

Calibration Options for Anritsu Site Master Cable and Antenna Analyzer Measurements

Introduction

Accurate cable and antenna measurements depend on proper calibration of the measurement system. The Anritsu Site Master Cable and Antenna Analyzer is widely used in the field for measurements such as return loss, VSWR, cable loss, and distance to fault (DTF). Before performing these measurements, the analyzer must be calibrated to remove systematic measurement errors caused by the instrument, test cables, and adapters in the measurement path. This application note describes the three primary calibration options available on the Anritsu Site Master platform and explains when each method should be used.

ReadyCal (Factory Calibration)

ReadyCal is the default factory calibration automatically applied by the analyzer when no user calibration is active. It allows the user to **begin measurements immediately** without performing a manual calibration procedure.

ReadyCal is suited for applications where the cable or device under test is connected directly to the test port on the instrument top panel. The factory calibration does not compensate for uncertainties introduced by adaptors or test port cable attached to the test port.

Figure 1 shows the return loss of a precision load connected directly to the test port of the Site Master MS2089A. The return loss is better than 36 dB to 4 GHz and better than 34 dB to 6 GHz. A typical cable and antenna system will have a return loss of 16 dB to 20 dB and so the ReadyCal calibration is able to measure real world antenna feeds with minimal error.

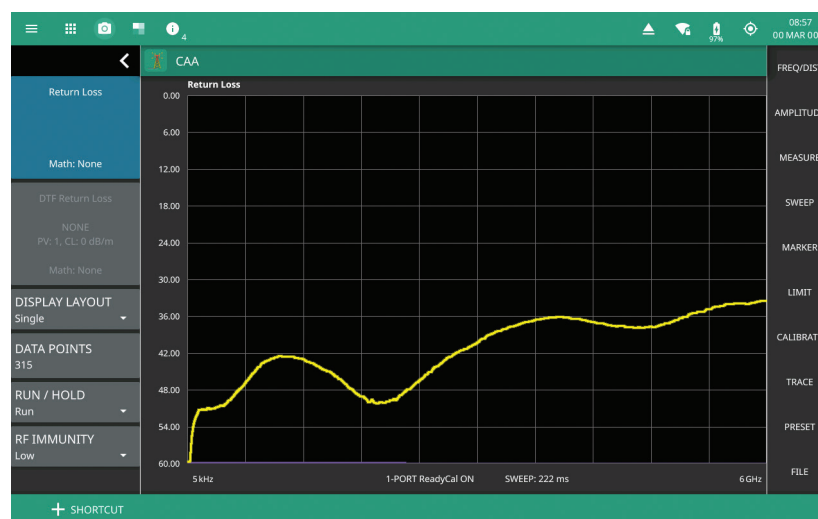


Figure 1. Precision Load on Test Port with ReadyCal Applied

If a test port cable is used to extend the position of the test port away from the top panel connector, the ReadyCal is not suitable. Figure 2 below shows the degradation in return loss when a 3-meter test port cable is attached to the top panel test port and a precision load connected to the end of the test port cable. Now the return loss is reduced to about 27 dB at 4 GHz. For this reason, when test port cables are used, a user Open/Short/Load or InstaCal should be used.

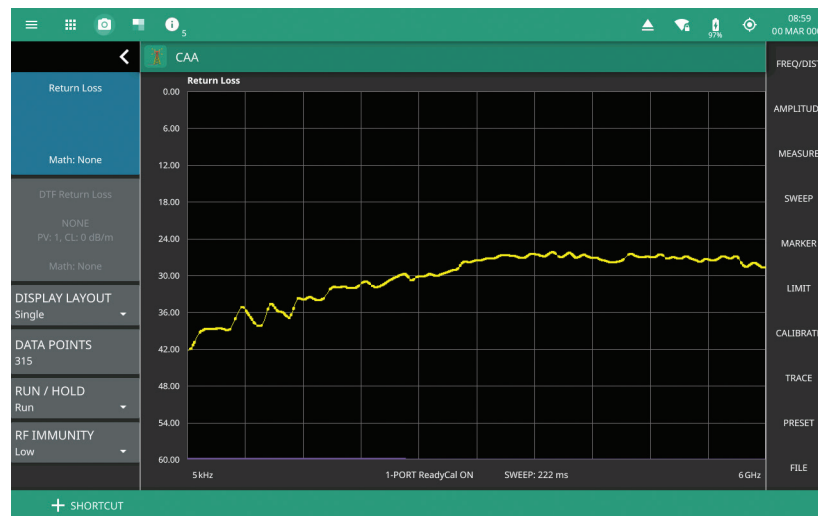


Figure 2. Return Loss of a Precision Load Connected to the End of a 3-Meter Test Port Cable with ReadyCal Applied

Advantages

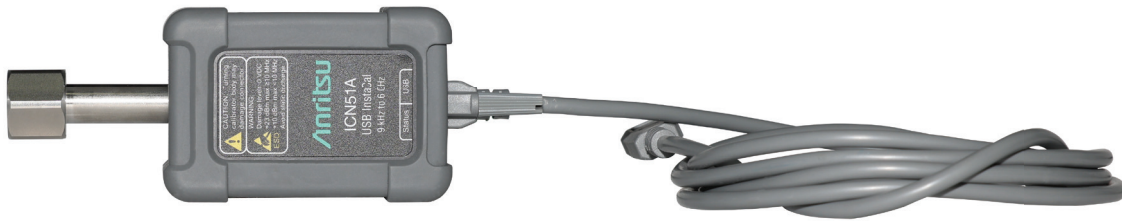
- Immediate measurement capability
- No external calibration hardware required
- Ideal for quick troubleshooting or preliminary checks

Limitations

- Does not compensate for external test cables or adapters
- Measurement accuracy may be reduced compared to other calibration methods

InstaCal Calibration

InstaCal uses a dedicated Anritsu InstaCal calibration module to **automate the calibration process**. When connected to the analyzer's RF port, the module performs an automatic open/short/load calibration. The InstaCal module integrates an open/short/load with an RF switch in front that is controlled through the USB cable.



The Anritsu InstaCal ICN51A

Typical Procedure

1. Set the measurement frequency range
2. Connect the InstaCal module USB lead to the Site Master MS2089A
3. Select iOSL Calibration in the Calibration menu
4. Connect the InstaCal module to the RF test port or at the end of the test port cable
5. Select Start Cal

The analyzer automatically performs the calibration sequence.

The process typically completes in less than a minute and minimizes operator error.

Figure 3 below shows the measured return loss of the same precision load following an InstaCal calibration.



Figure 3. Measurement of the Precision Load following an InstaCal Calibration

The measured return loss is better than 42 dB to 6 GHz. If a phase stable test port cable such as the Anritsu 15RNFN50-1.5-R is used this performance will be maintained as the uncertainties introduced by the cable are calibrated out.

Advantages

- Fast and convenient calibration
- Reduced chance of user connection mistakes
- Good measurement accuracy for most field applications

Open/Short/Load (OSL) Mechanical Calibration

OSL calibration uses precision open, short, and 50 ohm load standards to establish the measurement reference plane at the test port or end of the test port cable. Typically all three standards are integrated into a single mechanical device with three RF connectors. This method provides the **highest level of measurement accuracy**. The calibration process requires manually connecting each standard sequentially to the analyzer port:

Typical Procedure

1. Set the measurement frequency range
2. Select OSL Calibration in the Calibration menu
3. Connect the Open to the RF test port or at the end of the test port cable and initiate a calibration sweep
4. Connect the Short to the RF test port or at the end of the test port cable and initiate a calibration sweep
5. Connect the Load to the RF test port or at the end of the test port cable and initiate a calibration sweep

The analyzer measures each known standard and calculates error correction coefficients to remove systematic measurement errors.



A Typical Open/Short/Load Calibration Device with Additional Through Path Connection

Figure 4 below shows that the measured return loss of the precision load following an OSL mechanical calibration is better than 48 dB to 6 GHz. This provides the best possible calibration performance at the cost of additional calibration set up time with multiple connections.

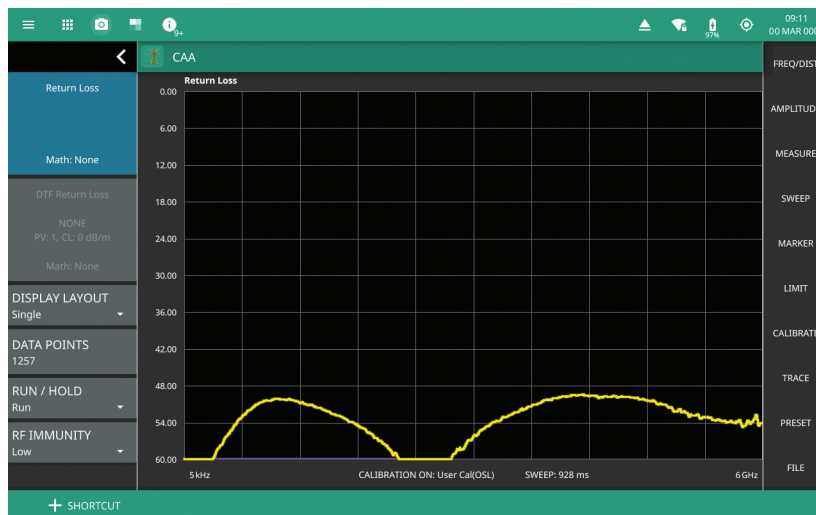


Figure 4. Measurement of the Precision Load following an OSL Calibration

Advantages

- Highest measurement accuracy
- Compensates for test cables and adapters
- Recommended for acceptance testing and formal measurements limitations
- Longest calibration time due to repeated connection/disconnection required at the test port

Importance of Correctly Torquing all Connectors

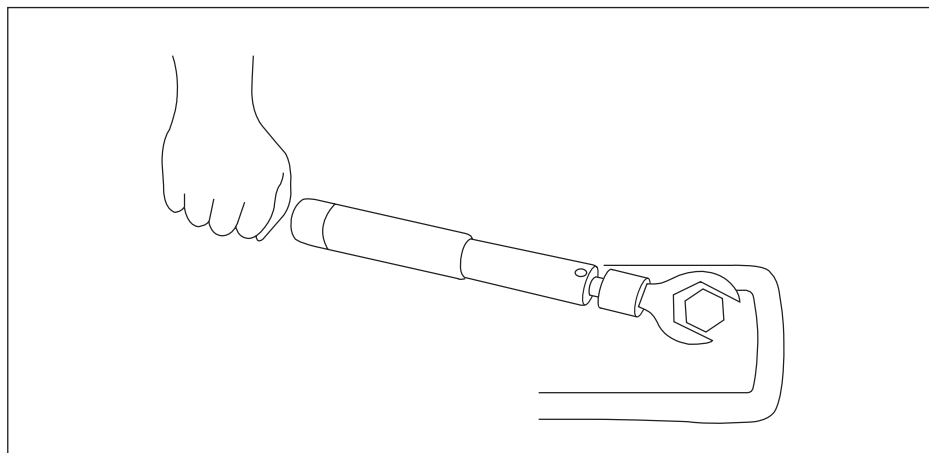
During the calibration and measurement process when sweeping RF cables and antennas, it is important to ensure the RF connectors have been tightened to their correct torque. This requires the use of a torque wrench for each connection during calibration and measurement.

The figure below shows the difference in measured return loss of a precision 50 ohm load when torqued “finger tight” compared to following torquing with a calibrated torque wrench. The measured return loss is generally better across all frequencies when the load is torqued correctly using a calibrated wrench.



Figure 5. Comparison of Return Loss Measurement when Connecting a Precision Load Finger Tight (yellow trace) and Using a Torque Wrench (pink trace)

When using a torque wrench it is important to hold the wrench at the end of the handle to ensure the correct level of torque is applied. See diagram below.



Comparison of Calibration Methods

Calibration Method	Accuracy	Speed of Calibration Process	Accessories Required	Typical Use
ReadyCal	Good (at test port only)	Instant	None	Quick Checks and Troubleshooting
InstaCal	Good	Fast	InstaCal Module	Routine Field Measurements
Mechanical Cal	Best	Slowest	Open/Short/Load Calibration Accessory	Field Use Plus Certification and Acceptance Testing

Anritsu Site Masters offer three calibration methods. This application note highlights their relative merits and use cases.

For further information this video demonstrates the calibration processes and results using all three methods, visit us at: <https://youtu.be/K-h-c5KVY38>.



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