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Moku:Go

The Engineering Education Lab Solution

LIQUID INSTRUMENTS

Moku:Go is a complete engineering lab solution for students to actively learn anything from circuits to senior design. Designed to be carried in a backpack, Moku:Go features 10+ instruments and optional programmable power supplies. With the Multi-instrument Mode, two instruments can be deployed simultaneously to create your own custom testbench. It eliminates the need for bulky benchtop instruments and empowers students to learn wherever they are. Hardware features include a Wi-Fi Hotspot, integrated high-quality connectors with enhanced electrical protection, USB-C for data, and 6 color options. An intuitive user interface (UI) is included for Windows and Mac, and API support integrates with the rest of your curriculum. We've thought of everything to ensure students have a complete experience for four years and beyond.

Analog Inputs/Outputs	Input Bandwidth	Digital I/O	Output Bandwidth	Programmable Power Supplies
Two 12 bit, 125 MSa/s	**30 MHz**	**16 channel @ 125 MSa/s**	**20 MHz**	**2 or 4 channel option**

10+ Powerful Instruments

- Arbitrary Waveform Generator
- Data Logger
- Digital Filter Box
- Frequency Response Analyzer
- FIR Filter Builder
- Logic Analyzer
- Oscilloscope / Voltmeter
- PID Controller
- Spectrum Analyzer
- Waveform Generator
- Lock-in Amplifier* (add-on option)

Programmable Power Supplies

2 channel option

- +5 V to -5 V @ 150 mA
- 0 to 16 V @ 150 mA

4 channel option

- +5 V to -5 V @ 150 mA
- 0 to 16 V @ 150 mA
- Dual 0.6 to 5 V @ 1 A

Specifications

Analog Inputs

- Two 12 bit, 125 MSa/s input channels
- 30 MHz analog bandwidth
- AC or DC coupling with 1 MΩ impedance
- Input range up to ± 25 V

Analog Outputs

- Two 12 bit, 125 MSa/s output channels
- 20 MHz analog bandwidth
- ± 5 V maximum output range

Digital I/O

- 16-channel DIO at 125 MSa/s
- Support 3.3 V (5 V tolerant) logic level

Programming Environment

- API support for Python, MATLAB, and LabVIEW
- Windows or MacOS
- Moku Cloud Compile support for FPGA customization

Models

M0

- 2 analog inputs, 2 analog outputs and 16 DIO
- USB-C, Wi-Fi, software, and APIs

M1

- All features from M0
- Two-channel programmable power supply

M2

- All features from M0
- Ethernet
- Four-channel programmable power supply

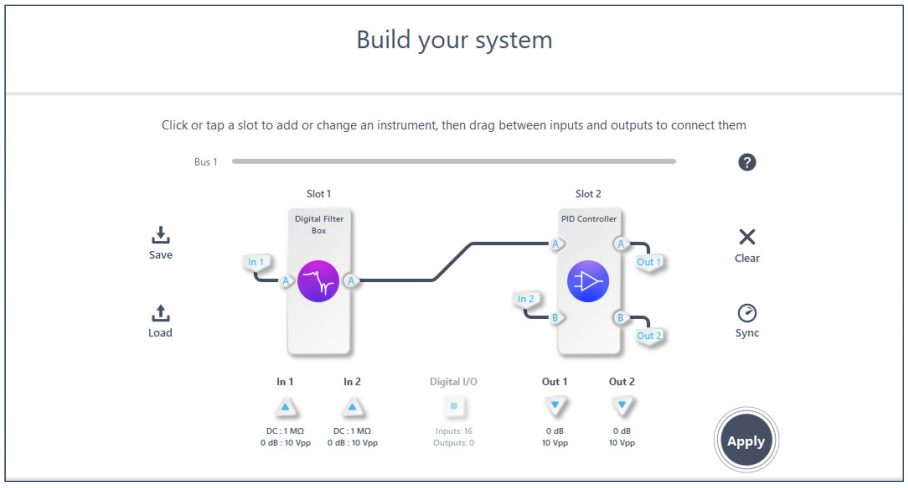
Options & Accessories

- *Lock-in Amplifier
- All models include relevant accessories: 2 oscilloscope probes, DIO cabling, power adapter, USB-C and Ethernet cable, and power supply cables
- 6 standard colors, or custom color upgrade

For full specifications and education pricing, please contact info@si-gmbh.de

High quality hardware and complete feature set, designed to last.

With hardware components including integrated BNC connectors, integrated banana jack connectors for programmable power supplies, a high-grip rubberized base to prevent slippage, and robust electrical protection to ensure safety in the lab, you have everything you need to maximize learning on safe, durable hardware.



The world's most intuitive user interface *meets the classroom.*

We've brought you a UI that makes teaching difficult concepts easy, and learning them even easier. Use the Moku:Go App for Mac or Windows to configure any of the 11 instruments, and switch between instruments in seconds. Want your students to experience industry-standard platforms? No problem. Full API integration is available for Python and MATLAB.

6 standard colors, or custom color upgrade

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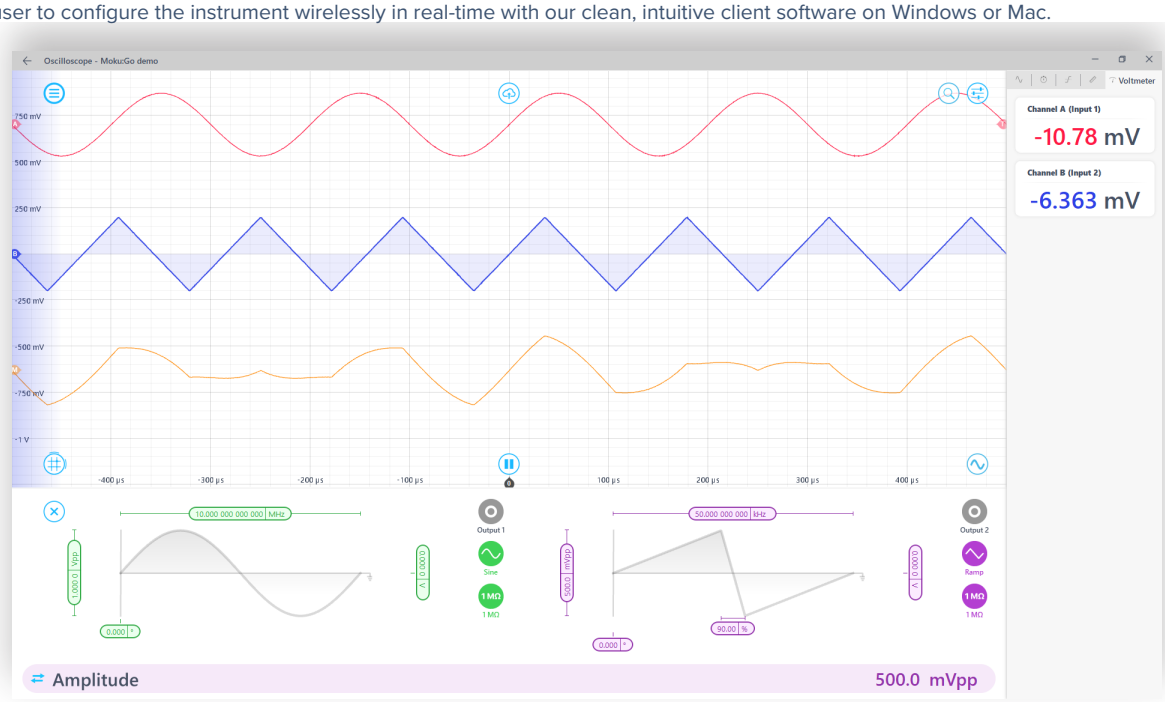
Moku:Go Instrument Datasheet

30 MHz Oscilloscope / Voltmeter

Moku:Go's Oscilloscope / Voltmeter features two input channels with sampling rates up to 125 MSa/s and 30 MHz analog bandwidth. Both channels support user-selectable AC / DC couplings, and ± 5 V or ± 25 V input ranges. The built-in two-channel waveform generator is capable of producing waveforms with a maximum bandwidth of 20 MHz. The ADCs and DACs are directly connected to a powerful programmable Zynq 7020 FPGA that allows the user to configure the instrument wirelessly in real-time with our clean, intuitive client software on Windows or Mac.



Sampling Rate	Bandwidth	ADC Resolution	Input Impedance	Input Coupling	Waveform Generator
Up to 125 MSa/s	30 MHz	12 bits	1 MΩ	AC or DC	2 Channels up to 20 MHz

Features

- Two analog inputs with 125 MSa/s sampling rate and 30 MHz bandwidth.
- Intuitive user interface on Windows or Mac.
- Onboard signal analysis toolbox.
- Math channel with support for arbitrary functions.
- Integrated, high-speed, 2-channel waveform generator with maximum frequency up to 20 MHz.

Specifications

- Vertical resolution: 12 bit
- Input range: ± 5 V or ± 25 V
- Sampling rate: 125 MSa/s
- Input bandwidth: 30 MHz
- Input coupling: AC or DC
- Input impedance: 1 MΩ
- Output bandwidth: 20 MHz
- Output waveforms: sine, square, ramp, DC
- Math channel: add, subtract, multiply, divide, XY, integrate, differentiate, FFT, min hold, max hold, arbitrary user-defined function.

Applications

- Signal monitoring and analysis
- Circuit design and characterization
- Photo detector alignment
- Automated system test
- System test and debug

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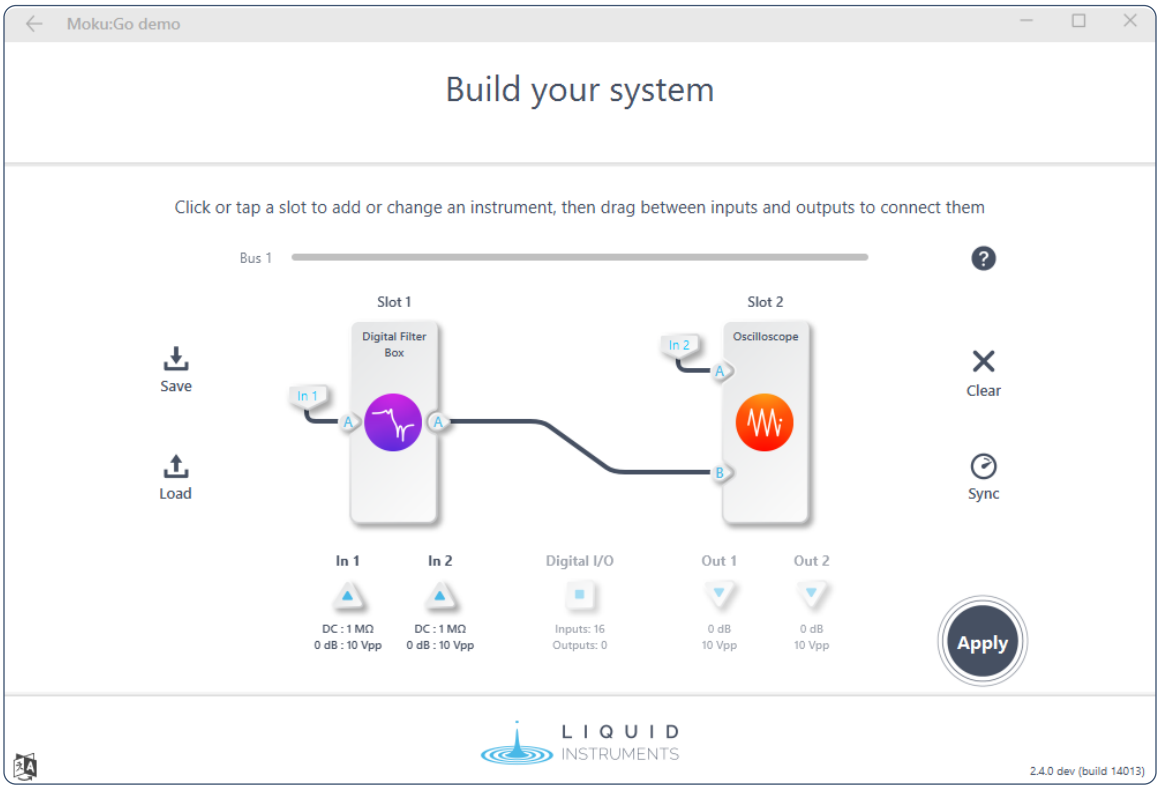
Multi-Instrument Mode

Simultaneously deploy multiple instruments on Moku:Go

Multi-instrument Mode on Moku:Go allows users to deploy two instruments simultaneously to create a custom test station. Each instrument has full access to the analog inputs and outputs along with interconnections between instrument slots. The interconnections between instruments support high-speed, low-latency, real-time digital communication up to 2 Gb/s, so instruments can run independently or be connected together to build advanced signal processing pipelines. Instruments can be dynamically swapped in and out without interrupting adjacent instruments. Advanced users can also deploy their own custom algorithms in Multi-instrument Mode using Moku Cloud Compile.



Deployable Instruments

- Arbitrary Waveform Generator
- Data Logger
- Digital Filter Box
- FIR Filter Builder
- Frequency Response Analyzer
- Oscilloscope
- PID Controller
- Spectrum Analyzer
- Waveform Generator
- Moku Cloud Compile

Hardware Highlights

- Xilinx Zynq 7020 SoC
- Optional integrated power supply

Specification

Two Analog Inputs

- 12-bit, 125 MSa/s ADC
- 30 MHz analog bandwidth
- AC or DC coupling, 1 MΩ input impedance
- 10 Vpp, or 50 Vpp input range

Two Analog Outputs

- 12-bit, 125 MSa/s DACs
- 20 MHz analog bandwidth
- 10 Vpp output range

Digital I/O

- 16-channel DIO at 125 MSa/s
- Support 3.3 V (5 V tolerant) logic level

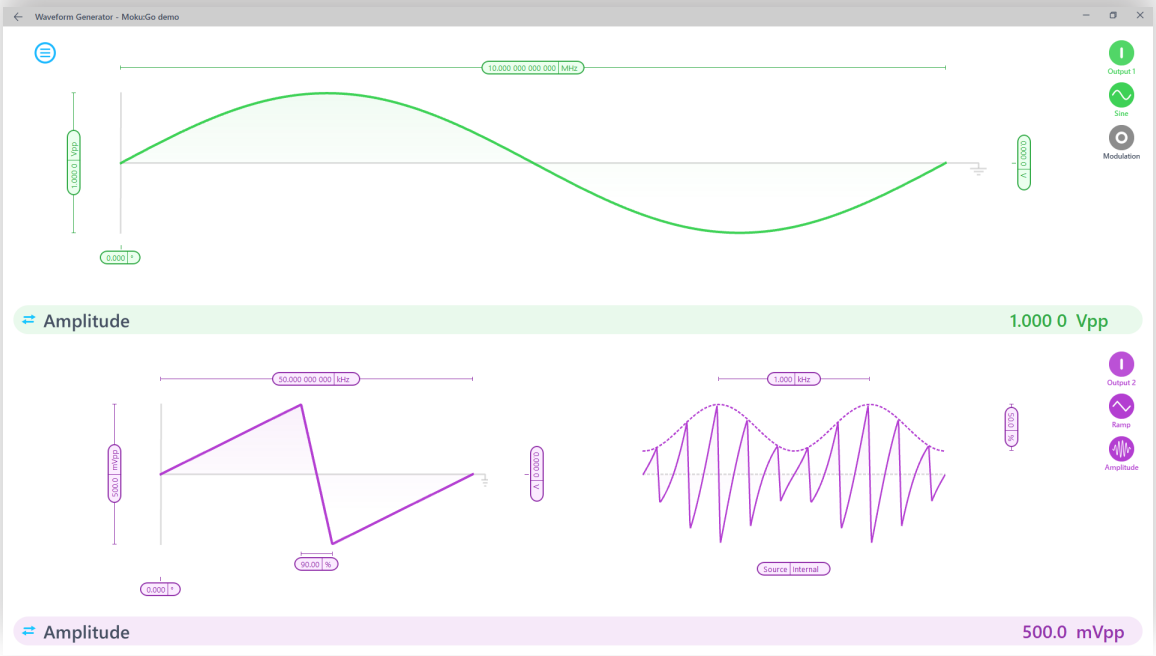
Applications

- Automated test sequence
- Mixed domain signal analysis
- System prototyping and simulation
- Closed loop control design
- Optical metrology and spectroscopy
- Control hub for optics, imaging, and other custom-made systems

Moku:Go Instrument Datasheet

20 MHz Waveform Generator

Moku:Go's Waveform Generator enables you to generate two independent waveforms with a sampling rate of 125 MSa/s, and a maximum frequency of 20 MHz with an output voltage range up to 10 Vpp. Select between sine, square, ramp, pulsed, or DC waveform shapes. Modulate the phase, frequency, or amplitude, or generate triggered bursts or sweeps from an internal or external source.



Frequency Range	Sampling Rate	Resolution	Output Voltage Range	Modulation	Other Modes
DC to 20 MHz	125 MSa/s	12 bit	10 Vpp	FM, AM, PM	Burst, Sweep

Features

- Generate 2 independent waveforms from DC to 20 MHz.
- 5 built-in waveforms: sine, square, ramp, pulse, and DC.
- FM, AM, and PM modulation with internal waveform (cross-channel modulation) or external input.
- Versatile trigger options: from input, or the other output channel.

Specifications

- Output bandwidth: 20 MHz (10 Vpp)
- Frequency range:
  - Sine: 1 mHz to 20 MHz
  - Square: 1 mHz to 5 MHz
  - Ramp: 1 mHz to 5 MHz
  - Pulse 1 mHz to 5 MHz
- Pulse width: 16 ns to period
- Modulation bandwidth: > 10 MHz
- Burst mode: start, N-cycle, gated
- Sweep time: 1 ms to 1 ks

Applications

- Signal simulation
- Circuit design and characterization
- System synchronization
- Clock source
- Op-amp characterization

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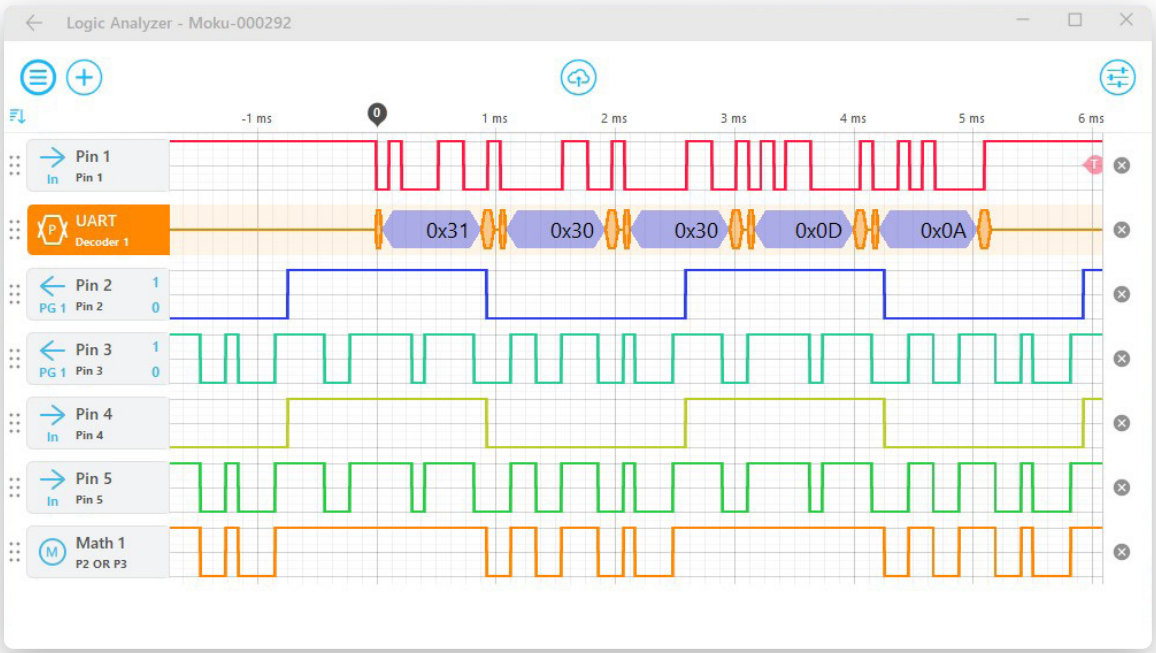
Moku:Go Instrument Datasheet

Logic Analyzer

Moku:Go's Logic Analyzer is equipped with 16 bidirectional digital I/O with sampling rates up to 125 MSa/s. It supports 3.3 V logic levels (5 V tolerant) and 1M × 16 input sample depth. Two independent protocol channels can be added to decode UART, I2C, and SPI. Common measurements are readily available and can be shared along with data and screenshots to your computer or cloud. Combined with the analog inputs and outputs, and the intuitive graphical user interface, Moku:Go is your go-to solution for undergraduate lab curriculum and senior design projects.



Number of DIO	Sampling Rate	Maximum Clock Frequency	Supported Logic Level	Input Memory Depth	Supported Protocol
16	125 MSa/s	62.5 MHz	3.3 V, 5 V tolerant	1M × 16	UART, I2C, SPI

Features

- Supported Protocol: UART, I2C, SPI
- Supported Math: AND, OR, XOR, NAND, NOR, XNOR
- 16 channel bidirectional digital I/O with sampling rates up to 125 MSa/s.
- Powerful, intuitive graphical user interface with Python, and MATLAB API support.

Specifications

- Input memory depth: 1M × 16
- Output memory depth: 1024 × 16

Input

- Logic level: 3.3 V, 5 V tolerant
- Impedance: >10 MΩ, <4 pF
- Sampling rate: up to 125 MSa/s
- Maximum clock frequency: 62.5 MHz*

Output

- Logic level: 3.3 V
- Impedance: 400 Ω, <4 pF
- Sampling rate: up to 125 MSa/s
- Maximum clock frequency: 62.5 MHz*

Applications

- Signal simulation
- Digital circuit design
- Digital communication diagnosis
- Protocol decoding
- Clock source
- IC testing and validation

** Please note that a high-speed cable is required to achieve maximum clock rate*

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Moku:Go Instrument Datasheet

20 MHz Frequency Response Analyzer

Moku:Go's Frequency Response Analyzer enables you to measure the frequency response of a system in both magnitude and phase using a swept sine output from 10 mHz to 20 MHz. Select from between 32 and 512 points per sweep and configure settling and averaging times to balance total sweep duration and signal-to-noise ratio.

Frequency Range	Input Impedance	Averaging time	Sweep	Output Voltage Range	Harmonics Detection
Up to 20 MHz	**1 MΩ**	**1 µs to 10 s**	**Linear/Logarithmic**	**10 Vpp**	**Up to 15th**

Features

- Linear or logarithmic swept sine output.
- Math channel to add, subtract, multiply, or divide response functions as they are acquired.
- Use cursors and markers to measure exact values on the plots.
- Measurement averaging and settling times are highly configurable.
- Easily save data and upload to the your computer.
- Probe two systems simultaneously, or one system at two points.
- Demodulate up to 15th harmonic.

Specifications

- Frequency range: 10 mHz to 20 MHz
- Averaging time: 1 µs to 10 s
- Settling time: 1 µs to 10 s
- Sweep points: 32, 64, 128, 256, 512
- Output Voltage Range: 10 Vpp
- Input Impedance: 1 MΩ
- Input voltage range: 10 Vpp or 50 Vpp
- Noise-floor: up to -80 dB

Applications

- Impedance measurement
- Capacitance/inductance measurement
- Stability analysis
- Power supply analysis
- EMI filter characterization

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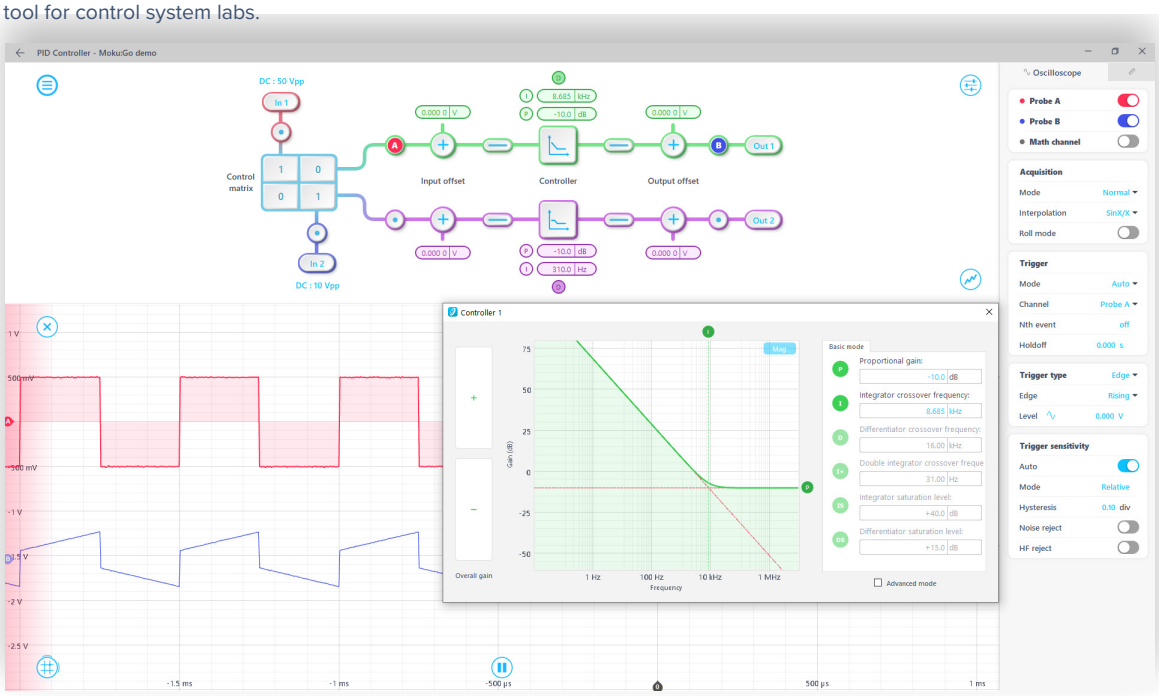
Moku:Go Instrument Datasheet

Multiple-Input Multiple-Output PID Controller

Moku:Go's PID Controller instrument features two fully configurable PID controllers with an output sampling rate of >2.5 MSa/s. This enables them to be used in various applications such as current or robotic arm control. The intuitive graphic user interface allows you to directly adjust the PID parameters on the Bode plot. Users are able to monitor the effects of the change with the built-in oscilloscope in real-time, which makes Moku:Go's PID the best tool for control system labs.



Versatile input	Output sampling rate	DAC resolution	Phase lag	Gain configuration	Advanced mode
2 inputs MIMO	**>2.5 MSa/s**	**12-bits**	**<30° at 20 kHz**	**Real-time**	**Multi-section builder**

Features

- 2 input channels, 2 output channels, and 2 independent PID controllers with control matrix for optional blending.
- Design your control system's frequency response using the interactive Bode plot in real-time.
- Block diagram view of the digital signal processing chain with built-in probe points.
- Advanced multi-section PID builder with single or double integrators and differentiators with low- and high-frequency gain saturation.

Specifications

- Control matrix linear gain: ± 0.1 to ± 20
- Input offset range: -2.5 to +2.5 V
- Output offset range: -2.5 to +2.5 V
- Gain profiles: Proportional (P), integral (I), differential (D), double-integral (I+), integral saturation (IS), differential saturation (DS)
- Proportional gain: -60 dB to 60 dB
- Integrator crossover frequency: 312.5 mHz to 31.25 kHz
- Differentiator crossover frequency: 3.125 Hz to 312.5 kHz

Applications

- Feedback and control systems design
- Laser frequency stabilization
- Temperature regulation
- Scan heads/sample stage positioning
- Pressure, force, flow rate, and other controls

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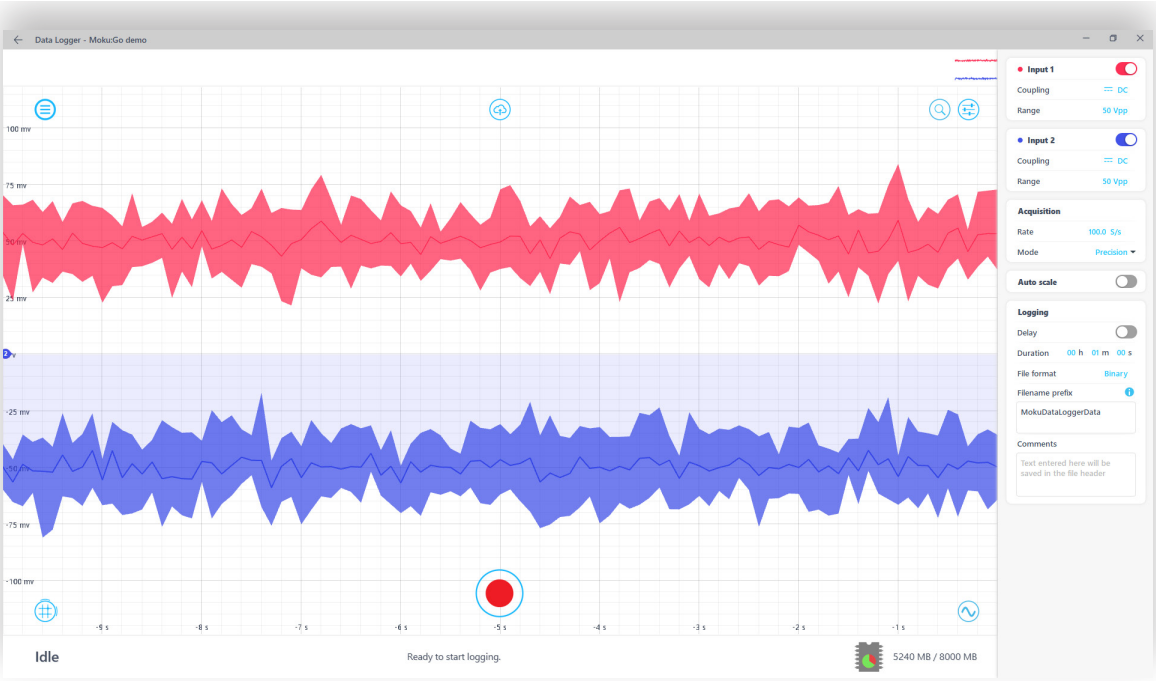
Moku:Go Instrument Datasheet

2-Channel Data Logger

Moku:Go's Data Logger enables you to log data up to 1 MSa/s directly to its internal memory. The versatile front ends allows the user to select between AC / DC couplings, and ± 5 V or ± 25 V input ranges based on the experiment. It also provides user-configurable sampling rate along with duration and delay start options. Data saved to Moku:Go's internal memory can be uploaded to computers for analysis once the measurement is complete.



Number of Inputs	Acquisition Rate	Input Range	Input Coupling	Input Impedance	Waveform Generator
2	**Up to 1 MSa/s**	**± 5 V to ± 25 V**	**AC or DC**	**1 MΩ**	**Integrated**

Features

- Log voltage data on two independent channels directly to the device.
- Built-in two-channel 20 MHz waveform generator.
- Easily download log files to your computer for analysis. Built-in conversion tool to convert the binary data to .csv, .mat, NumPy format.
- Schedule your log to start on a delay of up to 10 days.

Specifications

- Input range: 10 Vpp, or 50 Vpp
- Input Impedance: 1 MΩ
- Input coupling: AC/DC
- Maximum sampling rate:
  1 MSa/s with 1 channel enabled
  500 kSa/s with 2 channels enabled
- Minimum sampling rate: 10 Sa/s
- Acquisition modes:
  Normal: Direct digitization at the acquisition rate
  Precision mode: Downsampling from maximum sampling rate by averaging

Applications

- Temperature monitoring
- Vibration analysis
- Environment monitoring
- Other sensor data recording

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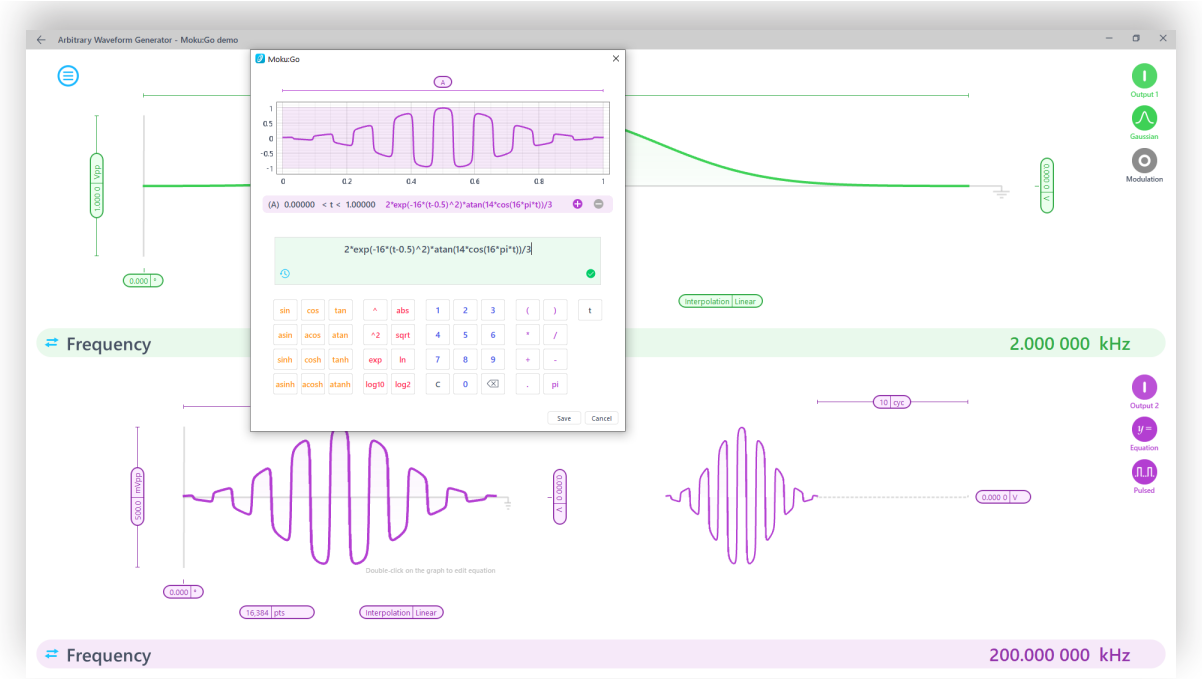
Moku:Go Instrument Datasheet

125 MSa/s Arbitrary Waveform Generator

Moku:Go's Arbitrary Waveform Generator can generate custom waveforms with up to 65,536 points at sample rates of up to 125 MSa/s. Waveforms can be loaded from a file or input as a piece-wise mathematical function with up to 32 segments, enabling you to generate truly arbitrary waveforms. In burst mode, waveform generation can be triggered from input channels with start or n cycle modes. In pulsed mode, waveforms can be output with more than 250,000 cycles of dead time between pulses.



Maximum Sample Rate	Output Bandwidth	DAC Resolution	Independent Triggering	Supported Waveforms
125 MSa/s	**20 MHz**	**12-bits**	**Burst/Pulsed**	**6 predefined, segmented equations (up to 32), or custom**

Features

- Two independent AWG channels with 20 MHz output bandwdith.
- Choose between one of the preset waveforms, load points from a file, or input an equation directly.
- Phase synchronization output between the two channels.
- Triggered start or n-cycle mode with burst output.
- Configure pulsed output with up to 250,000 cycles of dead time between pulses.

Specifications

- Supported waveforms: Sine, Gaussian, Exponential fall, Exponential rise, Sinc, Cardiac, Equation editor, and Custom (from file)
- Output bandwdith: 20 MHz
- DC offset: ± 5 V with 3 mV resolution
- Phase offset: 0° to 360° with 0.001° resolution
- Maximum output rate:
  15.625 MSa/s with 65,536 points
  31.25 MSa/s with 32,768 points
  62.5 MSa/s with 16,384 points
  125 MSa/s with 8,192 points

Applications

- Random pattern generation
- System response simulation
- Additive manufacturing
- Instrument response function simulation

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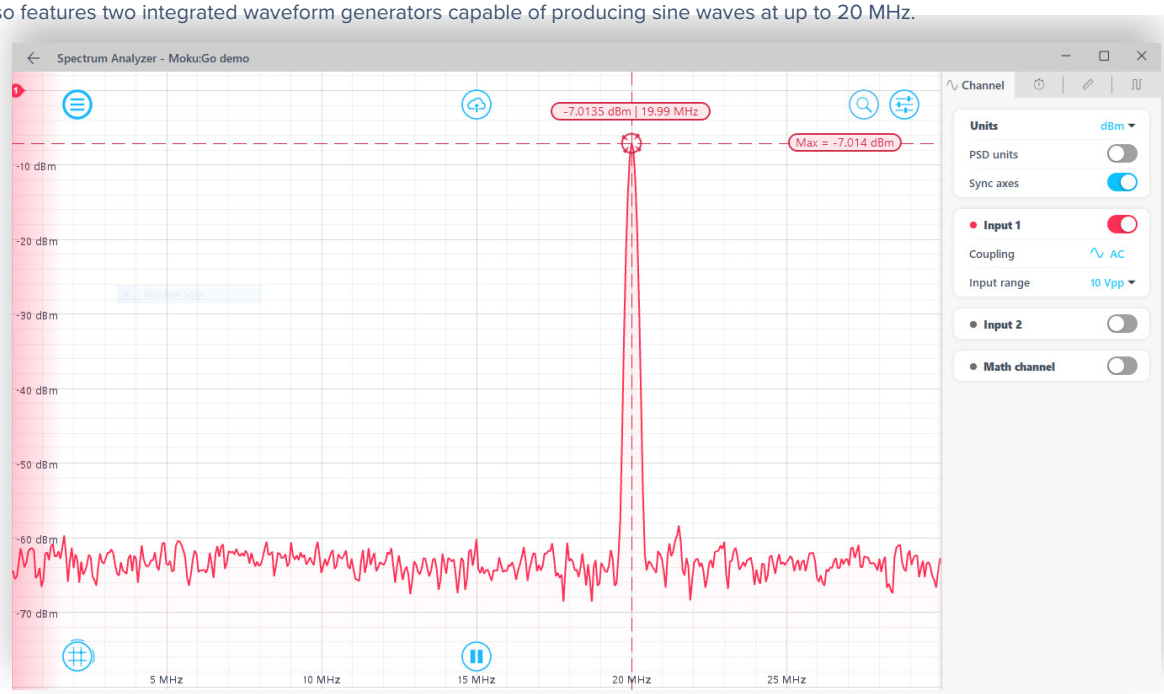
Moku:Go Instrument Datasheet

30 MHz Real-Time Spectrum Analyzer

Moku:Go's Spectrum Analyzer allows you to observe input signals in the frequency domain between DC and 30 MHz. The frequency down-conversion / FFT hybrid approach provides significant improvement in dynamic range and spectral resolution compared to an FFT-based spectral analysis. View two channels of data simultaneously with a resolution bandwidth as low as 470 mHz over a minimum span of 100 Hz. The Spectrum Analyzer also features two integrated waveform generators capable of producing sine waves at up to 20 MHz.



Frequency Range	Frequency Span	Minimum RBW	Video Filter Bandwidth	Signal Generator	Output Frequency
DC to 30 MHz	100 Hz to 30 MHz	470 mHz	20 Hz to 610 kHz	Integrated	up to 20 MHz

Features

- High bandwidth input and output options: display and record power spectra or power spectral densities in the frequency domain from DC to 30 MHz.
- Generate two sine waves up to 20 MHz using Moku:Go's built-in analog outputs.
- Quickly measure key metrics by dragging measurement cursors onto features of interest using the graphical interface.

Specifications

- Frequency range: DC to 30 MHz
- Frequency span: 100 Hz to 30 MHz
- Resolution bandwidth (RBW): span dependent, minimum RBW is 470 mHz
- Number of inputs: 2
- Input range: 10 Vpp
- Input impedance: 1 MΩ
- Number of outputs: 2
- Output frequency range: 1 mHz to 20 MHz
- Output voltage: 10 Vpp

Applications

- Frequency domain analysis
- System response characterization
- Noise measurement
- Spurious signal identification

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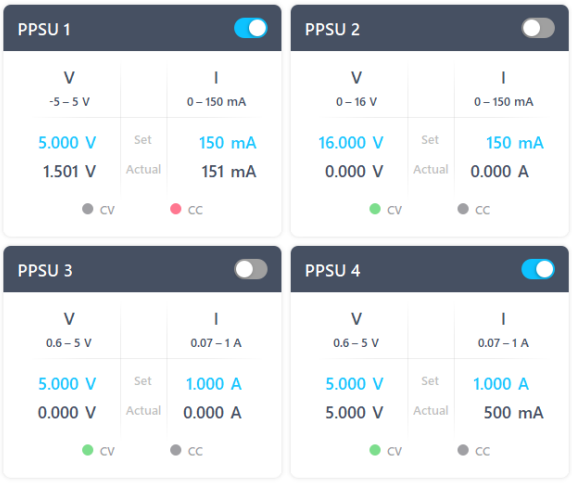
Moku:Go Datasheet

2 or 4 Channel Programmable Power Supply

Moku:Go M1 and M2 models are equipped with 2 and 4 channel programmable power supplies. The power supply is an embedded peripheral that can be independently configured and used in tandem with any of Moku:Go's instruments. M1 and M2 both provide -5 to 5 V and 0 to 16 V high-accuracy linear supplies for maximum flexibility in dual-rail and high voltage applications such as op-amp characterization and communications. The M2 adds two 0.6 to 5 V supplies. Each is capable of 1 A output currents for laser and motor applications while also being able to power a wide range of USB peripherals. Paired with eight other test and measurement instruments, Moku:Go is the ultimate undergraduate lab solution.



Voltage Output Range	Max Power Output	Operation Mode	Minimal Set Resolution	System Integration
-5 V to +16 V	**5 W @ 5 V**	**Constant I or V**	**2.5 mV or 10 mA**	**Operates with 8 T&M Instruments**

Features

- Up to four independently adjustable power supply channels.
- Constant voltage or current mode with auto overvoltage and overcurrent protection.
- Fully embedded with other 8 powerful instruments, such as an oscilloscope, waveform generator, etc.

Applications

- Op-amp characterization
- LED/laser diode power supply
- USB device powering

Specifications

		Port 1 (M1 & M2)	Port 2 (M1 & M2)	Port 3 & 4 (M2)
Output Voltage		-5 V to +5 V	0 V to +16 V	0.6 V to +5 V
Output Current		0 mA to 150 mA	0 mA to 150 mA	0.07 A to 1 A
Set Resolution		2.5 mV / 10 mA	5 mV / 10 mA	5.8 mV / 1 mA (I < 0.5 A) or 15 mA
Readback Resolution		4 mV / 0.1 mA	4 mV / 0.1 mA	4 mV / 0.1 mA
Set Accuracy	**Voltage**	≤ 1%	≤ 1%	2 %
	Current	±10 mA typical	± 10 mA typical	± 10 mA typical
Readback Accuracy	**Voltage**	±4 mV ± 1%	±4 mV ± 1%	±4 mV ± 1%
	Current	±100 µA ± 1%	±100 µA ± 1%	±100 µA ± 1%
Effective Output Impedance		0.5 R	0.5 R	<0.1 R
Ripple and Noise		20 mVrms	20 mVrms	TBD

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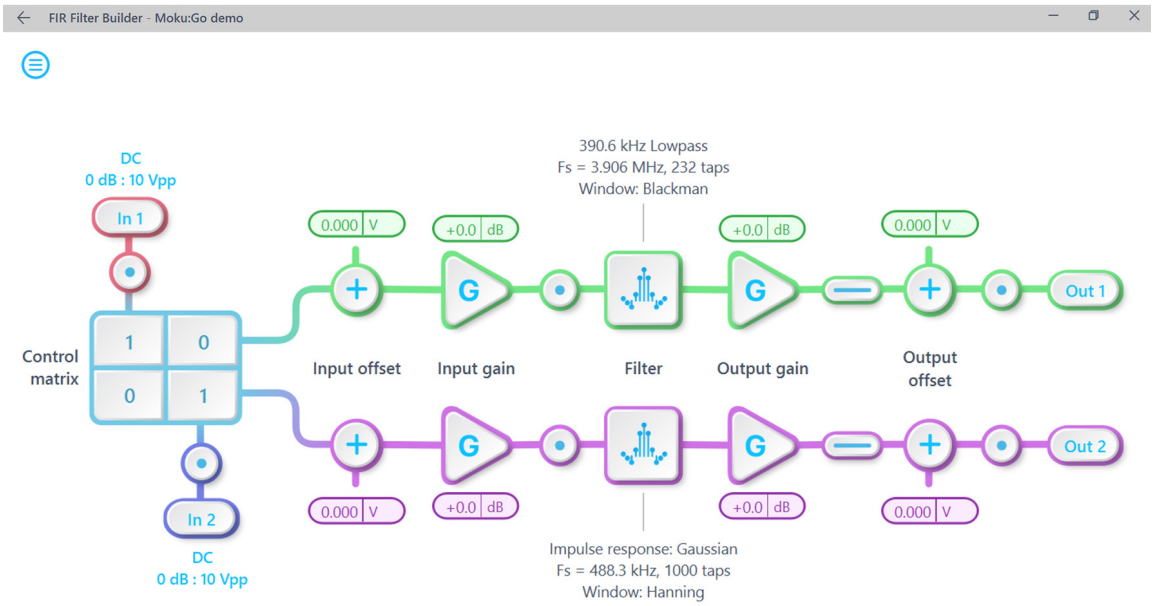
Moku:Go Instrument Datasheet

FIR Filter Builder

With Moku:Go's FIR Filter Builder, you can design and implement lowpass, highpass, bandpass, and bandstop finite impulse response (FIR) filters with up to 14,819 coefficients. Moku:Go's desktop interface allows you to fine-tune your filter's response in the frequency and time domains to suit your specific application. Select between four frequency response shapes, five common impulse responses, and eight window functions.



Sampling Rate	Filter Coefficients	Input Range	Output Voltage Range	Integrated Oscilloscope
Up to 3.906 MHz	Up to 14,819	± 5 V or ± 25 V	± 5 V into high-z	125 MSa/s

Features

- Visualize your signal and configuration in real-time: design filters in the time domain or in the frequency domain
- Visualize the filter's transfer function, impulse and step response, or group and phase delay
- Block diagram view of the digital signal processing chain with built-in probe points for signal monitoring and logging
- Load your own filter coefficients or enter an equation to create a customized impulse response

Specifications

- Independent channels: 2
- Coefficient count at various sampling rates:
  - 2 to 232 @ 3.906 MHz
  - 2 to 928 @ 976.6 kHz
  - 2 to 7424 @ 244.1 kHz
  - 2 to 14819 @ 61.04 kHz
  - 2 to 14819 @ 30.52 kHz
- Design domains: time (impulse response), frequency (frequency response)
- Impulse response: rectangular, sinc, equation input, custom, etc.
- Frequency response: lowpass, highpass, bandpass, bandstop
- Window functions: Blackman, Hanning, Barlett, etc.

Applications

- Impulse response simulation
- DSP system design
- Noise filtering
- Signal amplification
- Frational delay generation

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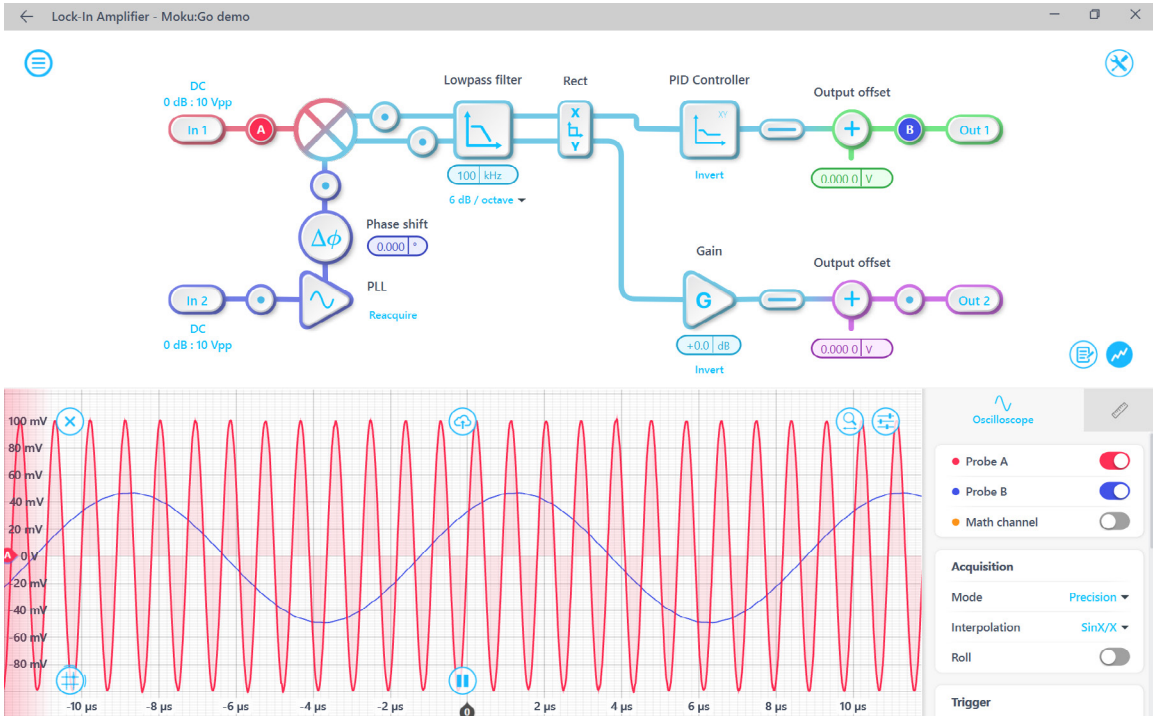
Moku:Go Instrument Datasheet

20 MHz Lock-in Amplifier

Moku:Go's digital Lock-in Amplifier supports dual-phase demodulation (XY/RΘ) from DC to 20 MHz. It features an integrated 2-channel oscilloscope and data logger, enabling you to observe signals at up to 125 MSa/s and log data at up to 1 MSa/s. A PID controller can also be placed after the demodulation stage for phase-locked loop applications.



Demod. Frequency	Time Constant	Filter Slopes	Dual-phase Demod.	Signal Generator	Built-in Feature
1 mHz to 20 MHz	128 ns to 1.59 s	6, 12, 18, 24 dB/Oct	X-Y or R-θ	Up to 20 MHz	PID Controller

Features

- Block diagram view of the digital signal processing chain
- Built-in probe points for signal monitoring and data logging
- Internal or external demodulation modes including a PLL (phase-locked loop)
- Dual-phase demodulation
- Toggle between rectangular (X/Y mode) or polar coordinates (R/θ mode)
- Built-in PID Controller

Specifications

- Demodulate with frequencies ranging from 1 mHz to 20 MHz with µHz resolution
- Phase shift precision of 0.001°
- 1 MΩ input impedance, AC/DC coupling
- Adjustable time constant from 128 ns to 1.59 s
- 6, 12, 18, or 24 dB/octave filter roll-off
- Output gain range: -80 to +160 dB
- LO output up to 20 MHz with variable amplitude
- Dynamic reserve > 100 dB
- Onboard data acquisition: snapshot mode up to 125 MSa/s, continuous mode up to 1 MSa/s

Applications

- Signal modulation and demodulation
- Software-defined radio
- Phase-locked loop
- Laser frequency stabilization
- Radio receiver education
- Signal extraction from noise education

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