

# Spectracom GSG eCall Test Suite

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## 1. Introduction

The Spectracom eCall Test Suite consists of a set of scenarios that run on a GSG-5 with 16 channels and OPT-ECL installed, or GSG-6 with OPT-ECL installed, and a StudioView module for eCall compliance testing. These scenarios and tools are created to comply with Commission Delegated Regulation (EU) 2017/79 Annex VI.

This guide is intended to assist the user in performing the tests described in Annex VI. It is broken down by test case. For an overview of the eCall test requirements please see the presentation found here:

<https://spectracom.com/documents/ecall-brochure>

*A note on PDOP – Position Dilution of Precision is an indication of the position error caused by the satellite geometry. The GSG front panel displays calculated PDOP for all satellites (except SBAS) generated by the GSG simulator during the test scenario. The PDOP for the eCall test scenarios is calculated on each constellation independently, so the value displayed on the front panel may not match the value given by the eCall test specification. The test scenarios were designed to be compliant to the eCall specification and are valid for use in testing compliance to the eCall specification.*

*A note on Galileo power levels – The Galileo E1 Open Navigation Service is made up of 2 signal components, E1B and E1C. These components are each set to the specification signal level for each test. When combined, they have a signal level that is higher than that of each component. The combined level is what is shown on the front panel of the GSG simulator during the test, so the value displayed on the front panel may not match the value given by the eCall test specification.*

## 2. Before Starting the Test

### 1. Required tools and equipment

- Spectracom GSG Simulator with OPT-ECL installed, running firmware 7.1.1 or greater
- Spectracom GSG StudioView software installed on a Windows PC, version 5.1.4.0 or greater
- Spectrum Analyzer, frequency range up to 1.8GHz or higher
- Test cable
- Proper adapters to connect cable to Unit Under Test (UUT)

### 2. Calibrating the Cable

To perform the receiver sensitivity tests properly, the loss due to the cable must be known. The following steps are performed to measure the cable loss at 1.57542GHz. If the cable loss is already known, skip to the 'Running the eCall Test Suite' section.

- a. Connect output of GSG unit to the input of the Spectrum Analyzer.
- b. Setup the GSG to output a CW signal at 1.57542GHz at -70dBm.

Select the Signal Generator from the Options menu –

```
Options.
Transmit power
Signal generator
Interface and reference
Manage files
Show system information
Reset to factory defaults
Calibration
```

With Signal type highlighted press the enter button.

```
Signal Generator
Signal type : GPS L1C/A
Satellite ID : 003
Ref.power (GPS L1C/A) : -125.0 dBm
Frequency offset : 0.000000MHz
Start time : 01 / 02 / 2012 12:00 Set ↕
Ephemeris : Default
AutoStart : Off ↕
```

Set signal type GPS C/A to On and all other signal types of Off.

Set the Mode to Unmod.

```

Configure signal types.
GPS C/A : On  ⇅  GLO L1 : Off  ⇅  QZSS C/A : Off  ⇅
L1P : Off  ⇅  L2 : Off  ⇅  SAIF : Off  ⇅
L2P : Off  ⇅  GAL E1 : Off  ⇅  L2C : Off  ⇅
L2C : Off  ⇅  E5a : Off  ⇅  L5 : Off  ⇅
L5 : Off  ⇅  E5b : Off  ⇅  BDS B1 : Off  ⇅
P(Y) : Off  ⇅  E6 : Off  ⇅  B2 : Off  ⇅
SBAS : Off  ⇅  IRNSS L5 : Off  ⇅  Mode : Unmod  ⇅
  
```

Press Exit to return to the signal generator menu.

With Ref. power (GPS L1C/A) highlighted press the enter button.

```

Signal Generator.
Signal type : Unmod GPS L1CA
Satellite ID : 003
Ref.power (GPS L1C/A) : -125.0 dBm
Frequency offset : 0.000000MHz
Start time : 01 / 02 / 2012 12:00 Set  ⇅
Ephemeris : Default
AutoStart : Off  ⇅
  
```

Set Ref. power (GPS L1C/A) to -70dBm.

Set Ext. attenuation to 0.0 dB.

Set Simulate Noise to No.

```

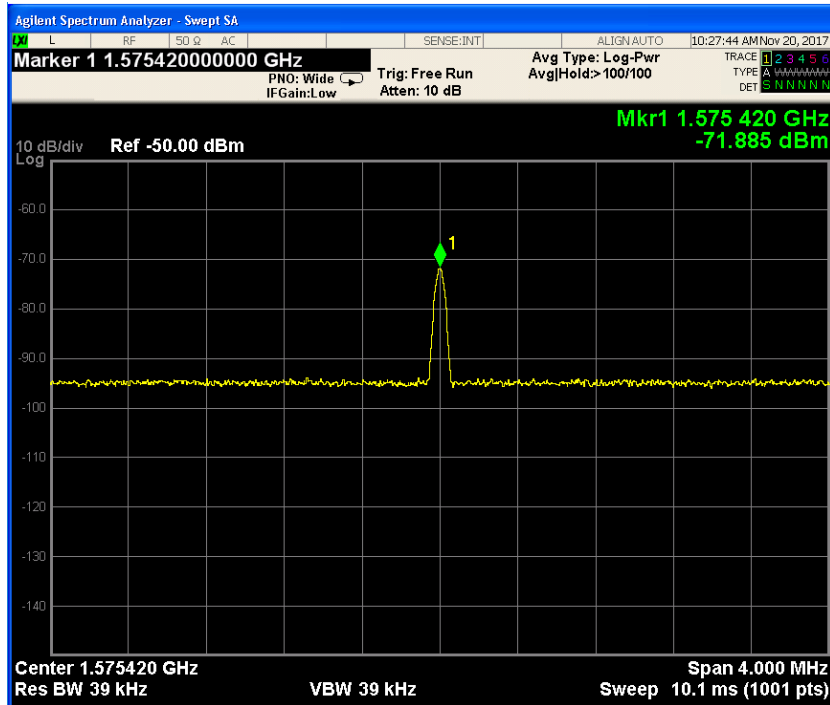
Transmit Power.
Ref.power (GPS L1C/A) : -70.0 dBm
Ext. attenuation : 0.0 dB
Simulate noise : No  ⇅
C/N0 : 44.0 dB-Hz
Signals power configuration
  
```

Press exit to return to the Signal Generator menu.

Press the start button to begin transmitting a CW signal at -70dbm.

- c. Configure the Spectrum Analyzer
  - Center Frequency – 1.57542GHz
  - Span – 4MHz
  - Reference Power Level - -50dBm

Use averaging as necessary to get a stable reading for the power level. The power level read on the Spectrum Analyzer <minus> (-70dBm) is the cable loss of the cable. In this example the spectrum analyzer shows -71.885. So  $-71.885 - (-70) = -1.885$ . Rounded to the nearest 10th, the cable loss in this case is 1.9dB.



#### d. Final Steps

Write down the measured cable loss.

Press the exit button 3 times to stop the simulation and return to the main menu.

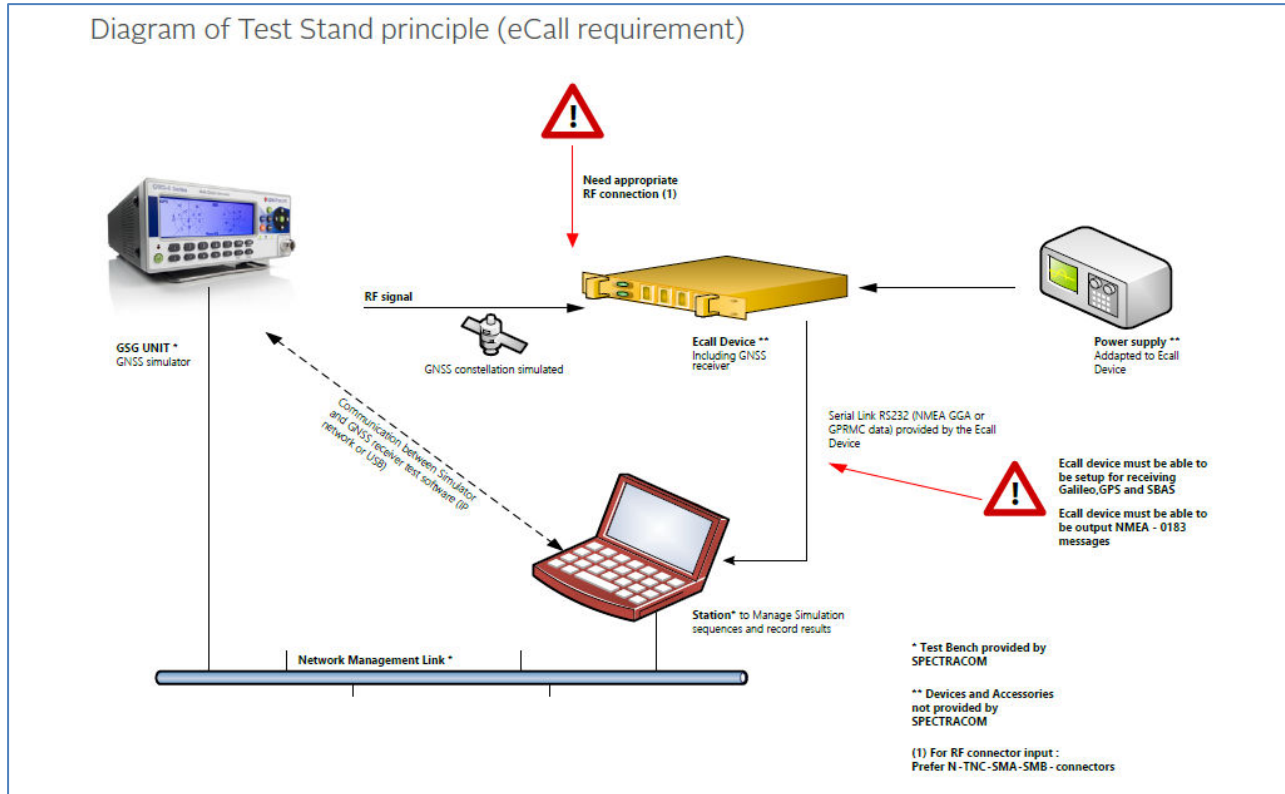
Disconnect the GSG from the spectrum analyzer.

## 3. Running the eCall Test Suite

### 1. Equipment Setup

- Connect the UUT antenna input to the output of the GSG simulator.
- Connect the UUT to the PC and locate the COM port assigned to the device (if necessary, check the Device Manager in Windows).
- Configure the UUT to output NMEA sentences as defined in Annex VI, section 1.2.1. RMC, GGA, VTG, GSA, and GSV messages should be configured.

- An Example test setup is shown here:



## 2. StudioView Setup

- StudioView and NI-VISA runtime should already be installed on the PC.

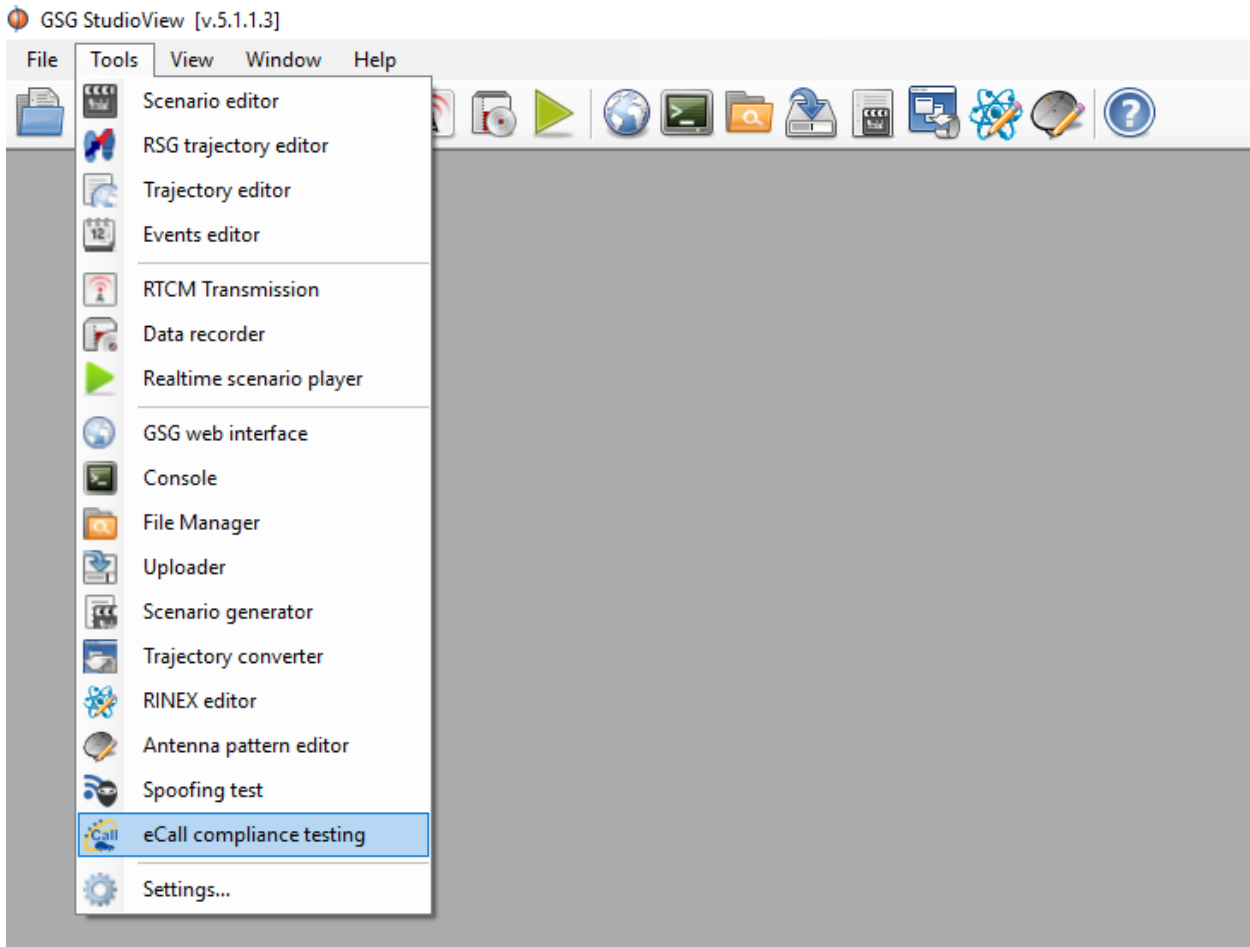
If not, please refer to the StudioView installation instructions:

[http://manuals.spectracom.com/GSG/Content/GSG/Topics/Tasks/SV\\_Installing.htm](http://manuals.spectracom.com/GSG/Content/GSG/Topics/Tasks/SV_Installing.htm)

and the StudioView connection instructions:

[http://manuals.spectracom.com/GSG/Content/GSG/Topics/Tasks/SV\\_Connect.htm](http://manuals.spectracom.com/GSG/Content/GSG/Topics/Tasks/SV_Connect.htm)



- From the StudioView Tools menu – open the eCall compliance testing tool



- On the Parameters tab of the eCall testing tool, select the GSG connection. If a connection has not been configured yet, see:

[http://manuals.spectracom.com/GSG/Content/GSG/Topics/Tasks/SV\\_Connect.htm](http://manuals.spectracom.com/GSG/Content/GSG/Topics/Tasks/SV_Connect.htm)

- In the External (RF cable) attenuation field enter the cable loss as previously determined.

<b>GSG:</b>	
Connection:	TCPIP::10.10.128.81::inst0::INSTR 
External (RF cable) attenuation:	1.9 

- In the Receiver section, select the COM port the receiver is configured to send NMEA on.

Click the  icon next to the COM port to configure the COM port settings.


*A note on COM port settings – The eCall compliance test only requires RMC, GGA, VTG, GSA, and GSV NMEA sentences to be sent to the PC from the receiver. Some receivers will also send additional NMEA or proprietary information on the same COM port connection. This may cause missed messages if the baud rate is not set high enough. If the test reports warnings like, “No data from receiver”, and the connection has been verified, then the baud rate may need to be increased.*

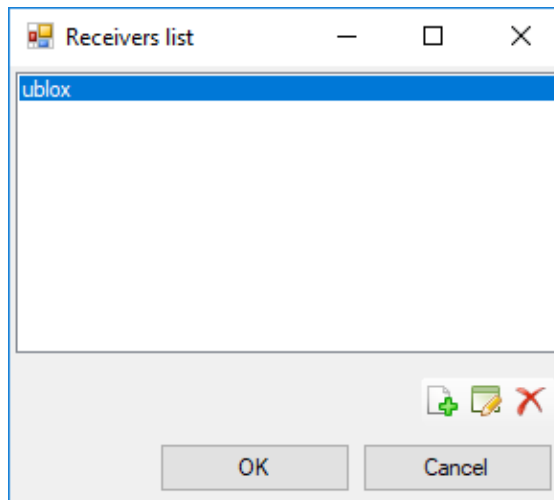
### 3. Cold Starting the UUT

The GNSS Receiver in the UUT must be cold started in between tests and in between test iterations when applicable.

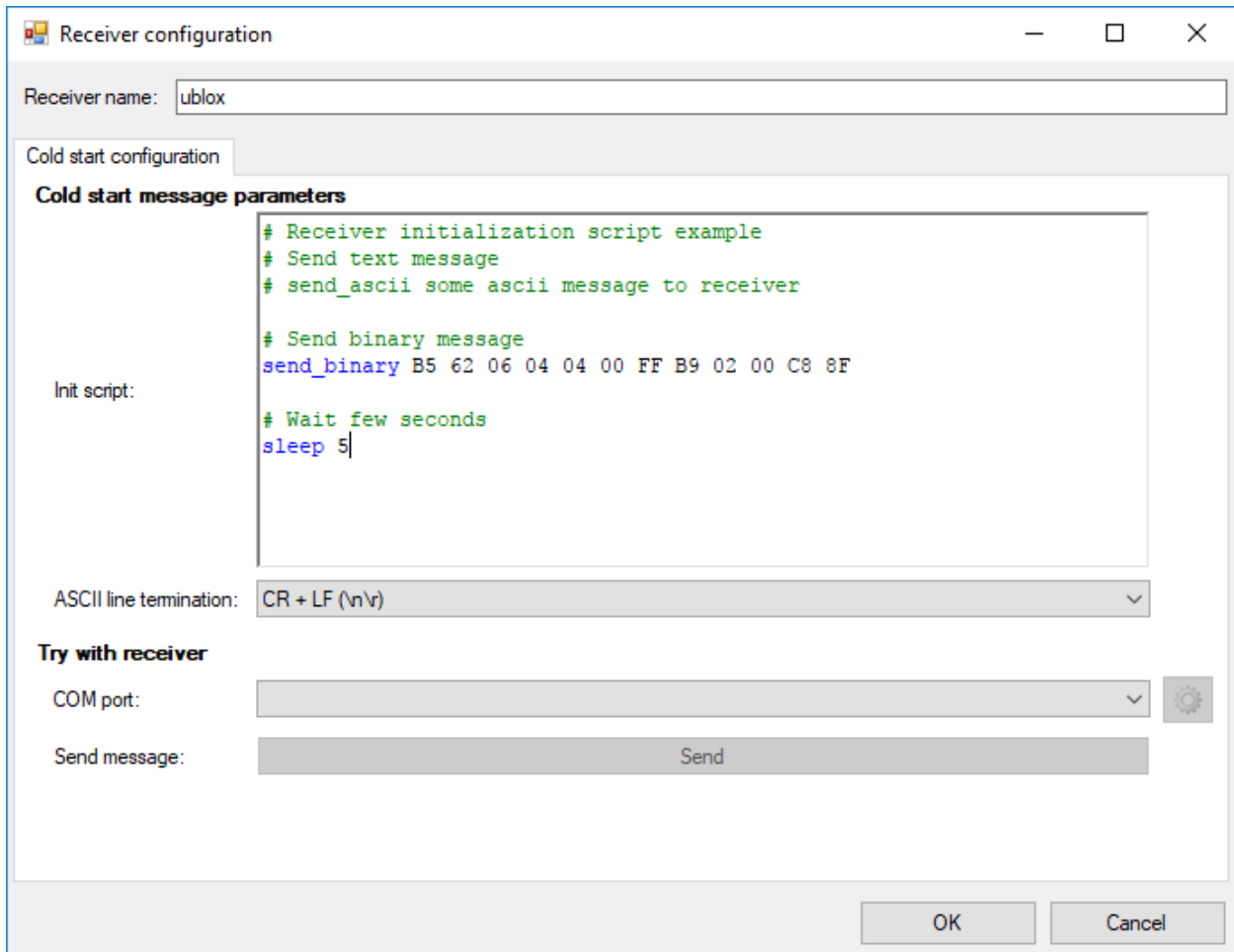
Where the manufacturer of the UUT has provided the command to be issued over the same COM port connection as the NMEA is received on, StudioView will perform a cold reset automatically when needed.

To configure this:

- Press the  icon next to Receiver dropdown box. This allows you to set up a new receiver. The Receivers list opens, and a new receiver is added by pressing the icon with the green + symbol.

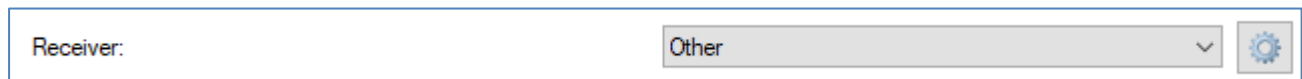


- In the Cold start message parameters decide whether the message to be sent is an ascii or binary message.
- Ublox M8 Example
  - ublox M8 receiver - binary message B5 62 06 04 04 00 FF B9 02 00 C8 8F
  - The send\_ascii can be removed or commented, and the send\_binary and sleep message are used. Adjust the sleep time to a value suitable for the UUT.

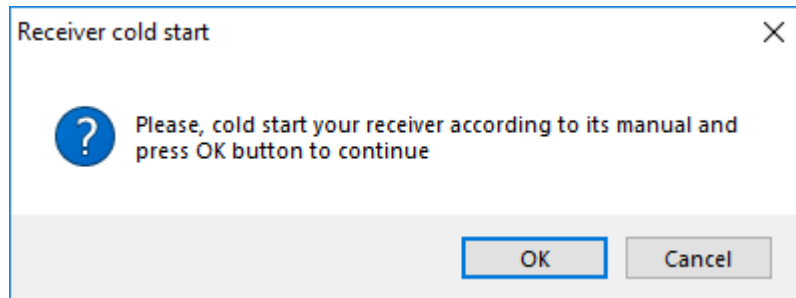


- Select the proper line termination for the ASCII message if used.
- It is possible to test the command from this window to see if the receiver reset is working.

If it is not possible to send a command to the receiver to perform the cold start in between tests and test interactions, then Other should be selected in the dropdown, and a manual cold start must be performed when prompted by the test tool.

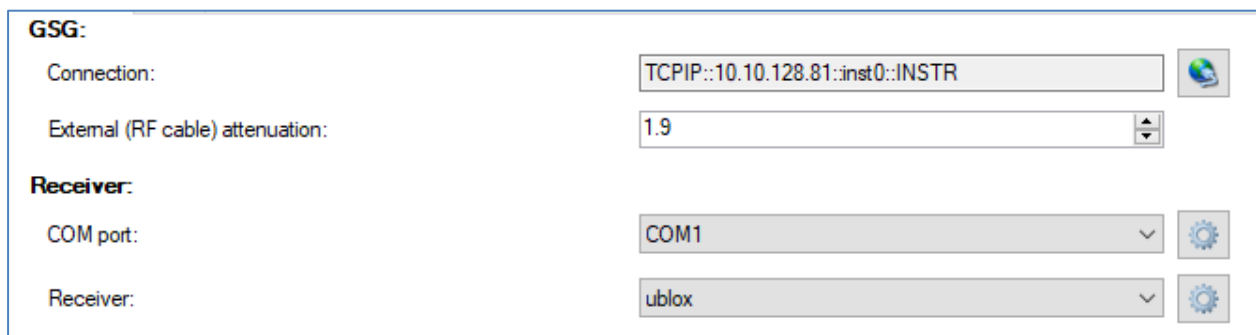






After the manual reset is performed, press ok to continue the test.

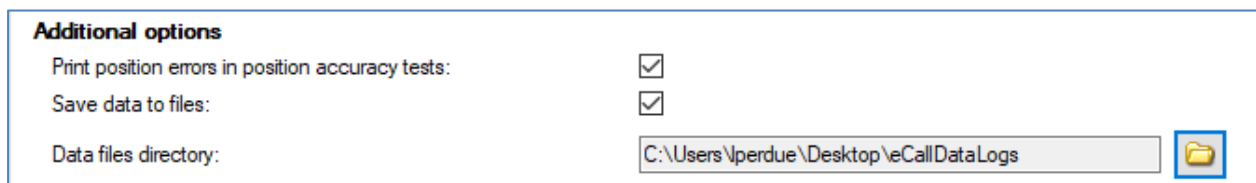
The GSG and the UUT receiver are configured and ready to start the test sequence.



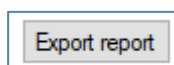
#### 4. Log and Save

If a log of each measurement in the position errors tests (rather than just the overall summary) is desired, check the box at the bottom of the parameters tab.

To save the NMEA data logs from the receiver and the GSG to file and then check the Save data to files box and select the save location.



At the end of each test it is also possible to export a report after the data is collected by pressing the export button. This exports the report only, it does not save the NMEA data.



## 4. Position Error Tests 2.2.2-2.2.4

### 1. 2.2.2 Assessment of positioning accuracy in autonomous static mode

Testing is performed by running 3 tests, each one-hour long. All 3 tests can be selected to run in a sequence. Position error calculations are done according to the method defined in Annex VI. The maximum allowed position error for this test is 15 meters.

#### Assessment of positioning accuracy in autonomous static mode (2.2.2)

Static GPS/Galileo/SBAS (2.2.2):	<input checked="" type="checkbox"/>
Static Galileo (2.2.2.15):	<input checked="" type="checkbox"/>
Static GPS (2.2.2.16):	<input checked="" type="checkbox"/>
Override defaults:	<input type="checkbox"/>
Scenario duration:	00:01

### 2. 2.2.3 Assessment of position accuracy in autonomous dynamic mode

Testing is performed by running 1, one-hour test. Position error calculations are done according to the method defined in Annex VI. The maximum allowed position error for this test is 15 meters.

#### Assessment of positioning accuracy in autonomous dynamic mode (2.2.3)

Dynamic (2.2.3):	<input checked="" type="checkbox"/>
Override defaults:	<input type="checkbox"/>
Scenario duration:	00:01

### 3. 2.2.4 Movement in shadow areas, areas of intermittent reception of navigation signals and urban canyons

Testing is performed by running 1, one-hour test. Position error calculations are done according to the method defined in Annex VI. During the test, the signals will be present for 5 minutes, then off for 10 minutes in a pattern that continues throughout the test. Receiver loss of lock is normal during this test. The maximum allowed error for this test is 40 meters.

#### Movement in shadow areas, areas of intermittent reception of navigation signals and urban canyons (2.2.4)

Dynamic (2.2.4):	<input checked="" type="checkbox"/>
Override defaults:	<input type="checkbox"/>
Scenario duration:	00:01

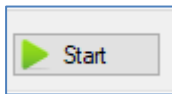
### 4. Override Defaults

The default scenario time for the positioning scenarios is one hour, but if it is desired to shorten the test length for set up and re-test purposes, the duration can be changed by selecting the Override default checkbox and changing the scenario time.

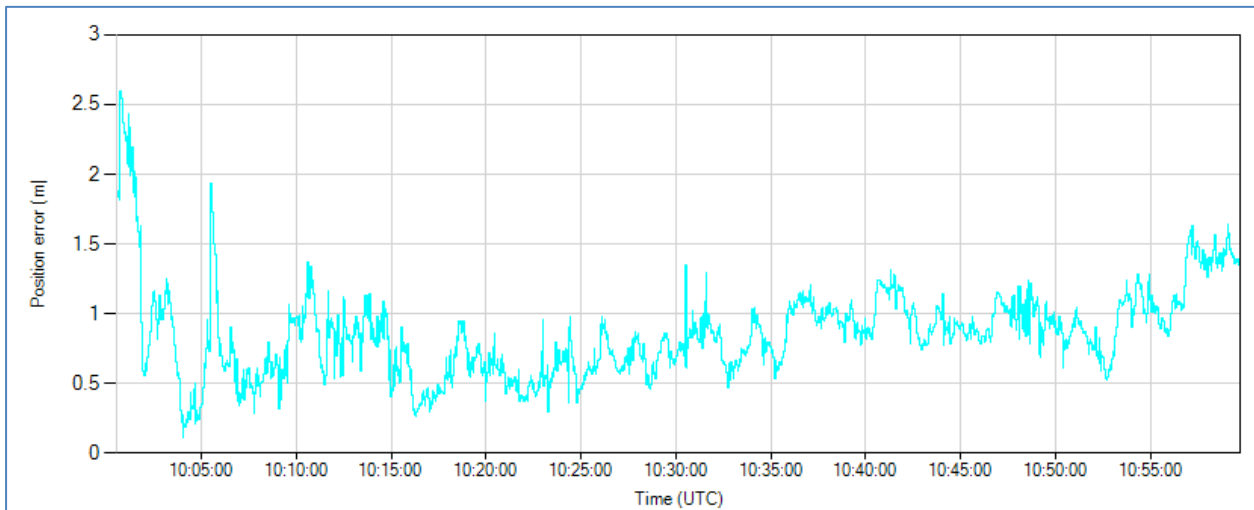
Override defaults:	<input checked="" type="checkbox"/>
Scenario duration:	00:01

### 5. Running the tests

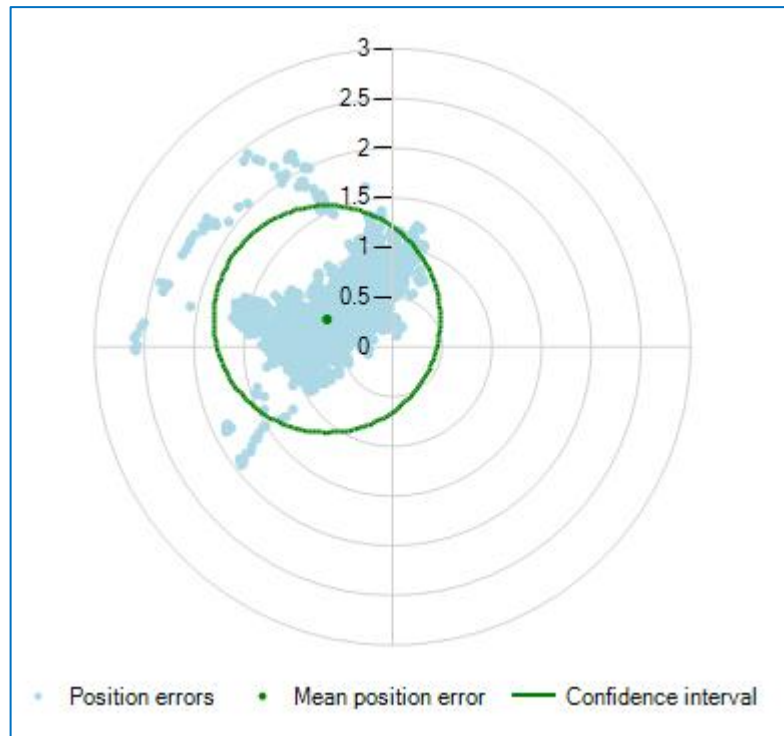
Press the start button to run the selected tests.



On the status tab, the test status is shown. Position errors are calculated every second and are shown on an error vs. time graph:

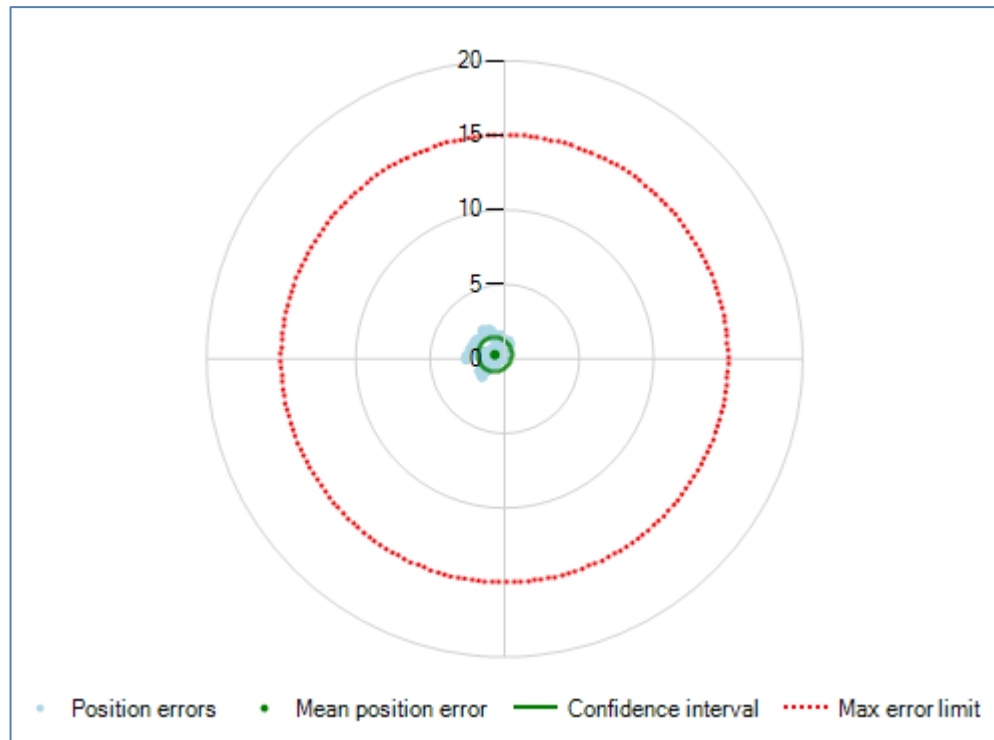


and plot indicating each position error, the mean position error, and the confidence interval. This is calculated using the methods and formulas given in 2.2.2.9 – 2.2.2.14, formula (6).



During the test run or after the test, it is possible to display the error limit by checking the Show max allowed error limit box.

 Show max allowed error limit



*A note on leap seconds – The position calculations are done by comparing NMEA from the GSG with NMEA from the receiver. Time of day in NMEA is specified in UTC. To calculate UTC time from GPS time, the receiver must know the current number of leap seconds. Until that information is received from the GPS signal, the receiver may not account for leap seconds at all or it may use a default value. If this occurs in stationary scenarios, a warning will be issued on the status page.*

[12/19/2017 14:13:39] Time on receiver jumped back. (10/4/2017 10:01:07 UTC)  
 [12/19/2017 14:13:39] This can be due to default leap seconds number in receiver is less than in simulated scenario  
 [12/19/2017 14:13:39] Time step between two consecutive NMEA epochs is 0.0 seconds, but >0 seconds expected.  
 [12/19/2017 14:13:39] Leap seconds number difference seems to be -1

*For mobile scenarios this can lead to a greater than expected error due to comparison of different timestamps. If this occurs, a warning will be issued on the status page and errors calculated prior to the reception of the leap second information will be disregarded from the position calculations.*

[12/19/2017 14:20:48] Time on receiver jumped back. (10/4/2017 10:01:07 UTC)  
 [12/19/2017 14:20:48] This can be due to default leap seconds number in receiver is less than in simulated scenario  
 [12/19/2017 14:20:48] Time step between two consecutive NMEA epochs is 0.0 seconds, but >0 seconds expected.  
 [12/19/2017 14:20:48] Leap seconds number difference seems to be -1  
 [12/19/2017 14:20:48] Clearing all previous position data.

## 5. Cold Start Time to First Fix 2.2.5

The cold start time to first fix tests are performed at two different power levels. 10 iterations of each test will be run.

### 1. Select the test(s) to run

Both tests can be selected and will be run back to back.

**Cold start time to first fix test (2.2.5)**

Time to first fix, -130 dBm (2.2.5.3):

Time to first fix, -140 dBm (2.2.5.8):

Override defaults:

Iterations:

### 2. Override defaults

To run fewer or more iterations of a test, check the Override defaults box and enter the number of iterations in the box. This will apply to the selected Time to first fix test(s) selected.

**Cold start time to first fix test (2.2.5)**

Time to first fix, -130 dBm (2.2.5.3):

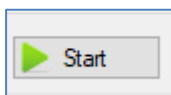
Time to first fix, -140 dBm (2.2.5.8):

Override defaults:

Iterations:

### 3. Running the tests

Press the start button to run the selected tests.



When the test is running, each iteration reports the time to first fix time. Finally, the average value of the 10 (or custom amount) iterations and the pass-fail result is shown.

For the -130 dBm test case, the time to first fix cannot exceed 60 seconds.

For the -140 dBm test case, the time to first fix cannot exceed 300 seconds.

Example of first two iterations of -130 dBm test case:

```
[12/15/2017 13:49:49] Cold start time to first fix test (2.2.5.3)
[12/15/2017 13:49:49] Iteration 1/10
[12/15/2017 13:49:49] Cold starting receiver
[12/15/2017 13:49:55] Receiver cold started
[12/15/2017 13:49:55] Starting scenario eCallTTFF2253.scen
[12/15/2017 13:50:17] Scenario started
[12/15/2017 13:50:17] Waiting for navigation solution...
[12/15/2017 13:50:53] Navigation solution received in 0 minutes 36 seconds [scen. time: 10/4/2017 10:00:17 UTC]
[12/15/2017 13:50:53] Stopping scenario
[12/15/2017 13:50:56] Scenario stopped
[12/15/2017 13:50:56] Iteration 2/10
[12/15/2017 13:50:56] Cold starting receiver
[12/15/2017 13:51:02] Receiver cold started
[12/15/2017 13:51:02] Starting scenario eCallTTFF2253.scen
[12/15/2017 13:51:24] Scenario started
[12/15/2017 13:51:24] Waiting for navigation solution...
[12/15/2017 13:52:00] Navigation solution received in 0 minutes 36 seconds [scen. time: 10/4/2017 10:00:18 UTC]
[12/15/2017 13:52:00] Stopping scenario
[12/15/2017 13:52:03] Scenario stopped
```

Example of the final test summary of -130 dBm test case:

```
[12/15/2017 14:01:07] Average time to first fix: 0 minutes 37 seconds. Expected <= 1 minutes 0 seconds
[12/15/2017 14:01:07] Test passed
```

Example of the first two iterations of the -140 dBm test case:

```
[12/18/2017 08:10:20] Cold start time to first fix test (2.2.5.8)
[12/18/2017 08:10:20] Iteration 1/10
[12/18/2017 08:10:20] Cold starting receiver
[12/18/2017 08:10:26] Receiver cold started
[12/18/2017 08:10:26] Starting scenario eCallTTFF2258.scen
[12/18/2017 08:10:49] Scenario started
[12/18/2017 08:10:49] Waiting for navigation solution...
[12/18/2017 08:12:02] Navigation solution received in 1 minutes 13 seconds [scen. time: 10/4/2017 10:00:55 UTC]
[12/18/2017 08:12:02] Stopping scenario
[12/18/2017 08:12:04] Scenario stopped
[12/18/2017 08:12:04] Iteration 2/10
[12/18/2017 08:12:04] Cold starting receiver
[12/18/2017 08:12:10] Receiver cold started
[12/18/2017 08:12:10] Starting scenario eCallTTFF2258.scen
[12/18/2017 08:12:33] Scenario started
[12/18/2017 08:12:33] Waiting for navigation solution...
[12/18/2017 08:13:23] Navigation solution received in 0 minutes 50 seconds [scen. time: 10/4/2017 10:00:32 UTC]
[12/18/2017 08:13:23] Stopping scenario
[12/18/2017 08:13:26] Scenario stopped
```

Example of the final test summary of -140 dBm test case:

```
[12/18/2017 08:24:48] Average time to first fix: 0 minutes 55 seconds. Expected <= 5 minutes 0 seconds
[12/18/2017 08:24:48] Test passed
```

## 6. Test of Re-acquisition time 2.2.6

The purpose of this test case is to test re-acquisition time of tracking signals after they are blocked out for 60 seconds at a time. Select the test to run by checking the Re-acquisition test box.

This test simulates the removal of antenna as described in 2.2.6.4 by turning all satellite power levels off for 60 second intervals.

### 1. Select the test to run

Check the re-acquisition test checkbox.

**Test of re-acquisition time of tracking signals after block out of 60 seconds (2.2.6)**

Re-acquisition test (2.2.6):

Override defaults:

Iterations:

Time to wait for solution (2.2.6.3):

### 2. Override defaults

By default, the test will wait for 15 minutes prior to removal of the signals, and it will perform 10 re-acquisition iterations. To override these defaults, check the override defaults box and enter a custom wait time and a custom number of iterations. The test is considered passed if the average re-acquisition time for at least 10 iterations is less than 20 seconds.

**Test of re-acquisition time of tracking signals after block out of 60 seconds (2.2.6)**

Re-acquisition test (2.2.6):

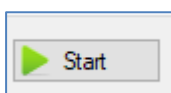
Override defaults:

Iterations:

Time to wait for solution (2.2.6.3):

### 3. Running the test

Press the start button to run the selected tests.



Example of start with wait time and first iteration:



```
[12/18/2017 08:36:49] Cold starting receiver
[12/18/2017 08:36:55] Receiver cold started
[12/18/2017 08:36:55] Starting scenario eCallReAcq226.scen
[12/18/2017 08:37:18] Scenario started
[12/18/2017 08:37:18] Waiting 15 minutes 0 seconds
[12/18/2017 08:37:56] Initially got position fix [scen. time: 10/4/2017 10:00:20 UTC]
[12/18/2017 08:52:18] Navigation solution is available after 15 minutes 0 seconds
[12/18/2017 08:52:18] Iteration 1
[12/18/2017 08:52:18] RF signal transmission disabled (simulation of antenna disconnection)
[12/18/2017 08:52:18] Waiting 1 minutes 0 seconds
[12/18/2017 08:52:22] No position fix (this is expected) [scen. time: 10/4/2017 10:14:46 UTC]
[12/18/2017 08:53:18] RF signal transmission enabled (simulation of antenna connection)
[12/18/2017 08:53:18] Waiting for navigation solution...
[12/18/2017 08:53:21] Navigation solution received in 0 minutes 2 seconds [scen. time: 10/4/2017 10:15:44 UTC]
```

Example of final test summary:

```
[12/18/2017 09:18:06] Average re-acquisition time: 0 minutes 2 seconds. Expected <= 0 minutes 20 seconds
[12/18/2017 09:18:06] Test passed
```

## 7. Receiver Sensitivity 2.2.7

This test uses different power levels for cold start acquisition sensitivity (-144 dBm), tracking sensitivity (-155dBm), and re-acquisition (-150 dBm). The simulator power level is automatically adjusted to meet the required output power level, so the external attenuators are not needed in this case.

### 1. Select the test to run

Check the box next to Sensitivity test (2.2.7)

Test of GNSS receiver sensitivity in cold start mode, tracking mode, and re-acquisition scenario (2.2.7)	
Sensitivity test (2.2.7):	<input checked="" type="checkbox"/>
Override defaults:	<input type="checkbox"/>
Pause after solution initially available (between 2.2.7.7 & 2.2.7.8):	00:00:00
Time to monitor for solution available (2.2.7.9):	00:00:00

### 2. Override defaults

The default time to wait after initial position fix is 20 seconds. To modify this value, check the override defaults box, and enter a new value for

'Pause after solution initially available'

The default time to monitor for a fix when the power level is lowest is 10 minutes. To change this value check the override defaults box and enter a new value for

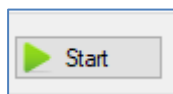
'Time to monitor for solution available'

When the override defaults box is checked, new entries should be made for both fields as these are the values that will be used in the test instead of defaults.

<b>Test of GNSS receiver sensitivity in cold start mode, tracking mode, and re-acquisition scenario (2.2.7)</b>	
Sensitivity test (2.2.7):	<input checked="" type="checkbox"/>
Override defaults:	<input checked="" type="checkbox"/>
Pause after solution initially available (between 2.2.7.7 & 2.2.7.8):	00:00:45
Time to monitor for solution available (2.2.7.9):	00:05:00

### 3. Running the test

Press the start button to run the selected tests.



The automated test sequence is as follows:

- Receiver is cold started
- Power level is set to -144dBm (2.2.7.6)
- Time to first fix is measured (must be less than 3600 seconds) (2.2.7.7, 2.2.7.13)
- Wait for 20 seconds to ensure receiver has stable fix
- Set power level down to -155dBm (2.2.7.8)
- Ensure that receiver continues to output position fix for 600 seconds (2.2.7.9, 2.2.7.13)
- Power level is set to -150 dBm (2.2.7.10)
- Power is turned off (to simulate a disconnected antenna) for 20 seconds (2.2.7.11)
- Power is turned on (-150dBm) (2.2.7.11)
- Verify re-acquisition time is less than 60 seconds (2.2.7.12, 2.2.7.13)

Example full test output:

```
[12/18/2017 09:43:02] Cold starting receiver
[12/18/2017 09:43:08] Receiver cold started
[12/18/2017 09:43:08] Starting scenario eCallSensitivity227.scen
[12/18/2017 09:43:31] Scenario started
[12/18/2017 09:43:31] Waiting for navigation solution...
[12/18/2017 09:44:34] Navigation solution received in 1 minutes 3 seconds [scen. time: 10/4/2017 10:00:45 UTC]
[12/18/2017 09:44:34] Waiting 0 minutes 20 seconds
[12/18/2017 09:44:54] RF signal power set to -155.0 dBm
[12/18/2017 09:44:54] Waiting 10 minutes 0 seconds
[12/18/2017 09:54:55] RF signal power set to -150.0 dBm
[12/18/2017 09:54:55] RF signal transmission disabled (simulation of antenna disconnection)
[12/18/2017 09:54:55] Waiting 0 minutes 20 seconds
[12/18/2017 09:54:58] No position fix (this is expected) [scen. time: 10/4/2017 10:11:09 UTC]
[12/18/2017 09:55:15] RF signal transmission enabled (simulation of antenna connection)
[12/18/2017 09:55:15] Waiting for navigation solution...
[12/18/2017 09:55:23] Navigation solution received in 0 minutes 9 seconds [scen. time: 10/4/2017 10:11:34 UTC]
[12/18/2017 09:55:23] Stopping scenario
[12/18/2017 09:55:26] Scenario stopped
[12/18/2017 09:55:26] Initial TTFF: 63.3 seconds; expected <= 3600.0 seconds
Solution available all the time when signal level is -155 dBm: yes
Re-acquisition time: 8.6 seconds; expected <= 60.0 seconds
[12/18/2017 09:55:26] Test passed
```