CrystaLatch™ 1x6 Fiber Optic Reflection Switch for LIDAR Sensor Applications

(SM, PM, High Power)

(Protected by U.S. patents 7224860，6757101，6577430 and pending patents)

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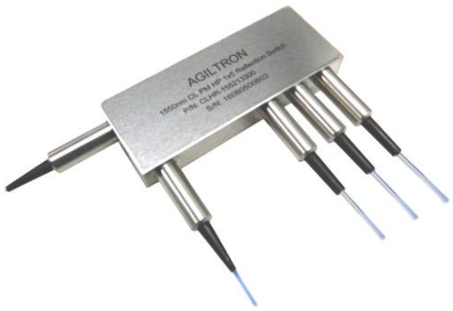

The CL 1x6 Series Fiber Optical Reflection Switch connects optical channels by redirecting an incoming optical signal into a selected output fiber at the same time collect the reflected signal into a dedicate sensor port. This proprietary configuration is designed for sensor and LIDAR application, minimizing optical loss and eliminating the need for an additional circulator or coupler. The switching is achieved using patented non-mechanical configurations and activated via an electrical control signal. The latching operation preserves the selected optical path after the drive signal has been removed.

This series of reflective switches is designed to meet the most demands of continuous operation without wear-out, longevity without fail, and live operation under vibration/shock, as well as -40°C operation. An electronic driver is available for this series of switches.

Features

- High Speed
- Non-Mechanical
- High Reliability
- Fail-Safe Latching
- Low Insertion Loss
- Rugged
- Compact
- Cost Effective
- Direct Low Voltage Drive

Applications

- Optical Sensing
- Optical Signal Routing
- Instrumentation

Specifications

Parameter		Min	Typical	Max	Unit
Operation Wavelength [1]		1520	1550	1580	nm
		1295	1310	1325	nm
Insertion Loss [2]			1.2	2.0	dB
Cross Talk [2]		40	50		dB
Return Loss [2]		50	55		dB
PDL (Except PM Series Switch)			0.15	0.25	dB
Directivity [3]		45	50		dB
Extinction Ratio (PM Series Switch only)		18	25		dB
Polarization Mode Dispersion				0.2	ps
Optical Switching Speed (Rise, Fall)		5		10	µs
Repetition Rate			2K		Hz
Durability		10^{15}			cycle
Operating Temperature [4]		-5		+70	°C
Storage Temperature		-40		+85	°C
Optical Power Handling	High Power Series Switch		3	5	W
	Others		300	500	mW
Fiber Type		SMF-28, Panda PM, or equivalent			

Notes:

[1]. Agiltron can achieve same SPEC at L band

[2]. Measured without connectors

[3]. Defined as the optical power at the sensor port when light is launched into the input

[4]. Operating temperature -40 ~ +85°C version is available as special

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Rev 02/04/25

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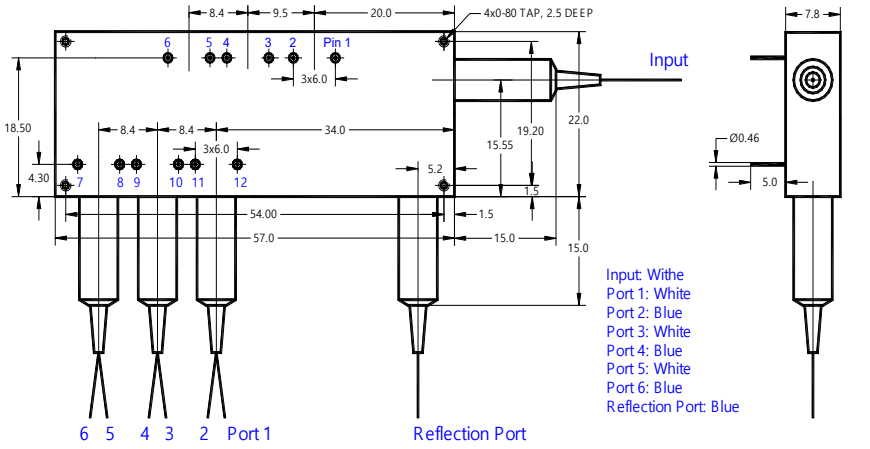
Mechanical Dimensions (Unit: mm)



*Product dimensions may change without notice. This is sometimes required for non-standard specifications.

Electrical Driving Information

Each switching point is actuated by applying a voltage pulse. Applying one polarity pulse, one light path will be connected and latched to the position. Applying a reversed polarity pulse, another light path will be connected and latched to the position after pulse removed.

Parameter	Minimum	Typical	Maximum	Unit
Resistance (each Pin group)	15	18	22	Ω
Switch Voltage	2.25	2.5	2.75 [1]	V
Pulse Duration	0.2	0.3	0.5	ms

[1]. Over this value will damage the device

Driving kit with USB and TTL interfaces and Windows™ GUI is available. We also offer RS232 interface as an option – please contact Agiltron sales.

Electrical Driving Table

Optical Path	Pin Group 1		Pin Group 2		Pin Group 3		Pin Group 4		Pin Group 5		Pin Group 6	
	Pin 1	2	3	4	5	6	7	8	9	10	11	12
IN →P1 & P1→R [1]	+ [2]	0	+	0	0	+	+	0	+	0	+	0
IN →P2 & P2→R	0	+	0	+	0	+	+	0	+	0	+	0
IN →P3 & P3→R	+	0	0	+	+	0	+	0	0	+	0	+
IN →P4 & P4→R	0	+	+	0	+	0	+	0	0	+	0	+
IN →P5 & P5→R	+	0	0	+	0	+	0	+	+	0	0	+
IN →P6 & P6→R	0	+	+	0	0	+	0	+	+	0	0	+

[1]. **IN**: Input port. **P1**: Port 1. **R**: Reflection Port.
[2]. "**+**": 2.25~2.75 V pulse

Note:

The driving voltage value is transient voltage with a full load. The driver circuitry needs to provide sufficient current (~300mA) during the switching. Inside the switch core is an electromagnet with a residual magnetic field. The residual magnetic field will be established when an electrical current flows in one direction through the coil for a sufficiently long period. The residual magnetic field latches the switch state even without applying a voltage (the current flow stopped). Flowing a current in the opposite direction for a sufficient time changes the switch stage by establishing a reversal magnetic field. The coil is forgiving to the driver unless one burns it by applying a higher voltage or a current for too long (day). The switch can also be operated at high repetition rates of kHz, where the residual magnetic field may not be fully established.

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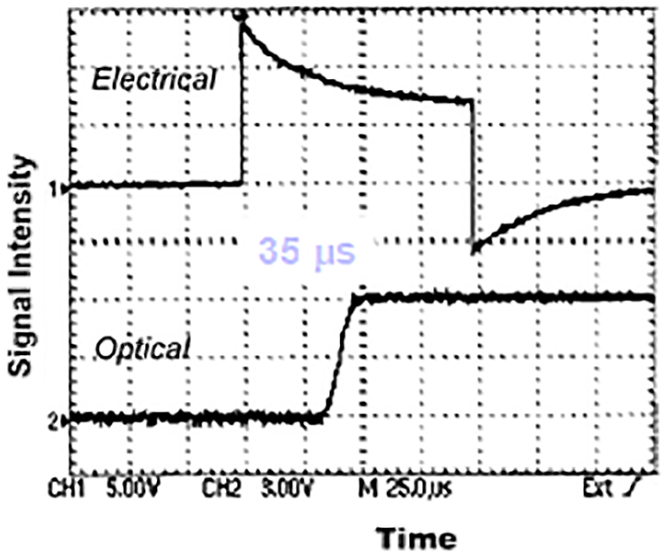
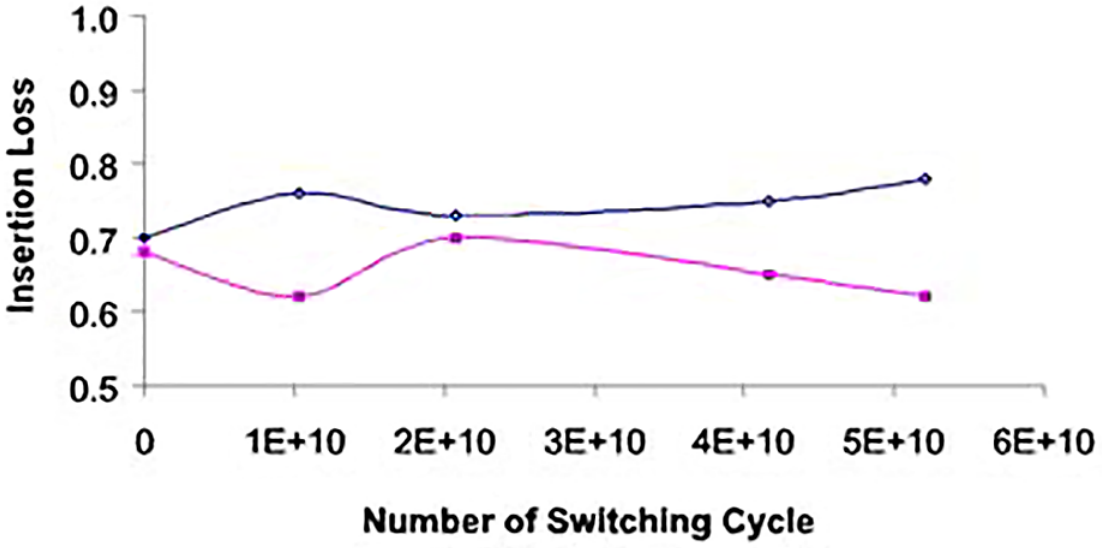
Typical Switching Response



Typical Loss Change of 1x2 vs Switching Numbers



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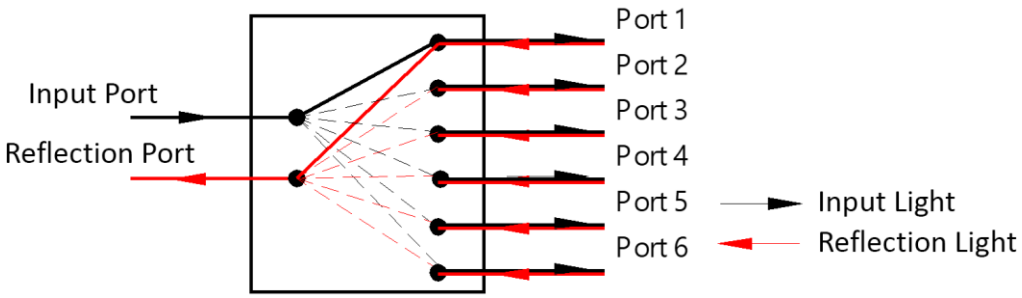
Functional Diagram



CL 1x5, 1x6 PM High Power Reflection Switch

Ordering Information (Part Number)

	☐☐	☐	2	☐	☐	☐	☐	☐
Prefix	**Type**	**Wavelength**	**Switch**	**Package**	**Fiber Type**	**Fiber Cover**	**Fiber Length**	**Connector [5][6]**
CLRS- [1] **CLPR-** [2] **CLHR-** [3] **CPHR-** [4]	1x2 = 12 1x3 = 13 1x4 = 14 1x5 = 15 1x6 = 16 Special = 00	1310 = 3 1550 = 5 Special = 0	Dual Stage = 2 Special = 0	Standard = 1 -40~+85°C = A -40~+70°C = B -20~+85°C = C Special = 0	SMF-28 = 1 PM 250 = B Special = 0	Bare fiber = 1 900um tube = 3 Special = 0	0.25m = 1 0.5m = 2 1.0m = 3 Special = 0	None = 1 FC/PC = 2 FC/APC = 3 SC/PC = 4 SC/APC = 5 ST/PC = 6 LC/PC = 7 Duplex LC/PC = 8 LC/APC = A LC/UPC = U Special = 0

[1]. **CLRS**: **C**rysta**L**atch Dual Stage **R**eflection **S**witch.

[2]. **CLPR**: **C**rysta**L**atch Dual Stage **P**M **R**eflection Switch.

[3]. **CLHR**: **C**rysta**L**atch Dual Stage **H**igh Power **R**eflection Switch.

[4]. **CPHR**: **C**rysta**L**atch Dual Stage **P**M High Power **R**eflection Switch.

[5]. There isn't any connector in the high power switches normally. Please contact us for high power connectors.

[6]. The default connector configuration uses fiber with 0.9 mm buffer protection. The connector cannot be installed directly onto bare fiber because the bare fiber is prone to damage during shipping. However, the connector can be assembled on bare fiber if a 3 cm protective loose tube is added for reinforcement. The customer may remove this protective tube after testing. The optical power handling of a standard connector is less than 0.5 W for SMF-28 fiber and decreases further for smaller-core fibers.

Fiber Core Alignment

Note that the minimum attenuation for these devices depends on excellent core-to-core alignment when the connectors are mated. This is crucial for shorter wavelengths with smaller fiber core diameters that can increase the loss of many decibels above the specification if they are not perfectly aligned. Different vendors' connectors may not mate well with each other, especially for angled APC.

Fiber Cleanliness

Fibers with smaller core diameters (<5 μm) must be kept extremely clean, contamination at fiber-fiber interfaces, combined with the high optical power density, can lead to significant optical damage. This type of damage usually requires re-polishing or replacement of the connector.

Maximum Optical Input Power

Due to their small fiber core diameters for short wavelength and high photon energies, the damage thresholds for device is substantially reduced than the common 1550nm fiber. To avoid damage to the exposed fiber end faces and internal components, the optical input power should never exceed 20 mW for wavelengths shorter 650nm. We produce a special version to increase the how handling by expanding the core side at the fiber ends.

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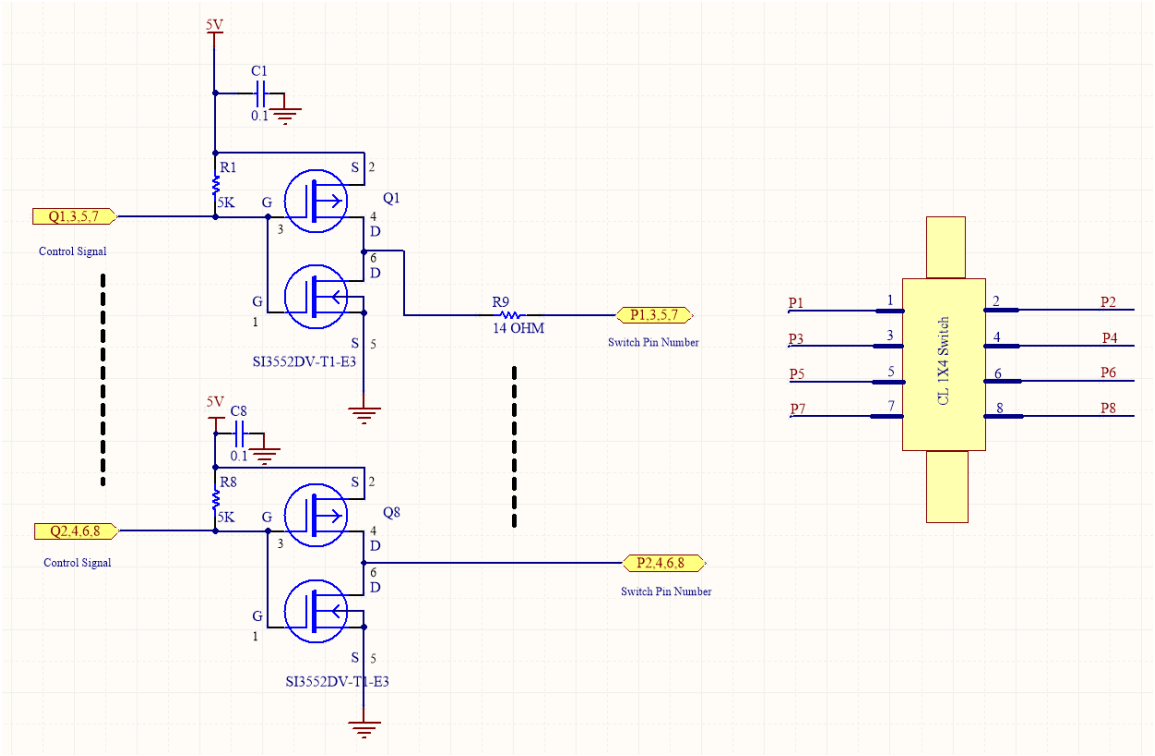
Driver Design Example for 1x4

A recommended +5VDC powered driving circuit is provided. The resistor network R1~R8 is to suppress the driving signal's voltage level to meet the "switch voltage" requirements. In specific applications, users can use lower voltage to eliminate the R1~R8. The Q1~Q8 is the control signal from either a function generator or a microcontroller general purpose I/O. The Q1-Q8 switching speed must meet the specific MOSFET switching requirement and CL 1x4 Switch specific requirement. Usually, the control signal speed is ≤ 2kHz.



Usually, a clean power supply source will be sufficient. However, decoupling capacitors for the transistor supply rail are recommended depending on different applications. Minimum the current loop on the switching circuits will minimize the switching noise. For other layout recommendations, please refer to books or application notes from the IC manufacturer.

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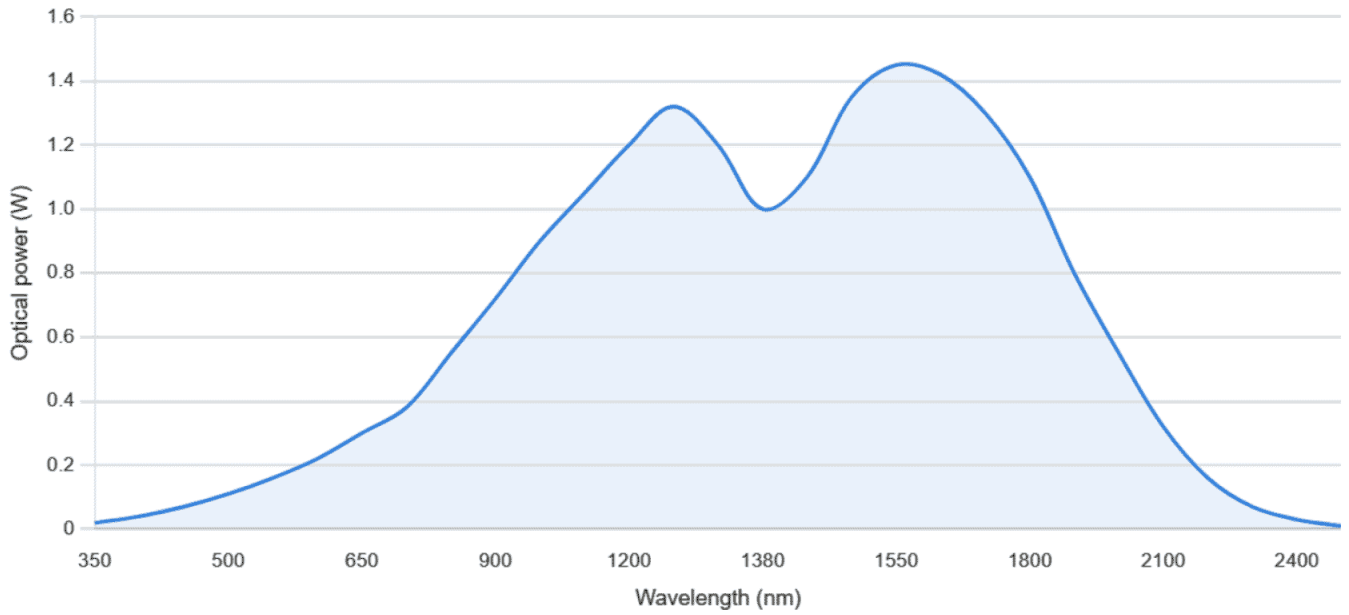
Regular Single Mode / Polarization Maintaining Fiber Optical Power Handing vs Wavelength



Single mode fiber optical power is limited by nonlinear effects in addition to absorption that increase loss and generate heat. The curve shows the approximate safe CW power envelope for standard single-mode fiber. Actual limits depend on fiber design, core size, length, and laser characteristics. Specialty fibers can significantly increase the power limit.

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