# Agilent PXI RF Switch Modules
## DC to 3 GHz

M9128A, M9146A, M9147A,
M9148A, M9149A, M9150A,
M9151A, M9152A, M9153A

Data Sheet


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# INTRODUCTION

## Product description

The Agilent PXI RF switch modules deliver high-performance, high-density switching up to 3 GHz, and are available in multiple configurations to integrate into a variety of test environments. Modern RF relay technology delivers low insertion loss and VSWR for excellent RF signal integrity and dynamic range when routing RF signals into your measurement equipment. Select from the 8x12 300 MHz full cross point matrix, for connecting multiple points at one time, to the 1x4, 1x8, or 1x16 3 GHz RF multiplexer configurations, for switching multiple points to a single point.

## Applications

- Aerospace and defense
- Electronic test
- Semiconductor test
- Wireless communications

## Features

- Frequency range: DC to 3 GHz
- Multiple configurations including high-density models
- 50 and 75 ohm versions
- High-quality SMB connectors
- Low insertion loss and VSWR
- Software drivers to support most common programming environments
- PXI form factor
- Chassis connector compatibility: cPCI (J1), PXI-1 (J1 only), PXIe hybrid slot

## Customer values

- High-density RF switching in a single PXI slot
- Excellent RF signal integrity and dynamic range
- Repeatable RF performance
- Work in your environment of choice and reduce development time
- Fast and easy installation and configuration

# EASY SETUP … TEST … AND MAINTENANCE

## Hardware platform

### Compliance

The RF switch modules are PXI compliant with a J1 connector and can be used in PXI chassis with cPCI (J1), PXI-1 (J1 only), or PXIe hybrid slot connectors.

The PXI format offers high performance in a small, rugged package. It is an ideal deployment platform for many automated test systems. In addition, a wide array of complementary PXI products are currently available, such as multimeters, waveform generators, local oscillators, digitizers, and switches.

## Software platform

### IO Libraries Suite

Agilent IO Libraries Suite offers fast and easy instrument connections and now extends to modular instruments. IO Libraries Suite 16.0 adds support for PXI, helping you display all of the modules in your system, whether they are PXI, PXIe, or AXIe, as well as view information about installed software. In addition, the new version allows you to more easily find the right driver and start module soft front panels directly with Agilent Connection Expert.

### Drivers

Agilent provides instrument drivers that work with your choice of software, saving time and preserving software and hardware investments. Agilent modular instruments come with IVI-COM, IVI-C, and LabVIEW software drivers that work in the most popular test and measurement development environments including LabVIEW, MATLAB, LabWindows/CVI, Visual Studio® C, C++, C#, VEE, and Visual Basic®.

With a broad selection of drivers already included, any Agilent PXI RF switch can be swapped out, replaced, or upgraded with the latest version, requiring only minimal software adjustments.

### Easy software integration

In addition, application code examples are included for LabVIEW, LabWindows/CVI, Visual Studio C, C++, C#, Visual Basic, and MATLAB, providing RF switch set-up and basic functionality. These application code examples are easily modified to quickly integrate the switch module into your measurement system.

## Software applications

Agilent soft front panels provide easy-to-use instrument communications. The PXI RF switch graphical user interface guides developers through module setup so users can quickly configure the switch parameters. More sophisticated functions are also available through the wide selection of instrument program interfaces.

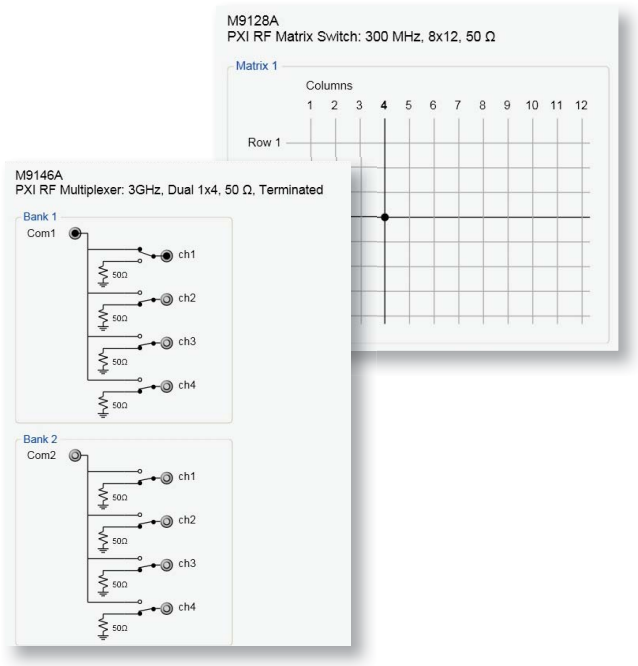



*Figure 1. RF switch soft front panel*

# SPECIFICATIONS AND CHARACTERISTICS

## Specification and characteristic summary

*Following is a summary of specifications and characteristics for the Agilent DC to 3GHz PXI switches. More detailed specifications and characteristics for each module are featured later in this document.*

**RF switch specification and characteristic summary**

| RF switches | Description | Type # slots | Frequency range | Insertion loss, typical | Isolation, typical | VSWR, typical | Impedance, nominal | Connectors |
|---|---|---|---|---|---|---|---|---|
| M9128A | 8x12 RF matrix switch | PXI x1 | 300Mhz | 2 dB @ 300MHz | 40 dB @ 300MHz | 2:1 @ 300 MHz | 50 Ω | SMB connectors |
| M9146A | Dual 1x4 RF multiplexer | PXI x1 | 3GHz | 0.8 dB @ 3 GHz | 45 dB @ 3GHz | < 1.3:1 to 3GHz | 50 Ω, off chan termination | SMB connectors |
| M9147A | Quad 1x4 RF multiplexer | PXI x1 | 3GHz | 1 dB @ 3GHz | 40 dB @ 3GHz | < 1.4:1 to 3GHz | 50 Ω terminated common | SMB connectors |
| M9148A | 1x8 RF multiplexer | PXI x1 | 3GHz | 0.8 dB @ 3GHz | 40 dB @ 3GHz | < 1.25:1 to 3GHz | 50 Ω | SMB connectors |
| M9149A | 1x16 high-density RF multiplexer | PXI x1 | 3GHz | 1.2 dB @ 3GHz | 40 dB @ 3GHz | < 1.5:1 to 3GHz | 50 Ω | SMB connectors |
| M9150A | Dual 1x4 RF multiplexer | PXI x1 | 3GHz | 1 dB @ 3GHz | 45 dB @ 3GHz | < 1.55:1 to 3GHz | 75 Ω | SMB connectors |
| M9151A | Quad 1x4 RF multiplexer | PXI x1 | 3GHz | 1.1 dB @ 3GHz | 40 dB @ 3GHz | < 1.6:1 to 3GHz | 75 Ω | SMB connectors |
| M9152A | 1x8 RF multiplexer | PXI x1 | 3GHz | 1 dB @ 3 GHz | 45 dB @ 3GHz | < 1.5:1 to 3 GHz | 75 Ω | SMB connectors |
| M9153A | 1x16 RF multiplexer | PXI x1 | 3GHz | 1.2 dB @ 3GHz | 40 dB @ 3GHz | < 1.55:1 to 3 GHz | 75 Ω | SMB connectors |

# SPECIFICATIONS AND CHARACTERISTICS

## M9128A 8x12 RF matrix

The M9128A contains an 8x12 RF switch matrix in a single PXI module. This switch matrix is used for routing multiple signals up to 300 MHz in a single instance, allowing any combination of channel closures to connect to multiple instruments. Disconnect switches isolate the rows for better overall RF performance.

### M9128A specifications and characteristics

| General specifications | |
|---|---|
| Channels | 8x12 |
| Switch type | Matrix |
| Input impedance | 50 Ω |
| Frequency range | 300 MHz |
| **Switching characteristics, nominal** | |
| Max volts | 30 V |
| Max current | 0.5 A |
| Max RF power | 10 W |
| Open/close time | 1 ms |
| Relay life, typical | > 20 Million @ < 100 mWatts |

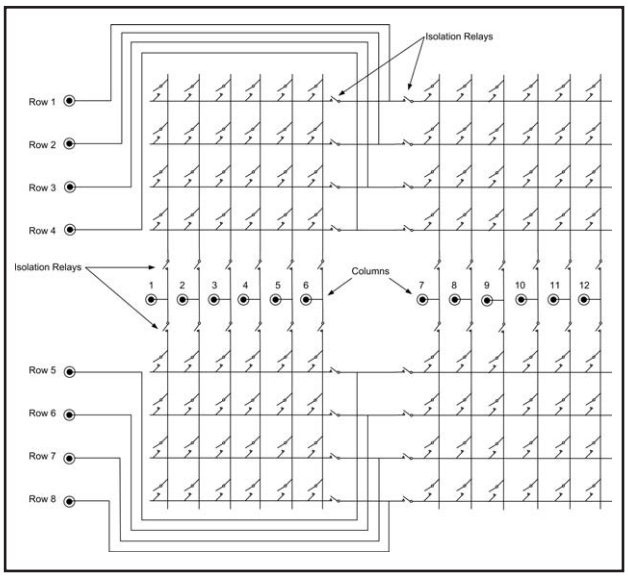
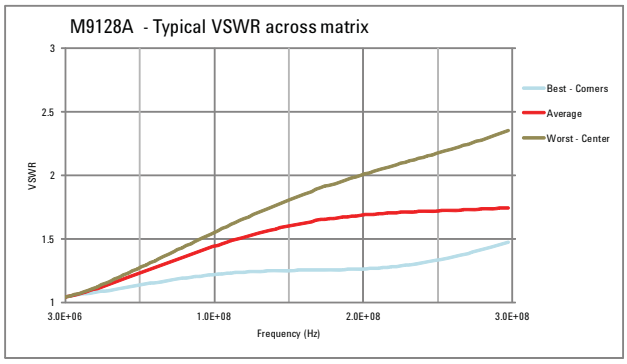
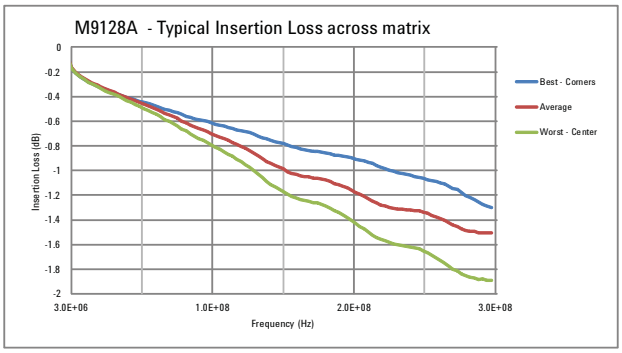



*Figure 2. M9128A 8x12 RF matrix*

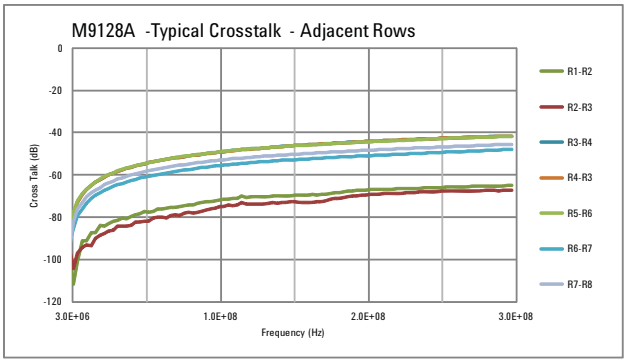
### M9128A typical characteristics




*M9128A Typical VSWR*




*M9128A Typical insertion loss*




*M9128A Typical cross talk-adjacent rows*

## M9146A and M9150A dual 1x4 RF switch multiplexers

The M9146A and M9150A each contain two 1x4 RF switch multiplexers in a single PXI module. They offer bi-directional switching up to 3 GHz. The M9146A has extra switches to route unused channels into a 50 ohm termination for improved signal integrity—there is also a 75 ohm version, ideal for routing video RF signals. Both modules offer excellent insertion loss and VSWR for better RF signal integrity.

### M9146A and M9150A specifications and characteristics

| General specifications | | |
|---|---|---|
| | M9146A | M9150A |
| Channels | Dual 1x4 | Dual 1x4 |
| Switch type | Multiplexer | Multiplexer |
| Input impedance | 50 Ω | 75 Ω |
| Frequency range | 3 GHz | 3 GHz |
| **Switching characteristics, nominal** | | |
| Max volts | 30 V | 30 V |
| Max current | 1 A | 1 A |
| Max RF power | 1 W | 10 W |
| Open/close time | 3 msec | 3 msec |
| Relay life, typical | 10 Million @ < 100 mWatts | |

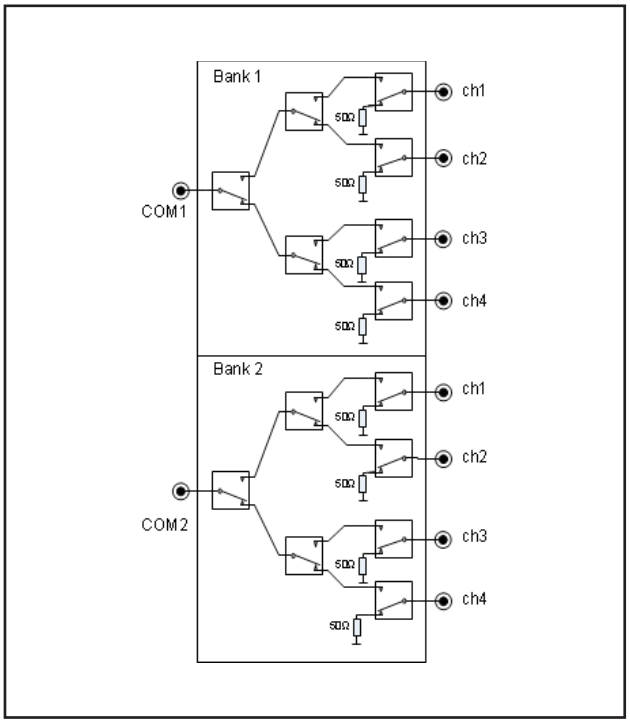
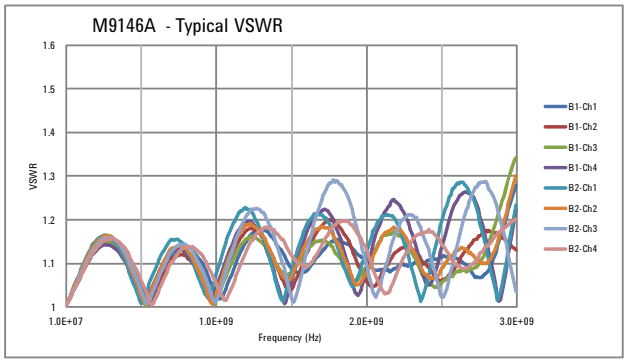
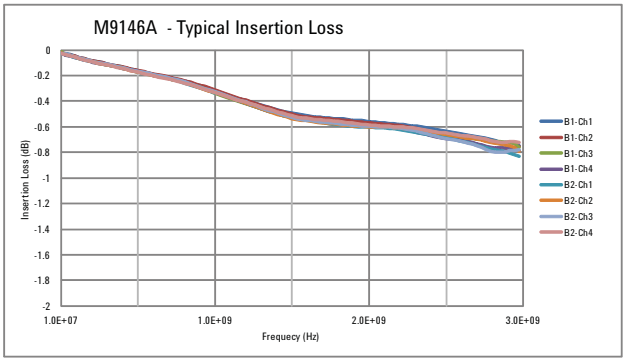



*Figure 3. M9146A dual 1x4 RF switch multiplexer*

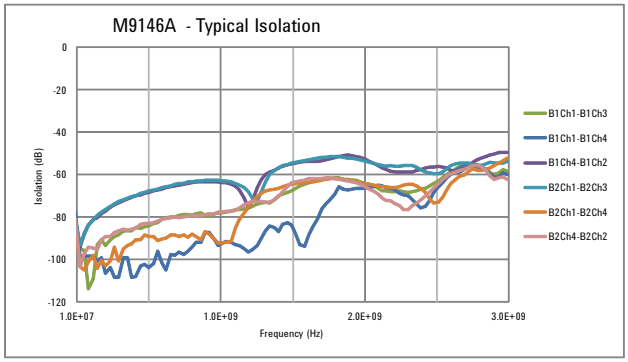
### M9146A typical characteristics




*M9146A Typical VSWR*

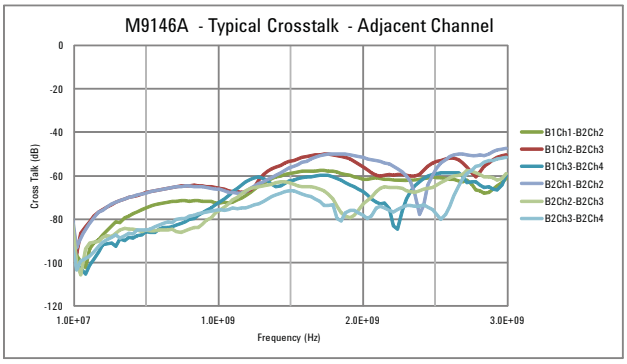



*M9146A Typical insertion loss*

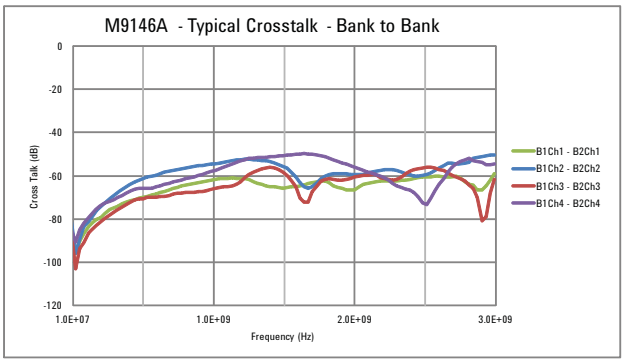



*M9146A Typical isolation*

## M9146A and M9150A dual 1x4 RF switch multiplexers *continued*




*M9146A Typical cross talk-adjacent channel*




*M9146A Typical cross talk-bank-to-bank*

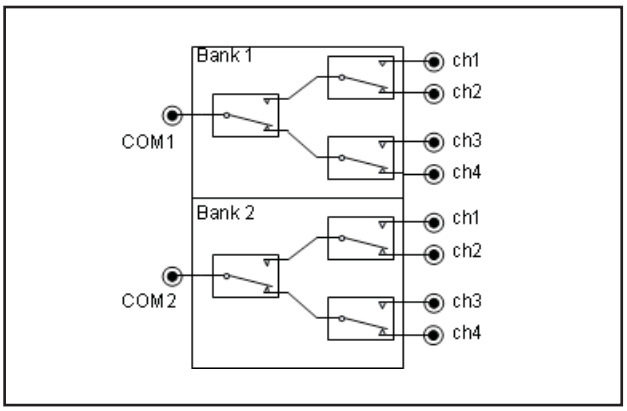
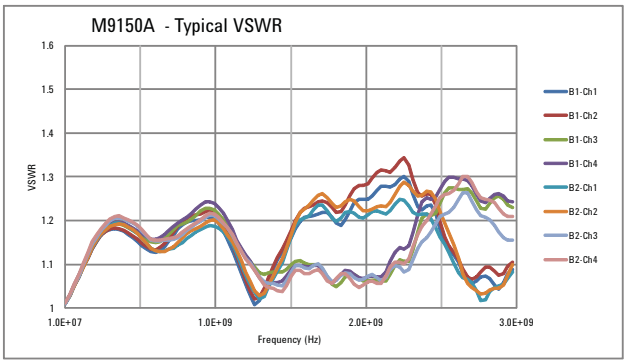
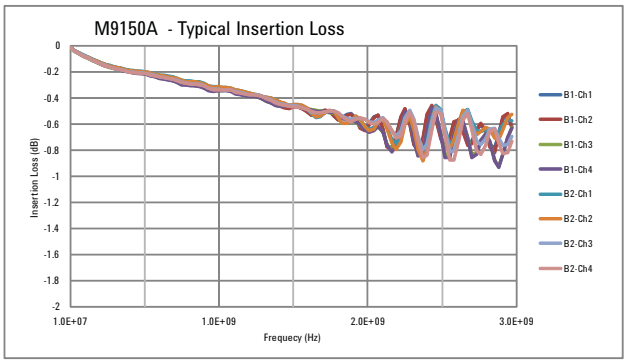



*Figure 4. M9150A dual 1x4 RF switch multiplexer*

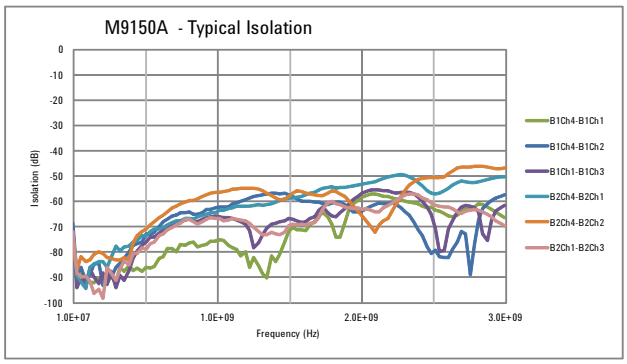
## M9150A typical characteristics



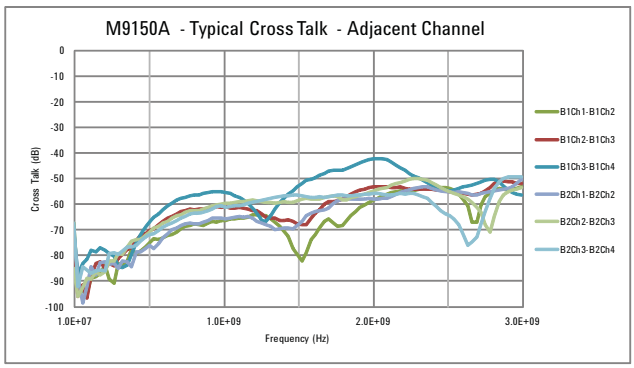

*M9150A Typical VSWR*




*M9150A Typical insertion loss*




*M9150A Typical isolation*




*M9150A Typical cross talk-adjacent channel*

## M9147A and M9151A quad 1x4 RF switch multiplexers

The M9147A and M9151A each contain four 1x4 RF switch multiplexers in a single PXI module. They offer bi-directional switching up to 3 GHz. The M9147A features a terminated common that delivers better insertion loss and VSWR to ensure RF signal integrity.

## M9147A and M9151A specifications and characteristics

| General specifications | | |
|---|---|---|
| | M9147A | M9151A |
| Channels | Quad 1x4 | Quad 1x4 |
| Switch type | Multiplexer | Multiplexer |
| Input impedance | 50 Ω | 75 Ω |
| Frequency range | 3 GHz | 3 GHz |
| **Switching characteristics, nominal** | | |
| Max volts | 30 V | 30 V |
| Max current | 1 A | 1 A |
| Max RF power | 2W | 10W |
| Open/close time | 3 msec | 3 msec |
| Relay life, typical | 10 Million @ < 100 mWatts | |

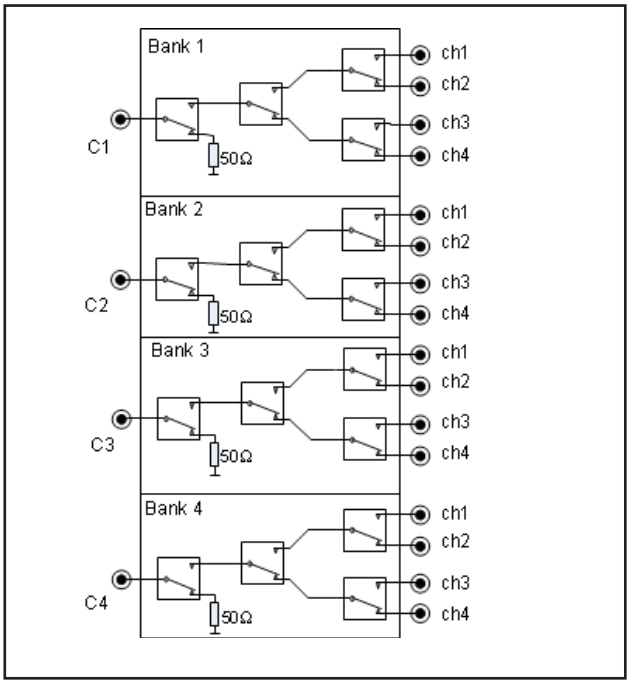
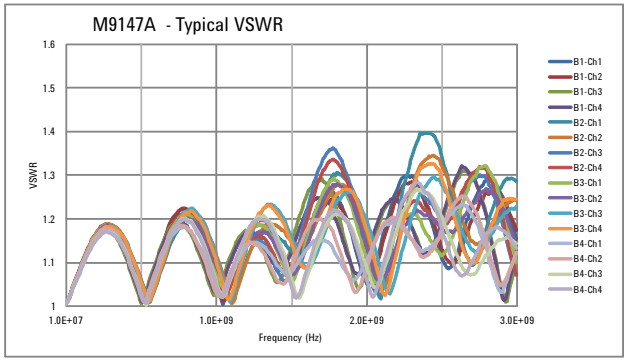
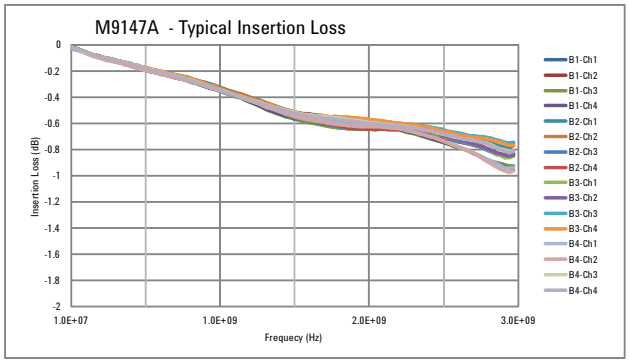



*Figure 5. M9147A quad 1x4 RF switch multiplexer*

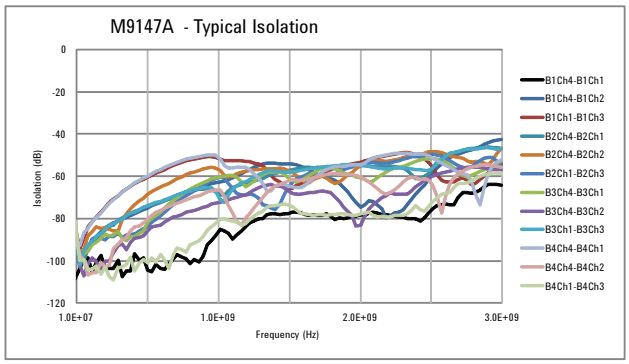
## M9147A typical characteristics



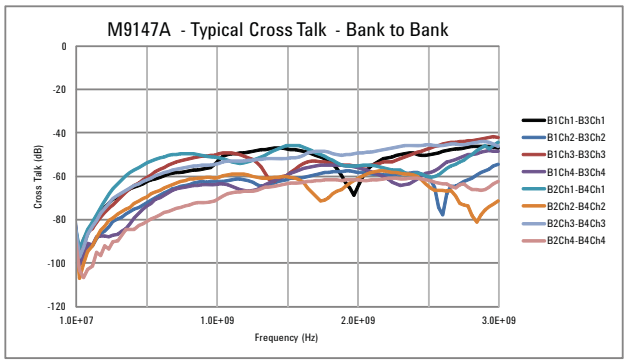

*M9147A Typical VSWR*




*M9147A Typical insertion loss*




*M9147A Typical isolation*




*M9147A Typical cross talk-bank-to-bank*

## M9147A and M9151A dual 1x4 RF switch multiplexers *continued*

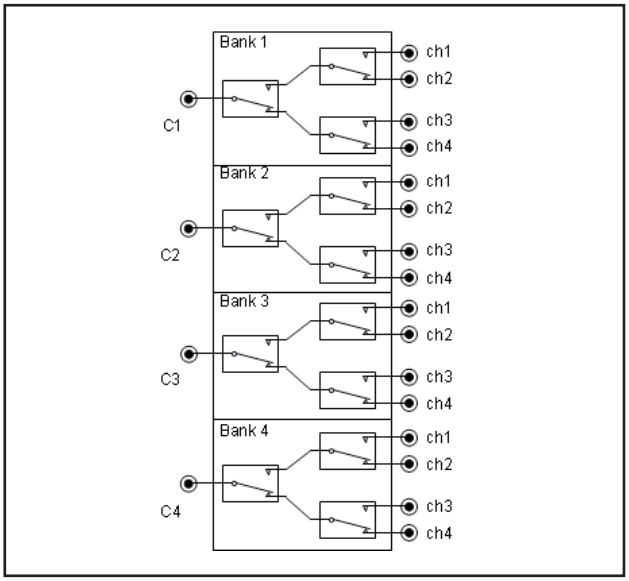
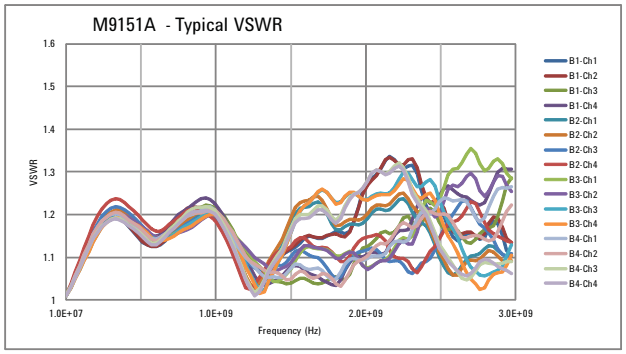
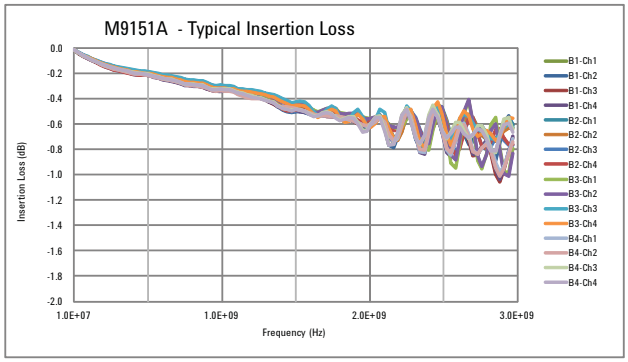



*Figure 6. M9151A quad 1x4 RF switch multiplexer*

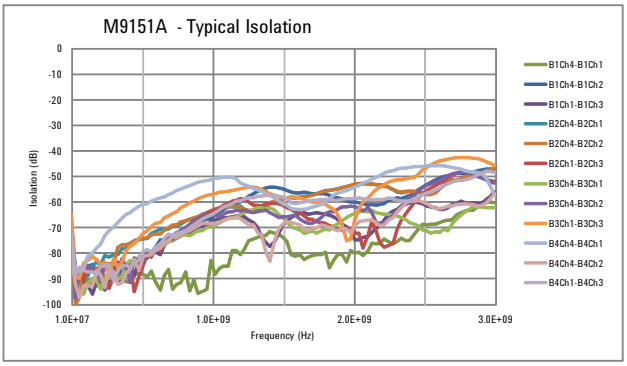
## M9151A typical characteristics



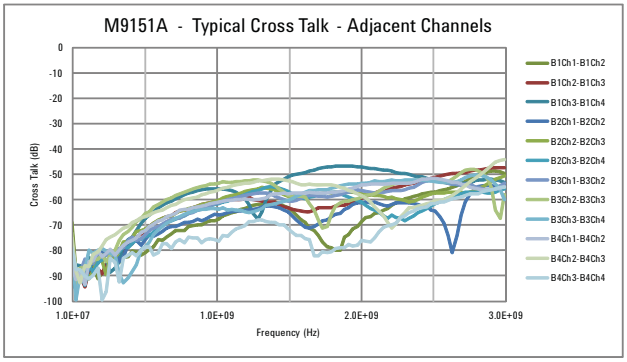

*M9151A Typical VSWR*



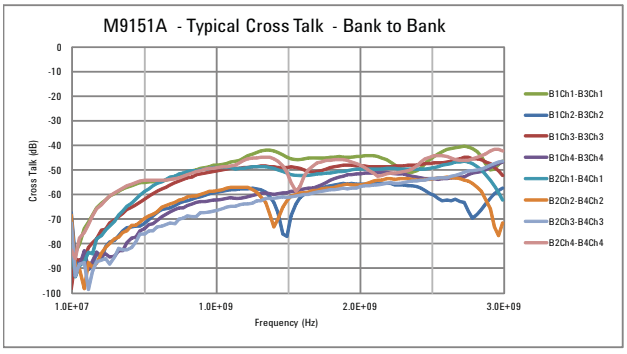

*M9151A Typical insertion loss*




*M9151A Typical isolation*




*M9151A Typical cross talk-adjacent channels*




*M9151A Typical cross talk-bank-to-bank*

## M9148A and M9152A 1x8 RF switch multiplexers

The M9148A and M9152A each contain a 1x8 switch multiplexer in a single PXI module. They offer bi-directional switching up to 3 GHz. The 1x8 configuration offers excellent insertion loss and VSWR for better RF signal integrity.

## M9148A and M9152A specifications and characteristics

| General specifications | | |
|---|---|---|
| | M9148A | M9152A |
| Channels | 1x8 | 1x8 |
| Switch type | Multiplexer | Multiplexer |
| Input impedance | 50 Ω | 75 Ω |
| Frequency range | 3 GHz | 3 GHz |
| **Switching characteristics, nominal** | | |
| Max volts | 30 V | 30 V |
| Max current | 1 A | 1 A |
| Max RF power | 10W | 10W @ 2GHz |
| Open/close time | 3 msec | 3 msec |
| Relay life, typical | 10 Million @ < 100 mWatts | |

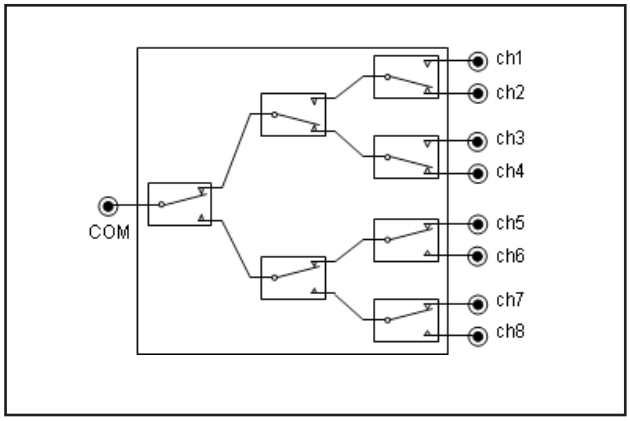
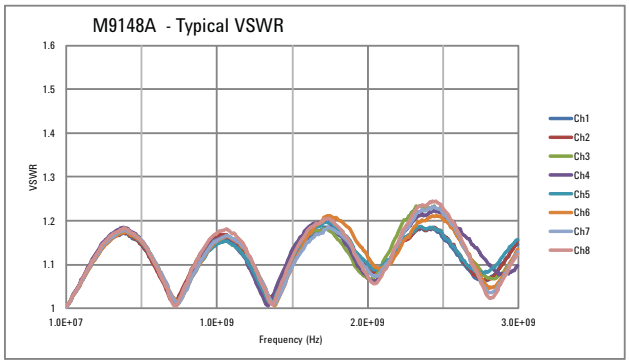
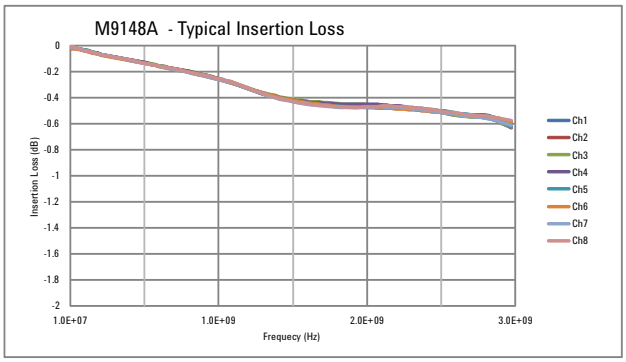



*Figure 7. M9148A and M9152A 1x8 RF switch multiplexers*

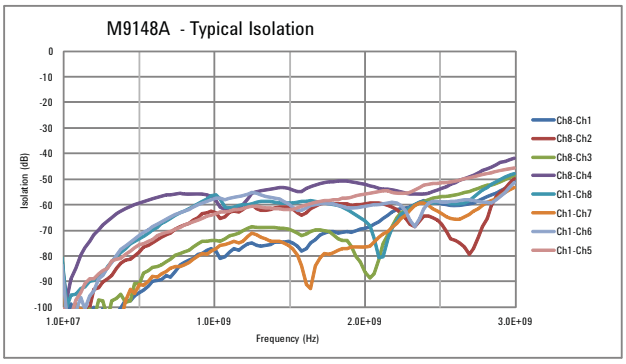
## M9148A typical characteristics



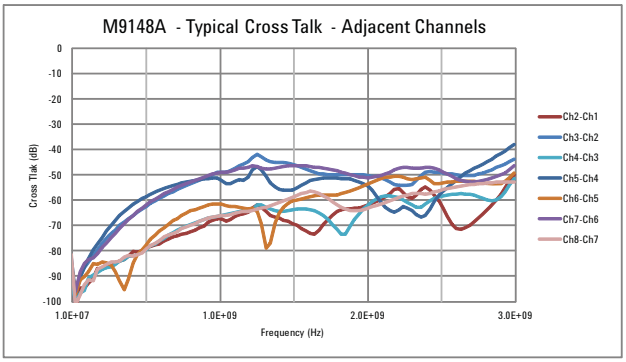

*M9148A Typical VSWR*




*M9148A Typical insertion loss*



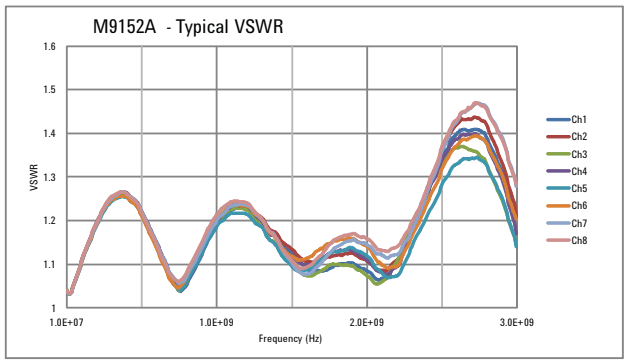

*M9148A Typical isolation*



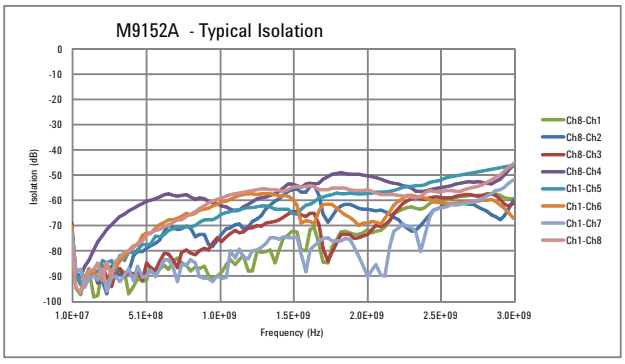

*M9148A Typical cross talk-adjacent channels*

## M9148A and M9152A 1x8 RF switch multiplexers *continued*

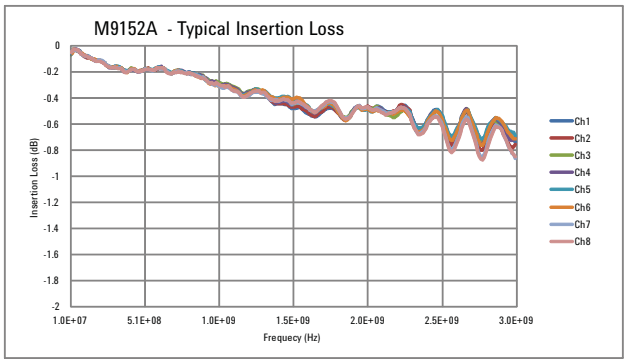
### M9152A typical characteristics



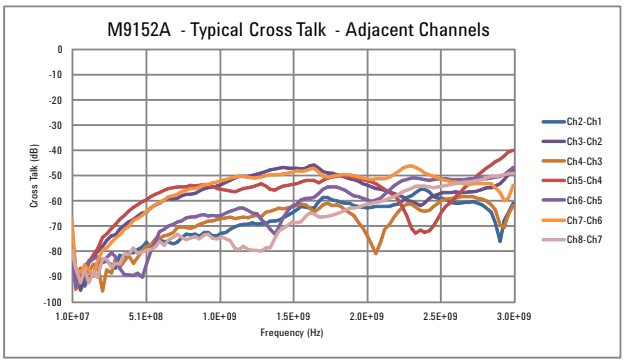

*M9152A Typical VSWR*




*M9152A Typical Isolation*




*M9152A Typical insertion loss*




*M9152A Typical cross talk-adjacent channels*

# SPECIFICATIONS AND CHARACTERISTICS

## M9149A and M9153A 1x16 high-density RF multiplexers

The M9149A and M9153A each contain a 1x16 RF switch multiplexer in a single PXI module. They offer bi-directional switching up to 3 GHz. With the 1x16 tree structure, each RF path has been designed for repeatable measurements with excellent insertion loss and VSWR.

## M9149A and M9153A specifications and characersitics

| General specifications | | |
|---|---|---|
| | M9149A | M9153A |
| Channels | 1x16 | 1x16 |
| Switch type | Multiplexer | Multiplexer |
| Input impedance | 50 Ω | 75 Ω |
| Frequency range | 3 GHz | 3 GHz |
| **Switching characteristics, nominal** | | |
| Max volts | 30 V | 30 V |
| Max current | 1 A | 1 A |
| Max RF power | 10W | 10W @ 2GHz |
| Open/close time | 3 msec | 3 msec |
| Relay life, typical | 10 Million @ < 100 mWatts | |

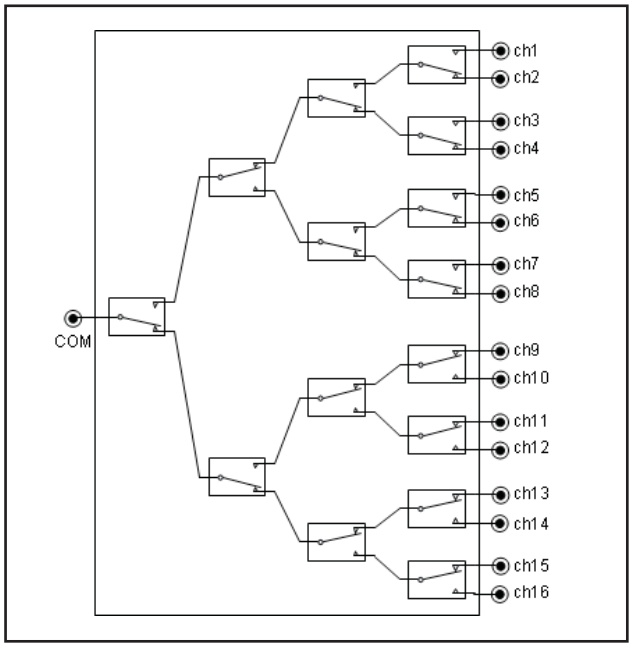
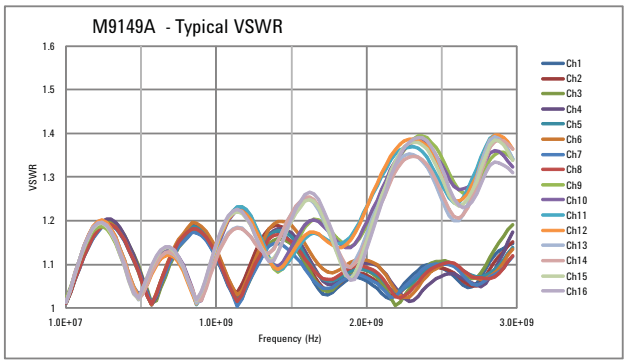
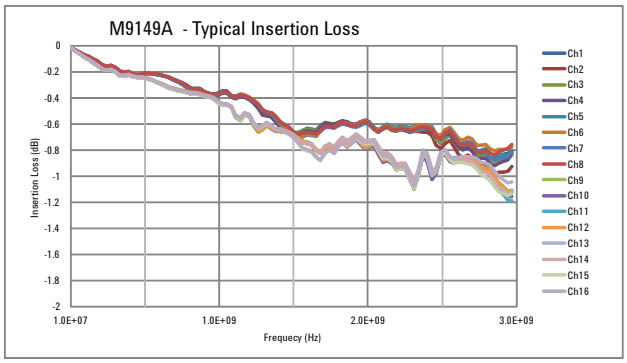



*Figure 8. M9149A and M9153A 1x16 high-density RF multiplexers*

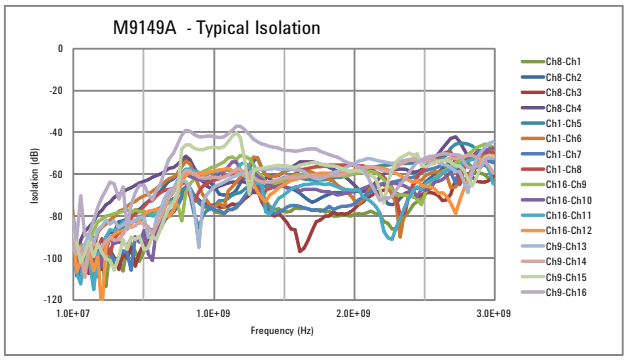
## M9149A typical characteristics



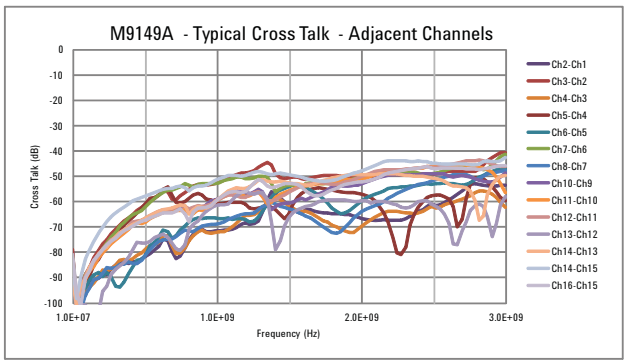

*M9149A Typical VSWR*




*M9149A Typical insertion loss*

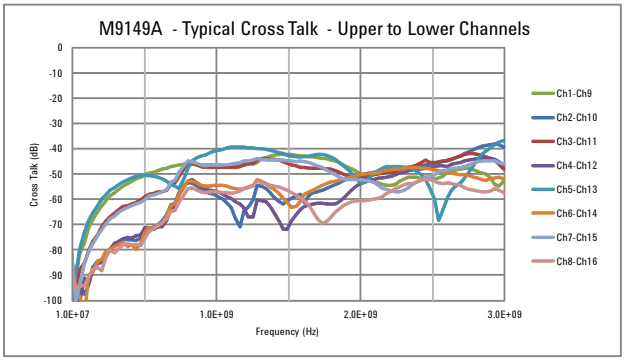



*M9149A typical isolation*

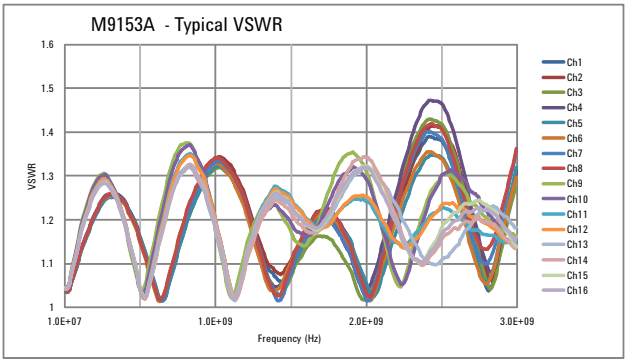



*M9149A Typical cross talk-adjacent channels*

## M9149A and M9153A 1x16 high-density RF multiplexers *continued*

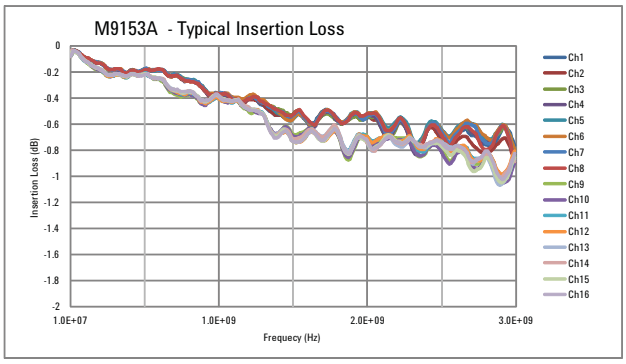



*M9149A Typical cross talk-upper to lower channels*

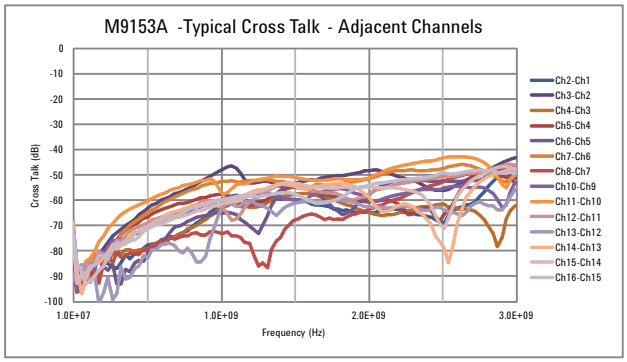



*M9153A Typical VSWR*

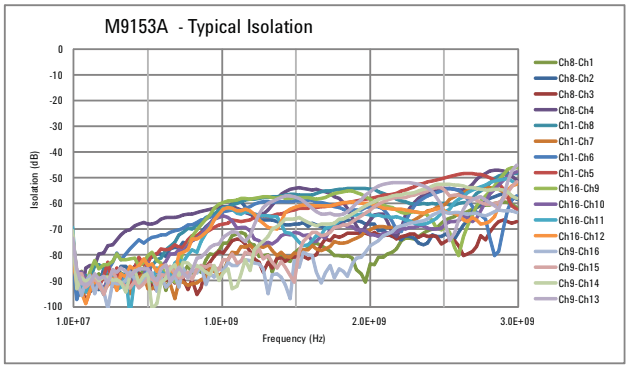
## M9153A typical characteristics



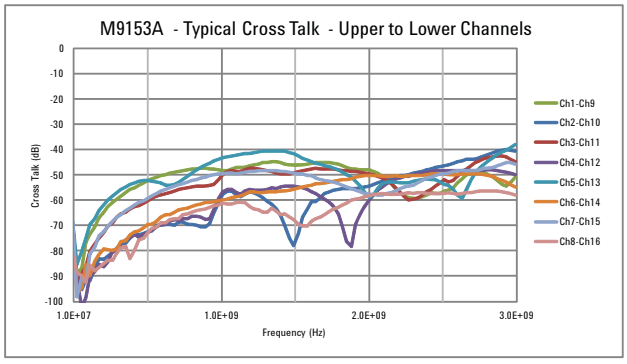

*M9153A Typical insertion loss*




*M9153A Typical cross talk-adjacent channels*




*M9153A Typical isolation*




*M9153A Typical cross talk-upper to lower channels*

# SPECIFICATIONS AND CHARACTERISTICS

## General specifications

| | |
|---|---|
| Connector type | SMB |
| Slot type | PXI 1 slot |

## Environmental characteristics

| | |
|---|---|
| Temperature | Operating: 0° to 55°C<br>Non-Operating: -40° to +70°C |
| EMC | Complies with European EMC Directive 2004/108/EC<br>• IEC/EN 61326-1<br>• CISPR Pub 11 Group 1, class A<br>• AS/NZS CISPR 11<br>• ICES/NMB-001<br>This ISM device complies with Canadian ICES-001; cet appareil ISM est conforme a la norme NMB-001 du Canada |
| Warm-up time | 15 minutes, min |

## Physical characteristics

| | |
|---|---|
| Dimensions | • 3U/1-slot PXI/CompactPCI standard<br>• Connector slot compatibility: cPCI (J1), PXI-1, PXIe hybrid slot<br>• Front panel complies with IEEE1101.10 certification and compliance |

Weight

| *M9128A* | *M9146A* | *M9147A* | *M9148A* | *M9149A* | *M9150A* | *M9151A* | *M9152A* | *M9153A* |
|---|---|---|---|---|---|---|---|---|
| 330 g (.73 lbs) | 230 g (.51 lbs) | 240 g (.53 lbs) | 220 g (.49 lbs) | 250 g (.55 lbs) | 220 g (.49 lbs) | 240 g (.53 lbs) | 220 g (.49 lbs) | 250 g (.55 lbs) |

# SPECIFICATIONS AND CHARACTERISTICS

## Power requirements

| | *M9128A* | *M9146A* | *M9147A* | *M9148A* | *M9149A* | *M9150A* | *M9151A* | *M9152A* | *M9153A* |
|---|---|---|---|---|---|---|---|---|---|
| +3.3V | 0.03 A | 0.03A | 0.03A | 0.03A | 0.03A | 0.03A | 0.03A | 0.03A | 0.03A |
| +5V | 0.8 A | 0.21A | 0.4A | 0.21A | 0.18A | 0.27A | 0.27A | 0.21A | 0.18A |
| +12V | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## System requirements

| | | | |
|---|---|---|---|
| Operating systems | Windows® XP, Service Pack 3 or later (32-bit) | Windows® Vista, SP1 and SP2 (32-bit and 64-bit), Business, Ultimate, Enterprise, Home Basic, and Home Premium | Windows® 7 (32-bit and 64-bit) Starter, Home Basic, Home Premium, Professional, Ultimate, Enterprise |
| Processor speed | 600MHz or higher required 800MHz recommended | 1Ghz 32-bit (x86), 1GHz 64-bit (x64), no support for Itanium64 | 1GHz 32-bit (x86), 1GHz 64-bit (x64), no support for Itanium 64 |
| Available memory | 256 MB minimum (1 GB or greater recommended) | 1 GB minimum | 1 GB minimum |
| Available disk space[1] | 1.5 GB available hard disk space, includes:<br>• 1GB available for Microsoft .NET Framework 3.5 SP1 [2]<br>• 100MB for Agilent IO Libraries Suite | 1.5 GB available hard disk space, includes:<br>• 1GB available for Microsoft .NET Framework 3.5 SP12<br>• 100MB for Agilent IO Libraries Suite | 1.5 GB available hard disk space, includes:<br>• 1GB available for Microsoft .NET Framework 3.5 SP12<br>• 100MB for Agilent IO Libraries Suite |
| Video | Super VGA (800x600) 256 colors or more | Support for DirectX 9 graphics with 128MB graphics memory recommended (Super VGA graphics is supported) | Support for DirectX 9 graphics with 128MB graphics memory recommended (Super VGA graphics is supported) |
| Browser | Microsoft® Internet Explorer 6.0 or greater | Microsoft® Internet Explorer 7 or greater | Microsoft® Internet Explorer 7 or greater |

*1. Because of the installation procedure, less memory may required for operation than is required for installation.*

*2. NET Framework Runtime Components are installed by default with Windows Vista and Windows 7. Therefore, you may not need this amount of available disk space.*

# CONFIGURATION AND ORDERING

## Hardware

| Model | Description |
|---|---|
| Each RF switch includes: | Getting started guide, software drivers, and Agilent I/O libraries |
| M9128A | PXI RF matrix switch: 300 MHz, 8x12, 50 Ω |
| M9146A | PXI RF multiplexer: 3GHz, dual 1x4, 50 Ω, terminated |
| M9147A | PXI RF multiplexer: 3GHz, quad 1x4, 50 Ω, terminated common |
| M9148A | PXI RF multiplexer: 3GHz, 1x8, 50 Ω |
| M9149A | PXI high-density RF multiplexer: 3GHz, 1x16, 50 Ω |
| M9150A | PXI RF multiplexer: 3GHz, dual 1x4, 75 Ω |
| M9151A | PXI RF multiplexer: 3GHz, quad 1x4, 75 Ω |
| M9152A | PXI RF multiplexer: 3GHz, 1x8, 75 Ω |
| M9153A | PXI high-density RF multiplexer: 3GHz, 1x16, 75 Ω |

## Recommended RF switch chassis configuration

For the ultimate in speed and flexibility, combine your RF switches with other PXI modules in the Agilent M9018A PXIe chassis as follows:

- Select a PXIe system module or embedded controller (the Agilent M9021A is recommended)
- If an external computer is being used, select an appropriate PC interface card (the Agilent M9047A is
- Recommended with an external PC)
- Select an appropriate cable to connect the computer interface board to the system module (the Y1202A is recommended to connect the M9047A and M9021A)
- Select rack mount and EMC filler panel kits as required

## Related products

| Model | Description |
|---|---|
| M9018A | 18-slot PXIe chassis |
| M9021A | PCIe® cable interface |
| M9045A | PCIe ExpressCard adaptor: Gen 1 |
| Y1200A | PCIe cable: x4 to x8, 2.0m (used with M9045A) |
| M9047A | PCIe desktop PC adapter: Gen 2, x8 |
| Y1202A | PCIe cable: x8, 2.0m (used with M9047A) |

## Software

| Model | Description |
|---|---|
| Supported operating Systems | Microsoft Windows® XP (32-bit), Microsoft Windows® Vista (32/64-bit) Microsoft Windows® 7 (32/64-bit) |
| Standard compliant drivers | IVI-COM, IVI-C, LabVIEW |
| Supported Application Development Environments (ADE) | VisualStudio® (VB.NET, C#, C/C++), LabVIEW, LabWindows/CVI, MATLAB |
| Agilent IO Libraries | Includes: VISA Libraries, Agilent Connection Expert, IO Monitor |

## Definitions for specifications

***Specifications*** *describe the warranted performance of calibrated instruments that have been stored for a minimum of 2 hours within the operating temperature range of 0 to 55 °C, unless otherwise stated, and after a 45 minute warm-up period. Data represented in this document are specifications unless otherwise noted.*

***Typical*** *describes characteristic performance, which 80% of instruments will meet when operated over a 20 to 30 °C temperature range. Typical performance is not warranted.*

***Nominal*** *describes the mean or average value of the performance of instruments when operated over a 20 to 30 °C temperature range. Nominal performance is not warranted.*

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

# WARRANTY AND CALIBRATION

### Advantage Services: Calibration and Warranty

Agilent Advantage Services is committed to your success throughout your equipment's lifetime.

### Warranty

| | |
|---|---|
| | Standard warranty is 1 year |
| R-51B-001-3C | 1 year return-to-Agilent warranty extended to 3 years |

## The Modular Tangram

The four-sided geometric symbol that appears in this document is called a tangram. The goal of this seven-piece puzzle is to create identifiable shapes—from simple to complex. As with a tangram, the possibilities may seem infinite as you begin to create a new test system. With a set of clearly defined elements—hardware, software—Agilent can help you create the system you need, from simple to complex.

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*For other unlisted Countries:* **www.agilent.com/find/contactus**

Revised: October 14, 2010

Product specifications and descriptions in this document subject to change without notice.


Printed in USA, December 30, 2010
5990-6585EN

Agilent Technologies