Arbitrary Waveform Generator

Moku:Go User Manual

Moku:Go's Arbitrary Waveform Generator can generate custom waveforms with up to 65,536 points at update 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 pulsed mode, waveforms can be output with more than 250,000 cycles of dead time between pulses, allowing you to excite your system with an arbitrary waveform at regular intervals over extended periods of time.

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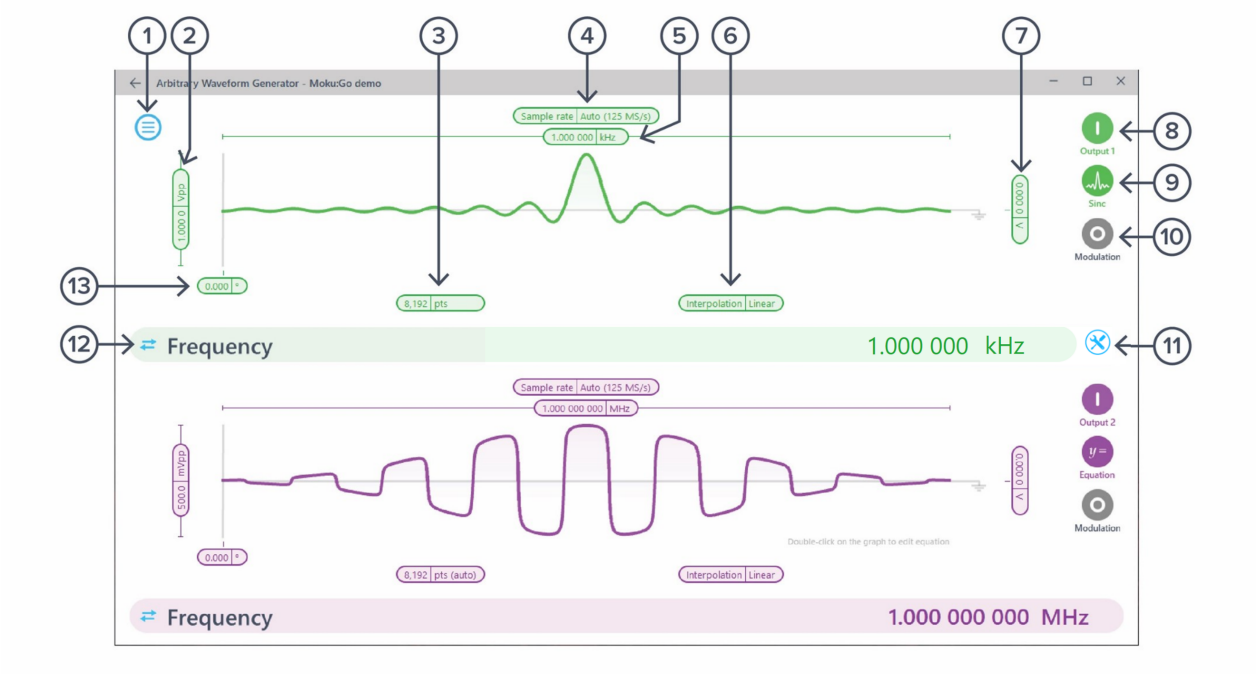
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User Interface



ID	Description	ID	Description
1	Main menu	**8**	Enable/disable output
2	Configure amplitude / high and low levels	**9**	Configure waveform shape
3	Configure number of points	**10**	Enable/disable modulation
4	Configure sample rate	**11**	Channel settings*
5	Configure frequency / period / update rate	**12**	Switch between representations**
6	Turn linear interpolation on or off	**13**	Configure phase
7	Configure offset		

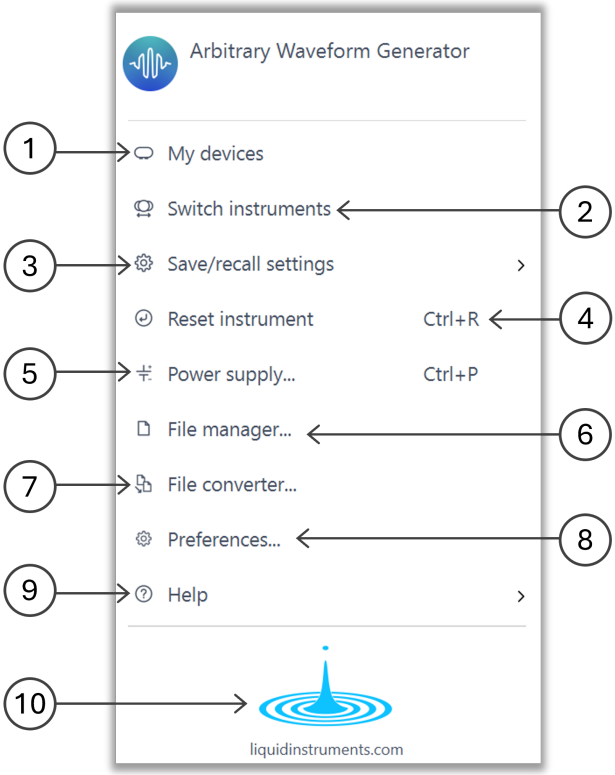
*Use this option to sync phase, copy settings from other outputs, load a waveform from file or clipboard.

**Click the amplitude, offset, frequency, or phase number to make it the active parameter. For amplitude and offset, click the swap button to switch between Vpp/offset or high/low level representations. For frequency, click the swap button to switch between frequency, period, or update rate representations.

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Main Menu

The **main menu** can be accessed by pressing the icon on the top-left corner.



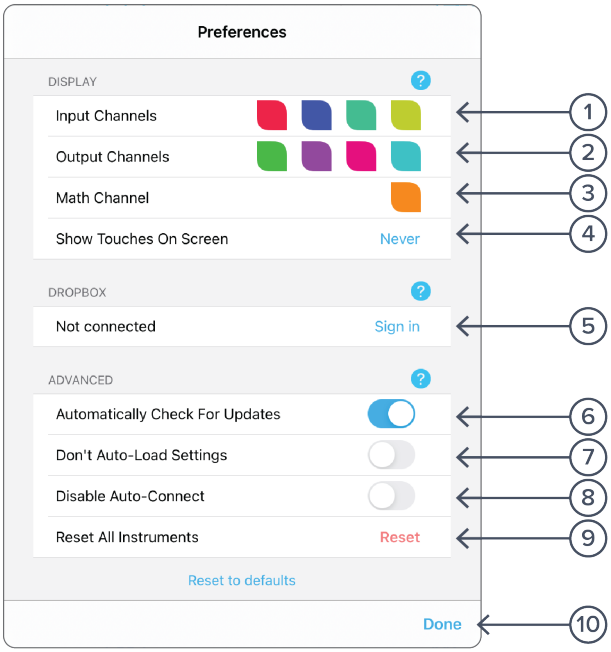
ID	Description
1	Select device or return to selection screen
2	Select instrument or return to instrument selection screen
3	Save and load instrument settings
4	Reset the instrument to its default state (cannot be undone)
5	Access power supply control window*
6	Open File manager to access saved data files
7	Open File converter to convert ".li" data files to other formats
8	Access settings for app theme and channel colors
9	Help • Access the Liquid Instruments website • Show the Moku Shortcuts list • Access the Instrument Manual • Report a bug to Liquid Instruments • About – show app version, check update, or licence information
10	Launch the liquidinstruments.com website

*Power Supply is available on the Moku:Go M1 and M2 models. Detailed information about the Power Supply can be found on page 14 of this user manual.

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Preferences

The preferences panel can be accessed via the main menu. In here, you can reassign the color representations for each channel, connect to Dropbox, etc. Throughout the manual, the default colors (shown in the figure below) are used to present instrument features.



ID	Description
1	Tap to change the color associated with input channels.
2	Tap to change the color associated with output channels.
3	Tap to change the color associated with math channel.
4	Indicate touch points on the screen with circles. This can be useful for demonstrations.
5	Change the currently linked Dropbox account to which data can be uploaded.
6	Notify when a new version of the app is available.
7	Moku:Go automatically saves instrument settings when exiting the app, and restores them again at launch. When disabled, all settings will be reset to defaults on launch.
8	Moku:Go can remember the last used instrument and automatically reconnect to it at launch. When disabled, you will need to manually connect every time.
9	Reset all instruments to their default state.
10	Save and apply settings.

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Output Configuration

Enable / Disable Outputs

Enable the output of the selected channel by pressing the  icon.

Disable the output of the selected channel by pressing the  icon.

Termination

Moku:Go assumes the output termination has a high impedance.

Selecting the correct termination

Moku:Go's outputs have a termination impedance of 200 Ω. As such, voltages supplied to a 50 Ω load will be reduced and not recommended.

Phase Synchronization

The phase of the two outputs can be synchronized by selecting the Configuration options button  and then tapping **Sync phase**.

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Output Modes

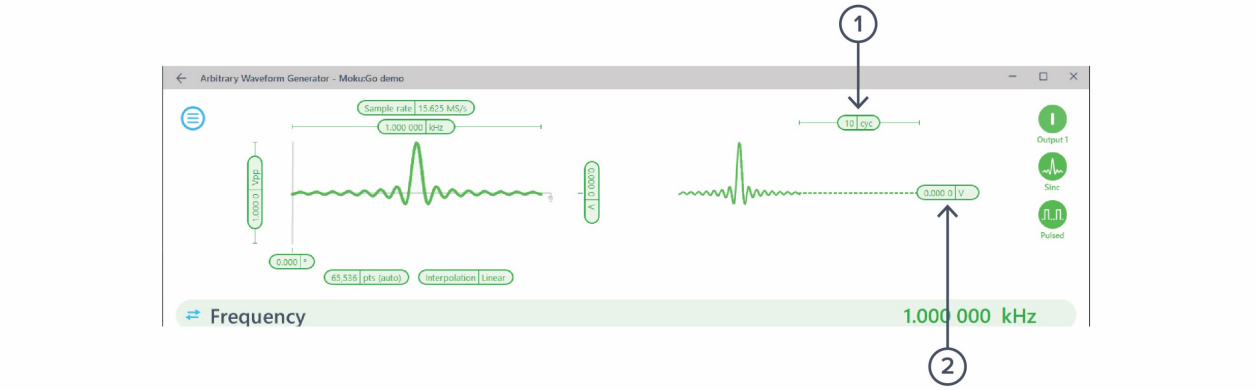
Moku:Go's Arbitrary Waveform Generator supports three output modes: Normal, Pulsed, and Burst.

Normal

In normal mode, the output waveform is repeated continuously with no dead time between cycles.

Pulsed

In pulsed mode, the output waveform can be configured to have up to 2^{18} = 262,144 cycles of dead time between each repetition of the arbitrary waveform.

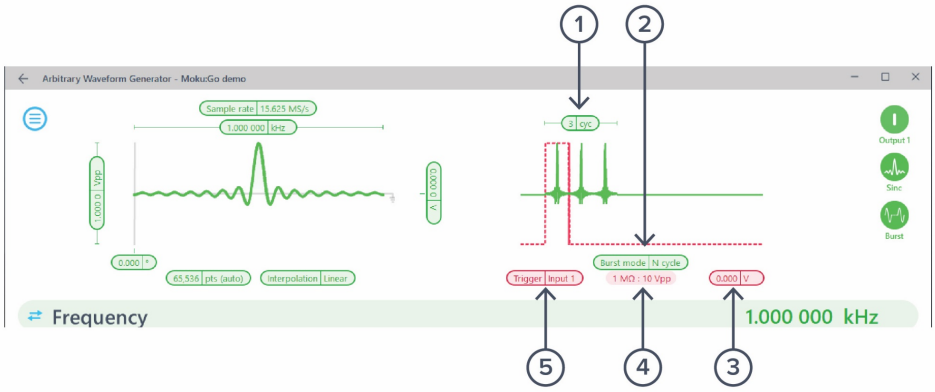


ID	Parameter	Description
1	Dead cycles	Dead time between each repetition of the arbitrary waveform. The period of each cycle of dead time is equal to the selected period of the waveform.
2	Dead voltage	The dead time voltage can be configured to equal any DC value between the waveform's minimum and maximum voltages.

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Burst

In burst mode, the output waveform can be triggered from another signal source. The output, once triggered, varies according to the trigger mode.

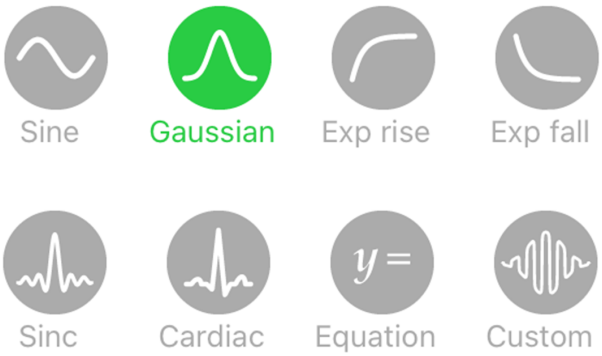


ID	Parameter	Description
1	Burst cycles	N-Cycle mode only. The number of cycles to generate before re-arming.
2	Burst mode	N-Cycle or Start. The Start mode generates infinite loops of the waveform after the trigger event.
3	Trigger level	Set the voltage level to trigger at.
4	Input range	Set the input channel range.
5	Trigger source	Select between Input 1 or Input 2.

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Waveform Types

Generate one of six pre-set waveforms, a custom waveform from a file, or a waveform defined by a series of piece-wise mathematical equations.

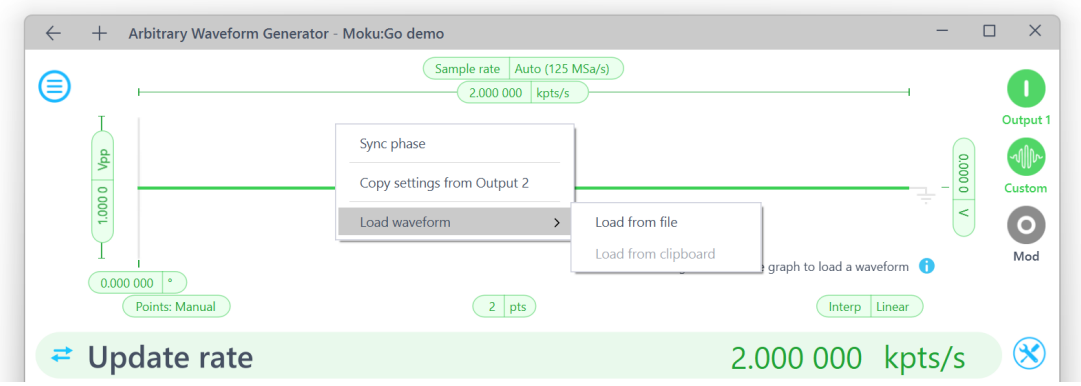


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Custom

Uploading custom waveforms

- Tap the waveform preview to load the waveform.
- Upload custom waveforms from comma- or newline-delimited text from a file or clipboard.
- Up to 8,192 points can be output at an update rate of 125 MSa/s, up to 16,384 points at 62.5 MSa/s, up to 32,768 points at 31.25 MSa/s and up to 65,536 points at 15.625 MSa/s.



Maximum recommended sampling rate

- The maximum safe frequency of the generated waveform is equal to the sampling rate divided by the number of points in the custom waveform
    - For example, the maximum safe frequency of a 1000-point waveform is 125 MSa/s ÷ 1000 Samples = 125 kHz.
- Exceeding the maximum recommended frequency will result in some points being skipped.

Amplitude scaling and interpolation

- The amplitude of custom waveforms will be normalized to the range [-1, +1] and then scaled to the desired amplitude and offset.
- Select between linear and no interpolation.

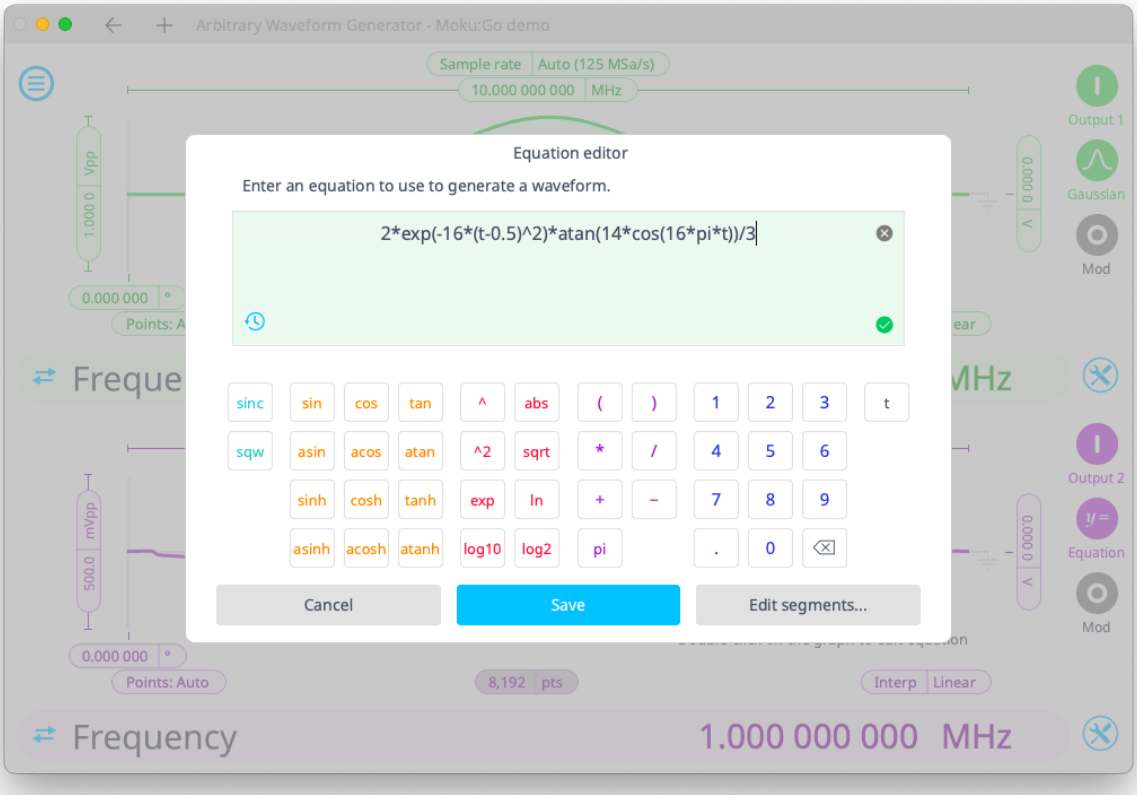
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Equation

The **equation waveform type** enables you to design arbitrary waveforms using up to 32 piece-wise mathematical functions.

Equation editor

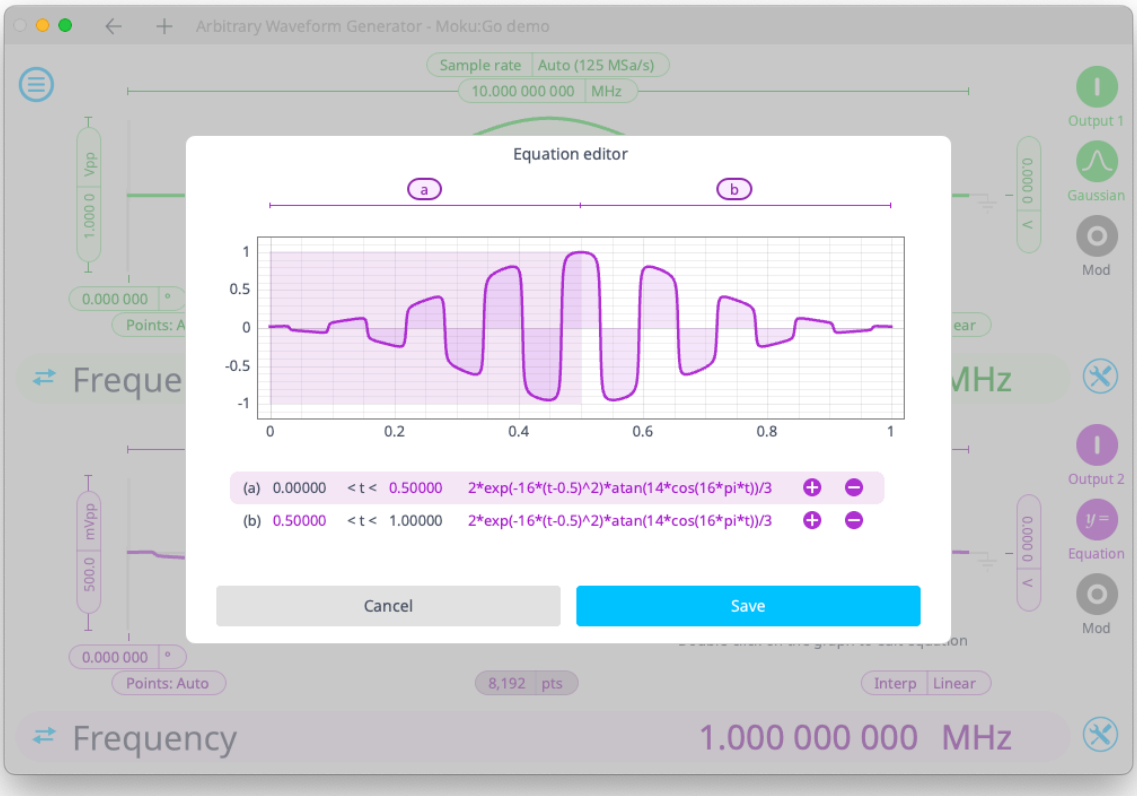
- The equation editor allows you to define arbitrary mathematical functions for each segment in the waveform.
- Select from a range of common mathematical expressions including trigonometric, quadratic, exponential and logarithmic functions.
- The variable **t** represents time in the range from 0 to 1 periods of the total waveform.
- Access recently entered equations by pressing the icon.
- The validity of the entered equation is indicated by the and icons that appear to the right of the equation box.



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Waveform segments

- Add up to 32 waveform segments and define their fractional time periods within a single period of the total waveform.
- To add or remove segments, press the Add / Remove label and click the ⊕ and ⊖ icons that appear to the left of the equations.
- To modify the period of an individual segment, click its **time segment** label and type in the desired end time for that period. The starting time for each segment is the end time for the previous segment.

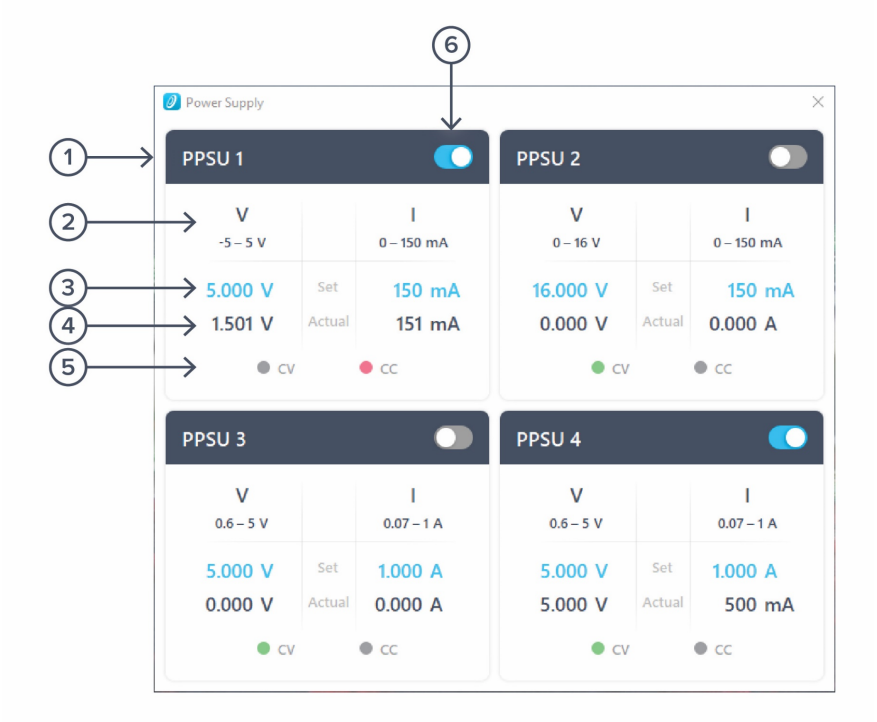


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Power Supply

Moku:Go Power supply is available on M1 and M2 models. M1 features a 2-channel power supply, while M2 features a 4-channel power supply. The power supply control window can be accessed in all instruments under the main menu.

The power supply operates in two modes: **constant voltage (CV)** or **constant current (CC)** mode. For each channel, the user can set a current and voltage limit for the output. Once a load is connected, the power supply operates either at the set current or set voltage, whichever comes first. If the power supply is voltage limited, it operates in the CV mode. If the power supply is current limited, it operates in the CC mode.



ID	Function	Description
1	Channel name	Identifies the power supply being controlled.
2	Channel range	Indicates the voltage/current range of the channel.
3	Set value	Click the blue numbers to set the voltage and current limit.
4	Readback numbers	Voltage and current readback from the power supply, the actual voltage and current being supplied to the external load.
5	Mode indicator	Indicates if the power supply is in CV (green) or CC (red) mode.
6	On/Off Toggle	Click to turn the power supply on and off.

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