



Data Logger

Moku:Lab User Manual

Moku:Lab's Data Logger instrument records time series voltages from 1 or 2 channels at rates from 1 sample per second up to 1 MSa/s. The data can be logged to RAM or removeable SD card in a variety of formats.

The resulting logs can be shared to email or cloud services such as iCloud or DropBox.

Moku:Lab's Data Logger also includes an embedded waveform generator.





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Ensure Moku:Lab is fully updated. For the latest information:

www.liquidinstruments.com



User Interface Quick Reference

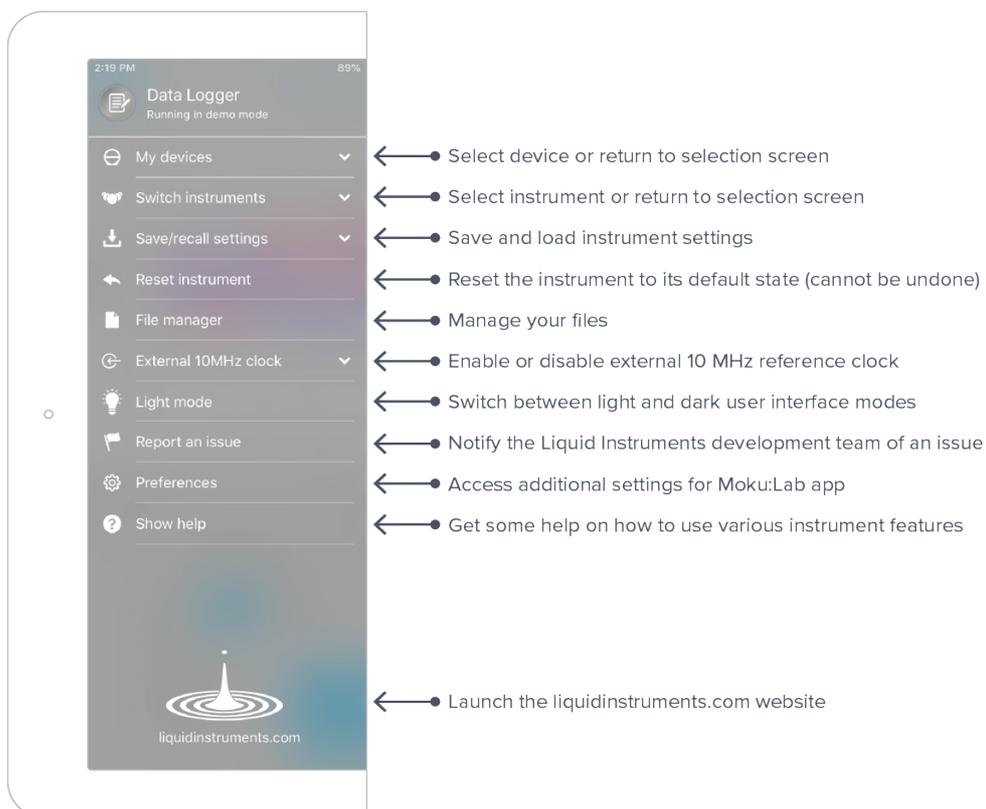


ID	Button/icon	Description
1	Main menu	The main menu contains controls for switching instruments, switching devices, selecting device clock and user interface modes, and more. See Main Menu .
2	Autoscale	Toggle continuous autoscaling on/off.
3	Ref	Capture/clear a reference trace.
4	Time window	Overview of the logging time history. Drag bars to zoom/select different timescales/time windows.
5	Settings	Show/hide the settings.
6	Clear	Clear the trace history.
7	Blue trace	Data channel 2 trace.
8	Red trace	Data channel 1 trace.
9	Bottom left	Double tap here to view entire log history.
10	Grid	Double tap on the grid to on-time autoscale.



Main Menu

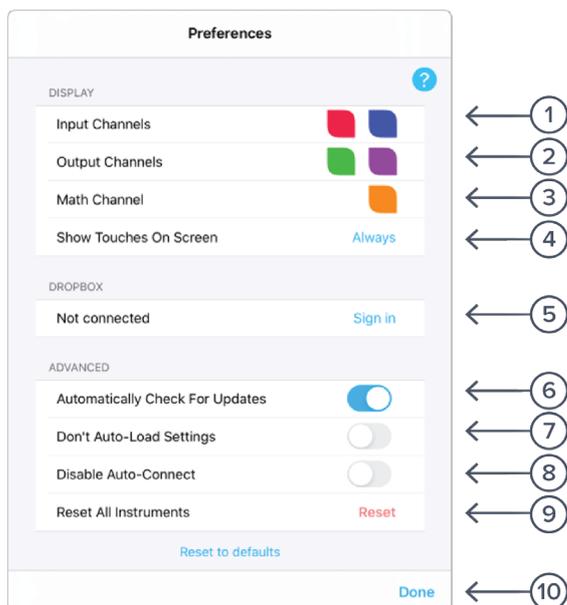
The **main menu** can be accessed by pressing the  icon, allowing you to:





Preferences

The preferences pane 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 (red for input 1, blue for input 2, green for output 1, purple for output 2) are used to present instrument features.



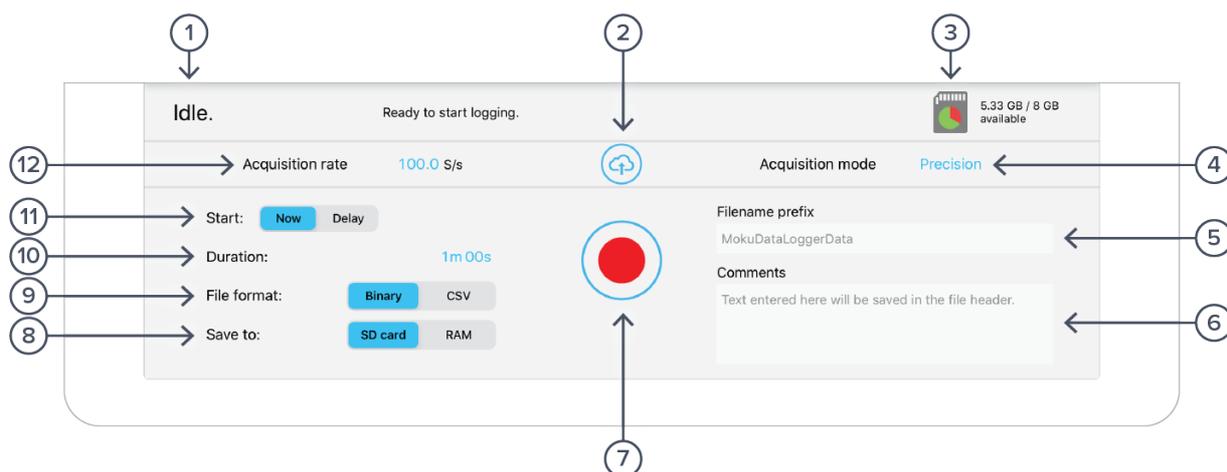
ID Description

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:Lab 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:Lab 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.



Data Logger control panel

Below the main Data Logger trace display is the control panel



ID	Button/icon	Description
1	Status	Logger status, either idle, aborted, waiting, or logging.
2	Share	The sharing button gives access to controls that allow you to save and share your data. See Saving and sharing data .
3	Memory	Displays the used and remaining memory available for logging. This may be either Moku:Lab's internal RAM or the removeable SD card.
4	Mode	Set acquisition mode as normal or precision.
5	Filename	Configure the prefix to be used on the data log filenames.
6	Comment	Text entered here will be saved in the file header.
7	Start/stop	Tap to start and top data logging.
8	Log memory	Tap to select log memory, either Moku:Lab's internal RAM or SD card.
9	Log format	Tap to select log format, CSV or LI binary format.
10	Duration	Tap to set log duration, up to 10,000 hrs, but limited to available memory.
11	Start	Tap to configure start delay, up to 240 hrs.
12	Acquisition rate	Tap to configure acquisition rate.



Sharing and saving data

Tap the share  button to access the file manager, allowing saving and sharing of the captured data logs. Dropbox, Mail, and iCloud service settings are configured in the iPad preferences.



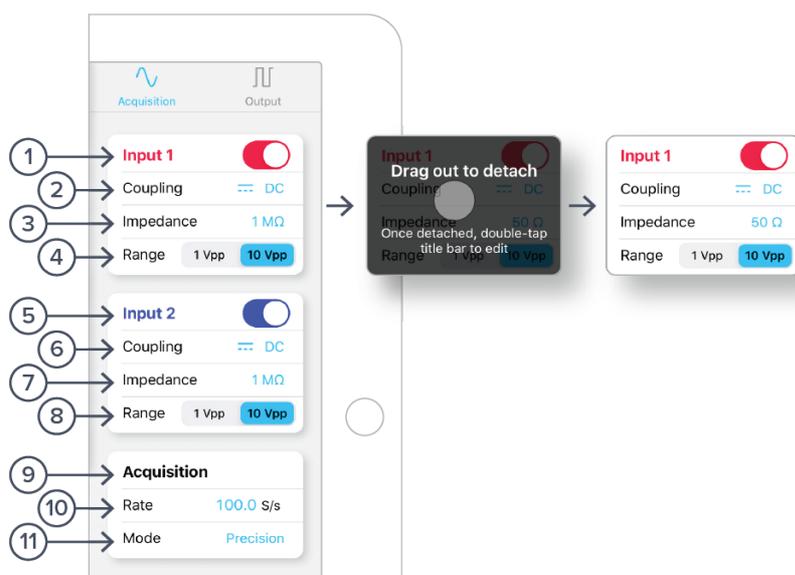
ID	Button/icon	Description
1	SD Card	Tap to save files on Moku:Lab's removable SD card.
2	RAM	Tap to save files on Moku:Lab's internal RAM.
3	Save options	Tap to share data files to "My Files" or any of these online services.



Settings side bar

Acquisition

The acquisition sidebar configures the acquisition parameters of both input channels. The channel 1, channel 2, and acquisitions sub-panels may be dragged into the main display by tap/hold and dragging.

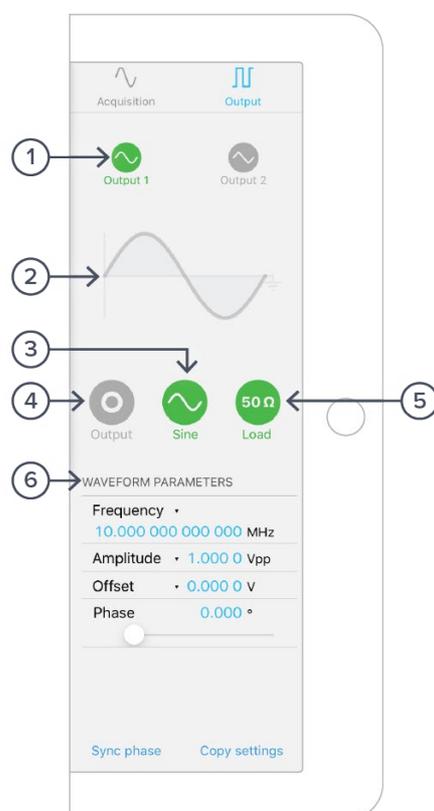


ID	Button	Description
1	Channels 1 settings	Channel 1 (red by default; configurable in main menu preferences) and channel 2 (blue by default) settings are configurable independently.
2	Coupling	Range selects the input range as either 1 V or 10 V peak-to-peak.
3	Impedance	Select AC or DC coupling.
4	Range	Select high (1M Ω) or 50 Ω input impedance.
5–8	Channel 2 settings	Configure channel 2 as described above for channel 1.
9	Acquisition settings	Configure acquisition settings.
10	Rate	For logging to Moku:Lab's internal RAM, the maximum rate is 1 MSa/s (1 channel) or 500 kSa/s (2 channel). For logging to SDcard, maximum rate is 100 kSa/s. Note: logging to CSV is at a lower rate. See Liquid Instruments website for binary \rightarrow CSV conversion utility.
11	Mode	Precision, normal.



Output

Moku:Lab's Data Logger has a built-in waveform generator capable of generating basic waveforms on the two output channels. For more complex waveforms, see Moku:Lab Waveform Generator and Arbitrary Waveform Generator.



ID	Button	Description
1	Configure channels	Tap to configure settings for channels 1 and 2. As illustrated, settings apply to channel 1.
2	Current waveform	Graphical representation of the selected waveform.
3	Waveform selection	Tap to choose between Sine, Square, Ramp, Pulse, or DC waveforms.
4	Enable	Tap to enable/disable channel output.
5	Load	Tap to select either 50Ω or high impedance (1MΩ) output load.
6	Waveform parameters	Tap to configure the selected waveform parameters varying according the waveform type selected.



Instrument Reference

Moku:Lab's Data Logger is designed to be intuitive and straightforward to use.

One or two channels of time-series voltages are recorded by Moku:Lab, for a specified duration, and at a specified rate.

The maximum logging rate depends on a number of factors, such as the file format chosen, file storage location, and the number of channels to be recorded.

Recording a Session

Recording data is done as follows:

1. Configure the channel(s) you wish to record using the acquisition sidebar. Ensure the voltage range, coupling, and impedance are all appropriate for your signals. Use the plotter window to ensure your signal is correctly connected and configured.
2. Configure the acquisition rate and acquisition mode, either normal or precision.
3. Select your file type and destination, ensuring that the destination has enough free space for the log.
4. Set the recording duration and any comments you want to be saved with the file.
5. Optionally configure the waveform generator outputs.
6. Tap "record".

Channel Configuration

Each channel can be enabled or disabled, 1 Vpp or 10 Vpp, AC or DC-coupled, and 50Ω or 1MΩ terminated.

Acquisition Parameters

The acquisition parameters refer to the logging rate and the down-sampling mode used to reduce Moku:Lab's native sampling rate to the logging rate.

The logging rate must be between 10 Sa/s and 1 MSa/s. The actual maximum is only achievable with a single channel, binary file format saved to RAM; other combinations will have lower maximum rates.

Acquisition mode may be either normal or precision. Normal mode down-samples by discarding points between those needed. This causes signals to alias; not desirable for most signals but can be useful for viewing frequency components outside the logging rate.

Precision mode down-samples by averaging, increasing precision and reducing noise. This mode is preferred for most applications.



File Types and Destinations

Moku:Lab's Data Logger can save natively to standard text-based CSV format files. CSV files contain a header that records the current instrument settings as well as any user-entered comments.

The binary file format is proprietary to Moku:Lab and has been extensively optimized for speed and size. Using the binary format, Moku:Lab is able to reach very high logging rates and very low memory usage.

The binary file can be converted to other formats by the iPad app or the file converter software available from the Liquid Instruments website. This software can convert the binary file to CSV, MATLAB, or NPY formats for access in major scientific software. The binary format may also be used in Python through the Liquid Instruments Pymoku software library.

Each file may be saved either to a removeable SD card in Moku:Lab, or to Moku:Lab's internal RAM.

RAM is extremely fast but volatile; if you restart Moku:Lab before downloading your data, that data will be lost. The RAM has a capacity of 512MB.

The SD card provides non-volatile, high-capacity storage. You may store as many files on the card as the capacity allows, however each file is limited to 4GB in size due to the nature of the filesystem on the card¹.

The speed of each SD card varies both with its quality and age, and this speed directly limits the maximum logging rate when saving to an SD card. A high quality, fast SD card may log up to 100x faster than an older slow device. A slow SD card may not be immediately apparent. It may cause Moku:Lab's Data Logger to drop data several minutes into longer runs. If the user plans to log to an SD card at a rate above 1 kSa/s, it's strongly advised that they test a new card with a few 10-minute logs before attempting anything longer.

When the file destination is changed, the free space icon in the top-right of the control panel will change to show the amount of space left on that destination. When a log is started, a warning will be shown if Moku:Lab's Data Logger estimates there is insufficient memory space.

Starting the Log

The red record button should be tapped to start.

The status indicator at the top of the control panel will display logging progress.

The log will stop either when the specified duration has been reached, or when the user taps the record button again to abort.

¹ Moku:Lab only supports SD cards formatted with the FAT32 Filesystem. This is the default out of the box for most cards including the units shipped with Moku:Lab.



Accessing your Data

Data logs can be shared to My Files, Dropbox, Mail, or iCloud services.

Additionally, data logs saved to Moku:Lab's RAM may be moved to the SD card after logging.

Embedded Waveform Generator

Moku:Lab's Data Logger integrates a simple waveform generator capable of providing Sine, Square, Ramp, Pulse, and DC waveforms on the output channels.



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