TI Designs: TID-00145

Automotive Brushed Motor Drive for Power Folding Side Mirrors - Test Data

This document shares the tests results of the DRV8801EVM with a TYC Automotive Side View Mirror.

The data is structured into two main categories:

1. Test set up
2. Motor characterization
3. Single Motor Bi Directional Control
    a. Start up
    b. Steady state
    c. Track resistance (near end of track)
    d. Stall
4. Thermal Image of Device Under Operation

Equipment used to create this data:

1. Oscilloscope
2. Current probe
3. 3 power supplies (12V, 3.3V, 3.3V)
4. DRV8801 EVM
5. DRV8801 EVM GUI installed on PC
6. Power folding side mirror (TYC1200142)

Image 1: Power Folding Mirror with DRV8801EVM

Section 1: Test set up

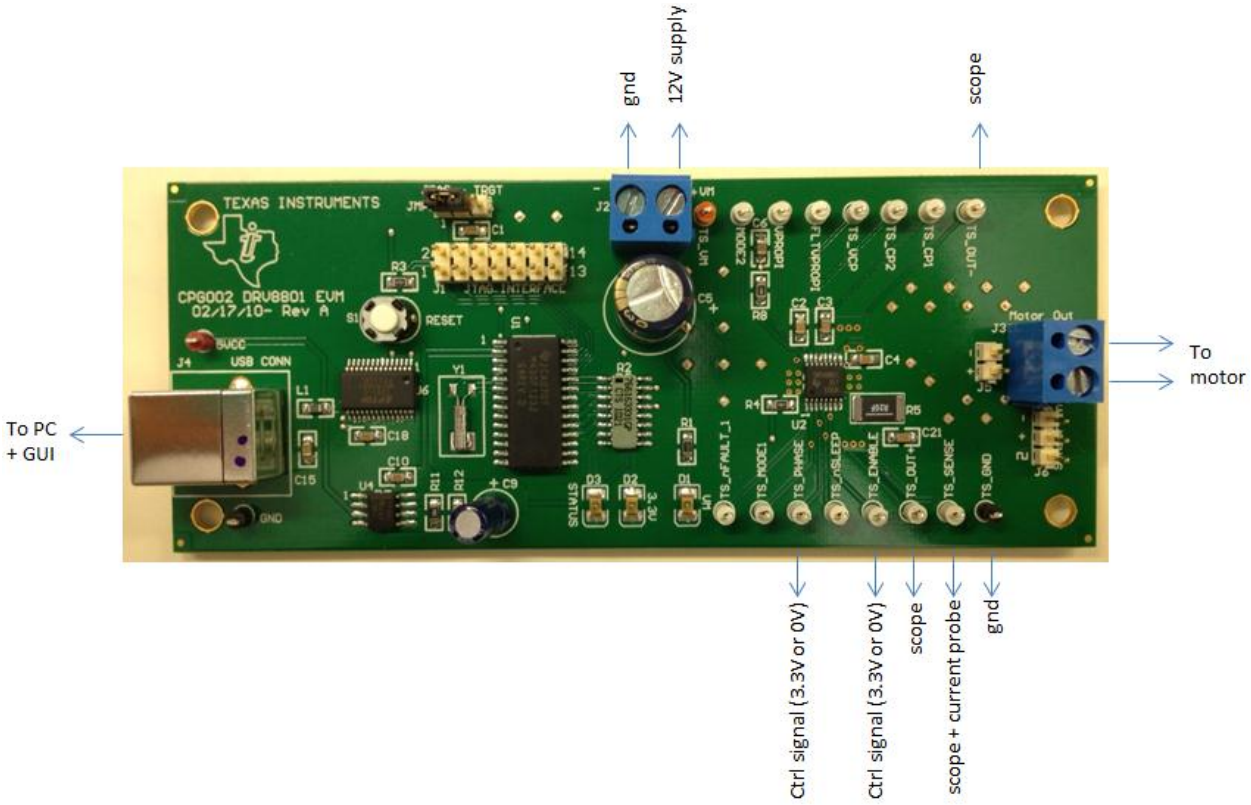

Image 2: DRV8801EVM Board Connections

•Install EVM GUI. Connect PC to DRV8801EVM board at “USB CONN”
•Connect 12V and ground to DRV8801EVM at “+ and – VM”
•Connect motor leads to DRV8801EVM at “Motor Out”
•Connect the TS_PHASE and TS_ENABLE pins to 3.3V supplies. (The firmware/GUI as is only supports PWM control, so connecting the pins to a logic supply simplified the testing to provide 100% duty cycle signals.)
•Connect scope leads to DRV8801EVM at TS_OUT+, TS_OUT-
•Connect scope and current probe to DRV8801EVM at TS_SENSE

Section 2: Motor characterization

To measure resistance and inductance, the motor leads were probed with a multimeter.

Motor resistance: 63.4 ohms
Motor inductance: 127 mH

The expected current draw at an input of 12V is about 200mA (12V / 63.4 Ω = 189 mA).

Section 3a: Start up

The figure below shows the motor moving forward from a stopped position. Though the peak current is about 5A, overcurrent is not tripped because the peak lasts for less than the overcurrent deglitch time of 3us (see red arrow). See page 9 of DRV8801EVM for overcurrent specifications. This motor has a large starting torque (amount required to overcome inertia) and consequently requires a high amount of current to initially move the motor.

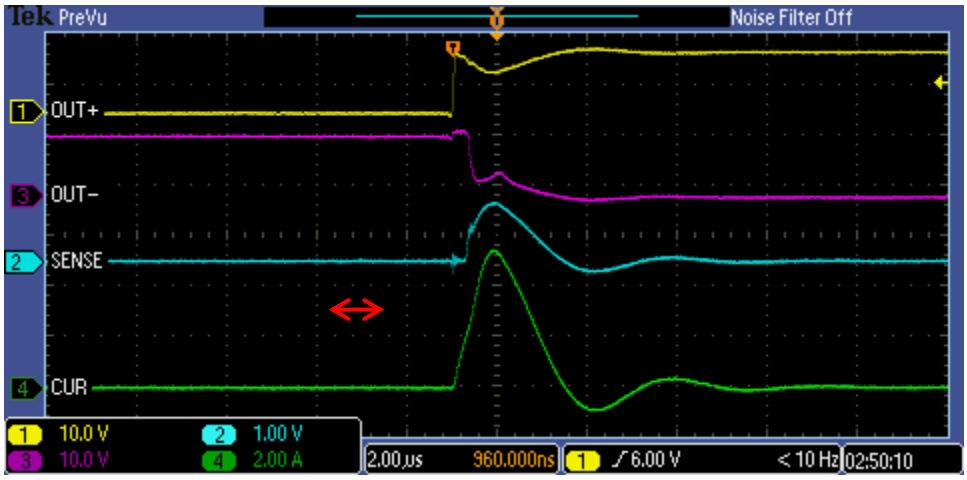

Figure 1: Scope image of motor folding forward from stopped position

In Figure 2, the scope image shows the motor moving reverse from a stopped position. Though the peak current is about 5A, overcurrent is not tripped because the peak lasts for less than the overcurrent deglitch time of 3us (see red arrow). See page 9 of DRV8801EVM for overcurrent specifications. Notice that OUT+, OUT-, and CUR are inverted from the previous scope shot.

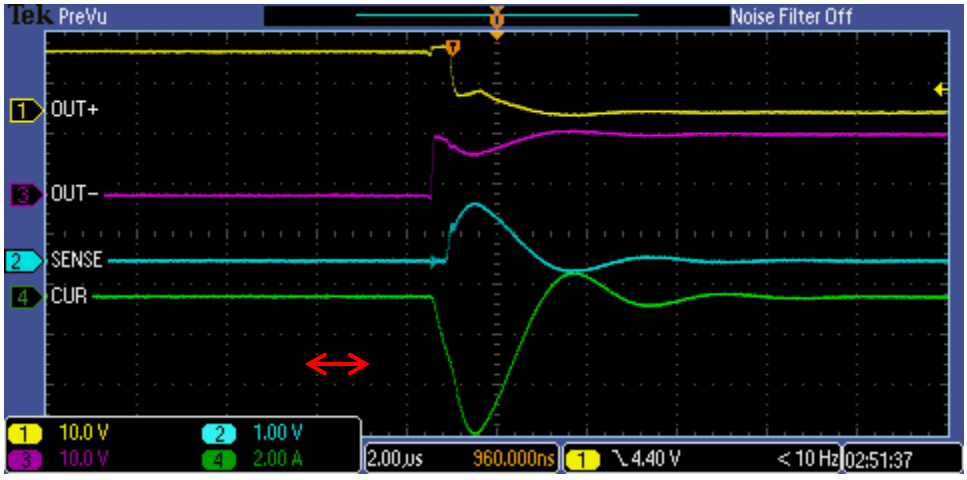

Figure 2: Scope image of motor folding reverse from stopped position

Section 3b: Steady state

Figure 3 shows the motor moving forward in steady state. Starting torque requirements have been met. In this region of operation, current is low. From the scope shot, the forward steady state DC current (with enable at 100% duty cycle) is 375mA.

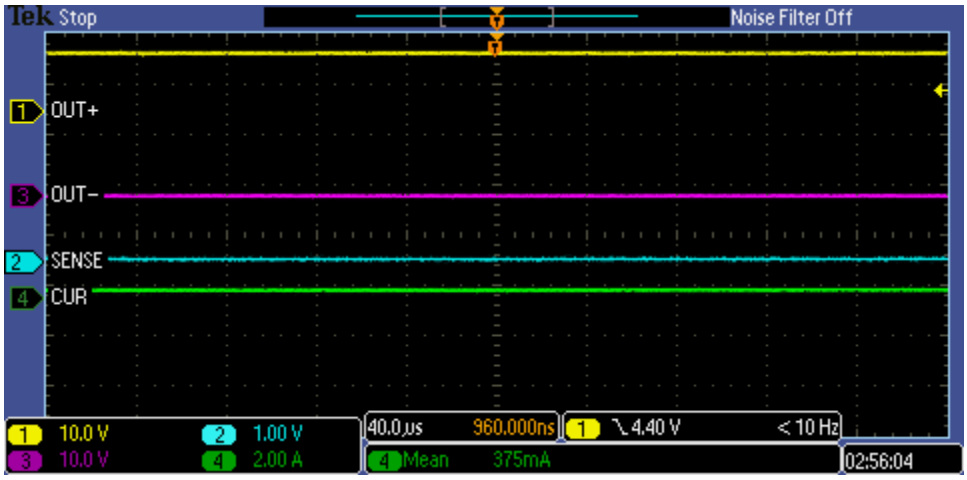

Figure 3: Scope image of motor folding forward in steady state

From the scope shot below, the reverse steady state DC current (with enable at 100% duty cycle) is -211mA.

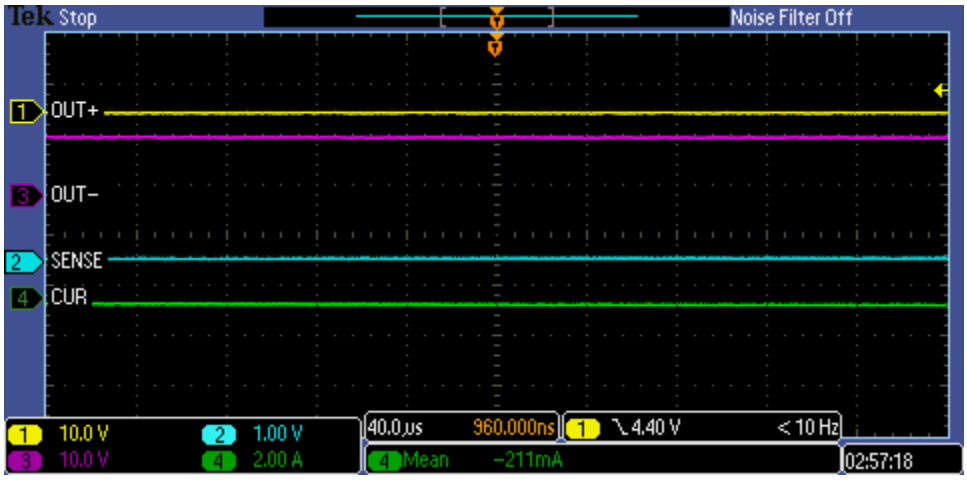

Figure 4: Scope image of motor folding reverse in steady state

Section 3c: Track resistance (near end of track)

Before the motor stall, the motor encounters mechanical resistance along the track. This is dependent upon the housing and mechanical surroundings of the motor. In the scope shot below, the green curved pulses represent the track resistance. Below is the scope shot for the forward direction.

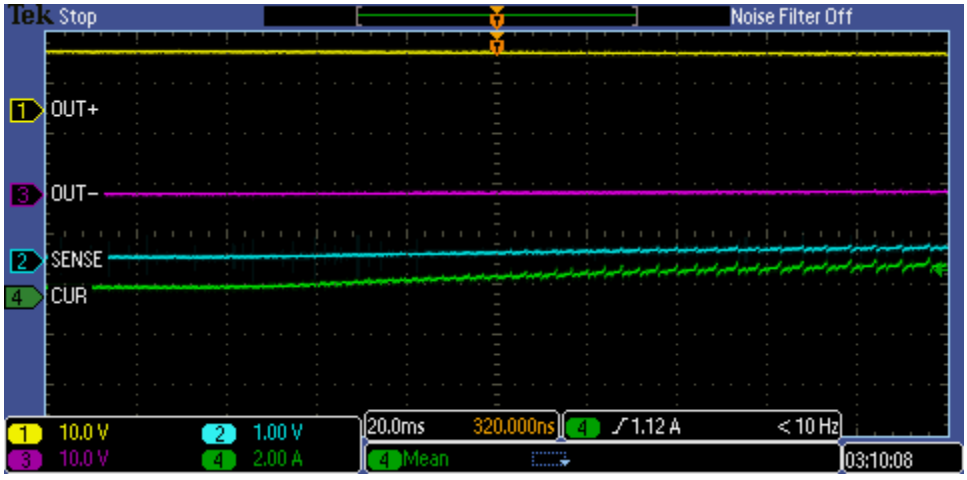

Figure 5: Scope image of track resistance (green) for forward direction

Note the track resistance in the reverse movement in the screenshot below. Based on the steepness of the green signal, the motor hits more resistance quicker than in the forward direction.

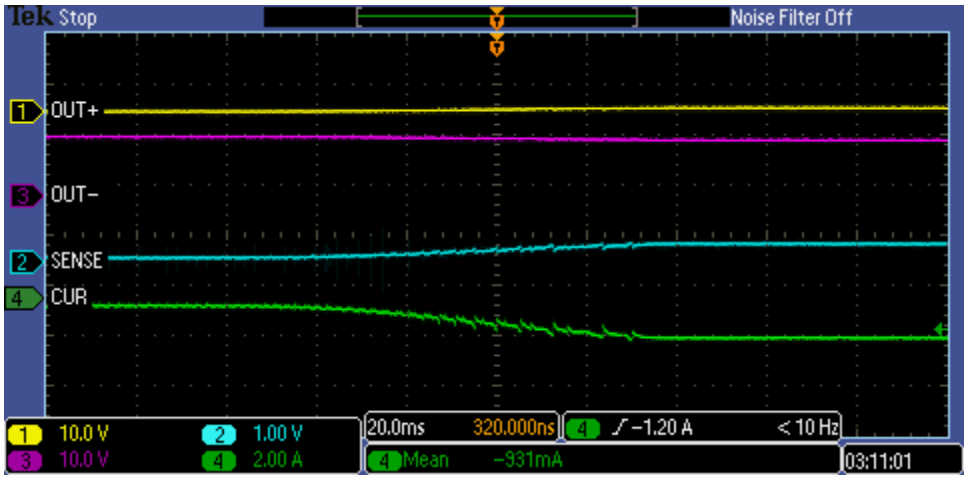

Figure 6: Scope image of track resistance (green) for reverse direction

Section 3d: Stall

When the motor reaches the end of the track, the motor continues to move forward and eventually stalls when a fault or overcurrent detection is tripped (depending on the motor driver). Sometime after this motor stalls, the current drops. Below are scope shot images of the motor stall behavior.

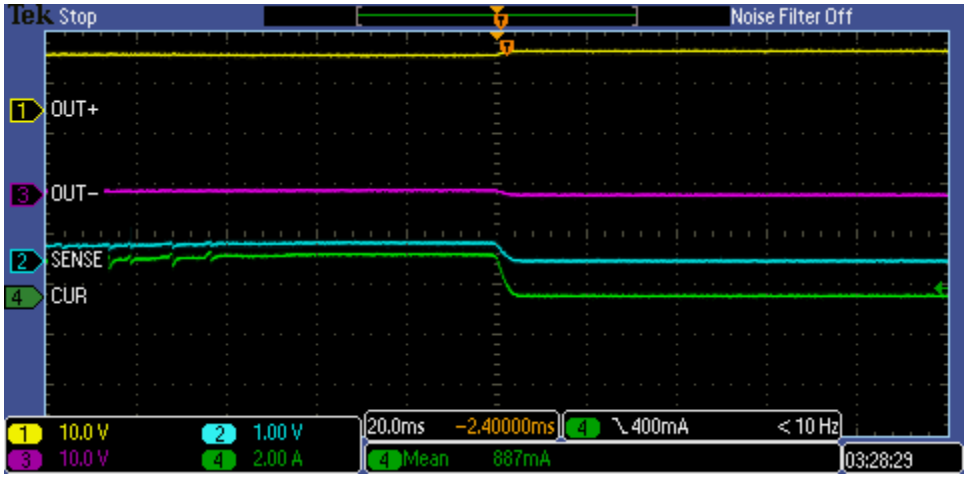

Figure 7: Scope image of forward direction motor stalling

Figure 8: Zoomed-in scope image of forward direction motor stalling

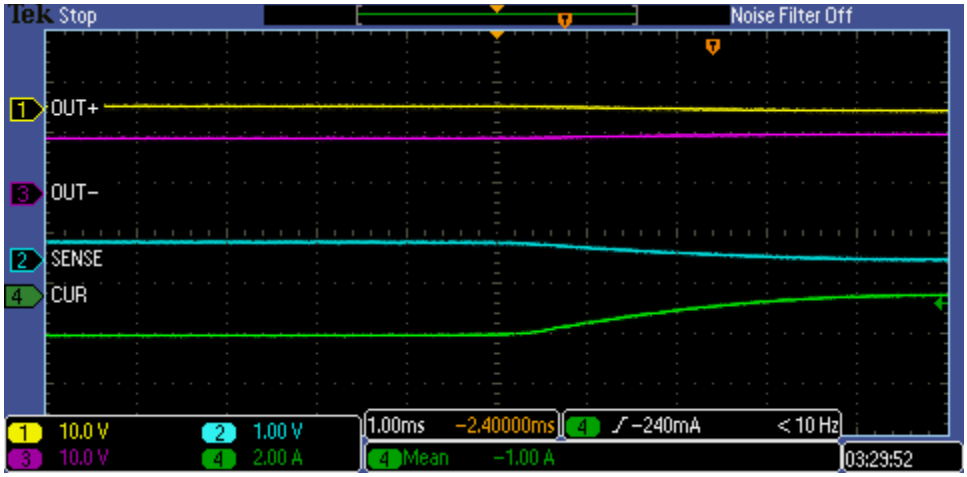

Figure 9: Scope image of reverse direction motor stalling

Section 4: Thermal Image of Device Under Test

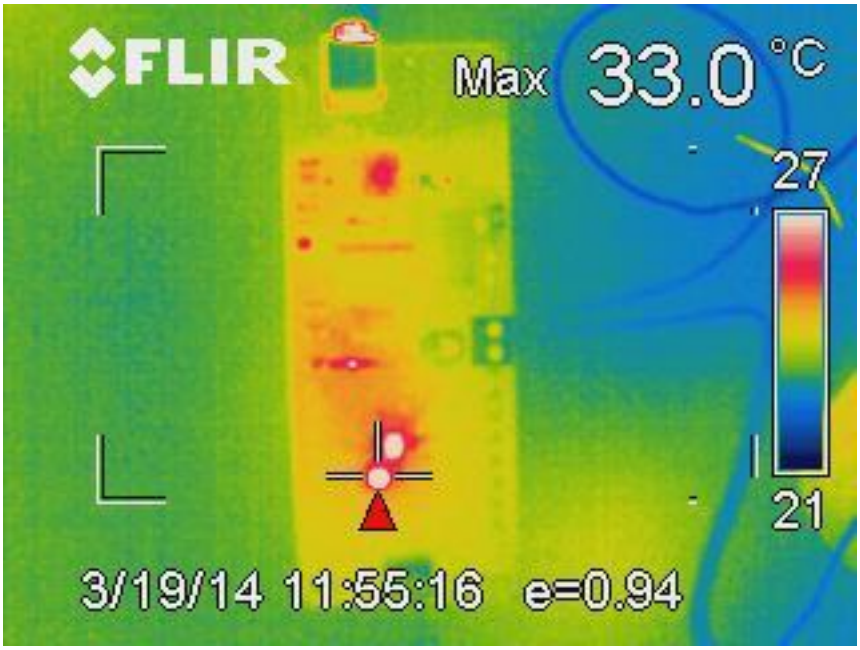

Image 3: Thermal image of DRV8801EVM after 10 minutes of repeated opening/closing of mirror

The above thermal image was taken with a FLIR thermal camera. The power folding side mirror was repeatedly opened and closed for 10 minutes before the thermal image was taken. The figure above shows most of the heat (red) dissipated through the DRV8801 and corresponding sense resistor.

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