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REFERENCE GUIDE

Molectron
DETECTOR, INCORPORATED



EPM2000/EPM2000e

Dual-Channel
Joulemeter/Power Meter



EPM2000/EPM2000e

Dual-Channel
Joulemeter/Power Meter
Reference Guide

EPM2000/2000e Reference Guide
September 2001
Published by
Molectron Detector, Incorporated
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Portland, OR 97224
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Document Number: QD-19.17

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Features & Description

Welcome

Overview

Thank you for purchasing an EPM2000/EPM2000e (referred to as "EPM2000" in this reference guide). The EPM2000 is a dual-channel AC powered, laboratory meter that can measure both pulsed and CW lasers: energy, power, voltage, and (pulsed only) frequency. The EPM2000 is compatible with all of Molectron Detector, Inc.'s pyroelectric, silicon, and PowerMax® thermopile probes.

The EPM2000 is fast, accurate, and easy to use. It features:

- two large, custom four-digit LCD's
- selectable operating modes
- multifunction
- peak reading with automatic baseline drift compensation
- results displayed in selected units
- analog outputs
- adjustable internal triggers
- external trigger inputs
- an RS-232 communication port
- an IEEE-488 communication port

SAFETY INFORMATION

Review this safety information carefully to avoid injury and prevent damage to this instrument or any instrument connected to it. There are no user serviceable parts in the EPM2000. For Service, please see *Maintenance, Service, & Calibration*.

This reference guide uses two terms to describe hazardous conditions: **Caution** and **Warning**.

Warning indicates serious injury or death may occur.

Caution indicates possible damage to equipment.



Use only the power cord specified for the instrument. The grounding conductor of the cord must be connected to earth ground.

Do not operate the instrument if its panels are removed or any of the interior circuitry is exposed.

Do not operate the instrument in wet or damp conditions or in an explosive atmosphere.



Do not operate the instrument from a power source which applies more than the voltage specified.

Do not apply a voltage outside the specified range to any of the terminals.

Use only the fuse type and rating specified for the instrument .

Provide proper ventilation to the instrument, particularly near the ventilation slots in the back.

Do not operate the instrument with suspected failures. Refer damaged units to qualified Molectron service personnel.

Manual Information

This reference guide may be read sequentially, but should be stored near the EPM2000 and used as a reference.

There are five basic components of this reference guide:

- *Features & Description* An introduction to the EPM2000 and its features and controls
- *Operation* A tutorial and complete description of the EPM2000's functions
- *Programming* A list of commands and examples of communicating with the EPM2000 via remote
- *Maintenance, Service, & Calibration* A list of frequently asked questions, and information regarding calibration and service
- *Specifications* The standards and limits of the EPM2000

Features

Interface

The EPM2000 features a standard RS-232 9-pin connector on the back panel. This can connect to any similar RS-232 port of a host PC.

IEEE-488 (or GPIB) interface is standard on every instrument. Use this port for the following advantages:

- Higher transfer rates than the RS-232
- Can be added to an already existing instrument chain
- Can be used with other IEEE-488 instruments on the same host computer

Units and Ranges

The EPM2000 can measure:

- *Energy* 1 pJ to 10 J in 28 ranges (depending on the probe type)
- *Power* 1 mW to 10 KW in 15 ranges
- *Rep Rate* 0.1 pps to 1000 pps
- *Volts* 2 mV to 30 V (for pyroelectric/silicon probes)
- *Volts* 200 µV to 1 V (for thermopile probes)

For more details, see *Specifications*.

Compatible Probes

The EPM2000 functions with any of Molectron's pyroelectric/Joulemeter probes with names of the form J*x* (for example: J25, J3, J4).

All PowerMax thermopile probes will function with the EPM2000. Connect thermopile probes that terminate with a BNC connector to the EPM2000 with the PM-BNC adapter (available separately).

Understanding the EPM2000 Internal Trigger

For greatest accuracy and repeatability, each channel of the EPM2000 must trigger reliably for each laser pulse.

The EPM2000 should be triggered externally, via one of the Trigger In connectors, for best results. This is particularly true in a noisy environment. The EPM2000 can be set to synchronize with either the positive or negative transition of this external signal.

Without a reliable external trigger, set the EPM2000 to extract an artificial trigger from the incoming signal. This is Internal Triggering.

To successfully extract an internally generated trigger, set the EPM2000 to a range such that the incoming signal is at least 5% of the full scale. Set the trigger level for at least 2% above the noise level and at least 2% below the peak height.

For example, with a peak height of 300 mJ, set the EPM2000 to a range of 3 J. A peak will occur at 10% of full scale, well above the 5% level. The trigger level should not be set higher than 8%. If the noise level is 5% of full scale (approximately 150 mJ) then the trigger level should be set no lower than 7%.

In Figure 1, the EPM2000's internal trigger threshold has been set to 8% (dashed line). Pulse D will definitely not generate a reliable trigger. Pulse C may generate a trigger, but not reliably. Pulses A and B will definitely generate reliable triggers.

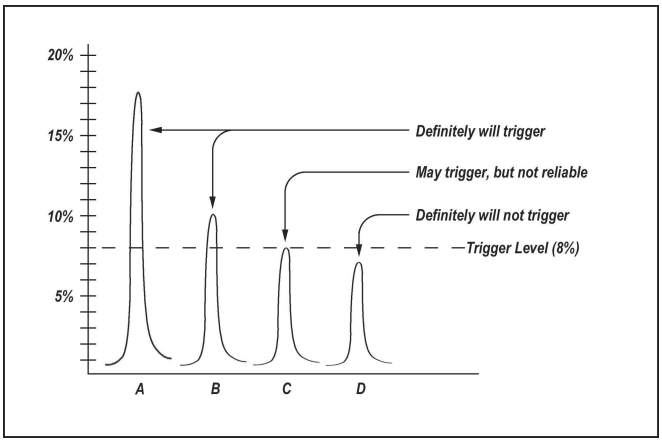


Figure 1: Pulses which will or will not trigger the EPM2000 Internal trigger.

The ranges differ by powers of ten. A full-scale signal on one range may not trigger on the next higher range unless the trigger level is set to less than 10%. For example, a near full-scale signal of 280 mJ on the 300 mJ range is less than 10% of full scale on the next higher range (2 J) and would not trigger the reading, so adjust the trigger level to less than 8% for reliable triggering.

The trigger is synchronous with the leading edge of the pulse, but the actual peak is determined algorithmically by sampling the input signal near the trigger. From the trigger point forward, the algorithm searches for peaks and from the trigger point back, it searches for a baseline.

The EPM2000 can be programmed to ignore triggers for a specified time after a valid trigger. This prevents "false" triggers in pulse tails from accidentally starting a new sample (see Figure 2). This amount of delay time is called the Trigger Holdoff (see *Operation -- Settings -- Trigger Holdoff*). The EPM2000 is set at the factory with a 0 ms trigger holdoff.

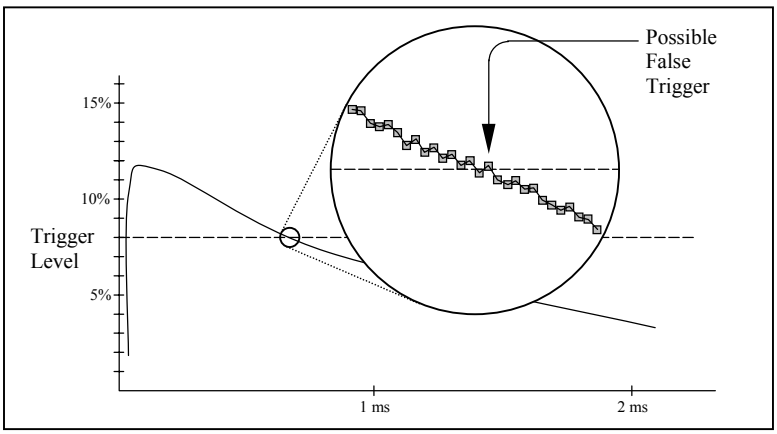


Figure 2: How a false trigger could occur.

UNDERSTANDING THE EPM2000 EXTERNAL TRIGGER CIRCUIT

The Circuit

Each External Trigger of the EPM2000 is a 100 W resistor in series with an optical coupler. The coupler is protected by an additional diode (see Figure 3). A rising edge at the Trigger In BNC forward biases the optocoupler diode and triggers the channel. If the EPM2000 channel is set for EXT NEG trigger, then the same sequence is initiated by a falling clock edge.

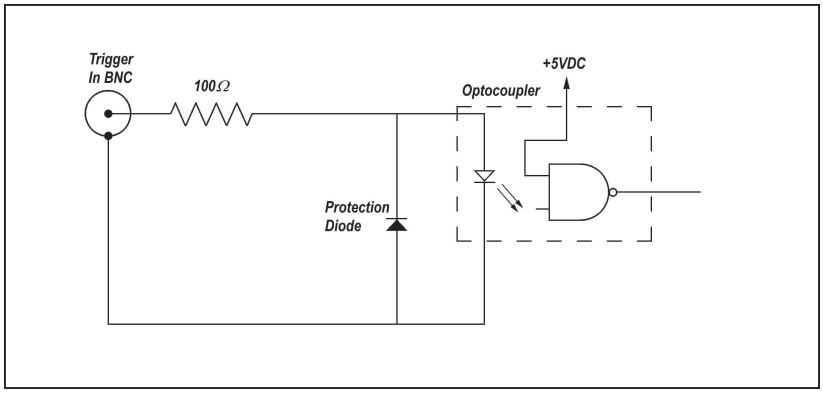


Figure 3: The external trigger circuit for the EPM2000.

The EPM2000 searches for a peak as soon as it receives the trigger signal. It compares successive A/D conversions, defining a peak as the first value followed by a lesser value, as shown in Figure 4. This allows the EPM2000 to read very long pulses with well-behaved rise characteristics.

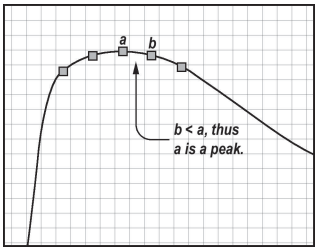


Figure 4: Determining a peak.

Trigger the EPM2000 as close to the pulse as possible. If the EPM2000 is triggered too early, it will detect fluctuations in the noise preceding the pulse and derive a false peak.

Triggering

Typical instrumentation triggers the EPM2000 reliably. If the triggering instrument cannot source enough current, boost the current supply externally using a trigger circuit such as shown in Figure 5.

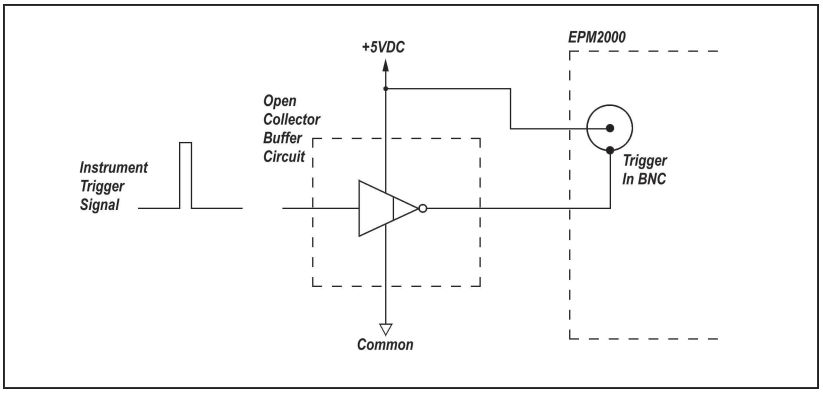


Figure 5: Method to boost source current of triggering device.

UNDERSTANDING THE EPM2000 SPEEDUP FEATURE

For most applications, it's important to determine laser power quickly and accurately. However, some probes, such as the PM5K, which can measure power as high as 7500 Watts, have a long response time. The EPM2000 solves this problem by using probe information and an internal algorithm, called the Speedup feature, to quickly estimate the final power value.

For long response time probes, the Speedup feature significantly reduces the amount of time required for an estimated value.

While the Speedup feature is useful for a stable laser output, it is not well suited for constantly changing or unstable laser outputs, as it tends to amplify noise. The most accurate way to measure power, particularly for unstable laser outputs, is to deactivate the Speedup feature.

The fastest and most accurate results can be achieved when the Speedup feature is in Selective mode. In Selective mode, the EPM2000 determines when the Speedup algorithm should be used. Whenever the actual measurement and the estimated measurement differ by more than 5%, the Speedup data will be displayed, but when the actual measurement falls within 1% of the estimated measurement, the EPM2000 displays the actual measurement. For most probes, using the Selective mode is very effective, taking advantage of the Speedup feature when needed and relying on the EPM2000's raw accuracy otherwise.

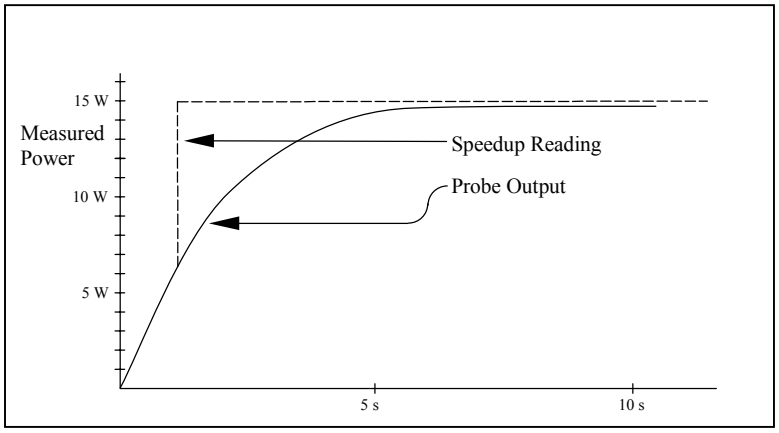


Figure 6: The Speedup feature estimating a 15 Watt power reading.

DESCRIPTION

REAR PANEL

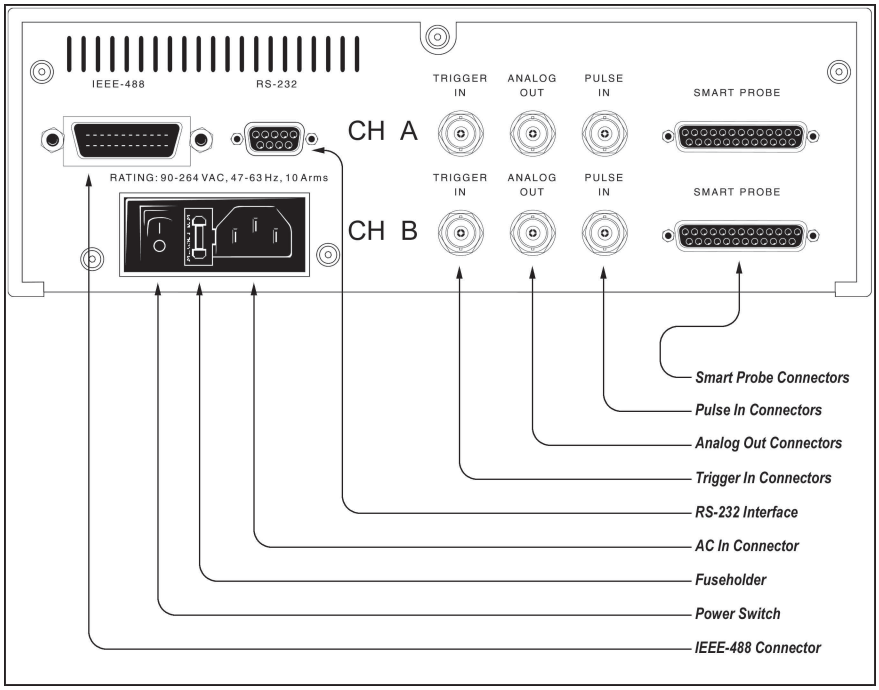


Figure 7: EPM2000 Rear Panel.

Smart Probe Connectors
These connections are for all of Molectron's PowerMax probes, as well as specially powered Joulemeter probes.

Pulse In Connectors
Pulse In connects pyroelectric laser energy probes and are internally terminated with 1MΩ impedance. Probes with 50 Ω impedance (such as J3, J3S, and J4 probes) must use a 50 Ω feed-through terminator, available through Molectron Detector, Inc., or equivalent to Pomona P/N 4119.

Analog Out Connectors
These connections provide an output voltage into loads ≥ 600 W that is proportional to the input pulse amplitude, scaled to the full scale of the display. The output range is 0 to V_{max} VDC, where V_{max} is defined in Figure 8. R_{load} is the impedance of the monitoring device (oscilloscope, A/D converter, etc.). The outputs update three times per second. Note that, although in some instances the EPM2000's display will exceed the selected range, under no circumstances will the output value exceed V_{max}.

$$V_{max} = 2.047\left(\frac{R_{load}}{R_{load} + 100}\right)$$

Figure 8: Conversion formula for Analog Out levels.

Trigger In Connectors
These inputs accept synchronized pulses from the laser. They are electrically isolated from the EPM2000 and consist of a 100 Ω resistor in series with an optoisolator. They can be set from the front panel or via remote to trigger on the rising or falling edge of the input signal. They only trigger pyroelectric/silicon measurements.

RS-232 Interface
The EPM2000 acts as a DTE (Data Terminal Equipment) device through this 9-pin RS-232 connector. It mates with a standard 9-pin straight-through serial cable to a typical IBM-AT compatible PC, or other DCE (Data Communications Equipment) device. Hardware handshaking is implemented.

Pin	Assignment
1	DCD (not used in the EPM2000)
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI (not used in the EPM2000)

Table 1: RS-232 pin assignments.

AC In Connector
Connect only to the factory supplied, polarized AC cord. The EPM2000 will function at AC voltages from 90 to 264 VAC at frequencies between 50 Hz and 60 Hz.

Fuseholder
Replace this fuse with only a 240 VAC 1 Amp fast-blow fuse. A convenient replacement fuse is stored in the holder. See *Maintenance, Service, & Calibration* for replacement instructions.

Power Switch
Press the I symbol for ON and the O symbol for OFF.

IEEE-488 Connector
This connector mates with a standard IEEE-488 cable.

Front Panel

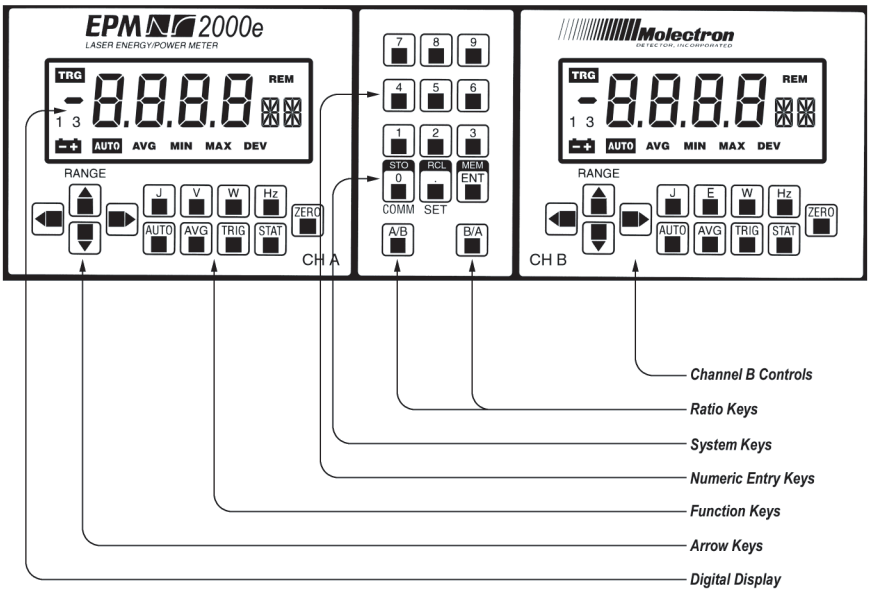


Figure 9: EPM2000 Front Panel.

Channel B Controls
Channel B Controls operate the same as channel A Controls. Indicators appear for channel B functions appear on the channel B LCD.

Ratio Keys

Use these keys to set the EPM2000 into Ratio Mode. One of the two channels must have a trigger source set to SLAVE.



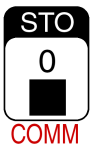
This key displays the ratio of A/B on the channel A.



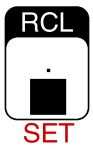
This key displays the ratio of B/A on channel B.

System Keys

These three keys navigate through the EPM2000's configuration menus.



This key permits modification of the EPM2000's communication parameters (such as baud rate, I/O port, etc.) by offering access to the communications parameters menu. It is also the "0" key for the Numeric Entry Keys.



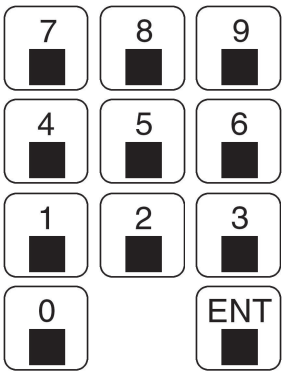
This key permits modification of the EPM2000's system parameters (such as Display Speedup and Backlight) by offering access to the system parameters menu. It also acts as the decimal point key for the Numeric Entry Keys.



Pressing this key during configuration menus or while entering a number on the numeric keypad will accept the currently displayed value or number.

Numeric Entry Keys

Use this keypad for data entry, such as detector responsivity or setup information such as statistics batch size.



Function Keys

Nine different keys control the primary functions of the EPM2000.

J — Sets the channel to report incoming energy in Joules during pyroelectric/silicon measurements.

V — Sets the channel to report probe output in Volts -- pulse height for pyroelectric/silicon measurements, DC voltage during thermopile measurement.

W — Sets the channel to display power in Watts, during pyroelectric/silicon or thermopile measurements.

Hz — Sets the channel to display the repetition rate for a laser during pyroelectric/silicon measurements, or to modify the wavelength compensation during thermopile measurement.

AUTO — Sets the channel into Autoranging. Autorange will not function with pyroelectric/silicon measurements that are internally triggered. Zero all thermopile ranges to allow the autorange function to operate properly when taking thermopile measurements.

AVG — Sets the channel to Average mode.

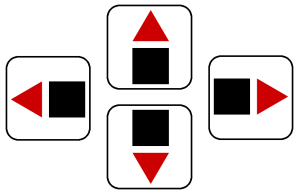
TRIG — Sets the channel's trigger source and internal trigger level during pyroelectric/silicon measurements.

STAT — Sets the channel into Statistics mode.

ZERO — During thermopile measurements, press this key to assign the current channel's value as a relative zero. Press this key in autorange mode to zero all ranges. Press this key to clear errors while entering data or setting such values as responsivity.

Arrow Keys

During a live reading, use the up/down arrow keys to change ranges. While setting parameters, use the up/down arrow keys to choose system parameters and the right/left arrow keys to select options for those parameters.



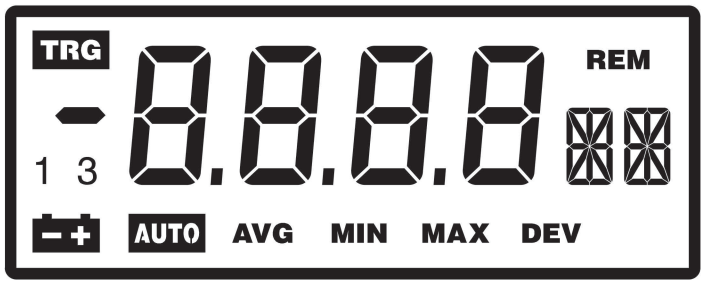


Figure 10: EPM2000 LCD Digital Display.

Digital Display
Twelve different readouts appear on the EPM2000's liquid crystal display (see Figure 10).

REM *REM Annunciator* Indicates the instrument is under remote control.

Numeric Display Typically indicates measurement value. 8.8.8.8

Alphanumeric Display Typically indicates measurement unit, and some auxiliary functions.

DEV *DEV Annunciator* Indicates the channel is displaying the standard deviation of the current batch in Statistics Mode.

MAX *MAX Annunciator* Indicates the channel is displaying the maximum batch value in Statistics Mode.

MIN *MIN Annunciator* Indicates the instrument is displaying the minimum batch value in Statistics Mode.

AVG *AVG Annunciator* Indicates one of two possible states. When the annunciator is steadily activated, the channel is displaying the mean batch value in Statistics Mode. When the annunciator is blinking, the channel is in Average Mode.

AUTO *AUTO Annunciator* Indicates the channel is in autorange mode.

Battery Indicator No function in this unit.

1 3 *Scale Indicators* No function in this unit.

Sign Indicator Indicates a negative reading during thermopile measurements.

TRG *TRG Annunciator* Indicates the EPM2000 is receiving a valid input pyroelectric/silicon pulse.

OPERATION

TUTORIAL

THERMOPILE

Measuring laser power using a PowerMax thermopile probe is easy with the EPM2000. It automatically searches for an attached thermopile probe when powered up. An attached thermopile probe is queried and the probe's responsivity is automatically programmed into the EPM2000.

Press [.] [W] [▶] to enter the PowerMax enable/disable feature (the text "TH" appears on the right hand side of the LCD). Press the [▲] or [▼] button to turn the feature on or off (the text "ON" or "OFF" will appear on the left hand side of the LCD). Press the [ENT] button to complete the selection.



Follow all laser safety procedures. Laser must be blocked or switched off before beginning this procedure.



Do not exceed the power/energy density limits for the thermopile probe as defined in the probe's data sheet.

1. Place the PowerMax probe in the path of the laser beam in such a way that the beam will strike the center of the probe surface when power is restored.

Caution

The EPM2000 must be off before connecting or disconnecting any powered probe such as the PowerMax thermopile probe. Connecting or disconnecting a probe while the EPM2000 is on will damage the probe.

2. Connect the detector to one of the EPM2000's rear panel 25-pin Smart Probe connectors, using the probe's cable.
3. Turn the EPM2000 on. If the desired channel isn't in Normal Mode, place it into Normal Mode by pressing W.
4. Switch the laser on or unblock the beam. Verify proper beam alignment on the probe surface.
5. Adjust the range up or down by pressing ▲ or ▼ respectively, until 30 to 300 counts appear on the digital display. A display reading of OL indicates the selected range is too low.
6. Block the beam and wait for the EPM2000 display to settle. Press ZERO to zero the display.
7. Unblock the beam and wait for the EPM2000 to settle on the new, more accurate reading. If the probe responds too slowly to power changes, activate Display Speedup and the EPM2000 will display an estimate of the final value within a few seconds.

PYROELECTRIC

If an EPM2000 doesn't detect the presence of a PowerMax thermopile probe or if the PowerMax function has been disabled, it monitors the pyroelectric/silicon input for signal peaks. Note that because the EPM2000 does not automatically read silicon/pyroelectric joulemeter probes, responsivity must be programmed manually.



Follow all laser safety procedures. Laser must be blocked or switched off before beginning this procedure.



Do not exceed the power/energy density limits for the pyroelectric probe as defined in the probe's data sheet.

1. Place the pyroelectric detector in the path of the laser beam in such a way that the beam will strike the center of the probe surface when power is restored.
2. Connect the detector to one of the EPM2000 rear panel connectors. In most cases, this connection will be a Pulse In connector, but in such cases as the J9-0660 pyroelectric probe, this will be a 25-pin Smart Probe connector.
3. Turn the EPM2000 on if it's not already on. If the instrument isn't in Normal Mode, place it into Normal Mode by pressing [J].
4. Program the EPM2000 with the correct responsivity by pressing [.] [J] and entering the value using the numeric entry keys. The proper responsivity value should be printed on a label attached to the probe. Note that the EPM2000 expresses responsivity as Volts/Joules, so if the probe responsivity is in other units (such as V/mJ), it must be converted before entry.
5. Switch the laser on or unblock the beam. Verify proper beam alignment on the probe surface.
6. Adjust the range by pressing [▲] or [▼] until the TRG annunciator activates and an energy reading appears on the digital display. Note that at lower rep rates, the annunciator will indicate each valid pulse by flashing on once, but at higher rep rates, it is activated continually as long as valid pulses arrive at the input. A display reading of OL indicates the selected range is too low.

MODES

NORMAL MODE

Use Normal Mode to make most measurements. The EPM2000 displays continuous live updates of incoming probe data in Joules, Volts, Watts, or Hertz for pyroelectric/silicon probes and data in Volts or Watts for thermopile probes.

If the frequency of incoming pulses exceeds the display refresh rate (3 Hz), then some readings will not appear on the LCD, but if the instrument has been programmed to store readings in the buffer, all readings will be stored.

An EPM2000 channel is in Normal Mode only when **AUTO** , **AVG**, **MIN** , **MAX** , and **DEV** are all not visible. Place the channel into Normal Mode by pressing [J] , [V] , [W] , or [Hz] .

AUTO MODE

Use Auto Mode to automatically seek the most appropriate range for any given input. Auto Mode is particularly useful when the input signal varies greatly during a sampling, because the EPM2000 is constantly seeking the best display range at each pulse. The EPM2000 can autorange while measuring Joules, Volts, or Watts, and the measurement unit can be changed while in Auto Mode, but the trigger source must always be external. The EPM2000 will not autorange from an internal trigger.

While in Normal Mode, measuring Joules, Volts, or Watts, press [AUTO] to set the channel in Auto Mode. The next pulse is used to determine the proper range and while the channel is seeking this range, the **AUTO** annunciator blinks. The annunciator stops blinking and locks on when the EPM2000 has located the proper range. The next pulse will use this new range. Press [AUTO] again to deactivate Auto Mode.

For best results, manually set the EPM2000 to its highest range before activating Auto Mode.

Average Mode

Use Average Mode to reduce pulse-to-pulse variation on the EPM2000 display. While in Average Mode, the EPM2000 reports the arithmetic mean of some number of consecutive samples. This number, the Average Batch Size, can be any integer from 2 to 99. Although only the resulting mean is displayed on the LCD, the EPM2000 can be programmed save each reading in its internal buffer for later transfer to a host computer. After reporting the mean value, the EPM2000 resets its counter and begins sampling the next batch. No readings are lost in the process. The previous value remains onscreen until the next value is calculated.

Average Mode will function while measuring Joules, Volts, or Watts, but changing measurement units will reset the EPM2000 to Normal Mode.

Press AVG to enter Average Mode. The LCD will display a countdown as the EPM2000 counts its first batch, but thereafter will only display calculated means. The **AVG** annunciator will blink while the EPM2000 is in Average Mode. Press AVG again to exit Average Mode.

Statistics Mode

Use Statistics Mode to measure statistical qualities of a predetermined number of samples. This number, the Statistics Batch Size, can be 0 or any number from 2 to 9999. The EPM2000 can be programmed to stop after taking a single batch (Manual Restart Mode), or continue sampling a new statistical batch (Automatic Restart Mode).

Statistics Mode will function while measuring Joules, Volts, or Watts, but changing units during a batch will reset the unit to Normal Mode.

A Statistics Batch Size of 0 sets the EPM2000 to continuously collect data, comparing values on the fly and updating the Minimum and Maximum values. During this continuous collecting, the channel does not collect or display the Arithmetical Mean or the Standard Deviation.

Press STAT to enter Statistics Mode. Use the ◀■ or ■▶ keys to sequence through the four statistical values. LCD annunciators indicate which value is displayed, **AVG** for the Mathematical Mean (or Average) of the batch, **MIN** for the Minimum value, **MAX** for the Maximum value, and **DEV** for the Standard Deviation. Press STAT again to exit Statistics Mode.

Ratio Mode

Use Ratio Mode to measure the ratio of both channels, either A/B or B/A. Because the channels must be synchronized for an effective calculation, exactly one channel's trigger must be slaved. The EPM2000 will not enter Ratio Mode unless one channel's trigger is set to SLAVE.

Press A/B to enter Ratio Mode. Channel B will continue to display the current readings, but Channel A will display the quotient A/B.

Press B/A to view the quotient B/A on Channel B's display. Channel A will display its current reading.

If programmed to store readings in the data buffer, the EPM2000 will store the quotient in the buffer -- not the raw readings.

If the two channels are set for the same unit, the reading is a unitless ratio of the readings. If the units are set differently, the reading is a quotient and the units are the appropriate quotient. For example, if channel A is measuring Volts and B is measuring Joules, pressing A/B will display the quotient on channel A. The measurement unit would be V/J (thus an EPM2000 can characterize an attached Joulemeter's responsivity).

Instrument Settings

The EPM2000 is an extremely versatile instrument, with a variety of operating modes and settings. In addition to the front panel controls, most of the settings listed are accessible via the remote interfaces.

Audible Beeper

The EPM2000 generates an audible tone during certain error conditions such as an input overrange, when the thermopile temperature exceeds 100°C, or when the FIFO is full (for more details, refer to *FIFO Full Condition* in the Programming section).

To turn the Beeper option on, press . . ▲ ENT .

To turn the Beeper off, press . . ▼ ENT .

Average Batch Size

The number of samples in each of the EPM2000 channel's Average Batch Size can be any value from 2 to 99. Note that each channel uses its own AVG button.

To change the quantity, press . AVG . The LCD will indicate the current value. For example, a value of 57 samples looks like 5 7 Pu. Change the value directly with the numeric Entry Keys. Increment or decrement the value by one by pressing ▲ or ▼, respectively.

Display Backlight

The EPM2000 LCD can be illuminated for viewing in a dim environment.

To turn the Backlight on, press . . ■▶ ■▶ ▲ ENT.
The Backlight should immediately turn on.

To turn the Backlight off, press . . ■▶ ■▶ ▼ ENT. The Backlight should immediately turn off.

Display Speedup

For a detailed description of the Display Speedup feature, see *Understanding the EPM2000 Speedup Feature*.

To enable Display Speedup, press . . ■▶. Press ▲ or ▼ until the LCD reads O n SU.
Finish the action by pressing ENT.

To disable Display Speedup, press . . ■▶ ▼ ▼ ENT.

To set Display Speedup to Selective, press . . ■▶ ▲ ▲ ENT.

Factory Defaults

For a complete list of the EPM2000's factory defaults, please see the *Specifications* section.

Reprogram the EPM2000 with its factory default values by pressing and holding the RCL . SET key while turning the power off, then back on again. The instrument will immediately reset with the new settings.

IEEE-488 Address

Set the EPM2000 IEEE-488 address to any value from 1 to 31. Although the EPM2000 can use address 0, this is not recommended, as the IEEE-488 bus expects the instrument at address 0 to be a Controller.

Press . 0 ▲ ▲ ■▶ to set the IEEE-488 address. The EPM2000 LCD will display the current address. For example, an address of 12 appears as 12 Ad. Use the ▲ or ▼ keys to increment or decrement the current address or the Numeric Entry Keys to select an address more quickly. Press ENT to complete the action.

IEEE-488 Enable/Disable

To enable the EPM2000EPM2000e's IEEE-488 port, press . 0 ▲ ▲ ENT .

To disable the port, press . 0 . Press ▼ until the LCD reads either 232 CS or OFF CS. The former activates the RS-232 interface, which automatically disables the IEEE-488 interface and the latter deactivates both communications interfaces. Press ENT to complete the action.

Line Frequency

The EPM2000 uses a 12-bit analog-to-digital converter for thermopile data. This converter must be programmed to reject the local AC line frequency for greatest accuracy. Two rejection frequencies are programmed into the EPM2000, 50Hz and 60Hz.

To reject 50Hz frequencies, press . . ■▶ ■▶ ■▶ ▼ ENT .

To reject 60Hz frequencies, press . . ■▶ ■▶ ■▶ ▲ ENT .

LONG RISETIME MODE

The EPM2000 can accurately measure pulses with risetimes greater than 2 milliseconds and as long as 10 milliseconds.

Press [ ] [ ] [AVG] to display the current risetime value. This value represents the maximum risetime that can be accurately measured (10 ms maximum). The EPM2000 is set at the factory to measure a 2 ms maximum risetime. Pressing [▲] or [▼] cycles this value through 2 ms, 4 ms, 8 ms, or 16 ms.

Changing the risetime value rescales the EPM2000's Trigger Holdoff time. Additionally, it rescales the Trigger Holdoff increment time, according to Table 2.

For example, if the risetime is 2 ms (factory default) and the Trigger Holdoff time is 10 ms, then setting the risetime for 8 ms will change the Trigger Holdoff time to 40 ms. Attempts to change it via the front panel by using the [▲] or [▼] buttons will cause changes only in increments of 4 ms.

Maximum Risetime Selected	Trigger Holdoff Increments	Trigger Holdoff Value
2 ms	1 ms	Current Value
4 ms	2 ms	Current Value * 2
8 ms	4 ms	Current Value * 4
16 ms	8 ms	Current Value * 8

Table 2: Results of changing the EPM2000 risetime.

Each of the EPM2000's channels can be programmed independently for different pulse risetimes.

POWERMAX ENABLE/DISABLE

An EPM2000 automatically detects an attached PowerMax probe when the power is switched on. Disable this feature when the pyroelectric/silicon input is needed but the PowerMax probe remains connected.

Disable the PowerMax function by pressing [ ] [▶]. When the PowerMax function is disabled, it will stay disabled, even after instrument power has been cycled.

Enable the PowerMax function by pressing [ ] [◀].

Responsivity (Pyroelectric)

The Pyroelectric Responsivity Value is the conversion factor, converting probe voltage to energy in Joules. The simple equation describing this is: Energy in Joules = Probe Voltage/Responsivity. The probe responsivity is typically printed on the probe label. Note that if the probe responsivity is expressed in some fractional unit (for example, Volts/millijoule), then the stated responsivity must be multiplied accordingly.

Each channel of the EPM2000 can use an independent Responsivity value. Use the channel's specific [J] key when programming.

To change the pyroelectric responsivity, press [.] [J]. The current pyroelectric responsivity will be displayed. For example, if the current responsivity is 2200 V/J, then the EPM2000 LCD will read 2.200 +3. Use the [▲] and [▼] keys to change the exponent and exponent sign. Use the Numeric Entry Keys to change the decimal value. When complete, press [ENT] to complete the action.

Compensate for optical attenuation by adjusting the responsivity accordingly. For example, if a detector's responsivity is 1.53 and the beam passes through a 50% optical attenuator before striking the probe, set the responsivity to 0.765 or 7.65 x 10^{-1} (1.53 x 0.5).

Responsivity (Thermopile)

The Thermopile Responsivity, like the pyroelectric responsivity, is a conversion factor, but to Watts instead of Joules. For most probes, each channel of the EPM2000 will automatically read the thermopile responsivity from the probe EEPROM, but sometimes the thermopile responsivity must be changed manually.

As with Pyroelectric Responsivity, each channel's Thermopile Responsivity can be manually programmed. Because an EPM2000 reads any attached PowerMax probe upon powerup, changing the Thermopile Responsivity is only good until the EPM2000 is turned off or a new probe is attached.

To change the thermopile responsivity, press [.] [W]. The current thermopile responsivity will appear on the LCD. As with the pyroelectric responsivity, press [▲] or [▼] to change the exponent and exponent sign. Change the decimal part using the Numeric Entry Keys. Finish by pressing [ENT].

RS-232 Baud Rate

The RS-232 interface requires a baud rate selected for the EPM2000 that matches the baud rate of the host machine. The instrument supports six different baud rates: 1200, 2400, 4800, 9600, 19200, and 38400.

To change the RS-232 baud rate, press . 0 . Press ▲ or ▼ until the display reads 232 CS. Press ■▶ . The current baud rate should appear on the LCD. For example, if the current baud rate is 9600, then 9600 BR appears on the LCD. Press ▲ or ▼ to select the desired baud rate, then press ENT to complete the action.

RS-232 Enable/Disable

To enable the RS-232 communications port, press . 0 . Press ▲ or ▼ until the LCD reads 232 CS, then press ENT to complete the action.

To disable the RS-232 port, activate the IEEE-488 port by pressing . 0 ▲ ▲ ENT . The RS-232 communications port will also be deactivated if both ports are deactivated. Deactivate both ports by pressing . 0 ▼ ▼ ENT .

RS-232 Parity

The RS-232 communications port of the EPM2000 has three possible settings for the parity bit: even, odd, or none.

To set the parity, press . 0 and then ▲ or ▼ until the LCD reads 232 CS. Then press ■▶ ■▶ . The current parity setting will be indicated by the alphanumeric display. Odd, even, and no parity appear as PO , PE , and PN respectively. Use the ▲ and ▼ keys to select the desired parity and press ENT to complete the action.

RS-232 Stop Bits

The RS-232 data stream from the EPM2000 can be set to contain one or two stop bits.

Set the number of stop bits by pressing [.] [0] and then [▲] or [▼] until the LCD reads 232 CS. Then press [■▶] [■▶] [■▶]. The LCD indicates the current number of stop bits. For example, one stop bit is indicated as 1SB. Use the [▲] and [▼] keys to select the desired number of stop bits and press [ENT] to complete the action.

Setup Store & Recall

The EPM2000 features four special memory locations. The instrument's current setup can be stored into any one of these four locations. A stored state can be retrieved, instantly reprogramming the EPM2000's attributes to the stored state.

The instrument state includes Average Batch Size, Display Speedup, Line Frequency Rejection, Pyroelectric Responsivity, Range, Statistics Batch Size, Statistics Restart Mode, Trigger Holdoff, Trigger Level, Trigger Source, and Units.

During procedures requiring many attribute changes, save time by "presetting" states into the four memory locations. Programming from a state recall takes much less time than changing the individual attributes, either manually or via the remote interfaces.

Save an instrument state by pressing [MEM ENT] [STO 0 COMM] and either [1], [2], [3], or [4].

Recall an instrument state by pressing [MEM ENT] [RCL . SET] and the desired memory location, either [1], [2], [3], or [4].

Statistics Batch Restart Mode

Each channel of the EPM2000 handles the end of a statistical batch in one of two different ways. In Automatic Restart Mode, at the end of a batch, the channel automatically begins collecting the next batch. The calculated statistical values are displayed on screen until the new batch has been collected. In Manual Restart Mode, at the end of a batch, the channel ignores additional incoming data and displays the finished batch's statistical data until the channel is reset manually by pressing the [ZERO] key or via the remote command: **ch a stat start** or **ch b stat start**.

To change a channel's Restart Mode, press . [STAT]. The LCD will display the Statistics Batch Size and the Restart Mode. For example, if the channel was set to a 1000-pulse Batch Size and Automatic Restart, then the LCD would read 1000 AR.

Use the [▲] and [▼] keys to toggle the restart mode from Automatic to Manual.

Press [ENT] to accept the selection or [ZERO] to cancel it.

Statistics Batch Size

Program each channel of the EPM2000 to collect a sample size from 2 to 9999 readings. Each channel can also be programmed with a batch size of 0.

When the batch size is 0, the channel enters a "running statistics" mode. The EPM2000 constantly tracks the minimum and maximum pulse energy read by that channel. Toggle between displaying the current maximum and current minimum values by pressing [◀] or [▶]. Press [ZERO] to clear the two values and begin collecting new statistical data.

Press . [STAT] to change the Batch Size. The LCD will display the statistics batch size and the restart mode. For example, a batch size of 6126 with manual restart appears as 6 126 MR.

Use the Numeric Entry Keys to change the value of the batch size. Press [ENT] to accept the new value or [ZERO] to cancel the action.

Trigger Holdoff

The Trigger Holdoff determines how long the EPM2000 waits after receiving a valid trigger before resetting the triggering circuit. This avoids false triggers from a noisy pulse tail (See *Understanding the EPM2000 Trigger*). The Trigger Holdoff can be set for 0 to 49 ms and the holdoff of each channel can be set independently.

Set the Trigger Holdoff by pressing . . Press the desired channel's [TRIG] key. Press [▲] or [▼] to increment or decrement through the possible delay values or use the Numeric Entry Keys to enter a value directly. Press [ENT] to complete the action.

Trigger Level

The EPM2000 internal trigger level can be set for as low as 2% of full scale and as high as 20% of full scale. Noisy environments require higher trigger levels. As with Trigger Holdoff, the trigger level of each channel can be set independently.

To set a channel's trigger level, press the TRIG key for that channel. Press ▲ or ▼ to increment or decrement through the possible level values or use the Numeric Entry Keys to enter a value directly. Press ENT to complete the action.

Trigger Source

Each channel of the EPM2000 can be set to trigger on some selected percentage of the current range (internal trigger), an external signal (applied to the TRIG IN connector), or the internal Trigger Bus. Note that neither channel will trigger if both are slaved to the Trigger Bus. At any time while setting the trigger source, pressing ZERO cancels the action and restores the previous value.

To set a channel's trigger source, press . and the appropriate channel's TRIG key.

For an internal trigger, press ▲ until the LCD reads IT.

For an external, positive-edge trigger, press ▲ until the LCD reads XT.

For an external, negative-edge trigger, press ▲ until the EPM2000 LCD reads -XT.

To slave the channel's trigger to the Trigger Bus, press ▲ until the LCD reads SL.

Press ENT to complete the action.

WAVELENGTH COMPENSATION

Sometimes a probe calibrated for one laser wavelength must be used to measure laser energy of another wavelength. Because of differing absorptive characteristics, the results are often incorrect.

Program the wavelength correction of each channel of the EPM2000 independently, using that channel's [Hz] key. The instrument will not allow access to this function unless it detects an attached PowerMax laser probe.

To activate Wavelength Compensation, press [.] [Hz] [▲] [ENT].

To change the compensation value, press [.] [Hz] [■▶]. Use the numeric entry keys to change the decimal value and the [▲] and [▼] keys to select µm or nm. Press [ZERO] at any time while entering data to restore the initial value. Press [ENT] to complete the action.

To deactivate Wavelength Compensation, press [.] [Hz] [▼] [ENT].

PROGRAMMING

CONNECTION METHODS

The EPM2000 has been designed to use one computer interface at a time. Before attempting to communicate with the EPM2000 via either the RS-232 interface or the IEEE-488 interface, be sure the interface has been activated (see *Operation -- Settings*). Verify that all computer host communication settings match the instrument settings (IEEE-488 address, RS-232 baud rate, etc.).

The EPM2000 will only transmit in response to a query command. It will not respond to set commands. For example, the EPM2000 will transmit a response to **`ch a stat bat ?`**, but not to **`ch a stat bat 100`**.

The EPM2000 activates the **REM** annunciator and disables the front panel controls while it processes a remote command. During IEEE-488 communication, the EPM2000 stays in this mode. Return the EPM2000 to local control by sending a **`*RST`** to the instrument or a **`loc`** command to the IEEE-488 bus. During serial communication, the EPM2000 returns to local control after completing the remote command.

COMMANDS

Commands will function as described with either the RS-232 or IEEE-488 interface.

If the EPM2000 receives a command it does not know or cannot process, no action will occur, unless IEEE-488 Communication Error reporting is activated, in which case, the instrument will reply with the error message: **`Unrecognized SCPI command: <`*`invalid command`*`> ?`**.

Although capitalization indicates a required substring of the command, command case isn't relevant. Commands can be separated by a space, a colon (:), or a tab. Channel-specific commands (all commands beginning with CH) can specify channels A, B, or ALL. If no channel is specified, the EPM2000 applies the command to Channel A.

Command parameters separated by a vertical slash are exclusive choices. For example, **`CHannel A UNITS <?|VOLts|JOUles| WATts|HZ>`** means that **`ch a units vol`** is a valid command or **`ch a units jou`**, but not **`ch a units vol jou`**. Command parameters separated by a comma are non-exclusive choices. For example, **`CHannel A STATistics SEND <AVG,DEV,MIN,MAX>`** means that **`ch a stat send avg`** is valid, as is **`ch a stat send avg min max`**.

The EPM2000 will not buffer commands, so commands received while the EPM2000 is processing a previous command will be ignored. 300 ms is enough time for the EPM2000 to recover from most commands.

AUDIBLE BEEPER

Set or query the status of the Audible Beeper option.

Command Form
SYSTem OPTion AUDio <?|ON|OFF>

Examples

Input	Instrument Reply
syst opt aud off	**none**
syst opt aud ?	**SYSTEM: OPTION: AUDIO OFF**

AVERAGE BATCH SIZE

Set or query the Average Mode Batch Size of each channel of the EPM2000.

Command Form
CHannel <A|B|ALL> AVERage BATch_size <?|2..99>

Examples

Input	Instrument Reply
ch a aver bat 42	**none**
ch b aver bat 28	**none**
ch all aver bat ?	**CHAN A: AVERAGE: BATCH_SIZE 42**
	CHAN B: AVERAGE: BATCH_SIZE 28

BACKLIGHT

Set or query the status of the EPM2000's backlight.

Command Form
SYSTem OPTion BACklight <?|ON|OFF>

Examples

Input	Instrument Reply
syst opt bac off	***<LCD backlight deactivates>***
syst opt bac ?	**SYSTEM: OPTION: BACKLIGHT OFF**

Buffer Contents

Queries the number of bytes residing in the EPM2000's data buffer. This command does not affect the data, nor prevent additional data from being added to the buffer.

Command Form
OUTput BUFFER CONTENTS

Example

Input	Instrument Reply
out buffer contents	**OUTPUT: BUFFER CONTENTS 16 BYTES**

Communications Error

Set the EPM2000 to echo back invalid commands.

Command Form
COMMunication ERROR <ON|OFF>

Examples

Input	Instrument Reply
comm error on	**none**
syst opt bak off	**Unrecognized SCPI command: syst opt bak off**

Display Current Reading

Query the EPM2000 for the data currently displayed on the LCD.

Command Form
CHannel <A|B|ALL> QUERY

Example

Input	Instrument Reply
ch all query	**CHAN A: QUERY 0.0 mV** **CHAN B: QUERY 1.400 mV**

IDENTIFICATION

Query the EPM2000 for identifying information, such as firmware revision date, model number, etc.

Command Form
***IDN?**

Example

Input	Instrument Reply
***idn?**	**Molectron Detector, Inc.** **EPM2000 Ver G4.30 13-Aug-98†**

† Actual reading will vary, depending on installed firmware.

IEEE-488 ADDRESS

Set or query the IEEE-488 address of the EPM2000. The instrument must be reset for this command to take effect.

Command Form
COMMunication GPIB ADDRess <?|0..31)

Examples

Input	Instrument Reply
comm gpib addr 5	**none**
comm gpib addr ?	**COMM: GPIB: ADDRESS 5**

INSTRUMENT SETUP STORE/RECALL

Set the EPM2000 to store certain instrument attributes in or retrieve those attributes from a numbered memory location. Both channels are stored and recalled, so no channel argument is required. The stored attributes are Average Batch Size, Display Speedup, Line Frequency, Pyroelectric Rv, Range, Statistics Batch Size, Statistics Restart Mode, Trigger Holdoff, Trigger Level, Trigger Source, and Units. Memory locations 1, 2, 3, or 4 are available.

Command Form
CHannel MEMory <STORE|RECALL> <1|2|3|4>

Examples

Input	Instrument Reply
ch mem store 1	**none**
ch mem recall 1	**none**

LINE FREQUENCY

Set or query the EPM2000's line frequency option.

Command Form
SYSTem OPTion LINE <?|50HZ|60HZ>

Examples

Input	Instrument Reply
syst opt line 60hz	**none**
syst opt line ?	**SYSTEM: OPTION: LINE 60HZ**

LONG RISETIME MODE

Set or query the scale factor for the Trigger Holdoff, which allows more accurate measurement of slower (> 2ms risetime) pulses. The argument corresponds to the maximum risetime (ms) which the EPM2000 can accurately measure. 2 ms is a scale factor of 1, 4 ms is a scale factor of 2, etc.

Command Form
CH <A|B|ALL> TRIGger RISEtime <?|2|4|8|16>

Examples

Input	Instrument Reply
ch a trig rise 2	**none**
ch b trig rise 4	**none**
ch all trig rise ?	**CHAN A: TRIG: RISETIME 2**
	CHAN B: TRIG: RISETIME 4

OPERATING MODE

Set or query the specified channel's current Operating Mode.

Command Form
CHannel <A|B|ALL> OPERating_mode <?|NORMal|AVERage|STATistics>

Examples

Input	Instrument Reply
ch a oper norm	**none**
ch b oper stat	**none**
ch all oper ?	**CHAN A: OPER NORMAL**
	CHAN B: OPER STATISTIC

OUTPUT BUFFER

Set or query the disposition of new data when the output buffer has reached the level specified by output depth. In Fixed mode, the new data is simply discarded. In Circular mode, the oldest data point is discarded and replaced with the newest data point.

Command Form
OUTput BUFfer <?|FIXED|CIRCular>

Examples

Input	Instrument Reply
out buf fixed	**none**
out buf ?	**OUTPUT: BUFFER FIXED**

OUTPUT CONTINUOUS

Set the EPM2000 to either continuously transmit data or store data in its internal buffer. To continuously transmit data via RS-232, the DTR line must remain asserted. If storing data, the EPM2000 will transmit all of its data upon receiving an **out dump** command.

Command Form
OUTput CONTinuous <ON|OFF>

Example

Input	Instrument Reply
out cont on	**none**

OUTPUT DEPTH

Set or query the depth of the EPM2000 data buffer in bytes, any value from 1 to 4095.

Command Form
OUTput DEPth <?|1..4095>

Examples

Input	Instrument Reply
out dep 1000	**none**
out dep ?	**OUTPUT: DEPTH 1000**

OUTPUT DUMP

Query the EPM2000 data buffer contents, but only when **out cont** is off. Upon receiving an **out dump** command, the EPM2000 immediately flushes the contents of its buffer out the selected communications port. **out form** dictates the nature of the data that is transmitted. Pulse information received by the instrument during the execution of an out dump is stored within the data buffer.

Command Form
OUTput DUMP

Example

Input	Instrument Reply
out dump	***<listing of data>***

OUTPUT FORMAT

Set or query the format which the EPM2000 uses to transmit data. Ordinary device queries are always answered by the EPM2000 in ASCII -- this command determines the format of pulse data only. The three forms are Binary, ASCII, and ASCII+.

Binary
The most compact form of data storage. In this mode, the EPM2000 transmits 8-bit values, which decode to one of the following four types of data: Status Byte, Data High Byte, Data Low Byte, or Timestamp Bytes.

Bit	7	6	5	4	3	2	1	0
Mnemonic	0	Chan	Type	d4	d3	d2	d1	d0

Status Bytes determine such qualities as channel, range, units, and type of data. Status Bytes only appear in the data stream when one or more of those data properties changes or at the beginning of the data transmission. Status Bytes will always be followed by other Status Bytes or by a Data High Byte. Bit 7 of a Status Byte will always be 0.

Status Bytes decode as follows:

Table 3: Status Byte Map.

Bit 7 Always 0

Bit 6 Channel
0 = Channel A
1 = Channel B

Bit 5 Information Type
0 = Range Information
1 = Unit Information

Bits 4-0 (If Range Information) Range
00000 = 10^{0}
00001 = 10^{1}
00010 = 10^{2}
…
01110 = 10^{14}
01111 = 10^{15}
10000 = not used
10001 = 10^{-15}
10010 = 10^{-14}
…
11110 = 10^{-2}
11111 = 10^{-1}

Bits 4-2 (If Unit Information) Type of Data
000 = Pulse Measurement
001 = Statistical Batch Mean (Average) Measurement
010 = Statistical Batch Standard Deviation Measurement
011 = Statistical Batch Maximum Measurement
100 = Statistical Batch Minimum Measurement
101 = Command in Process
110 = Command Completed
111 = End of Data

Bits 1-0 (If Unit Information) Units
00 = Joules
01 = Volts
10 = Watts
11 = Hertz

Data Bytes contain the 12-bit value of the reading. They are always in the order: Data High Byte, Data Low Byte. In the Data High Byte, bits 7 and 6 are always 1 and 0, respectively. Bits 5-0 are bits 11-6 of the Data Value. In the Data Low Byte, bits 7 and 6 are always both 1 and bits 5-0 are bits 5-0 of the Data Value. Append the two pieces of the Data Value, convert to decimal, add leading zeroes if necessary to complete the 4-digit decimal value, and add the implied decimal point. Use the most recent Status Byte values to complete the reading.

Table 4: Data High Byte Map.

Bit	7	6	5	4	3	2	1	0
Mnemonic	1	1	d5	d4	d3	d2	d1	d0

Table 5: Data Low Byte Map.

For example, an EPM2000 dumps its buffer. The following data is transmitted: **38 21 00 A6 C3 A6 CA 3C**. Translated:

38 = 0011 1000
Status Byte, CH A, Unit Information, "Command Completed"
21 = 0010 0001
Status Byte, CH A, Unit Information, "Pulse Measurement", "Volts"
00 = 0000 0000
Status Byte, CH A, Range Information, 10^0
A6 = 1010 0110
Data High Byte: 100110
C3 = 1100 0011
Data Low Byte: 000011
Complete data value: 100110 000011 = 2435
Interpreted reading is 2.435 x 10^0 Volts.
A6 = 1010 0110
Data High Byte: 100110
CA = 1100 1010
Data Low Byte: 001010
Completed data value: 100110 001010 = 2442
Interpreted reading is 2.442 x 10^0 Volts.
3C = 0011 1100
Status Byte, CH A, Unit Information, "End of Data"

Timestamp bytes are three-byte sequences containing a 21-bit time signature. Timestamp bytes are only transmitted in binary mode and only when the timestamp function is activated. Three timestamp bytes follow data low bytes.

Bit	7	6	5	4	3	2	1	0
Mnemonic	1	d63	d62	d61	d60	d59	d58	d57

Bit	7	6	5	4	3	2	1	0
Mnemonic	1	d20	d19	d18	d17	d16	d15	d14

Table 6: First Timestamp Byte map.

Tabel 7: Second Timestamp Byte map.

Table 8: Third Timestamp Byte map.

ASCII
A form of transmission used in A/D debugging and calibration -- rarely used in the field. Data are transmitted in raw A/D counts, followed by a unit designator: **2146V, 1864V, 1600V, 1366V**, etc. The decimal point after the first digit is still implied and the leading zeroes are blanked, so a reading such as **687V** would indicate a pulse height of 0.687V

ASCII+
A commonly used form of data transmission, most easily readable. Data is indicated using scientific notation and units are included. For example, **0.687E+00V**.

When multiple values are transmitted (such as statistical data), the values are separated by a comma. To avoid confusion, data headers should be utilized when transmitting multiple values (see *Programming -- Commands -- Statistics Send*). An example of multiple values with headers is: **AVG=0.950E+00V,DEV=0.001E+00V**.

Command Form
OUTputFORMat <?|BINary|ASCII|ASCII+>

Examples

Input	Instrument Reply
out form bin	**none**
out form ?	**OUTPUT: FORMAT BINARY**

PROBE TYPE

Query the channel to determine the type of probe attached. In the case of a PowerMax probe, the EPM2000 will also return the head code in hexadecimal notation.

Command Form
CHan <A|B|ALL> TYPE ?

Example

Input	Instrument Reply
ch all type ?	**CHAN A: TYPE PYRO**
	CHAN B: TYPE PYRO

RANGE, CURRENT

Set or query the channel's current range. Example range arguments include 300mv, 30mj, 3j, etc.

Command Form
CHan <A|B|ALL> RANGE <?|*range argument*>

Examples

Input	Instrument Reply
ch a range 3j	**none**
ch b range 10V	**none**
ch all range ?	**CHAN A: RANGE 3J**
	CHAN B: RANGE 10V

RANGE, MAXIMUM/MINIMUM

Query a channel's maximum or minimum possible range with the current units, responsivity, head, etc.

Command Form

```
CHan <A|B|ALL> RANGE <MAX|MIN> ?
```

Examples

Input	Instrument Reply
`ch all range max ?`	`CHAN A: RANGE MAX=30J`
	`CHAN B: RANGE MAX=10V`
`ch all range min ?`	`CHAN A: RANGE MIN=1mJ`
	`CHAN B: RANGE MIN=1mV`

RESET

Immediately reset the EPM2000.

Command Form

```
*RST
```

Example

Input	Instrument Reply
`*rst`	*<unit resets>*

RESPONSIVITY

Set or query the pyroelectric or thermopile responsivity of either channel. Express the value in decimal or scientific notation.

Command Form

```
CHan <A|B|ALL> RESPonsivity <THERmopile|PYROelectric> <?|value>
```

Examples

Input	Instrument Reply
`ch a resp pyro 2200`	`none`
`ch b resp pyro 1.331e5`	`none`
`ch all resp pyro ?`	`CHAN A: RESP: PYRO 2.200E+03`
	`CHAN B: RESP: PYRO 1.331E+05`
`ch all resp ther ?`	`CHAN A: RESP: THERMOPILE 4.000E+00`
	`CHAN B: RESP: THERMOPILE 4.000E+00`

RS-232 Baud Rate

Set or query the RS-232 baud rate of the EPM2000.

Command Form
COMMunication RS232 BAUD <?|1200|2400|4800| 9600|19200|38400>

Examples

Input	Instrument Reply
comm rs232 baud 2400	**none**
comm rs232 baud ?	**COMM: RS232: BAUD 2400**

RS-232 Parity

Set or query the RS-232 parity bit setting of the EPM2000.

Command Form
COMMunication RS232 PARity <?|ODD|EVEN|NONE>

Examples

Input	Instrument Reply
comm rs232 par even	**none**
comm rs232 par ?	**COMM: RS232: PARITY EVEN**

RS-232 Stop Bits

Set or query the number of stop bits the EPM2000 injects into the communications stream.

Command Form
COMMunication RS232 STOPbits <?|1|2>

Examples

Input	Instrument Reply
comm rs232 stop 2	**none**
comm rs232 stop ?	**COMM: RS232: STOPBITS 2**

SELF-TEST

Instructs the EPM2000 to perform a self-test and return the result.

Command Form
***TST ?**

Example

Input	Instrument Reply
***tst ?**	**PASS**

SPEEDUP

Set or query the status of the EPM2000 Display Speedup function.

Command Form
SYSTem OPTion SPEEDup <?|ON|OFF|SELective>

Examples

Input	Instrument Reply
syst opt speed off	**none**
syst opt speed ?	**SYSTEM: OPTION: SPEEDUP OFF**

STATISTICS BATCH SIZE

Set or query the specified channel's batch size in Statistics Mode. As with setting the batch size from the front panel, setting a quantity of 0 results in continuous statistical sampling. Setting this value automatically resets the EPM2000's statistical batch.

Command Form
CHan <A|B|ALL> STATistics BATch_size <?|0|2..9999>

Examples

Input	Instrument Reply
ch a stat bat 6126	**none**
ch b stat bat 496	**none**
ch all stat bat ?	**CHAN A: STAT: BATCH_SIZE 6126**
	CHAN B: STAT: BATCH_SIZE 496

STATISTICS RESTART MODE

Set or query the specified channel's action at the end of a statistical batch. Manual requires a restart signal, such as **ch stat start**, Automatic will begin a new batch immediately upon logging the data from the previous batch.

Command Form

CHan STATistics MODE <?|MANual|AUTOmatic>

Examples

Input	Instrument Reply
ch a stat mode auto	**none**
ch b stat mode man	**none**
ch all stat mode ?	**CHAN A: STAT: MODE AUTO**
	CHAN B: STAT: MODE MANUAL

STATISTICS SEND

Set or query the values transmitted by EPM2000 channels in Statistics Mode. Although they can be specified in any order, data will be transmitted only in the following order: AVG, DEV, MIN, MAX. Include headers to add an identifying string (such as AVG=) to the front of each piece of data.

Command Form

CHan <A|B|ALL> STATistics SEND <?|AVG|DEV|MIN|MAX|HEADers>

Examples

Input	Instrument Reply
ch a stat send avg min max head	
	none
ch b stat send avg head	**none**
ch all stat send ?	**CHAN A: STAT: SEND: AVG MIN**
	MAX HEADERS
	CHAN B: STAT: SEND: AVG
	HEADERS

STATISTICS START

Terminates the specified channel's current statistical batch and starts a new one.

Command Form

CHan <A|B|ALL> STATistics START

Example

Input	Instrument Reply
ch a stat start	**<batch restarts>**

TIMESTAMP

Set or query the Timestamp function, which places additional bytes in the data stream indicating the approximate time of each pulse's trigger. Timestamp only functions when data output format is Binary. After the two Data Bytes, when Timestamp is set ON, a 21-bit time index is transmitted, divided among three bytes as described below.

The 21-bit counter increments every 1.536 milliseconds, offering a timing period of just under 54 minutes (2^{21}*.001536 seconds) before rolling over to 0. The timestamp counter will also reset to 0 upon receipt of the **`out time on`** command.

Timestamp is cross-channel. If it's activated, then both channels are transmitting timestamp bytes -- if it's not, then neither channel transmits timestamp bytes.

Command Form

```
OUTput TIMEstamp <?|ON|OFF>
```

Examples

Input	Instrument Reply
`out time off`	`none`
`out time ?`	`OUTPUT: TIMESTAMP OFF`

TRIGGER HOLDOFF

Set or query the Trigger Holdoff level for each channel.

Command Form

```
CHan <A|B|ALL> TRIGger HOLDoff <?|0..49>
```

Examples

Input	Instrument Reply
`ch a trig hold 5`	`none`
`ch b trig hold 15`	`none`
`ch all trig hold ?`	`CHAN A: TRIG: HOLDOFF 5` `CHAN B: TRIG: HOLDOFF 15`

TRIGGER LEVEL

Set or query a channel's trigger level. Values accepted are 2 through 20.

Command Form

```
CHan <A|B|ALL> TRIGgering LEVel <?|2..20>
```

Examples

Input	Instrument Reply
`ch a trig lev 18`	`none`
`ch b trig lev 9`	`none`
`ch all trig lev ?`	`CHAN A: TRIG: LEVEL 18`
	`CHAN B: TRIG: LEVEL 9`

TRIGGER SOURCE

Set or query a channel's trigger source.

Command Form

```
CHan <A|B|ALL> TRIGgering SouRCe
<?|INTernal|EXTernalPOSitive|EXTernalNEGative|SLAVe>
```

Examples

Input	Instrument Reply
`ch a trig src extneg`	`none`
`ch b trig src slav`	`none`
`ch all trig src ?`	`CHAN A: TRIG: SOURCE EXTNEG`
	`CHAN B: TRIG: SOURCE SLAVE`

UNITS

Set or query a channel's measurement units. When setting the EPM2000 into Ratio Mode, the channel argument indicates the numerator of the fraction.

Command Form

```
CHan <A|B|ALL> UNITS <?|VOLts|JOUles|WATts|HZ|RATio>
```

Examples

Input	Instrument Reply
`ch a units jou`	`none`
`ch b units vol`	`none`
`ch all units ?`	`CHAN A: UNITS JOULES`
	`CHAN B: UNITS VOLTS`

WAVELENGTH COMPENSATION

Set or query the Wavelength Compensation value. Argument is in meters in scientific notation.

Command Form

```
CHannel <A|B|ALL> WAVElength <?|ON|OFF>
```

Examples

Input	Instrument Reply
`ch a  wave 5.47e-7`	`none`
`ch b wave  5.14e-7`	`none`
`ch all wave ?`	`CHAN A: WAVELENGTH COMPENSATION: 547 nm`
	`CHAN B: WAVELENGTH COMPENSATION: 514 nm`

ZERO

In thermopile mode, this command sets the specified channel's current probe input voltage as a zero baseline value. While taking a statistics measurement, the EPM2000 channel will reset the batch upon receiving this command.

Command Form

```
CHan <A|B|ALL> ZERO
```

Examples

Input	Instrument Reply
`ch a zero`	`<batch resets/ thermopile zeroes>`

MISSING DATA

***Note: Information in this section pertains to Version 4.32 or higher firmware* only.**

FIFO FULL CONDITION

Under various measurement conditions, the pulse data communication buffer—or FIFO—may become full. This causes pulse measurement data to be lost.

The EPM2000 has several means of alerting users to this type of situation:

1. Replacing the measurement value on the display with the word *FULL*.
2. Emitting an audible beep (if the beeper is enabled).
3. Alerting the host to the full condition (if host communications are enabled) by either:

   · Placing the word *FULL* in the output data stream (if the host output format is ASCII or ASCII+)

   or

   · Placing a hex 10 value in the output data stream (if the host output format is binary). The hex 10 value is the only remaining binary status value that can hold a special meaning—it represents missing or invalid data.

When the firmware detects a full condition, the FIFO clears and the system resynchronizes. Any pulse data stored at the time the FIFO clears, is deleted.

COMMUNICATIONS BUFFER OVERRUN

Under certain conditions of heavy processing load and with host communications enabled, the EPM2000 may generate measurement data at a rate faster than the communication port allows. If the host output format is ASCII or ASCII+, the word *OVERRUN* appears in the output data stream. If the host output format is binary, a hex 10 value appears in the output data stream. Buffer overrun is most likely to occur when RS-232 communications is enabled at slower baud rates (9600 baud, for example).

PROGRAMMING EXAMPLE

The following list of commands sets the EPM2000 to collect readings from a 1 KHz pulsed laser source. Channel A collects the raw data and Channel B collects 100-pulse statistical batches. The data are stored in the buffer in binary form (the most compact form) and can be retrieved with an **`out dump`** command. The buffer depth has been set to the maximum value to allow the greatest time between data dumps.

`ch all units jou`	Sets both channels to measure Joules
`ch all resp pyro 220`	Pyroelectric responsivity to 220 V/J
`ch a trig src int`	Trigger A source: internal
`ch b trig src slav`	Trigger B source: slaved to A
`ch a trig lev 8`	Trigger A level: 8%
`out cont off`	Deactivate continuous output
`out dep 4095`	Buffer depth 4095 bytes
`ch all range 30mj`	Range both channels 30mJ
`out form bin`	Set output format to binary
`ch a oper norm`	Set channel A to Normal Mode
`ch b oper stat`	Set channel B to Statistics Mode
`ch b stat bat 100`	Statistics batch size 100
`ch b stat mode auto`	Automatic restart at the end of a batch
`ch b stat send min max avg dev head`	Transmit all values

The following illustration shows a small LabVIEW® VI (Virtual Instrument) diagram which programs an EPM2000 with the above commands. It expects an EPM2000 on the IEEE-488 bus at address 5. Each command is separated by 300 milliseconds to avoid a command being lost while the instrument is processing a previous command.

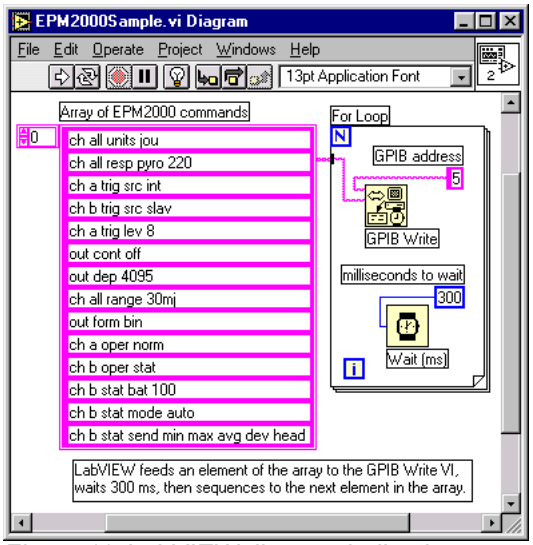


Figure 11: LabVIEW diagram indicating simple EPM2000 configuration program.

EPM2000E-SPECIFIC FEATURES AND FUNCTIONS

TAKING EXPOSURE MEASUREMENTS

The EPM2000e accepts a powered probe via the Smart Probe connector on the rear panel.



Never connect or disconnect a powered probe while power is ON. However, you may safely connect or disconnect a pyroelectric sensor at the Pulse In connector while the unit is powered up.

Note: For assistance with any of the following operations, contact a Molectron sales engineer at 1.800.366.4340.

Press **[J]** to measure energy in Joules during pyroelectric/silicon measurements.

Press **[EXP]** to enter Exposure mode.

- This adds successive pulse energy until pulses stop.
- To read the probe pulse magnitude in volts, press **[SET]** > **[EXP]**.

Press **[W]** during pyroelectric/silicon measurements to display power density in watts.

Press **[Hz]** when a pyroelectric or silicon probe is connected to display the laser pulse repetition rate in hertz.

EXPOSURE MODE

How to set up and operate a typical laser exposure measurement using the EPM2000e.

1. With the laser beam blocked or the laser turned OFF and the instrument turned OFF, place the pyroelectric detector in the path of the laser beam.



Do not exceed the power/energy density for the pyroelectric detector you are using. Consult the detector data sheet, or test the setup with a damage test slide, as appropriate.

2. Connect the detector to the Smart Probe connector or pulse-in BNC connector.
3. Turn ON the instrument.

4. If one of the annunciators on the LCD is lit (signaling Statistics mode) or flashing (signaling Average mode), place the instrument in Normal mode by pressing **[J]**, **[EXP]**, **[W]**, or **[Hz]**.
5. Press **[SET]** > **[J]** to enter the Responsivity (Rv) of the detector.
6. On the numeric keypad, enter the Rv as printed on the detector label.
7. Use the **[UP]**/**[DOWN]** keys to adjust the Rv exponent.
8. Press **[ENT]** to end the Rv entry.
9. Unblock the laser beam or start the laser. Verify proper beam alignment on the probe surface.

   Note: If the input signal is too great in amplitude for the selected range, the LCD will flash OL; use the UP arrow key to select a higher range. If the input signal is too small in amplitude for the selected range, the TRG annunciator will not be activated; use the DOWN arrow key to select a lower range.

10. Block the laser beam or stop the laser in preparation for an exposure. The TRG annunciator should deactivate.
11. Press **[EXP]** to enter the Exposure mode. Unblock the laser beam or start the laser to begin the Exposure accumulation. The TRG annunciator should activate again and the LCD should begin counting steadily upwards.
12. Block the laser beam, stop the laser or press **[EXP]** to end the Exposure accumulation. The TRG annunciator should deactivate.
13. Press **[ZERO]** to reset the LCD to zero before taking another exposure measurement.

Exposure Mode-specific Computer Interface Commands

Measurement Mode

Instructs the instrument to enter or exit the exposure operating mode.

Command Form

CHannel<A|B|ALL>MEAsure<POWER|ENERGY>

or

Channel <A|B|ALL> MEAsure EXPosure <ON|OFF>

Examples

Input	Instrument Reply
Ch a mea exp on	**<enters exposure mode and begins accumulation>**
Ch a mea exp off	**<stops accumulation>**
Ch a mea energy	**<enters energy mode>**

Zero

Resets the accumulated exposure measurement.

Command Form

CHannel <A|B|ALL> ZERO

Example

Input	Instrument Reply
Ch a zero	**<resets accumulated exposure>**

Display Current Reading
Query the instrument for the data currently displayed on the LCD readout.

Command Form
`Channel <A|B|ALL> QUERY`

Example

Input	Instrument Reply
`Ch a query`	**`CHAN A: QUERY 19.51 J exp on`**

Note: Exposure readings cannot be obtained with the use of the OUT DUMP or OUT CONTINUOUS ON commands.

MAINTENANCE, SERVICE, & CALIBRATION

TROUBLESHOOTING

The EPM2000 Dual-Channel Joulemeter/Power Meter is designed to provide a lifetime of simple, worry-free use. Most perceived problems are typically configuration errors. In addition to the questions and answers below, check Molectron Detector's website (http://www.molectron.com) for the latest FAQ documents.

The EPM2000 does not respond to anything, the screen is dark.

Verify the power cord is plugged securely to the back of the EPM2000 and that the AC socket is powered. Check the fuse and replace if necessary. (see *Maintenance, Service, & Calibration -- Fuse Replacement*)

The EPM2000 is on, but no reading occurs at a laser pulse.

Properly align the probe in the beam. Verify the probe is connected to the Pulse In or Smart Probe connector.

If the trigger source is external, be sure an actual trigger pulse is applied to the Trigger In connector. If the EPM2000 is expected to extract a trigger from the incoming laser pulse, set the trigger source for internal.

Lower the trigger level.

Lower the EPM2000's range.

The EPM2000 ignores an attached PowerMax or other thermopile probe.

Verify the probe is connected securely. Verify the PowerMax function is enabled by pressing  . When "ON" appears on the LCD, the PowerMax function is enabled.

The EPM2000 ignores an attached pyroelectric/silicon probe.

If the EPM2000 senses a PowerMax thermopile probe upon startup, it will ignore pyroelectric/silicon probe input. Either disconnect the PowerMax probe or deactivate it using the method described above.

The EPM2000 won't go into Ratio mode on either channel.

Verify that exactly one channel is slave-triggered.

Thermopile output appears noisy once the curve levels off.

Either deactivate the display speedup or set it to selective mode.

While transmitting data via IEEE-488, the EPM2000 crashes, reporting "018F SF".

This is a firmware error that Molectron has repaired in subsequent firmware/hardware upgrades. Please contact a Molectron Applications Engineer to upgrade/calibrate your EPM2000 to the latest revision.

The EPM2000 refuses to acknowledge commands sent via the IEEE-488 interface.

Verify the IEEE-488 port has been activated.

Verify the EPM2000 IEEE-488 address matches the host computer's address.

Verify the cable is securely attached to both devices.

Verify that other IEEE-488 devices can be used on the same bus.

The EPM2000 refuses to acknowledge commands sent via the RS-232 interface.

As above, verify the RS-232 option on the EPM2000 has been activated.

Verify the host computer has selected the correct COM port address.

Verify the cable is connected and in good condition. If the cable has become disconnected, the COM port may have to be reinitialized.

Verify the COM port works with other devices.

Verify hardware handshaking is implemented.

The `ch units ?` ***command returns the text string, chan a: units ?***

The EPM2000 may be in the middle of collecting the first of a series of statistical batches. Until the first batch is completed, a units query returns the above response. Either query units before entering statistics mode or wait until the first batch has been taken.

Some commands in a string of commands are not always implemented.

Be sure to allow sufficient time for the EPM2000 to complete a command before sending the next one. 300 ms is ideal, although some commands will execute in less time.

The EPM2000 won't save anything in its output buffer or dump its output buffer.

If the EPM2000 is set for continuous output, the buffer will not contain data and the **`out dump`** command will be ignored. Deactivate the continuous output with **`out cont off`**.

The buffer contains extra, incorrect pulse data.

Switching ranges on an EPM2000 can cause a trigger, which activates the A/D collectors. The resulting data is stored in the buffer just like real data. Avoid this by keeping the EPM2000 set to external trigger whenever possible. This only occurs when the EPM2000 trigger source is internal.

How can "stale" data from a previous experiment be cleared from the buffer to avoid contaminating data from a new experiment?

Prior to triggering a laser, execute an **`out dump`** command to assure that the buffer is completely empty of stale data or false data from switching noise.

When collecting a statistical batch, the mean value is much lower than expected.

Raise the trigger level as high as possible without missing pulses. A trigger level that is too low will trigger on and collect noise, which contaminates the batch.

When set to a low range, the EPM2000 doesn't trigger on large pulses.

When determining a proper range for an unknown signal, always start at the highest possible range and work downward from there.

The EPM2000 indicates a value, but there are no pulses arriving.

The EPM2000 will hold the last peak value measured, even if the pyroelectric/silicon probe has been disconnected. Change ranges or units to clear the display.

While in Thermopile mode, the EPM2000 may not display an overrange condition, nor sound an audible overrange alarm.

This is a known bug. Overrange will still be reported via the remote link as a value of 3.000.

Although the EPM2000 is in Ratio Mode, the buffer data, when in binary form, reports as Channel A or Channel B data.

This is a result of the limited number of bytes available to describe channels. Use **`ch all units ?`** to determine if the EPM2000 is in Ratio mode. If it is, then all data in the buffer is ratio data. The channel refers to the numerator of the calculation.

Binary ratio data from the EPM2000's buffer is slightly off from the same data reported via ASCII+.

This is a known bug. Until a revision is released, read Ratio data using ASCII+ data or simply transfer raw data from the EPM2000 and calculate the ratio using the terminal computer.

How can I set the EPM2000 for the highest volume of data transfer?

Set the buffer data type binary, the buffer depth to 4095, the buffer type to fixed, and output continuous off. Use the IEEE-488 bus. At intervals of less than one per second, use **`out dump`** to clear the buffer. The IEEE-488 bus can read the entire EPM2000 buffer (in binary mode) in less time than it takes to fill it at 1000 pps, so data can be transferred in a sort of "real time" mode.

Why doesn't the instrument indicate an invalid ratio when Channel A, Channel B, or both channels are overranging?

If either or both channels are overranging while the instrument is in ratio mode, the ratio reading will be invalid. This is a known bug for instruments containing firmware Version 4.32 or earlier. If an accurate ratio reading is desired, prevent overranging by making sure enough headroom is available on the ranges selected for the individual channels.

FUSE REPLACEMENT

The EPM2000 has no user-serviceable parts other than the replaceable fuse located on the rear panel. Replace the fuse by using a small flat-head screwdriver to carefully pry the fuse holder from the power entry module. Use only a 240VAC/1A fast-blow fuse. Locate a spare fuse in the removable fuse holder.

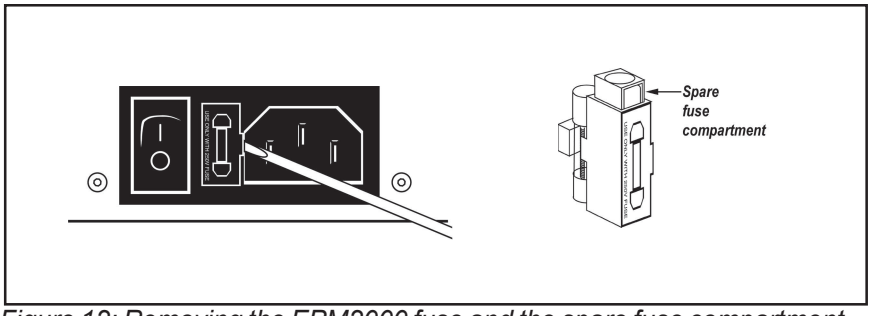


Figure 12: Removing the EPM2000 fuse and the spare fuse compartment.

Caution

If the EPM2000 blows two or more fuses in a short period of time, turn the unit off, disconnect it from the AC supply, and contact Molectron Detector, Inc.

Instrument Calibration and Service

When returned to Molectron for annual recalibration and servicing, Molectron probes and instruments include a parts and labor warranty for the life of the product. Like all test equipment, it is vital that these probes and instruments be maintained at the highest level and precision of calibration.

The Molectron calibration process is certified ISO9002 and fully ANSI Z540 compliant, assuring every customer of the highest possible quality and the most formally defined process. Probes are calibrated against NIST traceable working standard probes which are, in turn, calibrated against NIST calibrated golden standard probes. These working and golden standards are maintained with the utmost care, recalibrated annually, and verified even more regularly. We maintain multiple NIST calibrated standards at many laser wavelengths to support the growing calibration needs of our customers. Finally, we work directly with NIST in Boulder, Colorado, in the development of future calibration wavelength capabilities. Optical calibration is a core competency at Molectron and we strive to continually improve our methods, precision, and repeatability.

Molectron has increased its floor space to 20,000 square feet. Our Metrology department has expanded into this space with the addition of several new laser laboratories. We have a new state-of-the-art DUV lab for calibrating exposure/dose detectors, a new high-power Nd:YAG laser for industrial applications, and facilities for ruby and erbium lasers to calibrate medical sensors.

Additionally, most of the calibrations are performed with highly automated systems, thus reducing the possibility of human error to nearly zero. Strict quality inspections during many stages of calibration and testing assure a precise and accurate instrument that is NIST traceable and CE marked.

Molectron is fully committed to providing accurate and low-uncertainty calibrations for all our energy measurement products. We are an industry leader in calibration services and have dedicated ourselves to maintaining this lead in the future.

To prepare an EPM2000 for shipment to Molectron:

1. Contact Molectron Customer Service for a Return Material Authorization (RMA) number.

   - Domestic: 800.366.4340
   - International: 503.620.9069

2. Attach a tag to the instrument that includes the name and address of the owner, the person to contact, the serial number, and the RMA number you received from Molectron Customer Service.

3. Wrap the EPM2000 with polyethylene sheeting or equivalent material.

4. If the original packing material and carton are not available, obtain a corrugated cardboard shipping carton with inside dimensions that are at least 6 in (15 cm) taller, wider, and deeper than the EPM2000. The shipping carton must be constructed of cardboard with a minimum 375 lbs (170 kg) test strength. Cushion the instrument in the shipping carton with packing material or urethane foam on all sides between the carton and the instrument. Allow 3 in (7.5 cm) on all sides, top, and bottom.

5. Seal the shipping carton with shipping tape or an industrial stapler.

6. Ship the instrument to the following address:

   Molectron Detector, Inc.
   7470 SW Bridgeport Rd.
   Portland, OR 97224
   Attn: RMA # (*add the RMA number you received from Molectron Customer Service*)

SPECIFICATIONS

ELECTRICAL/MECHANICAL

DISPLAY

- Four numeric digits with polarity sign.
- Two alphanumeric characters
- Annunciators for statistical functions, trigger, and communications
- Backlight on/off switchable

RANGES

(Ranges are limited to 5 or 6 decades, depending on probe type)

• Energy	1 pJ to 10 J in 28 ranges
• Power	1 mW to 10 KW in 15 ranges
• Frequency	0.1 to 1000 Hz (for pyroelectric/silicon probes only)
• Volts	2 mV to 30 V (for pyroelectric/silicon probes only)
• Volts	200 µV to 1 V (for thermopile probes)

RESOLUTION

• Energy	1:3000 of full scale
• Power	1:3000 of full scale
• Frequency	0.1 Hz
• Volts	10 µV

MAXIMUM REP RATE

- 1000 Hz

LINEARITY

- ±1%

A/D Digital Resolution

- 12 bit

Input Impedance

- 1 MΩ (50 Ω output probes require a feedthrough terminator)

Noise Equivalent Voltage (NEV)

- 50 µV typical

Analog Output

- Full scale output 2.00 VDC
- Output Impedance 100 Ω
- Update Rate 3 Hz

External Trigger Input

- Optically coupled
- 100 Ω in series with LED
- Rising/falling edge trigger via user control.

Electronic Accuracy

- Analog output ±1%
- Digital display ±1%

System Accuracy

- Pyroelectric probe ±5%
- Thermopile probe ±3% (with wavelength correction)

Maximum Pyroelectric Pulse Width

- 8 ms

Internal Trigger

- Adjustable 2% to 20%

RS-232 Baud Rates

- 38400, 19200, 9600, 4800, 2400, and 1200

Power Requirements

- 90 to 264 VAC at frequencies between 50 Hz and 60 Hz

Dimensions

- 30.48 cm x 27.31 cm x 11.43 cm (12" x 10.75" x 4.5")

Weight

- 2.90 kg (6.38 lbs)

Firmware Revisions

Every EPM2000 contains three programmed chips, one for each analog board and one for the digital board. Knowing the firmware revisions of these chips is useful when calling Molectron Detector, Inc. Press

 to see the *digital firmware revision*.

Print that number here: _____ (digital firmware revision)

Press  to see the analog firmware revision.

Print that number here: _____ (analog firmware revision)

Factory Defaults

Audible Tone	On
Autorange	Off
Average Batch Size	50
Backlight	On
Communication Channel	Off
Display Speedup	Off
IEEE-488 Address	00
Line Frequency Rejection	60 Hz
Operating Mode	Normal
Pyroelectric Responsivity	2.00 V/J
Pyroelectric/Silicon Measurement Mode	Volts
Range	2 Volts
Risetime Mode	2 ms
RS-232 Settings	9600, N, 1 (8-bit data)
Statistics Batch Size	50
Statistics Restart Mode	Manual
Thermopile Compensation Wavelength	514 nm
Thermopile Measurement Mode	Watts
Trigger Holdoff	0 ms
Trigger Level	10%
Trigger Source	Internal

Warranted Characteristics

Power

90 - 264 VAC, 47 - 63 Hz, 25 VA

Atmospherics (Temperature)

Operating	0°C to +50°C (32°F to +122°F)
Storage	-40°C to +75°C (-40°F to +167°F)

Note: Maximum operating temperature is decreased 1°C per 305 m (1000 ft) above 1525 m (5000 ft).

Atmospherics (Relative Humidity)

0 to 95% at or below +30°C (+86°F)
0 to 75% from +31°C to +50°C (+87°F to +122°F)

Atmospherics (Altitude)

Operating	4570 m (15,000 ft)
Non-operating	to 12190 m (40,000 ft)

Dynamics (Random Vibration)

Operating	0.31 g rms, from 5 to 500 Hz, 10 minutes each axis.
Non-operating	2.46 g rms, from 5 to 500 Hz, 10 minutes each axis.

Emissions

Meets or exceeds the requirements of the following standards:

- EN 50081-1 European Community Requirements
- EN 55011 Radiated Emissions Class A
- EN 50081-1 Conducted Emissions Requirements

Note: To maintain emission requirements when connecting to the serial interface, use only high-quality, double-shielded (braid and foil) cables. The cable shield must have a low impedance to the connector housings at both ends.

Susceptibility

Meets or exceeds the requirements of the following standards:

- EN 50082-1 European Community Requirements
- IEC 802-2 Electrostatic Discharge, Performance Criteria B
- IEC 801-3 Radiated Susceptibility 3 V/meter from 27 MHz to 500 MHz unmodulated.
  Performance Criteria: Maximum LCD reading deviation ±3% of reading.
- IEC 801-4 Electrical Fast Transient/Burst

APPENDIX - DECLARATION OF CONFORMITY

CE-12.1 Revision B

Declaration of Conformity

We

Molectron Detector, Inc.
7470 SW Bridgeport Road
Portland, Oregon, USA 97224

declare under sole responsibility that the

EPM2000, EPM2000e

meet the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance and was demonstrated per testing to EN61326 Electromagnetic Compatibility Product Family Standard for Measurement, Control and Laboratory Equipment to include the following test specifications as of July 2001:

EN55011 Class A Radiated Emissions
EN55011 Class A Conducted Emissions

EN61000-4-2 Electrostatic Discharge – Performance Criteria B
Unit may respond to an ESD event but will return to normal without user intervention.

EN61000-4-3 Radiated Immunity – Performance Criteria A
EN61000-4-4 Electrical Fast Transient Immunity - Performance Criteria A
EN61000-4-5 Electrical Slow Transient Immunity- Performance Criteria A
EN61000-4-6 Conducted RF Immunity - Performance Criteria A
EN61000-4-11 Power Line Dropout - Performance Criteria A

Director of Engineering — Date 9/11/01

President — Date 9/10/01

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