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User Manual

EA-1

ETHERNET ADAPTER

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Contents

About this document:

This manual contains instructions for using the Ophir “EA-1 Ethernet Adapter” device.

The manual is divided into several sections:

- Introduction to the EA-1 and general description of the product
- Instructions for initial configuration and setup
- Instructions for using the accompanying PC application
- Instructions for using the device via user commands
- Device specifications

Note: For the latest version of this document please see our website: www.ophiropt.com

Definition of Terms:

The word “*device*” used throughout this manual refers to the EA-1 adapter itself.

Instructions regarding computer control of the adapter (for example, opening a Telnet connection or using the USB port) refer to a PC running Windows 7. Instructions for a PC running XP or newer versions of Windows are similar or identical in most cases but minor variations may be required.

Note: *It is possible to perform all these tasks using a computer running another operating system and not just with Windows, for example a MAC or Linux PC, but in that case the instructions will be different according to the specific operating system being used. All the tasks should still be possible using a different platform, as they are not specific to Microsoft Windows (for example, Telnet and USB Virtual COM Port) but instructions are included specifically for Windows as that is how the device and software have been tested.*

Chapter 1 - Introduction:

This chapter provides some basic information about the EA-1 and a general description of the device.

General Description:

The EA-1 is an Ethernet Adapter intended for OEM customers. It is designed to work with standard or OEM Ophir smart-plug sensors using a D15 connector. The EA-1 supports Ophir thermopile, photodiode, pyroelectric (PE-C) and PD10 series sensors.

The EA-1 device is supported by a special PC Application "*OphirEthernetApp*" or by Ophir's StarLab software package.

Physical connections to the device are as follows:

On the rear panel:

- Mini-USB input, used for configuration and factory calibration
- RJ-45 connector to Ethernet
- 12-24v DC power input socket, using standard Ophir connector (mating with 2.1/5.5mm axial plug)

On the front panel:

- D15 socket to Ophir smart-sensor plug

On the sides:

- Two M3 mounting holes are provided along each side of the device allowing attachment of an optional bracket (as shown in the illustration above). The bracket makes it easier for the customer to attach the device into his mechanical system. A set of two brackets and four screws are supplied with the device.

Full device specifications are included in Appendix A below.

Package Contents:

The EA-1 package includes the following items:

- EA-1 adapter
- Ethernet cross cable (for initial configuration)
- USB-A to USB-Mini-B cable (for initial configuration)
- Ophir 12v DC power supply
- 2x mounting brackets, 4x M3 screws for attaching the brackets to the device, 1x Allen Key

The *"OphirEthernetApp"* PC application and drivers for using the USB Virtual COM Port are available on the Ophir website, www.ophiropt.com, search for "EA-1" and "Software".

The device can be powered either via 'Power over Ethernet' (PoE) if available, or via the 12-24v DC input.

Connection Protocols:

There are four ways to connect to the device:

- Telnet
- HTTP
- UDP
- USB Virtual COM Port

Telnet:

A Telnet connection can be used to send commands and receive back replies from the device. The connection is established by using the device's IP address. The host device (for example, a PC) is the "client" and the EA-1 device is the "server". This type of connection can be used manually from a Telnet terminal, or can be programmed into the user's software application to add automation, in much the same way as using a COM port. This type of connection protocol is used in the *"OphirEthernetApp"* PC application to control the device. Details are listed later on in this document.

HTTP:

Using a web browser, a connection can be established to the device which allows basic configuration, sending commands, monitoring power from the sensor, and viewing general information about the device. The user needs to enter the IP address in the browser and a connection is made to the device. A top level “web-page” is displayed with several buttons that allow entry into several lower level pages. In addition, there is an option to send software commands directly using the HTTP protocol. As for the Telnet connection, the host device is the “client” and the EA-1 device is the “server”. Details are listed later on in this document.

UDP:

For situations where Telnet is not available (for example - working with some PLCs) another option is to connect to the device using a UDP connection. A special protocol is defined for working with UDP, see details below in the section "Details of User Commands”. Note that the preferred protocol is Telnet, and if Telnet is not supported by the device (for example – some PLCs), Telnet can be emulated using native TCP/IP. See Appendix 4 for more details.

USB Virtual COM Port:

A Mini-B USB connector is provided on the EA-1 device in addition to the RJ-45, to allow customers to connect to the device separately from the Ethernet for configuration purposes. This connection can be used to query or set the IP address for the first time, or to switch between dynamic and static IP address modes. For example, if the user is not certain of the IP address of the device and therefore cannot connect via the Ethernet connector, they have the option to connect via the USB port and query the IP address in an independent way from the Ethernet.

More details of using this connection are added below together with the basic configuration information.

This type of connection is supported also by the “*OphirEthernetApp”* software supplied with the device.

Ethernet Cables and Ground Connections to EA-1 Device:

See Appendix 3 below for information on what type of Ethernet cables are recommended to be used with the EA-1 device, and for information on issues of grounding and isolation.

Chapter 2 - Configuration:

Configuration of the EA-1 adapter is necessary before using the device for the first time. In particular, the IP address (and other related settings) must be set. Two IP address modes are supported - static allocation (default) or dynamic allocation (using DHCP).

In addition, the customer can optionally choose a “User Device Name” for the EA-1 adapter to make it easier to identify the device on the network. This is particularly useful if there are several EA-1 devices connected on the customer’s network at the same time.

This chapter describes how to set a static IP Address, how to change over to dynamic mode and how to change the user device name. Several configuration methods are described in detail, including using the “*OphirEthernetApp”* provided with the EA-1 Adapter, if using a PC running Windows. The user can choose whichever method is most convenient.

The last section in this chapter describes how to return the device to factory default settings.

Device Default Configuration:

The device is shipped with the following default configuration settings:

IP Address…… 10.0.0.2

Subnet Mask……..... 255.255.255.0

Default Gateway……. 10.0.0.1

User Device Name……. (blank)

IP Address allocation…….. static (DHCP disabled)

Note: *The default IP address “10.0.0.2” is a special IP address reserved for connecting directly to the device via a PC rather than via a network. In most cases it will not be possible to connect to the device via a network with this IP address. Conversely, if the IP address is changed by the customer to a new value, for example 172.16.16.49 as in the examples below, it will still be possible to connect to the EA-1 device directly from a PC, but only if the default gateway setting on the PC is also set to the correct value, in this example 172.16.16.1. See Appendix 2 for more details.*

Choosing New IP address for EA-1 Device:

The first stage in the EA-1 setup is to choose a new IP address for the device. In order to choose a new IP address, reference must be made to the network to which the device will be attached. Most networks have a subnet IP address (the first 2 or 3 parts of the IP address) which is fixed for all the devices on the network. Consult with your network administrator to obtain a suitable IP address for your device.

Alternatively, it is possible to choose a “dynamic” IP address (DHCP mode) which is allocated automatically by the network. The advantage of doing this is that there is no need to choose an IP address by hand. The disadvantage is that the user may not know what IP address has been allocated to the device and therefore it will be more difficult to connect to the device “by hand” via a Telnet connection or otherwise. The *OphirEthernetApp* will be able to search and find the device when using DHCP mode.

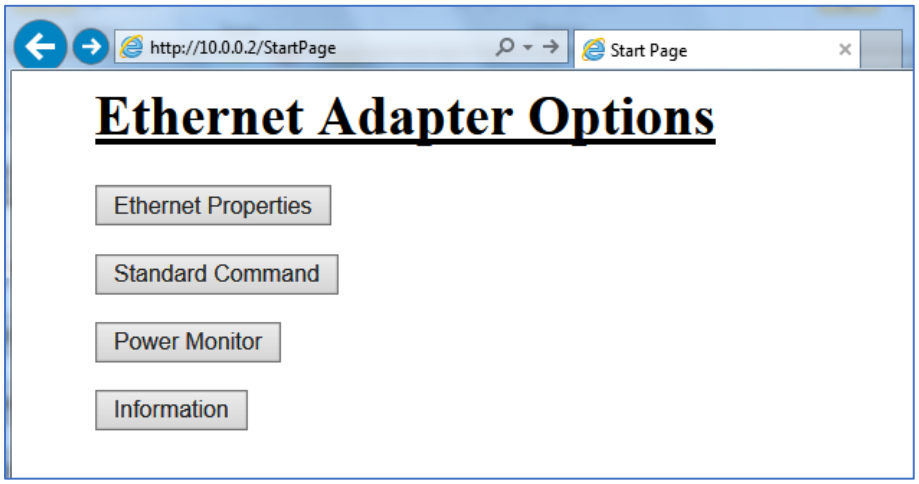
Setting up a static IP address using HTTP:

In order to set a new static IP address using HTTP, the device must first be connected directly to a PC via its network port (RJ-45 socket) using the supplied cross-over cable, and a web browser opened to IP Address "10.0.0.2"

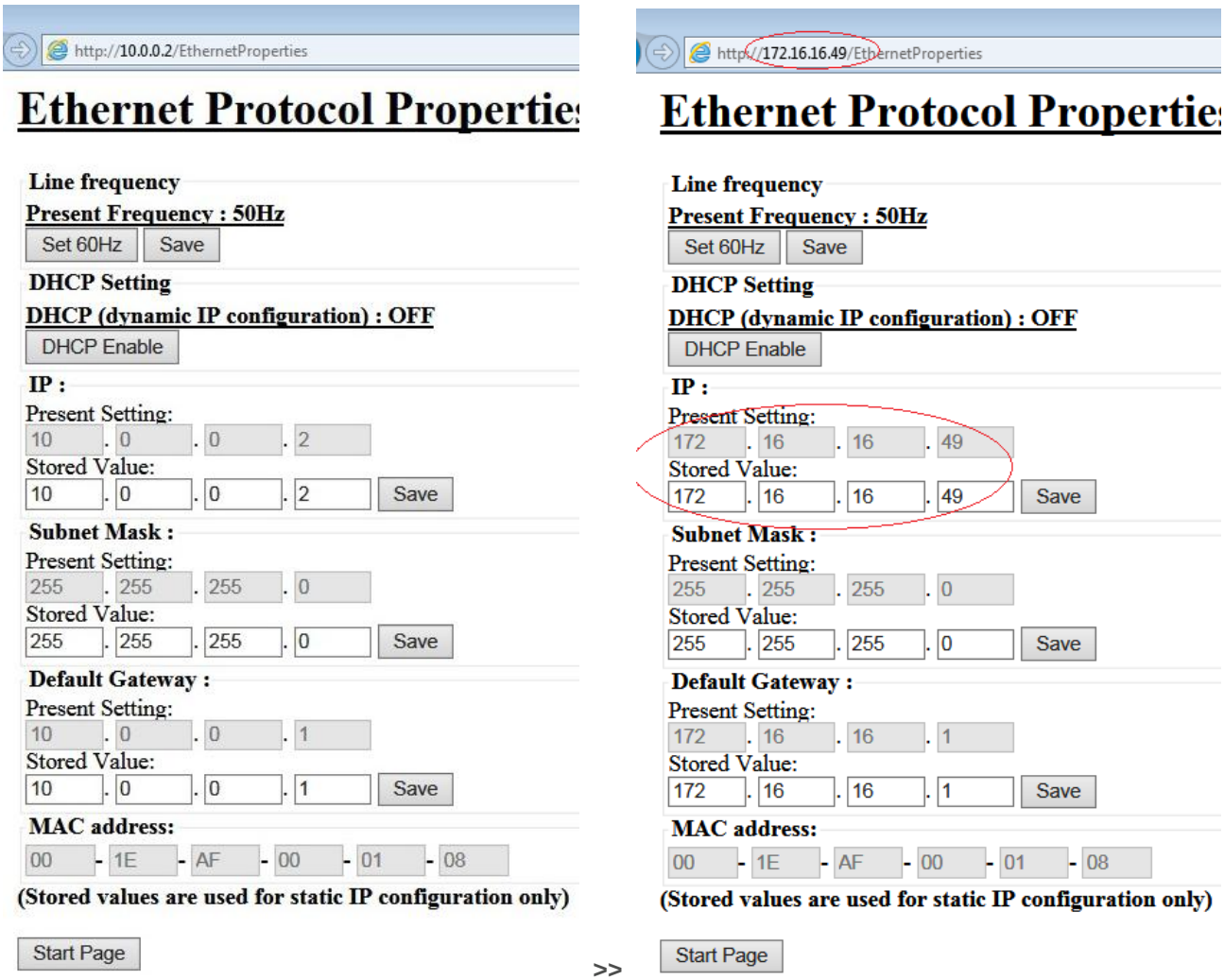
An IP address for the EA-1 adapter needs to be obtained from the network administrator; this example uses an IP Address 172.16.16.49, Subnet Mask 255.255.255.0 (default), IP Gateway 172.16.16.1

Note: *In order to connect to the device using a PC, it may be necessary to first set the PC to a static IP address. Instructions for doing this are shown in Appendix 2 below.*

The following page should be shown on the web browser once a connection is established for the first time:



Click on "Ethernet Properties" and the following page should be displayed (on the left):



Enter the new IP address, and click on “Save”. The following message will be displayed at the bottom of the webpage:

*SAVED (need reset)

The settings have been saved in the device EEPROM but will only become active after the next power up of the device.

Before disconnecting, repeat the above process for the Subnet Mask and Default Gateway settings, and press “Save” for each one. See example above (on the right).

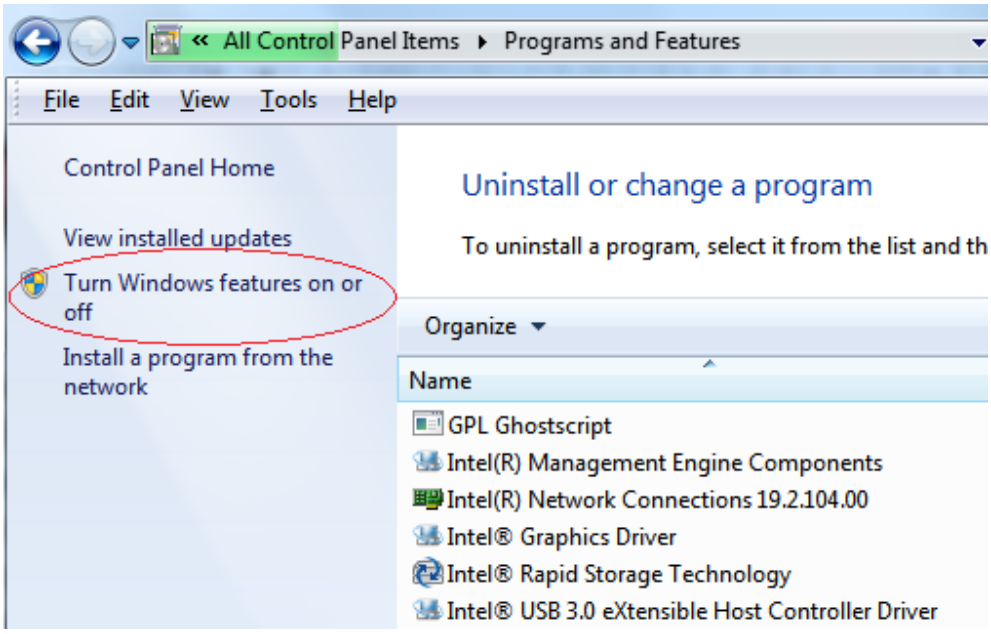
Now the device should be powered down (if using PoE, disconnect the Ethernet cable; if using the 12v DC input, disconnect the power cable). Reconnect the cable to power up the device again, and reestablish the HTTP connection as above. The IP address to use for connecting the second time will be the new IP address entered above, for example 172.16.16.49.

Note: *At present there is no option to switch on DHCP (Dynamic IP address allocation) using a button, this can be done using other methods, see below, or by typing the command “$ND 1” in the web browser from the “Standard Command” page (see details for this command below).*

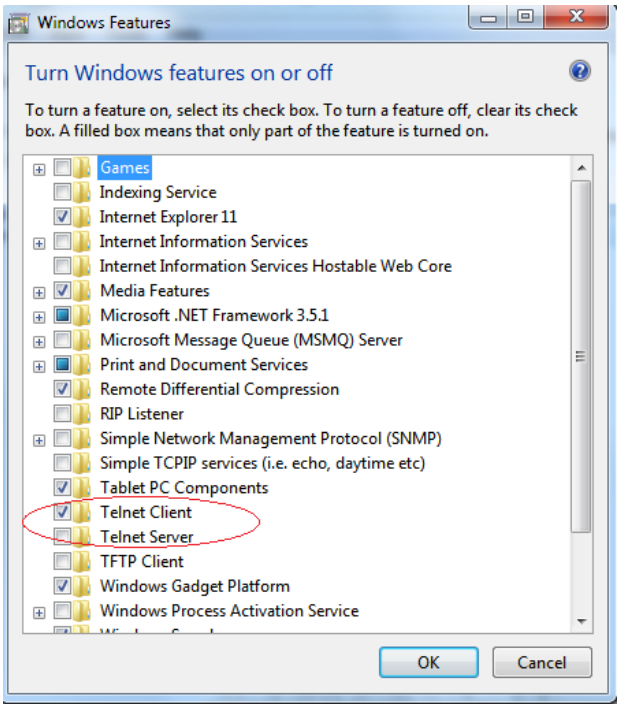
Setting up a static IP address using Telnet:

If using a Telnet connection, the method is similar to the process described above for HTTP, except that a connection must first be established using Telnet, and changing the IP address and other settings must be done manually by sending commands.

In order to open a Telnet terminal on a Windows PC, the user should first check that Telnet is enabled on the PC. Open “Control Panel”, then choose “Programs”, then choose “Turn Windows features on or off” *(this requires administrator privileges on the PC)*:

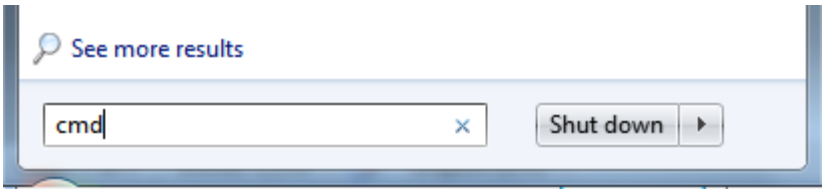


The “Windows Features” box will open; it might take a few seconds for it to be populated:



Check the “Telnet Client” option is switched on, then click “OK” and close the window.

To open the Telnet connection, go to a command prompt window. Go to the “Start” button, click in the “Search programs and files” box, and type “cmd”, then <enter>:

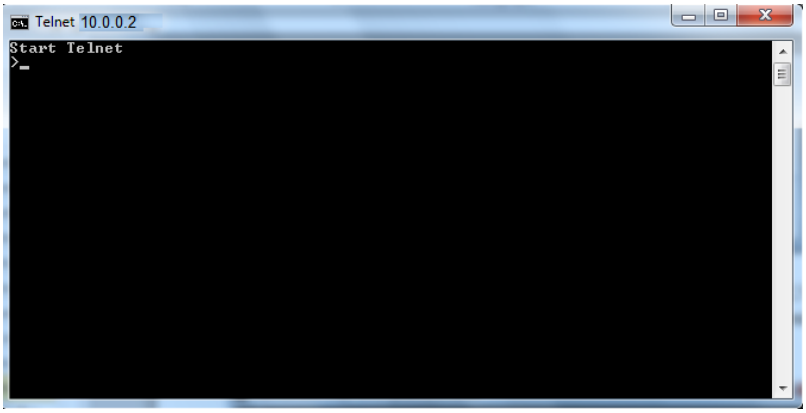


Alternatively, open windows explorer and navigate to the folder “C:\windows\system32\cmd.exe” (or the equivalent) and click on the icon or set up a shortcut to cmd.exe and place it on the desktop.

Once the command prompt window is open, click inside the window and type the following commands:

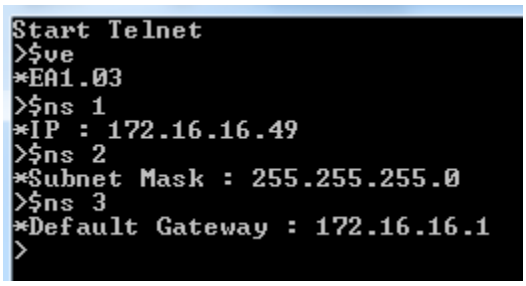
“telnet 10.0.0.2 <enter>” establishes the connection to IP address 10.0.0.2. The response should be “Start Telnet”.

The following window (or similar) should be seen:



$VE <enter>	queries the firmware version to check the connection, response should be “*EA1.06” *[the actual version will vary according to released firmware version]*
$NS 1 <enter>	queries the present setting of IP address in the local EEPROM
$NS 1 172.16.16.49 <enter>	writes the new IP address into the local EEPROM, response should be “SAVED (need reset)”
$NS 2 <enter>	queries the present setting of Subnet Mask
$NS 2 255.255.255.0 <enter> changed	writes the new Subnet Mask value into the local EEPROM, if the value was the response should be *SAVED (need reset)
$NS 3 <enter>	queries the present Default Gateway
$NS 3 172.16.16.1 <enter>	writes the new Default Gateway value into the local EEPROM
exit <enter>	closes the telnet connection

Example of commands and responses:



Once the new settings are saved in the local EEPROM as described above, the device can be powered down and powered back up, as described in the section on HTTP, and the Telnet connection can be reestablished using the new IP address. The settings can be checked as above using the commands $NS 1, $NS 2 and $NS 3 to check they are now correct.

Note: *See details of these commands below in "User Commands" chapter.*

Setting up a static IP address using the USB Virtual COM Port:

Sometimes it might be necessary to establish a connection to the device without relying on the Ethernet connection. This may happen, for example, when the IP address setting in the device is currently not known, or when connecting the device directly to a PC network port is not be possible. The way to do this is to connect via USB, which establishes a connection to the PC via a Virtual COM Port (VCP). The drivers necessary to establish this connection in Windows are provided on the Ophir website, and are also installed together with the *"OphirEthernetApp"* application in its installation folder under "\Ophir Ethernet Application\DRIVER_USB\".

In order to install the VCP device driver for the EA-1 Adapter (required the first time the VCP is used), the files "Ophir_cdc.inf" and "Ophir_cdc.cat" need to located on the computer. When Windows prompts for a driver, the user should provide the folder where these files can be located on the local PC. The driver installation needs to be performed using Administrator privileges.

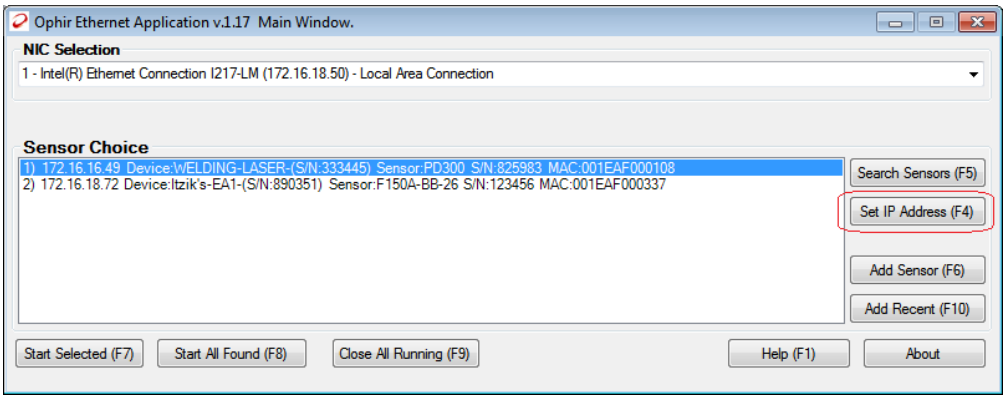
Once the connection is established and the drivers for the EA-1 Adapter are installed on the PC, a COM port needs to be opened using Hyperterminal or similar. Standard settings to use for the connection are 115200 baud, no parity, 1 stop bit, no hardware control. Then, the same commands as described above for Telnet can be sent manually in order to query or change the IP Address settings and other IP settings as shown above. Alternatively, once this connection is made the *"OphirEthernetApp"* application can be used to change the configurations, see below.

Setting up a static IP address using the "*OphirEthernetApp*" software:

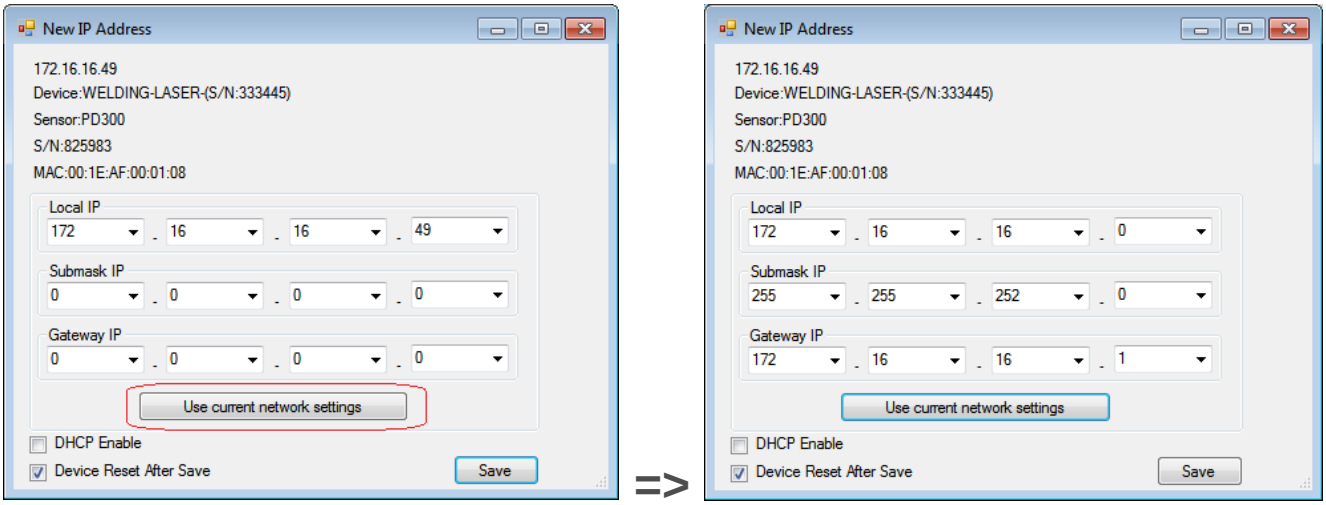
The IP configuration can be changed most conveniently using the "*OphirEthernetApp"* PC Application, using the "Set IP Address" button on the main window (available from app v1.17 or above), or under the "Setup - Device" menu in the lower screen after connecting to the device. The *"OphirEthernetApp"* is available on the Ophir website. The EA-1 device can be accessed either using an Ethernet connection, or using a USB Virtual COM Port (see above).

Using the "Set IP Address" button:

Using the “Set IP Address” button on the main window is the simplest method. This method will work even if the present IP address does not match the network to which the EA-1 is connected, for example the first time it is used. Open the application, choose a sensor, and click on “Set IP Address”:



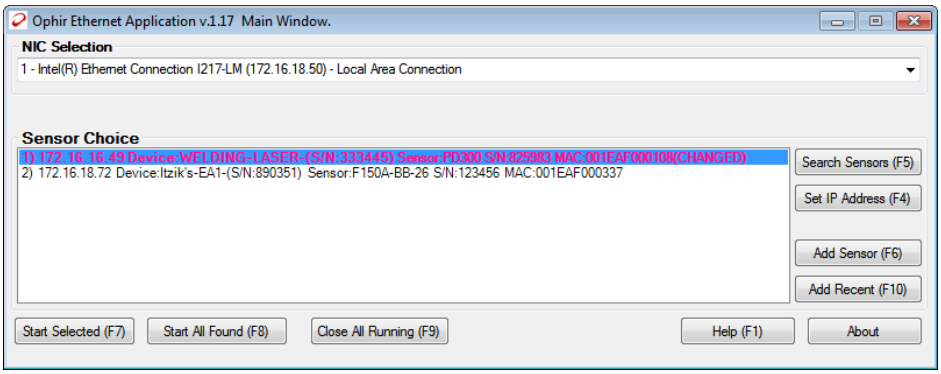
Then click on “Use current network settings” to automatically load the default settings of the connected network:



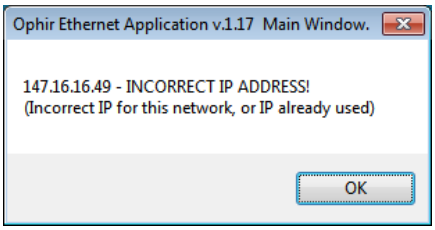
Choose the individual IP address, usually only the last value will need to be updated (for example as shown above, the default IP address loaded is 172-16-16-0, change the 0 to another value such as “49”). Click on “Save” and close the window. Back in the main window, press on “Search Sensors” to refresh the Sensor Choice window with the new IP address (if it was changed).

Handling devices with incorrect IP addresses:

If the EA-1 device is configured with an incorrect or “illegal” IP address, the “Sensor Choice” box will show the device in **bold red** (if sensor is selected) or **bold black** (if sensor is not selected):



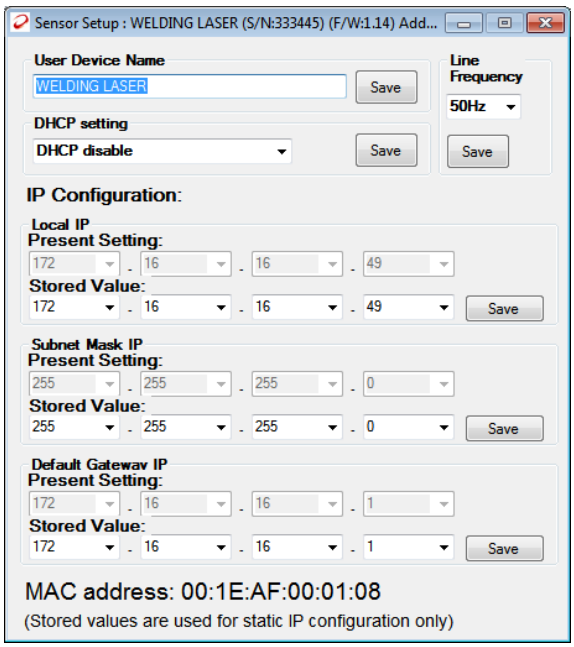
Clicking on this sensor or choosing “Start Selected” will give an error message:



Click on Set IP Address and follow the instructions above to fix the IP address to a good value.

Using the “Setup Device” screen:

An alternative method to change the IP settings is to use the “Select-Device” screen. After selecting the sensor in the main window (by clicking on it in the “Sensor Choice” window as shown above), enter the “Setup-Device” screen. Choose the new settings by hand and press “Save”. Note that this option is available only if the present IP address is acceptable for the network.



Note: *If the user changes the IP address to a new setting and presses “Save”, the new value will be saved to local memory inside the device and will be used the next time the device powers up.*

However, if the user then tries to restore the value back to its original setting and then presses "Save" again before exiting the application and resetting the device, a message "Unchanged" will be given, and the value will not be changed inside the device. The next time the device is powered up, it will use the new setting and not the original setting. This behavior is the same whether connected via Ethernet or USB.

This software application also provides a search feature which allows the IP address (or COM port number) to be found automatically once the device is connected to the network. For more details, see the chapter below on using the "*OphirEthernetApp"* software.

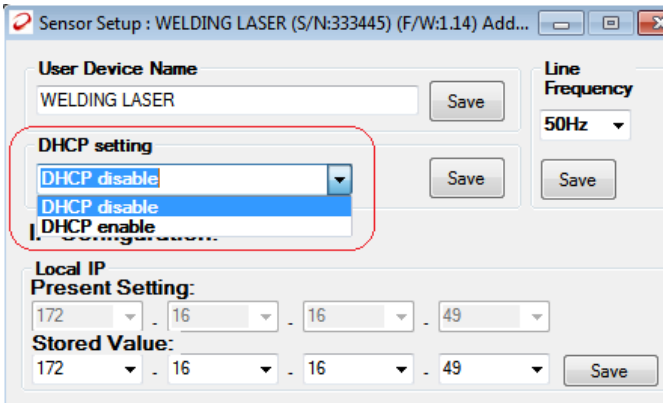
Changing to Dynamic IP Address Allocation Mode:

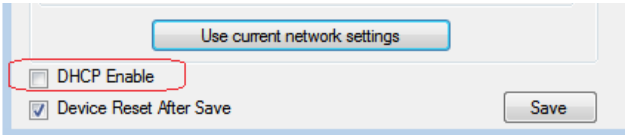
The EA-1 Ethernet Adapter provides the option to use Dynamic IP Address allocation. When enabled, after the EA-1 powers up it sends a request to the local network requesting a free IP address and other IP settings. Once allocated, this IP address is used automatically by the device without the user having to take any further steps. As long as the device is not disconnected from the network, this IP address will be permanently allocated to the device. A user command can be used to query the device about its IP settings (see command $NP below).

Note: *See further details about DHCP in the section on the $TD command below.*

Several software commands are provided to enable or disable dynamic allocation mode, and to query the IP Address allocated and the other device settings once it is enabled. These commands are listed in the Software Commands section below. In order to send these commands, a connection must be established with the device using one of the methods described above (HTTP, Ethernet, or USB VCP).

Alternatively, Ethernet settings can be changed using the *"OphirEthernetApp"* software provided, under the "Setup - Device" menu or using the "Set IP Address" button from the main screen.





This app also includes an automatic search feature which locates all Ophir devices on the network. This is a convenient method to use if the present IP Address is not known before trying to set the dynamic mode. When using this software, the EA-1 device can be accessed via Ethernet or via USB VCP.

Setting the User Device Name:

The user can choose to give the device a special User Device Name (for example "Welding Laser", "Research Lab A") which will make it easier for the user to identify the EA-1 Adapter and the sensor that is attached to it. This is especially useful if there are multiple Ophir Ethernet Adapters on the network.

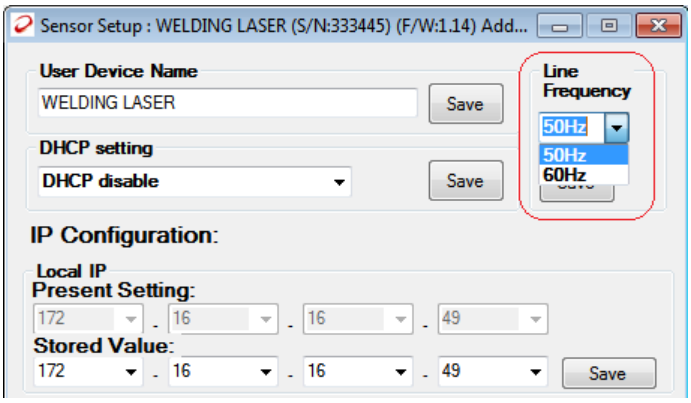
In order to set the Device Name, a connection to the device has to be established as described above. Once this is done, the user command "$DN" can be used to query or change the device name. The name can be up 30

characters long. This command is described more fully in the section on User Commands, see below.

Another method for setting the Device Name is to use the "*OphirEthernetApp*" software, in the Settings menu. See more details in the chapter below describing this software.

Setting the "Mains" Frequency:

Before using the device, it is recommended to set the EA-1 device to the local "mains frequency" setting (50Hz or 60Hz). This can be done by using the "Line Frequency" setting on the Setup Screen:



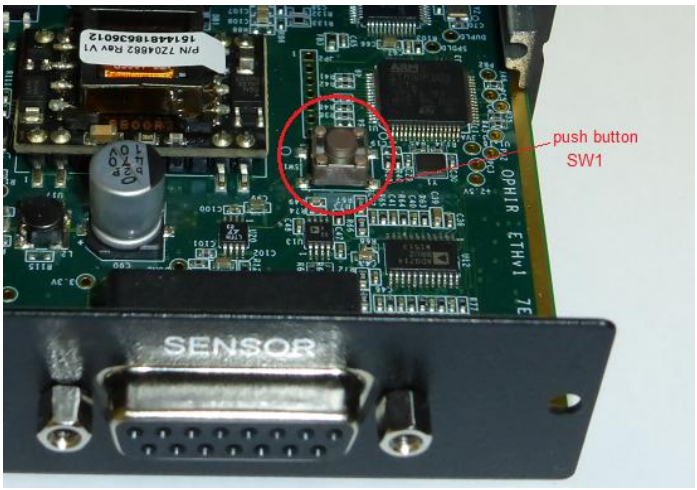
Choose the correct new setting and then press "Save". This has to be done once before using the device and is stored permanently in the device memory thereafter. The default factory setting is 50Hz. The same thing can be done by sending the series of commands $MA 1|2 (use parameter 1 for 50Hz, 2 for 60Hz), followed by $IC (see details below).

Returning to Factory Default Settings:

If connection has been lost to the device, and there is no way to find out the present IP address setting, as a last resort the user can return the device temporarily to factory default settings in order to establish a connection and then update the configuration as required.

In order to do this, the PCB needs to be removed from the mechanical box. The simplest way to do this is first to remove all connectors from the device; then unscrew the two screws on the left and right of the panel where the D15 "sensor" socket is located; and then pull the PCB out along with the D15 panel.

Once removed, press down the button labeled "SW1", then connect the power supply and Ethernet connector while holding the button down - the device will power up with default factory settings. The IP address will be set to default (see above), which is suitable for connection only via a direct connection to the PC network port. Establish connection to the device and then change the settings as described above. Then close the box by returning the screws removed earlier.



Keepalive Feature

Starting in firmware version 1.18, the Keepalive feature is being used to avoid the EA-1 device becoming “locked out” when a Telnet connection is lost without the EA-1 knowing about it. If this happens, when the Keepalive timeout is set to a value other than 0, the EA-1 F/W will automatically close the connection to allow the client (PC or PLC) to reconnect to the EA-1 after the Keepalive timeout is reached. When upgrading the EA-1 firmware from an older version than 1.18, the Keepalive feature may be switched off until the user enables it using the $KT command. See the section on the $KT command for more details.

Chapter 3 - HTTP and the Built-In Web Server:

The EA-1 Adapter has a web server built into its firmware, allowing the user to perform simple tasks via a standard web browser such as Internet Explorer.

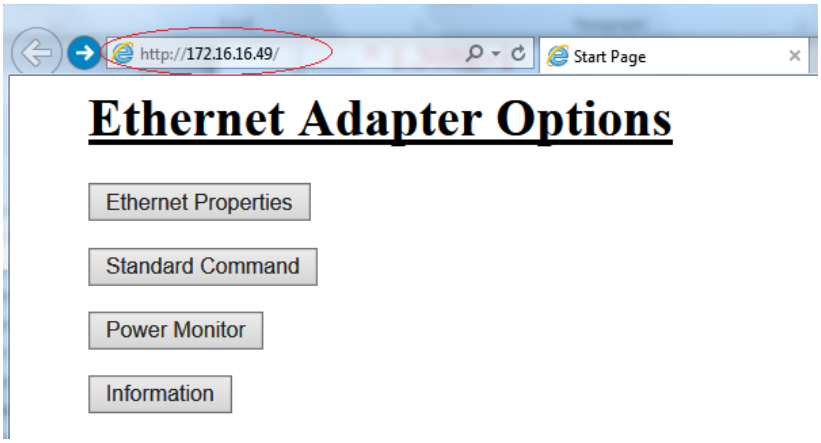
Tasks that can be performed via the web server include:

- Simple configuration tasks (see chapter 2)
- Monitoring power of the sensor
- Sending user commands
- Viewing basic information about the EA-1 and attached sensor

Connecting to the built-in web server:

The example give below refers to a device with IP address 172.16.16.49

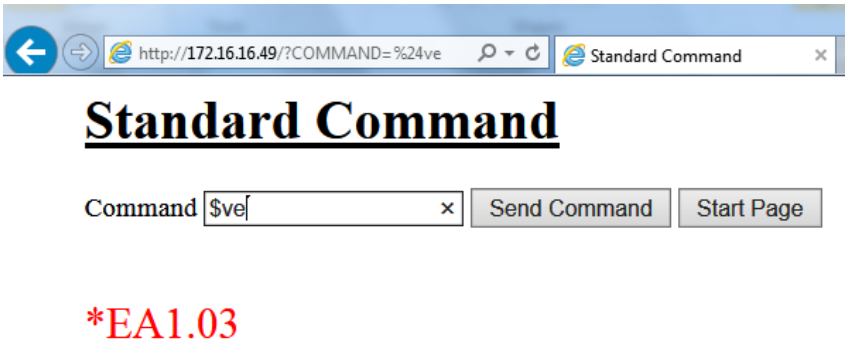
Open the web-browser, for example Internet Explorer, and type http://172.16.16.49/ in the link window at the top of the page. The following “Start Page“ will open:



Using the built-in web server:

To view Ethernet Properties, click on the “Ethernet Properties” button (see chapter 2 for more details).

To send user commands, return to the Start Page (click on “Start Page” button, or click on the “Back” button of the explorer) and click on the “Standard Command” button. The following window will open:



Click on the “Command” window, and type the command including the leading “$” symbol. For example, type “$VE” and then press <enter>. The response will appear below the window in red, for example “*EA1.03”.

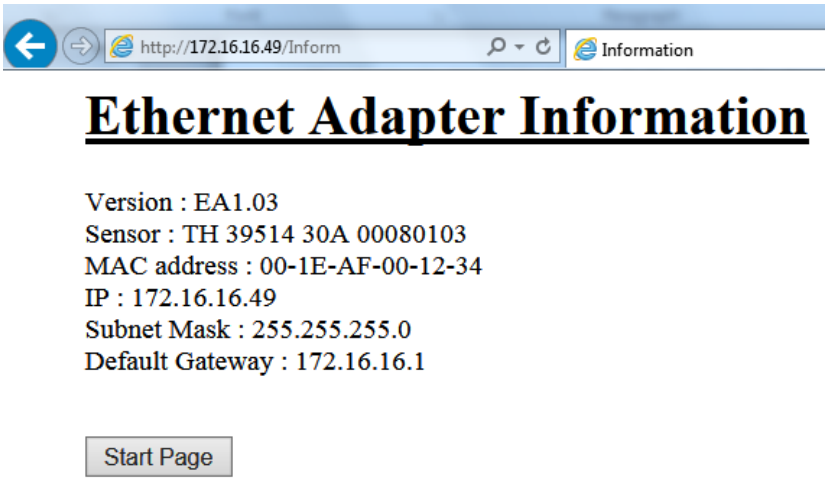
A full list of user commands is included at the end of this manual.

To view the power being measured by the attached sensor, return to the “Start Page” and click on the “Power Monitor” button. The following page will be displayed:

The latest power measurement will be displayed in red as in the example above. The value is updated once per second.

(Note: Thermopile Energy Mode is not supported in the Web Server)

To view basic information about the Ethernet connection, return to the Start Page and click on the “Information” button:



Chapter 4 - Using the "OphirEthernetApp" Application:

The most convenient way to get started with the EA-1 Adapter is to use the PC Application "OphirEthernetApp" supplied with the device. This chapter explains how to use the application.

Getting started:

The PC application is provided as a setup file which is self-installing. The name of the installation file is:

"OphirEthernetApp-1.xx.exe" *[where "1.xx" is the latest software version, for example 1.19, for example "OphirEthernetApp-1.19.exe"]*

Download the installation file from the Ophir website to your local PC and click on it to run it. The application will be installed in the local "Program Files" folder:

C:\Program Files\Ophir Optronics\Ophir Ethernet Application\x.xx\

or C:\Program Files (x86)\Ophir Optronics\Ophir Ethernet Application\x.xx\ *(where x.xx = latest version)*

Log files and output files will be located in your "My Documents" folder, under "\OphirEthernetApp\".

Before starting the program, make sure of the following:

- The EA-1 device is connected to the Ethernet network
- The device is powered up (either via PoE if available, or via the 12-24v DC connector)
- The sensor is attached to the adapter via the D15 plug

Alternatively, the device can be connected to the PC via USB. The device uses a "USB Virtual COM Port". The drivers required for the PC to recognize the EA-1 Adapter are available on the Ophir website and in the "OphirEthernetApp" installation folder, see Chapter 2. Note that the EA-1 Adapter is not powered via the USB port, so power must be provided via the 12-24V DC connection in this case.

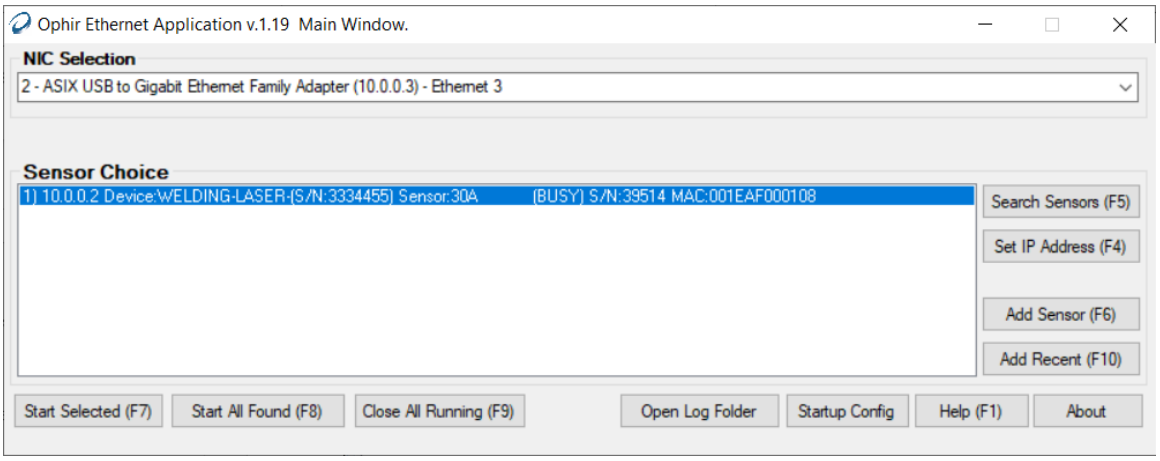
Starting the program and connecting to the EA-1 Adapter:

A shortcut to the application should be installed on the desktop, otherwise navigate with Windows Explorer to the installation folder and locate the EXE file (for example, for version 1.17):

C:\Program Files\Ophir Optronics\Ophir Ethernet Application\1.17\OphirEthernetApp-1.17.exe

or: C:\Program Files (x86)\Ophir Optronics\Ophir Ethernet Application\1.17\OphirEthernetApp-1.17.exe

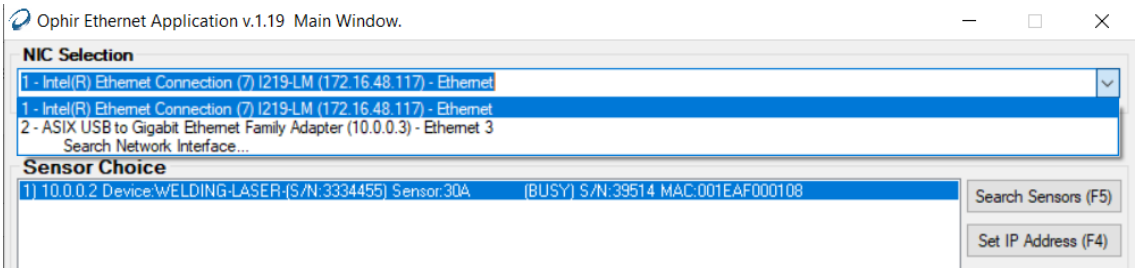
Open the application by clicking on the shortcut or direct on the EXE file. The following window will appear:



On opening the application, or after clicking on “Search Sensors”, the application searches for all Ophir EA-1 Adapters it can locate on the network and lists them in the box shown above, with details of the sensor attached to each device. While performing the search, the mouse icon is changed to the “busy” symbol. The search includes devices it can locate either via Ethernet or via the USB Virtual COM Port connection, if present.

Choosing Network:

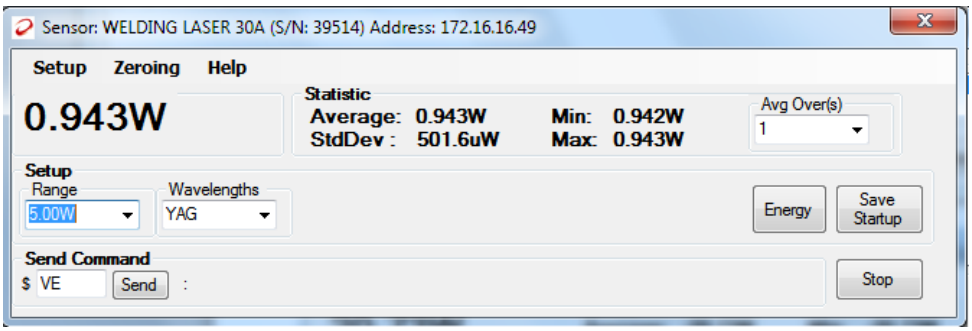
Starting from PC App version 1.17, there is an option to choose the network from the main screen. If more than one network is located, a drop down using the control on the right side of the screen (see below) allows the user to choose between the different networks:



Use the “Search Sensors” button to search for all EA-1 devices on chosen network.

The main sensor window:

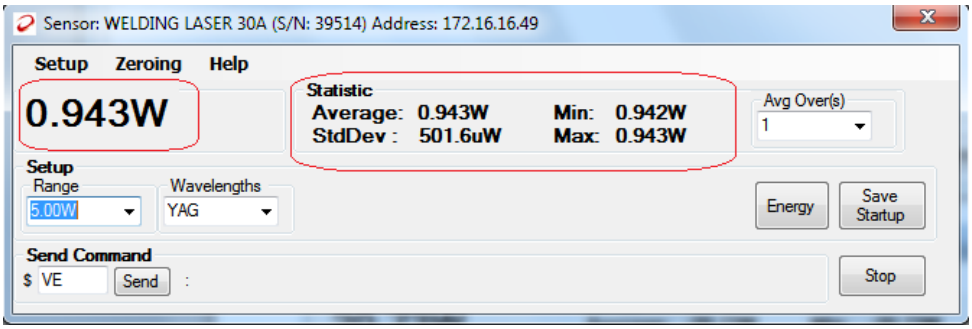
Click on one of the sensors shown in the list to highlight it and click on the “Start Selected” button (or click on “Start All Found” if preferred). The following Sensor Window will open, one for each selected sensor:



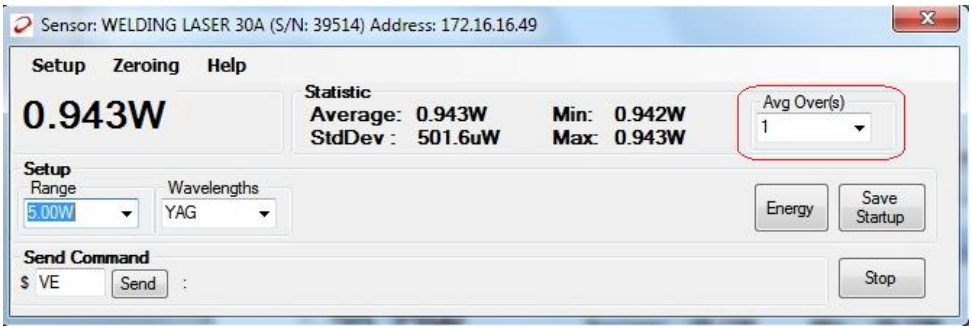
The main window allows the user to control all main features of the attached sensor and to view measurements.

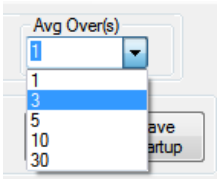
Power Display and Statistics:

The power (or energy) being measured now is shown on the left and the statistics are shown on the right. Statistics include Average, Standard Deviation, Min and Max. In single-shot energy mode, statistics are disabled.



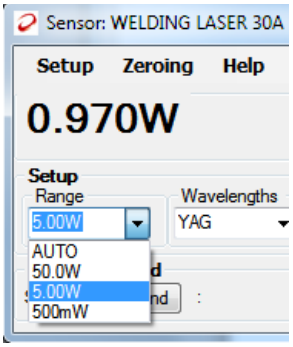
The statistics are derived over a time period defined by the user, default 1s. A drop down can be used to select other time periods if desired, or the value can be entered manually in the “Avg Over(s)” window itself:





Choosing Measurement Range:

Choose the power or energy range using the drop down “Range” menu as shown:

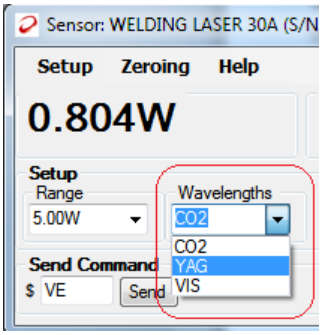


In most cases, an AUTO range option is available, allowing the sensor to choose its own best measurement range based on the present power incident on sensor. Alternatively the customer can choose manually from the available ranges, shown in descending order. Note that in Energy Mode, AUTO ranging is not available.

Choosing Wavelength Option, Discrete Laser Points:

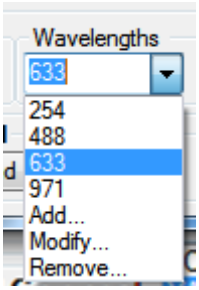
For many thermopile sensors, discrete laser points are offered. In this case the user can choose between several pre-defined laser wavelengths or regions, depending on the sensor being used. In the example below the laser options are CO2 (10.6um) YAG (1.064um) or VIS (around 532nm). But other sensors may have other regions defined.

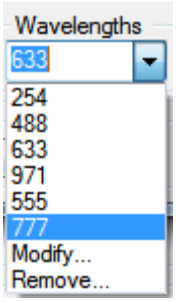
Choose the appropriate setting using the drop-down menu and clicking on the chosen option.



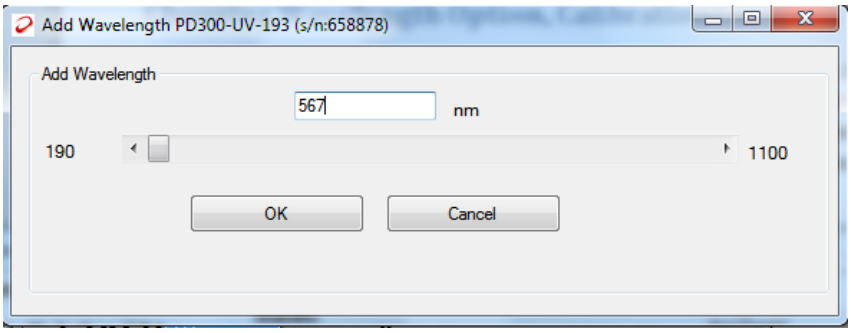
Choosing Wavelength Option, Calibration Curve:

Some sensors, such as photodiodes and some types of thermopiles, contain a calibration curve over a certain range of wavelength. With these sensors, the user can choose up to six “favorite” wavelengths, which can be chosen using the simple drop down as for the Discrete Laser Points mentioned above. In addition, the user can add, remove or modify any of the favorite wavelengths (within the wavelength measurement range of the sensor) by choosing these options in the drop-down menu:



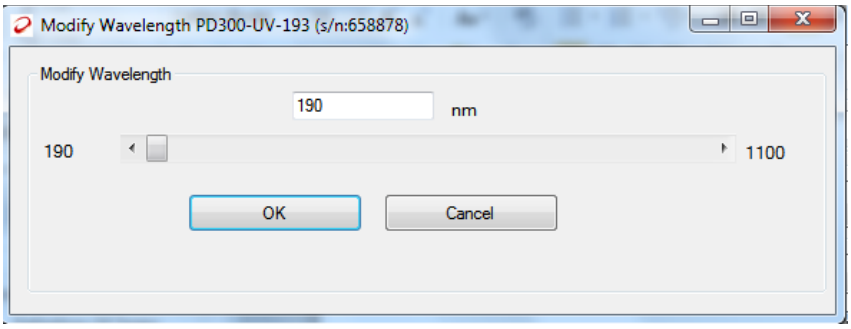


If less than six favorite wavelengths are currently defined, the user can simply choose “add” and then define a new measurement wavelength directly:



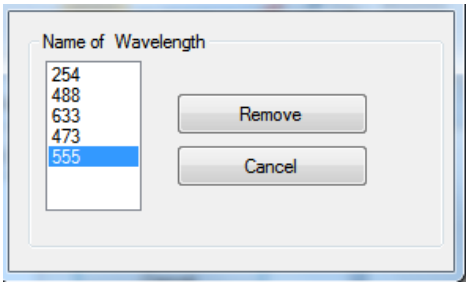
Use the scroll bar to increase of decrease the chosen wavelength, or simply type the value in the window, for example 567 as in the example above. Then click “OK” and the new wavelength is added to the favorites.

In order to modify one of the existing favorite wavelengths, first choose that option in the drop down menu; then use the drop-down to select “Modify”, and the following window will be displayed.



Change the wavelength value using the scroll bars or by typing the value in the window, as for the “Add” option above. Then click on “OK” to finalize the choice of wavelength.

In order to remove one of the existing 6 favorite wavelengths, choose “Remove” from the drop down menu. The following window will appear:

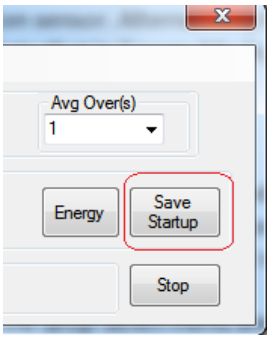


Select the wavelength option to remove and click on “Remove”, and that wavelength will be removed from the list.

After making any selection or modifying the favorites, if the user wants to keep the present setup after the next startup, he can click on the Save Startup button as mentioned below.

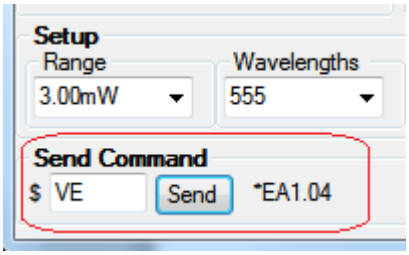
Saving the Startup Settings:

In order to save the present settings of measurement range and favorite wavelength as the default startup settings, click on the “Save Startup” button:



Sending User Commands:

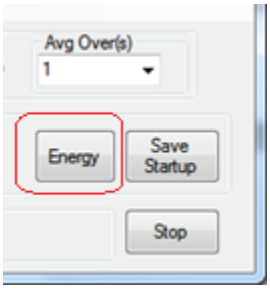
In order to send a user command, clock in the “Send Command” window, type the command and click on “Send”. The response will appear to the right of the “Send” button. In this case, it is not necessary to add the “$” symbol in front of each command, as it is added automatically by the application:



A detailed list of user commands is added below.

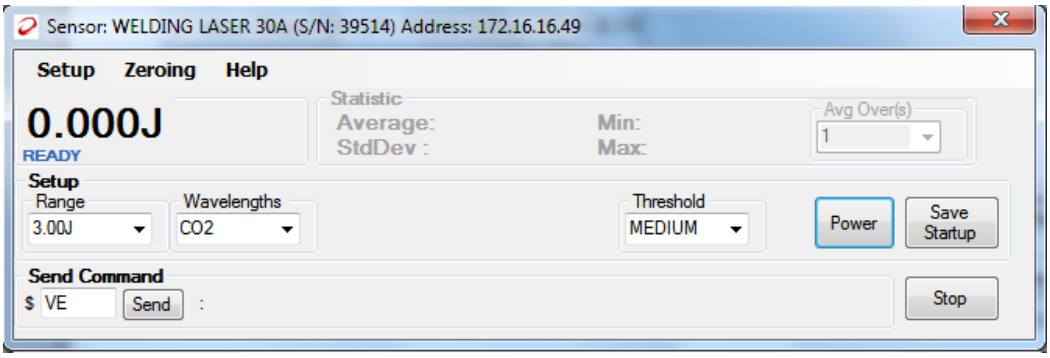
Measuring Energy:

Some thermopile sensors offer single-shot energy measurements in addition to measuring power. Click on the “Energy” button in the main sensor screen to open up the Energy screen:

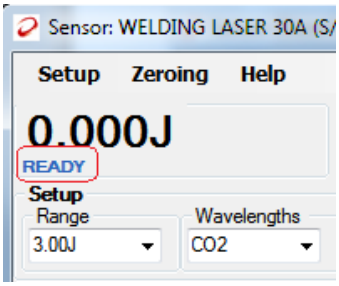


On sensors that do not offer energy measurements, this button will be hidden from view.

The energy measurement screen will open:



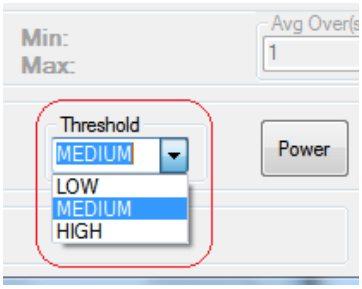
The controls in the energy screen are similar to the power screen, except that the statistics are not available. In addition there is a status label just below the Energy value display, as shown below:



Wait for the “READY” status before trying to measure a pulse of laser on the sensor.

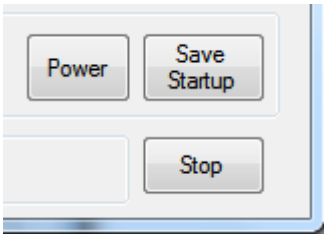
If the measurement displays “OVER” try changing to a less sensitive measurement range, or try reducing the energy.

In order to choose the trigger threshold, use the drop down menu to select LOW, MEDIUM or HIGH. The default threshold is “MEDIUM”. In order to increase or decrease the default threshold by a factor of 3, choose HIGH (least sensitive triggering) or LOW (most sensitive triggering). In very noisy environments, a HIGH threshold may be required. When measuring very low energy levels, a LOW threshold may be required.



In order to return to the power measurement mode, press the “Power” button.

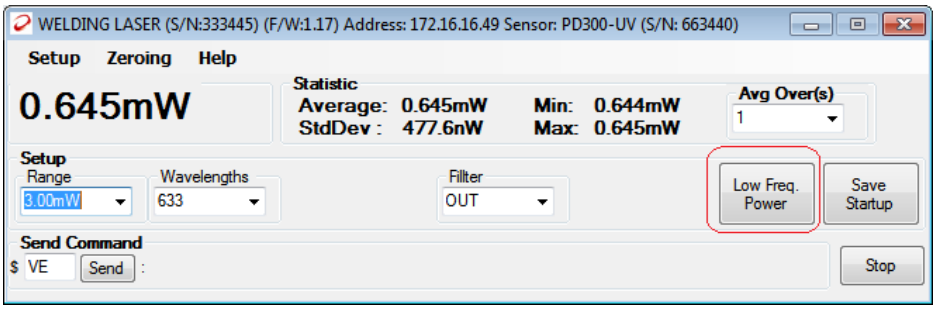
In order to set Energy as the default startup mode, press the “Save Startup” button.



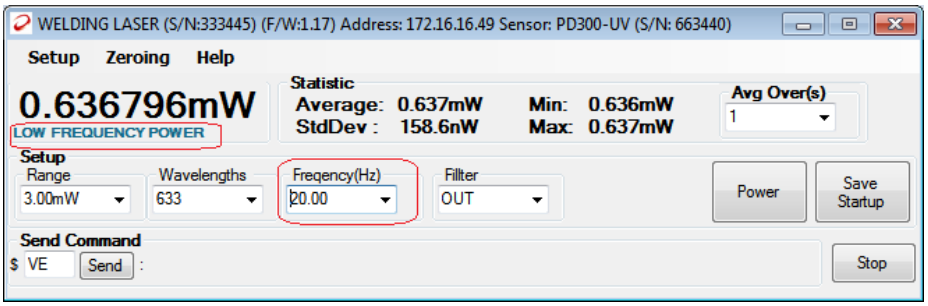
Measuring Average Power for Low Frequency Pulsed Lasers - “Low Freq. Power Mode”:

Starting from app & firmware v1.17 (Jan. 2019), a second method to measure average power on photodiode sensors is to use the “Low Freq. Power Mode”. This method is useful when measuring average power for pulsed lasers with frequency in the region of ~5Hz to ~100Hz. Using the regular power mode with such a laser source can cause beating effects and saturation of the electronics, which causes unstable or incorrect readings in many cases. The “Low Freq. Power Mode” solves these problems using a special measurement technique in the firmware that synchronizes to the laser frequency (as supplied by the user). This mode is supported only using Photodiode sensors (PD300-xx), but not when using Thermopile sensors (which normally do not exhibit such problems, as their response time is much slower than photodiodes).

To start measurements using the Low Freq. Power mode, click on the “Low Freq. Power” button:



Choose the laser frequency either using the provided drop-down or entering the value manually in the edit box. The value entered can contain several digits after the decimal point if required, such as 33.123Hz.



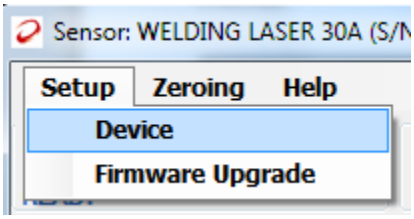
Some care needs to be taken when choosing the correct frequency value. If the frequency setting is slightly different from the actual laser frequency, the power readings may show beating effects. If the frequency setting is too low, this may result in periodic positive “spikes” of power above the average power level being measured. If the frequency is too high, the spikes will be negative, below the average power level. As the frequency is adjusted closer to the correct laser frequency, the spikes will become smaller and further apart, until they disappear altogether when the frequency is adjusted perfectly. Note that due to slight errors in the nominal internal clock frequency of the EA-1, or of the laser pulse frequency, the exact frequency setting required for perfect measurements may not be exactly as expected.

After setting the frequency, choose the correct power range. As a rough guide, the power range should approximately match the expected AVERAGE power to be measured. The correct range to use is usually the most sensitive range available that does not show “OVER” or “over” on the screen - meaning the average power is too high, or the peak power is saturating the electronics. Note that when using this mode, the EA-1 device can sometimes be in saturation before the average power level exceeds the maximum power defined for the selected

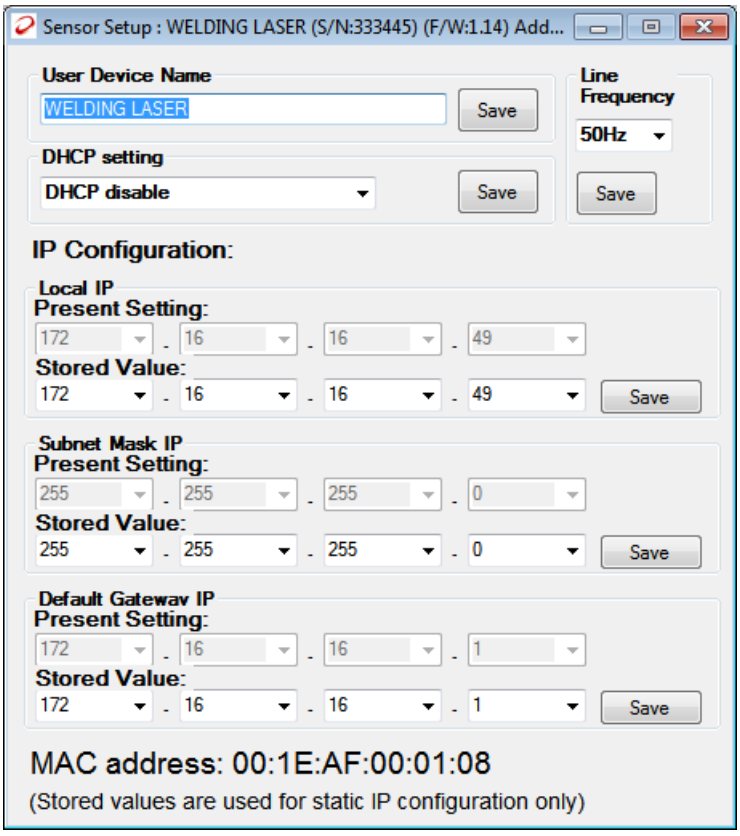
range. This is because the peak power of a pulse laser may exceed the allowed peak power for the selected power range. The software will detect this situation and warn the user to change to a less sensitive range.

Configuration and Setup:

In order to view or change Ethernet settings for the chosen sensor & EA-1 Adapter set, enter the Setup -> Device menu:



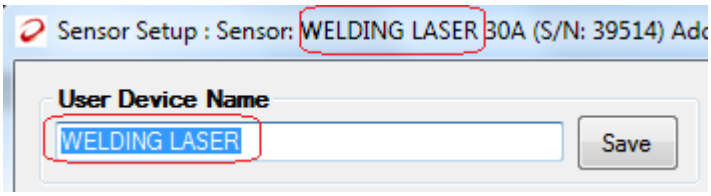
The following window is displayed:



The Local IP, Subnet Mask and Default Gateway can be adjusted as described in the Configuration section - any changes will be saved in the local EEPROM of the device and will take effect after the next startup.

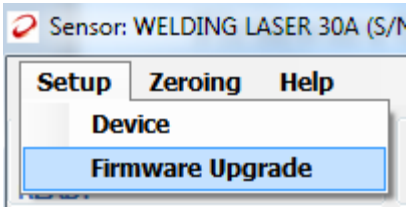
DHCP mode (“Dynamic Host Configuration Protocol”, dynamic allocation of the IP address) can be enabled or disabled using this setup screen. Clicking on “Save” will store the setting in the local EEPROM and the new setting will take effect after the next power up of the device. Note that the first time the DHCP mode is switched on, the IP address will probably change the next time the device is powered up.

The User Device Name can also be added, edited or removed using this screen. The name chosen will appear in the title bar of the windows and in future searches for devices as shown below:



Firmware Upgrade:

The "*OphirEthernetApp"* software allows the user to upgrade the firmware loaded into the EA-1 device. This should be done only when a new version firmware is available from Ophir:



The software will first check for a new firmware BIN file in the local sub-folder "Firmware" and will notify if a firmware upgrade is really necessary.

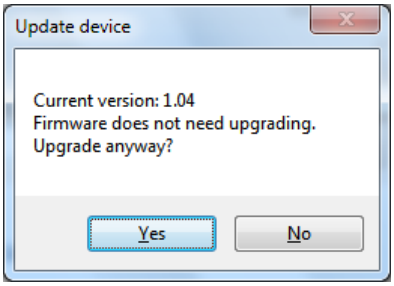
The location of firmware files is under the application installation folder, usually:

C:\Program Files\Ophir Optronics\Ophir Ethernet Application\x.xx\Firmware\

or: C:\Program Files (x86)\Ophir Optronics\Ophir Ethernet Application\x.xx\Firmware\ *(where "x.xx" = latest version)*

Note: *It is recommended not to upgrade firmware unless a new version is actually available.*

If a firmware upgrade is not actually required, the following message will be displayed; answer "no" to abort the firmware upgrade:



In the event that a new firmware upgrade is available and necessary, the software will continue with the upgrade automatically.

Note: *Do not disconnect the communications or power cables while the firmware is being upgraded. Firmware upgrade takes ~5 minutes.*

In the event that the firmware upgrade is disrupted before it is finished, the device will start up in a special "Boot" mode after the next power up. In that case, the firmware upgrade can be repeated and completed using the same menu and method as above.

Note: *It is recommended that the device be powered off and on again after performing a firmware upgrade, this is especially important when using DHCP mode.*

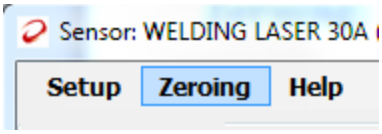
Obtaining firmware upgrades from the internet:

Sometimes a new version of firmware may be released on the Ophir website separately from the PC Application installation file. In that case, it will be necessary to copy the firmware "BIN" file ("EA1Axxx.bin") to the local firmware folder of the PC Application (as defined above). The next time the PC Application is started up with the EA-1 attached, the application will prompt to upgrade the firmware.

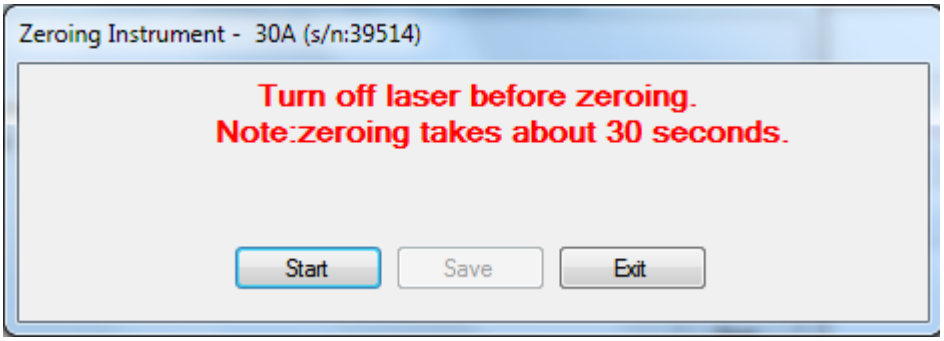
>It is recommended to check regularly for firmware upgrades on the website.

Zeroing:

Choose the Zero option in the menu:



The following window will appear:

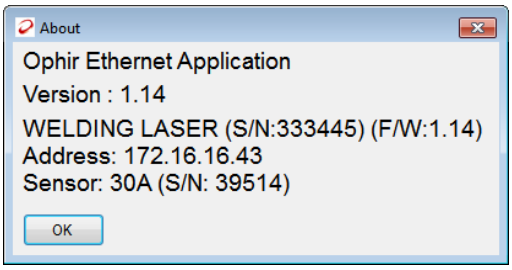


Zeroing should be performed with no laser light on the sensor, and with the sensor covered and protected from any sources of heat or light. At the end of the zeroing, press the "Save" button to store the new zero values in the local EEPROM.

Help Menu:

The "Help" Menu on the main sensor screen includes two buttons:

The "Help About" menu displays basic information about the sensor, its user name, the IP address and the firmware version loaded into the device.

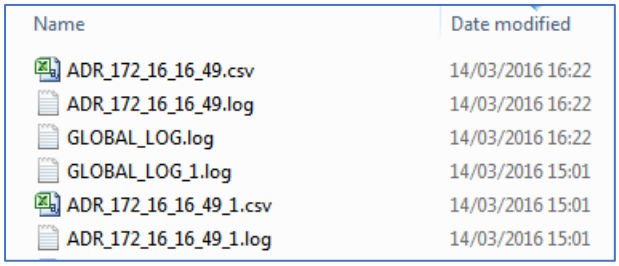


The second button opens the User Manual PDF file which is located inside the application folder. The latest version is available on the Ophir Website.

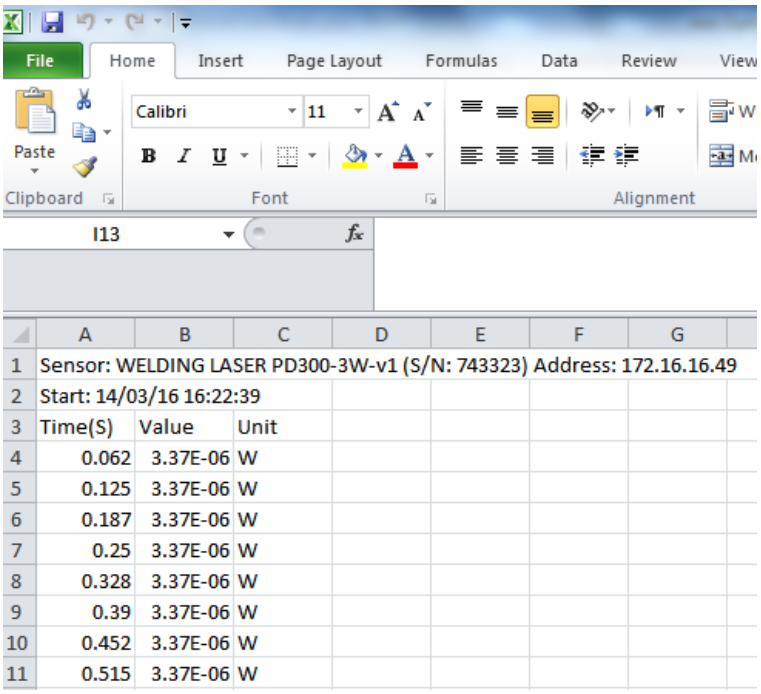
Log Files and Buffer Files:

The *"OphirEthernetApp"* application automatically creates log files while the sensor window is open and the sensor is measuring. These log files are located in the "My Documents" folder under "\OphirEthernetApp\". The files are stored in "CSV" format, which is a comma delimited text file that Microsoft Excel can open directly.

A new log file is created each time the sensor window is opened, and closed when the sensor window is closed.



The name of the log file contains the IP address of the EA-1 Adapter to which the sensor is attached, for example "ADR_172_16_16_49.csv". When the log file is created, the previous 4 log files are automatically backed up with names "*_1.csv", "_2", "_3" and "_4".



	A	B	C	D	E	F	G
1	Sensor: WELDING LASER PD300-3W-v1 (S/N: 743323) Address: 172.16.16.49						
2	Start: 14/03/16 16:22:39						
3	Time(S)	Value	Unit				
4	0.062	3.37E-06	W				
5	0.125	3.37E-06	W				
6	0.187	3.37E-06	W				
7	0.25	3.37E-06	W				
8	0.328	3.37E-06	W				
9	0.39	3.37E-06	W				
10	0.452	3.37E-06	W				
11	0.515	3.37E-06	W				

The log file contains the following information:

- Line 1: EA-1 device user-name, sensor name, sensor S/N, IP address
- Line 2: Date and start time of the log
- Line 3: Column headers: Time(s) Value Unit
- Line 4+: logged data: time-stamp (in seconds from the start of log), value in scientific format, measurement units

Note: *In some European countries the default separator character is a comma "," instead of a dot "." (for example "1,23" instead of "1.23"). Customers in those countries may not be able to open the standard English format CSV log files directly using Excel, as the delimiter for the CSV format will be a semi-colon ";" instead of a comma ",".*

Buffer Files:

In addition to the log files for each device, a communications buffer file is automatically produced by the application for each active device, with the same name as the log file but with the suffix "*.log". This file contains all the communication commands between the EA-1 device and the computer via the Telnet channel. This buffer file is a useful way to check which commands are being used by the application, and as a way to provide examples when writing custom software to talk to the device. It is also useful for debugging in case there are errors or problems with the software - the buffer file can be sent to Ophir to investigate any problem that might occur.

Another buffer file produced by the application is "GLOBAL_LOG.log", which may also be useful for debugging and finding out what the application is doing. This file records general information about the latest instance of the application, the UDP searches for Ophir devices, and which devices were opened and closed by the application.

In case there is a problem or a question about the PC application, copies of these buffer files should be sent to Ophir to assist with debugging any problem that the customer may encounter.

Example contents of file "GLOBAL_LOG.log":

07/04/16,15:42:54.038,Send UDP:Search Ophir's devices

07/04/16,15:42:54.108,Receive UDP:Search Ophir's devices (Timeout:70ms)

07/04/16,15:43:19.149,PopUp message: Sensor with this address not found

07/04/16,15:43:24.419,Open:COM12:23 (SUCCEED)

07/04/16,15:43:59.429,Close IP:COM12:0

Chapter 5 - Other Features and Protocols:

This chapter contains some general information about connecting with the EA-1 device using other methods and querying Ophir devices on the network using the UDP Protocol.

Using HTTP Protocol:

Using an HTTP connection, commands can be sent directly to the device using the IP address and some extra characters. Examples are shown below:

$VE => http://172.16.16.49/?COMMAND=%24ve

$WN 1 => http://172.16.16.49/?COMMAND=%24wn+1

$AW => http://172.16.16.49/?COMMAND=%24aw

The reply is received via the web page displayed. See section on HTTP configuration above for an example.

Note: *HTTP uses TCP Port 80 by convention*

Searching for EA-1 Devices on the Network:

The *"OphirEthernetApp"* application uses the UDP protocol to search for EA-1 devices connected on the network. The search is performed when the application starts up, or when pressing the "Search" button.

Customers can also incorporate a similar search using the UDP protocol into their own software, in order to detect any Ophir devices connected to their network. This is especially useful if there are multiple EA-1 devices connected, or if the customer wants to query the IP address of their device.

In order to use the UDP the following steps are necessary:

1. Send broadcast UDP message (UDP PORT:11000) "Search Ophir's devices\0"
2. Listen to broadcast UDP messages, wait for messages starting with string "Ophir's Sensor"
3. Extract the IP address for each device from the full UDP message it returns

The full reply string format is as follows:

Ophir's Sensor\n	*Fixed string, can be used to identify the Ophir device*
[sensor name]\n	*Local name of sensor attached to EA-1 device*
[s/n]\n	*Sensor serial number*
[xxx.xxx.xxx.xxx]\n	*EA-1 device IP address*
[device user name]\n	*EA-1 device user-defined name*
[checksum]\0	*Checksum consists of sum of all bytes not including checksum, followed by "null"*

For example:

Ophir's Sensor
FL250A-BB35
630979
172.16.16.41
PHOTODIODE
<checksum>

In addition, UDP can be used to send commands and receive replies, as an alternative to Telnet. See details below in chapter “Details of User Commands”.

Summary of TCP Port Numbers:

By convention TCP uses the following port numbers:

Connection:	Port Number:
Telnet	23
HTTP	80
UDP	11000

Chapter 6 - Details of User Commands:

The intended use of the EA-1 is for customers who wish to embed the device inside their own laser system. In order to allow customers to control the device using their own software package, a set of “User Commands” are provided which allow control and query of all the features of the device.

This chapter contains general rules about using the user commands and includes a complete list of all the user commands available.

General Rules:

These rules apply for all communication protocols available for the device. Any exceptions will be listed separately below.

- All commands and replies use ASCII symbols (characters)
- All user commands begin with the “$” symbol (ASCII code 0x24)
- All user commands consist of a two-letter code, in either upper-case or lower-case ASCII characters
- Using any protocol, best practice is to terminate all user commands using [CR][LF] (where [CR] is the “Carriage Return” symbol, ASCII code 13, Hex 0xD, \r; and [LF] is the “Line Feed” symbol, ASCII code 10, Hex 0xA, \n). For the Telnet protocol, [LF] is required and [CR] is optional. For the USB (Virtual COM Port) protocol, [CR] is required and [LF] is optional.
- User commands can optionally contain parameters in addition to the two-letter code command (details below)
- The first parameter of a command can be attached to the command or separated with at least 1 space, for example “$WN 1” or “$WN1”. Both are OK.
- Any leading or trailing spaces (ASCII code 0x20) are ignored, but the first 3 symbols must be “$xx” where “xx” is the command code.
- All subsequent parameters, in the event that there are more than one, should be separated by 1 or more spaces
- All replies are terminated by “[CR][LF]”
- Replies begin with a “*” symbol (ASCII code 0x2A) if there are no errors
- Replies begin with a “?” symbol (ASCII code 0x3F) if there is any kind of error: for example, the command is unknown (?UC) or contains an incorrect parameter
- All commands, both query commands and action commands, respond with “*” or “?”, sometimes with extra text describing what happened, acknowledging the new status or providing instructions. Details are provided with each command as appropriate.

Note: *In the sections below detailing all the User Commands, the [CR] and [LF] symbols are omitted for clarity, except in the section on UDP Protocol.*

Note: *The < > symbols surrounding text indicates a parameter to be filled in by the user as appropriate or a value returned by the device as appropriate.*

Using the USB Connection:

The USB connection on the EA-1 device uses a Virtual COM Port, or “VCP”. This allows the PC to connect to the EA-1 device in the same way it would connect to a regular RS232 device, using the same tools as used to open and communicate with a COM port. Any standard RS232 terminal programs such as “HyperTerminal” or “Termite” can be used. Standard settings are 115200 baud, no parity, 1 stop bit, no hardware control. For convenience, a terminal is also included in the *OphirEthernetApp* PC App.

Special Rules When Using Telnet:

If using a Telnet connection (via a “terminal” or direct using software code), the following extra rules apply:

- All commands are echoed back by the device before the reply is sent (see $EE command)
- All replies contain a “>” symbol after the final “[CR] [LF]”
- The “>” symbol at the end should not be used as the “end of reply” symbol because further “>” symbols may appear inside the bulk of the reply (before the end).

UDP Protocol:

If using a UDP connection, a special protocol is defined to enable sending commands to the device and receive back replies. This sub-section details the special UDP protocol. Note that the preferred protocol is Telnet. For devices that do not support Telnet directly (example: some PLCs) it is possible to emulate Telnet using the native TCP/IP protocol. See Appendix 4 for more details.

In order to send commands to the device via UDP:

Send a UDP packet to device IP address port 11000 with the command string as defined here:

Command String Format: OPHCMDXXXX$VE<params>[CR]

where:

OPHCMD = a special 6 letter prefix we have defined for UDP commands.
XXXX = a user defined 4-character string (ASCII characters), a code defined by the user, which will be returned by the device as part of the response to this command. For example the user can decide to use a counter (0001,0002,0003) in order to track the response for each particular command, in case command return out of order, or in case there are missing responses.
$VE = Ophir Command (for example $VE for version, see below).
<params> = whatever parameters are required for the specific command as defined in the Manual.
[CR] = carriage return character

Note: *In some platforms, it may not be necessary to send the CR character. In particular, when using a Linux environment to send the UDP commands, it has been reported that adding the CR at the end of the command string can cause problems for certain commands such as $PL. If any problems are observed using UDP, we recommend removing the CR command to see if that solves the problem.*

In order to receive data back from the device through UDP:

Listen to UDP from device IP address port 11000 and check format (see examples).

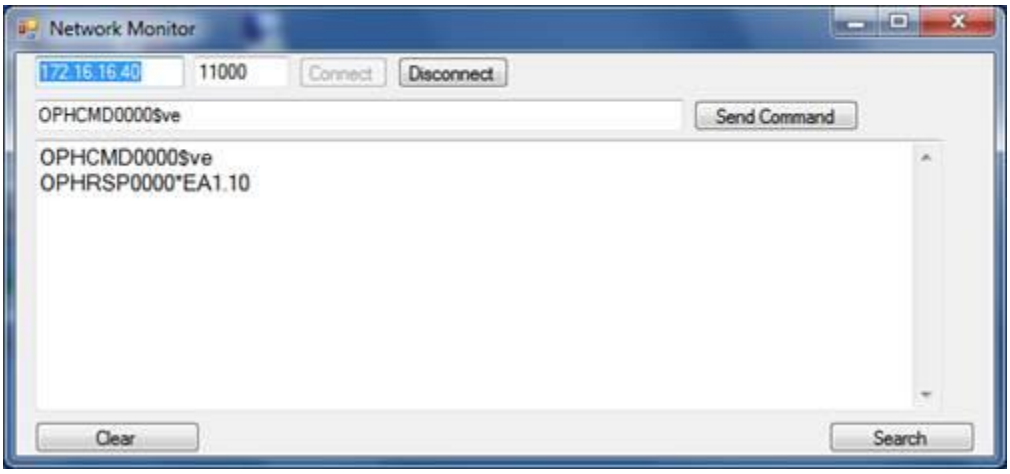
Receive String Format: OPHRSPXXXX*1.23[CR][LF]

where:

OPHRSP = a special 6 letter prefix we have defined for UDP receives.
XXXX = the same user defined string as defined above, to check which response is from which command.
*1.23 is the received data to this command. See details below – an error message might response with a ? instead of the * character.
[CR][LF] = carriage return & line feed characters at the end of the message, as in manual

Ophir can provide a small PC application (named “NetworkMonitor.exe”) that allows the user to send commands and receive replies via UDP, in order to test the UDP connection. Inside the application, the user needs to fill in

the IP address of the device, write a command string, and then click on “Send Command”. The response appears in the window below. For example to query power the user can send “OPHCMD0001$SP” and then click on the "Send Command" button.



To receive a copy of this PC application please use the product support link on our website:
https://www.ophiropt.com/en/product-support
Or contact Ophir via your local sales agent and ask for the question to be referred to the Ophir R&D Team.

Ethernet Commands:

These commands are specific to Ophir Ethernet devices and control the Ethernet settings and other related issues.

Device User Name ($DN):
Queries (with no parameter) or sets “Device User Name”.
If present value is undefined, returns “?NOT DEFINED”.
If parameter is “DELETE”, the present value is erased.
Note: *“DELETE” must be written in upper case letters only.*
Examples:
“$DN WELDING MACHINE” -> saves the user name “WELDING MACHINE”, and returns “*OK”
“$DN” -> queries the present value, returns “*WELDING MACHINE”
“$DN DELETE” -> erases the present User Name stored in the local EEPROM

MAC Address ($MC):
Queries MAC address of device.
This value is fixed and cannot be changed by the user.
Example:
$MC -> *MAC address: 00:1E:AF:00:12:34

Enable or Disable Echo ($EE):
Queries or changes the echo setting for Telnet connections. Echo is ENABLED by default at power up.
Parameters:
(no parameter) query present echo status, replies “*0 (ECHO OFF)” or “*1 (ECHO ON)”
0 - disables echo
1 - enables echo

Network Static Settings ($NS):
Sets or queries static IP address settings stored in the local EEPROM.
Values are entered and returned in format “172.16.16.49”.
When setting a new value, replies “*SAVED (need reset)”, and saves the value in the local EEPROM to be used after the next reset.
If the value entered is the same as the original setting, replies “NO CHANGE”.
When querying, returns the present values stored in the local EEPROM, whether or not these values are being used in practice at present.
Parameters:
1 - static IP address
2 - IP subnet mask
3 - IP default gateway
Examples:
$NS 1 -> “*IP : 172.16.16.42”
$NS 1 172.16.16.49 -> “*SAVED (need reset)”
$NS 1 172.16.16.49 -> “*NO CHANGE”
$NS 2 -> “*Subnet Mask: 255.255.255.0”
$NS 3 -> “*Default Gateway : 172.16.16.1”
Notes:
In all cases, new IP values will be valid only after next reset of device if using static IP address mode.

Network Present Settings ($NP):
Queries IP address settings actually being used now by device.
This command can be used in static or dynamic mode.
The values returned by this command may be different from $NS values.
Parameters:
1 - IP address
2 - subnet mask
3 - default gateway
4 - DNS - Dynamic Name Server
Examples:
$NP 1 -> “*IP : 172.16.16.42”
$NP 2 -> “*Subnet Mask: 255.255.255.0”

Network Dynamic IP Address Mode ($ND):
This command sets, or queries the present setting, of DHCP (Dynamic IP address mode). Any changes will be used after the next device power up.
Parameters:
No parameter -> queries present setting, replies 0 (DHCP OFF) or 1 (DHCP ON)
0 -> disables DHCP, replies *OK or *UNCHANGED
1 -> enables DHCP, replies *OK or *UNCHANGED

Timeout for DHCP Lease ($TD):
This command returns the remaining time (in seconds) for the dynamic IP address allocated by the local network, when using DHCP (dynamic IP address allocation). When not using DHCP, the command is not relevant.
Examples:
$TD -> *259188 [Using DHCP; 259,188 seconds or approximately 3 days, are left on the lease. The number returned will decrease by 1 every second]

$TD -> *-290 [Not using DHCP; the lease time is zero, so the time left on the lease is negative, -290 seconds, decreasing by 1 every second. 290s is the time since the device was last started up]
Background:
If DHCP is enabled, the device requests a new IP address whenever it powers up. Along with the IP address, the network provides a "lease time" during which the device is allowed to use the IP address allocated for it. Typically this time will be a few days or one week. After this time, the device is supposed to refresh the connection and request a new IP address from the network (in most cases, the same IP address will be allocated again).
This command returns the time remaining during which the device is allowed to use the IP address allocated, and counts down continually from the moment the IP address is allocated, with precision of one second.
In most cases the device is not likely to be connected to the network for many days at a time without a power-up or a reset; but if it is, the user's software will need to take care to periodically refresh the connection before the timeout limit is reached.

Note: *No action is taken by the device firmware when the timeout drops down to zero. The host software should take this into account on its own. In addition, the "OphirEthernetApp" software takes no action regarding this timeout and does not monitor it. The user should be aware to reset the device periodically when a connection is made for more than a day or two.*

Keepalive Timeout ($KT)
Sets the Keepalive timeout and saves its value in device's memory, or queries the present Keepalive timeout value, in units of 5 seconds. For example, setting the value to "10" will set a timeout of 50 seconds. The Keepalive timeout prevents unused or disconnected connections locking out the device from the client side. The connection is automatically disconnected after the timeout period has expired with no activity on the connection. Timeout values allowed are multiples of 5 seconds, up to a maximum of 1275 seconds (255 x 5s = 1275s = 21.25 minutes). Setting the Keepalive timeout value to zero disables the Keepalive feature.
Parameters:
(no parameter) Query present value
1 – sets the timeout to 5s
10 – sets the timeout to 50s
255 – sets the time to 1275s (= 255 x 5s)
0 – disables Keepalive feature
Examples:
$KT 7 -> *7 (35s) (Sets the timeout to 35 seconds)
$KT -> *7 (35s) (Queries the present timeout setting, 7 units of 5s, 35 seconds)
$KT 567 -> ?BAD PARAM (value out of range, generates an error message)
$KT 0 -> *0 (DISABLED) (parameter 0 disables the Keepalive feature)
Notes:
This command is supported from EA-1 firmware version 1.18 and above. For older devices delivered with previous firmware versions, the Keepalive feature may be disabled by default even after upgrading the firmware to v1.18 or above. To enable Keepalive, the $KT command needs to be used. Units of EA-1 delivered with firmware v1.18 or above will have Keepalive turned on by default.

General Notes on Commands:

The commands listed below are common to most Ophir devices, and not specific to Ethernet devices. They can be used to control the device settings and take measurements of power and energy from the sensor. This sub-section lists some general notes about these commands.

Standard Error Messages:

If a command is not recognized or the parameters are incorrect, for most standard commands one of the following error messages will be returned:

?BAD PARAM – if incorrect parameters received, for example the wrong number or missing parameters, when they are needed.
?UC <the 2 first characters received which were not recognized>
?BAD COMMAND 66,65 – if a single character instead of a double character command code is entered

Note: *The exact error messages may differ slightly for some commands.*

Note: *Some of the commands are specific to the type of sensor being used, for example some commands work only for energy mode; other commands work only with sensors which have a continuous calibration curve (all photodiodes and some thermopiles) rather than discrete calibration points (some thermos). Some commands work only with thermopile or only with photodiode sensors. Details are given with each command.*

Disclaimer: *Every effort has been made to list all the parameters, responses and error messages as accurately as possible for every command. If there are any discrepancies between details listed in this document and between the actual behavior of the device, the user should pay attention to the actual behavior. Any errors found in this document should be brought the notice of Ophir R&D staff via the product support link on our website: https://www.ophiropt.com/en/product-support*

Device Specific Commands:

Version ($VE):
Returns the firmware version of the device
Example:
$VE -> *EA1.06 (when device is running in regular application mode)
$VE -> *ED1.06 (indicates device is running in special “downloader” or boot mode, used for upgrading firmware)

Instrument Information ($ii):
$ii -> * ETHA <S/N of device> ETHERNET-ADAPTER
Returns information about the device: a 4 letter code ETHA, the S/N of the device, and the device description "ETHERNET-ADAPTER”. Can be used primarily to query the individual S/N of the device itself (as opposed to the S/N of the sensor that is attached to it).
Example:
$ii-> * ETHA 350002 ETHERNET-ADAPTER
Note: *The command will work with upper or lower case letters. Using lower case in this document for clarity.*

Sensor Information ($hi):
$hi -> * <2 letter sensor code> <S/N of sensor> <name of sensor> <capability code>
Returns information on the sensor, including name and S/N.
The 2 letter code is “TH” for thermopile sensors, or “SI” for photodiode sensors. Other types of Ophir sensors have different 2 letter codes.
The last parameter is an internal code for factory use only.
Example:
$hi -> * TH 345543 30(150)A-LP1 00400003 (thermopile sensor; S/N 345543; name “30(150)A-LP1”)
Note: *The S/N returned is for the attached sensor and not for the device itself. The device S/N can be queried using the $ii command.*

General Commands:

Test communications ("Ping" command, $HP):
This command does nothing to the device but returns a reply “*”. It can be used as a “ping” command to check communications with the device.
Example:
$HP -> *

Reset ($RE):
Resets the device firmware and forces a disconnection of the communications channel. Using this command is equivalent to powering the device off and on again. The device acknowledges by replying “*” before performing the reset.
Note: *When using the USB Virtual COM Port connection, it is recommended that the channel be closed in the support software immediately after sending this command, otherwise a physical disconnect and reconnect of the cable may be necessary to restore communications after the device is reset.*

Mains Setting ($MA):
Sets the internal measurement period used for sampling data to either 20ms for 50Hz regions, or 16.666ms for 60Hz regions. In some cases, this can reduce noise. Sending the command with no parameter queries the present setting; sending parameter "1" sets to 50Hz; sending parameter "2" sets 60Hz setting. To save the new setting as the default device startup setting, send the “$IC” command.
Example:
$MA 1 -> * 1 50Hz 60Hz (sets 50Hz)
$MA 2 -> * 2 50Hz 60Hz (sets 60Hz)
$MA -> * 1 50Hz 60Hz (queries present setting)
Note: *For this particular command, there must be exactly one space between the “MA” and the parameter, for example “MA 1” (with one space) and not “MA1”(no spaces) or “MA 1” with two or more spaces.*
Note: *This setting relates to the device and not the attached sensor.*

Instrument Configuration ($IC):
This command saves the present device configuration in local EEROM as the default startup setting (for example, the mains setting, see $MA)
Example:
$IC -> *SAVED (if a configuration change was made and saved)
$IC -> *UNCHANGED (if no configuration changes were made since startup or since

Zeroing Commands:

Zero Sensor ($ZE):
$ZE –> * (Initiates a zero of sensor. After sending this command, zeroing will be in progress for approximately 25s during which most other commands, except $ZQ or $HP, should not be used, as the device is not functioning in its normal mode. See also $ZQ, $ZA, $ZS)
Note: *Zeroing should be performed with the sensor attached and covered or protected from light or heat.*

Zero Query ($ZQ):
$ZQ -> * (Returns status of last zero performed using $ZE command. This command should be used after $ZE to find the status of the last zero command)
Returns:
"*ZEROING NOT STARTED" if zero has not yet been performed since power-up, or since last $RE reset
"*ZEROING IN PROGRESS" if zeroing is still in progress

"*ZEROING FAILED" if zeroing failed (either a bad zero value was measured or failed to write values to EEPROM)
"*ZEROING COMPLETED" zeroing completed successfully and should now be saved using $ZS

Zero Save ($ZS):
$ZS -> *<status> (Saves the values of last zero into the local EEPROM memory. Without sending this command, zero parameters will default back to previously saved values after next power up of the sensor)
Returns:
“*SAVED” (if zero was successfully saved)
“*UNCHANGED” (if no new zero data is available since last save)
“*ZEROING NOT STARTED” (if there has been no zero performed since last power up or reset)

Zero Abort ($ZA):
$ZA -> *<status> (Aborts zeroing. Return string depends on present status)
*ZEROING NOT STARTED
*ZEROING ABORTED

Power Measurement Commands:

This section describes commands that can be used for sensors measuring power, either thermopile or photodiode sensors. Some of the commands are relevant also for pyroelectric or PD-C sensors, as will be listed below in a separate section.

Send Power ($SP):
$SP ->*<Latest power measurement> (This command sends the next available power measurement when it becomes available. It never returns the same measurement twice. It can return measurements up to a maximum rate of 15 times per second (therefore there may be a delay of up to 66ms before receiving a reply, not including command latency). The response is in “E” format, preceded by "*" and ended by [CR][LF])
Example:
*1.234E0 for 1.234W
*2.345E-4 for 234.5uW
Note: *If power exceeds 110% of the chosen full-scale power range, $SP returns "*OVER”*

All Ranges ($AR):
$AR –> * 2 AUTO 10.0W 3.00W 300mW 30.0mW (Returns a list of all available power ranges (scales) (or energy scales if sensor is set to measure energy) including an index value showing which range is presently selected. In the example shown above, top scale (index 0) is 10W, scale 1=3W, scale 2=300mW, scale 3=30mW, and an auto-ranging scale is also available ("AUTO" corresponding to index -1). The "2" is the index and indicates that range 2 (300mW) is currently selected. See also $RN and $WN commands, the index value is the same as defined for those commands).

Write Range ($WN):
$WN 0 –> * (Changes power or energy range)
Parameters:
0 = highest (least sensitive) range.
1 = first range down from highest (if available).
2 = second range down from highest (if available)
-1 = Autorange (if available).
Note: Maximum allowed range is defined by $AR command. After using the $WN command, the software should wait ~3s before resuming power measurements with the $SP command. Use the $HC S command to save new range as default startup setting.

Read Range ($RN):
$RN –> *1 (Reads present chosen range, returns as parameter defined in $WN and $AR)

Save Sensor Configuration Settings ($HC):
$HC [S|C|R] -> *
Saves the present sensor settings as the power-up defaults. Parameter should be “S” (startup settings), “C” (calibration settings) or “R” (response tweak setting)
Note: *In order to change the power-up defaults, the following sequence is necessary:*
a. Set desired setting, e.g. power range using $WN command
b. Save chosen settings using $HC S command
c. If the incorrect parameter is sent, “?PARAM ERROR” is returned

Force Power Command ($FP):
$FP -> * (Forces sensor into power mode. Stops sensor measuring energy. Sending $HC S command after $FP will set sensor to start up in power mode)

Filter Query ($FQ):
$FQ <1 | 2> (Query and set the photodiode filter setting (IN or OUT), for photodiode sensors only.
Response is “* <code> <option 1> <option 2>” where “code” is the index of the option presently chosen (1 or 2); and options 1 and 2 are the two options offered for this sensor, for example OUT and IN. For some sensors, for example 3A-IS, only one option is available; for thermopile sensors the command will return an error message)
Parameters:
No parameter, or 0: Query for present filter setting, example response “* 1 OUT IN”
1: Configure head for Filter OUT mode, response “* 1 OUT IN”
2: Configure head for Filter IN mode, response “* 2 OUT IN”
Examples:
a) 3A-IS sensor:
$FQ -> “*1 N/A”. As there is only 1 setting the command is not applicable in this case, there is nothing to change.
b) regular PD300 sensor with filter IN/OUT:
$FQ -> “* 1 OUT IN”. Sensor is presently in Filter IN mode.
$FQ 1 -> “* 1 OUT IN”. Sensor has been configured to Filter OUT mode.
$FQ 2 -> “* 2 OUT IN”. Sensor has been configured to Filter IN mode.
$FQ 3 -> “?FILTER SET UNAVAILABLE”. Invalid setting and sensor remains in previous filter mode.
c) Thermopile sensor:
$FQ -> “?NOT A PHOTO HEAD”. Sensor does not support this command.

Note: *To save new setting as startup default, use $HC S command.*

Using the Low Freq. Power Mode (Photodiode Sensors):

This section is relevant for photodiode sensors measuring low frequency pulsed sources, such as VCSELs. This measurement mode is available using firmware 1.17 or above. See notes above on “Low Freq. Power Mode” for the PC application for more details.

Measurement Mode ($MM):
$MM [n] -> *[n] (Forces sensor into a new measurement mode. This is equivalent to using the $FP command (Force Power, MM 2) or the $FE command (Force Energy, MM 3). It is also required to start the “Low Freq. Power” mode (MM 16). Use the “$HC S” command to save setting permanently for next startup)
Parameters:

No parameter: Query present mode.
1: Places sensor in passive mode (not measuring)
2: Places sensor in regular power mode.
3: Places sensor in single-shot energy mode (thermopiles only).
16: Places sensor in Low Freq. Power mode for measuring average power of a pulsed laser source (photodiodes only)
Examples:
a) MM 2 -> forces regular power mode
b) MM 16 -> forces Low Freq. Power mode.

Sampling Period ($AAPC):
$AAPC <period in microseconds> -> * <period in microseconds> (Allows user to choose a measurement period equivalent to the laser pulse frequency when using MM 16 “Low Freq. Power Mode”. Values are entered in microseconds, from 10000 (10ms, 100Hz) up to 200000 (200ms, 5Hz). Use the “$HC S” command to save setting permanently for next startup)
Examples:
$AAPC -> 25000 - queries the present setting, shows 25000us or 25ms, equivalent to 40Hz.
$AAPC 50000 -> sets the period to 50ms, equivalent to 20Hz.

Selecting Power Range and Measuring Power:
Use the $WN command to select a power scale. Use the $SP command to query power or use the “Continuous Send” mode as described below. Note that when using MM 16 mode, the power measurement is delivered with 7 significant digits instead of 4 when using normal CW Power (MM 2) mode.
As described above (see the section “Low Freq. Power Mode” in the PC Application chapter) the correct power range to use depends on the average power level being measured and also on the peak power level, which may saturate the electronics. Choose the most sensitive power range possible that does not give “OVER” or “over”.

Energy Measurement Commands (Thermopile Sensors):

This section is relevant for thermopile sensors measuring single-shot energy pulses. Some of the commands are relevant also for pyroelectric/PD-C sensors measuring pulsed laser pulses, as will be noted below in a separate section.

Force Energy Command ($FE):
$FE -> * (Forces sensor into energy mode. Needed if sensor started up in power-only mode. Sensor can be set to start up in energy mode as default if required, by sending $HC S after sending $FE. When in energy mode, sensor can continue to measure power using $SP etc. To switch off energy mode, send $FP command)

Energy Flag Command ($EF):
$EF -> *1 or *0 (Returns status of energy measurements, whether there has been a new energy measurement since last Send Energy ($SE) command was processed)
Notes:
When starting up energy measurements, it is good practice to send the $EF command to check there is no “residual” energy measurement already present, and if the command returns “1” the old measurement should be cleared by sending the $SE command before continuing. See sub-section “Notes on Measurement Energy in Support Software” below.

Send Energy Command ($SE):
$SE -> *1.2345E1 (Energy in Joules), or “*OVER” (Returns latest energy value measured in Joules, or "OVER" if last energy measurement was overrange. Returns "?NOT MEASURING ENERGY" if sensor is not measuring energy but only power)
Notes:
The Energy value is returned using same format defined for $SP. The exponent value depends on the chosen energy scale. If the power level saturates the internal A-to-D while measuring energy, $SE returns "OVER".
The $SE command will repeatedly return the last energy measurement until a new energy pulse arrives, the $EF flag can be used to determine if a new energy measurement has arrived since the last time $SE was used
The maximum rate at which energy can be measured depends on the specific sensor parameters
See section below for suggestions on usage of this command in software.

Energy Status ($ES):
Returns status of energy measurements at this moment. Return value is one of the following codes:

- "NOT IN ENERGY" if not measuring energy (see $FE)
- "START" if energy measurements are resetting (when first entering energy mode it takes a few seconds for the software to prepare for the first measurement)
- "WAIT" if waiting for the next trigger to arrive
- "INT" if integrating the present energy pulse
- "VALUE" if a valid value is available (only for one cycle)
- "TIMEOUT" if integration failed (power level did not drop low enough to end integration, only for one cycle)
- "FINISH" after value is available, before new triggers are allowed

Energy Ready ($ER):
Sends *1 if the device is ready for a new energy measurement, or 0 otherwise. Does not relate to whether the value was queried using $SE. When first entering the energy mode, or after changing the energy scale, the device will not be ready to receive and measure a new energy pulse, and the command will return “*0”. When the device is ready to receive a new energy pulse, the command will return “*1”. If a pulse is received and the device is triggered, the command will return *0 while integrating the measurement, until it is ready to receive the next pulse.

Energy Threshold ($ET):
Queries or sets energy threshold. Allows the customer to adjust the internal trigger level used for detecting the start of an energy pulse.
0 or no parameter: Query
1= set low threshold (default / 3)
2= set medium threshold (default)
3= set high threshold (default x 3)

NOTES ON MEASURING ENERGY IN SUPPORT SOFTWARE:
Assuming that the support software is started after the device has been powered up, the correct sequence for working is as follows:

Set the unit to the lowest energy range that will not result in over-range message.
Establish communications with the device using the $HP command and looking for the response “*[CR][LF]” (see above). Send the $EF command and check its response. If the response is a "1" (new value available), this indicates that energy was measured before the software was opened. Assuming that this measurement is not useful to the application, send the $SE command once to clear the $EF response to "0", and throw away the result. Continue sending the $EF command until the response is "1" again (this indicates a new pulse has been measured by the sensor). The recommended period for polling the $EF command is ~100ms, so as not to choke the communications.

If the first response to $EF is "0", continue sending the $EF command until the response is "1". This indicates the sensor has received a new energy pulse and has finished measuring it.
In either case, once the $EF command returns "1", send the $SE command once. This should return the energy value of the latest pulse measured by the sensor. Log this measurement for the application; if the response is OVER then tell the application that this value was 'over-range', and that it should change to a higher energy scale before continuing (or reduce the energy of the laser).
Continue sending the $EF command until seeing "1" again, and then continue as above.
After changing energy range using $WN command, the sensor takes several seconds to settle before allowing energy measurements to resume. During this period, the $EF command returns 0.
Use the $ER command to determine if the device is ready to receive the next pulse of energy.

Wavelength Commands:

This section is relevant for all types of sensors.

GENERAL INFORMATION ON WAVELENGTH CONFIGURATION COMMANDS:
Ophir sensors are split into two groups:

- *Some sensors contain fixed (discrete) laser settings, which are permanently configured inside the sensor. These settings can be values in "nm" such as "1064" or names of a laser region or laser type, such as "CO2", "YAG" or "<0.8" (meaning: "less than 0.8um"). For these sensors, the user can choose one or other of the settings offered, but cannot change any of the settings. The laser setting can be chosen using $WI and viewed using $AW, and the default startup setting can be saved using the $HC S command.*
- *Other sensors contain a continuous calibration curve, defined between two wavelength limits for example 200nm and 1100nm for a photodiode sensor. The user can define up to six "favorite wavelengths", in nm, at whatever laser points are convenient. These favorites can be added, deleted or edited by the user using commands $WD, $WI, $WE, $AW and $WL. A default set of favorites is defined for each sensor in the factory. The favorites can be permanently saved in the device EEPROM memory using the $HC S command.*

Most thermopile sensors use the discrete method, whereas photodiode sensors and some thermopiles use the continuous method.
If any of the commands supporting the continuous calibration curve are used when the sensor does NOT support a calibration curve, the following error message will be given: "?NOT USING CALIBRATION CURVE".
If any command is used with an index outside the range 1-6 for a favorite wavelength ($WI, $WD, $WE commands), it will return an error message "?INDEX NOT IN RANGE"
If the sensor supports a calibration curve, but NO Favorite Wavelengths are defined, then the sensor will default to use the minimum defined wavelength supported in the calibration curve

All Wavelengths ($AW):
$AW -> <list of all defined wavelengths or favorite wavelengths defined for this sensor> (Returns the wavelengths defined for the sensor, see details below)

Example 1: "Discrete" laser wavelength points (some thermopile sensors)
" DISCRETE 2 CO2 YAG"*
Where:
"DISCRETE" indicates that this sensor contains several discrete laser wavelength calibration points, rather than a sensitivity curve. These points are hard wired inside the sensor and cannot be changed by the user, but the user has the option to choose between the individual points thereby adjusting the sensor's sensitivity according to the laser being used.
"2" is the index of currently chosen active laser relative to the list of names, "1" is first in the list, therefore 2 refers to "YAG" in this case.
"CO2" is the first laser option available, index 1.
"YAG" is the second laser option available, index 2.

(If more than 2 laser options are enabled in the sensor, the return string will vary accordingly)
Note: *The number of spaces between the parameters is not fixed*
See commands "$WI" for more details of selecting laser option

Example 2: "Continuous" laser calibration curve (some thermopile sensors, all photodiode sensors):
" CONTINUOUS 200 3000 2 2490 971 532 NONE NONE NONE"*
Where:
"CONTINUOUS" indicates that this sensor contains a laser calibration curve. In this case, the user can select any wavelength within the min and max limits of the curve configured inside the sensor, and also choose up to 6 "favorite" wavelengths that are more easy to choose using the $WI or $WL commands, see below.
"200" is the minimum wavelength in "nm" that can be selected by the user
"3000" is the maximum wavelength in "nm" that can be selected by the user
"2" is the index of the currently selected "favorite" wavelength offered
"2490" is the first available "favorite" wavelength, corresponding to index 1
"971" is the second available favorite wavelength
"532" is the third available favorite wavelength
"NONE" indicates that the following 3 favorite wavelengths are not currently enabled
See commands $WI, $WL, $WD, $WE for more details of controlling wavelength options

Set Wavelength Index ($WI):
$WI 1 –> * (Set Wavelength Index of sensor. Index '1' is for first defined wavelength, 2 for second wavelength, and so on, where the index is as defined by the $AW command. Value on power-up will be saved using $HC command, see below. Returns “?BAD PARAM” if parameter is greater than 6. Returns “?NO WL DEFINED AT INDEX” if index refers to an inactive wavelength setting, “NONE” returned by $AW command)

Set Wavelength Value ($WL) :
$WL 777 -> * (This command changes the presently chosen (active) favorite wavelength index from its current value to the new value in "nm". This command is not available for "Discrete" wavelength mode, see $AW above. To permanently save the change to local EEPROM memory for next startup, send command "$HC S")
Example:
Assume $AW command returned: "* CONTINUOUS 200 3000 2 2490 971 532 NONE NONE NONE"
$WL 111111 -> ?WAVELENGTH OUT OF RANGE
$WL 1111 -> * (successfully changes currently chosen index (2) to 1111nm)

Note: *Supports only sensors with a continuous calibration curve, photodiodes and some thermopiles. See $AW.*

Wavelength Add ($WD):
$WD <1-6> <wavelength> -> * (Add a favorite wavelength to the list of favorite wavelengths. Index chosen, 1 to 6, MUST be one that does not yet contain a favorite wavelength setting (listed as “NONE” by $AW). "Wavelength" is a decimal value in nm. Any changes will be saved temporarily in local RAM; after $HC S command, they will be stored permanently in EEPROM as the power-up setting. Use $WE to erase an existing wavelength setting if necessary)
Common Error Messages:
"?WL ALREADY USED" if the index chosen already has a favorite wavelength defined for it.
“?BAD WL” if wavelength value entered is out of range of defined curve.
“?BAD PARAM” if parameter is out of range
Examples:
Assume $AW command returned: " CONTINUOUS 200 3000 2 2490 971 532 NONE NONE NONE"*
$WD 7 1111 -> ?INDEX NOT IN RANGE
$WD 5 111111 -> ?WAVELENGTH OUT OF RANGE
$WD 1 1111 -> ?WAVELENGTH ALREADY DEFINED. USE WL COMMAND

*$WD 5 1111 -> * – successfully changed index 5 to 1111*

Wavelength Erase ($WE):
$WE <1-6> -> * (Wavelength Erase. Erase one of the existing favorite wavelengths, at index provided. This change will be saved temporarily in RAM; after $HC S command, it will be stored permanently in EEPROM as the power-up setting)
ERROR MESSAGES (in addition to general ones defined above):
"?NOT USING CALIBRATION CURVE" if sensor does not have Calibration Curve defined
"?BAD PARAM" if index is not within 1-6

Continuous Send Commands:

NOTES ON CONTINUOUS SEND MODE:

As opposed to the more normal "Command/Reply" mode that is used for most other commands such as $SP, $VE, "Continuous Send" mode places the device into a state where it transmits data continuously to the PC without being specifically requested to. This mode can sometimes make the software support easier inside a PC application supporting the device, and reduces the amount of communication overhead necessary to achieve the same thing using Command/Reply mode.

The Continuous Send mode is initiated by sending the "$CS 2" command and is terminated by sending the "$CS 1" command, or by sending any other command.

Once Continuous Send mode is stopped, the receive buffer inside the PC or host device must be flushed before trying to send more commands to the device.

Continuous Send - Power Mode:
When measuring power, data is sent at the measurement rate of the device (15Hz) in the same format as the $SP command. If the power is overrange then "OVER" is sent. For example:
*1.234E1
*1.238E1
*1.245E1

Continuous Send - Energy Mode:
When measuring energy, status or measurement data is sent depending on the state of the device at any given time. The device sends "*WAITING" (once) when waiting for the next energy trigger, "*SUMMING" (once) after the trigger is received, and a value (once) when the value is measured. For example:
*WAITING <--- waiting for a trigger
*SUMMING <--- trigger is received
*2.720E-1 <--- energy measurement is ready and sent once
*WAITING <---- waiting for next trigger

Start Continuous Send Mode ($CS 2):
$CS 2 -> *STARTED
Starts Continuous Send mode. Data is transmitted to the PC automatically. The exact data depends on the measurement mode and the status of the device at any given moment. See notes above.

Stop Continuous Send Mode ($CS 1 or any command):
$CS 1 (Sending CS 1 stops continuous send mode, as does sending any other command except $CS 2. Note that while a reply "*STOPPED" will be given to this command, it will be mixed in with all the other data transmitted by the device before the Continuous Send mode is stopped. Before sending any more commands and receiving "normal" replies in the Command/Reply mode, the receive buffer of the PC or host device must be flushed by

continuously reading data until there is a "time-out". The time-out should be set short enough to avoid the software needing to wait a long period of time after the data stops arriving)

Misc. Commands:

Upload Sensor ($UH):
$UH -> * (Forces device to upload sensor EEPROM of attached sensor, for example after detaching and reattaching a new sensor. This is quicker than using $RE as it does not disconnect the Ethernet connection)
Note: *Unless "polling" is switched off (see $DP), detaching or reattaching a new sensor will automatically cause the device to reset and reload data for the new sensor, and will cause a disconnection of the Ethernet or USB connection to the device. Therefore if "polling is switched on, $UH is not required.*

Disable Polling ($DP):
This command enables or disables device polling. When polling is enabled, the device continually checks if the sensor has been detached, or if a new sensor has been attached. When the device detects a change in status, it automatically performs a reset in order to load data for the new sensor. When doing so, it also disconnects the current connection to the Ethernet or USB.
Parameters:
$DP (no parameter) - queries present status, reply: 0=polling on, 1=polling off

$DP 0 - enables polling until next reset
$DP 1 - disables polling until next reset
$DP 2 - enables polling permanently (responds "0")
$DP 3 - disables polling permanently (responds "1")

Note: *Factory default is polling enabled; the result of disabling is that if a sensor is swapped over, the software (firmware and host application) will not be aware of the change and will carry on assuming nothing has happened. If polling is disabled, the host application will need to take this into account in some way.*

BeamTrack Data ($BT):
This command returns data for the Ophir BeamTrack series of sensors which measure Power, Position and Size (PPS).
The data can be returned with a few different formats. For non-PPS sensors, the command returns "?UC".
The command returns an error code (see details below) and then 3 values for X position, Y position and Size.
There are 3 different modes that are supported, each with a slightly different format to the values returned.
Parameters:
$BT (no parameter): returns "F", then an error code, then X <value>, Y <value> and S <value> (where S=size), in mm
$BT 1: returns an error code and then X, Y and S data in microns (without the "F", "X", "Y", and "S" as above)
$BT 2: same as no parameter, with more resolution
$BT 3: combination of option 1 and no parameter option
Examples:
$BT (no parameter) -> * F 00040000 X -1.50 Y -0.09 S 33.50
$BT 1 -> * 00040000 -1278 381 33842 [data for
$BT 2 ->* F 00040000 X -1.09833 Y -0.14685 S 37.79891
$BT 3 ->* 00040000 -1998 372 34047 F 00040000 X -2.00 Y 0.37 S 34.05

$BT COMMAND ERROR CODES:

The $BT error code is a bit map where each bit represents some specific error, as below:

Position Codes (bits 0-2 warning, 12-15 error):

0	Warning	0x0000 0001	Position Accuracy Warning (i.e. out of inner circle)
1	Warning	0x0000 0002	Spot Size too large for position measurement
2	Warning	0x0000 0004	Power Low (this might never be used)
12	Error	0x0000 1000	Position not measured (sensor can't measure position)
13	Error	0x0000 2000	Signal too low (i.e. signal is just noise, no meaningful measurements)
14	Error	0x0000 4000	Position Measurement out of range (i.e. out of outer circle)
15	Error	0x0000 8000	General Position Measurement Error

Size Codes (bits 16 warning, 25-31 error):

16	Warning	0x0001 0000	Size Accuracy Warning (i.e. distance from center / diameter > 20%)
17	Warning	0x0002 0000	Spot size less than EEROM limit
18	Warning	0x0004 0000	Spot size greater than EEROM limit
28	Error	0x1000 0000	Size not measured (head can't measure size)
29	Error	0x2000 0000	Negative Discriminant Or/And Negative Size
30	Error	0x4000 0000	Size Accuracy Error (i.e. distance from center / diameter > 33%)
31	Error	0x8000 0000	General Size Measurement Error

Commands for Pyroelectric/PD-C Sensors:

This section lists commands relevant for Pyroelectric and PD-C sensors. Some of the commands described above are relevant also for the Pyroelectrics/PD-C sensors.

General Energy Commands:

Some of the commands described above in the section “Energy Measurement Commands (Thermopile Sensors)” are also relevant for Pyroelectrics/PD-C sensors. They allow the user to measure pulses at slow data rates up to ~10Hz. See details above.

The commands supported are: $FE, $EF, $SE.

For higher performance, and in particular for higher data rates when using fast pulsed lasers, use the “Continuous Send” mode instead as described in the following section.

Diffuser Query ($DQ):

$DQ -> *1 OUT IN (This command queries or changes the setting for diffuser in/out for sensors which contain a removable diffuser. Using a parameter of zero, or no parameter, queries the present setting. Using a parameter of 1 or 2 sets the diffuser setting to OUT or IN, for sensors offering that option)

Example:

$DQ, or $DQ 1 -> * 1 OUT IN - query

$DQ 1 -> * 1 OUT IN - set to diffuser OUT (option 1)

$DQ 2 -> * 2 OUT IN - set to diffuser IN (option 2)

$DQ -> 1 N/A - query on a sensor where no diffuser in/out is configured.

Any other parameter will give an error message such as “?1 OUT IN”.

Note: *To save new setting as startup default, use $HC S command.*

Pulse Length ($PL):
$PL -> * 3 2us 30us 500us 1ms 5ms (This command queries or sets the Pulse Length option for the sensor. The exact response and parameters depend on the type of sensor attached. No parameter or a zero parameter, act as a query)
Examples:
$PL 0, or $PL -> * 3 2us 30us 500us 1ms 5ms - query
$PL 3 -> * - sets Pulse Length to option 3, in this example 500us
In this case there are 5 options, 1 to 5, in addition to 0 for query. Using any other parameter will give an error message.
Note: *To save new setting as startup default, use $HC S command.*

User Threshold ($UT):
$UT -> 300 106 2500 (This command queries or sets the user threshold for the chosen energy scale in units of 1 in 10,000 of the chosen full scale energy. For example setting the value to 300 will set the User Threshold for the sensor to 3% (= 300/10000) of the chosen energy scale. If the chosen energy scale is 200mJ the threshold will be set to 3% of 200mJ or 6mJ. Each energy scale has its own value for user threshold so different scales can be set to different user threshold values)
Examples:
$UT, or $UT 0 -> *300 106 2500 (Query using no parameter or 0 parameter)
$UT 500 -> * (set new user threshold to 5% of full scale of present chosen energy scale)
Note: *To save new setting as startup default, use $HC S command.*

Continuous Send Modes for Pyroelectrics/PD-C Sensors:

In addition to the usual command/reply format described above, a special “Continuous Send” (CS) mode is provided for Pyroelectric/PD-C sensors to enable data collection at much higher data rates. Several CS modes are provided in addition to those described above for thermopile/photodiode sensors. The different modes provide several options of increased data rates but at the expense of increased complexity - the user can choose which mode is most suitable for their particular application. The CS mode is supported only using a Telnet connection.

Each of these Continuous Send modes is initiated by sending the "$CS x" command and is terminated by sending the "$CS 1" command, or by sending any other command.

NOTE: CS Modes 2, 3, 4 for Pyroelectric/PD-C sensors require minimum firmware version 1.12 (use $VE command to query firmware version) included in PC Application from version 1.11 and above.

1. ASCII MODE $CS 2 (max data rate ~14kHz):

Using this mode, energy data is returned in a simple ASCII format with 4 significant digits. Data is terminated with the Line Feed/Carriage Return characters, in a similar way to responses from a regular command.
Once per second, frequency data averaged over the last second is provided with the additional key word “FREQ”.
Using this mode there is no way to know for each individual measurement when exactly this pulse arrived or whether there were pulses missing between each data point recorded.
The maximum data rate (to measure every pulse on the sensor) is ~14kHz using this mode.

Example: For every pulse measured: *1.234E-1 (*energy is 123.4mJ)*
Once per second: *1.234E-1 FREQ 4.321E2 (*energy is 123.4mJ, frequency over last second is 432.1Hz)*

2. ASCII MODE $CS 3 (max data rate ~9kHz):

This mode is similar to ASCII mode $CS 2 but with the addition of a pulse index and timestamp for every energy pulse measurement. The pulse index is a running count of the energy pulses measured. If the pulse rate is lower than the max data rate, the index will increment by 1 for every pulse measured. If the pulse rate is higher than the max data rate for every pulse, the index will increment by more than 1 to indicate how many pulses were missed between each data point. The timestamp records the exact time each pulse was measured with 1 microsecond resolution.

The value of pulse index will increase up to a maximum of 2.1 billion (to be exact, 2,147,483,647 =2^31 - 1) and then will cycle back.

Note: Due to a firmware bug up to and including firmware version 1.17, the value returns to a large negative value -2.1 billion and then counts back up to zero before starting again.

The value of timestamp will increase up to a maximum of 16.78 million (to be exact, 16,777,215 = 2^24-1) and then will cycle back around to zero.

Frequency is not provided in this mode, but the user can calculate frequency using the timestamp and pulse index.

The maximum data rate (to measure every pulse on the sensor) is ~9kHz for the first few seconds; it may be slightly slower after measuring for long periods as the timestamp and pulse index values become longer (= more bytes to deliver for each data point).

Example:

For every pulse measured: *2222 33333 1.234E-1

“2222” is the pulse index as a decimal integer (up to a maximum of 2^32-1)

“33333” is the timestamp in microseconds as a decimal integer (up to a maximum of 2^32-1)

1.234E-1 is the energy measured in Joules, 123.4mJ

3. BINARY MODE $CS 4 (max data rate ~40kHz):

Using this mode, the maximum data rate of 40kHz can be achieved. Data is delivered in blocks in binary format. Data includes the energy of the pulse as a 4-byte floating point value; timestamp for each pulse as a 3-byte value (zero to 16,777,216us and then cycling back to zero); and once per second an extra package with the frequency as a 4-byte floating point value. While this mode provides the highest data rate, it is also the format with the most complexity and therefore may take the most time to support in the user’s software or system.

NOTE: When using the Binary Mode $CS 4, data is sent from the EA-1 in pure binary format (TCP/IP) and does not use the Telnet Protocol. The user will need to bypass Telnet and parse the binary data themselves.

Details of Binary Mode:

In Binary Mode, data is delivered in large blocks. A block consists of a 16-byte header followed by multiple data packages (8-bytes each). The header contains information about the number of bytes included in the block, a counter, and some fixed value bytes which allow the user to synchronize the data.

A data block containing "N" data packages looks like this:

Header (16 bytes)
Data package #1 (8 bytes)
Data package #2 (8 bytes)
Data package #3 (8 bytes)
….
Data package #N-1 (8 bytes)
Data package #N (8 bytes)

The header looks like this:

Byte #	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***
Content	0xFE	0xFE	0xFE	0xFE	0xFE	0xFE	0xFE	0xFE
Byte #	***8***	***9***	***10***	***11***	***12***	***13***	***14***	***15***
Content	0x55	0xAA	0x55	0xAA	CS mode	Block byte count (*)		Counter

where "Block byte count" is the number of bytes contained in the block excluding the header, a two-byte value. This should be equivalent to N x 8 where "N" is the number of packages in the block.
"CS mode" is the CS mode number being used, in this case "4", as a binary value.
"Counter" is the block number (incremented for each block delivered) 0 to 255 and cycling back to zero.

The data package looks like this (N such packages in each block):

Byte #	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***
Content	Status byte	Timestamp in us (3 byte integer)			Data value in Joules or Hz (4-byte float)			

Details of data package format:

Byte_0 (status byte)	0x00 = regular energy value 0x01 = energy value OVER (out of range) 0x0A = frequency value
Byte_1	Timestamp byte 0 (LSB)
Byte_2	Timestamp byte 1
Byte_3	Timestamp byte 2 (MSB)
Byte_4 (FLOAT)	Value (energy or frequency) byte 0 (Least significant)
Byte_5 (FLOAT)	Value (energy or frequency) byte 1
Byte_6 (FLOAT)	Value (energy or frequency) byte 2
Byte_7 (FLOAT)	Value (energy or frequency) byte 3 (Most significant)

4. OTHER MODES:

At present the CS modes defined are as described above. In addition there are other options that could be added in the future according to customer requirements. Please be in contact with Ophir via your local sales agent or directly to the R&D Department (contact details below in Appendix 4) if you need assistance or if you have a request for a special measurement mode that is not currently supported.

Appendix 1 - Device Specifications - EA-1 Ethernet Adapter:

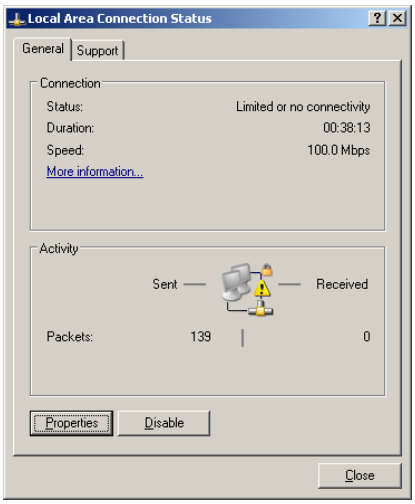
Specifications, Thermopile & Photodiode Sensors:	
Input Ranges	15nA - 1.5mA full scale in 16 ranges
A-to-D Sampling rate	15Hz
A-to-D Resolution	~17 bits plus sign
Electrical accuracy	±0.25% ±20pA new; ±0.5% ±50pA after 1 year
Electrical input noise level	500nV or 1.5pA + 0.0015% of input range @3Hz.
Specifications, Pyroelectric & PD-C Sensors:	
Input Range	0 - 6v full scale *(note: most sensors drive 0-3.3v)*
A-to-D Sampling Rate	One sample per pulse, up to 40kHz (Binary CS mode)
A-to-D Resolution	12 bits, no sign
Electrical accuracy	±0.25% new; ±0.5% after 1 year
Electrical input noise	2mV
Max data rate (every pulse), Command Mode	~10Hz
Max data rate (every pulse), ASCII CS Mode	~14kHz
Max data rate (every pulse), Binary CS Mode	~40kHz
Timestamp precision	1us (0.001ms)
General Specifications:	
Dimensions	73mm W x 93mm L x 29mm H
Mass	~0.1kg
Ethernet Specifications	10/100 Ethernet (10Base-T/100Base-TX)
Ethernet Protocols Supported	Telnet, HTTP, UDP, DHCP
Power Consumption	~1.3W
Power Input, PoE	48V DC, Powered directly over Ethernet bus via RJ-45
Power Input, External	12-24v DC, dual polarity, socket for 5.5mm barrel plug

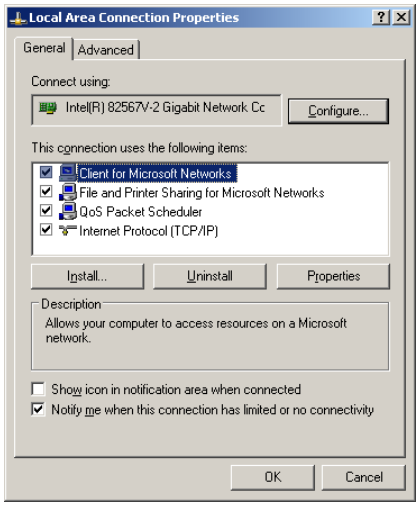
Appendix 2 - Configuring a PC to Connect Directly to the EA-1 Device:

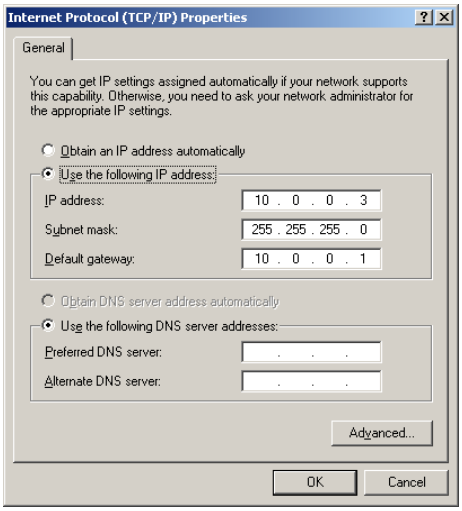
This Appendix describes how to set up a PC in order to connect using default EA-1 device IP Address 10.0.0.2, to configure the IP address. The PC is changed from using a Dynamic IP address to using a static IP address of 10.0.0.3 and the default gateway is changed to 10.0.0.1. In addition, a second method for connecting a PC to the EA-1 is described.

Changing the PC IP settings using Windows XP:

Go to: Control Panel -> Network Connections -> Local Area Network -> Properties

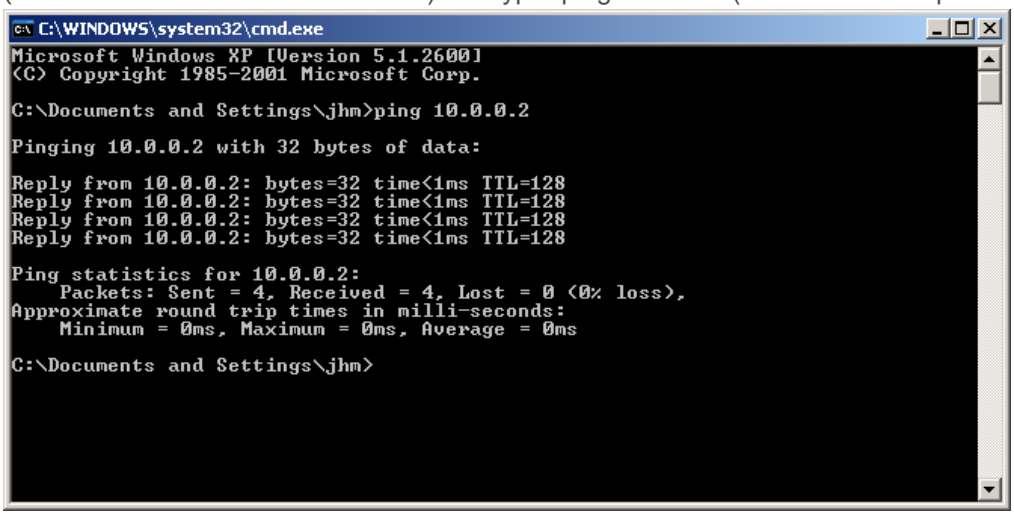






Select “Internet Protocol (TCP/IP) and click on “Properties”. Select “Use the following IP Address”, set as follows: IP address=10.0.0.3, Subnet mask=255.255.255.0, Default gateway=10.0.0.1 (see above example), and press “OK”.

To check communications, first connect the EA-1 device to the PC network port. Then open a command window (Start Menu -> Run -> cmd <enter>) and type “ping 10.0.0.2” (see above example under XP section).

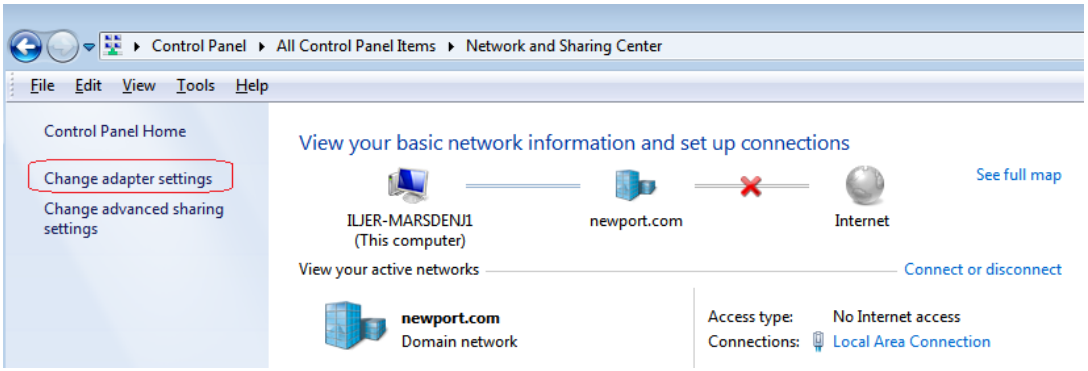


Alternatively, or in addition, open Internet Explorer, enter the IP address http://10.0.0.2/ and open the page. Follow the instructions in the configuration section above.

To restore PC settings, go back to “properties” page and set option “Obtain an IP address Automatically”

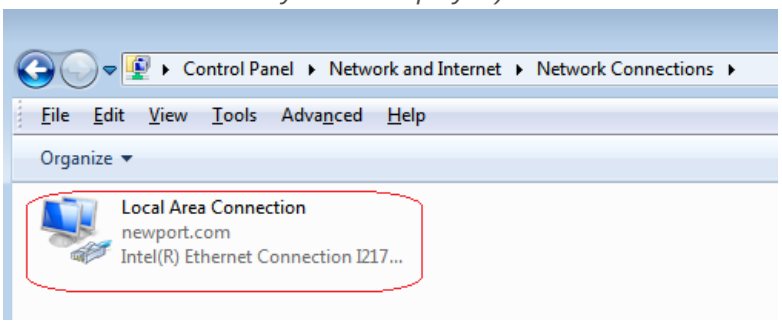
Changing the PC IP settings using Windows 7:

Go to: Control Panel -> Network and Sharing Center -> Change adapter settings (on left panel, shown below)
Properties

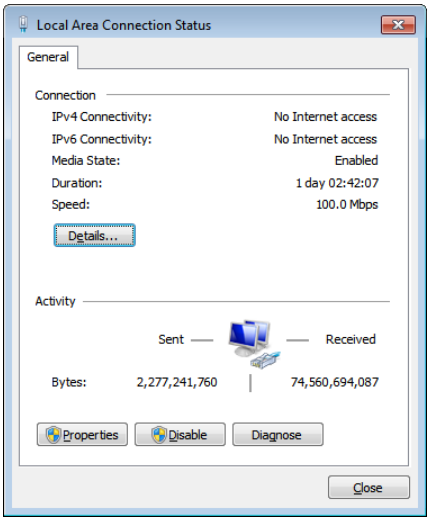


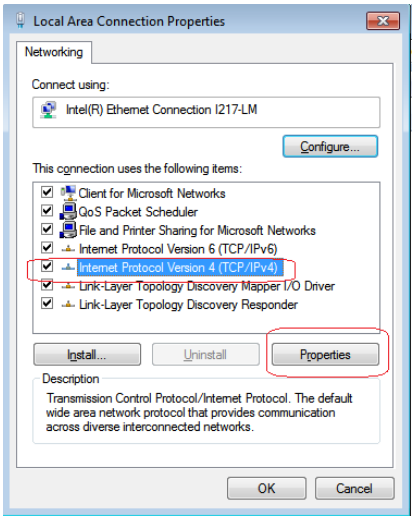
Select “Local Area Connection”.

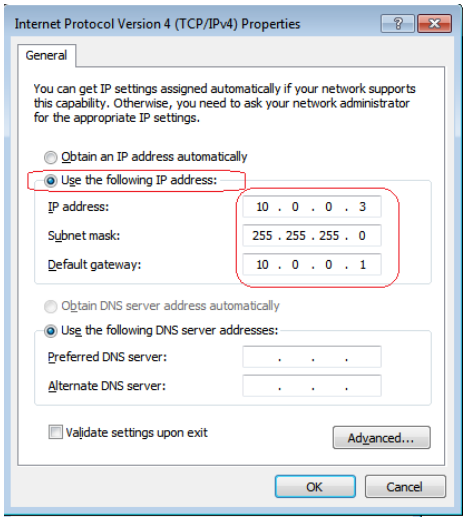
(Tip - connect the cable from the PC to the EA-1 device before entering this screen, otherwise the Local Area Network connection may not be displayed)



Double-click, or right click and choose “properties”, to open its properties screen.
Select “Internet Protocol Version 4 (TCP/IPv4)” and click on “Properties”







Select “Use the following IP Address”, set as follows:
IP address=10.0.0.3, Subnet mask=255.255.255.0, Default gateway=10.0.0.1 (see above example), and press “OK”.

To check communications, first connect the EA-1 device to the PC network port. Then open a command window (Start Menu -> Run -> cmd <enter>) and type “ping 10.0.0.2” (see above example under XP section).

To restore PC settings, go back to “properties” page and set option “Obtain an IP address Automatically”

Using Windows 8, 10, 11:

Similar to the above instructions for XP or Win7.

For Win10/11: Right-click on window icon (bottom left of screen, on taskbar) -> Network Connections. Then choose “Ethernet” (under settings on left) -> Network and Sharing Center -> Choose the relevant Ethernet connection to open the status window, and follow the instructions above.

Checking communications using Telnet:

Open a command window (Start Menu -> Run -> cmd <enter>) and type “telnet 10.0.0.2” to open a “Telnet” connection to the device.

Then type commands to send to the EA-1 device such as “$VE<enter>” and the EA-1 device should respond with its firmware version number.

Tip - if the Telnet connection is not echoing commands when you type, send command $EE 1 to restore echo mode. Echo mode is switched off when using StarLab, until the next reset/power up of the device.

Connecting with a different IP Address:

If the EA-1 device is set to a different IP address from the default, for example 172.16.16.49, it will still be possible to connect to it directly from a PC. But in that case the settings for the PC local network need to be changed as follows:

IP address=172.16.16.**40** (or any similar address starting 172.16.16.x, but not the same as the EA-1 device IP address); Subnet mask=255.255.255.0, Default gateway=172.16.16.1

Then proceed in the same way as described above.

Changing the EA-1 device IP Address:

To change the EA-1 device IP settings to match the PC’s existing IP address, or to restore the EA-1 device to its default IP address, follow the instructions in the section above “Setting up a static IP address” in the “Configuration” chapter. The most convenient way to change the IP address is via the USB connection, otherwise an Ethernet connection has to be established first.

Alternative method to connect PC to EA-1:

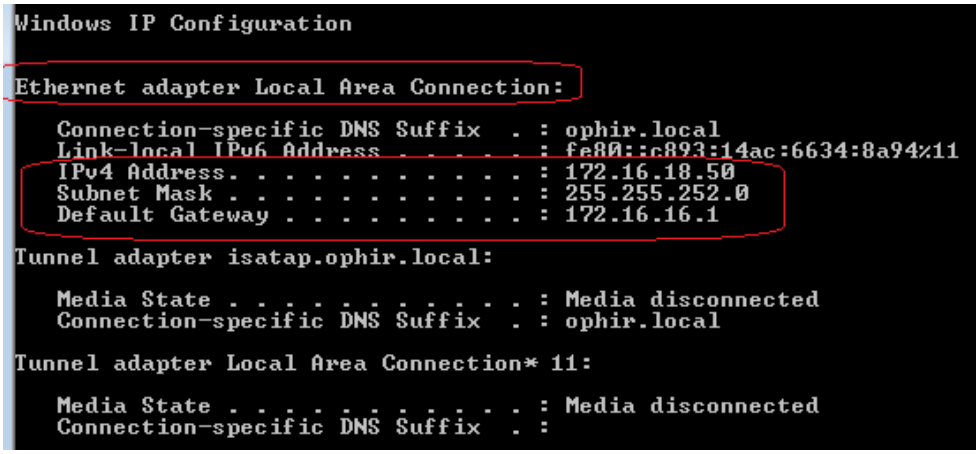
In some cases, it is not possible to change the IP address of the PC using the method described above, due to certain settings on the PC (WiFi, Firewall, VPN, BlueTooth). If this is the case, an alternative method is described in this section, where we first check the PC’s present IP settings, and then match the EA-1 device to those settings - instead of the method described above where we tried to set the PC’s IP settings to match the EA-1.

a. Check the PC is in its “default” state, if necessary restart the PC

b. In the windows start icon, bottom left of screen, click on "search programs and files" box and enter CMD <enter> to open a command box. (This refers to Win7, other versions may be slightly different).

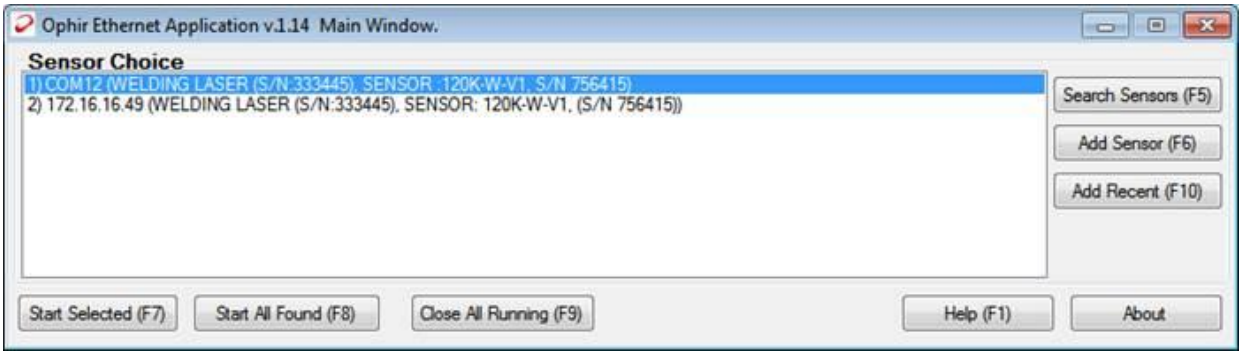
c. Type IPCONFIG <enter>

d. Check the responses on the screen. Look for a section called "Ethernet adapter Local Area Connection…." or similar. Under this section look for "IPv4 address" and note it down. Also look for “Subnet Mask” and “Default Gateway” values, if available. They should all be displayed together as shown in the example below.



As an example, let's assume the IP address of the PC is 172.16.18.50, the Subnet Mast is 255.255.252.0, and the Default Gateway is 172.16.16.1 (as shown in the example).

e. Connect the EA-1 device to the PC using both the USB and Ethernet cable, and connect the power cable to the EA-1. (First ensure that the USB drivers are installed correctly, see above). Start up the *OphirEthernetApp* and click on ‘Search sensors’. If everything is working, two lines should appear, one showing a COM connection (via USB) and one showing an IP address connection, something like this:



The second line above shows the IP address of the present configuration of the EA-1 device, before we change it.

f) First, click the line showing “COM” and then enter the second (lower) screen. Enter Setup -> Device to get to the screen showing the present IP address settings. (Full instructions are given above, see chapter 2).

g) Change the IP address to match the IP address of the PC, but +1 or -1 in the last digit. For example: 172.16.18.**51** – do NOT use the exact same address as obtained above from the PC (172.16.18.**50**). Press "Save".

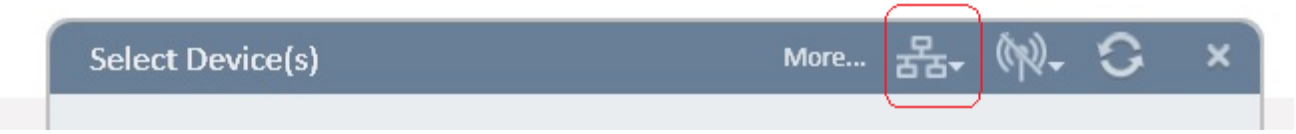
h) Set the Subnet Mask to match the PC value, 255.255.252.0 [default is usually 255.255.255.0 but it can vary]. Press "Save".

i) Set the Default Gateway to the same as value as used by the PC, in this case 172.16.16.1. If the PC's Default Gateway is not displayed, the default value to use is the same as the IP address, but with a "1" at the end, in this case it would be 172.16.18.**1**. Press "Save".

j) Restart the EA-1 by powering down and then powering up again.

k) Repeat "Search sensors" using the PC application. It should now show the same COM port as before, but the other line should show up with the new IP address just entered. Click on the line showing the IP address and it should now be able to connect via the Ethernet connection. Once this works, it should be possible to connect to the EA-1 device via any regular connection required including Telnet, using the *OphirEthernetApp*, or StarLab 3.30(+)

l) If using StarLab 3.30(+), the IP address will have to be set up correctly in the settings screen. Look for this icon in the Select Devices screen (below). The EA-1 device should be detected in the "Available Devices" list. Add the device to the list of "My Devices" by clicking "Add". See full instructions in the StarLab Manual.



m) The user should be aware that the next time the PC is started, it is possible its IP settings will have changed. If this is the case, the same process as above will need to be repeated, using IPCONFIG to check what the new IP address settings are.

Appendix 3 - Considerations Regarding Cables and Grounding:

This appendix discusses types of Ethernet cable that should be used with the EA-1 device.

Ophir supplies a short “cross-over” cable along with the EA-1 device, which can be used for initial setup if required. A “cross-over” cable is one where the Transmit pins on one side are shorted to the Receive pins on the other side, so the signals “cross-over” with each other. Unlike the EA-1, most Ethernet devices available today (switches, network cards, etc.) are capable of automatically detecting when they need to switch over their signals between Transmit and Receive, and therefore they can work with either a cross-over cable or a regular “straight-through” cable where the pins are connected one-to-one from one end of the cable to the other. Therefore in most cases, the EA-1 can be connected to any Ethernet device or switch using any type of cable whether it is cross-over or not cross-over. The cross-over cable is supplied to cover those rare cases where this is not the case.

Other considerations regarding the cable are whether to use shielded or unshielded cable; and whether to use “non-isolated” cable where the ground shield is shorted all the way through from one end to the other, or isolated cable where the ground is not shorted all the way through. These considerations need to be taken according to the particular network and equipment being used, and in most cases it does not affect the operation of the EA-1 device.

One further consideration that may be important for some customers: versions of the EA-1 manufactured up to ~June 2018 do not have a short between the local ground (connected to the metal box) and between the Ethernet ground (connected to the metal part of the RJ45 connector). Units manufactured after ~June 2018 meet full requirements for ESD and EMC compliance. These units do have a short between these grounds and therefore will no longer be “isolated”. If isolation is important to the customer, when using units manufactured from ~June 2018 and later, it will be necessary to use an “isolated” cable where the ground shield is not connected all the way through from one end to the other. Whether or not isolation is important will depend on the specific setup of the equipment, and on whether or not the sensor attached to the EA-1 is itself isolated from the surrounding equipment.

Appendix 4 – Tips using the EA-1 with PLC or other Ethernet Devices

The Ophir EA-1 Adapter is primarily for OEM customers who wish to embed the device inside their own laser system.

TCP Connection and ports:

The EA-1 can communicate via Ethernet using Telnet, HTTP and UDP. This guide focuses on Telnet and UDP connections for PLC integration.

Connection:	Port Number:
Telnet	23
HTTP	80
UDP	11000

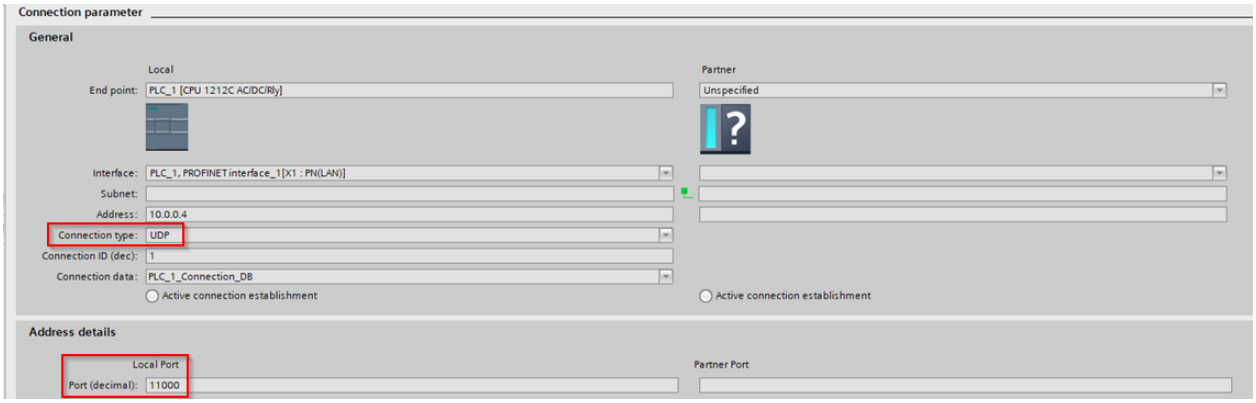
UDP Protocol:

The UDP protocol is the easiest to setup but has its drawbacks. There is no confirmation that the packet has been received or if a duplicate packet has been sent.
Siemens PLC Configuration: (*Figure 1*)

PLC is the Local Device
EA-1 is the Partner Device

Connection Type: UDP and Local Port 11000. No Partner device needs to be defined.

Figure 1



UDP PLC Communication Hints:

Siemens - see commands **TUSEND** and **TURCV**
Beckhoff - see commands **ITcIoUdpProtocol** and **ITcIoUdpProtocolRecv**

Example Communication using Siemens PLC:

Send Data: *(Figure 2)*

1. The first section (in blue) specifies the intended IP address for the command, reading down the IP subnets are 10-0-0-2. This corresponds to the IP address of the EA-1. In this case the IP address is: 10.0.0.2
2. The second section (in purple) specifies the UDP port that the command will be sent on.

3. The third section (in red) specifies the command that will be sent to the EA-1. Reading down “OPHCMD1211SPR in this case the $R stands for [CR] thus ending the command. For details of this UDP command see the EA-1 Manual.

Figure 2

"TUSEND_address".Parametri	DEC	10		
"TUSEND_address".Parametri	DEC	0		
"TUSEND_address".Parametri	DEC	0		
"TUSEND_address".Parametri	DEC	2		2
"TUSEND_address".Parametri	DEC	11000		
"TUSEND_data".string[1]	Character	'O'		'O'
"TUSEND_data".string[2]	Character	'P'		'P'
"TUSEND_data".string[3]	Character	'H'		'H'
"TUSEND_data".string[4]	Character	'C'		'C'
"TUSEND_data".string[5]	Character	'M'		'M'
"TUSEND_data".string[6]	Character	'D'		'D'
"TUSEND_data".string[7]	Character	'1'		'1'
"TUSEND_data".string[8]	Character	'2'		'2'
"TUSEND_data".string[9]	Character	'1'		'1'
"TUSEND_data".string[10]	Character	'1'		'1'
"TUSEND_data".string[11]	Character	'$'		'$'
"TUSEND_data".string[12]	Character	'S'		'S'
"TUSEND_data".string[13]	Character	'P'		'P'
"TUSEND_data".string[14]	Character	'$R'		'$R'

Receive Data: (*Figure 3*)

Looking at the receive array of the PLC after sending the command above.

“OPHRSP1211*0.09E-3RL”

For details on reading and evaluating the UDP response, please see the EA-1 Manual.

Figure 3

"TURCV_data".Data[1]		Character	'O'
"TURCV_data".Data[2]		Character	'P'
"TURCV_data".Data[3]		Character	'H'
"TURCV_data".Data[4]		Character	'R'
"TURCV_data".Data[5]		Character	'S'
"TURCV_data".Data[6]		Character	'P'
"TURCV_data".Data[7]		Character	'1'
"TURCV_data".Data[8]		Character	'2'
"TURCV_data".Data[9]		Character	'1'
"TURCV_data".Data[10]		Character	'1'
"TURCV_data".Data[11]		Character	'*'
"TURCV_data".Data[12]		Character	'0'
"TURCV_data".Data[13]		Character	'.'
"TURCV_data".Data[14]		Character	'0'
"TURCV_data".Data[16]		Character	'9'
"TURCV_data".Data[17]		Character	'E'
"TURCV_data".Data[18]		Character	'-'
"TURCV_data".Data[19]		Character	'3'
"TURCV_data".Data[20]		Character	'$R'
"TURCV_data".Data[21]		Character	'$L'

Telnet Protocol:

Telnet is a Client-Server protocol with reliable packet confirmation. The EA-1 is the server, and the PLC is the client. Communication is via port 23. Since Telnet is not usually supported by a PLC, it is necessary to emulate the IAC bytes (Interpret as Command) of the protocol.

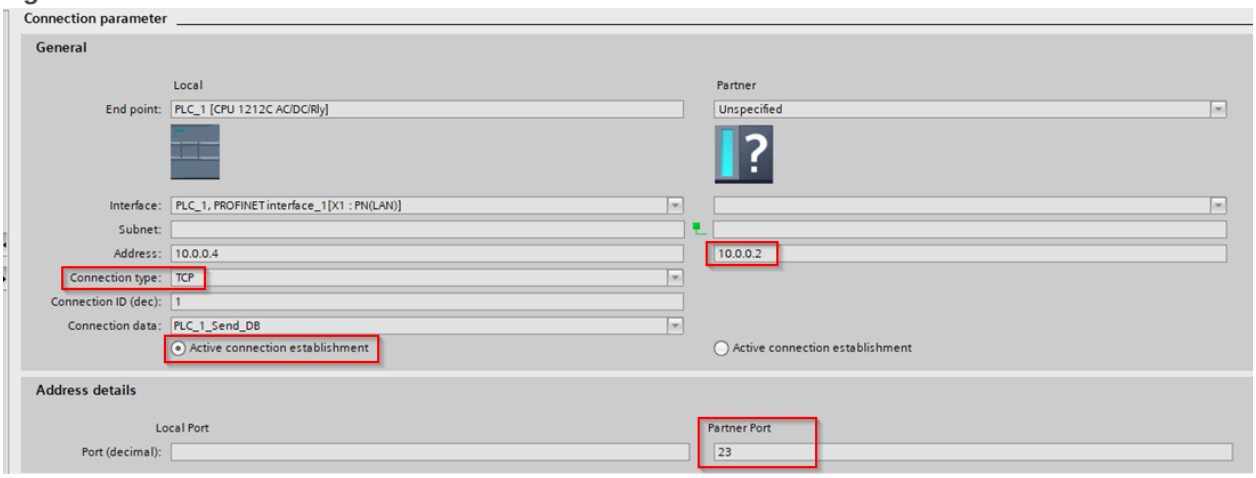
Siemens PLC Configuration: (*Figure 4*)

PLC is the Local Device
EA-1 is the Partner Device

With TCP/IP the connection must be established to a specific IP address and port. Figure 4 illustrates the connection parameters.

- Partner IP address is set to that of the EA-1 (10.0.0.2) and the port is set to 23.
- The PLC connection type is set to TCP.
- Selection of the device that will establish communication needs to be also picked. In this case the PLC will always request data from the EA-1 so select the PLC as the “Active Connection establishment”.

Figure 4



TCP/IP PLC Communication Hints:

Siemens - see commands similar to **TCONN**, **TSEND** and **TRCV**
Beckhoff - see commands **ITcIoTcpProtocol** and **ItcIoTcpProtocolRecv**

Example Communication using Siemens PLC:

Send Data: (*Figure 5*)

1. The first section (in blue) specifies the IAC commands for emulating the Telnet protocol. The IAC command is 0xFF 0xFE 0x18 0xFF 0xF0
2. The second section (in purple) specifies the command that will be sent to the EA-1. Reading down “SPR$L in this case the $R stands for [CR] and $L stands for (LF) for details of the $SP (Send Power) command see the EA-1 Manual.

Figure 5

"Data_block_1"."Send_data(DATA)"[0]	Hex	16#FF	16#FF
"Data_block_1"."Send_data(DATA)"[1]	Hex	16#FE	16#FE
"Data_block_1"."Send_data(DATA)"[2]	Hex	16#18	16#18
"Data_block_1"."Send_data(DATA)"[3]	Hex	16#FF	16#FF
"Data_block_1"."Send_data(DATA)"[4]	Hex	16#F0	16#F0
"Data_block_1"."Send_data(DATA)"[5]	Character	'$$'	'$$'
"Data_block_1"."Send_data(DATA)"[6]	Character	'S'	'S'
"Data_block_1"."Send_data(DATA)"[7]	Character	'P'	'P'
"Data_block_1"."Send_data(DATA)"[8]	Character	'$R'	'$R'
"Data_block_1"."Send_data(DATA)"[9]	Character	'$L'	'$L'

Receive Data: ***(Figure 6)***

Looking at the receive array of the PLC we can break this into sections.

1. The first section (in blue) the EA-1 Echo's the command that was sent.
2. The second section (in purple) we get the values for the command that was sent.
3. Reading from the top down we get *0.019E-3RL> again for details of this response please see the EA-1 manual.

Figure 6

"Data_block_2".Receive_data[1]	Character	'$$'
"Data_block_2".Receive_data[2]	Character	'S'
"Data_block_2".Receive_data[3]	Character	'P'
"Data_block_2".Receive_data[4]	Character	'$R'
"Data_block_2".Receive_data[5]	Character	'$L'
"Data_block_2".Receive_data[6]	Character	'*'
"Data_block_2".Receive_data[7]	Character	'0'
"Data_block_2".Receive_data[8]	Character	'.'
"Data_block_2".Receive_data[9]	Character	'0'
"Data_block_2".Receive_data[10]	Character	'1'
"Data_block_2".Receive_data[11]	Character	'9'
"Data_block_2".Receive_data[12]	Character	'E'
"Data_block_2".Receive_data[13]	Character	'-'
"Data_block_2".Receive_data[14]	Character	'3'
"Data_block_2".Receive_data[15]	Character	'$R'
"Data_block_2".Receive_data[16]	Character	'$L'
"Data_block_2".Receive_data[17]	Character	'>'

Closing Socket or Telnet connection:

The EA-1 will send 6 bytes of data upon terminating the socket connection. For reference the following data will be sent by the EA-1 upon termination of the connection (*Figure 7*).

0xFF 0xFD 0x24 0xFF 0xFB 0x01

Figure 7

"Data_block_2".Receive_data[1]		Hex	16#FF
"Data_block_2".Receive_data[2]		Hex	16#FD
"Data_block_2".Receive_data[3]		Hex	16#24
"Data_block_2".Receive_data[4]		Hex	16#FF
"Data_block_2".Receive_data[5]		Hex	16#FB
"Data_block_2".Receive_data[6]		Hex	16#01

Appendix 5 - Version History:

[Any questions? Errors in the document? Please contact https://www.ophiropt.com/en/product-support with your comments or questions]

12-Feb-19, Rev 1.17-3 (PC app rev 1.17; firmware v1.17)
Fixed typo in “General Rules” section: “[CR] [LF]” (ASCII codes 0x13 0x10 -> 13 10, Hex 0x0D 0x0A
Added details of new top screen with option to choose network.
Added details of Set IP Address button from main window.
Added details of Low Freq. Power Mode feature for photodiodes in PC app section and User Commands section.

18-Feb-25, Rev 1.19-1 (PC app rev 1.19; firmware v1.18)
Fixed error in document, timestamp in CS 3 mode does not cycle at 4.2 billion, it cycles at 16.777 million; index cycles to 2.1 billion and the back to -2.1 billion (will be fixed in later firmware version).
Added comment about option to not add CR for UDP commands, to solve problem on Linux for $PL command.
Fixed error in $ER command.
Updated information about checksum for UDP search.
Added $KT command (Keepalive Timeout).
Added section about Keepalive feature.
Formatting changes in chapter 6 User Commands & removed [CR] and [LF] in examples where possible.
Added some instructions for Win10 and Win11 to set the PC’s IP settings to connect directly to the EA-1 in factory default settings.
Added Appendix 4 – Tips for using EA-1 with PLCs.

4-Mar-25, Rev 1.21-1 (PC app rev 1.21; firmware v1.18)
No changes to User Manual content.
Update version of manual from 1.19-1 to 1.21-1 to match new PC App version release.

Ethernet Adapter EA-1 User Manual
4 Mar 2025
Rev 1.21-1

For the latest version, please visit our website: www.ophiropt.com