Arbitrary Waveform Generator
User Manual

Moku:Lab's Arbitrary Waveform Generator can generate custom waveforms with up to 65,536 points at update rates of up to 1 GS/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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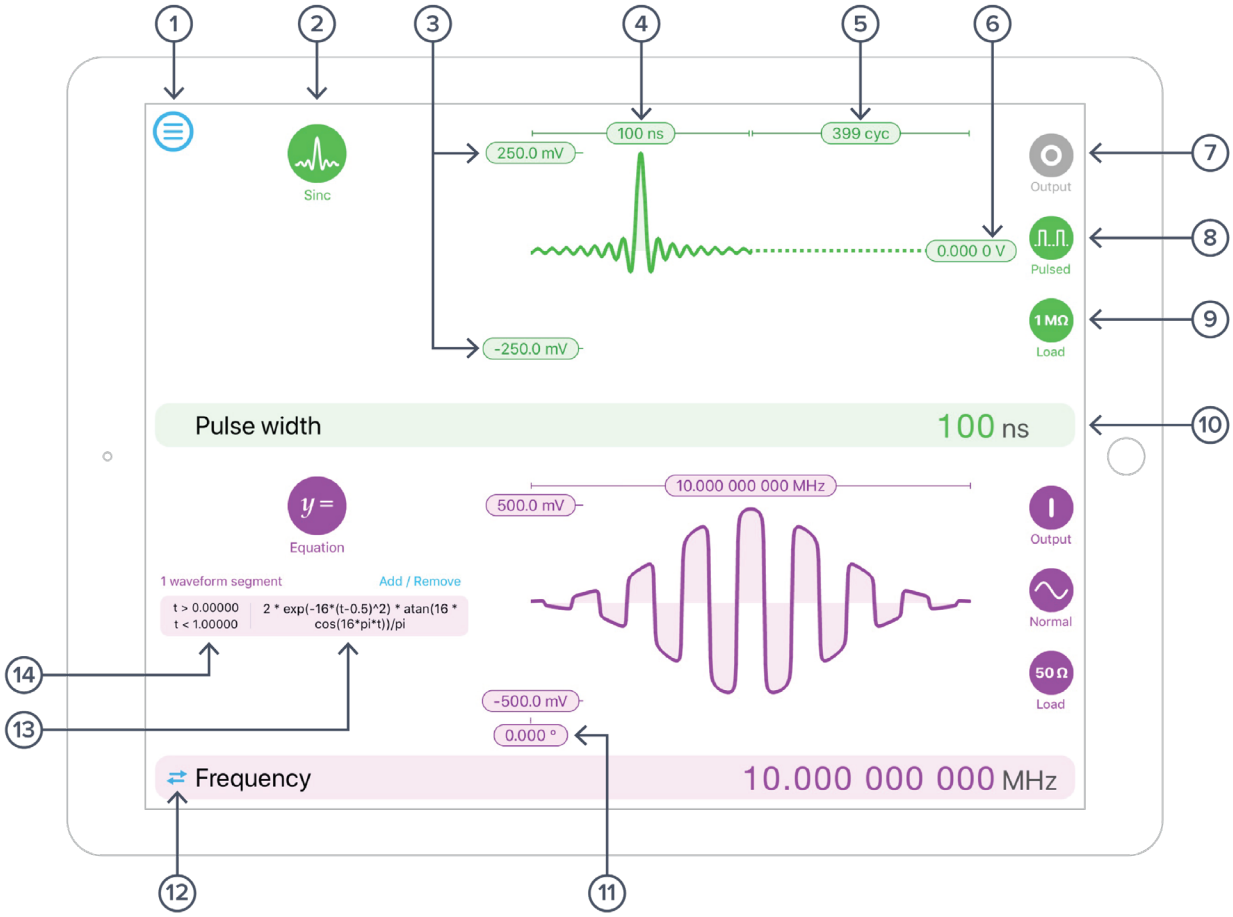
User Interface



ID	Description	ID	Description
1	Main menu	8	Waveform mode (Normal, Pulsed)
2	Waveform shape	9	Load impedance (50 Ω / 1 MΩ)
3	Configure amplitude	10	Configured parameter display
4	Configure pulse width / period / frequency	11	Configure phase (normal mode)
5	Configure dead time (pulsed mode)	12	Switch between frequency and period
6	Configure dead time voltage (pulsed mode)	13	Configure mathematical equations
7	Enable / disable output	14	Configure equation time segments

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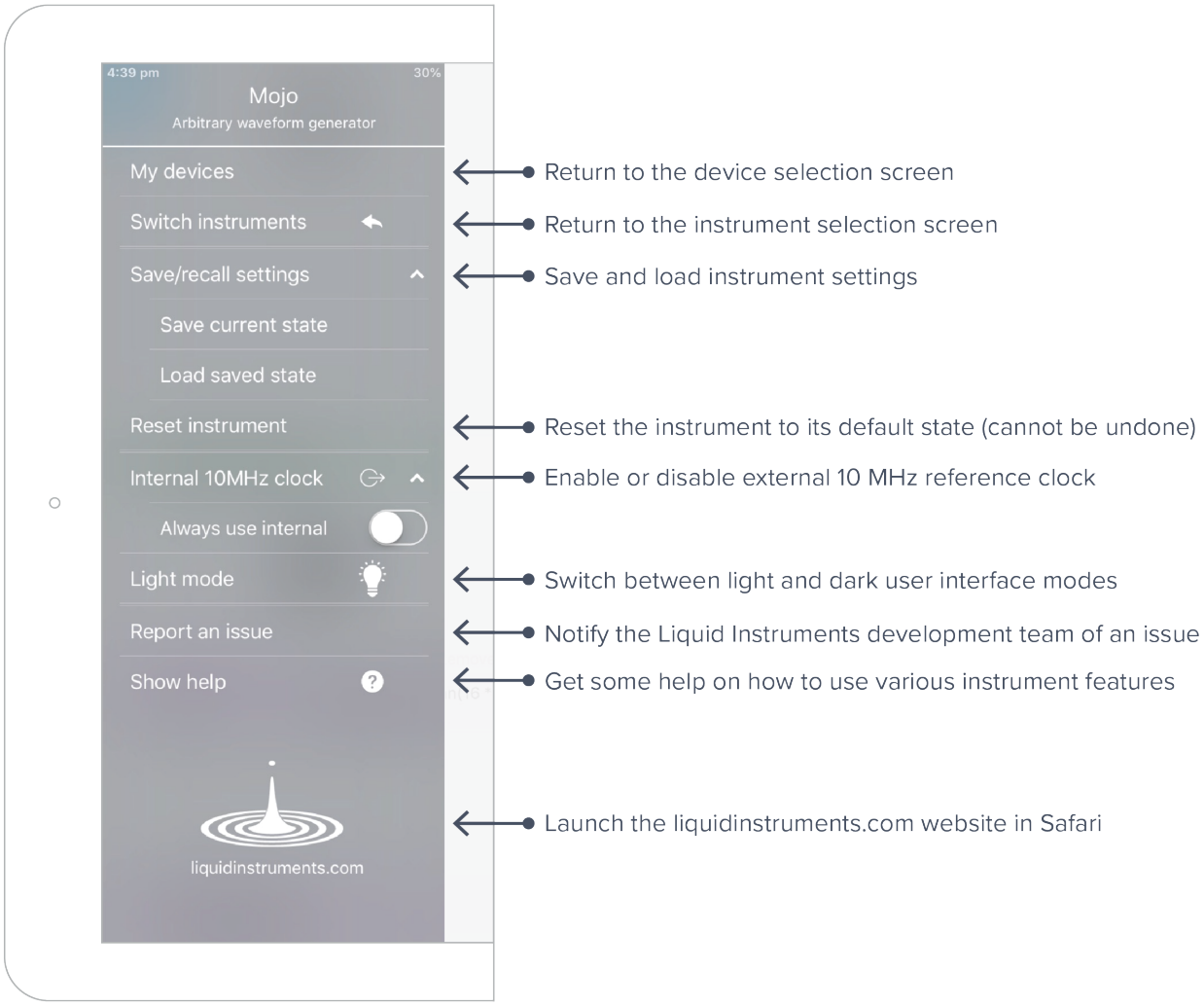
Main Menu

The **main menu** can be accessed by pressing the icon, allowing you to:



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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

Load Impedance

Select between 50 Ω and 1 MΩ load impedance.

Selecting the correct load impedance

Moku:Lab's outputs have an impedance of 50 Ω. As such, voltages supplied to a 50 Ω load will be reduced by a factor of two due to the voltage divider formed by the closed circuit. Moku:Lab compensates for this voltage division into 50 Ω loads by doubling the output voltage that is displayed on the interface. A consequence of this is that the voltage measured across a high-impedance load will be *twice* the value displayed on the interface since the voltage division of the high-impedance circuit is comparably small.

Selecting a load impedance of 1 MΩ does not double the amplitude of the generated signal.

Output Modes

Moku:Lab's Arbitrary Waveform Generator supports two output modes: Normal and Pulsed.

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} = 262144 cycles of 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
- The dead time voltage can be configured to equal any DC value between the waveform's minimum and maximum voltages

Phase Synchronization

The phase of the two outputs can be synchronised by selecting the phase configuration label (in Normal mode) and then tapping **Sync with Ch 1** or **Sync with Ch 2** depending on which channel you would like to synchronise to.

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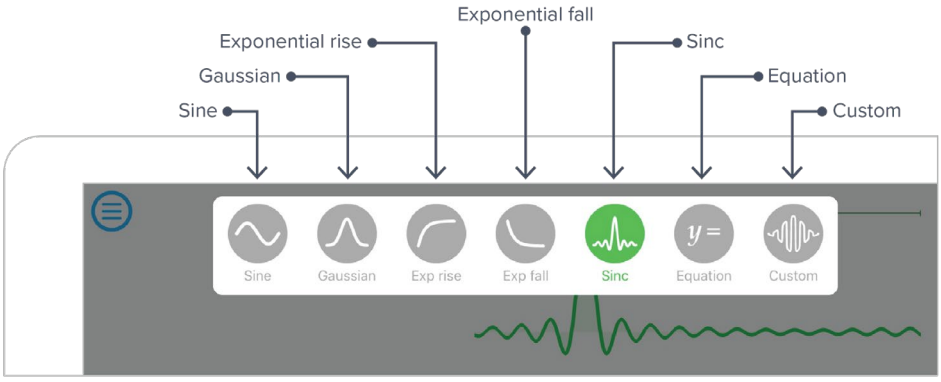
Waveform Types

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



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Custom

Uploading custom waveforms

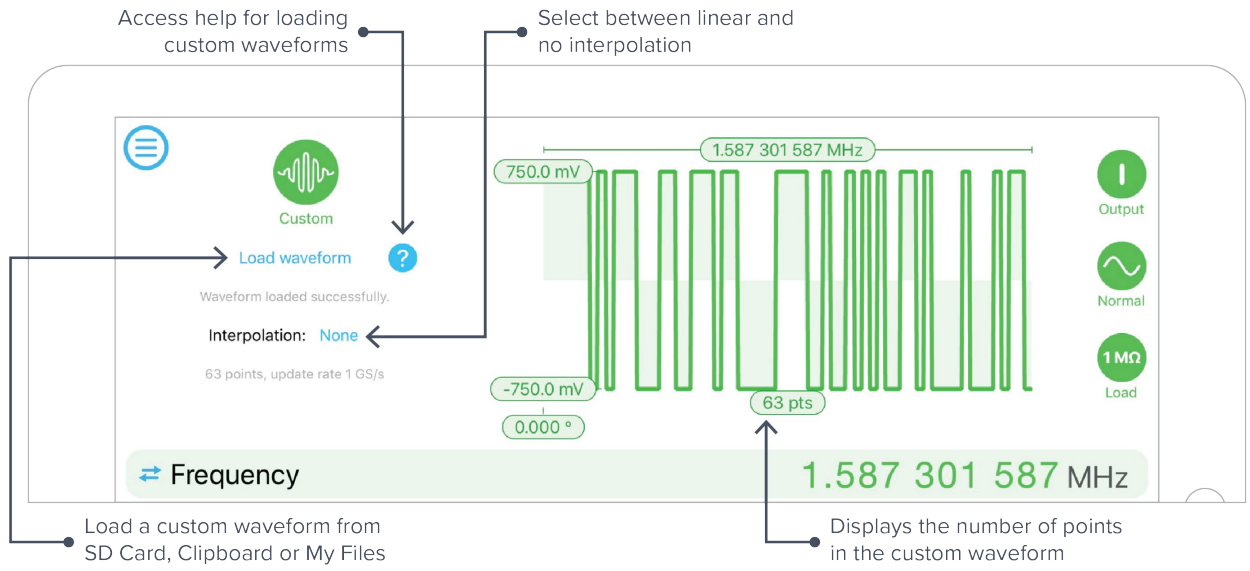
- Upload custom waveforms from comma- or newline-delimited text from SD card or the iPad's Clipboard and My Files directory
- Up to 8192 points can be output at an update rate of 1 GS/s, up to 16384 points at 500 MS/s, up to 32768 points at 250 MS/s and up to 65536 points at 125 MS/s

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 1 GS/s / 1000 Samples = 1 MHz
- 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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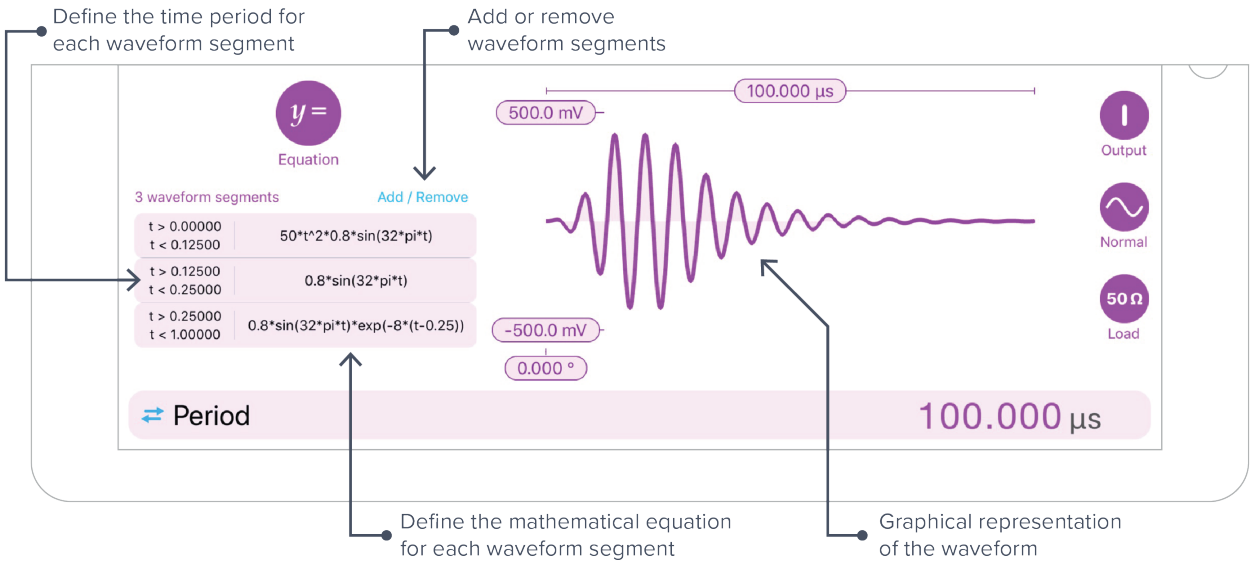
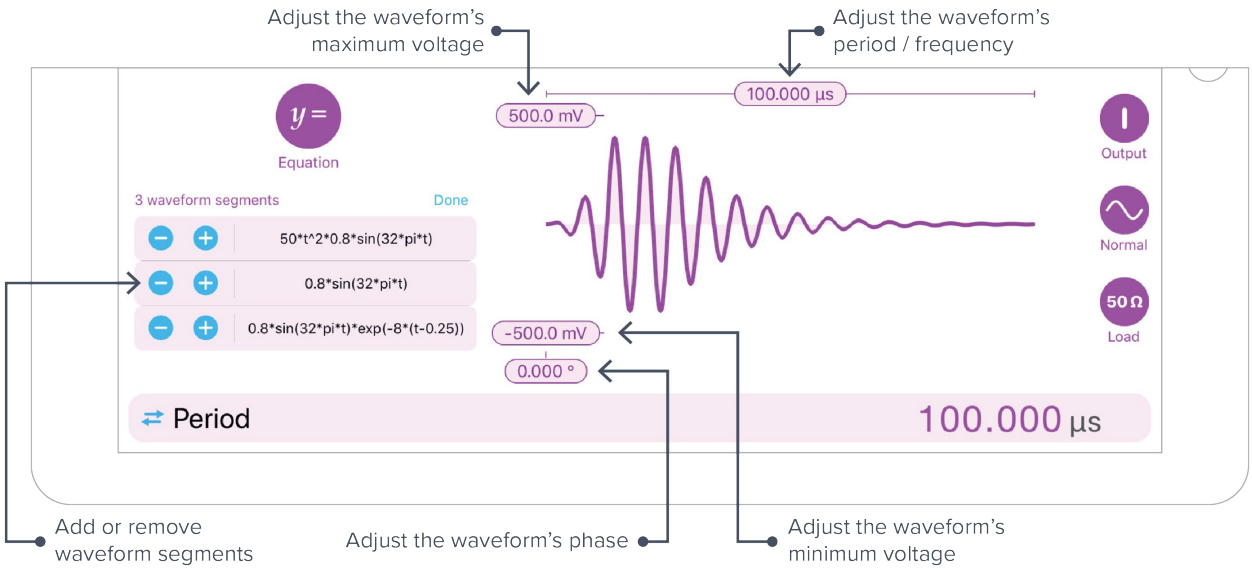
Equation

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

Waveform segments

- Add up to 32 waveform segments and define their time fractional time periods within a single period of the total waveform
- To add or remove segments, press the Add / Remove label and tap the ⊕ and ⊖ icons that appear to the left of the equations
- To modify the period of an individual segment, tap 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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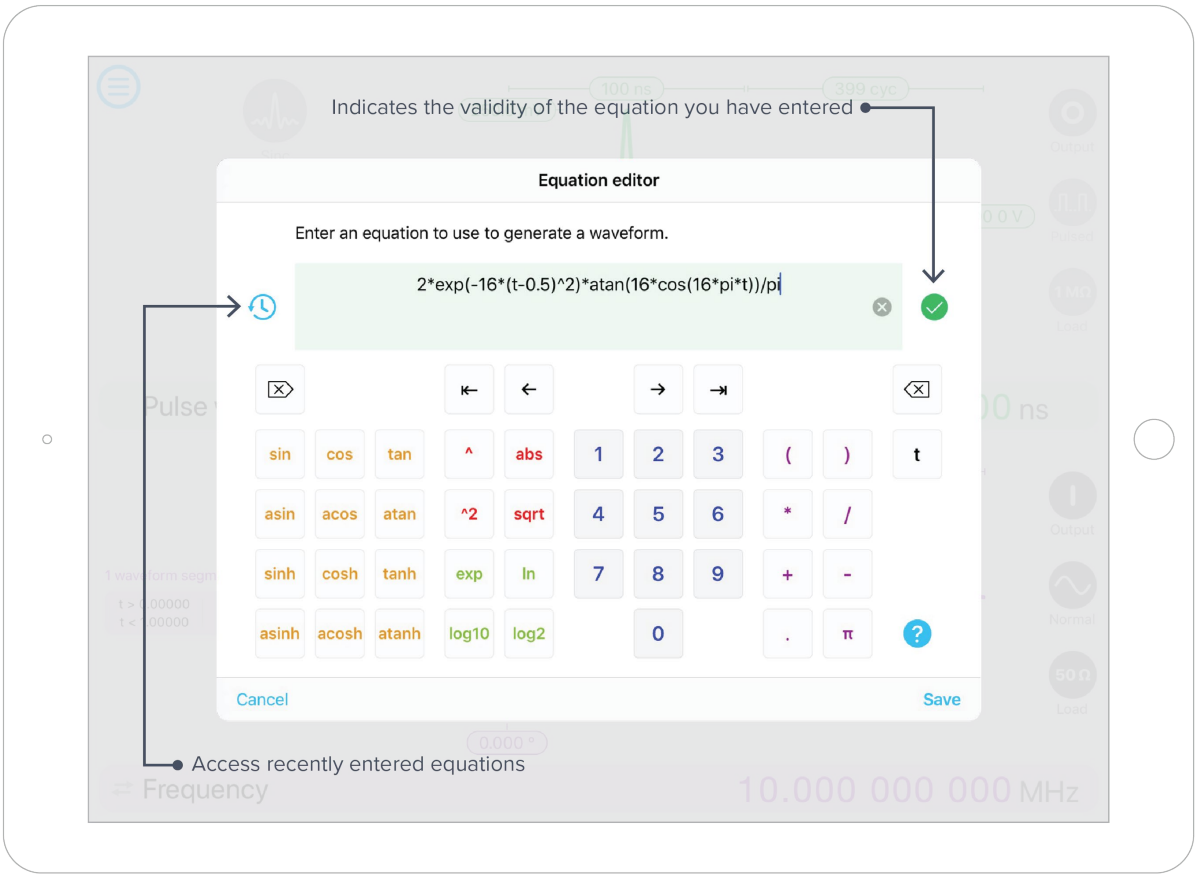
Equation editor

- 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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