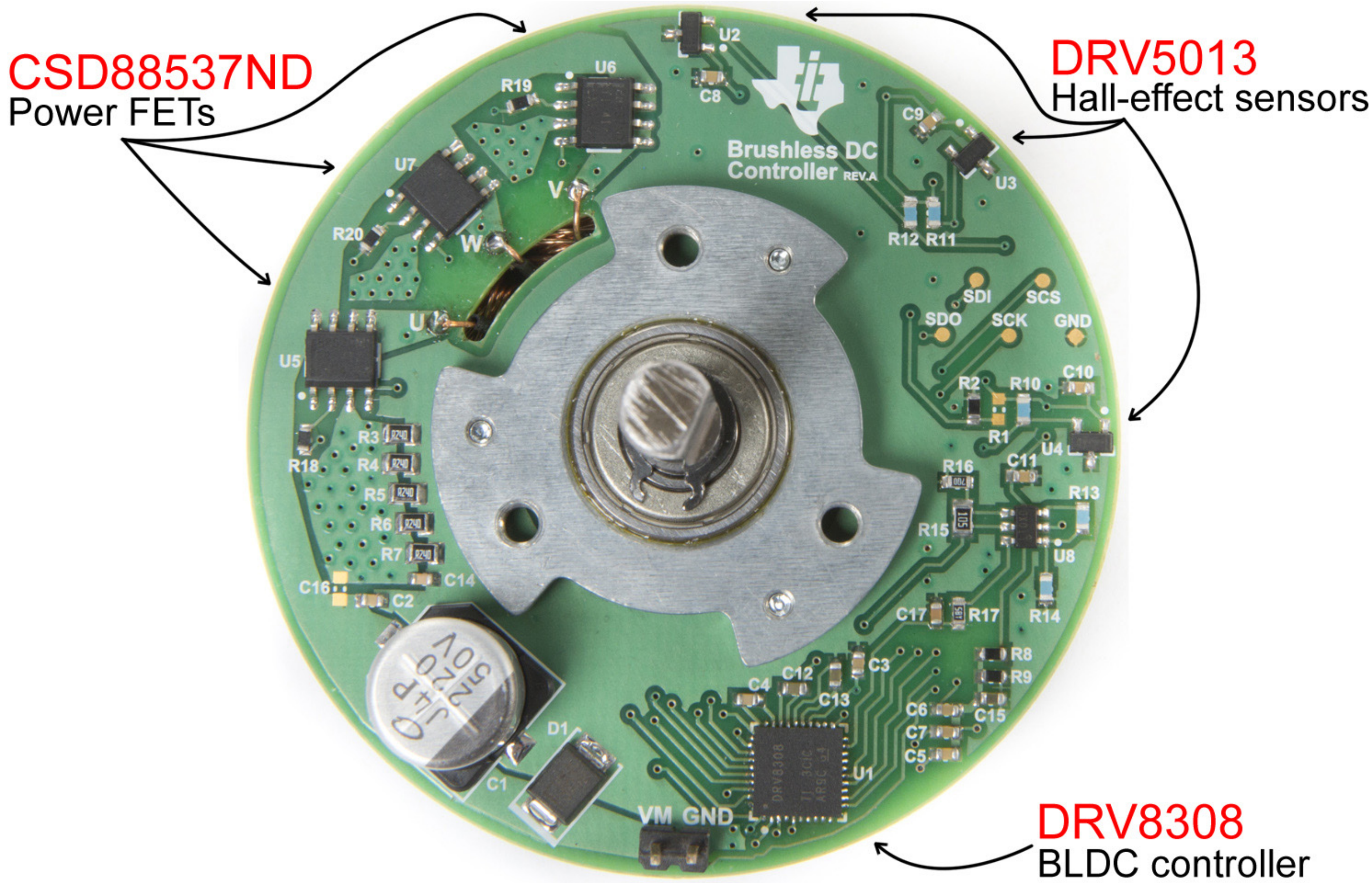
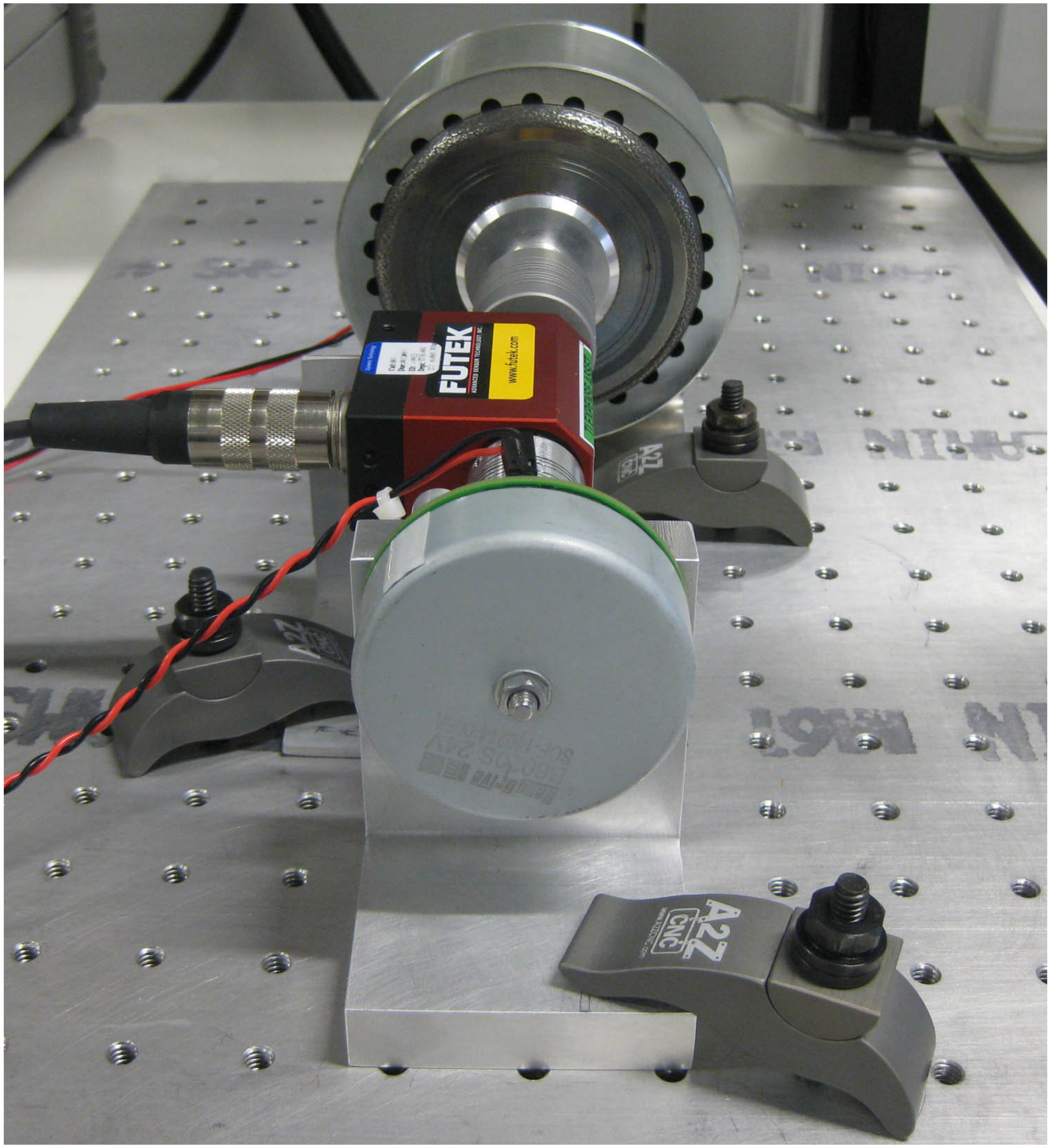
Brushless DC Motor with Speed Control, TI Design

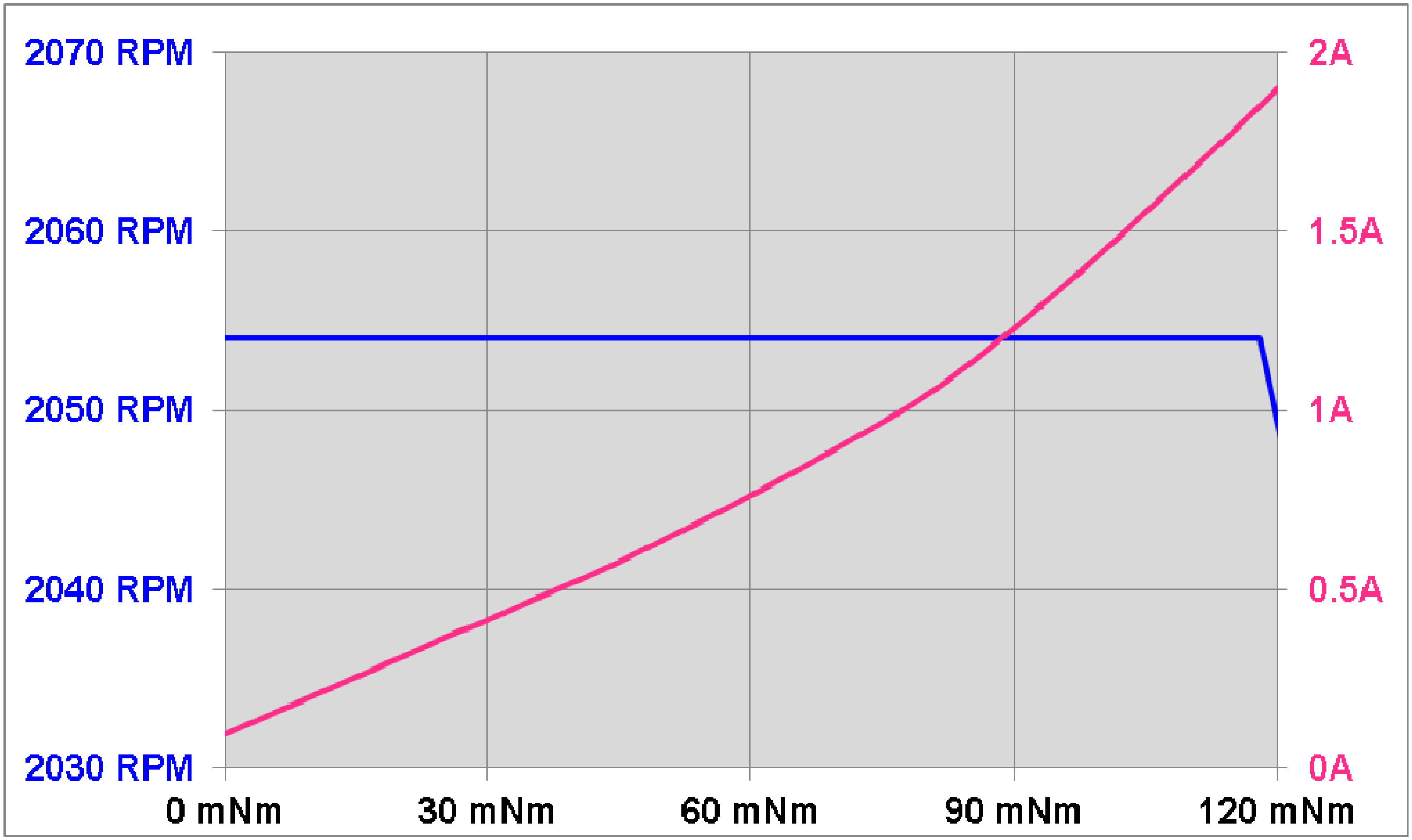
This design has a simple power connector that accepts 24V to 32V, and the motor spins at 2054 RPM. If a lower RPM is set (with resistor R13), a lower voltage down to 8.5V can also be used. Data in this report was taken using 24V. Motor current is limited to 5.2A using the DRV8308 $V_{LIMITER}$ feature.



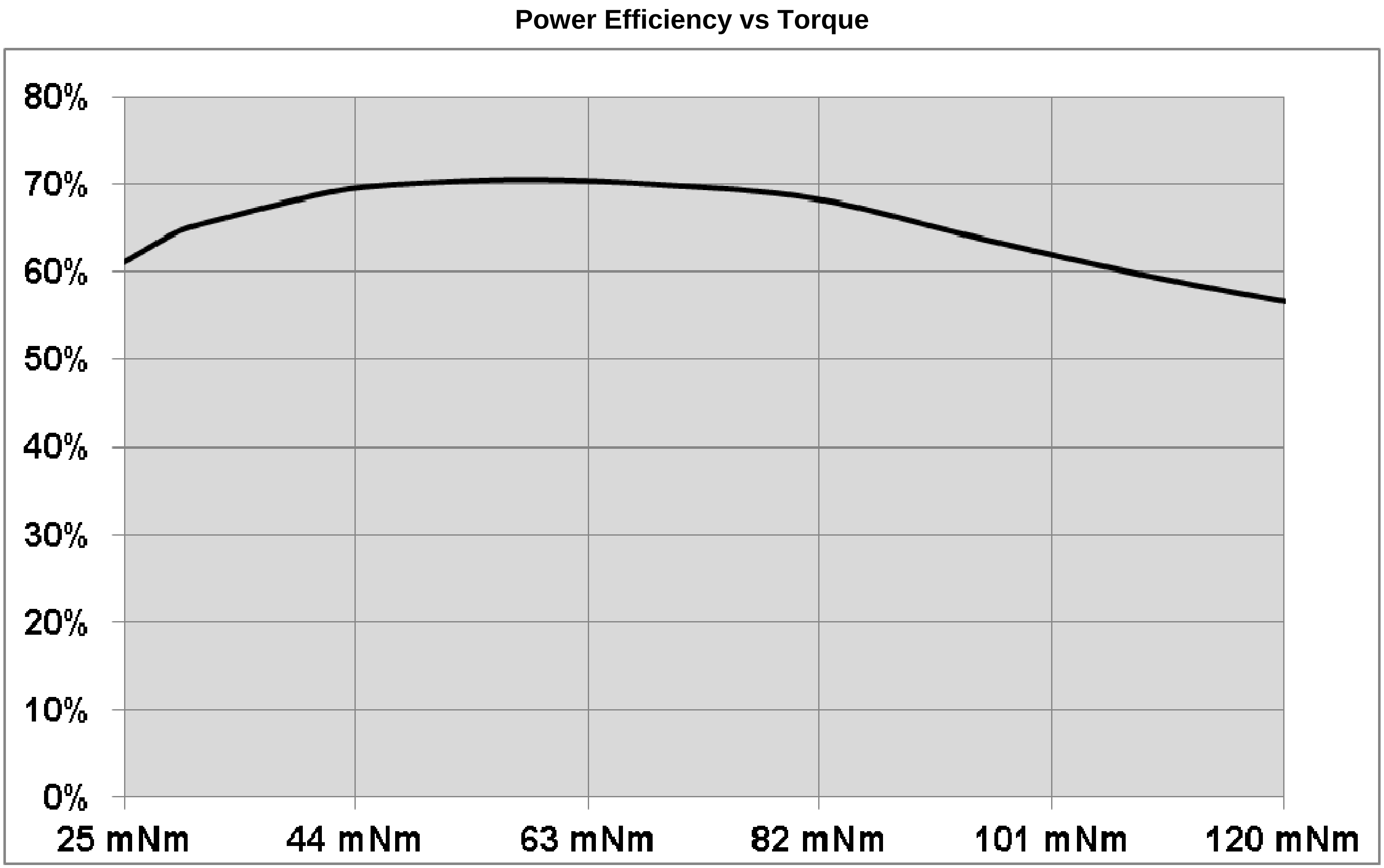
Test Setup



RPM and Supply Current vs Torque

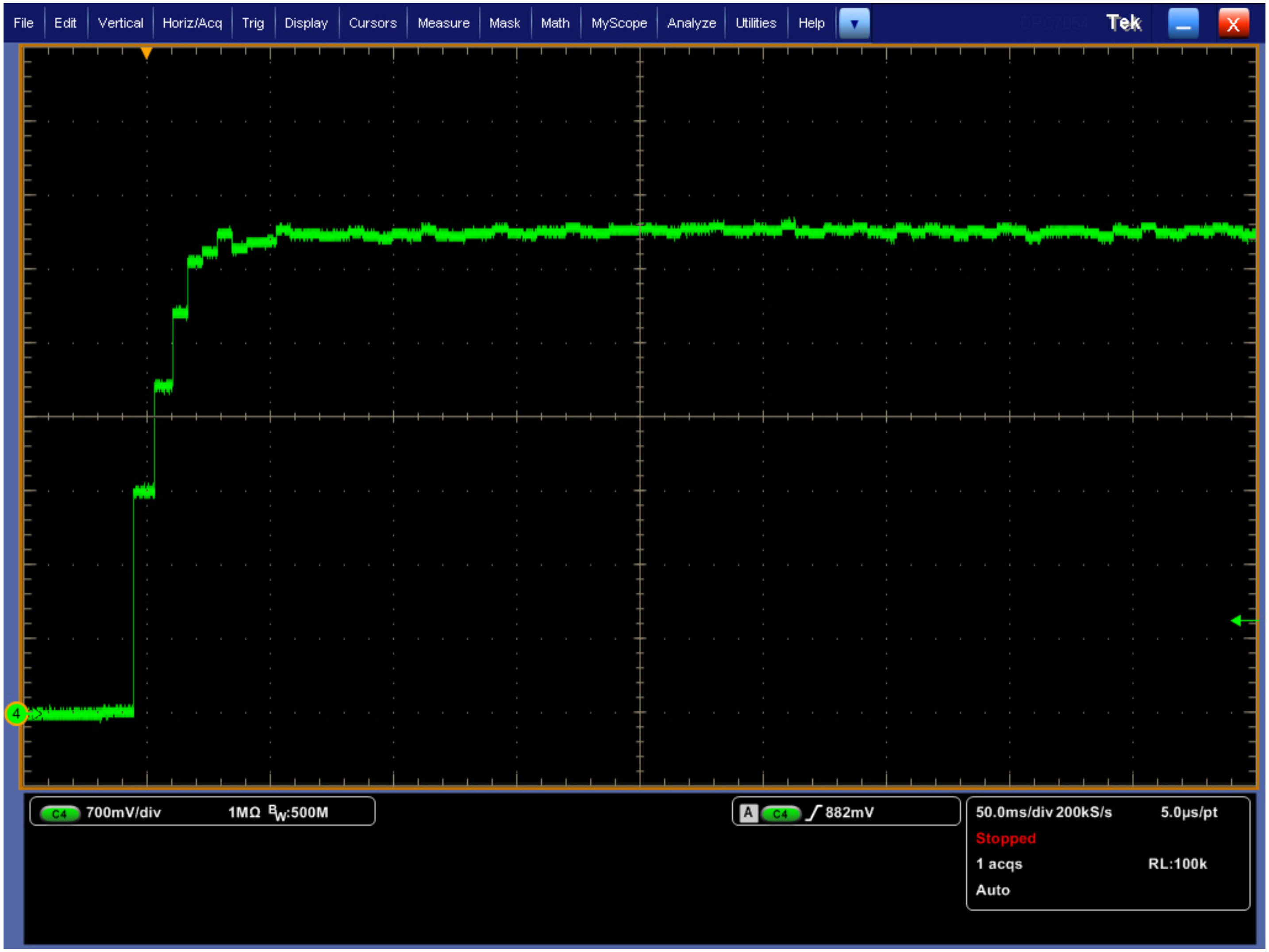


Most BLDC motors do not have closed-loop speed control, so RPM will decrease unpredictably as torque increases. But the DRV8308 maintains a precise RPM. The operating torque range of this design is 0 to 118 mNm (16.7 oz-in), and maximum motor power is 25W.



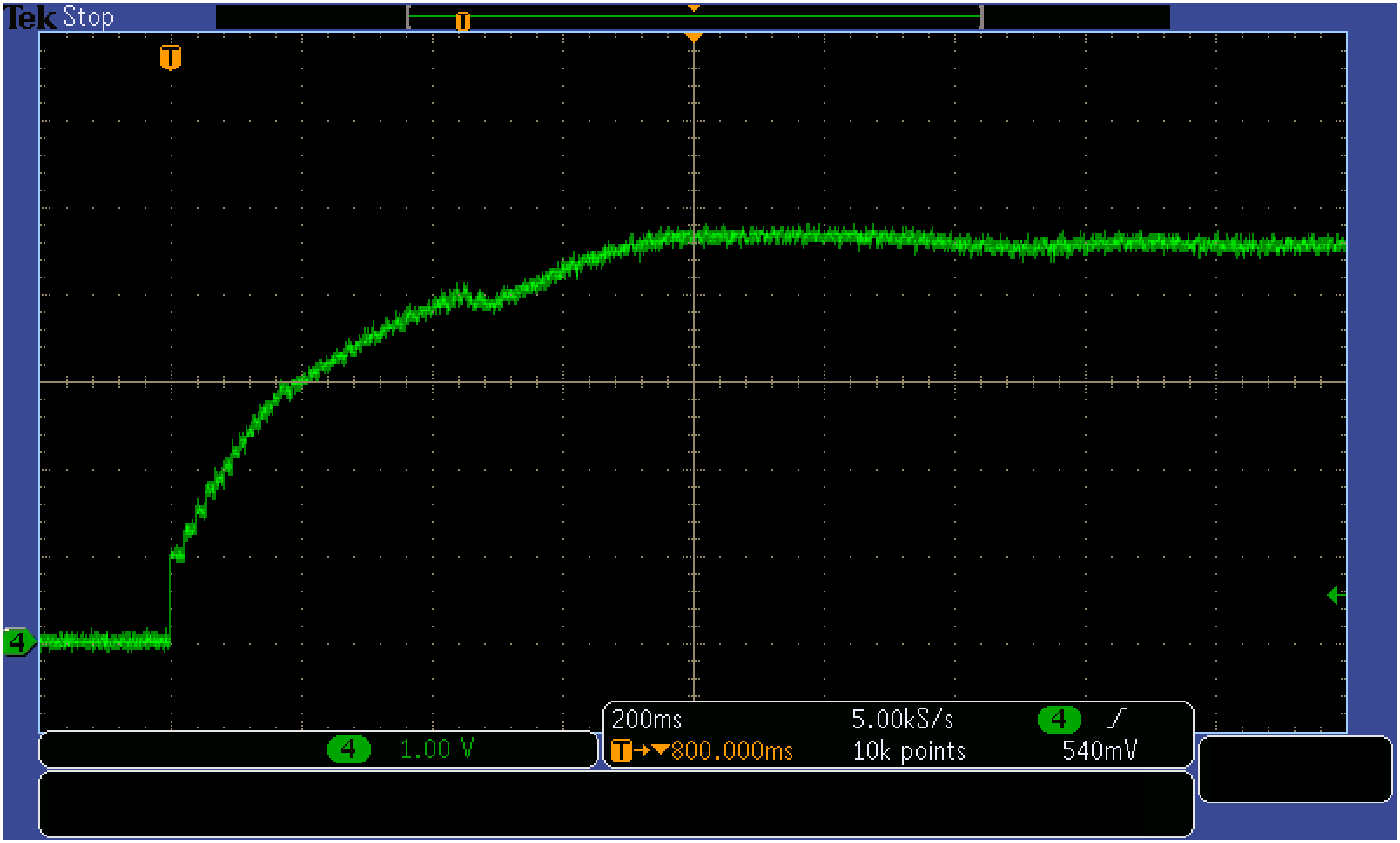
Power Efficiency = Motor Power / Supply Power = (Torque * Speed) / (Voltage * Current).

Spin-up Profile with No Load



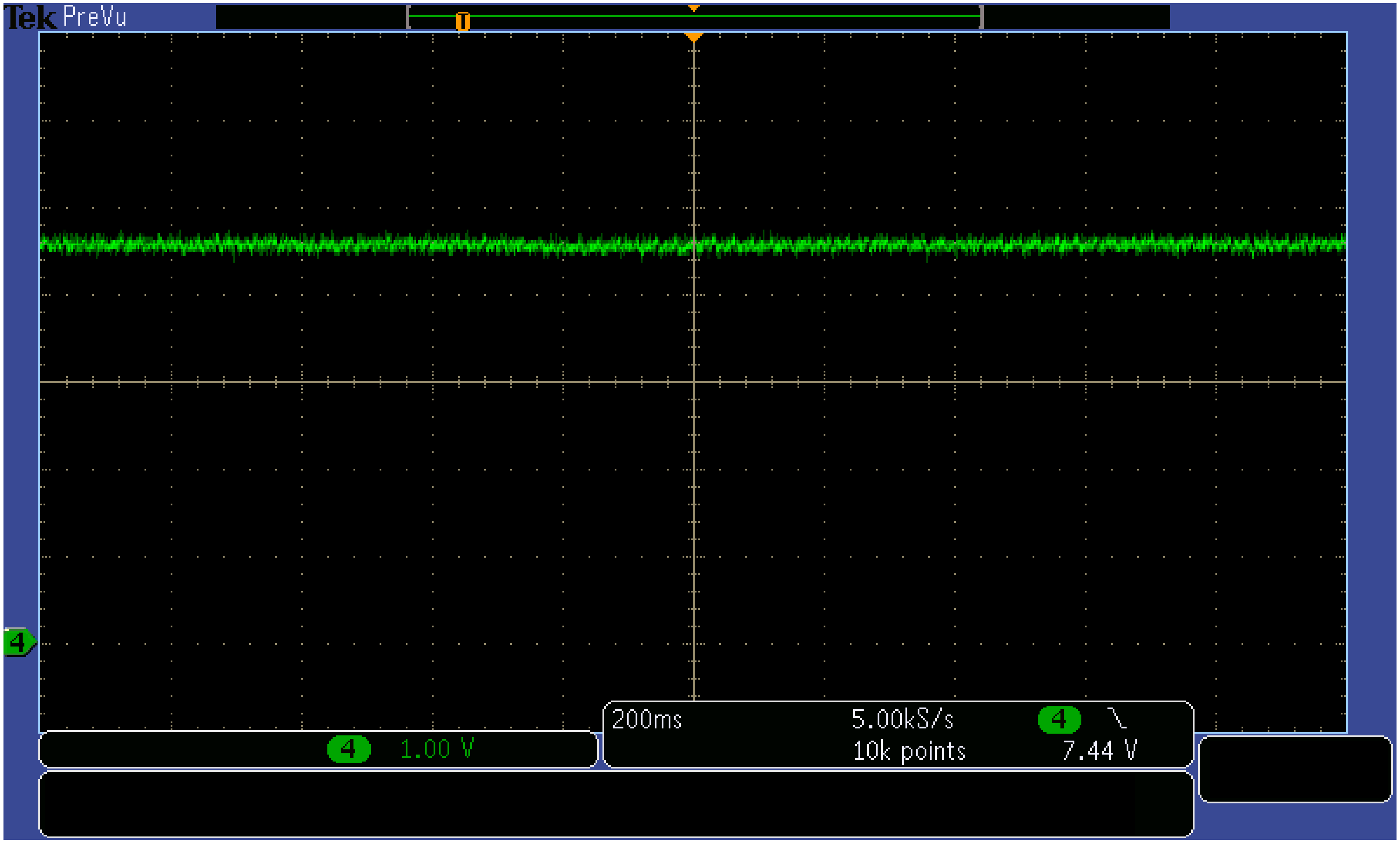
Motor speed was measured from the frequency of one Hall signal, and converted to this an analog waveform. Spin-up time was 60ms. The steady-state value represents 2054 RPM.

Spin-up Profile with 100 mNm Load



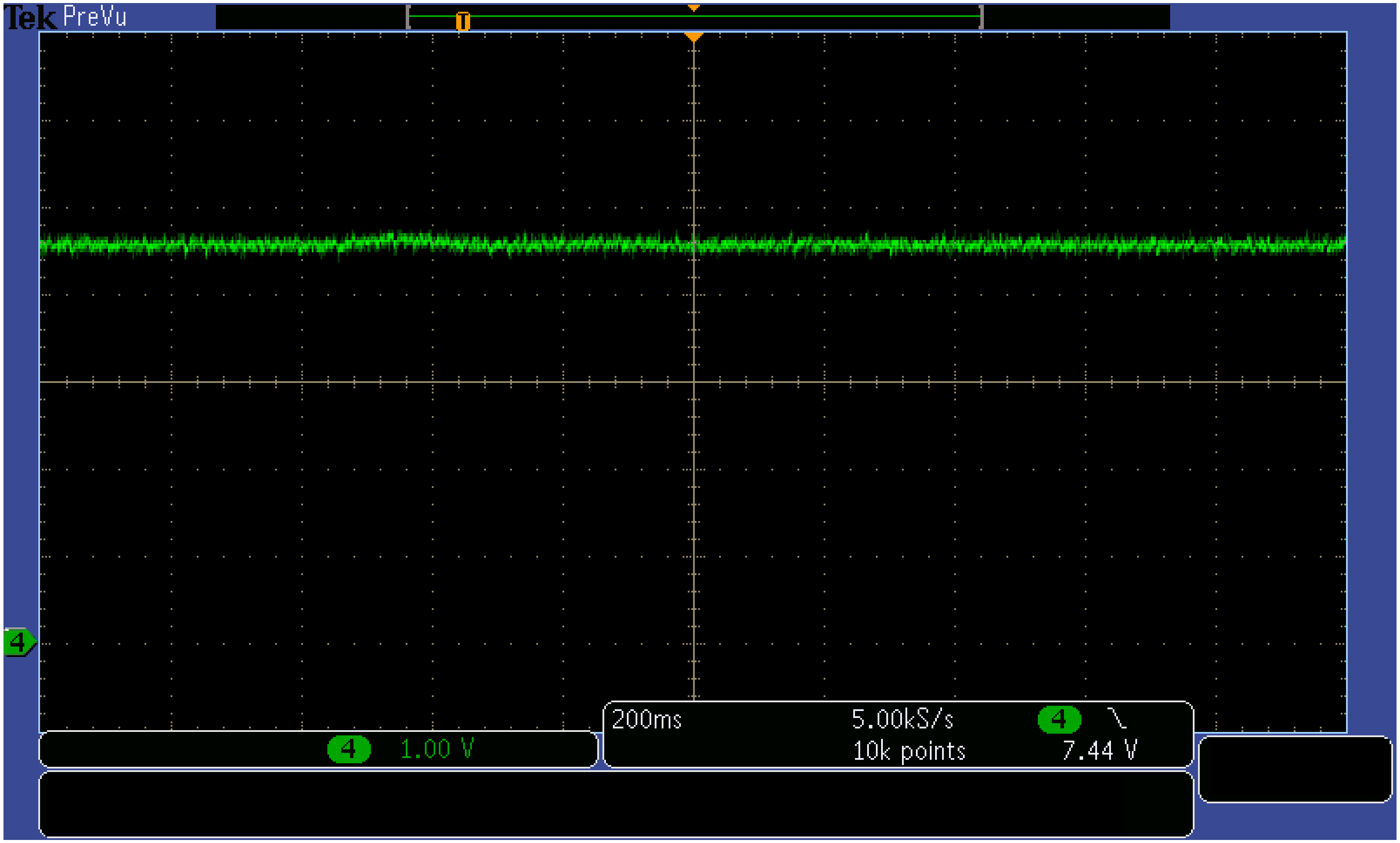
Again, motor speed was measured from the frequency of one Hall signal, and converted to this an analog waveform. Spin-up time was 680ms. The steady-state value represents 2054 RPM.

Transient Response of Speed, Going from 22.8 mNm to 90 mNm



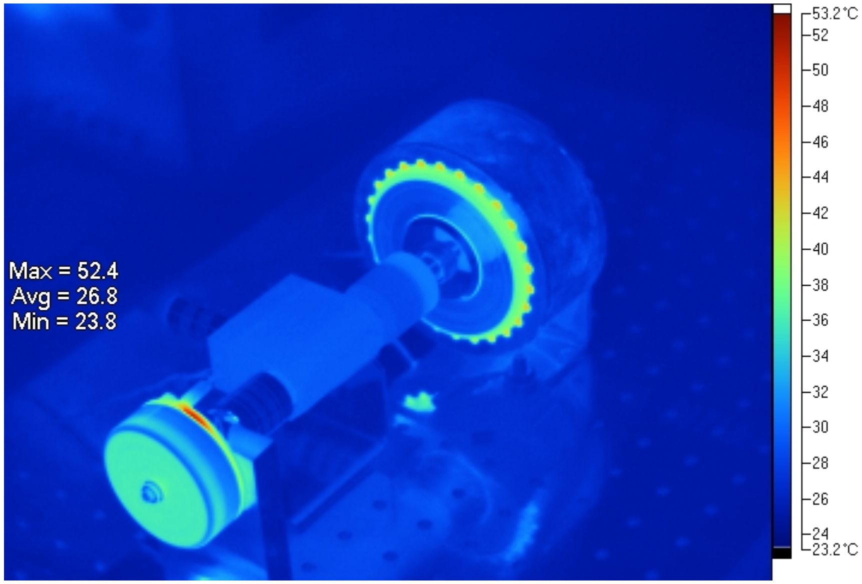
The waveform amplitude represents 2054 RPM. During the first 750ms, a 22.8 mNm load was driven, and then there was a step-change in load to 90 mNm. The DRV8308 closed-loop control compensated very effectively.

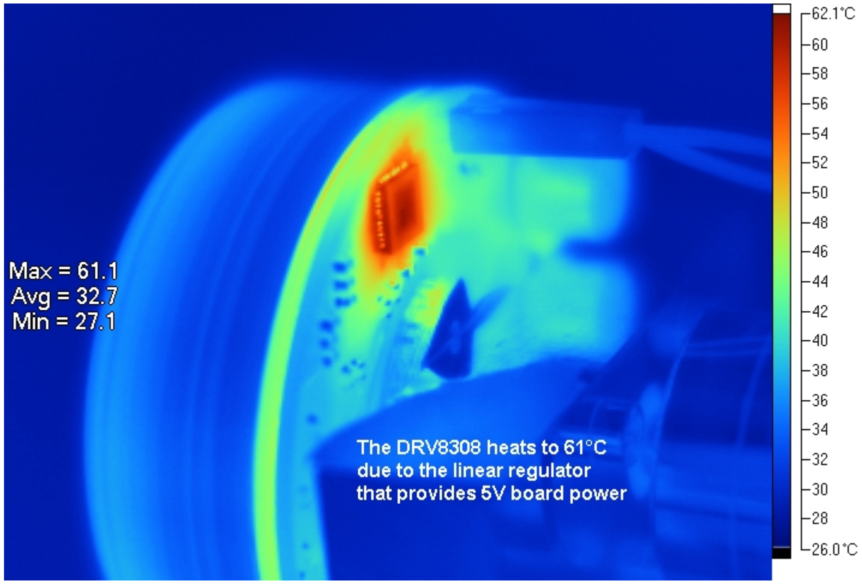
Transient Response of Speed, Going from 90 mNm to 22.8 mNm

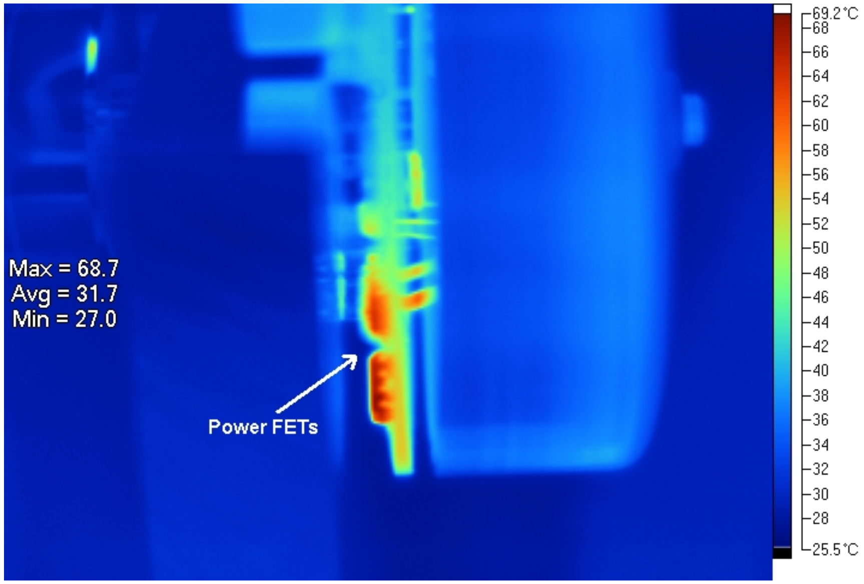


Again, the waveform amplitude represents 2054 RPM. During the first 500ms, a 90 mNm load was driven, and then there was a step-change in load to 22.8 mNm. The speed overshoot was about 1.5%.

Thermal Images with 1.6A, 106 mNm Load, and 2054 RPM





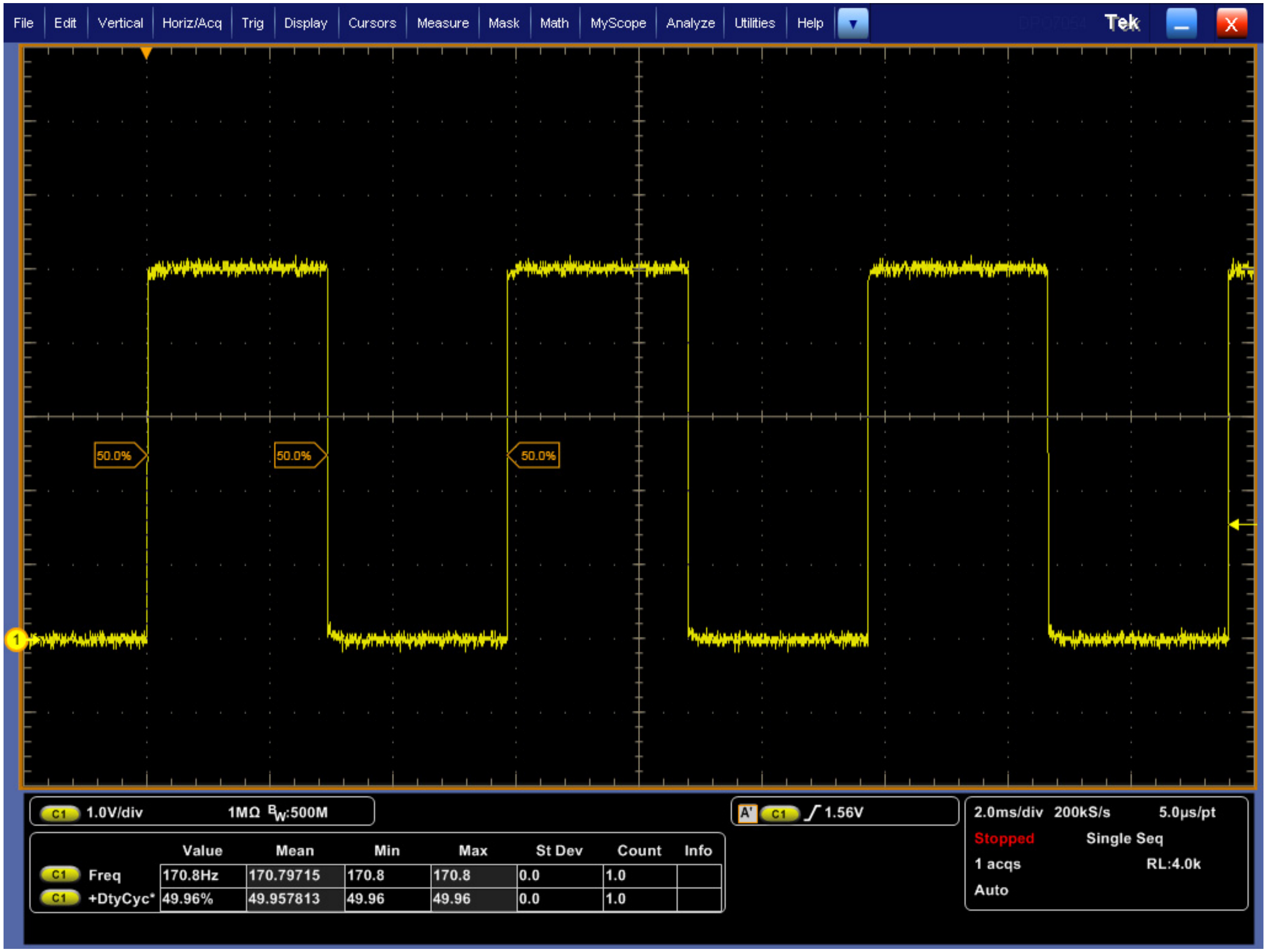


Flutter with No Load (measured from a Hall signal)

0.30%

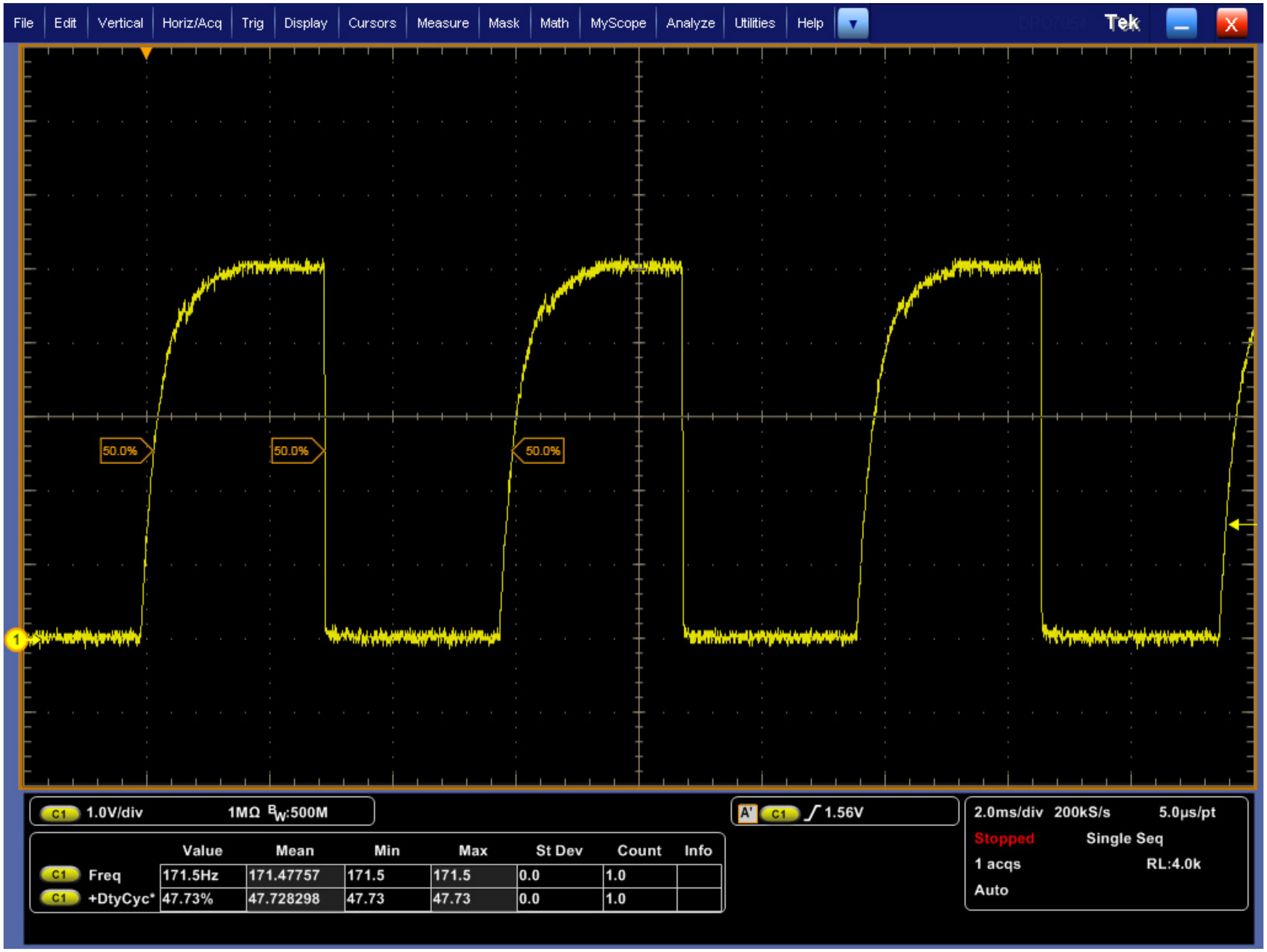
Flutter is a measure of rotational speed jitter, and it measures the edge variation of a periodic signal generated by the motor. It is most accurately measured from a serpentine board trace that senses magnetic reluctance, but in this case a Hall signal was used. The DRV8308 commutates based on 1 Hall sensor, and that improves flutter.

Input clock to the DRV8308



This clock is applied to DRV8308 pin “CLKIN”. The device matches the frequency of Hall U with the frequency of this reference clock.

Hall-effect sensor signal



The motor has 10 permanent magnet poles, so there are 5 Hall cycles per revolution. 171Hz / 5 * 60 = 2054 RPM.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265