not seem to be cal communicating with the 1830-C.	Use the National Instruments IBIC to communicate with the 1830-C. Typical sequence of operation would be as follows: C:\>ibic IBFIND dev4 IBWRT "d?\n" IBRD 20

Table 6 — Symptom/Fault Troubleshooting Guide

7.2 Cleaning Procedure

When 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 on the 1830-C. Organic solvents attack the ABS plastic case.

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7.3 Re-Calibration Schedule

The 1830-C calibration accuracy is warranted for a period of 1 year. After 1 year, the meter should be returned to Newport Corporation for re-calibration and NIST traceability recertification. Newport detectors also require recertification at one year intervals.

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Section 8
Factory Service

8.1 Introduction

This section contains information regarding obtaining factory service for the 1830-C Optical Power Meter. The user should not attempt any maintenance or service of this instrument and/or accessories beyond the procedures given in Section 7: Troubleshooting and Maintenance. Any problems which cannot be resolved using the guidelines listed in Section 7 should be referred to Newport Corporation factory service personnel. Contact Newport Corporation or your Newport representative for assistance. The 1830-C contains no user serviceable parts. Its calibration accuracy is warranted for a period of 1 year.

8.2 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 a copy of the service form, located on the following page, and have the information ready when contacting Newport Corporation. Return the completed service form with the instrument.

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Service Form

Newport Corporation
U.S.A. Office: 714/863-3144
FAX: 714/253-1800

Name _____ RETURN AUTHORIZATION # _____

Company _____ (Please obtain prior to return of item)

Address _____ Date _____

_____ Phone Number _____

Country _____

P.O. 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).

_____

_____

_____

_____

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Appendix A
Status Reporting System

Below is a graphical representation of the 1830-C's Status Reporting System for the GPIB bus. The two registers involved are the *Status Byte Register* and the *Service Request Enable Register.*

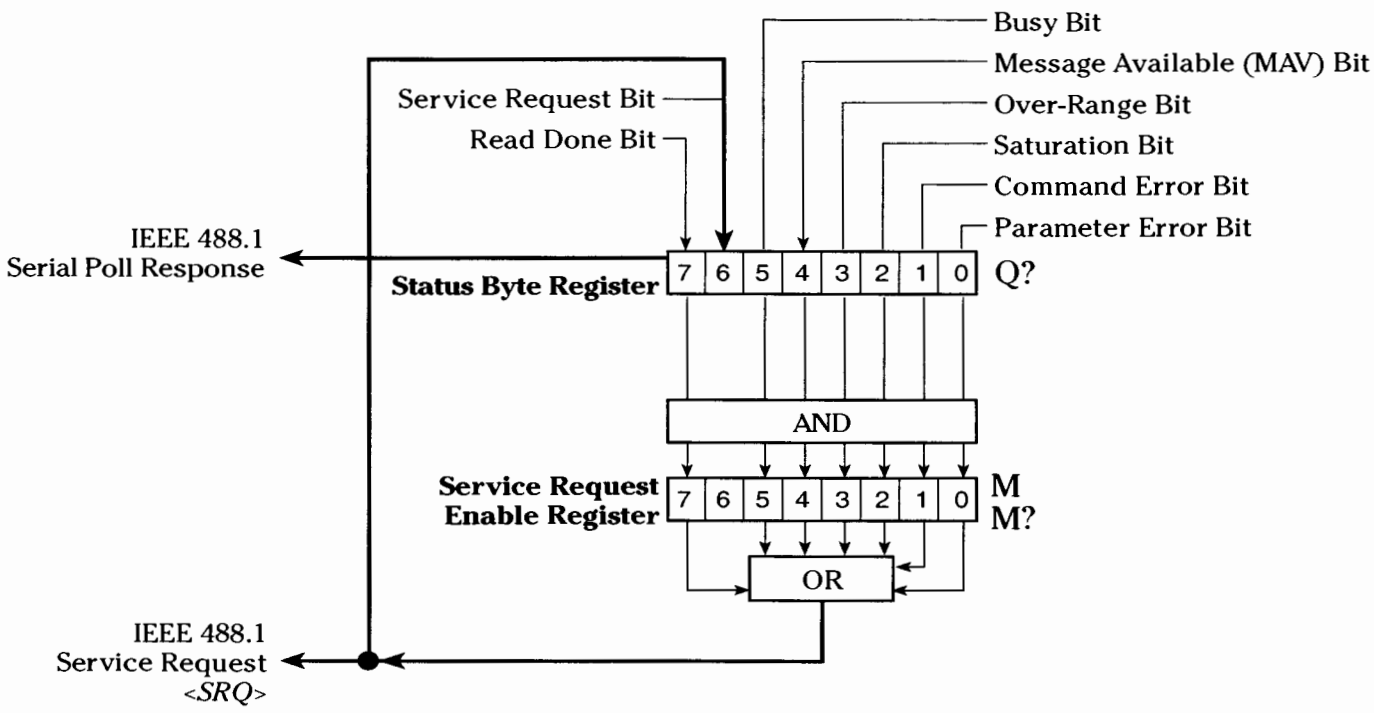


Figure 10. The 1830-C's Status Reporting System for the GPIB Bus.

The *Status Byte Register* is used to record a summary of the 1830-C's current condition for the Status Reporting System. The status of the 1830-C is returned to the controller when a serial poll is performed. The register is bit mapped, meaning that each condition is represented by a bit of different binary weight (...,8,4,2,1). When a bit is set high, (has a value of 1) the condition is true. The bits are cleared (set to zero) based on the conditions described for each bit. Additionally, all the bits in the Status Byte Register, except for the MAV bit, can be cleared by using the Clear Status Byte Register command, C.

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The *Service Request Enable Register* is used to define the conditions of the Status Byte Register that will generate an IEEE 488.1 service request, <SRQ>. This register performs a bit-wise AND'ing operation with the Status Byte Register. When an event occurs that causes a bit to be set high in the Status Byte Register and its corresponding bit is set high in the Service Request Enable Register, an <SRQ> will be generated once for the given event. When the <SRQ> is asserted and a serial poll of the 1830-C is performed, bit 6 and the bit(s) that initiated the <SRQ> will be set high in the byte returned by the serial poll. A serial poll will clear the <SRQ> until it is again asserted by a new event in the Status Byte Register.

NOTE

When using RS-232C, the service request <SRQ> and the serial poll features are not available. However the state of the status byte register can be obtained by the query, **Q?**.

Below is a description of each bit of the Status Byte Register.

PARAMETER ERROR:

This bit goes high whenever a valid command is issued but the command's parameters are out of range. e.g. U9

This bit is cleared by Q? or by the C command.

COMMAND ERROR:

This bit goes high whenever a bad command is sent regardless of the parameters. e.g. H1

When the meter is in the HOLD mode, good commands which try to change the measurement parameters will set this bit high.

This bit is cleared after an Q? or by the C command.

SATURATION:

This bit goes high whenever the photodetector is saturated, i.e. further increase in the input signal level does not cause any change in the measurement readings.

This bit goes low when the input signal is below the photodetector's saturation level.

OVER-RANGE:

This bit goes high whenever the input signal exceeds the maximum signal level for the present signal range.

This bit goes low when the signal level is within range.

MESSAGE AVAILABLE, (MAV):

This bit goes high when any message is ready to be transmitted over the interface. This bit is set only when the 1830-C is ready to respond with data for an issued query.

This bit goes low after the 1830-C completes sending the message.

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BUSY:

This bit goes high whenever the 1830-C is in auto-ranging mode and is changing ranges, when the 1830-C is in power-up initialization mode, or when the meter is performing an auto-calibration.

This bit goes low whenever the above three conditions do not exist.

SERVICE REQUEST:

When the status byte is read by means of a serial poll, this bit is set when the 1830-C is requesting service.

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

When the SERVICE REQUEST bit changes state from low to high, the 1830-C automatically asserts a service request <SRQ>.

READ DONE:

This bit goes high when a new reading has been taken by 1830-C that is not an over-range, or did not saturate the photodetector, and was not taken while ranging.

This bit is cleared by D? or by the C command.

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Appendix B
Sample Programs

B.1 Example Program for RS-232C Communication (GWBASIC)

```
10 '*****************************Program Header ***************************
20 'Newport Corporation
30 '1830-C to RS-232 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 1830-C via the RS-232 port on the 1830-C Rear panel and the
80 'RS-232 port  on an IBM PC/AT or compatible. The program was written in
90 'MICROSOFT GWBASIC on an IBM AT compatible.
100 '
110 'Note that if the 1830-C is reset while the program is running the
120 'program must be restarted so that the ECHO mode will be disabled.
130 '
140 'Written By : Rakesh Pandit
150 '      Date: June 24th,1994
160 '************************** End of Header ****************************
170 '
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 "COM1:9600,N,8,1" FOR RANDOM AS #1
1040    GOSUB   2000    ' Display Newport Greeting
1050    GOSUB   6000    ' 1830-C's echo  mode disabled
1060    GOSUB   3000    ' Process user input
1070    CLOSE   #1      ' Close the COM file
1080  END 'End of program
1090 '
2000 'Main Screen : Draw the main screen
2010    CLS
2020    LOCATE 1, 24: PRINT "NEWPORT CORPORATION  "
2030    LOCATE 2, 20: PRINT "1830-C TO IBMPC RS-232C Communication Program"
2040    PRINT : PRINT
2050 RETURN
```


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```
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$, "?") = 0 THEN GOTO 3090
3070       GOSUB 5000
3080       PRINT RS232IN$;
3090       END IF
3100    WEND
3110  RETURN
3120  '
4000  'Write.RS232.String: Write the string RS232OUT$ to the RS-232 port
4010    PRINT #1, RS232OUT$                'PRINT # appends <CR><LF> to the string
4020  RETURN
4030 '
5000 ' Read.RS232.String : Read a string from the 1830-C RS-232 port
5010 ' Characters are read one at a time until a <LF> character is
5020 ' read or 2 seconds elapse between consecutive character reads.
5030 ' At end of routine the string read or an  error 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(1) GOSUB 7000   'Set timer for a 1 second time out
5080    TIMER ON                 'Turn on timer
5090    'While port doesn't timeout and string delimiter <LF> not
5100    'read,continue trying to read input 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% = 1 THEN RS232IN$ = "Timed out when  reading RS-232 port. " +
CHR$(13)
5210 RETURN
5220 '
6000 'Turn.Echo.Off: Turns the echo mode off if it is enabled.
6010    RS232OUT$ = "E?"
6020  GOSUB 4000
```


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```
6030  GOSUB 5000
6040  IF RS232IN$ = "0" + CHR$(13) + CHR$ (10) THEN GOTO 6120
6050     PRINT "Disabling echo mode ....";
6060     RS232OUT$ = "E0"
6070    GOSUB 4000
6080    GOSUB 5000 'Read">1"
6090    GOSUB 5000 'Read ">E0"
6100    GOSUB 5000 'Read ">" ( timeout because no <NL> )
6110    PRINT "ECHO mode disabled "
6120  'ENDIF
6130 RETURN
6140 '
7000 'timeout: Set TIMEOUT.ERROR% flag. Called if t seconds, as
7010 'defined by  ON TIMER (t), elapsed between TIMER ON AND TIMER OFF.
7020    TIMEOUT.ERROR% = 1
7030  RETURN
10000 END 'End of Program listing
```


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B.2 Example Program for IEEE 488 Communication (QuickBASIC)

```
'************************ Program Header ************************************
'NEWPORT CORPORATION
'1830-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 1830-C controller via the IEEE-488 port.  This program was specifically
'written for the equipment below.
'
'This program was written on an IBM AT compatible using QuickBASIC 4.5
'  and software routines supplied 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 on the above GPIB board follow the
'      manufacturers instructions for installation of hardware and software.
'      Be sure to read the section on setting up the QuickBASIC environment.
'      Rename one of the devices "DEV4" when running the IBCONF program
'      included with the board.  Remember the device number you renamed
'      and set the DIP switches on the back of the 1830-C to reflect the
'      address you have selected.
'
'Written By: Rakesh Pandit
'      Date: June 30, 1994
'************************ End of Header *************************************
'Beginning of program
'$INCLUDE: 'C:\AT-GPIB\QBASIC\QBDECL.BAS'       'Use your own path here.
'Beginning of program
    IEEEout$ = "DEV4"                          'IEEE-488 1830-C address must be
                                               'named DEV4 in the GPIB.COM file.
    CALL IBFIND(IEEEout$, device.number%)      'Setup the device.number% variable
                                               'used in GPIB-PC routine calls.
                                               '(National Instruments command)
    IF device.number% < 0 THEN
      PRINT "Unable to find "; IEEEout$; " 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:
```


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```
  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 "1830-C to IEEE-488 Communication Program"
  PRINT : PRINT
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 user to issue device clear
      CALL IBCLR(device.number%)           'Send a device clear
                                           '(National Instruments command)
      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$(10)           'Append a deliminating <LF> to IEEEout$
  CALL IBWRT(device.number%, IEEEout$)     'Write IEEEouit$ to IEEE-488 port
                                           '(National Instruments command)
  RETURN
'Read.IEEE.String: Read a string from the 1830-C IEEE port.  The string
'  read from the IEEE-488 port is printed on the screen.
Read.IEEE.String:
  timeout.error% = 0                       'Initiate to no timeout error
  ON TIMER(3) GOSUB timeout
  IEEEin$ = SPACE$(255)                    'Initiate IEEEin$ to 255 spaces
poll% = 0

'wait for MAV bit to be set
TIMER ON
WHILE ((timeout.error% = 0) AND ((poll% AND &H10) = 0))
  CALL IBRSP(device.number%, poll%)
WEND
TIMER OFF                                  'Turn timer off
IF (timeout.error% = 1) THEN
```


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```
    PRINT "IEEE-488 port timed out when trying to read input."
    RETURN
  END IF
  CALL IBRD(device.number%, IEEEin$)       'Read IEEE-488 port

  IEEEin$ = RTRIM$(IEEEin$)                'Trim trailing spaces
  IF (LEN(IEEEin$) > 0) THEN               'If something was read from port
    PRINT IEEEin$;                         'print the input string
  ELSE
    PRINT "Error occurred when reading IEEE-488 port."
  END IF
  RETURN
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
```


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Appendix C
Simplified 1830-C Functional Block Diagram

A simplified block diagram of the 1830-C is shown in Figure 11. The heart of the 1830-C is a current to voltage converter followed by an A/D converter that translates the conditioned analog input signals into a form usable by the microcomputer. The microcomputer performs all necessary system control and calculations required to display the correct reading.

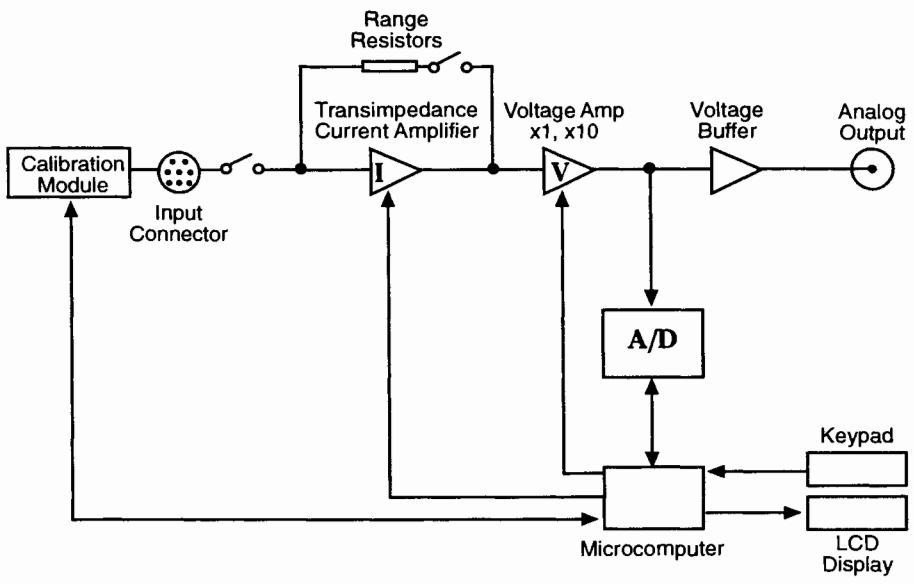


Figure 11. Simplified Functional Block Diagram

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