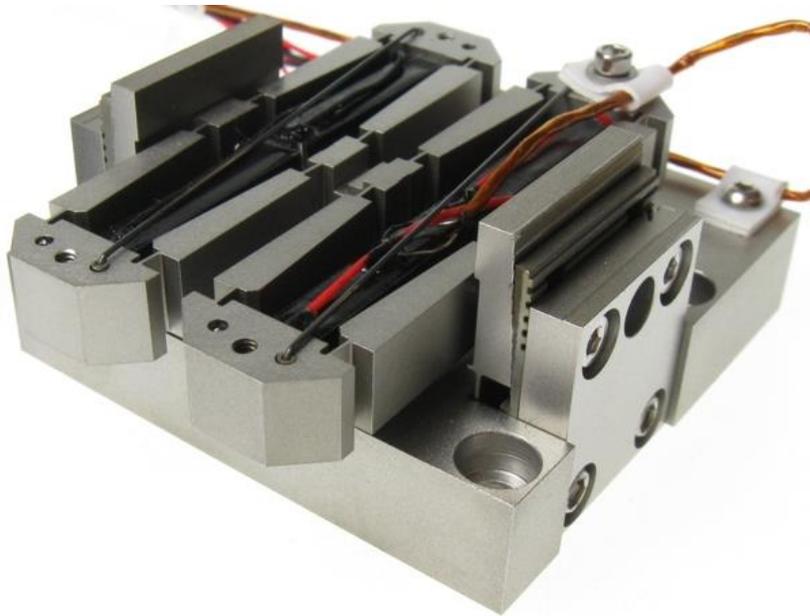


XRS1 Series USER MANUAL

XRS1-800/900/1600/2500
PIEZO SHUTTERS



Overview

DSM offers 4 standard XRS1 shutters, the 800, 900, 1600, and 2500. Each shutter uses two opposed piezoelectric actuators to block the beam. When energized, the actuators open to permit the beam to pass through. Please fully review this manual before using one of these shutters. It contains important information about proper operation of this equipment, including aspects related to personal and equipment safety.

Shutter Mechanical Performance

Two critical performance parameters of piezo shutters are the open aperture and the first translational natural frequency. Approximate values for the piezo shutters are shown below:

System Specifications (XRS1 Shutter with a VF-500-XRS Amplifier)

	XRS1-800	XRS1-900	XRS1-1600	XRS1-2500
Open Aperture (μm) (@ 0-160V)	680	900	1180	2500
First Translational Natural Frequency (Hz)	500	900	300	500
Open or Close move Duration (ms)	3.4	1.9	5.7	7
Open/Dwell/Close Cycle (ms)	8	5	12	15

It is important to understand the implications of natural frequency in regard to how rapidly the shutter can be opened and closed. The first translational natural frequency of an amplified piezoelectric actuator is a lightly damped resonant mode that will oscillate strongly when excited. Consequently, transitions between open and closed states should use a smooth waveform that does not contain spectral content near the natural frequency. DSM's VF-500-XRS amplifier can actuate the 800, 900, and 1600 models at their maximum mechanical rates, but the 2500 is limited by the VF-500-XRS's output current.. Faster speeds are possible for the 2500 with a custom amplifier (contact DSM for more information)

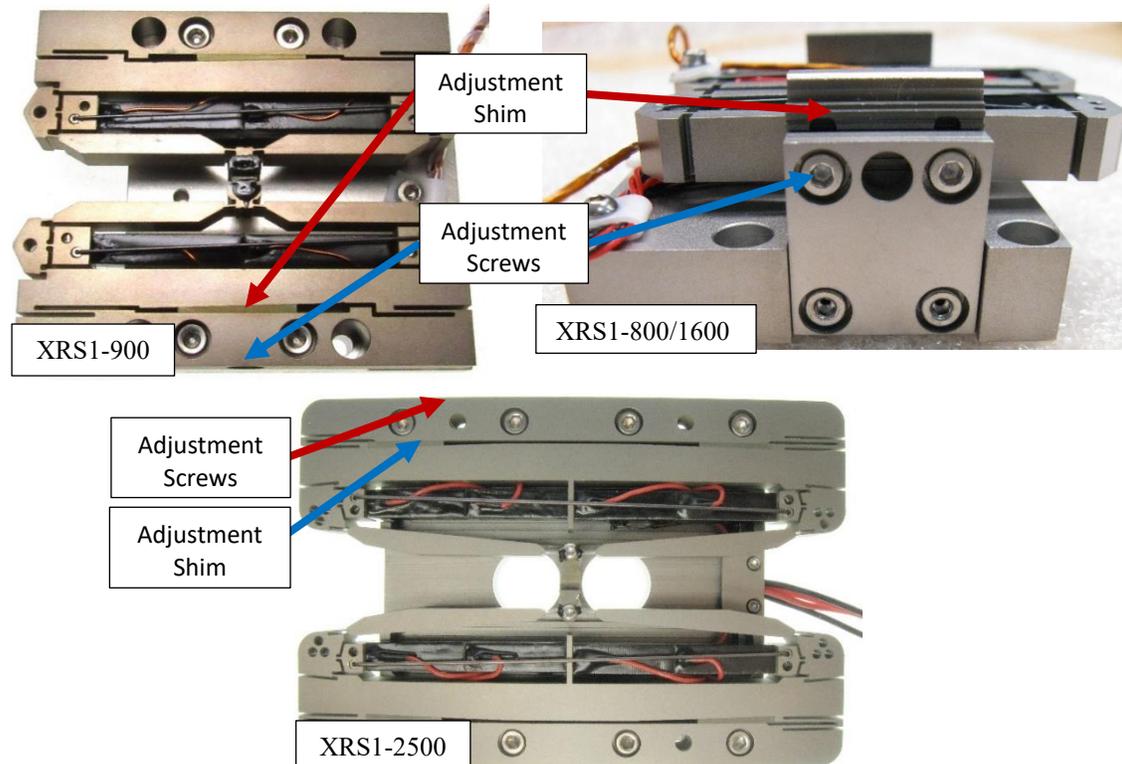
Dimensioned interface drawings for the XRS1 series shutters are available online at <https://www.dynamic-structures.com/> on the specific model's page. Other important points regarding proper use of piezoelectric actuators are described in DSM's [Flextensional Piezoelectric Actuator \(FPA\) User Manual](#), which can be downloaded from any FPA actuator page on DSM's website. *Please review the Flextensional Piezoelectric Actuator (FPA) User Manual before using an XRS1 type shutter.*

HV Compatibility

The XRS1 shutters are built with high-vacuum compatible materials. Care is taken during assembly to maintain cleanliness and avoid the introduction of contaminants that would compromise this compatibility. Most holes used for assembly are through holes, and vented screws are used in all blind holes. Options are available for ultra-high-vacuum compatibility for the XRS1 shutters.

Adjustment of Shutter Gap

DSM carefully sets the gap between the opposed actuators before each unit is shipped. The two teeth have a minimal overlap when the shutter is de-energized. Ideally, this gap will not need to be adjusted by the end user, but factors such as variation in operational temperature may necessitate adjustment. The gap can be adjusted by loosening two of the screws on the actuator adjuster block and repositioning the adjustment shim. Please contact DSM to discuss the proper technique for changing the gap before making this adjustment.



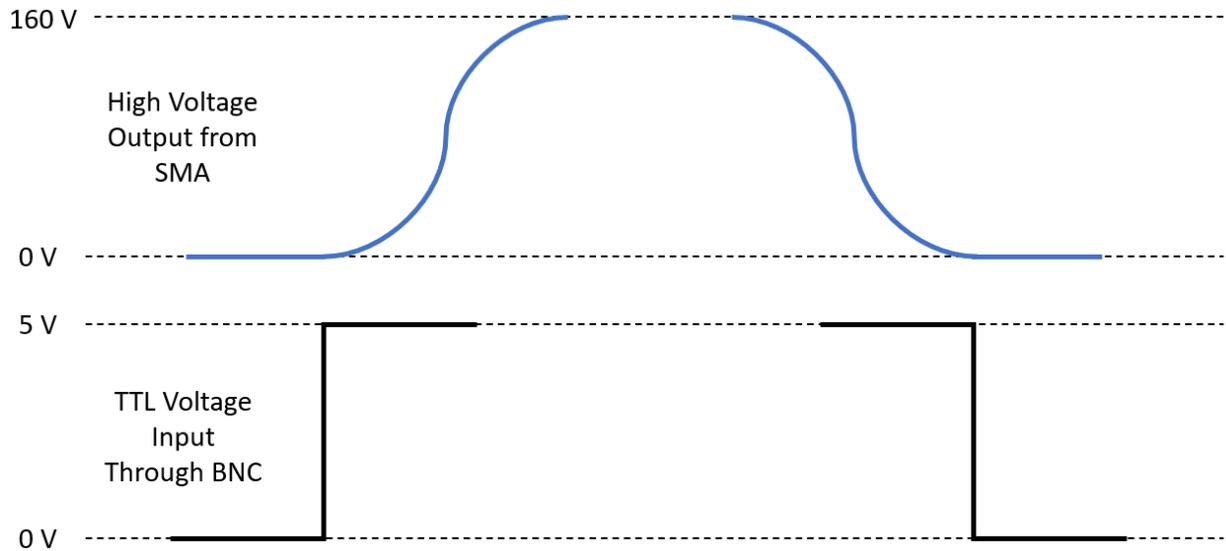
Actuator Temperature

Overheating is a concern for some shutter applications. Factors such as actuator drive frequency, duty cycle, incident radiation, and mounting interface can affect the temperature of the piezo actuators. To monitor this heatup, each shutter has a UHV compatible K type thermocouple. Operating the shutter beyond 80°C on the thermocouple can damage the shutter and must be avoided.

Driver Connections

The XRS1 shutters are driven with DSM's VF-500-XRS amplifier. The VF-500-XRS has a fixed preprogrammed (not user changeable) waveform that makes the fastest possible smooth transition between high and low voltage output. This smooth transition reduces unwanted oscillations in the positions of the piezoelectric actuators and prevents excessive deflection. The built in waveform generator must be triggered by a customer provided device that delivers a 0-5

V supply. An example of how the VF-500-XRS's preprogrammed waveform takes the users TTL input voltage, amplifies it and smooths it out is shown below.



Example of the VF-500-XRS amplifying and smoothing out the TTL input voltage

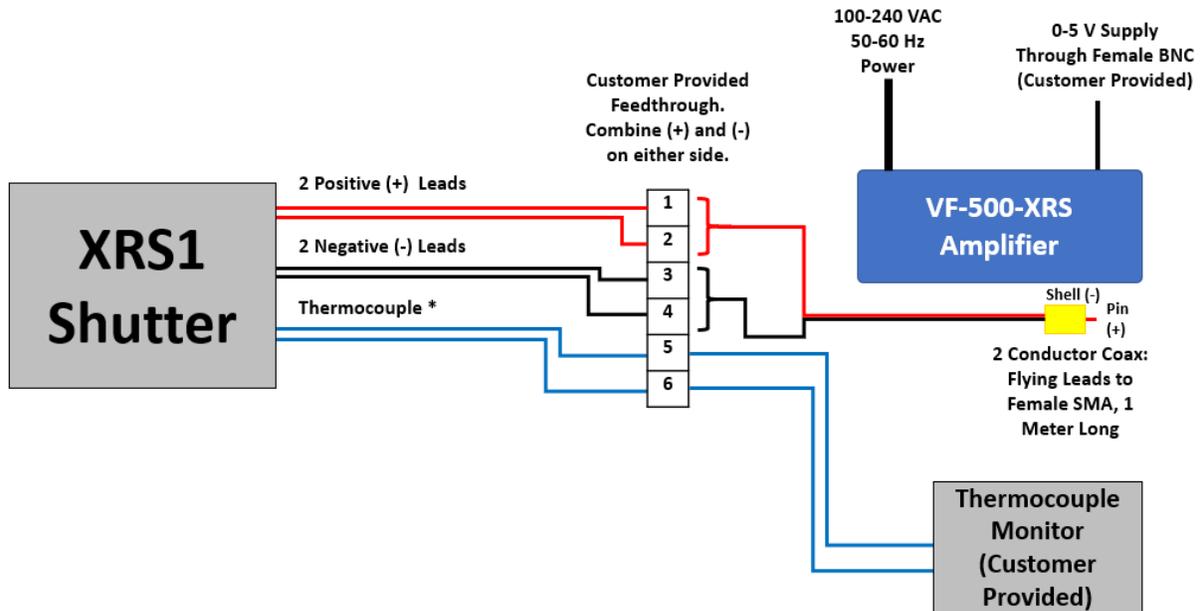
There are only two connections to the amplifier. The input signal is a standard BNC connector that accepts TTL voltage levels. Low voltage (0V) corresponds to the closed condition. High voltage (5 V) corresponds to open. If no input is connected to the input BNC, it defaults to closed. The image below shows the connections on the front on a VF-500-XRS.



Input and Output Connections on Front Panel of VF-500-XRS with Waveform Generator calibrated for an XRS-800 stage

The output of the amplifier is an SMA connector. Caution should be used in making junctions to the SMA, since its output is 160 volts. Use proper practices for high voltage when making junctions to it. When making connections, keep in mind that a piezoelectric actuator can be irreparably damaged if the polarity of the connection is reversed. When passing the output through a vacuum bulkhead, take care that the high voltage line (center pin of the SMA) is not grounded. All connections should be made to the amplifier before power is turned on. A

connection diagram is provided below. *Please refer to the user manual for the VF-500-XRS for important safety guidelines and other recommendations*



* Thermocouple: Accu-Glass #100771.4.

Connection Diagram for XRS1 Series Shutters