

# **Agilent Technologies N5244/45AS Option H30**

## **User's and Service Guide**

Reference the PNA Series Network Analyzer On-line Help System,  
N5244/45A Service Guide: N5245-90001 and  
PNA Installation and Quick Start Guide: E8356-90001



**Agilent Technologies**

**Manufacturing Part Number: N5245-90003**

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The following safety notes are used throughout this document. Familiarize yourself with each of these notes and its meaning before performing any of the procedures in this document.

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|                |                                                                                                                                                                                                                                                               |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WARNING</b> | <b>Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.</b> |
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|                |                                                                                                                                                                                                                                                                           |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CAUTION</b> | Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met. |
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## Definitions

- *Specifications* describe the performance of parameters covered by the product warranty (temperature –0 to 55 °C, unless otherwise noted.)
- *Typical* describes additional product performance information that is not covered by the product warranty. It is performance beyond specification that 80% of the units exhibit with a 95% confidence level over the temperature range 20 to 30 °C. Typical performance does not include measurement uncertainty.
- *Nominal* values indicate expected performance or describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- *Characteristic Performance* describes performance parameter that the product is expected to meet before it leaves the factory, but is not verified in the field and is not covered by the product warranty. A characteristic includes the same guard bands as a specification.



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# **N5244/45AS Option H30**

## Introduction

This document describes how to use and service the N5244AS and N5245AS Option H30 (IF Outputs) in the PNA-X Microwave Network Analyzer. The N5244/45AS is a custom PNA-X with special options in addition to the standard available options. Refer to the standard N5244/45A User and Service Guide for further information.

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## Description

The N5244/45AS Option H30 provide IF Outputs on the rear panel and require Option 020 (External IF INPUTS) to verify Option H30. This enables the PNA-X to be used as a downconverter.

The Option H30 IF Outputs, A, B, C/R1, D/R2 and R are the result of the RF Input signal at the PNA-X test port, or RCVR IN mixing with the internal source. The R IF Output is only available on the 4-Port N5244/45AS Option H30.

The IF Outputs are terminated with a 50 Ohm load when not in use to reduce radiated emissions and protect the IF Outputs.



## Identifying the Options in Your N5244/45AS PNA-X

Your PNA-X network analyzer was setup as an ordering convenience to respond to customer application and test needs requiring modification or enhancement to the standard PNA-X. Specifications, characteristics, or typical values, are based, leveraged or derived from the performance of the standard PNA-X network analyzers and their options.

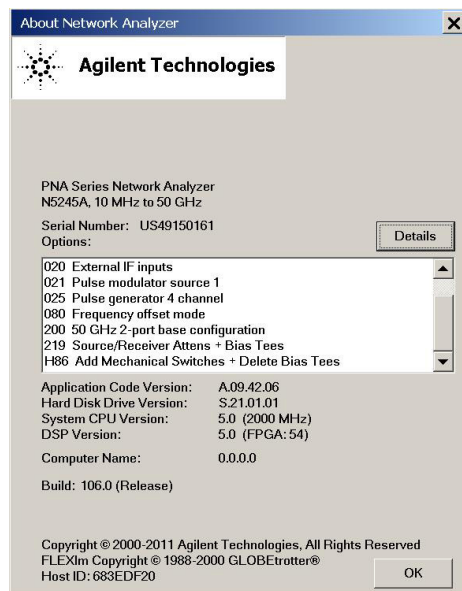
Ordering configurations and rear panel serial tags will differ from the standard model number and options indicated on the network analyzer front panel, and option field window of the instrument. When ordering and enabling Option H86, Option 219 is shown in the [Figure 2](#) in addition to the other options ordered.

- Option 200 50 GHz 2-Port base configuration<sup>1</sup>
- Option 219 Source/Receiver + Bias Tees
- Option H86 Mechanical Switches - Delete Bias Tees
- Option 286 Extended power range for a 2-Port analyzer (no bias tees)

**Figure 1** Serial Tag



**Figure 2** About Network Analyzer



1. The frequency is dependant on the PNA-X model.

## Specifications

**Table 1 IF Output Characteristics**

| Description                                 | 2-Port                                                                                | 4-Port                                                                                |
|---------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <b>Option H30 IF Output Characteristics</b> |                                                                                       |                                                                                       |
| Input Frequency Range <sup>1</sup>          | 10 MHz to 50 GHz                                                                      | 10 MHz to 50 GHz                                                                      |
| Center IF Frequency Output <sup>2</sup>     | $\text{PNA-X Freq} - \text{RF Input Freq} + \text{IF Offset} = \text{IF Freq Output}$ | $\text{PNA-X Freq} - \text{RF Input Freq} + \text{IF Offset} = \text{IF Freq Output}$ |
| IF Frequency Bandwidth:                     |                                                                                       |                                                                                       |
| 3 dB                                        | 30 MHz                                                                                | 30 MHz                                                                                |
| 6 dB                                        | 70 MHz                                                                                | 70 MHz                                                                                |
| 20 dB                                       | 100 MHz                                                                               | 100 MHz                                                                               |
| IF Output (A, B, Conversion Loss)           | -13 dB ( $\pm 5$ dB)                                                                  | -13 dB ( $\pm 5$ dB)                                                                  |
| IF Output (C/R1, D/R2 Conversion loss)      | -25 dB ( $\pm 5$ dB)                                                                  | -13 dB ( $\pm 5$ dB)                                                                  |
| IF Output (REF) Conversion loss             | n/a                                                                                   | -25 dB ( $\pm 5$ dB)                                                                  |
| Compression Input Level                     | +10 dBm at 1 GHz RF Input                                                             | +10 dBm at 1 GHz RF Input                                                             |
| IF Output Impedance                         | 50 Ohm                                                                                | 50 Ohm                                                                                |

1. The coupler in the test ports causes high conversion loss for frequency < 500 MHz.  
 Use RCVR Input for best conversion loss.
2. Refer to Equation 1, "IF Offset Frequency" on [Page 6](#).

## Rear Panel Features

Figure 3 Rear Panel

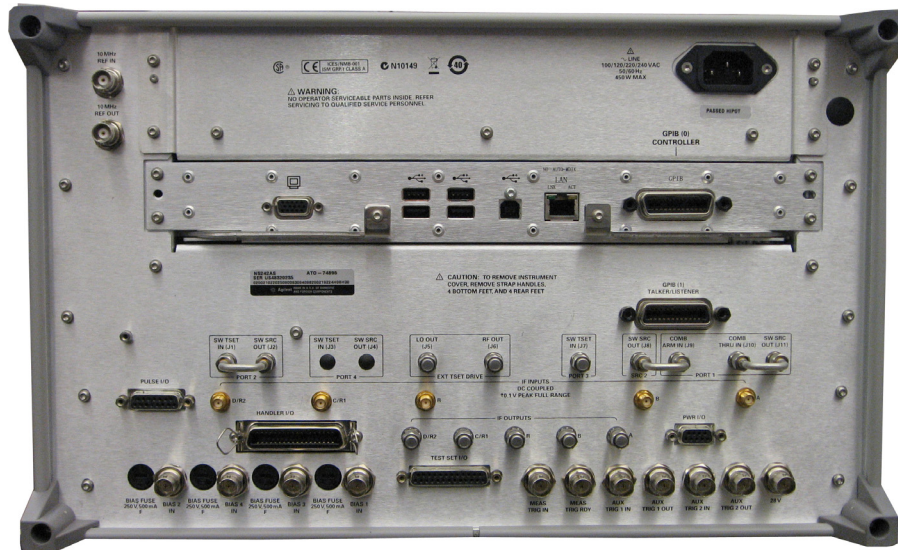
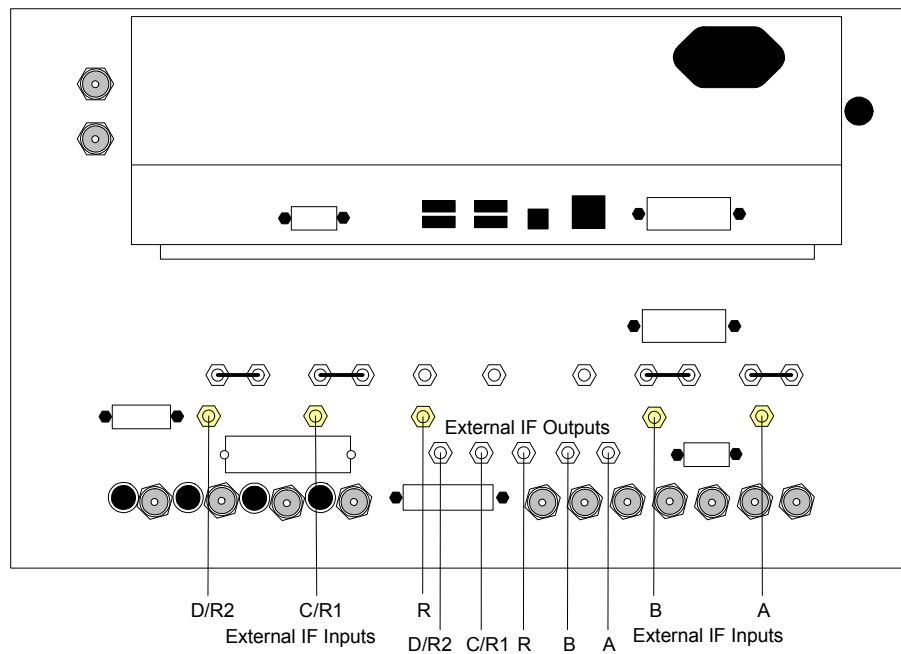


Figure 4 Rear Panel Labeling



## Operating the PNA-X as a Downconverter

The PNA-X test ports, or front panel receiver inputs (with jumper RCVR IN to CPLR ARM removed) can be used to downconvert an RF signal to a lower IF frequency. The downconverted IF signals are the difference between the RF signal frequency at the test port you are using, and the tuned frequency of the PNA-X.

The amplitude of the IF Output signals will increase or decrease if the RF Input signal amplitude changes.

The IF Output frequency will increase or decrease with the input frequency applied to the test port or RCVR Input as shown in Equation 1.

To simplify the equation set the IF Offset to a usable integer, for example 1 MHz IF would replace the default IF Offset (7.60563380282 MHz). Reference the following commands:

1. `sens:if:freq 1e6` (sets the desired IF frequency, in this example 1 MHz)
2. `sens:if:freq:auto off` (activates the selected IF frequency)

### Equation 1 IF Offset Frequency

$$IF = (RFSignalFreq + IFOffset) - PNAXFreq$$

---

**CAUTION** Do not apply DC or RF on the IF Outputs, the IF Outputs are DC coupled.

---

## Typeface Key Conventions

The following key conventions are used throughout this document.

- **[HARDKEYS]** are labeled front panel keys.
- **SOFTKEYS** are unlabeled key whose function is indicated on the instrument display.

## Downconverting the Signal Using a Test Port

Port 1 can be used to downconvert an RF Input signal using the PNA-X. Selecting S12 will enable the RF applied signal at Port 1 to be downconverted to the IF Offset  $\pm$  the difference of the RF signal and the tuned frequency of the PNA-X. Refer to Equation 1, “IF Offset Frequency” on [Page 6](#).

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**CAUTION** Do not exceed the maximum input power of the test ports or RCVR Inputs, or damage to the PNA-X will occur. The maximum input power on the PNA-X test port is 30 dBm (1 W) or 40 VDC.

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1. Connect the RF signal to be downconverted to Port 1.
2. Select [**Sweep**] > **Sweep Type** > **CW Time**.
3. Input the frequency desired to downconvert your RF signal. Note: The IF signal will decrease approximately 3 dB when your RF signal is 40 MHz more than the PNA-X frequency.

Example: Select [**Freq**] > [**1 GHz**].

4. Set the PNA-X to measure S12. Select [**Meas**] > **S12**. This will set Port 1 to be the receiver port and Port 2 will be a source port.

### 2-Port PNA-X

- Port 1 — Set the PNA-X to measure S12. **A** and **D/R2** IF Outputs will have the downconverted IF signal.
- Port 2 — Set the PNA-X to measure S21. **B** and **C/R1** IF Outputs will have the downconverted IF signal.
- There will be no signal on the IF Output R in a 2-Port PNA-X.

### 4-Port PNA-X

- Port 1 — Set the PNA-X to measure S12. **A** and **R** IF Outputs will have the downconverted IF signal.
- Port 2 — Set the PNA-X to measure S21. **B** and **R** IF Outputs will have the downconverted IF signal.
- Port 3 — Set the PNA-X to measure S31. **C/R1** and **R** IF Outputs will have the downconverted IF signal.
- Port 4 — Set the PNA-X to measure S41. **D/R2** and **R** IF Outputs will have the downconverted IF signal.

## Downconverting the Signal Using a External Receiver Input

The external RCVR Input (A, B, C or D) bypasses the internal test port coupler, resulting in less loss of the RF signal to be downconverted. It is recommended that you use the external RCVR for input frequency < 500 MHz. The coupler in the test ports causes high conversion loss for frequencies < 500 MHz.

To use the receiver input, remove the jumper (RCVR IN to CPLR ARM) and connect the RF signal to the RCVR IN female SMA on the front panel. Removing the jumper will disable the front panel test port.

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**CAUTION** Ensure the receiver input power level is < +15 dBm with 0 VDC if you are using RCVR A, B,C or D IN or damage may occur.

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## Performance Verification

The operational check allows the user to verify the IF Outputs are functioning. The N5244/45AS Option H30 can be verified in two different ways. Connect the IF Outputs to the IF Inputs and verify the trace on the PNA-X, or measure the IF Output using a separate instrument such as a power meter or spectrum analyzer.

### IF Output Verification Using N5244/45AS Internal Receivers

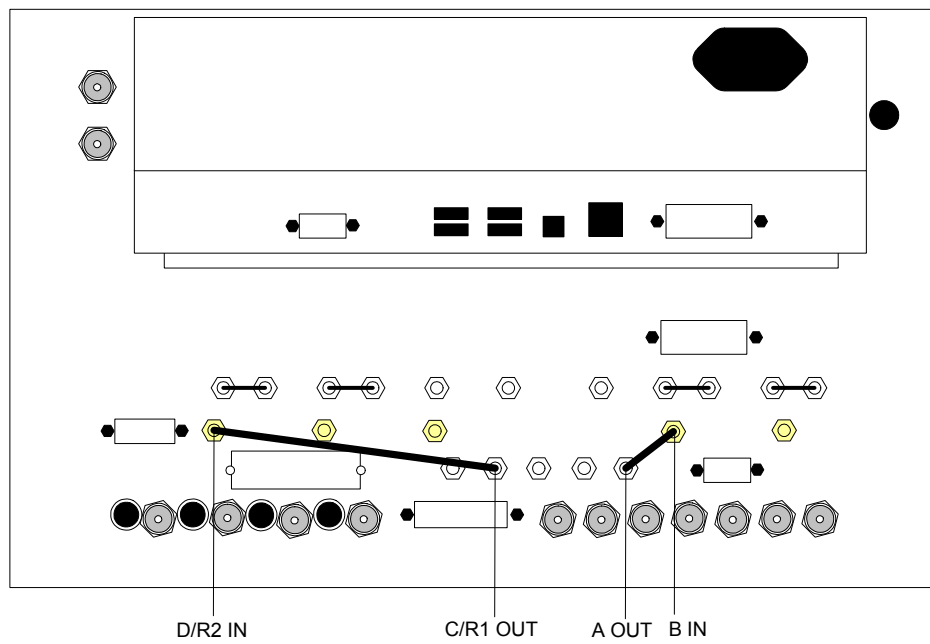
This procedure verifies the Option H30 IF Outputs using Option 020 (External IF Inputs) by connecting the IF Outputs to the IF Inputs. The IF Outputs will be measured by the internal N5244/45AS receivers.

- **A** and **C/R1** external IF Inputs measure **B** and **D/R2** IF Outputs.
  - **B** and **D/R2** external IF Inputs measure **A** and **C/R1** IF Outputs.
1. Connect the cables from the IF Outputs to the IF Inputs on the rear panel, using four 1 foot SMA cables as shown in [Table 3](#) (Agilent RF cable part number 5062-6662 or equivalent).

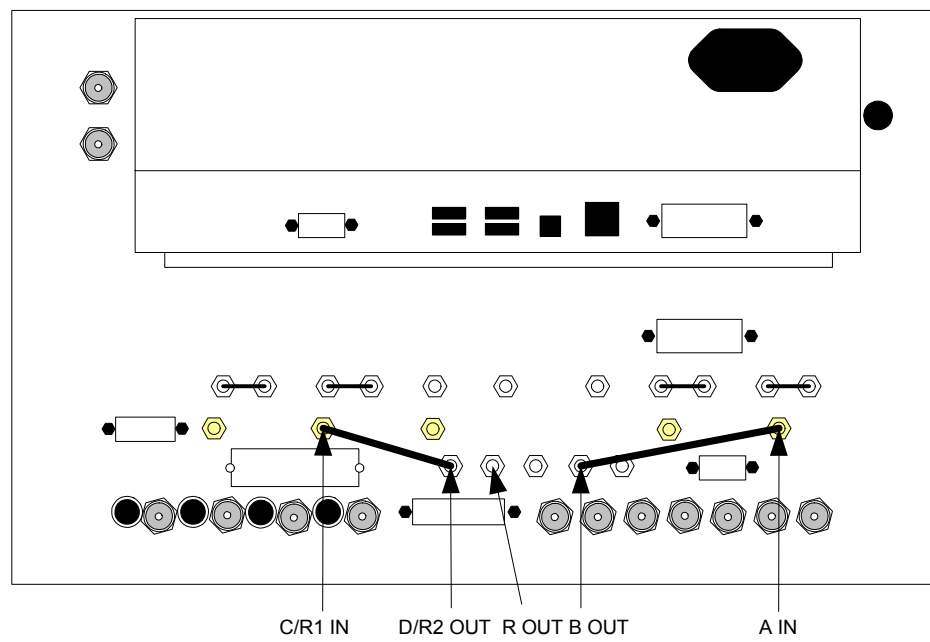
**Table 3** Rear Panel RF Connections

| IF OUT | IF IN |
|--------|-------|
| A      | B     |
| C/R1   | D/R2  |
| B      | A     |
| D/R2   | C/R1  |

**Figure 5 Cable Connections (1)**



**Figure 6 Cable Connections (2)**



## 2-Port Internal Receiver Measurement (B and D/R2 IF Outputs)

This procedure measures B and D/R2 IF Outputs using A and R1 IF Inputs.

1. Press **[Preset]**.
2. Select **[Power]** > **-5 dBm**.
3. Select **[Sweep]** > **Sweep Type** > **CW Time**.
4. Select **[Freq]** > **[1 GHz]**.
5. Select **[Avg]** > **IF Bandwidth** > **[1 kHz]**.
6. Select **[Channel]** > **Hardware Setup** > **IF Config**.
7. Select **External: A** and **External: R1** > **OK**.

**Figure 7 IF Config - Channel 1 (2-Port)**

| IF Path | IF Input | IF Attenuator | IF Filter | IF Gain | ADC Filter |
|---------|----------|---------------|-----------|---------|------------|
| A       | External | 30dB          | Wide      | Auto    | Auto       |
| B       | Internal | 30dB          | Wide      | Auto    | Auto       |
| R1      | External | 30dB          | Wide      | Auto    | Auto       |
| R2      | Internal | 30dB          | Wide      | Auto    | Auto       |

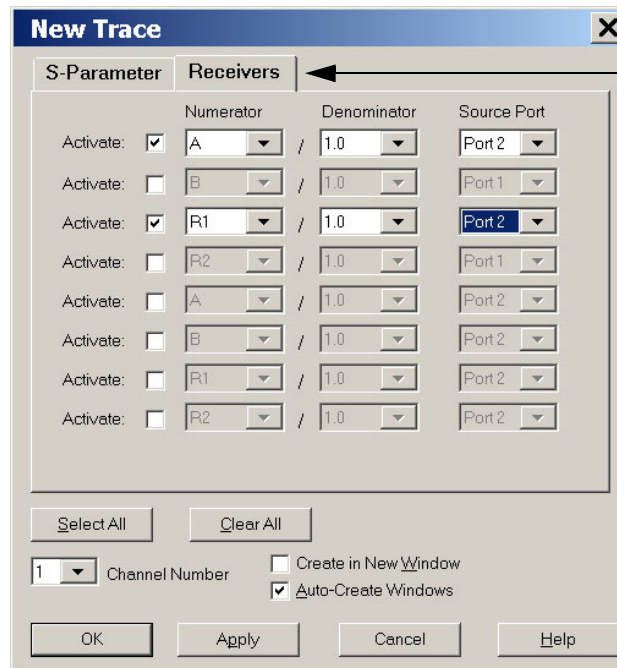
Couple all IF paths

OK Cancel Help



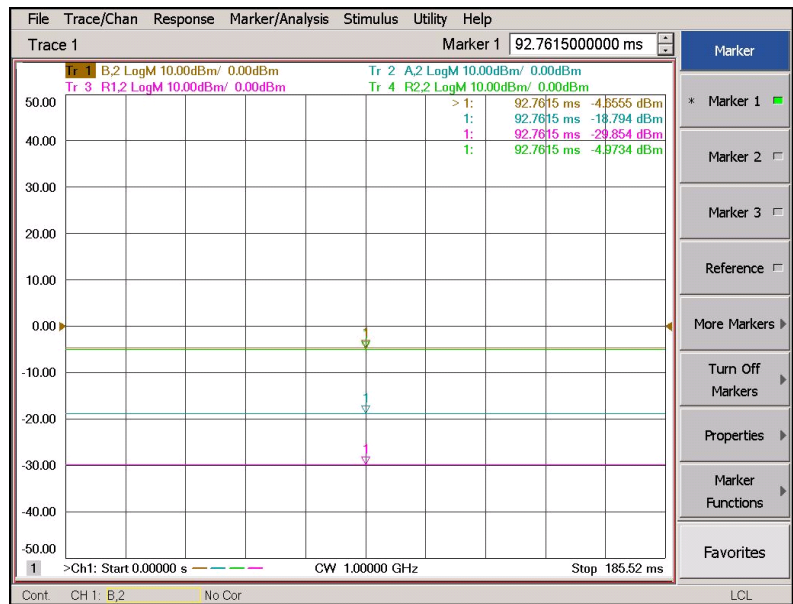
8. Select **Trace/Chan > Trace > Delete Trace > Trace 1 > OK**.
9. Select **Trace/Chan > Trace > New Trace** and select the **Receivers** tab.
10. Select **Activate** for Numerator **A** and **R1**, Denominator **1.0** and Source Port, **Port 2 > OK**.

**Figure 8 Measure B and D/R2 IF Output with A and R1 Receivers (2-Port)**

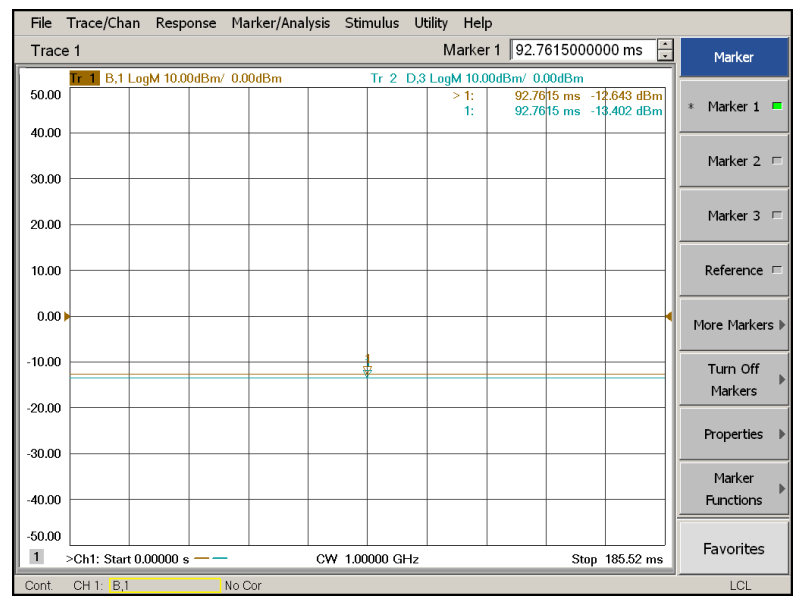


11. Select **Tr 2 (A,2) > [Marker]**. To measure B Output.
12. Select **Tr 3 (R1,2) > [Marker]**. To measure D/R2 Output.
  - **Tr 2 (A,2)** is the B IF Output level. Verify the power level is  $-18$  dBm ( $\pm 5$  dBm) for Option H30.
  - **Tr 3 (R1,2)** is the D/R2 IF Output. Verify the power level is  $-28$  dBm ( $\pm 5$  dBm) for Option H30. Refer to [Figure 9](#) and [Figure 10](#) on page 12.

**Figure 9 Option H30 B and D/R2 Output Measurement (2-Port)**



**Figure 10 Option H31 B and D/R2 Output Measurement (2-Port)**



## 4-Port Internal Receiver Measurement (B and D/R2 IF Outputs)

The procedure measures B and D/R2 IF Outputs using A and C IF Inputs.

1. Press **[Preset]**.
2. Select **[Power]** > **-5 dBm**.
3. Select **[Sweep]** > **Sweep Type** > **CW Time**.
4. Select **[Freq]** > **[1 GHz]**.
5. Select **[Avg]** > **IF Bandwidth** > **[1 kHz]**.
6. Select **[Channel]** > **Hardware Setup** > **IF Config**.
7. Select **External: A** and **External: C** > **OK**.

**Figure 11 IF Path Config - Channel 1 A and C (4-Port)**

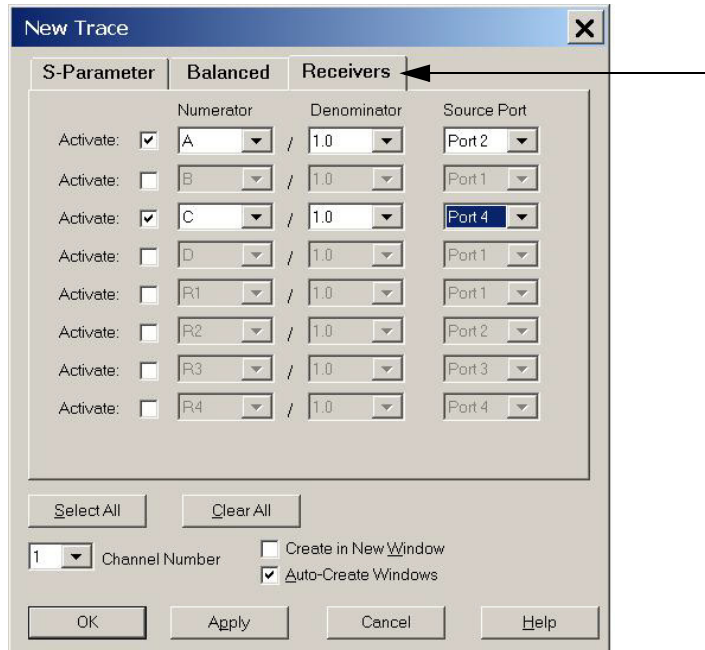
The screenshot shows the 'IF Path Configuration: Channel 1' dialog. At the top, a block diagram illustrates the signal path: IF Input (Internal/External) → IF Attenuator → IF Filter (Narrow/Wide) → IF Gain → ADC Filter. Below the diagram is a table with the following data:

| IF Path   | IF Input | IF Attenuator | IF Filter | IF Gain | ADC Filter |
|-----------|----------|---------------|-----------|---------|------------|
| <b>A</b>  | External | 30dB          | Wide      | Auto    | Auto       |
| <b>B</b>  | Internal | 30dB          | Wide      | Auto    | Auto       |
| <b>C</b>  | External | 30dB          | Wide      | Auto    | Auto       |
| <b>D</b>  | Internal | 30dB          | Wide      | Auto    | Auto       |
| <b>R1</b> | Internal | 30dB          | Wide      | Auto    | Auto       |
| <b>R2</b> | Internal | 30dB          | Wide      | Auto    | Auto       |
| <b>R3</b> | Internal | 30dB          | Wide      | Auto    | Auto       |
| <b>R4</b> | Internal | 30dB          | Wide      | Auto    | Auto       |

At the bottom of the dialog, there is a checkbox labeled 'Couple all IF paths' which is currently unchecked. Below the checkbox are three buttons: 'OK', 'Cancel', and 'Help'.

8. Select **Trace/Chan > Trace > Delete Trace > Trace 1 > OK**.
9. Select **Trace/Chan > Trace > New Trace** and select the **Receivers** tab.
10. Select **Activate** for Numerator **A**, Denominator **1.0** and Source Port, **Port 2**. Select **Activate** for Numerator **C**, Denominator **1.0** and Source Port, **Port 4** > **OK**.

**Figure 12 Measure B and D/R2 IF Outputs with A and C Receivers (4-Port)**



11. Select **Tr 1 (A,2) > [Marker]**.
12. Select **Tr 2 (C,4) > [Marker]**.
  - **Tr 1 (A,2)** is the B IF Output level. Verify the power level is  $-20$  dBm ( $\pm 5$  dBm) for Option H30.
  - **Tr 2 (C,4)** is the D/R2 IF Output. Verify the power level is  $-20$  dBm ( $\pm 5$  dBm) for Option H30. Refer to [Figure 13](#) and [Figure 14 on page 15](#).

Figure 13 Option H30 B and D Output Measurement (4-Port)

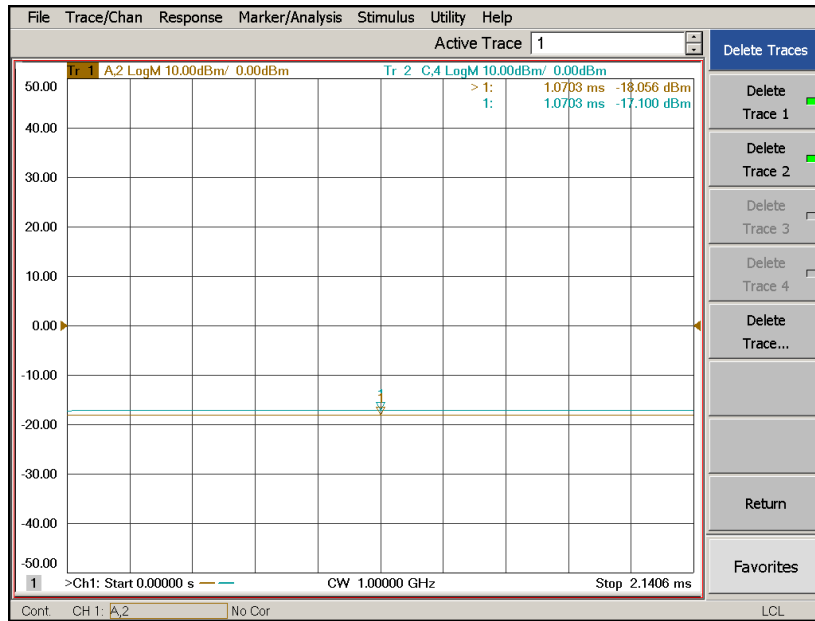
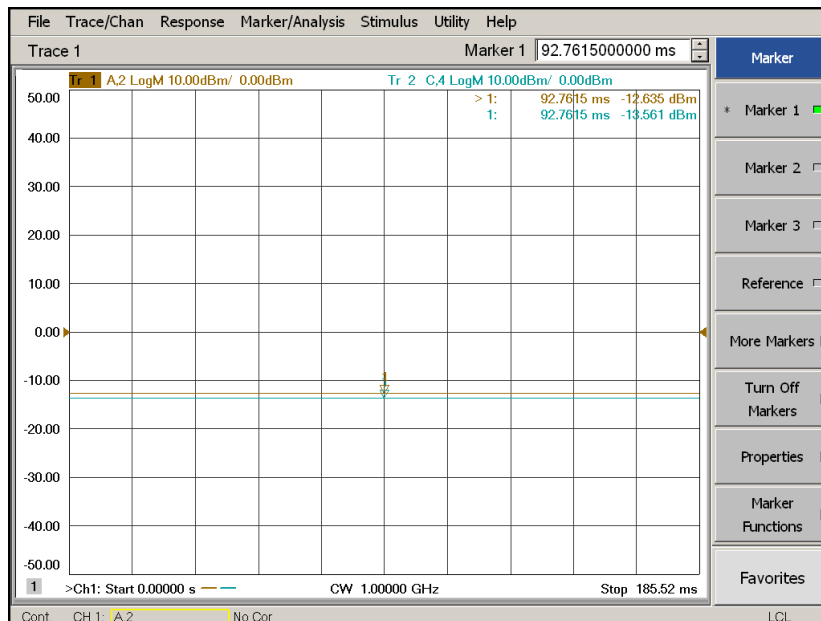


Figure 14 Option H31 B and D Output Measurement (4-Port)



## 2-Port Internal Receiver Measurement (A and C/R1 IF Outputs)

The procedure measures A and R1 IF Outputs using B and R2 IF Inputs.

1. Press **[Preset]**.
2. Select **[Power]** > **-5 dBm**.
3. Select **[Sweep]** > **Sweep Type** > **CW Time**.
4. Select **[Freq]** > **[1 GHz]**.
5. Select **[Avg]** > **IF Bandwidth** > **[1 kHz]**.
6. Select **[Channel]** > **Hardware Setup** > **IF Config**.
7. Select **External: B** and **External: R2** > **OK**.

**Figure 15 IF Path Config - B and R2 (2-Port)**

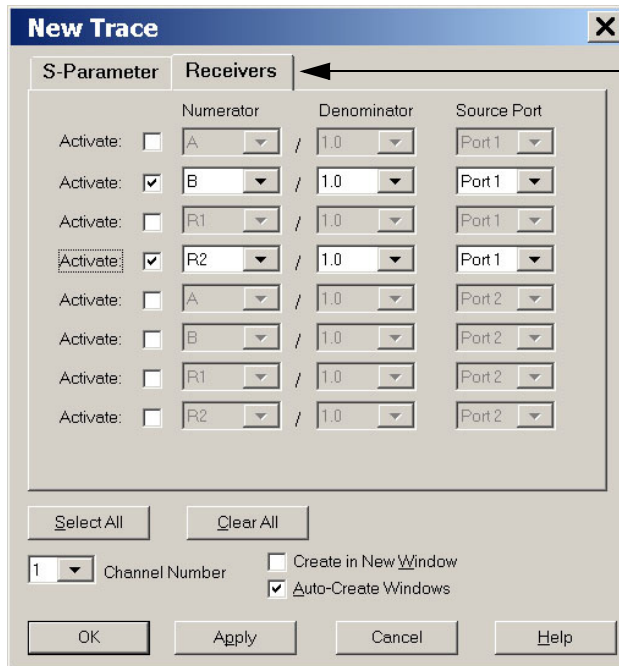
The screenshot shows the 'IF Path Configuration: Channel 1' dialog. At the top, there is a block diagram of the IF path with components: IF Input (Internal/External), IF Attenuator, IF Filter (Narrow/Wide), IF Gain, and ADC Filter. Below the diagram is a table with the following data:

| IF Path | IF Input | IF Attenuator | IF Filter | IF Gain | ADC Filter |
|---------|----------|---------------|-----------|---------|------------|
| A       | Internal | 30dB          | Wide      | Auto    | Auto       |
| B       | External | 30dB          | Wide      | Auto    | Auto       |
| R1      | Internal | 30dB          | Wide      | Auto    | Auto       |
| R2      | External | 30dB          | Wide      | Auto    | Auto       |

At the bottom of the dialog, there is a checkbox labeled 'Couple all IF paths' which is unchecked. Below the checkbox are three buttons: 'OK', 'Cancel', and 'Help'. Arrows on the left side of the image point to the 'B' and 'R2' rows in the table.

8. Select **Trace/Chan > Trace > Delete Trace > Trace 1 and Trace 2 > OK**.
9. Select **Trace/Chan > Trace > New Trace** and select the **Receivers** tab.
10. Select **Activate** for Numerator **B** and **R2**, Denominator **1.0** and Source Port, **Port 1 > OK**.

**Figure 16 Measure A and C/R1 Outputs with B and R2 Receivers (2-Port)**



11. Select **Tr 2 (B,1) > [Marker]**. To measure A IF Output.

12. Select **Tr 4 (R2,1) > [Marker]**. To measure C/R1 IF Output.

- **Tr 2 (B,1)** is the A IF Output level. Verify the power level is  $-20$  dBm ( $\pm 5$  dBm) for Option H30.
- **Tr 4 (R2,1)** is the C/R1 IF Output. Verify the power level is  $-30$  dBm ( $\pm 5$  dBm) for Option H30. Refer to [Figure 16](#) and [Figure 17 on page 18](#).

Figure 17 Option H30 A and C/R1 Measurement (2 Port)

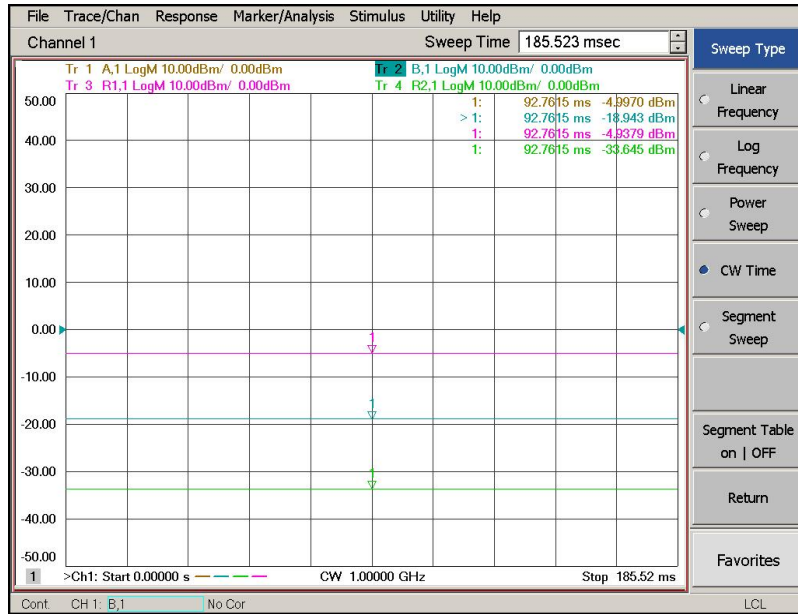
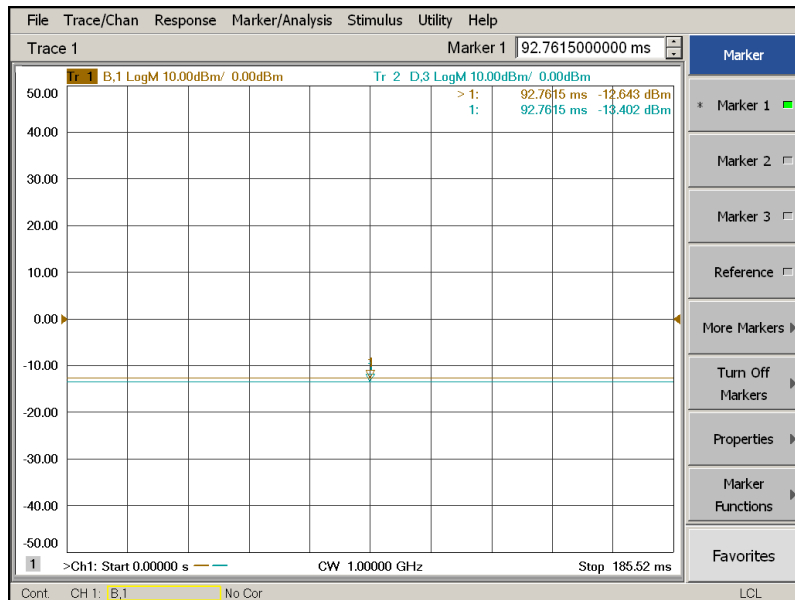


Figure 18 Option H31 A and C/R1 Measurement (2 Port)





## 4-Port Internal Receiver Measurement (A and C/R1 IF Outputs)

The procedure measures the A and C/R1 IF Outputs using the B and D IF Inputs.

1. Press **[Preset]**.
2. Select **[Power]** > **-5 dBm**.
3. Select **[Sweep]** > **Sweep Type** > **CW Time**.
4. Select **[Freq]** > **[1 GHz]**.
5. Select **[Avg]** > **IF Bandwidth** > **[1 kHz]**.
6. Select **[Channel]** > **Hardware Setup** > **IF Config**.
7. Select **External: B** and **External: D** > **OK**.

**Figure 19 IF Config - B and D (4-Port)**

IF Path Configuration: Channel 1

IF Input: Internal, External

IF Attenuator

IF Filter: Narrow, Wide

IF Gain

ADC Filter

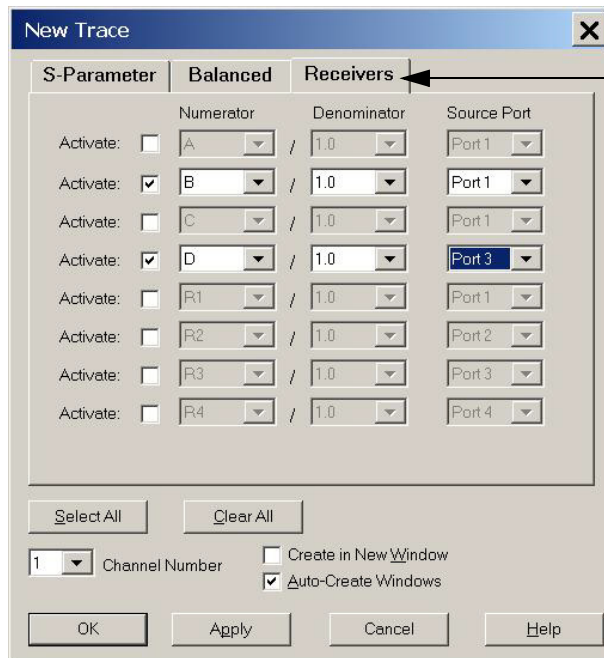
| IF Path | IF Input | IF Attenuator | IF Filter | IF Gain | ADC Filter |
|---------|----------|---------------|-----------|---------|------------|
| A       | Internal | 30dB          | Wide      | Auto    | Auto       |
| B       | External | 30dB          | Wide      | Auto    | Auto       |
| C       | Internal | 30dB          | Wide      | Auto    | Auto       |
| D       | External | 30dB          | Wide      | Auto    | Auto       |
| R1      | Internal | 30dB          | Wide      | Auto    | Auto       |
| R2      | Internal | 30dB          | Wide      | Auto    | Auto       |
| R3      | Internal | 30dB          | Wide      | Auto    | Auto       |
| R4      | Internal | 30dB          | Wide      | Auto    | Auto       |

Couple all IF paths

OK Cancel Help

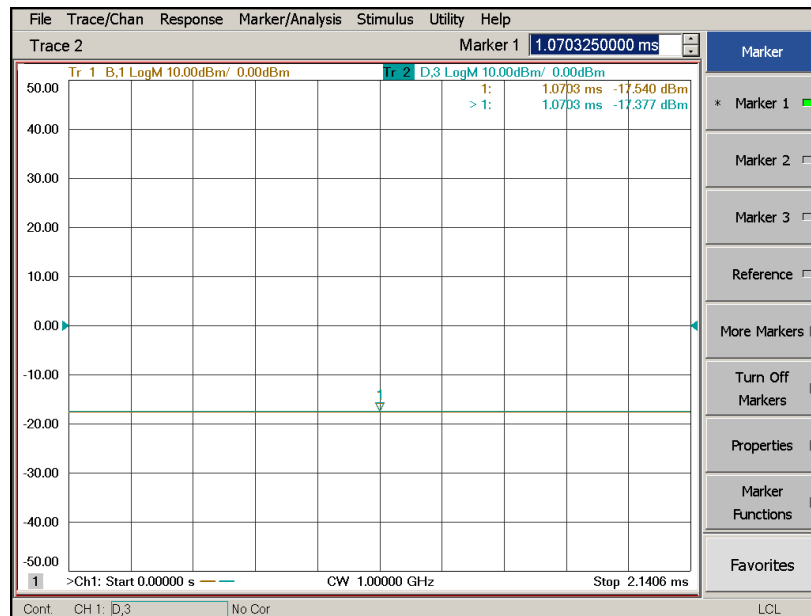
8. Select **Trace/Chan > Trace > Delete Trace > Trace 1** and **Trace 2 > OK**.
9. Select **Trace/Chan > Trace > New Trace** and select the **Receivers** tab.
10. Select **Activate** for Numerator **B**, Denominator **1.0** and Source Port, **Port 1**. Select **Activate** for Numerator **D**, Denominator **1.0** and Source Port, **Port 3** > **OK**.

**Figure 20 Measure A and C/R1 Using B and D Receivers (4-Port)**

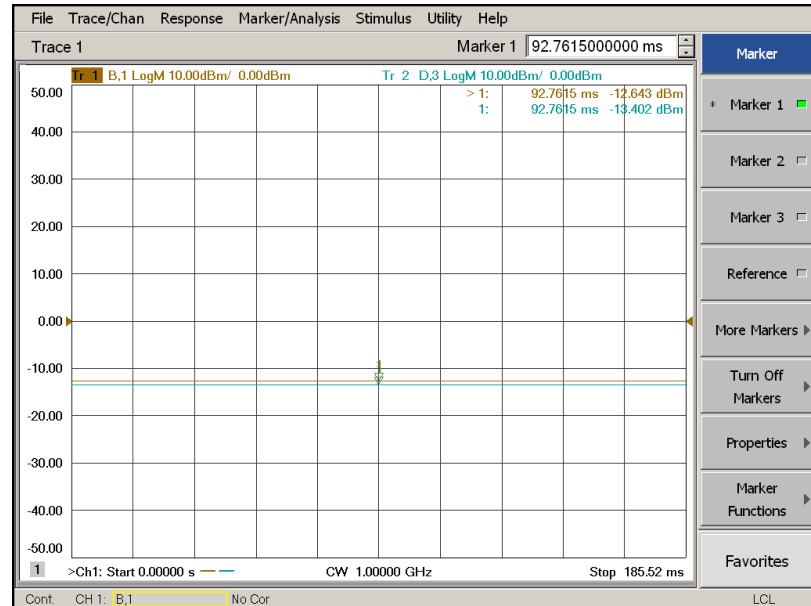


11. Select **Tr 1 (B,1) > [Marker]**.
12. Select **Tr 2 (D,3) > [Marker]**.
  - **Tr 1 (B,1)** is the A IF Output level. Verify the power level is  $-20$  dBm ( $\pm 5$  dBm) for Option H30.
  - **Tr 2 (D,3)** is the C/R1 IF Output level. Verify the power level is  $-20$  dBm ( $\pm 5$  dBm) for Option H30. Refer to [Figure 21](#) and [Figure 22 on page 21](#).

**Figure 21 Option H30 A and C/R1 Measurement (4-Port)**



**Figure 22 Option H31 A and C/R1 Measurement (4-Port)**



## 4-Port Internal Receiver Measurement (R IF Output)

1. Remove the cable from **B IF Output** to **A IF Input**.
2. Select **[Power]** > **-5 dBm**.
3. Connect **R IF Output** to **A IF Input** using RF cable (5062-6662) or equivalent.
4. Press **[Preset]**.
5. Select **[Sweep]** > **Sweep Type** > **CW Time**.
6. Select **[Freq]** > **[1 GHz]**.
7. Select **[Avg]** > **IF Bandwidth** > **[1 kHz]**.
8. Select **[Channel]** > **Hardware Setup** > **IF Config**.
9. Select **External: A** and **External: R1** > **OK**.

**Figure 23 IF Config - A and R1 (4-Port)**

IF Path Configuration: Channel 1

IF Path Configuration Diagram: IF Input (Internal/External) → IF Attenuator → IF Filter (Narrow/Wide) → IF Gain → ADC Filter

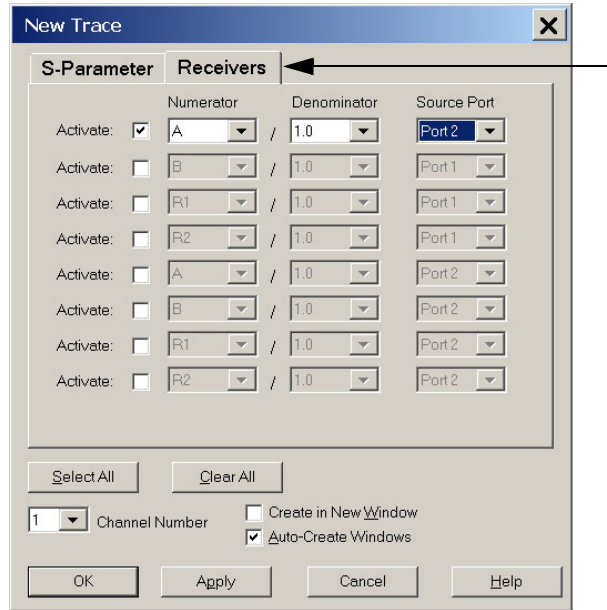
| IF Path   | IF Input | IF Attenuator | IF Filter | IF Gain | ADC Filter |
|-----------|----------|---------------|-----------|---------|------------|
| <b>A</b>  | External | 30dB          | Wide      | Auto    | Auto       |
| <b>B</b>  | Internal | 30dB          | Wide      | Auto    | Auto       |
| <b>C</b>  | Internal | 30dB          | Wide      | Auto    | Auto       |
| <b>D</b>  | Internal | 30dB          | Wide      | Auto    | Auto       |
| <b>R1</b> | External | 30dB          | Wide      | Auto    | Auto       |
| <b>R2</b> | Internal | 30dB          | Wide      | Auto    | Auto       |
| <b>R3</b> | Internal | 30dB          | Wide      | Auto    | Auto       |
| <b>R4</b> | Internal | 30dB          | Wide      | Auto    | Auto       |

Couple all IF paths

OK Cancel Help

10. Select **Trace/Chan > Trace > Delete Trace > Trace 1 > OK**.
11. Select **Trace/Chan > Trace > New Trace** and select the **Receivers** tab.
12. Select **Activate** for Numerator **A**, Denominator **1.0** and Source Port, **Port 2 > OK**.

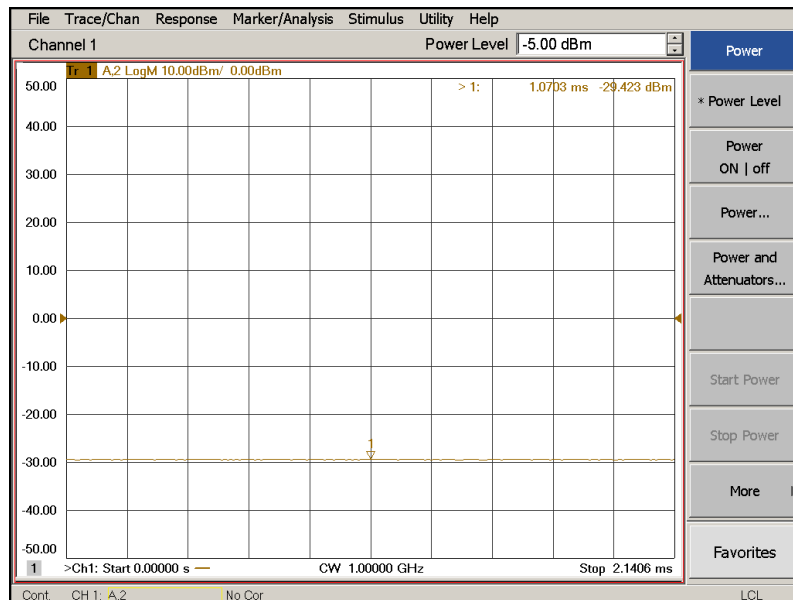
**Figure 24 Measure R Receiver Trace (4-Port)**



13. Select **Tr 1 (A,2) > [Marker]**.

- **Tr 1 (A,2)** is the R IF Output. Verify the power level is  $-30 \text{ dBm} (\pm 5 \text{ dBm})$ .

**Figure 25 R Measurement (4-Port)**



## Measuring the IF Outputs

The IF Outputs can be verified using a power meter with a sensor that can measure a signal at the IF Offset frequency selected, such as the E4413A and sensor 8482A (or equivalent). A spectrum analyzer can also be used, such as the E4411B ESA-L or N9010A EXA.

### Measuring Conversion Loss Using a Power Meter

Values are dependent on the accuracy of the power meter and sensor. It is recommended that the power meter be zeroed and the reference power level be verified before beginning.

#### PNA-X Option 200 (2-Port)

1. Press **[Preset]**.
2. Select **[Sweep] > Sweep Type > CW Time > [Freq] > CW > [1 GHz]**.
3. Select **[Power] > [0 dBm]**.
4. Select **[Meas] > S11**.
5. Connect the power sensor to **A IF Output**.
6. Verify the output power.  
Option H30 = -15 dBm ( $\pm 5$  dBm)
7. Connect the power sensor to **C/R1 IF Output**.
8. Verify the output power.  
Option H30 = -25 dBm ( $\pm 5$  dBm)
9. Select **[Meas] > S-Parameters > S22 > OK**.
10. Connect the power sensor to **B IF Output**.
11. Verify the output power.  
Option H30 = -15 dBm ( $\pm 5$  dBm)
12. Connect the power sensor to **D/R2 IF Output**.
13. Verify the output power.  
Option H30 = -25 dBm ( $\pm 5$  dBm)

### **PNA-X Option 400 (4-Port)**

1. Press [**Preset**].
2. Select [**Sweep**] > **Sweep Type** > **CW Time** > [**Freq**] > **CW** > [**1 GHz**].
3. Select [**Power**] > [**0 dBm**].
4. Select [**Meas**] > **S11**.
5. Connect the power sensor to **A IF Output**.
6. Verify the output power.  
Option H30 = -15 dBm ( $\pm 5$  dBm)
7. Select [**Meas**] > **S22**.
8. Connect the power sensor to **B IF Output**.
9. Verify the output power.  
Option H30 = -15 dBm ( $\pm 5$  dBm)
10. Select [**Meas**] > **S-Parameters** > **S33** > **OK**.
11. Connect the power sensor to **C/R1 IF Output**.
12. Verify the output power.  
Option H30 = -15 dBm ( $\pm 5$  dBm)
13. Select [**Meas**] > **S-Parameters** > **S44** > **OK**.
14. Connect the power sensor to **D/R2 IF Output**.
15. Verify the output power.  
Option H30 = -15 dBm ( $\pm 5$  dBm)
16. Connect the power sensor to **R IF Output** (Option H30 only).
17. Verify the output power.  
Option H30 = -25 dBm ( $\pm 5$  dBm)

## Measuring Conversion Loss Using a Spectrum Analyzer

Values are dependent on the accuracy of the spectrum analyzer and cable loss.

### PNA-X Option 200 (2-Port)

1. Press **[Preset]**.
2. Select **[Sweep] > Sweep Type > CW Time > [Freq] > CW > [1 GHz]**.
3. Select **[Meas] > S11**.
4. Select **[Power] > [0 dBm]**.

### Spectrum Analyzer

1. Press **[Preset]**.
2. Select **[Amplitude] > Log Scale > [10 dB/div]**.
3. Select **[Frequency] > Center Frequency**, and enter the frequency that you have selected as the **IF Offset**. Refer to Equation 1, “IF Offset Frequency” on [Page 6](#).
4. Select **Span > [10 MHz]**.
5. Select **[Reference Level] > [0 dBm]**.
6. Connect the spectrum analyzer to the PNA-X **A IF Output** on the rear panel.
7. Select **[Marker]**. Place the marker on the IF Offset signal or use the search feature.
8. Verify the output power.  
Option H30 = -15 dBm ( $\pm 5$  dBm)
9. Connect the spectrum analyzer to the PNA-X **C/R1 IF Output** on the rear panel.
10. Select **[Marker]**. Place the marker on the IF Offset signal or use the search feature.
11. Verify the output power as in [step 8](#).
12. Select **[Meas] > S22** on the PNA-X.
13. Connect the spectrum analyzer to the PNA-X **B IF Output** on the rear panel.
14. Select **[Marker]**. Place the marker on the IF Offset signal or use the search feature.
15. Verify the output power as in [step 8](#).
16. Connect the spectrum analyzer to the PNA-X **D/R2 IF Output** on the rear panel.
17. Select **[Marker]**. Place the marker on the IF Offset signal or use the search feature.
18. Verify the output power as in [step 8](#).



### PNA-X Option 400 (4-Port)

1. Press **[Preset]**.
2. Select **[Sweep] > Sweep Type > CW Time > [Freq] > CW > [1 GHz]**.
3. Select **[Meas] > S11**.
4. Select **[Power] > [0 dBm]**.

### Spectrum Analyzer

1. Press **[Preset]**.
2. Select **[Amplitude] > Log Scale > [10 dB/div]**.
3. Select **[Frequency] > Center Frequency**, and enter the frequency that you have selected as the **IF Offset**. Refer to Equation 1, "IF Offset Frequency" on [Page 6](#).
4. Select **Span > [10 MHz]**.
5. Select **[Amplitude] > [Reference Level] > [0 dBm]**.
6. Connect the spectrum analyzer to the PNA-X **A IF Output** on the rear panel.
7. Select **[Marker]**. Place the marker on the IF Offset signal or use the search feature. Adjust Video BW and/or Resolution BW as needed.
8. Verify the output power.  
Option H30 = -15 dBm ( $\pm 5$  dBm)
9. Select **[Meas] > S22** on the PNA-X.
10. Connect the spectrum analyzer to the PNA-X **B IF Output** on the rear panel.
11. Select **[Marker]**. Place the marker on the IF Offset signal or use the search feature.
12. Verify the output power as in [step 8](#).
13. Select **[Meas] > S-Parameters > S33 > OK** on the PNA-X.
14. Connect the spectrum analyzer to the PNA-X **C/R1 IF Output** on the rear panel.
15. Select **[Marker]**. Place the marker on the IF Offset signal or use the search feature.
16. Verify the output power as in [step 8](#).
17. Select **[Meas] > S-Parameters > S44 > OK** on the PNA-X.
18. Connect the spectrum analyzer to the PNA-X **D/R2 IF Output** on the rear panel.
19. Select **[Marker]**. Place the marker on the IF Offset signal or use the search feature.
20. Verify the output power as in [step 8](#).
21. Connect the spectrum analyzer to the PNA-X **R IF Output** on the rear panel.
22. Select **[Marker]**. Place the marker on the IF Offset signal or use the search feature.
23. Verify the output power.  
Option H30 = -25 dBm ( $\pm 5$  dBm)

## Measuring Bandwidth Using a Spectrum Analyzer

### On the PNA-X.

1. Select **[Measure]** > **S12**. Port 1 is now the receiver.
2. Select **[Sweep]** > **Sweep Type** > **CW Time** > **[Freq]** > **CW** > **[1 GHz]**.

On the Signal Source (ESG, MXG, or PSG).

3. Connect to Port 1 on the PNA-X.
4. Press **[Preset]**.
5. Select **[Frequency]** > **[1.076 GHz]** > **[RF On]**.
6. Select **[Incr Set]** > **[5 MHz]**.
7. Select **[Amplitude]** > **[0 dBm]**.

### On the Spectrum Analyzer (MXA, ESA, or PSA).

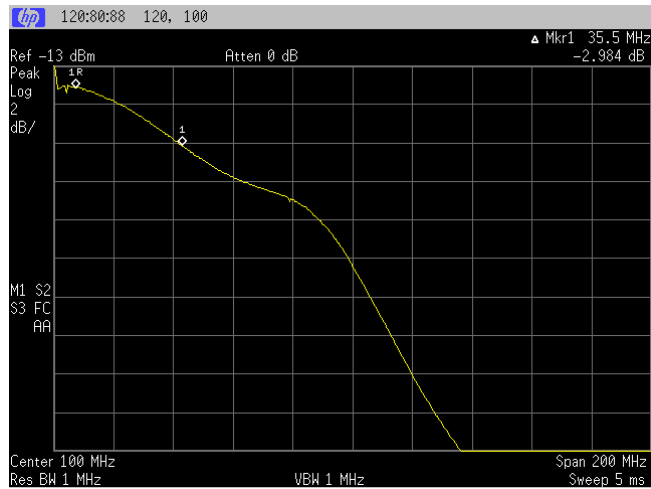
8. Connect the Input to **A IF Output** on the rear panel.
9. Press **[Preset]**.
10. Select **[Frequency]** > **Start Freq** > **[0 MHz]** and **Stop Freq** > **[200 MHz]**.
11. Select **[Marker]** > **Marker 1**. Place the marker on the 7.6 MHz signal or use the search feature.
12. Select **[Amplitude]** > **Scale/Div** > **[2 dB]**.
13. Select **[Amplitude]** > **Ref Level** > **[-5 dB]**. Set the signal to the top graticule on the display manually, or select **[Marker]** > **Mkr ->Ref Lvl**.
14. Select **[View/Trace]** > **Max Hold**.
15. Increase the frequency, in 5 MHz increments, on the signal source to **[1.2 GHz]** tracing the bandwidth of the IF Output.
16. Select **[Marker]** > **Marker 1** > **Delta** with the marker on the 7.6 MHz signal.
17. Marker 1 should read approximately 0 dBm. Using the RPG knob, move the Marker to read -3 dBm as shown in [Figure 26 on page 29](#).
18. Using the RPG knob, move the Marker to read -6 dBm as shown in [Figure 27 on page 29](#).
19. Connected the source to Ports 2, 3 or 4 and the spectrum analyzer to **B, C or D IF Output**.
20. Select **[Measure]** > **S21**. Port 2 is now the receiver. If you are measuring S31 or S41, Ports 3 and 4 will be the receiver.
21. Repeat [step 2](#) through [step 18](#) to measure B, C or D IF Outputs.

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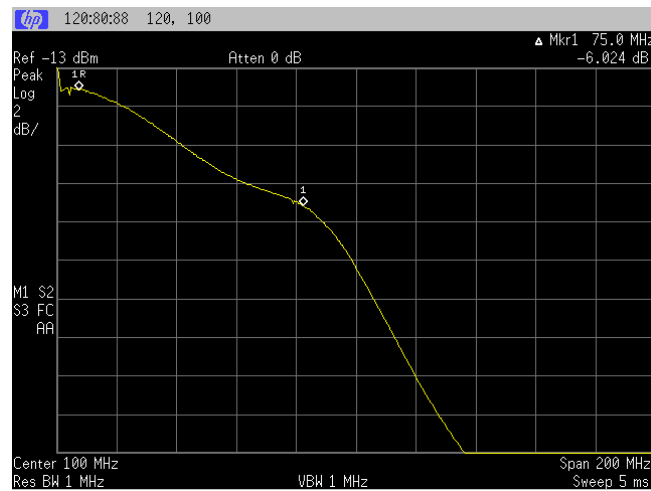
**NOTE** The step size of the source should not be greater than the resolution bandwidth of the spectrum analyzer you are using, or a measurement error may occur.

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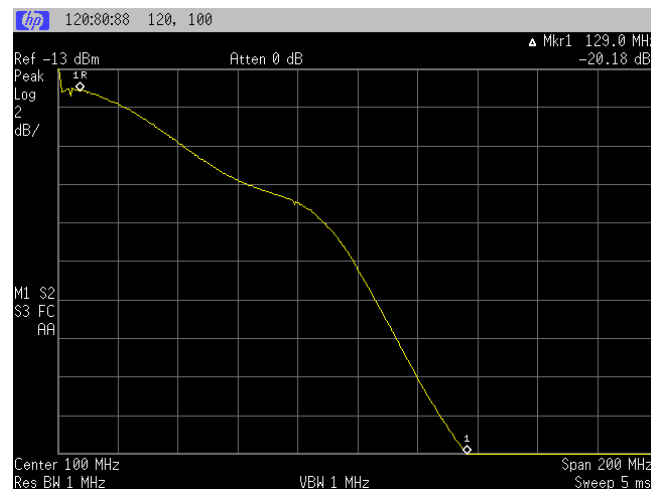
**Figure 26 3 dB Bandwidth**



**Figure 27 6 dB Bandwidth**



**Figure 28 20 dB Bandwidth**

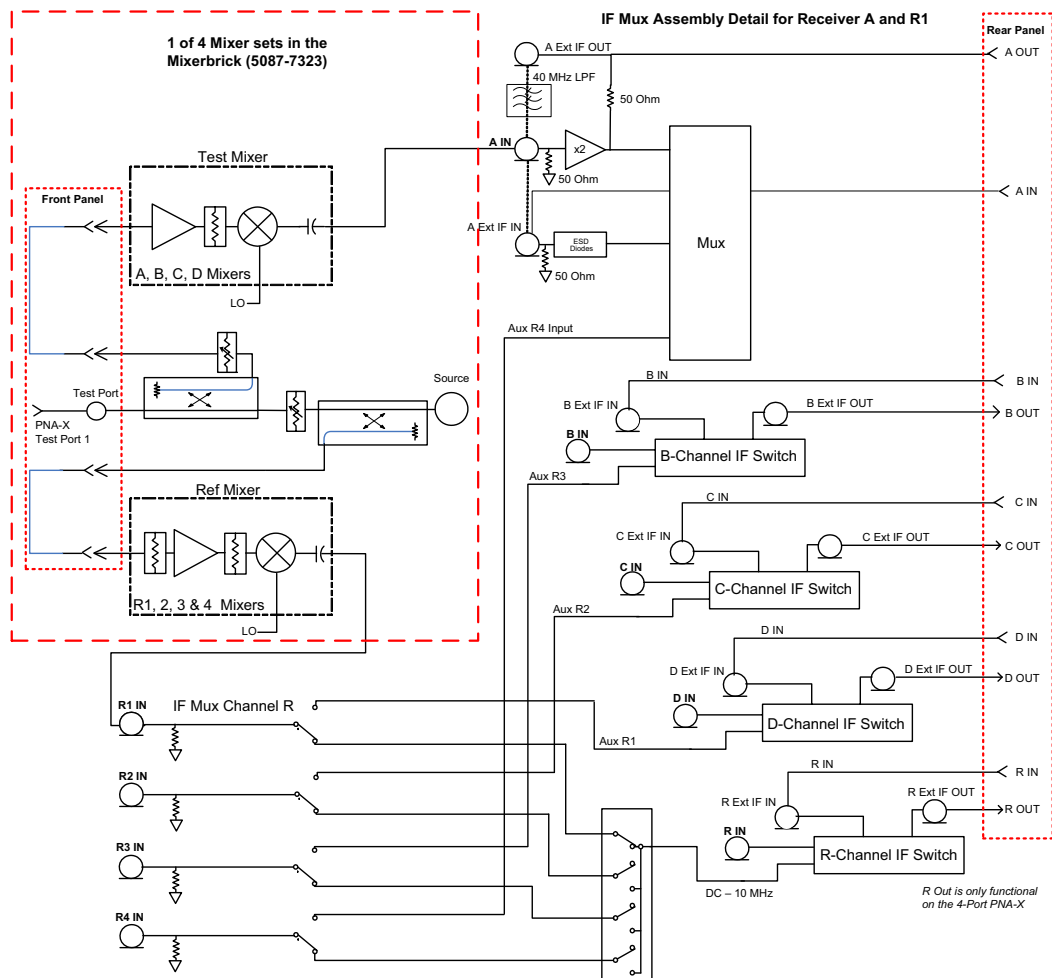


## Theory of Operation

The N5244/45AS Option H30 provides IF Output connectors on the rear panel that connect from the IF Mux assembly (N5240-60045) IF Outputs A (P2), B (P202), C (P602), D (P802) and R (R402). The test port or external receiver input is downconverted to an IF frequency (Input Freq + IF Offset - PNA set frequency). Refer to [Figure 29, “N5244/45AS Option H30 RF Block Diagram.”](#)

## N5244/45AS Block Diagrams

Figure 29 N5244/45AS Option H30 RF Block Diagram



## Replaceable Parts

**Table 4 N5244/45AS Option H30 Replaceable Parts**

| Qty | Description <sup>1</sup>                | Agilent Part Number |
|-----|-----------------------------------------|---------------------|
| 5   | RF Connector, SMA Male straight 50 ohm  | 1810-0118           |
| 5   | Cable Assembly, A06/A30 170 mm          | 8121-0149           |
| 1   | Rear Panel (IF Output)                  | N5245-00029         |
| 1   | N5244/45AS H30 User's and Service Guide | N5245-90003         |

1. Refer to the standard N5245A Service Guide for additional part information.

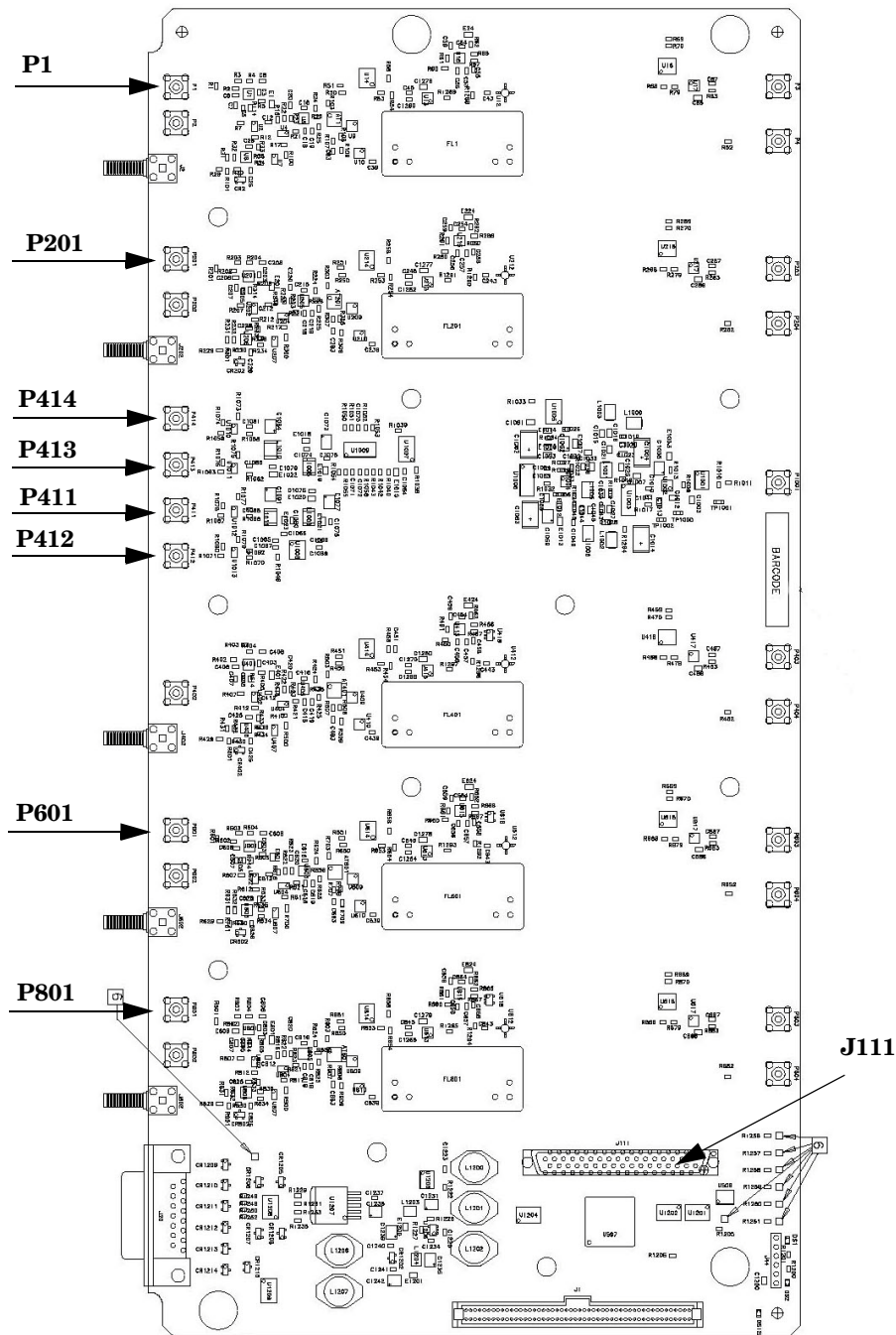
**Table 5 N5244/45AS Option H30 Internal Rear Panel Connections**

| From: IF MUX<br>(N5240-60045) | To: Rear Panel IF Out<br>SMA Connector |
|-------------------------------|----------------------------------------|
| P2                            | A                                      |
| P202                          | B                                      |
| P402                          | R                                      |
| P602                          | C/R1                                   |
| P802                          | D/R2                                   |

## Troubleshooting

If the IF Output test fails, refer to troubleshooting the IF MUX Assembly (N5240-60045), PNA-X RF or IF paths, in the N5242A Service Guide (N5242-90001). See the “N5244/45AS Block Diagrams” on page 30 and Table 5 on page 31.

Figure 30 IF MUX Board



## Safety and Regulatory Information

### Introduction

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

### Connector Care and Cleaning

If alcohol is used to clean the connectors, the power cord to the instrument must be removed. All cleaning should take place in a well ventilated area. Allow adequate time for the fumes to disperse and moist alcohol to evaporate prior to energizing the instrument.

---

**WARNING**     **Keep isopropyl alcohol away from heat, sparks, and flame. Store in a tightly closed container. It is extremely flammable. In case of fire, use alcohol foam, dry chemical, or carbon dioxide; water may be ineffective.**

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### Declaration of Conformity

A copy of the Declaration of Conformity is available upon request, or a copy is available on the Agilent Technologies web site at  
<http://regulations.corporate.agilent.com/DoC/search.htm>

### Statement of Compliance

This instrument has been designed and tested in accordance with CAN/CSA 22.2 No. 61010-1-04, UL Std No. 61010-1 (2nd Edition).

## 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.

---

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**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.

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**CAUTION** This product is designed for use in Installation Category II and Pollution Degree 2, per IEC 61010 (Second Edition).

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

---

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

---

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**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.

---



## Servicing

- 
- 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** 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.

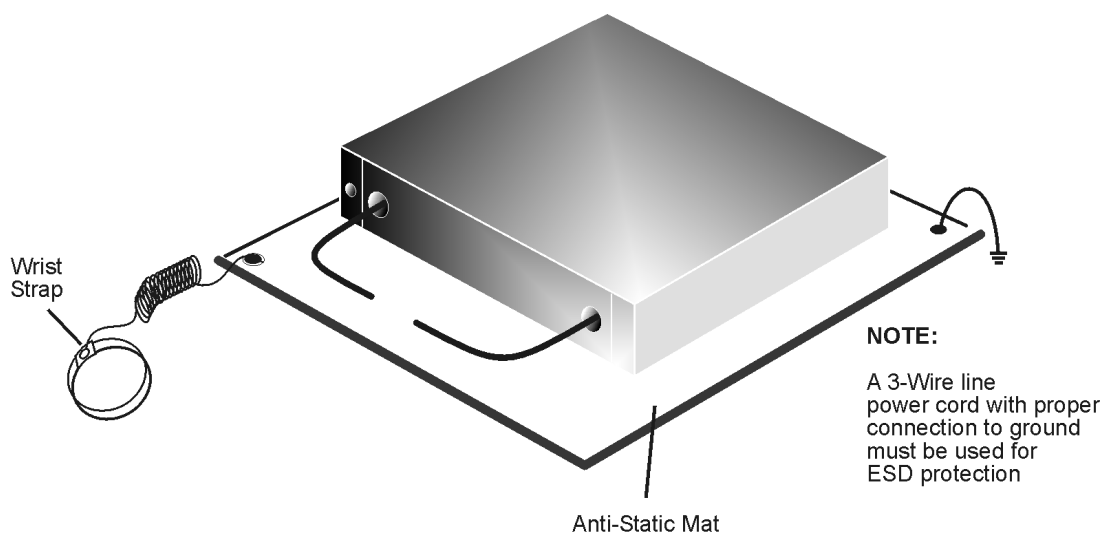
- 
- WARNING** To prevent electrical shock, disconnect the [Agilent Technologies N5244/45AS Option H30](#) from mains electrical supply before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.
- 
- WARNING** If flammable 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.
-

## Electrostatic Discharge Protection

Protection against electrostatic discharge (ESD) is essential while removing assemblies from or connecting cables to the instrument. Static electricity can build up on your body and can easily damage sensitive internal circuit elements when discharged. Static discharges too small to be felt can cause permanent damage. To prevent damage to the instrument:

- *always* have a grounded, conductive table mat (9300-0797) in front of your test equipment.
- *always* wear a grounded wrist strap (9300-1367) with grounding cord (9300-0980), connected to a grounded conductive table mat, having a 1 M $\Omega$  resistor in series with it, when handling components and assemblies or when making connections.
- *always* wear a heel strap (9300-1126) when working in an area with a conductive floor. If you are uncertain about the conductivity of your floor, wear a heel strap.
- *always* ground yourself before you clean, inspect, or make a connection to a static-sensitive device or test port. You can, for example, grasp the grounded outer shell of the test port or cable connector briefly.
- *always* ground the center conductor of a test cable before making a connection to the analyzer test port or other static-sensitive device. This can be done as follows:
  1. Connect a short (from your calibration kit) to one end of the cable to short the center conductor to the outer conductor.
  2. While wearing a grounded wrist strap, grasp the outer shell of the cable connector.
  3. Connect the other end of the cable to the test port and remove the short from the cable.

**Figure 31 ESD Protection Setup**



ku310b

## Regulatory Information

This section contains information that is required by various government regulatory agencies.

### Instrument Markings



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 instrument requires alternating current (ac) input.



This 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 (Reference WEEE Directive, 2002/96/EC).



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 mark is a registered trademark of the European Community. (If accompanied by a year, it is when the design was proven.)



The CSA mark is a registered trademark of the CSA International. This instrument complies with Canada: CSA 22.2 No. 61010-1-04.



This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.



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



Direct Current.



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



This is a required mark signifying compliance with an EMC requirement. The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.



Indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.



This symbol on all primary and secondary packaging indicates compliance to China standard GB 18455-2001.

## 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 Agilent Technologies for disposal. Refer to [“Contacting Agilent” on page 39](#) for assistance.

## Compliance with German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermverordnung-3. GSGV Deutschland).

| Acoustic Noise Emission/Geraeuschemission |                      |
|-------------------------------------------|----------------------|
| LpA<70 dB                                 | Lpa<70 dB            |
| Operator Position                         | am Arbeitsplatz      |
| Normal Operation                          | normaler Betrieb     |
| per ISO 7779                              | nach DIN 45635 t. 19 |

## EMC Information

Complies with European EMC Directive 2004/108/EC

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

## Agilent Support, Services, and Assistance

### Service and Support Options

The standard warranty is a one-year return to Agilent Technologies service warranty.

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

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### Contacting Agilent

Assistance with test and measurements needs and information or finding a local Agilent office are available on the Web at:

*<http://www.agilent.com/find/assist>*

You can also purchase accessories or documentation items on the Internet at:

*<http://www.agilent.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 Agilent product by its model number and full serial number. With this information, the Agilent representative can determine the warranty status of your unit.

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### Shipping Your Analyzer to Agilent for Service or Repair

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**IMPORTANT** Agilent 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 Agilent for repair.

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If you wish to send your instrument to Agilent 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.
- Ship the analyzer using the original or comparable antistatic packaging materials.
- Contact Agilent for instructions on where to ship your analyzer.

