

M9046A 18-slot PXIe Chassis

PCIe Gen 3, 24 GB/s, High Power,
Exceptional Cooling

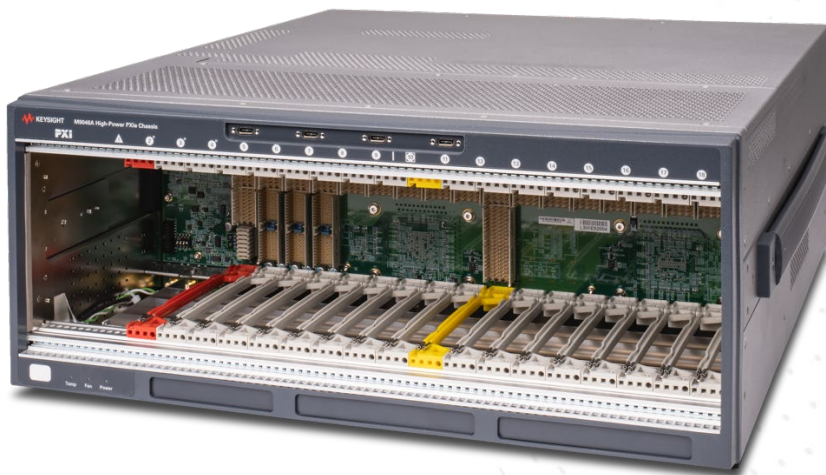


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Introduction

The Keysight Technologies, Inc. M9046A PXIe 18-slot chassis delivers the power and cooling required for high-performance applications. It includes 3 PXIe hybrid slots which gives the system designer the flexibility to mix PXIe and hybrid-compatible modules. With its Gen 3 backplane and x24 system slot, it is ready to tackle high-data bandwidth applications.

The M9046A is new from the ground up including a new power supply design providing unprecedented power per slot capabilities with the ability to monitor power and control switching frequency on a per-slot basis. With a greater than 2 times improvement in airflow compared to the **previous Keysight 18-slot chassis**, it delivers similar cooling performance at only 30% of the maximum fan speed. This improvement in cooling performance results in superior acoustical performance as well up to a maximum 85 watts per slot. The chassis is also designed for easy integration into large systems containing multiple PXIe chassis and other non-PXI instrumentation including access to 8 hardware trigger lines without consuming a slot.

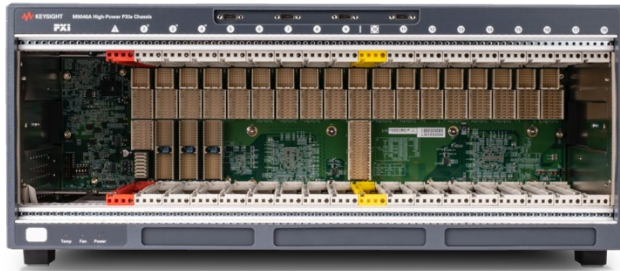


Key Features

- 3 PXIe hybrid slots, 13 PXIe slots, 1 PXIe timing slot, and 1 PXIe system slot
- High power with up to 1675W usable power
- Up to 85W/slot cooling with exceptional acoustical performance (100W/slot with option 3)
- High performance backplane (maximum 24 GB/s system and 8 GB/s slot-to-slot) with a two-link (x8, x16) system slot and x8 links to the PXIe slots
- Multi-chassis power-sequencing and optional rear trigger access (8 triggers)
- OCXO 10/100 MHz reference clock (± 1 ppm)
- Specified up to 55°C and 10,000 ft operating conditions

Hardware Overview

Backplane configuration



The M9046A PXIe chassis utilizes high performance PCIe switch fabric that operates at up to Gen 3 speeds. All the PXIe peripheral slots have a x8 PCIe link providing a maximum data bandwidth of 8 GB/s each. The two-link system slot (x8 + x16) has a maximum data bandwidth of 24 GB/s when all 24 PCIe lanes are utilized. When combined with the M9023A PXIe system module, M9049A PCIe adapter, and an external PC with a Gen 3 x16 PCIe slot, up to 16 GB/s of data bandwidth can be achieved between the PC and PXIe chassis.

The three PXIe hybrid slots are serviced by a PCIe-to-PCI bridge and all PXIe slots are also organized into three trigger bus segments with configurable interconnections between segments. An optional rear panel trigger distribution panel gives the user eight trigger ports (SMB) which are connected to the PXI [0:7].

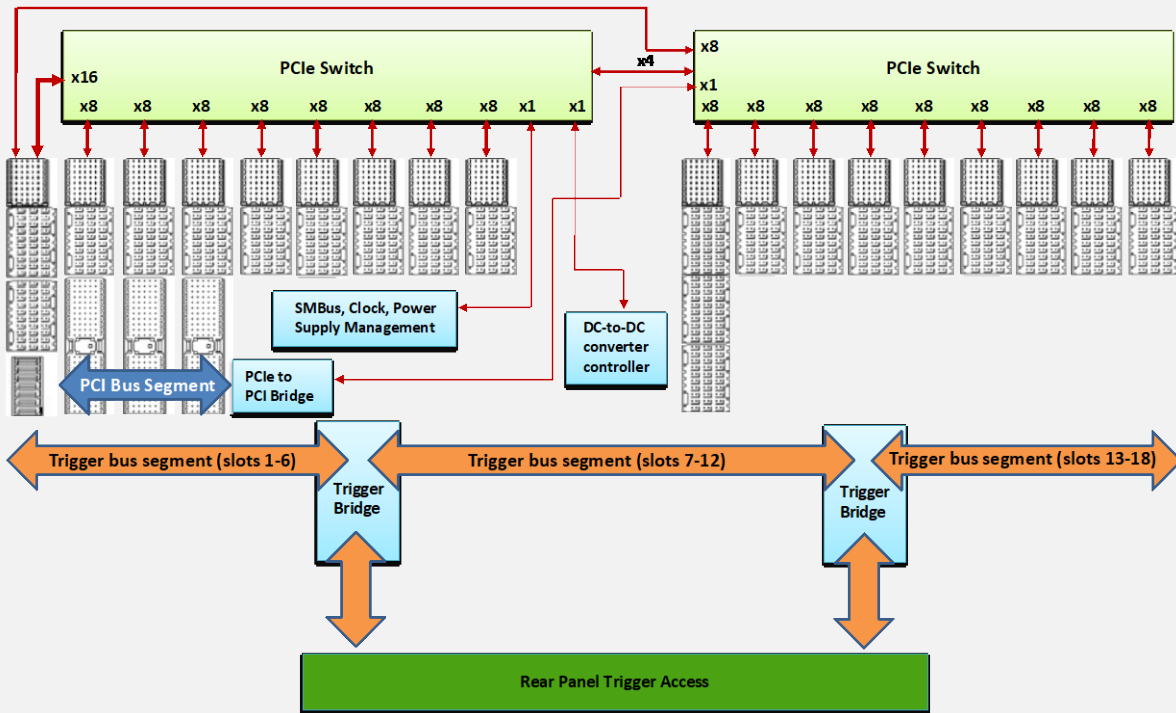


Figure 1. M9046A block diagram

Exceptional per-slot cooling capacity

The M9046A chassis utilizes a new chassis cooling system with an increased volume of airflow resulting superb per-slot cooling while producing a lower level of acoustical noise. Three auto-speed fans on the rear panel pull in cooling air and unlike other PXI chassis, auto mode can be used over the full operating temperature range of the chassis. Hot air is then expelled out of the top of the chassis after flowing from bottom to top of the slots (Figure 2).

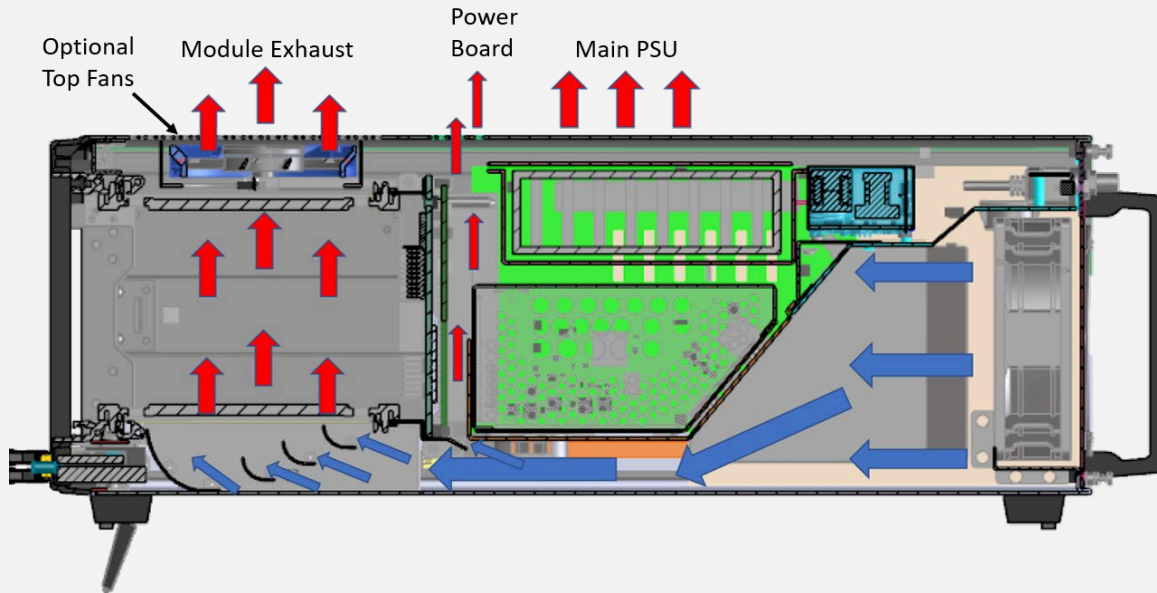


Figure 2. M9046A airflow

The fan speed is controlled by utilizing eight temperature sensors located just above the modules in the path of the module exhaust air. This enables the fans in the chassis to react to changes in module, temperatures, instead of relying on ambient air temperature readings. This can result in lower module operating temperatures when the auto fan setting is used.

System monitoring and system power

The M9046A chassis has a complete set of system monitoring functions for important parameters such as module exhaust temperatures, voltage rails, and fan speeds. Chassis operating conditions can be monitored via a software API or the soft front panel interface.

A DB-9 connector is also available at the rear of the chassis for remote inhibit and power rail monitoring. The chassis has configurable alarms that can be monitored via front panel LEDs, soft front panel interface, or software API.

Designed for large systems

When connecting multiple PXIe chassis together, the power sequencing becomes very important especially when an embedded controller is used. The M9046A PXIe chassis have special features built-in to make this easy. Cat 5 cables with RJ-45 connectors are used to interconnect the chassis. In a multi-chassis configuration, a user can press a single chassis power button to enable all chassis in the

system to power-up. If an embedded controller is being used, its chassis will automatically be powered up last. This provides a consistent, repeatable power-up sequence.

The chassis also has an optional, rear panel trigger distribution system (M9046A-001) which can accommodate up to eight SMB input/output triggers. These trigger ports connect to the PXIe backplane adding configuration flexibility to the system when non-PXIe instruments are used or when a PXIe instrument being used can only receive triggers over the PXIe backplane.

Software Platform

Drivers

The M9046A PXIe chassis is supported by a set of IVI, NET, IVI-C, and LabVIEW drivers. Windows 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).

Soft front panel interface and trigger manager

The soft front panel (SFP) interface (Figure 3) and PXIe-9 compliant trigger bus manager are provided with the chassis. The SFP can be used to monitor and control the PXIe chassis and has the following functions:

- Monitor chassis fan speed, chassis temperatures, rail voltages, and PCIe links
- Configure alarms for fan speed, temperature, rail voltage, and reference clock
- Run chassis self-test and update chassis firmware
- Review chassis information

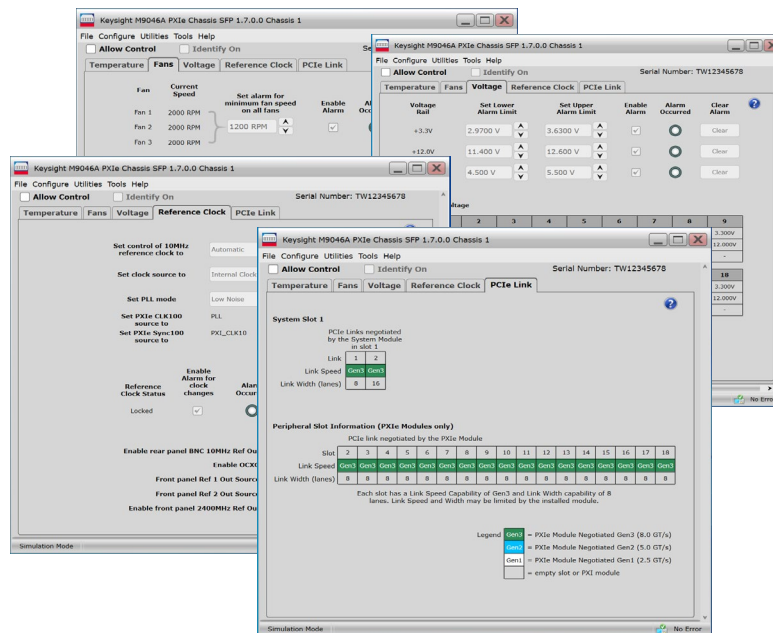


Figure 3. Soft front panel

Technical Specifications and Characteristics

General chassis characteristics	
Standards compliance	
- PXI-5 PXI Express hardware specification	
- PXI-1 hardware specification Rev 2.2	
- PICMG EXP.0 R2.0 specification	
Backplane	
Module size	3U
Total slots	18
Hybrid compatible slots	3
PXIe system slot	1 (with three system expansion slots)
PXIe timing slot	1 (also accepts PXIe module)
Module compatibility	PXIe, PXI-Hybrid, PXI-1 (J1 only), and cPCI (J1 only)
System slot link configuration	2-Link (x8 and x16)
Backplane speed	PCIe revision 3.0 (Gen 3)
Mechanical	
Size	445 mm W x 193 mm H x 515 mm D (with feet installed)
	445 mm W x 178 mm H x 515 mm D (with feet removed)
	4U x 1 rack width
Weight (without modules)	18.66 kg (41.14 lbs.)

Power supply characteristics	
AC input ¹	
Operating voltage/power (low-line) ²	100 to 120 V, 1350 W (maximum)
Operating voltage/power (high-line) ²	220 to 240 V, 2000 W (maximum)
Input frequency range (100 to 120V)	50/60/400 Hz ³
Input frequency range (220 to 240V)	50/60 Hz ³
Over current protection	Internal fuse in line
Available DC output power (for module slots) ⁴	
220 to 240 V input	1675 W
100 to 120 V input	887.5 W ⁵

¹ The instrument can operate safely with voltage fluctuations up to $\pm 10\%$

² Auto switching between high line and low line

³ 100-120VAC 400 Hz and 220-240VAC 60 Hz operation requires redundant earth ground. See installation manual for details

⁴ 2% derating per degree above 50°C and 2% derating per 100m (328.1ft) above 2000m (6561.7ft)

⁵ With option 003: 820 W

Individual slot power characteristics

DC supplies	Maximum current			Maximum power			Load regulation	Maximum ripple and noise (20 MHz BW)
	System slot	PXle slot	Hybrid slot	System slot	PXle slot	Hybrid Slot		
+3.3 V	15 A	9 A	9 A	49.5 W	29.7 W	29.7 W	5%	1.5% (pk-pk)
+5 V ⁶	15 A	0 A	6 A	75 W	0 W	30 W	5%	1% (pk-pk)
+12 V	30 A	6 A	6 A	360 W	72 W	72 W	5%	1% (pk-pk)
-12 V ⁷	0 A	0 A	1 A	0 W	0 W	12 W	5%	1% (pk-pk)
5 V _{AUX} ⁸	1 A	1 A	1A	5 W	5 W	5 W	5%	50 mV (pk-pk)

Backplane pin current capacity (nom)

Slot	+3.3 V	+5 V	+12 V	- 12 V	5 V _{AUX}
System controller slot	15 A	15 A	30 A	0 A	1 A
System timing/PXle slot	9 A	0 A	6 A	0 A	1 A
PXle hybrid slot	9 A	6 A	6 A	1 A	1 A

Chassis cooling and power dissipation characteristics

Slot airflow direction	Bottom of module to top of module	
Chassis cooling intake	Rear of chassis	
Chassis cooling exhaust	Top of chassis	
Chassis cooling fans		
Standard	Three 210 cfm fans on rear panel with HIGH/AUTO speed selector	
Option 003	Four 129 cfm fans on top panel with HIGH/AUTO speed selector	
Power dissipation	Standard	With option 003
System slot	300 W max	300 W max
Peripheral slot	85 W max**	100 W max**
Timing slot	85 W max**	100 W max**

DC supply protection

Over-current protection	Power supply is shut down when the output current is approximately 25% above maximum pin current per slot
Over-voltage protection	Maximum output is 8% of nominal voltage for all rails

⁶ A single 25A@5V supply is shared across the 3 Hybrid slots and the System Slot

⁷ A single 1A@-12V supply is shared across the 3 Hybrid slots

⁸ A single 2A 5V_{AUX} supply is shared across all slots

** Maximum per slot power dissipation at 55°C with 15°C temperature rise; requires a) that the chassis top is not blocked (1U rack space above or sitting on bench and b) a slot blocker is installed in each empty slot. Module cooling can be impacted by each module's resistance to air flow.

Clocks and trigger characteristics	
10 MHz system clock (PXI_CLK10) (typ)	
Maximum slot-to-slot skew	155 ps
Accuracy	± 1 ppm
100 MHz system clock (PXIe_CLK100) (typ)	
Maximum slot-to-slot skew	125 ps
Accuracy	± 1 ppm
100 MHz SYNC (PXIe_SYNC100) (typ)	
Maximum slot-to-slot skew	125 ps
Accuracy	± 1 ppm
External 10 MHz clock source input requirements (nom)	
Frequency input	10 MHz ± 20 ppm
Input signal (10 MHz REF In BNC)	100 mV _{PP} to 5 V _{PP} (square-wave or sine-wave)
Input signal (PXI timing slot PXI_CLK10_IN)	5 V or 3.3 V TTL signal
External 10 MHz clock output (nom)	
Output amplitude (10 MHz REF Out BNC)	1 V _{PP} ± 20% square-wave into 50 Ω 2 V _{PP} unloaded
Output impedance (10 MHz REF Out BNC)	50 Ω ± 5 Ω
PXI star trigger (typ)	
Maximum slot-to-slot skew	250 ps
PXI differential star triggers (typ)	
Maximum slot-to-slot skew	150 ps
Maximum differential skew	25 ps
Option 001 rear panel triggers (nom)	
Number of trigger ports	8
Connector type	SMB
Direction control	Input or output (configurable)
Output level	3.3 V CMOS (TTL compatible)
Output impedance	50 Ω (typ)
Output trigger source	PXI_Trig0 - PXI_Trig7 (Segment 1,2, or 3)
Input level	3.3 V CMOS (TTL compatible, 5 V tolerant)
Input impedance	2 kΩ (typ)
Input trigger destination	PXI_Trig0 - PXI_Trig7 (Segment 1, 2, or 3)
Input threshold	1.65 V (typ)
Minimum swing	250 mV (typ)
Minimum pulse width	100 ns (typ)



Figure 5. Rear panel with Option 001 rear trigger bus access installed

Environmental Characteristics^{9,10,11}

Operating and storage conditions	Operating	Storage
Temperature	0 °C to 55 °C ¹²	-40 °C to 70 °C
Altitude	Up to 10,000 ft (Approximately 3000 m) ¹²	Up to 15,000 ft (4572 m)
Maximum relative humidity (non-condensing)	Type tested, 95%RH up to 40 °C, decreases linearly to 45% RH at 55°C ¹³	
Shock and 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}	
Functional shock	Type tested at half-sine, 30 g, 11 ms	
Bench handling	Type tested per MIL-PRF-28800F	

⁹ 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.

¹⁰ Test Methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3.

¹¹ Intended for indoor use only

¹² The amount of power available derates at 2% per degree above 50°C and 2% derating per 100m (328.1ft) above 2000m (6561.7ft)

¹³ From 40°C to 55°C, the maximum % Relative Humidity (non-condensing) follows the line of constant dew point

Acoustical emissions with rear fans only (referenced to 20 µPa)		
Sound pressure level^{14,15}	Auto fan (25 °C ambient)	High fan (55 °C)
42 W/slot	52 dBA	72 dBA
60 W/slot	62 dBA	72 dBA
85 W/slot	69 dBA	72 dBA
Sound power level	Auto fan (25 °C ambient)	High fan (55 °C)
42 W/slot	60 dB	79 dB
60 W/slot	69 dB	79 dB
85 W/slot	77 dB	79 dB

Acoustical emissions with option 003 (referenced to 20 µPa)		
Sound pressure level¹⁵	Auto fan (25 °C ambient)	High fan (55 °C)
90 W/slot	74 dBA	80 dBA
100 W/slot	77 dBA	80 dBA
Sound power level	Auto fan (25 °C ambient)	High fan (55 °C)
90 W/slot	77 dB	83 dB
100 W/slot	80 dB	83 dB

¹⁴ At operator position.

¹⁵ At sea level.

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

EMC

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

- 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

Definitions

Specification (spec)

Describes the performance of parameters covered by the product warranty and are valid for the unit's operation within the stated environmental range unless otherwise noted. Specifications include production guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions. Standard calibration services offered by Keysight will ensure all these specifications are measured and a related statement of compliance with specification provided in the resulting calibration report.

Characteristic

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 nominal or typical values.

Typical (typ)

Intended to provide additional information including the expected performance of an average unit that is not covered by the product warranty. These characteristics are shown in italics or labeled as 'typical'. Performance of a customer unit to typical specifications may or may not be measured during a calibration service.

Nominal (nom)

A general, descriptive term that does not imply a level of performance. It is not covered by the product warranty. Represents the value of a parameter that is most likely to occur; the expected mean or mode of all instruments at room temperature (approximately 23 °C). These characteristics are shown in italics or labeled as 'nominal'. Performance of a customer unit to nominal specifications may or may not be measured during a calibration service.

Additional information

The data contained in this document is subject to change.

M9046A Rack Mounting and Configuration

Standard rack mounting kit

The optional Y1257A rack mounting kit can be used to flush-mount an M9046A chassis into an instrument rack. It is adjustable so that it can be adapted to non-Keysight racks. This kit is designed to ensure proper cooling performance when a single chassis is installed into a rack.

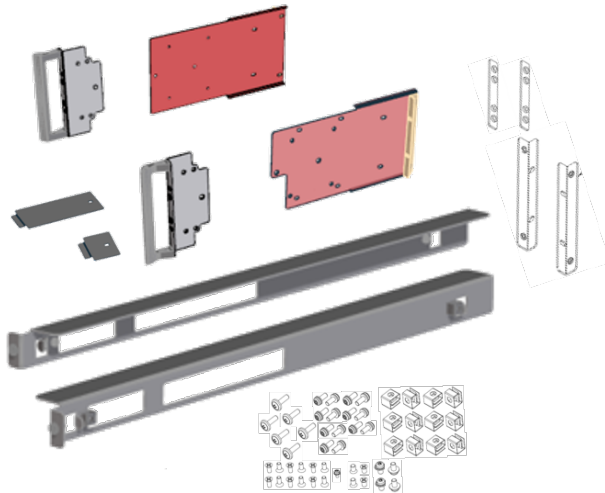


Figure 7. Y1257A Rackmount kit

Recess rack mounting kit

The optional Y1258A rack mounting kit can be used to recess-mount an M9046A chassis into an instrument rack. It is adjustable so that it can be adapted to non-Keysight racks. This kit is designed to ensure proper cooling performance when a single chassis is installed into a rack.

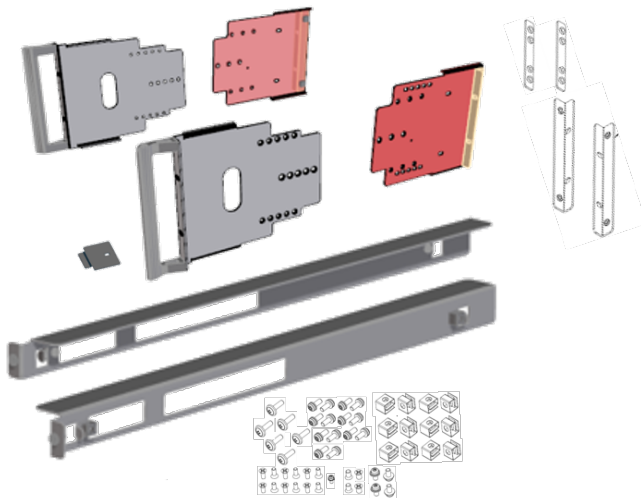


Figure 8. Y1258A Reccess-mounted rackmount kit

Advanced cooling spacer kit

The optional Y1259A spacer kit is used along with the Y1257A and Y1258A rackmount kits to provide optimal cooling in high-power applications and when multiple chassis are installed into a single rack. It is designed to isolate the intake and exhaust airflows to each chassis, managing efficient heat transfer out of the top of the rack.



Figure 9. Y1259A Advanced M9046A cooling spacer kit

Recommended configuration

Configure the Keysight M9046A PXIe chassis as follows:

- Select a PXIe system module or embedded controller (the Keysight M9022A/23A and M9037A/35A are recommended).
- If an external computer is being used, select an appropriate PC interface card (the Keysight M9048B/49A are recommended).
- Select an appropriate cable to connect the computer interface board to the chassis interface (the Y1202A is recommended to connect the M9048B and M9022A).
- Install a slot-blocker into each empty slot (Y1275A) and cover them with blank panels.
- Select other accessories (including rack mount kits) as required.

Ordering Information

Software

Supported software components	
Operating systems	Microsoft Windows 7 (32/64-bit), Windows 8.1 (32/64-bit), Microsoft Windows 10 (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
Keysight IO libraries Suite	Version 2020 Update 1 or later

Chassis Options

Model	Description
M9046A	PXIe chassis: High power, 18-slot, 24 GB/s Includes standard (non-EMC) PXI filler panels
M9046A-001	Advanced trigger access
M9046A-003	Top fan tray
Accessories	
Y1212A	Slot blocker kit: 5 single-slot
Y1213A	PXI EMC filler panel kit: 5 single-slot
Y1257A	M9046A rackmount kit
Y1258A	M9046A recess rackmount kit
Y1259A	M9046A advanced cooling spacer kit
Y1275A	M9046A slot-block kit: five, one-slot blockers

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