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CORALIGN™ Low Loss Moving Fiber Optical Switches

Luminos CORALIGN™ fiber optic switches utilize direct fiber-to-fiber coupling. The high accuracies that are required for singlemode fiber are easily achieved with the use of a precision deflection structure that both supports the fibers and provides significant mechanical advantage. Insertion losses are optimized by the addition of a diminutive amount of ultra-stable liquid matching oil in the air gap. The basic features of this switch are covered in US patent 5,757,991.

Figure 1: Dual 1X2 SM Switch with 900μm tight-buffer cables

Figure 2: 1X2 SM Switch with 900μm tight-buffer cables

Figure 3: 2X2 SM Switch with 900μm tight-buffer cables

Product Features

Low Insertion Loss: 0.25dB typical (singlemode)
High Power Capable
Wavelength Independent
Epoxy Free Optical Path
Low Back Reflection: $<$ 60 dB (typical)

High Repeatability: 0.01 dB max
High Reliability: $>$ 10 x 10^6
Compact Package: 1.6" x 1.4" x 0.55"
Direct PCB Mounting
Latching and Non-Latching Versions Available

Product Applications

Application	1X2	2X2	Dual 1X2
Test Equipment	♦	♦	♦
Channel Selection	♦	♦	♦
Fiber Channel Protection	♦	♦	♦
Optical Signal Routing	♦	♦	♦
Ring Applications with drop or insert switching		♦	♦
One half of an FDDI Switch		♦	
Redundant/Standby Channel Protection		♦	♦
Ring Applications with TX/RX Standby			♦

Table 1: Product Applications

Switch Specification Summary

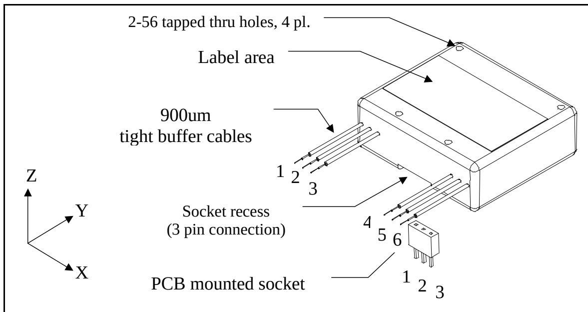
Characteristic	Comments	Singlemode 9/125 µm		Multimode 62.5/125 µm		Units	Notes
		Low Loss	Normal Loss	Low Loss	Normal Loss		
Insertion Loss * 1550 nm	Typical, no connector	0.25	0.7	0.05	0.5	dB	1
	Maximum, no connector	0.6	1.2	0.20	0.8	dB	1
Insertion Loss * 1310 nm	Typical, no connector	0.25	0.8	0.05	0.5	dB	1
	Maximum, no connector	0.6	1.3	0.20	0.8	dB	1
Insertion Loss * 850 nm	Typical, no connector			0.10	0.6	dB	1
	Maximum, no connector			0.25	0.9	dB	1
Switching Time	Typical	7				ms	2
	Max at 25 °C	10				ms	3
	Max 0 to 70 °C	12				ms	3
Back Reflection	Typical	-65	-60	-60		dB	
	Minimum	-55	-50	-50		dB	
Cross-talk	Max	-70				dB	4
Temperature Stability	Typical (0–70°C)	±0.1				dB	
	Max (0–70°C)	±0.3				dB	
Lifetime Drift	Max @ 10^7 cycles	±0.2				dB	
Repeatability	Max	0.01				dB	
Optical Power	Max	+17	+20	+20	+23	dBm	5
Temperature Range	Operational	0 to 70°C				°C	
	Storage	-30 to 70°C				°C	
Relative Humidity	Non-condensing	90				%	
Vibration	Max (power on)	20				g	6
Shock	Max (non-operational)	50				g	7
Fiber Types	50/125 available for MM	9/125		62.5/125		µm	
Cable Type	Tight buffer	900				µm	8
Connector Types Available	Pigtail (standard), FC, SC, LC, or ST						
Lead Length	Others available	1				meter	
Switch Driver 5V or 3V Option	Design value	5 or 3				volts	
	Typical current	50 or 86				mA	
Switch Voltage	5V one half-winding	4.2 – 6.0				volts	
	3V one half-winding	or 2.5 to 4				volts	
Coil Resistance	±10% per half-winding	100 or 35				ohm	9
Electrical Interface	3 pin header 0.1 spacing						10
Package Dimensions	Width	1.6				inch	
	Depth	1.4				inch	
	Height	0.55				inch	
Weight	Excluding connectors	1.6				ounce	

Table 2: Switch Specification Summary

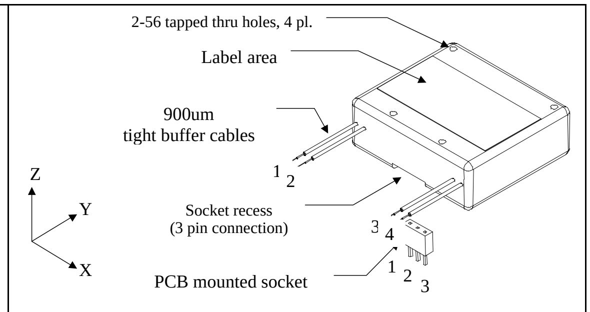
* In 2X2 version, path 1-4 has two air gaps and twice the insertion loss indicated above.
Specifications are subject to change without notification

NOTES:

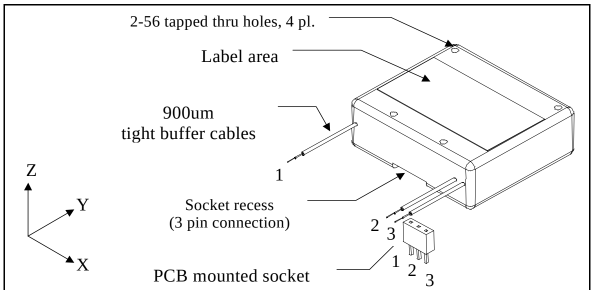
1. Insertion loss is specified per air gap. For 2X2 Switch only: when the switch is in state 1 as shown in table 3, Optical State Diagram, the optical path from 1 to 4 is a loop-back path with two optical gaps, and twice the insertion loss.
2. The switch has a typical electrical to optical transition time of about 6 milliseconds with a settling time of about 1 millisecond at the design drive voltage. See Figure 5 for a plot of a typical real-time switching cycle.
3. The maximum is specified to account for minor variations in each switch. At the extremes of temperature, the settling time will increase by about 3 milliseconds due to the damping characteristics of the switch.
4. Cross-talk is specified for any two fibers not in optical alignment.
5. The maximum power is limited only by the power handling of the fiber ends prepared with a polished 8° angled end face. (+17, +20 and +23 dBm are respective reference test levels only.) For higher power qualification levels, please consult the factory.
6. Optical continuity maintained. For the latching option state change does not occur: this value is reduced to 10 G's when power is not applied.
7. Half-sine impulse, optical continuity not guaranteed. For the latching option state change may occur. Direction of maximum sensitivity to acceleration: X
8. Winding configured as a center-tapped 200-ohm coil, 100 ohms nominal per coil for 5-volt operation. For the non-latching option the center-tap is not required and the full coil can be driven. A center-tapped 70 ohm, ±10% per coil option is available for nominal 3-volt operation.
9. The switch has three 0.025 " square pins on 0.100" centers recessed into the body designed for use with a low profile socket (SAMTEC #SSA-103-S-G or equivalent). One socket is supplied with each switch.



Dual 1 X 2 Switch in Perspective View



2 X 2 Switch in Perspective View



1 X 2 Switch in Perspective View

The switches are intended to mount directly onto a printed circuit board with the use of a low-profile 3-pin 0.100" spacing socket that is supplied with the unit. The switches can also be mounted with the connection pins facing up to allow a cabled connection to the device. An optional 3-wire jumper cable is available on request.

Optical State Diagrams

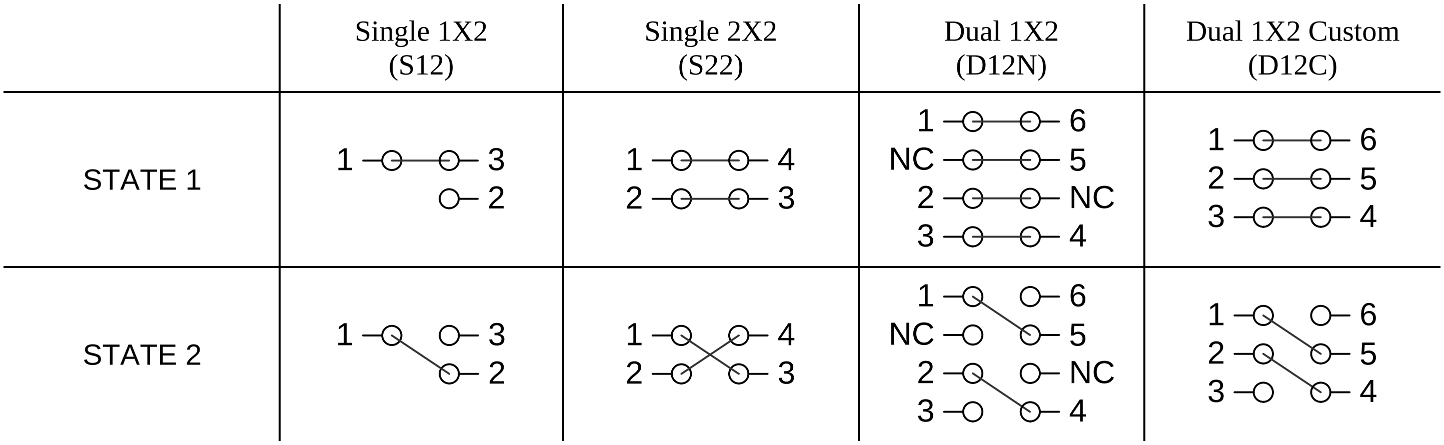


Table 3: Optical State Diagram

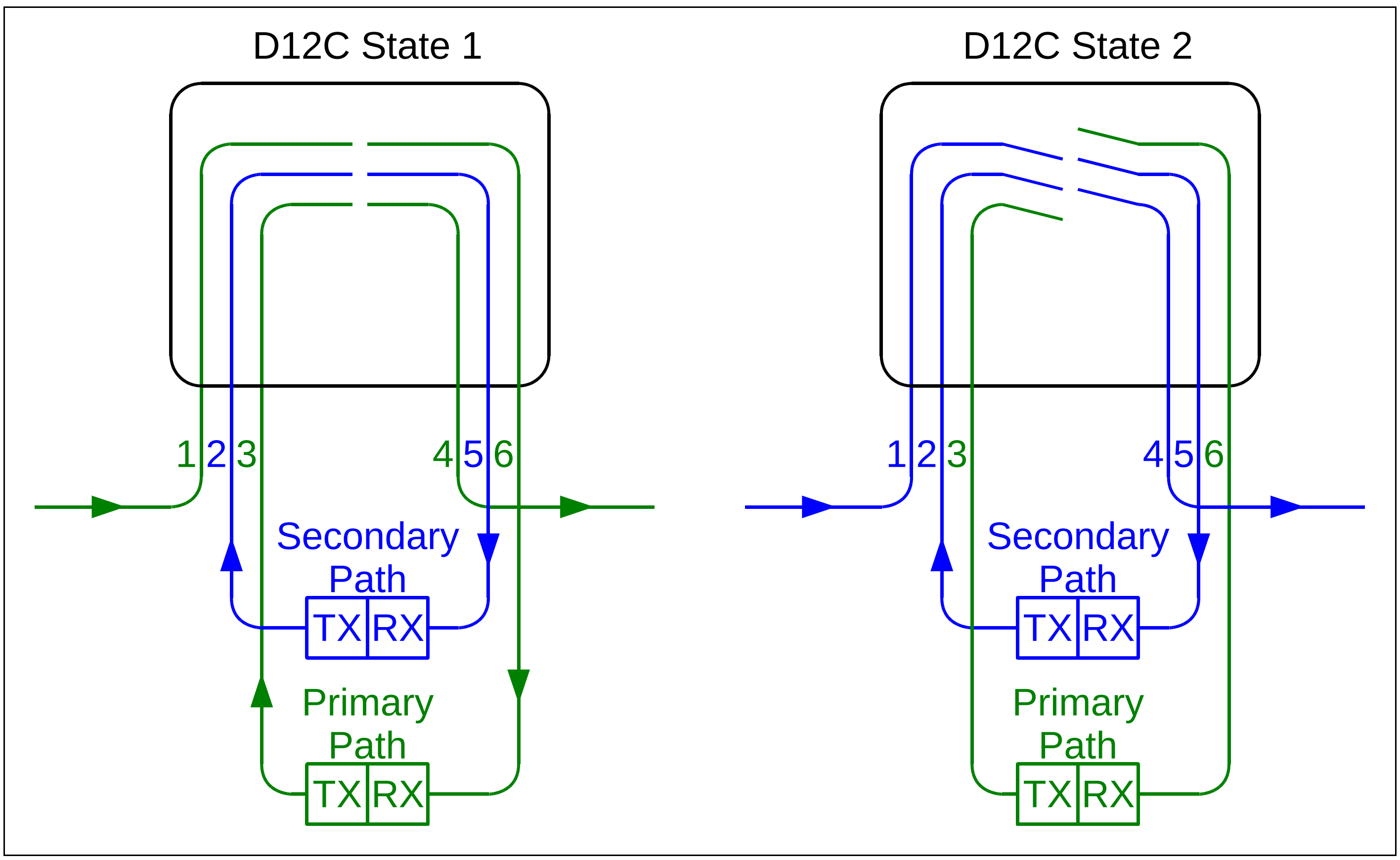


Figure 4: Dual 1X2 Custom Connectivity Diagram

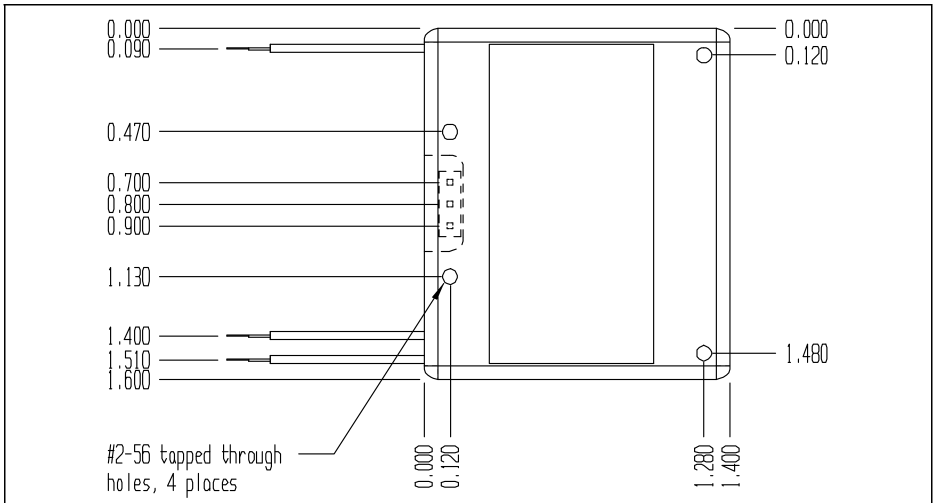
Figure 4 shows a TX/RX protection switch with a loop-back path provided for the secondary path that is not in use in state 1, but can monitor itself.

Electrical Connectivity

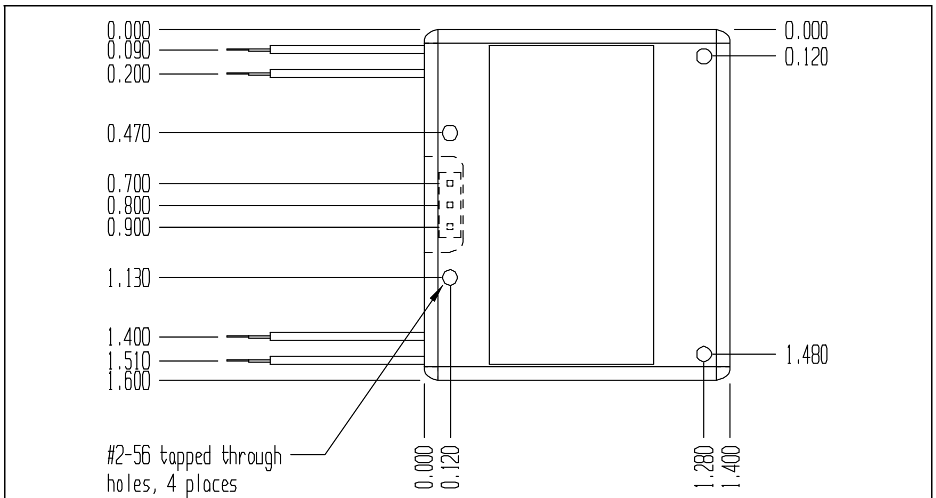
Switch option	State 1			State 2		
	Pin 1	Pin 2	Pin 3	Pin 1	Pin 2	Pin 3
Latching	V+	Gnd	V = 0	V = 0	Gnd	V+
Non-latching	Gnd	V = 0	V = 0	Gnd	V = 0	V+

Table 4: Electrical Connectivity

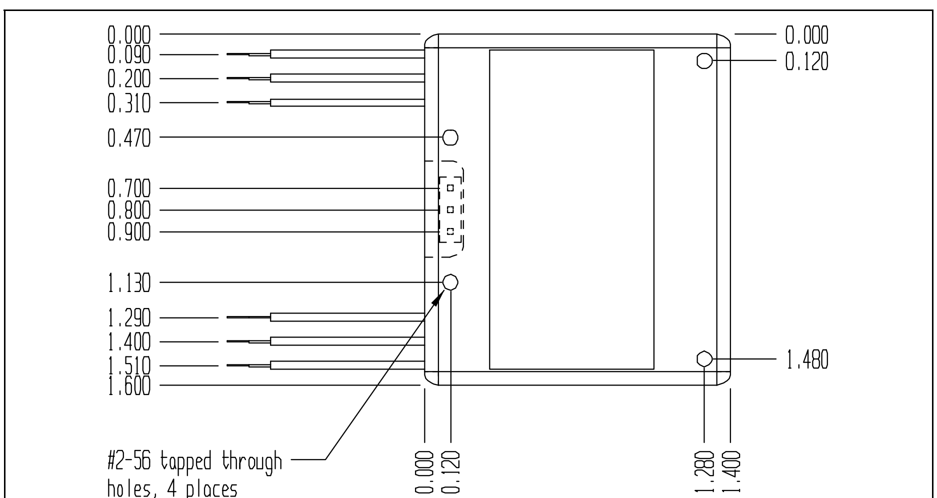
Top View Dimensions



1X2 Switch with 0.9mm cables



2X2 Switch with 0.9mm cables



Dual 1X2 Switch with 0.9mm cables

Typical Switching Cycle – Singlemode Switches

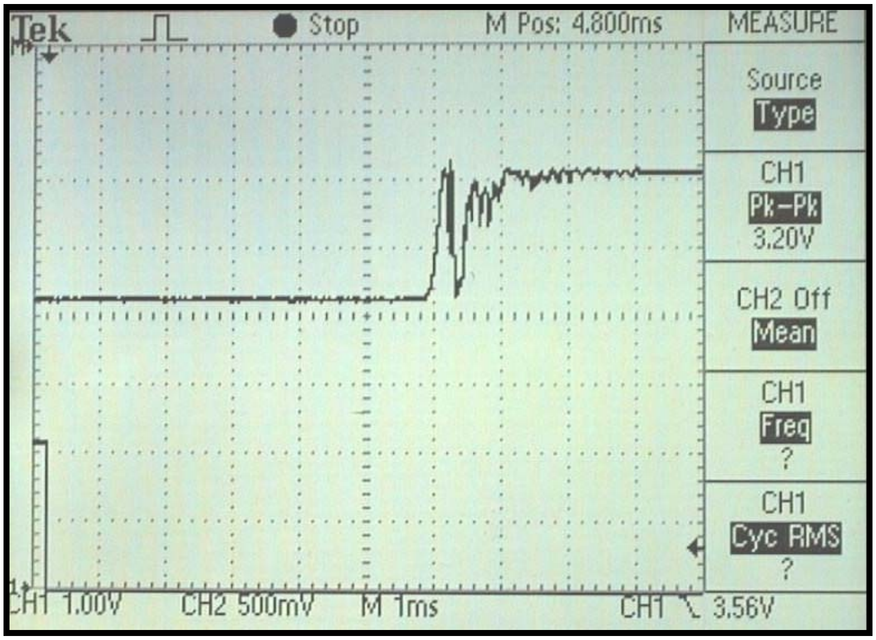


Figure 5: Typical Switching Cycle - Singlemode

Figure 5 illustrates the shape of an optical transition generated by the switch equipped with 9/125 singlemode fiber. The transition time is 6 to 7 milliseconds, followed by a damped overshoot and a narrow undefined region before final settling. The switch structure includes viscous damping to control the settling characteristics after each transition.

Typical Switching Cycle – Multimode Switches

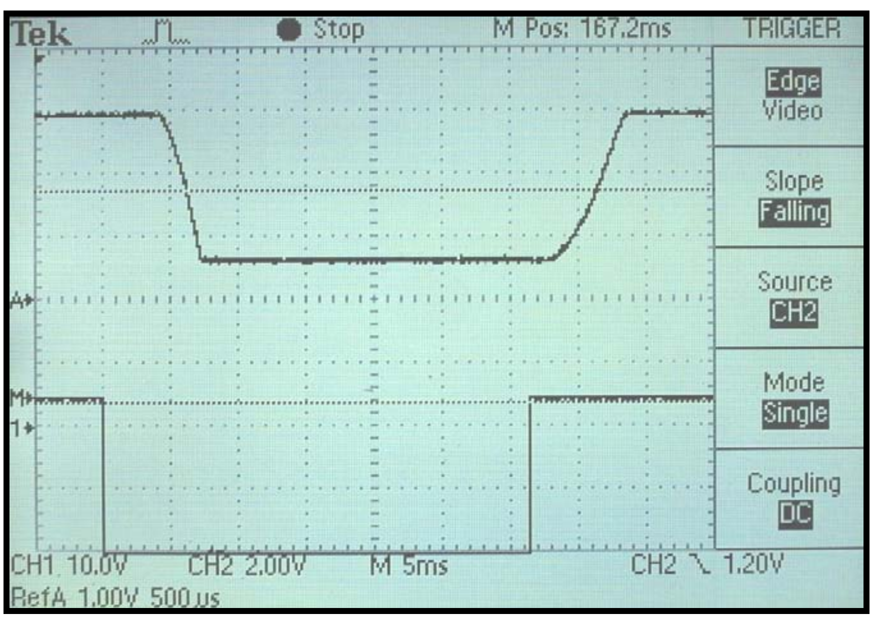


Figure 6: Typical Switching Cycle - Multimode

Figure 6 illustrates the shape of an optical transition generated by the switch equipped with 62.5/125 multimode fiber. The transition time is 6 to 7 milliseconds, followed by a damped overshoot and a narrow undefined region before final settling. The switch structure includes viscous damping to control the settling characteristics after each transition.

Options

Insertion Loss Options

Our standard, yet unmistakably Low Loss switches utilize a discrete amount of matching fluid at the gap resulting in ultra-low insertion losses: Singlemode - Typical 0.25 dB, Maximum 0.6 dB.

Normal Loss switches feature an air gap without the use of matching fluid resulting in slightly increased dB losses. While remaining competitive in the insertion loss, these are also priced at 25% below the low loss version. An excellent option for high power applications where ultra-low insertion loss is not critical; Singlemode - Typical 0.7 dB, Maximum 1.2 dB

Winding Options

The basic option is an isolated, center-tapped bi-phase winding, intended to provide single polarity operation for both state 1 and state 2, with the center tap at a fixed voltage, which can be either battery or ground. Reversing the polarity of one winding will reverse the switch state. The options include both 5 volt and 3 volt versions. The same center-tapped winding is connected without the center-tap for applications that require a fixed-polarity 0n-0ff drive voltage like a conventional relay. The dual winding is isolated, and can be returned to either battery or ground. When powered as a single overall winding, the pin 1 and 3 connections are used with pin 2 floating.

Latching Options

The standard option is a latching configuration, with the latch function designed into the internal magnetic structure. This configuration requires no steady state input power. The switch is set to state 1 or state 2 by a single pulse of 20 milliseconds or longer. Continuous current is preferable to maintain the switched state under high vibrational stress. The latching design retains its switched state during a power loss.

The non-latching option requires continuous drive current and functions like a conventional relay, which may not retain state during a power loss.

Power Cable Options

The basic package size is 1.4 by 1.6 by 0.55 inches. The base of the package has a recessed three terminal header for the drive coil input. The recess is set to clear a low profile socket strip for flush mount to a PCB or metal panel. The PCB mounted header socket is a Samtec SSA-103-S-G socket strip, or equivalent, which provides for flush mounting, when the switch is mounted flat to a PCB. One socket is included with each switch shipped.

Optical Connector Options

The standard option has 1-meter long cables (pigtails) for splicing, with no connectors. Other cable lengths are available on request.

Switches are available with FC, SC or ST connectors (consult factory for other connector types).

Optical Fiber Type Options

The standard SM fiber is Corning SMF-28 9/125 Corguide (Corning TM) 900µm tight buffered optical fiber. MM fiber of 50/125 or 62.5/125 is also available.

Mounting Options

The switch body has four #2-56 threaded holes which extend through the body for panel or bracket mounting from either side. Electrical connection can be made from either a PCB header or a ribbon cable.

Package Design and Cable Options

The aluminum package is finished with a heavy black anodize for high durability and excellent surface hardness. The package base, package cover and cables are sealed to prevent ingress of dust. This seal also minimizes short-term moisture ingress but is not hermetic. All part finishes are corrosion resistant. Due to space limitations for six cables, the dual 1 X 2 switch is presently only available with 900µm cables. 900µm cables are bonded into the package at multiple points and include a Buna-N rubber strain relief inside the package. The exit regions of the package are flared to give a safe bend radius under transient bend conditions during handling of the cables.

Other General Specifications

(See also: Table 2, page 2, Switch Specification Summary)

Short term tensile stress; cable to package at any angle, (accidental drop)

There shall be no continuous or long-term tensile stress applied to the cables.

900µm cables: 0.5 Kg maximum linear tension per cable.

FC connectors on 900µm cables weigh approximately 6.5 grams each. A single connector may not be “bungee-dropped” by more than 1.0 meter, or bent around an external radius less than 0.25 cm. This is an absolute maximum recommendation only, and does not imply that the manufacturer is responsible for any subsequent rough handling.

Connectorized 900µm cables longer than 1 meter are at higher risk of breakage if a connector is bungee-dropped.

Installed bend radius

The recommended minimum installed bend radius for cables is 1.0 inch.

Maximum DC input power

0.5 watts continuous per switch in either winding configuration.

Optical back reflection

Typical -60 dB, for back reflection of the switch only, excluding external connectors.

For example an FC style physical contact (PC) type connector typically dominates the back-reflection and limits it to a typical value of -45 dB.

Maximum optical input power any port

+20 dBm (higher power levels are possible but are not specified)

Note: Normal loss switches do not contain any matching fluid, or adhesives in the optical path. Low loss switches contain an ultra stable matching medium, impervious to optical power with an expected lifetime in excess of 100 years.

Drive pulse: unipolar drive threshold

Drive voltage: 4.2 volts minimum for the 5-volt option

Drive voltage: 2.5 volts minimum for the 3-volt option.

Operation at voltages below the design voltage will result in reduced switching speed.

Drive pulse duration for activating latching switches

Minimum 20 milliseconds at nominal voltage.

Operating relative humidity

0 to 90 % for non-condensing conditions.

Condensing conditions are nondestructive, but may temporarily effect the performance of the fiber air gap. All internal surfaces are moisture resistant.

Preconditioning

Switches are 100% preconditioned at the factory for 1 000 000 cycles.

Labeling

Each switch family is labeled as to its model and fiber type, and serialized for traceability.

The package/shipping boxes are foam packed and custom labeled.