S9101A 5G Multi-Band Vector Transceiver

380 MHz to 6 GHz and 24.25 to 43.5 GHz

The Keysight S9101A 5G Multi-Band Vector Transceiver is a streamlined, non-signaling measurement system that enables automated testing of 5G New Radio (5G NR) infrastructure equipment in both FR1 (380 MHz to 6 GHz) and millimeter wave FR2 (24.25 to 43.5 GHz) frequencies.

KEYSIGHT

STARTUP GUIDE

Notices

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Safety Notices

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like 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 notice denotes a hazard. It calls attention to an operating procedure, practice, or the like 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.

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1 Overview

The Keysight S9101A 5G Multi-Band Vector Transceiver
is a streamlined, non-signaling measurement system that enables automated testing of 5G New Radio (5G NR) infrastructure equipment in both the FR1 (380 MHz to 6 GHz) and millimeter wave FR2 frequencies (24.25 to 43.5 GHz).

In this document...

This document describes the installation process to start up and prepare the Keysight S9101A 5G Multi-Band Vector Transceiver for use.

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2 Review Safety Requirements

Review all safety information in this section before operating any of the equipment:

2. 1 Warning Statements and Symbols

The following notices are used throughout this document. Familiarize yourself with each of the notices and their meaning before operating these products.

CAUTION A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like 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 notice denotes a hazard. It calls attention to an operating procedure, practice, or the like 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.

2. 2 Safety

The safety information in this section applies to the following products.

Keysight S9101A 5G Multi-Band Vector Transceiver consists of:

- PXIe chassis and modules, rugged front panel, and cables
- Keysight S9101RH mmWave Transceiver

These products have been designed and tested in accordance with accepted industry standards and have been supplied in a safe condition. This documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain products in a safe condition.

2. 2. 1 Safety Compliance

These products comply with the essential requirements of the European LVD (Low Voltage Directive) as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

- IEC/EN 61010-1
- Canada: CSA C22.2 No. 61010-1
- USA: UL std no. 61010-1

2. 2. 2 Acoustic Statement (European Machinery Directive)

Acoustic noise emission
LpA <70 dB
Operator position
Normal operation mode per ISO 7779

2. 2. 3 General Safety Notices

WARNING If these products are not used as specified, the protection provided by the equipment could be impaired.
These products must be used in a normal condition (in which all means for protection are intact) only.

WARNING No operator serviceable parts inside.
Refer servicing to qualified personnel.
To prevent electrical shock, do not remove covers.

WARNING This is a Safety Protection Class I 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.

CAUTION The Keysight S9101A 5G Multi-Band Vector Transceiver is designed for use in Installation Category II and Pollution Degree 2, per IEC 61010 Second Edition and 664 respectively.

CAUTION **The S9101A is designed for indoor use only and does not support hot-swapping of modules;** for example, inserting and removing modules with the chassis powered up. Before installing modules in or removing modules from the chassis, power down the chassis, but leave the power cord connected to the AC Mains because it serves as a ground and helps protect the chassis and modules from electrostatic damage.

2. 3 Weight and Dimensions

Keysight S9101A:

- Height: 192.4 mm (7.6 in); with feet removed
- Height: 197.8 mm (7.79 in); with feet installed
- Width: 449.5 mm (17.70 in); with rugged panel
- Depth: 568.9 mm (22.40 in); with rugged panel (from back bumper to front BNC)
- Weight: 20.4 kg (45.0 lbs) for Keysight S9101A Option TR1
- Weight: 22.6 kg (49.8 lbs) for Keysight S9101A Option TR2

Keysight S9101RH mmWave Transceiver:

- Height: 66 mm (2.6 in)
- Width: 139 mm (5.5 in)
- Depth: 183 mm (7.2 in)
- Weight: 2.2 kg (4.85 lbs)

2. 4 Handling and Lifting

For best practice and proper ergonomics, the weight of the components may require the assistance of two persons to lift and carry.

WARNING **Use both side handles when lifting the S9101A.**

Use a rolling cart when transporting the S9101A.

2. 5 Cleaning

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

WARNING To prevent electrical shock, disconnect the S9101A from Mains before cleaning.

Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

WARNING Cleaning connectors with isopropyl alcohol shall only be done with the instruments 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 instrument.

WARNING Keep isopropyl alcohol away from heat, sparks, and flame. Store in a tightly closed container. The isopropyl alcohol shall not be stored, or left open, in the area of the equipment. Use isopropyl alcohol with adequate ventilation to prevent the combustion of fumes or vapors.

Avoid contact with eyes, skin, and clothing, as isopropyl alcohol causes skin irritation, may cause eye damage, and is harmful if swallowed or inhaled. It may be harmful if absorbed through the skin. Wash thoroughly after handling. In case of spill, soak up with sand or earth. Flush spill area with water. Dispose of isopropyl alcohol in accordance with all applicable federal, state, and local environmental regulations.

In case of fire, use alcohol foam, dry chemical, or carbon dioxide; water may be ineffective.

2. 6 Environmental Conditions (Operating)

CAUTION **The S9101A is designed for use in INSTALLATION CATEGORY II and POLLUTION DEGREE 2, per IEC 61010 Second Edition and 664 respectively.**

CAUTION **The S9101RH mmWave Transceiver is designed for use in Installation Category II and Pollution Degree 2, per IEC 61010-1 Third Edition and 664 respectively.**

The Keysight S9101A 5G Multi-Band Vector Transceiver is designed for use in the following conditions:

- For indoor use only
- Altitude up to 6,561.68 ft (2,000 m)
- Operating Temperature 10 to 40° C,
  Maximum Relative Humidity (non-condensing): 85% RH

Samples of these products have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of Storage, Transportation and end-use. Those stresses include, but are not limited to temperature, humidity, shock, vibration, altitude and power line conditions.

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

2. 7 EMC (Electromagnetic Compatibility)

These products comply with the essential requirements of the European LVD (Low Voltage Directive) as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

- IEC/EN 61326-1
- CISPR Pub 11 group 1, class A
- AS/NZS CISPR 11
- ICES/NMB-001

  This ISM device complies with Canadian ICES-001.
  Cet appareil ISM est conforme a la norme NMB-001 du Canada.

2. 7. 1 South Korean Class A EMC Declaration

This equipment has been conformity assessed for use in business environments. In a residential environment this equipment may cause radio interference. This EMC statement applies to the equipment only for use in business environment.

사 용 자 안 내 문
이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

※ 사용자 안내문은 "업무용 방송통신기자재"에만 적용한다.

2. 7. 2 Declaration of Conformity

Declarations of Conformity for these products and for other Keysight products may be downloaded from the Web. Go to http://www.keysight.com/go/conformity and click on "Declarations of Conformity." You can then search by product number to find the latest Declaration of Conformity.

2.8 Ventilation

CAUTION VENTILATION REQUIREMENTS: When installing the product into a cabinet, the convection into and out of the product must not be restricted. Consideration shall also be given to the individual instruments to avoid having the heated discharge of one instrument, now becoming the cooling intake air for another instrument.

Another area of concern is verification that the maximum ambient operating temperature of the instrument(s) is not exceeded by cabinet installation.

Keysight recommends forced air convection whenever instrument(s) are installed in a cabinet and further recommends that the maximum operating temperature of the cabinet be reduced 10°C from the lowest, of the maximum operating temperature of a single instrument.

If there are any concerns or special requirements, a Keysight Field Engineer should be consulted to assure instrument(s) temperature compliance and performance.

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

2. 9 Location and Mounting

Consider ergonomics when locating any keyboard or mouse which will be used in connection with an instrument.

Install the S9101A so that the detachable power cords are readily identifiable and is easily reached by the operator. The detachable power cord is the disconnecting device. It disconnects the Mains circuits from the Mains supply before other parts of the S9101A. (The front panel switches are only standby switches and are not LINE switches.) Alternatively, externally installed switches or circuit breakers (which are readily identifiable and is easily reached by the operator) may be used as disconnecting devices.

CAUTION **The S9101A requires a 1U space below when rack mounting.**

The S9101RH mmWave Transceiver does not have an AC power connection. It is powered by a DC voltage supplied over the
RF Cable Assembly to the **LO/Pwr/Ctrl/IF In** connector. The DC supply does not represent a risk of personal injury.

CAUTION **The RF Cable Assembly should not be connected to, or disconnected from, the S9101RH mmWave Transceiver while it is suppling DC power. This connection should be made only when powered off.**

If the LED status indicator on the front of the S9101RH is lit, this indicates that it is powered up and the cable should not be disconnected.

2. 10 Power Requirements

100/120 VAC, 220/240 VAC
50/60 Hz
1200 W Max (Lower range), 1300 W Max (Upper range)

WARNING "WARNING: Safety of any system incorporating the equipment is the responsibility of the assembler of the system."

NOTE "NOTE: The input terminals for this product are classified as Measurement Category None."

The S9101A does **not** contain customer serviceable fuses.

WARNING Failure to ground the test set properly can result in personal injury. Before turning on the test set, you must connect its protective earth terminals to the protective conductor of the main power cable. Insert the main power cable plug into a socket outlet that has a protective earth contact only. DO NOT defeat the earth-grounding protection by using an extension cable, power cable, or auto-transformer without a protective ground conductor.

CAUTION This instrument has auto-ranging line voltage input.

Before switching on the instrument, be sure the supply voltage is within the specified range and voltage fluctuations do not exceed 10 percent of the nominal supply voltage.

2. 10. 1 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 Front and Rear Panel Symbols / Markings on page 20.

WARNING The Mains wiring and connectors shall be compatible with the connector used in the premise electrical system. Failure to ensure adequate earth grounding by not using the correct components may cause product damage and serious injury.

2. 10. 2 Ground the Instrument

WARNING These products must be used in a normal condition (all means for protection are intact).

WARNING This is a Safety Protection Class I 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.

The S9101RH mmWave Transceiver does not have an AC power connection. It is powered by a DC voltage supplied over the RF Cable Assembly to the LO/Pwr/Ctrl/IF In connector. The DC supply does not represent a risk of personal injury.

CAUTION The RF Cable Assembly should not be connected to, or disconnected from, the S9101RH mmWave Transceiver while it is suppling DC power. If the LED status indicator on the front of the S9101RH is lit, this indicates that it is powered up and the cable should not be disconnected.

When the S9101RH mmWave Transceiver is used, use only the RF Cable Assembly that was supplied with the S9101RH to connect it with the other instrument and connect it only to the mmW ports on that instrument.

2. 11 AC Power Cord

The S9101A is equipped with three-wire power cords, in accordance with international safety standards. These power cords ground the S9101A cabinet when connected to an appropriate power line outlet.

Use the Keysight supplied power cord or one with the same or better electrical rating. The cable appropriate to the original shipping location is included with the S9101A. See: http://www.keysight.com/find/powercords4

CAUTION Always use the three-prong AC power cord supplied with these products. Failure to ensure adequate earth grounding by not using these cords can cause product damage.

WARNING If these products are not used as specified, the protection provided by the equipment could be impaired. These products must be used in a normal condition (in which all means for protection are intact) only. Install the S9101A so that its detachable power cord is readily identifiable and easily reached by the operator. The detachable power cord is the instrument's disconnecting device. It disconnects the Mains circuits from the Mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch. Alternatively, an externally installed switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be used as a disconnecting device.

The S9101RH mmWave Transceiver does not have an AC power cord connection. It is powered by a DC voltage that is supplied over the RF Cable Assembly to the LO/Pwr/Ctrl/IF In connector. The DC supply does not represent a risk of personal injury.

2. 12 Protecting Against Electrostatic Discharge (ESD)

CAUTION **Electrostatic discharge (ESD) can damage or destroy electronic components (the possibility of unseen damage caused by ESD is present whenever components are transported, stored, or used).**

Shipping Materials and ESD

Keysight's chassis and instrument modules are shipped in materials which prevent static electricity damage. These instruments should only be removed from the packaging in an anti-static area, ensuring that correct anti-static precautions are taken. Store all modules in anti-static envelopes when not installed.

Test Equipment and ESD

To help reduce ESD damage that can occur while using test equipment:

WARNING **Do not use these first three techniques when working on circuitry with a voltage potential greater than 500 volts.**

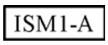
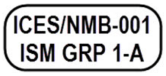
- Before connecting any coaxial cable to a test set connector for the first time each day, momentarily short the center and outer conductors of the cable together.
- Personnel should be grounded with a 1 MΩ resistor-isolated wrist-strap before touching the center pin of any connector and before removing any assembly from the test set.
- Be sure that all instruments are properly earth-grounded to prevent build-up of static charge.
- Perform work on all components or assemblies at a static-safe workstation.
- Keep static-generating materials at least one meter away from all components.
- Store or transport components in static-shielding containers.
- Always handle printed circuit board assemblies by the edges. This reduces the possibility of ESD damage to components and prevent contamination of exposed plating.

Additional Information About ESD

For more information about ESD and how to prevent ESD damage, contact the Electrostatic Discharge Association (http://www.esda.org). The ESD standards developed by this agency are sanctioned by the American National Standards Institute (ANSI).

2. 13 Front and Rear Panel Symbols / Markings

Symbols that may be on the exterior of S9101A hardware components are:

Symbol	Description
	This symbol is used to indicate power ON and to mark the position of the instrument power line switch.
	This symbol is used to indicate power STANDBY mode (yellow in standby, green when instrument is ON) and to mark the position of the instrument power line switch.
	The AC symbol is used to indicate the required nature of the line module input power.
	This symbol indicates instruction documentation. The product is marked with this symbol when it is necessary for the user to refer to the instruction in the documentation.
	UK conformity mark is a UK government owned mark. Products showing this mark comply with all applicable UK regulations.
	The CE marking is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven). It indicates that the product complies with all relevant directives.
	The RCM mark is a registered trademark of the Australian Communications and Media Authority.
	The Keysight email address is required by EU directives applicable to our products. ccr.keysight@keysight.com
	This is a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 5).
	ICES / NMB-001 This is a marking to indicate product compliance with the Industry Canada Interference-Causing Equipment Standard (ICES-001). The following statements must be in the user documentation. "This ISM device complies with Canadian ICES-001." "Cet appareil ISM est conforme a la norme NMB du Canada."
	South Korean Certification (KC) mark. It includes the marking's identifier code which follows this format: R-R-Kst-ZZZZZZZ.
	The crossed out wheeled bin symbol indicates that separate collection for waste electric and electronic equipment (WEEE) is required, as obligated by the EU DIRECTIVE and other National legislation. Please refer to www.keysight.com/go/takeback to understand your Trade in options with Keysight in addition to product takeback instructions.

Symbol	Description
	China Restricted Substance Product Label. The EPUP (environmental protection use period) number in the center indicates the time period during which no hazardous or toxic substances or elements are expected to leak or deteriorate during normal use and generally reflects the expected useful life of the product.
	Universal recycling symbol. This symbol indicates compliance with the China standard GB 18455-2001 as required by the China RoHS regulations for paper/fiberboard packaging.
	The CSA mark is a registered trademark of the CSA International.
	This symbol indicates that anti-static precautions should be taken.
	This symbol indicates earth ground.
	This mark designates Direct Current.

2. 14 Returning for Service

Should it become necessary to return the system for repair or service, follow these steps:

1. Review the warranty information shipped with the product.
2. Contact Keysight to obtain a Return Material Authorization (RMA) and a return address. For assistance finding Keysight contact information, go to: www.keysight.com/find/assist
3. Write the following information on a tag and attach it to the equipment:
   - Name and address of owner.
     P.O. boxes are not acceptable as return addresses.
   - System or module serial numbers. The serial number label is located on the side panel of the module. The serial number can also be read from the Soft Front Panel interface – after the hardware is installed.
   - Description of failure or service required.
4. Use original packaging or comparable.
   - Pack the system in its original ESD bag and packing carton.
   - If the original carton is not available, use bubble wrap or packing peanuts, place the system in a sealed container, and mark the container “FRAGILE”.
   - Include all original cables and modules when sending in the system for repair or service.
5. On the shipping label, write ATTENTION REPAIR DEPARTMENT and the RMA number.

NOTE **In your correspondence, refer to the system by serial number.**

3 Review Hardware Components

NOTE **The following list of hardware components are the models used with the Keysight S9101A 5G Multi-Band Vector Transceiver.**

Before installing hardware or software, review the following hardware components:

3. 1 Hardware Components

NOTE The hardware components in a S9101A configuration depend on whether Option TR1, Option BK1, or Option TR2 is selected.

S9101A-TR1, one-channel configuration

S9101A Option TR1 5G Multi-Band Vector Transceiver
includes:
- one S9101A Base System (with
  - one M9410A PXIe RF Vector Transceiver)
- one S9101RH mmWave Transceiver (with
  - one set of cables)

S9101A-BK1, one-channel configuration with Blocker signal capability

S9101A-BK1 5G Multi-Band Vector Transceiver TR1 with Blocker
includes:
- one S9101A Base System (with
  - two M9410A PXIe RF Vector Transceivers;
  - one creates a wanted signal and
  - one creates a blocker signal)
- one S9101RH mmWave Transceiver (with
  - one set of cables)

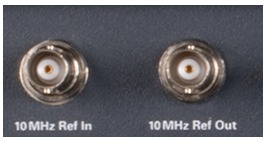
S9101A-TR2, two-channel configuration

S9101A Option TR2 5G Multi-Band Vector Transceiver
includes:
- one S9101A Base System (with
  - two M9410A PXIe RF Vector Transceivers)
- two S9101RH mmWave Transceivers (with
  - two set of cables)

3. 2 Connector Descriptions

3. 2. 1 Connectors, 100 MHz Ref Out & 10 MHz Ref In/Out above the Rugged Front Panel

100 MHz Ref Out, Frequency Reference (Connects behind rugged panel from M9300A PXIe Reference **100 MHz Out**.)	
Connector	BNC (f)
Amplitude	9.5 dBm, *nominal*



10 MHz Ref Out (Connects behind rugged panel from M9300A PXIe Reference **10 MHz Out**.)	
Connector	BNC (f)
Amplitude	9.5 dBm, *nominal*
10 MHz Ref In (Connects behind rugged panel, to M9300A PXIe Reference **Ref In**, and locks to another reference with a value of 10 MHz or 100 MHz.)	
Connector	BNC (f)
Frequency[1]	10 MHz or 100 MHz, sine wave
Lock range	± 1 ppm, *nominal*
Amplitude	0 to 10 dBm, *nominal*

3. 2. 2 Connectors, Trig 1 and Trig 2 on the Rugged Front Panel

Trig 1 and Trig 2 (Connects behind rugged panel to M9019A PXIe Chassis **Trig 1 and Trig 2**.)	
Connector	BNC (f)
Direction control	Input or output (configurable)
Output level	3.3 V CMOS (TTL compatible, 5 V tolerant)
Output impedance	50 Ω (typ)
Output trigger source	PXI_Trig0 - PXI_Trig7 (Segment 2 or 3)
Input level	3.3 V CMOS (TTL compatible, 5 V tolerant)
Input impedance	3 kΩ (typ)
Input trigger destination	PXI_Trig0 - PXI_Trig7 (Segment 2 or 3)
Input threshold	1.65 V (typ)
Minimum swing	250 mV (typ)
Minimum pulse width	100 ns (typ)

NOTE **These two front panel trigger connectors (Trig 1 and Trig 2) connect to the PXI [0:7] backplane trigger bus in the M9019A**

[1]The 10 MHz Ref In connector frequency range, on S910xA systems, is different from the M9300A PXIe Frequency Reference Data Sheet. The S910xA systems only support 10 MHz or 100 MHz inputs.

NOTE chassis and can be configured as Input or Output. To learn more about these connectors, see the Keysight PXIe Chassis Family, User Guide (M9019-90003).

3. 2. 3 Connectors, Transceivers on the Rugged Front Panel

RF In	
Connector	Type-N (f), 50 Ω, *nominal*
Frequency Range	380 MHz to 6 GHz
Amplitude	0 VDC, +27 dBm Maximum Safe Input Power
RF Out	
Connector	Type-N (f), 50 Ω, *nominal*
Frequency Range	380 MHz to 6 GHz
Amplitude	0 VDC, +30 dBm Maximum Reverse Input Power
Half Duplex	
Connector	Type-N (f)
Frequency Range	380 MHz to 6 GHz
Amplitude	0 VDC, +30 dBm Maximum Safe Input Power
Trig 1 and Trig 2 (Input or Output, Selectable)	
Connectors	SMA (f)
Input Impedance	1 kΩ or 50 Ω, *nominal*
Input Level Range	–3.3 V to +3.3 V
Output Impedance	50 Ω, *nominal*
Output Level Range	3.3 V LVTTL

NOTE RF In, RF Out, Half Duplex, Trig 1 and Trig 2 connect to the M9410A. To learn more about these connectors, see the Keysight M9410A PXIe VXT Vector Transceiver, Getting Started Guide (M9410-90003).

mmWave IF In	
Connector	Type-N (f), 50 Ω, *nominal*
Frequency Range	380 MHz to 6 GHz
Amplitude	± 10 VDC, +33 dBm Maximum
mmWave IF Out	
Connector	Type-N (f), 50 Ω, *nominal*
Frequency Range	380 MHz to 6 GHz
Amplitude	± 10 VDC, +33 dBm Maximum
mmWave LO/Pwr/Ctrl Out	
Connector	TNC (f)

NOTE IF In, IF Out, and LO/Pwr/Ctrl Out connect to the S9101RH IF Side.

mmWave Ch 1A In or Ch 1B In	
Connector	SMA (f)

NOTE Ch 1A In or Ch 1B In connect to the S9101A PXIe modules behind the cover.

3. 2. 4 Connectors, M9037A PXIe Embedded Controller

Status LEDs	
PWR (Green)	On, indicates power supply to embedded controller is good.
SSD (Amber)	Flashes when Solid State Drive is active.
Link (Green)	Indicates PCIe Link status: Off = No link; Blinking @ 1 Hz = Gen1 speed Blinking @ 2 Hz = Gen2 speed On steady = Gen3 speed
LAN (White), USR (Grey)	Both LEDs are reserved for Keysight use only.
Video/Dual Display Ports	
Connectors	Two, Dual Mode DisplayPort++ connectors can support either a DisplayPort or DVI-D monitor
USB 2.0 and 3.0	
Connectors	Four, USB 2.0 (Type A)
Connectors	Two, USB 3.0
LAN 1 and LAN 2	
Connectors	Two, 10/100/1000BASE-T (RJ-45) Gigabit Ethernet ports
LAN Connector Top LED (Amber)	Active, blinks if accessing IO
LAN Connector Bottom LED (Off) Bottom LED (Green) Bottom LED (Amber)	LAN Speed: 10 Mbps LAN Speed: 100 Mbps LAN Speed: 1000 Mbps
LAN Connectors, Top and Bottom LEDs (Off)	Network link not established or system is powered off.
LAN RST (Reset) Button	Reserved for Keysight use only.
Trig (PXI Trigger In/Out)	
Connector	SMB (m) snap-on, bi-directional trigger connector for routing an external trigger signal to/from PXI backplane
GPIB	
Connector	GPIB (Micro-D 25-pin)
PCIe	
Connector	x8 Gen 3 PCIe IPASS connector for controlling a second PXIe or AXIe chassis or RAID storage

CMOS Backup Battery

WARNING
Danger of explosion if battery is incorrectly replaced.

Replace only with the same or equivalent type recommended.

Discard used batteries according to manufacturer's instructions.

Follow proper disposal process. Only dispose of old battery according to local codes.

All electric and electronic equipment are required to be separated from normal waste for disposal.

NOTE
Typical battery life varies considerably and depends on operating temperature and standby (shutdown) time of the system. Typical life expectancy of a 190 mAh battery is 4 to 5 years with an average on-time of 8 hours per working day at an operating temperature of 30°C. To ensure that the lifetime of the battery has not been exceeded, you should change the battery after 3 to 4 years of service.

Keysight's M9037A is equipped with a 3.0 V "coin cell" lithium battery. This battery powers the clock circuit and retains configuration memory in CMOS RAM while the system is turned off.

To replace the CMOS Backup Battery

1. Turn off power to the PXIe chassis.
2. Remove the M9037A embedded controller from the chassis. Observe all anti-static precautions.
3. Locate and remove the battery. Press the battery release latch (1). The battery should pop out (2).

4. Place the new battery in the socket. Make sure that you correctly orient the battery for installation. The positive pole (+) must be on the top. You may find it helpful to angle the battery in and pull back on the battery release latch. Replace the lithium battery with an identical battery (BR2032 or equivalent).
5. Install the embedded controller back in the PXIe chassis and apply power. The battery's operational temperature range is less than that of the M9037A's storage temperature range. For exact range information, refer to the battery manufacturer's specifications.

NOTE See the Data Sheet for the Keysight M9037A, 5991-3661EN.

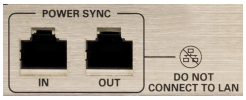
3. 2. 5 Connectors, S9101A Rear Panel (M9019A PXIe Chassis)

AC Line Input

(Use the AC line cord supplied with the S9101A.)

Connector, Three-Prong	100/120 V, 50/60 Hz, 1200 W MAX (Lower range) 220/240 V, 50/60 Hz, 1300 W MAX (Upper range)

NOTE See also AC Power Cord on page 18.



POWER SYNC

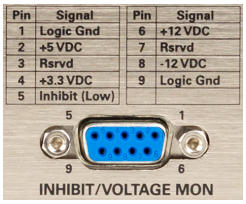
(DO NOT CONNECT TO LAN!)

Connector, IN and OUT	RJ-45 cables (CAT5 or better not exceeding two meters in length) can be used to connect multiple PXI chassis; up to four chassis may be connected together for power-up synchronization. **DO NOT connect to the LAN!** When connected with RJ-45 cables, the power button on any chassis may be used to power up or power down the entire system.

FAN and INHIBIT Switches

(Used for remote inhibit and power rail monitoring.)

FAN Switch	The **FAN** switch controls the fan speed: **HIGH** - the fan voltage duty cycle is set to 100%, which generates the highest fan speeds and best chassis cooling (as well as the most fan noise). **AUTO** - the speed of the three fans are controlled based on the temperature of the chassis and the setting on the Soft Front Panel (SFP) Temperature parameter. See the Keysight PXIe Chassis User Guide (M9019-90003).
INHIBIT Switch	The **INHIBIT** switch controls the method of powering up the chassis: **DEF (default)** - recommended position when connecting AC power cord. Front panel power button is used to switch between ON and Standby and requires that an M9024A or M9037A is installed in system controller slot 1. **MAN (manual)** - Inhibit signal on the rear panel DB-9 connector controls chassis power. When set to MAN, POWER SYNC feature is disabled.



INHIBIT/VOLTAGE MON

(Use for remote inhibit and power rail monitoring.)

Connector	DB-9

For details on use, see the Keysight PXIe Chassis User Guide (M9019-90003).

10 MHz REF IN and OUT

Connectors, Rear Panel	BNC (f), 50 Ω, *nominal*
Frequency Input	10 MHz ±100 PPM
Input Signal	100 mVPP to 5 VPP (square-wave or sine-wave)
Input signal (PXI timing slot PXI_CLK10_IN)	5 V or 3.3 V TTL signal

NOTE These 10 MHz REF IN and OUT connectors are for supplying the PXI_CLK10_IN and OUT signals from the System Timing Module.

To provide a 10 MHz Clock to the S9101A, see Connectors, 100 MHz Ref Out & 10 MHz Ref In/Out above the Rugged Front Panel on page 25.

NOTE For additional information, see the Data Sheet for the Keysight M9019A, 5992-1481EN.

3. 2. 6 Connectors, Option TR1, TR2, S9101RH mmWave Transceiver

3. 2. 6. 1 Ext Trig, LEDs, & Interfaces on S9101RH mmWave Transceiver

Ext Trig	
Connector	SMA (m), 50 Ω, *nominal*, DC to 40 GHz
Input Level Range	5 V TTL (Trigger signal below 0.8 volts is a "zero" (low) and anything above +2.4 volts is a "one" (high).
LEDs	
Trig (LED)	A trigger indicator (used by Keysight in testing; not needed for customer use). In normal usage (as described for Ext Trig) the LED does not light.
RF1 (LED)	Indicates the current status of the **RF Tx/Rx 1** port, according to the color scheme: – Blue = Tx (port is in transmit mode) – Green = Rx (port is in receive mode) – White = Idle (port is not in use) During switching between modes, intermediate shades of color occur temporarily.
RF2 (LED)	Indicates the current status of the **RF Tx/Rx 2** port, according to the color scheme described for RF1 above.
Status (LED)	Lights to indicate that the S9101RH is currently under instrument control, according to the color scheme: – Orange = connected, but no active communication currently – Green = connected, with active communication currently
USB	
Connector	Micro-USB B Reserved for Keysight internal use only.
Aux	
Connector	Micro-D 15-pin A power input (used by Keysight in testing; not needed for customer use).

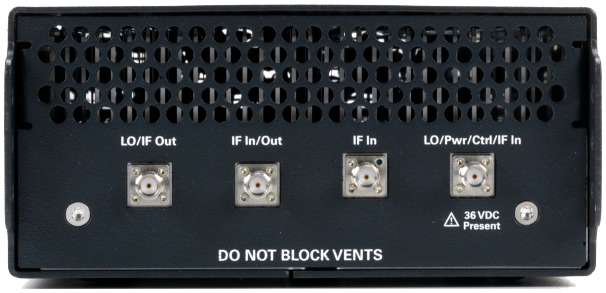
3. 2. 6. 2 Connectors, mmWave Side of S9101RH mmWave Transceiver

RF Tx/Rx 1	
Connector	2.4 mm (f), 50 Ω, *nominal* This port can be configured either to supply a mmWave signal to a Device Under Test (DUT), or to receive a mmWave signal from a DUT.
Frequency, S9101RH Frequency, S9101A Amplitude	24 to 44 GHz, 24.25 to 29.5 GHz and 37 to 40 GHz, 15 VDC, +20 dBm Maximum Input
RF Tx/Rx 2	
Connector	2.4 mm (f), 50 Ω, *nominal* This port can be configured either to supply a mmWave signal to a Device Under Test (DUT), or to receive a mmWave signal from a DUT.
Frequency, S9101RH Frequency, S9101A Amplitude	24 to 44 GHz, 24.25 to 29.5 GHz and 37 to 40 GHz, 15 VDC, +20 dBm Maximum Input

NOTE Although the S9101RH mmWave Transceiver is operational from 24 to 44 GHz, the performance information for the S9101A is only provided for the frequency bands called out in its Data Sheet.

See the Data Sheet for the Keysight S9101A, 7120-1254EN.

3. 2. 6. 3 Connectors, IF Side of S9101RH mmWave Transceiver



LO/IF Out		
	Connector	SMA (f), 50 Ω, *nominal* This port provides the IF output of the down-converter in the S9101RH. This port also accepts an LO input to be used by the downconverter.
IF In/Out		
	Connector	SMA (f), 50 Ω, *nominal* This port can be used either to accept an IF input to the upconverter in the S9101RH or to provide the IF output of the downconverter in the S9101RH.
	IF frequency range IF input power range IF output power range	2.5 to 4 GHz –20 to –30 dBm minimum, CW –24 to –8 dBm, CW
IF In		
	Connector	SMA (f), 50 Ω, *nominal* This port accepts an IF input to the upconverter in the S9101RH.
	IF frequency range IF input power range	2.5 to 4 GHz –20 to –30 dBm minimum, CW
LO/Pwr/Ctrl/IF In		
	Connector	SMA (f), 50 Ω, *nominal* This port accepts an IF input to the upconverter in the S9101RH. This port also accepts the following inputs, which are combined with the IF input signal: – An LO input to be used by the upconverter and/or downconverter in the S9101RH. – A +36 VDC voltage input to power the S9101RH. – A control signal to operate the S9101RH.
	Frequency range, LO, DC power	6 to 12 GHz, –20 dBm, minimum +36 VDC, 1A

CAUTION Do not connect or disconnect the RF cable, at either end, while the connected instrument is powered on.

4 Install Hardware

WARNING Before installing hardware, Review Safety Requirements on page 7.

Safety of any system incorporating the equipment is the responsibility of the assembler of the system.

4. 1 Standard Configurations

The S9101A is available in three standard configurations:

- Keysight S9101A-TR1 5G Multi-Band Vector Transceiver on page 36, one-channel configuration, consists of one RF transceiver and one mmWave transceiver providing one Tx channel and one Rx channel, operating in one frequency range at a time:
  - FR1 frequencies ranging from 380 MHz to 6 GHz
  - or FR2 banded mmWave frequencies from 24.25 to 43.5 GHz

- Keysight S9101A-BK1 5G Multi-Band Vector Transceiver TR1 with Blocker on page 38, one-channel configuration, with Blocker signal capability, consists of two RF transceivers and one mmWave transceiver providing one Tx channel and one Rx channel, operating in one frequency range at a time:
  - FR1 frequencies ranging from 380 MHz to 6 GHz
  - or FR2 banded mmWave frequencies from 24.25 to 43.5 GHz

  This configuration provides the capability to perform Rx tests with a blocking signal (interfering signal). It can generate a *Wanted* signal and at the same time generate a *Blocking* signal; a *Wanted* signal (produced from the RF Out of a Primary M9410A VXT) is combined with a *Blocking* signal (produced from the RF Out of a 2nd M9410A VXT). The combined *Wanted* and *Blocking* signals are available in both the FR1 or FR2 frequency ranges.

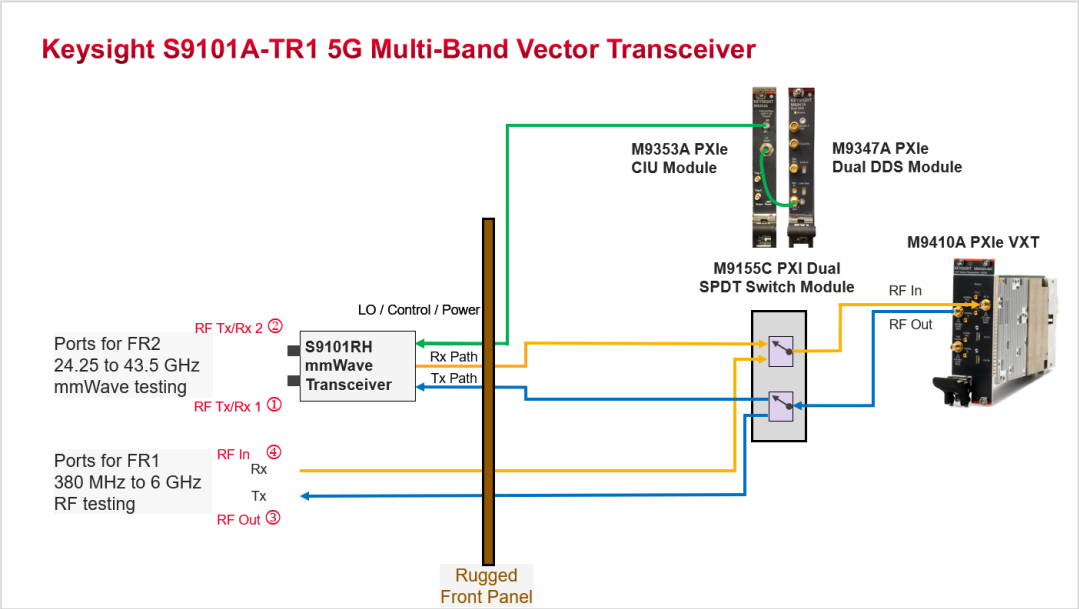
- Keysight S9101A-TR2 5G Multi-Band Vector Transceiver on page 40, two-channel configuration, consists of two RF transceivers and two mmWave transceivers providing two channels of Tx and Rx capabilities. Each channel of Tx and Rx operates in one frequency range at a time:
  - FR1 frequencies ranging from 380 MHz to 6 GHz
  - or FR2 banded mmWave frequencies from 24.25 to 43.5 GHz

4. 2 Keysight S9101A-TR1 5G Multi-Band Vector Transceiver

Connect the hardware as described in the following table.

Item	Qty	Connection To... From...
	1	– **S9100-60005 Three-Cable Bundle (Color-Coded)** – **Red** SMA (m) to TNC (m), 4000 mm (157.5 in) Connect S9101RH **LO/Pwr/Ctrl IF In** to S9101A **LO/Pwr/Ctrl Out**. – **Black** SMA (m) to Type-N (m), 4000 mm (157.5 in) Connect S9101RH **IF In** to S9101A **IF Out**. – White SMA (m) to Type-N (m), 4000 mm (157.5 in) Connect S9101RH **IF In/Out** to S9101A **IF In**.
	1	– **8121-3222 loop-back cable**, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in), Accessory Cable*: Used to connect from **RF Tx/Rx 1** to **RF Tx/Rx 2** on the S9101RH mmWave Transceiver.

*This cable is used when verifying operation with software at mmWave frequencies, for example 28 GHz. Disconnect this cable during normal operation. One cable is included with each Keysight S9101A-TR1 5G Multi-Band Vector Transceiver.



Keysight S9101A-TR1 5G Multi-Band Vector Transceiver on page 36, one-channel configuration, consists of one RF transceiver and one mmWave transceiver providing one Tx channel and one Rx channel, operating in one frequency range at a time:

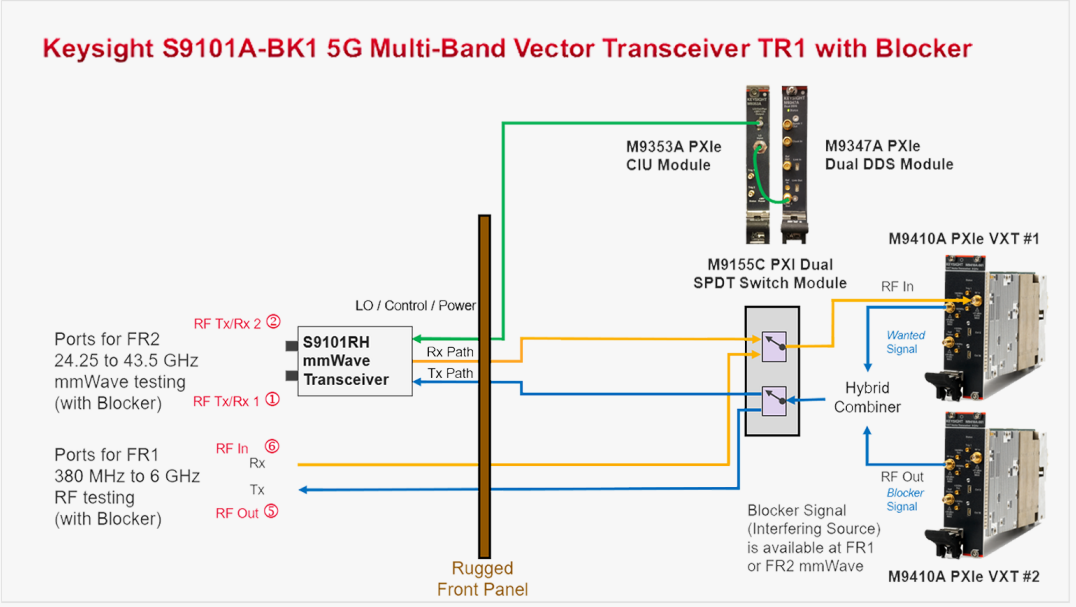
- FR1 frequencies ranging from 380 MHz to 6 GHz
- or FR2 banded mmWave frequencies from 24.25 to 43.5 GHz

4. 3 Keysight S9101A-BK1
5G Multi-Band Vector Transceiver TR1 with Blocker

Connect the hardware as described in the following table.

Item	Qty	Connection To... From...
	1	– **S9100-60005 Three-Cable Bundle (Color-Coded)** – **Red** SMA (m) to TNC (m), 4000 mm (157.5 in) Connect S9101RH **LO/Pwr/Ctrl IF In** to S9101A **LO/Pwr/Ctrl Out**. – **Black** SMA (m) to Type-N (m), 4000 mm (157.5 in) Connect S9101RH **IF In** to S9101A **IF Out**. – White SMA (m) to Type-N (m), 4000 mm (157.5 in) Connect S9101RH **IF In/Out** to S9101A **IF In**.
	1	– **8121-3222 loop-back cable**, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in), Accessory Cable*: Used to connect from **RF Tx/Rx 1** to **RF Tx/Rx 2** on the S9101RH mmWave Transceiver.

*This cable is used when verifying operation with software at mmWave frequencies, for example 28 GHz. Disconnect this cable during normal operation. One cable is included with each Keysight S9101A-BK1 5G Multi-Band Vector Transceiver TR1 with Blocker.

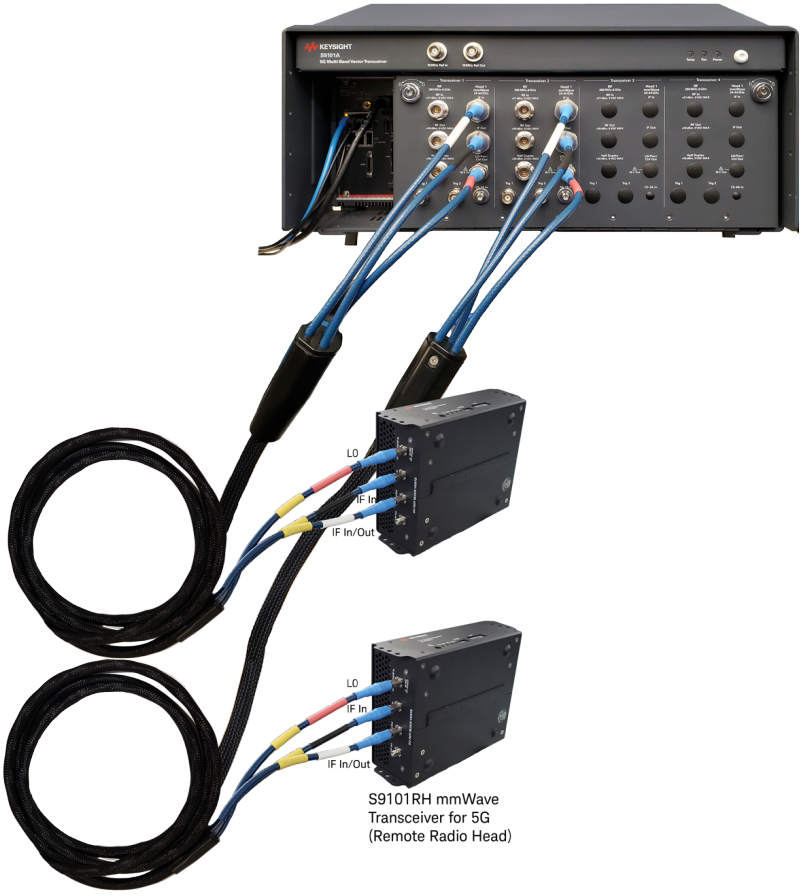


Keysight S9101A-BK1 5G Multi-Band Vector Transceiver TR1 with Blocker on page 38, one-channel configuration, with Blocker signal capability, consists of two RF transceivers and one mmWave transceiver providing one Tx channel and one Rx channel, operating in one frequency range at a time:

- FR1 frequencies ranging from 380 MHz to 6 GHz
- or FR2 banded mmWave frequencies from 24.25 to 43.5 GHz

This configuration provides the capability to perform Rx tests with a blocking signal (interfering signal). It can generate a *Wanted* signal and at the same time generate a *Blocking* signal; a *Wanted* signal (produced from the RF Out of a Primary M9410A VXT) is combined with a *Blocking* signal (produced from the RF Out of a 2nd M9410A VXT). The combined *Wanted* and *Blocking* signals are available in both the FR1 or FR2 frequency ranges.

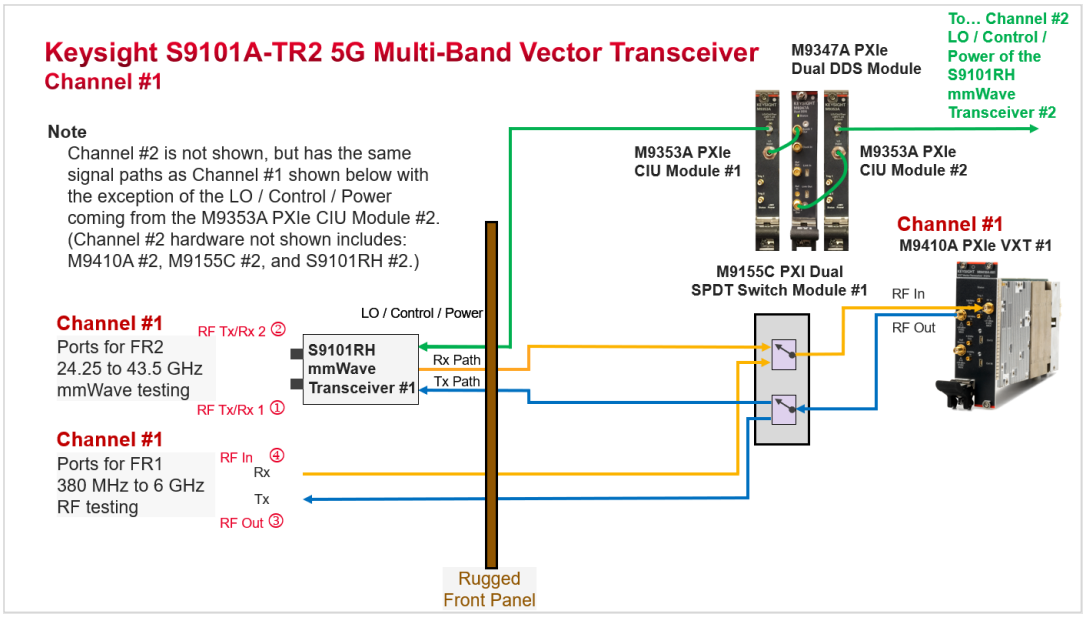
4. 4 Keysight S9101A-TR2 5G Multi-Band Vector Transceiver

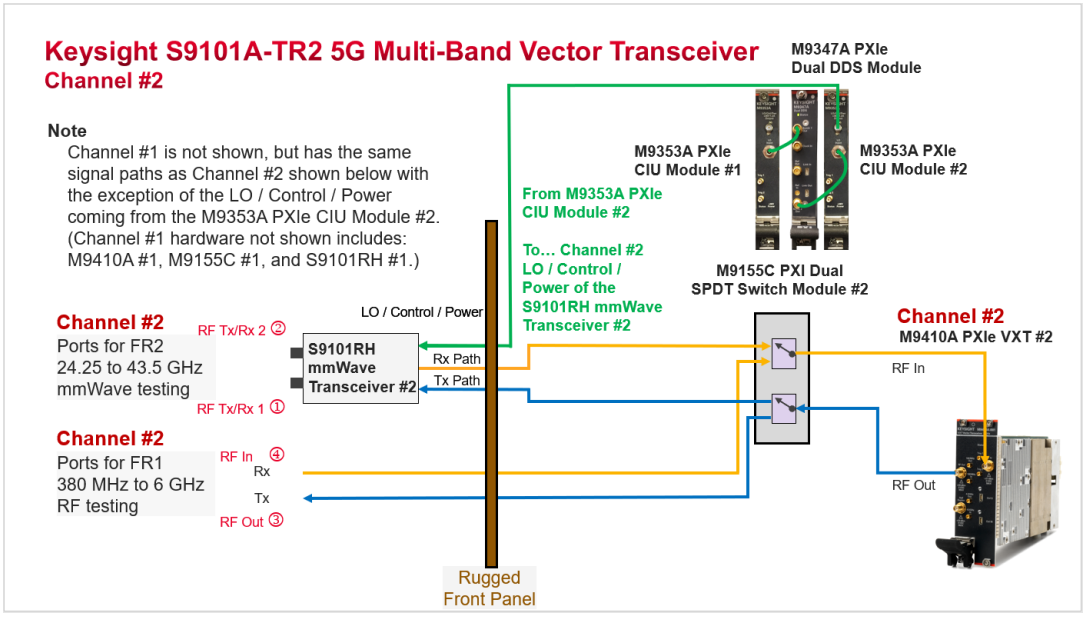


Connect the hardware as described in the following table.

Item	Qty	Connection To... From...
	2	– **S9100-60005 Three-Cable Bundle (Color-Coded)** – Red SMA (m) to TNC (m), 4000 mm (157.5 in) Connect S9101RH **LO/Pwr/Ctrl IF In** to S9101A **LO/Pwr/Ctrl Out**. – **Black** SMA (m) to Type-N (m), 4000 mm (157.5 in) Connect S9101RH **IF In** to S9101A **IF Out**. – White SMA (m) to Type-N (m), 4000 mm (157.5 in) Connect S9101RH **IF In/Out** to S9101A **IF In**.
	1	– **8121-3222 loop-back cable**, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in), Accessory Cable*: Used to connect from **RF Tx/Rx 1** to **RF Tx/Rx 2** on each S9101RH mmWave Transceiver (one at a time).

*This cable is used when verifying operation with software at mmWave frequencies, for example 28 GHz. Disconnect this cable during normal operation. Only one loop-back cable is included with each S9101A-TR2; move this loop-back cable between each S9101RH mmWave Transceiver when verifying operation.





Keysight S9101A-TR2 5G Multi-Band Vector Transceiver on page 40, two-channel configuration, consists of two RF transceivers and two mmWave transceivers providing two channels of Tx and Rx capabilities. Each channel of Tx and Rx operates in one frequency range at a time:

- FR1 frequencies ranging from 380 MHz to 6 GHz
- or FR2 banded mmWave frequencies from 24.25 to 43.5 GHz

5 Install Software

NOTE If a standard configuration that includes the M9037A PXIe Embedded Controller was ordered, all needed software should have come pre-installed; proceed to Verify Operation on page 45.

6 Verify Operation

NOTE **All of the previous sections must be completed before verifying operation of the Keysight S9101A 5G Multi-Band Vector Transceiver.**

In this section...

Verify Operation by performing the following:

1. Powering on the S9101A
   - The M9037A PXIe Embedded Controller and the M9300A PXIe Reference are part of the S9101A; they both power on and initialize automatically when the S9101A is powered on.

2. Verifying X-Apps Software Controls the S9101A on page 46
   - Verify the X-Apps Software Controls the S9101A at 3 GHz on page 46
   - Verify the X-Apps Software Controls the S9101A at 28 GHz on page 51

6. 1 Verifying X-Apps Software Controls the S9101A

NOTE This process must be repeated for each M9410A and its selected X-Apps software pair in a system.

6. 1. 1 Verify the X-Apps Software Controls the S9101A at 3 GHz

1. Connect an RF loop-back cable from RF In to RF Out connectors on the RF Transceiver, located on the Rugged Front Panel.
   (This loop-back cable is NOT included with the S9101A.)
   - This connection can be made using a cable with two adapters.

     For example, a cable with adapters (or equivalent) can be used:
     one 5063-1530 RF Cable, SMA (m) to SMA (m), 152.4 mm (6.0 in) and
     two 1250-1250 Adapters, SMA (f) to Type-N (m)

RF Transceiver

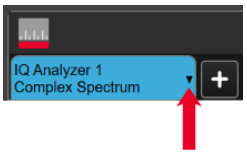
(Zoomed-Out from the Rugged Front Panel)

2. If it is not already running, start the Modular TRX software and review the interface; this interface is referred to as a **Mode:**

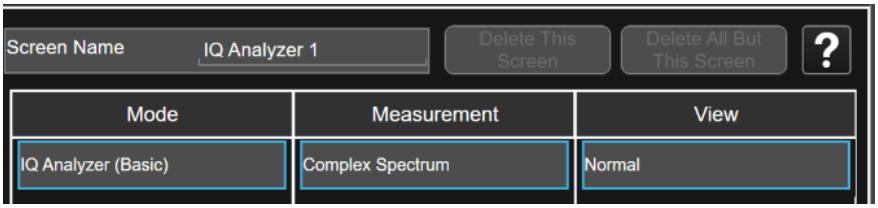
NOTE The Modular TRX interface can be started as follows:
Select the **Start** menu (lower-left corner icon)
> Scroll down to "**K**" applications
> Select the **Keysight Modular Transceiver** drop-down arrow
> Scroll down the list and select **LaunchModularTRX**

   - Each Mode looks different and has its own collection of measurement capabilities, controls, windows, and SCPI commands.
   - Each Mode runs within a screen (there can be multiple screens).
   - Screens are shown as tabs across the top of the interface.
     IQ Analyzer (Basic) Mode is included with the S9101A and appears as a tab with the label **IQ Analyzer 1**.

3. Select the **IQ Analyzer 1** drop-down selector.

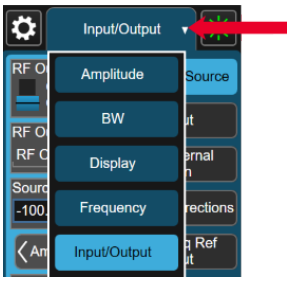


4. Set the **Mode / Measurement / View** for IQ Analyzer 1:

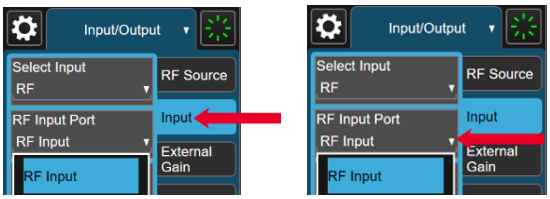


   a. Select **Mode** as **IQ Analyzer (Basic)**.
   b. Select **Measurement** as **Complex Spectrum**.
   c. Select **View** as **Normal**.
   d. Select **OK**.

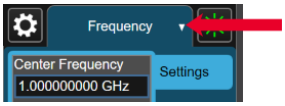
5. Set the **RF Input** to 3 GHz; this is the RF In port on the Rugged Front Panel.
   a. Select the drop-down menu panel (top-right corner) and select **Input/Output**.



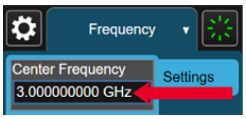
   b. Select the **Input** tab, select the **RF Input Port** drop-down menu, and select **RF Input**.



   c. Select the drop-down menu panel (top-right corner) and select **Frequency**.

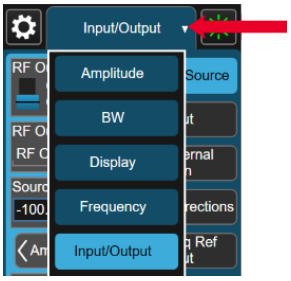


d. Select the **Frequency** entry box and set it to **3 GHz**.

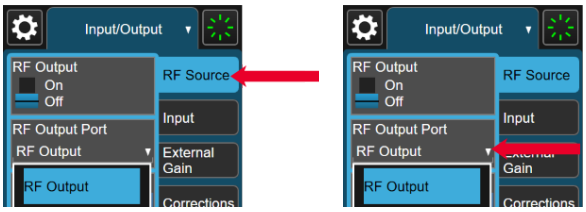


e. Leave all of the other RF Input Port settings in their preset state.

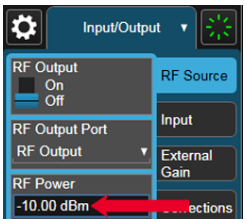
6. Set the **RF Output** to 3 GHz; this is the RF Out port on the Rugged Front Panel.
   a. Select the drop-down menu panel (top-right corner) and select **Input/Output**.



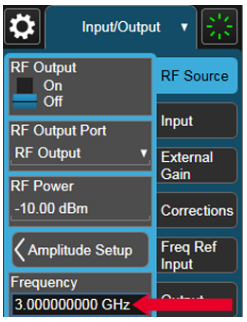
   b. Select the **RF Source** tab, select the **RF Output Port** drop-down menu, and set it to **RF Output**.



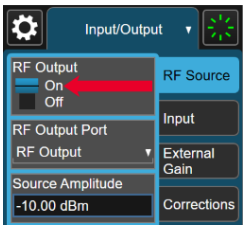
   c. Select the **RF Power** entry box and set it to **–10 dBm**.



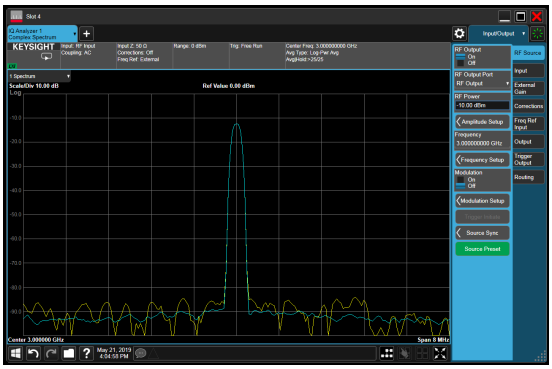
   d. Select the **Frequency** entry box and set it to **3 GHz**.



   e. Select the **RF Output On/Off** switch and set it to **On**.



7. Verify **IQ Analyzer (Basic)** Mode displays a signal at 3 GHz and –10 dBm.



   a. Select the drop-down menu panel (top-right corner) and select **Peak Search**.

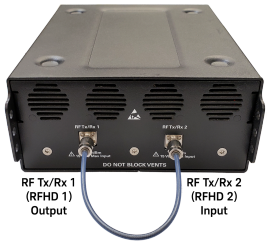
      – If there is a signal at 3 GHz and approximately –10 dBm, the RF Transceiver RF Input and RF Output ports of the S9101A are working properly. (The power level is only approximate because there is loss in the cable being used and this loss is not being corrected during the measurement.)

8. On S9101A-TR2 systems, repeat the same process on RF Transceiver 2.

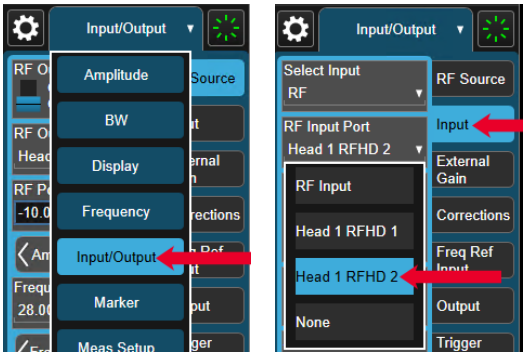
6. 1. 2 Verify the X-Apps Software Controls the S9101A at 28 GHz

1. Connect a loop-back cable from RF Tx/Rx 1 to RF Tx/Rx 2 connectors on the S9101RH mmWave Transceiver.

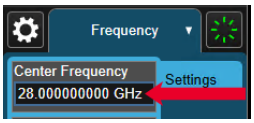
   One **8121-3222 loop-back cable**, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in), is included with each S9101A Option TR1 or Option TR2.



2. Set the **RF Tx/Rx 2** (Head 1 RFHD 2) to 28 GHz; this port can be thought of as the RF Input (Receiver or Analyzer port) on the S9101RH mmWave Transceiver.
   a. Select the drop-down menu panel (top-right corner) and select **Input/Output**, select the **Input** tab, select the **RF Input Port** drop-down menu, and set it to **Head 1 RFHD 2**.

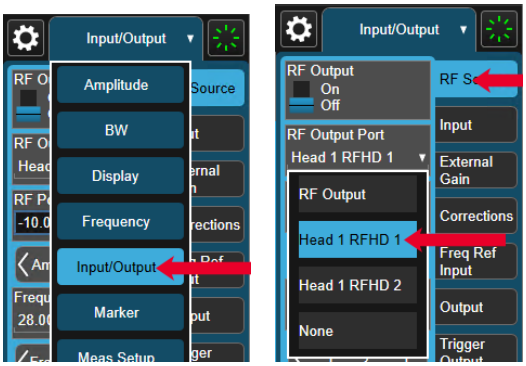


   b. Select the drop-down menu panel (top-right corner) select **Frequency**, select the **Center Frequency** entry box, and set it to **28 GHz**.

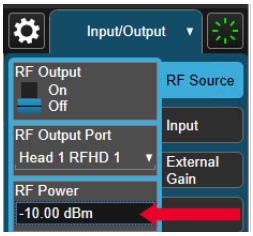


   c. Leave all of the other Input port settings in their preset state.

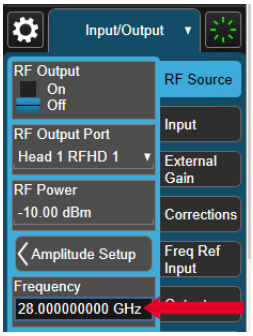
3. Set the **RF Tx/Rx 1** (Head 1 RFHD 1) to 28 GHz; this port can be thought of as the RF Output (RF Source port) on the S9101RH mmWave Transceiver.
    a. Select the drop-down menu panel (top-right corner) and select **Input/Output**, select the **RF Source** tab, select the **RF Output Port** drop-down menu, and select **Head 1 RFHD 1**.



    b. Select the **RF Power** entry box and set it to **–10 dBm**.

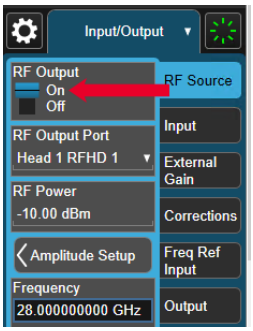


    c. Select the **Frequency** entry box and set it to **28 GHz**.



    d. Leave all of the other RF Output port settings in their preset state.

e. Select the **RF Output On/Off** switch and set it to **On**.



4. Verify **IQ Analyzer (Basic)** Mode displays a signal at 28 GHz and –10 dBm.

a. Select the drop-down menu panel (top-right corner) and select **Peak Search**.

- If there is a signal at 28 GHz and approximately –10 dBm, the RF Tx/Rx 1 and RF Tx/Rx 2 ports of the S9101A are working properly. (The power level is only approximate because there is loss in the cable being used and this loss is not being corrected during the measurement.)

5. On S9101A-TR2 systems, repeat the same process on each S9101RH, but with Head 2 used in place of Head 1; for example, RF Tx/Rx 2 (Head 2 RFHD 2) and RF Tx/Rx 1 (Head 2 RFHD 1).

7 Run Power Calibration

Before running Power Calibration on mmWave ports, review the following:

1. Review Power Calibration Conditions on page 56
2. Review Power Calibration Equipment Required on page 57
3. Review Power Calibration Connectors (Ports 1 to 6) on page 58

How to proceed...

4. Run S910xA System Calibration Software on page 60
5. Connect Equipment
   See Using the Equipment Tab on page 61
6. Perform Alignments
   See Using X-Apps to Perform Alignments on page 71
7. Perform Calibration
   See Using the Power Calibration Tab on page 72

7.1 Power Calibration Conditions

CAUTION All needed alignments and calibrations were performed at the factory before this S9101A system was shipped.

- Power Calibration on mmWave ports should be performed at least once a week to correct for drift caused by temperature or humidity changes.
- If additional calibrations are required, contact Keysight Support; see Returning for Service on page 22.

NOTE Before running Power Calibration on mmWave ports, confirm that all of the following conditions are met; these same conditions are also described in the Keysight S9101A Data Sheet, 7120-1254EN.

- S9101A system performance is valid for an ambient temperature of 25°C unless otherwise noted
- S9101A system is within its recommended calibration cycle of one year (described in the Data Sheet under "General Performance")
- S9101A system has been stored at an ambient temperature within the allowed operating range for at least two hours before being powered on
- S9101A system has been powered on continuously for at least two hours warm-up time, with IQ Analyzer or X-Series application (e.g. 5G NR) running and the M1740A mmWave Transceiver powered on (verify that LEDs are on)

  Depending on environmental conditions, longer warm-up time (up to 24 hours) may lead to more stable results. If the system met these warm-up time requirements and there is a brief power shutdown, such as a system reboot, allow 45 minutes of warm-up time after the system is powered back on.
- "Align Now All" alignments have been run in the M9410A PXIe VXT module, and performed at least once within the previous seven days, after warm-up period; see Using X-Apps to Perform Alignments on page 71
- A "Fast Alignment" has been run within the previous eight hours and again if the temperature has changed more than 5°C from when the previous "Fast Alignment" was performed
- Amplitude accuracy characteristics apply after calibration has been performed in the current environment and humidity has not changed by more than ±10%.

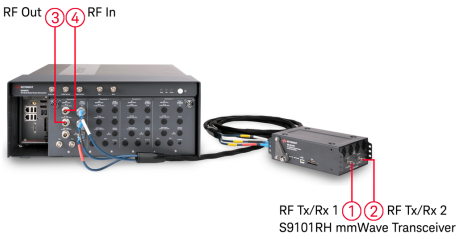
7. 2 Power Calibration Equipment Required

Keysight Equipment	Purpose
U8487A 10 MHz to 50 GHz USB Thermocouple Power Sensor or equivalent (Alternates) N8487A 50 MHz to 50 GHz Thermocouple Power Sensor with: N1913A or N1914A.	Power Sensor with built-in calibration.
8121-3222 cable, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in) or equivalent One of these loop-back cables are included with each S9101A standard configuration.	This loop-back cable can be connected from RF Tx/Rx 1 to RF Tx/Rx 2 (source to receiver) on the S9101RH mmWave Transceiver only when testing for operation; during normal use, this loop-back cable is removed.
11900B adapter, 2.4 mm (f) to 2.4 mm (f) or equivalent	This adapter is used to connect the U8487A Power Sensor or equivalent to the end of the loop-back cable (described above) that is used during Cable signal path calibration. It can also be used to connect two 2.4 mm (m) to (m) cables during Receiver (Rx) signal path calibration.
11903B adapter, 2.4 mm (f) to Type-N (f) or equivalent (Alternate) 1250-1472 adapter, Type-N (f) to Type-N (f) can also be used, but with lower accuracy. If an EPM or P-Series power meter is used, this adapter can be used on the power meter for sensor calibration.	This adapter is used to connect two Type-N (m) to (m) cables during Receiver calibration.
11903D adapter, 2.4 mm (f) to Type-N (m) or equivalent	This adapter is used to connect a 2.4 mm (m) to Type-N (f) ports, such as DUT IF and RF ports.
8121-3144 cable, Type-N (m) to Type-N (m), 500 mm (19.7 in) or equivalent	This cable is used to connect source to receiver during Receiver calibration.
1250-1472 adapter, Type-N (f) to Type-N (f) or equivalent	This adapter is used to connect two Type-N (m) to (m) cables during Cable calibration.

7. 3 Power Calibration Connectors (Ports 1 to 6)

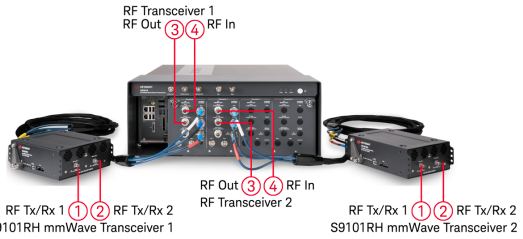
The S9101A system is available in three standard configurations with multiple ports:

S9101A-TR1 5G Multi-Band Vector Transceiver



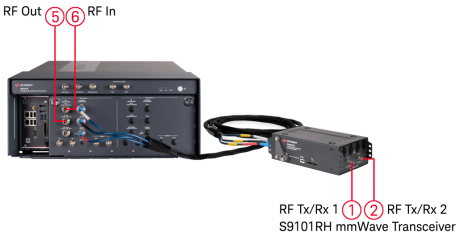
Port Selection	Hardware Calibration Paths...	Ports
`RRH 1 RFHD 1 -> RRH 1 RFHD 2`	RRH 1 RFHD 1 -> RRH 1 RFHD 2	1, 2
`RRH 1 RFHD 2 -> RRH 1 RFHD 1`	RRH 1 RFHD 2 -> RRH 1 RFHD 1	2, 1
`RF Output -> RF Input`	RF Transceiver	3, 4

S9101A-TR2 5G Multi-Band Vector Transceiver



Port Selection	Hardware Calibration Paths...	Ports
`RRH 1 RFHD 1 -> RRH 1 RFHD 2`	RRH 1 RFHD 1 -> RRH 1 RFHD 2	1, 2
`RRH 1 RFHD 2 -> RRH 1 RFHD 1`	RRH 1 RFHD 2 -> RRH 1 RFHD 1	2, 1
`RF Output -> RF Input`	RF Transceiver 1	3, 4
`RRH 1 RFHD 1 -> RRH 1 RFHD 2`	RRH 1 RFHD 1 -> RRH 1 RFHD 2	1, 2
`RRH 1 RFHD 2 -> RRH 1 RFHD 1`	RRH 1 RFHD 2 -> RRH 1 RFHD 1	2, 1
`RF Output -> RF Input`	RF Transceiver 2	3, 4

S9101A-BK1 5G Multi-Band Vector Transceiver TR1 with Blocker



Port Selection	Hardware Calibration Paths...	Ports
`RRH 1 RFHD 1 -> RRH 1 RFHD 2`	RRH 1 RFHD 1 -> RRH 1 RFHD 2	1, 2
`RRH 1 RFHD 2 -> RRH 1 RFHD 1`	RRH 1 RFHD 2 -> RRH 1 RFHD 1	2, 1
`RF Output -> RF Input`	RF Transceiver with a Blocker	5, 6

NOTE

If calibration is required for ports `RF Output -> RF Input`, contact Keysight Support; see Returning for Service on page 22.

CAUTION All needed alignments and calibrations were performed at the factory before this S9101A system was shipped.

- Power Calibration on mmWave ports should be performed at least once a week to correct for drift caused by temperature or humidity changes.
- If additional calibrations are required, contact Keysight Support; see Returning for Service on page 22.

- **All** S9101A-TR1 standard configurations have mmWave ports and RF ports:

  S9101RH mmWave Transceiver has ports RF Tx/Rx 1 ① and RF Tx/Rx 2 ②
  These ports can be calibrated when the Port Selection drop-down is set to one of the following:

  ```
  RRH 1 RFHD 1 -> RRH 1 RFHD 2
  RRH 1 RFHD 2 -> RRH 1 RFHD 1
  ```

  RF Transceiver has ports RF Out ③ and RF In ④
  All alignments and calibrations were performed for these ports at the factory.

- **All** S9101A-BK1 standard configurations have mmWave ports and RF ports:

  S9101RH mmWave Transceiver has ports RF Tx/Rx 1 ① and RF Tx/Rx 2 ②
  These ports can be calibrated when the Port Selection drop-down is set to one of the following:

  ```
  RRH 1 RFHD 1 -> RRH 1 RFHD 2
  RRH 1 RFHD 2 -> RRH 1 RFHD 1
  ```

  RF Transceiver has ports RF Out ⑤ and RF In ⑥
  All alignments and calibrations were performed for these ports at the factory.

- **All** S9101A-TR2 standard configurations have two sets of mmWave ports and two sets of RF ports:

  S9101RH mmWave Transceiver 1 has ports RF Tx/Rx 1 ① and RF Tx/Rx 2 ②
  These ports can be calibrated when the Port Selection drop-down is set to one of the following:

  ```
  RRH 1 RFHD 1 -> RRH 1 RFHD 2
  RRH 1 RFHD 2 -> RRH 1 RFHD 1
  ```

  RF Transceiver 1 has ports RF Out ③ and RF In ④
  All alignments and calibrations were performed for these ports at the factory.

  S9101RH mmWave Transceiver 2 has ports RF Tx/Rx 1 ① and RF Tx/Rx 2 ②
  These ports can be calibrated when the Port Selection drop-down is set to one of the following:

  ```
  RRH 1 RFHD 1 -> RRH 1 RFHD 2
  RRH 1 RFHD 2 -> RRH 1 RFHD 1
  ```

  RF Transceiver 2 has ports RF Out ③ and RF In ④
  All alignments and calibrations were performed for these ports at the factory.

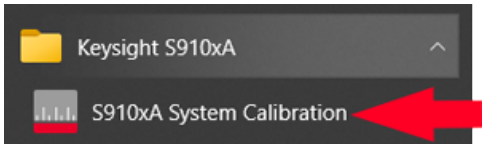
7. 4 Run S910xA System Calibration Software

Once S910xA System Calibration has been installed, a shortcut can be found in the Windows Start menu. S910xA System Calibration can also be started by navigating to the installation folder: `C:\Program Files\Keysight\S9100A\System Calibration` and running `S9100A System Calibration.exe`

If it is not already running, start S910xA System Calibration:

NOTE

S910xA System Calibration can be started as follows:
Select the Start menu (lower-left corner icon)
> Scroll down to "K" applications
> Select the Keysight S910xA drop-down arrow
> Scroll down the list and select S910xA System Calibration



The following tabs are available in S910xA System Calibration software:

Equipment

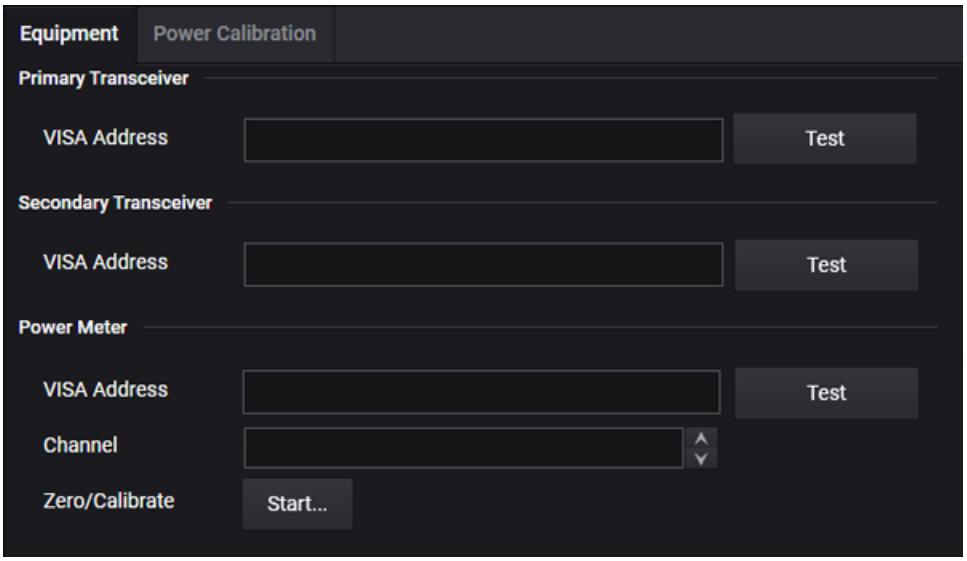
Using the Equipment Tab on page 61
to enter VISA Address and hislip socket number "Connection Strings" for all equipment used during Power Calibration.

Power Calibration

Using the Power Calibration Tab on page 72
to provide an accurate power level at each mmWave Transceiver input and output port.

7. 4. 1 Using the Equipment Tab

This section describes how the Equipment tab is used to set VISA Address and hislip socket number "Connection Strings" for a Primary Transceiver, Secondary Transceiver, and a Power Meter (Power Sensor).



`Primary Transceiver` and `Secondary Transceiver`

`VISA Address`

These `VISA Address` entry boxes accept "Connection Strings" for a `Primary Transceiver` (1st M9410A PXIe VXT) and a `Secondary Transceiver` (2nd M9410A PXIe VXT); only used in an S9101A-BK1 5G Multi-Band Vector Transceiver TR1 with Blocker.

"Connection Strings" differ depending on whether the Power Calibration is run on an embedded controller (local host) or an external controller (remote host); when run on an:

embedded controller (local host),

the "Connection String" should include a local host `hislip` socket; for example, `TCPIP0::localhost::hislip0::INSTR`
The default embedded controller (local host), is an M9037A PXIe Embedded Controller which is located in Slot-1 of the chassis containing the PXIe modules.

external controller (remote host),

the "Connection String" should include the name of the external controller (remote host);
for example, `TCPIP0::K-M9037A-12345::hislip0::INSTR`
or include the IP address of the external controller (remote host);
for example, `TCPIP0::141.121.XXX.YYY::inst0::INSTR`

`Power Meter (Power Sensor)`

`VISA Address`

This `VISA Address` entry box accepts a "Connection String" for a one or two channel power meter controlled over LAN or a "Connection String" for a USB power sensor controlled over USB; the "Connection String" should contain the IP address;
for example, `TCPIP0::141.121.XXX.YYY::inst0::INSTR`

`Channel`

The `Channel` entry box designates which channel the power sensor is connected to on the power meter.

- On a power meter with two channels, select `1` to use Channel 1 and select `2` to use Channel 2.
- On a power meter with one channel or a USB power sensor, select `1` to use Channel 1.

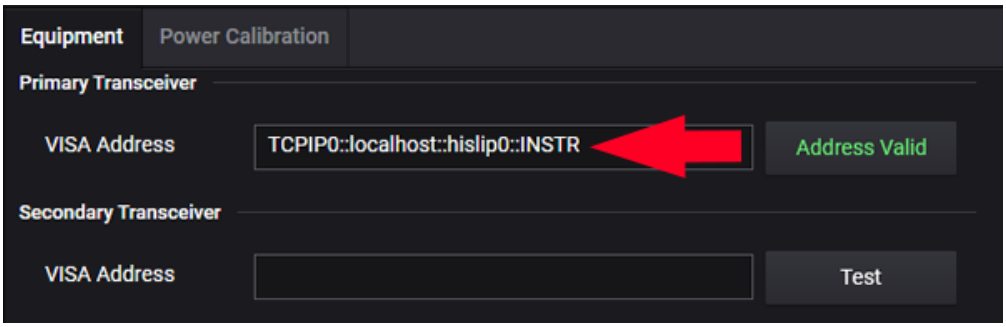
`Zero/Calibrate`

`Start...` is used to calibrate the power meter before use.

7. 4. 1. 1 Connection String Examples for S9101A-TR1

S9101A-TR1 5G Multi-Band Vector Transceiver

using an **embedded controller (local host)**
with one M9410A PXIe VXT as the `Primary Transceiver`,
the "Connection String" should include the name of the
embedded controller (local host):
`Primary Transceiver` `TCPIP0::localhost::hislip0::INSTR`
`Secondary Transceiver` `VISA Address` entry box should remain blank



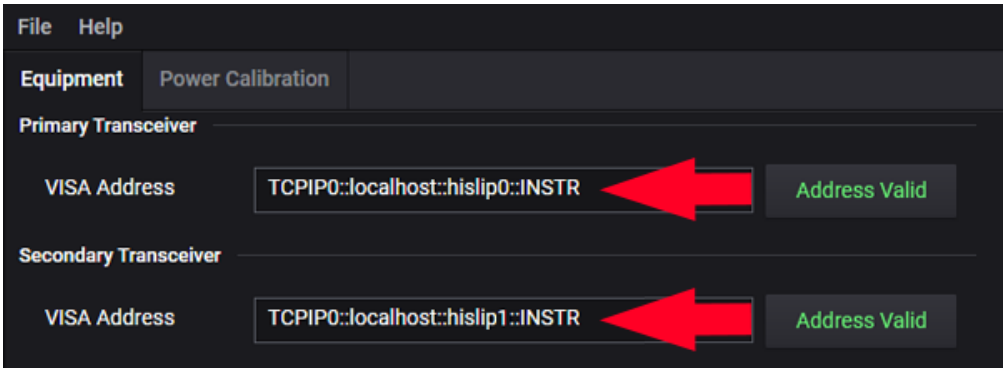
using an **external controller (remote host)**
with one M9410A PXIe VXT as the `Primary Transceiver`,
the "Connection String" should include the name of the
external controller (remote host):
`Primary Transceiver` `TCPIP0::K-M9037A-12345::hislip0::INSTR` or
`Primary Transceiver` `TCPIP0::141.121.XXX.YYY::inst0::INSTR`
`Secondary Transceiver`: `VISA Address` entry box should remain blank

7. 4. 1. 2 Connection String Examples for S9101A-BK1

S9101A-BK1 5G Multi-Band Vector Transceiver TR1 with Blocker

using an **embedded controller (local host)**
with one M9410A PXIe VXT as the `Primary Transceiver`
and one M9410A PXIe VXT as the `Secondary Transceiver`,
the "Connection String" should include the name of the embedded controller (local host):

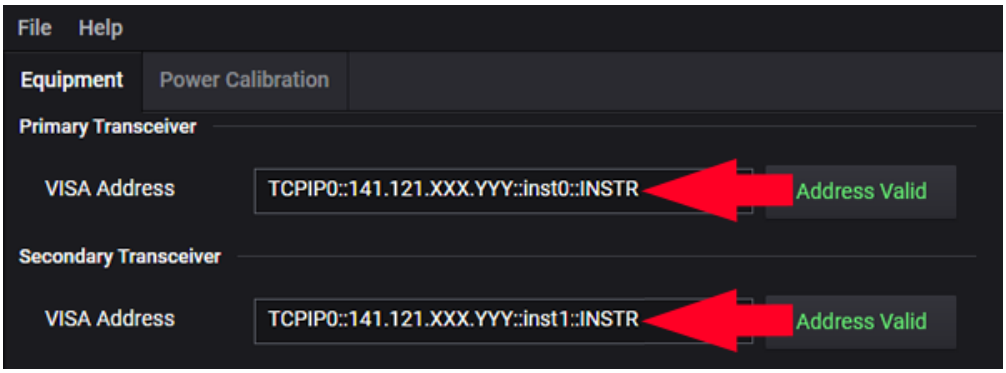
```
Primary Transceiver    TCPIP0::localhost::hislip0::INSTR
Secondary Transceiver  TCPIP0::localhost::hislip1::INSTR
```



using an **external controller (remote host)**
with one M9410A PXIe VXT as the `Primary Transceiver`
and one M9410A PXIe VXT as the `Secondary Transceiver`,
the "Connection String" should include the name of the external controller (remote host):

```
Primary Transceiver    TCPIP0::K-M9037A-12345::hislip0::INSTR  or
Primary Transceiver    TCPIP0::141.121.XXX.YYY::inst0::INSTR

Secondary Transceiver  TCPIP0::K-M9037A-12345::hislip1::INSTR  or
Secondary Transceiver  TCPIP0::141.121.XXX.YYY::inst1::INSTR
```



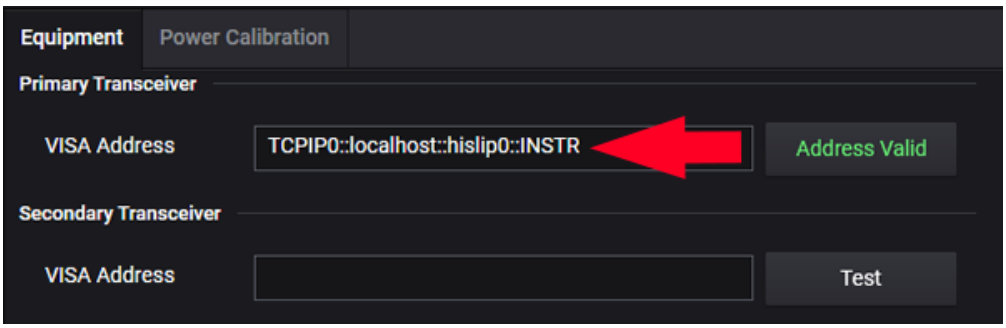
7. 4. 1. 3 Connection String Examples for S9101A-TR2

S9101A-TR2 5G Multi-Band Vector Transceiver

using an **embedded controller (local host)**
with **two** M9410A PXIe VXTs as the `Primary Transceivers`,
one separate `Primary Transceiver` for each channel which requires a unique VISA Address for each VXT:

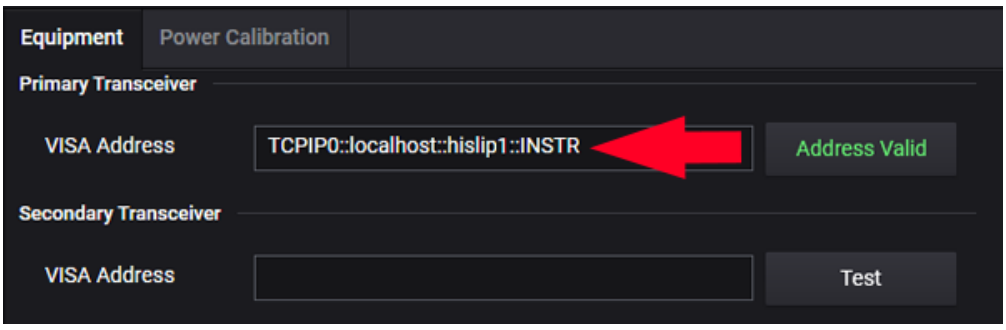
the "Connection String" should include the name of the embedded controller (local host):

`Primary Transceiver 1` `TCPIP0::localhost::hislip0::INSTR`
`Secondary Transceiver` `VISA Address` entry box should remain blank



NOTE Perform all calibrations on `Primary Transceiver 1` used for channel 1 before calibrating `Primary Transceiver 2` used for channel 2.

`Primary Transceiver 2` `TCPIP0::localhost::hislip1::INSTR`
`Secondary Transceiver` `VISA Address` entry box should remain blank



using an **external controller (remote host)**
with **two** M9410A PXIe VXTs as the `Primary Transceivers`,
one separate `Primary Transceiver` for each channel which requires a unique VISA Address for each VXT:

the "Connection String" should include the name of the external controller (remote host):

`Primary Transceiver 1` `TCPIP0::K-M9037A-12345::hislip0::INSTR` or
`Primary Transceiver 1` `TCPIP0::141.121.XXX.YYY::inst0::INSTR`
`Secondary Transceiver`: `VISA Address` entry box should remain blank

NOTE Perform all calibrations on `Primary Transceiver 1` used for channel 1 before calibrating `Primary Transceiver 2` used for channel 2.

`Primary Transceiver 2` `TCPIP0::K-M9037A-12345::hislip1::INSTR` or
`Primary Transceiver 2` `TCPIP0::141.121.XXX.YYY::inst1::INSTR`
`Secondary Transceiver` `VISA Address` entry box should remain blank

7. 4. 1. 4 Using Keysight Connection Expert to Retrieve VISA Addresses

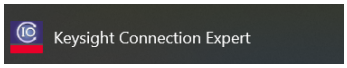
Keysight Connection Expert[1] can be used to retrieve the "Connection Strings" for the Primary Transceiver, Secondary Transceiver, and the Power Meter (Power Sensor).

To open Keysight Connection Expert

On Windows desktop:

1. Select the **Start** menu (lower-left corner icon) and a list of applications appear in alphabetical order.
2. Select any letter, such as "A", from this list of applications and a selection menu should appear.
3. Select the letter "K" from this selection menu.
4. Scroll down the list of "K" applications that appear and select **Keysight Connection Expert**.

This runs the `ConnectionExpert.exe` located at: `C:\Program Files\Keysight\IO Libraries Suite`

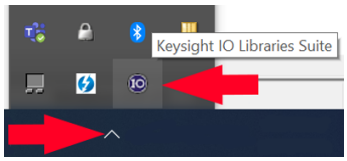


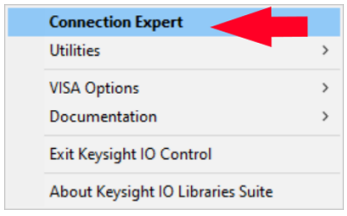
NOTE Keysight Connection Expert can also be started from the tray icon.

a. Select the tray icon.

b. Select the IO icon (Keysight IO Libraries Suite).

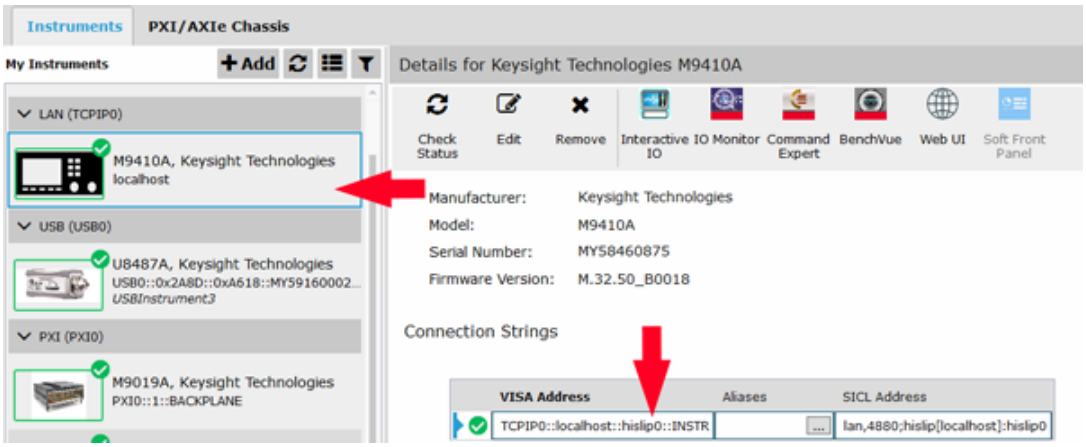
c. Select **Connection Expert**.





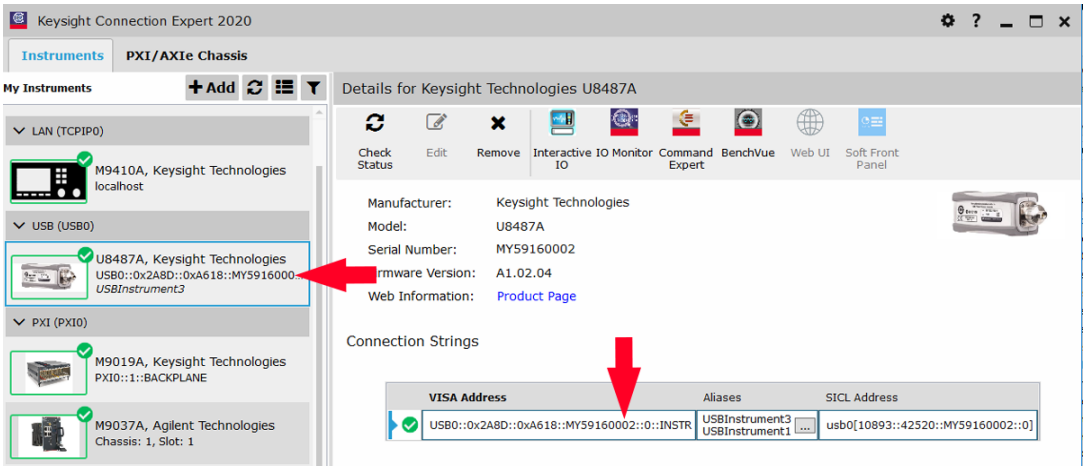
[1] Keysight Connection Expert is a utility of Keysight IO Libraries that helps connect instruments and display their status as determined by the Keysight Instrument Discovery Service.

To retrieve and set the VISA Address of the Primary or Secondary Transceiver



1. Open **Keysight Connection Expert**.
2. Select the **Instruments** tab.
    a. On the left side of the dialog box, from the list of LAN instruments, select the **M9410A, Keysight Technologies** `localhost`.
    b. On the right side of the dialog box, under "Connection Strings", highlight the VISA Address to be used on the S910xA System Calibration dialog **Equipment** tab.
    c. On the S910xA System Calibration dialog, select the **Equipment** tab.
    d. Once the VISA Address has been entered, verify connectivity by clicking **Test** located next to the VISA Address **entry box**; Address Valid is displayed on a button if the address connects properly.

To retrieve and set the VISA Address of the Power Meter (Power Sensor)

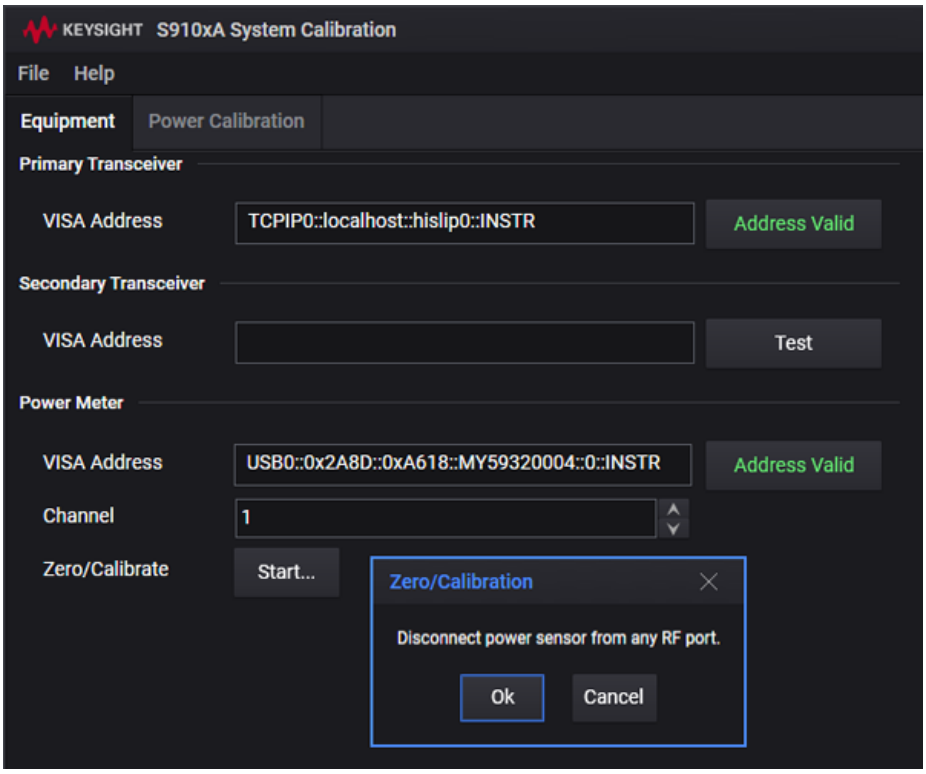


1. Open **Keysight Connection Expert**.
2. Select the **Instruments** tab.
   a. On the left side of the dialog box, from the list of USB instruments, select the **U8487A Power Sensor or equivalent**.
   b. On the right side of the dialog box, under "Connection Strings", highlight the VISA Address of the Power Sensor and select Ctrl-C (to copy the VISA Address to the Clipboard); this should be of the form: `USB0::0x2A8D::0xA618::MY59160002::0::INSTR`

   c. Open the S910xA System Calibration dialog, select the **Equipment** tab, click the VISA Address entry box, and type Ctrl-V (to paste the VISA Address from the Clipboard).

   d. Once the VISA Address has been entered, verify connectivity by clicking the **Test** button located next to the entry box; Address Valid is displayed on a button if the address connects properly.

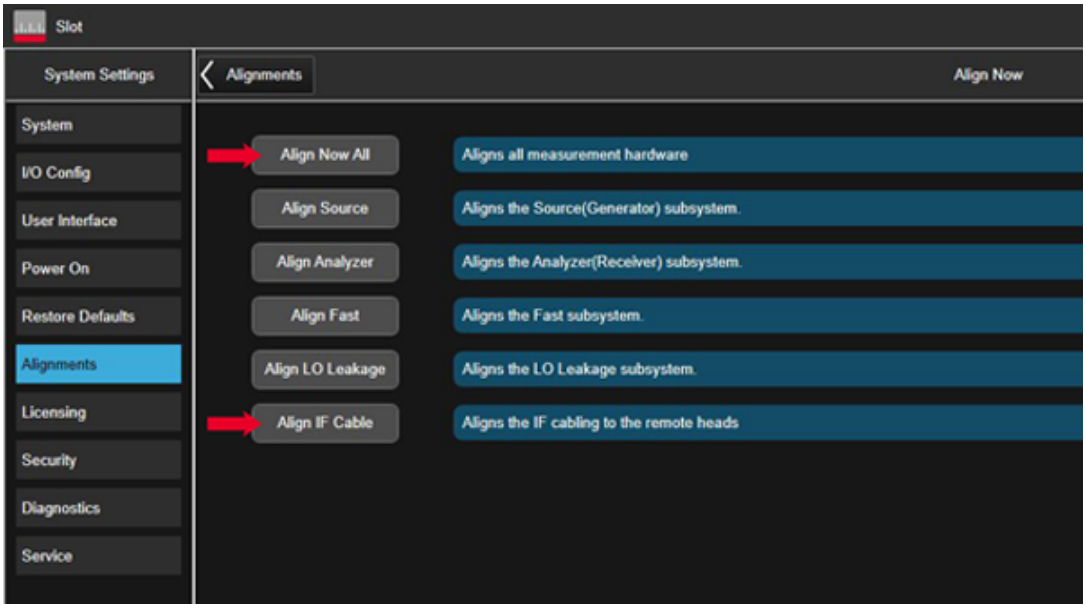
e. (Optional) Before use, Zero/Calibrate the Power Sensor by clicking **Start**.



NOTE Disconnect the power sensor from any RF ports; the zero/calibration will not be valid if any power is connected during the zero/calibration process.

7. 4. 2 Using X-Apps to Perform Alignments

NOTE All alignments must be performed before Power Calibration.



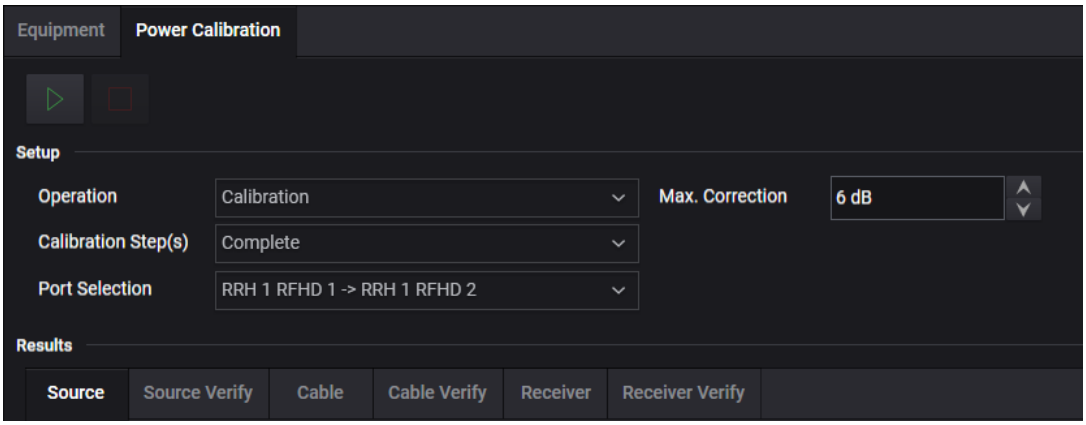
1. If it is not already running, start the Modular TRX interface:

   NOTE The Modular TRX interface can be started as follows:
   Select the **Start** menu (lower-left corner icon)
   > Scroll down to "**K**" applications
   > Select the **Keysight Modular Transceiver** drop-down arrow
   > Scroll down the list and select **LaunchModularTRX**

2. Select the **settings** icon (top right corner of the display).
3. Select **Alignments** (all alignments must be performed before calibrations).
   a. Select **Align Now All**.
   b. Select **Align IF Cable**.

7. 4. 3 Using the Power Calibration Tab

This section describes how the Power Calibration tab is used to provide an accurate power level at each mmWave Transceiver input and output port.



NOTE

- The calibrations to be run depend on the standard configuration being calibrated: S9101A-TR1, S9101A-BK1, or S9101A-TR2
- All alignments must be run before Power Calibrations. (See Using X-Apps to Perform Alignments on page 71.)

Power Calibrations

- If the standard configuration being calibrated is an:
  S9101A-TR1 5G Multi-Band Vector Transceiver, perform:
  a. Calibration 1 of 2: Power from RRH 1 RFHD 1 -> RRH 1 RFHD 2 on page 73
  b. Calibration 2 of 2: Power from RRH 1 RFHD 2 -> RRH 1 RFHD 1 on page 76
- If the standard configuration being calibrated is an:
  S9101A-BK1 5G Multi-Band Vector Transceiver TR1 with Blocker, perform:
  a. Calibration 1 of 2: Power from RRH 1 RFHD 1 -> RRH 1 RFHD 2 on page 79
  b. Calibration 2 of 2: Power from RRH 1 RFHD 2 -> RRH 1 RFHD 1 on page 82
- If the standard configuration being calibrated is an:
  S9101A-TR2 5G Multi-Band Vector Transceiver, perform:
  a. Calibration 1 of 4: Power from RRH 1 RFHD 1 -> RRH 1 RFHD 2, Transceiver 1 on page 85
  b. Calibration 2 of 4: Power from RRH 1 RFHD 2 -> RRH 1 RFHD 1, Transceiver 1 on page 88
  c. Calibration 3 of 4: Power from RRH 1 RFHD 1 -> RRH 1 RFHD 2, Transceiver 2 on page 91
  d. Calibration 4 of 4 Power from RRH 1 RFHD 2 -> RRH 1 RFHD 1, Transceiver 2 on page 94

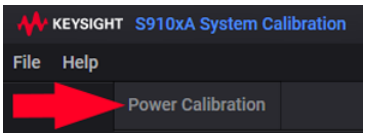
7. 4. 3. 1 Calibrating S9101A-TR1

Calibration 1 of 2: Power from RRH 1 RFHD 1 -> RRH 1 RFHD 2

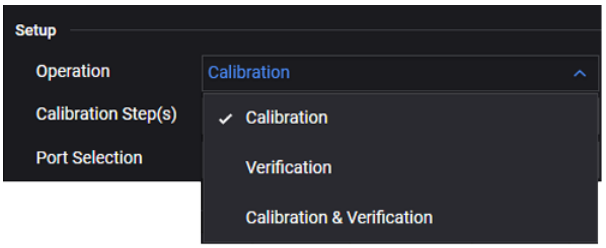
NOTE This calibration is used to calibrate the FR2 mmWave ports of the mmWave Transceiver (with RF Tx/Rx 1 ① used as the RF Output) on an S9101A-TR1 5G Multi-Band Vector Transceiver.

When performing this Power Calibration, the Source (Tx) output power level is set to -5 dBm by default.

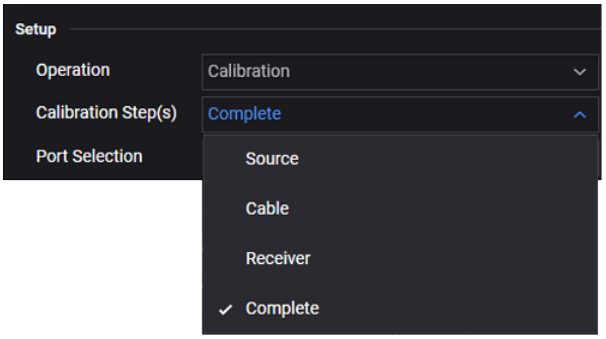
1. Calibrate the Source (Tx) signal path
   a. Select the **Power Calibration** tab.



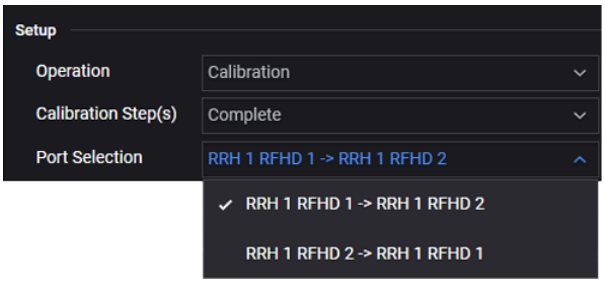
   b. Select the **Operation** drop-down arrow and select `Calibration`.



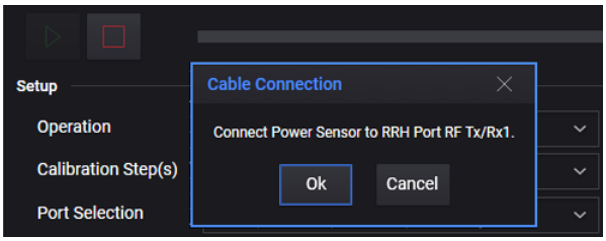
   c. Select the **Calibration Step(s)** drop-down arrow and select `Complete`.



d. Select the **Port Selection** drop-down arrow and select `RRH 1 RFHD 1 -> RRH 1 RFHD 2`.



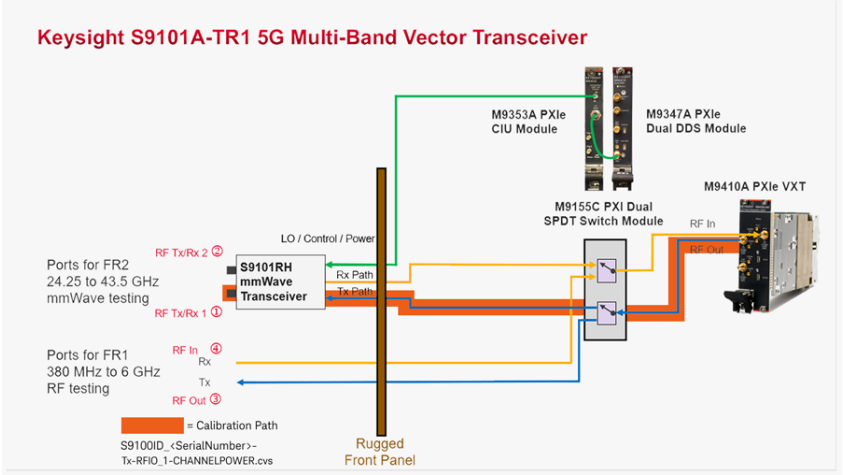
e. Select `Start the calibration` and follow the prompts.



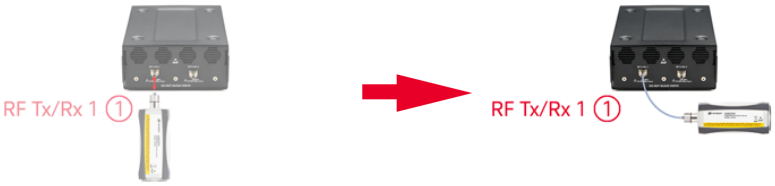
f. Connect the U8487A Power Sensor or equivalent to S9101RH mmWave Transceiver connector RF Tx/Rx 1 ①.

g. Select `Ok` to continue the calibration.

- View the `Results Source` tab when the calibration is complete.
- Corrections are stored in: `S9100ID_<SerialNumber>-Tx-RFIO_1-CHANNELPOWER.csv`

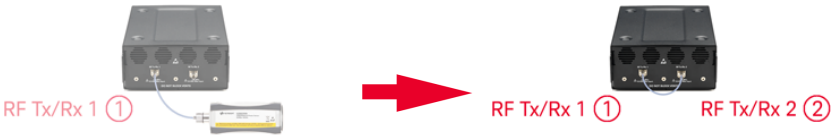


2. Calibrate the Cable signal path
    a. Disconnect the power sensor from the S9101RH mmWave Transceiver connector RF Tx/Rx 1 ①.
    b. Using an 8121-3222 cable, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in) or equivalent, connect one end of the cable to the S9101RH mmWave Transceiver connector RF Tx/Rx 1 ①.
    c. Using an 11900B adapter, 2.4 mm (f) to 2.4 mm (f) or equivalent, connect the U8487A Power Sensor or equivalent to the end of the cable.

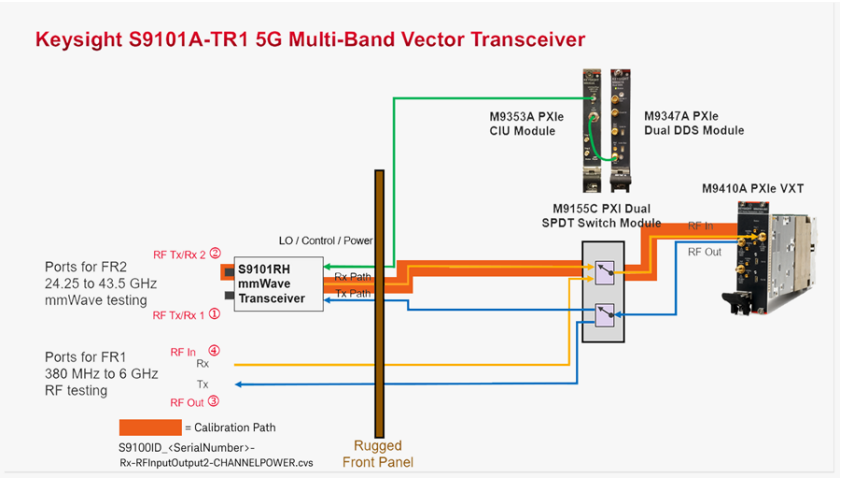


    d. Select `Ok` to continue the calibration.
        - View the `Results Cable` tab when the calibration is complete.

3. Calibrate the Receiver (Rx) signal path
    a. Disconnect the power sensor and adapter from the cable.
    b. Connect the free end of the cable to the S9101RH mmWave Transceiver connector RF Tx/Rx 2 ②.



    c. Select `Ok` to complete the calibration.
        - View the `Results Receiver` tab when the calibration is complete.
        - Corrections are stored in: `S9100ID_<SerialNumber>-Rx-RFInputOutput2-CHANNELPOWER.csv`

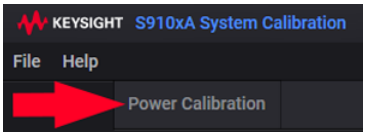


Calibration 2 of 2: Power from RRH 1 RFHD 2 -> RRH 1 RFHD 1

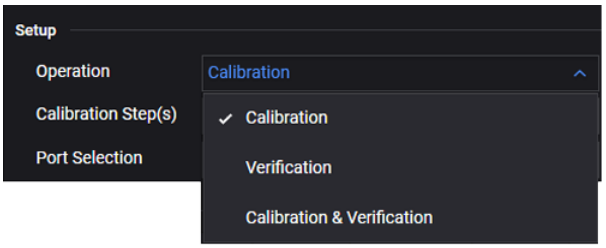
NOTE This calibration is used to calibrate the FR2 mmWave ports of the mmWave Transceiver (with RF Tx/Rx 2 ② used as the RF Output) on an S9101A-TR1 5G Multi-Band Vector Transceiver.

When performing this Power Calibration, the Source (Tx) output power level is set to -5 dBm by default.

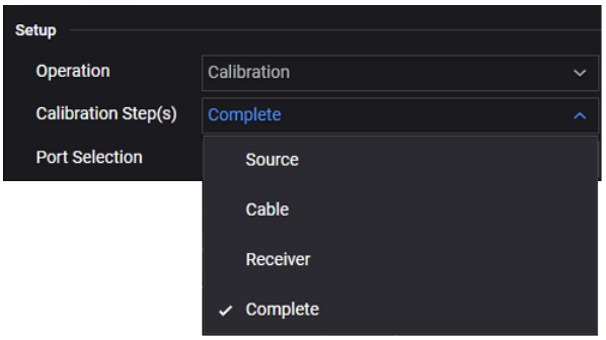
1. Calibrate the Source (Tx) signal path
   a. Select the **Power Calibration** tab.



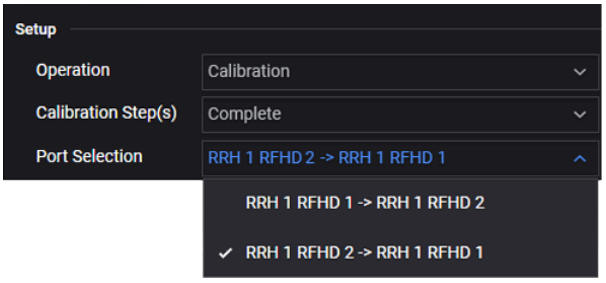
   b. Select the **Operation** drop-down arrow and select `Calibration`.



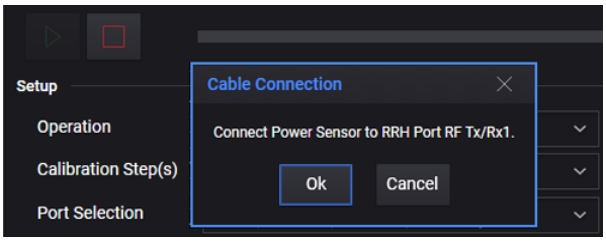
   c. Select the **Calibration Step(s)** drop-down arrow and select `Complete`.



   d. Select the **Port Selection** drop-down arrow and select `RRH 1 RFHD 2 -> RRH 1 RFHD 1`.



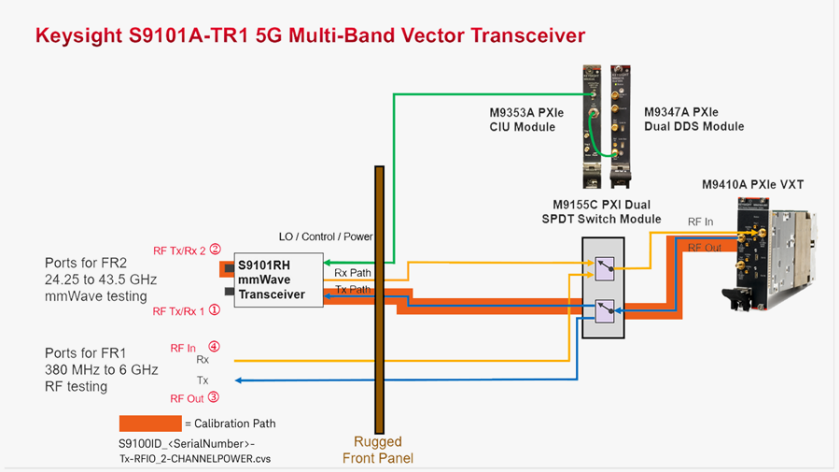
e. Select Start the calibration and follow the prompts.



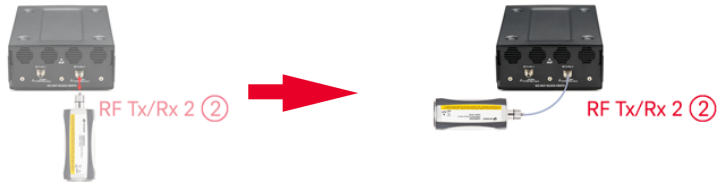
f. Connect the U8487A Power Sensor or equivalent to S9101RH mmWave Transceiver connector RF Tx/Rx 2 ②.

g. Select Ok to continue the calibration.

- View the Results Source tab when the calibration is complete.
- Corrections are stored in: S9100ID_<SerialNumber>-Tx-RFIO_2-CHANNELPOWER.csv

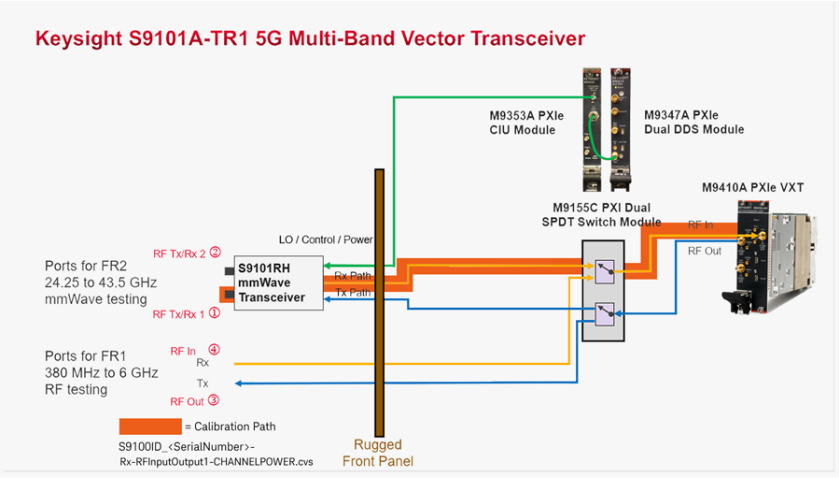


2. Calibrate the Cable signal path
    a. Disconnect the power sensor from S9101RH mmWave Transceiver connector RF Tx/Rx 2 ②.
    b. Using an 8121-3222 cable, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in) or equivalent, connect one end of the cable to the S9101RH mmWave Transceiver connector RF Tx/Rx 2 ②.
    c. Using an 11900B adapter, 2.4 mm (f) to 2.4 mm (f) or equivalent, connect the U8487A Power Sensor or equivalent to the end of the cable.



    d. Select `Ok` to continue the calibration.
        - View the `Results Cable` tab when the calibration is complete.
3. Calibrate the Receiver (Rx) signal path
    a. Disconnect the power sensor and adapter from the cable.
    b. Connect the free end of the cable to the S9101RH mmWave Transceiver connector RF Tx/Rx 1 ①.

    c. Select `Ok` to complete the calibration.
        - View the `Results Receiver` tab when the calibration is complete.
        - Corrections are stored in: `S9100ID_<SerialNumber>-Rx-RFInputOutput1-CHANNELPOWER.csv`



7. 4. 3. 2 Calibrating S9101A-BK1

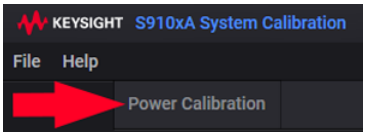
Calibration 1 of 2: Power from RRH 1 RFHD 1 -> RRH 1 RFHD 2

NOTE This calibration is used to calibrate FR2 ports (with RF Tx/Rx 1 ① used as the RF Output) on an S9101A-BK1 5G Multi-Band Vector Transceiver TR1 with Blocker.

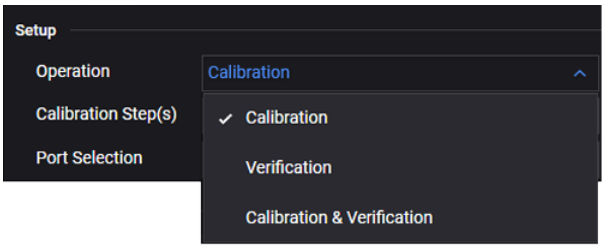
When performing this Power Calibration, the Source (Tx) output power level is set to -5 dBm by default. The power level from M9410A PXIe VXT #1 is calibrated while the RF Output for M9410A PXIe VXT #2 is set to Off.

---

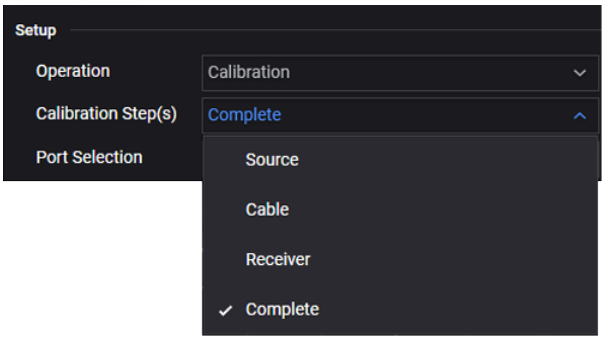
1. Calibrate the Source (Tx) signal path
   a. Select the **Power Calibration** tab.



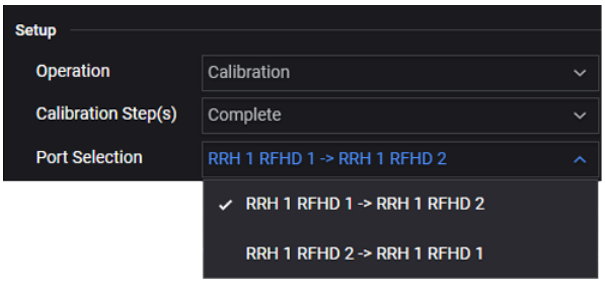
   b. Select the **Operation** drop-down arrow and select `Calibration`.



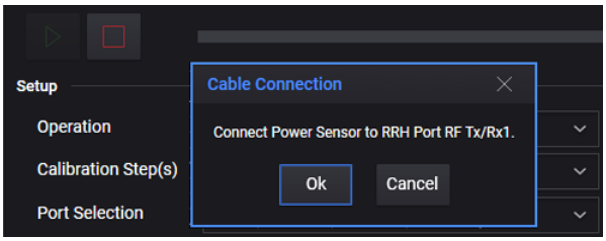
   c. Select the **Calibration Step(s)** drop-down arrow and select `Complete`.



d. Select the **Port Selection** drop-down arrow and select `RRH 1 RFHD 1 -> RRH 1 RFHD 2`.



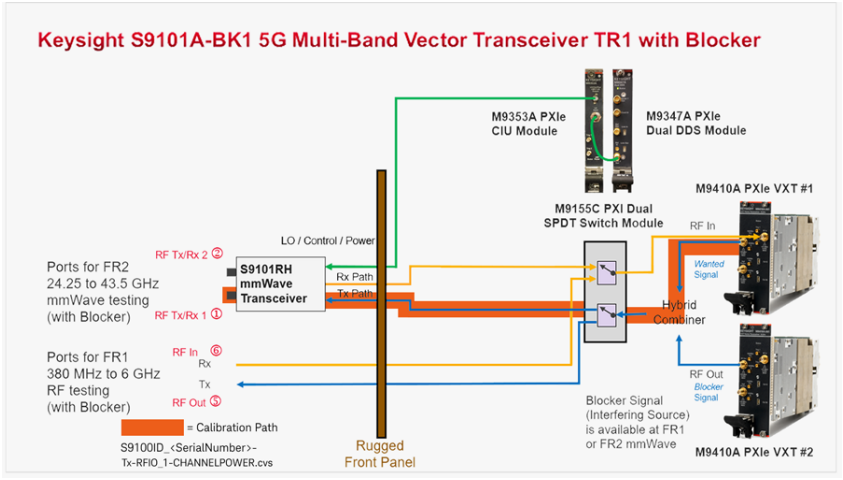
e. Select `Start the calibration` and follow the prompts.



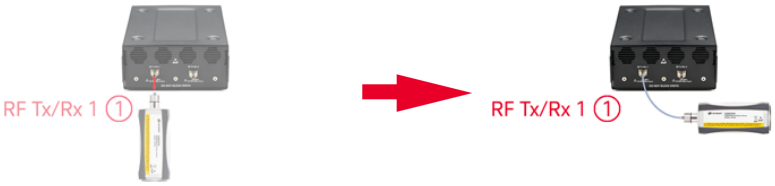
f. Connect the U8487A Power Sensor or equivalent to S9101RH mmWave Transceiver connector RF Tx/Rx 1 ①.

g. Select `Ok` to continue the calibration.

- View the `Results Source` tab when the calibration is complete.
- Corrections are stored in: `S9100ID_<SerialNumber>-Tx-RFIO_1-CHANNELPOWER.csv`

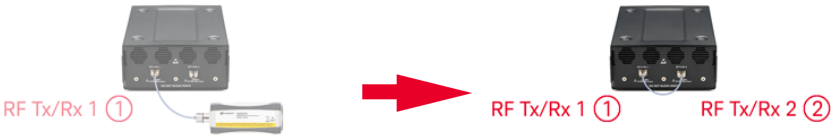


2. Calibrate the Cable signal path
    a. Disconnect the power sensor from S9101RH mmWave Transceiver connector RF Tx/Rx 1 ①.
    b. Using an 8121-3222 cable, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in) or equivalent, connect one end of the cable to S9101RH mmWave Transceiver connector RF Tx/Rx 1 ①.
    c. Using an 11900B adapter, 2.4 mm (f) to 2.4 mm (f) or equivalent, connect the U8487A Power Sensor or equivalent to the end of the cable.

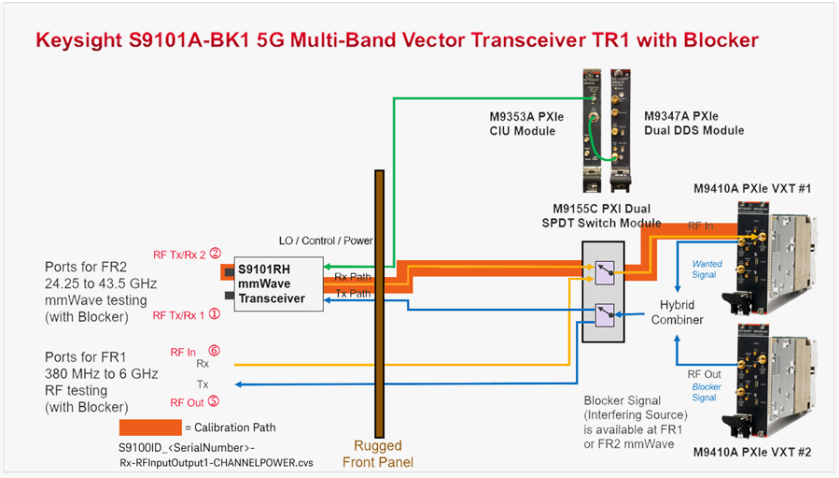


    d. Select `Ok` to continue the calibration.
        - View the `Results Cable` tab when the calibration is complete.

3. Calibrate the Receiver (Rx) signal path
    a. Disconnect the power sensor and adapter from the cable.
    b. Connect the free end of the cable to S9101RH mmWave Transceiver connector RF Tx/Rx 2 ②.



    c. Select `Ok` to complete the calibration.
        - View the `Results Receiver` tab when the calibration is complete.
        - Corrections are stored in: `S9100ID_<SerialNumber>-Rx-RFInputOutput2-CHANNELPOWER.csv`



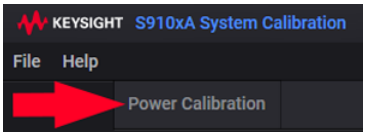
Calibration 2 of 2: Power from RRH 1 RFHD 2 -> RRH 1 RFHD 1

NOTE This calibration is used to calibrate FR2 ports (with RF Tx/Rx 2 ② used as the RF Output) on an S9101A-BK1 5G Multi-Band Vector Transceiver TR1 with Blocker.

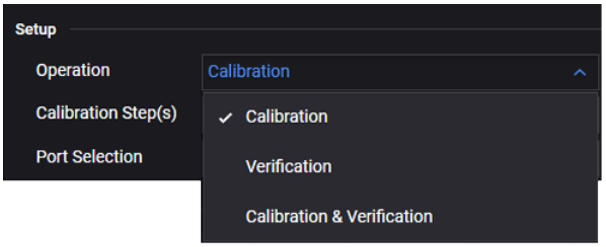
When performing this Power Calibration, the Source (Tx) output power level is set to -5 dBm by default. The power level from M9410A PXIe VXT #1 is calibrated while the RF Output for M9410A PXIe VXT #2 is set to Off.

---

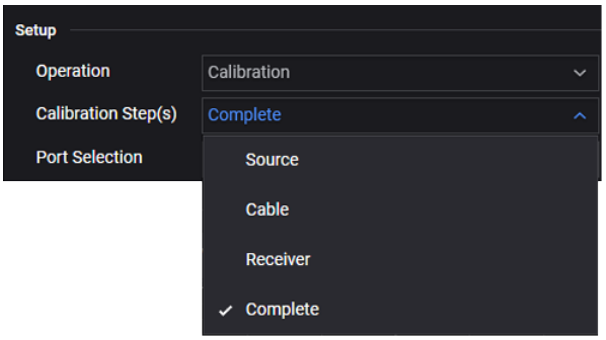
1. Calibrate the Source (Tx) signal path
   a. Select the **Power Calibration** tab.



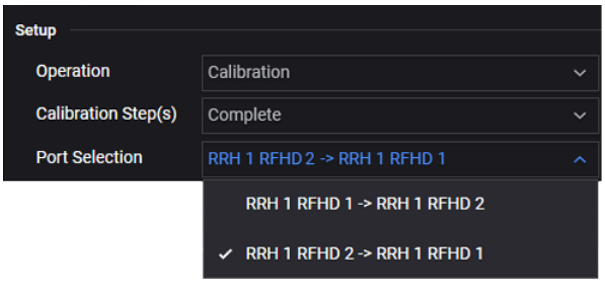
   b. Select the **Operation** drop-down arrow and select `Calibration`.



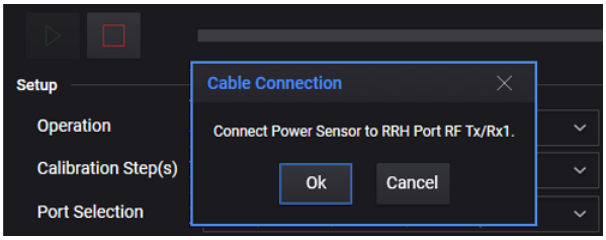
   c. Select the **Calibration Step(s)** drop-down arrow and select `Complete`.



d. Select the **Port Selection** drop-down arrow and select `RRH 1 RFHD 2 -> RRH 1 RFHD 1`.



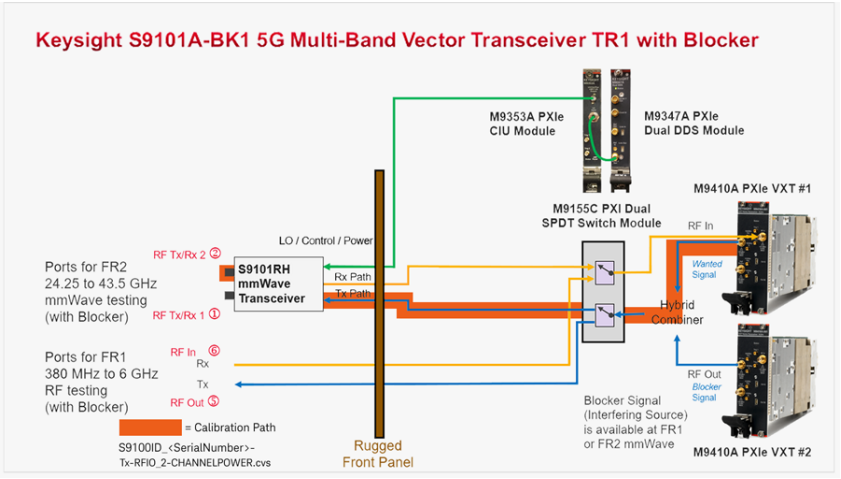
e. Select `Start the calibration` and follow the prompts.



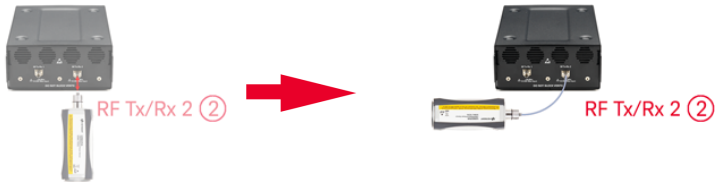
f. Connect the U8487A Power Sensor or equivalent to S9101RH mmWave Transceiver connector RF Tx/Rx 2 ②.

g. Select `Ok` to continue the calibration.

- View the `Results Source` tab when the calibration is complete.
- Corrections are stored in: `S9100ID_<SerialNumber>-Tx-RFIO_2-CHANNELPOWER.csv`



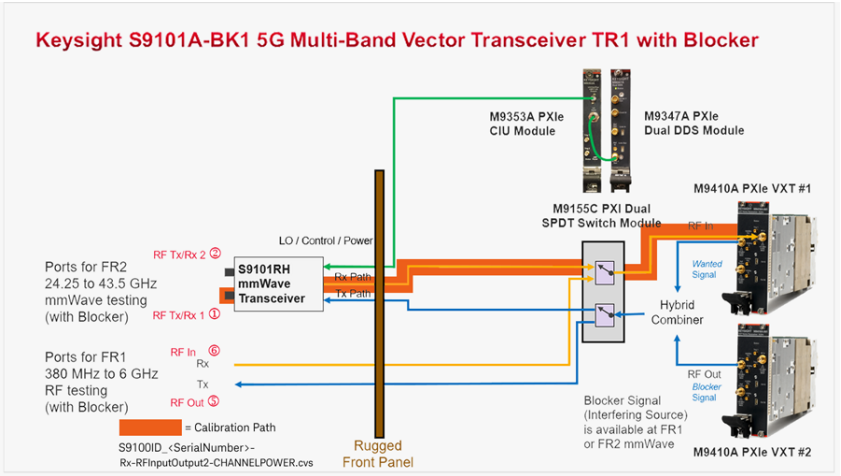
2. Calibrate the Cable signal path
    a. Disconnect the power sensor from S9101RH mmWave Transceiver connector RF Tx/Rx 2 ②.
    b. Using an 8121-3222 cable, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in) or equivalent, connect one end of the cable to S9101RH mmWave Transceiver connector RF Tx/Rx 2 ②.
    c. Using an 11900B adapter, 2.4 mm (f) to 2.4 mm (f) or equivalent, connect the U8487A Power Sensor or equivalent to the end of the cable.



    d. Select `Ok` to continue the calibration.
        - View the `Results Cable` tab when the calibration is complete.

3. Calibrate the Receiver (Rx) signal path
    a. Disconnect the power sensor and adapter from the cable.
    b. Connect the free end of the cable to S9101RH mmWave Transceiver connector RF Tx/Rx 1 ①.

    c. Select `Ok` to complete the calibration.
        - View the `Results Receiver` tab when the calibration is complete.
        - Corrections are stored in: `S9100ID_<SerialNumber>-Rx-RFInputOutput1-CHANNELPOWER.csv`



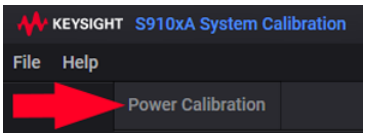
7. 4. 3. 3 Calibrating S9101A-TR2

Calibration 1 of 4: Power from RRH 1 RFHD 1 -> RRH 1 RFHD 2, Transceiver 1

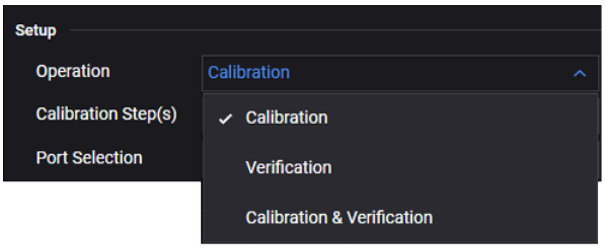
NOTE This calibration is used to calibrate the FR2 mmWave ports of mmWave Transceiver 1 (with RF Tx/Rx 1 ① used as the RF Output) on an S9101A-TR2 5G Multi-Band Vector Transceiver.

When performing this Power Calibration, the Source (Tx) output power level is set to -5 dBm by default.

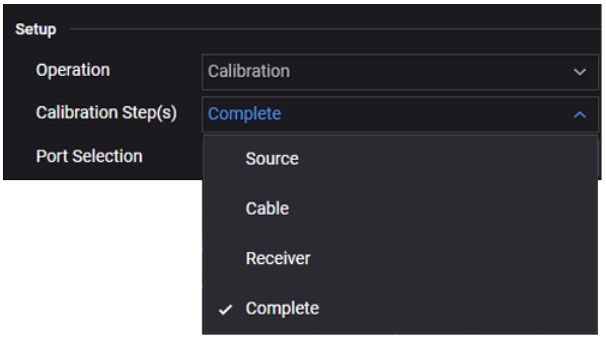
1. Calibrate the Source (Tx) signal path
   a. Select the **Power Calibration** tab.



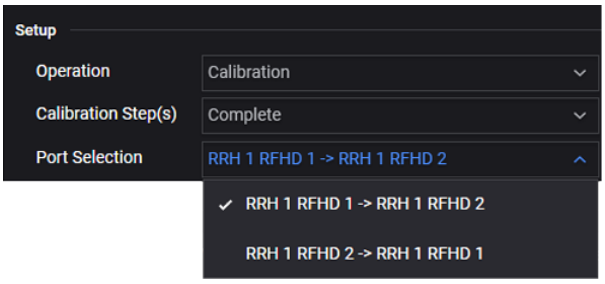
   b. Select the **Operation** drop-down arrow and select `Calibration`.



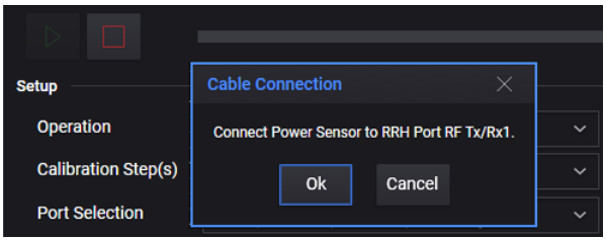
   c. Select the **Calibration Step(s)** drop-down arrow and select `Complete`.



d. Select the **Port Selection** drop-down arrow and select `RRH 1 RFHD 1 -> RRH 1 RFHD 2`.

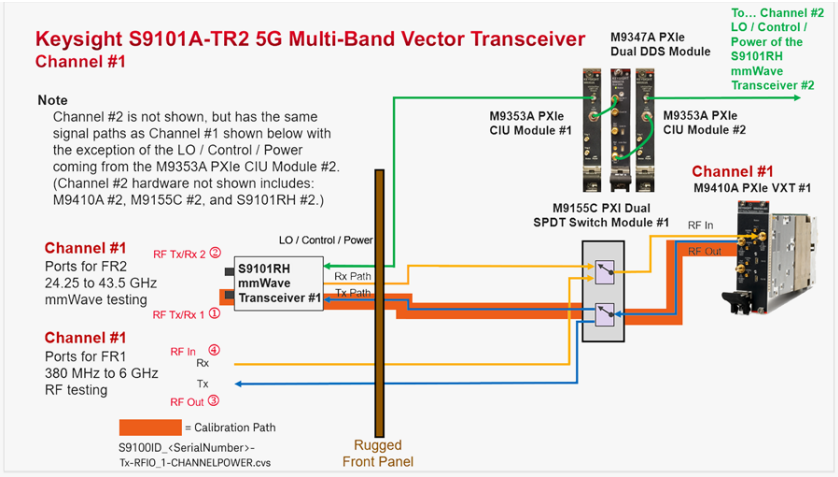


e. Select `Start the calibration` and follow the prompts.

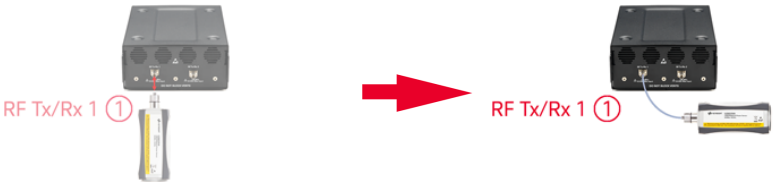


f. Connect the U8487A Power Sensor or equivalent to the S9101RH mmWave Transceiver 1 connector RF Tx/Rx 1 ①.

g. Select `Ok` to continue the calibration.
   - View the `Results Source` tab when the calibration is complete.
   - Corrections are stored in: `S9100ID_<SerialNumber>-Tx-RFIO_1-CHANNELPOWER.csv`

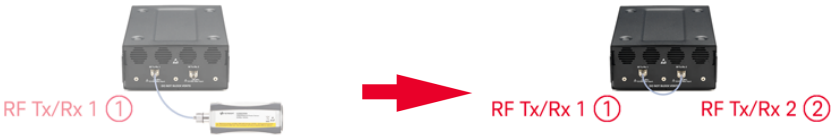


2. Calibrate the Cable signal path
    a. Disconnect the power sensor from the S9101RH mmWave Transceiver 1 connector RF Tx/Rx 1 ①.
    b. Using an 8121-3222 cable, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in) or equivalent, connect one end of the cable to the S9101RH mmWave Transceiver 1 connector RF Tx/Rx 1 ①.
    c. Using an 11900B adapter, 2.4 mm (f) to 2.4 mm (f) or equivalent, connect the U8487A Power Sensor or equivalent to the end of the cable.

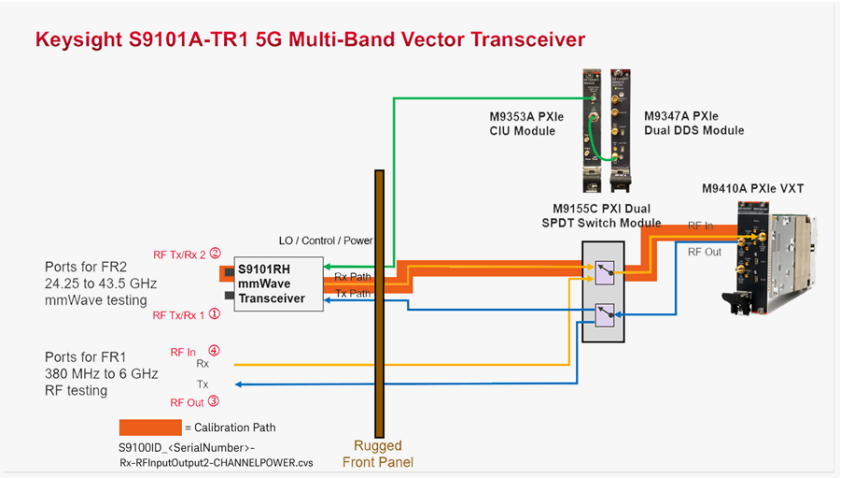


    d. Select `Ok` to continue the calibration.
        - View the `Results Cable` tab when the calibration is complete.

3. Calibrate the Receiver (Rx) signal path
    a. Disconnect the power sensor and adapter from the cable.
    b. Connect the free end of the cable to the S9101RH mmWave Transceiver 1 connector RF Tx/Rx 2 ②.



    c. Select `Ok` to complete the calibration.
        - View the `Results Receiver` tab when the calibration is complete.
        - Corrections are stored in: `S9100ID_<SerialNumber>-Rx-RFInputOutput2-CHANNELPOWER.csv`



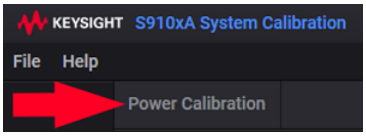
Calibration 2 of 4: Power from RRH 1 RFHD 2 -> RRH 1 RFHD 1, Transceiver 1

NOTE This calibration is used to calibrate the FR2 mmWave ports of mmWave Transceiver 1 (with RF Tx/Rx 2 ② used as the RF Output) on an S9101A-TR2 5G Multi-Band Vector Transceiver.

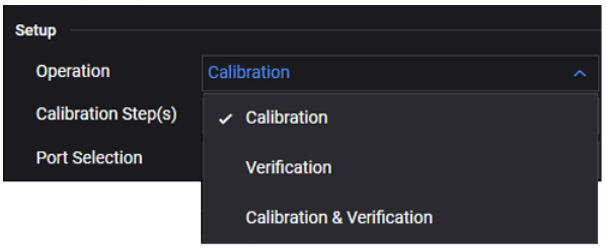
When performing this Power Calibration, the Source (Tx) output power level is set to -5 dBm by default.

---

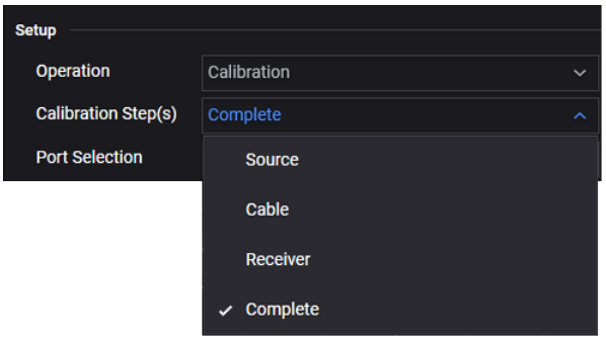
1. Calibrate the Source (Tx) signal path
   a. Select the **Power Calibration** tab.



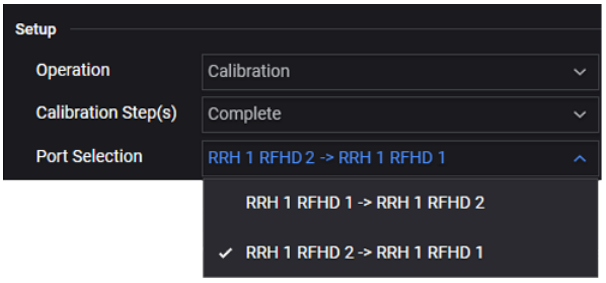
   b. Select the **Operation** drop-down arrow and select `Calibration`.



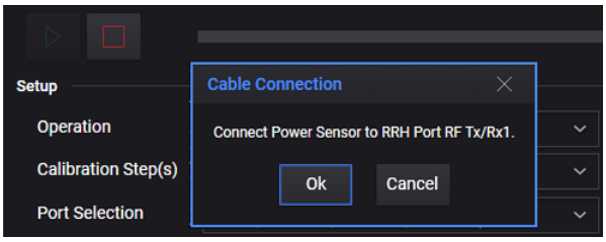
   c. Select the **Calibration Step(s)** drop-down arrow and select `Complete`.



   d. Select the **Port Selection** drop-down arrow and select `RRH 1 RFHD 2 -> RRH 1 RFHD 1`.



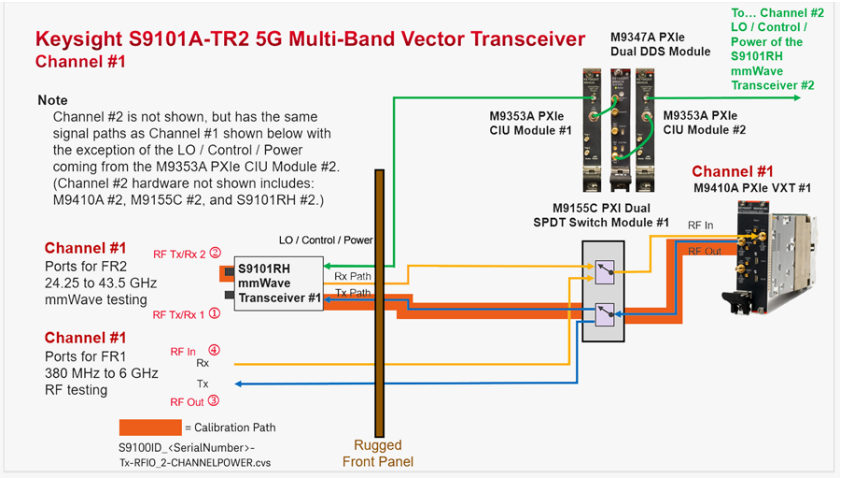
e. Select Start the calibration and follow the prompts.



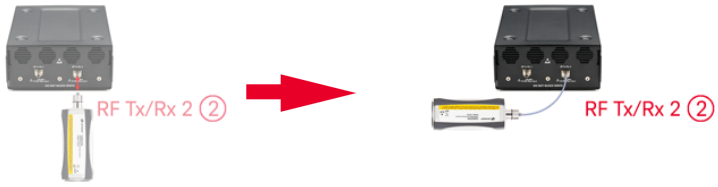
f. Connect the U8487A Power Sensor or equivalent to the S9101RH mmWave Transceiver connector RF Tx/Rx 2 ②.

g. Select Ok to continue the calibration.

- View the Results Source tab when the calibration is complete.
- Corrections are stored in: S9100ID_<SerialNumber>-Tx-RFIO_2-CHANNELPOWER.csv



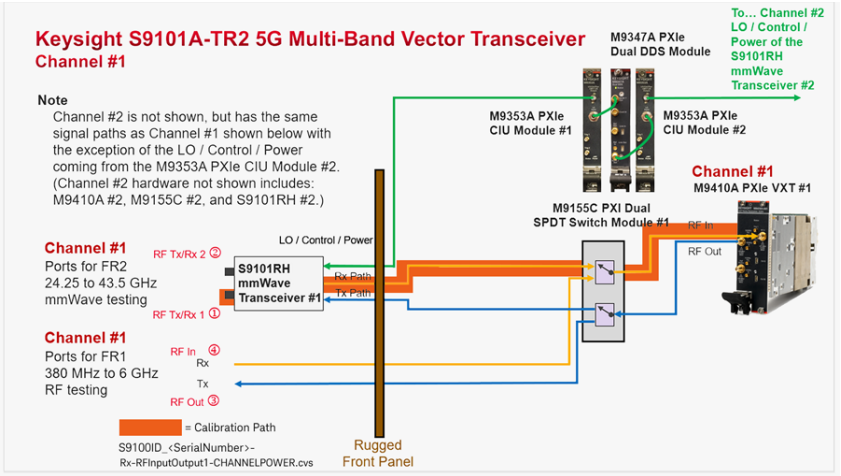
2. Calibrate the Cable signal path
    a. Disconnect the power sensor from S9101RH mmWave Transceiver connector RF Tx/Rx 2 ②.
    b. Using an 8121-3222 cable, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in) or equivalent, connect one end of the cable to the S9101RH mmWave Transceiver 1 connector RF Tx/Rx 2 ②.
    c. Using an 11900B adapter, 2.4 mm (f) to 2.4 mm (f) or equivalent, connect the U8487A Power Sensor or equivalent to the end of the cable.



    d. Select `Ok` to continue the calibration.
        - View the `Results Cable` tab when the calibration is complete.

3. Calibrate the Receiver (Rx) signal path
    a. Disconnect the power sensor and adapter from the cable.
    b. Connect the free end of the cable to the S9101RH mmWave Transceiver connector RF Tx/Rx 1 ①.

    c. Select `Ok` to complete the calibration.
        - View the `Results Receiver` tab when the calibration is complete.
        - Corrections are stored in: `S9100ID_<SerialNumber>-Rx-RFInputOutput1-CHANNELPOWER.csv`



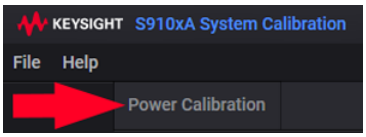
Calibration 3 of 4: Power from RRH 1 RFHD 1 -> RRH 1 RFHD 2, Transceiver 2

NOTE This calibration is used to calibrate the FR2 mmWave ports of mmWave Transceiver 2 (with RF Tx/Rx 1 ① used as the RF Output) on an S9101A-TR2 5G Multi-Band Vector Transceiver.

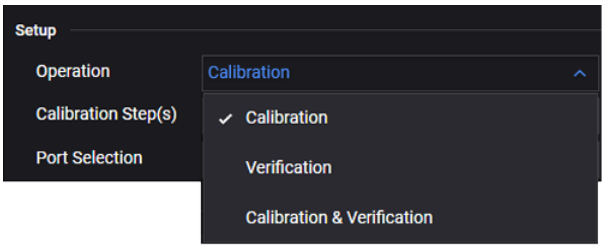
When performing this Power Calibration, the Source (Tx) output power level is set to -5 dBm by default.

---

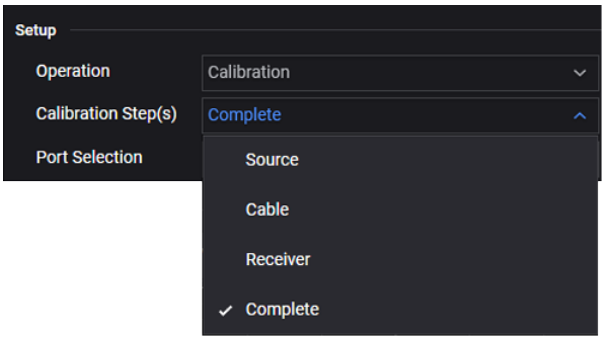
1. Calibrate the Source (Tx) signal path
   a. Select the **Power Calibration** tab.



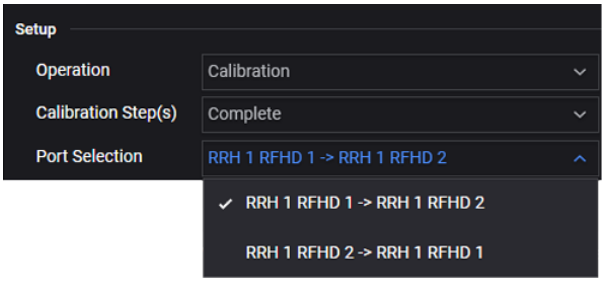
   b. Select the **Operation** drop-down arrow and select `Calibration`.



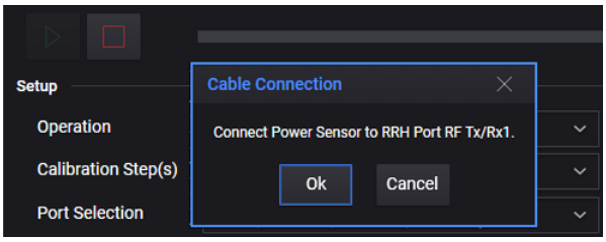
   c. Select the **Calibration Step(s)** drop-down arrow and select `Complete`.



   d. Select the **Port Selection** drop-down arrow and select `RRH 1 RFHD 1 -> RRH 1 RFHD 2`.



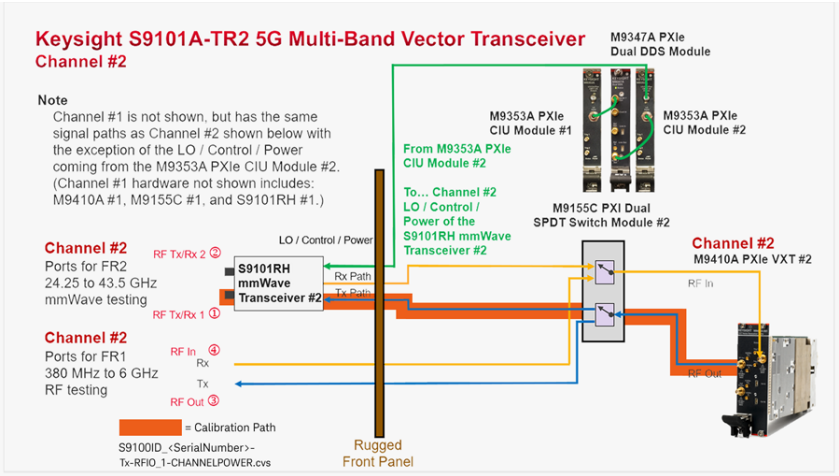
e. Select Start the calibration and follow the prompts.



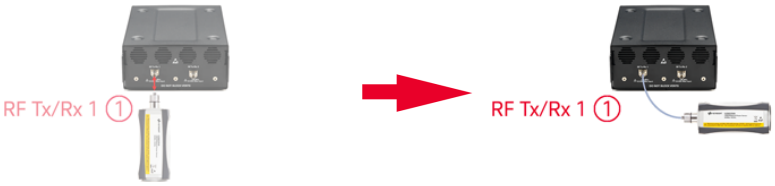
f. Connect the U8487A Power Sensor or equivalent to the S9101RH mmWave Transceiver 2 connector RF Tx/Rx 1 ①.

g. Select Ok to continue the calibration.

- View the Results Source tab when the calibration is complete.
- Corrections are stored in: S9100ID_<SerialNumber>-Tx-RFIO_1-CHANNELPOWER.csv

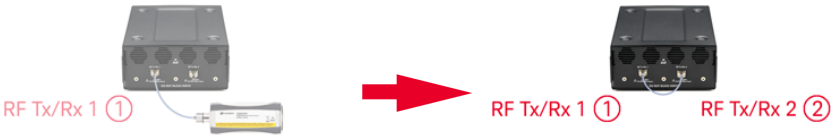


2. Calibrate the Cable signal path
    a. Disconnect the power sensor from the S9101RH mmWave Transceiver 2 connector RF Tx/Rx 1 ①.
    b. Using an 8121-3222 cable, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in) or equivalent, connect one end of the cable to the S9101RH mmWave Transceiver 2 connector RF Tx/Rx 1 ①.
    c. Using an 11900B adapter, 2.4 mm (f) to 2.4 mm (f) or equivalent, connect the U8487A Power Sensor or equivalent to the end of the cable.

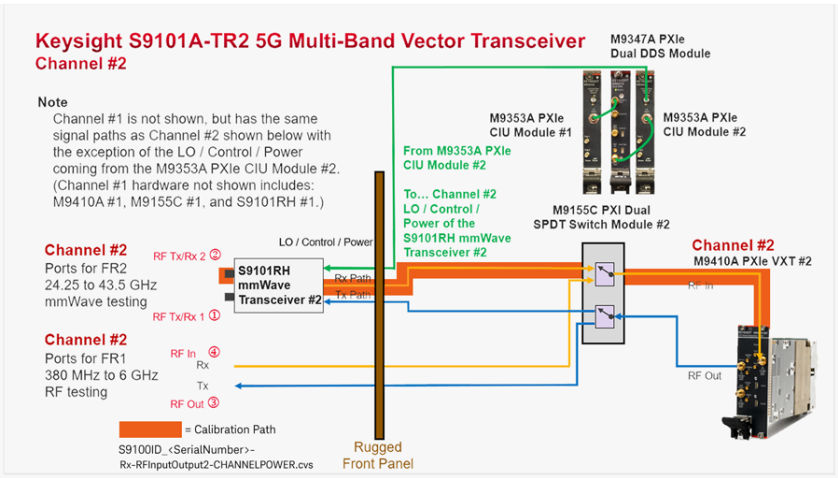


    d. Select `Ok` to continue the calibration.
        - View the `Results Cable` tab when the calibration is complete.

3. Calibrate the Receiver (Rx) signal path
    a. Disconnect the power sensor and adapter from the cable.
    b. Connect the free end of the cable to the S9101RH mmWave Transceiver connector RF Tx/Rx 1 ①.



    c. Select `Ok` to complete the calibration.
        - View the `Results Receiver` tab when the calibration is complete.
        - Corrections are stored in: `S9100ID_<SerialNumber>-Rx-RFInputOutput2-CHANNELPOWER.csv`

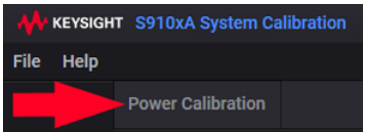


Calibration 4 of 4 Power from RRH 1 RFHD 2 -> RRH 1 RFHD 1, Transceiver 2

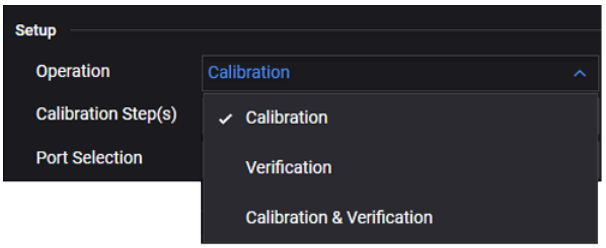
NOTE This calibration is used to calibrate the FR2 mmWave ports of mmWave Transceiver 2 (with RF Tx/Rx 2 ② used as the RF Output) on an S9101A-TR2 5G Multi-Band Vector Transceiver.

When performing this Power Calibration, the Source (Tx) output power level is set to -5 dBm by default.

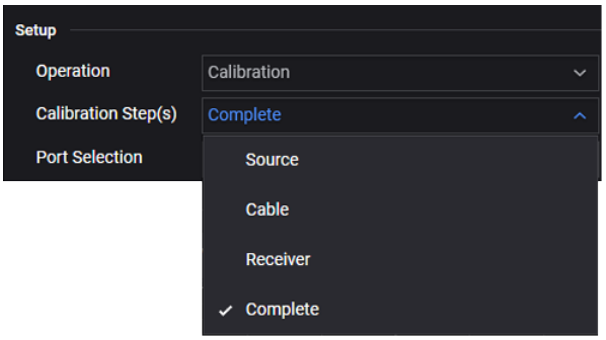
1. Calibrate the Source (Tx) signal path
   a. Select the **Power Calibration** tab.



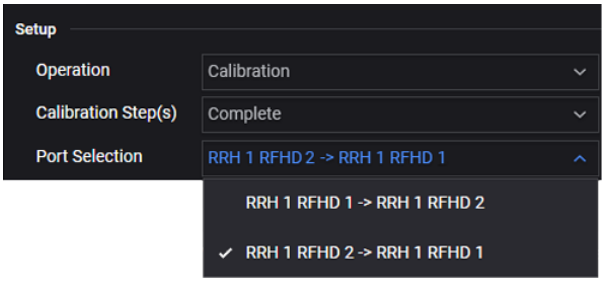
   b. Select the **Operation** drop-down arrow and select `Calibration`.



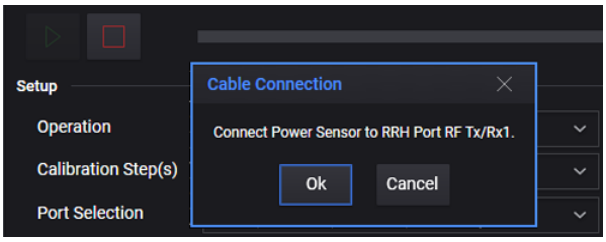
   c. Select the **Calibration Step(s)** drop-down arrow and select `Complete`.



   d. Select the **Port Selection** drop-down arrow and select `RRH 1 RFHD 2 -> RRH 1 RFHD 1`.



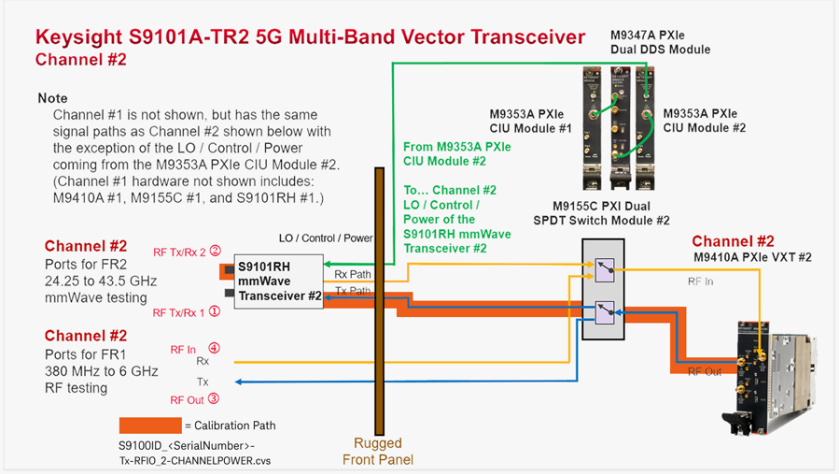
e. Select Start the calibration and follow the prompts.



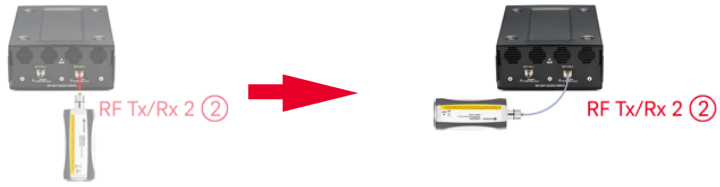
f. Connect the U8487A Power Sensor or equivalent to the S9101RH mmWave Transceiver 2 connector RF Tx/Rx 2 ②.

g. Select Ok to continue the calibration.

- View the Results Source tab when the calibration is complete.
- Corrections are stored in: S9100ID_<SerialNumber>-Tx-RFIO_2-CHANNELPOWER.csv

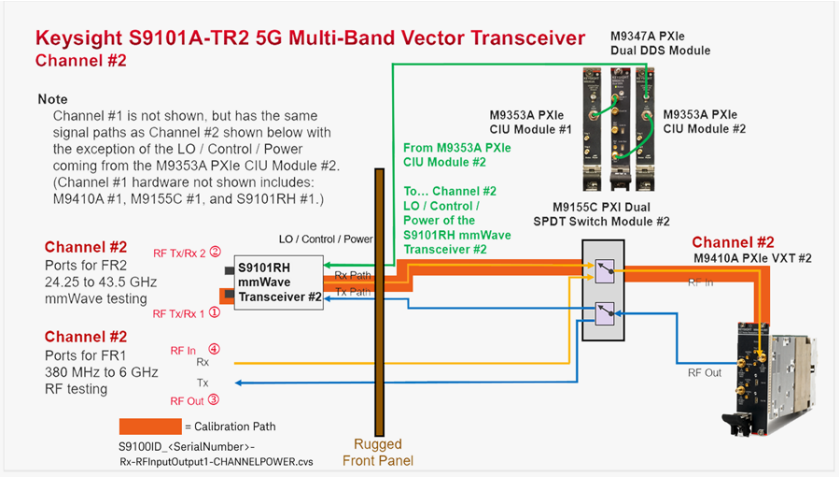


2. Calibrate the Cable signal path
    a. Disconnect the power sensor from the S9101RH mmWave Transceiver 2 connector RF Tx/Rx 2 ②.
    b. Using an 8121-3222 cable, 2.4 mm (m) to 2.4 mm (m), 152.4 mm (6.0 in) or equivalent, connect one end of the cable to the S9101RH mmWave Transceiver 2 connector RF Tx/Rx 2 ②.
    c. Using an 11900B adapter, 2.4 mm (f) to 2.4 mm (f) or equivalent, connect the U8487A Power Sensor or equivalent to the end of the cable.



    d. Select `Ok` to continue the calibration.
        - View the `Results Cable` tab when the calibration is complete.
3. Calibrate the Receiver (Rx) signal path
    a. Disconnect the power sensor and adapter from the cable.
    b. Connect the free end of the cable to the S9101RH mmWave Transceiver 2 connector RF Tx/Rx 2 ②.

    c. Select `Ok` to complete the calibration.
        - View the `Results Receiver` tab when the calibration is complete.
        - Corrections are stored in: `S9100ID_<SerialNumber>-Rx-RFInputOutput1-CHANNELPOWER.csv`



Where to Find the Latest Information

Documentation is updated periodically. For the latest information about these products, including instrument software upgrades, application information, and product information, browse to one of the following URLs, according to the name of your product:

To contact Keysight for sales and technical support:

Refer to support links on the following Keysight websites:
http://www.keysight.com/find (product specific information and support, software, and documentation updates)
www.keysight.com/find/assist (worldwide contact information for repair and service).

Keysight S9101A 5G Multi-Band Vector Transceiver
www.keysight.com/find/S9101A

Keysight M9019A PXIe Chassis: 18-slot, 3U, 24 GB/s, Gen 3
Keysight M9037A PXIe High Performance Embedded Controller
Keysight M9410A PXIe VXT Vector Transceiver
Keysight M9155C PXI Hybrid Dual SPDT Coaxial Switch
Keysight M9300A PXIe Frequency Reference
Keysight S9101RH mmWave Transceiver

To access the Keysight licensing website:

http://www.keysight.com/find/licensing

To receive the latest updates by email, subscribe to Keysight Email Updates:

www.keysight.com/find/MyKeysight

To get information on preventing instrument damage:

www.keysight.com/find/PreventingInstrumentRepair

To confirm your product software is up-to-date:

Periodically, Keysight releases software updates to fix known defects and incorporate product enhancements.

To search for software updates for your product, go to the Keysight Technical Support website at:

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