TECHNICAL MANUAL

GS–01

INSTRUMENT CALIBRATION PROCEDURE

COAXIAL PHASE SHIFTERS

NARDA
3752, 3753B
3 DBM LABS
CO-11956

USING HEWLETT-PACKARD 8510BOPT010
NETWORK ANALYZER SYSTEM

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Page No.	Change No. *	Change Date	Page No.	Change No. *	Change Date
Title	0				
A	0				
i	0				
1 to 11	0				
12 (blank)	0				
13, 14	0				
A–1 to A–4	0				

* Zero in this column indicates an original page.

TABLE OF CONTENTS

TABLES

SECTION 1

INTRODUCTION AND DESCRIPTION

1.1 This procedure describes the calibration of the Narda 3752, 3753B or 3 dBm Labs CO−11956 Coaxial Phase Shifters. The instrument being calibrated is referred to herein as the TI (Test Instrument).

1.2 All comments concerning this procedure should be directed to Navy Measurement Science Directorate, Naval Warfare Assessment Division, P.O. Box 5000 Corona, CA 91718−5000.

1.3 This procedure includes tests of essential performance parameters only. Any malfunction noticed during calibration, whether specifically tested for or not, should be corrected.

Table 1. Calibration Description

TI Characteristics	Performance Specifications	Test Method
Connector dimensions	Female connector dimensions: 0.187 to 0.207 inches	Measured with a coaxial gage during preliminary operations.
Phase shift indicator accuracy	Narda 3752 or 3 dBm Labs CO−11956: Frequency range: 1 to 5 GHz Range: 0° to 180°/GHz Resolution: 0.2°/GHz, 0.1°/GHz using interpolation between marks Tolerance: ±0.3°/GHz	TI dial accuracy tested at 1 GHz using a network analyzer.
	Narda 3753B: Frequency range: 3.5 to 12.4 GHz Range: 0 to 180° at 3.5 GHz Resolution: unspecified Tolerance: ±0.3°/GHz	Narda 3753B TI dial accuracy tested at 3.5 GHz using a network analyzer.
Phase shift indicator linearity	Tolerance: ±0.3°/GHz	Verified implicitly during the phase shift indicator accuracy test.
Insertion loss	Narda 3752 or 3 dBm Labs CO−11956: Tolerance: 0.5 dB max Narda 3573B: Tolerance: 0.7 dB max	Tested using a network analyzer.
Connector VSWR	Narda 3752 or 3 dBm Labs CO−11956: Tolerance: 1.25 max. Narda 3753B: Tolerance: 3.5 to 10 GHz, 1.35 max; 10 to 12.4 GHz, 1.4 max	Tested using a network analyzer.

SECTION 2

EQUIPMENT REQUIREMENTS

NOTE

Minimum use specifications are the principal parameters required for performance of the calibration, and are included to assist in the selection of alternate equipment, which may be used at the discretion of the using laboratory. Satisfactory performance of alternate items shall be verified prior to use. All applicable equipment must bear evidence of current calibration.

The instruments utilized in this procedure were selected from those known to be available at Navy calibration facilities, and the listing by make or model number carries no implication of preference, recommendation, or approval for use by other agencies. It is recognized that equivalent equipment produced by other manufacturers may be capable of equally satisfactory performance in this procedure.

Item	Minimum Use Specifications	Calibration Equipment
2.1 Network analyzer system	Frequency: 1 to 12.4 GHz Phase measurement uncertainty: ±0.125	Hewlett–Packard 8510BOPT010 (Fitted with S–parameter test set)
2.2 Network analyzer calibration kit	Supplied with standard open, short, and termination, fitted with N(m) and N(f) connectors and thru adapter* fitted with same connectors as TI Uncertainty: Calibrated by Type I or Type II laboratory	Supplied with item 2.1
2.3 Connector gage	Standardized to MIL–C–39012 or MIL–C–71B	Maury Microwave A007B
2.4 Thru adapter	N(f) to N(f)** Precision type	Maury Microwave 8801A or Wiltron 34NFNF50

* If the item 2.2 (Network analyzer calibration kit) is not supplied with an appropriate thru adapter, it is recommended that a precision thru adapter be permanently included in the calibration kit using the Modify Cal Kit procedure described in Appendix A. If it is not desired to permanently add an adapter to the Calibration kit at this time, use Appendix A to temporarily incorporate a precision adapter into the Network analyzer Cal kit

** Required only if the item 2.2 (Network Analyzer Calibration kit) does not include an N(f) to N(f) thru adapter.

SECTION 3

PRELIMINARY OPERATIONS

3.1 Ensure that all power switches are set to off, and set all auxiliary equipment controls as necessary to avoid damage to the equipment and so that dangerous voltages will not be present on output terminals when the power switches are turned on.

3.2 Connect all equipment to the appropriate power source.

3.3 Set all network analyzer system component power switches to on in the following order: synthesizer, S−parameter test set, printer or plotter (optional) and network analyzer. Allow at least 30 minutes for the equipment to warm up. Proceed with steps 3.4 and 3.6 during warm up.

3.4 Ensure that all equipment test connectors are clean and not damaged.

NOTE

Inspect each coaxial connector for cleanliness and integrity before attempting to mate it with another connector.

3.5 Use the coaxial gage to verify that the TI N−type female connectors conform to the MIL−C−39012 composite specification. If the coaxial gage has been standardized with MIL−C−39012 master gage, verify that the gage dial indicates between −0.020 inches and the zero mark. If the coaxial gage has been standardized with MIL−C−71B master gage, verify that the gage dial indicates between −0.010 and +0.010 inches.

NOTE

Proper microwave measurement techniques dictate that mating coaxial connectors be aligned before connection and that a torque wrench be used to achieve uniform tightness for all connections. The torque wrench supplied with item 2.2 (Calibration kit) should be used to increase connection repeatability. Do not overtighten connectors. During connection of 7−mm connectors, one of the two threaded outer sleeves should be left loose. Avoid unnecessary shifting or movement of network analyzer cables.

3.6 Ensure that the network analyzer is fitted with precision cables equipped with N(m) test connectors or the appropriate 7−mm to N−type adapters.

NOTE

The network analyzer system adapter removal technique employed in this procedure requires the use of a N(f) to N(f) thru adapter. Electrical length data for the adapter must be accessible to the network analyzer software. If a dedicated N(f) to N(f) adapter is not included in item 2.2 (Calibration kit), perform the Modify Cal Kit procedure described in Appendix A in order to properly specify the adapter characteristics and to add the adapter (either temporarily or permanently) to item 2.2 (Calibration kit).

3.7 If required, perform the Modify Cal Kit procedure for the N(f) to N(f) adapter as described in Appendix A.

NOTE

If appropriate network analyzer calibration data (that which services TIs with non–insertable N(f) connectors with adapter removal over the frequency range of the TI) is already stored in the network analyzer, proceed to step 3.9.

3.8 Perform the network analyzer full 2–port calibration twice as required for reversible/non–insertable TIs equipped with N(f) connectors as described in the following steps.

3.8.1 Program the network analyzer for stepped operation between 1 and 5 GHz with 101 points and 128 averages by depressing the following network analyzer hard and soft keys in the order presented:

Hard Keys	Soft Keys
STIMULUS START (TI low–end frequency)	
G/n STIMULUS STOP (TI high–end frequency)	
G/n STIMULUS MENU	
	STEP NUMBER OF POINTS 101
RESPONSE MENU	
	AVERAGING ON

3.8.2 Set the network analyzer controls for 128 averages.

3.8.3 Depress the network analyzer MENUS CAL hard key and access the calibration routine appropriate for N–type connectors. The N–type connector calibration routine may have to be downloaded to the network analyzer active memory from the network analyzer tape drive using the procedure described in the note following appendix step A.1.2.

NOTE

The network analyzer adapter removal procedure requires that two full 2–port calibrations be performed, with the results of each stored in separate CAL SETs. During the following steps, the network analyzer display may indicate that a CAL SET must be deleted in order to proceed with a full 2–port calibration. If this is the case, depress the MORE soft key followed by the DELETE CAL SET soft key and the soft key corresponding to the CAL SET to be deleted. Make note of the two CAL SETs in use.

3.8.4 Connect the thru adapter to the network analyzer port 2 cable.

3.8.5 Depress the network analyzer FULL 2–PORT soft key and proceed with the REFLECT'N calibration for N(f) opens, shorts, and loads for the S11 port (port 1). Note that the fixed load is for use at frequencies $\leq$2 GHz and that the sliding load should be used for frequencies above 2 GHz. The sliding load should be measured at least 5 different positions.

3.8.6 Perform the REFLECT'N calibration for the N(m) opens, shorts, and loads for the S22 port (port 2). When the reflection calibration is completed, depress the REFLECT'N DONE soft key.

3.8.7 Depress the network analyzer ISOLATION soft key. Use the N(f) and N(m) terminations at the network analyzer and thru adapter, respectively. Perform the FWD and REV isolation calibrations. When complete, depress the ISOLATION DONE soft key.

3.8.8 Depress the network analyzer TRANSMISSION soft key. Connect the network analyzer port 1 cable to the port 2 cable through the thru adapter. Perform the 4 thru transmission calibrations as prompted by the network analyzer display. When complete, depress the TRANS.DONE soft key.

3.8.9 Depress the SAVE 2–PORT CAL soft key and select the CAL SET to be used for correction factor storage. Note the CAL SET location selected as correction factor storage for port 1 for use in step 3.8.17.

3.8.10 Depress the network analyzer MENUS CAL hard key and access the calibration routine appropriate for N–type connectors. Select the FULL 2–PORT CAL soft key.

3.8.11 With the network analyzer port 1 and port 2 cables still connected together through the thru adapter, perform the 4 thru transmission calibrations. When the calibrations are complete, depress the TRANS.DONE soft key.

3.8.12 Disconnect the thru adapter from the network analyzer port 2 cable.

3.8.13 Proceed with the REFLECT'N calibration for N(m) opens, shorts, and loads for the S11 port (port 1).

3.8.14 Perform the REFLECT'N calibration for the N(f) opens, shorts and loads for the S22 port (port 2). When the reflection calibration is complete, depress the REFLECT'N DONE soft key.

3.8.15 Depress the network analyzer ISOLATION soft key. Use the N(f) and N(m) terminations at the network analyzer and thru adapter, respectively. Perform the FWD and REV isolation calibrations. When complete, depress the ISOLATION DONE soft key.

3.8.16 Depress the SAVE 2–PORT CAL soft key and select the second CAL SET to be used for correction factor storage for port 2. Note the CAL SET selected for use in step 3.8.18.

3.8.17 Depress the MORE, MODIFY CAL SET and ADAPTER REMOVAL soft keys. Depress CAL SET FOR PORT 1 and select the CAL SET designated in step 3.8.9.

3.8.18 Depress CAL SET FOR PORT 2 and select the CAL SET designated in step 3.8.16 for correction factor storage for port 2.

3.8.19 Depress the ADAPTER soft key that corresponds to N(f) to N(f) adapters.

3.8.20 Depress the MODIFY & SAVE soft key and select another CAL SET to receive the processed calibration coefficients.

3.9 Calibration Data Verification

3.9.1 Set the network analyzer for 8 averages by selecting RESPONSE MENU and depressing AVERAGING ON and entering 8 x 1 into the keypad.

NOTE

Perform steps 3.9.2 through 3.9.5 if precalibration was performed at frequencies ≥2 GHz.
Perform steps 3.9.16 through 3.9.8 if precalibration was performed at frequencies ≤2 GHz.

3.9.2 For calibration data verification at frequencies ≥2 GHz, disconnect the calibration standards from the network analyzer test cables and connect the sliding load to the network analyzer port 1 test cable.

3.9.3 Depress the network analyzer S11 and LOG MAG pushbuttons.

3.9.4 Depress the network analyzer RESPONSE AUTO and RESPONSE SCALE pushbuttons and enter 2 dB/div into the keypad.

3.9.5 Allow the network analyzer to complete several sweeps and wait for the averaging results to stabilize. Slowly adjust the phase of the sliding load, and verify that the display trace does not vary by more than ±2 dB at any point.

3.9.6 For calibration data verification at frequencies ≤2 GHz remove any standards from the network analyzer test cables and connect the low−band fixed termination to the port 1 test cable connector.

3.9.7 Select S11 and SMITH CHART format with 200m Units/div and set a frequency marker to 2 GHz by entering MENUS MARKER, MARKER #1 (soft key) and 2 G/n.

3.9.8 Disconnect any standards from the network analyzer port 1 test cable and repeat steps 3.9.2 through 3.9.7 as required for the network analyzer port 2 test cable substituting S22 for all references to S11.

3.10 Set the network analyzer controls for measurements with 128 averages by depressing the RESPONSE MENU and AVERAGING ON pushbuttons and selecting 128 x1 with the data entry keypad.

NOTE

The network analyzer is now ready to perform corrected measurements with the TI frequency range on instruments equipped with two N(f) connectors. The stored correction factors are valid for measurements of 128 averages or less. Measurements using different cables or adapters or use outside of the programmed range will be uncorrected and is not permitted.

SECTION 4

CALIBRATION PROCESS

NOTE

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met, before proceeding.

4.1 PHASE SHIFT INDICATOR ACCURACY

4.1.1 Connect the TI to the network analyzer port 1 and 2 cables.

4.1.2 Set the TI phase shift indication dial to 000.0 degrees/GHz, taking care not to introduce errors due to parallax or TI mechanism backlash.

4.1.3 Program the network analyzer for stepped phase measurement over the TI frequency range, with zeroed marker response at the TI low–end frequency by depressing the following network analyzer hard and soft keys in the sequence presented:

Hard Keys	Soft Keys
PARAMETER S21	
FORMAT PHASE	
MENUS MARKER	
(TI low–end frequency)	
G/n	
RESPONSE REF POSN	
1	
0	
X1	
MENUS DISPLAY	
	DATA––MEMORY
	MATH (/)

4.1.4 Adjust the TI phase control dial for an indication of 020.0 degrees/GHz on the TI display. Take care that errors due to parallax and TI gear–drive backlash are kept to a minimum.

4.1.5 Allow the network analyzer to complete one entire sweep and verify that the network analyzer marker display indicates between 19.7 and 20.3 degrees, or 69.7 and 70.3 (Narda 3753B only), neglecting polarity.

4.1.6 Perform steps 4.1.4 and 4.1.5 for the TI phase shift indications given in the following table. At each TI setting, verify that the network analyzer phase shift indication is within the specified tolerance limits.

TI Phase Shift Indication (degrees/GHz)	Network Analyzer Indication Tolerance Limits Narda 3752, 3 dBm Labs CO–11956 (degrees)	Network Analyzer Indication Tolerance Limits Narda 3753B (degrees)
031.0	30.7 to 31.3	108.2 to 108.8
049.0	48.7 to 49.3	171.2 to 171.8
052.0	51.7 to 52.3	–177.7 to –178.3
073.0	72.7 to 73.3	–75.2 to –75.8
094.0	93.7 to 94.3	–30.7 to –31.3
105.0	104.7 to 105.3	7.2 to 7.8
116.0	115.7 to 116.3	45.7 to 46.3
147.0	146.7 to 147.3	154.2 to 154.8
168.0	167.7 to 168.3	–47.7 to –48.3
180.0	179.7 to 180.3	–89.7 to –90.3

4.2 INSERTION LOSS

4.2.1 Program the network analyzer for insertion loss measurement by depressing the following network analyzer hard and soft keys in the sequence presented:

Hard Keys	Soft Keys
MENUS DISPLAY	
	DISPLAY DATA
FORMAT LOG MAG	
PARAMETER S21	

4.2.2 Program the network analyzer response scale and reference position by depressing the following network analyzer hard and soft keys in the sequence presented:

Hard Keys	Soft Keys
RESPONSE SCALE	
.	
5	
X1	
RESPONSE REF VALUE	
0	
X1	
RESPONSE REF POSN	
1	
0	
X1	

4.2.3 Wait for the network analyzer to complete at least one entire trace.

4.2.4 Find the minimum TI response by depressing the following network analyzer hard and soft keys in the sequence presented:

Hard Keys	Soft Keys
MENUS MARKER	
	MORE
	MINIMUM

4.2.5 Verify that the TI minimum insertion loss response does not fall below −0.5 dB or −0.7 dB (for the Narda 3753B).

4.2.6 Depress the TI PARAMETER S12 pushbutton and repeat steps 4.2.2 through 4.2.5 for the TI reverse path.

4.3 CONNECTOR VSWR

4.3.1 Program the network analyzer for port 1 VSWR measurements by depressing the following network analyzer hard and soft keys in the sequence presented:

Hard Keys	Soft Keys
PARAMETER S11	
FORMAT MENU	
	SWR
RESPONSE AUTO	

4.3.2 Wait for the network analyzer to complete at least one entire trace.

4.3.3 Find the TI maximum SWR response by depressing the following network analyzer hard and soft keys in the sequence presented:

Hard Keys	Soft Keys
MENUS MARKER	
	MORE
	MAXIMUM

4.3.4 Use the network analyzer data entry knob as required to verify that the network analyzer marker maximum SWR indication does not exceed the specified limits over the frequency range(s) of interest.

4.3.5 Set the TI for 090.0 degrees/GHz. Wait for the network analyzer to complete at least one entire trace.

4.3.6 Depress the MAXIMUM soft key and verify that the network analyzer marker SWR indication does not exceed 1.25.

4.3.7 Set the TI for 000.0 degrees/GHz. Wait for the network analyzer to complete at least one entire trace.

4.3.8 Depress the MAXIMUM soft key and use the network analyzer data entry knob as required to verify that the network analyzer marker SWR indication does not exceed the specified limits over the frequency range(s) of interest.

4.3.9 Program the network analyzer for port 2 SWR measurements by depressing the following network analyzer hard and soft keys in the sequence presented:

Hard Keys	Soft Keys
PARAMETER S22	
FORMAT MENU	
	SWR
RESPONSE AUTO	

4.3.10 Wait for the network analyzer to complete at least one entire trace.

4.3.11 Depress the following network analyzer hard and soft keys in the sequence presented.

Hard Keys	Soft Keys
MENUS MARKER	
	MORE
	MAXIMUM

4.3.12 Use the network analyzer data entry knob as required to verify that the network analyzer marker maximum SWR indication does not exceed the specified limits over the frequency range of interest.

4.3.13 Set the TI for 090.0 degrees/GHz.

4.3.14 Wait for the network analyzer to complete at least one entire trace.

4.3.15 Depress the MAXIMUM soft key and use the network analyzer data entry knob as required to verify that the network analyzer marker SWR indication does not exceed the specified limits over the frequency range(s) of interest.

4.3.16 Set the TI for 180.0 degrees/GHz.

4.3.17 Wait for the network analyzer to complete at least one entire trace.

4.3.18 Depress the MAXIMUM soft key and use the network analyzer data entry knob as required to verify that the network analyzer marker SWR indication does not exceed the specified limits over the frequency range(s) of interest.

4.3.19 If no other tests are to be performed, set all equipment power switches to off and disconnect the test set up.

CALIBRATION CHECKLIST

TEST INST (S) Narda 3752 or 3 dBm Labs CO–11956 Coaxial Phase Shifter

PROC. NO. NA 17–20GS–01 MFG. MODEL SER. NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL (6)	CALIBRATION TOLERANCES (7)
3.5	Connector dimensions	—	ck ( )			Conforms to MIL–C–39012
						(comp.)
4.1	Phase Shift Indicator Accuracy	(degrees)				(degrees)
4.1.5	020.0 degrees	20.0				19.7 to 20.3
4.1.6	031.0 ”	31.0				30.7 to 31.3
”	049.0 ”	49.0				48.7 to 49.3
”	052.0 ”	52.0				51.7 to 52.3
”	073.0 ”	73.0				72.7 to 73.3
”	094.0 ”	94.0				93.7 to 94.3
”	105.0 ”	105.0				104.7 to 105.3
”	116.0 ”	116.0				115.7 to 116.3
”	147.0 ”	147.0				146.7 to 147.3
”	168.0 ”	168.0				167.7 to 168.3
”	180.0 ”	180.0				179.7 to 180.3
4.2	Insertion Loss					
4.2.5	S21	—				$\geq$0.5 dB
4.2.6	S12	—				”
4.3	Connector VSWR					
4.3.4	S11, 180.0°/GHz	—				1.25 max
4.3.6	” , 090.0°/GHz	—				”
4.3.8	” , 000.0°/GHz	—				”
4.3.12	S22, 000.0°/GHz	—				”
4.3.15	” , 090.0°/GHz	—				”
4.3.18	” , 180.0°/GHz	—				”

CALIBRATION CHECKLIST

TEST INST (S) Narda 3753B Coaxial Phase Shifter

PROC. NO. NA 17–20GS–01		MFG.	MODEL			SER. NO.
PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL (6)	CALIBRATION TOLERANCES (7)
3.5	Connector dimensions	—	ck ( )			Conforms to MIL–C–39012
						(comp.)
4.1	Phase Shift Indicator Accuracy (degrees)					(degrees)
4.1.4	020.0 degrees	70.0				69.7 to 70.3
4.1.6	031.0 ”	108.5				108.2 to 108.8
”	049.0 ”	171.5				171.2 to 171.8
”	052.0 ”	–178.0				–177.7 to –178.3
”	073.0 ”	–75.5				–75.2 to –75.8
”	094.0 ”	–31.0				–30.7 to –31.3
”	105.0 ”	7.5				7.2 to 7.8
”	116.0 ”	46.0				45.7 to 46.3
”	147.0 ”	154.5				154.2 to 154.8
”	168.0 ”	–48.0				–47.7 to –48.3
”	180.0 ”	–90.0				–89.7 to –90.3
4.2	Insertion Loss					
4.2.5	S21	—				≥0.7 dB
4.2.6	S12	—				”
4.3	Connector VSWR					
4.3.4	S11, 180°/GHz 3.5 – 10 GHz	—				1.35 max
”	” ” 10 – 12.4 GHz	—				1.4 max
4.3.6	S11, 090°/GHz 3.5 – 10 GHz	—				1.35 max
”	” ” 10 – 12.4 GHz	—				1.4 max
4.3.8	S11, 000°/GHz 3.5 – 10 GHz	—				1.35 max
”	” ” 10 – 12.4 GHz	—				1.4 max
4.3.12	S22, 000°/GHz 3.5 – 10 GHz	—				1.35 max
”	” ” 10 – 12.4 GHz	—				1.4 max

CALIBRATION CHECKLIST

TEST INST (S) Narda 3753B Coaxial Phase Shifter

PROC. NO. NA 17–20GS–01 MFG. MODEL SER. NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL (6)	CALIBRATION TOLERANCES (7)
4.3	Connector VSWR (cont'd)					
4.3.15	S22, 090°/GHz 3.5 – 10 GHz	—				1.35 max
”	” ” 10 – 12.4 GHz	—				1.4 max
4.3.18	S22, 180°/GHz 3.5 – 10 GHz	—				1.35 max
”	” ” 10 – 12.4 GHz	—				1.4 max

APPENDIX A

Standard Thru Adapter Delay Characterization and Network Analyzer Cal Kit Modification Procedure

NOTES

Only a high quality precision thru adapter in good condition should be considered for inclusion into the network analyzer calibration kit. After inclusion into the calibration kit, the adapter should be considered dedicated to its purpose as a calibration kit standard and should be treated as any other standard included in the calibration kit.

Section A.1 contains instructions on how to characterize the adapter delay. Section A.2 contains instructions on how to add the adapter delay characteristics into the Network Analyzer Calibration Kit data array. The adapter data must be accessible by the network analyzer software during the FULL 2–PORT/ADAPTER REMOVAL calibration process, required for non–insertable TIs.

The adapter data added to the calibration kit array during the following procedure is only sufficient for use in the FULL 2–PORT/ADAPTER REMOVAL calibration process. The adapter should not be used for any other purpose than ADAPTER REMOVAL.

The calibration kit Standards Definition Table is required to properly document a standard that is to be permanently added to a calibration kit. The calibration kit Standards Definition Table is supplied with the documentation for each Hewlett–Packard Calibration Kit.

A.1 Adapter Delay Characterization

A.1.1 Connect the standard short circuit to the network analyzer port 1 test cable connector.

A.1.2 Perform an S11 Response calibration at the network analyzer port 1 test cable as follows:

Hard Key	Soft Key
PRESET	
STIMULUS STOP	
18	
G/N	
STIMULUS MENU	
	STEP
	NUMBER OF POINTS
	401
RESPONSE MENU	
	AVERAGING ON
1	
2	
8	
x1	

MENUS CAL

(select N–type Cal Kit)*
CALIBRATE RESPONSE
SHORT (f)

(wait for the measurement cycle to complete)

DONE RESPONSE
(select a Cal Set)**

* If the network analyzer display does not offer a Cal Kit selection appropriate for the item 2.2 (N–type Calibration Kit), the calibration kit data will have to be loaded from the tape media supplied with the calibration kit. If this is the case, insert the N–type calibration kit tape into the network analyzer drive and depress the TAPE/DISC hard key followed by the following soft keys: LOAD, CAL KIT 1–2, CAL KIT 2, FILE 1. Then depress the MENUS CAL hard key again.

** At this point the network analyzer display may indicate that a CAL SET must be deleted in order to store the response calibration data. If this is the case, depress the MORE soft key followed by the DELETE CAL SET soft key and the soft key corresponding to the CAL SET to be deleted. The Cal Set selected is needed only for the delay characterization of the adapter and can be overwritten following the characterization procedure.

A.1.3 Disconnect the short circuit from the port 1 test cable and connect the adapter to the test cable.

A.1.4 Connect the standard short circuit to the end of the adapter.

A.1.5 Measure the electrical delay of the adapter by depressing the following network hard and soft keys:

Hard Key	Soft Key
FORMAT PHASE RESPONSE MENU	
	ELECTRICAL DELAY

A.1.6 Use the network analyzer data control knob in order to flatten the sawtooth display on the network analyzer CRT.

NOTE

When the sum of the network analyzer induced phase shift and the adapter induced phase shift passes through zero or 180 degrees, the horizontal display will appear to “sprout”. This is normal and will not affect measurement accuracy. Consider the actual zero degree point as that point which causes an equal amount of trace both above and below the middle area between the two traces.

A.1.7 After achieving a flat trace, record the 2–way ELECTRICAL DELAY as indicated on the network analyzer CRT.

A.1.8 Divide the recorded electrical delay by 2 in order to achieve the 1–way electrical transit time through the adapter. Record the result for use in steps A.2.4 and A.2.8.

A.2 N–type Cal Kit Modification

A.2.1 Before modifying the current N–type calibration kit data array, it is recommended that a copy be made of it. Store the current N–type calibration kit data array on a formatted tape by depressing the following hard and soft keys in the sequence presented:

Hard Key	Soft Key
TAPE/DISC	
	STORE
	CAL KIT 102
	(select kit to be saved)
	FILE 1 (or same as notes following A.1.2)

A.2.2 Select the calibration kit to be modified by depressing the CAL hard key, the MORE soft key and by depressing the soft key corresponding to the cal kit to be modified.

A.2.3 Refer to the N–type calibration kit STANDARD DEFINITION TABLE and select a standard number which is currently unused. This number will represent the standard adapter to be added.

A.2.4 Enter the 1–way electrical transit time for the adapter, from Section A.1, under the STANDARD DEFINITION TABLE DELAY ps. column.

A.2.5 Enter the adapter description (thru) under STANDARD TYPE, enter DC and 18 GHz, for the MIN and MAX FREQUENCY (GHz) limits, respectively. Fill out the COAX or WAVEGUIDE and STND LABEL columns appropriately.

A.2.6 Depress the DEFINE STANDARD soft key and enter the standard number selected in step A.2.3 using the numeric key pad and the x1 pushbutton.

A.2.7 Select the standard type for the thru adapter by depressing the DELAY/THRU soft key.

A.2.8 Specify the electrical delay of the adapter by depressing the SPECIFY OFFSET and OFFSET DELAY soft keys and entering the 1–way transit time in nanoseconds into the network analyzer key pad.

A.2.9 Use the MINIMUM FREQUENCY and MAXIMUM FREQUENCY menu soft keys and enter the frequency limits for the standard adapter being added. Establish the added standard as COAX using the soft key menu and depress the STD OFFSET DONE soft key.

A.2.10 Depress the LABEL STD soft key and using the control knob and the title menu, enter a descriptive label for the adapter, such as “N(F–F)”. Depress the TITLE DONE and STD DONE (DEFINED) soft keys.

A.2.11 Depress the following soft keys in the sequence presented:

soft key
SPECIFY CLASS
MORE
MORE
ADAPTER

A.2.12 Use the numeric key pad and the x1 pushbutton to enter the standard number of the adapter to be added at this time.

A.2.13 Depress the CLASS DONE soft key.

A.2.14 Depress the following soft keys in the sequence presented:

soft key
LABEL CLASS
MORE
MORE
ADAPTER

A.2.15 Use the control knob and the title menu to enter a descriptive label for the standard class, such as "N(F–F)". Depress the TITLE DONE and LABEL DONE soft keys.

A.2.16 If it is desired to change the Cal Kit label, depress the LABEL KIT soft key and use the title menu to enter a label of 10 characters or less.

A.2.17 Depress the KIT DONE (MODIFIED) soft key to save the new Cal Kit definition.

A.2.18 If it is desired to save the new Cal Kit definition permanently on tape, carry out the procedure described in step A.2.1. If it is not desired to include the added adapter into the calibration kit permanently, the calibration kit definition just modified can be written over by down–loading the original calibration kit data array over it.

NOTE

The N–type Calibration Kit data array has been appended to include an adapter required for the ADAPTER REMOVAL calibration error removal technique. If the calibration kit data array is not saved to magnetic media and gets overwritten in the network analyzers non–volatile memory, Section A.2 and perhaps Section A.1 will have to be repeated before the ADAPTER REMOVAL technique can again be used.