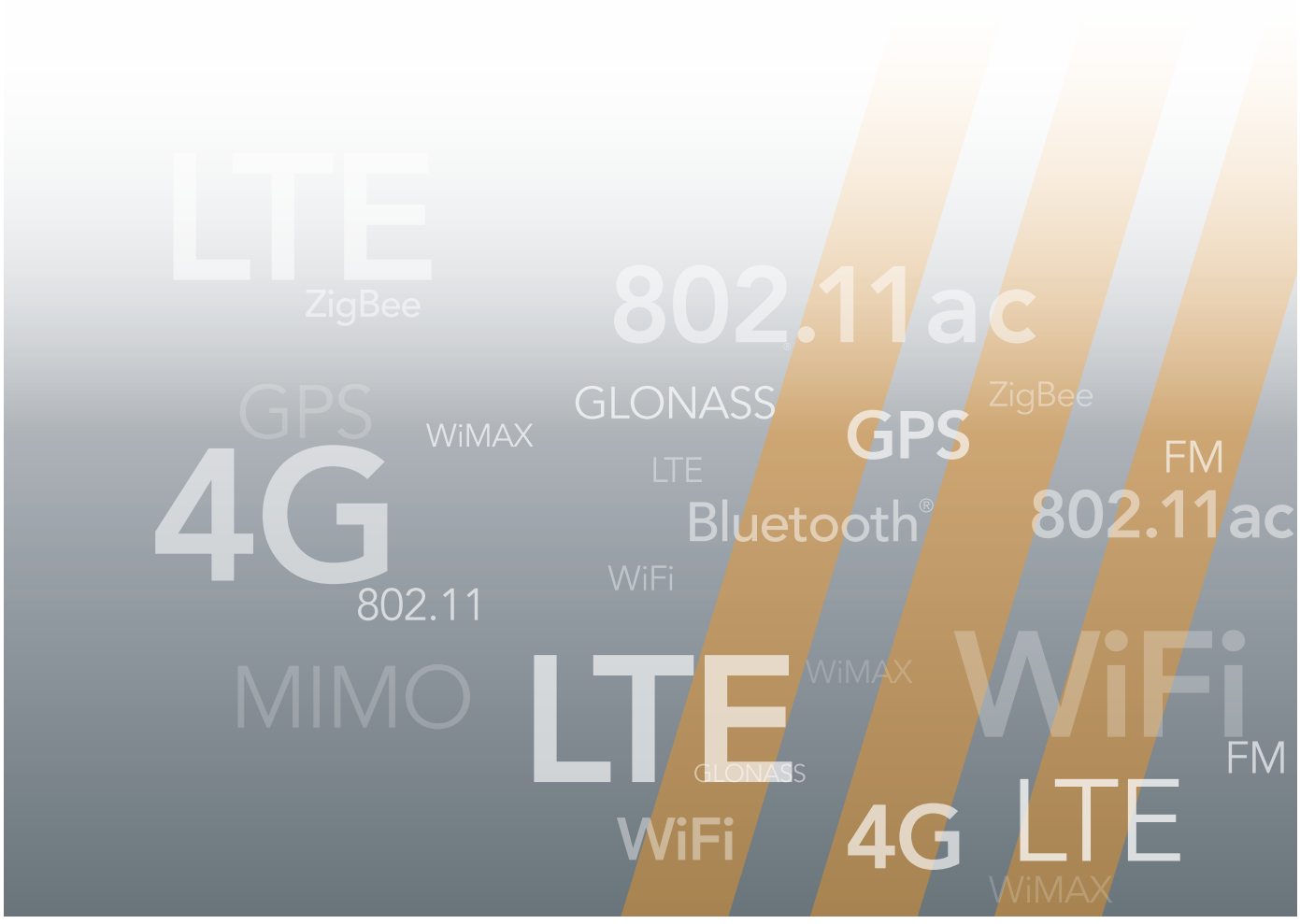
8651 VSA

TECHNICAL SPECIFICATIONS

z8651
Vector Signal Analyzer
PXI, PXIe



LITEPOINT

Port Descriptions

Front Panel

Label	Type	Description
I +,-	SMA	Differential baseband I input
Q +,-	SMA	Differential baseband Q input
RF IN	SMA	RF input signal
LO IN	SMA	Local Oscillator input
EXT IN	SMB	External input for trigger or reference
EXT OUT	SMB	External output for trigger, reference or event

RF Input

RF Input Channel

Specification	Value
Channel	Quantity 1
Input Impedance	50 Ω ≤ ±1% accuracy
Input VSWR (Attenuator #1 On)[1]** 500 MHz to 4 GHz 4 GHz to 5.4 GHz 5.4 GHz to 6 GHz Input VSWR (Attenuator #1 Off)** 500 MHz to 4 GHz 4 GHz to 5.4 GHz 5.4 GHz to 6 GHz	 ≤ 1.2:1 (-20.8 dB RL) ≤ 1.4:1 (-15.5 dB RL) ≤ 2.0:1 (-9.5 dB RL) ≤ 1.4:1 (-15.5 dB RL) ≤ 1.6:1 (-12.7 dB RL) ≤ 2.2:1 (-8.5 dB RL)
Attenuator & Preamplifier Stages[2] RF Attenuator #1 (electronic) RF Preamplifier (electronic) RF Attenuator #2 (electronic) IF Attenuator #3 (electronic) IF Amplifier (mechanical)	 0 – 31.5 dB attenuation, 0.5 dB steps 0 or 20 dB gain 0 – 31.5 dB attenuation, 0.5 dB steps 0 – 31.5 dB attenuation, 0.5 dB steps 0 – 30 dB gain, 10 dB steps
Typical Attenuator #1 & Preamp Configuration[3] Attenuator #1 On, Preamp Bypassed Attenuator #1 On, Preamp Enabled Attenuator #1 Off, Preamp Enabled	 Reference Level: ≥ 0 dBm -20 dBm to -0.5 dBm -50 dBm to -20.5 dBm
Connectors	SMA

[1] See Figure 1 for a plot of RF input return loss with Attenuator #1 On (data for ten instruments).

[2] See Figure 2 for a simplified block diagram of RF path showing programmable attenuator and preamplifier stages.

[3] The automatic attenuation mode will optimize the programmable amplifier and attenuator settings for balanced noise and distortion performance using the frequency-dependent level calibration data.

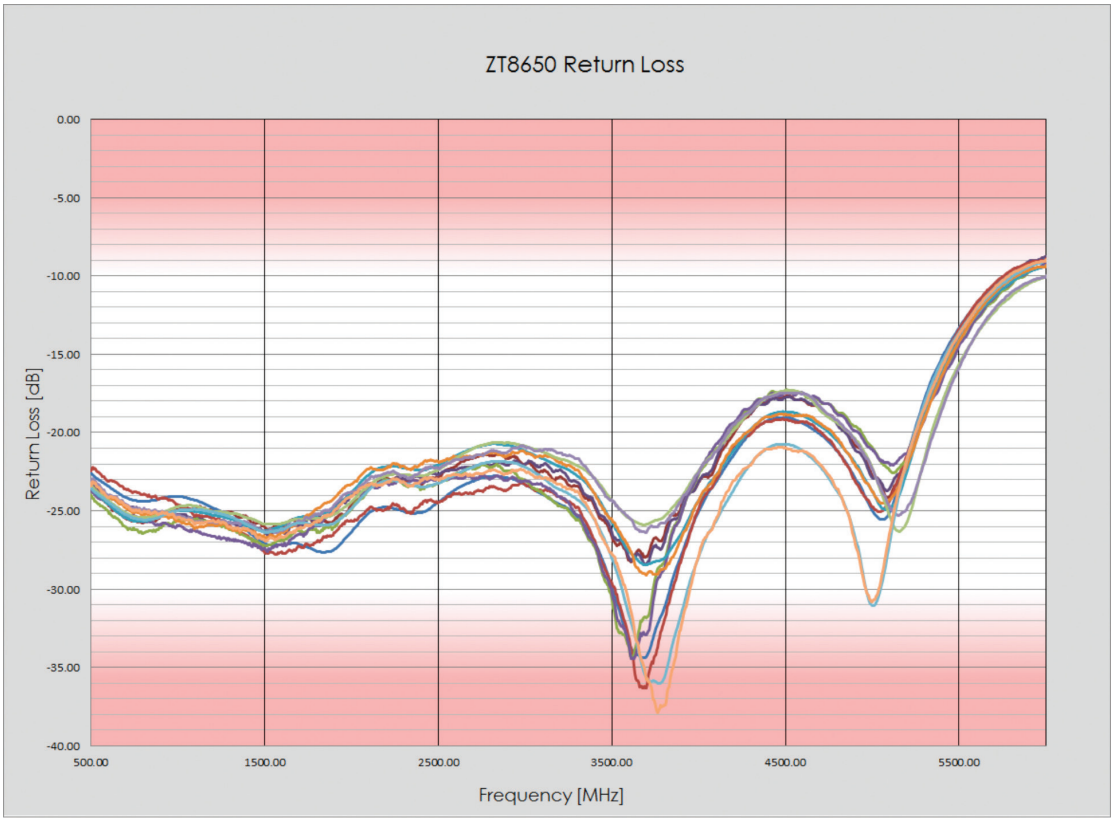


Figure 1: Typical RF Input Return Loss (RL) with Attenuator #1 On

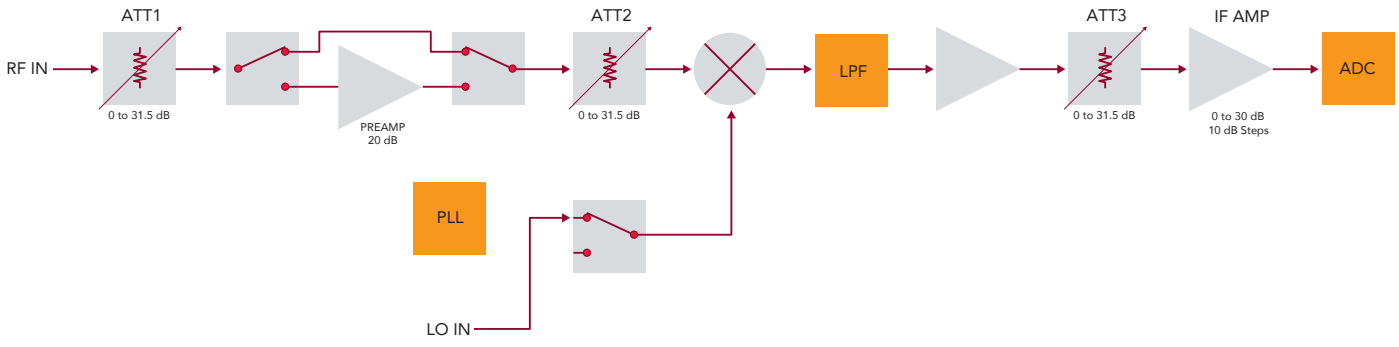


Figure 2: Simplified Block Diagram Showing Attenuator and Preamplifier Stages

RF Input Reference Level

Specification	Value
Absolute Maximum Input (no damage) Preamplifier Bypassed Preamplifier Enabled	 +30 dBm +10 dBm
Reference Level Range (set for average power)[4]	-50 dBm to +20 dBm 0.5 dB steps
Reference Level Accuracy (at 25 °C ambient)	≤ ±0.5 dB ≤ ±0.1 dB typical
Reference Level Temperature Drift**	-0.03 dB/°C
Reference Level Switching Speed	≤ 1 ms, any level change

RF Input Frequency

Specification	Value
Input Frequency Range	250 MHz to 6 GHz
Input Frequency Resolution	1 Hz
Input Frequency Switching Speed	≤ 1 ms, any frequency change

RF Input Instantaneous IF Bandwidth

Specification	Value
IF Bandwidth (IFBW)	162.5 MHz 81.25 MHz to 100 Hz 1 Hz resolution
Resolution Bandwidth	1 Hz to 3 MHz 0.1 Hz resolution 0.2
IFBW Flatness	≤ ±1 dB
IFBW Phase Linearity	≤ ±2°

RF Input Dynamic Performance

Specification	Value
Spurious-Free Dynamic Range (excluding harmonics)	≥ 75 dBc 0 dBm Reference Level
Third-Order Intermodulation Distortion (IMD3)[5]	≥ 80 dBc
RF Input Harmonics	≤ -40 dBc

[4] Assumes crest factor of +10 dB. Peak Envelope Power (PEP) is 10 dB higher than average power, and the ADC full-scale range provides 10 dB of headroom above the selected Reference Level.

[5] See Figures 3 and 4 for plots of the noise and distortion tradeoff versus input power for a fixed Reference Level setting (with preamplifier bypassed and enabled).

Displayed Average Noise Level (DANL)

Reference Level	Value
0 dBm	-145 dBm/Hz
-10 dBm	-155 dBm/Hz
-20 dBm	-162 dBm/Hz
-30 dBm	-165 dBm/Hz
-40 dBm	-165 dBm/Hz
-50 dBm	-165 dBm/Hz

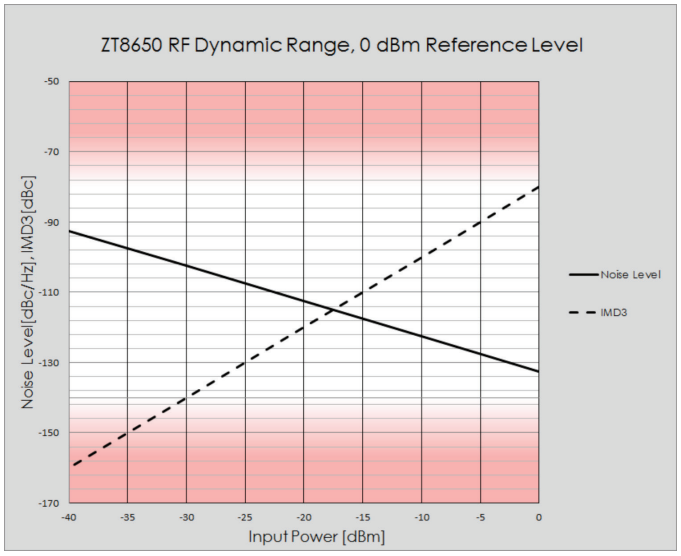


Figure 3: Noise and distortion for 0 dBm Reference Level (preamplifier bypassed)

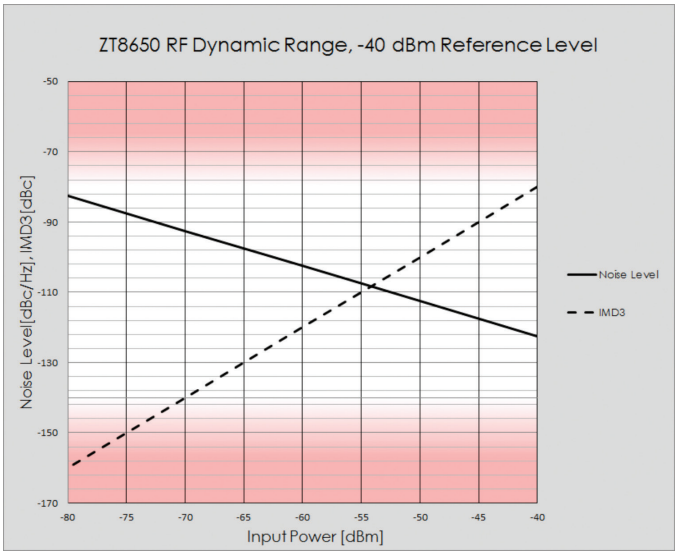


Figure 4: Noise and distortion for -40 dBm Reference Level (preamplifier enabled)

Phase Noise, Single Sideband, PXIe (Typical)

Offset	1.0 GHz	2.4 GHz	5.8 GHz
1 kHz	-99 dBc/Hz	-93 dBc/Hz	-85 dBc/Hz
10 kHz	-122 dBc/Hz	-115 dBc/Hz	-107 dBc/Hz
100 kHz	-125 dBc/Hz	-118 dBc/Hz	-109 dBc/Hz
1 MHz	-136 dBc/Hz	-133 dBc/Hz	-129 dBc/Hz

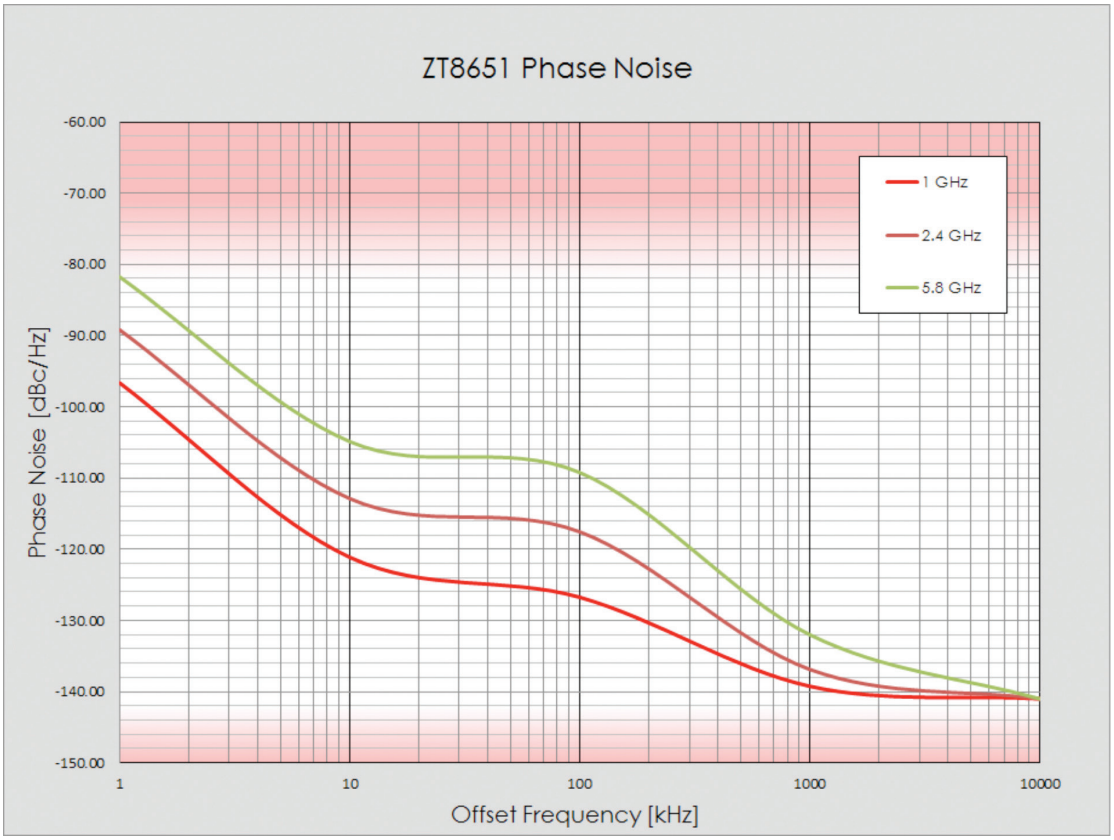


Figure 5: Typical Phase Noise (PXIe)

Local Oscillator Input

Local Oscillator (LO) Input Channel

Specification	Value
LO Input Channel	Quantity 1
Input Impedance	50 Ω
Connector	SMA
Input Level	0 dBm nominal, ±2 dB
Absolute Maximum Input	+10 dBm
Frequency Range	250 MHz to 6 GHz

Timebase Reference

Specification	Value
Timebase Reference	10 MHz or 100 MHz
Timebase Reference Source	Internal TCXO, External Input, Backplane CLK10 or CLK100 (PXIe)
Internal TCXO Timebase	±2.5 ppm accuracy
Timebase Output	External Output

Baseband Inputs

I/Q Input Channels

Specification	Value
Channels	Two Differential Input Channels I+/- and Q+/- (One I/Q)
Input Impedance Single-ended Differential	 50 Ω 100 Ω ≤ ±1% accuracy
Input VSWR** DC to 250 MHz	 ≤ 1.3:1
Input Bias Current**	≤ ±10 µA
Connectors	SMA

I/Q Input Voltage

Specification	Value
Absolute Maximum Input (no damage) Single-ended	-2 V to +5 V (DC + peak AC), CAT I
Input Voltage Ranges	+10 dBm (2 Vppd) 0 dBm (0.63 Vppd) -10 dBm (0.2 Vppd) -20 dBm (0.063 Vppd)
Input Voltage Range Accuracy (1 MHz)	≤ ±0.05 dB at 25°C ambient ≤ ±0.01 dB drift per °C
Input Offset Adjustment	±1 V 4 µV resolution
Input Offset Accuracy	< ±(2 mV + 0.5% offset) at 25°C ≤ ±200 µV drift per °C

I/Q Input Dynamic Performance

Specification	Value
Analog Bandwidth -3 dB Bandwidth Stopband Rejection	 DC to 300 MHz ≥80 dB at 800 MHz
Spurious-Free Dynamic Range (excluding harmonics)	≥ 80 dBc at 10 MHz
Harmonic Distortion	≥ 75 dBc at 10 MHz
Intermodulation Distortion (2 tone, 10.6 MHz & 10.8 MHz)	≥ 80 dBc
Average Noise Density +10 dBm Range 0 dBm Range -10 dBm Range -20 dBm Range	 ≤ -145 dBm/Hz (-155 dBFS/Hz) ≤ -150 dBm/Hz (-150 dBFS/Hz) ≤ -153 dBm/Hz (-143 dBFS/Hz) ≤ -154 dBm/Hz (-134 dBFS/Hz)
Phase Noise (187.5 MHz, typical) 1 kHz offset frequency 10 kHz offset frequency 100 kHz offset frequency 1 MHz offset frequency 10 MHz offset frequency	 -110 dBc/Hz -130 dBc/Hz -132 dBc/Hz -138 dBc/Hz -140 dBc/Hz
I/Q Channel-to-Channel Match (DC to 50 MHz, same range settings)	≤ 0.2 dB magnitude ≤ 0.5° phase
I/Q Channel-to-Channel Isolation DC to 100 MHz 100 MHz to 250 MHz	 ≥ 90 dB ≥ 80 dB

Analog-to-Digital Converter (ADC) & Digital Downconverter (DDC)

Specification	Value
ADC Configuration	Simultaneous Sampling Dual ADC
ADC Vertical Resolution	14 Bits 0.0061% of full-scale range
ADC Clock Frequency	400 MS/s simultaneous sampling
ADC Clock Jitter**	≤ 300 fs RMS
I/Q Data Vertical Resolution[6]	up to 32 bits 16-bit and 32-bit data formats
I/Q Data Rate (flexible data rate with fractional resampling)	123 S/s to 100 MS/s, 200 MS/s 400 MS/s (DDC Bypass) 1 Hz resolution 2
I/Q Data Memory	512 MiByte total
I/Q Waveform Size (matched I/Q sizes)	up to 128 MiSamples (16-bit data) up to 64 MiSamples (32-bit data)
I/Q Channel Mode (DDC input feed)	I/Q quadrature input pair I input only Q input only Independent I and Q (real mixing)
I/Q Instantaneous Bandwidth (alias-free)	162.5 MHz 81.25 MHz to 100 Hz 1 Hz resolution
I/Q Resolution Bandwidth (RBW)	1 Hz to 3 MHz 0.1 Hz resolution
I/Q Center Frequency	0 Hz to 1 GHz 1 Hz resolution

[6] DDC filtering of quantization noise adds to vertical resolution by 10*log10(OSR), where OSR is the oversampling ratio. For example, DDC filtering from 400 MS/s to 100 MS/s provides 10*log10(400/100)=6 dB, or 1 bit additional resolution.

WLAN Modulation Analysis

IEEE 802.11a/g/n/ac OFDM

Residual EVM, Internal LO (Typical)

Modulation Bandwidth	RF Input Frequency: 2.4 GHz to 2.5 GHz[7] RF Input Reference Level: -30 dBm to +5 dBm	
	preamble only	preamble, pilot & data
20 MHz	-50 dB (0.32%)	-52 dB (0.25%)
40 MHz	-47 dB (0.45%)	-49 dB (0.35%)

Modulation Bandwidth	RF Input Frequency: 5 GHz to 6 GHz[8] RF Input Reference Level: -30 dBm to +5 dBm	
	preamble only	preamble, pilot & data
20 MHz	-45 dB (0.56%)	-47 dB (0.45%)
40 MHz	-44 dB (0.63%)	-46 dB (0.50%)
80 MHz	-43 dB (0.71%)	-45 dB (0.56%)
160 MHz	-40 dB (1.00%)	-42 dB (0.79%)

Residual EVM, External LO using z8801 (Typical)

Modulation Bandwidth	RF Input Frequency: 2.4 GHz to 2.5 GHz[7] RF Input Reference Level: -30 dBm to +5 dBm	
	preamble only	preamble, pilot & data
20 MHz	-53 dB (0.22%)	-54 dB (0.20%)
40 MHz	-50 dB (0.32%)	-52 dB (0.25%)

Modulation Bandwidth	RF Input Frequency: 5 GHz to 6 GHz[8] RF Input Reference Level: -30 dBm to +5 dBm	
	preamble only	preamble, pilot & data
20 MHz	-53 dB (0.22%)	-54 dB (0.20%)
40 MHz	-50 dB (0.32%)	-52 dB (0.25%)
80 MHz	-47 dB (0.45%)	-49 dB (0.35%)
160 MHz	-42 dB (0.79%)	-44 dB (0.63%)

[7] Excluding channel center frequency of 2.467 GHz

[8] Excluding channel center frequencies of 4.99 GHz, 5.25 GHz, 5.69 GHz

Center Frequency Tracking

Specification	Value
Frequency Range	± 625 kHz
Frequency Error	± 10 Hz + (reference accuracy X center frequency)

Trigger

Specification	Value
Trigger Source	I1-2, Q1-2, I/Q1-2 Envelope, External Input, Pattern, Software, Immediate (no trigger), TTL Trigger 0-7, Star Trigger
Trigger Slope/Polarity	Positive or Negative
Trigger Position	Pre-Trigger & Post-Trigger
Trigger Jitter	≤ 2.5 ns peak-to-peak

External Input (front panel)

Specification	Value
Functionality	Trigger Input Timebase Reference Input
Absolute Maximum Input (no damage)	≤ ± 5 V (DC + peak AC), CAT I
Input Trigger Level Adjustment	-2 V to +2 V 0.5 mV resolution ≤ 20 mV accuracy 20 mV overdrive (input hysteresis)
Input Bandwidth (-3 dB)	≥ 250 MHz
Input Impedance	1 MΩ ‖ 30 pF or 50 Ω ≤ ±2% accuracy
Connector	SMB

External Output (front panel)

Specification	Value
Functionality	Trigger Output, Timebase Reference Output, Event Output, Programmable Clock Output, Programmable Pulse Output, Constant Level
Output Event Source	Trigger Event, Capture Complete Event, Operation Complete Event, Master Summary Status Event
Polarity	High or Low Truth
Programmable Event Pulse Width	50 ns to 163 ms
Programmable Clock	Period: 26.667 ns to 100 seconds 13.333 ns resolution 50% Duty Cycle
Programmable Pulse Pulse Repetition Interval Pulse Width	 26.667 ns to 100 seconds, 13.333 ns resolution 26.667 ns
Probe Compensation	10 kHz Clock which can be used to compensate probes
Limit Test Successful	Event pulse after each capture upon limit or mask test success
Output Level	TTL Compatible into ≥ 200 Ω ≥ ±24 mA Output Drive
Output Enable	Tri-State Output Capability
Connector	SMB

Backplane Triggers

Specification	Value
Functionality	Multi-Instrument Synchronization Trigger, Event Output Signals
Triggers	TTL Trigger 0-7
Direction	Input or Output
Source	Trigger Event, Capture Complete Event, Operation Complete Event, Master Summary Status Event, Constant Level
Polarity	High or Low Truth
Programmable Event Pulse Width	50 ns to 163 ms

Traces

Specification	Value
Trace Channels	Quantity 8
Trace Size	Up to 512 KiSample 32-bit floating point data
Trace Feed (source)	Input Channels or Reference Channels
Trace Type	Write (Live), Average, Max Hold, Min Hold (Reference Feeds use Write Type only)
Trace Average Count	2 to 65535
Trace Data Format	Linear Magnitude, Logarithmic Magnitude, Phase, Real, Imaginary, 32-bit floating point data

Reference Waveforms

Specification	Value
Reference Channels	Quantity 4
Reference Storage	Non-volatile memory storage
Reference Data	32 KiSample maximum waveform size 32-bit floating point data
Reference Data Format	Linear Magnitude, Logarithmic Magnitude, Phase, Real, Imaginary, 32-bit floating point data

Markers

Specification	Value
Marker Channels	Quantity 2
Marker Functionality	Waveform Trace Magnitude and Frequency Markers
Marker Source	Trace 1-8
Marker Peak Search Search Methods Selectable Search Options	 Maximum, Next Maximum by Amplitude, Next Maximum Left, Next Maximum Right Absolute Threshold, Relative Excursion

Data Processing & Download

Specification	Value
Self-Calibration	Automatic internal calibration: Input DC Offset Zero, Input DC Offset Adjust
Waveform Data Formats	16-bit or 32-bit signed integer (I/Q time-domain data) 32-bit floating point (Trace or Reference data) Intel or Motorola Byte Order

Instrument Stored States

Specification	Value
Functionality	Non-volatile storage of instrument setup configuration
Stored States	30 State 0 is Reset State Power-On State programmable

LED Indicators

Specification	Value
RDY (Ready)	OFF: Hardware Failure ON: Unit has passed power-up self-diagnostics TOGGLE: Unit has an error pending in error queue
TRG (Trigger)	OFF: Trigger event not detected ON/PULSE: Trigger complete event detected TOGGLE: Device identify enabled

PXI Interface

Specification	Value
PXI Slot Compatibility	PXI Standard Slot and PXIe Hybrid Slot Compatible
PXI Timing & Triggering Signals (XJ4 Connector)	PXI_TRIG[0:7] input/output PXI_STAR input PXI_CLK10 input

PXIe Interface

Specification	Value
PXIe Slot Compatibility	PXI Standard Slot and PXIe Hybrid Slot Compatible
PXI Timing & Triggering Signals (XJ4 Connector)	PXI_TRIG[0:7] input/output PXI_STAR input PXI_CLK10 input
PXIe Timing & Triggering Signals (XJ3 Connector)	PXI_DSTARA input (unused) PXI_STAR input PXI_CLK10 input

Status Reporting

Specification	Value
IEEE-488.2 Device Status	Reporting Structure including Status Byte, Standard Event Registers, Questionable Registers, Operation Registers and Self-Test Status Registers

Power & Cooling

Power Supplies

Platform	Voltage	Typical Current	Maximum Current
PXI	+3.3 VDC +5 VDC +12 VDC -12 VDC	5.13 A 2.11 A 0.14 A 0.00 A	6.28 A 2.28 A 0.16 A 0.00 A
PXIe	+3.3 VDC +12 VDC	1.75 A 1.80 A	1.80 A 2.50 A

Total Cooling & Power Consumption

Platform	Typical Cooling & Power	Maximum Cooling & Power
PXI	29.2 W	34.0 W
PXIe	34.5 W	36.0 W

Physical & Environmental

Size & Weight

Specification	Value
Physical Size	Double-Wide 3U PXI/PXIe Instrument 8.25" x 1.59" x 5.25" (L x W x H) 20.96 cm x 4.03 cm x 13.34 cm (L x W x H)
Weight	21.3 oz or 604 g

Temperature Range

Specification	Value
Operating	0°C to +50°C ambient (MIL-PRF28800F Class 3)
Storage	-40°C to +75°C (MIL-PRF28800F Class 3)
Over-Temperature	Automatic shutdown if internal temperature exceeds +65°C
Calibration Range	+20°C to +30°C ambient, after a 20 minute warm-up period, to meet all calibration specification accuracies

Relative Humidity

Specification	Value
Operating or Storage Up to +30 °C +30 °C to +40 °C above +40 °C	 5 to 95% ± 5% non-condensing 5 to 75% ± 5% non-condensing 5 to 45% ± 5% non-condensing

Altitude

Specification	Value
Operating	Up to 5 km
Storage	Up to 15 km

Terminology

Numeric Prefixes

When referring to numeric values, this document will use SI (International System of Units) and IEC (International Electrotechnical Commission) standard prefixes. Prefix definitions are in the following table.

Prefix	Multiplier
n (nano)	1/(1000x1000x1000)
µ (micro)	1/(1000x1000)
m (milli)	1/1000
k/K (kilo)	1000
M (Mega)	1000x1000
G (Giga)	1000x1000x1000
Ki (Kibi)	1024
Mi (Mebi)	1024x1024
Gi (Gibi)	1024x1024x1024

Differential Outputs

Single-Ended is used to refer to the output on either the + or – output pin

Differential is used to refer to the output between the + and- output pins

Vd indicates Volts differential

Vppd indicates Volts peak-to-peak differential

Safety

This product is designed to meet the requirements of the following standard of safety for electrical equipment for measurement, control and laboratory use: EN 61010-1

Electromagnetic Compatibility

CE Marking EN 61326-1:1997 with A1:1998 and A2:2001 Compliant

FCC Part 15 (Class A) Compliant

Emissions

EN 55011	Radiated Emissions, ISM Group 1, Class A, distance 10 m, emissions < 1 GHz
EN 55011	Conducted Emissions, Class A, emissions < 30 MHz Immunity
EN 61000-4-2	Electrostatic Discharge (ESD), 4 kV by Contact, 8 kV by Air
EN 61000-4-3	RF Radiated Susceptibility, 10 V/m
EN 61000-4-4	Electrical Fast Transient Burst (EFTB), 2 kV AC Power Lines
EN 61000-4-5	Surge
EN 61000-4-6	Conducted Immunity
EN 61000-4-8	Power Frequency Magnetic Field, 30 A/m
EN 61000-4-11	Voltage Dips and Interrupts

CE Compliance

This product meets the necessary requirements of applicable European Directives for CE Marking as follows:

73/23/EEC Low Voltage Directive (Safety)
89/336/EEC Electromagnetic Compatibility Directive (EMC)

See Declaration of Conformity for this product for additional regulatory compliance information.

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