COPPER MOUNTAIN
TECHNOLOGIES

Planar 808/1, Planar 804/1 and S5048

Network Analyzer

Performance Test Manual

Version September, 2014

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INTRODUCTION

The Planar 804/1, Planar 808/1, and S5048 vector network analyzers (Analyzers) are designed for measuring S-parameters of RF and microwave devices and coaxial transmission lines with N-type connectors.

The Planar 804/1 and S5048 analyzers have two ports and one test signal source, whereas the Planar 808/1 has four ports and two test signal sources. Except as noted, all models are referred to interchangeably in this document as “the Analyzer” .

The Analyzer’s recommended performance test interval is once each year.

1 SAFETY REQUIREMENTS

Carefully read through the following safety instructions before starting performance test of the Analyzer.

- The Analyzer must be used only by skilled and specialized staff or thoroughly trained personnel with the required skills and knowledge of safety precautions.
- The Analyzer complies with INSTALLATION CATEGORY II as well as POLLUTION DEGREE 2 in IEC61010-1. The Analyzer is INDOOR USE product.
- The Analyzer is MEASUREMENT CATEGORY I (CAT I). Do not use for CAT II, III, or IV.
- Never operate the Analyzer in the environment containing inflammable gases or fumes.
- Operators must not remove the cover or part of the housing. The Analyzer must not be repaired by the operator. Component replacement or internal adjustment must be performed by qualified maintenance personnel only.
- Do not replace components with the power cable connected. To avoid injuries, always disconnect the power and discharge circuits before touching them.
- Do not replace parts or modify the Analyzer to avoid the danger of additional hazards, do not install replacement parts or perform unauthorized modifications to the Analyzer.
- Do not connect the measuring terminals to mains.

Electrostatic discharge can damage your Analyzer when connected or disconnected from the DUT. Static charge can build up on your body and damage the sensitive circuits of internal components of both the Analyzer and the DUT.

To avoid damage from electric discharge, observe the following:

- Always use a desktop antistatic mat under the DUT.
- Always wear a grounding wrist strap connected to the desktop antistatic mat via daisy-chained 1 MΩ resistor.
- Connect the PC and the body of the DUT to protective grounding before you start operation.

2 PERFORMANCE TESTS

Table 1 – List of Performance tests.

Test Description	Section
Visual Inspection	6.1
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3 TEST EQUIPMENT

Equipment similar to the listed can be used provided it satisfies the specifications shown in Table 2.

Table 2 – Equipment required for conducting performance testing.

Test Equipment and Specifications
Agilent 53150A Frequency Counter: frequency range 10 Hz to 20 GHz, accuracy ±1×10^{-7}.
Agilent E4408B Spectrum Analyzer: frequency range 9 kHz to 26.5 GHz; power level measurement accuracy ±2 dB.
NRP-Z51 Thermal Power Sensor: DC frequency range up to 18 GHz, power level measurement range -30 to +20 dBm, power level measurement accuracy ±0.061 dB.
RPC-N Verification Kit 05CK200-150: DC frequency range up to 18 GHz, attenuation measurement accuracy ±0.06 dB, phase measurement accuracy ±0.5°.
RPC-N Calibration Kit 05CK10A-150: DC frequency range up to 18 GHz.
RPC-N Calibration Kit, LRL Version 05CK120-150: DC frequency range up to 18 GHz.
RPC-N Adapter 05S121-K20S3: male-female, DC frequency range up to 18 GHz, VSWR max 1.1.
RPC-N Load 05S150-C10S3: N-male, DC frequency range up to 18 GHz, VSWR max 1.1 (2 pcs for Planar 804/1 and 4 pcs for Planar 808/1).
05W00K-000 Gage female incl. block: measurement range ±500 µm, scale gradation 1 µm, accuracy ±5 µm.
Torque wrench: torque range 1.1 to 1.7 Nm.

ALL THE TEST EQUIPMENT SHALL BE VERIFIED AND HAVE VALID VERIFICATION OR CALIBRATION CERTIFICATES.

4 AMBIENT CONDITIONS

Execute performance test under the following ambient conditions:

- Ambient temperature 23±5 ^{0}C.
- Relative air humidity 30% to 80% at 25 ^{0}C.
- Atmospheric pressure 630 to 795 mm Hg.

When performing transmission coefficient magnitude and phase accuracy test (section 6.3.5) and reflection coefficient magnitude and phase accuracy test (section 6.3.6) ensure that the ambient temperature remains within ±1°C of the calibration temperature.

5 PREPARATION FOR TEST

Verification personnel should thoroughly read and understand the manuals of the Analyzer and test equipment to be used.

The Analyzer and the test equipment used for verification should be properly grounded and warmed up for the times specified in the corresponding manuals.

6 PERFORMANCE TEST PROCEDURE

Performance test of the Analyzer can be achieved in two ways:

1. Performance verification of the Analyzer can be automated using the special performance test program provided in the Analyzer software. To do this, open the [System, Performance Test] menu and select [Type – Periodic], then start the test by selecting [Create Report] and follow the program instructions.
2. Performance verification can be done manually.

This manual details the performance test procedure according to the manual performance verification option.

6.1 Visual Inspection

During visual inspection check the Analyzer for:

- Contaminated and damaged connectors and jacks.
- Housing damage and loose components (check any sound when tilting the Analyzer).

DO NOT PROCEED FURTHER WITH PERFORMANCE TEST OF ANY MECHANICALLY DEFECTIVE OR DAMAGED ANALYZERS OR ACCESSORIES. SUCH INSTRUMENTS SHOULD BE DISPOSED OF OR SENT FOR REPAIR.

6.2 GAGING CONNECTORS

To perform connector gaging of the Analyzer, use 05W00K-000 Gage female including block (measurement range ±500 µm, scale gradation 1 µm, accuracy ± 5 µm) or another available common gage set designed for gaging N-type connectors of vector network analyzers. Follow the gaging procedures specified in the manual to the gage set you are using.

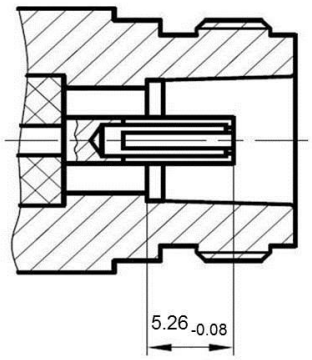

Figure 1 – Connecting dimensions of connector.

Note that normally, gages are intended for preventive maintenance and troubleshooting purposes only. The connector gages are only capable of performing rough measurements. However, with proper technique, the gages are useful in detecting gross pin depth errors in connectors of the Analyzer. To reduce random errors and achieve maximum accuracy, take the average of several measurements made with different gage orientations to the connector.

6.3 PERFORMANCE VERIFICATION

Before you start performance verification tests, warm up the Analyzer for 40 minutes.

6.3.1 CW FREQUENCY ACCURACY TEST

6.3.1.1 Prepare the frequency counter for operation in accordance with its operating manual.

6.3.1.2 Preset the Analyzer [System, Preset, Ok]. Connect the frequency counter to the port 1 of the Analyzer under test.

6.3.1.3 Switch the Analyzer to 300 kHz CW generation mode [Stimulus, Center 300 kHz, Span 0 MHz] and for measurements in single-sweep mode [Stimulus, Trigger, Single].

6.3.1.4 Enter the measured frequency value into the corresponding column of Table 3 (Planar 804/1 and 808/1) for port 1, or Table 4 for S5048.

6.3.1.5 Calculate the relative frequency error of the signal source using the following formula (1):

$$\Delta f = (f - f_0) \cdot 10^6 / f_0 , \quad (1)$$

where f – measured frequency, Hz;
f_0 –frequency setting, Hz.

6.3.1.6 Repeat the frequency measurement at the output frequency of 8 GHz (4.8 GHz for S5048) [Stimulus, Center 8 GHz], [Stimulus, Trigger, Single].

6.3.1.7 For Planar 808/1, connect the frequency counter to port 3 of the Analyzer under test. Select S_{33} as measured parameter.

6.3.1.8 Repeat the frequency measurement at the output frequencies of 300 kHz and 8 GHz. Enter the measured values into the corresponding columns of Table 3 for port 3.

THE TEST IS CONSIDERED TO BE PASSED IF THE RELATIVE FREQUENCY ERROR IS WITHIN THE SPECIFICATION INDICATED IN TABLE 3 OR TABLE 4.

Table 3 – Planar 804/1 and 808/1 frequency accuracy result table.

Port	Frequency [MHz]	Measured Frequency[Hz]	Rel Frequency Error [ppm]	Specification [ppm]
1	0.3			±5
	8000			
3 (808/1 only)	0.3			±5
	8000			

Table 4 – S5048 frequency accuracy result table.

Port	Frequency [MHz]	Measured Frequency[Hz]	Rel Frequency Error [ppm]	Specification [ppm]
1	0.3			±5
	4800			

6.3.2 OUTPUT POWER LEVEL ACCURACY TEST

6.3.2.1 Prepare the power sensor for operation and connect it to port 1 of the Analyzer.

6.3.2.2 Initialize the Analyzer under test [System, Preset, Ok]. Switch the Analyzer to absolute measurement mode [Measurement, Absolute, Receiver R1 – Source Port 1] for Planar 804/1 and S5048, or [Measurement, Reference Receiver, R1 (1)] for Planar 808/1.

6.3.2.3 Switch the Analyzer to 0 dBm CW mode [Stimulus, Span 0 MHz, Power 0 dBm] and for measurements in single-sweep mode [Stimulus, Trigger, Single].

6.3.2.4 Set the output frequency to 300 kHz [Stimulus, Center 300 kHz] for Planar 804/1 and Planar 808/1, or 20 kHz [Stimulus, Center 20 kHz] for S5048. Enter the measured level value using the power sensor in Table 5 for Planar 804/1 and

Planar 808/1, or Table 6 for S5048.

6.3.2.5 Repeat the measurements as described in section 6.3.2.3 for other frequency values specified in Table 5.

6.3.2.6 Set the Analyzer frequency range to 300 kHz-8 GHz (20 kHz-4.8 GHz for S5048) and connect the power sensor. Set the IF bandwidth to 100 Hz. Perform measurement normalization [Display, Data -> Memory, Data Math, Data / Mem].

6.3.2.7 Enable markers at 300 kHz, 10, 100, 200, 500, 1000, 2000, 4000, 6000 and 8000 MHz (20 and 300 kHz, 10, 100, 200, 500, 1000, 2000, 3000, 4000, and 4800 MHz for S5048).

6.3.2.8 For Planar 804/1 and Planar 808/1, set the output power level to 10 dBm and enter the marker values in Table 5 (do not measure the 10 dBm power level at 8 GHz). For S5048, set the output power level to 5 dBm and enter the marker values in Table 6.

6.3.2.9 For Planar 804/1 and 808/1, repeat the measurements as described in section 6.3.2.7 for 5, -10 and -60 dBm level values. For S5048, repeat the measurements for -10 and -50 dBm level values.

6.3.2.10 Connect the power sensor to port 2 of the Analyzer under test. Switch the Analyzer to the absolute measurement mode [Measurement, Absolute, Receiver R2 – Source Port2] for Planar 804/1 and S5048, or [Measurement, Reference Receiver, R2 (2)] for Planar 808/1. Repeat the measurements as described in sections 6.3.2.2 to 6.3.2.8.

6.3.2.11 For Planar 808/1, connect the power sensor to port 3 of the Analyzer under test. Switch the Analyzer to the absolute measurement mode [Measurement, Reference Receiver, R3 (3)]. Repeat as described in Sections 6.3.2.2 to 6.3.2.8.

6.3.2.12 For Planar 808/1, connect the power sensor to port 4 of the Analyzer under test. Switch the Analyzer to the absolute measurement mode [Measurement, Reference Receiver, R4 (4)]. Repeat the measurements as described in Sections 6.3.2.2 to 6.3.2.8.

6.3.2.13 Determine the power errors at the specified levels of by adding values in the 0 dBm line and the respective line of Table 5 for Planar 804/1 and 808/1, or Table 6 for S5048.

THE TEST IS CONSIDERED TO BE PASSED IF THE POWER ERRORS ACROSS THE SPECIFIED LEVEL RANGE, ARE WITHIN ±1.5 dB FOR Planar 804/1 AND 808/1, OR ±1.0 dB FOR S5048.

Table 5 – Planar 804/1 and 808/1 output power level result table.

Port	RF Output Level[dBm]	Measured RF Output Level [dBm]										Power Error[dB]	Specifica-tion [dB]
		Frequency [MHz]											
		0.3	10	100	200	500	1000	2000	4000	6000	8000		
1	0												±1.5
	10										–		
	5												
	-10												
	-60												
2	0												±1.5
	10										–		
	5												
	-10												
	-60												
3 (808/1 only)	0												±1.5
	10										–		
	5												
	-10												
	-60												
4 (808/1 only)	0												±1.5
	10										–		
	5												
	-10												
	-60												

Table 6 – S5048 output power level result table.

Port	RF Output Level [dBm]	Measured RF Output Level [dBm]										Power Error [dB]	Specifica-tion [dB]
		Frequency [MHz]											
		0.02	0.3	10	100	500	1000	2000	3000	4000	4800		
1	0												±1.0
	5												
	-10												
	-50												
2	0												±1.0
	5												
	-10												
	-50												

6.3.3 HARMONIC DISTORTION TEST

6.3.3.1 Output harmonic distortion is measured using a spectrum analyzer. Prepare the spectrum analyzer for operation in accordance with its operating manual. Set the reference power level of the spectrum analyzer to 10 dBm. Connect the spectrum analyzer to port 1 of the Analyzer under test.

6.3.3.2 Initialize the Analyzer under test [System, Preset, Ok]. Set the output power level to 0 dBm [Stimulus, Power 0 dBm] and for measurements in single-sweep mode [Stimulus, Trigger, Single].

6.3.3.3 Measure the maximum harmonic distortion (up to third order harmonic) at output frequencies of 300 kHz, 10, 100, 200, 500, 1000, 2000, 4000, 6000 and 8000 MHz for Planar 804/1 and 808/1. Measure the maximum harmonic distortion at output frequencies of 300 kHz, 10, 100, 200, 500, 1000, 2000, 4000, and 4800 MHz for S5048. Enter the measured values in Table 7.

6.3.3.4 Connect the spectrum analyzer to port 2 of the Analyzer under test. Enable the S_{22} measurement mode [Measurement, S_{22}] for Planar 804/1 and S5048, [Measurement, S-Parameter, S_{22}] for Planar 808/1. Repeat the measurements as described in section 6.3.3.2.

6.3.3.5 For Planar 808/1, connect the spectrum analyzer to port 3 of the Analyzer under test. Enable the S_{33} measurement mode [Measurement, S-Parameter, S_{33}]. Repeat the measurements as described in section 6.3.3.2.

6.3.3.6 For Planar 808/1, connect the spectrum analyzer to port 4 of the Analyzer under test. Enable the S_{44} measurement mode [Measurement, S-Parameter, S_{44}]. Repeat the measurements as described in section 6.3.3.2.

Table 7 – Harmonic distortion result table.

Port	Harmonic Distortion [dBc]											Upper Specification [dBc]
	Frequency [MHz]											
	0.3	10	100	200	500	1000	2000	3000 (S5048 only)	4000	6000 (4800 for S5048)	8000 (804/1 & 808/1 only)	
1												-25 (804/1 & 808/1); -20 (S5048)
2												
3 (808/1 only)												
4 (808/1 only)												

THE TEST IS CONSIDERED TO BE PASSED IF THE OUTPUT HARMONIC DISTORTION IS LESS THAN -25 dBc FOR PLANAR 804/1 AND 808/1, LESS THAN -20 dBc FOR S5048.

6.3.4 NON-HARMONIC SPURIOUS TEST

6.3.4.1 Non-harmonic spurious level is measured using a spectrum analyzer. Prepare the spectrum analyzer for operation in accordance with its operating manual. Set the reference level of the spectrum analyzer to 10 dBm. Set the stimulus start frequency to 10 kHz, stimulus stop frequency to 10 GHz (6 GHz for S5048), and IF bandwidth to 300 kHz.

6.3.4.2 Switch the Analyzer under test to slow sweep mode over 300 kHz to 8 GHz span (300 kHz to 4.8 GHz for S5048). Initialize the Analyzer [System, Preset, Ok]. Set the output power level to 0 dBm [Stimulus, Power 0 dBm], and the IF bandwidth to 1 Hz [Average, IF Bandwidth 1 Hz] (10 Hz for S5048). Connect the spectrum analyzer to port 1 of the Analyzer under test.

6.3.4.3 During the sweep measure the minimum difference between the levels of useful signal and spurious signal. Enter the measured value in Table 8.

6.3.4.4 For Planar 808/1, connect the spectrum analyzer to port 3 of the Analyzer under test. Enable the S_{33} measurement mode [Measurement, S-Parameter, S_{33}]. During the sweep, measure the minimum difference between the levels of useful signal and spurious signal. Enter the measured value in Table 8.

Table 8 – Non-harmonic spurious result table.

Port	Non-Harmonic Spurious [dBc]	Upper Specification[dBc]
1		-30
3 (808/1 only)		

THE TEST IS CONSIDERED TO BE PASSED IF THE MEASURED DIFFERENCE IS LESS THAN -30 dBc AT OUTPUT FREQUENCIES UP TO 8 GHz (4.8 GHz FOR S5048).

6.3.5 TRANSMISSION COEFFICIENT MAGNITUDE AND PHASE ACCURACY TEST

6.3.5.1 Transmission coefficient magnitude and phase accuracy test is performed by comparing the measured and actual values of transmission magnitude and phase of the 20 dB and 40 dB attenuators of the 05CK200-150 verification kit.

6.3.5.2 Initialize the Analyzer under test [System, Preset, Ok]. Enable four traces [Display, Num of Traces, 4]. Arrange traces in different windows [Display, Allocate Traces, x4 ▪]. Assign the S_{21} Log Mag measured parameter to Trace 1, S_{12} Log Mag to Trace 2, S_{21} Phase to Trace 3, and S_{12} Phase to Trace 4. See allocation of traces in Figure 2.

S21 LOG MAG	S12 LOG MAG
S21 PHASE	S12 PHASE

Figure 2 – Allocation of traces within window.

6.3.5.3 Enable segment sweep mode. The frequencies of the segments should correspond to the characterized frequencies of the attenuators. For Planar 804/1 and 808/1, the recommended points are 300 kHz, 3.2 GHz and 8 GHz. For S5048, the recommended points are 20 kHz, 3.0 GHz and 4.8 GHz. Set the same start and stop frequencies in each segment. Set the number measurement points in each segment to 1.

6.3.5.4 Enable markers for the segment frequencies on each trace.

6.3.5.5 Set the output power level to -5 dBm [Stimulus, Power -5 dBm], and IF bandwidth to 1 Hz [Average, IF Bandwidth 1 Hz] for Planar 804/1 and Planar 808/1, 10 Hz [Average, IF Bandwidth 10 Hz] for S5048.

6.3.5.6 Connect up the measurement setup as shown in Figure 3 for S5048, or as shown in Figure 4 for Planar 804/1, or as shown in Figure 5 for Planar 808/1. Do not connect the attenuators. Use the torque wrench to tighten the RF cable connectors and adapter. The RF cable should be a phase- and amplitude-stable test cable.

6.3.5.7 Perform full two-port calibration using 05CK10A-150 calibration kit. Use the torque wrench to tighten the connectors.

6.3.5.8 Transmission coefficient magnitude and phase accuracy at -20 dB is verified using the 20 dB 05AS122-K20S3 attenuator. Connect the attenuator as shown above. Determine the measured magnitude and phase values using markers and enter them in Table 9 and Table 10 for 20 dB attenuator. The deviation from the actual value is considered to be the measurement error. The test is considered to be passed if the measured magnitude error is less than 0.1 dB, and the measured phase error is less than 1°. When comparing the attenuator parameters, pay attention to its orientation. If necessary check the attenuator calibration certificate for the determination of the proper orientation.

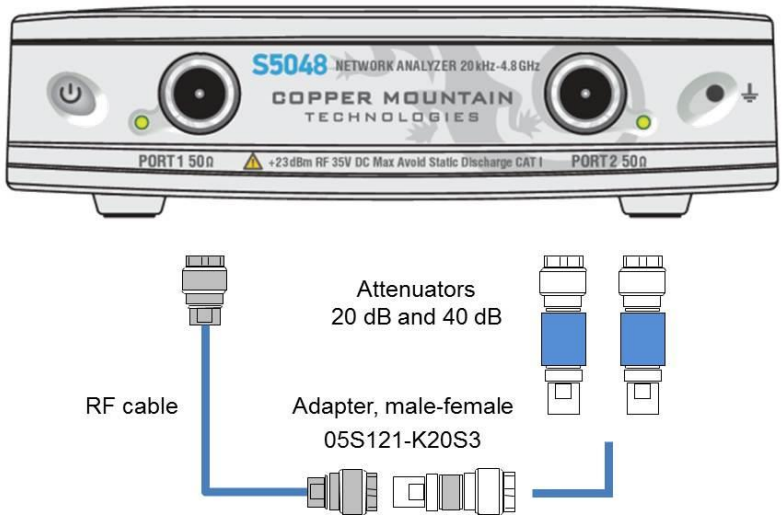

Figure 3 –Transmission coefficient accuracy measurement setup for S5048.

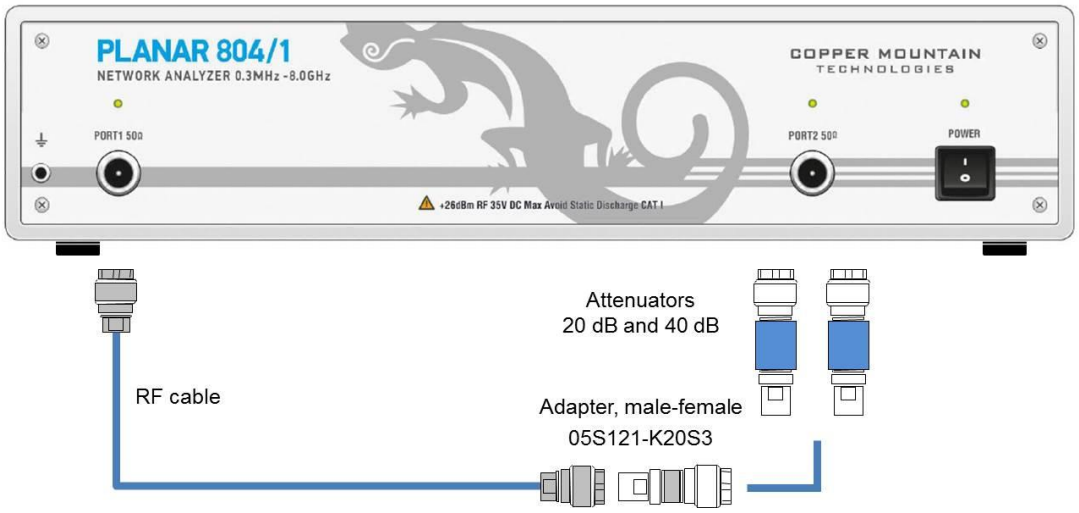

Figure 4 –Transmission coefficient accuracy measurement setup for Planar 804/1.

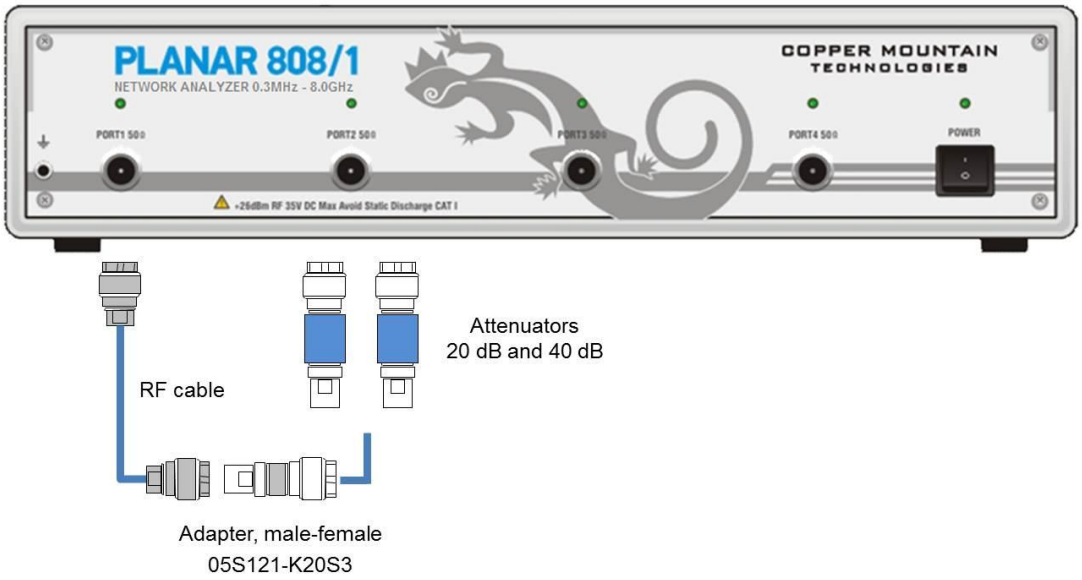

Figure 5 – Transmission coefficient accuracy measurement setup for Planar 808/1.

6.3.5.9 Transmission coefficient magnitude and phase accuracy at -40 dB is verified using the 40 dB 05AS122-K40S3 attenuator. Connect the attenuator as shown above. Determine the measured values using markers and enter them in Table 9 and Table 10 for 40 dB attenuator. Deviation from the characterized value is considered to be the measurement error. The test is considered to be passed if the measured magnitude error is <0.1 dB, and the measured phase error is < 1°. When comparing the attenuator parameters, pay attention to its orientation. If necessary check the attenuator calibration certificate to determine the proper orientation.

Table 9 – Transmission coefficient magnitude accuracy.

Frequency [MHz]	Actual Magnitude Value [dB]		$\lvert S_{21}\rvert$		$\lvert S_{12}\rvert$		Specification [dB]
	$\lvert S_{21}\rvert$	$\lvert S_{12}\rvert$	Measured Value [dB]	Magnitude Error [dB]	Measured Value [dB]	Magnitude Error [dB]	
0.3 (0.02 for S5048)							±0.1
3200 (3000 for S5048)							±0.1
8000 (4800 for S5048)							±0.1

Table 10 – Transmission coefficient phase accuracy.

Frequency [MHz]	Actual Phase Value [°]		$\arg(S_{21})$		$\arg(S_{12})$		Specification [°]
	$\arg(S_{21})$	$\arg(S_{12})$	Measured Value [°]	Phase Error [°]	Measured Value [°]	Phase Error [°]	
0.3 (0.02 for S5048)							±1
3200 (3000 for S5048)							±1
8000 (4800 for S5048)							±1

6.3.5.10 For Planar 808/1, repeat the test with the cable connected to ports 3 and 4; trace allocation is shown in Figure 6 and the measurement setup in Figure 7. Enter the measured values in Table 9 and Table 10. Change the names of table columns for measured values from S_{21} and S_{12} to S_{43} and S_{34} respectively.

S43 LOG MAG	S34 LOG MAG
S43 PHASE	S34 PHASE

Figure 6 – Allocation of traces within window for additional Planar 808/1 test.

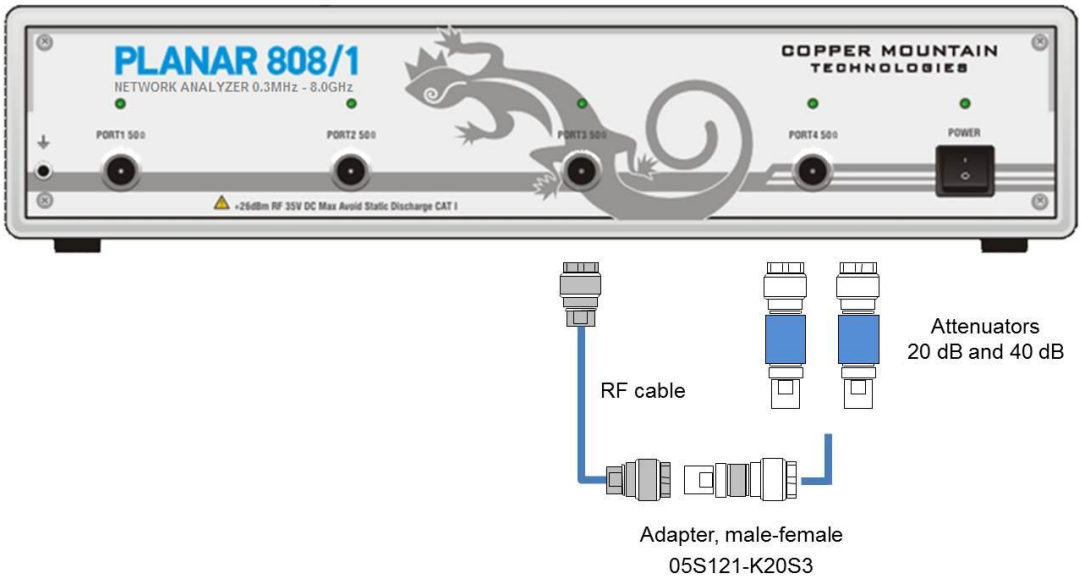

Figure 7 –Setup for Planar 808/1 transmission coefficient accuracy measurement.

THE TEST IS CONSIDERED TO BE PASSED IF THE MEASURED MAGNITUDE AND PHASE ERRORS ARE WITHIN THE SPECIFICATION INDICATED IN TABLE 9 AND TABLE 10 FOR BOTH 20 dB AND 40 dB ATTENUATORS.

6.3.6 REFLECTION COEFFICIENT MAGNITUDE AND PHASE ACCURACY TEST

6.3.6.1 Reflection coefficient magnitude and phase accuracy test is performed by comparing the measured and actual values of reflection magnitude and phase of the 05S102-K100 stepped 25 Ohm air line from 05CK200-150 verification kit.

6.3.6.2 Perform the following settings on the Analyzer under test: frequency range from 300 kHz to 8 GHz (20 kHz to 4.8 GHz for S5048); IF bandwidth to 1 Hz (10 Hz for S5048); number of traces displayed to 4 [Display, Num of Traces, 4]; and measured parameters to S_{11} (to traces 1 and 2) and S_{22} (to traces 3 and 4). Set trace 1 format to S_{11} Phase [Format, Phase]; set trace 2 format to S_{11} Log Mag [Format, Log Mag]; set trace 3 format to S_{22} Phase [Format, Phase]; and set trace 4 format to S_{22} Log Mag [Format, Log Mag]. Enable segment sweep mode. The frequencies of the segments should correspond to the characterized frequencies of the 05S102-K100 air line. Set the number of measurement points in each segment to 1. Enable the markers for the segment frequencies. Place the Analyzer in a vertical position; use a clamping fixture for S5048. Connect a phase- and amplitude-stable test cable with the 05S121-K20S3 adapter attached to Port 1 of the Analyzer.

6.3.6.3 Perform two-port TRL calibration of the Analyzer using the 05CK120-150 Calibration Kit. Connect the air line (male connector side) to Port 2 in the following manner: insert the inner conductor of the air line into Port 2 connector; put on the outer conductor, and tighten the screw nut using the torque wrench. Connect a cable with adapter attached to the free connector of the air line.

6.3.6.4 Use markers to determine the air line reflection magnitude and phase. Enter the measured magnitude values in Table 11, and the measured phase values in Table 12 for each port of the air line.

6.3.6.5 Determine the mean values for the actual magnitude and phase of the air line at each frequency using formula (2):

$$A_{nomi(j)} = (A_{malei(j)}+A_{femalei(j)})/2, \quad (2)$$

where $A_{male\ i(j)}$ – actual magnitude (i) or phase (j) values of the reflection coefficient on male connector; $A_{female\ i(j)}$ – actual magnitude (i) or phase (j) values of the reflection coefficient on female connector.

6.3.6.6 Enter the mean magnitude values $A_{nom\ i}$ and the mean phase values $A_{nom\ j}$ in Table 11 and Table 12, respectively.

6.3.6.7 Determine mean values for measured magnitude and phase using formula (3):

$$A_{meani(j)} = (A_{meas1\ i(j)}+A_{meas2\ i(j)})/2, \quad (3)$$

where $A_{meas1\ i(j)}$ - measured magnitude (i) or phase (j) values of the reflection coefficient on female connector;

$A_{meas2i(j)}$ - measured magnitude (i) or phase (j) values of the reflection coefficient on male connector.

6.3.6.8 Enter the mean magnitude values $A_{mean\ i}$ in Table 11, and enter the mean phase values $A_{mean\ j}$ in Table 12.

6.3.6.9 Determine magnitude error using formula (4):

$$\Delta A_i = A_{meani} - A_{nomi}. \quad (4)$$

6.3.6.10 Enter the magnitude error ΔA_i in Table 11.

Table 11 – Reflection coefficient magnitude accuracy.

Frequency [MHz]	Actual S-parameters 25 Ohm Air Line		Magnitude measurement [dB]			Magnitude Error [dB]	Specification [dB]
	Mean Mag [dB]	Mean Phase [°]	S11	S22	Mean Value		
		–					
		–					

Table 12 – Reflection coefficient phase accuracy.

Frequency [MHz]	Actual S-parameters 25 Ohm Air Line		Phase measurement [°]			Phase Error [°]	Specification [°]
	Mean Mag [dB]	Mean Phase [°]	S11	S22	Mean Value		

6.3.6.11 Determine phase error using the following formula (5):

$$\Delta A_j = A_{mean\ j} - A_{nomj}. \quad (5)$$

6.3.6.12 Enter the phase error ΔA_j in Table 12.

6.3.6.13 Enter the accuracy of the reflection coefficient measurement in columns Specification of Table 11 and Table 12.

If the actual mean magnitude value of the air line is:

- Between 0 and -15 dB, enter ±0.4 dB in Table 11 and ±3° in Table 12;
- between -15 and -25 dB, enter ±1 dB in Table 11 and ±6° in Table 12;
- between -25 and -35 dB, enter ±3 dB in Table 11 and ±20° in Table 12.

6.3.6.14 For Planar 808/1, repeat the reflection coefficient magnitude and phase measurement for ports 3 and 4. Performing the test, set trace 1 format to S_{33} Phase [Format, Phase]; set trace 2 format to S_{33} Log Mag [Format, Log Mag]; set trace 3 format to S_{44} Phase [Format, Phase]; and set trace 4 format to S_{44} Log Mag [Format, Log Mag]. Enter the measured values into the table. Change the names of table columns for measured values from S_{11} and S_{22} to S_{33} and S_{44} respectively.

THE TEST IS CONSIDERED TO BE PASSED IF MAGNITUDE AND PHASE ERRORS ARE WITHIN THE SPECIFICATION INDICATED IN TABLE 11 AND TABLE 12 FOR 25 Ohm AIR LINE.

6.3.7 RECEIVER NOISE FLOOR TEST (IF BANDWIDTH 10 HZ)

6.3.7.1 Connect the 05S150-C10S3 loads to all measurement ports of the Analyzer under test.

6.3.7.2 Initialize the Analyzer under test [System, Preset, Ok]. Enable four traces [Display, Num of Traces, 4] for Planar 804/1 and S5048, enable sixteen traces [Display, Num of Traces, 16] for Planar 808/1. Arrange traces in different windows [Display, Allocate Traces, x4] or [Display, Allocate Traces, x16].

6.3.7.3 Perform the following settings on the Analyzer: frequency range to 300 kHz to 8 GHz (20 kHz to 4.8 GHz for S5048); output power level to 0 dBm; IF bandwidth to 10 Hz. For Planar 804/1 and 808/1, the number of measurement points is 1000; for S5048 there are 50 points between 20 and 300 kHz, and 950 points between 300 kHz and 4.8 GHz. Enable the statistical analysis marker [Markers, Marker Math, Statistics — ON] for each transmission coefficient trace.

6.3.7.4 Determine the mean trace parameter (using Mean marker). Enter the measured value in Table 13.

6.3.7.5 For S5048 only, set the Analyzer frequency range from 300 kHz to 4.8 GHz. Determine the mean trace parameter. Enter the measured value in Table 13.

Table 13 – Receiver noise floor test result table.

Frequency	Receiver Noise Floor [dBm]		Max Measured Value [dBm]	Upper Specification [dBm]
300 kHz to 8 GHz (20 kHz to 300 kHz for S5048)	S_{21}			-125 (Planar 804/1 and 808/1); -90 for S5048
	S_{12}			
	S_{31} (808/1 only)			
	S_{41} (808/1 only)			
	S_{32} (808/1 only)			
	S_{42} (808/1 only)			
	S_{13} (808/1 only)			
	S_{23}(808/1 only)			
	S_{43}(808/1 only)			
	S_{14}(808/1 only)			
	S_{24}(808/1 only)			
	S_{34}(808/1 only)			
300 kHz to 4.8 GHz (S5048 only)	S_{21}			-115
	S_{12}			

THE TEST IS CONSIDERED TO BE PASSED IF THE MEASURED NOISE FLOOR IS LESS THAN the limits specified in TABLE 13.

6.3.8 TRACE NOISE TEST

6.3.8.1 Initialize the Analyzer under test [System, Preset, Ok]. Set the IF bandwidth to 3 kHz, the number of measurement points to 5000 (for S5048, 500 between 20 and 300 kHz, 4500 for 300 kHz to 4.8 GHz), and the output power level to 0 dBm.

6.3.8.2 Connect OPEN to measurement port 1. Perform normalization of measurement of S_{11} [Display, Data -> Memory, Data Math, Data / Mem].

6.3.8.3 Enable the statistical analysis marker [Markers, Marker Math, Statistics - ON]. Determine the mean square deviation value. Enter the measured value in Table 14.

Table 14 – Trace noise result table.

Frequency	Trace Noise Magnitude [dB]		Max Measured Value[dB]	Upper Specification[dB]
20 kHz to 300 kHz (S5048 only)	S_{11}			0.015
	S_{22}			
	S_{21}			
	S_{12}			
300 kHz to 8 GHz for 804/1 and 808/1; 300 kHz to 4.8 GHz for S5048	S_{11}			0.001 for Planar 804/1 and 808/1; 0.002 for S5048
	S_{22}			
	S_{21}			
	S_{12}			
	S_{33} (808/1 only)			
	S_{44} (808/1 only)			
	S_{43} (808/1 only)			
	S_{34} (808/1 only)			

6.3.8.4 Connect an OPEN to measurement port 2. Enable measurement of S_{22} [Measurement, S_{22}]. Repeat the measurements as described in section 6.3.8.2.

6.3.8.5 Connect measurement ports 1 and 2 using a measurement cable. Enable measurement of S_{21} [Measurement, S_{21}]. Perform measurement normalization [Display, Data -> Memory, Data Math, Data / Mem]. Repeat the measurements as described in section 6.3.8.2.

6.3.8.6 Enable measurement of S_{12} [Measurement, S_{12}]. Perform measurement normalization [Display, Data -> Memory, Data Math, Data / Mem]. Repeat the measurements as described in section 6.3.8.2.

6.3.8.7 For Planar 808/1, repeat a succession of measurements of S_{33} and S_{44} with the OPEN connected to ports 3 and 4, and of $S_{43}$and $S_{34}$with the test cable connected between ports 3 and 4.

THE TEST IS CONSIDERED TO BE PASSED IF THE MEAN SQUARE DEVIATION VALUE IS LESS THAN THE LIMITS SPECIFIED IN TABLE 14.

7 PERFORMANCE TEST REPORTS

Performance test reports are to be filled in during the test procedure.

If the test is passed, a performance test certificate is issued, and a performance test sticker is attached to the Analyzer housing or a corresponding stamp is placed in the Analyzer's technical documentation.

If the Analyzer has failed the performance test, the previous performance test certificate is cancelled, the performance test sticker or stamp is removed and a non-compliance notice stating the reasons of test failure is issued. Such an Analyzer should not be used.