

Solid state

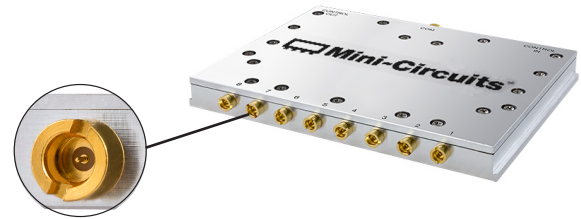
SPI RF SP8T Switch

SPI-SP8T-6G

50Ω 1 to 6000 MHz

The Big Deal

- Daisy Chain SPI Control
- High Isolation (80 dB typ)
- High speed switching (6 μs typ)
- High power handling (+27 dBm max)
- SMP snap-on RF connectors



Case Style: PM2656

Product Overview

Mini-Circuits' SPI-SP8T-6G is a low cost, high speed solid state RF SP8T absorptive switch, with control and power via a Hirose DF11 connector. The model contains an electronic, high speed (6 μs typ switching time), high linearity (IP3 50 dBm typ), SP8T switch. The RF switch is operated using a 3-wire SPI interface compatible with TTL and LVTTTL voltages and allows connecting up to 50 units in series to the same control line in a 'Daisy Chain' configuration. The RF switch operates over a wide frequency band from 1 to 6000 MHz with high isolation (80 dB typical) making the switch perfectly suitable for a wide variety of RF applications.

The SPI-SP8T-6G is constructed in a compact, rugged metal case (3.68" x 3.27" x 0.40") with 9 SMP(M) connectors (COM, and J1 to J8), and two Hirose DF11 connectors providing SPI control and power, one for input and one for output when connecting multiple units in series.

Key Features

| Feature | Advantages |
|-----------------------------------|---|
| Daisy chain SPI control | Allows connecting up to 50 units in series to a single power supply and 3 wire SPI control. |
| RF SP8T absorptive switch | Wideband (1 to 6000 MHz) with high isolation (80 dB typ.), and high power rating (+27 dBm through path). |
| High Linearity (IP3 +50 dBm typ.) | Results in little or negligible inter-modulation generation, meeting requirements for digital communications signals |
| Solid state switch | Provides high speed (6 μs typ) switching with no wear on the switch as with electro-mechanical designs |
| DC Blocking | No need for external DC blocking circuitry |
| SMP connectors | Snap on RF connectors allow quick assembly and disassembly and the small size of SMP connectors makes tighter assemblies possible |



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SPI RF SP8T Switch

SPI-SP8T-6G

50Ω 1 to 6000 MHz

Features

- High speed switching (6 μs typ)
- 1 to 6000 MHz SP8T absorptive RF switch
- High power handling, +27 dBm
- High linearity (IP3 +50 dBm)
- High isolation (80 dB typ)
- SPI control
- Daisy-chain up to 50 switches to control through a single interface (see pages 4-5)
- Easy installation and operation



Case Style: PM2656

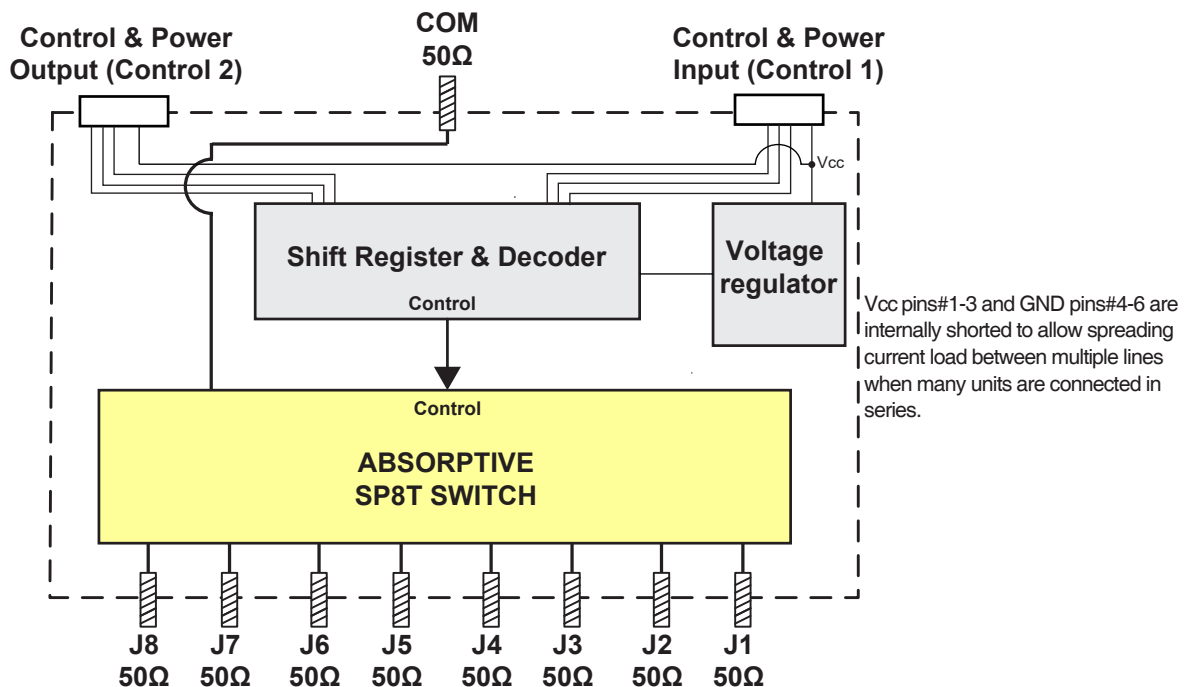
Applications

- R&D
- Automated Test equipment
- Controlling RF signal paths

RoHS Compliant

See our web site for RoHS Compliance methodologies and qualifications

Block Diagram



RF Electrical Specifications @ +25°C

| Parameter | Port | Conditions | Min. | Typ. | Max. | Units |
|---|--|---------------------------|------|------|------|-------|
| Operating Frequency | | | 1 | | 6000 | MHz |
| Insertion Loss | COM to active ports 1-8 | 1 to 3000 MHz | - | 3.2 | 5.0 | dB |
| | | 3000 to 6000 MHz | - | 4.7 | 6.5 | |
| Isolation | Between any two ports of J1 to J8 | 1 to 3000 MHz | 70 | 95 | - | dB |
| | | 3000 to 6000 MHz | 65 | 90 | - | |
| | COM to any terminated port | 1 to 3000 MHz | 65 | 90 | - | |
| | | 3000 to 6000 MHz | 60 | 85 | - | |
| VSWR | COM port | 1 to 3000 MHz | - | 1.25 | - | :1 |
| | | 3000 to 6000 MHz | - | 1.40 | - | |
| | Any port connected to COM | 1 to 3000 MHz | - | 1.25 | - | |
| | | 3000 to 6000 MHz | - | 1.45 | - | |
| | Any terminated port | 1 to 3000 MHz | - | 1.10 | - | |
| | | 3000 to 6000 MHz | - | 1.25 | - | |
| Power Input @ 1 dB Compression ^{1,2} | COM to any active port | 1 to 6000 MHz | 30 | - | - | dBm |
| IP3 ³ | COM to any active port | 10 to 6000 MHz | - | 50 | - | dBm |
| Switching time ⁴ | - | 1 to 6000 MHz | - | 6 | - | µs |
| Operating RF Input Power | COM to any active port | Hot Switching | - | - | +17 | dBm |
| | Any terminated port | - | - | - | +17 | |
| | COM to any active port | Through path ¹ | - | - | +27 | |
| Control | Control is via SPI in at Control In port. Control Out can be used to connect multiple units in a 'Daisy chain' without additional controls | | | | | |

¹ Max operating power degrades linearly below 10 MHz to +22 dBm at 1 MHz.

² Note absolute maximum ratings in table below

³ Tested with 1 MHz span between signals, +5 dBm per tone.

⁴ Tested Latch Enable(LE) signal to 90% RF signal at RF port

Connections

| | |
|-------------------------------------|---|
| RF Switch (J1 to J8, COM) | (SMP male) |
| Power & Control in (Control in)* | (Hirose DF11 10 pin Connector) ⁵ |
| Power & Control out (Control out)** | (Hirose DF11 10 pin Connector) ⁵ |

⁵ Mating connector is Hirose DF11-10DS-2C(20)

* Control in Pin Connections

| Pin Number | Function |
|------------|----------|
| 1 - 3 | Vcc In |
| 4 - 6 | GND |
| 7 | Data In |
| 8 | Clock In |
| 9 | LE In |
| 10 | Lock in |

** Control out Pin Connections

| Pin Number | Function |
|------------|-----------|
| 1 - 3 | Vcc out |
| 4 - 6 | GND |
| 7 | Data Out |
| 8 | Clock Out |
| 9 | LE Out |
| 10 | Lock Out |

Absolute Maximum Ratings

| | |
|--|---------------|
| Operating Temperature | 0°C to 50°C |
| Storage Temperature | -20°C to 60°C |
| DC supply voltage max. | 26V |
| Control input line max. | 6V |
| Max supply current per pin | 800 mA |
| RF power @ into inactive (internal termination) port | +20 dBm |
| RF power @ 1 -10 MHz into COM or active port | +25 dBm |
| RF power @ 10 -6000 MHz into COM or active port | +30 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.

DC Electrical Specifications

| Parameter | Min. | Typ. | Max. | Units |
|--------------------------------------|------|------|------|-------|
| Vcc, Supply Voltage | 5 | — | 24 | V |
| Load on Vcc between In and Out ports | — | 0.05 | — | Ω |
| Icc, Supply Current | @24V | 7 | — | mA |
| | @5V | — | 7 | |
| Control Input Low | -0.3 | — | +0.6 | V |
| Control Input High | 2.0 | — | 5.5 | V |
| Control Current | — | 400 | — | µA |

Control Interface

The SPI-SP8T-6G serial interface consists of 4 control bits per unit that select the desired switch state, as shown in Table 1: Switch Logic Table.

| A0 | A1 | A2 | A3 | Switch State |
|----|----|----|----|--------------|
| 1 | 0 | 1 | 0 | Com<->J1 |
| 1 | 0 | 1 | 1 | Com<->J2 |
| 1 | 0 | 0 | 1 | Com<->J3 |
| 1 | 0 | 0 | 0 | Com<->J4 |
| 0 | 0 | 1 | 0 | Com<->J5 |
| 0 | 0 | 1 | 1 | Com<->J6 |
| 0 | 0 | 0 | 1 | Com<->J7 |
| 0 | 0 | 0 | 0 | Com<->J8 |

The serial interface is a 4-bit serial in, parallel-out shift register buffered by a transparent latch. It is controlled by three-wire SPI protocol using Data, Clock, and Latch Enable (LE) and an additional Lock for added noise immunity and increased flexibility in controlling the units. All signal voltages are compatible with TTL and LVTTTL. The Data and Clock inputs allow data to be serially entered into the shift register, a process that is independent of the state of the LE input.

The LE input controls the latch. When LE is HIGH, the latch is transparent and the contents of the serial shift register control the switch. When LE is brought LOW, data in the shift register is latched.

Lock is used to lock the current state of the switch regardless of LE state or shift register, while allowing the LE to pass to other switches in the chain. If Lock is at logic HIGH the switch will respond to LE normally, when Lock is at logic LOW the switch will not respond to LE. If Lock is not required it can be kept constantly at logic high.

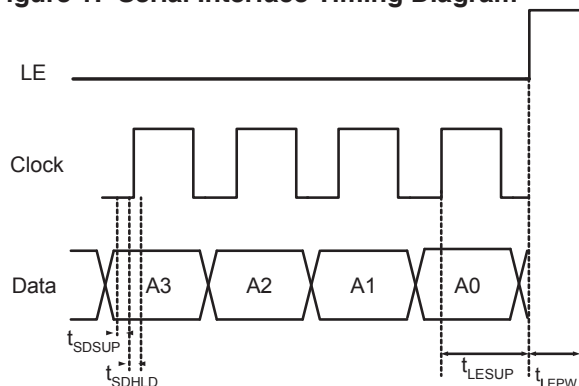
The shift register should be loaded while LE is held LOW to prevent the switch state from changing as data is entered. If multiple units are connected in series, data for all units should be entered before raising the LE to prevent switches assuming unanticipated states. Thus for example if three units are connected in daisy chain all 12 bits of control should be entered before raising the LE (see figures 2-4 for connecting units in daisy chain).

The LE input should then be toggled HIGH and brought LOW again, latching the new data. The timing for this operation is defined by Figure 1: Serial Interface Timing Diagram and Table 2: Serial Interface AC Characteristics.

Note:

1. LE is connected in parallel to all units in a daisy chain using the switches internal buffers to prevent control current from increasing as more units are connected.
2. Mini-Circuits' SPI converter, model RS232/USB-SPI, can be used to provide a single USB or RS232 interface for up to 50 daisy-chained SPI-SP8T-6G switches, with full software support (optional accessories on page 11).

Figure 1: Serial Interface Timing Diagram



| Symbol | Parameter | Min. | Max. | Units |
|-------------|--|------|------|-------|
| f_{clk} | Serial data clock frequency | | 20 | MHz |
| t_{clkH} | Serial clock HIGH time | 8 | | ns |
| t_{clkL} | Serial clock LOW time | 14 | | ns |
| t_{LESUP} | LE set-up time after last clock rising edge | 8 | | ns |
| t_{LEPW} | LE minimum pulse width | 8 | | ns |
| t_{SDSUP} | Serial data set-up time before clock rising edge | 8 | | ns |
| t_{SDHLD} | Serial data hold time after clock falling edge | 1 | | ns |

Control Interface (Daisy Chain)

Figure 2: Connection diagram for multiple units in series

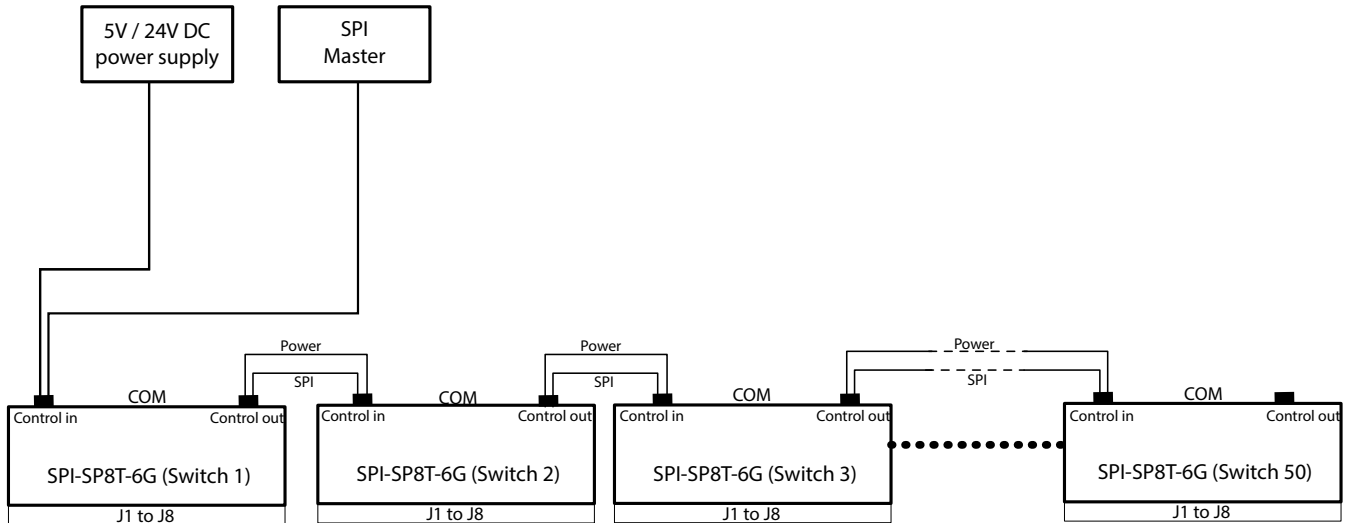


Figure 3: Serial Interface Timing Diagram for 3 units in series

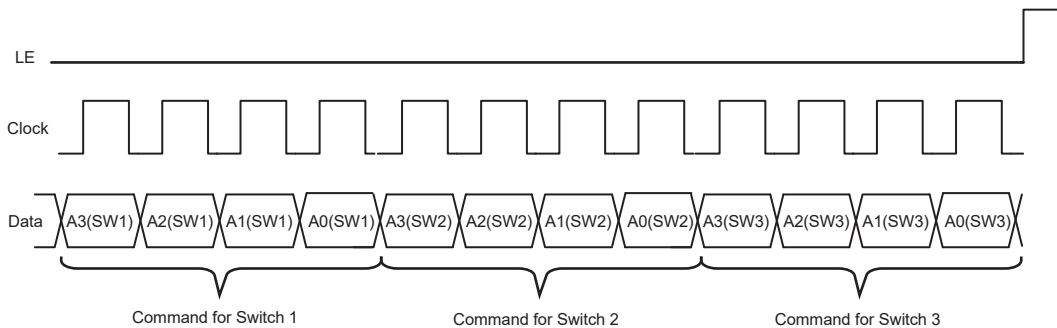
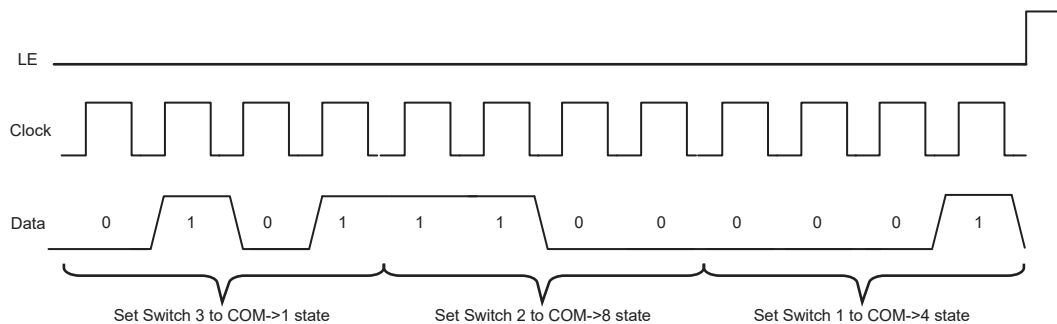
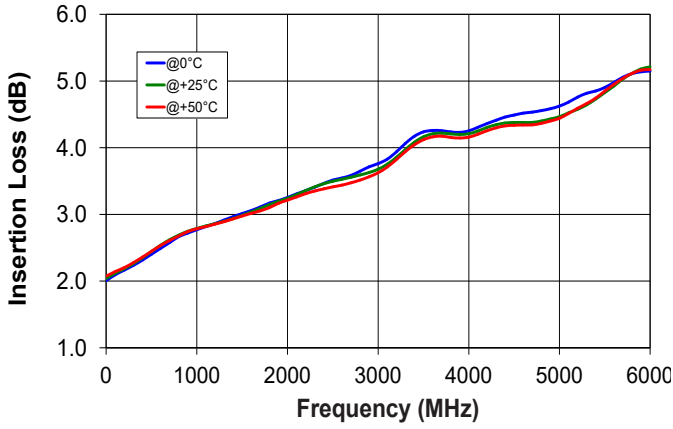


Figure 4: Example of command for 3 switches in series

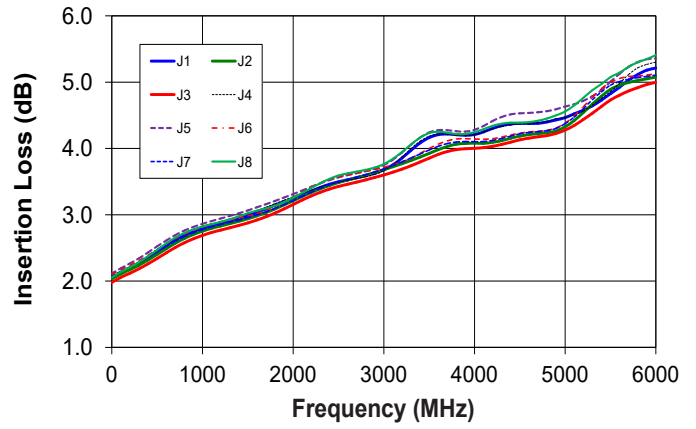


Typical Performance Curves

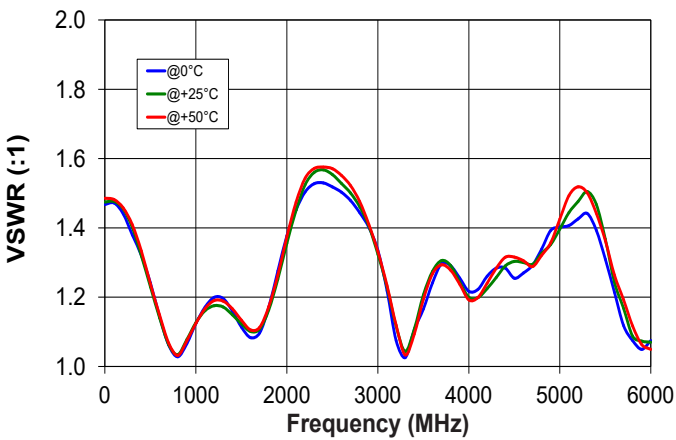
Insertion Loss over Temperature



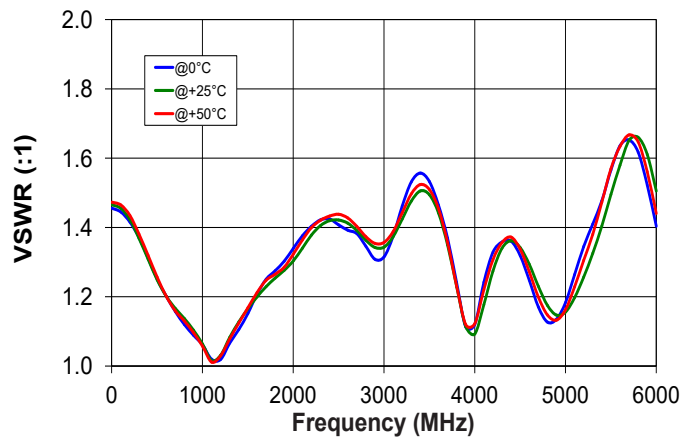
Insertion Loss at Ports J1-J8 vs. Frequency



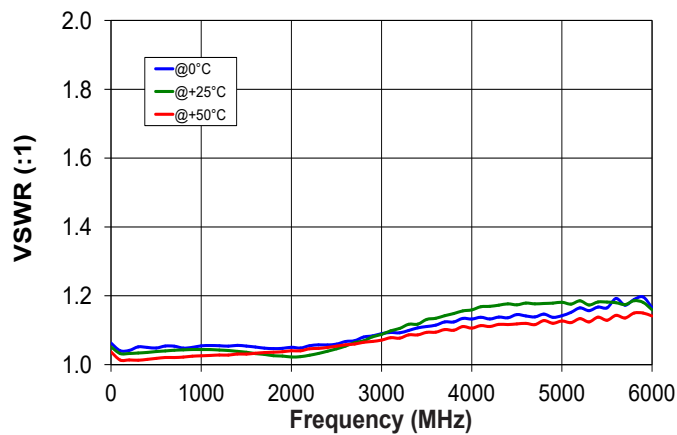
Active Port VSWR over Temp.



Common Port VSWR over Temp.

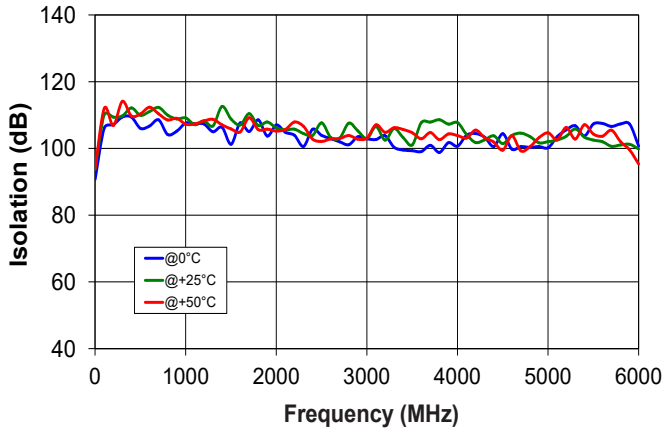


Internal Term. VSWR over Temp.

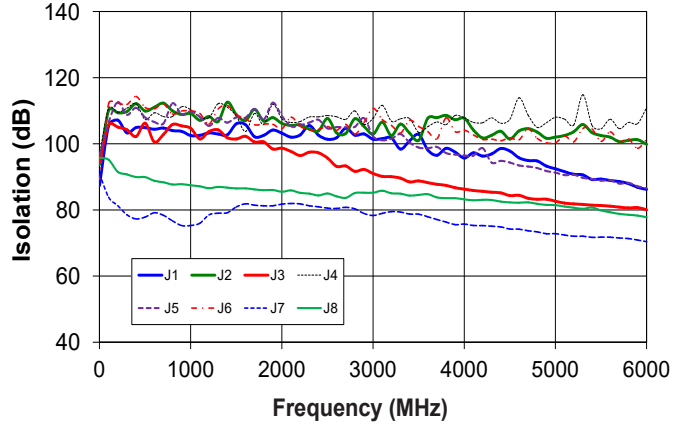


Typical Performance Curves (Continued)

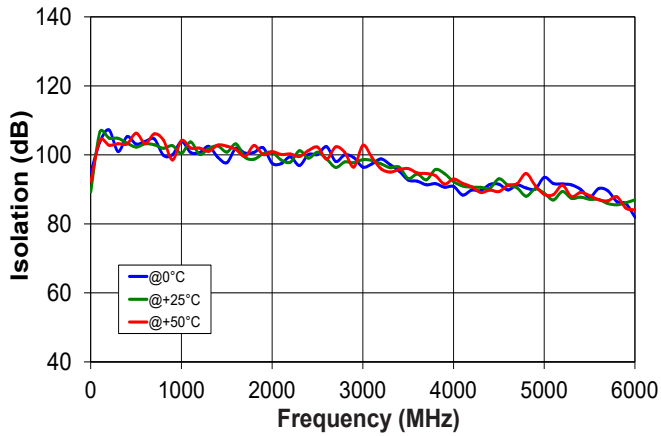
Isolation Com to Port J1 with J2 active over Temp.



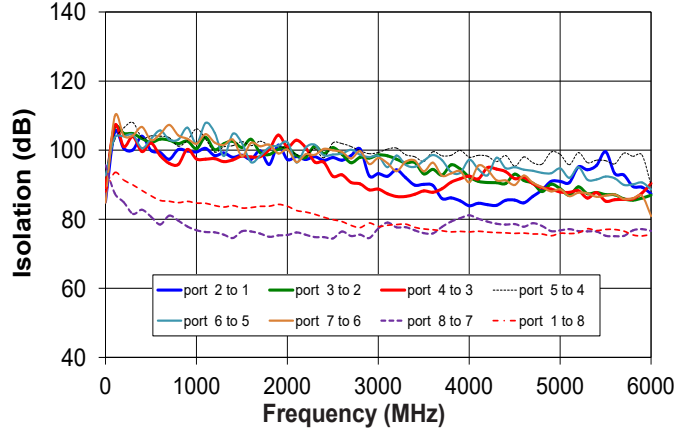
Isolation Com to Port J1-J8 vs. Frequency



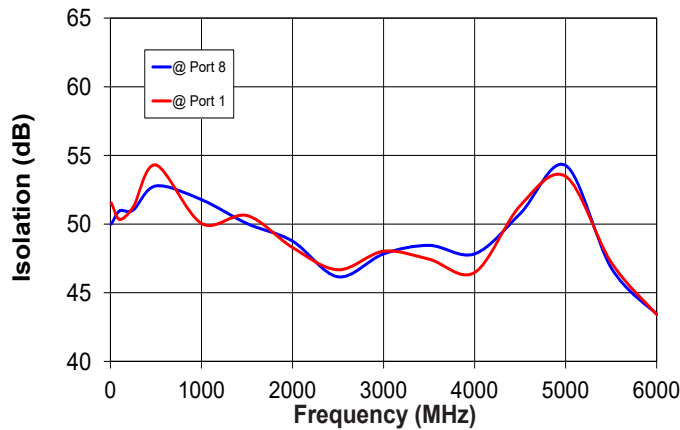
Isolation Port 2 to Port 1 Isolation over temp.



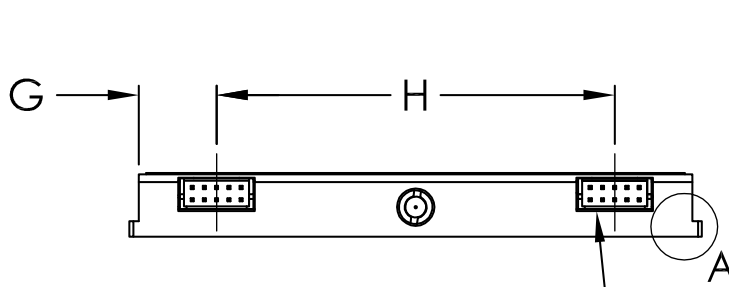
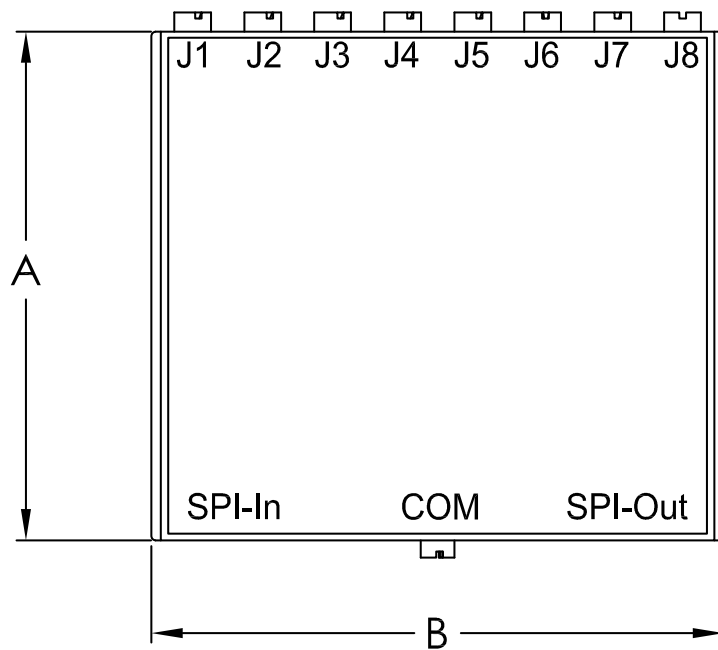
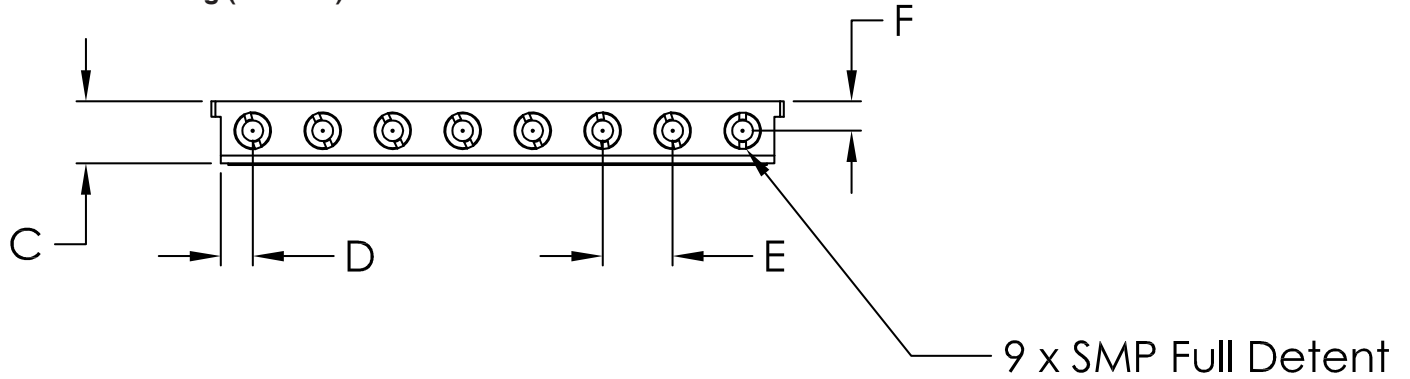
Isolation Port to Port vs. Frequency



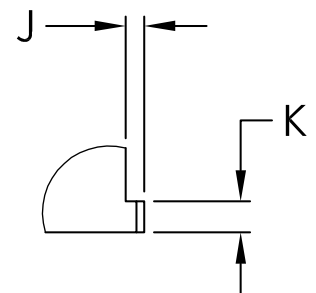
Input IP3



Outline Drawing (PM2656)



2 x Hirose DF11 series
10 pin male



Detail A

Outline Dimensions ($\frac{\text{inch}}{\text{mm}}$)

| A | B | C | D | E | F | G | H | J | K | WT. GRAMS |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----------|
| 3.270 | 3.680 | 0.400 | 0.205 | 0.450 | 0.190 | 0.500 | 2.560 | 0.060 | 0.100 | 180 |
| 83.06 | 93.47 | 10.16 | 5.21 | 11.43 | 4.83 | 12.70 | 65.02 | 1.52 | 2.54 | |

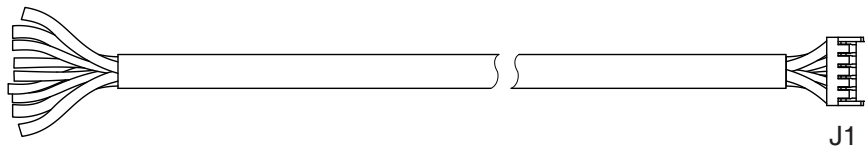
Recommended Accessories

Several optional cable accessories with and without interface connector are available with the SPI-SP8T-6G.

| Cable P/N | Cable Length | Wire Gauge | Cable connectors | Recommended use |
|-----------------|---------------|---------------------------------------|--|--|
| CBL-DF11-3FFD+ | 3 ft (0.91 m) | 30 AWG | Hirose DF11-10DS-2C(20) on each end | Connect between switches in series |
| CBL-DF11-3FPD+ | 3 ft (0.91 m) | 30 AWG | Hirose DF11-10DS-2C(20) on one end, pigtail (bare wires) on the other | Connect SPI-SP8T-6G switch to customer control board and power |
| CBL-DF11-3FMDP+ | 3 ft (0.91 m) | 30 AWG (data lines) 20 AWG (power) | Hirose ST40X-10S-CV(30) on one end, Hirose DF11-10DS-2C(20) on the other, and power cable ending in pigtail. | Connect SPI-SP8T-6G switch to Mini-Circuits' SPI converter model RS232/USB-SPI , and to a separate power supply. |

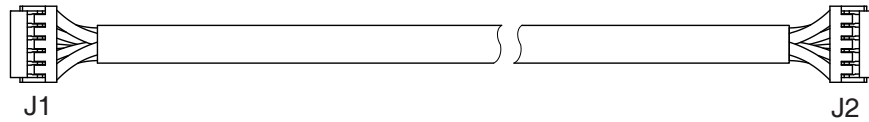
All cables are shielded and can handle the power draw of up to 50 switches in series.

CBL-DF11-3FPD+ Control Cable



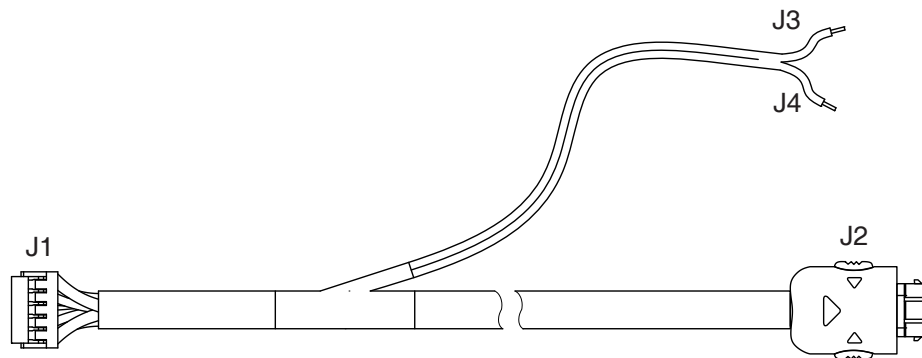
| Pin Number | Function | Description | Pigtail Wire Color |
|------------|----------|----------------------|--------------------|
| 1 | Vcc | Supply Voltage | WHITE |
| 2 | Vcc | Supply Voltage | BLACK |
| 3 | Vcc | Supply Voltage | RED |
| 4 | GND | Ground connection | GREEN |
| 5 | GND | Ground connection | YELLOW |
| 6 | GND | Ground connection | BLUE |
| 7 | Data | Data for SPI | BROWN |
| 8 | Clock | Clock for SPI | ORANGE |
| 9 | LE | Latch Enable for SPI | GRAY |
| 10 | Lock | Lock for SPI | VIOLET |

CBL-DF11-3FFD+ Control Cable



| J1 Pin Number | J2 Pin Number | Function | Description |
|---------------|---------------|----------|----------------------|
| 1 | 1 | Vcc | Supply Voltage |
| 2 | 2 | Vcc | Supply Voltage |
| 3 | 3 | Vcc | Supply Voltage |
| 4 | 4 | GND | Ground connection |
| 5 | 5 | GND | Ground connection |
| 6 | 6 | GND | Ground connection |
| 7 | 7 | Data | Data for SPI |
| 8 | 8 | Clock | Clock for SPI |
| 9 | 9 | LE | Latch Enable for SPI |
| 10 | 10 | Lock | Lock for SPI |

CBL-DF11-3FMDP+ Control Cable

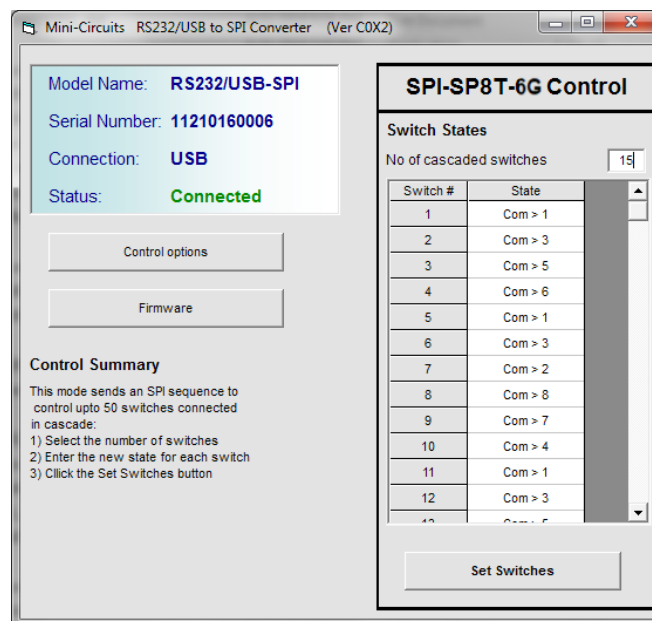


| J1 Pin Number | J2 Pin Number | J3 (Red wire) | J4 (Black wire) | Function | Description |
|---------------|---------------|---------------|-----------------|----------|----------------------|
| 1 | - | 1 | - | Vcc | Supply Voltage |
| 2 | - | 1 | - | Vcc | Supply Voltage |
| 3 | - | 1 | - | Vcc | Supply Voltage |
| 4 | - | - | 1 | GND | Ground connection |
| 5 | - | - | 1 | GND | Ground connection |
| 6 | 2 | - | 1 | GND | Ground connection |
| 7 | 9 | - | - | Data | Data for SPI |
| 8 | 7 | - | - | Clock | Clock for SPI |
| 9 | 3 | - | - | LE | Latch Enable for SPI |
| 10 | 6 | - | - | Lock | Lock for SPI |

Ordering, Pricing & Availability Information see our web site

| Model | Description |
|-------------|--------------------|
| SPI-SP8T-6G | SPI RF SP8T Switch |

| Optional Accessories | Description |
|----------------------|--|
| CBL-DF11-3FFD+ | 3 ft. Hirose DF11 (female-female) cable assembly (SPI) |
| CBL-DF11-3FPD+ | 3 ft. Hirose DF11 (female-pigtail) cable assembly (SPI) |
| CBL-DF11-3FMDP+ | 3 ft. Hirose DF11/ST40 (female-male) and power (pigtail) cable assembly (SPI) |
| SMPF-SF50+ | SMP Female to SMA Female Adapter |
| RS232/USB-SPI | <p>Bi-Directional converter for RS232 or USB to SPI:</p> <ul style="list-style-type: none"> • Provides a cost effective interface for up to 50 cascaded SPI-SP8T-6G switches • Allows USB and RS232 control • Simple API for automation of switch control in most common programming environments • User friendly GUI (Graphical User Interface) for manual switch control |



Additional Notes

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