



AE-QCM 2.0



USER MANUAL

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AE-QCM 2.0 User
Manual v.1.0



Certification

Novaetech certifies that this product met its published specifications at the time of shipment.

Warranty

This Novaetech product is warranted against defects in materials and workmanship for a period of one (1) year from the date of shipment.

Service

For warranty service or repair, this product must be returned to a Novaetech authorized service facility. Contact Novaetech or an authorized representative before returning this product for repair.

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Safety and Preparation for Use

Line Voltage

The AE-QCM 2.0 Control Unit operates at +9VDC. Power consumption is max 18W total.

Power AC/DC Adapter

The AE-QCM 2.0 requires power AC/DC adapter 9V - max 1.5A for connection to the power source.

Keep power line and all the other electrical wiring in your experimental setup neatly organized and in good working condition. Inspect all wires periodically for problems as part of your safety checkups.

Operate Only With Covers In Place

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without all covers and panels in place.

Liquid Contact

This product is intended for use only in a clean dry laboratory environment. Operation in other environments may cause damage to the product and reduce the effectiveness of the safety features. To reduce the risk of fire or electrocution do not expose this product to rain or excessive moisture. Be careful not to spill liquid of any kind onto or into the product.

Serviceable Parts

The AE-QCM 2.0 does not include any user serviceable parts inside.

WARNING!!

Peltier Operations

During measurement operations with the Peltier activated it is important to connect the sampling head to a suitable heat sink (through holes on the bottom side of the sampling head can be used to correctly fix it to the heat sink).

Getting Started

This section provides instructions for: unpacking, checking and connecting the AE-QCM 2.0 Quartz Crystal Microbalance to its accessories and to your experiment. Quick Start instructions are also provided to easily perform QCM measurements.

The AE-QCM 2.0 System is a high precision mass measuring sensor featuring excellent performances in the recovery of the beat oscillation frequency coming from two coupled working quartz crystals. The sensor has an integrated control electronic and it can be used standalone by interfacing to any frequency meter, oscilloscope or any kind of acquisition frequency system.

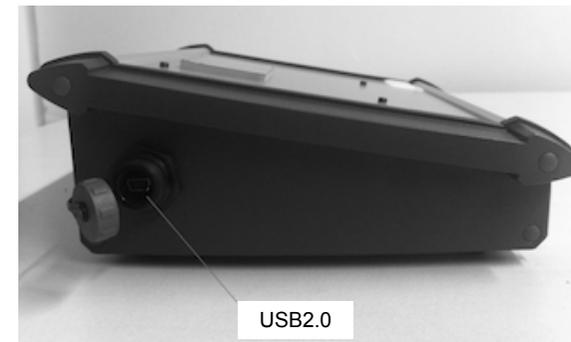
Sampling Head is provided with a temperature sensor and a Peltier element for temperature control of the quartz sensor.

Resonance frequency and Temperature are measured and displayed directly on the front panel.

In addition, the AE-QCM 2.0 has USB2.0 interface and comes with Windows® software providing real-time display and storage of QCM and thermal data.

-AECONTROL Unit Side Panels Overview

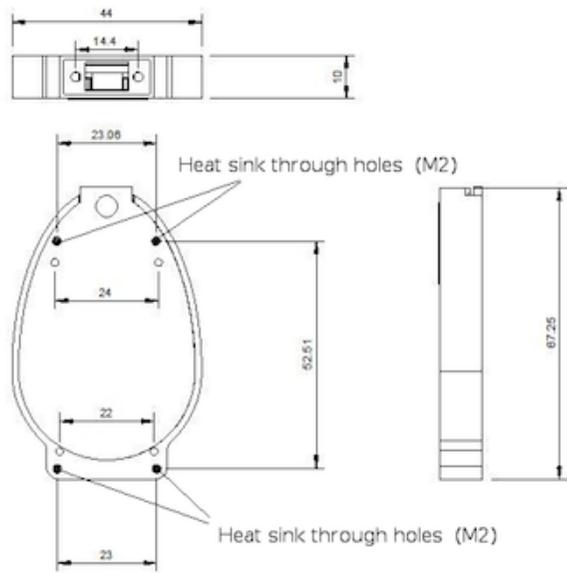
Left Side



Right Side



AE-QCM Sampling Head Overview



Unpacking

Before Setting Up

Read the entire Safety and Preparation for Use section of this manual before starting any setup procedure. Read and follow all installation and operation instructions in this manual to ensure that the performance of this instrument is not compromised.

- Open the box(es) and inspect all components of the AE-QCM 2.0 System.
- Report any damage to Novaetech immediately.
- Compare the contents of the shipping boxes against your original order and the checklist below. Report any discrepancies to Novaetech immediately.

Checklist

Standard Equipment Supplies

- ✓ AE-CONTROL Unit - The QCM Controller
- ✓ AE-QCM Sampling Head - The QCM with Peltier element and T sensor integrated
- ✓ Power supply ac/dc adapter 9V 1 A
- ✓ USB2.0 Cable
- ✓ Connection Cable: Micro-D/D-SUB cable only for instrumentation test, not good for experiment
- ✓ One (1) QCM crystal, polished - The Sensor Quartz Crystal with holder
- ✓ User Manual

Optional Equipment

- Replacement Quartz Crystals with holders
- Specific connection cables

Quick Start Instructions

- With the power switch in the OFF position, connect the AE-CONTROL Unit to the power supply adapter provided.
- Connect the AE-CONTROL Unit to the AE-QCM Sampling Head using the connection cable (see User Interface Section).
- Mount a fresh quartz crystal with holder in the AE-QCM head. See special instructions in the Crystal Installation section.
- Connect the AE-CONTROL USB port to your host PC where you have installed the Win AE-Control software (See User Interface Section for AE-Control software installation).
- Turn the power switch ON and check on the front panel display that AE-QCM is connected and is measuring Frequency and Temperature.
- Start Win AE-Control software and click on the connection icon.
- The AE-QCM 2.0 System is now ready for measurements. Frequency and Temperature are displayed on the front panel display and on the host PC monitor.
- Before starting Peltier operations please read the Safety and preparation for use Section

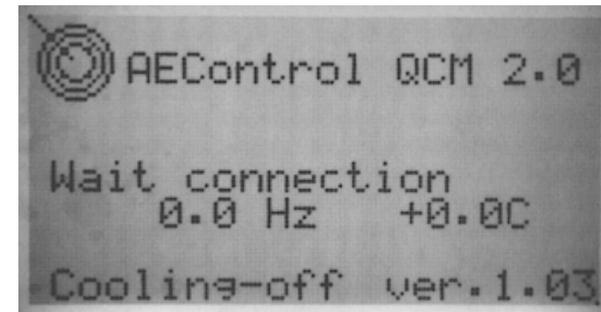
AE-QCM 2.0 User Interface

The AE-QCM 2.0 system user interface concerns the:

- Front Panel Display
- Cable connection
- Win AE-Control Software

Front Panel Display

A 128 x 64 Dots LCD Graphic Display on the front panel of the AE-CONTROL unit simply displays AE-QCM 2.0 Connection status, Measured Frequency and Temperature, Peltier status (cooling, warming) and software version.



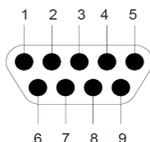


Cable connection

The AE-QCM Sampling Head can be connected to the Control Unit by means of a cable with a Micro-D 9 PIN connector, for the connection with Sampling Head, and a D-SUB 9 PIN connector for the connection with the Control Unit.

In order to prepare an AE-QCM 2.0 connection cable for your own experiment the PIN-COLOR Table is reported.

Please pay attention to the current expected on the indicated PIN useful for the choice of the wires.



Number	Pin	Current
1	Black	
2	Brown	
3	Red	
4	Orange	>2A
5	Yellow	
6	Green	>2A
7	Blue	
8	Violet	
9	Gray	



Win AE-Control Software

Note. Once you have received the AE-QCM 2.0 system box, please immediately contact Novatech in order to receive AE-Software. It will be sent by email.

AE-Software is a control and data acquisition software. By means of AE-Software it is possible to visualize and record data coming from the AE-QCM Sampling Head (Frequency and Sensor Temperature).

It is also possible to control the crystal sensor temperature by driving the built-in QCM sampling head Peltier element.

Win AE-Control Software requires Windows ®

Installation

➤ Start the installation program (file **SetupWinAEControl.msi**).

Now you can find the AE-Control software icon on the desktop. The installation program also creates the folder “**Novatech srl**” under Windows® folder “Program Files”.

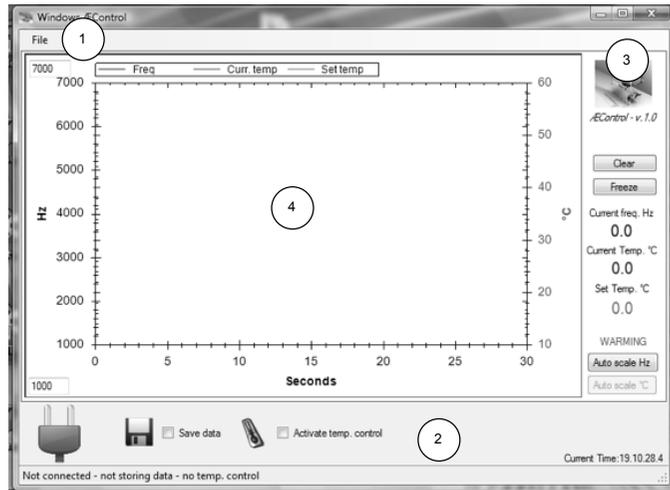
➤ Start the installation of the AE-Control Unit drivers.

Connect Control Unit to the PC by the USB cable. Power On the Control Unit and check the front panel display for connection.

Follow the Windows® standard driver installation procedure by searching for the drivers in the **Novatech srl\WinAEcontrol\Drivers** folder.

Once the installation of drivers is concluded Win AE-Control software is ready for use.

Main window



- 1) Top Menu
- 2) Bottom Menu
- 3) Side Bar Menu
- 4) Data Plot Screen

Functions

Top Menu

File

Sub Menus

Connect device --> Execute the connection with the AE-QCM

Device settings --> *Popup window*

PID Parameters --> Sets the Proportional/Integrative/Derivative values for the Peltier control

Get current --> Gets the current PID values

Set as default --> Sets new PID values as default

Storage

Average points/Set --> Sets the number of points stored per second

Close --> Closes without modification

Firmware update --> Allows firmware updates provided by Novaetech

Set temperature --> *Popup window*

Control mode/Parameters -->

Sets the type of control of the Peltier temperature

Set point/Set point temperature --> Fixes the final temperature to be reached

Linear ramp/Ramp pendence --> Not active in this version

Storage folder --> Sets the folder where to store data (default ..\Documents\AEControl\)

Exit --> Exit the program

Bottom Menu

- **Connection icon** --> Execute the connection with the AE-QCM
- **Save data check box** --> Save the data in the set storage folder when checked
- **Activate temp. control check box** --> Check the box to activate the temperature control with set parameters

Side Bar Menu

In this menu Current Frequency, Current Temperature, Temperature Set for control and Peltier operation (Warming/Cooling) are displayed. The following functions can be implemented

- **Clear** --> Clear the data plot screen
- **Freeze** --> Freeze actual data plot screen
- **Autoscale Hz** --> Autoscale the frequency data plot
- **Autoscale °C** --> Not active in this version

Data Plot Screen

In the plot screen Current Frequency, Current Temperature, Temperature Set for control are plotted in function of time (seconds). In this screen the Hz scale can be directly modified by inserting min/max values in the box on the scale. **(Note. If the Hz and T plotted appear of some orders different from those showed on front panel display, it is necessary to change decimal separator comma ‘,’ with the point ‘.’, in Windows® Control Panel).**

Storage Data Format

The storage data file is automatically generated with the following name format:

yyyyMMdd_HHmms_f.txt

The data are store in the following format:

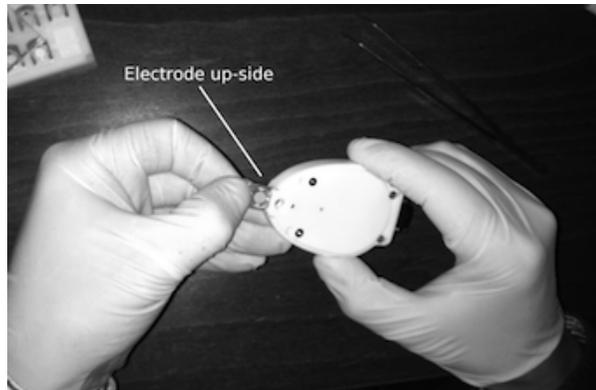
Date	Freq	Temp	Set Point Temp
yyyyMMdd_HHmms.f	Hz	°C	NOT NUMBER (when Point Temp is not set)

Crystal Installation

This section describes the procedure to install or replace the QCM crystal in the Sampling Head.

AE-QCM 2.0 Quartz Crystals sensor are carefully selected by Novaetech in order to have the best coupling with the reference crystal mounted inside the sampling head. For this reason please communicate the AE-QCM sampling head code reported on the heat sink in the bottom side when you order new fresh quartz crystals.

AE-QCM 2.0 quartz crystals are mounted in Al holders for the easy installation and replacing in the sampling head (see Figure).



Mounting and de-mounting of crystals should be always done with the maximum care, in order to keep the crystals safe and to assure the correct electrical contact.

The quartz sensor is correctly installed when gold electrode fits perfectly the circular window on the up side if the sampling head.

In order to avoid frequency noise do not touch sensor holder during the measurement operations.

In any case do not force the insertion of quartz crystal in the sampling head.

It is suggested not to replace a sensor crystal until the saturation is reached.

QCM Measurements

The first use of QCMs was as mass sensors and thickness monitors in gas phase, thin-film depositions. To this date, this continues to be an important area of application for this technology.

Sauerbrey Equation

Sauerbrey's equation is often used to calculate mass loadings and thin-film thicknesses in vacuum depositions. The basic assumption is that the incremental change in mass from the foreign film is treated as though it were really an extension of the thickness of the underlying quartz. The foreign film is considered rigid and so thin that it does not experience any shear forces during vibration. As a result, the sensitivity factor, S , is a fundamental property of the quartz crystal and does not consider any of the properties of the foreign film (i.e. it is only dependent on the acousto-elastic properties of quartz).

By means of Sauerbray Equation mass per unit area M in function of resonance Frequency shift $\Delta\nu$ (S is crystal sensitivity):

$$M = \frac{\Delta\nu}{S}$$

The dependence of the frequency change on the mass coverage per unit area, emphasizes the fact that, within certain limits, the sensitivity factor is independent of the electrode geometry. Thus, in theory, the QCM mass sensor does not require calibration for this application. This ability to calculate mass loading from first principles is obviously a very attractive feature of these devices.

Film thickness

Film thickness is often the parameter of interest in gas-phase thin-film depositions. If the mass coverage is believed to be uniform, the thickness t of the film is easily calculated by dividing the mass per unit area M provided by Sauerbrey's equation by the material's density ρ .

$$t = \frac{M}{\rho}$$

Specifications

AE-QCM 2.0

Electrical

Power supply +9VDC
Power consumption max 230mA
(max 2A with operating Peltier element)

Physical

Dimensions mm 200 x 72 x 184
(WHD)
Weight g 948.
Operating temperature 0 °C - 40 °C
Material Al e ABS

Quartz Crystals (polished)

Frequency 10 MHz, AT-cut,
plano-plano
Blank Diameter 0.34 inch
Electrodes titanium/gold
diameter 0.201 inch
Sensitivity 2.26×10^8
Hz/(g cm²)

Crystal Holder

Material Al

Sampling head

Material PTFE