APPLICATION NOTE



TestDrive GNSS - For Certification

An automation and reporting tool for repeatable and efficient verification and certification testing of GNSS devices with a GNSS simulator

A Spirent Application Note for Designers, Integrators and Manufacturers of GNSS Devices



Spirent Communications PLC

Paignton, Devon, TQ4 7QR, England Web: http://www.spirent.com/positioning Tel: +44 1803 546325 Fax: +44 1803 546301

Copyright © 2012 Spirent. All Rights Reserved.

All of the company names and/or brand names and/or product names referred to in this document, in particular, the name "Spirent" and its logo device, are either registered trademarks or trademarks of Spirent plc and its subsidiaries, pending registration in accordance with relevant national laws. All other registered trademarks or trademarks are the property of their respective owners.

The information contained in this document is subject to change without notice and does not represent a commitment on the part of Spirent. The information in this document is believed to be accurate and reliable; however, Spirent assumes no responsibility or liability for any errors or inaccuracies that may appear in the document.

Contents

Scope	4
Introduction	4
PART ONE: Introducing TestDrive-GNSS	
Fast, Automated Performance Testing for GNSS-Enabled Devices	5
Using RF Simulation for GNSS Testing	5
Key Benefits: Get to Market Faster, at Lower Cost	6
PART TWO: Using TestDrive-GNSS	
Generating a Test Suite	7
Editing Test Parameters	9
Configuring User Equipment	10
Executing a Test	12
Generating a Test Report	12
Archiving Test Results	12

Scope

This Application Note has been written for vendors and manufacturers of GNSSenabled devices who are submitting a device for certification by one or more certification authorities.

It sets out the benefits of using Spirent's TestDrive-GNSS receiver characterisation software to conduct a range of standard performance tests on the equipment and report on their results. It also provides a guide to using the TestDrive-GNSS tool, in order to help users to get the most relevant, accurate and comprehensive results during the testing process.

Throughout, we have assumed that the reader has a basic understanding of satellite navigation principles and an awareness of radio frequency (RF) simulation as a test method.

Introduction

Satellite positioning and navigation is a very fast-moving market, and vendors and manufacturers of GNSS-enabled devices need to get new products to market quickly in order to reap the most commercial benefit.

One of the key delaying factors in bringing a new receiver or device to market is the certification process. Vendors need to be sure that the device will pass certification first time, otherwise months can be lost in rework and resubmission. That means testing the product to the same exacting standards as the testing house will conduct - as thoroughly and cost-effectively as possible.

Spirent's TestDrive-GNSS testing software enables vendors and manufacturers of GNSS receivers to set up and automate industry-standard tests prior to submitting the product to a testing house or certification authority.

This Application Note introduces the benefits of the TestDrive-GNSS tool during the certification process, and provides a practical guide to using it.

PART ONE: Introducing TestDrive-GNSS

Fast, Automated Performance Testing for GNSS-Enabled Devices

Spirent, the global leader in GNSS testing, has introduced a fully automated performance testing solution for GNSSenabled equipment. TestDrive-GNSS works with the <u>GSS6700</u> and <u>GSS8000</u> series of Spirent Multi-GNSS simulators to create an integrated test solution that enables performance characterisation of GNSS receiver equipment by means of RF simulation. It is compatible with Spirent's SimGEN[™], SimREPLAY and SimREPLAY*plus* RF simulation software.

Using RF Simulation for GNSS Testing

An RF Constellation Simulator reproduces the environment that a GNSS receiver will experience by modelling vehicle and satellite motion, signal characteristics, atmospheric and other effects. When

connected to the RF simulator, the receiver will navigate according to the parameters of the test scenario.

A common misconception is that there is the need to exactly replicate real world conditions for a GNSS test to be valid. However, application of representative effects via RF simulation is proven (over 25 years of testing) to exercise receivers and adequately identify their limitations.

More importantly, RF simulation provides many advantages that 'live sky' testing with real GNSS signals cannot deliver. In particular, it gives complete repeatability, control and exact knowledge – down to bit level – of the signal which is stimulating the receiver. It can also be used to simulate signals from satellite constellations that are not yet in orbit, or fully operational – such as Compass and Galileo.

Figure 1 shows the concept of GNSS simulation using a Spirent GSS6700 simulator.

Designers of GNSS receivers can use TestDrive-GNSS to:

- Control both the GNSS RF Simulator and the UE simultaneously
- Manage and execute suites of tests automatically
- Archive sets of results
- Generate summary reports in a number of common formats

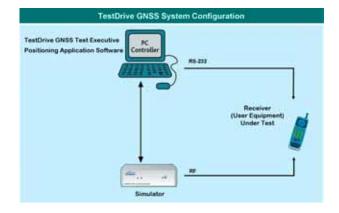


Figure 1 Example RF Simulation Flow

Key Benefits: Get to Market Faster, at Lower Cost

TestDrive-GNSS delivers significant advantages to manufacturers and OEM partners using GNSS receivers during the certification process:

Greater certainty: TestDrive-GNSS can automate industry-standard tests, enabling new devices to be tested to the same standards required by certification authorities prior to submission. Key tests that can be automated with TestDrive-GNSS include time to first fix, acquisition sensitivity, tracking sensitivity, reacquisition time, and static and dynamic navigation accuracy.

Faster time to market: By removing the need to write custom testing software and by automating individual tests and test suites, TestDrive-GNSS significantly reduces the testing timescale, enabling new devices to be submitted for certification earlier.

Lower costs: TestDrive-GNSS minimises the amount of human intervention required in the testing process, significantly reducing the cost of resourcing the process prior to submitting the product for certification.

Automated reporting: Test-Drive GNSS provides automated, easy-to-understand reports for every test conducted, which can be included as part of the submission process. **Rapid return on investment:** Once acquired, TestDrive-GNSS can be used to automate all future testing needs, significantly reducing testing budgets and delivering a rapid return on investment.

Improved value chain collaboration:

Tests and test sequences specified with TestDrive-GNSS can be shared throughout the value chain, so designers and manufacturers can agree and implement a common set of standards for performance testing of devices incorporating the approved receiver.

A world-class testing partner: Spirent has been the global leader in GNSS testing for 25 years, and is trusted by organisations in all sectors to deliver accurate and reliable test solutions. Spirent works with standards bodies worldwide to help define tests and standards for positioning and networking equipment.

For more about the benefits of using Spirent for automated GNSS testing, visit www.spirent.com/positioning or read the Spirent blog at: www.spirent.com/Blog/Positioning.aspx.

PART TWO: Using TestDrive-GNSS

Generating a Test Suite

The most simple test suite contains a single test case. Each line in a test suite can be one of several different test types. Different tests are used to measure different performance criteria. A unique set of parameters applies to each test type. Refer to the user manual for a detailed description of all supported test types.

Firstly, create a new suite from the **File > New > Suite** menu.

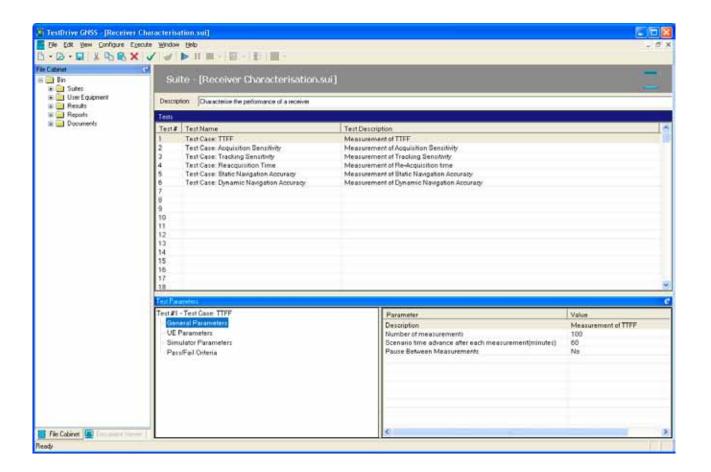


Figure 2 Creating a new suite

To select a test type when adding a new test:

- Click on a blank cell in the Test Name column of the suite window.
- Right-click on the cell to display the **Insert Test** menu.
- Select the desired test from the menus.

Figure 3 illustrates an example of adding a new UE Acquisition Sensitivity Test to a test suite.

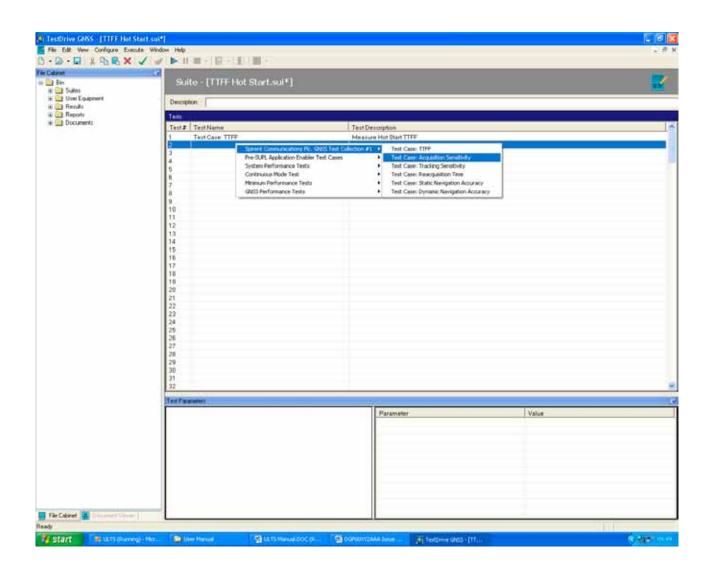


Figure 3: Adding a test to a test suite

Editing Test Parameters

Each test supported by TestDrive-GNSS includes a number of customisable test parameters that you can modify. Test parameters can be numerical values (e.g. *Number of Measurements*), text values (e.g. *Test Description*), or a list of selectable values (e.g. *Pause Between Measurements*).

To change the value of a particular test parameter:

- Click a specific line in the Tests pane to select the test.
- Select the parameter sub-group in the tree view on the left side of the Test Parameters pane.
- Click the parameter you want to edit and type or select a new value.

Before running a Test Suite, it should be validated to help avoid test execution errors. TestDrive can analyse an entire suite for test setup and parameter value problems before execution. Validation checks test conditions against the current system configuration and alerts you if the system does not contain sufficient hardware to perform certain tests.

Although this does not guarantee flawless execution, it significantly reduces the risk of problems during execution by detecting them beforehand.

To validate the Test Suite click the **Validate Suite** icon from the Toolbar or select **Execute > Validate.**

Ter Cabent Ter Cabent B Ter Suites B Ter Capterni C Terusti B	Suite - [TTFF Hot Start.sui*]		
	Desception		
	Test# TestName	Test Description	
	1 Test Case TIFF 2 3 4 5 6 7 8 9 9 10	Measure Hot Start TTFF	
	24 25 27 28 30 30 31 32		
	Test#1 - TestCase: TTFF	Parameter	Value
	General Parameters UE Parameters Bimulator Parameters - Pass/Fail Criteria	Dencription Dencription Number of measurements Boenario time advance after each measurement(mi Pause Between Measurements	Versure Hot Start TDFF 3 50 160 Ng Vers

Figure 4 shows an example of selecting '*Pause Between Measurements*' from the General Parameters sub-group of a test case.

SPIRENT Application Note

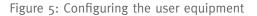
Configuring User Equipment

Before executing a test suite it is necessary to configure the user equipment.

Open a new user equipment file by selecting the **File > New > User Equipment** option from the menus.

Choose settings which represent the receiver connection to your computer. An example of such a configuration is displayed in Figure 5.

HyReceiverSettings.ue	
User Equipment (UE) - [MyReceiverSetting:	s.ue] 🧳
UE Configuration	•
Description: My Receiver Configuration	
Control Program:\GnssRxSerialControlDemo.exe	Browse Open
Serial Port Settings	
COM Port: COM7 V Data Bits: 8 V Pari	ity: None 🖵 Protocol: NMEA 🖵 Disconnect
Baud Rate: 57600 🚽 Stop Bits: 1 🚽 Flor	
Command Test	
Command: B5 62 06 16 08 00 00 01 01 00 00 00 00 26 9	37 Send
Response: \$GPGGA,012901,000,5002,8991,N,00234,7156 \$GPGGA,012902,000,5002,8991,N,00234,7156 \$GPGGA,012903,000,5002,8991,N,00234,7156 \$GPGGA,012904,000,5002,8991,N,00234,7156 \$GPGGA,012905,000,5002,8991,N,00234,7156	;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
Command Setting Click on function, type function and command strings and clic	
Functions Hot Start	Command String
UARTO settings, no transmissions	B5 62 06 00 14 00 00 00 00 00 10 00 00 00 00 E1 00 00 00 00 0.
UART1 settings, no transmissions UART2 settings, no transmissions	B5 62 06 00 14 00 01 00 00 00 10 00 00 00 00 E1 00 00 00 00 0 B5 62 06 00 14 00 02 00 00 00 10 00 00 00 00 E1 00 00 00 00 0 =
USB port settings	B5 62 06 00 14 00 03 00 00 00 10 00 00 00 00 E1 00 00 01 00 0.
Turn NMEA GGA off Set WGS84 Datum	B5 62 06 01 06 00 F0 00 00 00 00 FD 15 B5 62 06 06 02 00 00 00 E 4A
Use Message XY	B5 62 06 01 06 00 01 06 00 00 00 01 15 9A
Set message rate to 1Hz Disable SBAS	B5 62 06 08 06 00 E8 03 01 00 00 00 00 37 B5 62 06 16 08 00 00 01 01 00 00 00 00 00 26 97
· · ·	· · · · · · · · · · · · · · · · · · ·
Function Text: Disable SBAS	Insert
Command Text: 85 62 06 16 08 00 00 01 01 00 00 00 00 00 26 9	37 Insert Copy & Send
Delay between each UE command (seconds): 1	
	~



Once a connection has been made, the 'Response' window will be populated with the latest responses from the user equipment. The cursor can be positioned on the latest response by double-clicking in the response window. Note that it may be necessary to run the simulator at this point in order to generate responses from the user equipment.

TestDrive can control user equipment using the ubiquitous NMEA ASCII command set or alternatively using the SiRF binary protocol. More information on each of these protocols can be found in the references.

It should be noted that when making a connection in the user equipment configuration editor, it is possible to connect to a device which has been configured to use the SiRF binary protocol. In this case the response from the instrument will be displayed as binary data. To convert the binary data to human readable form it is required that the user sends a command to switch into NMEA mode and then a command to switch back into binary mode. For example, to switch between SiRF binary mode and NMEA GGA messages (using the COM port settings in Figure 5) send the following message to the UE:

where AoA2 is the SiRF message transport layer start sequence, oo18 represents the message payload length, 81 represents the message number, o2 represents the SiRF mode (NMEA), o1o1 switches on NMEA GGA messages with a checksum, ooo1 (repeated 9 times) represents switching other NMEA messages off with checksums, E100 is the hexadecimal representation of 57600 baud, o16F is the message checksum and BoB3 is the SiRF message transport layer end sequence.

Then send the following command to reenter SiRF binary mode (with the same COM port settings):

\$PSRF100,0,57600,8,1,0*37

The following list of commands is an example of how to populate the user equipment 'Command Settings' editor to control a GSD4e SiRF capable GPS receiver:

Switch to SiRF binary protocol	\$PSRF100,0,57600,8,1,0*37
Navigation Initialisation	AoA2001980000000000000000000000000000000000
	00000000000009CBoB3
Set PDOP to 30	AoA200058901321E32010CB0B3
Switch off DGPS mode	AoA200038A0200008CB0B3
Set elevation mask to 5 degrees	AoA200058B0032003200EFB0B3
Static Navigation Flag Off	AoA200028F00008FB0B3
Set binary serial port (57600bps)	A0A20009860000E100080100000170B0B3

Executing a Test

Once the UE settings have been configured and saved you may run the Test Suite by selecting **Execute > Run.** The Execute Automatic Test dialog box is displayed, allowing you to set several run specific options. Figure 6 gives an example of the Execute Automatic Test dialog box. When the test has completed the results will be stored in a file called TableView.csv which is located in the folder specified in Figure 6. This file can be used for further analysis.

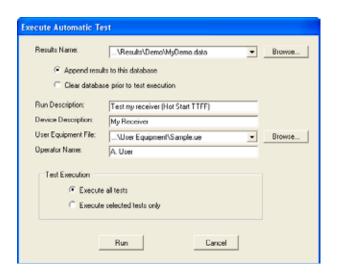


Figure 6: Execute Automatic test dialog box

Note: If the user is employing user equipment which responds with NMEA statements then the monitoring algorithm will determine that a measurement is successful by examining the NMEA GGA (Global Positioning System Fix Data) position fix flag in addition to the plan and spherical position error metrics specified in the test. If the user is employing user equipment which responds with the SiRF binary protocol then message 41 (Geodetic Navigation Data) will be examined to establish whether a fix has occurred in addition to the plan and spherical position error metrics specified in the test.

Generating a Test Report

Test Reports can be generated from the current set of test results loaded in application memory by selecting Execute > Generate Report from the menu. You can print or save reports in a variety of standard file formats including Adobe Acrobat (.PDF), Microsoft Excel (.CSV) and Microsoft Word (.DOC). To review reports after saving them, load the report documents with the appropriate associated application.

Archiving Test Results

To archive a set of test results select **File > Zip Active Results.**

For More Information

Please visit our website: <u>http://www.spirent.</u> <u>com/positioning</u> and do not hesitate to contact your nearest Spirent representative for more detailed information. To find the appropriate contact details please visit the 'Contact Us' page on the website and select your location and application.



Got a smartphone?

If you have a smartphone download a QR Code reader and then point your phone camera at the QR Code to read the graphic.

We are adding new content to our website on a regular basis. Bookmark this link: www.spirent.com/positioning

Visit the Spirent GNSS blog, there are currently over 90 posts with 2 to 3 new posts added each week. Catch up on what's new. www.spirent.com/Blog/Positioning.aspx

Need more information? gnss-solutions@spirent.com

Why not share this document?



Spirent Communications

+44 1803 546325 globalsales@spirent.com www.spirent.com/positioning

Spirent Federal Systems

+1 714 692 6565 info@spirentfederal.com www.spirentfederal.com

