Keysight Technologies N5281A

Notice: This document contains references to Agilent. Please note that Agilent's Test and measurement business has become Keysight Technologies. For more information, go to www.keysight.com.

KEYSIGHT TECHNOLOGIES

User's and Service Guide

Notices

Trademark Acknowledgments

Manual Part Number

N5281-90001

Edition

Print Date: December 2018

Supersedes: March 2017

Printed in USA/Malaysia

Published by:
Keysight Technologies
1400 Fountaingrove Parkway
Santa Rosa, CA 95403

Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED "AS IS," AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, KEYSIGHT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. KEYSIGHT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR ANY INFORMATION CONTAINED HEREIN. SHOULD KEYSIGHT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT WILL CONTROL.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

U.S. Government Rights

The Software is "commercial computer software," as defined by Federal Acquisition Regulation ("FAR") 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement ("DFARS") 227.7202, the U.S. government acquires commercial computer software under the same terms by which the software is customarily provided to the public. Accordingly, Keysight provides the Software to U.S. government customers under its standard commercial license, which is embodied in its End User License Agreement (EULA), a copy of which can be found at http://www.keysight.com/find/sweula The license set forth in the EULA represents the exclusive authority by which the U.S. government may use, modify, distribute, or disclose the Software. The EULA and the license set forth therein, does not require or permit, among other things, that Keysight: (1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public; or (2) Relinquish to, or otherwise provide, the government rights in excess of these rights customarily provided to the public to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation. No additional government requirements beyond those set forth in the EULA shall apply, except to the extent that those terms, rights, or licenses are explicitly required from all providers of commercial computer software pursuant to the FAR and the DFARS and are set forth specifically in writing elsewhere in the EULA. Keysight shall be under no obligation to update, revise or otherwise modify the Software. With respect to any technical data as defined by FAR 2.101, pursuant to FAR 12.211 and 27.404.2 and DFARS 227.7102, the U.S. government acquires no greater than Limited Rights as defined in FAR 27.401 or DFAR 227.7103-5 (c), as applicable in any technical data.

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Table of Contents

N5281A

Contents

N5281A

Introduction

The N5281A replaces the Hewlett Packard 8511B Four Channel Frequency Converter Test Set. This document describes how to use the N5281A Test Set with the following instruments.

- E8363B/C (10 MHz to 40 GHz) PNA Network Analyzer
- E8364B/C (10 MHz to 50 GHz) PNA Network Analyzer
- N5244A (10 MHz to 40 GHz) PNA-X Network Analyzer
- N5245A (10 MHz to 50 GHz) PNA-X Network Analyzer
- N5264A PNA-X Measurement Receiver

Figure 1 E8364B/C with N5281A

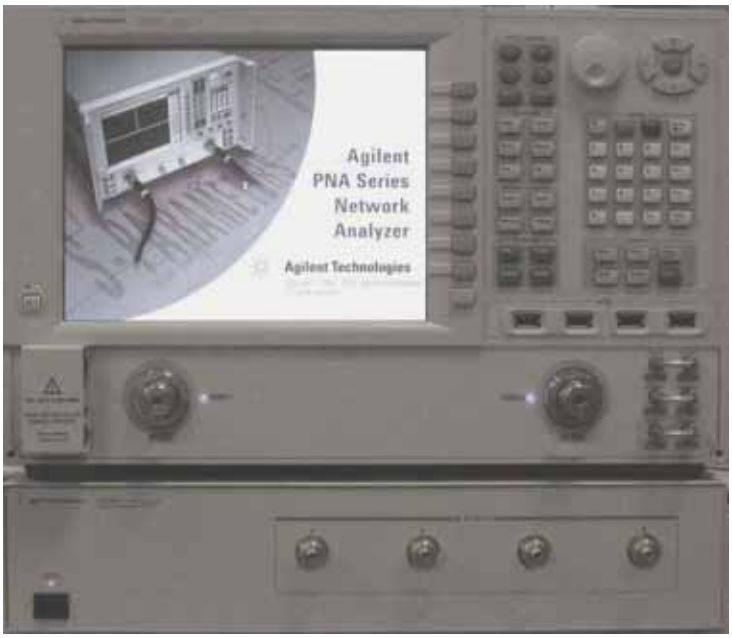


Figure 2 N5264A Measurement Receiver with N5281A

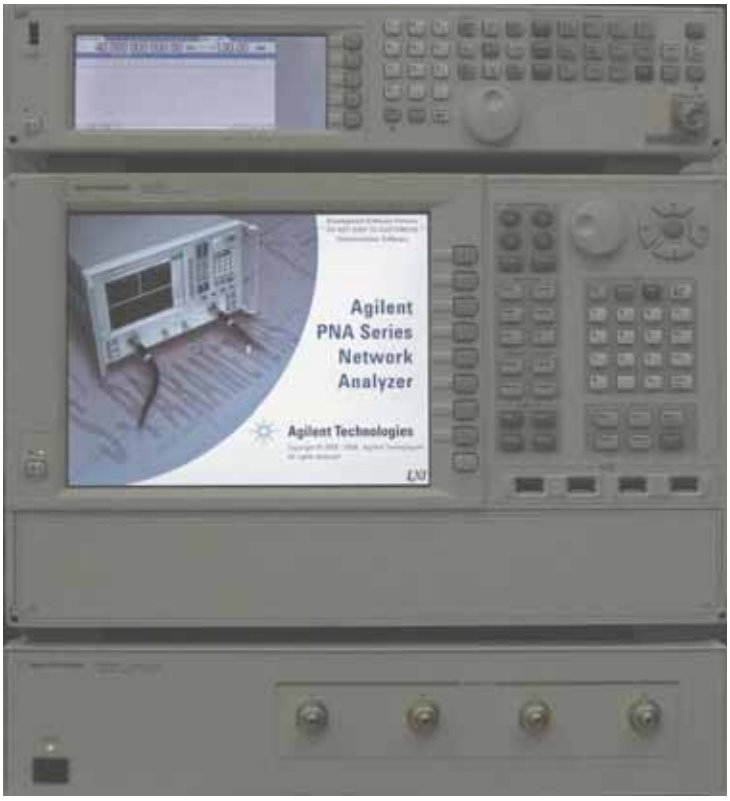


Figure 3 N5244/45A (2-Port) with N5281A

Figure 4 N5244/45A (4-Port) with N5281A

Description

The Keysight N5281A is a four channel frequency converter test set. This test set is used with the Keysight E8363B/C (10 MHz to 40 GHz), E8364B/C (10 MHz to 50 GHz) PNA Network Analyzers, N5244A (10 MHz to 40 GHz), N5245A (10 MHz to 50 GHz) PNA-X Network Analyzers, and the N5264A PNA-X Measurement Receiver. The N5281A provides a convenient means of customizing a test configuration for a variety of applications within a frequency range of 10 MHz to 50 GHz. In addition to configurations for measuring reflection and transmission parameters of 1-port or 2-port devices, you can build configurations to characterize antenna parameters, radar cross sections and frequency translation devices. Figure 5 on page 6 illustrates one possible measurement set-up configuration.

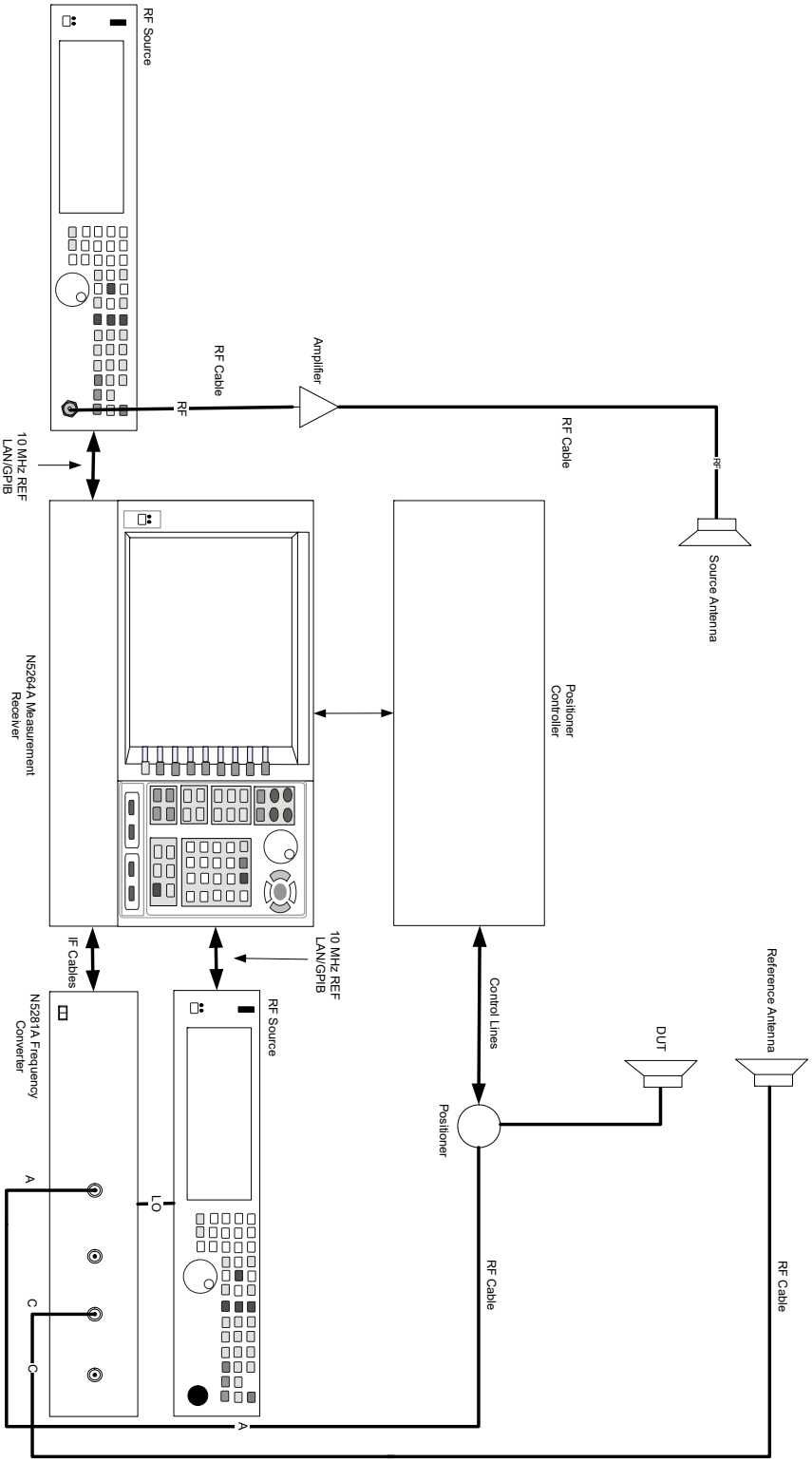
Network Analyzer Requirements

- The E8363B/C 2-Port, 4 Receiver, Vector Network Analyzer (10 MHz to 40 GHz) requires Option H11, which adds IF access.
- The E8364B/C 2-Port, 4 Receiver, Vector Network Analyzer (10 MHz to 50 GHz) requires Option H11, which adds IF access.
- The N5244A Microwave Network Analyzer (10 MHz to 40 GHz) requires Option 020, which adds external IF Inputs.
- The N5245A Microwave Network Analyzer (10 MHz to 50 GHz) requires Option 020, which adds external IF Inputs.

More Network Analyzer information is available on the following websites:

- Documentation - http://www.keysight.com/find/pna
- Network Analyzer Firmware - http://na.tm.keysight.com/pna/firmware/firmware.htm

Figure 5 Measurement Setup



Available Options

Test Set Options

The N5281A has two available test set options:
Refer to Figure 31 on page 41 and Figure 32 on page 42.

- Standard - There are no attenuators in the RF Input paths.
- Option 001 - There are four 35 dB attenuators in RF Input paths to reduce the power levels.

Verifying the Shipment

Inspect the shipping container. If the container or packing material is damaged, it should be kept until the contents of the shipment have been checked mechanically and electrically. If there is physical damage refer to "Keysight Support, Services, and Assistance" on page 51. Keep the damaged shipping materials (if any) for inspection by the carrier and an Keysight Technologies representative.

Table 1 contains the accessories shipped with your N5281A.

Table 1 Content List

Keysight Part Number	Description	Qty
9320-6636	Functional Test Certificate	1
9320-0333	Envelope-Cal Certificate	1
5063-9232	Rack Mount Kit with Handles	1
5063-9226	Front Handle Kit	1
5061-9038	Cable Assembly	5
1250-2015	Adapter, straight SMA (f) to BNC (m)	4
N5281-90001	User's and Service Guide	1

General Specifications

Specifications for the N5281A Frequency Converter Test Set (10 MHz to 50 GHz) are characteristic for the system performance of the PNA and test set. Actual performance of the system is based on the customers PNA that is used with the test set. A functional certificate is only offered for the N5281A.

A functional certificate is supplied for the N5281A. The N5281A performance is based on external components such as the calibration kit, network analyzer, external sources, and measurement receiver. There are no internal adjustments in the N5281A, therefore an annual calibration is not required.

Frequency range and connectors are listed in Table 2 for specific ports.

Table 2 Frequency Range and Connectors

Port	Frequency Range	Connectors
RF Port	0.01 to 50 GHz	2.4 mm female
LO Port	0.01 to 26.5 GHz	3.5 mm female
IF Port	7 MHz	SMA female

Power Requirements

Verify that the required ac power is available before installing the test set to the network analyzer.

- 100/120/220/240 V (50/60 Hz)
- The instruments can operate with mains supply voltage fluctuations up to ± 10% of the nominal voltage.
- Air conditioning equipment (or other motor–operated equipment) should not be placed on the same ac line that powers the test set and PNA.
- Table 3 contains the maximum wattage for all instruments. This table can be use to determine the electrical and cooling requirements.

Table 3 Power Requirements

Standard Equipment	
Instrument	**Maximum Wattage**
E8363B/C	350
E8364B/C	350
N5244A	450
N5245A	450
N5264A	450
N5281A	350

WARNING This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall be inserted only into a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited.

Environmental Requirements

The environmental requirements of the test set are listed in Table 4. Refer to the E8363B/C, E8364B/C, N5244/45A and N5264A User's Guide for environmental specifications.

CAUTION Ventilation Requirements: When installing the instrument in a cabinet, the convection into and out of the instrument must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the instrument by 4 °C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, forced convection must be used.

Table 4 N5281A Operating Environment

Temperature	
Measurement Calibration	20 °C to 26 °C (68 °F to 79 °F)
Performance Verification	Temperature must be within 1 °C (1.8 °F) of the temperature at which the measurement calibration was performed.
Pressure Altitude (Operation or Storage)	0 to 3,000 meters (~10,000 feet)

Environmental Tests

The N5281A complies with all applicable safety and regulatory requirements for the intended location of use.

Equipment Heating and Cooling

If necessary, install air conditioning and heating to maintain the ambient temperature within the appropriate range. Air conditioning capacity must be consistent with the BTU ratings given in Table 3.

Required Conditions for Accuracy Enhanced Measurement

Accuracy–enhanced (error–corrected) measurements require the ambient temperature of the PNA and test set to be maintained within ± 1 °C of the ambient temperature at calibration.

The instrument can safely operate in a relative humidity of 80% for temperatures to 31 degrees C, decreasing linearly to 50% relative humidity at 40 degrees C.

Dimensions and Space Requirements

Standard installation of the N5281A and network analyzers includes configuration and installation on a customer provided lab bench, or table top of adequate size and strength.

Table 5 Instrument Dimensions

Model	Weight	Height	Width	Depth
E8363B/C	29 kg (64 lb, ±0.5 lb)	26.7 cm (10.5 in)	43.43 cm (17.10 in)	46.99 cm (18.50 in)
E8364B/C	29 kg (64 lb, ±0.5 lb)	26.7 cm (10.5 in)	43.43 cm (17.10 in)	46.99 cm (18.50 in)
N5244/45A	See Table 6	26.7 cm (10.5 in)	42.5 cm (16.8 in)	58.2 cm (22.9 in)
N5264A	22 kg (48 lb, ±0.5 lb)	26.7 cm (10.5 in)	42.5 cm (16.75 in)	55.8 cm (21.97 in)
N5281A	9.1 kg (20 lb)	8.9 cm (3.5 in)	42.5 cm (16.75 in)	48.3 cm (19 in)

Table 6 Net Weight

Model	2-Port Modules (Option 200, or 219 or 224)	4-Port Modules (Option 400, or 419 or 423)
N5244/45A	39.1 Kg (86 lb) nominal	41.8 Kg (92 lb) nominal

Maximum Power Levels

Table 7 Power Levels

RF Input Power Damage Levels:	
RF Port	+18 dBm
LO Port	+5 dBm
Optimum LO Power	0 dBm (±1 dB)
RF Input @ 0.1 dB Typical Compression:	
10 MHz to 50 GHz	-10 dBm
IF Output Level[1]	
10 MHz to 26.5 GHz	5 dB to -10 dB
26.5 GHz to 50 GHz[2]	-10 dB to -20 dB

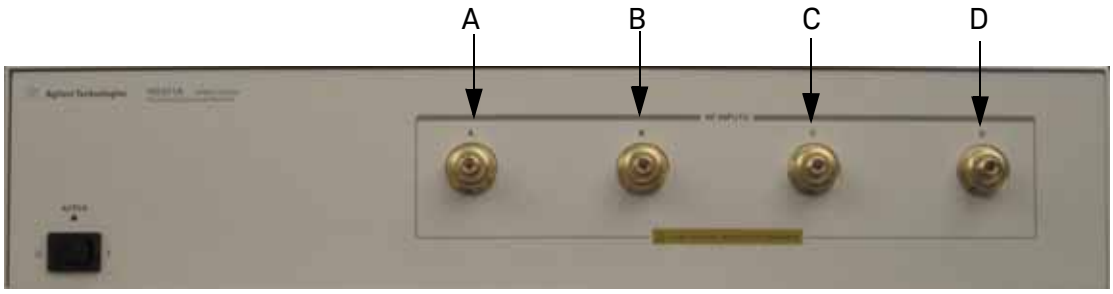
1. IF Output level is based on the RF Input @ 0.1 dB typical compression.
2. 3rd Harmonic mode.

NOTE Refer to your PNA specifications to determine the maximum input power levels for the PNA access and test ports, or to optimize the power levels in the receivers.

NOTE Damage and maximum levels are not necessarily the optimum level.

Front and Rear Panel Features

Figure 6 Front Panel



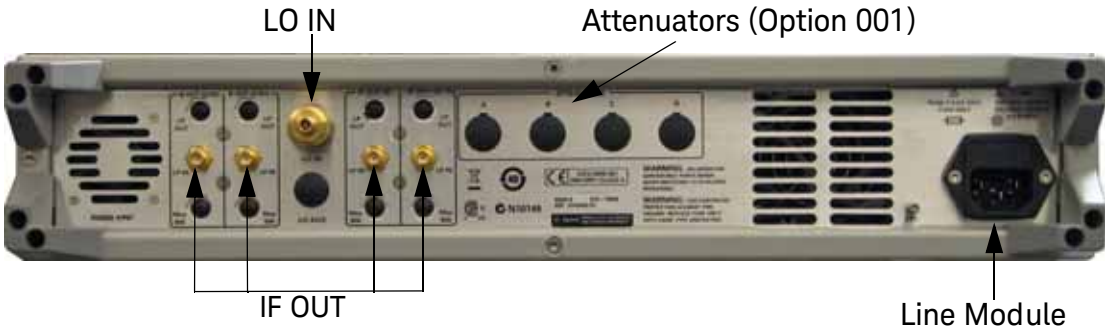
RF Input (A, B, C and D)

These input ports transmit RF energy to the sampler within the instrument.

Line Switch

The front panel LINE switch disconnects the mains circuits from the mains supply. The switch is located at the bottom left corner of the front panel.

Figure 7 Rear Panel (Multiport Test Set)



IF OUT (A, B, C/R1 and D/R2)

The IF Outputs are connected to the IF Inputs on the PNA. These connectors transmit the IF signal from the test set to the E8363B/C, E8364B/C, N5244A, N5245A and N5264A.

LO IN

LO IN is connected to the LO from the TEST SET DRIVERS on the network analyzer.

Attenuators (A, B, C and D)

These connectors are used only in test sets with Option 001. The four Viking attenuator connectors are controlled by the 11713C Attenuator Switch Driver.

Line Module

The line fuse, as well as a spare, reside within the line module. Figure 8 illustrates where the fuses are located and how to access them.

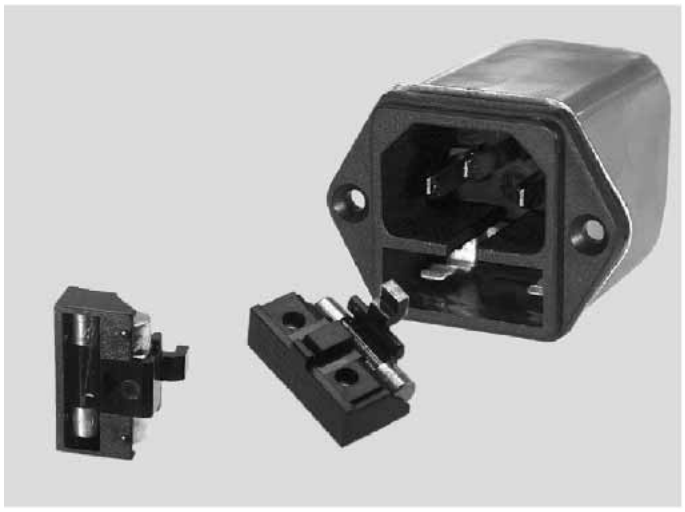
Install the instrument so that the ON/OFF switch is readily identifiable and is easily reached by the operator. The ON/OFF switch is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument, or the detachable power cord can be removed from the electrical supply. Alternately, an externally installed switch or circuit breaker which is readily identifiable and is easily reached by the operator may be used as a disconnecting device.

Available Fuses

- Fuse (F 5 A/250V, 2110-0709) UL listed and CSA certified.

CAUTION Verify that the premise electrical voltage supply is within the range specified on the instrument.

Figure 8 Line Fuse



CAUTION This instrument has autoranging line voltage input; be sure the supply voltage is within the specified range.

Controlling the Test Set with E8363B/C or E8364B/C

This section will describe how to setup and operate the N5281A Frequency Converter Test Set with the E8363B/C or E8364B/C PNA Network Analyzer with required Option H11, which adds IF access.

A PNA must be used to control the N5281A. The internal LO Source from the PNA can be used for testing. Refer to Figure 9 and Figure 10 for cable connections.

Figure 9 Front Panel N5281A and E8364B/C

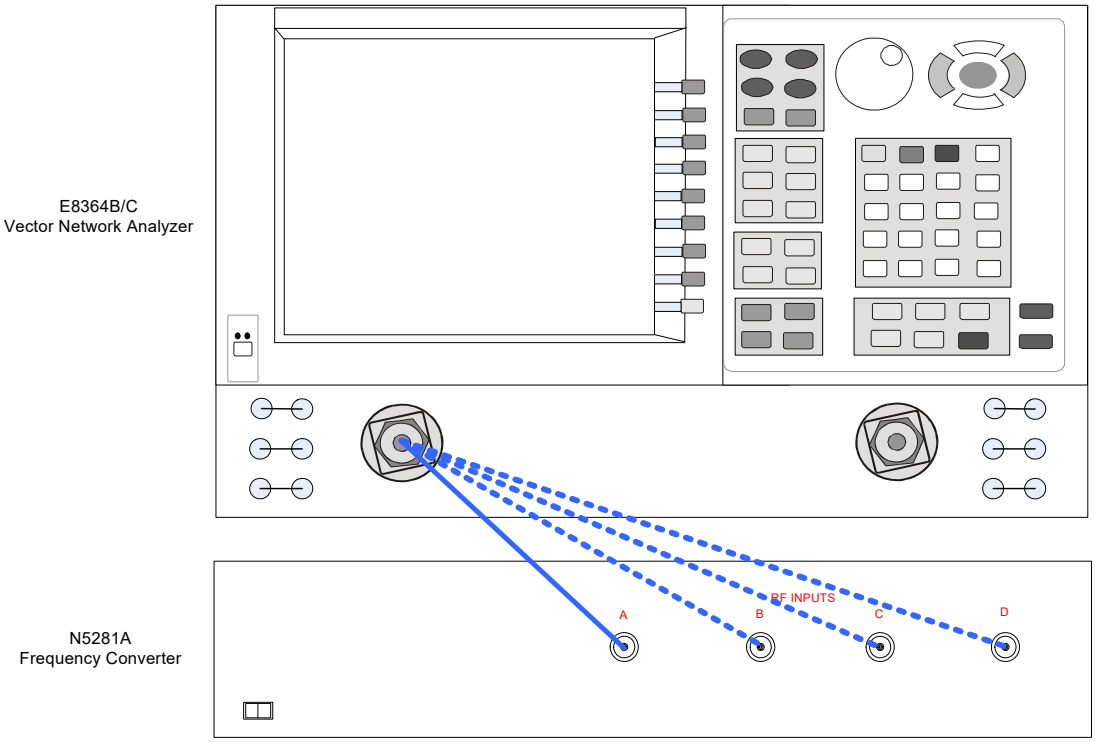
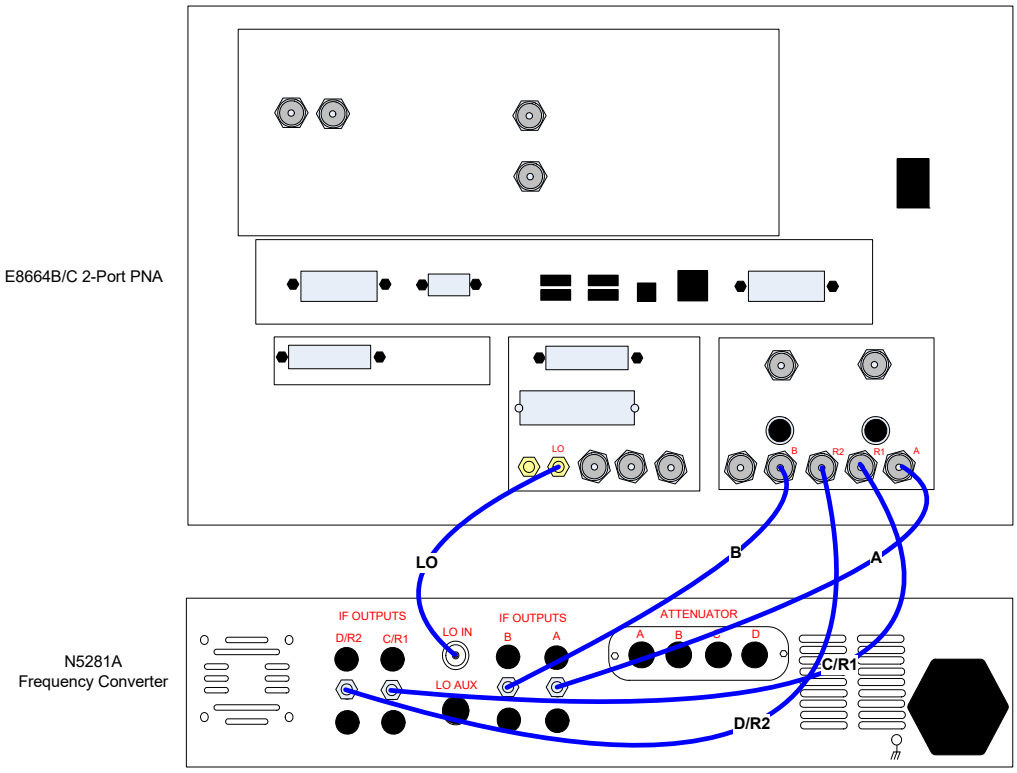


Figure 10 Rear Panel N5281A and E8364B/C



Controlling the Test Set with N5264A

This section will describe how to setup and operate the N5281A Frequency Converter Test Set with the N5264A Measurement Receiver.

A N5264A must be used to control the N5281A. The N5264A Option 108 adds an internal LO Source 26.5 GHz for testing. Refer to Figure 11 and Figure 12 on page 19 for cable connections.

You may also use an external LO Source for testing. Refer to Figure 13 on page 20 and Figure 14 on page 21 for cable connections.

Figure 11 Front Panel N5281A and N5264A with Option 108

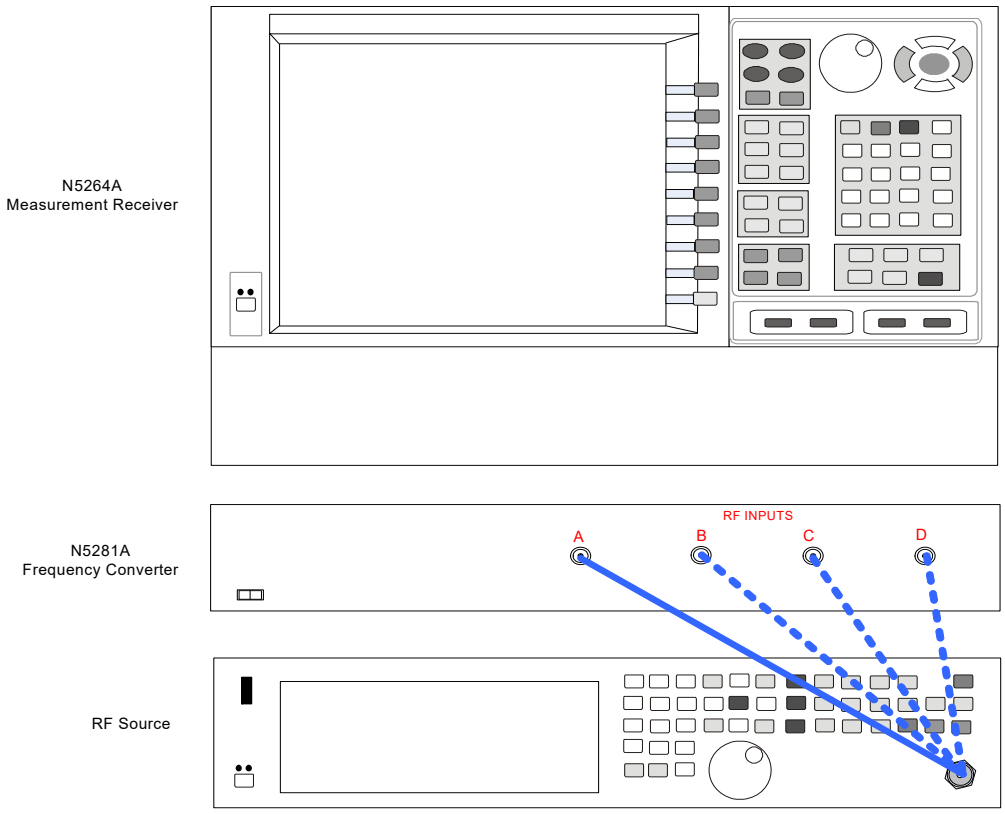


Figure 12 Rear Panel N5281A and N5264A with Option 108

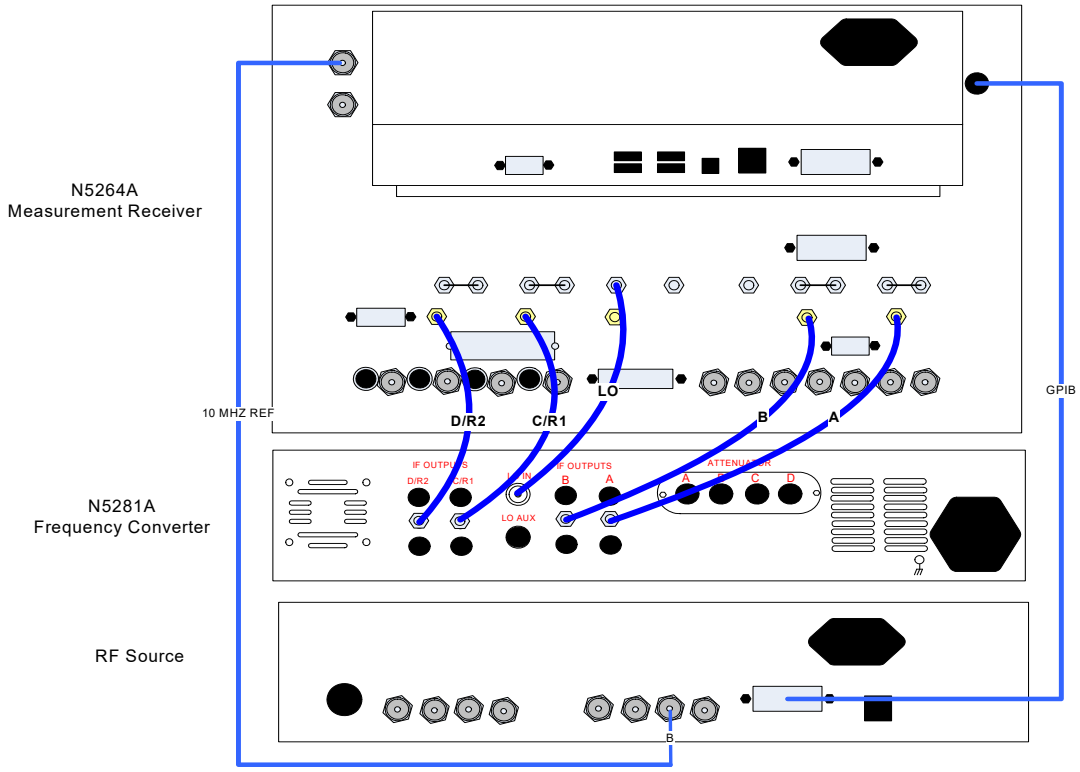


Figure 13 Front Panel N5281A and N5264A without Option 108

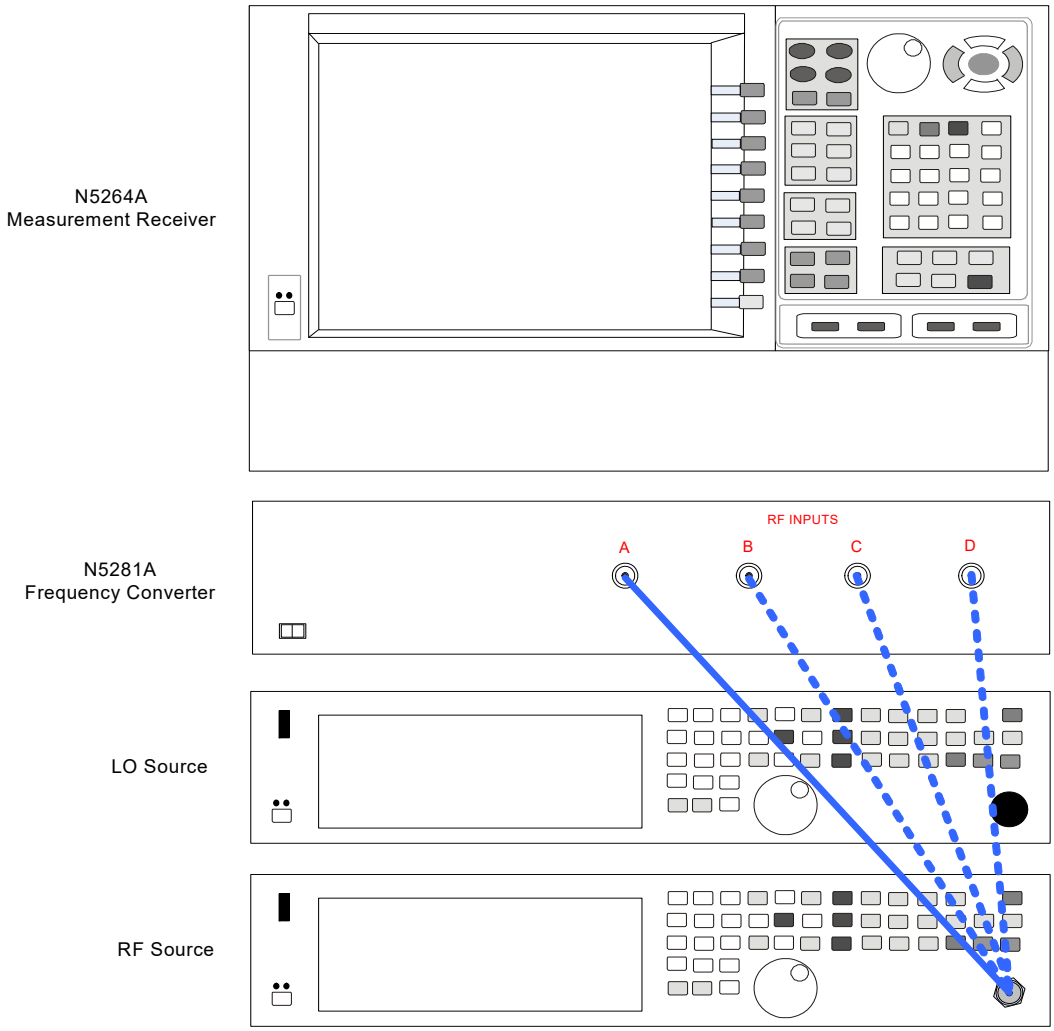
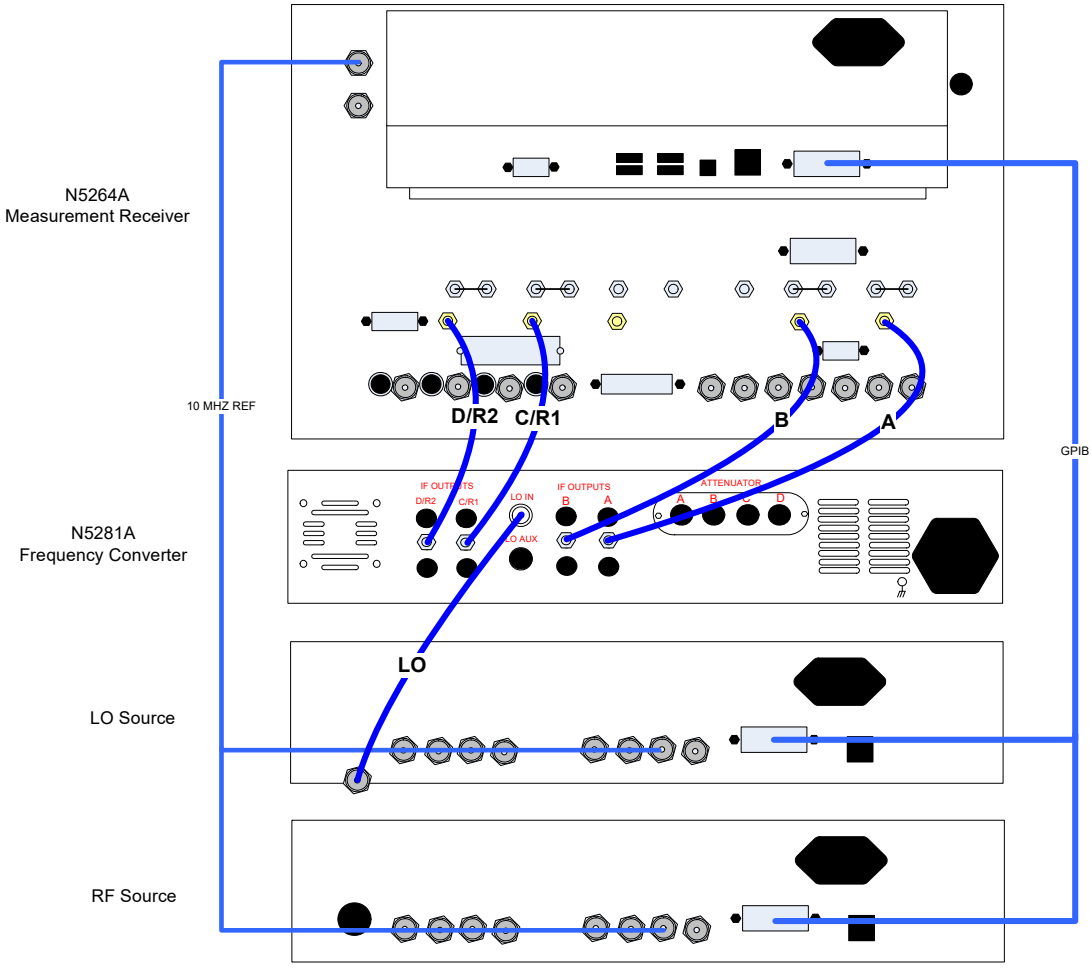


Figure 14 Rear Panel N5281A and N5264A without Option 108



Controlling the Test Set with N5244A or N5245A

This section will describe how to setup and operate the N5281A Frequency Converter Test Set with the N5244/45A PNA-X Network Analyzer with required Option 020, which adds External IF Inputs.

A PNA-X must be used to control the N5281A. The internal LO Source from the PNA-X can be used for testing. Refer to Figure 15 and Figure 16 for cable connections.

Figure 15 Front Panel N5281A and N5244/45A (2-Port)

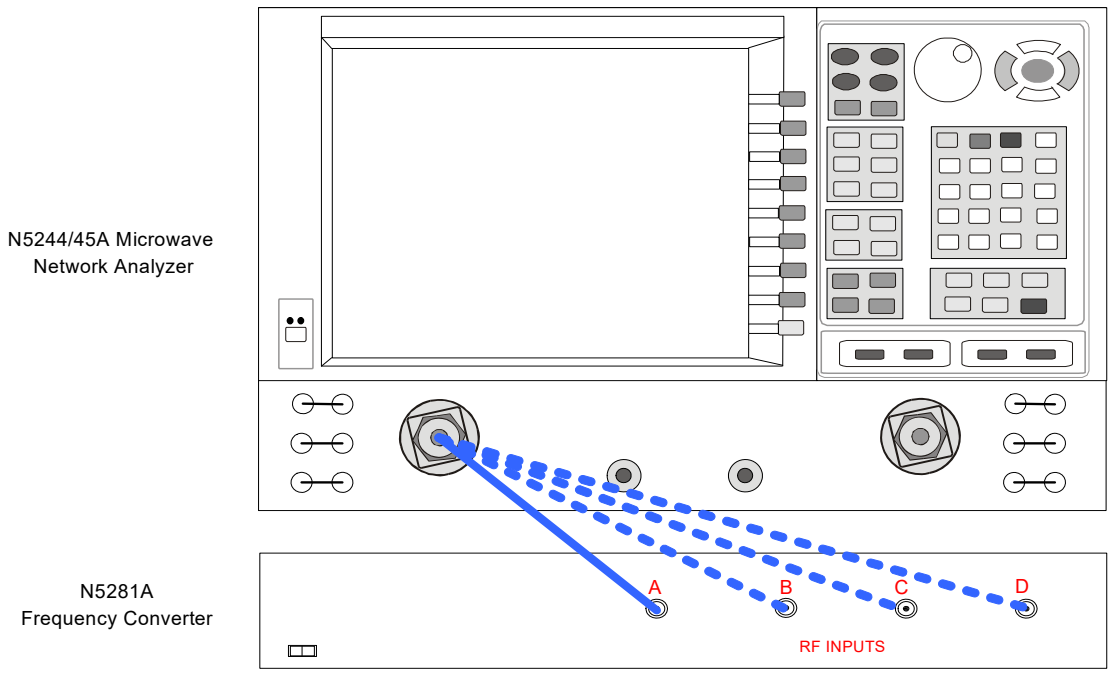


Figure 16 Front Panel N5281A and N5244/45A (4-Port)

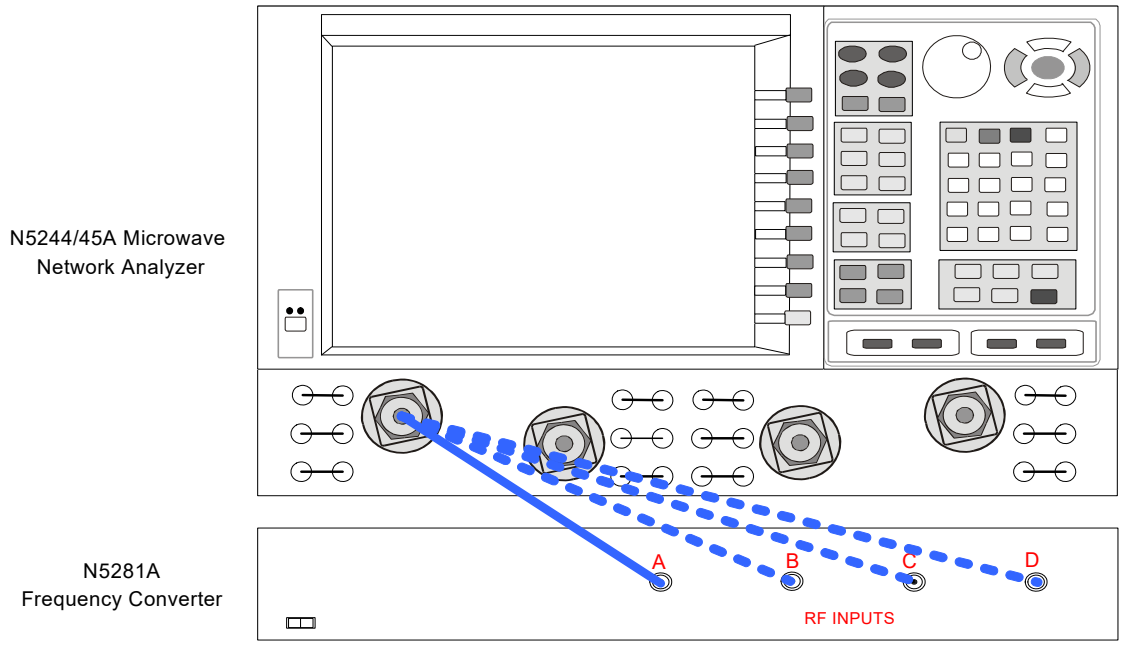
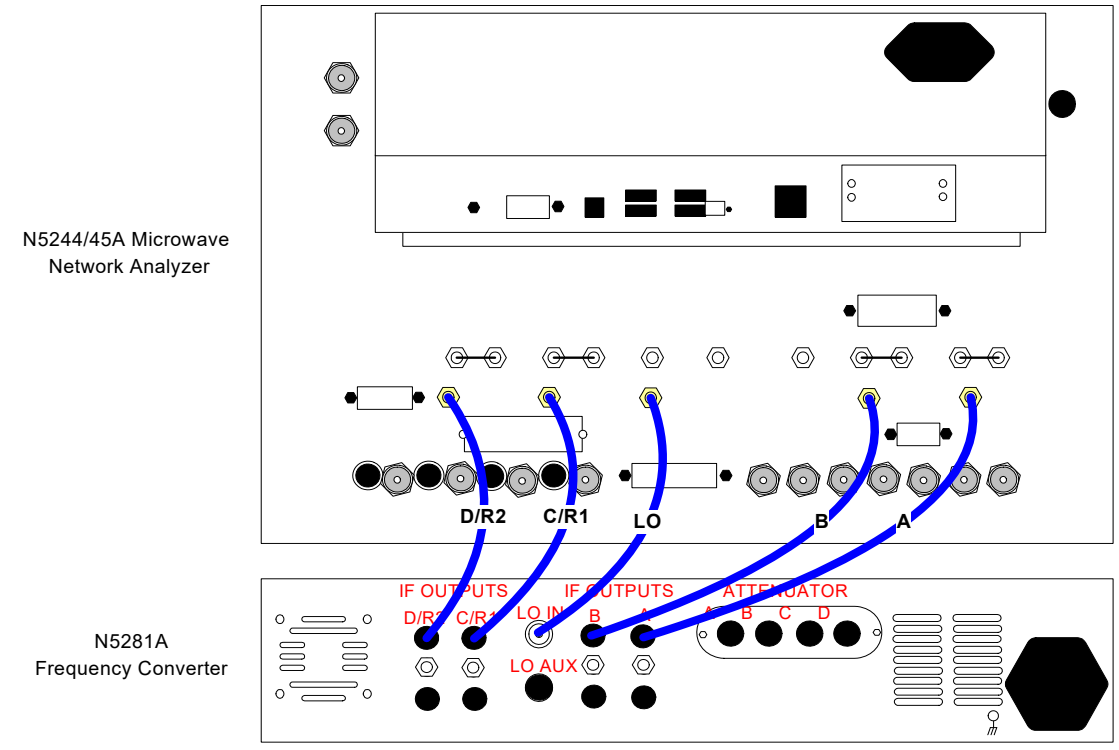


Figure 17 Rear Panel N5281A and N5244/45A



Controlling the RF Receiver Attenuators

The 11713C attenuator switch driver controls the test set through the Viking connector on the rear panel.

Figure 18 Rear Panel N5281A and 11713C

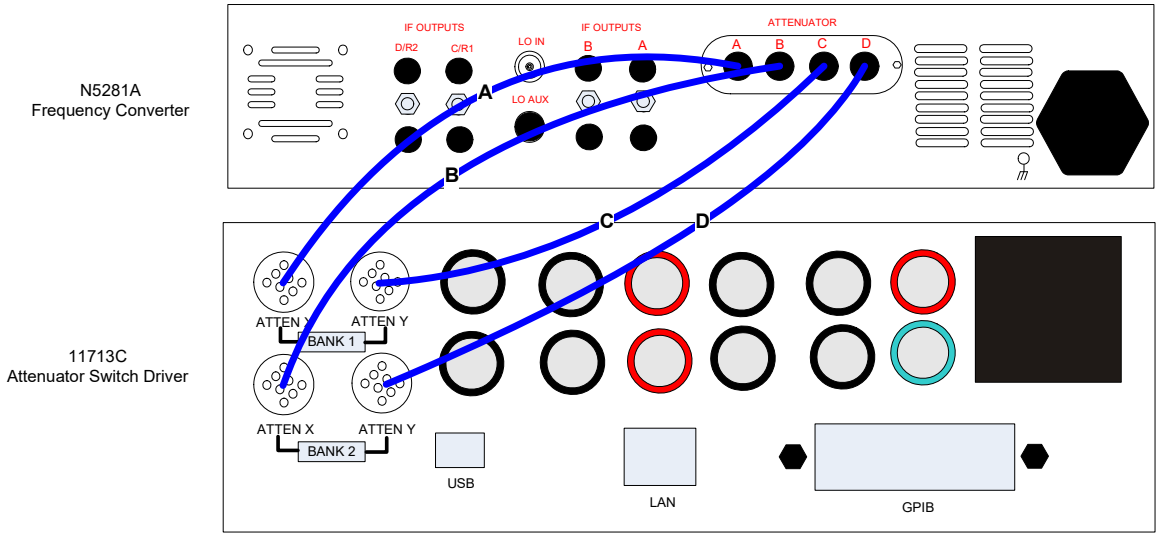


Table 8 illustrates the key combinations that are required to set the attenuation.

Example: In the Attenuator X panel, press 1 & 3 to set Channel A to 15 dB.

Table 8 Attenuators

	Attenuator X (Channel A)	**Attenuator Y (Channel C)**	**Attenuation (dB)**
Bank 1	1 2 3	5 6 7	10 20 5
	Attenuator X (Channel B)	**Attenuator Y (Channel D)**	**Attenuation (dB)**
Bank 2	1 2 3	5 6 7	10 20 5

Figure 19 Front Panel

Operational Check

This section provides the operational check to confirm the N5281A, E8363B/C, E8364B/C, N5244/45A and N5264A PNA operational performance. The operation verification limits provided ensure that your N5281A and network analyzers are operating properly. Frequencies below 500 MHz are not allowed with the E8363B/C and E8364B/C PNA with Option H11.

Equipment Required

The Keysight N5281A requires that the user be familiar with the equipment and components listed in Table 9.

This section provides an equipment list and setup of the network analyzers and the test set.

Table 9 Equipment List

Description	Qty
E8363B/C 2-Port, 4 Receiver, Vector Network Analyzer, 10 MHz to 40 GHz, (Option H11) *or*	1
E8364B/C 2-Port, 4 Receiver, Vector Network Analyzer, 10 MHz to 50 GHz, (Option H11) *or*	1
N5244A 2 or 4-Port, Microwave Network Analyzer, 10 MHz to 40 GHz, (Option 020) *or*	1
N5245A 2 or 4-Port, Microwave Network Analyzer, 10 MHz to 50 GHz, (Option 020) *or*	1
N5264A Measurement Receiver (Option 108)	1

Verification Limits

Specifications for the N5281A Multiport Test Set are typical. System performance for the network analyzer and test set are only characteristic and intended as non-warranted information. Only a functional certificate is provided for the N5281A.

It is recommended that you return your instrument to Keysight Technologies for servicing or repair if the Test Set and network analyzer performance exceed the operational verification limits.

NOTE Typical specifications are based on 1 to 2 units performance.

Table 10 RF Receiver Tracking

RF Port Magnitude Tracking	
Frequency	**Value**
10 MHz to 20 GHz	±2.0 dB
20 GHz to 30 GHz	±3.0 dB
30 GHz to 50 GHz	±4.0 dB

Table 11 Noise Floor

Direct Receiver Access Input Noise Floor[1] IF Bandwidth equal to 10 Hz		
Frequency	**Receiver Access Input (E8364B/C)**	**Receiver Access Input (N5245A)**
10 MHz to 500 MHz	n/a	-125 dBm
500 MHz to 2 GHz	-107 dBm	-125 dBm
2 GHz to 10 GHz	-107 dBm	-125 dBm
10 GHz to 20 GHz	-107 dBm	-120 dBm
20 GHz to 30 GHz	-107 dBm	-120 dBm
30 GHz to 40 GHz	-107 dBm	-120 dBm
40 GHz to 50 GHz	-107 dBm	-120 dBm

1. Noise floor measured with a 50 Ohm load at port, and measured as the mean value of a 801 point trace.

Table 12 Trace Noise

Trace Noise Magnitude (dB, rms)[1][2][3] 1 kHz IF Bandwidth		
Frequency	**Typical (E8364B/C)**	**Typical (N5245A)**
10 MHz to 500 MHz	n/a	0.02
500 MHz to 20 GHz	0.02	0.02
20 GHz to 40 GHz	0.04	0.04
40 GHz to 50 GHz	0.07	0.07
Trace Noise Phase (deg, rms)[1][4] 1 kHz IF Band wid th		
10 MHz to 500MGHz	n/a	0.15
500 MHz to 20 GHz	0.15	0.15
20 GHz to 40 GHz	0.25	0.25
40 GHz to 50 GHz	0.40	0.40

1. Trace Noise, sweep to sweep variation.
2. Measured linear magnitude CW Frequency at 201 points.
3. Trace Noise in dB = 20 * Log 10 (1+ standard deviation).
4. Trace Noise in degrees = standard deviation.

Table 13 RF Port Match

Frequency	**Value(E8364B/C)**	**Value (N5245A)**
10 MHz to 500 GHz	n/a	< -15 dB
500 MHz to 10 GHz	< -15 dB	< -15 dB
10 GHz to 20 GHz	< -12 dB	< -12 dB
20 GHz to 30 GHz	< -10 dB	< -10 dB
30 GHz to 50 GHz	< -5 dB	< -5 dB
LO Port Match		
10 MHz to 26.5 GHz	n/a	< -8 dB
500 MHz to 10 GHz	< -8 dB	n/a

Table 14 Dynamic Range

Dynamic Range @ 10 Hz IF Bandwidth					
Frequency	Typical (dB) Direct Receiver Access Input		Typical (dBm) Low-Level Noise Floor		Typical (dBm) Max Power[1]
	E8363/64B/C	N5244/45A	E8363/64B/C	N5244/45A	Option 700 & 001
10 MHz to 500 MHz	n/a	-115	n/a	-125	-10
500 MHz to 2 GHz	97	-115	-107	-125	-10
2 GHz to 10 GHz	97	-115	-107	-125	-10
10 GHz to 20 GHz	97	-110	-107	-120	-10
20 GHz to 30 GHz	97	-110	-107	-120	-10
30 GHz to 40 GHz	97	-110	-107	-120	-10
40 GHz to 50 GHz	97	-110	-107	-120	-10

1. RCVR IN @ 0.1 dB typical compression at max power.

The receiver access input dynamic range is calculated as the difference between the receiver access input low-level noise floor, and the source maximum power to the receiver that results with a typical 0.1 dB compression level.

Low-level noise floor measured with 50 Ohm load at the port.

The effective dynamic range must take measurement uncertainties and interfering signals into account. This set-up should only be used when the receiver input will not exceed its compression or damage level.

E8364B/C Operational Check Procedure

The sequence of this procedure is very important and must be followed or the performance accuracy and results may vary from the reference plots provided.

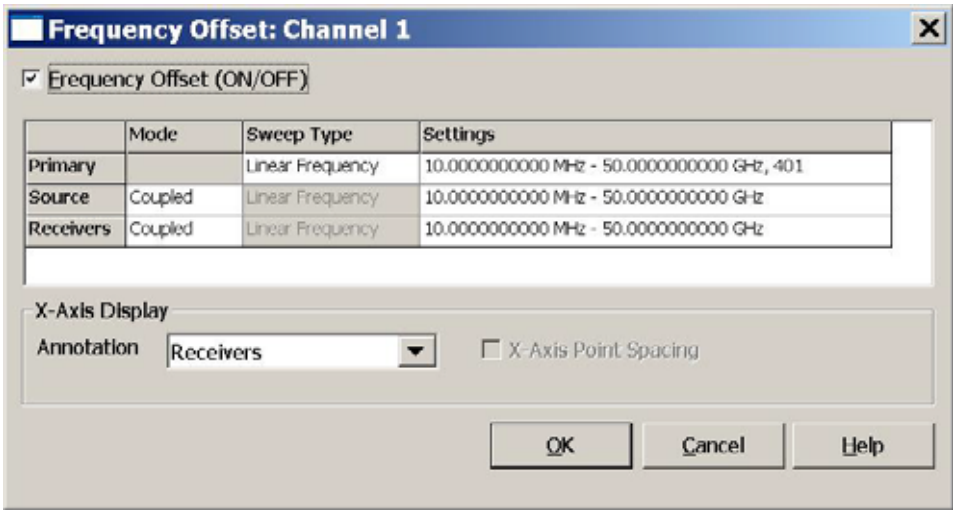
NOTE If you are using a E8364B or E8364C 2-Port PNA-X, channels C and D will be replaced with R1 and R2.

The following procedures are used with the E8364B/C.

Preparing the E8364B/C

1. Connect the Test Set to the E8364B/C using the cables as shown in Figure 9 on page 16 and Figure 10 on page 17.
2. Connect the 10 dB attenuator to the PNA-X reference port cable.
3. Turn On the Test Set.
4. Select **[Preset]**.
5. Verify that the Stop Frequency is set to the maximum frequency of the PNA and test set. If not, select **[Freq]** > **Stop**.
6. Verify that the Start Frequency is set to 10 MHz. If not, select **[Freq]** > **Start** > **[10 MHz].**
7. Verify that the Power is to set to -17 dBm. If not, select **[Power]** > **Power Level** > **[-17 dBm]**.
8. Select **[Avg]** > **IF Bandwidth** > **[1 kHz]**.
9. Select **[Sweep]** > **Number of Points** > **[401]**.
10. Allow the test set and the PNA to warm up for a minimum of 30 minutes.
11. Select **[Freq]** > **Frequency Offset** > select **Frequency Offset (ON/OFF)** > **OK**.

Figure 20 Frequency Offset

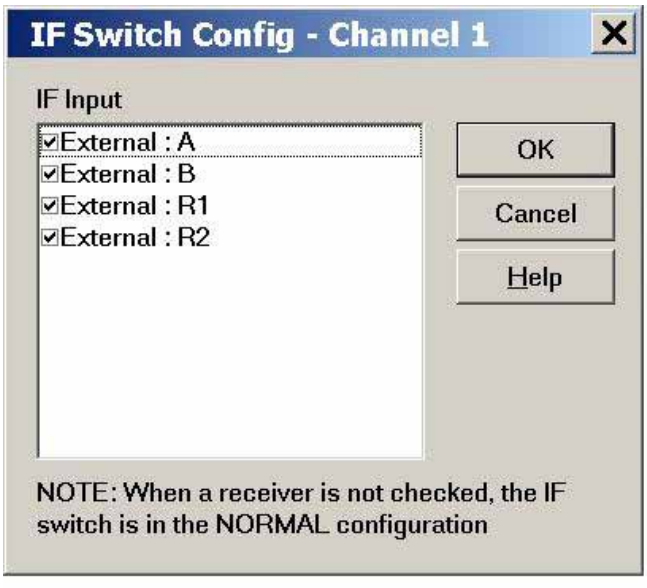


12.Set the IF Switch Config On. In the drop-down menu select **Trace/Chan** > **Channel** > **Hard ware Setup** > **IF Switch Config**.

Figure 21 IF Switch Config

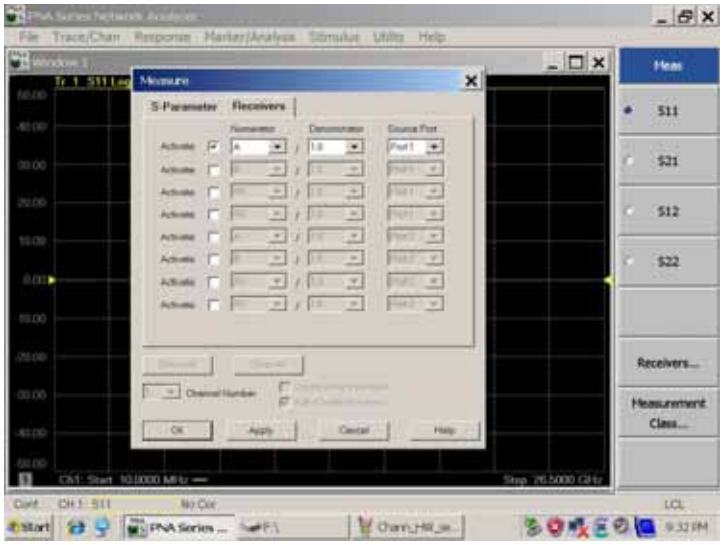
13.Select all of the IF Inputs **External A, B, R1 and R2** > **OK**.

Figure 22 IF Input



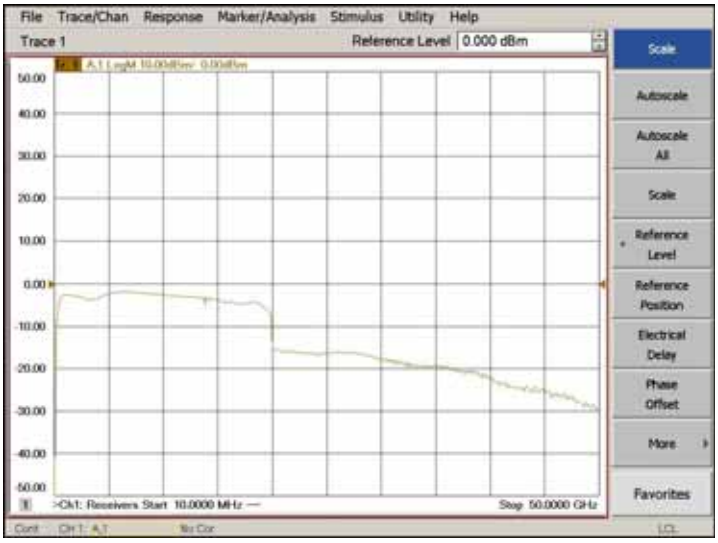
14. Connect the cable to A, RF INPUTS on the test set. Select **[Meas]** > **Receivers,** select **A** > **Apply** > **OK**.

Figure 23 Receiver A



15. Set the Reference level is at 0 dBm. Select **[Scale]** > **Reference level** > **[0 dBm]**.

Figure 24 Typical Receiver A



16. Connect the cable to B, RF INPUTS on the test set. Select **[Meas]** > **Receivers,** select **B** > **Apply** > **OK** to observe the power level trace.

17. Connect the cable to C, RF INPUTS on the test set. Select **[Meas]** > **Receivers,** select **R1** > **Apply** > **OK** to observe the power level trace.

18. Connect the cable to D, RF INPUTS on the test set. Select **[Meas]** > **Receivers,** select **R2** > **Apply** > **OK** to observe the power level trace.

N5245A Operational Check Procedure

The sequence of this procedure is very important and must be followed or the performance accuracy and results may vary from the reference plots provided.

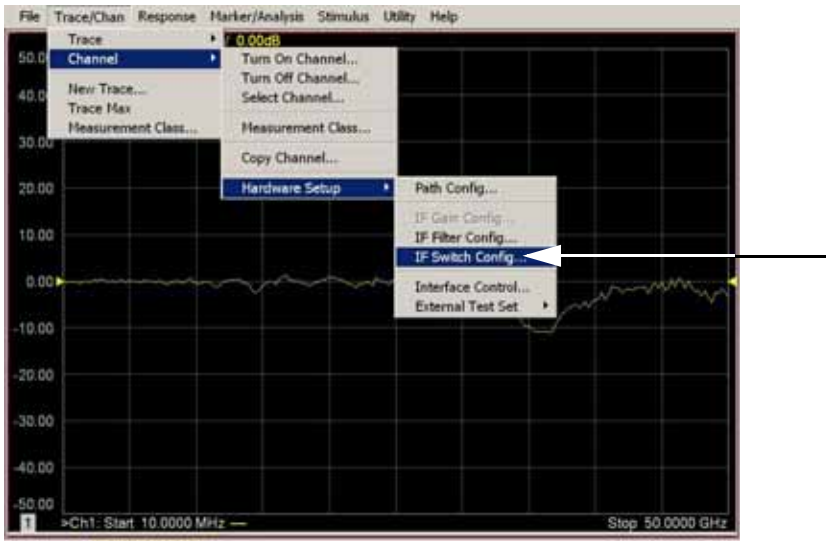
NOTE If you are using a N5244A or N5245A 2-Port PNA-X, channels C and D will be replaced with R1 and R2.

The following procedures are used with the N5245A.

Preparing the N5245A

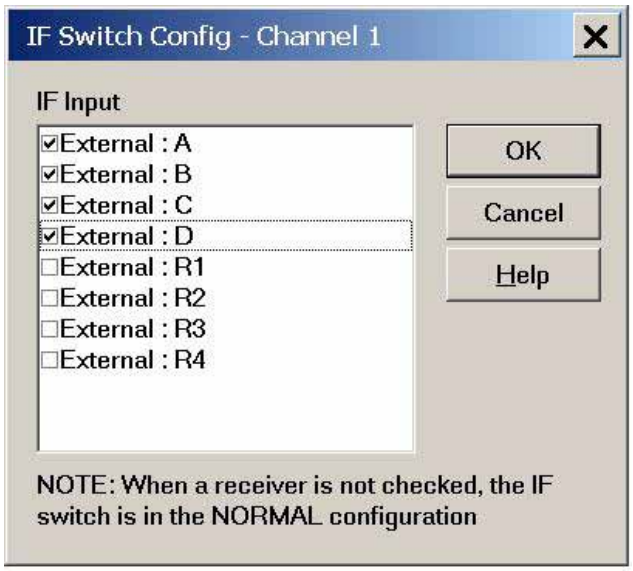
1. Connect the Test Set to the N5245A using the cables as shown in Figure 15 on page 22, Figure 16 on page 23 and Figure 17 on page 23.
2. Connect the 10 dB attenuator to the PNA-X reference port cable.
3. Turn On the Test Set.
4. Select **[Preset]**.
5. Verify that the Stop Frequency is set to the maximum frequency of the PNA and test set. If not, select **[Freq]** > **Stop**.
6. Verify that the Start Frequency is set to 10 MHz. If not, select **[Freq]** > **Start** > **[10 MHz]**.
7. Verify that the Power is to set to -5 dBm. If not, select **[Power]** > **Power Level** > **[-5 dBm]**.
8. Select **[Avg]** > **IF Bandwidth** > **[1 kHz]**.
9. Select **[Sweep]** > **Number of Points** > **[401]**.
10. Allow the test set and the PNA to warm up for a minimum of 30 minutes.
11. Set the IF Switch Config On. In the drop-down menu select **Trace/Chan** > **Channel** > **Hardware Setup** > **IF Switch Config**.

Figure 25 IF Switch Config



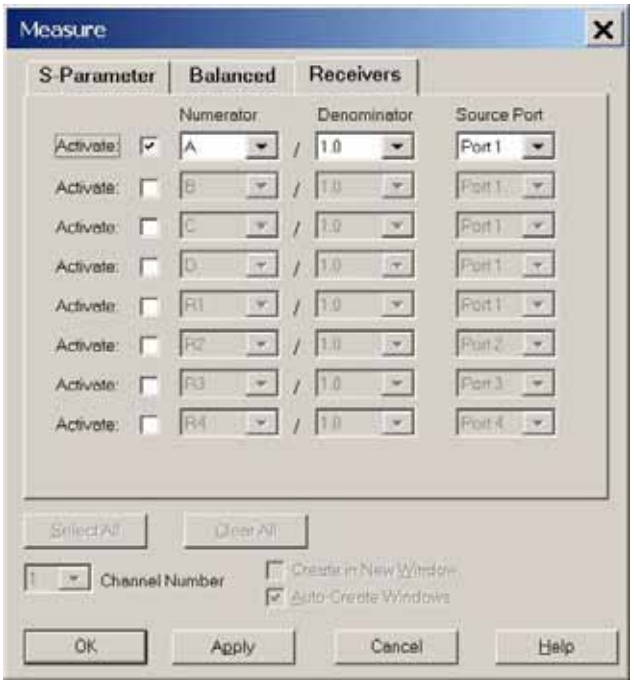
12.Select all of the IF Inputs **External A, B, C and D** > **OK**.

Figure 26 IF Input



13.Connect the cable to A, RF INPUTS on the test set. Select **[Meas]** > **More** > **Receivers,** select **A** > **Apply** > **OK**.

Figure 27 Receiver A



14.Set the Reference level is to 0 dBm. Select **[Scale]** > **Reference level** > **[0 dBm]**.

Figure 28 Typical Receiver A

15.Connect the cable to B, RF INPUTS on the test set. Select [**Meas**] > **More** > **Receivers,** select **B** > **Apply** > **OK** to observe the power level trace.

16.Connect the cable to C, RF INPUTS on the test set. Select **[Meas]** > **More** > **Receivers,** select **C** > **Apply** > **OK** to observe the power level trace.

17.Connect the cable to D, RF INPUTS on the test set. Select **[Meas]** > **More** > **Receivers,** select **D** > **Apply** > **OK** to observe the power level trace.

Attenuator Element Verification Procedure

The Attenuator Element Verification Procedure is a functional test only. This test verifies the functionality of the variable attenuator in each channel RF path. The following procedures are used with the 11713C attenuator switch driver.

1. Connect the cables from the test set to the 11713C as shown in Figure 18 on page 24.
2. Select **[Preset]**.
3. Select **[Freq]** > **Frequency Offset** > **select Frequency Offset (ON/OFF)** > **OK**. Refer to Figure 20 on page 30.
4. Set the IF Switch Config On. Select **Trace/Chan** > **Channel** > **Hard ware Setup** > **IF Switch Config**. Refer to Figure 21 on page 31.
5. Select all of the IF Inputs **External A, B, R1 and R2** > **OK**. Refer to Figure 22 on page 31.
6. Select **[Analysis]** > **Statistics On**.
7. Connect the cable to A, RF INPUTS on the test set. Select **[Meas]** > **Receivers and select A** > **Apply** > **OK**. Refer to Figure 23 on page 32.
8. Select **[Memory]** > **Normalize**.
9. Select **[1]** on the 11713C. The mean value should read -10 dB (± 1 dB). Select **[1]** again, it should read 0 dB.
10. Select **[2]** on the 11713C. The mean value should read -20 dB (± 1 dB). Select **[2]** again, it should read 0 dB.
11. Select **[3]** on the 11713C. The mean value should read -5 dB (± 1 dB). Select **[3]** again, it should read **0 dB.**
12. Repeat step 7 through step 11 for Channel B, C and D RF INPUTS.

Figure 29 N5281A Block Diagram (Standard 700)

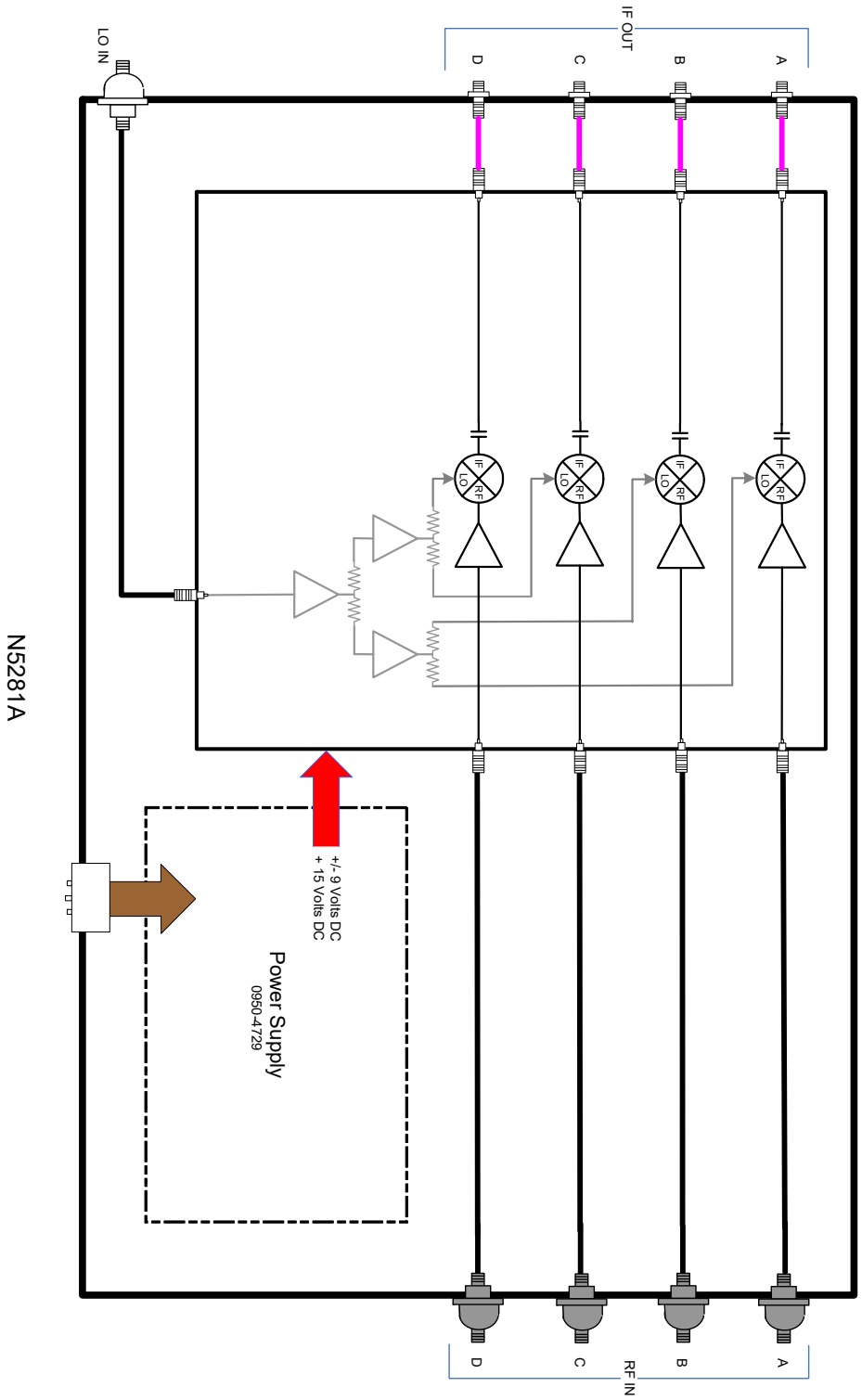
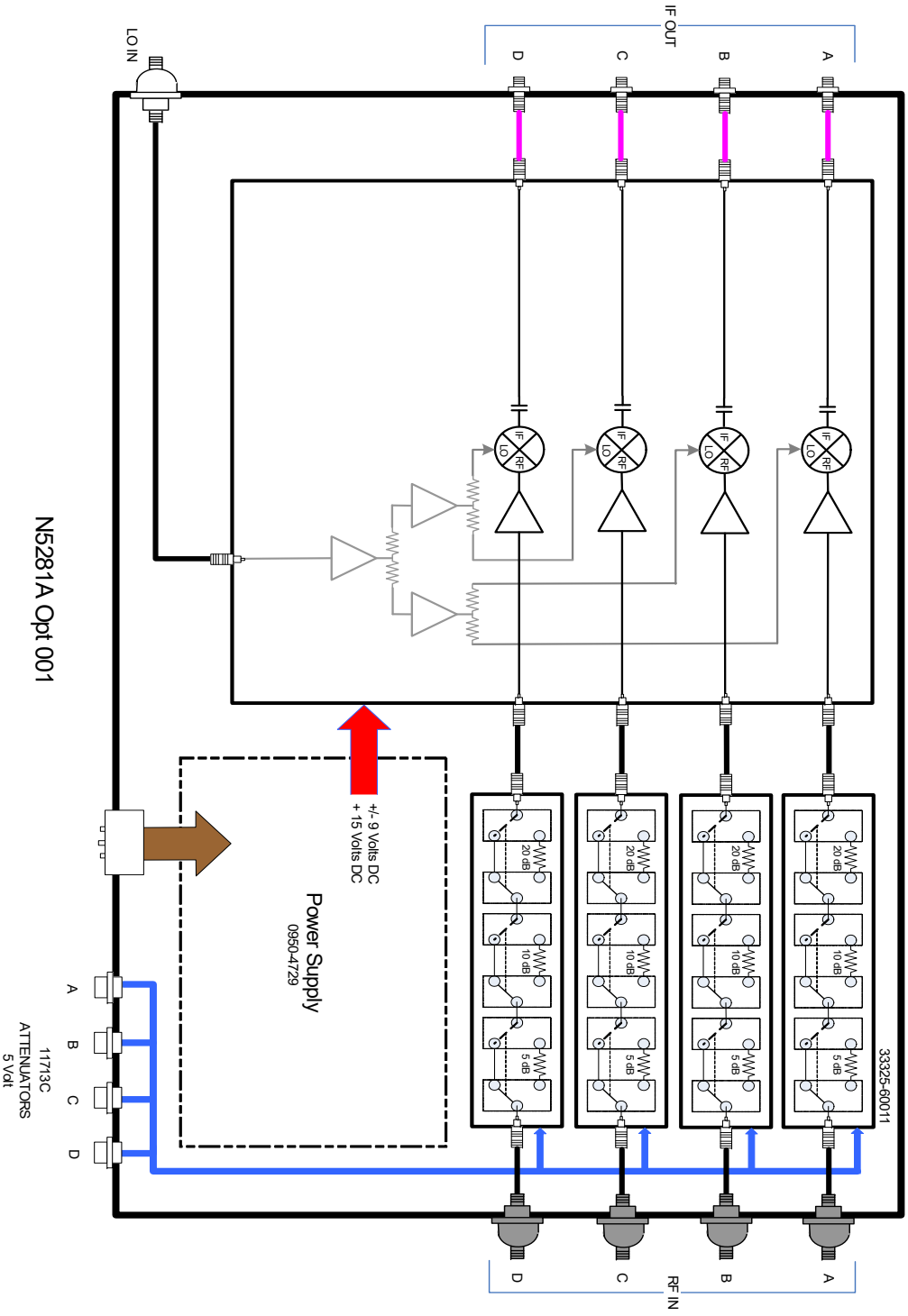


Figure 30 N5281A Block Diagram (Option 001)



Service Information

There are many other repair and calibration options available from the Keysight Technologies support organization. These options cover a range of service agreements with varying response times. Contact Keysight for additional information on available service agreements for this product.

WARNING No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.

WARNING These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

Replaceable Parts

Special options are built to order, long lead times may be encountered when ordering replacement parts.

Table 15 Replaceable Parts for Serial Numbers US48480101, US48480103 and US48480104

Description		Keysight Part Number
1	PWR Supply (AC/DC SWG 650 W 9-Output)	0950-4729
2	Fuse (8 A 250 V non-time delay 0.0146 Ohm)	2110-0342
3	Mixer Brick Bias Board Assembly	N5280-63015
4	Mixer Brick 50 GHz Assembly	5087-7279
5	3.5 mm Bulkhead Connector (female)	5062-6618
6	2.4 mm Bulkhead Connector (female)	5062-7243
7	RF Cable, semi-rigid (MXB to LO IN)	N5281-20001
N5281A Option 700 (Standard):		
8	RF Cable, semi-rigid (MXB to C)	N5281-20002
9	RF Cable, semi-rigid (MXB to B)	N5281-20003
10	RF Cable, semi-rigid (MXB to D)	N5281-20004
11	RF Cable, semi-rigid (MXB to A)	N5281-20005
N5281A Option 001:		
12	Attenuator (35 dB) 50 GHz, 3-Section Y-Contact, 5 V, 2.4 mm Connector	33325-60011
13	RF Cable, semi-rigid (ATTN-A to MXB)	N5281-20006
14	RF Cable, semi-rigid (ATTN-D to MXB)	N5281-20007
15	RF Cable, semi-rigid (ATTN-B to MXB)	N5281-20008
16	RF Cable, semi-rigid (ATTN-C to MXB)	N5281-20009
17	RF Cable, semi-rigid (ATTN-D to D)	N5281-20010
18	RF Cable, semi-rigid (ATTN-B to B)	N5281-20011
19	RF Cable, semi-rigid (ATTN-C to C)	N5281-20012
20	RF Cable, semi-rigid (ATTN-A to A)	N5281-20013

Figure 31 N5281A Option 700 with Mixer Brick (N5280-63015)

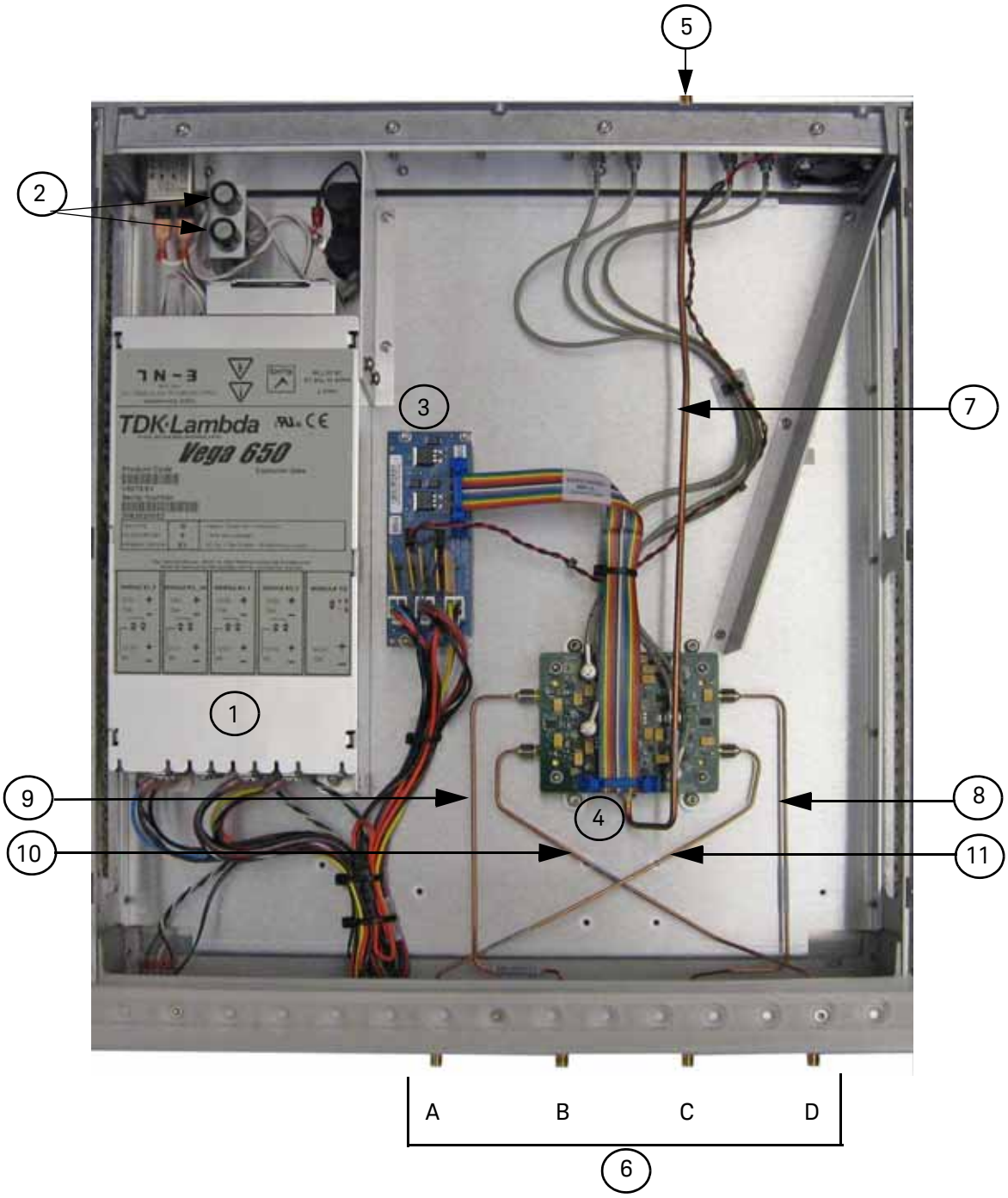


Figure 32 N5281A Option 001 with Mixer Brick (N5280-63015)

Table 16 Replaceable Parts for Serial Numbers US48480102, US48480105 and Greater

	Description	Keysight Part Number
1	PWR Supply (AC/DC SWG 650 W 9-Output)	0950-4729
2	Fuse (8 A 250 V non-time delay 0.0146 Ohm)	2110-0342
3	Mixer Brick Bias Board Assembly	N5281-63024
4	Mixer Brick 50 GHz Assembly	5087-7811
5	3.5 mm Bulkhead Connector (female)	5062-6618
6	2.4 mm Bulkhead Connector (female)	5062-7243
7	RF Cable, semi-rigid (LO IN)	N5281-20018
8	RF Cable, semi-rigid (LO OUT)	N5281-20019
N5281A Option 700 (Standard):		
9	RF Cable, semi-rigid (MXB-A/D to RF-A)	N5281-20020
10	RF Cable, semi-rigid (MXB-R2/R3 to RF-D)	N5281-20021
11	RF Cable, semi-rigid (MXB-R1/R4 to RF-C)	N5281-20022
12	RF Cable, semi-rigid (MXB-B/C to RF-B)	N5281-20023
N5281A Option 001:		
13	Attenuator (35 dB) 50 GHz, 3-Section Y-Contact, 5 V, 2.4 mm Connector	33325-60011
14	RF Cable, semi-rigid (ATTN-D to D)	N5281-20010
15	RF Cable, semi-rigid (ATTN-B to B)	N5281-20011
16	RF Cable, semi-rigid (ATTN-C to C)	N5281-20012
17	RF Cable, semi-rigid (ATTN-A to A)	N5281-20013
18	RF Cable, semi-rigid (MXB-B/C ATTN-B)	N5281-20014
19	RF Cable, semi-rigid (MXB-R2/R3 to ATTN-D)	N5281-20015
20	RF Cable, semi-rigid (MXB-A/D to ATTN-A)	N5281-20016
21	RF Cable, semi-rigid (MXB-R1/R4 to ATTN-C)	N5281-20017

Figure 33 N5281A Option 700 with Mixer Brick (N5281-63024)

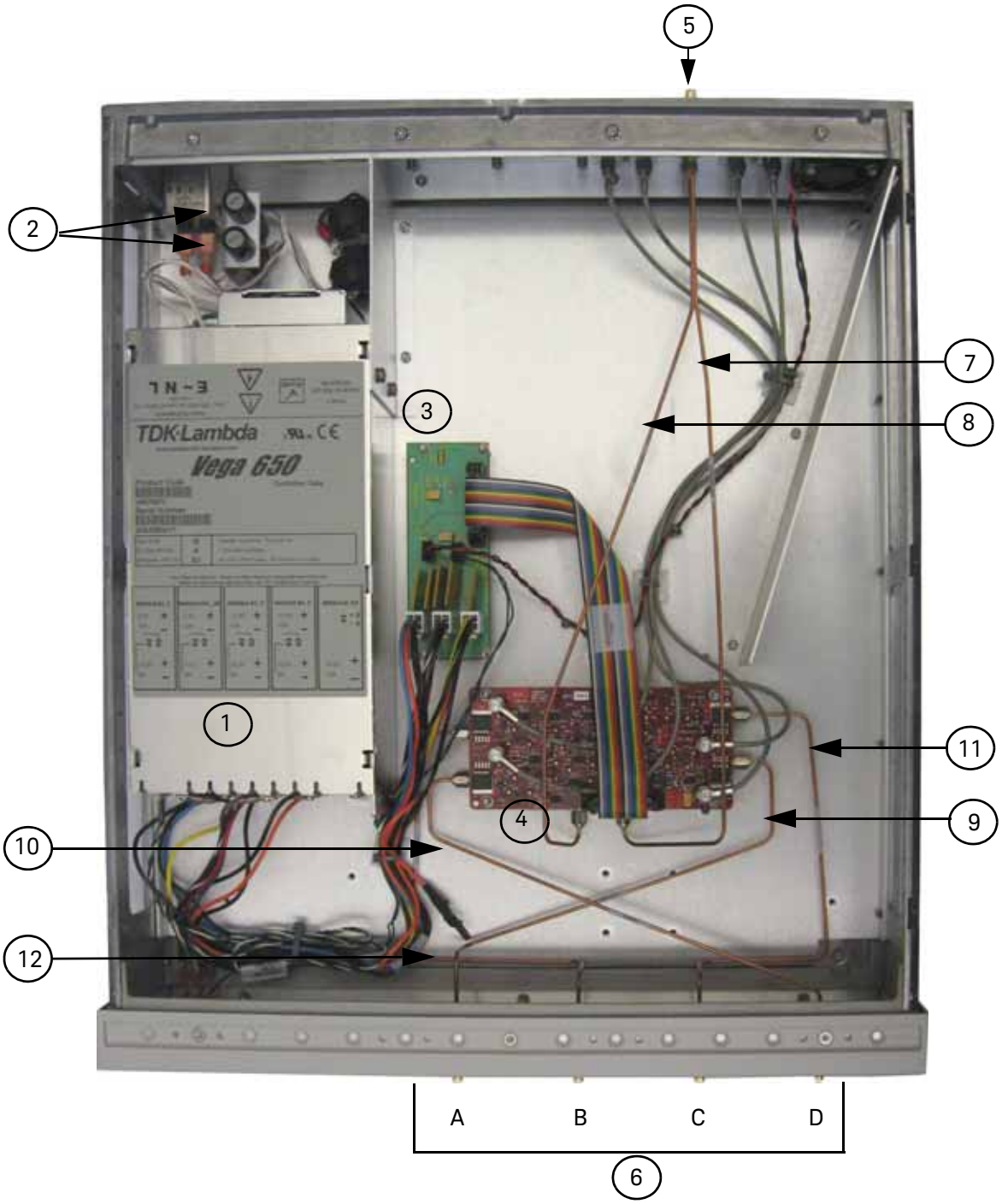
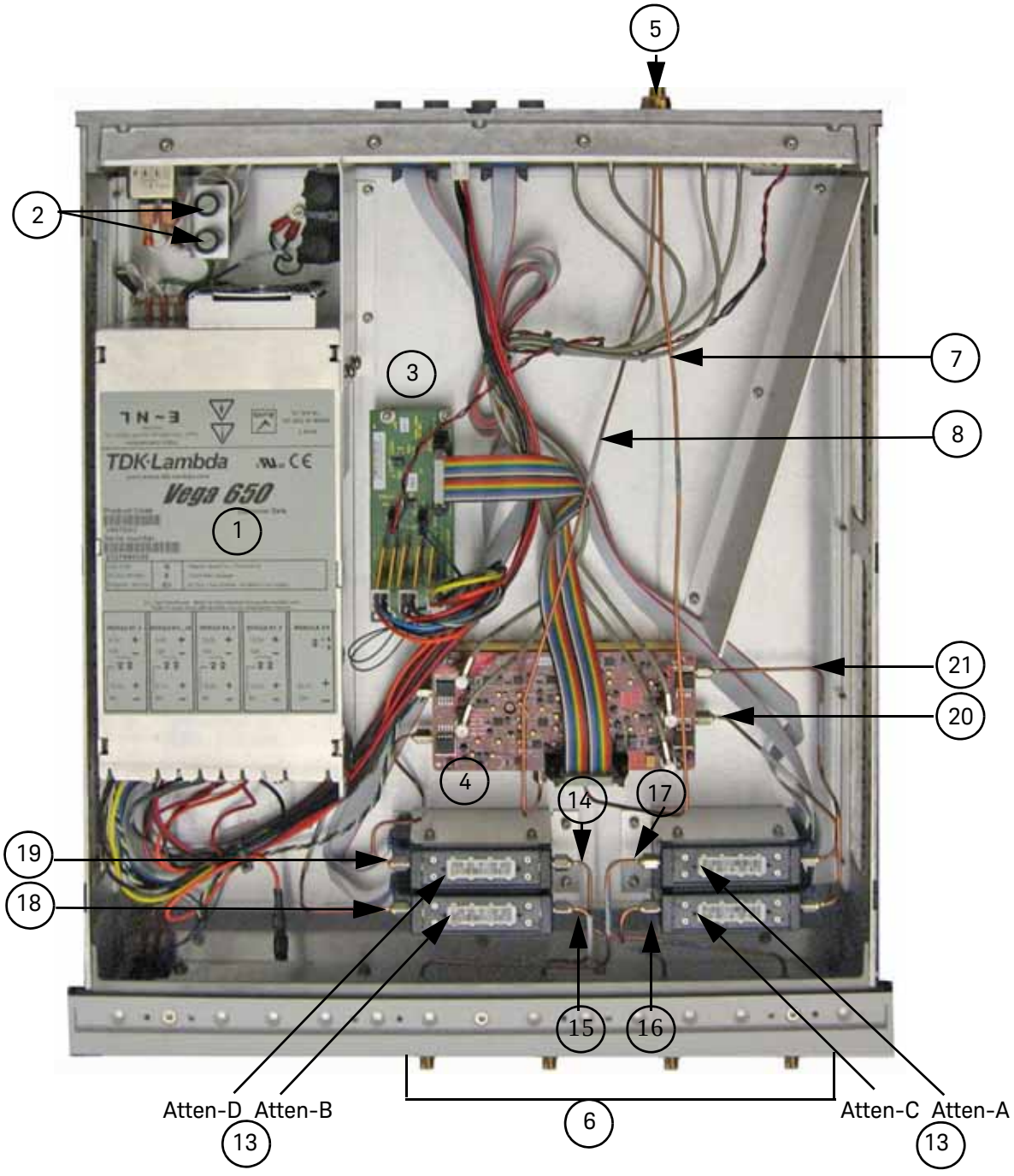


Figure 34 N5281A Option 001 with Mixer Brick (N5281-63024)



Safety and Information

Introduction

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument.

This product has been designed and tested in accordance with accepted industry standards, and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Safety Earth Ground

WARNING **This is a Safety Class I Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.**

CAUTION Always use the three prong AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage and the risk of electrical shock.

Declaration of Conformity

A copy of the Declaration of Conformity is available upon request, or a copy is available on the Keysight Technologies web site at http://regulations.keysight.com/DoC.htm

Statement of Compliance

This product has been designed and tested in accordance with accepted industry standards, and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Before Applying Power

Verify that the premises electrical supply is within the range of the instrument. The instrument has an autoranging power supply.

WARNING **If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.**

CAUTION The Mains wiring and connectors shall be compatible with the connector used in the premise electrical system. Failure, to ensure adequate earth grounding by not using the correct components may cause product damage, and serious injury.

CAUTION Always use the three prong AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage and the risk of electrical shock.

CAUTION This product is designed for use in Installation Category II and Pollution Degree.

CAUTION Before switching on this instrument, make sure the supply voltage is in the specified range.

CAUTION Verify that the premise electrical voltage supply is within the range specified on the instrument.

CAUTION Ventilation Requirements: When installing the instrument in a cabinet, the convection into and out of the instrument must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the instrument by 4 °C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, forced convection must be used.

WARNING **Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions.**

WARNING **For continued protection against fire hazard replace line fuse only with same type and rating. The use of other fuses or material is prohibited.**

WARNING **These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.**

WARNING **The opening of covers or removal of parts is likely to expose the user to dangerous voltages. Disconnect the instrument from all voltage sources before opening.**

WARNING **No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.**

WARNING **The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch (disconnecting device).**

Connector Care and Cleaning Precautions

Remove the power cord to the instrument. To clean the connectors use alcohol in a well ventilated area. Allow all residual alcohol moisture to evaporate, and fumes to dissipate prior to energizing the instrument.

WARNING **To prevent electrical shock, disconnect the Keysight U3020S22 from mains electrical supply before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

WARNING **If flammable cleaning materials are used, the material shall not be stored, or left open in the area of the equipment. Adequate ventilation shall be assured to prevent the combustion of fumes, or vapors.**

Instrument Markings

Listed below are definitions of markings that may be found on or with the product.

The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.

This symbol indicates that the input power required is AC.

This WEEE symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal.

This symbol indicates that the power line switch is ON.

This symbol indicates that the power line switch is in the STANDBY position.

This symbol indicates that the power line switch is in the OFF position.

This symbol is used to identify a terminal which is internally connected to the product frame or chassis.

The CE marking is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven). It indicates that the product complies with all relevant directives.

ccr.keysight@keysight.com

The Keysight email address is required by EU directives applicable to our product.

The CSA mark is a registered trademark of the CSA International.

ISM1-A

This is a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 5).

ICES/NMB-001

This is a marking to indicate product compliance with the Canadian Interference-Causing Equipment Standard (ICES-001).

Direct Current.

IP 2 0

The instrument has been designed to meet the requirements of IP 2 0 for egress and operational environment.

The RCM mark is a registered trademark of the Australian Communications and Media Authority.

China Restricted Substance Product Label. The EPUP (environmental protection use period) number in the center indicates the time period during which no hazardous or toxic substances or elements are expected to leak or deteriorate during normal use and generally reflects the expected useful life of the product.

Universal recycling symbol. This symbol indicates compliance with the China standard GB 18455-2001 as required by the China RoHS regulations for paper/fiberboard packaging.

South Korean Certification (KC) mark. It includes the marking's identifier code in the format shown.

Battery Collection

Do not throw batteries away but collect as small chemical waste, or in accordance with your country's requirements. You may return the battery to Keysight Technologies for disposal. Refer to "Contacting Keysight" on page 51 for assistance.

Electrical Safety Compliance

- Acoustic statement (European Machinery Directive)
  Acoustic noise emission
  LpA<70 dB
  Operator position
  Normal operation mode per ISO 7779

EMI and EMC Compliance

Complies with European EMC Directive as well as the current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

- IEC 61326-1
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11
- ICES/NMB-001
  This ISM device complies with Canadian ICES-001.
  Cet appareil ISM est conforme a la norme NMB du Canada.

South Korean Class A EMC Declaration

If there is a "KC" mark on the instrument, then the following statement applies:

This equipment has been conformity assessed for use in business environments. In a residential environment, this equipment may cause radio interference.

※ This EMC statement applies to the equipment only for use in a business environment.

사 용 자 안 내 문
이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

※ 사용자 안내문은 "업무용 방송통신기자재"에만 적용한다.

Declaration of Conformity

A declaration of conformity is available upon request, or a copy is available on the Keysight Technologies web site at https://regulations.about.keysight.com/DoC/

Keysight Support, Services, and Assistance

Service and Support Options

There are many other repair and calibration options available from the Keysight Technologies support organization. These options cover a range of service agreements with varying response times. Contact Keysight for additional information on available service agreements for this product.

Contacting Keysight

Assistance with test and measurement needs, and information on finding a local Keysight office are available on the Internet at:
http://www.keysight.com/find/assist

You can also purchase accessories or documentation items on the Internet at:
http://www.keysight.com/find

If you do not have access to the Internet, contact your field engineer.

NOTE In any correspondence or telephone conversation, refer to the Keysight product by its model number and full serial number. With this information, the Keysight representative can determine the warranty status of your unit.

Shipping Your Product to Keysight for Service or Repair

IMPORTANT Keysight Technologies reserves the right to reformat or replace the internal hard disk drive in your analyzer as part of its repair. This will erase all user information stored on the hard disk. It is imperative, therefore, that you make a backup copy of your critical test data located on the analyzer's hard disk before shipping it to Keysight for repair.

If you wish to send your instrument to Keysight Technologies for service or repair:

- Include a complete description of the service requested or of the failure and a description of any failed test and any error message.
- Remove and retain the front handles and all rack mount hardware. The analyzer should be sent to Keysight in the same configuration as it was originally shipped.
- Remove and retain the front handles and all rack mount hardware. The analyzer should be sent to Keysight in the same configuration as it was originally shipped.
- Contact Keysight for instructions on where to ship your analyzer.

Print Date: December 2018
Supersedes March 2017

N5281-90001

www.keysight.com