QCM OPEN

THE NEXT GENERATION
OF OPEN SOURCE
QUARTZ CRYSTAL MICROBALANCE

USER GUIDE

openQCM devices are released as scientific open hardware instruments, and they are intended solely for use for SCIENTIFIC, RESEARCH and DEVELOPMENT APPLICATION, DEMONSTRATION, OR EVALUATION PURPOSES and are not considered to be finished end- products fit for general consumer use.

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SUMMARY

Preliminary notes

Temperature

Some and parts of the openQCM case are 3D-printed and are made of nylon material. This material is resistant up to about 80°C. However, higher temperatures can significantly change its mechanical properties. It is therefore recommended to operate within the values ranging from 0°C to 50°C and not beyond.

The passive and integrated components (IC) of the electronic board have been selected to operate at temperatures in the so-called commercial range, therefore operation is recommended within the temperature limits from 0 ° to 70°C.

Using the device at temperatures other than those indicated may significantly alter the materials and components, consequently causing the device to malfunction. The openQCM device is intended solely for use for scientific purposes, R&D applications or demonstration and testing purposes. Users handling the device must comply with the rules of good engineering practice.

Voltage

The main electronics of the openQCM Next device are designed to be powered with 5 VDC through the connection to the USB port. The thermal control module is designed to be powered with continuous 5 VDC and a maximum current of 1.6 A

Using a power supply other than that indicated will damage the device. The openQCM device is intended solely for use for scientific purposes, R&D applications or demonstration and testing purposes. Users handling the device must comply with the rules of good engineering practice.

Warnings regarding materials

The openQCM devices are also made using the 3D printing technique. The 3D printed case is made of durable and flexible plastic. This material is highly adaptable, dishwasher safe and heat resistant up to 80°C / 176°F. The material data sheet is available at this link: https://goo.gl/NzkbSG and the material safety data sheet is available here https://goo.gl/abrP8y. In any case, it is advisable to pay close attention to aggressive chemical materials.

The only materials of the fluidic module that are in contact with the sample are those of the measuring chamber, consisting of the fluidic cell and the o-ring. The standard exposed material of the fluid cell is the synthetic fluoropolymer PTFE (Teflon®). The standard o-ring is made of FKM Viton®.

In any case, it is advisable to pay close attention to aggressive chemical materials. The openQCM device is intended solely for use for scientific purposes, R&D applications or demonstration and testing purposes. Users handling the device must comply with the rules of good engineering practice.

Safety

In no event Novaetech S.r.l. ever be held responsible or liable for any direct, indirect, incidental, special or consequential damages or costs whatsoever resulting from or related to the use or misuse of the openQCM instrument or components thereof, even if Novaetech S.r.l. has been advised, knows of, or should be aware of the possibility of such damages. Novaetech S.r.l. emphasizes the importance of consulting experienced and qualified professionals to assure the best results when using openQCM devices.

Safety Precautions

The safety requirements listed in this manual must be followed in order to avoid personal injury and damage to the openQCM instruments.

General Precautions

RISK OF ELECTRICAL SHOCK. Do not connect openQCM device to electrical power if the enclosure is damaged or any of the covers or panels are removed. Make sure the voltage rating on the instrumentation matches the line voltage available in the lab. Connect only to outlets with safety earth ground. Make sure that the power cord is easily accessible when the equipment has been installed.

Warnings

RISK OF ELECTRICAL SHOCK OR FIRE HAZARD. Switches may produce electrical sparks. Do not use the openQCM devices in the presence of flammable gases, fumes or liquids. · The instrument has been designed for indoor use only. Do not expose it to rain, snow or dust. During storage or transport the instrument should be kept dry. Temperatures below 0ºC and above 50ºC should be avoided. Do not operate at ambient temperatures below 5ºC and above 30ºC.

CAUTION! · Use only as specified in the operating instructions. Follow all instructions. Skipping steps can result in damage to the openQCM device. · Handle carefully when removing the instrument from the transport packaging. The product must always be shipped in either the original packaging supplied by Novaetech S.r.l. or equivalent.

CAUTION! · Do not use force when connecting or disconnecting connectors as damage may occur. · Do not subject the equipment to external shocks. Do not block or restrict ventilation slots. · Do not expose any parts other than the sample volume in the flow module(s) to water or other liquids.

CAUTION! If liquid is spilled on the instrument, disconnect it from the power source and have it checked by an authorized person. When handling chemicals, refer to the safety information from the supplier and general safety regulations in your country. Carry out appropriate decontamination if equipment is exposed to hazardous material. Do not install substitute parts or perform any unauthorized modification to the product. Return the product to Novaetech S.r.l. or other qualified and authorized personnel for service and repair to ensure that safety features are maintained. Before returning the instrument it must be free of hazardous contamination.

TECH-SPECS

openQCM NEXT Technical Specifications

Main specifications

Sensors and core sensor	Next
Number of sensors	Single quartz resonator sensor
Quartz sensors	5 MHz e 10 MHz , 14 mm blank diameter, - wrapped (single sided contacting)
Frequency Range	5 and 10 MHz : 1 to 50 MHz
Temperature control	
Working temperature	15 - 45 °C (nominal temperature Peltier range 5 °C - 45 °C)
Control direction	Heating and Cooling
TEC element	Peltier
Measurement Specification	
Electronics Interface	Network analyser
Physical quantities	Frequency and dissipation
Measurement mode	Multi - overtones 5 MHz: up to 9th overtone 10 MHz up to 5th overtone
Minimum sampling time	~ 150 ms for each harmonic
Hardware and Material Specification	
Volume of chamber	~ 50 μl
Standard fluidic module material	TOP COVER: Flash chrome plating aluminium shell and a PTFE fluidic core
	SENSOR HOLDER: Flash chrome plating aluminium
Other materials of the standard Fluidic module	Viton (FKM) oring
Heat sink material	Flash chrome plating Aluminium
Main case material	Aluminum 6061 and Nylon plastic PA2200
Main Dimension	(L x W x H): 20 x 8 x 4 cm
Core sensor dimension	(L x W x H): 2.5 x 2.5 x 0.5 cm
Weight	260 g

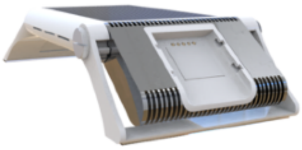
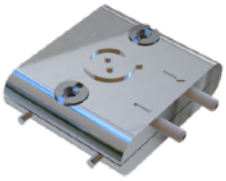
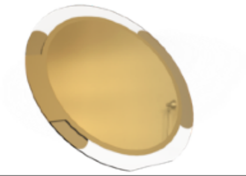
Microprocessor Embedded	
Microcontroller	Teensy 4.0 based on ARM Cortex-M7 at 600 MHz, Float point math unit, 64 & 32 bits 1984K Flash, 1024K RAM (512K tightly coupled) 1K EEPROM
Programming language	C++ arduino - language based code

Software	
Overview	Real - time frequency and dissipation monitoring in multi - overtone mode, Temperature control and monitoring Data storage CSV file
Programming language	Python
Operating System	Windows, MacOS and Linux OS
License	Freeware, CC BY-NC-SA 4.0 (NonCommercial ShareAlike 4.0 International)

Power	
Main electronics	USB 5VDC powered
Peltier module	5 VDC using 220 VAC adaptor

Package content

opeQCM NEXT comes with everything you need to start taking measurements. Below are all the accessories that you will find in the package.

	Description	Quantity
	openQCM NEXT main module	1
	A fluidic module	1
	5 MHz Ti/AU quartz sensor (for testing)	1
	USB data cable	1
	USB TEC power cable	1
	USB XP Power adaptor 5V cc, 2.1A	1

openQCM NEXT setup

How to connect the device to the power supply and computer

Environmental aspects: openQCM NEXT is designed for indoor use, particularly in a laboratory environment. It is advisable to avoid air conditioning flows or direct sunlight. Moreover, to prevent interference with the signals that could affect the quality of the measurements, we recommend using this experimental apparatus away from electromagnetic sources, such as smartphones and motors.

Connection cables: to connect openQCM NEXT correctly, both cables must be used:

- USB data cable
- USB TEC power cable

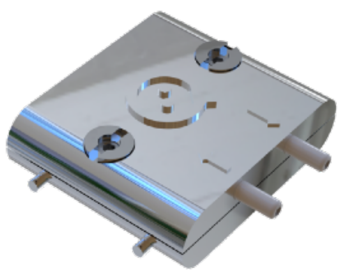
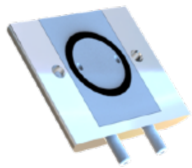
1	Connect the **"USB TEC"** power cable by inserting the USB side into the **"USB XP"** power adapter and the other side (female jack plug) into openQCM NEXT “5VDC”.
2	Connect the “**USB XP”** Power adapter to the power grid.
3	Connect the **USB data cable** to the PC

USB data cable

How to connect the fluidic module to the device

General description of the fluidic module

The sensor module is the heart of openQCM NEXT. It consists of two distinct parts:

	**Fluidic module:** its main function is to house the quartz sensor. It is composed of electropolished aluminum, and is placed in direct contact with the Peltier element	
	top fluidic cover: this component (supplied by default) is composed of an aluminum outer shell and a PTFE fluidic core that is inserted by means of a slot mechanism inside the outer shell.	

the top cover is designed to be easily detached into its 2 parts. In this way, once disassembled, it is possible to clean all the parts exposed to the samples, according to your needs (eg: ultrasonic bath).

All other materials have been specifically selected to have the widest range of chemical compatibility with your samples.

The fluidic circuit is engraved directly inside the "PTFE core". In this way, the thermalization of the fluid will be more efficient.

Notice: Don't worry if the PTFE core is free to move inside the slot. The system is designed so that, once assembled with the screws, it remains integral and, therefore, cannot move from its final position.

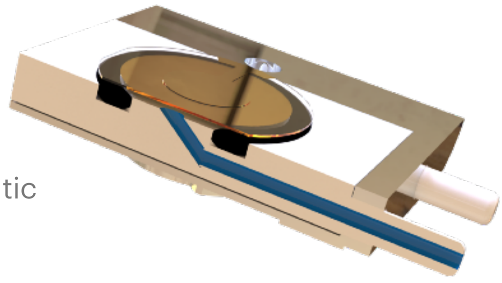
In addition to the standard fluidic module, the two optional modules can be used:

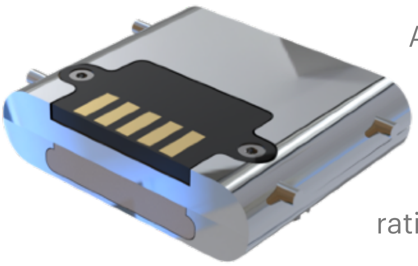
1. **Optical fluidic module:** this module is a particular "PTFE core" with a silica glass window that can be used for visual inspections or spectroscopic analysis. If a specific spectral bandwidth is required, the silica window can easily be removed to be replaced with an optical window of the same size.

2. **Pipetting module:** a specific PTFE module that allows direct access to the sensor (for example: pipetting, exposure to the external environment). This accessory has been designed specifically for openQCM NEXT and is designed to ensure the smallest possible sample volume. A minimum amount of liquid can be pipetted directly to cover the sensor. This cover is suitable for evaporation studies and external chemical reactions.

All modules are designed as a plug-and-play subsystem, which can be easily disconnected and also used for "out-of-device" treatments (e.g. ultrasonic bath, thermal cooking, etc.).

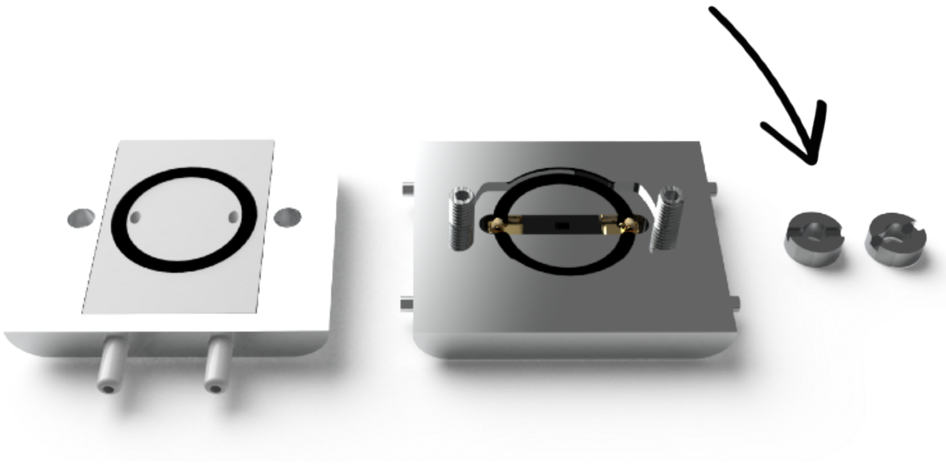
The inlet and outlet of the measuring chamber fluidic circuit were designed with a specific angle of inclination. This reduces the perturbative effects on the base line of the signals caused by the presence of an active flow in case of pumping (eg: peristaltic waves).





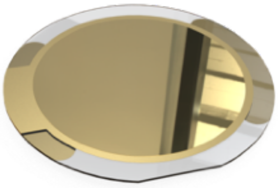
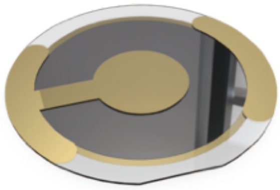
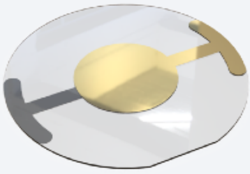
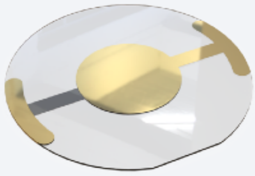
A 10K thermistor is positioned just below the lower surface of the quartz sensor, which monitors the internal temperature of the fluidic module. The electrical contact pads printed on the micro-PCB are produced with the gold immersion technique. This process drastically reduces the effects of oxidation and, consequently, the degradation of the S/N ratio over time.

The fluidic module is easily opened by unscrewing the **two slotted round nuts**. Once opened, the sensor can be placed in its dedicated housing.



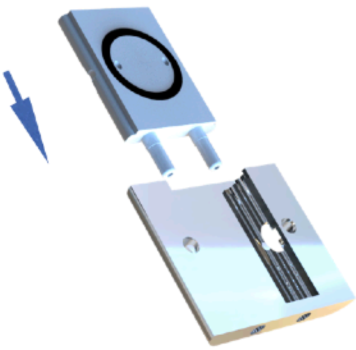
How to check the correct housing of the QCM sensors

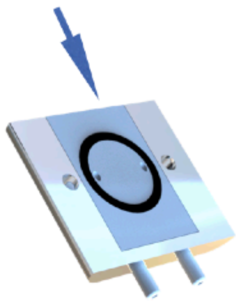
All openQCM devices use quartz sensors with wrapped contact electrodes. The electrical contacts are therefore only arranged on one side. As such, it is important to check the correct orientation of the quartz sensor and, above all, to ensure that the contact is made on the correct side. The most representative sensors are shown below.

	Top side (sensing side)	Bottom side (to be interfaced to pogo-pins)
Quartz sensor for liquid biosensing		
Standard quartz sensor		

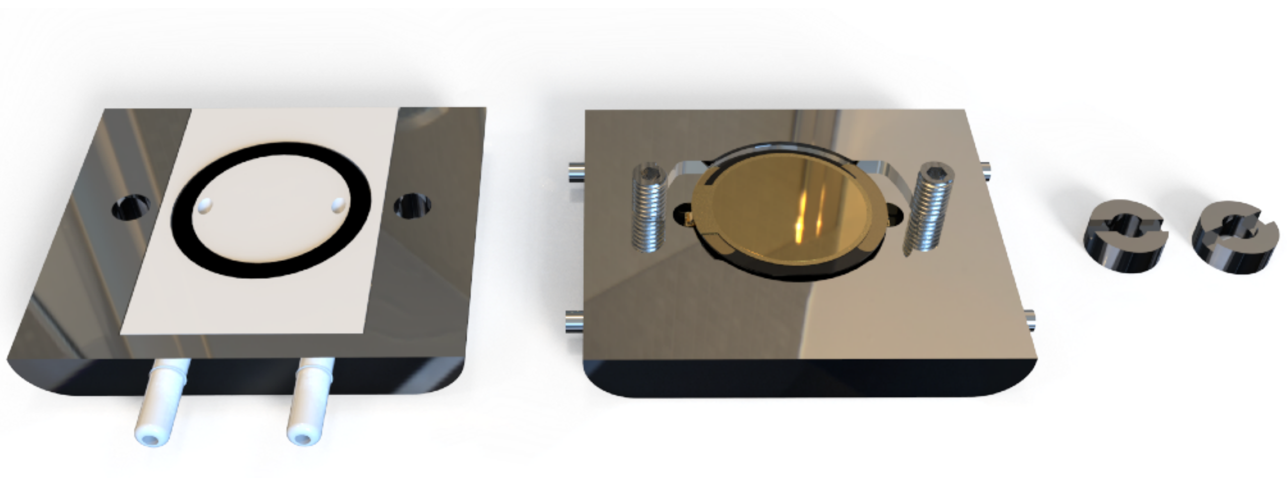
Fluidic module setup

If the two components of the top cover are not yet assembled together, insert the PTFE fluidic core into its aluminum shell, using the appropriate slot, taking care to insert the inlets and outlets in the appropriate holes in the aluminum part.



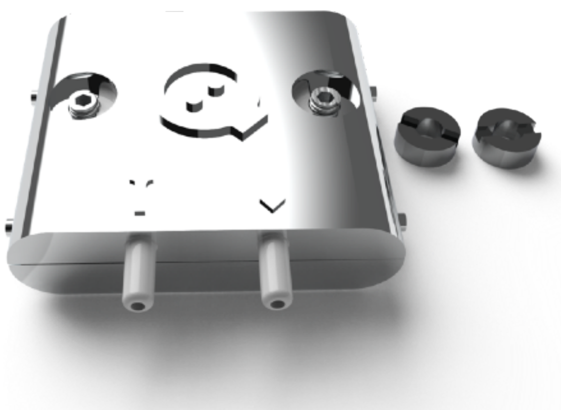


Place the sensor by aligning the bottom side contacts with the gold spring contacts of the fluidic module base. Use the orientation shown in the figure. It is important to position the sensor correctly so that the spring contacts are aligned correctly with the electrodes of the quartz sensor. Incorrect alignment will result in improper operation of the sensor.

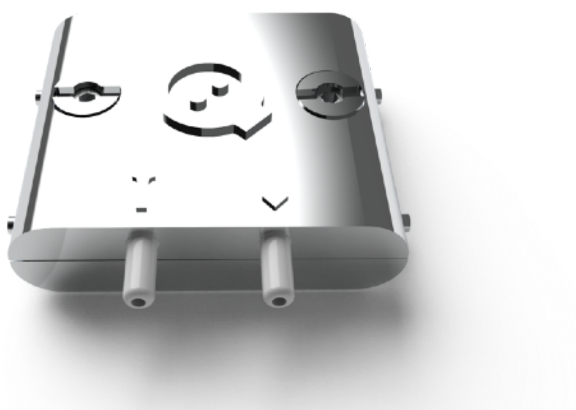


After verified that the quartz sensor is correctly positioned in its housing, close the cover (1) by tightening **slotted round nuts** (2).

(1)



(2)

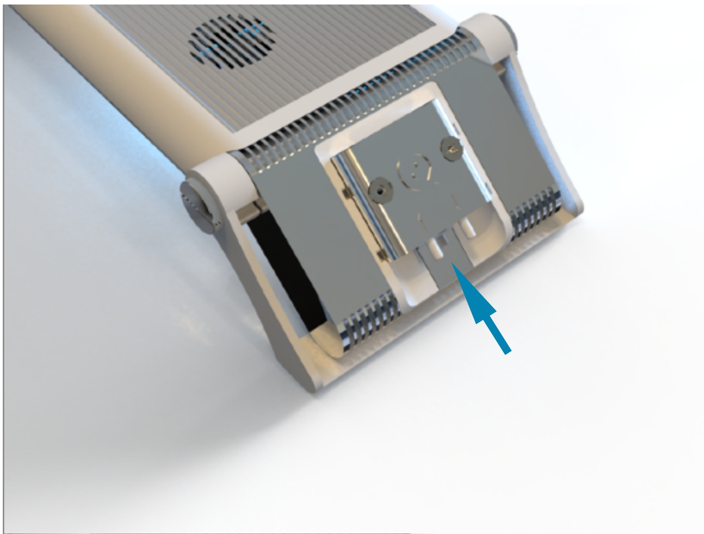


NOTE: The PTFE core can slide into its aluminum shell and is locked in the right position above the quartz when the round nuts are screwed.

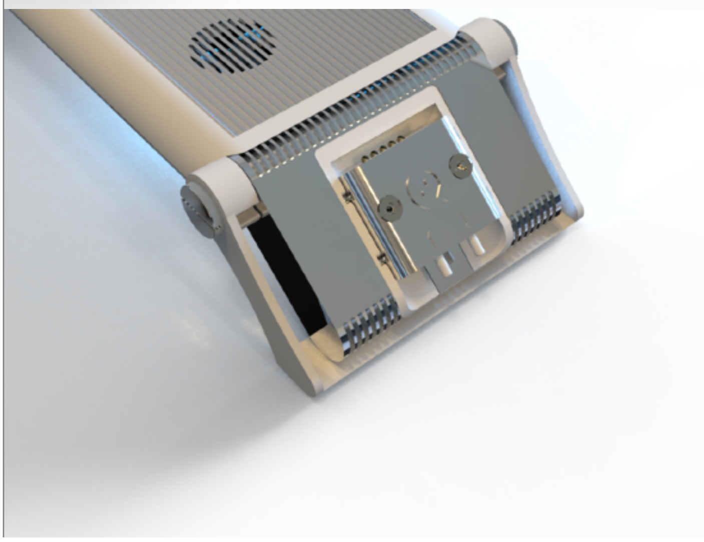
How to insert the fluidic module

The fluidic module is now ready to be connected to the heat sink, on the main unit of openQCM NEXT.

We have designed an integrated PFTE slot to have an effective plug and play connection that is both mechanical and electrical. Insert the fluidic module into the white PFTE slot, placing its side pins in the corresponding holes of the housing.



Gently slide the fluidic module upwards until it reaches the ledge and until you hear the characteristic click (only for versions starting from 2023). This will ensure the correct connection between the electrical contacts of the fluidic module and the main electronics.

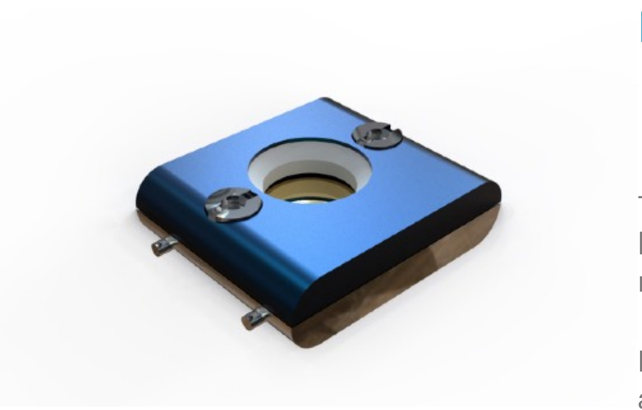


NOTE: for hardware versions prior to 2023, in order to avoid accidental disconnection, when removing the tubes from their fluidic interfaces, it is recommended that you hold the module with your hands.

How to remove the fluidic module

To remove the fluidic module, apply a pressure on the metal clip, using the included tool or another accessory (preferably made of plastic). While keeping the clip pressed, simply slide the fluidic module downwards.

Pipetting module setup (optional)



The pipetting module is an accessory element that can be purchased separately for static and controlled sample release activities on the surface of the QCM sensor.

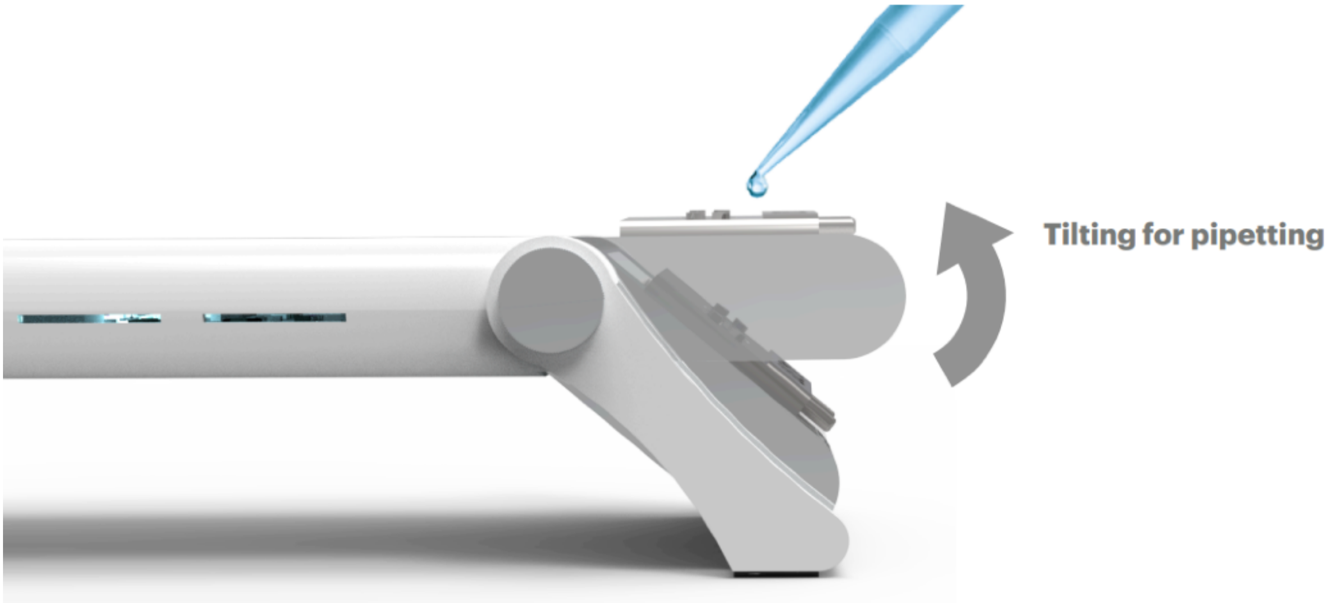
If the two components of the top cover are not yet assembled together, insert the PTFE "pipetting core" into its aluminum shell, using the appropriate slot. Pay attention to the direction of insertion. The PTFE "pipetting core" module is correctly inserted when its central hole is concentric to the hole on the "aluminum shell". If it does not line up, remove the PTFE pipetting core again, rotate it and insert it again.

Position the sensor by aligning the bottom side contacts with the gold spring contacts of the fluidic module base. Use the orientation shown in the figure. It is important to position the sensor correctly so that the spring contacts are aligned correctly with the electrodes of the quartz sensor. Incorrect alignment will result in improper operation of the sensor.

After verifying that the quartz sensor is correctly positioned in its housing, close the cover by tightening the slotted round nuts.

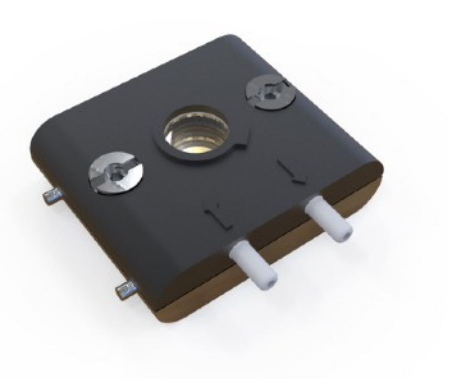
The pipetting module is now ready to be connected to the heat sink on the main unit of OPENQCM NEXT, as described in the previous paragraph.

As pipetting is an operation that must be carried out with the module positioned horizontally, openQCM NEXT has been designed to allow for the positioning of the heatsink, and consequently of the sensor module, in this position.



Two screws are positioned on the sides of the heatsink, which can be slightly unscrewed in order to facilitate tilting of the element. They only need to be unscrewed slightly. CAUTION: Do not unscrew the screws completely, otherwise the body of the device may become disassembled.

The system is now ready for pipetting. The pipetting module is equipped with a small lid, which can be used to protect the sample from contamination and/or evaporation.



Optical module setup (optional)

The "optical module" is an accessory element that can be purchased separately, if it is necessary to visually monitor what happens in the measuring chamber or, even more accurately, when it is necessary to carry out optical measurements in parallel (eg.: spectroscopy, Raman, etc.)

The "optical module" is a fluidic module in all respects, and there is a place for housing an optical window. By default, the optical module can be fitted with a 9mm diameter quartz window with a thickness of 3mm.

However, you can mount a custom window of the same size compatible with your research needs.

The optical window is inserted into the Teflon element by means of the mechanical joint. This choice is dictated by the aim of avoiding any adhesives that could contaminate the samples being measured. The "optical module" is more subject to the air bubble retention effect due to the mechanical discontinuity between the Teflon window and the "PTFE core". For this reason, carry out a visual check to ensure that there are no bubbles inside the measuring cell before carrying out the measurements.

The setup of the "optical module" is the same as the "fluidic module", therefore, refer to the paragraph relating to the latter for further information.

Thermal Control

Suggestions for a thermal check

openQCM NEXT is a portable and compact device, so its heatsink is proportionate to the size of the device. Its bridge shape was deliberately designed in order to improve convective heat exchange. In addition, a small fan is installed inside the main body that "blows" air that is taken from the outside and directed towards the heatsink.

The thermal control system is assigned to a Thorlabs component generally used to control the temperature of the laser diodes. It is a very compact electronic element equipped with a series of functions and safety controls, and is limited by the manufacturer to an operating range of temperatures from + 5°C up to a maximum temperature of 45°C.

The technical specifications can be consulted at the following link:
Thorlab Miniature Temperature Controller MTD415T Data Sheet

Although it is possible to reach the maximum temperature of + 45°C easily, it is important to stress that, if you want to reach minimum temperatures close to the nominal, a series of precautions must be considered.

First of all, it is advisable to check that the temperature of the laboratory is not too high. It must also be verified that the heatsink is not already hot at the time of starting the thermal check. It is also suggested that the minimum temperatures should not be reached too quickly, otherwise the excessive power output would heat the heatsink too quickly, preventing the target value from being reached and triggering the safety system, which would turn off the active thermal control.

If you want to "push on" and keep the thermal control active for a long time at minimum temperatures, it is suggested that you use an external ventilation system directed towards the heatsink or an alternative external cooling system.

These precautions are normally unnecessary if you work with an ambient temperature of around +25°C and you want an active and constant thermal control of around 15°C. For this reason, this lower limit is reported as the minimum value declared for openQCM NEXT. Below this temperature it is advisable to follow the suggestions above.

Using the pumps

How to best use the pumps with openQCM NEXT

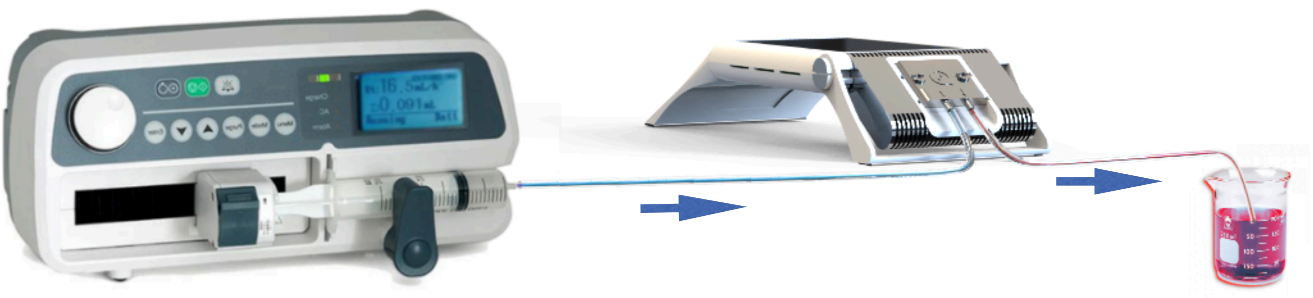
If you intend to use openQCM for measurements in fluidic environments, you need to pay attention to some simple procedures, depending on the pump you plan to use.

Suggested pumping mode: Pump-out. This pumping mode is the best for avoiding possible leakage problems. By using the pump-in mode, any obstructions or excessively high flowrates can induce overpressure in the chamber, which can even cause the quartz crystal to break. If you intend to use this latter pumping mode, it is recommended that you pay close attention to ensure that everything works normally.

Peristaltic pump: If you are using peristaltic pumps, the noise may depend on the pump used, the diameter of the pipe and especially on the flow rate. Generally, when using a peristaltic pump, "sinusoidal" behavior is observed on the baseline. This phenomenon can be easily eliminated by post-processing the data. To reduce the "peristaltic effect" on the base line, it is good practice to use a tube with a small inner diameter and a low flowrate.

Pump-in mode: if you use this type of mode you must follow (eg.: syringe pump) the diagram below. In this latter case, pay attention to ensure that the inlets and outlets are free from obstructions in order to avoid possible overpressure and consequent flooding or breakage of the quartz sensor.

PUMP-IN



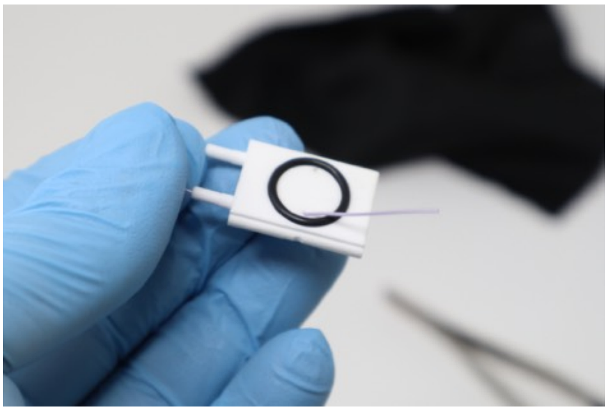
Cleaning

Cleaning the micro fluidic channels

The microfluidic channels, inlets and outlets, which connect to the sample fluid circulation tubes, have a diameter of less than 1 mm. For this reason, in some circumstances they may become clogged (for example, due to the deposition of solid or solidified residues), preventing normal flow inside the measuring chamber. In some circumstances, obstruction of one of the channels during pumping by peristaltic pump or infusion could induce a situation of overpressure, which would lead to a fluid loss or even breakage of the crystal sensor. The thickness of the crystal sensor is a few hundred microns and is, therefore, subject to rupture in the event of excess fluidic pressure.

For these reasons, before each experimental phase, it is advisable to ensure that the inlets and outlets are free from obstructions, and to clean them if necessary.

To achieve this, the following procedure is recommended.



- Use an electric wire segment (single wire conductor) with an external diameter of not more than 0.75 mm.

- Insert the wire through the holes in the fluidic channel and gently pull it through until it comes out the other side. If there is any resistance at the entrance, try to insert the wire from the other end of the fluidic channel.

- Alternately move the wire back and forth a few times

- Pull the wire out

- Repeat for the other channel.

CAUTION: do not use needles or wires that are too rigid. The core PTFE has very thin walls and inserting rigid elements can cause the Teflon to be perforated, consequently rendering the element unusable.

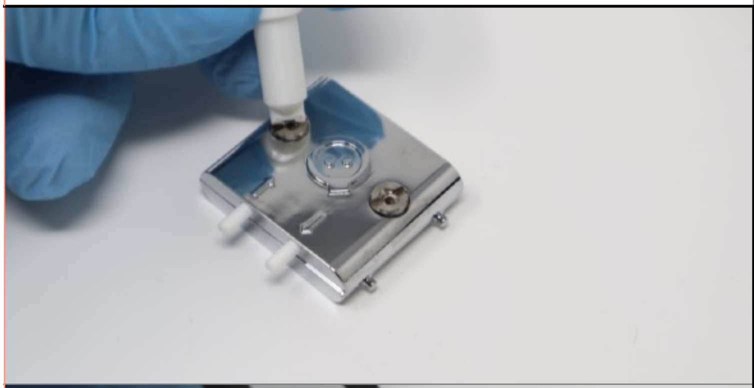
Cleaning the sensor module

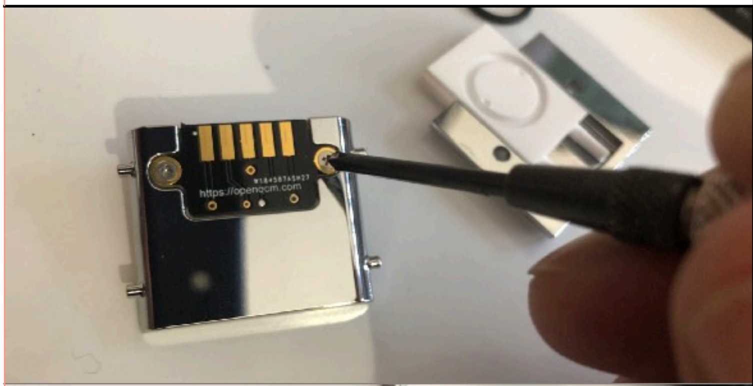
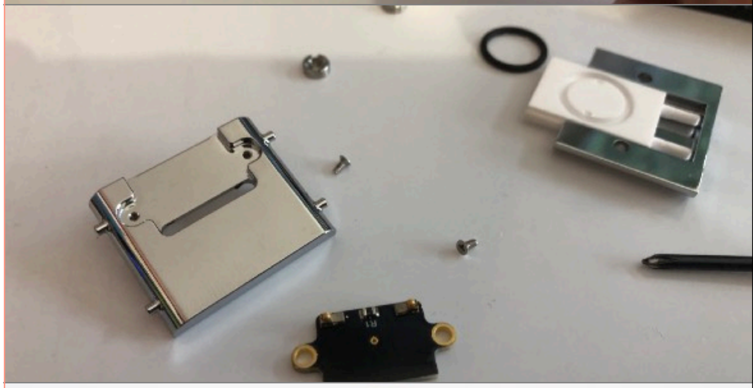
It is advisable to clean all the components of the sensor module periodically. Small losses can occur due to incorrect positioning of the sensor or improper mounting of the top cover. If fluid parts are deposited on the temperature sensor or on the electrical contacts of the sensor, these contaminations could interfere with the quality of the signals and/or the thermal control

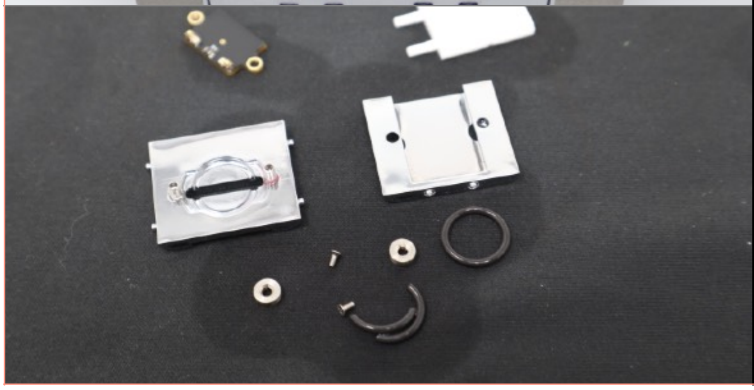
The procedure described here is applicable for all openQCM NEXT sensor modules:

- Fluidic module
- Pipetting module
- Optical module

The modules are designed to be easily disassembled, in order for thorough cleaning to be carried out.

	Description
	Open the fluidic module
	Remove the quartz sensor
	Remove the PFE fluidic core from its aluminium shell, by removing it from the slot.

	Description
	Unscrew and keep aside the two screws of the proximity electronics.
	Remove the proximity electronics from the aluminium housing
	Unmount all components and remove the half o-rings WARNING: do not unscrew the 2 grains near the half o-rings
	Place all components in a becker partially filled with isopropyl alcohol.

	Description
	Put the becker in an ultrasonic cleanir partially filled with pure water. Clean for at least 15 minutes The cleaning time can vary depending on the conditions of the fluidic module.
	Let all the components dry and, if necessary, go over them with an optical cloth. Dry with Nitrogen gas might improve the drying efficiency. Be sure that the inlet and outlet channels of the PTFE fluidic core are correctly dried before use .

Once all is ready, you can start with the reassembly process.

SENSOR HOLDER:

- insert the 2 o-rings (make sure that they are properly housed and do not interfere with the electrical contacts of the sensor)
- tighten the electronic board using the screws previously set aside.

TOP COVER:

- Insert the o-ring into the PTFE core, making sure it is correctly housed in its place, checking to ensure there are no deformations
- Reinsert the PTFE core inside its "aluminum shell". When inserting it into the appropriate slot, be careful to align the inlet and outlet interfaces of the PFTE core with the holes of the "aluminum shell" to prevent them from accidentally folding, causing them to break.

The sensor module components are now ready to be used again.

As already mentioned above, the procedure described is also valid for the pipetting module and the optical module.

How to clean the sensors

The cleaning protocols described below are generally not harmful to the sensor coatings themselves, however, it is not guaranteed that the desired result can always be achieved. This depends on a number of factors, and the materials deposited on the sensitive surface of the quartz play a fundamental role.

If the suggested protocols are not satisfactory, a series of references are given below from which you can obtain alternative protocols.

CAUTION: in order to avoid any kind of damage and/or scratches when handling the quartz sensors, it is recommended to use dust-free laboratory gloves and use soft-tipped tweezers if possible, preferably in Teflon. It is also advisable to use our teflon holder.

The following protocol is suggested for our gold electrode sensors:

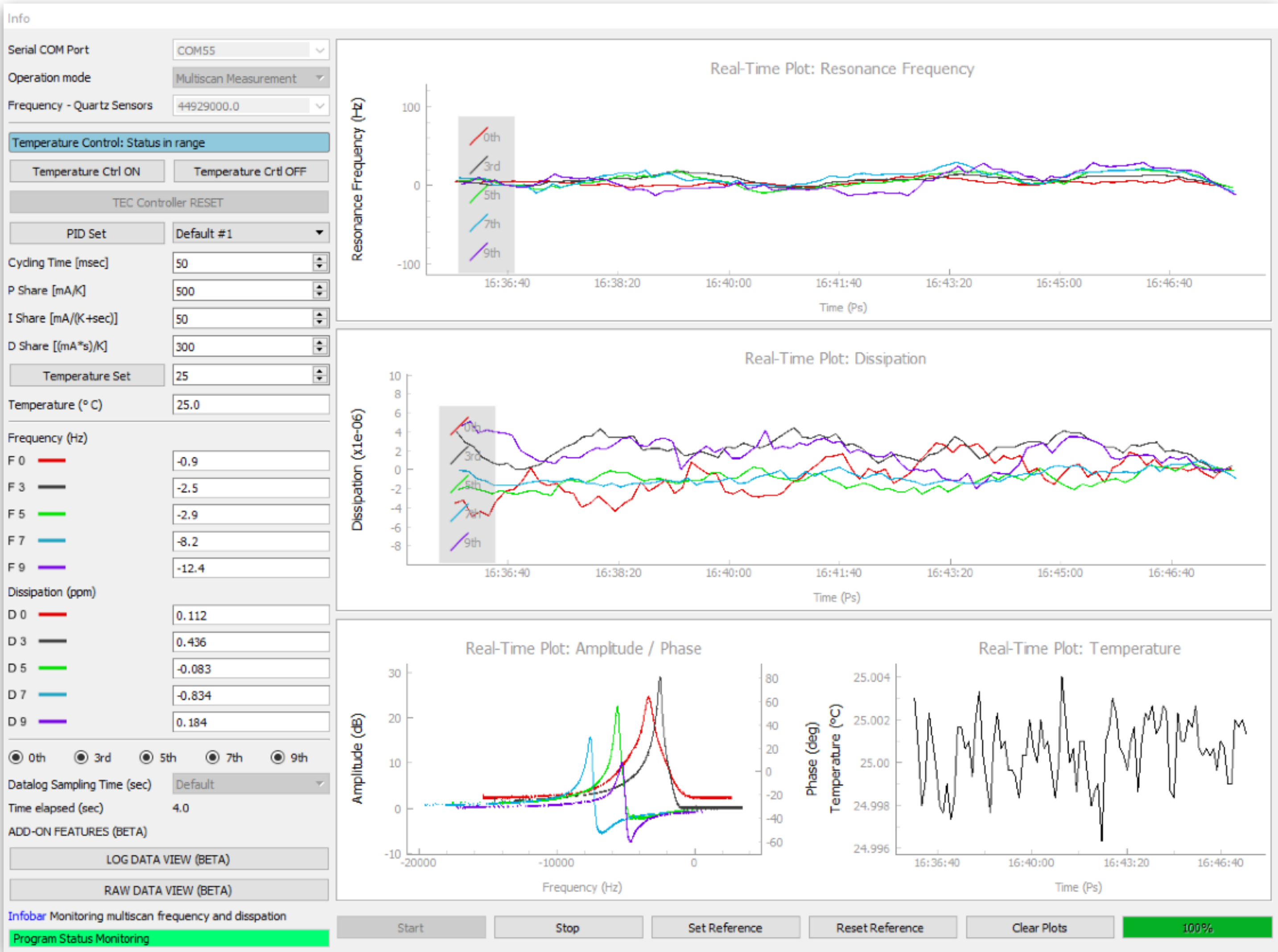
Please refer to:

- Wasilewski,T.;Szulczyn´ski, B.; Dobrzyniewski, D.; Jakubaszek, W.; Ge˛bicki, J.; Kamysz, W. Development and Assessment of Regeneration Methods for Peptide-Based QCM Biosensors in VOCs Analysis Applications. Biosensors 2022,12,309. https://doi.org/10.3390/bios12050309

- Fulgione, A., Cimafonte, M., Della Ventura, B. et al. QCM-based immunosensor for rapid detection of Salmonella Typhimurium in food. Sci Rep 8, 16137 (2018). https://doi.org/10.1038/s41598-018-34285-y

Setup the software

The openQCM Next software user interface is designed to utilize all the functionalities of the device. Developed using the Python programming language, it ensures an open-source approach for scientific applications.

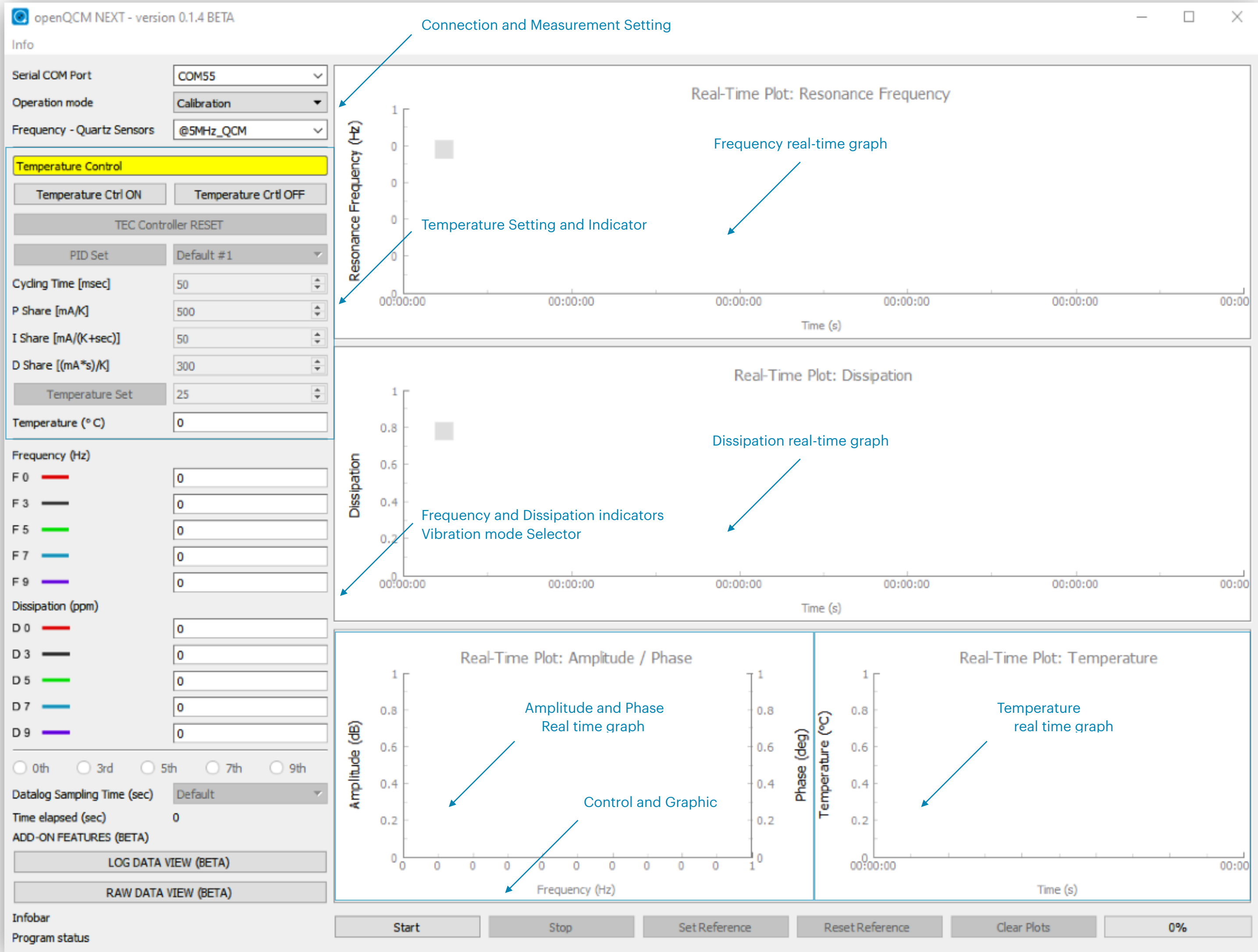


openQCM NEXT python software latest application

The new openQCM NEXT software is capable of leveraging all the main functionalities of the device, including real-time monitoring of frequency and dissipation on the fundamental mode and overtones. It can acquire nearly 5 sweep signals simultaneously and process frequency and dissipation measurements in approximately 7 seconds. Additionally, the application enables real-time control and monitoring of the sensor module temperature.

Please visit the openQCM Next software webpage and refer to the latest version of the openQCM Next user guide for detailed description, usage and development

Software Graphic User Interface: General Description



Connection and Measurement Setting

Serial COM Port	Drop-down menu for selecting the COM port connected to the openQCM Next device
Operation Mode	Calibration: record the quartz resonator calibration signal for resonance peak detection
	Single Measurement: real time monitoring of frequency and dissipation on a single frequency of the quartz resonator spectrum
	Multiscan Measurement: real time monitoring of frequency and dissipation on fundamental and overtone harmonics of the quartz resonator
Frequency / Quartz Resonators	Calibration operation mode: Select 10 MHz or 5 MHz quartz resonator fundamental frequency
	Single Measurement mode: Select the quartz resonator frequency to monitor

Temperature setting and indicator

Temperature Ctrl ON	Enable the temperature control
Temperature Ctrl OFF	Disable the temperature control
TEC Controller Reset	Press the button to reset the temperature controller after an error status event. Disabled by default
PID Set	Press the button to change the PID parameters of the TEC control
P Share	Proportional parameter. Default value 1000 mA/K Range: (0 to 100000 mA/K)
I Share	Intergral parameter. Default value 200 mA/(K*sec) Range: (0 to 100000 mA/(K+sec))
D Share	Differential parameter. Default value 100 (mA*s)/K Range: (0 to 100000 (mA*s)/K)
Temperature Set	Press the button to change in real time the set temperature Default value 25° C (Nominal Temperature range: 5°C to 45°C).
Temperature (°C)	Current value of the temperatrure

Temperature Real Time Graph

Real Time Plot: Temperature	Real time plot of temperature data measured in °C

Amplitude and Phase Real Time Graph

Real Time Plot: Amplitude / Phase	Calibration: plot of amplitude and phase signals over all frequencies ranging from 1 MHz to 51 MHz
	Single Measurement: plot of amplitude and phase signals around the selected single resonance frequency (fundamental or harmonic overtones)
	Multiscan Measurement: plot of amplitude of all resonance frequencies detected, fundamental and harmonic overtones

Frequency and Dissipation Real Time Graph

Real-Time Plot: Resonance Frequency Real-Time Plot: Dissipation	Single Measurement: real-time plot of frequency and dissipation of selected single vibration mode (fundamental or harmonic overtones)
	Multiscan Measurement: real-time plot of frequency and dissipation for all vibration modes detected, fundamental and harmonic overtones

Control and graphic buttons

Start	Start a session of measurement, applies for each operation modes
Stop	Stop a session of measurement, applies for single and multiscan operation modes
Set Reference	Press the button to set the current value of frequency and dissipation as the reference value to measure variations, applies for single and multiscan operation modes
Reset Reference	Press the button to reset the current value of frequency and dissipation to actual values, applies for single and multiscan operation modes
Clear Plots	Clear the history of each real time graph
Progress bar	Calibration: indicator showing the progress of the frequency scan over all frequencies ranging from 1 MHz to 51 MHz
	Single and Multiscan Measurement: indicator showing the accumulation of initial raw data before frequency and dissipation data processing

Frequency and Dissipation Indicator

Frequency and Dissipation Indicator	Single Measurement: real time indicator of current value of frequency (Hz) and dissipation (ppm) of selected single vibration mode (fundamental or harmonic overtones)
	Multiscan Measurement: real time indicator of current values of frequency (Hz) and dissipation (ppm) for all vibration modes detected, fundamental and harmonic overtones

Vibration Mode Selector

Fundamental and harmonic overtones	Multiscan Measurement: select radio buttons for showing frequency, dissipation and amplitude real time plot of the corresponding mode of vibration

Datalog Sampling Time

Datalog Sampling time	Multiscan Measurement: select the datalog sampling time using the drop - down menu. Default value is the hardware minimum sampling time, 7 seconds
Time elapsed	Time elapsed between consecutive datalog samples

Add - On Features (Beta)

LOG DATA VIEW	Multiscan Measurement: Application for viewing and processing the data acquired during the current session of measurement.
RAW DATA VIEW	Multiscan Measurement: Plot of current sweep signals for each mode of vibration, showing raw data, filtered data and frequency points for resonance and dissipation calculation