Keysight Technologies
Why Migrate from the First-Generation MXG to the New EXG X-Series Signal Generator?

Technical Overview

X-series signal generators are crafted to create RF signals capable of testing your very best devices and designs. They produce the signals you need—from simple to complex, from incredibly clean to highly impaired—to test your device within and beyond its limits.

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Key Benefits

– More capability than the first generation MXG, including reduced spurious levels, larger waveform memory, wider modulation bandwidth and robust reverse power protection

– Scale up performance and functionality with options that fit your test requirements

– Real-time baseband generator

– High output power

– Built-in multi-function generator

– Use existing Signal Studio arbitrary waveform generation applications as well as new capabilities for real-time LTE and GNSS for receiver testing

– Count on continued low cost-of-ownership based on proven track record of first-generation MXG

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Overview: N518xA MXG and the EXG X–Series Signal Generator

Since their 2006 introduction, the first-generation Keysight Technologies, Inc. N518xA MXG signal generators have been widely adopted for use in many RF signal generation applications, including device testing in both R&D and manufacturing. Since then, the instruments have been continually updated and enhanced and, when used in conjunction with the Keysight Signal Studio family of software products, support a broad range of wireless applications and formats, including GSM, WCDMA, LTE, *Bluetooth*®, WLAN, WiMAX™, as well as digital video and audio. Because transitioning to a new signal generator requires careful consideration, this document was created to provide an overview and comparison of the new Keysight N5171B and N5172B EXG X-Series RF signal generators with the first-generation MXG-Series sources (N5181A and N5182A).

While the first-generation MXG signal generators will continue to offer high performance signal generation and application versatility for years to come, new technologies and measurement demands will require even higher levels of performance in areas such as extended frequency range, signal bandwidth, significantly larger waveform memory size, and real-time vector signal genera-tion. Also, many users will prefer the latest instrument connectivity interfaces such as Gigabit LAN and dual USB ports. If these aspects interest you, then now is the time for you to make the transition from the N518xA MXG to the new EXG X-Series signal generators.

Table 1. First-generation MXG and new EXG X-Series general specifications at a glance

General characteristics	MXG models N5181A analog N5182A vector		EXG models N5171B analog N5172B vector		Additional comments
Frequency range					
	250 kHz to 6 GHz		9 kHz to 6 GHz		Max frequency depends on option selected
Stability					
Aging rate	$\pm 1 \times 10^{-6}$/yr				
Temperature	$\pm 1 \times 10^{-6}$				
Line voltage	$\pm 1 \times 10^{-7}$				
Maximum RF output power, dBm	0.1 to 50 MHz	+15	.009 to 10 MHz	+17	MXG and EXG output powers with Option 1EA installed
	> .05 to 3 GHz	+23	> .01 to 3 GHz	+21	
	> 3 to 5 GHz	+17	> 3 to 6 GHz	+18	
	> 5 to 6 GHz	+16			
Maximum reverse power protection	100 kHz to 6 GHz	2 W	≤ 1 GHz	50 W	
			> 1 to 2 GHz	25 W	
			> 2 to 6 GHz	20 W	
SSB phase noise @ 20 kHz offset, dBc/Hz					
500 MHz	≤ −126		≤ −128		
1 GHz	≤ −121		≤ −122		
3 GHz	≤ −110		≤ −110		
6 GHz	≤ −104		≤ −103		
Harmonics @ +4 dBm output, dBc					
	250 kHz to 3 GHz	< −35	9 kHz to 4 GHz	< −35	
	> 3 to 4 GHz	< −41			
	> 4 to 6 GHz	< −53	> 4 to 6 GHz	< −53	
Non-harmonics @ > 10 kHz offset, dBc					
500 MHz	< −73		< −86		
1 GHz	< −62		< −82		
3 GHz	< −62		< −76		
6 GHz	< −56		< −70		
Frequency switching speed (SCPI mode, typical)					
Digital mod off	< 950 µs				MXG and EXG times with Option UNZ installed. Without Option UNZ, switching time is 5 ms.
Digital mod on	≤ 1.05 ms				
Amplitude switching speed (SCPI mode, typical)					
Digital mod off	≤ 650 µs				MXG and EXG times with Option UNZ installed. Without Option UNZ, switching time is 5 ms.
Digital mod on	≤ 950 µs				
AM modulation					
Max rate	10 kHz		50 kHz		
Depth	100%				
FM modulation					
Max rate	7 MHz				Deviation value at 1 GHz
Max dev	10 MHz				
φM modulation					
Max rate	4 MHz				Deviation value at 1 GHz, high BW mode
Max dev	0.5 rad				

Table 1. First-generation MXG and new EXG X-Series general specifications at a glance *(Continued)*

General characteristics	MXG models N5181A analog N5182A vector	EXG models N5171B analog N5172B vector	Additional comments
Pulse modulation			
Min width	20 ns		MXG/EXG with Option UNW installed
Max PRF	10 MHz		
Internal analog modulation source			
Waveforms	Sine	Sine	EXG with Option 303 installed
		Triangle	
		Square	
		Ramp	
		Noise	
Max rate	2 MHz	10 MHz for sine, 1 MHz for other waveforms	
LF out			
	No	Yes	
Connectivity			
	GPIB [IEEE-488.2-1987]		The EXG has 2 USB ports on the front panel and 2 more on the rear panel; the N518xA has 1 USB port
	LAN [1000BaseT]		
	USB 2.0		
	LXI Class B		
Height dimensions in rack units			
	2U (3.5")		19 inch chassis width
Calibration cycle			
	24 months	36 months	Recommended interval

Table 2. First-generation MXG and EXG vector specifications at a glance

| General characteristics (vector models only)	MXG model N5182A vector	EXG model N5172B vector	Additional comments
Baseband generator waveform memory			
	8 to 64 MSa	32 to 512 MSa	Depending on option selected
Sequence memory			
	1 K	32 K to 4 M	Maximum number of packets, depending on option selected
Maximum sample rate			
	125 MSa/s	150 MSa/s	Depending on option selected
Maximum internally generated modulation bandwidth			
	100 MHz	120 MHz	Depending on option selected
Maximum modulation bandwidth using external I/Q inputs			
	200 MHz		Nominal 3 dB bandwidth
Operating modes			
	Arb only	Arb and real-time	
Maximum symbol rate			
	62.5 MSymbols/s	75 MSymbols/s	

Test Your Devices and Designs Within and Beyond Their Limits

The new Keysight X-Series' excellence begins with core signal generation performance. The extended RF range of 9 kHz to 3 or 6 GHz easily covers the highest and lowest frequencies of your device under test (DUT).

To test devices under high power conditions and overcome test system losses, the EXG offers substantial power, with standard +18 dBm and optional +21 dBm output power at 3 GHz, and up to +18 dBm at 6 GHz.

Just as important as high power is the need to provide a clean, undistorted signal. The EXG's innovative output circuitry delivers superior harmonic and spurious levels, as well as outstanding adjacent channel power ratio (ACPR) and error vector magnitude (EVM) performance to insure that you measure the performance of your DUT, not your test equipment.

The EXG builds upon these core signal generation attributes with the additional capabilities you need to generate today's complex waveforms. The baseband generator provides a high-speed arbitrary waveform generator capable of creating signals with 120 MHz modulation bandwidth. Up to 512 MSa of on-board memory assures your ability to create long duration waveforms. In addition, the EXG offers a new feature that was not available in the N5182A MXG— an optional real-time baseband generator that provides even more capability for your most demanding receiver tests.

N5172B EXG 1 GHz Absolute phase noise
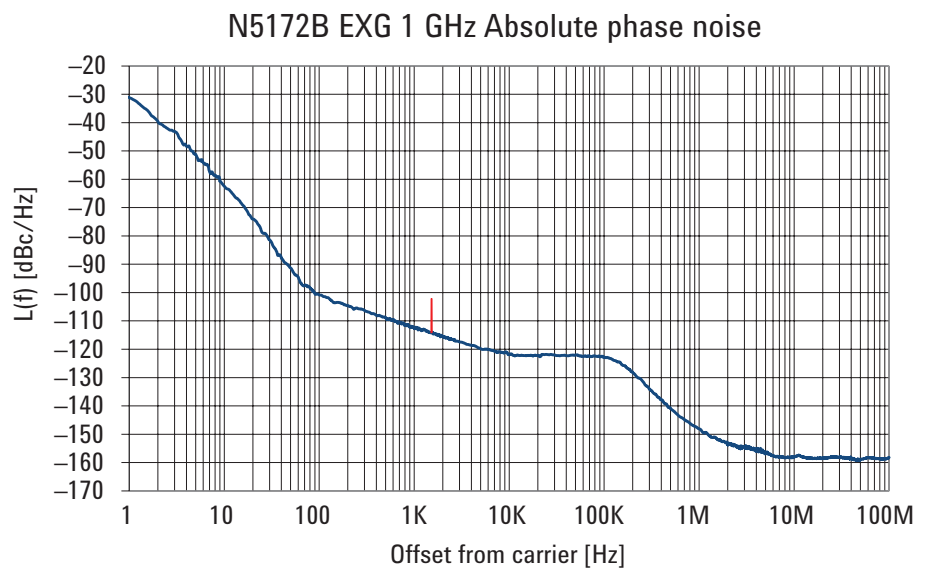
Figure 1. Superior spurious performance enables you to measure the true performance of your device.
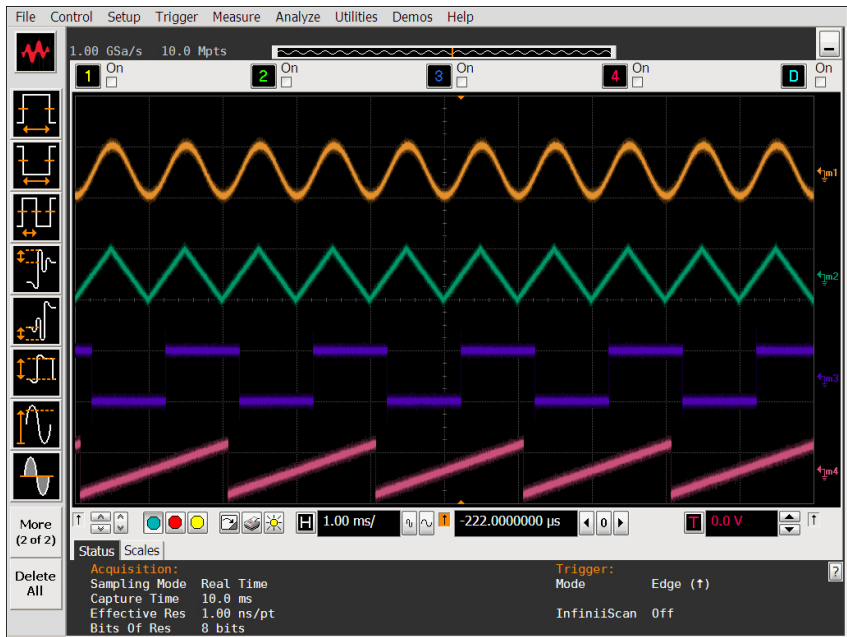
Figure 2. The flexible modulation generator is capable of creating a variety of waveform types.
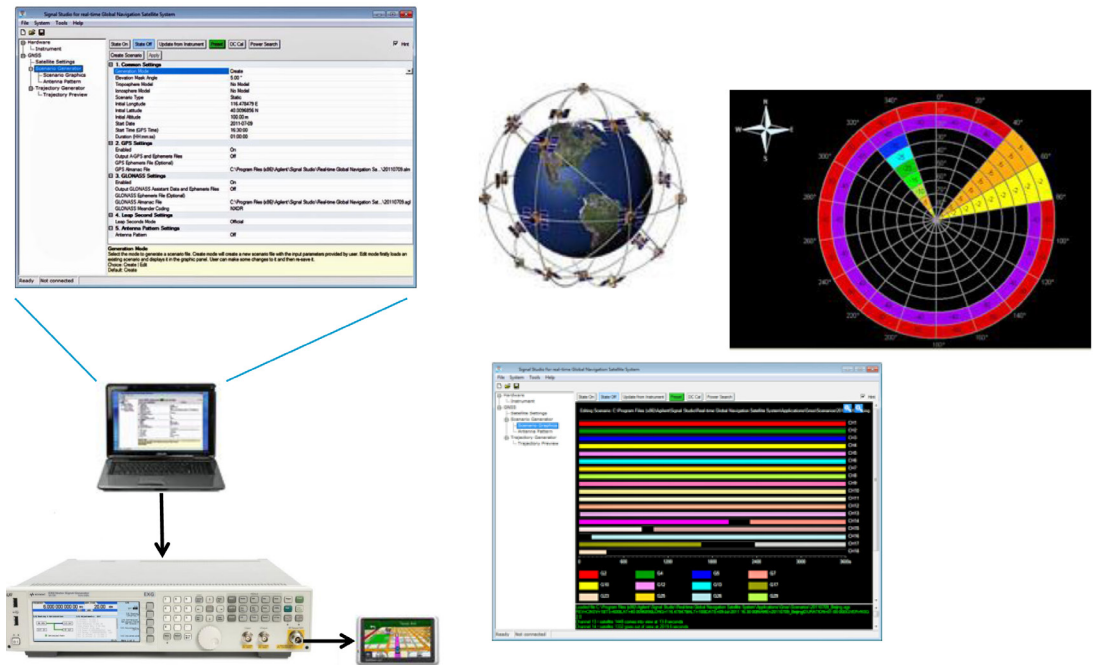

Figure 3. The EXG's real-time baseband generator works with a variety of Signal Studio applications, enabling you to create real-time signals such as the GNSS signal shown here.

Why Upgrade to the New EXG X-Series?

The cost-effective EXG helps you generate true performance.

Core performance and functionality

The EXG's low start frequency offers fully-calibrated signals down to 9 kHz, well beneath the N518xA MXG's 250 kHz start frequency. This extended range helps you address more applications, such as those that require electromagnetic immunity measurements.

The EXG offers substantial output power of +21 dBm to 3 GHz and +18 dBm to 6 GHz. This extra power helps you overcome test system losses and characterize devices at higher operating levels.

Spurious signals generated within a signal generator can interfere with sensitive receiver measurements. The EXG spurious levels are up to 14 dB lower than the first-generation MXG's, helping prevent false measurements.

The EXG comes standard with a robust reverse power protection (RPP) circuit that can withstand up to 50 W of power and 50 Vdc applied to the RF output connector, a significant increase over the N518xA MXG's 2 W RPP level. The EXG's RPP circuit improves reliability and provides an extra layer of protection from test setup up errors that could otherwise damage the instrument.

For flexible analog modulation and low frequency (LF) generation, the X-Series sources offer an optional advanced multifunction generator. This digitally synthesized source consists of 7 waveform generators that can be set up independently, with up to 5 simultaneously using the composite modulation features in AM, FM, PM and LF out.

Thanks to the advanced LF subsystem, the Keysight X-Series signal generators offer superior AM modulation performance. Compared to the first-generation MXG, it supports a higher 50 kHz AM rate with better accuracy and lower distortion.

EXG's brighter 6.5" (165 mm) color display, makes it easier to see all critical settings at a glance over a wide viewing angle. Because some measurement applications require multiple signal generators to operate in a phase coherent fashion, Option 012 is available to allow users to connect two EXG's together and share a common LO. Need more coherent sources? Just add an external LO source and splitter or a distribution network to connect up to 16 sources.

Secure work environments require the ability to remove sensitive data from an instrument. The Keysight X-Series sources offer removable flash memory to store all user files. A standard SD card slot is available on the rear panel, making it easy to remove all sensitive user information such as measurement settings and waveforms from the signal generator.

Vector modulation

For generating digitally modulated signals, the first-generation MXG offers an optional 125 MSa/s internal baseband generator with up to 100 MHz modulation bandwidth. The EXG goes even further, with an available high performance 150 MSa/s baseband generator capable of generating 120 MHz wide signals. This 20% bandwidth increase gives you more flexibility for generating wide bandwidth signals.

To expand EXG measurement application breadth beyond device test, vector-modulated signals can be created in either arbitrary waveform generation mode or in real-time mode. In particular, real-time mode adds receiver test capabilities for LTE, HSPA+/W-CDMA, GPS/GLONASS and multiple video standards that are not available in the first-generation MXG.

Keysight has developed a real-time channel correction algorithm that automatically corrects amplitude and phase flatness across the entire 120 MHz modulation bandwidth, resulting in greatly improved modulated signal fidelity with reduced distortion.

The EXG eclipses the N518xA MXG 64 MSa waveform memory by a factor of 8. With 512 MSa memory available, you'll have plenty of room for your largest video signal waveform files. Additionally, waveform playback time can be substantially multiplied using sequencing techniques to reuse waveform segments stored in memory. The EXG provides a generous sequence memory size of up to 4 MSa, providing much more capability compared to the first-generation MXG's 1 kSa.

All vector X-Series signal generators come standard with the ability to synchronize baseband generator operation across multiple EXG's, an essential capability for generating MIMO signals. Up to 16 signal generators can be synchronized at one time.

Speed

The agile X-Series architecture makes it possible to rapidly change frequency or amplitude in less than a millisecond, even with digital modulation turned on. For tests involving many data points, this can greatly speed up measurements.

All Keysight X-Series signal generators come with the latest connectivity standards, including GPIB, USB 2.0, and LAN. Ethernet users in particular will appreciate the 1000 BaseT LAN interface, which offers a significant speed boost over the MXG's 100 BaseT LAN.

With its improved connectivity interfaces and greater processing power, the EXG offers 10 to 15 times faster waveform upload/download times compared to the first-generation MXG. This is particularly useful when handling large waveform files.

Applications

One of the strengths of the first-generation MXG has been the application support via Keysight Signal Studio software for a wide range of wireless technologies. The EXG continues this tradition of simplified signal creation with the same waveform playback-based Signal Studio software with which you are already familiar.

Thanks to the real-time baseband generator, the EXG can now offer seven new real-time Signal Studio applications for advanced receiver testing to the latest LTE, HSPA+/W-CDMA, GSM/EDGE, cdma2000®, GPS/GLONASS, and Video standards.

Table 3. Signal Studio and embedded applications for the X-Series signal generators

	Wireless technology	Waveform generation mode	Real-time mode
Signal Studio product			
N7600B Signal Studio for W-CDMA/HSPA+	W-CDMA HPSA HSPA+	■	■
N7601B Signal Studio for cdma2000/1xEV-DO	cdma2000® cdmaOne 1xEV-DO Rev 0 1xEV-DO Rev A	■	■[1]
N7602B Signal Studio for GSM/EDGE/Evo	GSM/EDGE GPRS/EGPRS EDGE Evolution	■	■[1]
N7606B Signal Studio for Bluetooth®	*Bluetooth* V1.1 *Bluetooth* V2.1 + EDR *Bluetooth* low energy	■	
N7609B Signal Studio for Global Navigation Satellite Systems (GNSS)	GPS GLONASS		■
N7611B Signal Studio for Broadcast Radio	FM Stereo/RDS DAB/DMB/ETI support	■	
N7612B Signal Studio for TD-SCDMA/HSDPA	TD-SCDMA LCR	■	
N7615B Signal Studio for Mobile WiMAX	Mobile WiMAX (OFDMA) MIMO	■	
N7617B Signal Studio for WLAN 802.11a/b/g/n/ac	802.11 WLAN (a/b/g/p/j/n/ac) MIMO	■	
N7622B Signal Studio Toolkit	—	■	
N7623B Signal Studio for Digital Video	DVB-T/H/T2 DVB-S/S2 DVB-C J.83 Annex A/B/C DOCSIS DS ISDB-T/TB/TSB/Tmm ATSC, ATSC-M/H DTMB (CTTB) CMMB	■	■[2]
N7624B Signal Studio for LTE/LTE-Advanced FDD	LTE-FDD LTE-Advanced MIMO	■	■[1]
N7625B Signal Studio for LTE/LTE-Advanced TDD	LTE-TDD LTE-Advanced MIMO	■	■[1]
Embedded application			
403 Calibrated Noise (AWGN)	General purpose		■
430 Multitone and two-tone	General purpose	■	
431 Custom digital modulation	General purpose	■	■
432 Phase noise impairment	General purpose		■

1. *Real-time mode not available for 1xEV-DO, Edge Evolution, LTE-Advanced, or downlink signals.*

2. *Real-time mode available for DVB-T/H/T2, DVB-S/S2, and DVB-C.*

Not all measurements can be addressed with standards-based application software. In fact, many applications involve proprietary technologies for secure communication, as well as modified, enhanced and emerging technologies still in early development. To address these applications, more flexible software tools are available to aid test development. The EXG works with popular software tools including MATLAB and Keysight SystemVue to create the custom signals you need to get the job done.

Code compatibility

While improved performance is always desirable, its usefulness is limited if, in order to benefit from it, you must first rewrite existing test software or manual test procedures and redesign test systems. The X-Series signal generators offer comprehensive compatibility with the first-generation MXG. This compatibility includes both key physical attributes (form and fit) as well as manual and remote user interfaces (function). SCPI commands are provided to support the new EXG commands while retaining full compatibility with the N518xA MXG. Thus, there is no need to rewrite existing test software or manual test procedures to take full advantage of the EXG's outstanding performance.

In addition to first-generation MXG code compatibility, all X-Series sources come standard with compatibility modes for a large number of other Keysight and non-Keysight signal generators.

In cases where additional emulation modes are required, local Keysight Applications Engineering Services can provide additional support by working with your programmers and our factory experts to improve the EXG compatibility with your existing test software.

Hardware compatibility

Keysight X-series signal generators offer the same compact 2U height and standard EIA rack width as the N518xA MXG allowing easy replacement in your test system rack. Note that the X-series units are approximately 5 cm (2 in.) deeper, relative to the MXG.

Keysight X-Series signal generators offer the same input and output connectors found on the first–generation MXG for connecting reference, clock, I/Q, trigger, event, analog modulation, pulse, digital I/O and auxiliary I/O signals with other instruments. In addition, there are some new connections available, such as an LF output and a removable SD memory card.

N5182A MXG front panel

N5172B EXG front panel

N5182A MXG rear panel

N5172B EXG rear panel

What is simplified self-maintenance?

Simplified self-maintenance for the Keysight X-Series signal generators is an alternative to traditional maintenance and repair choices. Maintaining the MXG in-house empowers you to actively manage downtime, while maximizing uptime and reducing your total cost of ownership.

Quick calibration

Using a spectrum analyzer, a power meter, and Keysight's calibration software, you can do the majority of performance verification tests for the Keysight MXG down to –110 dBm in less than 4 hours—half the time required for the ESG.

Onsite repair

Should a failure occur, an Keysight X-Series signal generator is quick and easy to repair. Repair assemblies are field-orderable and come fully adjusted and certified. Onsite repair can be done in as little as 60 minutes.

Maximize uptime

Designed for long-term dependability in production, R&D, and operational environments, with a focus on reliability and simplified-self maintenance that reduces potential downtime, the Keysight EXG helps you maximize uptime and lower the cost of ownership. Keysight X-Series architecture, comprised of just five major sub-assemblies, increases system integrity without sacrificing performance.
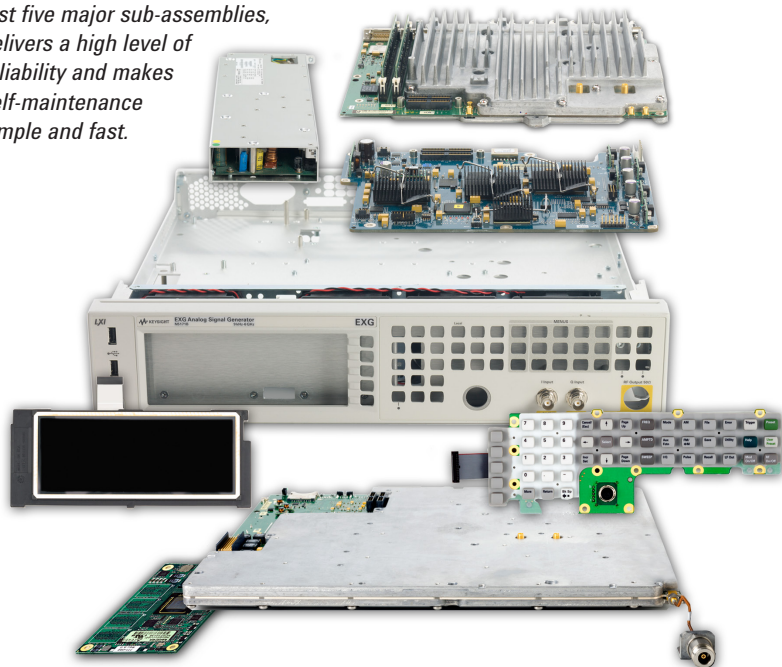
Reliability

The Keysight EXG delivers a high level of reliability and therefore overall quality that dramatically reduces the mean time between failures and delivers one of the lowest annual fail rates in the industry. This includes a wear-free electronic attenuator for frequencies up to 6 GHz to ensure fast, repeatable results.

Calibration and repair

The Keysight X-Series support strategy lets you decide how to manage your equipment to maximize system uptime. Elect to self-maintain your Keysight EXG—perform calibration and repairs onsite with Keysight calibration software, 100% self-diagnostics and field-orderable and replaceable assemblies—and ensure a fast return to the lab or production line. Alternatively elect to have maintenance done through one of Keysight's local service centers to keep your Keysight EXG signal generator performing like new.

The Keysight EXG, comprised of just five major sub-assemblies, delivers a high level of reliability and makes self-maintenance simple and fast.

Protecting Your Environment

Around the world, governments are setting new standards aimed at promoting the reduction of hazardous substances (RoHS) in electronic equipment. The MXG and EXG signal generators are part of Keysight's new generation of RoHS-compliant products designed and manufactured to be free of lead, mercury, and other hazardous substances to help keep our world cleaner and healthier.

Instrument migration planning services

Keysight also offers Instrument Migration Planning Services (IMPS) to help you implement Technology Refresh programs, and can help you to identify and optimize your migration from legacy or obsolete test equipment to the latest technology. Contact your Keysight Sales Representative for more information.

Additional Resources

Web

www.keysight.com/find/MXG2EXG
www.keysight.com/find/X-Series_sg
www.keysight.com/find/N5171B
www.keysight.com/find/N5172B

Literature

X-Series Signal Generator Selection Guide, Literature number 5990-9956EN

X-Series Signal Generator Brochure, Literature number 5990-9957EN

EXG Data Sheet, Literature number 5991-0039EN

EXG Configuration Guide, Literature number 5990-9958EN

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