

M9506A

High-Performance, 5-slot AXIe Chassis

PCIe Gen 3, 16 GB/s slot BW, up to 300 W/slot



Introduction

The Keysight Technologies, Inc. M9506A is a high-performance AXIe chassis and is the best choice for demanding, modular applications. The chassis is compliant with the AXIe 1.0 Rev 3.0 Wide-AXIe specification. It provides 5 slots for AXIe instrument modules, up to 300 watts per slot, and includes an embedded system module that does not take up an instrument slot. The embedded system module (ESM) provides a Gen 3 x8/x16 PCIe® interfaces for connecting the chassis to an external controller or expanding the system using multiple chassis. To minimize rack space, the instrument module slots are arranged horizontally. The chassis is the quietest AXIe chassis available with its new cooling design.



Key Features

- Five x16 Gen 3 slots compliant to AXIe 1.0 Revision 3 (AXIe-wide)
- Embedded system module with flexible, dual Gen 3 x8 PCIe interface for high data BW and multi- chassis configurations
- Thunderbolt TM 3 interface provides an alternative connection to a Thunderbolt-equipped laptop or desktop computer and doesn't require a PC interface card in most cases
- Optional integrated backside controller for digitizers (M9506A-BC1), enabling secure SCPI over LAN functionality
- 62 differential, high-bandwidth local bus lines provide very large data path between adjacent modules
- High-performance, push-pull cooling system increases airflow while decreasing fan noise
- High-power with up to 300W cooling per slot
- Open Zone 3 for system customization
- Multi-chassis power-sequencing and front panel external trigger inputs/outputs for multi-chassis synchronization
- Front-removable fan trays
- GPS synchronization and time stamping option

Backplane Configuration

The M9506A provides a Gen 3 x16 PCIe linked to each instrument along with a high-performance local bus, GbE LAN fabric, DC power rail, and triggering lines.



Figure 1. M9506A AXIe chassis backplane

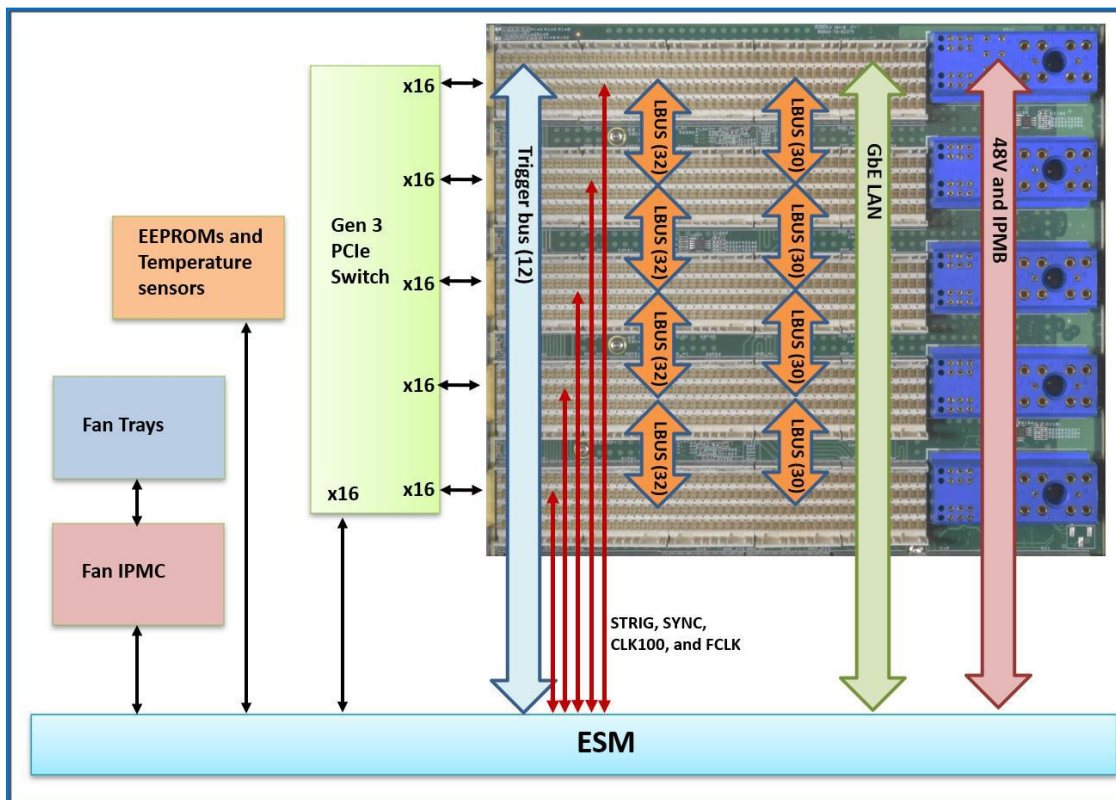


Figure 2. Backplane block diagram

Embedded System Module (ESM)

The M9506A AXIe chassis utilizes an embedded system module to perform the chassis management functions contained in the AXIe specification. In addition, the ESM also provides external clock and trigger in/out connectors for system synchronization. It can be connected to the host using either a Gen 3 x8/x16 PCIe or Thunderbolt 3 cable. The front panel x8 PCIe connectors are disabled when using the Thunderbolt connection.

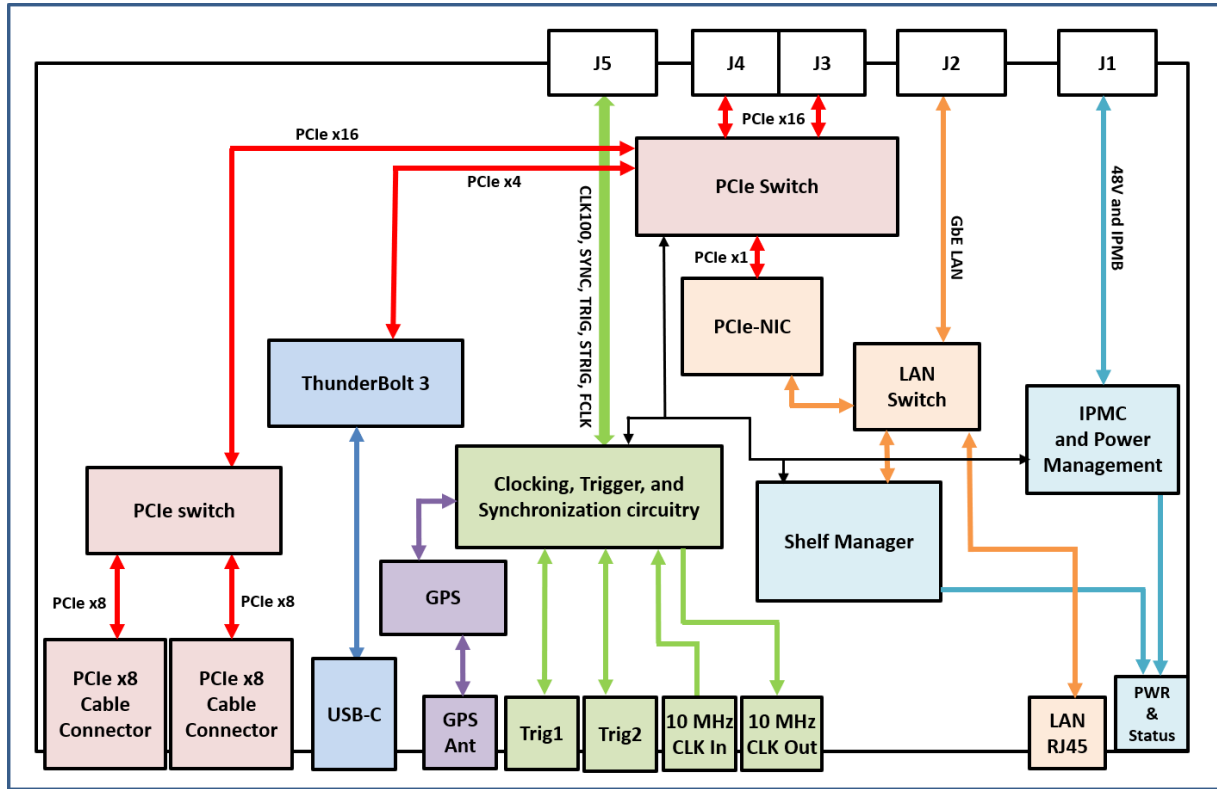


Figure 3. M9506A ESM block diagram

Open Zone 3

The M9506A chassis provides access to the Zone 3 defined in the AXIe standard. Access to Zone 3 is achieved by removing back panel and backplane covers. This will access to the Zone 3 area on modules in slots 2-5 and is perfect for applications such as running cable to the back of AXIe modules.



Figure 4. M9506A Zone 3 access

GPS Synchronization and Timestamping

The M9506A-GPS option adds GPS synchronization ability along with an external antenna port on the front panel. It provides an accurate 1 PPS output and the 10/100 MHz reference can be locked to this clock. The PPS signal can be propagated to trigger I/O and trigger events can be timestamped. Other GPS information is also provided including latitude, longitude, and altitude.

Software Platform

Driver

The M9506A chassis comes complete with IVI, NET, IVI-C, and LabVIEW drivers. Windows 7, 8.1, and 10 operating systems are supported, and applications can be created using a variety of software tools including LabVIEW, LabWindows/CVI, MATLAB, VEE, Visual Basic, VisualStudio.NET (C/C++, C#, VB.NET).

Chassis Web Interface

The AXIe chassis includes a built-in Web interface for configuration, control, and monitoring of the chassis (Figure 5). This interface can be accessed by either LAN or PCIe.

The screenshot displays the web interface for the M9506A AXIe 5 Slot Chassis. The interface includes a navigation menu with options like Home, Module Configuration, Fan Control, E-keying, Configure LAN, and Health. A main section shows the chassis status as 'Connected to AXIe M9506A chassis at IP address 141.183.189.112' and a 'Turn On Front Panel Identification Indicator' button. A description table provides details about the model, manufacturer, serial number, firmware, and license. A 'Fan Control' section shows a fan speed slider set to 35% of maximum RPM. A 'Chassis Health' section displays a table of sensor readings for various instruments and modules.

Module Slot	Instrument	State	Sensor Readings					
			ID	Type	Name	Lower Critical	Reading	Upper Critical
5	AXIe System Controller	Active						
Nominal			6	Voltage	SYSTEM 5V	4.96 Volts	5.04 Volts	5.02 Volts
Nominal			7	Voltage	SYSTEM 3.30V MG	3.00 Volts	3.28 Volts	3.64 Volts
Nominal			8	Voltage	SYSTEM 3.3V	3.00 Volts	3.44 Volts	3.64 Volts
Nominal			9	Voltage	PEX 1.8V	1.64 Volts	1.76 Volts	1.98 Volts
Nominal			10	Voltage	XLINLIX 1.2V MGT	1.08 Volts	1.18 Volts	1.32 Volts
Nominal			11	Voltage	XLINLIX 1.2V	1.08 Volts	1.18 Volts	1.32 Volts
Nominal			12	Voltage	0.9V 8718	0.78 Volts	0.90 Volts	1.00 Volts
Nominal			13	Voltage	0.9V_A 8749	0.78 Volts	0.88 Volts	1.00 Volts
Nominal			14	Voltage	0.9V 8749	0.78 Volts	0.90 Volts	1.00 Volts
Nominal			15	Temperature	IPMC Temp	-5.00 degrees C	27.00 degrees C	75.00 degrees C
Nominal			16	Temperature	PSU3 Temp	-5.00 degrees C	29.00 degrees C	75.00 degrees C
Nominal			17	Temperature	PSU4 Temp	-5.00 degrees C	30.00 degrees C	75.00 degrees C
Nominal			18	Temperature	GPB FPGA Temp	-35.00 degrees C	29.00 degrees C	85.00 degrees C
Nominal			19	Temperature	PLX8718 Temp	-5.00 degrees C	29.00 degrees C	65.00 degrees C
Nominal			20	Temperature	PLX8479 Temp	-5.00 degrees C	32.00 degrees C	85.00 degrees C

Figure 5. M9506A Web interface

Soft Front Panel Interfaces

Two Soft Front Panel (SFP) interfaces to monitor and control the AXIe chassis are provided with the M9506A driver. Both SFPs use the IVI driver for communications with the chassis.

- The chassis monitoring SFP has some of the basic functionality of the chassis Web page and allows the user to review numerous performance characteristics such as fan speeds, chassis temperatures, and power supply operating conditions. The monitoring SFP is shown in Figure 6.
- The triggering SFP provides an interface to the chassis triggering subsystem and simplifies triggering setup. The trigger SFP is shown in Figure 7.

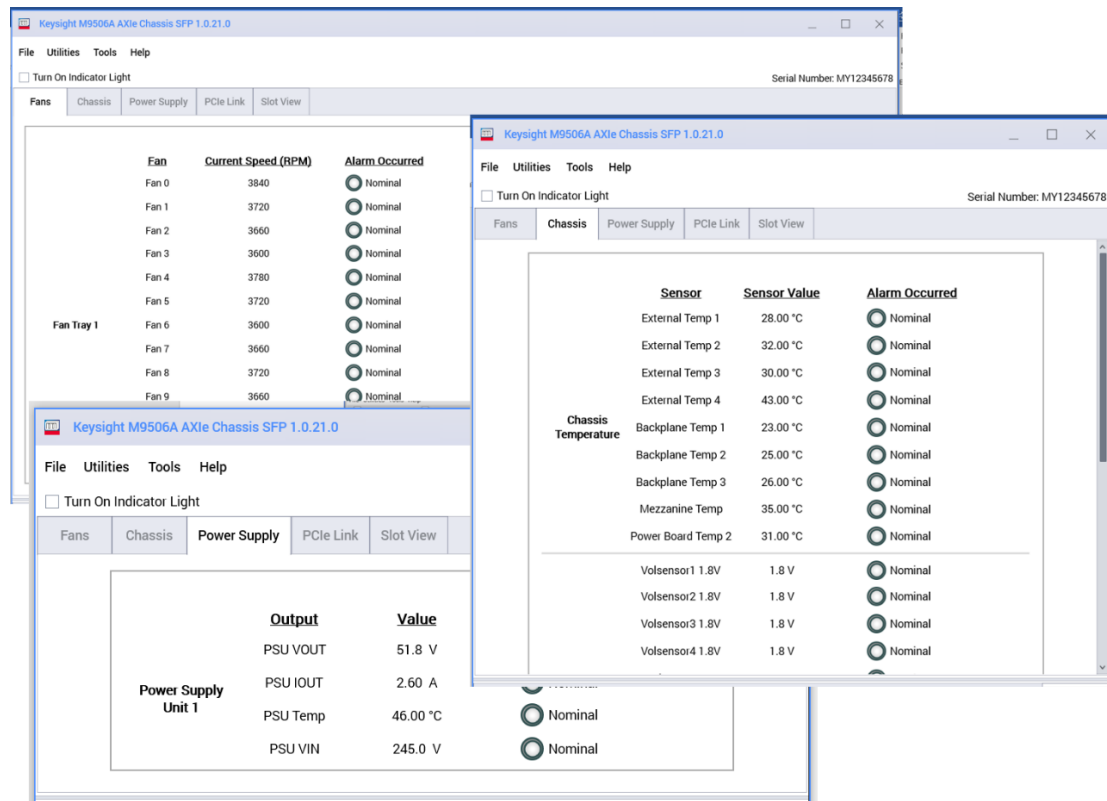


Figure 6. Chassis monitoring SFP

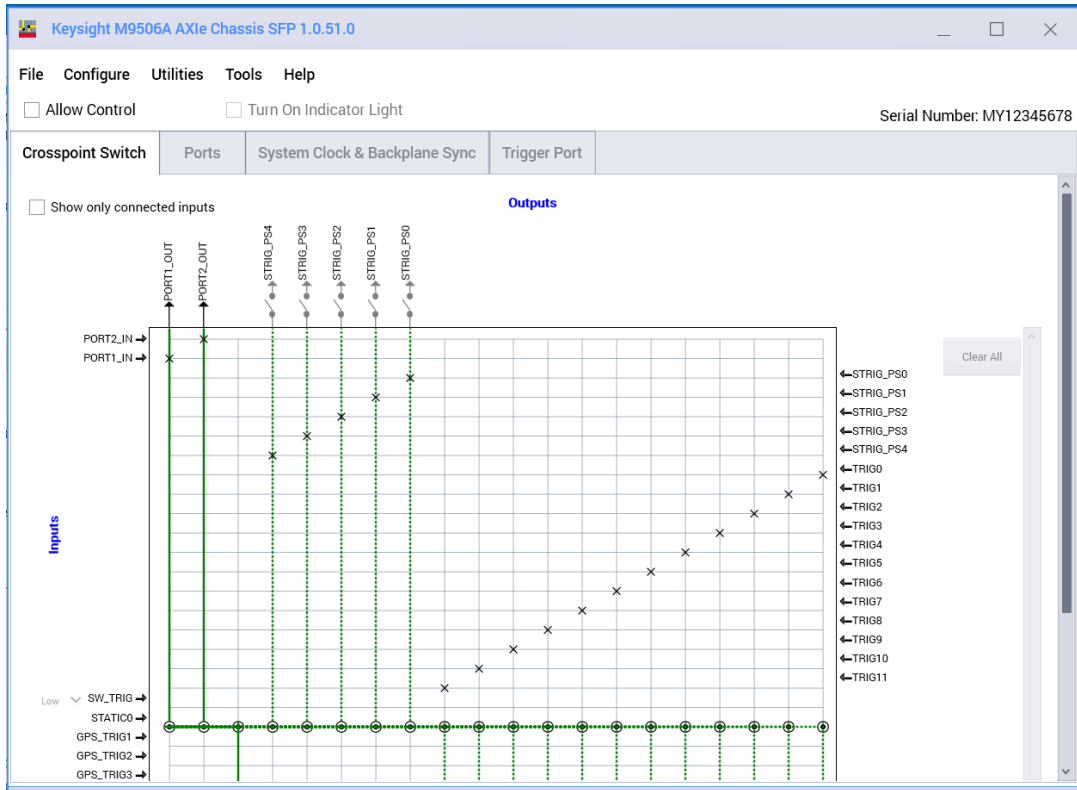


Figure 7. Trigger SFP

Technical Specifications and Characteristics

General Chassis Characteristics		
Standards Compliance		
AXIe-1 Revision 3.0		
Backplane		
Instrument module slots	5	
AXIe system module	Embedded	
ESM slot configuration	x16	
AXIe instrument slot configuration	x16	
Backplane speed	PCIe revision 3.0 (Gen 3)	
Mechanical		
Size	482mm W x 195mm H x 497mm D (with bumpers)	
	449mm W x 177mm H x 497mm D (with bumpers removed)	
	4U x 1 rack width	
Weight (without modules)	23.5 kg (51.8 lbs)	
Power Supply Characteristics		
AC Input		
Operating voltage/power ¹	100/120 V, 1380 W (maximum) 220/240 V, 2000 W (maximum)	
Input frequency range	50/60 Hz	
Over current protection	Auto-recovery	
DC output		
DC output voltage	52 V	
Maximum ripple and noise	500 mV pk-pk	
Instrument Module DC Output Power Characteristics	100/120 V AC	220/240 V AC
Maximum DC output power	940 W	1500 W
Maximum DC output current	18.0 A	28.8 A
Power dissipation, instrument slot		
100/120 V	300 W ^{2,3}	
220/240 V	300 W ³	
Chassis Cooling		
Slot airflow direction	Right to Left	
Chassis cooling intake	Right side of chassis	
Chassis cooling exhaust	Left side of chassis	
Chassis cooling fans	Six 90 cfm intake fans and six 90 cfm exhaust fans	

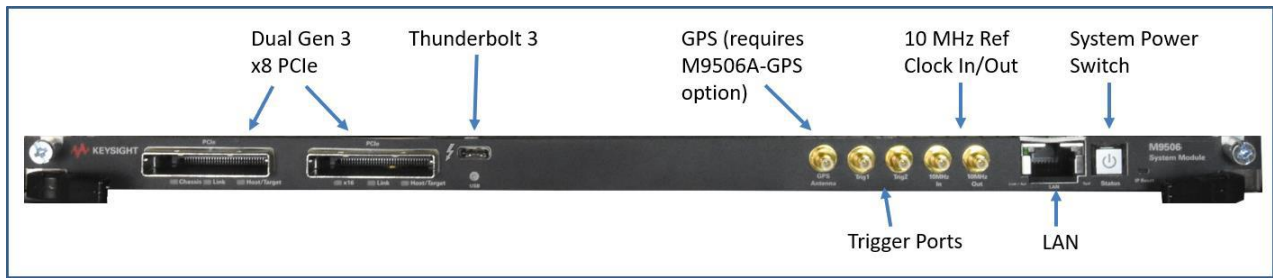
¹Auto switching between 100/120V and 220/240V

²Limit total slot power dissipation to 940W when using 100/120 VAC (a maximum of three slots dissipating 300W each are supported)

³A maximum per slot dissipation of 300W at 40°C and 1500m will result in a ≤15°C module temperature rise. At 50 °C and 3000m, module temperature rise will be ≤18°C

Clocks and Triggers	
100 MHz System Clock (CLK100)	
Maximum slot-to-slot skew	100 ps
Accuracy	±30 ppm
Input impedance	50 Ω
AXIe Differential Star Trigger (STRIG)	
Maximum slot-to-slot skew	100 ps
External Clock Out (10 MHz Out)	
Connector	SMB
Output frequency	10 MHz ± 30 ppm
Output level	3.3 V, AC coupled
Output impedance	50 Ω
External Clock In (10 MHz In)	
Connector	SMB
Frequency input	10 MHz ±100 ppm
Input level	5V pk-pk, AC coupled
Minimum swing	250 mV
Input impedance	50 Ω
External Triggers (Trig1 and Trig2)	
Connectors	SMB
Direction	Programmable
Output level	3.3 V CMOS
Output impedance (push-pull)	50 Ω
Output impedance (open-drain)	316 Ω pulled up to 3.3 volts
Input level	±5 V, adjustable threshold
Input impedance	50 Ω or 3 kΩ (programmable)
Minimum input swing	250 mV
GPS Option	
Receiver	U-Blox LEA-M8F
Supported systems	GPS (L1), GLONASS (L1), and BeiDou (B1)
PPS accuracy	≤ 20ns Clear sky
Tracking sensitivity	-165 dBm (GPS, GLONASS), -160 dBm (BeiDou)
Sensitivity (cold start)	-148 dBm (GPS), -145 dBm (GLONASS), -138 dBm (BeiDou)
Required antenna type	3.3V Active Antenna
Active antenna recommendations	Minimum gain: 15dB Maximum gain: 30dB Maximum noise figure: 1.5dB
Antenna connector	SMB

ESM Front Panel Connectors



Environmental Characteristics^{1,2}

Operating and Storage Conditions	Operating	Storage	
Temperature	0°C to 50°C	-40°C to 70°C	
Altitude	Up to 3000m	Up to 4600m	
Maximum Relative Humidity (non-condensing):	Type tested, 95%RH up to 40°C, decreases linearly to 45%RH at 50°C ³		
Vibration			
Operating random vibration: type-tested at 5 to 500 Hz, 0.21 g rms			
Survival random vibration: type-tested at 5 to 500 Hz, 2.09 g rms			
Acoustical Emissions (referenced to 1 pW)	Typical Emissions at Different Cooling Loads per Slot ⁵		
	200 W	250 W	300 W ⁶
Sound pressure level ⁴	60.8 dBA	64.5 dBA	71.0 dBA
Sound power	68.0 dBA	70.9 dBA	72.5 dBA

Regulatory Characteristics

Safety

Complies with the essential requirements of the European LVD Directive of the following standards (dates and editions are cited in the Declaration of Conformity):

- IEC/EN 61010-1
- Canada: CSA C22.2 No. 61010-1
- USA: UL std no. 61010-1

Acoustic Statement (European Machinery Directive)

Acoustic noise emission LpA < 70 dB

Operator position

Normal operation mode per ISO 7779

¹Samples 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

²Test Methods are aligned with IEC 60068 -2 and levels are similar to MIL-PRF-28800F Class 3

³From 40°C to 50°C, the maximum % Relative Humidity follows the line of constant dew point

⁴At operator position

⁵At sea-level and 25°C ambient temperature

⁶Maximum fan speed

Regulatory Characteristics (continued)

EMC
Complies with European EMC Directive of the following standards (dates and editions are cited in the Declaration of Conformity): <ul style="list-style-type: none">• 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 a la norme NMB-001 du Canada

Definitions for Specifications

Specification (spec)
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 the “Environmental and Regulatory” section of this data sheet. In addition, the following conditions must be met: <ul style="list-style-type: none">• Instrument is within its calibration cycle if calibration is required.• Instrument has been stored for a minimum of 1 hour within the operating temperature range prior to turn-on and after a 30-minute warm-up period.
Characteristics
Characteristics describe product performance that is useful in the application of the product, but that is not covered by the product warranty. Characteristics are often referred to as Typical or Nominal values.
Typical (typ)
Expected performance of an average unit when operated over a 20 to 30 °C temperature range. Typical performance is not warranted. The instrument must be within its calibration cycle if calibration is required.
Nominal (nom)
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.
Additional Information
All data are measured from multiple units at room temperature and are representative of product performance within the operating temperature range unless otherwise noted.
The data contained in this document is subject to change.

Configuration

Configure the Keysight M9506A AXIe chassis as follows:

1. Select the appropriate power cord based on the country where the chassis will be used. If this is North America, Japan, or Taiwan, there are two choices (100-120V and 200 – 240V). If more than 940 W are required based on the AXIe modules used, then the chassis must be operated on 200 – 240 VAC and the appropriate power cord should be selected.
2. Select control approach:
 - If an embedded controller is required, select an AXIe embedded controller (Keysight M9537A is recommended)
 - If an external computer is being used, select an appropriate PC interface card (Keysight M9048B / M9049A are recommended)
 - If SCPI over LAN for digitizers is required, select option -BC1
3. Select an appropriate cable to connect the computer interface board to the chassis interface (the Y1202A is recommended to connect the M9048B and M9022A)
4. Order an Y1221A AXIe Filler Module for each chassis slot which will be empty once the AXIe modules are installed. AXIe Filler Modules are not included with the chassis.
5. If the chassis is going to be rack-mounted, order the Y1227A rack mount kit (Figure 7)
6. Select other accessories as required



Figure 8. Y1227A Rack Mount Kit

Multi-chassis Configuration

The M9506A can be used in multi-chassis configurations with other AXIe chassis and PXIe Chassis (such M9019A). The number of chassis that can be interconnected depends on the controller and operating system used. See [Tested PC and PXI/AXIe Chassis Configurations \(5990-7632EN\) Technical Overview](#) for more details.

Option -BC1: Integrated Backside Controller for Digitizer Modules

Test system security is a challenge that many Aerospace and Defense (AD) customers face. The open operating systems found in current test equipment is a vulnerability point that requires significant management and overhead. Additionally, many of these customers prefer the ease of use of traditional benchtop equipment which have LAN interfaces, SCPI programming, and historically had closed operating systems.

Option -BC1 was developed to enhance security for high channel count digitizer applications, bringing the ease of use of traditional benchtop together with the benefits of a modular platform. A simple LAN connection gives you easy SCPI based control of many channels in a small space.

- Ease of use of traditional benchtop
 - LAN Interface
 - SCPI programming
 - Closed OS
- Benefits of modular platform
 - Performance
 - Channel density
 - Power consumption / cable management

Option -BC1 adds a closed, instrument-grade, Linux-based controller to the back of the M9506A chassis. It includes the necessary software layers (i.e. VISA / HiSLIP server, SCPI parser, Linux instrument driver) for SCPI over LAN control of the M9703B, M9710A, and M9709A digitizers. (see Figure 9).

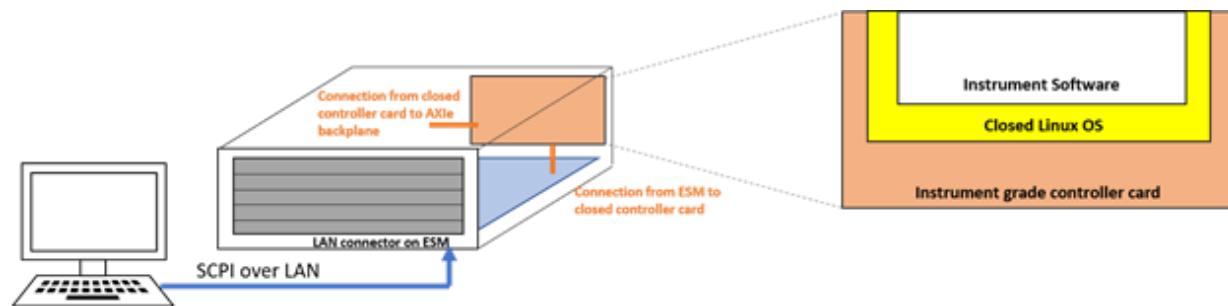


Figure 9. Conceptual block diagram for M9506A-BC1. Support of additional HW simply requires additional software

Ordering Information

Software

Supported Software Components	
Operating systems	Microsoft Windows 7 (32/64-bit), Microsoft Windows 8 (32/64-bit), Microsoft Windows 10 (32/64-bit)
Standard compliant drivers	IVI.NET, IVI-C, LabVIEW, MATLAB
Application development environments (ADE)	Visual Studio (VB.NET, C#, C/C++), LabVIEW, LabWindows/CVI, VEE
Keysight IO libraries	Version 2018 update 1 (or greater)

Hardware

Model	Description
M9506A	AXIe chassis: 5-slot, Gen 3, Embedded System Module AXIe Filler Modules are not included
M9506A-BC1	Integrated Backside Controller for Digitizer Modules ¹
M9506A-GPS	GPS synchronization and timestamping
Accessories	
Y1221A	AXIe Filler Module
Y1227A	M9506A rack mount kit
Related Products	
M9537A	Embedded AXIe controller
M9048B and M9049A	PCIe host adapter: Gen 3, x8 or x16
Y1202A	PCIe cable: x8, 2.0 m

¹Option -BC1 only supports M9703B, M9710A, M9709A digitizers

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