Calibration Guide

Model OSL Series

Precision Open/Short/Load Calibration Tees

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Danger

This indicates a risk from a very dangerous condition or procedure that could result in serious injury or death and possible loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Warning

This indicates a risk from a hazardous condition or procedure that could result in light-to-severe injury or loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Caution

This indicates a risk from a hazardous procedure that could result in loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Safety Symbols Used on Equipment and in Manuals

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions *before* operating the equipment. Some or all of the following five symbols may or may not be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.

This indicates a compulsory safety precaution. The required operation is indicated symbolically in or near the circle.

This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.

This indicates a note. The contents are described in the box.

These indicate that the marked part should be recycled.

Table of Contents

Chapter 1 — General Information

1-1 Introduction

This guide provides performance verification procedures for Anritsu Model OSL Series Open/Short/Load Calibration Tees.

1-2 Description

The model OSL Series family consists of the following models:

Table 1-1. OSL Series Precision Open/Short/Load Calibration Tees

Anritsu Part Number	Description
OSLN50LF	N male Precision Open/Short/Load, DC to 4 GHz
OSLNF50LF	N female Precision Open/Short/Load, DC to 4 GHz
OSLN50-1	N male Precision Open/Short/Load, DC to 6 GHz
OSLNF50-1	N female Precision Open/Short/Load, DC to 6 GHz
OSLN50	N male Precision Open/Short/Load, DC to 18 GHz
OSLNF50	N female Precision Open/Short/Load, DC to 18 GHz
OSLK50	K male Precision Open/Short/Load, DC to 20 GHz
OSLKF50	K female Precision Open/Short/Load, DC to 20 GHz

1-3 Recommended Test Equipment

Table 1-2. Recommended Test Equipment

Equipment	Critical Specification	Recommended Manufacturer/Model
Vector Network Analyzer	Frequency: 40 MHz to 20 GHz	Anritsu Model MS4642A, 37247D or 37347D
Calibration Kit	Connector Type: N Impedance: 50 Ω Termination: sliding termination	Anritsu Model SC8148
Adapter	Connector: N(m) to K(f)	Anritsu Model 34NKF50
Adapter	Connector: N(f) to K(f)	Anritsu Model 34NFKF50
Digital Multi-meter		Agilent Model 34401A
Calibration Kit	Connector Type: N Impedance: 50 Ω Termination: Sliding Termination	Anritsu Model 3652A-1
Adapter	Connector: K(f) to K(f)	Anritsu Model 33KFKF50
Adapter	Connector: K(m) to K(f)	Anritsu Model 33KKF50

Chapter 2 — OSL Performance Verification

2-1 Introduction

This chapter provides tests to verify the performance of the OSL Series Open/Short/Load Calibration Tees. Two separate verification procedures are provided, for using either a VectorStar MS4642A, a Model 37247x, or a Model 37347x VNA:

- Section 2-4 “Verification Using MS4642A”
- Section 2-5 “Verification Using 37247x/ 37347x”

Verification tests include:

- **Return Loss Verification**

  The Load is verified by measuring the return loss using a VNA.

- **Open and Short 180° Phase Shift Verification**

  The Open and Short 180° phase shift is verified by measuring the phase using a VNA.

- **Load DC Resistance Verification**

2-2 Required Equipment

- Anritsu Model MS4642A, 37247D or 37347D Vector Network Analyzer
- Anritsu Model SC8148 N Connector Calibration Kit or 3652A-1 K Connector Calibration Kit
- Anritsu Model 33KFKF50, 33KKF50, 34NKF50, or 34NFKF50 Adapter

2-3 Specifications

Refer to Table 2-1 for the OSL series specifications.

Table 2-1. OSL Series Specifications

Specification	Anritsu Part Number			
	OSLK50LF OSLKF50LF	**OSLN50LF OSLNF50LF**	**OSLN50-1 OSLNF50-1**	**OSLN50 OSLNF50**
Frequency Range	DC to 20 GHz	DC to 4 GHz	DC to 6 GHz	DC to 18 GHz
Load DC Resistance	50 Ω ± 0.20 Ω	50 Ω ± 0.25 Ω	50 Ω ± 0.25 Ω	50 Ω ± 0.15 Ω
Return Loss	42 dB: DC to 5 GHz 36 dB: 5 to 15 GHz 32 dB: 15 to 20 GHz	42 dB	42 dB	42 dB: DC to 5 GHz 36 dB: 5 to 15 GHz 32 dB: 15 to 18 GHz
Open and Short Phase Shift	180° ± 6°	180° ± 6°	180° ± 10°	180° ± 20°

Caution To avoid connector damage or inaccurate measurements, before making any connections, inspect mating surfaces for damage, clean the connectors, and use proper torquing practices. Review *10100-00031, RF and Microwave Connector Care*.

Table 2-2. Connector Torque Specifications

Connector Type/Size	Wrench Size	Torque Setting
K (2.92 mm)	8 mm (5/16 in)	0.9 N·m (8 lbf·in)
Type N (With Flats)	19 mm (3/4 in)	1.35 N·m (12 lbf·in)

2-4 Verification Using MS4642A

Model MS4642A Calibration

Preliminary

1. Allow the VNA to warm up for a minimum of 1 hour.
2. Install an appropriate adapter to the VNA Port 1 so the test port has a connector that can mate to the OSL Series Open/Short/Load Calibration Tee.

   For example, install a 34NFKF50 adapter to VNA Port 1 when testing an N-male Open/Short/Load Calibration Tee.
3. Press the **Preset** key to reset the VNA.

Set Frequency Range

1. Press the **Frequency** key then set the frequency as follows:
   a. START: 40 MHz
   b. STOP:
      - 4 GHz for OSLN50LF or OSLNF50LF
      - 6 GHz for OSLN50-1 or OSLNF50-1
      - 18 GHz for OSLN50 or OSLNF50
      - 20 GHz for OSLK50 or OSLKF50
   c. POINTS: 401

Load Cal Kit Coefficients

To load the Cal Kit Coefficients into the VNA:

1. Insert Calibration Component Coefficients USB Memory Stick of the appropriate calibration kit into the VNA USB port.
2. Press the Calibration key then:
   a. Select Cal kit/Autocal/Characterization | Install Kit/Charac | Cal Kit radio button
   b. Browse for and select USB Memory Stick.
   c. Select the Cal Kit file then select Open | OK | Install

Calibrate the Vector Star VNA

1. Press the Calibration key then:

a. Select Calibrate | Manual Cal | 1-Port Cal | Modify Cal Setup | Cal Method: SOLT/SOLR | Line Type: Coaxial

2. Edit Cal Params:

a. Test Port 1 selected.

b. DUT Connector:

Select one of the following from the drop-down:

- N-Conn(m) for OSLN50LF, OSLN50-1 or OSLN50
- N-Conn(f) for OSLNF50LF, OSLNF50-1 or OSLNF50
- K-Conn(m) for OSLK50
- K-Conn(f) for OSLKF50

c. BB Load: Select Load 1.

d. Load Type: Select Sliding Load.

e. Test Port 2: Unselected

f. Select OK.

3. Select Back.

4. Select Port 1 Reflective Devices.

a. Connect each calibration standard (Open, Short or Load) before selecting the matching box.

b. Connect the sliding load and then select Sliding Load.

c. Set the sliding load to the number 1 position before selecting the Position 1 box.

Repeat for positions number 2 through number 6.

5. Select Back | Back | Done

OSL Load Return Loss Verification

1. Connect the LOAD of the DUT Calibration Tee to the adapter on VNA Port 1.
2. Set the VNA as follows:
   - **a.** Double click on the Tr1/ S11 title so the Trace 1 plot will be displayed full screen.
   - **b.** Select Display | Trace Format | Log Mag
   - **c.** Select Scale | Auto Scale Active Trace
   - **d.** Select Marker | Mkr1 on
   - **e.** Select Marker Search | Max
   - **f.** The MARKER 1 will display the highest point (worst case in return loss) in frequency and a negative number in dB (for example, –43.123 dB at 3 GHz).
   - **g.** Record the absolute value of MARKER 1 as return loss (for example, 43.123 dB).
   - **h.** The Return Loss spec is 42 dB. The worst case absolute value of Marker 1 Readout in dB must be > 42 dB to pass this test.
   - **i.** For OSLK, OSLKF, OSLN50 and OSLNF50, the return loss is specified for three frequency bands. Manually drag Marker 1 with the mouse to read out the worst case return loss in each band.

OSL Open/Short 180° Phase Shift Verification

1. Set the VNA as follows:

a. Double click on the Tr1/ S11 title so the Trace 1 plot will be displayed full screen.

b. Select Display | Trace Format | Phase

c. Scale setup:

- Select Scale
- Select Resolution | enter 10°/div
- Select Reference value | enter 180°
- Select Reference Position | enter 5
- Select Wrap Setup | Wrapping OFF

d. Trace Limit Lines setup:

Phase limits are entered into a table displayed on the VNA screen as shown in the example Table 2-3 on page 2-7:

- Select Display | Trace Limit Lines
- Select Limit Line | ON
- Select Edit Limit Line
- Select Add (Fill in upper limit row in table)
- Select Add (Fill in lower limit row in table)

Enter the phase limits for the applicable OSL model into the table:

- OSLN50LF and OSLNF50LF:
  Upper 174°, lower 186°; for
- OSLN50LF-1 and OSLNF50LF-1:
  Upper 170°, lower 190°
- OSLN50 and OSLNF50:
  Upper 160°, lower 200°
- OSLK50 and OSLKF50:
  Upper 168°, lower 192°

Table 2-3. Example of Table with OSLK50 Limits

Type	X1	X2	Y1	Y2	X Offset	Y Offset
Upper	40 MHz	20 GHz	168°	168°		
Lower	40 MHz	20 GHz	192°	192°		

2. Connect the SHORT of the DUT Calibration Tee to the adapter on VNA Port 1.

3. Make the following selections on the VNA:

Select Display | View Trace | Store Data to Memory | Data Memory Math | Data Mem. Op. | Select Data/Mem. from the dropdown.

4. Remove the SHORT and connect the OPEN of the same DUT Calibration Tee to the adapter on VNA Port 1.

5. The displayed trace must be within the limit lines to pass the specification. The actual value can be verified using markers.

2-5 Verification Using 37247x/ 37347x

VNA Model 37247x, 37347x Calibration

1. Allow the VNA to warm up for a minimum of 1 hour.
2. Install an appropriate adapter to the VNA Port 1 so the test port has a connector that can mate to the OSL Series Open/Short/Load Calibration Tee. For example, install a 34NFKF50 adapter to VNA Port 1 when testing an N-male Open/Short/Load Calibration Tee.
3. Insert the Calibration Component Coefficients USB memory stick from the appropriate calibration kit into the VNA USB port (if available), or insert the Calibration Component Coefficients disk into the VNA floppy drive.
4. Load the Cal Kit Coefficients into the VNA:
   a. Press the **Utility Menu** key
   b. Cal Component Utilities
   c. Install the information from the USB memory stick or from the floppy disk.
5. Press the **Default Program** key to reset the VNA.
6. Press the **BeginCal** key then set the calibration as follows:
   a. CAL METHOD: SOLT
   b. TRANSMISSION LINE TYPE: COAXIAL
   c. CALIBRATION TYPE: REFLECTION ONLY
   d. PORT 1 ONLY (S11)
   e. CALIBRATION DATA POINTS: NORMAL (1601 points maximum)
   f. START frequency: 40 MHz
   g. STOP frequency:

      4 GHz for OSLN50LF or OSLNF50LF
      6 GHz for OSLN50-1 or OSLNF50-1
      18 GHz for OSLN50 or OSLNF50
      20 GHz for OSLK50 and OSLKF50

   h. MAXIMUM NUMBER OF DATA POINTS: 401

i. PORT 1 CONN:

N(f) for OSLN50LF, OSLN50-1 or OSLN50
N(m) for OSLNF50LF, OSLNF50-1 or OSLNF50
K(f) for OSLK50
K(m) for OLSKF50

j. LOAD TYPE: SLIDING

7. Select START CAL and follow the on screen prompt and connect the appropriate calibration standard(s) to complete the calibration.

OSL Load Return Loss Verification

1. Connect the LOAD of the DUT Calibration Tee to the adapter on VNA Port 1.

2. Set the VNA as follows:

a. Channel Menu: SINGLE CHANNEL

b. CH1

c. S-parameter: S11

d. GRAPH TYPE: LOG MAGNITUDE

e. Auto Scale

f. Marker Menu: MARKER 1 ON, DISPLAY MARKERS ON

g. Readout Marker: MARKER TO MAX

h. The MARKER 1 will display the highest point (worst case in return loss) in frequency and a negative number in dB (for example, –43.123 dB at 3 GHz).

i. Record the absolute value of MARKER 1 as return loss (for example, 43.123 dB).

j. The Return Loss spec is 42 dB. The worst case absolute value of Marker 1 Readout in dB must be > 42 dB to pass this test.

k. For OSLK50, OSLKF50, OSLN50, and OSLNF50, the return loss is specified for three frequency bands. The rotary knob should be used to move the Marker 1 to read out the worst case return loss in each band.

OSL Open/Short 180° Phase Shift Verification

1. Set the VNA as follows:

a. Channel Menu: Single channel

b. Ch 1

c. S-parameter: S11

d. Graph type: Phase

e. Set Scale: resolution 10°/div, reference value 180°; phase shift 10°

f. Limits:

upper 174°, lower 186°; for OSLN50LF and OSLNF50LF
upper 170°, lower 190°; for OSLN50-1 and OSLNF50-1
upper 160°, lower 200°; for OSLN50 or OSLNF50
upper 168°, lower 192°; for OSLK50 OR OSLKF50
display limits ON

2. Connect the SHORT of the DUT Calibration Tee to the adapter on VNA Port 1.

3. Make following selection on the VNA:

a. Ch 1

b. Trace Memory

c. VIEW DATA

d. STORE DATA TO MEMORY

e. VIEW DATA (/) BY MEMORY

4. Remove the SHORT and connect the OPEN of the same DUT Calibration Tee to the adapter on VNA Port 1.

5. The displayed trace must be within the limit lines to pass the specification. The actual value can be verified using markers.

2-6 Load DC Resistance Verification

Equipment Required

- Agilent Model 34401A Multi-meter

Procedure

Use an Ohmmeter to measure the DC resistance between the outer conductor and center conductor of the Load and verify that it is within specification (refer to Table 2-1, “OSL Series Specifications).

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