

USBI ActiveX Control

Revision History

07	19-Oct-10	1. Mention release of the OphirLMMeasurement COM object and recommendation that new designs work with that 2. Explain AF, AQ, and SG commands
06	06-May-10	1. WI works with Discrete Spectrum heads 2. Added section on OphirBetaX
05	27-Mar-08	1. Added the Vega device
04	17-Jan-08	1. Updated INF file. Now there is a shared one for USBI and Nova-II 2. Updated command summary 3. USBI-4 family of devices have been renamed Pulsar-4
03	11-Jul-07	1. Mention the FastX companion document 2. Update Introduction 3. Replaced ActivationWarning method with Error Code in OpenUSB 4. ActiveX registration without full installation
02	21-Sep-05	1. Added ResumeStream, StopTM, and ResumeStream methods as part of USBI 1.15 2. Added this revision history table
01		1. Initial Revision

Overview

This document is divided into four sections

- 1) [Overview](#). Introduction and general explanation how to communicate with Ophir USBI using the OphirUsbX ActiveX control and Ophir's suite of commands (this section)
- 2) [ActiveX: Detailed Description](#). Detailed description of the methods, events, and error codes of the OphirUsbX ActiveX control.
- 3) [Stream Mode Formats](#). Description of various measurement streams reported by the USBI device.
- 4) [Ophir USBI Commands](#). Detailed description of all commands necessary to fully control the Ophir USBI device.
- 5) [Appendix A: OphirUsbXBeta](#). Explanation extension of ActiveX for MatLab and Console applications.

Introduction

This document describes Ophir's ActiveX support of the USBI, Nova-II and Vega devices. Please see the companion document "***OphirFastX ActiveX Control.doc***" for details on the ActiveX support for the Pulsar-4, Pulsar-2, and Pulsar-1 devices.

Besides their use as stand-alone, fully featured laser power/energy meters, the Ophir USBI, Nova-II and Vega devices can also be used through an ActiveX control. This allows system integrators to integrate the measurement capabilities of the USBI, Nova-II and Vega with legacy analysis packages.

The OphirUsbX ActiveX control has been tested in VB 6.0, VB.NET 2005, VC 6.0 and Excel (Microsoft). In practice, OphirUsbX can be used in any environment that allows interaction with COM automation servers (although it hasn't been tested with tools other than those mentioned)

Note: As part of the 2.10 release of StarLab, Ophir now provides a COM object interface (OphirLMMeasurement) that supports all Ophir USB-speaking devices. The ActiveX packages

are included in the release so as to not disrupt legacy OEM installations by customers. For new designs, we highly recommend using OphirLMMMeasurement.

Registration

USBI PC software (1.09 and higher) registers OphirUsbX as part of the installation process of the USBI application. Registration is also possible via the Options Menu of the USBI application.

If working with an older version of USBI (1.08) and cannot upgrade to a newer version, then to install and register the ActiveX control, the User must perform the following steps.

- 1) Run OphirUsbX.exe. This is a self-extracting executable. Specify to unzip the contents of this file to the directory in which USBI 1.08 was installed. (Default is "C:\Program Files\Ophir Optronics\USBI 1.08").
- 2) Run regocx.bat
- 3) The OphirUsbX ActiveX control has now been registered and is ready to be used.

As of version 2.10, after installing the USBI PC application on one PC, it's possible to register the ActiveX control on additional PC's without installing the full USBI package. To do so, use the following steps

1. Copy the following files to C:\ophirx (all the files are in the installation directory C:\program files\ophir optronics\usbi 2.10)
 - OphirUsbX.ocx
 - wdreg.exe
 - ophdev.inf (for USBI ,Nova-II and Vega devices)
 - ophdev.cat
 - windrvr6.inf
 - windrvr6.sys
 - wd901.cat
2. Build a batch file with the following contents in C:\ophirx (rem means remark)
 - rem 1) install jungo driver (our 3rd party tool)
 - wdreg -inf windrvr6.inf install
 - rem 2) install ActiveX (this is Ophir specific)
 - regsvr32 OphirUsbX.ocx
 - rem 3) install device driver (Ophir specific INF file)
 - wdreg -inf ophdev.inf install
3. Copy C:\ophirx to your target PC and run the batch file

Examples

Examples of ActiveX containers using OphirUsbX in VB6, VC6, and VB.NET 2005 are provided with the installation package. All examples assume a rudimentary knowledge of the respective development platforms as well as an understanding of ActiveX controls.

USB Details

The Ophir USBI is a full-speed, bus-powered, high-powered USB device. Besides a control endpoint (over which most of the communication takes place), it also has one interrupt IN endpoint. This endpoint can be set to up to 4 different polling rates. It's used by the [StartCS](#) method (described later) to allow reporting of measurements with less USB protocol overhead and at a higher data rates.

Device Communication Details

In order to maintain code compatibility with other Ophir devices (Nova and LaserStar) note the following syntax.

- 1) All commands and responses are ASCII strings.
- 2) All commands are two characters, followed by parameters (when applicable).

- 3) All commands are prefixed by a "\$" (Hex 0x24) and suffixed by a <LF> (Hex 0x0A). Note: Methods that send commands to the USBI device ([Write](#), [StartCS](#), and [StartTM](#)) add these codes automatically. This frees the user to concentrate only on the command syntax itself (as described in [Ophir USBI Commands](#))
- 4) Response to successful command starts with a "*" (Hex 0x2A) and ends with a <LF>.
- 5) Response to an invalid commands starts with a "?" (Hex 0x3F). These codes are passed back to the user (as part of the string returned by the Read method) to allow the user to flag errors and perform application dependent error processing.

ActiveX: Detailed Description

This section describes the methods, events, and error codes of the OphirUsbX ActiveX control.

Note: Only once instance of OphirUsbX can be active. If a second instance is opened, a message box will pop up, reminding the Application Programmer of this limitation.

Note: Only once instance of OphirUsbX can be active. If a second instance is opened, the [OpenUSB](#) method will return a warning code, reminding the Application Programmer of this limitation.

Error Codes

- 1) 0x00000000: No Error.
- 2) 0x80040100: OphirUsbX has not been opened.
- 3) 0x80040101: OphirUsbX has already been opened.
- 4) 0x80040102: OphirUsbX drivers cannot be loaded.
- 5) 0x80040103: Open Warning.
- 6) 0x80040200: Device index out of range.
- 7) 0x80040201: Invalid device handle.
- 8) 0x80040202: Invalid interface selected.
- 9) 0x80040203: Failed to select interface as requested.
- 10) 0x80040204: Failed to write to device.
- 11) 0x80040205: Device is in Stream Mode. Cannot write to it.
- 12) 0x80040206: Failed to read from device.
- 13) 0x80040300: Failed to detect devices.
- 14) 0x80040301: Failed to restart device(s).
- 15) 0x80040302: At least one device is in Stream Mode.
- 16) 0x80040400: Stream Mode not started.
- 17) 0x80040401: Stream Mode already started.
- 18) 0x80040402: Stream Mode not suspended
- 19) 0x80040403: Stream Mode not resumed

Methods

As of version 2.10 this function has been deprecated and is no longer supported. Instead, [OpenUSB](#) will return a Warning code that the ActiveX has already been loaded

Name	ActivationWarning
Parameters	short Enable
Use	Enable/Disable Dialog Box warning message shown when activating the ActiveX after it has already been loaded. Parameter is1 for Enable and 0 for Disable.
Return Codes	1) 0x00000000. No Error. 2) 0x80040303. Activation Warning Operation Failed.

Name	CloseUSB
Parameters	None
Use	Closes Ophir USBI drivers and disables working with OphirUsbX. This method is the last one to be called, and ends the communication session with the USBI device.
Return Codes	1) 0x000000. No Error 2) 0x800400. OphirUsbX has not been opened yet

Name	DetectDevices
Parameters	None
Use	Detect if any Ophir USBI devices are attached to the PC.
Return Codes	<ul style="list-style-type: none"> 1) 0x00000000. No Error 2) 0x80040100. OphirUsbX has not been opened 3) 0x80040300. Failed to detect any devices. 4) 0x80040302: At least one device is in Stream Mode.

Name	GetDeviceHandle
Parameters	<ul style="list-style-type: none"> 1) short DeviceNumber 2) short *DeviceHandle
Use	Having called the GetNumberOfDevices method, this method is used to get a Device Handle for every USBI device that the Application Programmer wants to work with. OphirUsbX maintains a zero-based array of indexes. Therefore <i>DeviceNumber</i> must be a value less than what is returned by GetNumberOfDevices .
Return Codes	<ul style="list-style-type: none"> 1) 0x00000000. No Error 2) 0x80040100. OphirUsbX has not been opened 3) 0x80040200: Device index out of range.

Name	GetDriverVersion
Parameters	1) short *nDriverVersion
Use	Used for debugging purposes. If there is an error when using OphirUsbX, use this method to get the version of Ophir USBI drivers installed on this PC (returned in the <i>nDriverVersion</i> parameters).
Return Codes	<ul style="list-style-type: none"> 1) 0x00000000. No Error 2) 0x80040100. OphirUsbX has not been opened

Name	GetErrorFromCode
Parameters	<ul style="list-style-type: none"> 1) long IErrorCode 2) VARIANT *varErrorString
Use	Given an error code, will pass back a string explanation of the error. Note: <i>varErrorString</i> is VARIANT pointer to a BSTR. This was done in order to make the string easily accessible in all languages.
Return Codes	1) 0x00000000. No Error

Name	GetNumberOfDevices
Parameters	1) short *DeviceNumber
Use	Called after the OpenUSB method to get count (in DeviceNumber) of Ophir USBI devices attached to the PC.
Return Codes	<ul style="list-style-type: none"> 1) 0x00000000. No Error 2) 0x80040100. OphirUsbX has not been opened

Name	OpenUSB
Parameters	1) long *IWarning (Out)
Use	<p>Initialize OphirUsbX for use. All other methods should be called only after OpenUSB has been called.</p> <p>If OphirUsbX has been loaded by a different session OpenUSB will return 0x80040103: Open Warning. This means that it may be possible to communicate with the devices but if not, it's because the other session has loaded and also locked out OphirUsbX from use by others</p> <p>Note: Due to adding a parameter to this method, version 2.10 of the ActiveX will be incompatible with older versions of the ActiveX Client demo</p>
Return Codes	<p>1) 0x00000000. No Error</p> <p>2) 0x80040100. Failed to open OphirUsbX.</p> <p>3) 0x80040101. OphirUsbX already opened.</p> <p>4) 0x80040102: OphirUsbX drivers cannot be loaded.</p>

Name	Read
Parameters	<p>1) short DeviceHandle</p> <p>2) VARIANT *Data</p>
Use	<p>Read response from USBI device associated with <i>DeviceHandle</i>. The response is in the form of an ASCII string.</p> <p>Note: <i>Data</i> is VARIANT pointer to a BSTR. This was done in order to make the string easily accessible in all languages.</p>
Return Codes	<p>1) 0x00000000. No Error.</p> <p>2) 0x80040100. OphirUsbX has not been opened.</p> <p>3) 0x80040201: Invalid device handle.</p> <p>4) 0x80040206: Failed to read from device.</p>

Name	RefreshAllDevices
Parameters	None
Use	<p>Restarts all detected Ophir USBI devices.</p> <p>Note: This command method will not function unless no devices are in Stream Mode (i.e. StopCS, StopTM, or StopAllCS was not called since putting at least one device into Stream mode with the StartCS and StartTM methods)</p>
Return Codes	<p>1) 0x00000000. No Error.</p> <p>2) 0x80040100. OphirUsbX has not been opened.</p> <p>3) 0x80040301: Failed to restart devices.</p> <p>4) 0x80040302: At least one device is in Stream Mode.</p>

Name	RefreshDevice
Parameters	1) short DeviceHandle
Use	<p>Restarts Ophir USBI device specified by <i>DeviceHandle</i>.</p> <p>Note: This command method will not function unless no devices are in Stream Mode (i.e. StopCS, StopTM, or StopAllCS was not called since putting at least one device into Stream mode with the StartCS and StartTM</p>

	methods)
Return Codes	1) 0x00000000. No Error. 2) 0x80040100. OphirUsbX has not been opened. 3) 0x80040201: Invalid device handle. 4) 0x80040301: Failed to restart specified device. 5) 0x80040302: At least one device is in Stream Mode.

Name	ResumeStream
Parameters	1) short DeviceHandle
Use	Resume reporting of Stream Mode measurements to the Client Application. See also SuspendStream . Note: This command does not put the device in Stream Mode. To put a device in Stream Mode, use the StartCS or StartTM methods.
Return Codes	1) 0x00000000. No Error. 2) 0x80040100. OphirUsbX has not been opened. 3) 0x80040201: Invalid device handle. 4) 0x80040400: Stream Mode not started 5) 0x80040403: Failed to resume Stream Mode

Name	SelectInterface
Parameters	short DeviceHandle short InterfaceIndex
Use	To make better use of USB bandwidth when calling the StartCS method to gather data from a USBI device. For non-pyroelectric heads use interface 0 (the default interface). For Pyroelectric heads in exposure mode, use interface 1. For Pyroelectric heads that can measure lasers of frequencies up to 100 Hertz, use interface 2. For faster Pyroelectric heads, use interface 3. Note: This command will not succeed if the device selected is in Stream Mode. Call the StopCS or StopTM methods first.
Return Codes	0x00000000. No Error. 0x80040100. OphirUsbX has not been opened. 0x80040201: Invalid device handle. 0x80040202: Invalid interface selected. 0x80040203: Failed to select interface as requested. 0x80040205: Device is in Stream Mode.

Name	StartCS
Parameters	1) short DeviceHandle 2) VARIANT *varDeviceResponse
Use	Put device selected by <i>DeviceHandle</i> into Stream Mode. In this mode, measurements are reported on the USBI's Interrupt IN endpoint (instead of on the Control Endpoint with the Read method). A detailed description of the format of measurements reported is described in Stream Mode Formats . Note: <i>varDeviceResponse</i> is VARIANT pointer to a BSTR. This was done in order to make the string easily accessible in all languages.
Return Codes	1) 0x00000000. No Error.

	<ul style="list-style-type: none"> 2) 0x80040100. OphirUsbX has not been opened. 3) 0x80040201: Invalid device handle. 4) 0x80040400: Failed to start Stream Mode. 5) 0x80040401: Stream Mode already started.
--	--

Name	StartTM
Parameters	<ul style="list-style-type: none"> 1) short DeviceHandle 2) short PulseFrequency 3) VARIANT *varDeviceResponse
Use	<p>Special purpose Stream Mode (Turbo Mode) for high frequency Pyroelectric heads. This method selects Interface 3 for the USBI device selected by <i>DeviceHandle</i>. The USBI is put into a mode of reporting measurements in a condensed format (described in Stream Mode Formats). For some heads, this brings the measurement frequency up to as high as 2500 Hertz.</p> <p>Note: <i>varDeviceResponse</i> is VARIANT pointer to a BSTR. This was done in order to make the string easily accessible in all languages.</p>
Return Codes	<ul style="list-style-type: none"> 1) 0x00000000. No Error. 2) 0x80040100. OphirUsbX has not been opened. 3) 0x80040201: Invalid device handle. 4) 0x80040400: Failed to start Stream Mode. 5) 0x80040401: Stream Mode already started.

Name	StopAllCS
Parameters	None
Use	Take all devices out of Stream Mode reporting of measurements (started with the StartCS or StartTM methods)
Return Codes	<ul style="list-style-type: none"> 1) 0x00000000. No Error. 2) 0x80040100. OphirUsbX has not been opened.

Name	StopCS
Parameters	<ul style="list-style-type: none"> 1) short DeviceHandle
Use	<p>Take selected device out of Stream Mode that was started by the StartCS method</p> <p>Note: This method will take the selected device out of Stream Mode that had been started with the StartTM method as well. However, in such a case, the more appropriate method is StopTM</p>
Return Codes	<ul style="list-style-type: none"> 1) 0x00000000. No Error. 2) 0x80040100. OphirUsbX has not been opened. 3) 0x80040201: Invalid device handle. 4) 0x80040400: Selected Device not in Stream Mode.

Name	StopTM
Parameters	short DeviceHandle
Use	Take selected device out of Turbo Mode (started by the StartTM method)

	Note: This method will take the selected device out of Stream Mode that had been started with the StartCS method as well. However, in such a case, the more appropriate method is StopCS .
Return Codes	0x00000000. No Error. 0x80040100. OphirUsbX has not been opened. 0x80040201: Invalid device handle. 0x80040400: Selected Device not in Stream Mode.

Name	SuspendStream
Parameters	1) short DeviceHandle
Use	Suspend reporting of Stream Mode measurements to the Client Application. See also ResumeStream Note: This command does not take the device out of Stream Mode. To take the device out of Stream Mode, use the StopCS or StopTM methods.
Return Codes	1) 0x00000000. No Error. 2) 0x80040100. OphirUsbX has not been opened. 3) 0x80040201: Invalid device handle. 4) 0x80040400: Stream Mode not started 5) 0x80040402: Failed to suspend Stream Mode

Name	Write
Parameters	1) short DeviceHandle 2) VARIANT Data
Use	Write command to selected USBI device. For a complete listing of commands see Ophir USBI Commands . Note. This method will fail if the selected device is reporting measurements in Stream Mode. Call the StopCS method first.
Return Codes	1. 0x00000000. No Error. 2. 0x80040100. OphirUsbX has not been opened. 3. 0x80040201: Invalid device handle. 4. 0x80040204: Failed to write to device. 5. 0x80040205: Device is in Stream Mode.

Events

Name	MeasureArrived
Parameters	1) VARIANT Measurement 2) short DeviceHandle
Use	<p>This event is fired when data is being reported in Stream Mode. It informs the client application that the USBI device specified by <i>DeviceHandle</i> has reported more measurements. See Stream Mode Formats for description of data delivered.</p> <p>Note: In order to optimize performance, several measurement strings may be concatenated into one string. OphirUsbX does not parse the results.</p>
Return Codes	None

Stream Mode Formats

Whatever the measurement mode of the USBI, (Energy, Power, Exposure) the measurements can be reported in Stream Mode (using [StartCS](#) or [StartTM](#)). Like the results, of the Read method, the response is an ASCII string (prefixed by "*" and terminated with "\n"). However, the contents vary with the device measurement mode.

- 1) Thermopile and Photodiode heads in Power Mode
- 2) Thermopile heads in Energy Mode
- 3) Pyroelectric heads in Power or Energy Mode
- 4) Pyroelectric heads in Exposure Mode
- 5) Pyroelectric and heads in Turbo Mode (StartTM)

Thermopile and Photodiode heads in Power Mode

The USBI device measures and reports at a rate of 15 Hertz. There are 2 possible responses.

- 1) Standard E notation (example *1.500E-3 for 1.5 milliwatts) for a successful reading.
- 2) *OVER. If beyond the presently configured measurement capabilities of the USBI.

Thermopile heads in Energy Mode

Thermopile Detectors have a relatively long response time to changes in power. As such, energy measurement with a thermopile detector can only be done at a low frequency (one pulse every several seconds, depending on the head) and is performed in stages. All of these stages are reported to the client application.

- 1) *RESET: Waiting for head to stabilize (once per measurement session)
- 2) *WAITING: Waiting for start of pulse (reported for every pulse)
- 3) *SUMMING: In process of measuring a pulse (reported for every pulse)
- 4) Result of measurement (reported for every pulse). Will be one of
 - *<energy> : Successful energy measurement (same notation as for Power)
 - *OVER: Energy was beyond the presently configured measurement capabilities of the USBI.
 - *TIMEOUT: Pulse was too long (Error Condition)
 - *PEAK OVER: Energy too great at peak to be measured (Error Condition)
 - *ENERGY OVER: Total energy too great to be measured (Error Condition)

Example

- 1) Call [Write](#) method with the [Write range Now](#) command to set new measurement range
- 2) Call [StartCS](#) method
- 3) *RESET
- 4) *WAITING
- 5) *SUMMING
- 6) *2.500E-1
- 7) *WAITING
- 8) *SUMMING
- 9) *OVER
- 10) *WAITING
- 11) *SUMMING
- 12) *2.600E-1
- 13) *WAITING
- 14) Etc.

Pyroelectric heads in Power or Energy Mode

The USBI device measures and reports at a rate dependent on the laser frequency. The client application should use the [SelectInterface](#) method to select the optimal polling rate. The format of the response for power and energy is generally the same as for Thermopile and Photodiode heads in Power Mode (see above). However, when the USBI detects a change in laser frequency it appends the new frequency to the power/energy reading reported as follows

*<energy-measured> FREQ <frequency-measured>

Example

- 1) *1.600e-5 FREQ 2.000E3: Last energy measured was 16 microjoules, frequency of laser is now 2 Kilohertz

Pyroelectric heads in Exposure Mode

The USBI device measures and reports at a rate of 5 Hertz. Before starting stream mode, the client application should call the [SelectInterface](#) method with *InterfaceIndex* set to 1. The format of the response is

<total-exposure> <number-of-pulses> <time in 10ths of seconds>

Example

- 1) * 1.064E-1 2773 124: Total exposure is 106.4mJ, 2773 pulses have been measured, and 12.4 seconds have elapsed since the start of exposure measurement.

Pyroelectric heads in Turbo Mode

The USBI measures and reports every pulse for frequencies up to 1000 Hertz. For certain heads, every pulse is reported at frequencies up to 2500 Hertz. Upon calling the [StartTM](#) method, OphirUsbX sets the USBI interface to 3 (poll device 500 times a second). Each reading is condensed into the following format:

- 1) Leading sign (+ or -)
- 2) 4 digits (including leading 0's)
- 3) Trailing space

The USBI device may concatenate several measurements into one response. A typical response is as follows

“+1950 +1940 +1945 +1942<LF>”

Before calling the [StartTM](#) method, the client application should query the USBI for the present measurement range (Using the [All Ranges](#) and [Read range Now](#) commands with the [Write](#) and [Read](#) methods). This will enable Application Programmer to translate from this condensed format into actual measurements.

Ophir USBI Commands

This section describes the commands available to control the USBI device. It is divided into 4 sections.

- 1) [Command Summary](#). Table listing all the USBI commands.
- 2) [Basic Commands](#). These commands query and set the measurement configuration of the head and the USBI.
- 3) [Advanced Commands](#). Commands that change calibration factors of the heads and instrument. Use of these commands will change the results of measurements and should be used only after careful consideration.
- 4) [RP Commands](#). Commands that are unique to RP heads.

Commands are sent to the device by calling the [Write](#) method. Responses are received by calling the [Read](#) method. Note: The USBI device expects a command before sending a response. The user must call the [Write](#) method before waiting for a response by calling the [Read](#) method.

Command Summary

The following table contains a listing of all commands available with the USBI device.

Command	Meaning	No Head	Thermopile	Photodiode	Pyroelectric	RP
AF	Average Flag		•	•	•	
AQ	Average Query		•	•	•	
AR	All Ranges		•	•	•	•
AW	All Wavelengths		•	•	•	•
CQ	Calibration Query		•	•	•	•
DQ	Diffuser Query				•	
EE	Exposure Energy				•	
EF	Energy Flag		•		•	•
ER	Energy Ready		•			•
ET	Energy Threshold		•			•
FE	Force Energy		•		•	•
FI	Force mIssing					•
FM	Frequency Mode					•
FP	Force Power		•	•	•	•
FQ	Filter Query			•		•
FX	Force eXposure				•	
GU	Get range in Use		•	•	•	•
HC	Head Configuration		•	•	•	•
HI	Head Information		•	•	•	•
IC	Instrument Configuration	•	•	•	•	•
II	Instrument Information	•	•	•	•	•
MA	MAins	•	•	•	•	•
MF	Maximum Frequency				•	•
MP	Missing Pulses					•
OA	Optimize Abort					•
OE	Optimize Energy					•
OP	Optimize Power					•
OQ	Optimize Query					•
OS	Optimize Save					•
PL	Pulse Length				•	•
RN	Read range Now		•	•	•	•
RQ	Response Query		•			•
SE	Send Energy		•		•	•
SF	Send Frequency				•	•
SG	Send averaGe		•	•	•	
SI	Send unIts		•	•	•	•
SP	Send Power		•	•	•	•
SQ	Stabilization Query					•
VE	VErsion	•	•	•	•	•
WD	Wavelength adD		•	•	•	
WE	Wavelength Erase		•	•	•	
WI	Wavelength Index		•	•	•	
WL	WaveLength		•	•	•	
WN	Write range Now		•	•	•	•
WW	Wavelength Discrete		•		•	•
ZA	Zero Abort	•	•	•	•	•
ZE	Zero	•	•	•	•	•
ZQ	Zero Query	•	•	•	•	•
ZS	Zero Save	•	•	•	•	•

Basic Commands

Command	AF (Average Flag)
Syntax	AF
Description	Checks if a new averaged reading has been prepared since previous use of SG command.
Example	Returns: 0 (no new average) or 1 (new average prepared). Note: Thermopile sensors do not have an averaging option when measuring energy. If the command is sent when in energy mode, the instrument will return an error string
Limitations	With Nova-II and Vega only. Not supported by USBI.
See Also	AQ and SG

Command	AQ (Average Query)
Syntax	AQ <average-setting>
Description	Query and set the average setting of the sensor. Returns index of presently active Average setting as well as literal description of set of all available Average settings. If an unsupported index, is specified, will prefix a '?' to the response. Values for <average-setting> (if not set, default to 0) <ul style="list-style-type: none"> • 0: Query device for present average setting. • 1: Configure sensor for first setting ("NONE") • 2: Configure sensor for second setting. • Etc
Example	Example. PE50-BBDIF set to average over one second <ol style="list-style-type: none"> 1) User sent "AQ". Vega returned "** 3 NONE 0.5sec 1sec 3sec 10sec 30sec" 2) User sent "AQ 4". Vega returned "** 4 NONE 0.5sec 1sec 3sec 10sec 30sec". Sensor is now averaging over 3 seconds 3) User sent "AQ 9". Vega returned "? 4 NONE 0.5sec 1sec 3sec 10sec 30sec". Sensor is still averaging over 3 seconds
Limitations	With Nova-II and Vega only. Not supported by USBI.
See Also	AF and SG

Command	AR (All Ranges)
Syntax	AR
Description	Returns all ranges available in head. This is prefixed by the index of the presently active range.
Example	For a PD300 head in the 30 microwatt range, this command will return "** 3 AUTO 30.0mW 3.00mW 300uW 30.0uW 3.00uW 300nW 30.0nW". Note: The index of the highest numeric range is 0. The index of AUTO (when applicable) is -1
Limitations	None
See Also	GU , RN , and WN

Command	AW (All Wavelengths)
Syntax	AW
Description	Returns string fully describing the wavelengths that the head is configured to work with.
Example	<p>Example 1. PD300 with Filter Out. The USBI returned “*CONTINUOUS 350 1100 1 633 488 978 NONE NONE NONE”</p> <p>The user would know that it is a continuous curve head (from the prefix CONTINUOUS), that the range of wavelengths is 350nm through 1100nm, that the present wavelength that the head is configured to measure for is 633 (from the index 1), and the 6 favorite settings as they would be displayed in the USBI PC program (above 10000nm would be displayed as 10.0). The second and third parameters delimit the range of values that the \$WL command would succeed with.</p> <p>Example 2. 3AP head. The USBI returned “*DISCRETE 1 VIS NIR”</p> <p>The user would know that this head is configured for a discrete set of wavelengths (from the prefix DISCRETE), that the head is presently configured to work at the VIS wavelength (from the index 1) and that the set of wavelengths that the head could be configured to work with (via the \$WW command) is "VIS" and "NIR".</p>
Limitations	None
See Also	WD , WE , WI , WL , and WW

Command	DQ (Diffuser Query)
Syntax	DQ <diffuser-setting>
Description	<p>Query and set the diffuser setting of the head.</p> <p>Values for <diffuser-setting> (if parameter isn't set, default to 0)</p> <ul style="list-style-type: none"> • 0: Query USBI for present Diffuser Mode • 1: Configure head for Diffuser Out mode • 2: Configure head for Diffuser In mode
Example	<p>Example 1. A PE-10 head.</p> <p>1) User sent “DQ”. USBI returned “*1 N/A”. There is only 1 setting (that the command is not applicable).</p> <p>Example 2. PE50-BBDIF.</p> <p>4) User sent “DQ”. USBI returned “*1 OUT IN”. Head is in Diffuser Out mode.</p> <p>5) User sent “DQ 2”. USBI returned “* 2 OUT IN”. Head is now in Diffuser In mode.</p> <p>6) User sent “DQ 3”. USBI returned “? 2 OUT IN”. Request is invalid and head remains in Diffuser In mode.</p>
Limitations	For Pyroelectric heads only
See Also	HC

Command	EE (Exposure Energy)
Syntax	EE
Description	Instructs USBI to report up to date exposure measurement, number of pulses, and time elapsed (in tenths of seconds).
Example	<p>Example 1. Pyroelectric head in exposure mode. The USBI returns "* 1.064E-1 2773 124"</p> <p>Total exposure is 106.4mJ, 2773 pulses have been measured, and 12.4 seconds have elapsed since the start of exposure measurement.</p> <p>Example 2. Pyroelectric head in energy mode. The USBI returns "?HEAD NOT MEASURING EXPOSURE"</p> <p>Example 3. Pyroelectric head in power mode. The USBI returns "HEAD NOT MEASURING ENERGY"</p>
Limitations	For Pyroelectric heads only
See Also	FX

Command	EF (Energy Flag)
Syntax	EF
Description	Polls USBI if a new energy reading has been processed and not yet communicated to the user.
Example	USBI returns "*1" if there is a new reading or "*0" if there isn't.
Limitations	For Pyroelectric measuring power or energy; Thermopile and RP heads measuring energy.
See Also	ER (Thermopile and RP only), SE , and SP (for Pyroelectric only)

Command	ER (Energy Ready)
Syntax	ER
Description	Polls USBI if head is ready to take a new energy reading. This is useful for users that can control when their laser fires.
Example	USBI returns "*1" if it's ready for a new energy pulse or "*0" if there isn't.
Limitations	For Thermopile and RP (in single-shot energy mode) only
See Also	EF and SE

Command	ET (Energy Threshold)
Syntax	ET <threshold>
Description	<p>Query and set the threshold setting of the head.</p> <p>Values for <threshold> (if not set, default to 0)</p> <ul style="list-style-type: none"> • 0: Query USBI for present threshold setting. • 1: Configure head to work with LOW threshold. • 2: Configure head to work with MEDIUM threshold. • 3: Configure head to work with HIGH threshold. • 4: Configure head to work with OPTICAL threshold (for heads with photodiode trigger).
Example	<p>Example 1. 3A-P-CAL head</p> <p>1) User sent “ET 4”. USBI returned “*4 LOW MEDIUM HIGH OPTICAL”. Head has been configured to work in OPTICAL trigger mode.</p> <p>Example 2. 30A head.</p> <p>1) User sent “ET”. USBI returned “*2 LOW MEDIUM HIGH”. The head is in MEDIUM threshold mode.</p> <p>2) User sent “ET 4”. USBI returned “?1 LOW MEDIUM HIGH”. OPTICAL trigger is invalid for this head and it remains in LOW threshold mode.</p> <p>3) User sent “ET 3”. USBI returned “*3 LOW MEDIUM HIGH”. Head has been configured to work in HIGH threshold mode.</p>
Limitations	For Thermopile and RP (in single-shot energy mode) only
See Also	HC

Command	FE (Force Energy)
Syntax	FE
Description	Puts instrument into Energy Measurement mode. USBI returns “ * ” if successful and “ ?HEAD CANNOT MEASURE ENERGY ” if not.
Example	User sent “ FE ”. USBI returned “ * ”. Head is now measuring Energy.
Limitations	For Thermopile and Pyroelectric heads. RP heads behave differently and are described in a separate section .
See Also	FP , FX , HC , HI , and SE

Command	FP (Force Power)
Syntax	FP
Description	Puts instrument into Power Measurement mode. USBI returns “ * ” if successful and “ ?HEAD CANNOT MEASURE POWER ” if not.
Example	User sent “ FP ”. USBI returned “ * ”. Head is now measuring Power.
Limitations	None
See Also	FE , FX , HC , HI , and SP

Command	FQ (Filter Query)
Syntax	FQ <filter-setting>
Description	Query and set the filter setting of the head. Values for <filter-setting> (if not set, default to 0) <ul style="list-style-type: none"> • 0: Query USBI for present filter setting. • 1: Configure head for Filter Out mode. • 2: Configure head for Filter In mode.
Example	Example 1. 3A-IS head. 1) User sent "FQ" . USBI returned "*1 N/A" . There is only 1 setting (that the command is not applicable). Example 2. PD300 head. 1) User sent "FQ" . USBI returned "*1 OUT IN" . Head is in Filter In mode. 2) User sent "FQ 2" . The USBI returned "* 2 OUT IN" . Head has been reconfigured to Filter In mode. 3) User sent "FQ 3" . The USBI returned "? 2 OUT IN" . Invalid setting and head remains in Filter In mode.
Limitations	For Photodiode and RP heads only
See Also	HC

Command	FX (Force eXposure)
Syntax	FX
Description	Puts instrument into exposure measurement mode. USBI returns "**" upon success.
Example	User sent "FX" . USBI responded "**" . Head is now measuring Exposure.
Limitations	For Pyroelectric heads only
See Also	EE , FE , FP , and SE

Command	GU (Get range in Use)
Syntax	GU
Description	When in autoranging, returns presently active numeric range.
Example	PD300 with Filter Out in autoranging. The latest readings have been about 2mW. The USBI returns "*1" .
Limitations	None
See Also	AR , RN , and WN

Command	HC (Head Configuration)
Syntax	HC <configuration>
Description	<p>Save Head Configuration for Startup, Calibration, or Response settings. The new setting will be written to the head's memory.</p> <p>Values for <configuration></p> <ul style="list-style-type: none"> • 'S': startup settings (Filter Setting, Energy Range, Diffuser setting, etc.). • 'C': Calibration settings. • 'R': Response settings. <p>The USBI returns **SAVED** on success, **UNCHANGED** if nothing needed to be updated, or **FAILED** if not successful.</p>
Example	None
Limitations	R is for Thermopile and RP heads only
See Also	CQ , DQ , ET , FE , FM , FP , FQ , MP , PL , RQ , SQ , WD , WE , WI , WL , WN , WW

Command	HI (Head Information)
Syntax	HI
Description	<p>Returns type, serial number, name, and measurement abilities of head. Measurement abilities are reported as an 8 byte hexadecimal code where Bit 0 is lit if head can measure power. Bit 1 is lit if head can measure energy. Bit 31 is lit if head can measure frequency. All other bits are reserved and are not guaranteed to be 0 or 1.</p>
Example	<p>Example 1. A 03AP head. USBI returned ** TH 12345 03AP 00000183**. If configuration is 'R', response settings will be saved. The user knows that this is a Thermopile head (TH), its serial number (12345) and name (03AP), and that it can be used to measure power or energy (bits 0 and 1 are lit).</p> <p>Example 2. A PE10 head. USBI returned ** PY 22323 PE10 80000003**. The user knows that this is a Pyroelectric head (PY), the serial number and name, and that it can measure power, energy, and frequency</p>
Limitations	None
See Also	FE , FP , and II

Command	IC (Instrument Configuration)
Syntax	IC
Description	<p>Save Instrument Configuration. The new settings will be saved in the USBI's memory. The USBI returns **SAVED** on success, **UNCHANGED** if nothing needed to be updated, or **FAILED** if not successful.</p>
Example	None
Limitations	None
See Also	MA

Command	II (Instrument Information)
Syntax	II
Description	Returns id, serial number, and name of instrument being queried
Example	The USBI returned “* USBD 113217 SH2USB ”. The user knows that this is an Ophir USB Device (USBD) and its serial number (113217)
Limitations	None
See Also	HI

Command	MA (Mains)
Syntax	MA <line-frequency>
Description	<p>Query and set the line-frequency setting of the instrument.</p> <p>Values for <line-frequency> (if not set, default is 0)</p> <ul style="list-style-type: none"> • 0: Query USBI for present setting. • 1: Configure USBI to work with mains of 50Hz (European standard). • 2: Configure USBI to work with mains of 60Hz (North American and Japanese standard). <p>Note: Factory default for the USBI is 50Hz</p>
Example	<p>Example 1. User sent “MA”. The USBI responded “* 2 50Hz 60Hz”. The User knows that the USBI is configured to work with a line frequency of 60Hz.</p> <p>Example 2. European customer wants to set the USBI to correct line frequency and sends “MA 1”. USBI responds “* 1 50Hz 60Hz”</p>
Limitations	None
See Also	IC

Command	MF (Maximum Frequency)
Syntax	MF
Description	Queries USBI for maximum pulse frequency at which the head can sample the laser for energy measurements.
Example	<p>Example 1. PE50-V2 in short pulse mode. USBI responds “*6000”. The head can sample pulses of a laser whose frequency is 6000 Hertz.</p> <p>Example 2. PE50-V2 in long pulse mode. USBI responds “*60”. The head can sample pulses of a laser whose frequency is 60 Hertz.</p>
Limitations	For Pyroelectric and RP heads only
See Also	HI , PL , and SE

Command	PL (Pulse Length)
Syntax	PL <pulse-length>
Description	Query and set maximum pulse-length (in time) that head is configured to measure. Values for <pulse-length> (if not set, default is 0) <ul style="list-style-type: none"> • 0: Query USBI for present setting. • 1: Set head to Short Pulse mode. • 2: Set head to Long Pulse mode.
Example	Example 1. PE50-V2. <ol style="list-style-type: none"> 1) User sent “PL”. USBI responded “* 2 20us 1.0ms”. Head is presently configured for Long Pulse measurement, maximum pulse length in Short Pulse mode is 20 microseconds, and maximum pulse length in Long Pulse mode is 1.0 milliseconds. 2) User sent “PL 1”. The USBI responded “* 1 20us 1.0ms”. Head has been reconfigured to measure in Short Pulse mode. Example 2. PE10. <ol style="list-style-type: none"> 1) User sent “PL 2”. USBI responded “? 1 20us N/A”. The user knows that the head can only measure in Short Pulse mode and that attempting to set it to Long Pulse mode is an error.
Limitations	For Pyroelectric heads only. RP heads behave differently and are described in a separate section
See Also	HC and MF

Command	RN (Read range Now)
Syntax	RN
Description	Returns presently active measurement range.
Example	Example 1. PD300 in autoranging. THE USBI responds “*-1”. Example 2. PE50-V2 in 2mJ range. The USBI responds “*4”.
Limitations	
See Also	AR , GU , and WN

Command	SE (Send Energy)
Syntax	SE
Description	Queries USBI for Energy Measurement
Example	This command returns the most recent energy measurement. To verify that the USBI has not previously reported it to the user, this command should be used in together with the EF command. Example. <ol style="list-style-type: none"> 1) User sends EF command. 2) Read USBI response. If response is “*0” repeat step 1. If response is “*1” continue with step 3. 3) User send SE command 4) USBI responds “*1.100E-4” (110uJ)
Limitations	Not for Photodiode heads. Head must be measuring Energy
See Also	EF , ER , FE , SF , and SP

Command	SF (Send Frequency)
Syntax	SF
Description	Queries USBI for frequency at which the laser is firing. Note: Although heads can measure frequency up to 1000's of Hertz, at frequencies above 150 Hertz, the USBI samples the pulses for energy measurement (and does not measure the energy of each pulse). To attain higher measurement frequencies the User should use the StartCS and StartTM methods described in ActiveX Detailed Description
Example	Example 1. The USBI returned " *1.000E3 ". The laser is firing at a frequency of 1000Hz. Example 2. The USBI returned " ?FREQ TOO LOW ". The laser is firing at a frequency below 1 Hertz
Limitations	For Pyroelectric and RP heads only
See Also	MF , PL , SE , and SP

Command	SG (Send averaGe)
Syntax	SG
Description	Requests most recent average calculated by the instrument.
Example	Returns power or energy average as an ASCII string in scientific notation. Returns most recent average reading calculated by the instrument. Will return the same average more than once if the request is repeated before a new average has been prepared. Use with \$AF to ensure reading each average only once. Errors reported ?HEAD NOT MEASURING POWER if thermopile sensor is measuring energy
Limitations	Nova-II and Vega only. Not supported in USBI. Does not average energy for Thermopile sensors.
See Also	AF and AQ

Command	SI (Send unIts)
Syntax	SI
Description	Queries USBI for present measurement mode. Returns " *J " for Energy and " *W " for Power. If head isn't measuring anything, returns " *X "
Example	3AP measuring power. The USBI returns " *W ".
Limitations	None
See Also	None

Command	SP (Send Power)
Syntax	SP
Description	Queries USBI for Power Measurement
Example	<p>For all heads except Pyroelectric heads: Return next power measurement Example. User sent "SP". USBI responded "**1.300E-5". Power measured is 13 microwatts.</p> <p>For Pyroelectric heads This command returns the most recent power measurement. To verify that the USBI has not previously reported it to the user, this command should be used in together with the EF command.</p> <p>Example. User sends EF command. Read USBI response. If response is "**0" repeat step 1. If response is "**1" continue with step 3. User sends SP command USBI responds "**1.100E-1" (110mW)</p>
Limitations	Head must be measuring Power
See Also	EF , FP , SE , and SF ,

Command	VE (Version)
Syntax	VE
Description	Query USBI for version of embedded software
Example	Version USBA129.bin of software is installed. The USBI returns " **UB1.29 "
Limitations	None
See Also	None

Command	WD (Wavelength adD)
Syntax	WD <Index> <Wavelength>
Description	<p>Add a wavelength to list of favorite wavelengths that the head is configured to work with. Index: Location in list of wavelengths in which to insert the wavelength selected (must be between an unused value between 1 and 6 as returned by the AW command) Wavelength: New favorite wavelength (must be between the lower and upper wavelength limits as returned by the AW command)</p>
Example	<p>PE10 with the following settings as returned by the AW command **CONTINUOUS 193 12000 4 NONE 366 532 1064 2100 10.6</p> <ol style="list-style-type: none"> 1) User sent "WD 4 248". USBI responded "?WAVELENGTH ALREADY DEFINED. USE WL COMMAND" 2) Example 2. User sent "WD 1 100". USBI responded "?WAVELENGTH OUT OF RANGE" 3) Example 3. User sent "WD 7 248". USBI responded "?INDEX NOT IN RANGE". 4) 4. User sent "WD 1 248". USBI responded "**".
Limitations	For all Photodiode heads and for Pyroelectric and Thermopile heads with a continuous spectrum
See Also	AW , HC , WE , WI , and WL

Command	WE (Wavelength Erase)
Syntax	WE <Index>
Description	Instructs USBI to delete from its list of favorite wavelengths the wavelength at location <Index>. Index must be between 1 and 6 and not the presently active index.
Example	PE10 with the following settings as returned by the AW command “*CONTINUOUS 193 12000 4 248 366 532 1064 2100 10.6” 1) User sent “WE 4” . USBI responded “?CANNOT ERASE PRESENTLY ACTIVE INDEX” . 2) Example 2. User sent “WE 5” . USBI responded “*” .
Limitations	For all Photodiode heads and for Pyroelectric and Thermopile heads with a continuous spectrum
See Also	AW , HC , WD , WI , and WL

Command	WI (Wavelength Index)
Syntax	WI <Index>
Description	Set the USBI to work with wavelength at location <Index> in list of favorite wavelengths.
Example	PE10 with the following settings as returned by the AW command “*CONTINUOUS 193 12000 4 248 366 532 1064 NONE 10.6” 6) User sent “WI 5” . USBI responded “?NO WAVELENGTH DEFINED AT SELECTED INDEX” . 7) Example 2. User sent “WI 1” . USBI responded “*” .
Limitations	None
See Also	AW , HC , WD , WE , WL , and WW

Command	WL (WaveLength)
Syntax	WL <Wavelength>
Description	Set wavelength at presently active index to new value. <Wavelength> must be between the lower and upper limits of the spectrum as returned in the AW command
Example	PE10 with the following settings as returned by the AW command “*CONTINUOUS 193 12000 1 248 366 532 1064 NONE 10.6” 1) User sent “WL 19000” . USBI responded “?WAVELENGTH OUT OF RANGE” . 2) Example 2. User sent “WL 11000” . USBI responded “*” .
Limitations	For all Photodiode heads and for Pyroelectric and Thermopile heads with a continuous spectrum
See Also	AW , HC , WD , WE , and WI

Command	WN (Write range Now)
Syntax	WN <range-setting>
Description	Configure head to measure in a specific range Note: The index of the highest numeric range is 0. The index of AUTO (when applicable) is -1
Example	To force a PD300 in Filter Out mode into the 3mW range enter "WN 1" . The USBI responds "**" .
Limitations	None
See Also	AR , GU , and RN

Command	WW (set discrete Wavelength)
Syntax	WW <wavelength-string>
Description	Configure head to work with laser as defined in <wavelength-string> (must be a string as returned by the AW command).
Example	3AP head with the following settings as returned by the AW command. "*DISCRETE 1 VIS NIR" User sent "WW CO2" . USBI return "?LASER NOT FOUND" . Example 2. User sent "WW NIR" . USBI return "**" .
Limitations	For all Thermopile and RP heads. Also for Pyroelectric heads with a discrete spectrum. Note: WI works with Discrete Spectrum heads and as such is preferred over WW
See Also	AW , HC , and WI

Advanced Commands

Commands described in this chapter will affect the measurement performance of the USBI. They should be used with caution.

Command	CQ (Calibration Query - General)
Syntax	CQ <factor-index> <new-factor>
Description	Query and set presently active calibration factors. Values for <factor-index> (if not set, default is 0) 0: Query only. 1: Request to change the active overall factor. 2: Request to change the active laser's factor. For heads that don't have per-wavelength factors, will return error code. New-factor is a floating-point number between 0.0002 and 2.0 scaled up by 10000 (2 to 20000)
Example	Examples for different head types are listed below
Limitations	None
See Also	HC

Command	CQ (Calibration Query – Photodiode heads)
Syntax	See CQ (Calibration Query – Overview)
Description	Will return overall factor presently in use (depends on the Filter setting). Photodiode heads only have an overall factor. Therefore Factor-index should not be set to 2.
Example	User sent “ CQ ”. USBI responded “ *1.025 ” (correction factor of 2.5%) User sent “ CQ 2 10000 ”. USBI responded “ ?1.025 ” (factor not changed). User sends “ CQ 1 22000 ”. USBI responds “ ?PARAM ERROR ” (new-factor is greater than 20000). User sends “ CQ 1 10100 ”. USBI responds “ *1.0100 ” (factor set to 1%). Note. In order to adjust the calibration factors for both Filter Out and Filter In modes the User should perform the following steps 1) FQ 1 (Set the head to Filter Out mode) 2) Adjust Filter Out factor with the CQ command 3) FQ 2 (Set the head to Filter In mode) 4) Adjust Filter In factor with the CQ command 5) HC C (to save calibration factors permanently)
Limitations	None
See Also	FQ and HC

Command	CQ (Calibration Query – Thermopile and RP heads)
Syntax	See CQ (Calibration Query – Overview)
Description	<p>CQ returns 4 values</p> <ol style="list-style-type: none"> 1) User Power or Energy factor (depending on measurement mode). This factor can be updated by “CQ 1 <value>”. It affects measurements with any laser. 2) User Laser factor. This factor can be updated by “CQ 2 <value>”. It affects measurement with the presently active laser only 3) Overall Laser factor. This is the factor that the USBI uses for the present Laser in use. It is affected by the User Laser Factor and by an Ophir calibration factor for this wavelength that cannot be adjusted by the User 4) Overall Sensitivity. This is a composite of the User Power factor, the Laser factors in use, and an Ophir overall sensitivity factor that cannot be adjusted by the User. Note that changes in the Power Factor affect this field for all Lasers. Changes in the User Laser Factor affect this field only for the present laser in use.
Example	<ol style="list-style-type: none"> 1) User sent “AW”. USBI responded “*DISCRETE 1 CO2 YAG VIS”. Presently active laser is CO2 2) User sent “SI”. USBI responded “*W”. Head is in power mode. 3) User sent “CQ”. USBI responded “*1.0000 1.0000 1.0000 2.5926E-8”. These are the factors for CO2 laser in Power Mode. 4) User sent “CQ 1 11000”. USBI responded “*1.1000 1.0000 1.0000 2.3569E-8”. Note the change in fields 1 and 4. 5) User sent “CQ 2 11000”. USBI responded “*1.1000 1.1000 1.1000 2.1426E-8”. Note the change in fields 2, 3, and 4 6) User sent “WW YAG”. USBI responded “*”. Presently active laser is now YAG. 7) User sent “CQ”. USBI responded “*1.1000 1.0000 1.0950 2.1524E-8”. Fields 2, 3, and 4 were replaced by values for YAG laser 8) User sent “CQ 2 9000”. USBI responded “*1.1000 0.8999 0.9853 2.3919E-8”. Note change in fields 2, 3, and 4 9) User sent “WW CO2”. USBI responded “*”. Presently active laser is now CO2. 10) User sent “CQ”. USBI responded “*1.1000 1.1000 1.1000 2.1426E-8”. Notice that the values are the same as in step 5. The laser specific changes of step 8 have no affect on a different laser. 11) User sent “FE”. USBI responded “*”. Head is in energy mode 12) User sent “CQ”. USBI responded “*1.0000 1.1000 1.1000 2.1426E-8”. Field 1 is the energy factor. It has no affect on field 4.
Limitations	None
See Also	AW , FE , FP , HC , and WW

Command	CQ (Calibration Query – Continuous Spectrum Pyroelectric heads)
Syntax	See CQ (Calibration Query – Overview)
Description	Will return overall factor presently in use (depends on the Pulse Width setting). These Pyroelectric heads only have an overall factor. Therefore Factor-index should not be set to 2.
Example	<p>User sends "CQ". USBI responds "*1.025" (correction factor of 2.5%)</p> <p>User sends "CQ 2 10000". USBI responds "?1.025" (factor not changed)</p> <p>User sends "CQ 1 22000". USBI responds "?PARAM ERROR" (new-factor is greater than 20000)</p> <p>User sends "CQ 1 10100". USBI responds "*1.0100" (factor set to 1%)</p> <p>Note. In order to adjust the calibration factors for both Short Pulse and Long Pulse modes the User should perform the following steps</p> <ol style="list-style-type: none"> 1) PL 1 (Set the head to Short Pulse mode) 2) Adjust Short Pulse factor with the CQ command 3) PL 2 (Set the head to Long Pulse mode) 4) Adjust Long Pulse factor with the CQ command 5) HC C (to save calibration factors permanently)
Limitations	None
See Also	PL and HC

Command	CQ (Calibration Query – Discrete Spectrum Pyroelectric heads)
Syntax	See CQ (Calibration Query – Overview)
Description	<p>CQ returns 3 values</p> <ol style="list-style-type: none"> 1) Overall Energy Factor. This factor can be updated by “CQ 1 <value>”. It affects measurements with any laser. 2) User Laser factor. This factor can be updated by “CQ 2 <value>”. It affects measurement with the presently active laser only 3) Overall Laser factor. This is the factor that the USBI uses for the present Laser in use. It is affected by the User Laser Factor and by an Ophir calibration factor for this wavelength that cannot be adjusted by the User
Example	<ol style="list-style-type: none"> 1) User sent “AW”. USBI responded “* DISCRETE 2 248 1064 193”. Presently active wavelength is 1064 2) User sent “CQ”. USBI responded “*1.0000 1.0000 1.2500” 3) User sent “CQ 1 11000”. USBI responded “*1.1000 1.0000 1.2500”. Only first factor changed. 4) User sent “CQ 2 12000”. USBI responded “*1.1000 1.2000 1.5000”. Note change in fields 2 and 3. 5) User sent “WW 248”. USBI responded “*”. Presently active laser is now 248 6) User sent “CQ”. USBI responded “*1.1000 1.0000 1.0000”. Overall Energy factor is unchanged. Factors 2 and 3 have been replaced by values for 248 7) User sent “CQ 2 9000”. USBI responded “*1.1000 0.8999 0.8999”. Note change in fields 2 and 3. 8) User sent “WW 1064”. USBI responded “*”. Presently active laser is now 1064. 9) User sent “CQ 2 12000”. USBI responded “*1.1000 1.2000 1.5000”. Note values of factors 2 and 3 are same as in step 4. The laser specific changes of step 8 have no affect on a different laser. <p>Note. In order to adjust the Overall Energy Factor for both Short Pulse and Long Pulse modes the User should perform the following steps</p> <ol style="list-style-type: none"> 1) PL 1 (Set the head to Short Pulse mode) 2) Adjust Short Pulse factor with the CQ command 3) PL 2 (Set the head to Long Pulse mode) 4) Adjust Long Pulse factor with the CQ command 5) HC C (to save calibration factors permanently) <p>For heads with a diffuser, perform the above routine, replacing the PL command with the DQ command.</p>
Limitations	None
See Also	AW , DQ , HC , PL , and WW

Command	RQ (Response Query)
Syntax	RQ <response-factor>
Description	<p>Query and set the User adjustable response time factor.</p> <p>Response-factor is a floating-point number between 0.0002 and 2.0 scaled up by 10000 (2 to 20000)</p>
Example	<p>User sent “RQ”. USBI responded “*1.000”</p> <p>User sends “RQ 22000”. USBI responds “?PARAM ERROR” (Response-factor is greater than 20000).</p> <p>User sends “RQ 10100”. USBI responds “*1.0100”</p>

Limitations	For Thermopile and RP heads only
See Also	CQ and HC

Command	ZA (Zero Abort)
Syntax	ZA
Description	Aborts request to zero the USBI measurement circuitry. USBI returns status of the zeroing process. **ZEROING NOT STARTED** . If ZA was sent before the ZE command. **ZEROING ABORTED** . If ZA was sent before zeroing was completed. **ZEROING COMPLETED** . If ZA was sent after zeroing was completed.
Example	Example. User sent "ZE" followed by the "ZA" command. USBI returned **ZEROING ABORTED** .
Limitations	None
See Also	ZE , ZQ , and ZS

Command	ZE (Request to Zero the USBI measurement circuitry)
Syntax	ZE
Description	Analog components occasionally "drift" thereby introducing small errors in USBI measurement. This command measures that drift and subtracts it from measurements. We suggest zeroing the USBI once in two months.
Example	Example 1. User sent "ZE" . USBI responded **" . Example 2. User sent "ZE" before previous zeroing request terminated. USBI responded "?ZEROING IN PROGRESS" . Note. There are three different types of zeroings. 1) High Impedance: With no head attached or with a Photodiode head attached. 2) Low Impedance: With a Thermopile or RP head attached. For these heads, the User should first perform a Low Impedance zero, save the result, and then perform a High Impedance zero. 3) Fast Zero: With a Pyroelectric head attached
Limitations	None
See Also	ZA , ZQ , and ZS

Command	ZQ (Zero Query)
Syntax	ZQ
Description	User request to determine status of zeroing process. USBI will return **ZEROING NOT STARTED . If ZE command was never sent. **ZEROING IN PROGRESS . If ZE command was sent but the zeroing process has not yet terminated. **ZEROING COMPLETED . If the zeroing process terminated successfully. **ZEROING FAILED . If the zeroing process terminated unsuccessfully. **ZEROING ABORTED . If the zeroing process was terminated by the ZA command.
Example	<ol style="list-style-type: none"> 1) User sent "ZQ". USBI responded **ZEROING NOT STARTED. 2) User sent "ZE". USBI responded **. 3) User sent "ZQ". USBI responded **ZEROING IN PROGRESS. 4) Delay about 30 seconds. 5) User sent "ZQ". USBI responded **ZEROING COMPLETED.
Limitations	None
See Also	ZA , ZE , and ZS

Command	ZS (Zero Save)
Syntax	ZS
Description	Save results of the zeroing process to the USBI's memory. USBI returns ?ZEROING ABORTED . If ZS is issued after zero was aborted. ?ZEROING IN PROGRESS . If ZS is issued during zeroing process. ?ZEROING FAILED . If ZS is issued after zeroing process failed. **SAVED . Upon success
Example	<ol style="list-style-type: none"> 1) User sent "ZS". USBI responded ?ZEROING NOT STARTED. 2) User sent "ZE". USBI responded **. 3) User sent "ZS". USBI responded ?ZEROING IN PROGRESS. 4) Delay about 30 seconds. 5) User sent "ZS". USBI responded **SAVED.
Limitations	None
See Also	ZA , ZE , and ZQ

RP Commands

This section describes commands that are unique to RP (Rapid Pulse) heads. It also describes commands that are common with other heads but with significantly different behavior when used with RP heads.

Command	FE (Force Energy – RP heads)
Syntax	FE <energy-mode>
Description	Puts instrument into one of the RP Energy Measurement modes. Values for <energy-mode> (if not present, leave head in present mode) 'S': Single-Shot Energy (like Thermopile heads). 'R': Relative mode, RP Energy. 'A': Absolute mode RP Energy. USBI returns "*" upon completing the command
Example	Example 1. User sent " FE A ". USBI responded "*". Head is now configured for RP Absolute Energy measurement.
Limitations	None
See Also	FE , FP , HC , HI , and SE

Command	FI (Force missing)
Syntax	FI
Description	Puts head into RP energy mode and instructs it to report missing pulses as well.
Example	<ol style="list-style-type: none"> 1) User sent "SI". USBI responded "*W". Head is in Power Mode 2) User sent "FI". USBI responded "*". Head is now in RP measurement mode and will also report missing pulses.
Limitations	Missing pulses can only be measured accurately at laser frequencies up to 50 Hertz
See Also	FM and MP

Command	FM (Frequency Mode)
Syntax	FM <frequency-mode>
Description	Query and configure head for pace of RP measurements. Values for <frequency-mode> (if not set, default is 0) 0. Query USBI for present Frequency mode. 1. Set head for Fast Mode (greater than 3 Hertz) 2. Set head for Slow Mode (less than 3 Hertz)
Example	<ol style="list-style-type: none"> 1) User sent "FM". USBI responded "*1 >3Hz <3Hz". Head has been queried and found to be in Fast Mode 2) User sent "FM 2". USBI responded "*2 >3Hz <3Hz". Head has been set to Slow Mode.
Limitations	None
See Also	HC , MP , and SQ

Command	MP (Missing Pulses)
Syntax	MP <Mode>
Description	Set mode of missing pulse measurement. Values for <mode> (if not set, default is 0) 0: Query USBI for present Missing Pulse mode 1: Turn off missing pulse measurement 2: Set missing pulse measurement mode to slower than 40Hz. 3: Set missing pulse measurement mode to faster than 40Hz. For heads in Slow Mode 0: Query USBI for present Missing Pulse mode 1: Turn off missing pulse measurement 2: Turn on missing pulse measurement
Example	Example 1 30-A-P-RP in Slow Mode. User sent " MP 2 ". USBI responded " *2 OFF ON ". Example 2. 30-A-P-RP in Fast Mode. User sent " MP ". USBI responded " 3 OFF <40Hz >40Hz ".
Limitations	None
See Also	FI , FM , and HC

Command	OA (Optimize Abort)
Syntax	OA
Description	Abort RP Optimization Process.
Example	1) User sent " OA ". USBI responded " ?OPTIMIZE NOT STARTED " 2) User sent " OP ". USBI responded " ** ". 3) User sent " OA ". USBI responded " OPTIMIZE ABORTED "
Limitations	None
See Also	OE , OP , OQ , and OS

Command	OE (Optimize Energy)
Syntax	OE
Description	Command to enter second stage of RP Optimization process. This command must be preceded by the OP command
Example	1) User sent " OE ". USBI responded " ?OPTIMIZE NOT STARTED " 2) User sent " OP ". USBI responded " ** ". 3) User sent " OE ". USBI responded " ** "
Limitations	None
See Also	OA , OP , OQ , and OS

Command	OP (Optimize Power)
Syntax	OP
Description	<p>Command to enter the first stage of the RP optimization process. RP heads are very sensitive to changes in optical setup/alignment. This set of commands causes the head to reconfigure its electronic circuitry to best measure the energy as the laser pulses hit the head.</p> <p>The correct use of these commands is as follows</p> <ol style="list-style-type: none"> 1) OP. Wait for stable power as reported by the SP command 2) OE. To enter the Energy stage of the optimization process. This stage consists of 3 sub-stages. 3) OQ. To query USBI for status of the Optimization process 4) OS. To save the results upon successful completion.
Example	<ol style="list-style-type: none"> 1) User sent "OP". USBI responded "**". 2) User sent "OE". USBI responded "**" 3) User sent "OP". USBI responded "?OPTIMIZE SELECT CAP". USBI is up to the Capacitor Selection sub-stage of the Energy stage of Optimization
Limitations	None
See Also	OA , OE , OQ , and OS

Command	OQ (Optimize Query)
Syntax	OQ
Description	<p>Query USBI for status of RP optimization process. USBI will respond</p> <p>"*OPTIMIZE NOT STARTED". On startup.</p> <p>"*OPTIMIZE READ POWER". After issuing the OP command</p> <p>"*OPTIMIZE SELECT CAP". First sub-stage after the OE command</p> <p>"*OPTIMIZE SELECT GAIN". Second sub-stage after the OE command</p> <p>"*OPTIMIZE MEASURE FREQ". Third sub-stage after the OE command.</p> <p>"*OPTIMIZE ABORTED". After the OA command</p> <p>"*OPTIMIZE FAILED". If optimization process was unsuccessful</p> <p>"*OPTIMIZE COMPLETED". If optimization process was successful</p>
Example	See description
Limitations	None
See Also	OA , OE , OP , and OS

Command	OS (Optimize Save)
Syntax	OS
Description	Save result of optimization process to head's memory. USBI will respond " ?OPTIMIZE NOT STARTED ". If optimization not yet started " ?OPTIMIZE READ POWER ". If in power stage " ?OPTIMIZE SELECT CAP ". First sub-stage after the OE command " ?OPTIMIZE SELECT GAIN ". Second sub-stage after the OE command " ?OPTIMIZE MEASURE FREQ ". Third sub-stage after the OE command. " ?OPTIMIZE ABORTED ". After the OA command " ?OPTIMIZE FAILED ". If optimization process was unsuccessful " *SAVED ". If optimization process was successful and saved result to head's memory
Example	<ol style="list-style-type: none"> 1) User sent "OP". USBI responded "**". 2) User sent "OS". USBI responded "?OPTIMIZE READ POWER". 3) User sent "OE". USBI responded "**". 4) User sent "OQ". Repeat until USBI returns "*OPTIMIZE COMPLETED". 5) User sent "OS". USBI responded "*SAVED".
Limitations	None
See Also	OA , OE , OP , and OQ

Command	PL (Pulse Length – RP heads)
Syntax	PL <pulse-length-selected> <pulse-length-returned>
Description	Some RP heads have as many as 180 different pulse lengths to select from. This command allows independent selection of pulse-length index for head configuration (pulse-length-selected) and response to User of entire set of pulse lengths (starting from pulse-length-returned)
Example	<ol style="list-style-type: none"> 1) User sent "PL". USBI responded "*1 10us 20us 30us 40us 50us 60us 70us 80us 90us 100us 110us 120us". Head is using 10us pulse time. 12 possible pulse times started with the present setting are returned. 2) User sent "PL 8". USBI responded "8 80us 90us 100us 110us 120us 130us 140us 150us 160us 170us 180us 190us". User has selected the 80us pulse time. USBI responded with presently selected index as well as list of 12 pulse times, starting with the presently selected one 3) User sent "PL 0 100". USBI responded "8 40ms 42ms 44ms 46ms 48ms 50ms 55ms 60ms 65ms 70ms 75ms 80ms". Presently selected index is 8 (80us). Response to User starts with pulse time of 100th choice in list of pulse times.
Limitations	None
See Also	HC

Command	SQ (Stabilization Query)
Syntax	SQ <time>
Description	Instructs USBI to calculate Absolute Energy only after power measurements have stabilized over a period of time. Values for <time> (if not set, default is 0) 0: Query USBI for present setting 1: Set period to 0 (no stabilization time required) 2: Set period to 2 seconds in Fast Mode and 20 in Slow Mode. 3: Set period to 5 seconds in Fast Mode and 30 in Slow Mode. 4: Set period to 10 seconds in Fast Mode and 40 in Slow Mode. 5: Set period to 15 seconds in Fast Mode and 60 in Slow Mode.
Example	<ol style="list-style-type: none"> 1) User sent "SQ". USBI responded "*3 NONE 2s 5s 10s 15s". Stabilization period selected is 5 seconds. 2) User sent "SQ 5". USBI responded "*5 NONE 2s 5s 10s 15s". Stabilization period selected is now 15 seconds. 3) User sent "FM 2". USBI responded "*2 >3Hz <3Hz". RP is now in Slow Mode 4) User sent "SQ". USBI responded "*5 NONE 20s 30s 40s 60s". Stabilization period selected is now 60 seconds.
Limitations	None
See Also	FM and HC

Appendix A: OphirUsbXBeta

Several customers complained that OphirUsbX could not be used in console applications. This is because the ActiveX fires an event that is based in a window. If the client application is "window-less", then it will not work well with the ActiveX. Also, MatLab based applications couldn't call in to the ActiveX.

OphirUsbXBeta fixes these problems, as described below.

1. We have added another way to deliver data to the calling application. Instead of sending the data together with the event we don't fire an event. Rather, the application is expected to poll the ActiveX every 50mS for a new batch of data. This solves a problem with calling the ActiveX from within a console application.
 - Measurement: Use **StartCS2 / StartTM2** and **GetData**
2. To solve the problem of using our ActiveX in Matlab, we had to change the MFC interface of VARIANT * parameters in the following functions. The default interface is [in,out] whereas these parameters should really be [out]
 - Read [out] VARIANT *Data
 - GetErrorFromCode [out] VARIANT* varErrorString
 - StartCS [out] VARIANT* varDeviceResponse
 - StartTM [out] VARIANT* varDeviceResponse
3. To distinguish between OphirUsbX and OphirUsbXBeta, please note the following.
 - It has a different GUID and name (OphirUsbXBeta, OphirUsbXBetaLib) in order to distinguish it from the officially released version
 - The version of the beta is 2.6
 - OphirUsbXBeta.ocx must be registered with regsvr32 " OphirUsbXBeta.ocx"
 - OphirUsbXBeta.ocx and sample code will be found in the Beta subdirectory of the Automation Examples directory