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Keysight Technologies

8765A/B/C/D Microwave SPDT Switches

DC to 4, 20, 26.5 and 40 GHz

Technical Overview



KEYSIGHT TECHNOLOGIES

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Introduction

Features and description

- High isolation
- Exceptional reliability, long life (5 million cycles)
- Excellent repeatability (± 0.03 dB)
- Unterminated

The Keysight Technologies, Inc. 8765 family of switches is designed for microwave instrumentation and ATE systems and features excellent electrical and mechanical performance.

The 8765A and 8765B are equipped with SMA connectors and operate from DC to 4 and 20 GHz respectively. The higher performance 8765C and D switches operate from DC to 26.5 GHz with 3.5 mm connectors, and 40 GHz with 2.4 mm connectors.

For applications that call for 2.92 mm connectors, Option 292 can be ordered with the 8765D. All the switches are available with voltage options covering any drive voltage between 4.5 volts and 32 volts DC. Where performance data is required, Option UK6 includes a print out of test results.

This family of switches was designed from the ground up for maximum dependability and performance. The switches are all designed to operate within their specifications for 5 million cycles with better than 0.03 dB of insertion loss repeatability at 25 °C.

Driving the Keysight 8765A/B/C/D

The 8765 switch family is available with two methods for connecting to the DC control circuitry. The standard switch comes with a ribbon cable terminated with a single in-line five position male connector with one pin removed. The user has the option of ordering solder terminals (Option 3xx) where they are required (Figure 3). The 8765 Switches have both sides of the switching solenoids available to the user. Typically, as is the case with the 8762 switches, the switching solenoids will have a common positive terminal or a common ground. By making both sides of each coil available, users can select the DC drive method that best suits their needs. The suggested methods are:

1. Common negative drive
2. Common positive drive
3. Polarity reversal drive

Regardless of which method is chosen for switching, two conditions will always apply:

- The switch is positive latching, and
- Since there are no DC current interrupts, the supply may be continuous or may be switched off after the 15 ms switching time.

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Common negative drive

With the common negative drive method, the two outside pins on the ribbon cable or the two outside terminals on the solder block are connected together to form a common negative or ground. Switching is then accomplished by applying the appropriate positive voltage to either of the inner pins or terminals (Figure 1a).

Common positive drive

To drive the switch with a common positive arrangement, the two inner pins or terminals are tied together and then to a positive voltage. To effect switching, one of the two outer pins or terminals is brought to ground (Figure 1a).

Polarity reversal drive

To drive the switch using a polarity reversal scheme, the two inner pins or terminals are tied together. The switch will complete a circuit between the two RF contacts on the side of the switch to which the negative or ground potential has been connected (Figure 1a).

Interfacing the Keysight 8765

The 8765 family of switches is a available with two DC control connection options. The standard switch is connected to the DC drive circuitry via a ribbon cable. Option 3xx allows soldering wires between the control circuitry and the switch.

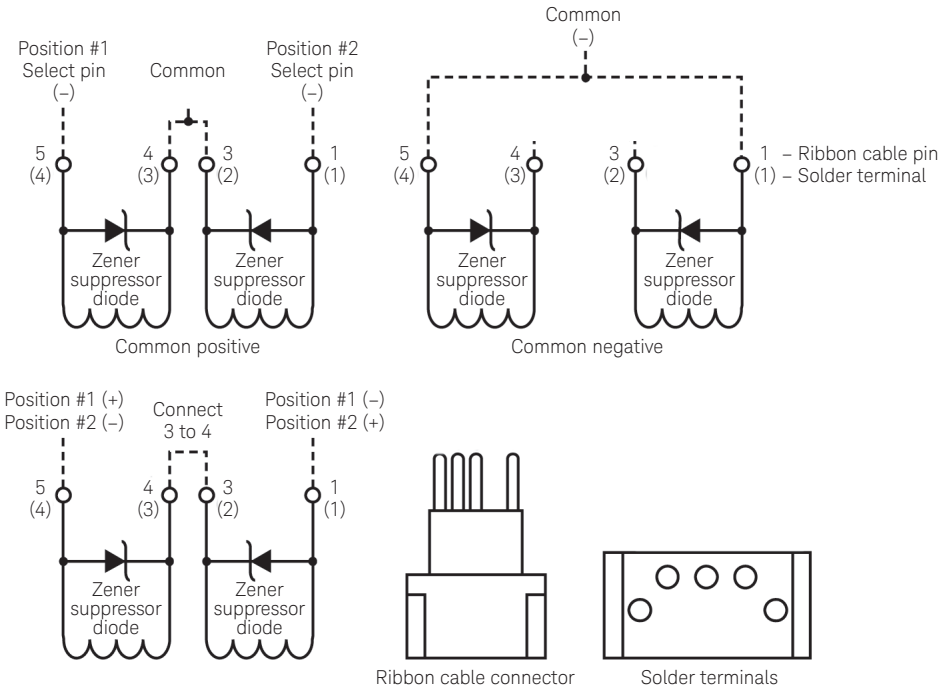


Figure 1a. DC control circuit configurations

Ribbon cable

The kapton flex circuit ribbon cable on the standard switch is terminated to a single in-line male polarized connector with four 0.64 mm (0.025 in.) square pin posts on 2.54 mm (0.100 in.) centers. Position number 2 has been removed to facilitate polarization of the plug and receptacle (Figure 1a). To assist you in connecting your drive circuit to the switch's ribbon cable connector, a six foot long four wire cable is included with every standard switch. The cable is terminated on one end with a 0.64 mm (0.025 in.) square pin receptacle. The five position receptacle is polarized to mate with the switch's ribbon cable connector. The opposite end of the cable is left unterminated for connecting to your control circuits.

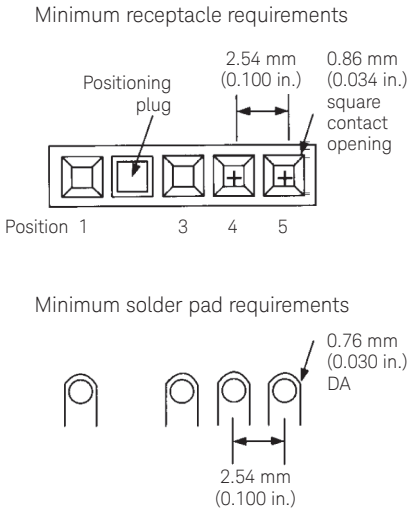


Figure 1b. Suggested receptacle dimensions

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The six foot cable provides a quick and convenient way of connecting the switch to your control circuits for evaluation and low volume production. For high volume production a more convenient or more permanent connection may be suggested. Soldering the ribbon cable connector into a circuit board provides a reliable and rugged connection. Mating the ribbon cable connector to a PC board connector provides a quick to install and remove connection. The suggestions below are intended to provide minimum connection requirements. These suggestions are not endorsements or recommendations of one method over another. It is the responsibility of the user to determine the suitability for use of any interconnect method for a particular application.

PC board connectors

PC board connectors are available in surface mount and solder pin styles and in horizontal and vertical orientations. This type of connector makes connection to and disconnection from the DC circuit quick and convenient. The connectors should be a minimum of five positions wide, and depending upon the number of switches to be connected can be any multiple of five positions (ie. 10, 15, 25, etc.). Single row or double row configurations can also be used to increase connector density. The contacts should accept 0.64 mm (0.025 in.) square pins set on 2.54 mm (0.100 in.) centers and up to 5.84 mm (0.230 in.) long. Use of a polarizing plug in the second position of each switch connection is recommended to help ensure proper orientation.

The PC board hole pattern should have the center lines of the through holes along a single axis separated by 2.54 mm ± 0.08 mm (0.100 in. ± 0.003 in.). The suggested hole diameter for a 0.64 mm (0.025 in.) pin is 1.00 mm ± 0.076 mm (0.040 in. ± 0.003 in.). Figure 1b shows a suggested receptacle dimension.

Soldered connections

The ends of the switch ribbon cable can also be soldered directly to a PC board. This method provides a semipermanent connection that can withstand higher vibration environments than can the PC board connectors. Omission of position 2 in the PC hole pattern is suggested to help prevent soldering the connector in the wrong orientation.

Optional ribbon connector extension cables

Optional extension cables for the switch ribbon cable connector are available as Option 108 for an 8 inch extension and Option 116 for a 16 inch extension. The cables have male and female ends configured as indicated in figure la “Ribbon Cable Connector” and Figure 1b “Minimum Receptacle Requirements.” These ribbon cables can be connected to the DC control circuitry with the same methods suggested above.

Optional solder terminals

Solder terminals in place of the ribbon cable for connecting to the DC control circuitry are available as Option 3xx. The four solder terminals provide access to both sides of each of the solenoids.

Easy GPIB programmability

The Keysight 8765 switch family can be easily used in ATE systems with GPIB control using the 11713A Attenuator/ Switch Driver. The 11713A provides manual and programmable control of up to 10 24 V switches or solenoids. Connecting between the 11713A and four 8765A/B/C/D Option 024 switches is made easy via the 11761A cable/ adapter. The 11713A provides 24 Vdc and 0.65 A continuously or 1.3 A peak (up to 1 second). The non-interrupting 8765 Option 024 draws 120 mA continuously, allowing the 11713A to drive up to five of these switches at a time. Five more DC circuit interrupting 8762/3/4s or up to five sections of step attenuators or multiport switches can be driven simultaneously.

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Specifications

Model	8765A	8765B	8765C	8765D
Frequency range	DC to 4 GHz	DC to 20 GHz	DC to 26.5 GHz	DC to 40 GHz
Insertion loss (dB) (f is frequency in GHz)	0.2 + 0.025 f	0.2 + 0.025 f	0.25 + 0.027 f	0.2 + 0.023 f (DC to 26.5 GHz) 0.75 + 0.023 f (26.5 to 40 GHz)
Typical insertion loss*	0.2 at 4 GHz	0.2 at 4 GHz 0.5 at 20 GHz	0.2 at 4 GHz 0.5 at 20 GHz 0.7 at 26.5 GHz	0.2 at 4 GHz 0.5 at 20 GHz 0.7 at 26.5 GHz 1.0 at 40 GHz
Isolation (dB) (f is frequency in GHz)	110 - 2.25 f	110 - 2.25 f	110 - 2.25 f	110 - 2.25 f (DC to 26.5 GHz) 50 dB (26.5 to 40 GHz)
Typical isolation*	120 at 4 GHz	120 at 4 GHz 90 at 20 GHz	120 at 4 GHz 90 at 20 GHz 60 at 26.5 GHz	120 at 4 GHz 90 at 20 GHz 60 at 26.5 GHz 50 at 40 GHz
SWR	<1.2 DC to 4 GHz	<1.2 DC to 4 GHz <1.35 4 to 12.4 GHz <1.45 12.4 to 18 GHz <1.7 18 to 20 GHz	<1.25 DC to 4 GHz <1.45 4 to 18 GHz <1.7 18 to 26.5 GHz	<1.10 DC to 4 GHz <1.30 4 to 26.5 GHz <1.50 26.5 to 40 GHz
Typical SWR*	<1.15 DC to 4 GHz	<1.15 DC to 4 GHz <1.3 4 to 12.4 GHz <1.4 12.4 to 20 GHz	<1.15 DC to 4 GHz <1.3 4 to 12.4 GHz <1.4 12.4 to 26.5 GHz	<1.05 DC to 4 GHz <1.24 to 26.5 GHz <1.3 26.5 to 40 GHz
Connectors: standard Options	SMA (f)	SMA (f)	3.5 mm (f)	2.4 mm (f) (Option 241) 2.92 mm (f) (Option 292)
Repeatability (Up to 5,000,000 cycles measured at 25 °C)	<0.03 dB	<0.03 dB	<0.03 dB	<0.03 dB
Maximum power rating	2 watt average for switching with power applied 100 watt peak, non-switching			
Life	5 million cycles			
Switching speed	15 ms maximum			

* Specifications describe the instrument's warranted performance. Supplemental and typical characteristics are intended to provide information.

Solenoid electrical specifications and switching voltage options

Option	Voltage	Current	Impedance
005, 305	5 (4.5 to 7) Vdc	385 mA at 5 Vdc	13 Ω, 8 mH
010, 310	10 (7 to 12) Vdc	300 mA at 10 Vdc	33 Ω, 25 mH
015, 315	15 (12 to 20) Vdc	200 mA at 15 Vdc	75 Ω, 55 mH
024, 324	24 (20 to 30) Vdc	120 mA at 24 Vdc	200 Ω, 135 mH

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Environmental

Operating temperature	–25 °C to 75 °C	
Storage temperature	–55 °C to 85 °C	
Temperature cycling	–55 °C to 85 °C, 10 cycles per MIL-STD 202F, Method 107D, Condition A (Modified)	
Vibration	Operating	7 g's: 5 to 2000 Hz at 0.25" p-p
	Survival	20 g's: 20 to 2000 Hz at 0.06" p-p, 4 min/cycle, 4 cycles/axis
Random	Survival	2.41 g(rms) 10 min/axis
Shock	Half sine	500 g's at 0.5 ms, 3 drops/direction, 18 total
	Operating	50 g's at 6 ms, 6 directions
Moisture resistance	65 °C, 95% RH, 10 days per MIL-STD-202F, Method 106E	
Altitude storage	50,000 ft (15,240 meters) per MIL-STD-202F, Method 105C, Condition B	
RFI	Per MIL-STD-461C, RE02, Part 4	
Electrostatic discharge	25 kV maximum	
Abuse	2 W, CW, 1 kw peak pulse (10 µS), 2 minute duration	

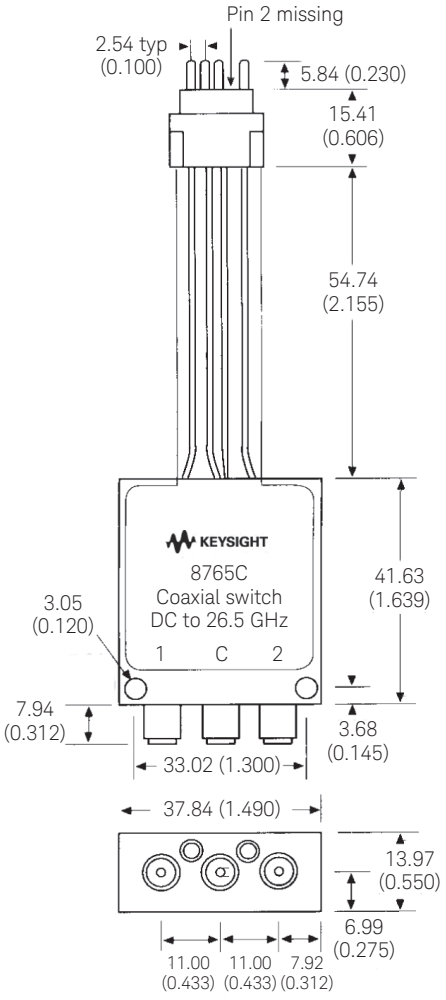
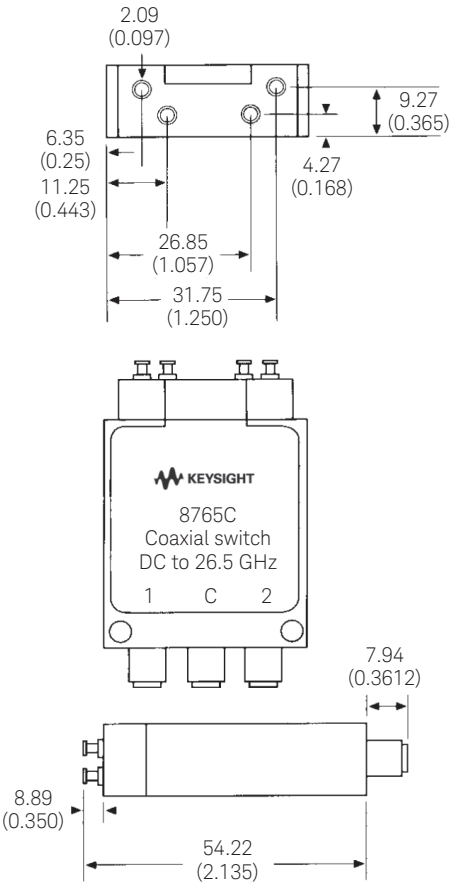


Figure 2. Standard unit part dimensions in millimeters and (inches)



This drawing is not to scale.

Figure 3. Option 3xx with solder terminals part dimensions in millimeters and (inches)

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Ordering information

All switches must be ordered with a voltage option to be valid. Standard switches are equipped with ribbon cables terminated to a single in-line connector (see information inside data sheet for application information). All standard switches come with a six foot cable with mating connector on one end to facilitate connection to the user's control circuitry.

Connectors

The Keysight 8765D may be ordered with optional 2.92 mm connectors in place of the 2.4 mm connectors. 2.92 mm connectors can mate with 3.5 mm connectors.

Calibration data

Option UK6 includes a print out of the SWR (reflection) and insertion loss data for the switch as measured on the automatic network analyzer. The network analyzer's measurement uncertainties have been minimized and all measurements are directly traceable to NIST standards (not available for Option 292).

Accessories

The Keysight 11761A Cable/Adapter is available for directly connecting the ribbon cables of up to four 8765 switches to the 11713A Attenuator/Switch Driver. This cable is 5 feet long.

The Keysight 11713A Attenuator/Switch driver is designed to provide manual and GPIB control of switches and attenuators. The 11713A can drive up to five 8765 series switches and five self-interrupting switches, such as the 8762, 3 or 4, or step attenuator sections. Option 024 switches (24 V) must be ordered for use with the 11713A.

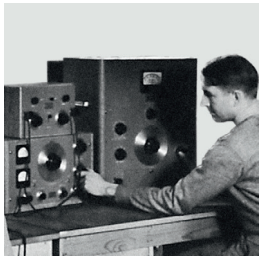
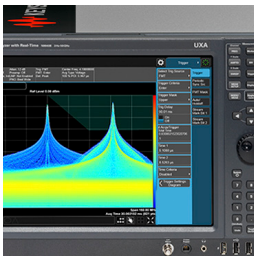
Keysight 8765A/B/C/D options and accessories

Microwave SPDT switches	
8765A	DC to 4 GHz
8765B	DC to 20 GHz
8765C	DC to 26.5 GHz
8765D	DC to 40 GHz
Options	
To add options to a product, use the following scheme:	
Model	8765x (x = A, B, C, D)
Model options	8765x – option 1 8765x – option 2
Supply voltage (must choose one)	
8765x-005	5 V DC supply voltage with 3 inch ribbon cable terminated with a single in-line
8765x-010	10 V DC supply voltage with 3 inch ribbon cable terminated with a single in-line
8765x-015	15 V DC supply voltage with 3 inch ribbon cable terminated with a single in-line
8765x-024	24 V DC supply voltage with 3 inch ribbon cable terminated with a single in-line
8765x-305	5 V DC supply voltage with solder terminal
8765x-310	10 V DC supply voltage with solder terminals
8765x-315	15 V DC supply voltage with solder terminals
8765x-324	24 V DC supply voltage with solder terminals
Calibration documentation	
8765x-UK6	Commercial calibration certificate with test data
Accessories	
8765x-108	8 inch (20.3 cm) DC cable extension
8765x-116	16 inch (40.6 cm) DC cable extension
RF connectors	
8765D-241	2.4 mm female
8765D-292	2.92 mm female

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