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Quadra MUX GUI quick-start guide.

Before installation, make sure that the device is not connected to USB port. Install the drivers by executing “QuadraUSBDriverInstaller_v1.1.EXE” in the “Windows Drivers” catalogue.

Description of the physical connectors and indicators.

SYNC IO can be used to sync external equipment to Quadra. The quadra outputs a square-wave signal that toggles its state when Quadra starts the measurement of a spectra. In default mode Quadra measures a spectrum of 1 kHz…349 kHz in 1 ms and the sync output signal is 500 Hz square-wave.

BAT LED (green/red) indicates the status of the battery:

Green	– charge complete / battery is full.
Red	– device is operating on battery supply.
Orange	– battery is charging.
Red blinking	– battery is low.

USB connector. Use good quality Mini USB Type A to Mini B cable to connect Quadra to PC USB port. USB port must be capable to deliver 500 mA current and USB voltage should not drop below 4.85 V.

BSY LED indicates active mode when LED is on and idle when LED is off.

ERR/ACK LED

Constant red indicates critical error during operation, DSP is halted.
Single 125 ms blink indicates acknowledgement of successfully received and executed command.
Double 125 ms blink indicates DSP USB controller TX buffer overflow (40ms of data is lost).
(ERR/ACK led also doubles as visual indicator for a mask violation error when the mask function is activated in the GUI)

RDY LED indicates that the DSP firmware has booted up.

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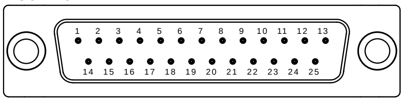
FRONT-END CONNECTOR

DSUB-25-M



Front-end connector pinout.

1	Passive	**GND**
2	Analog Input	**U_P_SENSE**
3	Analog Input	**U_P_GUARD**
4	Analog Input	**U_N_GUARD**
5	Analog Input	**U_N_SENSE**
6	Passive	**GND**
7	Analog Input	**I_P_SENSE**
8	Analog Input	**I_P_GUARD**
9	Analog Input	**I_N_GUARD**
10	Analog Input	**I_N_SENSE**
11	Passive	**GND**
12	Analog Output	**Excitation Signal Positive**
13	Analog Output	**Excitation Signal Negative**
14	Passive	**GND**
15	Digital Output	**MUX SYNC**
16	Analog Supply	**-5 V, 100 mA**
17	Passive	**GND**
18	Analog Supply	**+5 V, 150 mA**
19	Digital IO (PU)	**User GPIO 0 (front-end detect)**
20	Digital IO	**User GPIO 1**
21	Digital Input Output	**User GPIO 2**
22	Passive	**GND**
23	Digital IO	**I2C Bus Serial Data IO SDA**
24	Digital IO	**I2C Bus Serial Clock IO SCL**
25	Digital Supply	**+3.3 V, 150 mA**

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16 OUTPUT MULTIPLEXER FRONT-END

The multiplexer front-end allows to connect internal excitation and sense connections to any output pin of the multiplexer (16 or 32). Device under test can be connected to MUX with 2 wire or 4 wire methods but using 4 wire method is STRONLY advised. The internal channels have a parasitic resistance of about 50 Ω and this is added to the measured impedance in series so when measuring 1 kΩ the measured result is ~1.1 kΩ.

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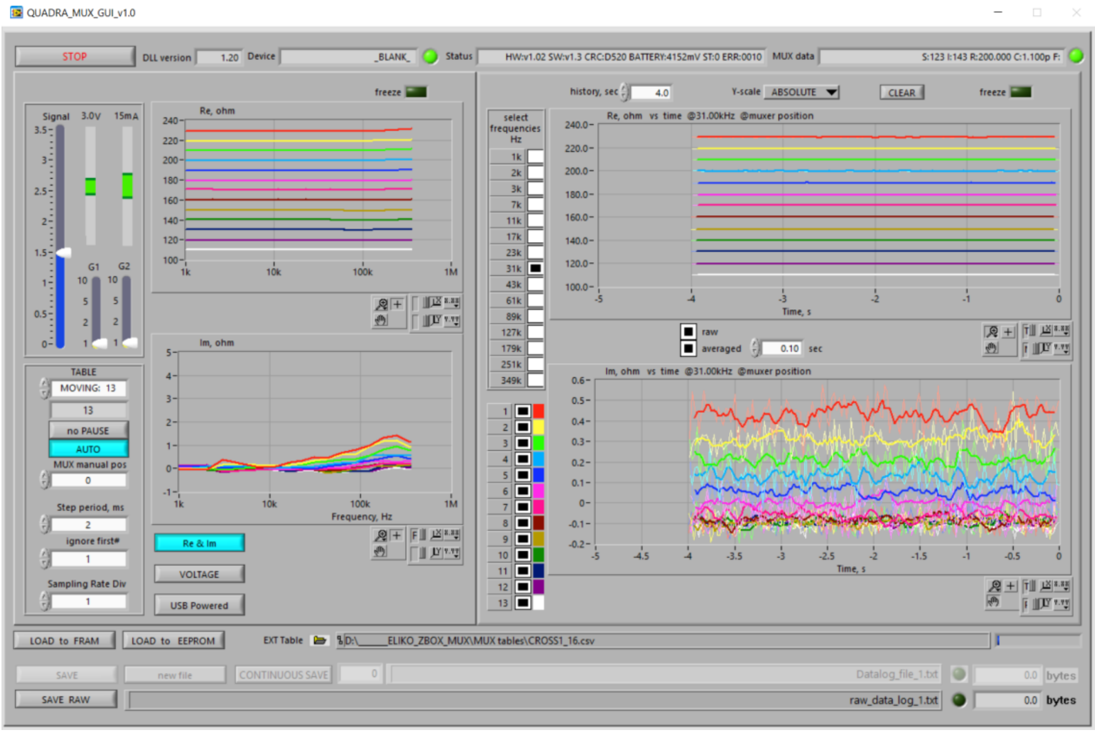
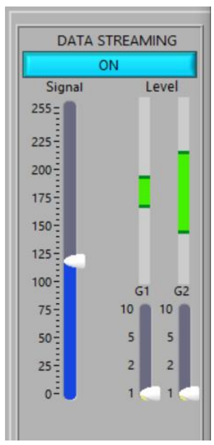
Attach multiplexer to Quadra. Connect the EBI demo board to the output connector of the multiplexer. An additional receptacle is provided that can be screwed under the output connector terminals for quick and convenient replacement of the cables and test circuits.

Run the GUI executable “QUADRA_MUX_GUI_vXX.exe”.
It will take some seconds while the Quadra is detected and initialized, after that the measured impedance spectra is displayed on the GUI.



The excitation level can be changed by “Signal” lever. The gains of the input amplifiers can be set to 1X, 2X, 5X or 10X by the G1 and G2 levers. The actual level at the ADC inputs are indicated on the level bars with green. When signal is too high then the ADC will be saturated and the measured values are not correct. The saturation is indicated by the ends of the level bar turning red.
It is advised to keep the signal levels above 10% of the full scale.



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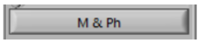
The current impedance spectra can be displayed either as magnitude and phase or real and imaginary parts in the left side graphs. The format can be changed using a button



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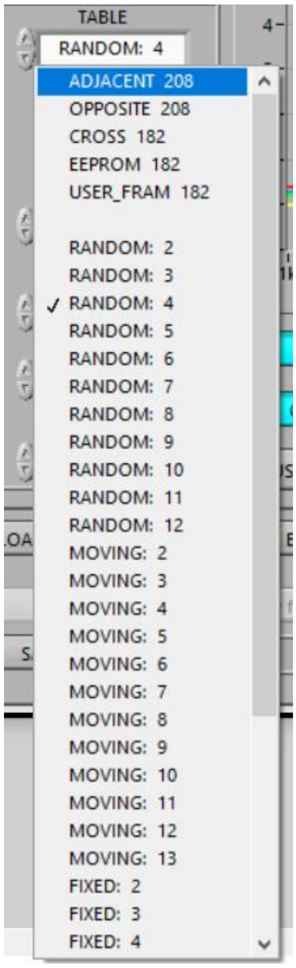


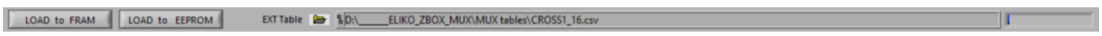
Multiplexer front-end has several pre-programmed switching patterns and the user can also construct their own patterns and load them to the multiplexer. There are two storage locations to save them. EEPROM area allows to store a single pattern of up to 250 positions and FRAM area allows to store a single pattern of up to ~8000 positions. The active table can be chosen under TABLE selector.

User can construct their own custom table with a text editor like notepad or notepad++. The format is:

```
INDEX    ,EX+,EX-,V+ ,V-
1        ,1  ,4  ,2  ,3
2        ,5  ,8  ,6  ,7
3        ,9  ,12 ,8  ,9
4        ,13 ,16 ,10 ,11
```

First line is ignored. First column is the index of the table. EX+ column describes the pin number where the positive excitation signal is connected. EX- specifies the pin to which the excitation current is sinked. V+ determines the pin where the positive voltage sense input is connected and V- column specifies the pin for negative voltage sense input. The file must be saved with csv extension.

Then from GUI navigate to that file in EXT table field and upload it either to FRAM memory or EEPROM memory. The progress bar on the right shows the progress of the upload.



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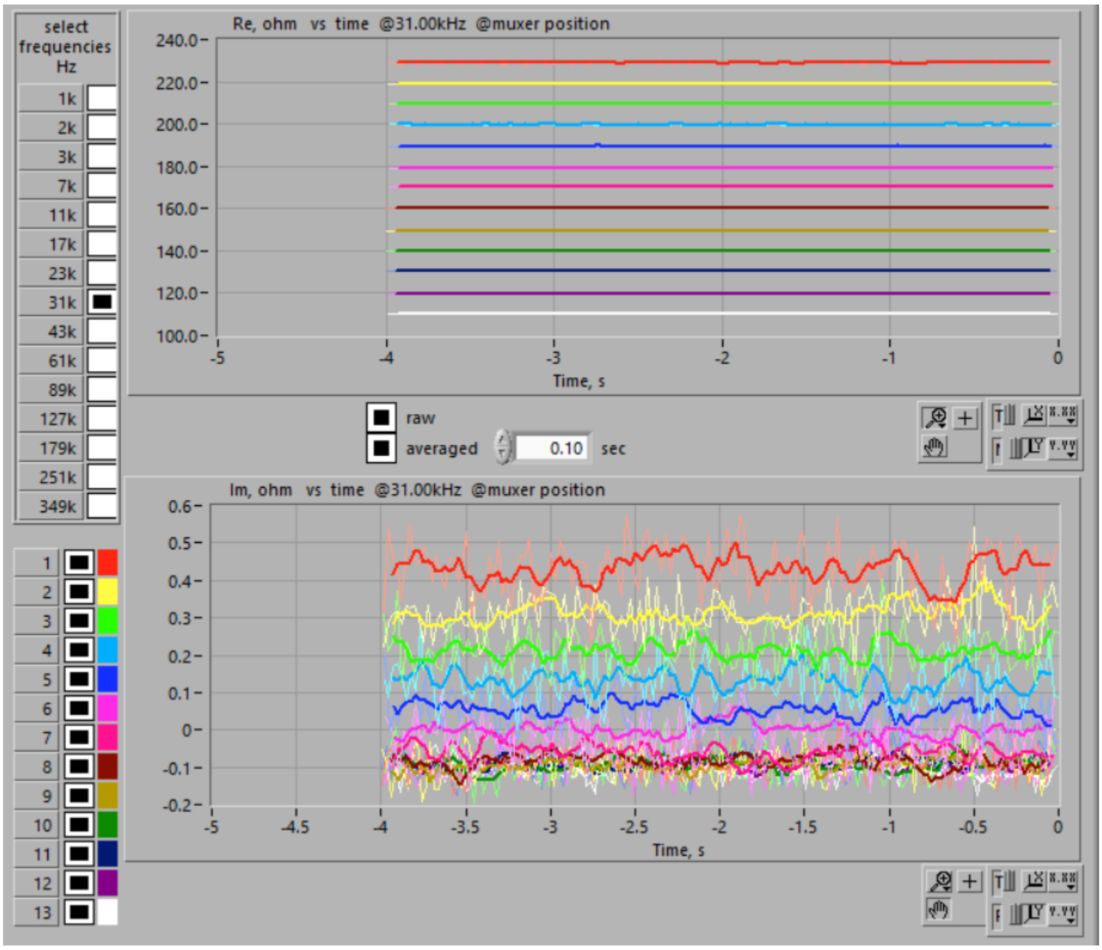
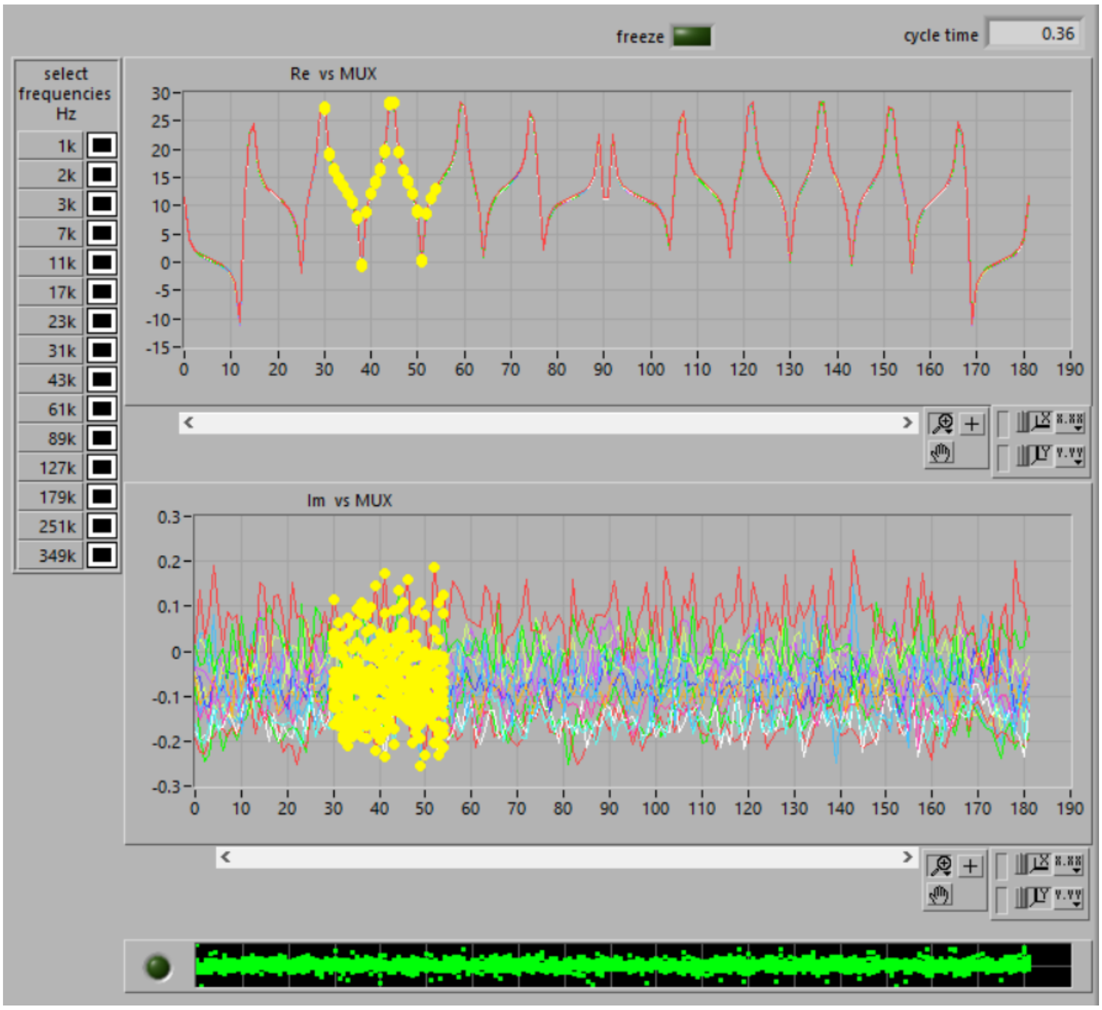
The graphs on the right side show the measurement history that can be displayed as separate frequency points vs time. Based on the type of measurement – multiposition or tomography the history chart is displayed differently. In case of multiposition the chart shows separate lines that visualize continuous impedance value at specific location and frequency. The history length can be changed and cleared. User can change the mapping of Y scale from absolute value to trend to monitor simultaneously small changes in impedance at different frequencies. It is advised to activate the visualization only a single frequency or as few as possible for the sake of readability. A sample of the history chart in multiposition mode and measuring 13 positions is shown below.



When measuring data for tomographic imaging (which must be made with third party tools like EIDORS) the entire impedance pattern of the electrode position table is visualized as a single chart.



The multiplexer has two different excitation sources, a voltage source (with series shunt resistance of ~100 Ω) and a current source.

The step period determined how many spectrums are measured at one location of the stepping table. The first measured spectra will be erroneous due to the switching of the multiplexer.

To remove the effect of that first measurement the “ignore first#” should be set to 1. And step period must be at least 2 since the first one will be discarded. If the switching of the electrodes causes long transient responses in the object the number of the samples to ignore can be increased together with step period. The number of periods that are measured and that are not ignored are

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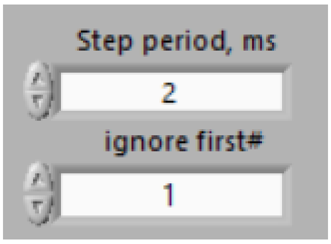
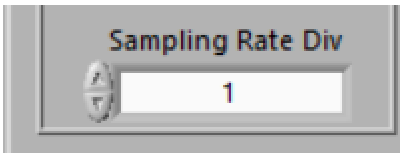
averaged together.



The measured spectra are not limited to the range of 1 kHz … 349 kHz but can be scaled down to 500 mHz … 194 Hz by changing the sampling rate divider:



Quadra is optimized to be used in the range of 1 kHz … 349 kHz. When used in lower ranges then it is advised to use the data from the first 10 frequencies and discard the data from the higher frequencies since they will be erroneous.

Sometimes it is desired to isolate the measured object and the measurement device electrically from the surrounding grid and devices. This helps to suppress noise and reduce the stray currents and, in some cases, may greatly improve the quality of the measurement results.

The Quadra can be isolated from the host PC by clicking on the “USB Powered” button which then changes its label to “BATTERY powered”.

Quadra will then use the power from its internal battery until the user switches back to USB power or the battery will be depleted. When the battery level drops to critical threshold the Quadra switches back to USB supply automatically and starts charging the battery.