

M9602A and M9603A

PXIe Precision Source/Measure Units

15 MSa/s, 1 pA/100 fA, 60 V, 3.5 A DC/10.5 A pulse

Introduction

The Keysight M9602A and M9603A are PXIe precision SMUs which offer a best-in-their-class narrow pulse width of 10 μ s, a fast sampling rate of up to 15 MSa/s, and a wide output range that enables dynamic/pulsed measurements for broad emerging applications such as VCSEL optical devices and IC testing. This table shows an overview of the M9602A and M9603A, product options, and associated accessories. This guide provides step-by-step instructions to help you configure the product to meet the desired test requirements.



Model number	
M9602A	PXIe SMU, 15 MSa/s, 1 pA, 60 V, 3.5 A DC/10.5 A pulse
M9603A	PXIe Precision SMU, 15 MSa/s, 100fA, 60 V, 3.5 A DC/10.5 A pulse
Accessories	
PX0101A-001/002	BNC-to-ferrule terminal cable, 1.5 m/ 3 m
PX0103A-001/002	Triaxial to SMB cable, 1.5 m/ 3 m
PX0104A-001/002	High current triaxial cable, 4 A, 1.5 m/ 3 m
PX0105A-001/002	Low inductance BNC cable, 1.5 m/ 3 m
PX0108A-001/002	BNC-to-SMB 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

Configuring Your Keysight M9602A/M9603A Precision SMU

Step 1. Define the required number of M9602A/M9603A modules

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

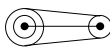
Product number	Required slots	Number of channels	Max. Voltage	Max. Current (DC/pulse)	Min. Voltage resolution	Min. Current resolution	Max. Sampling rate
M9602A	1	1	60 V	3.5 A/10.5 A	6 μ V	1 pA	15 MSa/s
M9603A						100 fA	

The following items come as standard with each M9602A/M9603A 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 pcs.)
Connector-terminal block 2.5 mm 6-terminal	1ea	Connector-terminal block to connect external trigger terminals and interlock terminal; orderable part number is M9601-87002 (includes 5 pcs.)

Step 2. Select optional accessories

The following accessories are available for connection between M9602A and M9603A to your DUT.

Product number	Description	Note
PX0101A-001/002	BNC-to-ferrule terminal cable, 1.5 m/ 3 m	Trigger or interlock cable
PX0103A-001/002	Triaxial to SMB cable, 1.5 m/ 3 m	Low sense cable
PX0104A-001/002	High current triaxial cable, 4 A, 1.5 m/ 3 m	Standard high force and high sense triaxial cable
PX0105A-001/002	Low inductance BNC cable, 1.5 m/ 3 m	High force cable for narrow pulse less than 50 μ s
PX0108A-001/002	BNC-to-SMB cable, 1.5 m/ 3 m	Low sense cable
N1254A-106	Triaxial(m) to BNC(f) adaptor 	To connect PX0105A cable to high force triaxial terminals of SMU.

M9602A/M9603A front panel

As shown in Figure 1, the M9602A/M9603A has High force, Low force, High sense, Low sense and Guard. It supports both two-wire and four-wire measurement, and low current measurement with a guard.

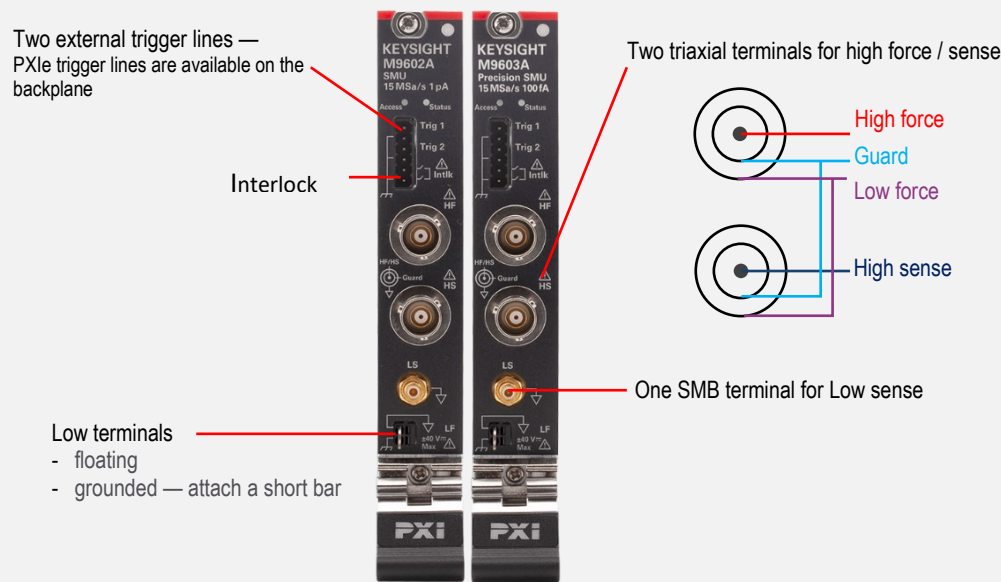


Figure 1. M9602A/M9603A Front panel

Step 2-1. Select cable and accessories for connection between M9602A/M9603A and your DUT

You will need to select an appropriate accessory according to the connection type. There are basically three types of connection configurations. The essential cables and accessories are as follows:

Two-wire or Four-wire	Pulse width	Recommended cable		
		High force	High sense	Low sense
Four-wire	$\leq 50 \mu\text{s}$	Triaxial(m) to BNC(f) + Low inductance cable ¹	High current triaxial cable ²	Triaxial-to-SMB cable ³
	$> 50 \mu\text{s}$ or DC	High current triaxial cable	High current triaxial cable	Triaxial-to-SMB cable
Two-wire		High current triaxial cable	NA	NA

1. A low inductance cable does not have Guard, and is limited in low current measurement. Guard connection is required for low current measurement ($\sim 10 \text{ nA}$ or less measurement.)
2. A low inductance cable can be used, though it is limited in low current measurement.
3. An SMB-BNC cable can be used, however, do not connect the outer shield, Low Force, to the chassis/frame ground of the DUT when M9603A is grounded.

Four-wire connection for narrow pulse ($\leq 50 \mu\text{s}$)

Figure 2 shows the connection for 4-wire connections for narrow pulse ($\leq 50 \mu\text{s}$). For this configuration, select the items shown in Table 1.

Note the following points for this connection:

- The low inductance cable does not have Guard, and is limited to low current measurement. Guard connection is required for low current measurement ($\sim 10 \text{ nA}$ or less measurement.)
- Do not connect the outer shield or Low Force to the chassis/frame ground of the DUT when M9603A is grounded

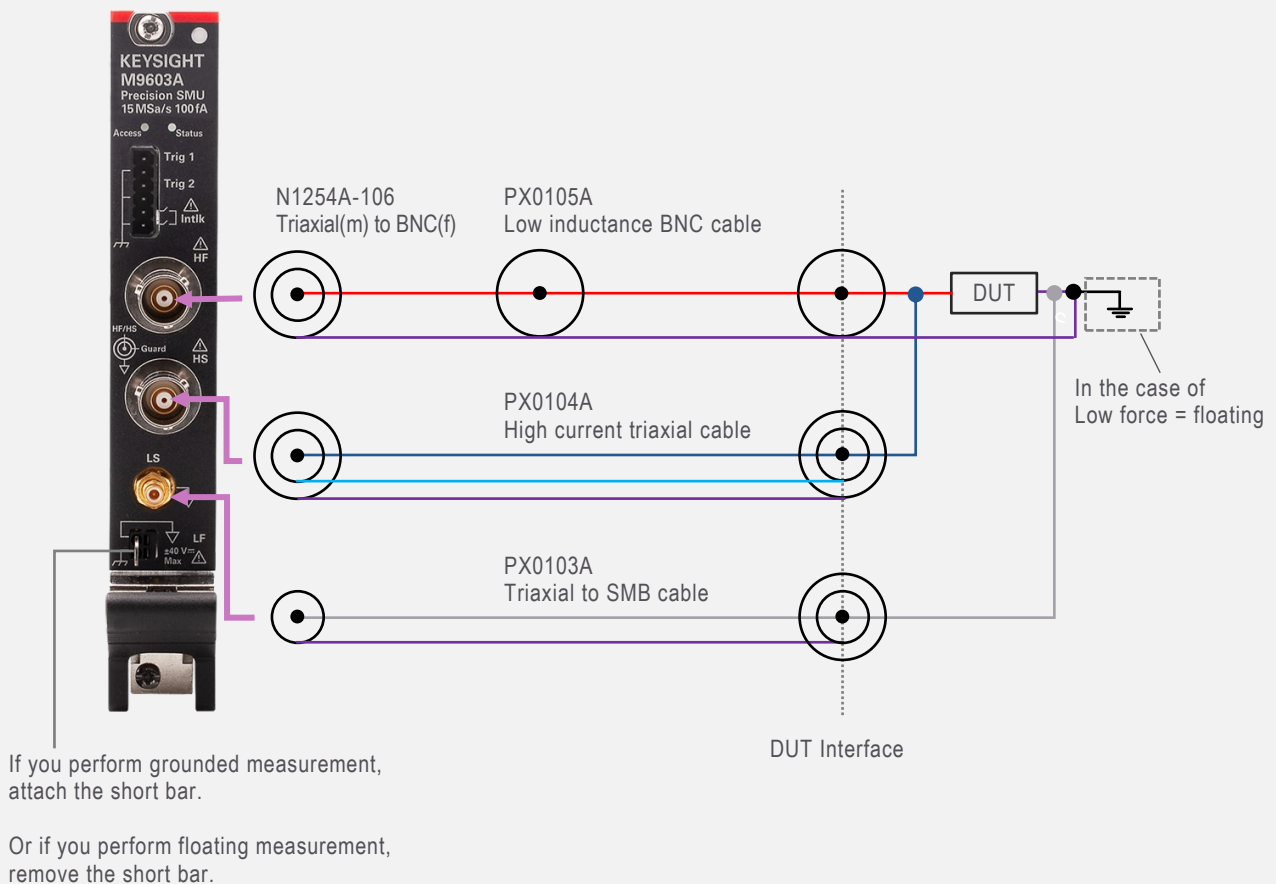


Figure 2. Connection for 4-wire connection for narrow pulse ($\leq 50 \mu\text{s}$)

Table 1. Required items for 4-wire connection for narrow pulse ($\leq 50 \mu\text{s}$)

Product number	Description	Qty.	Note
PX0103A-001/002	Triaxial to SMB cable 1.5 m/ 3 m	1	Low sense If your DUT interface is BNC, you can use a PX0108A BNC-to-SMB cable, instead.
PX0104A-001/002	High current triaxial cable, 4 A 1.5 m/ 3 m	1	High sense If your DUT interface is BNC, you can use a PX0105A Low inductance BNC cable with N1254A-106 Triaxial(m) to BNC(f) adaptor, instead.
PX0105A-001/002	Low inductance BNC cable 1.5 m/ 3 m	1	High force
N1254A-106	Triaxial(m) to BNC(f) adaptor	1	Used with PX0105A

Four-wire connection for pulse ($> 50 \mu\text{s}$) or DC

Figure 3 shows the connection for 4-wire connection for pulse ($> 50 \mu\text{s}$) or DC. For this configuration, select the items shown in Table 2.

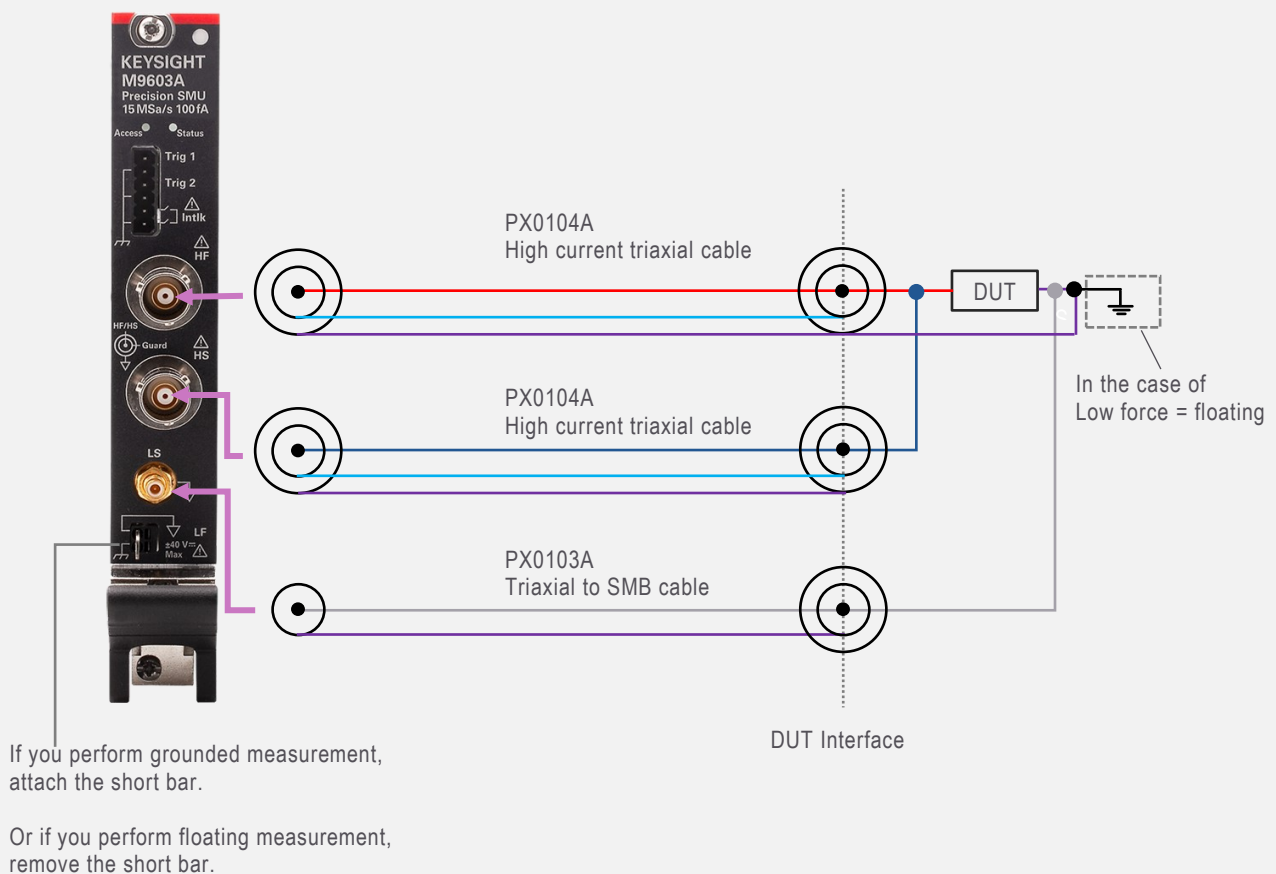


Figure 3. Connection for a 4-wire connection for pulse ($> 50 \mu\text{s}$) or DC

Table 2. Required items for 4-wire connection for pulse (> 50 μs) or DC

Product number	Description	Qty.	Note
PX0103A-001/002	Triaxial to SMB cable 1.5 m/ 3 m	1	Low sense
PX0104A-001/002	High current triaxial cable, 4 A 1.5 m/ 3 m	2	High force, High sense

Two-wire connection

Figure 4 shows the connection for 2-wire connection. For this configuration, select the items shown in Table 3.

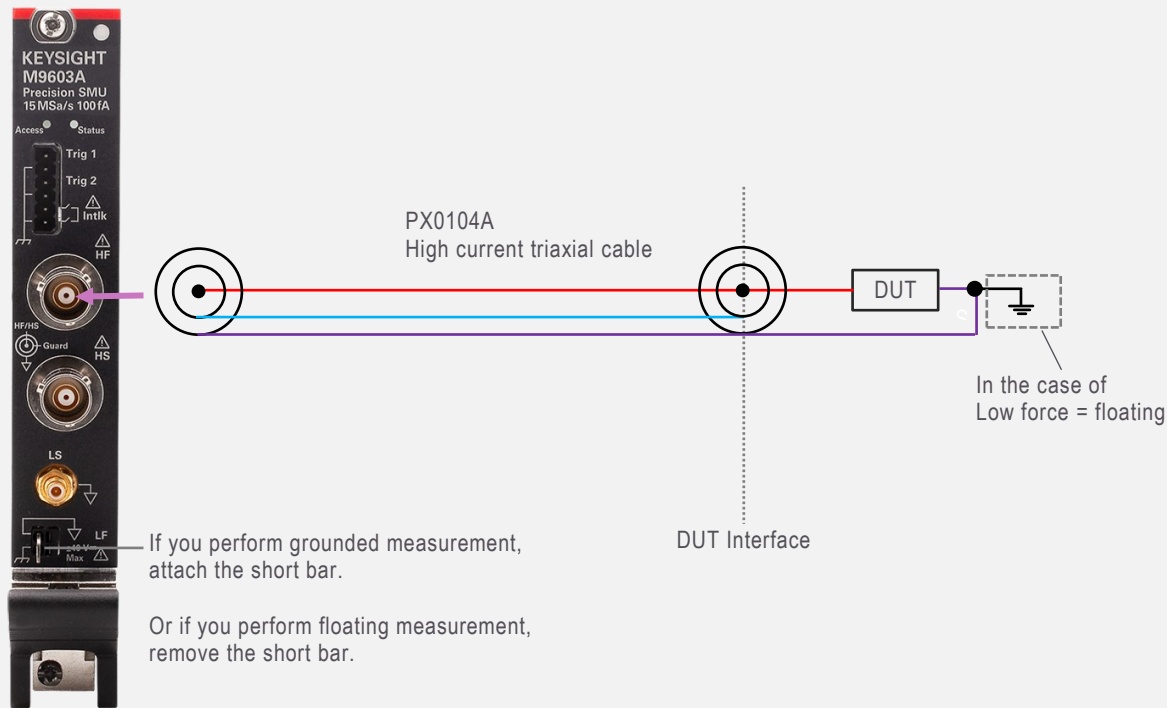


Figure 4. Connection for 2-wire connection.

Table 3. Required items for 2-wire connection

Product number	Description	Qty.	Note
PX0104A-001/002	High current triaxial cable, 4 A 1.5 m/ 3 m	1	High Force

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

The M9602A/M9603A is equipped with 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 M9602A/M9603A's interlock pins to it. For more detailed information, please refer to the Keysight M9602A/M9603A Startup Guide.

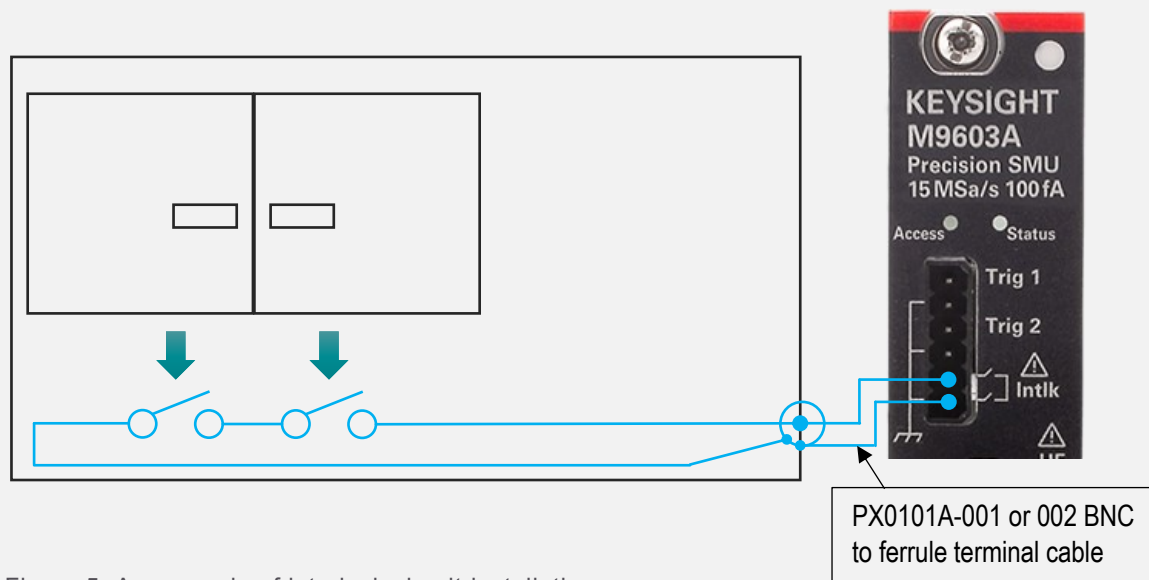


Figure 5. An example of interlock circuit installation

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

There are trigger lines in the PXIe chassis available to synchronize the M9602A/M9603A 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 M9602A/M9603A's external trigger lines to the external instrument.

Step 3. Select software license type (Optional)

The PX0109A Quick I/V Measurement Software For PXIe Precision SMU is recommended for easy and quick I/V measurement. Because it supports various license type, select the appropriate one for your purpose. Please visit: www.keysight.com/find/px0109a in detail.

Product	License type	License term (36 months subscription) License & support
PX0109A	Node-locked (fixed)	R-X45-001-Y
	Transportable	R-X45-004-Y
	USB Portable ¹	R-X45-005-Y
	Floating (single site)	R-X45-002-Y
	Floating (single region)	R-X45-006-Y
	Node-locked (fixed)	R-X45-001-Y

1. USB portable license requires a certified USB dongle (available for additional purchase. Keysight part number PX0100-D10)

Step 4. Select a calibration plan

Step 4-1. 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)	M9602A-1A7/ M9603A-1A7	Calibration certificate with measurement results are available only at time of purchase
ANSI Z540-1-1994 calibration	M9602A-A6J/ M9603A-A6J	Calibration certificate with measurement results are available only at time of purchase
Commercial calibration certificate with test data	M9602A-UK6/ M9603A-UK6	Calibration certificate with measurement results are available only at time of purchase

Step 4-2. 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 Title	Publication number
M9602A and M9603A PXIe Precision Source/Measure Unit, Data Sheet	3120-1427EN
PX0109A Quick I/V Measurement Software for PXIe Precision SMU, Technical Overview	3121-1317EN
Keysight PXI and AXIe Products and Solutions, Catalog	5992-0600EN
Keysight PXI & AXIe Instruments, Software, Reference Solutions, and Services	5990-6379EN

Appendix. Tips for Connection between M9602A/M9603A and your DUT

Two-wire connection or four-wire connection

If you are measuring very small resistances or applying a 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.

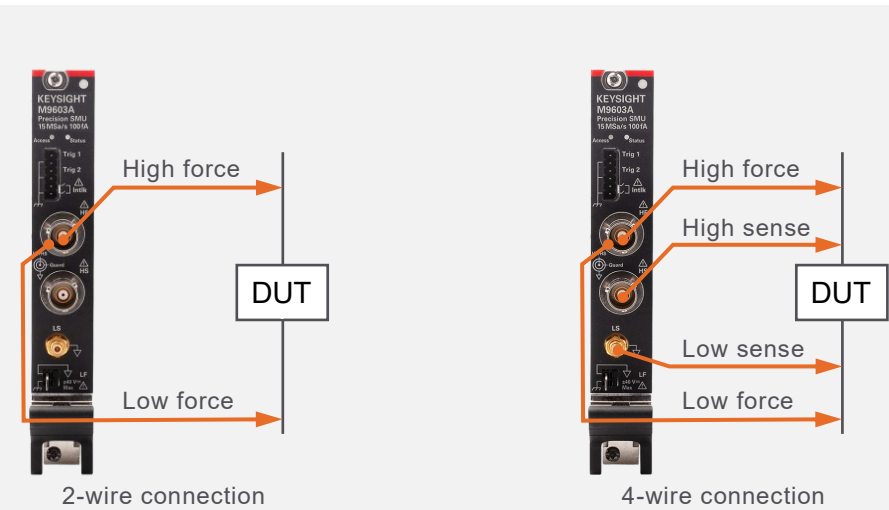


Figure 6. Two-wire connection and four-wire connection configuration

Guarding connections

Low current measurements ($< 1\text{ nA}$) requires a guarding to prevent leakage through the measurement cable. Figure 7 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.

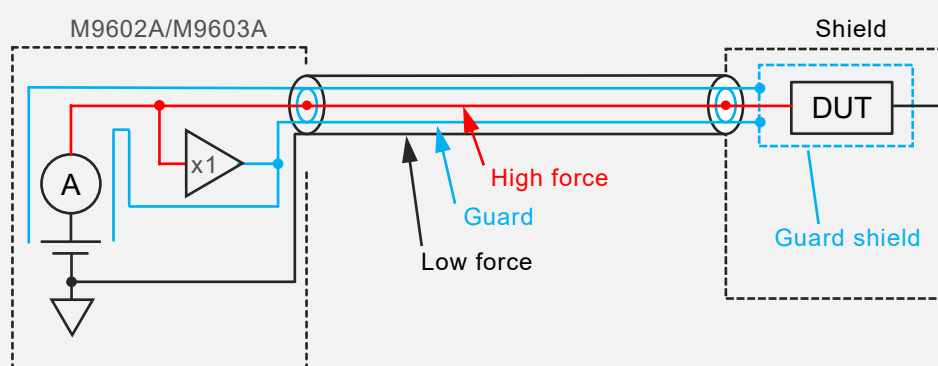


Figure 7. Guarding technique

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