

QMB6 - DUAL Quartz Thin Film Monitor

## Quartz Monitor HOQM20

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Server connected Device connected Selected device: My device 2 Version: 3.0.5

Monitor Chart Materials Settings **Logger**

Sensor 1 Sensor 2

Material: Au - Gold Material: Cu - Copper

Frequency: 5999560.08 Hz Frequency: 59995626.06 Hz

nm  
62 nm/s

Clear

Code	Date	Message
0x0081	Mon Jan 9 19:30:14 2017	Unable to read crystal status (channel 1)
0x0001	Tue Jan 10 07:06:08 2017	Unable to open TCP port.
0x0101	Tue Jan 10 07:06:10 2017	Connected with device.
0x0001	Tue Jan 10 07:07:23 2017	Unable to open TCP port.
0x0101	Tue Jan 10 07:07:24 2017	Connected with device.
0x0100	Tue Jan 10 07:25:36 2017	Connected with service driver.
0x0089	Tue Jan 10 09:01:50 2017	Unable to read firmware version
0x0101	Tue Jan 10 09:01:50 2017	Connected with device.
0x0101	Tue Jan 10 09:44:42 2017	Connected with device.

Clear

100%



# USER MANUAL

SOFTWARE QUARTZ MONITOR HOQM20 ver 3.0.11  
rev 1.5

VACUUM TECHNOLOGY  
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# 1 INTRODUCTION

*HOQM20 Quartz Monitor* software measures film thickness and rate during a thin film deposition process. The application displays information about the measured values of thickness of the deposited layer and also the deposition rate for two separate channels

The software allows monitoring and display of live deposition data in chart format, data logging and also historical data review. The application supports remote monitoring via a computer or tablet with LAN connection. Remote monitoring is achieved simply by running the QM application as server on any computer which is connected to the QM device. If server hasn't been installed yet (for example during software installation), it is automatically installed and run during first run application with administrator privileges. Next we have to run Quartz Monitor on tablet or computer where we want lead monitoring deposition process by entering the communication parameters of server.

Quartz Monitor Server is run as service of windows and it is transparency.

## 2 SYSTEM REQUIREMENTS

HOQM20 Quartz Monitor supports Windows 7, Windows 8 and Windows 10.

The program automatically adapts itself to the operating system on which it runs, eliminating the need for manual settings.

Recommended system configuration:

- CPU - Intel Pentium or processor equivalent to industry standards with 500 MHz or faster
- Memory - 128 MB RAM
- Hard drive - 15 MB free hard disk space .
- Operating Systems - Windows 7, Windows 8 and Windows 10

## 3 INSTALLATION

### 3.1 SOFTWARE

In order to install software run the *HOQM20 Setup x.x.x file*. Installation wizard will open.

**Notice:** Installation should be run with administrator privileges.

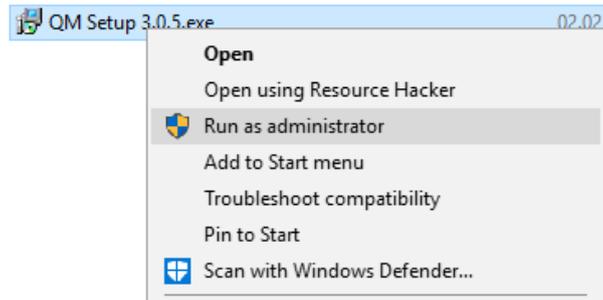


Figure 3.1: Run install with administrator privileges

Follow the direction in the installation wizard.

1. Select destination location where should *Quartz Monitor* be installed.

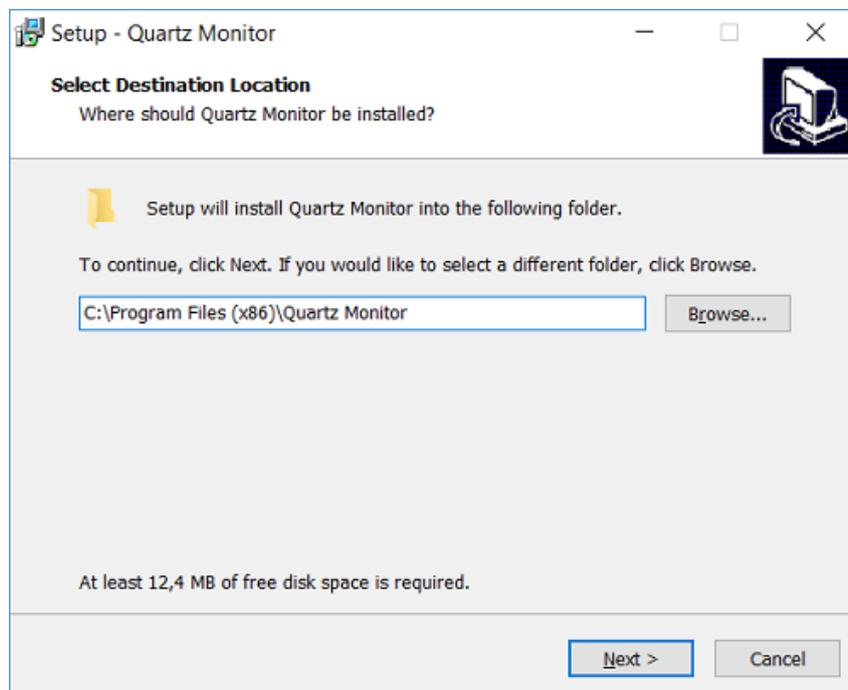


Figure 3.2: Select location of software

2. Select additional shortcuts for application on desktop.

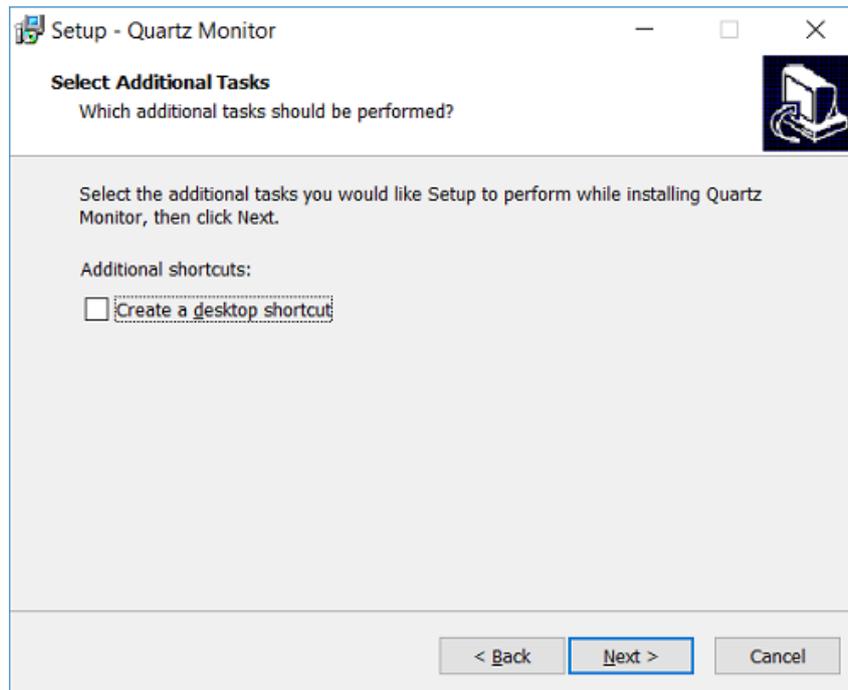


Figure 3.3: Select additional shortcuts

3. Install application.

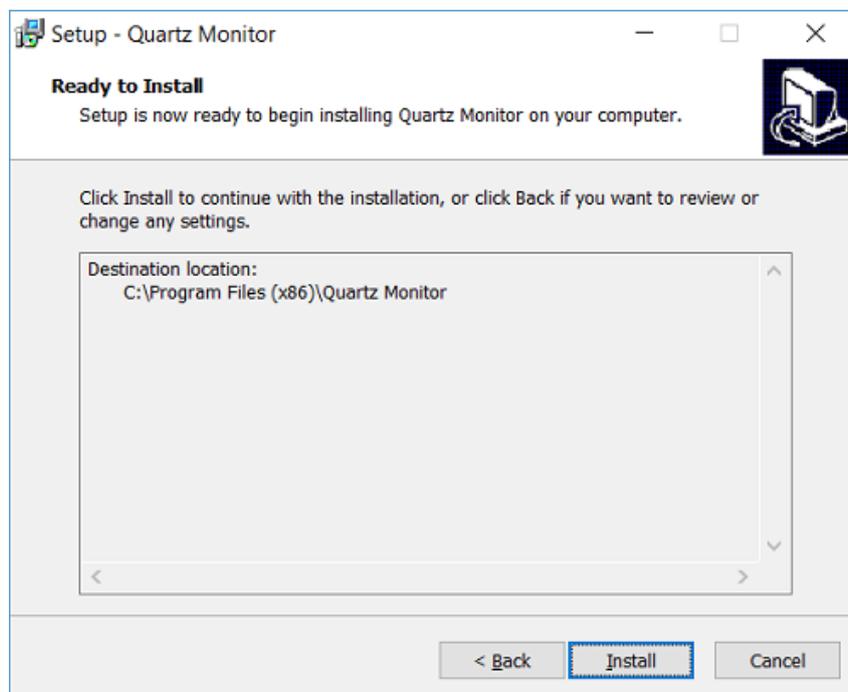


Figure 3.4: Ready to install

## 4. Application install in progress.

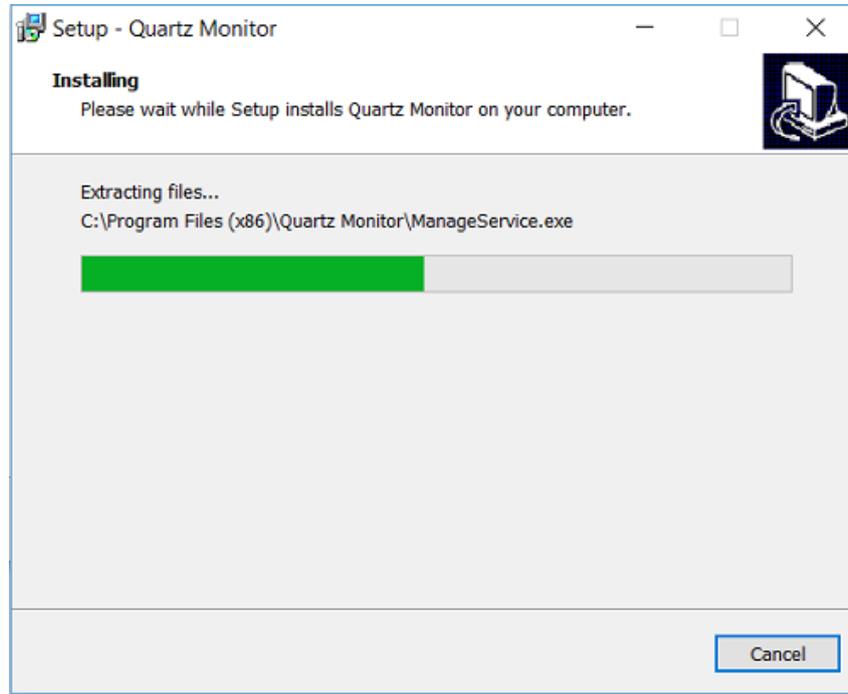


Figure 3.5: Install in progress

## 5. Install driver for USB.

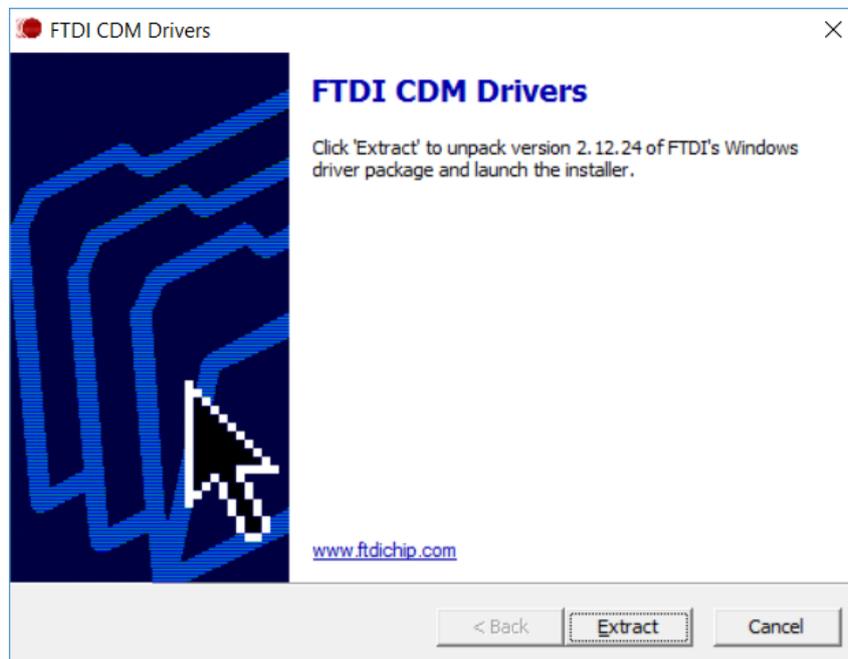


Figure 3.6: Install driver USB

6. Extract required files

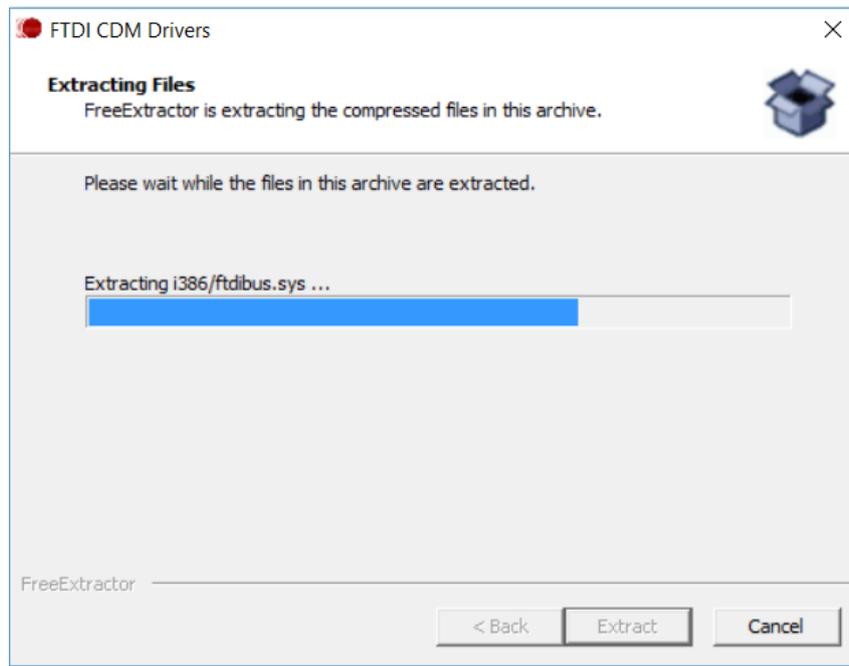


Figure 3.7: Extract required files for USB driver

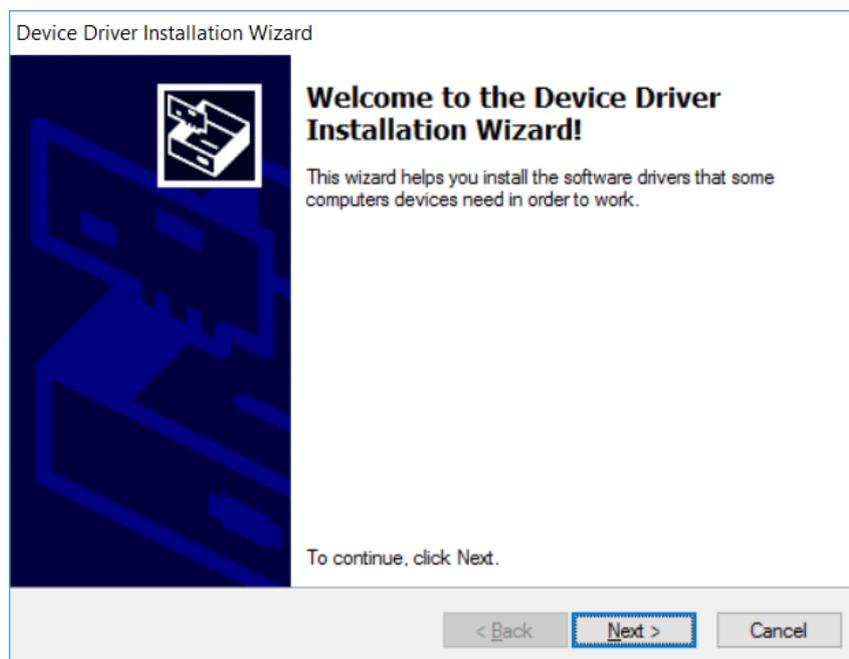


Figure 3.8: Finished extract files driver USB

## 7. License agreement

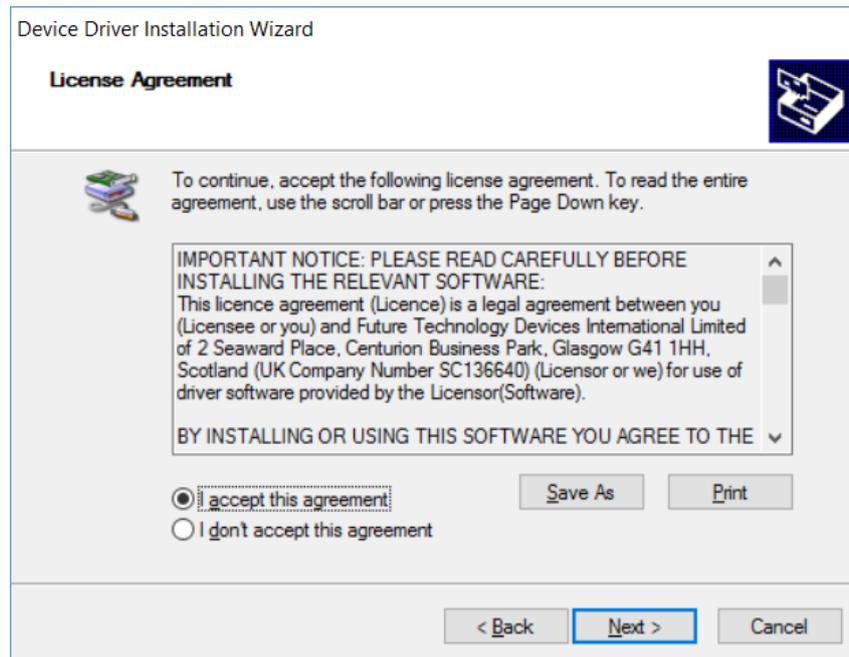


Figure 3.9: License agreement for Install driver USB

## 8. Install USB driver finished

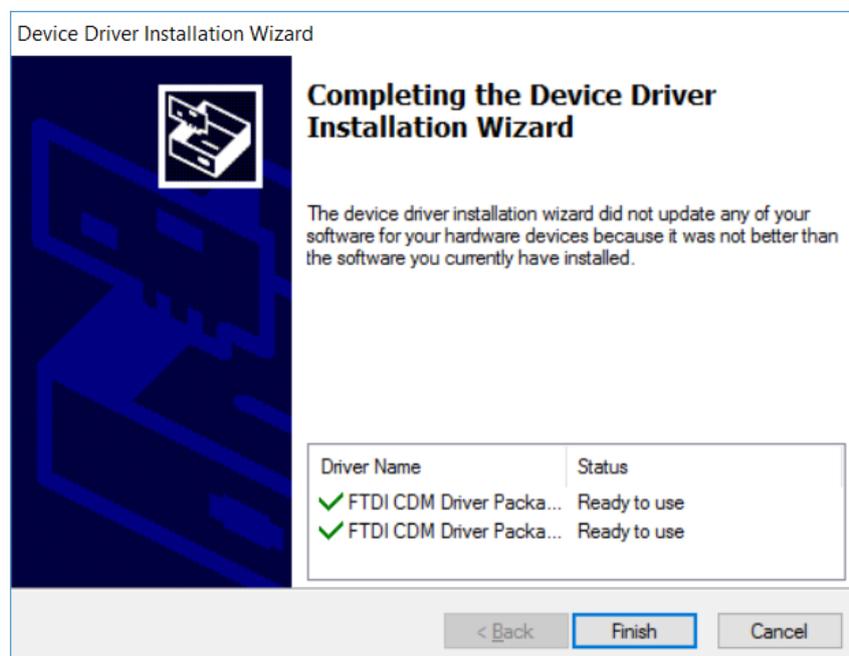


Figure 3.10: Install driver USB finished

9. Install program finished.

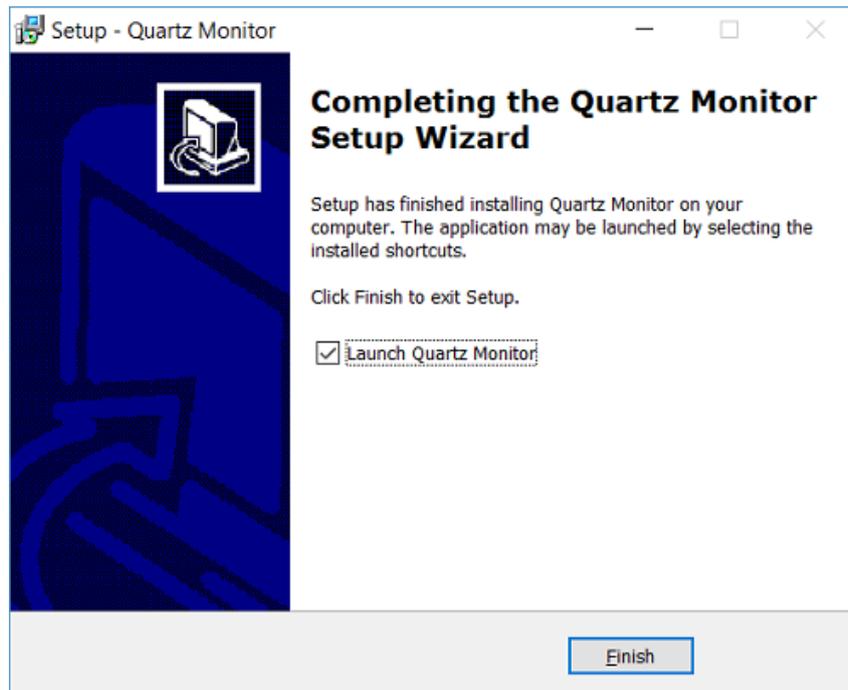


Figure 3.11: Install finished

## 3.2 DEVICE

Device installation is required when HOQM20 have hardware RS 232 / RS 485 / USB to communicate with computer. Then to correctly communicate HOQM20 with software you should check:

- if the USB drivers has been installed correctly (only in case of USB hardware)
- what is number of COM port

### 3.2.1 USB DRIVER INSTALATION

To install drivers for USB hardware follow the steps below:

1. Conect HOQM20 to USB of computer
2. Open *Device Manager* - in order to open window *Device Manager* click right button of mouse in *Windows Start* and select *Device Manager* with list which will be showed.

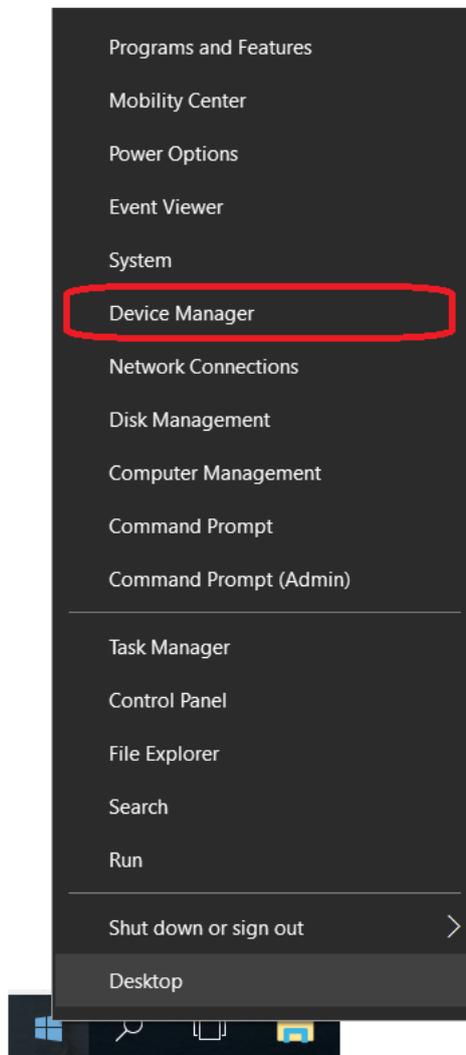


Figure 3.12: Open device manager

3. Check If drivers has been installed automatically - when driver has been installed automatically by system, in window *Device Manager* section *Ports (COM & LPT)* you could found registration: *USB Serial Port (COM x)*. That means, USB driver has been installed successfully.

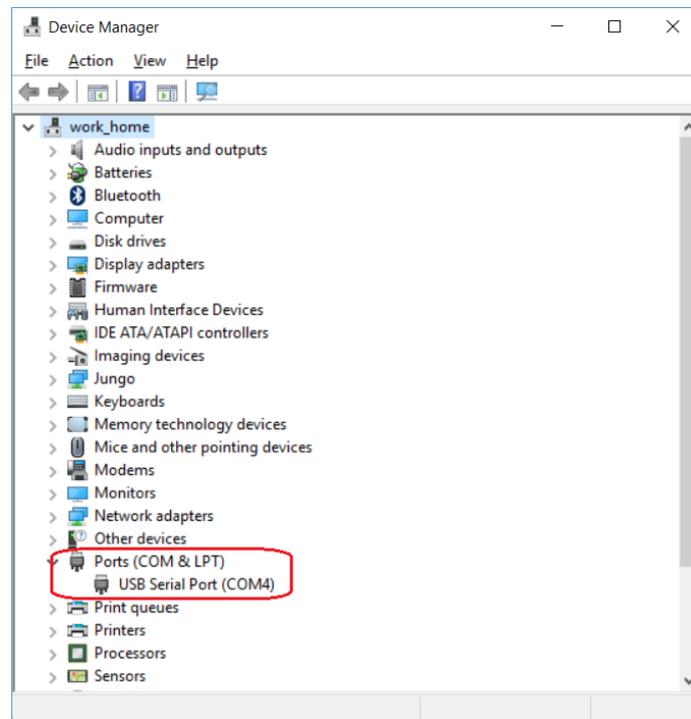


Figure 3.13: Driver USB installed

Otherwise you see exclamation mark beside not installed device. Then you have to install USB driver manually.

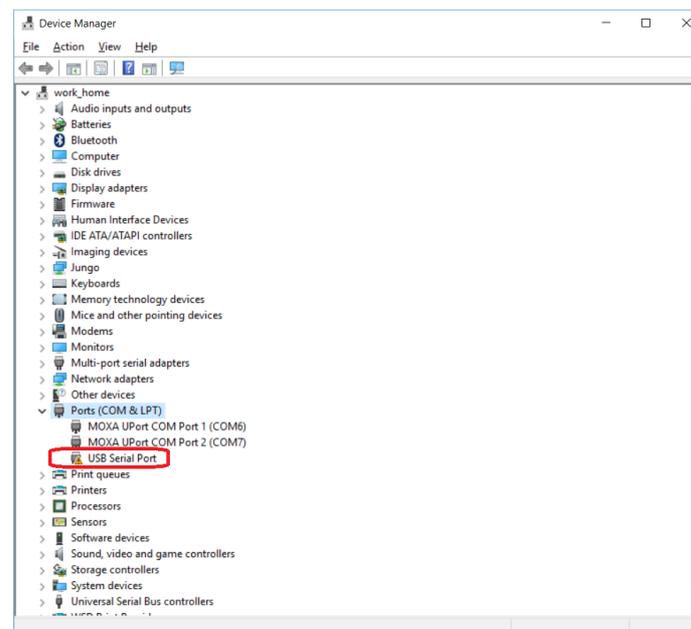


Figure 3.14: Driver USB no installed

4. Install driver USB manually - in order to install driver USB manually follow the steps below.
  - (a) select USB device to install - select device to install driver by click right mouse button. From popup menu choose *Update Driver Software*.

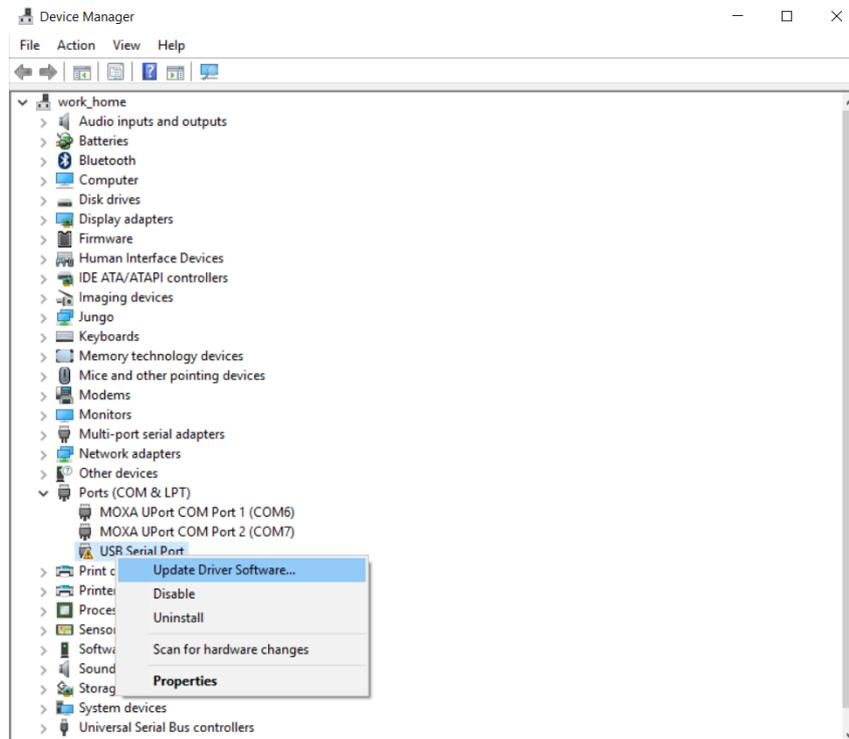


Figure 3.15: Select USB device to install

- (b) choose option *Browse my computer for update driver software*

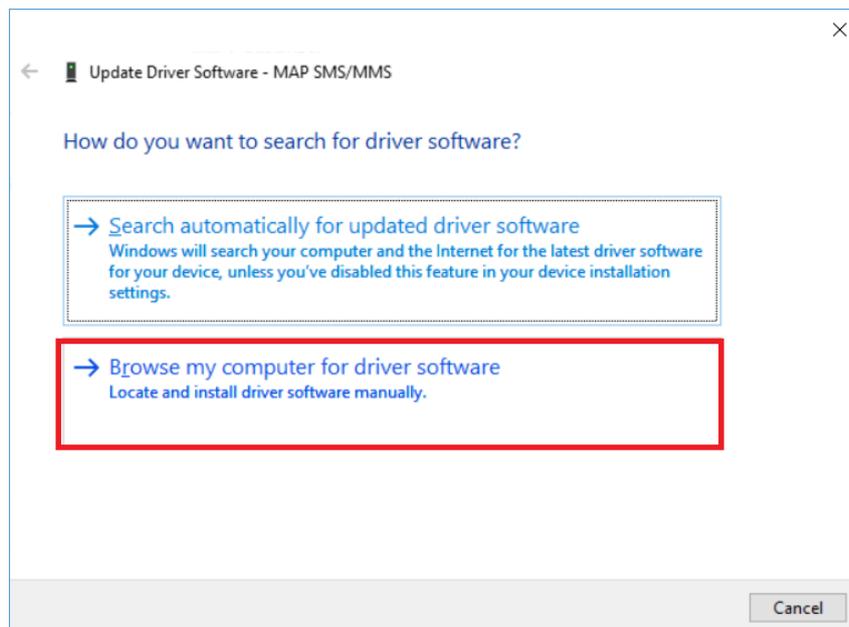


Figure 3.16: Choose manually option

- (c) select folder that contains files driver for HOQM20 . Driver files has been installed during software installation. You can find him in program directory (default: *c:\Program Files (x86)\Quartz Monitor\Drivers*)

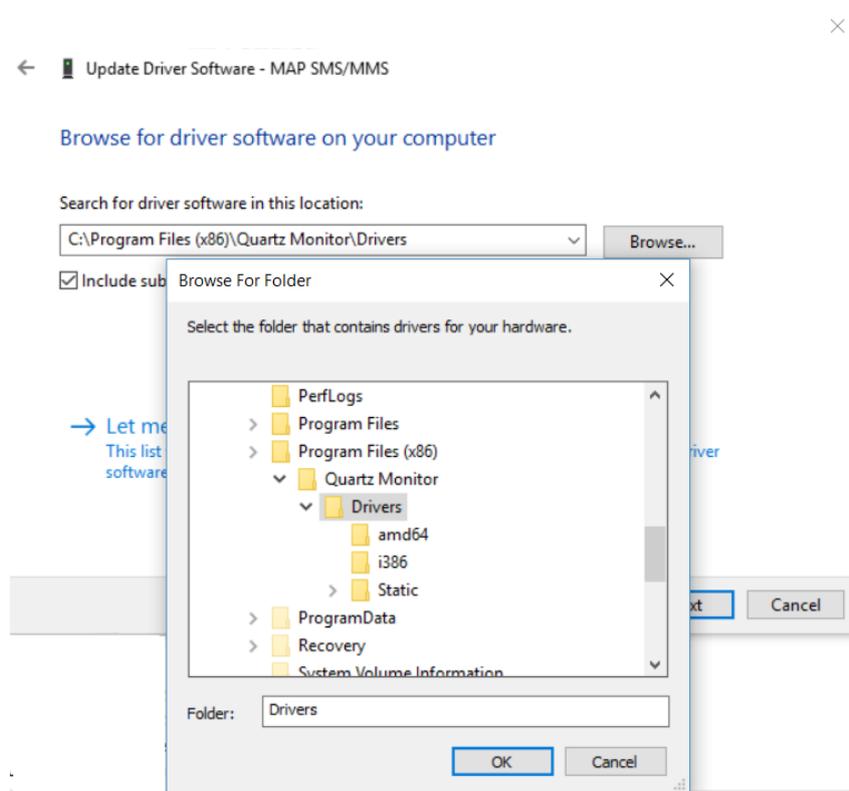


Figure 3.17: Select location files driver of USB

- (d) confirm location of USB driver files by click *Next*

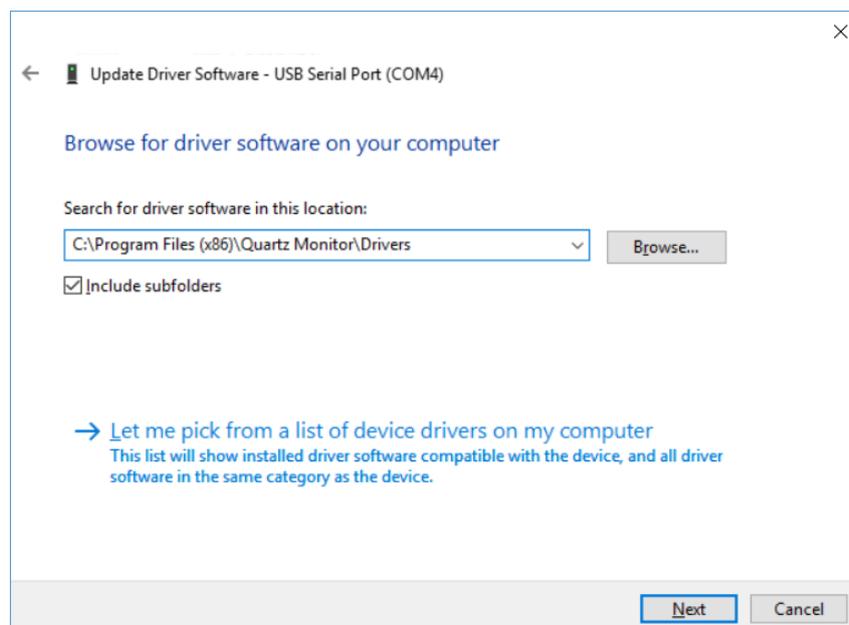


Figure 3.18: Confirm driver USB location

(e) finished

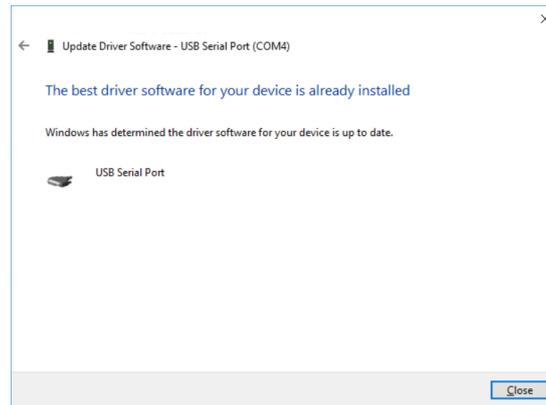


Figure 3.19: Install driver USB finished

### 3.2.2 CHECK COM PORT NUMBER

In order to read port COM number which was set automatically by system for HOQM20 during connected interface of device to computer you have to open window *Device Manager* (how open *Device Manager* see chapter 3.2.1 *USB Driver Installation*) and read from section *Port (COM & LPT)* number of COM. Number of COM is required to correctly fill communication parameters during configuration device for serial port interface.

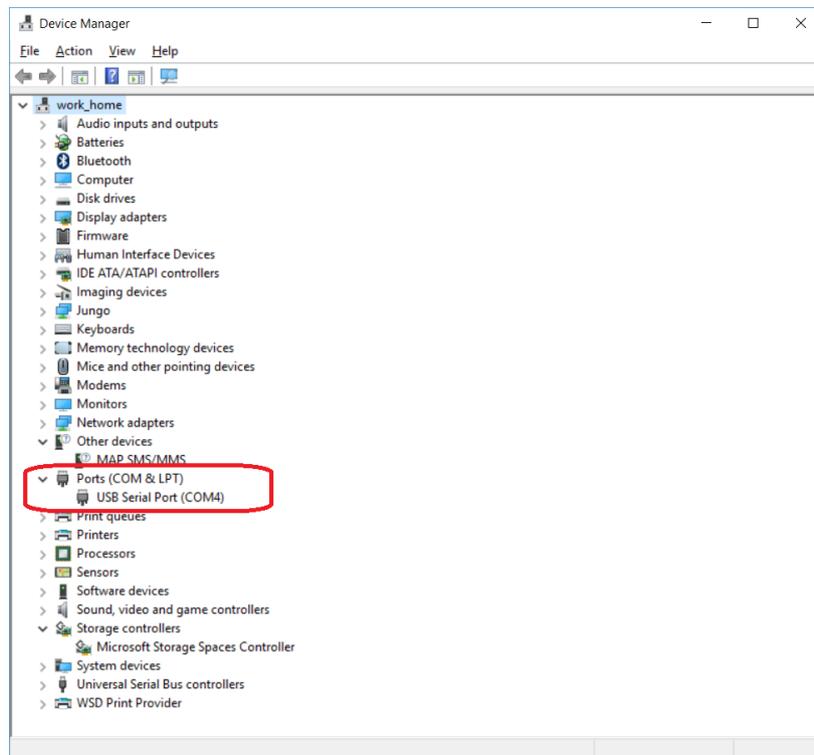


Figure 3.20: Check number port COM

COM port number you find in bracket beside text *USB Serial Port*. From example above you can recognize port as **COM4**.

## 4 USING SOFTWARE

### 4.1 RUN APPLICATION

In order to run application *HOQM20 Quartz Monitor* go to directory path where software has been installed and run file *HOQM20.exe* . Default install path is "*C:/Program Files (x86)/Quartz Monitor*". Application first check If server (service) has been correctly installed and runned. When one of those things wasn't executed, program automatically make required steps but need administrator privileges. When program not have administrator privileges, user will be informed. In this situation, program should be close and run with administrator privilege. This operation allows to transparency installed and started server as windows service.

For this purpose, click right mouse button on file *HOQM20.exe* and select option *Run as administrator*

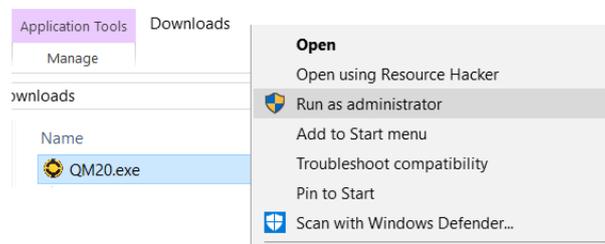


Figure 4.1: Run application as administrator

*ManageService* can be used to check correct installation and run server. This software is a part of tools which was installed during the application installation. It can be found in the main application directory (default directory path *C:/Program Files(x86)/Quartz Monitor/ManageService.exe*).

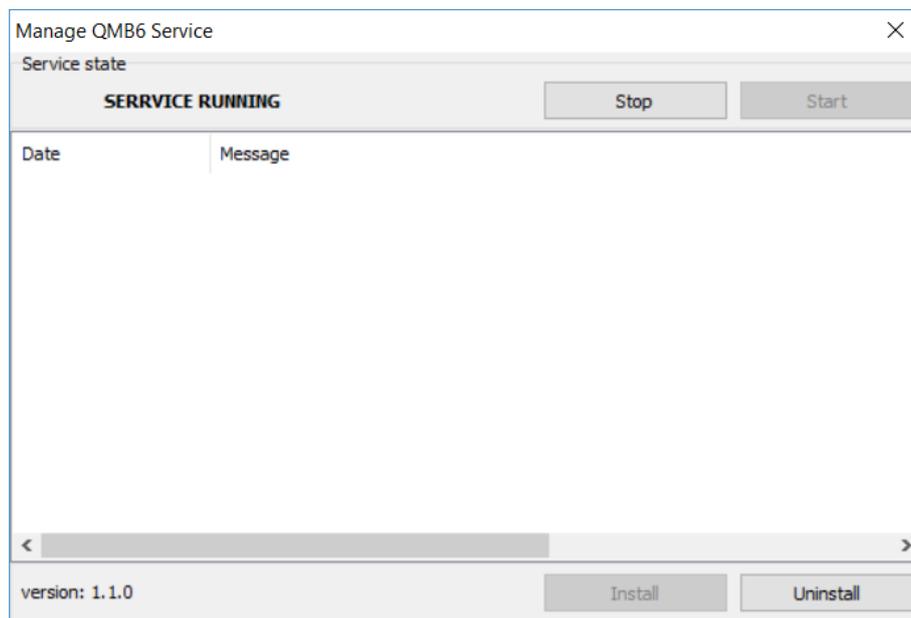


Figure 4.2: Manage server

Software *ManageService* can read and control the state of the server. Possible states of server are:

- *SERVICE NOT INSTALLED*
- *SERVICE STOPPED*
- *SERVICE RUNNING*

For correct operation of application *HOQM20 Quartz Monitor* service (server) must be running. Field *Service state* should display as *SERVICE RUNNING*. When service (server) is in another state we should install and start it. Both operation can be made using corresponding button:

- *Install* - allows to install software when is not installed
- *Start* - allows to start service (server)

## 4.2 CONFIGURE COMMUNICATION

### 4.2.1 CONFIGURE SERVER

In order to configure server connection open tab *Settings/Communication/Server*. There are two ways to achieve communication with server. The first method is to enter the communication parameters when these are already known. Parameters should be enter to fields:

- *IP Address Service Drive*
- *Port Service Drive* (default port is 5555)

The second method is to scan the network for looking servers by click button *Scan network for servers*. The server is selected once it is found.

After filling in the required fields, click button *Connect to server*.

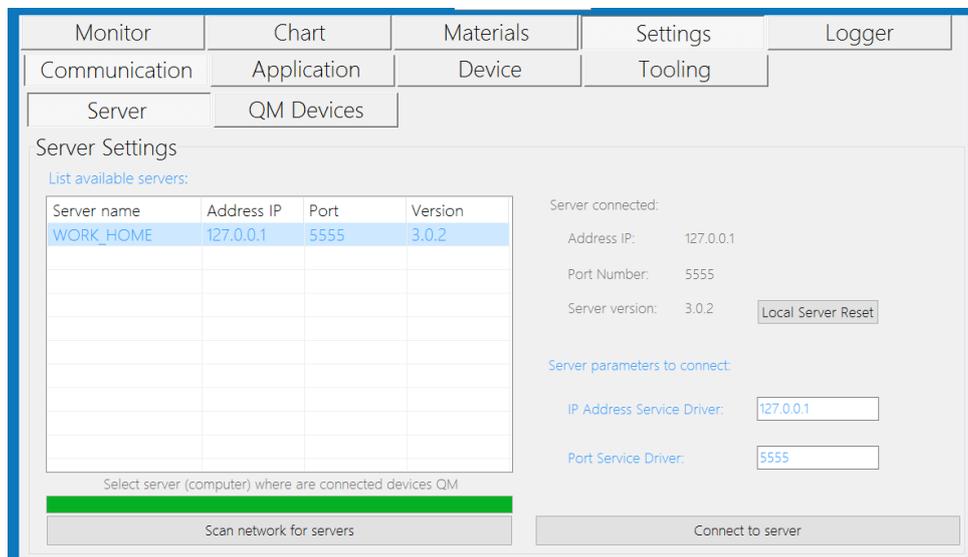


Figure 4.3: Server settings

After correctly setting parameters we should have communication with server. State of communication server will be displayed in main window of software.



Figure 4.4: Server connection state

## 4.2.2 CONFIGURE DEVICE

Each server contains its own list of devices. To create or configure device, open the tab *Settings/Communication/QM Devices*. First operation is to create a new device by click *New Device*. In this window type name of device and defined type of device.

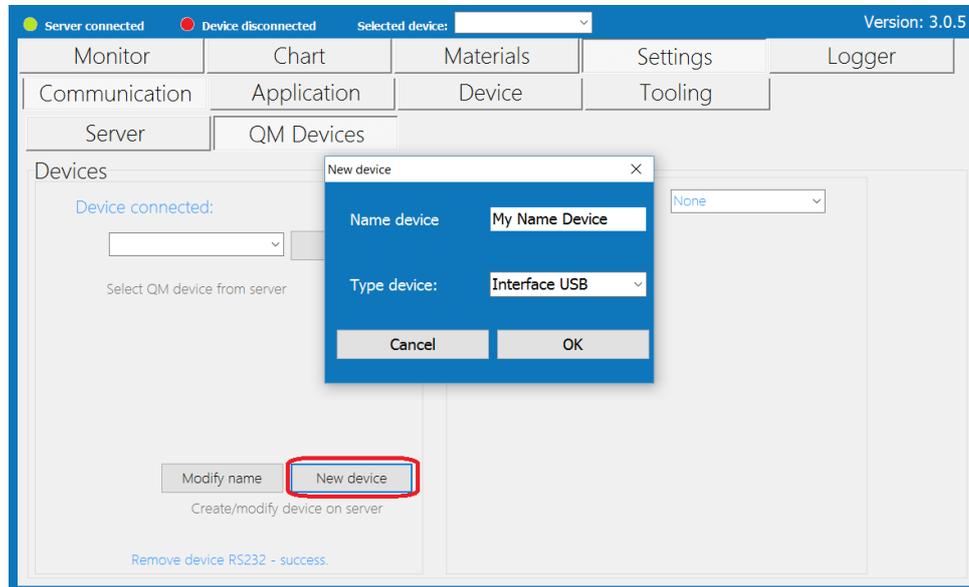
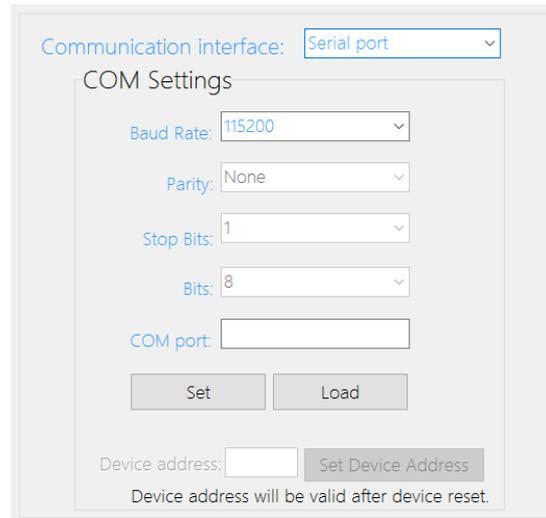


Figure 4.5: Create device

Communication parameters are defined once the device is created. The list of parameters which need to be filled depends on communication interface of device.

- Serial port :
  - Baud Rate: speed data exchange with device (default is 115200)
  - COM Port: number of COM port which was set by system for HOQM20 during connect device to computer (how can check this value was described in chapter 3.2.1 *CHECK PORT COM NUMBER* . When drivers for device is not installed you have to first install them. How do it was described in chapter 3.2.2 *USB DRIVER INSTALLATION* ).



Communication interface: Serial port

COM Settings

Baud Rate: 115200

Parity: None

Stop Bits: 1

Bits: 8

COM port:

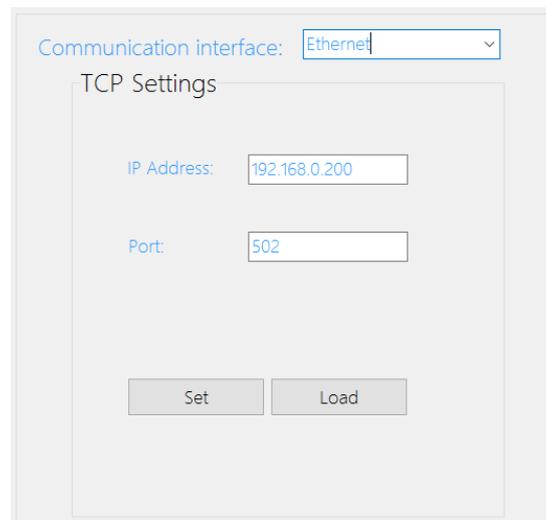
Set Load

Device address: Set Device Address

Device address will be valid after device reset.

Figure 4.6: COM Settings

- Ethernet
  - IP Address: address IP of device HOQM20
  - Port: port number of device HOQM20



Communication interface: Ethernet

TCP Settings

IP Address: 192.168.0.200

Port: 502

Set Load

Figure 4.7: TCP Settings

After correctly creating the device and configuring the parameters we should have communication with device. State of communication device is displayed in main window of software.



Figure 4.8: Device connection state

## 5 DEPOSITION PROCESS MONITOR

Data generated during deposition process can be monitoring from tab *Monitor* for two separate channels. For each channel we have possibility measure time duration of deposition process and follow average evaporation rate. Time and average evaporation rate are calculated from moment click button *Start*. Button *Clear* reset a time and average rate.

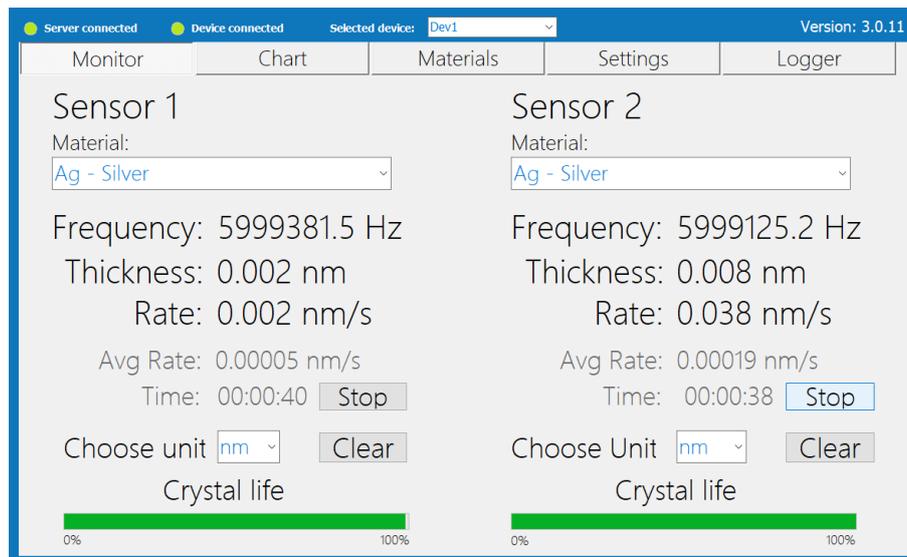


Figure 5.1: Quartz monitor

Parameters which can be monitored are:

- Cristal frequency
- Thickness layer
- Thickness rate

To correctly read data we should have connected quartz oscillator to device HOQM20 . In normal operation the *Frequency* value is displayed, otherwise the *Crystal Fail* error message is displayed which means that either the crystal isn't connected or the crystal should be exchanged.

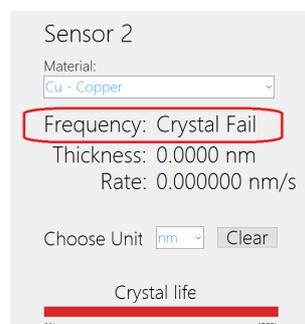


Figure 5.2: Cristal fail

Thickness and rate deposited layer can be calculated when material was selected. When material isn't chosen, thickness and rate will be 0. When we want check material parameters or change it, we should go to tab *Materials*

Thickness and rate can be displayed in one of the following units:

- nm
- A
- kA

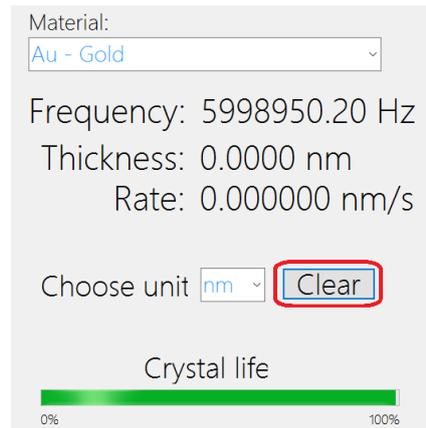


Figure 5.3: Clear thickness

**Notice:** When we start deposition process we should clear current calculated thickness deposited layer using the clear button. Otherwise calculated thickness can be wrong.

In addition to frequency, thickness and rate we are informed about state of crystal. Current state of crystal is shown as value in percent. Information can be displayed in two different forms:

- lifetime - decrease of quartz is shown from 100 percent to 0

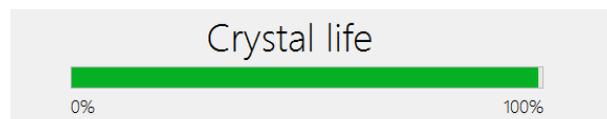


Figure 5.4: Crystal liveliness

- use - used of quartz is shown from 0 to 100 percent

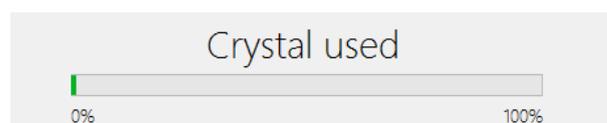


Figure 5.5: Crystal use

## 6 COLLECT DATA

### 6.1 ACQUISITION DATA

Before starting data acquisition we should configure path of directory where deposition process data files will be created. This is done from tab *Settings/Application*. The section *Acquisition data* can be found and is where the path is defined. In order to save data to log file field *Live data log* should be checked.

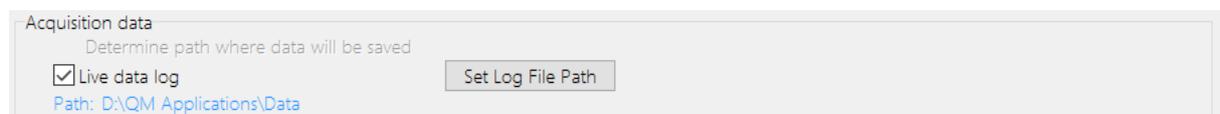


Figure 6.1: Configure acquisition

**Important:** Until path is defined or field *Live data log* will not be checked, the data will not be saved.

For data acquisition proceed to tab *Chart*. Tab contains tools button which allows control of data acquisition. To control data acquisition we should use tools button *Start / Stop*.

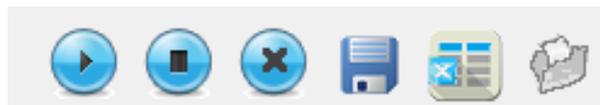


Figure 6.2: Control acquisition

Each data acquisition process is saved in a separate file. Name of file is generated automatically and contains date and start time of process. As the data acquisition process we understand each range time between start and stop data chart.

**Notice:** When data are saved in log file, path of output file is shown below chart.

## 6.2 CHART

Chart displays measured data as a function of time. New data is automatically added to the chart.

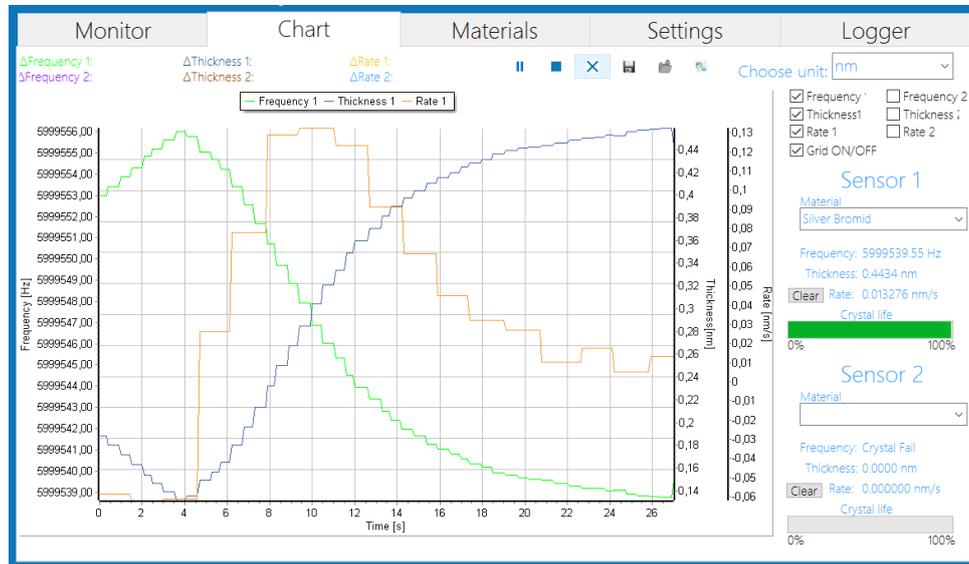


Figure 6.3: Chart

To start drawing of chart we use the same button from acquisition process. Chart data can be paused and cleared.

Log file data can be loaded and displayed on the chart using one of tools button.

All saved data can be viewed on the chart. Note that although the chart allows to display selected series data, all data is automatically saved even if isn't displayed. Live data are saved to a binary file and can be exported to a spreadsheet via the tools button. The unit field is used to change the displayed unit on the chart and also to change the displayed material.

## 6.2.1 ZOOM

### 6.2.1.1 ZOOM IN

To zoom in on a region of the chart, click and hold the left mouse button whilst dragging the mouse from upper left to bottom right corners.

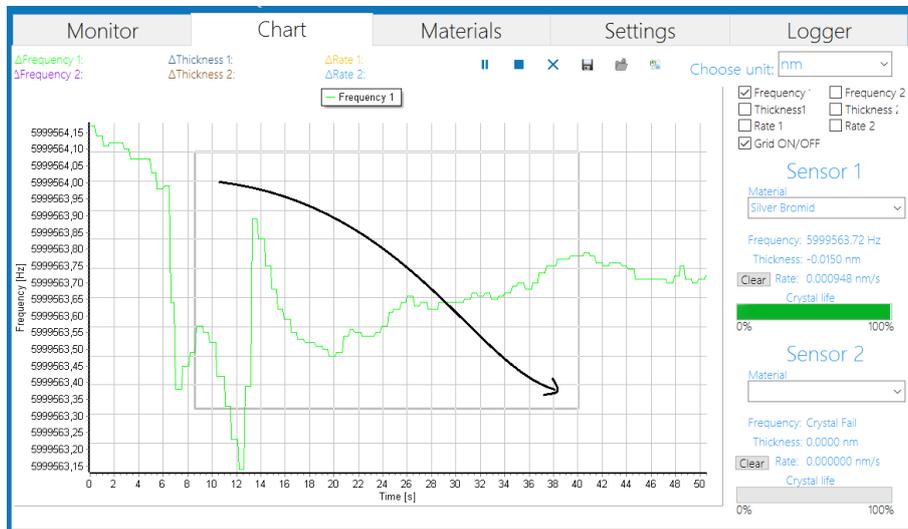


Figure 6.4: Zoom in

### 6.2.1.2 ZOOM OUT

To zoom out, click and hold the left mouse button whilst dragging the mouse from bottom right to upper left corners.

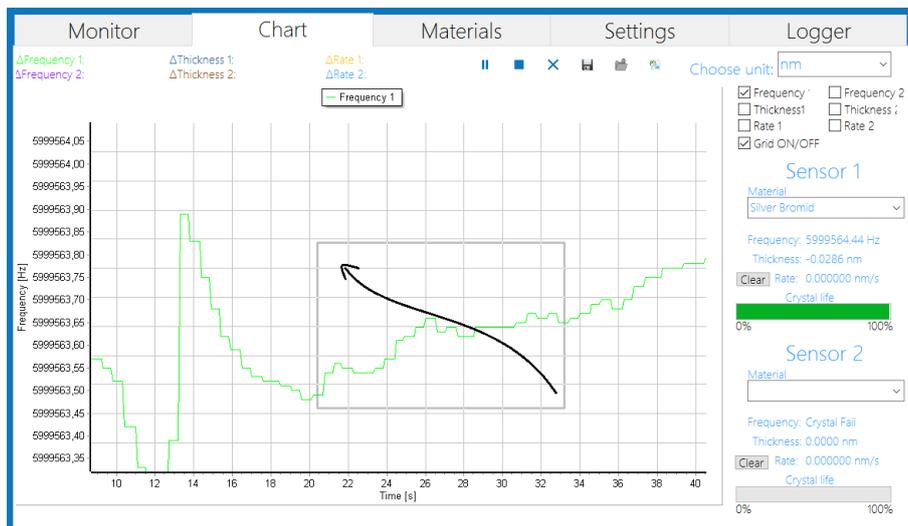


Figure 6.5: Zoom out

Chart data can also be moved. In order to move chart data we should click right mouse button and move mouse.

## 6.2.2 SELECT POINT

User has possibility read value in interesting place or measure a difference between two points.

In order to check value interesting point user should click on series data.

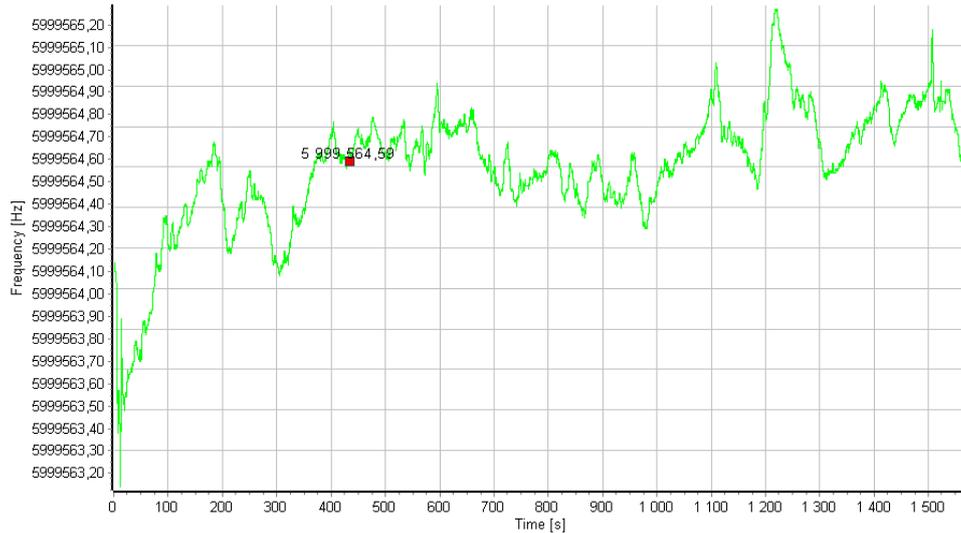


Figure 6.6: Selected point

The next selected point causes a calculation of the difference between two point. Value of difference is shown in upper area window (see red frame)

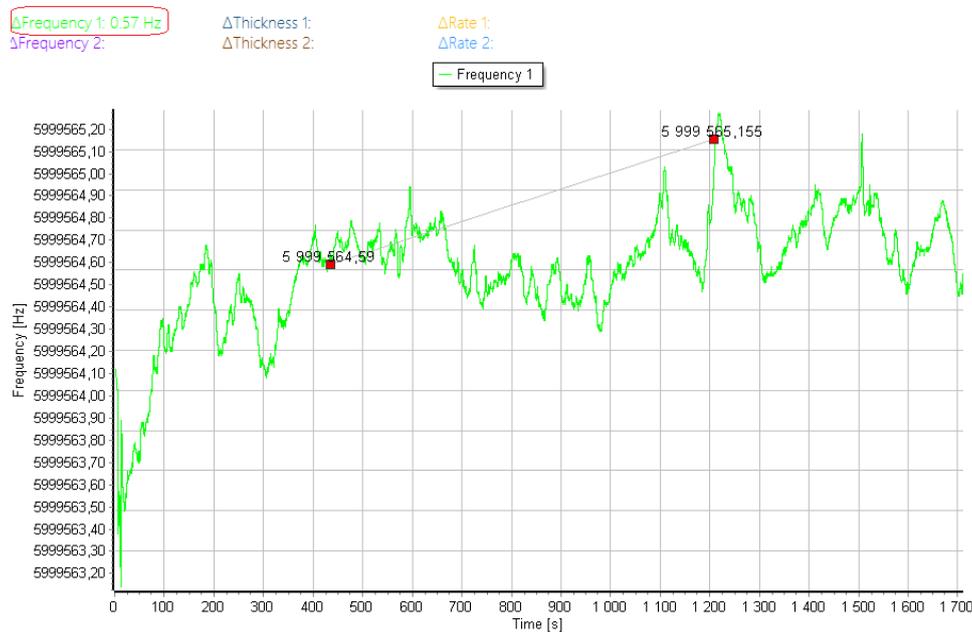
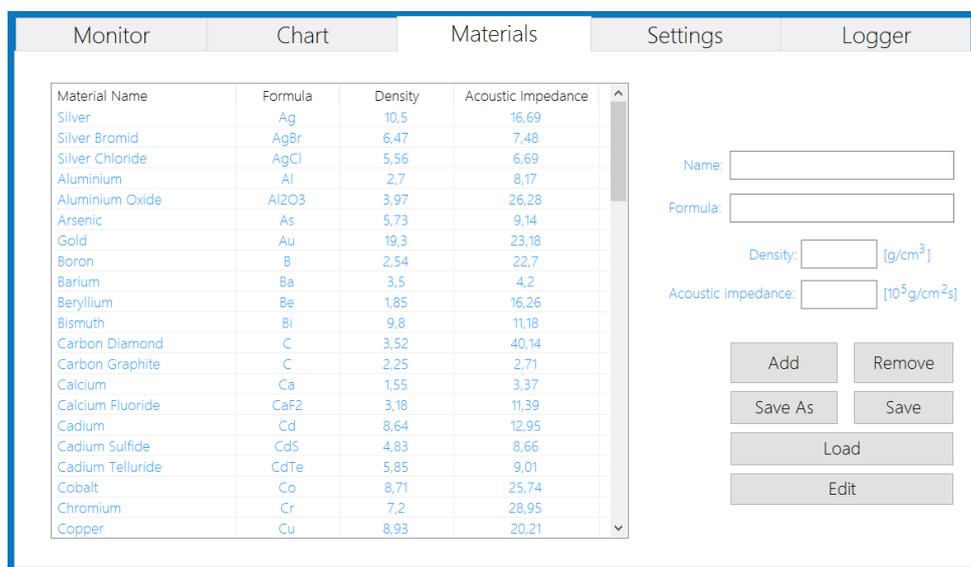


Figure 6.7: Difference between points

## 7 MATERIALS

Tab contains list of materials. Each material is defined as:

- material name
- formula
- density
- acoustic impedance.



Material Name	Formula	Density	Acoustic Impedance
Silver	Ag	10,5	16,69
Silver Bromid	AgBr	6,47	7,48
Silver Chloride	AgCl	5,56	6,69
Aluminium	Al	2,7	8,17
Aluminium Oxide	Al2O3	3,97	26,28
Arsenic	As	5,73	9,14
Gold	Au	19,3	23,18
Boron	B	2,54	22,7
Barium	Ba	3,5	4,2
Beryllium	Be	1,85	16,26
Bismuth	Bi	9,8	11,18
Carbon Diamond	C	3,52	40,14
Carbon Graphite	C	2,25	2,71
Calcium	Ca	1,55	3,37
Calcium Fluoride	CaF2	3,18	11,39
Cadmium	Cd	8,64	12,95
Cadmium Sulfide	CdS	4,83	8,66
Cadmium Telluride	CdTe	5,85	9,01
Cobalt	Co	8,71	25,74
Chromium	Cr	7,2	28,95
Copper	Cu	8,93	20,21

Figure 7.1: Materials

Fields such as *Density* and *Acoustic impedance* are used for calculated deposition process parameters.

User can add, remove and edit material. To edit material we should select item, change value and click button *Edit*. To save list of materials we have two possibilities:

- save in current file via click button “Save”
- save in new file click button “Save As”

## 8 SETTINGS

Tab contains settings for application and device.

### 8.1 COMMUNICATION

Tab contains settings about communication with server and devices

#### 8.1.1 SERVER

Tab contains information about server to which the application is connected, list of available servers to connect which are shown after scanned network and fields of communication parameters with server. To scan available servers we should click button *Scan network for servers*. All computers connected to the same local network of client are searched to find a server. To connect with server we should fill communication parameter fields and click button *Connect to server*.

Server name	Address IP	Port	Version
WORK_HOME	127.0.0.1	5555	3.0.2

Server connected:

Address IP: 127.0.0.1

Port Number: 5555

Server version: 3.0.2

Server parameters to connect:

IP Address Service Driver:

Port Service Driver:

Select server (computer) where are connected devices QM

Figure 8.1: Server settings

#### 8.1.2 QM DEVICES

Tab contains list available devices on server and gives us possibility to create new device, modify or remove selected device and configure communication parameters of selected device.

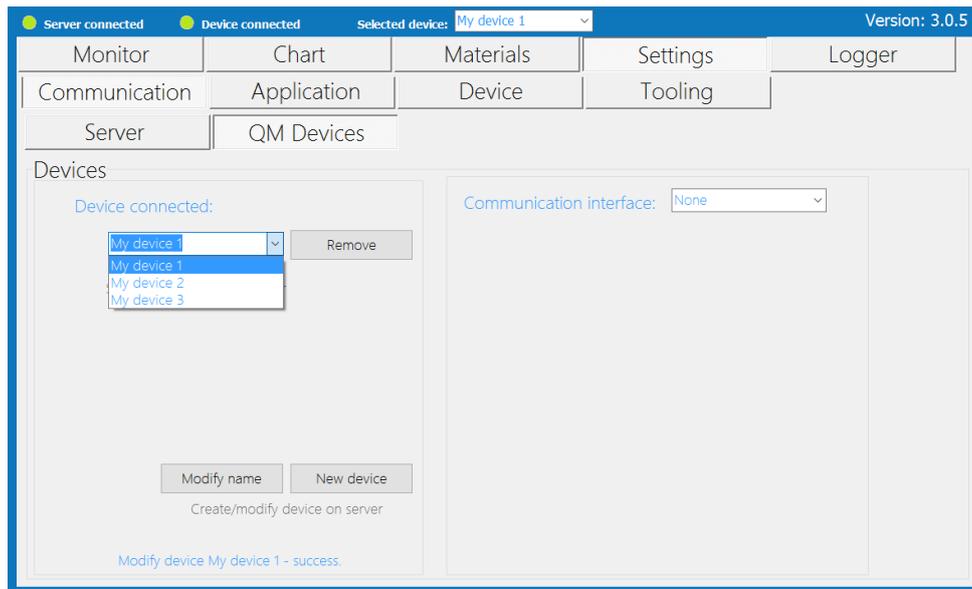


Figure 8.2: Server devices

In order to obtain communication with device, user should choose the correct communication interface according to the device type and then input the appropriate parameters. Interface choices are:

- Serial port
- Ethernet

#### 8.1.2.1 SERIAL PORT

Section contains communication parameters with HOQM20 which has hardware interface: USB / RS 232 / RS 485.

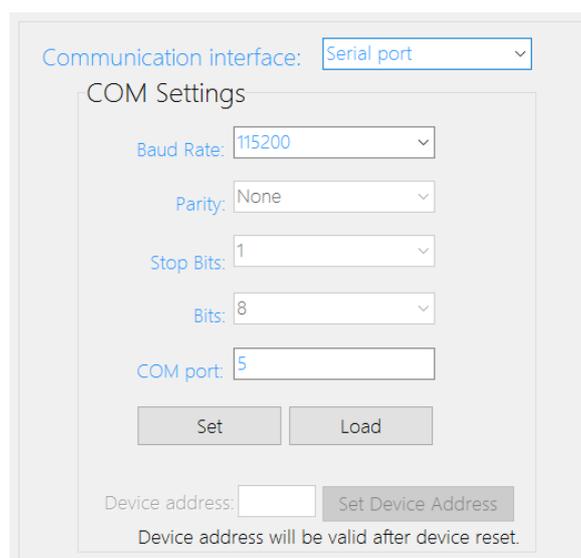


Figure 8.3: Serial port settings

In order to obtain communication user should correctly set the following parameters:

- baud rate
- COM port

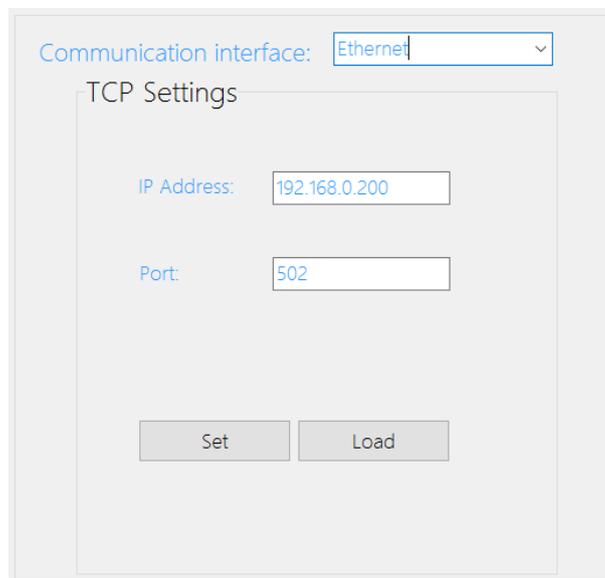
Parameters such as: parity, stop bits and data bits have default value and can't be changed.

**Important:** Default baud rate is 115200.

In the case of the RS485 interface, the device address can also be set using field "Device address" and button "Set Device Address"

### 8.1.2.2 ETHERNET

Tab contains communication parameters with HOQM20 which has Ethernet.



The screenshot shows a software interface for configuring communication parameters. At the top, there is a dropdown menu labeled "Communication interface:" with "Ethernet" selected. Below this is a section titled "TCP Settings" which contains two input fields: "IP Address:" with the value "192.168.0.200" and "Port:" with the value "502". At the bottom of the "TCP Settings" section, there are two buttons: "Set" and "Load".

Figure 8.4: Ethernet settings

In order to obtain communication user should correctly set communication parameters:

- IP address
- Port.

**Important:** Port default is 502

## 8.2 APPLICATION

Tab contains settings of crystal life, chart and acquisition data.

Figure 8.5: Application settings

In section *Crystal Life Settings* user defined levels of quartz frequency which will be considered as:

- working correctly
- close to requiring replacement
- requires replacement

Level quartz frequency which will be considered as correctly working is defined as range between maximum and warning value. Level of frequency below than warning is considered as being close to requiring replacement (progress bar of crystal life on main window lights yellow). When frequency is below than minimum value program show information *Crystal Fail*.

In section *Crystal life mode* we change visualization type crystal life on progress bar. Information can be displayed in two different form:

- Crystal life – mode show lifetime of crystal. Decrease of quartz is show from 100 percent to 0
- Crystal used – mode displays quartz usage. Decrease of quartz is show from 0 percent to 100

In section *Chart Settings* we can define the parameter associated with range of chart data and data acquisition.

Section *Range of frequency series* contains range of frequency values shown on chart. Where frequency value is higher or less than defined range, data is not visible on chart. Option is activated when value is outside the range otherwise range is scaled automatically. Section *Chart window* gives us possibility define the data range of axis X. User sets the time window, much past data to display. In section *Acquisition data* we defined path directory where data will be saved from process deposition and can turn on/off data acquisition via set check box *Live data log*

## 8.3 DEVICE

Tab contains parameters which we are set or read from/to HOQM20 .

Figure 8.6: Device settings

In section *Windows size* we defined how many sample readings of frequency should be in one second.

Section *Filter* gives possibility determine parameters of filter which is use to frequency filtering. In section *Device settings* we can remotely reset device via button *Device Reset*.

Section *Device network settings* is available when we use Ethernet hardware interface and gives possibility to change IP address of QM device. User could set manually address IP and DHCP option.

Section *Bootloader network settings* is available when we use Ethernet hardware interface and gives possibility to change IP address of bootloader QM device. Using option *Use default IP bootloader* user define IP bootlader as default (192.168.0.200 ). Using option *Use settings IP bootloader* user defined IP bootloader as set.

**Important:** Default IP address of HOQM20 is 192.168.0.200. Default port of HOQM20 is 502. Default IP address of bootloader HOQM20 is 192.168.0.200.

All changed parameters in below section are valid after device reset.

- Device settings
- Device network settings
- Bootloader network settings

Section *About Device* shows information about parameters of HOQM20

## 8.4 TOOLING

In this tab user can define tooling factor to calculate proper values of thickness in situation when the crystal is situated slightly off-center from the main evaporation source and we can determine parameters which is used to calculate rate of sample thickness.

Figure 8.7: Tooling settings

$$Toolingfactor = Tf_s \left( \frac{T_m}{T_{app}} \right)$$

$Tf_s$  - the initial value of tooling factor

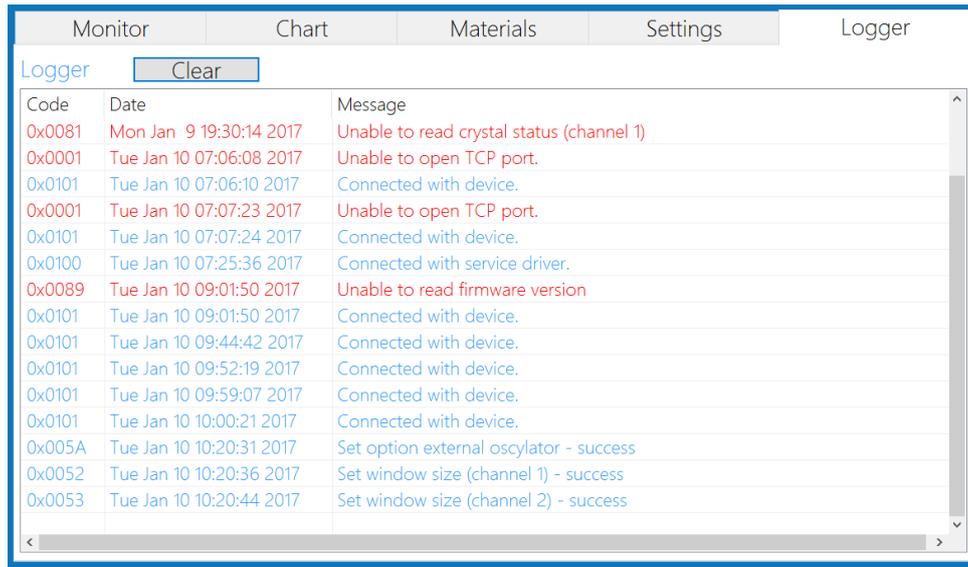
$T_m$  - measured thickness with external device

$T_{app}$  - thickness read from the application

Section *Rate factor* determine how many last samples of frequency should take part in calculate rate of thickness. Section also take parameters of filter  $\alpha - \beta$  (more information about this filter you find: [https://en.wikipedia.org/wiki/Alpha\\_beta\\_filter](https://en.wikipedia.org/wiki/Alpha_beta_filter))

## 9 LOGGER

Tab contains information about all events which happened on device or application. In first connection to device application reads all error information from device. Button *Clear* is used to clear table of events.



Code	Date	Message
0x0081	Mon Jan 9 19:30:14 2017	Unable to read crystal status (channel 1)
0x0001	Tue Jan 10 07:06:08 2017	Unable to open TCP port.
0x0101	Tue Jan 10 07:06:10 2017	Connected with device.
0x0001	Tue Jan 10 07:07:23 2017	Unable to open TCP port.
0x0101	Tue Jan 10 07:07:24 2017	Connected with device.
0x0100	Tue Jan 10 07:25:36 2017	Connected with service driver.
0x0089	Tue Jan 10 09:01:50 2017	Unable to read firmware version
0x0101	Tue Jan 10 09:01:50 2017	Connected with device.
0x0101	Tue Jan 10 09:44:42 2017	Connected with device.
0x0101	Tue Jan 10 09:52:19 2017	Connected with device.
0x0101	Tue Jan 10 09:59:07 2017	Connected with device.
0x0101	Tue Jan 10 10:00:21 2017	Connected with device.
0x005A	Tue Jan 10 10:20:31 2017	Set option external oscylator - success
0x0052	Tue Jan 10 10:20:36 2017	Set window size (channel 1) - success
0x0053	Tue Jan 10 10:20:44 2017	Set window size (channel 2) - success

Figure 9.1: Logger