



Halloran QCM (Quartz Crystal Microbalance) Molecular Contamination Monitor (Model HE-QCM-1) Ver.1.5

This system was developed to monitor clean room molecular contamination density changes on real-time basis.

[How the QCM works]

The quartz crystal becomes slightly heavier under conditions of surface contamination and as a result the oscillation frequency drops. This is how the QCM works. The relationship between the mass of contamination deposited on the crystal surface and the change in the oscillation frequency is shown below. The sensitivity of QCM increases in proportion to the square of the crystal frequency.

$$\delta f = - \delta m \cdot F^2 / N \cdot A \cdot \rho$$

Where δf is the incremental frequency change (Hz), δm is the incremental change in weight of the molecular contamination deposited on the crystal surface (g/cm^2), F is the fundamental frequency, N is a frequency constant ($167 \text{ kHz} \cdot \text{cm}$ at AT cut), A is the surface area (cm^2), and ρ is the crystal density ($2.65 \text{ g}/\text{cm}^3$).

D. A. Buttry, "Electroanalytical Chemistry", Vol. 17, Marcel Dekker, New York (1990)

The QCM Molecular Contamination Monitor, Model HE-QCM-1 uses 25 MHz crystals (standard model) installed in the metal sensor case and senses changes in molecular contamination in the air of a clean room of semiconductor fabs.

The QCM comes with five sensors, and each is connected to the controller with 10 meter long cables. All five sensors can be used for measurement at the same time. This makes it possible to identify the source of contamination and to know how molecular contamination are diffused in the room on real-time basis.

A PC screen shows the trend curve and differentials (option) distinguished by color for each channel over the most recent 24 hours. In this way the QCM provides you with an accurate overview of contamination.

Notice: HE-QCM-1 can measure the weight of the molecular contamination deposited on the crystal surface, but cannot identify the contamination.



Fig 1 : Notebook PC for Control (Option) and Controller




Fig 2 : Sensor

Molecular Contamination Monitor (Model HE-QCM-1)


[Specifications]

- 1) Size of Controller: 155 mm wide, 55mm high, 14mm deep
- 2) Power Supply: 100-120 v AC (200 v AC is also available)
- 3) Power Consumption: 10 w max.
- 4) Operating Environment: $+25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ (recommended). Moisture needs to be constant. (Please refer below)

	<p>Note ➡ The reading by the HE-QCM-1 will be affected by moisture and temperature. The HE-QCM-1 is recommended to be used in the stable condition for moisture and temperature as clean room.</p> <p>When the HE-QCM-1 is operated at wide temperature range, optional sensors are available depending upon the temperature to be operated.</p>
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- 5) Control Interface: RS-232C
- 6) Sensor Sensitivity (measured): about $0.46 \text{ ng/cm}^2/\text{Hz}$ on surface deposition basis (option: $0.07 \text{ ng/cm}^2/\text{Hz}$)
- 7) Number of Sensors to be connected: 5 sets max.
- 8) Sensor Size: 25 mm x 25 mm x 60 mm (without connector), Cable Length: 10 meters (standard model)
- 9) Software: Frequency Measuring Software OGraph.exe
Frequency Data Display Software OAnalysis.exe
Will be provided on CD-ROM

Recommended PC: Windows 95 or above with Pentium 150 MHz or better.

	<p>Note ➡ Depending on the settings your PC may go into standby or hibernation mode if there is no keyboard or mouse activity over a long period of time. Standby and hibernation modes must be disabled while monitoring.</p>
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[Measurement]

- 1) Data file: A data file is created using the date to distinguish the files. Each file thus created is closed each day at 23:57 and a new file is created 3 minutes later at 12:00AM (mid-night). (e.g. on 2002/5/18 a data file named 20020518A1.XTM is created in the designated folder)
- 2) Measurement timing: Measurements are performed every 10 seconds and the average of those measurements is stored every 3 minutes according to the system clock of the control PC.
- 3) Data format: CSV
- 4) Data size: the number of data points stored is 480 per day, which is about 38KB. Several years of data can be stored on a PC hard disk.

	<p>Note ➡ Please confirm that the system clock of the control PC is correct before monitoring starts.</p>
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[Trend Curve Display and Quick Data Analysis]

Data Measurement and Trend Curve Display (OGraph.exe)

- 1) Start Menu: You can create or select a folder of arbitrary name and path for data storage.
- 2) You can enable and disable channels as desired.

- 3) Display Trend Curve: The most recent 24 hours of data is shown for 5 channels using different colors for each channel.

Option: While you are measuring, you may switch the indication menu from the frequency data display to frequency differentials.

Quick Data Analysis (OAnalysis.exe)

- 1) You may select to display the trend curve data for the past one day, two days, three days or seven consecutive days.
- 2) You may move the vertical cursor horizontally to any desired position to view the data for that time.
- 3) Either the Trend Curve Display or the Frequency Differentials Display (option) can be chosen from the analysis menu depending upon your purposes.



ハロラン登録商標

Halloran Electronics Co., Ltd.

<http://www.halloran.co.jp>

tel: +(81) 426-61-9391/63-6967, fax: +(81)-426-61-9396

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