

Keysight L-Series Coaxial Multiport Switches



Operating and
Service Manual

Notices

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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.

Waste Electrical and Electronic Equipment (WEEE) Directive

This instrument complies with the WEEE Directive marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

Product category:

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

The affixed product label is as shown below.



Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit <http://about.keysight.com/en/companyinfo/environment/takeback.shtml> for more information.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/switches
(product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
(worldwide contact information for repair and service)

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General Information

L-Series coaxial multiport switches overview

Keysight L-series coaxial multiport switches consists of two main group of products. L7104A/B/C and L7106A/B/C are terminated switches with SP4T and SP6T configuration respectively while L7204A/B/C and L7206A/B/C are unterminated SP4Ts and SP6Ts. Both terminated and unterminated L-series coaxial multiport switches provide the life and repeatability for automated test and measurement, signal monitoring and routing applications with reasonable cost.



Figure 1 L-series coaxial multiport switches - L7106C and L7104C

Features

SP4T and SP6T configuration with magnetic latching

- Warranted 0.03 dB insertion loss repeatability for 2 million cycles
- Excellent isolation, typically > 85 dB at 26.5 GHz
- Opto-electronic indicators and interrupts
- TTL/5V CMOS compatible (optional)
- Terminated and unterminated ports

Innovative design and careful process control creates switches that meet the requirements for highly repeatable switching elements in test instruments and switching interfaces. The exceptional 0.03 dB insertion loss repeatability is warranted for 2 million cycles at 25°C. This reduces sources of random errors in the measurement path and improves measurement uncertainties. Switch life is a critical consideration in production test systems, satellite and antenna monitoring systems, and test instrumentation. The longevity of these switches increases system uptime, and lowers the cost of ownership by reducing calibration cycles and switch maintenance.

Table 1 shows the 12 models of L-series coaxial multipoint switches available.

Table 1 List of L-series coaxial multipoint switches

Model	Frequency range	Configuration	Terminated/unterminated
L7104A	DC to 4 GHz	SP4T	Terminated
L7104B	DC to 20 GHz	SP4T	Terminated
L7104C	DC to 26.5 GHz	SP4T	Terminated
L7204A	DC to 4 GHz	SP4T	Unterminated
L7204B	DC to 20 GHz	SP4T	Unterminated
L7204C	DC to 26.5 GHz	SP4T	Unterminated
L7106A	DC to 4 GHz	SP6T	Terminated
L7106B	DC to 20 GHz	SP6T	Terminated
L7106C	DC to 26.5 GHz	SP6T	Terminated
L7206A	DC to 4 GHz	SP6T	Unterminated

Table 1 List of L-series coaxial multiport switches (continued)

Model	Frequency range	Configuration	Terminated/unterminated
L7206B	DC to 20 GHz	SP6T	Unterminated
L7206C	DC to 26.5 GHz	SP6T	Unterminated

Driving the switch

Each RF path can be closed by applying ground (TTL “High” for Option T24) to the corresponding “drive” pin. In general, all other RF paths are simultaneously opened by internal logic. See Figure 2 for drive connection diagrams.

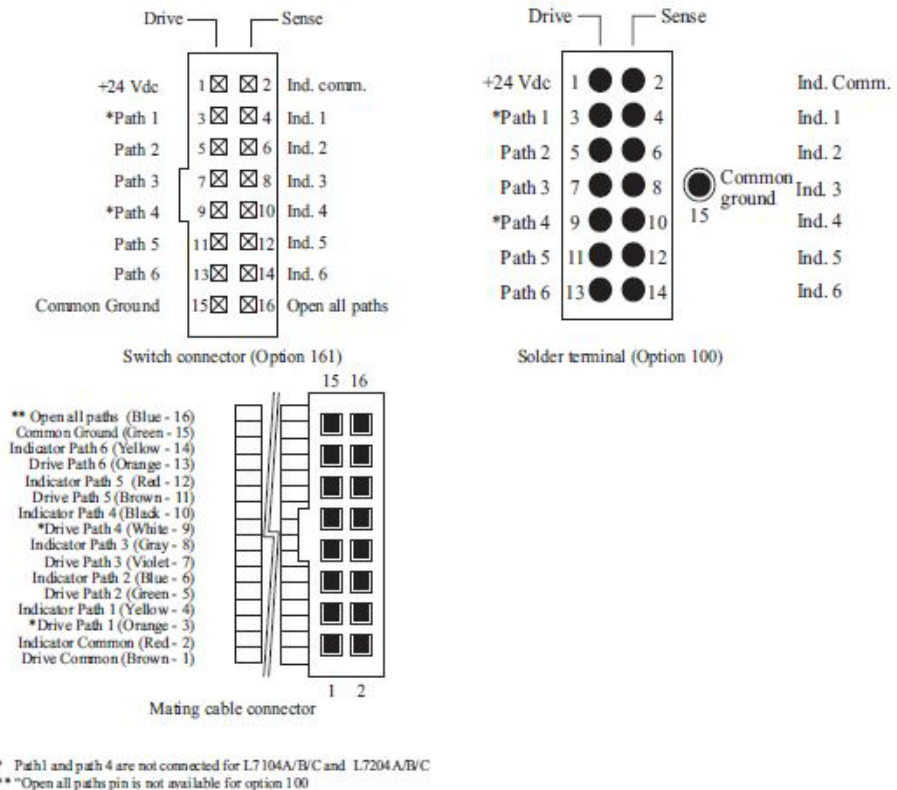


Figure 2 Drive connection diagram for Option 161 and Option 100

The default operation of the switches is break-before-make. Make-before-break switching can be accomplished by simultaneously selecting the “drive” pins for old RF path and new RF path. This will simultaneously close the old RF path and new RF path. Once the new RF path is closed (15 ms), de-select the old RF path “drive” pin while leaving the new RF path “drive” pin selected. The switch circuitry will automatically open the old RF path while leaving the new RF path engaged.

Standard drive

- Connect pin 1 to supply voltage (+20 Vdc to +32 Vdc) and pin 15 to ground.

NOTE

Pin 15 must always be connected to ground to enable the electronic position-indicating circuitry and drive logic circuitry.

CAUTION

If pin 15 is not connected to power supply ground, catastrophic failure will occur.

- Select (close) desired RF path by applying ground to the corresponding “drive” pin; for example ground pin 3 to close RF path 1.

NOTE

After the RF path is switched and latched, the drive current is interrupted by the electronic position-sensing circuitry. Pulsed control is not necessary, but if implemented, the pulse width must be 15 ms minimum to ensure the switch is fully latched.

- To select another RF path, ensure that all unwanted RF path “drive” pins are disconnected from ground (to prevent multiple RF path engagement). Ground the “drive” pin which corresponds to the desired RF path.
- To open all RF paths, ensure that all RF path “drive” pins are disconnected from ground. Then, connect pin 16 to ground. This feature is not available in option 100.

TTL drive (Option T24)

- Connect pin 1 to supply voltage (+20 Vdc to +32 Vdc) and pin 15 to ground.

NOTE

Pin 15 must always be connected to ground to enable the electronic position-indicating circuitry and drive logic circuitry.

In addition to the quiescent current supplying the electronic position-sensing circuitry, the drive current flows out of pin 15 (during switching) on TTL drive switches (option T24).

CAUTION

If pin 15 is not connected to power supply ground, catastrophic failure will occur.

- Select (close) desired RF path by applying TTL “High” to the corresponding “drive” pin; for example apply TTL “High” to pin 3 to close RF path 1.

NOTE

After the RF path is switched and latched, the drive current is interrupted by the electronic position-sensing circuitry. Pulsed control is not necessary, but if implemented, the pulse width must be 15 ms minimum to ensure the switch is fully latched.

- To select another RF path, ensure that all unwanted RF path “drive” pins are at TTL “Low” (to prevent multiple RF path engagement). Apply TTL “High” to the “drive” pin which corresponds to the desired RF path.
- To open all RF paths, ensure that all RF path “drive” pins are at TTL “Low”. Then, apply TTL “High” to pin. This feature is not available in option 100.

Electronic position indicators

The electronic position indicators consist of optically isolated, solid state relays which are driven by photo-electric sensors coupled to the mechanical position of the RF path's moving elements (See [Figure 3](#)). The circuitry consists of a common which can be connected to an output corresponding to each RF path. If multiple RF paths engaged, the position indicator corresponding to each closed RF path will be connected to common. The solid state relays are configured for AC and/or DC operation. See [Table 3](#) for indicator specifications. The electronic position indicators require that the supply (20 to 32 VDC) be connected to pin 1 and ground connected to pin 15.

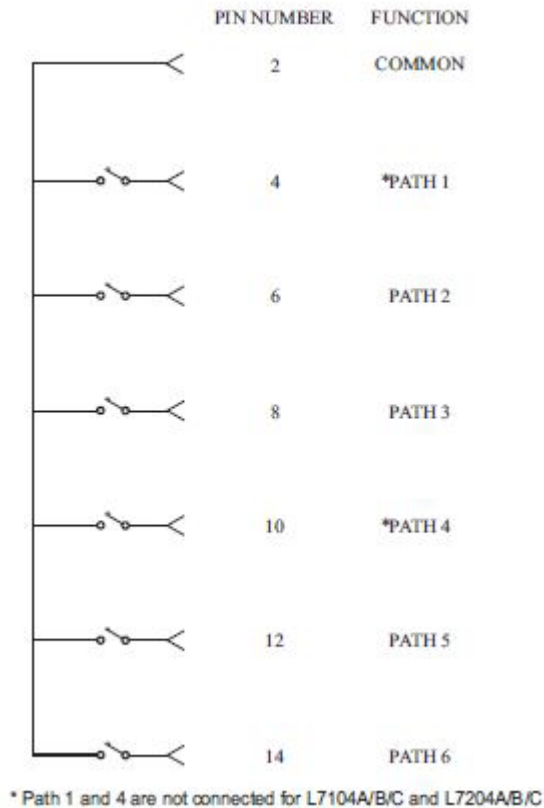


Figure 3 Pin function diagram for indicator

Specifications

Specifications refer to the performance standards or limits against which the coaxial multiport switches are tested.

Typical characteristics are included for additional information only and they are not specifications. These are denoted as “typical”, “nominal” or “approximate” and are printed in italics.

Table 2 General specifications for L-series coaxial multiport switches

Keysight model number	L7104A/B/C, L7106A/B/C, L7204A/B/C & L7206A/B/C
Maximum power rating	1 watt average into 50 Ω internal loads
- Switching	W CW for terminated 2 W CW for unterminated
- Non-switching	50 W Pk (not to exceed 1 watt average) for terminated 100 W Pk (not to exceed 2 watt average) for unterminated
Life	2 million cycles minimum
Switching speed	15 ms

Table 3 Indicator specifications for L-series coaxial multiport switches

Keysight model number	L7104A/B/C, L7106A/B/C, L7204A/B/C & L7206A/B/C
Maximum withstand voltage	60 V
Maximum current capacity	150 mA
Maximum “ON” resistance	2.5 Ω
Maximum “OFF” resistance	10 G Ω

Table 4 RF specifications for L710xA and L720xA coaxial multipoint switches

Keysight model number	L7104A & L7106A	L7204A & L7206A
Frequency range	DC to 4 GHz	DC to 4 GHz
Insertion loss	0.3 dB + 0.015 x freq (GHz)	0.3 dB + 0.015 x freq (GHz)
Isolation	> 90 dB	> 90 dB
SWR	< 1.20	< 1.20
Repeatability ^[a]	< 0.03 dB	< 0.03 dB
Characteristics	50 Ω , terminated	50 Ω , unterminated
Connectors	SMA (f)	SMA (f)

[a] Up to 2 million cycles measured at 25°C

Table 5 RF specifications for L710xB and L720xB coaxial multipoint switches

Keysight model number	L7104B & L7106B	L7204B & L7206B
Frequency range	DC to 20 GHz	DC to 20 GHz
Insertion loss	0.3 dB + 0.015 x freq (GHz)	0.3 dB + 0.015 x freq (GHz)
Isolation	> 90 dB (DC to 12 GHz) > 70 dB (12 to 15 GHz) > 65 dB (15 to 20 GHz)	> 90 dB (DC to 12 GHz) > 70 dB (12 to 15 GHz) > 65 dB (15 to 20 GHz)
SWR	< 1.20 (DC to 4 GHz) < 1.35 (4 to 12.4 GHz) < 1.45 (12.4 to 18 GHz) < 1.70 (18 to 20 GHz)	< 1.20 (DC to 4 GHz) < 1.35 (4 to 12.4 GHz) < 1.45 (12.4 to 18 GHz) < 1.70 (18 to 20 GHz)
Repeatability ^[a]	< 0.03 dB	< 0.03 dB
Characteristics	50 Ω , terminated	50 Ω , unterminated
Connectors	SMA (f)	SMA (f)

[a] Up to 2 million cycles measured at 25°C

Table 6 RF specifications for L710xC and L720xC coaxial multiport switches

Keysight model number	L7104C & L7106C	L7204C & L7206C
Frequency range	DC to 20 GHz	DC to 20 GHz
Insertion loss	0.3 dB + 0.015 x freq (GHz)	0.3 dB + 0.015 x freq (GHz)
Isolation	> 90 dB (DC to 12 GHz) > 70 dB (12 to 15 GHz) > 65 dB (15 to 20 GHz)	> 90 dB (DC to 12 GHz) > 70 dB (12 to 15 GHz) > 65 dB (15 to 20 GHz)
SWR	< 1.20 (DC to 4 GHz) < 1.35 (4 to 12.4 GHz) < 1.45 (12.4 to 18 GHz) < 1.70 (18 to 20 GHz)	< 1.20 (DC to 4 GHz) < 1.35 (4 to 12.4 GHz) < 1.45 (12.4 to 18 GHz) < 1.70 (18 to 20 GHz)
Repeatability ^[a]	< 0.03 dB	< 0.03 dB
Characteristics	50 Ω , terminated	50 Ω , unterminated
Connectors	SMA (f)	SMA (f)

[a] Up to 2 million cycles measured at 25°C

Table 7 Switch drive specifications for L-series coaxial multiport switches

	Min	Nominal	Max	Unit
Supply voltage, Vcc	20	24	32	V
Supply current, Icc		200 ^[a]		mA
Supply current (quiescent)	25		50	mA

[a] Closing one RF path required 200 mA. Add 200 mA for each additional RF path closed or opened. Using all RF paths open (selecting pin 16) requires 200 mA per RF path reset with Vcc = 24 VDC.

Table 8 TTL drive specifications for L-series coaxial multiport switches (Option T24)

	Min	Nominal	Max	Unit
High level input	20	24	32	V
Low level input		200		mA
Max high input current ^[a]	25		50	mA

[a] Vcc = Max, Vinput = 3.85 VDC

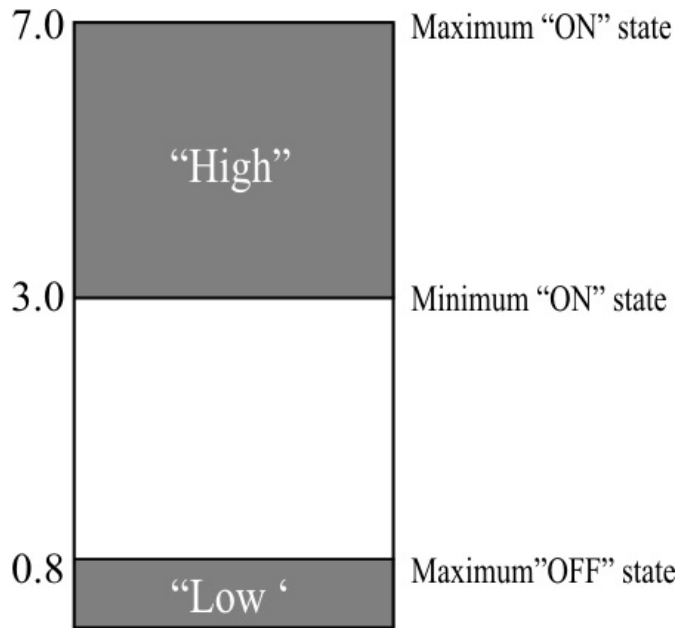


Figure 4 TTL control voltage states (Option T24)

Supplement specifications (cold switching)

Figure 5 illustrates the maximum incident CW power (cold switching) from 100 MHz to 18 GHz. The reference conditions are as below:

- Cold switching only (NO hot switching)
- Ambient temperature of 75°C or less
- Sea level (0.88 derating @15,000 feet)
- Low VSWR < 1.2 (See Figure 6 for derating above 1.2 VSWR)
- Power handling at 25°C is 100 W at 4 GHz

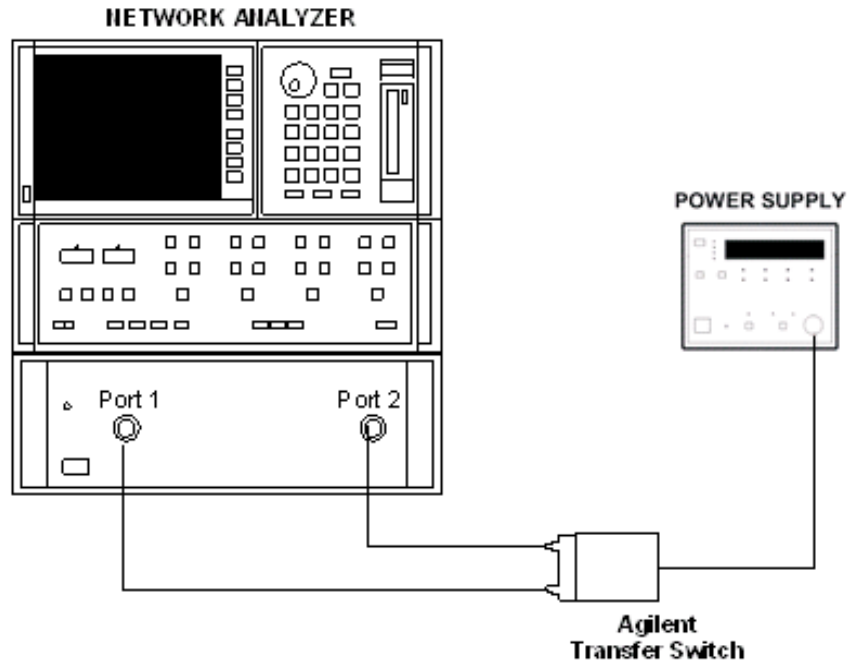


Figure 5 Maximum incident power (cold switching) vs. frequency

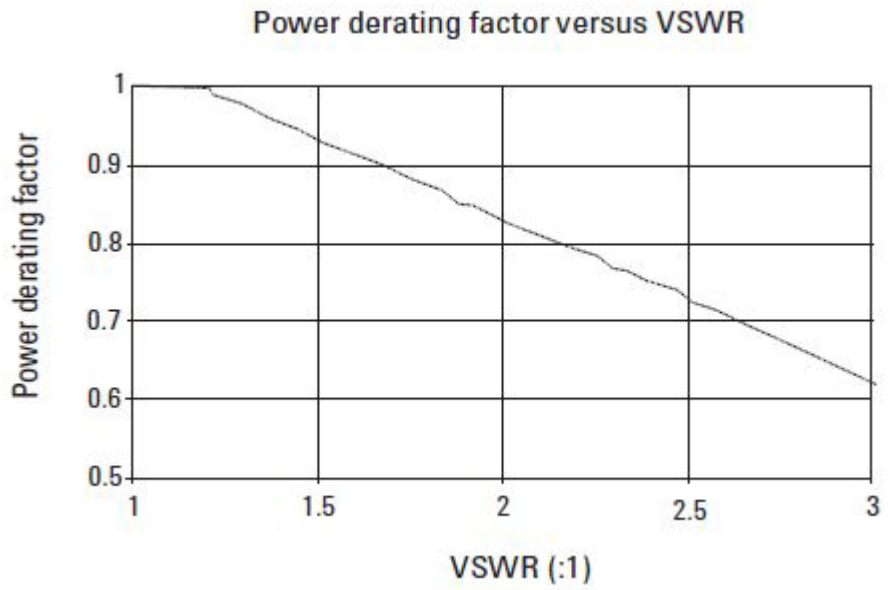


Figure 6 Power derating factor vs VSWR

Environmental Specifications

The L-series coaxial multiport switches are designed to fully comply with Keysight Technologies' product operating environmental specifications as shown in [Table 9](#).

Table 9 L-series coaxial multiport switches environmental specifications

Parameter	Specification
Temperature:	
- Operating	25°C to +75°C
- Storage	55°C to +85°C
- Cycling	55°C to +85°C, 10 cycles per MIL-STD-202F, Method 107D, Condition A (modified)
Humidity:	
- Operating	95% RH at 65°C, 10 days per MIL-STD-202F, Method 106E
Shock:	
- Half-sine	500 G @ 0.5 ms, 3 drops/direction, 18 total
- Operating	50 G @ 6 ms, 6 directions
Vibration:	
- Operating	7 G rms, 5 to 2000 Hz at 0.25 in p-p
- Survival	20 G rms, 20 to 2000 Hz at 0.06 in p-p, 4 min/cycle, 4 cycles/axis
- Random	2.41 G rms, 10 minutes/axis
Altitude:	
- Storage	<15,240 meters (50,000 feet) per MIL-STD-202F, Method 105C, Condition B
ESD immunity:	
- Direct discharge	4 kV (to outer conductor) per IEC 61000-4-2
- Air discharge	8 kV (to center conductor) per IEC 61000-4-2
RFI	Radiated emission per CISPR 11
Magnetic field	< 5 gauss 1/4 inch from surface

Physical Specifications

Table 10 L-series coaxial multiport switches physical specifications

Parameter	Specification
Dimensions	Per Figure 7
Net weight, kg (lb)	0.229 (0.5)

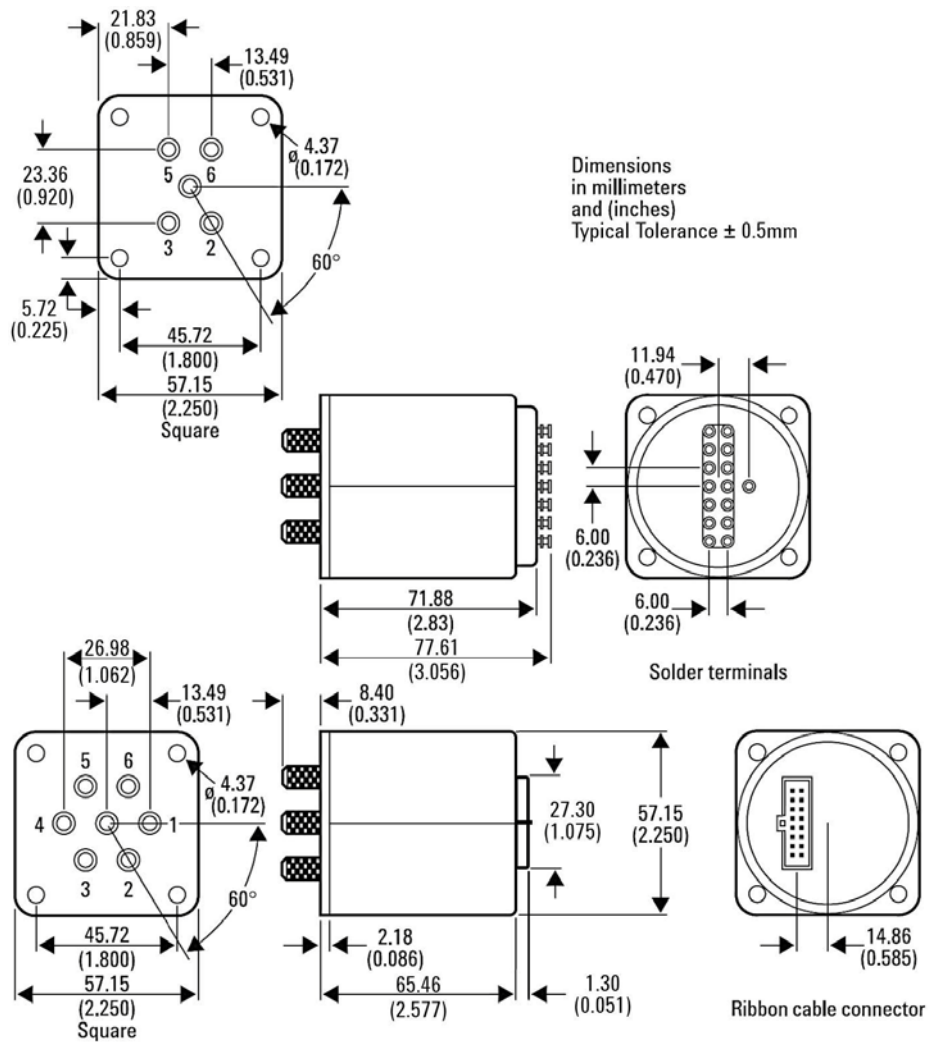


Figure 7 Dimensions of L-series coaxial multipoint switches

Installation

Initial inspection

- 1** Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked both mechanically and electrically.
 - Check for mechanical damage such as scratches or dents.
 - Procedures for checking electrical performance are given under [Operator's check](#) or [Performance Tests](#).
- 2** If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, contact the nearest Keysight Technologies Sales and Service office. Refer to the [Sales and Technical Support](#) in the front matter of this manual. Keysight Technologies will arrange for repair or replacement of the damaged or defective equipment. Keep the shipping materials for the carrier's inspection.
- 3** If you are returning the instrument under warranty or for service, repackaging the instrument requires original shipping containers and materials or their equivalents. Keysight Technologies can provide packaging materials identical to the original materials. Refer to [Sales and Technical Support](#) in the front matter of this manual for the Keysight Technologies nearest you. Attach a tag indicating the type of service required, return address, model number, and serial number. Mark the container **FRAGILE** to insure careful handling. In any correspondence, refer to the instrument by model number and serial number.

Operating Instruction

Operator's check

The operator's check is supplied to allow the operator to make a quick check on the coaxial multiport switches prior to use or if a failure is suspected.

CAUTION

ESD exceeding the level specified in [Table 9](#) or RF power applied is greater than the maximum specified as in [Table 2](#) may cause permanent damage to the device.

Description

The coaxial multiport switch is connected to a network analyzer configured for the s-parameter measurement. The network analyzer may be set to sweep over the whole or selected frequency range of the switch to be verified. The s-parameters measurement is the best way to determine if the switch is working properly.

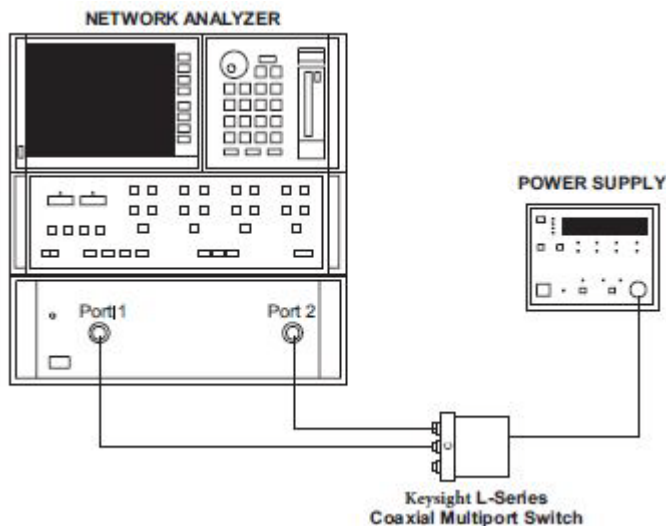


Figure 8 Connection to perform quick check

Quick-check procedure

- 1 Connect common port of switch to Port 1 of the network analyzer and one of the outer RF ports to Port 2 of network analyzer as illustrated in [Figure 8](#).
- 2 For standard drive, apply ground to the corresponding “drive” pin to close the selected path. Refer to [“Standard drive”](#) on page 4.
- 3 For TTL drive (option T24), apply “High” to the corresponding “drive” pin to close the selected path. Refer to [“TTL drive \(Option T24\)”](#) on page 5.
- 4 Perform s-parameters measurement and verify against specifications in [Table 4](#), [Table 5](#) or [Table 6](#).
- 5 Repeat from step 1 until all paths are measured and verified.

Performance Tests

The coaxial multiport switches can be tested to the accuracy of the specifications with a network analyzer or equivalent equipment of suitable accuracy. If a network analyzer is available, test the instrument using the procedure in the analyzer's operating manual.

Service Instructions

Adjustment

The L-series coaxial multipoint switches do not have internal adjustments and should not be opened.

Repair

The L-series coaxial multipoint switches are not recommended for repair as most components are not easily removed.

Maintenance

The connectors, particularly the connector faces, must be kept clean. For instruction on connecting and care of your connectors, refer to the Microwave Connector Care Quick Reference Card (08510-90360).



This information is subject to change without notice. Always refer to the English version at the Keysight website for the latest revision.

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