Keysight Technologies
RF and Microwave Switching Solutions

Selection Guide



KEYSIGHT TECHNOLOGIES

Introduction

Keysight Technologies — Your one-stop switching solution provider

Key Features

- High reliability and exceptional repeatability ensure excellent measurement accuracy
- Excellent RF specifications optimize your test system measurement capability
- Broad selection of switches provides configuration flexibility for various applications

Keysight RF and microwave switches provide:

- Superior RF performance to optimize test equipment performance
- Unmatched quality and reliability to minimize measurement uncertainty
- Ultra broadband to meet the demands of today's devices

Keysight Technologies, Inc. has been a leading designer and manufacturer of RF and microwave switches in the global marketplace for more than 60 years. RF and microwave switches are used extensively in microwave test systems for signal routing between instruments and devices under test (DUT). Incorporating a switch into a switch matrix system enables you to route signals from multiple instruments to single or multiple DUTs. This allows multiple tests to be performed with the same setup, eliminating the need for frequent connects and disconnects. The entire testing process can thus be automated, increasing the throughput in high-volume production environments.

Keysight designs and manufacturers a comprehensive range of RF and microwave switches to meet your switching requirements. There are two mainstream switch technologies in use today: solid state and electromechanical. Keysight's solid state and electromechanical switches operate across a broad frequency range and come in a variety of configurations. Designed with high accuracy and repeatability for automated test and measurement, signal monitoring and routing applications, Keysight switches have a proven track record for high performance, quality and reliability.

Keysight's RF and Microwave Switch Portfolio



Keysight offers a broad portfolio of switches in various configurations. This gives you the flexibility to create complex matrixes and automated test systems for many different applications.

Electromechanical switches

Frequency configuration	SPDT	SP3T	SP4T	SP5T	SP6T	Bypass	Transfer
DC to 4 GHz	■		■		■	■	
DC to 18 GHz	■					■	
DC to 20 GHz	■		■		■	■	
DC to 26.5 GHz	■	■	■	■	■	■	■
DC to 40 GHz	■		■		■	■	■
DC to 50 GHz	■		■	■	■	■	■
DC to 67 GHz	■					■	

Solid state switches

Frequency configuration	FET hybrid			PIN diode		
	SPDT	SP4T	Transfer	SPDT	SP4T	Transfer
300 kHz to 8 GHz	■		■			
100 MHz to 8 GHz				■	■	■
300 kHz to 18 GHz	■		■			
100 MHz to 18 GHz				■	■	■
45 MHz to 50 GHz				■	■	

Keysight Electromechanical Coaxial Switch Features



Guaranteed performance

– < 0.03 dB insertion loss repeatability guaranteed for 2 or 5 million cycles





Long operating life

– 5 or 10 million cycles (typical)

Flexible configurations

– SPDT, SP4T, SP6T

– bypass and transfer

– terminated and unterminated





High isolation

– typically > 85 dB at 26 .5 GHz

Low SWR

– minimize measurement uncertainty



Unique design

– wiping action mechanism eliminates particle buildup to ensure reliable switching

Broad frequency range

– DC to 4, 20, 26.5, 40, or 50 GHz

Choose Between Life Expectancy and Cost Without Sacrificing Performance



High performance

Keysight's high-performance electromechanical coaxial switches provide reliable switching in signal routing, switch matrices and ATE systems. With 0.03 dB insertion loss repeatability guaranteed up to five million cycles and exceptional isolation, Keysight high-performance switches provide the performance you need from DC to 50 GHz.

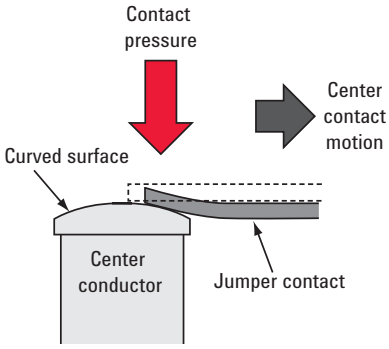
Low cost

Keysight's low-cost switches offer high-performance capability at a fraction of the cost. For example, 40% cheaper than Keysight's high-performance switches, the L Series offers 0.03 dB insertion loss repeatability guaranteed up to two million cycles and exceptional isolation, Keysight low-cost switches provide the performance you need from DC to 26.5 GHz.

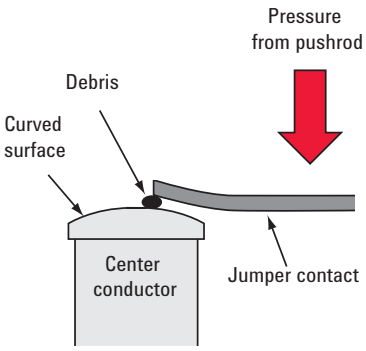
Keysight's electromechanical switch product offerings		
Terminated	**High performance**	**Low cost**
SPDT	N1810TL	8762A/B/C/F
SP4T	87104A/B/C/D	L7104A/B/C
SP6T	87106A/B/C/D	L7106A/B/C
Bypass	N1811TL	8763A/B/C
Unterminated	**High performance**	**Low cost**
SPDT	N1810UL	8765A/B/C/D/F
SP4T	8767K	L7204A/B/C
SP6T	8769K	L7206A/B/C
Bypass	N1812UL	8764A/B/C
Transfer	87222C/D/E	L7222C



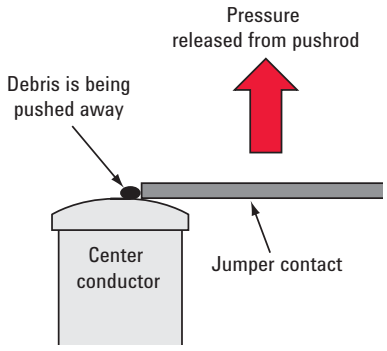
Unique design — a wiping mechanism eliminates particle buildup to ensure reliable switching



EM switch mating configuration illustrating microscopic wiping



A piece of small debris is stuck on the



surface of center conductor
Debris is being pushed away by wiping process of the jumper contact

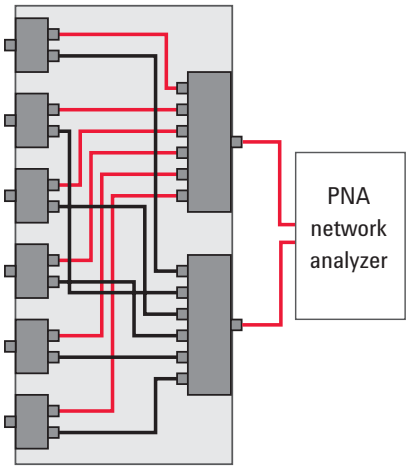
Long operating life with guaranteed 0.03 dB insertion loss repeatability

Keysight EM coaxial switches are produced with meticulous manufacturing processes and stringent quality assurance. The L Series is designed to guarantee specifications for two million cycles and typically operates up to five million cycles. The high performance series is designed to guarantee specifications up to five million cycles and typically operates up to ten million cycles.

Keysight electromechanical switches have a guaranteed 0.03 dB insertion loss repeatability throughout their operating life of two or five million cycles. To achieve this repeatability specification, Keysight EM switches incorporate a unique design, which includes a wiping mechanism that cleans debris off the center conductor tip every cycle, eliminating the particle buildup that is prevalent in conventional EM switch designs.

More information on the wiping mechanism can be found in *How Operating Life and Repeatability of Keysight's Electromechanical Switches Minimize System Uncertainty*, literature number 5989-6085EN.





PNA network analyzer with a multiport test set

Keysight switches exhibit exceptional isolation performance required to maintain signal integrity. Isolation between ports is typically > 90 dB to 12 GHz and > 80 dB to 26.5 GHz, reducing the influence of signals from other channels and system measurement uncertainties.

The repeatability of a switch has a direct effect on the measurement uncertainty of a test setup. Here, a PNA connected to a multiport test set is used to test multiple devices.

In this example, a total of three 2-port devices can be tested successively or individually, with any port. The following equations are used to calculate total measurement uncertainty.

Equations

Since uncertainty errors are random and not systematic, root sum square (RSS) is used calculate the total measurement uncertainty.

Scenario 1:

PNA repeatability = 0.01 dB, EM switch repeatability = 0.03 dB

Total measurement uncertainty $= \sqrt{0.01^2 + 0.03^2 + 0.03^2} = 0.044$ dB

Scenario 2:

PNA repeatability = 0.01 dB, EM switch repeatability = 0.1 dB

Total measurement uncertainty $= \sqrt{0.01^2 + 0.1^2 + 0.1^2} = 0.142$ dB

As shown in the equations, repeatability of the EM switch has a significant effect on the total measurement uncertainty of the system, affecting the accuracy of all measurements made.

Keysight's high performance 87 series offer exceptional RF performance with low cost per switching cycle. Keysight's L Series switches offer excellent performance at an affordable price, minimizing the pressure associated with stringent budgetary constraints.

Typical Applications for Electromechanical Switches



Electromechanical switch applications

- antennas
- transceiver modules
- low noise amplifiers (LNA)
- receiver modules

Application requirements

- 0.03 dB insertion loss repeatability
- power handling of 50 W peak
- terminated
- long operating life

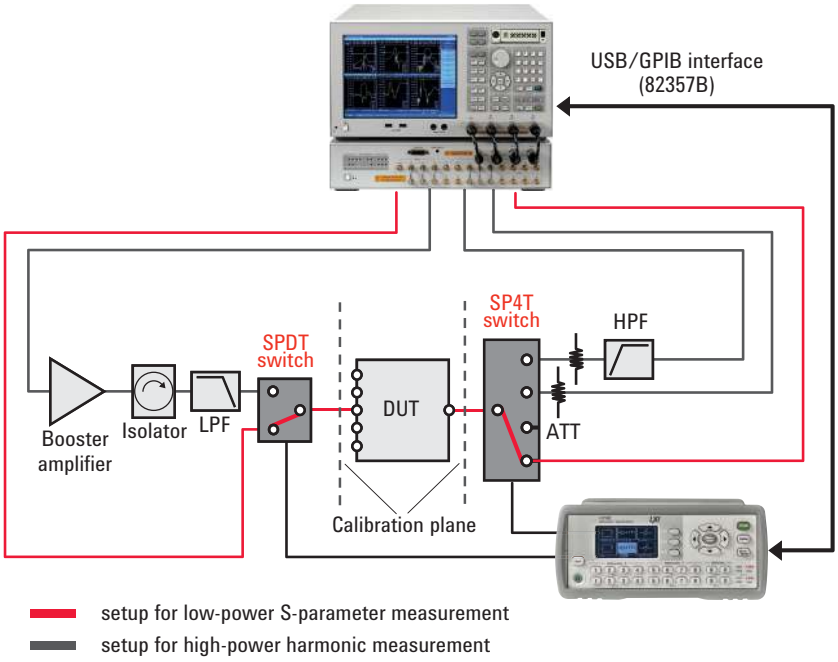
Recommended switches

- SPDT: N1810TL
- SP4T: 87104A/B, L7104A/B

Electromechanical switches are used in switch matrix systems for testing of telecommunication devices where low insertion loss is critical and power handling requirements are higher.

Electromechanical switches are widely used in both basic signal routing and application specific switch matrices such as tree matrices or full access matrices. They are also useful for bypassing an active device in a measurement system or in a multisource/multi-device switching system.

2-port measurement of a multiport device



This configuration enables switching between high- and low-power measurements

The figure above shows the test setup for 2-port measurements on a multiport device; additional EM switches may be required for a complete measurement setup. Green is the S-parameter measurement with a low-power signal applied to the DUT, while blue is for the harmonic distortion measurement with a high-power signal to the DUT. Both measurements can be selected by changing the EM switch ports.



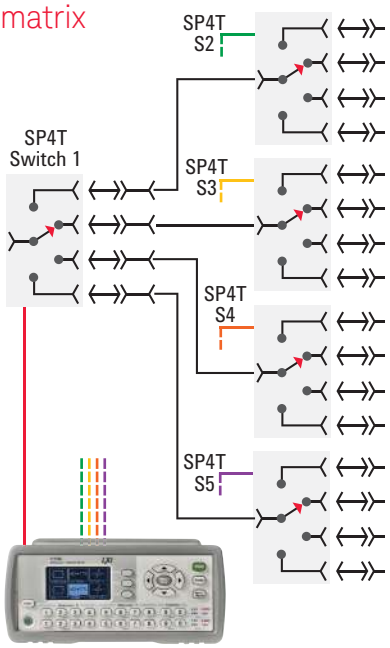
Flexible configurations for signal routing purposes

Keysight EM switches can be used in large number of applications, increasing system flexibility and simplifying system design. One of the most common applications is to use the switches in a switch matrix automated testing system which routes multiple input signals to multiple outputs. Examples shown below are some possible configurations. You can also freely configure Keysight switches to meet your needs.



Switch matrices use high performance multi-port switches to route multiple input signals to multiple output signals simultaneously.

1x16 full crossbar switch matrix



11713C attenuator/switch driver

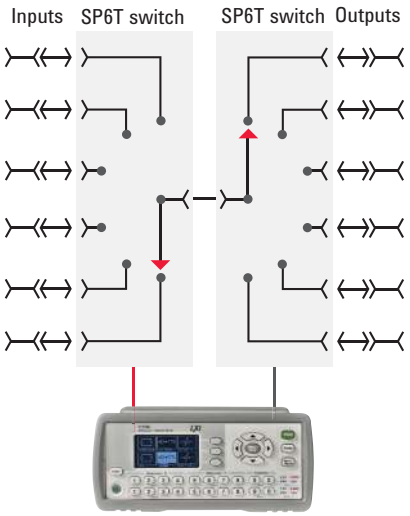
Application requirements

- 4-port switch configuration (SP4T) for S1, S2, S3, S4, S5
- 0.03 dB insertion loss repeatability
- power handling of 50 W peak
- terminated
- long operating life

Recommended switches

- SP4T: 87104A/B/C/D, L7104A/B/C

6 x 6 “common highway”



11713C attenuator/switch driver

Application requirements

- 6-port switch configuration
- 0.03 dB insertion loss repeatability
- power handling of 50 W peak
- terminated
- long operating life

Recommended switches

- SP6T: 87106A/B/C/D, L7106A/B/C

Keysight Solid State Switch Features



Fast switching speed

– 350 µs (typical)

High isolation

– > 100 dB at 8 GHz





Low video leakage

– prevent damage to sensitive components

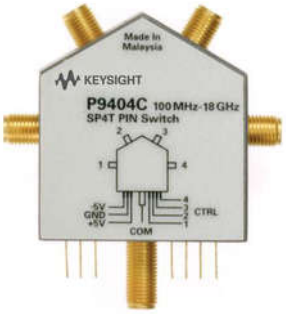
Broad frequency range

– from kHz to 8, 18 or 50 GHz

– low frequency testing







Exceptionally long operating life



Keysight Solid State Switch Features



There are three types of solid state switches

- PIN diode switches
- field-effect transistor (FET) switches
- hybrid switches (FET and PIN diode)

Solid state switches are more reliable and exhibit longer lifetimes than their electromechanical counterparts due to their superior resistance to shock, vibration and mechanical wear. They also offer faster switching times. However, solid state switches have higher insertion loss than electromechanical switches due to their higher innate ON resistance. Therefore solid state switches are preferred in systems where fast switching and long lifetime are essential.

Applications

- RFIC component test
- handset power amplifier test
- SAW filter test

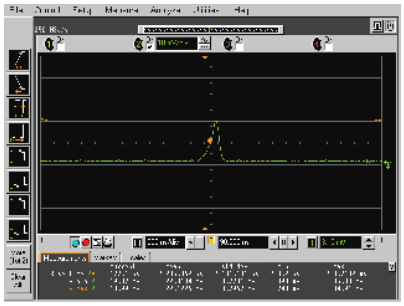
Solid state switches are often used in switch matrix systems for testing of semiconductor devices where high switching speed is critical and power handling requirements are lower.

General performance for solid state switches

	Pin diode	FET	Hybrid
Frequency range	from MHz	from DC	from kHz
Insertion loss	Medium (roll off at low frequencies)	High (roll off at high frequencies)	High (roll off at high frequencies)
Isolation	Good at high frequencies	Good at low frequencies	Good at high frequencies
Repeatability	Excellent	Excellent	Excellent
Switching speed	Fast	Average	Average
Video leakage	Medium	Low	Low
Power handling	Low	Low	Low
Operating life	Long	Long	Long
Power consumption	High	Low	Moderate
Sensitive to	RF power, overstress, temperature	RF power, overstress, temperature	RF power, overstress, temperature
Keysight switch examples	P9400/2/4 85331/2	U9397, U9400	U9397, U9400

Low Video Leakage and Ultra Fast Settling Time

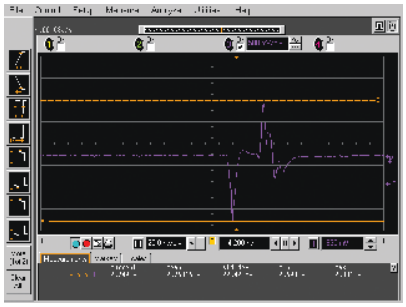




FET switches have low video leakage, typically < 30 mVpp



Keysight PIN diode switches have low video leakage for this type of switch, typically 780 mVpp



Most PIN diode switches have video leakage for of < 10 Vpp

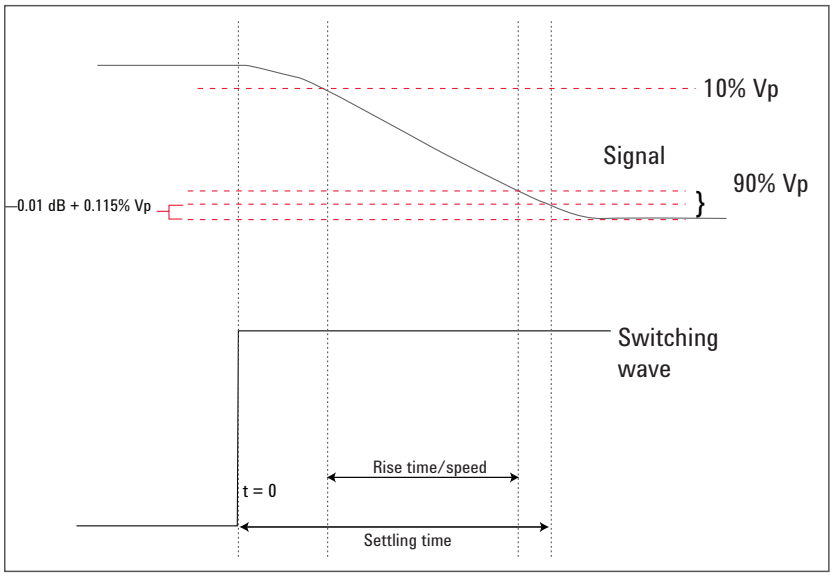
Low video leakage

Video leakage refers to the spurious signals present at the RF ports of the switch when it is switched without an RF signal present. These signals arise from the waveforms generated by the switch driver and, in particular, from the leading edge voltage spike required for high-speed switching of PIN diodes. The amplitude of the video leakage depends on the design of the switch and the switch driver. Video leakage can damage sensitive devices, such as satellite transponders, which use low-power switching (–100 dBm ON/OFF) and instruments, depending on the amplitude of the video leakage.

Keysight's solid state switches are carefully designed to ensure extremely low video leakage. For instance, P940x PIN diode switches offer video leakage of 10 mV ~ 500 mV which is extremely low for a PIN diode switch, while U9397 and U9400 FET switches have less than 30 mVpp video leakage.

Fast switching speeds

Fast switching speed is important in ATE applications where testing throughput is critical. It is especially important in applications that require the stacking of multiple switches in series. Keysight solid state switches exhibit fast switching speed to enable high throughput.



Switching waveform and settling time diagram

Typical Applications for Solid State Switches



Solid state switches are widely used in both basic signal routing and application specific switch matrices such as tree matrices and full access matrices as well as for multisource/multi DUT switching in ATE systems.

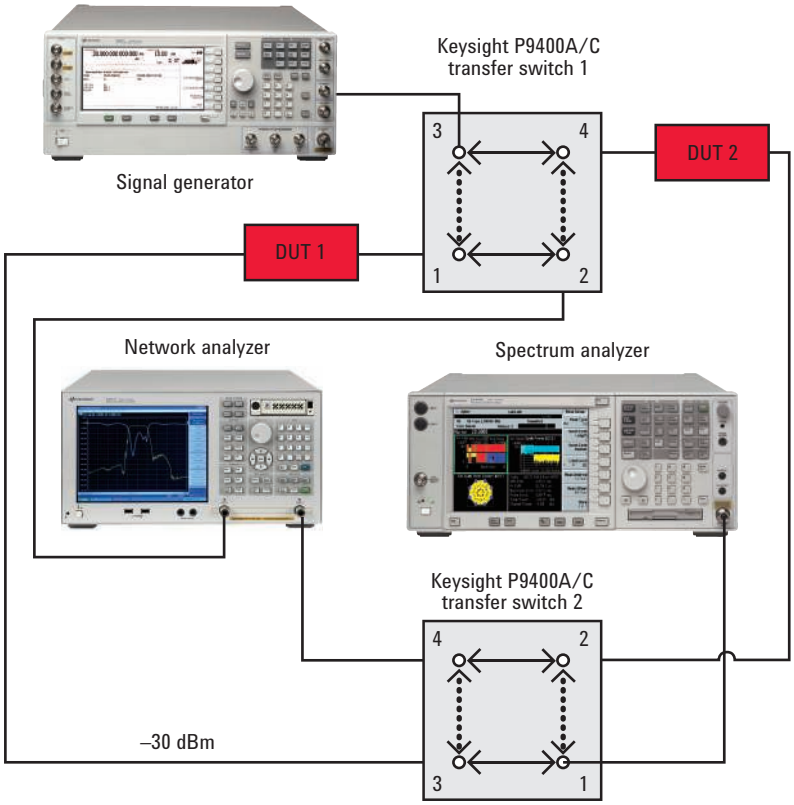
Application requirements

- high isolation
- fast switching speed

Recommended switches

- P9400A/C, U9400A/C

Signal routing for multiple-instrument, multiple-DUT testing



Testing two DUTs simultaneously using two different test sets

Control input	State	DUT 1 connected to	DUT 2 connected to	Tests
High	◄——►	Network analyzer	Network analyzer	S-parameter
Low	◄- - -►	Spectrum analyzer and signal generator	Spectrum analyzer and signal generator	Spurious signal, harmonics



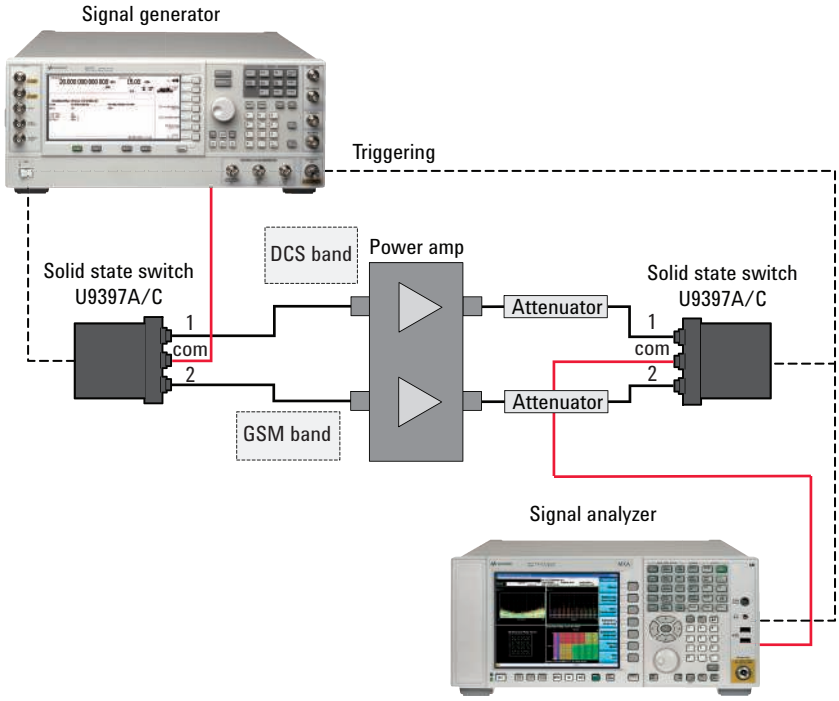
Mobile handset power amplifier testing

Application requirements

- fast settling time
- low video leakage

Recommended switches

- U9397A/C



Simplified test setup for testing GSM/EDGE handset power amplifiers

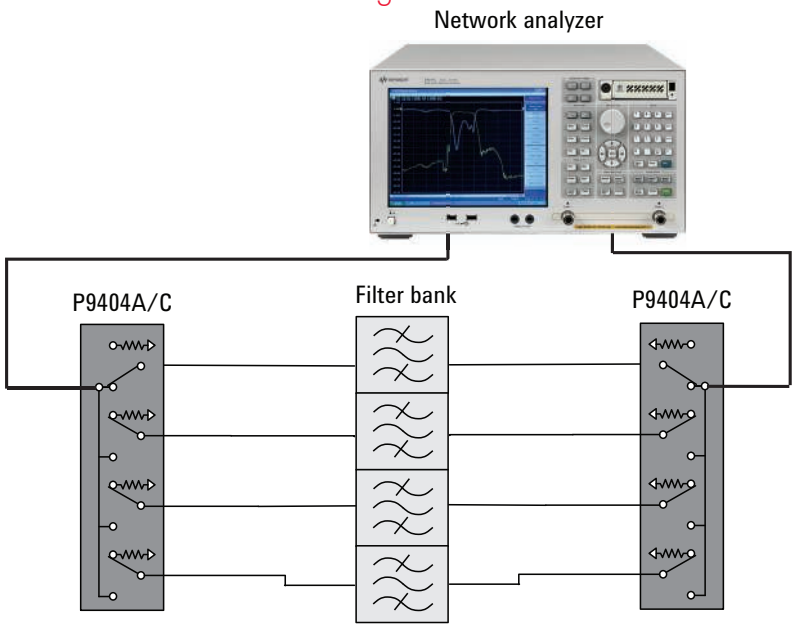
Filter bank: SAW filter testing

Application requirements

- fast switching speed
- fast settling time
- low insertion loss
- compatible logic

Recommended switches

- P9404A/C



Typical test setup for filter bank testing



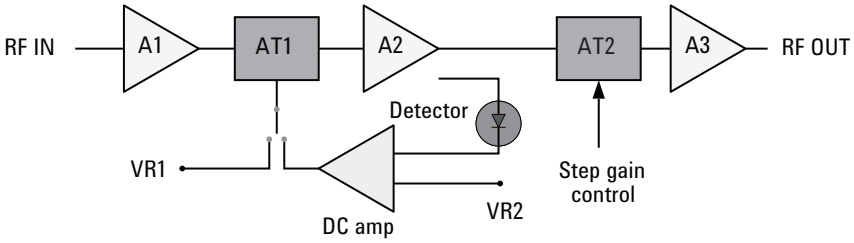
Satellite: testing channel amplifiers with ALC systems

Application requirements

- low video leakage
- fast switching speed

Recommended switches

- U9397A/C, U9400A/C



Channel amplifier with automatic level control (ALC) system for satellite applications

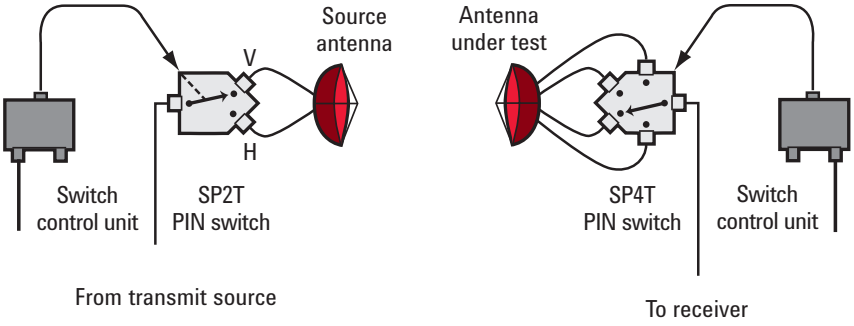
Base station and satellite: antenna testing

Application requirements

- high isolation
- fast switching speed
- fast settling time
- impedance matching

Recommended switches

- P9402A/C, P9404A/C



A typical multiple-channel, multiple-frequency system configuration

Completing Your Switching Solution — Driving the Switches



11713B/C attenuator/switch driver — easy to integrate, easy to use

Keysight 11713B/C attenuator/switch drivers provide remote or front panel drive control for programmable attenuators and electromechanical or solid state switches. Designed with both bench top and ATE environments in mind, these attenuator/switch drivers provide an intuitive user interface, a variety of switching options, software programmability and remote control features for quick, easy design validation and automated testing.



Keysight 11713B switch driver

- **GPIB (LXI optional)**
  control via front panel or remotely with GPIB
- **point-to-point interconnect**
- **intuitive user interface**
  easy to read LCD display
- **integrated power supply**
  +24 Vdc
- **software programmable**
  standard SCPI
- **switch control**
  2 programmable attenuators and 2 SPDT switches or up to 10 SPDT switches

Keysight 11713C switch driver

- **LXI compliant**
  control via front panel or remotely with GPIB, USB, or LAN
- **point-to-point interconnect**
- **intuitive user interface**
  easy to read LCD display
- **integrated power supply**
  + 5 Vdc, +15 Vdc, +24 Vdc, user defined
- **software programmable**
  standard SCPI
- **switch control**
  4 programmable attenuators and 4 SPDT switches or up to 20 SPDT switches



Point-to-point interconnect

Option	Description	Used for
11713B/C-201	Viking connector to 12-pin conductor cable, bare wire	Switch with solder lug (8762/3/4)
11713B/C-301	Viking connector to (4) ribbon cables	SPDT (8765)
11713B/C-401	Dual-viking connector to 16-pin DIP connector	SP6T (87106/L7106)
11713B/C-501	Viking connector to (4) 9-pin Dsub connectors	SPDT/bypass (N181x)
11713B/C-502	Viking connector to (2) 9-pin Dsub connectors	SPDT/bypass (N181x with TTL option)
11713B/C-601	Viking connector to 16-pin DIP connector	SP4T (87104/L7104)
11713B/C-701	Viking connector to 14-pin DIP connector	Inline (8769M)
11713B/C-801	Viking connector to (4) 4-pin DIP connectors	DPDT/transfer (87222/L7222)

Keysight switch drivers

Automated test equipment (ATE) systems come in different sizes and complexity. Keysight meets these needs with a variety of switch drivers. Please review *Switch driver quick selection* on page 18 for a quick overview of the different features.

11713B/C attenuator/switch driver

The 11713B/C attenuator/switch driver is recommended for easy routing of high-frequency signals in small scale ATE systems or benchtop testing. For information on connectivity and cable options for the 11713B/C, see "Ordering Information" at the end of this document. For more detailed configuration information see the *11713B/C Attenuator/Switch Driver Configuration Guide*, literature number 5989-7277EN.

U2121A USB digital I/O module for RF switch control

With the optional RF switch integration kit, the Keysight U2121A digital input/output (DIO) module becomes a convenient, cost-effective way to implement RF switching in small test systems for a variety of applications. The simplified installation and operation of the DIO card and breakout module allows straightforward control of small RF switching systems. This helps you quickly create simple, yet cost-effective RF switch systems.

- Control and monitor up to five RF switches
- Quick, easy setup with bundled RF switch driver software and cable
- Hassle-free setup eliminates complex DC connections, enabling you to focus on RF signal routing
- Programmable DIO power-up states allow storage of pre-defined RF switch state
- Watchdog timer provides fail-safe capability to preserve known states
- Support fail-safe and latching-relay switches for maximum flexibility

For more information on Keysight U2121A-based RF switch driver, go to **www.keysight.com/find/DIOSolution**



The following switch drivers/platforms are usually used in large-scale ATE systems and require configuration. Please see product literature or contact you Keysight Sale Representative for more information.

L4445A microwave switch/attenuator driver

For more detailed information, see the *Keysight L4445A Microwave Switch/ Attenuator Driver Data Sheet,* literature number 5989-4828EN

L4490A/91A RF switch platform

For more detailed information, see the *Keysight L4490A/91A RF Switch Platform Data Sheet*, literature number 5989-7857EN

34980A multifunction switch measure unit

For more detailed information, see the *Keysight 34980A Multifunction Switch/ Measure Unit Data Sheet,* literature number 5989-1437EN

Switch driver quick selection chart

Feature	U2121A with Option 101	11713B/C	L4445A	L4490A/91A	34980A with 34945A
Front panel control	No	Yes	No	No	Yes
LCD display	No	Yes	No	No	Yes
Application	bench-top for small systems	bench-top and ATE in fixture	ATE with switches in fixture	ATE with switches in rack	ATE with mixed signal needs
Capacity	5 channels with 3 general digital inputs and 3 digital output ports	up to 20 channels	32 channels standard, expandable to 256 switches	32 channels standard, expandable to 64 switches	32 channels standard, expandable to 256 switches (also wire multiplexer channels in one mainframe)
Physical size	154.60 mm x 120.00 mm x 32.60 mm (for U2121A); 153 mm x 85 mm x 38 mm (for Option 101 RF switch board)	2½ U	1U, ½ rack	2U/4U	3U mainframe
Voltage supply[1]	24 V	5 V, 15 V, 24 V (and user defined voltage)	24 V (external power supply needed for 5 V and 15 V)	5 V, 12 V, 24 V	24 V (external power supply needed for 5 V and 15 V)
Connectivity	USB	GPIB, USB, LAN (LXI Class C)	LAN (Optional GPIB)	GPIB, USB, LAN (LXI Class C)	GPIB, USB, LAN (LXI Class C)
Options for interconnect	Configuration needed	Point-to-point interconnect	Configuration needed	Configuration needed	Configuration needed

1. All switch drivers are programmable to 30 V with an external power supply.

Typical Application for 11713B/C Attenuator/Switch Drivers



4 x 4 Full access non-blocking switch matrix and 2 x 2 full access blocking switch matrix

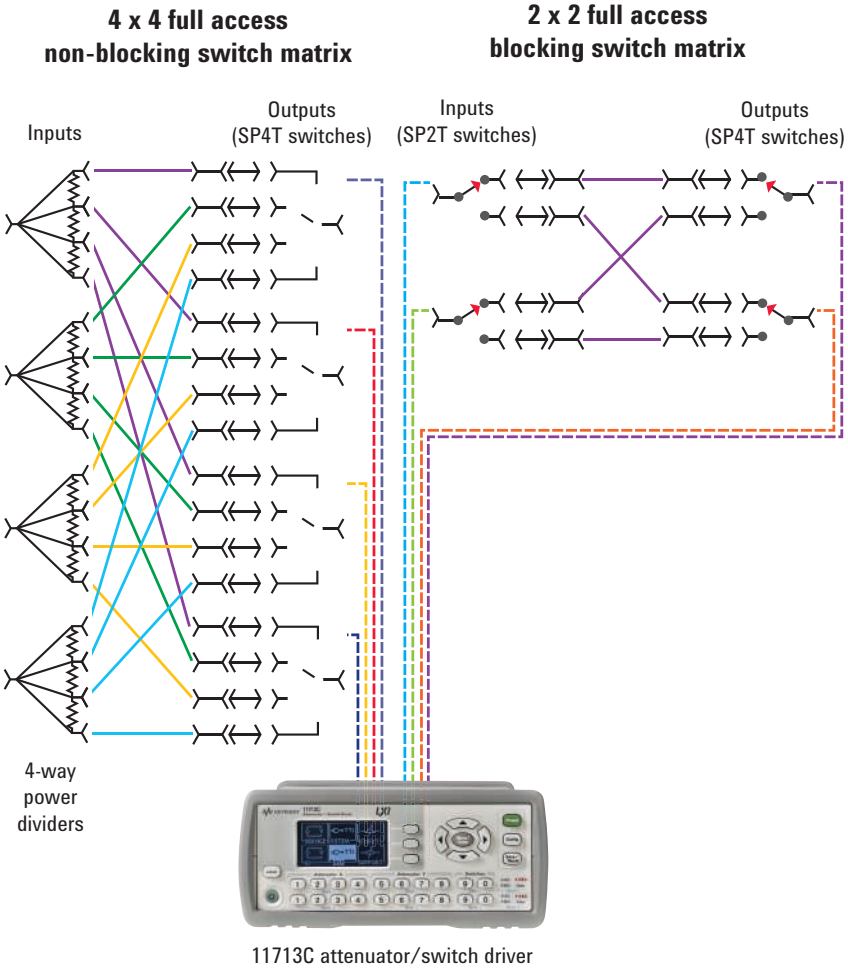
11713B/C attenuator/switch drivers provide the flexibility of driving switch matrices that you create. It is easy to configure, and the instrument and switches can be dismantled and reused where necessary.

Application requirements

- easy front panel and remote control
- point-to-point cables for easy integration

Recommended driver

- 11713B/C attenuator/switch driver



Selection Guide — Selecting the Right Switch Technology



RF and microwave switches are used in a large number of applications, increasing system flexibility and simplifying system design. Expanded capability of components requires numerous tests and more complex signal routing and monitoring capability. Selecting the right switch for your application helps ensure reliable, repeatable performance in your switch matrixes and automated test systems. This section provides useful guidelines to help you in the decision making process. The section that follows provides specifications for all Keysight RF and microwave switches.

Electromechanical and solid state switch parameters

Parameters	Electromechanical	Solid state
Frequency range	from DC	from kHz
Insertion loss	low	high
Return loss	good	good
Repeatability	good	excellent
Isolation	good	excellent
Switching speed	in ms	in ns
Settling time	< 15 ms	< 1 µs
Power handling	high	low
Video leakage	none	low
Operating life	5 million cycles	infinite
ESD immunity	high	low
Sensitive to	vibration	RF power overstress
Target markets	Wireless communications, system integrators	Semiconductor manufacturers, semiconductor testers



What selection criteria do I use?

Today's high-speed manufacturing requires high performance, repeatable switching elements in test instruments and switching interfaces and automated test systems. These elements are defined by the following characteristics:

Frequency range

RF and microwave applications range in frequency from 100 MHz for semiconductor to 60 GHz for satellite communications. Broadband accessories increase test system flexibility by extending frequency coverage. However, frequency is always application dependent and a broad operating frequency may be need to be sacrificed to meet other critical parameters. For example a network analyzer may perform a 1 ms sweep for an insertion loss measurement, so for this application settling time or switching speed becomes the critical parameter for ensuring measurement accuracy.

Insertion loss

In addition to proper frequency selection, insertion loss is critical to testing. Losses greater than one or two dB attenuate peak signal levels, and increase rising and falling edge times. A low insertion loss system can be achieved by minimizing the number of connectors and through-paths, or by selecting low insertion loss devices for system configuration. As power is expensive, especially at high frequencies, electromechanical switches should provide the lowest possible loss along the transmission path.

Return loss

Return loss, expressed in dB, is a measure of voltage standing wave ratio (VSWR). Return loss is caused by impedance mismatch between circuits. At microwave frequencies, the material properties as well as the dimensions of a network element play a significant role in determining the impedance match or mismatch caused by the distributed effect. Keysight switches guarantee excellent return loss performance by incorporating appropriate matching circuits to ensure optimum power transfer through the switch and the entire network.

Repeatability

Low insertion loss repeatability reduces sources of random errors in the measurement path, which improves measurement accuracy. The repeatability and reliability of a switch guarantees measurement accuracy and can cut the cost of ownership by reducing calibration cycles and increasing test system up time.



Isolation

Isolation is the degree of attenuation from an unwanted signal detected at the port of interest. Isolation becomes more important at higher frequencies. High isolation reduces the influence of signals from other channels, sustains the integrity of the measured signal, and reduces system measurement uncertainties.

For instance, a switch matrix may need to route a signal to a spectrum analyzer for measurement at –70 dBm and to simultaneously route another signal at +20 dBm. In this case, switches with high isolation, 90 dB or more, will keep the measurement integrity of the low-power signal.

VSWR

The VSWR of the switches is determined by the mechanical dimensions and tolerances used in their manufacture. Poor VSWR indicates internal reflections due to impedance mismatches, and can lead to inter-symbol interference (ISI) from stray signals caused by these reflections. These reflections usually occur near the connectors; therefore, good connector matching and proper termination are key test requirements.

Switching speed

Switching speed is defined as the time needed to change the state of a switch port (arm) from "ON' to "OFF" or from "OFF" to "ON".

Settling time

As switching time only specifies an end value of 90% of the settled/final value of the RF signal, settling time is often highlighted in solid state switch performance where the need for accuracy and precision is more critical. Settling time is measured to a level closer to the final value. The widely used margin-to-final-value of settling time is 0.01 dB (99.77% of the final value) and 0.05 dB (98.86% of the final value). This specification is commonly used for GaAs FET switches because they have a gate lag effect caused by electrons becoming trapped on the surface of the GaAs. Keysight GaAs FET switches have a patented design that dramatically reduces the gate lag effect and reduces settling time to less than 350 microseconds.



Power handling

Power handling defines the ability of a switch to handle power and is very dependant on the design and materials used. There are different power handling ratings for switches such as hot switching, cold switching, average power and peak power. Hot switching occurs when RF/microwave power is present at the ports of the switching at the time of the switching. Cold switching occurs when the signal power is removed before switching. Cold switching results in lower contact stress and longer life.

Termination

A 50-ohm load termination is critical in many applications, since each opened unused transmission line may have the possibility to resonate. This is important, especially when designing a system which works up to 26 GHz or higher frequencies, where switch isolation drops considerably. When the switch is connected to an active device, the reflected power of an unterminated path could possibly damage the source.

Electromechanical switches are categorized as terminated or unterminated. Terminated EM multiport switches: when a selected path is closed, all other paths are terminated with 50 ohm loads, and the current to all the solenoids is cut off. Unterminated switches reflect power.

Solid state switches are categorized as absorptive or reflective. Absorptive switches incorporate a 50 ohm termination in each of the output ports to present a low VSWR in both the OFF and ON states. Reflective switches conduct RF power when the diode is reverse biased and reflect RF power when forward biased.

Equal path

There are some applications which require equal paths for amplitude match or phase match. In differential signal systems, or systems where phase matching is critical, equal-length, phase-matched paths are recommended. For example, instead of having a low-profile multiport, an equal path is required. High-performance multiport switches configured to have the same path lengths between the common port and outer ports are needed for these types of applications. Also shorter path lengths in the switches lower insertion loss.



Video leakage

Video leakage refers to the spurious signals present at the RF ports of the switch when it is switched without an RF signal present. These signals arise from the waveforms generated by the switch driver and, in particular, from the leading edge voltage spike required for high-speed switching of PIN diodes. The amplitude of the video leakage depends on the design of the switch and the switch driver.

Operating life

A long operating life reduces cost per cycle and budgetary constraints allowing manufacturers to be more competitive in today's price sensitive markets. However manufacturers in some industries such as wireless communications and semiconductors that do not require premium RF switches with a long operating life, may prefer a low-cost alternative that doesn't compromise switching performance.

Switch configurations

Switches come in different configurations providing the flexibility to create complex matrixes and automated test systems for many different applications and frequencies. A list of typical switch configurations and usage follows:

- **Single-pole-double-throw (SPDT) switches** route signals from one input to two output paths.
- **Multiport switches** allow a single input to multiple (three or more) output paths. Keysight offers single-pole-three-throw (SP3T), single-pole-four-throw (SP4T), single-pole-five-throw (SP5T) and single-pole-six-throw (SP6T) multiport switches.
- **Transfer switches** (DPDT) can be used to switch between two inputs and two outputs, as a drop-out switch, for signal reversal, as a SPDT switch, or to bypass a test component.
- **Matrix switches** can be individually connected via internal microwave switches to form an RF path. They can be configured for blocking 1 x 5, 2 x 4, or 3 x 3 switching applications.
- **Bypass switches** insert or remove a test component from a signal path.

Electromechanical (EM) Switch Selection Tables



50 Ohm high performance EM switches

Family	Model	Frequency	Termination	Isolation (dB)	Insertion loss (dB)	SWR	Speed	Average power	Peak power	Life cycle	Connector	Driving voltage (VDC)
SPDT												
SPDT	N1810UL	DC to 67 GHz	Unterminated	60	1.12	1.9	15 ms	1 W	50 W	5 million	SMA (f)[1]	5, 15, 24
SPDT	N1810TL	DC to 67 GHz	Terminated	60	1.12	1.9	15 ms	1 W	50 W	5 million	SMA (f)[1]	5, 15, 24
Multiport												
SP3T	8766K	DC to 26.5 GHz	Unterminated	60	1.5	1.8	20 ms	1 W	100 W	5 million	3.5 mm (f)	5, 10, 15, 24
SP4T	87104A	DC to 4 GHz	Terminated	100	0.36	1.2	15 ms	1 W	50 W	5 million	SMA (f)	24
SP4T	87204A	DC to 4 GHz	Terminated	100	0.36	1.2	15 ms	1 W	50 W	5 million	SMA (f)	24
SP4T	87104B	DC to 20 GHz	Terminated	70	0.6	1.45	15 ms	1 W	50 W	5 million	SMA (f)	24
SP4T	87204B	DC to 20 GHz	Terminated	70	0.6	1.45	15 ms	1 W	50 W	5 million	SMA (f)	24
SP4T	87104C	DC to 26.5 GHz	Terminated	65	0.7	1.7	15 ms	1 W	50 W	5 million	SMA (f)	24
SP4T	87204C	DC to 26.5 GHz	Terminated	65	0.7	1.7	15 ms	1 W	50 W	5 million	SMA (f)	24
SP4T	8767K	DC to 26.5 GHz	Unterminated	60	1.5	1.8	20 ms	1 W	100 W	5 million	3.5 mm (f)	5, 15, 24
SP4T	87104D	DC to 40 GHz	Terminated	65	0.7	1.95	15 ms	1 W	50 W	5 million	2.92 mm (f)	24
SP4T	8767M	DC to 50 GHz	Unterminated	60	2.7	2.3	20 ms	1 W	100 W	5 million	2.4 mm (f/m)	5, 15, 24
SP5T	8768K	DC to 26.5 GHz	Unterminated	60	1.5	1.8	20 ms	1 W	100 W	5 million	3.5 mm (f)	5, 15, 24
SP5T	8768M	DC to 50 GHz	Unterminated	60	2.7	2.3	20 ms	1 W	100 W	5 million	2.4 mm (f/m)	5, 15, 24
SP6T	87106A	DC to 4 GHz	Terminated	100	0.36	1.2	15 ms	1 W	50 W	5 million	SMA (f)	24
SP6T	87206A	DC to 4 GHz	Terminated	100	0.36	1.2	15 ms	1 W	50 W	5 million	SMA (f)	24
SP6T	87106B	DC to 20 GHz	Terminated	70	0.6	1.45	15 ms	1 W	50 W	5 million	SMA (f)	24
SP6T	87206B	DC to 20 GHz	Terminated	70	0.6	1.45	15 ms	1 W	50 W	5 million	SMA (f)	24
SP6T	87106C	DC to 26.5 GHz	Terminated	65	0.7	1.7	15 ms	1 W	50 W	5 million	SMA (f)	24
SP6T	87206C	DC to 26.5 GHz	Terminated	65	0.7	1.7	15 ms	1 W	50 W	5 million	SMA (f)	24
SP6T	8769K	DC to 26.5 GHz	Unterminated	60	1.5	2.05	20 ms	1 W	100 W	5 million	3.5 mm (f)	24
SP6T	87106D	DC to 40 GHz	Termnated	65	0.7	1.95	15 ms	1 W	50 W	5 million	2.92 mm (f)	5, 15, 24
SP6T	8769M	DC to 50 GHz	Unterminated	60	2.7	2.3	20 ms	1 W	100 W	5 million	2.4 mm (f/m)	5, 15, 24
Transfer												
Transfer	87222C	DC to 26.5 GHz	Unterminated	40	0.9	1.65	15 ms	1 W	50 W	5 million	SMA (f)	24
Transfer	87222D	DC to 40 GHz	Unterminated	60	1.2	1.7	15 ms	1 W	50 W	5 million	2.92 mm (f)	24
Transfer	87222E	DC to 50 GHz	Unterminated	60	1.15	1.7	15 ms	1 W	50 W	5 million	2.4 mm (f)	24
Matrix												
6-ports	87406B	DC to 20 GHz	Terminated	70	1	1.9	15 ms	1 W	50 W	5 million	SMA (f)	24
6-ports	87606B	DC to 20 GHz	Terminated	70	1	1.9	15 ms	1 W	50 W	5 million	SMA (f)	24
Bypass												
4-ports	N1811TL	DC to 67 GHz	Terminated	60	1.12	1.9	12 ms	1 W	50 W	5 million	SMA (f)[1]	5, 15, 24
5-ports	N1812UL	DC to 67 GHz	Unterminated	60	1.12	1.9	15 ms	1 W	50 W	5 million	SMA (f)[1]	5, 15, 24

[1] Option 040: 2.92 mm (f), Option 050: 2.4 mm (f), Option 067: 1.85 mm (f)

Electromechanical (EM) Switch Selection Tables



50 Ohm economically priced EM switches

Family / SPDT	Model	Frequency	Termination	Isolation (dB)	Insertion loss (dB)	SWR	Speed	Average power	Peak power	Life cycle	Connector	Driving voltage (VDC)
SPDT	8762A	DC to 4 GHz	Terminated	90	0.25	1.2	30 ms	1 W	100 W	1 million	SMA (f)	5, 15, 24
SPDT	8762B	DC to 18 GHz	Terminated	90	0.5	1.3	30 ms	1 W	100 W	1 million	SMA (f)	5, 15, 24
SPDT	8762C	DC to 26.5 GHz	Terminated	50	1.25	1.8	30 ms	1 W	100 W	1 million	3.5 mm (f)	5, 15, 24
SPDT	8765A	DC to 4 GHz	Unterminated	100	0.3	1.7	15 ms	2 W	100 W	5 million	SMA (f)	5, 10, 15, 24
SPDT	8765B	DC to 20 GHz	Unterminated	65	0.7	1.7	15 ms	2 W	100 W	5 million	SMA (f)	5, 15, 24
SPDT	8765C	DC to 26.5 GHz	Unterminated	50	0.3	1.7	15 ms	2 W	100 W	5 million	3.5 mm (f)	5, 10, 15, 24
SPDT	8765D	DC to 40 GHz	Unterminated	50	1.12	1.5	15 ms	2 W	100 W	5 million	2.4 mm (f)	5, 10, 15, 24
Multiport												
4-port	L7104A	DC to 4 GHz	Terminated	90	0.36	1.2	15 ms	1 W	50 W	2 million	SMA (f)	24
4-port	L7204A	DC to 4 GHz	Unterminated	90	0.36	1.2	15 ms	2 W	100 W	2 million	SMA (f)	24
4-port	L7104B	DC to 20 GHz	Terminated	90	0.6	1.45	15 ms	1 W	50 W	2 million	SMA (f)	24
4-port	L7204B	DC to 20 GHz	Unterminated	90	0.6	1.45	15 ms	2 W	100 W	2 million	SMA (f)	24
4-port	L7104C	DC to 26.5 GHz	Terminated	60	0.7	1.7	15 ms	1 W	50 W	2 million	SMA (f)	24
4-port	L7204C	DC to 26.5 GHz	Unterminated	60	0.7	1.7	15 ms	2 W	100 W	2 million	SMA (f)	24
6-port	L7106A	DC to 4 GHz	Terminated	90	0.36	1.2	15 ms	1 W	50 W	2 million	SMA (f)	24
6-port	L7206A	DC to 4 GHz	Unterminated	90	0.36	1.2	15 ms	2 W	100 W	2 million	SMA (f)	24
6-port	L7106B	DC to 20 GHz	Terminated	90	0.6	1.45	15 ms	1 W	50 W	2 million	SMA (f)	24
6-port	L7206B	DC to 20 GHz	Unterminated	90	0.6	1.45	15 ms	2 W	100 W	2 million	SMA (f)	24
6-port	L7106C	DC to 26.5 GHz	Terminated	60	0.7	1.7	15 ms	1 W	50 W	2 million	SMA (f)	24
6-port	L7206C	DC to 26.5 GHz	Unterminated	60	0.7	1.7	15 ms	2 W	100 W	2 million	SMA (f)	24
Transfer												
Transfer	L7222C	DC to 26.5 GHz	Unterminated	57	0.9	1.65	15 ms	1 W	50 W	2 million	SMA (f)	24
Bypass												
4-ports	8763A	DC to 4 GHz	Terminated	100	0.25	1.2	30 ms	1 W	100 W	1 million	SMA (f)	5, 15, 24
4-ports	8763B	DC to 18 GHz	Terminated	90	1.3	1.3	30 ms	1 W	100 W	1 million	SMA (f)	5, 15, 24
4-ports	8763C	DC to 26.5 GHz	Terminated	50	1.8	1.8	30 ms	1 W	100 W	1 million	3.5 mm (f)	5, 15, 24
5-ports	8764A	DC to 4 GHz	Unterminated	100	0.25	1.2	30 ms	2 W	100 W	1 million	SMA (f)	5, 15, 24
5-ports	8764B	DC to 18 GHz	Unterminated	90	0.5	1.3	30 ms	2 W	100 W	1 million	SMA (f)	5, 15, 24
5-ports	8764C	DC to 26.5 GHz	Unterminated	50	1.25	1.8	30 ms	2 W	100 W	1 million	3.5 mm (f)	5, 15, 24

50 Ohm high power hot switching

Family / SPDT	Model	Frequency	Termination	Isolation (dB)	Insertion loss (dB)	SWR	Speed	Average power	Peak power	Life cycle	Connector	Driving voltage (VDC)
SPDT	8761A	DC to 18 GHz	Unterminated	45	0.8	1.3	50 ms	10 W	5 kW	1 million	SMA (f)	12
SPDT	8761B	DC to 18 GHz	Unterminated	45	0.8	1.2	50 ms	10 W	5 kW	1 million	SMA (f)	26

75 Ohm switch

Family / SPDT	Model	Frequency	Termination	Isolation (dB)	Insertion loss (dB)	SWR	Speed	Average power	Peak power	Life cycle	Connector	Driving voltage (VDC)
SPDT	8762F	DC to 4 GHz	Terminated	90	0.4	1.3	30 ms	2 W	100 W	1 million	Mini SMB (m)	24
SPDT	8765F	DC to 4 GHz	Unterminated	90	0.4	1.2	15 ms	2 W	100 W	5 million	Mini SMB (m)	5, 10, 15, 24

Electromechanical (EM) Switch Selection Tables



50 Ohm high performance EM switch options

Family / SPDT	Model	Frequency	Termination	Indicator	Current interrupt	TTL logic	Solder lug	Suppression diode	Driving voltage (VDC)
SPDT	N1810UL	DC to 67 GHz	Unterminated	Optional	■	Optional	Optional	■	5, 15, 24
SPDT	N1810TL	DC to 67 GHz	Terminated	Optional	■	Optional	Optional	■	5, 15, 24
Multiport									
SP3T	8766K	DC to 26.5 GHz	Unterminated	n/a	■	n/a	n/a	n/a	5, 15, 24
SP4T	87104A	DC to 4 GHz	Terminated	■	■	Optional	Optional	■	24
SP4T	87204A	DC to 4 GHz	Terminated	■	■	n/a	Optional	■	24
SP4T	87104B	DC to 20 GHz	Terminated	■	■	Optional	Optional	■	24
SP4T	87204B	DC to 20 GHz	Terminated	■	■	n/a	Optional	■	24
SP4T	87104C	DC to 26.5 GHz	Terminated	■	■	Optional	Optional	■	24
SP4T	87204C	DC to 26.5 GHz	Terminated	■	■	n/a	Optional	■	24
SP4T	8767K	DC to 26.5 GHz	Unterminated	n/a	■	n/a	n/a	n/a	5, 15, 24
SP4T	87104D	DC to 40 GHz	Terminated	■	■	Optional	Optional	■	24
SP4T	8767M	DC to 50 GHz	Unterminated	n/a	■	n/a	n/a	n/a	5, 15, 24
SP5T	8768K	DC to 26.5 GHz	Unterminated	n/a	■	n/a	n/a	n/a	5, 15, 24
SP5T	8768M	DC to 50 GHz	Unterminated	n/a	■	n/a	n/a	n/a	5, 15, 24
SP6T	87106A	DC to 4 GHz	Terminated	■	■	Optional	Optional	■	24
SP6T	87206A	DC to 4 GHz	Terminated	■	■	n/a	Optional	■	24
SP6T	87106B	DC to 20 GHz	Terminated	■	■	Optional	Optional	■	24
SP6T	87206B	DC to 20 GHz	Terminated	■	■	n/a	Optional	■	24
SP6T	87106C	DC to 26.5 GHz	Terminated	■	■	Optional	Optional	■	24
SP6T	87206C	DC to 26.5 GHz	Terminated	■	■	n/a	Optional	■	24
SP6T	8769K	DC to 26.5 GHz	Unterminated	n/a	■	n/a	n/a	n/a	5, 15, 24
SP6T	87106D	DC to 40 GHz	Termnated	■	■	Optional	Optional	■	24
SP6T	8769M	DC to 50 GHz	Unterminated	n/a	■	n/a	n/a	n/a	5, 15, 24
Transfer									
Transfer	87222C	DC to 26.5 GHz	Unterminated	■	■	n/a	Optional	■	24
Transfer	87222D	DC to 40 GHz	Unterminated	■	■	n/a	Optional	■	24
Transfer	87222E	DC to 50 GHz	Unterminated	■	■	n/a	Optional	■	24
Matrix									
6-ports	87406B	DC to 20 GHz	Terminated	■	■	n/a	Optional	■	24
6-ports	87606B	DC to 20 GHz	Terminated	n/a	■	n/a	Optional	■	24
Bypass									
4-ports	N1811TL	DC to 67 GHz	Terminated	Optional	■	Optional	Optional	■	5, 15, 24
5-ports	N1812UL	DC to 67 GHz	Unterminated	Optional	■	Optional	Optional	■	5, 15, 24

A black square (■) represents the default option.

Electromechanical (EM) Switch Selection Tables



50 Ohm economically priced EM switch options

Family / SPDT	Model	Frequency	Termination	Indicator	Current interrupt	TTL logic	Solder lug	Suppression diode	Driving voltage (VDC)
SPDT	8762A	DC to 4 GHz	Terminated	n/a	■	Optional	■	■	5, 15, 24
SPDT	8762B	DC to 18 GHz	Terminated	n/a	■	Optional	■	■	5, 15, 24
SPDT	8762C	DC to 26.5 GHz	Terminated	n/a	■	Optional	■	■	5, 15, 24
SPDT	8765A	DC to 4 GHz	Unterminated	n/a	n/a	n/a	Optional	■	5, 10, 15, 24
SPDT	8765B	DC to 20 GHz	Unterminated	n/a	n/a	n/a	Optional	■	5, 10, 15, 24
SPDT	8765C	DC to 26.5 GHz	Unterminated	n/a	n/a	n/a	Optional	■	5, 10, 15, 24
SPDT	8765D	DC to 40 GHz	Unterminated	n/a	n/a	n/a	Optional	■	5, 10, 15, 24
Multiport									
4-port	L7104A	DC to 4 GHz	Terminated	■	■	Optional	Optional	■	24
4-port	L7204A	DC to 4 GHz	Unterminated	■	■	Optional	Optional	■	24
4-port	L7104B	DC to 20 GHz	Terminated	■	■	Optional	Optional	■	24
4-port	L7204B	DC to 20 GHz	Unterminated	■	■	Optional	Optional	■	24
4-port	L7104C	DC to 26.5 GHz	Terminated	■	■	Optional	Optional	■	24
4-port	L7204C	DC to 26.5 GHz	Unterminated	■	■	Optional	Optional	■	24
6-port	L7106A	DC to 4 GHz	Terminated	■	■	Optional	Optional	■	24
6-port	L7206A	DC to 4 GHz	Unterminated	■	■	Optional	Optional	■	24
6-port	L7106B	DC to 20 GHz	Terminated	■	■	Optional	Optional	■	24
6-port	L7206B	DC to 20 GHz	Unterminated	■	■	Optional	Optional	■	24
6-port	L7106C	DC to 26.5 GHz	Terminated	■	■	Optional	Optional	■	24
6-port	L7206C	DC to 26.5 GHz	Unterminated	■	■	Optional	Optional	■	24
Transfer									
Transfer	L7222C	DC to 26.5 GHz	Unterminated	■	■	■	Optional	■	24
Bypass									
4-ports	8763A	DC to 4 GHz	Terminated	n/a	■	Optional	■	■	5, 15, 24
4-ports	8763B	DC to 18 GHz	Terminated	n/a	■	Optional	■	■	5, 15, 24
4-ports	8763C	DC to 26.5 GHz	Terminated	n/a	■	Optional	■	■	5, 15, 24
5-ports	8764A	DC to 4 GHz	Unterminated	n/a	■	Optional	■	■	5, 15, 24
5-ports	8764B	DC to 18 GHz	Unterminated	n/a	■	Optional	■	■	5, 15, 24
5-ports	8764C	DC to 26.5 GHz	Unterminated	n/a	■	Optional	■	■	5, 15, 24

50 Ohm high power hot switching switch options

Family / SPDT	Model	Frequency	Termination	Indicator	Current interrupt	TTL logic	Solder lug	Suppression diode	Driving voltage (VDC)
SPDT	8761A	DC to 18 GHz	Unterminated	n/a	n/a	n/a	■	n/a	12
SPDT	8761B	DC to 18 GHz	Unterminated	n/a	n/a	n/a	■	n/a	26

75 Ohm switch options

Family / SPDT	Model	Frequency	Termination	Indicator	Current interrupt	TTL logic	Solder lug	Suppression diode	Driving voltage (VDC)
SPDT	8762F	DC to 4 GHz	Terminated	n/a	n/a	n/a	■	■	24
SPDT	8765F	DC to 4 GHz	Unterminated	n/a	n/a	n/a	Optional	■	5, 10, 15, 24

A black square (■) represents the default option.

Solid State Switch Selection Table and Ordering Information



Solid state switches											
Family	Model	Frequency	Termination	Isolation (dB)	Insertion loss (dB)	Return loss for ON port (dB)	Switching speed rise/fall	Typical video le (mVpp)	Connector	Input power (average) (dBm)	Driving voltage (VDC)
PIN SPDT											
SPDT	P9402A	100 MHz to 8 GHz	Absorptive	80	3.2	15	380 ns	3400	SMA (f)	23	5
SPDT	P9402C	100 MHz to 18 GHz	Absorptive	80	4	10	380 ns	3400	SMA (f)	23	5
SPDT	85331B	45 MHz to 50 GHz	Absorptive	75	15.5 at 26.5 GHz	4.5	1 µs	7000	2.4 mm (f)	27	7
SP4T	P9404A	100 MHz to 8 GHz	Absorptive	80	3.5	15	350 ns	2800	SMA (f)	27	5
SP4T	P9404C	100 MHz to 18 GHz	Absorptive	80	4.5	10	350 ns	2800	SMA (f)	27	5
SP4T	85332B	45 MHz to 50 GHz	Absorptive	75	15.5 at 26.5 GHz	4.5	1 µs	7000	2.4 mm (f)	27	7
PIN Transfer											
Transfer	P9400A	100 MHz to 8 GHz	NA	80	3.5	15	200 ns	600	SMA (f)	23	5
Transfer	P9400C	100 MHz to 18 GHz	NA	80	4.2	10	200 ns	600	SMA (f)	23	5
FET SPDT											
FET SPDT	U9397A	300 kHz to 8 GHz	Absorptive	100	3.5	15	5 /0.5 µs	10	SMA (f)	29	12 to 24 V
FET SPDT	U9397C	300 kHz to 18 GHz	Absorptive	90	6.5	10	5 /0.5 µs	10	SMA (f)	27	12 to 24 V
FET Transfer											
FET Transfer	U9400A	300 kHz to 8 GHz	NA	100	3.5	15	4 /0.5 µs	5	SMA (f)	29	11 to 26 V
FET Transfer	U9400C	300 kHz to 18 GHz	NA	90	6.5	10	5 /1 µs	5	SMA (f)	27	11 to 26 V

Solid state switches are standard and do not require option selection.



Ordering Information for Electromechanical Switches



SPDT switch options

Model	Option type	Option	Option description
8761A/8761B	Coil voltage	A	12 to 15 Vdc
		B	24 to 30 Vdc
	Connector code option (Port1) (Port2) (PortC)	0	N (f)
		1	N (m)
		2	APC-7 threaded sleeve
		3	APC-t coupling nut
		4	7mm for UT-250 coax
		5	SMA (f)
		6	SMA (m)
		7	50 Ohm termination (for Port 1 and Port 2 only)
8762A/8762B/8762C	Coil voltage	024	24 Vdc
		T24	TTL/5V CMOS compatible logic with 24 Vdc supply
		011	5 Vdc
		015	15 Vdc
		T15	TTL/5V CMOS compatible logic with 15 Vdc supply
8762F	Coil voltage	024	24 Vdc
		011	5 Vdc
		015	15 Vdc
8765A/8765B/ 8765C/8765D/ 8765F	Coil voltage	005	5 Vdc with 3-inch ribbon cable
		305	5 Vdc with solder terminals
		010	10 Vdc with 3-inch ribbon cable
		310	10 Vdc with solder terminals
		015	15 Vdc with 3-inch ribbon cable
		315	15 Vdc with solder terminals
		024	24 Vdc with 3-inch ribbon cable
		324	24 Vdc with solder terminals
	RF connector	241	2.4 mm (f) (For 8765D only)
		292	2.92 mm (f)
	DC connector	108	8-inch ribbon cable extension
		116	16-inch ribbon cable extension
		004	DC to 4 GHz
N1810TL/ N1810UL	Frequency range	020	DC to 20 GHz
		026	DC to 26.5 GHz
		040	DC to 40 GHz
		050	DC to 50 GHz
		067	DC to 67 GHz
	Coil voltage	105	5 Vdc and includes Option 402
		115	15 Vdc
		124	24 Vdc
	DC connector	201	D-submini 9 pin (f)
		202	Solder lugs
	Performance	301	High isolation
		302	Low SWR & insertion loss
		UK6	Calibration certificate with test data
	Drive	401	TTL/5V CMOS compatible
		402	Position indicator

Ordering Information for Electromechanical Switches



Multiport switch options

Model	Option type	Option	Option description
8766K/8767K/ 8768K/8769K	Coil voltage	024	24 Vdc
		011	5 Vdc
		015	15 Vdc
	RF Connector	002	SMA (f) (Use to 18 GHz only)
		004	3.5 mm (f)
	DC connector	060	5 feet DC control cable; 12-pin viking
		016	16-inch ribbon cable extension
87104A/87104B/ 87104C/87104D, 87106A/87106B/ 87106C/87106D	Control logic	T24	TTL/5V CMOS compatible logic with 24 Vdc supply
		024	24 Vdc
	DC connector	161	Ribbon receptacle
		100	Solder terminals
87204A/87204B/87204C, 87206A/87206B/87206C	DC connector	161	Ribbon receptacle
		100	Solder terminals
L7104A/ L7104B/ L7104C, L7106A/ L7106B/ L7106C	Control logic	T24	TTL/5V CMOS compatible logic with 24 Vdc supply
		024	24 Vdc
	DC connector	161	Ribbon receptacle
		100	Solder terminals

Transfer switch options

Model	Option type	Option	Option description
87222C/87222D/ 87222E/L7222C	DC connector	161	10-PIN DIP
		100	Solder terminals and 10-PIN DIP
	Accessories	201	Mounting brackets; assembly required

Matrix switch options

Model	Option type	Option	Option description
87406B	DC connector	161	Ribbon receptacle
		100	Solder terminals
	Control logic	T24	TTL/5V CMOS compatible logic with 24 Vdc supply
		024	24 Vdc
87606B	DC connector	161	Ribbon receptacle
		100	Solder terminals



Bypass switch options

Model	Option type	Option	Option description
8763A/8763B/ 8763C, 8764A/ 8764B/8764C	Drive	T15	TTL/5V CMOS compatible logic with 15 Vdc supply
		T24	TTL/5V CMOS compatible logic with 24 Vdc supply
	Coil voltage	024	24 Vdc
		011	5 Vdc
		015	15 Vdc
N1811TL/ N1812UL	Frequency range	004	DC to 4 GHz
		020	DC to 20 GHz
		026	DC to 26.5 GHz
	Coil voltage	105	5 Vdc and includes Option 402
		115	15 Vdc
		124	24 Vdc
	DC connector	201	D-submini 9-pin (f)
		202	Solder lugs
	Performance	301	High isolation
		302	Low SWR & insertion loss
		UK6	Calibration certificate with test data
	Control logic	401	TTL/5V CMOS compatible
		402	Position indicator

Electromechanical switch option descriptions

In general, electromechanical switches will be comprised of the options below. Various options are needed for applications in the industry.

Indicator — A set of internally mounted contacts mechanically connected to the switch actuator allowing external monitoring of switch RF status.

Suppression diodes — This option offers fast-recovery rectifiers (diodes) connected in parallel with the coils of the switch to suppress any transient voltage generated by the coils. Suppression Diodes are recommended with TTL Logic.

TTL logic — Transistor-transistor-logic driver circuitry which enables the status of the switch to be controlled by the level of the TTL logic input.

Ordering Information for Electromechanical Switches



Switch ordering example

Sensing type

1: Provides position sensing when used with customer supplied external circuitry only.

2: Provides position sensing when used with Keysight 87130A/70611A driver or customer supplied external circuitry.

Keysight 87 2 4 B — Option 100 — Option T24 — Option UK6

Switch type	Frequency range	DC connector	Control logic [1]	Calibration documentation
4: SP4T	A: 4 GHz	161: Ribbon receptacle	024: 24 Vdc drive	UK6: Commercial calibration test data with certificate
6: SP6T	B: 20 GHz	100: Solder terminals	T24: TTL/5V CMOS compatible logic with 24 Vdc supply	
	C: 26.5 GHz			

Here is an example of ordering system of Keysight switches. More detailed information can be found in the *Keysight Technologies RF and Microwave Test Accessory Catalog 2006-07,* literature number 5968-4314EN or in the technical overview for the switch model.

11713B/C Attenuator/Switch Driver Ordering Information



11713B		
Connectivity options		
Option STD		Standard configuration, full backward compatibility to 11713A
Option LXI		LXI Class-C configuration, additional USB/LAN connectivity, full backward compatibility to 11713A
Cable options	**Part number**	
11713B-001	11764-60004	Viking connector to 10-pin DIP connector
11713B-101	8120-2703	Viking connector to viking connector
11713B-201	5061-0969	Viking connector to 12-pin conductor cable, bare wire
11713B-301	11761-60001	Viking connector to 4 ribbon cables
11713B-401	11713-60042	Dual-viking connector to 16-pin DIP connector
11713B-501	11713-60043	Viking connector to (4) 9-pin Dsub connectors
11713B-502	11713-60049	Viking connector to (2) 9-pin Dsub connectors
11713B-601	11713-60044	Viking connector to 16-pin DIP connector
11713B-701	5064-7848	Viking connector to 14-pin DIP connector
11713B-801	11713-60047	Viking connector to (4) 4-pin DIP connectors
Rack mount kit options (optional)	**Part number**	
11713B-908	5063-9240	Rack mount kit for one instrument
11713B-909	5061-9496 and 5063-9212	Rack mount kit for two instruments

11713C		
Cable options	**Part number**	
11713C-001	11764-60004	Viking connector to 10-pin DIP connector
11713C-101	8120-2703	Viking connector to viking connector
11713C-201	5061-0969	Viking connector to 12-pin conductor cable, bare wire
11713C-301	11761-60001	Viking connector to 4 ribbon cables
11713C-401	11713-60042	Dual-viking connector to 16-pin DIP connector
11713C-501	11713-60043	Viking connector to (4) 9-pin Dsub connectors
11713C-502	11713-60049	Viking connector to (2) 9-pin Dsub connectors
11713C-601	11713-60044	Viking connector to 16-pin DIP connector
11713C-701	5064-7848	Viking connector to 14-pin DIP connector
11713C-801	11713-60047	Viking connector to (4) 4-pin DIP connectors
Rack mount kit options (optional)	**Part number**	
11713C-908	5063-9240	Rack mount kit for one instrument
11713C-909	5061-9496 and 5063-9212	Rack mount kit for two instruments

Note: Cable and rack mount kit can be ordered as stand-alone accessories.

For more detailed configuration information see the *11713B/C Attenuator/ Switch Driver configuration Guide,* literature number 5989-7277EN.

Related Literature

Download free application notes

Selecting the right switch technology for your application,
literature number 5989-5189EN

Video Leakage Effects on Devices in Component Test,
literature number 5989-6086EN

How Operating Life and Repeatability of Keysight's Electro-mechanical Switches Minimize System Uncertainty, literature number 5989-6085EN

Power Handling Capability of Electromechanical Switch,
literature number 5989-6032EN

Understanding RF and Microwave Solid State Switch and Its Applications,
literature number 5989-7618EN

Download or order from www.keysight.com/find/mta

Request a free Keysight Technologies RF and Microwave Test Accessories Catalog, 2006/07

- Easy-to-read product selection and comparison tables
- Local product contact information and technical resources

Order a copy of the MTA catalog, literature number 5968-4314EN at www.keysight.com/find/catalogmta

For latest news on Keysight RF and Microwave Test Accessories, please visit www.keysight.com/find/mtanewproducts

Quantity discounts

Save up to 15% on selected microwave test accessories.

For more information, see *Save Up to 15% on Selected Microwave Test Accessories,* literature number 5989-6803EN,

FAST delivery

Keysight authorized distributors around the world have ready stock to meet your deadlines. Contact us today for more information. To find a distributor in your area, go to **www.keysight.com/find/distributors**

For information on Keysight switches, please visit www.keysight.com/find/switches

myKeysight

myKeysight

www.keysight.com/find/mykeysight
A personalized view into the information most relevant to you.

www.lxistandard.org
LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. Keysight is a founding member of the LXI consortium.

Three-Year Warranty
www.keysight.com/find/ThreeYearWarranty
Keysight's commitment to superior product quality and lower total cost of ownership. The only test and measurement company with three-year warranty standard on all instruments, worldwide.

Keysight Assurance Plans
www.keysight.com/find/AssurancePlans
Up to five years of protection and no budgetary surprises to ensure your instruments are operating to specification so you can rely on accurate measurements.

www.keysight.com/quality
Keysight Technologies, Inc.
DEKRA Certified ISO 9001:2008
Quality Management System

Keysight Channel Partners
www.keysight.com/find/channelpartners
Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

www.keysight.com/find/mta

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:
www.keysight.com/find/contactus

Americas

Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
United States	(800) 829 4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100

Europe & Middle East

Austria	0800 001122
Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
Italy	800 599100
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5009286
Spain	0800 000154
Sweden	0200 882255
Switzerland	0800 805353 Opt. 1 (DE) Opt. 2 (FR) Opt. 3 (IT)
United Kingdom	0800 0260637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-07-10-14)

KEYSIGHT TECHNOLOGIES

This information is subject to change without notice.
© Keysight Technologies, 2010-2014
Published in USA, July 31, 2014
5989-6031EN
www.keysight.com