

Moku:Delta



Precision meets speed and adaptability in one reconfigurable platform.

Moku:Delta is a versatile, high-performance software-defined test and measurement platform, purpose-built for precision, flexibility, and real-time performance. It features eight 2 GHz 14-bit and 20-bit analog inputs, eight 2 GHz 14-bit analog outputs, and 32 bidirectional digital I/O channels. Powered by a Xilinx® UltraScale+™ RFSoc FPGA, Moku:Delta supports integrated signal processing, control, analysis, and waveform synthesis in a single cohesive platform. A ± 1 ppb ultra-stable onboard reference clock and advanced timing options, including 10 MHz, 100 MHz, and GPS-disciplined references, ensure accurate synchronization. Moku:Delta enables engineers and scientists to develop test systems that combine high-performance instrumentation with user-defined, hardware-accelerated algorithms.



Analog inputs
8-channel, 5 GSa/s

Input bandwidth
Up to 2 GHz

Analog outputs
8-channel, 10 GSa/s

Output bandwidth
Up to 2 GHz

Connectivity
Ethernet, SFP,
QSFP, USB-C

Clock reference options
10 MHz, 100 MHz,
GPS

Specifications

Eight analog inputs

- 14-bit and 20-bit ADCs with frequency-dependent blending
- 5 GSa/s sampling rate on all eight channels simultaneously
- Input noise: < 10 nV/ $\sqrt{\text{Hz}}$
- AC or DC coupling, 50 Ω or 1 M Ω input impedance
- 100 mVpp, 1 Vpp, or 10 Vpp input range

Eight analog outputs

- 14 bit DACs
- 10 GSa/s sampling rate
- Output range (into 50 Ω):
 - ± 500 mV up to 2 GHz
 - ± 5 V up to 100 MHz

Additional I/O

- 32 bidirectional DIO pins
- TTL trigger input
- External clock reference input and output
- Ultra-high speed connectivity: 100 Gb QSFP, two 10 Gb SFP, 1 Gb Ethernet

Hardware highlights

- Exceptional low-frequency noise performance: 500 μV RMS noise at full input bandwidth
- ± 1 ppb stability onboard clock
- Internal 1 TB SSD for data logging and deep memory captures

A suite of powerful instruments

- Arbitrary Waveform Generator
- Data Logger
- Digital Filter Box
- FIR Filter Builder
- Frequency Response Analyzer
- Laser Lock Box
- Lock-in Amplifier
- Logic Analyzer
- Neural Network
- Oscilloscope
- Phasemeter
- PID Controller
- Spectrum Analyzer
- Time & Frequency Analyzer
- Waveform Generator

Programming environments

- Integrated system: MokuOS 4
- Windows, macOS, iPadOS, and visionOS apps
- Full API support is available for major languages, including Python and MATLAB
- Program Moku's onboard FPGA in VHDL or Verilog for custom, real-time signal processing

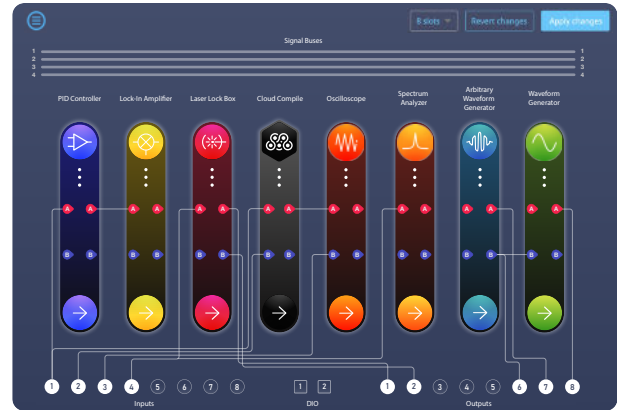
Applications

- Optical metrology and spectroscopy
- Quantum computing
- Cold-atom and quantum optics experiments
- Multi-harmonic or multi-system detection
- System prototyping and simulation
- Automated test sequencing
- Closed-loop control design
- Synchronized Waveform Generators and receivers for phased-array, MIMO applications
- High-bandwidth data streaming to network storage
- High-frequency mixed domain analysis
- Implementing real-time Neural Networks

For full specifications and ordering, contact info@si-gmbh.de.

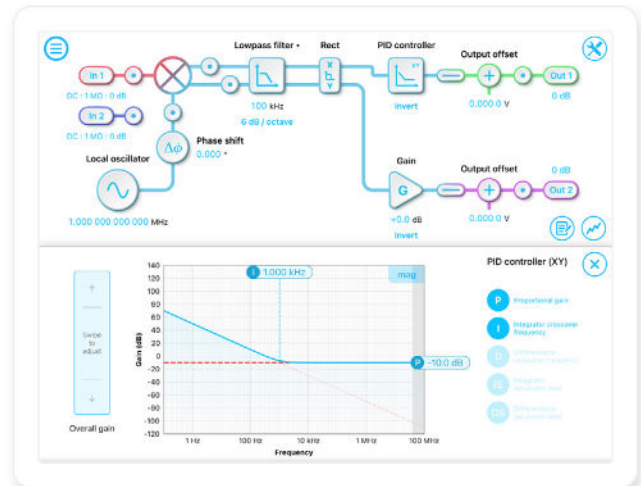
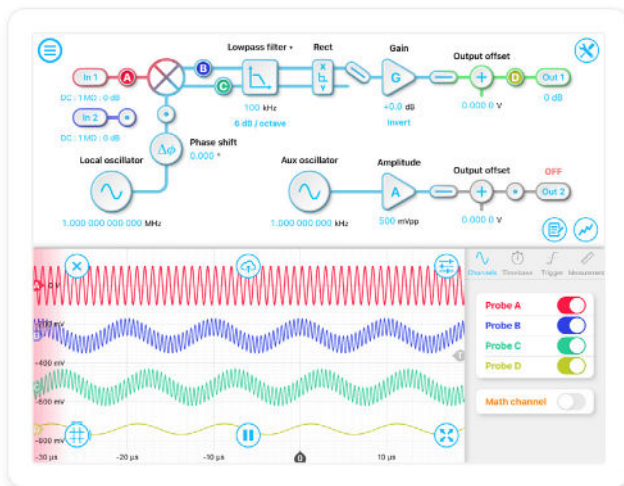
Deploy up to eight instruments simultaneously

Multi-Instrument Mode on Moku:Delta runs up to eight instruments simultaneously, so you can create custom test sequences and complex measurement workflows. Each instrument has full access to all analog inputs, outputs, and adjacent instrument slots. A low-latency, real-time 30 Gb/s signal path connects the slots, enabling independent operation or tightly integrated signal processing pipelines. Swap instruments in and out dynamically as needed, or deploy your own custom algorithms using Moku Cloud Compile for advanced, application-specific functionality.



2 GHz Lock-in Amplifier

The Moku:Delta digital Lock-in Amplifier performs dual-phase demodulation (X/Y or R/θ) from DC up to 2 GHz, with over 120 dB of dynamic reserve. Demodulate using the onboard Waveform Generator or phase-lock to an external reference at the fundamental, harmonic, or subharmonic. Blended ADC technology delivers a consistently low noise floor across the full 2 GHz input bandwidth. Built-in probe points make it easy to monitor and log signals at key stages of processing. A built-in PID Controller supports closed-loop control and phase-locked loop applications.



Built for quantum control



Moku:Delta provides a powerful, unified platform for advanced quantum experiments, combining essential tools in a single hardware system. It enables laser frequency stabilization with the Laser Lock Box, high-fidelity waveform generation using a 2 GHz Arbitrary Waveform Generator, and parallel demodulation with up to eight Lock-in Amplifiers. The Time & Frequency Analyzer supports zero-dead time photon counting and event timing. All instruments run on a shared, timing-stable, synchronized FPGA, delivering low-latency feedback, exceptional signal integrity, and seamless integration for complex quantum control workflows.