Location Accuracy Tests with the “R&S GNSS Demonstrator” Software Tool

User Guide

Products:

| R&S®SMBV100A

This user guide describes a basic software tool meant for demonstrating the Rohde &Schwarz GNSS solution.

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User guide

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1 Note

The abbreviation “SMBV” is used in this user guide for the Rohde & Schwarz product R&S®SMBV100A.

2 Background

Please refer to application note “GPS, Glonass, Galileo, BeiDou Receiver Testing Using a GNSS Signal Simulator” (1GP86) for background information, particularly on the test setup.

3 GNSS Receiver

The demo software was tested using, for example, the following receiver evaluation kit from the company u-blox: EVK-7N

http://www.u-blox.com/de/evaluation-tools-a-software/gps-evaluation-kits/evk-7-evaluation-kits.html

This receiver kit was used with the demo software in "AUTO" receiver COM port mode.

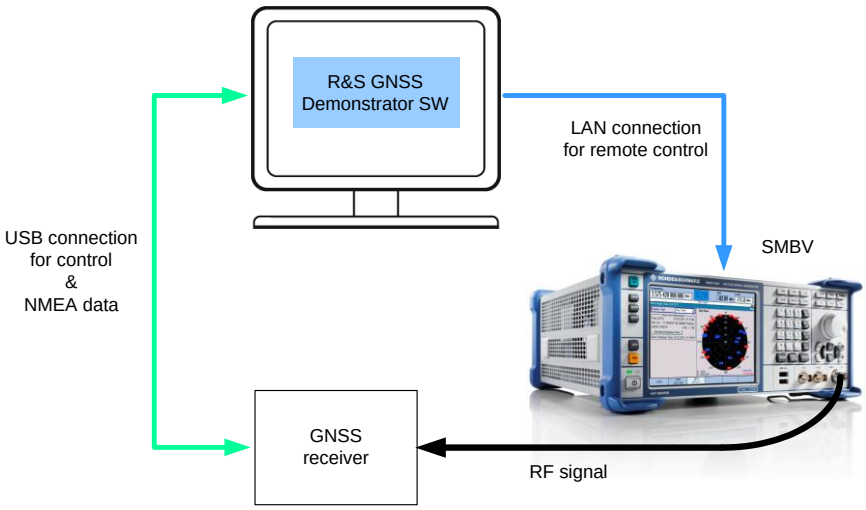
Of course, other GNSS receivers can be used with the demo tool as well.

4 Demo Software

This demo software is meant for demonstration purposes. The “R&S GNSS Demonstrator” helps to present two basic receiver tests:

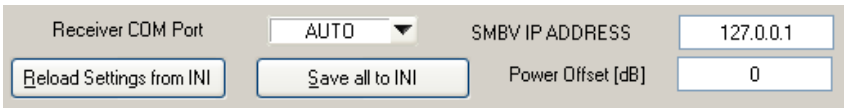
- Absolute location accuracy
- Absolute location accuracy with moving receiver simulation

4.1 Setup



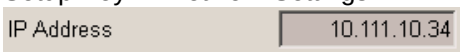
Make sure you turn off the RF signal of the SMBV before connecting the GNSS receiver to the instrument! Otherwise there is a risk of damaging the receiver, in case a non-GNSS digital standard is activated at a high RF power level (preset value is –30 dBm). When activating a GNSS standard, the RF level is automatically set to a safe value (preset value is –120 dBm).

4.2 General Settings



Receiver COM Port — Select the COM port of the receiver.

SMBV IP ADDRESS — Enter the IP address of the connected SMBV.
You can find the IP address in the SMBV under:
Setup Key → Network Settings



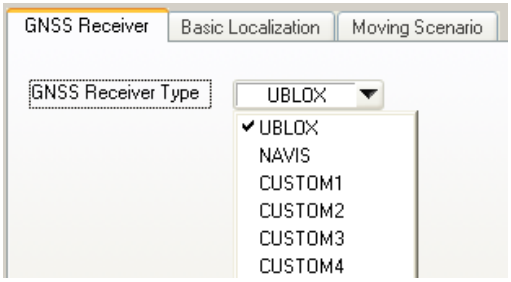
Reload Settings from INI — Loads settings from an INI file that you have saved before.

Save all to INI — Saves all current settings to an INI file.

Power Offset [dB] — Set the reference power used for the simulation. The reference power is set as a power offset in dB from the default reference power, which is –120 dBm. If you set 0 dB, then the default reference power is used.

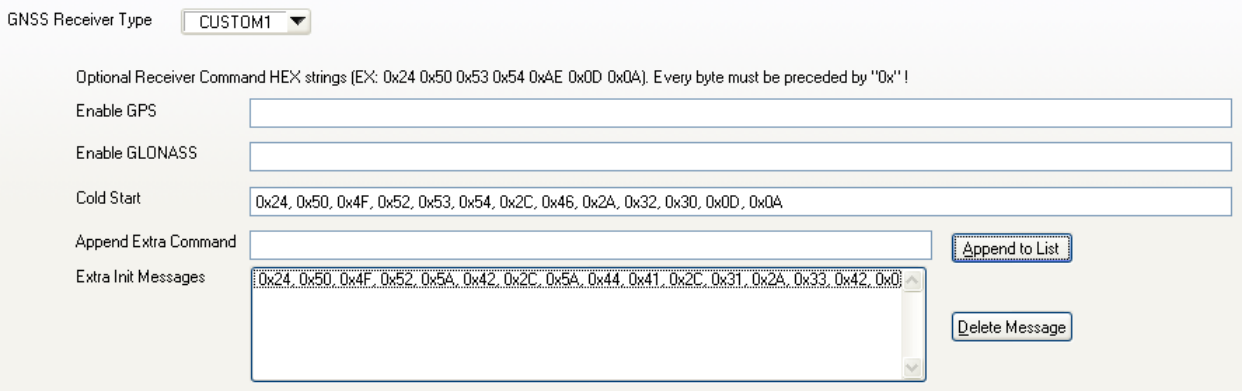
Exit — Exits the software.

The “GNSS Receiver” tab summarizes all settings related to the receiver in use.



GNSS Receiver Type — Select the receiver manufacturer. If you are not using a u-blox or NAVIS receiver, select one of the custom receivers.

If you have selected one of the custom receivers, the software will offer the following settings:



Enable GPS / Enable GLONASS	Enter receiver command string in hexadecimal format that configures the receiver for GPS / Glonass satellite reception.
Cold Start	Enter receiver command string in hexadecimal format that performs a cold start of the receiver.
Append Extra Command	Enter an additional receiver command string in hexadecimal format if desired.
Append to List	Appends this command to the list of commands displayed in “Extra Init Messages”.
Extra Init Messages	Displays the additional receiver command strings that are executed at the start of a test run.
Delete Message	Deletes a command from the list of commands if desired.

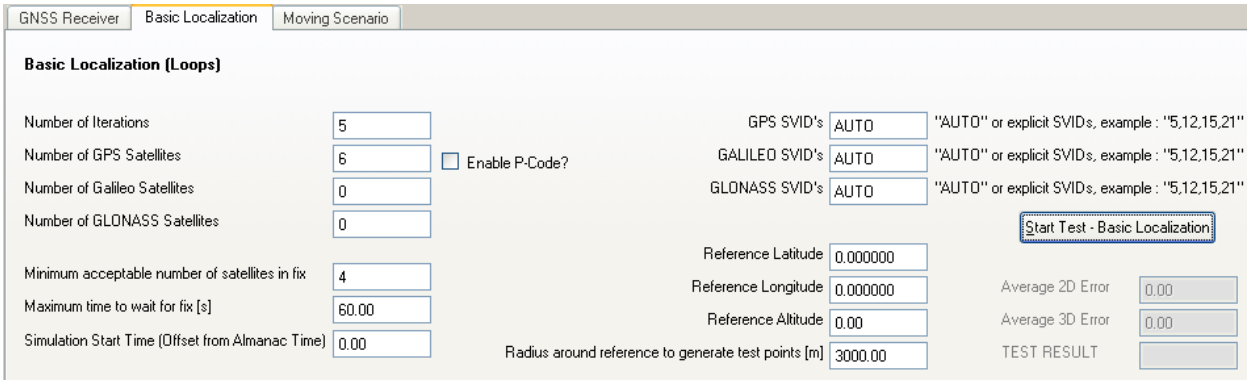
The commands are sent at the start of the test and at each iteration.

4.3 Basic Localization Test – Absolute Location Accuracy

For testing the absolute location accuracy, the SMBV simulates different static positions, i.e. random positions that are located within a certain radius around a reference location. The position reported by the receiver is compared with the simulated position, and a 2D and a 3D position error is calculated. The position errors determined for the different test positions are then averaged.

4.3.1 Basic Localization Settings

The “Basic Localization” tab summarizes all settings related to the static location accuracy test. The preset settings represent a good starting point for testing.

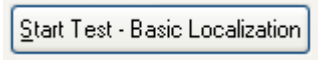


Number of Iterations	Set the number of different test positions.
Number of GPS / Galileo / GLONASS Satellites	Set the number of GPS / Galileo / Glonass satellites to be used in the simulation.
Enable P-Code?	Mark this box if you want to use P code.
Minimum acceptable number of satellites in fix	Set the minimum number of satellites that shall contribute to the position fix.
Maximum time to wait for fix [s]	Set the timeout in seconds for the position fix.
Simulation Start Time (Offset from Almanac Time)	Set the start time for the simulation. The start time is specified as a time offset in seconds from the almanac time.
GPS / GALILEO / GLONASS SVID’s	Specify the GPS / Galileo / Glonass satellites to be used in the simulation. You can either enter “AUTO” (which corresponds to “Auto Localization” mode) or the explicit SVIDs (which corresponds to “User Localization” mode).
Reference Latitude / Longitude / Altitude	Set the latitude / longitude / altitude of the reference position in meters.

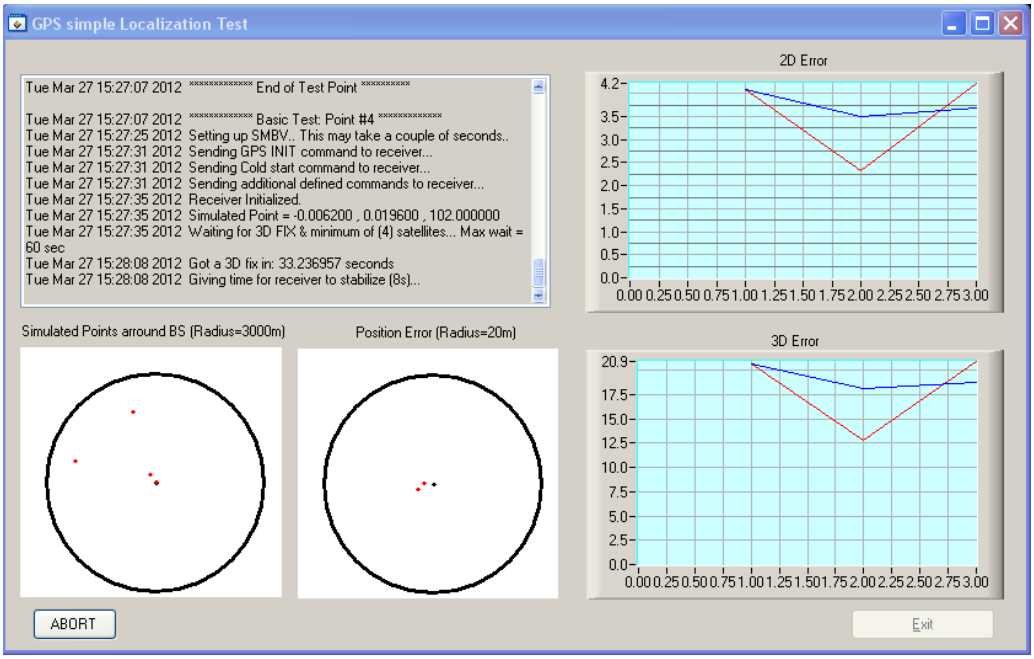
Radius around reference to generate test points [m]	Set a radius around the reference location in meters. The test position is calculated as a random position anywhere within this radius.
Start Test – Basic Localization	Starts the test run.

4.3.2 Basic Localization Test Run and Results

Configure the general and basic localization settings and start the test:

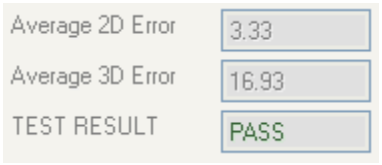


The following window opens:



Console	Shows information on the test run.
“Simulated Points” plot	Shows the simulated positions (red dots) within the defined radius around the reference location (blue center dot).
“Position Error” plot	Shows the position reported by the receiver (red dots) in relation to the simulated position (blue center dots). The shown radius is 20 m.
“2D Error” plot / “3D Error” plot	Shows the 2D / 3D position errors in meters as a function of test points. The red curve displays the position error, the blue curve the cumulative average of the position error.
ABORT	Aborts the test run.

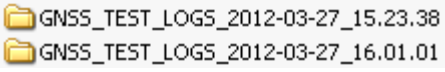
The averaged results are shown in the “Basic Localization” tab:



Average 2D / 3D Error — Displays the average of the 2D / 3D position errors for all simulated positions of a test run. The unit is meters.

TEST RESULT — The result is “PASS” if the average 2D / 3D error is below 25 m / 60 m for 96 % of all test positions (80 % for Galileo). In addition, the receiver must have a position fix for more than 80 % of the time after the first fix. Otherwise, the result is “NOT PASSED”.

A log file is generated that includes detailed information on the test run and all results. The log file is saved together with further information in a folder (labeled with date and time of the test run) under “C:\Program Files\GNSS_DEMO\LOG”.

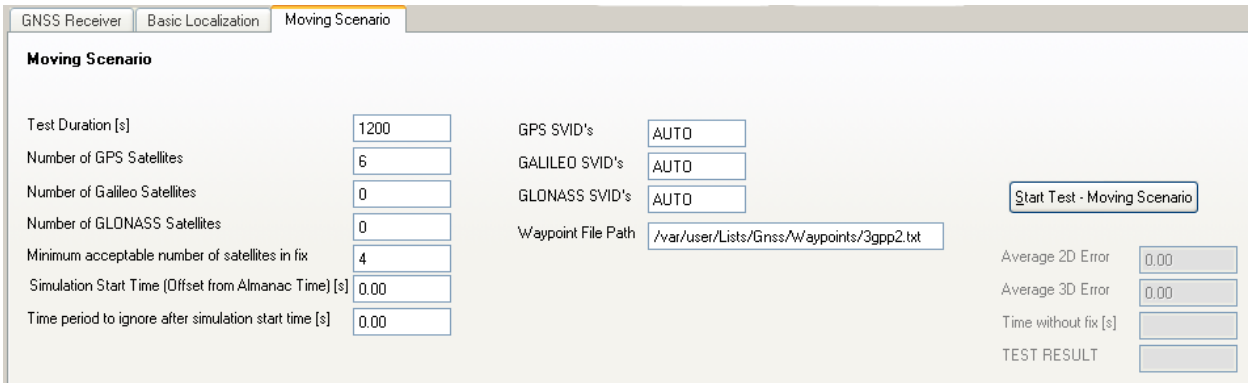


4.4 Moving Scenario Test – Absolute Location Accuracy with Moving Receiver

For this test, the SMBV simulates the movement of the receiver along a trajectory. The position reported by the receiver is compared with the simulated position defined in the waypoint file. A 2D and 3D position error is derived by calculating the distance between the reported values for longitude, latitude and altitude and the defined values in the waypoint file. The position errors determined for the test trajectory are then averaged.

4.4.1 Moving Scenario Settings

The “Moving Scenario” tab summarizes all settings related to the dynamic location accuracy test.



Test Duration [s] — Set the test duration in seconds.

Number of GPS / Galileo / GLONASS Satellites — Set the number of GPS / Galileo / Glonass satellites to be used in the simulation.

Minimum acceptable number of satellites in fix — Set the minimum number of satellites that shall contribute to the position fix.

Simulation Start Time (Offset from Almanac Time) [s] — Set the start time for the simulation. The start time is specified as a time offset in seconds from the Almanac time.

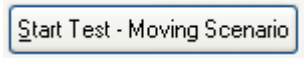
Time period to ignore after simulation start time [s] — Set this parameter to ignore all results obtained during this time period. Right after the simulation start, GPS receivers might report wrong UTC information, since the leap second information is still lacking. Additionally, the ionospheric corrections are still lacking.

GPS / GALILEO / GLONASS SVID’s — Specify the GPS / Galileo / Glonass satellites to be used in the simulation. You can either enter “AUTO”, which corresponds to “Auto Localization” mode, or you can enter the explicit SVIDs, which corresponds to “User Localization” mode.

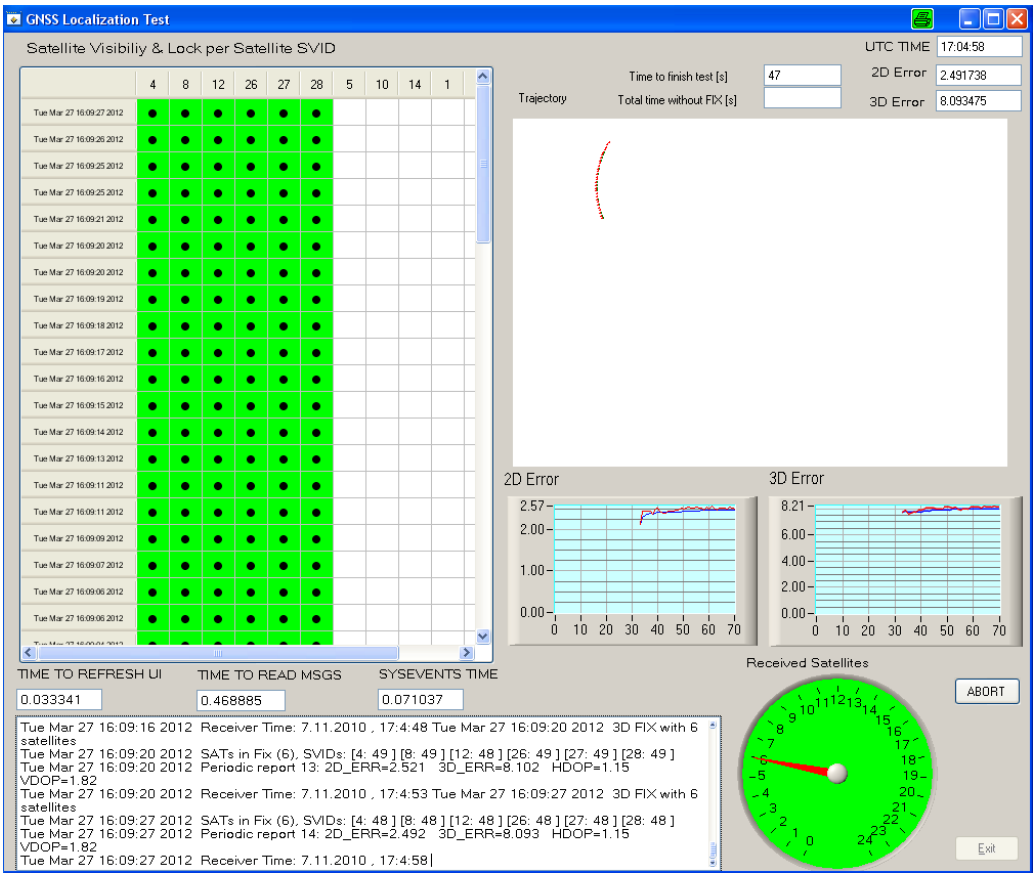
Waypoint File Path	Enter the waypoint file that shall be used for simulation including the full file path and name.
Start Test – Moving Scenario	Starts the test run.

4.4.2 Moving Scenario Test Run and Results

Configure the general and moving scenario settings and start the test:



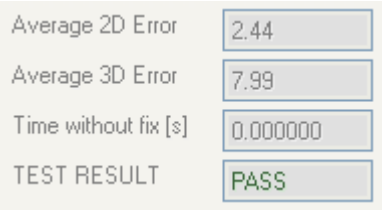
The following window opens:



Satellite Visibility & Lock per Satellite SVID	Indicates the visible satellites and if the receiver was able to acquire a lock for these satellites. A dot indicates that a C/N reading is available. A green field indicates that a position fix is established using the satellite.
Console	Shows information on the test run.
Time to finish test [s]	Shows the remaining test time in seconds.

Total time without FIX [s]	Displays the total time the receiver did not have a position fix (after the first fix).
UTC TIME	Displays the reported UTC time.
2D Error / 3D Error	Displays the current 2D / 3D position error in meters.
"Trajectory" plot	Shows the simulated trajectory in green and the trajectory reported by the receiver in red. North is on the top, East on the right like on a map.
"2D Error" plot / "3D Error" plot	Shows the 2D / 3D position errors in meters as a function of time in seconds. The red curve displays the position error, the blue curve the cumulative average of the position error.
Received Satellites	Indicates the number of satellites seen by the receiver.
ABORT	Aborts the test run.

The averaged results are shown in the "Moving Scenario" tab:



Average 2D / 3D Error	Displays the average 2D / 3D position error for the trajectory of a test run. The unit is meters.
Time without fix [s]	Displays the total time the receiver did not have a position fix (after the first fix).
TEST RESULT	The result is "PASS" if the average 2D / 3D error is below 25 m / 60 m. In addition, the receiver must have a position fix for more than 80 % of the time after the first fix. Otherwise, the result is "NOT PASSED".

A log file is generated that includes detailed information on the test run and all results. The log file is saved together with further information in a folder (labeled with date and time of the test run) under "C:\Program Files\GNSS_DEMO\LOG".

About Rohde & Schwarz
Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

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- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Certified Quality System
ISO 9001

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