

# CrystaLatch™ Bypassable Fiber Optical Circulator

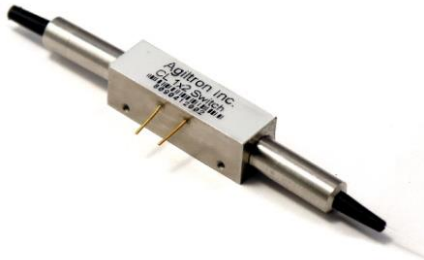
(SM, PM, Unidirectional, Bidirectional, High Power)

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



DATASHEET

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## Features

- Solid-State High Speed
- Low Insertion Loss
- High Isolation
- Fail-Safe Latching
- Non-Mechanical
- Compact & Rugged
- Direct Low Voltage Drive

## Applications

- Optical Signal Routing
- PMD compensation
- Network Protection
- Restoration
- Burst Switching
- Configurable Add/Drop
- Signal Monitoring
- Instrumentation

The CL Series bypassable Optical circulator works in either circulator mode or bypass mode. In the circulator mode, it works as a regular 3 port circulator, light entering port 1 passes out through port 2, and light entering port 2 passes out through port 3. In the bypass mode, light entering port 1 will output through port 3 bypassing port 2. Switching between these two working modes is activated via an electrical control signal. This is achieved using patent pending non-mechanical configurations, which also features Latching operation that preserves the selected working mode after the drive signal is removed. The all solid state bypassable circulator features low insertion loss, high channel isolation, fast switching speed and extremely high reliability and repeatability.

The magneto-optical crystals used in the CL switches have no fatigue nor drift effect.

## Specifications

Parameter	Min	Typical	Max	Unit
Operation Wavelength <sup>[1]</sup>	1520	1550	1580	nm
	1295	1310	1325	
Insertion Loss <sup>[2]</sup>		0.7	1.0 (1.2 <sup>[4]</sup> )	dB
Isolation <sup>[2]</sup>	40	50		dB
Directivity <sup>[2]</sup>	40	50		dB
Return Loss <sup>[2]</sup>	50	55		dB
PDL (SM Series)		0.1	0.2	dB
Extinction Ratio (PM Series)	18	25		dB
Optical Switching Speed (Rise, Fall)	5		10	μs
Repetition Rate		2K		Hz
Durability	10 <sup>15</sup>			cycles
Polarization Mode Dispersion		0.1	0.2	ps
Device Type	Solid-Stage Latching			
Operating Temperature <sup>[3]</sup>	-5		70	°C
Storage Temperature	-40		85	°C
Optical Power Handling <sup>[3]</sup>		300	500	mW
			2	W

### Notes:

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

[2]. Measured without connectors

[3]. Special operating temperature -40 to +85°C is available with Ordering Information

[4]. For special operating temperature, lower than -20°C and higher than +70°C

**Note:** For a polarized input light version, the isolation is optimized to block the light reflection of the same polarization. Although lights of other polarizations may also be blocked, the extinction may be poor. PM isolators can be specially made to block backward propagating lights of all polarizations. PM isolators can also be made with a light polarizing function.

**Warning:** This is an OEM module designed for system integration. Do not touch the PCB by hand. The electrical static can kill the chips even without a power plug-in. Unpleasant electrical shock may also be felt. For laboratory use, please buy a Turnkey system.

**Legal notices:** All product information is believed to be accurate and is subject to change without notice. Information contained herein shall legally bind Agiltron only if it is specifically incorporated into the terms and conditions of a sales agreement. Some specific combinations of options may not be available. The user assumes all risks and liability whatsoever in connection with the use of a product or its application.

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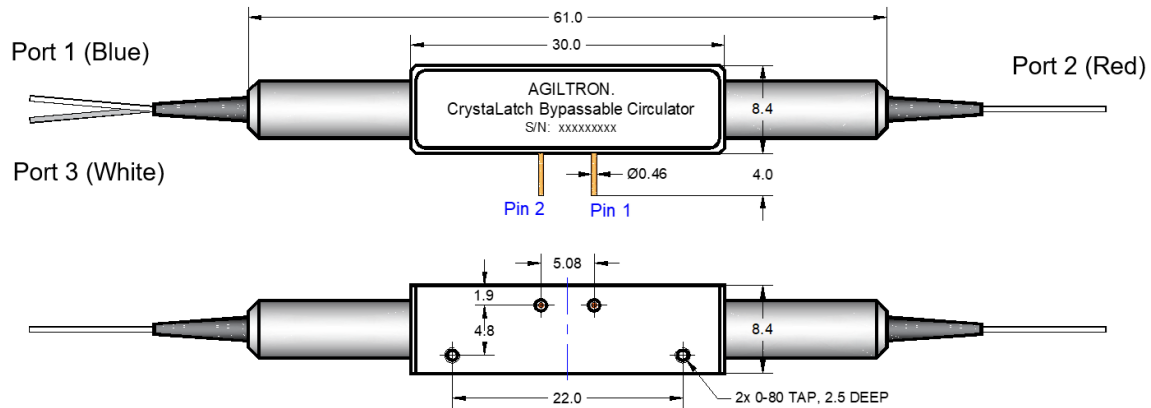
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### Mechanical Dimensions (Unit: mm)



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

### Electrical Driving Information

The switch 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
Drive Voltage	4.5	5	5.5	V
Resistance (each Pin Group)	31	35	42	$\Omega$
Pulse Duration	0.2	0.3	0.5	ms

Optical Path	Pin 1	Pin 2
Circulator (Port 1 $\rightarrow$ 2 $\rightarrow$ 3)	+5V Pulse	0
Bypass (Port 1 $\rightarrow$ 3)	0	5V Pulse

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

#### 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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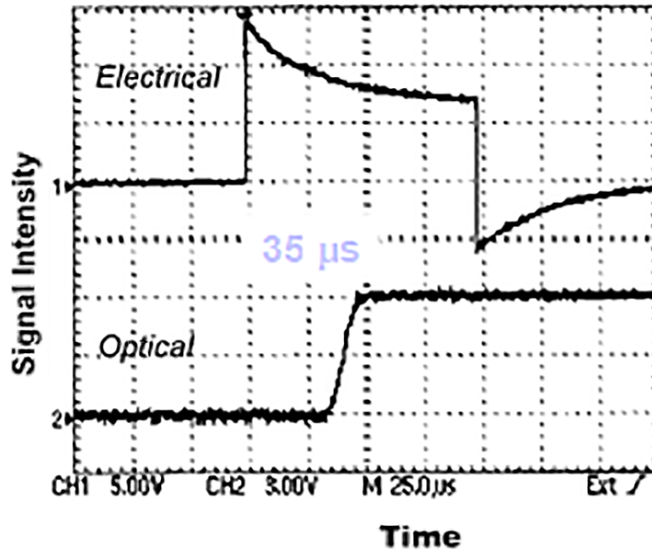
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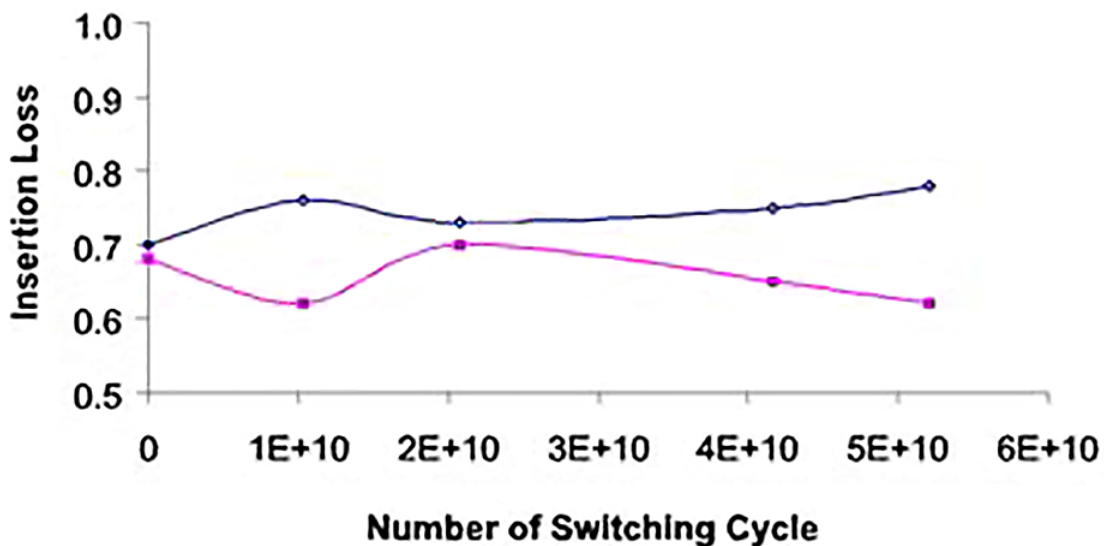


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### Typical Switching Response



### Typical Loss Change of 1x2 vs Switching Numbers



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### Ordering Information

Prefix	Type	Wavelength	Switch	Package	Fiber Type	Fiber Cover	Fiber Length	Connector <sup>[9]</sup>	
CBSC- <sup>[1]</sup>	3-port = C3	1550 = 5	Dual Stage = 2	Standard = 2	SMF-28 = 1	Bare fiber = 1	0.25m = 1	None = 1	
CBPC- <sup>[2]</sup>		1310 = 3	Special = 0	Special = 0	PM 1550 = B	900 um tube = 3	0.5m = 2	FC/PC = 2	
CBSH- <sup>[3]</sup>		Special = 0				PM 1310 = D	Special = 0	1.0m = 3	FC/APC = 3
CBPH- <sup>[4]</sup>								Special = 0	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]. **CBSC**: CL Bypassable **SM** Circulator.

[2]. **CBPC**: CL Bypassable **PM** Circulator.

[3]. **CBSH**: CL Bypassable **SM** High Power Circulator.

[4]. **CBPH**: CL Bypassable **PM** High Power Circulator.

#### 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 handling by expanding the core side at the fiber ends.

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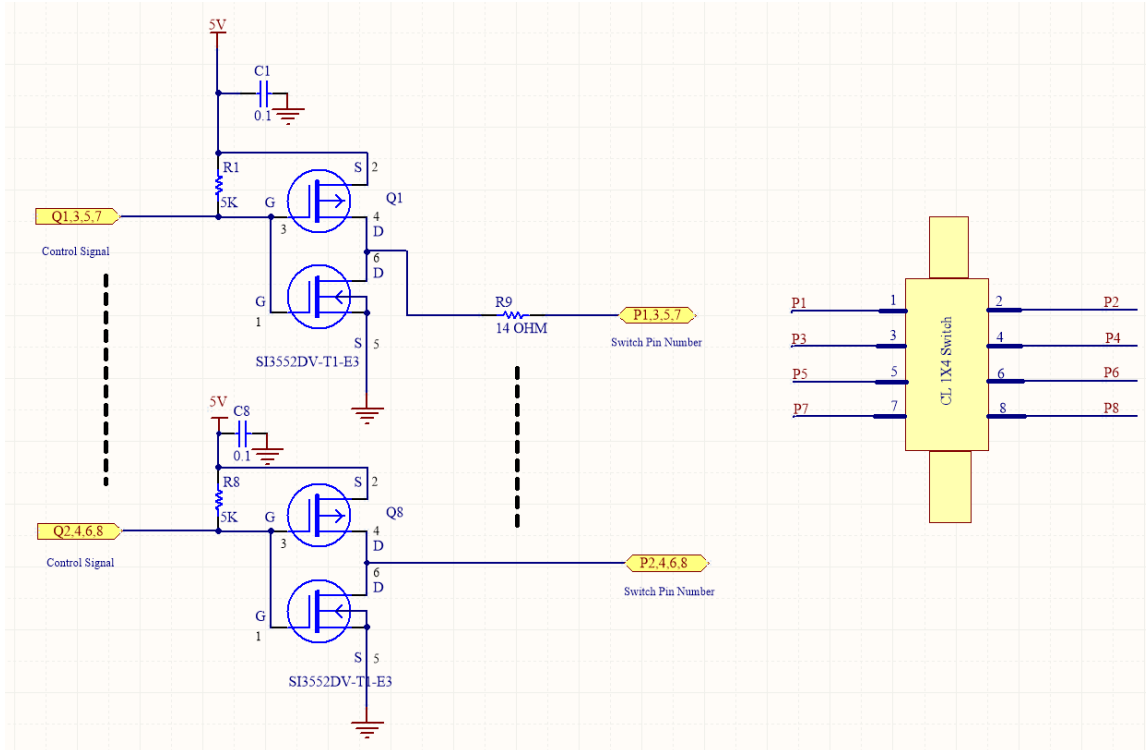
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### Driver Design Example for 1x4

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  $\leq 2\text{kHz}$ .



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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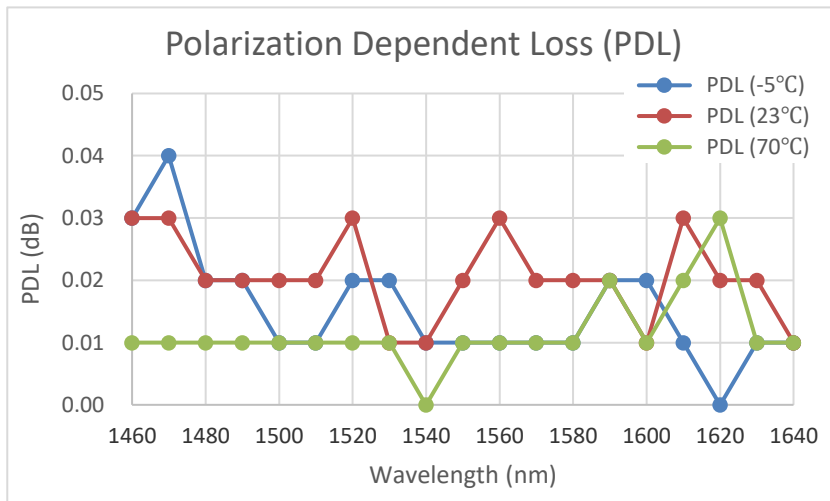
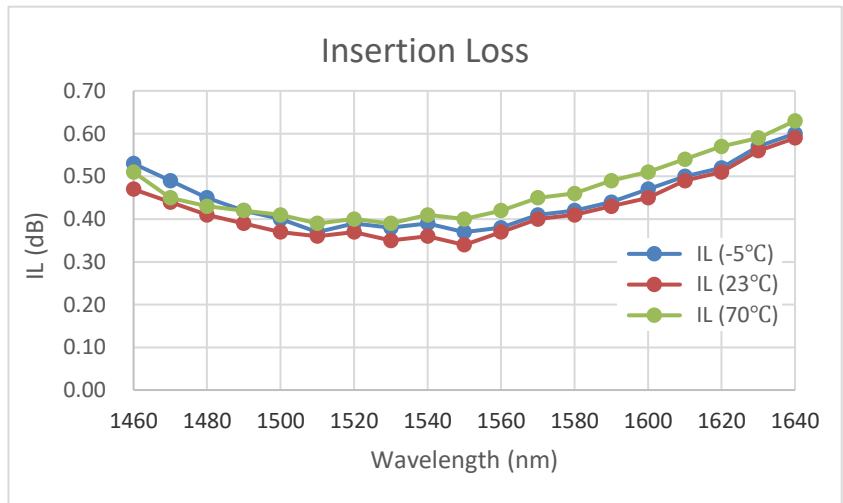
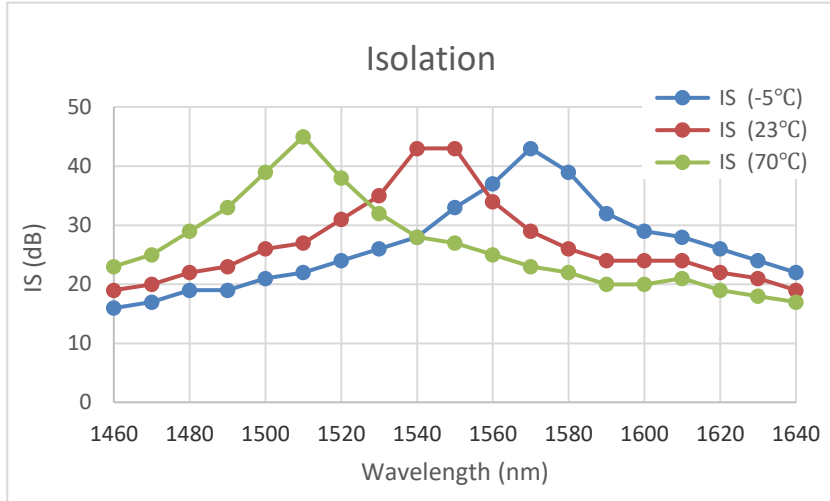
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### Typical Wavelength Dependence for Single Stage



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### Typical Wavelength Dependence for Dual Stage

