

CRS Series

Resonant Optical Scanners



- Available with 4 KHz and 8 KHz scan frequencies
- Velocity feedback provides amplitude stability
- Long life; no wearing parts
- Low power consumption
- Compact size



CRS Series optical scanners

for high frequency applications such as:

- Fluorescent microscopy
- Semiconductor imaging
- Confocal microscopy
- Process verification
- Mask inspection
- Machine vision
- Web inspection



The CRS Scanner Velocity Feedback Control

The *CRS* is a compact, high frequency resonant scanner which operates at nominal frequencies of 3938 or 7910 Hz. The scanner features two oscillating torsion rods that are mechanically tuned

to resonate in opposite phase. These torsional motions set up equal and opposite torques that cancel at the torsion rod attachment to its housing. Theoretically, the result is a mechanical oscillator that is reactionless and eliminates all external vibration. To minimize cross-axis wobble (repeatability), the torsional masses at the end of the oscillating torsion rods have been mass balanced along the rotational axis of the scanner. Typical scanning angles of 20 degrees OPTP and 15 degrees are approachable using 4 KHz and 8 KHz *CRS* scanners, respectively.

The Mirrors



mirrors are available with enhanced aluminum, silver, or custom high reflectivity coatings.

The scanner connector has four conductors, two provide current to the drive coil, two provide proportional feedback current derived from the velocity of the mirrors. This velocity pick-off maintains self-oscillation and amplitude control of the scanner using *CRS* Driver Board. Due to the exceedingly high quality factor (Q) possessed by the torsion rod, the *CRS* requires very little power. Typical quiescent scanner power is 1W.

The CRS Driver Board

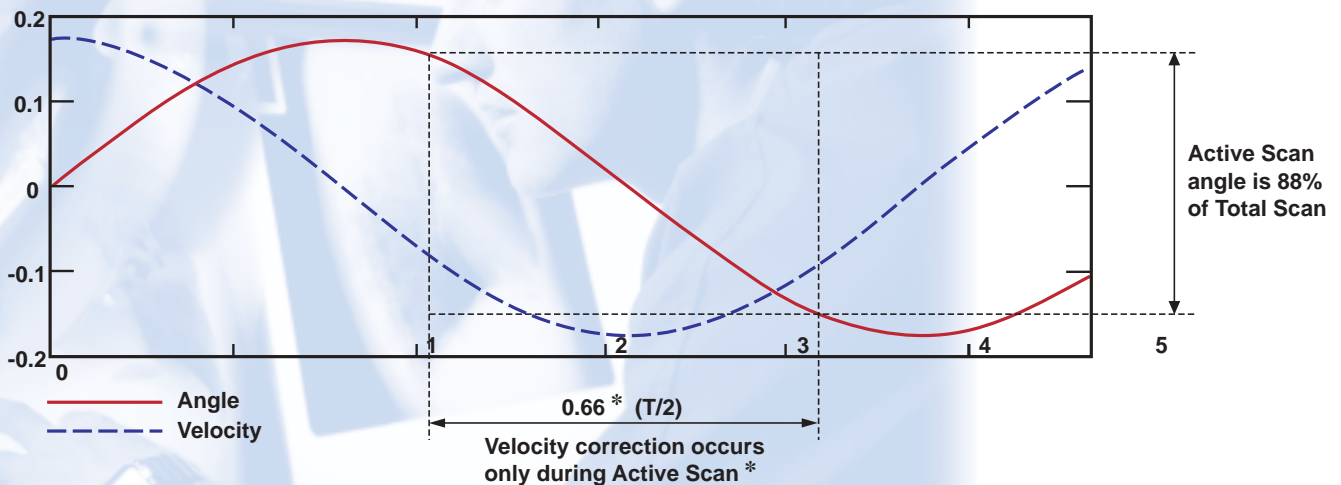
The preferred method for driving the scanner is with a GSI Group *CRS* Driver Board. The driver board has been designed to account for the slight scanner variation in the phase characteristic and Q. The board consists of a self-oscillatory loop which keeps the scanner at mechanical resonance. Amplitude modulation is performed by an additional closed-loop. The board outputs a TTL sync signal for use with external clocks or our Pixel Clock. This signal may be phase adjusted relative to the position of the scan mirror if desired. Amplitude control (scan angle) is determined with voltages between 0-5 V analog. Typical step and settle with the amplitude control loop is on the order of 6 msec. The amplitude stabilization of 0.2% of peak amplitude is indeed the result of the high bandwidth of the amplitude control loop.

The CRS Pixel Clock

The pixel clock is used to linearize spot placement throughout the scan field. The CRS has a sinusoidal angular displacement with a frequency equal to the scanner's resonant frequency. The angular velocity is a cosine function derived from the mirror position. The pixel clock board provides a velocity-corrected pixel clock that continually changes speed to match the scanner's angular velocity variation and resonant frequency. For example, using a constant speed pixel

clock, pixels would be spread out at the middle of a scan and compressed at the edges of the scan field. Minimal scan distortion is achieved with the linearizing pixel clock that spaces the pixels equidistant across the scan field. The pixel clock is also used to correct for small scan to scan resonant frequency variations and distortions due to lenses in the beam path.

CRS Scan Angle And Velocity



* Active Scan time is 66% of $T/2$, where T is the scanner oscillation period

Direct Worldwide Support

Only GSI Group provides the level of service, support, and technical expertise you and your application demand. Our three worldwide centers offer direct customer service and technical support throughout the Americas, Europe, and Asia/Pacific. The experienced staff in our electro-optical-mechanical development team can assist customers in meeting their requirements.





For over 30 years, GSI Group has led the market by providing original, fully engineered solutions to difficult optical scanning problems. We offer a wide range of technologies including; flexures, resonant scanners, *DSP* and analog servos, and multi access subsystems. This technology allows for unprecedented flexibility in developing the right solution for your needs.

Performance	4 KHz	8 KHz
Natural Frequency (Custom Tuning Possible)	3938 Hz	7910 Hz
Frequency Tolerance	+/- 50 Hz	+/- 15 Hz
Maximum Permissible Angle ¹	20 degrees	26 degrees
Typical Operating Angle ¹	15 degrees	15 degrees
Trace to Retrace Wobble Repeatable, Typical	300 urad	200 urad
Frequency Thermal Stability	110 ppm/°C	110 ppm/°C
Velocity Feedback, Typical	Yes	Yes
Typical Power Consumption, Scanner Only	1 W	1 W

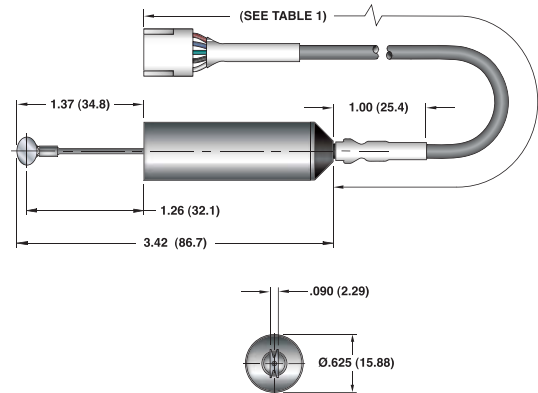
Mirror	4 KHz	8 KHz
Size	12.7 mm dia	7.8 mm x 5.5 mm
Useful Aperture	12 mm x 9.25 mm	6 mm x 4 mm
Surface Accuracy	1/2 wave @ 633 nm	1/4 wave @ 633 nm
Surface Quality	60/40 scratch/dig	40/20 scratch/dig
Reflectivity @ 45 degrees, silver ²	>97% above 400 nm, >96% above 600 nm	

General Specifications	4 KHz	8 KHz
Weight, Scanner	65 grams	
Operating Environment Temperature	10-40 °C	10-50 °C
Storage Environment Temperature	-20-65 °C	
Humidity	<90% non-condensing	

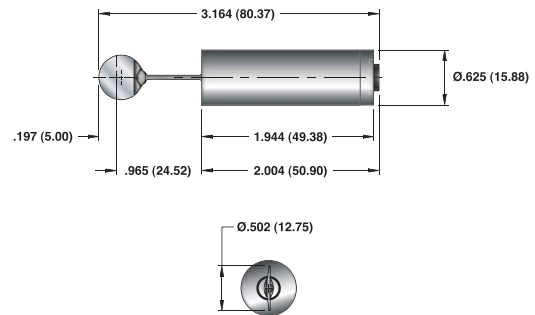
Drive Electronics	
Architecture	Self-oscillating, Amplitude Modulate
Amplitude Control/Bandwidth	0-5 Volts/160 Hz Typical
Amplitude Jitter	0.02% Peak Amplitude
Minimum Zoom	From full amplitude to 1/10 of full amplitude (continuous)
Outside Dimensions	160 mm x 100 mm x 27 mm
Typical Power Consumption, Drive and Scanner	7 W, 2.5 W Scanner Idle
Input Voltages @ +/- 5%	+/- 15 V <15 mV rms ripple/ +5 V ,60 mV rms ripple
Outputs	TTL Sync signal

Pixel Clock	4 KHz	8 KHz
Programmable Points (Max) Custom on Request	1024	512
Typical Power Consumption, Pixel Clock	2 W	
Outside Dimensions	160 mm x 100 mm x 27 mm	
Inputs	+/- 12V, 5V & Sync comes from driver module	
Output	RS422	

8 KHz CRS



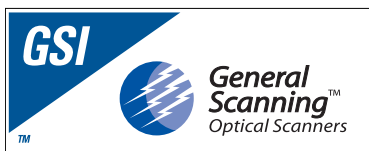
4 KHz CRS



Dimensions shown in inches (mm)

1. All scan angles are optical 2. Other coatings available. Specifications are subject to change. Please consult GSI Group for complete details.

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