CRS Frequently Asked Questions

1 Introduction

Our CRS Series of novel resonant scanners are ideally suited for high-speed imaging in real time. The CRS oscillates at a fixed, resonant frequency with a sinusoidal waveform; this unique scanner design enables a rapid scanning rate. The mirror is engineered out of lightweight beryllium, and broadband coatings which reflect a wide range of laser wavelengths. When paired with a galvanometer, the CRS enables high-speed raster scanning over a two-dimensional field and is well-suited for microscopy and scanning laser ophthalmology applications.

2 Frequently Asked Questions

2.1 General

2.1.1 Typical CRS Mounted Sets

Table 1 - Typical CRS Mounted Sets

Part #	Galvo	Servo	Clear Aperture	Coating
6SD11015	CRS8K 6215H	671-1-FS26	5 mm	Silver
6SD11798	CRS8K 8315K	671-1HP-FS26	5 mm	Silver
6SD11502	CRS8K 6215H	671-0HP-FS26	5 mm	Silver
6SD11328	CRS8K 8315K	671-2HP-FS26	5 mm	Silver

***Note:** Silver coating provides reflectivity ≥90% for wavelengths ≥450 nm

2.1.2 CRS Generations

2.1.2.1 Differences

1. Part number, the Gen 1 CRS begins with “1-003” and the Gen 2 CRS begins with “CRSxxK”, where xx is either 04, 08 or 12. For example, 1-003-3002009 is a Gen 1 CRS, and 6SC04KA040-01Y is a Gen 2 CRS.

Figure 1 - Visual comparison of the two versions.

2. Visually, the Gen 2 CRS has a miniaturized cable connector and a 0.14 inch hole. Most models of the Gen 2 CRSs have an integrated cable, but some have cables separate from the scanner.

2.1.2.2 Benefits of the Gen 2 CRS compared with Gen 1 CRS

1. Improved production process that provides higher peak toque
2. Single power supply of 12V, instead of needing both ±15 V and 5 V power supplies.
3. Smaller servo board.

2.2. Datasheet

2.2.1 Frequency Tolerances

Due to the mechanical design of the CRS, it is unlikely to get two units with the exact same frequency. However, it can be expected that a CRS' frequency will fall within the frequency tolerance range that is specified in the datasheet.

1. The actual frequency of a CRS is based on the production process.
2. It is not possible to frequency/phase lock two CRS units.

2.2.2 Trace to Retrace Wobble Repeatable

Think of trace and retrace each as one direction in a bi-directional scan motion. The scanmotion is in reality a very compressed ellipse with the major axis measured as the scan angle and minor axis the trace-to-retrace wobble. These motions are repeatable and are especially important when the scanner is used bi-directionally.

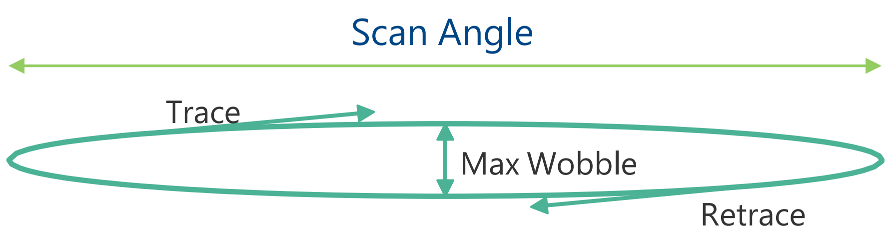

Figure 2 – Trace to retrace wobble.

Wobble is due to cross-axis motion from off-balance mass. For a CRS, it is due to tolerance stack-ups to exactly centering mirror mass and magnet mass.
As shown in Fig.2, wobble amplitude is defined as the minor axis of the ellipse. The maximum wobble occurs at the center of the scan field and should be within the rangeof the specified value in the datasheet. Please check the "Certificate of Conformance" of each CRS for its specific wobble value.The maximum amplitude of the wobble will be provided.
For bi-directional scanning, the anticipated line spacing should take consideration of the wobble.

It has been observed that this wobble changes linearly with scanner amplitude. In otherwords, wobble increases when scanning at larger angles.

2.3 Hardware/Components

2.3.1 Power Supply

For just a single CRS set, Cambridge Technology recommends a power supply with 12 V and 1 A. The CRS operates at only one frequency, it is very efficient and doesn't require alot of power.

2.3.2 Mating Connectors to the CRS PCB

Table 2 - Mating Connectors

Manufacturer	Manufacturer Part #
JST	SSHL-002T-P0.2
JST	GHR-09V-S

***Note:** Mating cables are included in the CRS sets

2.4 Set Up and Features

2.4.1 Temperature Control

Both warm up and heat-sinking are required to achieve the maximum stability.

1. Scanner:
   a. 10-40 °C operating environment temperature
   b. -20-60 °C storage environment temperature
   c. The scanning frequency of the scanner decreases 0.5 Hz as the temperature risesevery 1 °C at the rotor
   d. The scanning frequency spec in its "Certificate of Conformance" is tested at roomtemperature.
2. Servo:
   a. Adequate thermal dissipation with the thermal pad and heat sink provided byCambridge Technology.

2.4.2 Dust Control

1. Precautions should be taken to protect the CRS scanners from dust. The mirror coatingcan become damaged due to dust.
2. Cleaning the mirror regularly, will not necessarily extend its life.

2.4.3 Considerations for Synchronization

1. Frequency of the slow axis

   a. Value: CRS' frequency divided by an integer
      For example: For a 8 KHz CRS, the frequency of the CRS should be in the range of7910 +/- 15 Hz, so let's assume a frequency of 7900 Hz. In this case, with a 395 Hz frequency for the slow axis, there are 20 periods of the CRS in each period of the slow axis.
   b. The frequency of the slow axis should also consider the capabilities of the slow axis'galvo. With these considered, the proper additional frequency divider circuit could be set.

***Note:** *The customer is responsible for building the frequency divider circuit and implementing the appropriate trigger.*

2.4.4 Can a CRS Pair Draw Circles?

Due to the CRS' design, as mentioned in Sec. 2.2.1, it is not possible to frequency lock orphase lock two CRS units. Additionally, the CRS scanner is an open-loop scanner, so it is not possible to compensate for the variation. Other than that, the magnet end will heat upwhich causes drift of frequency, too. In conclusion, you might be able to mark a circle fora small period of time, but it will be extremely hard to maintain.

2.4.5 Can the Backside of the Mirror Be Exposed with a Laser Diode forSynchronization Purposes?

Yes. The 8K and 12K CRSs have a dual-side mirror coating option for silver coating. For the 4K CRSs, the backside of the mirror is slightly shaped and isn't polished, so it isn't ashighly reflective as the frontside of the mirror.

2.4.6 Pixel Clock (For Gen 1 CRSs)

Pixel Clocks are no longer available for future orders of both Gen 1 and Gen 2 CRSs.

The pixel clock phase locks with the CRS sync signal and enables synchronization with other devices. Notice that when the red light is illuminated, phase lock is not being achieved, indicating a problem.

2.4.7 Position Feedback

Since it is an open-loop system, there is no position signal. However, it is possible toobserve the "Velocity (Coil)" and "(CRS) Sync".

1. Velocity (Coil): Expected to be a sine waveform.
2. (CRS) Sync: A square wave in sync with the velocity signal. The rising edge and fallingedge each indicate the trace and retrace of the CRS.

Although this doesn't provide the live position signal, but it can be an indication of errors.For example, at rare occasions, the frequency of the CRS Sync signal can be incorrect or asymmetrical.

1. Pins for the Gen 2 CRS
   Velocity: Pin2
   Sync: Pin3

Pin	Signal	Comments
1	GND	
2	Velocity	For safety verification
3	Sync	At each change in direction
4	Fault	Integrator Saturated
5	Disable	Pull down to disable servo
6	Power	12V DC, model dependent
7	GND	
8	GND	
9	Ext. Amplitude Control	0-5V DC for zero to full scan angle

Figure 3 – Pin information for Gen 2 CRS

2. Test points/pins for the Gen 1 CRS
   Velocity coil: TP3 & TP4
   CRS Sync: Pin8

Left-side Pins (1 – 8)		Right-side Pins (9 – 16)	
Zoom High (0-5V)	1	16	-15Vdc
Zoom Return	2	15	-15Vdc
Signal Ground, Digital	3	14	+15Vdc
Relay Shutoff (Active Low)	4	13	+15Vdc
SEL 0 (Scaling Bit 0)	5	12	Analog Ground
SEL 1 (Scaling Bit 1)	6	11	Analog Ground
Analog Ground	7	10	+5Vdc
CRS Sync (W1 dependent)	8	9	+5Vdc

Test Points 1-4		Test Points 5-8	
Scanner Drive	1	5	Analog Ground
Scanner Drive Return	2	6	Integrator Out
Velocity Coil	3	7	Velocity
Velocity Coil Return	4	8	Rectified Velocity

Figure 4 – Pin and test point information for Gen 1 CRS

3 Additional Resources

Document location: SharePoint > Applications Engineering > Product Library > CRS

1. Datasheet Resonant Scanner.
2. Pixel Clock Time Diagram.
3. CRS Temp and Jitter.
4. Scanner Component and Head Development for Confocal Microscopy Using MovingMirror Technology
5. Vidreo – Resonant Scanning Concept: http://scanimage.vidriotechnologies.com/display/SI2016/Resonant+Scanning+Conce pt