DEVICE SPECIFICATIONS

NI PXIe-5632

8.5 GHz Full Two-Port Vector Network Analyzer

This document lists specifications for the NI PXIe-5632 (NI 5632) RF vector network analyzer.

Specifications are warranted under the following conditions:

- Minimum of 45 minutes warm-up time
- No averaging or smoothing applied to the data unless otherwise noted
- Less than 1 °C ambient temperature deviation after user calibration
- Calibration cycle maintained
- Type-K or Type-N, 50 Ω connectors used
- Chassis fan speed set to High
- Onboard Reference Clock applied
- NI-VNA version 2.0 or later used

Specifications describe the warranted, traceable product performance over ambient temperature ranges of 23 °C ± 5 °C, unless otherwise noted.

Typical values describe useful product performance beyond specifications that are not covered by warranty and do not include guardbands for measurement uncertainty or drift. Typical values may not be verified on all units shipped from the factory. Unless otherwise noted, typical values cover the expected performance of units over ambient temperature ranges of 23 °C ± 5 °C with a 90% confidence level, based on measurements taken during development or production.

Nominal values (or supplemental information) describe additional information about the product that may be useful, including expected performance that is not covered under *Specifications* or *Typical* values. Nominal values are not covered by warranty.

Specifications are subject to change without notice. For the most recent NI 5632 specifications, visit *ni.com/manuals*.

To access NI 5632 documentation, navigate to **Start»All Programs»National Instruments»NI-VNA»Documentation**.

Hot Surface If the NI 5632 has been in use, it may exceed safe handling temperatures and cause burns. Allow the NI 5632 to cool before removing it from the chassis.

NATIONAL INSTRUMENTS

Caution The protection provided by this product may be impaired if it is used in a manner not described in this document.

Contents

General Information

Measurements....S11, S21, S12, S22, user-defined

IF bandwidth (IFBW)....10 Hz to 500 kHz in 1, 3, 5, 7, and 10 steps

Sweep capability

- Maximum frequency....8.5 GHz
- Minimum frequency[1]....300 kHz
- Resolution....1 Hz
- Minimum number of points....1
- Maximum number of points....20,001
- Frequency spacing....Linear, shown in the following equation:
  (*Stop Freq* - *Start Freq*) / (*Number of Points* - 1)

[1] Operational to 50 kHz.

NI-VNA soft front panel (SFP) sweep modes ..... Single sweep and hold, continuous, and continuous wave (CW)

Types ..... Linear, segmented sweep, and power sweep

Data formats ..... Magnitude (log), magnitude (linear), phase, group delay, VSWR, impedance, reflection/transmission coefficient, real, and imaginary

NI-VNA SFP display types ..... Value vs. frequency plot, Smith chart, and value vs. power plot

Number of averages ..... 4,096 maximum

Smoothing ..... 25% maximum[2]

User calibration

Methods ..... Automatic, manual

Types ..... 1-port SOL, 2-port SOLT (full, 1-path forward, 1-path reverse), 2-port SOLR, LRL (TRL), LRM, transmission response, reflection response, source power calibration, and receiver power calibration

Source Characteristics[3]

Frequency range[4] ..... 300 kHz to 8.5 GHz

Frequency resolution ..... 1 Hz

Frequency accuracy ..... Equal to timebase accuracy (internal or external)

Power range (leveled)

Minimum leveled power ..... -30 dBm

Maximum leveled power ..... Refer to the *Source Maximum Leveled Power* table.

[2] You can use the NI-VNA SFP to achieve 100% smoothing.

[3] Specifications are valid for both PORT 1 and PORT 2 as source terminals unless otherwise noted.

[4] Operational to 50 kHz.

Table 1. Source Maximum Leveled Power

Frequency	Specification
300 kHz to <6 GHz	+15 dBm
6 GHz to 8 GHz	+12 dBm
>8 GHz	+10 dBm

Power accuracy

At +0 dBm test port power.....±1 dB

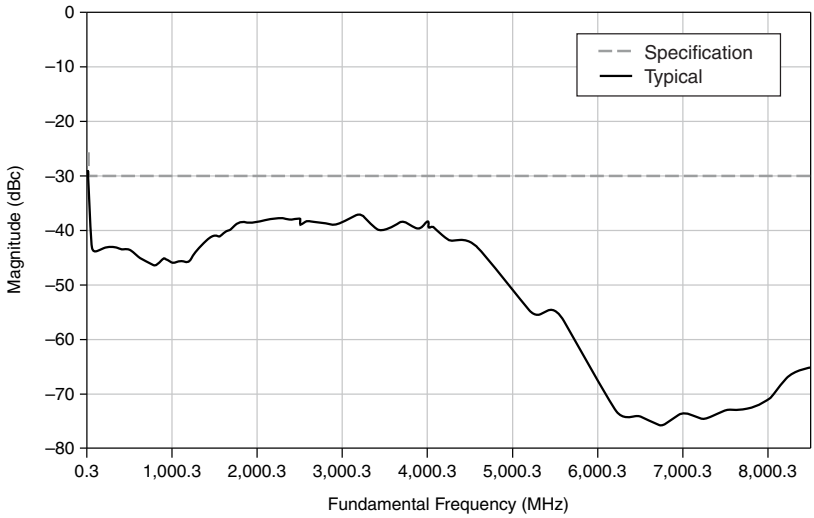
At any test port power.....±2 dB, typical

Power step resolution.....0.01 dB

Table 2. Harmonics (Measured at 0 dBm Source Power)

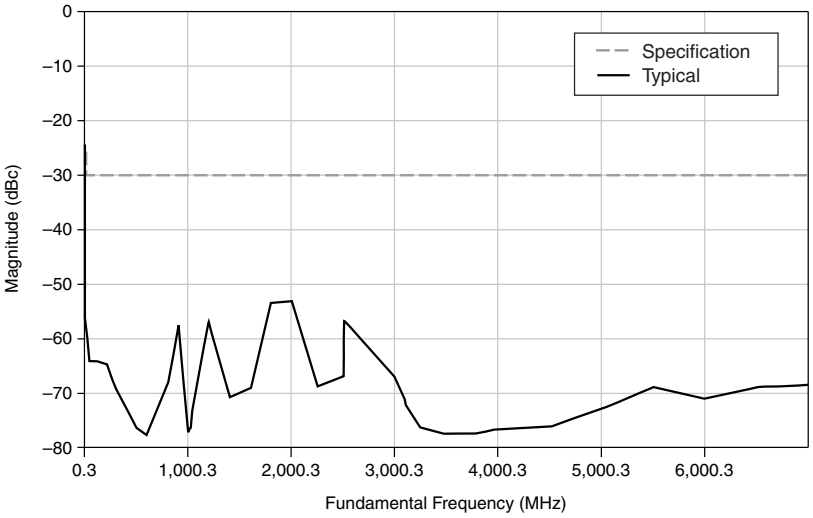
Frequency	Harmonic
300 kHz to <50 MHz	<-20 dBc
50 MHz to 8.5 GHz	<-30 dBc[5]

Figure 1. NI 5632 Source Second Harmonics



[5] This value may not be met from 2.5 GHz to 2.7 GHz on PORT 1.

Figure 2. NI 5632 Source Third Harmonics



Nonharmonic spurs.....<-30 dBc
(at 0 dBm source power)

LO OUT

Output power[6].....-10 dBm, nominal

Frequency range.....10 MHz to 8.5 GHz, nominal

Receiver Characteristics[7]

Receiver variation.....±0.1 dB across full power range, typical

Table 3. System Dynamic Range[8]

Frequency	Specification	Typical
500 kHz[9] to <3 MHz	100 dB	105 dB
3 MHz to <6 GHz	110 dB	115 dB

6 Must be terminated to 50 Ω.

7 Specifications are valid for both PORT 1 and PORT 2 as receiver terminals unless otherwise noted.

8 Measured at maximum leveled power in 10 Hz IF bandwidth.

9 Degrades by 10 dB (typical) below 500 kHz.

Table 3. System Dynamic Range[8] (Continued)

Frequency	Specification	Typical
6 GHz to <8 GHz	105 dB	110 dB
8 GHz to 8.5 GHz	—	90 dB

Table 4. Trace Noise[10]

Frequency	Specification	Typical
300 kHz to <8 GHz	6 mdB_{RMS}	3 mdB_{RMS}
8 GHz to 8.5 GHz	—	4 mdB_{RMS}

Damage input level.....+27 dBm

Measurement Speed[11]

Table 5. NI 5632 Measurement Speed (Typical)[12,13]

Span	IF Bandwidth (IFBW)	Number of Points				
		201	401	801	1,601	3,201
Zero Span[14]	500 kHz	15 ms	28 ms	52 ms	102 ms	203 ms
	1 kHz	439 ms	870 ms	1,733 ms	3,460 ms	6,912 ms
Small Span: 1 GHz to 2 GHz	500 kHz	22 ms	41 ms	77 ms	152 ms	300 ms
	1 kHz	475 ms	915 ms	1,795 ms	3,557 ms	7,079 ms
Full Span: 300 kHz to 8.5 GHz	500 kHz	28 ms	47 ms	85 ms	161 ms	306 ms
	1 kHz	648 ms	1,129 ms	2,016 ms	3,782 ms	7,302 ms

8 Measured at maximum leveled power in 10 Hz IF bandwidth.

10 Measured at +10 dBm with 100 Hz IF bandwidth.

11 Indicates the amount of time it takes after hardware configuration has been committed to the device to initiate a sweep, perform the measurement, then fetch the data from the device. Measurements taken using an NI PXIe-8135 controller and an NI PXIe-1075 chassis. Benchmarks run on a single device at a time.

12 Time-domain operations add 0.5 ms per 100 points.

13 Times include a full forward and reverse sweep and data transfer of all four S-parameters with correction applied.

14 Measured in continuous wave mode.

Corrected System Performance

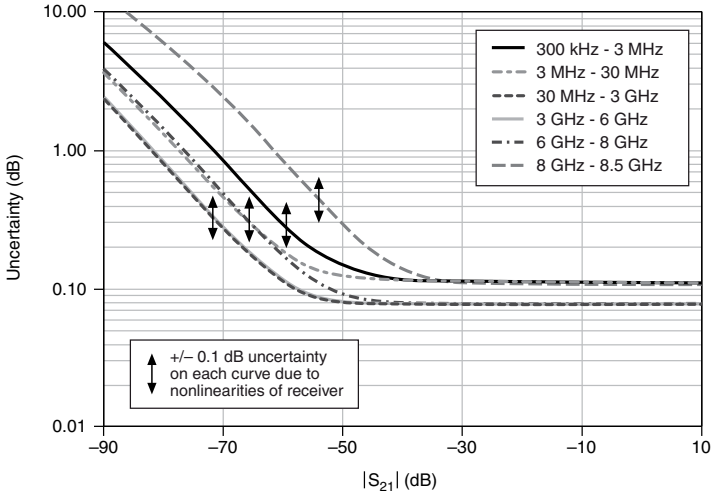
K-Type Connectors with NI Manual Calibration Kit and Precision Cables

Table 6. NI 5632 Corrected System Performance

Specification	Frequency	
	300 kHz to <5 GHz	5 GHz to 8.5 GHz
Directivity	>42 dB	>36 dB
Source match	>35 dB	>35 dB
Load match	>42 dB	>36 dB

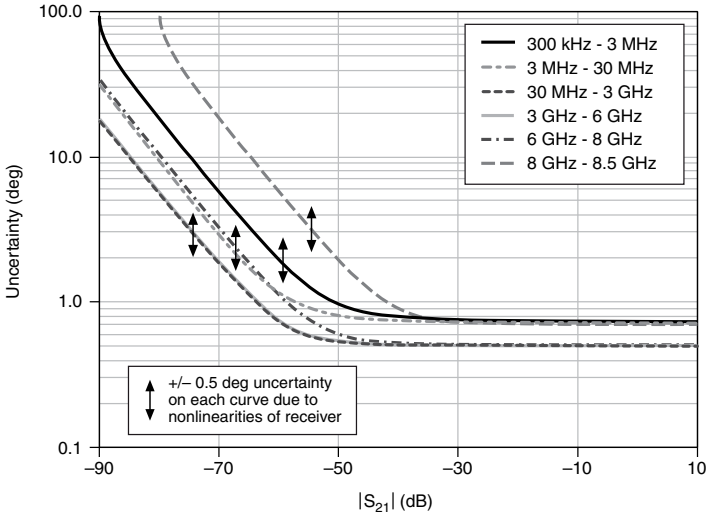
Transmission Uncertainty[15]

Figure 3. NI 5632 Magnitude Uncertainty (Typical)



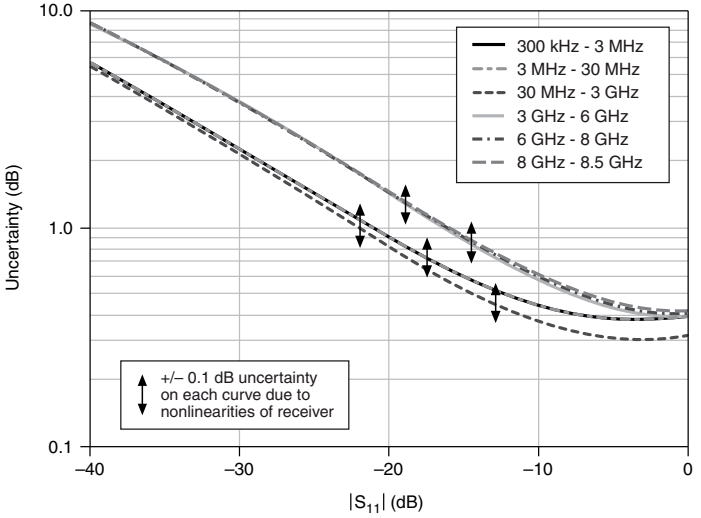
[15] Assumes $S_{11} = S_{22} = 0$; 10 Hz IF bandwidth; 0 dBm power; cable flex and drift not included.

Figure 4. NI 5632 Phase Uncertainty (Typical)



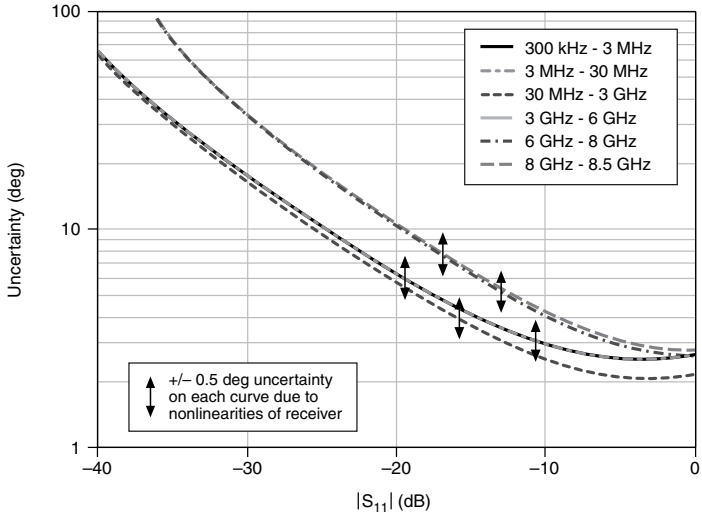
Reflection Uncertainty[16]

Figure 5. NI 5632 Magnitude Uncertainty (Typical)



[16] Assumes $S_{21} = S_{12} = 0$; 10 Hz IF bandwidth; 0 dBm power; cable flex and drift not included.

Figure 6. NI 5632 Phase Uncertainty (Typical)



N-Type Connectors with NI Manual Calibration Kit and Precision Cables

Table 7. NI 5632 Corrected System Performance

Specification	Frequency	
	300 kHz to <5 GHz	5 GHz to 8.5 GHz
Directivity	>42 dB	>36 dB
Source match	>35 dB	>35 dB
Load match	>42 dB	>36 dB

Transmission Uncertainty[17]

Figure 7. NI 5632 Magnitude Uncertainty (Typical)

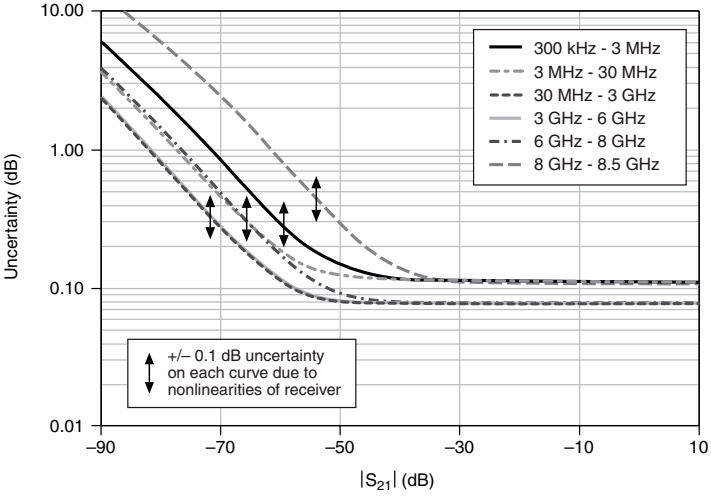
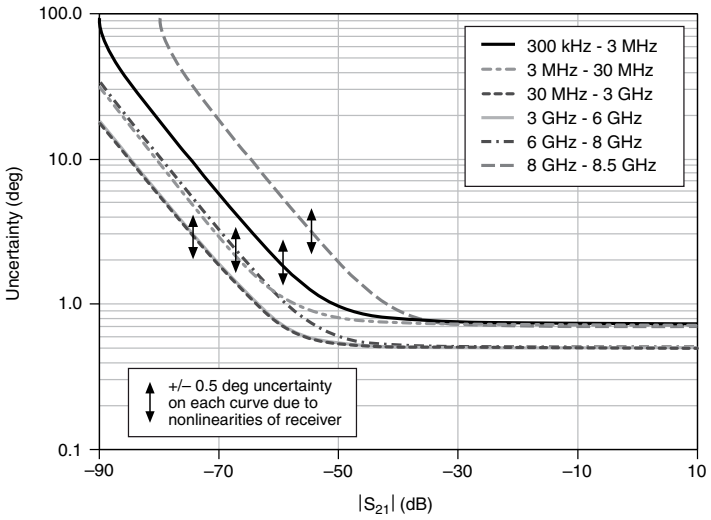


Figure 8. NI 5632 Phase Uncertainty (Typical)



[17] Assumes $S_{11} = S_{22} = 0$; 10 Hz IF bandwidth; 0 dBm power; cable flex and drift not included.

Reflection Uncertainty[18]

Figure 9. NI 5632 Magnitude Uncertainty (Typical)

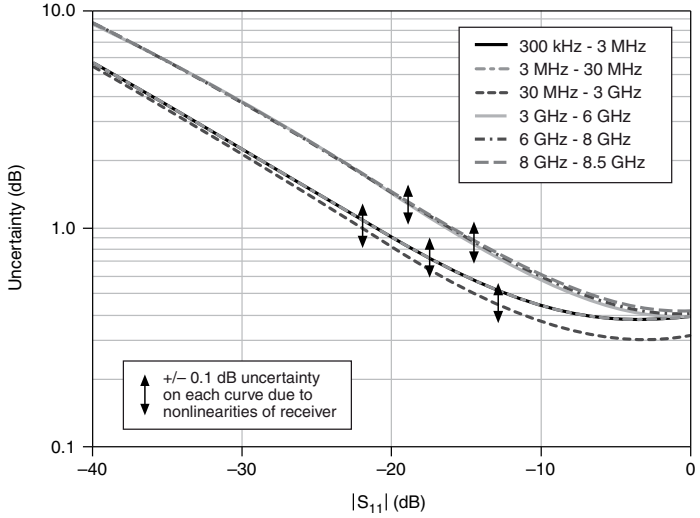
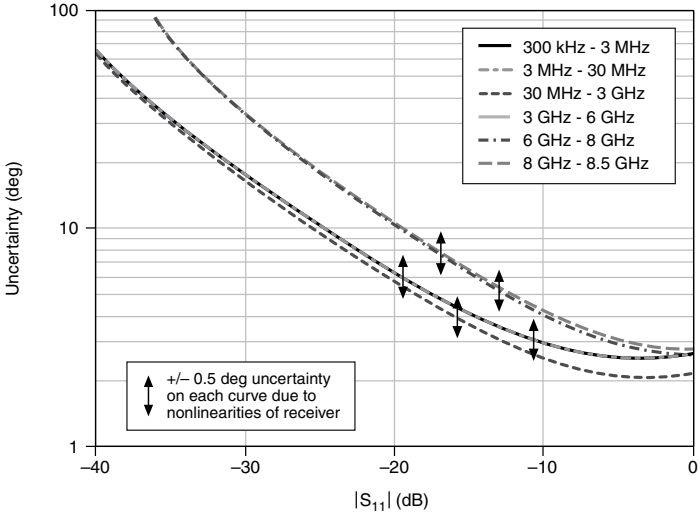


Figure 10. NI 5632 Phase Uncertainty (Typical)



[18] Assumes $S_{21} = S_{12} = 0$; 10 Hz IF bandwidth; 0 dBm power; cable flex and drift not included.

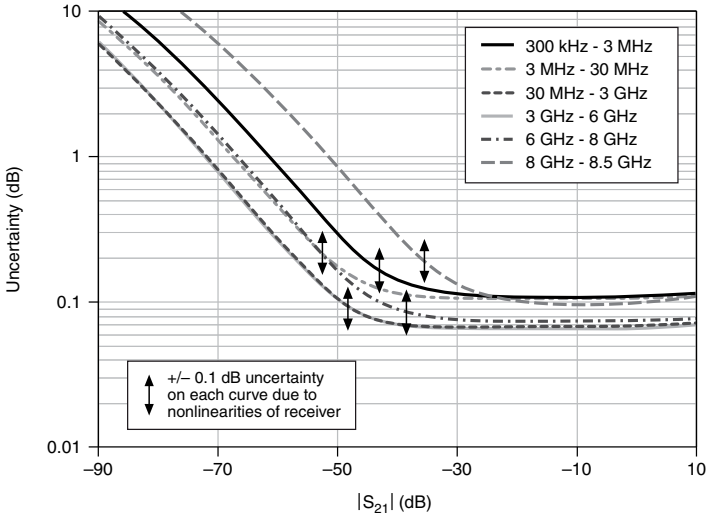
K-Type Connectors with NI Automatic Calibration Kit and Precision Cables

Table 8. NI 5632 Corrected System Performance

Specification	Frequency	
	300 kHz to <5 GHz	5 GHz to 8.5 GHz
Directivity	>42 dB	>36 dB
Source match	>35 dB	>35 dB
Load match	>42 dB	>36 dB

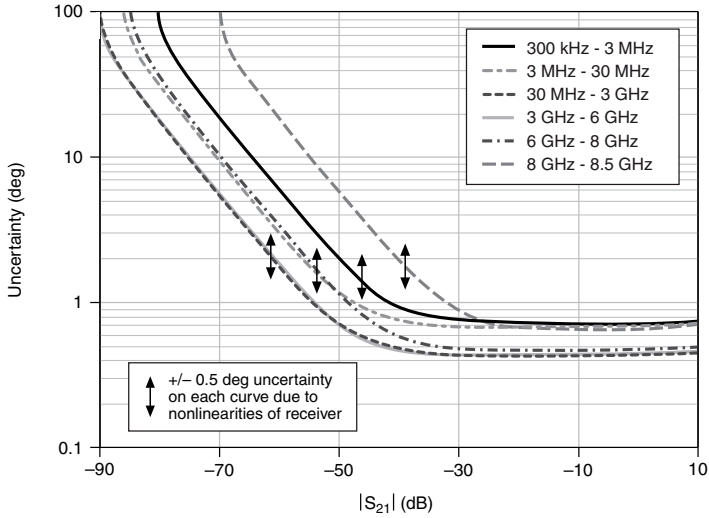
Transmission Uncertainty[19]

Figure 11. NI 5632 Magnitude Uncertainty (Typical)



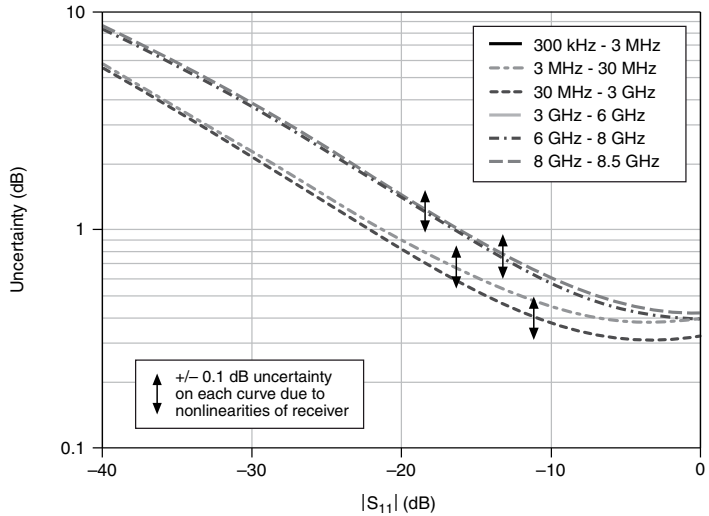
[19] Assumes $S_{11} = S_{22} = 0$; 10 Hz IF bandwidth; -10 dBm power; cable flex and drift not included.

Figure 12. NI 5632 Phase Uncertainty (Typical)



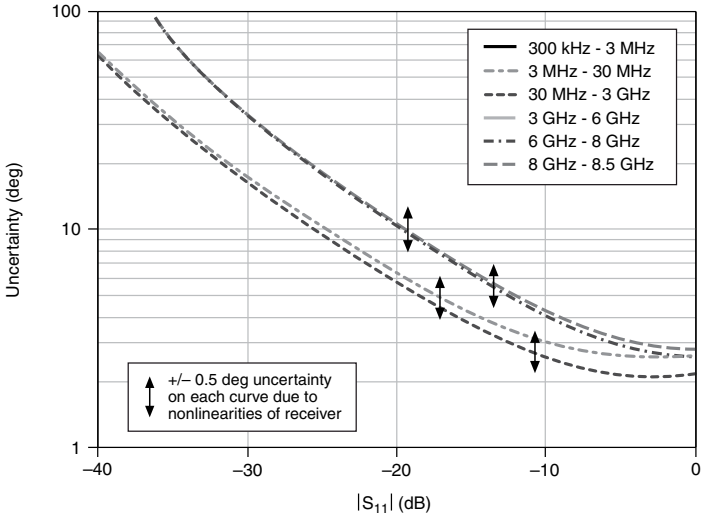
Reflection Uncertainty[20]

Figure 13. NI 5632 Magnitude Uncertainty (Typical)



[20] Assumes $S_{21} = S_{12} = 0$; 10 Hz IF bandwidth; -10 dBm power; cable flex and drift not included.

Figure 14. NI 5632 Phase Uncertainty (Typical)



Trigger

Start Trigger

Types.....Immediate, software, digital edge

Digital edge sources.....PFI 0, PXI_TRIG<0..7>

Step Trigger

Types.....Immediate, digital edge

Digital edge sources.....PFI 0, PXI_TRIG<0..7>

Input range.....+3.3 V logic (+5 V tolerant)

Minimum trigger width (typical)

PFI 0.....50 ns

PXI_TRIG<0..7>.....50 ns

Trigger delay.....6 µs, typical

Trigger jitter, PFI 0.....<3 µs, typical

Reference Frequency

Frequency sources.....REF IN, backplane (PXIe_CLK100), and internal

REF IN

- Frequency range.....10 MHz ± 5 ppm
- Input impedance.....50 Ω, nominal
- Input range.....+3 dBm to -10 dBm, typical, sine wave

Backplane (PXIe_CLK100).....100 MHz ± 25 ppm

Internal timebase

- Initial accuracy.....±2.5 ppm
- Aging.....<3 ppm per year
- Temperature stability.....<10 ppm over full operating temperature range

Calibration

Interval.....1 year (from first device use after external calibration)

Power

3.3 VDC.....6.2 A, typical

12 VDC.....3.3 A, typical

Hardware Front Panel and Connectors

Figure 15. NI 5632 Front Panel

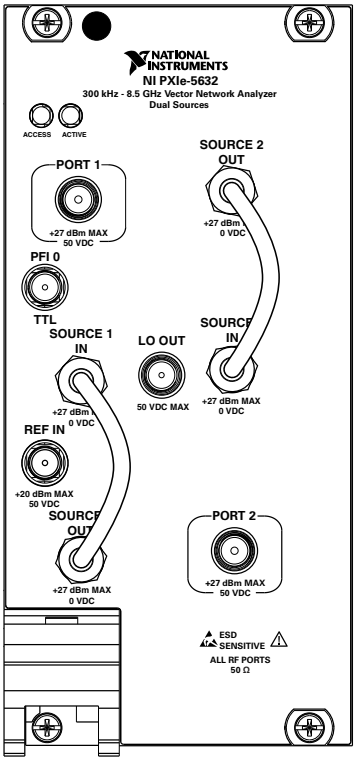


Table 9. NI 5632 Front Panel Connectors

Connector	Type	Function
PORT 1	Type-K	Input/output terminal for NI 5632 measurements. Refer to the *Source Characteristics* and *Receiver Characteristics* sections for more information about this connector.
SOURCE 1 IN	SMA	Input terminal for the source 1 access loop.
SOURCE 2 IN	SMA	Input terminal for the source 2 access loop.
REF IN	SMA	Input terminal for a 10 MHz external reference signal for the NI 5632. Refer to the *Reference Frequency* section for more information about this connector.

Table 9. NI 5632 Front Panel Connectors (Continued)

Connector	Type	Function
PFI 0	SMA	Input terminal for an external trigger signal. This connector is 3.3 V TTL logic (+5 V tolerant). Refer to the *Trigger* section for more information about this connector.
LO OUT	SMA	Output terminal for the NI 5632 local oscillator.
SOURCE 1 OUT	SMA	Output terminal for the source 1 access loop.
SOURCE 2 OUT	SMA	Output terminal for the source 2 access loop.
PORT 2	Type-K	Input/output terminal for NI 5632 measurements. Refer to the *Source Characteristics* and *Receiver Characteristics* sections for more information about this connector.

Table 10. NI 5632 Front Panel LEDs

LED	Indication
ACCESS	Indicates the basic hardware status of the NI 5632 module. OFF—The module is not yet functional. AMBER—The module is being accessed. Accessed means that the device is being communicated with over the PXI Express bus. GREEN—The module is ready to be programmed by NI-VNA. RED—The module has detected a hardware error, such as a hardware failure. The LED remains red until the error condition is removed.
ACTIVE	Indicates the state of the NI 5632 module. OFF—The module is not yet functional. AMBER—The module is armed and waiting for a trigger. GREEN—The module has received a Start trigger. This state also indicates that the module is making a measurement. RED—The module has detected a spurious error, such as when the PLL becomes unlocked. The LED remains red until the error condition is removed.

Physical Characteristics

Dimensions.....3U, three slot, PXI Express module, 21.6 cm × 6.0 cm × 13.0 cm (8.5 in. × 2.4 in. × 5.1 in.), nominal

Weight.....1,290 g (45.0 oz), nominal

Environment

Maximum altitude.....2,000 m (800 mbar) (at 25 °C ambient temperature)

Pollution Degree.....2

Indoor use only.

Operating Environment

Ambient temperature range.....0 °C to 55 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)

Relative humidity range.....10% to 90%, noncondensing (Tested in accordance with IEC 60068-2-56.)

Storage Environment

Ambient temperature range.....-40 °C to 71 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL-PRF-28800F Class 3 limits.)

Relative humidity range.....5% to 95%, noncondensing (Tested in accordance with IEC 60068-2-56.)

Shock and Vibration

Operating shock.....30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC 60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)

Random vibration

Operating.....5 Hz to 500 Hz, 0.3 g_{rms}

Nonoperating.....5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC 60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Compliance and Certifications

Safety

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia, and New Zealand (per CISPR 11), Class A equipment is intended for use only in heavy-industrial locations.

Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

Note For EMC declarations, certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit *ni.com/certification*, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* web page at *ni.com/environment*. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit *ni.com/environment/weee*.

电子信息产品污染控制管理办法（中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令(RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 `ni.com/environment/rohs_china`。(For information about China RoHS compliance, go to `ni.com/environment/rohs_china`.)

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