Application Note
Production Testing SSIII Modules

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1.   INTRODUCTION

This document provides guidance for the production floor testing of the SiRFstarIII GPS receivers. This document focuses on the GPS receiver functionality only and does not cover any generic board testing methods.

1.1.   Background

Information contained herein will provide the user with several methods to test GPS receivers on the production floor.

2.   APPLICABLE DOCUMENTS

SiRF Binary Reference Manual

SiRFDemo User Guide

SiRFLocDemo User Guide

SiRFLoc AI3 and F System Interface Control Documents

3.   GPS test methods. General description

SiRF recommends using one of the following methods on the production floor to verify proper assembly of the GPS receiver hardware. All tests described herein are for production hardware testing only, and are not recommended for software/system qualification. The options are:

A) Test Mode 3 (Backward compatible to SiRFstarII generations)

B) Test Mode 4

C) Live fix test

D) Test Mode and a Live Fix Test

Quick description of the methods is provided below:

Table 1 Overview of Testing Options

Method	Approximate testing	Test coverage	Special equipment required

	time		
A. Test Mode 3 (Compatible to SiRFstarII generations)	~15 s	Characterizes board integrity, as well as the GPS crystal, RF and baseband power supply. Allows for pass/fail criteria to be set up for multiple board characteristic measurements, such as clock offset, C/N_0 variations, and VCO lost lock. However, due to the limited test time, the statistical data is not 100% reliable. Therefore, Test Mode 3 should be used in conjunction with a live fix test for best results.	- One-channel GPS simulator (recommended)
B. Test Mode 4 (Recommended for SiRFstarIII designs)	~15 s	Characterizes board integrity, as well as the GPS crystal, RF and baseband power supply. Allows for pass/fail criteria to be set up for multiple board characteristic measurements, such as clock offset, C/N_0 variations, and VCO lost lock. However, due to the limited test time, the statistical data is not 100% reliable. Therefore, Test Mode 4 should be used in conjunction with a live fix test for best results.	- One channel GPS simulator (recommended)
C. Live Fix Test (Standard - GSW3)	40 s	Live fix provides the ability to ensure integrity of GPS function only and allows for generalized C/N_0 measurements. Very little statistical data is available for GPS crystal behavior, RF power supply, etc.	- External live antenna Or - 12 channels GPS simulator
C. Live Fix Test (SiRFLoc - SLC3)	2 s	Live fix provides the ability to ensure integrity of GPS function only and allows for generalized C/N_0 measurements. Very little statistical data is available for GPS crystal behavior, RF power supply, etc.	- External live antenna Or - 12 channels GPS simulator - Time Transfer Board
D. Test Mode and Live Fix Test	17 s – 55 s	Characterizes board integrity, as well as the GPS crystal, RF and baseband power supply. Allows for pass/fail criteria to be set up for multiple board characteristic measurements, such as clock offset, C/N_0 variations, and VCO lost lock. As well, this test method provides	- One channel GPS simulator and external live antenna Or

		redundancy allowing the tester to limit false positives.	- 12 channels GPS simulator - Time Transfer Board

4. Methods A and B. Test Mode 3 or Test Mode 4

This document will concentrate on outlining how to use Test Mode 4, which is recommended for use with SiRFstarIII. For users who have experience with Test Mode 3 from prior SiRF generations, SiRFstarIII will continue to support Test Mode 3. For details on Test Mode 3, please refer to the SiRF Binary Protocol Reference Manual and/or application note # 40.

This test method uses a single channel GPS signal simulator as a GPS RF signal source. The GPS receiver under test tracks the same SV on all its channels and collects statistical information at one RF signal power level.

This test characterizes board integrity, as well as the GPS crystal, RF and baseband power supply and allows for pass/fail criteria to be set up for multiple board characteristic measurements, such as clock offset, C/N_0 variations and others. However, due to the limited test time, the statistical data is not 100% reliable. Therefore, Test Mode 4 should be used in conjunction with a live fix test for best results.

This test takes approximately 15 seconds.

4.1. Test setup

Figure 1 shows a block diagram of the Test Mode 4 system setup. While this document describes the use of the UART for communication between the device under test (DUT) and the test equipment (ATE), any other communications link (e.g., API, network, USB) may be implemented.
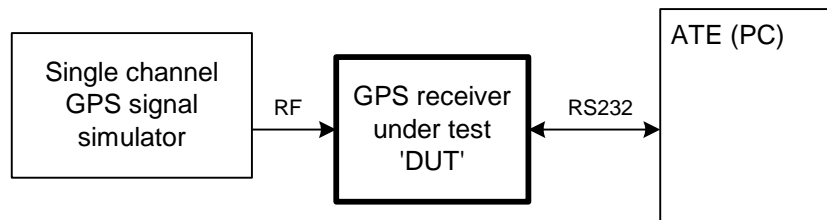

Figure 1 Test Mode 4 setup

GPS firmware required:

SiRF GPS standard GSW3 firmware or SLC3 firmware supports Test Mode 4.

Equipment required:

1. Single channel GPS signal generator which outputs code and data information. (e.g. Welnavigate GS100)

2. ATE system with a RS232 serial port for the purpose of communication with GPS under test.

3. Test fixture, DUT power supply, cables, RF DC blocks, etc.

    Note 1: The same GPS simulator can be used to feed multiple DUTs for parallel testing. In such a case an RF splitter should be used and the ATE should have as many RS232 serial ports as DUTs.

    Note 2: If the GPS receiver is designed to work with an active antenna, then it outputs a DC voltage on the antenna input connector (usually 3 V or 5 V). This voltage can cause issues with the GPS testing and needs to be blocked by putting an RF DC block on every DUT's antenna input.

The single-channel GPS simulator should be set to provide a signal at 40 dB-Hz. DATA and CODE switches need to be ON and DOPPLER - OFF. The SV ID number should be set to any valid value (from 1 to 32). A reference GPS receiver ('golden unit') should be used as an RF signal level measurement reference.

4.2. Test procedure

The following procedure needs to be processed in order to execute Test Mode 4. The procedure assumes that the GPS code is already loaded into the target, the GPS signal simulator is warmed up and the ATE is operational.

1. Power on the GPS receiver (supply current consumption measurement is recommended)
2. Wait for any SiRF message coming out of DUT. DUT can be considered a failure if no valid SiRF message arrives on the ATE within two seconds.
3. Send SIRF command ID 150 (Switch Operating Mode) with following parameters:
    - Mode = 0x1E54 (for Test Mode 4)
    - SvID = Satellite ID set on the GPS signal simulator (e.g. 21)
    - Period = 10
4. Wait one second. Within this time GPS will restart in test mode.
5. Wait for any SiRF message coming out of DUT. DUT can be considered a failure if no valid SiRF message arrives on the ATE within two seconds.

6. Wait for SiRF message ID 46 (Test Mode Data) and record data from it. If the message does not come within 20 seconds (Test period + 10 seconds) then DUT can be considered a failure, as it was not able to acquire a GPS signal.
7. This step is optional, as the DUT should reset into normal mode on its own. Send SIRF command ID 150 (Switch Operating Mode) with following parameters:
    - Mode = 0
    - SvID = 0
    - Period = 0

    This command will bring the receiver back to normal operating mode. Wait one second for command to be executed.
8. Power off the DUT. Test is complete.

*Note 1: initial users of Test Mode 4, should use the "Log a File" function that is available in SiRFDemo or SiRFLocDemo to capture the MID 46 output message. This will allow the user to become comfortable with the format and timing. In order to see MID 46 in the log file, please ensure that "Development Data" is turned on in the "Receiver Initialization" window.
*Note 2: Additional messages (MID 48, 49) are not required for Test Mode 4. These are additional messages used by SiRF internally, and should not be utilized by a customer.

4.3. Pass/fail criteria

The pass/fail limit values for all above parameters depend directly on the hardware design and component used. Please refer to the chapter 8 *Determining Pass/Fail Criteria* for more related information.

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5. Method C. Live Fix Test (GSW3)

This test method uses a live, rooftop, open sky antenna or a 12-channel GPS signal simulator as a GPS RF signal source. In this case, the GPS receiver under test acquires and tracks the signal to provide a final position fix. Note: the procedure below should be used in conjunction with GSW3 SW. For SiRFLoc SLC3.x SW, please proceed to Method D (Live Fix Test (SLC3)).

Live fix provides the ability to ensure integrity of GPS function only and allows for generalized C/N_0 measurements. Very little statistical data is available in regards to GPS crystal behavior, RF power supply, etc.

This test takes approximately 40 seconds.

5.1. Test setup

Figure 2 shows a block diagram of the Live Fix Test system setup. While this document describes the use of the UART for communication between the DUT and the ATE, any other communications link (e.g., API, network, USB) may be implemented.

Figure 2 Live Fix Test setup
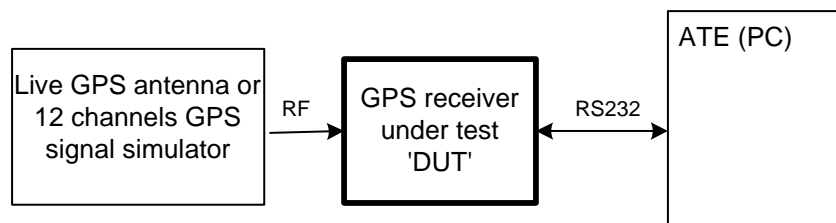
GPS firmware required:
- GSW3 standard firmware.

Equipment required:
- Live, rooftop, open sky GPS antenna or a 12-channel GPS signal simulator (e.g. SPIRENT STR 4500)
- RF signal splitter
- ATE system with at least two RS232 serial ports for the purpose of communicating with the GPS receiver under test and the reference receiver
- Test fixture, DUT power supply, cables, RF DC blocks, etc.

Note 1: The same RF signal can be used to feed multiple DUTs for parallel testing. In such a case, the RF splitter should have more outputs and the ATE should have as many additional RS232 serial ports as DUTs.

Note 2: If the GPS receiver is designed to work with an active antenna, then it outputs a DC voltage on the antenna input (usually 3 V or 5 V). This voltage can cause issues with the GPS testing and needs to be eliminated by putting an RF DC block on every DUT's antenna input.

Simulator Scenario Setup

- Simulator should have a static scenario. The optimum would be to have a static scenario, which does not have to be reset for each board test. Make this scenario repeat every 30 minutes to 1 hour to maintain a common scenario for each module test.

- The date of the simulation should be at the current year. Note that the simulation date must at least be after the default build date of the SiRF firmware. You can be sure of this by simply building a scenario with a date which coincides with your production start date.

5.2.   Test procedure

Follow the steps below to execute the Live Fix Test. The procedure assumes that the GPS code is already loaded into target, the GPS signal simulator (if used) is warmed up and the scenario is running, the GPS reference receiver (if used) has a fix with at least 5 satellites and the ATE is operational.

1. Power on the GPS receiver (we recommend that you verify power supply current is within acceptable limits). Receiver will start in a cold start mode.
2. Wait for any SiRF message coming out of DUT. DUT can be failed if no valid SiRF message arrives within two seconds.
3. Optional step. If DUT's state might be unknown at the moment of testing then SiRF message ID 128 (Initialization) should be sent to execute a cold start. This operation will extend test time by up to 3 seconds.
4. Monitor SiRF message ID 41 (Geodetic Navigation Data) or message ID 02 (Measured Navigation Data) and wait for a position fix.
5. Optional step. If a simulator is used, we recommend that the DUT be re-initialized for a cold start prior to powering off. This step will clear any data in RAM, which may cause problems in a live environment.
6. Power off the DUT. Test is complete.

5.3. Pass/fail criteria

The pass/fail limit values for all above parameters depend directly on the hardware design and components used. Please refer to the chapter 8, *Determining Pass/Fail Criteria,* for more related information.

6. Method D. Live Fix Test (SiRFLoc)

This test method uses a live, rooftop, open sky antenna or a 12-channel GPS signal simulator as a GPS RF signal source. In this case, the GPS receiver under test acquires and tracks the signal to provide a final position fix. In order to speed up the testing, the DUT may be provided aiding, such as coarse aiding, which takes advantage of the AI3/F interface which allows for time, position and ephemeris aiding among other things. This test is only feasible if the client is using SiRFLoc firmware.

Live fix provides the ability to ensure integrity of the GPS function only, and allows for generalized C/N_0 measurements. Very little statistical data is available for GPS crystal behavior, RF power supply, etc.

This test takes approximately 2 seconds to perform one iteration.

6.1. Test setup

Using a SiRFstarIII Evaluation kit outfitted with a TTB (Time Transfer Board), it is possible to perform a coarse aiding test scenario with the DUT. Use of SiRFLocDemo is required.

GPS firmware required:
    - SLC3 SiRFLoc firmware.

Equipment required:
- Live, rooftop, open sky GPS antenna or a 12-channel GPS signal simulator (e.g. SPIRENT STR 4500)
- RF signal splitter
- ATE system with one RS232 serial port for the purpose of communicating with the GPS receiver under test.
- SSIII EVK that supports a TTB (Time Transfer Board)
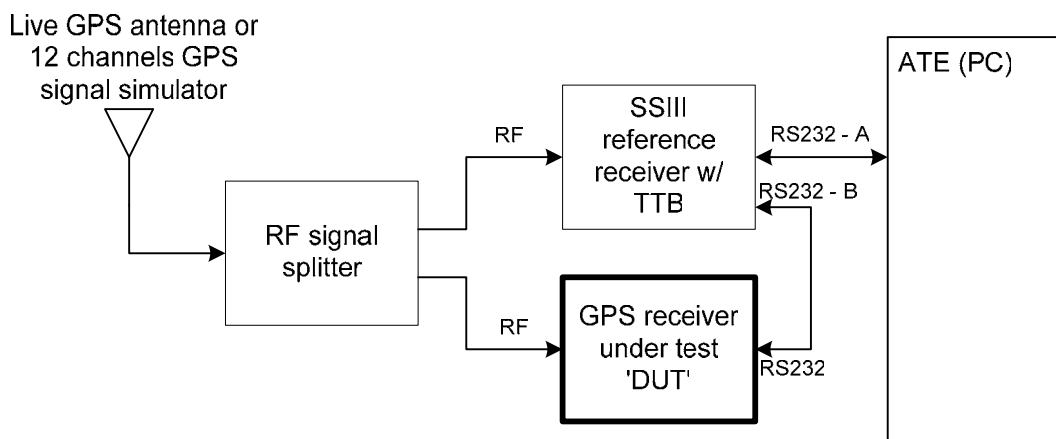- Test fixture, DUT power supply, cables, RF DC blocks, etc.

Figure 3 **SiRFLoc Live Fix Test Setup**

6.2. Test Procedure

Follow the steps below to execute the Live Fix Test with SLC3. The procedure assumes that the GPS code is already loaded into target, the GPS signal simulator (if used) is warmed up and the scenario is running, the TTB has a fix with at least 5 satellites and the ATE is operational. Note, that for the TTB to operate correctly, we recommend that the satellites it is tracking have signal strengths above 36dB/Hz. Thus, you may want to consider adding an attenuator between the RF signal splitter and the DUT in the figure above.   It is wise to have reviewed the evaluation kit manual on how to use SiRFLocDemo or to have used SiRFLocDemo prior to trying to run this exercise.

This test requires that the AI3, F messages are all accessible. Use of SiRF Binary in addition is recommended. Follow the instructions provided for in the SiRFLocDemo Evaluation Kit User's Guide to ensure that you have the communication ports open with AI3, F and SiRF Binary messages active for the DUT.

1. Supplying necessary power (Power to TTB at a minimum) and antenna connections (Antenna supply for TTB) to the SSIII EVK, place the SSIII EVK with TTB into "Split Mode". Using two RS-232 cables, connect port B of the EVK to your DUT, and connect port A of the EVK to the PC running SiRFLocDemo.
2. Setup the time aiding from the TTB. Under SiRFLocDemo, under the Setup Menu, select Display TTB. Once you are communicating with the TTB, under the TTB Menu, select Configure Time Aiding. Select the items below and press OK.

6.2.1. TTB/ Configure Time Aiding

	Coarse
Enable:	Enable
Mode:	Coarse
Accuracy:	2.0s
Skew:	0ms

3. Under the Setup Menu, select Display SLC (Same as your DUT). Once you are communicating with the DUT, go to the SiRFLoc Menu and select Autoreply and then Hardware Configuration. Select the items below, check the Autoreply box and press OK.

6.2.2. SiRFLoc/ Autoreply/ Hardware Configuration

	Coarse
Precise Time Available:	No
Precise Time Transfer Direction:	CP->SLC
Frequency Transfer Available:	No
Frequency Transfer Method:	Non-counter
RTC Available	Yes
RTC for GPS	Internal to GPS
Coarse Time Transfer Available	On
Reference Clock Status	On
Nominal Frequency:	0

Ensure that Autoreply is selected.

4. Under the SiRFLoc Menu/Autoreply/Approximate Position Request, select the items below and check the Autoreply box and press OK.

6.2.3. SiRFLoc/ Autoreply/ Approximate Position Request

	Coarse
Latitude	Use expected latitude from the simulation scenario
Longitude	Use expected longitude from the simulation scenario

Alt	Use expected altitude from simulation scenario
Est. Horizontal Error	30,000m
Est. Vertical Error	100m

Ensure that Autoreply is checked.

5. Under the SiRFLoc Menu/Autoreply/Frequency Transfer Request, select the items below and check the Autoreply box and press OK.

6.2.4. SiRFLoc/ Autoreply/ Freq Transfer Request

	Coarse
*Select "Use Receiver Reported Frequency Offset"	
Offset	96250
Accuracy	0.5ppm
Clock Source	SLC Clock
Ref Clock is	On
Ref Clock Request	None
Include Nominal Freq	No
Nominal Freq	0
Time Tag	Valid fwd

Ensure that Autoreply is checked.

6. Under the SiRFLoc Menu/Autoreply/AI3 Position Request, select the items below and check the Autoreply box and press OK.

6.2.5. SiRFLoc/ AI3 Position Request

	Coarse
Position Method	MS Based
Number of Fixes	Continuous or 10
Time between fixes	1
Horizontal Error	No max
Vertical Error	No max
Priority	No priority
Almanac Request	No Almanac
Ephemeris Source	TTB
Almanac Source	None

Nav Bit Source	NA

Ensure that Autoreply is checked.

6. We are now ready to run the test. Note, once SiRFLocDemo is configured as above, the configuration settings are saved to a local sld.ini file. Thus once you have configured this the first time, there is no need to go through the configuration again.
7. To run the test, the DUT needs to be sent either a power reset or a soft reset request. The soft reset can be achieved via SiRFLocDemo by using the SiRFLoc Menu and selecting Reset GPS
8. Monitor SiRF message ID 41 (Geodetic Navigation Data) or message ID 02 (Measured Navigation Data) and wait for a position fix.
9. Optional step. If a simulator is used, we recommend that the DUT be re-initialized for a cold start prior to powering off. This step will clear any data in RAM, which may cause problems in a live environment.
10. Power off the DUT. Test is complete.

6.3. Pass/fail criteria

The pass/fail limit values for all above parameters depend directly on the hardware design and components used. Please refer to chapter 8, *Determining Pass/Fail Criteria* for more related information.

7. Method E. Test Mode and Live Fix Test

This test method consists of combining two methods previously described: Test Mode and Live Fix Test. The Test Mode is used first to obtain statistical data and the Live Fix Test is executed later to ensure a proper GPS receiver operation.

This test characterizes board integrity, as well as the GPS crystal, RF and baseband power supply. It allows for pass/fail criteria to be set up for multiple board characteristic measurements, such as clock offset, C/N_0 variations, and VCO lost lock. As well, this test method provides redundancy allowing the tester to limit false positives.

This test takes approximately 17 seconds for SLC3 (15s for Test Mode and 2s for Live Test) and approximately 55s for GSW3 (15s for Test Mode and 40s for Live Test).

As an alternative, the actual testing may consist of performing Test Mode testing on all receivers, and Live Fix Testing on a sample of the receivers as a secondary verification test.

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As this form of testing is adding two of the tests described previously in this document, we will not go into details on this test setup and test procedure. The user must simply run in series the Test Mode stage and then the Live Fix stage.

8. Determining Pass/Fail Criteria

Pass/Fail limits are specific to each client's hardware design and components used, thus SiRF recommends that each client initially set their pass/fail limits based on sample lot runs.

Steps to determine the pass/fail limits are:

1. Build 100 GPS units and load released firmware. The GPS units will be referred to as the Device Under Test (DUT) for the remainder of this consideration.
2. Ensure that each DUT to be tested has a traceable serial number. This will allow you to re-test outliers to ensure that they have consistent values, and to determine how well they operate/do not operate in live fix testing.
3. Initially test each DUT to ensure that the DUTs will receive a fix using an open sky test or a 12 channels simulator test. As a note, we want to tune the pass/fail criteria using DUTs which we know work. DUTs, which cannot get a fix, should not be used to tune pass/fail limits, as these DUTs will falsely skew results. We assume that DUTs that cannot achieve a fix will fall outside of the pass/fail thresholds.
4. Run the ATE interface tool, which will allow for reading of C/N_0 values from SiRF message ID 04 (Measured Tracker Data). SiRFDemo or SiRFLocDemo program may be used for this purpose.
5. Turn the single-channel GPS simulator on and let it warm up for 20 minutes, then connect the GPS Generator OUTPUT to the receiver antenna. Set GPS signal generator to SV ID 20. Set DATA and CODE switch to ON and DOPPLER to OFF.
6. Calibrate the setup before test. Adjust power to a calibrated level that achieves a reported value of 40 dB-Hz C/N_0 on a golden GPS unit (or best available unit, such as a SiRF Evaluation Kit).
7. If using SPIRENT STR4500 GPS signal simulator, connect the simulator output to the DUT antenna. Make sure that only one satellite is turned ON. Turn the rest of the satellites to OFF position. Again, adjust power level as explained in step 6.
8. Run the ATE interface tool at the correct baud rate to ensure that the DUT and the interface tool are communicating.
9. Cold start the unit.
10. Switch the unit into the Test Mode by issuing a SiRF command ID 150 (Switch Operating Mode) with following parameters:
    - Mode = 0x1E54
    - SvID = 21 (the SV ID which is set on the GPS signal simulator)

- Period = 10

11. Record the output from Test Mode with each of the 100 DUTs. For data logging, wait for about 60 seconds after putting the receiver into the Test Mode option. Then save all results to a log file using the ATE tool to record all output messages. Make sure that all messages are selected for logging, and that there is a way to correlate the DUT's serial number to the log file. Log the data for 60 seconds. (You need to keep the duration of data collection time approximately the same for all 100 receivers).

12. For each log file, calculate the average and standard deviation of each test parameter output on MID 46. Please ensure that each log file is named with the DUT's serial number.

8.1. Sample Pass/Fail Limits Test Mode 4

To provide the user with a guideline, below is a pass/fail limit scenario for a typical SiRF receiver. These values will differ between clients, due to hardware distinctions, TCXO choice, etc., and thus it is your responsibility to tune actual limits to your systems.

Firstly, the table below describes Test Mode 4 sample pass/fail starting points.

Table 2 Sample Pass/Fail chart

Bit Sync Time	3 seconds
C/N_0 Mean	40 dB/Hz
C/N_0 Sigma	0.1 dB/Hz
Clock Drift	1000 Hz
Clock Offset	96250 Hz
Abs I20ms	240520
Abs Q20ms	45050
Phase Lock Indicator	98

8.2. Sample Pass/Fail Limits Test Mode 4

The Following parameters should be computed or decoded from SiRF Binary message ID 04 during test execution and compared with pass/fail limits:

- C/N_0 average (computed by ATE)

![SiRF logo]

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- TTFF (computed by ATE – measured from power reset until the "state" field in MID 04 is no longer a 0 value)
- Time to first 0x3F status on any one channel (computed by ATE)

Suggested benchmarks to begin with for the purpose of tuning pass/fail limits.

Table 3 GSW3 Live Test Suggested Pass/Fail Parameters

RF Supply	Live Signal	Simulator
C/N$_0$ Mean	Compare to a Golden Unit for the same time period. Suggest <0.5dB difference between DUT and Golden Unit	Compare to the set C/No being output by the simulator. Suggest <0.5dB difference between DUT and Golden Unit
Time to First 3F on any channel	< 5 seconds	< 5 seconds
Time to First Fix	< 38s with open sky antenna feed	< 38s with average C/No of 40dB/Hz

Table 4 SLC3 Live Test Suggested Pass/Fail Parameters

RF Supply	Live Signal	Simulator
C/N$_0$ Mean	Compare to a Golden Unit for the same time period. Suggest <0.5dB difference between DUT and Golden Unit	Compare to the set C/No being output by the simulator. Suggest <0.5dB difference between DUT and Golden Unit
Time to First 3F on any channel	No requirement to measure	No requirement to measure
Time to First Fix	< 2s after aiding. With open sky antenna feed	< 2s after aiding, with average C/No of > 36dB/Hz

6. Glossary

ATE - Automatic Test Equipment. A set of tools (hardware and software) on the production floor that execute and manage tests, make pass / fail decisions and prepare test reports. As a minimum the ATE can consist of a personal computer (PC) with appropriate software.

BER - Bit Error Rate. A measure of the number of data bits received in error per unit time.

DUT - Device under Test. The unit to be tested on the production floor.

GSW3 - Standard software supported by the SiRFstarIII chipset. No aiding interface.

Signal level - The signal level is the reported C/N_0 level in units of dB-Hz. The raw tracker data output reports ten of these values every second. The statistical mean (dB-Hz) and standard deviation, sigma (dB), are then calculated. The mean value is then compared against the programmed threshold and a decision on pass/fail is made. The mean signal level is a measure of the sensitivity of the receiver while sigma is an indication of its stability.

SLC3 - SiRFLoc software supported by the SiRFstarIII chipset. Intended for A-GPS solutions.

9. DOCUMENT MAINTENANCE

9.1. Required Approval for Changes

Changes to this document require the approval of Field Applications Engineering.

9.2. Revision History

Rev	Rev Date	CN Number	Description
0.1	7/30/03	N/A	Preliminary Release
1.0	3/1/05	2669	Official Release under CN Control

10. Appendix A – Test Mode 4 Message Description

Table 5. Detailed Description of Test Mode4 Message Id 46

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		2E			46
Test Mode	1		04			4
Message Variant	1		01			1
SV ID	2		01			1
Period	2		001E	sec		30
Bit Sync Time	2		0002	sec		2
C/N$_0$ Mean	2	*10	01C6		÷10	45.4
C/N$_0$ Sigma	2	*10	0005		÷10	0.5
Clock Drift	2	*10	1B0E	Hz	÷10	692.6
Clock Offset	4	*10	000EB41A	Hz	÷10	96361
Reserved	2		0000			0
Abs I20ms	4		0003AB88			240520
Abs Q20ms	4		0000AFF0			45040
Phase Lock Indicator	2	*100	0062		÷100	98

Table 6. Description of data items in Message ID 46

Name	Description
Message I.D.	Message I.D. number.
Test Mode	4 = Test Mode 4
Message Variant	The variant number of the message (variant change indicates possible change in number of fields or field description)
SV ID	The PRN code of the satellite being tracked.
Period	The total duration of time (in seconds) that the satellite is tracked.
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37.
C/N$_0$ Mean	Calculated average of reported C/N$_0$ by all 12 channels during the test period.

C/N$_0$ Sigma	Calculated sigma of reported C/N$_0$ by all 12 channels during the test period.
Clock Drift	Difference in clock frequency from start and end of the test period.
Clock Offset	The internal clock offset.
Reserved	Not Used
Abs I20ms	Absolute value of the 20ms coherent sums of the I count over the duration of the test period
Abs Q20ms	Absolute value of the 1ms Q count over the duration of the test period
Phase Lock Indicator	Unit less measurement of how effective the receiver has been in maintaining phase lock during a 10s period