Guideline Geo

MALÅ MIRA Controller

User Guide

Our Thanks...

Thank you for choosing Guideline Geo and MALÅ! The very core of our philosophy is to provide our users with excellent products, support, and services. Our team is committed to providing you with the most efficient and easy-to-use solutions to meet your efficiency and productivity needs.

Whether this is your first MALÅ product or an addition to the MALÅ collection, we believe that a small investment of your time to familiarize yourself with the product by reading this manual will be rewarded with a significant increase in productivity and satisfaction.

Please let us know about your use and experience of our products and the contents and usefulness of this manual. We're excited to be part of your journey!

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Preface

About this Manual

This manual is written for the product's end user, explains how to set up and configure the product, and provides detailed instructions on its use.

Additional Resources

Training: https://guidelinegeo.com/help-center/training/

Downloads: https://guidelinegeo.com/help-center/resources/

Applications: https://guidelinegeo.com/applications/

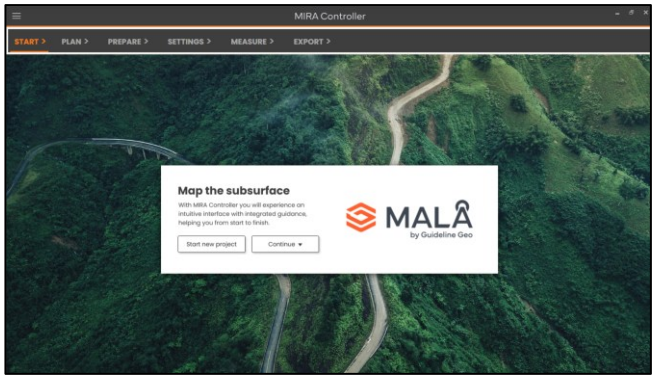
Feedback

Feedback regarding the contents of this manual or the product may be sent using any of the contact details found at www.guidelinegeo.com.www

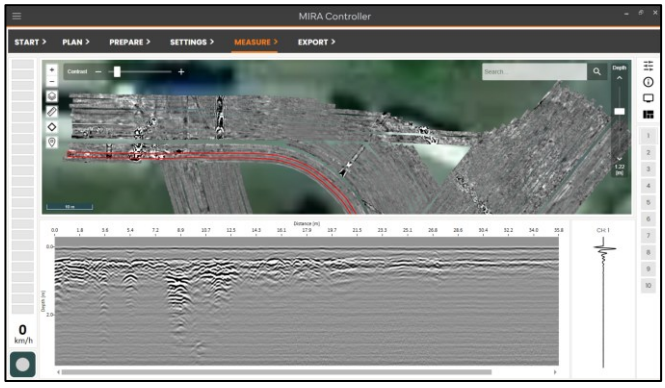
About MIRA Controller

MALÅ MIRA Controller is the data acquisition software dedicated to the MALÅ MIRA HDR, MIRA Compact and MIRA Flex systems from Guideline Geo.

The MIRA Controller software gives you an easy-to-use user interface, data collection guidance with several different positioning options, file management, and other vital features. Projects can be exported to MALÅ Vision Desktop for post-processing and interpretation (for further information, see the *MALÅ Vision Desktop User Guide*).









Installation

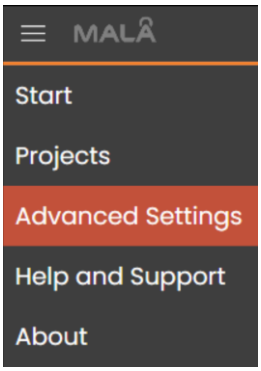
The MIRA Controller software is downloadable from the Guideline Geo´s homepage (www.guidelinegeo.com). Always make sure to use the latest version of the software.

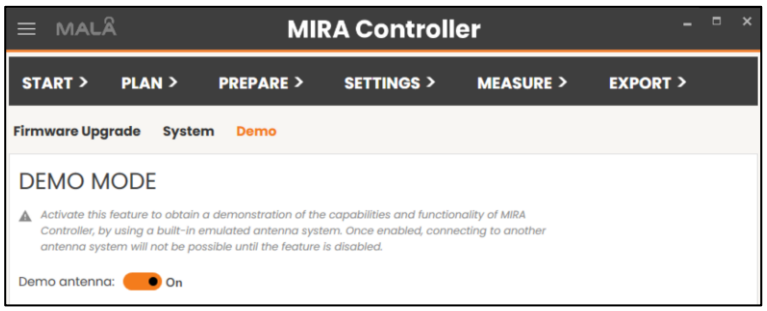
When downloading a new software version, note that different warnings may occur depending on the browser. For Microsoft Edge, you need to press the Keep link to save and see the file in the My Downloads folder.

When using Bluetooth devices (such as different GNSS antennas) with a computer running Windows 11, you need to set the Bluetooth devices discovery option (in the Bluetooth & Devices menu) to Advanced.

Note: Make sure to install MIRA Controller on a local folder on your computer and NOT on cloud synced folder as for example OneDrive.

Note: The software can be run in Demo mode. To change to Measurement mode, go to Advanced Settings' main menu and turn off the Demo antenna to enable measurements.





The software runs on Windows 10 or 11, and it is recommended to have a modern processor, i5 or later and at least 8 GB RAM. Depending on the settings, the MIRA HDR and MIRA Compact systems collect approximately 550 kb data/m2.

Overview MIRA Controller

This manual (together with the *MALÅ MIRA HDR User Guide, MALÅ MIRA Compact User Guide* or *MIRA Flex Integration Guide*) explains how to set up the measurements with the MIRA HDR, MIRA Compact and MIRA Flex antenna arrays, how to collect data and how to save and export this to a suitable format. Viewing the radargrams and traces collected from all channels during data collection is also possible.

The user interface of the MIRA Controller is developed to be easy to handle during fieldwork and to work on a computer with or without a touch screen. The workflow is straightforward and consists of the following steps:

- Ensure the MIRA HDR, the MIRA Compact antenna box or the MIRA Flex system is turned on and connected to the data acquisition platform.

1. Create a new project (with name and type) or open an existing project.
2. Check the measurement settings (different acquisition options, channel selection and trigger type).
3. Check the positioning (GNSS and Total Station parameters).
4. If needed, check the Advanced settings (trace position, geometry settings, power settings)
5. Now, you are ready to measure.

Note: Ensure the field computer is started before connecting a GNSS with a serial cable.

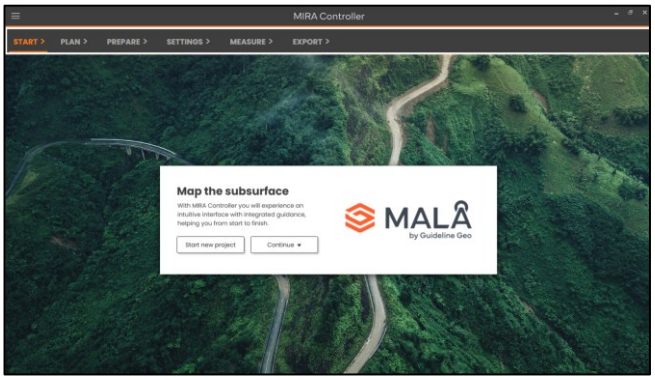
The following definitions are used in this User Guide:

Sample	Digital value of recorded radar signal at one specific time.
Trace	The recorded radar signal from one channel at one point, built up over a short time by a certain number of samples.
Point distance	The distance between each trace collected for all individual channels.
Stacks	The number of averages for each trace.
Swath	One complete profile line, including all channels in the array. Every swath's coverage depends on the individual channel spacing multiplied by the number of channels.
Tx	Abbreviation for a transmitter antenna.
Rx	Abbreviation for a receiver antenna.

Start the software

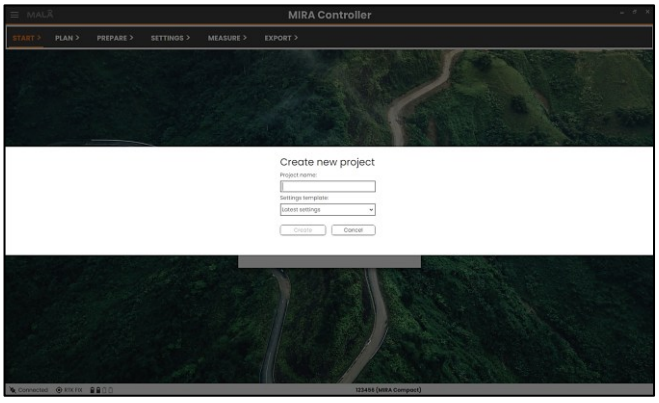
When you start the MIRA Controller, you are asked to Start a *new project* or to *Continue* a project.

You can return to the *Projects* menu (found in the Main menu) to change, create, or delete projects. See also the *Projects* section below.



Start new project

The *Start New Project option creates a new MIRA project with your own defined project name and the* possibility to choose between different pre-defined settings or the last used setting. If you have saved a template, it can also be found in the dropdown list (see section *Projects* below). Choose a suitable antenna setting for your MIRA system (MIRA HDR, MIRA Compact or MIRA Flex).



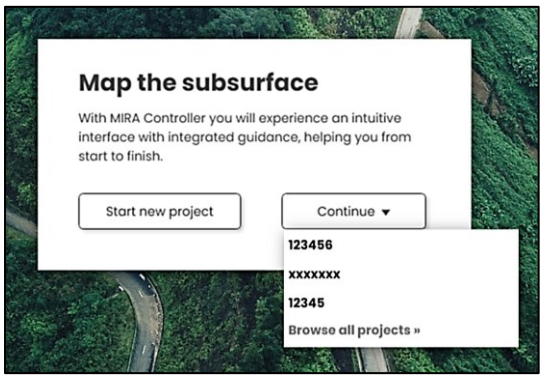
When you press Create, you will immediately reach the Prepare tab. See section *Prepare* below.

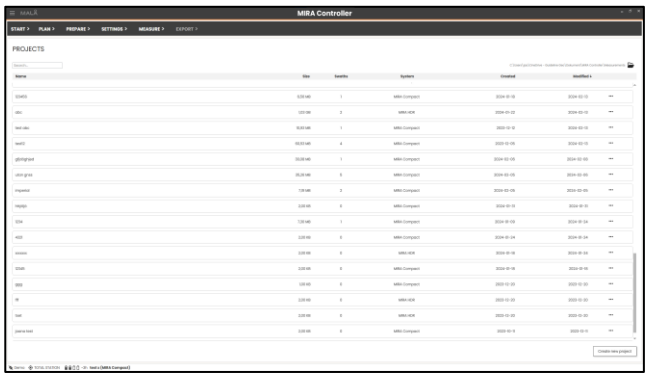
Note: If the project name already exists, you will receive a warning message.

Note: The project name is also used for the separate, single swaths in a project, but with an extension: 1, 2 and so on.

Continue

When choosing the option *Continue* project, you can choose to open an existing project. The latest three are visible in the drop-down menu; otherwise, *Browse all projects* to open the Projects tab. This can also be found in the Main menu ☰.

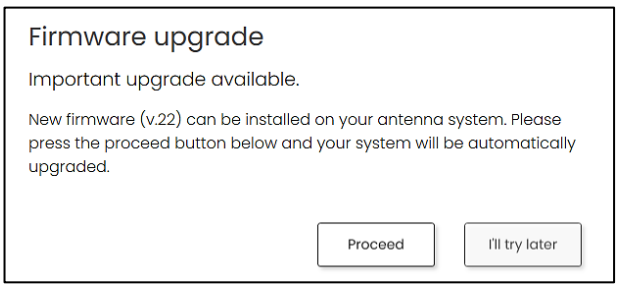




Click on the correct row, and the project will immediately open where you last left off.

Update pop-ups

If a new version of the MIRA Controller software or the firmware for the antenna box is available a pop-up will show when the system is up and running. Please make sure to install the latest version of the MIRA Controller software and read more on firmware upgrade in Section *Advanced settings*.



Main Screen

Workflow tabs

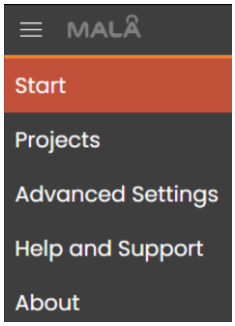
It is recommended to follow the workflow in the upper row of the MIRA Controller software, from left to right, throughout any of your MIRA projects:



See sections *Plan*, *Prepare*, *Settings*, *Measure* and *Export* for more information.

Main menu

The main menu is in the left upper corner, from where you can reach, e.g., Help and Support:



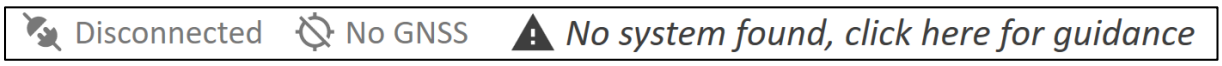
Status bar

At the bottom of the main screen, in the status bar, system information is displayed.

From left to right, the following information is displayed:

- Connection to MIRA system, active or not
- GNSS or Total Station connection and status
- Battery status and remaining battery time
- Guidance (if applicable)
- Project name and template
- Selected swath number

Example when no antenna or positioning system is connected:



Example with antenna and RTK GNSS connected:



Your antenna name will show up on the left hand side as well as used positioning and battery capacity.

The status bar's centre displays the project name and swath number. By pressing the arrow, you can switch between swaths.



MIRA Controller Function keys

- F1 - opens About page
- F2 - toggles to the Main menu
- F3 - starts measurement
- F5 - stops measurement
- F9 – F11 toggles the different views in the measurement tab.
- ALT+arrows up/down - switches between channels
- Press Spacebar to start and stop measurements

File Directory

MIRA Controller creates a file directory in the Documents folder, called MIRA Controller. This file directory contains a folder called Measurements, where all the projects created can be found.

The location of this folder can be changed, in the Project menu. You can also open data from other locations by changing the file directory route in the Project window; see the *Projects* section.

Note: It is advisable to check that the measurement folder is NOT a cloud synced folder (as OneDrive, GoogleDrive, DropBox). The operating system of the computer might interfere with the data capturing, when trying to keep the data synced in a cloud.

In detail, the following file folders and files are created by MIRA Controller:

1. Measurement folder

2. For each project, a project folder is created. In that folder, a <project_name>.yml file and a <project_name_backup>.yml file are created that contain all information related to the project (channel selection, channel settings and everything else). These files can be opened in a simple text editor such as Notepad.

3. For each measurement, the following files are created per swath:

- < project_name >_<swath>.YML (snapshot of system settings when measurement was done)
- < project_name >_<swath>.mpos (if the positioning is available, it will contain raw GNSS positions for the measurement stored in GeoJSON format)
- < project_name >_<swath>.mcor (if the positioning is available, it will contain the interpolated GNSS positions in GeoJSON format)
- < project_name >_<swath>.mtts (if the positioning is available, it will contain the timestamps for all traces)

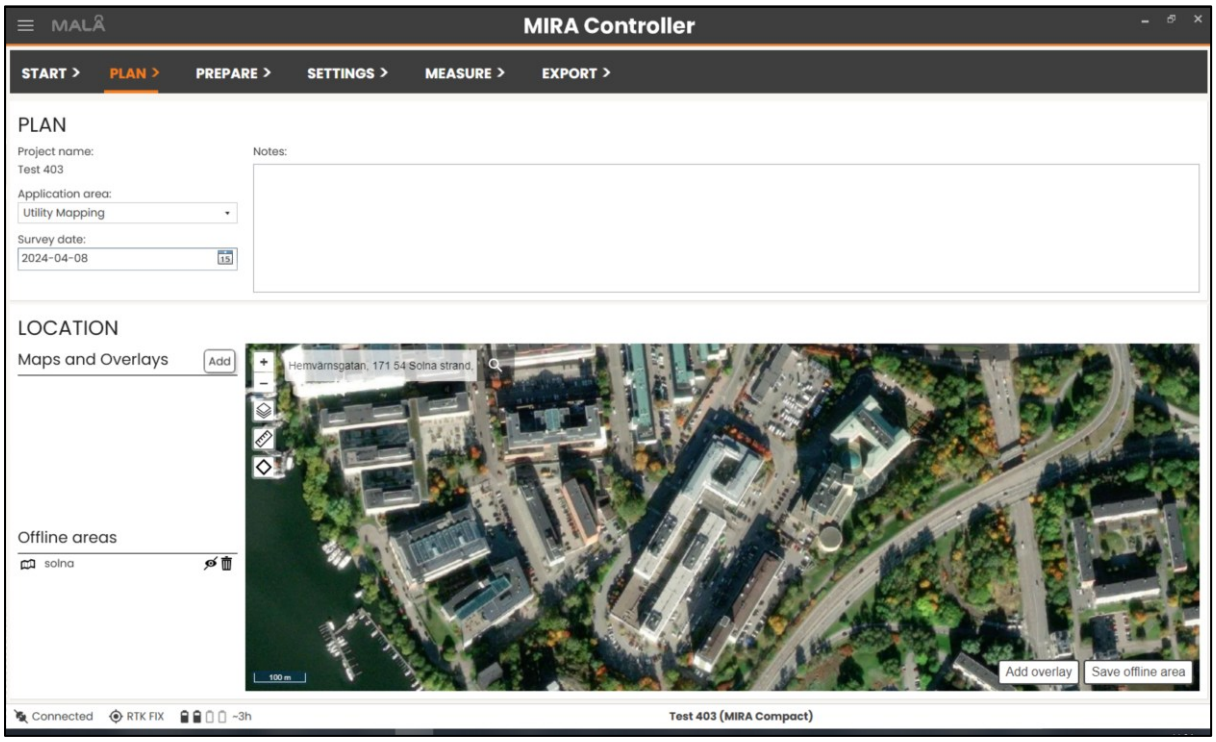
The following files are created per channel:

- < project_name >_<swath>_<channel>.rd8 (raw GPR data)
- < project_name >_<swath>_<channel>.rad (information on channel settings)

4. If data are exported to another format (as e.g., to rSlicer format), a folder is created to store all files in that export.

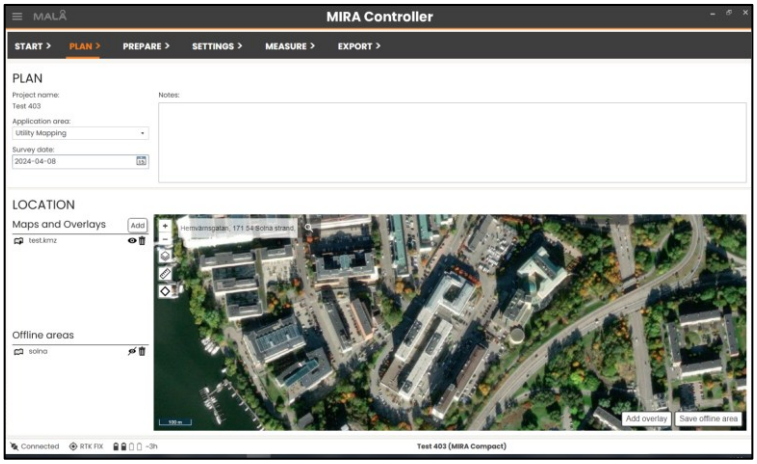
Plan

The Plan tab is used to plan the project. You can enter notes on the projects, set the application and date. You can also save maps in offline mode, or upload kmz/kml-files. In the map view, use the search window (upper left corner) to search for your location (street address, city, etc.).



Press *Add overlay* (in the lower right corner of the map) to upload a kmz/kml-file, which will be shown on the map.

This could be the limitations of the investigation area or other features that are good to have marked during fieldwork.



When overlays are uploaded, use ◇ to toggle the layers on and off.

You can also use the option *Save offline area* to save the map at the zoom level seen. This map can be named freely and saved for use off-line.

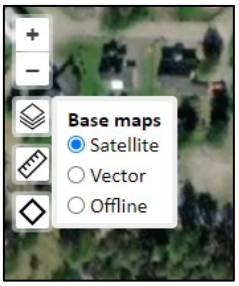
Note: The *Save offline area* button is greyed out if the area is too large to be saved. Zoom in, in the map view, until the button becomes active to save.

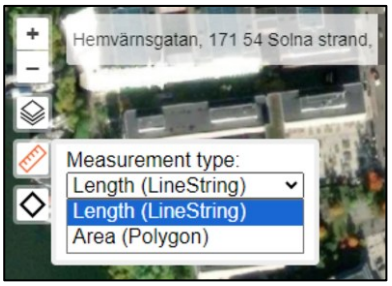
The map has the following features:

- Zoom 
- Change between offline or online base maps 
- Measure Line strings or Polygons 
- Turn kmz/kml-files on and off 

The layer switcher (in the *Plan* or *Measure* tab) allows for selecting whether to display the offline or the online base map.

The ruler can be used to both measure the lengths and size of areas.

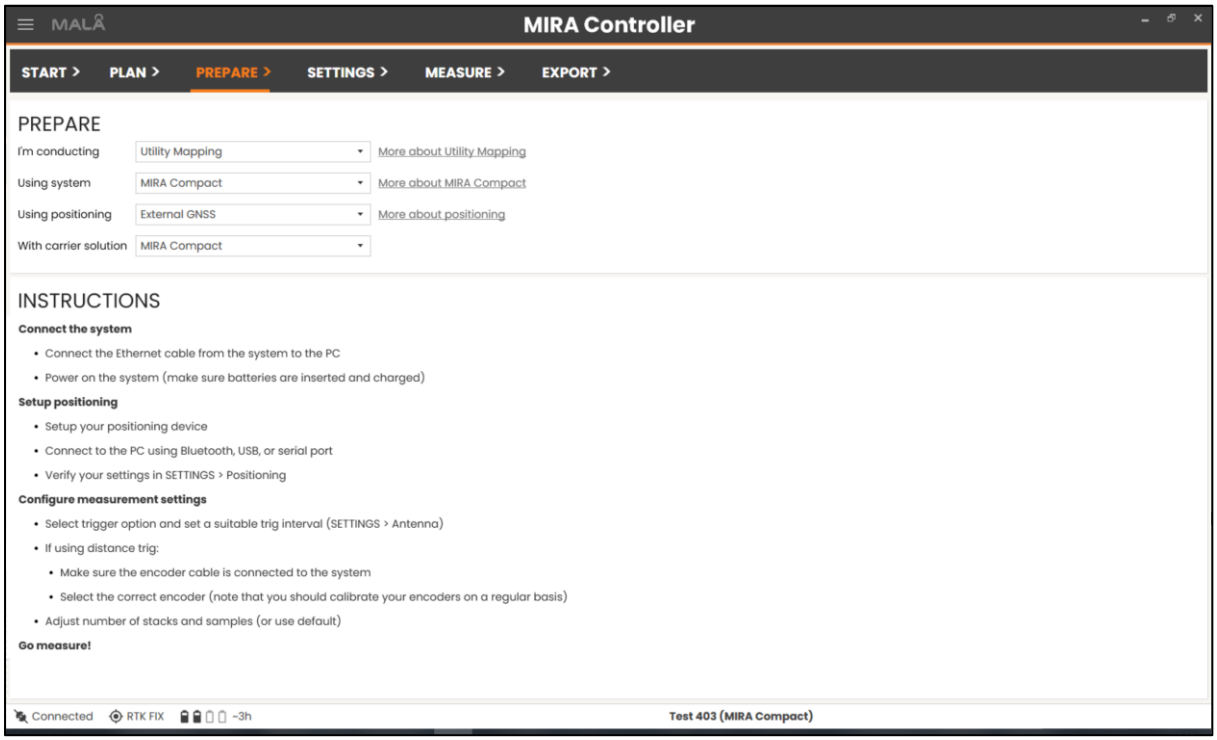




Prepare

In the Prepare tab, you can define what type of project you are doing and, by that, get guidance on suitable measurement settings.

Instructions for the setup are based on the selected system and are also available to make sure all necessary steps are carried out for successful investigations.



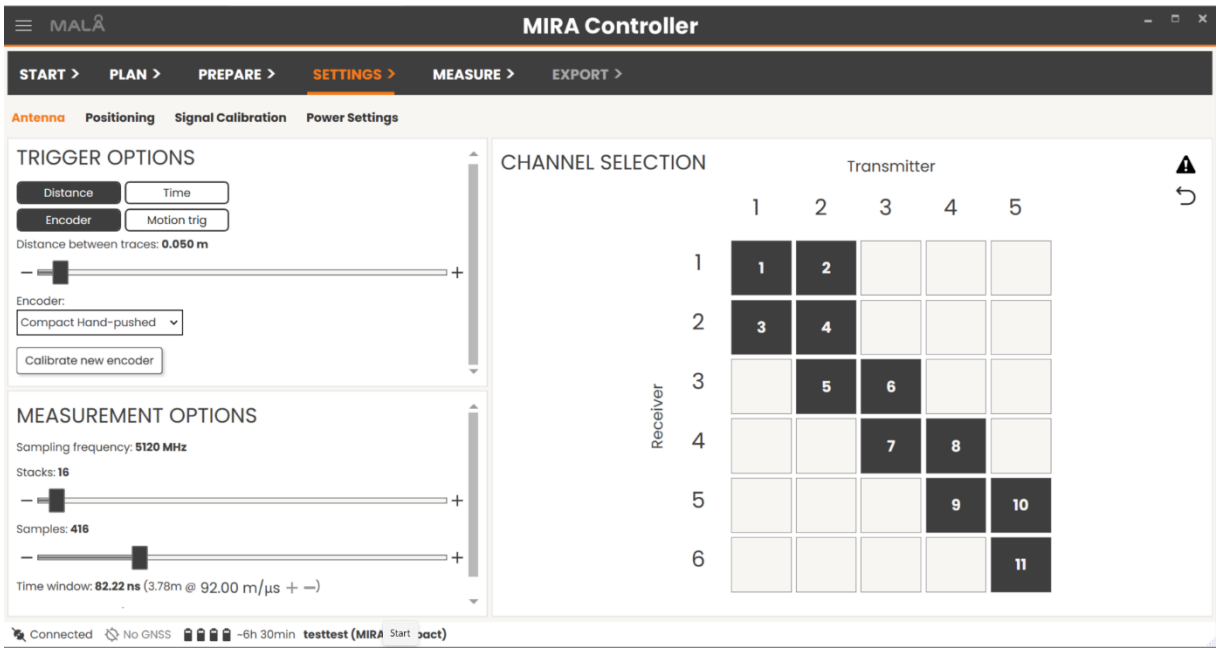
Settings

You can adjust measurement settings for the MIRA system and the external positioning device in the Settings menu.

Antenna **Positioning** **Signal Calibration** **Power Settings**

Antenna

In the Antenna tab, you will find measurement options for triggering, encoders, measurement settings, and channel selection.



Note: You can have different settings for different swaths measured within the same project. However, mixing different settings while measuring might impact the post-processing capabilities.

The warning triangle (upper right corner) is shown if the settings have changed since the last measurements made in the open active project. This indicates the signal position must be calibrated (see section *Signal Calibration*).

Trigger Options

The MALÅ MIRA systems can be trigged with *Distance*, *Time* or *MALÅ Motion Trig* depending on the MIRA system used.

For *Distance*, choose the *Distance between traces* and the correct encoder in the drop-down menu. If a new encoder is needed, or a re-calibration must be carried out, use the option *Calibrate new encoder*, which will guide you through some easy steps to calibrate and save a new measurement wheel.

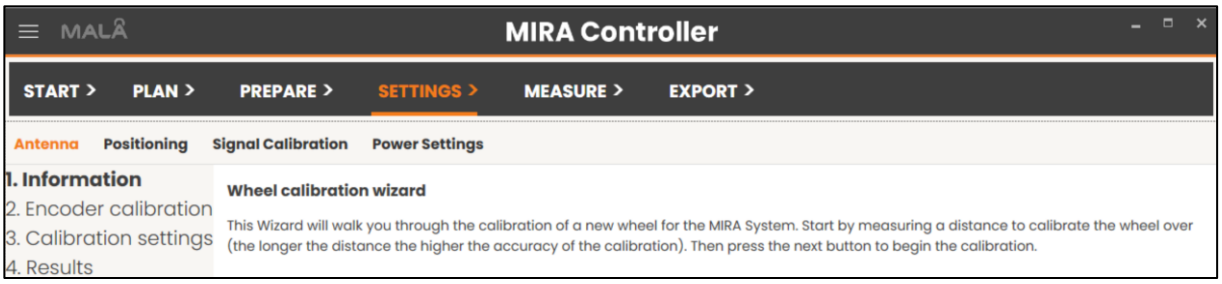
For the *Time* triggering option, set the *Time between traces*.

The *MALÅ Motion Trig* option (available for MIRA Compact and MIRA Flex users) utilizes the movement of the internal GPS to trigger the data collection, giving equidistant traces without encoder wheels being connected to the antenna. You set the wanted distance between the traces.

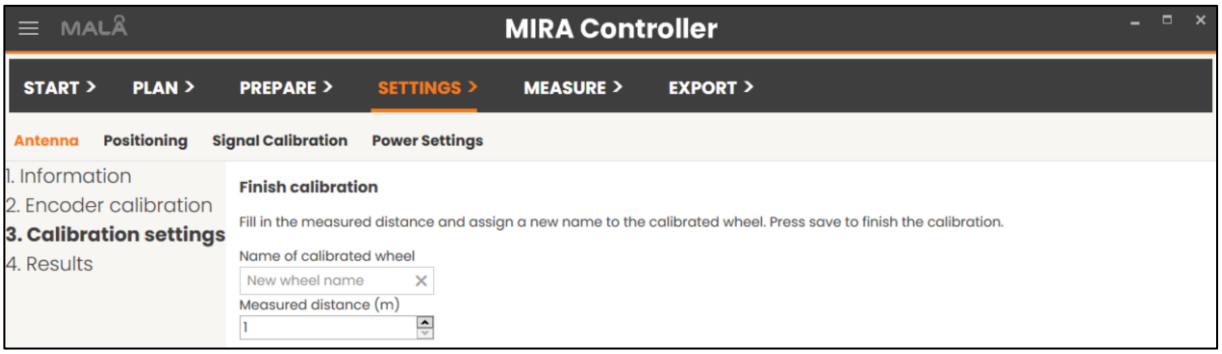
Note: See Appendix 1 for more information on the use of MALÅ Motion Trig.

Note: MALÅ Motion Trig and Time trigger independently of the direction of movement. To ensure correct positioning of the recorded data, maintain a constant travel direction throughout each swath. If the travel direction changes between swaths, the travel direction setting must be updated accordingly on the Positioning settings page.

The steps to calibrate or add a new encoder are as follows:







Note: While carrying out an encoder calibration, you must be connected to your MIRA system.

Measurement Options

- Sampling Frequency: A fixed value optimized for the antenna frequency used.
- Stacks: How many times each trace is to be stacked; higher numbers give better data quality but will lower the maximum acquisition speed.
- Samples: How many samples are collected for each trace.
- Time window: For current settings, adjust the velocity (with the + and – signs) to get the estimated depth value.

Note: The maximum measurement speed is shown for the current settings when using distance triggering.

Depending on the number of Tx units used in the array, the number of available samples will change, as below:

- 1-4 Tx: 1984 samples
- 5-8 Tx: 1728 samples
- 9-16 Tx: 672 samples

Channel Selection

The operator selects how the radar antenna array should be set up in the channel selection matrix to collect data, but we highly recommend to only use the standard default settings for the different MIRA systems. See different standard settings below.

The user can define a firing sequence by clicking on the matrix squares, turning them grey and displaying the channel number assigned to that combination of Tx (columns) and Rx (rows). This sequence of Tx-Rx combinations is repeated every time a measurement is triggered.

Note: This option to activate all channels is primarily intended to provide flexibility for advanced users, testing, and research applications, and to expose the full hardware capability without imposing artificial software limitations. For routine surveys, however, the recommended channel configurations represent the best option, for data quality, acquisition efficiency, and processing reliability.

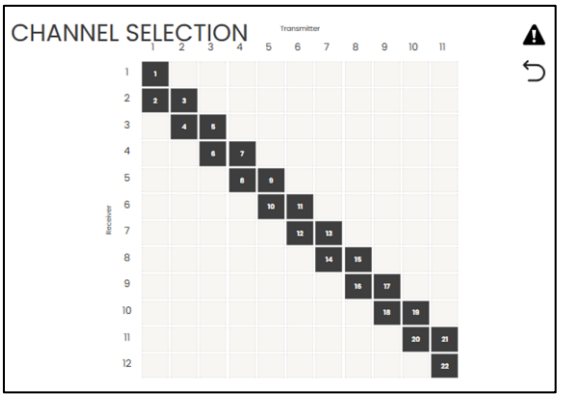
Note: The current post-processing software, MALÅ Vision Desktop, does not support importing projects acquired with shooting table layouts other than the standard configuration, which further limits the practical implementation of this approach.

Note: Activating a large number of channels reduces data acquisition speed. Achieving sufficient resolution typically does not require more than the recommended number of active channels. Increasing the number of channels leads to substantially larger file sizes, affecting both acquisition systems and post-processing computers.

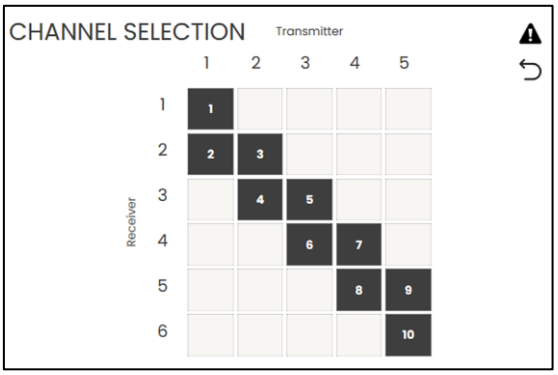
Note: If an antenna combination is red (instead of grey), it indicates that an antenna used in that combination is not working correctly.

The default channel configurations for MIRA HDR MIRA Compact and MIRA Flex antennas are shown in the pictures below. These are also provided within the software at purchase.

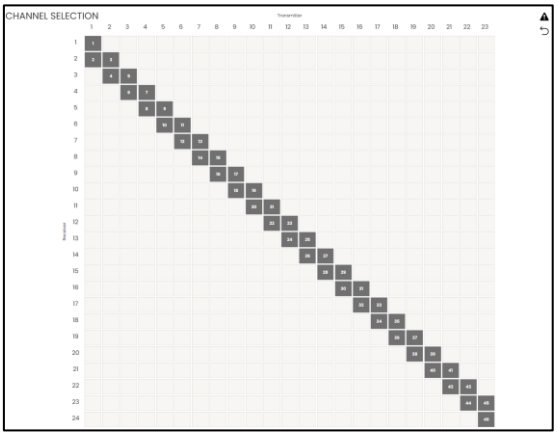
The default MIRA HDR setup: 22 channels with 11 transmitters and 12 Receiver antennas.



The default MIRA Compact setup: 10 channels with 5 Transmitters and 6 Receiver antennas.



The default 46-channel MIRA Flex setup: 46 channels with 23 Transmitters and 24 Receiver antennas.



To get back to the default settings use  in the upper right corner.

Positioning Menu

The MIRA antenna is positioned with an external GNSS system such as an RTK-GNSS or a Total Station.

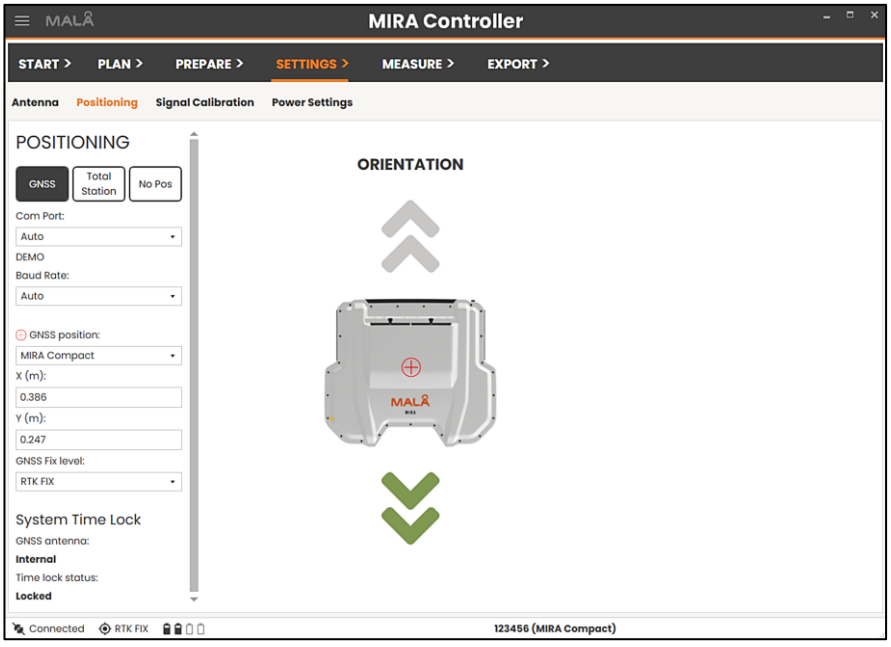
It is highly recommended that an accurate GNSS solution or a Total Station be used to position the MIRA measurements, as this will increase the quality of the resulting time slice images. The GNSS or Total Station, is connected to the computer used for data collection.

Note: The external GNSS should have an output frequency (output rate) of at least 5Hz (one point every 0.2 sec) but not more than 10-20 Hz.

MIRA Controller reads standard NMEA data, specifically G*GGA messages, from the connected GNSS/TS. It will, by default, discover the COM Port settings automatically to enable communication between the GNSS/TS and the MIRA Controller software. If you wish to manually set the Com Port and Baud Rate, use the drop-down menus to change from Auto to your preferred setting.

INGGA messages are also supported. More information on the positioning files is found in Appendix 1 Positioning.

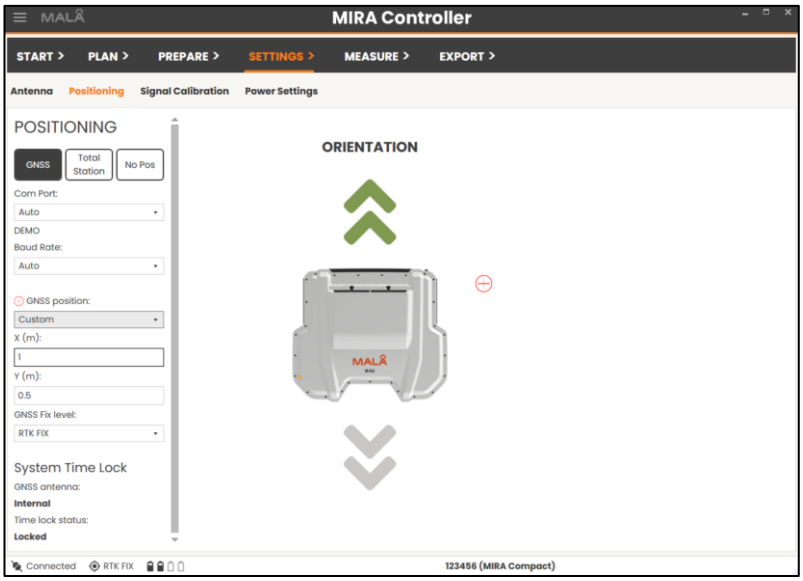
Warning: If the computer you are using for MIRA Controller and data collection has an internal GNSS, this must be turned off, as it can prohibit and interfere with the external positioning device used for the MIRA Compact. Please turn off the computer GNSS through the BIOS settings.



Acceptable *GNSS Fix levels* can be set as:

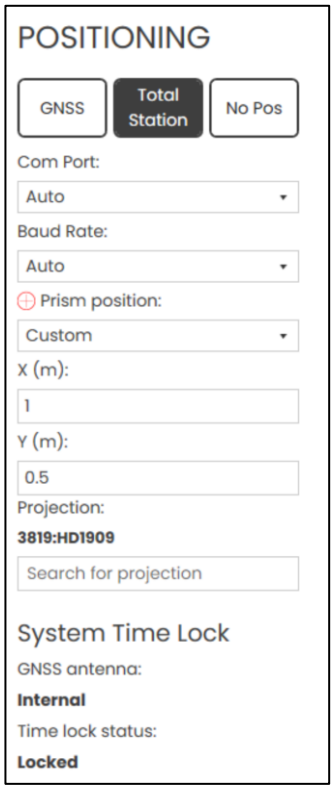
- *RTK FIX*, best quality, should be used during measurement
- *RTK Float*, positioning is of ok quality
- *GPS*, positioning is of poor quality

The *GNSS position* has several pre-sets for the MIRA Compact and MIRA HDR systems. If you use any other GNSS position or the MIRA Flex system, choose Custom and add the correct values. The red cross on the antenna box picture in the Positioning tab will show the location of the set GNSS position.



Example with a custom GNSS position

The *GNSS position* measurements are defined as the distance from the GNSS antenna's reference position (usually marked on the GNSS antenna itself but check the supporting documentation for your system) and the positioning reference point on the MIRA system. More information on the positioning reference point is found in Appendix 2 *Reference point* and the systems hardware user guide.



The system automatically recognizes the Com Port and Baud Rate for communications for the Total Station and the GNSS, or it can be selected from the drop-down menus.

The *Prism position* is defined similarly to the GNSS position; see above.

To fully utilise the positioning support in the MIRA Controller, a total station setup must be completed before measurements are started.

Once this is done, the projection for the used coordinate system can be selected in the MIRA Controller (*Projection*). This can be done by searching for the projection in the intelligent search box, which allows searching by EPSG code or projection identifier.

Note: The option *No Pos* (No positioning) should only be used for testing.

Note: The measurement orientation is forward or backward (i.e., push or tow) by choosing the correct arrow in the picture (green indicates the desired direction). This needs to be set correctly to position the entire swath accurately.

Signal Calibration

In the Signal Calibration tab, you can adjust the time zero position.

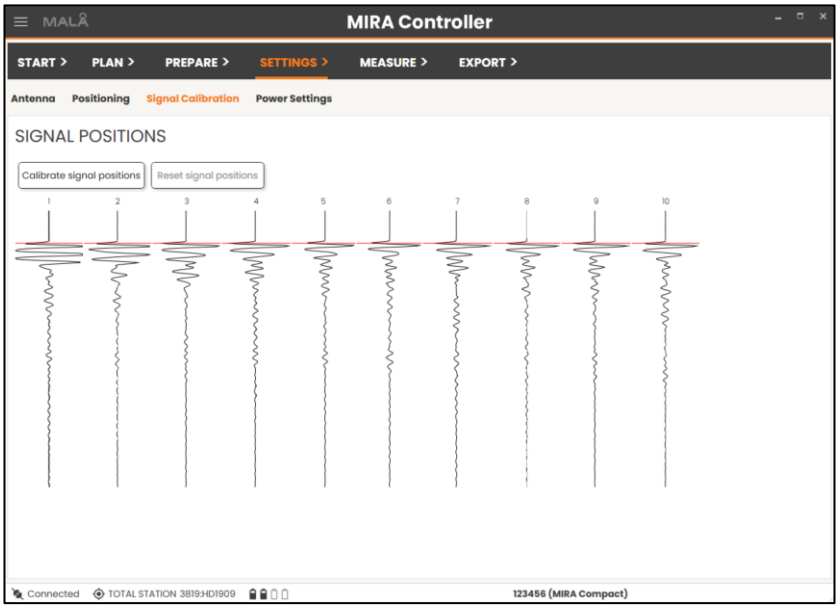
Note: We recommend reviewing the time zero levels before starting a measurement and performing the adjustment when necessary.

Correct time zero (first arrival) for all active channels is essential for accurate measurements, particularly when operating multi-channel systems. Before starting each survey, the time zero must be checked for all active channels and adjusted if necessary. To verify the time zero settings, open the Signal Calibration view and examine the red horizontal line running across the signal traces (see image below). This line indicates the current time zero position for each channel. The red line should align with the first arrival of the signal in each trace. If the red line does not align with the first arrival in one or more traces, signal calibration must be carried out to correct the time zero positions before starting the survey.

When running signal calibration, ensure that the system is positioned on a relatively flat surface. To achieve accurate calibration results, avoid placing the box directly on metal objects or surfaces, such as manhole covers or reinforcing bars (rebar), as these can interfere with the calibration process.

To assist the operator in aligning the trace positions, MIRA Controller provides the following commands:

- *Calibrate signal positions.* MIRA Controller automatically adjusts the time zero for all channels activated in Channel selection (see section *Antenna*), aligning the first arrival to the same reference position across the active channels.
- *Reset time zero positions.* Resets the time zero positions to the last stored/saved values.



An example of good signal positions, with the same time zero level, is indicated by the red lines.

Power Settings

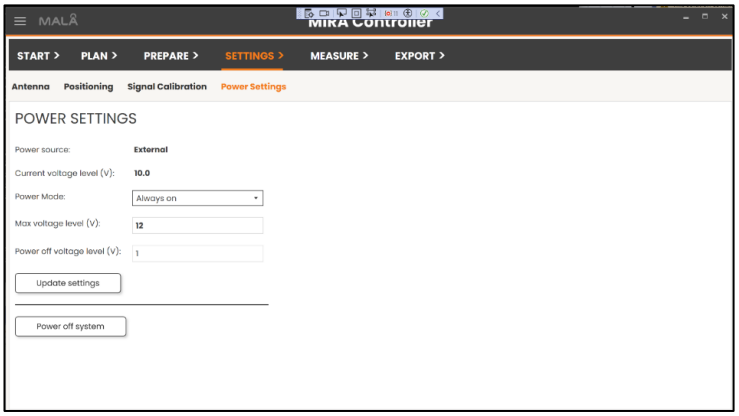
If using a system with an external power source, the power settings are essential to get accurate power status information and warnings.

In this tab, you can also power off the system remotely.

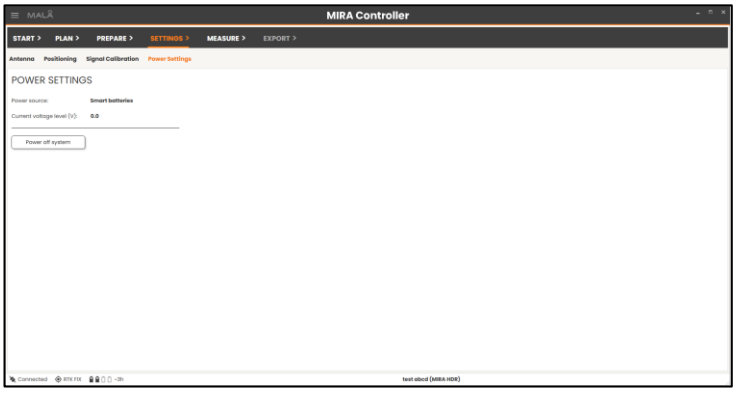
MIRA HDR

- *Power Mode*: Choose *Always On* or *Power Off at the voltage level*.
- *Max voltage level*: Enter the maximum voltage level in volts for the power source used. This affects the battery level displayed in the status bar.
- *Power off voltage level*: decide which battery level (mV) the system should be turned off. This setting can prevent draining, especially car batteries, to too low voltage levels.

When changes are made, press *Update settings* to send the new information to the MIRA system.

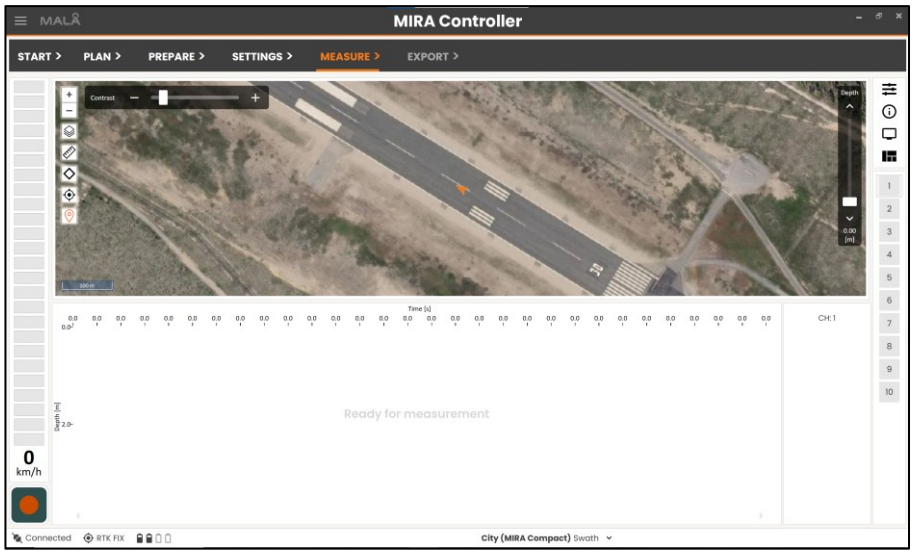


MIRA Compact



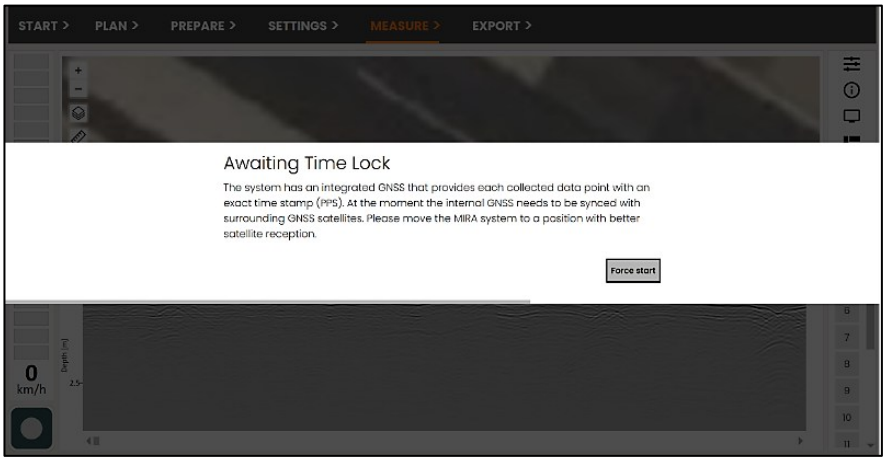
Measure

When all settings are done, choose the *Measure* tab. In the *Measure* tab, you can display the GPR data, the map, and a trace or just one of these (more information on how to adjust this is available below).



Press  to start the measurement of a swath.

The system waits for a good and accurate GPS position before it starts (or ends) a measurement.

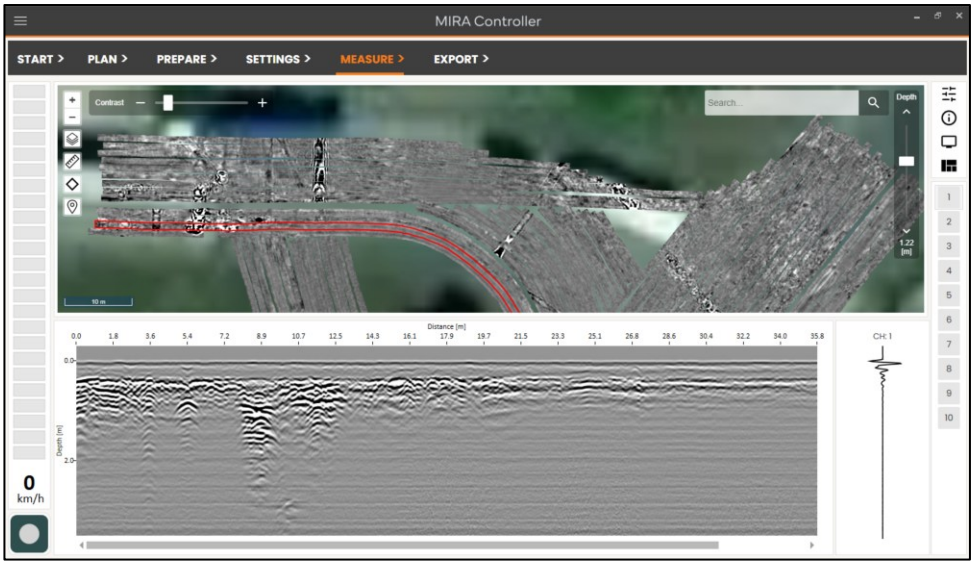


Note: Make sure you have RTK FIX. However, sometimes, if GPS conditions are poor, you may need to move your starting position, e.g., if you are too close to a building or underneath tree cover, or adjust the accuracy settings of your GNSS device to float in the GNSS settings tab.

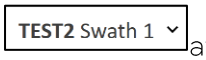
When a swath is complete, press  to stop the measurement.

Data is automatically saved when pressing  and the swath data can be visualised as a depth slice in the Map view.

Use the Depth slider (on the right-hand side of the map view) to change the depth and the contrast bar (top left side) to enhance the slice.

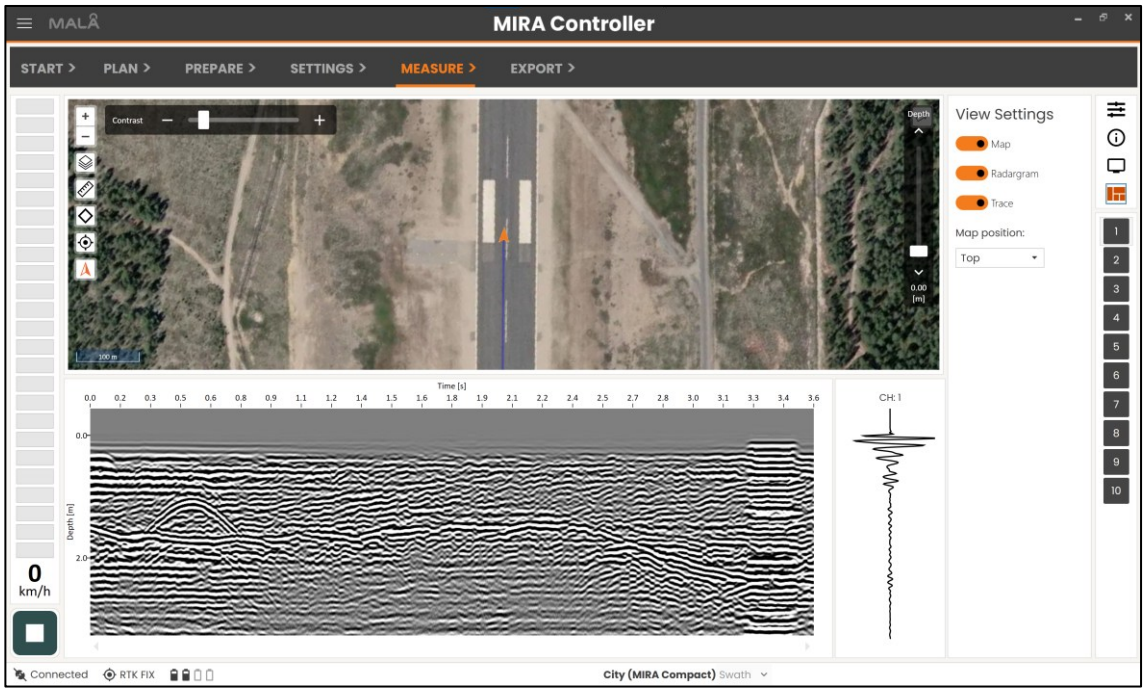


The depth slice option can be turned off in the Display Settings 

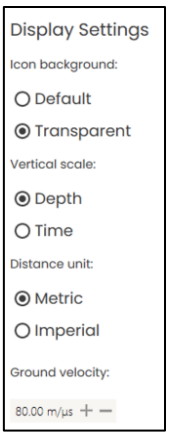
To view data from previous swaths, either select it in the map view or use the swath selector 

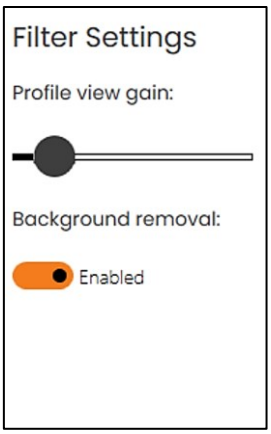
at the bottom right of the screen.

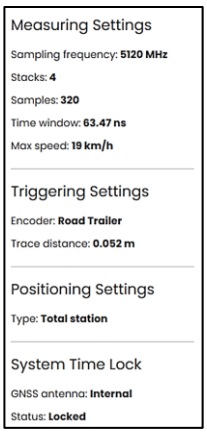
During measurements, the data and positioning can be viewed in different ways. Press the View settings button , on the right-hand side of the screen and choose among the view options. Close the window by pressing  again.



You can also change the display settings, as icon (antenna box in the map) background, distance unit, and the radar wave velocity with the Display button and add filters with the Filter button on the right-hand side of the measurement window. Information about project settings is also available .







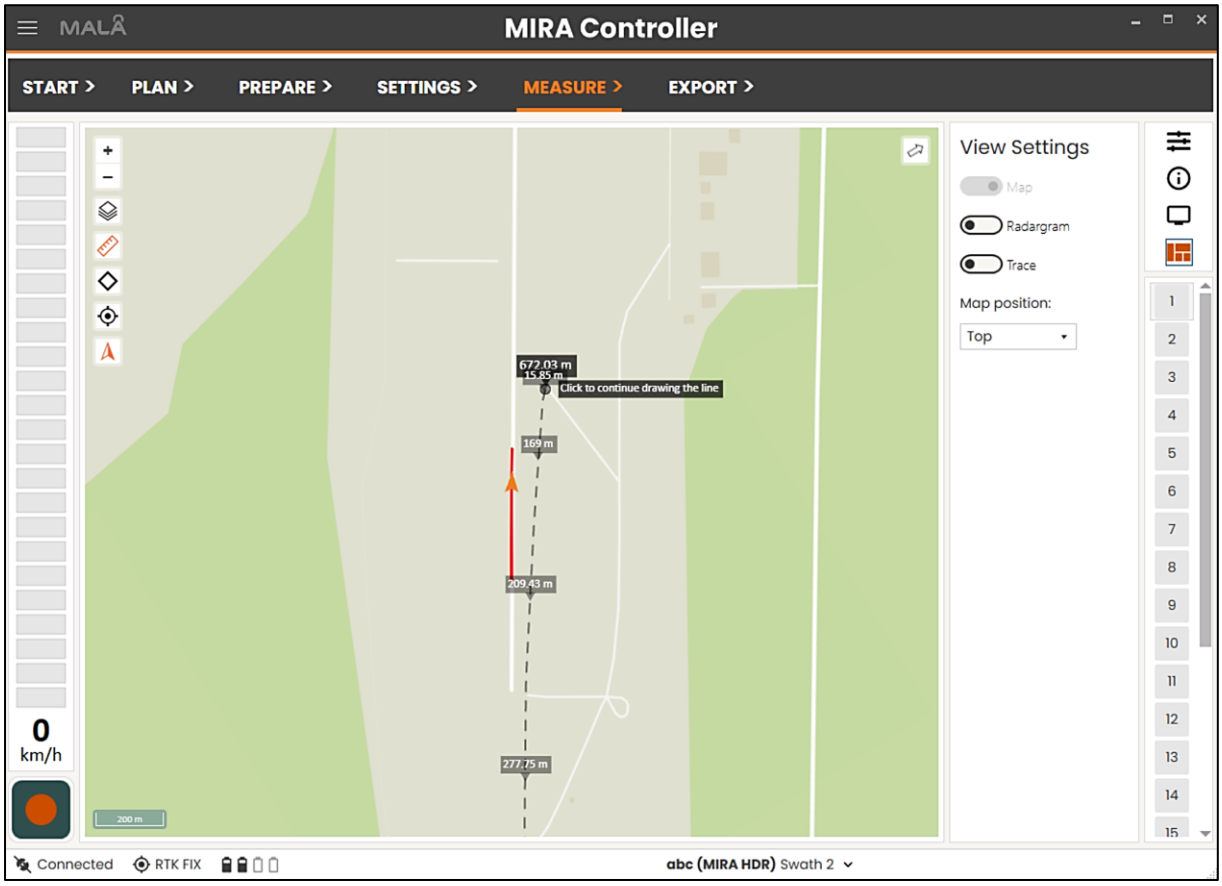
Note: Any gain or background removal applied to the data is only for display and does not affect the recorded data, which are saved in a raw state.

Note: The colour bar at the left shows the measurement speed; it should not be red, as this may cause a loss of traces. A loss of trace will show up as a grey vertical line in the radargram.

Note: On the right-hand side, you can toggle between the different measured channels and, by that, decide which is displayed in the radargram window.

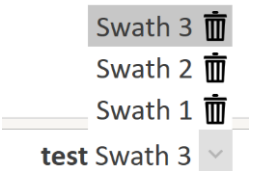
Note: If several swaths have been collected, you can choose which to display by clicking on the map view. Alternatively, in the status bar, you can select the swath to be displayed in the swath selector option.

In the map view, you can zoom in and out, decide to use an online or offline base map (see section Plan), centre the map, orientate it North or measure distances or areas. Choose Length (Line string) or Area (Polygon) to take measurements in the map. Click on the map with your mouse and double-click to end the line or polygon.



Tips and tricks during measurement

- If working with a field computer with touch screen, it is advisable to turn the touch screen option off, when working in bad weather conditions (rain and snow), to avoid interference. The touch screen can be turned off in the computers Device Manager. Look for Touch Screen or HID (Human Interface Devices) settings.
- Before GPR data acquisition, thorough survey planning should be done. It is advisable to conduct the data acquisition in straight lines whenever possible. Although the MIRA HDR, MIRA Compact and MIRA Flex systems do not require straight swaths, positioning errors will be reduced, and achieving full coverage of the survey area will be easier to manage if the geometry is kept simple.
- The MIRA Controller application has a moving map navigation aid showing swath coverage, which can be used to ensure total coverage of the investigation area. It is wise to have a visual reference point far away for each swath, to keep the measurements straight, and then use the map to see that data is collected side by side, without gaps. Swaths shown on the map are partially transparent and will darken where they overlap; try to maintain a slight overlap for best results.
- For every swath, each channel will be precisely positioned. It is recommended that data be collected with one channel overlap to prevent gaps in data. Uncovered areas will produce artefacts in the resulting images. The processing software has been designed to minimize these effects, but a careful data collection procedure is essential for the resulting image quality.
- The MIRA system should be kept on the ground, or as close to the ground as possible, for the best possible data quality and depth penetration.
- Be aware of all system warning messages from the MIRA Controller, such as exceeding maximum measurement speed or lack of positioning, etc.
- It is ok to stop the antenna array's movement and rest within a traverse. If the duration of the break is long, make sure to stop the measurement and turn off the antenna array, as it will otherwise continue to use power; however, traces are only collected when the encoder wheel is moving.
- If you wish to delete a swath, you can stop it and delete it in the swath selector. Then, start a new line. Even if a bad line has been collected and saved, you can remove these from the project folder.



- Swaths can also be remeasured later and included in earlier projects; double-check that the measurement settings of the new swaths match the old ones if you intend to process the whole project as one.
- The MIRA systems can collect data at high speeds, but depending on the carrier solution and the site conditions, this speed is often limited. Surface roughness, obstacles preventing data collection in straight lines, crossing traffic and other details often limit the average speed to below 20 km/h.

Note: Measurements made with straight lines will create a better result than very curved lines.

Measurement with a highly elevated GNSS position or remote GNSS position (i.e., on survey vehicle)

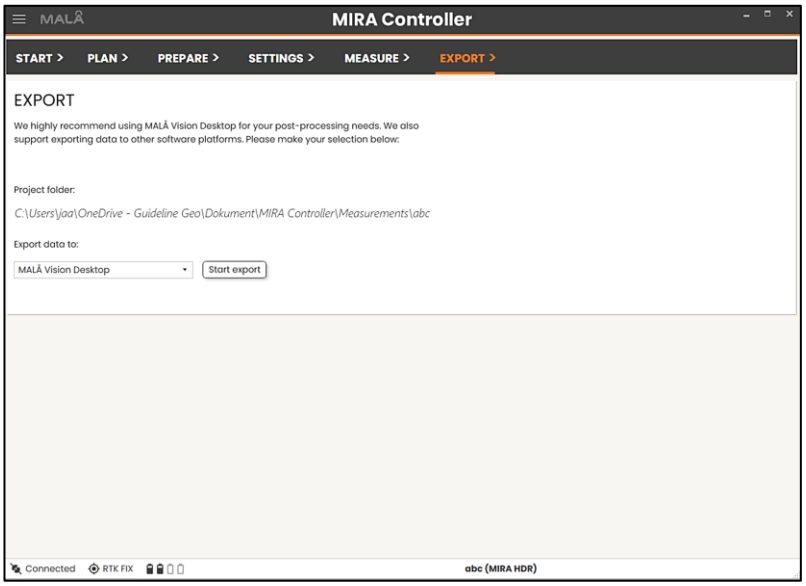
The advantage of placing your GNSS device in a high position is to achieve a clear view of the sky. Thus, more satellite signals can be detected, resulting in a more stable fix and improved accuracy. The disadvantage is that real-world positional accuracy decreases when the GNSS device or prism tilts because of uneven ground or steep slopes.

Suppose the GNSS antenna is placed further away from the antenna box (distances exceeding approximately 2 meters). In that case, it should be noted that there might be a changeable element to the offset (compared to the Geometry Settings entered under the Advanced menu), especially in curves, resulting in positioning discrepancies in the end result.

Remember to update your GNSS settings if you move or change the location of your GNSS system or prism (Settings-Positioning).

Export

In the *Export* tab, you can export your data to the project folder and decide in which format data should be exported. Choose between MALÅ Vision Desktop, GPR-SLICE, rSlicer, rSlicer without positioning, SEG-Y or RD8 to RD7 and press *Start export*.



Note: If measurements have been done with different settings for different swaths, the rSlicer export will be divided into several projects, grouping swaths with the same settings.

When exporting to rSlicer, the coordinates will be exported as UTM.

When exporting to rSlicer without positioning, each of the collected swaths are lined up next to each other based on the width of the channel selection. The swaths are assumed to be collected in the same direction.

An additional positioning file (.txt) is generated for each swath when exporting data to SEG-Y format.

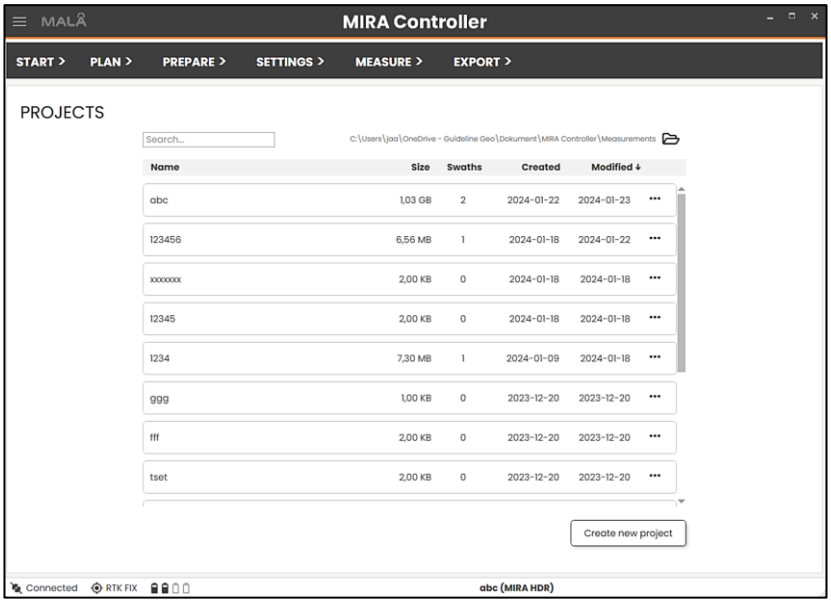
```
#Index  DateTime        Latitude        Longitude       Elevation       Velocity        Heading HeadingRate
#FormatVersion=1.0
#Culture=ja-JP
0       2019-11-11T01:32:30.4480Z       33.805986565    132.79415733866668      41.000999450683594      0       357.201233      0
1       2019-11-11T01:32:31.9400Z       33.80598754527707       132.7941572975775       40.995021820068359      0.0205356982    357.1706        -0.0421775021
2       2019-11-11T01:32:32.2230Z       33.805988250996847      132.79415718497987      41.017658233642578      0.0296556782    357.104156      -0.0116234021
3       2019-11-11T01:32:32.4320Z       33.80598894273097       132.79415712690329      41.028999328613281      0.0372865424    357.139862      0.0169308763
```

Projects

The *Projects* menu can be accessed from the MIRA Controller Main menu . It shows all existing projects and gives the option to delete old ones or select projects to view after a measurement is finished.

The location of the Measurement folder is changed by pressing

Note: It is advisable to check that the measurement folder is NOT a cloud synced folder (as OneDrive, GoogleDrive, DropBox). The operating system of the computer might interfere with the data capturing, when trying to keep the data synced in a cloud.

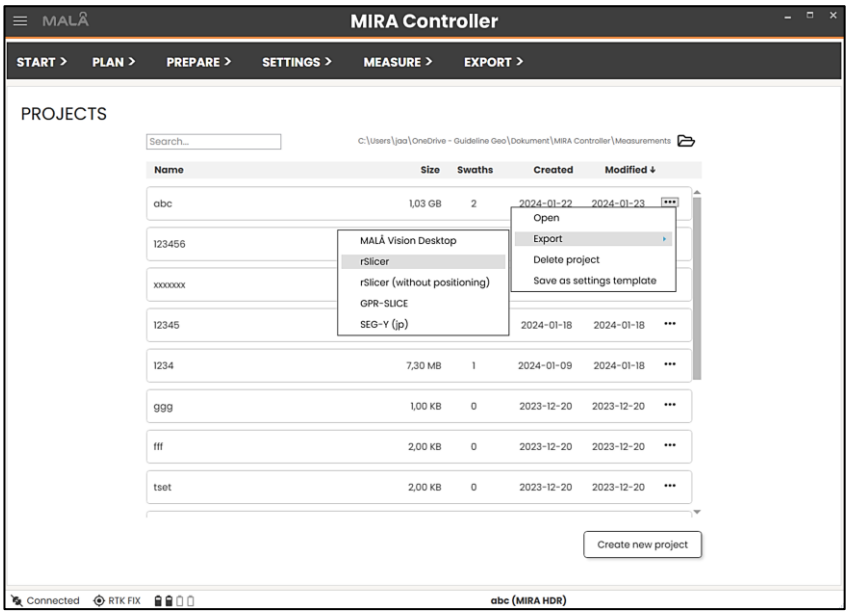


The project is opened with a single click on the chosen project row.

When an existing project is opened, it can be:

- Supplemented with new swaths -> Check measurement settings first in the *Settings* menu.
- Viewed, by choosing the *Measure* tab.

In the *Projects* menu, you can also export your data. Click ••• to export data. For more information, see the section *Export*.



Save settings

The option *Save as settings template* is found in a project's options menu. This allows you to save settings used for a project and reuse them in new projects. A template is saved with a user-defined name and will show in the list of templates that you can choose from when creating new projects; see section *Create new projects*.

Saved templates can be deleted in the drop-down menu when you create a new project. See the section *Create new projects*.

Advanced settings

In the Advanced menu, you will find options for Firmware Upgrade, System, and Demo.

Firmware upgrade

The *Firmware Upgrade* tab displays information on the current firmware (of the MIRA system), firmware versions downloaded and how to upgrade. This tab will have different options depending on which type of antenna system that is connected to the computer.

MIRA HDR

Download the installation package to the computer where the MIRA Controller is installed (from www.guidelinegeo.com) or use the button *Here* if you are online. The *Here* option will directly open the Guideline Geo resource center, filtered on relevant resources for MALÅ MIRA systems.

The installation package is in a particular format with *.GGM extension. Only files with this format are compatible and can be chosen.

Note: The file downloaded from the resource center, is a zip file that needs to be extracted to get hold of the firmware file used to upgrade the antenna system.

Based on the current system status and the firmware package selected, the MIRA Controller determines which components will need to be upgraded based on the current system status and the firmware package chosen. It will display the time required for the upgrade.

Note: If running the system on battery power, ensure you have enough battery before starting a system upgrade. Do NOT disconnect the system during the upgrade procedure.

WARNING: If you get a message stating that the firmware upgrade failed, you MUST try again until the message says: "Current firmware package version: xxx".

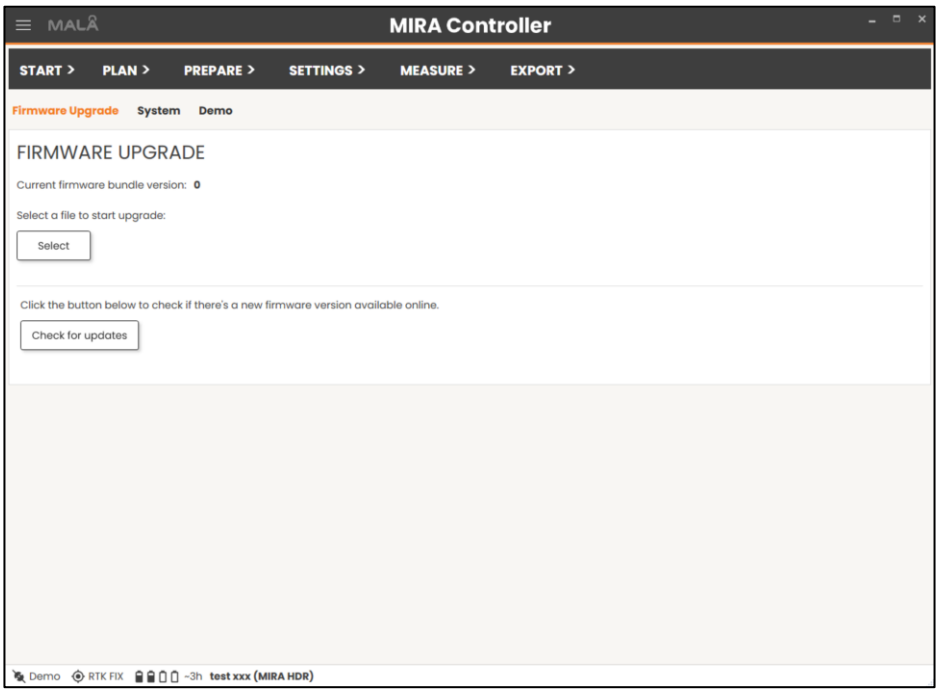
WARNING: If you get a message stating a "firmware package mismatch", you MUST try again until the message says: "Current firmware package version: xxx".

After the upgrade, please restart the MIRA system and restart the MIRA Controller.

MIRA Compact and MIRA Flex

The software will automatically check that connected antenna system has the latest firmware installed. When a newer version is available a popup window will appear, giving you the option to carry out an over-the-air upgrade of the antenna system.

WARNING: The upgrade is a critical procedure. Make sure to follow all the instructions on the screen carefully.



If you have declined to carry out the upgrade, you can start the procedure again by clicking the button "Check for upgrades". You also have the possibility to manually upgrade the system in the same way as with MIRA HDR by selecting a ggm-file that you have downloaded from the internet.

Note: The automatic upgrade features of MIRA Controller and MIRA Flex will only be available if your computer is connected to the internet.

System

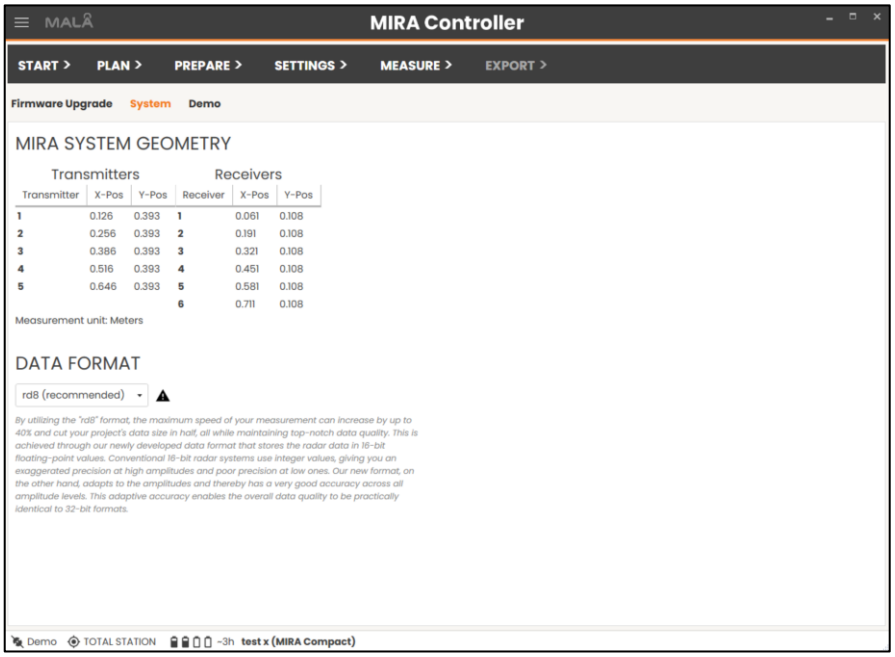
In the *System* tab, you define the location of each antenna element (Tx and Rx) related to the 0,0 position of the enclosing array box. These distances are needed to assign and sort the location of all individual channels in the chosen post-processing software.

If you choose the MIRA HDR, MIRA Compact or MIRA Flex template when creating a project, these numbers are automatically added and corrected (please note that these numbers shouldn't be changed). The measurements are made from the 0-point of the individual Tx/Rx antennas to the 0,0-point of the array box.

In the System tab you also set the output data format: rd8 (recommended) or rd7.

Note: In the Export tab you can export data in rd8 format to rd7 format if needed.

The geometry settings for a MIRA Compact system are shown below:



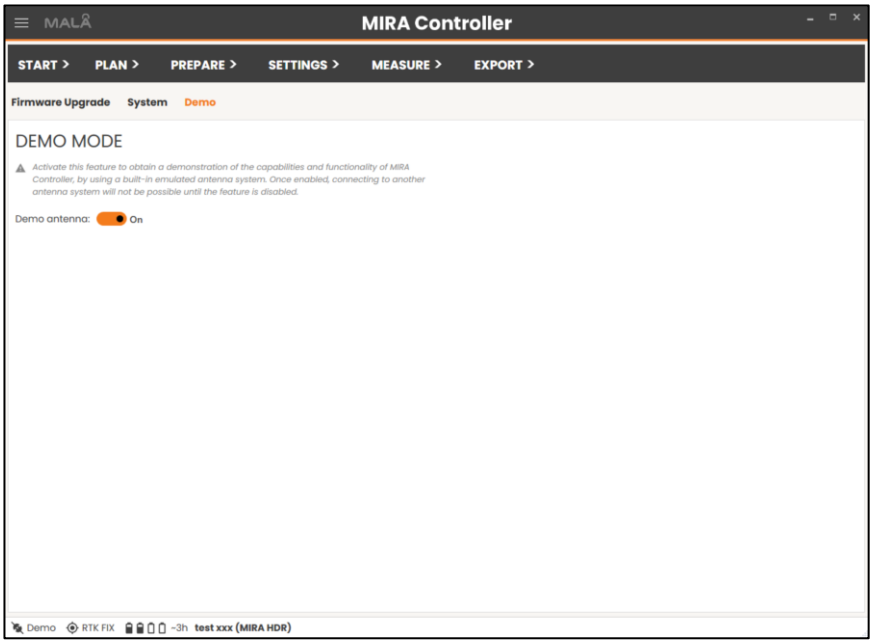
The MIRA HDR system has the following geometry:

Transmitters			Receivers		
Transmitter	X-Pos	Y-Pos	Receiver	X-Pos	Y-Pos
1	0.126	0.393	1	0.061	0.108
2	0.256	0.393	2	0.191	0.108
3	0.386	0.393	3	0.321	0.108
4	0.516	0.393	4	0.451	0.108
5	0.646	0.393	5	0.581	0.108
6	0.776	0.393	6	0.711	0.108
7	0.906	0.393	7	0.841	0.108
8	1.036	0.393	8	0.971	0.108
9	1.166	0.393	9	1.101	0.108
10	1.296	0.393	10	1.231	0.108
11	1.426	0.393	11	1.361	0.108
			12	1.491	0.108

Measurement unit: Meters

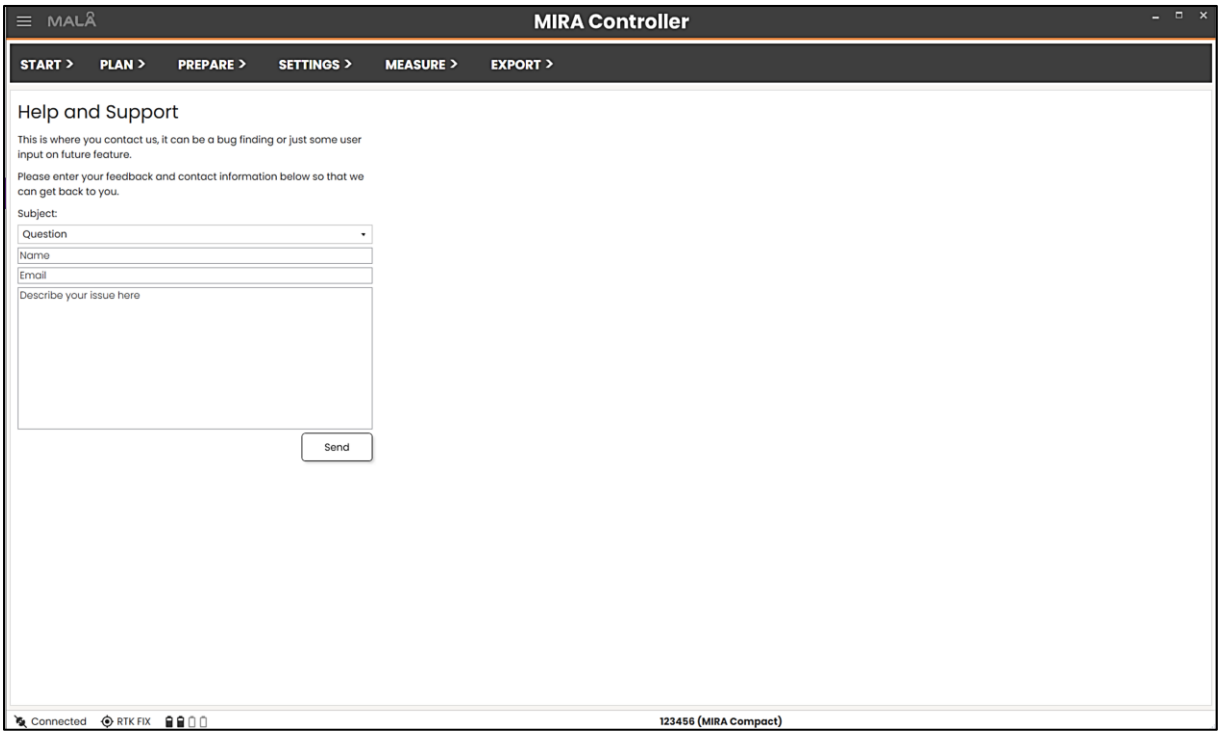
Demo

In the *Demo* tab, you can set MIRA Controller to Demo mode. The demo mode provides an opportunity to run the MIRA Controller without a connected MIRA system, still being able to start and stop measurements and display emulated data.



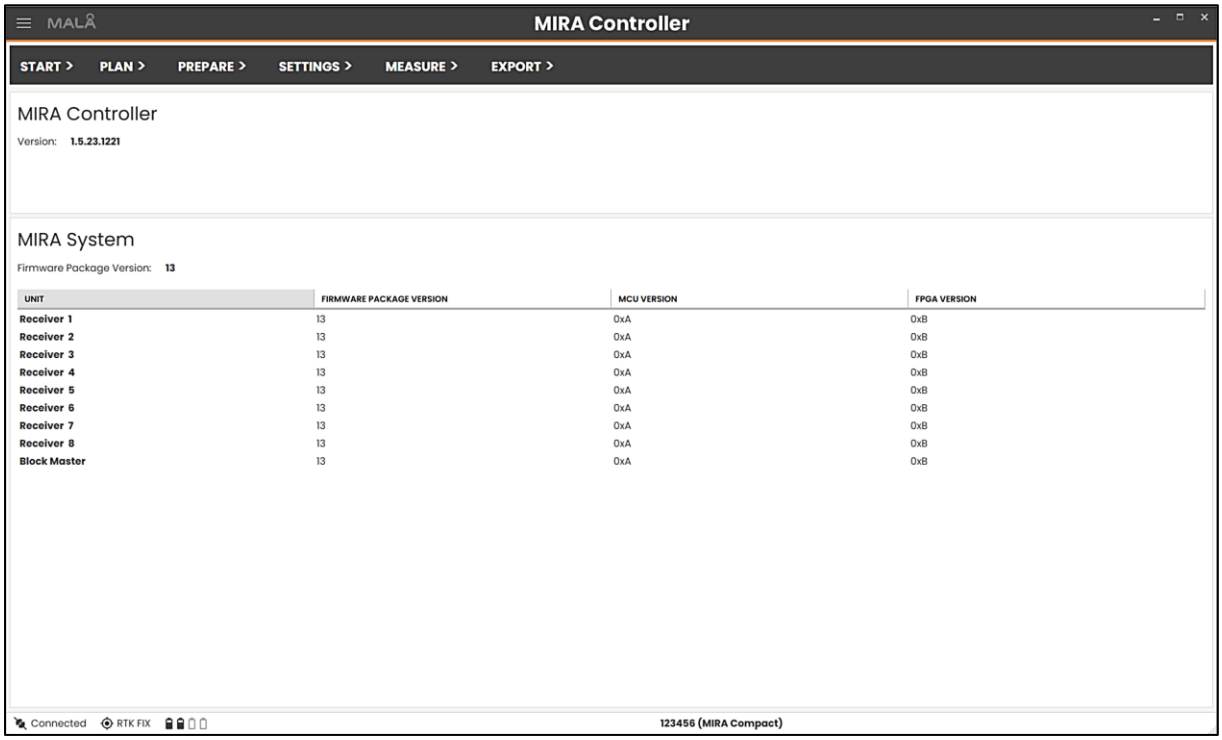
Help and Support

If you are online with your measurement computer, you can contact our Help and Support team directly from the MIRA Controller. Enter your name and email address and describe your problem.



About

In the *About* menu, you find information on the current MIRA Controller software and firmware versions installed on the connected MIRA system.



Appendix 1 MALÅ Motion Trig

The MALÅ Motion Trig option utilizes the movement of the internal GNSS to trigger the data collection, giving equidistant traces without encoder wheels being connected to the antenna.

MALÅ Motion Trig is currently available for the following MALÅ products:

- MALÅ GroundExplorer range of antennas
- MALÅ GeoDrone range of antennas
- MALÅ MIRA Compact
- MALÅ MIRA Flex

Traditional triggering methods, such as pulse encoder (survey wheel) and time triggering have certain limitations:

- Wheel-based triggering relies on physical ground contact to measure the distance. While accurate on smooth, firm terrain, this method becomes less reliable under challenging conditions, such as uneven or highly undulating terrain situations where ground contact is impossible or applications involving drone-mounted or suspended systems.
- Time triggering collects traces at fixed time intervals rather than fixed distances, making trace spacing dependent on survey speed. While a constant speed provides relatively uniform spacing, speed variations result in unevenly spaced traces. Since tools such as hyperbola fitting and MALÅ AI require equidistant traces, time triggering prevents their use. Additionally, pauses in movement lead to excessive data accumulation at a single location.

These limitations can be overcome with MALÅ Motion Trig, which enables distance-based triggering without the need for a survey wheel or physical ground contact.

Key benefits of MALÅ Motion Trig:

- Consistent, equidistant trace spacing regardless of survey speed
- Reduced collection of redundant traces
- Flexible survey operation without the need to maintain a constant speed
- Compatibility with hyperbola fitting tools and - MALÅ AI hyperbola detection
- No need for survey wheels or cables

- Reliable triggering in applications where ground contact is difficult or impossible, including drone-mounted, marine, and suspended systems

MALÅ Motion Trig is particularly well suited for:

- Open-field and forest surveys
- Marine and bathymetric surveys
- Drone-based GPR surveys
- High-speed mobile mapping
- Rough, uneven, or densely vegetated terrain
- Surveys where a consistent survey speed can be maintained.

Like other triggering methods, MALÅ Motion Trig has certain limitations. It is less suitable for surveys conducted under the following conditions:

- Indoor environments where GNSS satellite reception is poor or unavailable
- Areas with limited satellite coverage, where fewer than four satellites are detectable (at least four are required for reliable motion detection)
- Very low survey speeds
- Surveys requiring backtracking, where the backtracking function (yellow line) is needed
- Surveys involving frequent starts and stops, such as when navigating traffic, obstacles, or challenging terrain
- - Surveys with significant speed variations, involving frequent acceleration or deceleration

Note: MALÅ Motion Trig and Time trigger independently of the direction of movement. To ensure correct positioning of the recorded data, maintain a constant travel direction throughout each swath/profile.

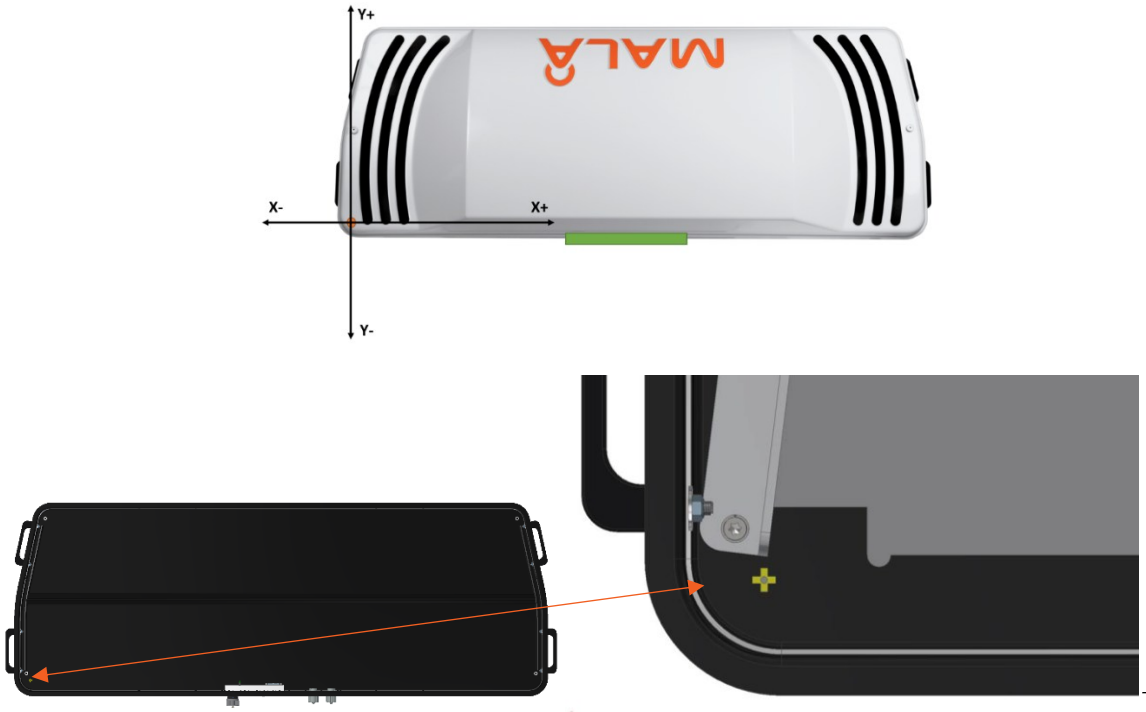
Appendix 2 Positioning

The positioning data is written in a so-called *.mpos file containing the raw positioning data received from the used positioning device and is in GeoJSON format. A *.mcor file is also created and contains interpolated positions for all traces collected during the measurement. The *.mcor file is also in GeoJSON format and differs from the *.mpos file, containing a reference to the associated trace. The *.mcor file is structured as follows:


```
{
    "type": "FeatureCollection",
    "features": [
        {
            "type": "Feature",
            "geometry": {
                "type": "Point",
                "coordinates": [
                    20.2338662818,
                    63.842677564,
                    10.989915602840484
                ]
            },
            "properties": {
                "PositionTime": "2020-10-16T14:19:31.5341705+02:00",
                "TraceNumber": 1
            }
        },
        .
        .
        .
        {
            "type": "Feature",
            "geometry": {
                "type": "Point",
                "coordinates": [
                    20.2352142097,
                    63.8433977665,
                    12.089915601536632
                ]
            },
            "properties": {
                "PositionTime": "2020-10-16T14:19:59.5988422+02:00",
                "TraceNumber": 1635
            }
        }
    ]
}
```

Appendix 3 Reference point

Suppose the GNSS antenna is attached elsewhere than the pre-sets, on the measurement set-up, as on top of the carrier vehicle when using the MIRA HDR or MIRA Flex. In that case, the position needs to be adjusted accordingly. The reference point is marked in orange in the picture below, where green represents the location of the connector panel, and red represents the zero-point positioning. For MIRA Flex, see the *MIRA Flex Integration Guide.*



The 0,0-point, the positioning reference point, of the MIRA HDR system is located in the back-left corner of the array box: