Test of ScannerMAX Saturn 1 with 600Hz Sine-wave input, having an optical scan angle of 40 optical degrees peak to peak.

What follows are scope screen shots of a test of ScannerMAX Saturn 1B with our standard mirrors capable of moving a 3mm beam through 60 degrees optical. Standard tuning was also used.

Note that our servo driver has a built-in oscilloscope function and so that is what we are seeing. The yellow trace is the command input. The pink trace is the scanner position signal. Here we have 2 mechanical degrees per division, showing 20 mechanical degrees peak to peak, or 40 optical degrees.

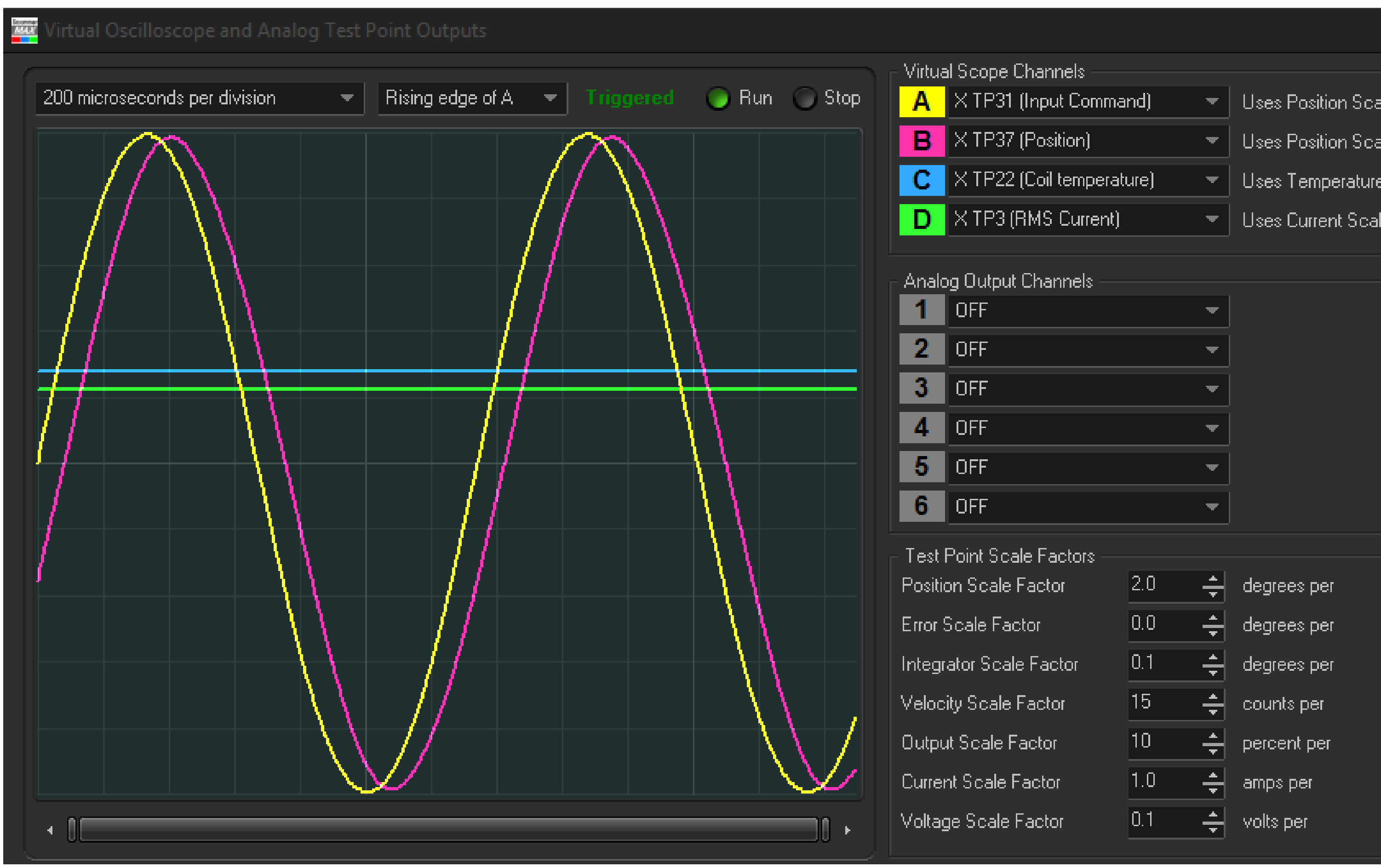
The blue trace shows coil temperature at 25C per division.

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

What we can see is that a bit more than 1 amp RMS current is flowing through the coil, and so the actual power supply voltage and current are +/-24V at a bit more than 0.5 amps per rail.

Since the coil resistance is nominally 1.8 ohms, this causes the scanner to dissipate perhaps around 2 watts of heat while doing this job.

The coil temperature is around 35C, with the outside of the scanner body itself held at 30C. So this job is very easy for the Saturn 1B to accomplish.



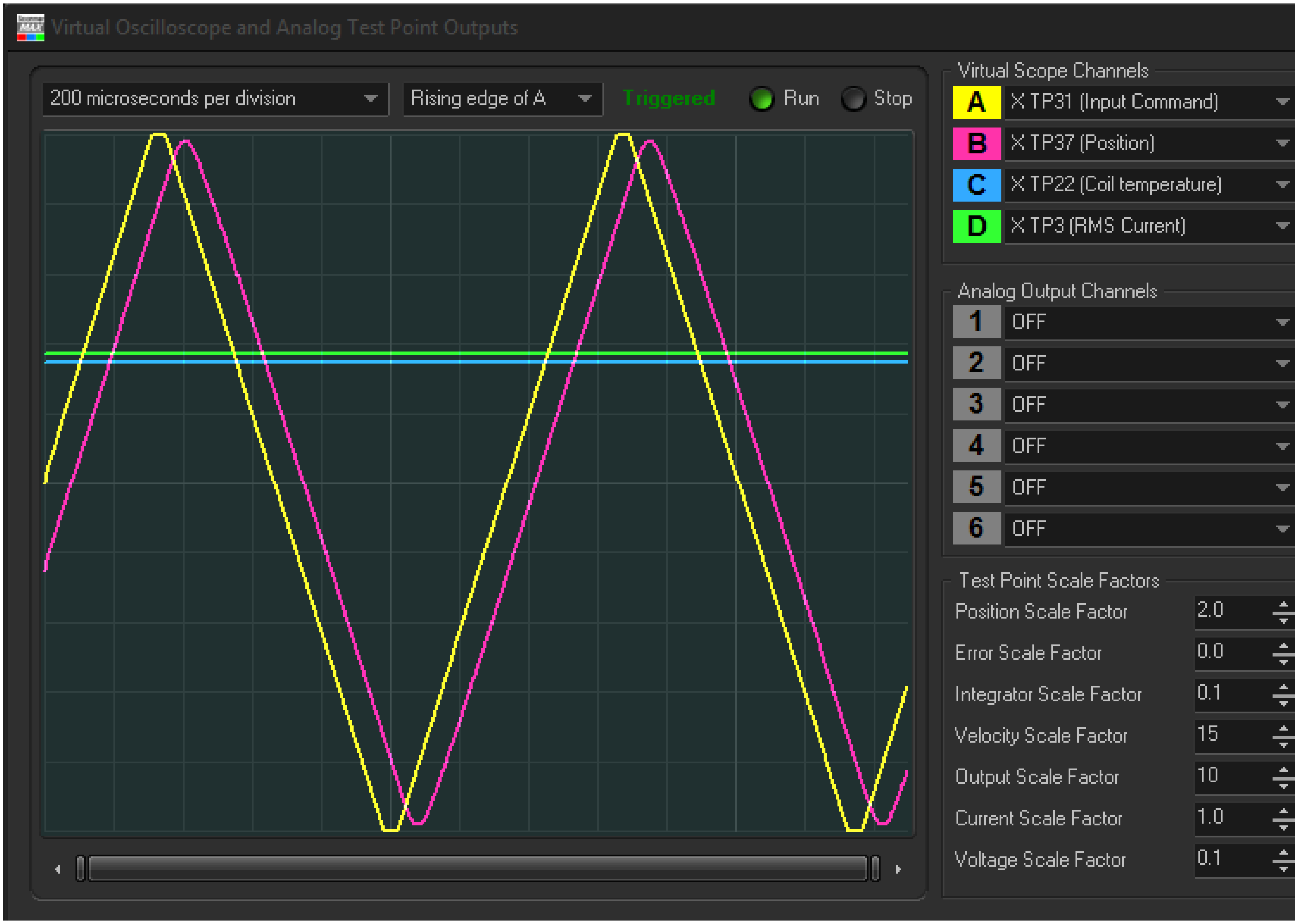
Same test, but with a triangle-wave input.

Here we have virtually the same setup, but with a triangle-wave input.

RMS current has increased to around 1.9 amps RMS, causing power supply current to rise to around 1.0 amps per rail.

Coil temperature increases to 47C, while the outside of the scanner body is still held at 30C.

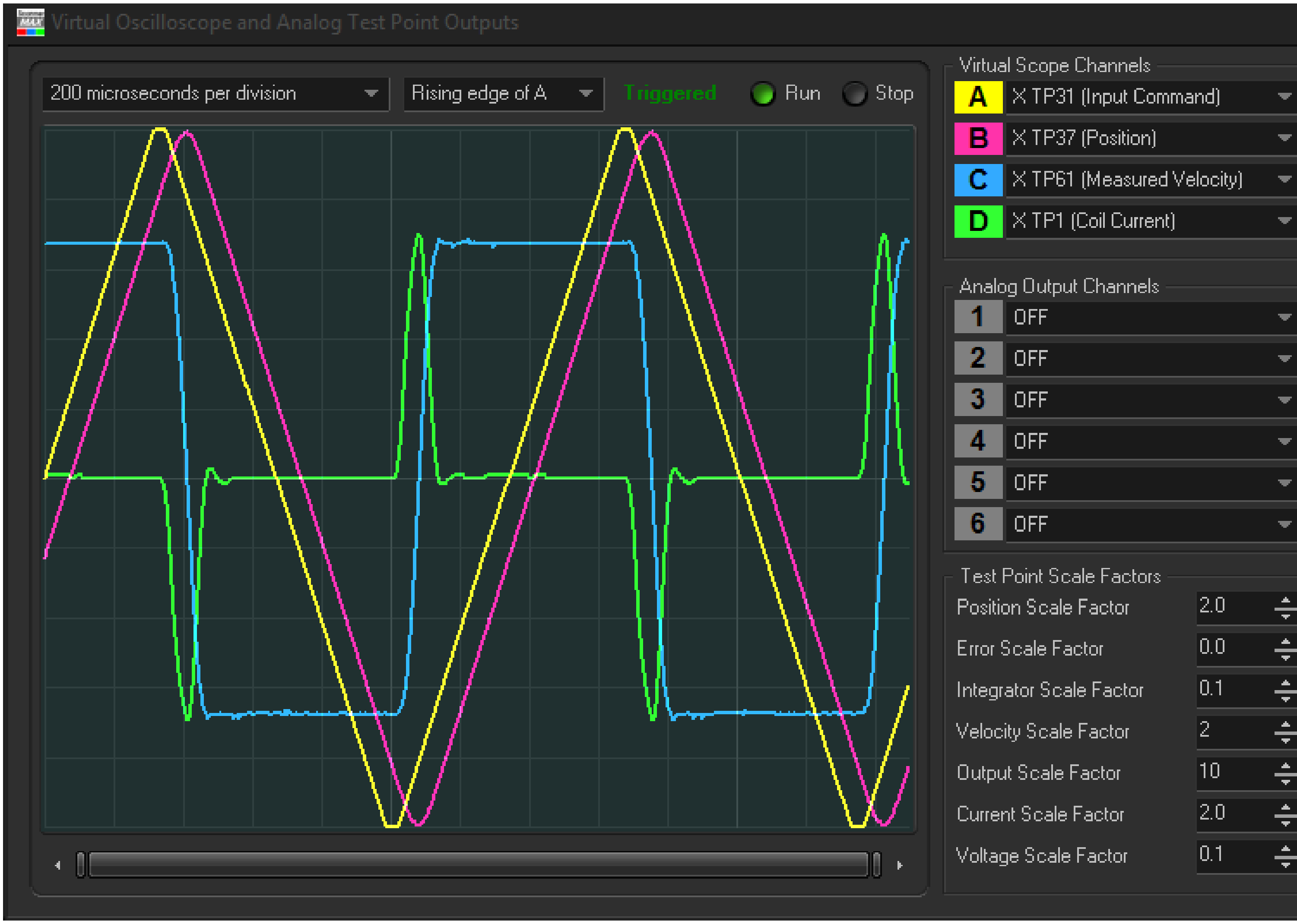
This job is also pretty easy to do for the Saturn 1B.



To try to get a sense of the “efficiency” of the triangle wave, I changed the scope channels such that the blue trace shows velocity and green trace shows the actual coil current.

Here we can see that – in order to perform the triangle wave, the scanner coil receives 7 amp peaks.

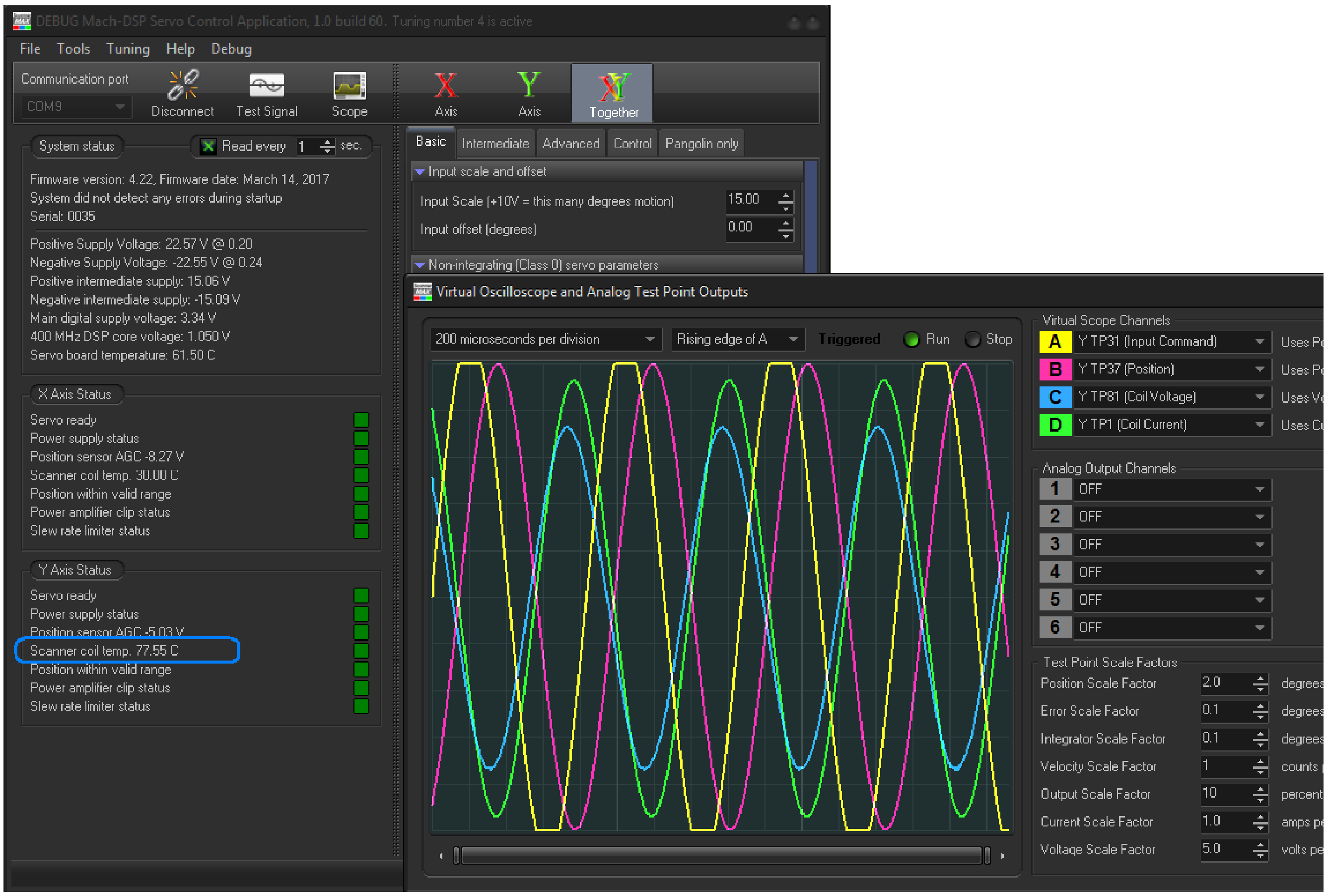
Looking at the amount of time the velocity waveform is in a particular state (high or low) compared to the amount of time that the velocity signal is in transition, it appears to me to be around 7 to 1 – so approximately 85% of the time is spent in a smooth portion of the scan, and around 15% of the time is spent turning around at each end of the scan.



“What’s the highest frequency sine-wave the Saturn 1B can do at 40 degrees optical”

The customer also inquired as to the highest possible frequency at 40 degrees optical. In the case of the Saturn 1B, there is a new coil version called 80S, that is designed for sinusoidal applications. We happened to have a Saturn 1B-80S on the bench, so performing a test with that scanner was convenient.

Below is a screen shot of the Saturn 1B-80S scanning 40 degrees optical at 1200Hz. Oscilloscope colors and functions are the same as above.



Coil voltage is around 36 volts peak to peak, thus for this frequency, power supplies would need to be +/-24V, with higher power supply voltages providing a margin for headroom.

Coil current is a bit more than 9 amps peak to peak, or 3.2A RMS. In this case, the power supply must provide around 1.8 amps per rail.

As shown in the blue highlighted area above, our software shows that the coil temperature is 78 degrees C, with the scanner body temperature held at 30 degrees C.

The Saturn 1B-80S coil resistance is 2.8 ohms at room temperature, and rises to around 3.36 ohms under this condition.

Therefore, to scan 1200Hz at 40 degrees, heat generated by the scanner is 34 watts.

Test of ScannerMAX Saturn 5 with 600Hz Sine-wave input, having an optical scan angle of 40 optical degrees peak to peak.

What follows are scope screen shots of a test of ScannerMAX Saturn 5B with our standard mirrors capable of moving a 5mm beam through 60 degrees optical. The test scenario is identical to the Saturn 1 tests shown on the first page.

The blue trace shows coil temperature at 25C per division.

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

What we can see is that around 1.95 amps RMS current is flowing through the coil, and so the actual power supply voltage and current are +/-24V at a bit more than 1.0 amps per rail.

Since the coil resistance is nominally 1.9 ohms, this causes the scanner to dissipate perhaps around 7.25 watts of heat while doing this job.

The Saturn 5 has somewhat better thermal conductivity, and so the coil temperature is around the same as it was for the Saturn 1 (35C), with the outside of the scanner body itself held at 30C. So this job is very easy for the Saturn 5B to accomplish.

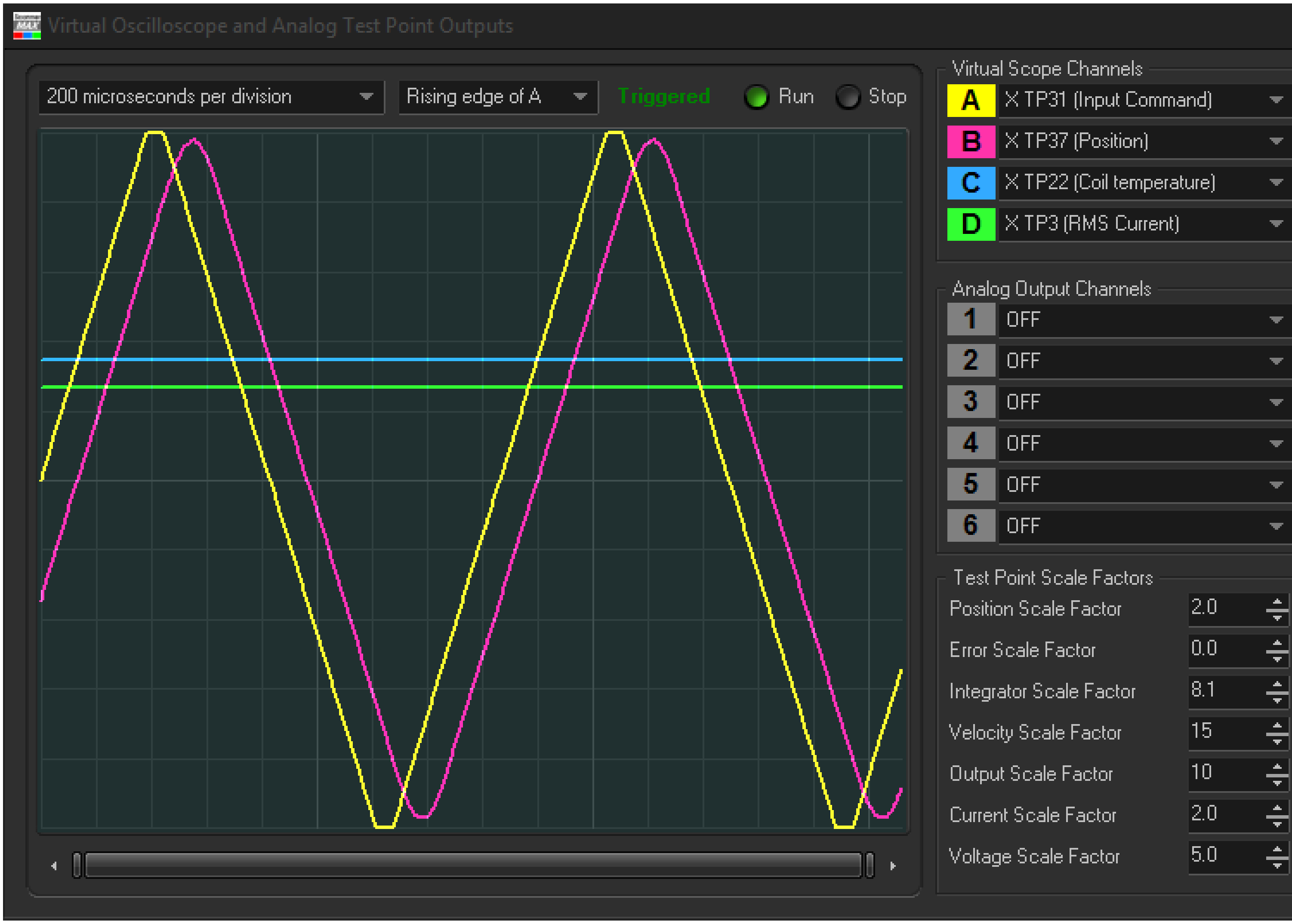
Same test, but with a triangle-wave input.

Here we have virtually the same setup, but with a triangle-wave input.

Since I increased the current scale factor from 1 amp per division to 2 amps per division, it is clear that RMS current has increased to around 2.6 amps RMS, causing power supply current to rise to around 1.5 amps per rail.

Coil temperature increases to 45C, while the outside of the scanner body is still held at 30C.

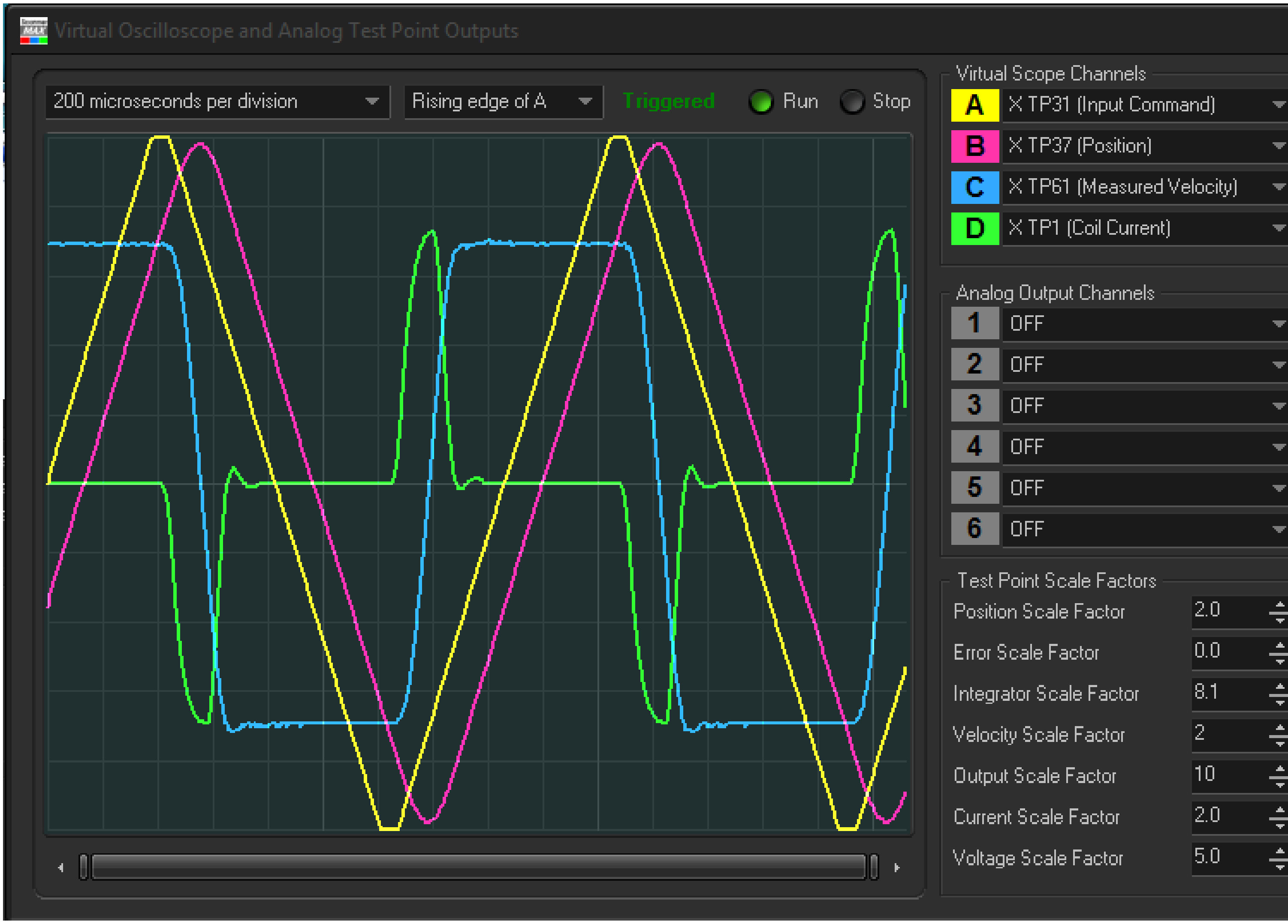
This job is also pretty easy to do for the Saturn 5B.



To try to get a sense of the “efficiency” of the triangle wave, I changed the scope channels such that the blue trace shows velocity and green trace shows the actual coil current.

Here we can see that – in order to perform the triangle wave, the scanner coil receives 7 amp peaks – just as it did with the Saturn 1B. However, we can see that – due to the higher inertia of the 5mm mirrors and somewhat higher rotor inertia as well, more time is spent during the turn-around periods.

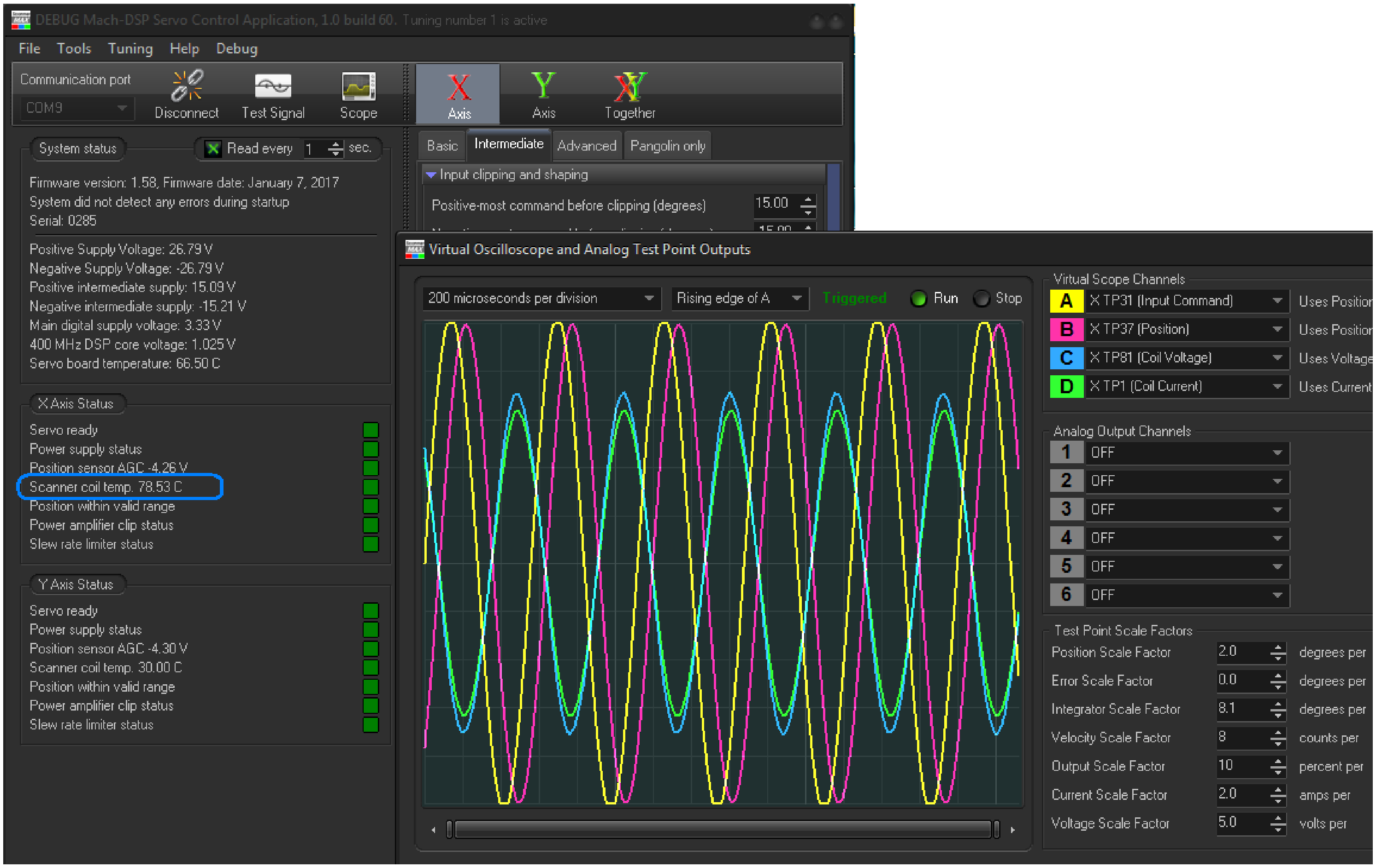
Looking at the amount of time the velocity waveform is in a particular state (high or low) compared to the amount of time that the velocity signal is in transition, it appears to me to be around 4 to 1 – so approximately 75% of the time is spent in a smooth portion of the scan, and around 25% of the time is spent turning around at each end of the scan.



“What’s the highest frequency sine-wave the Saturn 5B can do at 40 degrees optical”

Like the Saturn 1B, the Saturn 5B is also available in other coil configurations that are optimized for different applications, including sinusoidal scanning. The Saturn 5B-74S is one example of this. Unfortunately, none of those were available at the time this testing was being done, and so for the following test, we used a standard Saturn 5B, with standard 5mm / 60 degree mirror set.

Below is a screen shot of the standard Saturn 5B scanning 40 degrees optical at 900Hz. Oscilloscope colors and functions are the same as above.



Coil voltage is around 36 volts peak to peak, thus for this frequency, power supplies would need to be at least +/-24V, and +/-30V would be better as a margin for headroom.

Coil current is a bit more than 12.4 amps peak to peak, or 4.4A RMS. In this case, the power supply must provide around 2.4 amps per rail.

As shown in the blue highlighted area above, our software shows that the coil temperature is 78 degrees C, with the scanner body temperature held at 30 degrees C.

The standard Saturn 5B coil resistance is 1.9 ohms at room temperature, and rises to around 2.3 ohms under this condition.

Therefore, to scan 900Hz at 40 degrees, heat generated by the scanner is 46 watts.