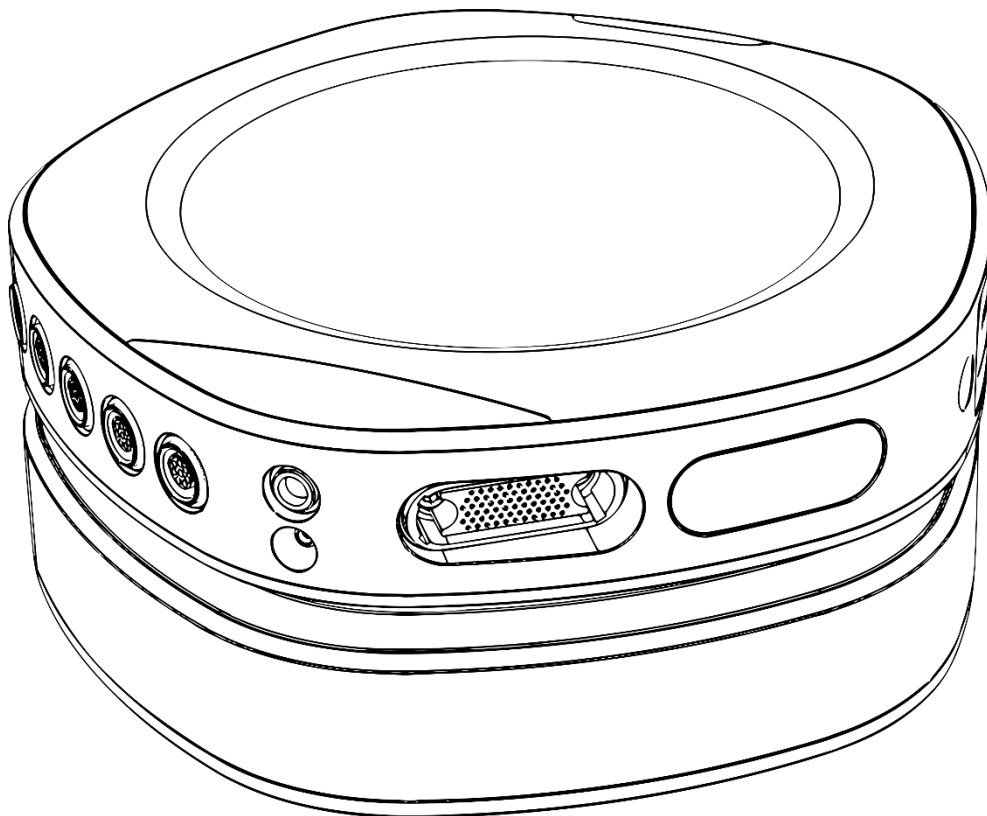


# saga <sup>32+</sup><sub>64</sub>



**DOCUMENTATION QRA for  
SAGA  
Quick Recording Application 1.1.0**

**TMSi**

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# 1 INTRODUCTION

The Quick Recording Application (QRA for SAGA 1.1.0) is specifically built for the use of the SAGA device. It can be used stand-alone or in combination with the Polybench Data Manager. The QRA guides the user through the process of connecting to the device, defining the measurement settings and channel configuration, performing an impedance check and finally the data viewing and recording. In the following flow-chart (Figure 1), these steps are shown.

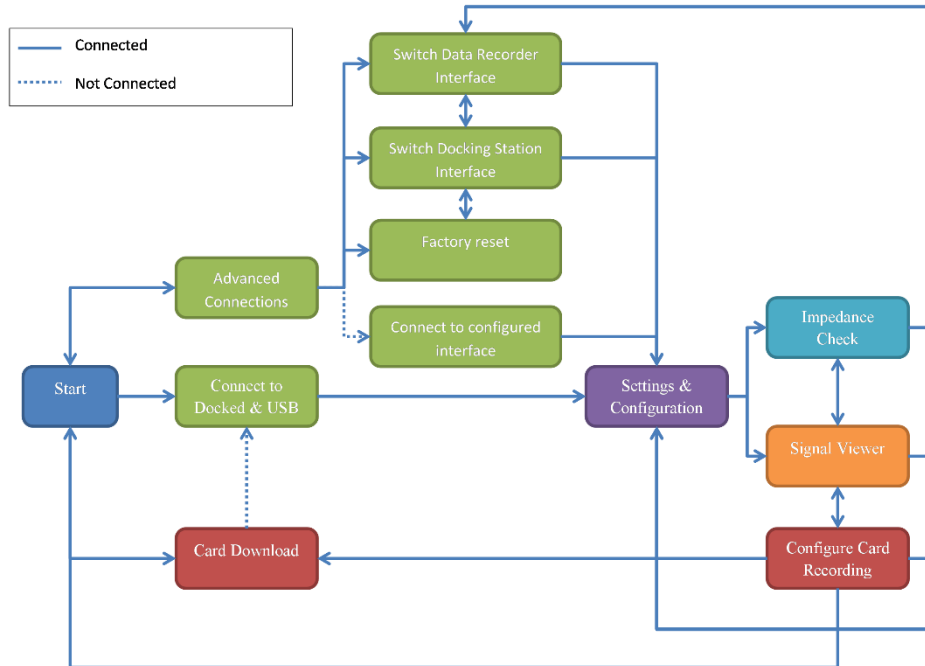


Figure 1: Flow chart of the different steps in the QRA. Different colors represent different pages in the QRA / the separate chapters in this documentation

The different steps of the flow chart are described in this document and illustrated with screenshots of the corresponding QRA pages.

The QRA and the SAGA support three types of interfaces between the Data Recorder and the Docking Station: (1) Docked (Electrical), (2) Fiber (Optical) or (3) Wi-Fi (Wireless). The user can switch between these different interfaces through the QRA. When using the Wi-Fi interface, there will often be a number of missing samples. To be able to retrieve a data file without missing samples, backup logging on the device is also started when starting the data recording. When the recording is finished, both datasets will be combined to create a repaired and complete dataset, which is called data repair. The process of data recording and data repair is visualized in the following flow chart (see Figure 2).

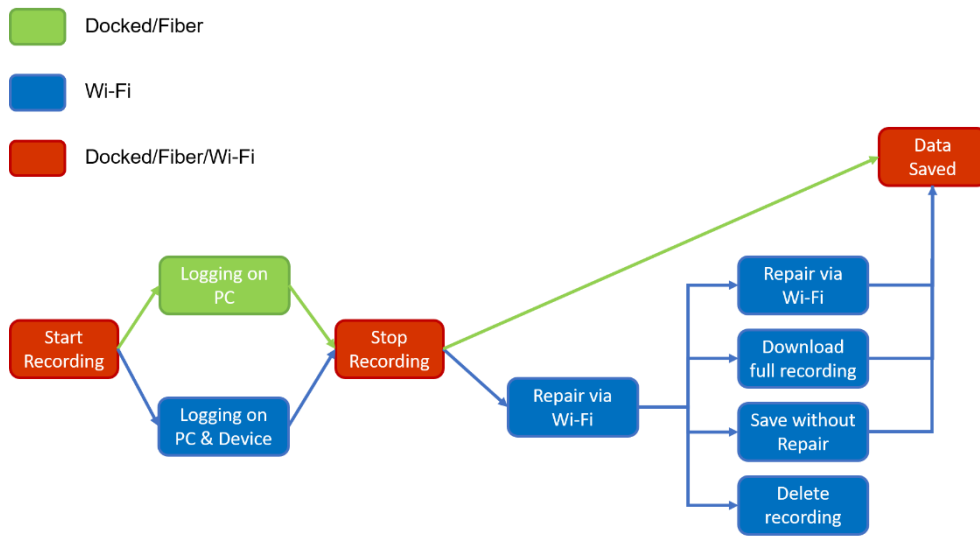


Figure 2: Flow chart of the recording process in the QRA. Depending on the interface, different steps are taken.

## 2 START SCREEN

At Startup, the following screen is shown ([Figure 3](#)).

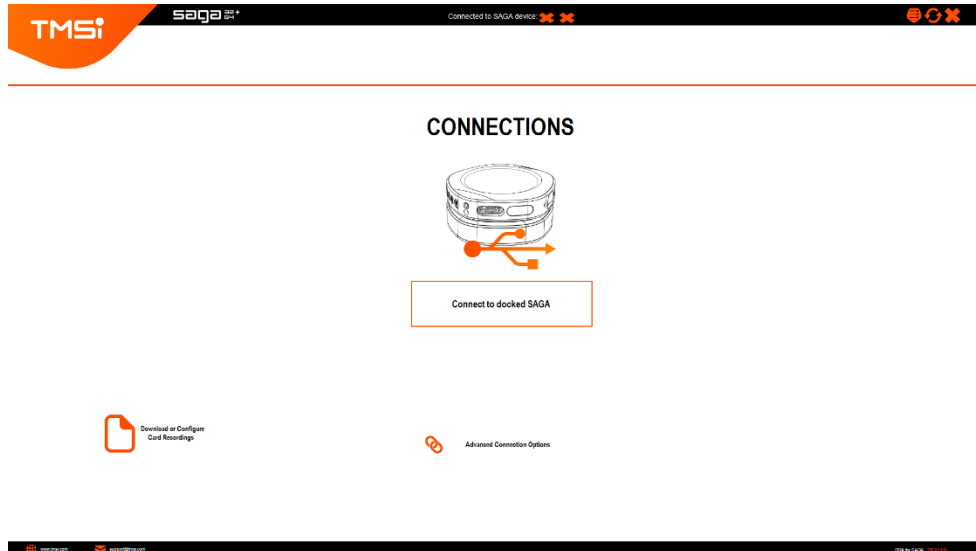


Figure 3: QRA screenshot - Start screen of the QRA, always shown at startup of the QRA

The large 'Connect to docked SAGA' button forces the user to always start with a Docked (electrical) connection via USB. When this button is pressed, the connection will be made automatically and the user will be redirected to the Configuration page.

Below the large button some feedback about the connection process is given (except upon opening the QRA): 'Disconnected!' when there is no connection with the device, 'Connecting...' when the process of making a connection is ongoing, 'Connected' when the connection is established and 'CONNECTION FAILED! Docking Station does not respond, is it connected to USB and Power?' when connection cannot be established. This message is shown for example when the user tries to connect the device while it is off or the USB cable is not plugged in.

When the user already knows which interfaces (between Data Recorder and Docking Station and between Docking Station and PC) are configured on the SAGA device, the user can choose to directly connect to this interface via 'Advanced Connection Options' (see [Connect to SAGA via configured interface](#)).

When there is a card recording on the device, this recording should be downloaded before continuing to the Configuration page. When the user clicks on the 'Download Recording' button, the user is directed to the Download page (see [Download Recording](#)). A card download is only possible when the device is Docked. When this is not the case, the warning 'To configure or download a card recording the device should be docked!' is shown below the button 'Download Card Recording'. When the device is not connected when the button is pressed, the QRA will automatically try to connect to the SAGA device via Docked and USB interface.

When the user connects to the SAGA device, the QRA checks whether there is a data file on the device (number of recordings > 0) and redirects the user to the Check Card Recording page (Figure 4).

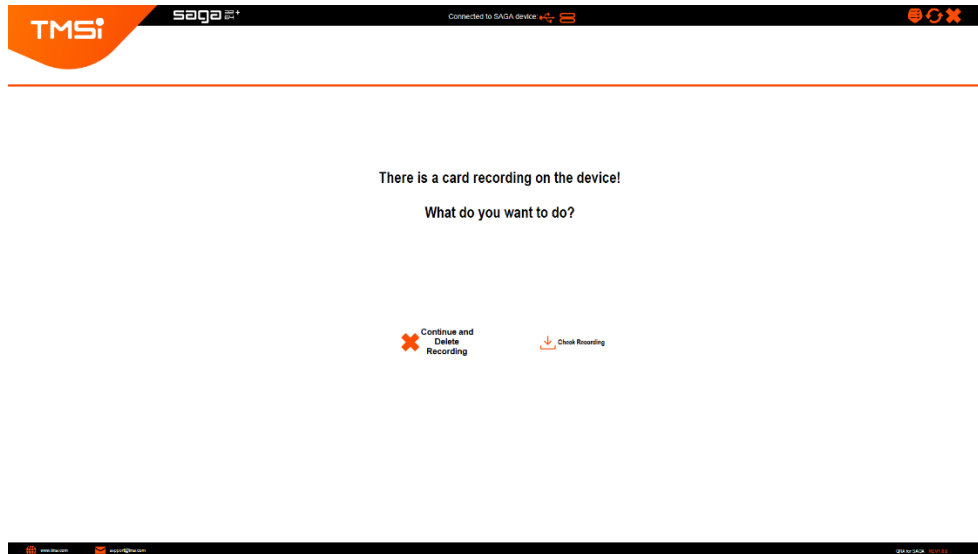


Figure 4: QRA screenshot - Check Card Recording page

When the user selects 'Continue and Delete Recording', the user is redirected to the Configuration page and all available recordings are deleted from the device. When the user is moving from the Connections page to the Configuration page again (e.g. after a connection switch), this warning might still be there, however no recordings will be listed on the Download page.

After a connection has been made with the SAGA device, the QRA also checks whether there is a Card Configuration active on the device (Start with Record button = 'On' or Start at specific time = 'On') and redirects the user to the Check Card Configuration page (Figure 5).

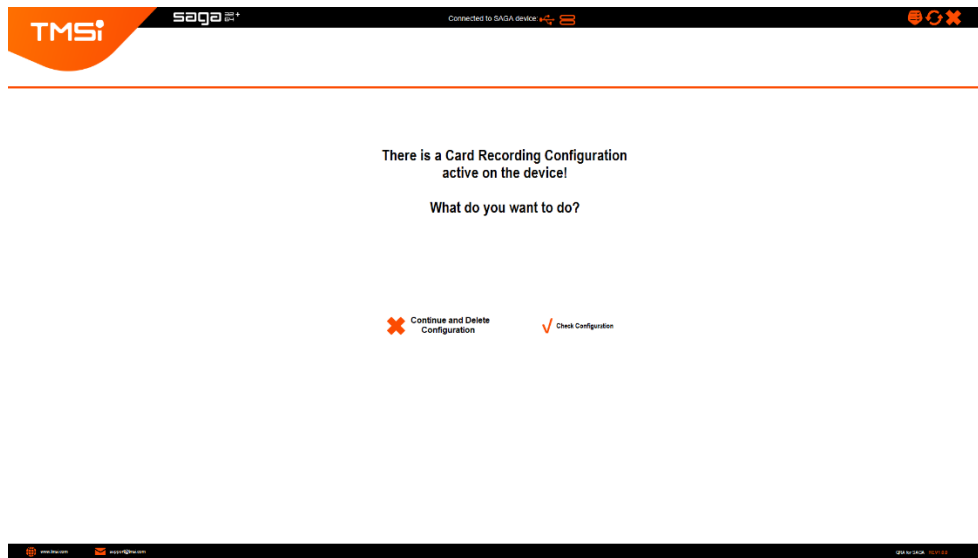


Figure 5: QRA screenshot - Check Card Configuration page

When the user selects 'Continue and Delete Configuration' the user is redirected to the Configuration page and the Start Recording is set to 'Off' (either the Start button or the Start at specific time). When the user wants to check the card configuration that is on the device, the Card Configuration Overview is shown (see [Card Configuration](#)). The user can choose to either keep this configuration and exit the QRA or to delete the configuration and continue with the QRA.

### 3 CONNECTIONS

The default interface between the Data Recorder and the Docking Station is 'Docked (electrical)' and 'USB' for the interface between the Docking Station and the PC. To change an interface, the user should go to the Advanced Connection Options page. Depending on whether the device is already connected, different options are shown to the user.

#### 3.1 Advanced Connection Options – Not connected

When no connection is made yet, the following screen ([Figure 6](#)) is shown.

##### Connect to SAGA via configured interface

When the user already knows which interface is configured on the device, the user can switch to this interface directly.

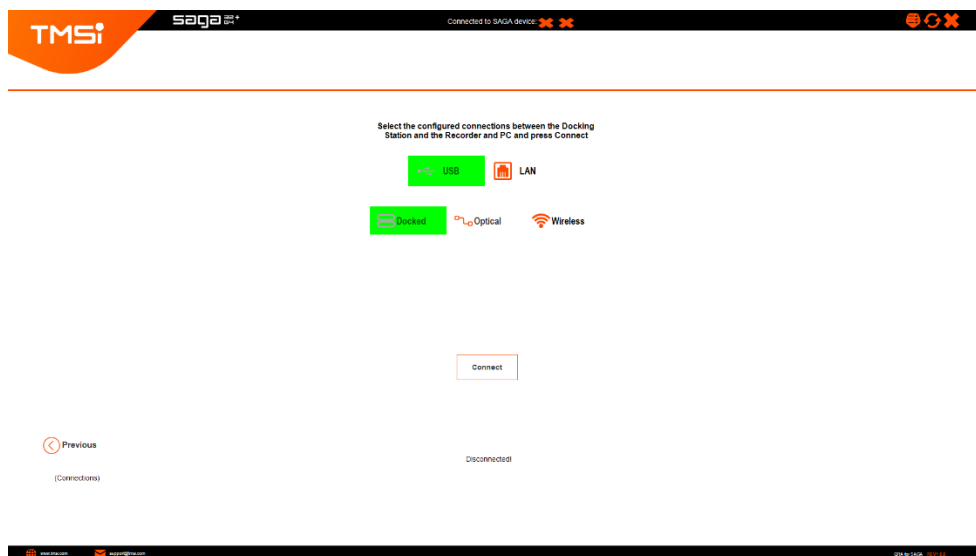


Figure 6: QRA screenshot - Connect to configured interface

The user should select the configured interface and press 'Connect' afterwards (see [Figure 6](#)). The selected interfaces are green.

#### 3.2 Advanced Connection Options – Connected

When the device is connected, the Advanced Connection Options page shows, by default, the option to switch the Connection between the Data Recorder and the Docking Station. When the 'Other Connection Options' button is pressed, all advanced connection options are shown (see [Figure 7](#)).



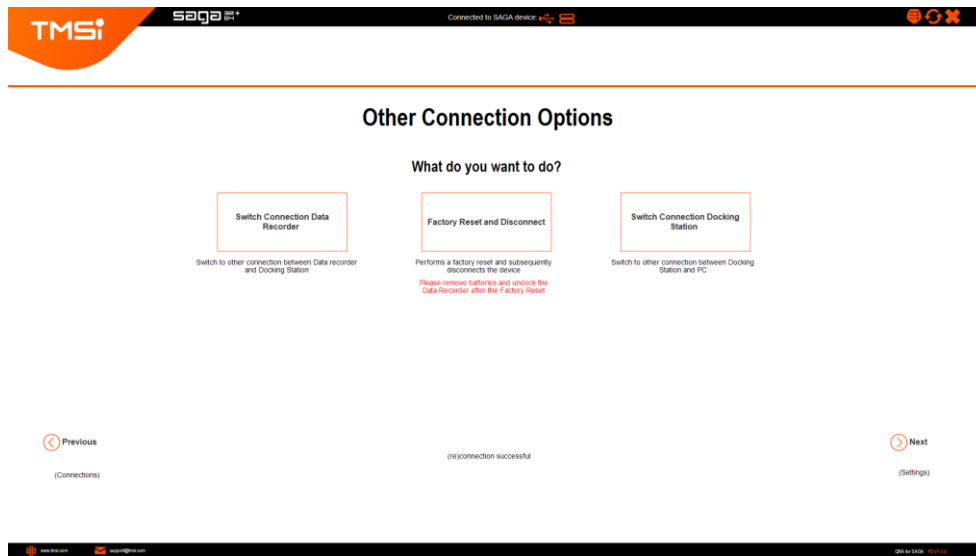


Figure 7: QRA screenshot - Other Connection Options - Connected

### Switch Connection Data Recorder

In green, the current interface connection is shown (see Figure 8). The user should select the desired interface first and press 'Switch' afterwards.

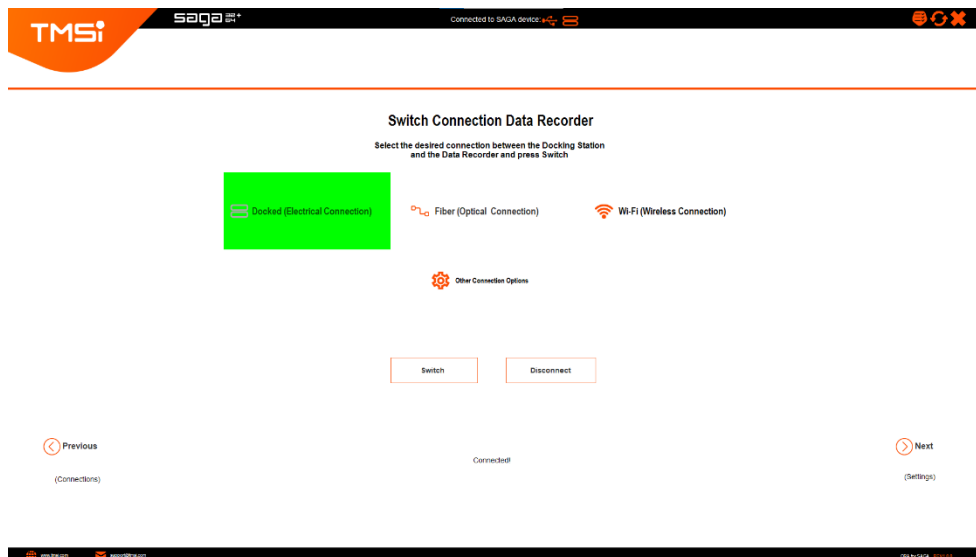


Figure 8: QRA screenshot - Switch Connection Data Recorder

During the switch procedure some feedback is given to the user below the 'Switch' and 'Disconnect' buttons. It shows the different steps that are taken in this process: (1) '(re)connecting to Interface...', (2) 'Disconnected', (3) 'Scanning for devices...', (4) 'Connecting...' and (5) '(re)connection Successful!'

Especially when switching to the Wi-Fi interface it might occur that the device cannot be found directly. When this is the case, another round of scanning and connecting will be started (see [Figure 9a](#)).

The message 'Retry scanning...' will be shown and an 'Abort' button appears.

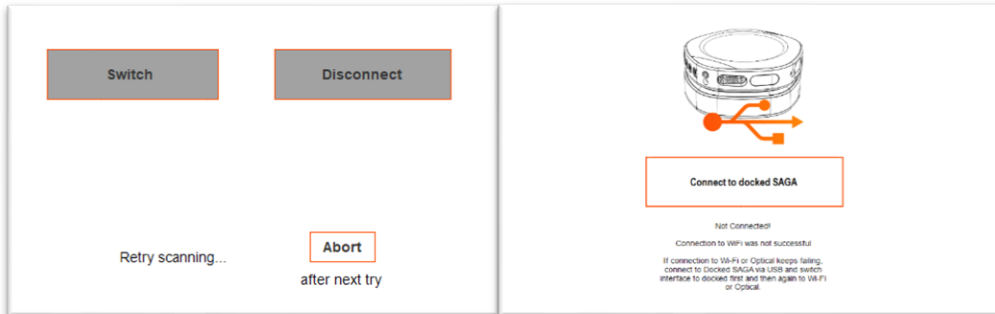


Figure 9: QRA screenshot (cut-outs) - (a) Retry scanning message, (b) Interface switch not successful

When after a number of tries, the device can still not be found, the user can abort the scanning process by clicking the button. The user is then redirected to the Start page and the advice to connect via Docked and USB first is shown (see [Figure 9b](#)).

When switching to Wi-Fi was not successful after a large number of tries, a solution might be to switch to Docked, even when the device is already connected via Docked, and afterwards try to switch to Wi-Fi again.

### Factory Reset and Disconnect

Performing a Factory Reset might be useful when the behaviour of the device is not as expected anymore. After performing the factory reset, the device is disconnected and the user is redirected to the Start page. The user is informed that the batteries should be removed and the Data Recorder should be undocked after performing the Factory Reset.

### Switch Connection Docking Station

It is possible to reach a SAGA device via a network (LAN) connection, which should be configured on the PC beforehand. To switch to the LAN interface, the user should select the LAN button first and afterwards press 'Switch' (see [Figure 10](#)). It follows the same switching procedure as for the Data Recorder Interface switch.

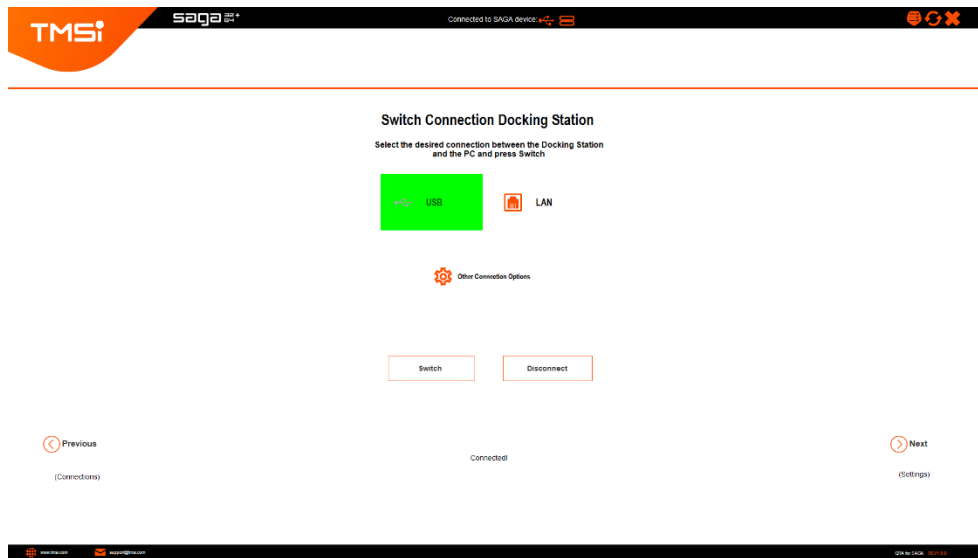


Figure 10: QRA screenshot - Switch Connection Docking Station

### Successful switch

When the switch was successful, an overview window is shown. The new connection interfaces are shown by text and icons (see Figure 11). From here the user can choose to continue to the Configuration page or to go back to the Connection page. The connection icons are also shown in the black bar at the top of the screen and therefore always visible, regardless the page that is shown.

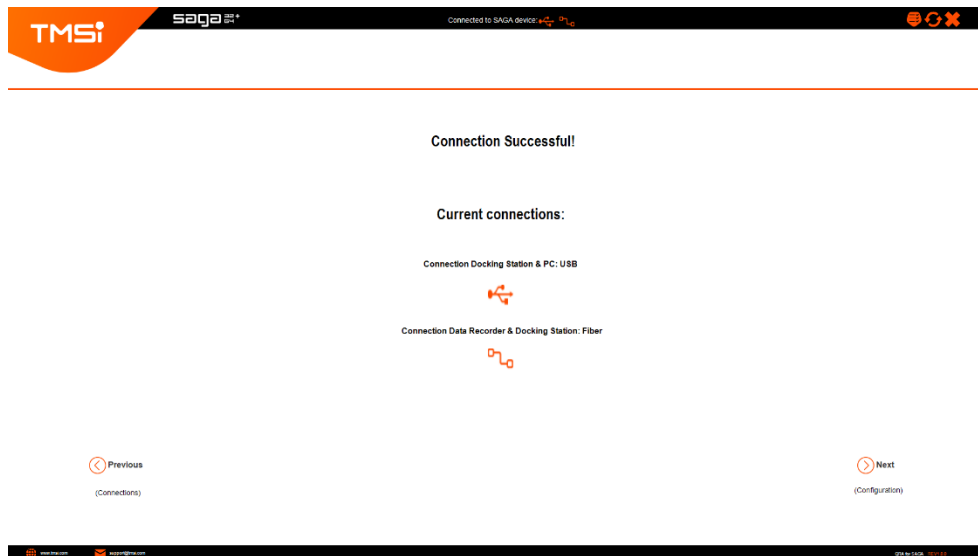


Figure 11: QRA screenshot - Switch successful

## 4 CONFIGURATION

The user can observe and edit the measurement settings and channel configuration on the device (see **Figure 12**) on the Configuration page. Configured settings are sent to the device when the Impedance Check or Signal Viewer page is opened.

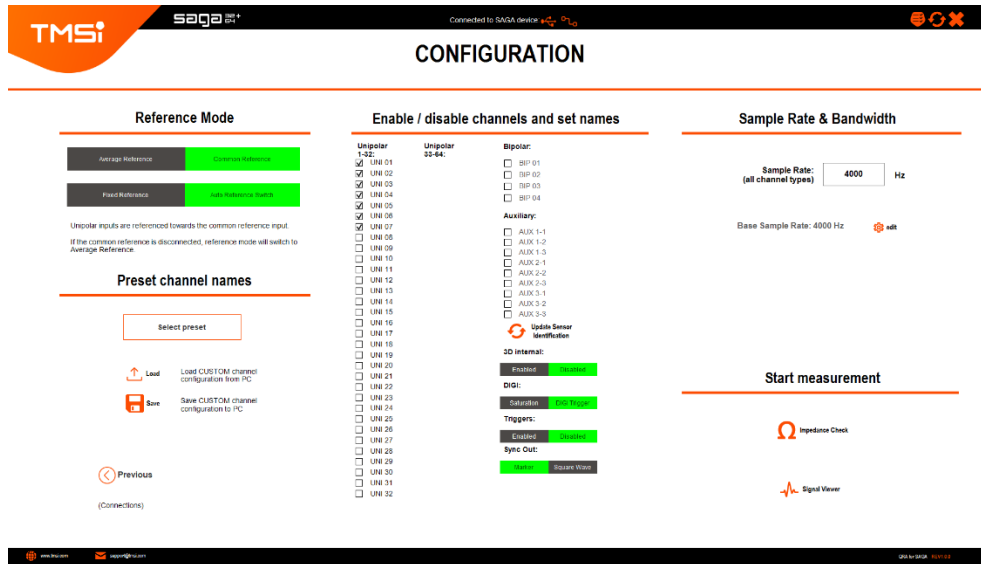


Figure 12: QRA screenshot - Configuration page

### 4.1 Reference mode

The SAGA device supports Average reference and Common reference measurements (**Figure 13**).

If common reference is selected a choice must be made between 'Fixed Reference' and 'Auto Reference Switch'. When Auto Reference Switch is selected, the SAGA device automatically switches from Common Reference to Average Reference in case the common reference electrode lost connection.

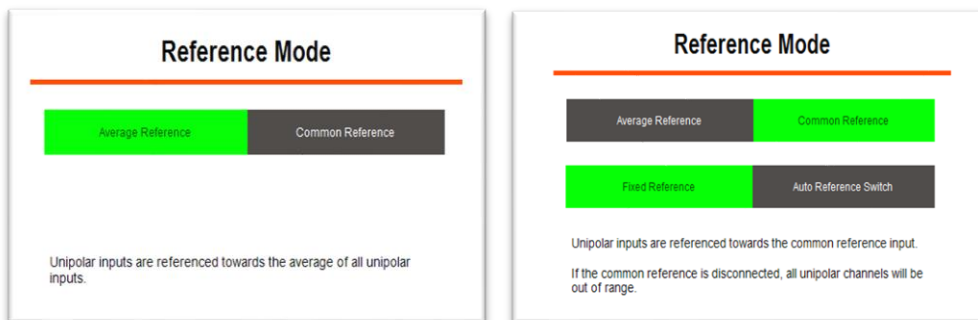


Figure 13: QRA screenshot (cut-outs) - (a) Average Reference mode, (b) Common Reference mode

The occurrence of this switch event is shown in the data viewer by a red marker ('Ref Switch') on the screen and is stored in the data in the status channel as well as a separate event in the .events.csv file.

## 4.2 Sampling Rate and Bandwidth

The sampling rate is the same for all channels (Unipolar, Bipolar, Auxiliary and Sensors) when the configured interface is the docked or optical interface. When the Wi-Fi interface is configured, different sampling rates can be set per channel type by selecting the 'Edit' button. A dropdown list with sampling rates is shown when the user clicks on the sampling rate (Figure 14a).

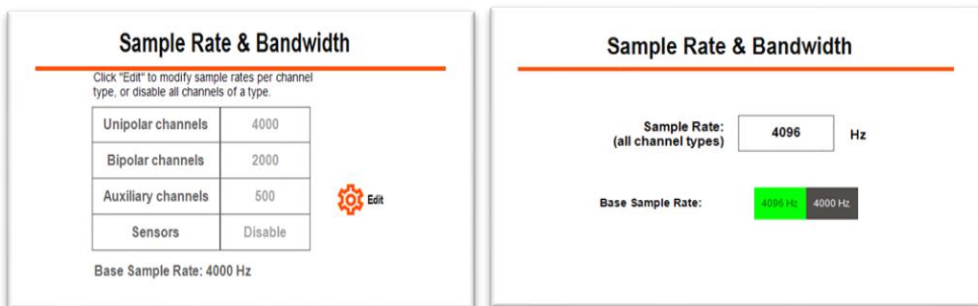


Figure 14: QRA screenshot (cut-outs) - (a) Selection of the sampling rate per channel type, (b) Editing of the Base Sample Rate

A selection between two different Base Sampling rates (4000 and 4096 Hz) can be made via the 'edit' button (Figure 14b). After selecting a new base sampling rate, the sampling rate is adjusted automatically (can take a few seconds).

For measurements via a Docked or Fiber interface there are no bandwidth limitations. For the Wi-Fi interface and in case of a card recording there is a maximum bandwidth defined, which is set to 1.7 Mb.

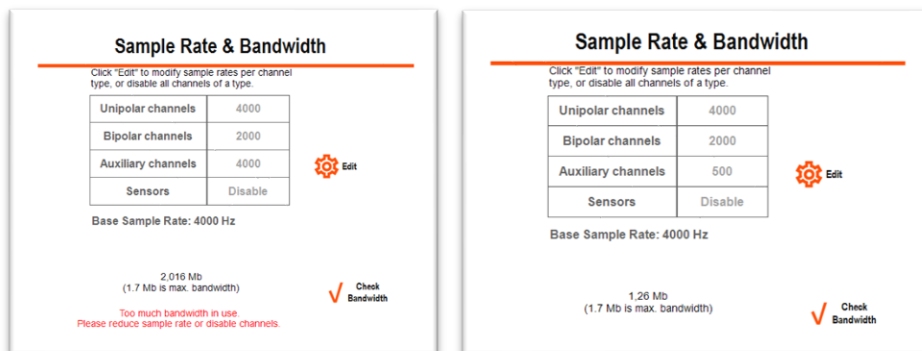


Figure 15: QRA screenshot (cut-outs) - (a) Bandwidth too high, (b) Bandwidth OK

When the device is connected via Wi-Fi, the bandwidth calculation is always performed. When it is above the threshold, the user cannot continue to the Signal Viewer or Impedance Check. Furthermore, a warning is shown in red (Figure 15a). The user should reduce the bandwidth by decreasing the sampling rate and/or the number of selected channels before continuing. When the bandwidth is ok, no warning is shown (Figure 15b). The same procedure is applied for the card recording

configuration; the user cannot continue or save a configuration when the bandwidth is above 1.7 Mb.

### 4.3 Sync

Synchronization between other devices can be achieved via several Sync options.

#### Sync Out

There are two Sync Out options in the SAGA device: (1) the Marker button or (2) the Square wave.

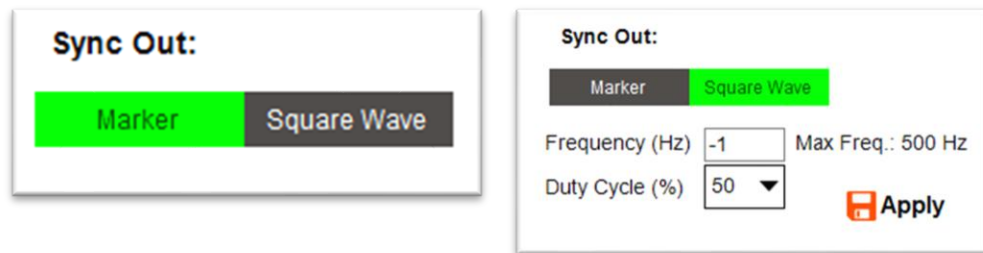


Figure 16: QRA screenshot (cut-outs) - (a) Selection of the Marker button, (b) Selection of the Square wave as Sync Out

When the 'Marker' button is selected, the marker button on the SAGA device can be used to create a Sync Out signal (Figure 16a). The event of the button press is shown by an orange marker ('Marker button') in the data viewer and also saved as an event in the .events.csv file.

When the Square Wave is selected as a Sync out signal, a continuous square wave with a certain frequency and duty cycle will be saved in the status channel of the data. The Sync Out signal is visualised by a green indicator that blinks during the measurement on the Signal Viewer page (see Viewer Settings). After changing the frequency and/or duty cycle of the square wave, the user should always press 'apply', otherwise the values will not be set on the device (Figure 16b).

When the Marker button is selected, this is set on the device through a frequency of -1 for the square wave. When a negative value is selected by the user in configuring the square wave, the value of the frequency is forced to 1Hz.

#### Triggers

Up to 16 trigger inputs can be used with SAGA. To retrieve the trigger inputs, they should be enabled on the Configuration page (Figure 17). Afterwards, they can be visualized in the Signal Viewer (see Viewer Settings).

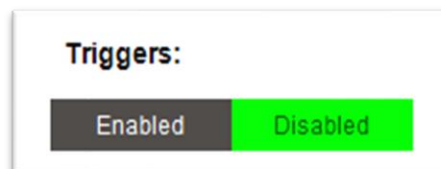


Figure 17: QRA screenshot (cut-out) - Enable or disable Triggers in configuration

## 4.4 Channel Configuration

On the Configuration page, predefined channel names can be applied. Furthermore, custom names can be defined or loaded (see [Figure 12](#)). The channels that are enabled (checked) are the channels that will be used for data collection. Disabled channels are disabled on the device and will not be stored in the data file!

Two columns of unipolar channels are shown. In case of a 32+ channel device, the right column is left empty (as is the case in [Figure 12](#)).

## 4.5 Select Channel Configuration

By default, the channel names that were already stored on the device are shown. These channel names are named 'INITIAL CONFIG (at QRA start)' and can always be selected by the user again. There are three sets of predefined channel names that can also be selected by the user: HDEMG, EEG and DEFAULT ([Figure 18a-c](#)).

The user can change the names of all Unipolar channels ([Figure 18d](#)). These channel names can be saved as the Custom channel list (see [Load and Save Configuration](#)). This list is then stored in an ini-file in the 'roaming user folder' (C:\Users\User\AppData\Roaming\Polybench\key\ConfigSettings2 for a 64+ channel device and ConfigSettings32 for a 32+ channel device). The names of the BIP, AUX and Sensor channels cannot be changed, but they can be enabled or disabled.

<input checked="" type="checkbox"/>	R1C1	<input checked="" type="checkbox"/>	Fp1	<input checked="" type="checkbox"/>	UNI 01	<input checked="" type="checkbox"/>	Edit
<input checked="" type="checkbox"/>	R1C2	<input checked="" type="checkbox"/>	Fpz	<input checked="" type="checkbox"/>	UNI 02	<input checked="" type="checkbox"/>	Channel
<input checked="" type="checkbox"/>	R1C3	<input checked="" type="checkbox"/>	Fpz	<input checked="" type="checkbox"/>	UNI 03	<input checked="" type="checkbox"/>	Names
<input checked="" type="checkbox"/>	R1C4	<input checked="" type="checkbox"/>	F7	<input checked="" type="checkbox"/>	UNI 04	<input checked="" type="checkbox"/>	UNI 04
<input checked="" type="checkbox"/>	R1C5	<input checked="" type="checkbox"/>	F3	<input checked="" type="checkbox"/>	UNI 05	<input checked="" type="checkbox"/>	UNI 05
<input checked="" type="checkbox"/>	R1C6	<input checked="" type="checkbox"/>	Fz	<input checked="" type="checkbox"/>	UNI 06	<input checked="" type="checkbox"/>	UNI 06
<input checked="" type="checkbox"/>	R1C7	<input checked="" type="checkbox"/>	F4	<input checked="" type="checkbox"/>	UNI 07	<input checked="" type="checkbox"/>	UNI 07
<input checked="" type="checkbox"/>	R1C8	<input checked="" type="checkbox"/>	F8	<input checked="" type="checkbox"/>	UNI 08	<input checked="" type="checkbox"/>	UNI 08
<input checked="" type="checkbox"/>	R2C1	<input checked="" type="checkbox"/>	FC5	<input checked="" type="checkbox"/>	UNI 09	<input checked="" type="checkbox"/>	UNI 09
<input checked="" type="checkbox"/>	R2C2	<input checked="" type="checkbox"/>	FC1	<input checked="" type="checkbox"/>	UNI 10	<input checked="" type="checkbox"/>	UNI 10
<input checked="" type="checkbox"/>	R2C3	<input checked="" type="checkbox"/>	FC2	<input checked="" type="checkbox"/>	UNI 11	<input checked="" type="checkbox"/>	UNI 11
<input checked="" type="checkbox"/>	R2C4	<input checked="" type="checkbox"/>	FC6	<input checked="" type="checkbox"/>	UNI 12	<input checked="" type="checkbox"/>	UNI 12
<input checked="" type="checkbox"/>	R2C5	<input checked="" type="checkbox"/>	M1	<input checked="" type="checkbox"/>	UNI 13	<input checked="" type="checkbox"/>	UNI 13
<input checked="" type="checkbox"/>	R2C6	<input checked="" type="checkbox"/>	T7	<input checked="" type="checkbox"/>	UNI 14	<input checked="" type="checkbox"/>	UNI 14
<input checked="" type="checkbox"/>	R2C7	<input checked="" type="checkbox"/>	C3	<input checked="" type="checkbox"/>	UNI 15	<input checked="" type="checkbox"/>	UNI 15
<input checked="" type="checkbox"/>	R2C8	<input checked="" type="checkbox"/>	Cz	<input checked="" type="checkbox"/>	UNI 16	<input checked="" type="checkbox"/>	UNI 16
<input checked="" type="checkbox"/>	R3C1	<input checked="" type="checkbox"/>	C4	<input checked="" type="checkbox"/>	UNI 17	<input checked="" type="checkbox"/>	UNI 17
<input checked="" type="checkbox"/>	R3C2	<input checked="" type="checkbox"/>	T8	<input checked="" type="checkbox"/>	UNI 18	<input checked="" type="checkbox"/>	UNI 18
<input checked="" type="checkbox"/>	R3C3	<input checked="" type="checkbox"/>	M2	<input checked="" type="checkbox"/>	UNI 19	<input checked="" type="checkbox"/>	UNI 19
<input checked="" type="checkbox"/>	R3C4	<input checked="" type="checkbox"/>	CP5	<input checked="" type="checkbox"/>	UNI 20	<input checked="" type="checkbox"/>	UNI 20
<input checked="" type="checkbox"/>	R3C5	<input checked="" type="checkbox"/>	CP1	<input checked="" type="checkbox"/>	UNI 21	<input checked="" type="checkbox"/>	UNI 21
<input checked="" type="checkbox"/>	R3C6	<input checked="" type="checkbox"/>	CP2	<input checked="" type="checkbox"/>	UNI 22	<input checked="" type="checkbox"/>	UNI 22
<input checked="" type="checkbox"/>	R3C7	<input checked="" type="checkbox"/>	CP6	<input checked="" type="checkbox"/>	UNI 23	<input checked="" type="checkbox"/>	UNI 23
<input checked="" type="checkbox"/>	R3C8	<input checked="" type="checkbox"/>	P7	<input checked="" type="checkbox"/>	UNI 24	<input checked="" type="checkbox"/>	UNI 24
<input checked="" type="checkbox"/>	R4C1	<input checked="" type="checkbox"/>	P3	<input checked="" type="checkbox"/>	UNI 25	<input checked="" type="checkbox"/>	UNI 25
<input checked="" type="checkbox"/>	R4C2	<input checked="" type="checkbox"/>	Pz	<input checked="" type="checkbox"/>	UNI 26	<input checked="" type="checkbox"/>	UNI 26
<input checked="" type="checkbox"/>	R4C3	<input checked="" type="checkbox"/>	P4	<input checked="" type="checkbox"/>	UNI 27	<input checked="" type="checkbox"/>	UNI 27
<input checked="" type="checkbox"/>	R4C4	<input checked="" type="checkbox"/>	P8	<input checked="" type="checkbox"/>	UNI 28	<input checked="" type="checkbox"/>	UNI 28
<input checked="" type="checkbox"/>	R4C5	<input checked="" type="checkbox"/>	POz	<input checked="" type="checkbox"/>	UNI 29	<input checked="" type="checkbox"/>	UNI 29
<input checked="" type="checkbox"/>	R4C6	<input checked="" type="checkbox"/>	O1	<input checked="" type="checkbox"/>	UNI 30	<input checked="" type="checkbox"/>	UNI 30
<input checked="" type="checkbox"/>	R4C7	<input checked="" type="checkbox"/>	Oz	<input checked="" type="checkbox"/>	UNI 31	<input checked="" type="checkbox"/>	UNI 31
<input checked="" type="checkbox"/>	R4C8	<input checked="" type="checkbox"/>	O2	<input checked="" type="checkbox"/>	UNI 32	<input checked="" type="checkbox"/>	UNI 32

Figure 18: QRA screenshot (cut-outs) - (a) HDEMG channel names, (b) EEG channel names, (c) Default channel names, (d) Edited channel names

## 4.6 Load and Save Configuration

When the user changes the names of the channels and afterwards tries to select another channel list he will be asked whether the changed names should be saved to the Custom channel configuration list (Figure 19a). Selecting 'Yes' will result in the same action as pressing the 'Save' button.

When selecting the Custom channel configuration list from the drop-down menu, while the user has not loaded an ini-file yet, the user will be notified (Figure 19b). When there is no ini-file, the user will also be notified (Figure 19c).

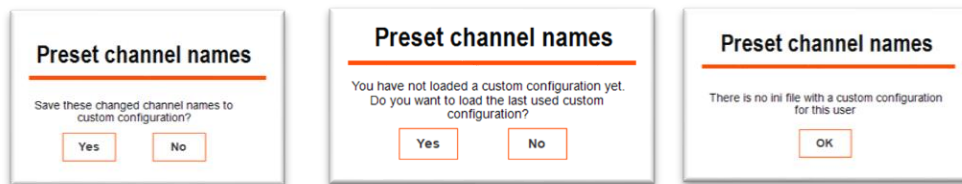


Figure 19: QRA screenshot (cut-outs) - (a) Message shown when channel names have been edited, but not saved yet, (b) Message shown when the user selects the Custom Channel Configuration, but no Custom file has been loaded yet, (c) Message shown when the user tries to load a Custom Channel Configuration, but there is no ini-file.

Pressing 'Save' saves the current list of channel names in the Custom configuration list, as well as which channels are enabled/disabled. Pressing 'Load' opens the ini-file with configuration names and enabled channels that is stored in the 'roaming user folder'.

## 4.7 Update Sensor Identification

When an AUX sensor with a Chip ID is connected to the device and the 'Update Sensor Identification' button is pressed, the channel names are read out from the sensor and displayed in the list of channel names (see Figure 20).

## 4.8 Digi channel

The DIGI channel can be configured in two ways (see Figure 21): 1) As a DIGI trigger, where it is used as Trigger input channel on the Data Recorder. 2) Selecting 'Saturation' automatically enables the saturation sensor channels 'SpO2', 'PLETH', 'HRate' and 'Stat'.



Figure 21: QRA screenshot (cut-out) - Enable DIGI Trigger or Saturation sensor channels.

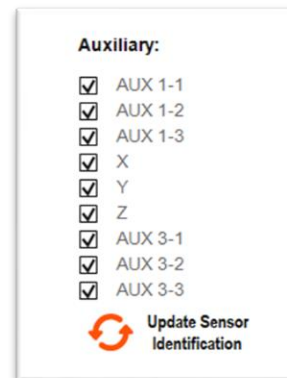


Figure 20: QRA screenshot (cut-out) - AUX channels with identified accelerometer.



## 5 IMPEDANCE CHECK

On the Impedance Check page, the impedances are shown through color-coded indicators. Furthermore, a table of values is shown, which can also be hidden (Figure 22).

When channels are disabled on the Configuration page, they are grey in the impedance grid and will get a value of 5000 kΩ. Channels that are not connected will get a value of 500 kΩ and their colour will be dark red. Impedances of 500 kΩ or higher are displayed in the list as 500 kΩ and have the same colour indicator as the not connected channels. Two more special values exist for impedance measurements. The first one is the Odd/Even error which is given when only odd or only even channels are enabled. This corresponds to a value of 5100 kΩ. Finally, when the Patient Ground is not connected, a GND disconnected error value is presented. The value of the error message is 5200 kΩ.

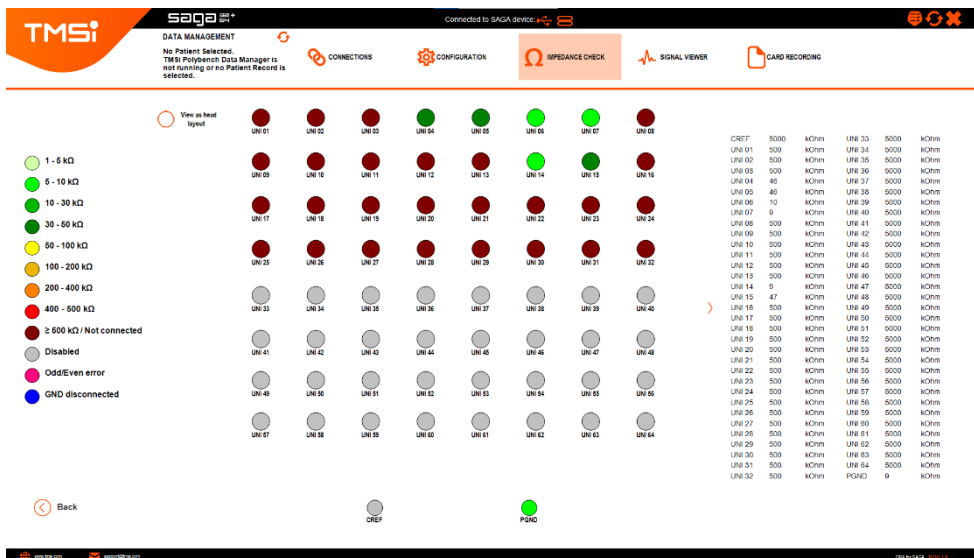
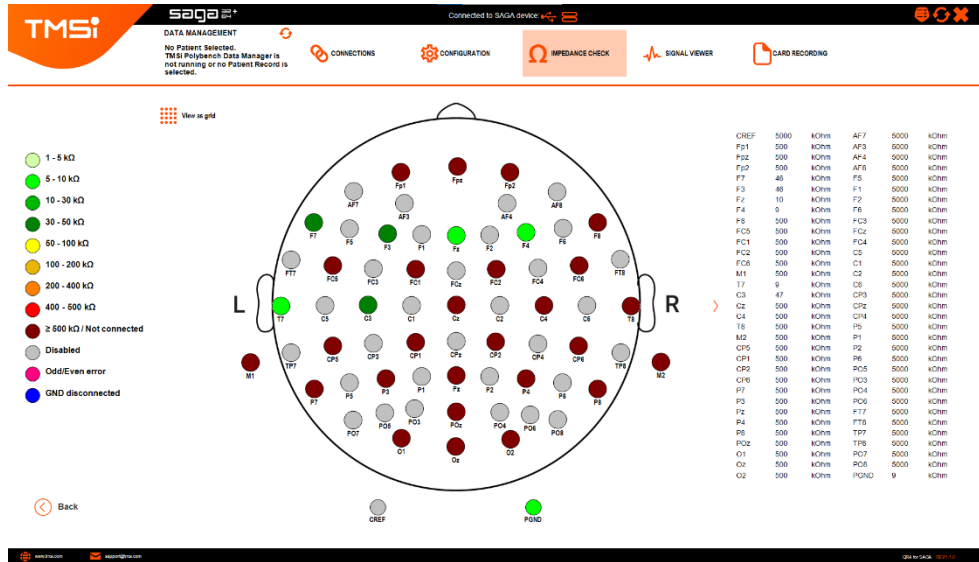


Figure 22: QRA screenshot - Impedance Check - Grid layout

## 5.1 Head and Grid layout

The user can switch between the grid and head layout (see [Figure 22](#) and [Figure 23](#)). By default, the grid layout is shown for all channel configurations, except the EEG configuration. For the EEG configuration the default layout is the head layout. Different grids will be shown for the 32+ and the 64+ devices.



## 6 SIGNAL VIEWER

In the Signal Viewer, the data from the channels that are selected on the Configuration page can be shown (Figure 24). Several choices can be made to optimally represent the data on the screen. Furthermore, on this page the data recording can be started and stopped.

The Signal Viewer starts automatically. When the data stream is stopped, the Signal Viewer can be started again by pressing the 'Start' button in the upper right corner (Figure 31a). In the data viewer 'Not recording' is shown to make clear that only the data stream has started, but no data is being recorded yet.

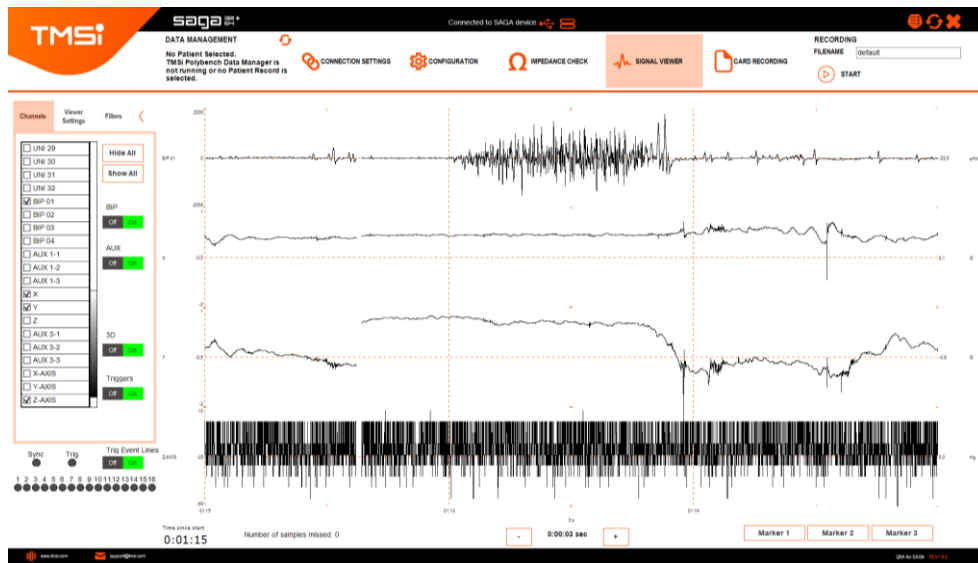


Figure 24: QRA screenshot - Signal Viewer page

Below the data viewer, the time since the start of the measurement is shown.

Next to the 'Time since start', the 'Number of samples missed' is shown. In case of a Wi-Fi measurement, samples can be missed (which will be repaired later, see [Data Repair \(Wi-Fi\)](#)). This value gives an indication on the rate of missing samples.

With the '+' and '-' buttons below the data viewer, the time scale of the viewer can be adjusted. The default range of the screen is 3 seconds.

By pressing the Marker buttons at the lower right of the screen, a Marker (vertical line) will be shown in the signal viewer (see [Figure 25](#)). The event will also be stored in the .events.csv file that is created during the data recording. Markers can be assigned to different events occurring during the measurement and the same marker can therefore be pressed several times. In Wi-Fi mode the markers cannot be used and the buttons are therefore not visible.



Figure 25: QRA screenshot - Markers in the data viewer

To create a larger data viewer, the tabs on the left side of the Signal Viewer page can be hidden by pressing the small arrow button at the upper left corner (Figure 26).

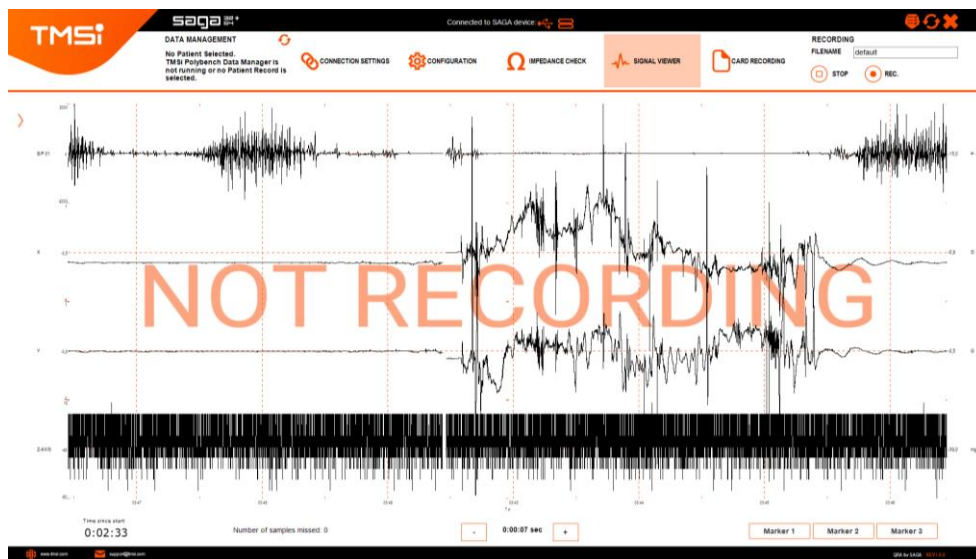


Figure 26: QRA screenshot - Enlarged data viewer

## 6.1 Channels

At the Channels tab on the Signal Viewer page (see Figure 27), the user can select the channels that should be displayed in the viewer. All channels that are not selected here will still be stored in the data file, while channels that were disabled on the Configuration page, are not visible here and will not be stored.

Channels can be enabled and disabled individually or by group (Bipolar, Auxiliary, Nonin, 3D and Triggers).



Figure 27: QRA screenshot - Channels tab of the Signal Viewer

## 6.2 Viewer Settings

At the Viewer Settings tab (see Figure 28), the user can adjust the scaling and ranges of the different channels and show or hide the Triggers signal.



Figure 28: QRA screenshot - Viewer Settings tab of the Signal Viewer

When the Signal Viewer is started, the ranges for the different channels are set to their default values, which is  $\pm 500 \mu\text{V}$  for the Bipolar channels,  $\pm 1000 \mu\text{V}$  for the Auxiliary channels and  $\pm 250 \mu\text{V}$  for the Sensors. Depending on the selected channel configuration the ranges for the Unipolar channels are  $\pm 100 \mu\text{V}$  for the EEG configuration and  $\pm 250 \mu\text{V}$  for the other configurations.

The user can set the Scaling, Range and Offset automatically by first selecting the Channel group from the drop-down list and afterwards pressing the corresponding button. Furthermore, the user can choose a Zero Offset view.

The range for each channel group can be adjusted by either inserting a certain value and pressing the 'Set' button next to the input field or by selecting a specific range from the drop-down menu.

Besides using the buttons in this tab, the user can also select the channels of interest by clicking with the right mouse button on the channel name in the viewer to perform scaling actions.

Finally, the user can choose 'Show Triggers' or 'Hide Triggers' (see Figure 29). When 'Show Triggers' is chosen, 18 indicators are shown. The 'Sync' indicator blinks when a Sync Out Square Wave is configured, with a frequency equal to the Square Wave's frequency. For low frequencies, the blinking indicator is shown reliably. The 'Trig' indicator blinks when the Data Recorder's Trigger input is high. These Data Recorder Trigger inputs can be used to generate events, which are displayed in the data stream in a similar manner as the Marker events and saved in the .events.csv file. The generation of these Trigger Event Lines can be enabled/disabled by selecting the button. When the Trigger events are disabled in the viewer, they are not saved to the .events.csv file either, but the information remains available in the STATUS channel.

Below the 'Sync' and 'Trig' indicators, 16 indicators are shown that light up when the respective Docking Station Trigger input is high (again, only low frequencies are shown reliably). The Signal Viewer will warn the user when Wi-Fi is active during docked measurements, as Docking Station triggers can be unreliable when Wi-Fi is active (see Figure 29). No warning can be presented when data loss events occur during measuring over the Wi-Fi interface.

### 6.3 Filters

On the Filters tab (see Figure 30), the user can apply high- and low-pass filters on the Unipolar, Bipolar and Auxiliary channels respectively. The upper threshold for the filters is set to the Nyquist frequency (1/2 of the sampling frequency). When setting the value above this threshold, it will be forced to the Nyquist frequency.

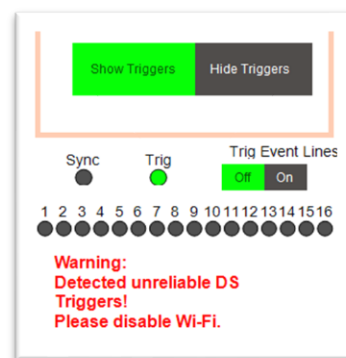


Figure 29: QRA screenshot (cut-out) - Trigger viewer settings, including the warning given when Docking Station Triggers are unreliable.

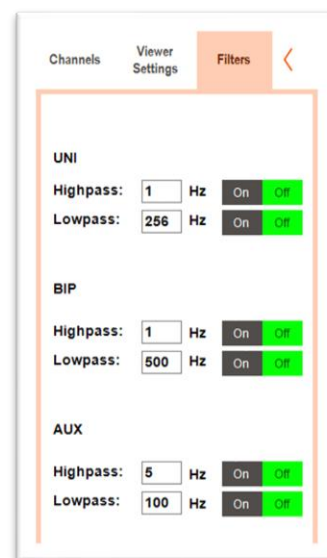


Figure 30: QRA screenshot (cut-out) - Filter viewer.

## 6.4 Recording

In the upper right corner of the Signal Viewer page, the data recording can be started by pressing the 'REC. button' (Figure 31b). In case of a Docked or Fiber interface, a Poly5 file will be created in the 'Documents folder' or the folder specified in the Data Manager directly. In case of a Wi-Fi interface, first two temporary files (one on the device and one on the PC) will be created and later, during data repair (see [Data Repair \(Wi-Fi\)](#)), combined in one data file that will also be stored in the 'Documents folder' or the Data manager folder.

Before starting the recording, a filename can be specified in the input field, which will be combined with the time and date of the measurement to create the final filename (see [File naming](#)).

During recording, the recording time is shown next to the 'Stop Rec. button' and the message 'Not Recording' is removed from the data viewer (Figure 31c).

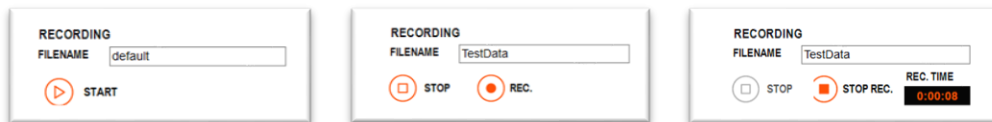


Figure 31: QRA screenshot (cut-outs) - (a) Signal Viewer not started, (b) Signal Viewer started - not recording, (c) Recording started

### File naming

A measurement started in the Signal Viewer with a Docked or Fiber interface, will have the following format: "*Filename*"-"*year*"-"*month*"-"*day*"-"*hour*"-"*minutes*"-"*seconds*".DATA.Poly5.

"*Filename*" is the filename that is defined by the user in the input field of the Signal Viewer. The "*year*", "*month*", "*day*", "*hour*", "*minutes*", and "*seconds*" are taken from the PC time at the moment of starting the recording.

A file created after data repair with the Wi-Fi interface will have the same filename format, except for the word 'DATA' that is being replaced by the word 'Repair'.

A file that has been created by downloading a card recording, will have the following filename format:

"*Filename*"\_"ID\_"\_"*year*"\_"*month*"\_"*day*"\_"*hour*"\_"*minutes*"\_"*seconds*".SAGA Recording.Poly5

## 7 DATA REPAIR (WI-FI)

In Wi-Fi mode, data repair is always enabled. When a recording is finished, the Data Repair page will be shown (Figure 32).

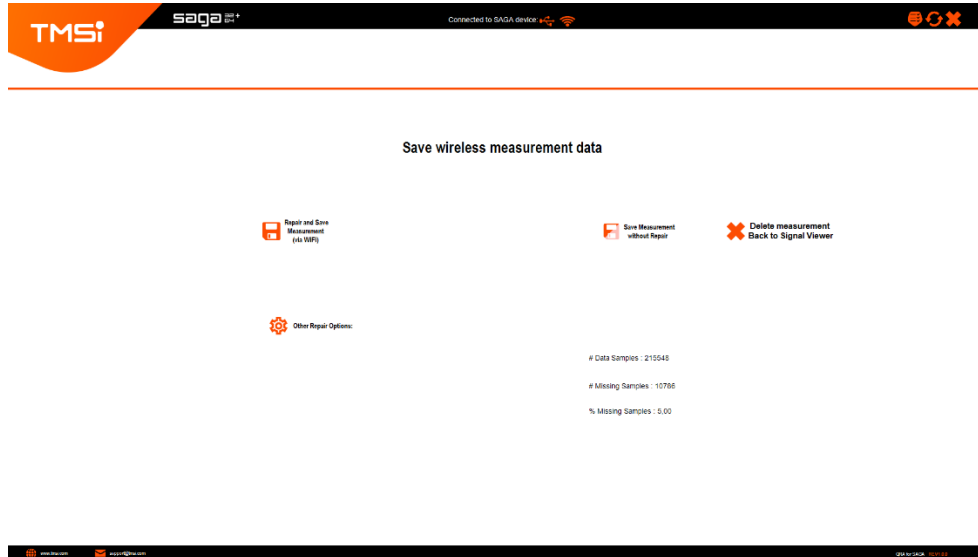


Figure 32: QRA screenshot - Data Repair page

In the lower right corner, the number of data samples in the recorded file are shown together with the number of missing samples and the percentage of missing samples. Based on these values a choice between the different repair options can be made (see Figure 33).

When the percentage of missing samples is <15% the other repair options are not shown and the default choice for the data repair would be the 'Repair and Save Measurement (via Wi-Fi)'. When this button is pressed, the SAGA device will start the repair of the data (filling in the missing samples) by combining the two collected datasets. When the number of missing samples is below 500, the 'Repair and Save Measurement (via Wi-Fi)' option will be automatically chosen and executed. An indicator of the progress (in percentage and sample counter number) will be shown when the repair is started. When the repair is finished, the repaired file is stored in the 'Documents' folder or the folder specified in the Data Manager (see File naming) and the user is redirected to the Signal Viewer page.

When the percentage of missing samples is >15%, the repair option to download the full recording is shown and recommended. When the user clicks on the 'Download Full Recording' button, the message that the SAGA should be docked is shown. When the user then clicks on the 'OK start download' button, the interface will be switched to Docked, the user will be redirected to the Download recording page and the download of the full recording starts automatically.

The user can also choose to save the data without performing a data repair by selecting the 'Save Measurement without Repair' button.



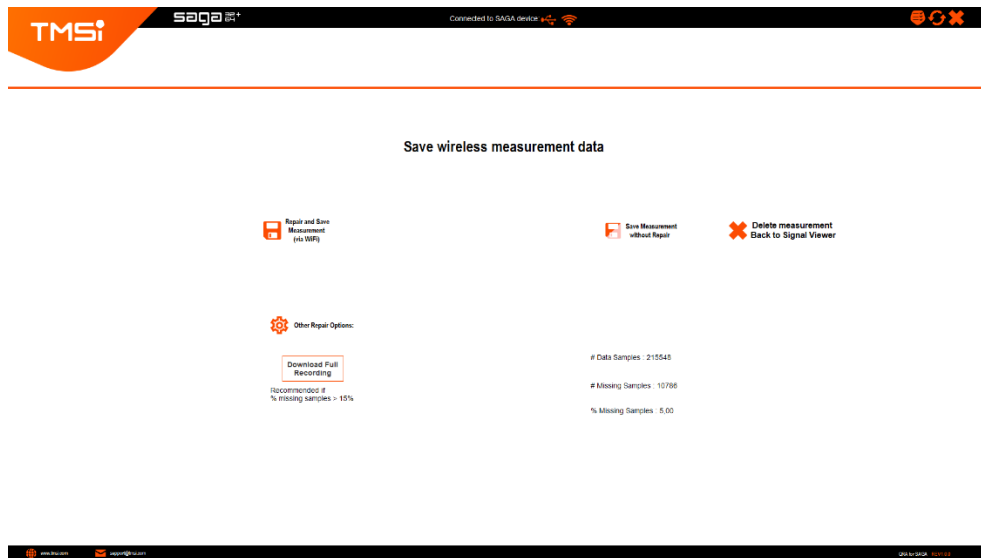


Figure 33: QRA screenshot - Other Repair Options

When the user doesn't want to perform any data repair at all, and doesn't want to save the measured data, the user can press the 'Delete measurement, Back to Signal Viewer' button and will be redirected to the Signal Viewer page.

When the user clicks on the 'Don't save measurement' button during the process of data repair, the Repair Fail Options page will be shown (Figure 34).

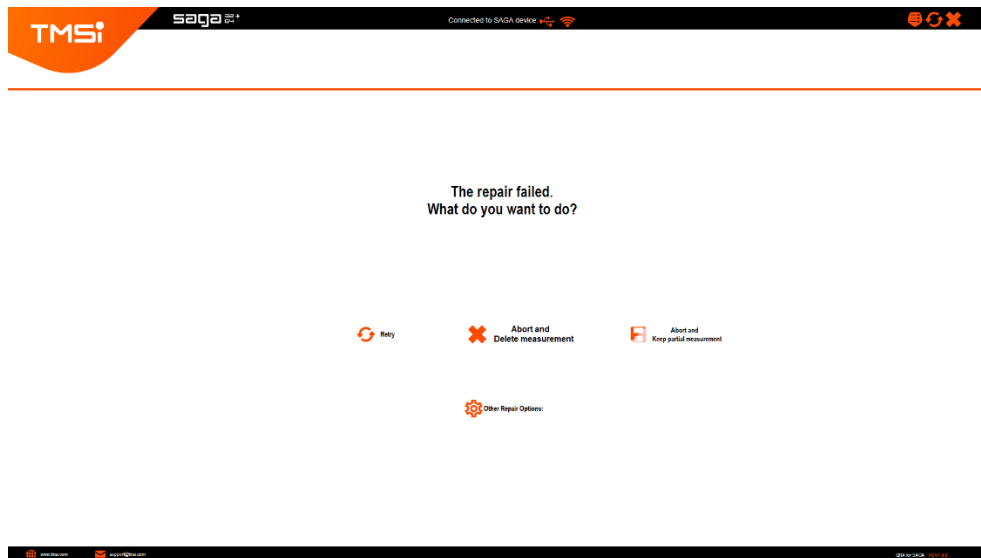


Figure 34: QRA screenshot - Repair Fail Options

There are three options when the repair failed: 'Retry', 'Abort and Delete measurement' and the 'Abort and Keep partial measurement' option. Selecting 'Retry' will restart the repair process (via Wi-Fi). The repair file that was already started will be deleted automatically. When the user presses the 'Abort and Delete measurement' button, the user will be redirected to the Signal Viewer page, no data files will be saved and the repair file that was already started will be deleted. When

choosing the option 'Abort and Keep partial measurement', the repaired file is saved, which contains data up to the point where the repair was aborted. This means that when the repair was aborted at sample 8000 of 20000, the partial measurement will contain only 8000 samples. The user will be redirected to the Signal Viewer page after selecting this option.

In case of a repair fail, for example due to loss of the connection between Data Recorder and Docking Station during data repair, a message is displayed at what point repair failed (see [Figure 35](#)). The data from the complete measurement is saved, but the data is only partially repaired. Data after the sample counter value stated in the 'Repair issues' can contain missing samples. To retrieve the complete measurement data file, the QRA should be reset. Next, the Data Recorder should be docked. By selecting the 'Connect to docked SAGA' button, the connection to the device is opened. The user will see a screen that states 'There is a card recording on the device!' (see [Figure 4](#)). Selection of the 'Check Recording' button will redirect the user to the 'Download Recording' Page, where the full recording can be downloaded from SAGA's onboard memory.

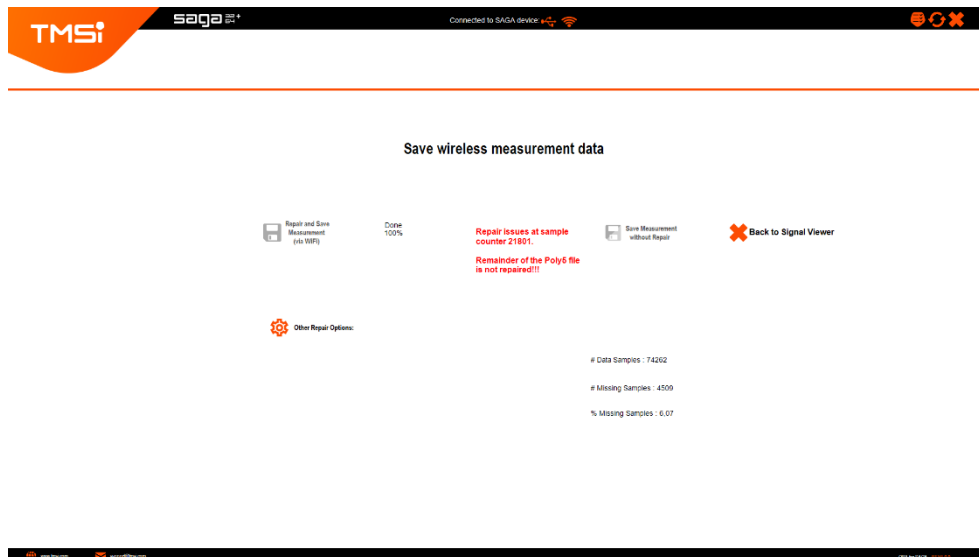


Figure 35: QRA screenshot - Repair failed due to loss of connection between Docking Station and Data Recorder.

An important difference between 'Data Repair' and 'Download full Recording' is the availability of Trigger data. In the Data Repair option, the locally stored file on the PC is combined with the data on the Data Recorder. The file on the PC contains Trigger data as this is recorded on the Docking Station. Hence, the combination of both files during Repair will contain data on Triggers that were recorded on the Docking Station. The 'Download full Recording' option can only save data that is stored on SAGA's Data Recorder. As no Trigger data is stored on the Data Recorder, the downloaded recording will not contain data on measured Triggers.

## 8 CARD RECORDING

On the Card Recording page, a card recording can be configured or a recording can be downloaded.

A card configuration or card download is only possible when the device is Docked. When the user tries to open the Card Recording page when the device is not Docked the user will get two options: (1) either to be redirected to the connection page and afterwards switch to the Docked interface or (2) to go back to the previous page from where the Card Recording button was pressed (Figure 36).

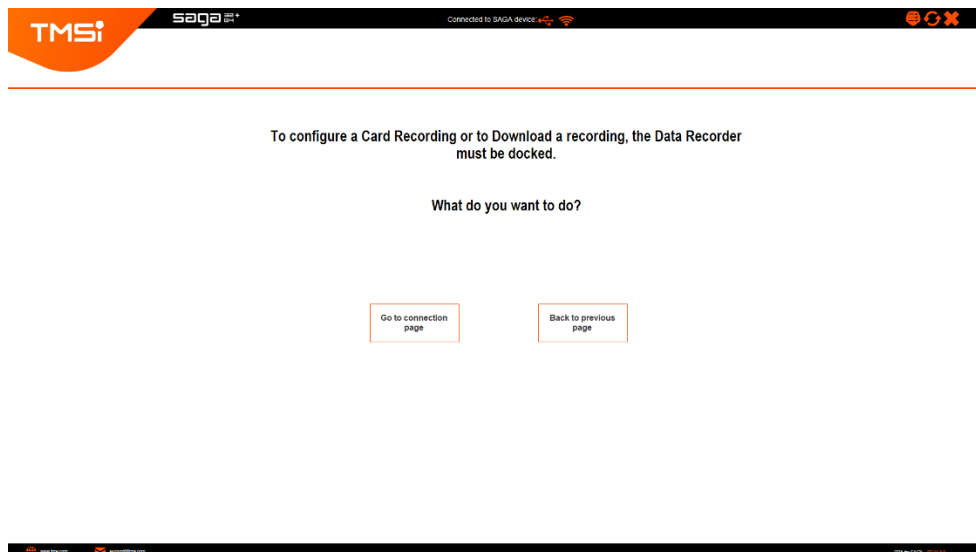


Figure 36: QRA screenshot - Card Recording message when device is not Docked

### 8.1 Download Recording

The Download Recording page (see Figure 38) can either be reached via the Start screen, via the Recording Check, via the Card Recording button, or via the repair option to get the full (unrepaired) file after measuring with the Wi-Fi interface. When it is reached via the Start screen, the Card Recording button or the Repair page, the user can always get back to the previous page. When it is reached via the Recording Check, the user can only press the 'Delete all recordings and go to settings' or 'Delete all recordings and disconnect' buttons. After pressing one of the two buttons, all measurements that are still on the device will be deleted when continuing (Figure 37).

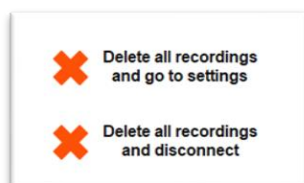


Figure 37: QRA screenshot (cut-out) – Delete recordings and continue to either settings or disconnect, after Recording check.

**WHEN CONTINUING TO THE CONFIGURATION OR CONNECTIONS PAGE OF THE QRA WITHOUT HAVING DOWNLOADED ALL THE AVAILABLE RECORDINGS, ALL THESE RECORDINGS WILL BE DELETED!**

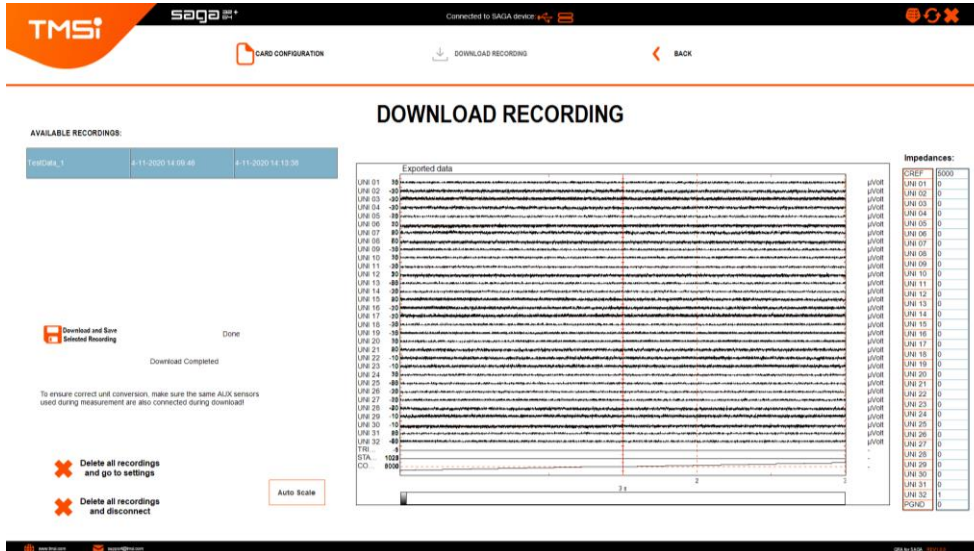


Figure 38: QRA screenshot - Download Recording page

The list below 'Available recordings' shows the recordings that are currently on the device. The filename that is shown in the left column can be defined by the user on the Card Configuration page, but in case of a download after a measurement in Wi-Fi mode, this column is left empty.

After selecting a file from the list (blue background) and pressing the 'Download and Save Selected Recording' button, the file will first be downloaded by the QRA and afterwards saved in the 'Documents' folder or the folder specified in the Data Manager as a Poly5 file. To ensure correct unit conversion, the AUX sensors used during measurement are also connected during download. A message is displayed that instructs the user to do so.

The process of downloading can take some time and therefore an indicator of the percentage of download is shown (Figure 39a). However, if a very large file needs to be downloaded, it can even take some time before the progress indicator changes from 0 to 1%. During the download process nothing else can be done with the QRA (all buttons, except for the Cancel button, are blocked). The download process can be cancelled by pressing the Cancel button and can be started again later. When the download process has been finished, the saving will start immediately (Figure 39 b-c). The progress of saving the recording is shown by displaying the amount of time of the recording that has been saved.

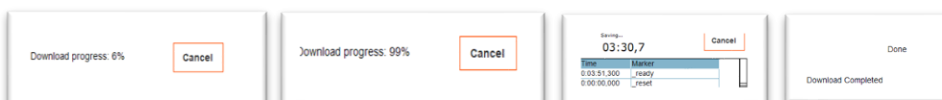


Figure 39: QRA screenshot (cut-outs) - (a) Download in progress, (b) Download (almost) finished, (c) Saving started, (d) Download process completed

After the download and saving process has been finished (Figure 39d), the data is shown in the signal viewer on the right. The Auto Scale button can be used to apply auto scaling on all visible channels at the same time. In the right table the average impedance values (over 30 seconds) are shown. These values are only collected when in the card recording configuration the prerecording impedance measurement is set to 'on'. Both the downloaded file as well as the impedance measurement values are saved in the 'Documents folder' or the folder specified in the Data Manager. The impedance values are stored in an ini-file with a filename ending with '.PreReclmpData'.

## 8.2 Card Configuration

On the Card Configuration tab, the user can set all the settings for a card recording (Figure 40). The user should first adapt the Measurement Settings by selecting the 'Settings and Channel Configuration' button, before making changes to the Recording timing or Subject info settings.

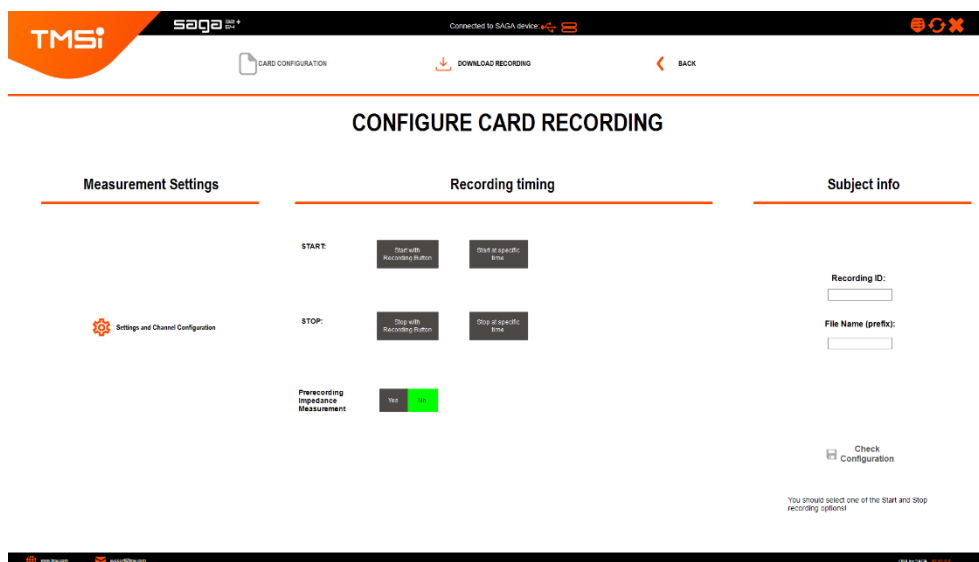


Figure 40: QRA screenshot – Configure Card Recording page

### Subject info

If Data Manager is used, under the tab 'Subject info' the details from the Data Manager (name and subject ID) are shown, otherwise this field is left blank.

The Recording ID and File Name can be specified by the user and will be used for the naming of the file that is shown on the Download Recording page and the filename of the downloaded data.

### Recording Timing

When the Configure card recording page is reached for the first time, no selection for the timing of a recording has been made. Before being able to save the configuration on the device, one of the two options (start via button or start at specific

time) should be selected. If no selection is made, the Check Configuration button is greyed out and the explanation is displayed below the button (see [Figure 40](#)).

When selecting one of the two 'start options', the corresponding 'stop option' will also be selected and vice versa (see [Figure 41](#)).

Figure 41: QRA screenshot - Specify start and stop recording time

When 'Start at specific time' is selected, the start and stop date and time are shown and can be edited by the user. By default, the start and stop date is the current date. The default start time is the connection time +1 hour and the default stop time is the connection time +1 hour and +10 minutes. The connection time is defined at the moment of QRA launch. Both the hours and minutes should be given as double digits, meaning that the input for 9.03 should be entered as *hh: 09, mm: 03*.

When Prerecording Impedance Measurement is selected, the impedances of the selected channels will be measured over the first 30 seconds of the measurement (after starting the recording). These values will be stored after download of the measurement file in a separate ini-file (see [Download Recording](#)).

## Measurement Settings

If no measurement settings and channel configurations are defined yet for the card recording, this can be done via the 'Settings and Channel Configuration' button. When accessing these from the Configure Card Recording page, the user cannot go back to the connections page and cannot go to the Signal Viewer or Impedance Check. When the user has finished the measurement settings, he can go back to the Configure Card Recording page by pressing the 'Save Settings and Back to Card Config' button on the Configuration page (see [Figure 42](#)). The maximum bandwidth for a Card Recording has been defined at 1.7 Mb. When the combination of channel selection and sampling rate leads to a higher bandwidth, a warning is printed below the bandwidth that is in use (see [Figure 42](#)). The user has to adapt the configuration to fall within the bandwidth constraints before being able to go back to the 'Configure Card Recording' page. The Bandwidth check will also be performed when the user

presses the 'Check Configuration' button (on the 'Configure Card Recording' page) and when the bandwidth is too high, the user is redirected to the Configuration page, where a warning is printed below the bandwidth that is in use.

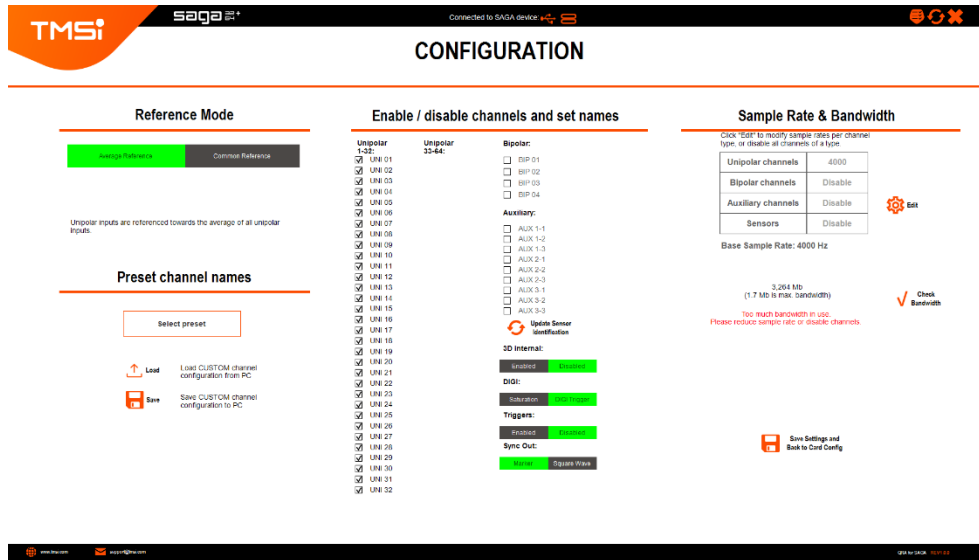


Figure 42: QRA screenshot - Bandwidth check and 'Save Settings and Back to Card' button in case of a Card Configuration

When the user is done with the card configuration, the user should press the 'Check Configuration' button, which provides an overview of the configuration settings as defined by the user (see Figure 43). Especially the recording timing should be checked; one of the two starting options should be 'on'. When all settings are correct, the user can press the 'Save this Configuration and disconnect' button. A new card recording configuration will then be set on the device and the user is redirected to the Start screen, where the user can choose to completely close the QRA and start a recording later (either automatically or by pressing the recording button) or connect to SAGA again. If the user still wants to change something to the configuration, the user can press 'Back' and the Configure Card Recording page will be shown again.

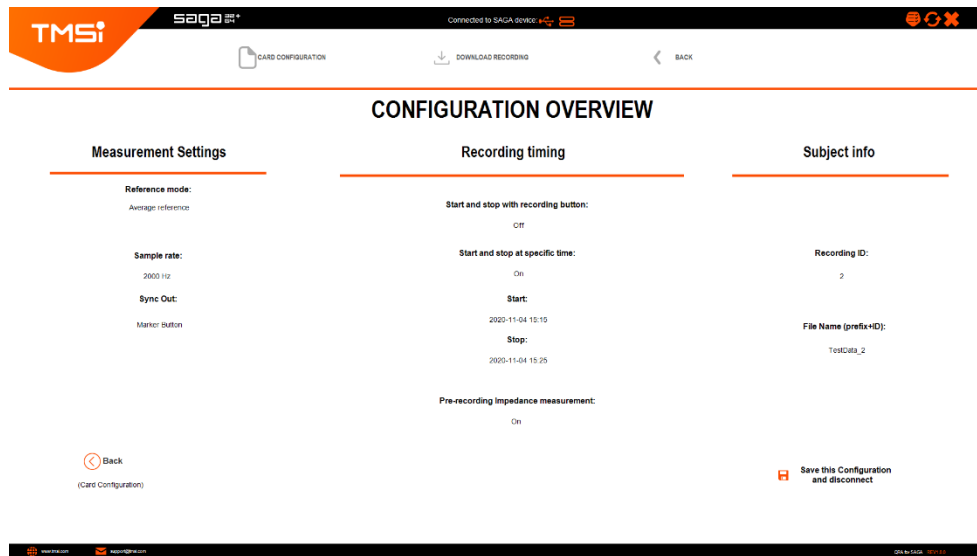


Figure 43: QRA screenshot - Configuration Overview page



## 9 RECORDING AND CONFIG CHECK

Going through the different steps of the QRA flow will set new parameters and settings to the SAGA device, which in turn deletes all the previous settings, including card configurations and recordings. Therefore, before continuing after a connection has been made, the QRA performs a check whether there is still a card configuration or a card recording on the device.

The Card recording check and the Card configuration check are explained in the [Start screen](#) section of this document.

## 10 STATUS, RESET AND EXIT

At the upper right corner, three buttons, representing 'Status', 'Reset' and 'Exit' respectively, are shown (Figure 44). These buttons can be selected at all times, except during recording, repair or download.



Figure 44: QRA screenshot (cut-out) - Status, Reset and Exit buttons respectively

### Status

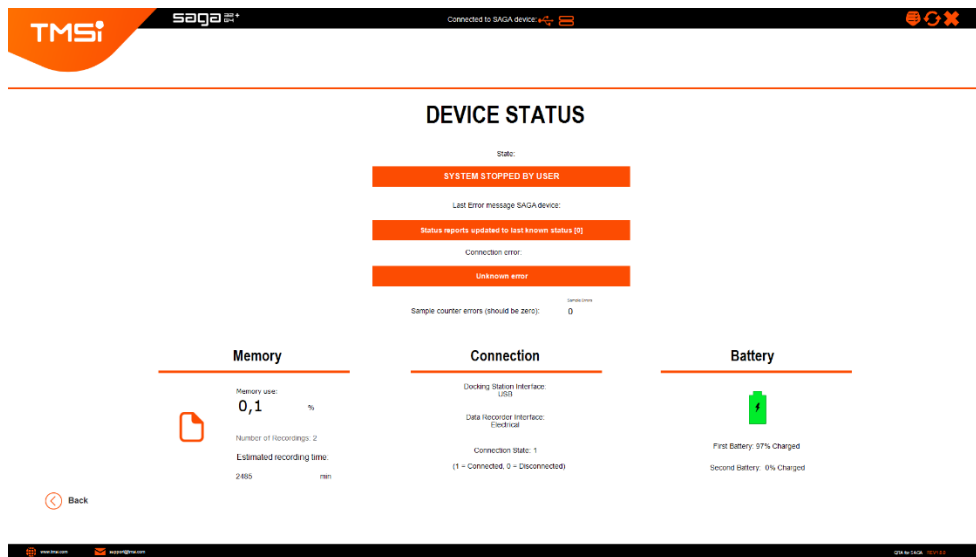


Figure 45: QRA screenshot - Status page

The status page provides an overview of the current status of the SAGA device (Figure 45). In the three orange bars, the current state message generated by the QRA, the last status message provided by the SAGA and the last error code given by the SAGA device are shown. Below the orange bars, the sample counter errors are shown. This value should always be equal to zero.

On the Memory tab, the percentage of memory on the card that is currently being used is shown. Based on this percentage and the current bandwidth in use, the estimated recording time is calculated. Furthermore, the number of available recordings is displayed in the Memory tab.

On the Connection tab, the Interface types for both Docking Station and Data Recorder are shown, as well as the current connection state (connected or disconnected).

On the Battery tab a battery level indicator is shown and the percentage charge of both batteries is given.

The user can leave the Status page by pressing the 'Back button.

## Reset

When pressing the reset button, the Reset page is shown. The user can choose whether to reset the QRA or to return to the previous page (Figure 46).

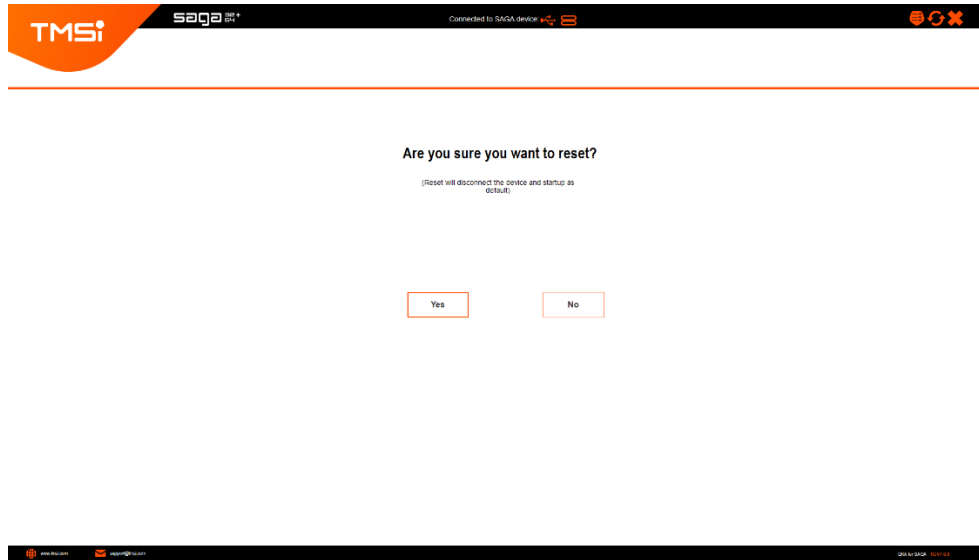


Figure 46: QRA screenshot - Reset page

Resetting means that all settings will be reset to the last saved settings, SAGA will be disconnected and the user is redirected to the Start screen.

## Exit

When pressing the exit button, the Exit page is shown and the user can choose whether to exit the QRA or to return to the previous page (Figure 47).

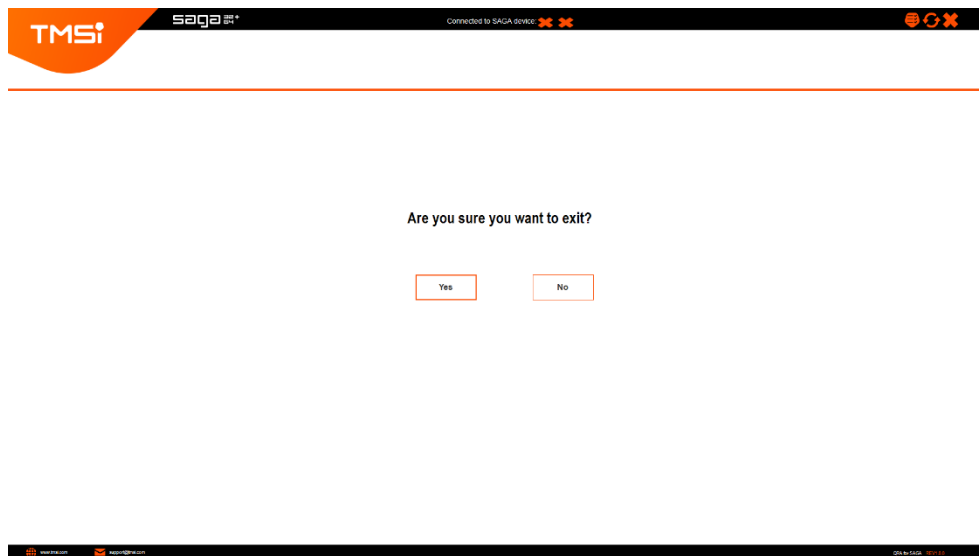


Figure 47: QRA screenshot - Exit page

When Exit is chosen, SAGA will be disconnected, if this wasn't done yet, and the QRA will be closed.

## 11 DATA MANAGER

The QRA can be opened as a stand-alone application or in combination with the Polybench Data Manager.

When selecting 'Designer active' in Data Manager, the user can still access the Polybench code by using the Escape button, but no changes can be made directly, because the QRA is made read-only (Project → Project Properties → Advanced → Read only = true).

All subject information that has been set in the Data Manager is sent to the QRA. In the menu bar the subject ID, the name and notes on the subject are shown (Figure 48). The information can be updated by pressing the orange 'Refresh' button.



Figure 48: QRA screenshot (cut-out) - Data Management details

The same details are also used when configuring a Card Recording (see [Subject info](#)), except for the notes on the chosen subject.

## 12 CHANGELOG

December 3<sup>rd</sup>, 2020 – Initial Release QRA for SAGA 1.0.0.

December 17<sup>th</sup>, 2020 – Changed legend of the impedance viewer in QRA for SAGA 1.1.0 to better reflect impedance values of 500 k $\Omega$  (and higher).

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