USB & LVTTL

Solid-State Switch

USB-1SP16T-83H

50Ω 1 to 8000 MHz Absorptive SP16T SMA Female

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

Generic photo used for illustration purposes only

APPLICATIONS

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

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.

The switch is supplied in a low profile, rugged metal case (10.98" x 2.50" x 0.60") with 17 SMA (F) RF connectors, a USB Mini-B port, a D-Sub 9 pin port for power and control, and two data bus connectors for Master / Slave connections to other switch 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	High 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.

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

ELECTRICAL SPECIFICATIONS AT -10 TO 60°C

Parameter	Ports	Condition (MHz)	Min.	Typ.	Max.	Unit
Frequency Range	–	–	1	–	8000	MHz
Insertion Loss	COM to any active port	1 - 3000	–	5.5	7.5	dB
		3000 - 7000	–	7.5	11.0	
		7000 - 8000	–	9.5	13.0	
Isolation	Between ports J1 to J16	1 - 3000	63	90	–	dB
		3000 - 7000	67	88	–	
		7000 - 8000	60	78	–	
	COM to any terminated port (including Disconnected states)	1 - 3000	80	100	–	dB
		3000 - 7000	83	100	–	
		7000 - 8000	75	100	–	
	COM to any terminated port (Active states)	1 - 3000	67	85	–	dB
		3000 - 7000	67	85	–	
		7000 - 8000	62	78	–	
Return Loss	COM port (in all active states)	1 - 3000	–	19.0	–	dB
		3000 - 7000	–	14.5	–	
		7000 - 8000	–	14.0	–	
	Any port connected to COM	1 - 3000	–	19.0	–	dB
		3000 - 7000	–	15.5	–	
		7000 - 8000	–	16.5	–	
	Any terminated port (including Disconnected states)	1 - 3000	–	19.0	–	dB
		3000 - 7000	–	21.0	–	
		7000 - 8000	–	17.5	–	
Power Input @1 dB Compression [1]	COM to any active port	10 - 8000	–	+31.5	–	dBm
IP3 [1, 2]	COM to any active port	10 - 5000	–	+50	–	dBm
		5000 - 8000	–	+45	–	
Transition Time [3]	–	–	–	5.0	9.5	µs
Minimum Dwell Time [4]	High-Speed Mode	–	–	15	–	µs
Switching Time	USB [5]	–	–	2	–	ms
	LVTTL [6]	–	–	12	–	µs

1. Compression and IP3 may degrade below 10 MHz.
2. IP3 Tested with 1 MHz span between signals, +5 dBm per tone.
3. Transition Time spec represents the time that the RF signal paths are interrupted during switching and thus is specified without communication delays.
4. Minimum dwell time is the shortest time that can be achieved between 2 switch transitions when programming an automated switch sequence.
5. 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.
6. 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.

ELECTRICAL SPECIFICATIONS AT -10 TO 60°C

Parameter	Ports	Condition (MHz)	Min.	Typ.	Max.	Unit
Supply Voltage (V_{dc})	USB or D-Sub port	–	4.75	5	5.25	V_{DC}
Supply Current (I_{dc}) [7]		–	–	60	90	mA
Current Pass-Through [8]	–	–	–	–	500	mA
Operating RF Input Power	Through path (Hot switching)	1 - 8000	–	–	+20	dBm
	Through path (Cold switching)	1 - 10	–	–	Note 9	
		10 - 8000	–	–	+30	
	Into termination	1 - 8000	–	–	+25	

7. Current consumption is specified for a single unit without any slave modules.
8. 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. Refer to "Connecting Multiple Modules" section for more details.
9. Derates linearly from +30 dBm at 10 MHz to +25 dBm at 1 MHz.

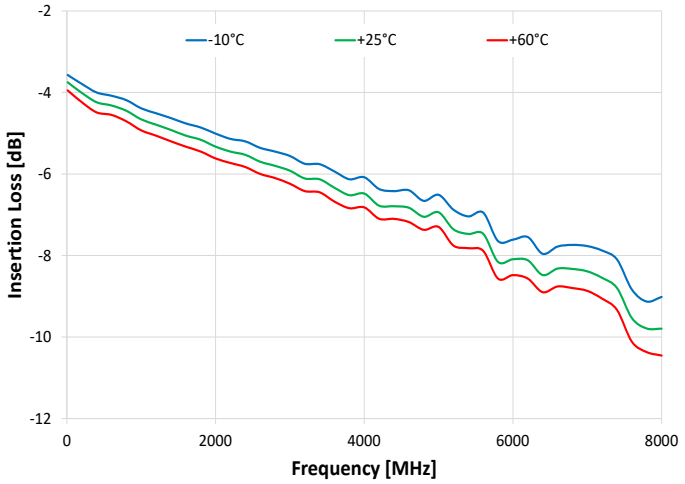
ABSOLUTE MAXIMUM RATINGS [10]

Operating Temperature	-10°C to 60°C
Storage Temperature	-20°C to 85°C
DC Supply Voltage max @ USB and pin #6 of D-Sub	6 V
Voltage at LVTTL control pins	3.6 V
DC Voltage @ RF Ports	16 V

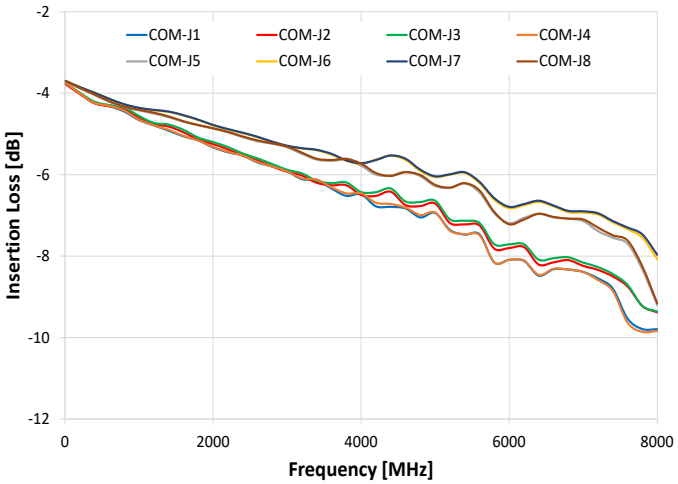
10. Permanent damage may occur if any of these limits are exceeded. Operating in the range between operating power limits and absolute maximum ratings for extended periods of time may result in reduced life and reliability.

TYPICAL PERFORMANCE GRAPHS

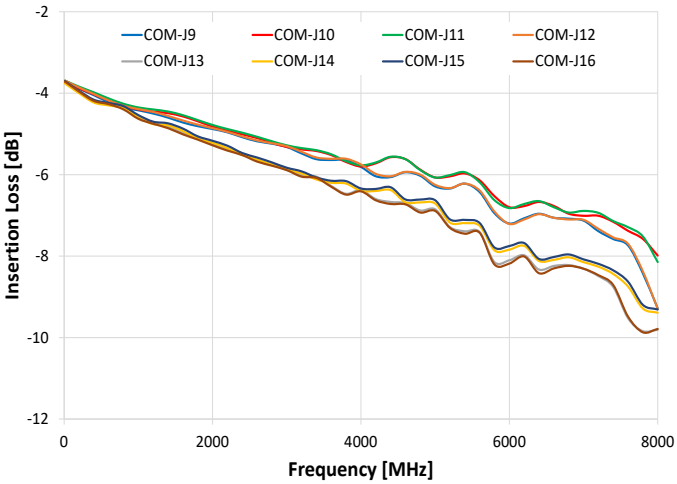
Insertion Loss over Temperature (J1 Active)



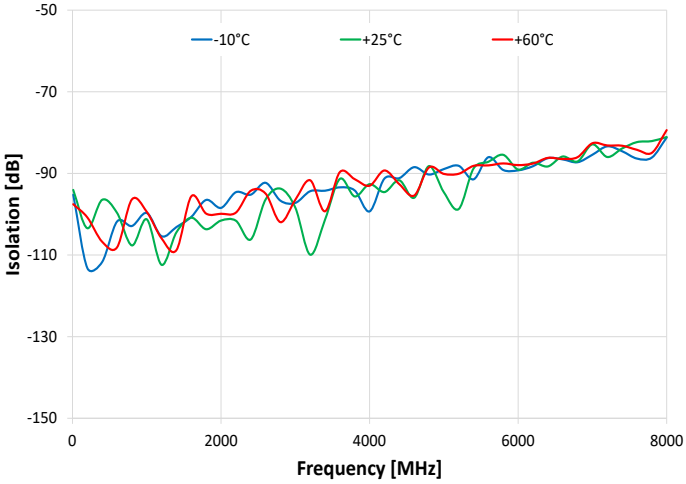
Insertion Loss, Ports J1 - J8



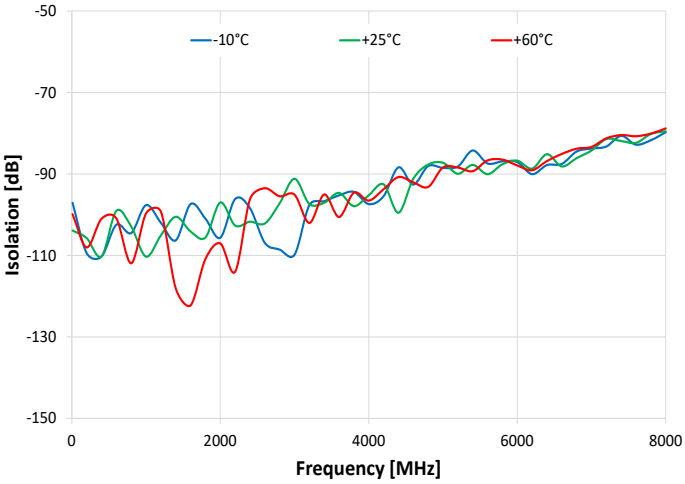
Insertion Loss, Ports J9 - J16



Isolation, J1 to J2 over Temperature (J1 Active)

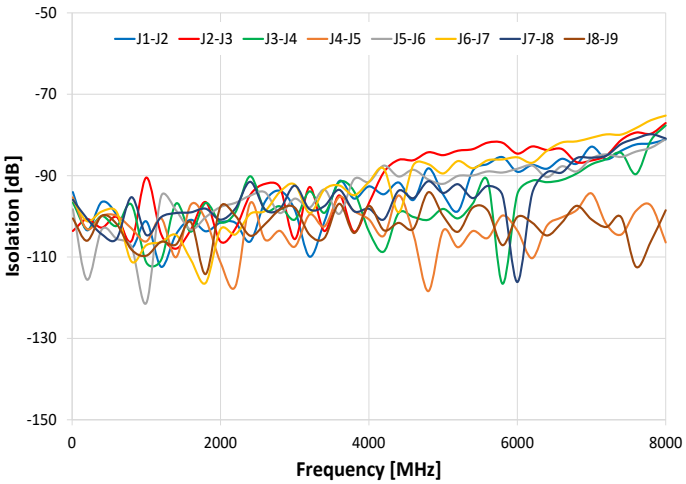


Isolation, COM to J1 over Temperature (J16 Active)

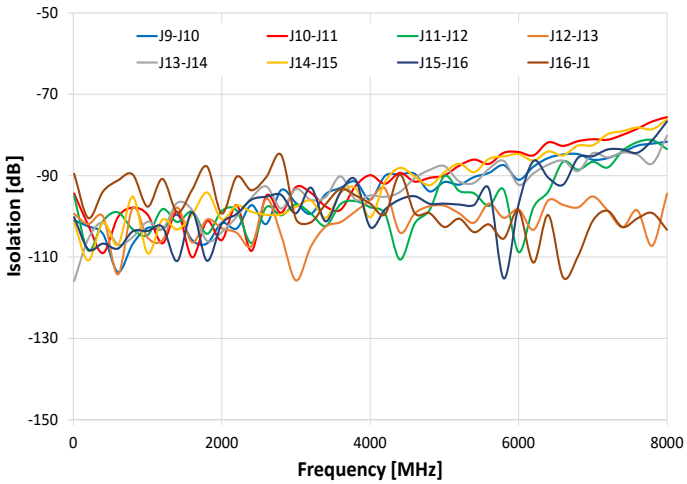


TYPICAL PERFORMANCE GRAPHS (CONTINUED)

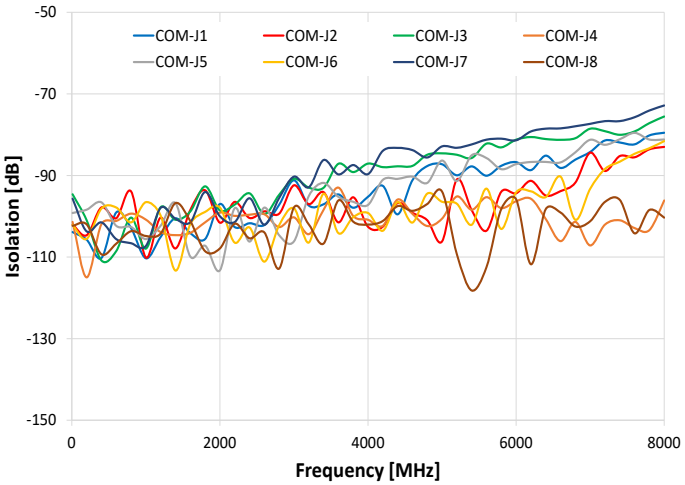
Isolation, Ports J1 - J8 Active



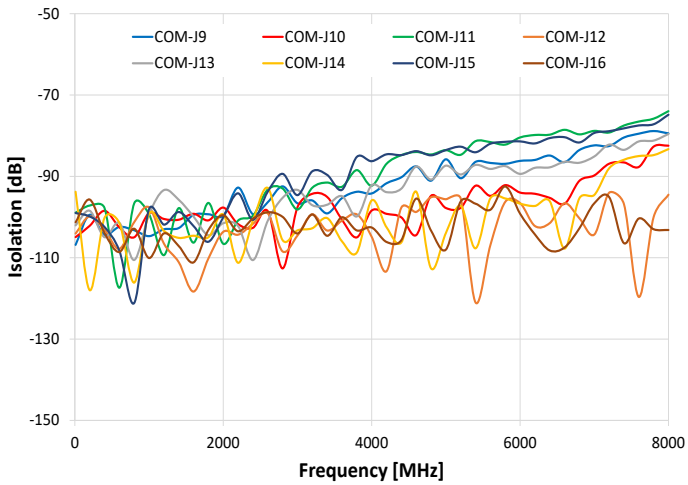
Isolation, Ports J9 - J16 Active



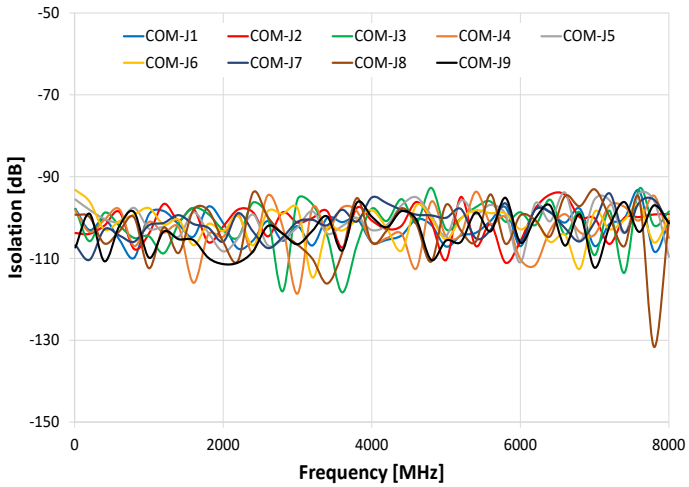
Isolation, Ports J1 - J8 Terminated



Isolation, Ports J9 - J16 Terminated

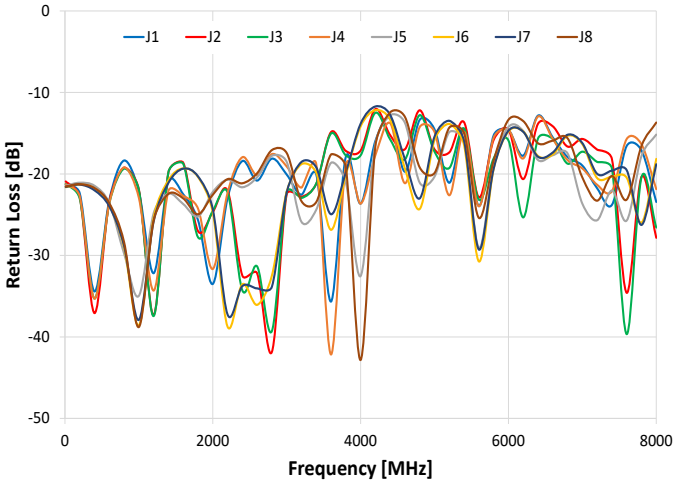


Isolation, Com to Ports J1 - J9 (Disconnected)

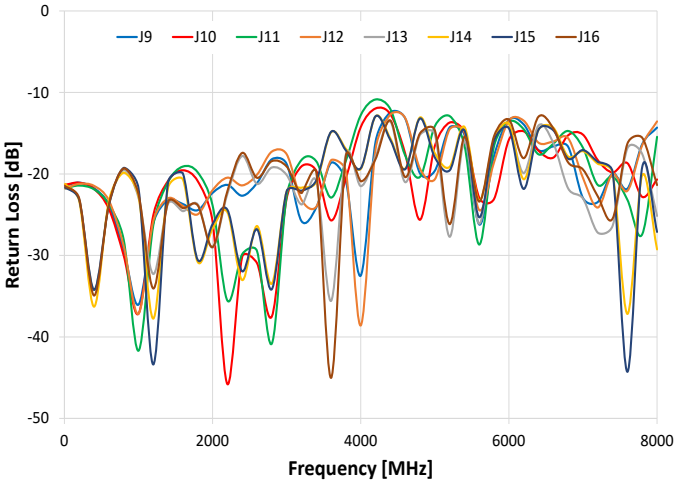


TYPICAL PERFORMANCE GRAPHS (CONTINUED)

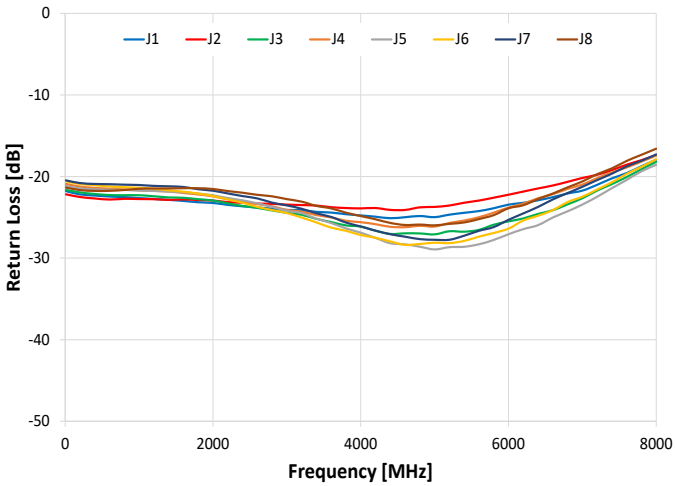
Return Loss, Ports J1 - J8 Active



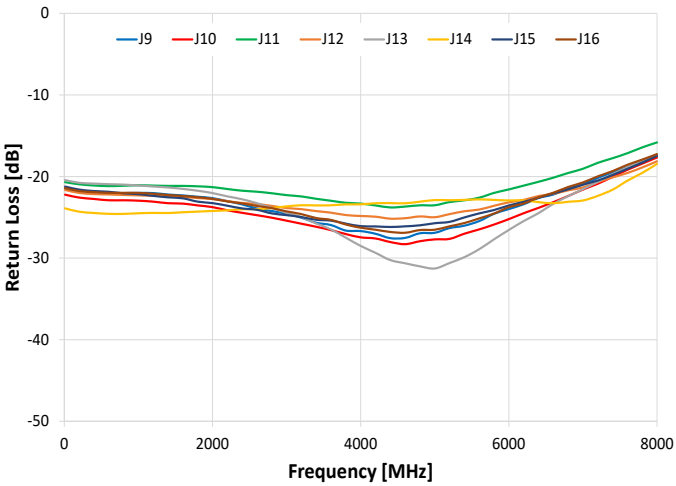
Return Loss, Ports J9 - J16 Active



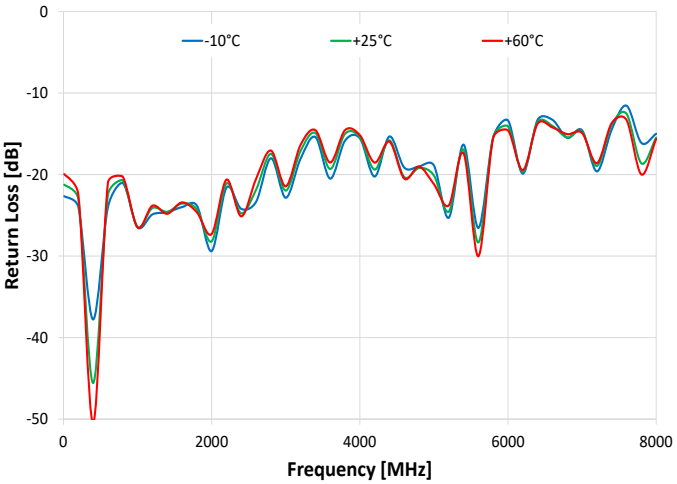
Return Loss, Ports J1 - J8 Terminated



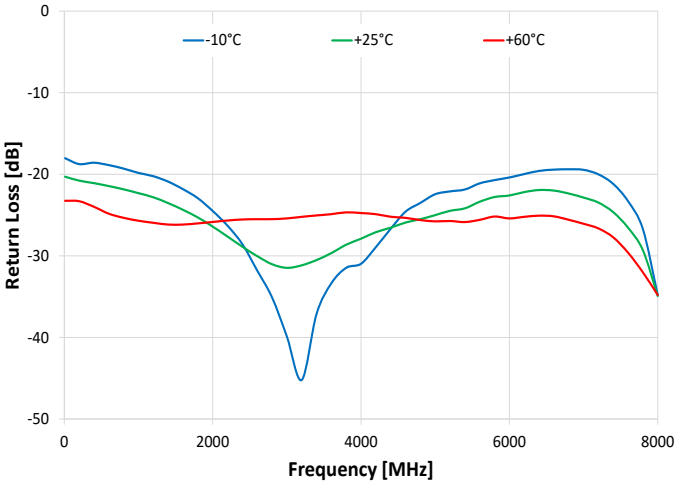
Return Loss, Ports J9 - J16 Terminated



Return Loss, COM over Temperature (J1 Active)



Return Loss, COM over Temperature (Disconnected)



CONTROL INTERFACES

USB Control	Supported Protocols	HID (Human Interface Device) - Full-speed
	Min Communication Time [11]	3 ms typ (full transmit/receive cycle)
LVTTL Control	Refer to "LVTTL Communication Parameters" section for more details.	

11. USB Min Communication Time is based on the polling interval of the USB HID protocol (1 ms polling interval, 64 bytes per packet), medium CPU load and no other high speed USB devices using the USB bus.

SOFTWARE & DOCUMENTATION

Mini-Circuits' full software and support package including user guide, Windows GUI, API, programming manual and examples can be downloaded free of charge (refer to the last page for the download path).

A comprehensive set of software control options is provided:

- GUI for Windows – Simple software interface for control via Ethernet and USB (model dependant).
- Programming / automation via USB:
  - DLL files provide a full API for Windows with a set of intuitive functions which can be implemented in any programming environment supporting .Net Framework or ActiveX.
  - Direct USB programming is possible in any other environment (not supporting .Net or ActiveX).

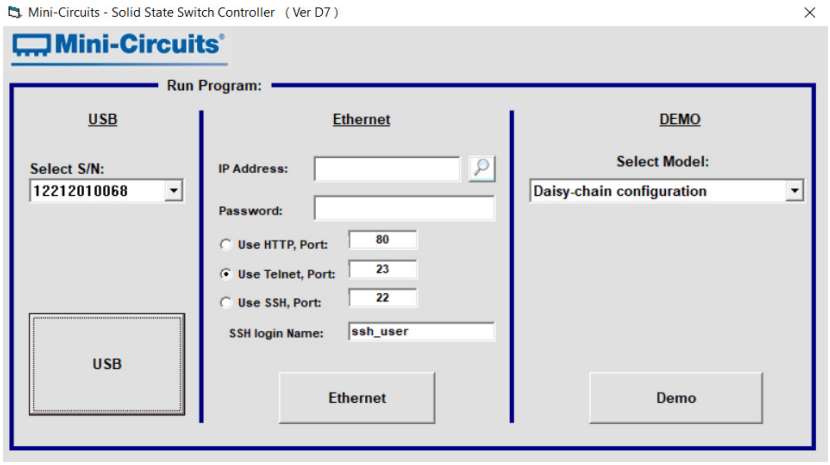
Please contact testsolutions@minicircuits.com for support.

MINIMUM SYSTEM REQUIREMENTS

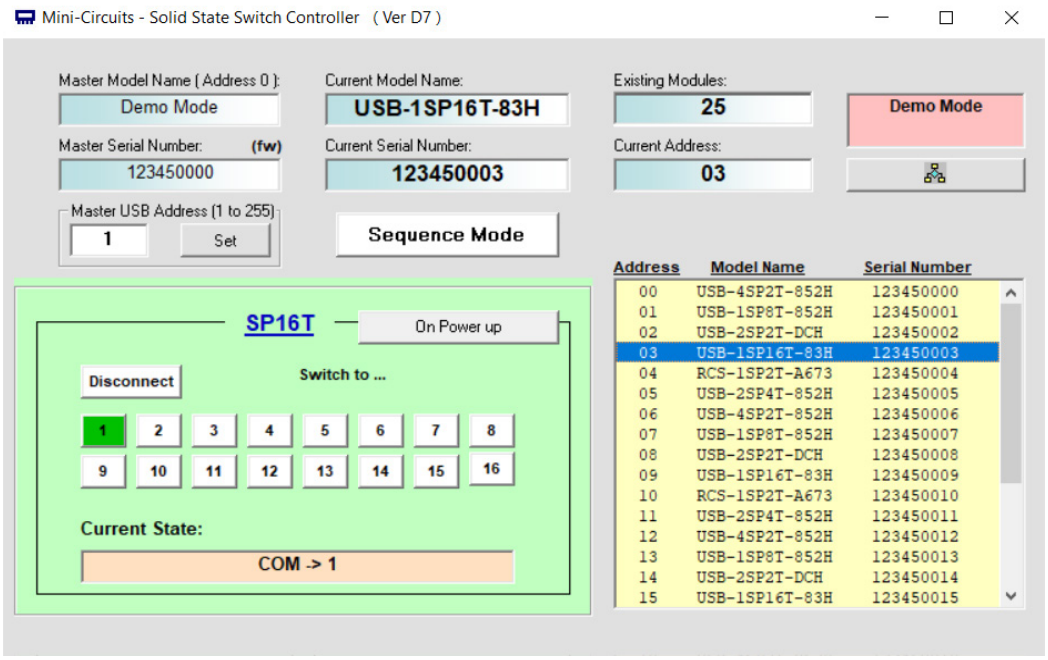
GUI	Windows 7 or later
USB API DLL	Windows 7 or later and programming environment with ActiveX or .NET support
USB Direct Programming	Linux, Windows 7 or later
Daisy-Chain Dynamic Addressing	An additional Mini-Circuits unit supporting dynamic addressing
Hardware	Intel i3 (or equivalent) or later

GRAPHICAL USER INTERFACE (GUI) FOR WINDOWS - KEY FEATURES

- Connect via USB or Ethernet to control the module (model dependant).
- Password protected access for safe remote usage over Ethernet (model dependant).

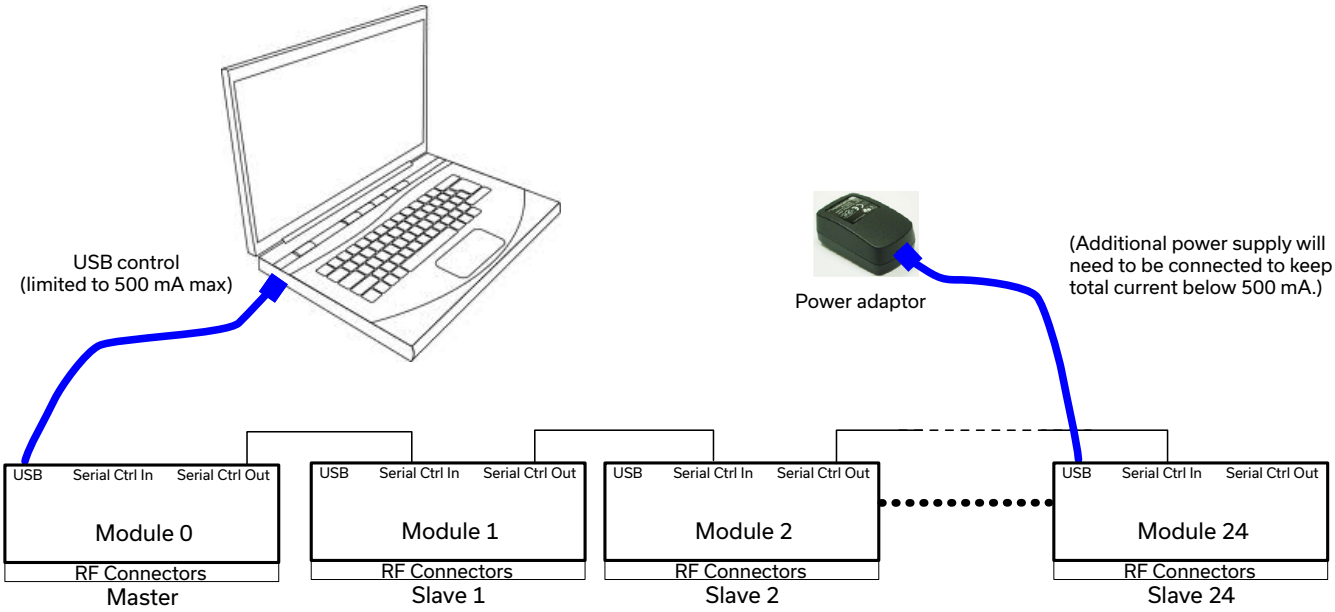


- Run GUI in “demo mode” to evaluate software without a hardware connection.
- View and set switch states at the click of a button.
- Configure and run timed switching sequences.



CONNECTING MULTIPLE MODULES (DAISY CHAIN)

The model 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 computer. The module connected to the computer's 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 24 (slave).



Connections between modules will be made using the serial in/out ports with the module connected to the PC act as a master and all other as slave modules. All control will be through the master module (address 0) 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 500 mA. Generally, additional power supply will be needed to keep total current below 500 mA. 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 setup, simply connect the module and refresh the address listing, no need to reset any of the existing modules or assign addresses manually.

Note: Different module types may have different current consumption which will change the number of units which can be connected before an additional power supply is needed. For example ,if connecting units with a current consumption of 100 mA each, additional power supply is recommended every sixth module. If using units with current consumption of 50 mA additional power supply is recommended every eleventh module.

LVTTL COMMUNICATIONS 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 switch model's 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 -> J1	Logic High	Logic Low	Logic Low	Logic Low	Logic Low
COM -> J2	Logic Low	Logic High	Logic Low	Logic Low	Logic Low
COM -> J3	Logic High	Logic High	Logic Low	Logic Low	Logic Low
COM -> J4	Logic Low	Logic Low	Logic High	Logic Low	Logic Low
COM -> J5	Logic High	Logic Low	Logic High	Logic Low	Logic Low
COM -> J6	Logic Low	Logic High	Logic High	Logic Low	Logic Low
COM -> J7	Logic High	Logic High	Logic High	Logic Low	Logic Low
COM -> J8	Logic Low	Logic Low	Logic Low	Logic High	Logic Low
COM -> J9	Logic High	Logic Low	Logic Low	Logic High	Logic Low
COM -> J10	Logic Low	Logic High	Logic Low	Logic High	Logic Low
COM -> J11	Logic High	Logic High	Logic Low	Logic High	Logic Low
COM -> J12	Logic Low	Logic Low	Logic High	Logic High	Logic Low
COM -> J13	Logic High	Logic Low	Logic High	Logic High	Logic Low
COM -> J14	Logic Low	Logic High	Logic High	Logic High	Logic Low
COM -> J15	Logic High	Logic High	Logic High	Logic High	Logic Low
COM -> J16	Logic Low	Logic Low	Logic Low	Logic Low	Logic High

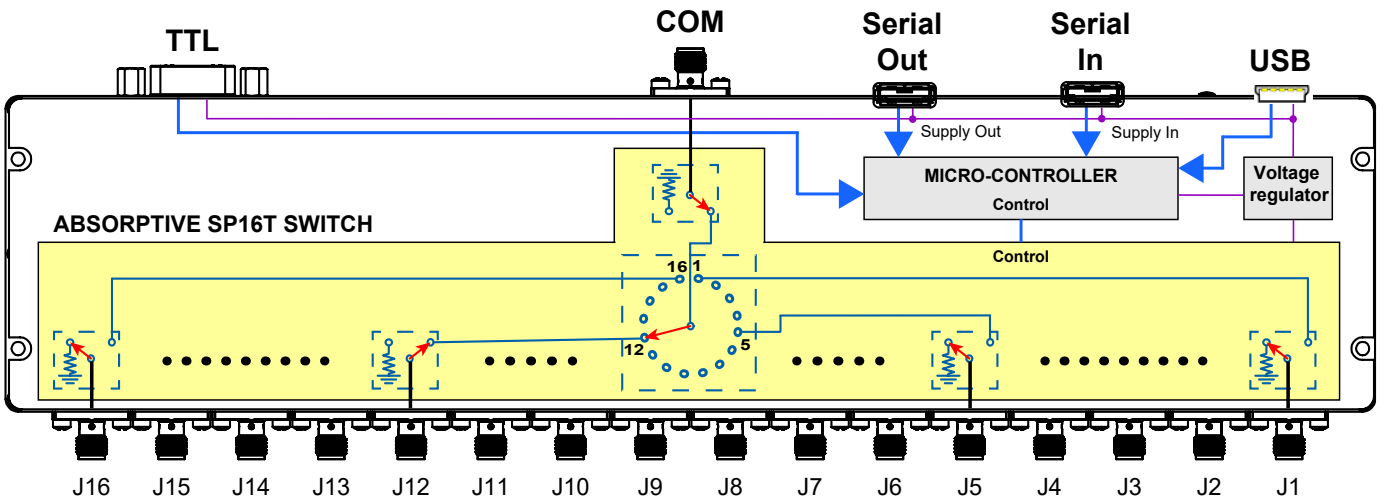
Notes:
* All inactive ports will be internally terminated to 50 Ω.
* In disconnected state, all ports including COM port will be terminated internally.
* Note maximum input power to internal termination listed on "Electrical Specifications" section.

Solid-State Switch

USB-1SP16T-83H

50Ω 1 to 8000 MHz Absorptive SP16T SMA Female

BLOCK DIAGRAM



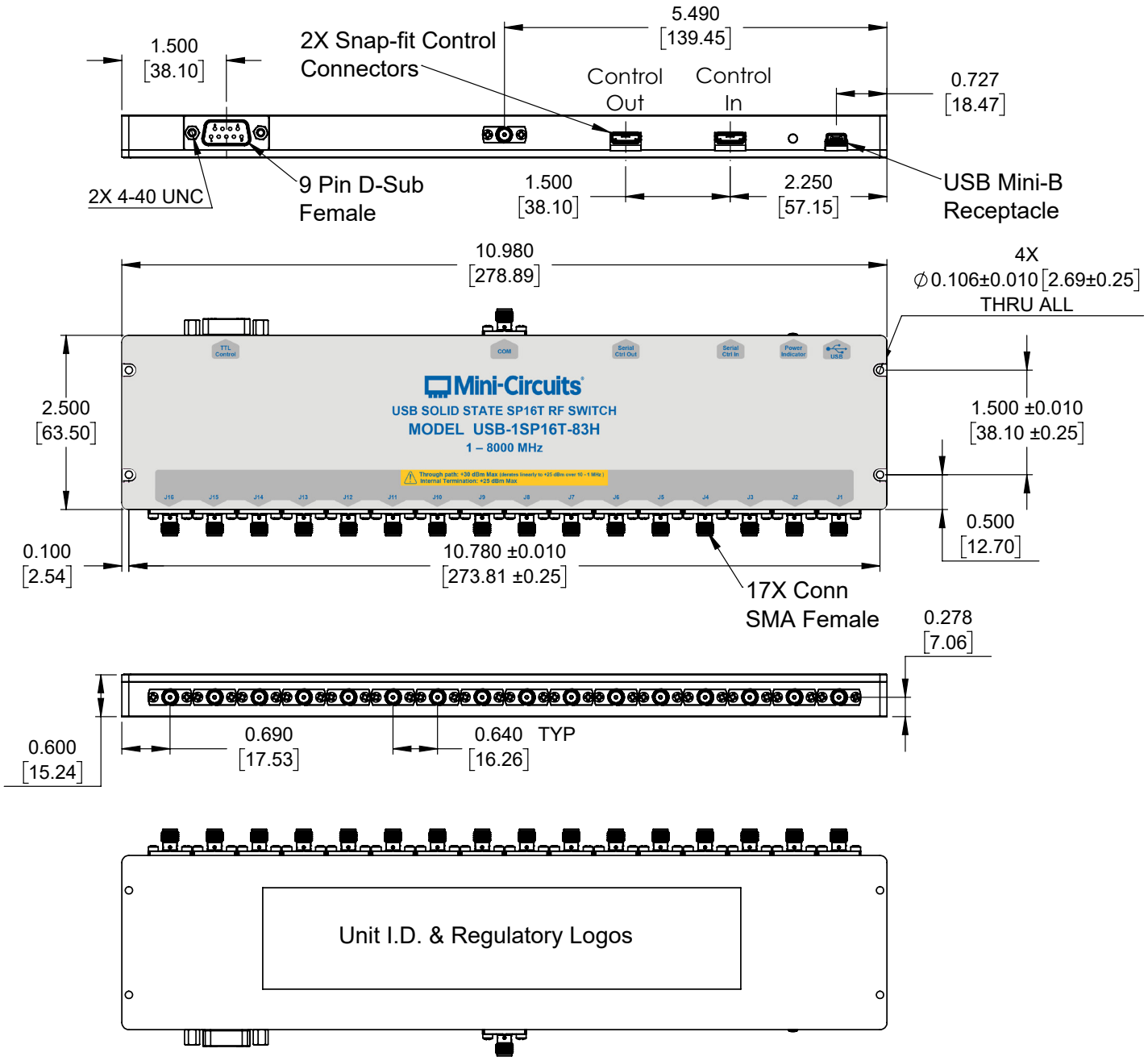
Switch functional diagram shown in
Common port to J12 (with J12 active)

CONNECTIONS

Port name	Connector type
RF ports (COM, J1 to J16)	SMA female
USB	USB type Mini-B receptacle
Serial in (digital control 2 port)	Digital snap fit connector [12]
Serial out (digital control 1 port)	Digital snap fit connector [12]
TTL	9-pin D-Sub Female

12. Mating connector is Hirose ST40X-10S-CV(30).

CASE STYLE DRAWING (RB2574-2)



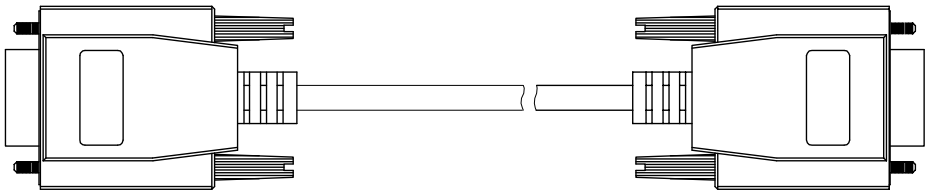
NOTES:

1. Case material: Aluminum alloy.
2. Case Finish: Nickel Plate.
3. Dimensions: Inches [mm]. Tolerances 2 Pl. ±.03 inch; 3 Pl. ±.015 inch.
4. Weight: 650 grams
5. Marking may contain other features or characters for internal lot control.

RECOMMENDED ACCESSORIES

USB-1SP16T-83H is controlled via a standard 9 pin D-Sub connector and is supplied with a male-female D-Sub 9 cable. The cable is 6 feet (1.8 meter) long and uses 28 AWG wires.

CONTROL CABLE D-SUB9-MF-6+



Pin Number (Male)	Function	Description	Pin Number (Female)
1	D1	Control bit 1	1
2	D2	Control bit 2	2
3	D3	Control bit 3	3
4	D4	Control bit 4	4
5	Not Connected	Not Connected	5
6	Supply +5V	Supply Voltage (Positive)	6
7	GND	Ground connection	7
8	Supply -5V	Supply Voltage (Negative)	8
9	GND	Ground connection	9

Solid-State Switch

USB-1SP16T-83H

50Ω 1 to 8000 MHz Absorptive SP16T SMA Female

DETAILED MODEL INFORMATION IS AVAILABLE ON OUR WEBSITE

CLICK HERE

Performance Data & Graphs	**Data** **Graphs**
Case Style	**RB2574-2**
Environmental Rating	**ENV55T2**
User Guide	https://www.minicircuits.com/softwaredownload/solidstate.html
Regulatory Compliance	Refer to user guide for compliance information CE UKCA https://www.minicircuits.com/app/AN49-012.pdf
Support	testsolutions@minicircuits.com

INCLUDED ACCESSORIES

	Part No.	Description	Qty.
	MUSB-CBL-3+	3.3 ft (1.0 m) USB Cable: USB type A (Male) to USB type Mini-B (Male)	1

OPTIONAL ACCESSORIES

	Part No.	Description
	MUSB-CBL-3+ (spare)	3.3 ft (1.0 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)
See drawing on page 13	D-SUB9-MF-6+	6.0 ft (1.8 m) D-Sub cable: 9 pin D-sub (Male) to 9 pin D-sub (Female)
	CBL-1.5FT-MMD+	1.5 ft (0.45 m) Cable assembly for serial control daisy chain with snap fit connectors
	USB-AC/DC-5+	AC/DC +5V power adaptor with USB connector [13, 14]

13. The power adaptor may be used to provide additional power via USB port when connecting several units in daisy chain control.
14. Includes power plugs for US, UK, EU, IL, AU & China. Plugs for other countries are also available. If you need a power cord for a country not listed, please contact testsolutions@minicircuits.com

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 https://www.minicircuits.com/terms/viewterm.html