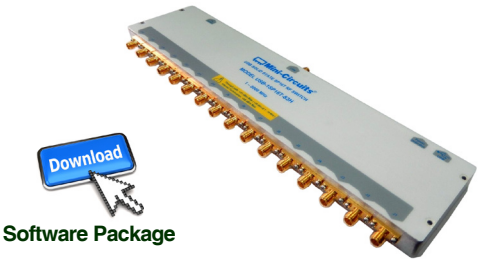
Solid state

USB / LVTTL 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
- Daisy-chain control of up to 35 modules



Software Package

Case Style: RB2574-2

Typical Applications

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

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

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 LVTTL 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 two data bus connectors for Master / Slave connections to other modules.

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
Dynamic daisy-chain control	Simplify control software and interconnections by cascading up to 35 modules of multiple switch types into a Master / Slave chain with a single USB interface.
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®
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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
Switching Time (LVTTL) [7]	–	–	–	12	–	µs
Supply voltage (Vcc)	USB or D-Sub port	–	4.75	5	5.25	V_{DC}
Supply Current (Icc) [8]		–	–	60	90	mA
Current Pass-through [9]		–	–	–	500	
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.
[7] Switching time(LVTTL) is the time from setting the control at he LVTTL input to the desired logic state, to the RF signal at the specified output reaching 90% of the steady state.
[8] Current consumption specified for a single unit without any slave modules.
[9] Pass through current is the maximum current handling of a unit with slave modules attached. If controlling a large number of slave modules additional power supplies should be included to ensure this limit is not exceeded. See page 5 for details.

Control voltages for LVTTL Control

Parameter		Min.	Typ.	Max.	Units
Control Input	Low	0	—	0.8	V
	High	2.0	—	3.3	

Connections

RF SP16T Switch (J1 to J16, COM)	(SMA female)
USB	(USB type Mini-B receptacle)
Serial In (Digital Control 2 port)	(Digital Snap Fit Connector)
Serial Out (Digital Control 1 port)	(Digital Snap Fit Connector)
LVTTL control & power	(9 pin D-sub - Female)*

Absolute Maximum Ratings

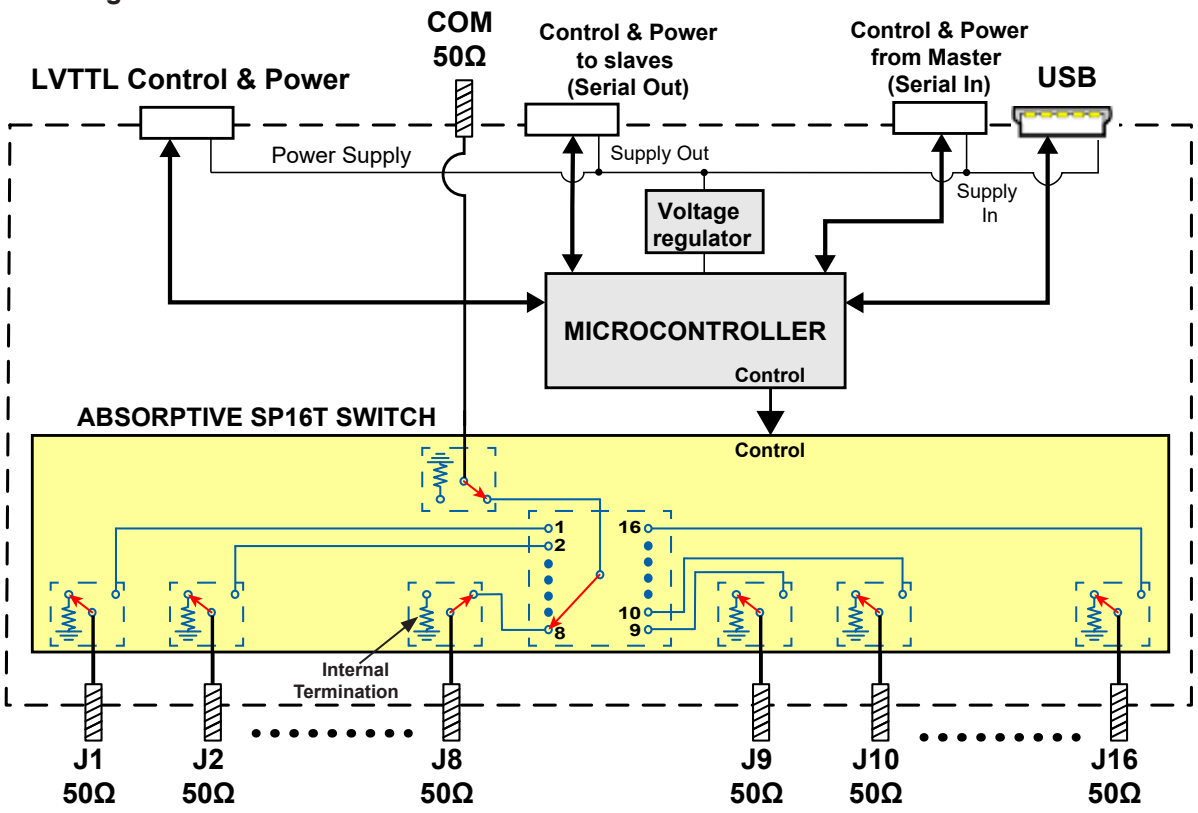
Operating Temperature		0°C to 50°C
Storage Temperature		-20°C to 60°C
DC supply voltage max. (USB or D-Sub pin 1)		6V
Voltage at LVTTL control pins		3.6V
RF power into termination		+26 dBm
RF power @ Through path	1 to 10 MHz	Derate linearly from +31 dBm @ 10 MHz to +30 dBm @1 MHz
	10 to 8000 MHz	+31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

*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



LVTTL communication parameters

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

The USB-1SP16T-83H LVTTL 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 LVTTL control until the switch is reset by disconnecting and then reconnecting power.

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

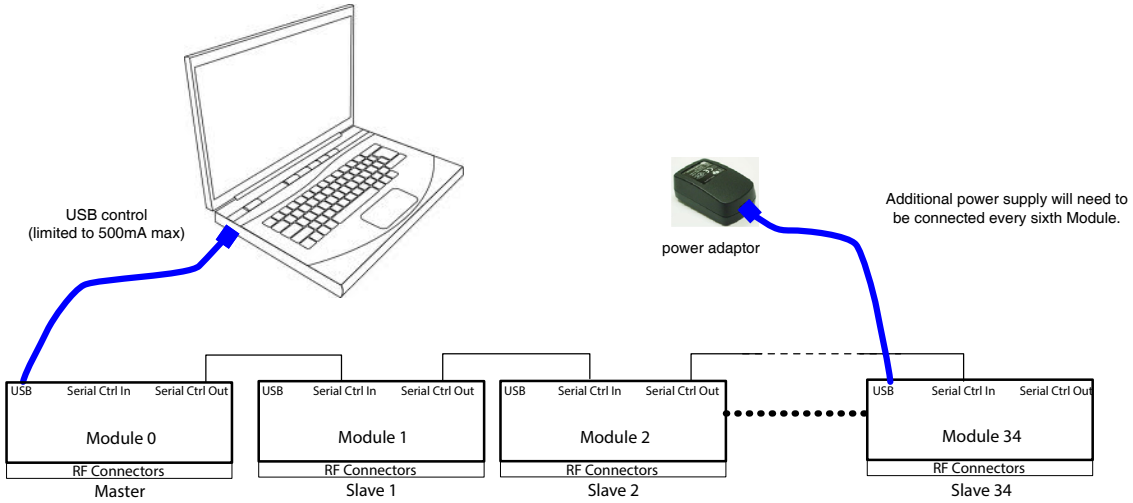
Power can be provided via either the D-Sub port or USB port, regardless of the control method used.

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.

Connecting multiple modules (Daisy Chain)

The USB-1SP16T-83H is designed to connect up to 35 modules in series (Daisy chain) using dynamic addressing, meaning there is no need to specifically set the address of the modules, the addresses will be set automatically as part of establishing the communications with the PC. The module connected to the PC USB port will be assigned address 0 (Master), the first module connected to it will get address 1(slave) and subsequent modules incrementing up to address 34 (slave).



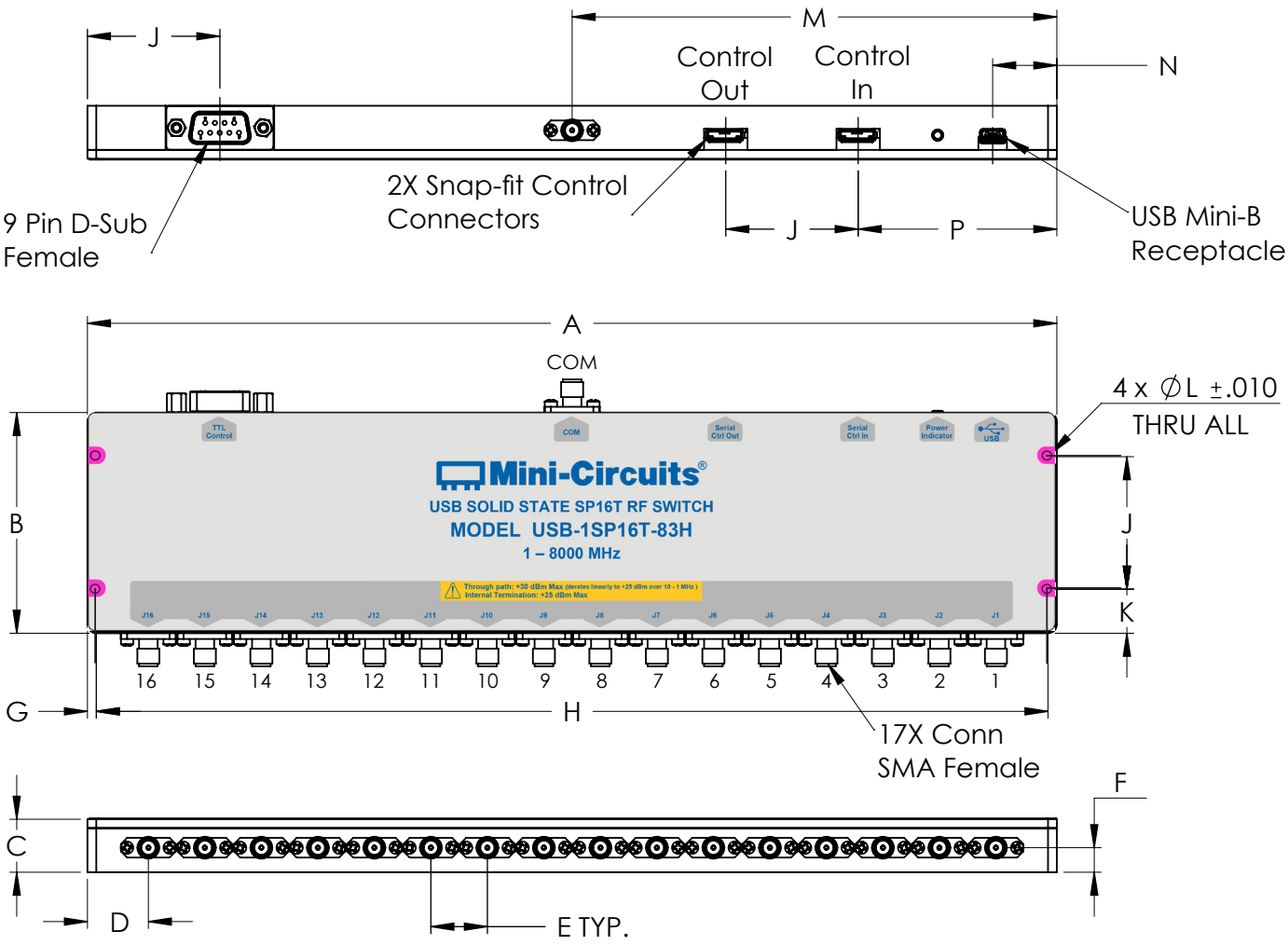
Connections between modules will be made using the serial in/out ports with the module connected to the PC as a master and all others as slave modules. All control will be through the master module (address zero) which is the only one communicating with the PC. Serial control out port of each module should be connected to the serial control in port of the next module. Power will be supplied from the PC via the master module up to a maximum of 500mA.

If connecting USB-1SP16T-83H units in series, additional power supply will generally be needed every six to eight modules. If mixing modules of different types ensure the max current through any unit does not exceed 500mA. All power supplies should be connected to the module via the module's USB port, connecting an additional power supply will automatically cut off power draw from the serial control in port for that module.

The Serial master/slave bus allows connecting modules of different types to the same daisy chain as long as all support Mini-Circuits Dynamic addressing setup. To add a new module to the set up simply connect the module to the setup and refresh the address listing, no need to reset any of the existing modules or assign addresses manually.

Connecting slave units should be done only with control cables provided by Mini-Circuits

Outline Drawing (RB2574-2)

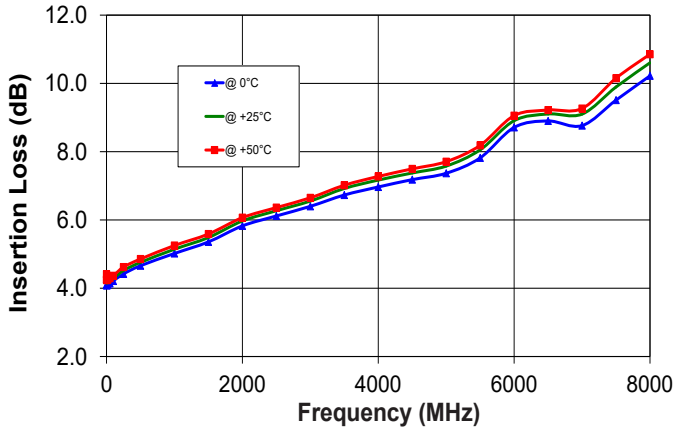


Outline Dimensions (inch / mm)

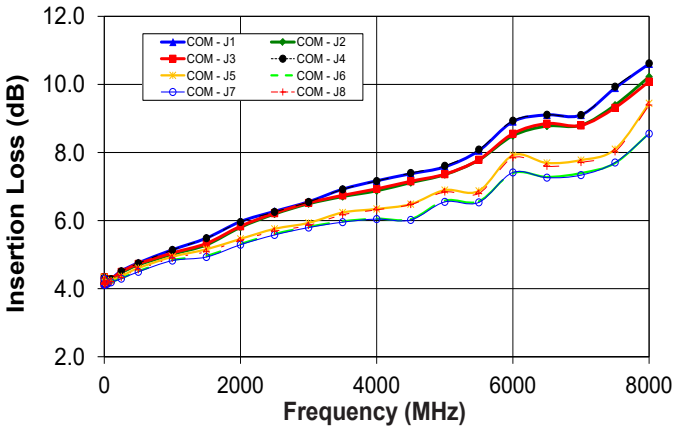
A	B	C	D	E	F	G	H	J	K	L	M	N	P	WT. GRAMS
10.98	**2.50**	**0.60**	**0.69**	**0.640**	**0.278**	**0.10**	**10.780**	**1.500**	**0.50**	**0.106**	**5.49**	**0.73**	**2.25**	**650**
278.9	63.5	15.2	17.5	16.26	7.06	2.54	273.81	38.10	12.7	2.69	139.45	18.5	57.15	

Typical Performance Curves

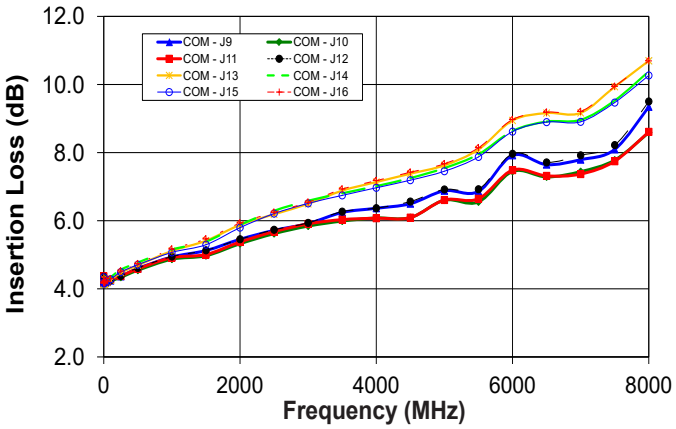
Insertion Loss over Temp.



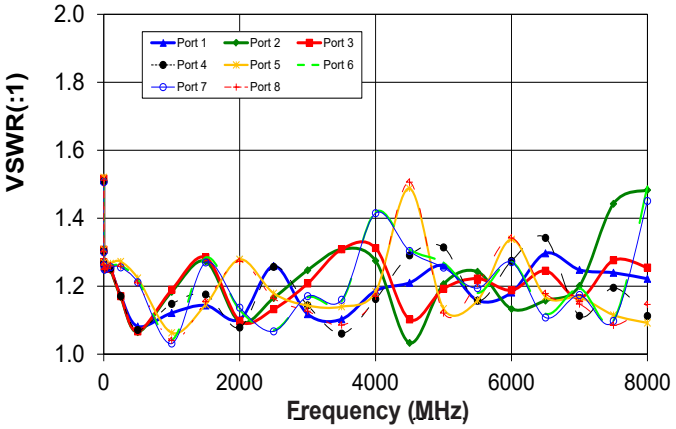
Insertion Loss of outputs J1-J8 in switch



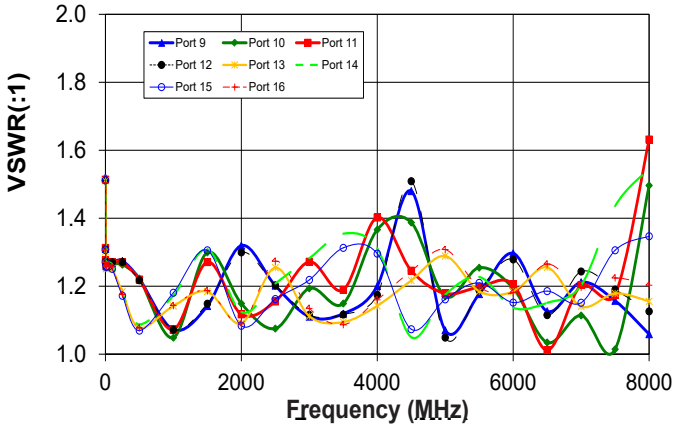
Insertion Loss of outputs J9-J16 in switch



VSWR of active ports J1- J8

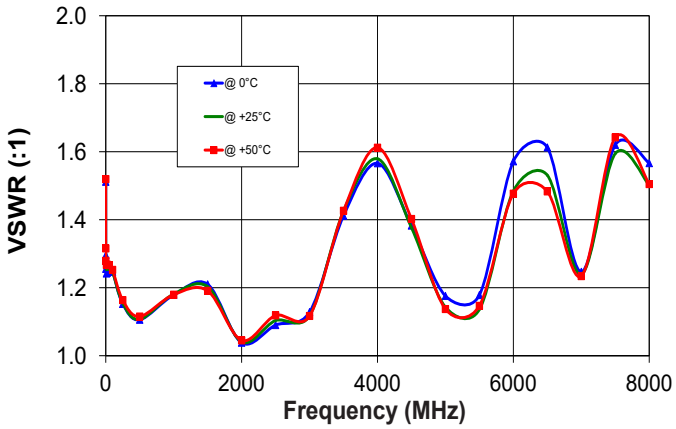


VSWR of active ports J9- J16

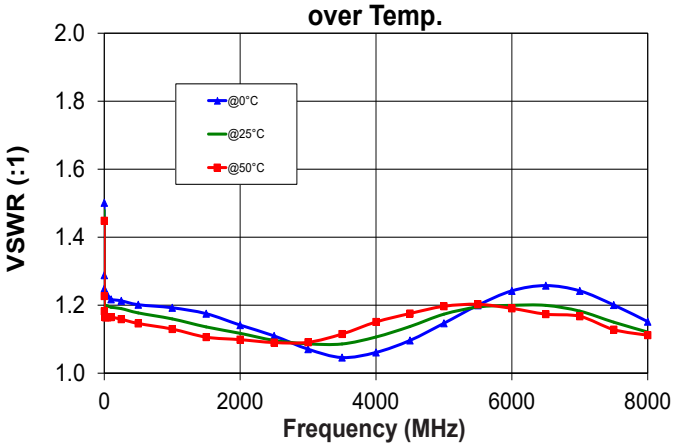


Typical Performance Curves

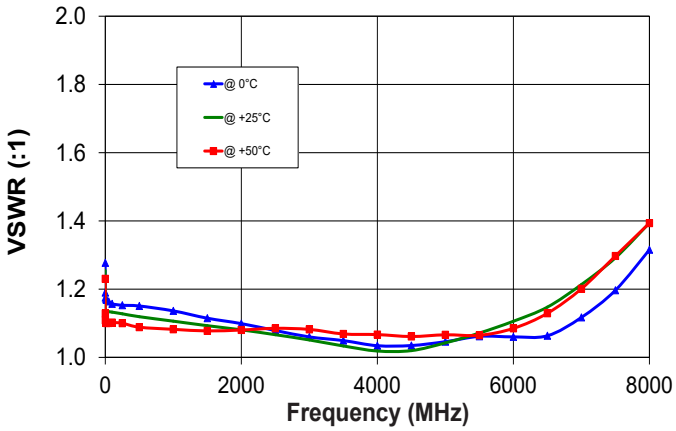
VSWR Common Port (Active) over Temp.



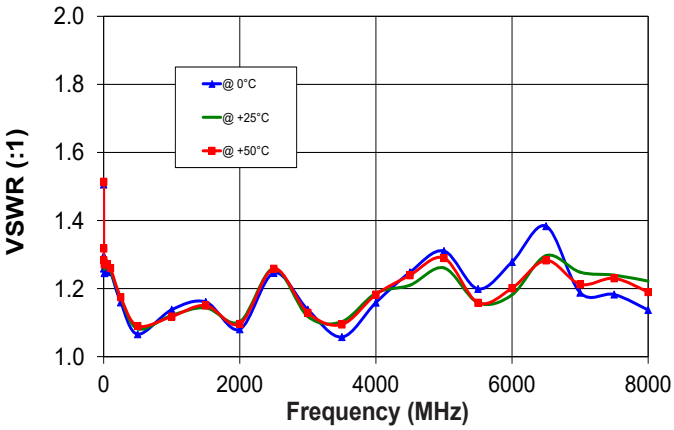
VSWR Common Port (Terminated) over Temp.



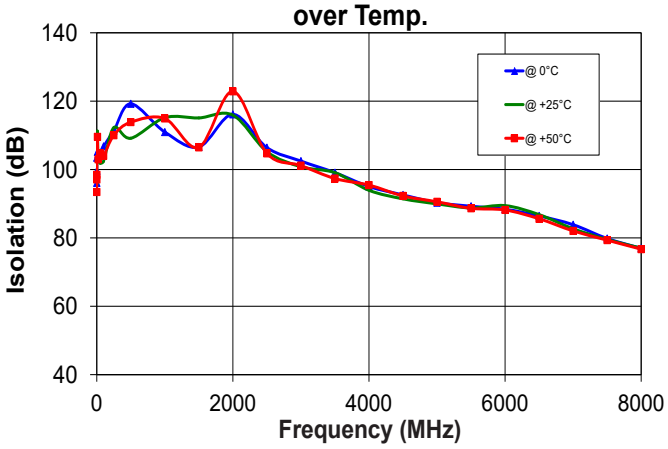
VSWR Output (Terminated) over Temp.



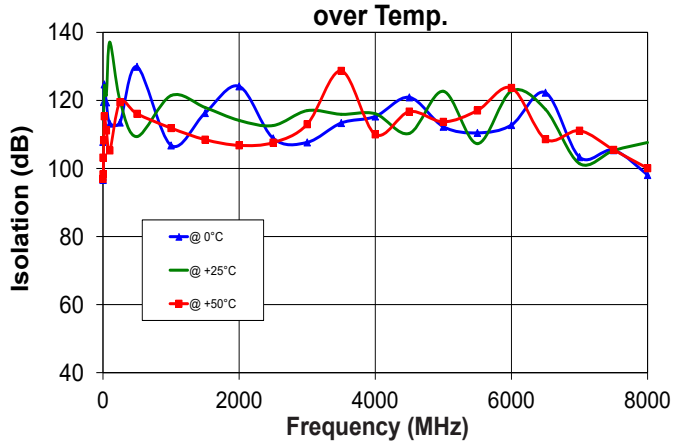
VSWR Output (Active) over Temp.



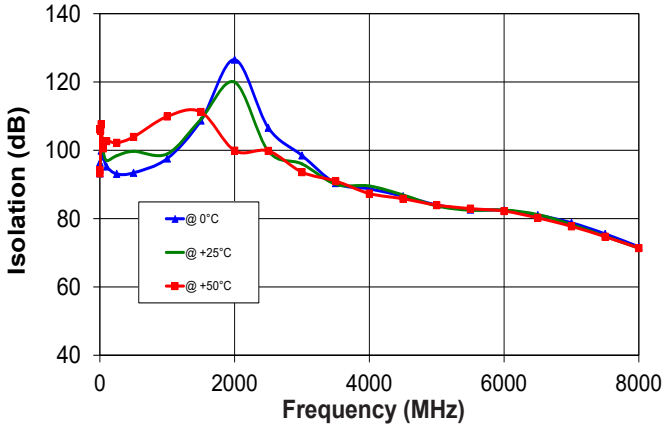
Isolation COM to J2 with J1 active over Temp.



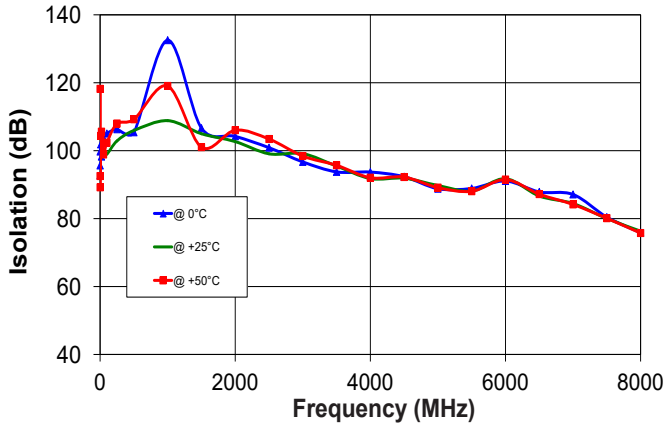
Isolation COM to J1 with J16 active over Temp.



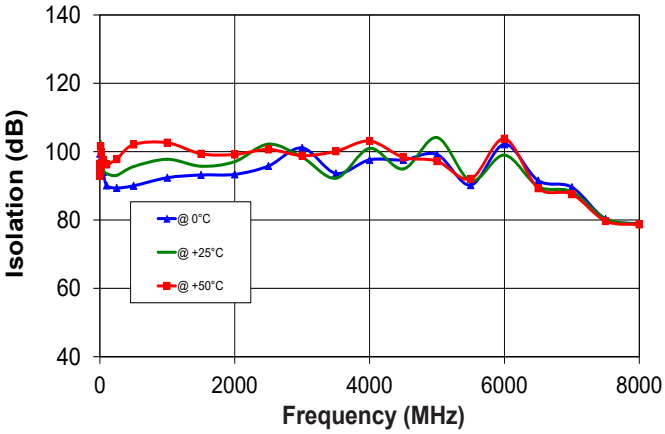
Isolation COM to J8 with J7 active over Temp



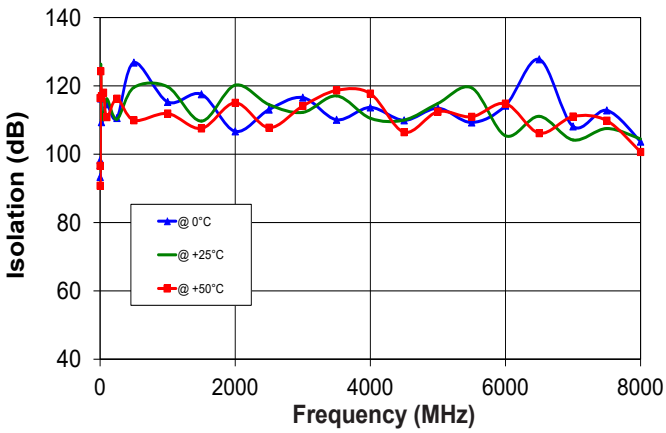
Isolation J1 to J2 with J1 active over Temp



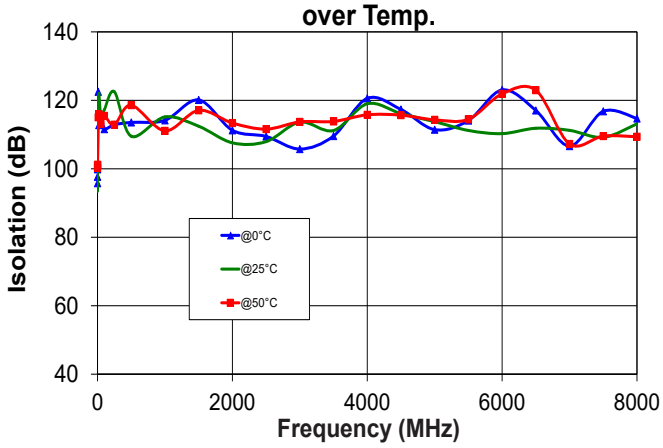
Isolation J7 to J8 with J7 active over Temp.



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

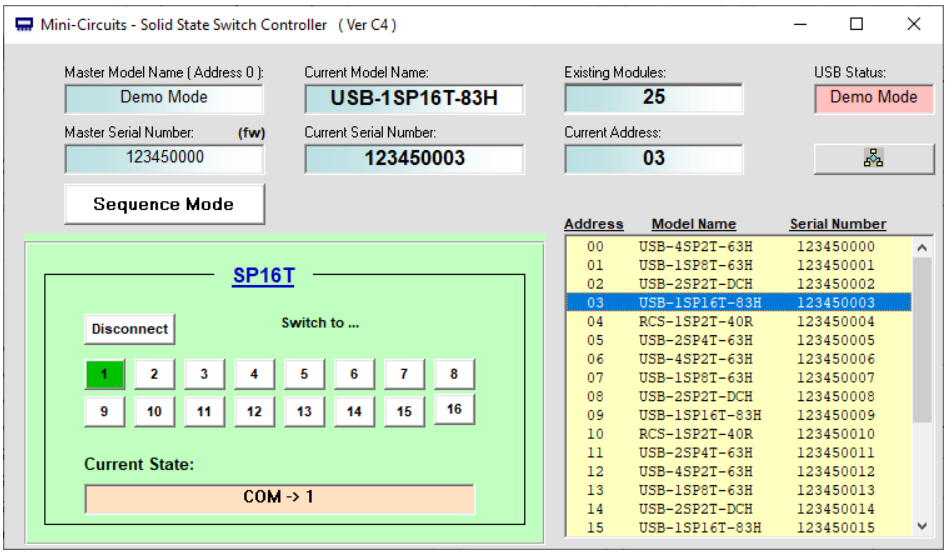
Minimum System Requirements

Parameter	Requirements	
Interface	USB HID or LVTTL or Daisy Chain Dynamic addressing	
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
	Daisy Chain Dynamic addressing	Additional unit of this model or another Mini-Circuits model supporting Dynamic addressing
	LVTTL 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
- Controlling up to 35 modules in 'daisy chain' configuration



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 / LVTTL 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 LVTTL Cable: 9 pin D-sub(Male) to 9 pin D-sub(Female)
CBL-1.5FT-MMD+	1.5 ft cable assembly for serial control Daisy Chain with snap fit connectors
USB-AC/DC-5+	AC/DC +5V power adaptor with USB connector [10,11]

[10] The USB-AC/DC-5 may be used to provide power via USB port when control is via LVTTL, or to provide additional power if needing to connect a number of switches in series exceeding 500mA total current draw.

[11] 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