UM2422
User manual

ST TESEO-SUITE - User Manual

Introduction

ST TESEO-SUITE is a powerful PC Tool able to manage all the capabilities of ST Teseo GNSS family. It can manage more ST Teseo GNSS solutions in parallel. On each ST Teseo GNSS solution the TESEO-SUITE is able to read, modify and save the configuration. NMEA sentences logging and analysis supported. NMEA message-list configurable per port.

The functions offered by the tool can be divided into two main areas:

1. Viewer: NMEA or binary protocol decoding and display of some views
2. Test plan: module for writing and running scripts on ST GNSS receivers

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1 Prerequisite

TESEO-SUITE application requires the following components to be installed to run properly:

- The .NET Framework 4.5 (see Microsoft web site for details) or higher
- Visual C++ Redistributable Packages for Visual Studio 2013 (see Microsoft web site)

TESEO-SUITE application uses parts of source code developed by other companies or groups.

- Maps for Windows forms:
  - Copyright © Radioman
- Output log:
  - Copyright © Apache Software Foundation

2 Getting started with the TESEO-SUITE

When the application is started for the very first time, TESEO-SUITE scans all available UART COM ports to detect any connected receiver whatever the protocol used.

In case that no receiver has been found, the TESEO-SUITE opens the configuration session panel (see *Section 2.1: Create New Session (View Session)*) to allow the user to add them manually.

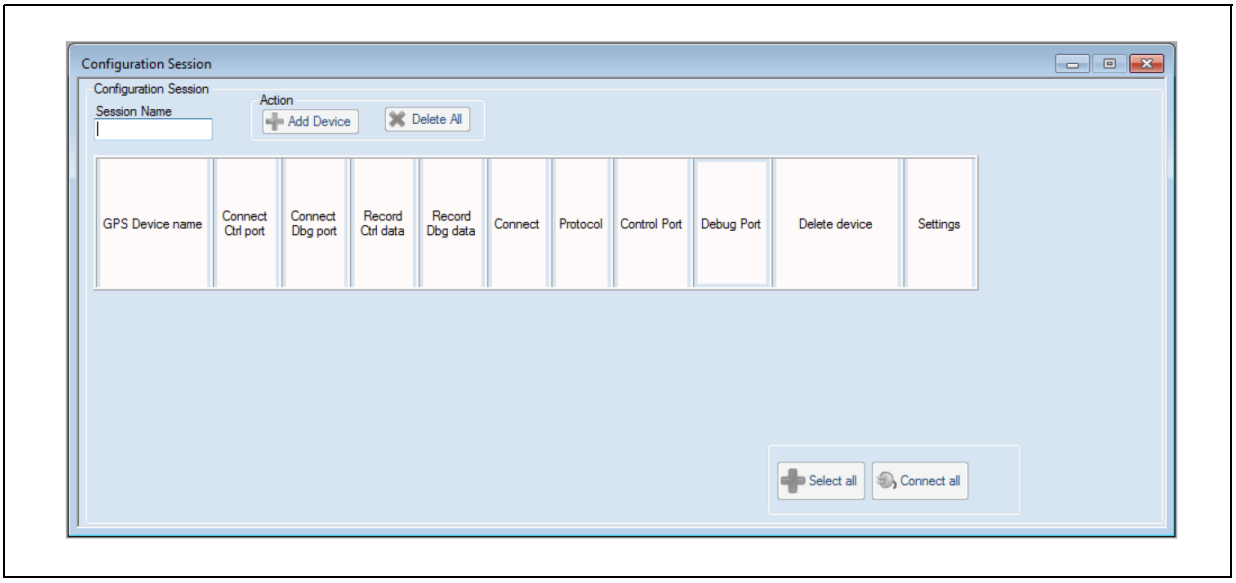
TESEO-SUITE can manage up to four receivers in parallel. In this case, the display of data in real-time cannot be guaranteed, especially when graphical views are open.

2.1 Create New Session (View Session)

When there is no device, the session panel is empty. The user can add up to 4 GNSS devices by clicking on the “Add Device” button.

If the session panel is not yet open, go in the "File" menu, select "New Session" and enter a session name to enable the “Add Device” button.

Figure 1. New Session panel



A button “Edit Session configuration”, as shown in *Figure 3*, allows to open and close the session configuration panel.

Figure 2. Open Edit Session configuration

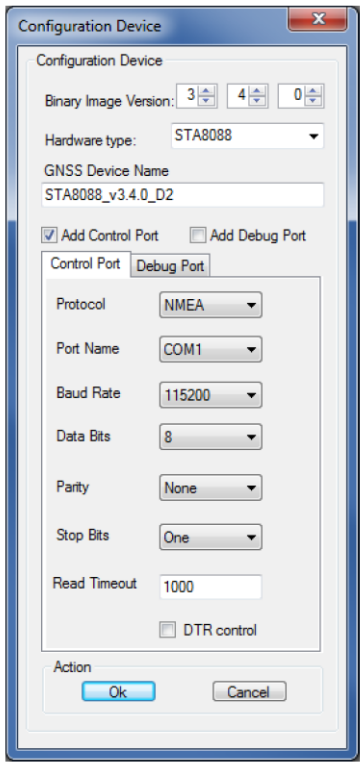
2.2 Add/Delete Device in Session – Configuration Device

Via the form of "Session Configuration", you can add / remove GNSS devices in the work session, and monitor the existing ones.

To enable the functionality of adding / removing devices, you must first set the name of the work session.

Pressing the button "Add Device" the "Device Configuration" form is shown in *Figure 3*.

Figure 3. Configuration Device panel



The Teseo Binary Software Image version, the hardware type and the GNSS device name are set to a default value.

The user has to change the value of the Teseo Binary Software Image version and the hardware type according to the device used and the Teseo Binary Software Image downloaded. This step is compulsory to allow a proper binary or NMEA payload decoding.

There is the possibility to select up to two ports, Control and / or Debug port, and to choose the parameters of the serial connection.

On Control port, the user can select which protocol is used by the GNSS device (NMEA or Binary).

The user must select the DTR option when using a virtual UART port over USB.

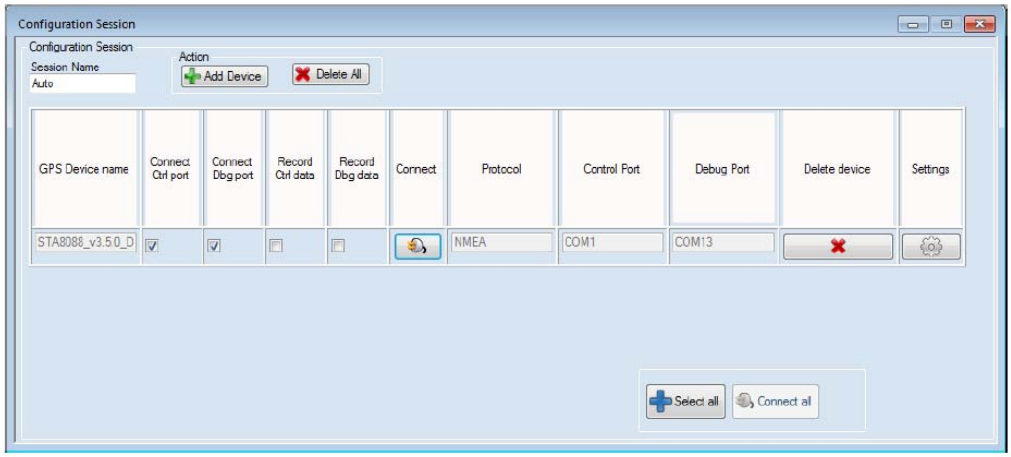
Press the “OK” button to create the device.

When selecting the port name, the TESEO-SUITE provides an enumeration of all the COM ports available (including Bluetooth-SPP COM ports) even if these COM ports are already used by another application

Please note that the protocol of the device and its name cannot be changed once the “OK” button has been clicked.

To delete a device from the session, disconnect the device first and press the corresponding delete button in the “Delete Device” column from the "Configuration Session" form (*Figure 4: Configuration session panel with one device added*).

Figure 4. Configuration session panel with one device added



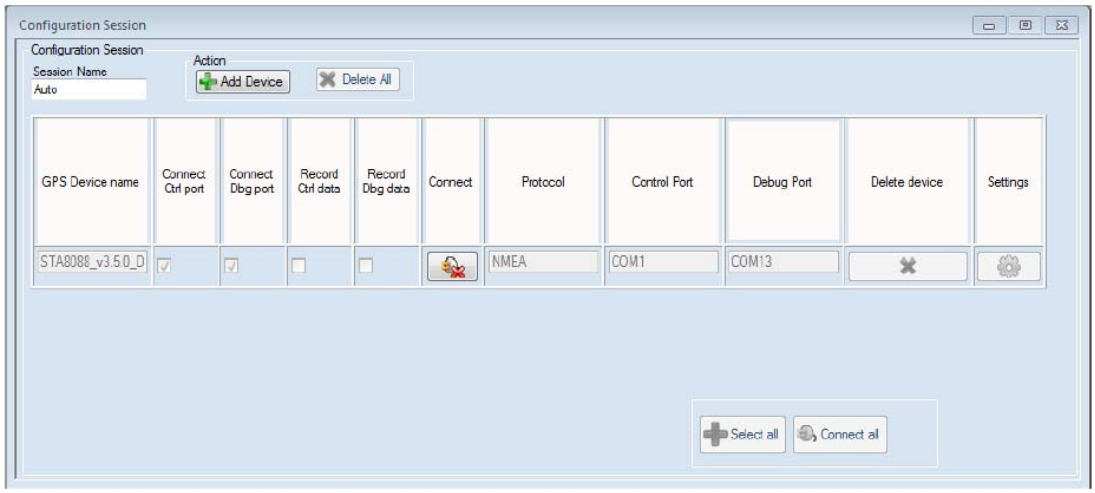
The button “Delete All” removes all the devices of the current session.

2.3 Connect or disconnect Control/Debug Ports

The ports defined when devices have been added can be opened. If a port is defined, the corresponding checkbox is enabled. Selecting the checkboxes in the “Connect Ctrl ports” column and in the “Connect Debug port” column enables the corresponding connection buttons.

Click on the connect button to open the selected ports. Then the appearance of the button changes to show that you can disconnect the device (*Figure 5: Ports connection*).

Figure 5. Ports connection



3 Database

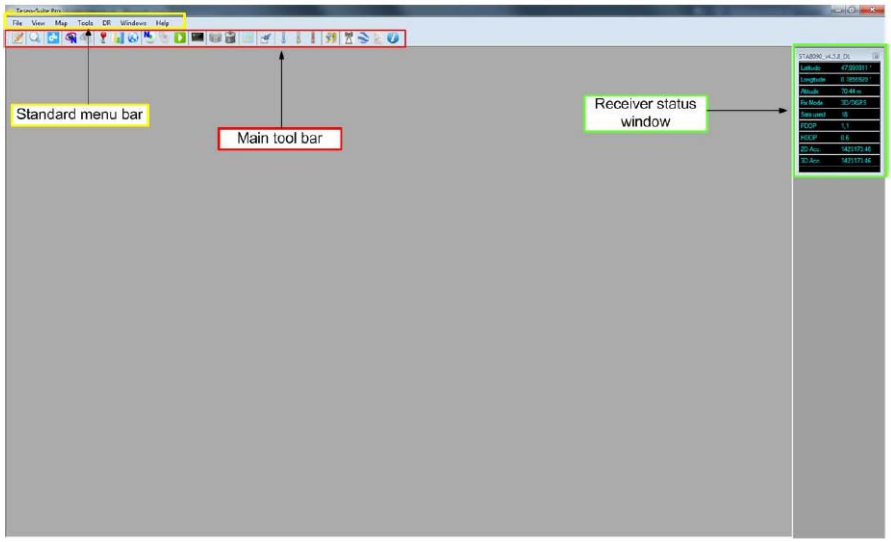
Database is a collection of stream inputs, sorted by protocol commands, recordable and editable in the Database monitor.

4 TESEO-SUITE menus and windows

4.1 Main GUI and toolbars

The main GUI (*Figure 6: Main GUI*) is the preliminary display screen of TESEO-SUITE. It displays all the views and tool bars. A status window is displayed on the right side of the screen for each receiver.

Figure 6. Main GUI



4.1.1 Standard menu bar

All main functionalities of TESEO-SUITE can be accessed through the standard menu.

File

The file menu (*Figure 7: File menu*) proposes the items in *Table 1: File menu items*.

Figure 7. File menu

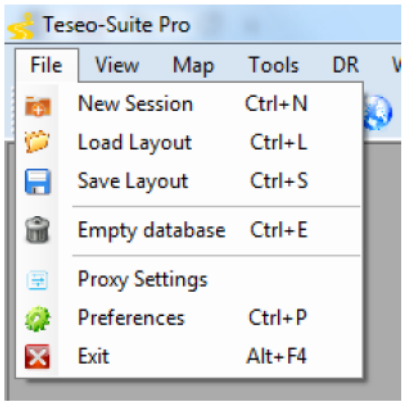


Table 1. File menu items

New session	Kill the current session if any. An empty session panel is then displayed
Load Layout	Restore saved state of the tool
Save layout	Save the state of the tool in a binary file i.e. location and size of the views, serial connection settings etc…
Empty database	Clear the database of the current session
Proxy settings	User can configure a global proxy for the application. Proxy settings will be used when the application will have to download files from the internet (i.e.: Assisted GNSS data). User's credentials are encrypted before being saved into the user setting file.
Preferences	**User settings** Application log path: the path where the application log files will be saved (e.g. database log file). NMEA/Binary/debug log path: the path where the files (Recording Files and tests results) will be saved. To load the latest session configuration when the application starts, select the check box "Load last layout at start-up". Detect devices at start-up: allows to detect and mount all the connected device at the application start-up. Please note that if the check box "Load last layout at start-up" is checked, this feature is disabled. Auto baud rate at start-up: it enables the baud rate detection at the application start-up. Please, note that enabling this feature can lead to slow down drastically the start-up of the application. Player: go straight to the selected scroll bar position: if this option is selected, the history in graph and map view won't be deleted when user moves the player cursor backward, the cursor moves directly to the choose position without any replay of the previous database content. **GNSS settings** NMEA start-up synchro message: string associated with the device start-up (used by test module). NMEA trigger synchro message: give the very first message received at a given fix rate. This trigger determines the beginning of a sequence (i.e. a set of messages received periodically at 1Hz). For instance, $GPRMC is the first message to be received in a typical ST GNSS binary SW. The trigger cannot be a message that can be received several times like $PSTMTS messages. Binary start-up synchro message: command id associated with the device start-up. Binary trigger synchro message: command id used by the database to start to record data from a message sequence
Exit	Exit the application

View

The View menu (*Figure 7: File menu*) proposes items in *Table 2: View menu items*.

Figure 8. View menu

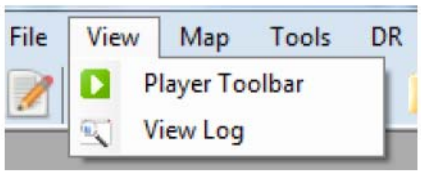


Table 2. View menu items

Player Toolbar	Open the log file toolbar
View log	Open an window with application's errors or information

Map

The Map menu (see *Figure 9: Map menu*) proposes items in *Table 3: Map menu items*.

Figure 9. Map menu

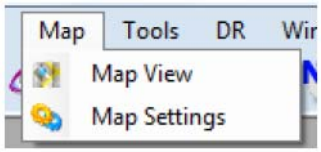


Table 3. Map menu items

Map View	Open the map window. Note that this window requires a valid internet connection to work properly. If your internet connection goes through a proxy, make sure to enter your credentials by opening your usual internet browser first.
Map Settings	Open the map window with the settings panel.

Tools

The Tools menu (*Figure 10: Tool menu*) proposes the following entries:

Figure 10. Tool menu

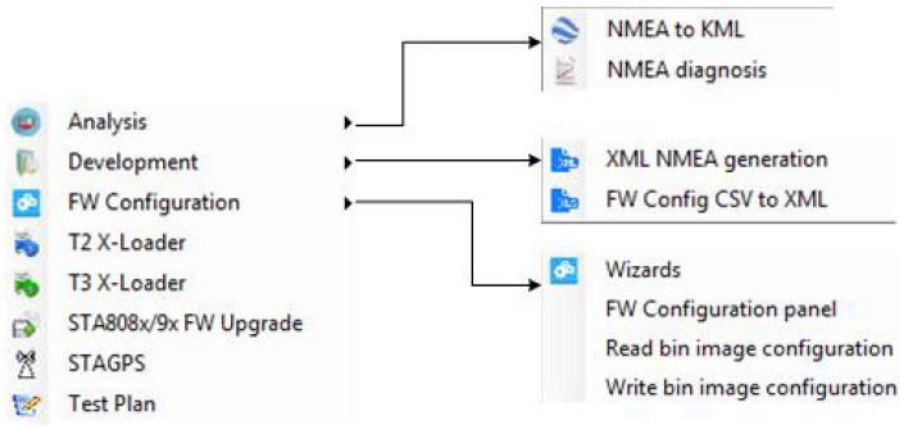


Table 4. Tool menu items

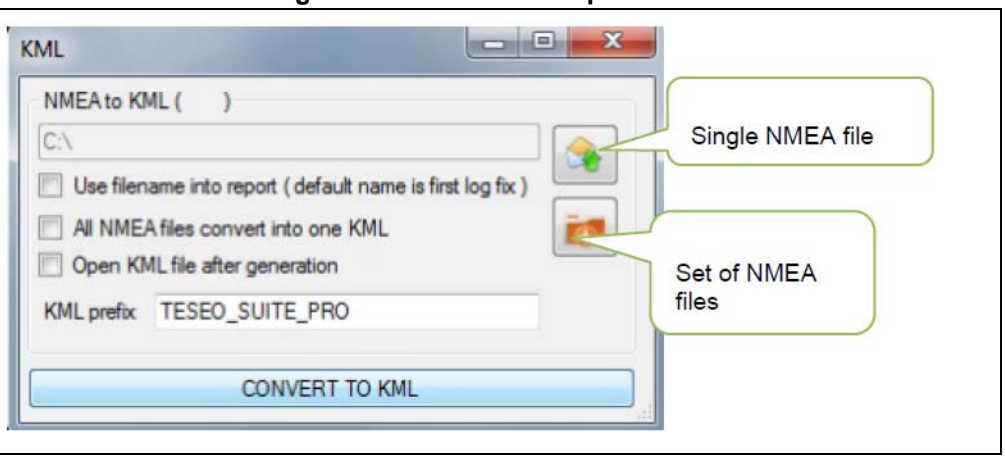
Analysis / NMEA to KML	Export data of a NMEA log into KML data format for displaying with Google Earth. See Note 1 below.
Analysis / NMEA diagnosis	NMEA log post processing tool which generates a report file in html format. This report is a first help to analyze a log and the file can be opened thanks to a Web browser. This report file contains statistics and anomalies detected when parsing the log. See Note 2 below.
Development / XML NMEA generation	This menu is intended for developers only. Trying to modify XML payload files is at your own risk! This menu allows to generate a NMEA XML payload file from a CSV file.
Development / FW config CSV to XML	This menu is intended for developers only. Trying to modify XML payload files or FW configuration files is at your own risk! This menu allows to generate the firmware configuration XML file from a CSV file.
FW Configuration / Wizards	Open the wizard selection panel which allows to change the firmware configuration of your device, a binary software or to generate a patch file thanks to comprehensive wizards
FW Configuration / FW configuration panel	Open the firmware configuration panel which allows to read and write firmware configuration parameters of a connected receiver
FW Configuration / Read binary image configuration	Read the firmware configuration of a binary image. This feature relies on the FWconfig.exe.
FW Configuration / Write binary image configuration	Write a user's defined firmware configuration into a binary image. This feature relies on the FWconfig.exe.
T2 X-Loader	Run the STA8088 X-Loader. See *Figure 13*.
T3 X-Loader	Run the STA8089/90 X-Loader. See *Figure 13*.
STA808x/9x FW Upgrade	Run the STA8089/90 firmware upgrade. See *Figure 14*.
STAPGS	Open the STAGPS testing panel
Test Plan	Open the scripting panel

Note 1:

The "NMEA to KML" feature is based on Capture2map which is a program converting NMEA log files into kml format. The tool, which supports GNSS and DR outputs, is available through the TESEO-SUITE but is also provided inside the DRAW binary release package as an executable which can be called from DOS command prompt.

Select menu Tools>analysis>NMEA to KML to open the KML window as shown in *Figure 11: NMEA to KML panel*.

Figure 11. NMEA to KML panel

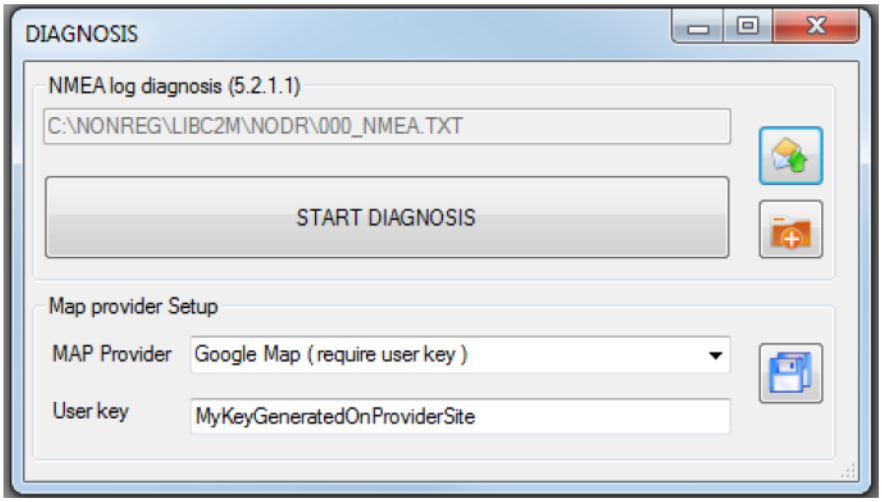


Note 2:

The “Diagnosis” feature generates an HMTL report, where physical values extracted from the NMEA file are print out. Settings, defects, sensors outputs and setup, CPU load, can be found into this document. Diagnosis chapter will help you to understand quickly what goes wrong during your trip record.

Select menu Tools>analysis>NMEA diagnosis to open the KML window as shown in *Figure 12: Diagnosis*.

Figure 12. Diagnosis



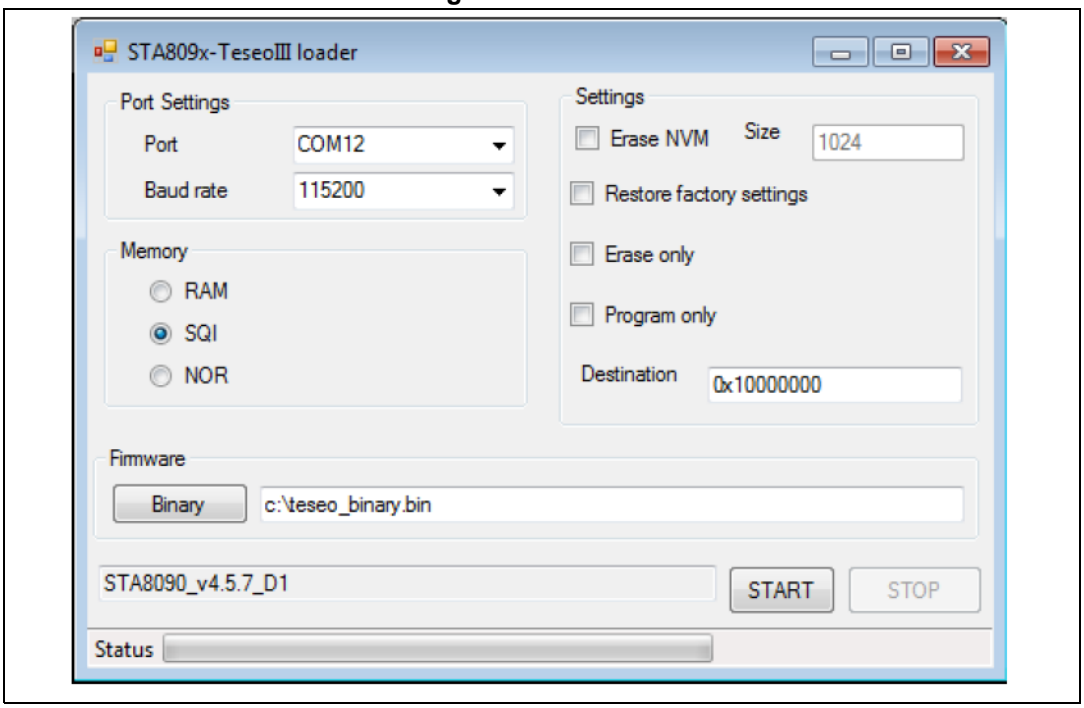
Diagnosis feature is able to generate (optionally) map preview of events, like tunnels & GNSS versus DR residuals. In this case, a map provider must be selected in the second part of the panel. Three providers are available in the combo-box “MAP Provider”:

- OpenStreetMap offers map tile for free, nevertheless the access of the server is not unlimited. The access is quickly prohibited after some download.
- MapQuest offers a high level of services under “open street map” content. It’s possible to register on site and obtains commercial or free access key. This key must be registered into panel and followed by pressing save button.
- GoogleMap requires user key access which can be subscribed with your own google account. This key must be registered into panel and followed by pressing save button.
- If network access is not available, select “None”.

Note 3:

Xloader (*Figure 13: X-loader*) Teseo allows to load boot & firmware. The boot sequence is associated to Teseo component pinout, documented in dedicated hardware documentation.

Figure 13. X-loader

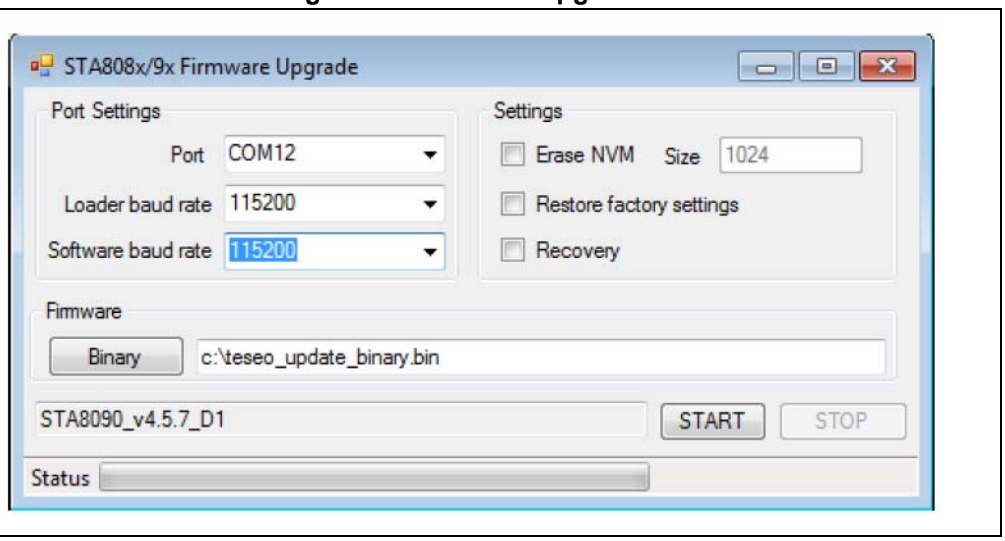


- **Port Settings**: define UART port number and its baud rate for loading.
- **Memory**: type of memory
- **Settings**:
  - **Erase NVM**: erase settings of Teseo
  - **Restore factory settings**: copy default settings in the current configuration
  - **Erase Only**: erase firmware area
  - **Program only**: load firmware without perform erase (only available if flash is previously erased)
  - **Destination**: Start address of firmware. Modify memory type to get the default one.
- **Firmware**: edit firmware binary or press Binary button to browse your file system.
- **START** initiates programming. **STOP** cancels programming sequence.

Note 4:

- Firmware upgrade tool (*Figure 14: Firmware upgrade*) allows to update firmware. The initial Teseo configuration is the current mode (no boot sequence pinout)

Figure 14. Firmware upgrade



- **Port Settings**:
  - **Port**: define UART port number.
  - **Loader baud rate:** define programming baud rate.
  - **Software baud rate:** define NMEA baud rate of current firmware loaded.
- **Settings**:
  - **Erase NVM**: erase settings of Teseo
  - **Restore factory settings** : copy default settings in current configuration
  - **Recovery**: If your previous firmware is erased or last loading has been interrupted or failed, enable recovery mode and restart your product after START.
- **Firmware**: edit firmware binary or press Binary button to browse your file system.

START initiates programming. **STOP** cancels programming sequence.

DR

The DR (Dead Reckoning) menu open the Dead reckoning panel.

Windows

The Windows menu (*Figure 15: Windows menu entries*) proposes items in *Table 5: Windows menu items*.

Figure 15. Windows menu entries

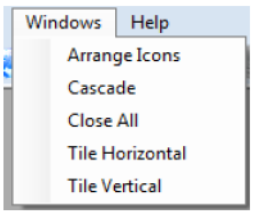


Table 5. Windows menu items

Arrange icons	Arranges the icons at the bottom of the window.
Cascade	Arranges all open dialogs cascaded.
Close All	Closes all open dialogs and windows.
Tile Horizontal	Arranges all open dialogs horizontally.
Tile Vertical	Arranges all open dialogs vertically.

Help

The Help menu (*Figure 16: Help menu entries*) proposes items in *Table 6: Help menu items*.

Figure 16. Help menu entries

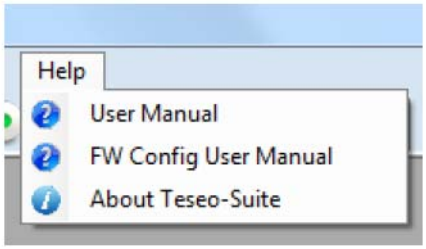


Table 6. Help menu items

User manual	Open the TESEO-SUITE user manual
FW Config User Manual	Open the firmware config user manual
About TESEO-SUITE	Open the TESEO-SUITE information panel

4.2 Main Toolbar

The Main toolbar (*Figure 17: Main toolbar*) allows a fast access to the most used operations and/or panels as described in *Table 7: Main menu items*.

Figure 17. Main toolbar

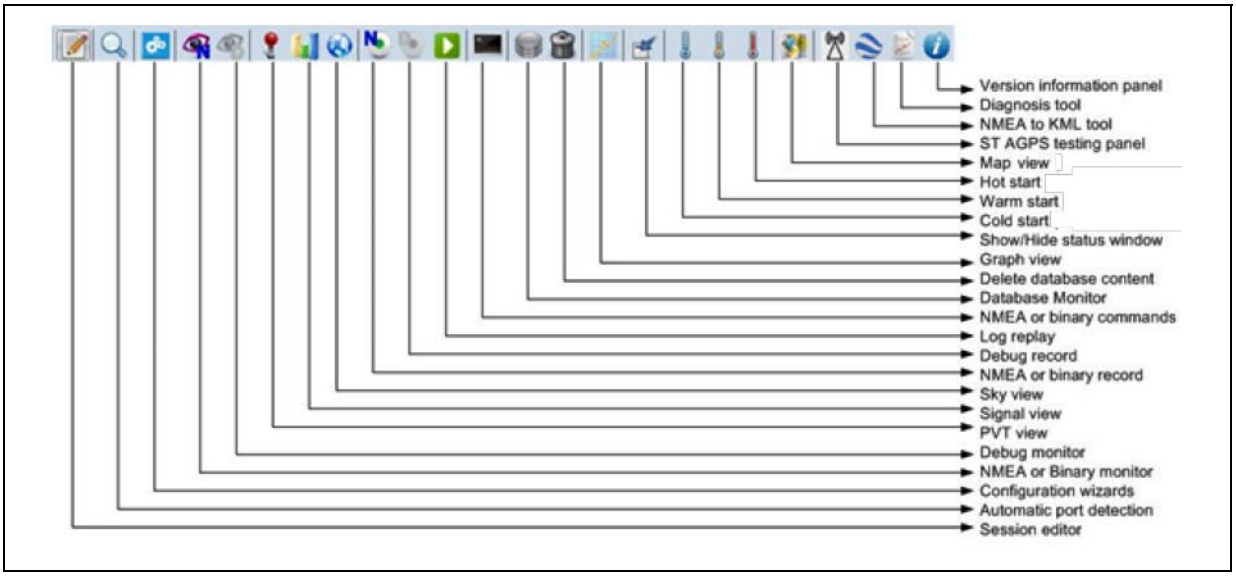


Table 7. Main menu items

Items	Description
Session Editor	Show/Hide the Configuration Session panel
Automatic port detection	Probe and detect every GNSS device connected in the COM port and add them in the configuration session panel
Configuration wizard	Open the configuration wizard to configure the GNSS device
NMEA or binary protocol	Show/Hide the ‘NMEA Decoding’ panel
Debug Monitor	Show/Hide the ‘Debug monitor’ panel
PTV view	Show/Hide the ‘PTV monitor’ panel
Signal view	Show/Hide the ‘Signal monitor’ panel
Sky view	Show/Hide the ‘Sky view’ panel
NMEA or binary record	Start/Stop a record log session
Debug record	Start/Stop a debug record log session
Log replay	Show/Hide the ‘Log file toolbar’ panel
NMEA or binary commands	Show/Hide the ‘NMEA Commands’ panel
Database Monitor	Show/Hide the ‘Database Monitor’ panel
Delete database content	Delete the database content
Chart View	Show/Hide the ‘Chart view’ panel
GNSS Status windows	Show/Hide the ‘GNSS Status windows’ panel
Cold start	Perform a cold start to all connected GNSS device
Warm start	Perform a warm start to all connected GNSS device
Hot start	Perform an host start to all connected GNSS device
Map view	Show/Hide the ‘Map view’ panel

Table 7. Main menu items (continued)

Items	Description
STAGPS	Show/Hide the ‘Assisted GNSS view’ panel
NMEA converter	Convert NMEA log to KML file
Diagnosis	Show/Hide the ‘Diagnosis’ panel
Information	Show/Hide the ‘Information version panel

4.3 Log file toolbar

The Log file toolbar (*Figure 18: Log file toolbar*) allows operation on the log as described in *Table 8: Log file toolbar items*.

Figure 18. Log file toolbar

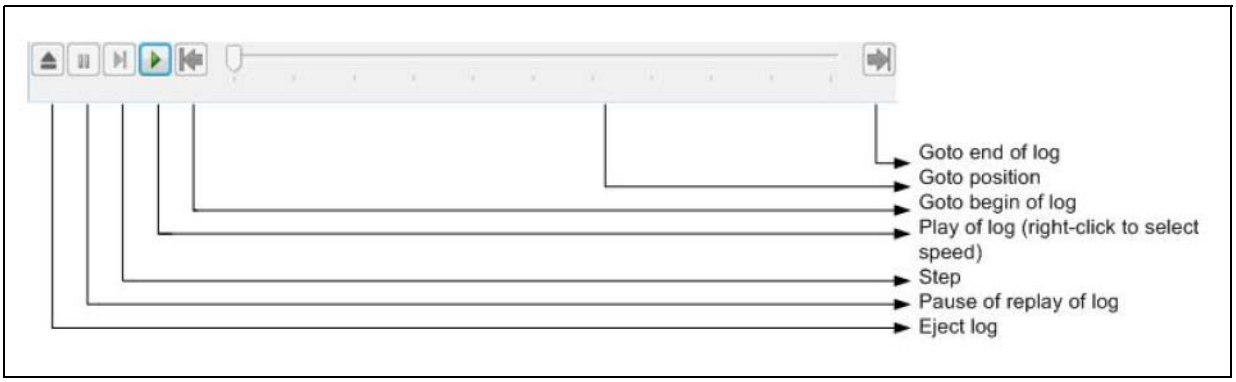


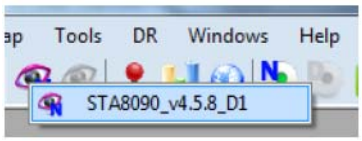
Table 8. Log file toolbar items

Eject	
Pause	Pause the running log
Step	Move the log one event ahead
Play	Play the log as normal
GOTO begin	Rewinds the log to the first event
Position	Show the current event position
GOTO begin	Move the log to the last event

4.4 Views and windows

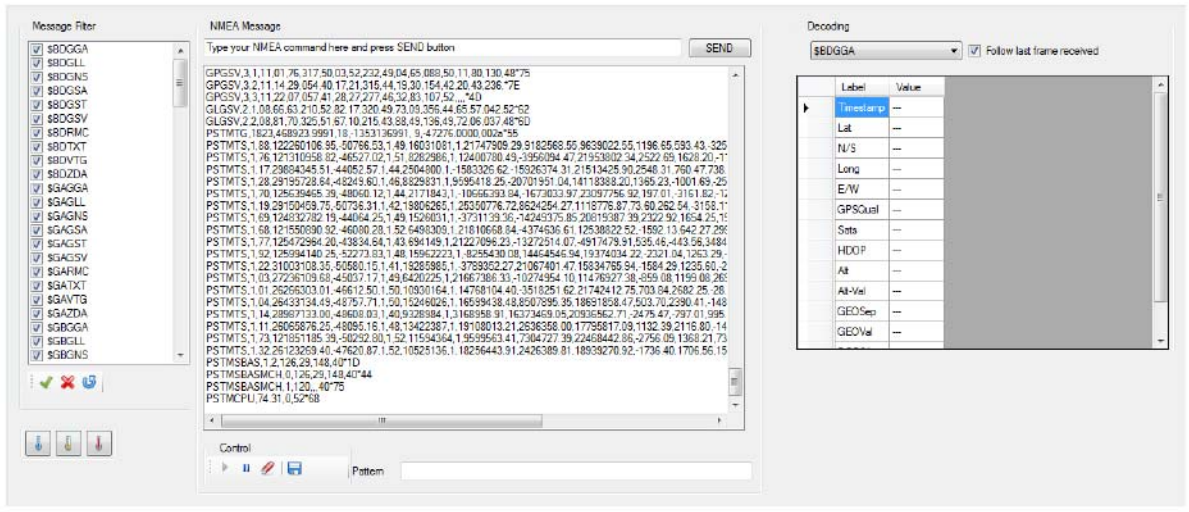
4.4.1 NMEA monitor

Table 9. NMEA monitor action description

Control button in the main tool-bar	Action	
	Mouse left-click	**Mouse right-click**
Figure 19. NMEA monitor button 	Open a NMEA or Binary monitor for all the devices connected (according to the protocol selected in the device setup)	Open NMEA or Binary monitor for the selected connected device (according to the protocol selected in the device setup) as shown in the figure below: 

The NMEA monitor is shown in the *Figure 20: NMEA Monitor*.

Figure 20. NMEA Monitor



This form gathers:

- A filter functionality on the left
- A message viewer in the middle
- A decoding panel on the right
- A send command line on top of the message viewer
- A pattern filter at the bottom
- A Cold start button
- A Warm start button
- A Hot start button

Filters

The message filter role is to select the messages to be displayed and stored in the buffer. By default all messages defined in the NMEA xml configuration file are selected and, though, displayed and saved in the buffer. If one or several messages are unchecked in the list, they won't be displayed nor saved anymore once the update is done. This feature can be useful to decrease the size of a log for instance.

Any changes in the list box must be validated by clicking on the update button to be taken into account by the application.

The *Figure 21: Filter controls* shows the controls associated to the filters:

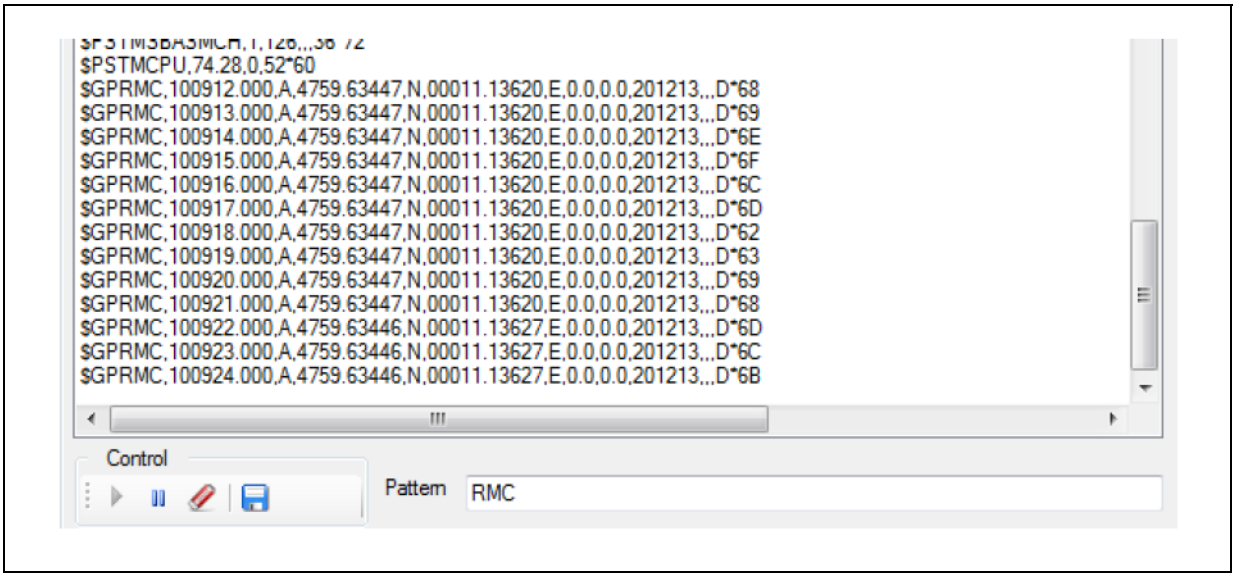
Figure 21. Filter controls

From the left to the right:

1. Check all items
2. Uncheck all items
3. Apply changes in filter

The pattern filter at the bottom allows to show only the messages matching the pattern as shown in *Figure 22: Pattern filter*.

Figure 22. Pattern filter



NMEA message view

The NMEA message view displays all the messages that have not been filtered before.

Double-clicking on line will allow to decode the content of the message. If the “follow last frame received” feature was enabled in the decoding window, it is disabled.

The *Figure 23: View controls* shows the controls associated to the view.

Figure 23. View controls

From the left to the right:

- Play
- Pause (suspend refresh of the message view)
- Erase the content of message view
- Save content of the NMEA monitor buffer

NMEA decode

This form decodes the NMEA messages received from the device. Through the combo box, it is possible to select the message to be decoded. The selectable messages are those defined in an xml file. The list box changes appearance, displaying the fields of the selected message.

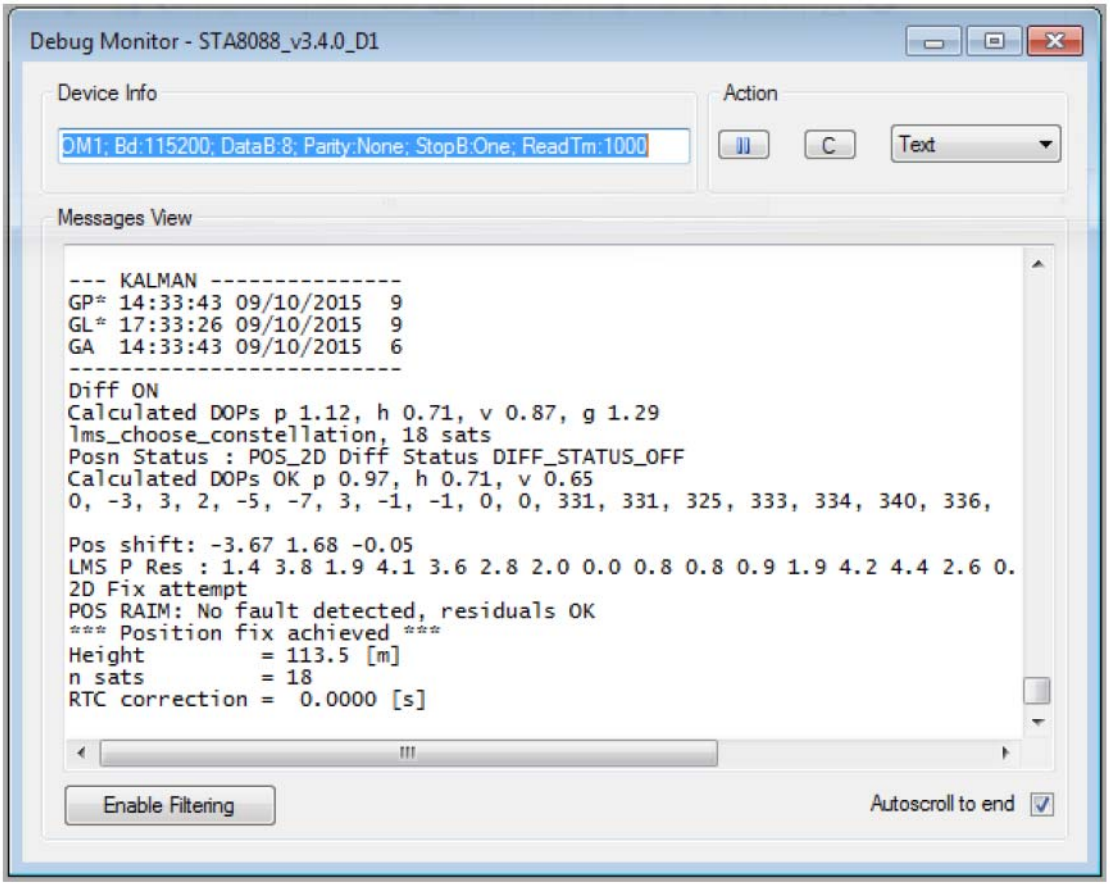
4.4.2 Debug monitor

Debug monitor is shown in *Figure 25: Debug Monitor*.

Table 10. Debug monitor action description

Control	Action	
	Mouse left-click	Mouse right-click
Figure 24. Debug monitor button 	Open Debug monitor for all the devices connected	Open Debug monitor for the selected connected device

Figure 25. Debug Monitor



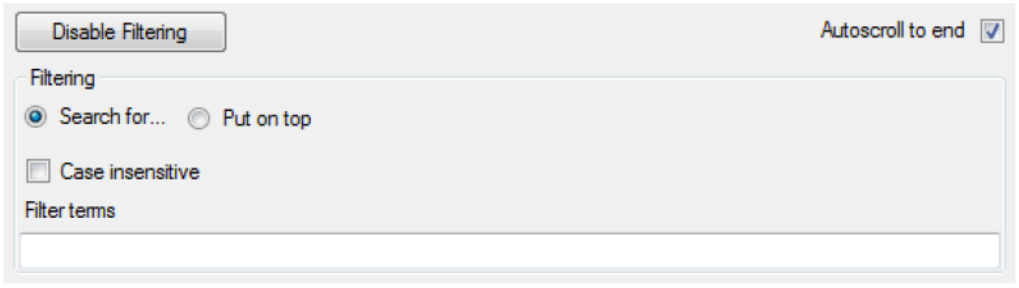
Debug monitor has the following features:

1. **Play / Pause**: stops the logging data on the monitor
2. **Clear Data**: Clears the data displayed
3. **Display data**: textual and hexadecimal format view
4. **Filtering data**: Filter the debug trace

Filtering the debug trace

The Debug monitor allows you to filter the debug trace.

Figure 26. Filtering Panel



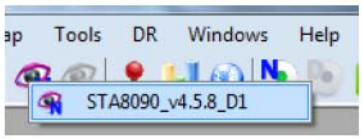
Two filtering modes are available:

- **Search for…**: allow you to only display the line that contains your “filter terms”
- **Put on top**: will display at the top of the “Messages View” the last line that matches with “Filter Terms”

You may also make the matching case insensitive by using the corresponding checkbox and you can stop the auto-scrolling feature so you can concentrate on some data.

4.4.3 Binary monitor

Table 11. Binary monitor action description

Control	Action	
	Mouse left-click	**Mouse right-click**
Figure 27. Binary monitor button 	Open a NMEA or Binary monitor for all the devices connected (according to the protocol selected in the device setup)	Open NMEA or Binary monitor for the selected connected device (according to the protocol selected in the device setup) as shown in the figure below: 

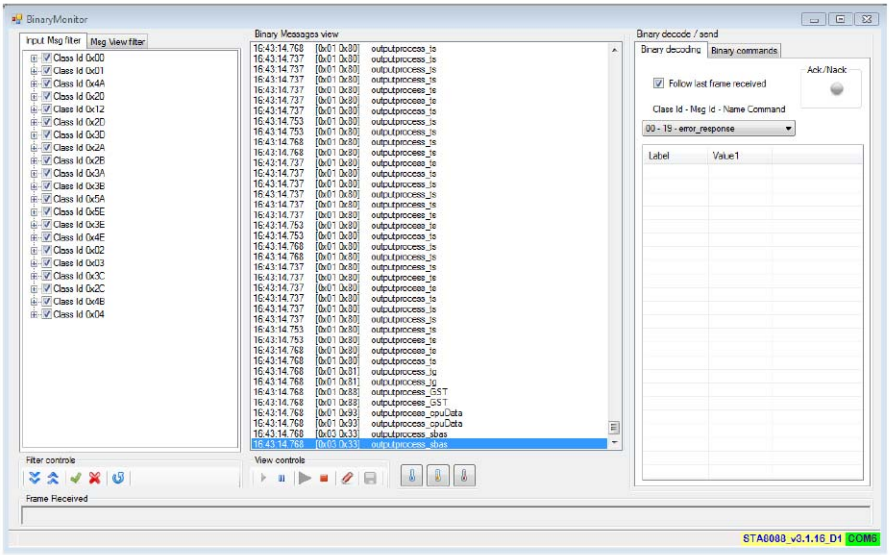
This form gathers:

- A filter functionality on the left (input message filter + view message filter)
- A message viewer in the middle
- A decoding and send message panels on the right
- A binary data display at the bottom
- A Cold start button
- A Warm start button
- A Hot start button

The selected device and used port com are shown at the bottom right of the monitor.

The binary monitor is shown in *Figure 28: Binary Monitor*.

Figure 28. Binary Monitor



Filters

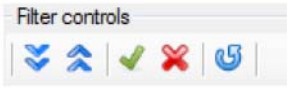
The input message filter role is to select the messages to be displayed and stored in the viewer buffer. By default all messages defined in the binary xml configuration file are selected and, though, displayed and saved in the buffer. If one or several messages are unchecked in the list, they won't be displayed nor saved anymore once the update is done. This feature can be useful to decrease the size of a log for instance.

The view message filter selects which messages are displayed in the view form. By default all messages defined in the binary xml configuration file are selected and displayed. This action is possible only when the stop button has been pressed before.

Any changes in the list box must be validated by clicking on the update button to be taken into account by the application.

The *Figure 29: Filters controls* shows the controls associated to the filters.

Figure 29. Filters controls



From the left to the right:

- Expand the list of items
- Collapse the list of items
- Check all items
- Uncheck all items
- Apply changes in filter

Binary message view

The binary message view displays all the messages that have not been filtered before.

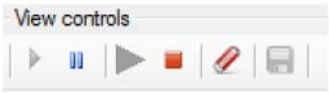
Display format is the following:

```
[Class Id    |    Message Id    ]      Message name
```

Double-clicking on line will allow to decode the content of the message. If the “follow last frame received” feature was enabled in the decoding window, it is disabled.

The *Figure 30: View controls* shows the controls associated to the view.

Figure 30. View controls



From the left to the right:

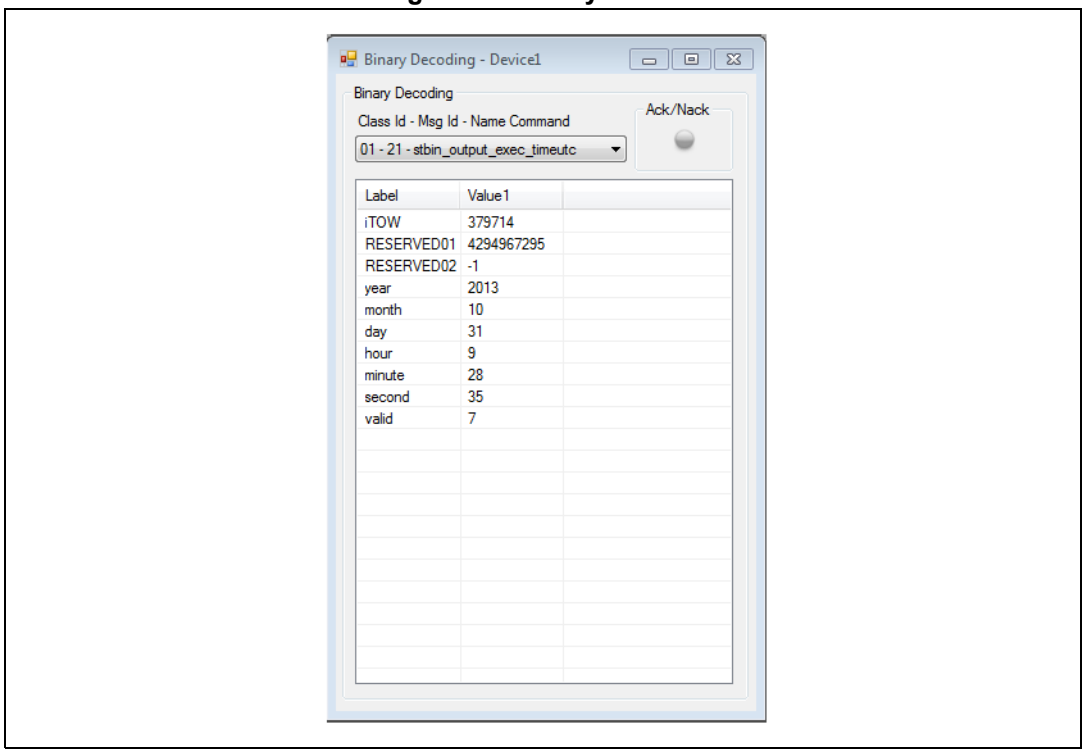
- Play
- Pause (suspend refresh of the message view)
- Start receive incoming messages (message history is cleared)
- Stop receiving incoming messages (new incoming messages are lost)
- Erase the content of message view (message history is lost in the binary monitor buffer)
- Save content of the binary monitor buffer

Binary decode

This form decodes the binary message received from the device, in ASCII format (*Figure 31: Binary Decode*).

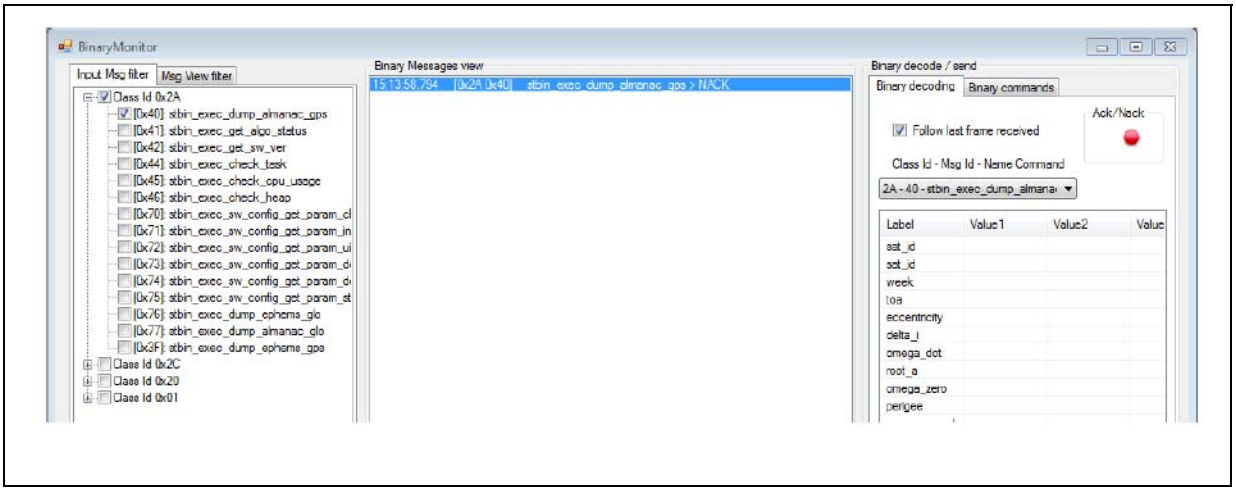
A binary message is identified by a Class Id, Message Id and Command Name, as defined in an xml file. Through the combo box, it is possible to select the message to be decoded. The selectable messages are those defined in the xml file. The list box changes appearance, displaying the fields of the selected message.

Figure 31. Binary Decode



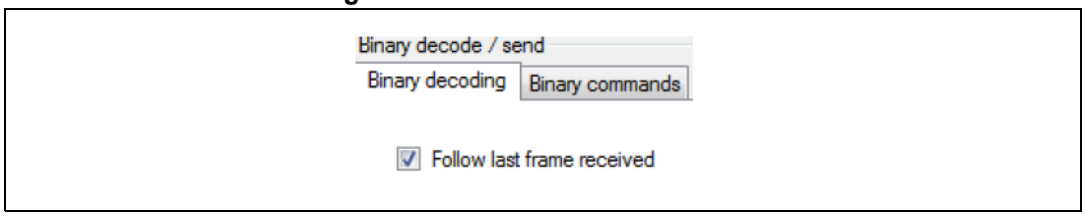
A led for the reception of Ack and Nack signals is placed in the form. The LED turns red on receiving a Nack signal, green on receiving an Ack signal (see *Figure 32: Binary decoding form – NACK received*):

Figure 32. Binary decoding form – NACK received



If ticked, the “follow last frame received” feature (see *Figure 33: Follow last frame feature*) decodes the last message (selected in the combo box) received and not filtered. This feature is automatically disabled by double-clicking in the message view.

Figure 33. Follow last frame feature



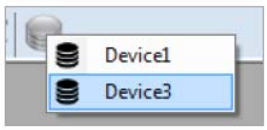
Binary commands

The functionality is similar to the standard binary command form described in *NMEA decode* section.

4.4.4 Database monitor

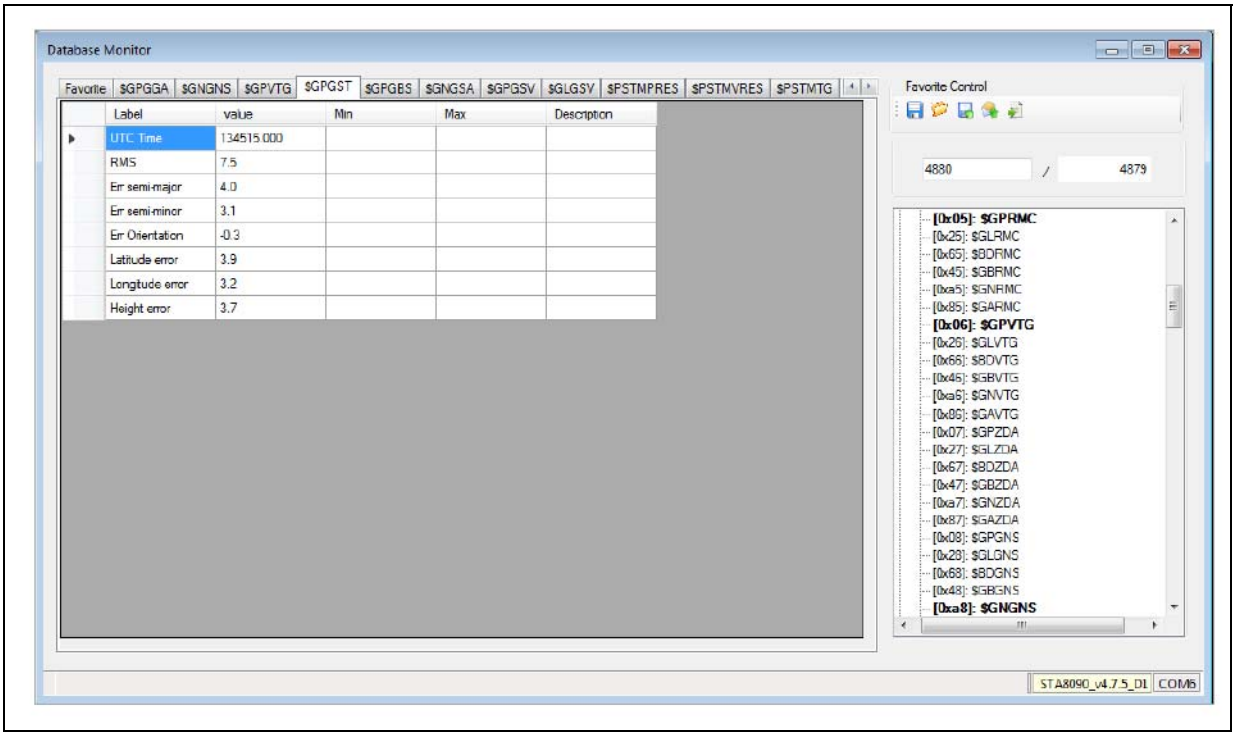
Through the button shown in the *Table 12*, it is possible to activate the "Database Monitor" form (see *Figure 36: Database monitor*) that shows the collection of data coming from the receiver whatever the protocol supported by the device is.

Table 12. Database monitor action description

Control	Action	
	Mouse left-click	**Mouse right-click**
Figure 34. Database monitor button 	Open a database viewer for all the binary devices connected	Open a database viewer for the selected connected binary device as shown in the figure below: **Figure 35. Database device selector** 

Commands highlighted in bold in the command tree on the right are those that have been received. Click on bold command to open the dedicated tab page or select the tab page directly.

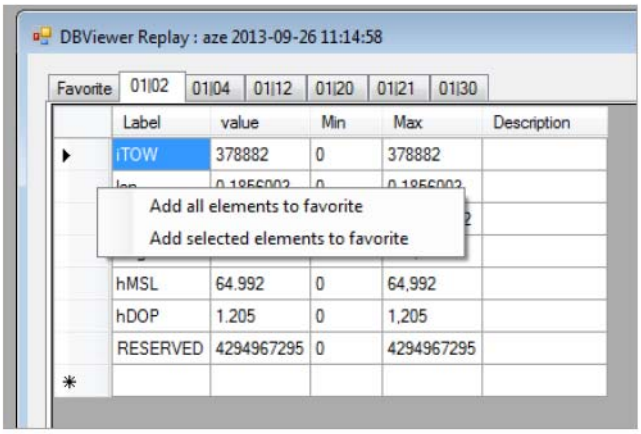
Figure 36. Database monitor



Favorite management

To select new favorite items, go on command page, click on the right button, and select option. Select only dedicated lines, if whole parameters are not interesting (see *Figure 37: Database monitor – command page*).

Figure 37. Database monitor – command page

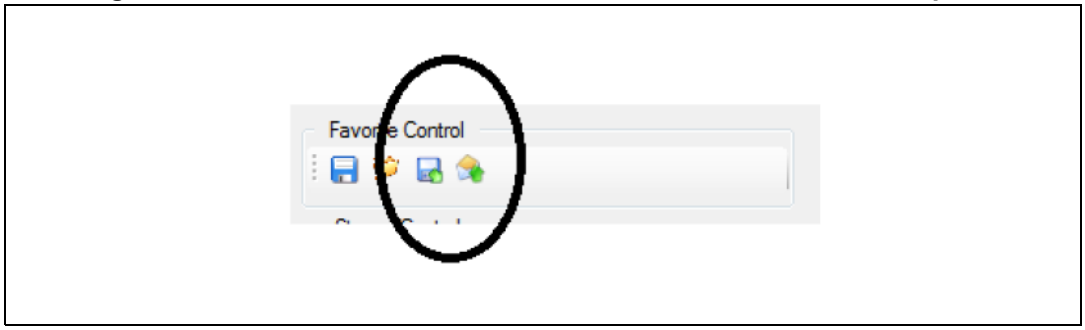


To save and restore your configuration use the first twins button in Favorite control panel (see *Figure 38: Database monitor - first twins button in Favorite control panel*).

Figure 38. Database monitor - first twins button in Favorite control panel

To save and restore your configuration as default one, use the last twins buttons (see *Figure 39: Database monitor – last twins button in Favorite control panel*).

Figure 39. Database monitor – last twins button in Favorite control panel

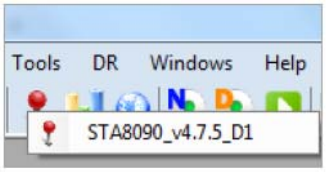


The default configuration is loaded at each DB Viewer form start-up. The configuration is not linked to device or session.

4.4.5 Positioning

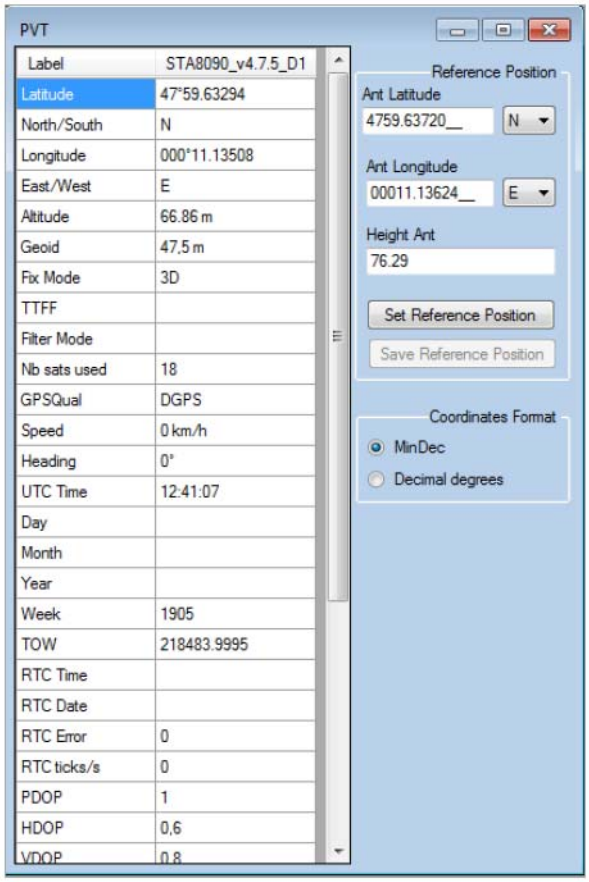
Through the button shown in the table, it is possible to activate the "View Positioning" (see *Figure 42: PVT positioning form*) form that shows some information about GPS positioning of device.

Table 13. Positioning action description

Control	Action	
	Mouse left-click	**Mouse right-click**
Figure 40. Control button 	Open a positioning form for all the devices connected (according to the protocol selected in the device setup)	Open a positioning form for the selected connected device (according to the protocol selected in the device setup) as shown in the figure below: **Figure 41. Tips device selector** 

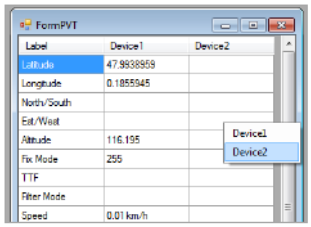
For a device running either with the NMEA protocol or the ST binary protocol, the form is fed by the database linked to the device.

Figure 42. PVT positioning form



Right-clicking in the binary device positioning form makes a context menu appear in order to to add or remove a device (see *Figure 43: Add/remove device with context menu*).

Figure 43. Add/remove device with context menu



Antenna reference position

The right panel is used to set the lab antenna reference position according to the user location. Some default coordinates are set during start up. This is up to the user to change

those coordinates to fit with its current reference position. 2D and 3D position accuracy values are computed with this reference position.

To change your antenna reference position:

- Enter new coordinates (lat format = DDMM.mmmmmmm, lon format = DDDMM.mmmmmmm).
- Click on “Set reference position” button
- Click on “Save reference position” button to keep new coordinates in the user settings. The reference position will be restored at the next start up.

4.4.6 Signal Level

Through the button shown in *Figure 44: Control button*, it is possible to activate the form "Signal Level View" (see *Figure 48: Signal Level form*) that shows the signal level of satellites in view (flags with transparency), satellites used for fix (solid bar) and SBAS satellites (green bar).

Table 14. Signal level action description

Control	Action	
	Mouse left-click	**Mouse right-click**
Figure 44. Control button 	Open a signal level form for all the devices connected	Open a signal level form for the selected connected device as shown in the figure below: **Figure 45. Tips device selector** 

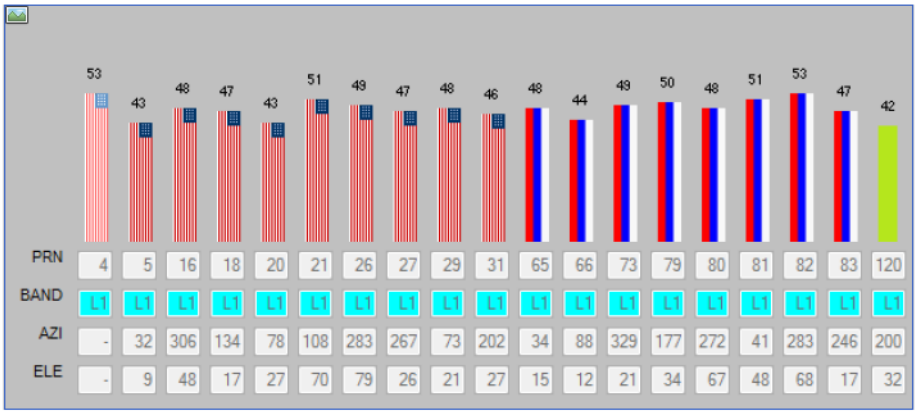
An icon at the bottom of the form indicates which protocol is used by the device:

Table 15. Protocol icons description

Protocol icons	Description
Figure 46. Binary protocol icon indicator 	ST binary protocol
Figure 47. NMEA protocol icon indicator 	NMEA protocol

The CN0 level is indicated above each flag. The information displayed below is the PRN, the frequency band used by the satellite, the azimuth and the elevation of the satellite.

Figure 48. Signal Level form



The supported frequencies bands are:

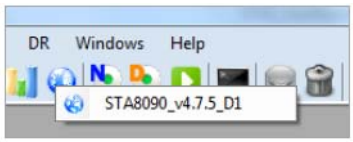
- L1(GPS L1, GLONASS L1, GALILEO E1, BEIDOU, SBAS)
- L2 (GPS L2C, GLONASS L2C, BEIDOU L2C)
- L5 (GPS L5, IRNSS L5)
- E1 (GALILEO E1)
- E5 (GALILEO E5a)
- E6 (GALILEO E6)

Right-clicking in the form makes a context menu appear in order to add or remove a device.

4.4.7 Sky View

Through the button shown in the table below, it is possible to activate the "Sky View" form (see *Figure 49: Sky View*), that shows the current azimuth and elevation of satellites used for the fix.

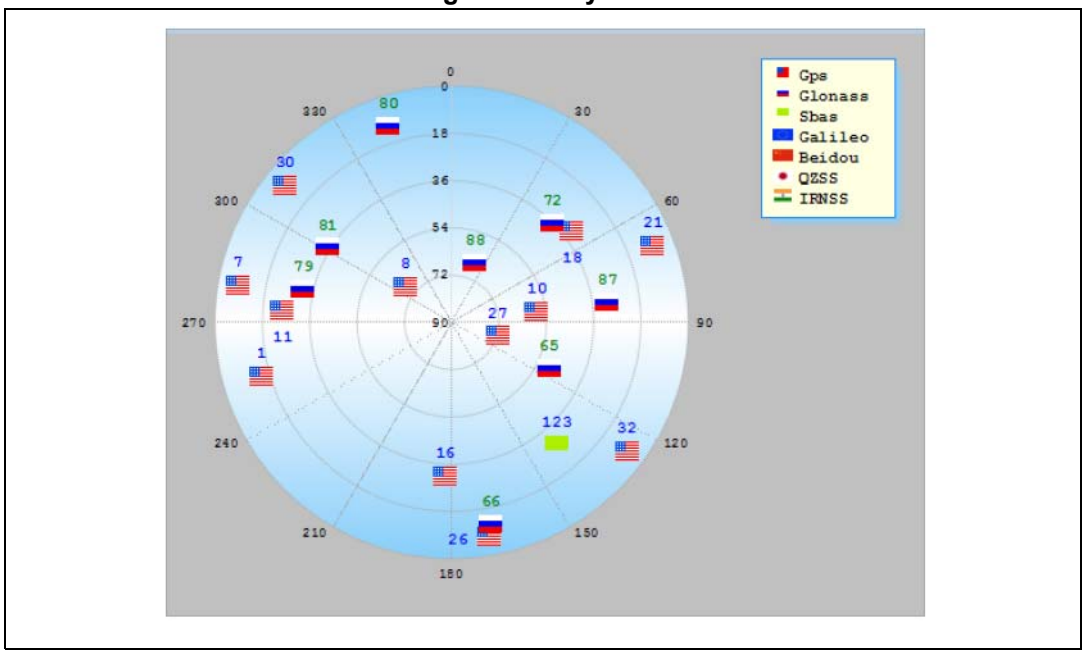
Table 16. Sky view action description

Control	Action	
	Mouse left-click	**Mouse right-click**
	Open a sky view form for all the devices connected	Open a sky view form for the selected connected device as shown in the figure below: 

An icon at the bottom of the form indicates which protocol is used by the device as in *Table 15: Protocol icons description*.

Right-clicking in the form makes a context menu appear in order to add or remove a device.

Figure 49. Sky View



4.4.8 Chart

Through the button shown in the table below, it is possible to activate the "Chart View" form (see *Figure 51: Chart View*) that shows the collection of data coming from the GPS device in a chart. If several devices are connected, the corresponding series are stacked in the view.

Table 17. Chart action description

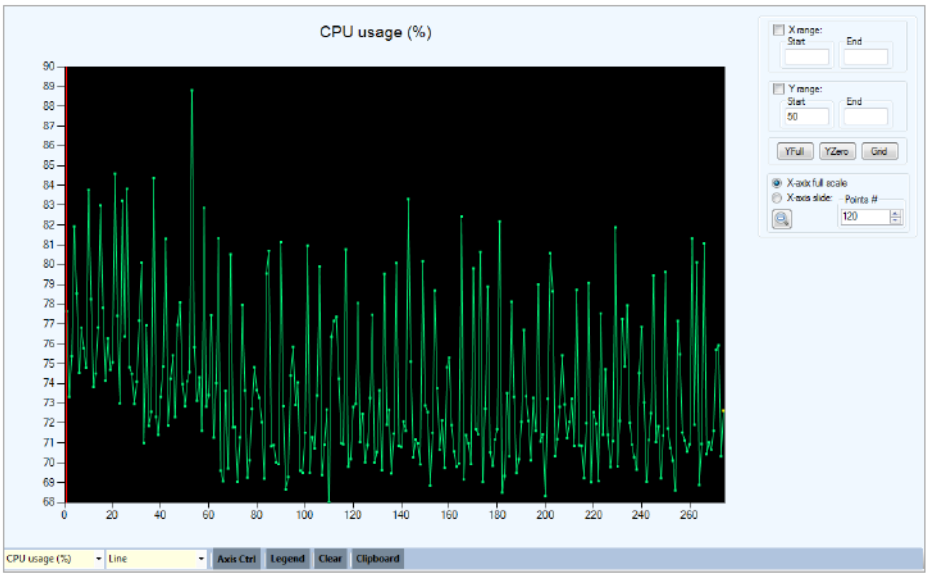
Control	Action	
	Mouse left-click	**Mouse right-click**
Figure 50. Chart icon button 	Open a chart view for all the devices connected	N.A.

The user can:

- Select the series to display (e.g. Latitude, Longitude etc …) thanks to a pick list
- Select the chart type (either line either points)
- Show the major axis grid
- Change the X axis and Y axis scales
- Clear the data history for all the series
- Copy the graphic to the clipboard

The data are indexed on the X axis. The X axis value doesn't correspond to a database index.

Figure 51. Chart View



All the serie's data are deleted when closing the chart view.

X-Axis control

The user can zoom in the graph area with the mouse. Depending on the number of zoom done, the full scale display can be retrieved by clicking several times on the zoom out button.

The panel offers also an option to enable a slicing window using a limited number of samples by ticking the radio button "X-axis slide". The number of samples can be modified thanks to the combo box. This option is interesting to limit the RAM usage during a long run.

The full scale display can be retrieved by ticking the radio button "X-axis full scale" (see *Figure 52: X-axis control*).

Figure 52. X-axis control

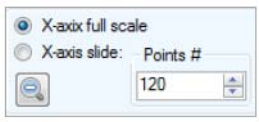
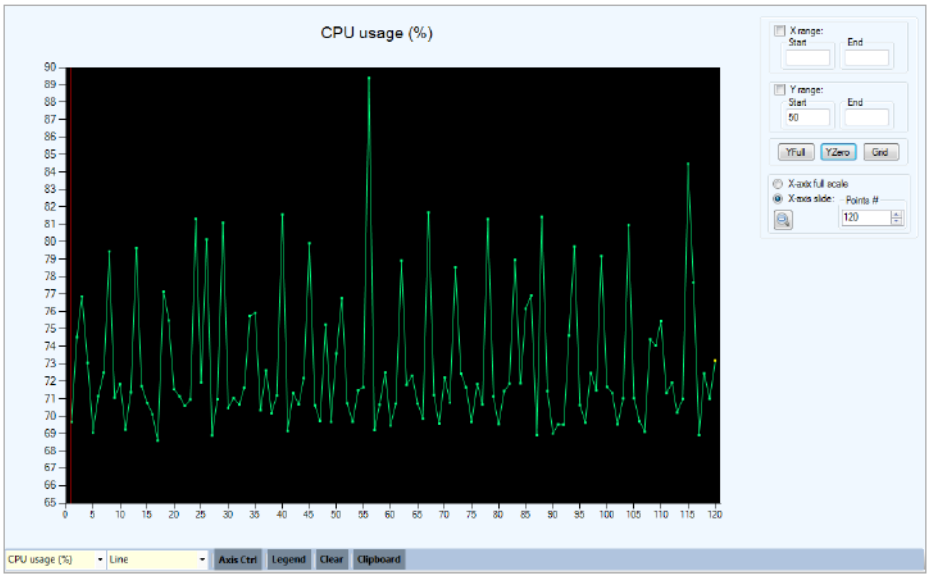


Figure 53: X-axis slicing window shows the slicing window usage with 120 samples.

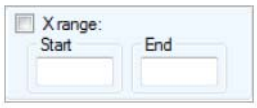
Figure 53. X-axis slicing window



X-axis range control

A specific range can be selected by ticking the “X range” check box (*Figure 54: X-axis range*) and providing the start X value and the end X value. In the meantime, the chart continues to store the incoming samples. The full scale display can be retrieved by deselecting the checkbox.

Figure 54. X-axis range



Y-axis control

A specific range can be selected by ticking the “Y range” check box (see *Figure 55: Y-axis range*) and providing the start Y value and the end Y value. The full scale display can be retrieved by deselecting the checkbox.

Figure 55. Y-axis range

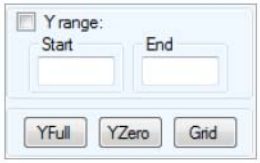
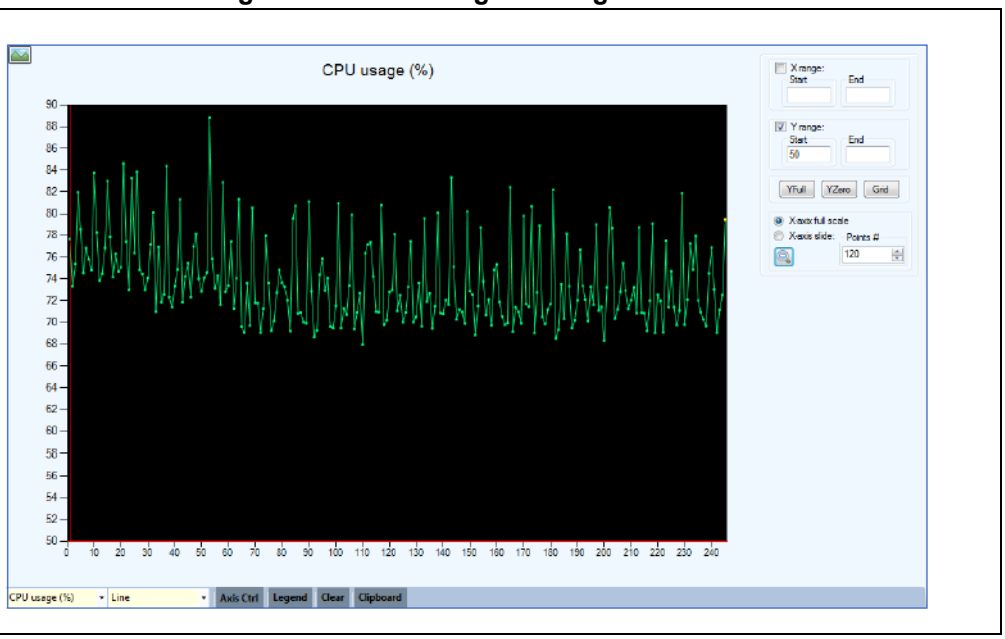


Figure 56: Y-axis range starting from 50 shows the Y-axis range usage starting from 50.

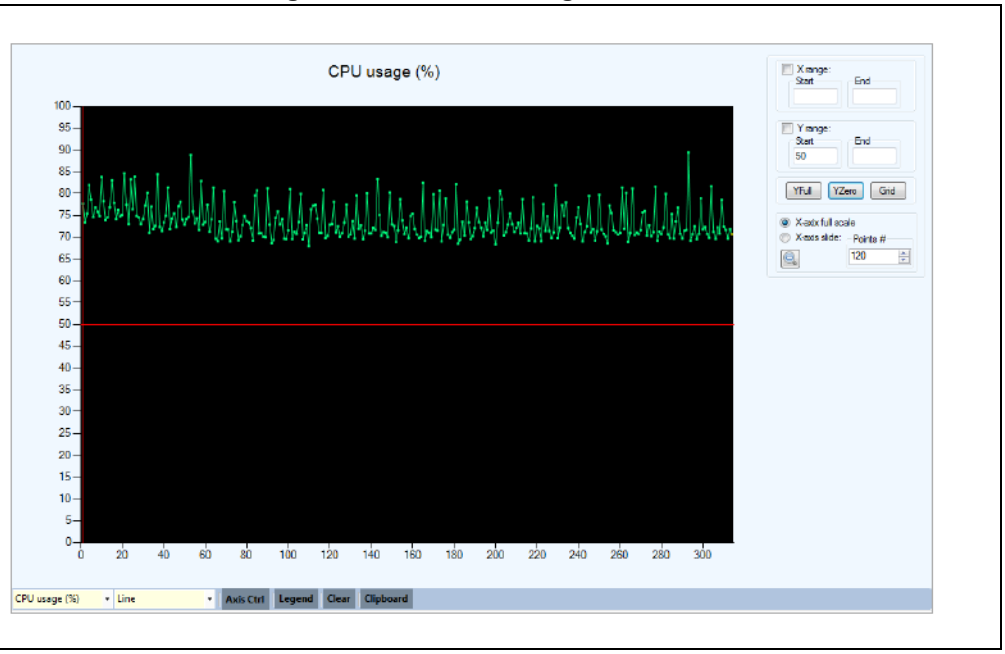
Figure 56. Y-axis range starting from 50



The “YFull” button can be used to retrieve a full scale display based on the current Y min and Y max values when switching from a parameter to another one.

The “YZero” button can be used to show the graph with the Y axis starting at zero or not. *Figure 57: Y-axis starting from 0* shows the result of the action.

Figure 57. Y-axis starting from 0



The “Grid” button shows or hide the major axis grid.

Panel foot bar

The panel foot bar gathers several controls:

- a pick list to select the parameter to monitor
- a pick list to choose the graph type (either lines either points)
- an “Axis Ctrl” button to show or hide the axis control panel on the right
- a “legend” button to show or hide the graph legend
- a “clear” button to delete all samples from the graph
- a “clipboard” button to copy the graph to the Windows’s clipboard

4.4.9 Map

Thanks to the button shown in the table below, it is possible to activate the "Map View" form (*Figure 58: Map view*) that shows the current position of the device on map.

Table 18. Map action description

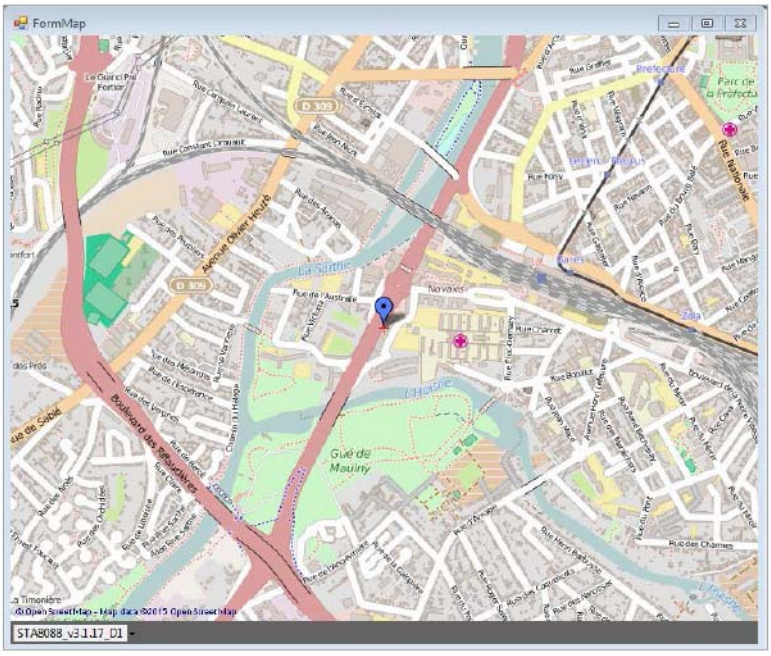
Control	Action	
	Mouse left-click	**Mouse right-click**
	Open a map view for the selected device	N.A.

If a fix is available for the selected device, a marker indicates the current position on the map. Otherwise the default map is the map of the city of Paris, France.

If the device is moving, the marker is automatically centered each time it is going out of the map boundaries. The user can disable this feature in the settings:

- Right-click > Select the “View settings” menu > Disable the “Auto Follows” option

Figure 58. Map view



The user can also switch in between a map view and a satellite view by selecting the “satellite” option in the “View settings” menu.

The user may also display the Dead Reckoning positions. To enable the DR positions check the “Plot DR” checkbox in the Map Settings.

4.4.10 Dead Reckoning panel

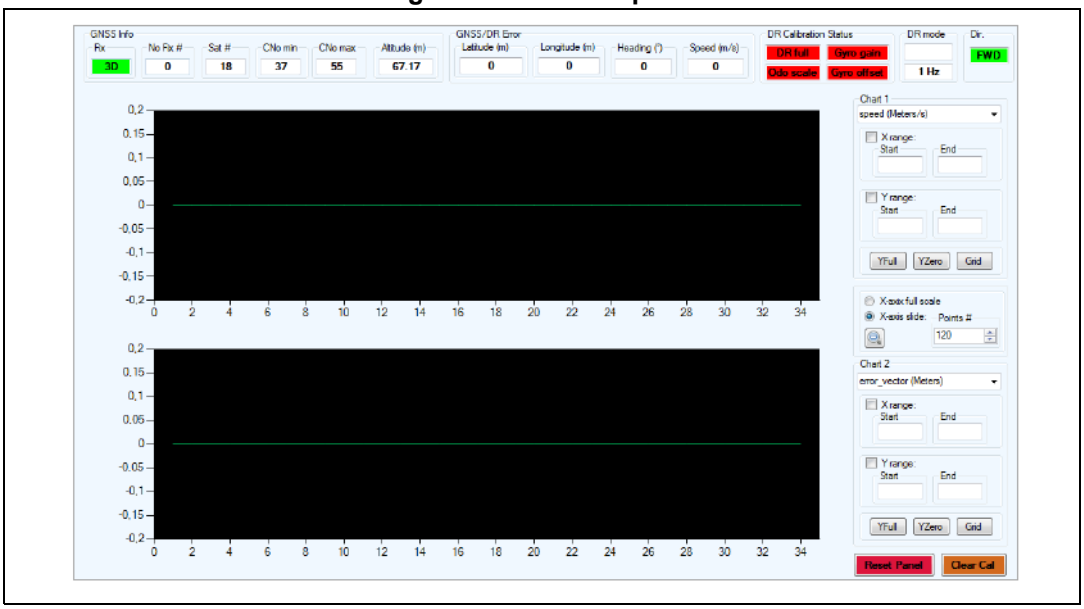
The DR main panel (see *Figure 59: Main DR panel*) allows to monitor the main DR parameters.

The panel reports the following information:

- GNSS Info (type of fix, number of satellites used for the fix, number of no fix, CN0 min and max.). The “no fix” event is triggered when there is no fix information during more than 1.2 s.
- GNSS/DR errors values (from $PSTMDRDEBUG)
- DR calibration status (from $PSTMDRCAL)
- DR mode and rate (from $¨STMDRTYPE and $¨STMDRSTEP)
- DR direction (reverse or forward)

The panel offers two areas of graphics. These areas share a common X-axis by design. Two pick lists allow the user to select the parameter to monitor.

Figure 59. Main DR panel



By default, the chart stores all the values once the panel is opened. All these values are lost once the panel is closed.

It is possible to select another device thanks to the pick list at the bottom right of the panel.

A reset button is available to clear all the graphs and text boxes.

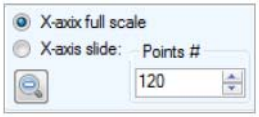
Common X-Axis control

If the user zooms in one of the two areas of graph with the mouse, the zoom applies in both areas. Depending on the number of zoom and where they have been done, the full scale display can be retrieved by clicking several times on the zoom out button.

The panel offers also an option to enable a slicing window (in the two graph areas) using a limited number of samples by ticking the radio button “X-axis slide” (see *Figure 60: Common X-axis control*). The number of samples can be modified thanks to the combo box. This option is interesting to limit the RAM usage during a long run.

The full scale display can be retrieved by ticking the radio button “X-axis full scale”.

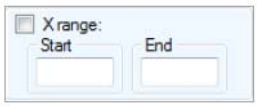
Figure 60. Common X-axis control



X-axis range control

A specific range can be selected by ticking the “X range” check box and providing the start X value and the end X value (see *Figure 61: X-axis range*). It doesn’t affect the second graphic area. In the meantime, the chart continues to store the incoming samples. The full scale display can be retrieved by deselecting the checkbox.

Figure 61. X-axis range



Y-axis control

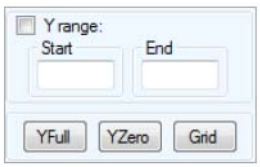
A specific range can be selected by ticking the “Y range” check box and providing the start Y value and the end Y value (see *Figure 62: Y-axis range*). It doesn’t affect the second graphic area. The full scale display can be retrieved by deselecting the checkbox.

The “YFull” button can be used to retrieve a full scale display based on the current Y min and Y max values when switching from a parameter to another one.

The “YZero” button can be used to show the graph with the Y axis starting at zero or not.

The “Grid” button shows or hides the major axis grid.

Figure 62. Y-axis range



4.4.11 ST-AGPS Testing

Testing panel

Figure 63: ST-AGPS testing panel shows the ST-AGPS panel which makes available the commands used for testing the STAGPS™ performance in different working scenarios. It supports commands to enable/disable usage of real or predicted ephemeris, to enable/disable real ephemeris update or to upload real ephemeris into the device.

The panel also displays the predicted ephemeris ages for the GPS and GLONASS constellations if the $PSTMAGPS and $PSTMAGLO messages are reported by the receiver.

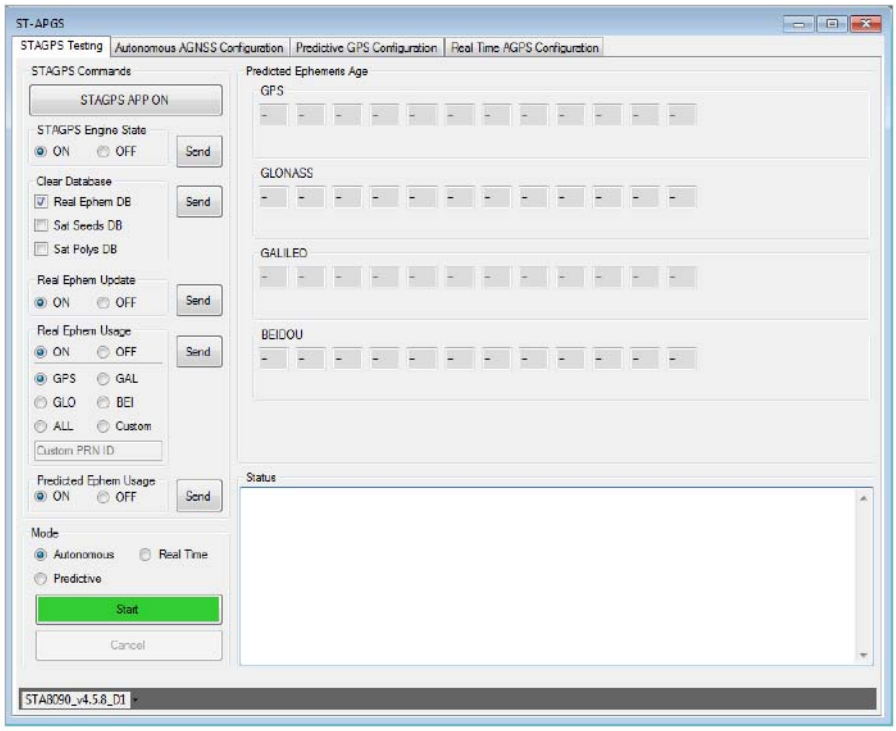
The STAGPS functionality must be enabled first in the firmware configuration.

The user can select one of the 3 modes:

- Autonomous AGNSS (to evaluate ephemeris data based on previous observation)
- Predictive AGPS (to download predicted ephemeris from RXN server)
- Real time AGNSS (to transfer real ephemeris data to the device)

Depending on the mode selected, the user must open first the corresponding configuration tab to enter the configuration to be tested.

Figure 63. ST-AGPS testing panel



Autonomous AGNSS configuration panel

To speed-up the learning time required to the Autonomous AGNSS subsystem to evaluate ephemeris in the future, user can download the ephemeris file providing information also for satellites not currently seen from the device.

The user can choose to use either a GPS or GLONASS RINEX ephemeris file downloaded from the CDDIS ftp server or a RINEX file already saved on the computer. In both cases, the user must give the path to save or read the RINEX files on the computer.

Only RINEX V3 files are supported. They support GPS, Glonass, Galileo, QZS and Beidou constellations.

The RINEX files can be acquired from NASA FTP site.

Append the following directory and file names to the starting directory:

- daily/rinex3/**YYYY**/brdm/brdm**DDD**0.**YY**p.**Z**

as described in the *Table 19*.

Table 19. Rinex path-file name description

Code	Meaning
YYYY	4-digit year
YY	2-digit year
DDD	3-digit day of year
.Z	Compressed Unix file

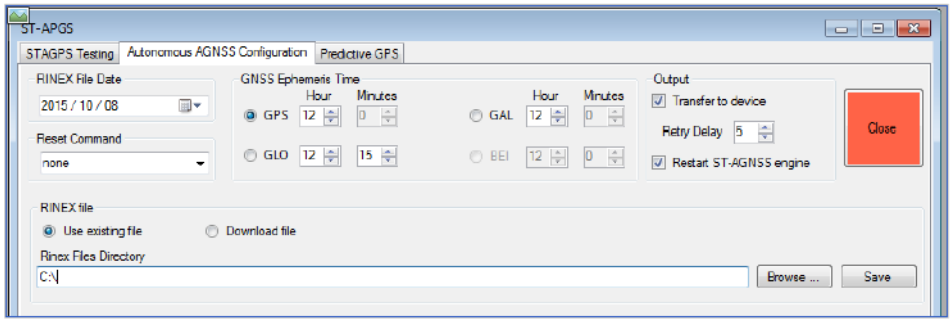
Pressing the start button in the testing panel will start an automatic sequence which extracts the ephemeris data from the RINEX file according to the constellation and the time chosen.

The ephemeris data is then sent to the device with some “$PSTMINDBEPHEM” NMEA commands.

Before sending the data to the device, the application takes care of stopping the STAGPS engine and to clear all device’s databases. Once the data have been transferred, the application starts again the STAGPS engine unless stated otherwise from the user

If a proxy is used to access the internet, the user has to give his credentials to access the CDDIS ftp server.

Figure 64. Autonomous AGNSS configuration panel



Predictive AGPS configuration panel

The Predictive AGPS configuration panel (see *Figure 65: Predictive AGPS configuration panel*) allows the user to configure the testing process of the PGPS functionality.

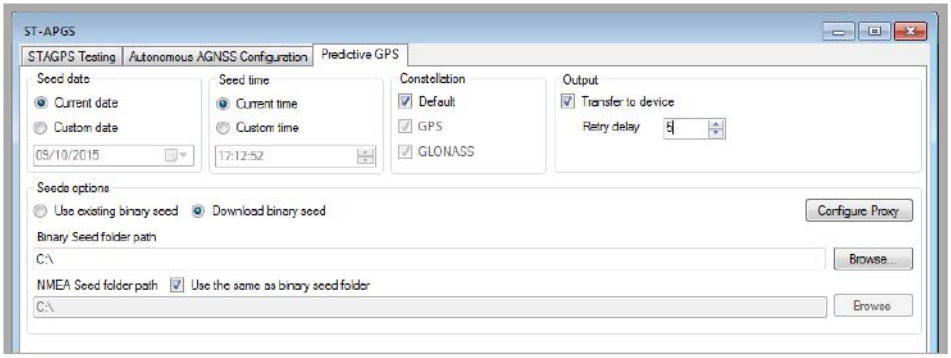
The user can select a custom date and time, or use the current one. The constellation can also be selected. By default GPS and GLONASS are used.

The user must specify a folder to store Binary seeds and NMEA seeds (can be the same folder or distinct folders).

The user can choose to use the existing seeds and avoid downloads from the internet; and may choose to only download and convert seeds without sending it to the device.

When starting the P-AGPS procedure TESEO-SUITE will first ask the device for a download password, then a binary seed will be downloaded from RxNetwork servers. If the download is successful the seed will be converted to an NMEA script. Finally the NMEA script is parsed and the NMEA commands are sent to the device.

Figure 65. Predictive AGPS configuration panel



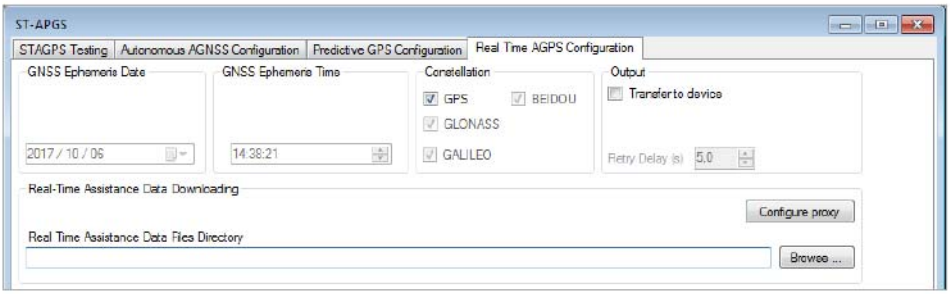
Real Time AGPS configuration panel

The real-time AGPS is able to provide the approximate current time, the ephemerides, the almanacs in a time frame less than the usual time (about 30 seconds) needed to download real ephemeris from the sky. This reduces considerably the time to get fix especially in critical environments when the ephemeris download time could be very long.

Real-time AGPS requires a network connection to download assistance data from the server. Assistance data include the current time (if not available, from instance, from RTC), the ephemerides and the almanacs.

All the assistance data can be injected into the device backup memory using a few NMEA commands.

Figure 66. Real-Time A-GPS configuration panel



4.4.12 FW configuration management

The TESEO-SUITE offers the possibility to change the firmware configuration of the device connected to the application but also the one of a binary image or to generate a patch file for a further usage.

The user has two options to manage a firmware configuration:

- Either by using the firmware configuration panel which allows to edit any of the parameters
- Or by using the wizards

The firmware configuration relies on a software configuration number (i.e. SWCFG_xxxxxxxx) that guarantees the consistency of the data model xml vs the binary image loaded into the device.

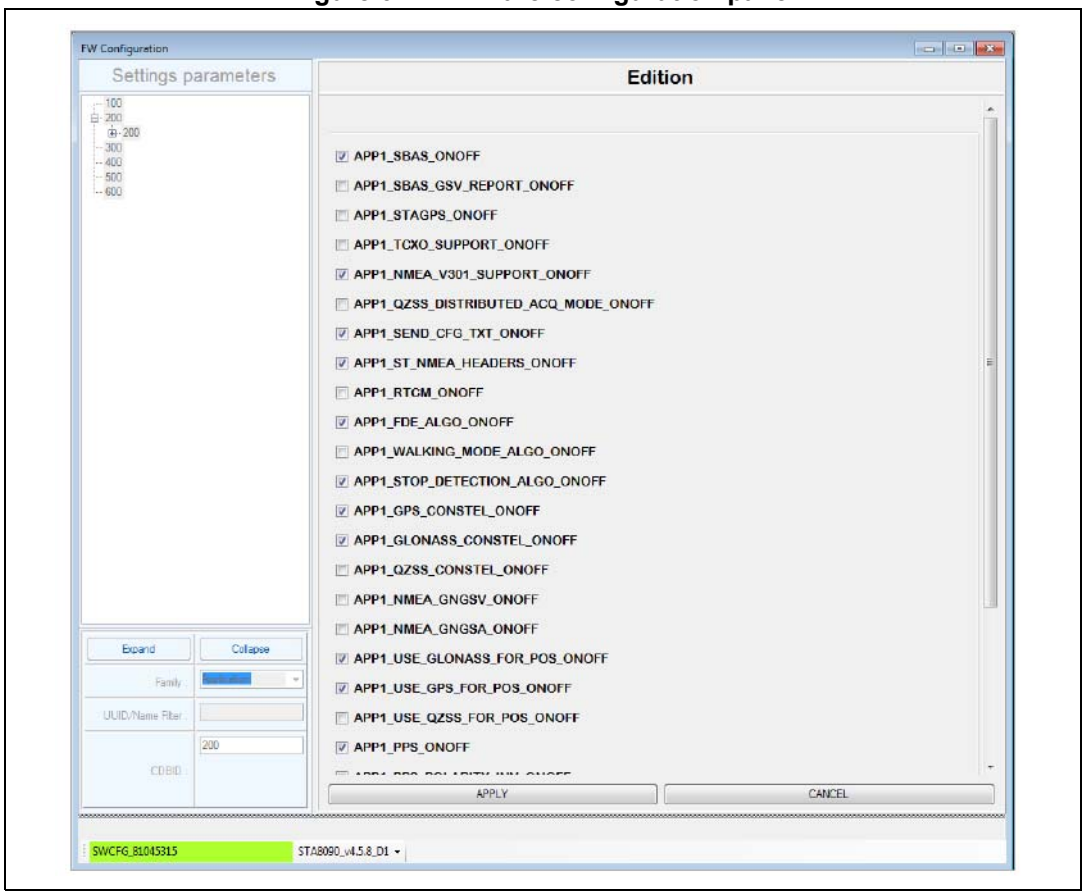
Firmware configuration panel

Figure 67: Firmware configuration panel shows the firmware configuration panel. Each firmware parameter can be edited and changed.

It is split in 3 areas:

- A tree view on the left that allows to select the parameters. Parameters are sorted either by group or by family (according to the filter below).
- A panel showing the selected parameter's detail on the right
- Some action commands at the panel's footer

Figure 67. Firmware configuration panel



When launching the panel, a command is sent to the connected device to get the SW binary version used and the application looks for the corresponding data model file on the computer (TESEO-SUITE's installation directory).

If there is no corresponding data model file, the user is invited to it. The file given will be then stored on the computer for a further usage.

If the proper data model file is found or provided by the user, a command to read all the device data blocks is sent and the answer is decoded to fill in all the parameter's values. Then this is the current device configuration which is displayed when opening the panel.

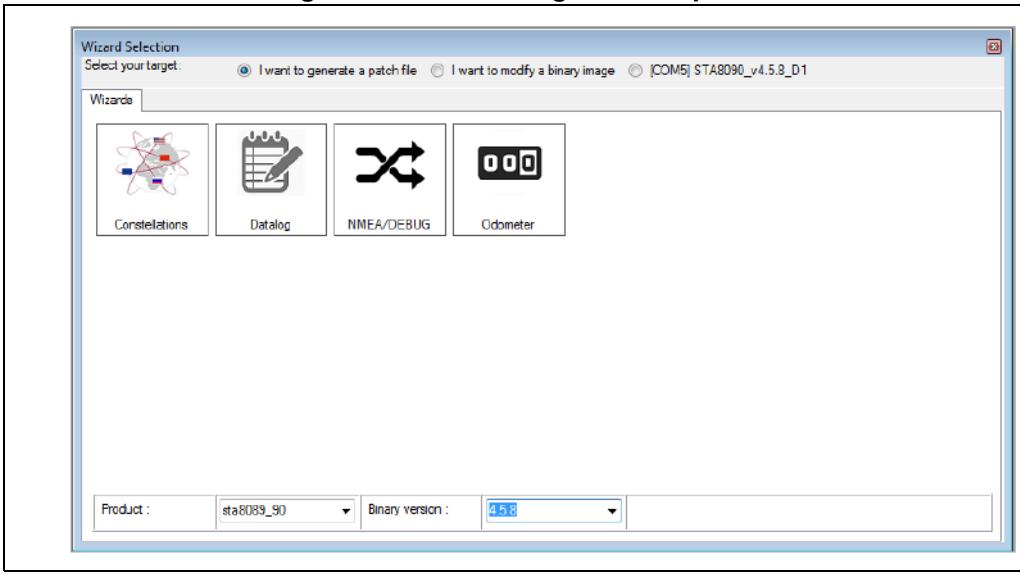
Configuration wizards

When using the wizards (see *Figure 68: Wizards to generate a patch file*), a selection panel is displayed. The user must choose first his target: either one of the connected devices if any, or a binary image or a patch file.

Depending on the selection, different kind of wizards are presented:

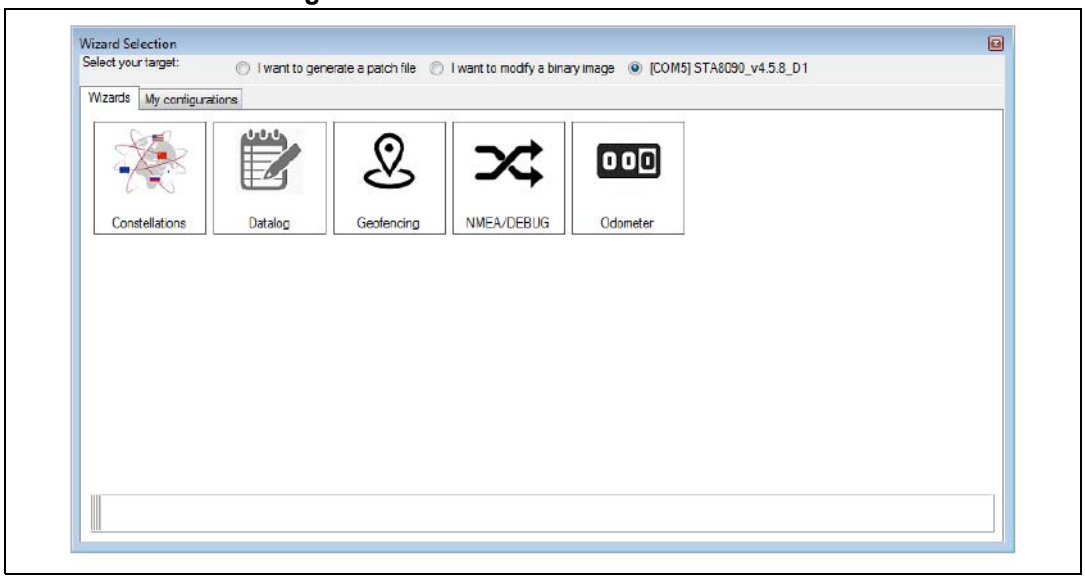
- Selecting a patch file as shown below, the user must enter the product name and the binary version to get the corresponding wizards. Patch files are saved locally on the computer so they can be re-used later on.

Figure 68. Wizards to generate a patch file



- Selecting a binary file, the user will have to select a binary image file before getting the corresponding wizards.
- Selecting a device as shown below, the user will have a first tab with the wizards available for his binary image and a second tab, so called "My configuration" filled up with some patch files that he may have done.

Figure 69. Wizards associated to a device



4.5 Recording/playing a log file

TESEO-SUITE allows recording and playing log files. Use the main toolbar controls to start and stop logging data of control and debug ports:

Table 20. Record/Play action description

Control	Action	
	Mouse left-click	Mouse right-click
Figure 70. Start record stream button 	Start record of data coming from all connected control ports	Start record of data coming from the selected connected control port
Figure 71. Stop record stream button 	Stop record of data coming from all connected control ports	Stop record of data coming from the selected connected control port

Table 20. Record/Play action description (continued)

Control	Action	
	Mouse left-click	Mouse right-click
Figure 72. Start Debug record stream button 	Start record of data coming from all connected debug ports	Start record of data coming from the selected connected debug port
Figure 73. Stop Debug record stream button 	Stop record of data coming from all connected debug ports	Stop record of data coming from the selected connected debug port

Note: The log files will be created in the directory chosen through the "Preferences" form, accessible from the" File ->Preferences" Menu.

Use the player controls to record or playback a log file. Select the log file to be opened through the log file toolbar. The series of buttons in the player toolbar can be used to navigate through the log file. The records will be displayed on the navigation display window, in the same way that live GNSS data are displayed when using TESEO-SUITE.

4.6 Sending commands

Through the button shown in the table below, it is possible to activate the "Binary Commands" and/or the "NMEA Commands" form.

Table 21. Send command action description

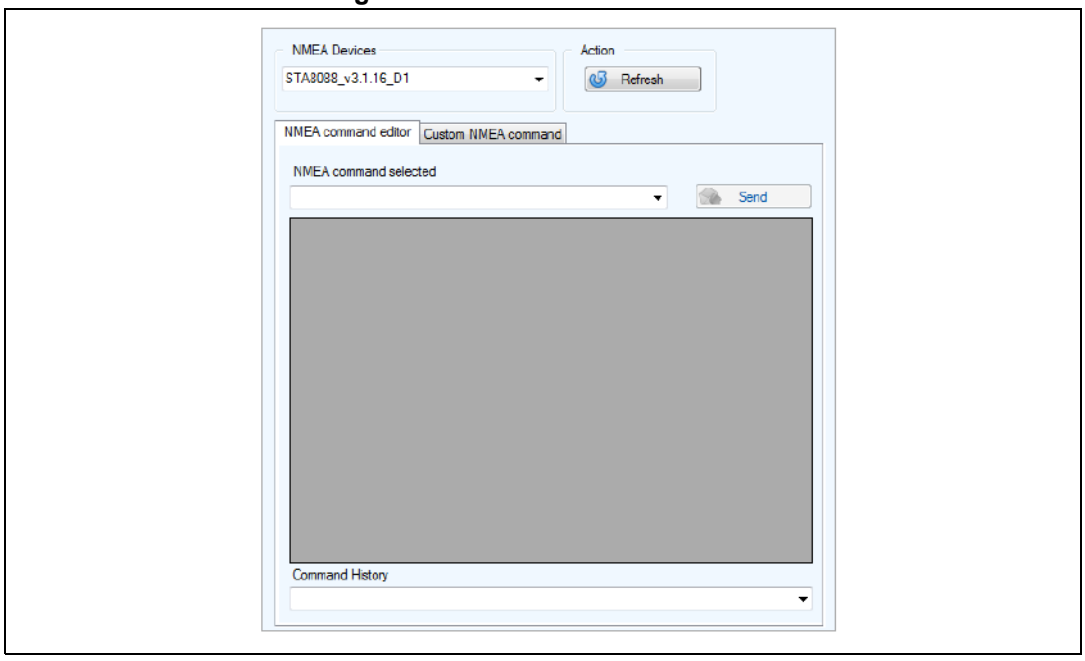
Control	Action	
	Mouse left-click	Mouse right-click
	Open a binary command form	N.A.

The forms allow to broadcast a message to the connected devices. The message fields are edited in ASCII format according to the specifications in the file ConfigPayloadBinary.xml, and before sending the message it is decoded in ST binary protocol.

4.6.1 NMEA Commands

Figure 74: NMEA commands form shows the NMEA commands panel; this panel proposes a list of devices. Press the refresh button to see the latest list of NMEA devices. The commands are sent to the selected device only.

Figure 74. NMEA commands form



Two tabs are displayed:

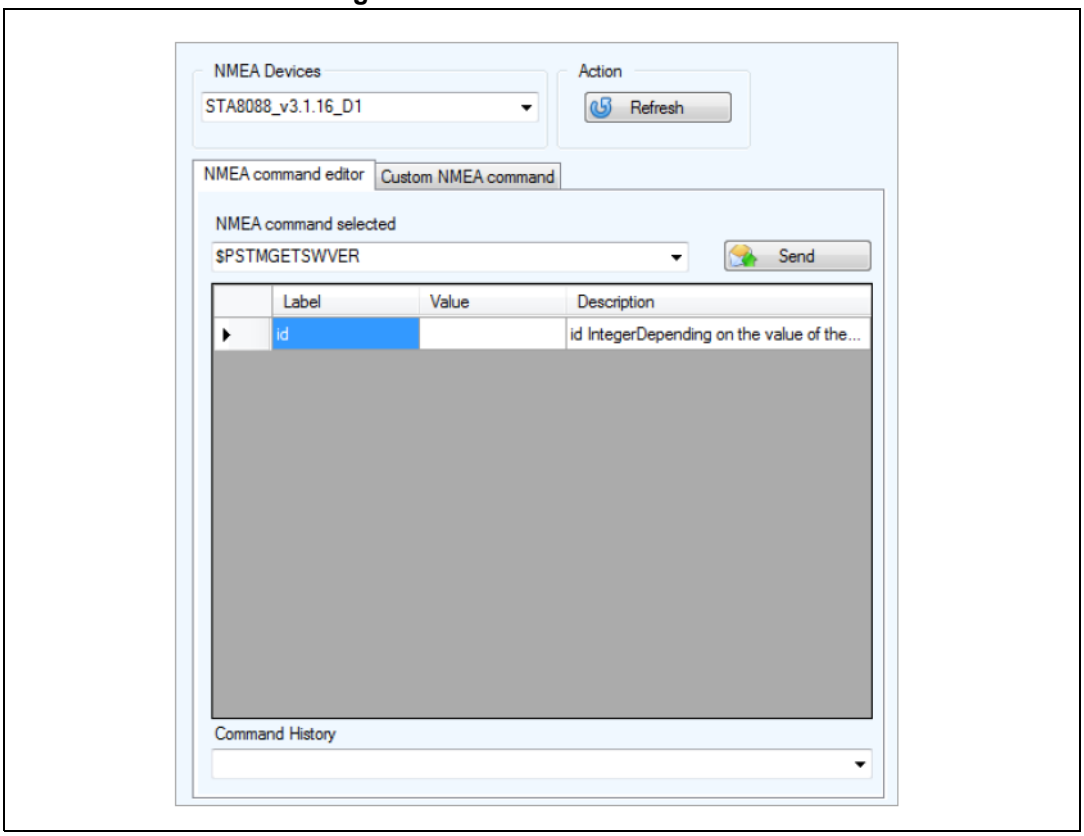
1. The first one is a NMEA command editor based on a NMEA payload xml file (depending on the SW binary image version and the HW type).
2. The second one is a NMEA custom command editor. The user can send its own NMEA commands. This is convenient for development purpose.

NMEA command editor

The payload of the NMEA command selected is displayed in the NMEA command editor (see *Figure 75: NMEA command editor*). The user must fill in the fields and click on the “Send” button to send the command to the selected device.

The command sent is saved in the history list and can be recalled later on.

Figure 75. NMEA command editor



NMEA custom command editor

NMEA custom command editor (see *Figure 76: Custom NMEA command editor*) allows to send some custom NMEA commands to the selected device.

The command is written down by the user in the box highlighted in the red field below.

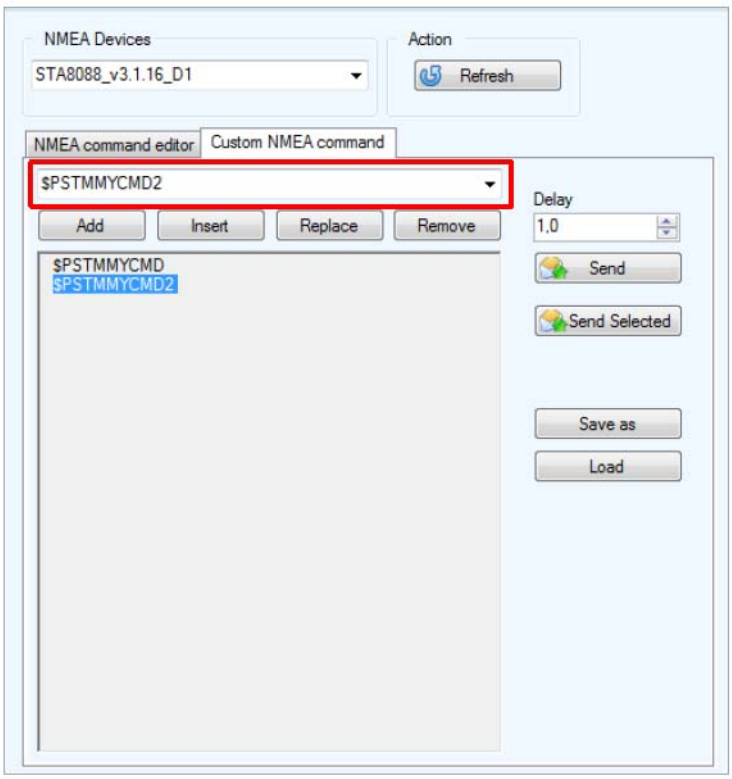
Press “Add” to add the command to the list. The command can be inserted before any command selected in the list. The user can also replace a command in the list with the new one or remove a selected command from the list.

Pressing the “Send” button, all the commands in the list are sent with the defined delay in between.

A single command can be sent by selecting it then pressing the “Send selected” button.

The command list can be saved in a text file (press “Save as”) and reloaded (press “Load”).

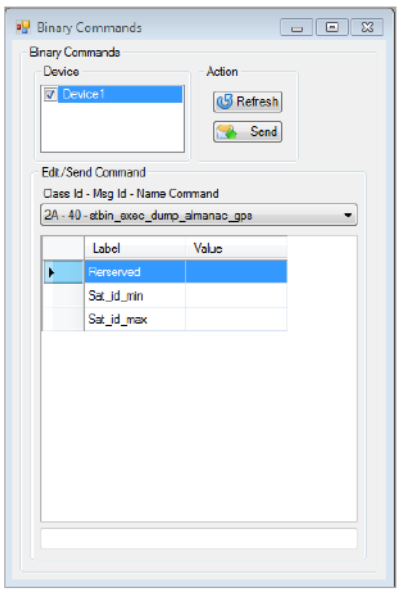
Figure 76. Custom NMEA command editor



4.6.2 Binary commands

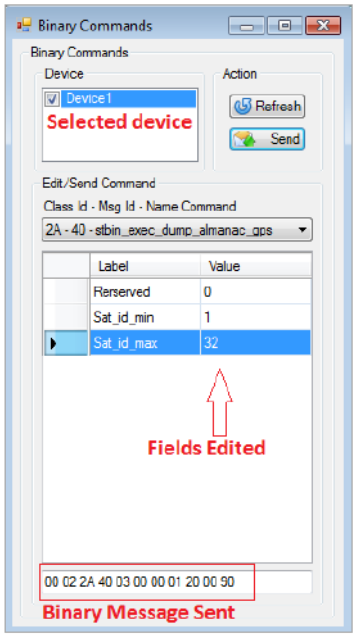
Press the refresh button to see the latest list of binary devices.

Figure 77. Binary commands form



The message to send is chosen thanks to the combo box. The messages that can be sent are defined in an xml file.

Figure 78. Binary Commands details



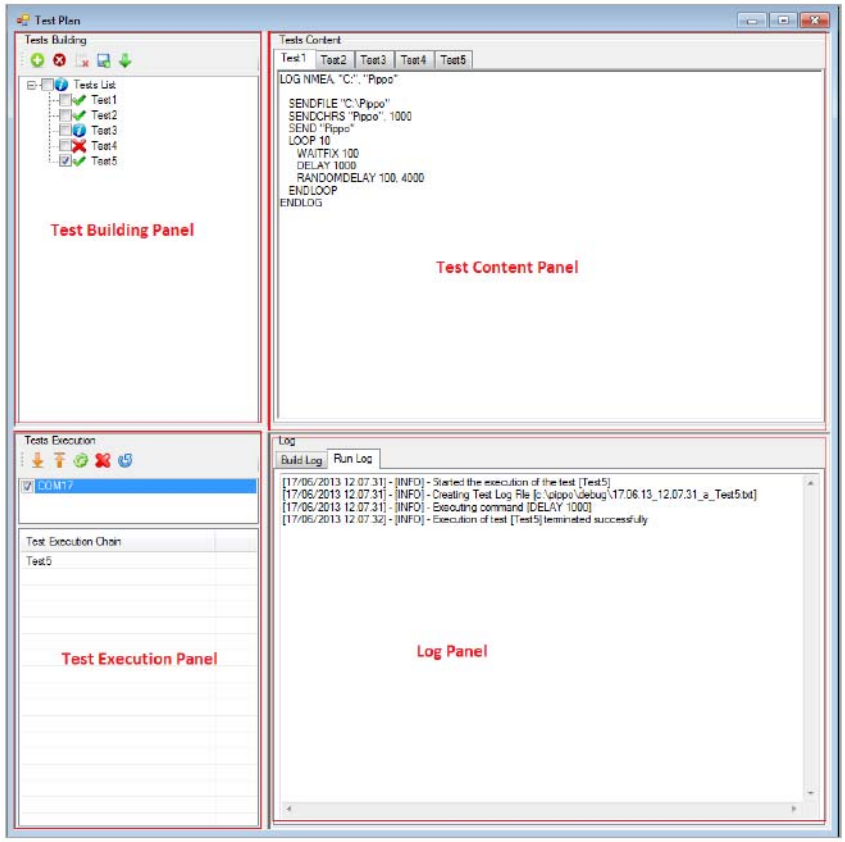
5 Test Plan

TESEO-SUITE provides a test module, accessible from the "Tools - Test Plan" menu; through a scripting language, it is possible to write and execute tests on one or more devices connected.

5.1 Test Plan Form

The "Test Pan" form (see *Figure 79: Test Plan Form*) is divided into four panels, which are described below.

Figure 79. Test Plan Form



5.1.1 Tests Building Panel

The building panel (see *Figure 80: Tests Building Panel*) provides functionality for adding, removing, saving and compiling test.

Figure 80. Tests Building Panel

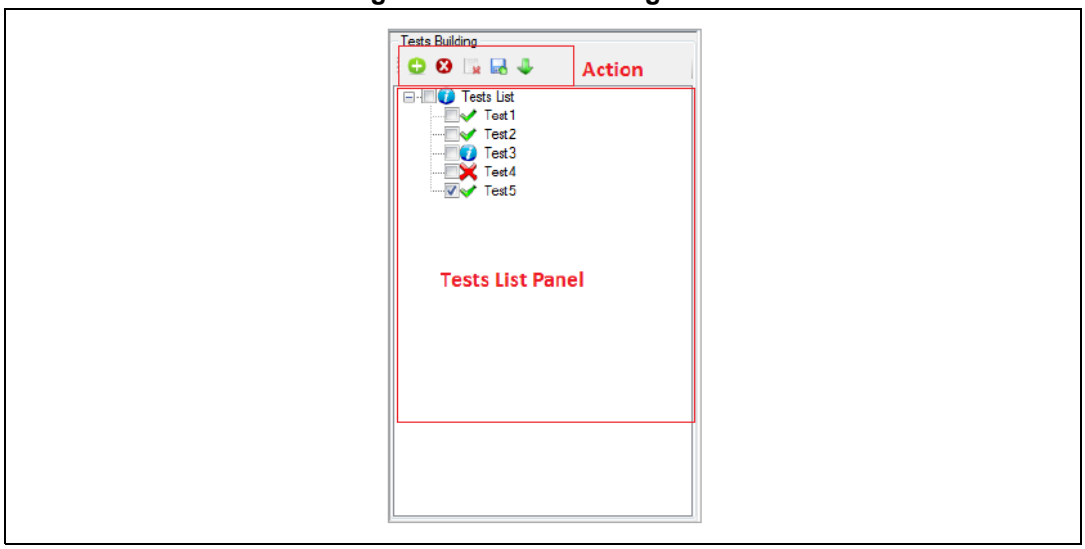


Table 22. Actions in Tests Building Panel

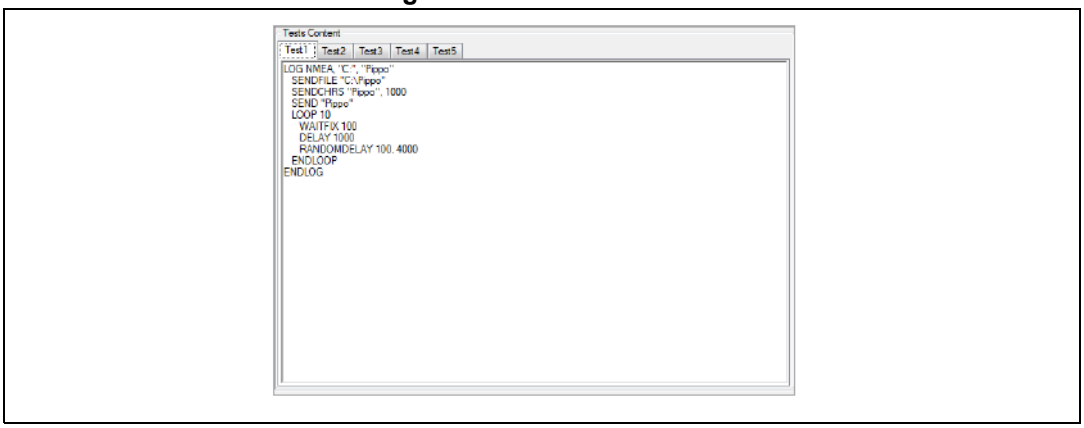
	**Add Test:** adds a new test to be edited in “Tests List” Panel.
	**Remove Checked Test**: Removes the checked tests in Tests List.
	**Close Checked Tab Test**: Closes the tabs associated to the test checked, in Tests Content Panel.
	**Save checked tests**: saves the content of the tests checked.
	**Compile checked tests**: compiles the tests checked.
One click on Test in Tests List	Renames the test name.
Double click on Test in Tests List	Opens the tab associated to the test, in Tests Content Panel.

To compile a test, it must be saved before.

5.1.2 Tests Content Panel

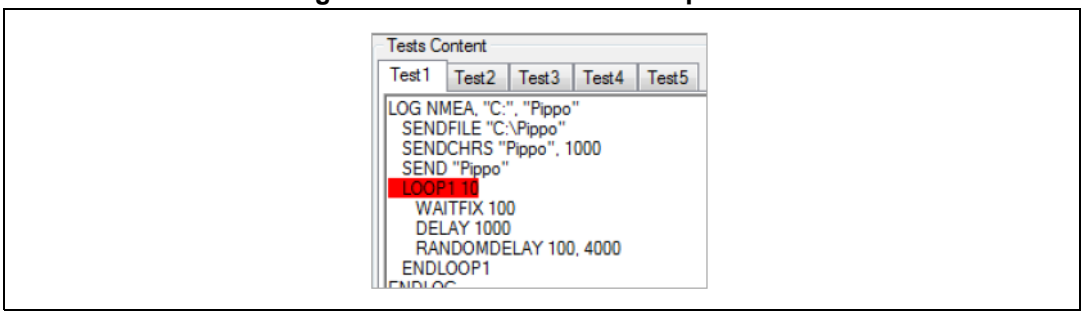
Content Panel (see *Figure 81: Multi-tab Editor*) is a multi-tab editor, where to write the script associated with the test.

Figure 81. Multi-tab Editor



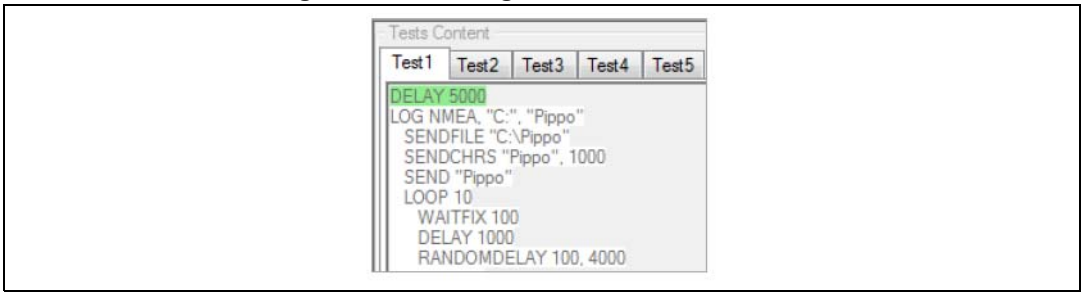
At compile time, if an error occurred, the incorrect line is highlighted in red (see *Figure 82: Incorrect line at compile time*).

Figure 82. Incorrect line at compile time



At run time, the running current line is highlighted in green (see *Figure 83: Running current line at run time*).

Figure 83. Running current line at run time



5.1.3 Tests Execution Panel

Execution panel (see *Figure 84: Tests Execution Panel*) is the panel that exposes the functionalities for the tests execution.

Figure 84. Tests Execution Panel

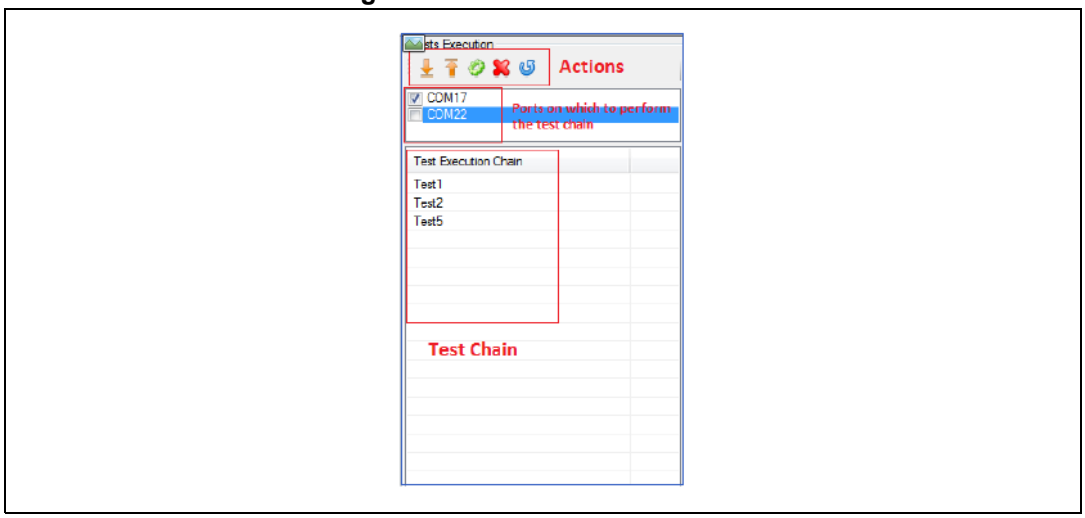


Table 23. Actions in Tests Execution Panel

	Adds the tests checked and compiled in Tests Execution Chain
	Removes the selected test from the execution chain
	Runs the tests execution chain
	Stops the tests execution chain
	Refresh the Nmea com

The tests will be performed in parallel on the devices checked.

The test execution produces a test result file in the directory specified in the "Preferences" form.

5.1.4 Log panel

Log panel contains the log information concerning the test module; this log is grouped into two tabs:

Build log: it contains information about the building and compiling of tests (see *Figure 85: Log Panel: Build*);

Run Log: it contains information about the execution of tests (see *Figure 86: Log Panel: Run*).

Figure 85. Log Panel: Build

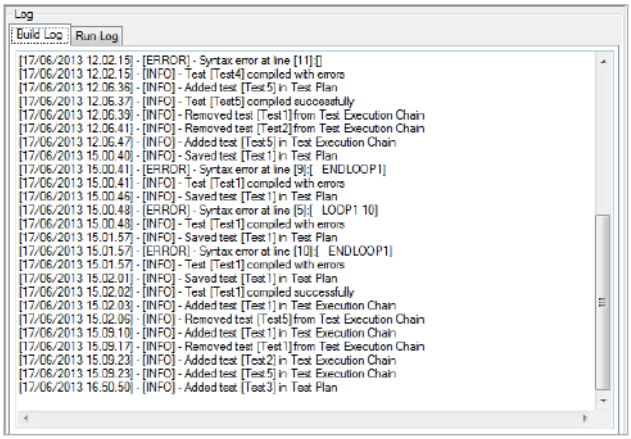
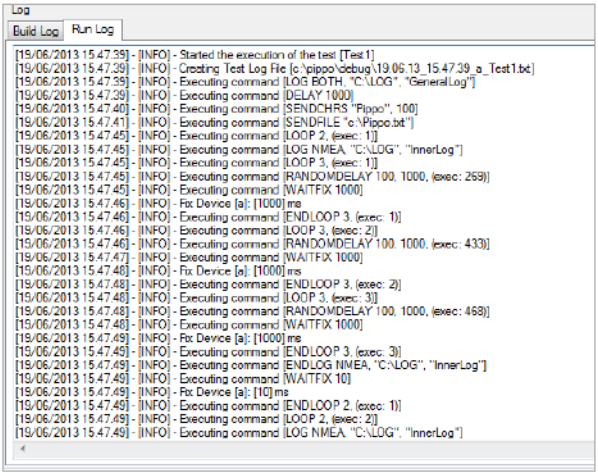


Figure 86. Log Panel: Run



5.2 Scripting language for writing tests

The scripting language used for writing test consists of the following constructs.

Table 24. Script key words

DELAY msDelay	Waits msDelay milliseconds.
RANDOMDELAY msDelayMin , msDelayMax	Waits for an interval between msDelayMin and msDelayMax milliseconds.
SEND "contentSend"	Sends to device the content (contentSend) of the ascii string.
SENDCHRS "contentSend", msDelay	Sends to device a sequence of characters, waiting msDelay millisecond for each character.
SENDFILE "absolutepathFile"	Sends to device the contents of the file with path absolutepathFile.

Table 24. Script key words (continued)

WAITFIX msFix	Waits the fix of device for msFix milliseconds. If fix is within msFix milliseconds, the fix time is recorded in the test log file. The test log file is created in directory chose through the “Preferences” Form
LOOP nCounter **…** **other construct** **…** **ENDLOOP**	Repeats the execution of the constructs in the loop for nCounter times. Nested loops are allowed.
LOG NMEA | DEBUG | BOTH, "absolutePath","nameFileLog" **…** **other construct** **…** **ENDLOG**	Records the contents of the NMEA or/and DEBUG por,t in the file with “absolutePath “ absolute path and “nameFileLog “ name. **absolutePath**: If it does not exist, it is created. **BOTH**: If this option is choice, are automatically created two files, one for each port If this construct is inside nested loop constructs, the name of the log file will contain the current counters of Loop instruction. Nested LOG are allowed.

Script File Example

```
LOG BOTH,  "C:\LOG", "GeneralLog"
        DELAY 1000
        SENDCHRS "Pippo", 100
        SENDFILE "c:\Pippo.txt"
        LOOP 2
        LOG NMEA, "C;\LOG", "InnerLog"
                LOOP 3
                        RANDOMDELAY 100,1000
                        WAITFIX 1000
                ENDLOOP
        ENDLOG
        WAITFIX 10
        ENDLOOP
        SEND "Pippo"
        RANDOMDELAY 100,1000
ENDLOG
```

Figure 87. Log files generated

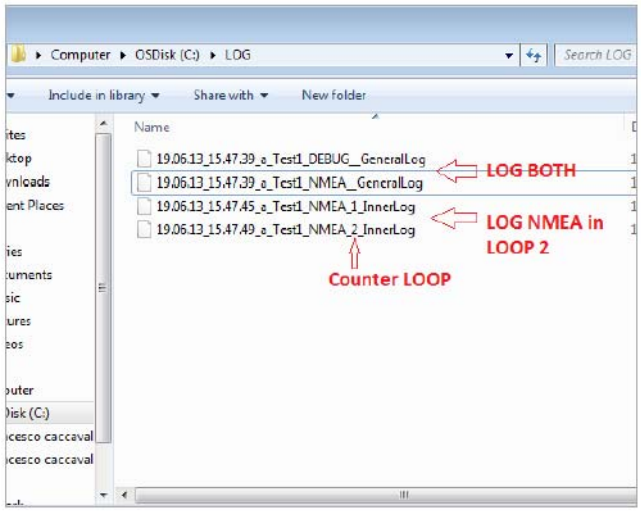
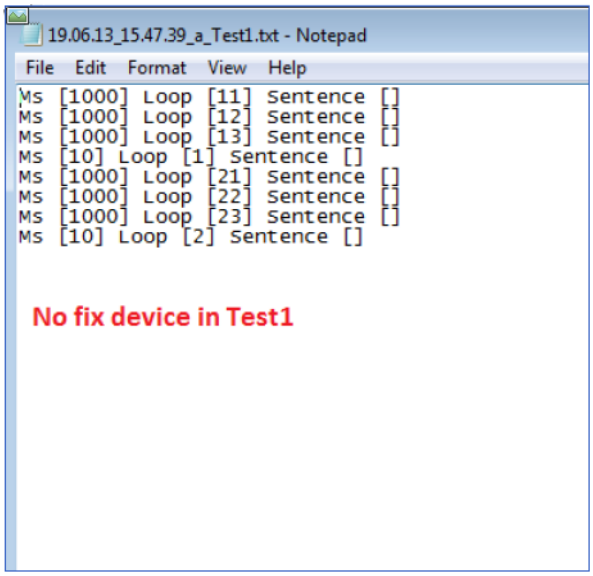


Figure 88. File Test Results



6 Configuration Files

The NMEA and ST Binary payload files are respectively located in the NMEA_Payload directory and in the STBIN_Payload directory in the TESEO-SUITE installation directory.

It is strongly recommended not to modify them.

Appendix A Document management

A.1 Acronyms

Table 25. Acronyms

Keyword	Definition
AGNSS	Assisted GNSS
AGPS	Assisted GPS (included in the AGNSS)
BEIDOU	China’s regional navigation satellite system
CN0	Carrier to Noise Ratio - Identifies the quality of a received signal
Cold start	Start Condition for a GPS system having no position nor time. Almanac and Ephemeris is not available, too.
DR	Dead Reckoning. Sensor based process to determine the movement of a mobile unit, utilizing Gyro, Odometer and Wheel Pulses.
GALILEO	Europe’s global navigation satellite system
GLONASS	Russian Global Navigation Satellite System
GNSS	Global Navigation Satellite System - Satellite based system to calculate the position of the receiver on the earth surface.
GPS	Global Positioning System - United States Satellite Navigation System
GUI	Graphical User Interface
Hot start	Start Condition for a GPS System having position, time, Almanac and Ephemeris already available. High time accuracy is required
IRNSS	Indian Regional Navigational Satellite System
NMEA	National Marine Electronics Association - United States Standards Organization For Marine Equipment
MDI	Multiple Document Interface
PGPS	Server based assistance done by ST-AGPS™ using GPStream™ technology from RxNetworks
RT	Real-Time
ST-AGPS™	Autonomous ephemeris prediction algorithm by STMicroelectronics
UART	Universal Asynchronous Receiver Transmitter
Warm start	Start Condition for a GPS system having current Almanac, position and time availability. Ephemeris are not available. Time needs to be available with reasonable accuracy (some seconds).

Revision history

Table 26. Document revision history

Date	Revision	Changes
01-Jun-2018	1	Initial release.