LabMaster *Ultima*

Laser Power & Energy Measurement System

Software Revision 2.34, February, 1999

COHERENT® AUBURN GROUP

Part Number 0214-448-00 Rev. A

Contents

Contents

Contents

Contents

Contents

Contents

Remote control commands

Contents

Remote control commands

Data collection queries

Contents

Remote control commands

IEEE-488 commands & queries

General Description

LabMaster Ultima is a microprocessor based laser measurement system for CW and pulsed lasers featuring real-time analog tuning, digital precision, beam alignment, beam position measurement and tracking, complete statistics, and full computer interfaces. The dual channel version of the Ultima adds simultaneous two channel measurement, ratio measurement and difference measurement to provide the best value in complete laser measurement available.

Ultima can be used with all lasers commonly manufactured today – CW and pulsed, from UV to far IR, with power from nanowatts to kilowatts and energy from microjoules to joules – simply by plugging in the appropriate Smart Detector Head into the console

Features

Pulsed/CW

Complete family of pyroelectric detectors for pulsed energy measurement. Quantum detectors (Si and Ge) for low power CW measurement. Patented thermal disk detectors for CW and single pulse measurement.

Versatility

More than just a power/energy meter, Ultima provides power/energy trend information, beam drift measurement, statistics and tuning.

Communications

Analog out

Provides 0-1 Volt output to operate strip chart or other analog recorder.

RS-232, GPIB Interfaces

Standard RS-232 and GPIB (IEEE) interfaces allow full interactive operation of the Ultima by a computer control system. Interfaces can also be used for downloading data from the Ultima to a computer for storage, graphing and analysis.

Printer

With the standard printers operated by the Ultima (Epson, HP Deskjet, HP Laserjet, IBM ProPrinter), any screen can be printed to record experimental data or document test results.

General Description

Auxiliary I/O

I/O port for future accessories to further enhance the versatility of the Ultima.

Speed

Ultima provides the fast response time necessary for laser tuning.

Smart Detector Technology

Sensor head characteristics are programmed into an EEPROM in each head and read by the console when the head is plugged in, eliminating the need to make manual changes to console settings when changing sensor heads.

Analog sensitivity and feedback

In the TUNE mode, Ultima provides real time analog feedback for tuning of lasers. The Peak Power Indicator provides both visual and audible indication of the highest power reached to assist in maximizing laser performance.

Digital precision

The HOME screen provides a large easy-to-read digital display of laser power or energy.

Dual channels

The power of two. Dual channels allow simultaneous measurement of two points in a laser system or of two lasers for optical element characterization or dye laser tuning.

Ratio & Difference measurement

The ratio or difference of the two channels can be displayed for measurement of absorption peaks, conversion efficiencies, etc.

Updatable microprocessor architecture

The software controlling the LabMaster Ultima can be readily updated to include the latest developments and enhancements of the instrument. With the new memory card, updates can be sent to the field and inserted by the user, eliminating requirements for sending the console to the factory for upgrade.

General Description

Beam alignment

With the thermal quad detector heads, beam position on the disk is displayed. These detectors are particularly useful for alignment of UV or IR beams.

Beam position change over time

Beam position on the thermal quad detectors can be collected and displayed over selected time intervals to measure and record beam pointing drift.

Power vs. Time trending

LabMaster Ultima can collect power vs. time trend information for a period from 20 seconds to 99 hours for laser burn-in and stability testing. The results are displayed on the Ultima screen and can be downloaded to an analog device or via the computer interfaces for storage, analysis or comparison.

Statistics

Ultima calculates full statistical information either on historical data or for a real-time updated

Ease of use

LabMaster Ultima's Sophisticated menu driven design provides ease of use with minimal training or studying of manuals.

Portability

The compact, lightweight console and internal battery pack create a system that is easily transported, either from lab to lab, or around the world with the field service engineer.

Accuracy

The combination of Smart Detector Technology, microprocessor wave-length correction and accurate beam positioning information create a laser measurement system that provides up to ± 3% **total system accuracy** (console & detector accuracies combined).

Unpacking & Setup

The LabMaster Ultima is shipped in foam inserts in a corrugated carton. The box will contain the Ultima console, the AC Adapter and this instruction manual. Two of the smaller Smart Detector heads (LM-2, LM-3,LM-10, LM-20, LM-30v, LM-45) may be packed in the same box with the Ultima. All other heads and accessories will be packed in separate cartons.

The battery pack and performance package option (if ordered) are shipped installed in the LabMaster Ultima. The battery pack is charged before shipment and does not require charging before use of the LabMaster Ultima.

Visually check cartons and contents for damage before unpacking. Advise Coherent of any damage immediately and a Returned Material Authorization will be issued for return of the instrument.

Remove all components from carton. Plug the AC adapter into 110 VAC (in Europe, 220 VAC) outlet and into the 9V Input socket on the rear panel of the LabMaster Ultima (see Figure 1). Plug the detector head(s) into the DB25 socket(s) on the rear panel labelled Detector A and (dual head model only) Detector B. The unit is now ready to use.

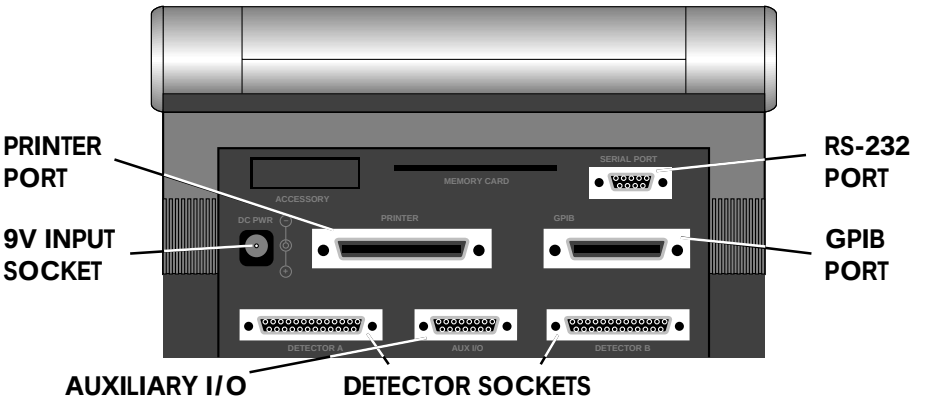


Fig. 1 Back Panel

A compatible printer (EPSON dot matrix, HP Deskjet or HP Laserjet) can be plugged into the parallel printer port, and a computer can be connected to either the RS-232 or GPIB port (see RS-232 and GPIB sections for commands and data specifications).

System Start-up (getting started fast)

This section is intended to enable you to use your new LabMaster Ultima as quickly as possible. Answers to questions about functions on each screen can be found in the Reference section of the manual.

1.) Turn on unit

Plug in detectors and AC adapter (see Unpacking & Setup section). Open the screen of the LabMaster so that it is at a comfortable viewing angle (angle is infinitely adjustable). Turn on unit with switch located in front left of console base (see Figure 2). Ultima will perform a self test on the console and detectors. When self test is completed, home screen (Figure 3.) will be displayed.

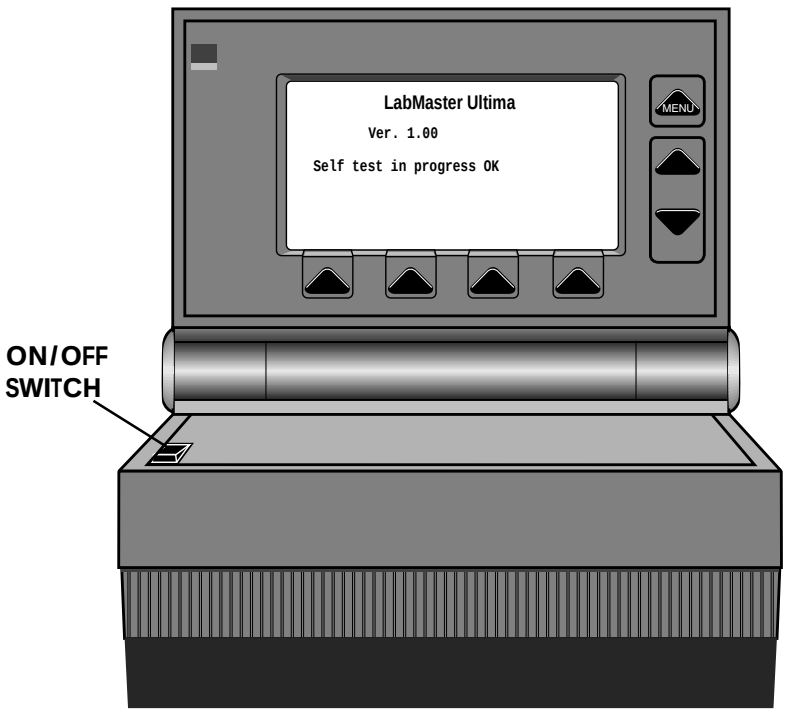


Fig. 2 Front View - LabMaster Ultima

System Start-up (getting started fast)

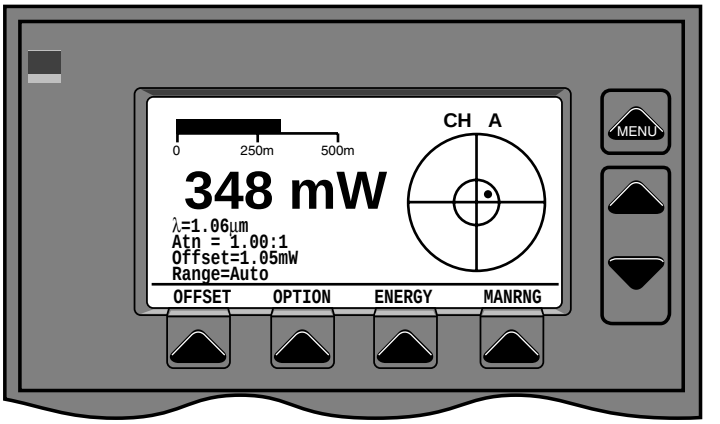


Fig.3 Home Screen

Getting Around LabMaster Ultima

There are two ways to select and display various screens and functions on the Ultima; the menu, and the shortcut keys.

From menu

The top button to the right of the screen (labelled MENU) can be pressed at any time to display a menu of LabMaster Screens and functions. When the menu is displayed, the buttons at the bottom of the screen will have labels above them. The button labelled CHANNEL will allow selection of either or both (for dual channel models) channels. The button labelled FUNCTION will allow selection of the various Ultima functions.

With short cut keys

Channels and functions can also be selected by using the short-cut keys. These are the two keys below the menu key to the right of the Ultima screen. These keys allow cycling of the functions and channels without going through the MENU screen. Short cut keys are functional at all times unless a dialog box requiring vertical selection is being displayed.

Enter wavelength for each channel

In order to achieve specified accuracy, the wavelength of the laser being measured must be entered. From the HOME screen, press the selection button labelled OPTION. Use the UP or DOWN arrow keys (the short-cut keys) to select the GLOBAL OPTIONS choice in the pop-up menu.

System Start-up (getting started fast)

Press the selection key labelled SELECT to display the GLOBAL OPTIONS menu screen. Now use the UP/DOWN arrow keys to select the CHANNEL SET-UP option and display the screen shown in Figure 4. With WAVLN selected (reversed), use the left and right digit keys

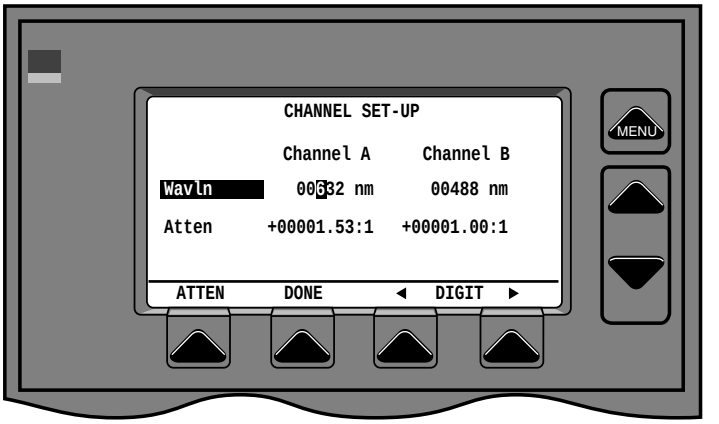


Fig. 4 Channel Set-up Screen

to select the digit to be changed, then the UP and DOWN arrow keys to the right of the screen to set each digit to the wavelength being measured for each channel. When wavelength for each channel is set correctly, either press DONE button to close screen, or press ATTEN button to set attenuation values for each channel. If the wavelength entered is outside the wavelength range for the detector, the warning mesage “Oustside wavelength range. Press a key to continue.” will be displayed. The wavelength will be automatically set to the closest wavelength at which the detector operates. For example, if a wavelength of 1200 nm is entered for an LM-2 detector (wavelength range 400 to 1100 nm) the warning message will be displayed and the wavelength will be set to 1100 nm.

Enter attenuation for each channel

An attenuation factor can be entered for each channel. This allows the user to enter the amount of attenuation due to beam splitters, attenuators, or other optical elements. This attenuation factor is used to calculate a correct reading on the display. To enter an attenuation factor, select OPTION on the Home Screen. Select GLOBAL OPTIONS from the options menu. Select CHANNEL SET-UP to display the screen shown in Figure 4. Press the button labelled ATTEN to highlight the Atten line. Now use the left and right DIGIT buttons to highlight each digit to be changed in the attenuation factors for each channel.

System Start-up (getting started fast)

(For additional ways to set attenuation, see SET B=A in the HOME, DUAL CHANNEL screen in the SCREENS reference section. Attenuation factor is entered as ±#####.##:1. An attenuation factor of 2.00: 1 will cause the screen to show 2 Watts when 1 Watt is on the detector. When the proper attenuation factors are entered for each channel, press DONE to close the screen and return to the HOME screen. Attenuations may be from -10,000:1 to +10,000:1. If an attenuation outside this range is entered, a warning message will be displayed and attenuation will be set to 1.00:1.

NOTE: If a very high attenuation factor is entered, the range of the detector may be exceeded by ambient light/heat. If this happens, a warning tone sounds and a warning message is displayed. To cancel the attenuation, hit the OPTION key twice very quickly until option menu is displayed. Select Set Attn 1:1.

Make the measurement

The LabMaster Ultima is now ready to make a measurement. Block the beam or turn the laser off and place the detector head so that the beam will strike the sensor in the center.

NOTE: Before making a measurement, insure that your detector head is rated for the power density of your laser. Power density greater than the sensor is rated for will damage the detector.

Turn on the laser or unblock the beam. The power or energy is shown on the screen. For additional capabilities such as collecting trend data, displaying statistics, using the analog tune bar and using the alignment and positioning capabilities of the Ultima, press the MENU key and select the function desired from the menu. Complete explanations of each function can be found in the SCREENS reference section.

Navigation (getting around Ultima)

There are several ways to select screens or functions on the LabMaster Ultima. Either the MENU key or SHORTCUT KEYS can be used to go from screen to screen. Functions within each screen are invoked by pressing the SELECTION key under the named function. Special options (either pertaining to a particular screen or to all screens) are accessed via the OPTIONS button found on all screens

Menu

Basic navigation among screens is done by pressing the MENU button at the top right of the screen. This button is physically labelled MENU, and always has the same function. When the MENU button is pressed, the screen shown in Figure 5 is displayed. Two lists on the menu screen list channels to be displayed and functions. (The single channel Ultima, or an Ultima with only one detector plugged in, will only show Channel A or B, and there will be no channel selection available.)

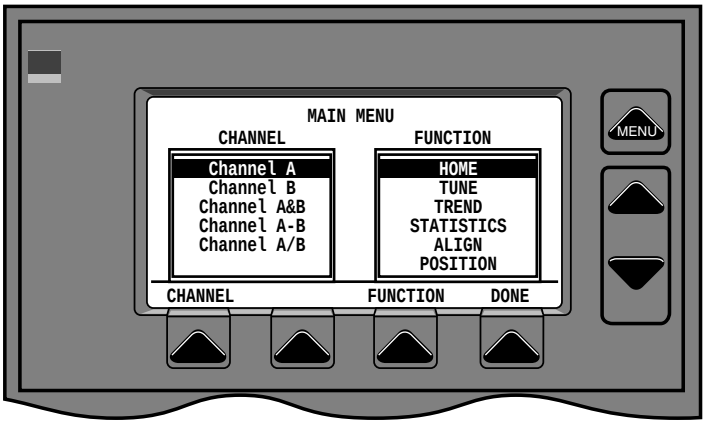


Fig. 5 Main Menu

The left most button on the bottom of the screen (labelled CHANNEL) is used to select which channel will be displayed. Each time the button is pressed, the selection bar moves down one line. At the bottom line, it wraps back to the top. The button labelled FUNCTION works similarly to select the item from the FUNCTION menu. When the proper channel and function are selected, press the key labelled DONE to close the MENU screen and open the selected screen.

Navigation (getting around Ultima)

Shortcut Keys

Shortcut keys are provided to allow the user to quickly cycle through the channels and the commonly used functions. The Shortcut keys are the UP and DOWN arrow keys to the right of the screen below the MENU key (Figure 5). These are available except when they are being used to increase or decrease digits, or make selections in menus. The UP arrow key cycles through commonly used FUNCTIONS. The DOWN arrow key cycles channels. (see Figure 6.) **NOTE: Not all channel combinations are available for all screens.**

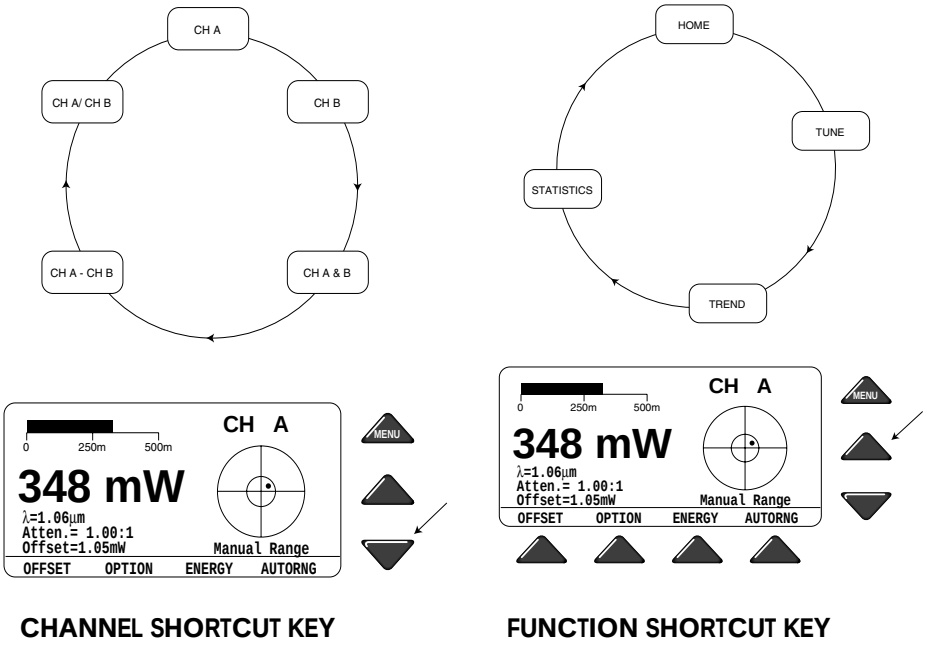


Fig. 6 Shortcut Keys

Selection Keys

The four buttons below the screen are software defined SELECTION KEYS. The function of these buttons changes on different screens. The function of the button is always labelled on the screen directly above the button. All buttons are not used on all screens. If there is no label above a button on a particular screen, it is not functional on that screen and pressing it will have no effect.

Controls & Connections

Front Panel

Fig. 7 Front Panel

The Front Panel of the LabMaster Ultima has seven push-button controls. A rocker switch for POWER is on the base of the Ultima (see Figure 7).

The three buttons to the right of the Liquid Crystal Display Screen always have the same function. The top button, marked MENU, will display a menu of functions (see Navigation section). The MENU can be accessed at any time, from any screen. After completion of the MENU functions, the user can RETURN to the point at which the MENU was called by pressing the FEATURE SELECTION button marked RETURN on the display.

The UP and DOWN buttons below the MENU button are used to scroll up and down for MENU choices, power ranges, or choices presented in any other menu by the Ultima system. When they are not needed for scrolling, they are Shortcut keys for moving among Channels and Functions (see Navigation section).

Controls & Connections

Below the display are four buttons pointing toward the display. These are software defined FEATURE SELECTION BUTTONS. Their function will be defined by the software for the particular screen being displayed. The function for each button will be displayed on the LCD directly above the button.

The ON/OFF switch is located on the base of the LabMaster at the front left of the console. Note that the console is designed to automatically turn the power off when it is closed for transport.

Rear Panel

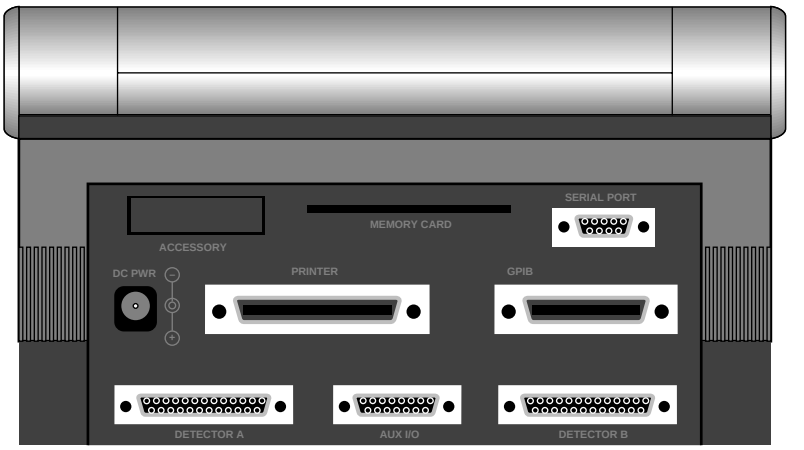


Fig. 8 Rear Panel

The Rear Panel of the LabMaster Ultima has the connectors shown in Figure 8. Note that the configuration shown in Figure 8 is for the dual channel model. Single channel models with and without performance package will not have all the connectors shown (see below).

Accessory

The Accessory Connector will only be present when the LabMaster Ultima is to be connected to the ModeMaster Beam Propagation Analyzer.

Serial Port (RS-232)

The Serial Port is a female DB9 connector. Data connections are:

Pin 2	TxD	Pin 3	RxD
Pin 5	GND		

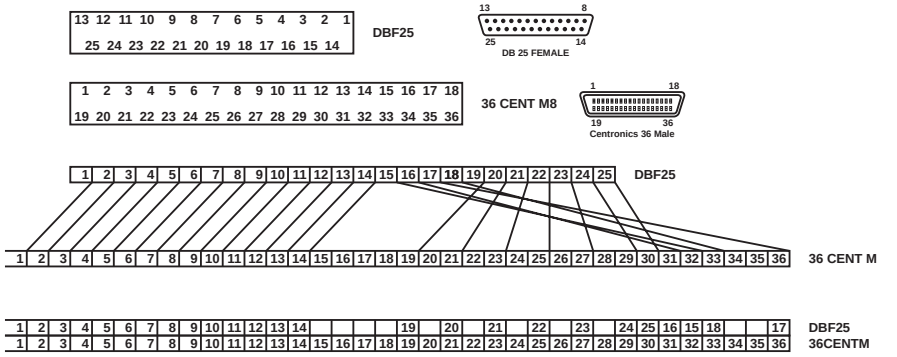
DC Power

Power input is 9 VDC, 1.1 amp, unregulated. Only AC converter supplied with LabMaster Ultima or approved by Coherent should be used.

Controls & Connections

Printer

Standard Centronics 36 Pin printer connector. Only present in dual channel Ultimas and single channel Ultimas with performance package. It is recommended that catalog part number 33-0761 be used to connect the printer to the Ultima or a gender changer with the following wiring.



GPIB

Standard GPIB 24 Pin connector. Only present in dual channel Ultimas and single channel Ultimas with performance package.

Detector A

Female DB 25 connector. Only Coherent Smart Detector heads should be connected.

Aux I/O

Female DB 15 connector. Data connections are:

Pin 1	CH A, Alarm #1	Pin 9	Auxiliary 0 (input only)
Pin 2	CH A, Alarm #2	Pin 10	Auxiliary 1 (input only)
Pin 3	CH A, Alarm #3	Pin 11	CH B, Pwr. analog out
Pin 4	CH A, Alarm #4	Pin 12	CH B, Fast analog out*
Pin 5	CH B, Alarm #1	Pin 13	CH A, Pwr. analog out
Pin 6	CH B, Alarm #2	Pin 14	Ground
Pin 7	CH B, Alarm #3	Pin 15	CH A, Fast analog out*
Pin 8	CH B, Alarm #4		

* Fast analog out for quantum detectors only with performance package

Detector B

Female DB 25 connector. Only Coherent Smart Detector heads should be connected. Only present in dual channel Ultimas.

Screens (Global Options)

Global Options

Most screens have a button labelled OPTION. This will display a menu of options pertaining to the screen. There will also be a selection in the options labelled GLOBAL OPTIONS. Selecting GLOBAL OPTIONS will display the screen shown in Figure 9. GLOBAL OPTIONS are items that affect all screens. The following global options are available.

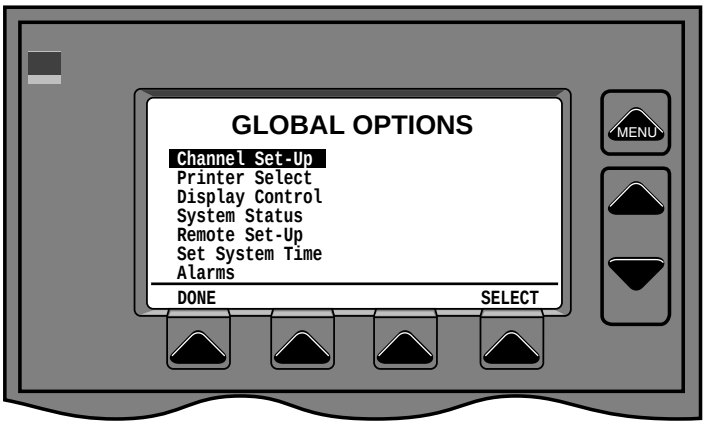


Fig. 9 Global Options

Channel Set-up

Channel set-up is used to enter wavelength and attenuation for each channel. (see page 6 & 7).

Display

Display selection will open the screen shown in Figure 10. There are three choices that control the appearance of the Ultima screen.

Backlight

Backlight can be turned on or off. Backlight on will enhance readability in a low light environment. Backlight off will extend battery life. Switch backlight on/off by selecting Backlight with the UP/DOWN arrow keys and pressing the selection button labelled TOGGLE (only available for Backlight and Presentation).

Screens (Global Options)

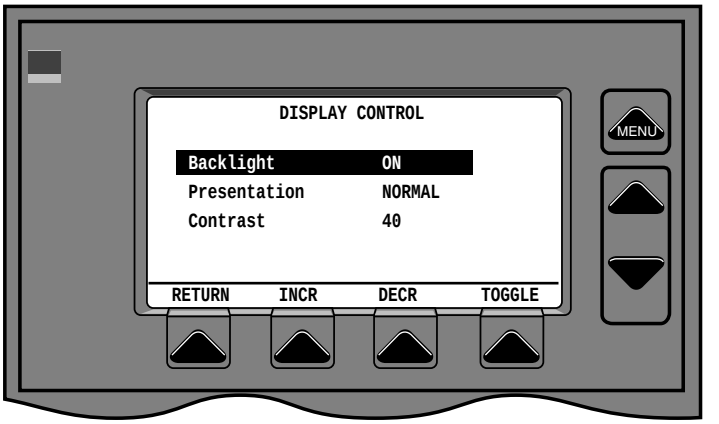


Fig. 10 Display Control

Presentation

Presentation can be either NORMAL (dark on light background) or REVERSE (light on dark background). Change presentation by selecting PRESENTATION and pressing the selection button labelled TOGGLE (only available for Backlight and Presentation).

Contrast

Contrast can be adjusted to suit individual preference. Select CONTRAST with the UP/DOWN arrow buttons. Increase contrast by pressing the button labelled INCR. Decrease contrast by pressing the button labelled DECR. (INCR and DECR are only available when Contrast is selected.)

Printer Select

LabMaster Ultima supports several industry standard printers for printing screens. To designate a printer, choose PRINTER SELECT from the GLOBAL OPTIONS menu. The screen shown in Figure 11 will be displayed.

Use the UP/DOWN arrow buttons to cycle through the available printer selections. Use the SELECT button to choose the currently selected printer and close the screen.

Screens may be printed by selecting PRINT SCREEN from the OPTION menu.

Screens (Global Options)

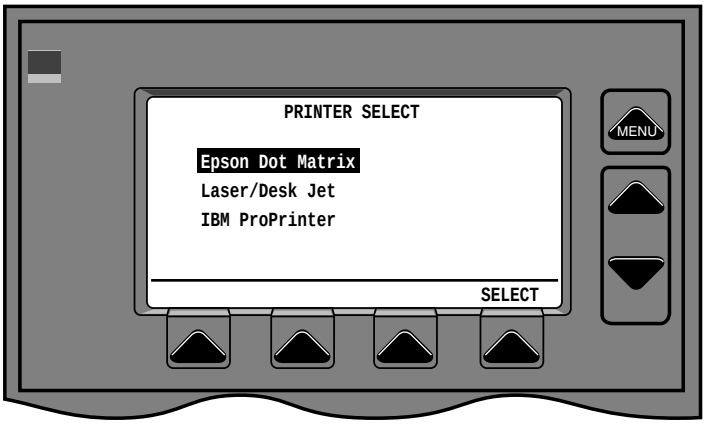


Fig. 11 Printer Select

System Status

Displays screen shown in Figure 2 with information about the console and detector software and calibration status. Press any key to close screen and return to the screen from which GLOBAL OPTIONS was selected.

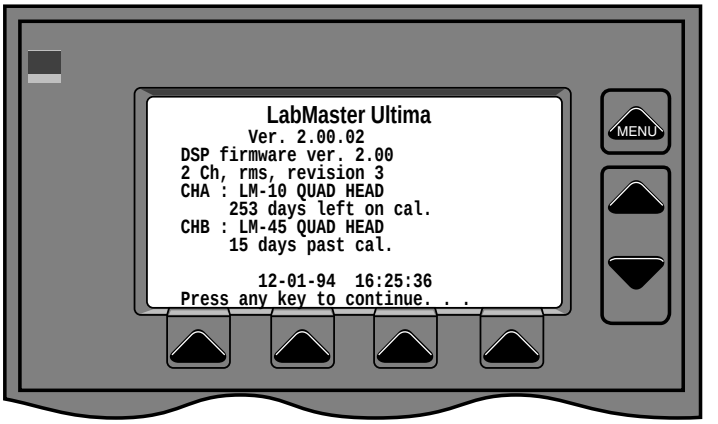


Fig. 12 System Status

Screens (Global Options)

Set Time

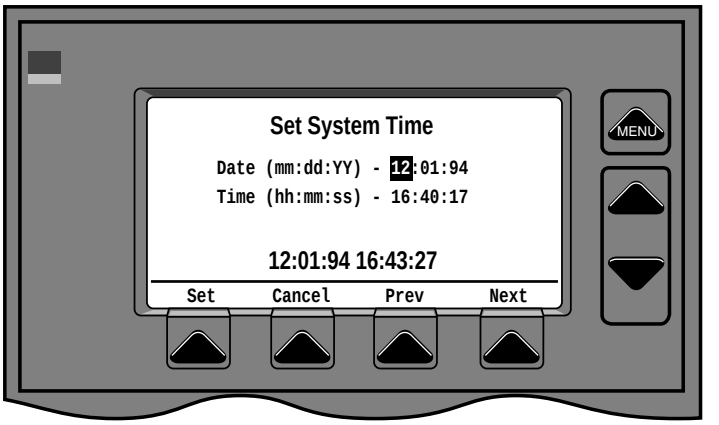


Fig. 13 Set Time

Displays screen shown in Figure 13 to allow user to set the system time for the Ultima. The PREV and NEXT keys cycle the selection bar through MM, DD, YY, HH, MM, SS in opposite sequence. The UP and DOWN arrow keys to the right of the screen increase or decrease the value of the current selection as follows: MM - 01 to 12; DD - 01 to 31; YY - 00 to 99; HH - 00 to 23; MM - 00 to 60; SS - 00 to 59. When date and time are displayed correctly, press the button labelled SET. The time and date shown will become the system time at the moment the SET button is pressed and the screen will be closed. The CANCEL button will close the screen without changing the system date and time.

Alarms

The Alarms screen allows four alarm conditions to be defined for each channel. Alarm limits can be high or low power or energy, or beam movement exceeding a defined distance. When an alarm limit is exceeded, a 5 volt TTL level signal is sent via the Auxiliary I/O port (see p. 13).

Screens (Global Options)

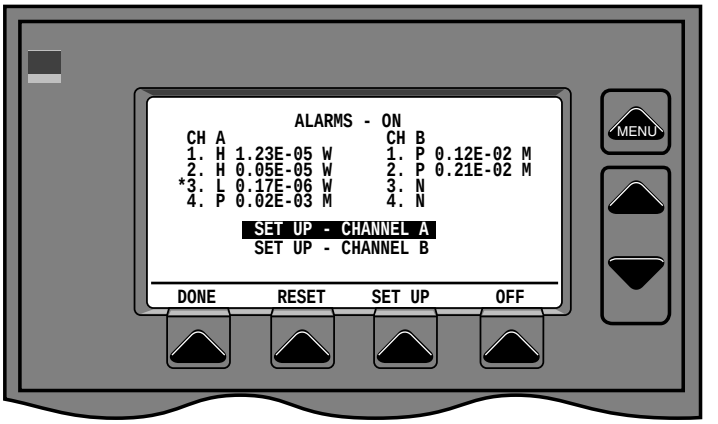


Fig.14 Alarms Control Screen

The Alarms Control Screen (Figure 14) displays the alarm conditions for each channel. Alarm numbers 1 through 4 for each channel are shown. Alarm types are: high (H), power/energy exceeds this value; low (L), power/energy goes below this value; position (P), position from the center exceeds this value; none (N), alarm is not active.

On/Off button

Turns alarms feature on if off, off if on. Current condition is shown in top line of screen.

Reset button

When an alarm condition is exceeded and a signal is sent via the Auxiliary I/O port, an asterisk is displayed to the left of the alarm number on the Alarm Control Screen. Press the RESET button to turn asterisks off.

Set up button

There are two set-up selections below the alarm conditions; one for each channel. Select the channel you wish to set up with the UP/DOWN arrow buttons and press the button marked SET UP to display the set up screen for that channel (Figure 15.)

Screens (Global Options)

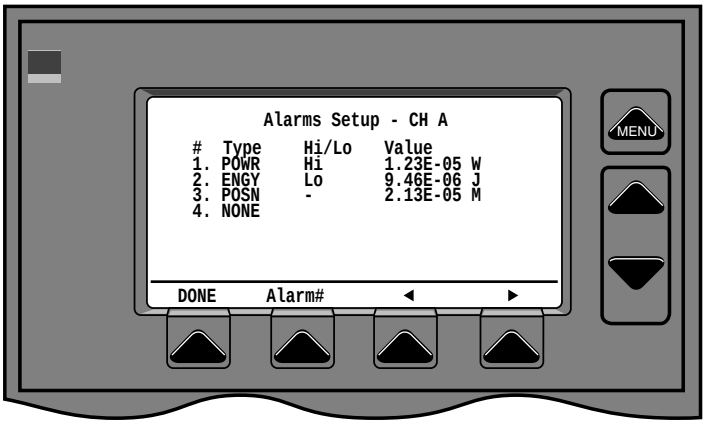


Fig. 15 Alarms Set-up

Alarm set up

To set an alarm condition, use the ALARM# key to select the alarm # to be set.

Use the UP/DOWN arrow keys to select the type of alarm (types are none (NONE), power (POWR), energy (ENGY) and position (POSN). Note that only the valid selections for the detector type in that channel are shown.

Then press the left or right arrow buttons to select the field to change.

Fields are (from left to right): TYPE – can be POWR (power), ENGY (energy), POSN (position) or NONE; HI/LO – can be HI (high), alarm is triggered when value exceeds this value, or LO (low), alarm is triggered when value falls below value (field not active if alarm type is POS); VALUE – alarm limit value in scientific notation.

Use the UP/DOWN arrow buttons to increase or decrease the value of numeric fields and to cycle non-numeric fields.

Done button

The DONE button closes the set up screen and returns to the Alarm Control Screen.

Screens (Global Options)

Done button

The DONE button on the Alarm Control screen closes the screen and returns to the screen from which Global Options was selected.

Remote Setup

The Remote Setup screen is used to set controllable output parameters for the RS-232 and GPIB and Analog Out ports. Settable parameters are data transfer rate for the RS-232 port (1200, 2400, 4800, 9600), and address for the GPIB port (00 to 31). Other values for the RS-232 port are fixed and are displayed for information only. To set Output Parameters, select Remote Setup from the Global Options menu. The screen shown in Figure 16 will be displayed. To select output parameter to be changed, press buttons labelled Prev or Next. They will cycle the selection through BPS and ADDRESS in opposite order. To change the selected parameter, use the UP/DOWN arrow keys. When output parameters are set to the desired value, press the button labelled RETURN to close the screen and return to the screen from which Global Options was accessed.

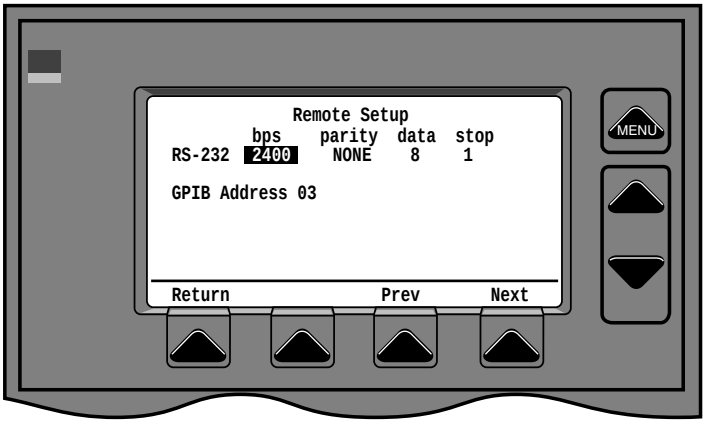


Fig. 16 RemoteSetup

LabMaster Ultima Remote Setup Menu Additions

The Remote Setup menu now allows selection of a Message Termination character for both RS232 and GPIB, and selection of a Message Timeout for GPIB.

Message Termination Character

The IEEE 488.2 standard specifies use of the Line Feed character as a message terminator, but many Host systems are unable to provide a Line Feed as the terminator. So a menu has been added, allowing selection of one of the following terminators:

- CR - Carriage Return only (Hex value 0D)
- LF - Line Feed only (Hex value 0A)
- CR/LF - Carriage Return/Line Feed pair (Hex value 0D0A)
- EOT - End of Transmission (Hex value 04)
- / - Forward Slash (Hex value 2F)

Note however, that GPIB only allows one termination value, so if the CR/LF pair is selected, only the Carriage Return value is used.

GPIB Timeout

When using GPIB, if a transaction does not complete within the Timeout period, the message is discarded. In normal operation, this would typically occur if a query for data was issued, but the Host failed to read the response queued by the Ultima. Previously, the Timeout was fixed at 3 seconds, which is adequate for most applications. However, when developing a Host controlling program, it would be convenient for the programmer to be able to use an interactive approach for sending and receiving messages, in which case 3 seconds is not enough time.

Although the Timeout still defaults to 3 seconds (3.00e03 milliseconds), it can now be changed from 0 to 9.99e99 milliseconds. Since an unread message is normally discarded when the Timeout expires, settings the Timeout to 0 means an unread message will never be discarded. If the Timeout is disabled, and the Host fails to read the response to one query, the Ultima cannot respond to any successive queries since the unread message is holding up the queue. Note also that the Ultima cannot collect data while it is trying to deliver a query response. So when a query is issued, data is not collected until either the Host reads the query response, or the Timeout expires.

Screens (Home)

Home

The Home screen displays basic power or energy measurement information. Home screens will vary depending on the type of detector(s) plugged into the Ultima.

CW- Thermal Detector

CW thermal detectors include Smart Head detector models LM-3, LM-10, LM-20, LM-30v, LM-45, LM-100, LM-100E, LM-100XL, LM-150FS LM-200, LM-200XL, LM-200XLE, LM-1000, LM-2500, LM-5000 and the BeamFinder. Coherent's thermal detectors are unique in giving accurate indication of beam position on the detector. Home screens for CW Thermal Detectors include a target with a dot showing beam position on the detector. To achieve specified accuracy, detector position should be adjusted until beam position dot is within the central circle on the display target. The analog power/energy indicator is present on all Home screen displays, and provides visual feedback of changes in power/energy levels. The large numeric display gives precise reading of power or energy on the detector.

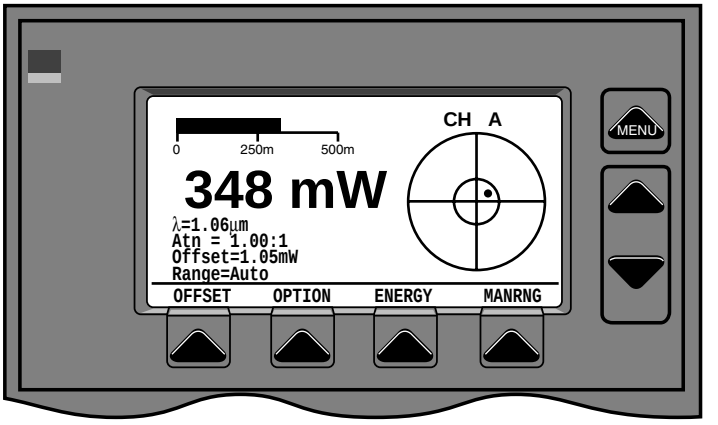


Fig. 17 CW Thermal Detector Home Screen - Single Channel

Single Channel

Single channel screen (see Figure 17) displays power for Channel A or (dual channel Ultima only) for Channel B. In addition to power, display shows wavelength (λ) that channel is set up for, attenuation (Atn) entered for channel, current offset value for channel and current range for channel.

Screens (Home)

Offset

The OFFSET button enters the current power reading as an offset amount. Offset value is subtracted from power reading on the detector to give the displayed power. The offset value is shown on the display beneath the power reading. Pressing the OFFSET button when the current offset value is not equal to zero cancels the current value and returns the offset value to zero.

Option

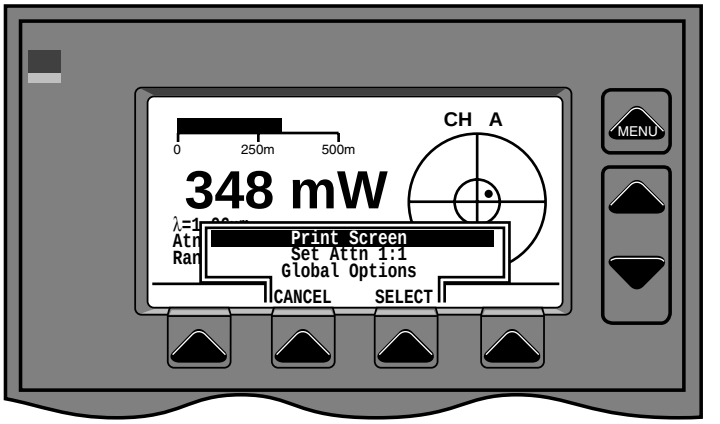


Fig. 18 Home Options Menu

Displays the option menu shown in Figure 18. Home screen options are PRINT SCREEN, SET ATTN 1:1 and GLOBAL OPTIONS (see page 14). PRINT SCREEN prints a copy of the current screen if a compatible printer is attached to the parallel printer port (available on performance package Ultima's only). SET ATTN 1:1 resets the attenuation value for the channel to 1.00:1

Energy (CW Single Pulse)

LabMaster Ultima offers single pulse energy measurement with CW Thermal detectors. Press the button labelled ENERGY to make a single pulse measurement. If this is the first time the single pulse measurement feature has been invoked after the Ultima is turned on, only one button labelled ZERO will be active (see Fig. 19). Turn off the laser or block the beam and press the ZERO button.

Screens (Home)

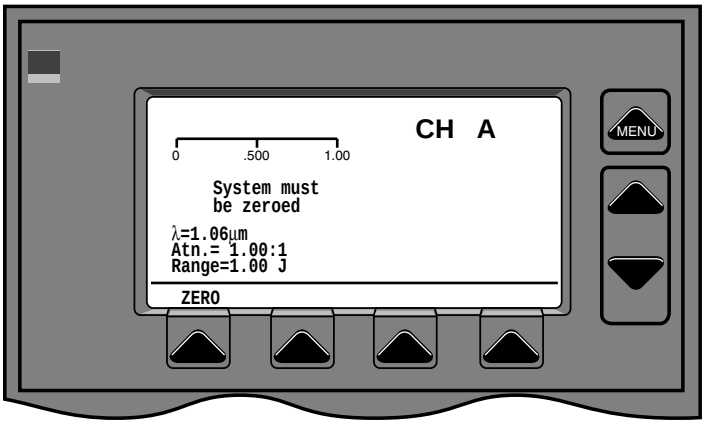


Figure 19 CW Detector Single Pulse Measurement - Zeroing

This allows the LabMaster to measure any background light and set a zero condition prior to making measurements. (Zeroing only happens the first time the screen is accessed after turn-on unless it is specifically invoked. After the ZERO button is pushed and the system establishes the zero condition, the screen shown in Fig. 20 will be displayed.

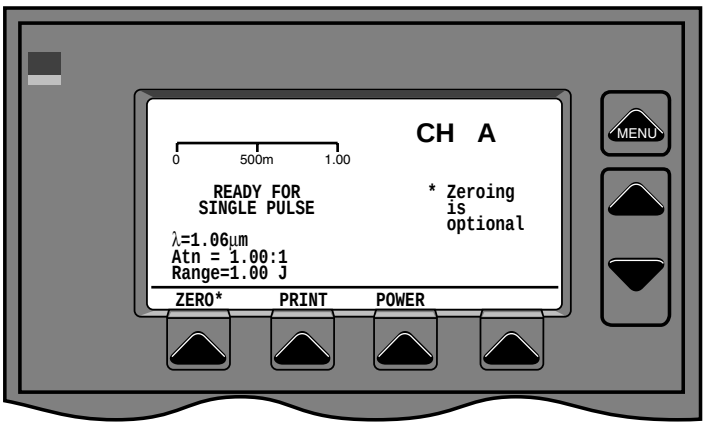


Figure 20 CW Detector – Single Pulse Measurement

Fire the laser pulse and the words PULSE RECEIVED and the pulse energy will be displayed. (Fig. 21)

Screens (Home)

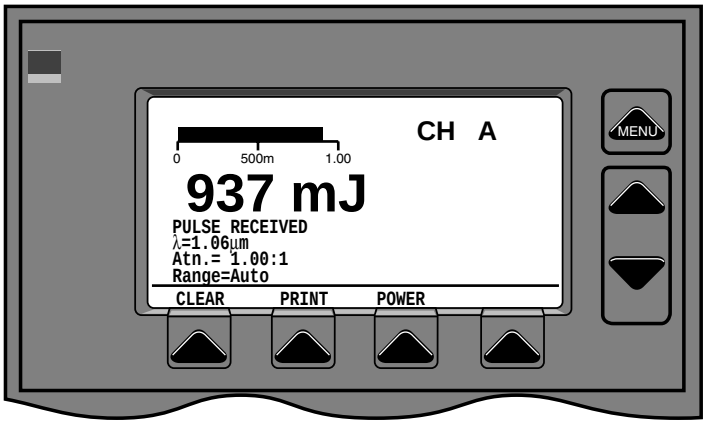


Figure 21 CW Detector Single Pulse Received

CLEAR will erase the current energy reading and prepare the Ultima to receive another pulse. The ZERO* button is available to re-zero the Ultima at any time but is optional. For the greatest accuracy, Ultima should be re-zeroed before measurement. The button labelled POWER will return to the normal CW Thermal Detector Home Screen.

Range

The range select button is labelled MANRNG if LabMaster is in auto-range and AUTORNG if in manual range.

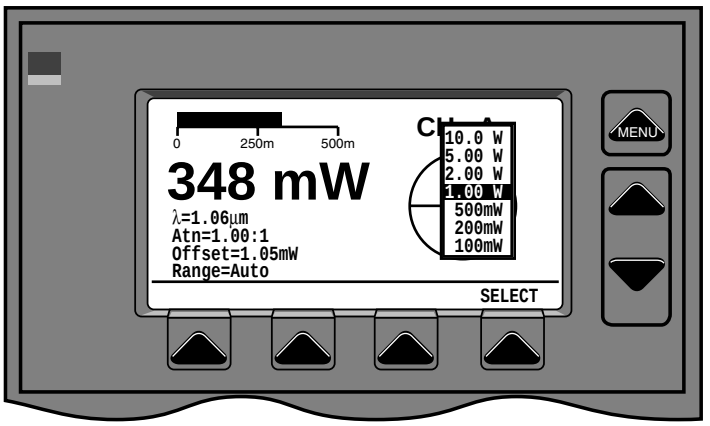


Figure 22 CW Detector – Manual range selection

MANRNG will display a pop-up menu of available ranges

Screens (Home)

as in Figure 22. (ranges are determined by the detector head plugged into the channel being displayed, modified by the attenuation factor set for that channel). Use the UP/DOWN arrow keys to the right of the screen to select the desired range, then press the button labelled SELECT to close the pop-up menu. The range select button will now be labelled AUTORNG and pressing it will return the Ultima to automatic range selection.

Dual Channel (dual channel Ultima only)

Dual channel screen (see Fig. 23) simultaneously displays output for both Channel A and Channel B. Channels can be CW thermal, CW quantum, pulsed or any combination. Wavelength, attenuation, offset and range are displayed, as well as beam position, and digital and analog power. The Option menu offers eithe PRINT SCREEN (p. 15) or GLOBAL OPTIONS (p.14). Single pulse energy measurement is not available on the dual channel screen. Ranges must be entered on the single channel screen.

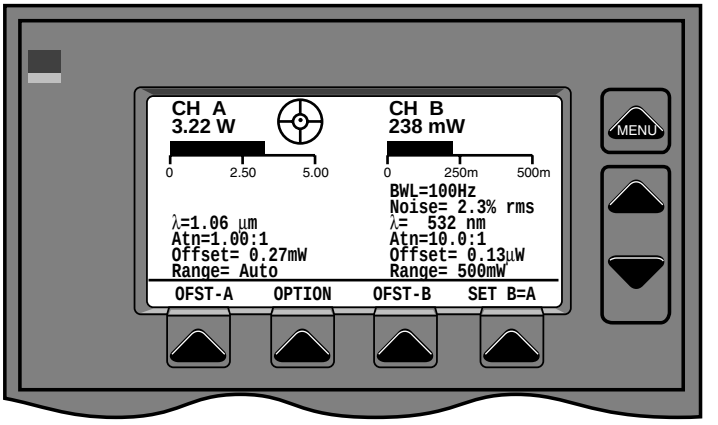


Figure 23 CW Home Screen - Dual Channel

OFST-A, OFST-B

Offset buttons operate identically to the offset button on the single channel screen (page 22). Offset for either channel can be entered by pushing the appropriately labelled buttons.

Screens (Home)

SET B=A

Set B=A button adjusts the attenuation factor for channel B so that the power displayed for channel B is equal to the power displayed for channel A. This feature is used to set up pick off beamsplitters so that the reading from the pick-off is the actual power delivered. The sense of this button can be changed from set B = A to set A= B by pressing the button labelled FLIP on either the RATIO or DIFFERENCE screens

CW Ratio (dual channel Ultima only)

The Ratio Screen (see Fig. 24) displays the ratio of one channel to the other. Ratio is unitless and is displayed in scientific notation. When a CW detector is used on one channel and a pulsed detector is used on the other, average power on the pulsed detector is used for the ratio. A ratio value of 10.13 would be displayed as 1.01e+01 (i.e. 1.01 x 10^{1}). A ratio value of 0.00127 would be displayed as 1.27e-03. The analog scale at the top of the screen shows an analog representation of the ratio value.

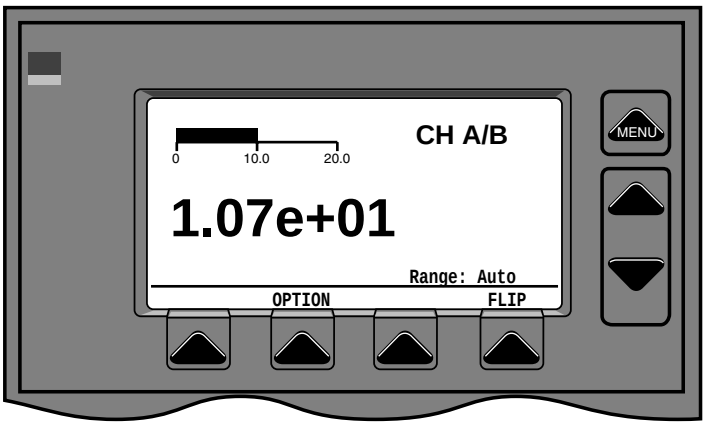


Figure 24 Home Ratio Screen

FLIP

Flip button inverts the ratio calculation. If the current calculation is Channel A/ Channel B flip will invert the calculation to Channel B/Channel A. Flip state is the same for difference and ratio.

Screens (Home)

OPTION

The option menu offers PRINT SCREEN (p.15) or GLOBAL OPTIONS (p.14).

CW Difference (dual channel Ultima only)

The Difference Screen (see Fig. 25) displays the difference between the two channels. Difference will be shown in watts. When a CW detector is used on one channel and a pulsed detector is used for the ratio. An analog bar at the top of the screen shows analog representation of difference.

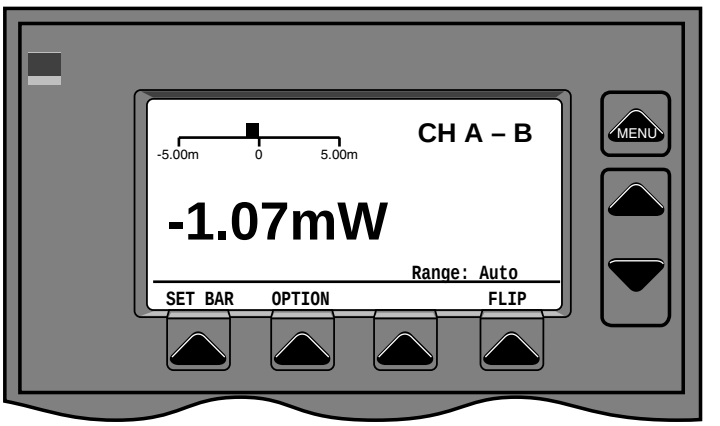


Figure 25 CW Difference Screen

SET BAR

The SET BAR button resets the scale of the analog bar to either the positive or negative condition depending on the current difference value.

OPTION

The option menu offers PRINT SCREEN (p.15) or GLOBAL OPTIONS (p.14).

Screens (Home)

FLIP

Flip button reverses the difference calculation. If the current calculation is Channel A - Channel B, FLIP will change the calculation to Channel B - Channel A. Flip state is the same for difference and ratio.

CW-Quantum Detector

When a CW Quantum Detector Head (LM-2UV, LM-2, LM-2IR) is used with the LabMaster Ultima the Home Screen will look like Fig. 26. There will not be any beam position target or button for single pulse energy measurement. An additional parameter, NOISE, will be displayed. The Option menu includes an additional selection, CHANGE BWL. This toggles the bandwidth of the power reading between 10 Hz and 100 Hz. The lower bandwidth allows integration of readings to smooth display in noisy environments. The Other buttons (OFFSET and RANGE) work the same as on theThermal Home Screen (p.22-23).

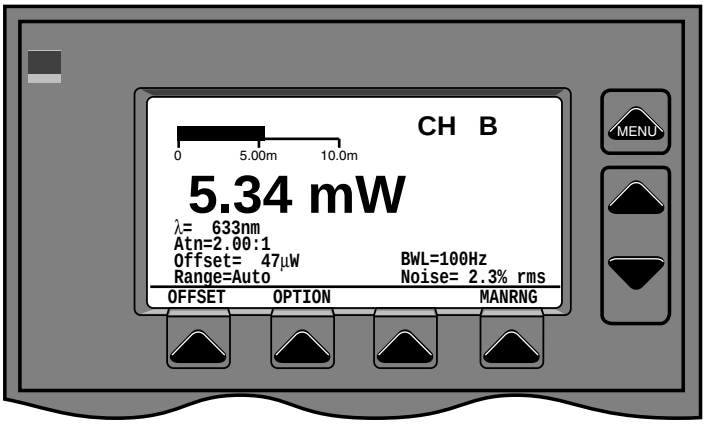


Figure 26 Home Screen - CW Quantum Detectors

RMS Noise

When using Quantum Detectors, LabMaster Ultima can be used as a sensitive noise meter. Ultima measures noise from 10 Hz to 50 kHz. Noise is displayed as %rms. Average power is measured and divided into measured rms power to calculate the noise reading. With the appropriate attenuation Ultima can be used to measure noise on all types of CW lasers with wavelengths from 0.25 to 1.55 µm.

Screens (Home)

Pulse Detectors

Pulse Detectors available for the LabMaster Ultima include the LM-P2-09, LM-P5, LM-P5LP, LM-P5HR, LM-P10, LM-P10i, LM-P10LP, and LM-P10HR. Home screens for pulsed detectors do not have beam position information.

Single Channel

The single channel home screen display includes frequency and average power as well as energy per pulse (Fig. 27). The screen also displays an analog energy indicator bar to provide visual feedback of changes in energy levels. Buttons available on the pulse home screen are CLEAR, OPTION, RANGE and AVERAGE. OPTION and RANGE work in the same manner as on CW Home Screen (p. 22-23).

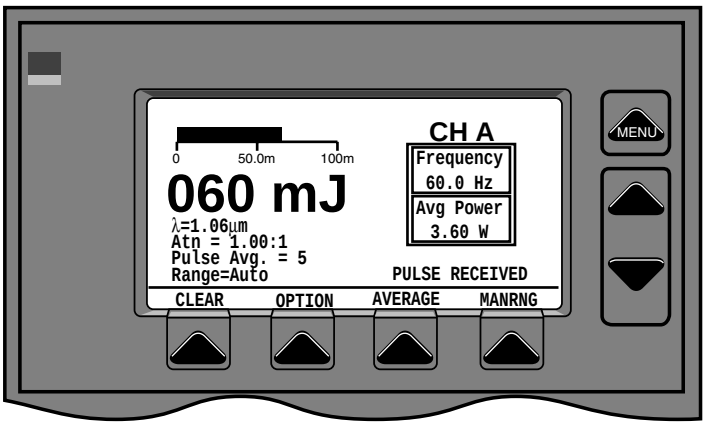


Figure 27 Pulse Home Screen

CLEAR

CLEAR clears the values from the analog and digital display and erases the “Pulse Received” message.

AVERAGE

AVERAGE is used to enter number of pulses to be averaged for energy display. Pressing the AVERAGE button will pop up a menu of numbers of pulses to be averaged (Fig. 28). Use the UP/DOWN arrow keys to select the number of pulses to be averaged and press SELECT. When a number of pulses is selected, a buffer with that number of pulses will be filled with the current value. The

Screens (Home)

number of pulses selected will be displayed on the Home Screen. Each incoming pulse will then displace the oldest pulse. When the buffer is filled with measured values an asterisk will be displayed following the number of pulses averaged message. Number of pulses to be averaged will default to 1 on start-up.

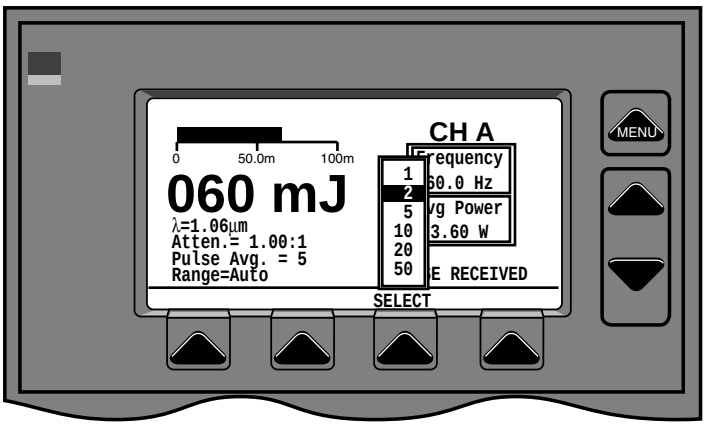


Figure 28 Pulse averaging selection

Dual Channel (dual channel Ultima only)

The dual channel energy screen will display energy readings for both channels simultaneously. All information shown on single channel home screen is shown on dual channel screen (Fig. 29).

AVG-A, AVG-B

Pulse average selection for each channel. Work the same as the pulse average for single channel (p.29).

OPTION

The option menu offers PRINT SCREEN (p.15) or GLOBAL OPTIONS (p.14).

SET B=A

Set B=A button adjusts the attenuation factor for channel B so that the energy displayed for channel B is equal to the energy displayed for channel A. (For mixed CW and pulsed detectors,average power of the pulsed detector is

Screens (Home)

set equal to power of the CW detector. This feature is used to set up pick off beamsplitters so that the reading from the pick-off is the actual power delivered. The sense of the button can be changed by pressing the FLIP button on the RATIO or DIFFERENCE screen.

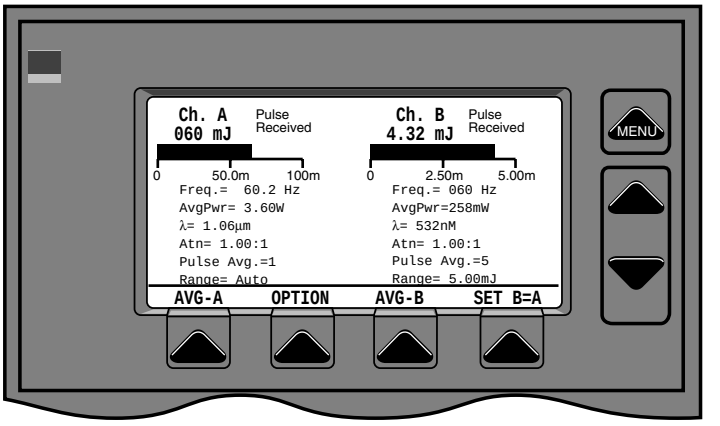


Figure 29 Pulse Home Screen - Dual Channel

Screens (Tune)

Tune

Tune screens provide a large, high speed analog tune bar display which moves right or left with increases or decreases in laser power or energy level, difference or ratio. (Fig. 30) A peak indicator at the top of the analog bar shows maximum excursions of the bar. Tune displays show single channel only and may be switched from Channel A to Channel B on dual channel model.

Power/Energy Tune

The Power or Energy tune screen bar indicates current power or energy level. The peak indicator shows the highest power/energy level attained. Current and maximum power and energy values are displayed at top of screen.

Reset

Reset button resets the Peak Power/Energy Indicator and the Maximum Power/Energy value to the current value at the time the button is pushed.

Option

The option menu offers PRINT SCREEN (p.15) or GLOBAL OPTIONS (p.14).

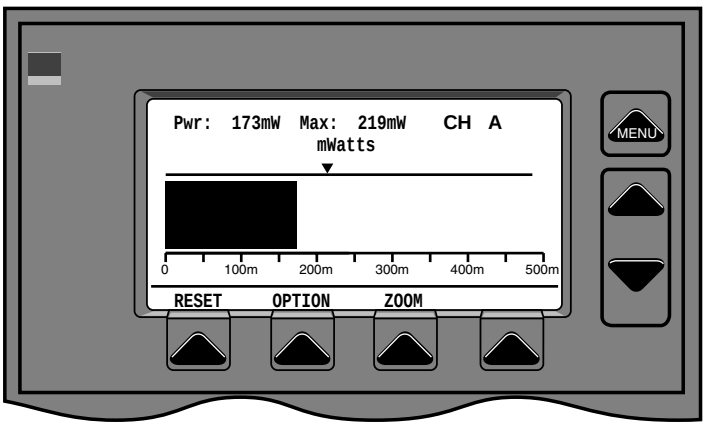


Figure 30 Power/Energy Tune Screen

Screens (Tune)

Zoom

Zoom increases the resolution (sensitivity) of the display 3X. Current value will be centered on display. Maximum and minimum of display will be ± .5 (current range/3). When in the ZOOM mode, the ZOOM key will be displayed reversed. Pressing the key while in the zoom mode cancels the zoom.

Center

CENTER is only active in the ZOOM mode. Pressing the center key redraws the display with the current value at the center.

Ratio Tune (dual channel Ultima only)

The Ratio tune screen bar indicates current ratio of Channel A value to Channel B value. For mixed detectors, average power is used.Value can either be calculated as Channel A/Channel B or Channel B/Channel A (determined by the calculation on the Home ratio screen, page 24). There are two Ratio Limit Indicators (see Fig. 31) above the Ratio Tune Bar. These show the extreme limits the ratio value has reached while tuning. An audible beep is heard each time one of these limits is exceeded. The scale for ratio is initially set at 2X the current ratio value. When the current ratio value exceeds 200% or goes lower than 10% of the initial value, the scale is reset to 2X the current value. A digital display of the current ratio value is shown above the tune bar.

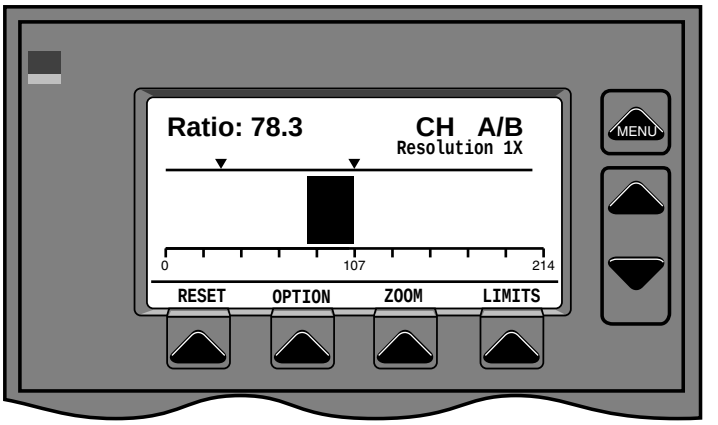


Figure 31 Ratio Tune Screen

Screens (Tune)

Reset

The RESET button replaces the initial ratio value with the current ratio value and rescales and redraws the display.

Option

The option menu offers PRINT SCREEN (p.15) or GLOBAL OPTIONS (p.14).

Zoom

Increases the resolution of the screen 2X for each of three button pushes, then returns to 1X resolution (cycle is 1X-2X-4X-8X-1X). Current resolution is shown on the screen above the tune bar. e.g. The initial ratio value when the ratio tune screen is entered is 8.0. The scale will be set initially as 0.0 to 16.0. If ZOOM is pressed once the resolution goes to 2X (shown on the screen). The scale will now be 2.0 to 10.0. If the button is pressed again (4X resolution) the scale will be 4.0 to 8.0. One additional press (8X resolution) will change the scale to 5.0 to 7.0, and the next press will return to 1X resolution with the scale at 0.0 to 16.0.

Limits

The LIMITS button resets the limit indicators to the current differences (+ and -) from the initial ratio.

Difference Tune (dual channel Ultima only)

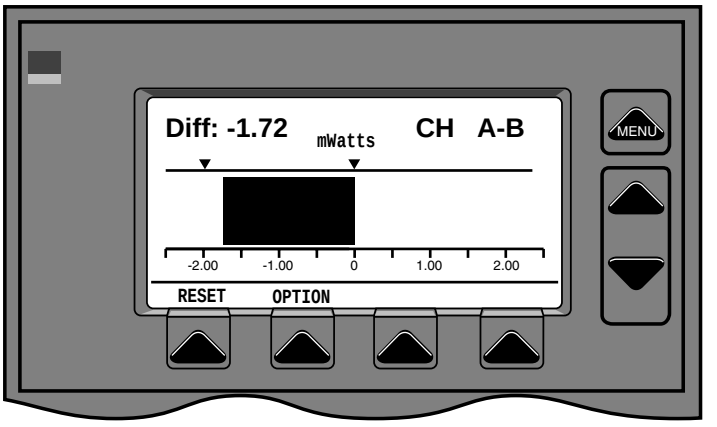


Figure 32 Difference Tune Screen

Screens (Tune)

The Difference Tune Screen provides a tune bar that indicates the current difference between the channels. Value can either be A-B or B-A depending on the setting of the Home Difference Screen (page 27). For mixed CW and pulsed detectors, average power is used. There are two Difference Limit Indicators (see Fig. 32) above the tune bar that show the extreme difference values reached while tuning. Each time a limit is exceeded, an audible beep is heard. A digital display of the current difference value is shown above the tune bar.

Reset

Reset button resets the Peak Power/Energy Indicator and the Maximum Power/Energy value to the current value at the time the button is pushed.

Option

Option Menu is the same as Home Screen options (p. 21).

Screens (Trend)

Trend

The power/energy vs. time trend feature provides automatic collection of laser output over a selectable time period from one second to 99 hours. A maximum of 2000 data points can be captured on each channel. Data can either be collected at fixed intervals or (for pulsed lasers) each time a pulse is received. Trend data display is 200 points wide. All data points collected can be displayed on the vertical axis, with the horizontal axis being incremented each (Total Points/200) points. Alternatively, the values of necessary number (Total Points/200) of points to make a total of 200 points can be averaged and the average value displayed. Statistical information for the data collected can be displayed and printed, and the raw data can be printed.

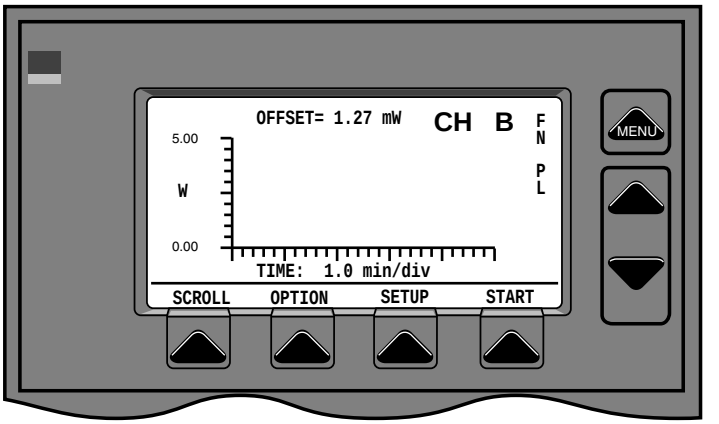


Figure 33 Trend Screen - Single channel start

Single Channel-Start

When the single channel trend screen is selected a blank graph is shown (Fig. 33). The letters on the right edge of the screen indicate the currently selected graphic display options. (FN = no fitting, FM = Min/Max fitting, FS = ±3σ fitting, PL = all points plotted, PV = average of points plotted.)

Scroll

SCROLL button switches to continuous trend mode. Data is collected continuously at selectable intervals. The first 200 points are collected and displayed. After that the oldest collected data point is erased, all points are shifted one pixel to the left and

Screens (Trend)

the newest point is written at the right. Limit indicators at the right edge of the display show the maximum and minimum power and energy attained. Current value and offset value are displayed digitally at top of screen.

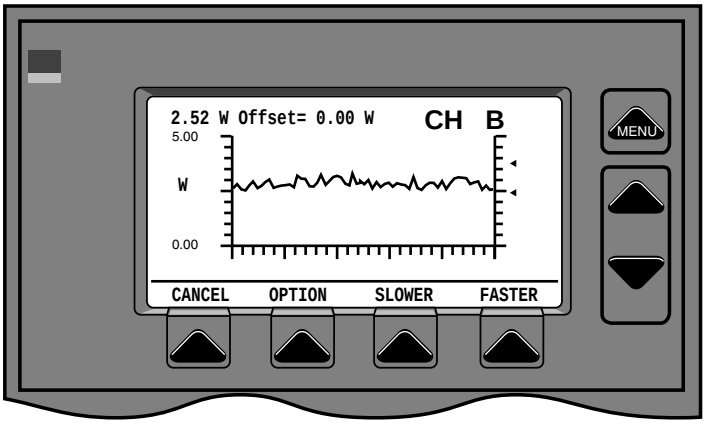


Figure 34 Trend Screen - Scroll

Cancel

Cancels scroll mode and returns to the Trend-Start screen.

Option

The option menu offers PRINT SCREEN (p.15) or GLOBAL OPTIONS (p.14).

Slower/Faster

Changes the width of the current window displayed. Choices are 10, 20, 50, and 100 seconds. Current value is displayed below horizontal scale. FASTER is not displayed when screen is at highest speed and SLOWER is not displayed when screen is at slowest speed.

Option

Screens (Trend)

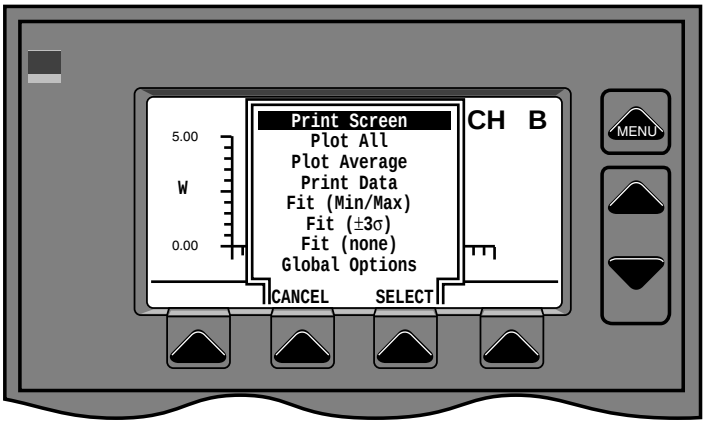


Figure 35 Trend Screen - Options

The OPTION button displays the Trend Screen Options menu (Fig. 35).

Print Screen

See p.15.

Plot All

Puts trend display in plot all points mode. Each data point is plotted on the vertical axis. The horizontal axis is incremented one pixel each (total points/200) points. e.g. If 1000 total points are collected, points 1 through 5 will be plotted in the same vertical pixel column, 6 through 10 in the next column to the right, etc.

Plot Average

Puts trend display in Plot Averaging mode. Averages the values of the necessary number of data points to make 200 points. (e.g. if 2000 data points are collected, each point plotted will be an average of 10 points (2000/200).

Screens (Trend)

Print Data

Selecting Print Trend Data will send a report to the printer port of all trend data. Report format is:

```
   Ultima Trend Data - Channel A - Watts
   Interval = 00:00.1  Start Time = 12/02/94 18:39:30

  1-5    7.25e+00  7.25e+00  7.38e+00  7.38e+00  7.41e+00
  6-10   7.34e+00  7.34e+00  7.50e+00  7.34e+00  7.44e+00
 11-15   7.38e+00  7.41e+00  7.22e+00  7.50e+00  7.41e+00
 16-20   7.31e+00  7.38e+00  7.38e+00  7.44e+00  7.44e+00
                      •
                      •
                      •
191-195  7.03e+00  7.28e+00  7.26e+00  7.25e+00  7.16e+00
196-200  7.22e+00  7.13e+00  7.25e+00  7.25e+00  7.22e+00

End of Ultima Trend Data
```

Fit (min/max)

Sets the minimum and maximum values on the vertical axis of the graph equal to the minimum and maximum values of displayed data.

Fit (±3σ)

Sets minimum and maximum values on the vertical axis of the graph equal to ±3 standard deviations of the data collected.

Fit (none)

Sets minimum and maximum values on the vertical axis of the graph to 0 and the range greater than the maximum data value (cancels the “Fit” choices above).

Global Options

See p. 14.

Screens (Trend)

Setup

Trend Set-up Screen provides for input of parameters controlling data collection run. (Fig. 36)

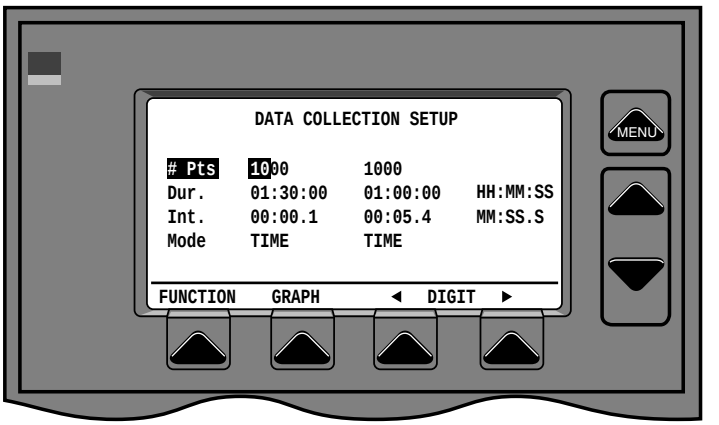


Figure 36 Trend - Set-up Screen

Number of points, duration, interval and mode can be selected for each channel. Number of points can be from 200 to 2000 increments of 200. Duration of data collection can be 20 seconds to 99 hours, but no more than 10 Hz. Duration is only available if the MODE is TIME. Interval between data points can vary from .1 second to 29 minutes 42 seconds (a value greater than this defaults to the maximum value). Interval is only available if the MODE is TIME. MODE can be TIME (captures data at designated intervals for designated duration, or PULSE (captures every pulse - can't select duration or interval). PULSE is only available if the head plugged into the channel is a pulsed detector.

Function

Function button cycles selection (indicated by reversed bar) through #PTS, DURATION, INTERVAL, MODE and back to #PTS. (MODE can only be changed for pulsed detectors.)

Graph

Returns to trend screen.

Screens (Trend)

Digit (left or right)

Selects digit to be changed within selected parameter. UP/ DOWN arrow buttons increase or decrease selected digit.

Start

The start button begins the data collection run. The data is plotted as the run progresses.

Single Channel-Progress

Once the data collection run has started, the screen will look like Fig. 37. The only active button during a data collection run is STOP.

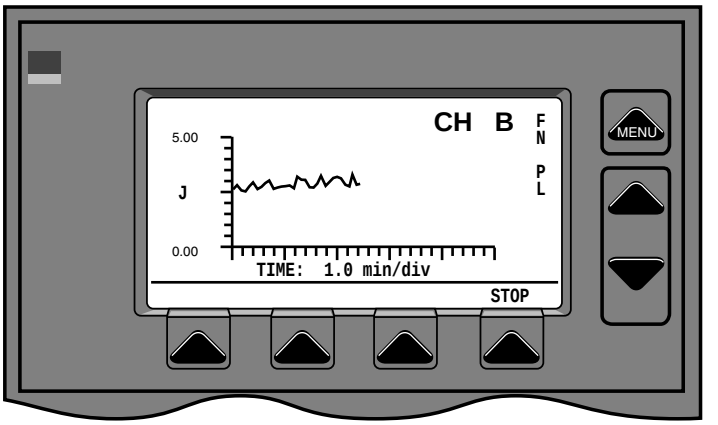


Figure 37 Data collection in progress

Stop

STOP button stops data collection and displays data collection complete screen. (Fig. 38)

Single Channel-Complete

When the data collection run is complete, the screen shown in Fig. 38 will be displayed.

Screens (Trend)

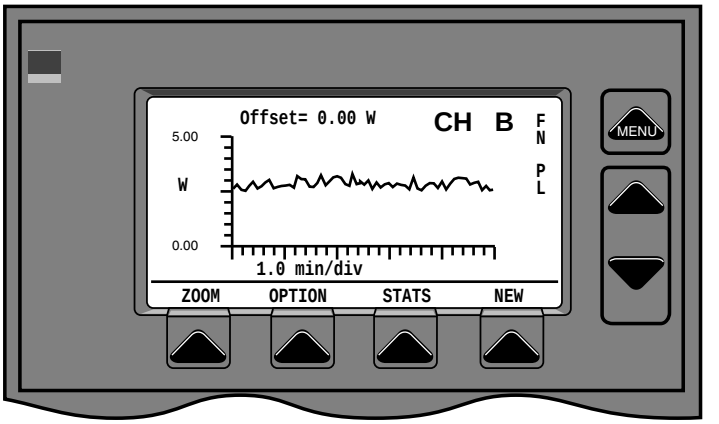


Figure 38 Trend Screen – Complete

Zoom

Zoom button allows viewing a selected portion of the data on an expanded scale. Pressing ZOOM will display the selection screen (Fig. 39). The zoom selection area (indicated by the dotted

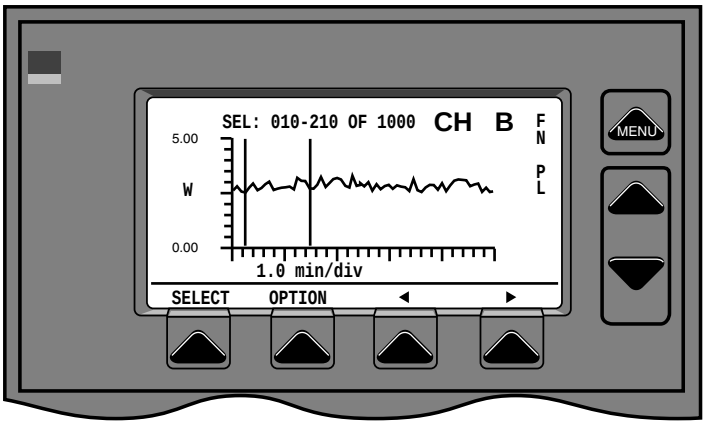


Figure 39 Trend Screen - Zoom Selection

vertical lines) will always be 200 data points wide. The left and right arrow buttons are used to move the selection area left and right. When the area of interest is within the vertical dotted lines, press the button labelled SELECT to display only that portion of the data (Fig. 40). The sequential numbers of the points within the selection area are shown at the top of the

Screens (Trend)

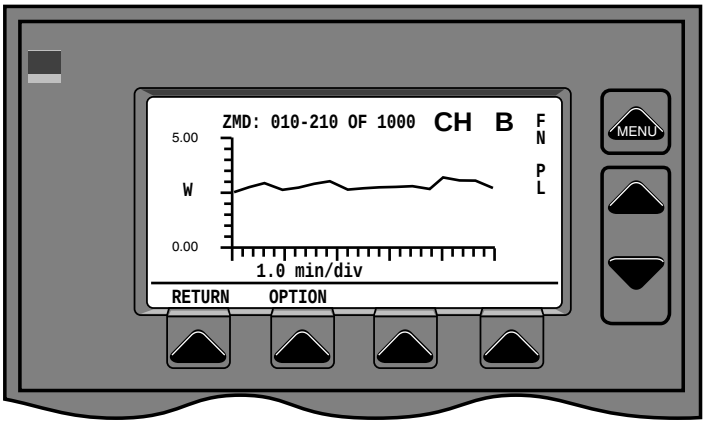


Figure 40 Trend Screen – Zoomed

screen. The button labelled RETURN redisplays the graph showing all data points (Fig. 38).

Option

The OPTION button displays the trend option menu (Fig. 35).

Stats

The STATS button displays statistical information calculated from the trend data (Fig. 41 and 42) Statistical information includes MEAN, MAX, MIN, STANDARD DEVIATION and STAB for power, energy and frequency, as well as number of points, duration and interval of the data collection run. GRAPH button redisplays Trend Screen – Complete screen (Fig. 38). OPTION button displays Trend Options menu (Fig. 35). HIST displays a histogram of the data collected (Fig 43). NEW displays a warning message that data is about to be erased and prepares for new trend run.

NOTE: Trend display update may lag behind actual data collection at higher acquisition rates. ALL POINTS ARE BEING CAPTURED. The lag is only in calculating and drawing the display.

Screens (Trend)

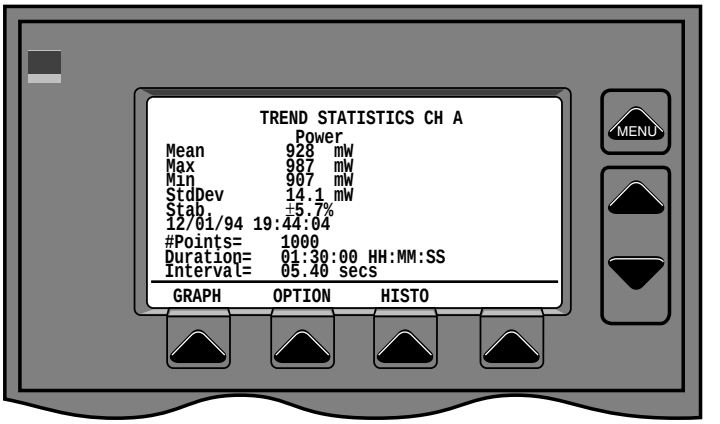


Figure 41 Trend Statistics-CW

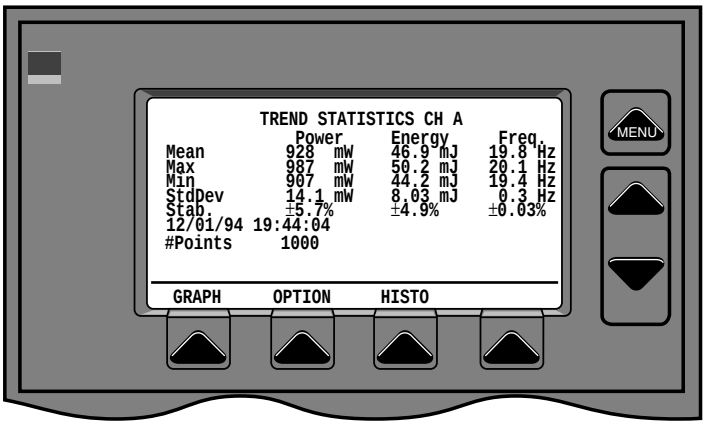


Figure 42 Trend Statistics Pulsed

Histogram

Histogram (Fig. 43) of the data is developed as follows.

$$RANGE = DATA_{max} - DATA_{min}$$
$$INTERVAL = RANGE/20$$
$$INTERVAL_1 = DATA_{min} + INTERVAL$$
$$INTERVAL_2 = DATA_{min} + 2(INTERVAL)$$
$$INTERVAL_3 = DATA_{min} + 3(INTERVAL)$$
$$\vdots$$
$$INTERVAL_{20} = DATA_{min} + 20(INTERVAL)$$

Screens (Trend)

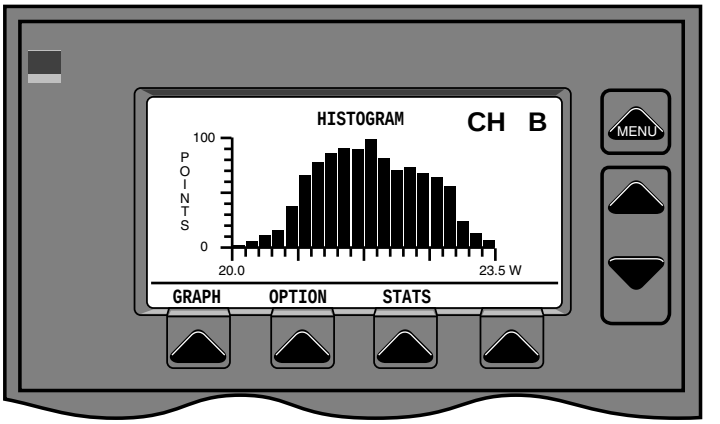


Figure 43 Trend Histogram

Display in the left most column of graph number of data points ≥ $DATA_{min}$ and ≤ $INTERVAL_1$. Display in next column of graph number of data points > $INTERVAL_1$ and ≤ $INTERVAL_2$. Continue until all columns are completed. From the Histogram Screen, the OPTION button displays the Trend Options menu (Fig. 35), the STATS button returns to the Trend Statistics Screen (Fig. 41,42) and the NEW button displays a warning message that data is about to be erased and prepares for new trend run.

New

The NEW button on any of the Trend Screens erases current data and displays the Trend – Start screen to begin a new data collection run. A warning that current data is about to be erased is displayed first, and the action can be cancelled and current data will remain untouched.

Screens (Trend)

Dual Channel Trend (dual channel Ultima only)

Data collection runs can be made for two channels simultaneously via the Dual Channel Trend Screen. Selecting Channel A&B Trend displays the screen shown in Fig. 44. Dual Channel trend set-up and collection is done in the same manner as for single channel (p. 33 - 40). Note that the ZOOM function is not available on the dual channel screen. To display ZOOMED data, single channel screen must be used.

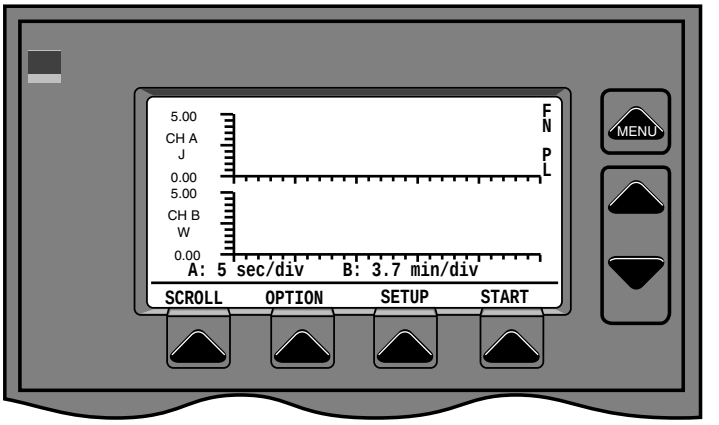


Figure 44 Trend, 2 Channel

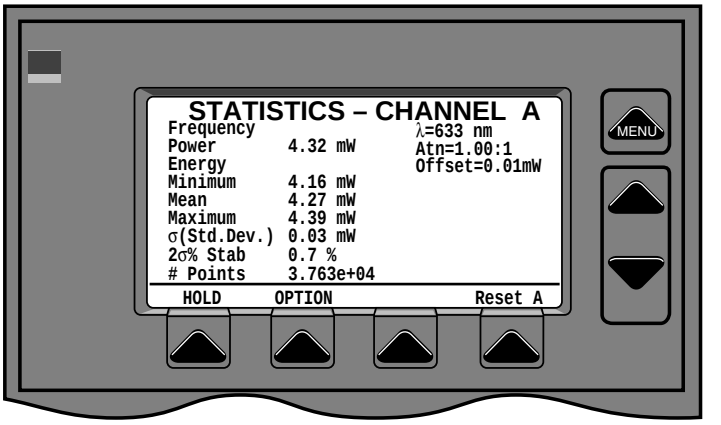
NOTE: Trend display update may lag behind actual data collection at higher acquisition rates. ALL POINTS ARE BEING CAPTURED. The lag is only in calculating and drawing the display.

Screens (Statistics)

Statistics

Real time statistical information can be calculated and displayed via the Statistics Screen (Fig. 45). Data is collected and recalculated continuously for from the time the LabMaster is turned on or the reset key is pressed.

Single Channel (CW and pulsed)



Statistics – 1 Channel CW

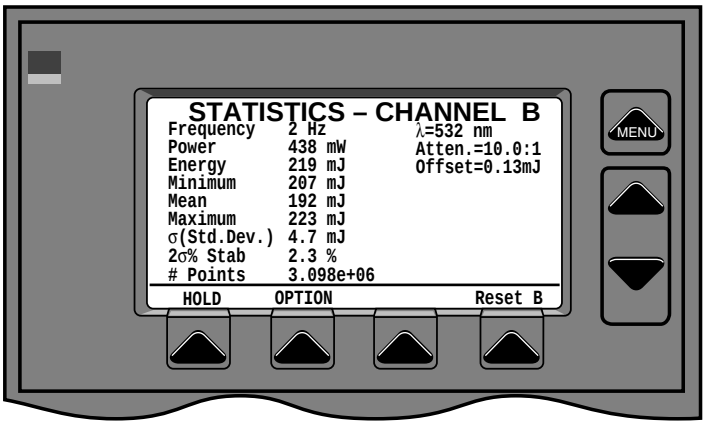


Figure 45 Statistics - 1 Channel Pulsed

CW and pulsed Statistics screens show the same basic information. The CW screen does not display frequency or energy. Statistical information displayed is Frequency, Power, Energy, Mean, Minimum,

Screens (Statistics)

Maximum, Standard Deviation (s) and 2s% Variation. In addition, wavelength, attenuation and offset are shown. The number of points for which data is calculated is displayed.

Data collection rate is 10 Hz for CW detectors. For pulsed detectors, every pulse is captured up to the maximum rate of the Ultima and the detector.

Hold

Stops adding data points to the buffer and freezes display.

Option

The option menu offers PRINT SCREEN (p.15) or GLOBAL OPTIONS (p.14).# Points

Reset A, Reset B

Restarts the sample for which statistics are calculated (Channel A or Channel B).

Dual Channel (dual channel Ultima only)

On dual channel models, both channels statistics can be displayed simultaneously (Fig. 46). Interval and number of points cannot be changed on the dual channel screen. To change these parameters, go to the single channel statistics screen.

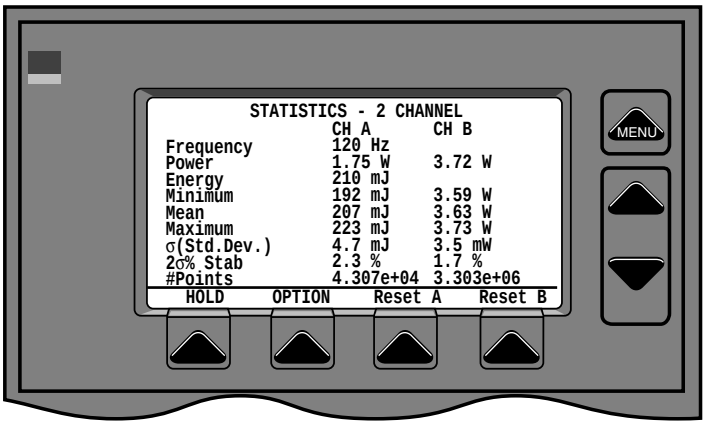


Figure 46 Statistics – Dual Channel

Screens (Position)

Position

The Position Screens allow tracking of changes of beam position on the detector. Note that this feature is available only for CW Thermal detectors.

Single Channel

The single channel position stability screen looks like Fig. 47. Beam position is shown both as movement of axis over time and as a polar plot of movement on the detector. The duration of the run is shown at the lower right of the screen. The diameter represented by the polar plot is shown directly under the plot on the right side of the screen.

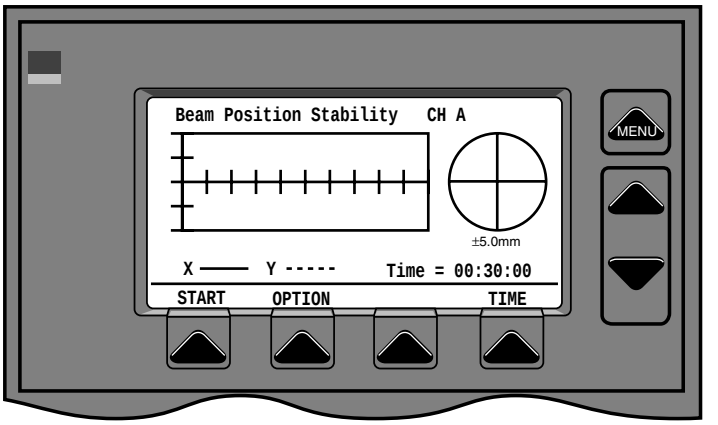


Figure 47 Single Channel Position – Ready

Ready

No data has been collected.

Start

Starts data collection.

Option

The option menu offers PRINT SCREEN (p.15) or GLOBALOPTIONS (p.14).

Screens (Position)

Time

Time period selection is done by pressing the button labelled TIME. A selection bar (reversed) will be shown on the Duration display. Button labels will be changed to a right and left arrow and DONE. Use the right and left arrows to select the digit to be changed and the UP and DOWN arrow buttons to the right of the screen to increase or decrease the selected digit. When the desired duration is displayed, press the button labelled DONE.

In progress

After data collection is started, data for each axis will be plotted as it is collected (Fig. 47). The only active button during data collection is STOP.

Stop

Halts data collection and displays collection complete screen (Fig. 48).

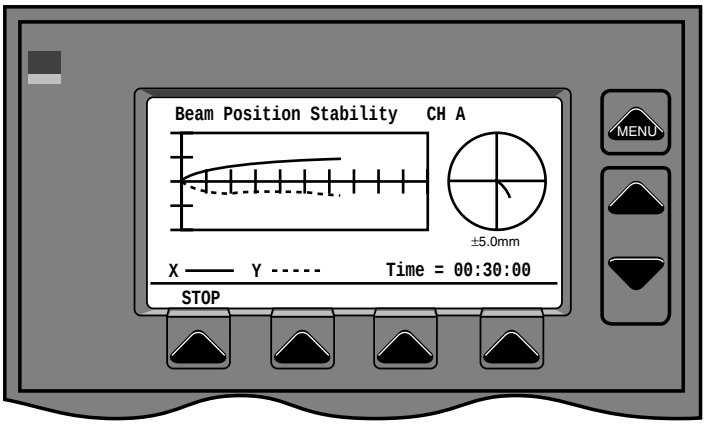


Figure 47 Position - 1 Channel in progress

Complete

The Position Data complete screen shows all data plotted both versus time and as a polar plot. (Fig. 48) Active buttons are NEW and OPTION. The option menu offers PRINT SCREEN (p.15) or GLOBAL OPTIONS (p.14).

Screens (Position)

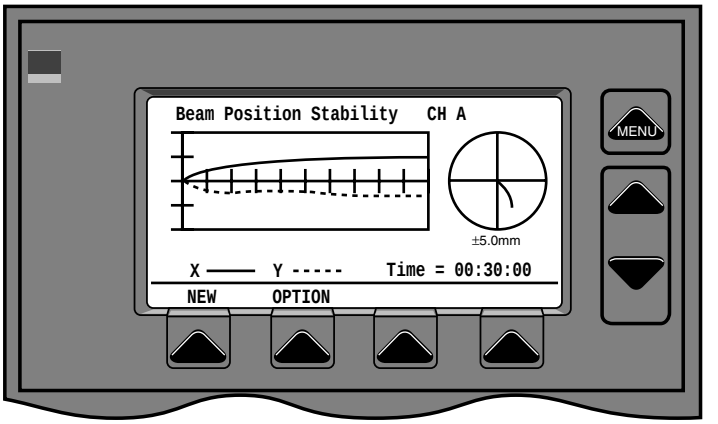


Figure 48 Position – 1 Channel complete

New

NEW button erases current data and returns to Position Ready screen for a new data run. A warning message that data is about to be erased will be displayed first and you will be given the opportunity to cancel the action.

Position – Dual Channel (dual channel Ultima only)

Position data can be collected for both channels simultaneously (Fig. 49). The duration will be the same for both channels. All buttons work identically to the single channel position screens

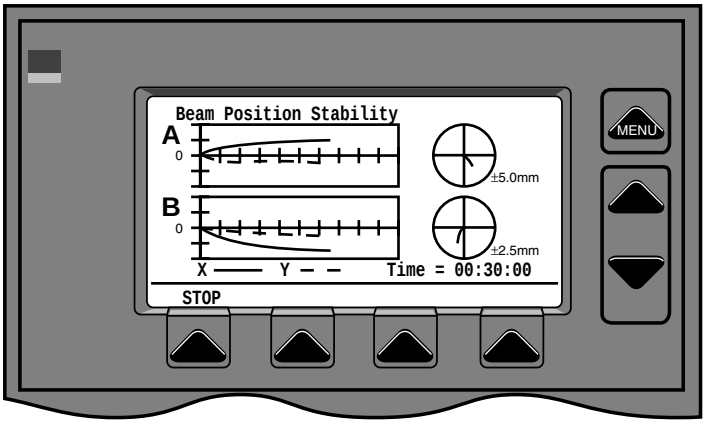


Figure 49 2 Channel Position Screen

Screens (Alignment)

Align

Alignment screens show a high resolution display of beam position on the detector (quad thermal CW detectors only) to assist in beam alignment applications. Alignment is accessed through the main menu.

Single Channel

Single channel alignment shows position of the beam on one detector (Fig. 50). The target at 1X resolution represents the clear aperture of the detector. The diameter represented by the target is shown at the lower right edge of the target. The distance from the “center” of the target in the X and Y directions is shown on the right side of the screen. (The center of the target represents the center of the detector if the display is in Absolute mode, or the initial position of the beam if the display is in Relative mode.)

ABS/REL

Switches the display to relative mode if in absolute mode and vice versa. Absolute mode shows the actual position of the beam on the detector. Relative mode shows the initial beam position as center of the target.

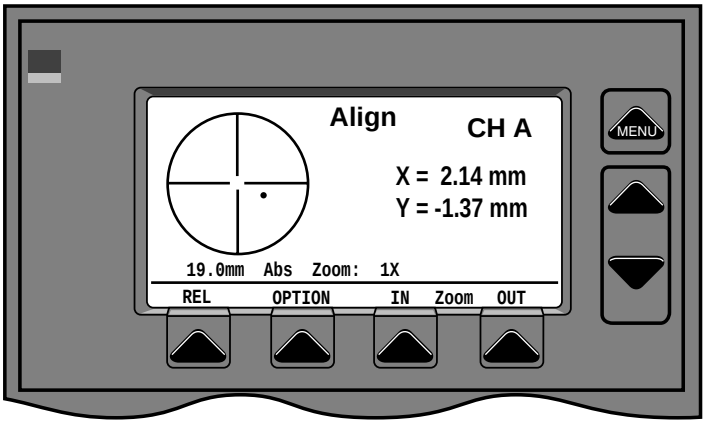


Figure 50 Single Channel Alignment Screen

OPTION

The align option menu (Fig. 51) has, in addition to the Print Screen and Global Options selections, a Calibrate selection.

Screens (Alignment)

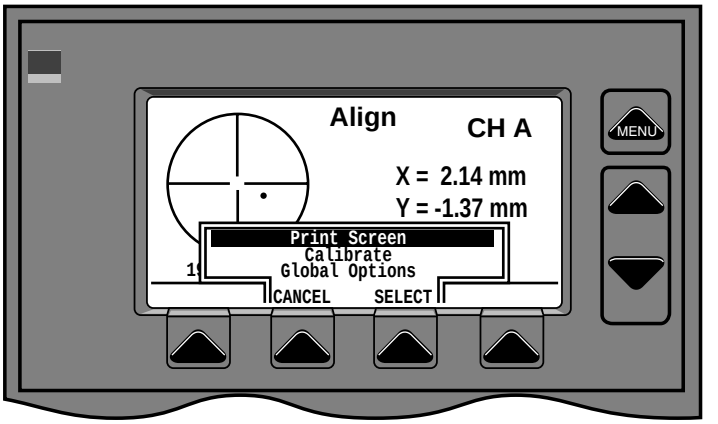


Figure 51 Alignment Options Menu

CALIBRATE

A message on the screen will request that you move the detector so that the beam is exactly at the center of the target, then press start (Fig. 52).

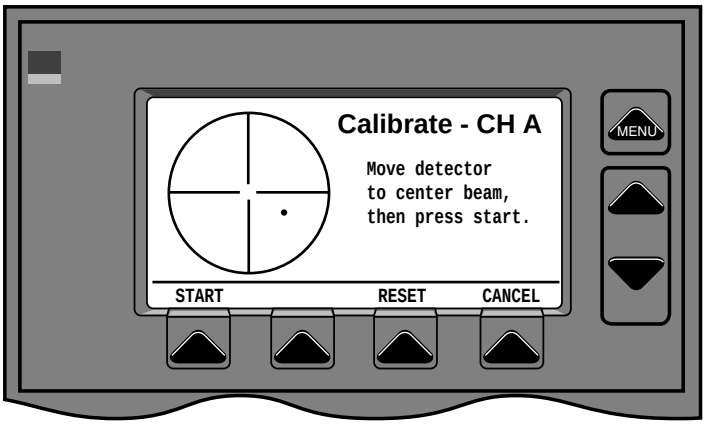


Figure 52 Calibrate, Start

After pressing start, you will be requested to move the detector exactly 5 mm in any direction, then press CALIBRATE (Fig. 53). This will reset the calibration of the detector so that the distance moved is exactly 5 mm.

Screens (Alignment)

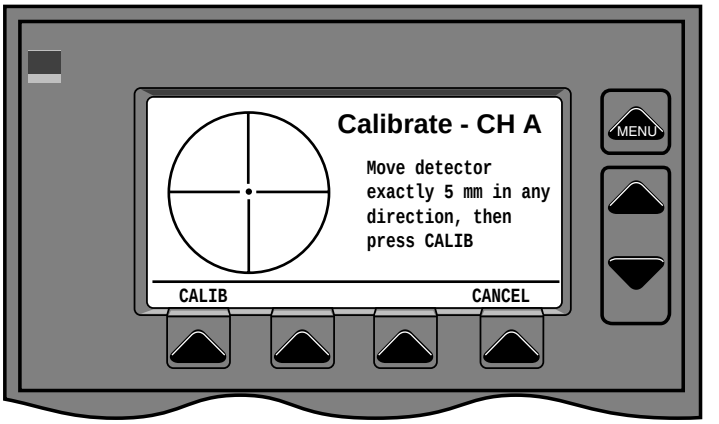


Figure 53 Calibrate, Complete

Zoom in, Zoom out

Zoom buttons increase or decrease resolution each time the button is pressed. Resolution values are 1X, 2X, 4X, 8X, 16X and 32X.

Dual Channel (dual channel Ultima only)

The Dual Channel alignment screen displays alignment targets for both channels simultaneously Fig. 54. (Both channels must have CW Thermal Detectors.)

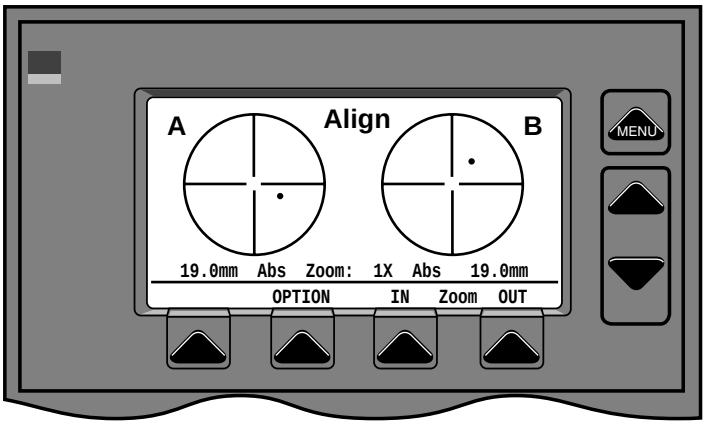


Figure 54 Dual Channel Alignment Screen

Screens (Alignment)

Option

Same as for single channel align (p.51).

Zoom in, Zoom out

Same as for single channel align (p.51). Note that the zoom level is the same for both channels.

Using the Ultima with RS-232

Making the hardware connection

For IBM PC compatible serial ports, just use a straight through cable (**not** a null MODEM cable). Use either 9 pin to 9 pin or a 25 pin to 9 pin depending on your serial port connector. Connect your computer's receive data (RxD) line to the Ultima's transmit data (TxD) line, connect your computer's TxD line to the Ultima's RxD line, and connect the signal ground lines together. The Ultima performs no out of band flow control (hardware handshaking), so no other signal connections are required. If your software cannot ignore the control lines, you may connect the necessary control signals as they are looped through the Ultima to provide an active state.

Making the software connection

Now you will need a program to communicate with the Ultima. An example program is provided in Microsoft Qbasic (provided free with DOS) to continually request the power for channel A and display the current value as well as the minimum and maximum values. Additionally, script files for ProComm Plus for DOS and ProComm Plus for Windows are provided to setup a trend run for channel A, start the run, and then retrieve the data to a text file which may then be loaded into a spreadsheet, word processor, or any other application that can read a standard text file. You will need to modify the COM port used to reflect the one actually in use, the example uses COM2. Also, make sure the baud rate in the program and on the Ultima's remote setup screen agree. With these examples, you should find it easy to make modifications to suit your needs.

If you want to write your own program, there are a couple of points to note. First, whenever you send a command or query to the Ultima, make sure to terminate it with a linefeed. Second, when the Ultima sends data over the serial port, it terminates it with **two** linefeeds (this differs from the GPIB sending only one). When you are receiving data from the Ultima, read the characters (all data is sent in ASCII form) up to and including the two linefeeds before issuing any further commands or requests. It might also be wise to check the 'ERR?' query each time you send something, this was omitted from the example programs for simplicity.

Remote control commands (IEEE-488.2 Status Registers)

Introduction

The remote control language used by the LabMaster Ultima is compliant with the IEEE-488.2 1987 Standard. All commands can be used for both the RS-232 and the GPIB ports.

IEEE-488.2 Status Registers

The LabMaster Ultima uses the Status Byte register group and the Standard Event register group to record instrument conditions. A diagram of the status system is shown in Fig. 55.

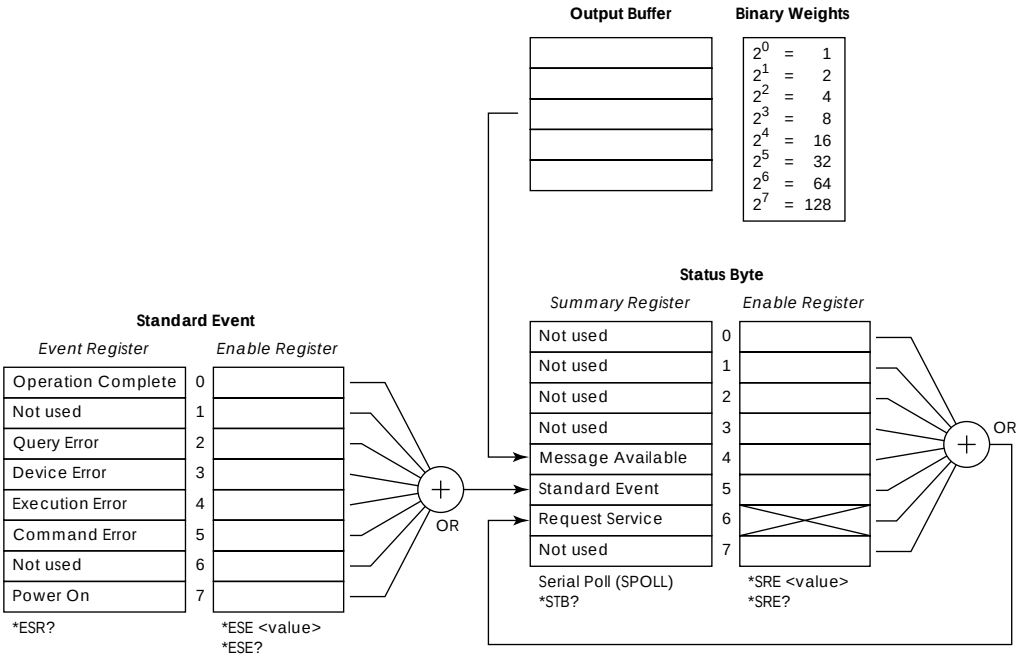


Figure 55 LabMaster Ultima Status System

An event register is a read-only register that reports defined conditions within the LabMaster Ultima. Bits in an event register are latched. When an event bit is set, subsequent state changes are ignored. Bits in an event register are automatically cleared by a query of that register or by sending the ***CLS** (clear status) command. The ***RST** (reset) command or device clear will not clear bits in an event register. Querying an event register returns a decimal value which corresponds to the binary-weighted sum of all the bits set in the register.

An *enable register* defines which bits in the corresponding event

Remote control commands (IEEE-488.2 Status Registers)

register are logically ORed together to form a single summary bit. You can read from, and write to, an enable register. Querying an enable register will not clear it. The ***CLS** (clear status) command does not clear enable registers but it does clear the bits in the event registers. To enable bits in an enable register, you must write a decimal value which corresponds to the binary-weighted sum of the bits you wish to enable in the register.

Status Byte Register

The Status Byte summary register reports conditions from the other status registers. Query data that is waiting in the LabMaster Ultima's output buffer is immediately reported in the "message available" bit (bit 4). Bits in the summary register are not latched. Clearing an event register will clear the corresponding bits in the Status Byte summary register. Reading all messages in the output buffer, including any pending queries, will clear the message available bit.

Bit Definitions – Status Byte Register

Bit	Decimal Value	Definition
0 Not Used	1	Always set to 0
1 Not Used	2	Always set to 0
2 Not Used	4	Always set to 0
3 Not Used	8	Always set to 0
4 Message Available	16	Data is available in the output buffer
5 Standard Event	32	One or more bits are set in the Standard Event register (bits must be "enabled" in enable register).
6 Request Service	64	Requesting service (serial poll).
7 Not used.	128	Always set to 0

The Status Byte Summary Register is cleared when:

- You execute the *CLS (clear status) command.
- Querying the Standard Event register (*ESR? command) will clear only bit 4 in the Summary Register.

The Status Byte Enable Register (request service) is cleared when:

- The *SRE 0 command is executed

Remote control commands (IEEE-488.2 Status Registers)

Using Service Request (SRQ) and Serial POLL

The bus controller must be configured to respond to the IEEE-488 service request (SRQ) interrupt to use this capability. Use the Status Byte enable register (*SRE command) to select which summary bits will set the low-level IEEE-488 service request signal. When bit 6 (request service) is set in the Status Byte, an IEEE-488 service request interrupt message is automatically sent to the bus controller. The bus controller may then poll the instruments on the bus to identify which one requested service (the instrument with bit 6 set in its Status Byte).

The request service bit is cleared only by reading the Status Byte using an IEEE-488 serial poll or by reading the event register whose summary bit is causing the service request.

To read the Status Byte summary register, send the IEEE-488 serial poll message. Querying the summary register will return a decimal value which corresponds to the binary weighted sum of the bits set in the register. Serial poll will automatically clear the "request service" bit in the Status Byte summary register. No other bits are affected. Performing a serial poll will not affect instrument throughput.

CAUTION

The IEEE-488.2 standard does not ensure synchronization between the bus controller program and the instrument. Use the *OPC? *query to guarantee that commands previously sent to the instrument have been completed. Executing a serial poll before a* *RST, *CLS, *or other commands have been completed can cause previous conditions to be reported.*

Using *STB? to Read the Status Byte

The ***STB?** (status byte query) command is similar to a serial poll but it is processed like any other instrument command. The ***STB?** command returns the same result as a serial poll but the "request service" bit (bit 6) is not cleared if a serial poll has occurred.

The ***STB?** command is not handled automatically by the IEEE-488 bus interface hardware and will be executed only after previous commands have completed. Polling is not possible using the ***STB?** command. Executing the ***STB?** command does

Remote control commands (IEEE-488.2 Status Registers)

not clear the Status Byte summary register.

Using the Message Available Bit (MAV)

The Status Byte "message available" bit (bit 4) can be used to determine when data is available to read into the bus controller. The LabMaster Ultima subsequently clears bit 4 only after all messages have been read from the output buffer.

Standard Event Register

The Standard Event register reports the following types of instrument events: power-on detected, command syntax errors, command execution errors, self-test or calibration errors, query errors, or when an ***OPC** command is executed. Any or all of these conditions can be reported in the Standard Event summary bit through the enable register. To set the enable register mask, you write a decimal value to the register using the ***ESE** (event status enable) command.

Bit	Decimal Value	Definition
0 Operation Complete	1	All commands prior to and including an *OPC command have been executed.
1 Not used	2	Always set to 0.
2 Query Error	4	The LabMaster Ultima tried to read the output buffer but it was empty. Or, a new command line was received before a previous query was read.
3 Not used	8	Always set to 0.
4 Execution Error	16	An execution error occurred (see error codes 9 through 16).
5 Command Error	32	A command syntax error occurred (see error codes 1 through 8).
6 Not used	64	Always set to 0.
7 Power On	128	Power has been turned off and on since the last time the event register was read or cleared.

Remote control commands (Remote control error codes)

Remote Control Error Codes

An error condition (Standard Event register bits 4 or 5) will always record the most recent error in an error register. Read the error register using the ***ERR?** query.

The **err?** query will return error codes as shown. If there are no errors, the query response is zero. When an error occurs, the error code is stored until it is asked for, or a new error occurs. After the **err?** query is responded to, the error code is cleared. If the error code is not read, and another error occurs, the old error code is replaced by the new error code. This means the error code will always reflect the last error that occurred.

Command Parsing Errors

Code	Error	Probable Cause
1	A data separator (comma) was expected but not found.	A data parameter is missing, or contains an illegal character.
2	Digits (0 - 9) were expected but not found.	Numeric value contains a non digit character, or a numeric parameter is missing.
3	A message separator (semicolon) was expected, but not found.	Multiple messages are not separated by a semicolon, or the command or query has too many data parameters.
4	Expected alphanumeric characters	The header or data parameter contains a character other than a letter (a - z), a digit (0 - 9) or an underscore (_).
5	End Of Message was found but not expected.	A data parameter is missing.
6	A space was expected but not found.	The command or query header is not separated from the data parameter by a space.
7	Not a valid command or query	
8	unused	

Remote control commands (Remote control error codes)

Command Execution Errors

Code	Error	Probable Cause
9	Parameter value is invalid.	A non-numeric parameter was misspelled.
10	Parameter out of range	A numeric parameter is outside the valid range for the specified operation.
11	No detector connected	An operation was requested for a channel that does not have a detector connected.
12	Request not valid for current detector	A Pulsed operation was requested for a CW detector, or a CW operation was requested for a Pulsed detector.
13	Requested data not available	New data has not been collected since the system was cleared, or powered up.
14	unused	
15	unused	

Remote control commands (Syntax)

Remote Control Language Syntax

Command Words

One or more command words make up the program message that is sent to the LabMaster Ultima to perform one or more operations.

Commands and command parameters

Both common commands and Ultima commands may or may not use a parameter. Examples:

`ts a`	Parameter (**a**) required
`rn a, 2e-3`	Parameters (**a**), (**2e-3**) required
`*rst`	No parameter used

Note that there must be a space between the command word and the parameter.

Parameter types:

Parameter	Type	Example	Action
ON/OFF	Boolean: Used to enable or disable an instrument operation. OFF disables operation. ON enables the operation.	`of a on`	Sets Channel A offset to ON
T/P	Explicit: Two or more explicit parameters to choose from; T or P.	`tp a t`	Sets Channel A trigger to time
####	Numeric representation format. Parameter is a number that can be expressed as an integer (e.g. 8), a real number (e.g. 10.6), or an exponent (e.g. 23e3).	`rn a, 2e-3`	Sets range Channel A to .002
"hh:mm:ss"	String data.	`td a, "00:15:00"`	Set trend duration to 15 mins.

Query commands

This type of command requests (queries) the currently programmed status. It is identified by the question mark (?) at the end of the fundamental form of the command. Most commands

Remote control commands (Syntax)

have a query form. Example:

`td a, "00:15:00"`	Set trend duration to 15 minutes
`td? a`	Request trend duration, Channel A

Case sensitivity

Common commands and Ultima commands are not case sensitive. You can use upper or lower case or any case combination. Example:

```
td a =    TD A      =    Td   A
```

Program Messages

A program message is made up of one or more command words sent by the computer to the instrument.

Single command messages

The commands in this structure can be executed by sending two separate program messages as follows:

```
tp a , 500\n

td a, "00:15:00"\n
```

Multiple command messages

Multiple commands can be sent in the same program message as long as they are separated by semicolons (;) as follows:

```
tp a, 500; td a, "00:15:00"\n
```

Program message terminator (\n)

Each program message must be terminated with a line feed (in C, \n). The bus will hang if your computer does not provide this termination. The following example shows how a program message must be terminated:

```
ti a, "00.05.0"; ts a\n
```

Command execution rules

A. Commands are executed in the order that they are presented

Remote control commands (Syntax)

in the program message.

B. An invalid command will generate an error and not be executed.

C. Valid commands that precede an invalid command in a multiple command program message will be executed.

D. Valid commands that follow an invalid command in a multiple command program message will be ignored.

Response Messages

A response message is the message sent by LabMaster Ultima to the computer in response to a query command program message.

Sending a response message

After sending a query command, the response message is placed in the Output Queue. When the Ultima is then addressed to talk, the response message is sent from the Output Queue to the computer. The following example requests the first point of the trend run.

```
sprintf(out_str, "tv? a, 1\n");  /* request trend point #1 */
ibwrt(ultima, out_str, strlen(out_str));
if (ibwait(ultima, TIMO | RQS) & RQS)  /* wait for Service
                                          Request */
{
   ibrsp(ultima, &spr);    /* read the serial poll response */
   if (spr & MAV)          /* make sure Message is Available */

   {

      ibrd(ultima, in_str, 80);  /* read data point */

      printf("data point = %s\n",in_str);/* print data point */
   }
}
```

Response message terminator

Each response message is terminated with a line feed. Example:

```
wv? a\n     /* query the LabMaster for Chnl A wavelength */
5.32e-9\n   /* response message sent by the LabMaster */
```

Remote control commands (Syntax)

Message Exchange Protocol

The message exchange protocol can be summarized as follows:

1. You must always tell the LabMaster Ultima what to send to the computer.

The following two steps must always be performed in the order shown to send information from the Ultima to the computer:

a.) Send the appropriate query command(s) in a program message.

b.) Address the Ultima to talk.

2. The complete response message must be received by the computer before another program message can be sent to the LabMaster Ultima.

Remote control commands (Using commands)

LabMaster Ultima Remote Control Commands

IEEE 488.2 Compliance

All commands and queries are in the form of ascii text, and comply with the standards defined by ANSI/IEEE Std. 488.2-1987.

In general, the following rules apply to the formatting of data that is sent or received on the bus.

Data Type	Definition	Example
Numeric	Numeric data may consist of digits, a decimal point, a leading sign (+/-), and an exponent with or without a leading sign.	`123, -0.0123, 1.23e-2.`
Character	Character data may consist of alphabetic characters (a-z), digits, and underscores (_), although it must begin with an alphabetic character. Note that no other punctuation characters are allowed.	`abc, a_b_c, a1, b2, c3.`
String	String data allows any 7 bit ascii character. This includes alphabetic characters, digits, and all punctuation characters. String data MUST be delimited by either single or double quotation marks (' or ").	`"11/07/94", '10:30:00'`
Arbitrary	Arbitrary ascii data may include 8 bit ascii values. It does not require any delimiters, but it must be the LAST value in a transmission. In the LabMaster Ultima, the only item that uses the arbitrary ascii data format is the IEEE-488.2 mandated query "*idn?".	`Coherent Inc, LabMaster Ultima, 0, 2.00`

Sample Code Segment

Following are sample code segments in 'C', that use the National Instruments IEEE 488 drivers that come with the GPIB-PCII board. The constants used in the examples are defined in the National Instruments header file named "decl.h". The functions beginning with "ib" are provided in a National Instruments object file that must be linked with the program. The object file will be named based on the brand of Compiler used (e.g. Microsoft), and the language (C or Basic). In the example the Microsoft C file, named mcib.obj is used.

To send a command, copy the command into a text string, and pass the string to the function that will write the string to the bus. The following

Remote control commands (Using commands)

example will set up the trend run to collect 100 points on channel A, with a 1 second interval between points. Note that the interval value requires quote marks because it contains a non-alphanumeric punctuation character. We can also send multiple commands in the same string, provided they are separated by a semicolon.

```
sprintf(out_str, "tp a, 100; ti a, \"00:01.0\"\n");
ibwrt(ultima, out_str, strlen(out_str));
```

In order to transfer data from the Ultima, the Service Request Enable register should be set to issue a Service Request on Message Available (MAV). This is done with the following command.

```
sprintf(out_str, "*sre %d\n", 0x10)  /* Msg Avail is bit 4 */
ibwrt(ultima, out_str, strlen(out_str));
```

To actually transfer data, we must send the command requesting the data, then wait for a Service Request to be generated by the Ultima. Using the National Instruments drivers, we MUST read the serial poll response, in order to clear the Service Request indicator (RQS). Then we can read the data from the bus. The following example requests the first point of the trend run.

```
sprintf(out_str, "tv? a, 1\n");  /* request trend point #1 */
ibwrt(ultima, out_str, strlen(out_str));
if (ibwait(ultima, TIMO | RQS) & RQS) /*wait for Service Req*/
{
   ibrsp(ultima, &spr);    /* read the serial poll response */
   if (spr & MAV)          /* make sure Message is Available */
      ibrd(ultima, in_str, 80); /* read data point */
}
```

Remote control commands (System configuration commands)

System Configuration Commands

Set Wavelength (wv)

Header: **wv** - set wavelength
Parameters: channel (**A, B**), wavelength (**###.###, #.##e##**)
Ranges: wavelength determined by detector
Example: Set the wavelength for channel A to 532 nm

```
wv a, 5.32e-9
```

Set Attenuation (at)

Header: **at** - set attenuation
Parameters: channel (**A, B**), attenuation (**#####.##, #.##e##**)
Ranges: atten range 0.01 to 10000.0
Example: Set the attenuation for channel A to 100:1

```
at a, 100
```

Set Range (rn)

Header: **rn** - set range
Parameters: channel (**A, B**), range (**###.###, #.##e##**)
Ranges: Valid range is dependent on detector & attenuation. Input range of zero means autorange.
Example: Set the range for channel A to 2 mW

```
rn a, 2e-3
```

Set Offset (of)

Header: **of** - set offset
Parameters: channel (**A, B**), **On/Off**
Ranges: Only On or Off allowed. When On, current reading becomes offset.
Example: Set the offset for channel A to the current reading

```
of a, on
```

Set number of pulses to average

Header: **pa** - set pulses to average
Parameters: channel (**A, B**), pulses (##)
Ranges: Valid values are 1, 2, 5, 10, 20, 50
Example: Set channel A to average 10 pulses

```
pa a, 10
```

Remote control commands (System configuration commands)

Set alarms (al)

Header: **al** - set alarms

Parameters: channel (**A, B**), num (**1-4**), type (**W, J, M, N**), mode (**H,L**), value(**###.###, #.##e##**)

Ranges: Specific values indicated after parameter name. Value range is determined by detector type.

Example: Set alarm 1 for channel A to indicate when the energy reading is higher than 5 mJ.

```
al a, 1, j, h, 5e-3
```

Alarm enable (ae)

Header: **ae** - alarm enable

Parameters: On/Off

Ranges: Alarms are enabled or disabled for both channels.

Example: Turn alarms on (for both channels).

```
ae on
```

Alarm reset (ar)

Header: **ar** - alarm reset

Parameters: none

Ranges: Alarms are reset for both channels.

Example: Reset alarms (for both channels).

```
ar
```

Remote control commands (Data collection commands)

Data Collection Commands

Set trigger type (tr)

Header: **tr** - set trigger type
Parameters: channel (**A, B**), type (**T, P**)
Ranges: Trigger types are (T)ime, and (P)ulse
Example: Set channel A to trigger on Time intervals.

```
tr a, t
```

Set number of trend points (tp)

Header: **tp** - trend points to collect
Parameters: channel (**A, B**), pts (**####**)
Ranges: # pts from 1 to 2000, multiples of 200 .
Example: Set channel A to collect a Trend run of 400 points.

```
tp a, 400
```

Set trend duration (td)

Header: **td** - set trend duration
Parameters: channel (**A, B**), dur (**"hh:mm:ss"** - text string, delimited by quotes)
Ranges: Duration ranges from "00:00:20" to "99:00:00"
Note: *In compliance with IEEE-488.2 standards, a string containing colon characters (:) must be delimited by quote marks (single or double).*
Example: Set the duration for channel A Trend data collection to 15 minutes (00:15:00).

```
td a, "00:15:00"
```

Set trend interval (ti)

Header: **ti** - set trend interval
Parameters: channel (**A, B**), interval (**"mm:ss.s"** - text string, delimited by quotes)
Ranges: Interval ranges from "00:00.1" to "29:42.0"
Note: *In compliance with IEEE-488.2 standards, a string containing colon characters (:) must be delimited by quote marks (single or double).*
Example: Trend
Set the interval between points for channel A data collection to 5 seconds (00:05.0).

```
ti a, "00:05.0"
```

Remote control commands (Data collection commands)

Start trend data collection (ts)

Header:	**ts** - start trend data collection
Parameters:	channel (**A, B, D** - dual)
Ranges:	none
Error:	If trend run in progress, generate Operation Not Valid error.
Example:	Start Trend data collection for channel A. **ts a**

Stop trend data collection (te)

Header:	**te** - stop trend data collection
Parameters:	channel (**A, B, D** - dual)
Ranges:	none
Example:	Stop Trend data collection for channel A. **te a**

Set position run duration (pd)

Header:	**pd** - set position run duration
Parameters:	duration (**"hh:mm:ss"** - text string, delimited by quotes)
Ranges:	Duration ranges from "00:00:30" to "99:59:59".
Note:	*In compliance with IEEE-488.2 standards, a string containing colon characters (:) must be delimited by quote marks (single or double).*
Example:	Set the duration for Position measurement run to 15 minutes (00:15:00). **pd "00:15:00"**

Remote control commands (Data collection commands)

Start position run (ps)

Header: **ps** - start position run

Parameters: channel (**A, B, D** - dual)

Error: If position or trend run in progress, generate Operation Not Valid error. If detector is not a Quad type, generate Wrong detector error.

Example: Start Position measurement run for channel A.

```
ps a
```

Stop position run (pe)

Header: **pe** - stop position run

Parameters: channel (**A, B, D** - dual)

Ranges: This command is only valid for Quad type detectors.

Error: If detector is not a Quad type, generate Wrong detector error.

Example: Stop Position measurement run for channel A.

```
pe a
```

Set bandwidth (bw)

Header: **bw** - bandwidth

Parameters: channel (**A, B**), mode (**H, L**)

Ranges: Bandwidth mode is (**H**)igh or (**L**)ow, and is only valid for Quantum detectors.

Error: Non Quantum detector generates Wrong Detector error.

Example: Set channel A for High bandwidth mode.

```
bw a, h
```

Reset real time stats

Header: sr - reset real time stats

Parameters: channel (A, B, D - dual)

Ranges: none

Example: Reset real time stats for Channel A

```
sr a
```

Remote control commands (System configuration queries)

System Configuration Queries

Request error code (err?)

Header:	**err?** - Return remote control error code
Parameters:	none
Returns:	error #1 thru 16 (see error code tables)
Ranges:	none
Example:	Request the system error code.
	err?
Response:	**1**

Request detector type (dt?)

Header:	**dt?** - query detector
Parameters:	channel (**A, B, D**)
Returns:	detector (text string, delimited by double quote marks(“))
Ranges:	none
Example:	Request the detector type for channel A.
	dt? a
Response:	**“LM-10”**

Request wavelength setting (wv?)

Header:	**wv?** - query wavelength
Parameters:	channel (**A, B, D**)
Returns:	wavelength (**#.##e##**)
Ranges:	none
Example:	Request the wavelength for channel A.
	wv? a
Response:	**5.32e-9**

Remote control commands (System configuration queries)

Request attenuation (at?)

Header: **at?** - query attenuation
Parameters: channel (**A, B, D**)
Returns: attenuation (**#####.##** - value between 0.01 and 10000.0)
Ranges: none
Example: Request the attenuation for channel A.
at? a
Response: **100**

Request range (rn?)

Header: **rn?** - query range
Parameters: channel (**A, B, D**)
Returns: range (**#.##e##** - 0 indicates autorange)
Ranges: none
Example: Request the range for channel A.
rn? a
Response: **2.0e-3**

Request offset (of?)

Header: **of?** - query offset
Parameters: channel (**A, B, D**)
Returns: offset (**#.##e##**)
Ranges: none
Example: Request the offset for channel A.
of? a
Response: **1.43e-9**

Request number of pulses averaged (pa?)

Header: **pa?** - query pulses to average
Parameters: channel (**A, B, D**)
Returns: pulses (**##** - If pulsed detector - number pulses; otherwise - **0**)
Ranges: none
Example: Request the number of pulses being averaged for channel A.
pa? a
Response: **10**

Remote control commands (System configuration queries)

Request alarm types and values

Header:	**al?** - query alarm settings
Parameters:	channel (**A, B, D**), num(**1-4**)
Returns:	type (**W, J, M, N**), mode (**H, L**), value
Ranges:	num must be between 1 and 4
Example:	Request the alarm setting for channel A, alarm number 1.
	al? a, 1
Response:	**J, H, 5.0e-3**

Request system date (dd?)

Header:	**dd?** - query date
Parameters:	none
Returns:	date (**mm:dd:yy** - text string, delimited by double quotes (“))
Ranges:	none
Note:	*In compliance with IEEE-488.2 standards, a string containing colon characters (:) must be delimited by quote marks (single or double).*
Example:	Request the system date.
	dd?
Response:	**“11:07:94”**

Request system time (tt?)

Header:	**tt?** - query time
Parameters:	none
Returns:	time (**hh:mm:ss** - text string, delimited by double quotes (“))
Ranges:	none
Note:	*In compliance with IEEE-488.2 standards, a string containing colon characters (:) must be delimited by quote marks (single or double).*
Example:	Request the system time.
	tt?
Response:	**“11:35:24”**

Remote control commands (Data collection queries)

Data Collection Queries

Request power reading (pw?)

Header:	**pw?** - query power
Parameters:	channel (**A, B**)
Returns:	pwr (**#.##e##** - If detector is pulsed and freq < 1.0, return 0. If detector is pulsed and freq >= 1.0 return Average power.)
Ranges:	none
Example:	Request the current power reading.
	pw? a
Response:	**1.43e-3**

Request energy reading (en?)

Header:	**en?** - query energy
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##**) - If detector is pulsed
Ranges:	none
Error:	If detector is not pulsed, generate Wrong Detector error.
Example:	Request the current energy reading.
	en? a
Response:	**1.43e-3**

Request frequency (ff?)

Header:	**ff?** - query frequency
Parameters:	channel (**A, B**)
Returns:	freq (**#.##e##** - if detector is pulsed and frequency is < 1.0, return 0.)
Ranges:	none
Error:	If detector is not pulsed, generate Wrong Detector error.
Example:	Request the current frequency measurement.
	ff? a
Response:	**2.0e1**

Remote control commands (Data collection queries)

Request trend run number of points (tp?)

Header:	**tp?** - query number trend points collected
Parameters:	channel (**A, B**)
Returns:	pts **(#####** - number of points currently in trend buffer. NOTE: may be less than number requested if collection isn't complete.)
Ranges:	none
Note:	When the number of points collected is equal to the number of points set, the Trend run is complete.
Example:	Request the number of points collected so far in a trend run.
	tp? a
Response:	**100**

Request trend interval (ti?)

Header:	**ti?** - query interval between trend data points
Parameters:	channel (**A, B**)
Returns:	data collection interval **"mm:ss.s"**
Ranges:	none
Error:	Returns error if trend collection mode is pulsed
Example:	Request the interval between the first and second trend points.
	ti? a, 2
Response:	**"00:05.0"**

Request trend frequency (tf?)

Header:	**tf?** - query frequency for a point in trend run
Parameters:	channel (**A, B**), point (**####** - 1 to 2000)
Returns:	frequency in Hz
Ranges:	point must be between 1 and 2000
Error:	Returns detector error if CW detector
Example:	Request the interval between the first and second trend points.
	tf? a, 2
Response:	**150**

Remote control commands (Data collection queries)

Request trend duration (td?)

Header: **td?** - query duration of trend collection

Parameters: channel (**A, B**)

Returns: duration (**"hh:mm:ss"** - duration of trend run)

Ranges: none

Errors: If trend collection is in progress, generate No Data Available error.

Note: *In compliance with IEEE-488.2 standards, a string containing colon characters (:) must be delimited by quote marks (single or double).*

Example: Request the duration of the trend data collection run.

```
td? a
```

Response: **"00:15:00"**

Request trend data point value (tv?)

Header: **tv?** - query value of trend data point

Parameters: channel (**A, B**), point (#### - 1 to 2000)

Returns: val (**#.##e##**)

Ranges: point must be between 1 and 2000

Example: Request the value of the first point in the trend data collection.

```
tv? a, 1
```

Response: **1.52e-3**

Request position point value (po?)

Header: **po?** - query current position

Parameters: channel (**A, B**)

Returns: x, y (**##.###, ##.###** - location in mm)

Ranges: none

Errors: If not Quad detector, generate Wrong Detector error.

Example: Request the current position reading for channel A.

```
po? a
```

Response: **0.984, 0.731**

Remote control commands (Data collection queries)

Request position trend run number of points (pp?)

Header:	**pp?** - query number of points in position run
Parameters:	channel (**A, B**)
Returns:	pts (### - between 0 and 170)
Ranges:	none
Errors:	If not Quad detector, generate Wrong Detector error.
Note:	When the number of points collected is equal the number of points set, the Position run is complete.
Example:	Request the number of points collected so far in a position run.
	pp? a
Response:	**170**

Request position run duration (pd?)

Header:	**pd?** - query duration of position run
Parameters:	none
Returns:	duration (**"hh:mm:ss"** - in seconds)
Ranges:	Position run duration ranges from "00:00:30" to "99:59:59".
Errors:	If not Quad detector, generate Wrong Detector error.
Note:	*In compliance with IEEE-488.2 standards, a string containing colon characters (:) must be delimited by quote marks (single or double).*
Example:	Request the duration of position run.
	pd
Response:	**"00:15:00"**

Remote control commands (Data collection queries)

Request position run data point value (pv?)

Header:	**pv?** - query position of point
Parameters:	channel (**A, B**), point (**####** - 1 to 170)
Returns:	x, y (**##.###, ##.###** - location in mm)
Ranges:	point must be between 1 and 170
Errors:	If not Quad detector, generate Wrong Detector error.
Example:	Request the value of the first point in the position data collection.
	pv? a, 1
Response:	**0.984, 0.731**

Request trend stats - average power (tpa?)

Header:	**tpa?** - query trend average power
Parameters:	channel (**A, B**)
Returns:	average power (**#.##e##**)
Error:	data not available error if run not complete
Ranges:	none
Example:	Request the trend average power for channel A.
	tpa? a
Response:	**1.55e-3**

Request trend stats – maximum power (tpm?)

Header:	**tpm?** - query trend maximum power
Parameters:	channel (**A, B**)
Returns:	power (**#.##e##**)
Ranges:	none
Error:	data not available error if run not complete
Example:	Request the trend maximum power for channel A.
	tpm? a
Response:	**2.01e-3**

Remote control commands (Data collection queries)

Request trend stats – minimum power (tpl?)

Header:	**tpl?** - query trend minimum power
Parameters:	channel (**A, B**)
Returns:	power (**#.##e##**)
Ranges:	none
Error:	data not available error if run not complete
Example:	Request the trend minimum power for channel A.
	tpl? a
Response:	**1.21e-3**

Request trend stats – power standard deviation (tpd?)

Header:	**tpd?** - query trend standard deviation power
Parameters:	channel (**A, B**)
Returns:	power (**#.##e##**)
Ranges:	none
Error:	data not available error if run not complete
Example:	Request power standard deviation for channel A.
	tpd? a
Response:	**4.51e-6**

Request trend stats – power 2σ% stability (tps?)

Header:	**tps?** - query trend 2σ% power stability
Parameters:	channel (**A, B**)
Returns:	power (**#.##e##**)
Ranges:	none
Error:	data not available error if run not complete
Example:	Request the trend power stability for channel A.
	tps? a
Response:	**2.3e0**

Remote control commands (Data collection queries)

Request trend stats – average energy (tea?)

Header:	**tea?** - query trend average energy
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##** - If detector is pulsed)
Ranges:	none
Error:	If detector is not pulsed, generate Wrong Detector error. Data not available error if run not complete.
Example:	Request the trend average energy for channel A.
	tea? a
Response:	**1.55e-3**

Request trend stats – maximum energy (tem?)

Header:	**tem?** - query trend maximum energy
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##** - If detector is pulsed)
Ranges:	none
Error:	If detector is not pulsed, generate Wrong Detector error. Data not available error if run not complete.
Example:	Request the trend maximum energy for channel A.
	tem? a
Response:	**2.01e-3**

Request trend stats – minimum energy (tel?)

Header:	**tel?** - query trend minimum energy
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##** - If detector is pulsed)
Ranges:	none
Error:	If detector is not pulsed, generate Wrong Detector error. Data not available error if run not complete.
Example:	Request the trend minimum energy for channel A.
	tel? a
Response:	**1.21e-3**

Remote control commands (Data collection queries)

Request trend stats – energy standard deviation (ted?)

Header:	**ted?** - query trend standard deviation energy
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##** - If detector is pulsed)
Ranges:	none
Error:	If detector is not pulsed, generate Wrong Detector error. Data not available error if run not complete.
Example:	Request the trend energy standard deviation for channel A. **ted? a**
Response:	**4.51e-6**

Request trend stats – energy 2σ% stability (tes?)

Header:	**tes?** - query trend 2σ% stability energy
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##** - If detector is pulsed)
Ranges:	none
Error:	If detector is not pulsed, generate Wrong Detector error. Data not available error if run not complete.
Example:	Request the trend energy stability for channel A. **tes? a**
Response:	**2.3e0**

Request trend stats – frequency average (tfa?)

Header:	**tfa?** - query trend average frequency
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##** - If detector is pulsed. If freq < 1.0, return 0.)
Ranges:	none
Error:	If detector is not pulsed, generate Wrong Detector error. Data not available error if run not complete.
Example:	Request the trend average frequency for channel A. **tfa? a**
Response:	**2.0e1**

Remote control commands (Data collection queries)

Request trend stats – frequency maximum (tfm?)

Header:	**tfm?** - query trend maximum frequency
Parameters:	channel **(A, B)**
Returns:	energy (**#.##e##** - If detector is pulsed. If freq < 1.0, return 0.)
Ranges:	none
Error:	If detector is not pulsed, generate Wrong Detector error. Data not available error if run not complete.
Example:	Request trend maximum frequency for channel A.
	tfm? a
Response:	**2.02e1**

Request trend stats – frequency minimum (tfl?)

Header:	**tfl?** - query trend minimum frequency
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##** - If detector is pulsed. If freq < 1.0, return 0.)
Ranges:	none
Error:	If detector is not pulsed, generate Wrong Detector error. Data not available error if run not complete.
Example:	Request trend minimum frequency for channel A.
	tfl? a
Response:	**1.99e1**

Request trend stats – frequency standard deviation (tfd?)

Header:	**tfd?** - query trend standard deviation frequency
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##**)
Ranges:	none
Error:	If detector is not pulsed, generate Wrong Detector error. Data not available error if run not complete.
Example:	Request the trend frequency standard deviation for channel A.
	tfd? a
Response:	**0.01e0**

Remote control commands (Data collection queries)

Request trend stats – frequency 2σ% stability

Header:	**tfs?** - query trend 2σ% stability frequency
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##**)
Ranges:	none
Error:	If detector is not pulsed, generate Wrong Detector error. Data not available error if run not complete.
Example:	Request the trend frequency stability for channel A.
	tfs? a
Response:	**2.3e0**

Request real time stats – no. of points (spt?)

Header:	**spt?** - query number of points in real time stats
Parameters:	channel (**A, B**)
Returns:	points (**#.##e##**)
Ranges:	none
Example:	Request number of points included in stats for channel A.
	spt? a
Response:	**1.55e3**

Request real time stats – average power (spa?)

Header:	**spa?** - query real time stats average power
Parameters:	channel (**A, B**)
Returns:	power (**#.##e##** - Pulsed Average Power for Pulse detectors)
Ranges:	none
Example:	Request the real time stats average power for channel A.
	spa? a
Response:	**1.55e-3**

Remote control commands (Data collection queries)

Request real time stats – maximum power (spm?)

Header:	**spm?** - query real time stats maximum power
Parameters:	channel (**A, B**)
Returns:	power (**#.##e##** - Pulsed Average Power for Pulse detectors)
Ranges:	none
Example:	Request the real time stats maximum power for channel A.
	spm? a
Response:	**2.01e-3**

Request real time stats – minimum power (spl?)

Header:	**spl?** - query real time stats minimum power
Parameters:	channel (**A, B**)
Returns:	power (**#.##e##** - Pulsed Average Power for Pulse detectors)
Ranges:	none
Example:	Request the real time stats minimum power for channel A.
	spl? a
Response:	**1.21e-3**

Request real time stats – power standard deviation (spd?)

Header:	**spd?** - query real time stats standard deviation power
Parameters:	channel (**A, B**)
Returns:	power (**#.##e##** - Pulsed Average Power for Pulse detectors)
Ranges:	none
Example:	Request the real time stats power standard deviation for channel A.
	spd? a
Response:	**4.51e-6**

Remote control commands (Data collection queries)

Request real time stats – power 2σ% stability

Header:	**sps?** - query real time stats 2σ% stability power
Parameters:	channel (**A, B**)
Returns:	power (**#.##e##** - Pulsed Average Power for Pulse detectors)
Ranges:	none
Example:	Request the real time stats power stability for channel A.
	sps? a
Response:	**2.3e0**

Request real time stats – average energy (sea?)

Header:	**sea?** - query real time stats average energy
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##**)
Ranges:	none
Errors:	Non Pulsed detector generates Wrong Detector error.
Example:	Request the real time stats average energy for channel A.
	sea? a
Response:	**1.55e-3**

Request real time stats – maximum energy (sem?)

Header:	**sem?** - query real time stats maximum energy
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##**)
Ranges:	none
Errors:	Non Pulsed detector generates Wrong Detector error.
Example:	Request the real time stats maximum energy for channel A.
	sem? a
Response:	**2.01e-3**

Remote control commands (Data collection queries)

Request real time stats – minimum energy (sel?)

Header:	**sel?** - query real time stats minimum energy
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##**)
Ranges:	none
Errors:	Non Pulsed detector generates Wrong Detector error.
Example:	Request the real time stats minimum energy for channel A.
	sel? a
Response:	**1.21e-3**

Request real time stats – energy standard deviation (sed?)

Header:	**sed?** - query real time stats standard deviation energy
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##**)
Ranges:	none
Errors:	Non Pulsed detector generates Wrong Detector error.
Example:	Request the real time stats energy standard deviation for channel A.
	sed? a
Response:	**4.51e-6**

Request real time stats – energy 2σ% stability (ses?)

Header:	**ses?** - query real time stats 2σ% stability energy
Parameters:	channel (**A, B**)
Returns:	energy (**#.##e##**)
Ranges:	none
Errors:	Non Pulsed detector generates Wrong Detector error.
Example:	Request the real time stats energy stability for channel A.
	ses? a
Response:	**2.3e0**

Remote control commands (Data collection queries)

Request bandwidth mode (bw?)

Header:	**bw?** - query bandwidth
Parameters:	channel (**A, B**)
Returns:	mode ((**H**)igh, (**L**)ow)
Ranges:	none
Errors:	Non Quantum detector generates Wrong Detector error.
Example:	Request bandwidth setting for channel A. **bw a**
Response:	**h**

Remote control commands (IEEE-488 commands & queries)

IEEE-488 Commands & Queries

Clear status registers (*cls)

Header: **`*cls`** - clear status registers
Parameters: none
Ranges: none
Example: Clear the status registers

```
*cls
```

Enable status event reporting (*ese)

Header **`*ese`** - enables reporting of status events. Value is character string representing a single byte with a value between 0-255. Individual bits within the byte enable specific status reporting.
Parameters: Value of byte (###)
Ranges: 0-255
Example: Set the Event Status Enable register to enable reporting of Command Errors, Execution Errors, and Query Errors. The decimal value corresponding to these errors is 52.

```
*ese 52
```

Request standard event register contents (*ese?)

Header: **`*ese?`** - standard event register status query
Parameters: none
Returns: contents of the events status enable register
Range: 0-255
Example: Query the current settings in the Event Status Enable register. The example reports the setting issued by the *ese example.

```
*ese?
```

Response: **52**

Remote control commands (IEEE-488 commands & queries)

Request event status register contents (*esr?)

Header: **`*esr?`** - returns contents of Event Status Register.

Parameters: none

Returns: (###) contents of event status register. Returns a character string with a value between 0-255 representing a single byte. The value is the binary weighted sum of all the bits in the register (see Fig. ##)

Range: 0-255

Example: Query the Event Status Register. The example response indicates that a Command Error occurred.

```
*esr?
```

Response: 32

Service request enable (*sre)

Header: *sre - service request enable command. Sets service request mask register. Command is character string representing a single byte with value between 0-255. Individual bits within the byte enable a device to issue a service request upon specified action.

Parameters: Value (###).

Range: 0-255

Example: Set the Service Request Enable register to generate a service request when an enabled Event (in the Event Status Enable Register) has occurred, or when a Message is Available. The decimal value corresponding to these bits (ESB and MAV) is 48.

```
*sre 48
```

Request event status enable register contents (*sre?)

Header: **`*sre?`** - service request enable query. Returns the contents of the event status enable register.

Parameters: none

Range: 0-255

Example: Query the current settings in the Service Request Enable register. The example reports the setting issued by the *sre example.

```
*sre?
```

Response: **48**

Remote control commands (IEEE-488 commands & queries)

Request status byte register contents (*stb?)

Header: **`*stb?`** - read status byte query. Returns contents of the Status Byte Register. The value is the binary weighted sum of all the bits in the register (see Fig. ##)

Parameters: none

Returns: (###) Returns a character string with a value between 0-255 representing a single byte. The value is the binary weighted sum of all the bits in the register (see Fig. ##)

Range: 0-255

Example: Query the Status Byte Register. The example response indicates that a Message is Available.

```
*stb?
```

Response: **16**

Request device identification (*idn?)

Header: **`*idn?`** - device identification query

Parameters: none

Returns: Field 1 = Coherent, Inc Field 2 = LabMaster Ultima Field 3 = 0 Field 4 = Firmware Rev. (#.##)

Example: Query the device identity.

```
*idn?
```

Response: **`Coherent Inc, LabMaster Ultima, 0, 1.00`**

Set operation complete bit (*opc)

Header: **`*opc`** - sets operation complete bit in the standard event status register.

Parameters: none

Example: Instruct the LabMaster Ultima to set the Operation Complete bit in the Event Status Register. If the Event Status Enable Register has the Opera tion Complete event enabled, and the *opc command is issued as the last command in a sequence of commands, then a Service Request will be generated after all commands in the sequence have been executed.

```
*opc
```

Remote control commands (IEEE-488 commands & queries)

Request operation status (*opc?)

Header: ***opc?** - operation complete query

Parameters: none

Returns: (#) 0 or 1. 0 = current operation still pending. 1 = operation complete.

Range: 0 or 1

Example: The *opc? query is used to indicate if a previously issued command has completed or not. Because the LabMaster Ultima processes remote control commands sequentially, the response to *opc? will always be 1, indicating that operation is complete.

```
*opc?
```

Response: **1**

Reset instrument (*rst)

Header: ***rst** - Resets the LabMaster Ultima to the Home Screen with power on defaults.

Parameters: none

Range: none

Example: Reset the LabMaster Ultima.

```
*rst
```

Request self test (*tst?)

Header: ***tst?** - self test query.

Parameters: none

Returns: 0 = no errors. 1 = error.

Range: none

Example: Instructs Ultima to perform self test and return an error code. A return code of 0 means no errors.

```
*tst?
```

Response: **0**

Wait (*wai)

Header: ***wai** - Wait to continue command.

Parameters: none

Range: none

Example: Because the LabMaster processes commands sequentially, the *wai command has no effect.

```
*wai
```

LabMaster Ultima Remote Command Additions

The following remote control commands and queries have been added to the Ultima, since the latest revision of the manual. These commands and queries apply to both RS232 and GPIB.

Commands

Clear Channel (cc)

Header: cc - Clear the specified data channel. This is valid only for pulsed detectors. The value displayed on the Ultima screen will be reset to 0.00, and subsequent Energy Read queries will return a value of 0.00 UNTIL the laser fires again. A return value of 0.00 to an Energy Read Query, therefore indicates that the laser has not fired since the last valid energy value was read.
Parameters: channel (A, B)
Ranges: none
Error: If the detector is not pulsed, generate Wrong Detector Error.
Example: cc a

Data Collection Queries

Request energy reading, then clear channel (ec?)

Header: ec? - Query the latest energy reading, then clear the data channel. This is valid only for pulsed detectors. Once the channel is cleared, the value displayed on the Ultima screen will be reset to 0.00, and subsequent Energy Read queries will return a value of 0.00 UNTIL the laser fires again. A return value of 0.00 to an Energy Read Query, therefore indicates that the laser has not fired since the last valid energy value was read. Note: this query effectively combines **en?** (query energy) and **cc** (clear channel) into one operation.
Parameters: channel (A, B)
Returns: energy (#.##e##) - If detector is pulsed
Ranges: none
Error: If the detector is not pulsed, generate Wrong Detector Error.
Example: ec? a
Response: 1.43e-3

LabMaster Ultima Remote Setup Menu Additions

Set GPIB Bus Timeout (BTO)

Header: *BTO - Set the Bus Timeout (in milliseconds)*
Parameters: *milliseconds (#####, #.##e##)*
Ranges: *Set the Timeout from 0 to 9.99e99 milliseconds. Zero disables the Timeout.*
Example: *Set the Timeout to 5 seconds*
bto 5000

Request GPIB Bus Timeout (BTO?)

Header: *BTO? - Query the current Bus Timeout (in milliseconds)*
Parameters: *None*
Ranges: *The Timeout ranges from 0 to 9.99e99 milliseconds.*
Zero indicates the Timeout is disabled.
Example: Query the current Bus Timeout
bto?
Response: 5.00e03

Remote control commands (Example program)

Example program

```
/*============== FILE DESCRIPTION =======================
File:      trend.c
Description:  This is a sample GPIB control program for the
LabMaster Ultima.  It uses the National Instruments GPIB
drivers Ver. 2.1.1, which are included with the National
Instruments GPIB-PCII board.  It includes the file “decl.h”,
and links with the object file “mcib.obj”, both of which are
included with the National Instruments drivers.  This file
was compiled and linked using Microsoft C version 7.0.  This
sample program will setup the Ultima to collect 200 Trend data
points on channel A.  It will then download and display to
the screen the first 10 of those 200 points.
============== HEADER INFORMATION ======================*/
/*============ INCLUDE FILES ============================*/
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include “decl.h”  /* National Instruments header file */
/*============== CONSTANTS ============================*/
/*****
   Bit 4 of the Status Byte is the Message Available bit.  We
   will need to instruct the Ultima to generate a Service
   Request when it has a Message Available, using the IEEE-
   488.2 command “*sre”. When we detect a Service Request,
   we need to check if the Message Available bit is set in
   the Status Byte, before we try to read data from the bus.
*****/
#define MAV (1<<4) /* Msg Available bit in Status Byte */

/*================ DATA ================================*/
char   out_buf[80];   /* buffer for outgoing messages */
char   in_buf[20];    /* buffer for incoming messages */
/*============= FUNCTION PROTOTYPES ====================*/
int   gpib_init(void);
int   gpib_write(int ud, char * str);
void  main(void);
/*=====================================================
Function:   gpib_init()
```

Remote control commands (Example program)

```
Input:      none
Returns:   ud - unit descriptor referencing the GPIB device
Description:
   Initialize the GPIB board by calling “ibfind” with the
   name of a device as setup in the GPIB driver via
   “ibconf.exe”. We are assuming the default name of “DEV1”.
   The GPIB board can support up to 16 devices, so the
   National Instruments functions must reference each device
   through a unit descriptor.  This unit descriptor is
   returned by “ibfind”. We must then use this unit
   descriptor on all subsequent calls to National Instru-
   ments functions.
============================================================*/
int   gpib_init(void)
{
   int ud;      /* unit descriptor for device */
   /*****
      Initialize the gpib board.  Open the board and get the
      unit descriptor.  If successful, init the communica-
      tions modes.
   *****/
   if ((ud = ibfind(“DEV1”)) >= 0)
   {
     ibpad(ud, 13);   /* set primary address */
     ibtmo(ud, T3s);  /* set gpib time limit to 3 secs */
     ibeos(ud, 0x0C0A); /* enable EOS and set to Line Feed*/
     ibeot(ud, 1);    /* set GPIB EOI line with last byte
                         of write */
   }
  return(ud);     /* the rest of the program needs to know
                     ud also */
}   /* end gpib_init() */
/*============================================================
Function:   gpib_write()

Input:      ud - unit descriptor associated with Ultima
            str - the string to write to the bus
Returns:   error - value of ERR bit in the GPIB status word
                   (ibsta)
```

Remote control commands (Example program)

```
Description:
   Write the given string to the GPIB bus.  Check for and
   report any error during the write process.  Return the
   error code, so the caller can take additional action as
   necessary.
=============================================================*/
int   gpib_write(int ud, char * str)
{
   int error = 0;
  /* the return value will have the ERR bit set if an error
      occurred */
   error = ibwrt(ud, str, strlen(str)) & ERR;
   if (error)
      printf("Error writing to bus\n");
   return(error);
}   /* end gpib_write() */
/*=============================================================
Function:   main()
Input:
Returns:
Description:
   Initialize the GPIB board.  Setup the Ultima to collect
   some trend data points.  Delay for enough time for the
   Ultima to collect data, then request a series of collected
   data points from the Ultima.
=============================================================*/
void   main (void)
{
   int   i;
   int   ud;    /* unit descriptor referencing Ultima */
   char  spr;   /* serial poll response */
   /*****
     Initialize the gpib board.  If there is an error
     initializing, print a message and exit.
   *****/
   ud = gpib_init();
   if (ud < 0)
   {
```

Remote control commands (Example program)

```
    printf("named \"DEV1\". Make sure the driver\n");
    printf("\"gpib.com\" is loaded in the file\n");
    printf("\"config.sys\". Also make sure the driver\n");
    printf("has a device named \"DEV1\". This can be\n");
    printf("verified using the National Instruments\n");
    printf("configuration program \"ibconf.exe\".\n");
    exit(0);
  }
  /*****
    Setup the trend run to collect 200 points on channel
    A, with a 0.1 second interval between points. Note that
    the interval value requires quote marks because it
    contains a non-alphanumeric punctuation character. We
    can also send multiple commands in the same string,
    provided they are separated by a semicolon.  The line
    feed character (\n) is always appended as the message
    termination  character.
  *****/
  printf("\nConfiguring for trend data collection ...\n");
  sprintf(out_buf, "tp a, 200; ti a, \"00:00.1\"\n");
  if (gpib_write(ud, out_buf))
    exit(0);

/* Issue command to start the trend run for channel A. */
  sprintf(out_buf, "ts a\n");
  if (gpib_write(ud, out_buf))
    exit(0);

  /*****
    We will use the National Instruments ibwait function
    to wait for a 3 second timeout to occur.  This will allow
    the Ultima to collect several data points before we
    begin downloading data.  (Note: The timeout period can
    be changed by the ibtmo() function.)
  *****/
  ibwait(ud, TIMO);      /* wait for 3 seconds */

  /*****
    Setup the Ultima to generate a Service Request when it
    has data ready to send, by setting the Message Available
```

Remote control commands (Example program)

```
   bit in the Service Request Enable register.  This is
   done using the IEEE 488.2 command "*sre".
*****/
 sprintf(out_buf, "*sre %d\n", MAV); /* Message Available
                                        bit */
if (gpib_write(ud, out_buf))
   exit(0);
/*****
   Execute a loop requesting the first 10 trend data
   points. If an error occurs writing to, or reading from
   the bus, we will abort our data transfer loop.
 *****/
for (i = 1; i <= 10; ++i)
{
   sprintf(out_buf, "tv? a, %d\n", i);  /* request
                                           trend point */
   if (gpib_write(ud, out_buf))    /* If error abort */
      break;
   /*****
      Wait for the Service Request.  If we timeout instead
      of getting a Service Request, then we have a problem
      communicating with the Ultima, so abort our data
      transfer.
    *****/
   ibwait(ud, TIMO | RQS);
   if (ibsta & RQS)
   {
      /*****
         When a Service Request occurs, we need to read
         the serial poll response byte, which will
         indicate why the Service Request was generated.
         In our case, it should indicate Message
         Available.
      *****/
      ibrsp(ud, &spr); /* read serial poll response */
      if (spr & MAV)   /* If Message Available */
      {
        ibrd(ud, in_buf, 20);  /* read data point from
                                  Ultima */
        in_buf[ibcnt] = 0;   /* terminate the string */
```

Remote control commands (Example program)

```
                printf("%s", in_buf);  /* print the value to
                                          the screen */
              }
           }
           else
           {
                printf("Timed out waiting for data\n");
                break;
           }
      }   /* end for */
}   /* end main() */
/*=========================================================*/
```

Using the Ultima with RS-232

```
‘ Program to read Ultima CH A power through the RS-232
‘ Displays current, min and max.
‘ Written for Microsoft QBasic v 1.0 (the one that comes
free with DOS)

DECLARE FUNCTION GetInput$ ()


CLS
LOCATE 1, 5
PRINT “LabMaster Ultima RS-232 demo program”

‘ change the com port and baud rate as required
OPEN “com2:9600,n,8,1,CD0,CS0,DS0,OP0,RS” FOR RANDOM AS
#1


LOCATE 23, 10
PRINT “Press any key to stop”;
LOCATE 8, 21
PRINT “Current”
LOCATE 8, 36
PRINT “Min”
LOCATE 8, 51
PRINT “Max”
LOCATE 10, 5
PRINT “Power CH A = “;

pwrMin = 1000000!
pwrMax = 0!

PRINT #1, “dt? a” + CHR$(10); ‘ request current detector
name
detr$ = GetInput$
LOCATE 4, 5
PRINT “CH A Detector = “;
PRINT detr$;

PRINT #1, “wv? a” + CHR$(10); ‘ request current wave-
length
wvln$ = GetInput$
LOCATE 5, 5
PRINT “Wavelength = “;
PRINT wvln$;
PRINT “ meters”
```

Using the Ultima with RS-232

```
WHILE INKEY$ = “”          ‘ Update until a key pressed
        PRINT #1, “pw? a” + CHR$(10);
        pwr$ = GetInput$
        power = VAL(pwr$)   ‘ convert string to number for
                            ‘ compares
        LOCATE 10, 20
        PRINT USING “##.##^^^^”; power
        IF power > pwrMax THEN
                pwrMax = power
                LOCATE 10, 50
                PRINT USING “##.##^^^^”; pwrMax
        END IF
        IF power < pwrMin THEN
                pwrMin = power
                LOCATE 10, 35
                PRINT USING “##.##^^^^”; pwrMin
        END IF
WEND

‘ This function reads one character at a time from the
‘ com port until
‘ two linefeeds are rec’d.  It returns the string without
‘ the linefeeds.
FUNCTION GetInput$
        cnt% = 0
        done% = 0

        DO
                temp$ = INPUT$(1, 1)
                IF temp$ = CHR$(10) THEN
                        cnt% = cnt% + 1
                END IF
                IF cnt% = 2 THEN
                        done% = 1
                        GetInput$ = resp$
                END IF
                IF cnt% = 0 THEN
                        resp$ = resp$ + temp$
                END IF

        LOOP UNTIL done%

END FUNCTION
```

Using the Ultima with RS-232

```
; Sample script file for ProComm Plus for DOS v. 2.01 to
; setup Ultima to collect 200 points at an interval of .1
; seconds on Channel A. After the setup is complete, the
; Ultima is commanded to start the trend run. The program
; then pauses for 25 seconds to let the run finish. The
; data is then retrieved for all 200 points and saved to
; the file “TRND_CHA.DAT”.  This file may then be loaded
; into a spreadsheet for further analysis.

proc main
     statmsg “Setting Up...”
     call SetupAll

     ; the ^J is a linefeed, all transmissions to Ultima
     ; MUST be terminated with a linefeed
     transmit “ts a^J”     ; start the trend run on CH A

     statmsg “Waiting for completion...”
     pause 25   ; wait for Ultima to collect all data

     statmsg “Retrieving data and saving to file...”
     call GetData
     statmsg “Complete!”
endproc

;*************************************************************
; get all 200 points and write to a text file
proc GetData
integer counter
string msg
string respstr

     set rxdata on
     fopen 0 “trnd_cha.dat” “wt”
     for counter=1 upto 200
          strfmt msg “tv? a, %d`n” counter
          transmit msg               ; request point
          call UltimaGetS with &respstr    ; get point
          fputs 0 respstr            ; put to file
          fputc 0 10 ; add a LF, this fputs doesn’t
     endfor
     fclose 0
endproc
```

Using the Ultima with RS-232

```
;*************************************************************
; Get a response string from the Ultima that is terminated by TWO
; linefeeds.  Return the string without the linefeeds.
proc UltimaGetS
      strparm s
      integer done = 0
      integer cnt = 0
      integer stpos = 0
      integer nxchar

      strcpy s “”      ; clear string
      while !done
            comgetc nxchar
            if nxchar == -1       ; nothing in buffer
                  loopwhile  ; loop back and try again
            endif
            if nxchar == 10          ; is a LF?
                  cnt++
                  strpoke s stpos 0   ; yes, replace w/ null
            else
                  strpoke s stpos nxchar      ; no, put char in
string
            endif
            stpos++          ; incr string position
            if cnt == 2      ; do we have TWO Lf’s?
                  done = 1
            endif
      endwhile
endproc


;*************************************************************
proc SetupAll
      call SetupPort
      call SetupTrend
endproc
```

Using the Ultima with RS-232

```
;*************************************************************
; change the port from COM2 to the actual port used
; make sure the baudrate agrees with Ultima remote setup
proc SetupPort
      set port com2
      set baud 9600
      set databits 8
      set parity none
      set stopbits 1
endproc

;*************************************************************
; tell Ultima to collect 200 points for CH A at an inter-
val of .1 s
proc SetupTrend
      transmit “tp a, 200; ti a, `”00:00.1`”`n”
endproc
```

Using the Ultima with RS-232

```
; Sample script file for ProComm Plus for Windows v. 1.01
; to setup Ultima to collect 200 points at an interval of
; .1 seconds on Channel A. After the setup is complete,
; the Ultima is commanded to start the trend run. The
; program then pauses for 25 seconds to let the run
; finish. The data is then retreived for all 200 points
; and saved to the file "TRND_CHA.DAT".  This file may
; then be loaded into a spreadsheet for further analysis.

proc main
     statmsg "Setting Up..."
     SetupAll()

     ; the 'n is a linefeed, all transmissions to
     ; Ultima
     ; MUST be terminated with a linefeed
     transmit "ts a`n"     ; start the trend run

     statmsg "Waiting for completion..."
     pause 25   ; wait for Ultima to collect all data

     statmsg "Retrieving data and saving to file..."
     GetData()
     statmsg "Complete!"
endproc

;*************************************************************
; get all 200 points and write to a text file
proc GetData
integer counter
string message
string respstr

     set aspect rxdata on
     fopen 0 "trnd_cha.dat" create text
     for counter=1 upto 200
          strfmt message "tv? a, %d`n" counter
          transmit message ; request point
          UltimaGetS (&respstr)
          fputs 0 respstr
     endfor
     fclose 0
endproc

;*************************************************************
```

Using the Ultima with RS-232

```
; Get a response string from the Ultima that is terminated
; by TWO linefeeds.  Return the string without the
; linefeeds.
proc UltimaGetS
      strparm s
      string response = ""
      integer done = 0
      integer cnt = 0

      strcpy s ""      ; clear string
      while !done
            comgets response 1 15 ; get one char
            strcmp response "`n"  ; is it a LF?
            if success       ; yes
                  cnt++;
                  strcat s "`000"     ; replace with null
            else
                  strcat s response   ; no, add char to
                                      ; string
            endif
            if cnt == 2
                  done = 1
            endif
      endwhile
endproc

;*************************************************************
proc SetupAll
      SetupPort()
      SetupTrend()
endproc

;*************************************************************
; tell Ultima to collect 200 points for CH A at an inter-
val of .1 s
proc SetupTrend
      transmit "tp a, 200; ti a, `"00:00.1`"`n"
endproc

;*************************************************************
; change the port from COM2 to the actual port used
; make sure the baudrate agrees with Ultima remote setup
proc SetupPort
      set connection port COM2
      set baudrate 9600
endproc
```

Specifications

Display Type	High speed, high contrast, back lit liquid crystal display. 256 x 128 pixels
Display Options	Software control of contrast, normal or reverse display and screen backlighting
Ranges	Microprocessor controlled. Display ranges determined by EEPROM in sensor heads. No range limitation on display.
Update rate	< 1 sec.
Display accuracy	±1% (must be added to detector accuracy for total system accuracy)
Interfaces: RS-232 GPIB	Full remote capability 300, 1200, 4800, 9600 baud IEEE-488.2 Compatible
Analog out Computer corrected Full bandwidth	0-1V, ±2% 5 Hz 50 KHz (optional,for Quantum detectors only)
Printer	Parallel, compatible with Epson, IBM Proprinter, HP laser printer
Auxiliary out (alarm signals)	0-5V, TTL compatible
Pulse detector Maximum pulse capture rate	 500 Hz dual channel, 1KHz single channel
Quantum detector Internal true RMS noise measurement Selectable reading averaging	 5% accuracy, 20 Hz to 50 KHz bandwidth with a crest factor of 6. 10 Hz or 100 Hz
CW Thermal Detector Single pulse detection Position	 10% (for uncalibrated detector, detectors may be calibrated for greater accuracy) 5% at 5mm (built in calibration)
Trend	2000 points per channel Pulse or Time acquisition modes
Real time statistics	10 Hz acquisition for CW detectors Up to 500 Hz acquisition for pulse dual channel Up to 1 KHz acquisition for pulse single channel
Power Requirements – AC operation – DC operation	 115 VAC or 230 VAC 50/60 Hz 50/60 Hz 10 VA 10VA 9 VDC, 1 A, (6 V internal rechargeable battery pack. Recharged automatically during AC operation. Battery life 4 hours.

Warranty

The seller warrants to the original Buyer each item manufactured by it to be free from defects in material and workmanship for a period of time and under such conditions as specified in the Seller's warranty for the individual product, or for twelve (12) months from delivery if a warranty for the individual product is not specified. Major sub-systems manufactured by other firms but integrated into the Seller's systems are covered by the original Manufacturer's warranty. The Seller's liability under valid warranty claims is limited to repair or replacement at the Seller's plant or the Buyer's location, all at the option of the Seller.

The foregoing warranty is exclusive and in lieu of all other warranties, whether written, oral or implied and shall be the Buyer's sole remedy and the Seller's sole liability on contract or warranty or otherwise for the product. The Seller disclaims any implied warranty or merchantability or fitness for purpose.

All claims under warranty must be made promptly after occurrence of circumstances giving rise thereto, must be received within the applicable warranty period by the Seller, and shall be subject to the terms and conditions stated herein. Such claims should include the product serial number, the date of shipment, and a full description of the circumstances giving rise to the claim. Before any products are returned for repair and/or adjustment, authorization for the Seller for the return and instructions as to how and where these Products should be shipped must be obtained. Any product returned to the Seller for examination and/or warranty repair shall be sent prepaid via the means of transportation indicated as acceptable by the Seller. The Seller reserves the right to reject any warranty claim on any item that has been shipped by non-acceptable means of transportation. When any product is returned for examination and inspection, or for any other reason, the Buyer and its shipping agency shall be responsible for all damage resulting from improper packing or handling, and for loss in transit, notwithstanding any defect of non-conformity in the Product. In all cases, the Seller has sole responsibility for determining the cause and nature of failure, and the Seller's determination with regard thereto shall be final.

If it is found the Seller's Product has been returned without cause and is still serviceable, the Buyer will be notified and the Product returned at the Buyer's expense. In addition, a charge for testing and examination may, in the Seller's sole discretion, be made on products returned.

Sales & Service Information

Thirty years of innovation

Coherent has been the world leader in the manufacture of lasers, and the instruments to measure them, for over thirty years. Coherent Auburn Group offers complete solutions for laser characterization, process control, and system design. Beam diagnostic systems such as BeamView Analyzer PC and LaserGauge provide the precise solution for all your beam diagnostic applications. ModeMaster™ provide's total analysis of laser beam quality from profile to propagation. LabMaster Ultima and FieldMaster™ give you exact measurement of laser power and energy. WaveMate™ provides economical and precise wavelength measurement.

You may contact your local representative or Coherent Auburn Group for further information regarding these items. Call 530-888-5107 and ask for one of our customer care specialists. Purchase orders may be placed by phone, FAX or mail.

UNITED STATES
2303 Lindbergh Street
Auburn, California 95602
U.S.A.
Sales Tel: 1 (800) 343-4912
Sales Fax: (530) 889-5366
Service Tel: (530) 888-5062
Service Fax: (530) 889-5262

UNITED KINGDOM
Greycaine Road
Watford, Herts WD2 4PW
England
Tel: +44 (0) 1923 242261
Fax: +44 (0) 1923 234220

GERMANY
Dieselstraße 5b
D-64807 Dieburg
Germany
Tel: +49-6071-968-302
Fax: +49-6071-968-499

FRANCE
Domaine Technologique de Saclay
Bâtiment AZUR
4, rue René Razel.
91892 Orsay Cedex
France
Tel: +33-1-60 19 40 40
Fax: +33-1-60 19 40 00

JAPAN
Toyo MK Building
7-2-14 Toyo
Koto-ku, Tokyo 135
Japan
Tel: +81 (0) 3 5635 8680
Fax: +81 (0) 3 5635 8681