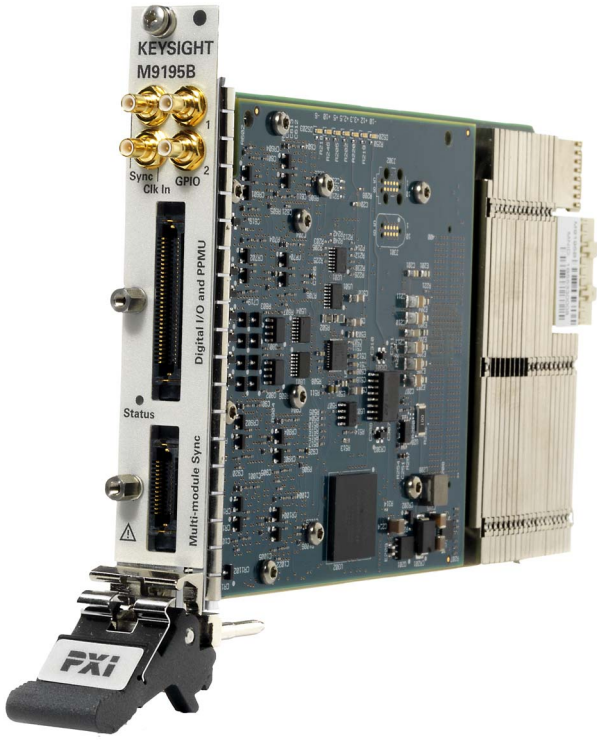


Specification Guide

For the User Guide, software and other important documentation, see the Software and Product Information CD.

Keysight M9195A/B PXIe Digital Stimulus/Response with PPMU: 250 MHz, 16 channel



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Keysight Technologies does not warrant third-party system-level (combination of chassis, controllers, modules, etc.) performance, safety, or regulatory compliance unless specifically stated.

Safety Information

CAUTION

A CAUTION denotes a hazard. It calls attention to an operating procedure or practice 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 denotes a hazard. It calls attention to an operating procedure or practice, 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.

Safety Information

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings or operating instructions in the product manuals violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

General

Do not use this product in any manner not specified by the manufacturer. The protective features of this product must not be impaired if it is used in a manner specified in the operation instructions.

Before Applying Power

Verify that all safety precautions are taken. Make all connections to the unit before applying power. Note the external markings described under "Safety Symbols".

Ground the Instrument

Keysight chassis are provided with a grounding-type power plug. The instrument chassis and cover must be connected to an electrical ground to minimize shock hazard. The ground pin must be firmly connected to an electrical ground (safety ground) terminal at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Do Not Operate in an Explosive Atmosphere

Do not operate the module/chassis in the presence of flammable gases or fumes.

Do Not Operate Near Flammable Liquids

Do not operate the module/chassis in the presence of flammable liquids or near containers of such liquids.

Cleaning

Clean the outside of the Keysight module/chassis with a soft, lint-free, slightly dampened cloth. Do not use detergent or chemical solvents.

Do Not Remove Instrument Cover

Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.

Keep away from live circuits

Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers and shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.

Do Not Operate Damaged Equipment

Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to an Keysight Technologies Sales and Service Office for service and repair to ensure the safety features are maintained.

Do Not Block The Primary Disconnect

The primary disconnect device is the appliance connector/power cord when a chassis used by itself, but when installed into a rack or system the disconnect may be impaired and must be considered part of the installation.

Do Not Modify the Instrument

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Keysight Sales and Service Office to ensure that safety features are maintained.

In Case of Damage

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel

CAUTION

Do NOT block vents and fan exhaust: To ensure adequate cooling and ventilation, leave a gap of at least 50mm (2") around vent holes on both sides of the chassis.

Do NOT operate with empty slots: To ensure proper cooling and avoid damaging equipment, fill each empty slot with an AXle filler panel module.

Do NOT stack free-standing chassis: Stacked chassis should be rack-mounted.








All modules are grounded through the chassis: During installation, tighten each module's retaining screws to secure the module to the chassis and to make the ground connection.

WARNING

Operator is responsible to maintain safe operating conditions. To ensure safe operating conditions, modules should not be operated beyond the full temperature range specified in the Environmental and physical specification. Exceeding safe operating conditions can result in shorter lifespan, improper module performance and user safety issues. When the modules are in use and operation within the specified full temperature range is not maintained, module surface temperatures may exceed safe handling conditions which can cause discomfort or burns if touched. In the event of a module exceeding the full temperature range, always allow the module to cool before touching or removing modules from the chassis.

Safety Symbols

Products display the following symbols:

-  Warning, risk of electric shock
-  Refer to manual for additional safety information.
-  Earth Ground.
-  Chassis Ground.
-  Alternating Current (AC).
-  Standby Power. Unit is not completely disconnected from AC mains when switch is in standby.
-  Antistatic precautions should be taken.

For localized Safety Warnings, Refer to Keysight Safety document (p/n 9320-6792).

CE ICES/NMB-001
ISM GRP 1-A

Notice for European Community: This product complies with the relevant European legal Directives: EMC Directive (2004/108/EC) and Low Voltage Directive (2006/95/EC).



The Regulatory Compliance Mark (RCM) mark is a registered trademark. This signifies compliance with the Australia EMC Framework regulations under the terms of the Radio Communication Act of 1992.

ICES/NMB-001

ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001.



This symbol represents 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 this product.



MSIP-REM-Kst
-BLM9195A

South Korean Class A EMC Declaration. This equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.

A 급 기기 (업무용 방송통신기자재)
이 기기는 업무용 (A 급) 전자파적합기
기로서 판 매자 또는 사용자는 이 점을 주
의하시기 바라 며 , 가정외의 지역에서
사용하는 것을 목적으 로 합니다.



Waste Electrical and
Electronic
Equipment (WEEE)
Directive
2002/96/EC

This product complies with the WEEE Directive (2002/96/EC) marking requirement. The affixed product label (see below) indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a "Monitoring and Control Instrumentation" product.

Do not dispose in domestic household waste.

To return unwanted products, contact your local Keysight office for more information.



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M9195A/B Digital Stimulus/Response Module Specification Guide

How to use this document

This document contains technical specifications for all versions, to date, of the M9195A/B PXIe Digital Stimulus/Response Module.

NOTE

Unless specifically noted, all specifications in this guide pertain to both the M9195A and the M9195B.

NOTE

The specification, characteristics, and typical data in this version of the M9195A/B Specification Guide supersedes the information in all previous versions.

Some specifications in this document may apply only to a specific manufacturing version of the M9195A/B. When a specification applies only to a specific version, the version number is listed next to that specification in the table.

Technical Specification and Characteristics

Terminology definitions

Term	Definition
Specification (Spec.)*	<p>Warranted performance. Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions. All specifications and characteristics apply over the operating environment outlined in “Environmental and Regulatory” on page 21. In addition, the following conditions must be met:</p> <ul style="list-style-type: none"> • Instrument has been turned on for 30 minutes with the DSR software running. • Instrument is within its calibration cycle. • Instrument remains at a stable surrounding environment temperature (between 0°C to 45°C) for 1 hour prior to turn-on. <p>Specifications in this document are identified by an asterisk (*).</p>
Characteristic (Char.)	<p>A performance parameter that the product is expected to meet before it leaves the factory, but that is not verified in the field and is not covered by the product warranty. A characteristic includes the same guardbands as a specification.</p>
Typical (typ.)	<p>Expected performance of an average unit at a stable temperature between 20°C to 30°C for 30 minutes prior to turn-on and during operation; does not include guardbands. It is not covered by the product warranty. The instrument must be within its calibration cycle.</p>
Nominal (nom.)	<p>A general, descriptive term or design parameter. It is not tested, and not covered by the product warranty.</p>

Requirements for temperature control

For optimal cooling and proper operating temperatures,

- Any empty module slot in the chassis should be fitted with a slot blocker (from kit Y1212A) and EMC filler panel (from kit Y1213A).
- If a PCIe Cable Interface module is used in place of a controller, the open area to the left of the interface module should be filled with the filler panel and bracket (from kit Y1214A).
- All lower and side vents should remain unobstructed.
- The chassis fan speed should be set to HIGH.

TECHNICAL SPECIFICATIONS AND CHARACTERISTICS

Additional information

- All data are measured from multiple units at room temperature and are representative of product performance within the controlled temperature range unless otherwise noted.
- The specifications contained in this document are subject to change.

TECHNICAL SPECIFICATIONS AND CHARACTERISTICS

M9195A/B Digital Stimulus/Response Module

GENERAL CHARACTERISTICS		
Module Characteristics		
Bus interface & compatibility	PXI Express (PXIe) peripheral module (x1, x4, x8 PCIe specification v2.1)	
Number of data channels	16, per-channel parametric measurement unit (PPMU)	
Number of sites per module	One 16-channel site or four 4-channel sites (M9195B option dependent)	
Maximum data rate for data channels	250 Mbps (M9195B option dependent)	
Maximum Return to Zero (RTZ) Clock on data channels	250 MHz (M9195B option dependent)	
Number of high voltage channels	4	
Number of auxiliary open-drain channels	4	
Module memory	2 GB (allocated between patterns, response capture, sequence control)	
Maximum Number of Synchronized Modules (M9195B only)	12 (requires M9195B option MMS)	
Maximum Number of Synchronized Channels (M9195B only)	192 (requires M9195B option MMS)	
Front Panel Connectors		
Data, Open Drain, HV, PPMU Sense, GND(s)	ERCD30	
Reference Clock Input (CLK IN)	SMB Connector	
Sync In/Out (SYNC)	SMB Connector	
Trigger In/ Marker Out (GPIO 1 and GPIO 2)	SMB Connector (Used on M9195B or M9195A with firmware revision 2.0 and later)	
Mechanical Characteristics		
Dimensions (H x W x D)	3U/1-slot PXIe standard (130.1 x 21.7 x 210) mm; includes connector and handle extensions	
Weight	482 g	
DC Power Requirements		
DC Supply	Typical	Maximum
DC Supply Current:		
+3.3 V	3.0 A	4.5 A
+12 V	2.8 A	3.2 A
Power Dissipation (max)	44 W	53 W

TECHNICAL SPECIFICATIONS AND CHARACTERISTICS

DATA CHANNEL CHARACTERISTICS		
Characteristic	Value	Comments
* denotes warranted specification		
Number of data channels	16	
Maximum pattern memory	125 Mvectors per channel	For M9195B, depends on option
Channel type	Single-ended, ground referenced	
Channel impedance	50 Ω	Nominal
Direction control (In, Out, In/Out)	Per channel, per cycle (period)	
Per cycle digital states	2 drive states, 1 receive state	
Programmable drive states	Force high, force low, force terminate	Terminate state either drives active termination or is high-Z with reflection clamps
Programmable receive states	Compare high, compare low, compare three-state, compare off	Three-state: a signal level between the "receive high" and "receive low" thresholds
Programmable voltage setting	Per channel	
Drive/receive voltage range	-1.5 V to +6.5 V (16 bit /w 152 μ V resolution)	VIH – VIL \geq 100 mV VIL (-1.5 V to +6.4 V) VIH (-1.4 V to +6.5 V)
Drive voltage accuracy*	\pm 25 mV (VIH & VIL)	DUT centric, Maximum accuracy from \pm 5°C of AutoCorrections.
Receive voltage accuracy*	\pm 20 mV (VOH & VOL)	DUT centric, Hysteresis off. Maximum accuracy from \pm 5 °C of AutoCorrections.
Channel output short circuit current limit	\pm 75 mA, nominal.	Maximum of 250 mA per module in combination with all other channels
Channel rise time	< 450 ps @ 1 Vpp (programmed) < 700 ps @ 3 Vpp (programmed) < 1250 ps @ 6 Vpp (programmed)	Into 50 Ω , 20%-80%. Typical
Channel fall time	< 450 ps @ 1 Vpp (programmed) < 700 ps @ 3 Vpp (programmed) < 1250 ps @ 6 Vpp (programmed)	Into 50 Ω , 20%-80%. Typical
Minimum detectable voltage swing, receive	40 mV	Nominal, Hysteresis off
High impedance Current leakage		
- Receive-only channel	\pm 6 nA	Typical, Static or dynamic digital mode
- Bi-directional channel	\pm 2 μ A	Typical. Static or dynamic digital mode
- Receive-only, low leakage mode*	\pm 1.5 nA	Dynamic digital mode only
	0 °C - 30 °C operating range	
	\pm 2 °C of measure leakage current	
	250 mV of measure leakage voltage (\pm 1 V range)	

TECHNICAL SPECIFICATIONS AND CHARACTERISTICS

DATA CHANNEL CHARACTERISTICS (continued)		
Channel power-on state	high-Z	
Receive hysteresis settings	0 mV, 50 mV, 100 mV	
Channel jitter	< 25 ps RMS	Typical. EPR ¹ = 1 ns
Channel to channel jitter	< 25 ps RMS	Typical. EPR ¹ = 1 ns
Active termination range	-1.5 V to +6.5 V (16 bit /w 152 μ V resolution)	50 Ω terminated into VIT
Active termination accuracy*	± 25 mV (VIT)	Maximum accuracy from $\pm 5^\circ\text{C}$ of AutoCorrections
Reflection clamp range	-2 V to +7 V (16 bit /w 152 μ V resolution)	VCH – VCL > 0.8 V VCL (-2 V to +6.2 V) VCH (-1.2 V to +7 V)
Reflection clamp accuracy	± 30 mV @ 1 mA (VCH & VCL) ± 200 mV @ 10 mA (VCH & VCL) ± 400 mV @ 25 mA (VCH & VCL)	50 Ω source impedance into clamps. Characteristic accuracy from $\pm 5^\circ\text{C}$ of AutoCorrections neglecting source impedance voltage drop.
Active load range (IOH & IOL)	0 mA to 25 mA (16 bit with 762 nA resolution)	Maximum of 250 mA per module in combination with all other channels.
Active load accuracy	± 0.40 mA (IOH & IOL)	Characteristic accuracy from $\pm 5^\circ\text{C}$ of AutoCorrections
Commutation voltage range	-1.5 V to +6.5 V -1 V to +5.5 V	$ IOL \& IOH \leq 1$ mA $ IOL \& IOH \leq 25$ mA
Commutation voltage accuracy	± 20 mV (VCOM)	Characteristic accuracy from $\pm 5^\circ\text{C}$ of AutoCorrections

¹EPR = Edge Placement Resolution

High Voltage (HV) Channel Characteristics		
Characteristic	Value	Comments
*denotes warranted specification		
Number of High Voltage channels	4	
Channel type	Single-ended, ground referenced	
Channel control	Shared with dependent data channel	Refer to M9195A/B User Guide for control information. HV20 shared /w CH02 HV21 shared /w CH06 HV22 shared /w CH10 HV23 shared /w CH14
Channel impedance	< 10 Ω (when forcing to terminate) 50 Ω (when forcing High or Low)	Nominal.
Channel power-on state	Passive 50 Ω termination	
Maximum data rate	10 MHz	
Programmable voltage range setting	Per channel	
HV drive range	0 V to +13.5 V (16 bit /w 305 μ V resolution)	Force Terminate
HV drive accuracy*	\pm 40 mV (VHH)	Maximum accuracy from \pm 5°C of AutoCorrections
Drive voltage range	-0.1 V to +6.5 V (16 bit /w 152 μ V resolution)	Force high or low
Drive voltage accuracy*	\pm 35 mV (VIH & VIL)	Maximum accuracy from \pm 5°C of AutoCorrections
HV drive settling time	< 4 μ s @ 13.5 Vpp into 1M Ω (1nF) < 350 μ s @ 13.5 Vpp into 1M Ω (1nF)	Typical. Settled to 1% of final value
HV channel short circuit limit	\pm 60 mA	Nominal. Maximum of 250 mA per module in combination with all other channels
Drive rise time	< 9 ps @ 1 Vpp (programmed) < 10 ps @ 3 Vpp (programmed) < 11 ps @ 6 Vpp (programmed)	Typical. Into 50 Ω , 20%-80%.
Drive fall time	< 9 ps @ 1 Vpp (programmed) < 10 ps @ 3 Vpp (programmed) < 11 ps @ 6 Vpp (programmed)	Typical. Into 50 Ω , 20%-80%.
Drive channel short circuit limit	\pm 60 mA	Maximum of 250 mA per module in combination with all other channels.

Open Drain Channel Characteristics		
Characteristic <small>*denotes warranted specification</small>	Value	Comments
Number of channels	4	
Channel type	Output only, single-ended, ground referenced	
Channel termination	Open drain	internal 10k Ω , pull-up to +5 V
Sink current per channel	1 A max	Nominal
Channel power-on state	Off	10 k Ω pull-up to +5 V
Maximum working voltage	+ 12 Vdc	

GPIO Characteristics		
Characteristic <small>*denotes warranted specification</small>	Value	Comments
Number of GPIO Channels	2	Trigger In/ Marker Out (GPIO 1/2 SMB) Used on M9195B or M9195A with firmware revision 2.0 and later)
Channel Type	Single Ended, ground reference	
Direction Control	Per channel	
Channel Input Impedance	50 Ω or 10 k Ω	DC Coupled, software selectable
Programmable polarity	Positive or negative slope	
Programmable threshold setting	per channel	
Input voltage range	-2 to +5 V	
Programmable input threshold	-2 to +5 V	
Input threshold accuracy	\pm 100 mV	Typical. 10 k Ω input impedance
Input minimum pulse width	16 nS	
Input Rate	DC to 30 MHz	
Channel output impedance	50 Ω	
Output voltage	3.3 Vpp (into high-Z) 1.65 Vpp (into 50 Ω)	
Output rate	DC to 100 MHz	
Output rise time	<3 nS	Typical into 50 Ω . 20% -80%
Source/sink current limit per channel	\pm 64 mA	Nominal
Channel power-on state	Input	

PMU Characteristics		
Characteristic	Value	Comments
* denotes warranted specification		
Number of PPMU channels	16	
PPMU modes	Force V measure V; Force V measure I; Force I Measure I; Force I Measure V; Force nothing Measure V	
Measurement averaging modes	None; 64 averages; 50Hz one PLC; 60 Hz one PLC	
Force voltage range	-2 V to +6.50 V ($ Current \leq 4$ mA) -2 V to +6.00 V ($ Current \leq 25$ mA) -2 V to +5.75 V ($ Current \leq 40$ mA) (16 bit /w 152 μ V resolution)	
Force voltage accuracy*	± 10 mV	with Remote Sense on, Maximum accuracy from $\pm 5^{\circ}\text{C}$ of AutoCorrections. Ground sense tied to ground.
Measure voltage accuracy*	± 10 mV	Maximum accuracy from $\pm 5^{\circ}\text{C}$ of AutoCorrections with one PLC averaging at sense location. Ground sense tied to ground.
Force voltage settling time	< 20 μ s (40 mA range) < 20 μ s (1 mA range) < 25 μ s (100 μ A range) < 100 μ s (10 μ A range) < 525 μ s (2 μ A range)	Typical. 1 V rising & falling step settled to 1% of final value into 1 M Ω 1 nF load.
Force voltage stability	Stable at all ranges into 1 μ F	Larger load capacitance possible, but response limited by current slew rate.
Current range	-40 mA to +40 mA (16 bit with 2.44 μ A resolution) -1 mA to +1 mA (16 bit with 61 nA resolution) -100 μ A to +100 μ A (16 bit with 6.1 nA resolution) -10 μ A to +10 μ A (16 bit with 610 pA resolution) -2 μ A to +2 μ A (16 bit with 122 pA resolution)	Maximum of 250 mA per module in combination with all other channels.

PMU Characteristics (continued)		
Force current accuracy*	±1% of range	Maximum accuracy from ±5°C of AutoCorrections. Remote sense disconnected.
Measure current accuracy*	±1% of range	Maximum accuracy from ±5°C of AutoCorrections with one PLC averaging. Remote sense disconnected.
Force current settling time	Dependent on load	
Channel leakage	±10 nA	Typical
Remote sense	16 channels 1 GND	Ground sense should be tied to ground at measurement location for maximum accuracy.
Remote sense leakage	±4 nA	Typical
Force current voltage clamp range	-2 V to +6.5 V (16 bit /w 152 µV resolution)	VCH > VCL VCL (-2 V to +4 V) VCH (0 V to +6.5 V)
Force current voltage clamp accuracy	±50 mV	Characteristic accuracy from ±5°C of AutoCorrections

Timing and Trigger Specification and Characteristics		
Channel Clock		
Number of independent clock domains	1 - when running a single, 16 channel site 4 - when running 4, 4 channel sites (4 banks)	Number of independent clocks depends on the number of dynamic sites selected
Maximum RZ clock rate on a data channel	250 MHz (For M9195B, depends on option)	
Minimum RZ clock rate on a data channel	5 mHz	
Clock jitter	< 25 ps RMS	
Internal Reference Clock		
Frequency	100 MHz	
Accuracy	±25 ppm	
Period jitter	<2 ps RMS	
Lock source settings	PXI_CLK100, PXIe-DSTARA, CLK IN	
External Reference Clock Input (SMB Front Panel)		Conditions
Input frequency	10 MHz or 100 MHz	
Input impedance (CLK IN)	50 Ω	Nominal, AC coupled
Input voltage range (CLK IN)	+1.8 Vpp to +3.3 Vpp	
Lock range accuracy	±25 ppm	
Duty cycle	40% to 60%	
Channel Timing (per channel)		
Waveform timing change	Per vector	
Edge placement resolution (EPR):	1 ns minimum	Dependent on waveform table period
Stimulus delay resolution, per test: For EPR ≥ 1 ns and ≤ 1.3 ns For EPR > 1.3 ns	24 ps EPR	Edge Placement Resolution (EPR) is specified at the time of test activation.
Stimulus delay range, per test	254 x EPR	
Response delay compensation resolution, per test: For EPR ≥ 1 ns and ≤ 1.3 ns For EPR > 1.3 ns	24 ps EPR	Edge Placement Resolution (EPR) is specified at time of test activation.

Timing and Trigger Specification and Characteristics (continued)

Response delay compensation range, per test	254 x EPR
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Channel-to-Channel skew	± 300 ps
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Trigger Characteristics

Trigger sources	Software (API-driven) or Hardware (for M9195B or M9195A with firmware revision 2.0 and later) (GPIO1/2, PXI_TRIG0-7, PXI_STAR, and PXIe_DSTAR)
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Waveform Characteristics

Number of waveform tables	32
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Number of waveform characters	15 (user definable)
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Generation waveform iteration count (Loop)	once, n times, infinite
--	---------------------------

Receive post trigger sampling	0 to full record waveform
-------------------------------	---------------------------

Environmental and Regulatory

Environmental		
Operating and storage conditions		
	Operating	Storage
Temperature	0 °C to 45 °C	-40 °C to 70 °C
Altitude	3000 meters, de-rate max temperature by 5 °C above 2000 meters	
Humidity	Maximum 80%, +40 °C (non-condensing)	
Warm-up time	30 minutes	
Calibration interval	1 Year: Return to Keysight Service Center or use Y1252A with N7800A/N7867A	
Mechanical		
Operating vibration	5 to 500 Hz: 0.21 g RMS, random (type tested)	
Survival Sine Vibration	5 to 500 Hz: 0.5 (0 to peak) Swept Sine (type tested)	
Survival random vibration	5 to 500 Hz: 2.09 g RMS, random (type tested)	
Transportation shock	125 g, 8.6 m/s, trapezoidal pulse (type tested)	
End use handling shock	1.6 m/s, <3 ms duration, half sine pulse (type tested)	
Warm-up time	30 minutes	

Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of Storage, Transportation and End-use; those stresses include but are not limited to temperature, humidity, shock, vibration, altitude, and power line conditions. Test Methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class3.

Regulatory
Safety
IEC/ EN 61010-1 USA: ANSI/UL 61010
EMC
IEC 61326-1



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