ScannerMAX Saturn 9B-46S scanning an 8mm beam at several high frequencies

This is a test of the ScannerMAX Saturn 9B-46S scanner with the standard ScannerMAX 8mm mirror set. The scanning being performed in these tests uses only a scan narrow angle, although the standard 8mm mirror set being used in this test is capable of scanning up to 40 degrees optical. Therefore better performance can be had with a mirror set customized for the narrow angle.

The Saturn 9B-46S is our lowest coil impedance (lowest resistance and inductance) version of this scanner. This coil configuration provides the fastest dynamic response and coincidentally the lowest amount of heat. Low heat generation was also important for the customer who was inquiring about our capabilities.

For convenience and for low heat dissipation by the servo driver, the Mach-DSP uses a single-ended power amplifier – not an H-bridge as is the case for most competitors. Nevertheless, performance is certainly impressive. It should also be noted that, work is being done on an H-bridge power amplifier add-on for the Mach-DSP, which would certainly provide faster flyback times for the sawtooth patterns.

The Mach DSP has a built-in oscilloscope function. This comes in handy as it can be used to measure virtually any quantity of the overall scanning system. For example, the screen shots below show four separate channels being measured. In most cases the yellow trace shows “Input command” and the pink trace shows “Position”. (Both Input and Position are in mechanical degrees, thus, optical scan angle is double that shown in the traces). The other two traces are changed, depending on the particular aspect of the test being highlighted.

For all of the testing, we drove the input command signal using a function generator capable of generating ramp waveforms with any desired frequency and “symmetry” (with 50% “symmetry” representing a triangle wave). You will notice that, in some cases, the input command signal has a significantly higher amplitude than the position signal. This is common, since all servo drivers act like low-pass filters and have some “rolloff”. The rolloff could also be compensated for in our driver.

400Hz Sawtooth-Wave at 3.6 degrees optical

The goal of this particular test was to evaluate the scanning "efficiency" (flyback time) while also evaluating the heat implications at both the servo driver and the scanner.

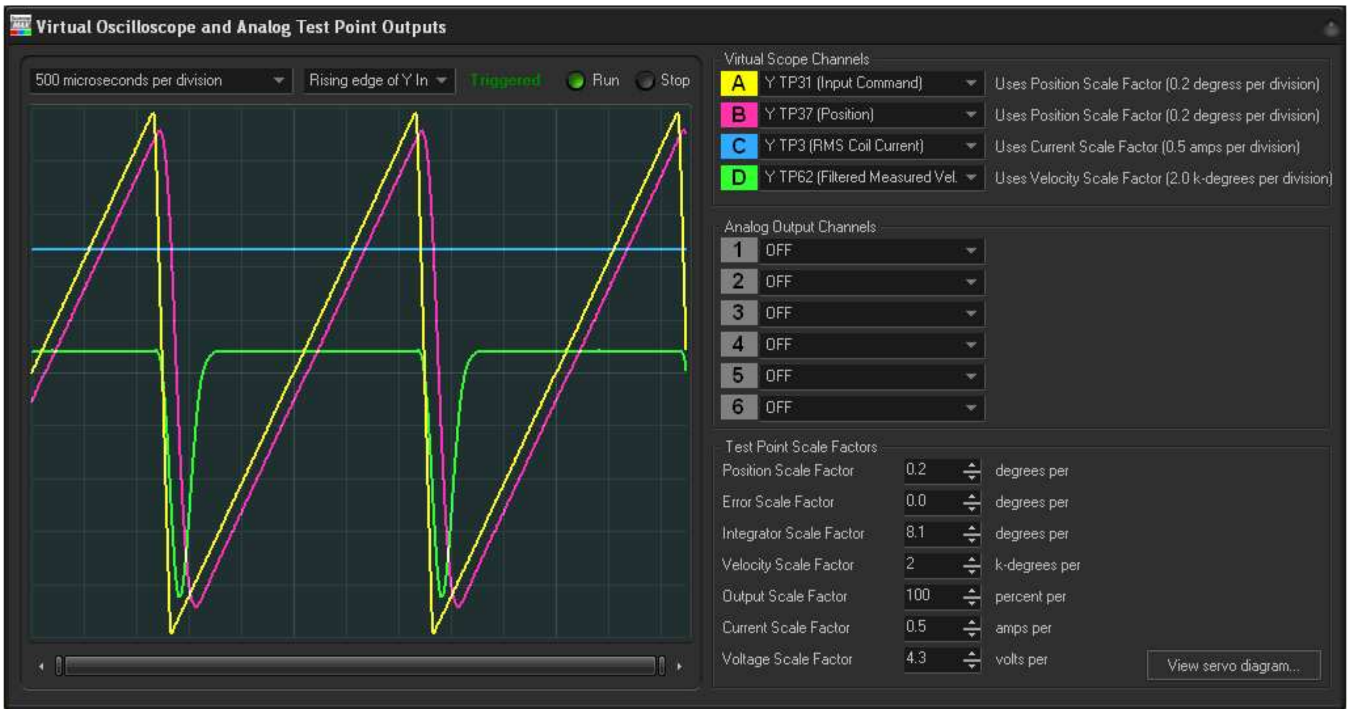
The scope screen shot below shows the overall results at 400Hz triangle wave with very fast flyback.

RMS coil current is 1.1 amps. Given the 1.12 ohm coil resistance of this scanner, the scanner only dissipates 1.36 watts, with coil temperature rising only 1.38 degrees above ambient.

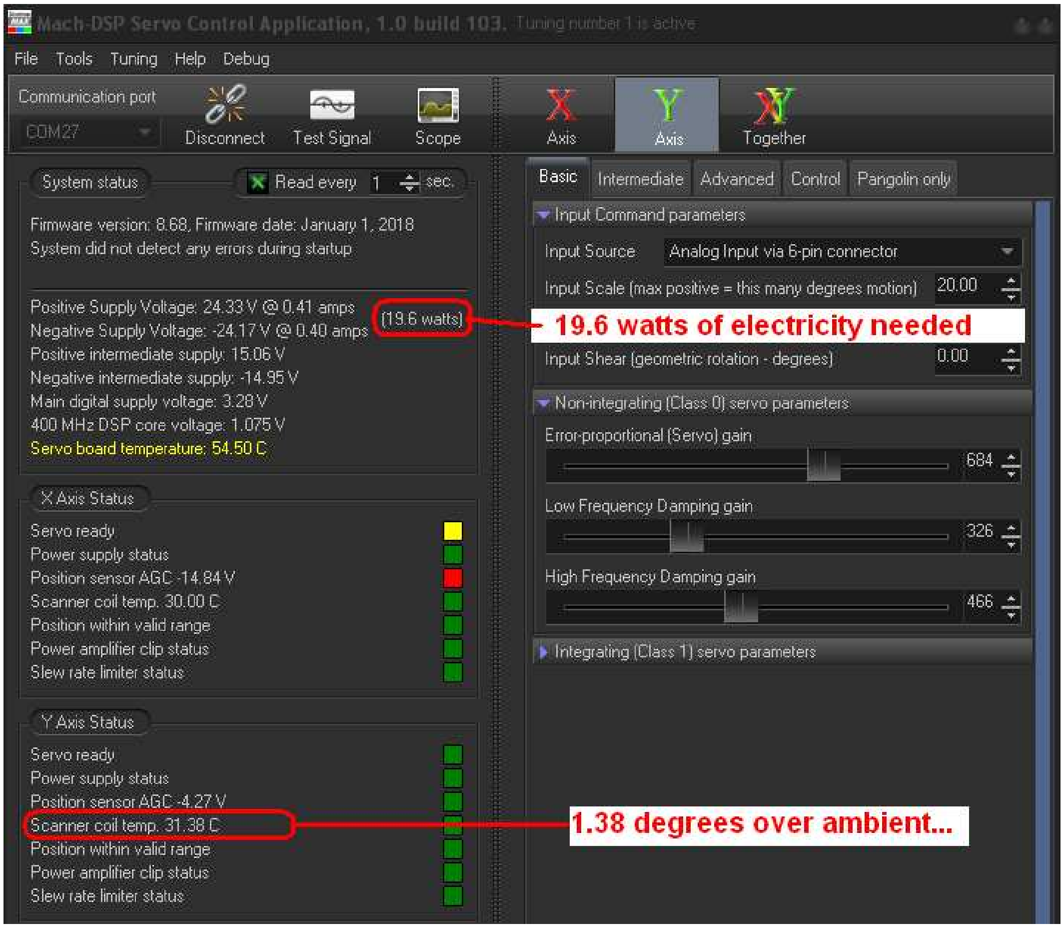
The heat at the power amplifier portion of the servo driver is approximately 8 watts.

With +/-24V power supplies, the electrical power supplied to the servo driver is 19.6 watts.

The green scope trace shows scanner velocity. This is chosen to illustrate that, during the "trace" portion of the sawtooth, velocity is certainly very flat.



The screen shot below illustrates this in terms of power consumption and heat. Our servo driver computes power and heat in real time. It can be seen that electrical power supply consumption (for the single axis being driven) is 19.6 watts. Heat generated by the scanner is nearly immeasurable, at 1.38 degrees above the 30 degree C ambient temperature used for testing.



2200Hz Sawtooth-Wave at 1 degrees optical

As was the case with the test above, the goal of this particular test was to evaluate the scanning "efficiency" while also evaluating the heat implications at both the servo driver and the scanner.

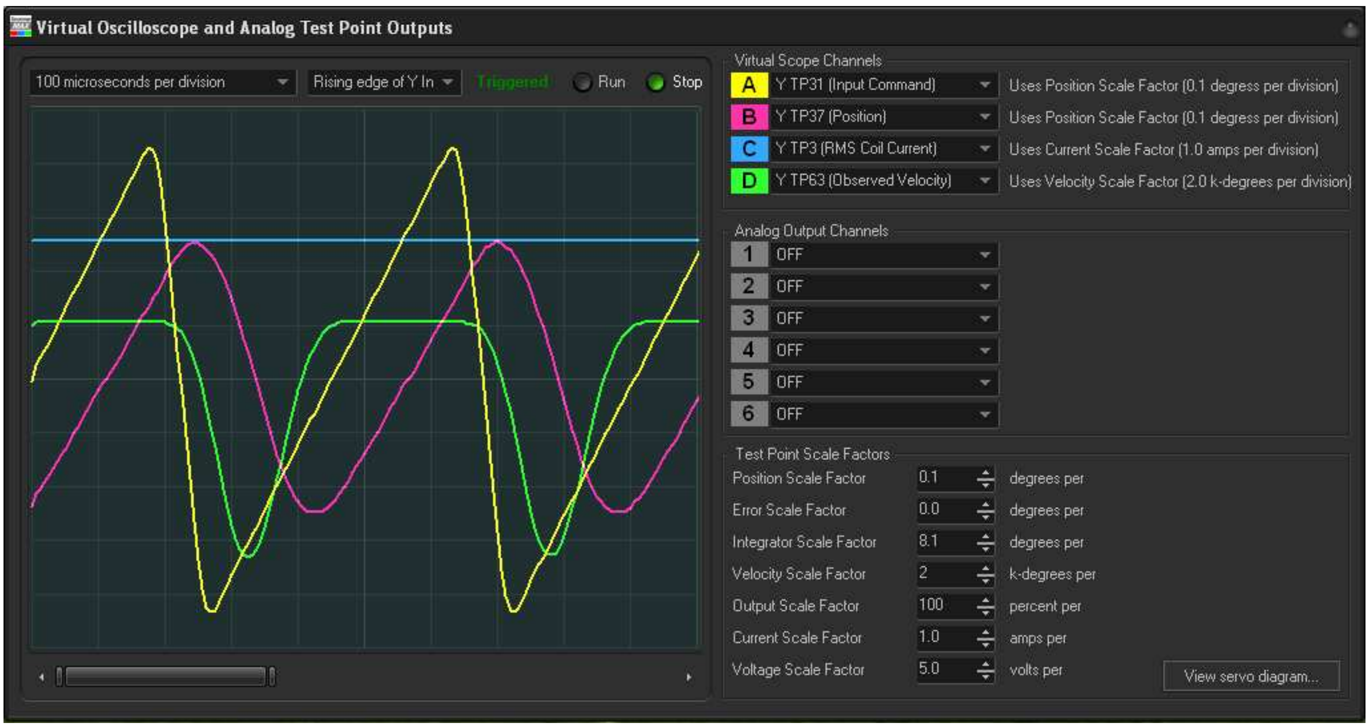
The scope screen shot below shows the overall results at 2200Hz. In this case, the function generator was set for 84% symmetry (382 microsecond "trace" portion and 73 microsecond "retrace").

RMS coil current is 2.4 amps. Given the 1.12 ohm coil resistance of this scanner, the scanner only dissipates 6.45 watts, with coil temperature rising less than 7 degrees above ambient.

The heat at the power amplifier portion of the servo driver is approximately 32 watts.

With +/-24V power supplies, the electrical power supplied to the servo driver is 51.5 watts.

The green trace is scanner velocity. This is chosen to illustrate that, during the "trace" portion of the sawtooth, velocity is certainly very flat.



2200Hz Sine-Wave at 1 degrees optical

In many cases, high-speed imaging is done using a sine-wave instead of a triangle-wave or sawtooth. This is usually done to reduce the heat at the scanner and servo driver. The purpose of this test is to evaluate the difference…

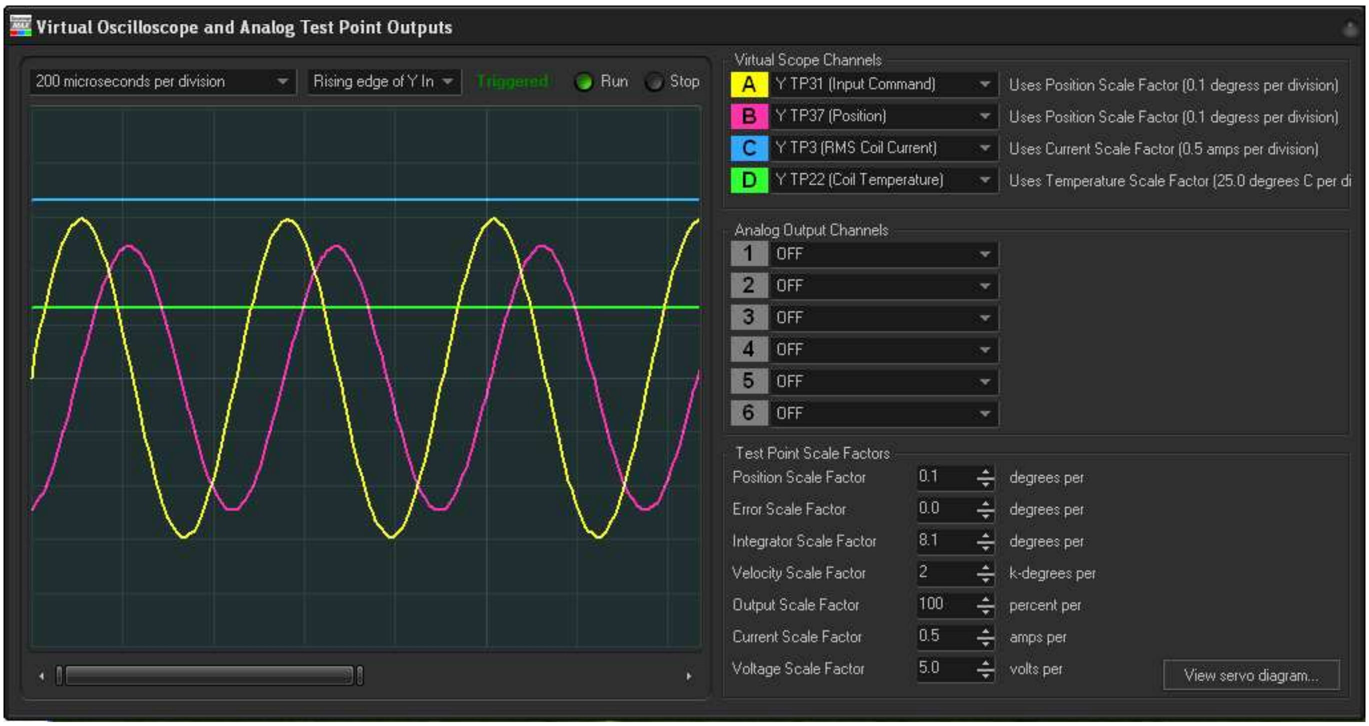
The scope screen shot below shows the overall results at 2200Hz with sine-wave drive.

RMS coil current is 1.65 amps. Given the 1.12 ohm coil resistance of this scanner, the scanner only dissipates 3.05 watts, with coil temperature rising around 2.8 degrees above ambient.

The heat at the power amplifier portion of the servo driver is approximately 35 watts.

With +/-24V power supplies, the electrical power supplied to the servo driver is 45.5 watts.

In this case, the green trace shows scanner coil temperature, at 32.81 degrees.



Conclusions

It is clear that Saturn 9B-46S allows for high-efficiency sawtooth-wave scanning to be performed with minimal heating of the scanner. Heating of the servo driver is also easily managed.

If faster flyback times are desired, more voltage must be supplied to the galvo. The present configuration of the Mach-DSP servo driver only provides a peak voltage of around 20 volts with +/-24V power supplies. Future versions of the Mach-DSP will double this drive voltage. That configuration should be available in Q4 of 2018.