

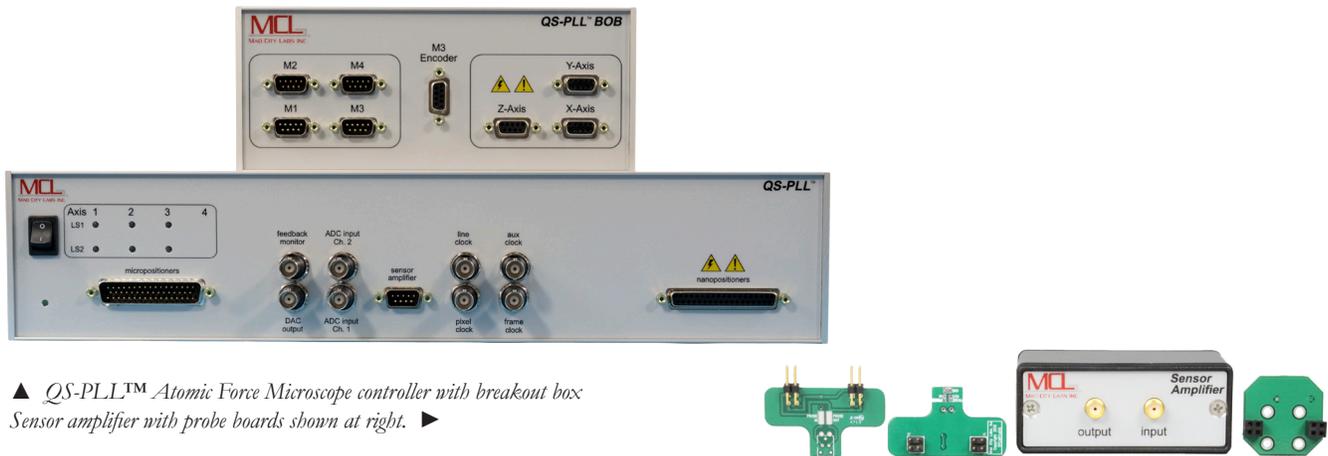
# QS-PLL™ AFM Controller

## Features

- ▶ *AFMView™2 software included*
- ▶ *Lift mode scans for Nano-Magnetometry*
- ▶ *Integrated PLL and motion control*
- ▶ *Amplitude oscillation controllable to 1 nm*
- ▶ *Low noise, atomic step performance*
- ▶ *Automated software and hardware setup*
- ▶ *Compatible with Mad City Labs Nanopositioners*
- ▶ *Compatible with Akiyama and QZabre probes*

## Applications

- ▶ *Scanning NV Magnetometry*
- ▶ *Magnetic Force Microscopy*
- ▶ *Electric Force Microscopy*
- ▶ *Atomic Force Microscopy*



▲ QS-PLL™ Atomic Force Microscope controller with breakout box  
Sensor amplifier with probe boards shown at right. ▶

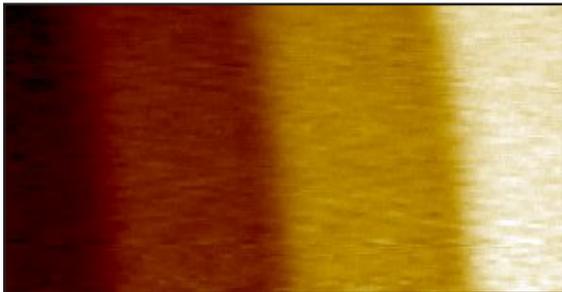
## Product Description

QS-PLL™ is an atomic force microscope (AFM) controller designed for use with resonant probes, such as tuning forks, and Mad City Labs nanopositioners and micropositioners. The controller integrates motion control and phase lock loop (PLL) control thus streamlining the hardware interface. Hardware and the digital PLL are controlled via the AFMView™2 software supplied with the QS-PLL™ controller. The QS-PLL™ controller allows users to customize a resonant probe AFM instrument with the unique feature of “Lift Mode” scans in addition to the usual scanning modes. This instrument is ideal for scanning probe microscopy where tip-surface interactions are modulated by a field, such as scanning NV magnetometry.

The QS-PLL™ is compatible with all Mad City Labs closed loop nanopositioners and stepper motor driven micropositioners. Up to 3 axes of piezo nanopositioning is supported and up to 4 axes of micropositioning, giving an unparalleled ability to configure an instrument for your application. In addition, there is an option to add encoders to 3 axes of the micropositioning. A breakout box is supplied to facilitate cable management between the motion control devices and QS-PLL™. Mad City Labs closed loop nanopositioners offer superb stability and precision via our proprietary PicoQ® sensors. Our nanopositioners have been deployed previously in resonant probe AFM instruments with atomic step resolution. As a result, many different instrument configurations can be formed to enable optical and sample access.

The phase lock loop (PLL) contains a digitally controlled proportional integral (PI) loop designed to work seamlessly with Mad City Labs' nanopositioning systems and provide amplitude oscillations down to 1nm. This high degree of control with resonant probes offers significant advantages for applications that require high sensitivity and low optical noise.

The QS-PLL™ controller is compatible with tuning forks, Akiyama probes, and QZabre probes. There is also capability to bias the probe via the DAC output which is controllable within the AFMView™2 software. AFMView™2 software, which is supplied with the controller, simplifies the control of your atomic force microscope. Among the software features are automated setup, configuration control, auto-Q calculation and automatic parasitic capacitance compensation (PCC) control. These included features are designed to simplify setup and accelerate the data acquisition process.



SiC with 1.5nm steps

1.5µm × 0.75µm

Data taken with QS-PLL™ with Nano-3D200 nanopositioning system and tungsten tip on a quartz tuning fork.

#### Related products

- MadPLL®
- SPM-M Kit
- MCL-NSOM

## Technical Specifications

Motion Control	
Closed loop nanopositioner	1-3 axes
Nanopositioning control	20 bit
Micropositioners	1-4 axes
Micropositioner step size	95 nm
Encoders (option)	1-3 axes
Encoder resolution	50 nm
Phase Lock Loop Control	Digital
I/O Connections	
Nanopositioner	DB-37
Micropositioner	DB-50
Feedback Monitor	1 x BNC
16 bit DAC output	-10V to +10V (BNC)
16 bit ADC input	0-10V (2 x BNC)
Sensor Amplifier	DB-9
Pixel Clock	TTL (out)
Line Clock	TTL (out)
Frame Clock	TTL (out)
Aux Clock	TTL (out)
PLL Features	
Feedback Modes	Amplitude
	Frequency
	Phase Shift
Automatic Range Selection	YES
Parasitic Capacitance Compensation (PCC)	YES
Automatic PCC	YES
Adjustable PI Loop Filter	YES
Digitally Set Parameters	YES
Error Signal Inversion Capability	YES
Automatic Loop Filter Setup	YES, after initialization.
Frequency Range	10 kHz - 100 kHz
General	
AC Power	90 - 260 VAC (50/60 Hz)
Controller Dimensions*	16.75" x 14" x 3.5" (42.6 cm x 35.6 cm x 8.9 cm)
PC Connection	USB 2.0
Operating System	Windows 7/8/10/11 32 bit and 64 bit

\* Breakout box dimensions: 8.375" x 8" x 3.5" (21.3 cm x 20.3 cm x 8.9 cm)