SQ SERIES
FLEXIBLE SMALL CHANNEL COUNT SWITCH MODULE

User's Manual

JDS Uniphase

Instrumentation Support

Regular support hours of operation are 8:00 AM - 5:00 PM ET, Monday through Friday, excluding Canadian holidays.

Emergency Technical Support
For emergency assistance, technical support is available 7 days a week, 24 hours a day. Dial one of the telephone numbers below and follow the voice prompts to page a specialist.

North America
Toll Free: 800 406-9559
Toll Free Fax: 800 898-8537
Tel: 613 843-3000 Ext. 4999
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Outside North America
Toll Free: +800 4069-5599
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China
Toll Free: +10 800 140 5599

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Please refer to the JDSU Terms and Conditions of Sale for warranty coverage information.

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General Information and Specifications

General Information

The SQ switch, shown in Figure 1, is ideal for applications requiring high optical performance in latching or non-latching applications. The full feature set and large number of optical configurations available in a common package and interface make it ideal for a wide spectrum of applications.

Figure 1: SQ Switch

The switch connects one or two channels to one of several (up to eight) channels. Both single-mode and multimode versions are available. T

While in operation, the switch connects optical channels by using prisms to redirect the signal from an input port into a selected output port. Using collimating optics minimizes the insertion loss and improves the repeatability and stability of the optical parameters. The switches are optically passive and therefore are transparent to signaling formats.

Configurations can be manufactured for bi-directional performance as a factory option. he switch is also available in multi-pack configurations, for example, 2 x 4, 2 x 6, 2 x 8 D configuration (Duplex 1 x 2, 1 x 3, 1 x 4). Custom configurations are available upon request.

Configurations

The SQ switch may be optically configured as follows:

- 1x3 up to 1x8
- 2x4, 2x6, 2x8 D configuration (Duplex 1x2, 1x3, 1x4)
- Dual 1x2
- Single-mode or multimode fiber
- 900 µm buffered fiber or 3 mm cable

All units are customer-configurable as:

- Latching
- Non-latching
- Default channel for non-latch operation

Available electrical interfaces include::

- 2x12 male header on the side of the package
- 2x12 male (recessed) socket on the bottom of the package (for PCB mounting)

D Configuration

Figure 2 shows the SQ switch in the off position.

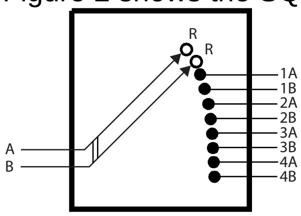


Figure 2 - SQ Switch in the off position

The 2 x N configuration allows for mass reconfiguration of optical paths. It provides simultaneous connections of 2 inputs to a number of outputs.

Key Features

- High optical performance
- High repeatability
- Latching or non-latching
- Field configurable default non-latch channel
- Wide choice of configurations
- Off position (optional)
- Status feedback
- GR-1073 compliant
- Compact size

Applications

- Incorporation into customized switch assemblies for test and measurement applications
- Network monitoring and testing
- Sensor switching
- Source/detection selection
- Research and development

Specifications

Table 1 shows the options for the SQ series

Table 1: Options

Parameter	Options
Wavelength range	
SM or MM	1270 to 1670 nm
MM only	850 to 1350 nm
Fiber type	
SM	9/125 µm
MM	50/125 µm, 62.5/125 µm
Fiber jacket size	900 µm fiber, 3.0 mm cable
Configuration	1 x 3 to 1 x 8
	Dual 1 x 2 (2 independent 1 x 2's)
	Duplex 1 x 2 (2 x 4 "D")
	Duplex 1 x 3 (2 x 6 "D")
	Duplex 1 x 4 (2 x 8 "D")
Optical Connectors	FC/PC, FC/APC, SC/PC, SC/APC, LC/PC, no connector
Length	0.3 to 9.9 m (± 5 cm for lengths under 1 m, ± 5% for lengths 1 m or greater)
Test Orientation	Standard
	Bi-directional

Table 2 shows the specifications for the SQ series.

Table 2: Specifications

Parameter[1]	Specification	
	SM	**MM**
Insertion loss[2] (includes one FC/PC connection)		
1 x 3, 1 x 4, Dual 1 x 2, 2 x 4 "D"	< 1.1 dB	< 1.0 dB
1 x 5, 1 x 6, 1 x 7, 1 x 8, 2 x 6 "D", 2 x 8 "D"	< 1.25 dB	< 1.15 dB
Return loss (excludes connectors)		
selected port SM	> 55 dB	
selected port MM	> 30 dB	
Polarization dependent loss (SM only)		
1 x 3, 1 x 4, Dual 1 x 2, 2 x 4 "D"	< 0.08 dB	
1 x 5, 1 x 6, 1 x 7, 1 x 8, 2 x 6 "D", 2 x 8 "D"	< 0.10 dB	
Insertion loss stability[3]		
1 hr	± 0.02 dB	
24 hr	± 0.05 dB	
Repeatability[4]		
1 x 3, 1 x 4, Dual 1 x 2, 2 x 4 "D"	< 0.01 dB (p-p)	(± 0.005 dB)
1 x 5, 1 x 6, 1 x 7, 1 x 8, 2 x 6 "D", 2 x 8 "D"	< 0.02 dB (p-p)	(± 0.01 dB)
Crosstalk/isolation		
selected port to other ports	< - 60 dB	< - 50 dB
bi-directional - non-selected to other non-selected	< - 50 dB	< - 40 dB
Optical input power	300 mW max	

Lifetime	> 10 million cycles
Switching time	< 20 ms
Control interface	Configurable TTL
Operating voltage (DC)[2,5]	5.0 V DC ± 10 % at 100 mA (300 mA max during switching)
Qualification testing	GR1073 for Central Office
Operating temperature	0 to 60 ° C
Storage temperature	- 40 to 85 ° C
Humidity (relative, non-condensing) Operating Storage	 < 90 % at 23 °C < 20 % at 60 °C < 90 % at 60 °C < 40 % at 85 °C
Dimensions (W x H x D)	70 x 17 x 70 mm
Weight	119 g (1x8, 1.5 meters of 900 µm fiber, no connectors) 182 g (1x8, 1.5 meters of 900 µm fiber, FC/PC connectors)

1. Unless otherwise specified, all specifications include one FC/PC connection, at start of life at 23 C 3 C and 45% RH 5%.
2. At 23° C 3° C at specified test wavelengths (850/1310 MM or 1310/1550 SM) and optical input power of -25 to 0 dBm.
3. Drift of any channel at ±3° C deviation of ambient temperature without changing channels (excludes repeatability).
4. Repeatability as per Telcordia GR-1073-CORE (100 cycles, max-min/peak to peak).
5. At 23° C. Over full temperature range: (5.0V ±5%)

Getting Started

The SQ Switch package consists of the switch, test report and user's manual.

Before Initializing and Operating the Unit

- ☑ Inspect the unit for any signs of damage.
- ☑ Read the user's manual thoroughly, and become familiar with all safety symbols and instructions to ensure that the unit is operated and maintained safely.
- ☑ Install the unit as specified in the Physical Mounting and Connection.
- ☑ Ensure that the unit and any devices or cords connected to it are properly grounded.
- ☑ If the unit is used in a manner not specified by JDS Uniphase, the protection provided by the unit may be impaired.

Safety Instructions

The following safety instructions must be observed whenever the unit is operated, serviced, or repaired. Failure to comply with any of these instructions or with any precaution or warning contained in the user's manual is in direct violation of the standards of design, manufacture, and intended use of the unit. JDS Uniphase assumes no liability for the customer's failure to comply with any of these safety requirements.

Operating the Unit

	**Warning** To avoid the risk of injury or death, always observe the following precautions before initializing the unit: Never look into the end of an optical cable connected to an optical output device that is operating. Laser radiation is invisible, and direct exposure can severely injure the human eye. For more information, see the user's manual of the laser source in use. Repairs are to be carried out only by a JDS Uniphase qualified technician. Do not perform any operating or maintenance procedure that is not described in the user's manual. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Cleaning Connectors

⚠	**Caution** Connecting damaged or dirty fibers to the unit can damage the connectors on the unit. Never force an optical connector. Some connectors have a ceramic ferrule that can easily be broken.

Optical cable ends need to be cleaned before using them with the unit.

The following items are required for cleaning:

Filtered compressed air or dusting gas
Lint-free pipe cleaners or lint-free swab
Lint-free towels/tissues
Optical grade isopropyl alcohol or optical grade 200° ethanol (do not use rubbing alcohol, which contains 30% water)

To clean the connectors:

1. Blow the sleeve with filtered compressed air (Figure 3).

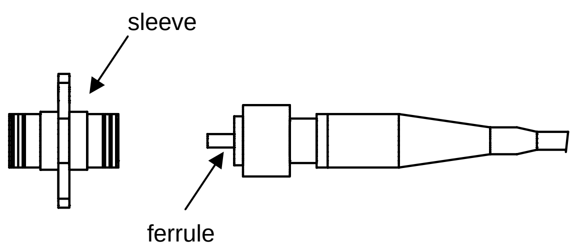


Figure 3: Connector Cleaning (connector type can vary)

2. Apply optical grade isopropyl alcohol or optical grade ethanol (do not use rubbing alcohol) to a small area of a lint-free towel and rub the end of the ferrule over the wet area.

3. Wipe the ferrule on a dry area of the lint-free towel.

4. Using the dusting gas or compressed air, blow the end of the ferrule.

5. Apply the alcohol or ethanol to a lint-free pipe cleaner or swab and wipe off the remaining parts of the connector.

6. With the other end of the pipe cleaner or swab, dry the areas cleaned.

7. Using the dusting gas or compressed air, blow the areas cleaned.

Storing Fiberoptic Connectors

All fiberoptic connectors are shipped with dust caps installed. Keep the dust caps on the connectors whenever they are not mated.

Handling Fiberoptic Cables

The SQ switch can be shipped with fiber pigtail outputs. These pigtails must be handled with care to avoid damage.

	Caution Do not bend the pigtails with a radius less than 4 cm (1.5 in). A small bend radius adversely affects the optical performance of the pigtail and leads to early failure of the pigtail.

Service

Storing and Shipping

To maintain optimum operating reliability, do not store the unit in locations where the temperature falls below -40°C or rises above 85°C. Avoid any environmental condition that can result in internal condensation. Ensure that these temperature and humidity requirements can also be met whenever the unit is shipped.

Claims and Repackaging

Immediately inform JDS Uniphase and, if necessary, the carrier, if

- The contents of the shipment are incomplete
- The unit or any of its components are damaged or defective
- The unit does not pass the initial inspection

In the event of carrier responsibility, JDS Uniphase will allow for the repair or replacement of the unit while a claim against the carrier is being processed.

Returning Shipments to JDS Uniphase

JDS Uniphase only accepts returns for which an approved Return Material Authorization (RMA) has been issued by JDS Uniphase sales personnel. This number must be obtained prior to shipping any material to JDS Uniphase. The owner’s name and address, the model number and full serial number of the unit, the RMA number, and an itemized statement of claimed defects must be included with the return material.

Ship return material in the original shipping container and packing material. If these are not available, packaging guidelines are as follows:

1. Cover the front panel with a strip of foam.
2. Wrap the unit in anti-static packaging.
3. Pack the unit in a reliable shipping container.
4. Use enough shock-absorbing material (10 to 15 cm or 4 to 6 in on all sides) to cushion the unit and prevent it from moving inside the container. Pink poly anti-static foam is the recommended material.
5. Seal the shipping container securely.
6. Clearly mark FRAGILE on its surface.
7. Always provide the model and serial number of the unit and the RMA number on any accompanying documentation.

Please contact the RMA department, using the contact information at the beginning of this document, to provide an RMA number and a shipping address.

Installation and Physical Interface

Electrical Interface Specifications

Two options of electrical interface are available for the SQ switch.

Table 3: Recommended Mating Connectors

Connector Option	Connector Part Number	Recommended Mating Connector
Side connector	2x12 pin male header (Samtec[1] MMT-112-01-S-DH-A)	Ribbon cable: Samtec TCSD-12-D-xx-01-F-N
		Board-mount ribbon cable connector: Samtec STMM-112-02-S-D-SM-LC
Bottom connector (for PCB mounting)	2x12 pin flush mount male socket (Samtec TW-12-03-S-D-275-SM-A)	PCB mounted connector: Samtec SQW-112-01-L-D-VS-A

Physical Mounting and Connection

To install the switch:

1. Mount the switch using the four mounting holes provided. Recommended mounting screws are: #6-32 (or M3.5X0.6) hex socket head cap screw with a minimum length of 5/8 inches (16 mm). See Figure 8 for mounting hole locations.

NOTE: CAD files are available for modeling purposes. Please contact JDS Uniphase for access to these files.

2. For the side mount connector version: connect a mating harness to the switch (see Table 5 for pin-outs). For the bottom mount connector version: plug the switch onto a PCB.

3. Read the information below regarding power connection. Turn on the power supply. The switch is now ready for use.

Caution

Protection against reverse connection of the power input is not incorporated in the SQ switch. Reverse connection of the power input results in damage to the switch.

The SQ switch requires that the power input be within the tolerance given at the unit. A system power design must compensate for any wiring losses in cabling. Failure to maintain the correct supply voltage can result in unpredictable operation of the switch.

NOTE: The +5 V DC required by the SQ switch is to be measured at the connector of the SQ unit itself, not the power source. This is particularly important when the SQ switch is expected to operate over a wide temperature range or is located at a distance from the power source (i.e. applications where system conditions are such that voltage drop over the harness might exceed the SQ switch specifications.

[1] Samtec is a trademark of Samtec Inc.

Operating Instructions

NOTE: Please read this section carefully in order to understand the various methods available to control the SQ switch.

	**Laser Safety** Use of passive optical devices with no optical energy source in conjunction with sources must be conducted with care and recognition of the safety required according to the classification of the source.

In order to support the various implementation methods demanded by the OEM market, the SQ switch offers various control interfaces. The appropriate type of implementation will vary depending on individual customer circumstances. Please contact JDS Uniphase Instrumentation Technical Support if assistance is required to determine the most suitable implementation method for your system. The following information briefly introduces each interface.

Interfacing to the SQ Switch

The SQ switch has been designed to connect directly to a parallel bus interface. Switch control signals are latched into the internal registers of the SQ switch on a rising edge of the CLK signal (if the ~NOCLK signal is high). Position status outputs are tristate outputs controlled by the active low output enable (~OE). See the timing information in Figure 4 through Figure 7.

For applications other than parallel bus interfaces, the CLK input can be disabled by connecting ~NOCLK to GND. Switch control inputs are then asynchronous level sensitive inputs, and the switch will respond to any changes on these inputs immediately. Position status outputs can also be enabled by connecting ~OE to GND if desired.

~Error output alarm signal is an active low indicator that a switch actuator is in an invalid state or the sensor has failed. The error line will remain low until the power is cycled. This is an internal switch failure. This signal is never tristated, and is not gated by ~OE.

Operational Modes

The SQ switch offers both latching and non-latching operational modes. The default channel for non-latching mode is externally configurable. There are two sets of control inputs used to set the switch position:

The active inputs (A0, A1, A2/B0, B1) are used to set the switch during normal operation.

The default inputs (DEF_A0, DEF_A1, DEF_A2/DEF_B0, DEF_B1) are used to control what position the switch moves to when power is removed from the device (thereby permitting configuration as latching or non-latching).

Latching Operation

For latching operation, the default inputs (DEF_x pins) should be written with the same desired switch position as is written to the active inputs. On a power failure, the switch will then remain in the same position. When using latching mode, it is recommended that the data be clocked in.

Non-Latching Operation

For non-latching operation, the default position for the switch when power is removed can be controlled in a number of ways. The DEF_x pins can be tied low or left unconnected as desired, to select a fixed power down default state for the switch.

NOTE: Refer to Table 9 for the required amount of time that power must be applied in order for non-latching operation to function properly.

Electrical Characteristics

The electrical characteristics of the SQ switch are summarized in Table 4.

Table 4: DC Operating Characteristics

Symbol	Parameter	Conditions	Min	Nom	Max	Units
Vcc	Supply voltage[1]		4.5	5.0	5.5	V
Icc	Supply current	Peak	70	100	300	mA
Vih	High input level voltage		2.0		Vcc	V
Vil	Low input level voltage		GND		0.8	V
Voh	High output level voltage		2.7			V
Vol	Low output level voltage				0.5	V

1. At 23° C

SQ Switch Interface

The pin-outs of the SQ switch interface connector are detailed in Table 5.

Table 5: SQ Switch Pin-out

Pin Number	Signal Name	Notes	I/O	Pin Number	Signal Name	Notes	I/O
1	Vcc			2	GND		
3	A0	Internal pull-up	I	4	POS0	Tri-state output when ~OE is high	O
5	A1	Internal pull-up	I	6	POS1	Tri-state output when ~OE is high	O
7	A2/B0	Internal pull-up	I	8	POS2	Tri-state output when ~OE is high	O
9	B1	Internal pull-up	I	10	POS3	Tri-state output when ~OE is high	O
11	DEF_A0	Internal pull-up	I	12	~ERROR	Active low, indicates invalid switch state or failed sensor	O
13	DEF_A1	Internal pull-up	I	14	~NOCLK	Low disables CLK pin - switch position input signal become unclocked inputs Internal pull-down	I
15	DEF_A2/ DEF_B0	Internal pull-up	I	16	~OE	Active low output enable for POSx outputs. Internal pull-up	I
17	DEF_B1	Internal pull-up	I	18	CLK	Rising edge latches switch position control input signals (A0, A1, A2/B0, B1, DEF_A0, DEF_A1, DEF_A2/DEF_B0, DEF_B1) Internal pull-down	I
19	Reserved	Leave NC		20	Reserved	Leave NC	
21	Reserved	Leave NC		22	Reserved	Leave NC	
23	Reserved	Leave NC		24	Reserved	Leave NC	

Controlling Optical Switch Position

Methods to control the different configurations of the SQ switch are detailed in Table 6, Table 7 and Table 8. See Figure 8 in appendix A for channel labeling.

Table 6: 1xN Configuration

Active/Default Control Pins (Input)				**Switch Configuration**						**Position Status Pins (Output)**			
B1	**A2**	**A1**	**A0**	**1x8**	**1x7**	**1x6**	**1x5**	**1x4**	**1x3**	**POS 2**	**POS1**	**POS0**	**POS3**
High	Low	Low	Low	A – 1	A – 1	A – 1	A – 1	A – 1	A – 1	Low	Low	Low	High
High	Low	Low	High	A – 2	A – 2	A – 2	A – 2	A – 2	A – 2	Low	Low	High	High
High	Low	High	Low	A – 3	A – 3	A – 3	A – 3	A – 3	A – 3	Low	High	Low	High
High	Low	High	High	A – 4	A – 4	A – 4	A – 4	A – 4	A – 3	Low	High	High	High
High	High	Low	Low	A – 5	A – 5	A – 5	A – 5	A – 3	A – 3	High	Low	Low	High
High	High	Low	High	A – 6	A – 6	A – 6	A – 3	A – 3	A – 3	High	Low	High	High
High	High	High	Low	A – 7	A – 7	A – 4	A – 3	A – 3	A – 3	High	High	Low	High
High	High	High	High	A – 8	A – 4	A – 4	A – 3	A – 3	A – 3	High	High	High	High
Low[1]	X	X	X	OFF/ 8	OFF/ 4	OFF/ 4	OFF/ 3	OFF/ 3	OFF/ 3	X	X	X	Low

1. Shows “OFF” if position option is present, or shows channel indicated (3,4, or 8).

Table 7: 2xN “D” Configuration

Active/Default Control Pins (Input)				**Switch Configuration**			**Position Status Pins (Output)**			
B1	**A2**	**A1**	**A0**	**2x8**	**2x6**	**2x4**	**POS2**	**POS1**	**POS0**	**POS3**
High	Low	Low	Low	A – 1A B – 1B	A – 1A B – 1B	A – 1A B – 1B	Low	Low	Low	High
High	Low	Low	High	A – 2A B – 2B	A – 2A B – 2B	A – 2A B – 2B	Low	Low	High	High
High	Low	High	High	A – 3A B – 3B	A – 3A B – 3B	A – 2A B – 2B	Low	High	High	High
High	High	High	High	A – 4A B – 4B	A – 3A B – 3B	A – 2A B – 2B	High	High	High	High
Low[1]	X	X	X	OFF A – 4A B – 4B	OFF A – 3A B – 3B	OFF A – 2A B – 2B	X	X	X	Low

1. Shows “OFF” if position option is present, or shows channel indicated (A-2A, B-2B, A-3A, B-3B, A-4A, B-4B).

Table 8: Dual 1x2 Configuration

Active/Default Control Pins (Input)				**Switch Configuration**	**Position Status Pins (Output)**			
B1	**A2**	**A1**	**A0**	**Dual 1X2**	**POS3**	**POS2**	**POS1**	**POS0**
High	X	High	Low	A – A1	High		High	Low
High	X	High	High	A – A2	High		High	High
High	Low	High	X	B – B1	High	Low	High	
High	High	High	X	B – B2	High	High	High	
Low	X	X	X	ALL OFF	Low	X	X	X

NOTE: X indicates that the pin status is not relevant.

Off Position

Some SQ switches are manufactured with an "Off Position" if specified as such in the part numbering structure (SQ...Y+..... for units with this option, or SQ...N+... for units without this option). This Off Position allows the user to block all input signals from reaching all of the output lines. SQ units without an Off Position will, at all times, transmit an optical signal to an output.

Please contact JDS Uniphase Corp. for additional information regarding additional specifications (signal suppression/return loss/etc.) for the Off Position. All other specifications apply during normal operation.

Timing

Figure 4: Asynchronous Mode (~NOCLK = Low)

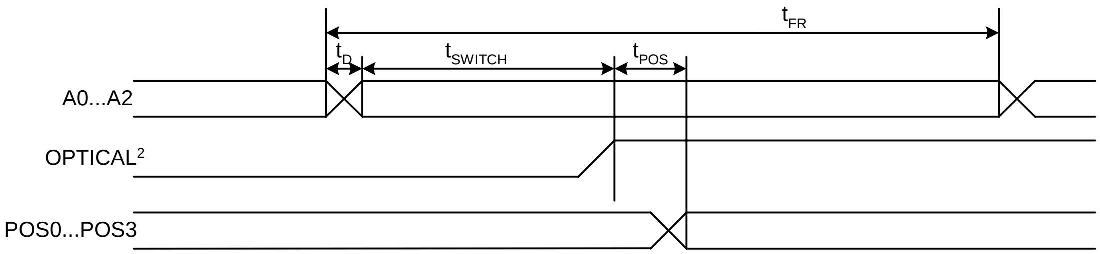


Figure 5: Synchronous Mode (~NOCLK = High)

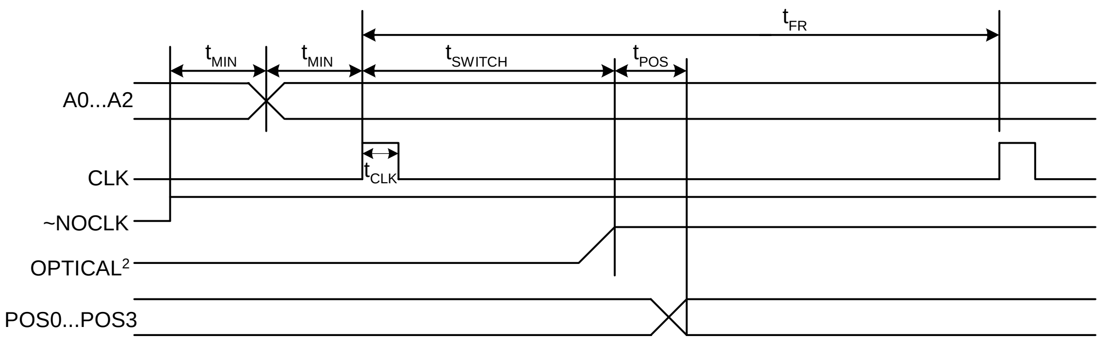


Figure 6: Error Signal (Internal Failure)

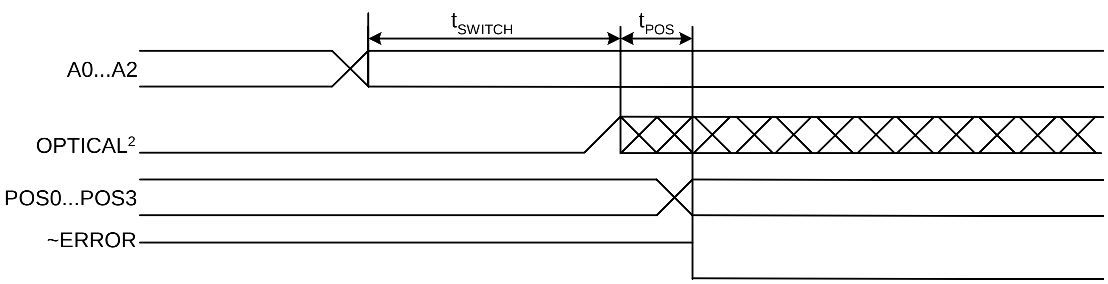
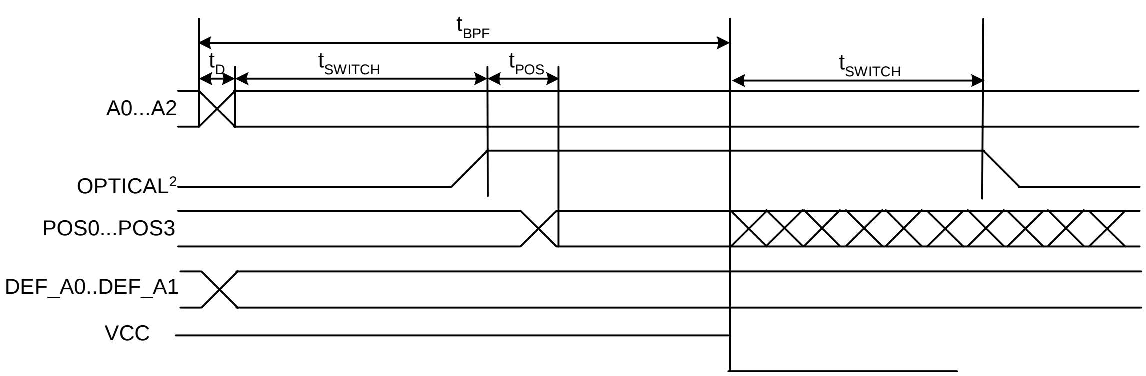


Figure 7: Power Fail / Default Inputs



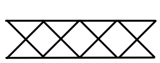
 = Invalid State

Table 9: Timing Parameters

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Optical switch time	t_{SWITCH}		5	10	20	ms
Debounce time[1]	t_D	Asynchronous mode only	1			µs
Clock pulse width	t_{CLK}	Synchronous mode only	500			ns
Position signal	t_{POS}				1	ms
Control signal delay	t_{MIN}		50			ns
Switching frequency	t_{FR}		100			ms
Time before power failure	t_{BPF}	Only available in non-latching mode	50			ms
Reset time	t_{RESET}		10			µs

1. Data must be valid for at least 1 µs.
2. Optical signal is illustrated to show relative switch position.
3. The switch requires 20 ms to engage after power on.

Appendix A: SQ Switch Dimensions

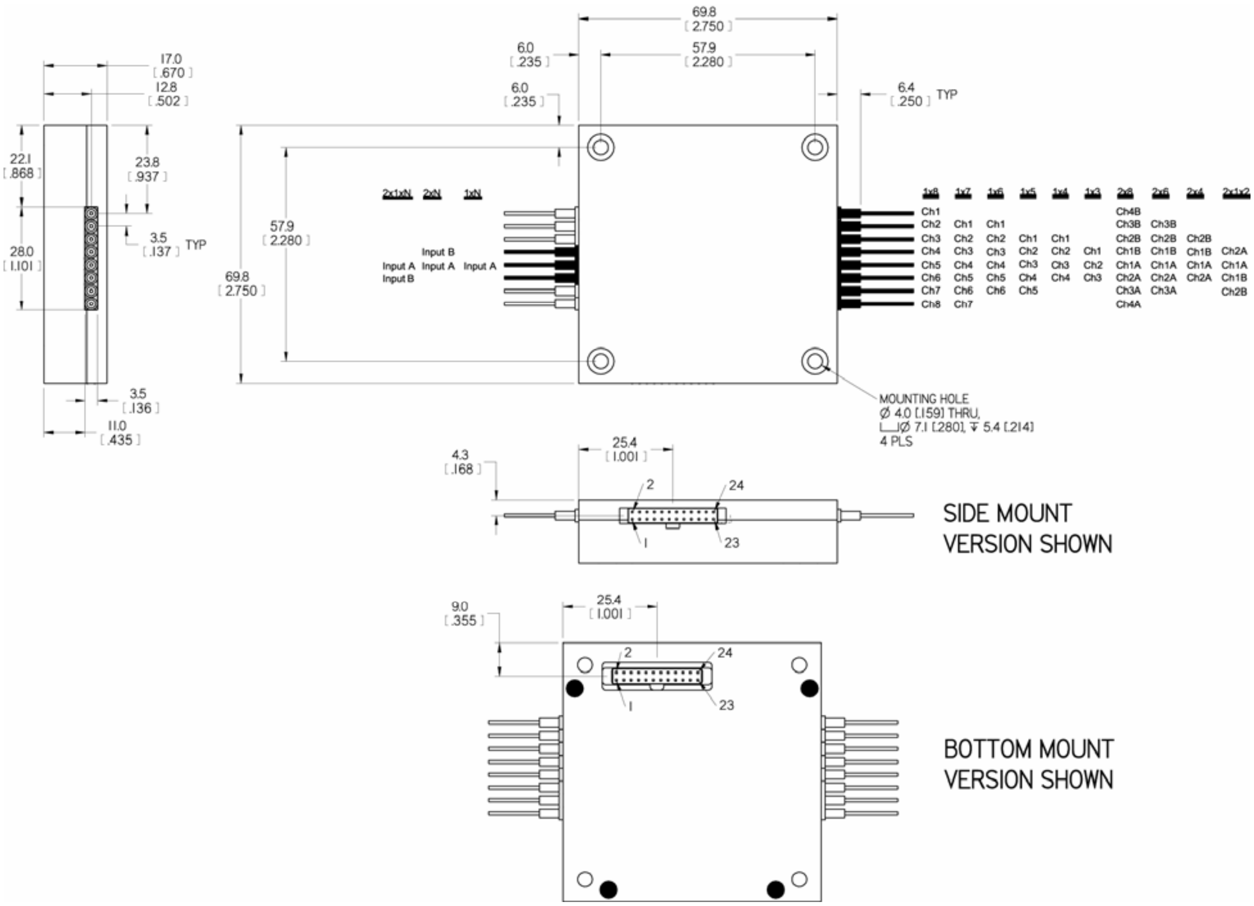


Figure 8: SQ Switch Dimensioning Schematic

Appendix B: Application Note

Implementation of the SQ Series Switch into an Existing SW Series Switch Application

The intent of this application note is to describe the implementation of the SQ switch in an SW switch application. In this mode, the SQ switch is functionally compatible to a non-latching SW switch, with the exception of the requirement to use an external power supply.

Table 10: Switch Operation

Switch		Pin Name				
Configuration	**Type**	**B1**	**A2/B0**	**A1**	**A0**	**Channel**
1x3	Direct Drive	-	-	-	0V	C – 1
		-	-	-	-	C – 2
		-	0V	-	-	C – 3
	TTL Drive	-	-	0V	+5V	C – 1
		-	-	0V	0V	C – 2
		-	-	+5V	0V	C – 3
1x4	Direct Drive	-	-	-	0V	C – 1
		-	-	0V	-	C – 2
		-	-	-	-	C – 3
		0V	-	-	-	C – 4
	TTL Drive	-	0V	0V	+5V	C – 1
		-	0V	+5V	0V	C – 2
		-	0V	0V	0V	C – 3
		-	+5V	0V	0V	C – 4
1x5	Direct Drive	-	-	-	0V	C – 1
		-	-	0V	-	C – 2
		-	-	-	-	C – 3
		-	0V	-	-	C – 4
		0V	-	-	-	C – 5
	TTL Drive	0V	0V	0V	+5V	C – 1
		0V	0V	+5V	0V	C – 2
		0V	0V	0V	0V	C – 3
		0V	+5V	0V	0V	C – 4
		+5V	0V	0V	0V	C – 5
2x4	Direct Drive	X[2]	-	0V	-	C 1 – 2
		X	-	-	-	C 1 – 3
		-	-	X	-	C 2 – 4
		0V	-	X	-	C 2 – 5
	TTL Drive	X	-	+5V	-	C 1 – 2
		X	-	+0V	-	C 1 – 3
		0V	-	X	-	C 2 – 4
		+5V	-	X	-	C 2 – 5

1. “-“ indicates “no connect”
2. “X” indicates “does not matter”.

NOTE: When configured as an SW switch, the default pins are "Do not connect". The power down position depends on the configuration; SW 1x3 position 2, 1x4 - position 3, 1x5- position 3, 2x4- position 1A and 1B.