User Guide

M9019A

Keysight PXIe Chassis Family

KEYSIGHT TECHNOLOGIES

Notices

Manual Part Number

M9019-90003

Edition

Edition 1, July 2016
Keysight Technologies, Inc. 1400 Fountaingrove Parkway Santa Rosa, CA 95403 USA

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Safety Information

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings or operating instructions in the product manuals violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

General

Do not use this product in any manner not specified by the manufacturer. The protective features of this product must not be impaired if it is used in a manner specified in the operation instructions.

Before Applying Power

Verify that all safety precautions are taken. Make all connections to the unit before applying power. Note the external markings described under "Safety Symbols".

Ground the Instrument

Keysight chassis' are provided with a grounding-type power plug. The instrument chassis and cover must be connected to an electrical ground to minimize shock hazard. The ground pin must be firmly connected to an electrical ground (safety ground) terminal at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Do Not Operate in an Explosive Atmosphere

Do not operate the module/chassis in the presence of flammable gases or fumes.

Do Not Operate Near Flammable Liquids

Do not operate the module/chassis in the presence of flammable liquids or near containers of such liquids.

Cleaning

Clean the outside of the Keysight module/chassis with a soft, lint-free, slightly dampened cloth. Do not use detergent or chemical solvents.

Do Not Remove Instrument Cover

Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.

Keep away from live circuits

Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers and shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.

DO NOT operate damaged equipment

Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to an Keysight Technologies Sales and Service Office for service and repair to ensure the safety features are maintained.

DO NOT block the primary disconnect

The primary disconnect device is the appliance connector/power cord when a chassis used by itself, but when installed into a rack or system the disconnect may be impaired and must be considered part of the installation.

Do Not Modify the Instrument

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Keysight Sales and Service Office to ensure that safety features are maintained.

In Case of Damage

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

CAUTION

Do NOT block vents and fan exhaust: To ensure adequate cooling and ventilation, leave a gap of at least 50mm (2") around vent holes on both sides of the chassis.

Do NOT operate with empty slots: To ensure proper cooling and avoid damaging equipment, fill each empty slot with an AXIe filler panel module.

Do NOT stack free-standing chassis: Stacked chassis should be rack-mounted.

All modules are grounded through the chassis: During installation, tighten each module's retaining screws to secure the module to the chassis and to make the ground connection.

WARNING

Operator is responsible to maintain safe operating conditions. To ensure safe operating conditions, modules should not be operated beyond the full temperature range specified in the Environmental and physical specification. Exceeding safe operating conditions can result in shorter lifespan, improper module performance and user safety issues. When the modules are in use and operation within the specified full temperature range is not maintained, module surface temperatures may exceed safe handling conditions which can cause discomfort or burns if touched. In the event of a module exceeding the full temperature range, always allow the module to cool before touching or removing modules from the chassis.

Safety Symbols

CAUTION

A CAUTION denotes a hazard. It calls attention to an operating procedure or practice that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING denotes a hazard. It calls attention to an operating procedure or practice, that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Products display the following symbols:

Refer to manual for additional safety information.

Earth Ground.

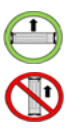
Chassis Ground.

Alternating Current (AC).

Direct Current (DC).

Standby Power. Unit is not completely disconnected from AC mains when power switch is in standby position

Indicates that antistatic precautions should be taken.



Operate the PXIe chassis in the horizontal orientation. Do NOT operate this chassis in the vertical orientation.

The CSA mark is a registered trademark of the Canadian Standards Association and indicates compliance to the standards laid out by them. Refer to the product Declaration of Conformity for details.

Notice for European Community: This product complies with the relevant European legal Directives: EMC Directive (2004/108/EC) and Low Voltage Directive (2006/95/EC).

The Regulatory Compliance Mark (RCM) mark is a registered trademark. This signifies compliance with the Australia EMC Framework regulations under the terms of the Radio Communication Act of 1992.

ICES/NMB-001

ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001.

This symbol represents the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of this product.

South Korean Class A EMC Declaration. this equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.

A 급 기기 (업무용 방송통신기자재)
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This product complies with the WEEE Directive (2002/96/EC) marking requirement. The affixed product label (see below) indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a “Monitoring and Control instrumentation” product.

Do not dispose in domestic household waste.

To return unwanted products, contact your local Keysight office, or see www.keysight.com/environment/product for more information.

Contents

1. About this guide

This *Keysight PXIe Chassis Family User Guide* provides detailed information on using the PXIe chassis, including the following:

- How to configure the PXIe chassis to meet your needs. Parameters such as the following can be configured:
  - Voltage limits around the power supply rails at which an alarm will be generated if a rail falls outside of its limit
  - The temperature at which an alarm will be generated if the chassis exceeds this temperature
  - The fan speed at which an alarm will be generated if a fan speed falls below this limit
  - Temperature set point
  - Chassis clock source
  - Trigger reservations and routes
- Rack mounting of the chassis

NOTE

It is assumed that you have used the *Keysight PXIe Chassis Family Startup Guide* to turn on the chassis system, and install the Keysight IO Libraries Suite, the chassis drivers, and the chassis soft front panel. If the chassis has not yet been turned on, use the *Keysight PXIe Chassis Family Startup Guide* to perform the initial chassis turn on prior to configuring the chassis as described in this guide.

If you have been unable to turn on the chassis system using the *Keysight PXIe Chassis Family Startup Guide* and need assistance, see the *Keysight PXIe Chassis Family Service Guide*. The startup guide provides step-by-step guidance on turning on the chassis system.

Note that having ready access to certain spare parts may accelerate the troubleshooting process. The *Keysight PXIe Chassis Family Service Guide* includes a list of spare parts that you may want to acquire to support any repairs that are ever needed.

2. Introduction to PXIe chassis

The PXIe chassis is the backbone of a PXIe system. It contains a high performance backplane giving the cards in the system the ability to communicate rapidly with one another. It also provides power and cooling.

Keysight provides two 18-slot PXIe chassis:

- M9018A
- M9019A

NOTE **For more information on M9018A, refer to the M9018A user documentation available at www.keysight.com/find/M9018A. This guide provides detailed information on using the M9019A.**

M9019 Key Features

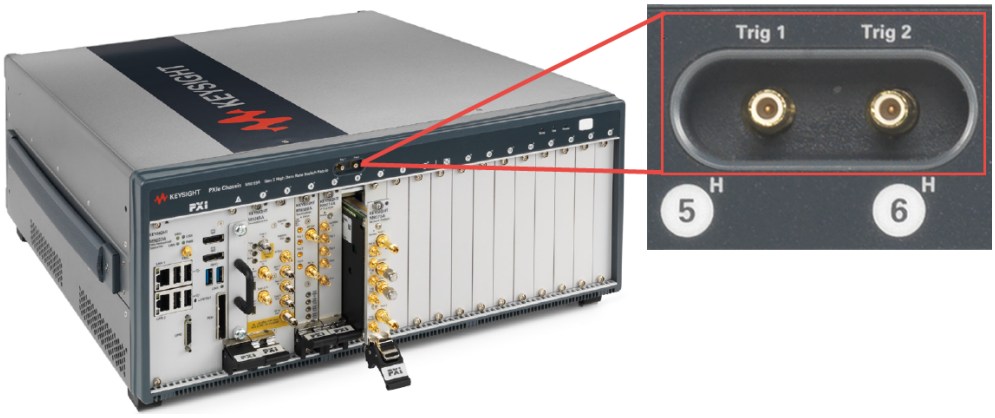
The Keysight Technologies M9019A PXIe chassis is designed for easy integration into large systems containing multiple PXIe chassis and other non-PXI instrumentation . It has 16 PXIe hybrid slots, which allows the system designer to mix and match the number and location of PXIe and hybrid-compatible modules. Its ultra-high performing PCIe switch fabric can operate up to Gen 3 providing up to 24 GB/s of system data bandwidth. The innovative cooling design allows the chassis to fit into 4U of rack space, in most cases. The Keysight M9019A PXIe chassis has these key features:

- 16 PXIe hybrid slots, 1 PXIe timing slot, and 1 PXIe system slot
- 4U chassis with innovative cooling design
- Ultra-high performance Gen 3 PCIe switching with a two-link (x8, x16) system slot and x8 links to the hybrid/timing slots
- High data bandwidth (maximum 24 GB/s system and 8 GB/s slot-to-slot)
- Multi-chassis power-sequencing and front panel external trigger inputs /outputs
- Specified up to 55^{o}C and 10,000 ft operating conditions

The following image shows a front view of the M9019A chassis.

Front panel trigger

Two front panel trigger ports (SMB) are connected to the PXI (0:7) trigger bus.



Block Diagram

View the complete interactive block diagram from the Windows **Start** button:

Start > All Programs > Keysight > PXIe Chassis Family > Interactive Block Diagram

You can also download the block diagram from www.keysight.com/find/M9019A.

Rack mounting of the chassis

CAUTION

- To position chassis vertically, they should be rack mounted as described in this section.
- In handling the chassis in preparation for rack mounting, do not stand the chassis on its side; the side handles can cause the chassis to tip over.
- Depending on the power consumed by the chassis, a 1U space may be required below the chassis to ensure adequate ventilation for cooling. Be sure to provide this space if required as described in this section.
- If you are stacking chassis on top of each other, place any NI (National Instruments) chassis above Keysight chassis, wherever applicable.

To rack mount the PXIe chassis, order the Y1215A Rack Mount Kit. This kit provides the hardware and instructions to mount the chassis in a standard 482.6 mm (19 inch) wide rack. To rack mount the chassis, follow these guideline

- Always begin installing chassis at the bottom of the rack and work up. This maintains a lower center of gravity and reduces the likelihood of the rack tipping.
- Anti-tipping feet, if available with the rack, should always be extended.
- The heaviest chassis should always be mounted in the bottom of the rack.
- For maximum cooling and optimum rack thermal efficiency, place the chassis with the greatest power consumption towards the top of the rack. This promotes efficient cooling since heat rises. When placed nearer to the top of the rack, higher power chassis will not unnecessarily heat other chassis. However, in doing this, do not violate the guideline that the heaviest chassis be placed at the bottom of the rack.
- As described in in Power supply operation on page 16, the maximum power that can be supplied to the modules is 800 watts. If your modules are consuming the maximum power, 1U of space is required for ventilation below the chassis when you rack mount it.

CAUTION

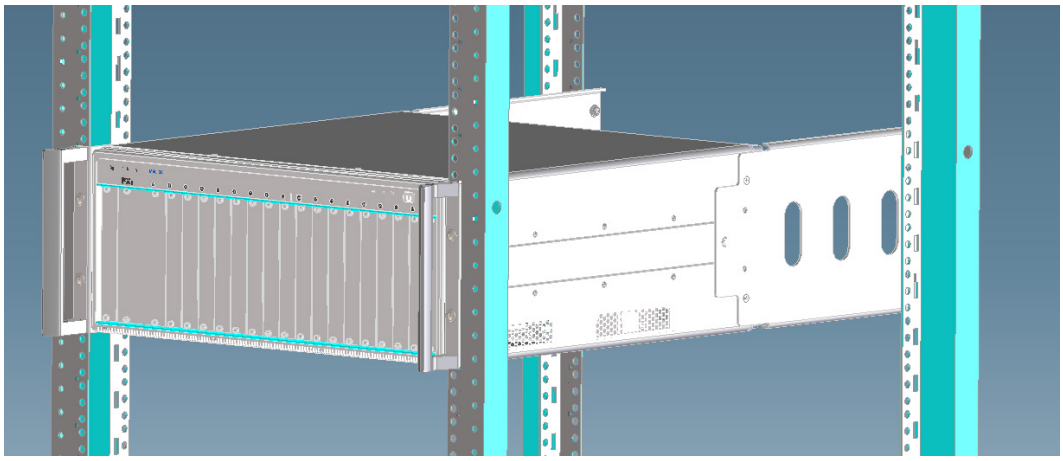
The weight of an empty PXIe chassis (no modules installed in the chassis) is approximately 29.8 lbs (13.5 kg). Lift the chassis using a single side handle only when the total chassis weight (chassis plus installed modules) does not exceed 75 lbs (34.0 kg). Otherwise use both side handles to lift the chassis. Two people may be required to lift the chassis and install it in a rack.

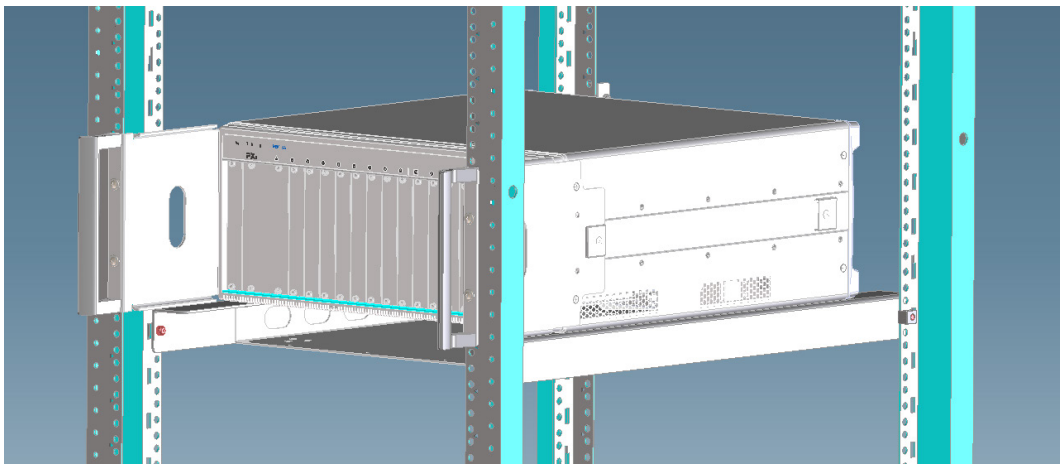
Installing modules in the chassis may increase its weight to a point where two people are required to lift the chassis. If two people are not available, use a mechanical lift to lift the chassis. The chassis should be transported using a rolling cart.

Rack mount accessory kits

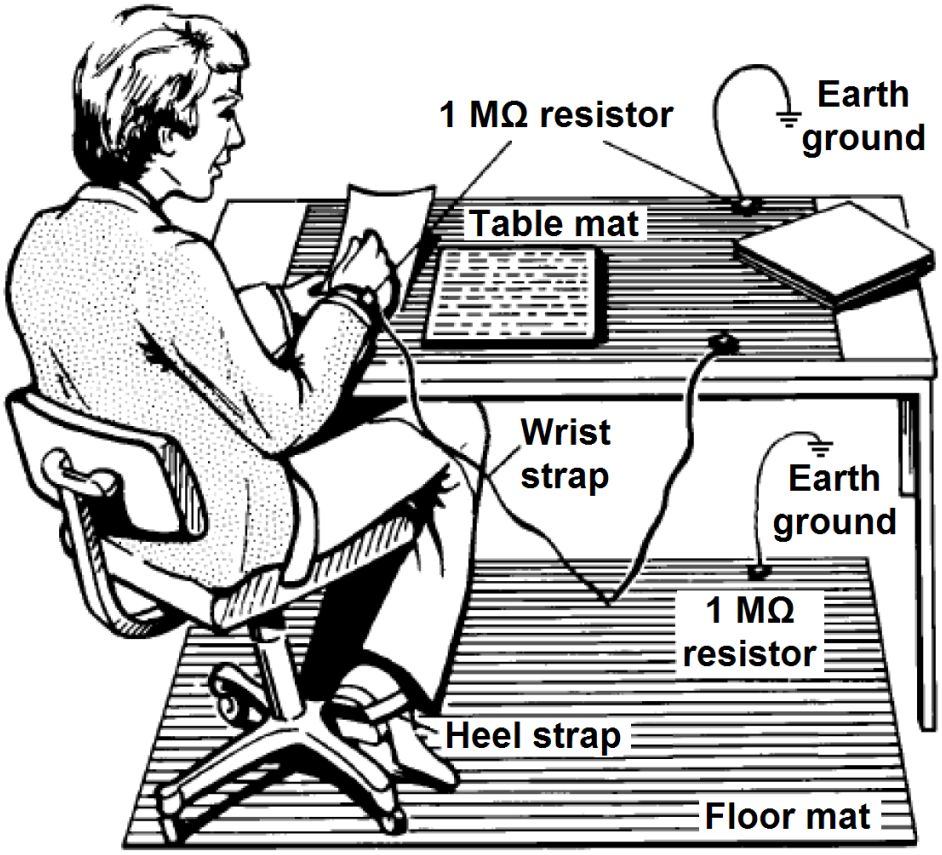
Chassis rack mount accessory kits provide system design flexibility. The following kits can be mix-and-matched to suit the needs of a given application:

- Y1215C Flush mount rack kit: Complete kit including rack flanges, handles, and attachment hardware. The kit suspends the chassis in a Keysight rack using only 4U of rack space. Rack rails may be needed in a non-Keysight rack.
- Y1216B Recess mount rack kit: Complete recess-mount kit including rack flanges, handles, and attachment hardware. The kit recesses the chassis by 4 inches and suspends the chassis in a Keysight rack using only 4U of rack space. Rack rails may be needed in a non-Keysight rack.
- Y1217B Rack mount rail kit: This optional kit provides additional stability to the chassis when rack-mounted. When using rails, the chassis will require 5U of rack space. Rails may not fit in a non-Keysight rack.
- Y1218A Cable tray kit: Adds a 1U high cable tray to the chassis and includes cable tray, feet for using the chassis/tray on a table, and attachment hardware.





3. Static-safe handling procedures



Electrostatic discharge (ESD) can damage or destroy electronic components. Use a static-safe work station to perform all work on electronic assemblies. The figure (left) shows a static-safe work station using two types of ESD protection:

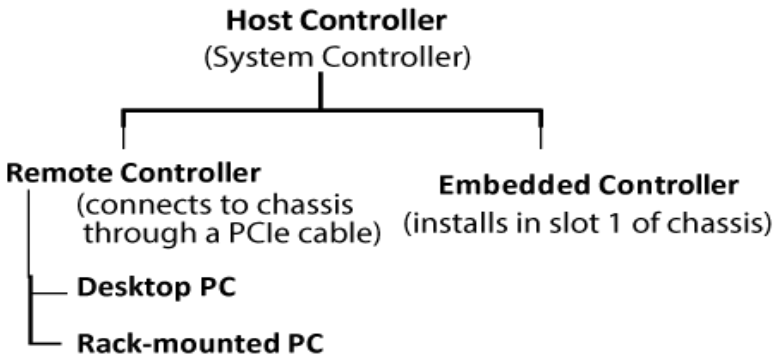
- Conductive table-mat and wrist-strap combination
- Conductive floor-mat and heel-strap combination

Both types, when used together, provide a significant level of ESD protection. Of the two, only the table-mat and wrist-strap combination provides adequate ESD protection when used alone. To ensure user safety, the static-safe accessories must provide at least 1 MΩ of isolation from ground.

WARNING **DO NOT use these techniques for a static-safe work station when working on circuitry with a voltage potential greater than 500 volts.**

4. Terminologies

Before continuing, some important terminology is presented. The computer that controls the chassis is known as the host controller or system controller, and is shown at the top of the hierarchy in the following figure.



The host controller can either be a remote controller or an embedded controller. A remote controller is a Windows-based PC, and can be a desktop PC or a rack mounted PC. The remote controller interfaces to the chassis through a PCIe cable.

An embedded controller, such as the Keysight M9037A Embedded Controller, is a small form factor, Windows-based PC that is designed for installation in the system controller slot (slot 1) of the chassis. An embedded controller also consumes two or three expansion slots to the left of slot 1.
The combination of the chassis, the host controller (and a PCIe cable if the host controller is a remote controller), and the chassis I/O software running on the host controller is referred to as a chassis system.

NOTE In order for a PC to serve as a remote controller, its BIOS must support enumeration of the PCIe slots in the chassis; many computers are not capable of enumerating a sufficient number of PCIe slots to ensure that slots in an external chassis are enumerated.

Keysight provides the document *PCI and AXIe Modular Instrumentation Tested Computer List Technical Note,* which lists the embedded, desktop, laptop, and rack-mounted PCs that have been verified to enumerate the PCIe slots in the PXIe chassis. Use this document, available under the **Document Library** tab at www.keysight.com/find/pxi-chassis, to guide your selection of remote controller PCs.

5. Power supply operation

Voltage rails

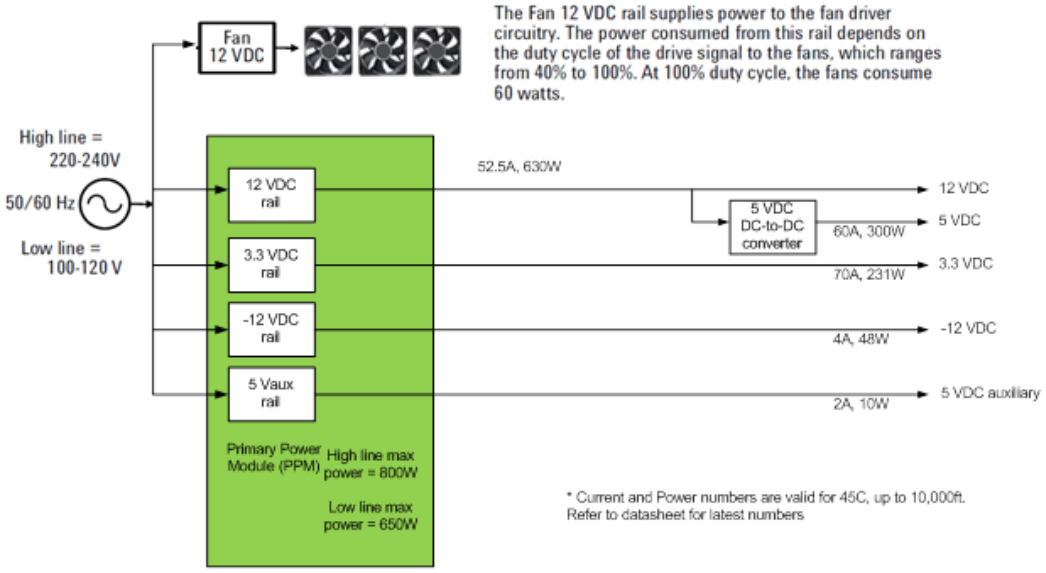
The power supply provides the six voltage rails listed below. The name of each voltage rail as it appears on the chassis backplane connectors is shown in the second column. The image in the following section shows these voltage rails in a block diagram format, and describes the power available from each rail.
Note that two of the rails, 5 VDC auxiliary and Fan 12 VDC, are active (powered) whenever the chassis is connected to AC power. The remaining rails are switched on/off either by the front panel power push button or by the INHIBIT signal on the rear panel DB-9 connector.

Voltage Rail	Backplane name	Comments	
3.3 VDC	3.3V	This rail can be switched on/off, either by the front panel power push button or the **INHIBIT** signal on the rear panel DB-9 connector. [1]	
5 VDC	5 V	This voltage rail is generated by a DC-to-DC converter operating from the 12 VDC rail. As shown by the backplane names, this rail connects to the backplane under two different names.[1]	The 5 VDC rail connects to the 5V pins of the CompactPCI XP1 connector.
	5V V(I/O)		The 5 VDC rail also connects to the 5V V(I /O) pins of the CompactPCI XP1 connector.
5 VDC auxiliary	5Vaux	This rail provides standby power to the Monitor Processor and the modules, and is available anytime the chassis is connected to AC power.	
12 VDC	12V T	This rail can be switched on/off, either by the front panel power push button or the **INHIBIT** signal on the rear panel DB-9 connector.[1]	
–12 VDC	–12V	This rail can be switched on/off, either by the front panel power push button or the **INHIBIT** signal on the rear panel DB-9 connector. [1]	
Fan 12 VDC	Fan 12V	This rail supplies the fan driver circuitry, and is not connected to the backplane connectors. This power supply is active anytime the chassis is connected to AC power.	

1 The 3.3VDC, 5VDC, 12 VDC, and the –12VDC rails can be switched on/off, either by the front panel power push button or by the INHIBIT signal on the rear panel DB-9 connector. The 5V rail regulators is fed by the +12VDC. [a b c d]

Power supply capacity

The following image shows the maximum power available from each rail. The rails cannot provide their maximum power simultaneously to the modules in the chassis. Hence, trade offs are required to ensure that certain maximum power limits are not exceeded, as described below.



The maximum power available from each rail are shown above. The Primary Power Module (PPM) shown in green provides 4 rails (12V, 3.3V, -12V, and 5Vaux). The maximum power available for the 12 VDC rail is 630W, while the maximum power available for the 3.3 VDC rail is 231W. 4A is available from the -12 VDC rail, and 2A is available from the 5 Vaux rail. The sum of the powers drawn from these four rails shall not exceed the maximum power available from the PPM, which itself depends on the AC voltage. For example, at low line AC (100-120V), the total power drawn from the PPM cannot exceed 650W, At high line AC (220-240V), the total power drawn from the PPM cannot exceed 800W.

Similarly, the sum of the power drawn from the 12 VDC and 5 VDC rails shall not exceed the total power available from the 12 VDC, i.e., 630W.

NOTE For more detailed specification of the modules used in the chassis, see the *Keysight M9019A Specification Guide* and *Keysight Technologies M9019A PXIe Chassis Data Sheet*.

Over temperature protection

The Primary Power Module (PPM) shuts down if its internal temperature threshold is exceeded. The chassis is rated to perform from 0 to 55 °C. As long as the power limits are adhered to, an over temperature condition is unlikely to occur. Therefore, if the chassis appears to be powered down (for example, based on the front panel LEDs being off), you should consider other possible causes prior to considering an

over temperature condition.

The Primary Power Module (PPM) will shut down if its internal temperature exceeds 110 °C. This not only shuts down all rails.

NOTE If the chassis is operating within its normal ambient temperature range of 0-55° C and is operating within the power limits described previously, an over temperature condition is unlikely to occur. Therefore, if the chassis appears to be powered down (for example, based on the front panel LEDs being off), you should consider other possible causes prior to considering an over temperature condition. See the *Keysight PXIe Chassis Service Guide* for further information.

Note that it is not possible to determine the temperature of the PPM based on the temperatures reported by the air flow exit temperature sensors. The PPM and the air flow exit temperature sensors have different ventilation air flows.

To recover from a suspected over temperature shutdown, the PPM internal temperature must be below 110 °C and the chassis must be power cycled. Power cycling of the chassis should be performed by detaching and re-attaching the power cord because neither the front panel ON/OFF push button nor the Inhibit signal on the rear panel DB-9 connector will function if the PPM is shut down.

If the chassis is power cycled but does not resume operation, either the PPM was not at fault or the PPM internal temperature is still above 110 °C. Additional cooling time should be allowed followed by another power cycle to see if that resolves the problem.

Temperature derating of the primary power module

In general, the total power output of the PPM does not derate with temperature. However, the output current of each rail derates linearly with temperature and with altitude, as specified in the datasheet table. For more information on the latest power supply specifications and temperature derating information, see the M9019A datasheet available at www.keysight.com/M9019A.

DC supplies				
Voltage	Maximum[1] 45°C, <10kft	Current 50 ° C, 10kft	Load regulation	Maximum ripple and noise (20 MHz BW)
+3.3V	70A	67A	5%	1.5% (pk-pk)
+5V	60A [2]	52.5A [2]	5%	1% (pk-pk)
+12V	52.5A[2]	45A[2]	5%	1% (pk-pk)

DC supplies				
-12V	4A	4A	5%	1% (pk-pk)
5 Vaux	2A	2A	5%	50 mV (pk-pk)

1	The total power supplied for all rails must not exceed 650W (100 - 120V) or 800W (200-240V).
2	The total power supplied for 5V and 12V rails must not exceed 630W at 45C, <10kft, or 540W at 50C. [a b c d]

Power calculator spreadsheet

The Microsoft Excel power calculator spreadsheet is available online at www.keysight.com/M9019A . This spreadsheet allows you to enter the following information and determine if the chassis will be operating within its power limits:

1. The ambient temperature that the chassis will be operating at the ambient temperature affects the power available to the modules from the power supply, as noted in the previous section.
2. The mains voltage of the chassis, either low line (100-120V) or high line (220-240V).
3. The power consumed on each rail by each module.

After the above information is entered, the spreadsheet indicates if any power supply limits are exceeded.

Overcurrent protection

The PPM has overcurrent protection on its 5Vaux, 12V, -12V, and 3.3V outputs. Overcurrent protection can occur at currents from 105% of the specified maximum. The overcurrent protection on the 5V DC/DC converter output is specified typically at 135% or above.

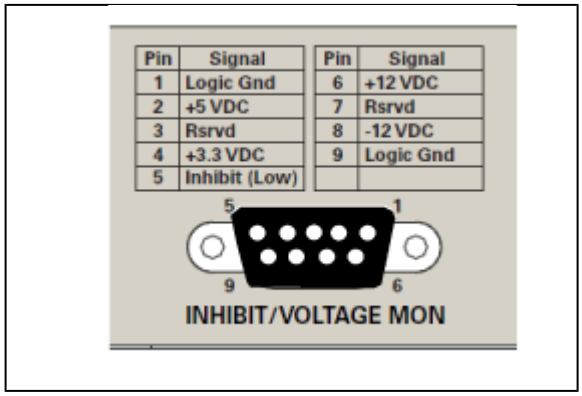
In the event of a short circuit or overcurrent condition, the chassis shuts down in order to protect the power supplies from further damage. To recover from the fault, the short circuit or overcurrent condition needs to be eliminated, and the chassis needs to be reset or power cycled. To reset the chassis, push the power button for at least 5 seconds.

Internal fuses

Each supply connected directly to AC is protected by an internal fuse. These fuses are not customer- replaceable. Contact Keysight if you suspect a fuse is blown.

Measuring the four main voltage rails directly

The four main voltage rails can be measured on the DB-9 connector on the chassis rear panel using a digital multi-meter. The voltage rail pin assignments are shown in the following image.



Each voltage rail contains a current limiting resistor to prevent accidentally shorting the supplies during measurements.

6. Chassis and host controller power up or down sequence

This section describes the chassis and host controller PC power up and power down sequences. In order for the chassis and the host controller PC to inter-operate correctly, they must be powered up and down in specific sequences. Furthermore, the PC must be restarted in certain situations after the chassis and PC are powered up. If these sequences are not followed, the PC may not be able to access the chassis or the modules in the chassis.

NOTE

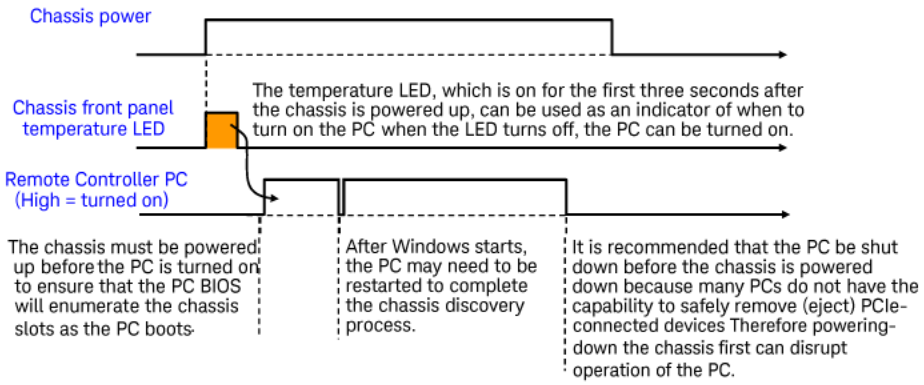
- The chassis has three power states: Powered up, powered down, and unplugged. When powered up, the chassis is fully operational. When powered down, the Primary Power Module (described in Power supply operation on page 16) is turned off, but 5 Vaux is available to the Monitor Processor and the modules. When unplugged, the chassis is completely unpowered. Unless otherwise stated, the chassis is presumed to be plugged in, and is changing power states between powered up and powered down.

- When you press the chassis power-on button, if the chassis does not power up and the front panel LEDs do not light, it is possible for the chassis to be in a safety shutdown state. Remove the chassis AC power cord from the chassis for one minute. Reconnect the power cord and turn on the chassis again. If it still does not power on, refer to the *Keysight PXIe Chassis Service Guide*.

The following sections describe differences in starting up the host controller PC based on the version of Keysight IO Libraries Suite installed on your system controller.

Power sequencing

When powering up the system, the chassis must be powered up first. After powering up the chassis, you should wait at least three seconds before turning on the PC. The chassis front panel temperature LED, which is on for three seconds after the chassis is powered up, provides a convenient way to measure this delay, as shown below.



The PC should be shut down before the chassis is powered down. This will prevent the chassis, as it is being powered down, from disrupting operation of the PC.

In brief, the PC should be off whenever the chassis is powered up or down. Because chassis modules are not hot-swappable, chassis modules should only be added or removed when the chassis is powered down.

The above power sequence does not apply to an embedded controller installed in the chassis because the embedded controller and chassis are powered together.

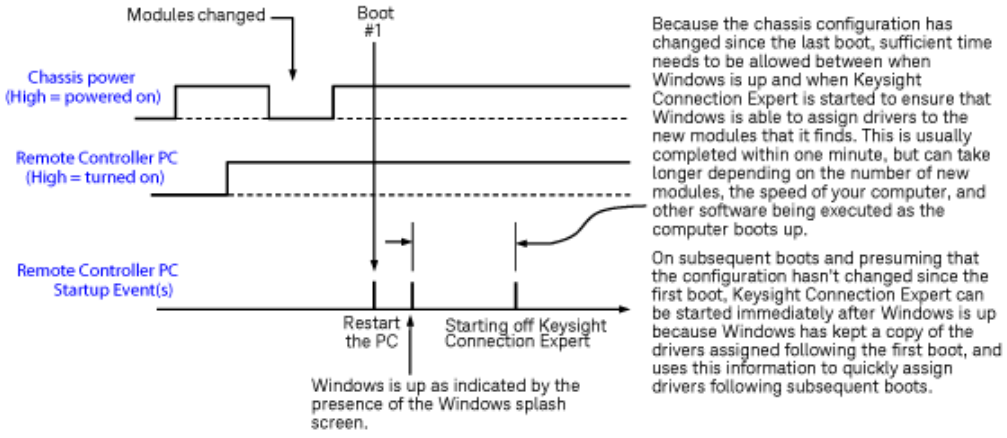
PC startup requirements for Keysight IO Libraries Suite

This section describes the PC startup events for Keysight IO Libraries Suite. Improvements have been made in Keysight IO Libraries Suite that considerably simplify the PC startup process. Keysight recommends use of latest version Keysight IO Libraries Suit.

Before describing the PC startup events for each version, two situations are described where Connection Expert, which is part of Keysight IO Libraries Suite, will not display a PCIe device, be it the chassis or a module in the chassis.

1. If Windows can not find a driver for a device, Windows will not be able to identify the device and therefore Connection Expert will not be able to display it. If this occurs, you will typically be presented with the Windows New Hardware Found Wizard, which will give you the opportunity to assist Windows in finding a driver. If a driver is found, you should restart the PC and verify that Windows identifies the device (which will be evident by the lack of the New Hardware Found Wizard for that device).
2. The other situation where Connection Expert will not display a PCIe device is in the event that, when Connection Expert is started, Windows has not yet completed assigning drivers to the devices (the chassis or modules in the chassis) found during enumeration. Connection Expert will not display modules that it cannot identify. In this situation, however, the driver exists but it has not yet been assigned to the device by the time Connection Expert is started.

This situation should be very rare; if it occurs, it would be expected to occur with slower PCs. The solution for this situation depends on which version of IO Libraries Suite you have installed and is described below. For the first-ever connection of the chassis to the PC, or after changing the chassis configuration, only a single boot of the PC is needed. However, sufficient time needs to be allowed between when Windows is up and when Keysight Connection is started in the following figure.



The two cases described above where Connection Expert does not display the chassis or a module in the chassis can occur with Connection Expert. If the New Hardware Found Wizard is displayed, follow the steps in the Using Connection Expert to connect to the chassis section in the *Keysight PXIe Chassis Family Startup Guide* to associate a driver with the device. If Connection Expert, does not display a particular device, click the Rescan button to see if Windows has now assigned a driver to the device, which will allow Connection Expert to display the device.

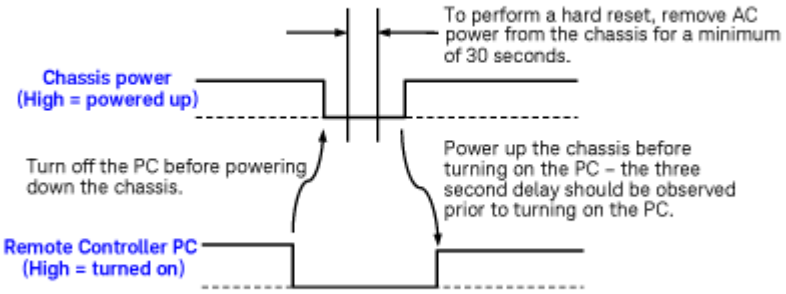
In general, if it ever appears that your chassis configuration as displayed by Connection Expert differs from your actual configuration, click the Rescan button. This should align the displayed configuration to the actual configuration.

NOTE **Even with the latest version of IO Libraries, it is always advisable to boot the PC a second time to ensure that the PC properly enumerates all of the modules within the chassis.**

Performing a chassis hard reset

A chassis hard reset refers to powering down the chassis and then disconnecting it from AC power. A hard reset is required in response to certain self test failures as described in Self test codes and messages on page 55. As noted in in the above image, when the chassis is connected to AC power, the 5Vaux supply is powered, and is supplying power to certain chassis components, such as the Monitor Processor. Performing a hard reset ensures that power is removed from all chassis components.

To perform a chassis hard reset, the chassis should be removed from AC power for a minimum of 30 seconds, this is to ensure that the 5Vaux supply is completely powered down. The entire sequence is shown in below image.

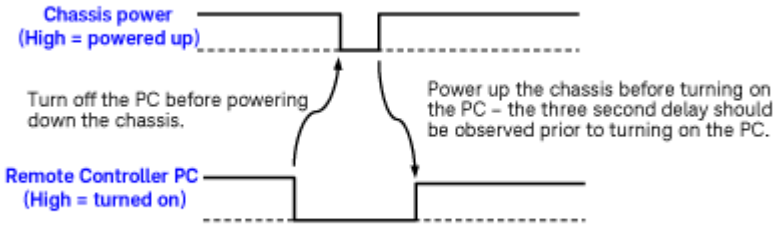


In essence, a chassis hard reset is a system restart that includes unplugging the chassis from AC power after the chassis is powered down.

Performing a system restart

For a system with a remote controller PC, system restart refers to the power sequence shown in the following image. The remote controller PC is turned off followed by the chassis being powered down for at least one second. The chassis is then powered up followed by turning on the PC.

NOTE When the chassis is powered down using the front panel ON/Standby pushbutton or the **Inhibi**t signal on the rear panel DB-9 connector, the chassis is still connected to AC power. Therefore, the 5Vaux (auxiliary) supply is powered, and is supplying power to components such as the Monitor Processor. The other chassis supplies (3.3V, 5V, 12V, and -12V) are not powered.



If the chassis contains an embedded controller, a system restart consists simply of power cycling the chassis, which will also restart the embedded controller.

7. PXIe chassis management capabilities

PXIe chassis provides extensive management capabilities to allow you to monitor and control many aspects of the chassis operation. For example, you can monitor the temperatures reported by the air flow exit backplane temperature sensors using the soft front panel (SFP). Furthermore, you can use the SFP to set a maximum temperature alarm threshold such that an alarm will be generated if the temperature of any temperature sensor exceeds the threshold.

In addition to using the SFP to monitor and control the chassis, you can develop programs to monitor and control the chassis. Keysight provides IVI (Interchangeable Virtual Instrument, see www.ivifoundation.org) drivers for the chassis. To support the most popular programming languages and development environments, Keysight offers both the IVI-C and IVI.NET drivers. See the IVI Foundation website for a description of these drivers. In addition, Keysight provides a LabVIEW driver for the chassis.

Keysight recommends that you use the SFP to learn the chassis management capabilities. Because the programmatic capabilities largely parallel the capabilities provided by the SFP, learning the SFP first will provide the basis for learning how the IVI.NET and IVI-C drivers interface to the chassis. In support of this approach, each chassis management capability is first described by a diagram showing how that chassis management capability is accessed using the SFP.

Summary of chassis management capabilities

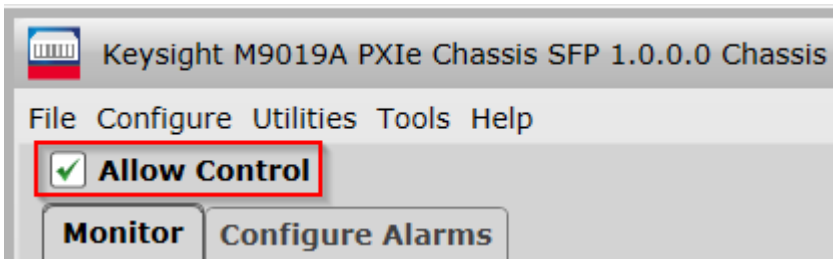
The chassis provides the following management capabilities:

- Viewing the chassis hardware and software revision information
- Monitoring the speed of the fans. This monitoring capability includes the ability to set a fan speed threshold such that, if any fan speed falls below the threshold, an alarm is generated.
- Monitoring the temperatures of the air flow exit chassis temperature sensors. This monitoring capability includes the ability to set a temperature threshold such that, if the temperature reported by any sensor rises above the threshold, an alarm is generated.
- Setting of the fan speed vs. chassis temperature profile
- Monitoring of the main power supply rails: 3.3 VDC, 5 VDC, 12 VDC, -12 VDC and 5Vaux. This monitoring capability includes the ability to set upper and lower voltage limits around each voltage rail such that, if a voltage rail falls outside of its limits, an alarm is generated.
- Monitoring and manually configuring the 10 MHz reference clock source
- Configuring and monitoring the parallel trigger bus signals in PXI-9 standard
- Executing a chassis self test

- Front panel external trigger inputs/outputs

Enabling use of the SFP to configure chassis parameters

In order to use the SFP to configure the chassis, the **SFP Allow Control** check box shown in the following image must be checked. This check box, which is available on all three tabs of the SFP, is provided to prevent unintentionally changing a chassis parameter.

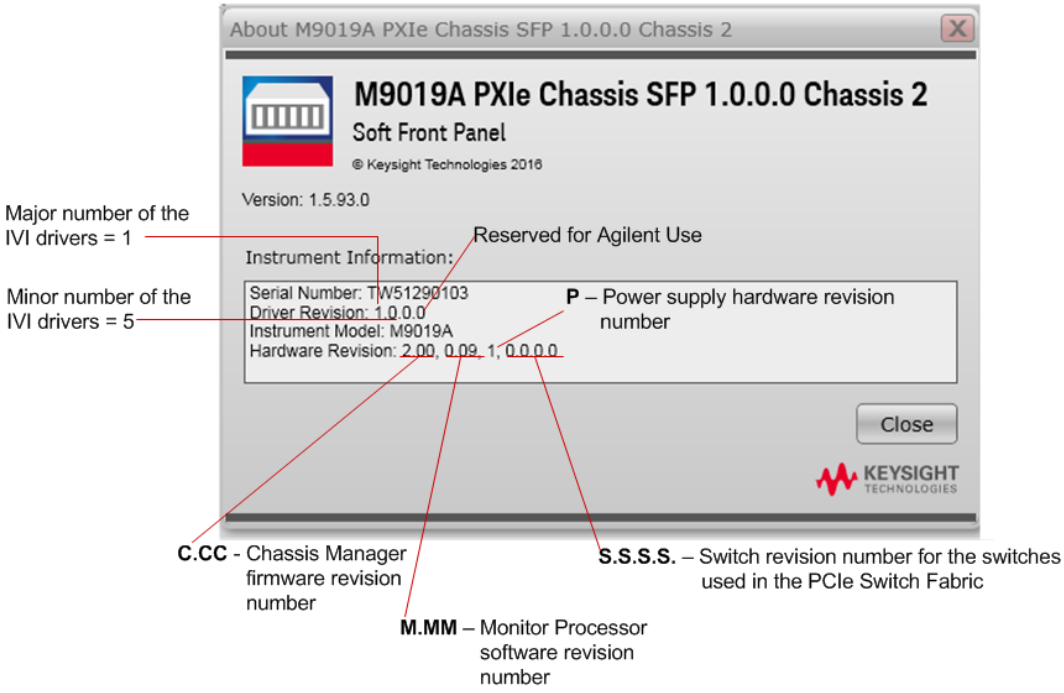


8. Chassis revision

This section describes how to use the PXIe Chassis SFP and IVI drivers to view the chassis revision information. The revision number of the chassis firmware is included in this information. The chassis firmware is shown within the Chassis Manager block diagram (see Block Diagram) and controls much of chassis operation. The following sections describe how to determine if there is a later revision of the chassis firmware available from Keysight.

Viewing the chassis revision information using the SFP

Bring up the SFP About dialog from the SFP menu bar by clicking Help > About. This will display the dialog in the following image.



The Hardware Revision contains four numbers representing four chassis components the chassis firmware revision is the first number listed. Of the four components whose revision numbers are being reported, only the chassis firmware is customer upgradeable. Information on upgrading chassis firmware is provided below.

Viewing the chassis revision information using the IVI drivers

The chassis revision string can be viewed using the IVI.NET and IVI-C drivers as follows:

IVI.NET: Use the Instrument Firmware Revision property.

IVI-C: Use the KTMPXICHASSSIS_ATTR_INSTRUMENT_FIRMWARE_REVISION attribute

9. Updating chassis firmware

To determine if there is a later revision of chassis firmware available, perform the following steps:

1. Go to www.keysight.com/find/M9019A and click the **Technical Support** tab.
2. Under Technical Support, click the **Drivers & Software** tab. If there are chassis firmware updates available, they will be listed under this tab, and can be viewed by clicking **Firmware Update** under **Refine the List**.
3. Compare your chassis firmware revision number to the list of chassis firmware revision numbers that are available. If there are later revisions available, Keysight recommends installing the latest version.

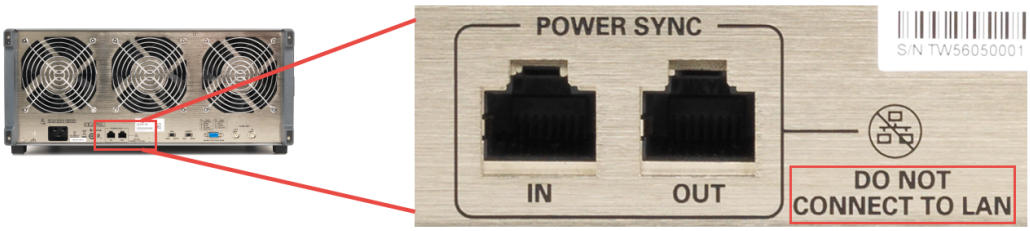
To install the latest chassis firmware, perform these steps:

1. Click the link to the latest (or desired) firmware update and follow the instructions provided to download and install the firmware on your chassis.
2. Power cycle the chassis after the firmware installation is complete, and verify that your host controller PC can communicate to the chassis.

10. Multiple chassis operation

In a multiple chassis system, the time base and triggering for each chassis operates independently from the other chassis. You can use this type of configuration to increase the number of chassis/modules. For more information, refer to Keysight's Multiple PXIe and AXIe Chassis Configuration tool . This tool is available online at: www.keysight.com/find/pxie-multichassis.

The power-up and power-down sequences, also termed as power sync, in multiple chassis configurations are similar to a single chassis configuration. However, additional cabling is required for synchronized chassis power coordination. Two RJ-45 connectors on the chassis rear panel provide this coordination.



CAUTION **These RJ45 connectors are for multichassis power-up synchronization. Do not connect cables to a corporate or local LAN to these connectors.**

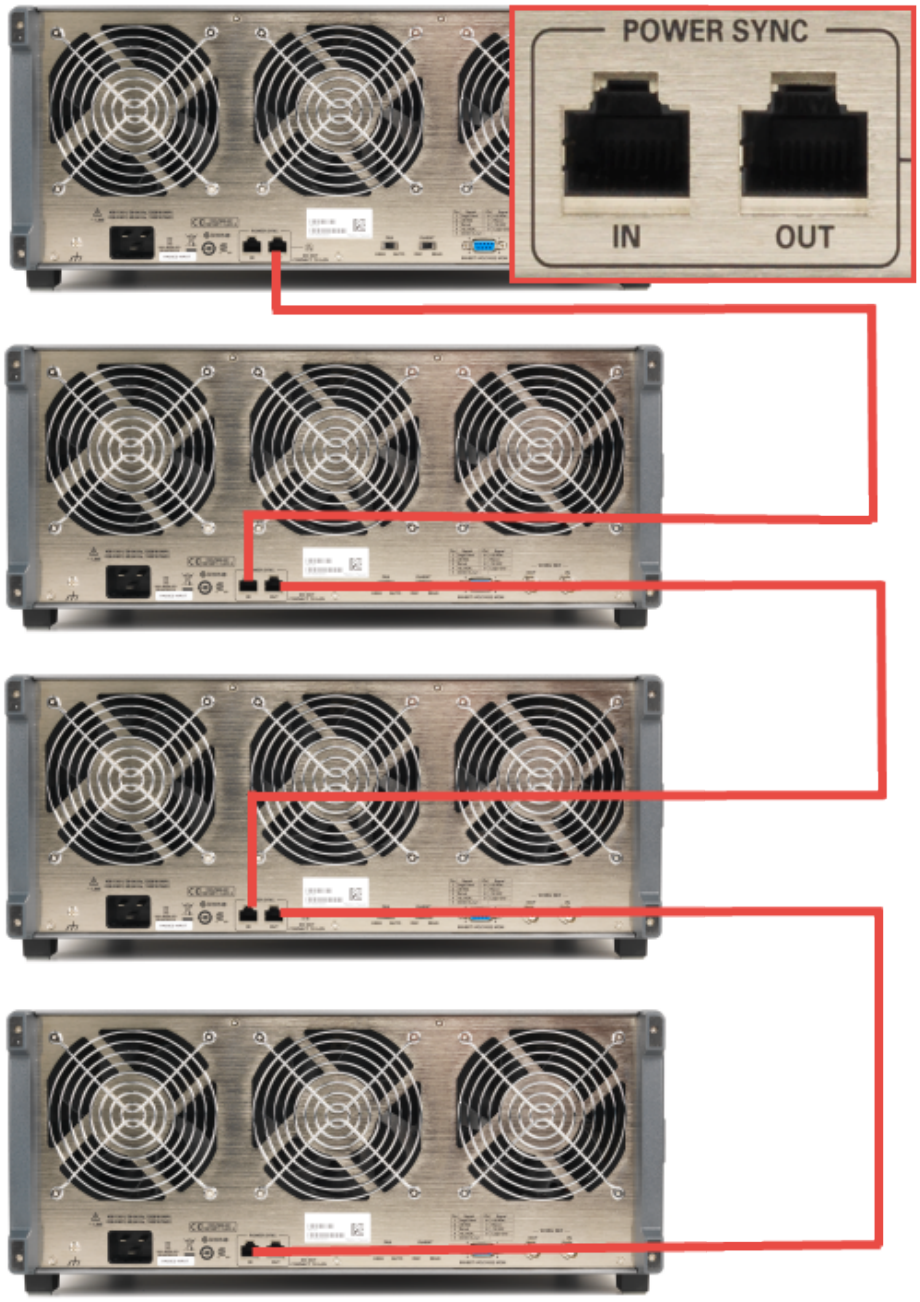
PXIe chassis may be connected in any order.

Power-up

When connected via the RJ-45 connectors, the power button on any chassis may be used to power up the entire system.

If you are using an external host controller, it should be turned off until all chassis are powered on.

Cables used for multiple chassis power-up synchronization purposes should not exceed 30 meters in length. Straight CAT5 or better cables are required.


POWER SYNC
IN
OUT

11. Chassis alarm architecture

The chassis provides seven alarms to assist you in monitoring the chassis. For example, you can set a temperature alarm threshold such that, if a chassis temperature sensor reports a temperature above the threshold, an alarm will be generated. Alarms can be set and monitored programmatically and using the SFP.

The following image describes the chassis alarm architecture, including identifying the functionality that is provided in hardware and the functionality that is provided in software. The figure also describes how alarms operate if multiple processes are using the same alarm.

In the following sections, the information provided by the front panel Power, Fan, and Temperature LEDs is described.

Chassis Alarm Architecture

Alarm operation

The chassis has these eight alarms:

1. Fan speed alarm
2. Temperature alarm
3. 3.3V alarm
4. 5V alarm
5. 12V alarm
6. -12V alarm
7. 5Vaux alarm
8. 10 MHz reference clock changed alarm

Each alarm has an Alarm Set/Reset Latch ("latch") – please see the figure below for an example of one latch . Each of the seven latches is set if its associated alarm threshold is exceeded. In the case of the fan speed alarm, exceeded means that at least one fan speed is *lower* than the Minimum Fan Speed Alarm Threshold. Similarly, a power supply rail that has exceeded its alarm threshold means that its voltage is *outside* of the range defined by the upper and lower voltage limits.

Setting of the latches allows alarm conditions to be detected/captured in the absence of an operator. The latch OUT does not have a default value—if the SET input is true (for example, at power-on due to a fan speed being below the default Minimum Fan Speed Threshold of 1200 RPM), the fan alarm latch OUT will be set True at power-on.

Each latch can be reset (cleared) using its associated Clear Alarm button on the SFP. Reset on the SFP Utility dropdown menu will reset all seven latches. However, if any alarm threshold is still exceeded when the latch is reset, the latch will be immediately set true again.

If the latch output is True and if the SFP Alarm Enabled is true, Alarm Occurred will be lit on the SFP. Alarm Occurred is set false if Alarm Enabled is set false. However, setting Alarm Enabled false does not reset the latch—this can only be done using Clear Alarm or Reset. Likewise, changing the corresponding alarm threshold to a value such that the alarm limit is no longer being exceeded does not reset the latch.

Interactions between programs using the chassis alarms

It is important to understand how your IVI.NET or IVI-C program interacts with the SFP alarms -- or, for that matter, with any program(s) that use the alarms. Programs that are operating simultaneously will need to share certain alarm resources. Each of the seven alarms has one instance of the tan-colored Set/Reset Latch and each alarm has the OR gate feeding into the latch – these tan elements represent hardware in the chassis. For discussion purposes, the Fan Speed Alarm Set/Reset Latch will be used as an example. The chassis contains one Fan Speed Alarm Set/Reset Latch, which all processes share.

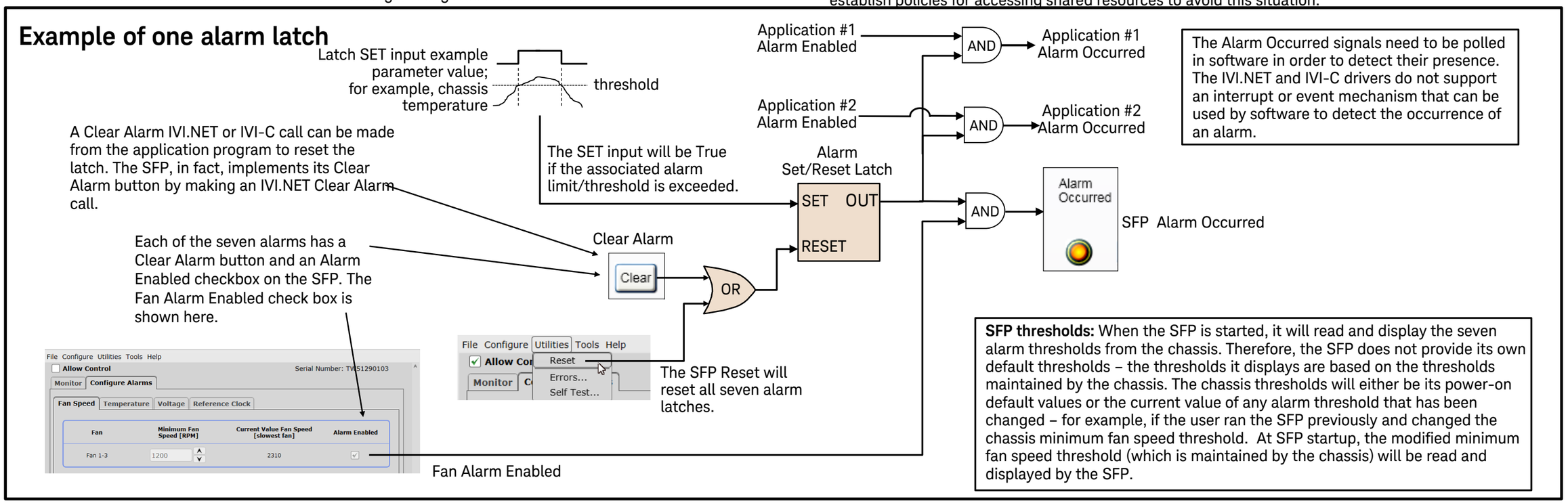
The elements which provide *inputs* to the tan-colored hardware elements are also singular and shared. For example, there is only one Minimum Fan Speed Alarm Threshold. If the threshold is set using the SFP and is then set to a different value using the IVI.NET driver, the last-set threshold will be in effect.

NOTE: To keep the SFP in sync with any changes that have been made programmatically to their shared resources, the SFP will poll the relevant chassis parameters every second and update its display accordingly. For example, if your program changes the Minimum Fan Speed Alarm Threshold, the new value will be reflected on the SFP Configure Alarms tab (if the SFP is running, of course) within one second. If your application program is running in an environment where the SFP is also running and if chassis parameters are being changed using the SFP, your program can likewise poll the relevant parameters in order to detect if they have been changed by the SFP user.

Continuing with the fan alarm example, the two fan alarm resources that are not shared are Alarm Enabled and Alarm Occurred. Each process, including the SFP, will have its *own software version* of these two properties as shown in the figure below. This allows a process that is interested in the fan alarm to enable its version of fan alarm while another, disinterested process can disable its version of fan alarm. In the example below, there are three Alarm Occurred properties, one for the SFP and two representing user applications. While they share the output of the Set/Reset Latch, they each have their own Alarm Enabled signal and their own Alarm Occurred signal.

IMPORTANT: Even though the Alarm Enabled and Alarm Occurred properties are separate for each process, all processes share the same latch as shown below. This can lead to the situation where one process detects that its version of Alarm Occurred is true and then resets the shared latch (using the Clear Alarm call) *before* a second, also-interested process has read its version of Alarm Occurred. This can result in the second process missing its version of Alarm Occurred. As recommended in the section PXIe chassis Software Architecture, application developers should establish policies for accessing shared resources to avoid this situation.

Example of one alarm latch



Power-on default alarm thresholds

This section summarizes the power-on default values of the chassis alarm thresholds as well as the valid range over which the alarm thresholds can be set. The phrase power-on default means that, regardless of how the thresholds are changed while power is applied, the thresholds return to factory-defined default values whenever the chassis is power cycled.

For example, if you use the SFP to set the Minimum Fan Speed Alarm Threshold to 500 RPM, this setting will not persist through a power cycle; the Minimum Fan Speed Alarm Threshold will be restored to the power-on default value of 1200 RPM when the chassis is power cycled.
Both the SFP and the IVI drivers will error check the alarm values to ensure they are within the valid range. The SFP will prevent setting of alarm values outside the valid range while the IVI drivers will return an error for values outside the valid range.

Threshold		**Default Threshold**	**Settable Range**
Minimum Fan Speed Alarm Threshold		1200 RPM	1 to 10,000 RPM
Maximum Temperature Alarm Threshold		70 °C	1 to 70°C
3.3V Rail	Upper Voltage Limit	3.630V (3.3V + 10%)	nominal value +.01% up to nominal value + 20%
	Lower Voltage Limit	2.970V (3.3V - 10%)	nominal value -.01% down to nominal value -20%
5V Rail	Upper Voltage Limit	5.25V[1]	nominal value +.01% up to nominal value + 20%
	Lower Voltage Limit	4.75V	nominal value -.01% down to nominal value -20%
12V Rail	Upper Voltage Limit	12.6V	nominal value +.01% up to nominal value +20%
	Lower Voltage Limit	11.4V	nominal value -.01% down to nominal value -20%
–12V Rail	Upper Voltage Limit	-11.4V	nominal value +.01% up to nominal value + 20%
	Lower Voltage Limit	-12.6V	nominal value -.01% down to nominal value -20%

Threshold		Default Threshold	Settable Range
+5.0V_{aux} Rail	Upper Voltage Limit	5.25V	nominal value +.01% up to nominal value + 20%
	Lower Voltage Limit	4.75V	nominal value -.01% down to nominal value - 20%

1 Note that the 5V rail initially has voltage limits of ±5% around the nominal value. However, the IVI driver will expand the 5V limits to ±10%. Because the PXIe chassis SFP uses the IVI.NET driver, the SFP also expands the 5V limits to ±10%

Events which re-establish the power-on default thresholds

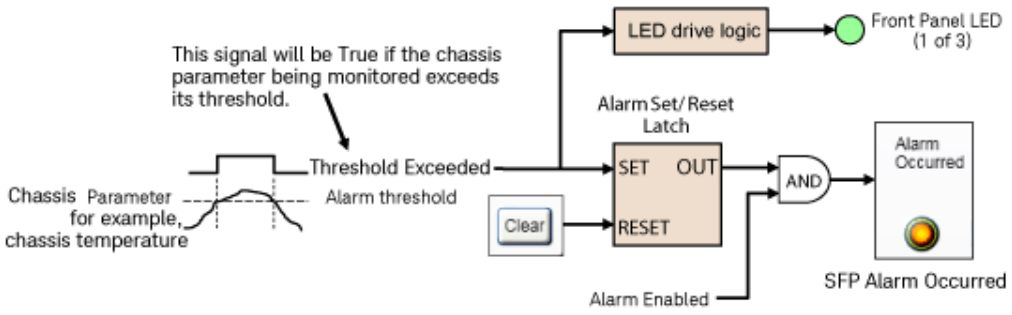
Power cycling is just one event that causes the chassis power-on default alarm thresholds to be re-established by the chassis. The complete list is:

- Power cycling, as mentioned
- Asserting a chassis reset using the SFP Utility > Reset menu
- Asserting a programmatic chassis reset using the IVI.NET, IVI-C or LabVIEW drivers

Relationship between alarm occurred and the front panel LEDs

The fans, temperature sensors, and voltage rails have front panel LEDs associated with them. This section describes the relationship between each LED and its associated Alarm Occurred indicator.

The following image shows one example of an alarm latch and an LED.



In this example, the Threshold Exceeded signal will be True if the chassis parameter being monitored exceeds its threshold. For example, if a temperature sensor reports a temperature greater than the temperature threshold. A True value of Threshold Exceeded causes the following:

1. The LED drive logic will flash the front panel LED, indicating that the parameter being monitored has exceeded its threshold.
2. The Alarm Set/Reset Latch will be set. If, in addition, Alarm Enabled is True, the SFP Alarm Occurred indicator will be illuminated.

If the parameter being monitored then returns to below its threshold (for example, the room temperature is lowered, causing the chassis temperature sensors to report lower temperatures), Threshold Exceeded will go False. This will cause the LED to cease flashing. However, the alarm latch will remain latched. This can lead to the situation where Alarm Occurred (based on the latched signal) will be indicating an alarm condition, while the associated LED is not likewise indicating an alarm condition.

This situation simply means that the condition that caused the alarm is no longer present. While the alarm can be easily cleared by pressing the SFP Clear button, it is suggested that the cause of the alarm be explored. Although it can be difficult to determine the cause of a prior alarm, the SFP will often provide information regarding what might have caused the alarm. For example, the temperature threshold may be set too close to the temperature being reported by one of the chassis temperature sensors, which could cause intermittent setting of the temperature alarm latch. Possible next steps include determining if a module is running excessively hot, or adjusting the temperature threshold higher to provide additional margin.

Note that, while the front panel Temperature LED is off when temperatures are normal, the Fan and Power LEDs are on when their associated parameters are normal. In all cases, a flashing LED indicates that the associated parameter has exceeded its alarm threshold.

The SFP alarm thresholds

In Simulation Mode, the SFP default alarm thresholds are identical to the chassis alarm thresholds. However, in SImulation Mode, the alarms are not active. In Hardware Mode, however, the SFP reads and displays the chassis thresholds. In other words, the SFP does not provide its own default thresholds in Hardware Mode.

For example, assume that the SFP has been used to change the Minimum Fan Speed Threshold from 1200 RPM to 500 RPM followed by closing the SFP. When the SFP is started next, it will read the value of Minimum Fan Speed Threshold from the chassis (500 RPM, in this example), and display this value on the SFP as the Minimum Fan Speed Alarm Threshold.

Power cycling the chassis will re-establish all default values. Continuing with the previous example, the chassis Minimum Fan Speed Alarm Threshold will be set back to its power-on default value of 1200 RPM by the power cycle. When the SFP next connects to the chassis, it will read this value from the chassis and display 1200 RPM as the Minimum Fan Speed Alarm Threshold.

NOTE In the description of each SFP alarm capability, the SFP alarm diagrams will show the *chassis* default alarm thresholds. This is because, as described above, the SFP reads and displays the chassis alarm thresholds. As long as the particular chassis alarm has not been changed earlier (for example, during a prior SFP session), the chassis power-on default alarm threshold will still be in effect and will be read and displayed by the SFP.

12. PXIe chassis fan speed

Overview of chassis cooling

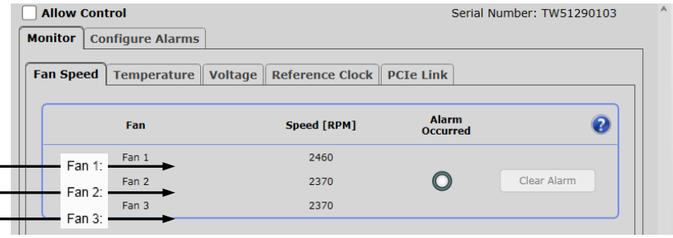
The key points regarding chassis cooling are:

- The chassis is cooled by three 186 cubic feet per minute (CFM) fans, providing a total airflow of up to 558 CFM.
- The fans are mounted on the chassis rear panel and exhaust air out the rear of the chassis. The air intakes are in the front, sides and bottom of the chassis.
- A minimum of 50 mm (2 inches) of clearance should be provided in the front, rear and sides of the chassis for ventilation. Depending on module power consumption, clearance may also be needed below the chassis to accommodate the air intakes on the bottom of the chassis. This is discussed further in the next section.
- The fans can either be set to operate at maximum speed, or can be set so that the fan speeds are a function of the chassis temperature. With the latter capability, you can specify the fan speed vs. temperature profile using either the soft front panel (SFP) or programmatically using the IVI drivers.
- The chassis contains air flow exit temperature sensors mounted to the top of the backplane to allow you to monitor the temperatures in the airflow downstream from the modules. These temperatures can be read using the SFP or programmatically. See Monitoring the chassis temperature on page 40 for information on the sensor locations and how to read their temperatures.

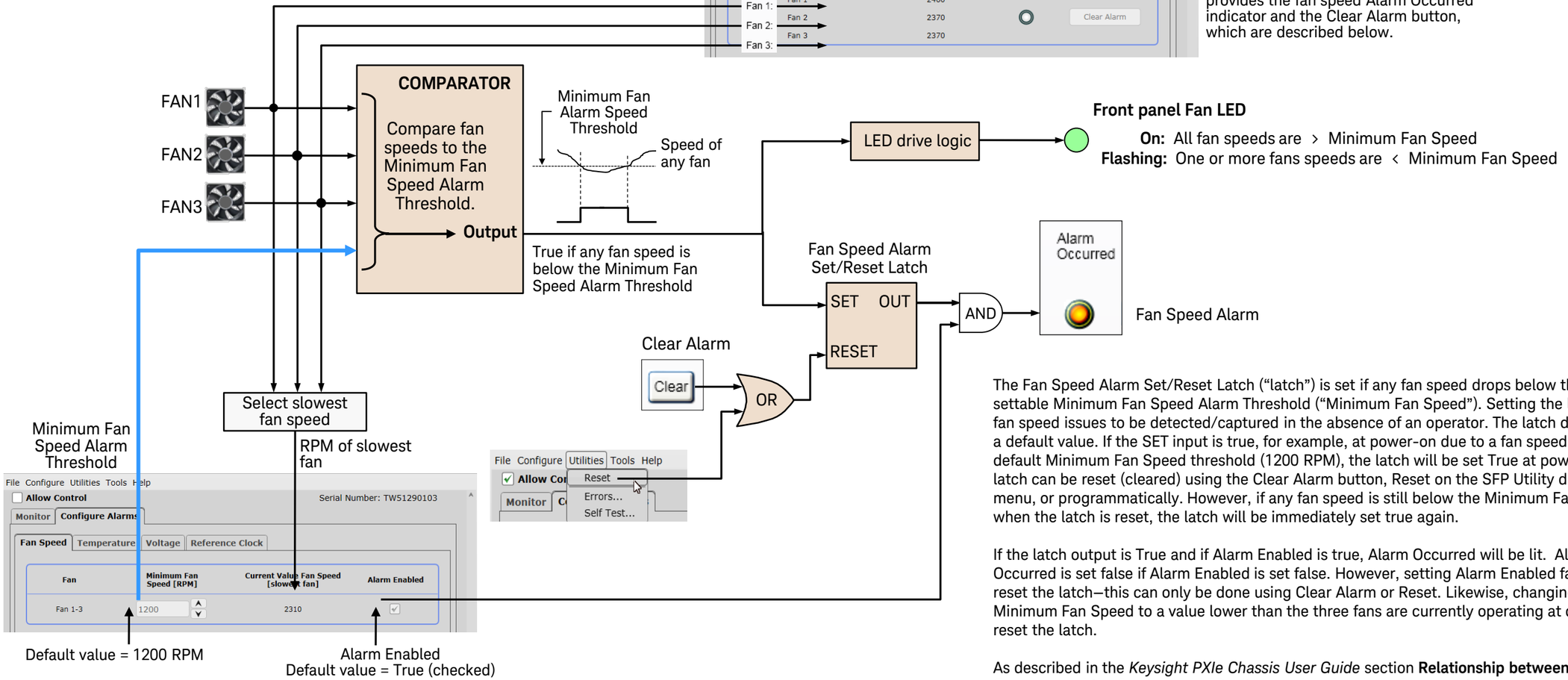
Monitoring Fan Speeds

The M9019A chassis contains three fans that are mounted on the chassis rear panel and provide cooling for the chassis. The chassis allows you to monitor the speed of each fan in revolutions per minute (RPM). You can also set a minimum fan speed threshold such that, if any fan speed falls below this threshold, a fan speed alarm is generated.
These monitoring capabilities are available using the SFP and programmatically using the chassis drivers. In addition, the front panel Fan LED provides information on fan speeds. Use of the SFP, the front panel Fan LED, and the IVI drivers to monitor the chassis temperature sensors are described in the following SFP and the front panel Fan LED diagram:

Fan Speed Monitoring using the SFP and the Front Panel Fan LED



The **Monitor** tab allows the three fan speeds to be monitored. This tab also provides the fan speed Alarm Occurred indicator and the Clear Alarm button, which are described below.



The **Configure Alarms** tab is used to set the Minimum Fan Speed threshold and enable/disable the Fan Speed Alarm. The Minimum Fan Speed can be set from 1 to 10,000 RPM either by entering the value directly or by using the up/down arrow buttons. As an aid in setting the Minimum Fan Speed, the current value of the slowest fan is displayed.

The Fan Speed Alarm Set/Reset Latch ("latch") is set if any fan speed drops below the user-settable Minimum Fan Speed Alarm Threshold ("Minimum Fan Speed"). Setting the latch allows fan speed issues to be detected/captured in the absence of an operator. The latch does not have a default value. If the SET input is true, for example, at power-on due to a fan speed below the default Minimum Fan Speed threshold (1200 RPM), the latch will be set True at power-on. The latch can be reset (cleared) using the Clear Alarm button, Reset on the SFP Utility dropdown menu, or programmatically. However, if any fan speed is still below the Minimum Fan Speed when the latch is reset, the latch will be immediately set true again.

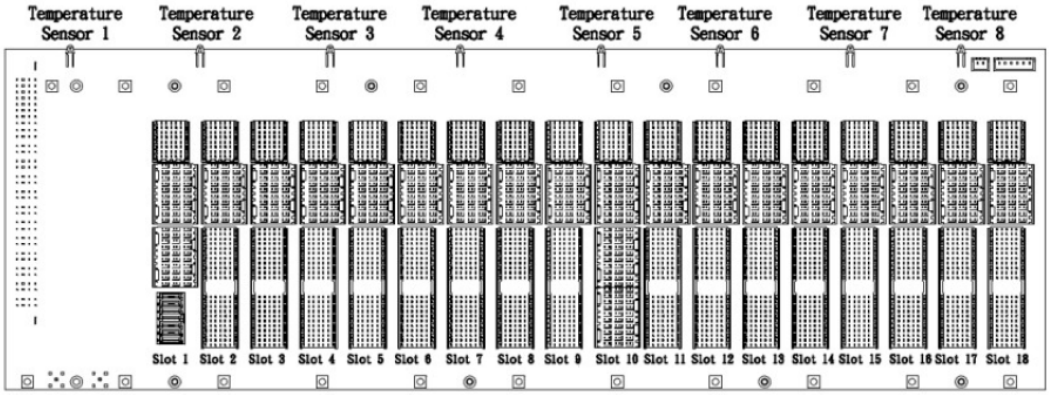
If the latch output is True and if Alarm Enabled is true, Alarm Occurred will be lit. Alarm Occurred is set false if Alarm Enabled is set false. However, setting Alarm Enabled false does not reset the latch—this can only be done using Clear Alarm or Reset. Likewise, changing the Minimum Fan Speed to a value lower than the three fans are currently operating at does not reset the latch.

As described in the *Keysight PXIe Chassis User Guide* section **Relationship between Alarm Occurred and the front panel LEDs**, it is possible for Alarm Occurred to indicate a low fan speed while the front panel Fan LED indicates that fan speeds are normal. This situation can occur if a fan speed is momentarily below the Minimum Fan Speed (which sets the latch) followed by the fan speed increasing above the Minimum Fan Speed, which restores the Fan LED to being on continuously (normal).

13. Monitoring the chassis temperature

PXIe chassis allows you to monitor each of the air flow exit temperature sensors using either the SFP, the IVI drivers, or the LabVIEW driver. In addition, the SFP and IVI drivers can be used to set an upper temperature threshold such that an alarm will be generated if any temperature sensor reports a temperature above the specified threshold. The front panel Temperature LED also provides information about the chassis temperature.

The air flow exit chassis temperature sensors are located on the chassis printed circuit board that contains the module connectors as shown in the following image. This board is known as the *chassis backplane* or just *backplane*.

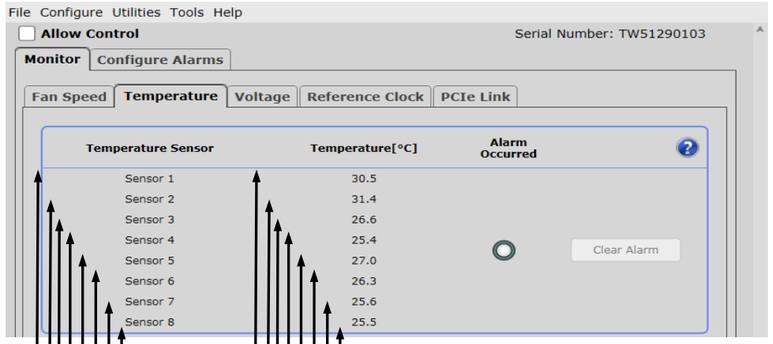


By knowing the location of the temperature sensors relative to the chassis slots, you can determine which modules are potentially contributing to excessive temperatures. To address this, you can take steps such as redistributing modules in the chassis or installing air inlet modules adjacent to high power modules to provide additional ventilation.

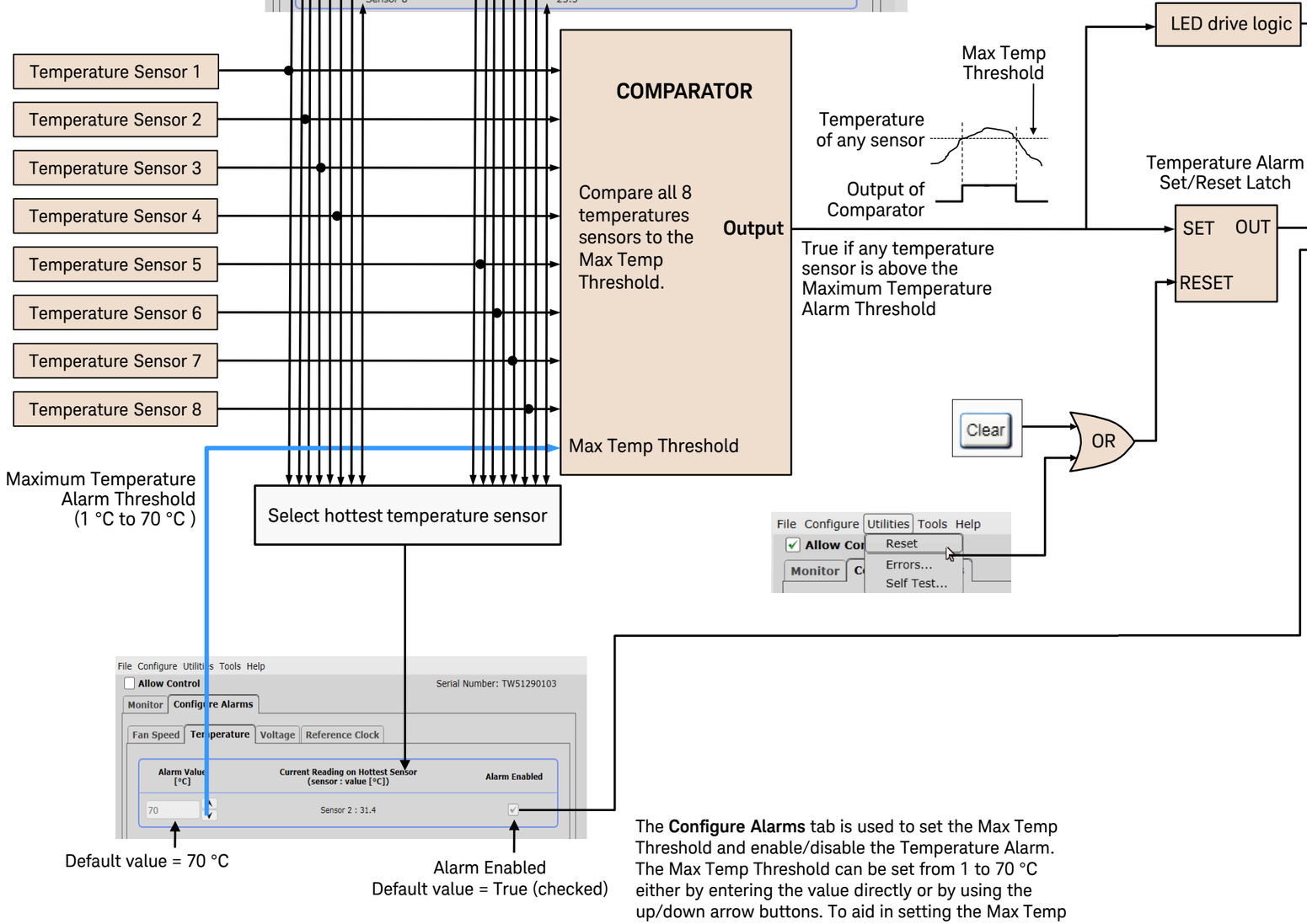
Use of the SFP , the front panel Temperature LED, and the IVI drivers to monitor the chassis temperature sensors is described in the following Temperature Monitoring using the SFP and the Front Panel Temperature LED diagram.

The **Monitor** tab allows the temperatures reported by the air flow exit chassis temperature sensors to be monitored. This tab also provides the temperature **Alarm Occurred** indicator and the **Clear Alarm** button.

Temperature Monitoring using the SFP and the Front Panel Temperature LED



The **Monitor** tab allows the temperatures reported by the eight chassis temperature sensors to be monitored. This tab also provides the temperature Alarm Occurred indicator and the Clear Alarm button.



The **Configure Alarms** tab is used to set the Max Temp Threshold and enable/disable the Temperature Alarm. The Max Temp Threshold can be set from 1 to 70 °C either by entering the value directly or by using the up/down arrow buttons. To aid in setting the Max Temp Threshold, the current value of the hottest temperature sensor is displayed.

Front panel Temperature LED

On: The LED is illuminated for 3 seconds at power on to permit verification that the LED and its drive circuitry are operational.

Off: All temperature sensors are < Maximum Temperature Alarm Threshold

Flashing: One or more temperature sensors are > Maximum Temperature Alarm Threshold

The Temperature Alarm Set/Reset Latch ("latch") is set if any temperature is above the user-settable Maximum Temperature Alarm Threshold ("Max Temp Threshold"). Setting the latch allows temperature issues to be detected/captured in the absence of an operator. The latch does not have a default value—if the SET input is true, for example, at power-on due to a temperature sensor reporting a temperature above the default Max Temp Threshold (70 °C), the latch will be set True at power-on.

The latch can be reset (cleared) using the **Clear Alarm** button, Reset on the Utility dropdown menu, or programmatically. However, if any temperature sensor is still reporting a temperature above the Max Temp Threshold when the latch is reset, the latch will be immediately set True again.

If the latch is set and if Alarm Enabled is True, Alarm Occurred will be True. Alarm Occurred is set False if Alarm Enabled is set False; however, setting Alarm Enabled False does not reset the latch. Likewise, changing the Max Temp Threshold to a temperature higher than all eight temperature sensors are currently reporting does not reset the latch.

As described in the Keysight PXIe Chassis User Guide section **Relationship between Alarm Occurred and the front panel LEDs**, it is possible for Alarm Occurred to indicate an over temperature condition while the front panel LED indicates the temperatures are normal. This situation can occur if a temperature sensor momentarily reports a temperature above Max Temp Threshold (which sets the latch) followed by the chassis temperature dropping such that all sensors now report temperatures below Max Temp Threshold – this will turn the LED off (normal operation).

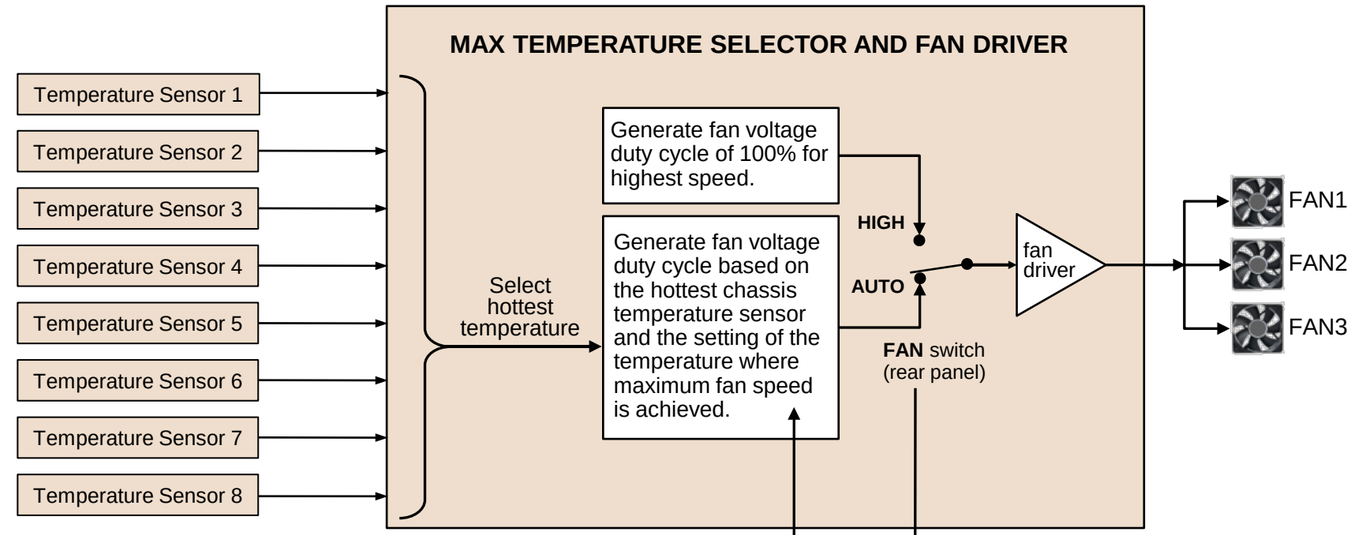
14. Setting the fan speed vs. chassis temperature profile

The chassis allows you to control the fan speed vs. temperature profile . This is done by specifying a chassis temperature at which the three fans will operate at maximum speed. Maximum speed is achieved by the chassis supplying a drive voltage to the fans with a 100% duty cycle.

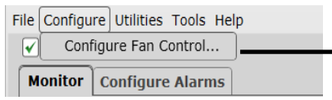
For temperatures below the specified chassis temperature, the duty cycle of the fan drive voltage will be less than 100%, which reduces the fan speed and the fan noise. The reduction in fan speed is proportional to how far the chassis temperature is below the specified chassis temperature. To ensure adequate cooling at any temperature, the drive voltage to the fan will never drop below 40% duty cycle.

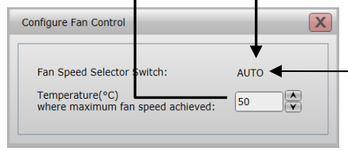
These fan speed vs. chassis temperature profile can be set using both the SFP and programmatically, as described in the following Using the SFP diagram.

Setting the Temperature at which the Maximum Fan Speed is Achieved using the SFP



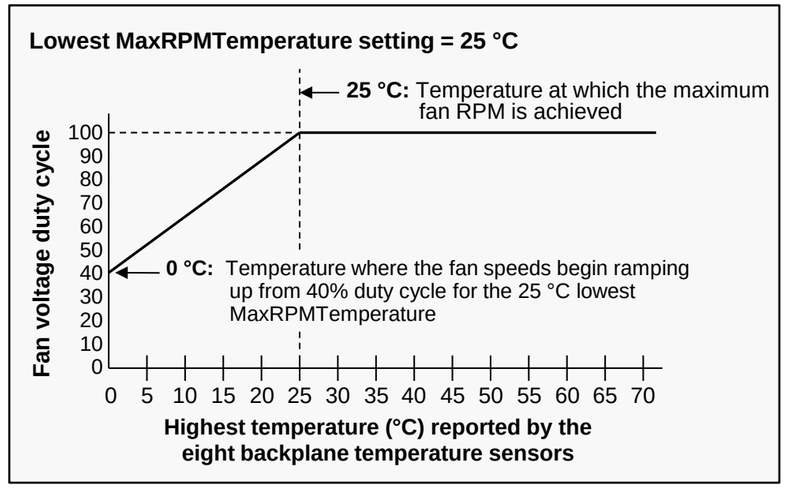
The **Allow Control** check box must be checked in order to use the functionality described on this diagram.

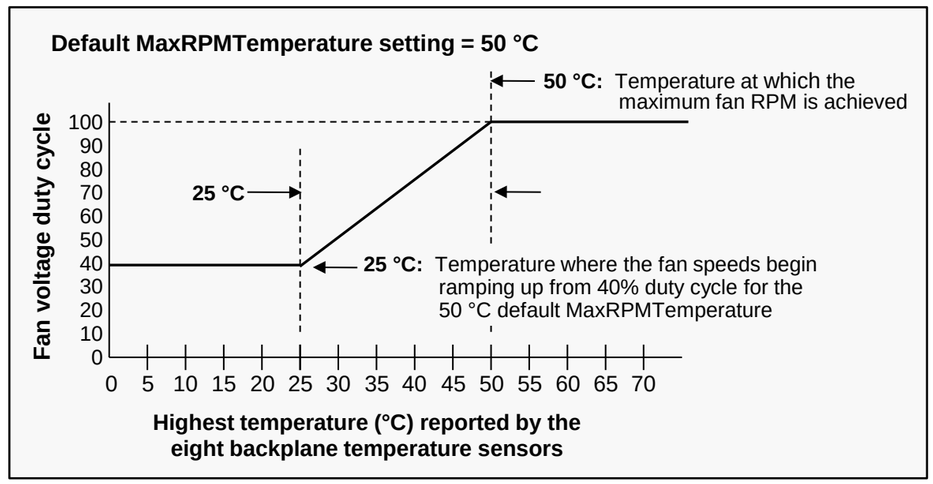


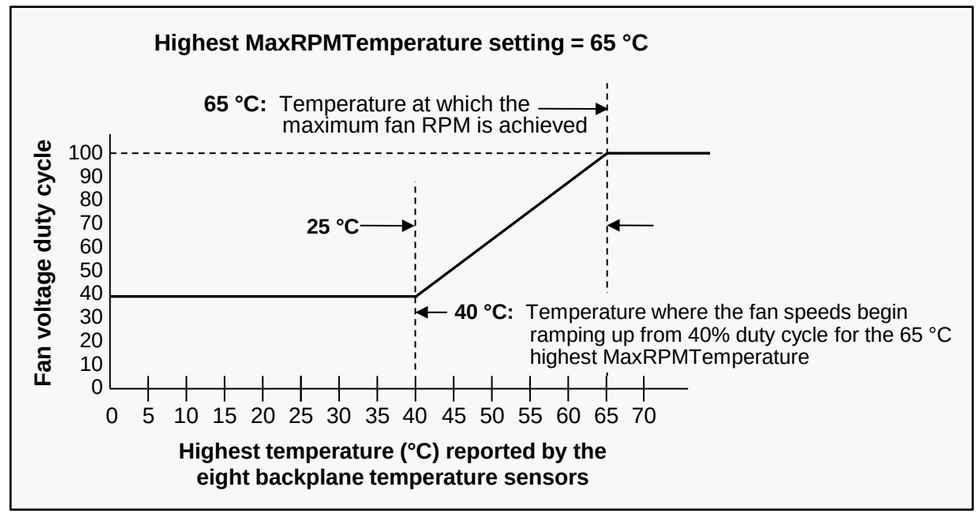


This field displays the position of the Fan Speed Selector Switch. This switch is on the rear panel and is labeled **FAN**.

The **Configure Fan Control** dialog is used to set the parameter "Temperature (°C) where maximum fan speed achieved" – this parameter will be referred to by its IVI.NET driver name, MaxRPMTemperature. At SFP startup, the SFP reads the chassis value of MaxRPMTemperature and inserts that value here. The chassis default value is 50 °C.







The PXIe chassis controls the speed of its three fans by varying the duty cycle of the drive voltage to the fans. When the rear panel **FAN** switch (referred to as the "Fan Speed Selector Switch") is set to **HIGH**, the fan voltage duty cycle is set to 100%, which generates the highest fan speeds and the best chassis cooling – however, this also generates the most fan noise.

When the Fan Speed Selector Switch is set to **AUTO**, the speed of the three fans is controlled based on the temperature of the chassis *and* the setting of the SFP parameter "Temperature (°C) where maximum fan speed achieved" shown above (which will be referred to by its IVI.NET driver name for brevity, "MaxRPMTemperature"). MaxRPMTemperature specifies the chassis temperature where the maximum (100% duty cycle) fan speed is achieved, and is set using the Configure Fan Control dialog – this dialog is opened from the SFP **Configure** pull down menu. The hottest temperature reported by the eight temperature sensors is used to control the fan speed as shown in the block diagram. MaxRPMTemperature can be set from 25 °C (right top curve) to 65 °C (right bottom curve) in 1 °C increments either by entering the value directly or by using the up/down arrow buttons. The default MaxRPMTemperature parameter is 50 °C (right middle curve).

Regardless of the MaxRPMTemperature that is set, the fan speeds begin ramping up at 25 °C *below* MaxRPMTemperature. For example, if MaxRPMTemperature is set to 65 °C (bottom curve), the fan speed begins ramping up at 25 °C below this temperature, or at 40 °C. At 65 °C, the fan voltage duty cycle will be 100% (maximum fan speed).

Note that the chassis doesn't attempt to maintain its temperature at a particular temperature although it is expected that, in most cases, the chassis temperature will stabilize before MaxRPMTemperature is reached. To maximize cooling, MaxRPMTemperature should be set lower while, to minimize fan noise, MaxRPMTemperature should be set higher.

15. Monitoring the power supply rails

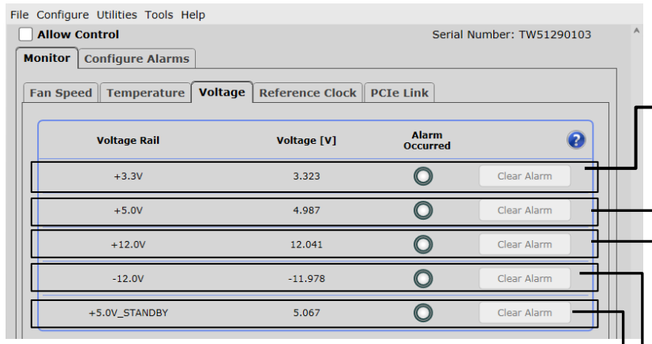
The chassis allows you to monitor the following five power supply rails :

- 3.3V
- 5V
- 5 Vaux (This rail is monitored indirectly using the front panel Power LED)
- 12V
- –12V

For a description of these rails, see Power Supply Operation on page 16. With the exception of the 5Vaux rail, all voltage rails can be viewed using the SFP, can be read programmatically using the chassis drivers, and can be read directly on the rear panel DB-9 connector using a voltmeter.
In addition, the SFP and the chassis drivers can be used to set voltage limits around the rails (again, except for the 5Vaux rail) such that an alarm will be generated if a rail voltage falls outside of the specified limits. The front panel Power LED provides collective information about all five rails.
Use of the SFP, the front panel Power LED, and the IVI drivers to monitor the power supply rails is described in the following Soft front panel (SFP) and the front panel Power LED diagram.

NOTE **In rare cases where the 5Vaux is loaded to the point where it deviates outside of the ±5% tolerance, it can cause the Power LED to blink. Unfortunately, the 5Vaux is not visible through the IVI command layer. Therefore, you will not see voltage nor alarm change on the Soft Front Panel.**

Voltage Monitoring using the SFP and the Front Panel Power LED



The **Configure Alarms** tab is used to set the Upper and Lower Voltage Limits for each of the four primary voltage rails.

The **Configure Alarms** Voltage column displays the current value of each supply; these values are also displayed on the **Monitor** tab. Each voltage rail has a Comparator and Voltage Alarm Set/Reset Latch ("latch") that are used to detect and store the occurrence of an out-of-limit power supply condition. The voltage rail latch is set if the associated voltage rail is outside of its Upper/Lower Voltage Limits. Setting of the latch allows power supply issues to be detected/captured in the absence of an operator. The latch can be reset (cleared) using the corresponding Clear Alarm button, Reset on the Utility dropdown menu, or programmatically. However, if the voltage rail is still outside of its Upper/Lower Voltage Limits when the latch is cleared, the latch will immediately be set true again.

If a latch is set and if the corresponding Alarm Enabled is True, Alarm Occurred will be True. Alarm Occurred is set False if Alarm Enabled is set False; however, setting Alarm Enabled False does not reset the latch. Likewise, changing the Upper/Lower Voltage Limits such that the voltage rail is within the limits does not reset the latch.

As described in the Keysight PXIe Chassis Family User Guide section **Relationship between Alarm Occurred and the front panel LEDs**, it is possible for Alarm Occurred to indicate an out-of-range voltage condition while the front panel Power LED indicates the voltages are normal. This situation can occur if a voltage rail momentarily exceeds its limits (which sets that particular latch) followed by the voltage rail changing such that the voltage rail is now within its limits -- this will restore the Power LED to being on continuously (normal operation).

The Output of a Comparator will be True if the power supply voltage is outside of its upper and lower voltage limits. This will set the corresponding Set/Reset Latch.

On: The five voltage rails are within their limits
Flashing: One or more voltage rails are outside of their upper/lower voltage limits

Front panel Power LED

LED drive logic

3.3V Upper Voltage Limit
3.323
3.3V supply
Enabled
+3.3V
Clear Alarm
3.3V Lower Voltage Limit

3.3V COMPARATOR
Upper voltage limit
3.3V input
Output
Lower voltage limit

3.3V Alarm Set/Reset Latch
SET
OUT
RESET
3.3V Alarm Occurred
Clear
OR
AND

5V Upper Voltage Limit
4.987
5V supply
Enabled
+5.0V
Clear Alarm
5V Lower Voltage Limit

5V COMPARATOR
Upper voltage limit
5V input
Output
Lower voltage limit

5V Alarm Set/Reset Latch
SET
OUT
RESET
5V Alarm Occurred
Clear
OR
AND

12V Upper Voltage Limit
12.041
12V supply
Enabled
+12.0V
Clear Alarm
12V Lower Voltage Limit

12V COMPARATOR
Upper voltage limit
12V input
Output
Lower voltage limit

12V Alarm Set/Reset Latch
SET
OUT
RESET
12V Alarm Occurred
Clear
OR
AND

12V Upper Voltage Limit – For the -12V rail, the Upper Voltage Limit is more positive than the nominal voltage of -12V; for example, -11.4V.

-12V supply
Enabled
-12.0V
-11.978
Clear Alarm

-12V COMPARATOR
Upper voltage limit
-12V input
Output
Lower voltage limit

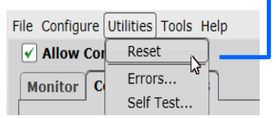
-12V Alarm Set/Reset Latch
SET
OUT
RESET
-12V Alarm Occurred
Clear
OR
AND

-12V Lower Voltage Limit – For the -12V rail, the Lower Voltage Limit is more negative than the nominal voltage of -12V; for example, -12.6.

5Vaux Upper Voltage Limit
5.067
5Vaux supply
Enabled
+5.0V_STANDBY
Clear Alarm
5Vaux Lower Voltage Limit

5Vaux COMPARATOR
Upper voltage limit
5Vaux input
Output
Lower voltage limit

5Vaux Alarm Set/Reset Latch
SET
OUT
RESET
5Vaux Alarm Occurred
Clear
OR
AND



Reset clears all four voltage latches.

16. Monitoring the 10 MHz reference clock source

Chassis timing is based on a 10 MHz reference clock. The 10 MHz reference clock can originate from the three sources listed below. These sources are listed in the order of precedence from low to high if multiple 10 MHz reference clock sources are available:

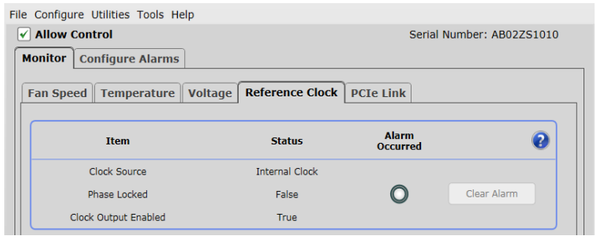
1. Chassis internal 10 MHz clock
2. Rear panel 10 MHz clock (connected to the chassis through a BNC connector)
3. System timing slot (slot 10) 10 MHz clock

A clock source with a higher number supersedes a clock source with a lower number if both are present. For example, if both a rear panel 10 MHz clock (#2) and a system timing slot 10 MHz clock (#3) are provided, the system timing slot 10 MHz clock (#3) will be used by the chassis to generate its internal timing signals. There are no means to override this order of precedence; for example, there are no means to select the rear panel 10 MHz clock if a system timing slot clock is present. The module in the system timing slot would need to be removed from the chassis in order to activate selection of the rear panel 10 MHz clock.

NOTE **The chassis references either the rear panel 10 MHz clock or the system timing slot 10 MHz clock as long as the clock frequency remains within the specification range of ±100 ppm. The chassis clocks are undefined if the reference clock is outside of this range.**

Use of the SFP and the IVI drivers to monitor the 10 MHz reference clock source is described in the following Using the SFP diagram.

10 MHz Reference Clock Source Monitoring Using the SFP



The **Monitor** tab allows the source of the 10 MHz reference clock to be monitored. This tab also provides the 10 MHz reference clock source change Alarm Occurred indicator and the Clear Alarm button, which are described below.

The order of clock precedence is as follows:

1. Chassis internal 10 MHz clock
2. Rear panel external 10 MHz clock
3. System timing slot (slot 10) 10 MHz clock

A clock source with a higher number supersedes a clock source with a lower number if both are present. For example, if both a rear panel 10 MHz clock (#2) and a system timing slot 10 MHz clock (#3) are provided, the system timing slot 10 MHz clock (#3) will be used by the chassis as its reference clock to generate its internal timing signals.

The **Configure Alarms** tab is used to enable the 10 MHz Reference Clock Source Change Alarm.

The 10 MHz Reference Clock Source Change Alarm Set/Reset Latch ("latch") is set whenever the source of the 10 MHz reference clock changes. Setting the latch allows a clock source change to be detected/captured in the absence of an operator. The latch is reset (cleared) at power-on. The latch can also be reset using the Clear Alarm button, Reset on the SFP Utility dropdown menu, or programmatically.

If the latch output is True and if Alarm Enabled is true, Alarm Occurred will be True. Alarm Occurred is set False if Alarm Enabled is set False. However, setting Alarm Enabled False does not reset the latch—this can only be done using Clear Alarm, Reset on the SFP Utility dropdown menu, or programmatically.

17. Configuring the PXI trigger bus

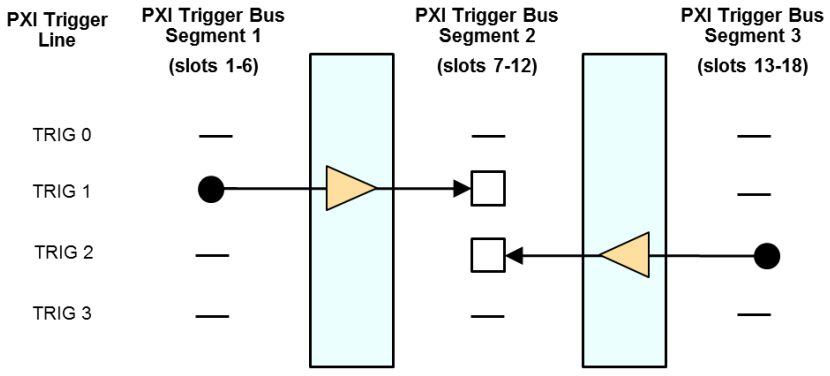
The PXI trigger bus consists of eight trigger lines spanning the XP4 backplane connectors. The trigger lines are divided into three trigger bus segments, numbered 1-3. There are also two front panel trigger ports (SMB) are connected to the PXI (0:7) trigger bus. See Front panel trigger on page 11 for more information.

NOTE To view the PXI trigger bus, see the Block Diagram. To open Block Diagram, go to **Start > All Programs > Keysight > PXIe Chassis Family > Block Diagram**. In the block diagram, select the PXI_TRIG[0:7] check box under the **Show Triggers** label.

By default, when you power-on the chassis, these trigger bus segments are isolated from one another. Only the modules inside a given segment are able to detect a trigger signal originating from another module in that same segment. The dash ▬ in the following figure represents a trigger line in the default isolated state.

For each trigger line in a segment, you can enable buffers that to allow a trigger signal on that line to either flow out of a segment and into an adjacent segment, or to flow into that segment from an adjacent segment.

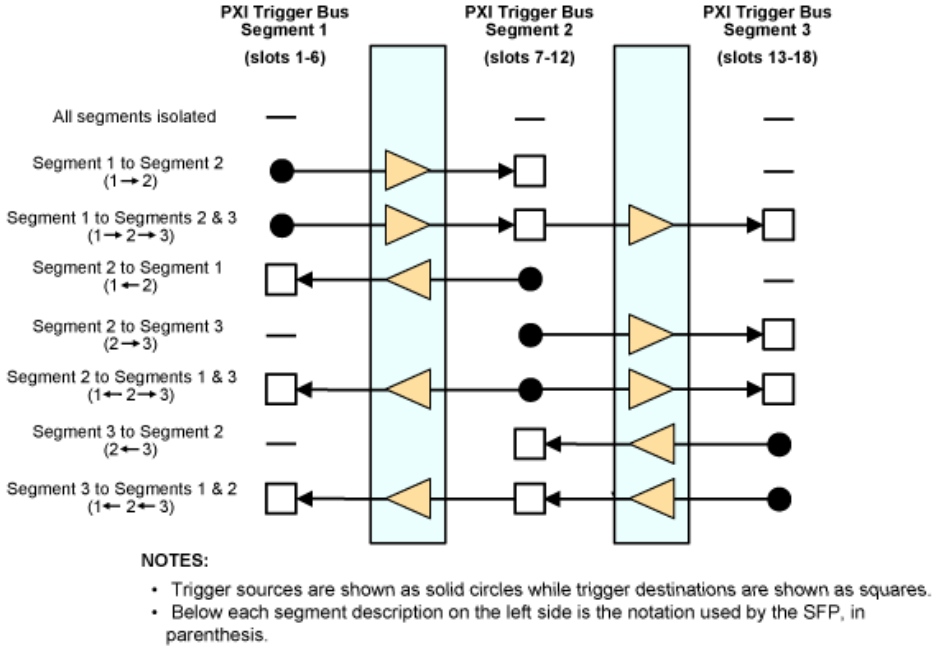
When you enable a buffer to allow a trigger line to cross into another segment, it is called a route or trigger route. A trigger route always has a source segment and a destination segment. The following image shows an example where trigger lines 0 and 3 have no routes, trigger line 1 has a route from segment 1 to segment 2, and trigger line 2 has a route from segment 3 to segment 2.



NOTES:

- Trigger sources are shown as solid circles while trigger destinations are shown as squares. Trigger buffers are shown as yellow triangles.
- Only four of the eight trigger lines are shown in the diagram.

With three trigger bus segments, there are eight possible trigger bus segment connections. In the following image, there are eight trigger lines, each line is showing a different connection so that all eight may be seen. Any of these combinations can be applied to each of the eight trigger lines PXI_TRIG[0:7].



NOTE Do not confuse the eight combinations of trigger bus segment connections with the eight trigger lines of the PXI_TRIG[0:7] bus.
Any one of the eight trigger bus segment combinations in Figure 31 can be applied to each of the eight trigger lines PXI_TRIG[0:7].

Some multi- slot PXI instruments, such as the M9381A use peer-to-peer (module-to-module) triggering to function. If you install these modules on the same trigger bus segments, no routes are needed. But if you install them on different trigger bus segments, you must configure trigger routes.

The need for trigger management

A PXI chassis may contain multiple PXI instruments, some of which may require trigger bus resources that must be configured and reserved for its use. Software applications that operate these PXI instruments should have a systematic way to share the backplane trigger lines without interfering with each other.

For example, consider that application A uses backplane trigger line 0 to send a trigger signal sourced from the slot 2 module to a destination module in slot 3. There is another application named B that needs to send a signal source from the slot 4 module to the slot 5 module. It would not work well if both applications tried to use the same trigger line 0, because the slot 5 module would receive trigger signals generated by Application A's slot 2 module. Application B's use of trigger

line 0 would likewise confuse Application A's slot 3 module. Such resource contention not only interferes with the applications, but also has the possibility of damaging the trigger drive hardware multiple trigger source modules try to drive a signal to the same trigger line.

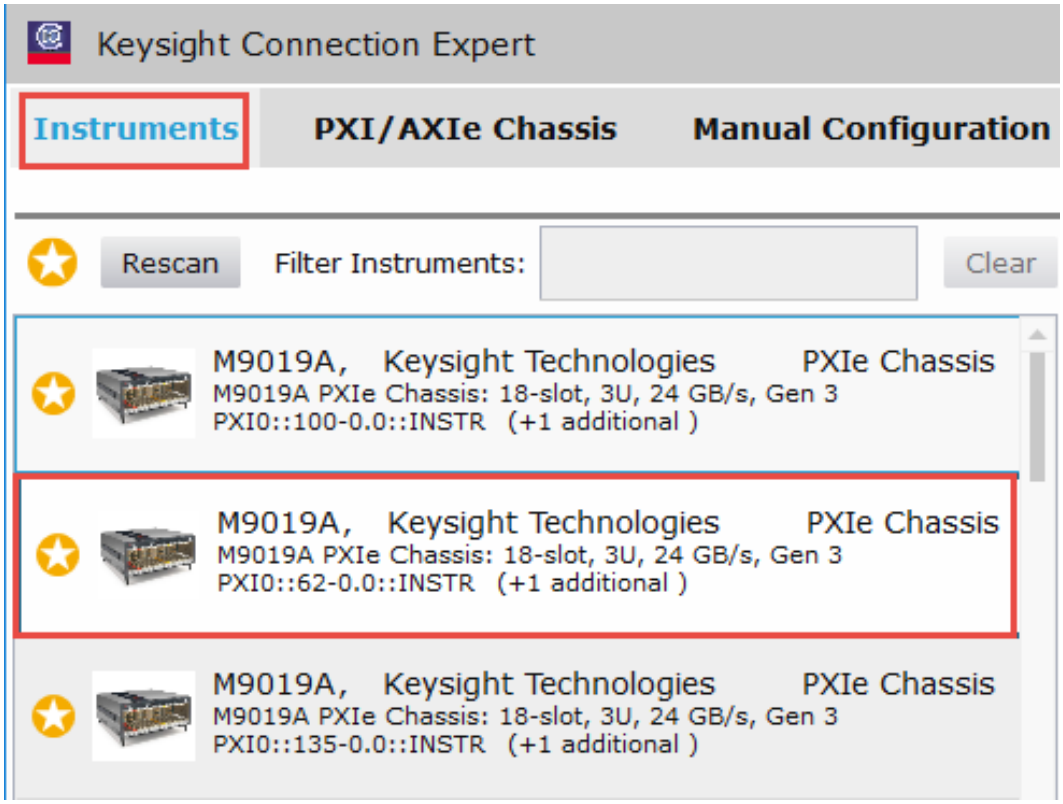
To help manage the use of trigger lines between applications, the PXI and PXI Express Trigger Management Specification (PXI-9) was developed. Chassis manufacturers who supply a PXI-9 Trigger Manager DLL that is compliant to that specification provide a consistent way for applications to share backplane trigger lines without interfering with one another.

Keysight supplies the PXI Systems Alliance (PXISA) PXI-9 Trigger Manager as a part of Keysight Connection Expert.

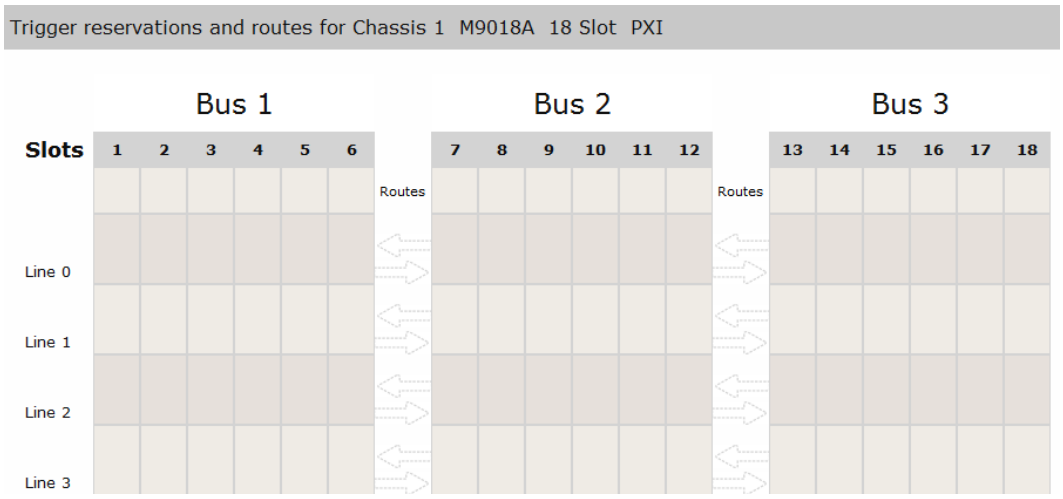
Configuring persistent PXI trigger bus connections

The Keysight Connection Expert is the recommended tool for configuring persistent (static) routes and reservations. To illustrate how to configure persistent trigger routes and reservations, the following shows the steps you must perform in Connection Expert to configure trigger line 1 to the configuration shown in Figure 31 on page 69. Recall that since we are configuring persistent routes and reservations, you must use Connection Expert (there is no programmatic way to configure Persistent routes using the KtMTrig driver). The follow steps configure a persistent route on trigger line 1 from bus segment 1 to bus segment 2:

1. Open Keysight Connection Expert and select the **Instruments** tab. Then, if you have more than one chassis shown under Chassis Content, select the chassis you want to configure.

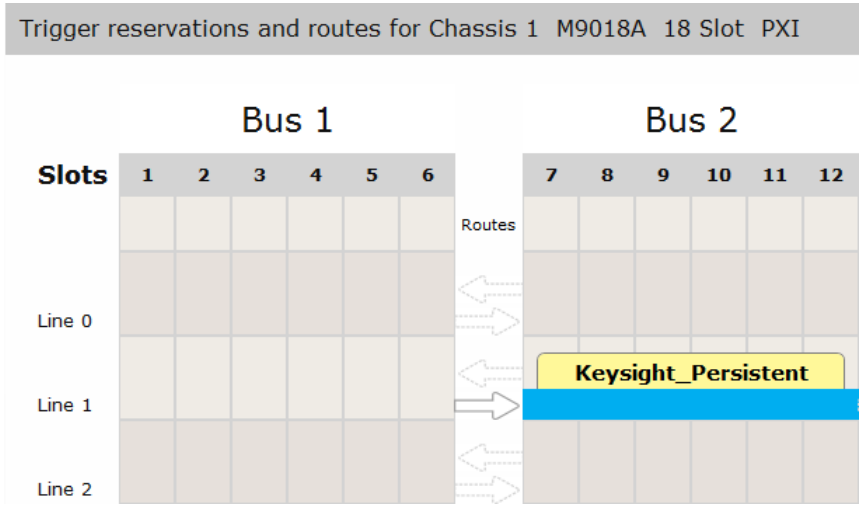


2. Click the **Chassis Triggers** tab, and the Trigger Manager appears in the right window pane. A partial view is shown in the following image (note that no pre-existing routes are present in this case).



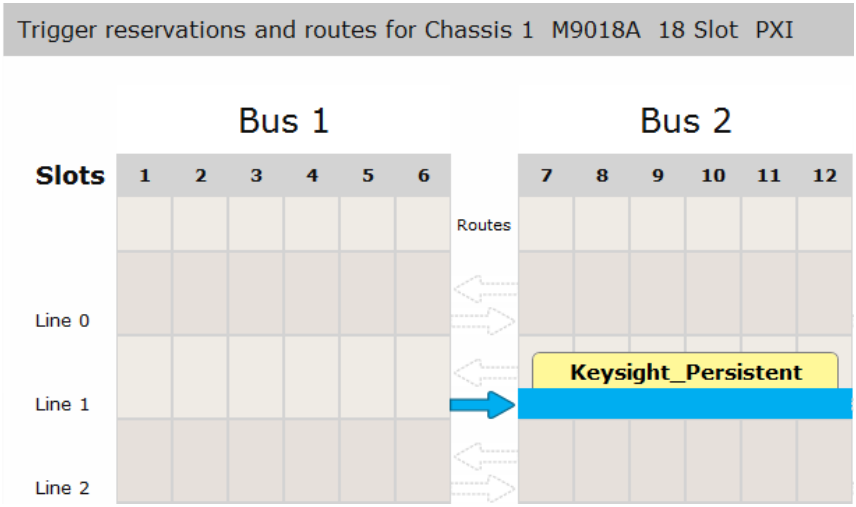
3. To reserve trigger line1, place the cursor onto Line 1 area inside the Bus 2 column and then click.

NOTE Keysight Connection Expert automatically uses a PXI-9 client label of Keysight_Persistent as the owner of this reservation.

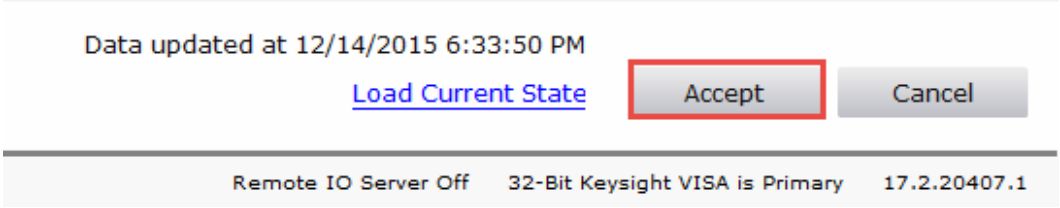


To create a route from Bus 1 to Bus 2, the PXI-9 specifications require only the destination segment (Bus) to have a reservation. This is why only one of the arrows shows a solid line. If you had reserved both lines, both Bus 1 and Bus 2 segments could be the destination of the route and both arrows would have solid outlines indicating that a route in that direction is allowed.

4. To create the route, click the solid arrow in the following image and the arrow is filled in which indicates that there is now a route from Bus 1 to Bus 2.



5. Click the Accept button to save the changes and create the route.



After clicking the **Accept** button, the trigger bus is configured with the new route and the configuration has been saved by Connection Expert for use at the next boot of the system controller (when the Keysight_Persistent settings is reconfigured again automatically).

NOTE **This route is now applied and the route is persistent; it will persist across boot /restart of the computer.**

Configuring volatile PXI trigger bus connections

You can make volatile (dynamic) trigger bus connections using PXI-9 trigger manager DLL.

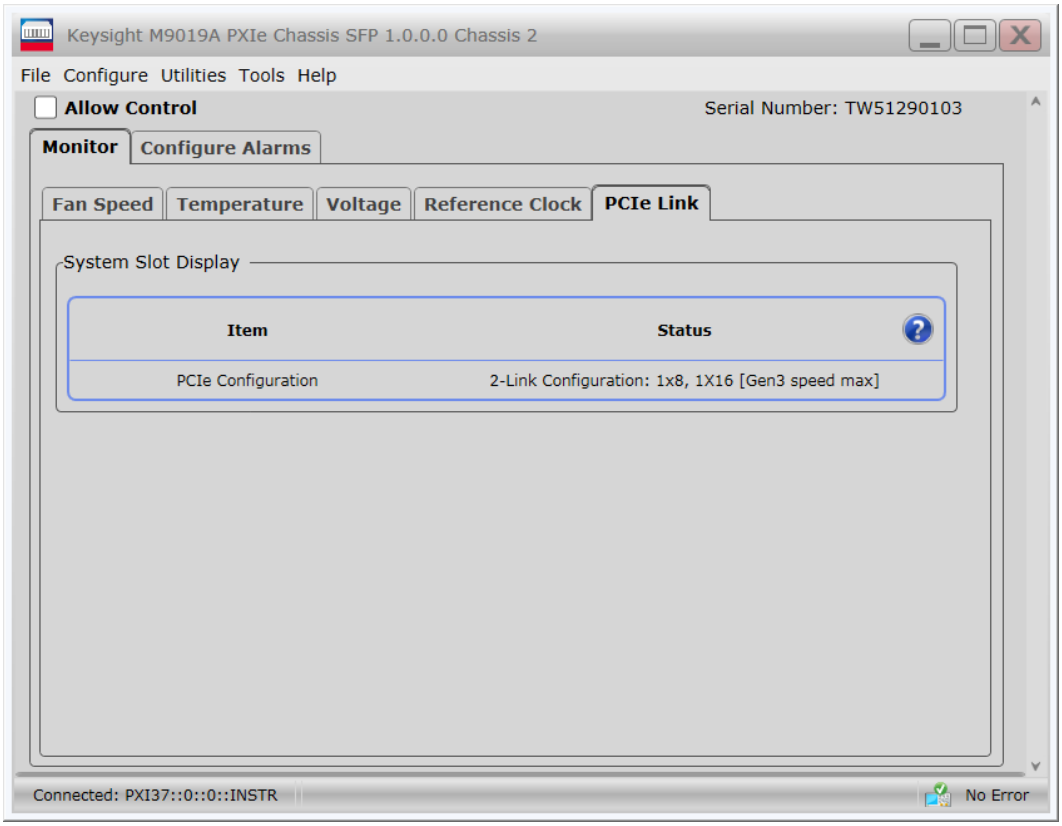
Creating volatile routes and reservations programmatically

Volatile routes and reservations can also be made programmatically. The programmatic approach gives the user full access to all of the features of the PXI-9, PXI and PXI Express Trigger Management Specification.Recall that Persistent routes and reservations can only be made through the Keysight Connection Expert Chassis Triggers panel. The programmatic approach only supports configuration of Volatile trigger settings.

18. PCIe link configuration

PCIe Switch Fabric is fixed to 2 Link x8 x 16 in M9019A. You cannot change or restore the PCIe Link Configuration . Do not run the PCIe Link Fabric Configurator utility .

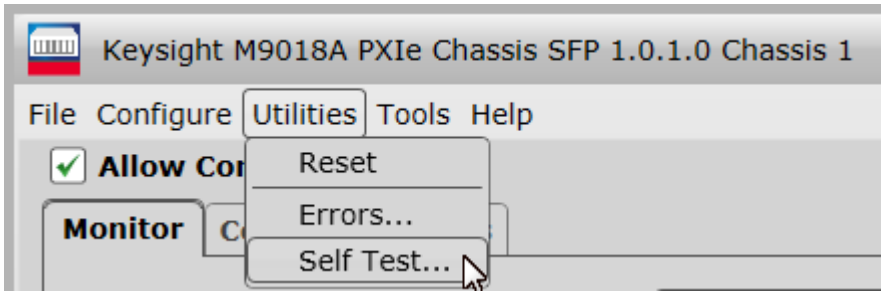
The PCIe link configuration can be viewed from the Monitor tab of the SFP as follows:



19. Performing a chassis self test

This section describes how to perform a chassis self test , and lists the codes and messages generated by self test . For detailed information on the self test messages and how to use the self test results to troubleshoot issues with the chassis, see the Troubleshooting Based on the Self Test Results section in the *Keysight PXIe Chassis Service guide*.

Self test can be initiated from the SFP or programmatically using the IVI or LabVIEW drivers.The following image shows how to initiate self test from the PXIe chassis soft front panel. Note that the Allow Control check box must be checked in order to perform a self test.



The following diagram shows the SFP implementation of self test. The diagram shows that a limited set of self tests are performed whenever any program, including the SFP, performs the first initialization call to the chassis. Any self test results from the first initialization call are then merged with any self test results generated when the full self test is executed.

The programmatic execution of self test is performed in a similar manner to the SFP implementation of self test. In fact, the process by which the SFP reads the self test results is the same process that would be followed by an application program.

Performing self test using the IVI drivers

Refer to the IVI help system for information on performing self test programmatically. As noted above, executing self test programmatically is very similar to the SFP implementation of self test.

Self test codes and messages

The self test codes and messages are listed below. The messages are grouped into low numbered codes (starting at 1) and high numbered codes (starting at 500). Low-numbered codes generally indicate a situation where service is required. High-numbered codes indicate situations that you can often resolve yourself. For details on these groups, the meaning of each message and possible actions to take in response to the messages, refer to *Keysight PXIe Chassis Service Guide*.

Low-numbered self test codes

Test Code	Error
1	"Chassis Monitor processor is not responsive."
2	Unused
3	"Unable to operate IO channel that allows PCIe Switch Fabric reconfiguration."
4	"Unable to operate IO channel to PXI Trigger routing buffers."
5	"Unable to operate IO channel to chassis EPROM."
6	"Error writing to the chassis EPROM. Reinstall chassis PCIe Switch Fabric."
7	"One or more chassis fans operating outside valid RPM range."
8	"Chassis fan 1 in fan tray 1 operating outside valid RPM range"
9	"Chassis fan 2 in fan tray 1 operating outside valid RPM range."
10	"Chassis fan 3 in fan tray 1 operating outside valid RPM range."
11	"Chassis fan speed selector switch is in HIGH position, but one or more fans not operating at maximum speed."
12	"Chassis fans are operating at dissimilar speeds."
13	"Chassis fan AUTO speed control is not functioning properly."
14	"IO failure during self test. If problem persists, contact Keysight Technical Support."
15	unused
16	unused

Test Code	Error
17	"Reading from non-volatile chassis memory failed."
18	"Corrupt serial number in non-volatile memory."
19	"Chassis self-test cache memory inaccessible."
20	"Failed to recover to the Base (factory default) PCIe Switch Fabric during initialization."

High numbered self test codes

Test Code	Error message
500	”Chassis Manager operating on backup (read-only) firmware image. See Keysight Technical Support.”
501	”Chassis Manager firmware was updated since power-up. Power cycle the chassis and reboot system controller.”
502	”Chassis memory structure corrupted. Run IVI driver (or SFP utility) Reset command, and then rerun self test to validate.”
503	”Previous reset operation found chassis memory structure corrupted, chassis memory was re-initialized.”
504	”PCI Configuration Space Header corrupted. Power cycle the chassis and reboot the system controller.”
505	”Unable to operate IO channel to Chassis Manager. Check PCIe connection.”
506	”New PCIe Switch Fabric has been selected, but not loaded. Reboot the system controller to load the new fabric.”
507	”Previous PCIe Switch Fabric update failed. Restoring Base (factory default) PCIe Switch Fabric.”
508	”PCIe Switch Fabric currently in use is of a type that is not recognized by this version of chassis driver software. Consider updating your chassis driver software to a newer version.”
509	”Chassis EPROM checksum failure. Reinstall PCIe Switch Fabric.”
510	”Chassis EPROM does not match currently installed PCIe Switch Fabric. Reinstall PCIe Switch Fabric.”
511	unused
512	”Non-volatile memory failure during PCIe Switch Fabric install/repair operations. Reinstall PCIe Switch Fabric.”

Test Code	Error message
513	”Chassis driver's built-in PCIe Switch Fabric cache has an older fabric revision than the PCIe Switch Fabric currently in use. Consider updating your chassis driver software to a newer version.”
514	”Chassis driver's built-in PCIe Switch Fabric cache has newer fabric than the PCIe Switch Fabric currently in use. Consider updating your chassis to your driver's newer fabric.”
515	”PCIe Switch Fabric chip loaded with wrong image for that chip. Reinstall PCIe Switch Fabric.”
516	”PCIe switch fabric chips loaded with mismatching Type code. Reinstall PCIe switch Fabric.”
517	”PCIe switch fabric chips loaded with mismatching Revision code. Reinstall PCIe Switch Fabric.”
518	”PCIe switch fabric chips loaded with unexpected Revision. Reinstall PCIe Switch Fabric.”
519	”One or more chassis temperatures operating outside valid range.”
520	”Chassis temperature sensor 1 operating outside valid range.”
521	”Chassis temperature sensor 2 operating outside valid range.”
522	”Chassis temperature sensor 3 operating outside valid range.”
523	”Chassis temperature sensor 4 operating outside valid range.”
524	”Chassis temperature sensor 5 operating outside valid range.”
525	”Chassis temperature sensor 6 operating outside valid range.”
526	”Chassis temperature sensor 7 operating outside valid range.”
527	”Chassis temperature sensor 8 operating outside valid range.”
528	”One or more voltage rails operating outside valid range.”
529	”3.3V voltage rail operating outside valid range.”
530	”5V voltage rail operating outside valid range.”
531	”-12V voltage rail operating outside valid range.”
532	”+12V voltage rail operating outside valid range.”

Test Code	Error message
533	”5V auxiliary voltage supply operating outside valid range.”
534	”Non-volatile self test memory cache size is invalid. Cache repaired, please rerun self test to validate repair.”
535	”Non-volatile self test memory cache checksum failure. Cache repaired, please rerun self test to validate repair.”
536	”Non-volatile self test memory problem required re-initializing the memory.”
537	”Error detected during PCIe Switch Fabric configuration. Base (factory default) PCIe Switch Fabric was re-selected.”
538	”Load Base Configuration Pushbutton press was latched. Power cycle chassis to clear latch, and then reboot the system controller.”
539	”Currently loaded PCIe Switch Fabric has no revision information.”
540	“Chassis Manager operating on backup (read-only) firmware image. DIP switch 1 is flipped to on.”
999	“Too many self-test codes generated, aborting.”

20. Chassis maintenance and inspection

WARNING

- This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited. Inspect the protective conductor periodically to ensure that it is uninterrupted.
- No operator serviceable parts inside. Refer servicing to qualified personnel.
- To prevent electrical shock, do not remove covers.
- To prevent electrical shock, disconnect the chassis power cord before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.
- Cleaning connectors with alcohol shall only be done with the chassis power cord removed and in a well-ventilated area. Allow all residual alcohol moisture to evaporate, and the fumes to dissipate prior to energizing the chassis.

No periodic maintenance of the chassis is required. However, Keysight recommends monitoring the following chassis parameters on an ongoing basis:

- Power supply voltages—The four main power supply rails (3.3V, 5V, 5Vaux, 12V, and –12V) should all be within ±5% of their nominal values. Keysight recommends checking the power rails at least yearly using the chassis soft front panel (SFP) or programmatically. In addition, the power rails are accessible on the rear panel DB-9 connector, and can be checked with a DMM as described in Measuring the four main voltage rails directly on page 20.
- Fan speeds —The chassis has fans located at the rear of the chassis. A low fan speed possibly indicates that a fan is wearing out or a fan blade is partially obstructed. Keysight recommends using the chassis SFP to check the fan speeds yearly as well.
- Chassis firmware —Keysight recommends that you periodically check to see if there is a chassis firmware revision available that is later than your chassis firmware revision. If so, it is suggested that you download and install the latest firmware revision available as described in Updating chassis firmware on page 29.

If a power supply voltage is out of tolerance or a fan speed is low, see the *Keysight PXIe Chassis Service Guide* for diagnostic information and troubleshooting tips.

21. Related documentation

The documentation listed below can be found on the Software and Product Information CD (M9019-10001) that came with your chassis.

- *Keysight PXIe Chassis Family Startup Guide*
- *Keysight PXIe Chassis Family User Guide*

For the latest versions of the above documents, visit the Keysight website at www.keysight.com/find/M9019A. The following documents are also available on this website:

- *Keysight M9019A PXIe Chassis Data Sheet*
- *Keysight M9022A/ M9023A/ M9024A PXIe system module Data Sheet*
- *PC Tested Configuration with PXIe/AXIe Chassis Technical Overview* – This document lists the PCs that have been verified to work with the M9019A chassis.
- Multiple PXIe and AXIe Chassis System Configuration Tool

To assist you in locating the documentation that will best meet your needs, the following table lists the recommended chassis documents by audience. Also listed are the key topics covered in each group of documents.

Product specifications, available accessories, firmware and software may change over time. Check the Keysight website at www.keysight.com/find/pxi-chassis for the latest updates to the product software, guides, help files and data sheets.

PXIe chassis documents by audience

Audience	Recommended Documents	Key Topics
First-time users of the PXIe chassis	- *PXIe Chassis Family Startup Guide* - *M9019A Data Sheet* - *M9022A/ M9023A/ M9024A/ M9048B/ M9049A Data Sheet* - *PC Tested Configuration with PXIe/AXIe Chassis Technical Overview* - Documentation for each module - SFP Help - Interactive Block diagram - Multiple PXIe and AXIe Chassis System Configuration Tool	- PXIe chassis architecture and capabilities - Selection of the host controller PC - Connecting the chassis to a computer and powering up the system - Using Connection Expert and the soft front panel (SFP) to verify chassis operation - Installing Keysight modules in the chassis - Using the SFP to configure the chassis

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Edition 1, July, 2016

M9019-90003

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