APPLICATION NOTE

TestDrive GNSS - For Product R&D

An automation and reporting tool for repeatable and efficient testing of GNSS technology performance in the R&D phase

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

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Scope

This Application Note has been written for designers of GNSS receivers for use in all market sectors, from aerospace, defence and maritime to agriculture and consumer applications.

It sets out the benefits of using Spirent's **TestDrive-GNSS** receiver characterisation software to test the performance of different receiver designs to a high degree of precision under a wide range of conditions. It also provides a guide to using the TestDrive-GNSS tool, in order to help receiver designers 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

In all market sectors, designers of GNSS receivers are under pressure to deliver high-quality products faster and at lower overall cost. One of the most time-consuming elements of the R&D process is lab-testing the performance of new designs and prototypes under different conditions.

Testing is a critical activity and cutting corners is not an option – particularly for instruments that must deliver high performance in a wide range of conditions. Designers need to understand the impact of every potential design change on the receiver's performance, which means simulating conditions, testing the design, recording the results, and then retesting for the same conditions after each change.

All this takes time – and when manufacturers are under pressure to bring new products to market fast, time spent in testing can diminish or even obliterate competitive advantage.

Spirent's TestDrive-GNSS automated testing software enables designers of GNSS receivers to complete the test phase faster, more accurately and more cost-effectively than ever before. This Application Note introduces the benefits of the TestDrive-GNSS tool and provides a 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 testing solution for designers of GNSS receivers for use in all industry sectors.

TestDrive-GNSS works with the GSS6700 and GSS8000 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.

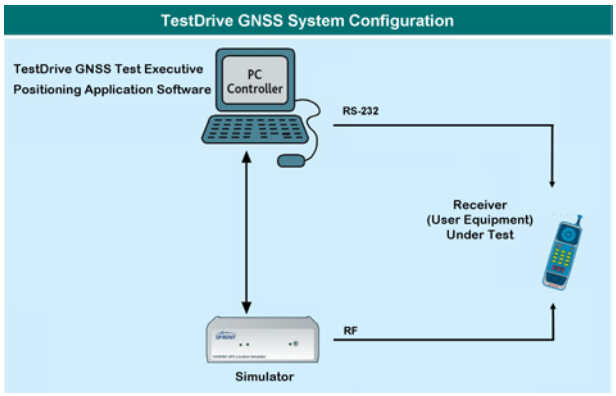

Figure 1 Example RF Simulation Flow

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

Key Benefits: Get to Market Faster, at Lower Cost

TestDrive-GNSS delivers significant financial and commercial advantages to designers of GNSS receivers:

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 timeframe of the test cycle, enabling new receivers to be delivered to market faster than competing products.

Lower costs: TestDrive-GNSS decimates the number of man-hours that need to be devoted to testing, significantly reducing the cost of resourcing the testing process.

Automated reporting: Test-Drive GNSS provides an automated report on every test and test result, saving days or weeks of manual recording and reporting of results.

Fine-grained control: TestDrive-GNSS provides an additional layer of control over test scenarios, enabling testers to precisely repeat testing while subtly iterating the design.

Better performance: TestDrive-GNSS enables each design iteration to be thoroughly tested under identical simulated conditions, so designers can be sure that any alteration in performance is due to design changes rather than signal conditions.

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.

Faster certification: The detailed test reports produced by TestDrive-GNSS can be submitted to certification authorities as evidence of receiver performance, speeding up time to certification.

A world-class testing process: Spirent has been the global leader in GNSS testing for 25 years, and is trusted by many organisations across all sectors to deliver accurate and reliable test solutions.

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.

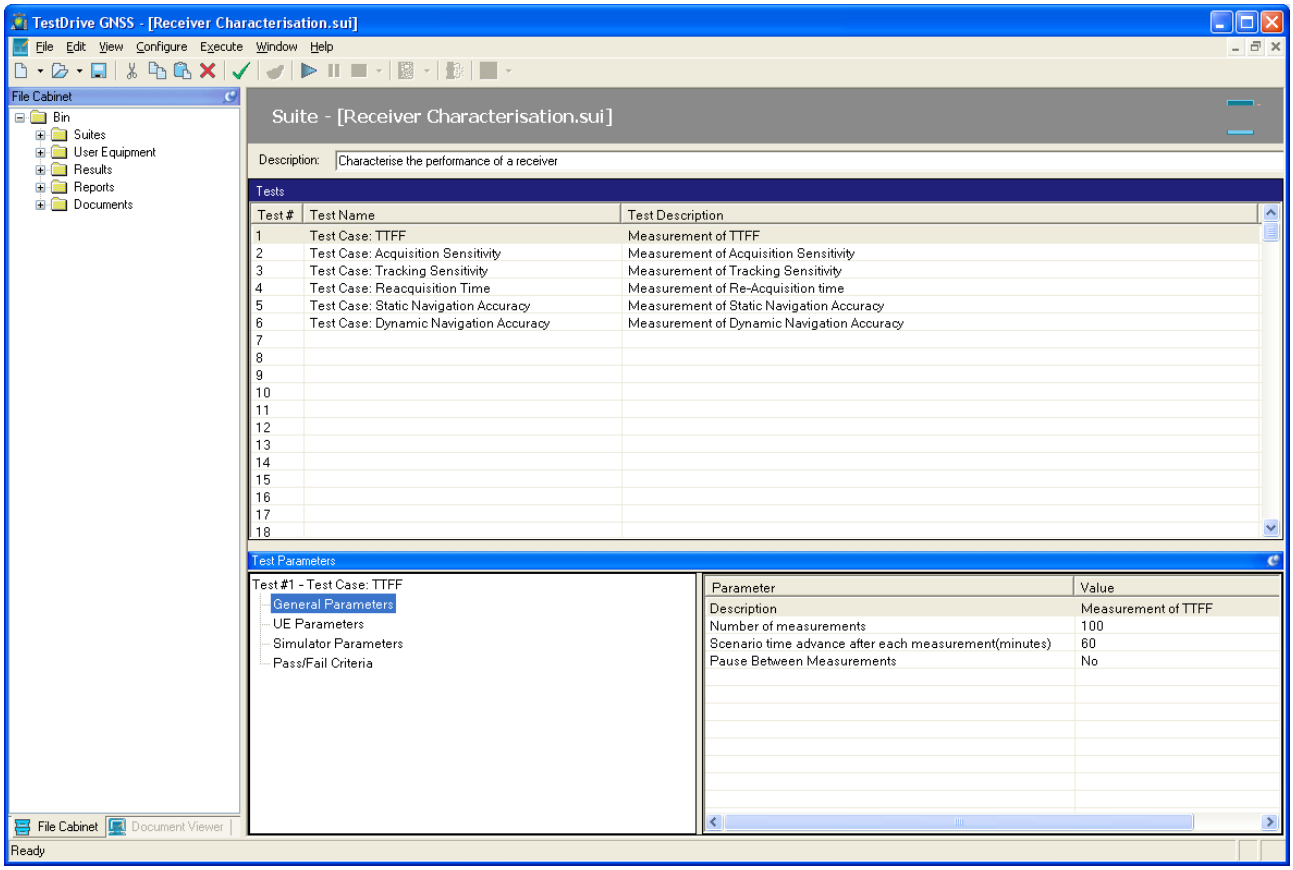

Figure 2 Creating a new suite

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.

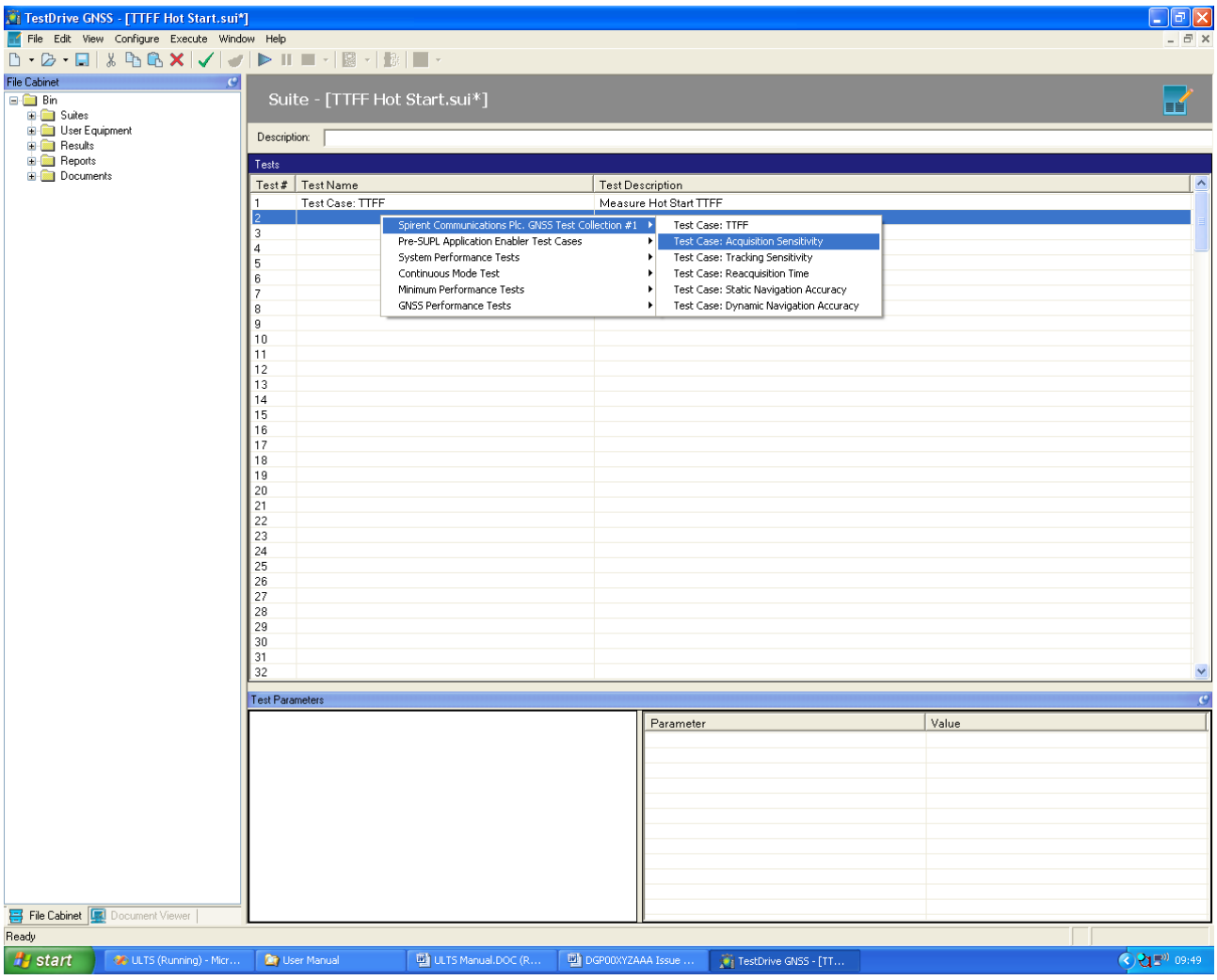

Figure 3: Adding a test to a test suite

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.

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

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.**

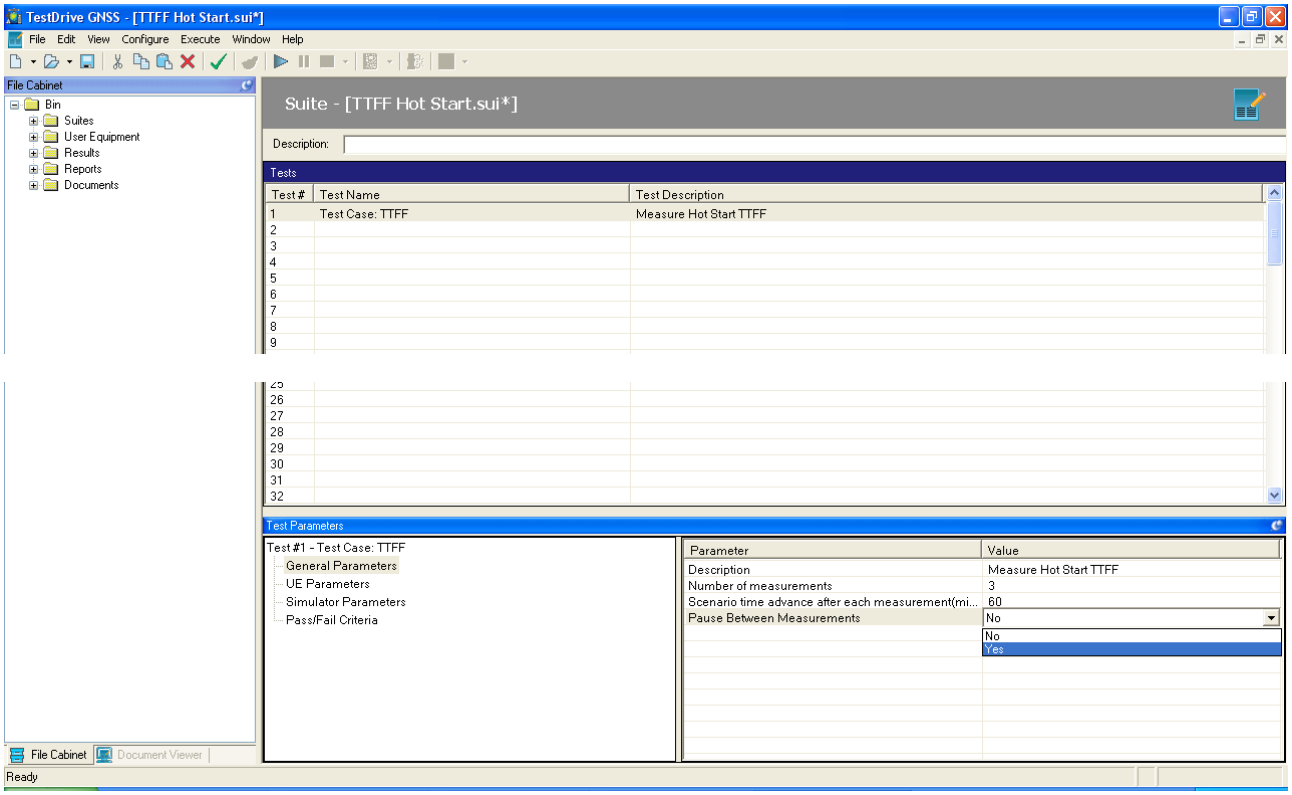

Figure 4: Selecting *'Pause between measurements'* from the *'General Parameters'*

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.

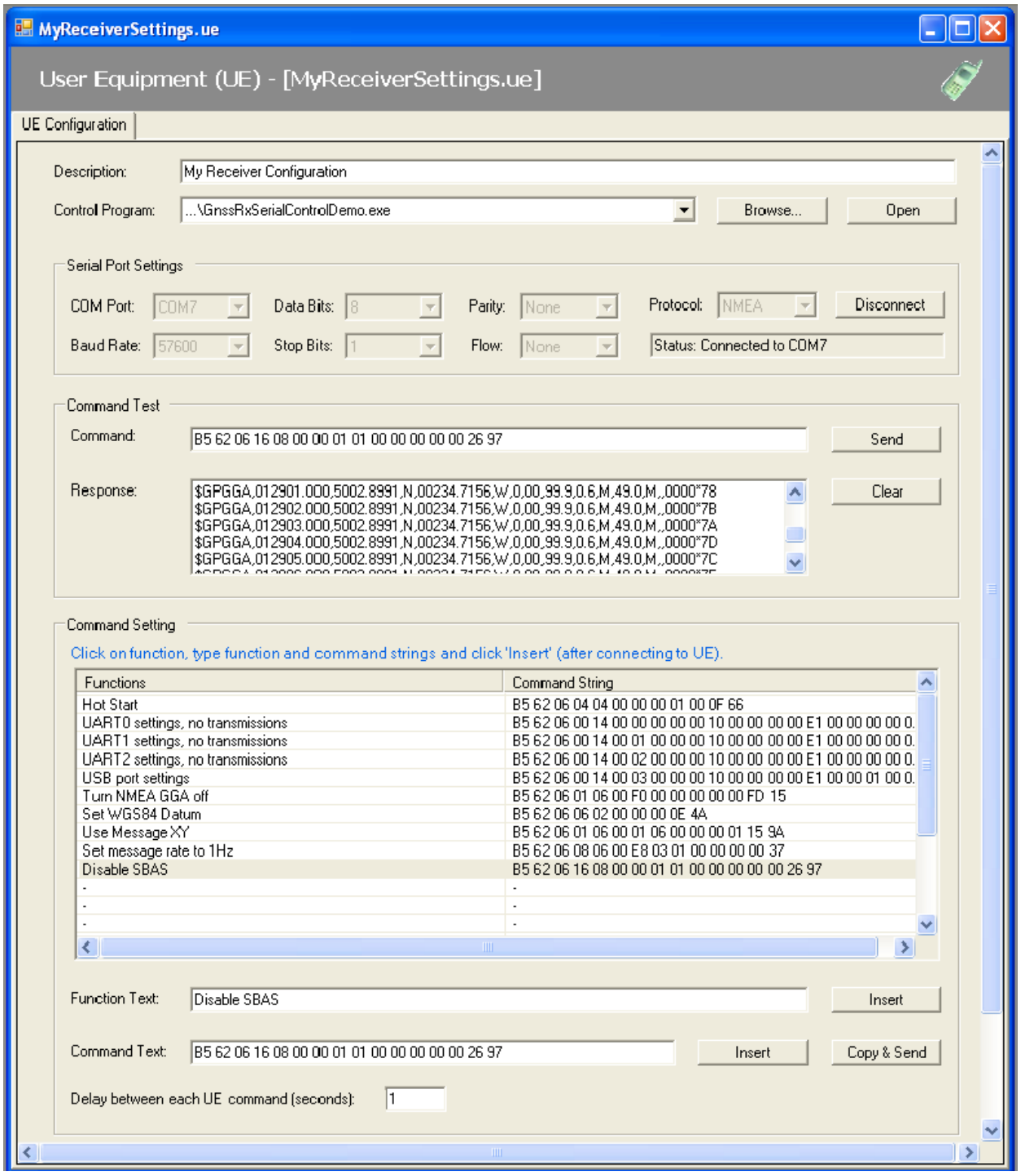

Figure 5: Configuring the user equipment

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:

A0A2001881020101000100010001000100010001000100010001E100016FB0B3

where A0A2 is the SiRF message transport layer start sequence, 0018 represents the message payload length, 81 represents the message number, 02 represents the SiRF mode (NMEA), 0101 switches on NMEA GGA messages with a checksum, 0001 (repeated 9 times) represents switching other NMEA messages off with checksums, E100 is the hexadecimal representation of 57600 baud, 016F is the message checksum and B0B3 is the SiRF message transport layer end sequence.

Then send the following command to re-enter 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	A0A200198000000000000000000000000000000000000000000000009CB0B3
Set PDOP to 30	A0A200058901321E32010CB0B3
Switch off DGPS mode	A0A200038A0200008CB0B3
Set elevation mask to 5 degrees	A0A200058B0032003200EFB0B3
Static Navigation Flag Off	A0A200028F00008FB0B3
Set binary serial port (57600bps)	A0A20009860000E10008010000017 0B0B3

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.

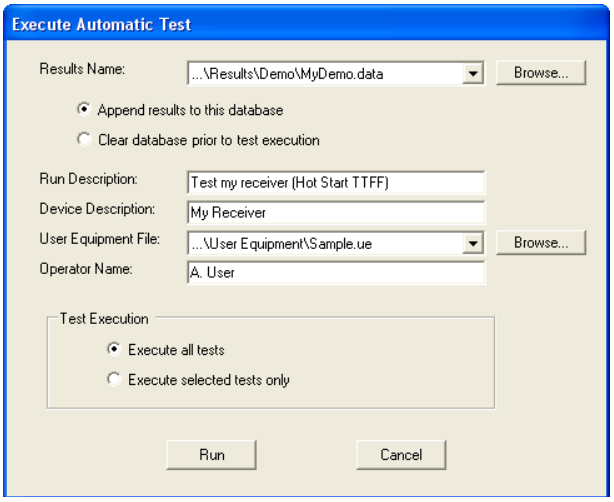

Figure 6: Execute Automatic test dialog box

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: http://www.spirent.com/positioning 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.

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