SIGNAL HOUND

Field Calibration Software

User's Manual

Version 1.0

9/25/2014

Requirements, Installation, Instructions, Usage

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1   Introduction

The Signal Hound field calibration software is a PC based application for running performance verification tests, and making adjustments to the Signal Hound BB60C spectrum analyzer.

2   System Requirements

PC Requirements for BB60C calibrations

- 64-bit Windows 7/8
- Intel quad-core i-Series processors
- 4096 MB of RAM or more is recommended
- Native USB 3.0 support
- 2x USB 3.0 port (recommended)   *or*   1x USB 3.0 and 1x USB 2.0 port (For BB60C)
- 1x USB 2.0 for USB to GPIB controller
- BB60C Software Application installed (Version 2.0.5 or higher)

Additional Requirements

- USB to GPIB controller

3   Before Installing the Software

Before installing the Signal Hound calibration software, ensure the main BB60C software application is installed and working. The BB60C software application can be found on the Signal Hound website (www.signalhound.com). It includes the USB device drivers for the BB60C spectrum analyzer, which is necessary for the calibration software to communicate to the device. The minimum BB60C application version required is 2.0.5.

4   Installation Instructions

The Signal Hound calibration software can be downloaded from the Signal Hound website. Unzip the downloaded compressed folder and run the *setup.exe* file. Follow the on-screen instructions to finish the installation. We recommend installing the software to the default installation directory at C:/Program Files/Signal Hound/Field Calibration

5   Uninstalling

On Windows 7/8, the Signal Hound calibration software can be uninstalled from the *Programs and Features* menu. The *Program and Features* menu can be found in the *Control Panel.* Find the Signal Hound calibration software, right click the icon, and select uninstall. Once uninstalled, the calibration software can be installed again on the same computer at any time.

6   Getting Started

This chapter prepares the user to perform calibrations using the software.

6.1   Calibration Cycle

A one year calibration cycle is recommended for the BB60C.

6.2   Lab Standards

The calibration software calls for a number of lab standards. The tests are automated over GPIB. Agilent VISA drivers are used, and a National Instruments or Agilent GPIB adapter is required. To perform all calibrations, all lab standards will need to be present. If any standard is missing, some performance tests will be unavailable. All lab standards need to be within calibration.

6.2.1   BB60C Lab Standards

Equipment Type	Key Specifications Used	Required Make / Model
Signal Generator	10 MHz to 6 GHz, -50 dBm to +10 dBm output, <-55 dBc harmonics	Agilent 83712B/83732B
Function Generator	9 kHz to 10 MHz, -20 dBm to +13 dBm output	Agilent 33120A or compatible
Power Meter	Supports E9304A sensor	Agilent EPM-series, E4418, E4419
Spectrum Analyzer	2 GHz to 7.5GHz RF input	Agilent 8562E-8565EC
Power Sensor	9kHz – 6GHz RF input, all E9304A specifications required	Agilent E9304A
Power Splitter	9kHz – 6GHz, VSWR < 1.22, 0.25 dB output tracking	Agilent 11667B or equivalent
Attenuator (10dB)	9kHz – 6GHz, VSWR < 1.1, ±0.3 dB	Agilent 8493C or equivalent

*Depending on the test setup, various adapters may be needed and are not listed here.

If an 83712B/83732B signal generator is not available, the Agilent 8340/8341 or Agilent 8665B may be used for all tests except for Spurious Mixer Products.

For calibration of the BB60C 10 MHz time base reference, your signal generator's internal time base must be within 0.2 ppm, or an accurate external 10 MHz reference must be connected to your signal generator's **10 MHz Input** connector. Adjusting the BB60C 10 MHz reference without an accurate external 10 MHz reference is discouraged.

7   Running the Software

This chapter acts as a guide to running the Signal Hound field calibration software.

7.1 Before starting the software

At this point all lab standards need to be identified and should be on a GPIB network connected to your PC with a unique GPIB address.

The Signal Hound spectrum analyzer under test should be connected to your PC, and should be allowed at minimum 15 minutes of idling time before starting the software. This allows the device to reach a stable operating temperature.

7.2 Starting a New Calibration Session

Upon launching the software, the user will be presented with a splash screen and application menu bar. Using the menu bar, select *Start New Test -> BB60C* to begin a new calibration test session.
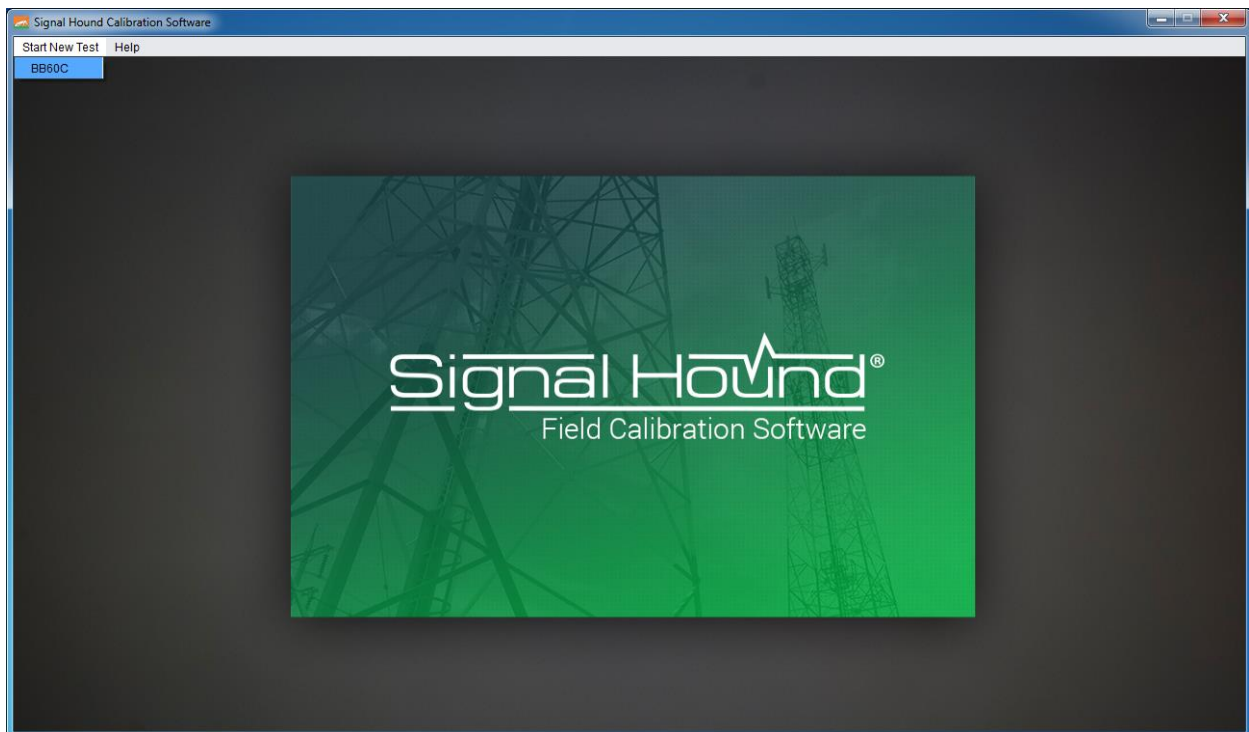

Figure 1: Using the file menu to start a new calibration session

7.3 Application Layout

When a test has been selected the software will immediately change into an interface designed to manage the calibration session.
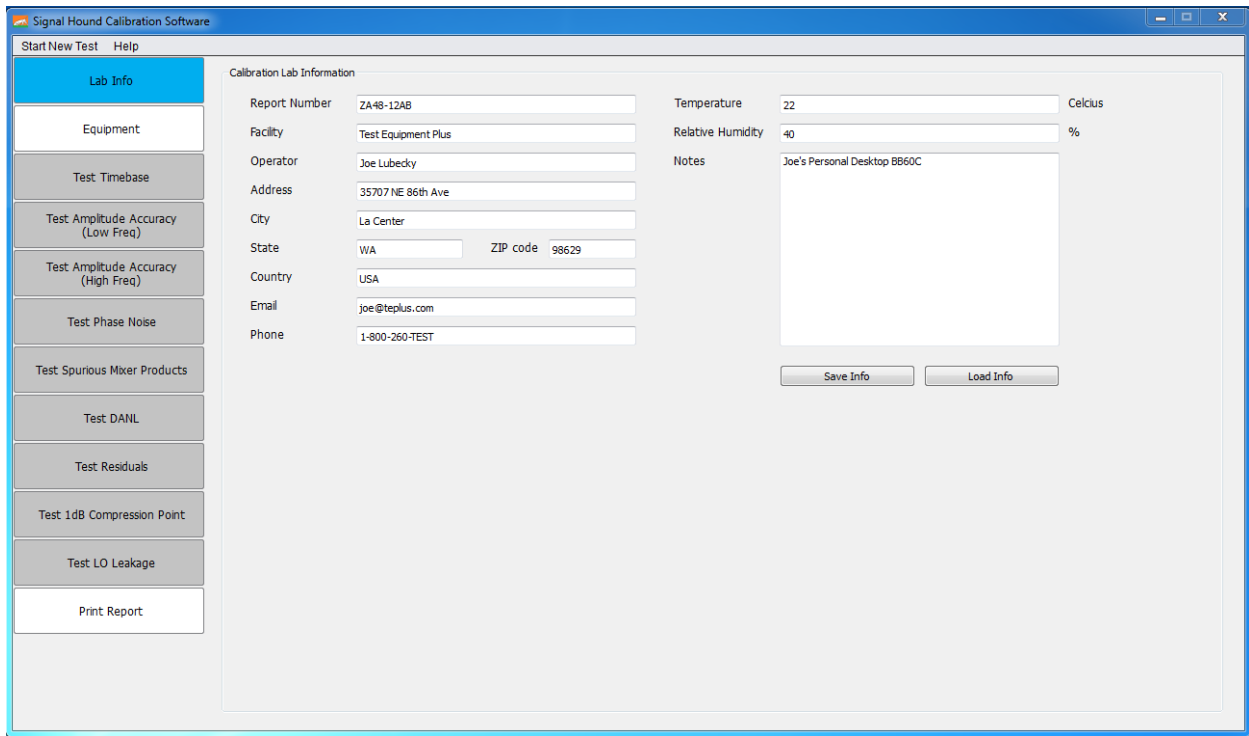
Figure 2: Application Layout for the BB60C Calibration Session

On the left portion of the application you will see various tabs, and on the right is the designated workspace for a given tab. Tabs can be selected with your mouse. Available tabs are colored white, and greyed out tabs indicate tests that are unavailable.

7.4   Filling Out Lab Information

Selecting the *Lab Info* tab displays a workspace for entering your calibration lab information as well as test environment information. You can add any notes and a report number for tracking purposes. This information will be printed on the final test report. You can save/load the information on this page to prevent having to re-type it on future tests.

7.5   Adding Test Standards

Selecting the *Equipment* tab displays a workspace for entering and connecting your available test standards. From this tab you will connect the device under test, all GPIB instrument, and enter all passive test standards.

It is recommended to add all test standards before beginning the calibration tests.
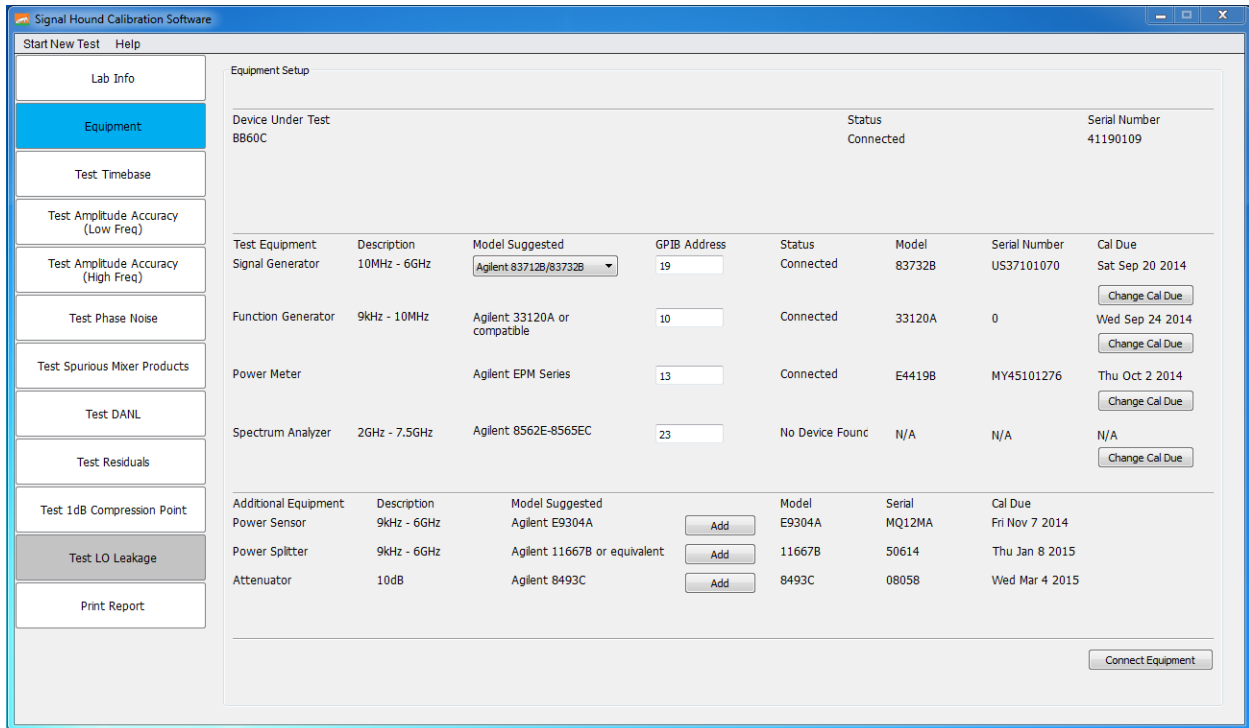
Figure 3: Equipment entry tab for a BB60C calibration session

7.5.1 Adding the Device Under Test

The device under test (DUT) can be added simply by having the device connected to your PC and pressing the *Connect Equipment* button. If it has been properly detected, the *Device Under Test* section under the equipment tab will be updated to show the connection status and serial number.

If at any point during the calibration the DUT becomes disconnected, the software will alert you to this and you will need to return to the *Equipment* tab and re-connect the DUT.

7.5.2 Adding GPIB Instruments

To add a test standard with a GPIB interface, you need to enter a GPIB address for the standard, and press the *Connect Equipment* button. If the device responds at that address, the session will populate the Model / Serial Number / and Cal Due date for that device. You will need to select the Cal Due date the first time you connect a new test standard.

Once any test standard with a GPIB interface has been added to the software, it cannot be changed until the software is restarted.

7.5.3 Adding Passive Test Standards

Passive equipment must be added manually. All equipment in this category can be found under the *Additional Equipment* section in the *Equipment* tab. Pressing *Add* next to each piece of equipment allows you to enter the model, serial, and calibration due date of each piece of equipment.

7.6 Running the Performance Verification Tests

As you add test standards to the session, test tabs will become available. Each test tab will display a workspace containing a description of the test, and image depicting the test setup, test output, and a start test button.
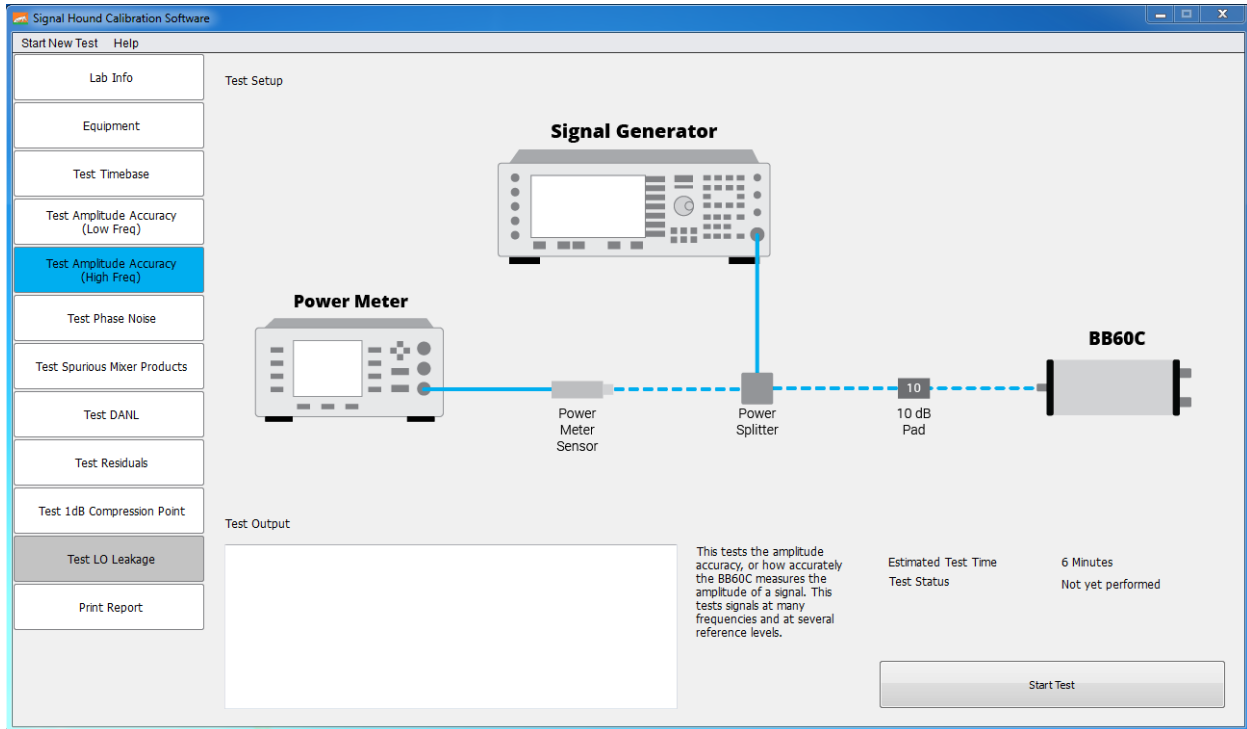

Figure 4: The test workspace for BB60C Amplitude Accuracy

Tests are grouped together to minimize the changes in the test setup. It is recommended to start at the top of the test list and work your way down. For each test, ensure your test setup matches the one depicted in the image and press *Start Test.*

The test time is shown above the *Start Test* button. The tests will take less than the estimated time on average. Some tests may require you to change the setup part way through the test. The setup changes will be depicted on the setup images for those tests.

Wait for the test status to change to pass/fail before continuing. If the test passes, the test status will be updated to *Test Passed* and the test tab will be colored green. If the test fails, the test status will be updated to *Test Failed* and the test tab will be colored red. In either case, a test may be re-run, and the old results overwritten.

7.7 Adjustments

7.7.1 10 MHz Reference

The 10MHz reference time base test will allow you to adjust the device upon completion. The software will give you the choice to make the adjustment once the test is complete. There is a limited amount of FLASH memory dedicated to 10 MHz reference adjustments, so adjustments should not be performed

more than once per month. It is very important to read the dialog box that appears to give you the option. All adjustments made are permanent until the device is returned to Signal Hound. If you choose to make an adjustment the software must be manually restarted, and the calibration session restarted.

7.8   Printing the Calibration Report

When you are finished with the device calibration tests, you can print a report of the calibration session using the *Print Test Report* button under the *Print Report* tab.
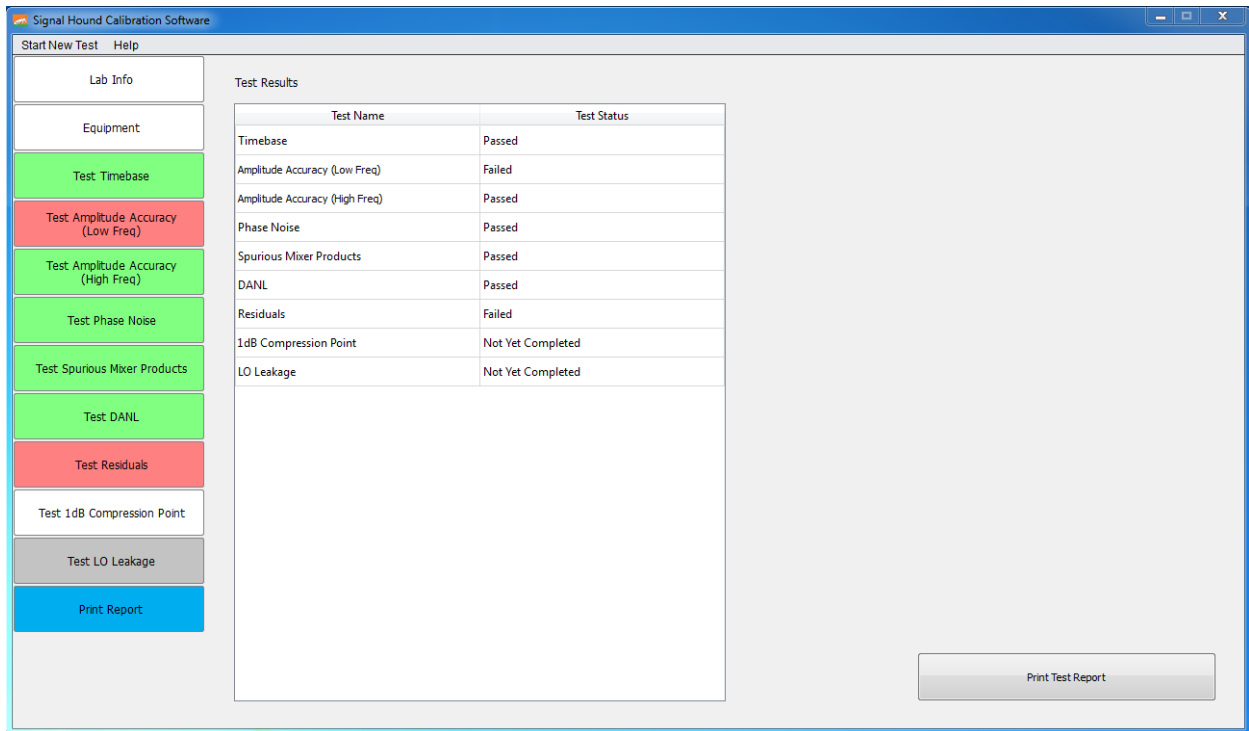

Figure 5: Printing the Calibration Report

You can select the file name and location for the report. You can also print the report at any time during the calibration session. The calibration report includes the facility information, lab standards, and test points and status for each test performed.

8   Troubleshooting

9   Upgrade History

Version 1.0 (September 2014)

- Initial release

10 Test Uncertainty Ratio and Guard Bands

10.1 Managed Risk Approach

Since the BB60C is a relatively new device, we do not have data on the probability of a device being in tolerance prior to calibration (*a priori* probability). Because of this, in an effort to meet ANSI/NCSLI Z540.3-2006 specifications while minimizing false reject risk, we cannot safely use the simple 4:1 Test Uncertainty Ratio (TUR) to guarantee the required <2% false-accept risk for a calibration. Instead, we use equation 5 of "A Guard-Band Strategy for Managing False-Accept Risk" by Michael Dobbert, Agilent Technologies:

$$A = T - U_{95\%} * (1.04 - e^{(0.38\,\ln(TUR)\,-\,0.54)})$$

where $U_{95\%}$ is the measurement uncertainty (95%confidence interval), **A** is the Acceptance Limit, and **T** is the specified tolerance. We can derive from this equation that, for a TUR of 4.6:1 or better, it is acceptable to set the acceptance limit equal to the tolerance limit, even without statistics on what percentage of devices are expected to pass calibration, by simply assuming the worst case.

Where TUR is less than 4.6:1, a guard-band will be subtracted from the tolerance limit to give a tighter acceptance limit. In the case of the BB60C at 0 dB internal attenuator setting (worst case VSWR), the calculated RSS uncertainty of 0.521 dB gives us a TUR of (2.0dB / 0.521 dB) = 3.84:1. Using the above equation, we set our acceptance limit for amplitude accuracy to ±1.96 dB to keep the false-accept risk below 2% independent of *a priori* probability.

Where TUR is 4.6:1 or better, the acceptance limit is equal to the test limit.

10.2 Amplitude Accuracy Test Uncertainty Ratio Calculations

Parameter	Uncertainty, 0 dB Atten
Power Splitter Output Tracking	0.25 dB
10 dB 8493C Attenuator Uncertainty	0.3 dB
Mismatch gain uncertainty, sensor to splitter (SWR 1.22, 1.19)	0.075 dB
Mismatch gain uncertainty, splitter to 10 dB pad (SWR 1.22, 1.1)	0.04 dB
Mismatch gain uncertainty, 10 dB pad to BB60C	0.205 dB
Power Meter Instrumentation Uncertainty	0.5%
Sensor Calibration Factor Uncertainty	2.2%
Uncertainty from Power Sensor Linearity	3%
Calibrator Output Power Level Uncertainty	0.6%
Total System Uncertainty in dB (combined using RSS)	±0.521 dB
Specified Tolerance	±2.0 dB
Test Uncertainty Ratio (TUR)	3.84
Acceptance Limit (Managed Risk Approach)	±1.96 dB