

## Optical Shutters

### Features

- *Maximum switching speed performance*
- *Unlimited OEM sizes and shapes*
- *Fifty percent duty cycle operation*
- *Portable and lightweight*
- *No mechanical motion*
- *Unmounted*

### Applications

- *Three-dimensional imaging*
- *Optical instrumentation*
- *Medical imaging*
- *Holography*
- *Printing*

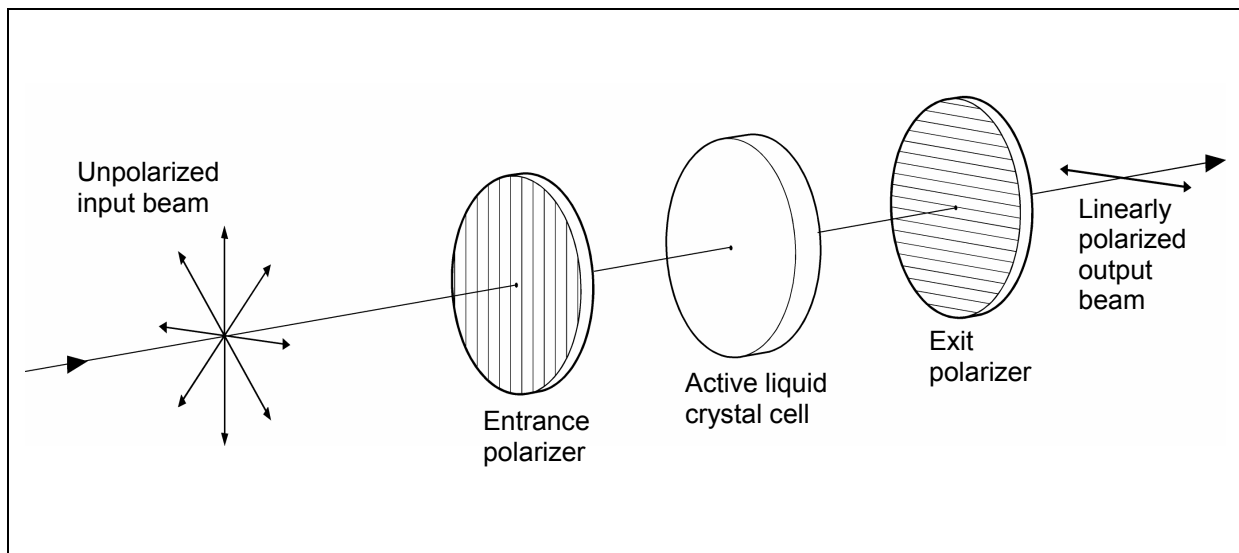
### Benefits

- *Meets your application-specific requirements*
- *Silent, vibration-free, low-voltage operation*
- *Solid state construction*
- *Value priced*

### Description

An Optical Shutter is a two-state device used to rapidly open and close a light path (from lens to film, for example). Optical Shutters are typically used to control the amount of time that a light-sensitive material is exposed to optical radiation. Figure 1 provides a conceptual illustration of the function of an Optical Shutter.

Boulder Nonlinear Systems (BNS) manufactures and sells liquid crystal based Optical Shutters for applications requiring active timing control of beam transmittance. Key features of our Optical Shutters include high-speed binary operation, high purity linear polarized output, and maximum extinction ratio performance. Since these devices are solid state – undesirable mechanical motion, associated noise, and vibration problems are eliminated.



*Figure 1 ~ Conceptual illustration of an Optical Shutter function.*

**VS Series Optical Shutters**

**Maximum switching speed performance at an affordable price**

The VS Series offers a significant performance advantage in Optical Shutter applications demanding the fastest optical response times, typically ranging from 15 – 150  $\mu$ s. Attractive for their high switching speeds and affordable prices, VS Optical Shutters require a dc-balanced ac drive signal, typically resulting in 50% duty cycle operation. Minimum drive voltage levels are required; as low as  $\pm 5$  V ac is sufficient for most applications.

**Device Construction**

Figure 2 below provides a typical Optical Shutter cross section.

VS Series Optical Shutters begin with fusion-drawn, sheet glass. After deposition of a transparent conductive coating layer (indium-tin oxide or ITO, typically) these window substrates are then evenly covered with a polymer layer, which is then rubbed or buffed, forming tiny

microgrooves in the polymer layer. These microgrooves provide the alignment directionality critical in liquid crystal device production.

The coated and buffed windows are then spaced a few microns apart. The cavity between substrates is now filled with liquid crystal material and sealed.

High extinction linear polarizers are crossed, and then laminated to the window substrates. External surfaces are left uncoated to minimize cost. With this crossed polarizer orientation, VS Series Optical Shutters exhibit full optical transmittance at the negative voltage state. Minimum transmission occurs at the positive voltage level, as specified with your device.

Pressure, in the form of compression and/or bending, should be avoided to prevent permanent damage to the VS Series of Optical Shutters. If a more rugged design is required, please see our MS Series of Optical Shutters.

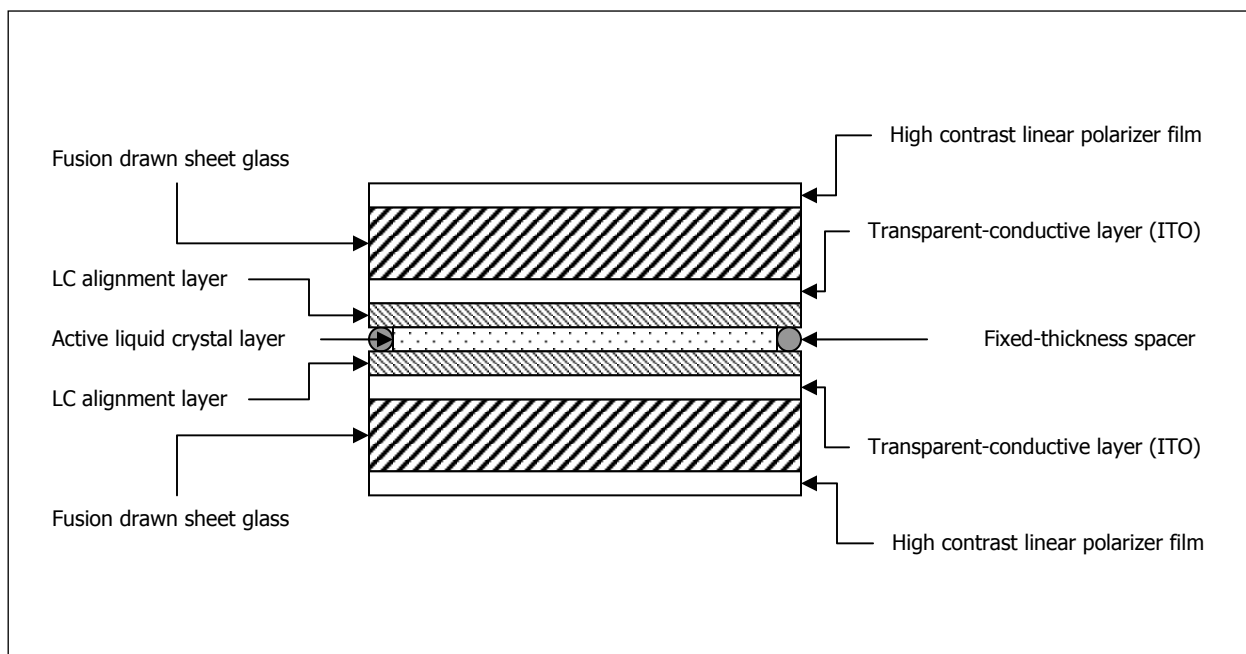


Figure 2 ~ Cross sectional representation of an VS Series Optical Shutter.



## Optical Shutters

### VS Series

#### Specifications (Draft)

<b>Clear Aperture</b>		22 x 20 mm (Standard) 2 – 150 mm (Custom)	
<b>Wavelength Range</b>		425 – 675 nm	
<b>Open State Transmission<sup>1</sup></b>		25%	
<b>Contrast Ratio<sup>1</sup></b>		<i>Minimum</i> 100:1	<i>Average</i> 200:1
<b>Response Time</b>	<b>open to closed (90 – 10%)</b>	<i>Minimum<sup>2</sup></i> 15 $\mu$ s	<i>Maximum<sup>3</sup></i> 150 $\mu$ s
	<b>closed to open (10 – 90%)</b>		
<b>Driver Requirement</b>		$\pm 5$ to $\pm 30$ volts (faster response at higher voltage)	
<b>Duty Cycle</b>		50%	
<b>Switching Frequency<sup>3</sup></b>		5 kHz (maximum)	
<b>Operating Temperature</b>		20 to 30° C	
<b>Storage Temperature</b>		0 to 60° C	

1. Averaged over entire Wavelength Range, improved performance can be achieved at specific laser lines.
2. At room temperature,  $\pm 30$  V ac, 22 x 20 mm clear aperture.
3. At room temperature,  $\pm 5$  V ac, 22 x 20 mm clear aperture.

Above specifications are subject to change without notice. Please contact Boulder Nonlinear Systems for additional updates.

### Company Profile

Boulder Nonlinear Systems, Inc. (BNS) is an innovative technology company specializing in dynamic liquid crystal polarization control solutions for both laser-based and imaging systems. Company strengths in scientific research and development are leveraged into OEM and standard product offerings targeted for astronomy, biomedical, defense, microscopy, optical computing, optical storage, and telecommunications applications.

For additional product and company information, please contact:

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