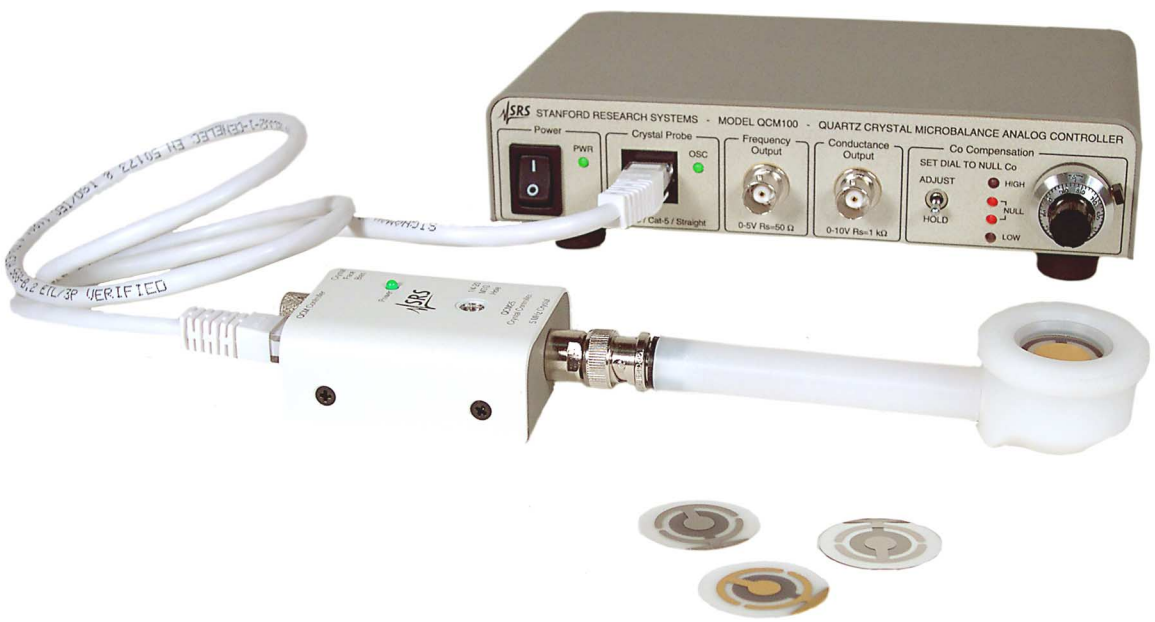
Quartz Crystal Microbalance

QCM100 — 5 MHz quartz crystal microbalance



QCM100 Quartz Crystal Microbalance

- **Series resonance frequency and resistance outputs**
- **Simple shunt capacitance cancellation**
- **Transformer-isolated crystal for EQCM measurements**
- **Compatible with highly loaded crystals (up to 5 kΩ)**
- **No network or impedance analysis necessary**

- **QCM100 ... $995** *(U.S. list)*

The QCM100 is a highly accurate quartz crystal microbalance system specially developed for real-time mass and viscosity measurements in processes occurring at or near surfaces, or within thin-films.

The QCM100 accurately measures the resonant frequency and resistance of an AT-cut quartz crystal. The resonant frequency changes as a linear function of the mass of material deposited on the crystal surface, and the resonant resistance changes with the viscoelasticity of the material (film or liquid) in contact with the crystal's face.

As a gravimetric instrument, the QCM100 can measure masses ranging from micrograms to fractions of a nanogram, with detection limits corresponding to submonolayers of atoms. Simultaneous measurement of resistance provides the opportunity to examine the viscosity and elasticity of films and liquids at or near the crystal surface, making it feasible to observe conformational changes, such as phase transitions, swelling and cross-linking, in real time. The electronics are specially designed to handle heavy loads (up to 5 kΩ) making it ideal for studies involving lossy films and highly viscous liquids.

The QCM100 comes complete with analog controller, crystal oscillator electronics, quartz crystal and holder. All you need is a frequency counter and a precision voltmeter to complete the QCM measurement setup. Replacement crystals, oscillator and crystal holders are also available.

The analog controller provides power to the crystal oscillator electronics and has outputs (BNCs) for frequency and conductance. It also has a potentiometer for canceling shunt capacitance. Proper capacitance cancellation is required to assure true series resonance operation of the crystal oscillator, and eliminate frequency and resistance errors.

The QCM100's capacitance cancellation adjustment is extremely simple. There are no complicated tuning steps and no special tool requirements—just a single 10-turn pot and an LED display that shows you which way to turn the knob and when to stop. The achievable capacitance cancellation is 0.01 pF—an order of magnitude better than competitive models.

The crystal oscillator electronics are designed around a unique automatic gain control (AGC) circuit instead of the traditional phase-lock oscillator (PLO). The AGC provides the quartz crystal resonator with the necessary gain to overcome viscoelastic losses and achieve series resonance. It also provides a signal that monitors the energy dissipated by the sensor (which is related to the series resonance resistance). The crystal oscillator will reliably drive crystals with resistance up to 5 kΩ. For example, it will maintain oscillation in viscous aqueous solutions containing over 88 % glycerol (w/w %).

The QCM100 uses a 5 MHz, 1" diameter, AT-cut quartz crystal. All quartz crystals are designed specifically for operation in liquids, and are available in a variety of electrode materials and finishes.

The crystal holder is designed so that only the front electrode is exposed to the gas or liquid under test, as required in EQCM experiments. A conductive metallic pad (wrap-around electrode) allows connection to the front electrode from the back of the crystal. This feature, combined with transformer isolation between the crystal electrodes and the oscillator circuit, makes the QCM100 ideal for electrochemical research, and compatible with virtually all potentiostats.

As a laboratory instrument, the QCM100 is a valuable research tool for experiments ranging from pure surface science to electrochemical reactions. Frequency, mass and resistance measurements can be performed in both gas and liquid phase environments. Quartz crystal sensors can be pre-coated with virtually any thin film material including organic polymers, hydrogels, composites, ceramics, biomolecules, bacteria and living cells providing unlimited potential for the development of novel gas and biological sensors.

For biological laboratories, the QCM100 is an essential addition to standard techniques such as surface plasmon resonance (SPR) and atomic force microscopy (AFM), often providing the complementary information required to fully understand complex biological interactions.

Applications

Sensors
Gas Sensors
Immunosensors
Sorption sensors
Moisture analyzers
Particulate monitors
Contamination monitors

Electrochemical Quartz Crystal Microbalance (EQCM)
Thin-film investigations
Electrovalency measurements
Hydrogen absorption on metal films
Bubble formation
Redox and conductive polymer research
Double-layer characterization
Corrosion studies
Surface oxidation
Batteries

Biochemistry and Biology
DNA and RNA hybridization studies
Antigen-antibody reactions
Protein adsorption
Detection of virus capsids, bacteria and mammalian cells
Adhesion of cells and liposomes
Biofouling and antifouling
Biomembranes
Biomaterials
Cell adhesion
Protein-protein interactions

Functionalized Surfaces
Lipid membranes
Phospholipid bilayers
Polymer coatings
Protein coatings
Self-assembled monolayers (SAMs)
Viscoelastic films
Molecularly imprinted polymers (MIPs)

Thin-Film Research
Langmuir/Langmuir-Blodgett films
Adsorption processes (physical and chemical)
Laser ablation/desorption/breakdown studies

Materials Science
MEMs nanomaterials
Intelligent biomaterials

Other applications include Drug Research, Thin-Film Deposition, Surfactant Research and Rheology.

Specifications

Frequency Output

Frequency	5 MHz (nominal)
Level	TTL (square wave)
Source impedance	50 Ω
Connector	BNC

Conductance Output (Vc)

Resistance	$R = 10{,}000 \times (10^{-Vc/5}) - 75\ \Omega$
Resistance range	0 to 5000 Ω
Voltage level	0 to 10.625 VDC, log scale
Impedance	1 kΩ
Connector	BNC

Capacitance Cancellation

Range	10 to 40 pF (20 pF nominal)
Limit	0.01 pF

Quartz Crystals

Frequency	5 MHz, AT-cut, plano-plano
Diameter	1 inch
Electrodes	chromium/gold (titanium/gold, titanium/platinum are optional)

Crystal Holder

Material	Kynar
O-ring	Viton
Connector	BNC

Ordering Information

QCM100	Controller, oscillator, 3 crystals and holder	$995
O100FC	Flow cell	$195
O100RH	Replacement holder (Kynar)	$395
O100RX1	Replacement crystals (qty. 10)	$295
O100RXO	Replacement oscillator module	$395