Test of ScannerMAX Saturn 1 with 2kHz Sine-wave input, having an optical scan angle of 8 optical degrees peak to peak.

What follows is a scope screen shot of a test of ScannerMAX Saturn 1B version 80S, with our standard mirrors capable of moving a 3mm beam through 60 degrees optical. Standard tuning was also used. Although the application requires scanning at only 8 optical degrees, the scanner and mirrors are capable of 60 degrees optical. This would allow the 8 degrees optical to be “panned” – allowing the user to move the 8 degree optical scan over a much wider field.

Note that the Mach-DSP servo driver has a built-in oscilloscope function and so that is what we are seeing in the screen shot below.

The yellow trace is the command input.

The pink trace is the scanner position signal. Here we have 0.5 mechanical degrees per division, showing 4 mechanical degrees peak to peak, or 8 optical degrees.

The blue trace shows the coil voltage at 5 volts per division.

The green trace shows current flowing through the coil, at 1 amp per division.

We can see approximately 20 volts peak to peak and 5 amps peak to peak flowing through the scanner coil. RMS Coil current is thus 1.77 amps.

For this setup we tried power supply voltages ranging from +/-15V to +/-24V with no observable difference in performance. In all cases there was 1 amp flowing through each power supply rail.

Since the coil resistance of this scanner is nominally 2.8 ohms, the 1.77 amp RMS current causes the scanner to dissipate around 9 watts of heat while doing this job. According to our servo driver, the coil temperature rose to around 44C, with the outside of the scanner body itself held at 30C.

Exceeding the customer inquiry

After successful testing at 8 degrees optical as per the original inquiry, tests were then performed at 12 degrees optical. RMS current flowing through the coil rose to 2.8 amps and coil temperature rose to 62C (with the body temperature at 30C).

Tests were then performed at 16 degrees optical. RMS current flowing through the coil rose to 3.8 amps, which exceeds the 3.3 amp max spec for this scanner (but that max spec assumes a body temperature of 50C). Nevertheless, we adjusted the coil temperature alarm on the servo driver to ignore the over-current condition, just to perform the test.

With 3.8 amps flowing through the coil, the coil temperature slightly exceeded 100C. Power into the scanner was 52 watts. If a customer could keep the scanner's body temperature at 25C, while continuously removing 52 watts away from the scanner during operation, 16 degrees optical peak to peak is possible with the Saturn 1B-80S.

The Saturn design is very flexible. We can easily change the stator length or coil configuration depending on the customer's application. For example, in the past we made a Saturn 1 variant with 50% longer stator, and analysis suggests that it would provide a greater-than 20% improvement in thermal performance. Thus, with the extended Saturn 1B, it appears that 2kHz at 16 degrees optical could be accomplished without much difficulty.

Bottom line: Testing demonstrates that it is relatively easy for the Saturn 1B-80S to scan a laser beam at 2kHz and 8 degrees optical. While doing this particular job, heat generated by both the servo driver and galvo are both easily manageable. Further testing demonstrates that increasing the scan angle beyond 12 degrees optical is also possible, although the customer will have to pay closer attention to heat removal.

In all cases, heat generated by the servo driver is proportional to the square of power supply voltage used, and therefore reducing the power supply voltage from our typical +/-24V to +/-18V would reduce power dissipation from the servo driver.