mks | Ophir®

Helios, Helios Plus

Helios, Helios Plus

High Power Industrial Laser Measurement

User Manual

Table of Contents

About this Manual

This manual provides information for the Ophir Helios series:

- "**Helios – Profinet**" power meter (P/N 7Z02768) (End of life)
- "**Helios – EtherNet/IP**" power meter (P/N 7Z02789) (End of life)
- "**Helios Plus – Profinet**" power meter (P/N 7Z07100) supporting multiple lasers (End of life)
- "**Helios Plus – Profinet**" power meter (P/N 7Z07134) supporting multiple lasers (replaces P/N 7Z07100)
- "**Helios Plus – EtherNet/IP**" power meter (P/N 7Z07101) supporting multiple lasers
- "**Helios Plus – EtherNet/IP-M**" power meter (P/N 7Z07104) supporting multiple lasers
- "**Helios Plus – EtherCAT**" power meter (P/N 7Z07105) supporting multiple lasers

Note: *Throughout the manual, wherever the name "Helios" appears, it refers to all types of Helios unless specified otherwise.*

The manual describes how to operate and control the Ophir **Helios** power meters with the following interfaces:

- Profinet (for P/N 7Z02768, P/N 7Z07100, P/N 7Z07134)
- EtherNet/IP (for P/N 7Z02789, P/N 7Z07101, P/N 7Z07104)
- EtherCAT (for P/N 7Z07105)
- RS232 (for all models)

How the Document is Organized

This manual describes installation and operation in the following order:

- How the **Helios** power meter works, Specifications
- **Helios** setup
- Profinet, EtherNet/IP general communication
- RS232 communication
- PC control application
- EtherNet/IP specific examples

Chapter 1 – Helios Operating Principle

Overview

The Helios sensor measures high power industrial lasers by measuring the energy of a short time exposure of the CW laser. The laser should be set to pulse from 0.1 to several seconds. The Helios measures the energy and exposure time of this sample of the power, and from this calculates the CW power.

The Helios can measure power up to 12 kW and energy to 10 kJ. The short exposure time enables power measurement by a small sensor without water cooling (see the table in Chapter 2 for recommended exposure times by power level).

The Helios can be operated via RS232 using a PC Application supplied with the sensor, or via RS232 user commands. In addition, three industrial protocols and two connector types are supported:

These models have AIDA compatible Han Push-Pull type connectors for power and data:

- Helios-Profinet (P/N 7Z07134, previous model P/N 7Z07100 & 7Z02768)
- Helios-EtherNet/IP (P/N 7Z07101, previous model 7Z02789)
- Helios-EtherCAT (P/N 7Z07105)

This model has 7/8" connectors for power and M12 for data:

- Helios-EtherNet/IP-M (P/N 7Z07104)

Please check the latest version of the datasheet on our website for information on cables supplied and optional accessories for all these models.

Other industrial protocols may be available in the future, contact Ophir for more information.

Physical Principle

The core of Helios is a high power copper thermopile disk that can measure short exposures of very high power lasers. The response time is 2-3 seconds so only energy of single-shots can be measured at such short exposure times.
An internal, uncalibrated photodiode detects the backscattered light to measure the exposure time.
Average power is then calculated by,

$$P = \frac{E}{\Delta t},$$

where P is power, E is energy, and Δt is the time interval.
All this allows short measurements of multi-kW lasers in a small, uncooled body.

Example of Use: Laser Welder in a Robotic Cell

A typical application of the Helios is to check the power of a laser welder in between welds. This process can be automated and optimized to take the least time away from production possible.
Here's a typical sequence of events:

1. Welding production "Item A" is almost done
2. Open Helios cover and check sensor is "Ready"
3. Finish welding production "Item A"
4. Turn off laser
5. Move laser to Helios
6. Turn on laser for preset amount of time (0.1-10 s)
7. Move laser back to production
8. Start welding production "Item B"
9. Read measurement (~3 seconds after laser measurement)

Chapter 2 – Specifications

== Subject to change. Check our website for latest version spec: www.ophiropt.com

1.1.2.11 Short Exposure High Power Sensors (spec v10, 1.6.23)

1.1.2.11.1 Helios Plus

50W to 12000W

Features

- No water cooling, up to 12,000W
- Profinet / EtherNet/IP / EtherCAT and RS232 interfac
- Remote actuated protective cover
- Dual wavelength range IR & visible spectrum
- Field replaceable protective window

The Helios Plus measures high power industrial lasers of up to 12kW by measuring the energy of a short time exposure to this power. The laser is set to a pulse of from 0.3 to several seconds. The Helios Plus measures the energy and exposure time of this sample of the power, and from this calculates the power. By keeping the pulse energy under 5kJ, there is no need for water cooling and the sensor can be kept to a compact size. It works in two wavelength ranges: 900-1100nm (Near IR) and 450-550nm (Blue-Green). The sensor is housed in a dust-resistant industrial body to keep the Helios Plus in clean working order even under harsh factory conditions. Its protective cover can be opened and closed remotely to protect the sensor when not in use. Its protective window is antireflection coated to reduce back reflection from high power beams. The Helios Plus offers three industrial communication protocols: Profinet, EtherNet/IP and EtherCAT, with an additional RS232 interface. It is equipped with two power and two data ports for easy integration into existing line or ring topologies as well as an RS232 connection. The Helios Plus comes with a simple PC application for easier integration into the customer's system.

Helios Plus Model Table:

Model	Description	Communication	Data connectors	Power connectors	P/N
Helios Plus – Profinet V1	Profinet, AIDA compatible connectors for power and data	Profinet, RS232	2x AIDA compatible RJ45 connectors, 1x RS232 - DB9 connector	2x AIDA compatible connectors	**7Z07134**
Helios Plus - EtherNet/IP	EtherNet/IP, AIDA compatible connectors for power and data	EtherNet/IP, RS232	2x AIDA compatible RJ45 connectors, 1x RS232 - DB9 connector	2x AIDA compatible connectors	**7Z07101**
Helios Plus - EtherNet/IP-M	EtherNet/IP, M12 connector for data, Mini 7/8" connector for power	EtherNet/IP, RS232	2x M12 D-coded connectors, 1x RS232 - DB9 connector	2x Mini 7/8" connectors (male / female)	**7Z07104**
Helios Plus - EtherCAT	EtherCAT, AIDA compatible connectors for power and data	EtherCAT, RS232	2x AIDA compatible RJ45 connectors, 1x RS232 - DB9 connector	2x AIDA compatible connectors	**7Z07105**

* For specifications please see page 103 and for drawings see page 104

Specifications of Helios Plus (following the Model Table on page 102)

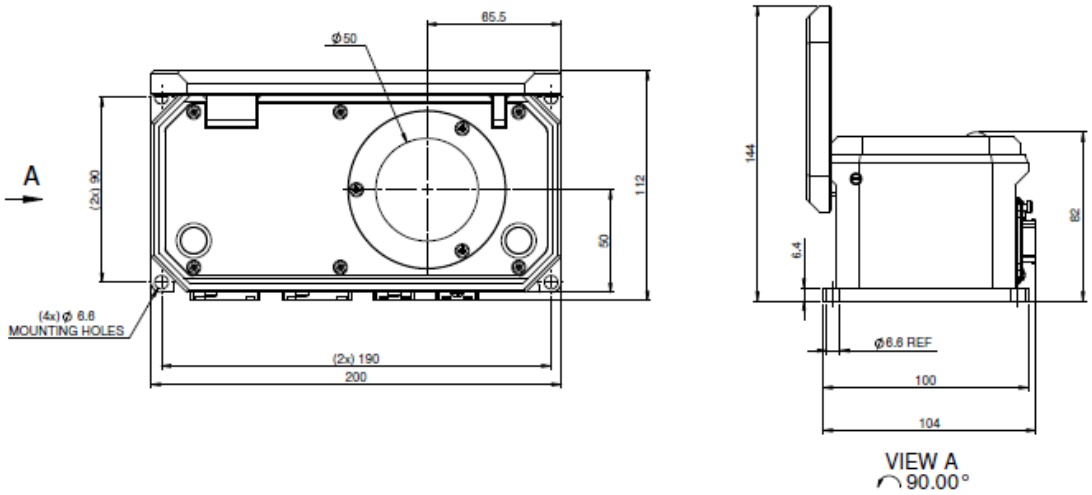
Use	**High power industrial laser measurement**					
Absorber Type	LP2, absorption ~94%					
Power Range	50W – 12kW					
Energy Range	100J – 5kJ					
Exposure Time (see table below)	0.3 - 4s [a]					
Wavelength	450 - 550nm, 900 - 1100nm					
Aperture	Ø50mm					
Max Beam Diameter	35mm					
Maximum Energy Density	4kJ/cm²					
Calibration Uncertainty	±1.9%					
Accuracy [b]	±3% (900 - 1100nm) ±3.5% (450 - 550nm)					
Linearity with Energy	±1.5% [c]					
Reproducibility	±1%					
Response Time	3s					
Waiting Time for Next Measurement	12s					
Maximum Exposure Before Cooling Down is Necessary	Maximum operating temperature of 60ºC will be reached after exposure to 30kJ (e.g. 6 shots at 5000W, 1s). Cooling down time before another 5kJ shot, 3min.					
Power Supply	24 VDC ±5%, max 2A (for daisy-chaining)					
Power Consumption	4.8W					
Dimensions	Model: Profinet, EtherNet/IP, EtherCAT - (L x W x H) mm - 200 x 100 x 84 (closed); 200 x 123 x 144 (open) Model: EtherNet/IP-M - (L x W x H) mm - 200 x 122 x 84 (closed); 200 x 145 x 144 (open)					
Position of Mounting Holes	6.6 mm holes spaced at 90x190 mm					
Weight	Model: Profinet, EtherNet/IP, EtherCAT - 2.5kg, EtherNet/IP-M – 2.7 kg					
Indicators	7 indicator LEDs					
Operating Temperature	10 - 60ºC					
Humidity	10 - 80%					
Recommended exposure times and 1/e² Gaussian beam diameters	Laser Power W	Recommended Exposure s	Min 1/e² beam dia. mm	Laser Power W	Recommended Exposure s	Min 1/e² beam dia. mm
	50	2	9	2000	1	12
	100	2	9	5000	1	18
	500	2	9	10000	0.3	22
	1000	1	9	12000	0.3	25
Cover	Motor driven cover opens sideways					
Accessories Supplied with Helios Plus	Model: Profinet, EtherNet/IP, EtherCAT - 1. Power Supply Cable (P/N 7Z10458A), 2. Data Cable – Profinet & EtherCAT (7E01298), EtherNet/IP (P/N 7E01299) Model: EtherNet/IP-M - No accessories included					
Optional Accessories	Model: Profinet, EtherNet/IP, EtherCAT - 1. D9F to D9M Shielded 10m RS232 Cable (P/N 7E01209), 2. Helios Plus Window Replacement Kit (P/N 7Z08369) Model: EtherNet/IP-M - 1. D9F to D9M Shielded 10m RS232 Cable (P/N 7E01209), 2. Helios Plus Window Replacement Kit (P/N 7Z08369), 3. Power Supply Cable, 7/8" to flying leads termination 2m (P/N 7E01535), 4. Data Cable, EtherNet/IP M12 to RJ45 plug IP67 3m Cable (P/N 7E11211)					
Compliance	CE, UKCA, China RoHS					

Part number	See P/Ns in Helios Plus Model Table on previous page 102

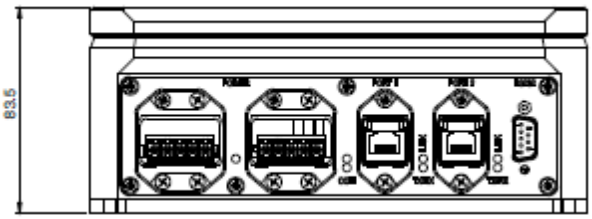
Notes: (a) Repetitive pulses can also be measured as long as the total exposure time is within this range.
(b) The power is calculated by measuring the energy and exposure time. The laser pulse is assumed to be rectangular for this calculation.
(c) For pulse widths in the range 0.3 – 4s.

Helios Plus Drawings

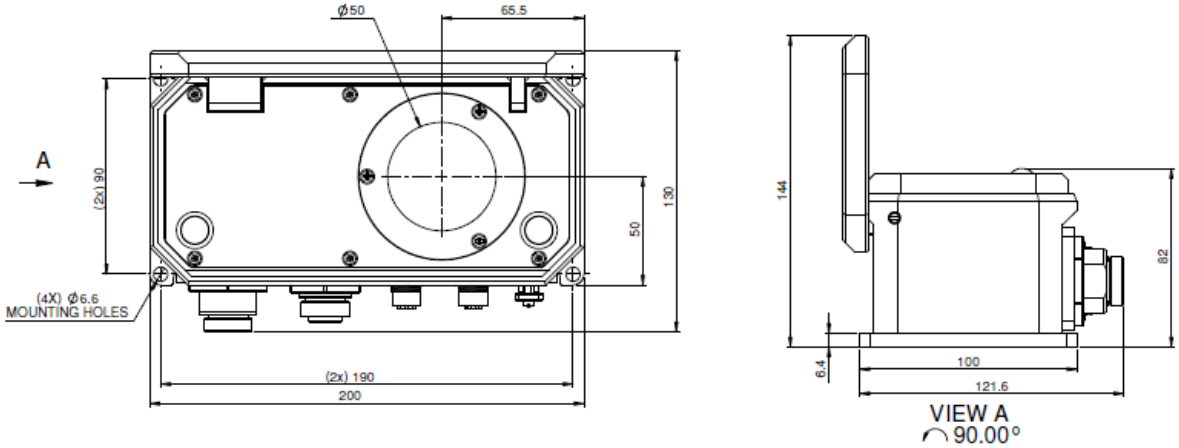
Helios Plus - Profinet / Helios Plus - EtherNet/IP / Helios Plus - EtherCAT with Cover Open



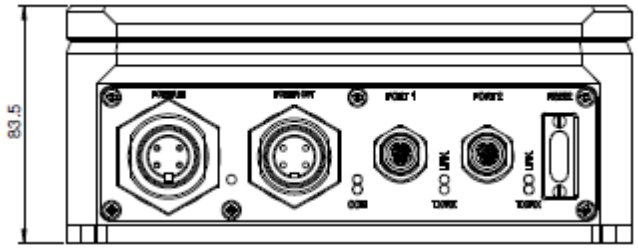
Helios Plus - Profinet / Helios Plus - EtherNet/IP / Helios Plus - EtherCAT with Cover Closed



Helios Plus - EtherNet/IP-M with Cover Open



Helios Plus - EtherNet/IP-M with Cover Closed



Chapter 3 – Setup

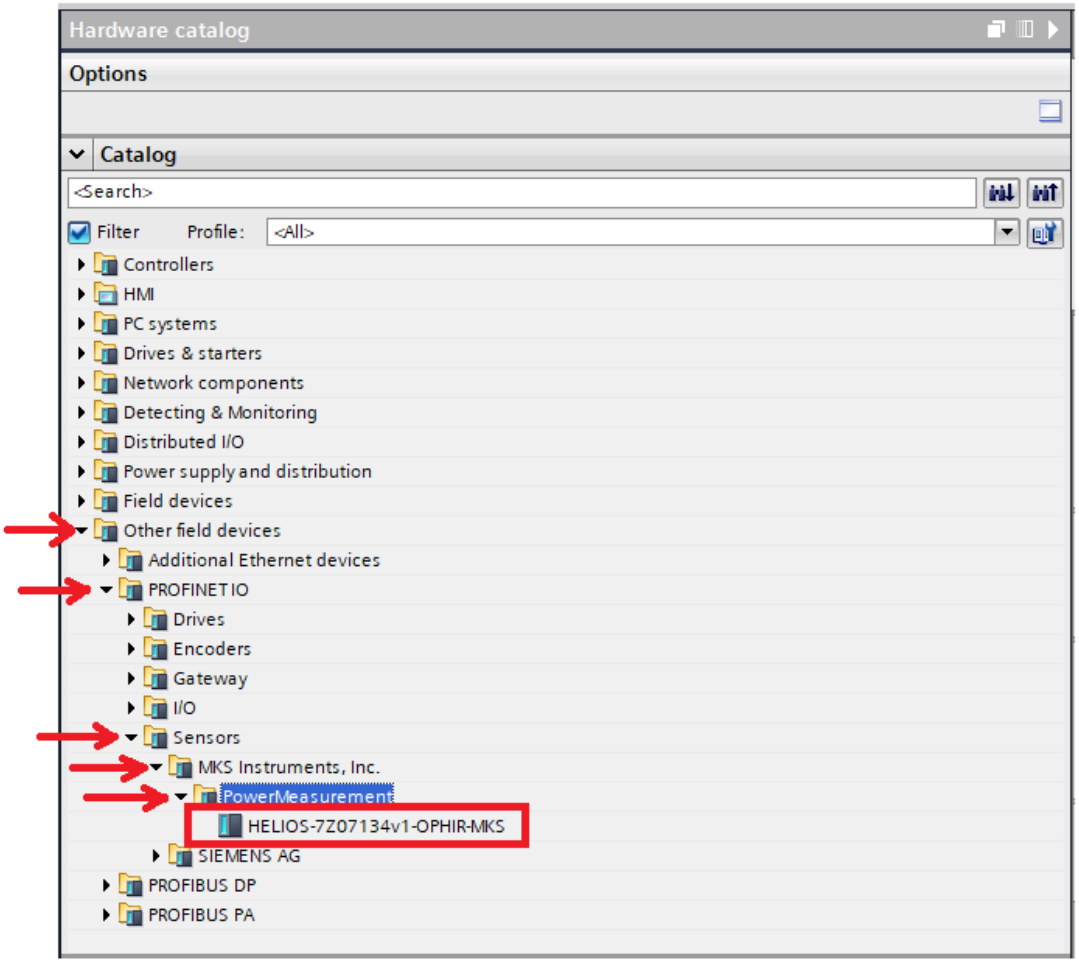
There are four ways to interface with the Helios laser power meter:

1. Profinet
2. EtherNet/IP
3. RS232 commands (e.g., with HyperTerminal)
4. PC application

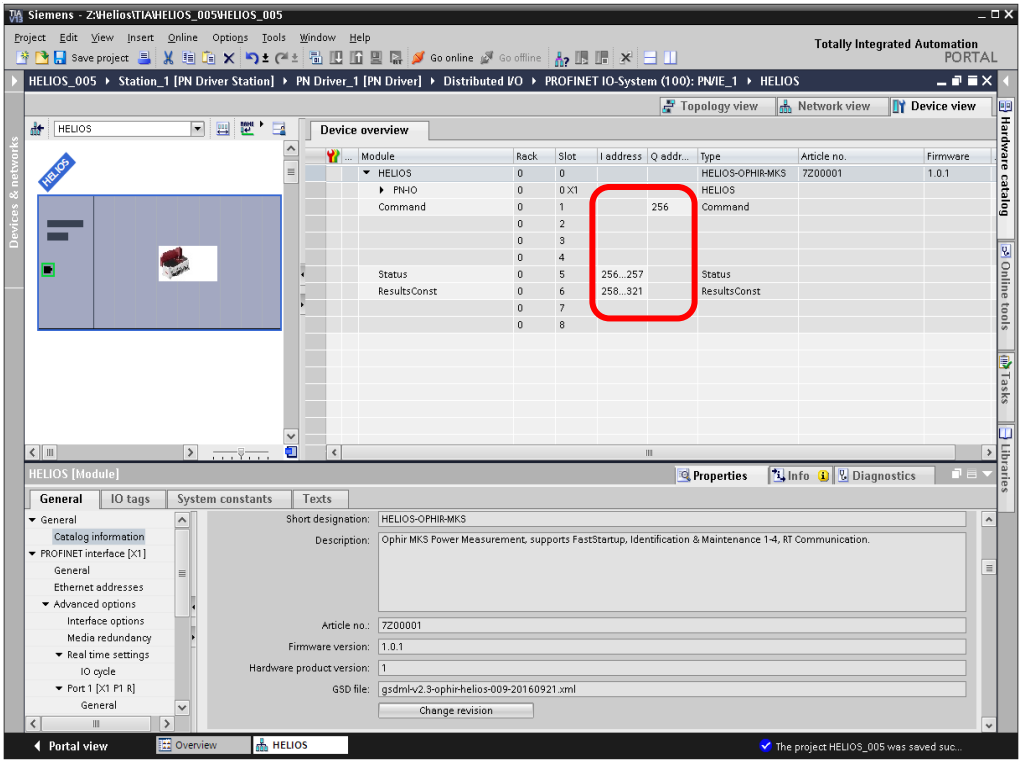
The setup of Helios depends on the mode of operation.

Profinet Setup

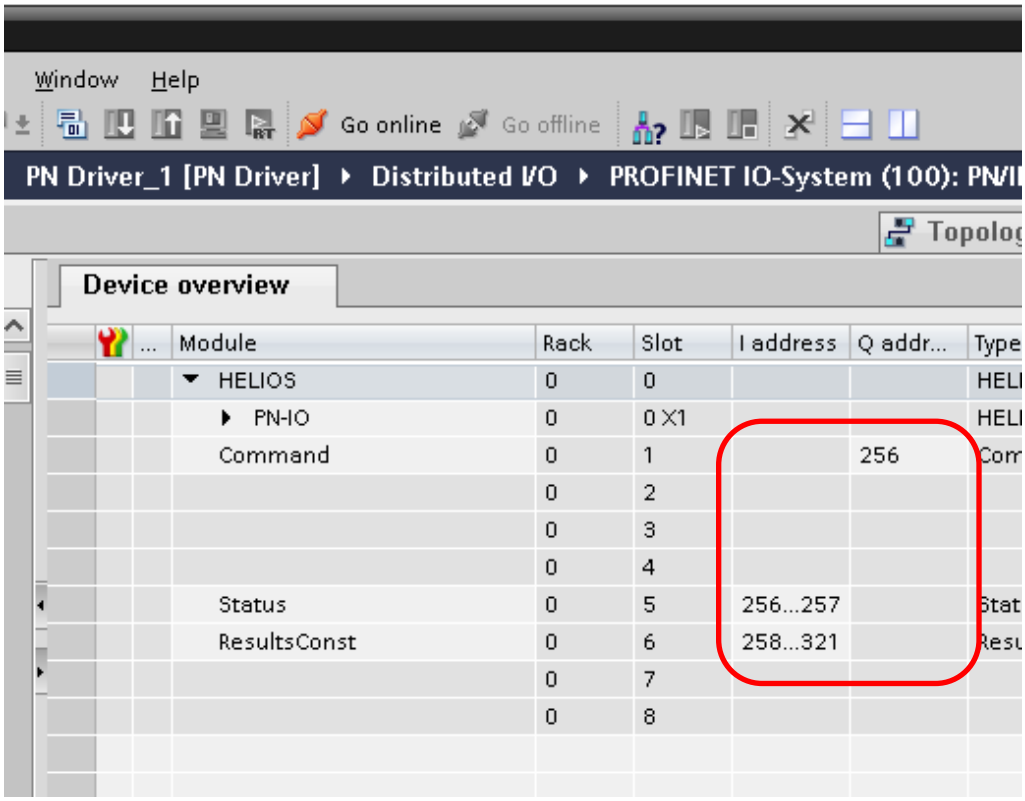
- Place the Helios where it will be convenient to measure the laser (can bolt down to the chassis with M6 screws).
- Connect 24 V DC to standard Profinet / EtherNet/IP jack. (Use Ophir Power Cable for Helios P/N 7Z10458A, see Chapter 6 “Connectors” for more details)
- Connect Profinet RJ45 cable to jack. (Use Ophir Profinet Cable for Helios P/N 7E01298, see Chapter 6 “Connectors” for more details)
- Integrate the device into the network. (Need: GSDML file from Helios product page on the website; customer’s network administrator.)
  NOTE: *GSDML file on website is for latest Helios P/N. Contact Ophir for file supporting previous P/Ns.*
- Set up Profinet network in software (e.g., TIA, STEP7):



- Set up device addresses as marked inside the red circle:



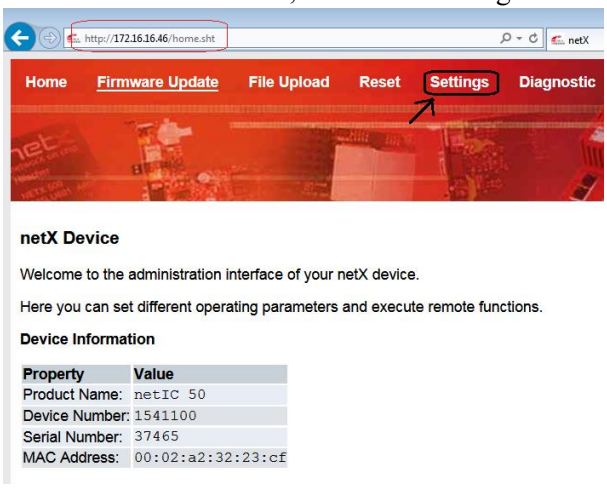
Zoomed-In:

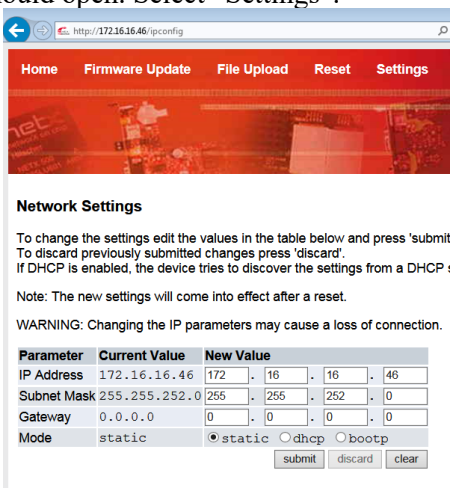


- Integrate the power measurement into the customer software (controlled by the PLC) as fits their application and needs.
- See Chapter 7 for more details on Profinet setup and read/write registers (called “submodules”).
- Begin test measurements.
- Integrate into production line routine.

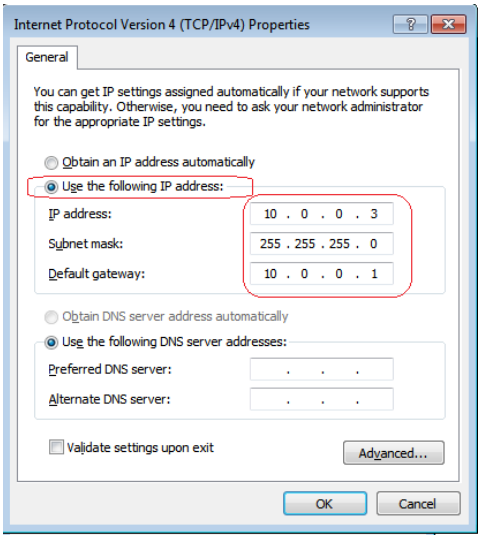
EtherNet/IP Setup

- Place the Helios where it will be convenient to measure the laser.
- Connect 24 V DC to standard Profinet / EtherNet/IP jack. (Use Ophir Power Cable for Helios P/N 7Z10458A, see Chapter 6 “Connectors” for more details)
- Connect EtherNet /IP RJ45 cable to jack. (Use Ophir EtherNet/IP Cable for Helios P/N 7E01299, see Chapter 6 “Connectors” for more details)
- The Helios is delivered with a factory default IP address of 10.0.0.2, Subnet Mask 255.255.255.0, and Default Gateway 10.0.0.1. Update the IP address of the Helios using one of the following methods.
- If the present IP address is known, and it is possible to connect to it via a PC or PLC, connect to the Helios using a web browser tool such as Chrome or Internet Explorer. Enter the present IP address in the browser address window, and the following window should open. Select “Settings”.

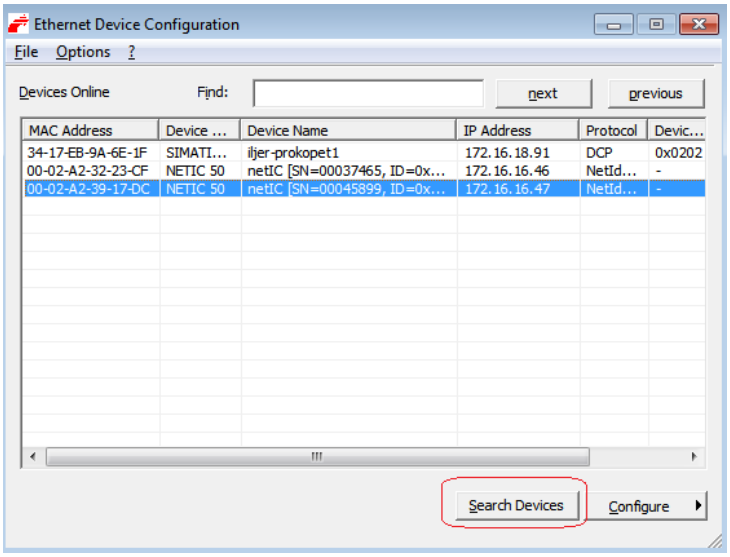


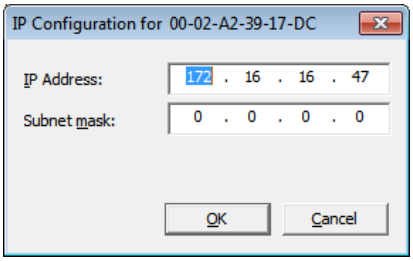


- At the next prompt enter the user name “admin” and password “admin”
- The configuration window will open showing the present IP settings. Change them as required and then click the “submit” button to make the change permanent.
- If the IP address is known but a connection is not possible, if using a PC it may be possible to change the IP settings of the PC to match the present settings of the Helios in order to connect as above. Go to: Control Panel -> Network and Sharing Center -> Change adapter settings. Select “Local Area Connection”, properties. Select “Internet Protocol Version 4 (TCP/IPv4)”, Properties.



- Change the PC IP address to match the same gateway as the Helios but do NOT use the same exact IP address, for example if the Helios is set to default settings, choose IP address 10.0.0.**3**, Subnet Mask 255.255.255.0, Default Gateway 10.0.0.1. Then continue as above using a web browser.
- If neither of the above options is possible, a tool called “Ethernet Device Configuration” is available. Please contact Ophir for more details.
- Install the tool and start it up. Choose “Search Devices” to display all devices found on the network.





- Choose the Helios device - it will be identified as “NETIC” or similar as shown above.
- Click the “Configure” button, then “SetIP Address…”. Enter the new values of IP Address and Subnet Mask (usually 255.255.255.0) and click “OK”. After a few seconds, repeat “Search Devices” to check the IP settings are updated successfully. Note that this tool changes the IP settings temporarily; to change permanently connect to the device via a web browser and continue as described above.
- Import the EDS file (available via the Ophir website) using the “EDS Hardware Installation Tool” from Rockwell Automation, or similar. This tool is part of the Rockwell “RSLinx Classic” tool.
- It is NOT possible to set up the IP address via the RS232 link

RS232 Setup

- Place the Helios where it will be convenient to measure the laser (can bolt down to chassis with M6 screws).
- Connect 24 V DC to standard Profinet jack (Use Ophir Power Cable for Helios P/N 7Z10458A, see Chapter 6 “Connectors” for more details)
- Connect a standard RS232 to the D9 jack.
- Install the “Helios PC Application” by copying it from the Helios product page in the website and following the installation wizard steps.
- Integrate the power measurement into customer software (by scripting commands) as fits their application and needs. See Chapter 8 for more detail and a list of commands.
- Integrate into the production line routine, using RS232 program.

PC Application

- The PC application is needed to upgrade the Helios firmware.
- It can also be used to measure with the Helios without any programming. This can be useful for pre-integration testing.
- To begin test measurements, follow these steps:
    - Set scale to be above the max expected energy
    - Press “Open” cover
    - Turn on laser and wait for measurement results to appear
- Can also use RS232 commands directly by enabling the terminal.
- Options include: logging, instantaneous power reading, housing temperature, and the terminal
- The PC application can be downloaded from the Ophir website

Chapter 4 – Check before Use

Be sure to check the laser parameters before turning it on to ensure no damage to Helios. Specifically, the power, beam size, and exposure time must be within the specifications. (Use this calculator to easily find the power density from laser power and beam size.)

Preliminary test

Here's a sample test to be sure everything is operating as it should:

(1) Setup the Helios. (See section 3.)
(2) Cover test:
    a. Open and close the cover, then open again.
(3) Measurement test prep:
    a. Select the desired energy scale. The selection should be greater or equal to the maximum energy expected.
    b. Set "current power" in options menu, to see the instantaneous power.
    c. Set laser parameters to below 50% damage for the first test.
    d. Check that status is "Ready" (not "Wait" or "Integrating")
(4) Measurement test:
    a. Fire laser.
    b. Confirm reasonable power in "current power" screen.
    c. Wait for energy results. (Status will be "integrating" until the results come in.)
    d. Read power, energy, and exposure time. Confirm these are reasonable, too.

Timing Considerations

There are a few criteria to consider when setting up a measurement timing scheme:

- Each pulse or "shot" of the laser must of course be within spec (under 10 kJ, as well as within the maximum power, time range, and damage threshold; see section 2).
- Wait at least 12 seconds between shots.
- When the Helios reaches 60 °C it must be left to cool down, which typically takes 10-20 minutes. (This temperature is reached after about 40 kJ of accumulated exposure.)

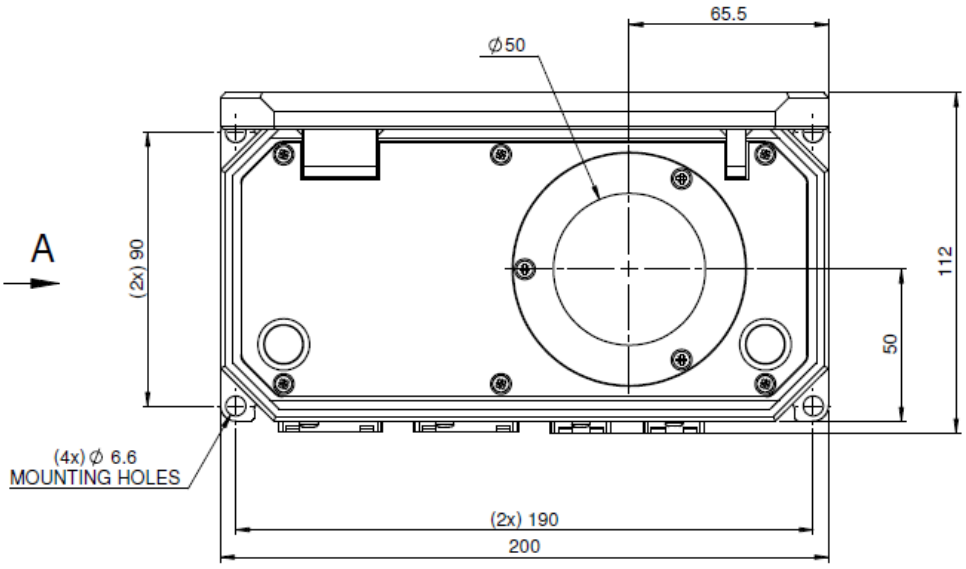
Recommended beam sizes and exposure times for various laser powers can be found in the specifications table (Chapter 2).

Temperature Failsafe

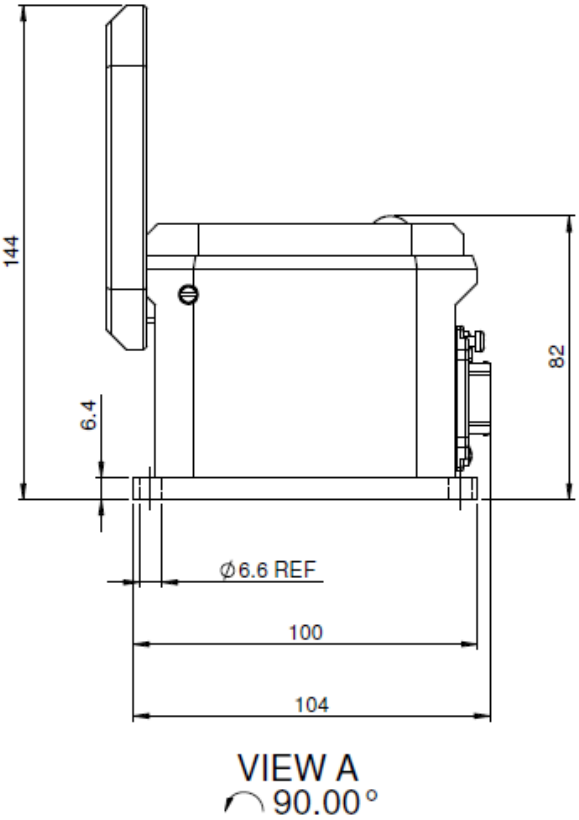
The Helios should not be used when the housing temperature exceeds 60 °C. To ensure this is always the case, there is a bit (when using Profinet) and a command (when using RS232) that measures the current temperature and checks it against the maximum temperature (60 degrees).
It is the responsibility of the customer software integrator to include a condition in the laser control that automatically shuts off the laser if the temperature is exceeded.

Chapter 5 – Mechanical dimensions

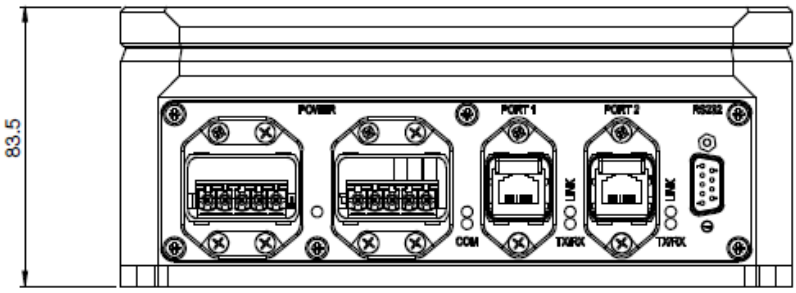
Helios, Helios Plus models – Cover Open:



Helios, Helios Plus models – Cover Open:



Helios, Helios Plus models – Cover Closed:

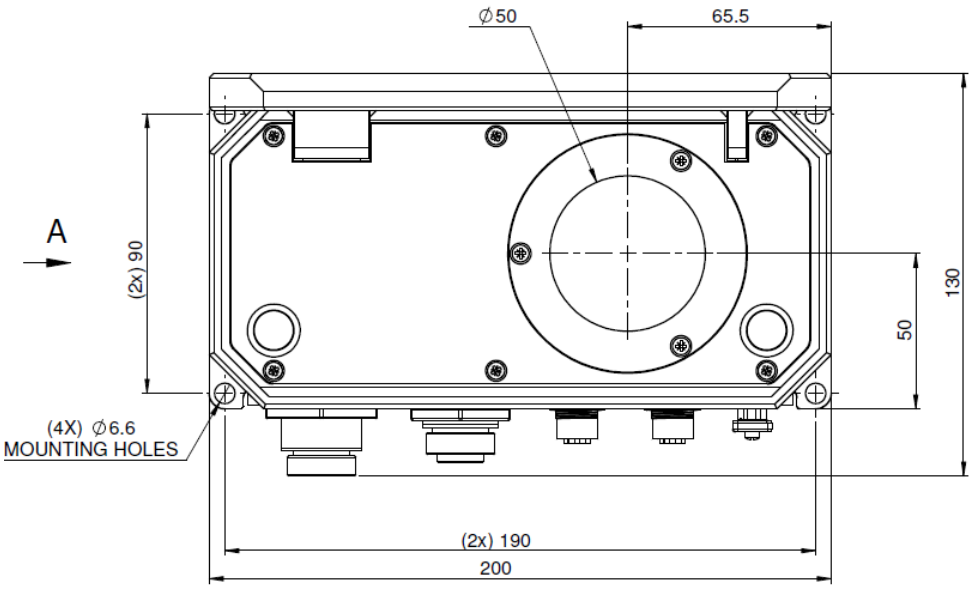


Helios, Helios Plus [a]:

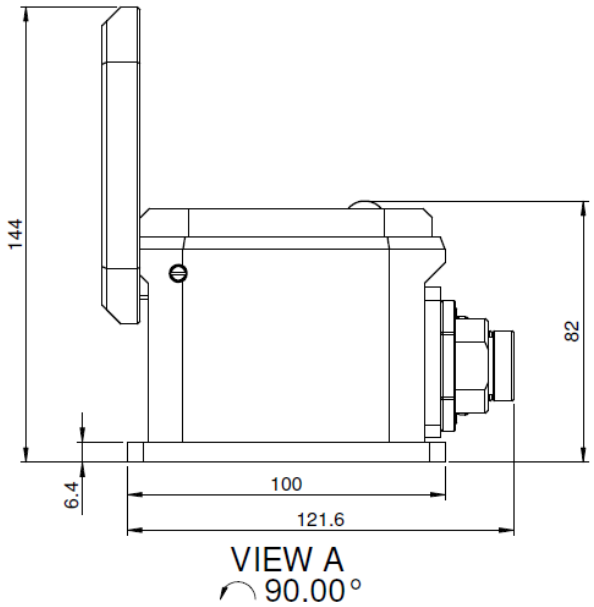
Cover closed: 200 x 100 x 84 mm (length x width x height)

Cover open: 200 x 123 x 144 mm

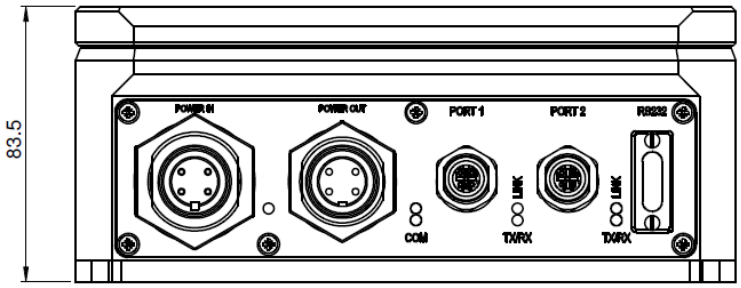
Helios Plus-M model – Cover Open:



Helios Plus-M model – Cover Open:



Helios Plus-M model – Cover Closed:



Helios Plus-M [(a)]:
Cover closed: 200 x 100 x 84 mm (length x width x height)
Cover open: 200 x 123 x 144 mm

Note (a) - both models:
The cover opens further than the pictures show. When the cover is open at 90° as shown, the width is 112 mm. When the cover is open as far as possible, the width will be 123 mm. (In practical use, the width when open will be in between these figures as the motor control may not allow the cover to reach the mechanical stop-point).

Chapter 6 – Connectors

Helios, Helios Plus models:

From left to right, the connectors above are:

(1) Two power connectors, both 5-pin AIDA compatible Han Push-Pull Power.
(2) Two RJ45 Profinet / EtherNet/IP connectors, both AIDA compatible Han Push-Pull RJ45 PN (compatible with Ophir P/N 7E01298 / 7E01299 or Harting part 09 35 226 0401. Standard IP20 cables can also be used, but without a locking mechanism.)
(3) One D9 connector for RS232

Power Connectors

The power sockets are AIDA compatible Harting Han PP Power, part 09 35 004 3003 or Phoenix part 1657915 (pin connector) and part 09 35 002 0303 (metal hood). It is compatible with the Helios Power Cable, Ophir P/N 7Z10458A or (for example) Harting part 09 35 433 0401 (see www.Harting.com), or Phoenix Contact part 1421783 (see www.phoenixcontact.com).

Pinout, with pin 1 at left:

Pin	Function	Power Cable - Color of Wire
1	24 V DC, Sensor (used by Helios)	Brown
2	Sensor Ground	Black
3	24 V DC, Actuator (not connected to Helios circuit; used only for daisy-chaining)	Blue
4	Actuator Ground	Grey
5	Chassis	Green-Yellow

RJ45 Connectors

The RJ45 sockets are AIDA compatible Hirose (RJ45 connector), part TM21R5C88(50) and Harting (metal hood), part 09 35 002 0301. They are compatible with Ophir P/N 7E01298 (for Profinet) or Ophir P/N 7E01299 (for EtherNet/IP) or (for example) Harting part 09 35 226 0401, or Phoenix Contact part 1408972

Pin	Function
1	TD+
2	TD-
3	RD+
4	[NC]
5	[NC]
6	RD-
7	[NC]
8	[NC]

RS232 Pinout

RS232 can be used by connecting a standard RS232 cable to the D9 connector.

Pin	Function
1	[NC]
2	TxD
3	RxD
4	[NC]
5	Ground
6	[NC]
7	[NC]
8	[NC]
9	[NC]

Helios Plus-M model:

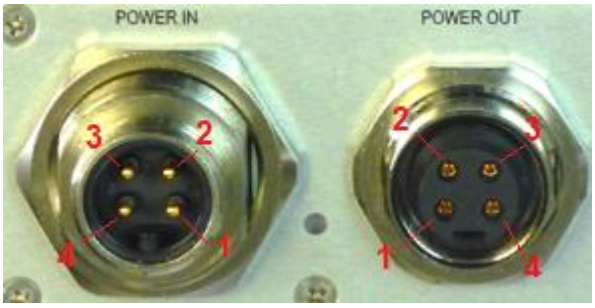
From left to right, the connectors above are:

(1) One power-in connector, 4-pin 7/8" male
(2) One power-out connector, 4-pin 7/8" female
(3) Two M12 4-pin Ethernet connectors, female
(4) One D9 connector for RS232

Power Connectors

The input power connector is a male 7/8" 4-pin type, Ophir P/N **7E01435**, manufacturer FineCables, p/n **A838-CP-T0194 REV.A2** (see www.finecables.com). It is compatible with Ophir P/N **7E01535**, Turck p/n **RKM 40-2M** (see www.turck.com) or similar.

The output power connector (used for daisy chaining to another device) is a female 7/8" 4-pin type, Ophir P/N **7E01436**, manufacturer FineCables, p/n **A838-CP-T0195 REV.A1** (see www.finecables.com). It is compatible with Turck p/n **RSM 40-2M** (see www.turck.com) or similar.



Pin	Function	Color [b]
1	24 V DC actuator [a]	Brown
2	24 V DC (used by Helios)	White
3	GND	Blue
4	GND actuator [a]	Black
Shield/Case	GND_EARTH	

Note (a) – the "Actuator" pins are not connected internally to the Helios circuit but are connected to each other internally (power-in pins 2, 4 are connected to power-out pins 2, 4) and are used for Daisy Chaining.

Note (b) – the colors refer to the optional mating connector supplied by Ophir as an accessory, P/N 7E01535, see datasheet.

Ethernet Connectors

The two Ethernet connectors are female 4-pin D-coded M12 connectors, manufacturer Phoenix Contact, p/n **1551529** (see www.phoenixcontact.com). They are compatible with Ophir P/N **7E11211**, Phoenix Contact p/n **1403499** or similar.

Pin	Function
1	TD+
2	RD+
3	TD-
4	RD-

Summary of connector P/Ns for Helios Plus-M model:

Conn.	Description	Helios connectors			Mating connectors		
		Ophir P/N	MFR	MFR P/N	Ophir P/N	MFR	MFR P/N
power in	4 pin 7/8 Male	7E01435	FINECABLES	A838-CP-T0194 REV.A2	7E01535	TURCK	RKM 40-2M
power out	4 pin 7/8 Female	7E01436	FINECABLES	A838-CP-T0195 REV.A1	N/A	TURCK	RSM 40-2M
Ethernet	4 pin M12-D coded	7E01437	PHOENIXCON	1551529	7E11211	PHOENIXCON	1403499

RS232 Pinout

(As above)

Chapter 7 – Registers & Commands

This chapter is relevant when using the Profinet or EtherNet/IP protocols. It describes the registers and data that can be read from the Helios, and the commands that can be sent to the Helios.

LED indicators table

There are seven LEDs for different status/error indications. From left to right (and top to bottom), the LEDs are:

1. Power
2. COM (Green)
3. COM (Red)
4. Link (Port 1)
5. TX/RX (Port 1)
6. Link (Port 2)
7. TX/RX (Port 2)

Here is a more detailed explanation of what each LED means:

LED	On	Flashing	Off
Power	Power is connected		No power
COM (Green)		DCP signal service is initiated via the bus	No error
COM (Red)	No configuration; slow or no physical link	No data exchange	No error
Link (Port 1)	Port 1 is connected to Ethernet		Port 1 is NOT connected
TX/RX (Port 1)		Port 1 is sending/receiving	Port 1 is NOT sending/receiving
Link (Port 2)	Port 2 is connected to Ethernet		Port 2 is NOT connected
TX/RX (Port 2)		Port 2 is sending/receiving	Port 2 is NOT sending/receiving

Modules and Registers

In Profinet Mode, 66 bytes of data are read from the Helios. The data is “Big Endian”.
In EtherNet/IP mode, 66 bytes of data are read from the Helios. The data is “Little Endian”.
In EtherCAT mode, 66 bytes of data are read from the Helios. The data is “Little Endian”.

The format of these bytes is shown in the tables below.

The first 2 bytes (0-1) form a “Status Register”. Each bit represents a specific status (on/off).
The next 20 bytes (2-21) contain “Constants”, values that define the Helios capabilities and never change.

NOTE: As the “Constants” do not change their value, they can be used to “sync” the data in order to verify which byte is which in the data. See examples below.

The next 24 bytes (22-45) contain “Measurement Results”, Helios data that changes during measurements.
The last 12 bytes (for Profinet) or 14 bytes (for EtherNet/IP) are spare and should always return 0.

Some constants and data bytes are defined as 1-byte characters, some as 2-byte integers, and some as 4-byte integers.

The details of each field are shown in the tables below.

Status: 16-bit Register

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Cover Ack.	Scale Ack.	Undefined Cmd.	Exp. Time Error	Sensor Too Hot	Meas. Complete	Meas. in Progress	Meas. Ready	(Spare)	(Spare)	(Spare)	Cover Other Error	Cover Timeout	Cover in Motion	Cover Closed	Cover Open

NOTE: In Big Endian mode, the UPPER (top) byte is output first (byte 1). In Little Endian mode, the bytes are swapped over and the LOWER byte is output first (byte 0).
NOTE: In earlier versions of this manual the "Cover" was referred to as the "Shutter".
NOTE: Items displayed in red have been added from Helios firmware version 1.13, Sept. 2020

Bit	Byte	Register	Length	Read/Write
0	0	Cover is open	1 bit	Read
1	0	Cover is closed	1 bit	Read
2	0	Cover in motion	1 bit	Read
3	0	Cover timeout error	1 bit	Read
4	0	Cover other error	1 bit	Read
5	0	(Spare)	1 bit	Read
6	0	(Spare)	1 bit	Read
7	0	(Spare)	1 bit	Read

Bit	Byte	Register	Length	Read/Write
8	1	Sensor is ready to measure laser	1 bit	Read
9	1	Laser measurement in progress	1 bit	Read
10	1	Laser measurement complete	1 bit	Read
11	1	Sensor is too hot; let device cool 10-20 minutes	1 bit	Read
12	1	Exposure time error	1 bit	Read
13	1	Undefined command	1 bit	Read
14	1	Change in parameters – acknowledge (* Note 1)	1 bit	Read
15	1	Cover command – acknowledge	1 bit	Read

** Note 1: This bit is set when changing any parameter using one of the commands defined below, for example energy scale or laser option.*

Constants:

Byte	Register	Units	Length	Read/Write
2-5	Maximum energy that can be measured	mJ	4 bytes	Read
6-9	Minimum energy	mJ	4 bytes	Read
10-11	Maximum exposure time	ms	2 bytes	Read
12-13	Minimum exposure time	ms	2 bytes	Read
14-15	Maximum power	W	2 bytes	Read
16-17	Minimum power	W	2 bytes	Read
18-19	Maximum allowed temperature of Helios	°C	2 bytes	Read
20-21	Number of supported laser options (* Note 2)	N/A	2 bytes	Read

** Note 2: See details of laser option control below*

Measurement Results & Information:

Byte	Register	Units	Length	Read/Write
22-25	Latest power measurement	mW	4 bytes	Read
26-29	Latest irradiation time measurement	µs	4 bytes	Read
30-33	Latest energy measurement	mJ	4 bytes	Read
34-37	Present power (* Note 3)	mW	4 bytes	Read
38-39	Temperature of Helios device	°C	2 bytes	Read
40-41	Current energy scale (index)	N/A	2 bytes	Read
42-45	Maximum energy in current scale	J	4 bytes	Read
46-47	Active laser option index (1..5) (* Note 4)	N/A	2 bytes	Read
48	Active laser name character #1 (of 4) (* Note 5)	Ascii	1 byte	Read
49	Active laser name character #2 (of 4)	Ascii	1 byte	Read
50	Active laser name character #3 (of 4)	Ascii	1 byte	Read
51	Active laser name character #4 (of 4)	Ascii	1 byte	Read
52..65	(Spare)	N/A	14 bytes	Read

** Note 3: 'Present power' value can be returned negative, value is 4 bytes signed integer*
** Note 4: 'Active laser option index' is the index of the presently selected laser option. Up to 5 laser options may be available. The actual number of options available is reported in bytes 20-21, 'Number of supported laser options', see above.*
** Note 5: The name of the active laser is reported as Ascii coded characters, up to 4 characters long. For example "NIR " (=near infra-red) will be reported as "0x4E, 0x49, 0x52, 0x20" where the last character is filled with a blank space (Ascii character 0x20).*

Commands:

Command	Register	Length	Read/Write
0x00	Clears bits 13-15 of status register	1 byte	Write
0x01	Set energy scale to 10 kJ (max)	1 byte	Write
0x02	Set energy scale to 1 kJ (max)	1 byte	Write
0x03	Set energy scale to 100 J (max)	1 byte	Write
0x08	Open cover	1 byte	Write
0x10	Close cover	1 byte	Write
0xA1	Set laser option 1 (* Note 6)	1 byte	Write
0xA2	Set laser option 2	1 byte	Write
0xA3	Set laser option 3	1 byte	Write
0xA4	Set laser option 4	1 byte	Write
0xA5	Set laser option 5	1 byte	Write
0xFE	Clear bit 12 of status register "Exposure time error" bit	1 byte	Write

** Note 6: The active laser option can be set to index 1 by sending command 0xA1, or to index 2 by sending 0xA2, etc. The number of laser options available is reported in bytes 20-21, 'Number of supported laser options'. The name and index of the active laser option (the one currently selected) is reported in bytes 46-51, see above.* *****Attempting to set the laser to an undefined option will cause an error message 'Undefined command', bit 13 of the status register****. Successfully setting the laser option will set 'Change in parameters – acknowledge', bit 14 of the status register.*

Example of sequence of commands and status:

These sequences show examples of how to control the Helios and check the status. The check of status can be omitted but is added for clarity. The Status Register values are shown in the Little Endian format (EtherNet/IP, EtherCAT), when using Big Endian (Profinet) the bytes will be reversed (for example, 81 01 instead of 01 81).

1. To open & close the cover:

Send command "8" (= open cover)

Check status register - 01 81 (01 = “open”; 81 = ack from cover command, ready to measure)
Send command “0” (= clear ack bits)
Check status register - 01 01 (01 = “open”; 01 = ready to measure)
Send command “10” (= close cover)
Check status register - 02 81 (02 = “closed”; 81 = ack from cover command, ready to measure)
Send command “0” (= clear ack bits)
Check status register - 02 01 (02 = “closed”; 01 = ready to measure)

2. To change measurement range:

Send command “2” (= set second energy scale, 1000J full scale)
Check status register - 01 41 (01 = “open”; 41 = ack from range command, ready to measure)
Send command “0” (= clear ack bits)
Check status register - 01 01 (01 = “open”; 01 = ready to measure)

3. Exposure Time Error status:
(NOTE: This status is given if the Helios exposure time circuit was triggered but not energy pulse was detected)

Check status register - 01 11 (01 = “open”; 11 = exposure time error; ready to measure)

Querying and Changing laser options: *(available from firmware v1.13, Sept 2020):*

As of firmware version 1.13, the Helios supports multiple laser options. This allows users to select between more than one built-in set of calibration factors, which are tailored to specific lasers or wavelength regions. For example, the “NIR” laser option is suitable for near Infra-red wavelengths such as YAG 1064nm. In addition, there is another option “B-G” for the blue – green laser region ~450-550nm. See the latest version of the datasheet for your model of Helios for more details of available laser options.

There are several tools available to query and control the laser option.

Bytes 20-21 = number of supported laser options. This value reports the number of available laser options; as of Sept 2020 there are 2 options (NIR and B-G).

Bytes 46-47 = active laser option index. This value reports the active (presently chosen) laser option index, between 1 and N where N = *number of supported laser options.*

Bytes 48-51 = Active laser name, characters 1..4. These 4 bytes report the NAME of the active laser option as Ascii characters. For example ‘NIR ’ would be 0x4E, 0x49, 0x52, 0x20 (the names are padded up to 4 characters with the “space” character 0x20).

Commands 0xA1-0xA5 = set laser option 1-5. These 5 commands are used to select one of the available laser options, 1 to 5. Attempting to select a laser option beyond the maximum defined ‘number of supported laser options’, will cause an ‘Undefined command’ error bit in the Status Register (bit 13, see above). Successfully setting one of the laser options will set the bit ‘Change in parameters – acknowledge’ in the status register (bit 14, see above).

Suggested method to scan available laser options:

In order to automate the selection of laser options, and to be ready in case new laser options are added to the Helios in the future, it is recommended to scan the available laser options before selecting the correct laser, as follows:

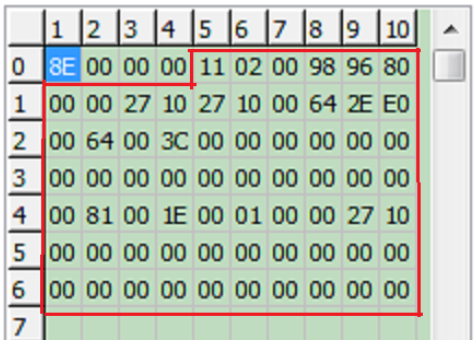
1. Check the ‘number of supported laser options’ (= ‘N’)
2. Set the ‘active laser option index’ to 1 by sending command 0xA1 (set laser option 1)
3. Query the ‘active laser name’ of the first laser option and store in s/w
4. Repeat for laser option 2, 3, …. up to ‘N’
5. After scanning all the available options, choose the appropriate laser option required using commands 0xA1,0xA2 as required.

The following sections show examples how to understand the data received from the Helios, for BIG and LITTLE Endian systems.

NOTE: The examples give below do not mention laser options, the values reported by the Helios appear as zeroes.

Analysis of Example Data, BIG Endian:

Response



	1	2	3	4	5	6	7	8	9	10
0	8E	00	00	00	11	02	00	98	96	80
1	00	00	27	10	27	10	00	64	2E	E0
2	00	64	00	3C	00	00	00	00	00	00
3	00	00	00	00	00	00	00	00	00	00
4	00	81	00	1E	00	01	00	00	27	10
5	00	00	00	00	00	00	00	00	00	00
6	00	00	00	00	00	00	00	00	00	00
7										

This example shows how the data will look with Big Endian format, for example when using Profinet.

In this example, the data was obtained when the Helios was first powered up, before any measurements are taken.

11 02 - status
00 98 96 80 00 00 27 10 27 10 00 64 2E E0 00 64 00 3C 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 81 00 1E 00 01 00 00 27 10 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 - data

The data can be analyzed by splitting it up into groups as defined above, Constants and Measurement Results.
There are 66 bytes returned from the Helios, the first 2 bytes are the status register.

11 02 - Status register bit map. In Binary: (top byte, bits 15..8) 0001-0001, (lower byte, bits 7..0) 0000-0010.

Starting from right-most bit (=bit 0):

Bit	Value	Notes
0	0	Cover is NOT open
1	1	Cover IS closed
2	0	Cover NOT in motion
3	0	NOT cover timeout error
4	0	NO cover other error
5	0	Spare
6	0	Spare
7	0	Spare
8	1	Sensor IS ready to measure laser
9	0	Measurement NOT in progress
10	0	Measurement NOT complete
11	0	Sensor NOT too hot
12	1	IS exposure time error
13	0	NO undefined command
14	0	NO ACK for Energy Scales command
15	0	NO ACK for cover command

Other Examples of Status Register values:

Status register = 01 01 (01 = “open”; 01 = ready to measure)
Status register = 81 01 (01 = “open”; 81 = ack from cover command, ready to measure)
Status register = 01 02 (02 = “closed”; 01 = ready to measure)
Status register = 11 02 (02 = “closed”; 11 = exposure time error; ready to measure)
Status register = 81 02 (02 = “closed”; 81 = ack from cover command, ready to measure)

00 98 96 80 - max energy that can be measured (mJ). Bytes are ordered least significant on the right, so true hex value = 0x00989680, or decimal 10000000 (mJ) or 10000J or 10kJ.
NOTE: This value is constant and can be used as a “signature” to locate the exact position of all the other bytes.

00 00 27 10 - min energy (mJ). Same order as above, hex value 0x00002710, decimal 10000 (mJ) or 10 J

27 10 - max exposure time (ms). Hex value 0x2710, decimal 10000 (ms) or 10 seconds

00 64 - min exposure time (ms). Hex value 0x0064, decimal 100 (ms)

2E E0 - max power (W). Hex value 0x2EE0, decimal 12000 (W) or 12 kW

00 64 - min power (W). Hex value 0x0064, decimal 100 (W)

00 3C - max allowed temperature of Helios. Hex value 0x003C, decimal 60 degrees C.

00 00 - spare (2 bytes)
00 00 00 00 - last power measurement (mW)
00 00 00 00 - last time measurement (µs)
00 00 00 00 - last energy measurement (mJ)

00 00 00 81 - current power (mW). Hex value 0x00000081, decimal 129 mW (note, the current power can be

negative, in which case it will be displayed as 2s-compliment, for example FF FF FF 27, Hex value 0xFFFFFF27, decimal -217 mW)

00 1E - temperature of Helios. Hex value 0x001E, decimal 30 degrees C
00 01 - current energy scale is index 0x0001 (10kJ scale) - other scales are 2 (1kJ scale) and 3 (100J scale)
00 00 27 10 - max energy in current scale (J). Hex value 0x2710, decimal 10000 (J) or 10kJ
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 - spare bytes

Analysis of Example Data, LITTLE Endian:

This example shows how the same data as above will look with Little Endian format, for example when using EtherNet/IP or EtherCAT.

In this example, the data was obtained when the Helios was first powered up, before any measurements are taken.

8E 00 00 00 - header from EtherNet/IP
02 11 80 96 98 00 10 27 00 00 10 27 64 00 E0 2E 64 00 3C 00 00 00 00 00 00 00 00 00 00 00 00 00 00 81 00 00 00 1E 00 01 00 10 27 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

The data can be analyzed by splitting it up into groups as defined above, Constants and Measurement Results. There are 66 bytes returned from the Helios. The first 4 bytes are a header (8E 00 00 00) generated by the system, and are not part of the data from the Helios.

8E 00 00 00 - Header

02 11 - Status register bit map. In Binary: (lower byte, bits 7..0) 0000-0010, (top byte, bits 15..8) 0001-0001.

Starting from right-most bit (=bit 0):

Bit	Value	Notes
0	0	Cover is NOT open
1	1	Cover IS closed
2	0	Cover NOT in motion
3	0	NOT cover timeout error
4	0	NO cover other error
5	0	Spare
6	0	Spare
7	0	Spare
8	1	Sensor IS ready to measure laser
9	0	Measurement NOT in progress
10	0	Measurement NOT complete
11	0	Sensor NOT too hot
12	1	IS exposure time error
13	0	NO undefined command
14	0	NO ACK for Energy Scales command
15	0	NO ACK for cover command

Other Examples of Status Register values:

Status register = 01 01 (01 = “open”; 01 = ready to measure)
Status register = 01 81 (01 = “open”; 81 = ack from cover command, ready to measure)
Status register = 02 01 (02 = “closed”; 01 = ready to measure)
Status register = 02 11 (02 = “closed”; 11 = exposure time error; ready to measure)
Status register = 02 81 (02 = “closed”; 81 = ack from cover command, ready to measure)

80 96 98 00 - max energy that can be measured (mJ). Bytes are ordered most significant at the right, so true hex value = 0x00989680, or decimal 10000000 (mJ) or 10000J or 10kJ
NOTE: This value is constant and can be used as a “signature” to locate the exact position of all the other bytes.

10 27 00 00 - min energy (mJ). Same order as above, hex value 0x00002710, decimal 10000 (mJ) or 10 J

10 27 - max exposure time (ms). Hex value 0x2710, decimal 10000 (ms) or 10 seconds

64 00 - min exposure time (ms). Hex value 0x0064, decimal 100 (ms)

E0 2E - max power (W). Hex value 0x2EE0, decimal 12000 (W) or 12 kW

64 00 - min power (W). Hex value 0x0064, decimal 100 (W)

3C 00 - max allowed temperature of Helios. Hex value 0x003C, decimal 60 degrees C.

00 00 - spare (2 bytes)
00 00 00 00 - last power measurement (mW)
00 00 00 00 - last time measurement (µs)
00 00 00 00 - last energy measurement (mJ)
81 00 00 00 - current power (mW). Hex value 0x00000081, decimal 129 mW (note, the current power can be negative, in which case it will be displayed as 2s-compliment, for example 27 FF FF FF, Hex value 0xFFFFFF27, decimal -217 mW)

1E 00 - temperature of Helios. Hex value 0x1E, decimal 30 degrees C
01 00 - current energy scale is index 0x0001 (10kJ scale) - other scales are 2 (1kJ scale) and 3 (100J scale)
10 27 00 00 - max energy in current scale (J). Hex value 0x00002710, decimal 10000 (J) or 10kJ
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 - spare bytes

For examples of how to send commands and receive status using PROFINET see Chapter 11 below.

For examples of how to send commands and receive status using EtherNet-IP see Chapter 10 below.

Chapter 8 – RS232

This chapter gives details about the Helios RS232 command set. The RS232 connection allows the user an alternative method to connect to the Helios, in addition to the Industrial Protocols.

RS232 Setup:

8 data bits, 1 stop bit, no parity, 9600 baud (default)

General Information:

1. All commands are initiated by PC; Helios responds to them ONLY AFTER RECEIVING THE FINAL [CR] symbol
2. All communications with PC are in ASCII symbols – not binary values
3. All commands from PC begin with '$' symbol
4. All commands and replies END with Carriage Return symbol (#13, '[CR]','\r' in "C" language)
5. All commands are defined by two ASCII characters that can be lower or upper case
6. All REPLIES begin with a '*' symbol (for 'OK') or a '?' (for an error)
7. The FIRST parameter of any command CAN be placed next to the letters of the command (e.g. 'WB0 …') OR there can be a space (#32) between the letters and the first parameter
8. The SECOND+ parameters ALWAYS must be separated by at least one SPACE

Standard Error Messages:

If a command is not recognized or the parameters are incorrect, the following standard error messages are returned:

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

Details of RS232 Commands:

Test communications ("Ping"):
$HP[CR] -> *[CR] [LF]

Send Version:
$VE 1[CR] -> *UU1.04[CR][LF] {Returns software version. Note – exactly one space between 'E' and '1'}
$VE[CR] -> *404[CR] [LF] {Any other parameter, or no parameter: Returns s/w version code in different format}

Baud Rate:
$BD <new baud rate>[CR] ->*[CR] {This command changes the baud rate to a new value and saves the new value as the default after the next startup or reset. The command will reply *[CR] at the *OLD* Baud Rate and then restart communications using the new baud rate. Subsequent commands need to be sent using the new baud rate. Allowed Baud Rates are: 4800, 9600 (default), 19200, 38400, 57600, 115200}

Reset:
$RE[CR] -> *[CR][LF] {Resets the MCU software – begins code running from 0. Should RETURN the *[CR] BEFORE doing the reset…}

Head Information:
$HI[CR] -> *<2 letter head code> <S/N of head> <name of head> <capability code>[CR][LF]
Returns information on the head, including its name and S/N.

Write Head Range:

$WN 0[CR] –> *[CR] {changes range: 0,1,2 parameter, 0=highest, or least sensitive, range. Power-up settings will be defined using $HC command, see below. NOTE that after using the $WN command, the software should wait ~3s before resuming power measurements with the $SP command.}

Read Head Range:
$RN[CR] –> *1[CR] {Reads head range, returns as parameter defined in $WN}

All Ranges:
$AR[CR] –> *0 10.0KJ 1.00KJ 100J[CR][LF] {Returns a list of all available energy ranges (scales) including an index value showing which range is presently selected. In the Helios, top scale (index 0) is 10.0kJ, scale 1=1.00kJ, and scale 2=100J. The "0" is the index and indicates that range 0 (10.0kJ) is currently selected. See also $RN and $WN commands, the index value is the same as defined for those commands.}

Save Head Configuration Settings:
$HC S[CR] -> *[CR] {Saves the CURRENT SETTINGS of energy scale as the power-up defaults}
Note: In order to change the power-up defaults, the following sequence is necessary:
a. Set desired power scale using $WN command
b. Save chosen settings using $HC S command

Calibration Query:
$CQ <0|1|2> <new-factor>[CR] ->*<User energy factor> <User laser factor> <Overall laser factor> <Overall power sensitivity in A/W>[CR] {Query and set presently active calibration factors. Sending the command with no parameter (or parameter 0) queries the current factors. Send parameter “1” followed by a new factor to change the user energy factor. Send parameter “2” followed by a new factor to change the user laser factor, which only affects the current laser setting (wavelength).}
Note: The overall laser factor is affected by the user laser factor and an Ophir calibration factor that cannot be changed by the user. The overall sensitivity is a composite of the User Energy factor, the Laser factors in use, and an Ophir overall sensitivity factor that cannot be adjusted by the User. Note that changes in the Energy Factor affect this field for all Lasers. Changes in the User Laser Factor affect this field only for the present laser in use.
New-factor is a floating-point number between 0.0002 and 2.0 scaled up by 10000 (2 to 20000).
Examples:
$CQ->*1.0000 1.0000 1.0000 2.5926E-8 – Query – The user energy factor, user laser factor, and overall laser factor are all set to 1. The overall sensitivity is 2.5926E-8.
$CQ 1 11000->*1.1000 1.0000 1.0000 2.5926E -8 – The energy factor is adjusted, but the power sensitivity remains the same. (It is affected by power factor but not energy factor which was adjusted now.)
$CQ 2 11000->*1.1000 1.1000 1.1000 2.1426E-8 – Notice changing the user laser factor also affects the overall laser factor and overall power sensitivity.

Cover Control:
$CC<1 | 2>[CR] ->*1 C | 2 O | 3 M | OK[CR] {Controls cover movement. Sending the command with no parameter queries the current status: 1 C means cover is closed, 2 O means cover is open; 3 M means cover is in motion or error; ?ERROR means the device senses the cover is both open and closed. Sending parameter “1” closes the cover, sending parameter “2” opens the cover.}
Examples:
$CC 1 – closes the cover, returns "*OK"
$CC 2 – opens the cover, returns "*OK"
$CC – status query, command returns:
*1 C – if cover is closed
*2 O – if cover is open
*3 M – if cover is in motion

Send Exposure Time (Photodiode):
$SW[CR] ->*<Latest exposure time measurement in µs>[CR] {This command sends the latest laser exposure time measurement or zero if the sensor is in the middle of measuring a pulse. It can return measurements up to a maximum rate of 15 times per second.}
Examples:
*123456 for 0.123456s
*2345678 for 2.345678s

Send Complete Measurement:
$SC[CR] ->*<power> <energy> <exposure time>[CR] {This command sends the latest laser measurements, power (W), energy (J), exposure time (s), separated by a space between each, and ended by [CR]. It can return measurements up to a maximum rate of 15 times per second.}
Example:
9.876E3 4.938E3 5.000E-1[CR] for 9876W, 4938J, 0.5s

Send Temperature
$RT[CR] ->* <Internal temperature> <maximum allowed temperature>[CR] {This command sends the internal temperature of the power meter, in degrees Celsius, followed by the maximum allowed temperature, and terminated with [CR]. It can return measurements up to a maximum rate of 15 times per second. The integrator should use this to ensure that the Helios is left to cool down when the internal temperature reaches or exceeds the maximum allowed temperature.}
Example:
* 33.5 60 – current temperature of 33.5 °C and maximum temperature of 60 °C.

MAC Address
$MC[CR] ->*<MAC Address>[CR]
Example:
*00:02:A2:34:5B:91[CR]

All Wavelengths
$AW[CR] -> *"DISCRETE 1 B-G NIR[CR]" {This command returns a list of available laser options, for example: "B-G NIR" together with the present active laser option index: "1" in this example, referring to the first item in the list, B-G. If the index is "2" it would refer to the second item in the list "NIR", etc.}

Wavelength Index
$WI [CR] -> *[CR] {This command selects the laser option index, as referred to in the $AW command. Selecting an index beyond the maximum number of settings will result in an error message. Sending the parameter '0' will query the present active index, the same value returned by the $AW command. The $HC S command (see above) can be used to save the present setting as the startup default}

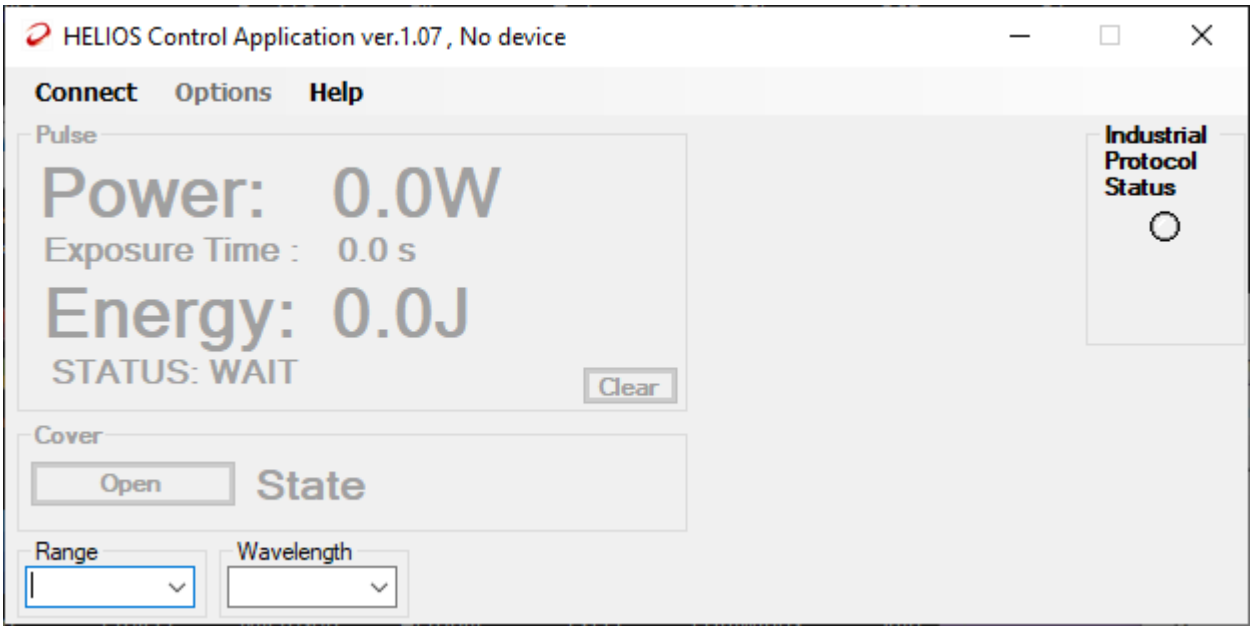
Communications Module Query
$mi 3 [CR] -> * <name of module>[CR] {this command queries the type of industrial communication module inside the Helios device}

Chapter 9 – PC Application

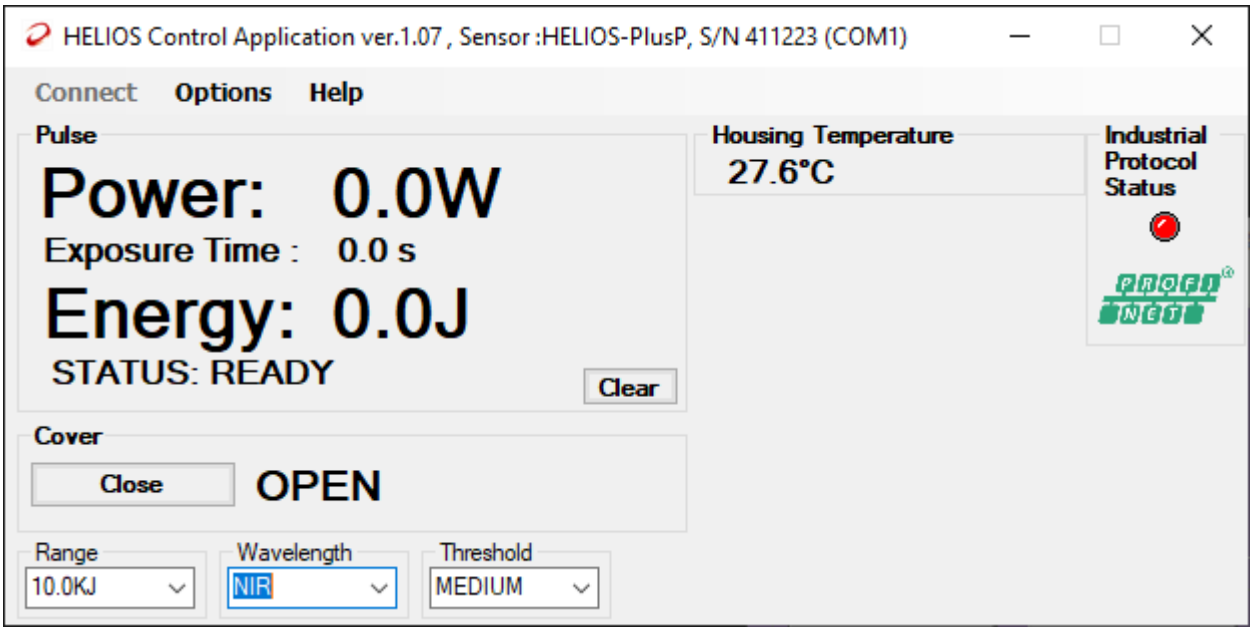
Getting Started

The PC application can be found in the Helios product page in the website. Copy the executable file to your local computer and run it (as an administrator) to install.
Follow the steps in the installation wizard to complete.

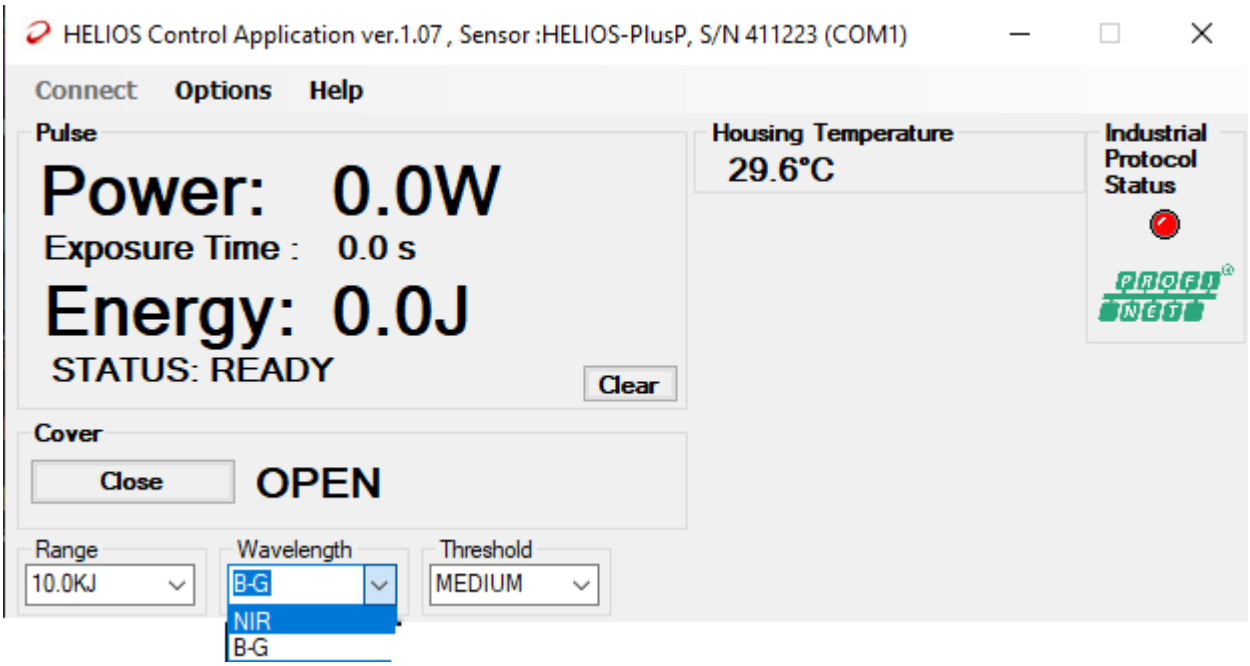
This is the initial screen. Upon startup, the program will check for a device connected with RS232 to the COM port. If it doesn't find anything, it will show this "No device" screen:



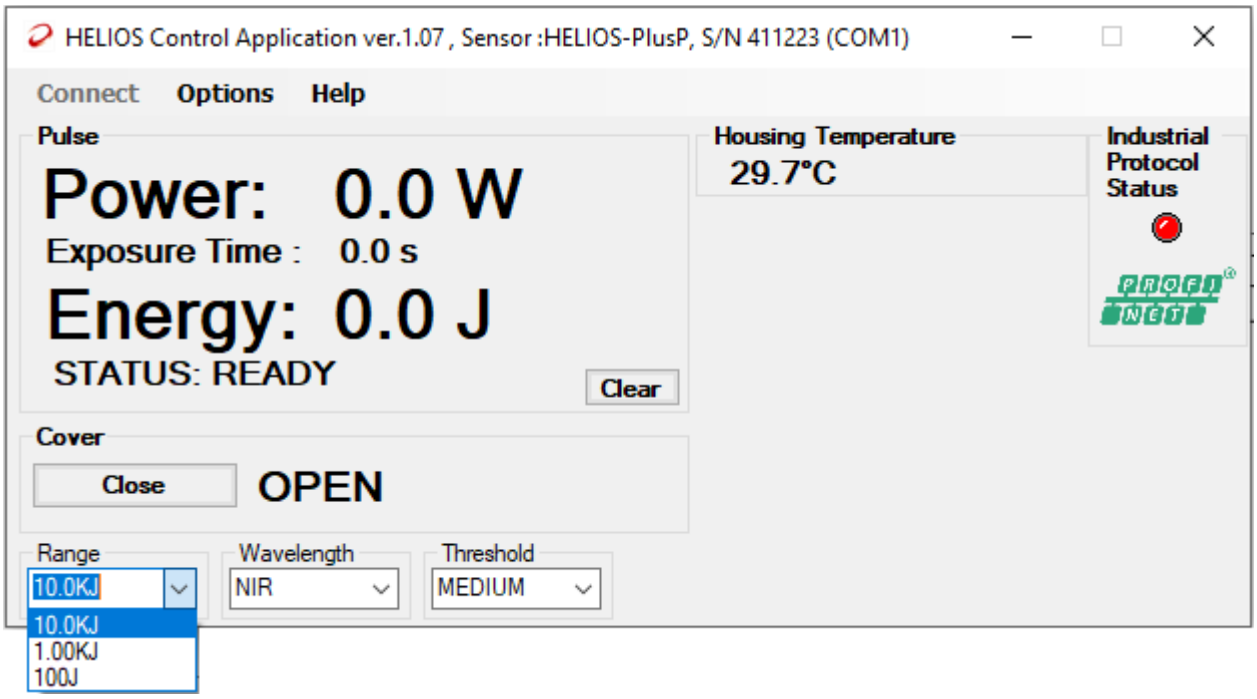
Once the Helios device is properly connected, this screen will be shown.



Use the “Wavelength” dropdown to select the desired wavelength range. In this example there are two available wavelength ranges, NIR (Near Infrared e.g. 1064nm) and B-G (Blue-Green region, ~450-550nm). Check the datasheet for your specific model for information about exact wavelength ranges supported.

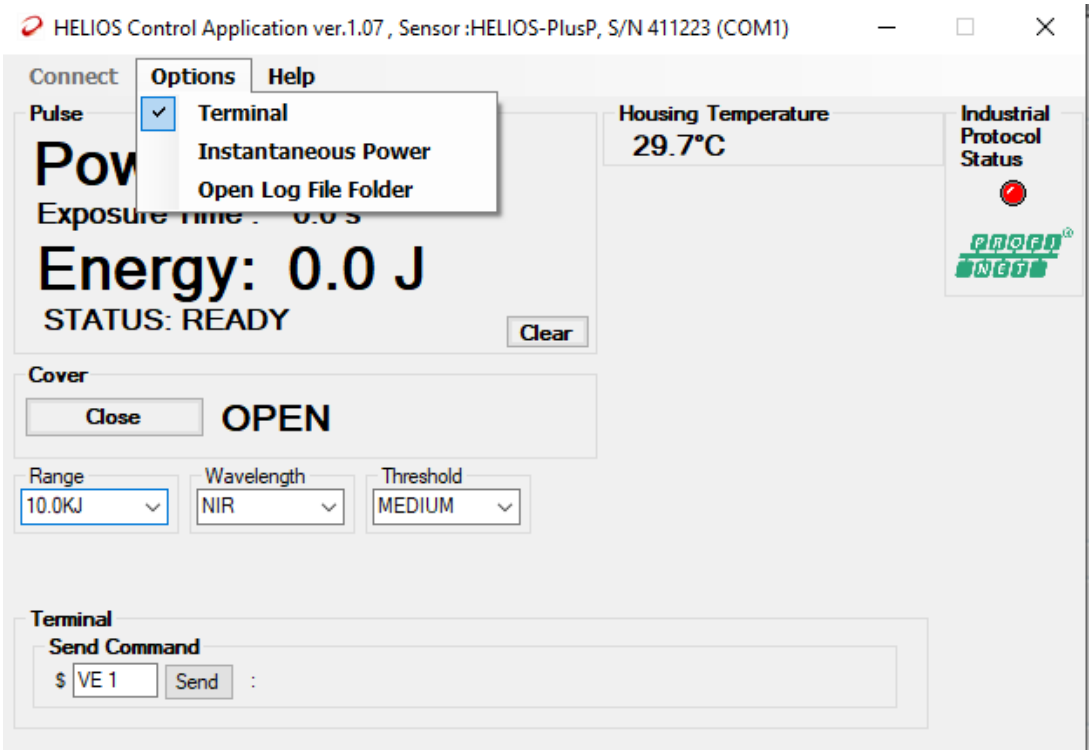


Use the “Range” dropdown to select the desired energy range (or scale). Keep in mind that the expected energy should be lower than this number, but greater than 10% of it.
For example, a laser of 5 kJ should use the 10.0KJ range, but 900 J should use 1.00KJ.

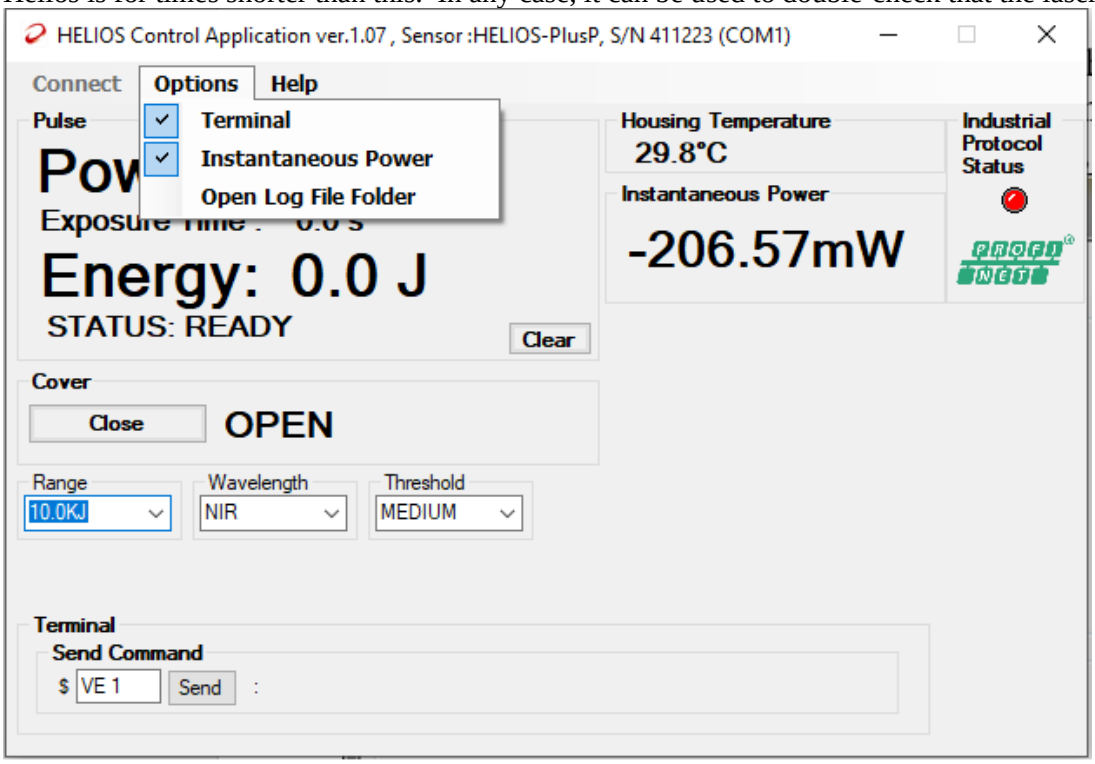


Options

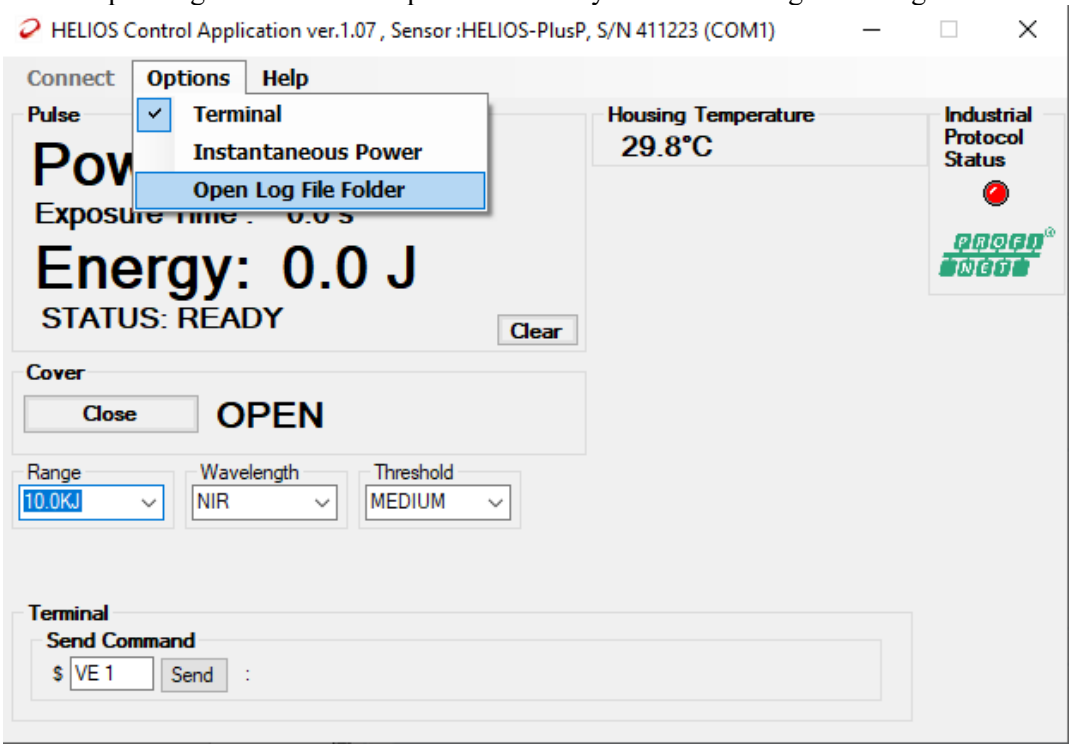
For advanced operations using the commands from the previous chapter, select Options > Terminal. The Terminal section can be seen at the bottom of the screen. Commands are entered after the ‘$’ sign and are sent by clicking “Send.” Messages are returned (when applicable) on the right side of this button:



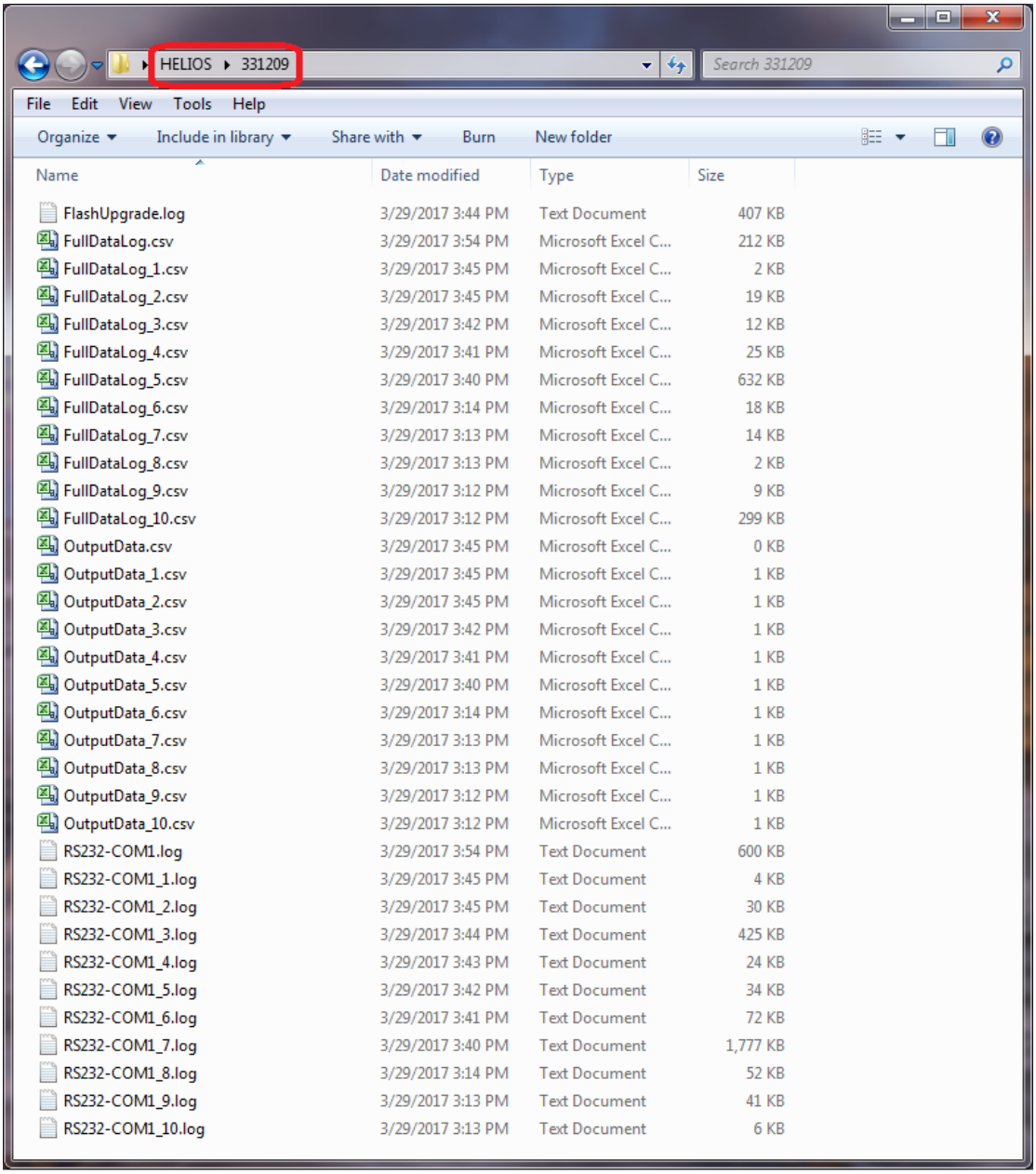
"Instantaneous Power" can be selected to show the power of the laser at any given moment. This is not generally useful for accurate power reading, since the thermopile has a 2-3 second response time and a typical use-case of the Helios is for times shorter than this. In any case, it can be used to double-check that the laser is on.



Click “Open Log File Folder” to open the directory in which the log files are generated:



Note, the log file is found inside a folder named by the serial number of Helios device used. This folder is found within the Helios installation directory.

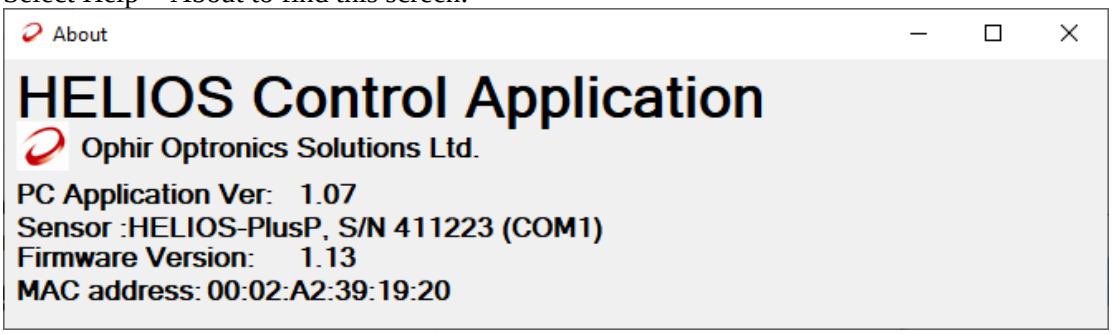


Three types of files are created here: The CSV file is a list of all the measurements taken, including:

1. "FullDataLog.csv" – This file includes all the data from the latest use of the PC application. It includes power, energy, and exposure of each laser shot, as well as instantaneous power, temperature, Profinet status, and pulse status (wait / ready / integrating)
2. "OutputData.csv" – This file includes only the data on each laser shot.
3. "RS232-COM1.log" – This text file includes all the communication via RS232 (whether through the PC application or by sending direct commands, e.g., with the Terminal feature).

Additionally, a file called "FlashUpgrade.log" can be seen above. That file will only be generated when the Helios firmware is updated (see below).

Select Help > About to find this screen:



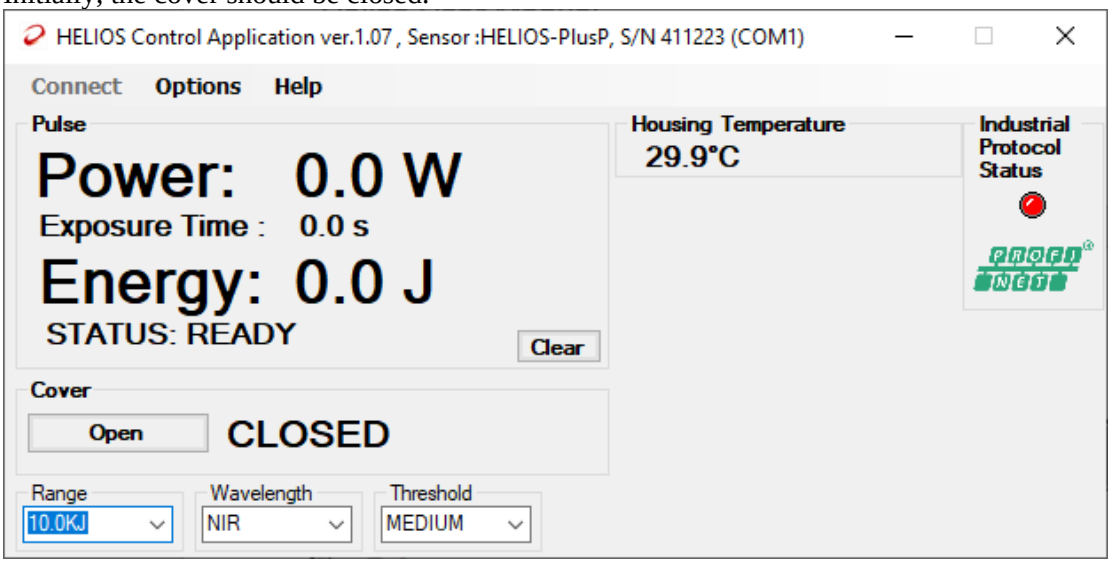
It contains:

- Software name
- Company name
- Software version
- Device name and serial number
- Firmware version
- MAC Address

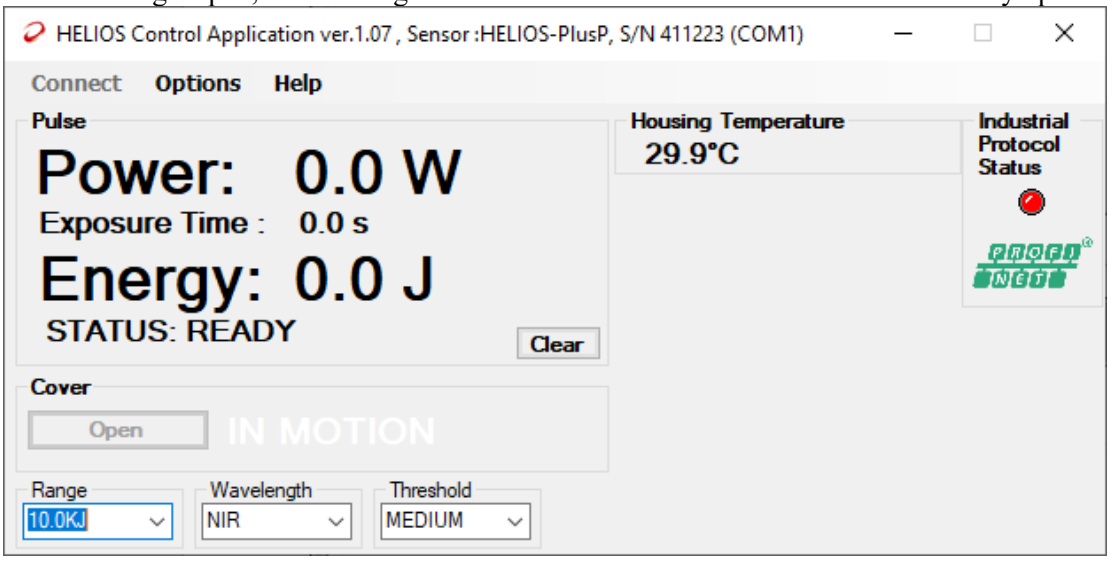
The “Help” menu also contains an option for upgrading firmware as new versions are released.

Cover Operation

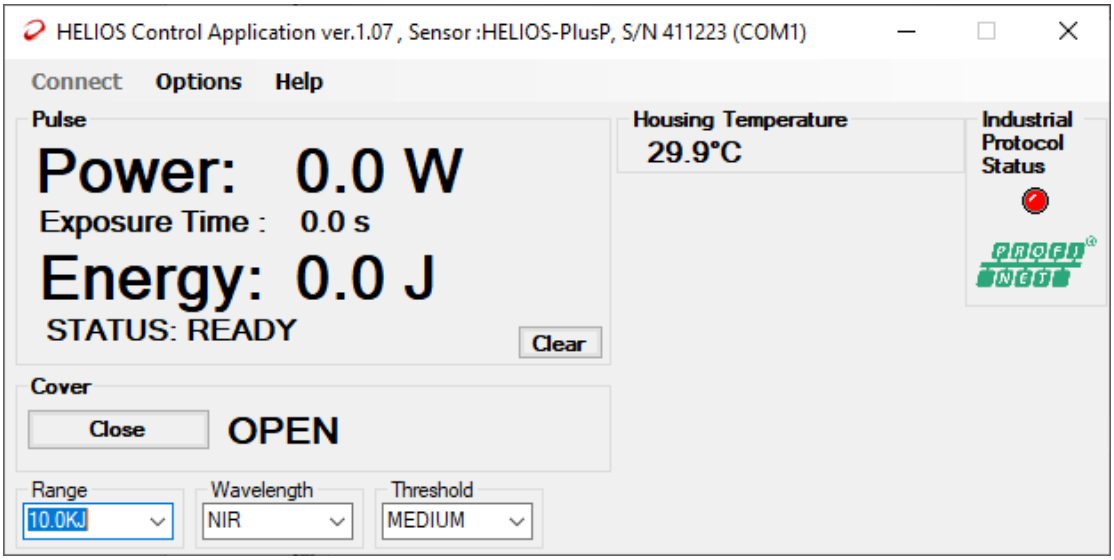
Initially, the cover should be closed.



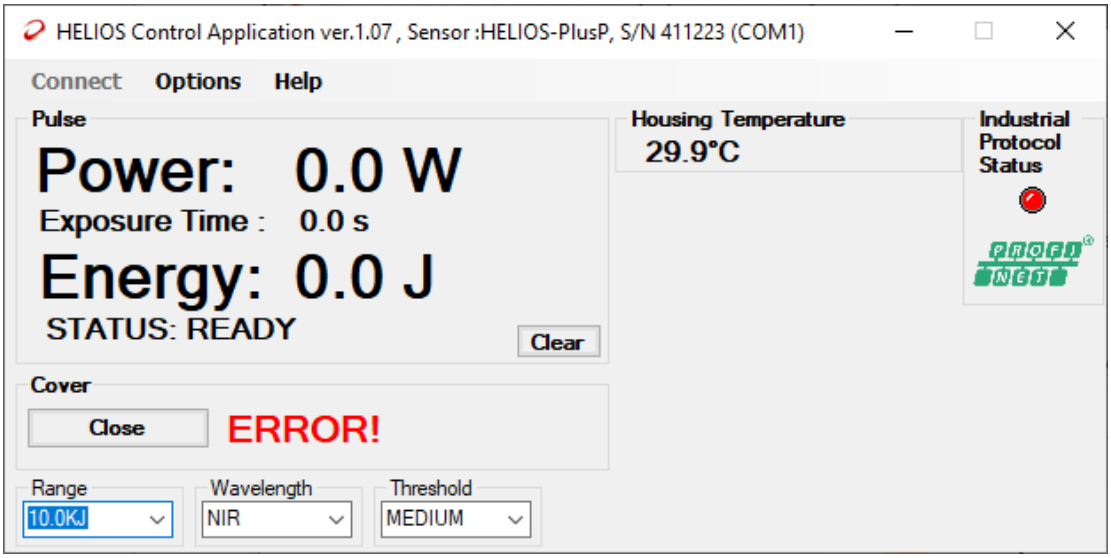
After clicking “Open,” the message “IN MOTION” flashes until the cover is in a fully open or closed position.



After opening completely, the status changes to “OPEN” and the button will now close the cover, if pressed again.



The “ERROR!” message means the cover is neither completely open nor closed, and has timed out (and so isn’t considered “in motion” anymore). This usually indicates something blocking the cover. If this is not the issue, contact Ophir for further assistance.



Chapter 10 – Getting Started With EtherNet/IP

This chapter describes how to control the Helios using the EtherNet/IP protocol, and how to read data from the Helios.

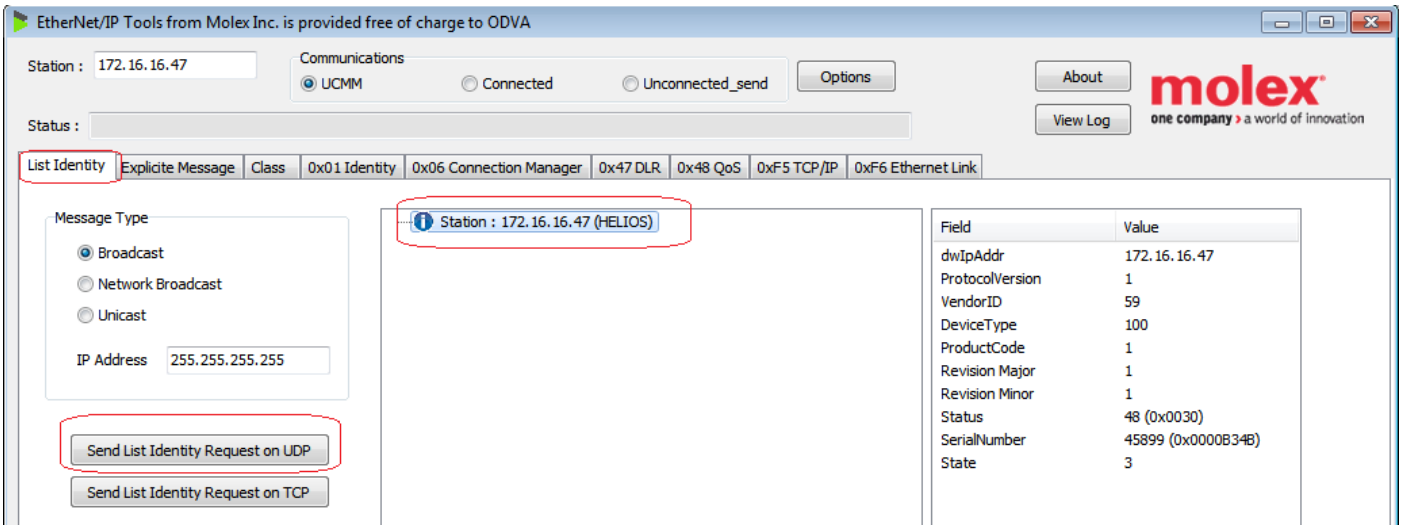
Examples are shown using a PC based tool called “EIP_TOOL”, available on the internet from Molex/ODVA.
The principles described in this chapter should be applicable to any EtherNet/IP tools running on a PLC or a PC.

The tool can be downloaded from the Molex website.

Download the tool and install on the PC. The Helios “EDS” file will need to be imported to the network before starting, see above.

Connecting to the Helios:

From the top screen of the tool, choose the first tab (page) on the left “List Identity” and press “Send List Identity Request on UDP”. You may need to click twice before getting a response. The Helios will appear under “Station: <IP address> (HELIOS), see below. Click on this line where it shows the Helios to select this unit.



Configuration:

Choose the second page “Explicite Message”. The following configurations need to be entered to communicate with the Helios via EtherNet/IP.

Service:
Get_Attribute_Single (Service Code: 0x0E) - to read data and status from Helios, 66 bytes.
Set_Attribute_Single (Service Code: 0x10) - to send data (command) to Helios, 1 byte command code.
Choose the option in the selection box to the right of the word “Service” (not the one displaying “14” in the picture below).

Class:
0x04 - Assembly object stores process data for exchange with other EtherNet/IP devices over the network

Instance:
101 (0x65) - output, to read data from Helios, 66 bytes.
100 (0x64) - input, to write command to Helios, 1 byte.
The value should be entered in the window as “101” or “100”.

Instance Attribute:
3 - To perform the request (read data from Helios or send command to Helios)
4 - To query number of bytes supported in Attribute 3; reads back the number from Helios.

Click on the check box to the left of the word “Attribute” to open the entry window.

When all the values are entered correctly, click on “Send Request” button to perform the data transfer.

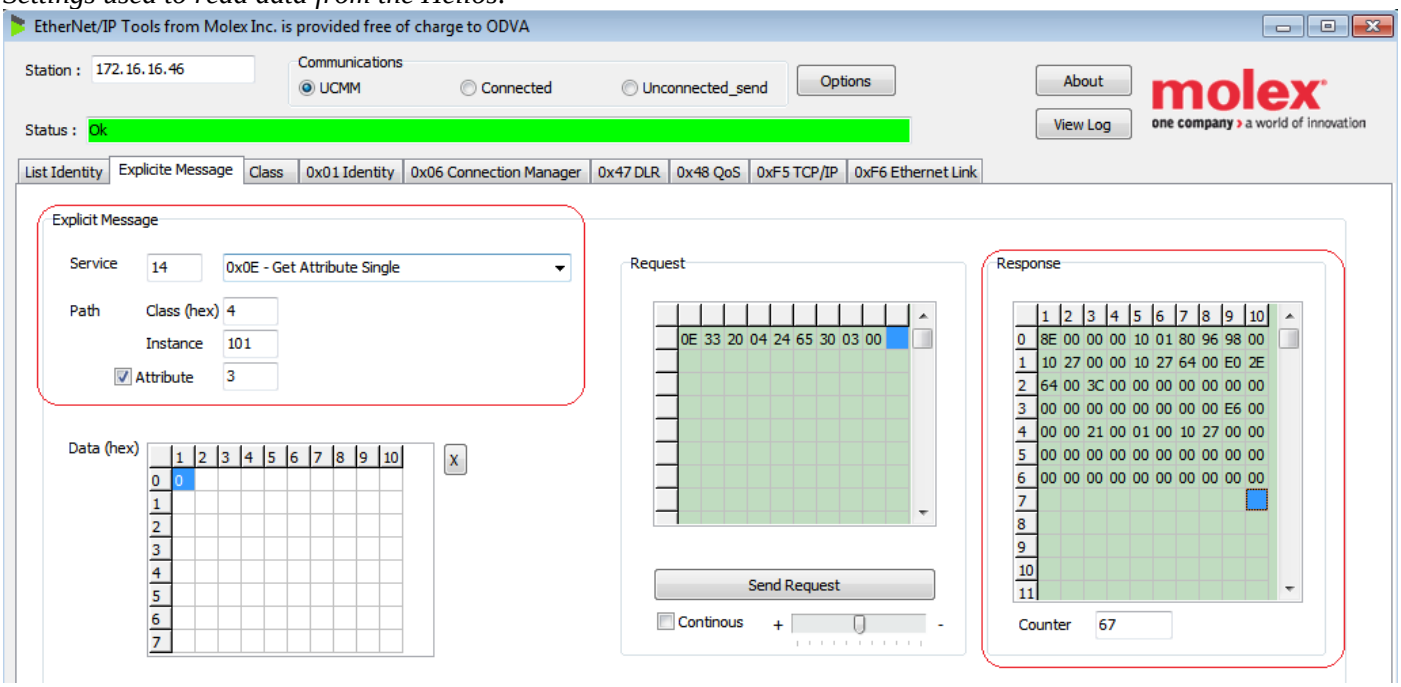
Data Example:

These examples are given using the tool mentioned above.

To **read data** from the Helios, use the settings shown in the screen shot below: 0x0E, 4, 101, 3, and click on the “Send Request” button. 66 bytes of data will be read out of the Helios, they will be displayed in the “Response” table as shown. The first 4 bytes are an acknowledge from the system, the next 2 bytes are the “Status Register” as defined above.

Using the “View Log” button, a log of the recent data sent to/from the Helios can be viewed.

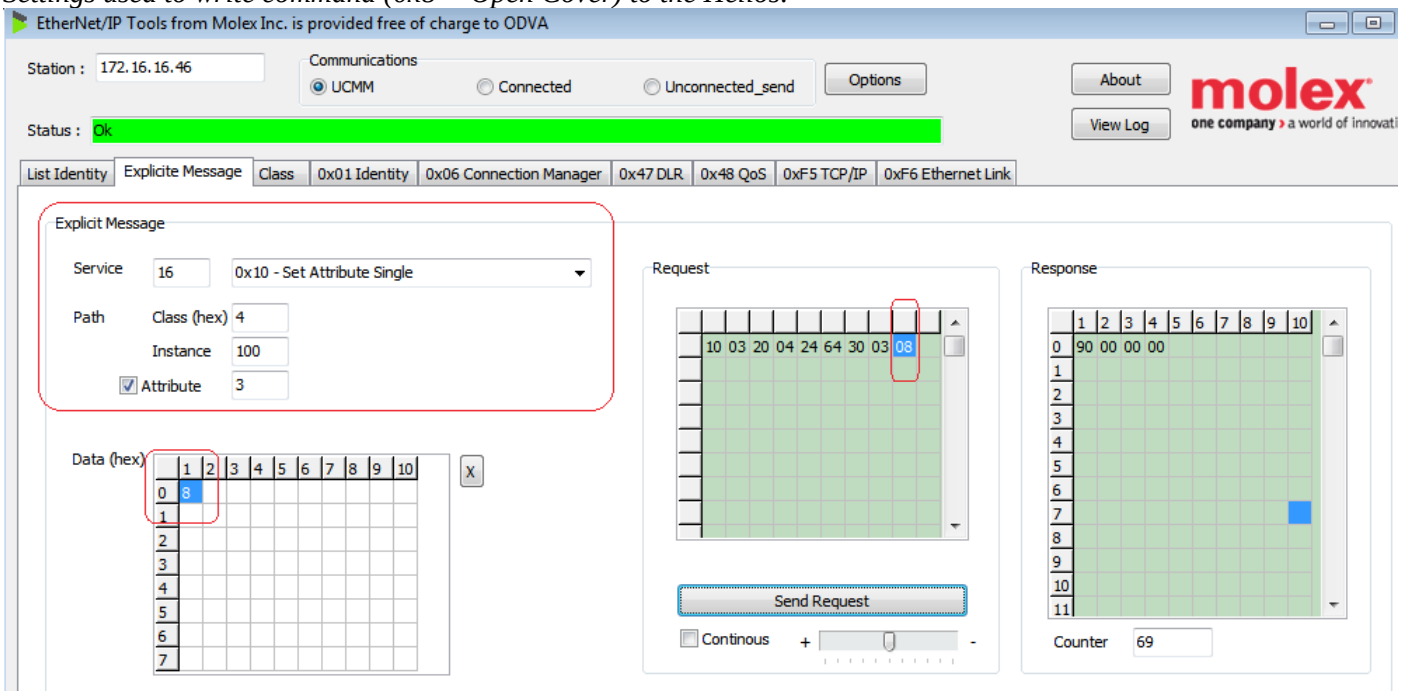
Settings used to read data from the Helios:



To **send a command** to the Helios, use the settings shown in the window below: 0x10, 4, 100, 3. Write the command byte to be used in the “Data(Hex)” window (in the top left position of the table) and then click on the “Send Request” button.

Examples of values from the Status Register are given above in the Registers and Commands chapter.

Settings used to write command (0x8 = Open Cover) to the Helios:

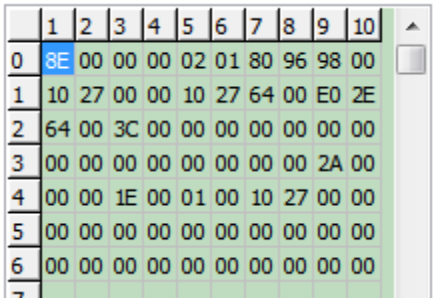


Analyzing the data from the Helios:

An example of data read from the Helios is shown below. This first example shows data when the Helios has close to zero incident power on the sensor, and no energy pulse has been measured recently. No commands have been sent since the last power up. Other examples will be shown further below.

The data in EtherNet/IP Mode is “Little-Endian”, meaning the order of the bytes within a 2-byte or 4-byte integer has the least significant byte at the end.

Example data:



	1	2	3	4	5	6	7	8	9	10
0	8E	00	00	00	02	01	80	96	98	00
1	10	27	00	00	10	27	64	00	E0	2E
2	64	00	3C	00	00	00	00	00	00	00
3	00	00	00	00	00	00	00	00	2A	00
4	00	00	1E	00	01	00	10	27	00	00
5	00	00	00	00	00	00	00	00	00	00
6	00	00	00	00	00	00	00	00	00	00

Here is the data shown above (in Hex):

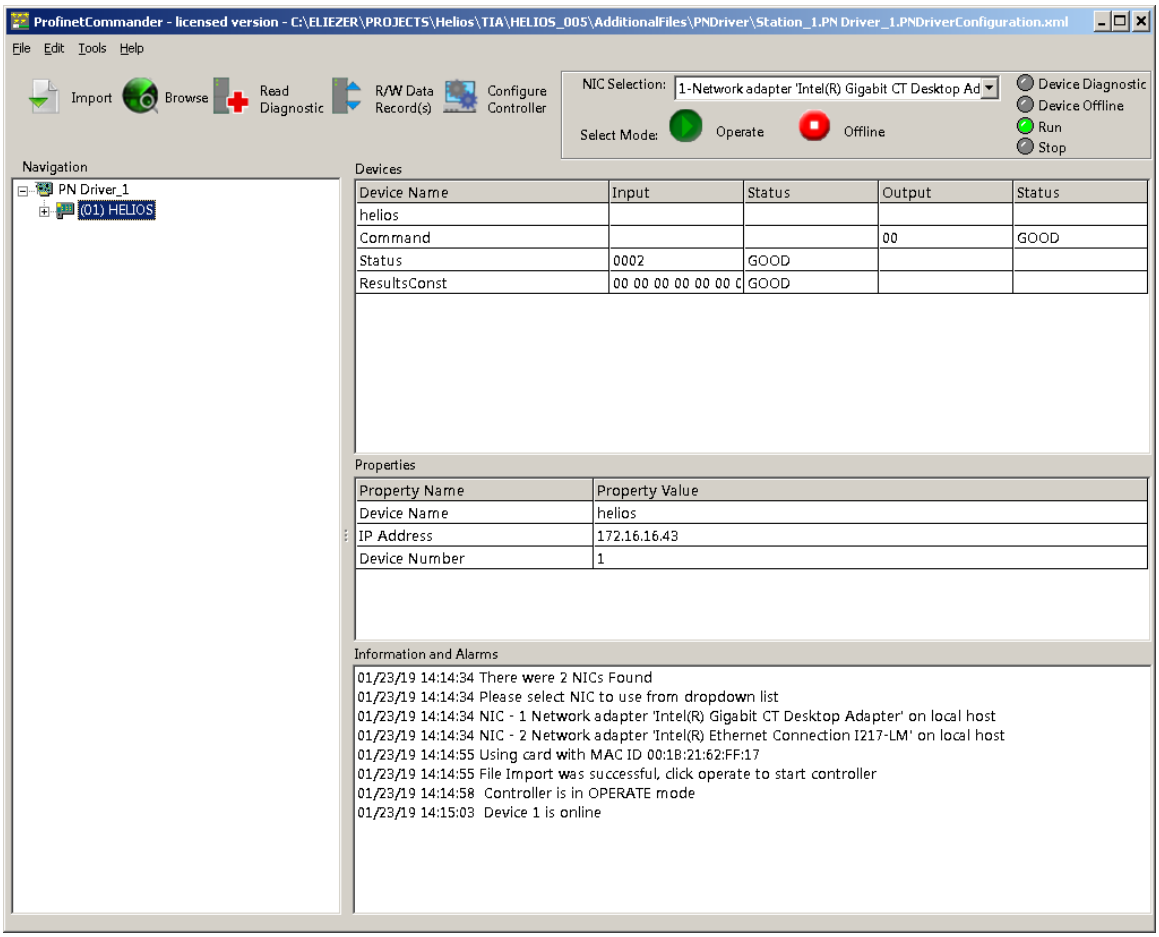
8E 00 00 00
02 01 80 96 98 00 10 27 00 00 10 27 64 00 E0 2E 64 00 3C 00 00 00 00 00 00 00 00 00 00 00 00 00 00 2A 00 00
00 1E 00 01 00 10 27 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

A full analysis of how to translate this data is shown above, see the “Registers and Commands” chapter.

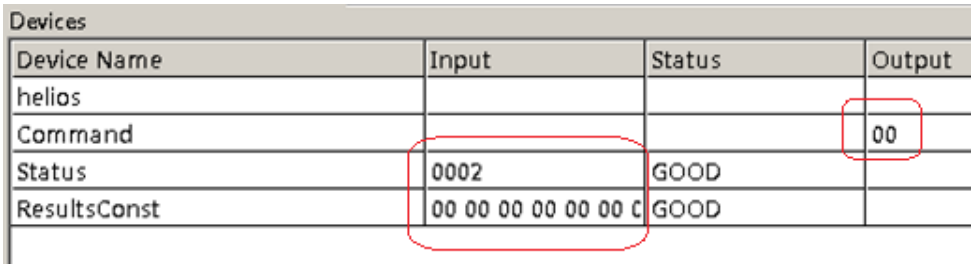
Chapter 11 – Getting Started With Profinet

This chapter describes how to control the Helios using the Profinet protocol, and how to read data from the Helios. Examples are shown using the tool “ProfinetCommander” to provide examples.

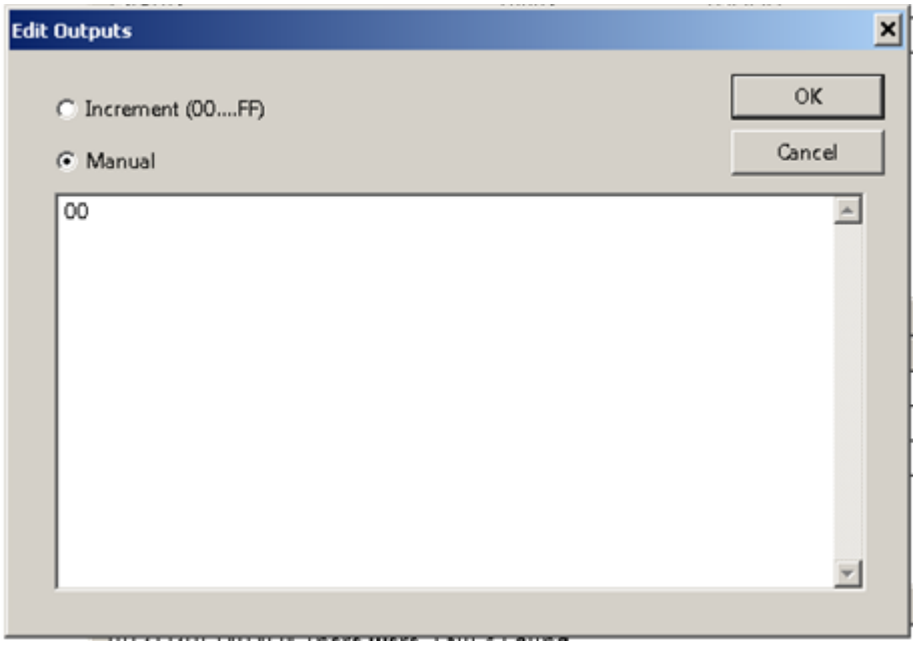
The tool “ProfinetCommander” presents the data from the Helios like this:



The status register (2 bytes) and results (multiple bytes) are presented in the “Input” section, and the “Output” section shows the command byte that will be sent to the Helios:



To send a command, click on the value shown in the “Output” section, and an edit box appears:



Type the data (in HEX) into the window and click on “OK” to send the data to the Helios.

Check the status and ResultsConst again to see updated status information from the Helios.

Chapter 12 – Getting Started With EtherCAT

This chapter describes how to control the Helios using the EtherCAT protocol, and how to read data from the Helios.

Examples are shown using the PC based tool “TwinCAT”, available from Beckhoff on their website. (Note that the TwinCAT tool can also provide support for Profinet and EtherNet/IP protocols as described in earlier chapters).

12.1 Installation of TwinCAT:

TwinCAT is available for (free) download from the Beckhoff website at this link:

https://infosys.beckhoff.com/english.php?content=../content/1033/tc3_installation/179465611.html&id=

More information is available at this link: www.beckhoff.com/twincat

Alternatively, search for “TwinCAT” in Google.

The tool needs to be installed on the PC.

12.2 Installing the XML file:

Before opening TwinCAT, copy the Ophir-supplied XML file for the Helios in this folder:

C:\TwinCAT\3.1\Config\Io\EtherCAT\

The file can be downloaded from the Ophir website, search for Helios EtherCAT version.

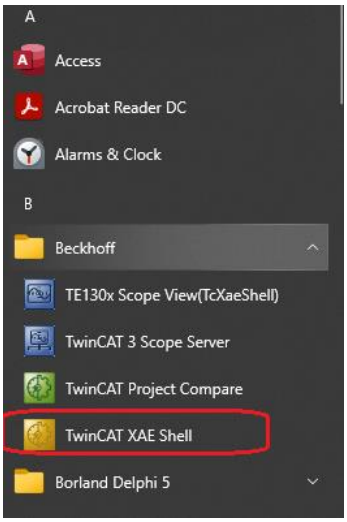
12.3 Opening the TwinCAT tool:

During the standard installation, the following tool should be installed at this location:

“C:\Program Files (x86)\Beckhoff\TcXaeShell\Common7\IDE\TcXaeShell.exe"

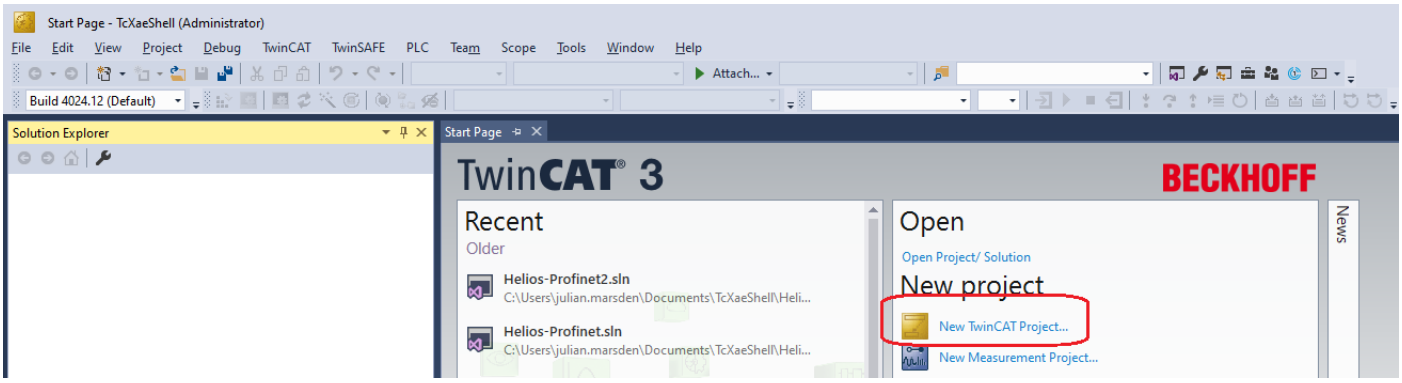
A link to this tool should be added to the desktop. Click on the icon to open the tool.

Alternatively, navigate to the tool using the Windows start button, under “Beckoff|”:

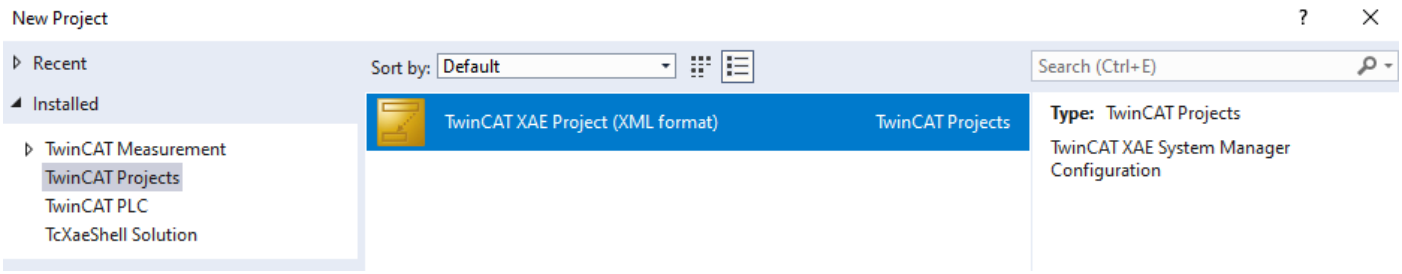


12.4 Opening a new TwinCAT Project:

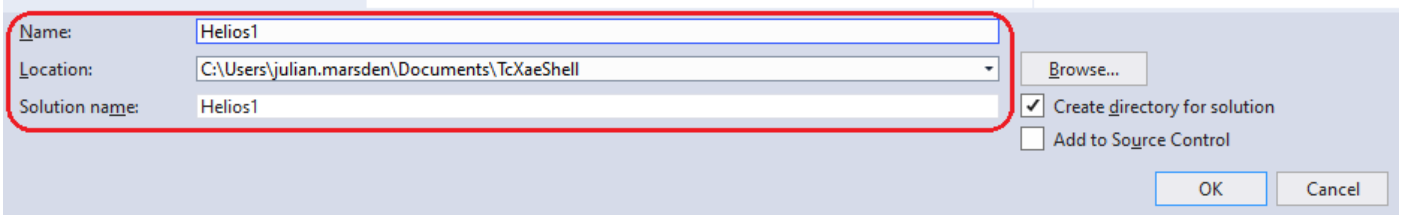
1. Select “New TwinCAT Project”:



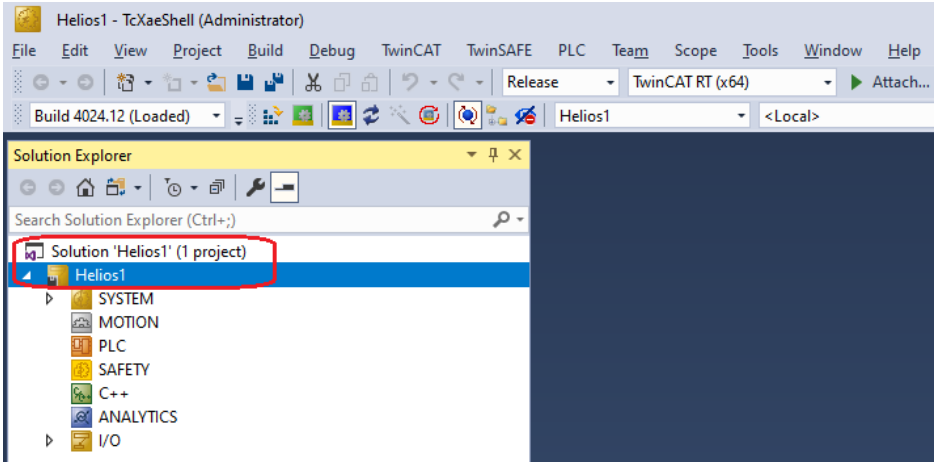
2. Choose "TwinCAT XAE Project" from the "Installed Templates:



3. At the bottom of the screen, choose a name for the project; the “Solution name” will update automatically as you type:



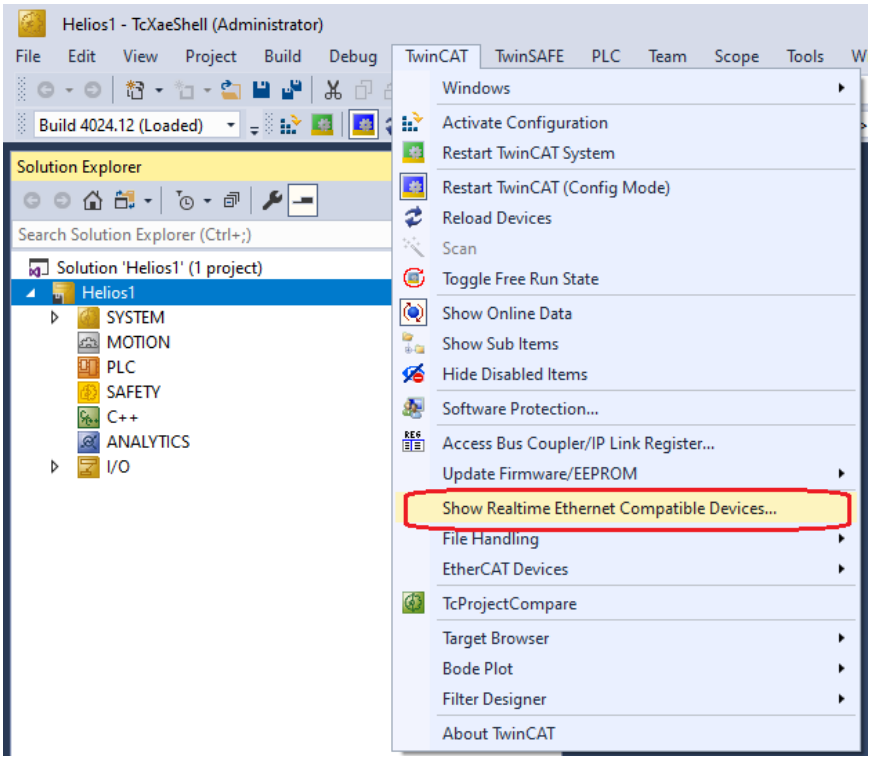
4. Ensure “Create directory for solution” is checked, and define a location for the project. Click OK. The new project will be loaded.



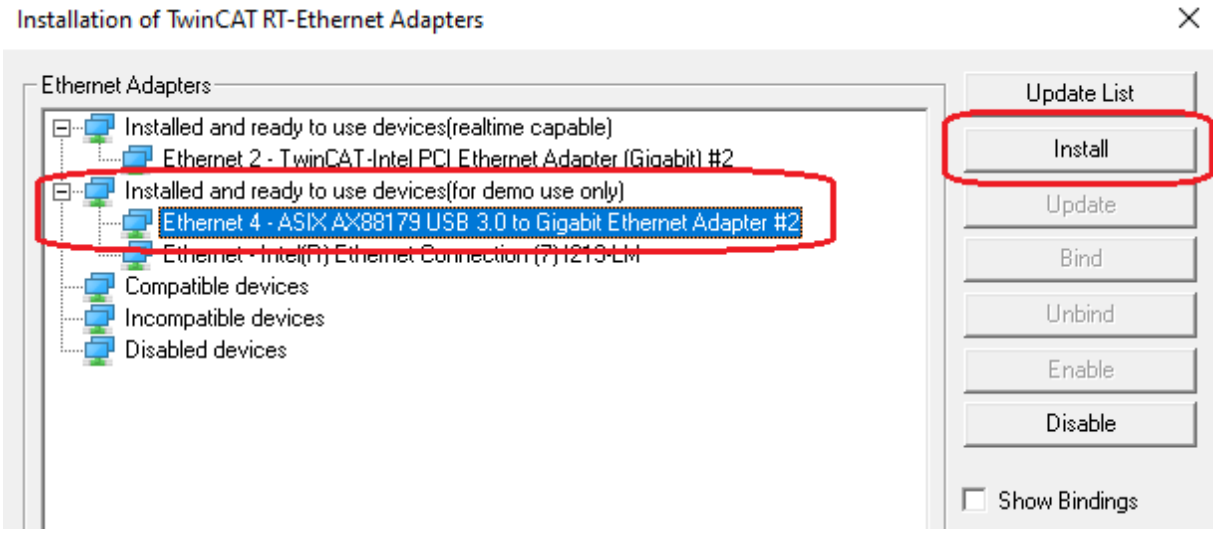
12.5 First time installation of compatible drivers for the Ethernet card:

Not all NIC cards are compatible with TwinCAT. If not fully compatible, the card you are using may be able to work in Demo Mode. TwinCAT will tell you if this is the case.

Go to menu item “TwinCAT -> Show Realtime Ethernet Compatible Devices…”



In this example, a StarTech USB 3.0 to Gigabit Ethernet Adapter P/N USB31000S was connected to the PC USB port, and the Ethernet side was connected to the Helios. TwinCAT identifies this adapter as one that can work in demo use only:

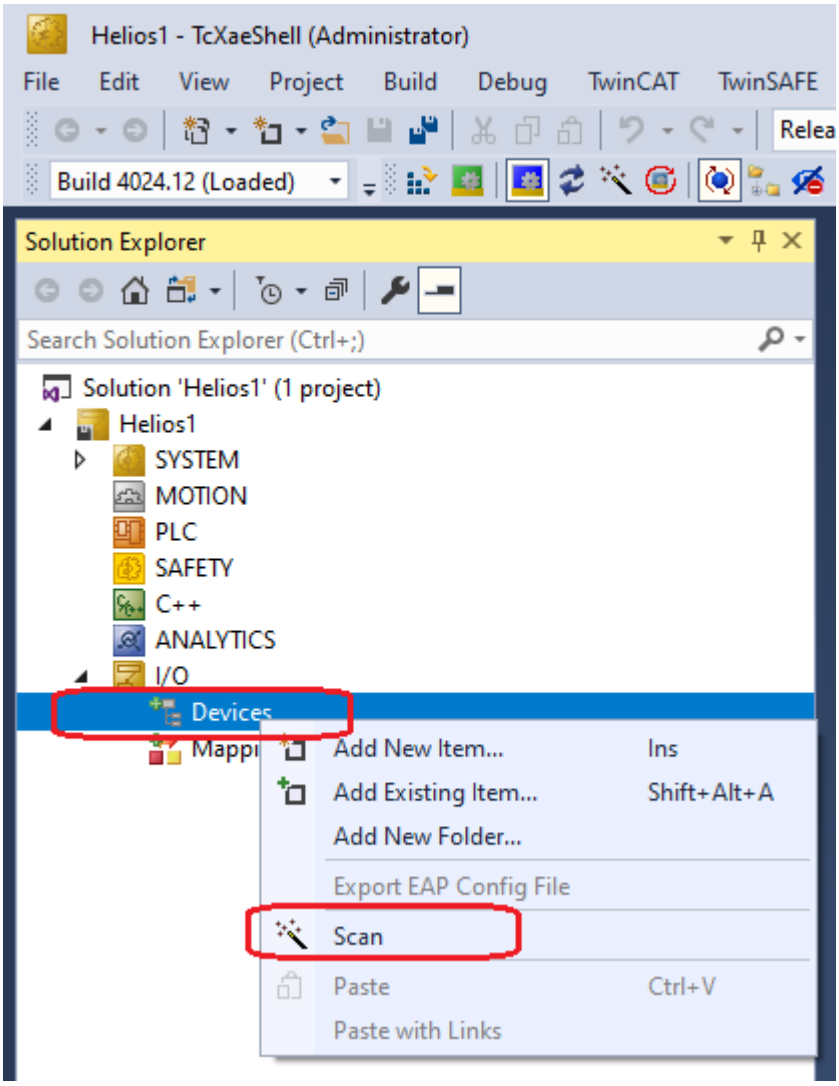


Click “Install” to install the drivers.

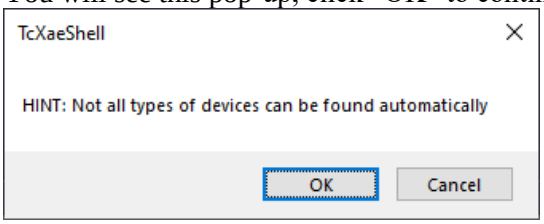
If your NIC is not compatible, a different NIC (for example, the USB adapter mentioned above) will need to be used instead.

12.6 Connecting to Slave Device:

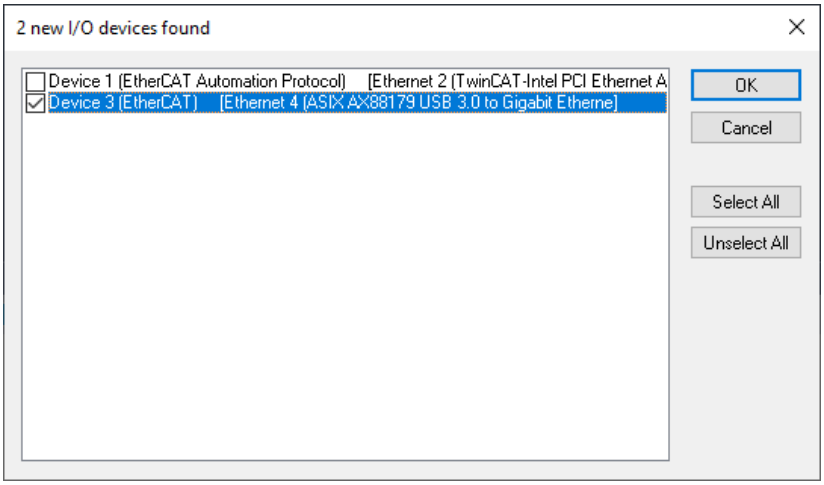
Under the “Solution Explorer” open the “I/O” item and choose “Devices”, then right click and choose “Scan”.



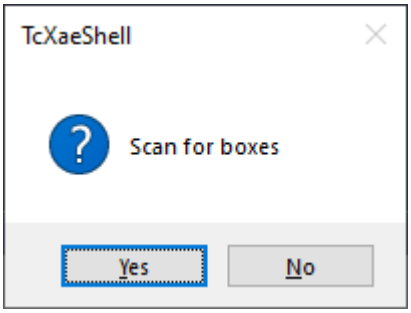
You will see this pop-up, click “OK” to continue:

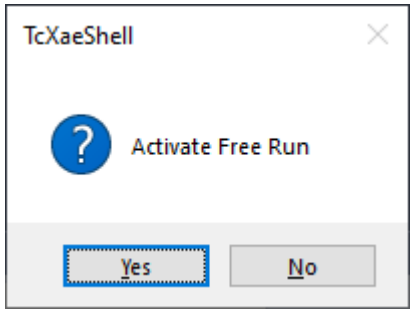


TwinCAT will locate and display available NICs. Choose the correct NIC and press “OK”



After clicking OK, you may see one or more of these pop-ups, answer “Yes” to each one:



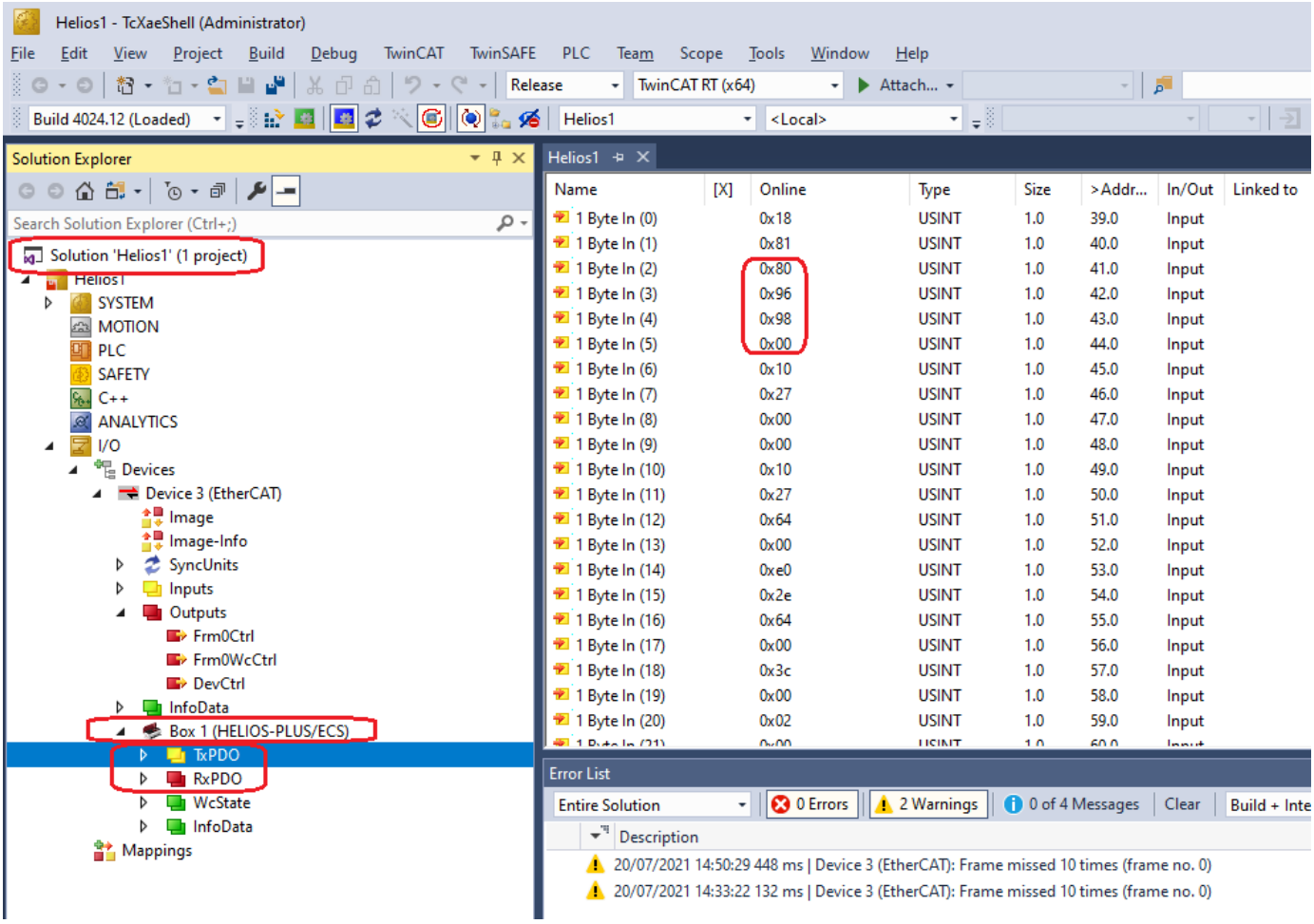


12.7 Viewing raw data from the Helios device & sending commands:

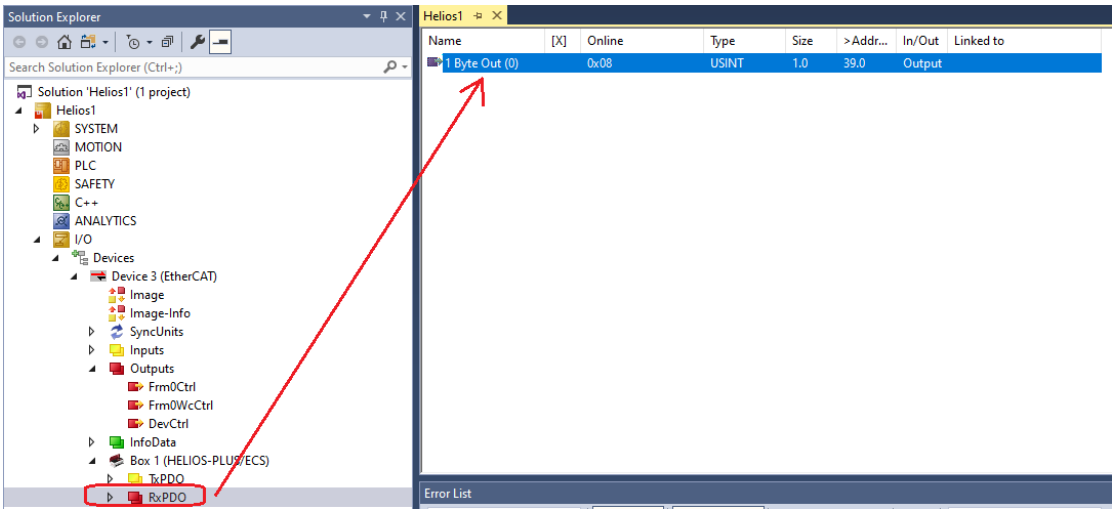
If all the above steps are completed successfully, the device should appear under the project as shown below and the Helios should be connected to EtherCAT correctly.

In order to view raw data from the Helios, click on the icon “TxPDO” as shown below. On the right-hand side of the screen, all the data from the Helios (66 byte register) will be displayed. To view the data in HEX, right click on the values and choose “Display Mode -> Hex”.

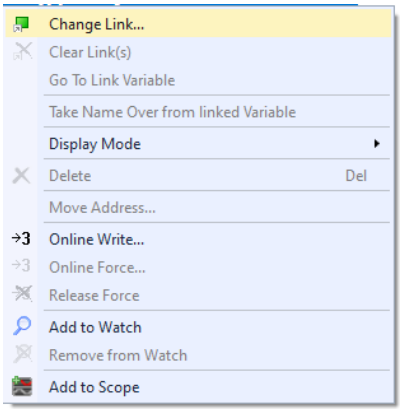
Bytes in address 0x02 to 0x05 should be 0x80 0x96 0x98 0x00 as shown below (see above, section “Analysis of Example Data, LITTLE Endian”, the value is 10,000,000 mJ max energy, with bytes swapped around).

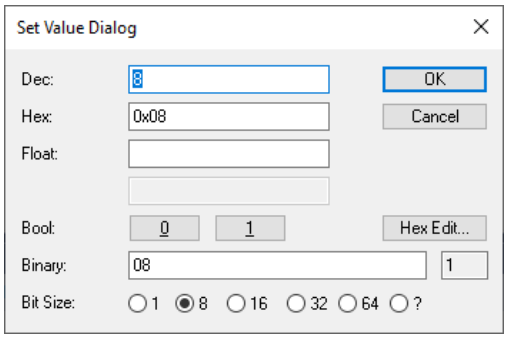


In order to send commands to the Helios (for example, to open or close the cover) click on the icon “RxPDO”,



Choose the line “1 byte out”, right click and choose “online write”



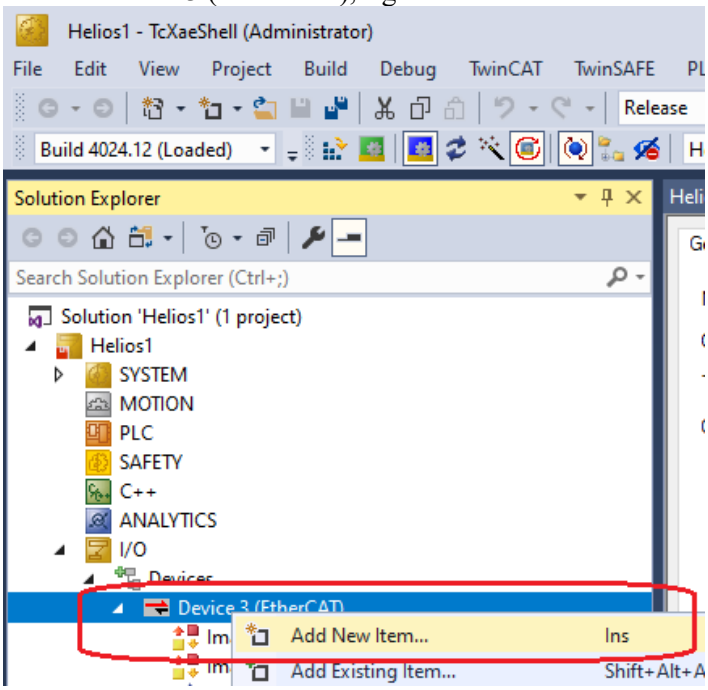


Enter the value to be written to the Helios on one of the top two lines (Dec or Hex) and press “OK”. For example, the command 0x10 closes the cover, 0x08 opens the cover.

12.8 Viewing formatted data from the Helios:

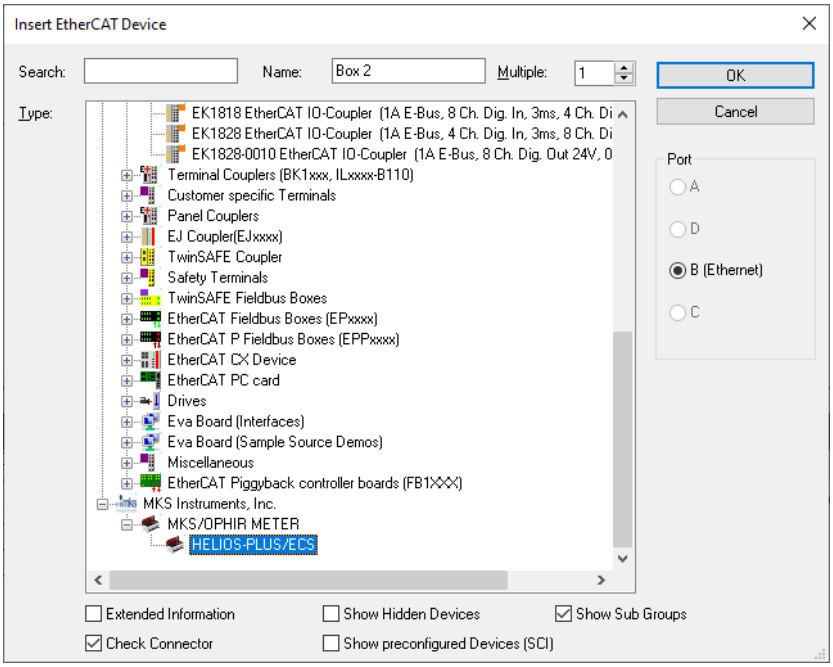
During the above process the Helios XML file may not have automatically loaded into TwinCAT. In order to load it now, follow this procedure:

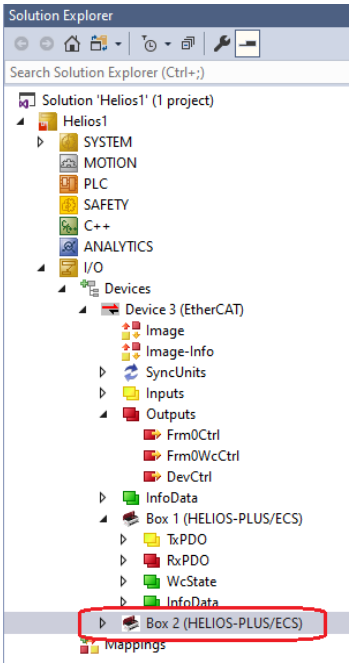
Select “Device 3 (EtherCAT), right click and select “Add New Item”



A drop down of all available XML files from folder C:\TwinCAT\3.1\Config\Io\EtherCAT\ will be displayed:

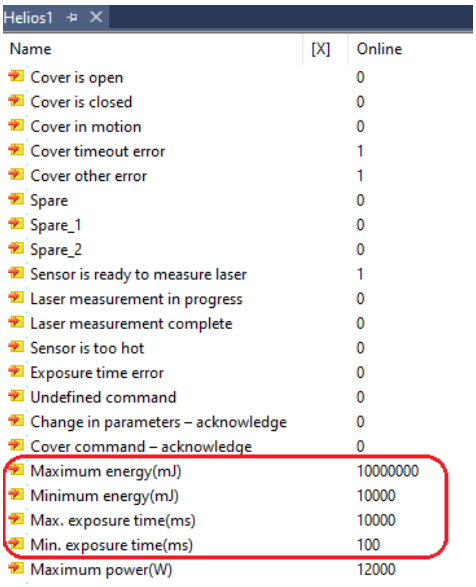
Navigate to the bottom of the list and locate MKS Instruments and choose the correct Helios file. Press “OK”.





The formatted Helios will appear in the list on the left as “Box 2”.
At this point it is necessary to delete “Box 1” to allow “Box 2” to continue working. Right click “Box 1” and choose “Remove”.
To connect to “Box 2” click on the “Reload Devices” icon in the tool bar at the top of the page 

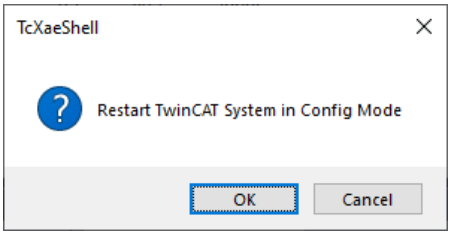
Click on “Inputs0”. All defined parameters are now visible with their correct format on the right side of the screen, for example Maximum energy (mJ) is displayed as 10,000,000 or 10kJ.

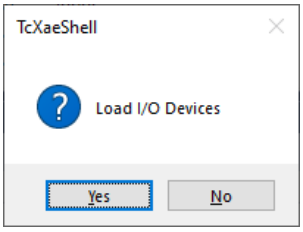


12.9 Restarting communications with the device:

It is possible to restart communications with the device if this should be necessary by clicking on the icon “Restart TwinCAT” 

The s/w will give the pop-up “Restart TwinCAT System in Config Mode? Choose OK.

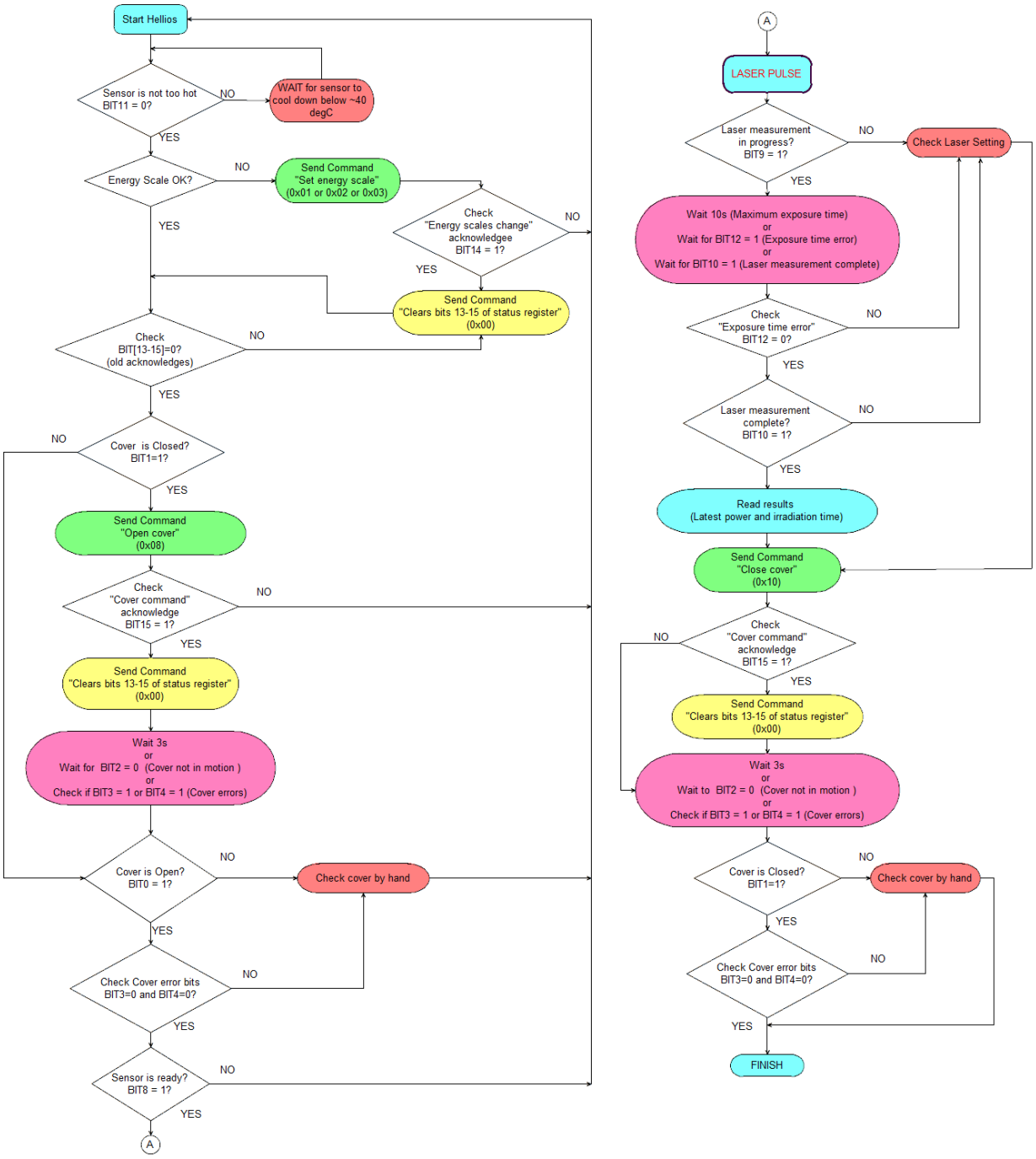




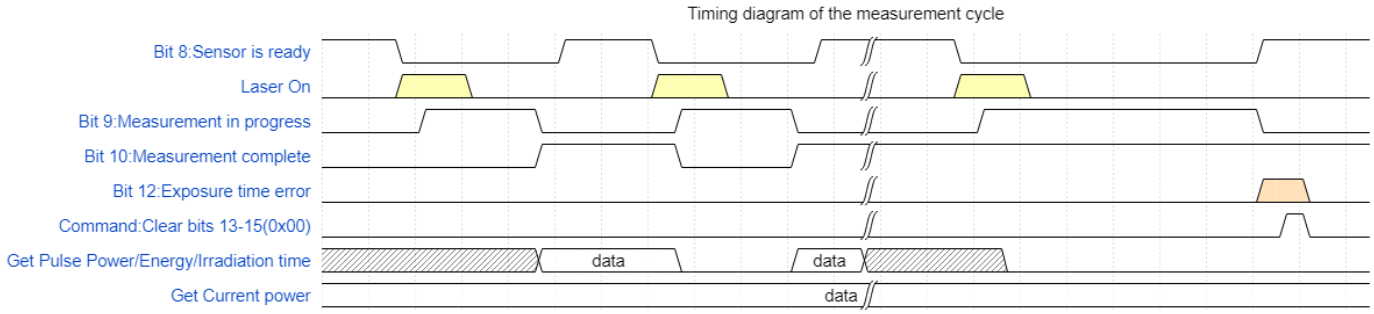
After that you can choose to load the I/O devices (“Yes”), or not (“No”) if you want to disconnect the device from EtherCAT to connect in another tool. After choosing “Yes” you may need to restart the device using the “Reload Devices” icon as above.

Appendix 1 – Flow Chart & Timing Diagrams

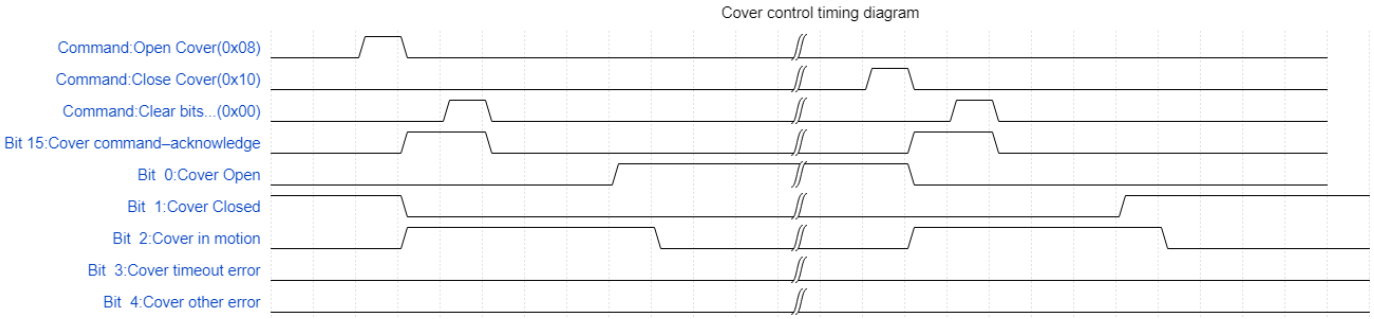
Measurement Flow Chart



Power Measurement Timing Diagram



Shutter Timing Diagram



Changes in version 1.08-1

Replaced all screen shots of Helios Application & removed comment about some pictures from old s/w version.
Added support for M model and EtherCAT model.
Chapter 2: Updated spec sheet and added new P/Ns (M and EtherCAT versions)
Chapter 5, 6 (Mechanics, Connectors): Extensive changes to add details of two new models
Chapter 12: New chapter on getting started with EtherCAT
Chapter 8: Added Baud rate settings at the top, added $BD command details inside commands section

Changes in version 1.08-2

Pages 4,5 – added 7Z07134 in addition to 7Z07100, added “(End of life)” on old P/Ns
Pages 6,7 – added new spec (modified P/N and added “V1”)
Page 8 – changes in text & NEW ILLUSTRATION showing Helios with P/N
Page 29 – added $mi command.

Helios & Helios Plus User Manual
29 May 2023
Rev 1.08-2

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