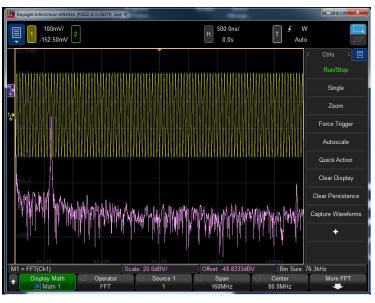
Keysight M924XA

InfiniiVision PXIe Modular Oscilloscopes

Full-featured 1 GHz oscilloscope for the modular environment

Data Sheet





Keysight is taking modular analysis to a whole new level

This is not just a digitizer with an oscilloscope SFP (soft front panel). The InfiniiVision PXIe modular oscilloscopes utilize Keysight's InfiniiVision benchtop oscilloscope technology and packages it for PXI.

- M9241A PXIe modular oscilloscope 200 MHz bandwidth
- M9242A PXIe modular oscilloscope 500 MHz bandwidth
- M9243A PXIe modular oscilloscope 1 GHz bandwidth



The Power of a Benchtop Oscilloscope in a Modular Package

The InfiniiVision M924XA Series redefines modular oscilloscopes. It gives you the most signal detail with maximum investment protection and is built with technology that leverages decades of Keysight's high-performance oscilloscope expertise.

Performance

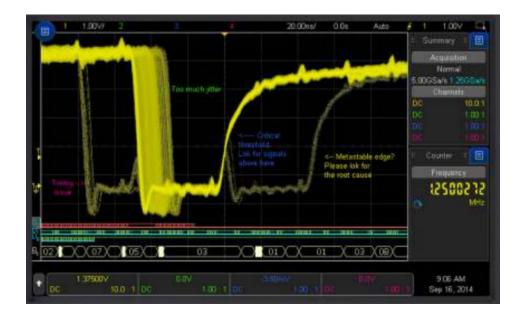
- 200 MHz, 500 MHz or 1 GHz bandwidths available to match your measurement application
- Advanced triggering enables capture and analysis of complex signals
- Visual triggers (zone touch and mask) make trigger and capture of signal errors quick and easy
- Serial protocol analysis and triggering for most common protocols
- Automated FFT and waveform math extend analysis to match your needs
- Segmented memory can analyze 1000 events without ever offloading to a PC

Measurement capability

- AutoProbe support for most Keysight probes
 - High-accuracy current probes
 - Differential and single-ended active probes
 - Power rail analysis
 - High-voltage probes
- 30+ automated measurements provide simple-to-access analysis

Multiple instruments in one

- Oscilloscope support for up to 1 GHz bandwidth with 5 GSa/s
- DVM (Digital voltmeter) 3-digit using the same scope probes
- 8-digit counter for integrated totalizer/frequency counter measurements
- Protocol analyzer for I2C, UART, CAN, LIN, CXPI and more
- Spectrum analysis with hardware-accelerated FFT measurements
- 20-MHz arbitrary waveform generator

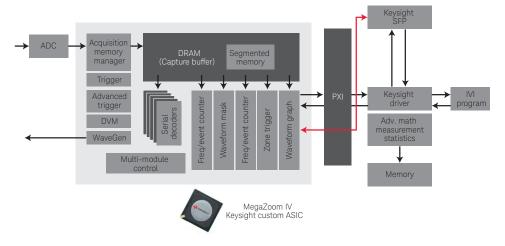


Uncompromising Analysis Capability

Many modular users have been using digitizer hardware with software that simulates an oscilloscope for test and troubleshoot implementation. The limitations of this configuration are often overlooked, but they can cause signification problems. When a instrument says it has a high waveform update rate, people usually expect it to have a higher probability of catching random and infrequent glitches, but this isn't the case for those instruments. In addition, common measurements like waveform averaging and advanced waveform triggers are not available.

Keysight is currently the only vendor that delivers oscilloscope hardware in a PXI modular package. Keysight's M924XA Series PXIe oscilloscopes begin with basic digitizer hardware, but then they add measurement tools directly into the hardware of the PXI card.

The InfiniiVision PXIe modular oscilloscopes require minimum support from a central processing unit (CPU), as most of their core operations are handled by the MegaZoom IV smart memory ASIC, which is Keysight proprietary technology. MegaZoom includes hardware serial decoders and hardware mask/limit testing capability; plots analog and digital data directly to the display; supports GUI operation; and integrates additional instruments like a WaveGen function/arbitrary waveform generator.

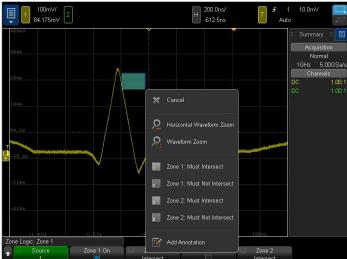


The M924XA Series PXIe modular oscilloscopes utilize hardware to perform many of the functions traditional digitizers do with software on the CPU. By doing more in hardware, M924XA Series oscilloscopes can analyze more of the signal than ever before.

Industry-exclusive Zone Touch Trigger Makes Triggering Simple

Zone touch triggering eliminates the complexity of setting up advanced triggers. If you have a touch-enabled display on your controller, you can trigger on events by simply drawing a box with your finger on the display of the signal you want to isolate. Keysight pioneered the zone touch trigger, which allows easy capture of difficult-to-define trigger events.





The M924XA Series' high, uncompromised update rate increases your chance of seeing random and infrequent signal anomalies, and zone touch trigger helps you isolate the signals. Now your testing can be faster and more thorough.

Other touch-based operation

Just like Keysight's touch-enabled InfiniiVision benchtop oscilloscopes (3000T, 4000 and 6000 X-Series), the M924XA Series also uses touch capability to interact with signal display. In addition to zone touch trigger, these oscilloscopes also let you move the waveform up/down; adjust the time offset and zoom; and define one of the two touch zone triggers. All that is required is a touch-enabled display connected to your modular scope.

Probing Solutions for PXI Modular

Keysight has probing solutions for the most challenging test applications. The M924XA Series PXIe modular oscilloscopes support standard 50 Ω or 1 $M\Omega$ connections. They also support a wide range of passive and active probes.

M924XA Series oscilloscopes require the M9240A PXIe AutoProbe power module to use Keysight active probes. The M9240A provides power and the communication circuit required for proper operation of the active probes. One M9240A will supply the power and connection for up to four probes when two oscilloscope modules are installed on either side of the M9240A module.



M9240A AutoProbe PXIe power module.

Probes		
N2843A	Passive probe 500 MHz, 10:1, 1 M Ω , 11 pF	Optional
		Option 808 (2 probes)
N2870A	Passive probe 35 MHz, 1:1, 1 M Ω	Optional
10076C	Passive probe 500 MHz, 100:1 (4 kV)	Optional
N2804A 1	300 MHz, 100:1 differential probe, 4 MΩ, 4 pF, ± 300 V DC+peak AC with AutoProbe	Optional
N2805A 1	200 MHz, 100:1 differential probe, 4 M Ω , 4 pF, \pm 100 V, 5 m cable	Optional
N2790A ¹	100 MHz, 50:1/500:1 high-voltage differential probe, 8 M Ω , 3.5 pF, \pm 1,400 V	Optional
N2795A ¹	Active single-ended probe 1 GHz, 1 pF, 1 M Ω with AutoProbe	Optional
N2797A ¹	Active single-ended probe 1.5 GHz extreme temperature	Optional
N2750A 1	InfiniiMode differential probe 1.5 GHz, 700 fF, 200 k Ω with AutoProbe	Optional
N2790A ¹	Differential active probe 100 MHz, ± 1.4 kV with AutoProbe	Optional
N2791A	Differential active probe 25 MHz, ± 700 V	Optional
N2818A ¹	200 MHz, 10:1 differential probe with AutoProbe	Optional
N2819A ¹	800 MHz, 10:1 differential probe with AutoProbe	Optional
1146B ¹	AC/DC current probe 100 kHz, 100 A	Optional
1147B ¹	AC/DC current probe 50 MHz, 15 A with AutoProbe	Optional
N2893A ¹	AC/DC current probe 100 MHz, 15 A with AutoProbe	Optional
N2820A ¹	2-channel high-sensitivity current probe 50 uA to 5 A	Optional
N2821A ¹	1-channel high-sensitivity current probe 50 uA to 5 A	Optional
N7020A 1	Power rail probe 2 GHz, 1:1, \pm 24 V offset range at 50 Ω	Optional
N2744A ¹	T2A probe interface adapter	Optional

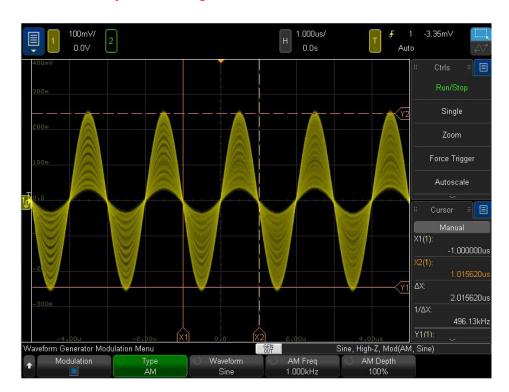
^{1.} Active probe that requires the use of M9240A AutoProbe power module.

Additional Software for Added Functionality

M9240AWGA WaveGen 20 MHz function/arbitrary waveform generator

The M924XA Series oscilloscopes offer a 20-MHz built-in function/arbitrary waveform generator. The WaveGen provides standard stimulus output waveforms to your device under test as well as user-definable frequencies, amplitudes, offset and pulse widths and arbitrary waveform capability. The WaveGen output is routed to a MMCX connector on the front panel of the oscilloscope.

Use the built-in waveform editor to create custom waveforms to output on the oscilloscope's WaveGen. It is also possible to capture a known good or 'golden' waveform on a scope channel and then save that to the ARB so you can generate it to stimulate your system under test.



M9240FRAA frequency response analyzer

Frequency response analysis is a critical measurement to characterize the stability of feedback networks and switch-mode power supplies. This capability is achieved with a gain and phase measurement versus frequency (Bode plot). By using the waveform generator output to stimulate your design and probing the input and output signals on channels 1 and 2, the oscilloscope provides a clear report on the gain and phase operation of the system.



Additional Software for Added Functionality (Continued)

M9240MSKA mask limit testing

With the mask limit testing measurement application, you can quickly test more than 200,000 waveforms per second to a known good waveform with quick go/no-go test results, saving you valuable test time while providing you with more confidence in test results. Test your signals to specified standards, and uncover unexpected signal anomalies.

Mask testing on other oscilloscopes is usually based on software-intensive processing technology, which tends to be slow. Keysight's M924XA Series oscilloscopes' mask test option is based on hardware-based technology. This means M924XA Series oscilloscopes can perform more than 200,000 real-time waveform pass/fail tests per second. This provides testing throughput that is orders of magnitude faster than what is available on other oscilloscope mask test solutions, making valid pass/fail statistics almost instantly.



M9240VIDA enhanced video/TV application package

The M924XA Series oscilloscopes support a video IRE display grid, as well as cursors measurements performed in video IRE units for the NTSC and PAL standards. This new capability is standard on M924XA Series oscilloscopes. The M9240VIDA software provides an array of additional HDTV triggering standards. The additional triggering options provided by the M9240VIDA software speed debug and characterization for engineers working on HDTV video applications.



Additional Software for Added Functionality (Continued)

M9240PWRA power analysis application

Today's power supply designers are facing an increasing number of constraints in the development of high-efficiency, low-cost power supplies. The power analysis application provides clear and consistent reporting on the operation of key operation parameters of your power supply design.

Input measurements

- Power quality: Real power, apparent power, reactive power, power factor, crest factor (V and I), phase angle
- Current harmonics (based on IEC 61000-3-2 up to the 40th harmonic)
- Inrush current

Switching measurements

- Rds-on and Vce-sat
- Switching loss (power and energy)
- Slew rate (dv/dt and di/dt)
- Modulation (duty cycle, pulse-width, period, frequency, versus time plot, etc.)

Output measurements

- Output ripple
- Turn-on/turn-off time
- Transient response time
- Efficiency

Frequency response measurements

- Power supply rejection ratio (PSRR)
- Control loop response Bode



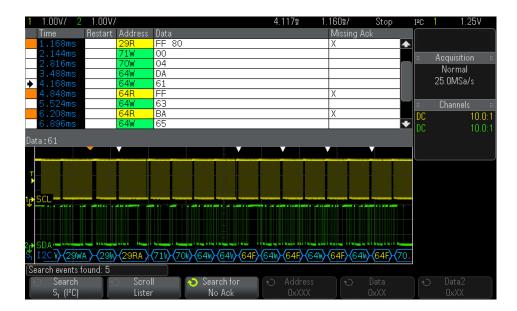
M9240NFCA NFC triggering

Testing NFC-enabled devices is essential during the design validation and manufacturing test phases to ensure quality and reliability of data transmission. This is especially important when you consider that the data being transferred/exchanged between NFC-enabled devices is often secured financial transactions. The M9240NFCA NFC trigger application enables easy configuration to capture the signals of interest for NFC-A, NFC-B and NFC-F messages.

Decodes

M9240EBMA embedded serial triggering and analysis (I2C)

The I²C serial decode software option for M924XA Series oscilloscopes displays responsive, time-aligned, on-screen decode of Inter-Integrated Circuit (I²C) serial communication. Because this capability is hardware-based, it provides the fastest throughput solution for triggering on and analyzing I²C serial buses found in a wide variety of embedded designs. You can easily isolate serial packets to find sources of errors due to hardware- or software-related problems. Sometimes it may be necessary to correlate data from one serial bus to another. Keysight's M924XA Series oscilloscopes can decode two serial buses simultaneously using hardware-based decoding.



M9240CMPA computer serial trigger/analysis (RS232/422/485/UART)

The RS232/422/485/UART serial triggering and decode option for M924XA Series oscilloscopes displays responsive, time-aligned, on-screen decode of RS-232/422/485 and other UART serial buses. It provides triggering capabilities on specified transmit or receive values, as well as on parity errors. Trigger on and acquire RS-232/422/485/UART signals using either oscilloscope or logic channels. Hardware-based decode means the scope stays responsive and fast when decode is turned on. Real-time counters continually count transmit and receive frames and errors.

M9240ATOA automotive serial triggering and analysis (CAN, CAN-dbc, CAN FD, LIN)

The automotive serial triggering and analysis (CAN, LIN) option for M924XA Series oscilloscopes allows you to trigger on either standard or extended CAN message IDs, including the message ID of a remote transfer request frame. It supports triggering on a data frame and allows you to specify message IDs, data and data length for filtering messages of interest. Triggering on active error frames is also supported. In addition, it supports triggering on LIN frame IDs and data and includes color-coded parity and check sums errors. You can easily isolate serial packets to find sources of errors due to hardware- or software-related problems. Sometimes it may be necessary to correlate data from one serial bus to another.

Decodes (Continued)

M9240SNSA SENT (single edge nibble transmission) trigger and analysis

The SENT (single edge nibble transmission) is a point-to-point serial bus that interfaces sensors to ECUs and is used primarily in automotive applications. Keysight's M9240SNSA SENT software option for the M924XA Series oscilloscopes provides decoding of fast and slow channel serial data and also offers extensive triggering selections, including the ability to trigger on various error conditions that can accelerate efficiency in debugging this bus.

Keysight's M924XA Series oscilloscopes can display captured data from multiple buses in a time-interleaved "lister" display. Sometimes it may be necessary to correlate data from one serial bus to another, such as CAN to SENT.

M9240CXPA CXPI trigger and decode

CXPI (clock extension peripheral interface) is the next-generation automotive communication protocol intended to reduce the number and weight of wiring harnesses by making multiplexing possible even in advanced, multifunction HMI (human machine interface) automotive systems. In many cases, CXPI is an alternative serial bus used in place of many of today's LIN serial bus applications for automotive body control.

Keysight's M9240CXPA CXPI software for M924XA Series oscilloscopes provides decoding of standard and long CXPI frames and also offers extensive triggering selections, including the ability to trigger on various error conditions that can accelerate the engineer's efficiency in debugging this bus.

Keysight's M924XA Series oscilloscopes can display captured data from multiple buses in a time-interleaved "lister" display. This allows correlation of data being passed through gateways, such as CAN to CXPI.

M9240AROA MIL-STD 1553 and ARINC 429 aerial triggering and analysis

The MIL-STD 1553 serial bus is primarily used to interconnect avionics equipment in military aircrafts. This bus is based on tri-level signaling (high, low and idle) and requires dual-threshold triggering, which the M924XA PXIe modular oscilloscopes support. This bus is also implemented as a redundant multi-lane bus (dual-bus analysis), which is also supported.

The ARINC 429 serial bus is used to interconnect avionics equipment in civilian aircrafts. This bus is also based on tri-level signaling (high, low and null) and requires dual-threshold triggering. Since ARINC 429 is a point-to-point bus, multi-lane analysis is also required to capture both send and receive data.

M9240NRZA user-definable Manchester and NRZ trigger and analysis

Keysight's Manchester and NRZ decode and trigger software supports user-defined protocols, offering flexibility and preventing the need to define multiple specific protocol decoding and triggering. This trigger and decode software application is geared toward automotive customers, who commonly use Manchester and NRZ encoded buses (ex: Profibus PA, DALI, PSI5, etc.).

Configuration

Step 1. Choose your bandwidth

M9241A - 2 channel, 200 MHz M9242A - 2 channel, 500 MHz M9243A - 2 channel, 1 GHz

Step 2. Tailor your oscilloscope with integrated capabilities and measurement applications

Model #	Description
M9240AWGA	WaveGen 20 MHz function/arbitrary waveform generator
M9240FRAA	Frequency response analyzer
M9240MSKA	Mask limit testing
M9240VIDA	Enhanced video/TV Application Package
M9240PWRA	Power analysis application
M9240NFCA	NFC triggering
M9240EMBA	Embedded serial triggering and analysis (I ² C)
M9240CMPA	Computer serial triggering and analysis (RS232/422/485/UART)
M9240ATOA	Automotive serial triggering and analysis (CAN, CAN-dbc, CAN FD, LIN)
M9240SNSA	SENT (single edge nibble transmission) triggering and analysis
M9240CXPA	CXPI trigger and decode
M9240AROA	MIL-STD 1553 and ARINC 429 serial triggering and analysis
M9240NRZA	User-definable Manchester and NRZ trigger and analysis

Software licenses offer multiple options. Typically users purchase the fixed permanent license that enables the software for as long as the oscilloscope is installed where the software license is located. Controller-based licensing enables licensed feature for all M924XA oscilloscopes in the system.

There are other alternatives:

- 1. Fixed permanent license (described above)
- 2. Transportable permanent license Can move the software license as needed
- 3. Fixed time-based license Enabled license for a limited time period
- 4. Transportable time-based Can move the software license as need for a limited time period

Step 3. Choose your probes

The M924XA Series oscilloscopes do not include any probes.

- Option 808 - Add N2843A 500 MHz passive probes

Other probes are supported but must be purchased as separate products. Please note that active probes (current, differential, extreme environment probes) require the purchase of the M924XA AutoProbe power module. This module supports the connection, power and communication of the AutoProbe interface. A single M924XA AutoProbe power module will supply the connections and power for two modular oscilloscopes installed in adjacent module slots.

Performance Characteristics

M924XA PXIe modular oscilloscopes

M924XA PXIe modular oscilloscopes over	view				
	M9241A	M9242A	M9243A		
Bandwidth (–3 dB) ¹	200 MHz	500 MHz	1 GHz		
Calculated rise time (10 to 90%)	≤ 1.75 ns	≤ 700 ps	≤ 450 ps		
Input channels	2	2	2		
Maximum sample rate	5 GSa/s one channel,	5 GSa/s one channel, 2.5 GSa/s two channels			
Maximum memory depth	Standard 4 Mpts, sta	Standard 4 Mpts, standard segmented memory			
Waveform update rate	≥ 1,000,000 waveform	≥ 1,000,000 waveforms/sec ²			

Vertical system analog channels				
		M9241A	M9242A	M9243A
Hardware bandwidth limits		Approximately 20 MH	Iz (selectable)	
Input coupling		AC, DC		
Input impedance		Selectable: 1 M Ω ± 19	% (15 pF), 50 Ω ± 3%	
Input sensitivity range		1 mV/div to 5 V/div (1	$M\Omega$ and 50 Ω)	_1 mV/div to 5 V/div (1 MΩ)
				1 mV/div to 1 V/div (50 Ω)
Vertical resolution		8 bits (measurement	resolution is 12 bits with averaging)	
Maximum input voltage		135 Vrms		
		With N2843A 10:1 pr	obe: 300 Vrms	
		Frequency de-rating	(assumes sine wave input): 400 Vpk	until 40 kHz. Then de-rates at 20 db/dec
		until 6 Vpk		
DC vertical accuracy		± [DC vertical gain accuracy + DC vertical offset accuracy + 0.21% full scale] ³		
DC vertical gain accuracy 1		± 2.0% full scale		
DC vertical offset accuracy		\pm 0.1 div \pm 2 mV \pm 1% of offset setting		
Channel-to-channel skew		> 100:1 from DC to maximum specified bandwidth of each model (measured with same V/div and		
		coupling on channels)	
Offset range		± 2 V (1 mV/div to 200 mV/div)		
		± 50 V (> 200 mV/div	to 5 V/div)	
Time base range		2 ns/div to 50 s/div	1 ns/div to 50 s/div	500 ps/div to 50 s/div
Time base accuracy ¹	Pre-trigger	± 1.6 ppm + aging fac	tor (1st year: ± 0.5 ppm, 2nd year: ±	0.7 ppm, 5 years: ± 1.5 ppm, 10 years:
		± 2.0 ppm)		
Time base delay time range Post-trigger		Greater of 1 screen width or 250 μs		
		1 to 500 s		
Channel-to-channel deskew range		± 100 ns		
Δ Time accuracy (using cursors)		\pm (time base acc. x reading) \pm (0.0016 x screen width) \pm 100 ps		
Modes		Main, zoom		

^{1.} Denotes warranted specifications. All others are typical.

Requires infinite persistence in order to visually display 1,000,000 wfm/sec.
 Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature. 1 mV/div and 2 mV/div are a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 1 mV div and 2 mV/div sensitivity setting.

Acquisition system				
		M9241A	M9242A	M9243A
Maximum analog channels sample		5 GSa/s half channel in	terleaved, 2.5 GSa/s all channel	
rate				
Maximum analog channels record		4 Mpts half channel into	erleaved, 2 Mpts all channel	
length				
Acquisition mode	Normal	Default mode		
	Peak detect	Capture glitches as narrow as 250 ps at all-time base settings		
	Averaging	Selectable from 2, 4, 8	, 16, 64, to 65,536	
	High	Real-time boxcar avera	ging reduces random noise and ef	fectively increases vertical resolution to
	resolution	12 bits of resolution wh	nen \geq 10 μ s/div at 5 GSa/s or \geq 20	μs/div at 2.5 GSa/s
	Segmented	Segmented memory optimizes available memory for data streams that have long dead times		
		between activity. Maxir	mum segments = 1000. Re-arm tin	ne = 1 μs (minimum time between trigger
		events)		
Time mode	Normal	Default mode	<u> </u>	

Trigger system					
	M9241A	M9242A	M9243A		
Trigger sources	Analog channel (1-2),	Analog channel (1-2), external, WaveGen (1 or mod) (FM/FSK)			
Trigger modes	Normal (triggered): R	equires trigger event for scope to	trigger		
	Auto: Triggers autom	atically in absence of trigger even	t		
	Single: Triggers only	once on a trigger event, press [Sir	ngle] again for scope to find another trigger		
	event, or press [Run]	to trigger continuously in either A	uto or Normal mode		
	Force: Trigger immed	iately and display acquisition			
Trigger coupling	DC: DC coupled trigg	er			
	AC: AC coupled trigger, cutoff frequency: < 10 Hz (internal); < 50 Hz (external)				
	HF reject: High-frequency reject, cutoff frequency ~ 50 kHz				
	LF reject: Low-frequency reject, cutoff frequency ~ 50 kHz				
	Noise reject: Selectable OFF or ON, decreases sensitivity 2x				
Trigger holdoff range	40 ns to 10.00 s				
Trigger sensitivity					
Internal ¹	< 10 mV/div: Greater	of 1 div or 5 mV; ≥ 10 mV/div: 0.6	div		
External ¹	200 mVpp from DC to	200 mVpp from DC to 100 MHz			
	350 mVpp 100 to 200 MHz				
Trigger level range					
Any channel	± 6 div from center screen				
External	±8 V				

 $^{1. \}quad \hbox{Denotes warranted specifications. All others are typical}.$

Trigger type selections			
	M9241A	M9242A	M9243A
Zone touch trigger		s drawn on the display. Applies to or ect." Up to two zones. > 200,000 so	ne analog channel at a time. Specify zones as either "must cans/sec update rate
	Supported modes: normal, pe	ak detect, high resolution	
	Also works simultaneously wi	th the serial trigger and mask/limit	test
Edge	Trigger on a rising, falling, alte	ernating or either edge of any sourc	e
Edge then edge (B trigger)	Arm on a selected edge, wait	a specified time, then trigger on a s	specified count of another selected edge
Pulse width	Trigger on a pulse on a select range	ed channel, whose time duration is	less than a value, greater than a value, or inside a time
		ns (500 MHz, 1 GHz), 6 ns (200 MHz	z)
	Maximum duration setting: 10		•
	Range minimum: 10 ns		
Runt		se that fails to exceed a high level th	nreshold. Trigger on a negative runt pulse that fails to
		-	e based on two threshold settings. Runt triggering can
			10 ns and maximum timesetting of 10 s
		100 MHz), 2 ns (500 MHz, 1 GHz)	
Setup and hold			me can be set from -7 to 10 s. Hold time can be set from
octup una nota	0 s to 10 ns	and/or note time violation. Getap til	into can be set from 7 to 10 s. Hota time can be set from
Rise/fall time		ne edge speed violations (< or >) ba	sed on user-selectable threshold
1000/ fatt tillio	Select from (< or >) and time s		Sea on aser selectable timeshola
	Minimum: 1 ns (500 MHz, 1 G		
	Maximum: 10 s	112), 3 113 (200 WI112)	
N th edge burst		5) edge of a pulse burst. Specify idl	a time (10 no to 10 a) for framing
Pattern			Is on any combination of analog or trigger channels is
rattern		-	
			2 ns to qualify as a valid trigger condition
		ns (500 MHz, 1 GHz), 6 ns (200 MHz	<u>/</u>
	Maximum duration setting: 10	18	
0	Range minimum: 10 ns		
Or		across multiple analog channels	'. '
Video	SECAM, PAM-M)		composite video or broadcast standards (NTSC, PAL,
Enhanced Video (optional)		enhanced and HDTV standards (480 750, 1080p760, 1080i750, 1080i760	0p/60, 567p/50, 720p/50, 720p/60, 1080p/24, 0)
I ² C (optional)	Trigger at a start/stop conditi	on or user defined frame with addre	ess and/or data values. Also trigger on missing acknowl-
	edge, address with no accq, r	estart, EEPROM read, and 10-bit w	rite
RS-232/422/485/UART	Trigger on Rx or Tx start bit, s	top bit or data content or parity err	or
(optional)			
CAN (optional)	Trigger on CAN (controller are	ea network) version 2.0A,2.0B, and	CAN-FD (flexible data-rate) signals. Trigger on the start of
	frame (SOF), the end of frame	(EOF), data frame ID, data frame IE	and data (non-FD), data frame ID and data (FD), remote
	frame ID, remote or data fram	ie ID, error frame, acknowledge erro	or, from error, stuff error, CRC error, spec error (ack or
	form or stuff or CRC), all error	rs, BRS bit (FD), CRC delimiter bit (F	FD), ESI bit active (FD), ESI bit passive (FD), overload
	frame., message, message ar	id signal (non-FD), message and sig	nal (FD, first 8 bytes only)
LIN (optional)			ne ID, or frame ID and data, parity error, checksum error,
•	frame (symbolic), frame and s	-	
MIL-STD 1553 (optional)			mmand/status), remote terminal address, data and errors
. 1	(parity, sync, Manchester end	3,1	**
ARINC 429 (optional)			op, label, label + bits, label range, error conditions (parity,
•		ll bits (eye), all 0 bits, all 1 bits	

Trigger type selections	s (Continued)			
	M9241A	M9242A	M9243A	
SENT (optional)	slow channel message II	-	start of slow channel message, fast channel SC and data, blerance violation, fast channel CRC error, slow channel ulses error (1/64)	
CXPI (optional)	Trigger and decode on CXPI data. Trigger on frame, PTYPE, frame ID or error by type. Decodes all message types and errors			
NFC (optional)	Trigger for NFC-A, NFC-	B,and NFC-F		

Waveform measu	ırements					
		M9241A	M9242A	M9243A		
Cursors		Single cursor accuracy: ± [DC vertical gain accuracy + DC vertical offset accuracy + 0.21% full scale]				
		Dual cursor accuracy 1: ± [DC vertical gain accuracy + 0.42% full scale]				
		Units: Seconds(s), H	z (1/s), phase (degrees), ratio (%)			
Automatic measur	rements	Measurements conti	nuously updated with statistics. C	ursors track last selected measurement.		
		Select up to eight me	easurements from the list below:			
		- Snapshot all: M	easure all single waveform measu	rements (31)		
		 Voltage: Peak-to 	o-peak, maximum, minimum, amp	litude, top, base, overshoot, pre-shoot,		
		average-N cycle	es, average-full screen, DC RMS-N	N cycles, DC RMS-full screen, AC RMS-N		
		cycles, AC RMS	-full screen (std deviation), ratio-N	N cycle, ratio-full screen		
		 Time: Period, free 	equency, counter, + width, - width	, burst width, +duty cycle, -duty cycle, bit		
		rate, rise time, f	fall time, delay, phase, X at min Y, X	⟨at max Y		
		 Count: Positive 	pulse count, negative pulse count	r, rising edge count, falling edge count		
		 Mixed: Area-N o 	cycles, area-full screen			
Automatic measu	rement logging	Available via BenchV	ue			
Counter		Built-in frequency co	unter			
		Source: On any analog				
		Resolution: 8 digits				
		Maximum frequency	: Bandwidth of scope			
Waveform math						
Number of math f	unctions		d one math simultaneously. Can b			
Arithmetic				FFT, Ax + B, squared, square root, absolute		
				ial, base 10 exponential, low pass filter, high		
		pass filter, averaged value, smoothing, envelope, magnify, max hold, min hold, measurement trend,				
		chart logic bus (timing or state)				
Enhanced FFT	Record size	Up to 64 kpts resolu				
	Window types		ectangular, Blackman-Harris			
	Time gated FFT	_	of data for FFT analysis in the zoor	m view. For time and frequency domain		
		correlated analysis				
	Waveforms	FFT, max hold, min hold, average				
	Peak search	Max 11 peaks, threshold and excursion control				
	Channel power	Power across one fre	, , ,			
	Occupied bandwidth			d channel frequency as specified by user		
	Adjacent channel power	Ratio the power in th	e main frequency range to the pov	wer contained in one or more sidebands		
	ratio					
	Total harmonic distortion	'	e fundamental frequency to the po	ower contained in the rest of the harmonics		
		and noise				

^{1.} Denotes warranted specifications. All other are typical.

Search, navigate a	nd lister				
		M9241A	M9242A	M9243A	
Type		Edge, pulse width, ris	Edge, pulse width, rise/fall, runt, frequency peak, serial bus 1, serial bus 2		
Сору		Copy to trigger, copy	Copy to trigger, copy from trigger		
Frequency peak	Source	Math functions			
Max # of Peaks		11			
	Control	Results order in frequency or amplitude			
Result display		Event lister or navigation. Manual or auto scroll via navigation or touch event lister entry to jump to a			
		specific event			

WaveGen - Built-in func	tion/arbitrary waveform generator (specifications are typical)	
	M9241A M9242A	M9243A
WaveGen out	Front-panel MMCX connector	
Waveforms	Sine, square, ramp, pulse, DC, noise, sine cardinal (sinc), exponential rise, expo	onential fall, cardiac, Gaussian pulse and
	arbitrary	
Modulation	Modulation types: AM, FM, FSK	
	Carrier waveforms: Sine, ramp, sine cardinal, exponential rise, exponential fall	and cardiac
	Modulation source: Internal (no external modulation capability)	
	AM:	
	 Modulation: sine, square, ramp 	
	 Modulation frequency: 1 Hz to 20 kHz 	
	Depth: 0 to 100%	
	FM:	
	 Modulation: sine, square, ramp 	
	 Modulation frequency: 1 Hz to 20 kHz 	
	 Minimum carrier frequency: 10 Hz 	
	 Deviation: 1 Hz to carrier frequency or (2e12/carrier frequency), whicheve 	er is smaller
	FSK:	
	 Modulation: 50% duty cycle square wave 	
	FSK rate: 1 Hz to 20 kHz	
	 Hop frequency: 2 x FSK rate to 10 MHz 	
Sine	Frequency range: 0.1 Hz to 20 MHz	
	Amplitude flatness: ± 0.5 dB (relative to 1 kHz)	
	Harmonic distortion: -40 dBc	
	Spurious (non harmonics): -40 dBc	
	Total harmonic distortion: 1%	
	SNR (50 Ω load, 500 MHz bandwidth): 40 dB (Vpp > = 0.1 V); 30 dB (Vpp < 0.1	V)
Square wave /pulse	Frequency range: 0.1 Hz to 10 MHz	
	Duty cycle: 20 to 80%	
	Duty cycle resolution: Larger of 1% or 10 ns	
	Pulse width: 20 ns minimum	
	Rise/fall time: 19 ns (10 to 90%)	
	Pulse width resolution: 10 ns or 5 digits, whichever is larger	
	Overshoot: < 2%	
	Asymmetry (at 50% DC): ± 1% ± 5 ns	
	Jitter (TIE RMS): 500 ps	
Ramp/triangle wave	Frequency range: 0.1 Hz to 200 kHz	
	Linearity: 1%	
	Variable symmetry: 0 to 100%	
	Symmetry resolution: 1%	

	M9241A	M9242A	M9243A		
Noise	Bandwidth: 20 MHz typical				
Sine cardinal (sinc)	Frequency range: 0.1 Hz to 1.	0 MHz			
Exponential rise/fall	Frequency range: 0.1 Hz to 5.	0 MHz			
Cardiac	Frequency range: 0.1 Hz to 20	00.0 kHz			
Gaussian pulse	Frequency range: 0.1 Hz to 5.	0 MHz			
arbitrary	Waveform length: 1 to 8k poi	nts			
	Amplitude resolution: 10 bits	. 0 0 .			
	Repetition rate: 0.1 Hz to 12 I	MHz			
	Sample rate: 100 MSa/s				
	Filter bandwidth: 20 MHz				
requency	Sine wave and ramp accuracy				
	- 130 ppm (frequency < 10 kHz)				
	50 ppm (frequency > 10 kHz)				
	Square wave and pulse accuracy:				
	- [50+frequency/200] ppm (frequency < 25 kHz)				
	50 ppm (frequency ≥ 25 kHz)				
	Resolution: 0.1 Hz or 4 digits, whichever is larger				
Amplitude	Range:				
	20 mVpp to 5 Vpp into Hi-Z				
	-10 mVpp to 2.5 Vpp into $50~\Omega$				
	Resolution: 100 μ V or 3 digits, whichever is higher				
	Accuracy: 2% (frequency = 1	kHz)			
OC offset	Range:				
	$-\pm 2.5$ V into Hi-Z				
	$-\pm 1.25$ V into 50Ω				
	Resolution: 100 μV or 3 digits, whichever is higher				
	Accuracy (waveform modes): ± 1.5% of offset setting ± 1% of amplitude ± 1 mV				
	Accuracy (DC mode): ± 1.5% of offset setting ± 3 mV				
rigger output	Trigger output available on trig out MMCX				
Main output	Impedance: 50 Ω typical				
	Isolation: Not available				
	Protection: Overload automa	tically disables output			
Output mode	Normal				
	Single-shot (arbitrary, sine, ra	amp, sine cardinal, exp rise/fall, cardiac, Gaussian pu	lse)		

^{1.} Full resolution is not available at output due to internal attenuator stepping.

Note: Gaussian pulse: 4 Vpp maximum into Hi-Z; 2 Vpp maximum into 50 Ω .

Digital voltmeter (specifications are typical)			
	M9241A	M9242A	M9243A
Functions	ACrms, DC, DCrms		
Resolution	ACV/DCV: 3 digits		
Measuring rate	100 times/second		
Autoranging	Automatic adjustment of vertical amplification to maximize the dynamic range of measurements		
Range meter	Graphical display of most recent measurement, plus extrema over the previous 3 seconds		

Precision counter	r/totalizer (specifications a	e typical)			
		M9241A	M9242A	M9243A	
Counter	Source	Any analog channel o	Any analog channel or trigger qualified event		
	Resolution	8 digits (for trigger q	8 digits (for trigger qualified event)		
	Max frequency 1 GHz				
Trig qual events 1/(trigger hold off time) for trigger qualified events (max 25 MHz,			(25 MHz, minimum dead time of 40 ns)		
Measurement		Frequency, period, to	talize		
Totalizer	Counter size	64-bit totalizing cour	64-bit totalizing counter		
	Edge	Rise or fall			
	Gating	Positive or negative l	evel. Select from analog channels	except the source	

Connectivity

Physical and virtual connections				
	M9241A	M9242A	M9243A	
Probe	$50\Omega/1M\Omega$			
Autoprobe connection	Supported with M924	Supported with M9240A AutoProbe power module		
WaveGen connector	MMCX	MMCX		
External trigger	MMCX 30Vrms/60Vdc max			
Auxiliary output	MMCX			
Reference I/O	MMCX			
PXI trigger	Off/Slave/Master	Off/Slave/Master		
	PXI_TRIG[0 - 7]			
	ARM PXI_TRIG[0-7]			

General and Environmental Characteristics

General and environmental			
	M9241A	M9242A	M9243A
Power consumption	35 W (typical) power on PXI connector		
	+ 3.3 V 3.2 A (typical)		
	+ 12 V 2.0 A (typical)		
	Operating	Storage	
Temperature	0 to 55 °C	–40 to 70 °C	
Altitude	Up to 10,000 ft (3048 m)	Up to 15,000 ft (4572 m)	
Humidity	Type tested 95% RH @ 40C non-condensing		
Dimensions	PXIe 3U/1 slot		
	(W x D x H) 20 mm x 210 mm x 135 mm		
Weight	.38 kg		

System requirements			
	M9241A	M9242A	M9243A
Operating systems	Windows 10 (32-bit and 64-bit)		
	Windows 8.1 (32-bit and 64-bit)		
	Windows 7 SP1 (32-bit and 64-bit)		
Processor speed	1 GHz 32-bit (x86), 1 GHz 64-bit (x6	ô4)	
Memory	Available memory 1 GB minimum		
Disk	Available disk space 2.5 GB available hard disk space		
Required application	n Keysight IO Libraries Suite version 17.2 or greater		
	Microsoft .NET Framework		
Display minimum	1024 x 768, 96 or 120 DPI		

Included standard with oscilloscope				
	M9241A	M9242A	M9243A	
Calibration	2 year			

Related literature

Publication title	Publication number
Mask/Waveform Limit Testing For InfiniiVision Series Oscilloscopes - Data Sheet	5990-3269EN
Serial Bus Options for InfiniiVision X-Series Oscilloscopes - Data Sheet	5990-6677EN
Triggering on Infrequent Anomalies and Complex Signals using Zone Trigger - Application Note	5991-1107EN
Using an Oscilloscope Time Gated Fast Fourier Transforms for Time Correlated Mixed Domain Analysis - Application Note	5992-0244EN



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