

# M9614A and M9615A PXIe 5-ch Precision Source / Measure Unit

500 kSa/s, 100 pA/10 pA, 30 V, 500 mA

## Introduction

The Keysight M9614A and M9615A is a PXIe five-channel precision source / measure units (SMUs). These SMUs supports accurate measurements up to 30 V / 500 mA with resolution down to 6  $\mu$ V / 10 pA. The M9614A and M9615A are suitable for applications that requires high channel density, such as semiconductor reliability testing and integrated circuit (IC) tests.



This table shows an overview of the M9614A and M9615A, the product options and its associated accessories. This guide provides a step-by-step instruction to help you configure to meet the desired test requirements.

Model Number	
M9614A	PXIe 5-channel SMU, 500 kSa/s, 100 pA, 30 V, 500 mA
M9615A	PXIe 5-channel precision SMU, 500 kSa/s, 10 pA, 30 V, 500 mA
Accessories	
PX0106A	Dsub25-to-5 SMB adapter for M9614A/15A
PX0108A-001/002	BNC-to-SMB cable, 1.5 m/ 3 m
N1254A-106	Triaxial(m) to BNC(f) adaptor
PX0101A-001/002	BNC-to-ferrule terminal cable, 1.5 m/ 3 m
Options	
1A7	Calibration + uncertainties + guardbanding (not accredited)
A6J	ANSI Z540-1-1994 calibration
UK6	Commercial calibration certificate with test data

# Configure Your Keysight M9614A/M9615A 5-channel Precision SMU

## Step 1. Define the required number of M9614A/M9615A modules

You need to define the required number of modules based on your application requirements.

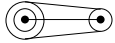
Product Number	Required Slots	Number of Channels	Max. Voltage	Max. Current	Min. Voltage Resolution	Min. Current Resolution	Max. Sampling Rate
M9614A	1	5	30 V	500 mA	6 $\mu$ V	100 pA	500 kSa/s
M9615A						10 pA	

The following items comes as standard with each M9614A/M9615A PXIe precision SMU module:

	Qty.	Additional information
Quick startup poster	1ea	Printed reference for quick startup (English)
Certificate of calibration (without test data)	1ea	Certificate of calibration (without actual test data). If you need the test data, please specify option UK6.
Short bar	1ea	Short bar to connect low terminals to chassis common; orderable part number is M9601-87001 (includes 5 qty.)
Connector-terminal block 2.5 mm 5-terminal	1ea	Connector-terminal block to connect external trigger terminals and interlock terminal; orderable part number is M9615-87001 (includes 5 qty.)

## Step 2. Select optional accessories

The following accessories are available for connection between M9614A and M9615A to your DUT.

Product Number	Description	Additional Information
PX0106A	Dsub25-to-5 SMB adapter	
PX0108A-001	BNC-to-SMB cable, 1.5 m	For Two-wire, non-guarded connection
PX0108A-002	BNC-to-SMB cable, 3.0 m	
N1254A-106	Triaxial(m) to BNC(f) adaptor	Convert Triaxial to BNC 
PX0101A-001	BNC to ferrule terminal cable, 1.5 m	Convert trigger or interlock terminals to BNC
PX0101A-002	BNC to ferrule terminal cable, 3 m	



## Two-wire, no guard connection

Figure 2 shows the two-wire and no guard connection configuration. For this configuration, select 1 x PX0106A Dsub25-to-5 SMB adapter 5 x PX0108A BNC-to-SMB cable per module. If your DUT has triaxial interface, add a suitable number of N1254A-106 Triaxial(m) to BNC(f) adaptor.

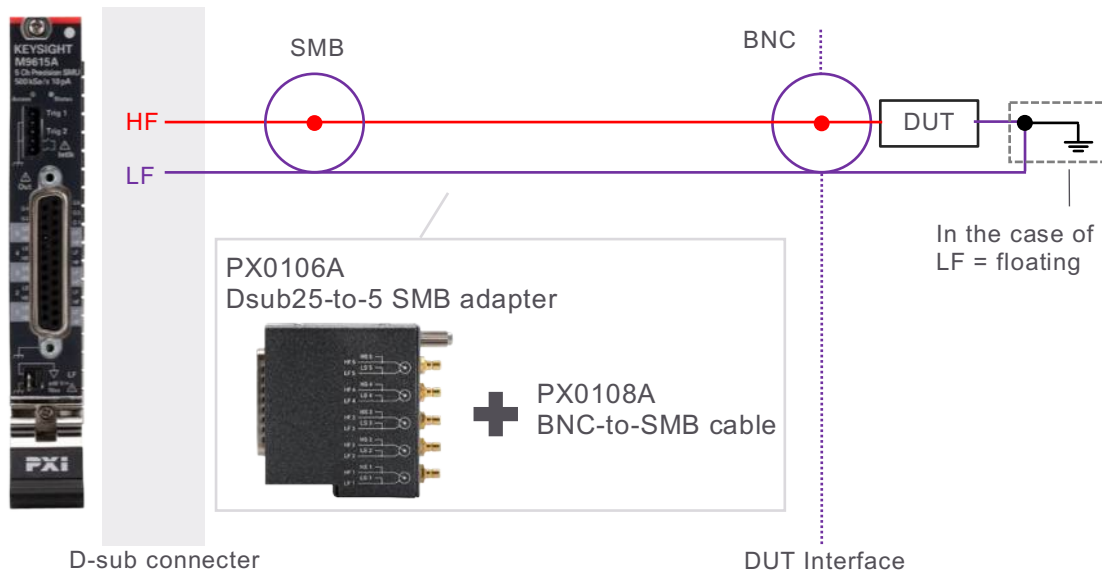


Figure 2. Two-wire, non-guarded connection configuration

## Any connections other than two-wire, no guard

For other connections, you need to develop custom cables to fit your measurement needs. Please refer the Appendix for the tips of making custom cables.

## Step 2-2. Select the cable if you utilized an interlock circuit

The M9614A/M9615A has an interlock safety feature to protect against exposure to voltages above a user-specified value. You can engage the safety lock using interlock pins on the connector located at the front panel. Normally, these pins are routed to a shielding box or test fixture that must be closed to complete the interlock circuit.

You can install an interlock circuit as shown in Figure 3. If your shielding box has a BNC connector for the interlock circuit, you can use the PX0101A-001 or 002 BNC to ferrule terminal cable with a connector-terminal block to connect the M9614A/M9615A's interlock pins to it. For more detail information, please refer to the Keysight M9614A/M9615A Startup Guide.

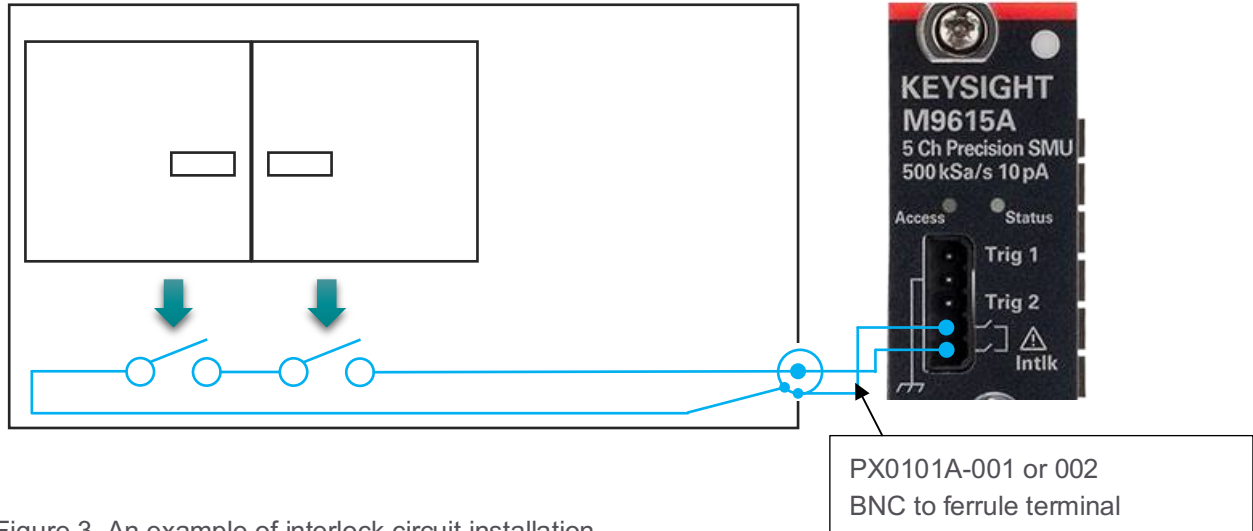


Figure 3. An example of interlock circuit installation

### Step 2-3. Select the cables if you use an external trigger

There are trigger lines in the PXIe chassis available to synchronize the M9614A/M9615A with the other PXIe modules. In addition, there are two external trigger lines available if you need to synchronize it with an external instrument. You can use the PX0101A-001 or 002 BNC to ferrule terminal cable with a connector-terminal block to connect the M9614A/M9615A's external trigger lines to the external instrument.

## Step 3. Select a calibration plan

### Step 3-1. Select a relevant calibration services plan (optional)

Factory calibration and certification of calibration comes as standard. The optional ISO 17025 (not accredited), ANSI Z540, and commercial calibration certificate with test data are available as follows:

Description	Product Number	Additional Information
Calibration + uncertainties + guardbanding (not accredited)	M9614A-1A7/ M9615A-1A7	Calibration certificate with measurement results available only at time of purchase
ANSI Z540-1-1994 calibration	M9614A-A6J/ M9615A-A6J	Calibration certificate with measurement results available only at time of purchase
Commercial calibration certificate with test data	M9614A-UK6/ M9615A-UK6	Calibration certificate with measurement results available only at time of purchase

### Step 3-2. Select recalibration service plans (optional)

The following options are available. If you need other options — for example, the standard compliant calibration option — please contact your local Keysight office for availability.

Description	Product Number
Calibration plan — return to Keysight — 3 years	R-50C-011-3
Calibration plan — return to Keysight — 5 years	R-50C-011-5

### Related Literature

Publication Number	Publication Title
3120-1310EN	M9614A and M9615A PXIe Precision 5-Channel Source/Measure Unit — Data Sheet
5992-0600EN	Keysight PXI and AXIe Products and Solutions — Catalog
5990-6379EN	Keysight PXI & AXIe Instruments, Software, Reference Solutions, and Services

### Appendix. Tips for Connection between M9614A/15A and your DUT

#### Two-wire connection or four-wire connection

If you are measuring very small resistances or applying very large current, you should use the four-wire measurement method (also known as the Kelvin method). This technique uses both force and sense terminals. Performing the measurement through the sense terminals (in which no current is flowing) eliminates the undesirable effects of cable resistance.

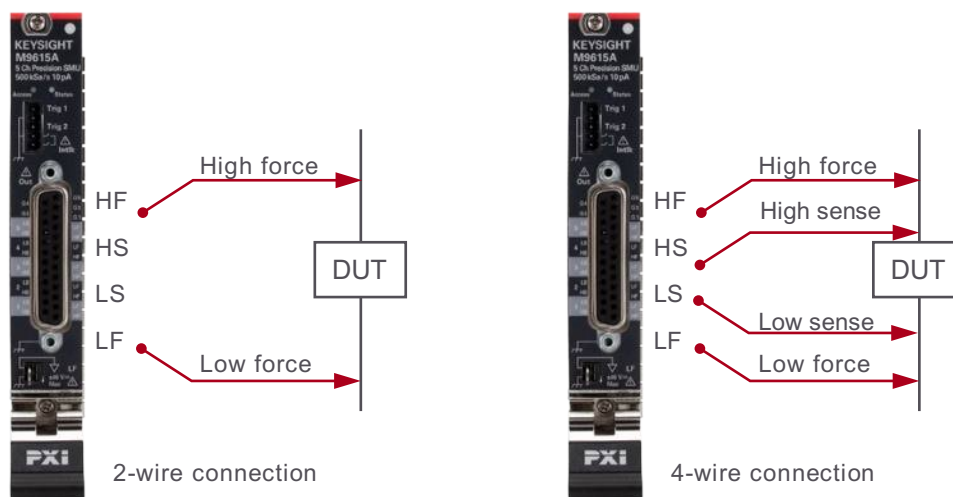


Figure 4. Two-wire connection and four-wire connection configuration

## Guarding connections

Low current measurements ( $< 1 \text{ nA}$ ) requires a guarding to prevent leakage through the measurement cable. Figure 5 illustrates a simplified overview of the guarding technique. Guarded measurements require the use of triaxial cables. A follower ( $\times 1$ ) buffer amplifier maintains the same potential between the guard conductor and the center conductor. Since there is no voltage difference, there is no current from the center conductor to the guard.

Note: in this example, the device interface also has a guarded shield to prevent leakage at the device interface.

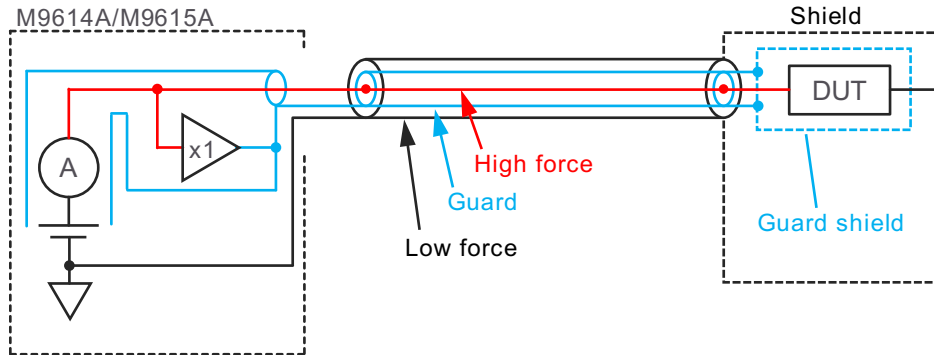


Figure 5. Guarding technique

## Tips for making custom cables

The following three types of connections requires the custom cable for connections:

- Four-wire, guarded connection
- Four-wire, non-guarded connection
- Two-wire, guarded connection

The PX0106A Dsub25-to-5 SMB adapter and the PX0108A BNC-to-SMB cable is available for two-wire, non-guarded connection. For other connections, you need to develop custom cables to fit your measurement needs.

These are common tips for all connections:

- Although LF is shared by all channels, it is recommended to use each HF terminal with the LF terminal of the same channel.
- The simpler two-wire configuration uses only the force terminals. In two-wire mode, the sense terminals remain open.
- Never connect the guard shield to any output, including the frame/chassis ground or any other guard terminal.

Figure 6 to 8 are tips for each connection.

## Four-wire, guarded connection

- Shield HF and HS by G to reduce the leakage current between the instrument and a DUT.
- Shield G by LF, because G can be over 42 V when LF is floating
- Shield LS by LF to avoid the external noise influence.

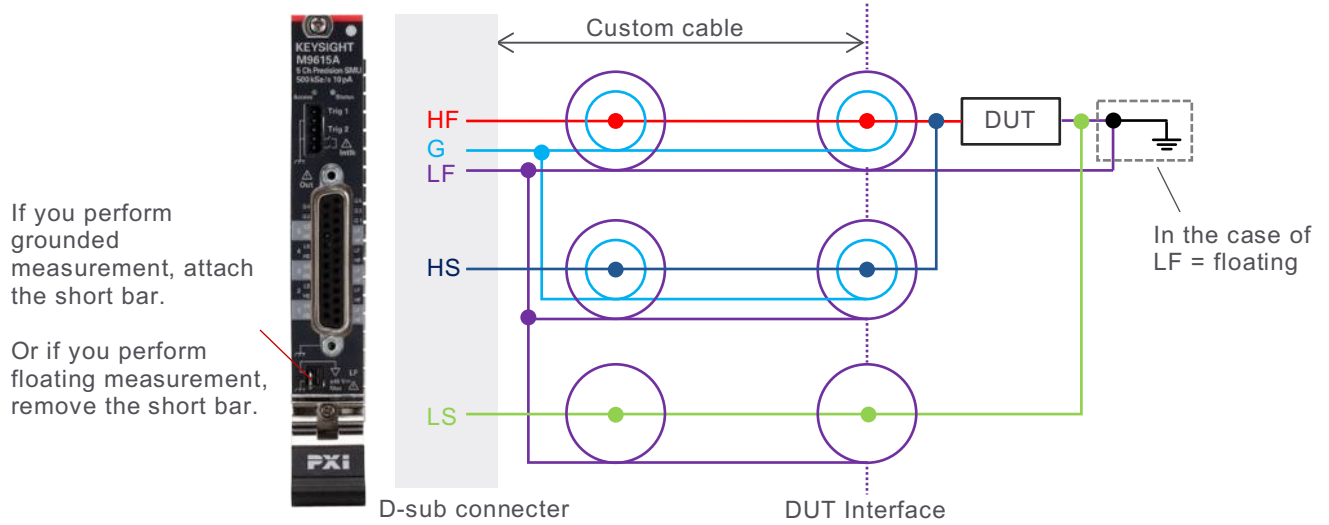


Figure 6. Four-wire, guarded connection configuration

## Four-wire, non-guarded connection

- Shield HF, HS, LS by LF to avoid any external noise influence.

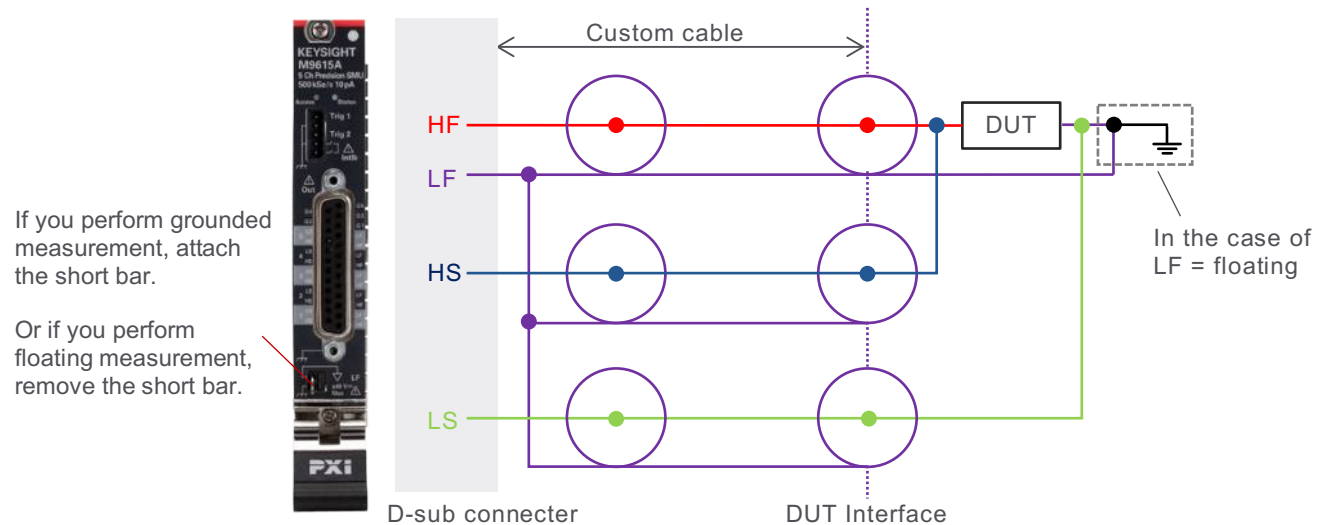


Figure 7. Four-wire, non-guarded connection configuration



## Two-wire, guarded connection

- The simpler two-wire configuration uses only the force terminals. Retain the sense terminals open.
- Shield HF by G to minimize the leakage current and stray capacitance from the cables.
- Shield G by LF, because G can be over 42 V when LF is floating.

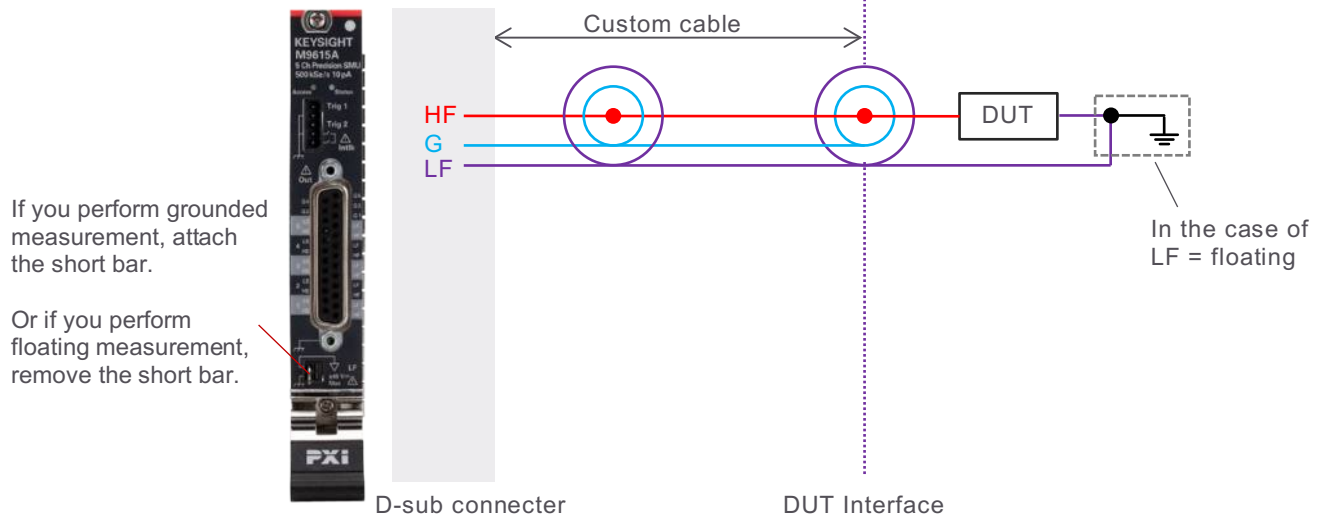


Figure 8. Two-wire, guarded connection configuration

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