Solid state

USB / TTL RF SP16T Switch

USB-1SP16T-83H

50Ω 1 to 8000 MHz

The Big Deal

- Very high isolation, 90 dB typ
- High speed switch transition, 5 µs typ
- High power handling, +30 dBm max
- USB & TTL power & control

Software Package

Case Style: RB2574

Model No.	Description	Qty.
USB-1SP16T-83H	**Switch Matrix**	**1**
	Included Accessories	
MUSB-CBL-3+	2.6 ft USB cable	1

Typical Applications

- Cellular handset / BTS testing
- High volume production testing / ATE
- Design verification testing
- RF signal routing / switch matrices

RoHS Compliant

See our web site for RoHS Compliance methodologies and qualifications

Product Overview

Mini-Circuits' USB-1SP16T-83H is a high isolation (90 dB typical), absorptive SP16T switch with USB and TTL control. The fast switching, solid state switch operates from 1 MHz to 8000 MHz with 5 µs typical switch transition speed and high linearity (+50 dBm typ IP3) which allow the model to be used for a wide variety of RF applications.

Full software support is provided for USB control, including our user-friendly GUI application for Windows and a full API with programming instructions for Windows and Linux environments (both 32-bit and 64-bit systems). The latest version of the full software package can be downloaded from **https://www.minicircuits.com/softwaredownload/solidstate.html** at any time.

The USB-1SP16T-83H is housed in a low profile, rugged metal case (10.98" x 2.50" x 0.6") with 17 SMA (F) connectors (COM, and J1 to J16), a USB Mini-B port and a D-Sub 9 pin port for power and TTL control.

Key Features

Feature	Advantages
RF SP16T absorptive switch	Wideband (1 to 8000 MHz) with high isolation (90 dB typ.), and high power rating (+30 dBm through path) makes this switch suitable for a wide range of applications.
High Linearity (IP3 +50 dBm typ.)	Results in little or negligible inter-modulation generation, meeting requirements for digital communications signals
Internal DC Blocking capacitors at RF ports	No need for external DC blocking circuitry
Full software support included	Mini-Circuits' full software package, programming and user manual are available for down load from **https://www.minicircuits.com/softwaredownload/solidstate.html** at no extra cost.

Mini-Circuits®
www.minicircuits.com P.O. Box 350166, Brooklyn, NY 11235-0003 (718) 934-4500 sales@minicircuits.com

Electrical Specifications @ 0 to 50°C

Parameter	Port	Conditions	Min.	Typ.	Max.	Units
Operating Frequency			1		8000	MHz
Insertion Loss	COM to any active port	1 to 3000 MHz	–	5.5	7.5	dB
		3000 to 7000 MHz	–	7.5	11.0	
		7000 to 8000 MHz	–	9.5	13.0	
Isolation	Between any ports J1 to J16	1 to 3000 MHz	63	90	–	dB
		3000 to 7000 MHz	67	88	–	
		7000 to 8000 MHz	60	78	–	
	COM to any terminated port @ disconnected state	1 to 3000 MHz	80	100	–	
		3000 to 7000 MHz	83	100	–	
		7000 to 8000 MHz	75	100	–	
	COM to any terminated port @ active states	1 to 3000 MHz	67	85	–	
		3000 to 7000 MHz	67	85	–	
		7000 to 8000 MHz	62	78	–	
VSWR	COM port @active states	1 to 3000 MHz	–	1.25	–	:1
		3000 to 7000 MHz	–	1.45	–	
		7000 to 8000 MHz	–	1.50	–	
	Any port connected to COM @ active states	1 to 3000 MHz	–	1.25	–	
		3000 to 7000 MHz	–	1.40	–	
		7000 to 8000 MHz	–	1.35	–	
	Any terminated port (includes COM in disconnected state)	1 to 3000 MHz	–	1.25	–	
		3000 to 7000 MHz	–	1.20	–	
		7000 to 8000 MHz	–	1.30	–	
Power Input @1 dB Compression [1]	COM to any active port	10 to 8000 MHz	–	+31.5	–	dBm
IP3 [1,2]	COM to any active port	10 to 5000 MHz	–	+50	–	dBm
		5000 to 8000 MHz	–	+45	–	
Transition Time [4]	–	–	–	5	9.5	µs
Minimum dwell time [5]	High Speed Mode	–	–	15	–	µs
Switching Time (USB) [6]	–	–	–	2	–	ms
Rated voltage	USB or D-Sub port	–	4.75	5	5.25	V
Rated Current		–	–	60	90	mA
Operating RF Input Power	Through path	Hot Switching	–	–	+20	dBm
		Cold switching, 1 - 10 MHz	Derate Linearly from +30 dBm @10 MHz to +25 dBm @ 1 MHz			
		Cold switching, 10 - 8000 MHz	–	–	+30	
	Any terminated port	–	–	–	+25	

[1] Compression and IP3 may degrade below 10 MHz.
[2] IP3 Tested with 1 MHz span between signals, +5 dBm per tone.
[3] Switching time spec represents the time that the RF signal paths are interrupted during switching and thus is specified without communication delays.
[4] Transition time spec represents the time that the RF signal paths are interrupted during switching and thus is specified without communication delays.
[5] Minimum dwell time is the shortest time that can be achieved between 2 switch transitions when programming an automated switch sequence.
[6] Switching time(USB) is the time from issuing a single software command via USB to the switch state changing. The most significant factor is the host PC, influenced by CPU load and USB protocol. The time shown is an estimate for a medium CPU load and USB 2.0 connection.

Absolute Maximum Ratings

Operating Temperature		0°C to 50°C
Storage Temperature		-20°C to 60°C
DC supply voltage max. (USB or D-Sub pin 1)		6V
Voltage at TTL control pins		3.6V
RF power into termination		+26 dBm
RF power @ Through path	1 to 10 MHz	Derate linearly from +31 dBm @ 10 MHz to +30 dBm @1 MHz
	10 to 8000 MHz	+31 dBm
DC voltage @ RF Ports		16V

Permanent damage may occur if any of these limits are exceeded. Operating in the range between operating power limits and absolute maximum ratings for extended periods of time may result in reduced life and reliability.

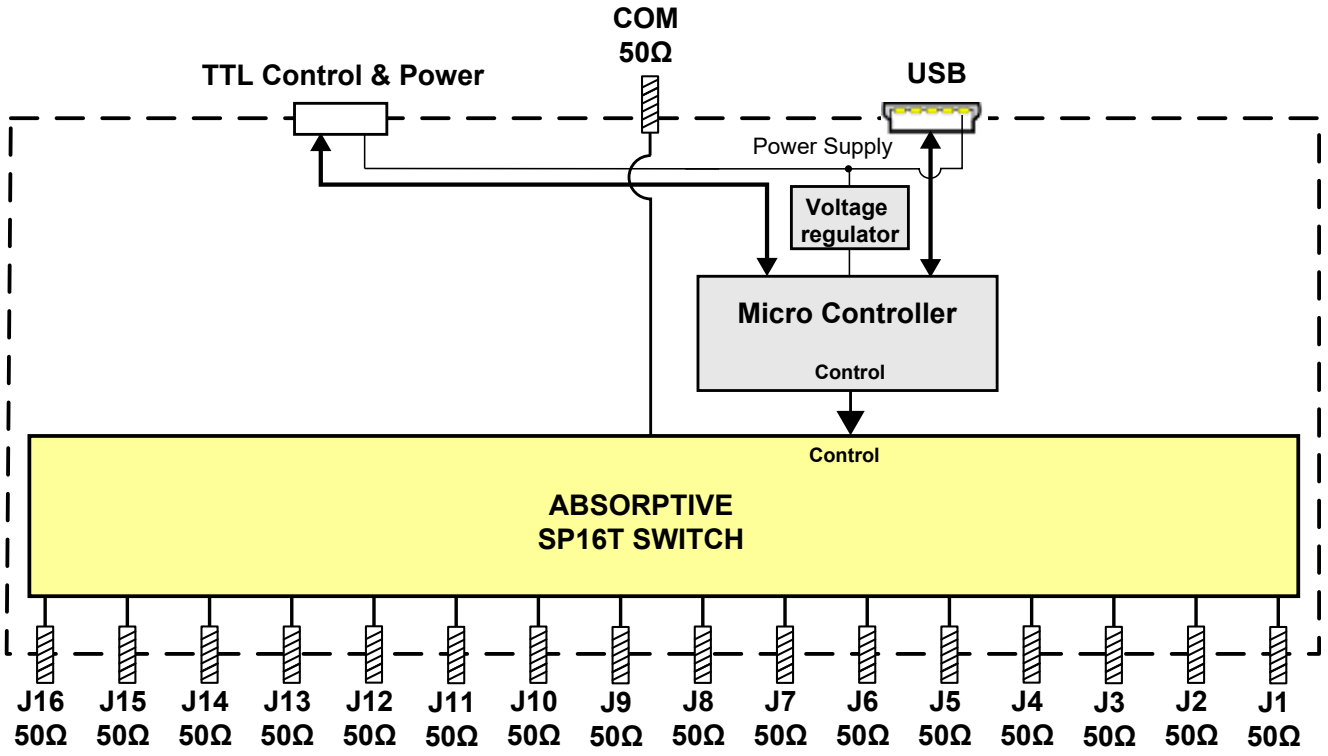
Connections

RF SP16T Switch (J1 to J16, COM)	(SMA female)
USB	(USB type Mini-B receptacle)
TTL control & power	(9 pin D-sub - Female)*

*9 Pin D-Sub Pin Connections

PIN Number	Function
1	Vcc
2	GND
3	D0
4	D1
5	D2
6	D3
7	D4
8	Not Connected
9	Not Connected

Simplified Diagram



TTL communication parameters

Parameter	Conditions		Min.	Typ.	Max.	Units
Voltage levels	Logic High Voltage	Input	2.0	–	3.3	V
	Logic Low Voltage	Input	0	–	0.8	

The USB-1SP16T-83H TTL control interface consists of 5 unlatched parallel control bits that select the desired switch state, as shown in the truth table below. The parallel control does not have any latch and thus will respond immediately to any change.

Connecting the switch to USB control and establishing USB communication will disable the TTL control until the switch is reset by disconnecting and then reconnecting power.

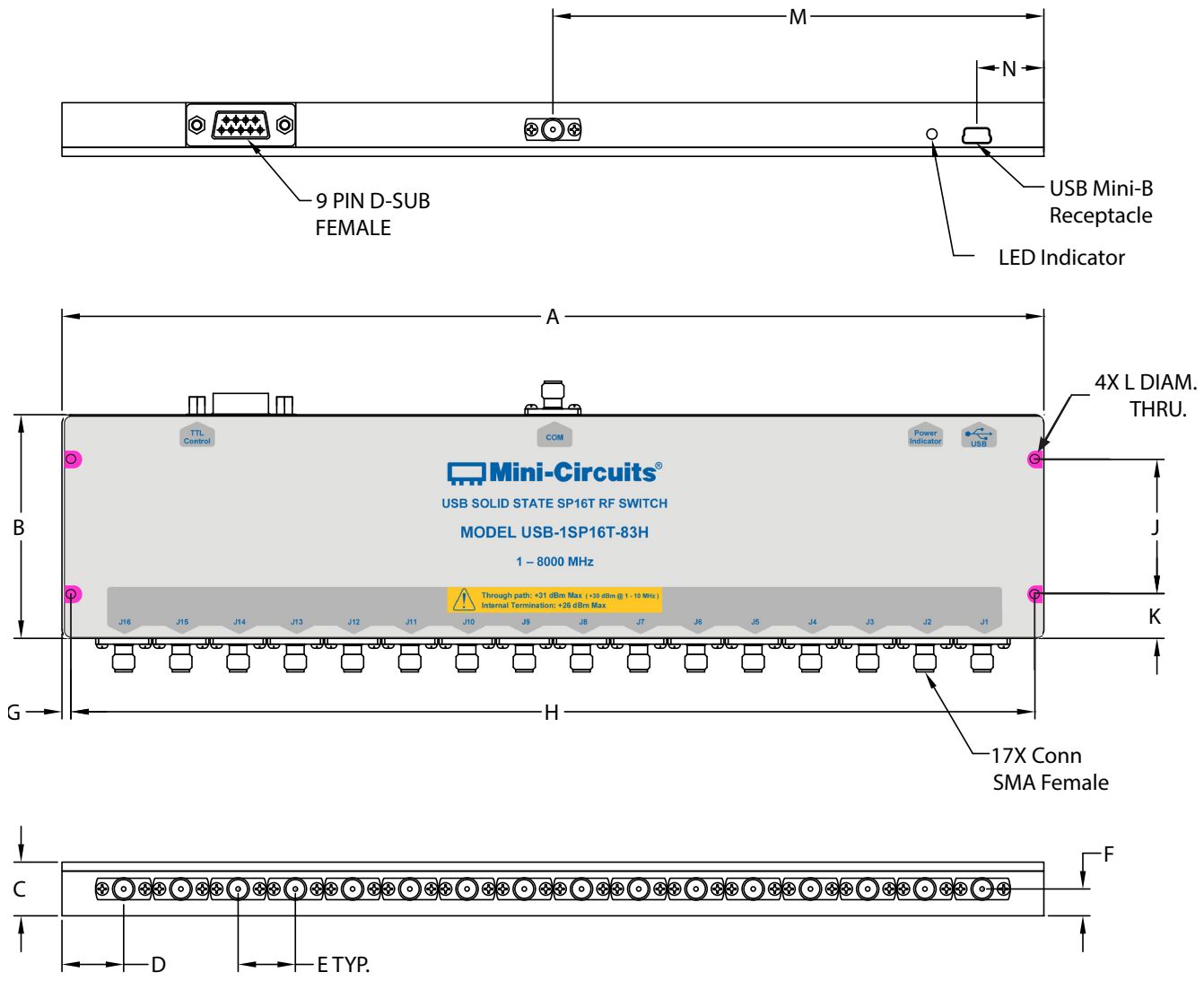
All TTL controls are connected with internal pull-down resistors so the default state of the switch is disconnected state.

Power can be provided via either the D-Sub port or USB port, regardless of the control method used.

Switch state	Control Bits				
	D0	D1	D2	D3	D4
Disconnected	Logic Low	Logic Low	Logic Low	Logic Low	Logic Low
COM -> 1	**Logic High**	Logic Low	Logic Low	Logic Low	Logic Low
COM -> 2	Logic Low	**Logic High**	Logic Low	Logic Low	Logic Low
COM -> 3	**Logic High**	**Logic High**	Logic Low	Logic Low	Logic Low
COM -> 4	Logic Low	Logic Low	**Logic High**	Logic Low	Logic Low
COM -> 5	**Logic High**	Logic Low	**Logic High**	Logic Low	Logic Low
COM -> 6	Logic Low	**Logic High**	**Logic High**	Logic Low	Logic Low
COM -> 7	**Logic High**	**Logic High**	**Logic High**	Logic Low	Logic Low
COM -> 8	Logic Low	Logic Low	Logic Low	**Logic High**	Logic Low
COM -> 9	**Logic High**	Logic Low	Logic Low	**Logic High**	Logic Low
COM -> 10	Logic Low	**Logic High**	Logic Low	**Logic High**	Logic Low
COM -> 11	**Logic High**	**Logic High**	Logic Low	**Logic High**	Logic Low
COM -> 12	Logic Low	Logic Low	**Logic High**	**Logic High**	Logic Low
COM -> 13	**Logic High**	Logic Low	**Logic High**	**Logic High**	Logic Low
COM -> 14	Logic Low	**Logic High**	**Logic High**	**Logic High**	Logic Low
COM -> 15	**Logic High**	**Logic High**	**Logic High**	**Logic High**	Logic Low
COM -> 16	Logic Low	Logic Low	Logic Low	Logic Low	**Logic High**

All inactive ports will be internally terminated to 50 Ω.
In disconnected state, all ports including COM port will be terminated internally.
Note maximum input power to internal termination listed on page 2 & 3.

Outline Drawing (RB2574)

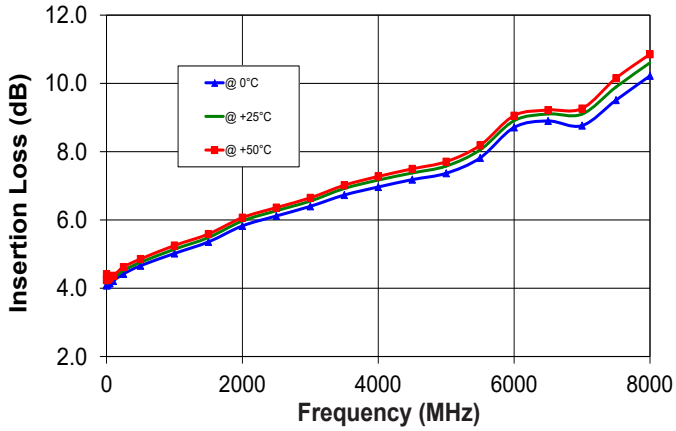


Outline Dimensions (inch / mm)

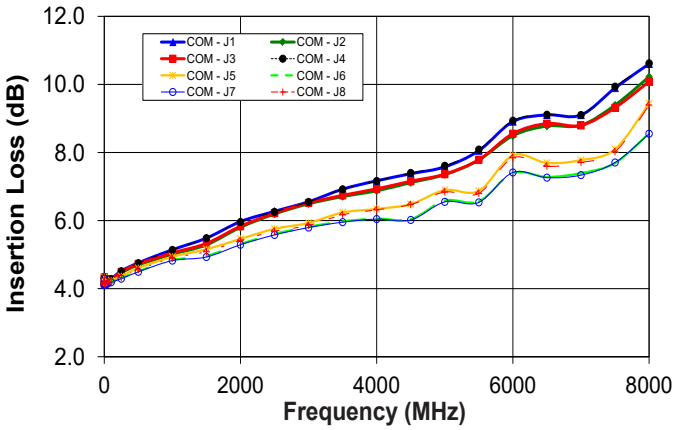
A	B	C	D	E	F	G	H	J	K	L	M	WT. GRAMS
10.98	**2.50**	**0.60**	**0.69**	**0.640**	**0.300**	**0.10**	**10.780**	**1.500**	**0.50**	**0.106**	**5.49**	**650**
278.9	63.5	15.24	17.53	16.26	7.62	2.54	273.81	38.10	12.7	2.69	139.45	

Typical Performance Curves

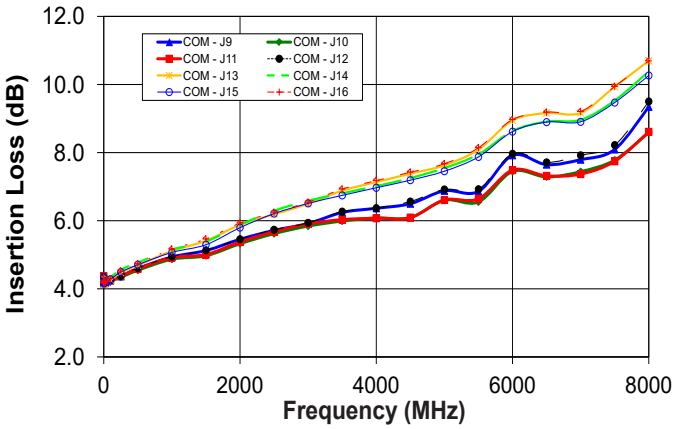
Insertion Loss over Temp.



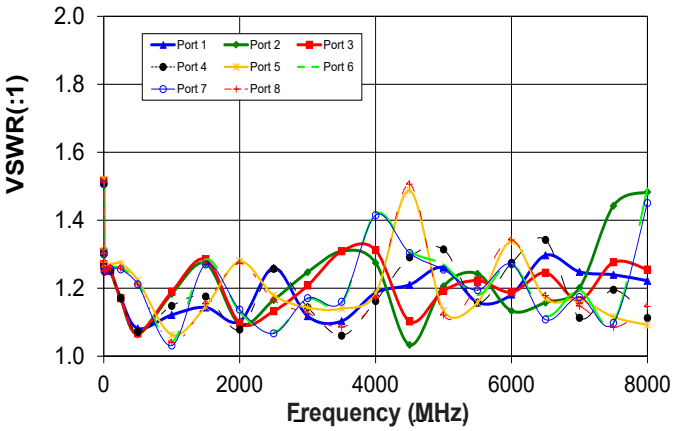
Insertion Loss of outputs J1-J8 in switch



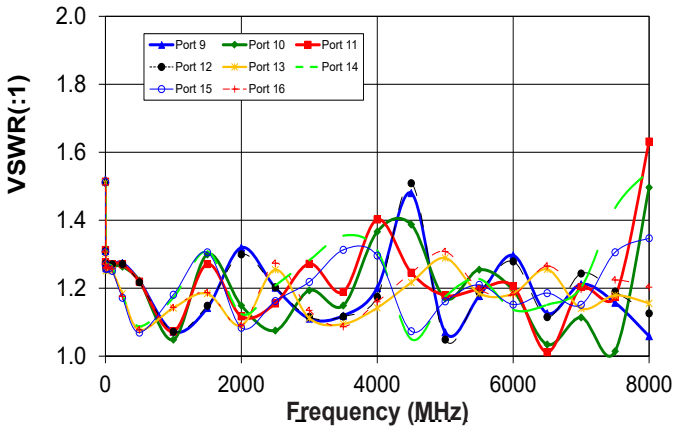
Insertion Loss of outputs J9-J16 in switch



VSWR of active ports J1- J8

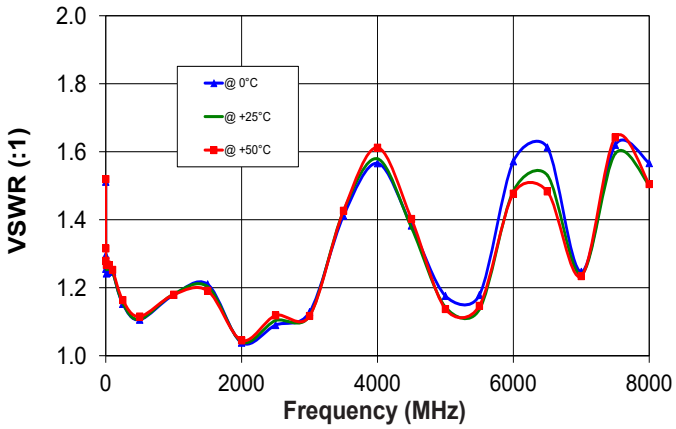


VSWR of active ports J9- J16

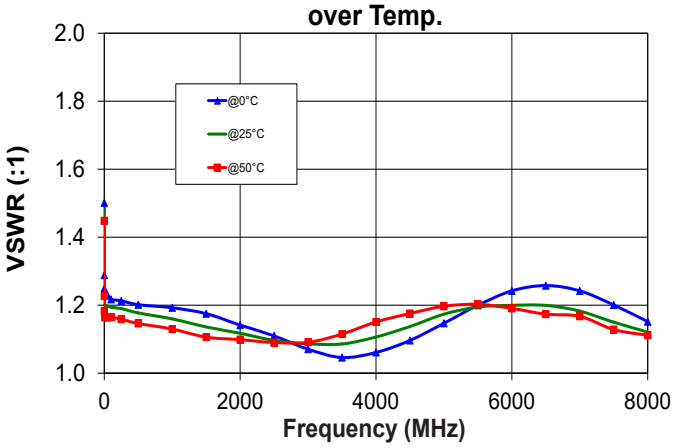


Typical Performance Curves

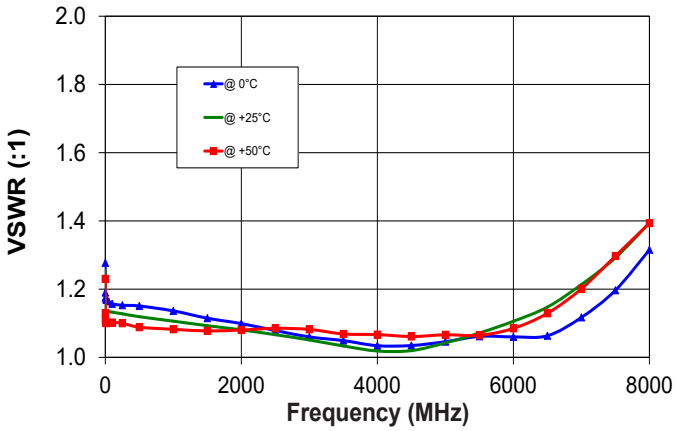
VSWR Common Port (Active) over Temp.



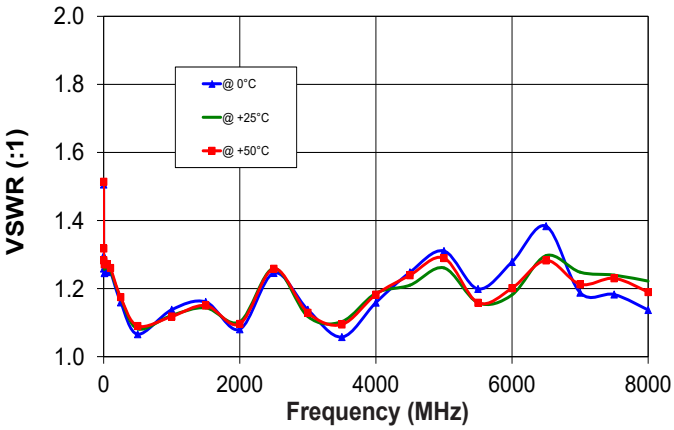
VSWR Common Port (Terminated) over Temp.



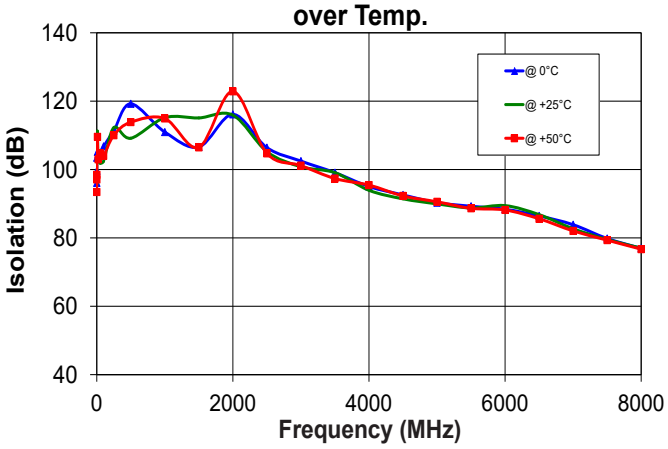
VSWR Output (Terminated) over Temp.



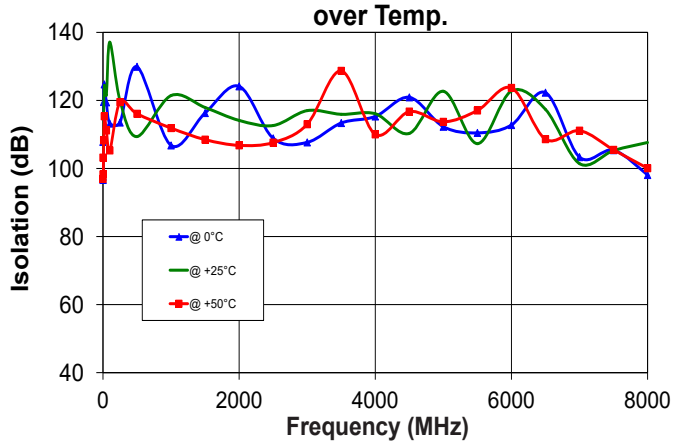
VSWR Output (Active) over Temp.



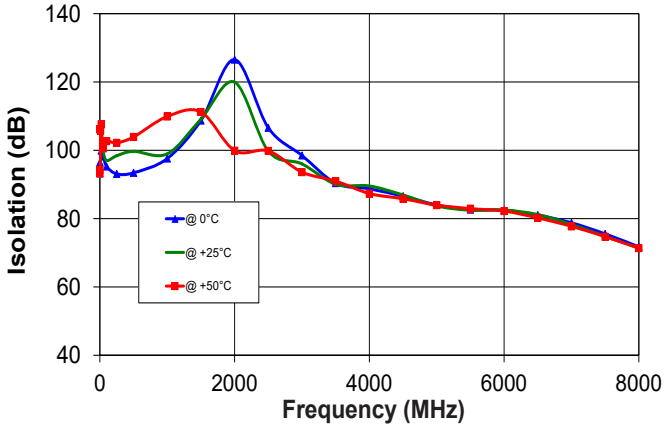
Isolation COM to J2 with J1 active over Temp.



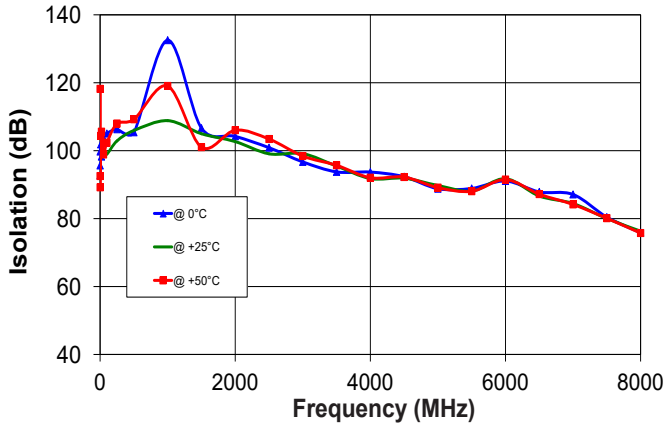
Isolation COM to J1 with J16 active over Temp.



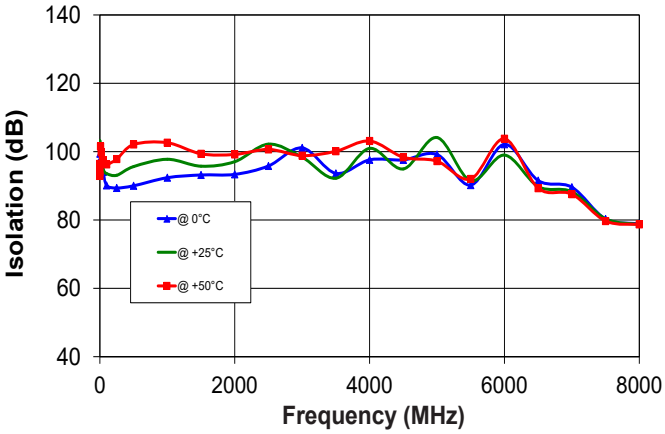
Isolation COM to J8 with J7 active over Temp



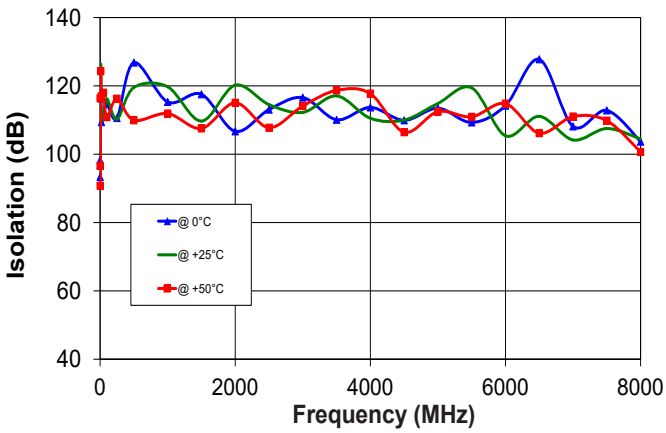
Isolation J1 to J2 with J1 active over Temp



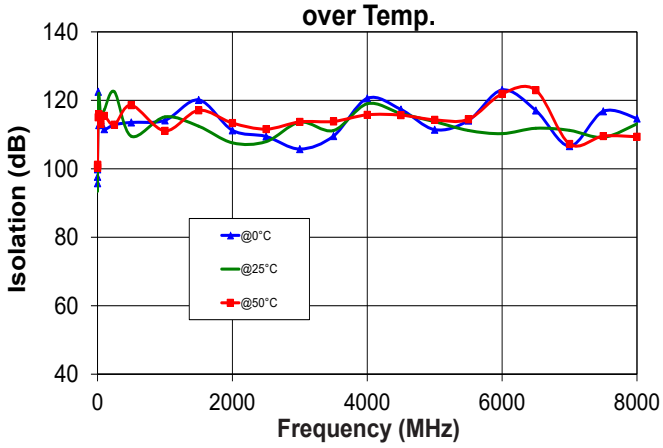
Isolation J7 to J8 with J7 active over Temp.



Isolation J1 to J16 with J1 active over Temp



Isolation COM to J1 @ Disconnected State over Temp.



Software & Documentation Download:

- Mini-Circuits' full software and support package including user guide, Windows GUI, DLL files, programming manual and examples can be downloaded free of charge from https://www.minicircuits.com/softwaredownload/solidstate.html
- Please contact **testsolutions@minicircuits.com** for support

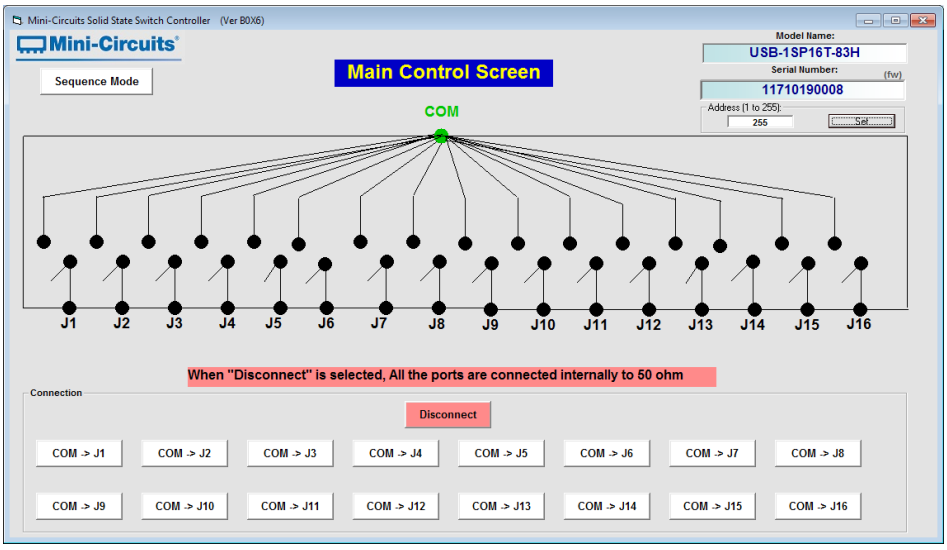
Minimum System Requirements

Parameter	Requirements	
Interface	USB HID or TTL	
System requirements	GUI:	Windows 32 & 64 bit systems from Windows 98 up to Windows 10
	USB API (ActiveX & .Net)	Windows 32 & 64 bit systems with ActiveX or .Net support from Windows 98 up to Windows 10
	TTL control	Any computer with a suitable I/O port
	USB direct programming support	Linux, Windows systems from Windows 98 up to Windows 10
Hardware	Pentium® II or higher, RAM 256 MB	

Graphical User Interface (GUI) for Windows

Key Features:

- Set each switch manually
- Set timed sequence of switching states
- Configure switch address and upgrade Firmware



Application Programming Interface (API)

Programming Manual: https://www.minicircuits.com/softwaredownload/Prog_Manual-H_Series_Switches.pdf

Windows Support:

- API DLL files exposing the full switch functionality
  - ActiveX COM DLL file for creation of 32-bit programs
  - .Net library DLL file for creation of 32 / 64-bit programs
- Supported by most common programming environments (refer to application note AN-49-001 for summary of tested environments)

Linux Support:

- Full switch control in a Linux environment is achieved by way of USB interrupt commands.

Ordering, Pricing & Availability Information see our web site

Model	Description
USB-1SP16T-83H	USB / TTL RF SP16T Switch

Included Accessories	Part No.	Description
	MUSB-CBL-3+	2.6 ft (0.8 m) USB Cable: USB type A(Male) to USB type Mini-B(Male)

Optional Accessories	Description
MUSB-CBL-3+ (Spare)	2.6 ft (0.8 m) USB Cable: USB type A(Male) to USB type Mini-B(Male)
MUSB-CBL-7+	6.6 ft (2.0 m) USB Cable: USB type A(Male) to USB type Mini-B(Male)
D-SUB9-MF-6+	6 ft TTL Cable: 9 pin D-sub(Male) to 9 pin D-sub(Female)
USB-AC/DC-5+	AC/DC +5V power adaptor with USB connector [4,5]

[4] The USB-AC/DC-5 may be used to provide power via USB port when control is via TTL.
[5] Includes power plugs for US, UK, EU, IL, AU & China. Plugs for other countries are also available, if you need a power plug for a country not listed please contact testsolutions@minicircuits.com

Additional Notes

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.

B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.

C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp