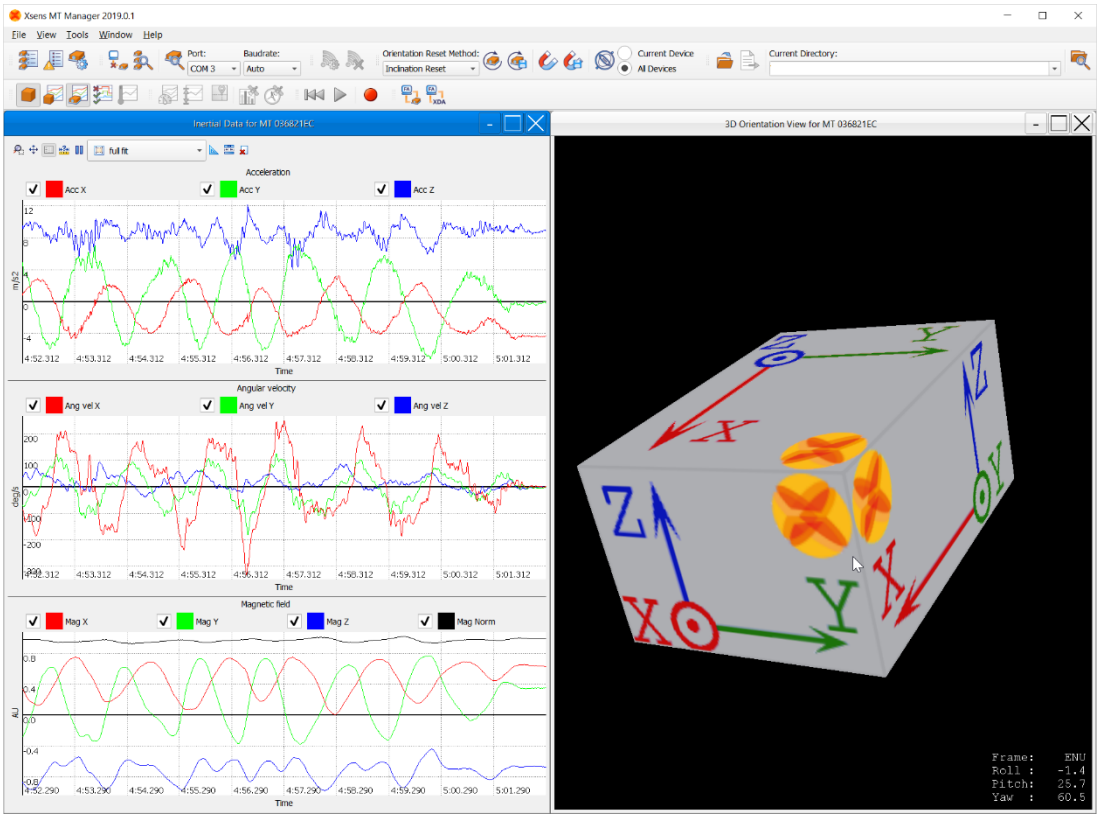


Document MT0605P, Revision 2020.A, June 2020

MT Manager User Manual

For all MT devices

Revision	Date	By	Changes
A	1 Apr 2008	MMI	Initial release
R1	14 Dec 2017	MHA	Added mention about Config Mode after closing MT Manager
2018.A	25 June 2018	SGI	Added information about MTi-7
2019.A	11 Jan 2019	SGI	Updated for release of MTSS v2019.0, added NMEA output message parser
2019.B	Nov 2019	AKO	Xsens Brand Update
2020.A	June 2020	SGI PRI	Added Free Acceleration view Included CAN output configuration window Included NTRIP Client window Added GNSS Lever arm support

Table of Contents

List of Tables

List of Figures

List of Abbreviations

The MT Family Reference Manual[1] provides a list of abbreviations used across our MT documentation.

[1]The latest available documentation can be found in your MT Software Suite installation folder or via the following link: *https://xsens.com/xsens-mti-documentation*

1 References

Reference id	Document description
[LLCP]	"MT Low-Level Communication Protocol Documentation.pdf", document ID MT0101P
[MFM]	"Magnetic Field Mapper Documentation.pdf", document ID MT0202P
[FWU]	"Firmware Updater User Manual.pdf", document ID FU0100P
[MTi_10s_100s]	"MTi User Manual.pdf", document ID MT0605P
[MTw_SDK]	"MTw SDK User Manual.pdf", document ID MV0319P
[MTi_1s]	"MTi 1-series Data sheet", document ID MT0512P
[MTI_600s]	"MTi 600-series Data sheet", document ID MT1603P
[CAN]	"MT CAN Protocol Documentation", document ID MT1604P

Note: The latest available documentation can be found in your MT Software Suite installation folder or via the following link: *https://xsens.com/xsens-mti-documentation*

2 Xsens Help Center and User Community

Xsens has an extensive help center, a place where users of Xsens and Xsens employees (support, field application engineers, sales and R&D engineers) meet. The knowledge base contains tips and tricks, guidance and answers to frequently asked questions. News is also shared at the knowledge base and it is possible to ask additional questions (registration required).

The user community is the place to ask questions. Answers may be given by other users or by Xsens employees. The response time in the user community is significantly shorter than the response time at Xsens support.

The knowledge base and user community are searchable simultaneously. A search query thus shows results irrespective of the source.

Please visit https://base.xsens.com to complete your 1 minute registration.

Table 1 summarizes all available official documents for the Xsens MTi product line.

Table 1: MTi product documentation overview

<table>
<tr><th>MTi 1-series</th><th>MTi 600-series</th><th>MTi 10/100-series</th></tr>
<tr><td colspan="2">MTi Family Reference Manual</td><td rowspan="5">MTi User Manual</td></tr>
<tr><td>MTi 1-series Datasheet</td><td>MTi 600-series Datasheet</td></tr>
<tr><td>MTi 1-series DK User Manual</td><td>MTi 600-series DK User Manual</td></tr>
<tr><td rowspan="2">MTi 1-series HW Integration Manual</td><td>MTi 600-series HW Integration Manual</td></tr>
<tr><td>MT CAN protocol Documentation</td></tr>
<tr><td colspan="3">MT Manager Manual</td></tr>
<tr><td colspan="3">Magnetic Calibration Manual</td></tr>
<tr><td colspan="3">MT Low Level Communication Protocol Documentation</td></tr>
<tr><td colspan="3">Firmware Updater User Manual</td></tr>
</table>

3 Introduction

This user manual describes the product features and operating instructions for Xsens' MT Manager 2019.

MT Manager is compatible with all Xsens Motion Trackers (for a complete list of supported MTs, refer to section 5.3). Note that listed features and sections in this document may not apply to all Xsens devices. For device specific details please refer to the documentation listed in Section **Error! Reference source not found.**.

The MT Manager uses the XsensDeviceApi64.DLL or XsensDeviceApi32.DLL with the dynamic library interface. This is the same API that is provided for software development in the MT SDK.

The MT Manager software is an easy-to-use software with familiar Windows user interface, which allows you to:

- view 3D orientation in real-time
- view inertial and magnetic sensor data in real time
- view latitude, longitude, altitude plots in real time (depends on Motion Tracker used)
- monitor and compose message to and from the device via a message terminal
- export log files to other formats like ASCII and KMZ
- change and view various device settings and properties
- run a self-test to check the mechanical functions of the inertial sensors and magnetometer

The MT Manager is therefore an easy way to get to know and to demonstrate the capabilities of the Motion Tracker.

4 Quick start

This section is intended to help you install and use the MT Manager quickly. For detailed instructions, please go to sections 5 and 6.

4.1 Installing the MT Manager

First you need to install the MT Manager on your computer. This is easily done by using the MT Software Suite application that guides you through the installation.
NOTE: the most recent version of the software, source code and documentation can be downloaded from the support section of www.xsens.com.

For users of previous Xsens' MT software:
Be sure to uninstall the previous version of the USB converter drivers:
Open the Windows Control Panel and go to Add or Remove Programs.
Look for the entry 'Windows Driver Package - Xsens USB-serial Converter Driver Package'. Please uninstall all entries of these drivers.

For Windows Vista/Windows 7/Windows 8/Windows 10 users:
Download the installer fromwww.xsens.com. This installation procedure also tells the procedure to install the entire MT Software Suite.
The installation procedure installs several components and starts with the screen as shown below:

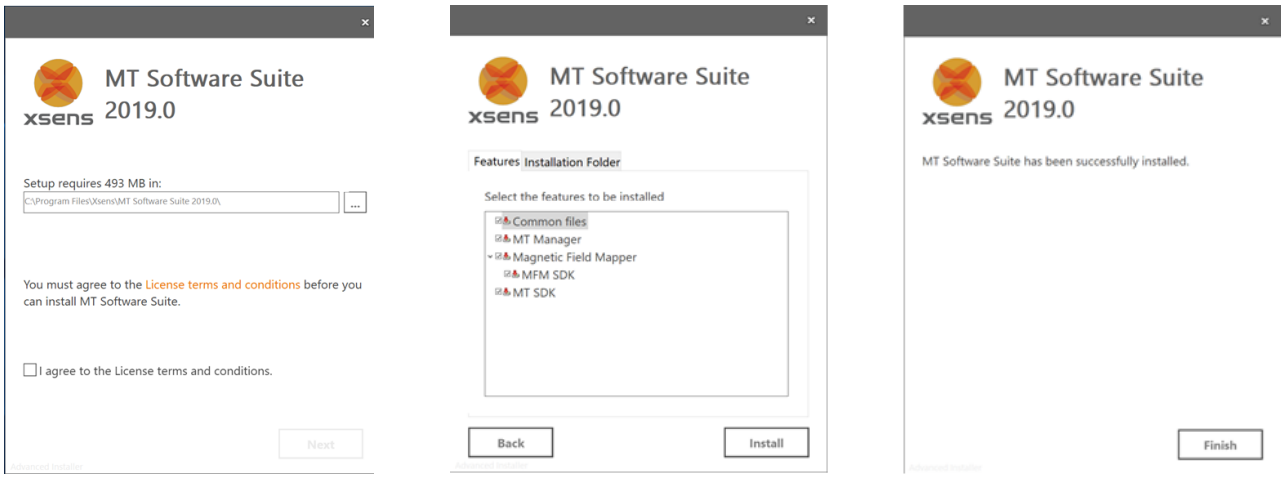


Figure 1: The installation procedure is straightforward. In the second screen, you can choose to skip installation of several components (not recommended)

4.2 Connecting your device to MT Manager

Connect a device to your PC using the supplied USB cable. With the USB cable, the MTi device is automatically found.

4.2.1 Automatic COM port selection

Upon execution of the MT Manager it automatically scans the available COM-ports and/or MTi USB devices on the PC for connected devices.

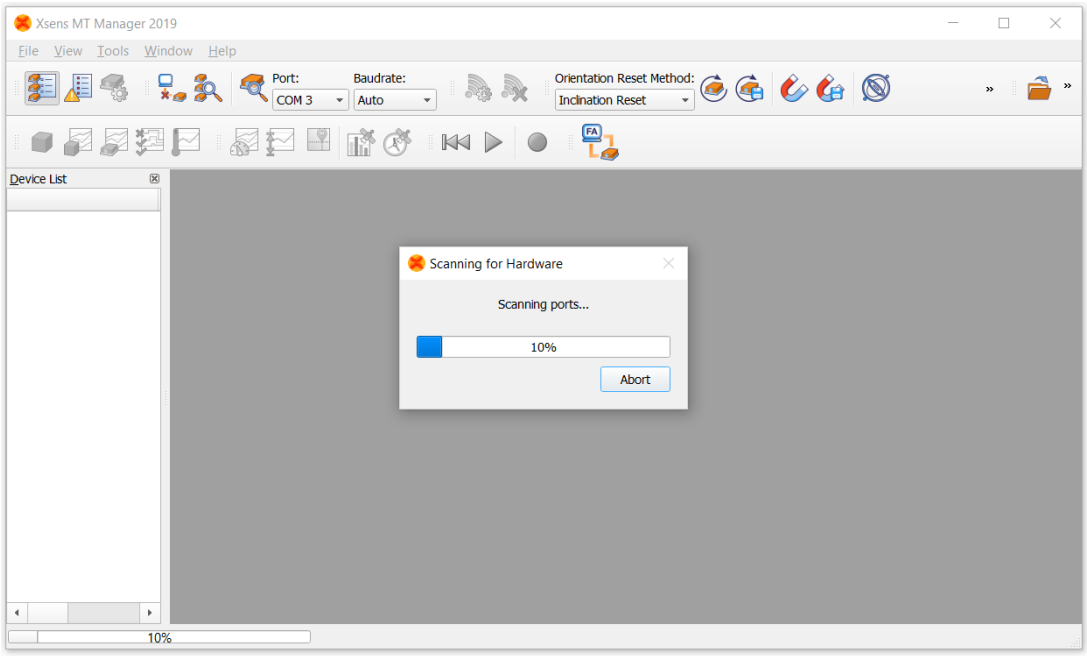


Figure 2: MT Manager scanning for attached devices

If you are using an RS-485 sensor, be sure to enable the RS-485 compatibility mode in the General pane via "Tools" → "Options…", refer to section 5.6. Without RS-485 compatibility enabled, the RS485 MTi device may not be found.

The MTis are displayed in the Device List with the respective unique MT device ID number.

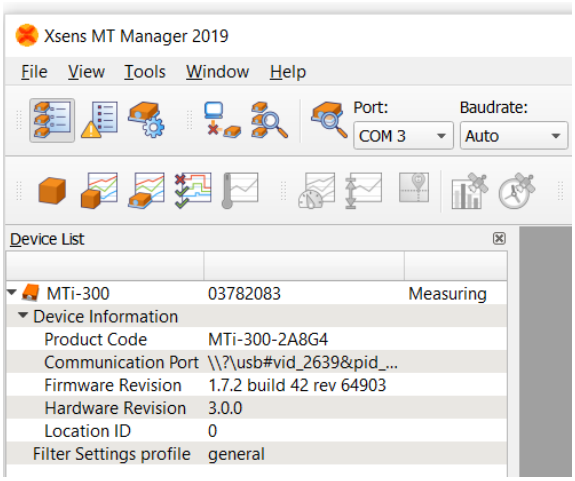


Figure 3: The main screen of MT Manager with an MTi-300 attached via USB

After physically connecting one or more devices, press the rescan button  to let MT Manager search for connected devices on any available COM port and update the device list.

When you want to disconnect all devices, press the disconnect button  .

4.2.2 Manual COM port selection

If you want to select the COM port manually, then in the Connectivity toolbar:

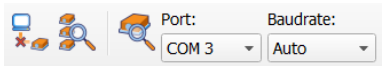


Figure 4: The connectivity toolbar

You can choose a COM port and the baud rate if you are using a serial connection or a USB converter, see below. Note that the direct USB connection does not have a COM-port. Instead, the USB has a unique USB name that you can find in the Device Settings dialog window, see section 6.2.2.4.

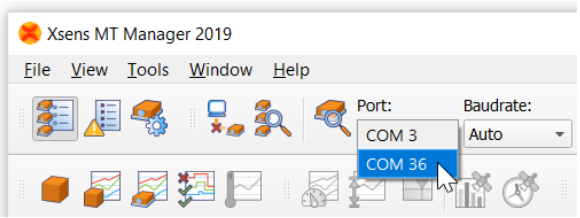


Figure 5: Manually selecting the COM port that MT Manager uses during its scanning procedure

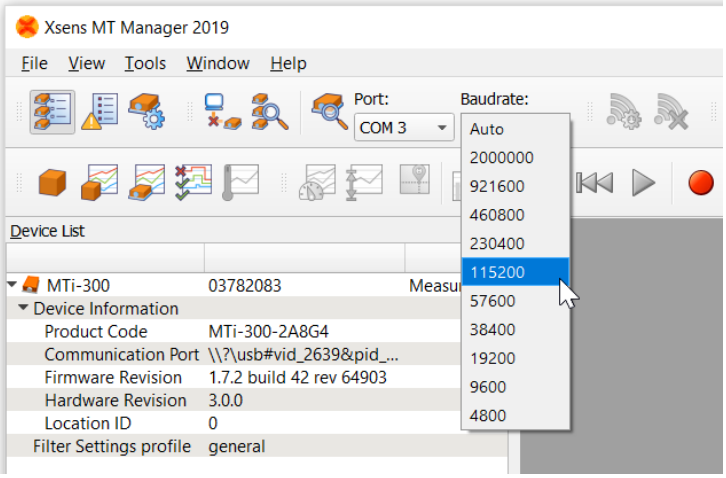


Figure 6: Manually selecting the baud rate that MT Manager uses during its scanning procedure

For the COM ports you can choose between all active COM ports. It is recommended to use the "Auto" baud rate to have the baud rate determined automatically. Then, press the "Scan Port" button[2]  .

To learn how to retrieve the USB name, please refer to section 6.2.2.4.

Now you are ready to go using your Motion Tracker with the MT Manager.

4.3 Basic functionality of MT Manager

This section describes how to setup the MTi for recording and exporting data.

4.3.1 Configuring Motion Tracker

After the MTi is connected, the MTi should be in the Device List in the bar on the left.

[2] If you are using an RS-485 sensor, be sure to enable the "RS-485 compatibility mode" (refer to section 4.2.1).

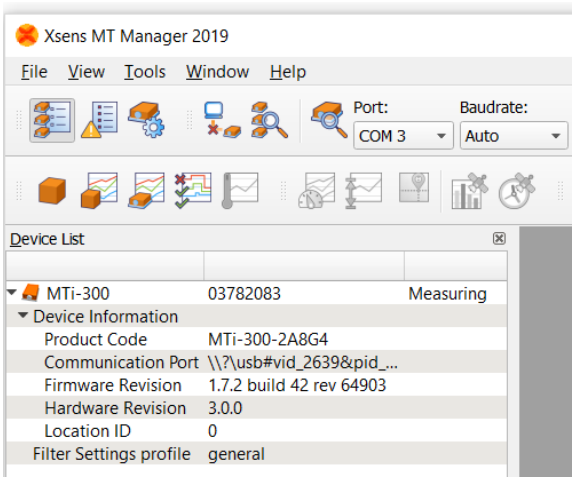


Figure 7: MT Manager showing the MTi-300 with DeviceID 03782083 in the Device List

The first step is to configure the MTi. Open the Device Settings window  . The Output Configuration settings tab will be shown.

The default output configuration can be found in [LLCP]. The preset drop down bar allows choosing other options. Recording data with the XDA processing preset allows reprocessing the file with any compatible filter profile. It is possible to select individual data IDs, but note that when orientation is selected, the onboard processed orientation is recorded. Files with onboard processed orientation data cannot be reprocessed using a different filter profile.

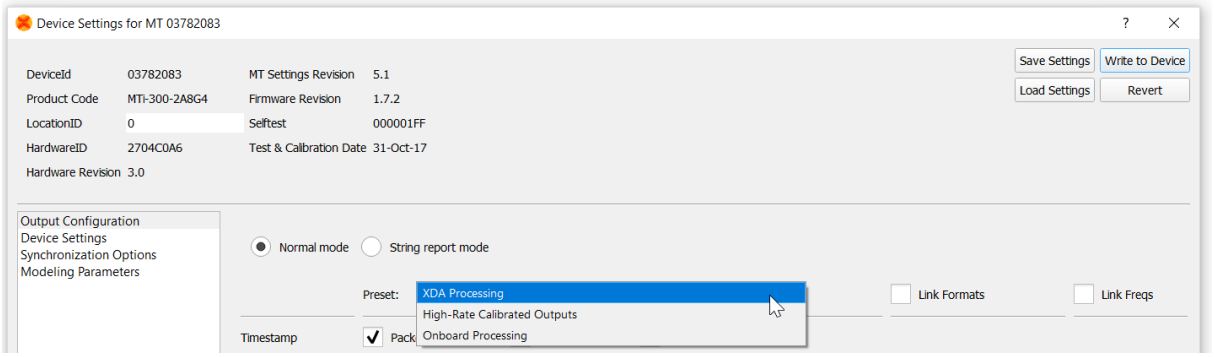


Figure 8: The Output Configuration windows features easy to use presets.

In this step-through, the settings of the MTi other than the output configuration will not be changed. It is however possible to change filter settings, configure synchronization options or to review the calibration parameters. In the header, it also shows the hardware ID, Firmware Revision and other MTi information.

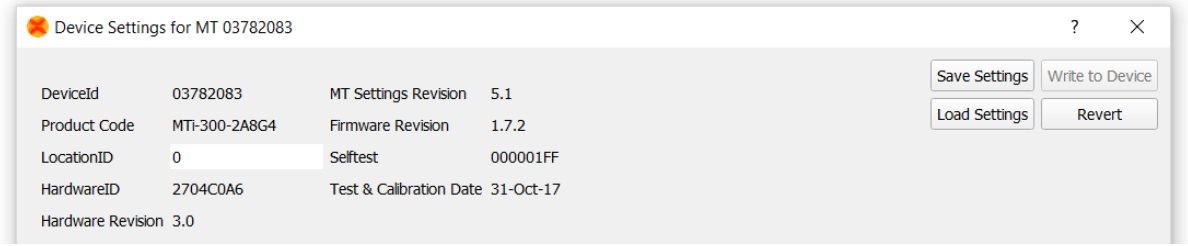


Figure 9: The header of the Device Settings window shows general information on the MTi

4.3.2 Recording data

First check if you receive data. Open for example the 3D view  and the inertial data graph  .

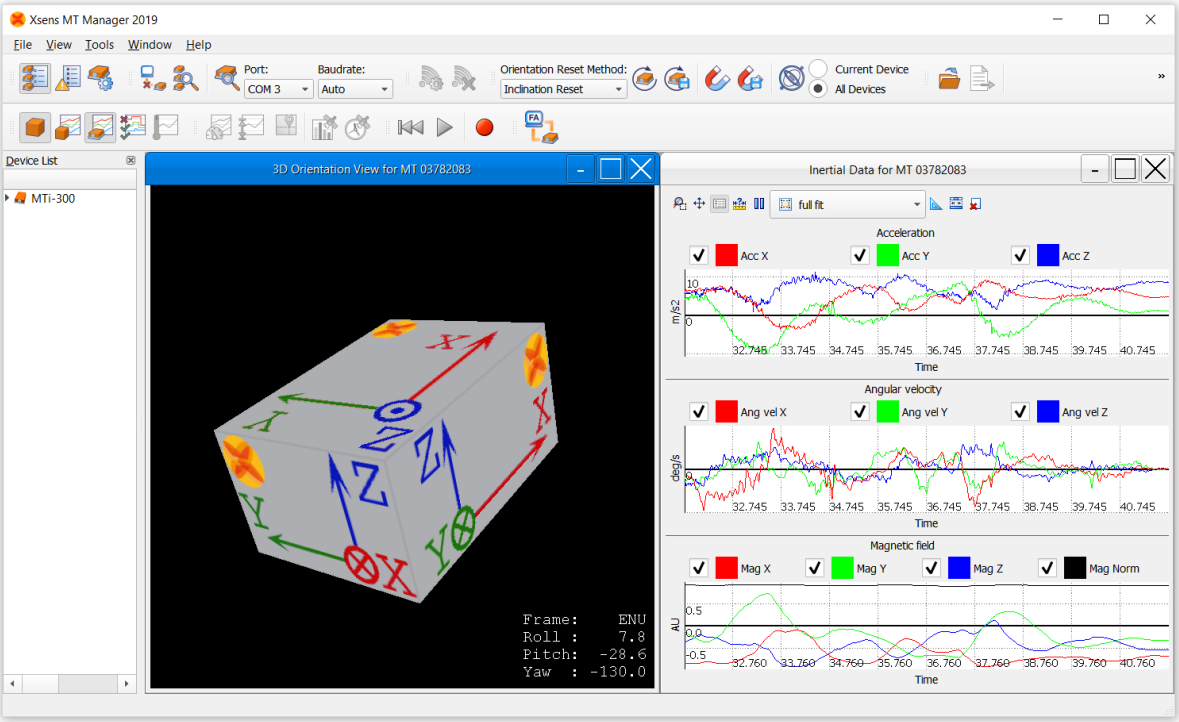


Figure 10: A typical view of MT Manager

Press the record button in the menu bar: 

.

The record status is shown in the bottom right corner: 

Press the record button again to stop recording.

4.3.3 Opening the file and playback data

Open the file with File – Open,CTRL+O or the Open File icon  . When orientation data is not in the file, a pop-up window will ask for the required filter profile. When applicable, additional processing options can be enabled or disabled by using the check boxes. See [MTi_10s_100s] for more information on filter profiles and additional processing options.

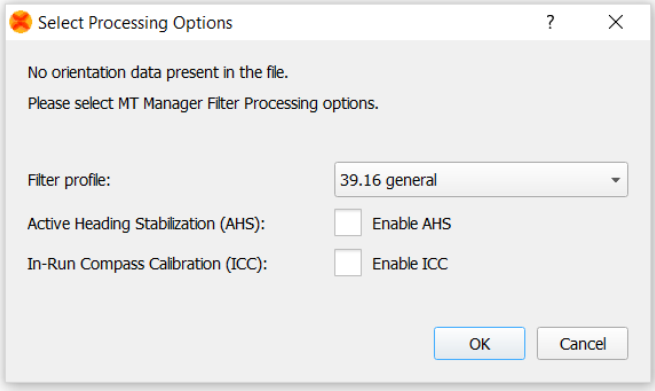


Figure 11: After opening a file with MT Manager, a window is shown when orientation is not available in the file.

You can now playback the file by pressing the Play-button. You can revert to the beginning of the file with the Rewind to Start-button.

Figure 12: The Playback toolbar

Choose to playback data in real-time or at once by changing graph settings in Tools - Preferences.

Table 2: Playback and plotting options

Parameter	**Comments**
File plotting	Real-time plays data in real-time; All Data (as fast as possible) plots all data at once. Note that you need to increase the Maximum Display time to see all data; All Data (update every 5 sec..) is required when the file is extremely large
Maximum display time	Increase this value to a higher value (File) in order to show more data, especially useful when investigating a file.

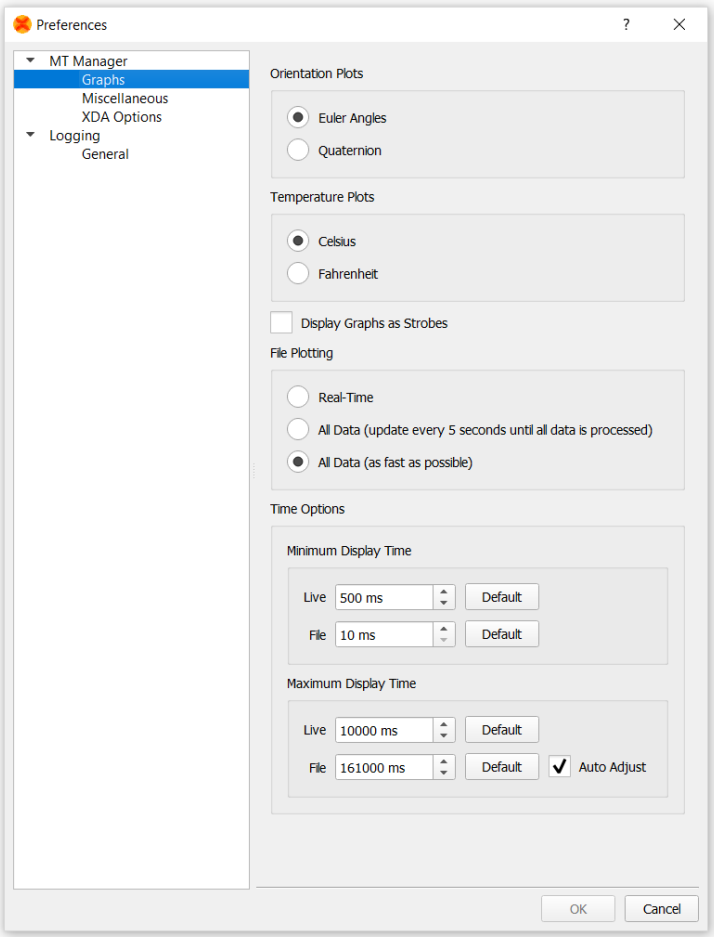


Figure 13: The Graphs options in the Tools - Preferences window

4.3.4 Exporting a file to ASCII

In order to use the data in other programs, e.g. Excel or MATLAB, the MT Manager allows to export the data to a text file. To do so, click open a log file and press the Export button  . A window will open in which you can elect the data to be exported. When the exported data is not available, the field will be filled with the Empty Field option. Click Export to generate the ASCII text file.

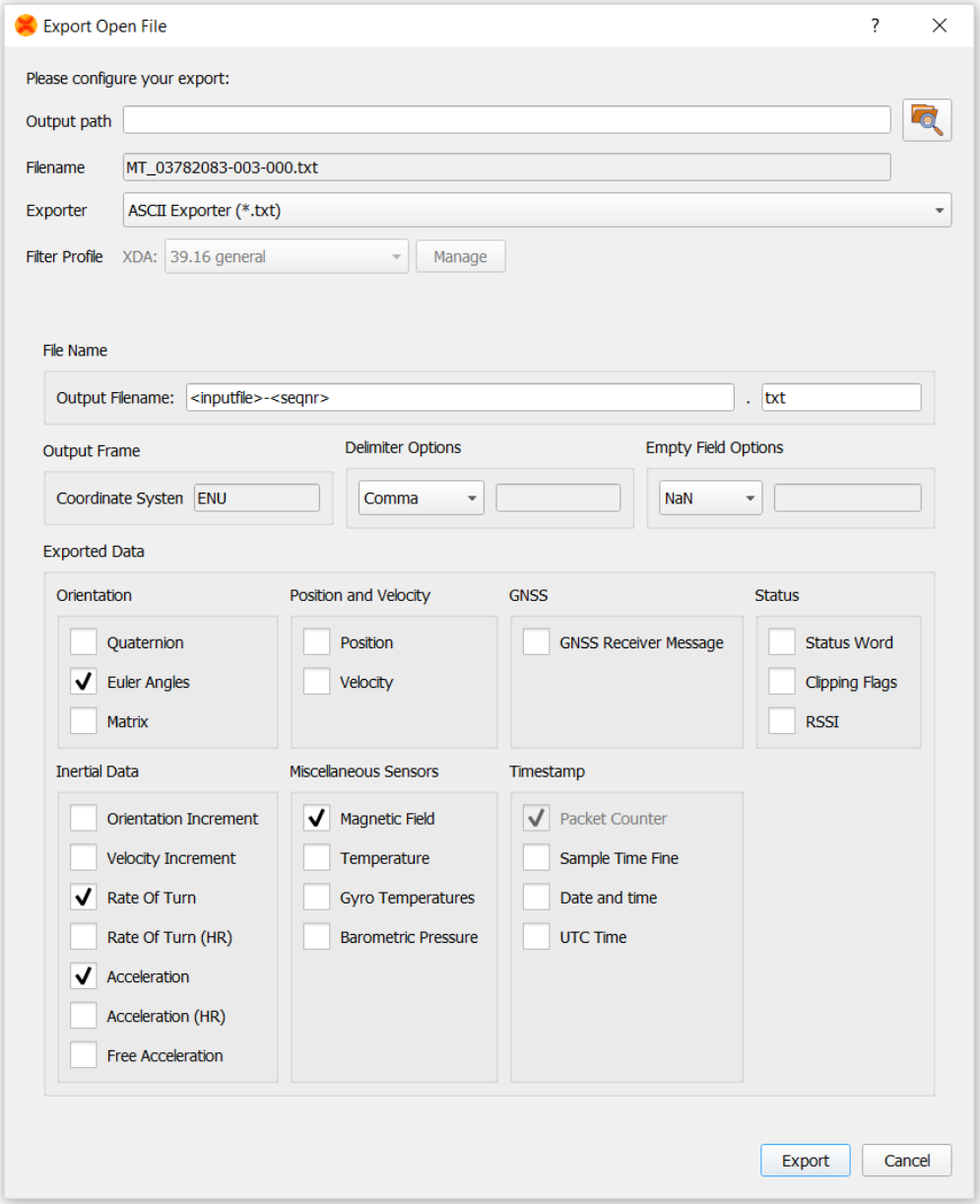


Figure 14: The Preferences – ASCII Exporter window

5 Overview MT Manager

This section describes the options available to the user in the MT Manager.
In section 6 operating the MT Manager is described.

5.1 Purpose

The purpose of the MT Manager is to provide easy access to the capabilities of any of the currently supported devices (refer to section 5.3).
The MT Manager can be used to interface with the MT and to visualize and log data. It offers export options for ASCII text files. The ASCII export format can be customised to your needs.

5.2 MT Manager features

The MT Manager software is an easy-to-use software with a familiar Windows user interface, which allows you to:

- view 3D orientation in real-time
- view inertial and magnetic sensor data in real time
- view latitude, longitude, altitude plots in real time (depends on Motion Tracker used)
- view and compose messages to and from the device via a real time message terminal
- reprocess binary data log files
- export log files to ASCII
- change and view various device settings and properties
- run a self test to check the mechanical functions of the inertial sensors and magnetometer
-

The MT Manager is therefore an easy way to get to know and to demonstrate the capabilities of your Xsens Motion Tracker.

5.3 Supported devices

Currently the following devices are being supported by the MT Manager:

- MTi 1-series
- MTi 10-series 5th generation
- MTi 100-series, including MTi-G-710 GNSS/INS 5th generation
- MTi 600-series
- MTw Awinda [MTw_SDK])

For detailed information about these MTs, please refer to the corresponding User Manuals and Technical Documentation: [MTi_1s], [MTI_600s] and [MTi_10s_100s].
Future Xsens Motion Trackers will be supported as of their release.

5.4 Input Options

The MT Manager can handle real-time input and input from recorded binary files (see also sections 6.5.1 and 6.5.2).

Real-time: Serial data using USB or COM port (via USB virtual COM-port or RS232[3]).

[3] COM1 and COM2 only

Files: `.MTB` (MT Binary Communication Protocol)[4] log files. Contain recorded output log-files from a Motion Tracker.

In both cases the input (file) format is the same.

The `.MTB` log files generated with the MT Manager will contain the following MT Data messages:

- Configuration data
- Extended MT Specification data (eMTS)
- Filter state message, message ID 0x98 (in case of data with preset "XDA processing")
- If enabled, UTC date and time at regular intervals (as configured)
- If enabled, GNSS satellite SVInfo at regular intervals (as configured)
- MTData2 at output frequency (as configured)

The MT Manager software handles the request of these additional data packets from the MT (not only requesting MT Data) to enable full analysis of log-files in the MT Manager software later.

NOTE: An MTB file can contain any number of MTData2 packets that are requested from the MT. Only if an MTB file contains Sensor Component Readout or sensors data ($\Delta q/\Delta v$ or inertial data) and/or GNSS data messages, the data can be re-processed using different filter profiles. In all other cases the .MTB file is considered a log-file, which can be played back again for viewing.
In the case that only sensors data and/or GNSS data is requested from the MTi, the MT Manager will run the sensor fusion filter in XsensDeviceApi64.DLL of the host PC (and not on the DSP of the MT) to estimate orientation, position, velocity.

5.5 Output Files

The MT Manager can export data logged in .MTB files to different formats as described in section 6.5.3.

ASCII text data

- Calibrated sensor data (3D acceleration, rate of turn, magnetic field, $\Delta q/\Delta v$, free acceleration, etc.)
- Orientation data
- Position
- Velocity

The output orientation can be represented in different conventions:

- Unit normalised Quaternions (also known as Euler parameters)
- Euler angles: roll, pitch, yaw (XYZ Earth fixed type, also known as Cardan)
- Rotation Matrix (Direction Cosine Matrix)

Data and (UTC) time can also be included in the exported files. See 6.5.3.5 for more information on the columns of the exported ASCII file.

[4] The `.MTB` extension is associated with MT Manager.

KMZ geographic data

- Timestamp
- Position
- Velocity
- Orientation
- GNSS Mode
- UTC time

KMZ files (available from MTi-G-710 and MTi-7data sets only) are excellent to study trajectories in e.g. Google Earth.

5.6 Menu bar

In the MT Manager menu bar you will find the following entries:

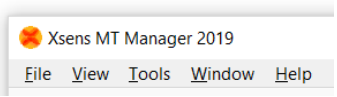


Figure 15: The menu bar in MT Manager

In the table below each (sub-) entry is explained.

Table 3: The MT Manager menu structure

Entry (level 1)	Entry (level 2)	Entry (level 3)	Description
File	Open File		Open a previously recorded (shortcut: CTRL-O): • MT Manager log file (`.mtb`) • Xsens log file (`.bin` and `.xm`) • Xbus Master log file (`.xm`) • Binary log file (`.bin`)
	Close		Closes the currently opened file
	Export		Export an opened log file to (shortcut: CTRL-E): • ASCII formatted file For more details, refer to section 6.5.3.
	List of last opened files		A list of last opened files
	Exit		Closes MT Manager
View	Displays	Device List	Toggle to open/close Device list. Refer to section 5.7.1
		Message Window	Toggle to open/close the Messages window
		Device Settings	Toggle to open/close the MT Settings dialog
		3D Orientation	Toggle to open/close the 3D display of orientation
		Inertial Data	Toggle to open/close the inertial data graph
		Orientation data	Toggle to open/close the orientation graph
		Status Data	Toggle to open/close the status graph
		Temperature Data	Toggle to open/close the temperature graph
		Velocity	Toggle to open/close the velocity graph
		Altitude	Toggle to open/close the altitude graph
		Device Data View	Toggle to open/close the Device Data terminal
		XDA Data View	Toggle to open/close the XDA Data terminal (hidden by default, enable this feature through Tools>Preferences)

		Position	Toggle to open/close the position graph
		Space Vehicle Information	Toggle to open/close the SV information graph
		UTC Date/Time	Toggle to open/close the UTC date/time window
	Status bar		Toggle to switch on/off the status bar at the bottom of the MT Manager window. This status bar shows playback information, "extended" tool tips etc.
Tools	Preferences	MT Manager	Here you can change the following general settings: Graphs: - Euler Angles or Quaternions - Celsius or Fahrenheit - Toggle display graphs as strobes - File Plotting mode: Real time or All data - Display time in graphs Miscellaneous: - Orientation output frame - Toggle show docked MTw's and log and visualize docked MTw's - Enable RS485 Compatibility - Enable XDA Data View XDA options: - Allows to load an alternative filter profiles file (use by Xsens support department only)
		Logging	Here you can change Logging Settings (refer to section 6.5.1) - Name of the log file (template)
	Restore Communication		Resets the communication settings of an MTi to the default factory settings, allowing to regain communication with an MTi in MT Manager (COM port interface only)
	Wireless configuration		Opens the wireless configuration window (MTw only)
	Power off	All Docked MTws	Powers off all docked and USB connected MTws
		Wireless system	Powers off all MTws that have a wireless connection
		All Devices	Powers off all MTws
	NTRIP Client		Opens the NTRIP Client window (refer to section 6.3).
Window	Tile		Tiles the open graph windows. Tiling will be done in order of opening. With 3 graphs, opening the graphs in a specific order determines which graph is over the entire height of the window in the left column and which graphs are placed as smaller windows in the right column.
	Cascade		Cascades the open graph windows
Help	Documentation		Links to the latest online documentation
	Support	BASE – Knowledge Base and Community Forum	Links to BASE – Articles, guides, FAQ and online user forum
		Contact Support	Contact Xsens Product Specialists
	Updates	Download Firmware Updater	Links to the download page for the MTi Firmware Updater
		Check for new MT Software Suite versions	Check for new MT Software Suite versions
	Online Shop		Opens the webpage http://shop.xsens.com where accessories and MT's can be ordered.
	About MT Manager		Display version information and includes EULA

5.7 Data views, toolbars and buttons

In this section the sub-windows, toolbars and button functionalities of the MT Manager are explained:

5.7.1 The Device List

By default, the Device List is displayed in a sub-window, showing useful information about your MT. Note that the Device List is read only.

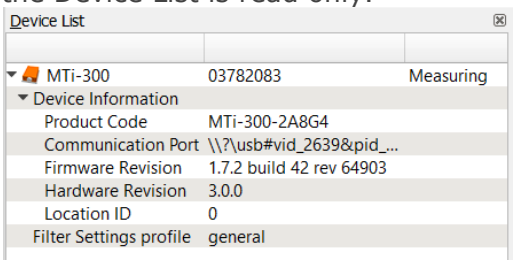


Figure 16: The Device List

The information in Table 4 is available.

Table 4: The data shown in the Device List

Parameter	Description	Comments
DeviceID	A unique DeviceID. See [MTi_10s_100s] for explanation of the DeviceID	Fixed value, retrieved from device
Product Code	Product code, built up from type of device, product series, interface, accelerometer range and gyroscope range.	Fixed value, retrieved from device
Location ID	Location ID that allows identifying the MTi in a system setup	Can be set in MT Settings Dialog
Serial Port	USB or COM port number	Automatically detected
Filter Settings Profile	The filter setting profile used for orientation	Can be set in MT Settings dialog

Table 5: The MT System State shown in the Device List

MT System State	Description	Comments
Measuring	The MT is outputting data	
Recording	Data is being saved to file	
Flushing	Data is being retransmitted after recording has been stopped	Applies to Awinda MTw only
Config Mode	MT is in config mode. This happens when configuration messages are sent to the MT or when the user puts the MT in config mode	When you close MT Manager, the MTi will go to Config Mode. See https://base.xsens.com/hc/en-us/articles/115003997494
File Mode (open)	A file is selected. MT Manager is waiting for the user to process the file.	
File Mode (loading)	A file is being loaded and processed	Progress is displayed in the fourth column.

File Mode (ready)	Displayed when a file is loaded and when the entire file has been processed.	
File Mode (playing)	Displayed when the file is being played back	

With the Device List, it is possible to disconnect specific devices. Right-click on any parameter associated with the MTi that needs to be disconnected, right click and choose Disconnect. The MTi will be removed from the Device List.

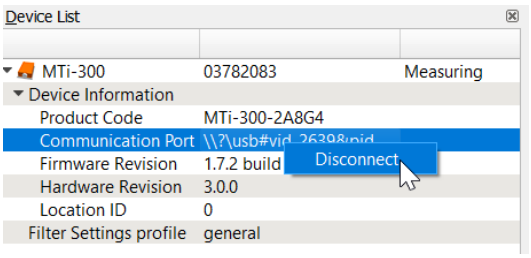


Figure 17: Right-click on the Device allows to disconnect a single MT

5.7.2 Device Settings

In the Device Settings window several (low-level) settings can be changed, including the output configuration. Take caution in changing settings in Device Settings as these settings can have large effects on the MTi device. In this window it is possible to save and load a set of device-specific settings, including the output configuration that can be copied to other devices (with the same product code). You can always revert a device to its Factory Settings using the Revert button.

For details on the Device Settings, please refer to Section 6.2.2.

5.7.2.1 Output configuration

In the Output Configuration tab, all output options of the MTi can be set, including frequencies and formats.

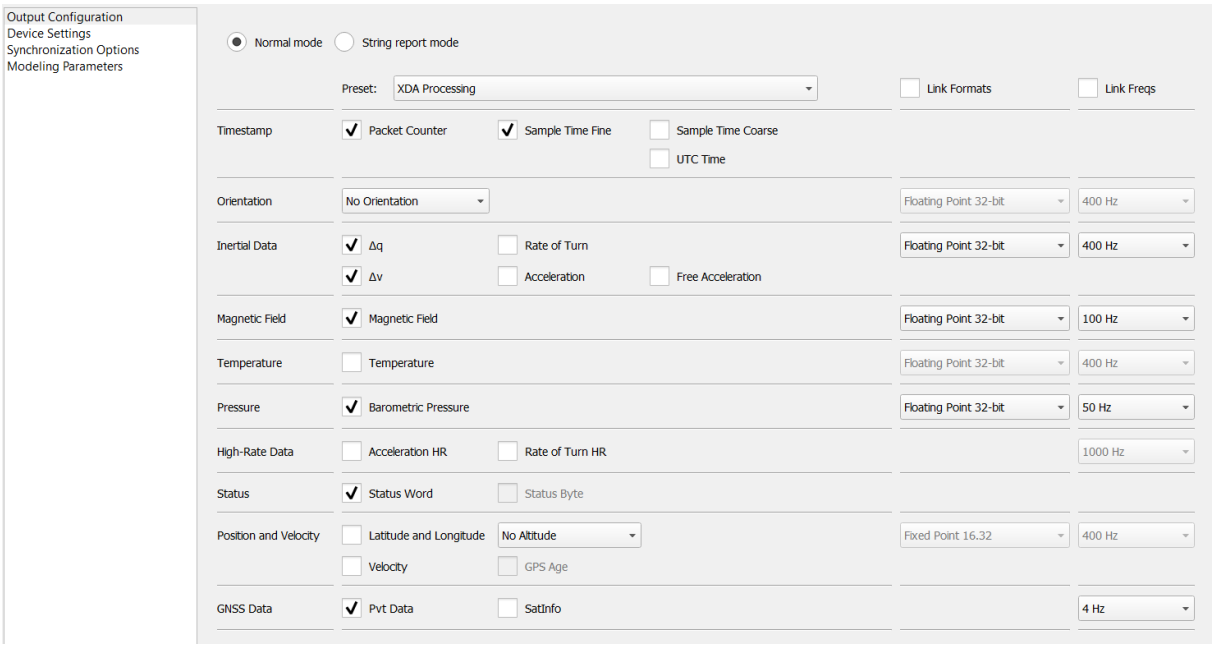


Figure 18: the Output Configuration tab for an MTi-G-710 GNSS/INS. Depending on the MTi attached, the Output Configuration window may show fewer options.

5.7.3 Data Views

The MT Manager offers a wide range of information displayed in its sub-windows, which can be opened and closed via the (Main Views and GNSS) toolbar buttons or the menu bar:

Figure 19: The Data Views and GNSS toolbars

The individual buttons and their functionality will be explained in the next sub-sections; availability of some of the buttons and related sub-windows depends on the type of the connected device (e.g. position and velocity information will not be accessible with e.g. MTi-20 VRU or MTi-300 AHRS).
The icons corresponding with the button that activates a specific sub-window are displayed on the top left of each subsection.

5.7.3.1  3D Box view

The 3D Box View is a real-time graphical (OpenGL) representation of the MT orientation measurements, i.e. roll, pitch and yaw.

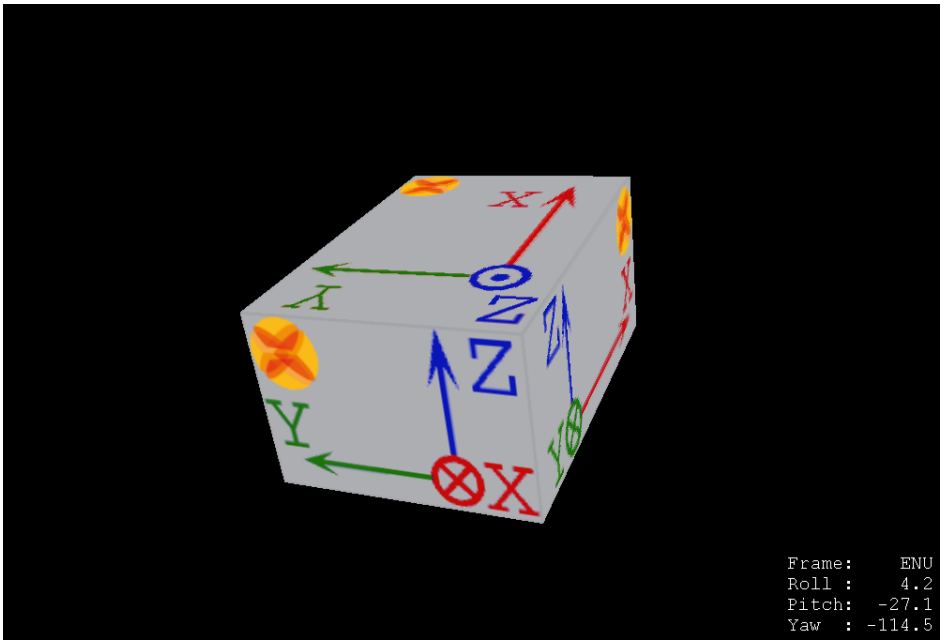


Figure 20: The 3D Box view is an easy way of visualizing the orientation of any MTi

5.7.3.2 Inertial data view

Per sensor type, the Inertial Data view graphically shows the 3D calibrated measurement data vs. time:

- acceleration (from the accelerometers) in m/s^2;
- angular velocity (from the gyroscopes) in deg/s;
- magnetic field (from the magnetometers) in normalised arbitrary units (a.u.).

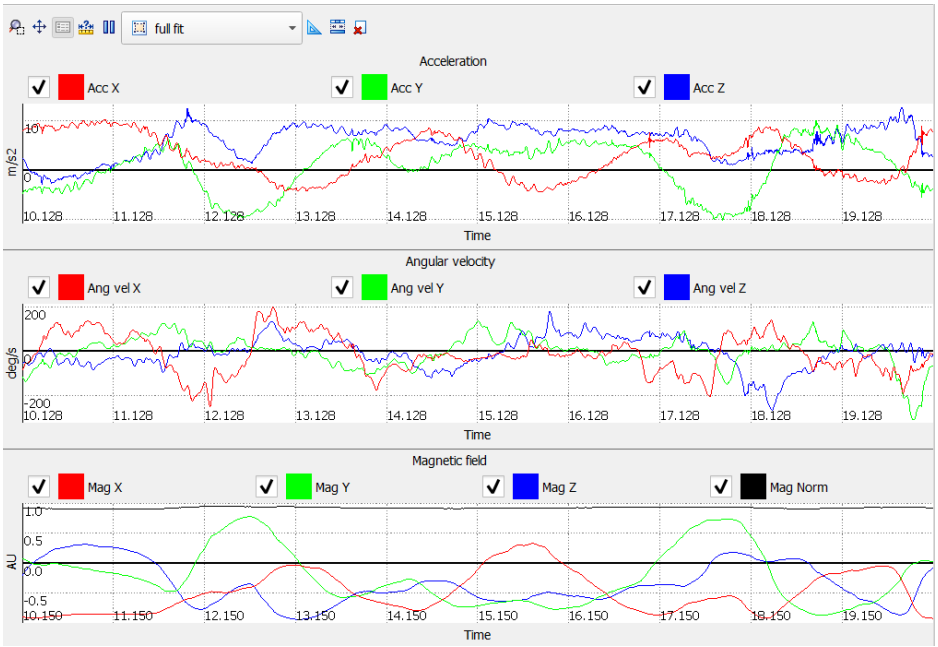


Figure 21: The Inertial data view for acceleration, angular velocity and magnetic field

Table 6 explains the line colours and the buttons in this view.

Table 6: The line colours in the inertial data graph

Colour	Corresponding axis
Red	Acceleration, angular velocity (roll) and normalised magnetic field in X direction
Green	Acceleration, angular velocity (pitch) and normalised magnetic field in Y direction
Blue	Acceleration, angular velocity (yaw) and normalised magnetic field in Z direction
Black	Total acceleration, angular velocity or magnetic field, if available

Automatic scaling

It is possible to choose the scaling of the inertial data plot using the pull-down dialog.

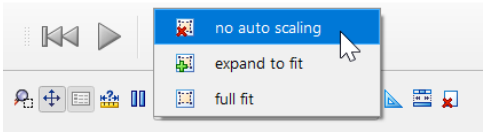


Figure 22: Tools let you configure the graphs

Table 7: The different scaling options in the graph windows.

Scaling option	Functionality
No auto scaling	Y-scale will no longer be scaled
Expand to fit	Y-scale will be stretched to show all data in plot
Full fit	Y-scale will be stretched to show all data in plot

Zooming

When the Zoom-icon  is selected, you have several options to zoom.

Option 1: Press and hold either mouse button, drag mouse to make a zoom rectangle (right button zooms out, left button zooms in):

Figure 23: A zoom rectangle in the Euler angles graph

-Release mouse button to zoom in/out to the zoom rectangle
-Press other mouse button to cancel the zoom
-Use scroll wheel to make minor adjustment to first point of the rectangle

Option 2: Double click and hold one of the mouse buttons to generate a default zoom rectangle centered around the mouse position with zoom factor 2.0 (right button zooms out, left button zooms in):
Then:

-Release mouse button to zoom in/out to the zoom rectangle
-Press other mouse button to cancel the zoom
-Move the mouse to move the zoom rectangle
-Use the scroll wheel to increase/decrease the zoom factor

Option 3: Use scroll wheel without buttons pressed to simulate a double click centered around the mouse position and immediately applying the zoom i.e. apply a default zoom rectangle centered around the mouse position (right button zooms out, left button zooms in).

- NOTE: Zooming is not possible when the autoscale method is set to "full fit".

Zooming in y-direction only
When zooming with the above option, it can happen that new data will not be shown in the zoom box, as the x-scale (time) ends before the place where new data is created. In order to zoom only in y-direction, enable the function "show all samples" with the show all samples button: 

When “show all samples” is enabled, the x dimension of the zoom rectangle is always the complete width of the graph:

Figure 24: Zooming in y-direction only can be enabled with the button "show all samples"

Panning the graph

When the pan icon is enabled, you can pan the graph with the following actions:
- Press and hold left/right mouse button
- Release the mouse to stop panning
- Move the mouse to pan the graph

NOTE: Panning is not allowed when the autoscale method is full fit

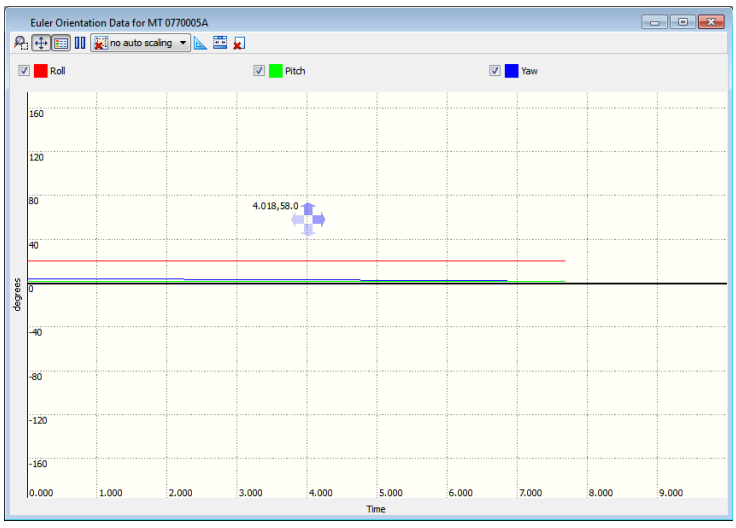


Figure 25: Panning is available in all directions

Showing data values

With the Show Values button enabled, hovering over the graph will display the values at that moment.

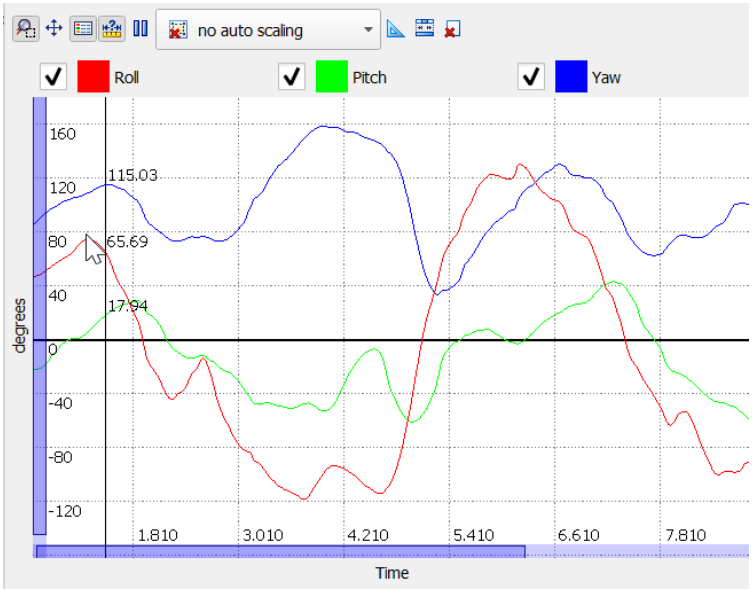


Figure 26: The Show Values button activates the possibility to see the values in the graph

Showing less data channels

With the checkboxes, it is possible to omit data from the plot. This way, you can closely investigate one particular signal.

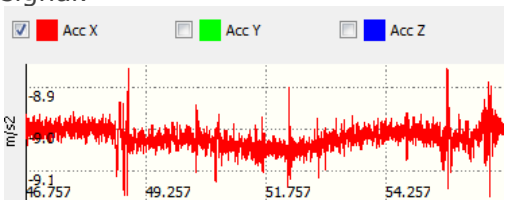


Figure 27: Turning off some of the channels allows for closer investigation of a particular signal

Freezing a graph

When you are using an MTi in live view, you cannot pause the file (see section 5.7.6), to investigate data further. In that case, you can use the freeze button and zoom and pan on visible data:

Clearing and resetting graphs

There are two ways of clearing and resetting graphs. To clear the graph, use the clear button .

Another way to reset the zoom that is very convenient when you have used zoom and pan functions, is to close and open the graph.

5.7.3.3 Orientation data view

The Orientation data view shows the 3D orientation (calculated from the angular velocities) in either Euler angles in degrees vs. time or Quaternions vs. time

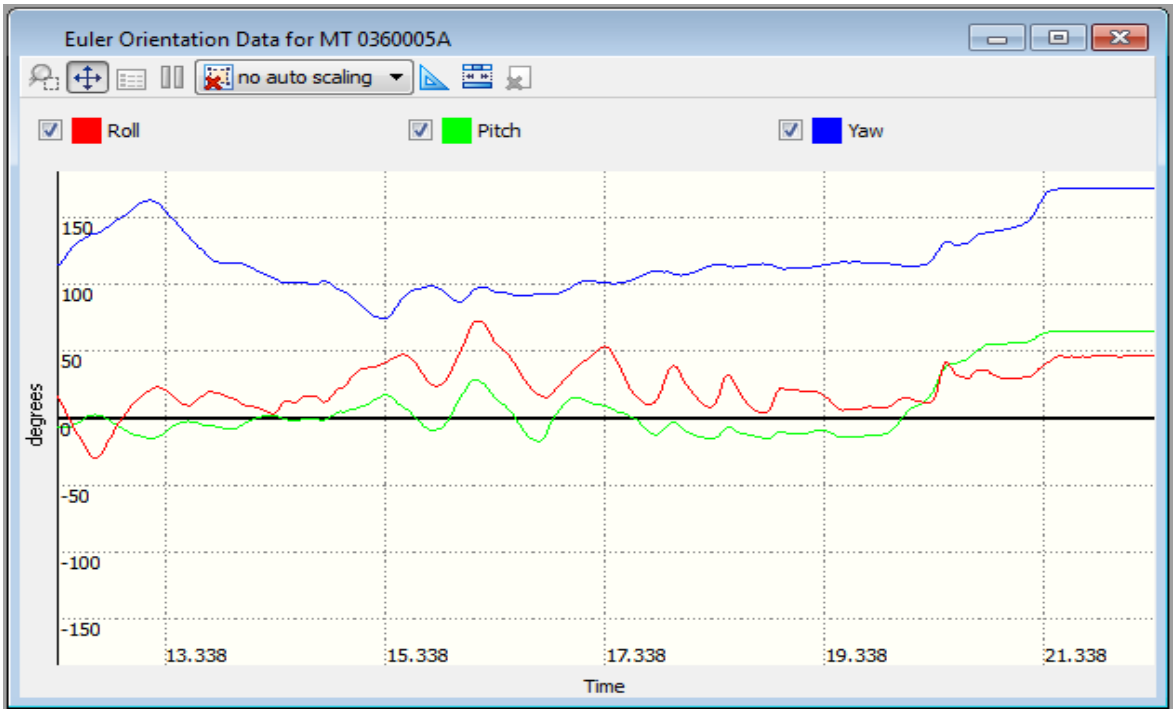


Figure 28: The orientation graph shows the orientation of the MTi over a period of 10 seconds

Table 8 explains the line colours in "degrees vs. time" view:

Table 8: Colours in the Euler angles graph

Colour	Corresponding axis
Red	Orientation of the X-axis
Green	Orientation of the Y-axis
Blue	Orientation of the Z-axis

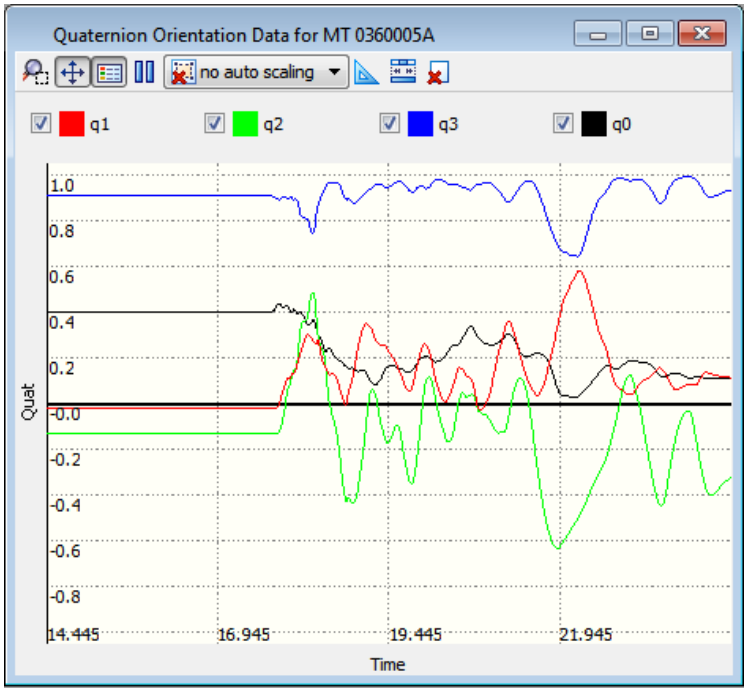


Figure 29: The quaternion graph shows the 4 components in one graph

Table 9 explains the line colours in the "Quaternions vs. time" view:

Table 9: Colours in the quaternion graph

Colour	Description
Red	q1
Green	q2
Blue	q3
Black	q0

Please refer section 5.7.3.2 for explanation of the various buttons and checkboxes.

5.7.3.4 Free Acceleration view

The Free Acceleration view window visualizes the 3D Free Acceleration of the MTi (VRU, AHRS and GNSS/INS devices only). By default, Free Acceleration is visualized in the East-North-Up (ENU) format. In order to switch between ENU, NWU and NED visualizations, go to Tools > Preferences > MT Manager > Graphs.

Figure 30: The Free Acceleration view, visualizing 3D Free Acceleration in m/s^2

5.7.3.5 MT Status

The MT Status sub-window displays various status flags.

Be sure to enable the Status Data Output in MT Output Configuration dialog:

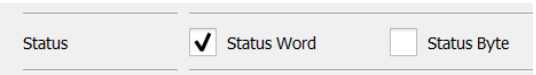


Figure 31: Tick boxes for status in the Output Configuration window

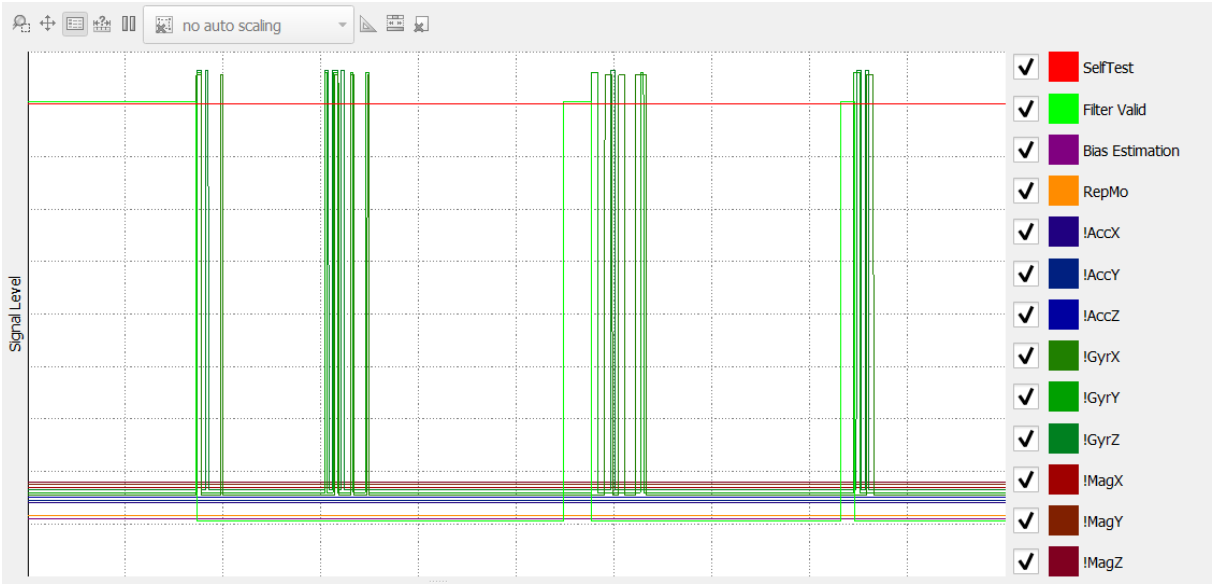


Figure 32: The status window of an MTi-30 AHRS. In this particular screen shot, several gyroscopes are clipping

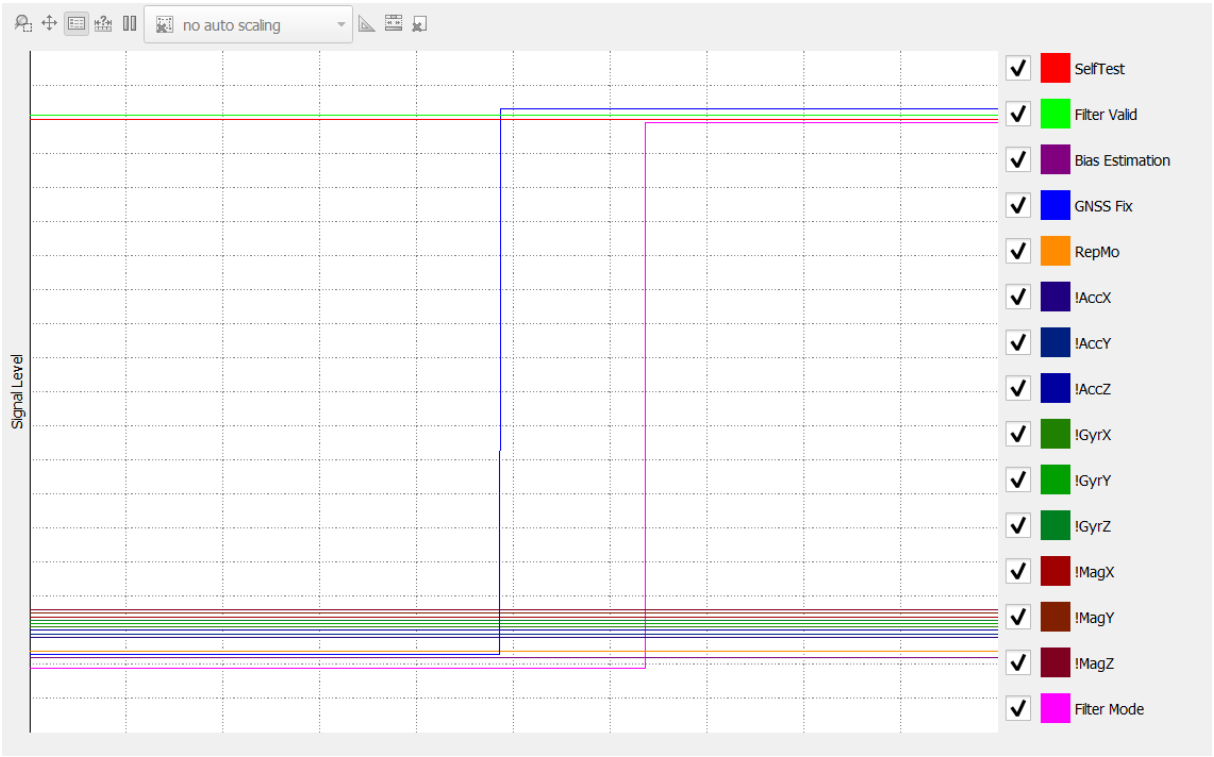


Figure 33: The status windows of the MTi-G-710 and MTi-7 have two extra channels, GNSS Fix and Filter Mode

Please refer section 5.7.3.2 for explanation of the various buttons and checkboxes.

Table 10: Signals in the Status window

Colour	Status data description
Red	Motion Tracker has passed the self-test according to eMTS. For an up-to-date self-test indicator, see [LLCP], **`RunSelfTest`**
Light green	Filter accuracy indicator; low="not accurate", high="accurate"
Dark purple	Manual Gyro Bias Estimation (refer to https://base.xsens.com/hc/en-us/articles/360002763354): 1 (high): running with no rotation assumption at $^2/_3$ of the y-axis: error: rotation detected, no gyro bias estimated 0 (low): estimation complete, no errors
Bright blue	GNSS fix; indicates if the GNSS receiver has a valid fix
Orange	RepMo: Representative Motion mode of In-run Compass Calibration (ICC) active
Dark blue (3x)	Clipping flags for the accelerometers, 20g
Dark green (3x)	Clipping flags for the gyroscopes, 450 deg/s or 1000 deg/s
Dark red (3x)	Clipping flags for the magnetometers
Magenta	Filter mode; indicates what the state of the filter in the MTi-G-710 or MTi-7 is, see [LLCP]

5.7.3.6 Temperature view

The Temperature view window shows the internal temperature of the device. Temperature data is visualized in degrees Celsius by default. In order to change to degrees Fahrenheit, go to Tools > Preferences > MT Manager > Graphs.

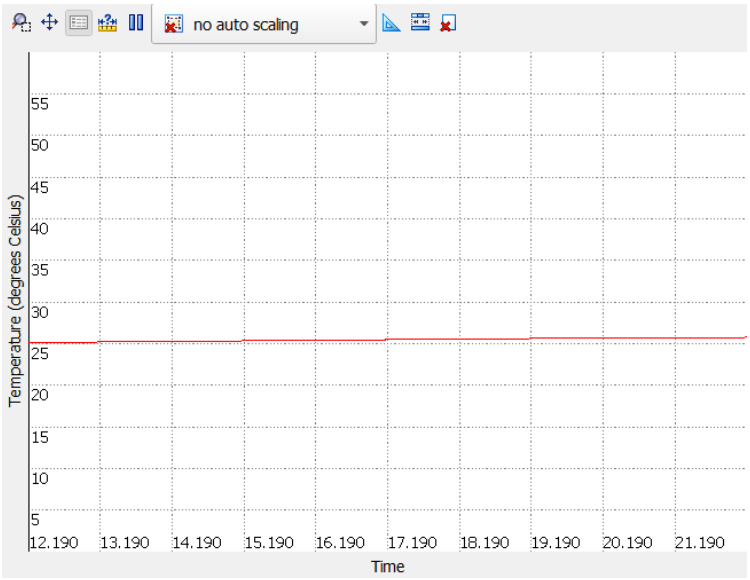


Figure 34: The Temperature view window, showing that the MTi is warming up directly after powering it.

5.7.3.7  Velocity view

The Velocity view window visualizes the 3D velocity of the MTi (MTi-G-710 and MTi-7 only). By default, Velocity is visualized in the East-North-Up (ENU) format. In order to switch between ENU, NWU and NED visualizations, go to Tools > Preferences > MT Manager > Graphs.

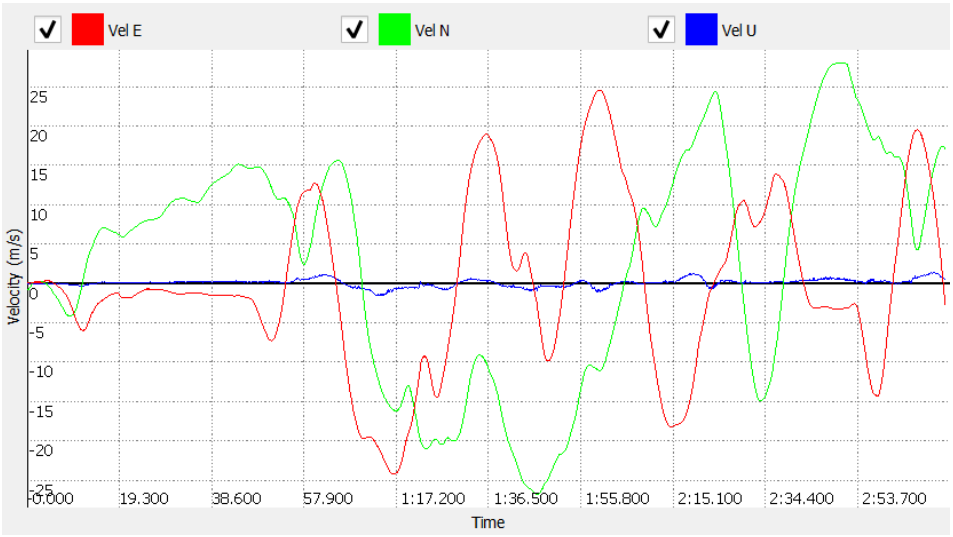


Figure 35: The Velocity data view, displaying 3D velocity in m/s

5.7.3.8  Altitude view

The Altitude view window visualizes the altitude of the MTi (MTi-G-710 and MTi-7 only). Altitude is displayed as height above the WGS-84 Ellipsoid in meters.

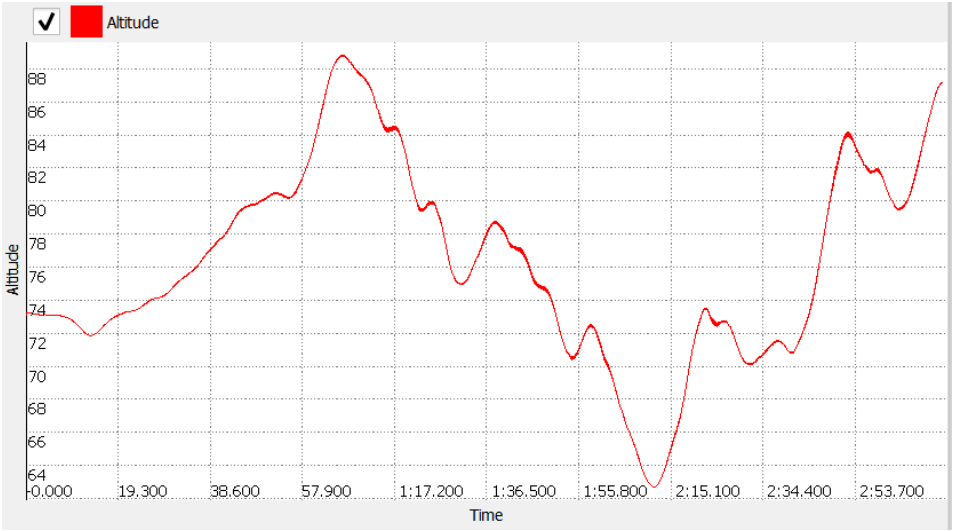


Figure 36: The Altitude data view, displaying height above the WGS-84 Ellipsoid in meters

5.7.3.9 Position view

The Position view window visualizes the 2D position of the MTi (MTi-G-710 and MTi-7 only). Position is displayed in terms of longitudinal and latitudinal coordinates.

Figure 37: The Position view, displaying 2D position

5.7.3.10 Space Vehicle Information window

The Space Vehicle Information (or SatInfo) Window shows the various satellites with their respective signal strength in dBHz.

The columns are labelled according to the constellation and the number of the space vehicle. The digit in front of the semicolon indicates the satellite system, the number after the semicolon is the satellite number. E.g. 0:5 indicates Space Vehicle #5 from the GPS constellation. The labels are

Table 11: Colours used in the SV information window

Label	Color	Meaning
Detected (unused)	Blue	The satellite data is not used for the navigation solution. Note that SBAS satellites (1:#) can only be detected or unhealthy. If SBAS corrections are being used for the GPS satellites, the GPS satellites are light green.
Used	Dark green	The satellite data is used for the navigation solution. No differential corrections have been applied.
Used+D	Light green	The satellite data is used for the navigation solution; differential correction have been applied. GLONASS satellites do not have differential corrections, so they are always dark green if used for the navigation solution
Unhealthy	Red	The satellite data is not used

Figure 38 The SV info window showing 5 GPS satellites and 6 GLONASS satellites being used for the navigation solution and 2 satellites that have been detected.

5.7.3.11 UTC Time view

The UTC Time view window visualizes the UTC Time output of the MTi. The GNSS receiver automatically retrieves UTC Time for the MTi-G-710 and MTi-7. For all other devices, UTC Time can be set manually (see 6.2.2.4).

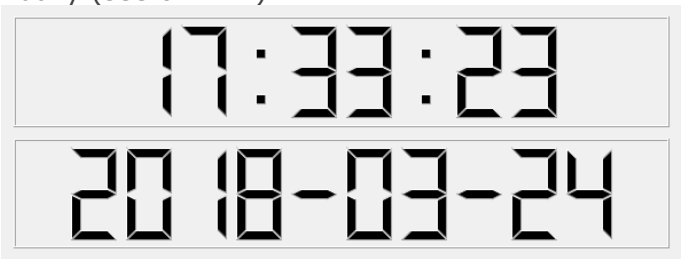


Figure 39: The UTC Time view.

5.7.3.12 Device/XDA Data View terminals

The message terminal shows messages sent to and received from the device or the Xsens Device API (XDA) in real-time. The Device Data View terminal can also be used to compose low-level messages in order to quickly understand the communication protocol. See section 6.4 for more information about the message terminals. The XDA Data View is hidden by default. It can be enabled through Tools>Preferences.

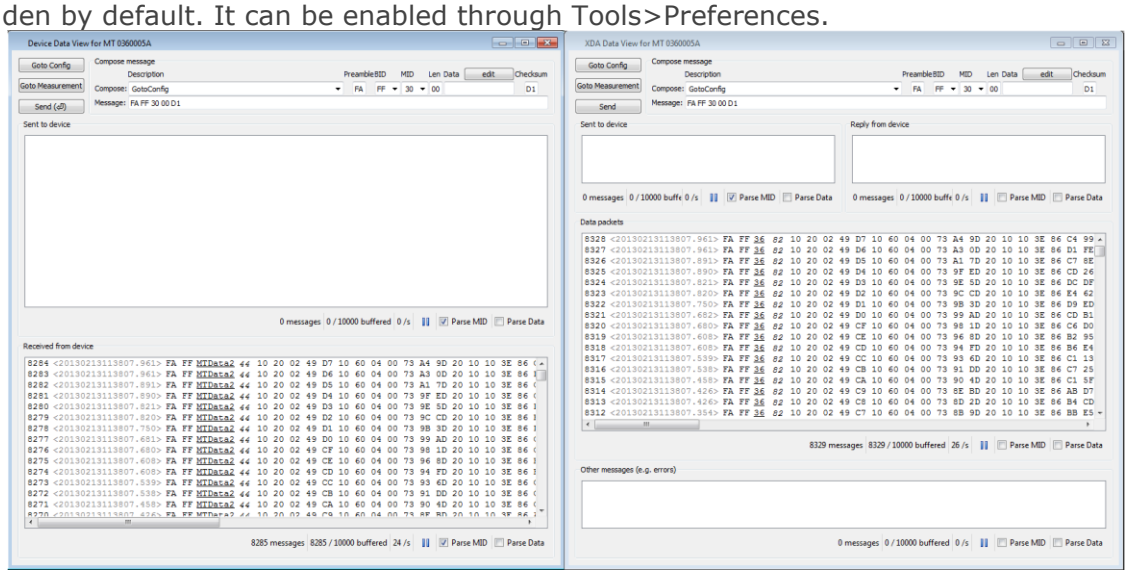


Figure 40: The message terminals for the device (left) and XDA (right)

5.7.3.13 Message window

The message window shows warnings and other informational messages.

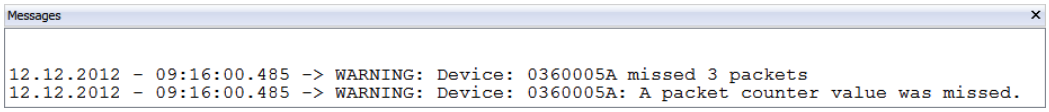


Figure 41: The messages window may show warnings on e.g. missed data packets

5.7.4 Connectivity

With the Connectivity toolbar you can control connecting your devices:

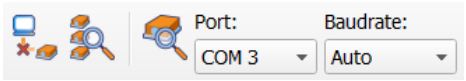


Figure 42: The Connectivity toolbar

Please refer to section 4.2 for details on how to connect and disconnect your devices.

5.7.5 File control

The file control tool bar makes it possible to choose where files are stored and opened.

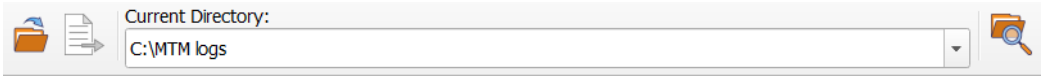


Figure 43: The File control toolbar

Table 12: Meaning of buttons in the File Control toolbar

Icon	Action
	Open a previously recorded file (see also "File → Open…")
	Export an opened log file (see also "File → Export…")
	Set the Current Directory (by browsing)

5.7.6 Playback & recording

To be able to record data and playback recorded data, the MT Manager offers the Playback & Recording toolbar.

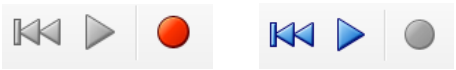


Figure 44: The Playback and recording bar when an MTi is attached (left) and when a file is loaded in MT Manager (right)

Table 13: Meaning of the buttons in the Playback and Recording toolbar

Button name	Button icon	Functionality
Record/ Stop Record		Pressing this button will turn on the logging of data to a file (see also section 6.5.1) Releasing this button in recording mode, will turn off the logging
Play		Pressing this button will start (or continue) playback of logged data (see also section 6.5.2)
Rewind		During playback, pressing this button will go to the start of the logging

5.7.7 Orientation resets

Please refer to [MTi_10s_100s] for detailed information about orientation resets and the effects these have. Available resets are summarized in Table 14. Note: be cautious to use the orientation resets.

Table 14: The available orientation resets

Reset type	Functionality
Heading reset	redefines North to the x-axis of the device – applies to RotLocal
Inclination reset	redefines device coordinates system such that momentary inclination is zero – Applies to RotSensor
Alignment reset	combines the heading reset and the object reset – applies to both RotLocal and RotSensor

After choosing the reset type, press the Reset Orientation button  .

You can also choose to apply the reset on the current device or on all connected devices. After a reset you can store the new values to the MT Settings by pressing the Store Orientation button  .

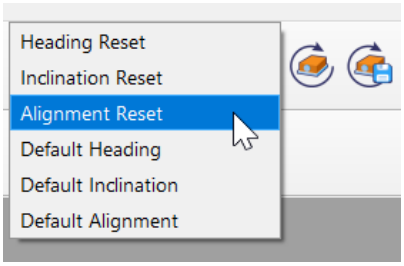


Figure 45: The orientation resets toolbar can be used to apply a specific reference coordinate system to the MTi's orientation, velocity and sensors data output

5.7.8 In-run Compass Calibration & Representative Motion

In-run Compass Calibration is a way to calibrate for magnetic distortions present in the sensor operation environment using an onboard algorithm leaving out the need for a host processor like a PC. It estimates the hard- and soft-iron effects and provides new magnetometer calibration parameters. To expedite the calibration of the magnetometer sensor readings with respect to the new field, there is a feature called Representative Motion. Click the button Start/Stop Representative Motion and rotate the device together with the object that disturbs the magnetic field in all directions of the actual application.

Figure 46: Click the Representative Motion button to start the Representative Motion mode. Click it again to stop the Representative Motion mode.

If you want to store the new values in the non-volatile memory (remember that they are discarded when you power cycle the MTi), press the store button:

Figure 47: This button stores the ICC parameters in the non-volatile memory

For more information on ICC and Representative Motion, refer to the following link on BASE: https://base.xsens.com/hc/en-us/articles/213588029

5.7.9 Manual Gyro Bias Estimation

Manual Gyro Bias Estimation is a way to quickly estimate the gyroscope zero-rate offsets or biases. This feature can be particularly useful when trying to reduce Heading drift with VRU devices or slowly moving GNSS/INS devices. Manual gyro bias estimation forces the filters of the MTi to estimate the gyroscope biases by assuming that the MTi will be held motionless for a given period of time.

In order to perform a manual gyro bias estimation using MT Manager, click the corresponding icon,  . A window will open, providing guidelines to the user. For more information on this feature, refer to BASE: https://base.xsens.com/hc/en-us/articles/360002763354.

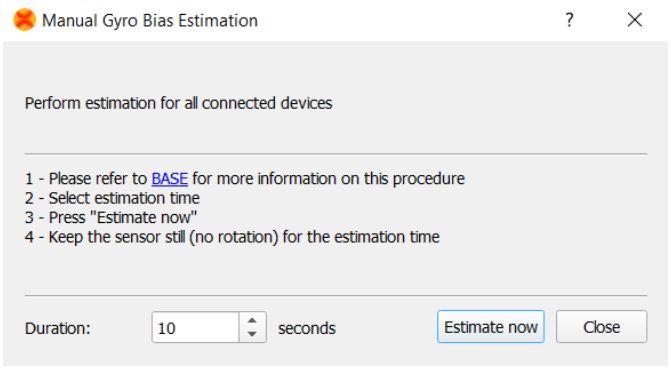


Figure 48: The Manual Gyro Bias Estimation window guides the user through the use of the feature.

6 Operating guidelines

6.1 Overview

This section describes the configuration and typical utilisations for managing your devices with the MT Manager.

6.2 Configuring the MT Manager and your devices

6.2.1 General settings

Changing the settings of your devices can be done (dependent on the setting) in:

1. Device Settings sub-window (refer to section 5.7.2).
2. Message terminals (refer to section 6.4). Be cautious when changing settings here, as you can send any message to the MTi, even if the specific MTi does not support the message.

Note: changing the settings in the *Device Settings* window requires the user to explicitly invoke writing to the MT:

Press the "Write to MT" button, **to actually save your changes** to non-volatile memory in the MT device. MT Manager will then write the settings to the device and rescan for devices:

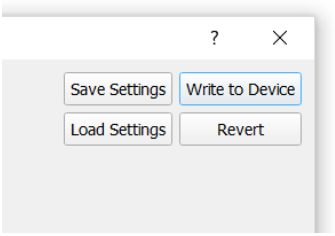


Figure 49: In the Device Settings window, it is important to write the changes made to the MTi

6.2.2 Using the Device Settings window

The Device Settings window  lets you modify all non-data output related settings, such as communication and filter settings.

6.2.2.1 Header

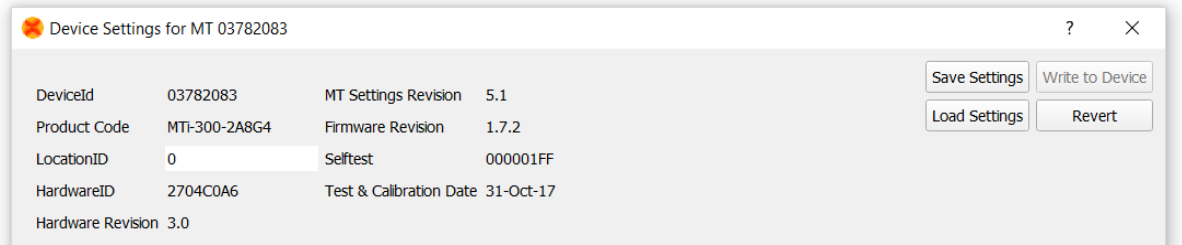


Figure 50: The header shows general information on the MTi

In the header, you will find the following parameters (all read-only, except for LocationID).

Table 15: Explanation of the information in the header of the Device Settings window

Parameter	Description
DeviceID	8-digit unique DeviceID of MTi (hexadecimal), refer to [MTi_10s_100s] for details on the format
Product Code	The product code of the connected MTi or file, refer to [MTi_10s_100s] for details on the format
LocationID	Can be used to identify Motion Tracker by a number (0-255) instead of its Device ID. This can be particularly useful when a fixed setup with multiple interchangeable MT's is used
HardwareID	HardwareID indicates the hardware DeviceID. This ID is assigned during assembly
Hardware Revision	Hardware revision of the MTi
MT Settings revision	The extended Motion Tracker Settings layout
Firmware Revision	Firmware revision of the currently connected MTi.
Self test	When all sensors passed the Built-in Selftest (BIT), this shows 00001FF. This field is only visible for MTis supporting the self test functionality
Test & Calibration Date	Shows when the device was tested and calibrated at Xsens

6.2.2.2 MTi configuration file

With the MT Manager it is possible to save and load predefined set of settings, such as synchronization settings, output configuration and baud rate. These settings can be copied from a device into a dedicated file. The file can then be loaded and the same settings can be applied to another MTi with the same product code, e.g. MTi-30. This feature is useful for system integrators that need to configure many MTi's. Note that this feature is only available with devices with a firmware version of 1.2.3 or higher.

The following settings are saved (message ID between square brackets):

1. RotSensor and RotLocal [0xEC]
2. Baudrate [0x18]
3. Filter profile (if available, otherwise the filter profile in the device will be used) [0x64]
4. Extended Output Mode [0x86]
5. Position (Latitude, Longitude, Altitude) [0x6E]
6. Location ID [0x84]
7. OptionFlags (see [LLCP] for full contents) [0x48]
8. OutputConfiguration [0xC0]
9. OutputMode (legacy) [0xD0]
10. OutputSkipFactor (legacy) [0xD4]
11. Period (legacy) [0x04]
12. SyncSettings [0x2C]
13. GnssPlatform [0x76]

To save a setting, click the "Save Settings" button in the MT Settings dialog.

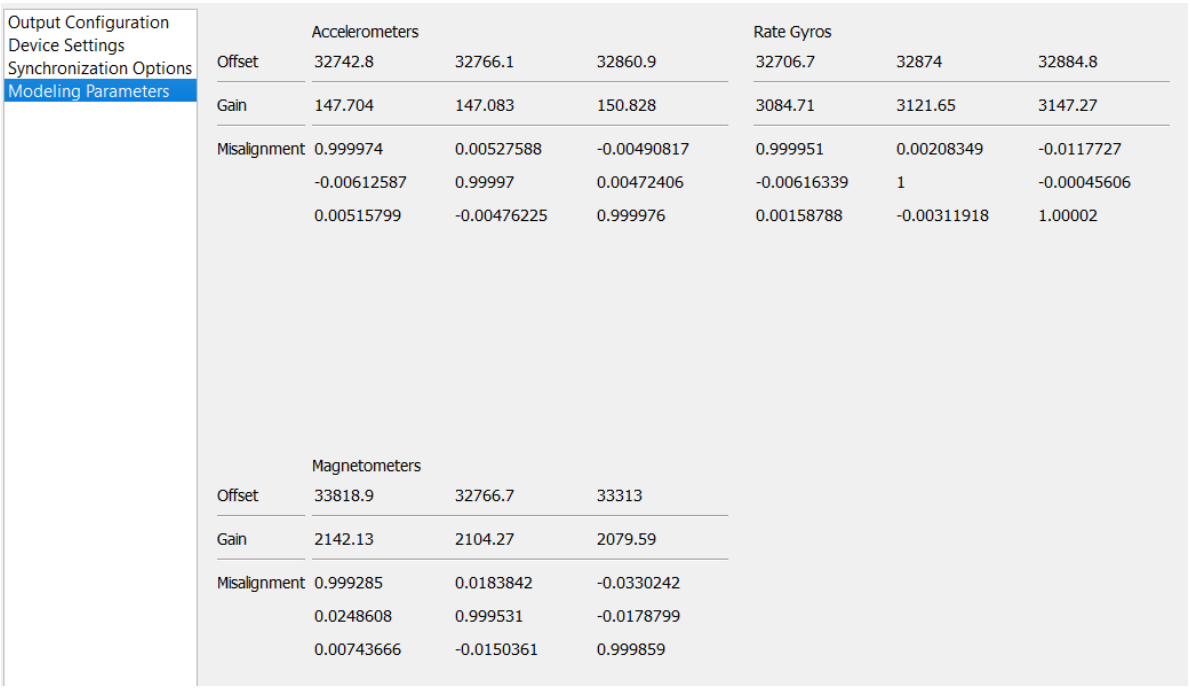
A pop-up screen opens that allows you to save the settings in a name that you prefer. As the settings are product dependent, you could include the name of the product in your file name, e.g.”Test1_MTi-30.xsa”.

To load a settings file, click the “Load settings” button. Again, a window opens that lets you navigate to an xsa configuration file. Opening the file applies all the settings to the MTi in the order listed above. When no or only some settings cannot be applied, a warning will be issued. Settings that could be applied up until the incompatible setting will be applied though.

Although the configuration file can be read, it is not recommended to make changes in the file. It is easier to load the settings in the device, make the required changes and save the settings again (in the same file).

6.2.2.3 Modeling parameters

In the modeling parameters tab you can find the calibration parameters of the accelerometers, gyroscopes and magnetometers (offset, gain and misalignment, refer to [MTi_10s_100s] for details).



	Accelerometers			Rate Gyros		
Offset	32742.8	32766.1	32860.9	32706.7	32874	32884.8
Gain	147.704	147.083	150.828	3084.71	3121.65	3147.27
Misalignment	0.999974	0.00527588	-0.00490817	0.999951	0.00208349	-0.0117727
	-0.00612587	0.99997	0.00472406	-0.00616339	1	-0.00045606
	0.00515799	-0.00476225	0.999976	0.00158788	-0.00311918	1.00002

	Magnetometers		
Offset	33818.9	32766.7	33313
Gain	2142.13	2104.27	2079.59
Misalignment	0.999285	0.0183842	-0.0330242
	0.0248608	0.999531	-0.0178799
	0.00743666	-0.0150361	0.999859

Figure 51: The modeling parameters show values determined in Xsens' calibration procedure

6.2.2.4 Device Settings

In the Device Settings tab, you will find options to set up the MTi’s communication and it is possible to change the behaviour of the sensor fusion algorithm in the MTi.

Table 16: The information displayed in the Device Settings tab

Parameter	Description
COM port baud rate (MTi 1/10/100-series)	Although the easiest setup with MT Manager is to communicate with the USB cable that has no baud rate, it is possible to set the baud rate here. This can be used when you configure the MTi in MT Manager and later want to use the serial interface on another platform. In order to reduce waiting times in the usage of MT Manager, the MT Manager is designed for high baud rates. Don't use baud rates of 9600 or 4800 when connecting the MTi to MT Manager.
Port Configuration (MTi 600-series)	This field allows to configure the RS232, UART and CAN interfaces of the MTi 600-series. For RS232 and UART, the communication protocol (Xbus or String Output) and baud rate can be selected. The CAN interface can be disabled or enabled here, and the desired baud rate can be configured.
USB name (MTi 10/100-series)	This string identifies the USB string. Use this string in your application when you want to communicate directly to the USB-port.
Filter Settings 	Choose the filter profile that you want to have the orientation estimated with. When you choose an orientation output in the Output Configuration window, choose "Onboard: …." If you are outputting **only** Δq/Δv, inertial data or SCR, choose the required setting profile in "XDA: ….." Refer to [MTi_10s_100s] for more information on the various filter profiles. Only filter profiles that are applicable for the attached MTi are shown.
Option Flags	You can indicate here whether the sensor fusion algorithm should use additional sensor fusion algorithms. These features are disabled by default. Refer to [MTi_10s_100s] for more information on these features.
GNSS Configuration	This field allows to choose which constellations must be used. This can be GPS & BeiDou, or GPS & GLONASS (default). MTi-G-710 and MTi-7 only.
GNSS Lever Arm (MTi-680G)	This field allows setting the lever arm. GNSS Lever arm is the length/position of the antenna with respect to the center of the sensor It is a 3-vector: x,y,z. The unit is in meters.
GNSS Platform	This field allows to use a different GNSS setting. Advised to use only after consultation with Xsens. MTi-7 and MTi-G-710 with FW version 1.7.x or higher only.
Position	This position is the last known position of the MTi, either inputted via a message (see [LLCP]) or via the GNSS receiver. This data is used to estimate local magnetic declination and local gravity.
UTC Time	With Set current, the current time (in UTC format) is retrieved from the computer and written into the RAM of the MTi. When recording, the data will now include the time. Note that the time is discarded after a rescan, power off or revert.
RotSensor and RotLocal	These two rotation matrices are used to apply orientation resets or arbitrary alignments. Refer to [MTi_10s_100s] for more information on these two matrices. RotSensor rotates S to S', RotLocal rotates L to L'.

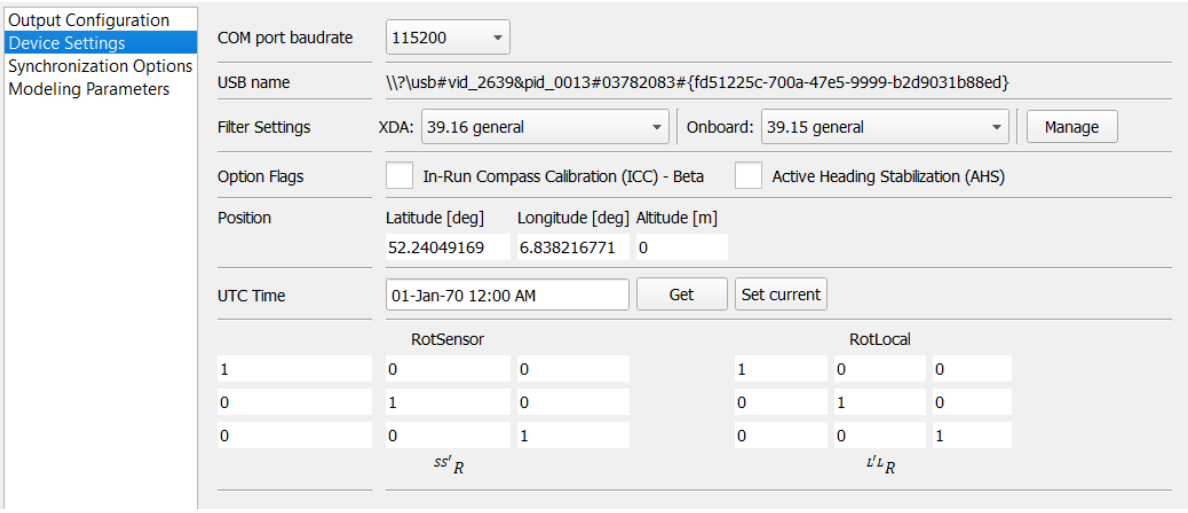


Figure 52: Device settings in the MT Settings dialog show various device-specific settings

6.2.2.5 Output Configuration

The output of the MTi can be fully configured in terms of data packets in the data message, output frequency, and representation format. This can all be done in the Output Configuration tab. Depending on the used Motion Tracker there can be different modes available in the output configuration dialog as shown in Figure 53.

Table 17: The modes in the Output Configuration window

Mode	Description
Xbus mode	Mode that supports MTData2 data packets.
String report mode	Mode that supports ASCII Strings (NMEA).
CAN mode	Mode that supports CAN messages.

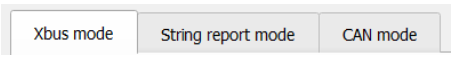


Figure 53: The mode can be selected at the top of the Output Configuration Window

Xbus mode Output Configuration Window

The most complete Output Configuration Window is shown in Figure 54. When the MTi is first used, or when it is in factory settings, the Output Configuration window will be in Xbus Mode with the outputs in the default configuration (the default configuration depends on the product, see [LLCP]). The Output Configuration Window only shows the outputs available for the connected MTi.

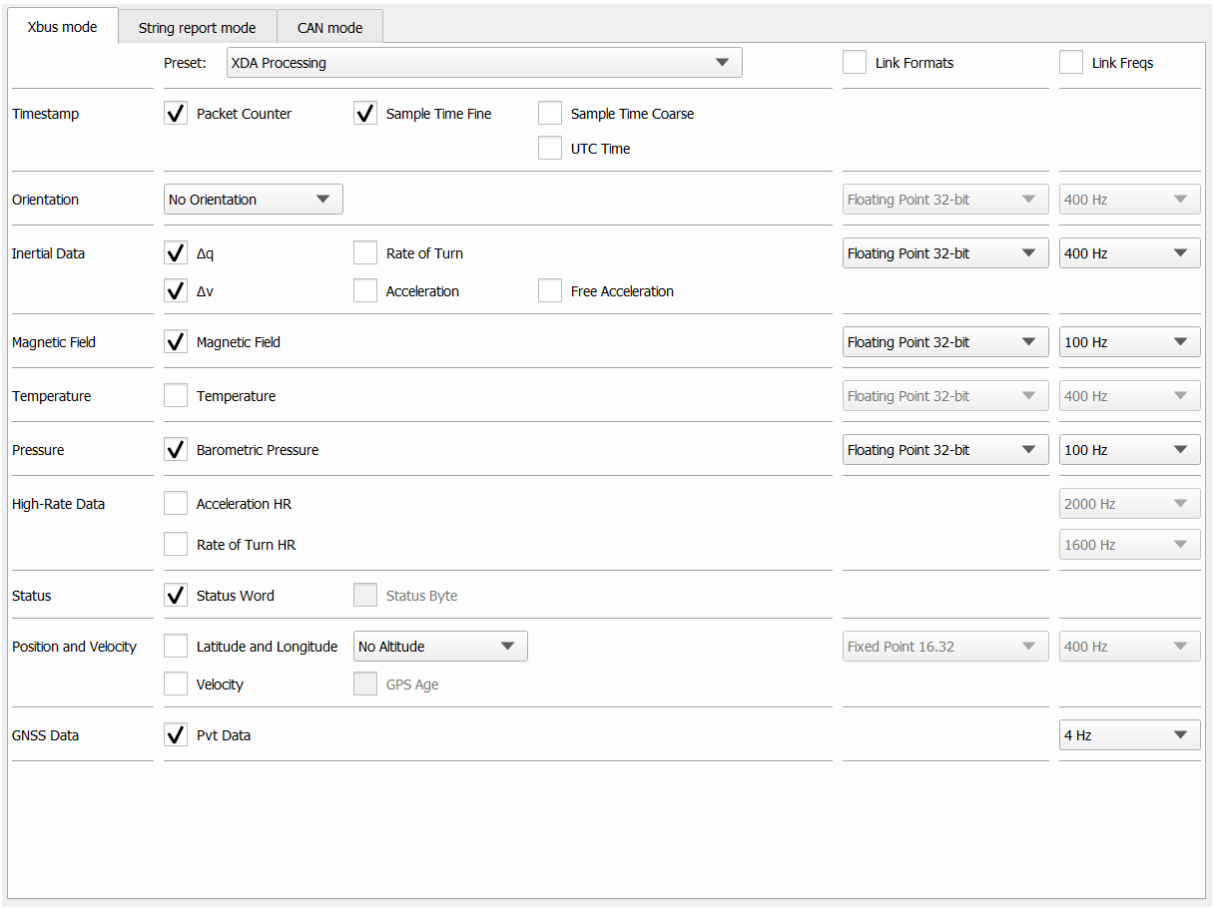


Figure 54: The Output Configuration window of an MTi-670 that is attached to MT Manager. When another device is attached, the output configuration window may contain fewer options.

String report mode Configuration Window

The String report mode Configuration Window allows setting the ASCII strings for MTi 10-series, MTi 600-series and MTi 100-series. Note that only a single frequency can be chosen here. Setup the string reports with the message terminals or via XDA to apply

different update frequencies per string output.

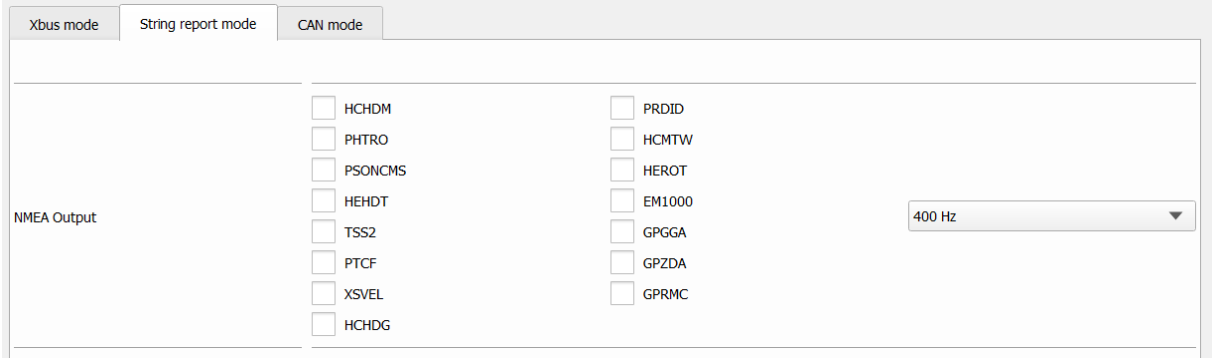


Figure 55: String report mode output configuration options

See [LLCP] for details on the various NMEA messages.

CAN mode Configuration Window

The CAN mode Configuration Window allows setting the CAN output messages for the MTi 600-series. See [CAN] for details on the various CAN messages.

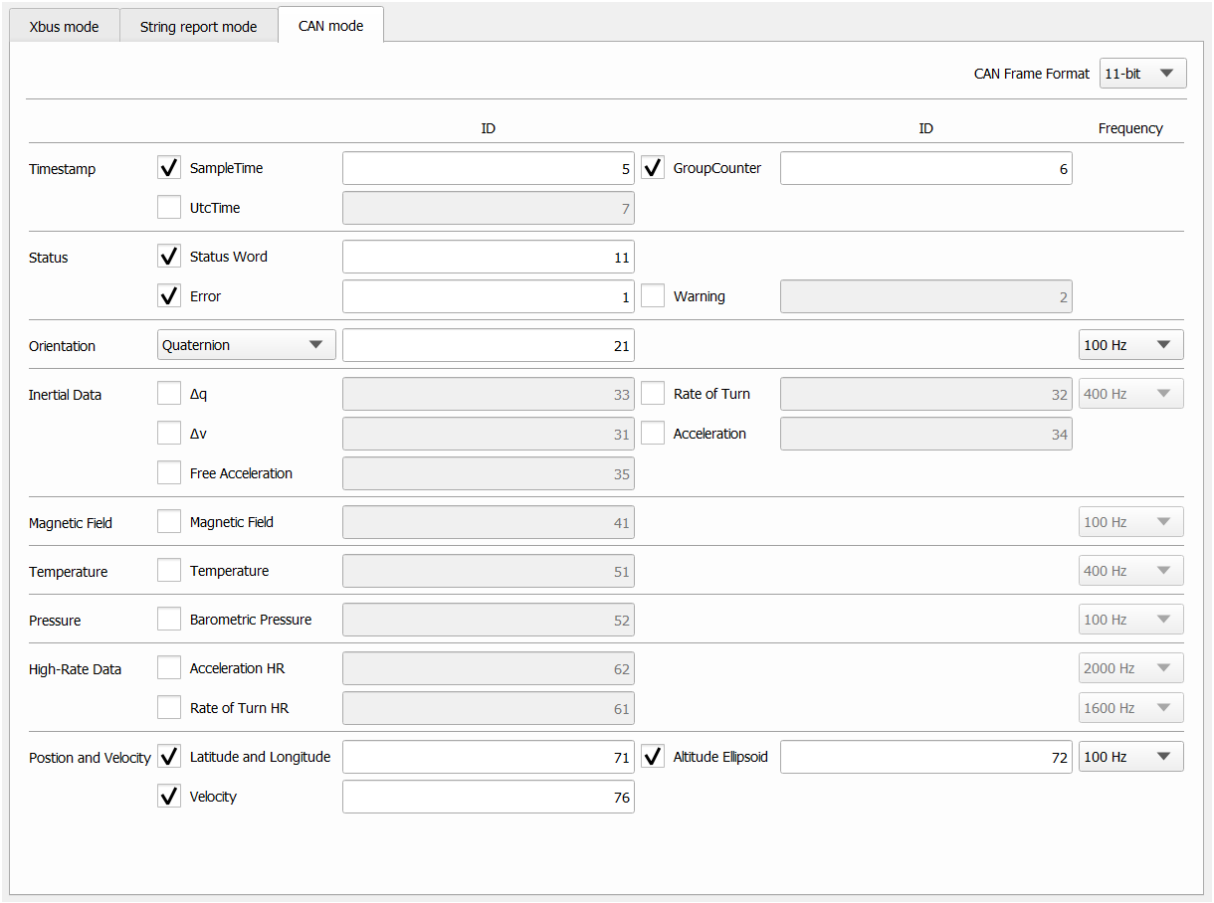


Figure 56: CAN mode output configuration window of an MTi-670

Output configuration window in file mode

The output configuration window will be read-only when a file is loaded. It is possible however to view the settings of the recorded file.

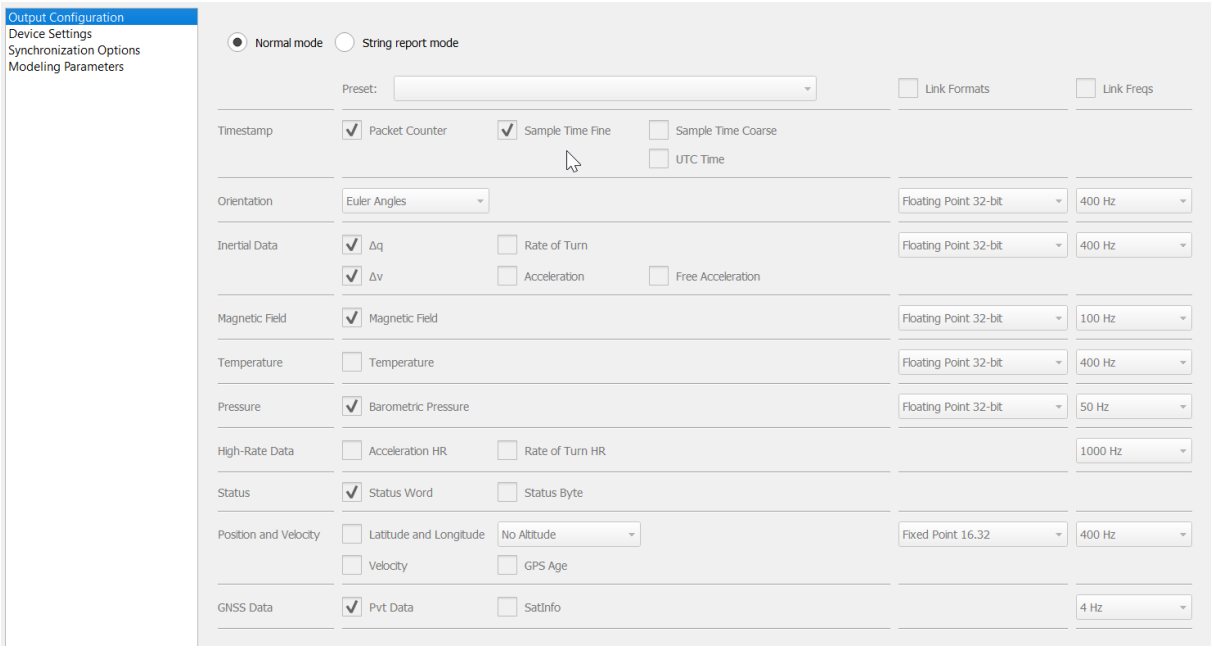
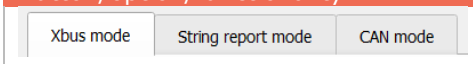
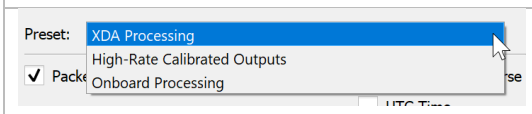


Figure 57: The Output Configuration Window of a file that contains data from an MTi-G-710. All outputs are shown, but cannot be edited.

The meaning of all data fields and screens is explained in [MTi_10s_100s] and [LLCP]. A few functionalities of the Output Configuration window are explained in Table 18.

Table 18: Buttons in the Output Configuration window

Button/option/functionality	Description
	The buttons allow switching between Xbus, String report and CAN mode.
	The presets are a safe choice if you do not know which data you need for later re-processing with other filter profiles, how to retrieve processed data etc. It is highly recommended to use these presets. There are three presets: - XDA processing - High-Rate Calibrated Outputs - Onboard processing XDA processing offers the most flexibility and is the recommended setting when you want to reprocess data later with different settings in XDA. The data of all sensors has already been processed in the SDI algorithm, so that the amount of data stored is relatively low, yet the accuracy is guaranteed. High-Rate Calibrated Outputs includes AccelerationHR and RateOfTurnHR, which are calibrated outputs at frequencies up to 2000 Hz. Maximum output rate, degree of signal processing,

	and calibration applied depends on device and hardware version. For more information, see [LLCP]. Onboard processing is the desired setting, when you know what settings you need. All data is calculated onboard the MTi and does not need further processing. Starting from a preset, you can tick/untick outputs. In this case, the preset drop-down menu will become empty.
Link Formats	Ticking this box will make all formats (Floating point, Fixed point etc.) the same for each output as long as these are available. See [MTi_10s_100s] and [LLCP] for more information on the output formats.
Link Freqs	Ticking this box will make all output frequencies the same for each output if they are available. If a certain frequency is not available, the output frequency of that output will be rounded off to the next lower available output frequency
Frequency of Timestamp and Status	Timestamp and Status do not have an output frequency: they are outputted with every data message.

Getting ready for logging

Before you start logging your data, be sure to make the following steps first:

1. Set the Log File Name and set the desired working directory, refer to section 6.5.1
2. Choose the desired output format, refer to section 6.2.2.5. For post-processing purposes, make sure to use the XDA processing preset. MT Manager will select the required data packages for post-processing, so it is possible to add more outputs.
3. Setup the desired coordinate system (see section6.2.2.4) on using the Sensor Rotation Matrix and the Local Rotation Matrix. With the MT Manager, the coordinate system used in the sensors data cannot be changed during post-processing.
4. Choose the correct baud rate when using serial interfacing. Make sure this baud rate is high enough to accommodate data sent over the serial interface (total data size and frequency, see [LLCP]).
5. Choose the setting profile most appropriate for your application. It is possible to process sensors data with another filter profile, but note that orientation data cannot be reprocessed at all.

   Note: The first packet counter is an arbitrary number between 0 and 65535 due to the recording concept used in MT Manager.

6.2.2.6 Synchronization options

For detailed explanations of the functions and how to use them, refer to the [LLCP] and https://base.xsens.com/hc/en-us/articles/211592185-Synchronization-with-the-MTi.

When opening the Synchronization configuration tab in the Device Settings window, the Configured Settings list is empty for most MTi devices. Press add to start configuration of a synchronization function.

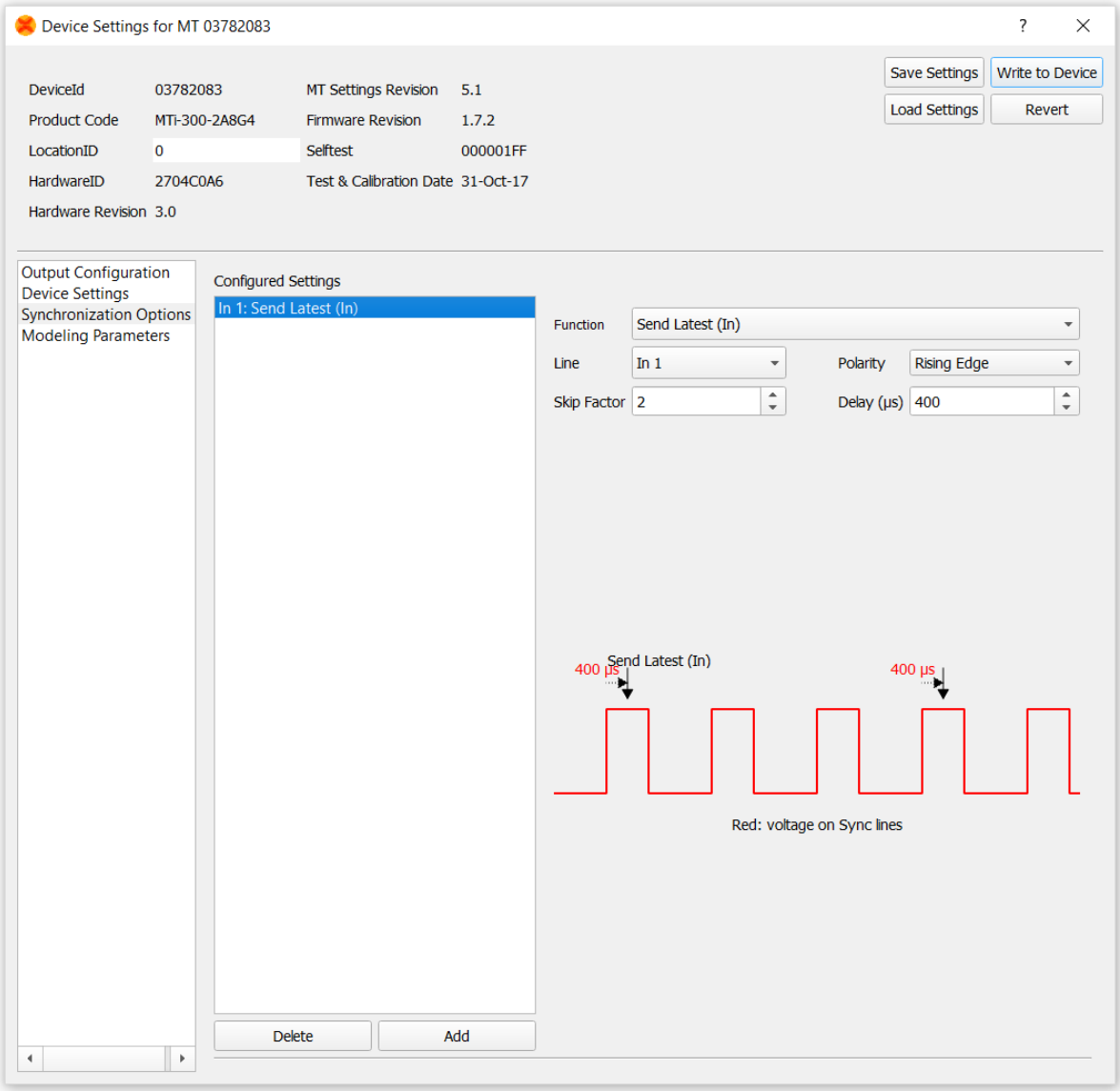


Figure 58: Starting the setup of a synchronization option.

Table 19: List of available synchronization functions

Function	Sync Line[1]	Functionality
Trigger Indication	In 1	When a pulse is received, a marker is set in the MTData2 packet
Send Latest	In 1 ReqData message	When a pulse or specific (`ReqData`) message is received, the latest available data in the MTi is sent to the user.
Interval Transition Measurement	SyncOut	A pulse is generated at 400 Hz and can be used to trigger external devices.
Clock Bias Estimation	ClockSync	Using this function allows you to synchronize the MTi with an external pulse (0.1 to 1000 Hz).
GPS Clock Sync	GPS Clock In	This (default on) synchronization pulse synchronizes the clock of the MTi-7 and MTi-G-710 with the GPS clock.
StartSampling	In 1	When a pulse is received, samples will be sent to the digital signal processing pipeline.
1 PPS	SyncOut	1 Pulse Per Second, sent directly from the GNSS receiver from the MTi-7 and MTi-G-710.

[1] Refer to [MTi_1s], [MTI_600s] and [MTi_10s_100s] to find the hardware lines that correspond to the terms used in the MT Software Suite.

The graphic in the screen will help you determine the behaviour of each function and parameters. The red line in the graphic shows the voltage received or sent out; the grey arrows or grey lines show the MTData2 packets. If functions are on separate Sync lines, they can be used together.

Trigger Indication:
The function trigger indication can be used to get a marker inside the MTData2 packet without interfering with the data itself.

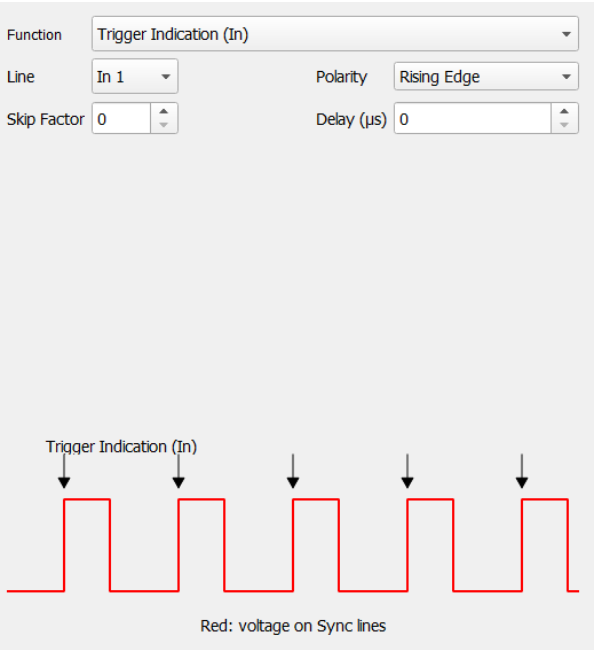


Figure 59: Trigger Indication sets a marker in the MTData2 packet when a voltage is read on the SyncIn line. The red line represents the voltage on the Sync line

Table 20: Synchronization options of the Trigger Indication function

Parameter	Options
Line	In 1
Skip factor	Applying a Skip factor allows you to omit markers from the MTData2 packet. E.g. when a Skip Factor of 1 is used, Trigger Indication will omit every second marker.
Polarity	Rising Edge, Falling Edge or both: allows you to change the edge on which the TriggerIndication must be included
Delay (µs)	The number of microseconds before the marker must be included in the data

Send Latest:
Send Latest allows to send the latest available data that has been processed onboard the MTi (it is thus used as a SyncIn). Send Latest ignores the output frequency selected in the Output Configuration window (but not which outputs are selected) and will prevent data from being outputted until a Send Latest pulse or `ReqData` message is received. As sampling is done at a very high frequency, it is not possible to let the sample moment be determined by the Send Latest function. However it is possible to adjust the frequency of the sampling, use the ClockBiasEstimation function for that. Remember that it is possible to use functions together if they are on separate Sync lines.

The following parameters can be used:

Table 21: List of options for Send Latest synchronization functionality

Parameter	Options
Line	In 1 or via a message (`ReqData`)

Skip factor	Applying a Skip factor allows you to discard SyncIn pulses. This makes it possible to have e.g. a 1 Hz input pulse or ReqData message, but output MT Data only every 5 seconds.
Polarity	Rising Edge, Falling Edge or both: allows you to change the edge on which the Send Latest command must act. Not applicable to ReqData.
Delay (µs)	The number of microseconds before data must be sent. If new data is available after the reception of Send Latest and the delay together, that new data will be sent.

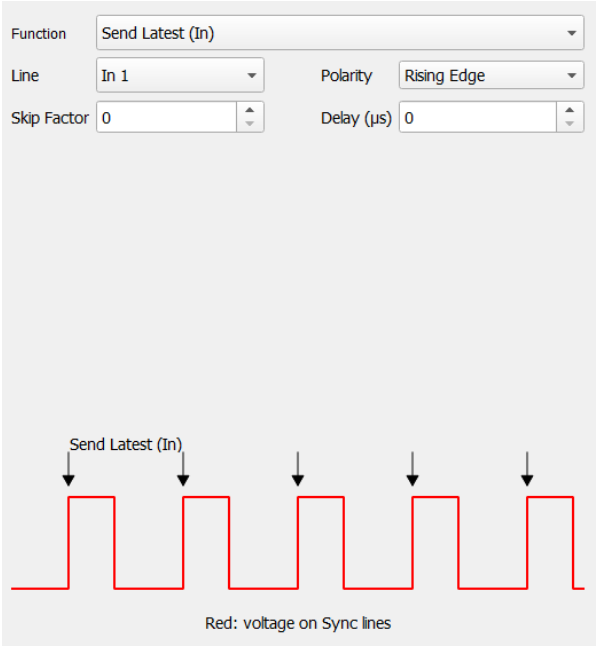


Figure 60: Send Latest configured as Rising Edge

Interval Transition Measurement: Interval Transition Measurement sends out a pulse on the SyncOut line at a frequency of 400 Hz (when Skip factor is 0). Interval Transition Measurement can be used to trigger external devices.

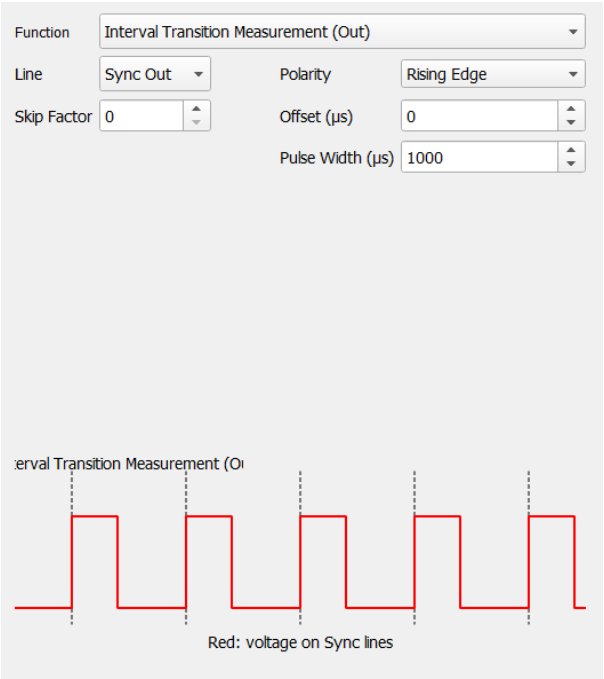


Figure 61: The Interval Transition Measurement with its default settings.

Table 22: List of options for Interval Transition Measurement (SyncOut) functionality

Parameter	Options
Line	SyncOut
Skip factor	Applying a Skip factor will reduce the number of sync pulses on the SyncOut line. In the MTData2 packet, a marker is included that allows you to see which data packet corresponds to the Interval Transition Measurement pulse. Note that it is recommended to have a resulting SyncOut frequency that is a integer division of the data output frequency. E.g. when a SyncOut frequency of 100 Hz is chosen and the data output is 80 Hz, you will miss markers in the data.
Polarity	The polarity field allows you to choose whether the pulse should be low and will rise upon a SyncOut pulse (Rising Edge), should be high and will fall upon a SyncOut pulse (Falling Edge) or should toggle between high and low upon a SyncOut pulse (Rising & Falling Edge). In the latter case, pulse width does not have an effect.
Offset (µs)	The offset allows you to send out a pulse before or after the MTData2 package it corresponds to, is sent to the host. As timing in the MTi is exactly known, it is possible to send out a pulse up to 3 seconds before the data package.
Pulse Width (µs)	Pulse Width allows you to determine the duration of the pulse on the SyncOut. If the pulse width is longer than 2500 µs and no Skip Factor is applied, the pulses will overlap.

Clock Bias estimation: It is possible to slightly adjust the duration of the clock ticks of the internal sampling in the MTi. This can be useful when you have an accurate external clock (e.g. GPS time pulse, 1 PPS) that you want to synchronize the MTi to. It can also be useful to synchronize multiple MTi's, so that the number of data points in a certain

amount of time is equal. For Clock Bias Estimation, it is needed to know the frequency of the signal you feed into the MTi. Note that you can still choose another output frequency, unrelated to Clock Bias Estimation.

Table 23: List of options for Clock Bias Estimation synchronization functionality

Parameter	Options
Line	Clock In
Skip factor	Applying a Skip factor allows you to discard SyncIn pulses. Make sure however that the Clock Period matches the voltage frequency, including Skip Factor. Example: when applying a 100 Hz voltage signal with a skip factor of 1, the period should be 20 ms.
Polarity	Rising Edge, Falling Edge or both: allows you to change the edge on which the Clock Bias Estimation must calculate.
Delay (ms)	The number of milliseconds between pulses. Read Skip Factor (above) if you want to use Skip Factor as well.

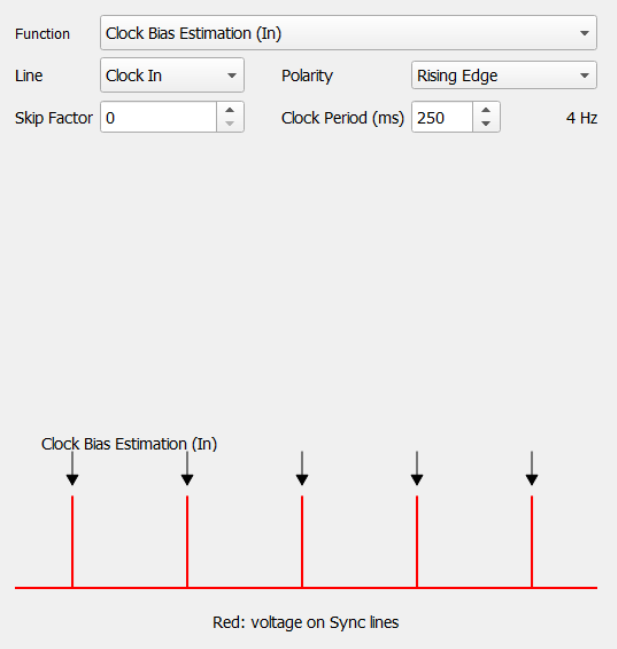


Figure 62: Clock bias estimation on a clock of 4 Hz.

GPS ClockSync:

When the MTi-7 or MTi-G-710 has a valid GNSS fix, the time pulse from the GNSS receiver is used to synchronize the internal clock of the MTi. The functionality is identical to the (external) Clock Bias estimation.

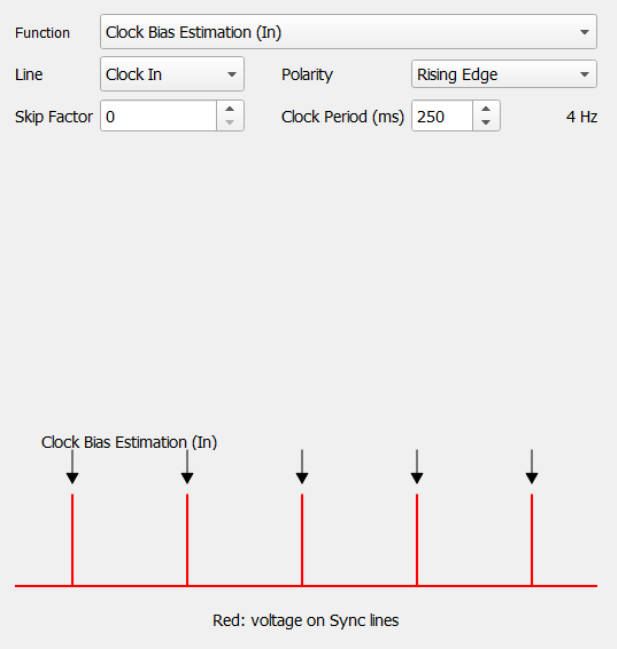


Figure 63: GPS Clock Sync synchronizes the crystal of the MTi and the GPS clock.

The GPS ClockSync function is enabled by default with specific settings; it is possible to disable the functionality or adapt the settings though. This is not recommended and should only be done when a more accurate clock is available or when a different clock bias estimation is required. A warning dialog will pop-up; choosing Yes will re-enable the GPS Sync.

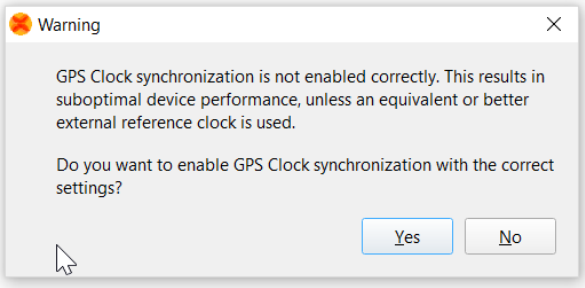


Figure 64: Warning that you are about to delete the GPS clock Sync

StartSampling

StartSampling can be used to accurately time the reception of the MTi data. It is not possible trigger every sample, but it is possible to start the digital signal processing. Refer to [MTi_10s_100s] for more info.

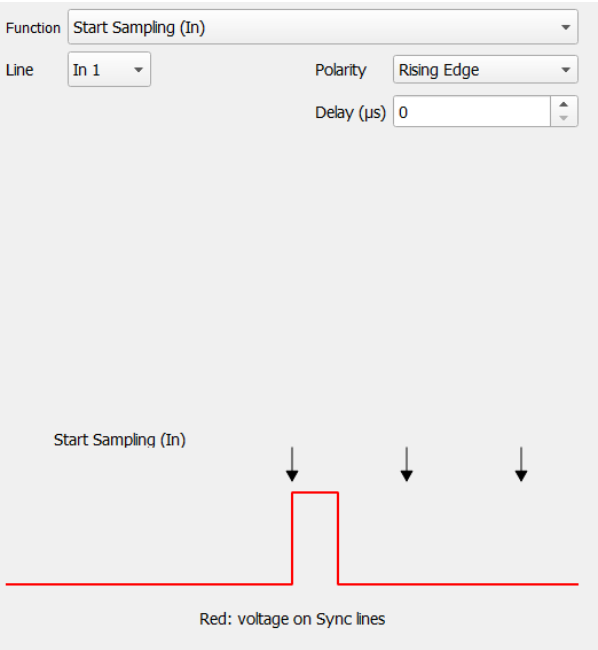


Figure 65: With StartSampling, the MTi will only start sending data when a pulse has been received

1PPS Time-pulse (Out): The MTi-7 and MTi-G-710 can output a hardware pulse (length 100 us) every second at the exact UTC second.

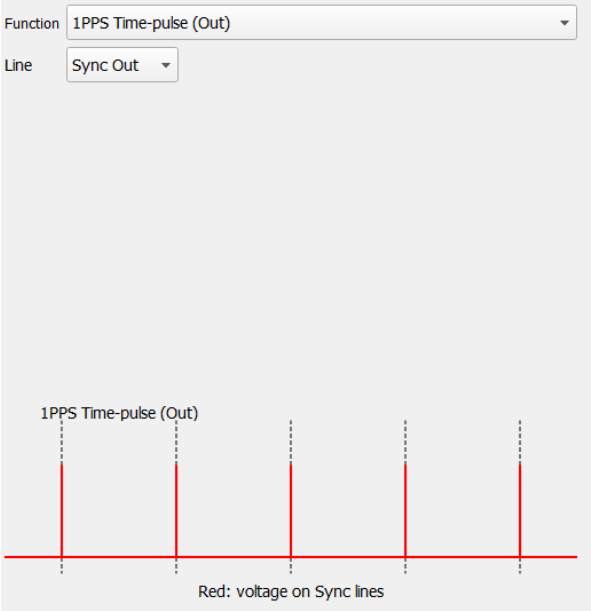


Figure 66: 1 PPS Time pulse in the Synchronization dialog

Multiple functions:

It is possible to configure multiple synchronization functions on the MTi. This can be useful if you need to synchronize multiple devices, see [MTi_10s_100s]. If multiple entries are set on the same line, an error is given (see below).

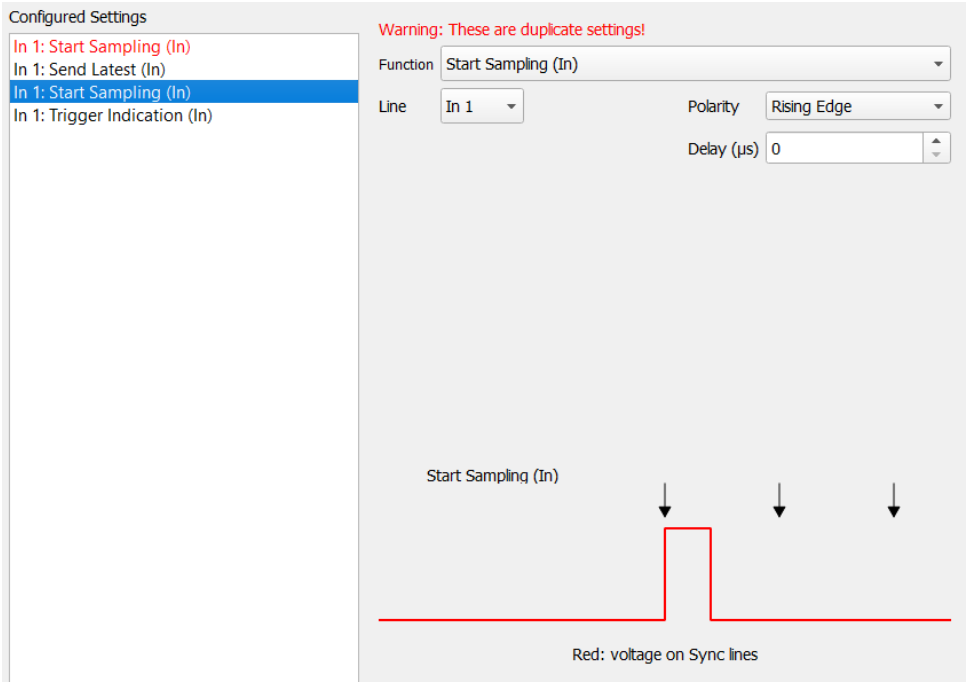


Figure 67: The Sync Options dialog gives a warning when settings are conflicting or duplicate

Deleting a configured setting:
In order to remove a setting, select the configured setting in the Configured Settings list and click Delete.

6.3 Using the NTRIP Client

The NTRIP Client window (figure X) can be accessed via the Tools drop-down menu and allows the user to connect with an NTRIP mounting point in order to receive RTCM correction messages via internet. The RTCM messages will automatically be fed back to the GNSS receiver of the connected MTi in order to achieve accurate positioning data. This window is only available when a GNSS/INS device with RTK support is connected.

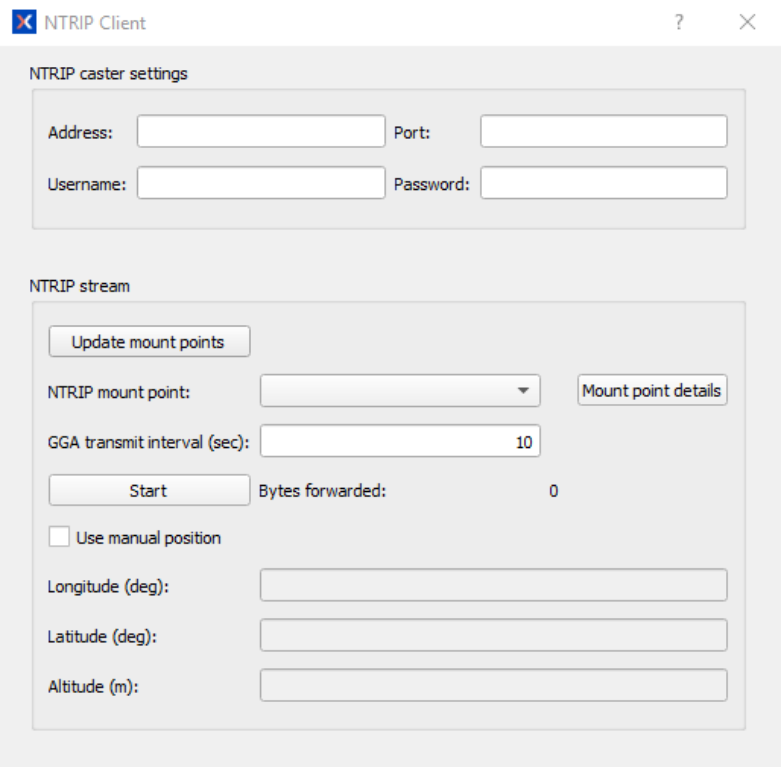
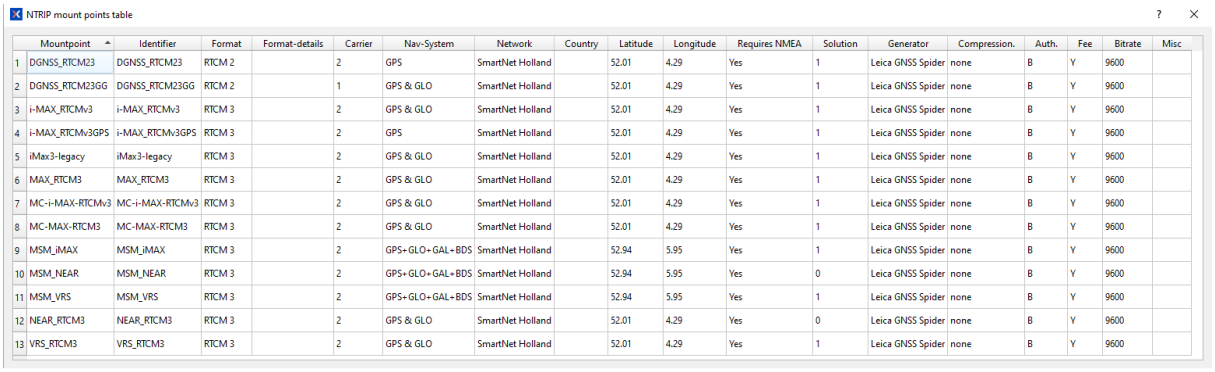


Figure 68: NTRIP Client configuration window.

The NTRIP Client window is divided into two sections:

1. Under NTRIP caster settings, the user can log-in to the desired NTRIP server by providing the address, port number, username and password.
2. The NTRIP stream section allows for further configuration of the NTRIP setup:
    a. The "Update mount points" button can be used to refresh the dropdown menu for NTRIP mount points.
    b. The "Mount point details" button will open a separate window with an overview of all available mount points for the configured provider (Figure 69).
    c. The "GGA transmit interval" indicates the interval in seconds at which the current location of the MTi is transmitted to the NTRIP server. This is a requirement for obtaining RTCM messages.
    d. Alternatively, it is possible to manually set the position (latitude, longitude altitude) that is transmitted to the NTRIP server, instead of transmitting the real-time position as estimated by the MTi.
    e. Finally, the "Start" button will initiate the NTRIP connection. An increasing number of bytes transmitted should be visible. The MT Status View (section 5.7.3.5) can now be used to check the RTK fix status.

Note: Closing the NTRIP Client window will automatically stop the NTRIP connection.
Note2: The NTRIP client expects to receive only RTCM data



	Mountpoint	Identifier	Format	Format-details	Carrier	Nav-System	Network	Country	Latitude	Longitude	Requires NMEA	Solution	Generator	Compression.	Auth.	Fee	Bitrate	Misc
1	DGNSS_RTCM23	DGNSS_RTCM23	RTCM 2		2	GPS	SmartNet Holland		52.01	4.29	Yes	1	Leica GNSS Spider	none	B	Y	9600	
2	DGNSS_RTCM23GG	DGNSS_RTCM23GG	RTCM 2		1	GPS & GLO	SmartNet Holland		52.01	4.29	Yes	1	Leica GNSS Spider	none	B	Y	9600	
3	i-MAX_RTCMv3	i-MAX_RTCMv3	RTCM 3		2	GPS & GLO	SmartNet Holland		52.01	4.29	Yes	1	Leica GNSS Spider	none	B	Y	9600	
4	i-MAX_RTCMv3GPS	i-MAX_RTCMv3GPS	RTCM 3		2	GPS	SmartNet Holland		52.01	4.29	Yes	1	Leica GNSS Spider	none	B	Y	9600	
5	iMax3-legacy	iMax3-legacy	RTCM 3		2	GPS & GLO	SmartNet Holland		52.01	4.29	Yes	1	Leica GNSS Spider	none	B	Y	9600	
6	MAX_RTCM3	MAX_RTCM3	RTCM 3		2	GPS & GLO	SmartNet Holland		52.01	4.29	Yes	1	Leica GNSS Spider	none	B	Y	9600	
7	MC-i-MAX-RTCMv3	MC-i-MAX-RTCMv3	RTCM 3		2	GPS & GLO	SmartNet Holland		52.01	4.29	Yes	1	Leica GNSS Spider	none	B	Y	9600	
8	MC-MAX-RTCM3	MC-MAX-RTCM3	RTCM 3		2	GPS & GLO	SmartNet Holland		52.01	4.29	Yes	1	Leica GNSS Spider	none	B	Y	9600	
9	MSM_iMAX	MSM_iMAX	RTCM 3		2	GPS+GLO+GAL+BDS	SmartNet Holland		52.94	5.95	Yes	1	Leica GNSS Spider	none	B	Y	9600	
10	MSM_NEAR	MSM_NEAR	RTCM 3		2	GPS+GLO+GAL+BDS	SmartNet Holland		52.94	5.95	Yes	0	Leica GNSS Spider	none	B	Y	9600	
11	MSM_VRS	MSM_VRS	RTCM 3		2	GPS+GLO+GAL+BDS	SmartNet Holland		52.94	5.95	Yes	1	Leica GNSS Spider	none	B	Y	9600	
12	NEAR_RTCM3	NEAR_RTCM3	RTCM 3		2	GPS & GLO	SmartNet Holland		52.01	4.29	Yes	0	Leica GNSS Spider	none	B	Y	9600	
13	VRS_RTCM3	VRS_RTCM3	RTCM 3		2	GPS & GLO	SmartNet Holland		52.01	4.29	Yes	1	Leica GNSS Spider	none	B	Y	9600	

Figure 69: The NTRIP Mount point details contains a detailed overview of all available mount points.

6.4 Using the Device/XDA Data View terminals

MT Manager has two message terminals: the Device Data View shows the communication over the serial or USB port; the XDA Data View shows the communication between MT Manager and the Xsens Device API. To understand the low level XBus Communication protocol, it is recommended to use the Device Data View.

6.4.1 Device Data View

The Device Data View allows monitoring the communication over the serial or USB interface of the MT (i.e. the XBus Communication protocol, see [LLCP]). It can also be used to compose messages in ASCII; the composer will set the required bits, will include the XBus header (preamble, message ID etc) and will calculate the correct checksum. The message can then be written to the device.

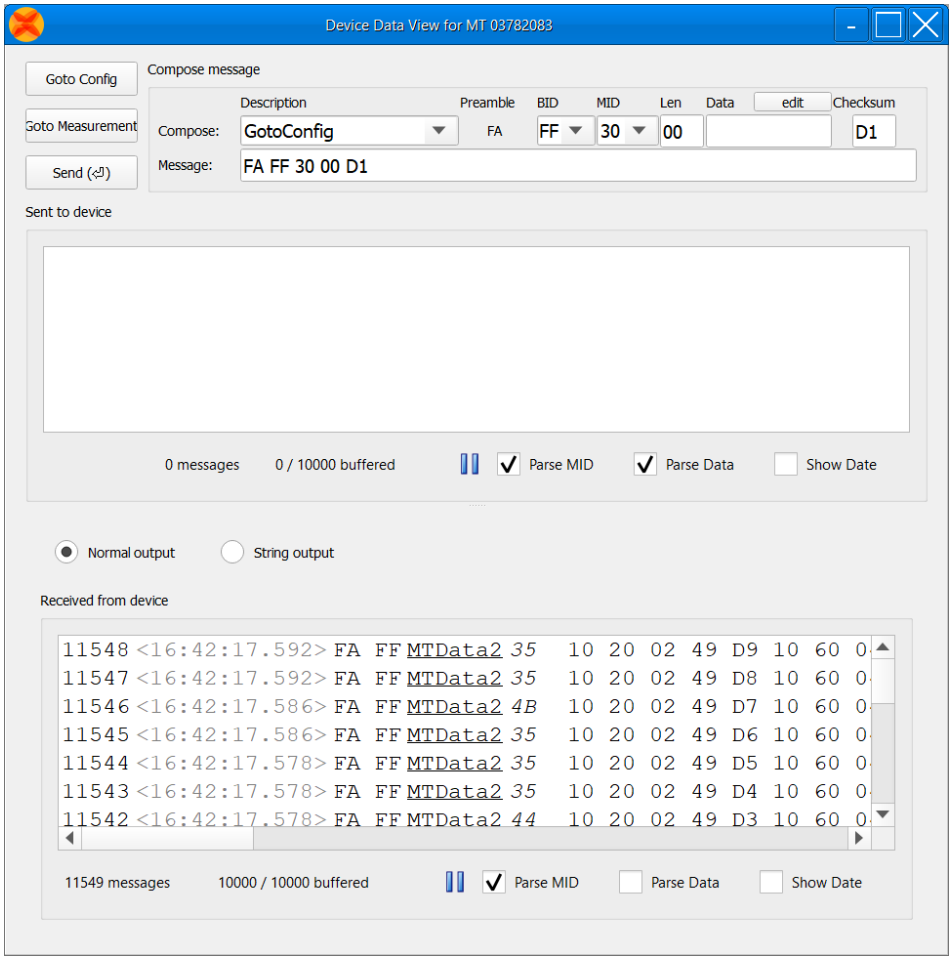


Figure 70: The Device Data View showing data that is being received from the MTi device.

Table 24: Functions available in the Device Data Viewer

Button/field	Description
GoTo Config	This button can be used to put the MT in Config mode. Config mode is required to set most messages.
GoTo Measurement	This button can be used to put the MT in Measurement mode. Measurement mode is the mode in which the MT sends data messages.
Send	The send button is used to send composed messages to the device.
Compose message	The part "compose message" contains several fields: - "Compose": Use this field to find the message you want to send to the device. You may also start typing in this field; the field has an autofill function. - "Preamble": This is always FA - "BID": Bus Identifier, FF means that the message will be sent to all devices on the bus. - "MID": Message Identifier, this field will be filled out automatically when the "Compose:" field is filled out. You can also insert a MID here, the correct "Compose": message will then be chosen.

	- "Len data": this field indicates the length of the data field. Extended length appears automatically when data field is longer than 254 bytes. - "Data": The data field is used to set arguments for messages. Refer to [LLCP] for more interpretation. - "Edit": Use the edit button to easily set the "Data" field. - "Checksum": the checksum is calculated when composing a message - "Message": the entire message is shown in this field. It is possible to edit the message here as well.
Sent to Device and Received from device	This window shows all messages sent to/received from the device. The sent window includes messages that were generated by e.g. the user interface of MT Manager, so it is ideal to investigate which communication is used when using the MT Manager. - The number of total messages sent is shown - The number of messages in the buffer is shown. Right-clicking on the window allows you to change the buffer. - The rate of messages per second is shown. - A pause button is available to stop the message stream, so you can investigate and scroll - When Parse MID is checked, the Message ID is shown in human readable format. - When Parse Data is checked, the data is shown in human readable format.

6.4.1.1 Using the message dialogs

The Device Data view has two fields that display the messages sent to the device and received from the device. Both fields have the same features. This section covers the analysis of Xbus data or "Normal output" messages. Alternatively, if the MT is configured to output NMEA strings, then these outputs can be visualized by selecting the "String output" radio button.

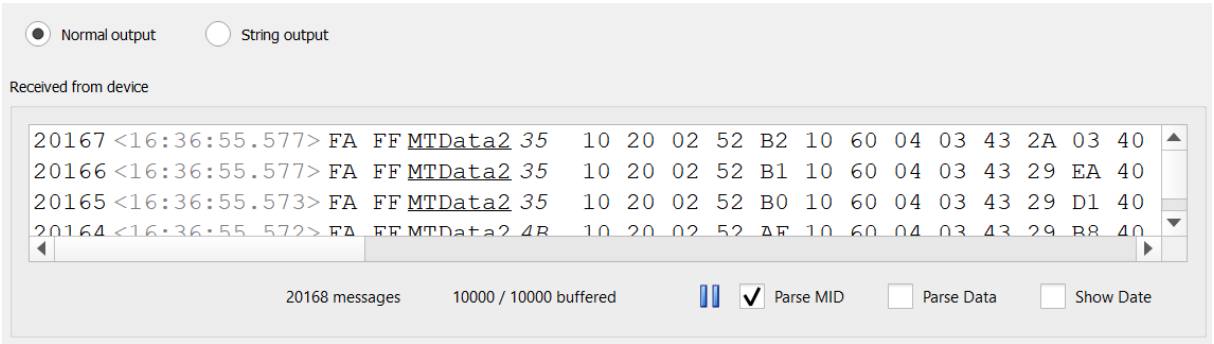


Figure 71: A typical view of received MTData2 messages shown in the Device Data View

The first column contains a counter, not related to the Data ID "Packet Counter". The second column contains the timestamp of the message (hh:mm:ss.sss). The message itself is split into 5 different parts

- FA FF: Preamble and Bus ID
- MID: default shown in human-readable format, e.g. MTData2
- Length of the data message (in *italic*)
- Data in the message, default in hexadecimal format
- Checksum (in **bold**)

Double-clicking on the data message opens a dialog that shows which data is in the message. It shows the message ID, number of data items (if applicable) and a description of the individual items, both parsed and in hexadecimal format.

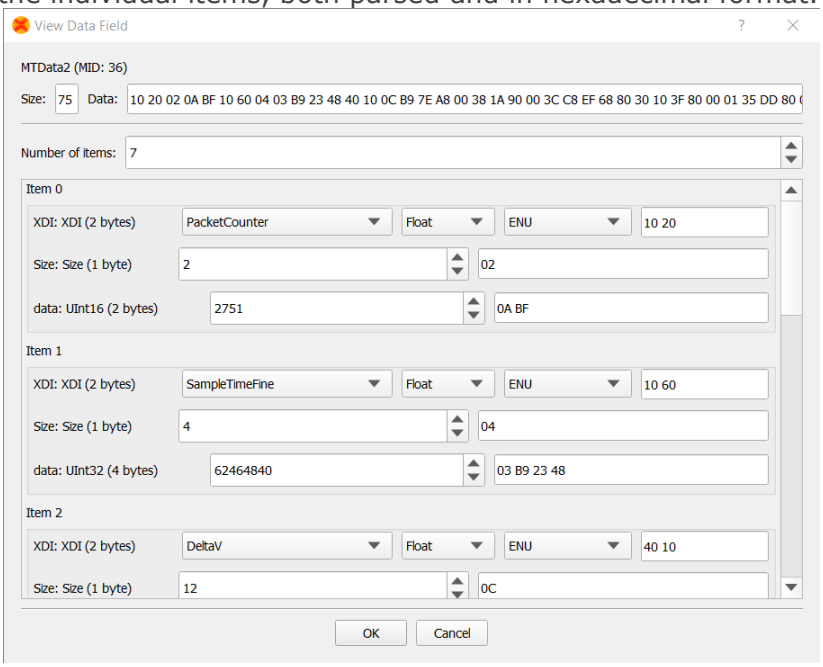


Figure 70: Double-clicking on the data will show the contents of a message, both parsed and in hexadecimal format

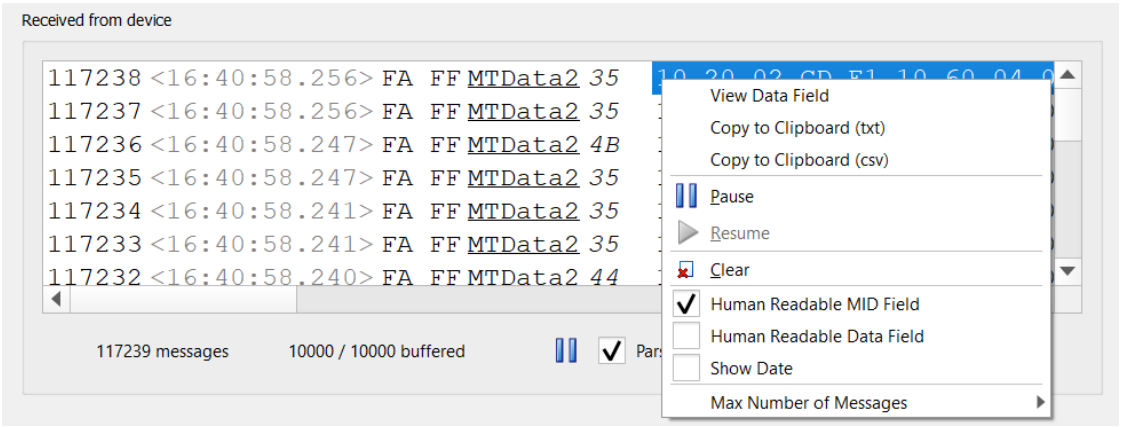


Figure 72: Right-clicking on the data in the window shows a menu with options

Table 25: The options in the menu in the Device Data Viewer after right-clicking the data.

Menu option	Description
View Data Field	View Data Field opens the dialog that shows the components of the data message
Copy to Clipboard	Copies selected messages to .txt or .csv. Use CTRL+A to select all messages in the window
Pause	Pauses the message stream

Resume	Resumes the message stream
Clear	Clears the buffer and screen
Human readable MID field	When checked, the hexadecimal message ID's are parsed to human readable text. This field is checked when opening the message terminal
Human readable data field	When checked, the hexadecimal data values are parsed to human readable text
Show Date	When checked, the date (dd/mm/yy) is shown next to the timestamp
Max number of messages	This setting allows to change the buffer size

6.4.1.2 Composing a message

Using the message terminals to set the MTi is straightforward. Note that you often need to be in Config Mode to be able to write a message. Then, choose the Message you want to send, using the dropdown menu.

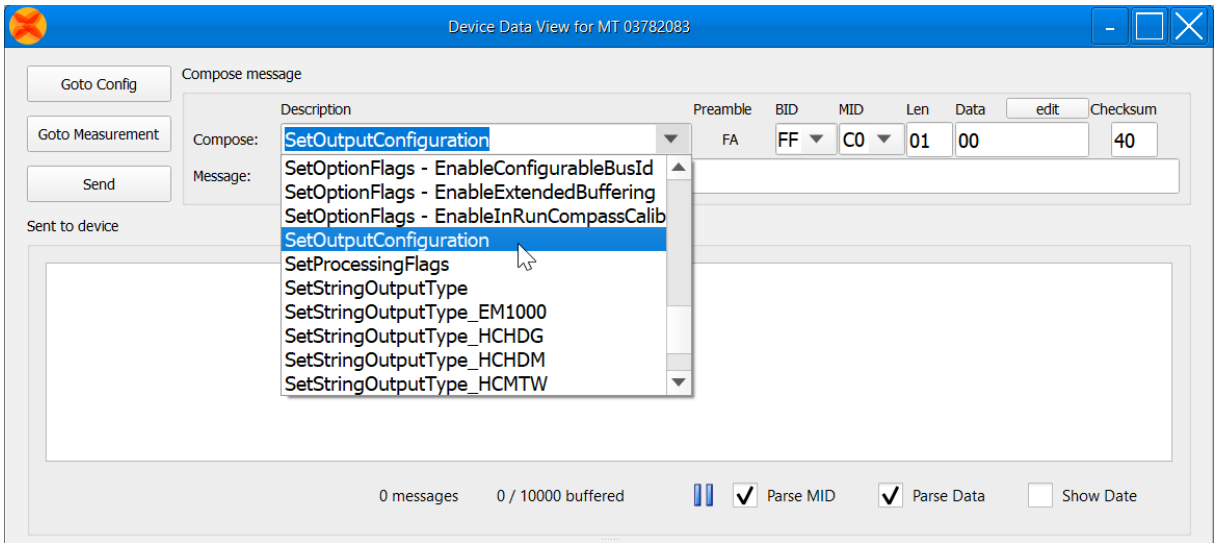


Figure 73: Composing a message in the Device Data View can be done by selecting a message from the "Compose' menu

When you choose a message that starts with "Set" or that needs extra arguments, the text in the button marked "Edit" will be augmented with an Enter icon (⏎).

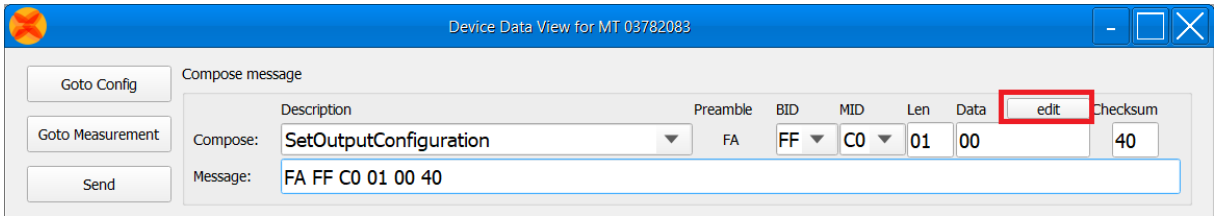


Figure 74: Click "edit" to make changes to the message selected from the "Compose" menu

Press Enter or Edit to edit the Data field; you could make changes in the field itself as well.

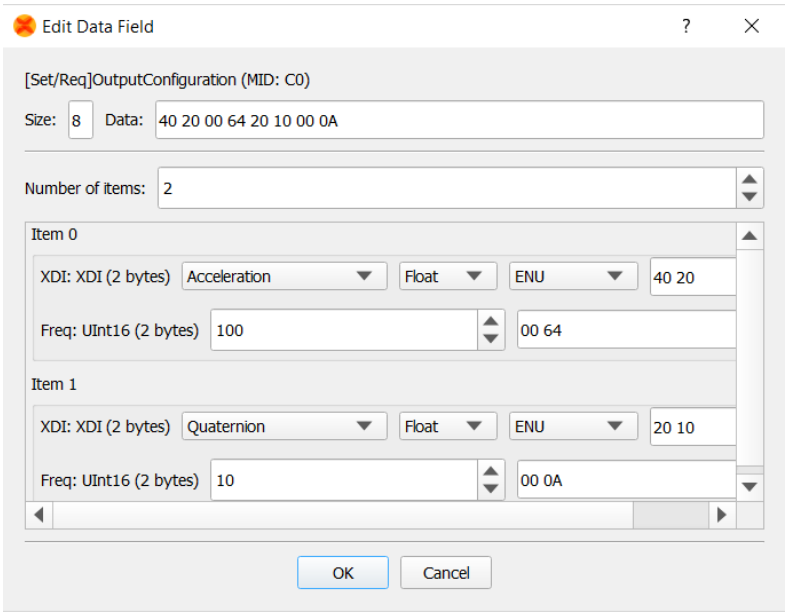


Figure 75: After clicking "edit", the data field from the message can be edited.

When the data message is composed, the Send button is augmented with an Enter icon (⏎). Press Enter or the Send button to send the message to the MT. Note that you should receive an Acknowledge message; visible in the "Received from"-field.

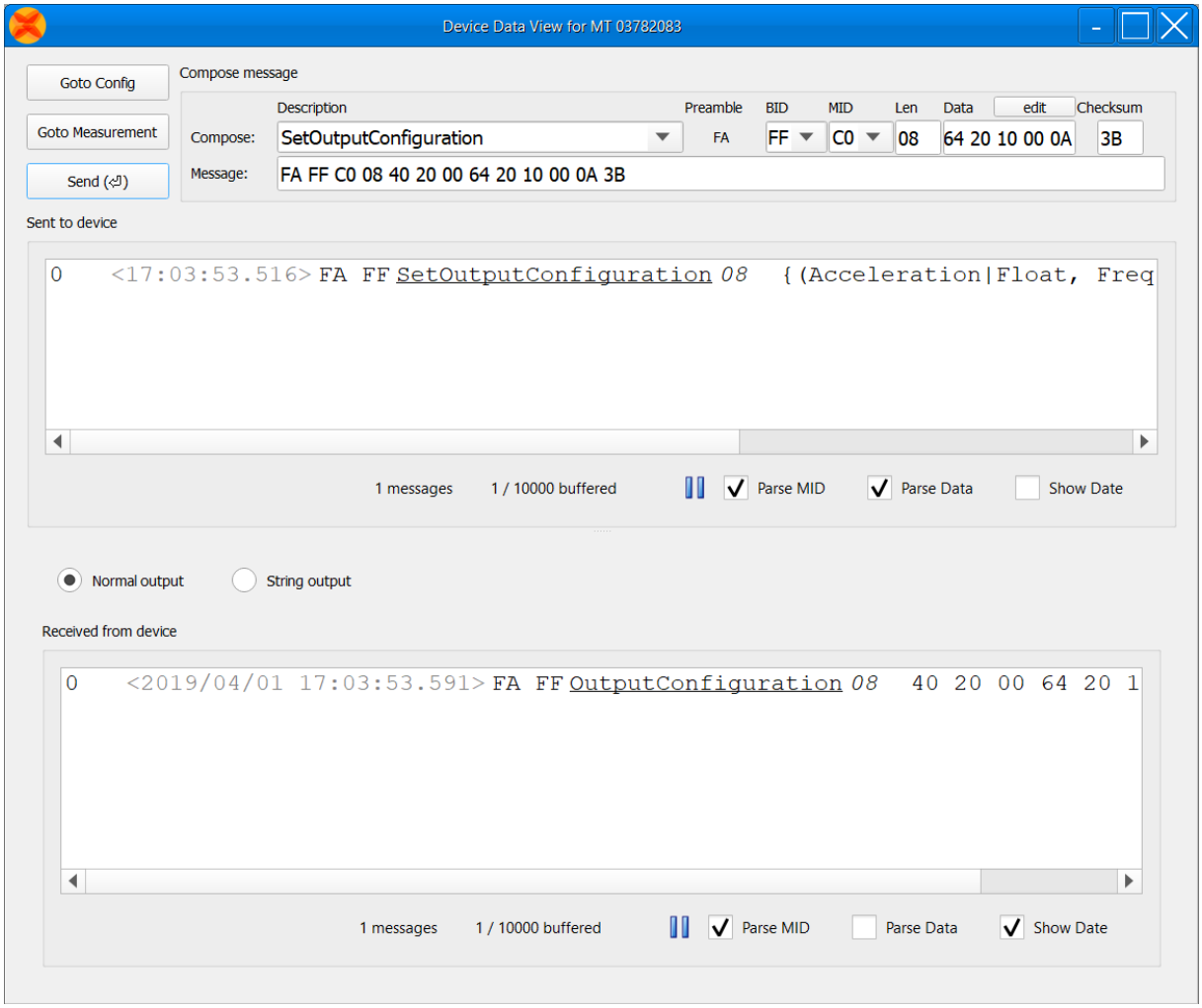


Figure 76: Messages showing the acknowledge sequence in the low-level Xbus protocol

To verify the settings you just wrote to the device, you can request the settings; in this case the settings were correctly set:

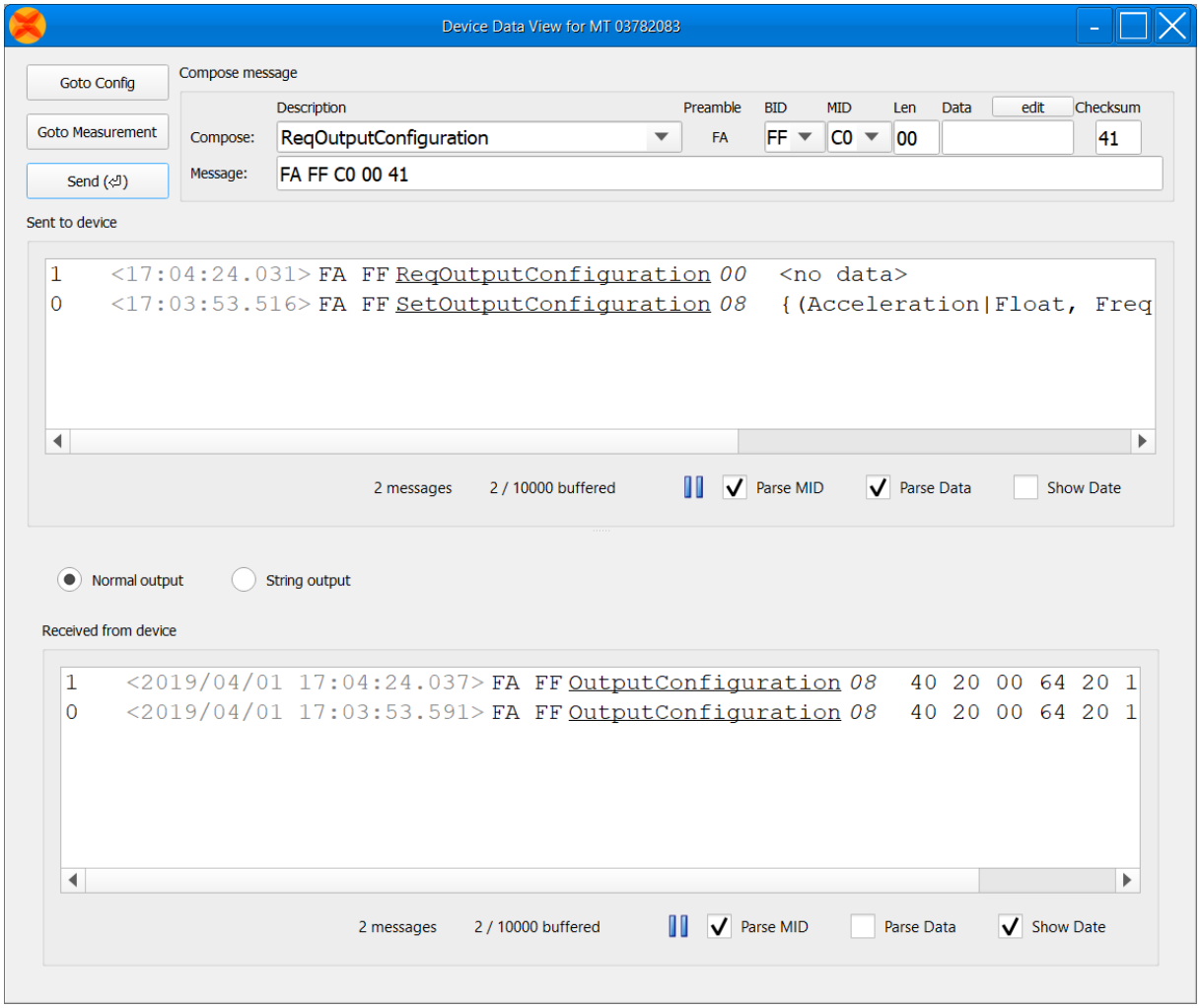


Figure 77: An example showing how to request settings from the MTi device.

6.4.2 XDA Data View

The XDA Data View is hidden by default. It can be enabled through Tools > Preferences. The XDA Data View allows monitoring the communication from XDA to MT Manager. Comparing this with the messages in the device message terminal shows which messages are added or calculated by XDA. The XDA message terminal can also be used to compose messages in ASCII; the composer will set the required bits, will include the XBus header (preamble, message ID etc) and will calculate the correct checksum. The message can then be written to the device.

The dialog for the XDA message terminal is very similar to the dialog of the device message terminal. Two fields are added: the "Data packets"-field and the "Other messages"-field. The fields "Sent to device" and "Received from device" are the same as the fields in the device message terminal (see 6.4.1), with the exception that MTData2 messages are excluded from these fields (i.e. only Set-, Req-messages and their acknowledge messages are shown).

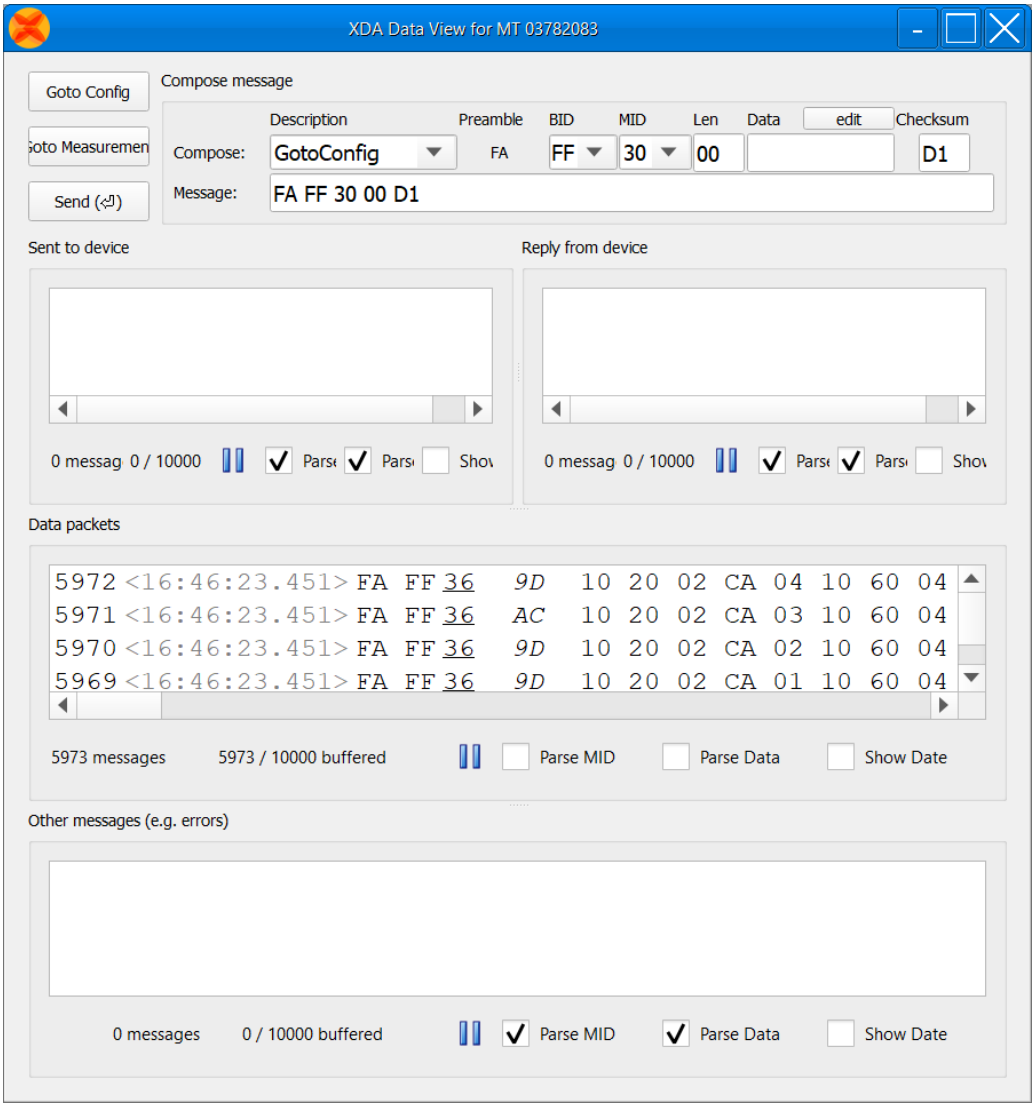


Figure 78: The XDA message terminal has an extra field with respect to the Device Data Viewer, showing the data received from the Xsens Device API (XDA)

The "Data packets"-field shows the data packets that are generated by the Xsens Device API. These do not have to be the same as the data messages that are sent by the MT: when XDA processes e.g. orientation data based on dq/dv, orientation data is added to the data packets stream (depending on the selected output configuration).

The "Other messages"- field shows warnings generated by XDA.

Documentation on all functionality can be found in 6.4.1.

6.5 Typical utilisations

This section describes a selection of typical utilisations of the MT Manager.

Note: It is necessary to let the system stabilise right after start-up (filter stabilisation can take up to 60 seconds) in order to get more reliable measurements.

6.5.1 Logging data

Logging data can be started and stopped by pressing the "Record / Stop Record" button (see also section 5.7.6):

The generated log file (`.MTB` file) will be written to the folder specified in the toolbar in the top of the main window under "Current directory". By default, this is the root directory of the MT Manager installation (e.g. C:\Program Files\Xsens\MT Software Suite xxxx.x\MT Manager).
This setting can be changed in the toolbar in the top of the main window under "Current directory". Make sure that you have administrator permission for the folder you want to save data in.

The default log file name can be changed by going to "Tools" ➔ "Preferences…" and selecting "Logging":

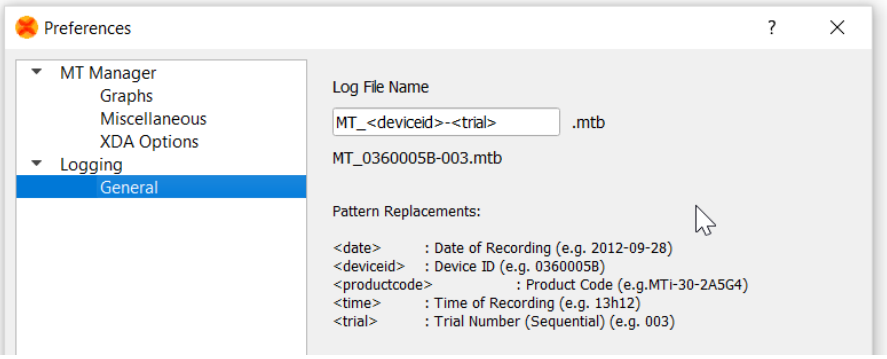


Figure 79: The logging name can be changed in the Preferences window. Use <time> and/or <trial> to ensure unique file names

6.5.2 Replaying logged data

Playback of logged data can be done by opening an `.MTB` file that has been previously recorded:
Go to "File" ➔ "Open File…" (or by pressing "CTRL+O") and select the `.MTB` file:

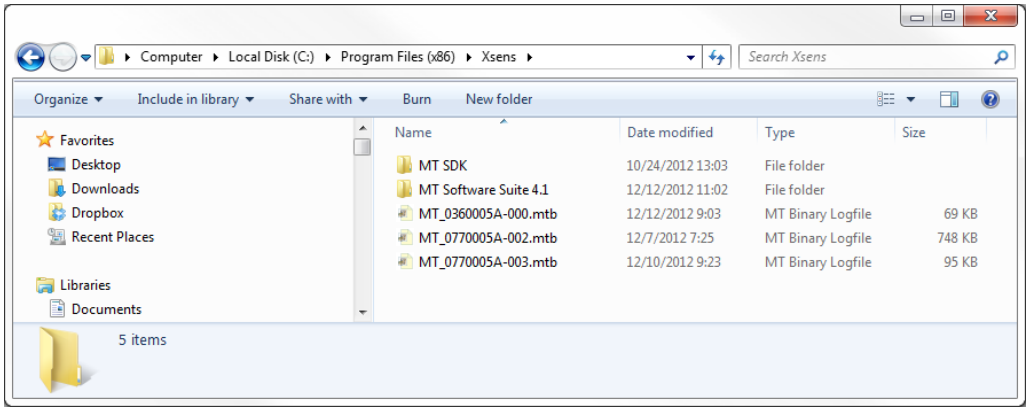


Figure 80: Log files of the MT Manager have an .mtb extension

A dialog will be opened that allows you to set the filter profile to process the data with (also exporting). If you want to process the data with a different filter profile, you have to reopen the file.

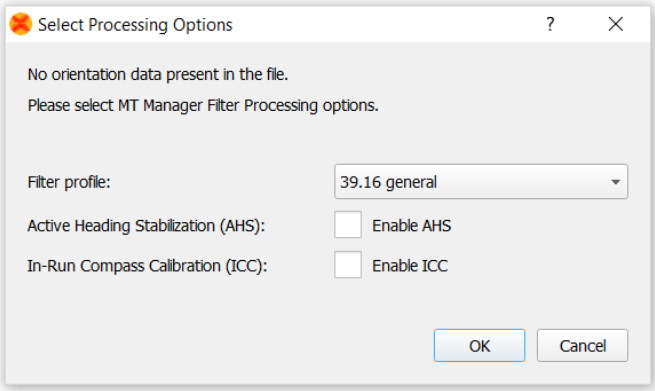


Figure 81: When opening an .mtb that contains SDI data, you choose the desired filter profile

When you have selected the applicable filter profile, a dialog opens that shows the file loading progress.

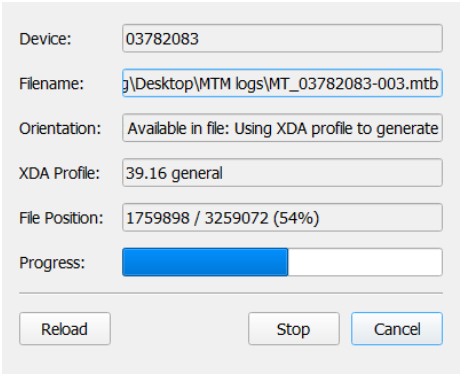


Figure 82: The file loading screen, displaying relevant information on file

Table 26: Parameters shown when data is being processed from a file

Button/field	Description
Device	Shows the DeviceID of the Motion Tracker of which data is being loaded
Filename	Full path and file name of the file being loaded
Orientation	- Not available in file: XDA processes orientation (and position) data with the filter profile selected. - Available in file: orientation and position data is not reprocessed, not even when dq/dv is available in the file. The filter profile is ignored
XDA profile	When XDA (MT Manager) is processing orientation data, this file shows the XDA profile being used. When orientation data is in the file, this field shows <ignored>
File position and Progress	Data is processed from beginning to end. This bar shows the number of bytes from the file that is already processed. The total file size (in bytes) is shown after the slash
Reload	This button can be used to process the file with a different XDA profile. The current loading procedure will be cancelled.
Stop	Processing the file will be stopped. Already processed data is available in MT Manager
Cancel	Loading the file will be cancelled. Data is not available in MT Manager

Logged data can either be presented at once in a graph or played back in real time. These two settings can be chosen via "Tools" → "Preferences..." → MT Manager → Graphs → File Plotting Method: Real-time or All Data

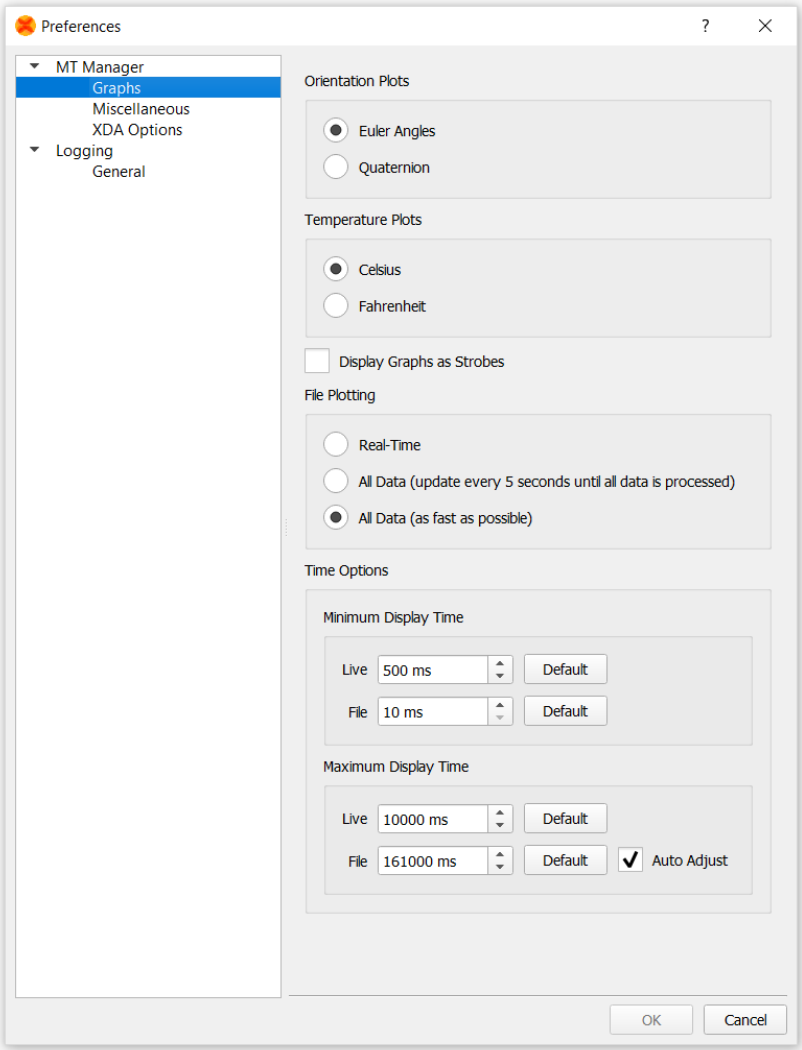


Figure 83: The behaviour of the graphs can be adapted in the Preferences - Graphs window

Time options:

The number of points in the graphs can be chosen in this dialog. When setting the time to a higher value, the data in the graphs can be investigated over a long period of time.

The "Play" and "Rewind" buttons can then be used to control the playback (see also section 5.7.5):

Figure 84: The Playback toolbar

It is recommended to open the desired views before starting the playback.

6.5.3 Exporting ASCII data

Data previously logged into an .MTB file can be exported to the ASCII format. After opening an .MTB file, click Export . The Export Configurations window will open.

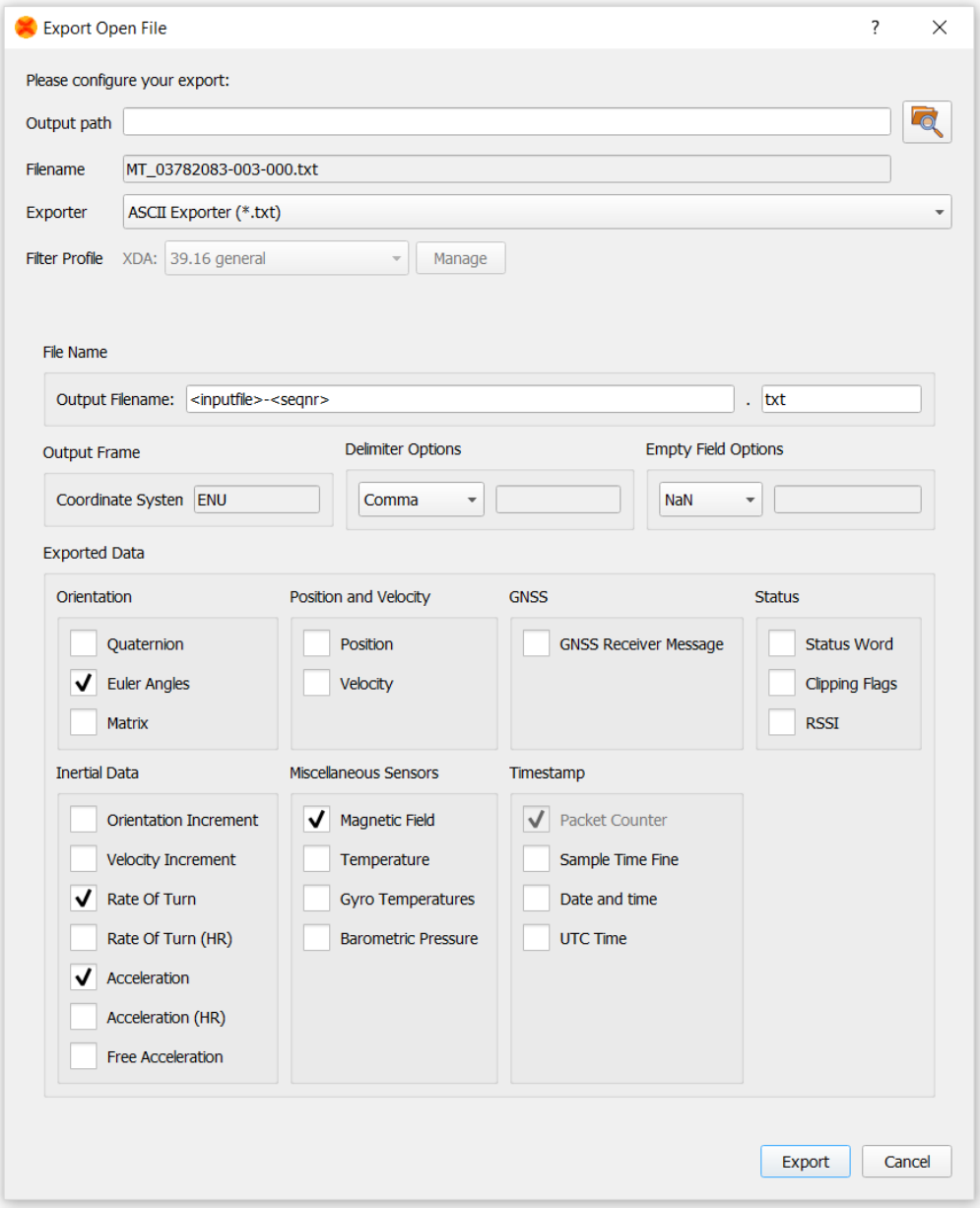


Figure 85: ASCII exporter settings dialog

Here the default file name is defined as:

`<inputfile>-<seqnr>-<time>.txt`, where

`inputfile` is the original name of the logged file

`seqnr` is incremented each time the corresponding .MTB file is processed.

`time` is the time read from the system (Windows) clock

You can change the output path in this screen (the output path is the same as the "current directory" in MT Manager). The default export file name is displayed in the Filename field. You can edit this name before exporting. Press the "Export" button to complete the export. Make sure you have writing rights for the specified folder.

In the next sub-sections you will find details of the exporter types.

6.5.3.1 ASCII Exporter – File Name

The file name can be configured with the following parameters:

Table 27: Parameters that can be chosen to automatically form a file name for the ASCII exporter

Parameter	Description
<date>	Data of export (e.g. 2014-09-28)
<deviceid>	Device ID (e.g. 0360005B)
<inputfile>	Original Filename without extension (e.g. MT0360005B-005)
<seqnr>	Sequential number (e.g. 003). Include <seqnr> or <time> to ensure unique output file names
<productcode>	Product code (e.g.MTi-30-2A5G4)
<scenario>	Filter profile used (e.g. general)
<time>	Time read from the system clock. Include <seqnr> or <time> to ensure unique output file names
Any text	It is possible to add any text, such as dashes, underscores, but also words and digits in the file name format.

6.5.3.2 ASCII Exporter – Delimiter Options

It is possible to choose the delimiter options that can help you to import the columns of data of the exported file into an external program. You can also define your own delimiter (one character from the extended ASCII table).

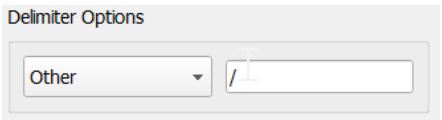


Figure 86: In the delimiter options, you can even choose your own exotic delimiter, e.g. § or ¼

6.5.3.3 ASCII Exporter – Empty field options

As the MTi can export data at different output frequencies per data output, it is required to choose the behaviour when data does not exist in one (exported) data package. You can choose with which placeholder this field is filled. You can also insert your own string (unlimited). The empty field placeholder will help you when importing the data into an external program. NaN is commonly used in Excel.

Figure 87: When no data is available in a row, specify your own characters for the empty cell/field

6.5.3.4 ASCII Exporter – Exported data

The ASCII exporter can export many data quantities. Select those required in the Exported Data section.

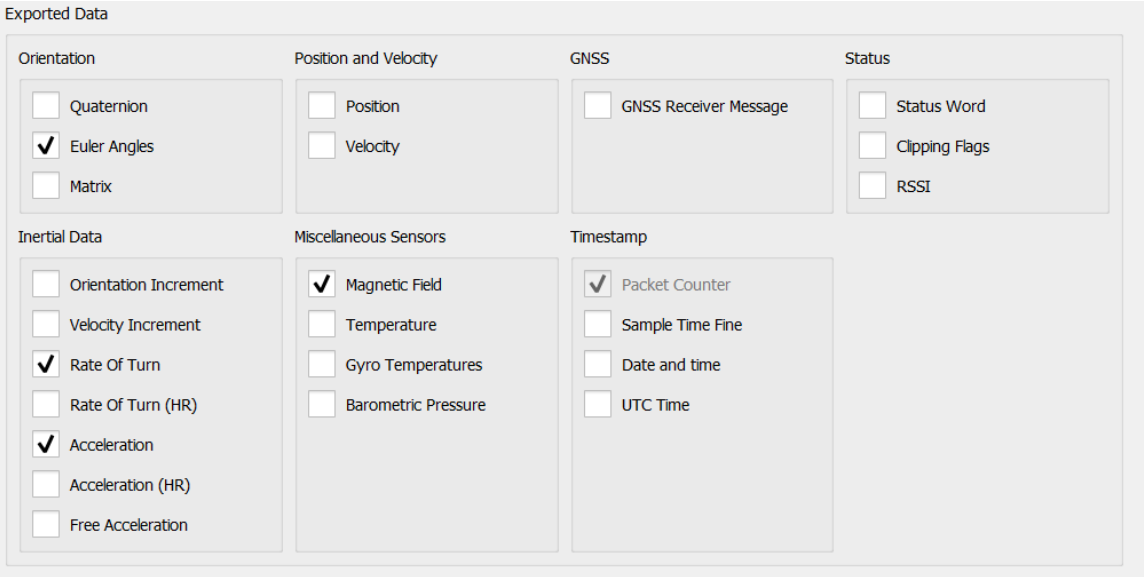
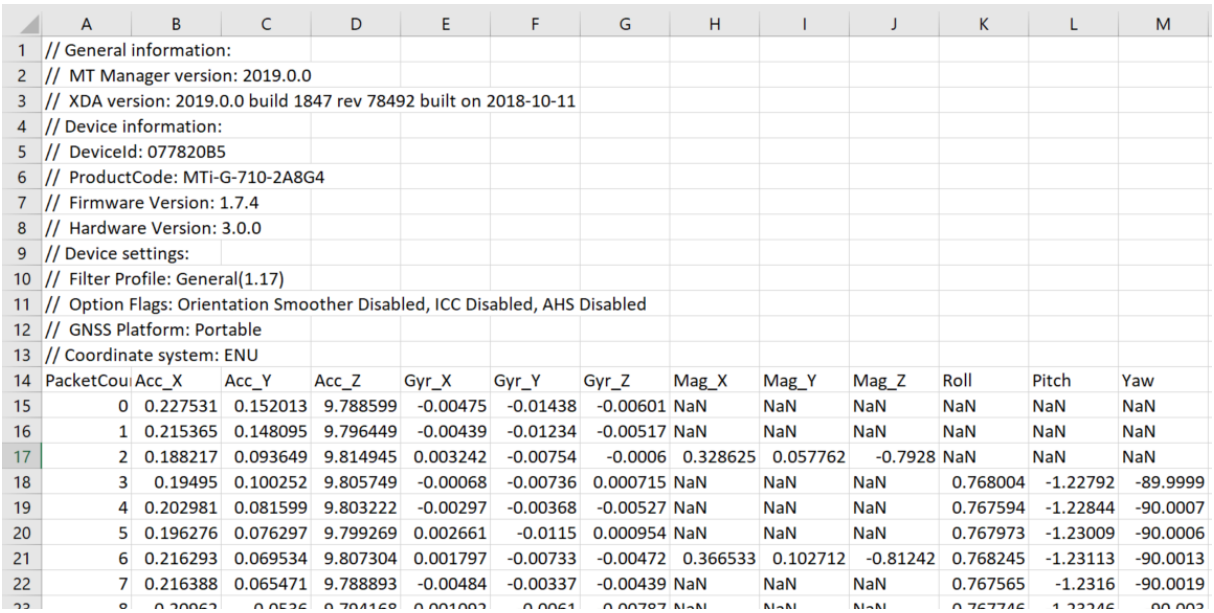


Figure 88: Options for data export

6.5.3.5 ASCII Exporter – file format

The output consists of a header with settings information and the actual data which is delimited by the delimiter chosen.
The following picture shows the first part of an example exported ASCII data file in Excel, still as .txt format:



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	// General information:												
2	// MT Manager version: 2019.0.0												
3	// XDA version: 2019.0.0 build 1847 rev 78492 built on 2018-10-11												
4	// Device information:												
5	// DeviceId: 077820B5												
6	// ProductCode: MTi-G-710-2A8G4												
7	// Firmware Version: 1.7.4												
8	// Hardware Version: 3.0.0												
9	// Device settings:												
10	// Filter Profile: General(1.17)												
11	// Option Flags: Orientation Smoother Disabled, ICC Disabled, AHS Disabled												
12	// GNSS Platform: Portable												
13	// Coordinate system: ENU												
14	PacketCou	Acc_X	Acc_Y	Acc_Z	Gyr_X	Gyr_Y	Gyr_Z	Mag_X	Mag_Y	Mag_Z	Roll	Pitch	Yaw
15	0	0.227531	0.152013	9.788599	-0.00475	-0.01438	-0.00601	NaN	NaN	NaN	NaN	NaN	NaN
16	1	0.215365	0.148095	9.796449	-0.00439	-0.01234	-0.00517	NaN	NaN	NaN	NaN	NaN	NaN
17	2	0.188217	0.093649	9.814945	0.003242	-0.00754	-0.0006	0.328625	0.057762	-0.7928	NaN	NaN	NaN
18	3	0.19495	0.100252	9.805749	-0.00068	-0.00736	0.000715	NaN	NaN	NaN	0.768004	-1.22792	-89.9999
19	4	0.202981	0.081599	9.803222	-0.00297	-0.00368	-0.00527	NaN	NaN	NaN	0.767594	-1.22844	-90.0007
20	5	0.196276	0.076297	9.799269	0.002661	-0.0115	0.000954	NaN	NaN	NaN	0.767973	-1.23009	-90.0006
21	6	0.216293	0.069534	9.807304	0.001797	-0.00733	-0.00472	0.366533	0.102712	-0.81242	0.768245	-1.23113	-90.0013
22	7	0.216388	0.065471	9.788893	-0.00484	-0.00337	-0.00439	NaN	NaN	NaN	0.767565	-1.2316	-90.0019

Figure 89: Exported ASCII txt file in Excel. Empty fields are filled with NaN (configurable in the Preferences window).

The table below describes the column headers in the ASCII exported file.

Table 28: Overview of all possible exported columns in an ASCII file

Column header	# of col.	Unit	Description
Time and date related data			
PacketCounter	1	N/A	Packet counter, wraps on 65535
SampleTimeFine	1	N/A	Sample Time of the sensor in ticks of 10 kHz (note that data may come in the file asynchronous; sample times of rows don't necessarily have to increase). Sample time fine is a data packet, and is always exported. This means that if the recorded file has a higher frequency than the exported file (e.g. when you are not exporting all data), some rows may seem to be empty except for the PacketCounter and SampleTimeFine.
Year	1	N/A	Year
Month	1	N/A	Month
Day	1	N/A	Day
Second	1	s	Seconds from the day (midnight starts at 0.00)
UTC_Nano	1	ns	Nanosecond of second (UTC format, not necessarily UTC time)
UTC_Year	1	N/A	Year (yyyy) (UTC format, not necessarily UTC time)
UTC_Month	1	N/A	Month of the year (UTC format, not necessarily UTC time)

UTC_Day	1	N/A	Day of the month (UTC format, not necessarily UTC time)
UTC_Hour	1	hours	Hour of the day (UTC format, not necessarily UTC time)
UTC_Minute	1	min	Minute of the hour (UTC format, not necessarily UTC time)
UTC_Second	1	sec	Second of the minute (UTC format, not necessarily UTC time)
UTC_Valid	1	N/A	UTC_Valid is 0 when no GPS is used; otherwise it adopts UTC_Valid from GPSTimeValidity (see below)
Status data			
StatusWord	1	N/A	32-bit status, see [LLCP] for information on the Status Word
ClippingFlags			
RSSI			Received Signal Strength Indicator – used for Awinda to determine signal strength of MTw wireless communication
Sensors data			
Acc_X / _Y / _Z	3	m/s^2	3D acceleration, processed via SDI and inverse SDI. When exported from SCR data, this data is only compensated for bias, temperature, gain and misalignment (no SDI and inverse SDI)
FreeAcc_X / _Y / _Z	3	m/s^2	3D acceleration, where gravity has been subtracted from. Maximum frequency is 400 Hz
AccHR_X /_Y / _Z	3	m/s2	3D acceleration at rates up to 1000 Hz. See [LLCP] for meaning of the output per device
Gyr_X / _Y / _Z	3	rad/s	3D rate of turn, processed via SDI and inverse SDI. When exported from SCR data, this data is only compensated for bias, temperature, gain, misalignment and g-sensitivity (no SDI and inverse SDI)
GyrHR_X /_Y / _Z	3	rad/s	3D rate of turn at rates up to 1000 Hz. See [LLCP] for meaning of the output per device
Mag_X / _Y / _Z	3	a.u.	3D magnetic field, maximum output rate is 100 Hz When exported from SCR data, data is copied from 100 Hz to match output frequency
VelInc_X / _Y / _Z	3	m/s	3D delta_velocity (dv); result of SDI algorithm
OriInc_q#	4	N/A	3D delta_quaternion (dq); result of SDI algorithm
Pressure	1	Pa	Static pressure (MTi 100-series only)
Orientation, Position and Velocity (data that is processed by the Xsens fusion filter algorithm)			
Roll / Pitch / Yaw	3	deg	Euler angles orientation output
Quat_q0 / q1 /q2 / q3	4	N/A	Quaternion orientation output

Mat[#][#]	9	N/A	Rotation Matrix orientation output
Latitude / Longitude	2	deg	Decimal representation of latitude and longitude – estimated by Xsens fusion filter algorithm – MTi-7 and MTi-G-710 only
Altitude	1	m	Altitude above geoid (WGS84 datum) – estimated by Xsens fusion filter algorithm – MTi-7 and MTi-G-710 only
Vel_X / _Y / _Z	3	m/s	3D velocity in same coordinate system as orientation – estimated by Xsens fusion filter algorithm – MTi-7 and MTi-G-710 only
Sensor Component Readout (10-series and 100-series only)			
Temperature	1	ºC	Reading of the general temperature sensor, located near the accelerometers and magnetometer
GyrTemp_X / _Y / _Z	3	ºC	Reading of the gyroscope temperature sensor, located inside each individual gyroscope
SCRAcc_X / _Y / _Z	3	N/A	Digitized (16-bits) analog readout of the accelerometers (bits)
SCRGyr_X / _Y / _Z	3	N/A	Digitized (16-bits) analog readout of the gyroscopes (bits)
SCRMag_X / _Y / _Z	3	N/A	Readout (no bias/gain compensation) of magnetometer (bits)
SCRTemperature	1	N/A	Readout of the general temperature sensor (bits)
SCRGyrTemp_X / _Y /_Z	3	N/A	Readout of the temperature sensors in the gyroscopes (bits)
GNSS message– composed of 2 distinctive messages that are in exported file in different rows			
NUTimeOfWeek	1	ms	GPS time of week
TimeAccuracyEst	1	ns	Time accuracy estimate
GNSS UTC time (GPS)	7	Units according to column header	These 7 columns output the UTC time as outputted by the GNSS receiver: GNSSNanoSecOfSec, GNSSYear, GNSSMonth, GNSSDay, GNSSHour, GNSSMin, GNSSSec Time is determined by GPS only
GNSSTimeValidity	1	-	Validity flags: bit (0) = UTC Date is valid bit (1) = UTC Time of Day is valid bit (2) = UTC Time of Day has been fully resolved (i.e. no seconds uncertainty)
GNSSFixtype	1	-	GNSS fix type (range 0..5): 0 = No Fix 1 = Dead Reckoning only 2 = 2D-Fix 3 = 3D-Fix 4 = GNSS + dead reckoning combined 5 = Time only fix
GNSSFixStatusFlags	1	-	Fix Status Flags: bit (0) = valid fix (within DOP and accuracy masks) bit (1) = differential corrections are applied

			bit (2..4) = reserved (ignore) bit (5) = heading of vehicle is valid
NumberOfSV	1	-	Number of satellites used in navigation solution
Longitude	1	deg	Longitude
Latitude	1	deg	Latitude
Height	1	mm	Height above ellipsoid
HeightMeanSeaLevel	1	mm	Height above mean sea level
HorizonalAccuracyEst	1	mm	Horizontal accuracy estimate
VerticalAccuracyEst	1	mm	Vertical accuracy estimate
VelocityN/E/D	3	mm/s	NED velocity
GroundSpeed	1	mm/s	2D ground speed
MotionHeading	1	deg	2D heading of motion
SpeedAccuracyEst	1	mm/s	Speed accuracy estimate
HeadingAccurayEst	1	deg	Heading accuracy estimate (both motion and vehicle)
Heading	1	deg	2D heading of vehicle
*DOP	7	-	DOP values
Itow	1	ms	GPS time of week
GnssId[#];SvId[#];Cno[#];Flags[#]	60*4	-	GnssId: GNSS identifier 0 = GPS 1 = SBAS 2 = Galileo 3 = BeiDou 4 = IMES 5 = QZSS 6 = GLONASS SvId: Satellite identifier Cno: Carrier to noise ratio (signal strength) Flags: bit (0..2) = signal quality indicator 0 = no signal 1 = searching signal 2 = signal acquired 3 = signal detected but unusable 4 = code locked and time synchronized 5, 6, 7 = code & carrier locked; time synchronized bit (3) = SV is being used for navigation bit (4..5) = SV health flag 0 = unknown 1 = healthy 2 = unhealthy bit (6) = differential correction data is available bit (7) = reserved
Triggers (Trigger1 and Trigger2); MTw only, Trigger Indication of MTi can be found in StatusWord			

TrigIn1_Polarity	1	N/A	Polarity of the signal received: 1: Rising Edge 2: Falling Edge 3: Both
TrigIn1_Timestamp	1	N/A	The time stamp of the trigger
TrigIn1_Framenumber	1	N/A	The frame number in which the trigger was received
TrigIn2_Polarity	1	N/A	Polarity of the signal received: 1: Rising Edge 2: Falling Edge 3: Both
TrigIn2_Timestamp	1	N/A	The time stamp of the trigger
TrigIn2_Framenumber	1	N/A	The frame number in which the trigger was received

6.5.4 Exporting KMZ data

It is possible to export data from a GNSS/INS device to a KMZ file. The KMZ file contains geo-referenced data points with corresponding orientation, velocity, GNSS mode and times. The contents of the KMZ file can be customized to match the user's preferences. The steps to export a KMZ file are:

1. Load an .mtb file of a GNSS/INS device. This file must contain processed orientation and position, SCR data (including GNSS PVT data) or data that can be processed with XDA.
2. Set the preferences of the KMZ exporter via Tools-Preferences-Exporters.
    a. Choose a Filename template (see 6.5.3.1).
    b. Choose the maximum numbers of markers per second. The default value is 1; you should adapt this value to your velocity: too many data points per second may cloud the data points in Google Earth.
3. Export the file via File – Export. You can change the output path and file name here.

The file can now be loaded into e.g. Google Earth.

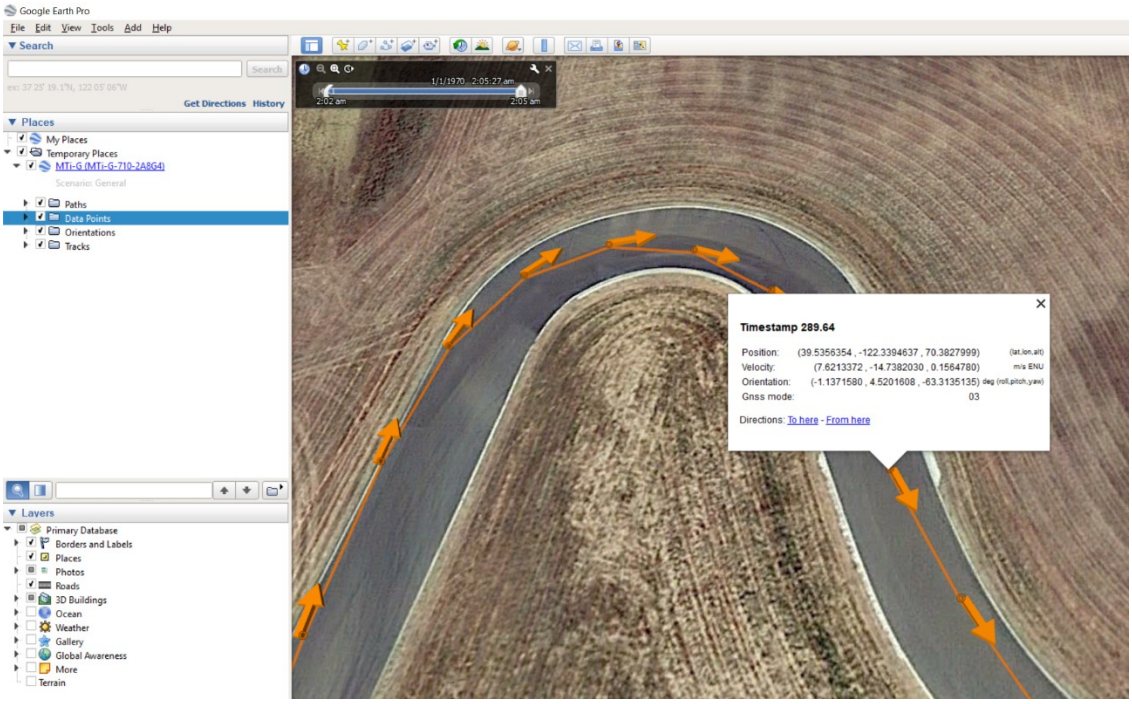


Figure 90: An MTi-G-710 data point in Google Earth

6.5.5 Using multiple MTis

Multiple Motion Trackers can be managed with the MT Manager.

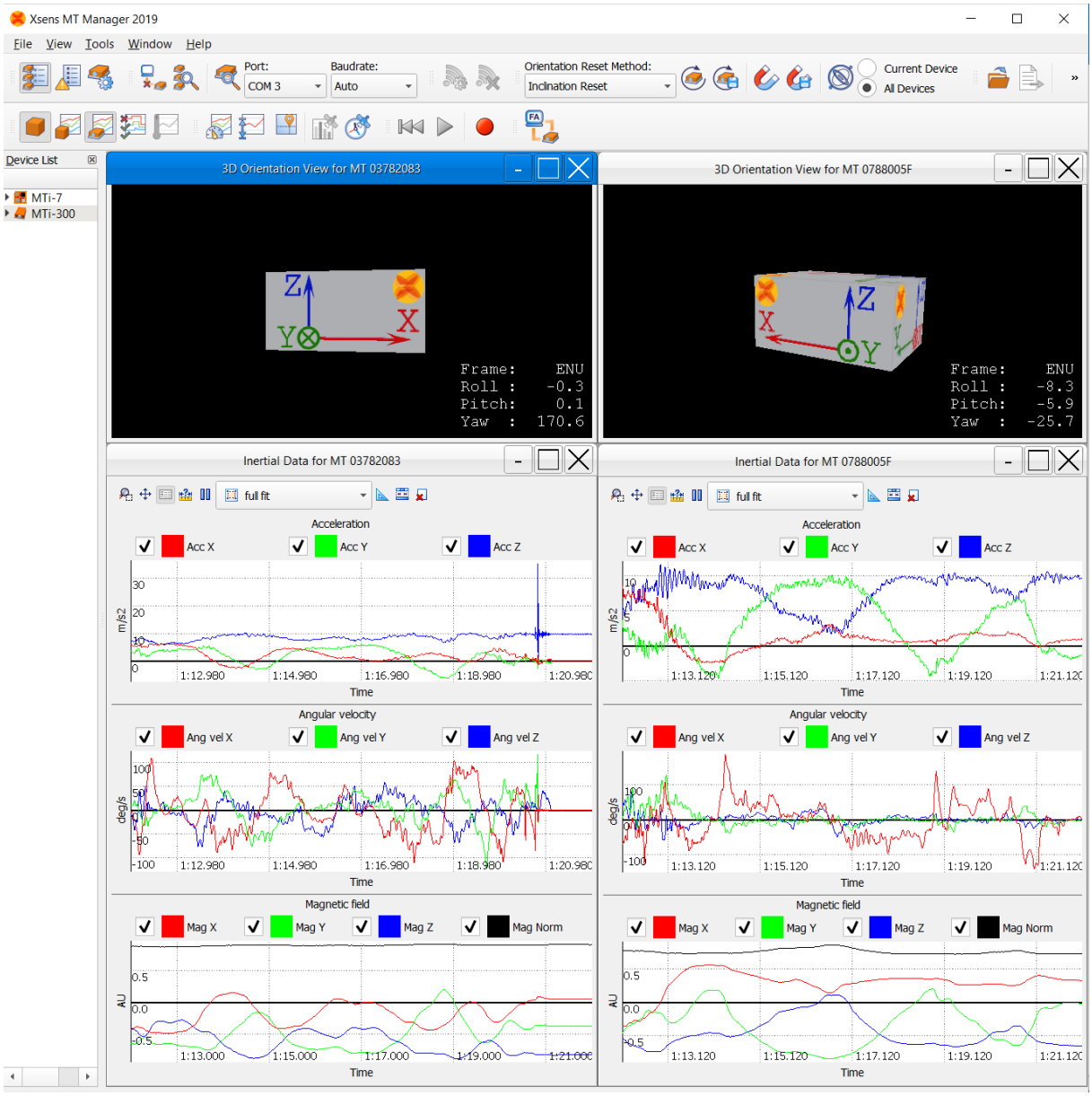


Figure 91: Managing an MTi-300 (left) and an MTi-7 (right)

7 System requirements

The MT Manager is designed for Windows 10 and Linux; the following system setup is recommended to properly run the software:

- Windows 10 64-bit or Linux 64-bit (no official support for Windows 7/8 or 32-bit platforms)
- Intel® Pentium® or AMD® processor, 1 GHz (minimum) Pentium® IV 2.00 GHz or AMD Athlon® XP 2000+ or higher (recommended)
- USB port (1.1 or higher) or standard PC serial COM-port (RS-232) [5,6]
- Graphics card with 3D hardware acceleration and OpenGL support. Contact your graphics card manufacturer to ensure your graphics card drivers are up to date. Recommended screen resolution (height) is 900 pixels or higher.

NOTE: MT Manager is designed to assign a low priority to graphics functions if your computer can not update the screen smoothly due to insufficient computing resources. This is done on purpose to avoid interfering with the core functionality of the MT Manager.

[5] RS-232 add-on cards are not supported
[6] Custom RS-232 USB converters are not supported