User Notes

# 70K-W (P/N 7Z07141)

## OPHIR POWER METER


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# 1 Introduction

Ophir 70K-W is a calorimetric laser power meter for up to 70KW. The concept of a calorimetric laser power meter is presented in the following figure.

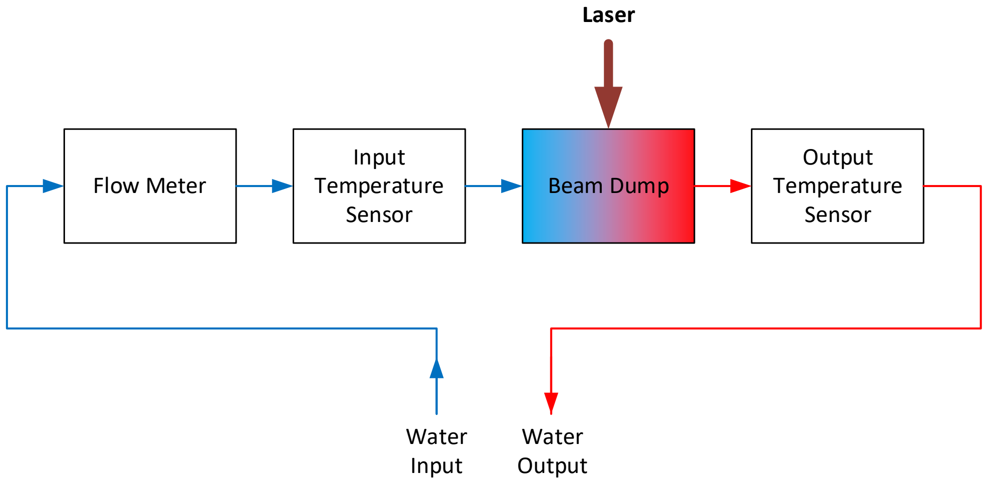



*Figure 1. calorimetric laser power meter block diagram*

The laser radiation is absorbed and converted into heat in the water-cooled beam dump. By measuring the water's flow rate, input temperature and output temperature, the incident laser power can be accurately calculated.

The 70KW continuously compensates for change in input temperature and flow rate. When the cooling water temperature changes too fast, measurement noise will increase. In this case a water buffer tank may be used to reduce the rate of change of the water temperature.

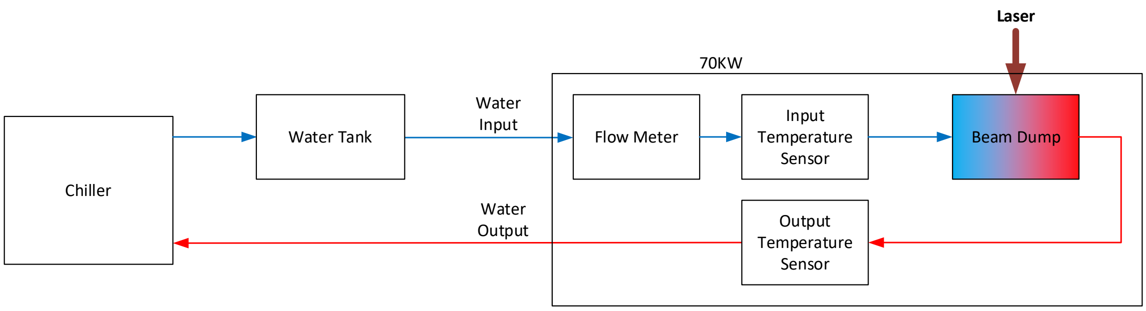



*Figure 2. 70KW connected to chiller and water tank*

# 2 Operational Safety

| | |
|---|---|
| **CAUTION** | **Beam size, profile, and orientation must match the power meter requirements listed in the specification.**<br>**For the Beam Dump to work properly and prevent excess concentration of power on the critical surfaces, the beam must match the beam requirements given in the product specifications.** |

- It is recommended to connect a safety interlock to shut off the laser instantly if the water flow drops below a preset flow rate.
- The chiller should have sufficient heat dissipation capacity to match the laser power.
- Pressure should not exceed the maximum pressure defined in the Specification.
- Store the *Ophir 70K-W Power Meter* in a dry, temperature-controlled space.
- The Water Flow rate and the water input temperature must match the **Cooling Water Requirements**.
- Improperly centered beam can damage the sensor. Make sure all the beam passes through the aperture.

## 2.1 Cooling Water

### 2.1.1 General

- Connect the 70K-W to a chiller system.
- The water inlet and outlet are located and marked on the side of the 70K-W.
- The water connections are compatible with 16mm and 5/8'' tubing.
- The Chiller heat dissipation capacity should be equal or greater than the laser power that will be measured.
- The minimum flow rate at 70KW is 35 Liter/min. The minimum flow rate scales with the power, e.g. at 35KW the minimum flow rate will be 15Liter/min. Note that the measurement will not be accurate below 10 Liter/min.
- Maximum flow rate is 40 Liter/min.

### 2.1.2 Water temperature

- The water temperature should be non-condensing. A temperature of 15-20°c is generally recommended.
- Water freezing inside the sensor should be avoided as it will damage the sensor severely.
- The inlet water temperature stability should be less than 1°c/min
- If the chiller cannot provide the required water temperature stability, a ballast water tank may be used to improve water temperature stability (see Figure 2).

- For accurate measurement, you must avoid trapped air bubbles in the circulating water.
- When a water circulation system is used without a chiller, the water temperature rate of change can be roughly calculated as:

$$R = \frac{P}{70 * V}$$

where R is the water temperature rate of change in °c/min, P is the laser power in Watts, and V is the total volume of water in the system in Liters.

### 2.1.3 Water quality, conductivity and PH

- The 70KW can be operated with tap water, deionized or distilled water.
- For best performance and durability, we recommend using deionized or distilled water in a closed circulating system over tap water, mainly because PH and ion content in deionized water is well defined and in tap water it is not. Additional information can be found in Ophir's guide to water cooled sensors. https://www.ophiropt.com/en/n/how-to-use-water-cooled-sensors.
- Clean, filtered water should be used. Take care to prevent contamination and particles in the cooling water such as dirt, debris, metal chips, rust, and Teflon tape sealant particles as these can affect performance and damage the sensor.
- Rinsing your system regularly is recommended, however, do not use compressed air for cleaning or draining the 70K-W as it can damage the flow meter.
- Working with glycols additives
- Glycol additives are used as anti freeze agents. The 70K-W is compatible with this material but it can affect system accuracy, and max power. please contact Ophir for consultation.

### 2.1.4 Compatibility with cooling systems plumbing

- The 70K-W is compatible with copper and stainless-steel plumbing.
- Operation with systems containing Aluminum should be avoided

# 3 Electrical connections

The connector panel of the 70KW is depicted in the following figure.

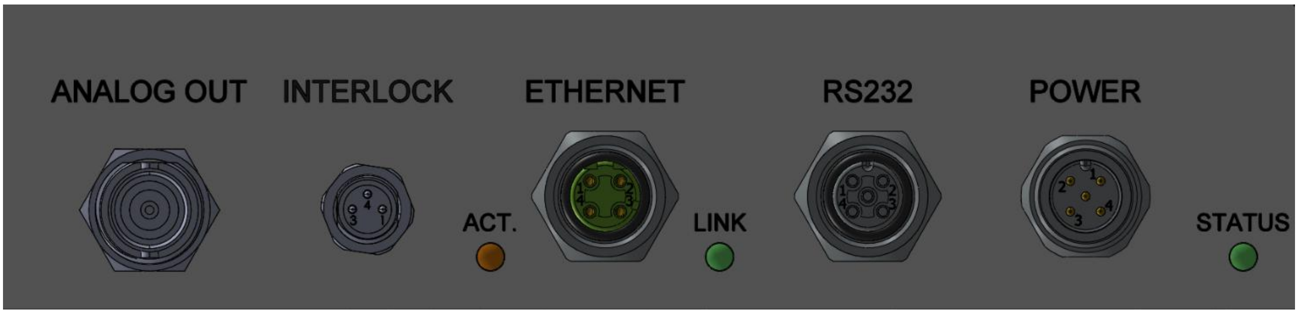



*Figure 3. 70K-W Connector panel*

### 3.1.1 Interlock

Connector type: M8 male

Pin description:

| Pin | Function |
|---|---|
| 1 | COM (Common) |
| 3 | NO (Normally Open) |
| 4 | NC (Normally Closed) |


Functionality:

If using pins 1 and 3, then normally they are disconnected, and in the event of interlock trigger, they will be shorted

If pins 1 and 4 are used, then normally they are shorted, and in the event of interlock trigger, they will be disconnected

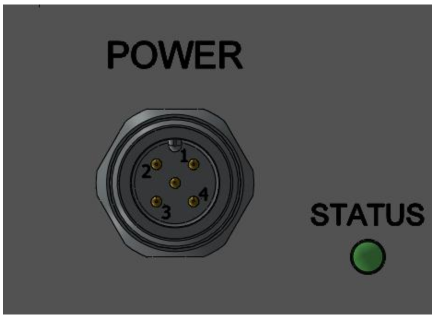
This is also known as ‘dry-contact’

### 3.1.2 Power

Connector type: M12 male

Pin description:

| Pin | Function |
|---|---|
| 1 | +24v |
| 2 | RxD (input into the 70K-W) |
| 3 | GND |
| 4 | TxD (output from the 70K-W) |
| 5 | N/C |




Functionality:

Power, ground and RS232 communication.

### 3.1.3 RS232

Connector type: M12 female

Pin description:

| Pin | Function |
|---|---|
| 1 | +24v |
| 2 | TxD (output from 70K-W) |
| 3 | GND |
| 4 | RxD (input to 70K-W) |
| 5 | N/C |


Functionality:

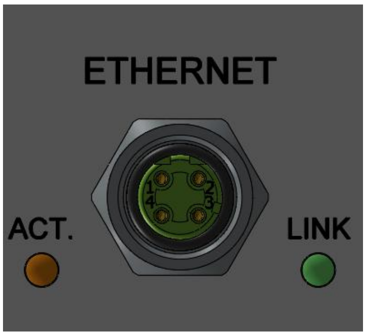
Power, ground and RS232 communication.

### 3.1.4 Ethernet

Connector type: M12-D female

Pin description:

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




Functionality: 10/100 Ethernet and PoE

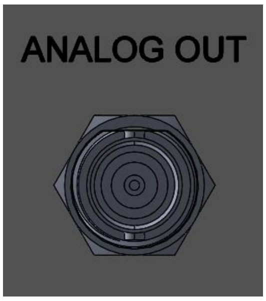
### 3.1.5 Analog output

Connector type: BNC

Functionality:

The 70K-W is equipped with an analog out BNC connector. This voltage on the BNC connector is user selectable (using the PC application or commands) between two options:

1. A voltage representing the measured power. (1v,2v,5v,10v = full scale power). For example, if 10V scale is selected and the power is 70KW, the voltage will be 10V.
2. Raw, uncalibrated voltage from a photodiode incorporated inside the 70KW. This voltage can be used to monitor laser rise time, stability and pulse duration in real time.



# 4 Operation

## 4.1 Before Operation

1. Set the 70K-W on a flat and sturdy surface. The 70K-W can be operated both with horizontal and vertical laser beams.

2. Connect the Ophir 70K-W Power Meter to a chiller system containing water that meets the required water quality (see Water Quality). Use ¾'' or 16mm outer diameter tubing.

| NOTE | **It is important (the user's responsibility) to connect a safety interlock to shut off the laser instantly if the water flow drops below a preset flow rate (see Operation Safety) according to the local safety regulations.** |
|---|---|

3. Properly align the laser using the laser guide beam. When properly aligned, the light reflected from the cone will be evenly distributed on the absorber.

4. Connect the 70K-W to power and communication (RS232 or Ethernet)

5. Measure the water flow rate either by using RS232 commands (see 4.5 RS232 Commands) or by installing the Water Flow Meter PC software and monitoring the screen. To minimize errors ~~due to the flow meter's non-linearity~~, it is recommended to work at a fixed flow rate, for the entire range of powers to be measured.

6. Once the flow rate is set, let the water run until the reading stabilizes, then set an offset when the laser is off. At low powers, it is important to make a new offset every time the flow rate is changed.

7. Turn up the laser power gradually and measure the power using the RS232 commands or the Water Flow Meter PC software provided, as shown below.

## 4.2 Operation with PC application

Run the “Ophir Calorimetric Sensor” PC Application software. If using Ethernet, select the Ethernet card in ‘NIC Selection’. If using RS232 this is not needed. The SW will identify the attached sensor. click on the sensor in the ‘Sensor Choice’ box or click ‘Start Selected (F7)

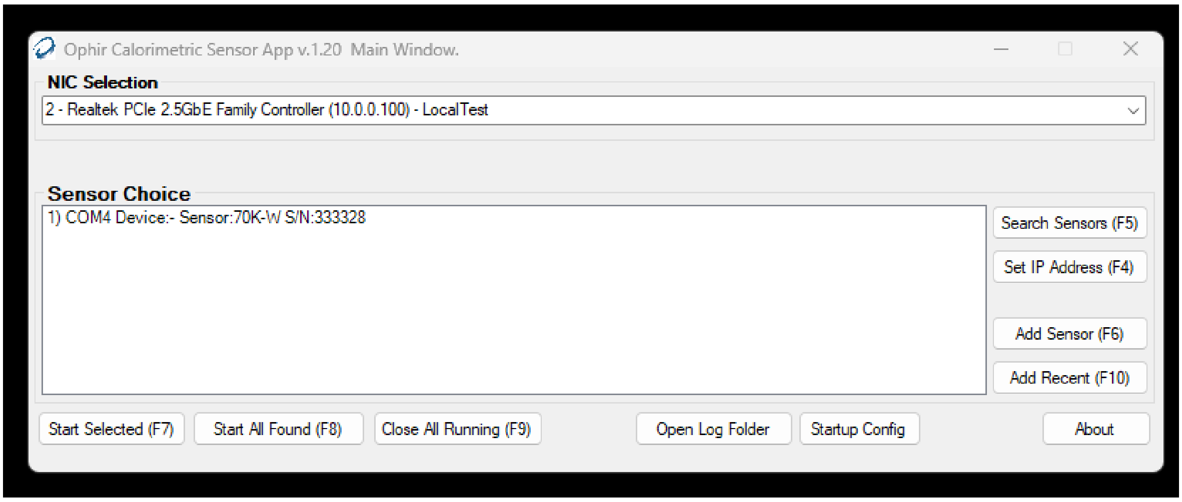



*Figure 4. initialization window*

The following screen will open. This is the main screen of the calorimeter user application.

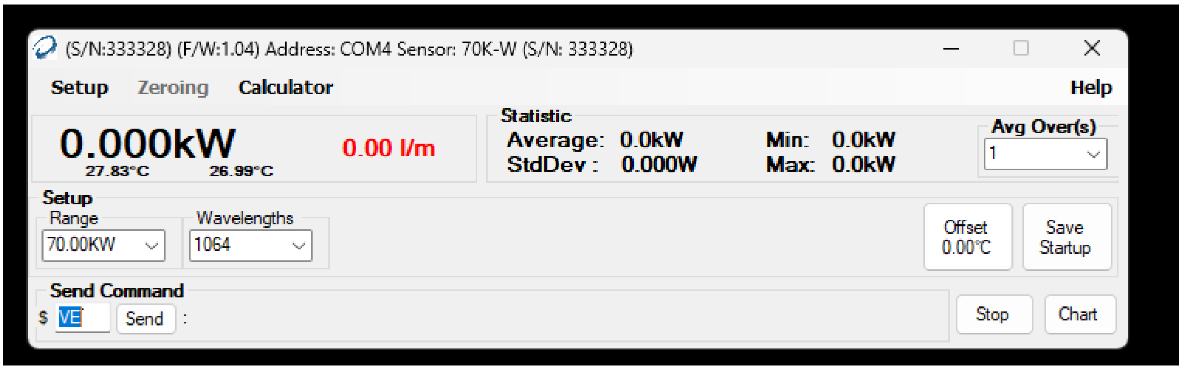



*Figure 5. Main window*

Start the water flow. You may get a non meaningful reading because of an offset between the input and output water temperature sensors. Click on offset to cancel this reading.

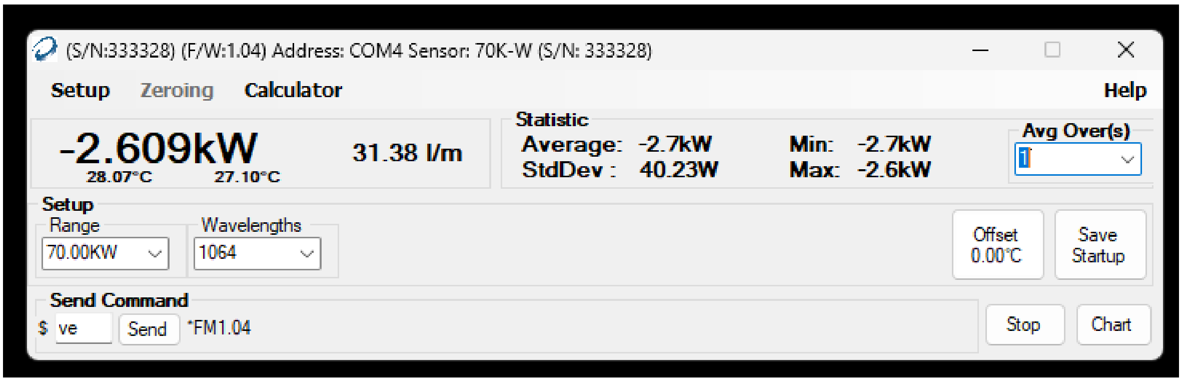



*Figure 6. Main window showing water flow*

The measurement is now close to zero and we are ready to turn on the laser.

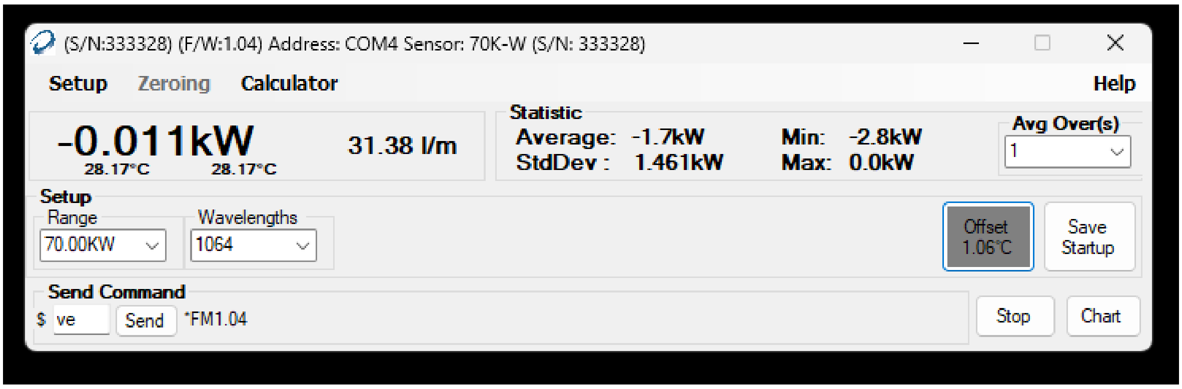



*Figure 7. Main window after clicking on Offset*

Turn on the laser.

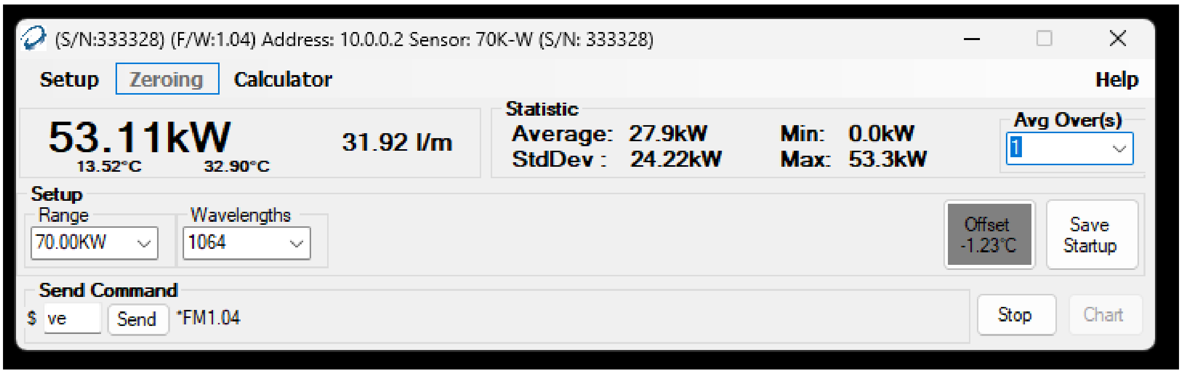



*Figure 8. Main window after turning on the laser*

You can also click the ‘Chart’ button to see the power as a function of time.

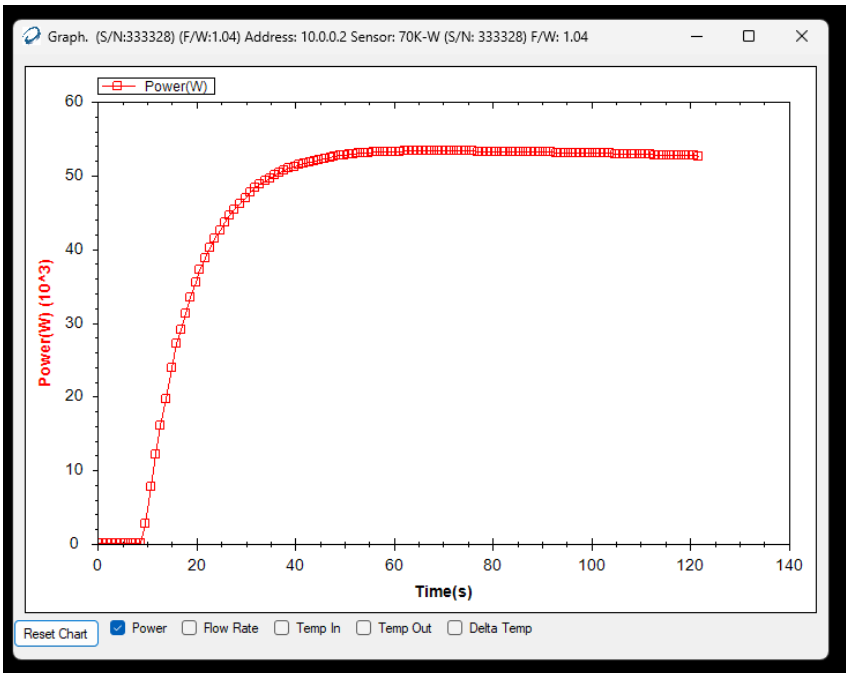



*Figure 9. Chart view*

The 'Send Command' tab is used to send text commands over RS232 or Ethernet. Type the command (without the $ sign) and click 'Send'. The reply is shown on the right. For example, the command $FV gives back present water flow rate. The returned value is 31.920 which corresponds to the value shown next to the power level indicator.

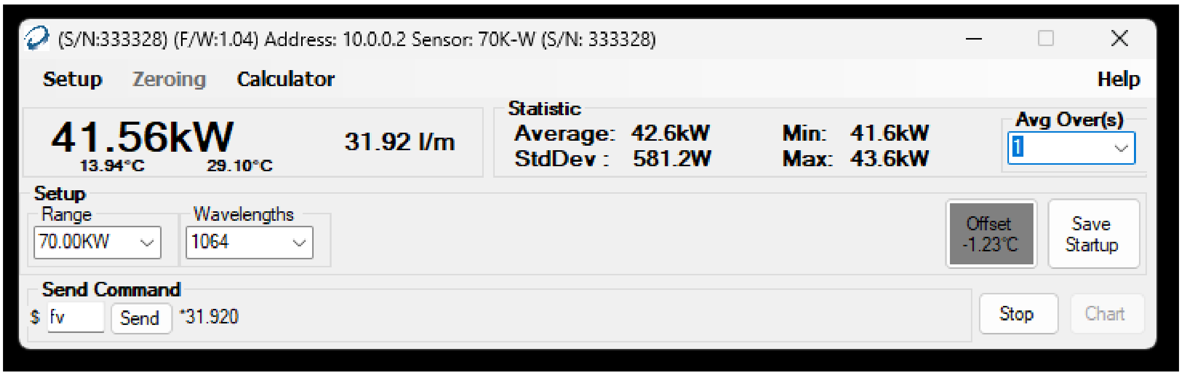



*Figure 10. Main window showing $FV command*

Calorimetric simulator. Click on ‘Calculator’. This tool is not connected to the measurement device and only provides a theoretical calculation of the measured power for a given set of parameters: temperature in, temperature out and flow meter.

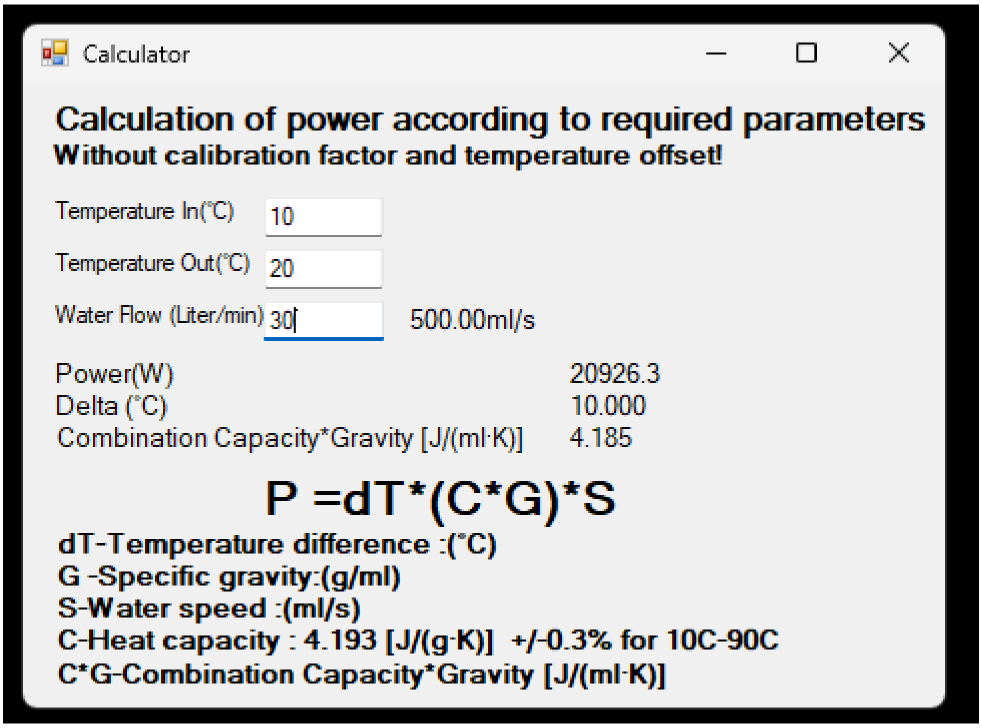



*Figure 11. Calculator*

The setup screen. This screen is used to edit the device name, IP configuration and maximum power limits for activating the interlock.

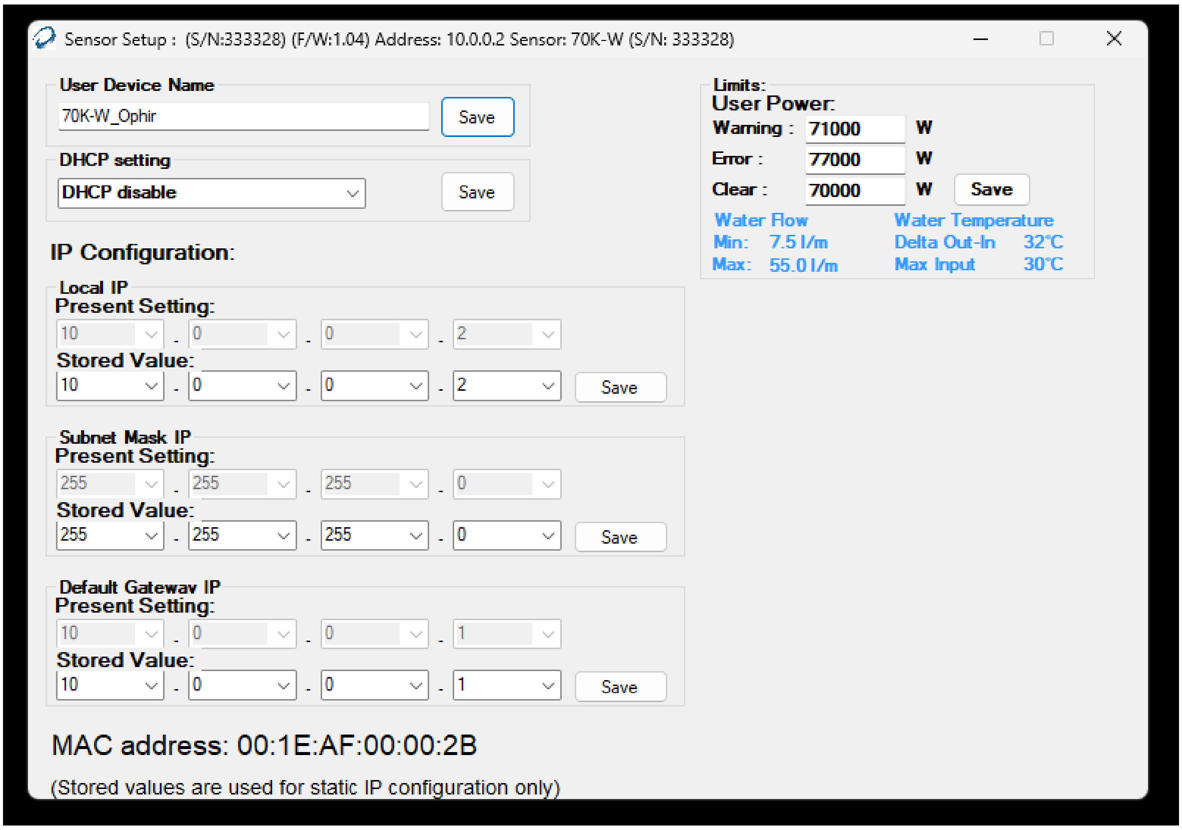
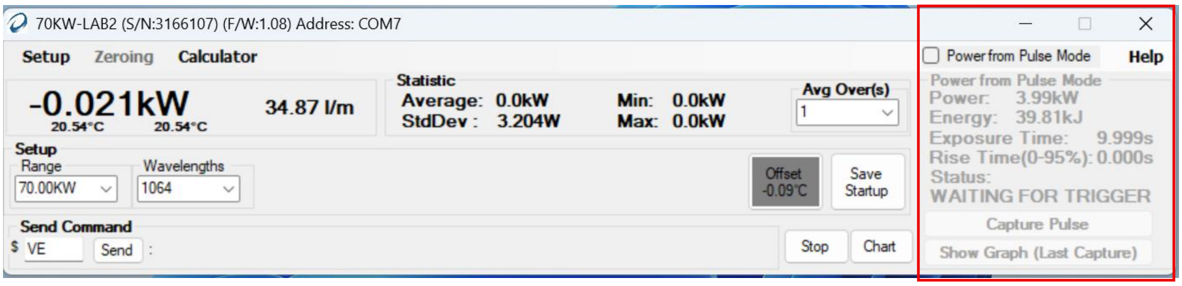



*Figure 12. Setup window*

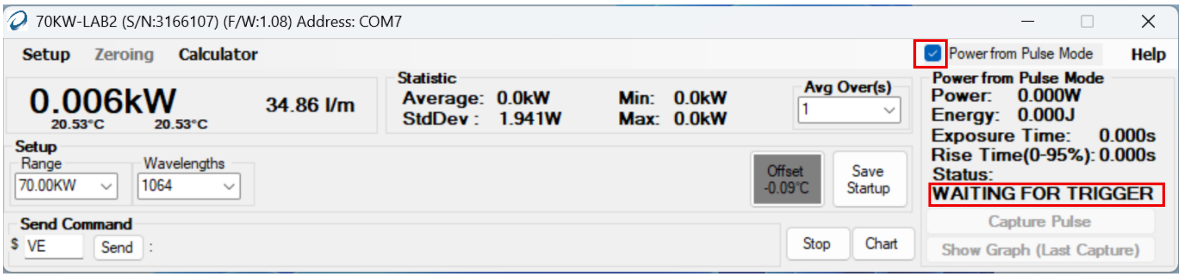
Using the power from pulse function

The power from pulse function enables power measurement of laser exposures which are much shorter than the 70K-W stabilization time for CW measurements. This is achieved by using the integrated photodiode to acquire the temporal shape of the laser pulse and integration of the calorimetric measurement to obtain the total energy of the laser exposure. The combination of the two measurments provides an accurate power measurement of the laser pulse. With this function, power of up to 100KW can be measured using a 4-12 seconds exposures when using flow rates ≥30 L/min.

The power from pulse functionality is controlled from the right portion of the PC application window.



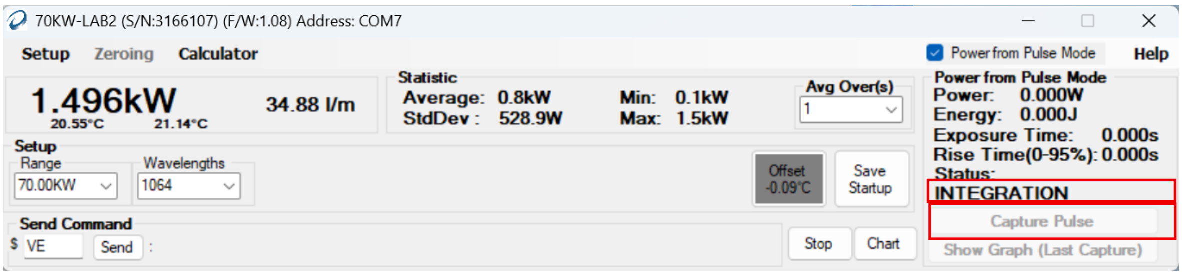

Click on the 'Power from Pulse Mode' checkbox to activate the function. The 70K-W now waits for the laser pulse as indicated by 'WAITING FOR TRIGGER'. Before making the measurement make sure that the offset between the input temperature and output temperature is stable and close to zero, if not, take a new offset using the 'offset' button.



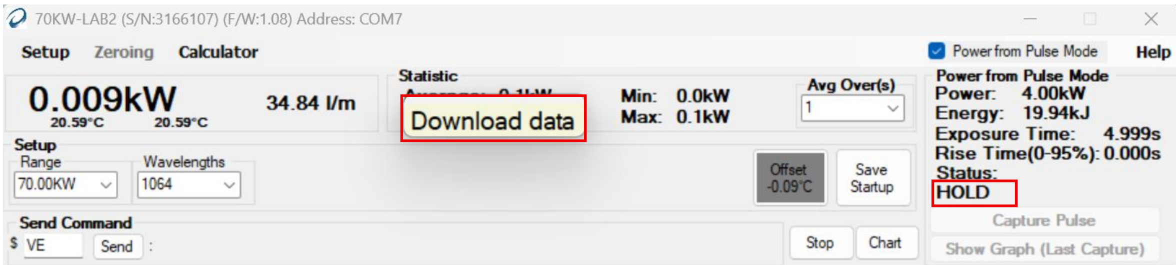

**Note relating to the measurement of low powers:**

- When measuring low powers (<10 kW) failure to take a correct offset before measurement can cause a significant error in the measurement.
- It is recommended to use exposure times >8 seconds when measuring low powers.

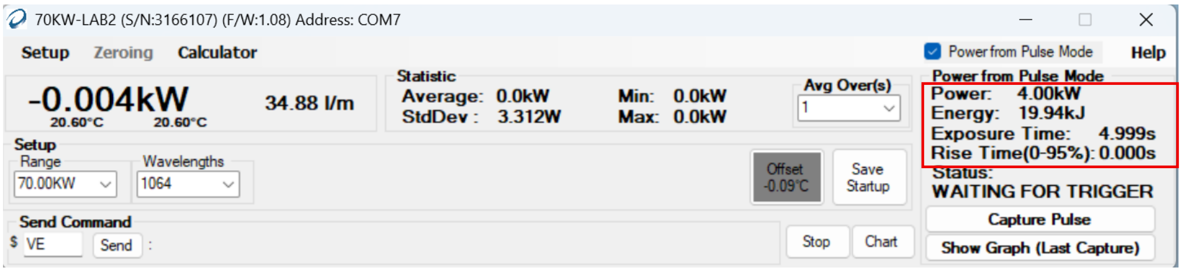
Click on 'Capture Pulse' to enable or disable display of the temporal shape of the pulse after the measurement. Once the pulse is detected, the 70K-W starts the calorimetric integration as indicated by 'INTEGRATION'. While the laser pulse duration can be 4-12 seconds, the integration will take up to 1min.



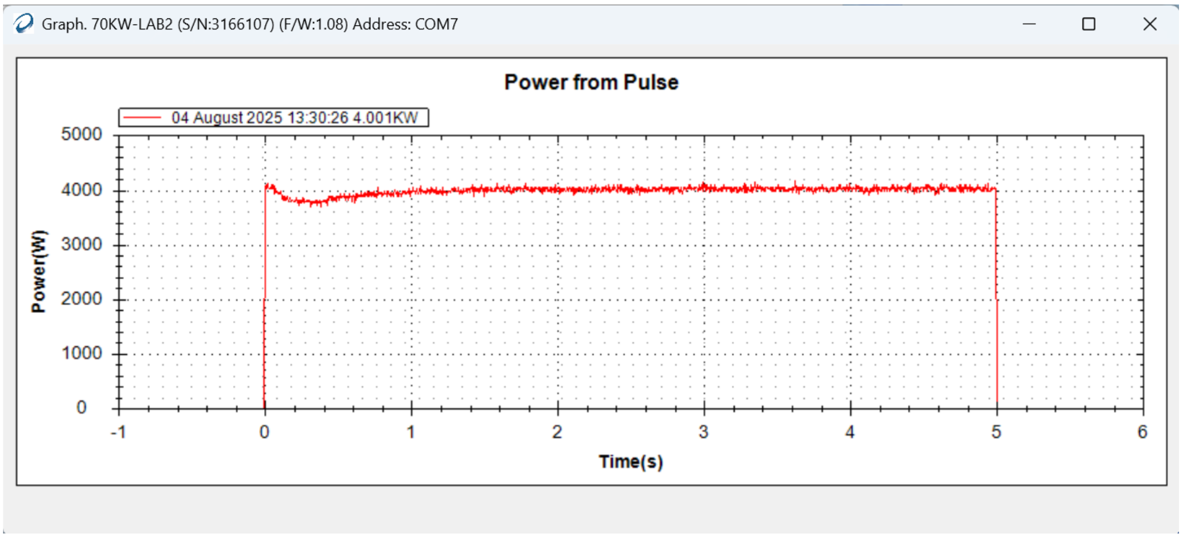

After the integration is complete, the system is will be on hold for a few seconds while the data is transffered to the PC. The duration of this process depends on whether 'Capture Pulse' was selected or not.




After data transfer has finished, the measurement data will be displayed and the system is ready for the next pulse measurement. The rise time resolution is ~3 ms.




The temporal shape of the pulse will be displayed in a seperate window. This is very helpful in examining the rise time, overshoot and undershoot of the laser.




# 5 Operation with RS232 commands

## COMMUNICATION COMMANDS:

**x.1 General Information:**

Communications can be established with the sensor via RS232 or Telnet (Ethernet).
Commands end with a Carriage Return symbol (0xD, '[CR]','\r'). Adding a Line Feed symbol (0xA, [LF], \n) after the [CR] is optional.
Commands are initiated by the host computer (PC, PLC); the sensor responds to them after receiving the final [CR] symbol.
Communications to and from the sensor use ASCII symbols only (no binary values are required).
Commands from the host begin with a '$' symbol.
Commands are defined by two ASCII characters that can be lower or upper case.
Replies begin with a '*' symbol (for 'OK') or a '?' (for an error), and end with [CR][LF] symbol.
The default Baud rate is 9600, but the Baud Rate can be changed using the $BD command (see below).
The RS232 setup is 8 data bits, 1 stop bit, no parity.

Commands can be sent using an Ethernet connection also via HTTP or UDP (details are not included in this document, but see the User Manual for the Ophir EA-1 device for more details)

**x.2 Commands:**

**Version ($VE):**
Returns the firmware version of the device
*Example:*
$VE -> *FM1.06 (when device is running in regular application mode)
$VE -> *FD1.06 (indicates device is running in special "downloader" or boot mode, used for upgrading firmware)

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

**Reset ($RE):**
Resets the device firmware and forces a disconnection of the communications channel. Using this command is equivalent to powering the device off and on again. The device acknowledges by replying "*" before performing the reset.
*Example:*
$RE[CR] -> *[CR][LF]

**Sensor Information ($hi):**
Returns information on the sensor: a two-letter code "TH", the serial number of the sensor, the name of the sensor ("70K-W"), and an 8-digit code for internal code for factory use only. Values returned are delimited with a space character.
*Example:*
$hi[CR] -> * TH 3344556 70K-W 00408001[CR][LF] (thermopile sensor; S/N 3344556; sensor name "70K-W")

**Baud Rate ($BD):**
This command changes the baud rate to a new value and saves the new value as the default after the next startup or reset. The command will reply *[CR] at the *OLD* Baud Rate and then restart communications using the new baud rate. Subsequent commands need to be sent using the new baud rate. Allowed Baud Rates are: 4800, 9600 (default), 19200, 38400, 57600, 115200. Note that the Ophir PC App works by default at 9600 but can be adjusted to any of these Baud Rates using the "Startup Config" button.
*Example:*
$BD 19200[CR] ->*[CR][LF] (sets Baud Rate to 19200 after sending the reply at old Baud Rate)
$BD 3456[CR] -> ?BAD PARAM[CR][LF] (error message if send illegal Baud Rate value)

**Analog Output Source ($RO):**
This command gets or sets the source of the Analog Output (BNC). The two options are "DAC" (option 1, voltage output proportional to the power measurement, driven by the internal Digital-to-Analog convertor) and "RAW" (option 2, amplified output from the internal photodiode, used to detect the laser pulse shape). Using no parameter or parameter zero queries the present setting.
*Example:*
$RO 1[CR] ->*1 DIGITAL RAW[CR][LF] (Sets DAC mode)
$RO 2[CR] ->*2 DIGITAL RAW[CR][LF] (Sets PD mode)
$RO[CR]    ->*2 DIGITAL RAW[CR][LF] (Query, no parameter)
$RO 0[CR] ->*2 DIGITAL RAW[CR][LF] (Query, parameter 0)

**Analog Output Scale ($DS):**
This command chooses the Analog Output full scale. Options are 1v, 2v, 5v, 10v. Parameters are 1, 2, 5, or 10. Using no parameter or zero queries the present setting.
Example:
$DS 2[CR] -> *2[CR][LF] (Sets full scale 2v)
$DS 0[CR] -> *5[CR][LF] (Query)

**All Wavelengths ($AW):**
Returns the laser settings defined for the sensor.
*Examples:*
$AW[CR] -> * DISCRETE 2 1064 10.6[CR][LF]" (list of all defined laser settings for the sensor, 1064nm and 10.6u)
*See command "$wi" for more details of selecting laser option.*

**Set Laser Index ($wi):**
Set index of laser setting. Index '1' is for first defined laser setting, in this case 1064. Index ‘2’ is for second laser setting, 10.6, as defined by the $AW command. Returns “?BAD PARAM” if parameter is out of range.
***Note:*** It is not possible to change the startup laser index, the sensor always starts up with index 1. The $HC command does not save this setting as it does for other startup settings.
*Examples:*
$wi 1[CR] –> *[CR][LF] (sets laser option 1, 1064)
$wi 2[CR] –> *[CR][LF] (sets laser option 2, 10.6)
$wi 3[CR] –> ?BAD PARAM[CR][LF] (bad parameter, only two options are available)

**Save Sensor Configuration Settings ($HC):**
Saves the present sensor startup settings such as Analog Output options or Offset Temperature.
***Note:*** *In order to change the power-up defaults, the following sequence is necessary:*
*a. Set desired setting, e.g. Analog Output full scale option using $DS command.*
*b. Save chosen settings using $HC command*
$HC[CR] -> *OK[CR] (responds OK)

**Offset Temperature ($OT):**
The command “$OT 2” performs a “zero offset” of the sensor so that the output power reads zero with the present configuration and conditions. The software inside the sensor calculates the difference between the input water temperature and output water temperature and stores the value internally. Use the $HC to save the zero value permanently into the memory of the sensor. Only use this command when the sensor has no power incident on it and the sensor has reached temperature equilibrium with the cooling water. Using the command with no parameter or parameter zero queries the present zero offset used by the sensor.
*Example:*
$OT 2[CR] -> *[CR][LF] (performs the zero offset)
$OT 0[CR] -> *2345[CR][LF] (queries present zero offset, returns value in milli-degC, 2345 is equivalent to 2.345 degC)
$OT [CR] -> *2345[CR][LF] (no parameter also queries present zero offset)

**Send Power ($SP):**
This command sends the power measurement. The response is in “E” format, preceded by "*" and ended by [CR][LF].
*Example:*
$SP[CR] -> *1.234E4[CR][LF] (power measured is for 12.34kW)
***Note:*** *If power exceeds 110% of full-scale, $SP returns "*OVER[CR][LF]".*

**Send Temperature ($ST):**
This command sends the input and output water temperature in degC. The values are updated once per second.
*Example:*

$ST[CR] -> *30.375 65.181[CR][LF] (Returns the input and output water temperatures in degC)

**Send Water Flow ($FV):**
This command sends the water flow rate in liters/minute, updated once per second.
*Example:*
$FV[CR] -> *10.657[CR][LF] (Returns the water flow rate in liters/min)

**Send Combination of results ($SC)**
This command sends all the data from the sensor on one line, or specific data according to the parameter. The data returned is delimited with a space character. Data returned:

- Power (W)
- Water Flow Rate (liters/min)
- Temperature in (degC)
- Temperature out (degC)
- Flag "1" for new data, "0" for old data already send previously, if the command is sent more than once per sec

Using specific parameters, specific data can be returned instead of all the data together.
*Examples:*
$SC[CR] -> *1.2345E5 10.345 25.333 35.444 1[CR][LF] (no parameter, sends all the data together: power, flow, temperature in; temperature out, flag)
$SC 1[CR] -> *1.2345E5 1[CR][LF] (param 1, power only in W)
$SC 2[CR] -> 10.345 1[CR][LF] (param 2, flow only in liters/min)
$SC 3[CR] -> *1.2345E5 10.345[CR][LF] (param 3, power and flow rate only)
$SC 4[CR] -> *1.2345E5 10.345 25.333 35.444 1[CR][LF] (param 4, same as no parameter, all data together)

**Buzzer Control ($KB)**
This command enables or disables the buzzer control inside the sensor and queries the buzzer control status. The buzzer is used for warning or errors, see $UL command. Use the $HC command to save the setting inside the sensor.
*Examples:*
$KB 0[CR] -> *[CR][LF] (disables buzzer control)
$KB 1[CR] -> *[CR][LF] (enables buzzer control)
$KB[CR] -> *1[CR][LF] (no parameter, queries buzzer status, 0 = disabled, 1 = enabled)

**Flow Limits $FL:**
Queries lower and upper flow rate limits in liters/min. These are the warning levels used by the sensor. If the water flow rate of the sensor drops below the lower limit (or rises above the upper limit), an error condition will be generated (red LED and buzzer).
*Examples:*
$FL[CR] -> *10.0 30.0[CR][LF] (queries present lower and upper settings in liter/min)

**Get Lower Flow Rate Limit ($CV):**
Returns the lower flow rate limit in liters/minute. This is the same value returned using $FL (see above).
$CV[CR] -> 2.0[CR][LF] (returns the lower flow rate limit in liters/min)

**User Power Level Limits ($UL):**
This command sets or queries the "user power level limits". These limits are user-controlled levels which control when the sensor generates a warning and error condition (LED and buzzer) if the measured power is too high, and then clears the error condition when the measured power has dropped low enough. For example, the user could decide that the maximum power for their laser system is 50kW and that they want to see a warning when the laser reaches 45kW. They might decide that when the laser power drops below 30kW, they want the error condition to be cleared. In this example, they need to set the limits to 45kW (warning limit), 50kW (error limit) and 30kW (clear

limit). When the measured laser power reaches 45kW, a warning will be generated (flashing red LED, buzzer on-off). When the measured laser power reaches 50kW, an error will be generated (red LED and buzzer permanently on). When the power level drops below 30kW, the error condition will be cleared (green LED and buzzer off). The values set must be in the correct ascending order: the warning level must be lower than the error level, and the clear level must be lower than the warning level. The values are set in the order: power limit, error limit, clear limit as shown in the examples.
*Examples:*
$UL 45000 50000 30000[CR] -> *45000 50000 30000[CR][LF] (sets the limits as in the example, 45kW warning, 50kW error, 30kW clear, in that order)
$UL[CR] -> *45000 50000 30000[CR][LF] (queries the present settings)
$UL 70000 60000 80000[CR] -> ?BAD PARAM [CR][LF] (if the values are not in correct ascending order, clear limit < warning limit < power limit, returns an error message)

## ETHERNET COMMANDS:

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

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

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

### Network Static Settings ($NS):
Sets or queries static IP address settings stored in the local EEPROM.
Values are entered and returned in format "172.16.16.49".
When setting a new value, replies "*SAVED (need reset)", and saves the value in the local EEPROM to be used after the next reset.
If the value entered is the same as the original setting, replies "NO CHANGE".
When querying, returns the present values stored in the local EEPROM, whether or not these values are being used in practice at present.
*Parameters:*
1 - static IP address
2 - IP subnet mask

3 - IP default gateway
*Examples:*
$NS 1 -> "*IP : 172.16.16.42"
$NS 1 172.16.16.49 -> "*SAVED (need reset)"
$NS 1 172.16.16.49 -> "*NO CHANGE"
$NS 2 -> "*Subnet Mask: 255.255.255.0"
$NS 3 -> "*Default Gateway : 172.16.16.1"
*Notes:*
In all cases, new IP values will be valid only after next reset of device if using static IP address mode.

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

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

**Timeout for DHCP Lease ($TD):**
This command returns the remaining time (in seconds) for the dynamic IP address allocated by the local network, when using DHCP (dynamic IP address allocation). When not using DHCP, the command is not relevant.
*Examples:*
$TD -> *259188 [Using DHCP; 259,188 seconds or approximately 3 days, are left on the lease. The number returned will decrease by 1 every second]
$TD -> *-290 [Not using DHCP; the lease time is zero, so the time left on the lease is negative, -290 seconds, decreasing by 1 every second. 290s is the time since the device was last started up]
*Background:*
If DHCP is enabled, the device requests a new IP address whenever it powers up. Along with the IP address, the network provides a "lease time" during which the device is allowed to use the IP address allocated for it. Typically this time will be a few days or one week. After this time, the device is supposed to refresh the connection and request a new IP address from the network (in most cases, the same IP address will be allocated again).

This command returns the time remaining during which the device is allowed to use the IP address allocated, and counts down continually from the moment the IP address is allocated, with precision of one second.
In most cases the device is not likely to be connected to the network for many days at a time without a power-up or a reset; but if it is, the user’s software will need to take care to periodically refresh the connection before the timeout limit is reached.

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

**Exit from Telnet ($QU):**
Sending this command will exit the Telnet connection (only for Ethernet). For RS232, a warning message will be returned.
*Examples:*
$QU[CR] -> *OK[CR][LF] (returns the reply and then exits Telnet connection)
$QU[CR] -> ?NOT TELNET COMMAND[CR][LF] (if sent using RS232 connection)

**Keepalive Timeout ($KT)**
Sets the keepalive timeout and saves in sensor memory or gets the present keepalive timeout, in units of 5 seconds (i.e. setting the value to “10” will set a timeout of 50s). The keepalive timeout prevents unused connections locking out the sensor from the client side, the connection is automatically disconnected after the timeout time has expired with no activity on the connection. Timeout values allowed are multiples of 5 seconds, up to maximum 1275 seconds (255 x 5s = 21.25 minutes). Setting the value to zero disables the keepalive feature.
*Examples:*
$KT 7[CR] -> *7 (35s)[CR][LF] (Sets the timeout to 35 seconds)
$KT[CR] -> *7 (35s)[CR][LF] (Queries the present timeout setting, 7 units of 5s, 35 seconds)
$KT 567[CR] -> ?BAD PARAM[CR][LF] (value out of range, generates an error message)

**NOTES ON CONTINUOUS SEND MODE:**

As opposed to the more normal "Command/Reply" mode that is used for most other commands such as $SP, $VE, "Continuous Send" mode places the device into a state where it transmits data continuously to the PC without being specifically requested to. This mode can sometimes make the software support easier inside a PC application supporting the device and reduces the amount of communication overhead necessary to achieve the same thing using Command/Reply mode.
The Continuous Send mode is initiated by sending the command "$CS 2" or “$CS 3” and is terminated by sending the "$CS 1" command.

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

***Continuous Send - Power Mode ($CS 2):***
Power data is sent once a second in the same format as the $SP command. If the power is overrange then "OVER" is sent. For example:

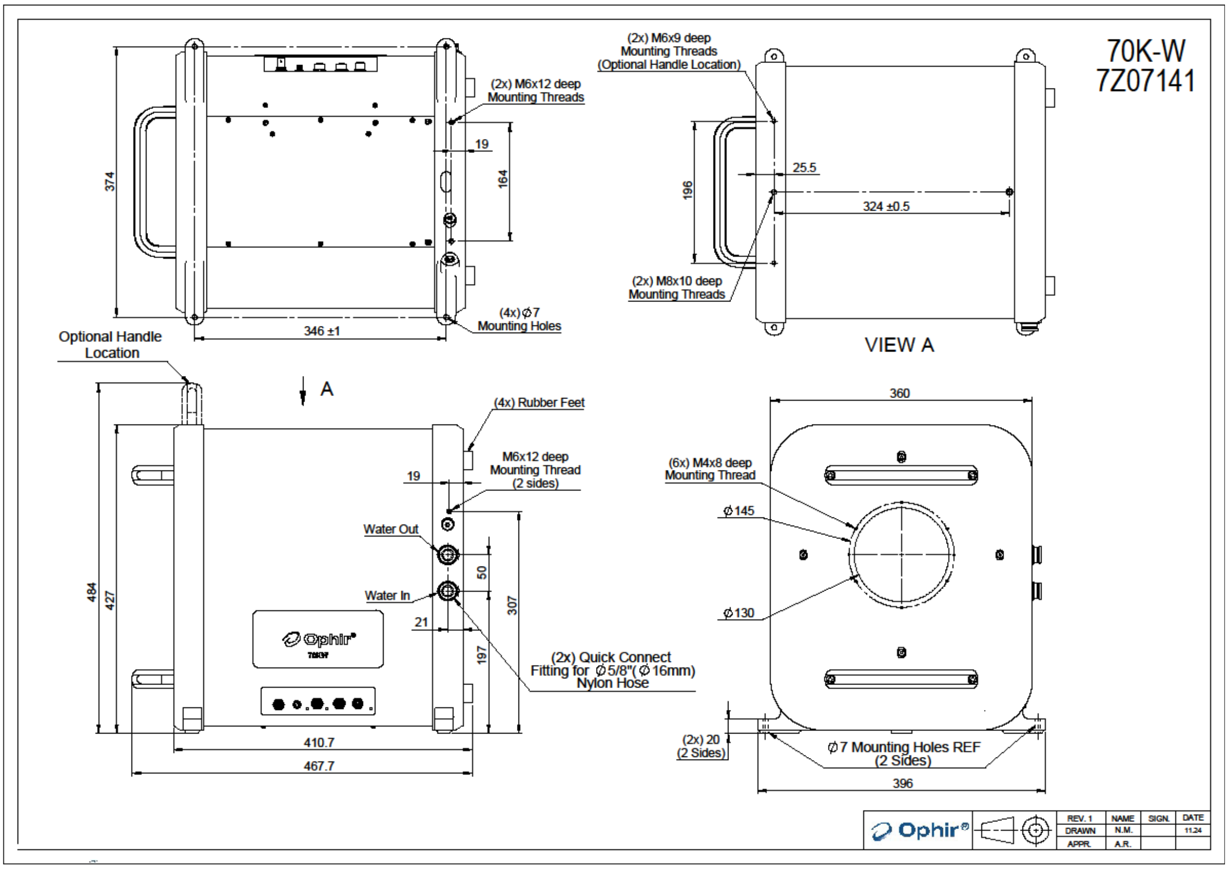
*1.234E1[CR][LF]
*1.238E1[CR][LF]
*1.245E1[CR][LF]

***Continuous Send - Full Mode ($CS 3):***
This mode sends full data from the sensor, temperature in, temperature out, water flow rate and power, once per second. For example:
*24.567 36.789 10.657 1.23456E5[CR][LF]
*24.567 36.879 10.657 1.27456E5[CR][LF]
*24.567 36.789 10.657 1.23456E5[CR][LF]

**Start Continuous Send Mode ($CS 2 or $CS 3):**
$CS 2|3[CR] -> *STARTED[CR][LF]
Starts Continuous Send mode. Data is transmitted to the PC automatically. The exact data depends on the measurement mode and the status of the device at any given moment. See notes above.

**Stop Continuous Send Mode ($CS 1):**
$CS 1[CR]
Sending CS 1 stops continuous send mode. Note that while a reply "*STOPPED" will be given to this command, it will be mixed in with all the other data transmitted by the device before the Continuous Send mode was stopped. Before sending any more commands and receiving "normal" replies in the Command/Reply mode, the receive buffer of the PC or host device must be flushed by continuously reading data until there is a "time-out". The time-out in the software should be set short enough to avoid the software needing to wait a long period of time after the data stops arriving.

# 6 Drawings


70K-W
7Z07141
(2x) M6x12 deep
Mounting Threads
374
19
164
346 ±1
(4x) Ø7
Mounting Holes
Optional Handle
Location
(2x) M6x9 deep
Mounting Threads
(Optional Handle Location)
25.5
196
324 ±0.5
(2x) M8x10 deep
Mounting Threads
VIEW A
A
(4x) Rubber Feet
M6x12 deep
Mounting Thread
(2 sides)
19
Water Out
Water In
50
21
307
197
484
427
(2x) Quick Connect
Fitting for Ø5/8"(Ø16mm)
Nylon Hose
410.7
467.7
360
(6x) M4x8 deep
Mounting Thread
Ø145
Ø130
(2x) 20
(2 Sides)
Ø7 Mounting Holes REF
(2 Sides)
396
Ophir
REV. 1
NAME
SIGN.
DATE
DRAWN
N.M.
11.24
APPR.
A.R.

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