Keysight Technologies M9709A

AXIe High-Speed Digitizer/DAQ with High Channel Density

32 channels, 8-bit, up to 1 GS/s,
DC up to 500 MHz input frequency range

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Overview

Introduction

The M9709A is an extremely dense 8-bit high-speed digitizer, providing 32 synchronous channels of 1 GS/s sampling in a single-slot AXIe format, making it ideal for high channel density applications in advanced physics experiments, and aerospace & defense.

Product Description

The M9709A is an 8-bit digitizer, able to capture signals from DC up to 500 MHz at 1 GS/s with excellent measurement accuracy across 32 synchronous channels within a single card.

The M9709A also provides up to 16 GB of DDR3 acquisition memory and real-time data processing capability with four Xilinx FPGAs.

Applications

– Advanced research experiments such as hydrodynamics or plasma fusion
– Multichannel experiments

Product Features

- – 8-bit ADC resolution
- – 32 channels
- – 1 GS/s sampling rate
- – DC up to 500 MHz input frequency range (with -F05 option)
- – Up to 16 GB (512 MSamples/ch) of DDR3 acquisition memory
- – 50 Ω input impedance, DC coupled
- – Selectable 250 mV to 5 V input full scale range (FSR)
- – ± 0.5x FSR input voltage offset range
- – 15 ps RMS trigger time interpolator (TTI) precision
- – Support for Windows and Linux

Uncompromising Values

- – Exceptional channel density
- – Fast AXIe 8-bit digitizer
- – Excellent measurement fidelity
- – Large on-board acquisition memory
- – Very high digitized data throughput
- – Software support including multiple programmable interfaces for easy integration into existing environments
- – Reduced development time, fast time to market

Hardware Platform

Hardware Overview

The M9709A is a flexible modular AXIe 8-bit digitizer offering scalable features depending on application requirements. The standard configuration implements 32 channels of DC to 300 MHz instantaneous analog bandwidth (input frequency range), and acquiring data at 1 GS/s. For higher frequency signals, the -F05 option provides an extended instantaneous bandwidth of DC to 500 MHz.

Block Diagram

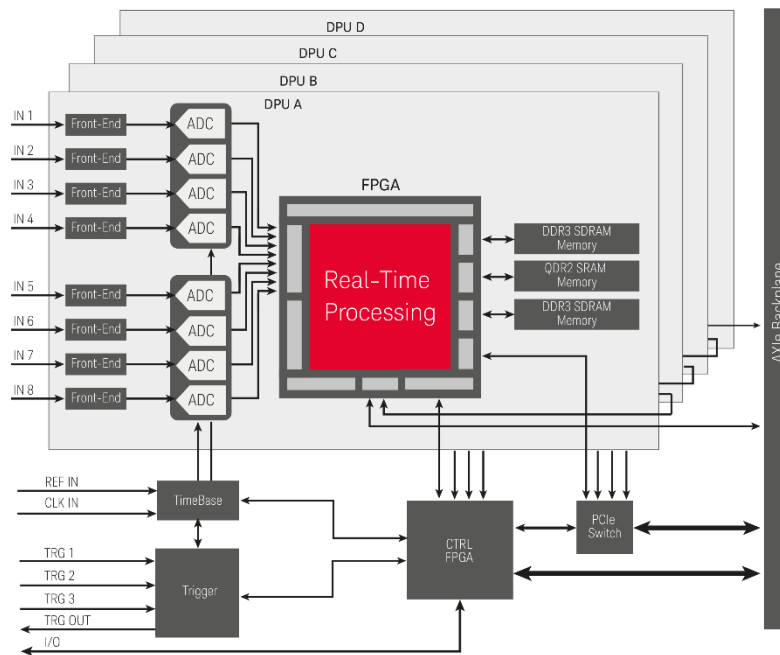Figure 1. Simplified block diagram of the M9709A, showing one DPU channel.U channel.

Data Processing

The M9709A implements four Xilinx Virtex-6 FPGAs dedicated to data processing. The four data processing units (DPU) implement a standard digitizer functionality firmware by default, allowing digitization of the signal, storage of the resulting data in the onboard memory and transfer through the PCIe backplane bus.

Front View

Data Processing Unit A
Input 1 - 8

Data Processing Unit B
Input 9 - 16

Data Processing Unit C
Input 17 - 24

Data Processing Unit D
Input 25 - 32

Reference Input

External Clock Input

Trigger In 1

Trigger In 2

Trigger In 3

Trigger Out

Input/Output 1

Input/Output 2
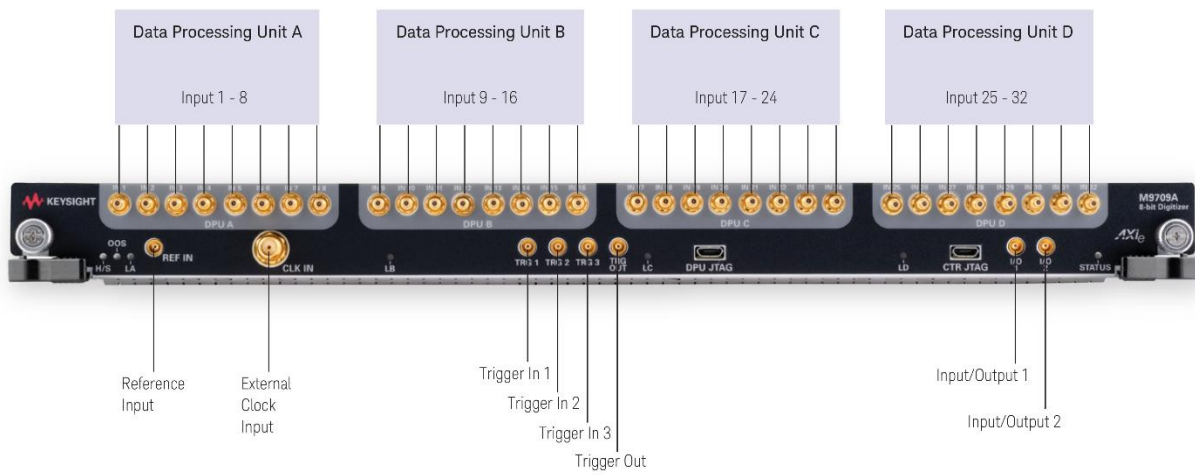
Top View
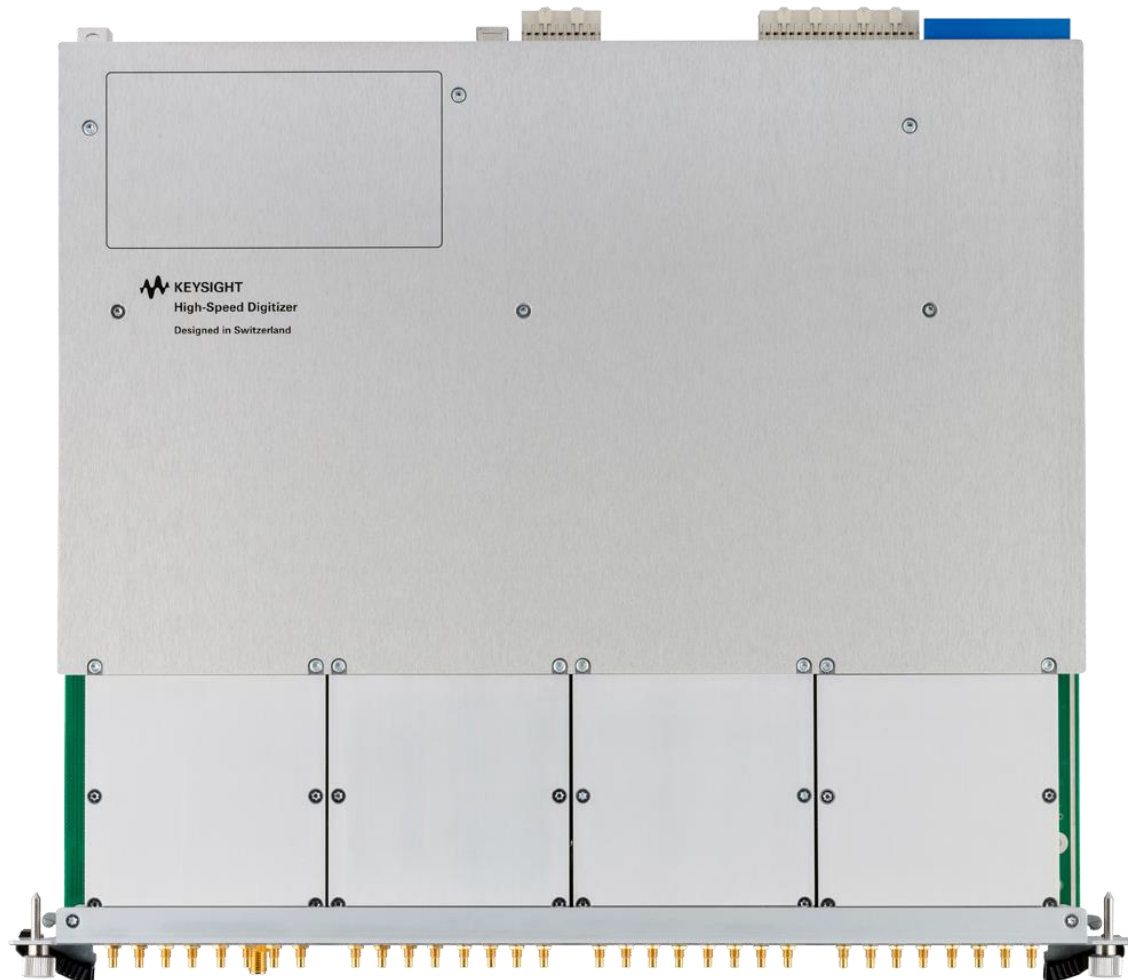
Multichannel Data Acquisition Systems

The M9709A occupies a single slot of AXIe chassis. The architecture is modular and extensible, to provide a fully operational multichannel system in a compact format.

Note that due to AXIe chassis power limitations, the multichannel system is limited to one M9709A digitizer in the M9502A 2-slot AXIe chassis, and three M9709A digitizers in the M9505A 5-slot AXIe chassis.

The examples below show some of the possible configurations:

– One M9709A digitizer in the M9502A 2-slot AXIe chassis delivers a 32-channel 8-bit system
– Three M9709A digitizers in the M9505A 5-slot AXIe chassis delivers a 96-channel 8-bit system

Figure 2. One M9709A digitizer and an M9537A high performance embedded controller installed in the M9502A 2-slot chassis, forming a 32-ch 8-bit standalone acquisition system.
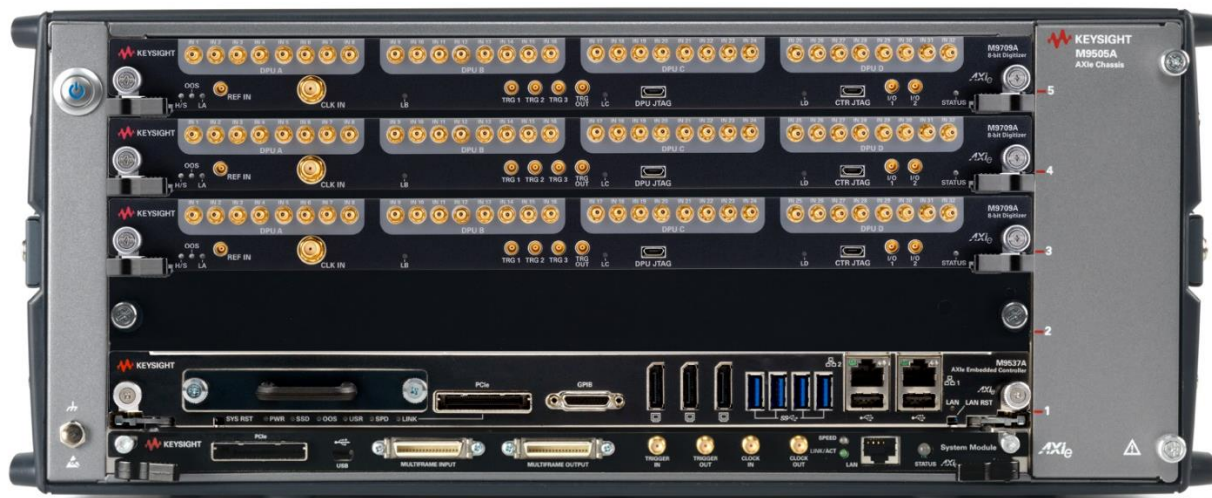

Figure 3. Three M9709A digitizers and an M9537A high performance embedded controller installed in the M9505A 5-slot chassis, forming a 96-ch 8-bit standalone acquisition system.

Software Platform

I/O Libraries

Keysight IO Libraries Suite offers fast and easy access to the M9709A digitizer using a standardized interface and ensuring compatibility and upgradability of the software applications.

The Keysight IO Libraries Suite displays all the modules in your system. From here you can view information about the installed software or launch the modules' soft front panel directly from Keysight Connection Expert (KCE). In addition, KCE offers an easy way to find the correct driver for your instrument.

Drivers

The module comes with the IviDigitizer class compliant Keysight MD2 IVI-COM and IVI-C drivers that work in the most popular development environments including Visual C/C++, C#, VB.NET, MATLAB, and LabVIEW. Linux is also supported using the IVI-C driver.

Easy Software Integration

To help you get started and complete complex tasks quickly, the M9709A digitizer is supplied with a comprehensive portfolio of module drivers, documentation, examples, and software tools to help you quickly develop test systems with your software platform of choice.

Compliance

The M9709A is compliant with AXIe$^{®}$ and AdvancedTCA (ATCA) formats. Designed to benefit from fast data interfaces, the product can be integrated into AXIe or ATCA chassis slots. Based on ATCA, the AXIe standard implements extensions for instrumentation and test, and uses clever techniques to add powerful timing features.

Software Applications

In addition, the M9709A includes the Keysight MD2 soft front panel (SFP) graphical interface. This software application can be used to control, verify the functionality, and explore the capabilities of the Keysight modular high-speed digitizers.
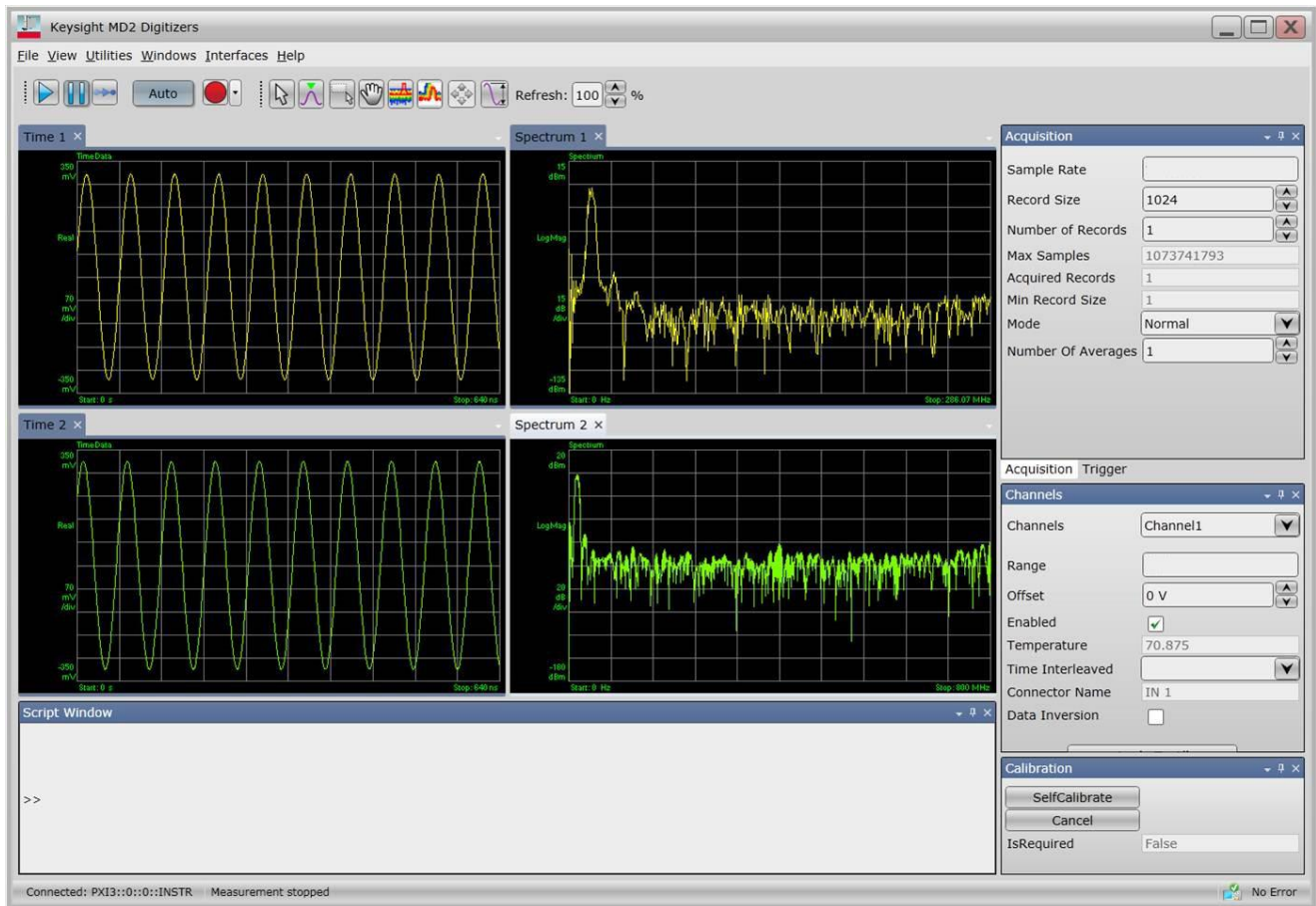
Figure 4. MD2 software front panel (SFP) interface.

The M9709A is also supported by the Keysight U1092A Multichannel Acquisition Software. This provides easy control and monitoring of advanced data acquisition systems with many channels, and is ideal for single-shot/event applications.

Firmware Options

The M9709A high-speed digitizer includes firmware option:

– DGT: Digitizer firmware

DGT Digitizer Firmware

This is the standard digitizer firmware which:

– Allows standard data acquisition, including: digitizer initialization, setting of acquisition and clocking modes, management of channel triggering for best synchronization, storing data in internal memory and/or transferring data through the backplane bus.
– Implements multi-record acquisition functionality.
– Supports fixed internal clocking frequency with internal or external reference, and variable frequency external clock.

Technical Specifications and Characteristics

Analog Input (SSMC Male Connectors)		
Number of channels		32
Impedance		50 Ω ± 2 % [1]
Coupling		DC
Full scale ranges (FSR)		250 mV, 500 mV, 1 V, 2.5 V, and 5 V
Maximum input voltage		± 5 V
Input voltage offset		± 0.5x FSR
Input frequency range (-3 dB bandwidth)	-F05	*DC to 500 MHz (nominal)*
	-F03	*DC to 300 MHz (nominal)*
DC gain accuracy		*± 1.0 % (typical)*
Offset accuracy		± 1.0 % in 1V FSR
Frequency response flatness		*± 1.0 dB from DC to 250 MHz (typical)*
Effective number of bits (ENOB) [2]	At 100 MHz	6.5 *(6.8 typical)*
Signal to noise ratio (SNR) [2]	At 100 MHz	41 dB *(43 dB typical)*
Spurious free dynamic range (SFDR) [2]	At 100 MHz	45 dB *(50 dB typical)*
Total harmonic distortion (THD) [2]	At 100 MHz	-42 dB *(-48 dB typical)*
Digital Conversion		
Resolution		8 bits
Acquisition memory	-M10	1 GB (32 MSamples/ch); standard
	-M40	4 GB (128 MSamples/ch); option
	-M16	16 GB (512 MSamples/ch); option
Sample clock sources		Internal or external
Internal clock source		Internal, external or backplane reference
Max. real-time sampling rates		Up to 1 GS/s per channel
Sampling jitter		*225 fs (nominal) [3]*
Clock accuracy		± 1.5 ppm
External clock source (CLK IN SMA connector)		
Impedance		*50 Ω (nominal)*
Frequency [4]	-SR1	4 GHz
Signal level		*+5 dBm to +15 dBm (nominal), 0 V DC*
Coupling		AC
External reference clock (REF IN MCX connector)		
Impedance		*50 Ω (nominal)*
Frequency range		*100 MHz ± 5 kHz (nominal)*
Signal level		*-3 dBm to +3 dBm (nominal)*
Coupling		AC
Acquisition modes		Single shot
		Sequence (multi-record) [5]

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1. Input impedance is 150 Ω during the calibration process.
2. Measured at 1.0 GS/s and 1 V FSR for a -1 dBFS input signal in internal clock mode with -F05 option.
3. Jitter figure based on phase noise integration from 100 Hz to 1000 MHz.
4. The sampling rate corresponds to the external clock frequency/4.
5. Up to 65,536 records. Maximum record length = memory size/number of channels.

Trigger

Trigger modes		Positive or negative edge
Trigger sources		External, Software, Channel, AXIe Synchronization
External trigger (TRG 1, TRG 2, TRG 3 MCX connectors)		
Coupling		DC
Impedance		*50 Ω (nominal)*
Level range		*± 5 V (nominal)*
Amplitude		0.5 V pk-pk
Frequency range		DC to 2 GHz
Maximum time stamp duration		52 days
Trigger time interpolator resolution	External	*8 ps (nominal)*
	Channel	1 sample
Trigger time interpolator precision	External	*15 ps RMS (nominal)*
	Channel	1 sample
Rearm time (deadtime)		*< 800 ns (nominal)*
Trigger out (TRG OUT MCX connector) [1]		1 (programmable), 50 Ω source
	Signal level	*0.8 Vpp ± 2.5 Voffset (nominal) into high impedance*

Control IO (I/O 1 and I/O 2 MCX connectors)

Output functions	Acquisition active Trigger is armed Trigger accept resynchronization Low level High level

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1. At 10 MHz on a 50 Ω load.

Environmental and Physical [1]

Temperature range	Operating	0 to +40°C
	Non-operating	-40 to +70°C

Altitude		Up to 10,000 feet (3,048 meters)
EMC		Complies with European EMC Directive

EMC – Complies with European EMC Directive
- IEC/EN 61326-1
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11
- ICES/NMB-001

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

Power Dissipation

-48 V	Total Power
4.4 A (typical)	*210 W (typical)*

Mechanical Characteristics

Form factor	1 slot AXIe
Size	30 mm W x 322.2 mm H x 280 mm D
Weight	3.3 kg (7.27 lbs)

System requirements

Topic	Windows	Linux
Operating systems	Windows 10 (32-bit and 64-bit), All versions Windows 8.1 (32-bit and 64-bit), All versions Windows 7 SP1 (32-bit and 64-bit)	Linux Kernel 2.6 or higher (32 or 64-bit), Debian 7.0, CentOS 6
Processor speed	1 GHz 32-bit (x86), 1 GHz 64-bit (x64), no support for Itanium 64	As per the minimum requirements of the chosen distribution
Available memory	1 GB minimum [2]	As per the minimum requirements of the chosen distribution
Available disk space	2.5 GB available hard disk space, includes: [3] – 1 GB for Keysight IO Libraries Suite – 1 GB for Microsoft .NET Framework	100 MB
Display	Minimum of 1024 x 768, 96 or 120 DPI	No display required
Browser	Use a supported version of Internet Explorer; see https://support.microsoft.com/en-gb/help/17454/lifecycle-faq-internet-explorer	Distribution supplied browser

1. 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 Class 3.
2. On older PCs with minimum RAM, installation can take a long time when installing the IO Libraries Suite and the .NET Framework.
3. Because of the installation procedure, less disk space may be required for operation than is required for installation. The amount of space listed above is required for installation. The .NET Framework Runtime Components are installed by default with most Windows installations, so you may not need this amount of available disk space.

Definitions for Specifications

Specifications describe the warranted performance of calibrated instruments that have been stored for a minimum of 2 hours within the operating temperature range of 0 to 40°C, unless otherwise stated, and after a 45 minute warm-up period. Data represented in this document are specifications unless otherwise noted.

Characteristics describe product performance that is useful in the application of the product. Characteristics are often referred to as Typical or Nominal values.

–   *Typical* describes characteristic performance, which 80% of instruments will meet when operated over a 20 to 30°C temperature range. Typical performance is not warranted.
–   *Nominal* describes representative performance that is useful in the application of the product when operated over a 20 to 30°C temperature range. Nominal performance is not warranted.

Note: All graphs contain measured data from several units at room temperature unless otherwise noted.

Calibration intervals

The M9709A is factory calibrated and shipped with a calibration certificate.

Calibration is recommended every year in order to verify product performance.

Configuration and Ordering Information

Software Information

Chassis Slot Compatibility: AXIe, ATCA	
Supported operating systems	See system requirements
Keysight IO libraries	Includes: VISA libraries, Keysight Connection Expert, IO Monitor

Related Products

Model	Description
M9502A	2-slot AXIe Chassis
M9505A	5-slot AXIe Chassis
M9514A	14-slot AXIe Chassis
M9048A	PCIe Desktop Adapter, PCIe Gen 2 (x8)
Y1202A	PCIe Cable, 2.0 m Long, PCIe Gen 3 (x8)
M9537A	AXIe High Performance Embedded Controller
U1092A-S0x	Keysight AcqirisMAQS Multichannel Acquisition Software
M9703B	AXIe 12-bit Digitizer, 8 Channels
M9710A	AXIe 10-bit Digitizer, 4 Channels

Accessories

Model	Description
U5300A-100	SSMC Female to BNC Female Cable, 1 m Long
U5300A-111	SSMC Torque Wrench
U5300A-105	MCX Male to BNC Male Cable, 1 m Long

Typical System Configuration

Model	Description
M9709A	AXIe 8-bit Digitizer, 32 Channels
M9505A	5-slot AXIe Chassis
M9048A	PCIe Desktop Adapter, PCIe Gen 2 (x8)
Y1202A	PCIe Cable, 2.0 m Long, PCIe Gen 3 (x8)

Ordering information

Model	Description	
M9709A	AXIe High-Speed Digitizer/DAQ, 8-bit, 1 GS/s, 32-ch	
	Includes:	Software, example programs and product information on CD SSMC female to BNC female cable, 1m (qty 2) MCX male to BNC male cable, 1 m (qty 2)

Configurable Options		
Sampling Rate		
✓ M9709A-SR1	1 GS/s sampling rate version	
Bandwidth		
✓ M9709A-F03	DC to 300 MHz bandwidth	
M9709A-F05	DC to 500 MHz bandwidth	
Memory		
✓ M9709A-M10	1 GB (32 MSamples/ch) acquisition memory	
M9709A-M40	4 GB (128 MSamples/ch) acquisition memory	
M9709A-M16	16 GB (512 MSamples/ch) acquisition memory	
Firmware		
✓ M9709A-DGT	Digitizer firmware	

Calibration	
M9709A-UK6	Commercial Calibration Certificate with Test Data
M9709A-A6J	ANSI Z540-1-1994 Calibration
M9709A-1A7	Calibration + Uncertainties + Guardbanding (not Accredited)
Recalibration Service Plans	
R-50C-011-3	Calibration Assurance Plan - Return to Keysight - 3 years
R-50C-011-5	Calibration Assurance Plan - Return to Keysight - 5 years

✓   These options represent the standard configuration.

Instrument Upgrades

Description	Upgrade Number	Additional Information
Bandwidth upgrade from 300 MHz to 500 MHz	M9709AU-F05	**Return to Keysight for upgrade**
Memory upgrade from 1 GB to 4 GB	M9709AU-M40	Customer installable license key
Memory upgrade from 4 GB to 16 GB	M9709AU-M16	Customer installable license key
Memory upgrade from 1 GB to 16 GB [1]	M9709AU-M40 M9709AU-M16	Customer installable license keys

1. Upgrading from 1 GB to 16 GB requires two upgrade licenses.

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

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