

**User Manual**

# **OPHIR IPM – INDUSTRIAL POWER METER**

## **HIGH POWER INDUSTRIAL LASER MEASUREMENT**



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# 1 Warranty & Safety Information

## 1.1 Safety Procedures and Precautions

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of intended use of the instrument and may impair the protection provided by the equipment. MKS Instruments, Inc. assumes no liability for the customer's failure to comply with these requirements.

### DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to an MKS Calibration and Service Center for service and repair to ensure that all safety features are maintained.

### SERVICE BY QUALIFIED PERSONNEL ONLY

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel only.

## 1.2 Symbols Used in This Instruction Manual

### NOTE

The NOTE sign denotes important information. It calls attention to a procedure, practice, condition, or the like, which is essential to highlight.

## 2 Specifications

This section contains COPIES of the spec sheets for each of the 3 units of the IPM system available at the time of publishing the User Manual. For the LATEST specifications, please check the Ophir website.

### INTRODUCTION


- Based on the tried-and-true 10K-W sensor, the new IPM modular industrial sensor for measuring the average power of high-power lasers up to 11kW is ideal for tough industrial use. Ruggedized by design, it has all the features needed for reliable, fail-safe operation in a tough operational environment. Its modular design provides the flexibility needed to address customers' specific needs.
- The IPM-10KW has heavy duty connectors and an interlock output. For more protection, the user can order the IPM-Shutter10 which provides an automated shutter with a field replaceable anti reflective coated window (see next section). Integration into modern automation systems is available with the IPM-COM communication module (EtherNet and Profinet).

### IPM-10KW Industrial Sensor

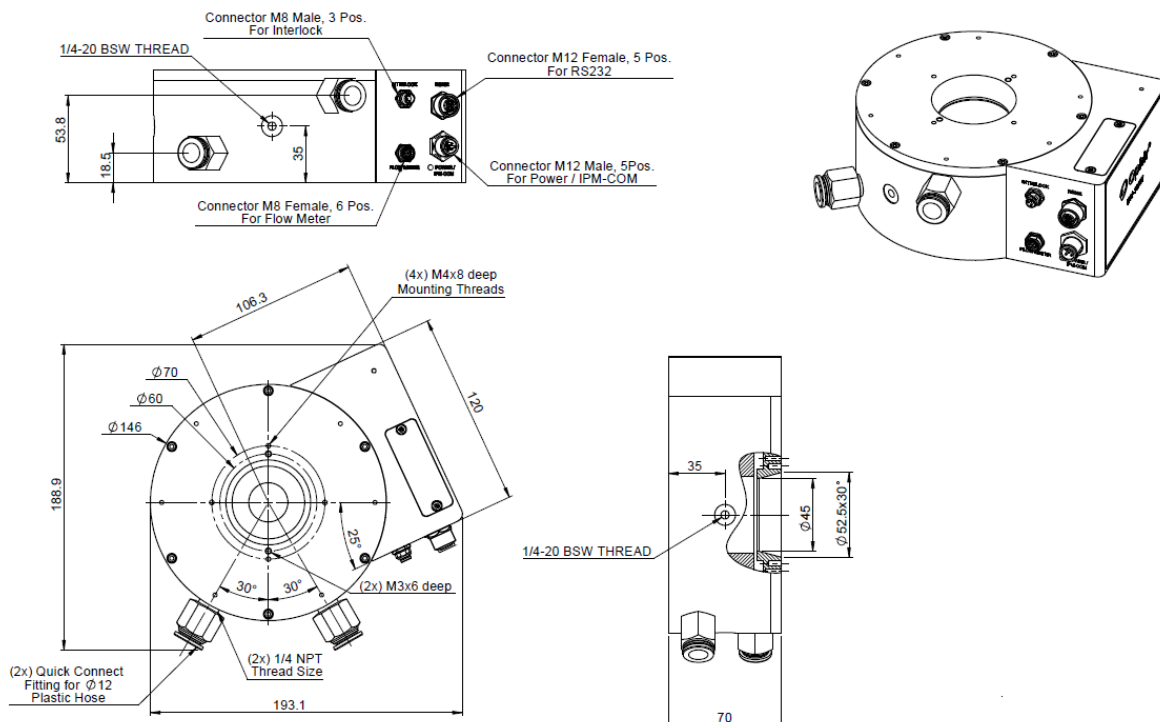
- ISO17025 NIST & PTB traceable calibration
- Measure up to 11kW
- Modular architecture
- Heavy duty design with industrial interface and connectors
- Interlock to protect from overpower or cooling water failure
- Real time visibility, traceability and logging for predictive maintenance

IPM-10KW



Model	IPM-10KW
Use	Laser power measurement in industrial environment up to 11kW
Control	RS232
Absorber Type	Beam deflector + broadband absorber
Spectral Range $\mu\text{m}$ <sup>(a)</sup>	0.9-1.1 $\mu\text{m}$ , 10.6 $\mu\text{m}$
Aperture mm	Ø45mm
<b>Power Mode</b>	
Power Range	100W – 11KW
Power Scales	11KW / 6KW / 600W
Power Noise Level	5W
Backscattered Power	~3.5% <sup>(b)</sup>
Maximum Average Power Density kW/cm <sup>2</sup>	See note <sup>(c)</sup> and table <sup>(1)</sup> below
Response Time with Meter (0-95%) typ. s	2.7
Response Time with Meter (0-99%) typ. s	10
Power Accuracy $\pm\%$	5 <sup>(a)</sup>
Repeatability $\pm\%$	0.4
Linearity with Power $\pm\%$ (0-100% range)	2
Linearity with Power $\pm\%$ (0-90% range)	1.5
<b>Energy Mode</b>	
Energy Range	60J – 10KJ
Energy Scales	10KJ / 5KJ / 500J
Energy Accuracy	Additional 2% error to power accuracy
Minimum Energy J	60
Maximum Energy Density J/cm <sup>2</sup>	See table <sup>(1)</sup> below
Cooling	Water <sup>(d)</sup>
Minimum Water Flow Rate	8 liter/min at full power <sup>(d)</sup>
Water Connectors	Quick connector for 12mm OD nylon tubing (see page 86)
Weight kg	5
Connectors <sup>(e)</sup>	 <ul style="list-style-type: none"> <li>Interlock, M8 male, 3-pin</li> <li>RS232, M12 female 5-pin</li> <li>Flow meter – M8 female, 6-pin</li> <li>Power/IPM-COM, M12 male, 5-pin</li> </ul>

Cables <sup>(e)</sup>	Part		P/N			
	RS232 cable, M12 male 5-pin to D9 female, 1.8m (supplied with sensor)		7Z10532			
	Power cable, M12 female 5-pin to flying leads, 1.5m (supplied with sensor)		7E01519			
	Interlock cable, M8 female 3-pin to flying leads, 1.5m (not supplied)		7E01513			
	Water Flow Meter cable, M8 male 6-pin to flying leads, 1.5m (not supplied)		7E01536			
Related Products <sup>(a)</sup> <sup>(b)</sup>	Name		Description		P/N	
	IPM-SHUTTER10		Combined protective shutter with built in scatter shield		7Z08409	
	IPM-SHUTTER10 Window replacement kit		Replacement anti reflective coated window		7Z08411	
	IPM-COM-Profinet		Profinet communications adapter with AIDA connectors		7Z08404	
	IPM-COM-EtherNet/IP-M		EtherNet/IP communications adapter with M connectors		7Z08405	
Compliance	CE, UKCA, China RoHS					
Part number	7Z07106					
Notes: (a)	Calibrated at 1.07µm and 10.6µm. When working at 10.6µm (CO2), if using the SHUTTER10 unit, the window should be removed.					
Notes: (b)	The shutter unit IPM-SHUTTER10 has a built-in scatter shield. If this is installed, the backscatter is reduced to ~1%.					
Notes: (c)	For circular beam centered within 25% of beam diameter. IMPROPERLY CENTERED BEAM CAN CAUSE DAMAGE TO SENSOR. Maximum tilt angle ±5 degrees. For rectangular beam please consult Ophir representative.					
Notes: (d)	Water temperature range 18-30°C. Water temperature rate of change <1°C/min. Pressure drop across sensor 0.1MPa. The recommended flow rate can be lowered proportionately at lower than full power but should not be below 3 liter/min. The response time will be optimal with the recommended flow rate. For solutions for prolonged usage with untreated water (tap water, non DI water), please, contact Ophir.					
Notes: (e)	See IPM User Manual for details of connectors and cables					
Table (1)	Beam diameter	Max power density	Max energy density – by pulse width			
			1ms PW	3ms PW	10ms PW	100ms PW
	<15mm	10kW/cm²	30J/cm²	60J/cm²	150J/cm²	1350 J/cm²
	15 – 20mm	7kW/cm²	20J/cm²	40J/cm²	100J/cm²	900 J/cm²
	20 – 40mm	5kW/cm²	15J/cm²	30J/cm²	70J/cm²	600 J/cm²
	40 – 45mm	4kW/cm²	12J/cm²	25J/cm²	60J/cm²	500J/cm²

**IPM-10KW**




## IPM-SHUTTER10 Shutter Assembly for IPM-10KW

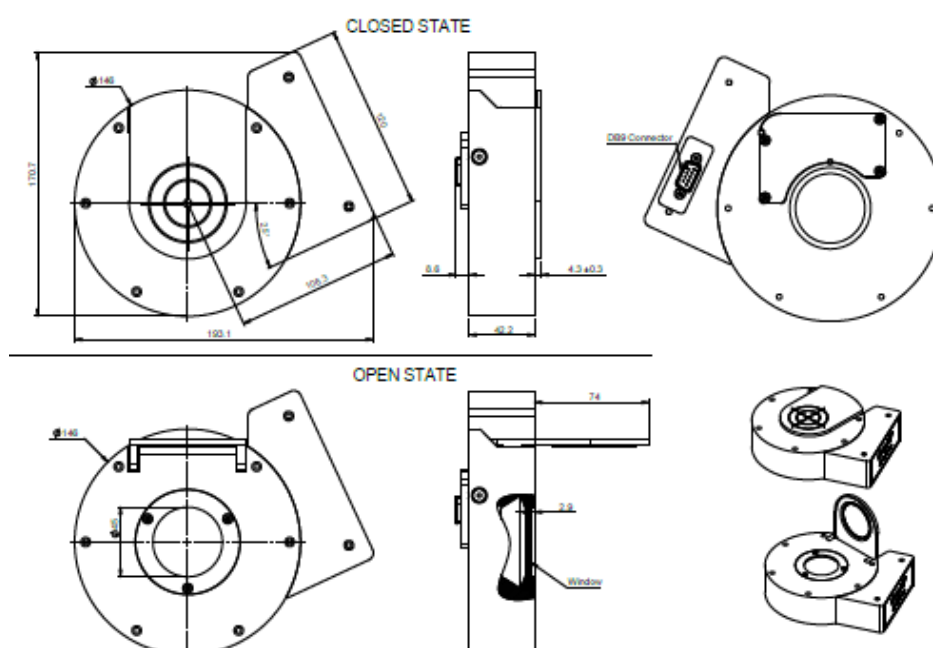
For usage in a dirty industrial environment, the IPM-10KW can be fitted with an automated dust tight shutter assembly to protect the unit from dust and debris. The shutter unit has a built-in scatter shield and includes a field replaceable antireflection coated protective window.

- Built-in scatter shield
- Antireflective coated window <sup>(a)</sup>
- Motorized dust-resistant shutter
- IP62 rated



<b>Model</b>	<b>IPM-SHUTTER10</b>		
<b>Use</b>	Provides IP62 in industrial environment		
<b>Control</b>	Via host IPM-10KW unit		
<b>Aperture mm</b>	Ø45mm		
<b>Backscattered Power <sup>(b)</sup></b>	~1%		
<b>Weight kg</b>	2		
<b>Connectors</b>	Connection to IPM-10KW unit – D9		
<b>Part Numbers and Optional Accessories</b>	<b>Name</b>	<b>Description</b>	<b>P/N</b>
	IPM-SHUTTER10 IPM-SHUTTER10 Window replacement kit	Combined protective shutter. Includes built in scatter shield Replacement anti reflective coated window	<b>7Z08409</b> <b>7Z08411</b>
<b>Related Products</b>	<b>Name</b>	<b>Description</b>	<b>P/N</b>
	IPM-10KW IPM-COM-Profinet IPM-COM-EtherNet/IP-M	IPM industrial laser power sensor Profinet communications adapter with AIDA connectors EtherNet/IP communications adapter with M connectors	<b>7Z07106</b> <b>7Z08404</b> <b>7Z08405</b>
Notes: (a)	When working at 10.6µm (CO <sub>2</sub> ), the window should be removed.		
Notes: (b)	Using built in scatter shield, use the NIRS or CO <sub>2</sub> S setting to compensate for slightly higher reading.		

### IPM-SHUTTER10





## IPM Industrial High Power Sensor

### IPM-COM – IPM adapter for industrial protocols

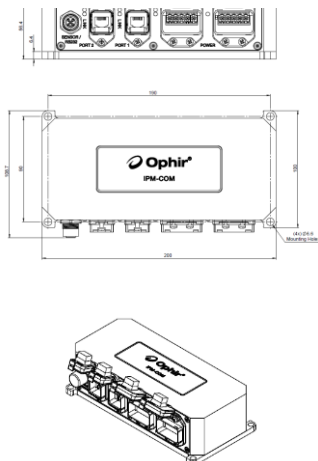
Modern automation systems integrate equipment from multiple vendors into a common Ethernet infrastructure. The IPM-COM is an industrial communication module enabling the integration of the IPM industrial sensor into Profinet or EtherNet/IP automation systems. For additional protocols please approach your local Ophir sales representative.

- Connects to the IPM sensor to provide industrial communication protocols
- Supports communication and power daisy chaining
- Supports Profinet, EtherNet/IP
- Industrial ruggedized housing and connectors
- Mounting plate and holes for wall mounting
- Two connector options: M12 & Mini 7/8", or AIDA

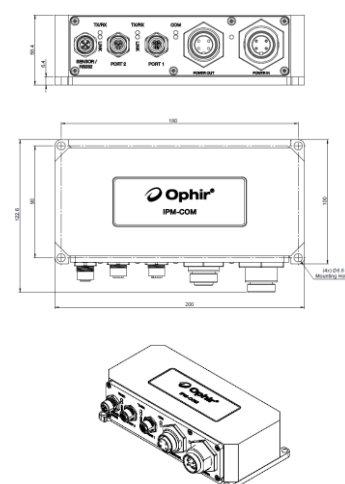


Model	IPM-COM				
Use	Support industrial communication protocols for IPM sensor				
Connectors	2x Industrial Ethernet connectors, 2x 24V power connectors, 1x M12 interconnection with the IPM sensor				
Cables	Cable to IPM sensor, M12 male to M12 female, 5-pin, 1.5m (P/N 7E01540, supplied)				
Weight kg	2				
Part Numbers	Name	Protocol <sup>(a)</sup>	Data Connector <sup>(b)</sup>	Power Connector	P/N
	IPM-COM-Profinet	Profinet	AIDA RJ45	AIDA Power	7Z08404
	IPM-COM-EtherNet/IP-M	EtherNet/IP	M12	Mini 7/8"	7Z08405
Related Products	Name				P/N
	IPM-10KW sensor				7Z07106
	Combined protective shutter and scatter shield IPM-SHUTTER10				7Z08409
	IPM-SHUTTER10 window replacement kit				7Z08411
Optional Accessories	Name				P/N
	Power Cable, Mini 7/8" female, 4-pin, to flying leads, 2m (not supplied)				7E01535
	Power Cable, AIDA female, 4-pin, to flying leads, 5m (not supplied)				7Z10458A
	Profinet Cable, RJ45 AIDA to RJ45, 5m (not supplied)				7E01298
	EtherNet/IP Cable, M12-D to RJ45, 3m (not supplied)				7E11211
Notes: (a)	Other protocols (EtherCAT, CC-link) can be supported, contact Ophir for more information				
Notes: (b)	Other combinations of protocol and connector types are possible, contact Ophir for more information				

#### IPM-COM-Profinet (AIDA)



#### IPM-COM-EtherNet/IP-M (M12, Mini 7/8")



### 3 IPM Overview

The Ophir **IPM** (Industrial Power Meter) is a family of products designed to offer laser power measurement solutions in a tough industrial environment. The products are designed to be rugged, dust proof and splash proof with an IP rating. They use only industrial connectors such as M12, Mini 7/8" and AIDA types.

The IPM-10KW has heavy duty connectors and an interlock output. For dust and splash protection, the user can order the IPM-SHUTTER10 which provides an automated shutter and a field replaceable anti reflective coated protective window. Integration into modern automation systems is available with the IPM-COM communication module (EtherNet/IP or Profinet).

Based on the tried-and-true "10K-W" sensor, the IPM-10KW can be used for measuring the average power of high-power lasers up to 11kW. As in all water-cooled sensors, proper attention should be paid to the water flow rate, water temperature and temperature stability. The limitations mentioned in the specification sheet should be carefully followed. Furthermore, for recommendations on the quality of the water and water flow rate, please consult the Ophir paper on the subject at <https://www.ophiropt.com/laser-measurement/knowledge-center/article/10000>

The power, power density, energy and energy density limitations on the use of the IPM are related to the beam size and those limitations as stated in the specification should also be followed. There are also limitations on beam divergence and beam centering as stated in the specification.

It is recommended that safety precautions should be taken to turn off the laser in event of overheating of the sensor. For this purpose, a safety interlock is provided for connection to the laser source. (See section 3.2.3).

#### 3.1 Introduction

The IPM product family is made up of several modular components allowing the most cost-effective solution for every application.

##### The IPM family components:

- **IPM-10KW:** A water cooled 10kW laser power sensor with built in measurement electronics and RS232 communication, interlock output and water flow meter interface.
- **IPM-SHUTTER10:** An optional shutter module containing a protective glass window and an electromechanical dust-tight shutter, as well as a built-in scatter shield.
- **IPM-COM:** An optional industrial communication module. Separate modules offer EtherNet/IP or Profinet communications.

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#### NOTE

The IPM-10KW is referred to as "IPM sensor" throughout this document

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##### Additional features and interfaces:

- **Interlock connection:** Can be used to automatically disable the laser if an error condition is detected, for example overheating or inadequate water cooling of the sensor
- **Disk temperature sensor:** The IPM sensor contains an internal temperature sensor to detect an overheating condition, for example if the cooling water flow rate is too low, or if the laser power is too high. This can be used to switch the interlock to disable the laser via the interlock connector.

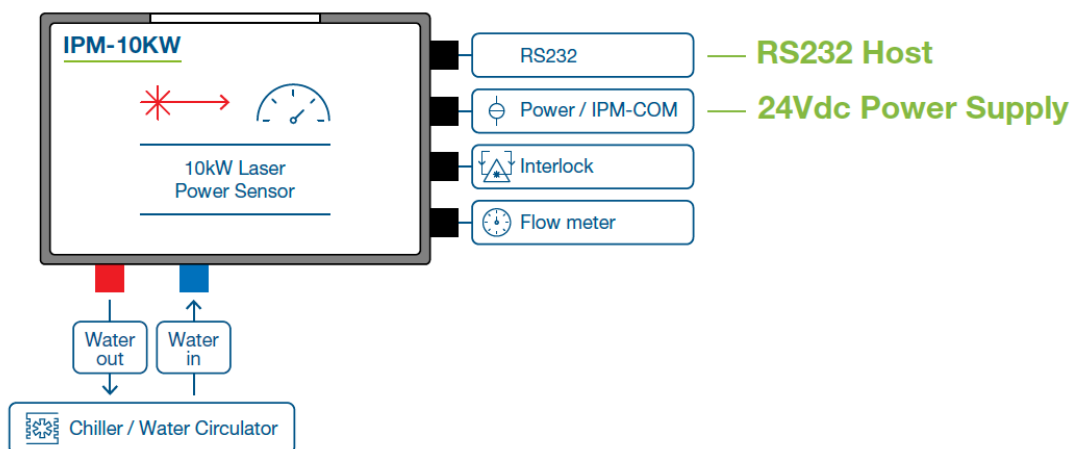
- **Water flow meter interface:** A connector is provided to connect an external water flow meter (customer supplied) to monitor the flow rate of the cooling water; this can also be used to switch the interlock to disable the laser.
- **RS232 command set and StarLab software package:** A full set of RS232 user commands are provided to control and monitor the IPM sensor. Additionally, Ophir's StarLab PC Application provides support for the IPM sensor via RS232 control. See below for more details.
- **Industrial Protocol Registers:** A fully documented set of binary registers offering control commands (write mode) and monitoring (read mode) is provided with the IPM-COM unit. See below for more details.

## 3.2 Application options (*all combinations of the options below are possible*)

### 3.2.1 Basic application

- In this application the IPM sensor is connected via the (supplied) RS232 cable to an RS232 host such as a PC or a PLC.
- 24V power is supplied via a separate M12 power connector
- Alternatively, power can be supplied via the RS232 connector itself (which has dedicated pins for power) using a custom-built cable (not supplied). See below for more details.

Basic Application example:

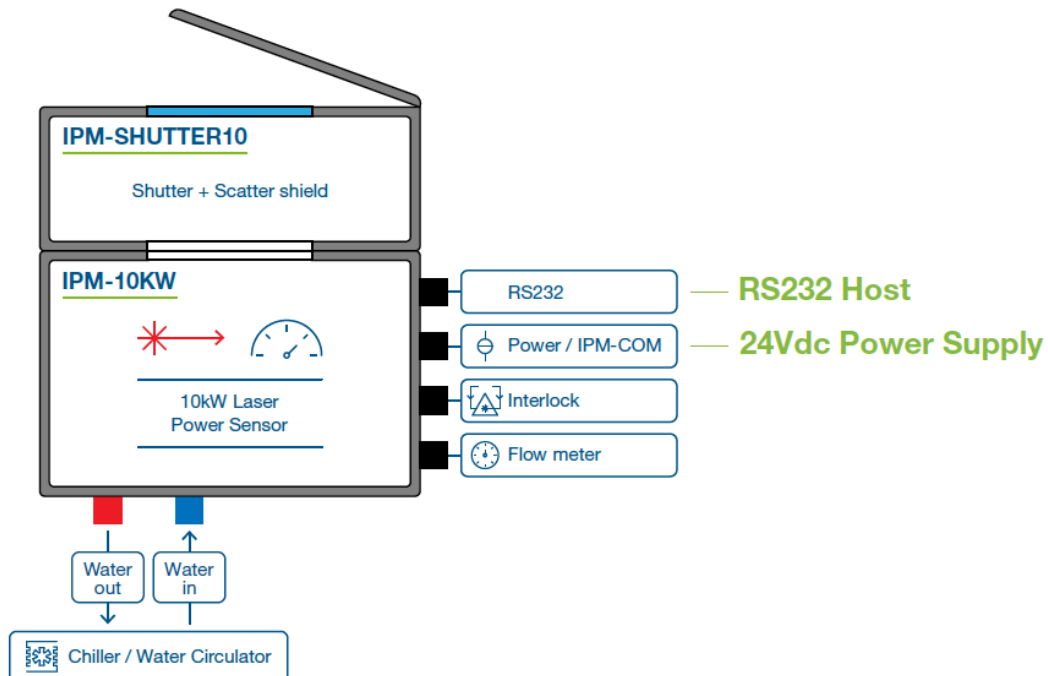


### 3.2.2 Shutter module IPM-SHUTTER10.

The shutter module is sold separately and has several features:

- Remote controlled shutter with dust tight rubber seal
- Anti-reflective coated protective window
- Scatter shield for reduced back scatter

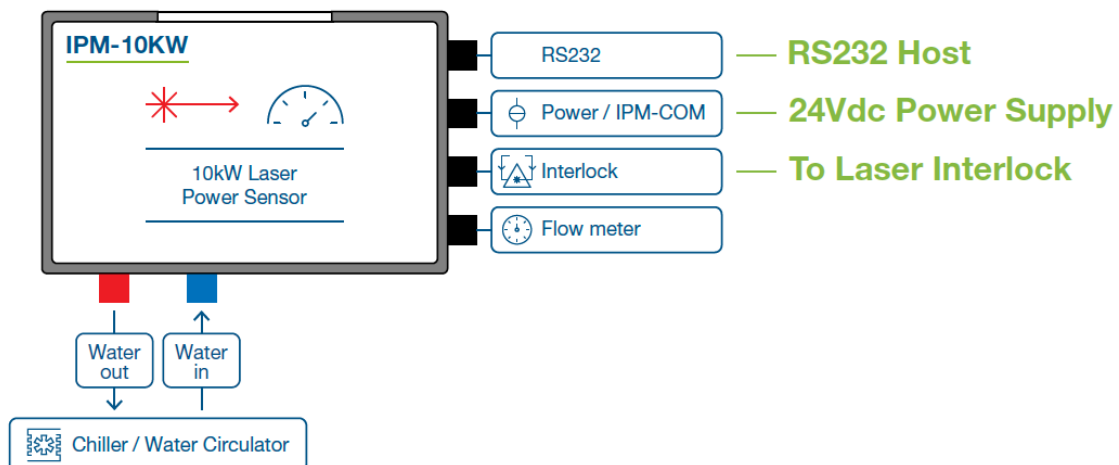
With additional IPM-SHUTTER10:



### 3.2.3 Interlock

- If the sensor overheats due to insufficient cooling water flow, an internal temperature sensor can be used to trigger the interlock mechanism. This output can be connected to the laser interlock system in order to turn off the laser automatically and prevent damage to the sensor.
- The interlock can also be controlled by the water flow meter, if the water flow rate drops below a pre-determined minimum level
- Details for connecting the interlock are provided below
- The sensor temperature can also be monitored via the RS232 link

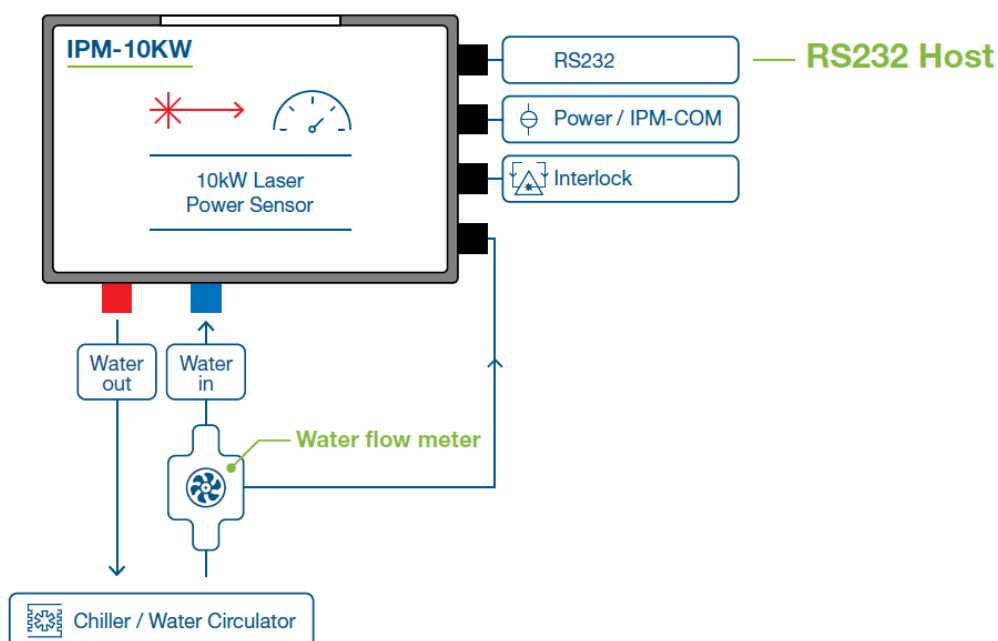
With interlock:



### 3.2.4 Water Flow Meter interface

- Can be used for precise water flow measurement and control of the laser interlock
- Ophir does not provide the flow meter, the customer will purchase and connect it to their water cooling system
- See below for instructions on how to connect the flow meter to the IPM sensor and suggested flow meter models
- The water flow meter measurement data is available via the RS232 or industrial link and can be calibrated by the customer

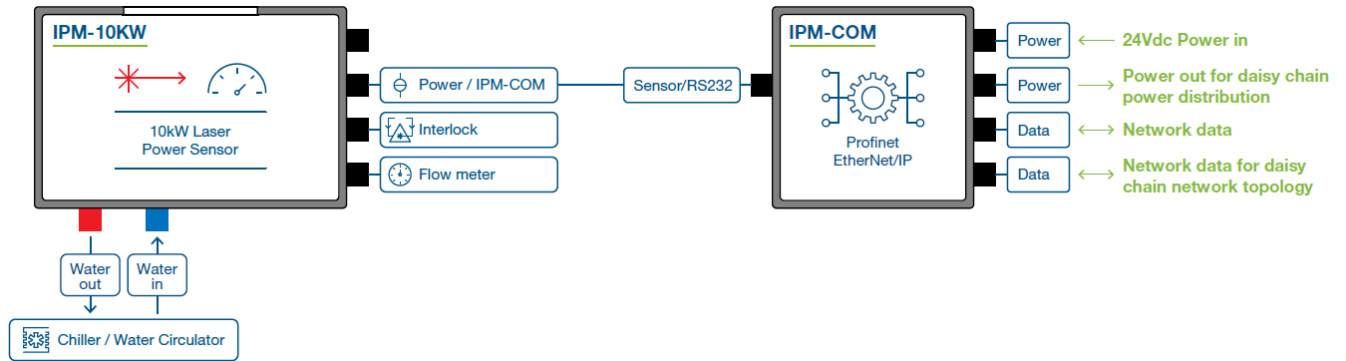
*With Water Flow Meter connected*



### 3.2.5 Integration with an industrial protocol network

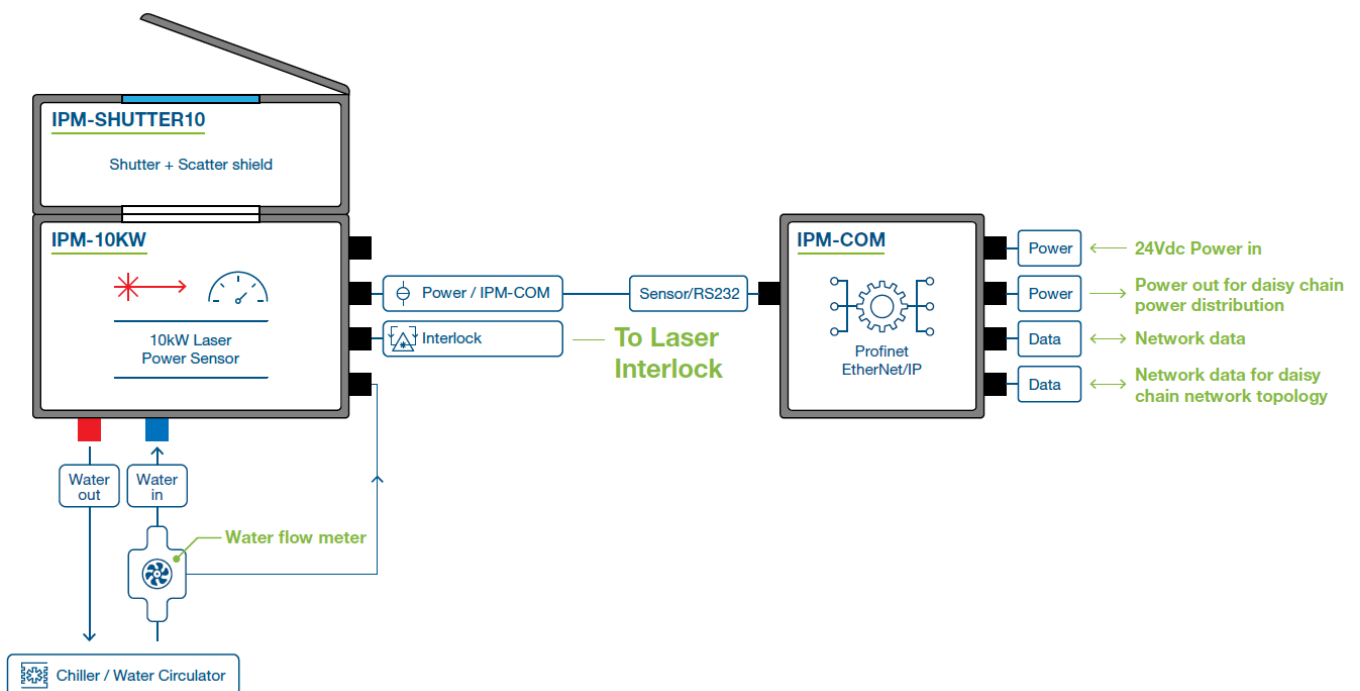
- The IPM-COM is an optional unit that converts the RS232 communication from the IPM sensor to commercial industrial communication protocols such as EtherNet/IP and Profinet
- The IPM-COM has two communication connectors and two power connectors for easy daisy chaining
- **Only one cable is required to connect the IPM-COM with the IPM sensor (supplied with the IPM-COM).**
- Power for the IPM sensor is supplied from the IPM-COM.

Using the IPM sensor with EtherNet/IP, Profinet industrial protocols



### 3.2.6 Full System Setup

Full System Setup





## 4 Details of connectors

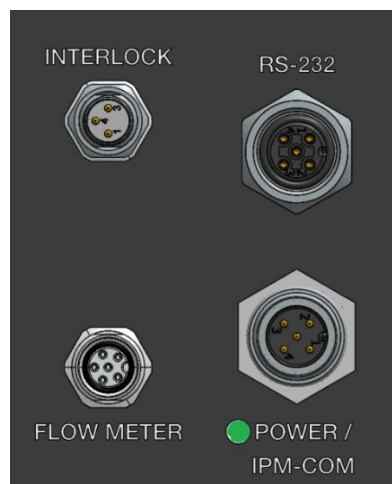
### 4.1 IPM Sensor – Connectors & Pinouts

This section provides details of the connectors on the IPM sensor.

These are the connectors and indicators provided on the IPM sensor:

- RS232, M12 female 5-pin
- Power/IPM-COM, M12 male, 5-pin
- Interlock, M8 male, 3-pin
- Interface with optional External Water Flow Meter – M8 female, 6-pin
- Green LED – power indicator

In addition a D9 connector is provided to connect with the optional shutter unit. This connector is covered by a metal plate when not in use and is not intended for customer use.

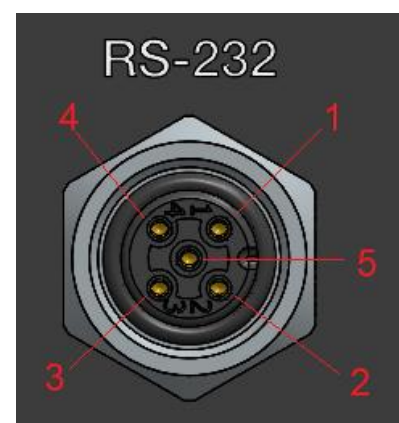


#### 4.1.1 RS232 connector

This connector is used for RS232 communications with a host PC or PLC, or for firmware upgrades of the sensor.

##### Connector Pinout:

Pin	Function
1	+24v
2	TxD (output)
3	GND
4	RxD (input)
5	N/C



**Features:**

- M12 Female 5-pin connector
- Used to connect the sensor by RS232 to a host PC or PLC.
- Intended for customers using direct RS232 communications
- Also required by customers using IPM-COM for sensor firmware updates
- Matching RS232 cable **supplied with sensor**, P/N 7Z10532

**NOTE**

This connector can also be used to supply +24v power to the sensor, but a custom connector is required, not supplied by Ophir

**NOTE**

This connector is identical to the RS232 connector on the IPM-COM unit. The RS232 cable supplied with the sensor can be used for the IPM-COM firmware upgrades as well.

**4.1.2 Power / IPM-COM connector**

This connector is used for connection to the IPM-COM unit; or to supply +24v power to the sensor (when used with a direct RS232 connection)

**Pinout:**

Pin	Function
1	+24v
2	RxD (input)
3	GND
4	TxD (output)
5	N/C

**Features:**

- M12 Male 5-pin connector
- When using with RS232: Used to supply +24v power
- When using with IPM-COM: Used to connect the sensor to the IPM-COM unit & supply power from the IPM-COM
- Matching cable for power, **supplied with IPM sensor**, P/N 7E01519
- Matching cable for IPM-COM, **supplied with IPM-COM**, P/N 7E01540

### 4.1.3 Interlock connector

This connector is used to provide an interlock interface to the laser

#### Pinout:

Pin	Function	Color <sup>(1)</sup>
1	COM (Common)	Brown
3	NO (Normally Open)	Blue
4	NC (Normally Closed)	Black



**Note 1:** "Color" refers to wire coloring on optional interlock cable

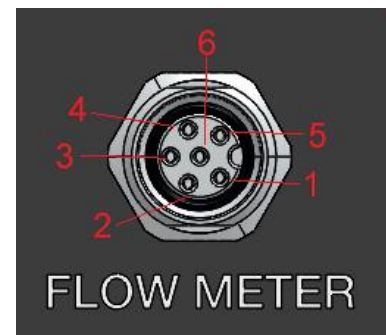
#### Features:

- M8 Male, 3-pin
- In normal state, pin 1 (COM) is connected to pin 4 (NC) and disconnected from pin 3 (NO)
- In error state, pin 1 (COM) is connected to pin 3 (NO) and disconnected from pin 4 (NC)
- Error state is under software control, can include overheating or water flow rate too low
- Matching cable for interlock to flying leads, not supplied, P/N 7E01513

### 4.1.4 Interface with optional Water Flow Meter

This connector provides an interface to an external water flow meter supplied by the customer

Pin	Function	Color <sup>(1)</sup>
1	Pickup1 (analog input)	Brown
2	Pickup2 (analog input)	Grey
3	+5v output	Black
4	Pulse Input (digital)	Blue
5	GND	White
6	Shield	Pink



**Note 1:** "Color" refers to wire coloring on optional water flow meter cable

#### Features:

- M8 Female, 6-pin
- Supports two types of water flow meter: Analog and Digital
- Analog: Connect to Pickup1 and Pickup2; the input signal should be an analog sine wave, frequency proportional to water flow rate, min 25mV pk-pk, max 3.3v pk-pk
- Digital: Connect to +5v output to supply power to water flow meter; connect Pulse Input to flow meter output pin; frequency proportional to water flow rate, input min 2.0v, max 5.5v
- Matching cable for water flow meter to flying leads, not supplied, P/N 7E01536

**NOTE** Different manufacturers number the M8 pins in different ways, beware with the pinout

## Recommended vendors of Water Flow Meters:

See GEMS - [www.gemssensors.com](http://www.gemssensors.com)

See GPI - [www.gpimeters.com](http://www.gpimeters.com)

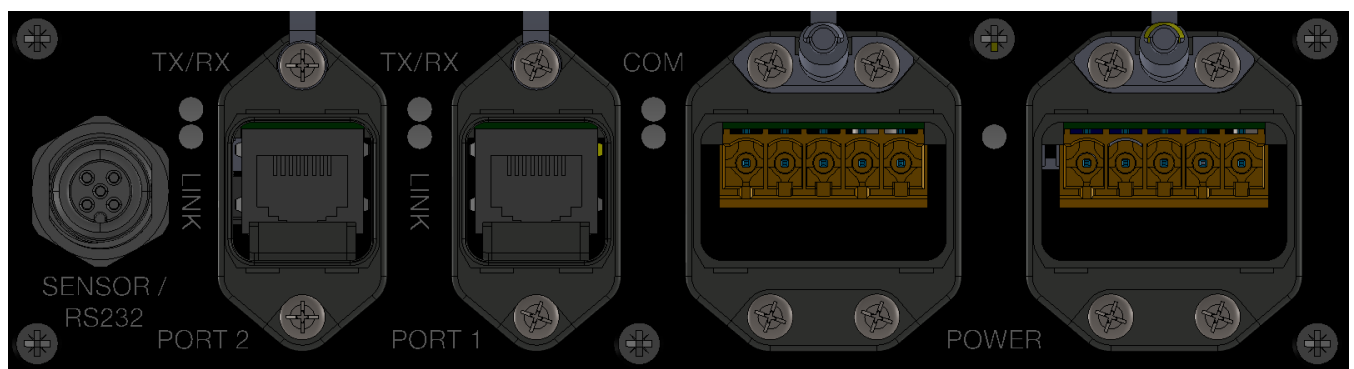
See OMEGA – [www.omega.com](http://www.omega.com)

## 4.2 IPM-COM – Connectors & Pinouts

This section provides details of the connectors provided on the IPM-COM and IPM-COM-M units.

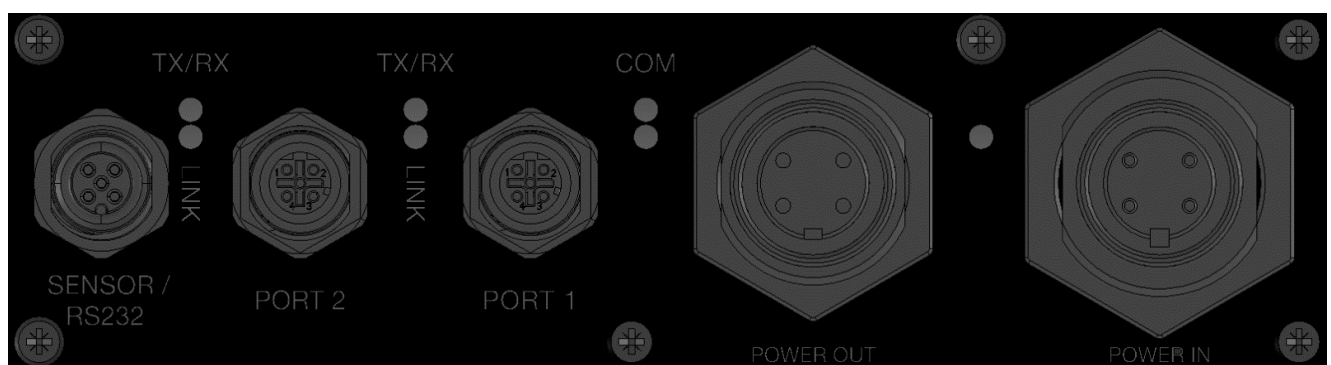
These are the connectors and indicators provided on the IPM-COM unit:

- Sensor / RS232, M12 female 5-pin
- Two AIDA Ethernet connectors, Port 1 and Port 2
- Two AIDA power connectors
- Multiple LED indicators showing connection and communications



These are the connectors and indicators provided on the IPM-COM-M unit:

- Sensor / RS232, M12 female 5-pin
- Two M12-D Ethernet connectors, Port 1 and Port 2
- Power Out Mini 7/8" Female 4-pin connector
- Power In Mini 7/8" Male 4-pin connector
- Multiple LED indicators showing connection and communications



#### 4.2.1 Sensor / RS232 connector (both types)

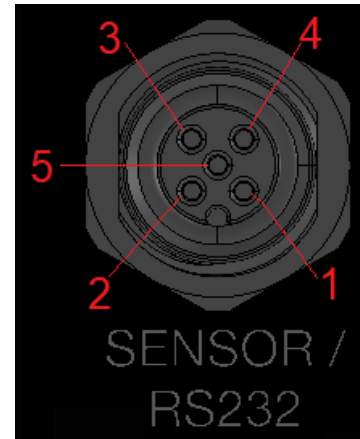
This connector is used to connect to the IPM sensor, and for RS232 communications with a host PC for firmware upgrades of the IPM-COM.

##### Connector Pinout:

Pin	Function
1	+24v
2	TxD (output)
3	GND
4	RxD (input)
5	N/C

##### Features:

- M12 Female 5-pin connector
- Used to connect the sensor by RS232 to a host PC for firmware upgrade
- Matching RS232 cable **supplied with sensor**, P/N 7Z10532



### NOTE

This connector is identical to the RS232 connector on the IPM sensor. The RS232 cable supplied with the sensor can be used for the IPM-COM firmware upgrades as well.

#### 4.2.2 AIDA Ethernet Connector

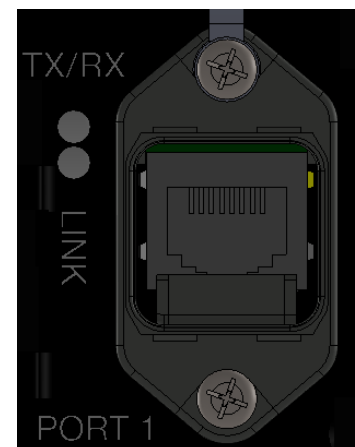
This connector provides the Profinet connection

##### Connector Pinout:

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

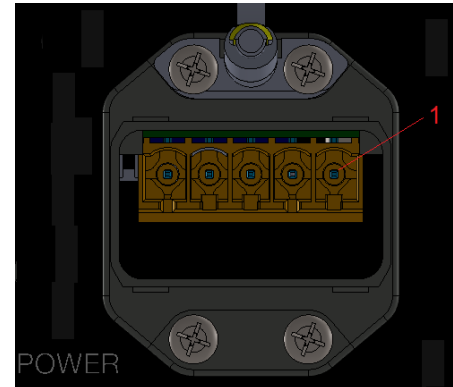
##### Features:

- AIDA RJ45 socket
- Profinet connection
- Two sockets (Port 2, Port 1) to allow daisy chaining



### 4.2.3 AIDA Power Connector

This connector is used to provide +24v power to the IPM-COM



#### Connector Pinout:

Pin	Function	Color
1	+24v input	Brown
2	GND	Black
3	+24v actuator (not connected to IPM-COM, connected to second connector only) <sup>(1)</sup>	Blue
4	Actuator GND (not connected to IPM-COM, connected to second connector only) <sup>(1)</sup>	Grey
5	Shield	Green-Yellow

**Note 1:** The “Actuator” pins are not connected internally to the IPM-COM circuit but are connected to each other internally (power-in pins 3, 4 are connected to power-out pins 3, 4). They are used for daisy chaining.

#### Features:

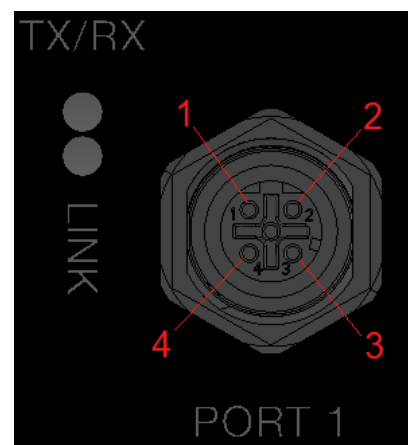
- AIDA Power male connector
- Actuator pins are not connected to IPM-COM, connected to second connector only
- Two connectors provided to allow daisy chaining (one input, one output to next device)
- Matching power cable, AIDA to flying leads, not supplied, P/N 7Z10458A

### 4.2.4 M12-D Ethernet Connector (IPM-COM-M)

This connector provides the EtherNet/IP connection for the IPM-COM-M unit.

#### Connector Pinout:

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



#### Features:

- M12-D female connector
- EtherNet/IP connection
- Two connectors (Port 2, Port 1) to allow daisy chaining
- Matching ethernet cable, M12D to RJ45 plug, 3m, not supplied, P/N 7E11211

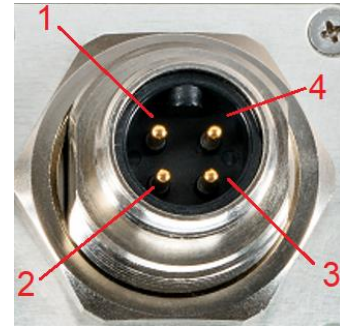


#### 4.2.5 Power In Mini 7/8" Male Connector (IPM-COM-M)

This connector is the power input connector, providing +24v power to the IPM-COM-M unit  
(for clarity, this connector and the next are shown in a different format to the others)

##### Connector Pinout:

Pin	Function	Color
1	+24v actuator <sup>(1)</sup>	Brown
2	+24v input	White
3	GND	Blue
4	Actuator GND <sup>(1)</sup>	Black



**Note 1:** The "Actuator" pins are not connected internally to the IPM-COM circuit but are connected to each other internally (power-in pins 3, 4 are connected to power-out pins 3, 4). They are used for daisy chaining.

##### Features:

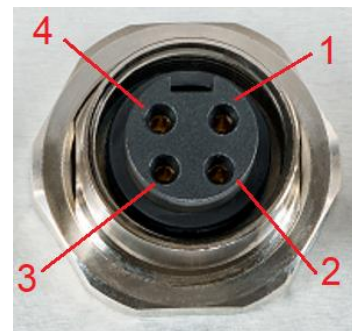
- Mini 7/8" male 4-pin power input connector
- Provides +24v input to IPM-COM-M
- Actuator pins are not connected to IPM-COM-M, connected to second connector only
- Two connectors (male input, female output) provided to allow daisy chaining
- Matching power cable, Mini 7/8" female to flying leads, 2m, not supplied, P/N 7E01535

#### 4.2.6 Power Out Mini 7/8" Female Connector (IPM-COM-M)

This connector provides power output for daisy chaining to another device

##### Connector Pinout:

Pin	Function	Color
1	+24v actuator <sup>(1)</sup>	Brown
2	+24v input	White
3	GND	Blue
4	Actuator GND	Black



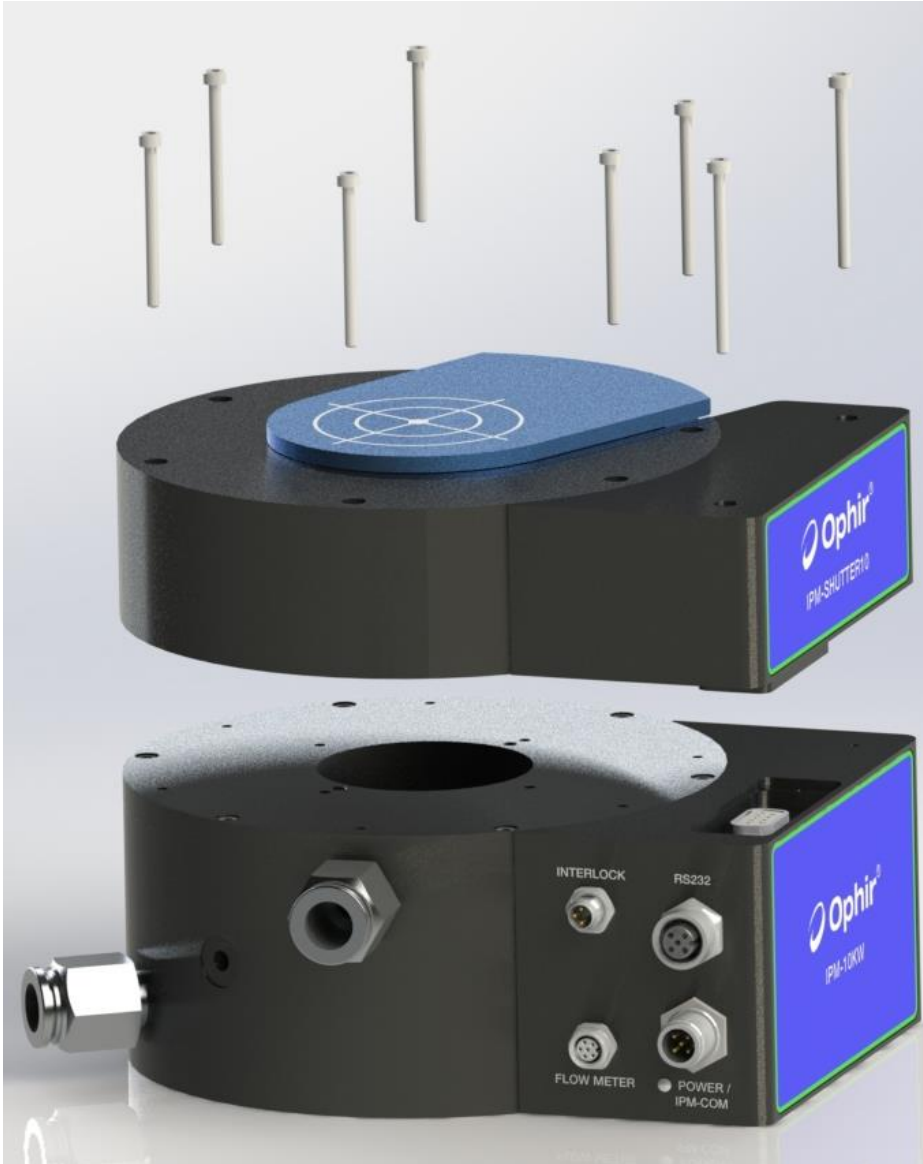
**Note 1:** The "Actuator" pins are not connected internally to the IPM-COM circuit but are connected to each other internally (power-in pins 3, 4 are connected to power-out pins 3, 4). They are used for daisy chaining.

##### Features:

- Mini 7/8" female 4-pin power output connector
- Supplies +24v output to another device
- Actuator pins are not connected to IPM-COM-M, connected to first connector only
- Two connectors (male input, female output) provided to allow daisy chaining
- No matching cable is available from Ophir

### 4.3 Assembly of the Shutter Unit onto the IPM sensor

The customer can assemble the IPM-SHUTTER10 unit on the sensor by themselves. Below is an illustration of how this is done



#### NOTE

The IPM SHUTTER unit contains a built-in scatter shield which effects the calibration of the sensor. The user should choose the wavelength option depending on the presence of the shutter unit.

As the sensor unit contains a scatter shield, the customer should ensure that the correct laser option is chosen depending on the presence or absence of the shutter unit.

- Without the shutter unit installed, the options chosen should be either **NIR** or **CO2**
- With the shutter unit installed, the options chosen should be either **NIRS** or **CO2S**.

See the specification sheet for more details

## 5 Firmware Upgrade for IPM Sensor and IPM-COM

This section provides basic information about firmware upgrades for the IPM sensor unit and IPM-COM unit. Firmware upgrades for both units are supported by Ophir StarLab software. **For full details, see the StarLab User Manual.**

### 5.1 Connections

Firmware upgrades are performed using the RS232 cable supplied with the IPM sensor (D9 female to M12-5 female). The same cable supports also the IPM-COM unit. For both sensor and IPM-COM, the unit should be powered with 24v using a separate connector (as appropriate for each unit), see above for details of power connectors.

**NOTE** During the firmware upgrade for the IPM-COM unit, the IPM-COM needs to be disconnected from the sensor, as the same M12 connector is used.

### 5.2 StarLab instructions

#### 5.2.1 Preparations

**StarLab version 3.72 build 3 (or above) is required for firmware upgrade of the IPM.**

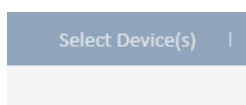
The latest StarLab can be downloaded from the Ophir Website, search for the StarLab page.

If not included with the StarLab installation, the latest firmware upgrade BIN file can be downloaded from the Ophir Website, search for the IPM page. The file should be placed in the "firmware" folder under the StarLab installation folder, for example:

C:\Program Files\Ophir Optonics\StarLab 3.72\firmware\

#### 5.2.2 Connecting to the IPM:

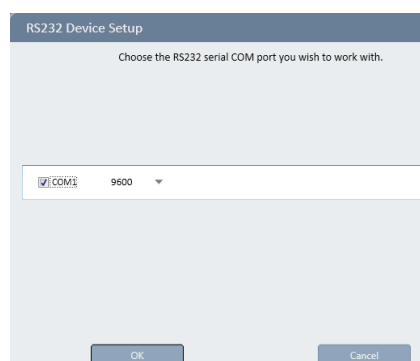
Start StarLab software and select the "Select Devices" icon from the main menu at the top right of the screen.



Using the RS232 control, enable "Use RS232 Devices".

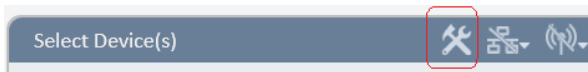


Choose "Configure RS232 Devices". Select 9600 Baud and choose the correct COM port number.

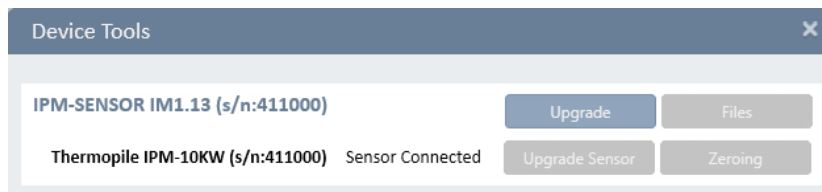


### 5.2.3 Performing firmware upgrade

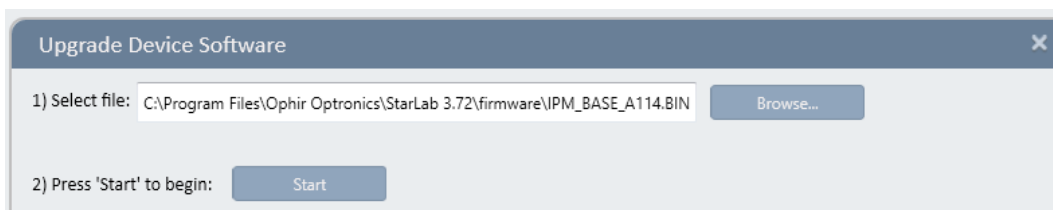
Select the Device Tools icon:



Select the "Upgrade" button:

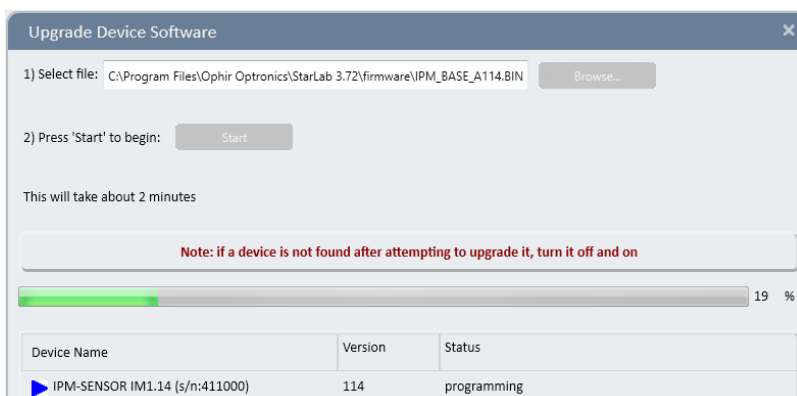


Select the firmware file (StarLab will automatically show the latest file it can find in the correct location as shown below).

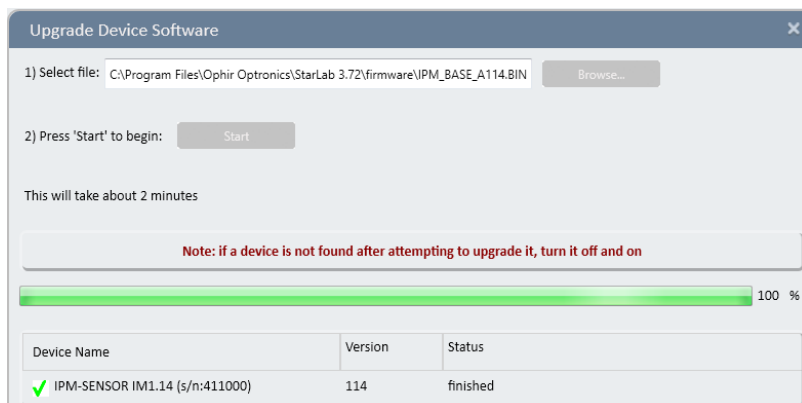


Press the "Start" button.

During the firmware upgrade, the progress and status (erasing followed by programming) will be shown on the screen:



At the end of the firmware upgrade, the progress will show 100% and the status will show "finished" . Press the "Done" button.



Firmware upgrade of the IPM-COM can be performed in the same way as the IPM sensor.

## 6 RS232 Commands

The IPM Sensor is intended to be used in one of three ways:

- Via an industrial protocol (such as Profinet, EtherNet/IP) – using the IPM-COM
- Via the "Service Portal" (see below) – using the IPM-COM
- **Via RS232 commands – with the IPM Sensor connected directly to a PC or PLC**

This chapter contains details of the RS232 commands used to control the IPM Sensor, and mentions also some commands that may be required for the IPM-COM.

*This chapter contains:*

- A summary list of the IPM Sensor RS232 Commands
- General rules about the RS232 commands
- A detailed description of all the RS232 commands
- A summary list and details of the IPM-COM specific commands

### 6.1 Summary of RS232 Commands For IPM Sensor

Name	Function	
<b>General</b>		
\$HP	No function, command to check connection	
\$RE	Reset – restarts the software inside sensor	
\$VE	Firmware Version	
\$VF	Firmware Version & Subversion	
\$II	Instrument Information – returns S/N and other information	
\$HI	Sensor ("Head") Information	
\$CC	Cover Control (Open, Close, Status)	
<b>Temperature Commands</b>		
\$RT	Body Temperature	
\$GT	Disk Temperature	
\$GL	Disk Temperature Limit	
<b>Zeroing Commands:</b>		
\$ZE	Zero - Initiate zeroing of sensor (relevant for Power Mode only)	
\$ZQ	Zero Query – check status of zeroing	
\$ZA	Zero Abort – abort zeroing	
\$ZS	Zero Save – save zeroing	



<b>Measurement Commands:</b>		
\$MM 2 3	Measurement Mode – Selects Power or Energy Measurement Mode	
\$SP	Send Power	
\$SE	Send Energy	
\$ES	Energy Status	
\$EF	Energy Flag	
\$ET	Energy Threshold	
\$ER	Energy Ready	
\$LA	All Measurement information – returns all measurement data available on a single line	
\$GE <n>	Get Event – returns status bits and clears relevant status bits	
\$FG	Flags – returns status bits without clearing	
\$TZ	Time Stamp Zero – zeros the timestamp, allowing customer to sync timestamps	
\$CS	Continuous Send mode	
<b>Control Commands:</b>		
\$IC	Instrument Configuration	
\$HC C S R	Sensor ("Head") Configuration	
\$AR	Returns list of all power/energy scales available for present mode	
\$WN <n>	Select Measurement Scale "n"	
\$RN	Read Measurement Scale	
\$AW	All Wavelengths – returns list of all available wavelength (laser) settings	
\$WI	Wavelength Index – selects one of available wavelength (laser) settings	
<b>Water Flow Rate &amp; Interlock Commands:</b>		
\$FW 1 2 3	Flow Meter Type – defines presence and type of Water Flow Meter in use	
\$FK 1 2 3	Flow Meter Control – how to use Water Flow Meter, if connected	
\$FL 1 2 <n>	Flow Meter Limits – defines Min and Max limits for Water Flow Meter	
\$FN <n>	Flow Meter Calibration	
\$FV	Water Flow rate (in Liters/minute)	
\$IA	Interlock Activated – queries or clears the interlock status	
<b>Calibration Commands:</b>		
\$CQ	Calibration Query / Adjust	
\$RQ	Response Tweak Query / Adjust	
\$CD	Calibration Date	
\$NC	Next Calibration Date	
<b>Misc. Commands</b>		
\$CN	Catalog Number – returns sensor Part Number (P/N)	
\$MX <n>	Max/Min Limits for a range of parameters	
\$BD	Baud Rate – returns fixed baud rate 9600	
\$MA 1 2	Mains Setting Query or Set (50Hz or 60Hz region)	
\$SI	Send Measurement Units (J or W)	
\$HT	Head Type – returns type of sensor (TH) and measurement units (J or W)	

\$SX	Send Max Scale – return full scale measurement presently chosen scale	
\$LM	Limits for Go/No-Go feature	
\$GG	Get status bit values for Go/No-Go feature	

## 6.2 Details of RS232 Commands for IPM Sensor

These rules apply for all the RS232 Commands available for the sensor. Any exceptions will be listed separately below.

- All commands and replies use ASCII symbols
- All user commands begin with the "\$" (dollar) symbol (ASCII code 0x24)
- All user commands consist of a two letter code, in either upper or lower case ASCII characters (e.g. VE or ve)
- All user commands should be terminated by a "Carriage Return" symbol "[CR]" (ASCII code 13, Hex 0x0D, \r in "C" code)
- User commands can optionally contain parameters in addition to the two letter code (details below)
- The first parameter of a command can be attached to the command code 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] (where "[LF]" is the "Line Feed" character, ASCII code 10, Hex 0x0A, \n in "C" code – it is omitted in the text below for simplicity)
- Replies begin with a star "\*" symbol (ASCII code 0x2A), if there are no errors
- Replies begin with a question mark "?" symbol (ASCII code 0x3F) if there is any kind of error: for example, the command is unknown ("?UC"), or if it contains an incorrect parameter ("?PARAM ERROR")
- 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.

*In the section below the triangle bracket "< >" symbols surrounding text indicate a parameter to be filled in by the user as appropriate or a value returned by the device as appropriate.*

### 6.2.1 General

#### \$HP – Communications Check

This command does nothing to the device but returns a reply "\*". It can be used to check communications with the device.

*Example:*

\$HP[CR] -> \*[CR] [LF]

#### \$RE – Reset

Resets the sensor's firmware. Using this command is equivalent to powering the device off and on again. The device acknowledges by replying "\*" before performing the reset.

### \$VE – Firmware Version

Returns a two-letter code identifying the sensor and the firmware version running in the sensor

*Example:*

\$VE[CR] -> \*IM1.14[CR] (IPM sensor)

\$VE[CR] -> \*DM1.14[CR] (IPM sensor, in downloader mode during firmware upgrade)

\$VE[CR] -> \*IC1.07[CR] (IPM-COM unit)

\$VE[CR] -> \*PD1.07[CR] (IPM-COM, in downloader mode during firmware upgrade)

### \$VF – Firmware Version & Subversion

Same as \$VE but returns version and subversion

*Example:*

\$VF[CR] -> \*IM1.14.00[CR] (IPM sensor)

### \$II – Instrument Information

Returns general information about the sensor family: a 4 letter code IPMR, the S/N of the sensor, and a general description "IPM-BASE-UNIT". If sent to the IPM-COM unit, different information will be returned, relating to the IPM-COM unit itself. The 4 letter code will be IPMC and the description will be "IPM-COM-UNIT".

*Example:*

\$II[CR] -> \* IPMR 3031234 IPM-BASE-UNIT[CR] (details of the attached IPM Sensor)

\$II[CR] -> \* IPMC 700004 IPM-COM-UNIT[CR] (details of the attached IPM-COM unit, different S/N and identity)

### \$HI – Sensor Information

Returns specific information about the sensor: a 2 letter code TH indicating the sensor class, the S/N of the sensor, the name of the sensor, and a character code indicating the capabilities of the sensor (for factory use).

*Example:*

\$II[CR] -> \* TH 3031234 IPM-10KW 00400003[CR]

### \$CC – Cover Control

Queries status of optional shutter unit, or controls cover position if optional shutter unit is installed

*Example:*

\$CC 0[CR] -> (query, see below)

\$CC 1[CR] -> \*OK[CR] (closes cover)

\$CC 2[CR] -> \*OK[CR] (opens cover)

\$CC 1[CR] -> \*4 NOT PRESENT[CR] (if shutter unit not installed)

\$CC 2[CR] -> \*4 NOT PRESENT[CR] (if shutter unit not installed)

\$CC[CR] -> \*1 C (query, cover closed)

\$CC[CR] -> \*2 O (query, cover open)

\$CC[CR] -> \*3 M (query, cover in motion, or cover stuck between open and closed positions)

\$CC[CR] -> \*4 NOT PRESENT (query, shutter unit not installed)

## 6.2.2 Temperature Commands

### \$RT – Body Temperature

Queries sensor's body temperature and max allowed body temperature.

*Example:*

\$RT[CR] -> \*28.9 60[CR] (returns body temperature 28.9 degC, max defined body temperature 60 degC)

*Notes:*

With adequate water cooling, the body temperature will normally be close to constant even if the sensor is measuring high power.

### \$GT – Disk Temperature

Queries sensor's disk temperature.

*Example:*

\$GT[CR] -> \*154.6[CR] (returns disk temperature 154.6 degC)

*Notes:*

It is normal that the disk will get hot during power measurements. The disk temperature should not exceed the maximum defined by the \$MX 8 command. The user can optionally define a lower error limit to trigger the interlock, see \$GL command).

### \$GL – Disk Temperature Limit

This commands allows the user to change the max disk temperature limit, above which an error can be registered in the status bits and the interlock can optionally be triggered. The max disk temperature set by the user cannot exceed the factory maximum defined by the \$MX 8 command, see below, but it can be set lower than that limit if required. By default, the user limit and the factory limit are the same. The command requires three parameters, T1, T2, T3, but in practice only T2 is relevant. T2 defines the user disk temperature limit. The values of T1 and T3 are not relevant, but for the command to succeed, T2 must be larger than T1, and T3 must be smaller than T1.

*Example:*

\$GL[CR] -> \*170 195 100[CR] (returns present values – T1=170, T2=195, T3=100)

\$GL 170 190 100[CR] -> \*OK (T1=170, T2=190, T3=100, where T2 > T1, T3 < T1; otherwise an error will be returned)

*Possible responses:*

\*OK[CR] (command succeeded)

?PARAM ERROR: T1 HIGHER THAN T2[CR]

?PARAM ERROR: T3 HIGHER THAN T2[CR]

?PARAM ERROR: T3 HIGHER THAN T1[CR]

?PARAM ERROR: T2 HIGHER THAN FACTORY MAX[CR]

?PARAM ERROR: T1 INVALID VALUE[CR] (if the specified parameter value is below 1 degC)

?PARAM ERROR[CR] (one of the parameters entered is not a valid number, for example xyz)

(in the case of any error response, the present values will remain unchanged)

## 6.2.3 Zeroing Commands

### \$ZE – Zero Sensor

Initiates zeroing of the IPM sensor. After sending this command, zeroing will be in progress for approximately 30s during which most other commands, except \$ZQ or \$HP, should not be used, as the sensor is not functioning in its normal mode. See also \$ZQ, \$ZA, \$ZS.

*Example:*

\$ZE[CR] -> \*[CR]

#### Notes:

Zeroing should be performed with the sensor covered or with the laser switched off. For best performance, zero the sensor after it has reached a steady temperature and after the cooling water temperature and flow are stable.

#### \$ZQ – Zero Query

Reports status of most recent zeroing session of sensor. This command can be used after \$ZE, and before \$ZS, to check the status of the zeroing session before saving the values using \$ZS.

##### Example:

\$ZQ[CR] -> (reports zeroing status)

\*ZEROING NOT STARTED[CR] (zero has not yet been performed since power-up or since last \$RE command)

\*ZEROING IN PROGRESS[CR] (zeroing is still in progress)

\*ZEROING FAILED[CR] (zeroing failed - a bad or non-zero value was measured)

\*ZEROING COMPLETED[CR] (zeroing completed successfully and should now be saved using \$ZS)

#### \$ZS – Zero Save

Saves the values of last zero into local EEROM memory of sensor. Without sending this command, zero parameters will default back to previously saved values after next power up of the sensor.

##### Example:

\$ZS[CR] -> (returns status)

\*SAVED[CR] (zero was successfully saved)

\*UNCHANGED[CR] (no new zero data is available since last save)

\*ZEROING NOT STARTED[CR] (no zero has been performed since last power up or reset)

#### \$ZA – Zero Abort

Aborts zeroing.

##### Example:

\$ZA[CR] -> (returns status)

\*ZEROING NOT STARTED[CR] (no zero is in progress)

\*ZEROING ABORTED (zero in progress was aborted)

### 6.2.4 Measurement Commands

#### \$MM – Measurement Mode

Selects the measurement mode on the sensor. Options are Power (2) or Energy (3).

In **Power** mode the sensor measures CW power in Watts – usually the default measurement mode of the sensor.

In **Energy** mode the sensor measures single-shot energy in Joules.

Parameter 0 or no parameter are a query; parameter 1 is used to take the sensor out of measurement mode.

Use the **\$HC S** command to save the new setting as the default startup setting.

##### Example:

\$MM 2[CR] -> \*2 2 3 14[CR] (set to Power mode, code 2; responds with option chosen (2) and all 3 choices)

\$MM 3[CR] -> \*3 2 3 14[CR] (set to Energy mode, code 3; responds with option chosen (3) and all 3 choices)

\$MM[CR] -> \*3 2 3 14[CR] (query, responds with option chosen (3) and all 3 choices)

\$MM 0[CR] -> \*3 2 3 14[CR] (query, responds with option chosen (3) and all 3 choices)

\$MM 1[CR] -> \*1 2 3 14[CR] (sets mode 1, no measurements; responds with option chosen (1) and all 3 choices)



### \$SP – Send Power:

Returns the latest power measurement from the sensor, when it becomes available. The same measurement is never returned twice. Measurements can be obtained at 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, the exact format depends on the chosen power scale. If the power measurement exceeds 110% of the chosen power scale, the response will be "OVER".

*Example:*

\$SP[CR] -> \*1.234E3[CR] (measurement is 1.234kW)

\$SP[CR] -> \*OVER[CR] (measurement is above 110% of chosen power scale)

### \$SE – Send Energy

Returns latest energy value measured in Joules, or "OVER" if last energy measurement was over 110% of the chosen energy scale, or if the measurement saturated during the energy measurement. If the sensor is not in Energy mode, an error message will be returned. The Energy value is returned in "E" format similar to the \$SP command. The exact format depends on the chosen energy scale. Unlike the \$SP command, the \$SE command will repeatedly return the last energy measurement until a new energy measurement is completed. The \$EF command can be used to determine if a new energy measurement is available since the last time \$SE was used. See section below for suggestions on using this command under software control in combination with the other energy commands.

*Example:*

\$SE[CR] -> \*1.2345E1[CR] (Energy in Joules)

\$SE[CR] -> \*OVER[CR] (Energy measurement is above 110% of chosen energy scale, or saturation)

\$SE[CR] -> ?NOT MEASURING ENERGY[CR] (sensor is not in energy mode)

### \$ES - Energy Status

Returns status of energy measurements at this moment. Responses can be one of the following. Some of the responses will appear only once per measurement cycle.

- "NOT IN ENERGY" if not measuring energy (see \$MM 3)
- "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 energy pulse to arrive
- "INT" if integrating the present energy pulse after a pulse arrives and triggers a new measurement
- "VALUE" if a valid value is available (only once per measurement cycle)
- "TIMEOUT" if energy integration failed (power did not drop low enough to end measurement; once per cycle)
- "FINISH" after new measurement is available, before new energy pulses are allowed

*Example:*

\$ES[CR] -> \*WAIT[CR] (one of responses above)

\$ES[CR] -> ?NOT MEASURING ENERGY[CR] (sensor is not in energy mode)

### \$EF – Energy Flag

Used to determine if there has been a new energy measurement since last \$SE Send Energy command was processed. Responds "1" if a new measurement in waiting, or "0" if not. When starting up energy measurements, it is recommended to send the \$EF command to check there is no "residual" energy



measurement already present, and if the response is "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.

*Example:*

\$EF[CR] -> \*1[CR] (returns 1 if a new measurement is present, or 0 if not)

\$EF[CR] -> ?NOT MEASURING ENERGY[CR] (sensor is not in energy mode)

### \$ET – Energy Threshold

Queries or sets energy threshold. Allows the user to adjust the internal trigger level used for detecting the start of an energy pulse between 3 possible levels (1=Low, 2=Medium, 3=High). Setting the threshold low will make the sensor more sensitive to detecting energy pulses but is more likely to cause false triggers in noisy environments. Setting the threshold high will make the sensor more immune to noise but may prevent triggering of very small energy pulses. Sending a parameter 0 or no parameter is a query. The default threshold level is Medium; Low is 1/3 default; High is 3x default.

*Example:*

\$ET 1[CR] -> \*1 LOW MEDIUM HIGH[CR] (sets energy threshold to LOW level)

\$ET 2[CR] -> \*2 LOW MEDIUM HIGH[CR] (sets energy threshold to MEDIUM level)

\$ET 3[CR] -> \*3 LOW MEDIUM HIGH[CR] (sets energy threshold to HIGH level)

\$ET 4[CR] -> ?BAD PARAM[CR] (value out of range)

\$ET 0[CR] -> \*2 LOW MEDIUM HIGH[CR] (parameter 1, query)

\$ET[CR] -> \*2 LOW MEDIUM HIGH[CR] (no parameter, query)

### \$ER – Energy Ready

Queries the sensor to see if it is ready to receive a new energy measurement, returns "1" for ready or "0" for not ready. When first entering energy mode, or after changing the energy scale, the sensor may not immediately be ready to receive a new energy pulse. During or immediately after an energy measurement, the sensor also will not be ready to receive a new energy pulse. In both of these cases, the command will return "0".

*Example:*

\$ER[CR] -> \*1[CR] (sensor is ready for a new energy measurement)

\$ER[CR] -> \*0[CR] (sensor is NOT ready for a new energy measurement)

\$ER[CR] -> ?NOT MEASURING ENERGY[CR] (sensor is not in energy mode)

### NOTES ON MEASURING ENERGY:

Assuming that the support software is started after the sensor has been powered up, the correct sequence for working is as follows:

- Set the sensor to the lowest energy scale that will not result in "OVER".
- Establish communications with the sensor using the \$HP command and looking for the response "\*[CR]" (see above)
- Before firing the laser for the first time, send the \$EF command and check its response. If the response is "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.
- Send \$ER command to determine if the sensor is ready to receive the first energy pulse. When ready, fire the laser.
- Send 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.

- When 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 value measured is OVER, then tell the application that this value was 'over', and that it should change to a higher energy scale before continuing (or reduce the energy of the laser).
- Send the \$ER command to determine if the sensor is ready to receive the next energy pulse. When ready, fire the laser.
- Send the \$EF command until seeing "1" again, and then continue as above.
- Note: After changing energy scale using \$WN command, the sensor takes several seconds to settle before allowing energy measurements to resume. During this period, the \$ER command will return 0.

### \$LA – All Measurement information

This command returns all relevant information about the sensor in a single line, using a standard format, in command/reply mode. It is intended to be used once per second to receive updates from the sensor. Each parameter is separated by easily identifiable flags such as P, E, W.

#### Format of \$LA response:

\*<power> P <not used> E <energy> W <pulse width in secs> TEMP <disk temperature> FIPM <flags> FLOW <flow rate> T <timestamp in us> M <multiplier> <checksum>

#### Parameters:

First parameter = always the present CW power, in all modes, in units of mW

P = always returns 0 (reserved for future use)

E = Energy when in Energy Mode, or "0" when in Power Mode, in mJ

W = "0" in Energy or Power Mode (reserved for future use).

TEMP = disk temperature in degC x 10 for example 453 = 45.3 degC

FIPM = Flags, returns values from status register 32 bits, 8 ASCII characters as hex for example "00000024" (see details below, \$FG, \$GE commands, 32-bit Status Register defined for Industrial Protocol)

FLOW = flow rate in mL/minute; if water flow meter not present or disabled, will return "0"

T = timestamp (32-bit value in microseconds, wraps around exactly every 4000 seconds – as 8 char Hex value)

M = multiplier, fixed value indicating the units used for power/energy values, default is 1 indicating mW, mJ units.

[in future sensors if the value of M is different, its meaning is: 0=W or J, 1=mW or mJ, 2 = uW or uJ, 3 = nW or nJ]

Last Parameter = CHECKSUM, a 2 character Hex value calculated as sum of all bytes in reply excluding itself and final [CR] symbol.

#### Examples:

Power Mode – P, E, W return 0:

\*1234567 P 0 E 0 W 0 TEMP 456 FIPM 1A2B3C4D FLOW 1234 T 1C3D56E8 M 1 8A[CR]

Energy Mode – P, W return 0:

After measurement: \*1234567 P 0 E 765432 W 0 TEMP 456 FIPM 1A2B3C4D FLOW 1234 T 1C3D56E8 M 1 8A[CR]

After trigger: \*1234567 P 0 E 0 W 0 TEMP 456 FIPM 1A2B3C4D FLOW 1234 T 1C3D56E8 M 1 8A[CR]

#### Notes on Timestamp values:

##### General:

The timestamp is intended to provide the host application with information about the timing of events within the sensor, allowing sync with other events or other sensors.

The timestamp is a 32-bit value representing time in microseconds since the time stamp was initiated (at power up, or after a \$TZ command). The timestamp is delivered as an 8 character value in HEX. After reaching the value of 3,999,999,999 microseconds (~66.667 minutes), the timestamp clocks back around to zero. It is up to the host software to allow for this using its own internal clock to determine which cycle of 66.667 minutes we are in.

#### *ENERGY mode:*

After an energy pulse the \$LA command will return the last measurement and the timestamp when it was triggered.

After a new trigger, BEFORE we have the new measurement, it will send energy=0.0 and timestamp=0. Before the first trigger, it will send zeroes. If there is a change in scale, it will send zeros

#### *In POWER mode:*

Will always return the time of the last measurement according to 15 times per second measurement.

### **\$GE – Get Event [IPM Sensor or IPM-COM]**

Returns Status Register "Flags" as an 8 character HEX value and clears relevant status bits according to parameter sent. Returns the flags before clearing them. The parameters are controlled as a bit map. See below chapter on "Industrial Protocol Registers" for more details on the Status Register.

#### *Parameters:*

0 or (no parameter) – clear ALL bits.

1 – clear only the ACK bit (*not relevant for IPM sensor – will not clear any bits*)

2 – will clear Error bits

4 – will clear the Event bits

3 – will clear ACK and Error bits (= combination of options 1 & 2)

7 – will clear ALL bits (= combination of options 1 & 2 & 4)

#### *Example:*

\$GE 0[CR] -> \*00000024[CR] (returns flag and then clears all relevant bits)

### **\$FG – Flags**

Returns Status Register "Flags", works the same way as \$GE but without clearing any flags

#### *Example:*

\$FG[CR] -> \*00000024[CR] (returns flags and does not clear any bits)

### **\$TZ – Timestamp Zero**

This command zeros the timestamp value inside the sensor. See more details above under \$LA command. Once zeroed, the timestamp begins counting again from zero.

\$TZ[CR]-> \*OK[CR] (zeros the timestamp)

### **\$CS - Continuous Send mode**

In comparison 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 host controller or PC without being specifically requested to. This mode can sometimes make the software support easier inside the host software application, 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 \$CS 2 and is terminated by sending \$CS 1 or any other command. Once Continuous Send mode is stopped, the receive buffer inside the host device must be flushed before trying to send more commands to the device, otherwise commands will be out of sync with replies.

#### *Example:*

\$CS 2[CR] -> \*STARTED[CR] (returns "STARTED" and then CS mode commences)

\$CS 1[CR] -> \*STOPPED[CR] (returns "STOPPED" after each \$CS 1 command even if CS mode was already stopped)

\$CS[CR] -> \*1[CR] (query, can be sent only when NOT in CS mode; sending while in CS mode will stop CS mode)

#### Continuous Send - Power Mode:

When measuring power, data is sent at the measurement rate of the device (15Hz). If the power is overrange then "OVER" is sent. Data will be sent with 4 significant digits with a timestamp. Once every second, temperature and status data will be sent on a separate line of data, including water flow data (in Liter/min) if enabled.

*Example:*

\*1.234E2 T 1EEFA440[CR] (normal power measurement)

\*OVER T 1EF0A8AB[CR] (if power is "OVER")

\*TEMP 123.0 FIPM 00000004 T 1EEF4FF1[CR] (without flow enabled)

\*TEMP 123.0 FLOW 5.67 FIPM 00000004 T 1EEF4FF1[CR] (if flow is enabled)

#### Continuous Send - Energy Mode:

When measuring energy, status or measurement data is sent once every two seconds depending on the state of the device at any given time. The device sends "WAITING" when waiting for the next energy trigger, or "SUMMING" after a trigger is received and a measurement initiated. Once the energy value is measured, its value is returned. Once a second, the temperature of the disk, water flow rate (in Liter/min) and status bits will be returned on a separate line of data.

*Example:*

\*WAITING T 1C63E3AF[CR]

\*SUMMING T 1C63E3AF[CR]

\*2.723E2 T 1C63E3AF[CR]

\*TEMP 123.0 FIPM 00000024 T 1C6E7170[CR]

\*TEMP 123.0 FLOW 5.67 FIPM 00000024 T 1C6E7170[CR]

### 6.2.5 Control Commands

#### \$IC – Instrument Configuration

Saves present configuration of sensor as startup default.. The setting that is affected by this command is the mains setting, see \$MA command. There are no parameters needed.

*Example:*

\$IC[CR] -> \*SAVED[CR]

### \$HC – Sensor ("Head") Configuration

Saves present sensor settings as startup default settings. Settings affected are **Startup** power or energy scale and wavelength index ("S" parameter; see \$WN, \$WI); **Calibration** data ("C" parameter; see \$CQ command); and **Response** time tweak ("R" parameter; see \$RQ command)

*Example:*

\$HC S[CR] -> \*SAVED[CR] (saves present scales and wavelength settings as default startup settings)

\$HC C[CR] -> \*SAVED[CR] (saves present calibration settings as default startup setting)

\$HC R[CR] -> \*SAVED[CR] (saves present response tweak as default startup setting)

\$HC[CR] -> ?PARAM ERROR[CR] (incorrect or no parameter)

### \$AR – All Scales

Returns the index of the present measurement scale selected, and a list of all available power or energy scales of sensor. In power mode, returns information about power scales. In energy mode, returns information about energy scales. The index value is defined the same way as the parameter used for the \$WN command.

*Example:*

\$AR[CR] -> \* 2 AUTO 11.0KW 6.00KW 600W [CR] (power scales, when in power mode)

\$AR[CR] -> \* 0 10.0KJ 5.00KJ 500J [CR] (energy scales, when in energy mode)

(the exact values returned may vary in the future or according to the specific sensor settings)

### \$WN – Select Measurement Scale

Selects one of the measurement scales of sensor. Parameter 0 is the highest (top) scale (least sensitive), parameter 1 is the next scale, etc. Parameter -1 is "autorange", only available for power mode. The lowest scale that can be selected can be queried using the \$AR command.

*Example:*

\$WN 0[CR] -> \*WN[CR] (selects top measurement scale)

\$WN 1[CR] -> \*WN[CR] (selects second measurement scale)

\$WN 2[CR] -> \*WN[CR] (selects third measurement scale)

\$WN -1[CR] -> \*WN[CR] (selects autorange, power mode only)

\$WN 9[CR] -> ?PARAM ERRO[CR] (invalid parameter, there is no scale 9)

### \$RN – Read Measurement Scale

Returns just the index of the present measurement scale selected. This is the same index as returned by \$AR. See also \$WN.

*Example:*

\$RN[CR] -> \*2[CR] (sensor is presently in measurement scale 2)

### \$AW – All Wavelengths

Returns a list of all available wavelength (laser) settings for the sensor, and the index of the present selected wavelength. Also indicates that the sensor contains a set of "discrete" laser points. In the example below, the index is 1, indicating that the "NIR" laser is presently selected.

*Example:*

\$AW[CR] -> \* DISCRETE 1 NIR NIRS CO2 CO2S [CR] (four laser options available, first option presently selected)

*Note:*

Laser options with the letter "S" (NIRS, CO2S) are intended to be used with the optional shutter unit installed. The other laser options (NIR, CO2) are intended to be used without the optional shutter unit.

### \$WI – Wavelength Index

Queries or selects one of available wavelength (laser) settings to use. See \$AW for more details.

*Example:*



\$WI 2[CR] -> \*[CR] (selects second laser option, "NIRS")  
 \$WI[CR] -> \*2[CR] (query, second laser option selected, "NIRS")  
 \$WI 5[CR] -> ?PARAM ERROR[CR] (bad parameter, there is no laser option 5)

### 6.2.6 Water Flow Rate & Interlock Commands

#### \$FW - Flow Meter Type

This command allows the user to define whether a Water Flow Meter is attached to the sensor, and if so which type. Two types of flow meter are supported, analog and digital. The analog type of flow meter generates a sine wave with frequency proportional to flow rate, and uses 2 pins. The digital type produces a digital logic signal with frequency proportional to flow rate, and uses 3 pins (power, gnd, output). For pin-outs and more details, see section "Details of connectors". This command automatically saves the new setting inside the sensor, with no need to use the \$HC command.

*Examples:*

\$FW 1[CR] -> \*1 NONE DIGITAL ANALOG[CR] (selects option "NONE" - NO flow meter attached, default)  
 \$FW 2[CR] -> \*2 NONE DIGITAL ANALOG[CR] (digital interface water flow meter selected)  
 \$FW 3[CR] -> \*3 NONE DIGITAL ANALOG[CR] (analog interface water flow meter selected)  
 \$FW 0[CR] / \$FW[CR] -> \*1 NONE DIGITAL ANALOG[CR] (query – parameter 0 or no parameter)

#### \$FK – Flow Meter Control

This command defines how the sensor uses the information from the water flow meter, if attached. The three options are (1) monitor the flow rate and allow the host application to measure it; (2) monitor flow rate, and in addition update the status register if the flow rate is outside the defined limits (if it is below the minimum defined rate or above the maximum defined rate); (3) monitor and update status register, and in addition switch the interlock if the flow rate is outside the defined limits. This command automatically saves the new setting inside the sensor, with no need to use the \$HC command.

*Example:*

\$FK 1[CR] -> \*1 QUERY STATUS INTERLOCK[CR] (set to query mode, lowest control level, default)  
 \$FK 2[CR] -> \*2 QUERY STATUS INTERLOCK[CR] (set to status mode, second control level)  
 \$FK 3[CR] -> \*3 QUERY STATUS INTERLOCK[CR] (set to interlock mode, third control level)  
 \$FK[CR] / \$FK 0[CR] -> \*1 QUERY STATUS INTERLOCK[CR] (query flow meter control mode)  
 \$FK 4[CR] -> ?BAD PARAM[CR] (bad parameter, out of range)

#### \$FL – Flow Meter Limits

This command queries or sets the lower and upper limit for water flow rate, in units of **liters per minute**, with resolution of 0.001 liter/min. These limits are relevant only if using the Water Flow Meter with control level 2 or 3. See \$FK and \$FW commands. Sending the command with no parameter or a 0 queries the present values.

Sending parameter 1 and a value sets the lower limit (water flow rate must not drop below this limit). Sending parameter 2 and a value sets the upper limit (water flow rate must not be higher than this limit). The lower limit must be smaller than the upper limit. Allowed values are 0.001 to 1000 liters/min.

*Example:*

```
$FL 1 5[CR] -> *5.000 10.000[CR] (sets lower limit to 5 liter/min, upper limit was already set to 10 liter/min)
$FL 2 15[CR] -> *5.000 15.000[CR] (sets upper limit to 15 liter/min, lower limit was already set to 5 liter/min)
$FL[CR] / $FL 0[CR] -> *5.000 15.000[CR] (query)
$FL 3 10[CR] -> ?BAD PARAM (first parameter out of range, can be only 1 or 3)
$FL 1 20[CR] -> ?MIN GREATER THAN MAX[CR] (error message, cannot set lower limit above upper limit)
$FL 2 2[CR] -> ?MAX LOWER THAN MIN[CR] (error message, cannot set upper limit below lower limit)
$FL 1 0.0002[CR] -> ?TOO SMALL[CR] (error message, cannot set either value below 0.001)
$FL 2 1500[CR] -> ?TOO LARGE[CR] (error message, cannot set either value above 1000)
```

### **\$FN – Flow Meter Calibration**

This commands allows the user to define the calibration factor for the flow meter attached to the sensor, in units of pulses/liter multiplied by 10. For example, 2345.6 pulses/liter will be represented using the command as value the 23456. The value can be queried with no parameter (as setting 0 gives a ?BAD PARAM error).

*Example:*

```
$FN 23456[CR] -> *23456[CR] (sets the value to 23456, or 2345.6 pulses/liter)
$FN[CR] -> *23456[CR] (query)
$FN -3[CR] -> ?BAD PARAM[CR] (invalid value, including 0)
```

### **\$FV – Water Flow Rate**

This commands returns the water flow rate in liters/minute, assume a water flow meter is attached to the sensor, and assuming the flow meter type is set to 2 or 3. See \$FW command.

*Example:*

```
$FV[CR] -> ?NOT ATTACHED[CR] (flow meter type is set to "NONE" using $FW command)
$FV[CR] -> *0.000[CR] (flow meter type is set to 2 or 3, but no flow meter is attached, or no flow is detected)
$FV[CR] -> *4.567[CR] (water flow rate is 4.567 liter/min)
```

### **\$IA – Interlock Activated**

This command queries or clears the status of the interlock switch. The return value will be "GOOD" if the interlock is inactive, or "ERROR" if the interlock has been activated. If activated, sending \$IA 0 will clear the interlock to its inactive state, unless the error event is still ongoing.

*Example:*

```
$IA[CR] -> *GOOD[CR] (interlock is not activated)
$IA[CR] -> *ERROR[CR] (interlock is activated: temperature or flow rate out of range)
$IA[CR] -> *ERROR[CR] (interlock is activated: temperature or flow rate out of range)
$IA 0[CR] -> *GOOD[CR] (clears interlock if it was already activated)
$IA 7[CR] -> ?PARAM ERROR (parameter invalid)
```

## **6.2.7 Calibration Commands**

### **\$CQ - Calibration Query**

This command allows the user to query or adjust the sensor calibration values, either for the all the laser options together (parameter 1) or for the currently chosen laser option (parameter 2) only. Parameter 1 adjusts the overall power calibration factor when working in power mode, or the overall energy calibration factor when working in energy mode. The value entered can be an integer between 2 and 19999, equivalent to 0.0002 and 1.9999, where the value is interpreted by dividing by 10000. To set the calibration factor to 1.0000, enter the



value 10000. Setting a value above 1.0000 causes the reading to be increased, setting a value below 1.0000 causes the reading to be decreased.

## WARNING

Ophir does NOT recommend that users adjust calibration values on their own. The sensor should be returned to one of the Ophir Calibration Centers to perform adjustment of the calibration factors.

The third and fourth parameters returned by the command are the combined user and factory calibration tweaks, and the combined sensitivity in A/W of the sensor at the chosen setting and laser option. To save values that were changed as startup defaults, use the \$HC C command.

*Examples:*

\$CQ[CR] -> \*1.0100 1.0200 1.0200 0.3397E-9[CR] (query: present settings, overall sensitivity is 0.3397E-9 A/W)  
 \$CQ 1 10200[CR] -> \*1.0200 1.0200 1.0200 0.3364E-9[CR] (set overall tweak, param 1, to 1.02)  
 \$CQ 2 10300[CR] -> \*1.0200 1.0300 1.0300 0.3331E-9[CR] (set laser specific tweak, param 2, to 1.03)  
 \$CQ 2 9876[CR] -> \*1.0200 0.9876 0.9876 0.3474E-9[CR] (set laser specific tweak, param 2, to 0.9876)  
 \$CQ 3 10300[CR] -> ?PARAM ERROR[CR] (bad parameter, can only be 1 or 2)

## \$RQ – Response Tweak Query

This command allows the user to make small adjustments to the sensor's response time. The value returned (default 1.0000) can be set higher to increase the speed of response if there is a slight undershoot in response, or below 1.0000 to decrease the speed of response if there is a slight overshoot. The value entered can be an integer between 2 and 19999, equivalent to 0.0002 and 1.9999, where the value is interpreted by dividing by 10000. The \$HC R command can be used to save any changes as default startup values.

*Example:*

\$RQ[CR] -> \*1.0000[CR] (query: present value is 1.0000, default value)  
 \$RQ 10234[CR] -> \*1.0234[CR] (sets the value to 1.0234, slight increase in response time)  
 \$RQ 9876[CR] -> \*0.9876[CR] (sets the value to 0.9876, slight decrease in response time)  
 \$RQ 1000000[CR] -> \*1.9999[CR] (trying to set the value above 19999, the value will be limited to 1.9999)

## \$CD – Calibration Date

Returns sensor last calibration date in month/day/year format

*Example:*

\$CD[CR] -> \*03/31/2022[CR] (last calibration date was March 31, 2022)

## \$NC – Next Calibration Date

Returns sensor next recommended calibration date in month/day/year format

*Example:*

\$NC[CR] -> \*07/24/2023[CR] (next recommended calibration date is July 24, 2023)

## 6.2.8 Misc. Commands

### \$CN – Catalog Number

Returns the sensor's Catalog Number (Part Number, P/N). If sent to the IPM-COM, returns the IPM-COM P/N.

*Example:*

\$CN[CR] -> \*7Z07106[CR] (sensor P/N is 7Z0716)

### \$MX Max/Min Limits

Returns the maximum and minimum limits on several sensor parameters. Each parameter has its own value.

- 1 -> Multiplier value as defined for Industrial Protocol (default value=1, meaning mW / mJ values are returned)
- 2 -> Max Energy (in mJ, if multiplier = 1)
- 3 -> Min Energy (in mJ)
- 4 -> Max Power (in mW)
- 5 -> Min Power (in mW)
- 6 -> Max Pulse Width – in us
- 7 -> Min Pulse Width – in us
- 8 -> Factory Max Disk Temperature in degC

*Example:*

\$MX 1[CR] -> \*1[CR] (Multiplier value as defined for Industrial Protocol, see below – defines units as mJ, mW)  
 \$MX 2[CR] -> \*10000000[CR] (Max Energy is 10,000,000 mJ or 10kJ)  
 \$MX 3[CR] -> \*60000[CR] (Min Energy is 60,000 mJ or 60 J)  
 \$MX 4[CR] -> \*11000000[CR] (Max Power is 11,000,000 mW or 11kW)  
 \$MX 5[CR] -> \*100000[CR] (Min Power is 100,000 mW or 100W)  
 \$MX 6[CR] -> \*20000000[CR] (Max Pulse Width is 20,000,000 us or 20s, units in us regardless of "multitplier")  
 \$MX 7[CR] -> \*100[CR] (Min Pulse Width is 100 us, units in us regardless of "multitplier")  
 \$MX 8[CR] -> \*195[CR] (Factory Max Disk Temperature is 195 degC)  
 \$MX 9[CR] -> ?BAD PARAM (highest parameter supported is 8)

### \$BD – Baud Rate

Returns the RS232 Baud Rate, always defaults to 9600

*Example:*

\$BD[CR] -> \*9600[CR] (baud rate defaults to 9600)

### \$MA 0 Mains Setting

Returns or controls the "Mains Setting", 50Hz or 60Hz, depending on the local power mains frequency for the AC supply. This setting controls the sensor's internal A-to-D measurement period in order to optimally filter out signals for a 20ms (50Hz) or 16.667ms (60Hz) cycle. Setting the wrong mains setting for the region may cause slightly increased noise. Set to 1 (50Hz) or 2 (60Hz). Setting any other value will default to one of these options. Use \$IC to save as startup default setting.

*Example:*

\$MA 1[CR] -> 1 50Hz 60Hz[CR] (set mains to 50Hz region)  
 \$MA 2[CR] -> 2 50Hz 60Hz[CR] (set mains to 60Hz region)

### \$SI – Send Measurement Units

Returns sensor measurement units, J (energy mode) or W (power mode)

*Example:*

\$SI[CR] -> \*J[CR] (J, energy mode selected)  
 \$SI[CR] -> \*W[CR] (W, power mode selected)

### \$HT – Head Type

Returns code for sensor ("head") type, "TH", and either J or W depending on energy or power mode selected.

*Example:*

\$HT[CR] -> \*TH J[CR] (J, energy mode selected)  
 \$HT[CR] -> \*TH W[CR] (W, power mode selected)

### \$SX – Send Max Scale

Returns the maximum full scale measurement on the present chosen scale, either power or energy. See \$AR.

*Example:*

\$SX[CR] -> \*6.000E3[CR] (top scale chosen is 6000, 6kW power scale, index 1, second scale)

\$SX[CR] -> \*1.000E4[CR] (top scale chosen is 10000, 10kJ energy scale, index 0, top scale)

### \$LM – Set and Query User Limits for "Go/No-Go" feature

Allows the user to define two sets of lower ("Min") and upper ("Max") power level limits for the "Go/No-Go" user feature. Each set of Min/Max limits has a corresponding bit within the Status Register. When the power level is within the limits defined, the corresponding bit in the Status Register will be set high ("1"). The two sets of limits will be:

Limit Set #1 Min/Max (corresponding to Status Register Bit 18)

Limit Set #2 Min/Max (corresponding to Status Register Bit 19).

*Note:* The command sets one of the four parameters at a time. No error checking is implemented to ensure that Min is less than Max for each pair of limits.

*Example of use:*

Limit Set #1 is set to (Min=500W, Max=1000W)

Limit Set #2 is set to (Min=3000W, Max=4000W).

>If the power is 400W, neither status bit will be 1 (not within either set of limits)

>If the power is 700W, status bit 18 will be 1 (corresponding to within Limit Set #1)

>If the power is 2000W, neither status bit will be 1 (not within either set of limits)

>If the power is 3500W, status bit 19 will be 1 (corresponding to within Limit Set #2)

>If the power is 5000W, neither status bit will be 1 (not within either set of limits)

*Note:* It is possible to overlap the limits, if Max1 > Min2. In that case it is possible for both bits to be set to 1 at the same time.

*Command examples:*

\$LM / \$LM 0 -> Query all 4 values: Min (set 1) Max (set 1) Min (set 2) Max (set 2):

[Reply: 500 1000 3000 4000]

\$LM 1 800[CR] -> Limit Set #1, set value of min power to 800W [reply: \*1: 800.000]

\$LM 2 1200[CR] -> Limit Set #1, set value of max power to 1200W [reply: \*2: 1200.000]

(Note: if min limit is set greater than max limit, the limit set will effectively be disabled)

\$LM 3 3200[CR] -> Limit Set #2, set value of min power to 3200W [reply: \*3: 3200.000]

\$LM 4 3800[CR] -> Limit Set #2, set value of max power to 3800W [reply: \*4: 3800.000]

\$LM 1 0[CR] -> Limit Set #1 min will be set to 0 [reply: \*1: 0.000]

\$LM 2 0[CR] -> Limit Set #1 max will be set to 0 [reply: \*2: 0.000]

\$LM 3 0[CR] -> Limit Set #2 min will be set to 0 [reply: \*3: 0.000]

\$LM 4 0[CR] -> Limit Set #2 max will be set to 0 [reply: \*4: 0.000]

*Note:* Values can be "real" numbers (floats), for example 123.456

*Error messages:*

If parameter entered is not a value (e.g. "xy") will return "?BAD PARAM"

### \$GG – Get status bit values for Go/No-Go feature

Returns two values 0 or 1, one for each status bit 18 & 19 (see \$LM command above).

The first value returned is 0 if the power is outside the min/max limits for set 1, or 1 if it is within the limits.

The second value returned is 0 if the power is outside the min/max limits for set 2, or 1 if it is within the limits.

*Examples:*

\$GG -> \*0 0 [0 = outside limits for set 1, 0 = outside limits for set 2]

\$GG -> \*0 1 [0 = outside limits for set 1, 1 = inside limits for set 2]

\$GG -> \*1 0 [1 = inside limits for set 1, 0 = outside limits for set 2]

\$GG -> \*1 1 [1 = inside limits for set 1, 1 = inside limits for set 2]

### 6.3 Summary of RS232 Commands For IPM-COM

The IPM-COM will normally be connected to a PLC via one of the industrial protocols, and to the IPM sensor via RS232.

In order to upgrade the IPM-COM firmware, or for debug, it may be necessary to disconnect the IPM-COM from the sensor and connect it via RS232 to a PC.

The firmware upgrade process is automated and supported by Ophir's **StarLab** software package – see above.

A limited number of RS232 commands are published for customers for debug purposes

Name	Function	
\$HP	No function, command to check connection	
\$RE	Reset – restarts the software	
\$VE	Firmware version	
\$MC	MAC Address	
\$NN	Network Protocol	
\$NA	Network Activity	
\$II	Instrument Information – returns S/N and other information	
\$CN	Catalog Number – return unit Part Number (P/N)	

Commands **\$HP**, **\$RE**, **\$VE**, **\$II**, **\$CN** are defined the same way as for the IPM Sensor, see details above.

#### **\$MC – MAC Address**

*Example:*

\$MC[CR] -> \*00:02:A2:37:C3:EF[CR] (returns MAC address of IPM-COM unit)

#### **\$NN – Network Activity**

This command queries the Industrial Network Activity of the IPM-COM unit. It returns a code number and a description.

*Example:*

\$NN[CR] -> \* 21 PROFINET[CR] (IPM-COM unit with Profinet support)

\$NN[CR] -> \* 10 ETHERNET/IP[CR] (IPM-COM-M unit with EtherNet/IP support)

\$NN[CR] -> \* 9 ETHERCAT[CR] (future option for EtherCAT support)

\$NN[CR] -> \* 0[CR] (this is an error, it means no protocol has been programmed into the IPM-COM)

### **\$NA – Network Protocol**

This command queries the Industrial Network Protocol being used by the IPM-COM unit. It returns a code number 0, 1 or 2.

*Example:*

\$NA[CR] -> \*0[CR] (no network connected)

\$NA[CR] -> \*1[CR] (protocol OFF, network present but no activity, master not connected)

\$NA[CR] -> \*2[CR] (protocol ON, network present and active, master is connected)

## 7 Industrial Protocol Registers

This section describes the registers used to implement the industrial protocols supported by the IPM-COM unit.

### 7.1 Introduction

The IPM-COM contains read and write registers used to control the sensor and to read back data from the sensor. The following registers are defined:

- a) One 4-byte Write Register
- b) One 32-byte Read Register

The Write Register is used to send commands to the sensor, while the read register is used to read status, measurements and general information about the sensor. This chapter describes these registers in detail. This information is independent of the industrial protocol supported (Profinet, EtherNet/IP, etc.)

### 7.2 Write Register – Commands:

The 4-byte Write Register is used for sending "Binary Commands" – details below

Details of Binary Commands – Write Register Bytes 0 to 3

Code (2 bytes)	Parameter (2 bytes)	Description	Notes / Equivalent Ascii Command:
0x0000	0x0001	Clear "ACK command" bit in status register (bit 24)	\$GE 1 (Do NOT use this command with parameter zero).
0x0000	0x0002	Clear all "Error" bits in status register	\$GE 2
0x0000	0x0004	Clear "Event" bits in status register	\$GE 4
0x0000	0x0007	Clear ALL bits in status register ("Event", "Error" and ACK bits)	\$GE 7. Parameter 0x0007 will clear ALL relevant bits.
0x0001	Index (0..N)	Selects Measurement Scale "index" (0..N)	\$WN x (with shift +1 in index) 0=AUTO ranging (Power Mode only) 1=top scale, 2=second scale, etc. Max index allowed depends on number of power/energy scales defined for sensor, and on present measurement mode of sensor Saves as default automatically



0x0002	0x0002	Selects POWER Mode	\$MM 2 & saves as default automatically
0x0002	0x0003	Selects ENERGY Mode	\$MM 3 & saves as default automatically
0x0003	index <b>(1..5)</b>	Select laser option index, 1 to 5	\$WI & saves as default automatically 1=first laser option, 2=second laser option, etc. Max index depends on number of laser options defined for sensor
0x0004	0x0001	Close cover	\$CC 1; Requires optional shutter unit. If shutter unit not present, will light ERROR bit in Status Register.
0x0004	0x0002	Open cover	\$CC 2; Requires optional shutter unit
0x0005	value	Select single-shot energy threshold	\$ET & \$HC S; selects and saves the energy threshold level for single-shot energy measurement, options: 1=LOW (1/3 <sup>rd</sup> default) 2=MED (default) 3=HIGH (3x default)
0x0006	0x0001	Initiate zeroing of sensor	\$ZE & \$ZS (IPM-COM automatically saves zero after finishing zero cycle)
0x0006	0x0002	Abort zeroing of sensor	\$ZA
0x0008	0x0000	Zero timestamp	\$TZ; zeros the timestamp
0x0010	value	Set Flow Rate Mode	\$FW - Sets the flow rate meter mode. 0 or 1 = no flow meter attached 2 = Digital type (square wave signal, 3 pin) 3 = Analog type (sinusoidal signal, 2 pin)
0x0011	value	Set Flow Rate Calibration	\$FN - Sets calibration of flow meter in pulses/liter divided by 10, for example 1000 pulses/liter will be represented as value 10000
0x0012	value	Set Min Flow Rate	\$FL 1 In ml/min, used for status bits



0x0013	value	Set Max Flow Rate	\$FL 2 In ml/min, used for status bits
0x0014	value	Set Flow Rate Control	\$FK 1=just measure flow 2=update register error bits 3=control interlock
0x0020	value	Set max body temperature	\$RT 1, in degC, used for interlock (cannot exceed factory defined maximum)
0x0022	value	Set max disk temperature for ERROR	\$GL (T2 value). Sets max temperature in degC, used for interlock & disk temperature error bit in register. Value cannot exceed factory defined maximum value.
0x0028	value	Set calibration factor tweak for present laser setting	\$CQ 2 10000 is equivalent to 1.0000, values allowed 0.01 to 1.9999 (value=100 to 19999)
0x0030	0x0001	Deactivate (clear) Interlock	Reconnect the interlock switch after an error event which disconnected it to switch off laser
0x0030	0x0456	Activate Interlock	For test only, to activate (disconnect) the interlock (\$IA)
0x0040	0x0789	Reset IPM-COM (comms unit)	\$RE - Reset comms unit F/W only (does NOT send reset also to sensor).
0x0041	0x0876	Reset sensor	\$XZ\$RE, Sends \$RE to sensor unit
0x0048	Value	Set MIN value, limit set 1	Sets minimum value for Go/No-Go limit set 1, \$LM 1
0x0049	Value	Set MAX value, limit set 1	Sets maximum value for Go/No-Go limit set 1, \$LM 2
0x004A	Value	Set MIN value, limit set 2	Sets minimum value for Go/No-Go limit set 2, \$LM 3
0x004B	Value	Set MAX value, limit set 2	Sets maximum value for Go/No-Go limit set 2, \$LM 4
0x0060		General Command to read data from IPM sensor. <b>** NOTE:</b> Supported from IPM-COM firmware version 2.02 and above.	All results will be returned at Address 20-23 of Read Register.

0x0060	0x0001	Max power in present selected scale	
0x0060	0x0002	Max energy in present selected scale	Returns 0 if not in Energy Mode
0x0060	0x0003	Multiplier for power/energy values	1 by default
0x0060	0x0004	Index of present measurement scale	\$AR
0x0060	0x0005	Active laser option index (1..5)	\$AW
0x0060	0x0006	Sensor measurement mode	2=Power, 3=Energy, \$MM
0x0060	0x0007	Active laser name (ASCII)	Creates a long from 4 chars of ASCII name
0x0060	0x0008	Time stamp	
0x0060	0x0009	Calibration tweak factor at present laser setting x10000	12345 == calibration tweak of 1.2345
0x0060	0x000A	Energy Threshold Setting	1=LOW, 2=MED, 3=HIGH
0x0060	0x0010	Sensor maximum power in mW	Constant defined for sensor
0x0060	0x0011	Sensor minimum power in mW	Constant defined for sensor
0x0060	0x0012	Sensor maximum energy in mJ	Constant defined for sensor
0x0060	0x0013	Sensor minimum energy in mJ	Constant defined for sensor
0x0060	0x0014	Sensor max exposure time in ms	Constant
0x0060	0x0015	Sensor min exposure time in ms	Constant
0x0060	0x0016	Max body temperature in degC x10	600 for 60.0 degC, Constant
0x0060	0x0017	Max disk temperature in degC x10	1950 for 195 degC, Constant
0x0060	0x0018	Max factory disk temperature, degCx10	1950 for 195 degC, Constant
0x0060	0x0020	Number of laser options defined	Constant, \$AW
0x0060	0x0021	Number of power scales defined	Constant, \$AR
0x0060	0x0022	Number of energy scales defined	Constant, \$AR
0x0060	0x0023	Flow Rate calibration, pulses/liter x10	As defined by user, \$FN
0x0060	0x0024	Min Flow Rate, in mL/min	\$FL
0x0060	0x0025	Max Flow Rate, in mL/min	\$FL
0x0060	0x0026	Flow Rate Mode setting	\$FW
0x0060	0x0027	Flow Rate Control setting	\$FK
0x0060	0x0041	Minimum value, Go/No-Go Limit set 1	\$LM 0
0x0060	0x0042	Maximum value, Go/No-Go Limit set 1	\$LM 0
0x0060	0x0043	Minimum value, Go/No-Go Limit set 2	\$LM 0
0x0060	0x0044	Maximum value, Go/No-Go Limit set 2	\$LM 0
0x0060	0x0050	Sensor S/N	
0x0060	0x0051	Sensor F/W version	Displayed as integer, 123 for v1.23
0x0060	0x0052	IPM-COM S/N	
0x0060	0x0053	IPM-COM F/W version	Displayed as integer, 123 for v1.23

### 7.3 Read Register – Data:

The Read Register contains 30 bytes as detailed below. The first 4 bytes contain the Status Register.

### 7.4 Status Register

This section describes the 32-bit Status Register. This register can alternatively be treated like 4 bytes, or two 16-bit values.

Bit	Description	Type <sup>1</sup>	Notes
0	Cover / shutter unit not present	Status	
1	Cover open	Status	
2	Cover closed	Status	
3	Cover in motion	Status	Cover is moving between open <> closed
4	Cover movement timeout	Status	Cover is stuck between two limit switches
5	Sensor ready for next energy measurement	Status	Not relevant for power mode
6	Energy measurement in progress	Status	Not relevant for power mode
7	Energy measurement complete	Event	The sensor will clear this field on new trigger. Not relevant for power mode.
8	Energy error	Error	Timeout or overrange. Not relevant for power mode
9	Zeroing in progress	Status	1=in progress, 0=finished/not zeroing
10	Zeroing error	Error	1=zeroing error, cleared by Clear ZEROING bits or by restarting zeroing
11	Zeroing completed	Event	1=completed, cleared by Clear ZEROING bits command or by restarting zeroing
12	Interlock status	Status	0=interlock inactive, 1=interlock active (laser disabled)
13	Flow too LOW	Error	0=ok, 1=error
14	Flow too HIGH	Error	0=ok, 1=error
15	Body temperature above max limit	Error	0=ok, 1=error
16	Measurement Mode, Power or Energy	Status	0=Power Mode, 1=Energy Mode
17	Disk temperature above max limit	Error	0=ok, 1=error
18	Power is within set of limits #1	Status	0=outside limits #1, 1=within limits #1 [SLM]
19	Power is within set of limits #2	Status	0=outside limits #2, 1=within limits #2 [SLM]
20	Measurement is OVER	Status	1=measurement is OVER <b>Power mode:</b> above 110% of defined full scale power.

			<b>Energy mode:</b> either energy above 110% of defined full-scale energy, or power was saturated during energy integration).
21	Spare		
	<b>IPM-COM unit specific bits:</b>		
22	Sensor not connected	Status	0 = sensor present, 1 = sensor not present
23	ERROR - undefined command or bad parameter	Error	Also used for bad command such as Cover command when Shutter Unit not present, or Flow Meter command when Flow Meter not present.
24	ACK – command acknowledge	Event	Goes high when command is received and has been processed. (This bit goes high even when there is an undefined command).
25	Comms unit ready	Status	0=not ready, 1=ready
26	Reserved	Status	May be set to 0 or 1 by software
27	PC connection to RS232	Status	Indicates that IPM-COM has entered "slave" mode (example: firmware upgrade via RS232 to PC) and cannot connect to sensor until next reset
28	Spare		
29	Spare		
30	Spare		
31	Spare		

## 7.5 Read Register - Data (32 bytes)

Start	End	Description	Units	Len	Notes
0	3	Status register, 32-bits	N/A	4	As defined above
4	5	Present power, "Whole number of Watts"	W	2	\$SP; used for all modes. Not allowed to be negative.
6	7	Present power, "Fraction of Watts" in mW	mW	2	Remainder of power value, in mW. TOTAL POWER (mW) = [(Whole number of Watts) x 1000] + (Fraction of Watts in mW)
8	9	Latest energy measurement, "Whole number of Joules"	J	2	\$SE; used for Energy mode
10	11	Latest energy measurement, "Fraction of Joules" in mJ	mJ	2	Remainder of energy value, in mJ. TOTAL ENERGY mJ = [(Whole number of Joules x 1000) + (Fraction of Joules in mJ)]

12	13	Water flow rate	mL/min	2	\$FV. Returns zero if water flow meter not enabled using S/W commands.
14	15	Sensor body temperature	degC/10	2	Returns 354 for 35.4 degC (see \$RT)
16	17	Sensor disk temperature	degC/10	2	Returns 354 for 35.4 degC (see \$GT)
18	21	Command Replies	N/A	4	General field for command replies. See Binary Command 0x060.
22	29	Spare bytes		8	Spare
30	31	Reserved bytes		2	May be set to 0 or 1 by S/W
		<b>TOTAL bytes</b>		<b>32</b>	

## 8 Service Portal

This section describes the "Service Portal" provided as a series of webpages within the IPM-COM unit. The Service Portal provides a method for a technician to configure the sensor without the need to connect directly to the sensor via RS232, while keeping the interface to the sensor via the industrial protocol (Profinet, EtherNet/IP) as simple as possible. This section describes the details of the Service Portal webpages.

In addition to the Service Portal, a PC App called the "**IPM-COM WEB UTILITY**" is available from Ophir which searches for any IPM-COM unit on the network and provides a method to temporarily change its IP Address if necessary. Once the unit is identified and the IP Address is set correctly, the Service Portal home page can be opened using a link provided within the PC App. This facilitates the initial connection to the IPM-COM Service Portal via a standard web browser such as Chrome or Edge. The PC App is described in more detail in the next section, see below.

### NOTE

A password is required on some of the pages within the Service Portal. The password is "**admin**" in lower-case letters. The password is required every time these pages are accessed.

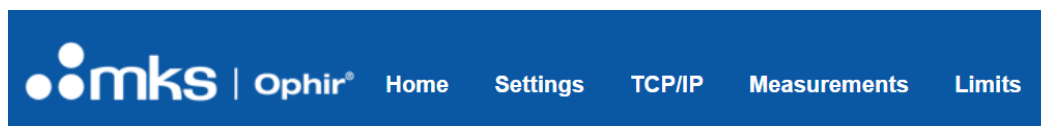
The TCP/IP page requires both a user name ("admin") and password ("admin"). The user name and password are only required the first time this page is accessed.

### 8.1 Navigating to the Service Portal

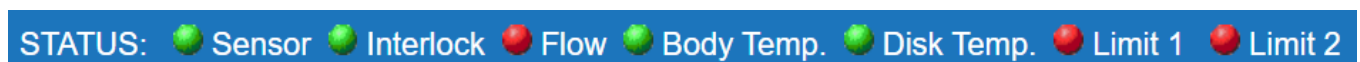
Once the IPM-COM's IP Address is known, it is possible to navigate to the Service Portal webpage directly by entering the IP Address into any web browser, such as Edge or Chrome on a PC, or a web browser on any other platform such as i.OS or Android. Type the IP address into the navigation pane of the web browser, and open the page – the "Home" page will be displayed.

### 8.2 Service Portal – Top Panes

At the top of each web page within the Service Portal, there are links which allow the user to enter the individual pages: Home, Settings, TCP/IP (= IP Address settings), Measurements and Limits.



Below this are status bits represented as green or red "LEDs" or "lamps" (green represents "ok", red represents "error"). These status bits correspond to some of the status bits defined in the Status Register for the industrial protocol, described above.





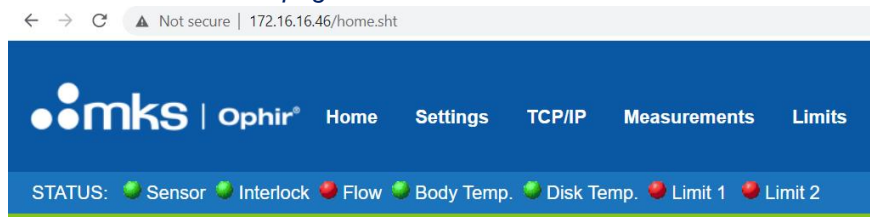
- **Sensor:** Corresponds to status register bit 22, "Sensor not connected": Green=sensor connected, Red=sensor not connected.
- **Interlock:** Corresponds to status register bit 12, "Interlock status": Green=interlock inactive (all ok), Red=interlock active (i.e. an error in laser system, for example sensor is too hot; flow rate too low or too high. These settings can be configured by the user, see details below).
- **Flow:** Corresponds to bits 13 and 14, Flow too LOW, Flow too HIGH: Green=flow meter not enabled or flow rate ok, Red=flow rate enabled and out of limits (the user can configure the flow meter and choose if these bits will be controlled by the flow meter, see details below).  
**NOTE:** If this bit is set red, disabling the flow meter does not clear it to green. The sensor needs to be reset to clear this bit to green after changing the configuration.
- **Body Temp.:** Corresponds to bit 15, Body temperature above max limit: Green=body temperature ok, Red= body temperature above limit.
- **Disk Temp.:** Corresponds to bit 17, Disk temperature above max limit: Green=disk temperature ok, Red= disk temperature above limit.
- **Limit 1:** Corresponds to bit 18, "Power is within set of limits #1": Green=inside the limits (bit=1), Red=outside limits (bit=0)
- **Limit 2:** Corresponds to bit 19, "Power is within set of limits #2": Green=inside the limits (bit=1), Red=outside limits (bit=0)

These two panes are visible on all active pages within the Service Portal webpages.

### 8.3 Service Portal – Home Page

The home page is the "top" page of the Service Portal. It contains basic information about the sensor and IPM-COM unit, such as serial numbers and firmware versions.

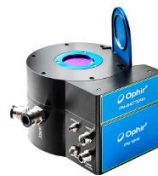
*Service Portal – Home page:*



#### General Information:

##### IPM-Sensor:

Firmware version:	1.19
S/N:	300001
Name:	IPM-10KW



##### IPM-COM:

Firmware version:	2.02
S/N:	3039743
MAC Address:	00:02:a2:6b:f3:49
Protocol:	EtherNet/IP (not active)
Service Portal Firmware version:	1.08



Information displayed in the Home Page:

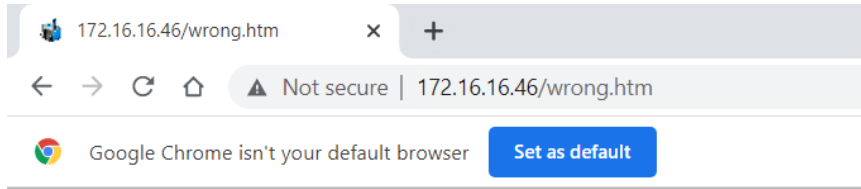
- Sensor firmware version
- Sensor serial number (S/N)
- Sensor name (for example, IPM-10KW).
- IPM-COM firmware version
- IPM-COM serial number (S/N)
- IPM-COM MAC address
- IPM-COM protocol type (EtherNet/IP, Profinet) & status of the industrial protocol network, "active" (in green) or "not active" (in red).
- Firmware version of the Service Portal code itself (in the example above, version 1.08)

### 8.4 Service Portal – Settings Page

A password is required to enter the "Settings" page ("admin" in lower-case letters). This page allows the user to configure settings for the sensor. For more help on each control, hover over the "i" icons with the mouse.

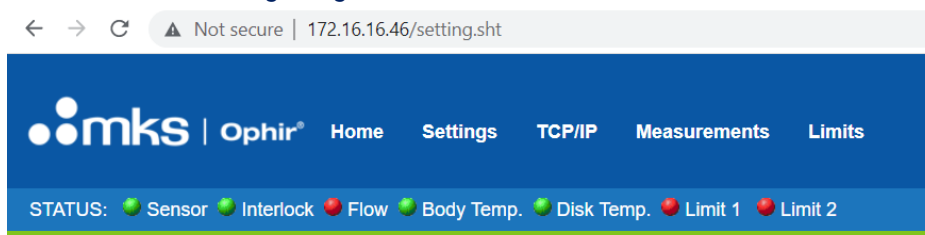
If the wrong password is entered, a "Wrong Password" screen will be displayed. Press the "Back" button in the browser to return to the previous webpage and then try again to enter the "Settings" page with the correct password.

### Service Portal – Wrong Password screen:



Wrong Password

### Service Portal - Settings Page:



## Settings

**Note:** Changing settings in this screen while the sensor is under control via the Industrial Protocol may cause conflicts.

### General:

Measurement Mode: **Power**    
 Scale (W): **600 (3)**    
 Energy Threshold Mode: **Med**    
 Zeroing Status:    
 Cover status: **Closed**

### Laser Settings

Laser Name: **CO2 (3)**

### Limits for Go/No-Go Settings

Limits 1 - MIN: **200**    
 Limits 1 - MAX: **800**    
 Limits 2 - MIN: **1000**    
 Limits 2 - MAX: **2000**

The settings screen contains the following controls:

- **Measurement Mode** – toggles the setting between power mode and energy mode

- **Scale** – toggles between the power scales (W, in power mode) or energy scales (J, in energy mode). In power mode, an extra option is "Auto" mode which sets the sensor into Autorange mode where it selects its own power scale based on the incident power level
- **Energy Threshold** – chooses between low, medium or high energy threshold, for energy mode only. The threshold level determines the power level required to trigger an energy measurement when in energy mode. For more details, see the section above on the \$ET command
- **Zeroing Status** – clicking the "start" button starts a zeroing cycle; the zeroing status is displayed to the left of the button while zeroing
- **Cover Status** – clicking on the button opens or closes the sensor's cover (when using the SHUTTER unit). The cover status (closed, in motion, open) is displayed to the left of the button. If the SHUTTER unit is not installed, this control will be hidden.
- **Laser Name** – clicking on the "Change Laser" button toggles through the laser settings of the sensor. The laser setting chosen is displayed to the left of the button. Hovering over the "i" icon displays the number of options available.
- **Limits for Go/No-Go Settings:** These buttons allow the user to adjust the two sets of min/max limits for the Go/No-Go feature. To change a setting, enter a number in the text box and press "SET". This feature is described in more detail below.
- **Show flow meter settings:** This button opens a section of the page with options for an external Flow Meter if used. This feature is described in more detail below.
- **Reset COM:** This button allows the user to reset the IPM-COM unit.
- **Reset Sensor:** This button allows the user to reset the sensor.

## NOTE

Due to timing issues between the IPM-COM, the sensor, the network and the web browser, pressing the buttons on the "Settings" page occasionally does not register in the IPM-COM. This results in the setting not being changed. If this occurs, the button press should be repeated after a few seconds.

## NOTE

As noted in red on the "Settings" page itself, a conflict could occur if the user tries to change settings via the industrial protocol commands, such as the measurement mode or measurement scales, while the sensor is under control via the Service Portal. This could cause conflicts and may lead to unpredictable behavior.

*Note from the settings page:*

**Note: Changing settings in this screen while the sensor is under control via the Industrial Protocol may cause conflicts.**

### 8.4.1 Go/No-Go Feature – Details

The "Go/No-Go" feature allows the user to choose two sets of lower and upper (min and max) limits corresponding to two bits within the Status Register (bits 18 and 19, see above). When the power level of the sensor is between the lower and upper limits, the corresponding bit in the Status Register is on (1) and when the sensor is outside the limits, the bit is off (0).

The two sets of limits are independent of each other and could overlap.

For example, suppose the laser system under normal use should have 7000W +/- 500W. The first set of limits ("Limits 1") would be set to 6500 W min and 7500 W max. If the power level of the laser is within these two limits, the "Limit 1" lamp in the Status Pane will be green and bit 18 of the Status Register will be on (1). If the laser power is below 6500 W or above 7500 W the "Limit 1" lamp will be red and bit 18 of the Status Register will be 0.

Similarly, suppose there is a different mode for the laser system, such as maintenance mode, where the laser should have 3000W +/- 200W. The second set of limits ("Limits 2") could be set to 2800 W min and 3200 W max. If the power level is between 2800 W and 3200 W, the "Limit 2" lamp in the Status Pane will be green and bit 19 of the status register will be 1. If the laser is outside these limits, the "Limit 2" lamp will be red and bit 19 of the status register will be 0.

The software does not prevent setting the min value greater than the max value for each of the sets of limits. Setting the min value greater than the max value will effectively disable this set of limits.

#### 8.4.2 Flow Meter Settings – Details

The Flow Meter is an optional accessory supplied by the customer. If used, it can be attached to the IPM sensor using the M8 female connector. The user can configure the Flow Meter settings to disable or enable the Flow Meter and choose how the flow meter will be used by the IPM sensor.

This section of the "Settings" page can be collapsed or expanded as required by pressing on the "Show flow meter settings" / "Hide flow meter settings" button. Details of the Set Flow Rate Mode and Control settings can be displayed by hovering over the "i" icons.

*Service Portal - Flow Meter Settings:*

Hide flow meter settings

##### Flow Meter Settings

Set Flow Rate Mode (1-3) :	2	<input type="text"/>	SET	i
Set Flow Rate Control (1-3) :	2	<input type="text"/>	SET	i
Flow Rate Calibration (pulses/liter, 0..6500.0) :	350.0	<input type="text"/>	SET	
Min Flow Rate (mL/minute, 0..65000) :	500	<input type="text"/>	SET	
Max Flow Rate (mL/minute, 0..65000) :	20000	<input type="text"/>	SET	

**Set Flow Rate Mode (1-3):** This option chooses between "No Flow Meter attached" (1); digital type Flow Meter (2); or analog type Flow Meter (3). The "digital" type requires 3 pins: ground, power and a digital signal input from the Flow Meter into the IPM sensor. The frequency of the digital input pin indicates the water flow rate. The "analog" type requires 2 pins: an analog sine wave signal is created by the flow meter between the pins, whose frequency indicates the water flow rate.

If the mode is set to 1 (no flow meter attached) the other controls will be disabled.

**Set Flow Rate Control (1-3):** This option chooses how the Flow Meter will be used by the sensor, when enabled (Mode = 2 or 3). The Flow Meter can be used just to **measure the water flow rate**, with no warnings and no interlock (1); it can be used to measure water flow rate and also **control two bits in the Status Register**: bits 13, 14: flow too low, flow too high (2); or it can be used to measure the water flow rate, control

the Status Register bits, and also **control the interlock** if the flow rate is below min flow rate or above max flow rate.

Note that setting the flow meter active (mode options 2 or 3) when no flow meter is attached to the sensor will cause the software to detect a flow rate of zero. If the control mode is set to 2 or 3, this will violate the min flow rate level if the min flow rate defined is above zero. Setting the mode back to 1 will not unset the min flow rate warning bit in the Status Register; the sensor will need to be reset in order to clear the warning bit to zero.

**Flow Rate Calibration (pulses/liter, 0..6500.0):** This value is the user-selected Flow Rate meter calibration factor, defined in pulses per liter. The user should set this number to match the flow meter being used so it gives an accurate flow rate measurement.

**Min Flow Rate (mL/minute, 0-65000):** This value is the minimum flow rate defined for the sensor, in units of milli-liters (mL) per minute. The user can select a suitable minimum value for their application. For example, setting this value to 1000 sets the min flow rate to 1 L/minute.

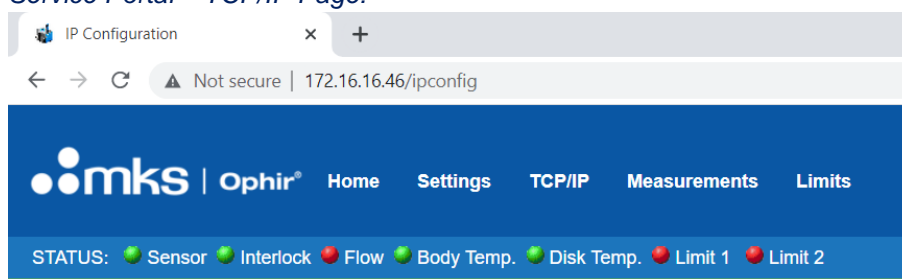
**Max Flow Rate (mL/minute, 0-65000):** This value is the maximum flow rate defined for the sensor, in units of milli-liters (mL) per minute. The user can select a suitable maximum value for their application. For example, setting this value to 20000 sets the max flow rate to 20 L/minute.

## 8.5 Service Portal – TCP/IP Page

This page within the Service Portal is used to change the IP Address or settings of the IPM-COM unit.

- For EtherNet/IP, the IP Address is changed permanently after the next reset of the IPM-COM unit
- For Profinet, the IP Address is changed only until the next reset or restart of the IPM-COM unit

### Service Portal – TCP/IP Page:



### Network Settings

To change the settings edit the values in the table below and press 'submit'.  
To discard previously submitted changes press 'discard'.  
If DHCP is enabled, the device tries to discover the settings from a DHCP server automatically.

Note: The new settings will come into effect after a reset.

WARNING: Changing the IP parameters may cause a loss of connection.

Parameter	Current Value	New Value
IP Address	172.16.16.46	<input type="text" value="172"/> . <input type="text" value="16"/> . <input type="text" value="16"/> . <input type="text" value="46"/>
Subnet Mask	255.255.252.0	<input type="text" value="255"/> . <input type="text" value="255"/> . <input type="text" value="252"/> . <input type="text" value="0"/>
Gateway	172.16.16.1	<input type="text" value="172"/> . <input type="text" value="16"/> . <input type="text" value="16"/> . <input type="text" value="1"/>
Mode	static	<input checked="" type="radio"/> static <input type="radio"/> dhcp <input type="radio"/> bootp
		<input type="button" value="submit"/> <input type="button" value="discard"/> <input type="button" value="clear"/>



The IP Address, Subnet Mask, Gateway and mode can be changed inside this page. Changing the mode to DHCP allows the network to allocate a dynamic IP Address to the IPM-COM. By default a static IP Address is used.

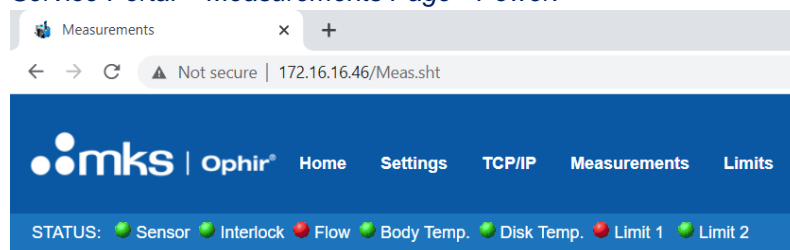
Changing the IP Address to one that does not match the local network subnet may cause a loss of connection of the IPM-COM unit.

After making any changes in this screen, the IPM-COM requires a reset. A reset can be performed by using the button on the settings screen or by cycling power off and on. It will typically take around 40 seconds before the IPM-COM reconnects after a reset or after switching on power.

## 8.6 Service Portal – Measurements Page

This page allows the user to view the measurements from the sensor. This is provided as an alternative to the industrial protocol connection and as a way to test or debug the sensor.

### *Service Portal – Measurements Page - Power:*



### Measurements

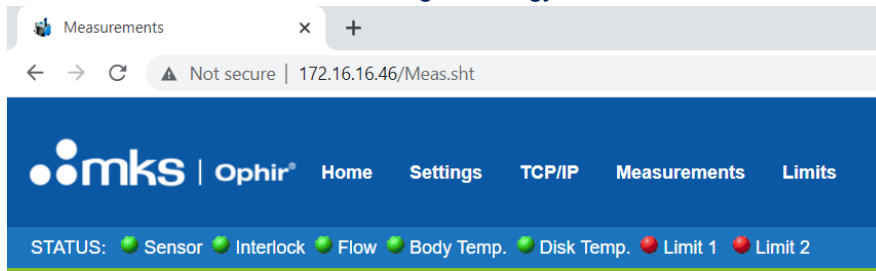
Power: 1046.971 W

Body Temperature: 25.9 °C

Disk Temperature: 24.9 °C

Water Flow Rate: 0.00 L/minute

### Service Portal – Measurements Page - Energy:



### Measurements

Power: 0.000 W  
Energy: 1161.165 J **Ready**

Body Temperature: 25.9 °C  
Disk Temperature: 24.9 °C  
Water Flow Rate: 0.00 L/minute

**Power:** Displays the present power on the sensor in Watts.

**Energy:** In Energy Mode only, displays the most recently completed energy measurement, and the "Ready" status (displays "Ready" in green when the sensor is ready to receive a new pulse of energy).

**Body Temperature:** Displays the temperature of the body of the sensor in degrees Centigrade

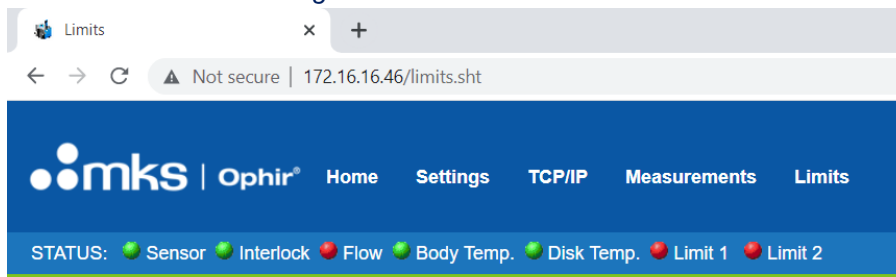
**Disk Temperature:** Displays the temperature of the sensor's thermopile disk in degrees Centigrade

**Water Flow Rate:** Displays the water flow rate in Liter/Minute, if the Water Flow meter is attached and enabled, or zero if the Water Flow meter is not attached or not enabled.

## 8.7 Service Portal – Limits Page

This page displays limits of the sensor: some factory defined limits such as min/max power and energy; and some user defined limits such as min/max flow rate.

### Service Portal – Limits Page:



## Limits

Maximum power :	11000 W
Minimum power :	100 W
Maximum energy :	10000 J
Minimum energy :	60 J
Maximum body temperature :	60 °C
Maximum disk temperature :	195 °C
Max Value In Present Scale :	11000 W
Max Flow Rate :	20.0 L/minute
Min Flow Rate :	0.5 L/minute

**Maximum power:** Maximum power supported by the sensor, in Watts (factory default).

**Minimum power:** Minimum power supported by the sensor, in Watts (factory default).

**Maximum energy:** Maximum energy supported by the sensor, in Watts (factory default).

**Minimum energy:** Minimum energy supported by the sensor, in Watts (factory default).

**Maximum body temperature:** Maximum body temperature of the sensor, in degrees Centigrade (factory default).

**Maximum disk temperature:** Maximum disk temperature of the sensor, in degrees Centigrade (factory default).

**Max Value in Present Scale:** The maximum power (W) or energy (J) in selected scale. This value will change depending on the user selected power/energy mode and the user selected measurement scale.

**Max, Min Flow Rate:** These values are the user-defined maximum and minimum flow rate limits. They are displayed even if the Flow Meter is disabled.

## 9 IPM-COM WEB UTILITY

The IPM-COM WEB UTILITY is a PC App provided by Ophir, available on the Ophir Website. The PC App provides the following functionality:

- Searching IPM-COM units connected to the network
- Viewing & changing the IP Address of an IPM-COM unit
- Allowing upgrade of the Service Portal software inside the IPM-COM, if a newer version is available

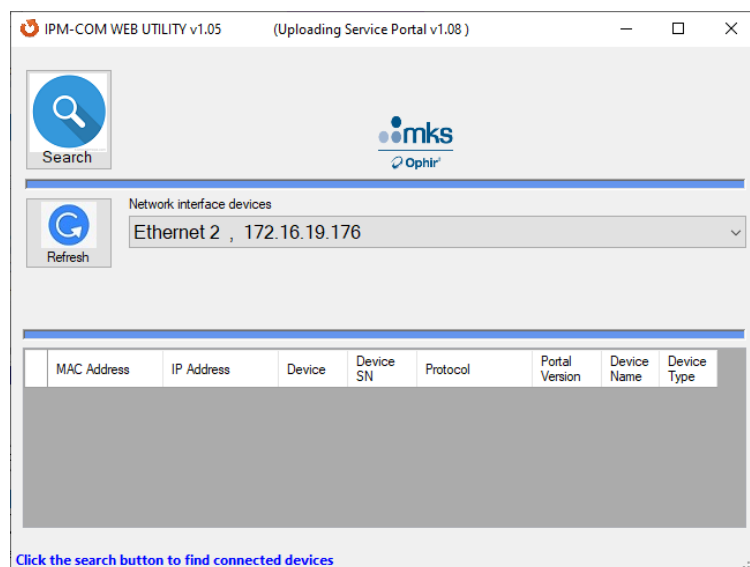
To use the PC App, first locate the file "IPM\_COM\_WEB\_UTILITY vXXX HTTP vYYY.EXE on the Ophir Website. It will be available in the "Software" tab under the IPM web page.

**(Note:** XXX is the version of the PC App itself, YYY is the version of the Service Portal software that the PC App contains within it).

### 9.1 Downloading and opening the PC App

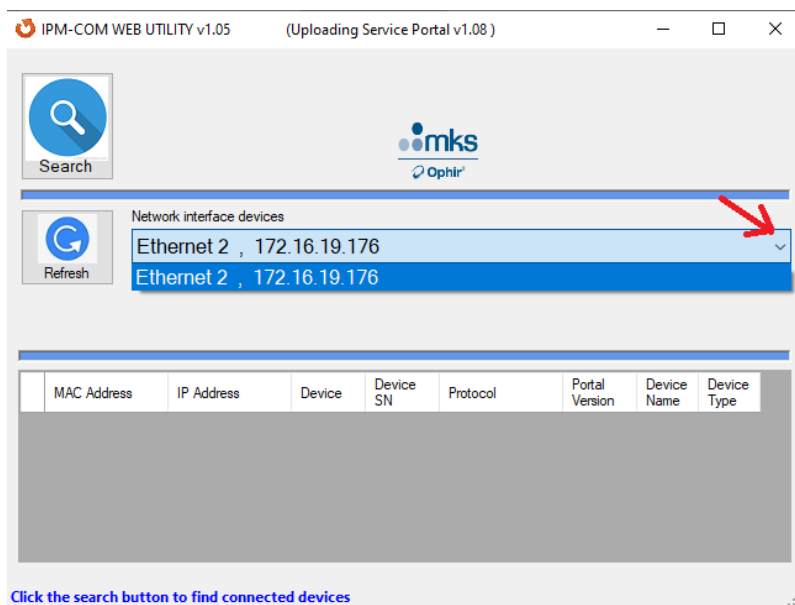
1. Download the EXE file to the local PC (for example, to the local "Downloads" folder) and double-click to open it. The EXE file can be located anywhere convenient on the local PC, in any local folder.

The main screen of the utility will be displayed:



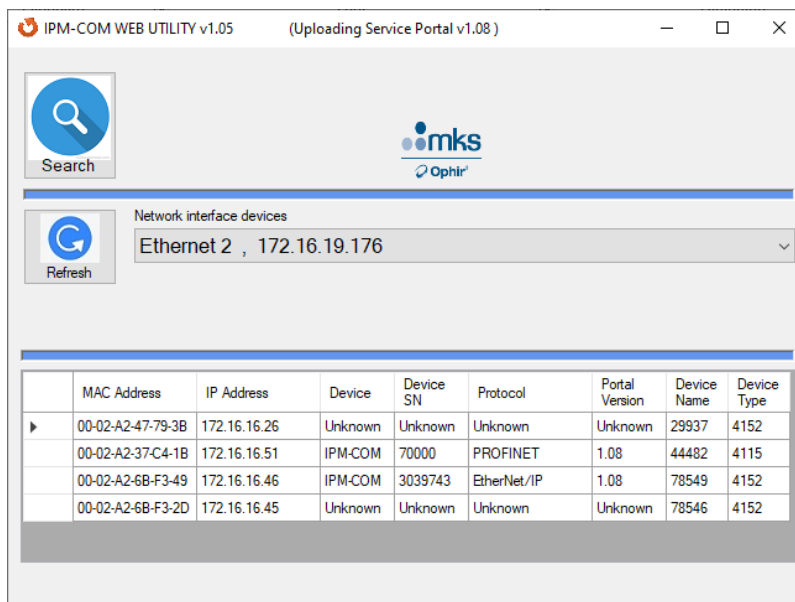
The version of the PC App and the version of the Service Portal embedded inside it are displayed on the title line at the top of the screen. In the example above, version 1.05 is the PC App version and version 1.08 is the Service Portal version).

2. Using the "Network interface devices" drop-down, choose the relevant network interface.



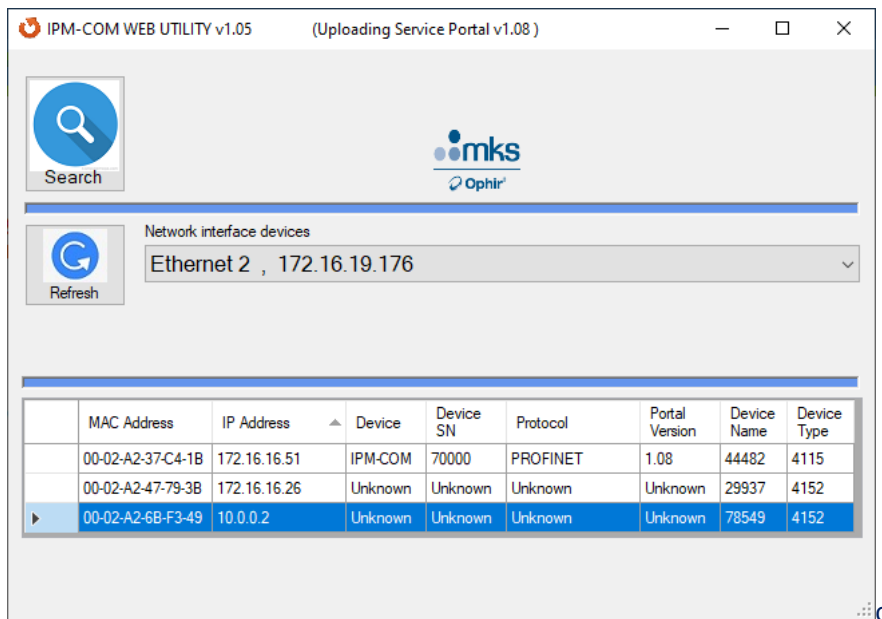
## 9.2 Searching and Connecting to IPM-COM Device the First Time

1. Search for IPM-COM devices on the network by clicking on the "Search" button. A list of devices located on the network will be shown in the table in the lower part of the window. If no devices are located, try selecting another Network interface device to search, and press "Search" a second time.

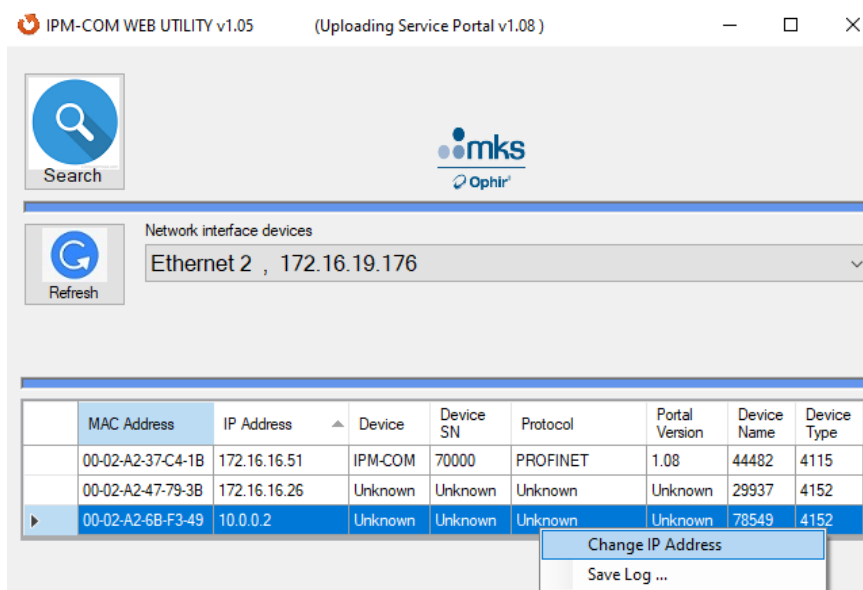


2. Some of the devices found on the network may not be IPM-COM devices; those devices will be shown as "Unknown" in the list. It will not be possible to connect to these devices or query their details. The PC App allows connection only to IPM-COM devices, to prevent damage to other devices that might be found on the same network.

3. The first time a new IPM-COM unit from the factory is powered up, it will have a default IP Address. For EtherNet/IP devices, the default IP Address is 10.0.0.2. For PROFINET devices, the default IP Address is 0.0.0.0. In either case, if the default IP Address is not a valid IP Address for the network, the PC App will not be able to query the IPM-COM to check its S/N and other settings, so the device will be displayed as "unknown" as in the example below.

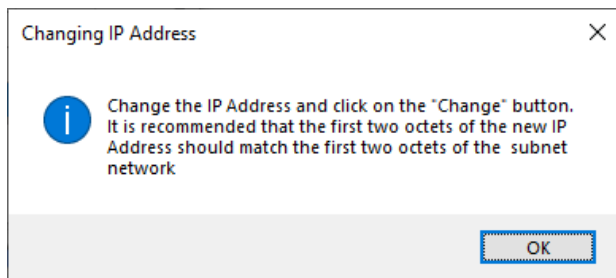


4. Select the relevant device by left-clicking with the mouse. If the device is displayed as "Unknown", it is still possible to change its IP Address by right-clicking with the mouse and choosing "Change IP Address".

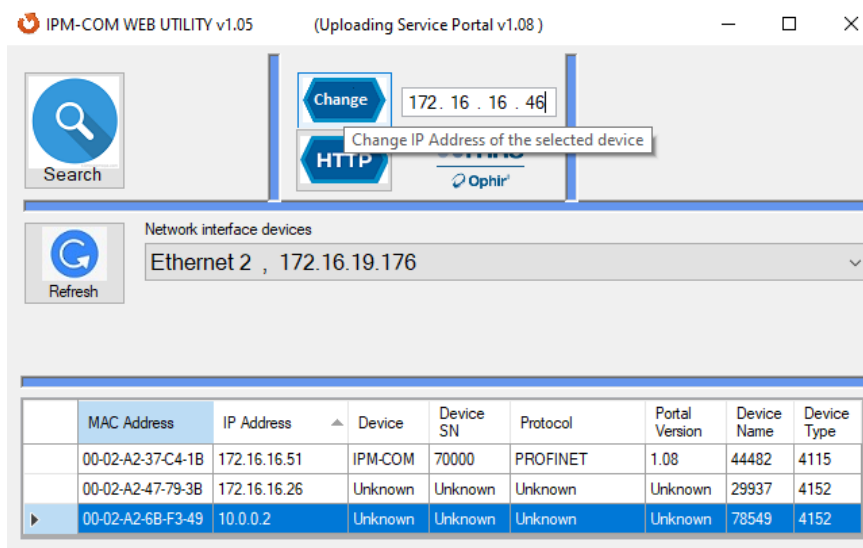


5. The following message box will appear.





6. Choose "OK"; an edit box allowing a change of the IP Address will appear at the top of the window. If the selected device was not "Unknown" (if it already had an IP Address that was compatible with the network IP Address), the "Change" icon will already be displayed at the top of the window, without using the "right-click".

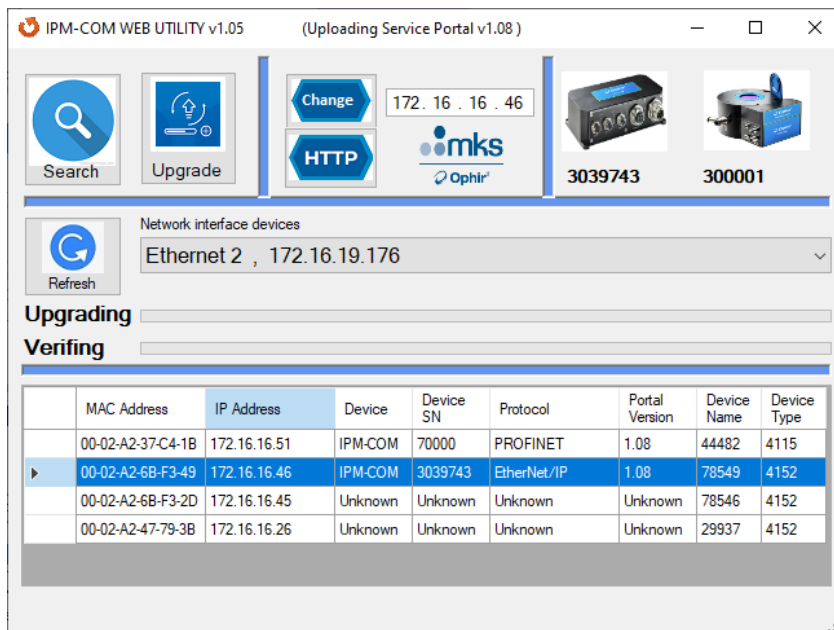


7. Change the IP Address of the device as described below.

## 9.3 Changing the IP Address

1. Select the IPM-COM device which needs to be configured by left-clicking the mouse on the relevant row in the table.

2. If the device's IP Address is a valid IP Address for the network, the relevant icons will appear at the top of the window. The IPM-COM can be identified by its Serial Number, or by its existing IP Address. Its MAC address will also be shown in the left-most column of the table.



3. If the IP Address is not a valid IP Address for the network and the device is displayed as "Unknown", see how to proceed in the section above (use "right-click" to enable a change to the IP Address).

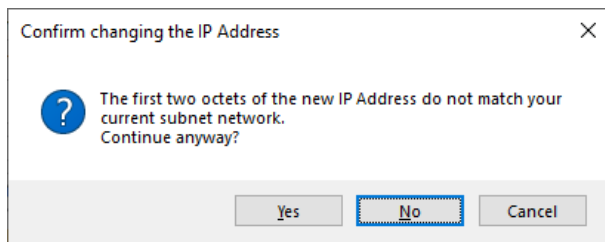
4. The current version of the Service Portal for each device is shown in the "Portal Version" column in the table. The PC App will not allow an Upgrade of the Service Portal for a device which already contains a NEWER version of the Service Portal, and will warn when trying to upgrade the Service Portal for a device which already contains the SAME version.

5. If required, change the IP Address of the selected device by updating the values in the box next to the "Change" button, and then clicking on the "Change" button.

- The IP Address for an **EtherNet/IP** model of IPM-COM will be 10.0.0.2 by default from the factory. It can be changed temporarily using the PC App. It is possible to save a permanent IP Address for the device using the "TCP/IP" page of the Service Portal (see details above).

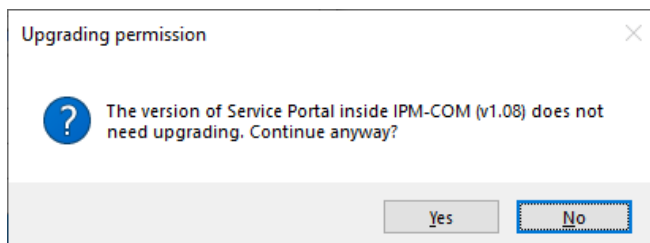
The IP Address for a **PROFINET** model of IPM-COM will be 0.0.0.0 after each power up and a new IP Address cannot be saved as default inside the device. The IP Address can be changed temporarily using the PC App to a suitable IP Address that matches the Network to allow connection to the IPM-COM, but the same process will need to be repeated every time the device is powered up or reset. If an IP Address has already been allocated using the PROFINET network, it can be used also to connect to the Service Portal until the device is next powered down.

6. When connecting to an IPM-COM device for the first time, the IP Address needs to be changed to one that matches the Network IP Address. The first two octets of the IP Address should match the Network IP Address (172.16.x.x in the example shown above). Trying to set an IP Address with the first two octets different from the Network IP Address is likely to cause problems connecting to the device later on, and will generate an error message from the PC App. Select "No" in this case.

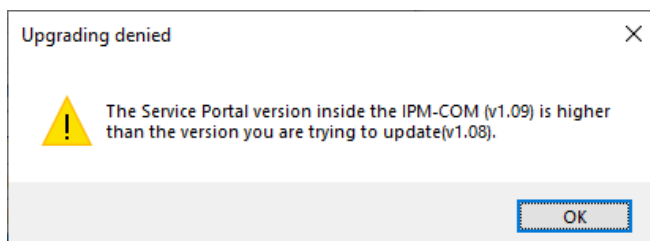


## 9.4 Upgrading the Service Portal Version

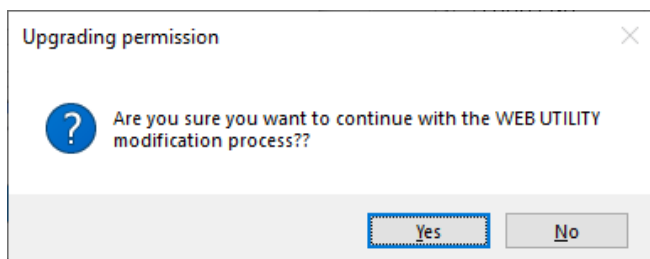
1. If the IPM-COM contains an old version of the Service Portal software, it can be upgraded by clicking on the "Upgrade" button at the top of the window. If the current version is the SAME as the version contained within the PC App, a message will appear:



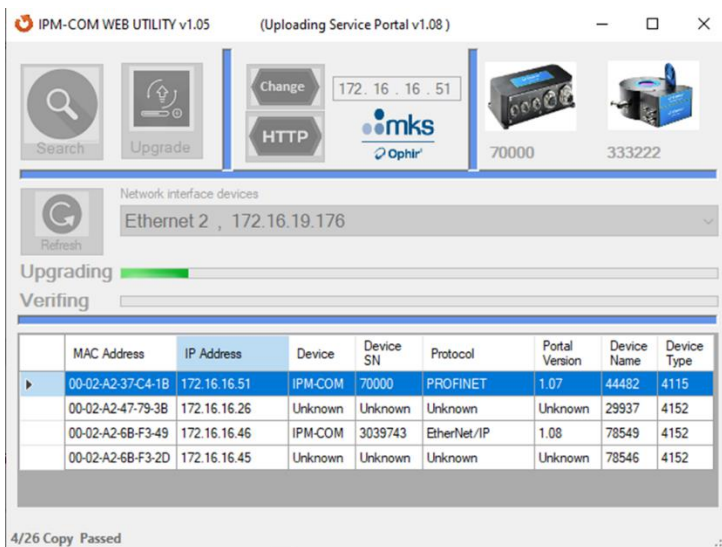
2. If the current version is NEWER than the version contained within the PC App, a warning message will appear and the upgrade will not be possible:



3. If the current version is OLDER than the version contained within the PC App, a message asking for approval will appear, choose "Yes".

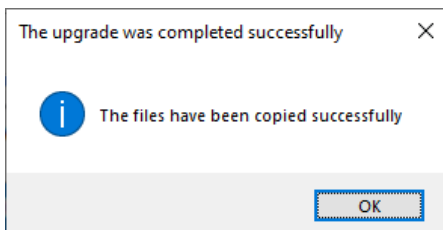


4. During the upgrade process, files will be copied from the PC into the IPM-COM, and the progress will be shown in the "Upgrading" progress bar.



5. After the upgrade, the files will be verified, and the progress will be shown in the "Verifying" progress bar.

6. At the end of a successful upgrade process, a message will appear to confirm the upgrade was successful:



## 9.5 Opening the Service Portal

1. Open the Service Portal for the selected device by clicking on the "HTTP" button. The default browser defined for the PC will open to the IP Address of the selected device, and the "Home" page of the Service Portal will be opened.

2. It is possible to connect to the IPM-COM Service Portal using any type of web browser on any platform, for example, Android, i.OS or Windows, as long as the device is connected on the same network. Type the IP Address of the IPM-COM manually into the browser to open its home page.

## 9.6 Closing the PC App

1. When closing the PC App, all temporary files are removed from the PC. The PC App can be reopened simply by clicking on the EXE file again.

2. An INI file will automatically be stored in the "users" folder which holds the last chosen network IP Address, so that the next time the PC App is used, it will default to the same network setting.

**Version History:**

**Rev 1** – first release April 2022

**Rev 2** – second release Oct 2022

*Changes in Rev 2:*

Changed to 32 bytes for Read Register, 4 bytes for Write Register

Added several new bits in Status Register

Added \$LM and \$GG commands for sensor to define two sets of limits for Go/No-Go feature (chapter 6)

Fixed some errors and typos in RS232 commands section (chapter 6)

Added details of Service Portal (chapter 8)

Added details of PC App (chapter 9)

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**IPM User Manual v2**

**25 Oct 2022**

**IPM-COM F/W v2.02; IPM-SENSOR F/W v1.19; Service Portal v1.08; IPM-COM Web Utility v1.05**

**For the latest version, please visit our website: [www.ophiropt.com/laser-measurement](http://www.ophiropt.com/laser-measurement)**