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LIQUID INSTRUMENTS Moku:Go Digital Filter Box User Manual

Contents

LIQUID INSTRUMENTS Moku: Go Digital Filter Box

Product Information

Digital Filter Box Moku
The Moku: Go Digital Filter Box is a device that allows users to design and generate different types of infinite impulse response filters with sampling rates of 61.035 kHz, 488.28 kHz and 3.9063 MHz. It offers four filter shapes, namely low pass, high pass, band pass, and band stop filter shapes, with up to eight fully configurable types including Butterworth, Chebyshev, and Elliptic.

The device features a user interface with different configuration options:

User Interface

- Main menu
- Input configuration for Channel 1 and 2
- Control matrix
- Configuration for filters 1 and 2
- Output switch for Channel 1 and 2
- Enable/disable the Oscilloscope view
- Enable/disable the Data Logger view

Main Menu
The main menu can be accessed by pressing the icon in the top-left corner. The following options are available:

- Search for Moku devices.
- Switch instruments on this Moku: Go.
- Save/recall settings: Ctrl+S, Ctrl+O.
- Show the current instrument settings.
- Reset the instrument to its default state: Ctrl+R.
- Access the Power Supply control window.*
- Open the file manager tool.**
- Open file converter tool.**
- **Help:** Ctrl+H, F1.

Product Usage Instructions

Before using the device, ensure that Moku: Go is fully updated. For the latest information, visit liquidinstruments.com.

**To use the Digital Filter Box Moku: Go, follow these steps:**

1. Access the main menu by pressing the icon on the top-left corner of the user interface.
2. Select the desired filter shape from the configuration options available.
3. Configure the filter characteristics according to your needs, including sampling rates, filter types, filter orders, ripples, and coefficient quantization.
4. If necessary, you can create a custom filter by selecting the "Custom filter" option and providing the details in the "Custom filter details" section.

5. Select the output switches for Channel 1 and 2 as needed.

6. You can enable or disable the Oscilloscope view and Data Logger view as needed.

For more information on using the device's additional tools such as the Power Supply control window, file manager tool, and file converter tool, refer to the product user manual.

With the Moku:Go Digital Filter Box, you can interactively design and generate different types of infinite impulse response filters with sampling rates of 61.035 kHz, 488.28 kHz and 3.9063 MHz. Select between low pass, high pass, band pass, and band stop filter shapes with up to eight fully configurable types including Butterworth, Chebyshev, and Elliptic.

User interface
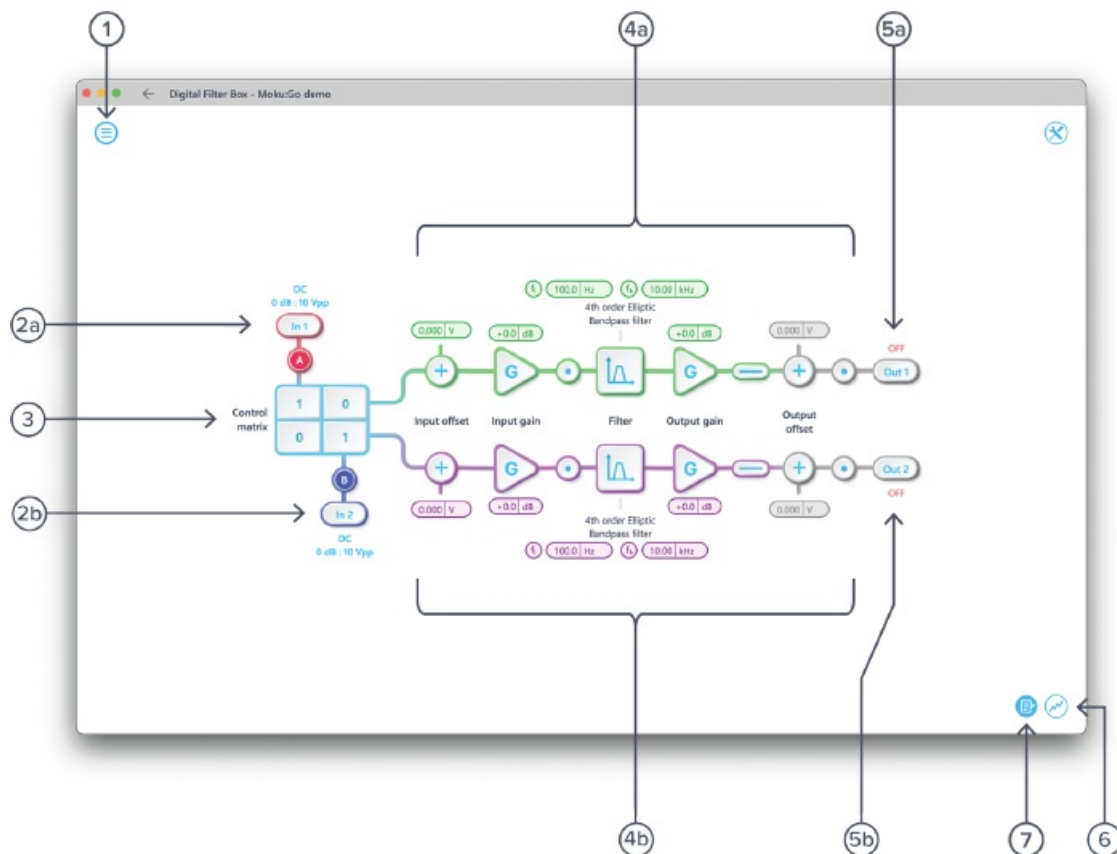
ID	Description
1	Main menu
2a	Input configuration for Channel 1
2b	Input configuration for Channel 2
3	Control matrix
4a	Configuration for filter 1
4b	Configuration for filter 2
5a	Output switch for Channel 1
5b	Output switch for Channel 2
6	Enable/disable the Oscilloscope view
7	Enable/disable the Data Logger view

Main menu

The main menu can be accessed by pressing the icon on the top-left corner.
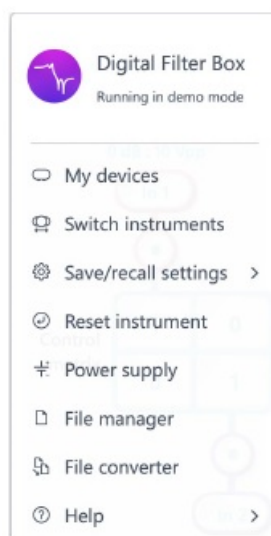
Options	Shortcuts	Description
My devices		Search for Moku devices.
Switch instruments		Switch instruments on this Moku:Go.
Save/recall settings:		
· **Save instrument state**	Ctrl+S	Save the current instrument settings.
· **Load instrument state**	Ctrl+O	Load last saved instrument settings.
· **Show current sate**		Show the current instrument settings.
Reset instrument	Ctrl+R	Reset the instrument to its default state.
Power Supply		Access Power Supply control window.*
File manager		Open file manager tool.**
File converter		Open file converter tool.**
Help		
· **Liquid Instruments website**		Access Liquid Instruments website.
· **Shortcuts list**	Ctrl+H	Show Moku:Go app shortcuts list.
· **Manual**	F1	Access instrument manual.
· **Report an issue**		Report bug to Liquid Instruments.
· **About**		Show app version, check for updates, or show license information.

- Power Supply is available on Moku:Go M1 and M2 models. Detailed information about Power Supply can be found in the Moku:Go Power Supply section toward the end of this user manual.
- Detailed information about the file manager and file converter can be found toward the end of this user manual.

Input configuration

The input configuration can be accessed by clicking the or icon, allowing you to adjust the coupling and input attenuation (and therefore voltage range) for each input channel.

DC
0 dB : 10 Vpp

In 1

A

Control matrix

| 1 | 0 |
| 0 | 1 |

B

In 2

DC
0 dB : 10 Vpp
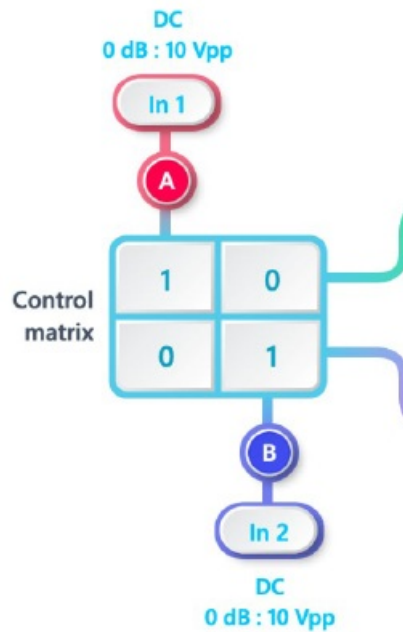
Details about the probe points can be found in the Probe Points section.

Control matrix

The control matrix combines, rescales, and redistributes the input signal to the two independent filters. The output vector is the product of the control matrix multiplied by the input vector.

$$\begin{bmatrix} Path1 \\ Path2 \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \times \begin{bmatrix} In1 \\ In2 \end{bmatrix}$$

$$Path1 = a \times In1 + b \times In2$$

$$Path2 = c \times In1 + d \times In2$$

For example, a control matrix $\begin{bmatrix} 1 & 1 \\ 0 & 2 \end{bmatrix}$ equally combines Input 1 and Input 2 to the top Path1 (filter 1), multiples Input 2 by a factor of two, and then sends it to the bottom Path2 (filter 2). The value of each element in the control matrix can be set between -20 to +20 with 0.1 increments when the absolute value is less than 10, or 1 increment when the absolute value is between 10 and 20. Click the element to adjust the value.

Digital filters
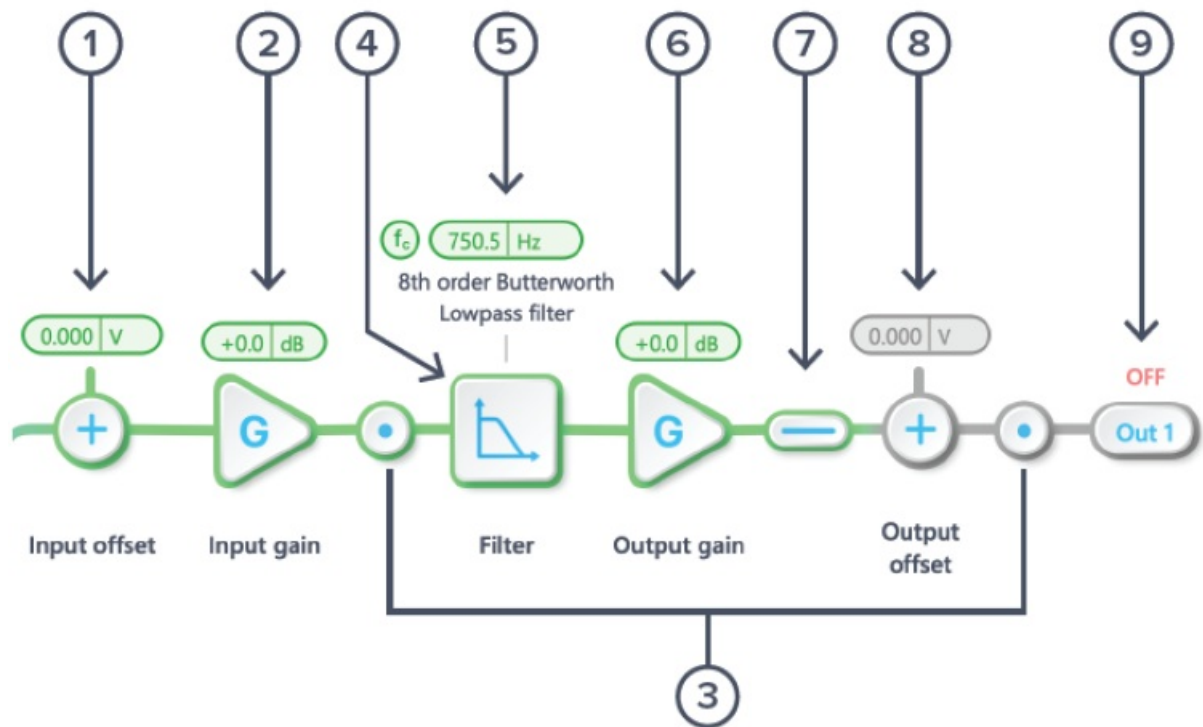
The two independent, real-time configurable digital IIR filter paths follow the control matrix in the block diagram, represented in green and purple for filters 1 and 2, respectively.

User interface

ID	Parameter	Description
1	Input offset	Click to adjust the input offset (-2.5 to +2.5 V).
2	Input gain	Click to adjust the input gain (-40 to 40 dB).
3	Probe points	Click to enable/disable the probe points. See **Probe Points** section for details.
4	Digital filter	Click to view and configure the digital filter builder.
5	Quick filter control	Click or slide to quickly adjust the filter settings.
6	Output gain	Click to adjust the output gain (-40 to 40 dB).
7	Output switch	Click to zero the filter output.
8	Output offset	Click to adjust the output offset (-2.5 to +2.5 V).
9	DAC switch	Click to enable/disable the Moku:Go DAC output.

Configure IIR filter characteristics

Detailed filter interface

Click the [icon] icon to open the full filter view.
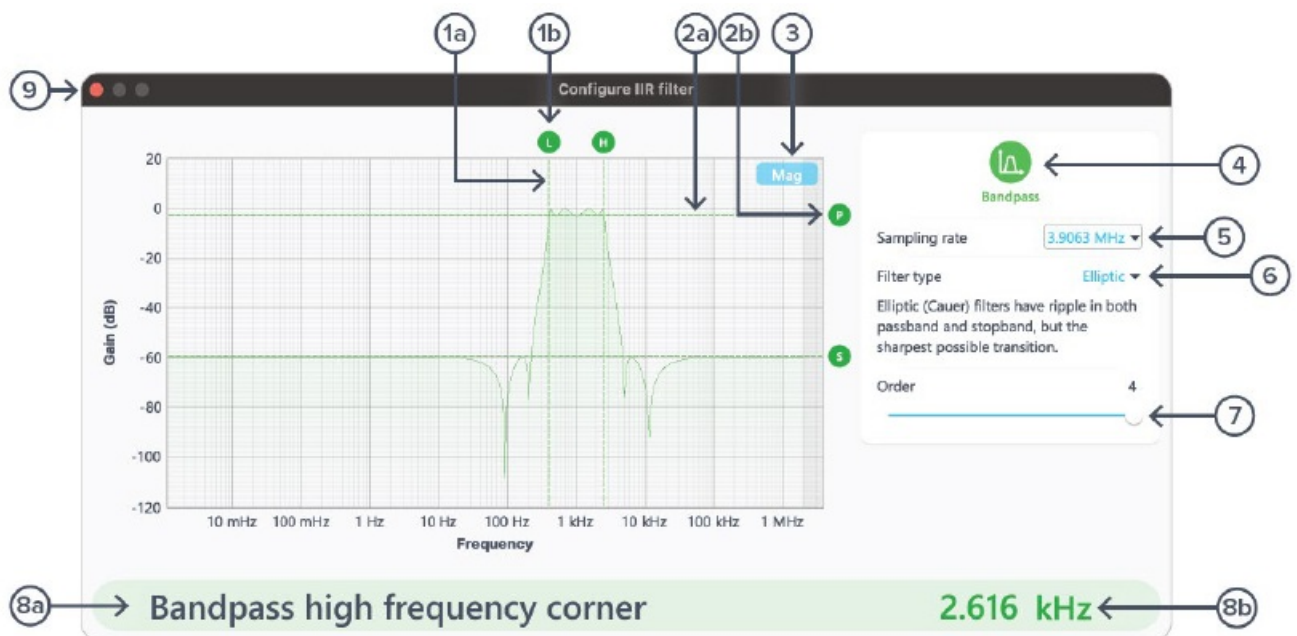
ID	Parameter	Description
1a	Frequency (horizontal) cursor	Cursor for corner frequency.
1b	Cursor reading	Reading for frequency cursor. Drag to adjust the corner frequency. Click to select and manually enter the corner frequency in 8b.
2a	Gain (vertical) cursor	Cursor for ripple/gain/attenuation level.
2b	Cursor handle	Short name and handle for gain cursor. Drag to adjust the gain/ripple level. Click to select and manually enter passband ripple in 8b.
3	Display toggle	Toggle between magnitude and phase response curve.
4	Filter shape selection	Click to select between low pass, high pass, band pass, band stop, and custom filters.
5	Sampling rate	Click to select between 3.9063 MHz, 488.28 kHz, or 61.035 kHz.
6	Filter type selection	Click to select between Butterworth, Chebyshev I/II, Elliptic, Bessel, Gaussian, Cascaded or Legendre filters. When selected, a short description of the filter type will be given below.
7	Filter order	Slide to adjust filter orders.
8a	Active configurable parameter	Name of the active configurable parameter.
8b	Parameter value	Click to manually enter the active configurable parameter value.
9	Save and close	Click to save and close the filter builder.

Filter shapes
The shape of the filter can be selected by clicking the 4 button. There are four pre-defined filter shapes and a fully customizable filter option.

Lowpass **Highpass** **Bandpass** **Bandstop** **Custom**

Sampling rates

Users can select between 3.9063 MHz, 488.28 kHz, or 61.035 kHz of output sampling rate based on the desired corner frequencies. The following table summarizes the lower and upper bounds for each shape of pre-defined filters with different sampling rates:

Shape	Sampling Rate	Minimum corner frequency	Maximum corner frequency
Lowpass	61.035 kHz	11.73 mHz	27.47 kHz
	488.28 kHz	93.81 mHz	219.7 kHz
	3.9063 MHz	750.5 mHz	1.758 MHz
Highpass	61.035 kHz	144.7 mHz	27.47 kHz
	488.28 kHz	1.158 Hz	219.7 kHz
	3.9063 MHz	9.263 Hz	1.758 MHz
Bandpass	61.035 kHz	610.4 mHz	27.47 kHz
	488.28 kHz	4.883 Hz	219.7 kHz
	3.9063 MHz	39.06 Hz	1.758 MHz
Bandstop	61.035 kHz	11.73 mHz	27.47 kHz
	488.28 kHz	93.81 mHz	219.7 kHz
	3.9063 MHz	750.5 mHz	1.758 MHz

Filter types

The type of filter can be selected by pressing the 6 button. There are seven pre-defined filter types with user-selectable filter orders from 2 up to 8, depending on the filter shapes.

Filter types	Description
Butterworth	Butterworth filters have a maximally flat passband and a monotonic frequency response.
Chebyshev I	Chebyshev I filters have ripple in the passband but a sharper transition than Butterworth filters.
Chebyshev II	Chebyshev II filters have ripple in the stopband but a sharper transition than Butterworth filters.
Elliptic	Elliptic (Cauer) filters have ripple in both passband and stopband, but the sharpest possible transition.
Cascaded	Cascaded first-order filters have zero overshoot in the time domain.
Bessel	Bessel filters have a maximally flat group and phase delay in the passband, thus preserving the wave shape of passed signals.
Gaussian	Gaussian filters have the minimum possible group delay, and a step response with no overshoot and minimum rise and fall time.
Legendre	Legendre (Optimum L) filters have the sharpest possible transition while maintaining a monotonic frequency response.

Documents / Resources

LIQUID INSTRUMENTS Moku:Go Digital Filter Box [pdf] User Manual
Moku Go Digital Filter Box, Moku Go, Digital Filter Box, Filter Box, Box

References

- **Moku API Home | Moku API**
- **Moku API Home | Moku API**
- **Liquid Instruments**
- **Liquid Instruments**