

u-center

GNSS evaluation software for Windows

User Guide

Abstract

This document leads you through the efficient use of the u-center evaluation software, the powerful and easy to use tool from u-blox for evaluating, performance analysis and configuration of u-blox GNSS positioning chips and modules.



www.u-blox.com

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Preface

Overview

u-center is u-blox' powerful GNSS evaluation and visualization tool which can be downloaded free-of-charge from our website (www.u-blox.com). This user guide provides a description of the features of this software. It allows end users to assess and test u-blox GNSS positioning chips and modules for navigation and positioning performance.

The purpose of u-center is to enable users to:

- Conduct performance tests on u-blox and other GNSS devices.
- Configure u-blox GNSS positioning chips and modules.
- Update the firmware on GNSS modules.
- Test the added performance provided by u-blox' AssistNow service.

Using this guide

This guide assumes that the user has basic computer skills and is familiar with the Windows Graphical User Interface (GUI) and GNSS receiver environments.

The following symbols are used to highlight important information:



An index finger points out key information pertaining to integration and performance.



A warning symbol indicates actions that could negatively impact or damage the receiver.

Technical support

If you have questions about installing or using u-center:

- Read this user guide carefully.
- Check our homepage (<http://www.u-blox.com>) to ensure that your GNSS device, firmware and the u-center software are the latest versions.
- Refer to our web based information service.

Worldwide Web

Our website (www.u-blox.com) is a rich pool of information. Product information and technical documents can be accessed 24/7.

By email

If you have technical problems or cannot find the required information in the provided documents, contact the closest technical support office. To ensure that we process your request as soon as possible, use our service pool email addresses rather than personal staff email addresses. Contact details are at the end of the document.

Helpful information when contacting technical support

When contacting technical support, have the following information ready:

- Receiver type (e.g. NEO-7N), firmware version (e.g. 1.00), and u-center release (e.g. u-center 8.00)
- Receiver configuration and short description of the application
- Your complete contact details

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1 Features

u-center evaluation software provides system integrators and end users with a quick and simple way to interface with u-blox GNSS chipsets, modules and boards. It enables easy evaluation, performance testing, development and debugging of GNSS positioning chips and modules. u-center allows easy connection to u-blox products and provides a suite of features to view, log, and analyze performance. The features include:

- Support for u-blox' receivers using u-blox positioning technology. u-center can communicate with these receivers using either the UBX protocol or the NMEA-0183 standard protocol.
- Support for receivers that utilize standard NMEA strings.
- u-center presents all the information collected during the operation of the GNSS device. All aspects of GNSS data (position, velocity, time, satellite tracking, etc.) can be monitored and logged under various test scenarios for the evaluation of a receiver. u-center software allows analysis of the collected data in order to investigate performance issues such as accuracy, road test position and trajectory, satellite tracking, time to first fix, etc. All processed data can be captured in ASCII format and ported into popular spreadsheets for creating additional plots and statistics.
- Camera View: photographic data can be stored in the log file together with the navigation data and later be replayed in the application.
- Export data files to Google Earth and Google Maps.
- Supports (Multiple GNSS) AssistNow Online and AssistNow Offline.
- Data recording and playback function.
- Structural and graphical data visualization in real-time.
- Export functionality to standard PC applications.
- Docking views (real-time cockpit instruments):
Satellite constellation, compass, clock, altimeter, speedometer, GNSS and satellite information views.
- Download firmware updates to GNSS positioning modules.

2 Getting started

2.1 General information about displayed values

- Longitude and latitude are displayed according to the datum selected in the GNSS device (usually: WGS-84). This option can be polled and set using the UBX-CFG-DAT message.
- Time is displayed with reference to UTC
- Elevation is displayed with reference to either MSL (Height above mean sea level or Orthometric Height) or to HAE (Height above WGS-84-Ellipsoid). The reference is controlled by the GNSS configuration.

2.2 Connecting an u-blox evaluation kit to the PC

This section assumes that you have purchased an u-blox evaluation kit. Should you try to connect a different GNSS device to the PC, make sure you use appropriate RS-232 level shifters.

The evaluation kit can be connected to the PC by using either an USB or a serial cable. In case of using the USB port, a driver is required (contained in the u-center installer or downloadable from our homepage). Be sure to install the driver **before** connecting the evaluation kit to the computer.

2.3 Installing u-center

The installation program guides you through the necessary steps for a successful program installation. During the installation, you can choose the destination folder for the program.



u-center uses dynamic link libraries (DLL). The installation program will automatically install the required DLL's into the u-center program directory. Should you try to copy a u-center installation from one location to another after the installation, make sure you copy the DLL files as well.

After a successful installation, u-center can be started from the Start Menu (All Programs -> u-blox -> u-center -> u-center) and will start up as shown in:

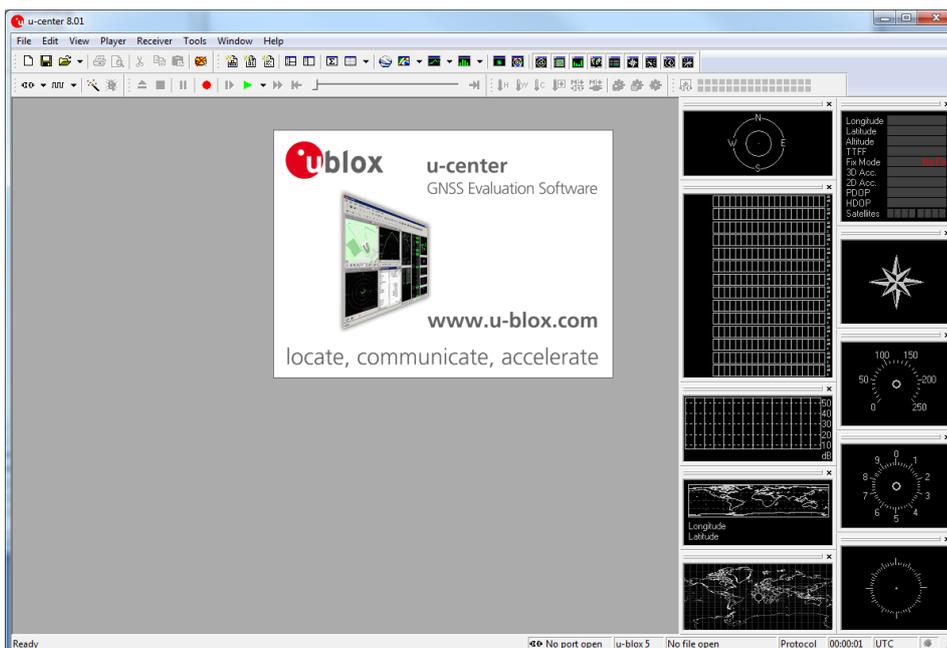
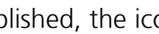


Figure 1: Start display

2.4 Connect to the receiver

2.4.1 Select the port

Locate the communication toolbar (Figure 2) and click on the arrow beside the  icon. This will show a list with all available COM ports (Figure 3). Select the corresponding COM port where the receiver is connected. If a link could be established, the icon will turn green  and the text in the status bar changes from  to  (in this example u-center is connected to COM6). This does not mean that the communication already works but only that the port could be opened.

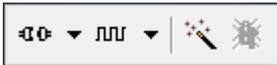


Figure 2: Communication toolbar

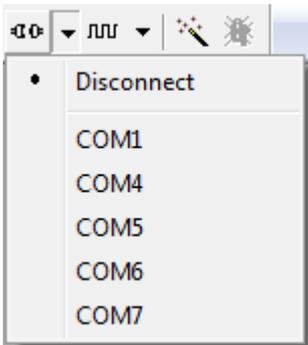


Figure 3: List of available COM ports

2.4.2 Select the baud rate (only for COM ports)

Again in the communication toolbar, click on the arrow beside the  icon. This will show a list with all available baud rates (Figure 4). Select the correct baud rate on which the receiver is communicating (typically 9'600 baud). If u-center is able to decode data from the receiver, the status bar begins to blink in green as shown in the following icon:  . This means that the connection is established successfully and the communication between the receiver and u-center is working.

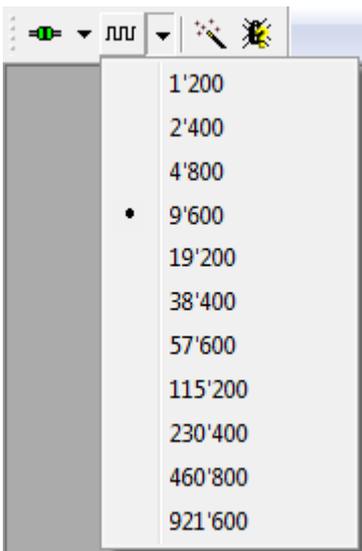


Figure 4: List of available baud rates

You are now ready to use the receiver.

3 Concept and philosophy

Understanding the basic concept behind u-center is important in order to get the highest benefit out of this powerful evaluation software. Figure 5 depicts the architecture of the software. The program gets a data stream from either a COM port or a log file and splits this stream into protocol messages. From the messages, relevant parameters are extracted and inserted into the current dataset of the database.

In the current dataset, statistical values of the parameters are calculated. Average, Minimum, Maximum and Standard Deviation are calculated for most parameters. If a protocol does not provide a parameter, u-center tries to calculate the parameter from the ones that are available. For example if velocity-north and velocity-east are available, u-center calculates the speed over ground and course over ground, unless this data is already available in the protocol.

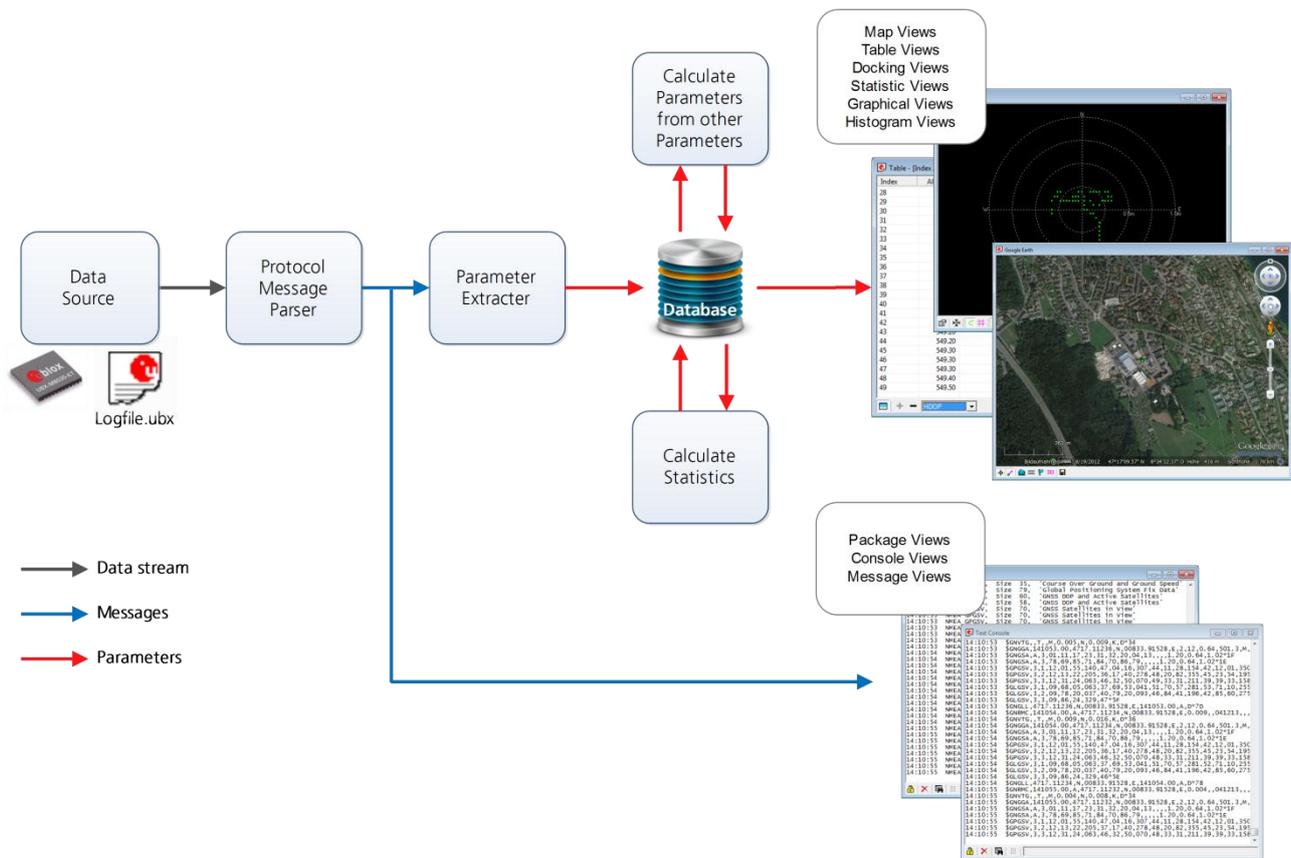


Figure 5: Engine Architecture

When a new epoch (change in time) is detected, the current dataset is stored as history in the database. This history has a limited size. If the size is exceeded u-center keeps only the latest datasets and the oldest ones are removed. The history size may be adjusted. Refer to section 3.3 for the details

u-center provides various view classes for observation. Most views take their data from the database, but some get their data directly from the message without using the database at all. The other views are updated when the database changes.

- Message Views** Displays and decodes a copy of every known message. This view allows observing a single message in detail and it may also be used to configure the GNSS device. Refer to Section 4.2.4 for details. The configuration view is a subset of the message view and only displays message to configure the receiver.

- **Console Views** Displays the messages in text form. They are particularly useful for users to develop GNSS firmware code. There is also a wide range of information available which is useful for evaluation and testing. Refer to sections 4.2.1, 4.2.2 and 4.2.3 for details.
- **Graphical Views** Displays parameters from the database in graphical form. Charts (see section 4.2.9), Histograms (section 4.2.10) and a Map Overlay (section 4.2.8) can be created. There are two more views (Deviation View and Sky View, see sections 4.2.12 and 4.2.13) that may be used for statistical performance and antenna pattern analysis.
- **Tabular Views** Shows the parameters of the database in tabular form. They can be freely configured to allow customized tables. Refer to sections 4.2.5 and 4.2.6 for details.
- **Docking Windows** Can be docked to the frame of u-center. An analog watch, compass, world map, altitude and speed meter are available. There are also docking windows showing the current signal power and the constellation of the satellites received by the device as well as a summary of the GNSS status.



Displaying various views and docking windows requires computing power. Minimizing or closing them may significantly reduce CPU usage.

3.1 Color and satellite coding scheme

In the graphical views and some docking windows, colors are used to indicate data quality. Table 1 shows the color codes for graphical views depending on the quality of the navigation solution.

Color	Meaning
+ Yellow	Current value
+ Orange	Valid 3D navigation fix + Dead Reckoning
+ Green	Valid 3D navigation fix
+ Cyan	Valid 2D navigation fix
+ Magenta	Dead Reckoning Fix
+ Blue	Degraded navigation fix
+ Red	No or invalid navigation fix

Table 1: Color-coding scheme for graphical views

Table 2 gives the color-coding scheme for the Docking Windows and Sky View. It indicates the state of each satellite.

Color	Meaning
Green	Satellite used in navigation (with Ephemeris)
Olive	Satellite used in navigation (with Ephemeris and PPP)
Dark Green	Satellite used in navigation (with aiding data: AssistNow Autonomous, AssistNow Online/Offline)
Cyan	Satellite signal available, available for use in navigation
Blue	Satellite signal available, not available for use in navigation
Red	Satellite signal not available

Table 2: Color-coding scheme for the docking windows and sky view

Table 3 gives the satellite-coding scheme for the docking windows and sky view.

Satellite Code	System
Gxx	GPS
Rxx	GLONASS
Bxx	BeiDou
Exx	Galileo
Sxx	SBAS
Qxx	QZSS

Table 3: Satellite-coding scheme for the docking windows and sky view

Figure 6 shows the color legend. This is available under: Tools → Preferences → Status Colors.

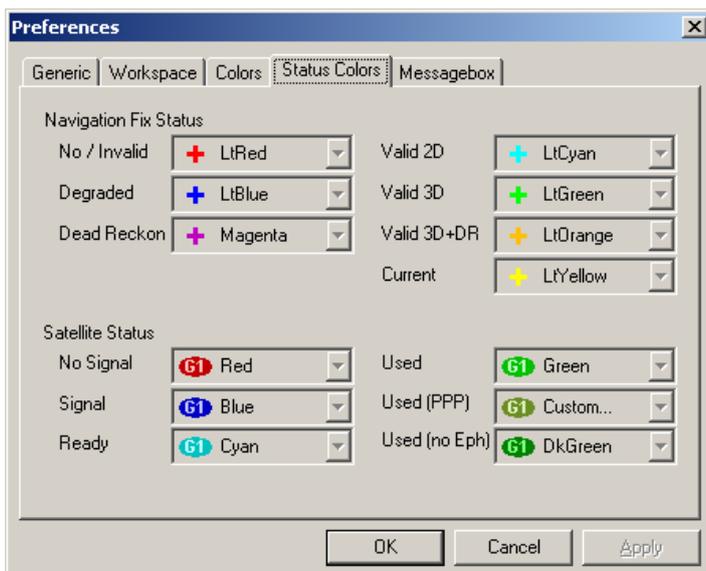


Figure 6: Color-coding scheme for graphical views, docking windows, and sky view

3.2 Operating modes

u-center has different operating modes (see Figure 7). The mode changes when you open or close a log file or when you make an action in the player. To be able to use the record mode you have to create a new file, save to a new file or open an existing file. The record and player mode are only available if you have created a new file or when you have opened a write-able file.

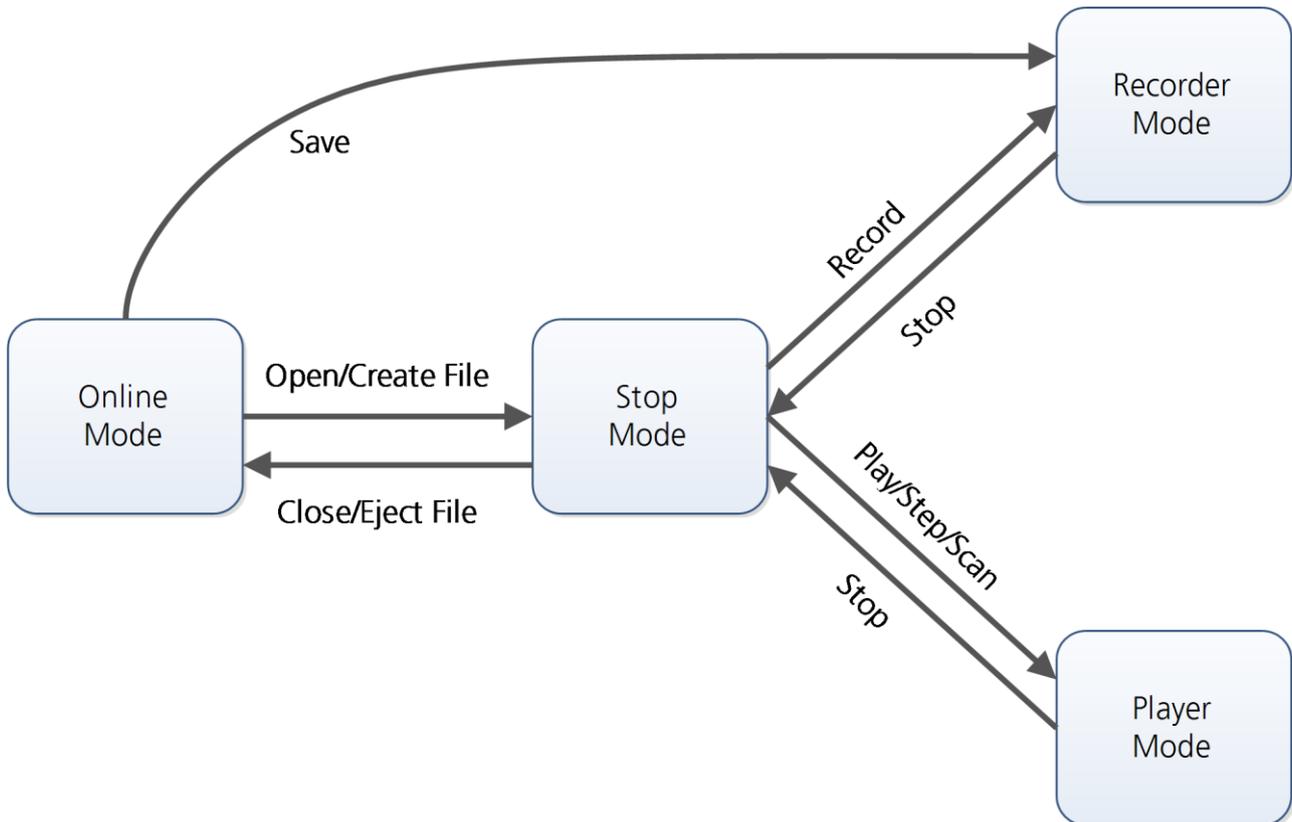


Figure 7: Relations between operating modes

3.2.1 Online mode

In this mode a GNSS device is directly connected to u-center via a COM port. u-center can control and configure the receiver and it will display the data that the receiver is sending periodically.

3.2.2 Stop mode

In this mode no data from a receiver or a log file is forwarded to the database and views. u-center is in this mode when a log file is open but player and recorder are not active.

3.2.3 Recorder mode

Recorder Mode is the same mode as the Online Mode, except u-center additionally creates a log file, concatenating all the messages sent by the receiver. You enter this mode by creating a new log file or opening an existing log file without write protection and pressing the record button. An example of using this mode would be to make overnight measurements and evaluate the data at a later time. u-blox customer support may request a log file from you when you are experiencing a problem with one of our receivers.

3.2.4 Player mode

The Player Mode allows replaying a previously recorded log file step by step, in real-time or at an accelerated rate. You enter this mode by opening a file and pressing the play, step or scan button.

3.2.5 Relations between modes

The operating mode depends on the status of the log file player. Modes are changed by user actions. Each mode has different states that are changed by a user action or by an event (see Figure 7).

In **Online** and **Recorder** modes, u-center displays data from the receiver. In **Player** mode data from a log file is displayed. Player mode has different states. In **Play** state messages are read and displayed periodically from the log file. The very intuitive user interface is derived from that of a CD player. u-center updates the views after each message. **Step** state only gets one message from the log file and immediately returns to paused **Play** state. **Scan** state also reads messages periodically but the display is only updated when paused or by changing the state. Position can be set in a log file. This behaves differently in the Player and Stop modes. In Stop mode the position is just set and no data is read and displayed. u-center will start recording or playing from that position when changing the mode. If position is set in **Player** mode, u-center will load the data up to this position from the log file and display the contents.

3.3 Database limitation

The number of epochs displayed in u-center is limited in order to allow an efficient analysis of large log files. The limit is set to 1800 epochs by default. This means if an epoch is available every second you can analyze data for up to 30 minutes. After this time the oldest values are discarded. Data stored to a log file is not affected by the database limitation.

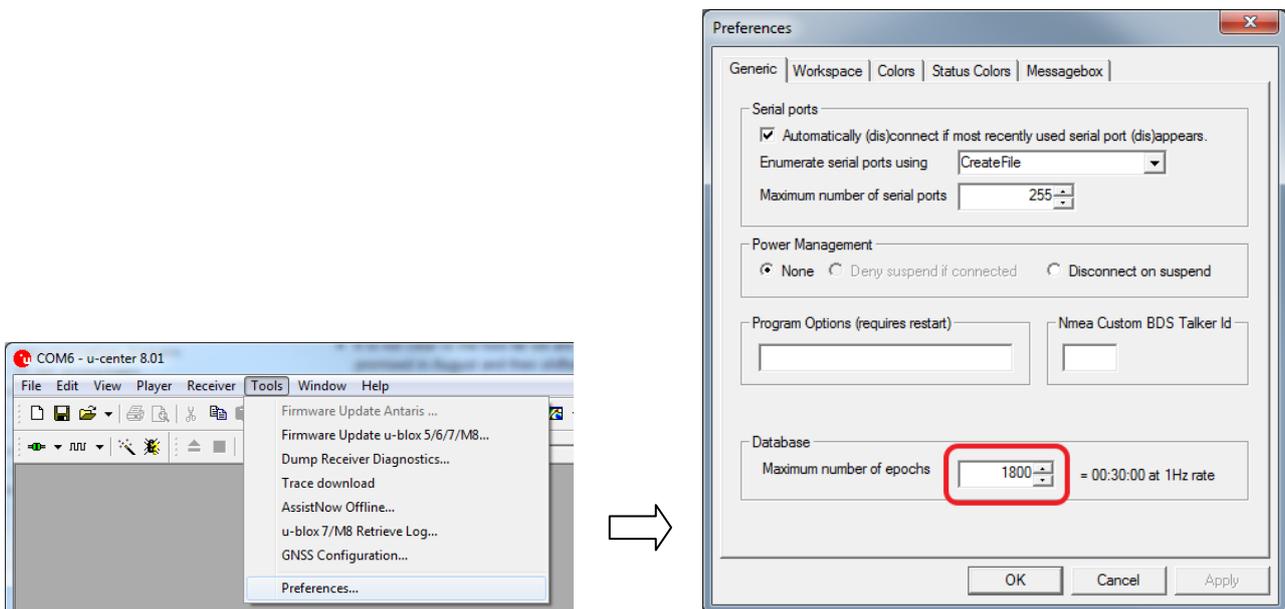


Figure 8: Set maximum number of epochs to keep in database



For long-term observations, it's recommended to start recording a log file before analysis begins.



If a high value of epochs is selected, the display of data in real-time cannot be guaranteed, especially when graphical views are open.

4 u-center menus and windows

4.1 Main frame and toolbars

The main frame is the primary display screen of u-center. It displays all tool bars and some of the information provided by the device. In the standard status bar, information about communication, UTC time, connection time, used protocol (NMEA or UBX), used file, etc. is shown.

- Button tool tip:** A description about each button in the toolbars can be obtained by holding the mouse cursor over the button for a few seconds. A tool tip message will appear near the icon with additional information while a detailed description is displayed in the status display.

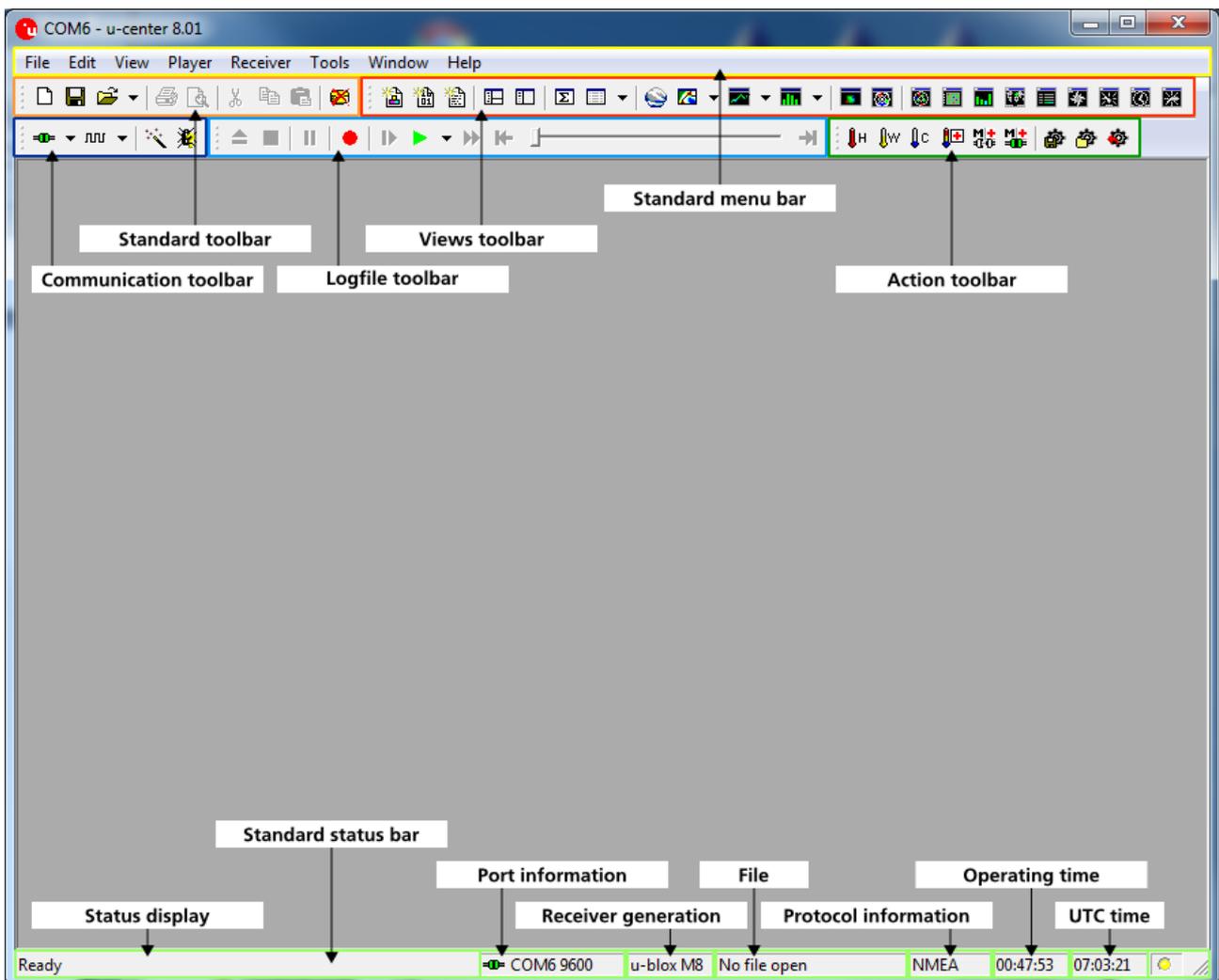


Figure 9: u-center main frame and toolbars

4.1.1 Standard menu bar

All u-center functions can be accessed through the standard menu bar. Commands can also be accessed by shortcuts that are listed in the menus. Some often used operations are also available in the different toolbars.

4.1.1.1 File

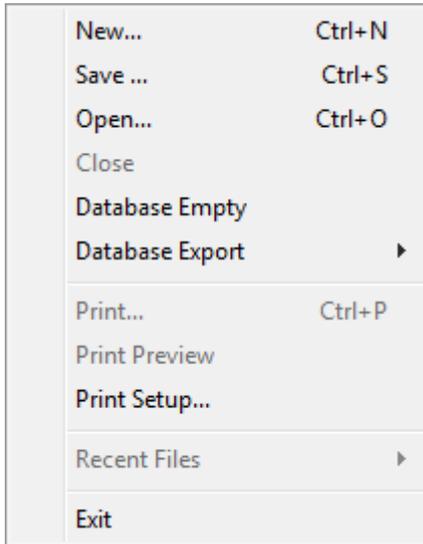


Figure 10: File menu entries

Function	Description	Shortcut / Toolbar icon
New...	Creates a new log file. No data is yet written but only the file is opened. The duration of the logging time is displayed in the status bar field Operating time.	Ctrl+N / 
Save...	Creates a new log file, saves the data from the internal database to the log file and starts immediately recording all new data from the receiver. This is useful when an error or an unexpected event occurred and no log file was recorded. The size of the ring buffer (4 MB) is large enough to retain the data for the last hour (approx.).	Ctrl+S / 
Open...	Opens a stored log file to be replayed.	Ctrl+O
Close	Closes the active file.	Ctrl+E / 
Database Empty	Deletes the internal database and all saved values.	
Database Export	Exports the internal database into HTML or KML data formats for displaying with Google Map or Google Earth.	
Print...	Prints the active document.	Ctrl+P / 
Print Preview	Shows a preview of the print output.	
Print Setup...	Shows the setup dialog of the printer.	
Recent Files	Lists all recently used files.	
Exit	Exits u-center.	

Table 4: File menu entries

4.1.1.2 Edit

Cut	Ctrl+X
Copy	Ctrl+C
Paste	Ctrl+V
Delete	Del
Select All	Ctrl+A
Clear All	Ctrl+Del

Figure 11: Edit menu entries

Function	Description	Shortcut / Toolbar icon
Cut	Cut the current selection and put in to the clipboard	Ctrl+X / 
Copy	Copy the current selection to the clipboard	Ctrl+C / 
Paste	Paste the clipboard content to the current position	Ctrl+V / 
Delete	Delete the current selection	Del
Select All	Select all in the current view	Ctrl+A
Clear All	Clear all in the current view	Ctrl+Del

Table 5: Edit menu entries

The Edit menu is fully Microsoft Windows compliant.

4.1.1.3 View

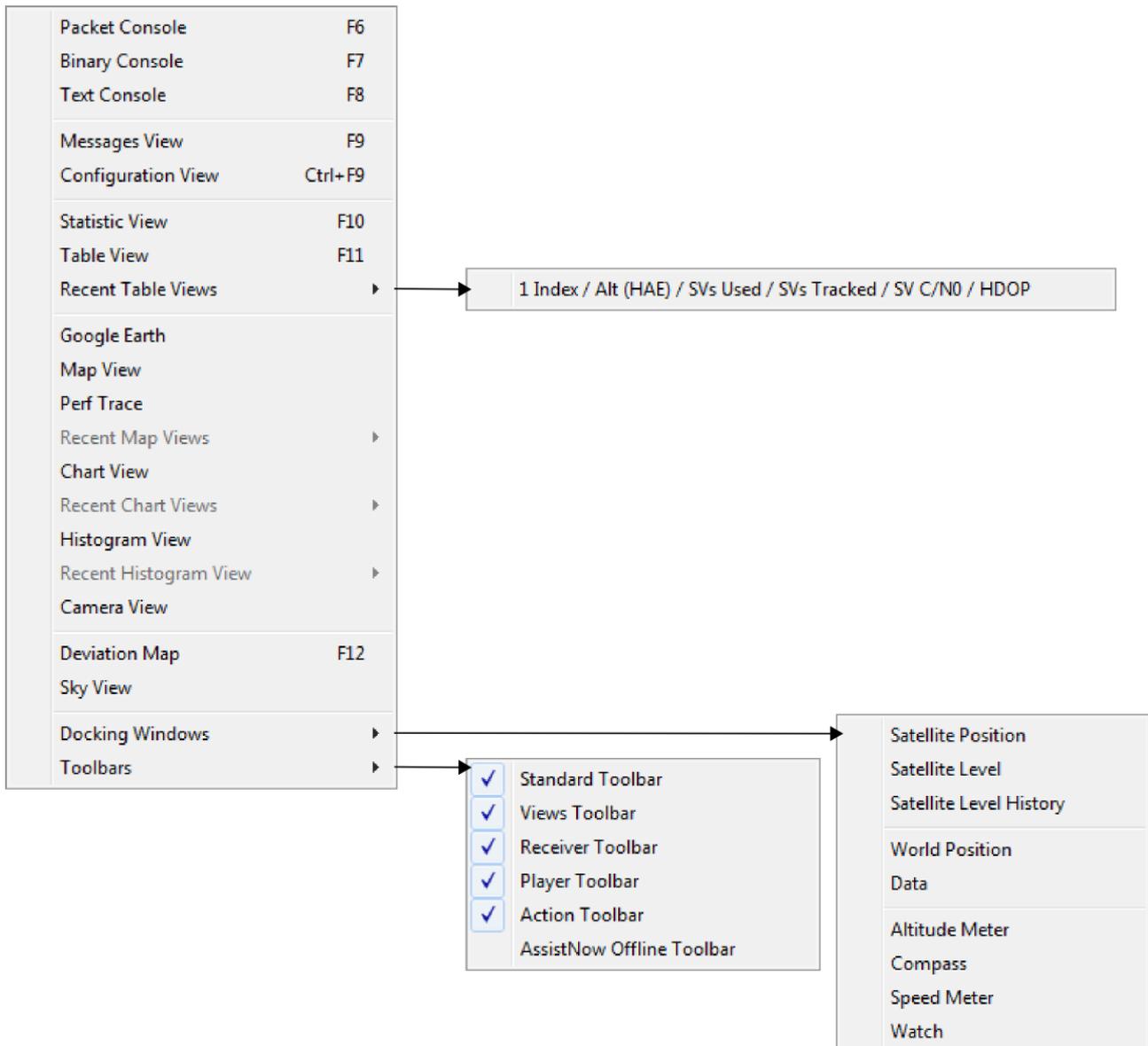


Figure 12: View menu entries

Function	Description	Shortcut / Toolbar icon
Packet Console	Opens the packet console.	F6 /
Binary Console	Opens the binary console.	F7 /
Text Console	Opens the text console.	F8 /
Messages View	Opens the dialog with all supported messages.	F9 /
Configuration View	Opens the dialog with all configuration messages. This is a subset of the Messages View.	Ctrl+F9 /
Statistic View	Opens the statistic view with all data from the internal database.	F10 /
Table View	Opens the empty table view. All values from the	F11 /

	internal database can be displayed individually.	
Recent Table Views	Lists all the table views that have been opened. This information comes from the Windows registry and is also valid after a restart of u-center.	
Google Earth	Opens a window using the Google Earth plugin. (Read and accept the terms of usage the first time.)	
Map View	Opens a window allowing to display a map.	
Chart View	Opens a window with chart functionality. All values from the internal database can be displayed individually.	
Histogram View	Opens a window with histogram functionality. All values from the internal database can be displayed individually.	
Camera View	Opens a window allowing to connect to a webcam and visualize and save the image.	
Deviation Map	Opens a window with a position deviation map.	F12 / 
Sky View	Opens a window with the sky view. The current position of the satellites and their values from the internal database are shown.	
Docking Windows	Opens a list with all available docking windows that can be shown.	
Satellite Position	Shows or hide the current satellite positions.	
Satellite Level	Shows or hide the current satellite levels.	
Satellite Level History	Shows or hide the history of the satellite levels.	
World Position	Shows or hide the current position on the world map.	
Data	Shows or hide data from the navigation solution (like position, TTFF, accuracy and DOPs)	
Altitude Meter	Shows or hide the altitude meter.	
Compass	Shows or hide the compass.	
Speed Meter	Shows or hide the speed meter.	
Watch	Shows or hide the clock.	
Toolbars	Opens a list with all available toolbars that can be shown.	
Standard Toolbar	Shows or hide the standard toolbar.	
Views Toolbar	Shows or hide the views toolbar.	
Receiver Toolbar	Shows or hide the receiver toolbar.	
Player Toolbar	Shows or hide the player toolbar.	
Action Toolbar	Shows or hide the action toolbar.	
AssistNow Offline Toolbar	Shows or hide the AssistNow Offline toolbar.	

Table 6: View menu entries

4.1.1.4 Player

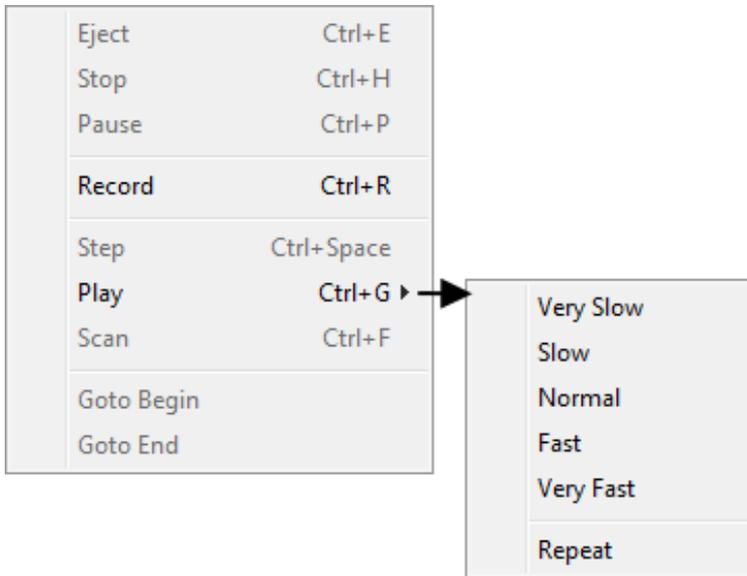


Figure 13: Player menu entries

Function	Description	Shortcut / Toolbar icon
Eject	Closes the active log file	Ctrl+E /
Stop	Stops reading or recording from the active log file	Ctrl+H /
Pause	Pauses reading or recording from the active log file	Ctrl+P /
Record	Starts recording to a new or already opened log file. Any data in the internal database will not be written to the file. If you want to save this data into a log file, open the File menu and click Save.	Ctrl+R /
Step	Single step function. The next message is read.	Ctrl+Space /
Play	Starts reading from the active log file. The speed of the action can be chosen on the sub-menu.	Ctrl+G /
Scan	Reads the entire log file into the database and updates the display at the end of the scan period	Ctrl+F /
Goto Begin	Sets the read position to the begin of the log file	
Goto End	Sets the read position to the end of the log file	

Table 7: Player menu entries

4.1.1.5 Receiver

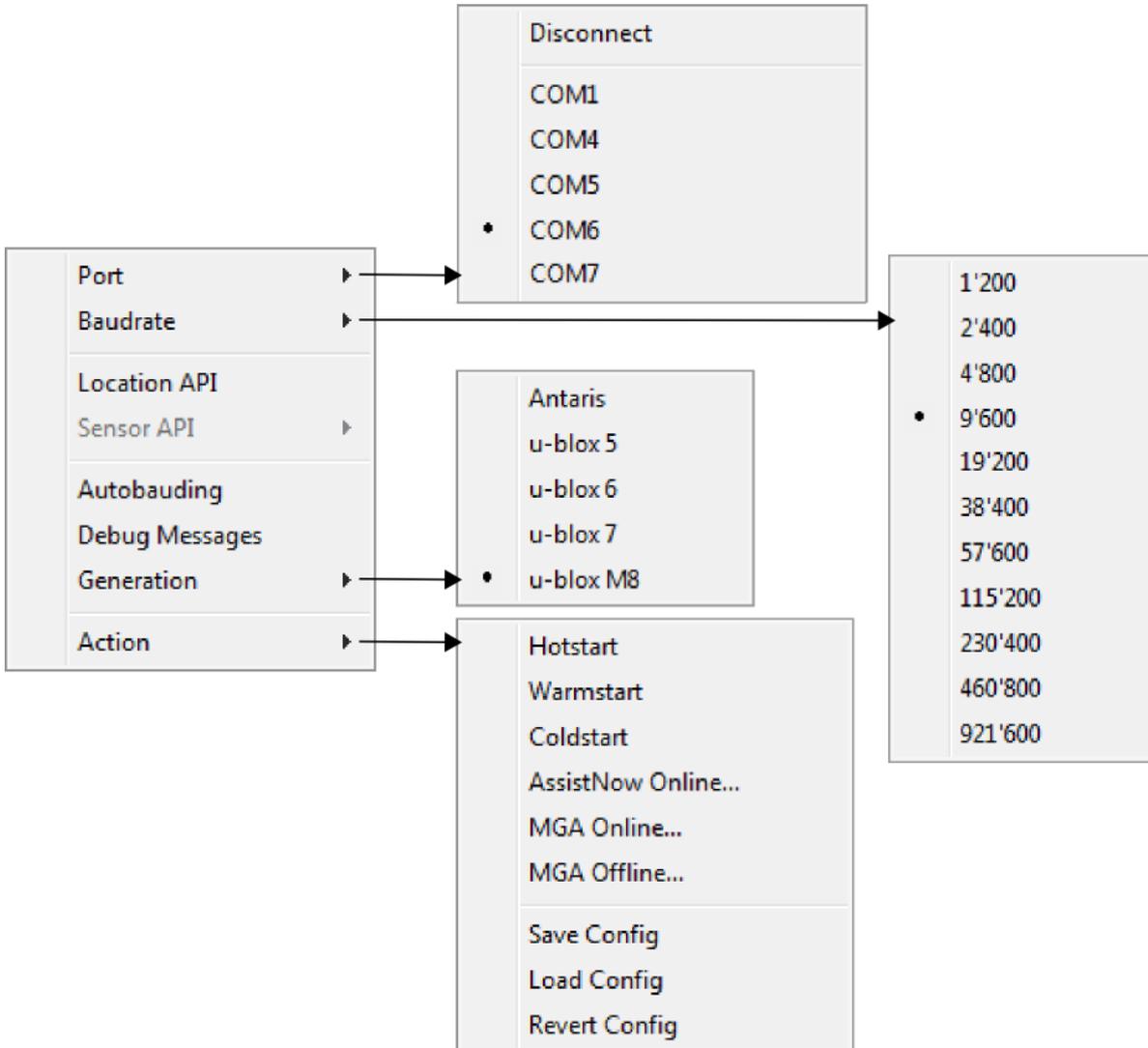


Figure 14: Receiver menu entries

Function	Description	Shortcut / Toolbar icon
Port	Defines the port u-center connects to. The list is generated automatically using the enumeration method under Tools → Preferences → Generic Enumerate serial ports using. The currently used port will be indicated with a •.	
Baud rate	Defines the baud rate of the communication. The list is pre-defined and cannot be changed. The currently set baud rate will be indicated with a •.	
Location API	Connects to the receiver using the Location API	
Sensor API	Connects to the receiver using the Sensor API (the USB Sensor driver is required in this case)	

Autobauding	Enables or disables autobauding for the current communication with the receiver	
Debug Messages	Enables all debug messages in the receiver. Can be requested by the u-blox support.	
Generation	Defines the generation of the attached u-blox GNSS receiver. u-center also tries to detect automatically the correct generation.	
Action	Lists all possible actions that can be performed with the u-blox GNSS receiver. This includes the following:	
Hotstart	Sends a hotstart command to the receiver. No data is deleted in the receiver.	
Warmstart	Sends a warmstart command to the receiver. Only the ephemeris are deleted from the memory.	
Coldstart	Sends a coldstart command to the receiver. All information is deleted from the memory.	
AssistNow Online...	Opens the AssistNow Online dialog to aid the receiver with satellite information. This method is supported until u-blox 7 receivers.	
MGA Online...	Opens the Multiple GNSS AssistNow Online dialog to aid the receiver with satellite information from the internet. This method is only supported since u-blox M8 receivers.	
MGA Offline...	Opens the Multiple GNSS AssistNow Offline dialog to aid the receiver with satellite information from the internet. This method is only supported since u-blox M8 receivers.	
Save Config	Saves the current receiver configuration to the memory so that it will be loaded after a restart.	
Load Config	Loads the last saved configuration from the memory.	
Revert Config	Deletes all configurations in the memory and reverts the receiver to the default configuration.	

Table 8: Receiver menu entries

4.1.1.6 Tools

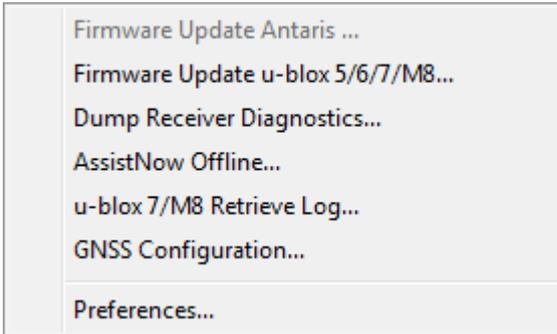


Figure 15: Tools menu entries

Some of the menu items will only be displayed when the correct receiver generation is connected and identified by u-center. If you cannot select one option, change the receiver generation under Receiver → Generation.

Function	Description	Shortcut / Toolbar icon
Firmware Update Antaris...	Opens the firmware update dialog for u-blox Antaris generation receivers.	
Firmware Update u-blox 5/6/7/M8...	Opens the firmware update dialog for u-blox 5-M8 generation receivers.	
Dump Receiver Diagnostics...	Tool to create the receiver diagnostic. Can be requested by the u-blox support team.	
AssistNow Offline...	Opens the AssistNow Offline dialog. This is supported only until u-blox 7 receivers.	
u-blox 7/M8 Retrieve Log...	Opens the dialog to download log information from the receiver. This is supported only since u-blox 7 receivers.	
GNSS Configuration...	Opens the dialog to save the receiver configuration to a file on the PC or to restore a configuration from a file on the PC.	
Preferences...	Opens the dialog for the u-center preferences.	

Table 9: Tools menu entries

4.1.1.7 Window

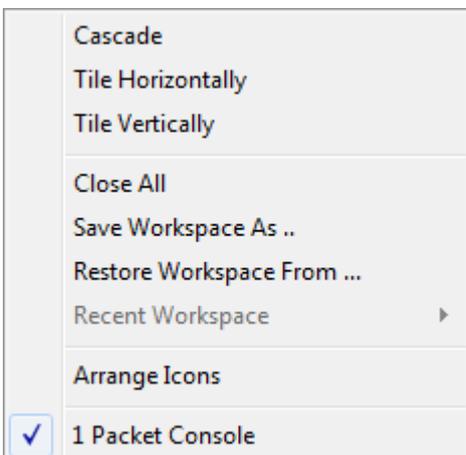


Figure 16: Window menu entries

Function	Description	Shortcut / Toolbar icon
Cascade	Arranges all open dialogs cascaded.	
Tile Horizontally	Arranges all open dialogs horizontally.	
Tile Vertically	Arranges all open dialogs vertically.	
Close All	Closes all open dialogs and windows.	
Save Workspace As...	Allows to save the position of the open dialogs and windows to a file on the computer.	
Restore Workspace From...	Allows to restore the position of the dialogs and windows from a file on the computer.	
Recent Workspace	Lists all recently used workspace files.	
Arrange Icons	Arranges the icons at the bottom of the window.	
List of dialogs and windows	Lists all visible and hidden dialogs and windows in u-center.	

Table 10: Window menu entries

4.1.1.8 Help

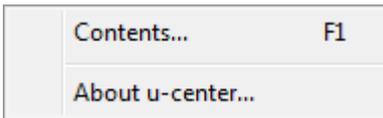


Figure 17: Helpmenu entries

Function	Description	Shortcut / Toolbar icon
Contents...	References to this user guide.	F1
About u-center...	Shows the about dialog with the software version and the used libraries and their versions.	

Table 11: Help menu entries

4.1.2 Standard toolbar

The standard toolbar gives access to standard operations like opening and saving files, print the current view or empty the database.

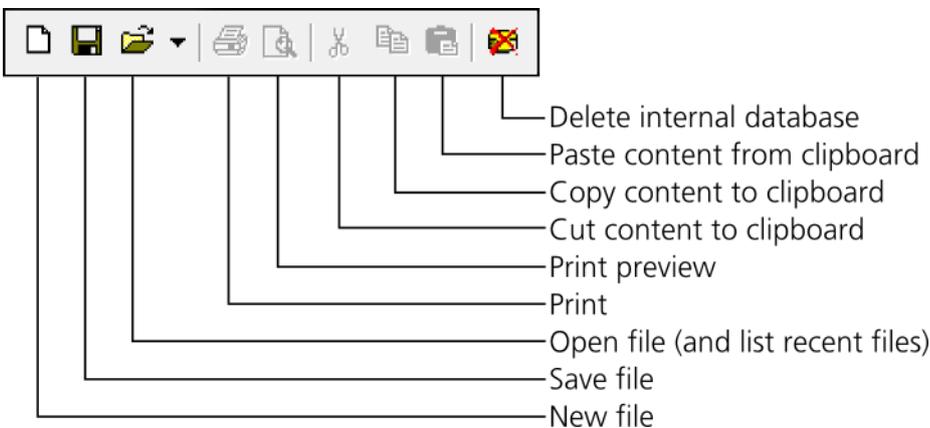


Figure 18: Standard toolbar entries

4.1.3 Views toolbar



Figure 19: Views toolbar entries

4.1.4 Communication toolbar

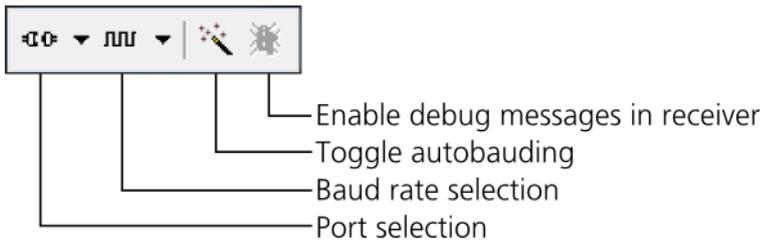


Figure 20: Communication toolbar entries

4.1.5 Log file toolbar

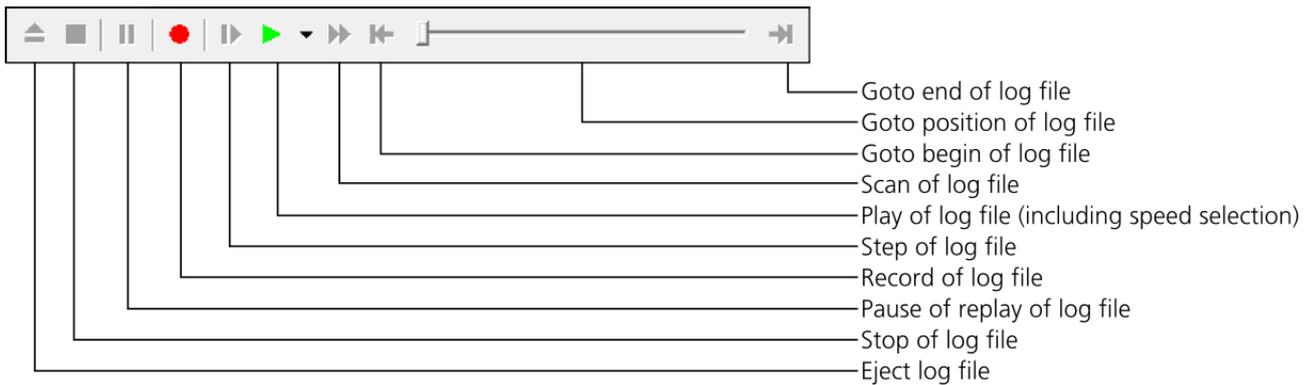


Figure 21: Log file toolbar entries

4.1.6 Action toolbar

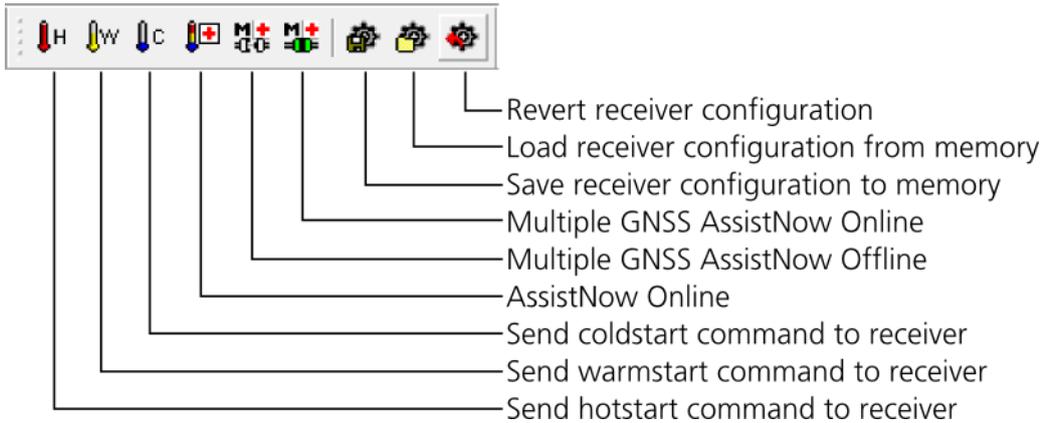


Figure 22: Action toolbar entries

4.1.7 Standard status bar

The standard status bar is updated automatically and shows the information about the opened file, the connection and the time.

The following fields are available:

Status display: Displays the current action or the function of a button if the mouse cursor is over the button

Port information: Shows the active COM port and baud rate.

Color coding of the icon:

- Disconnected
- Waiting for first data
- Data is being received but errors are detected (mostly because of wrong baud rate settings)
- Last data received was valid but there is no data to collect at this time
- No data is being received but errors have been detected in the past
- Data is being received and collected at the correct baud rate

Receiver generation: u-center tries to automatically detect the type of device connected and activates the appropriate mode of operation in order to take optimal advantage of the features. The mode can also be manually selected through the menu bar (Receiver → Generation).

File: As soon as a file is used (this file must first be opened) the name of the file will be displayed (xxxxxx.ubx).

Protocol information: This box indicates the current message set that is being used to communicate with the device. This can be the NMEA-0183 standard or the UBX protocol. The UBX protocol provides more extensive information with the receiver. u-center can handle both protocols.

Operating time: The time elapsed since you started u-center.

UTC time: The current time sent by the device. This field is only updated if a receiver is connected.

4.2 Views and windows

4.2.1 Packet console

The packet console lists all incoming and outgoing messages, and provides information about message length and type. The direction of the message is shown in the following way:-

- R <- Indicates the message was sent to the receiver
- R -> Indicates the message came from the receiver

4.2.2 Binary console

The binary console lists all incoming messages in binary and ASCII format.

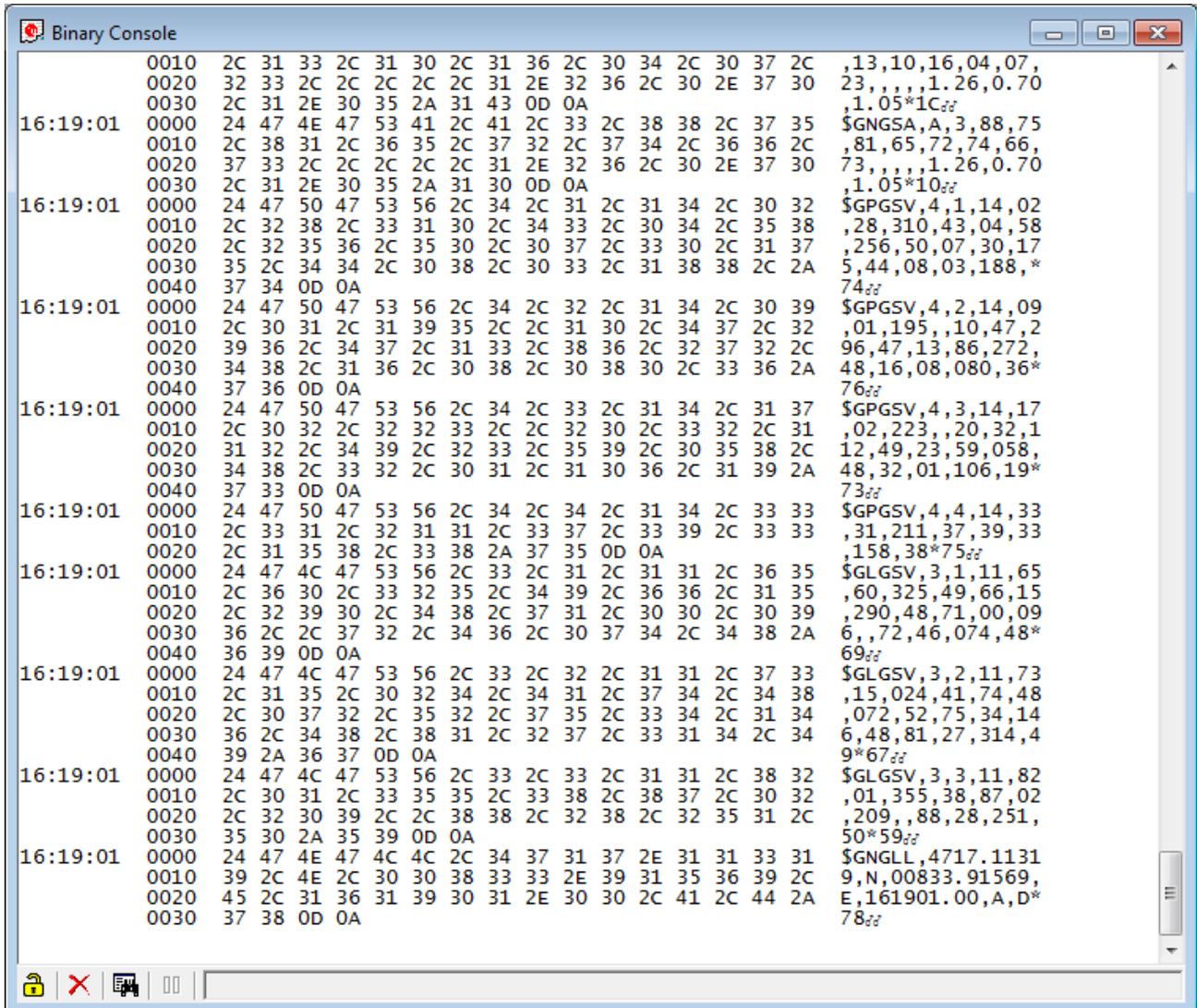


Figure 24: Binary console

Refer to Table 12 for an explanation of the icons and text fields.

4.2.3 Text console

The text console displays the content messages in textual form such as UBX-INF or NMEA messages.

NMEA messages are shown with heading \$Gxyyy, where x stands for the satellite system (P = GPS, SBAS, QZSS, L = GLONASS, A = Galileo, B = BeiDou, N = Any combination of GNSS) and yyy for the type of message (e.g. ZDA=Time & Date).

```

16:17:35 $GPGSV,3,1,11,65,59,323,49,66,14,289,49,71,01,095,12,72,47,072,49*6A
16:17:35 $GPGSV,3,2,11,73,16,024,42,74,48,072,49,75,34,147,47,81,27,315,48*63
16:17:35 $GPGSV,3,3,11,82,01,355,34,87,03,210,,88,28,252,51*5E
16:17:35 $GNLL,4717.11189,N,00833.91543,E,161735.00,A,D*72
16:17:36 $GNRMC,161736.00,A,4717.11186,N,00833.91546,E,0.006,,061213,,D*63
16:17:36 $GNVTG,,T,,M,0.006,N,0.012,K,D*3D
16:17:36 $GNNGGA,161736.00,4717.11186,N,00833.91546,E,2,12,0.70,500.6,M,47.3,M,,0000*4F
16:17:36 $GNNGSA,A,3,02,20,13,10,16,04,07,23,,,,,1.26,0.70,1.04*1D
16:17:36 $GNNGSA,A,3,88,75,81,65,72,74,66,73,,,,,1.26,0.70,1.04*11
16:17:36 $GPGSV,4,1,14,02,28,310,45,04,58,257,50,07,29,175,42,08,03,188,*7D
16:17:36 $GPGSV,4,2,14,09,00,195,,10,47,296,48,13,86,267,48,16,07,081,36*72
16:17:36 $GPGSV,4,3,14,17,02,224,,20,33,112,48,23,59,058,48,32,02,106,35*79
16:17:36 $GPGSV,4,4,14,33,31,211,38,39,33,158,38*7A
16:17:36 $GPGSV,3,1,11,65,59,323,50,66,14,289,48,71,01,095,12,72,47,072,49*63
16:17:36 $GPGSV,3,2,11,73,16,024,42,74,48,072,49,75,34,147,47,81,27,315,48*63
16:17:36 $GPGSV,3,3,11,82,01,355,34,87,03,210,,88,28,252,51*5E
16:17:36 $GNLL,4717.11186,N,00833.91546,E,161736.00,A,D*7B
16:17:37 $GNRMC,161737.00,A,4717.11185,N,00833.91547,E,0.003,,061213,,D*65
16:17:37 $GNVTG,,T,,M,0.003,N,0.005,K,D*3E
16:17:37 $GNNGGA,161737.00,4717.11185,N,00833.91547,E,2,12,0.70,500.6,M,47.3,M,,0000*4C
16:17:37 $GNNGSA,A,3,02,20,13,10,16,04,07,23,,,,,1.26,0.70,1.04*1D
16:17:37 $GNNGSA,A,3,88,75,81,65,72,74,66,73,,,,,1.26,0.70,1.04*11
16:17:37 $GPGSV,4,1,14,02,28,310,44,04,58,257,50,07,29,175,42,08,03,188,*7C
16:17:37 $GPGSV,4,2,14,09,00,195,,10,47,296,48,13,86,267,48,16,07,081,36*72
16:17:37 $GPGSV,4,3,14,17,02,224,,20,33,112,48,23,59,058,48,32,02,106,34*78
16:17:37 $GPGSV,4,4,14,33,31,211,38,39,33,158,38*7A
16:17:37 $GPGSV,3,1,11,65,59,323,51,66,14,289,48,71,01,095,12,72,47,072,49*62
16:17:37 $GPGSV,3,2,11,73,16,024,42,74,48,072,49,75,34,147,47,81,27,315,48*63
16:17:37 $GPGSV,3,3,11,82,01,355,34,87,03,210,,88,28,252,50*5F
16:17:37 $GNLL,4717.11185,N,00833.91547,E,161737.00,A,D*78
16:17:38 $GNRMC,161738.00,A,4717.11184,N,00833.91548,E,0.004,,061213,,D*63
16:17:38 $GNVTG,,T,,M,0.004,N,0.007,K,D*3B
16:17:38 $GNNGGA,161738.00,4717.11184,N,00833.91548,E,2,12,0.70,500.5,M,47.3,M,,0000*4E
16:17:38 $GNNGSA,A,3,02,20,13,10,16,04,07,23,,,,,1.26,0.70,1.04*1D
16:17:38 $GNNGSA,A,3,88,75,81,65,72,74,66,73,,,,,1.26,0.70,1.04*11
16:17:38 $GPGSV,4,1,14,02,28,310,44,04,58,257,50,07,29,175,42,08,03,188,*7C
16:17:38 $GPGSV,4,2,14,09,00,195,,10,47,296,48,13,86,267,48,16,07,081,36*72
16:17:38 $GPGSV,4,3,14,17,02,224,,20,33,112,48,23,59,058,48,32,02,106,34*78
16:17:38 $GPGSV,4,4,14,33,31,211,38,39,33,158,38*7A
16:17:38 $GPGSV,3,1,11,65,59,323,51,66,14,289,48,71,01,095,12,72,47,072,49*62
16:17:38 $GPGSV,3,2,11,73,16,024,42,74,48,072,49,75,34,147,47,81,27,315,48*63
16:17:38 $GPGSV,3,3,11,82,01,355,35,87,03,210,,88,28,252,50*5E
16:17:38 $GNLL,4717.11184,N,00833.91548,E,161738.00,A,D*79
    
```

Figure 25: Text console displaying UBX-INF and NMEA messages

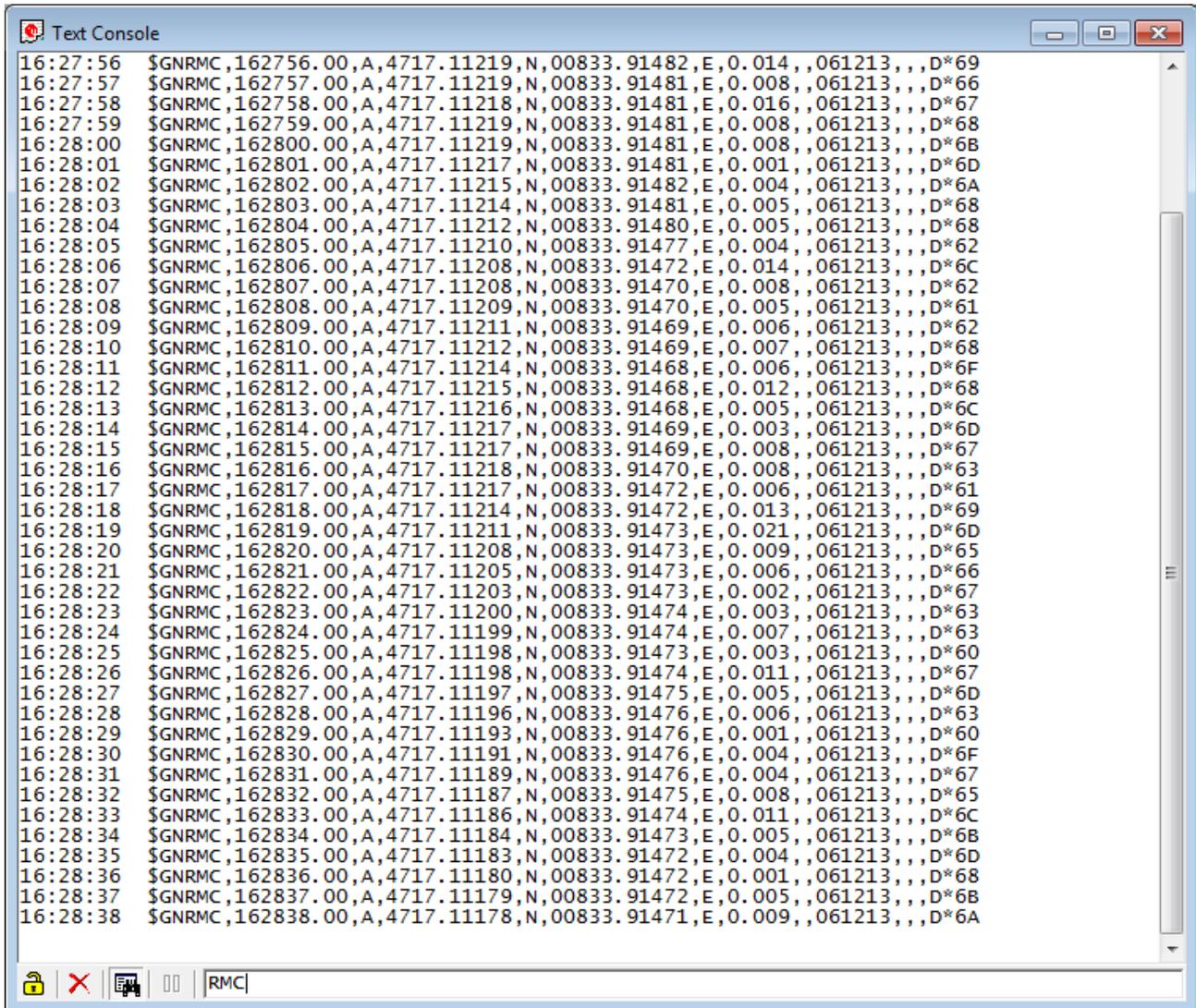


Figure 26: Text console displaying only RMC messages

Element	Name	Description
	Lock / Locked	Prevents the console from being updated with new data when locked.
	Clear All	Erases all data in the console
	Filter On/Off	Filters unwanted data from the data stream. This allows searching for certain expression, e.g. all RMC messages (Figure 26).
	Pause player	Pauses the player when the search expression is found. Only works in playback mode.

Table 12: Description of the buttons of the console views

4.2.3.1 Regular expression evaluation

Normally, when you search for a sub-string in a string, the match should be exact. So if we search for a sub-string "abc" then the string being searched should contain these exact letters in the same sequence for a match

to be found. We can extend this kind of search to a case insensitive search where the sub-string "abc" will find strings like "Abc", "ABC" etc. That is, the case is ignored but the sequence of the letters should be exactly the same. Sometimes, a case insensitive search is also not enough. For example, if we want to search for numeric digit, then we basically end up searching for each digit independently. This is where regular expressions come in to our help. Regular expressions are text patterns that are used for string matching. Regular expressions are strings that contain a mix of plain text and special characters to indicate what kind of matching to do. Here's a very brief tutorial on using regular expressions.

Suppose, we are looking for a numeric digit then the regular expression we would search for is "[0-9]". The brackets indicate that the character being compared should match any one of the characters enclosed within the bracket. The dash (-) between 0 and 9 indicates that it is a range from 0 to 9. Therefore, this regular expression will match any character between 0 and 9, that is, any digit. If we want to search for a special character literally we must use a backslash before the special character. For example, the single character regular expression "*" matches a single asterisk. In the table below the special characters are briefly described. A regular expression search is case sensitive.

Character	Description
^	Beginning of the string. The expression "^A" will match an 'A' only at the beginning of the string.
[^	The caret (^) immediately following the left-bracket ([]) has a different meaning. It is used to exclude the remaining characters within brackets from matching the target string. The expression "[^0-9]" indicates that the target character should not be a digit.
\$	The dollar sign (\$) will match the end of the string. The expression "abc\$" will match the sub-string "abc" only if it is at the end of the string.
	The alternation or logic OR character () allows either expression on its side to match the target string. The expression "a b" will match 'a' as well as 'b'.
.	The dot (.) will match any character.
*	The asterisk (*) indicates that the character to the left of the asterisk in the expression should match 0 or more times.
+	The plus (+) is similar to asterisk but there should be at least one match of the character to the left of the + sign in the expression.
?	The question mark (?) matches the character to its left 0 or 1 times.
()	The parenthesis affects the order of pattern evaluation.
[]	Brackets ([and]) enclosing a set of characters indicates that any of the enclosed characters may match the target character.

Table 13: Regular expression syntax

4.2.3.2 Example

Let's assume that the following lines would appear in the NMEA console without filtering.

```

14:00:03 $GPGGA,140003.242,4717.1126,N,00833.7862,E,1,06,1.3,543.0,M,.,.,0000*09
14:00:03 $GPGLL,4717.1126,N,00833.7862,E,140003.242,A*34
14:00:03 $GPGSA,A,3,06,17,25,22,30,10,,,,,,,,,2.9,1.3,2.6*3A
14:00:03 $GPGSV,2,1,07,06,58,062,44,17,52,161,44,25,45,239,44,22,35,301,44*7F
14:00:03 $GPGSV,2,2,07,30,31,123,44,10,17,059,39,01,05,316,*4E
14:00:03 $GPRMC,140003.242,A,4717.1126,N,00833.7862,E,0.03,80.59,010201,.,*36
14:00:03 $GPVTG,80.59,T,.,M,0.03,N,0.1,K*56
14:00:04 $GPGGA,140004.242,4717.1126,N,00833.7862,E,1,06,1.3,542.0,M,.,.,0000*0F
14:00:04 $GPGLL,4717.1126,N,00833.7862,E,140004.242,A*33
14:00:04 $GPGSA,A,3,06,17,25,22,30,10,,,,,,,,,2.9,1.3,2.6*3A
14:00:04 $GPGSV,2,1,07,06,58,062,45,17,52,161,44,25,45,239,44,22,35,301,44*7E
14:00:04 $GPGSV,2,2,07,30,31,123,44,10,17,059,39,01,05,316,*4E
14:00:04 $GPRMC,140004.242,A,4717.1126,N,00833.7862,E,0.02,152.96,010201,.,*0D
14:00:04 $GPVTG,152.96,T,.,M,0.02,N,0.0,K*6B
    
```

In the following examples the characters marked red match the regular expression.

Example 1: Searching for the RMC with a valid position and all GGA Messages

```
"GP (GGA | RMC, . *, A, )"
```

```
14:00:03 $GPGGA,140003.242,4717.1126,N,00833.7862,E,1,06,1.3,543.0,M,,,,,0000*09
14:00:03 $GPRMC,140003.242,A,4717.1126,N,00833.7862,E,0.03,80.59,010201,,*36
14:00:04 $GPGGA,140004.242,4717.1126,N,00833.7862,E,1,06,1.3,542.0,M,,,,,0000*0F
14:00:04 $GPRMC,140004.242,A,4717.1126,N,00833.7862,E,0.02,152.96,010201,,*0D
```

Example 2: Searching for all GSV with the message index of '2' or '3'

```
"GSV, . *, [2-3],"
```

```
14:00:03 $GPGSV,2,2,07,30,31,123,44,10,17,059,39,01,05,316,*4E
114:00:04 $GPGSV,2,2,07,30,31,123,44,10,17,059,39,01,05,316,*4E
```

Example 3: Searching for all messages starting with \$GP, which have a 'G' in the message identifier but not at the first position

```
"^\$GP.+G.*,"
```

```
14:00:03 $GPGGA,140003.242,4717.1126,N,00833.7862,E,1,06,1.3,543.0,M,,,,,0000*09
14:00:03 $GPVTG,80.59,T,,M,0.03,N,0.1,K*56
14:00:04 $GPGGA,140004.242,4717.1126,N,00833.7862,E,1,06,1.3,542.0,M,,,,,0000*0F
14:00:04 $GPVTG,152.96,T,,M,0.02,N,0.0,K*6B
```

Example 4: Searching for all message having a checksum of which the higher nibble is 3

```
"\*3.$"
```

```
14:00:03 $GPGLL,4717.1126,N,00833.7862,E,140003.242,A*34
14:00:03 $GPGSA,A,3,06,17,25,22,30,10,,,,,2.9,1.3,2.6*3A
14:00:03 $GPRMC,140003.242,A,4717.1126,N,00833.7862,E,0.03,80.59,010201,,*36
14:00:04 $GPGLL,4717.1126,N,00833.7862,E,140004.242,A*33
14:00:04 $GPGSA,A,3,06,17,25,22,30,10,,,,,2.9,1.3,2.6*3A
```

4.2.4 Messages View

The messages view is utilized to communicate with the device. Receiver output messages (e.g. navigation output, status and debug information) are displayed; input messages (e.g. configuration messages) can be sent. There are different sections for NMEA and UBX protocol.

Message tree
A list of all NMEA and UBX messages.

Message Display
Decodes and visualizes the content of the message.

Hex Dump
Displays the message content in .hexadecimal and ASCII form.

Message Content:

```

0000 B5 62 0A 04 A0 00 32 2E 30 31 20 28 37 35  µb?? ?2.01 (75
000E 33 35 30 29 00 00 00 00 00 00 00 00 00 00  350)??????????
001C 00 00 00 00 00 00 00 00 30 30 30 38 30 30  ??????????000800
002A 30 30 00 00 30 2E 32 32 20 28 36 37 30 37  00??0.22 (6707
0038 30 29 00 00 00 00 00 00 00 00 00 00 00 00  0)????????????
0046 00 00 00 00 00 00 50 52 4F 54 56 45 52 20  ??????PROTVER
0054 31 35 2E 30 30 00 00 00 00 00 00 00 00 00  15.00??????????
0062 00 00 00 00 00 00 00 00 46 49 53 20 30 78  ??????????FIS 0x
0070 42 46 32 36 30 31 20 28 37 36 35 33 37 29  BF2601 (76537)
          00 00 00 00 00 00 47 50 53 3B  ??????????GPS;
          3B 47 4C 4F 3B 42 44 53 3B 51  SBAS;GLO;BDS;Q
          00 00 00 00 00 00 00 00 6C F4  ZSS?????????16
    
```

Figure 27: Message View

Element	Name	Description
	Lock / Locked	Prevents the message view from being updated with new data when locked.
	Clear All	Erases the entire message view.
	Send	Sends the current message to the device.
	Poll	Polls the selected message once.
	Auto poll	Automatically polls a newly selected message once
	Message Hotkey	Assigns a hotkey to the selected message

Table 14: Description of the buttons in the messages view toolbar

4.2.4.1 Receiver output messages

The screenshot shows the 'Messages - NMEA - GxGGA (Global Positioning System Fix Data)' window. The left pane displays a message tree with various NMEA and UBX messages. The right pane shows a table of parameters for the selected GxGGA message. Below the table is a hex dump of the message content. A toolbar with icons for Send, Poll, and other actions is at the bottom.

Parameter	Value	Unit	Description
UTC	074353.00	hhmmss.sss	Universal time coordinated
Lat	4717.11213	ddmm.mmmm	Latitude
Northing Indicator	N		N=North, S=South
Lon	00833.91480	dddmm.mmmm	Longitude
Easting Indicator	E		E=East, W=West
Status	2		0=Invalid, 1=2D/3D, 2=DGPS, 6=Dead Reckoning
SVs Used	12		Number of SVs used for Navigation
HDOP	0.60		Horizontal Dilution of Precision
Alt (MSL)	501.7	m	Altitude (above means sea level)
Unit	M		M=Meters
Geoid Sep.	47.3	m	Geoid Separation = Alt(HAE) - Alt(MSL)
Unit	M		M=Meters
Age of DGPS Corr		s	Age of Differential Corrections
DGPS Ref Station	0000		ID of DGPS Reference Station

```

0000 24 47 4E 47 47 41 2C 30 37 34 33 35 33 2E $GNGGA,074353.
000E 30 30 2C 34 37 31 37 2E 31 31 32 31 33 2C 00,4717.11213,
001C 4E 2C 30 30 38 33 33 2E 39 31 34 38 30 2C N,00833.91480,
002A 45 2C 32 2C 31 32 2C 30 2E 36 30 2C 35 30 E,2,12,0.60,50
0038 31 2E 37 2C 4D 2C 34 37 2E 33 2C 4D 2C 2C 1.7,M,47.3,M,,
0046 30 30 30 30 2A 34 38 0D 0A 0000*4837
    
```

Figure 28: Message display of an output message



Double-clicking on an output message enables or disables the periodic message update if the communication protocol is active. This feature is currently only supported for the UBX protocol.

4.2.4.2 Receiver input messages

Input messages can be edited and sent to the device from the messages view. It is also possible to poll the current receiver settings.



u-center performs some range checks on input messages. If an input value exceeds the permitted range, u-center will highlight the field in red but it is still possible to send the value to the receiver. However, the receiver is likely to reject such a message.

4.2.5 Statistic view

Title	Count	Age	Current	Minimum	Maximum	Average	Deviation	Unit	Description
UTC	3475	0	08:00:01.000 ...	07:01:36.000 ...	08:00:01.000 ...			time d...	Time UTC
GPS time	3475	0	1770:115217....	1770:111712....	1770:115217....			wno:tow	Time GPS
TTAG	0							s	TTAG (from ITOW)
TACC	0					0.000000		us	Time Accuracy
TimeStartup	0					0.000		s	Time since Startup
TTF	0					0.000		s	Time to first fix
TM0 rising	0					0.000000000			Timemark0 Rising Edge
TM0 falling	0					0.000000000			Timemark0 Falling Edge
TM1 rising	0					0.000000000			Timemark1 Rising Edge
TM1 falling	0					0.000000000			Timemark1 Falling Edge
TM2 rising	0					0.000000000			Timemark2 Rising Edge
TM2 falling	0					0.000000000			Timemark2 Falling Edge
TP Qerr	0					0.000		ns	Timepulse Quantisatio...
Lat	3450	0	47.285206	47.285185	47.285227	47.285201	0.000008	°	Position LTP Latitude
Lon	3450	0	8.565248	8.565208	8.565257	8.565243	0.000008	°	Position LTP Longitude
Alt (HAE)	3450	0	552.50	544.90	553.10	548.80	1.39	m	Position LTP Altitude (...)
Alt (MSL)	3450	0	505.20	497.60	505.80	501.50	1.39	m	Position LTP Altitude (...)
X	3450	0	4286472.77	4286467.36	4286473.27	4286470.76	1.10	m	Position ECEF X
Y	3450	0	645608.96	645605.65	645609.50	645608.23	0.59	m	Position ECEF Y
Z	3450	0	4663737.31	4663731.67	4663738.20	4663734.21	1.08	m	Position ECEF Z
PACC 3D	0					0.000		m	Position Accuracy 3D
PACC H	0					0.000		m	Horizontal Position Ac...
PACC V	0					0.000		m	Vertical Position Accur...
VX	0					0.00		m/s	Velocity ECEF X
VY	0					0.00		m/s	Velocity ECEF Y
VZ	0					0.00		m/s	Velocity ECEF Z
VN	0					0.00		m/s	Velocity LTP North
VE	0					0.00		m/s	Velocity LTP East
VD	0					0.00		m/s	Velocity LTP Down
Speed	0					0.00		m/s	Speed
SoG	3450	0	0.00	0.00	0.04	0.00	0.00	m/s	Speed over Ground
CoG	0					0.00		deg	Course over Ground
Pitch	0					0.00		°	Pitch
VACC 3D	0					0.00		m/s	Velocity Accuracy 3D

Figure 29: Statistic View

All available database values (transmitted from the device or calculated by u-center) are displayed. The following statistics are displayed:

- Current value
- Minimum value
- Maximum value
- Average value
- Standard Deviation

The following color scheme for the values is applied:

- Grey color: The value was not set for the current epoch
- Blue color: The value was calculated by the application from other data
- Empty field: No data is available



Choosing 'Database Empty' in the file menu or pressing the button  clears the statistic view.



The content of the statistic view can easily be exported to other programs using Copy/Paste.

4.2.6 Table view

Index	UTC	Lat	Lon	Alt (HAE)	PACC 3D	VDOP
231	08:07:42.000 12/09/2013	47.285219	8.565248	550.60		1.1
232	08:07:43.000 12/09/2013	47.285219	8.565249	550.60		1.1
233	08:07:44.000 12/09/2013	47.285219	8.565249	550.50		1.1
234	08:07:45.000 12/09/2013	47.285219	8.565249	550.50		1.1
235	08:07:46.000 12/09/2013	47.285219	8.565250	550.40		1.1
236	08:07:47.000 12/09/2013	47.285219	8.565250	550.30		1.1
237	08:07:48.000 12/09/2013	47.285219	8.565250	550.20		1.1
238	08:07:49.000 12/09/2013	47.285219	8.565251	550.10		1.1
239	08:07:50.000 12/09/2013	47.285219	8.565251	550.10		1.1
240	08:07:51.000 12/09/2013	47.285219	8.565251	550.10		1.1
241	08:07:52.000 12/09/2013	47.285219	8.565251	550.00		1.1
242	08:07:53.000 12/09/2013	47.285219	8.565251	550.00		1.1
243	08:07:54.000 12/09/2013	47.285219	8.565252	550.00		1.1
244	08:07:55.000 12/09/2013	47.285219	8.565252	549.90		1.1
245	08:07:56.000 12/09/2013	47.285219	8.565253	549.80		1.1
246	08:07:57.000 12/09/2013	47.285219	8.565253	549.80		1.1
247	08:07:58.000 12/09/2013	47.285218	8.565253	549.80		1.1
248	08:07:59.000 12/09/2013	47.285218	8.565254	549.80		1.1
249	08:08:00.000 12/09/2013	47.285217	8.565254	549.80		1.1
250	08:08:01.000 12/09/2013	47.285217	8.565254	549.80		1.1
251	08:08:02.000 12/09/2013	47.285217	8.565254	549.70		1.1
252	08:08:03.000 12/09/2013	47.285216	8.565254	549.70		1.1
253	08:08:04.000 12/09/2013	47.285216	8.565254	549.60		1.1
254	08:08:05.000 12/09/2013	47.285216	8.565254	549.60		1.1
255	08:08:06.000 12/09/2013	47.285216	8.565254	549.50		1.1
256	08:08:07.000 12/09/2013	47.285216	8.565254	549.50		1.1
257	08:08:08.000 12/09/2013	47.285216	8.565254	549.50		1.1
258	08:08:09.000 12/09/2013	47.285216	8.565254	549.50		1.1
259	08:08:10.000 12/09/2013	47.285216	8.565254	549.50		1.1
260	08:08:11.000 12/09/2013	47.285216	8.565254	549.50		1.1
261	08:08:12.000 12/09/2013	47.285216	8.565254	549.60		1.1
261	08:08:12.000 12/09/2013	47.285216	8.565254	549.60		1.1

Figure 30: Table view

All values from the database can be displayed in a tabular form (Figure 30). This is very useful when analyzing the log file in detail.

To add a new column, first select the desired value (Figure 31) and click the **+** button. To remove a displayed value, click the **-** button. To see the table header click the button. Statistical information will be shown.

Unit	time date	°	°	m	m	
Count	469	469	469	468	0	468
Age	0	0	0	0		0
Current	08:11:39.000 12/09/2013	47.285213	8.565255	549.70		1.1
Minimum	08:03:51.000 ??/??/????	47.285206	8.565244	549.00		1.1
Maximum	08:11:39.000 12/09/2013	47.285220	8.565259	551.20		1.1
Average		47.285212	8.565253	550.20	0.000	1.1
Deviation		0.000004	0.000004	0.50		0.0

The screenshot shows a window titled "Table - [Index / UTC / Lat / Lon / Alt (HAE) / PACC 3D / VDOP]". The table contains 42 rows of data with columns for Index, UTC, Lat, Lon, Alt (HAE), PACC 3D, and VDOP. Below the table, a dropdown menu is open, showing a list of options including VDOP, GDOP, TDOP, PDOP, NDOP, EDOP, CLK Drift, CLK Bias, CLK Acc, Nav. Mode, Nav. OK, DGPS, ITFM Status, EKF Temp, EKF Tick, EKF Gyro, EKF Tick SF, EKF Gyro SF, EKF Gyro Bias, EKF Tick SF Cal, EKF Gyro SF Cal, and EKF Gyro B Cal.

Index	UTC	Lat	Lon	Alt (HAE)	PACC 3D	VDOP
347	08:09:38.000 12/09/2013	47.285210	8.565253	550.40		1.1
348	08:09:39.000 12/09/2013	47.285210	8.565252	550.40		1.1
349	08:09:40.000 12/09/2013	47.285210	8.565252	550.40		1.1
350	08:09:41.000 12/09/2013	47.285210	8.565251	550.40		1.1
351	08:09:42.000 12/09/2013	47.285210	8.565251	550.40		1.1
352	08:09:43.000 12/09/2013	47.285210	8.565251	550.30		1.1
353	08:09:44.000 12/09/2013	47.285210	8.565251	550.30		1.1
354	08:09:45.000 12/09/2013	47.285211	8.565251	550.40		1.1
355	08:09:46.000 12/09/2013	47.285211	8.565251	550.40		1.1
356	08:09:47.000 12/09/2013	47.285211	8.565252	550.40		1.1
357	08:09:48.000 12/09/2013	47.285210	8.565252	550.50		1.1
358	08:09:49.000 12/09/2013	47.285210	8.565252	550.50		1.1
359	08:09:50.000 12/09/2013	47.285209	8.565252	550.40		1.1
360	08:09:51.000 12/09/2013	47.285209	8.565253	550.40		1.1
361	08:09:52.000 12/09/2013	47.285208	8.565253	550.40		1.1
362	08:09:53.000 12/09/2013	47.285208	8.565253	550.40		1.1
363	08:09:54.000 12/09/2013	47.285208	8.565254	550.40		1.1
364	08:09:55.000 12/09/2013	47.285208	8.565254	550.50		1.1
365	08:09:56.000 12/09/2013	47.285208	8.565254	550.50		1.1
366	08:09:57.000 12/09/2013	47.285207	8.565254	550.50		1.1
367	08:09:58.000 12/09/2013	47.285207	8.565254	550.50		1.1
368	08:09:59.000 12/09/2013	47.285207	8.565254	550.50		1.1
369	08:10:00.000 12/09/2013	47.285207	8.565254	550.40		1.1
370	08:10:01.000 12/09/2013	47.285207	8.565254	550.30		1.1
371	08:10:02.000 12/09/2013	47.285207	8.565254	550.20		1.1
372	08:10:03.000 12/09/2013	47.285207	8.565254	550.10		1.1
373	08:10:04.000 12/09/2013	47.285208	8.565254	549.90		1.1
374	08:10:05.000 12/09/2013	47.285208	8.565253	549.90		1.1
375	08:10:06.000 12/09/2013	47.285208	8.565253	549.80		1.1
376	08:10:07.000 12/09/2013	47.285208	8.565252	549.80		1.1
377	08:10:08.000 12/09/2013	47.285208	8.565252	549.80		1.1
378	08:10:09.000 12/09/2013	47.285208	8.565252	549.70		1.1

Figure 31: Selecting a new value

-  The number of displayed epochs is set to 1800 by default (see also section 3.3).
-  Choosing 'Database Empy' in the file menu or pressing the button  clears the table view.
-  The content of the table view can easily be exported to other programs using Copy/Paste.

4.2.7 Google Earth

u-center features a Google Earth view and enhanced kml export for visualizing position and tracks with Google Earth (see Figure 32).

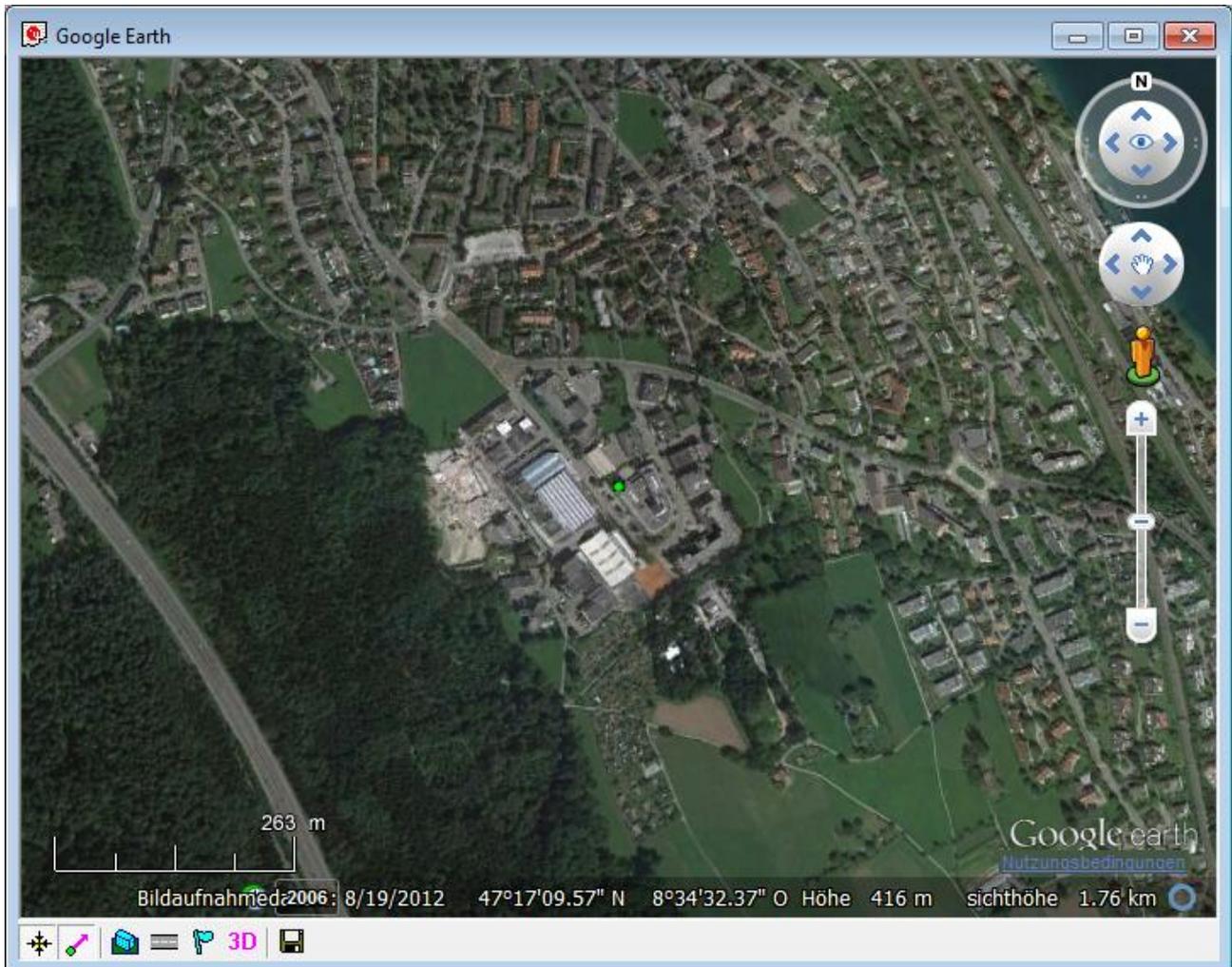


Figure 32: Google Earth view



To use the Google Earth View acceptance of the Google Map API Terms of Service is required.
<http://code.google.com/apis/maps/terms.html>

4.2.8 Map view

u-center can display positions on pre-calibrated maps (Figure 33). This allows a basic analysis of road tests.



Figure 33: Map view

4.2.8.1 Using map view

You can access the view specific commands in two different ways:

- Using the command in the tool bar below the map view.
- Holding the cursor inside the map view and pressing the right mouse button will. This will open the following context menu (see Figure 34).

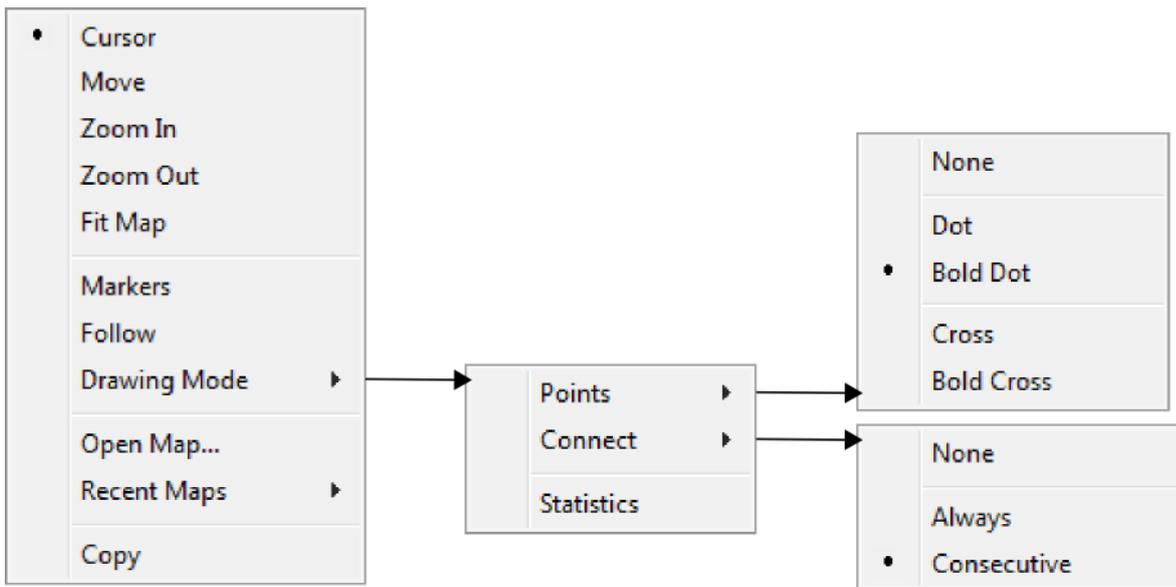


Figure 34: Map view context menu

Function	Description	Shortcut / Toolbar icon
Cursor	The position of the cursor is shown on the lower left edge of the u-center screen (Longitude, Latitude and Pixel-Position). By holding the left mouse button and moving the cursor over the map you can measure distance from one position to another	
Move	The map inside the map view window can be moved	
Zoom In	The map is enlarged by selecting a rectangle	
Zoom Out	The size of the Map is decreased	
Zoom Factor	Different specific zoom level can be selected	
Fit Map	The map size is adjusted to fit the Map Window	
Markers	Add or remove the defined markers (see also section 4.2.8.2, Map calibration)	
Follow	Center the map on the current GNSS position	
Drawing Mode	The size and form of the displayed position can be changed; the connection line between the points can be selected in the menu Connect. To see statically values (average, minimum, maximum, standard deviation) directly in the map, select the Menu Statistic.	
Open Map... / Recent Maps	Load a new or one of 8 recently used maps.	
Copy		
Save map (only in toolbar)	The current display can be stored in different formats	
Image settings (only in toolbar)	Brightness, contrast and color saturation of map can be adjusted by moving the glides	

Table 15: Description of the buttons and context menu entries in map view



Map Views can be copied to the clipboard using the 'Print Screen' function.



Choosing 'Database Empy' in the file menu or pressing the button  deletes all recently displayed positions and routes.

4.2.8.2 Map calibration

To create your own map you will need a digitized map or pictures with orthogonal projection in one of the following pixel graphics formats.

png	Portable Network Graphics,
bmp	Windows Bitmap
dib	Device Independent Bitmap
gif	Graphics Interchange Format
jpg/jpeg	Jpeg File Interchange Format
pcx	PC paintbrush
tif	Tag Image File Format

If your map is not in one of the above formats, you can simply convert it in one of the supported formats by a third party program. u-blox provides two sample maps. Office.png is a small map of the surroundings of the u-blox headquarters. World.png is a map of the whole world but with limited resolution.

To use a map in u-center, three calibration points are needed. For these points you have to know the pixel coordinates and the according WGS84 coordinates in the latitude/longitude format in degrees (longitude: -180.0 to 180.0, latitude: -90.0 to 90.0). These points are stored in the map calibration file. The calibration file must be stored at the same location as the bitmap itself. It has the same name but a different extension (*.mcf). The format of the calibration file is very simple and can be edited in a simple editor like notepad.

Examples:

As an example we will have a closer look at the provided map 'world.png' and its calibration file 'world.mcf'.

Y/X

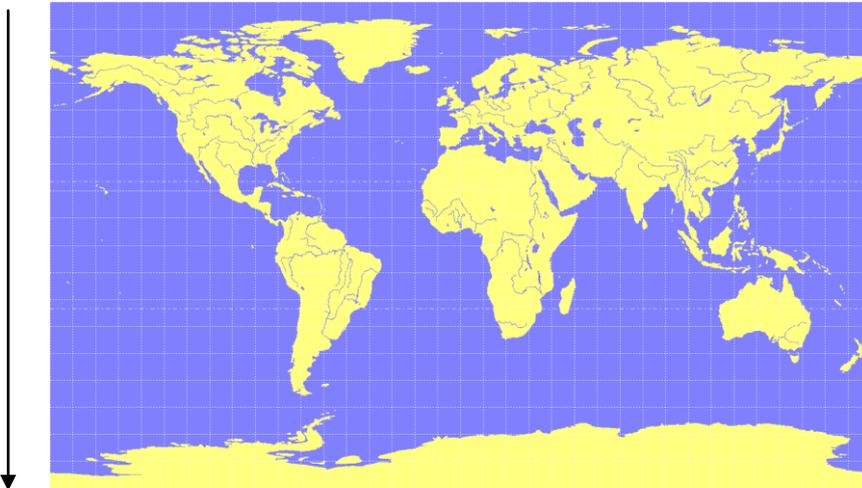


Figure 35: Digital map file: world.png

The Map has 1765 Pixels (0 to 1764) in the horizontal and 1046 Pixels (0 to 1045) in the vertical direction. The origin is the upper left corner. To calibrate this map we will use the following three calibration points (#1 to #3).

Reference Point	#	Pixel		WGS84 Coordinate	
		X	Y	Longitude	Latitude
Upper Left Corner	1	0	0	-180.0	90.0
Lower Right Corner	2	1764	1045	180.0	-90.0
Upper Right Corner	3	1764	0	180.0	90.0

To determine the exact pixel position you can use Microsoft Paint (mspaint.exe) or any other pixel-editing program.

The calibration file is a plain ASCII text file. The file may contain comments. The file consists of two sections, which start with keywords encapsulated in braces.

The REFERENCE section, which is mandatory, contains the three points used to calibrate a map. Each reference point is on a single line and has the following syntax:

```
"# = <x>, <y>, <lon>, <lat>"
```

where # is the index of the reference point <x> is the horizontal and <y> is the vertical image coordinate and <lat> is the latitude and <lon> is the longitude in degrees and WGS84.

The optional MARKER section defines additional points on the map. Each point is on a single line with the syntax:

```
"# = i, <x>, <y>[, <text>]" or "# = c, <lat>, <lon>[, <text>]"
```

where # is the index of the marker point <x> is the horizontal and <y> is the vertical image coordinate or <lat> is the latitude and <lon> is the longitude in degrees and WGS84. <text> is a optional string in quotes labeling the marker point. The points must have a unique index from 1 to <num>. The maximum marker point index <num> is written to the same section on a separate line with the syntax "Count = <num>".

```
; I N F O
; -----
; File:   world.mcf
; Source: (sample data set)

; R E F E R E N C E
; -----
; 3 Points must be defined to calibrate a Map
; Parameters:
; #       = index of the point (1 to 3)
; x,y     = image coordinates
; lat,lon = world coordinates
; Syntax:
; # = <x>, <y>, <lon>, <lat>

[REFERENCE]
1 = 0, 0, -180.0, 90.0
2 = 1764, 1045, 180.0, -90.0
3 = 1764, 0, 180.0, 90.0

; M A R K E R
; -----
; You can add points (image or world coord) to the map
; Parameters:
; num     = number of markers that follow
; #       = index of the point (1 to num)
; type    = c for world or i image coordinates
; x,y     = image coordinates
; lat,lon = world coordinates
; text    = quoted text decription to the marker (optional)
; Syntax:
; Count = <num>
; #     = <type>, <x|lon>, <y|lat>[, <text>]

[MARKER]
Count = 1
1 = c, 8.56525, 47.28519444, "u-blox ag"
```

Map calibration file: world.mcf

4.2.8.3 Map calibration tool

u-center includes a built-in calibration tool for providing coordinates to maps and photographs in supported data formats to create u-center maps. To use the tool open the map view window as seen in Figure 36 and then as seen in Figure 37 open the file of the map to be calibrated (in our example GoogleScreenShot.bmp).

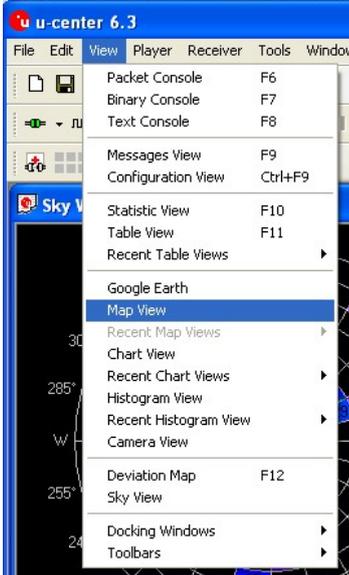


Figure 36: Opening map view window

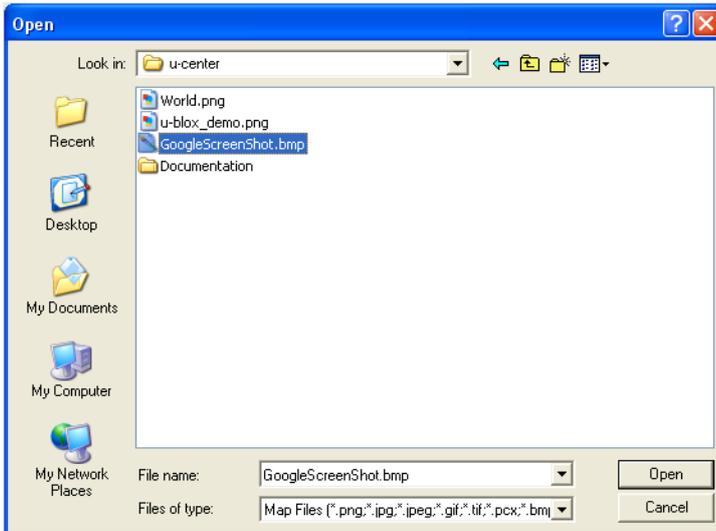
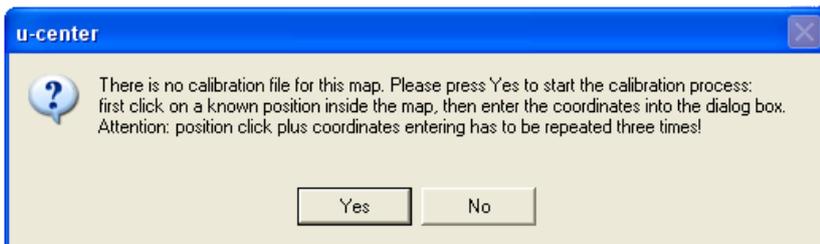


Figure 37: Opening the file of the map to be calibrated

If the file to be opened has not been calibrated, the following message will appear:



Select three points on the map and enter the calibration coordinates in the specified format as seen in Figure 38, Figure 39 and Figure 40.

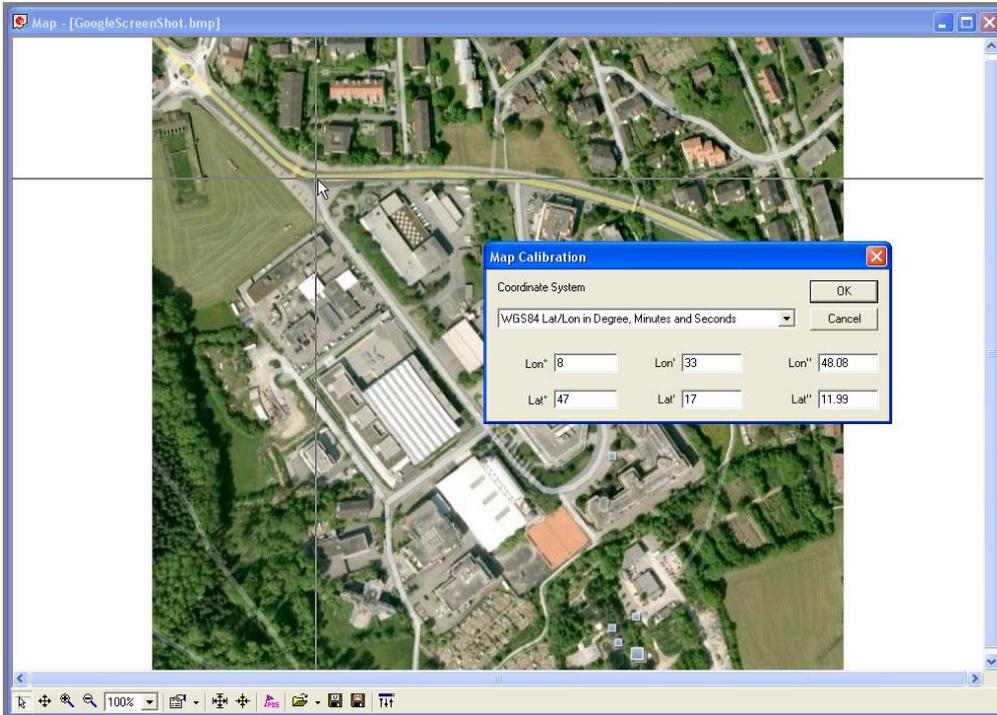


Figure 38: Calibrating a map using calibration tool (position 1)

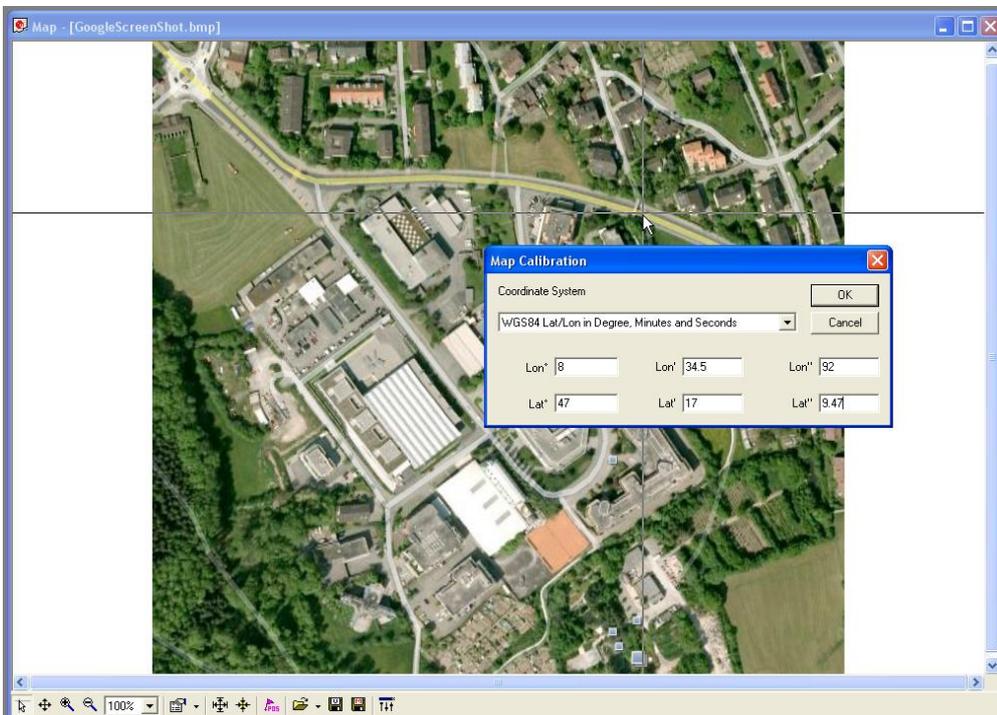


Figure 39: Calibrating a map using calibration tool (position 2)

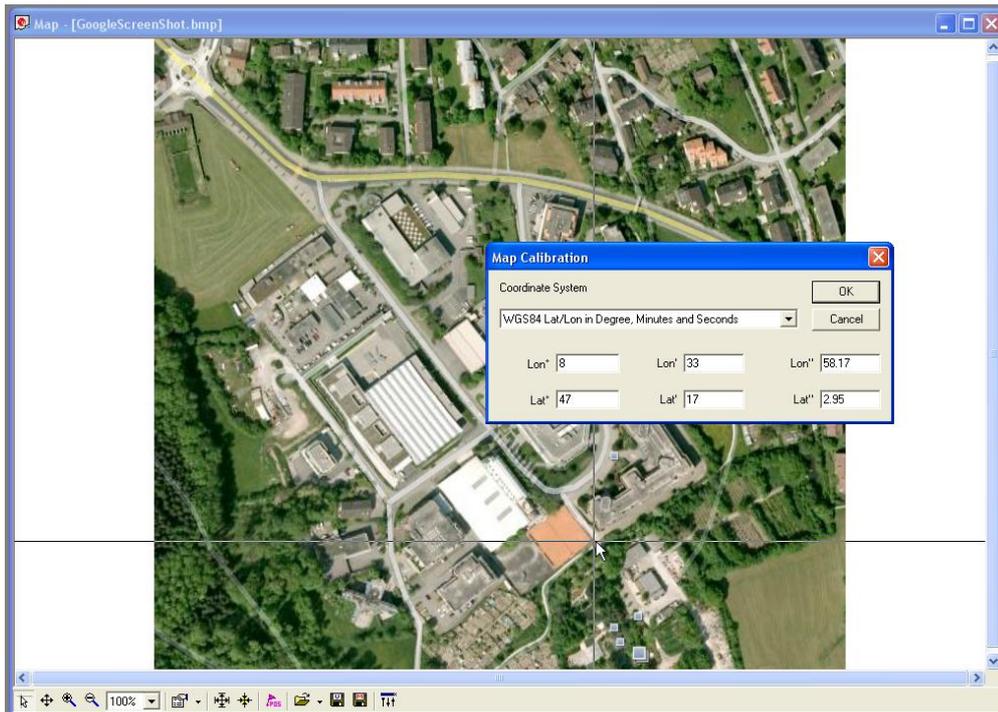


Figure 40: Calibrating a map using calibration tool (position 3)

Following these steps the map is now calibrated and can be used with u-center for visualizing road tests etc.

4.2.9 Chart view

Chart view allows the user to conveniently view GNSS data records in graphical form. The data can be scaled in many different ways and formats. It's even possible to print the entire chart.

The examples below illustrate two different typical applications



Figure 41: Altitude as a function of Index (X = Index, Y = Alt)

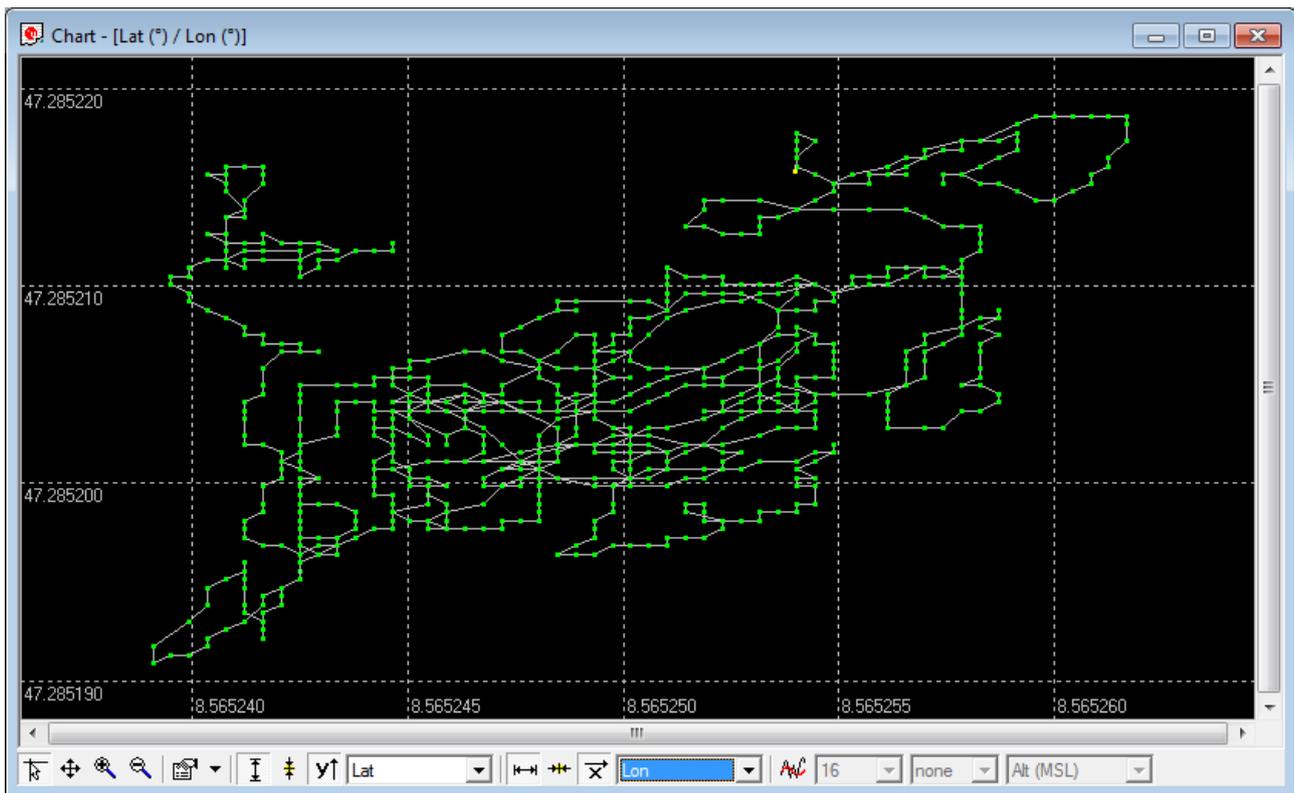


Figure 42: Latitude as a function of longitude (X =Longitude, Y = Latitude)

Function	Description	Toolbar icon
Cursor	The position of the cursor is shown on the lower left edge of the u-center screen (Longitude, Latitude and Pixel-Position). By holding the left mouse button and moving the cursor over the chart you can measure distance from one position to another	
Move	The chart inside the chart view window can be moved	
Zoom In	Drawing a rectangle enlarges the chart to the new view. To zoom in the chart double-click on the chart.	
Zoom Out	Drawing a rectangle decreases the chart to the new view. To zoom out the chart double-click on the chart.	
Drawing Mode	The size and form of the displayed values can be changed in the menu points; the connection line between the values can be selected in the menu connect. For viewing the statically values (average, minimum, maximum, standard deviation) directly in the chart select the statistics menu	
Fit Y range	Fits the Y range	
Follow Y	Follow the most current Y value (the most current Y-value is always in the middle of the chart)	
Index or Y value	Switch between the index and the Y value	
Y value	Select the Y value to be displayed	
Fit X range	Fit the X range	
Follow X	Follow the most current X value (the most current X value is always in the middle of the chart)	

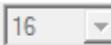
Index or X value	Switch between the index and the X value	
X value	Select the X value to be displayed	
Moving average	Adds a moving average. The average is calculated over the number of most recent values, specified with the parameter.	  

Table 16: Description of the buttons and displays in Chart View



The number of displayed epochs is set to 1800 by default (see also section 3.3).

4.2.10 Histogram view

Histogram views allow the user to view GNSS data and probability distributions (Figure 43) and print the entire histogram if desired. The number of bins (storage containers) can be set by the user.

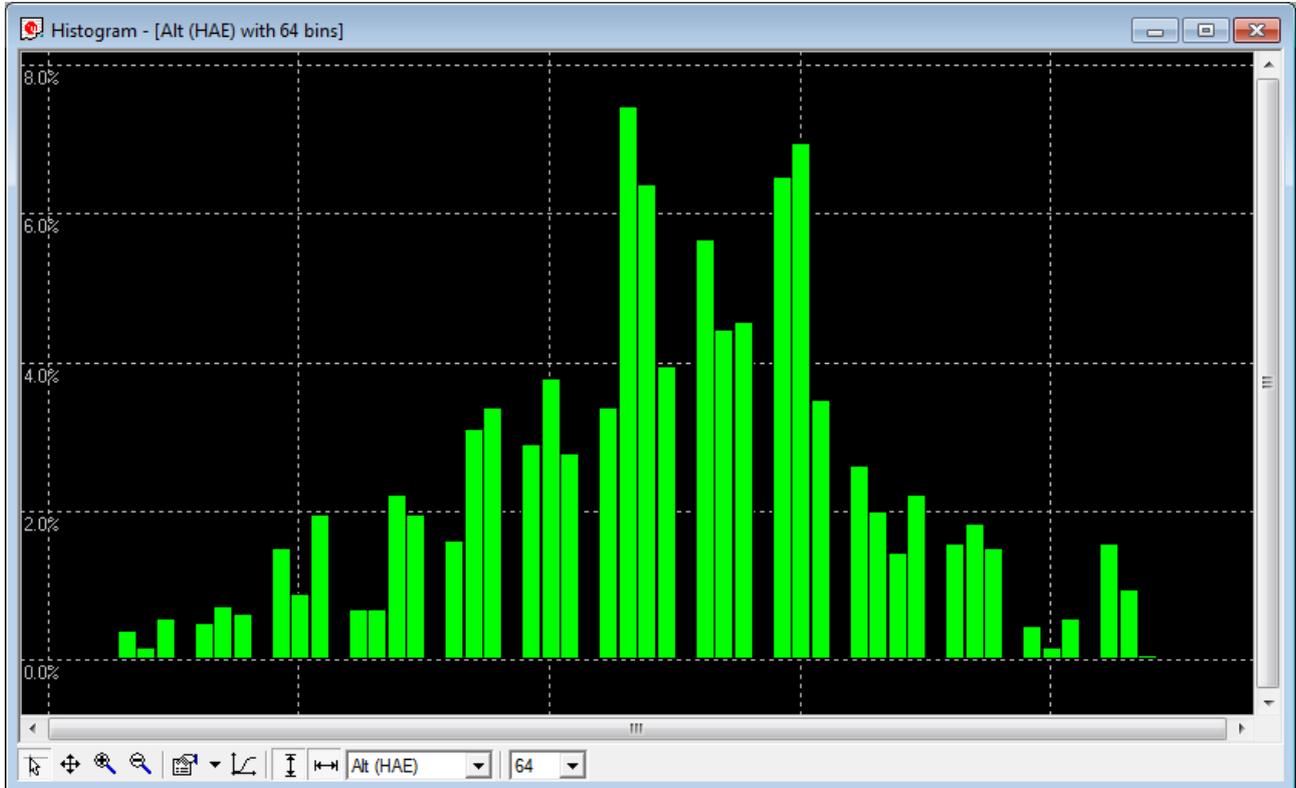


Figure 43: Altitude Histogram View

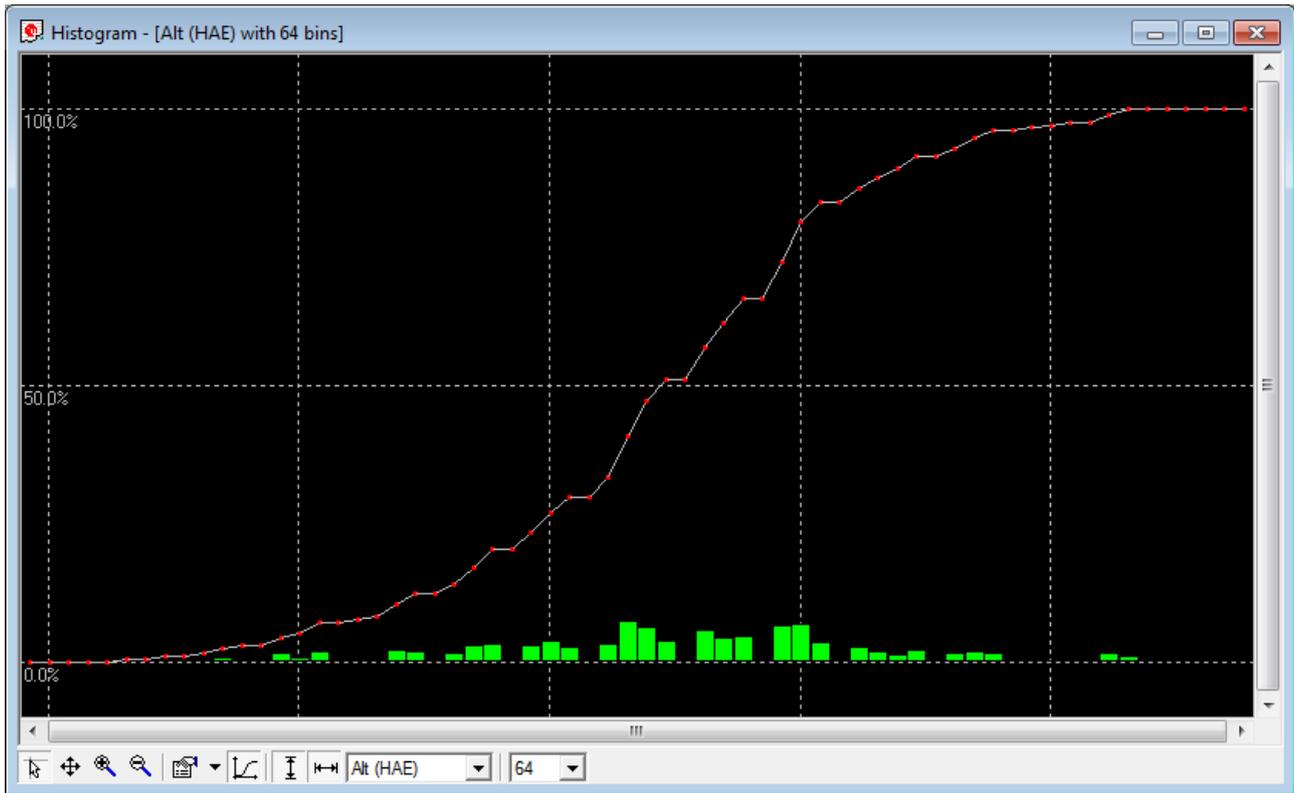


Figure 44: Probability chart



The number of displayed epochs is set to 1800 by default (see also section 3.3).

Function	Description	Toolbar icon
Cursor	The position of the cursor is shown on the lower left edge of the u-center screen (Longitude, Latitude and Pixel-Position). By holding the left mouse button and moving the cursor over the histogram you can measure distance from one position to another.	
Move	The histogram inside the histogram view window can be moved.	
Zoom In	Drawing a rectangle enlarges the histogram to the new view. To zoom in the histogram double-click on the histogram.	
Zoom Out	Drawing a rectangle decreases the histogram to the new view. To zoom out the histogram double-click on the histogram.	
Drawing Mode	The size and form of the displayed values can be changed in the menu points; the connection line between the values can be selected in the menu connect. For viewing the statically values (average, minimum, maximum, standard deviation) directly in the histogram select the statistics menu.	
Probability	Displays the probability histogram (see Figure 40).	
Fit Probability	Fit the Probability range.	
Y value	Select the Y value to be displayed	Alt (HAE) ▾
Bins	The number of bins	64 ▾

Table 17: Description of the buttons and displays in histogram view

4.2.11 Camera view

The camera view function enables photographs, taken during recording of log files, to be linked to the GNSS data stored in the corresponding log files. This allows a video depiction of the test, with a picture assigned to a specific point of GNSS data.

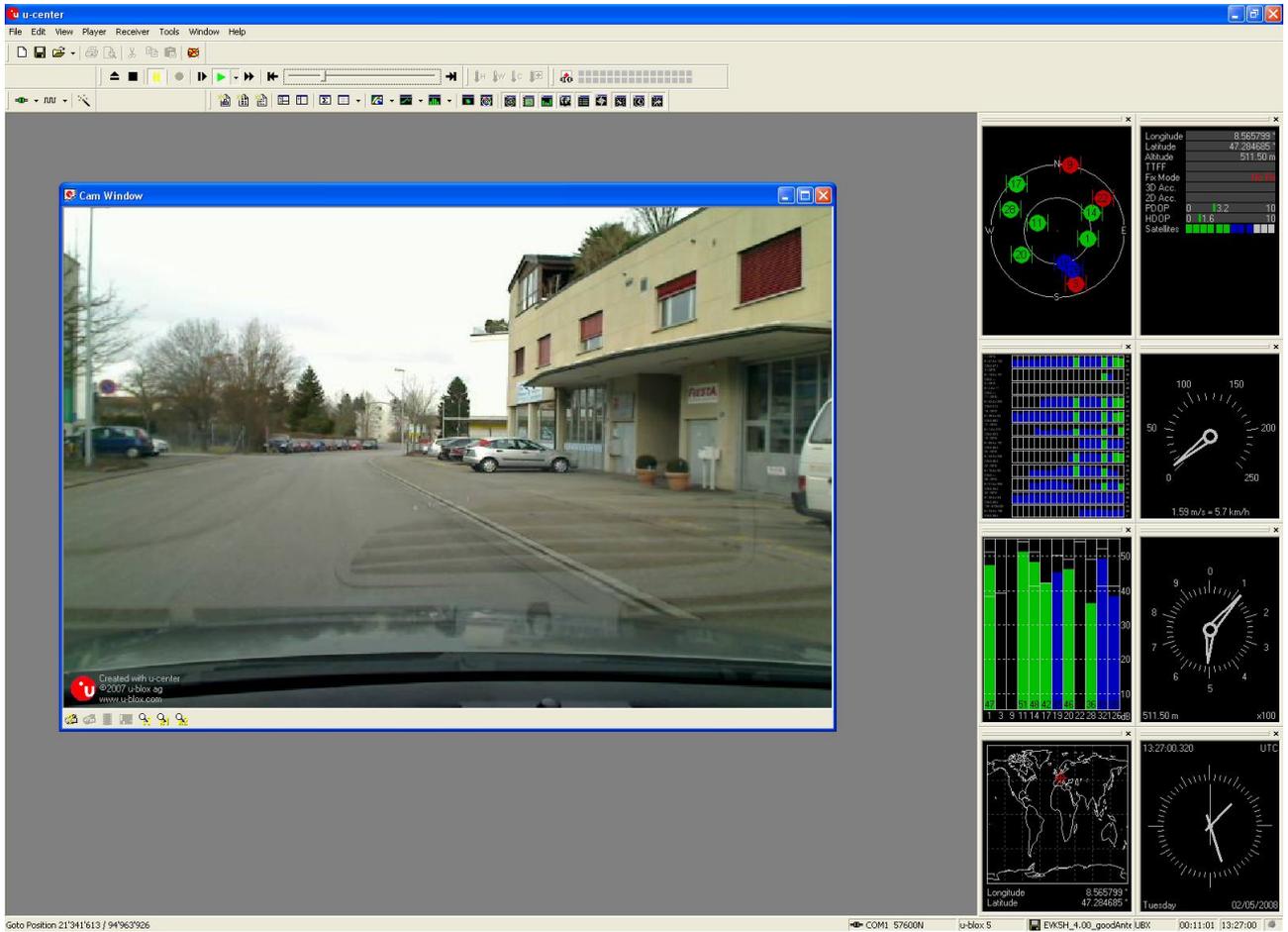


Figure 45: Camera view



Using Camera View can result in very large log files and can slow down u-center when playing such files.

4.2.12 Deviation map

The deviation map displays positions in longitude and latitude relative to a defined reference position.

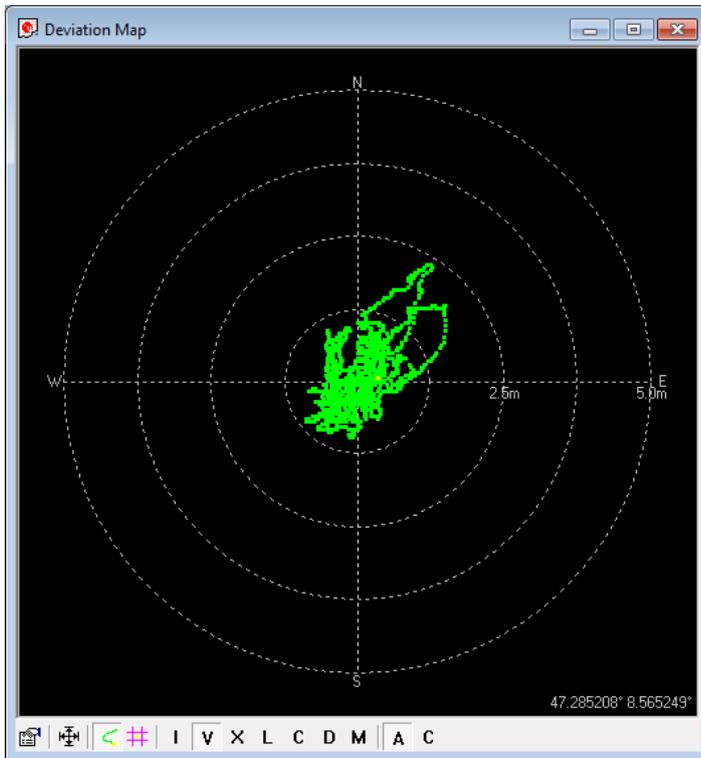


Figure 46: Deviation Map

Function	Description	Toolbar icon
Properties	The reference position can be defined as: <ul style="list-style-type: none"> - The average of all previously measured positions - The current position - A fixed, predefined value - The radius of the outer circle can be adjusted with the Max. Deviation parameter. 	
Fit	Automatically adjusts the reference position and the maximum deviation to fit all positions into the deviation map.	
Track	Show track of values from the internal database.	
Statistics	Show statistics of the values from the internal database.	
Maximum deviation shortcut	Shortcut for changing the scale of the deviation map to prefixed values:	I V X L C D M
Reference position shortcut	Shortcut for setting the reference position: <ul style="list-style-type: none"> - A = average position - C = current position 	A C

Table 18: Description of the buttons and displays in Deviation Map



The number of displayed epochs is set to 1800 by default (see section 3.3).

4.2.13 Sky view

Sky view is an excellent tool for analyzing the performance of antennas as well as the conditions of the satellite observation environment. The polar plot graphically displays the averaged relative satellite signal strength (see Figure 47), the position of satellites in the sky, identifies satellites by number and indicates which satellites are being used in the receiver calculation (see section 3.1). Right-clicking the mouse on sky view allows the copying of C/N0 values in tabular form to another program.

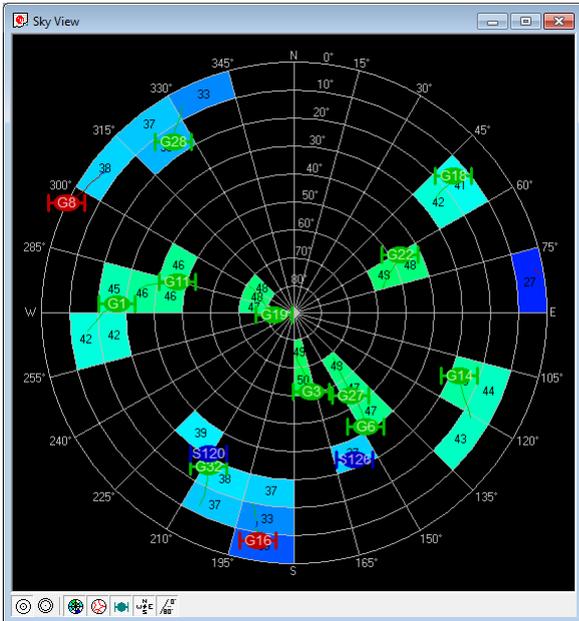


Figure 47: Sky view

Function	Description	Toolbar icon
Linear projection	Displays the sky view with a linear projection.	
Sine projection	Displays the sky view with a sine projection.	
C/N0	Displays or hides the averaged C/N0 values.	
Orbits	Displays or hides the satellite orbits.	
Satellites	Displays or hides the current satellite positions.	
Coordinates	Displays or hides the caption for the azimuth.	
Elevation	Displays or hides the caption for the elevation.	

Table 19: Description of the toolbar in sky view

5 Tools

This section will give an overview of the embedded tools of u-center. They can be used for different purpose and should facilitate the usage of u-blox GNSS receivers.

The tools can be found under the 'Tools' menu but some of the options are only displayed when a receiver is connected to u-center. The firmware update tools also depend on the connected receiver generation.

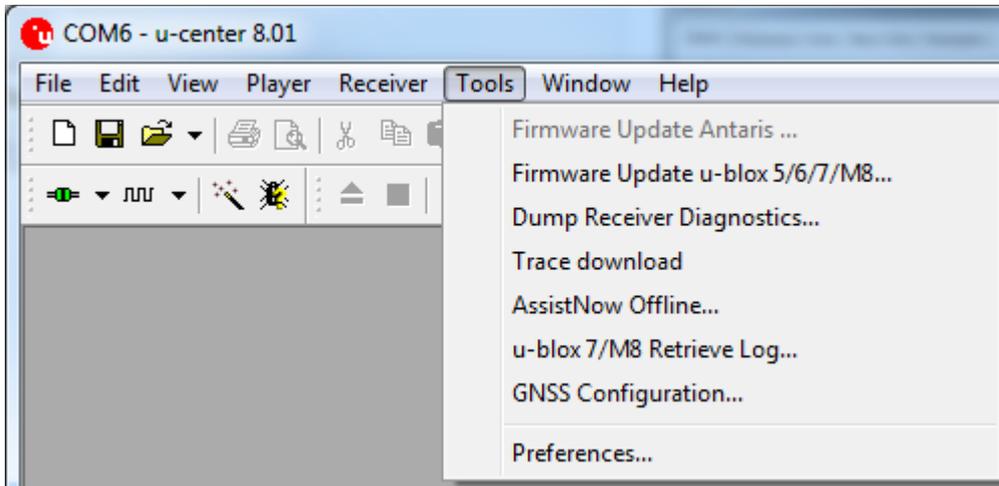


Figure 48: Tools menu entries

5.1.1 Firmware Update Antaris...

This tool is not described as the generation Antaris has been announced end-of-life.

5.1.2 Firmware Update u-blox 5/6/7/M8...

This tool will allow you to update the firmware of a receiver. This only works if your receiver has a flash memory attached as the firmware has to be stored in this location.

Perform the following steps to update the firmware:

- 1) Establish the serial communication between u-center and the device (see also section 2.4).
- 2) Open firmware update tool by clicking on Tools → Firmware Update u-blox 5/6/7/M8...

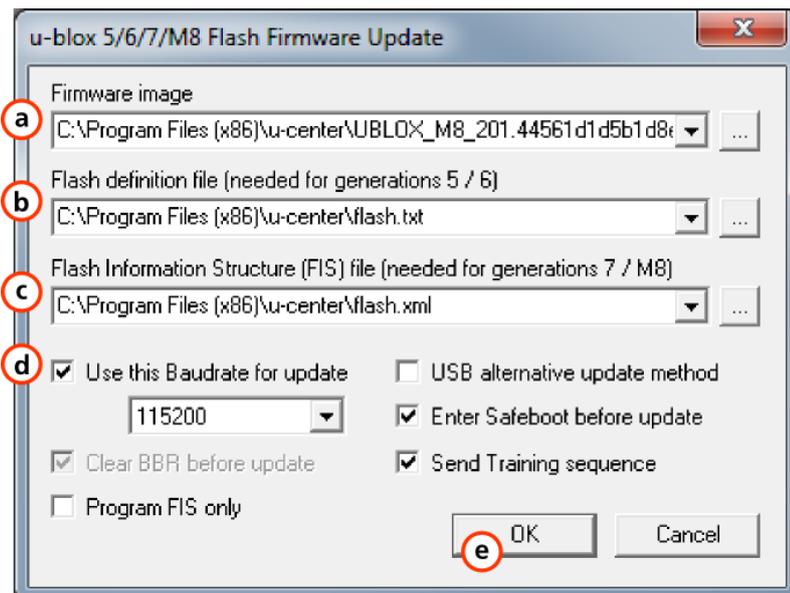


Figure 49: u-blox 5 Firmware update window

- a) Select the firmware image suitable for the connected receiver.
- b) Select the flash definition file (only needed before u-blox receiver generation 7). This file should be provided bundled with u-center. Point to the latest file version.
- c) Select the flash information structure file (only needed after and including u-blox receiver generation 7). This file should be provided bundled with u-center. Point to the latest file version.
- d) Select the correct options for your receiver:

Option	Description	Recommended
Use this Baudrate for update	Selects the speed of the communication for updating the firmware on the receiver. Only has an effect when the receiver is connected over a serial port.	115200
Clear BBR before update	Deletes the complete battery backed memory (BBR) so that the receiver will start with the default configuration.	enabled
Program FIS only	Writes only the flash information structure (FIS) into the external memory and does not update the firmware. This option is used for receivers running from ROM but with an attached SQI memory (for example for logging). Only supported after and including u-blox receiver generation 7.	disabled
USB alternative update method	Erases the first sector of the flash memory and restarts the receiver. The receiver will then start from ROM and the flash firmware can be updated. Use this method if you want to update the firmware of a receiver connected over USB.	disabled
Enter Safeboot before update	Sends the command to enter safeboot. In this state, the receiver boots from the internal ring oscillator and does not rely on any external components. GNSS functionality is not started and the receiver does not output any data. Don't use this method when having the receiver connected over USB.	enabled
Send Training sequence	Sends the training sequence after safeboot was entered. This synchronizes the internal ring oscillator so that a communication can be established.	enabled

- e) Click on "OK".

5.1.3 Dump receiver diagnostics

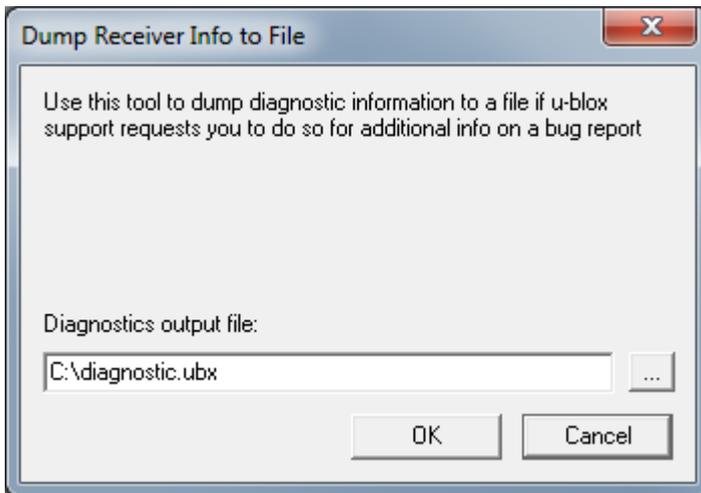


Figure 50: Dump receiver diagnostics tool

This tool is used to dump the receiver diagnostic to a file. Use this tool if requested by the support team.

5.1.4 GNSS configuration

u-center is capable of getting the actual configuration of a u-blox GNSS positioning chip or module and storing it to an ASCII text file containing hexadecimal records. Such a file can be edited and stored to a u-blox GNSS device again. By clicking the menu "Tools -> GNSS Configuration..." of u-center, the GNSS Configuration dialog opens. The following functions are available:

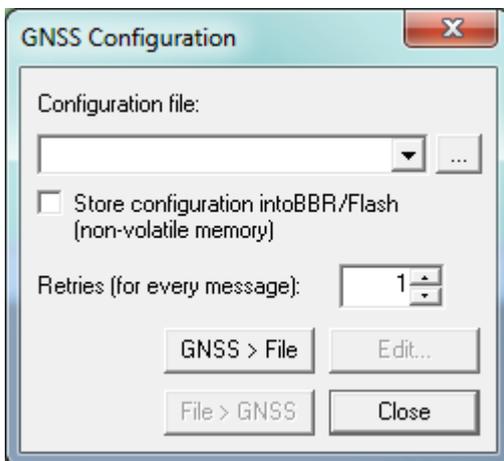


Figure 51: GNSS configuration tool

- Specify the name of a new configuration file to store current configuration from the u-blox GNSS device
- Specify the name of an existing configuration file and load this configuration into the u-blox GNSS device
- A flag can be set to force storing the configuration into the Battery Backed RAM (BBR) or Flash.

5.1.4.1 Read/Write configuration files

1. Connect to the device.
2. Open Tools / GNSS Configuration.
3. To read an existing configuration file, select the name of the file, then click on "File > GNSS" button. The GNSS Configuration window then closes and the progress window pops up, showing the configuration being sent to the receiver. This progress window closes after finishing the transfer without error.



Select "store configuration into BBR/Flash" checkbox if the parameters need to be stored into the device's non-volatile memory (BBR/Flash).



Sending a configuration to a u-blox GNSS device may fail due to a baud rate change on the current serial port of the receiver to which the configuration is being sent. If this happens, simply change the u-center baud rate and send the configuration again.

To write a new configuration file, click on "GNSS > File". The GNSS Configuration window closes and the progress window pops up, showing the configurations being polled and stored into a local file in ASCII format.

If reading or writing configuration data fails too frequently, try to increase the number of retries u-center should do on a single message if one fails.

The user can abort the transfer by clicking the "Abort" button. It's not possible to close the window unless transfer has completed or the user aborted it.



It is not recommended to read/write configuration while the u-blox GNSS device is in sleep mode.

5.1.4.2 Editing configuration file

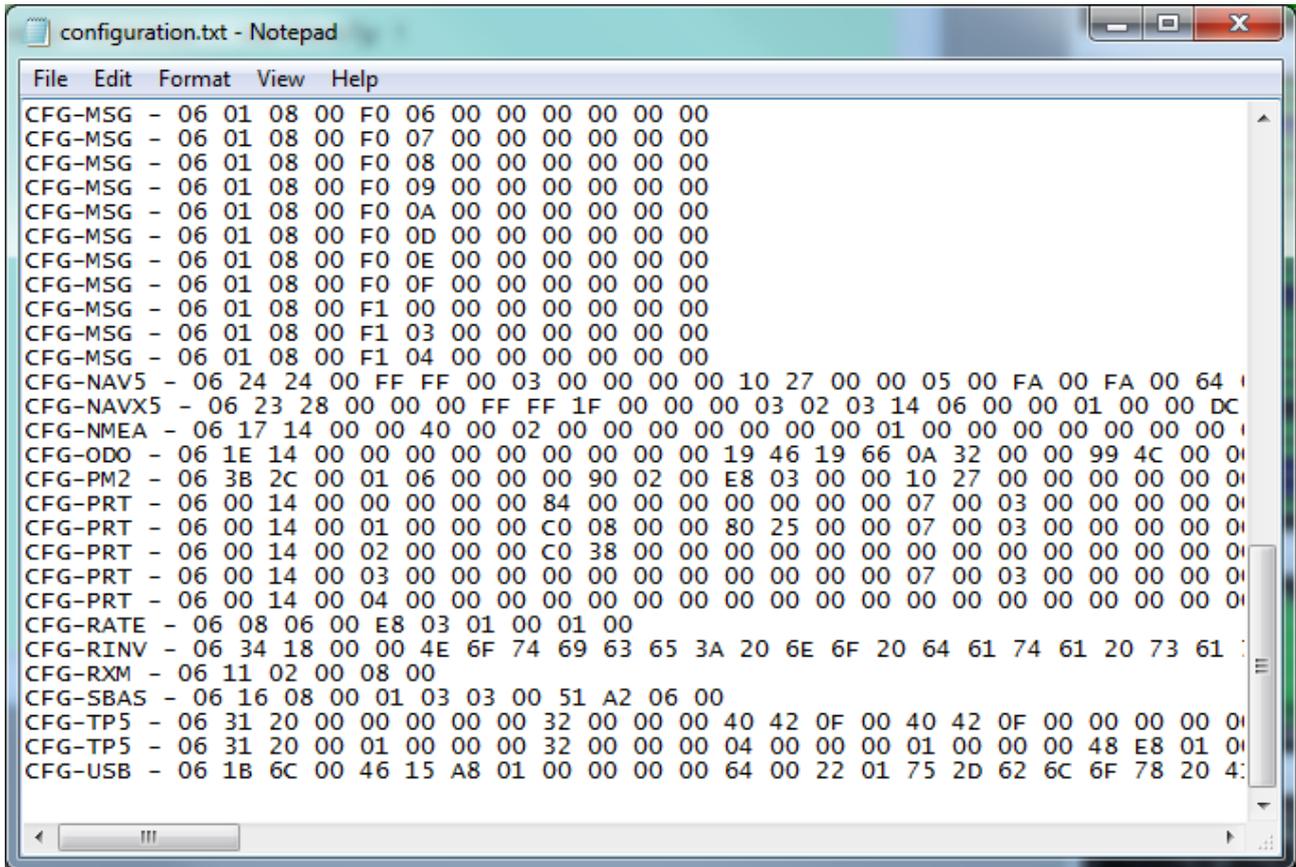


Figure 52: Content Configuration File

When clicking the “Edit” button in the GNSS Configuration dialog, the Notepad editor opens (standard Windows software). Configurations are stored the following way:

- 1st line: it contains the version of the u-blox GNSS receiver where the configuration is from. **Never change this line!**
- For the 2nd line and following each line contains the same: <class ID>-<message ID> - <hexadecimal byte code of the message>. The byte code consists of class and message IDs (2 bytes), payload length (2 bytes), payload (payload length bytes). The sync characters and the checksum are not included. They will be calculated automatically.

Refer to u-blox Receiver Description including Protocol Specification for detailed information and ranges.

5.1.5 Hotkeys

The Tools Menu allows administrating the Hotkeys defined in the Message View. Refer to section 4.2.4 for more information on the Hotkeys.

5.1.6 Preferences

The preferences tool can be used to configure a number of u-center parameters.

6 How To

6.1 Change baud rate of receiver

- 1) Connect to the device.
- 2) Open View / Messages View (Hotkey: F9).
- 3) Select UBX-CFG-PRT.
- 4) Poll the current configuration from the receiver ().
- 5) Change the setting to the desired baud rate.
- 6) Send the message to the receiver ().

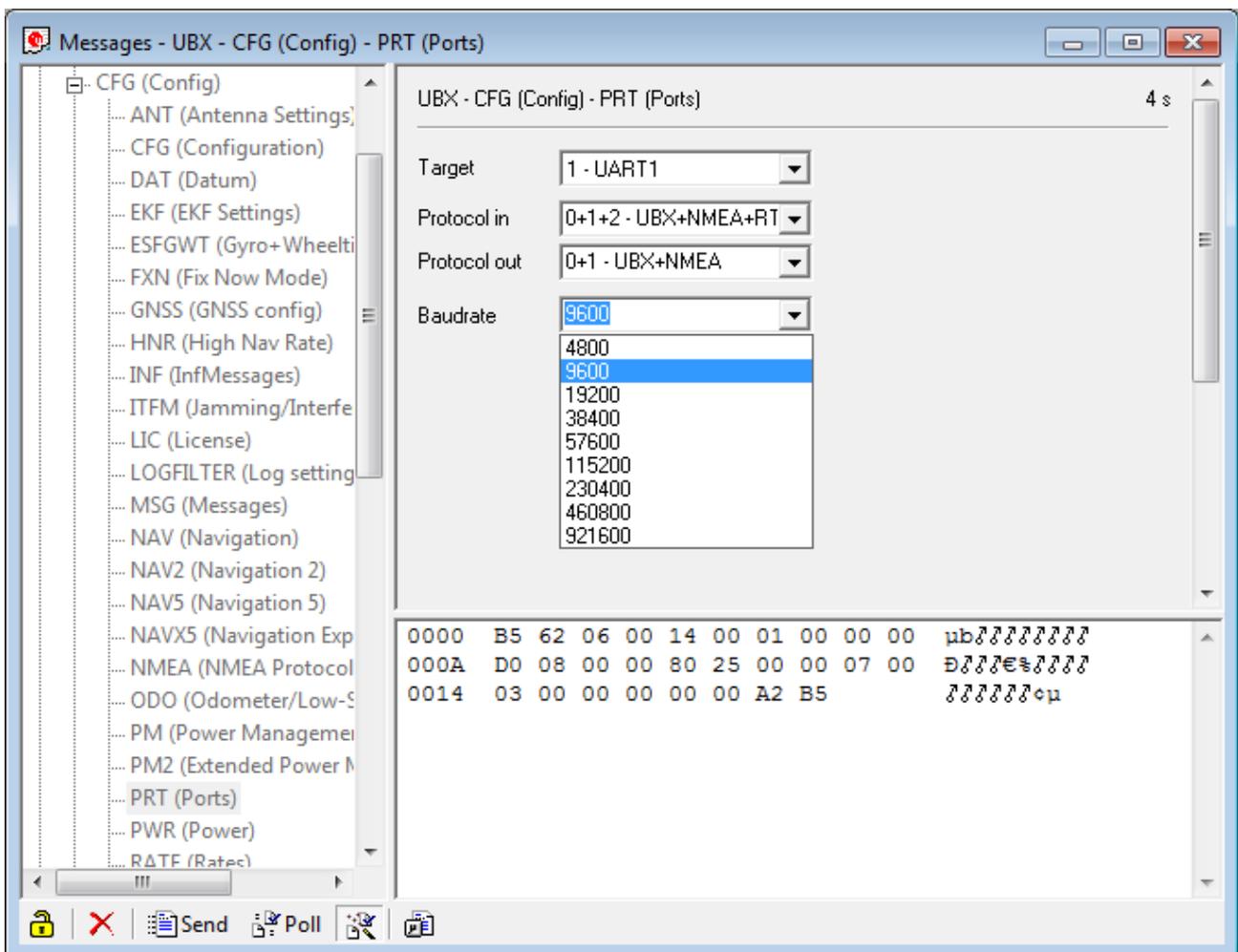


Figure 53: Changing baudrate (using UBX-CFG-PRT)

6.2 Save parameters to receiver non-volatile memory (BBR/Flash)

There are 2 ways to save parameters to the receiver's non-volatile memory (BBR/Flash).

6.2.1 Saving parameters with UBX-CFG-CFG

- 1) Connect to the device.
- 2) Open View / Messages View (Hotkey: F9).
- 3) Select UBX-CFG-CFG.
- 4) Select "save current configuration" (see Figure 54).
- 5) Send the message to the receiver (Send).

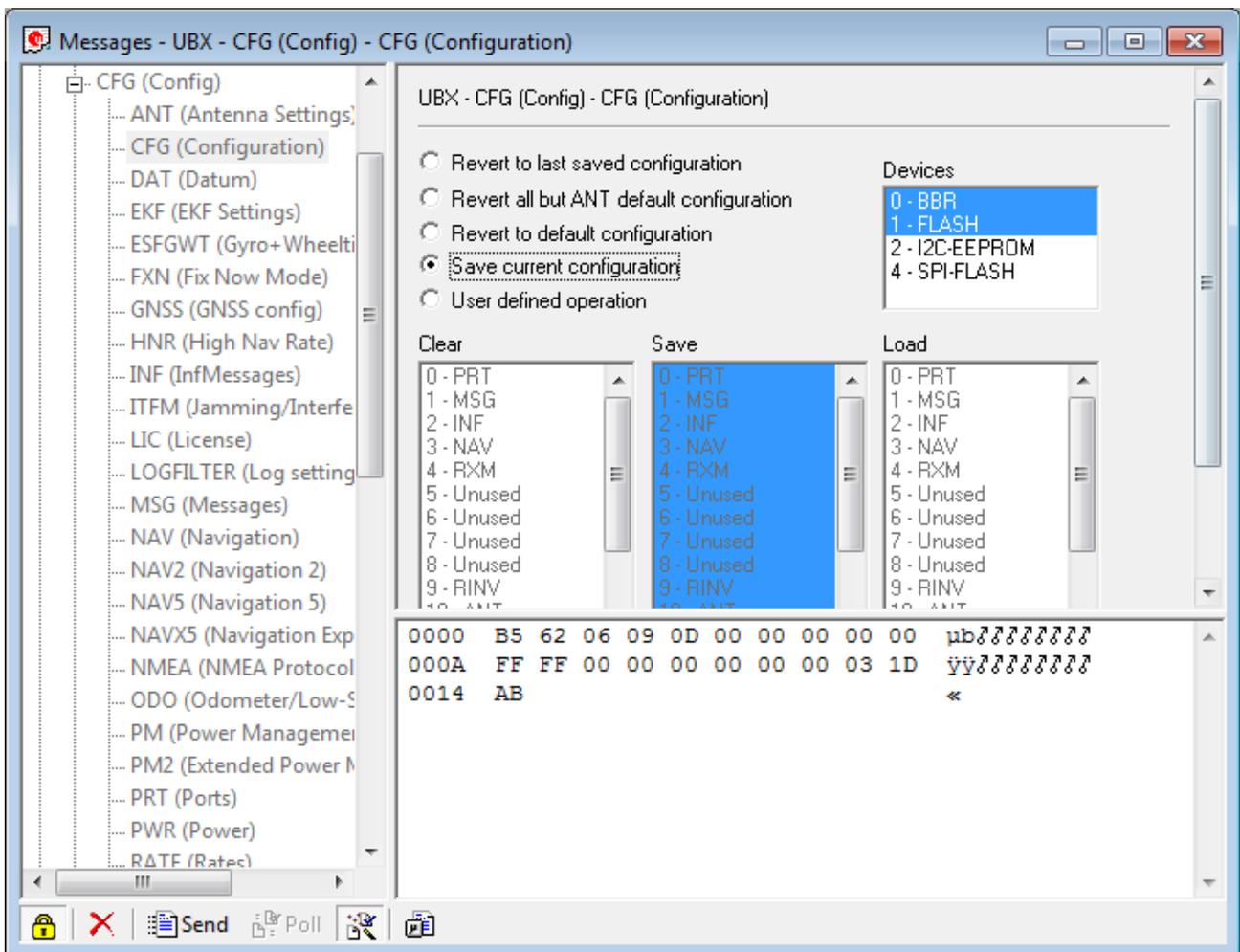


Figure 54: Saving Parameters (using UBX-CFG-CFG)

6.2.2 Saving parameters with GNSS configuration

Refer to 5.1.4.1 step 3

6.3 Recording/playing a log file

u-center allows recording and playing log files. Use the player controls, to record or playback a log file. Select the log file to be opened through the file menu tool bar. 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 is displayed when using u-center.

6.4 Conduct sensitivity tests

u-center is a useful tool for conducting sensitivity tests of GNSS positioning chips and modules and receiver designs. To do so, under open sky conditions record a log file of the receiver to be tested and an Evaluation Kit as reference. Make sure that the log files are recorded under the same conditions. Using the Statistic View or Table View windows from u-center, compare the C/N0 values of the five strongest satellites. With Table view, export the values to a spreadsheet for analysis.

6.5 Read/write configuration files

Refer to 5.1.4.1.

6.6 Set GNSS system configuration

- 1) Connect to the device.
- 2) Open View / Messages View (Hotkey: F9).
- 3) Select UBX-CFG-GNSS.
- 4) Place or remove the checkmark for the desired GNSS under "enable".
- 5) Send the message to the receiver ( Send).

The following Figure 55 shows an example that configures the device to receive only GLONASS.

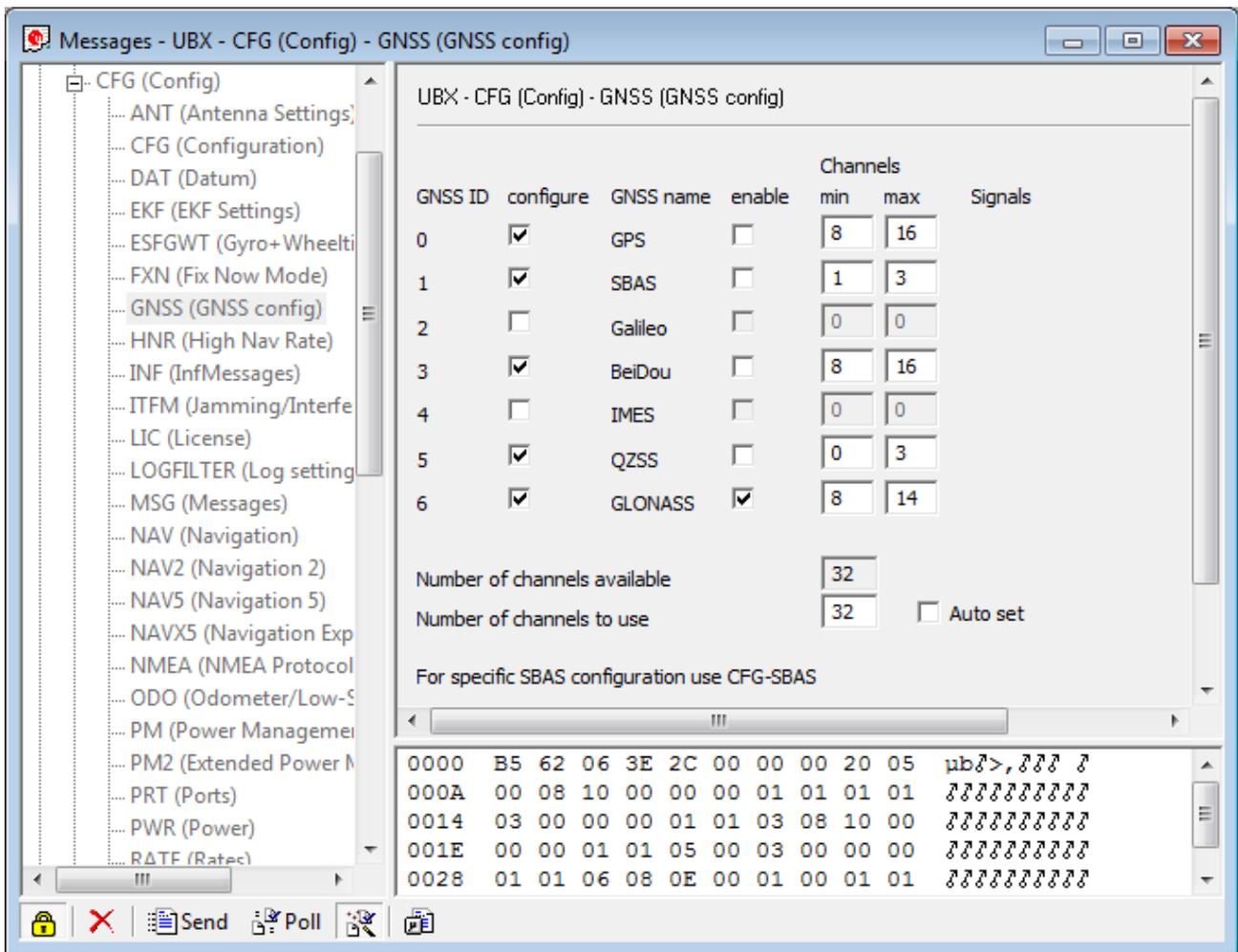


Figure 55: GNSS configuration (using UBX-CFG-GNSS)

6.7 Activating PPP (EVK-6PPP only)

- 1) Connect to the device.
- 2) Open View / Message View.
- 3) Select UBX-CFG-NAVX5 window.
- 4) Place or remove the checkmark for "Use PPP".
- 5) Send the message to the receiver (Send).

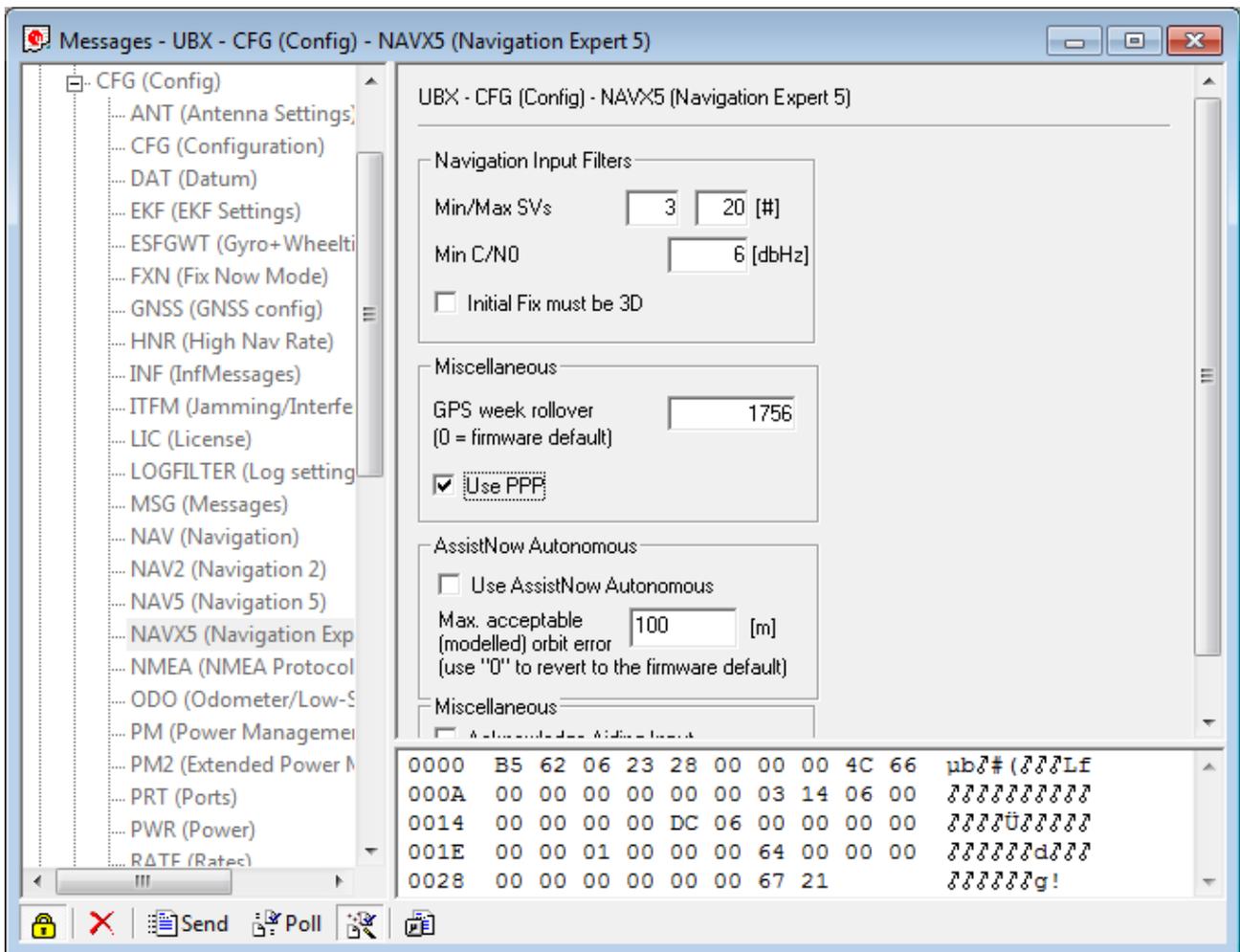


Figure 56: How to activate and deactivate PPP using UBX-CFG-NAVX5

7 Troubleshooting

NMEA or UBX protocol is not available in the Messages View

u-center uses dynamic link libraries (DLL). The installation program will automatically install the required DLL's into the u-center program directory. Should you try to copy a u-center installation from one location to another, make sure you also copy the DLL files. Verify, the version of u-center matches the DLL version.

u-center doesn't display all messages

Make sure the baud rate is sufficient. If the bandwidth is insufficient, receivers based on the ANTARIS™ Technology will skip excessive messages.

Some serial port cards/adapters (i.e. USB to RS232 converter) frequently generate errors. If a communication error occurs during while u-center receives a message, the message will be discarded.

u-center loses the connection to the device

u-blox GNSS positioning chips and modules have an autobauding feature. If frequent communication errors occur (i.e. due to problems with the serial port), the connection may be lost as u-center and the device will autonomously try to adjust the baud rate. Do not enable the u-center autobauding feature if the device has the autobauding enabled.

Some COM port are not shown in the port list

Only the COM ports that are available on your computer will show up in the COM port drop down list. If a COM port is grayed out, another application in the computer is using it.

PC is very slow when u-center runs

If a high value of epochs is selected, the display in real-time cannot be guaranteed, especially when many graphical views are open. u-center does not update minimized views and console in real-time. Close or minimize as many of the graphical views and consoles as possible and u-center will run faster.

Log file / Data are only partly displayed

The number of epochs displayed in u-center is limited in order to allow an efficient analysis of larger logfiles. The limitation is set to 1800 epochs by default. That means if an epoch is available every second you can analyze data for as much as 30 minutes. After this time the oldest values are discarded. Data stored to a log file are not affected by the database limitation. Refer to section 3.3 for instructions on how to increase this limit.

When planning long-term observations, it's recommended to start recording a log file before analysis begins.

Output messages are not updated in the Messages View

Make sure that the protocol you would like to receive is enabled. If so, double-click on the desired output message. Double-clicking on an output message enables or disables the periodic message update if the respective protocol is active. Alternatively, select the desired input or output message and press the 'Poll' button.

If you would like to get UBX-INF () messages in the log file, configure the receiver accordingly with the UBX-CFG-INF input message.

No logfile is recorded

After a new logfile is created, logging will not automatically start but only after selecting the Record button in the Player Toolbar.

Related documents

- [1] GPS Compendium, Doc No GPS-X-02007
- [2] u-blox 5 Receiver Description including Protocol Specification, Docu. No GPS.G5-X-07036
- [3] u-blox 6 Receiver Description including Protocol Specification, Docu. No GPS.G6-SW-10018
- [4] u-blox 7 Receiver Description including Protocol Specification V14, Docu. No GPS.G7-SW-12001
- [5] u-blox M8 Receiver Description including Protocol Specification V15, Docu. No UBX-13003221



For regular updates to u-blox documentation and to receive product change notifications, register on our homepage.

Revision history

Revision	Date	Name	Status / Comments
-	08-Oct-2008	tgri	Initial release
A	22-Jul-2009	tgri	New CI
A1	17-Feb-2011	tgri	Third party libraries
B	1-Nov-2011	tgri	Google Earth View added
C	03-Jun-2012	khir	Updated for u-center 6.3. GNSS configuration added Last revision with document number GPS-SW-08007
R06	09-Dec-2013	maba	Update for u-center 8.01 and u-blox 7 and M8 generations
R07	01-Oct-2014	jbow	Packet view update describing message direction indicators

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