Abstract

This test report describes the results obtained from procedures undertaken to test the TIDA-00296/SAT0103 reference design, “BCM Load Driver”.

Contents

The following sections are included in this report:

A. Load configuration

The load configuration used for the testing described in this report follows – loads were selected according to power requirements and subject to availability.

- TPS92630 – LED driver, 3 channels
    1. 30mA rated white LED (PCB mounted)
    2. 30mA rated white LED (PCB mounted)
    3. 30mA rated white LED (PCB mounted)
- TPL7407L – Low-side driver, 5 outputs
    1. Eiko 194 glovebox/taillight lamp
    2. Eiko 194 glovebox/taillight lamp
- LMD18400 – High-side driver, 4 outputs
    1. Automotive relay – power window actuator
    2. Automotive relay – power window actuator
    3. Automotive relay – windshield wiper actuator
    4. Automotive relay – windshield wiper actuator
- LM9061 – Pre-FET driver, 1 output
    1. Seat heater
- High-side driver, 1 output
    1. Automotive relay – HVAC blower
- TPIC44H01 – Pre-FET driver, 4 outputs
    1. Seat heater*
- High-side/low-side driver, 4 outputs
    1. Automotive relay – Door lock actuator

* Note the seat heater loads are direct driven, thus the heating element is powered directly from system input battery power. Due to the high current requirement of a seat heater at 12V, only one seat heater was used for overall system testing, driven by the LM9061.

B. Start-up and shut-down power sequence

The system power rails are shown during start up in Figure 1. The 12V plot is a direct battery connection, before system protection and step down is applied.

The 5V and 3.3V plots are taken from jumpers around the board and thus may be subject to negligible voltage drops from the power supply outputs. The system is fully loaded during these tests.

Figure 2 shows the shut-down power sequence when system input power is cut. The 3.3V rail shows a slow decay to steady state at 0V, which occurs off plot.

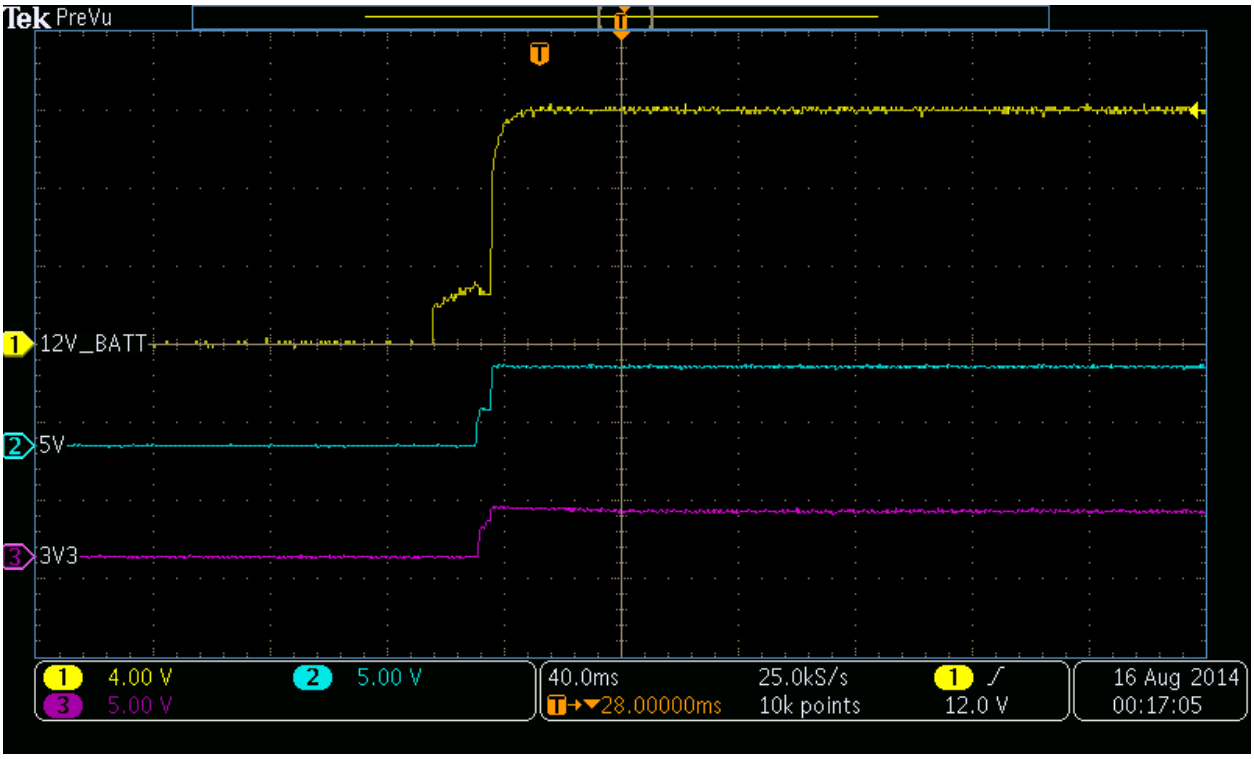

Figure 1 - Start-up sequence

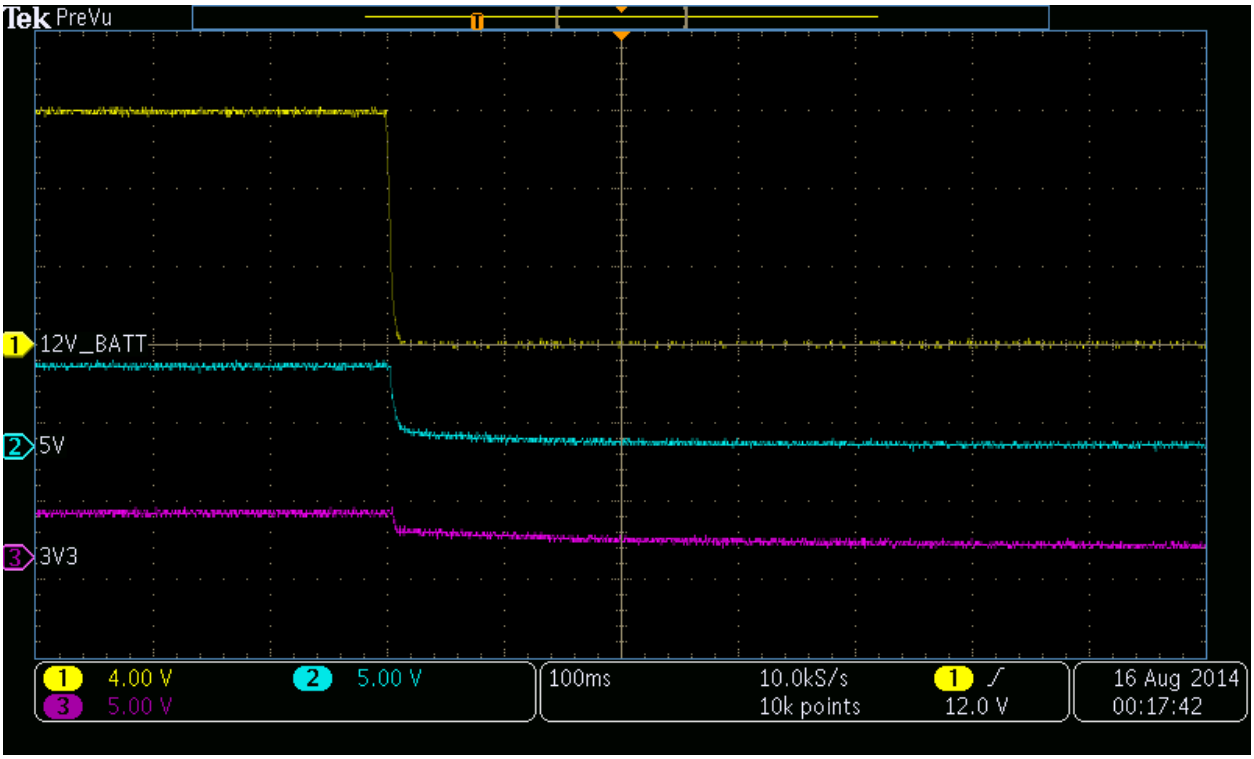

Figure 2 – Shut-down sequence

C. System current consumption

The current was tested at 11.5V, with the load drivers switching on/off to an approximate 50% duty cycle/1s period square wave, and with all illumination drivers remaining constantly on (TPL7407L and TPS92630).

It is seen from the Figure 3 waveform that the “off” state current consumption is approximately 500mA; this is due to the lamps (2*250mA) and LEDs remaining on during the drive duty cycle, and the load devices not engaging ‘sleep’ mode (if available) when the loads are switched off.

The maximum initial current draw for these conditions is approximately 4A at 11.5V, 5.8A at 18V and 6.6A at 20V.

The staggering before and after transitions seen in the waveform is due to the two door lock relays, driven by the high-side/low-side driver, receiving the I^2C transmission (and with it an associated clocking delay for transmission time) before the rest of the system is switched.

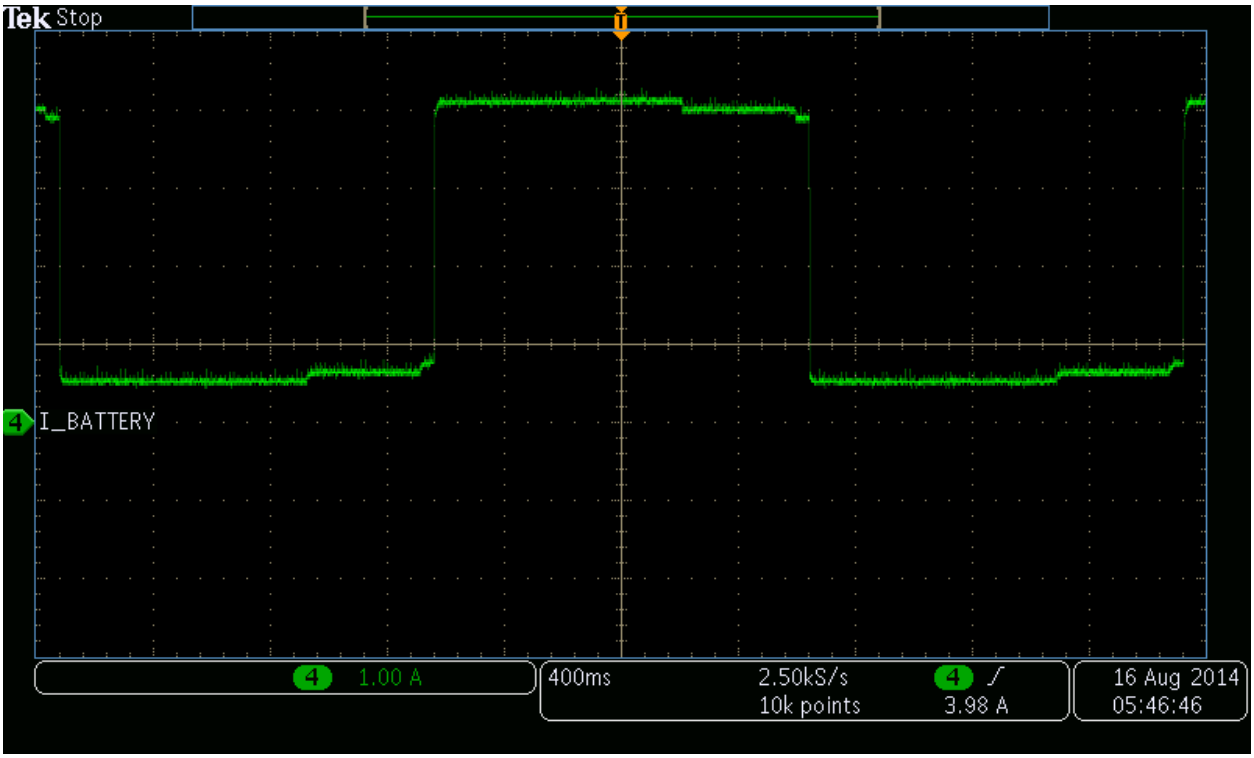

Figure 3 – System current consumption

D. TPL7407L drive test

The TPL7407L was driven on an approximate 1s period/50% duty cycle input, with the output plotted against the system power and shown in Figure 4. Note that this test was conducted on output channel 1; all other channels perform identical to this plot.

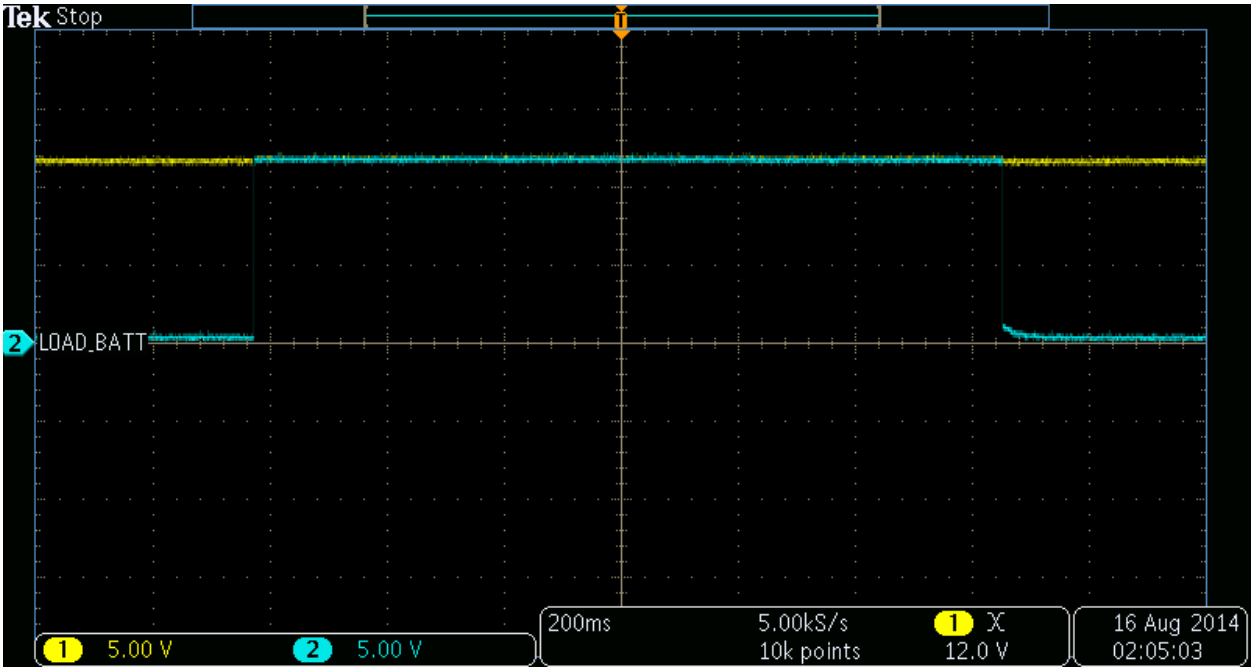

Figure 4 – TPL7407L drive test

E. LMD18400 drive test

The LMD18400 was driven on an approximate 1s period/50% duty cycle input, with the output plotted against the system power and shown in Figure 5. Note that this test was conducted on output channel 4; all other channels perform identical to this plot.

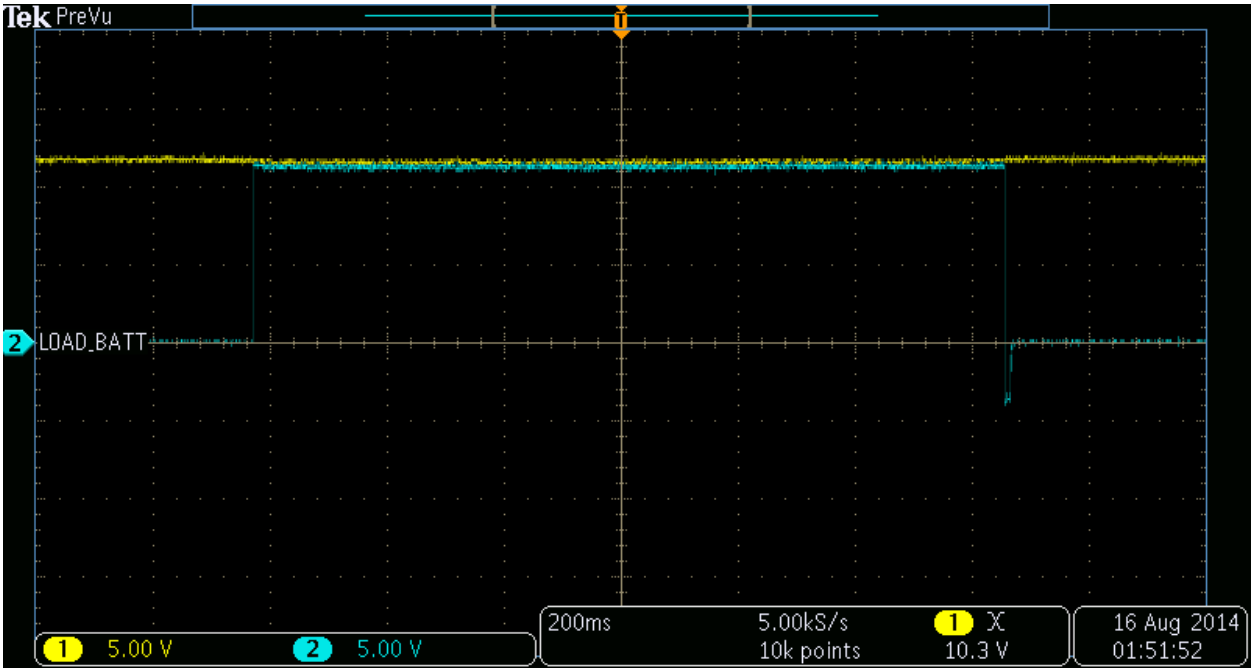

Figure 5 – LMD18400 drive test

F. LM9061 drive test

The LM9061 was driven on an approximate 1s period/50% duty cycle input, with the output plotted against the system power and shown in Figure 6.

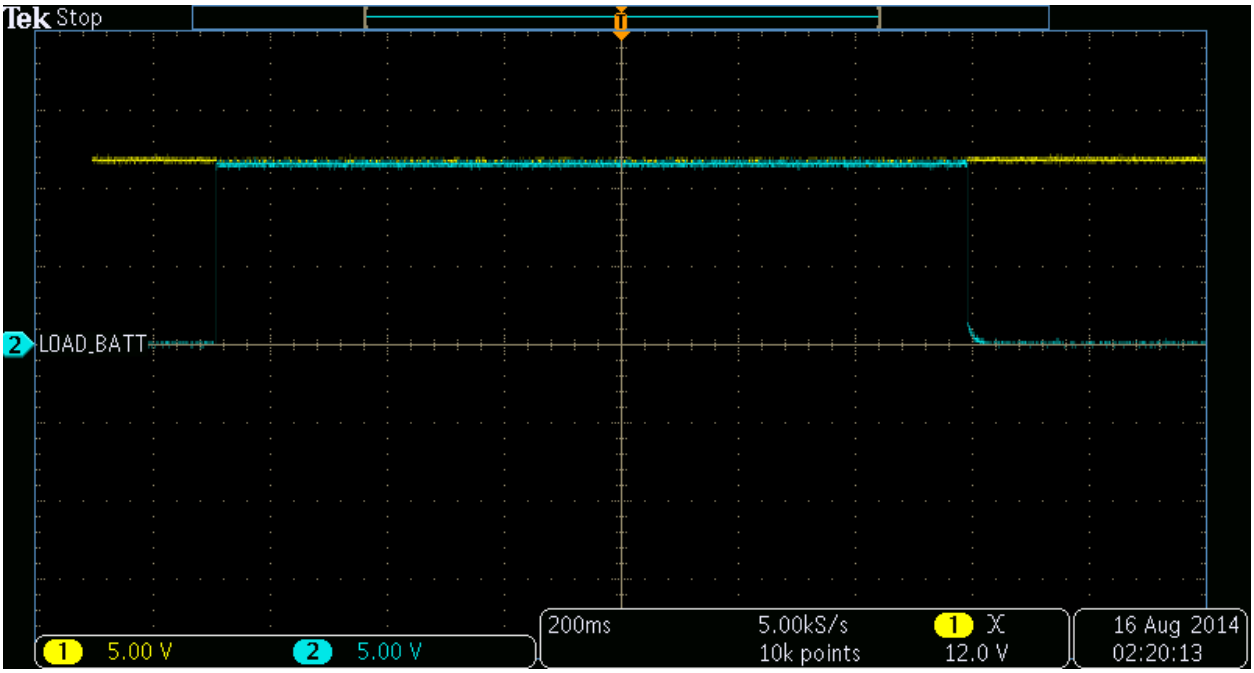

Figure 6 – LM9061 drive test

G. High side drive test

The device was driven on an approximate 1s period/50% duty cycle input, with the output plotted against the system power and shown in Figure 7.

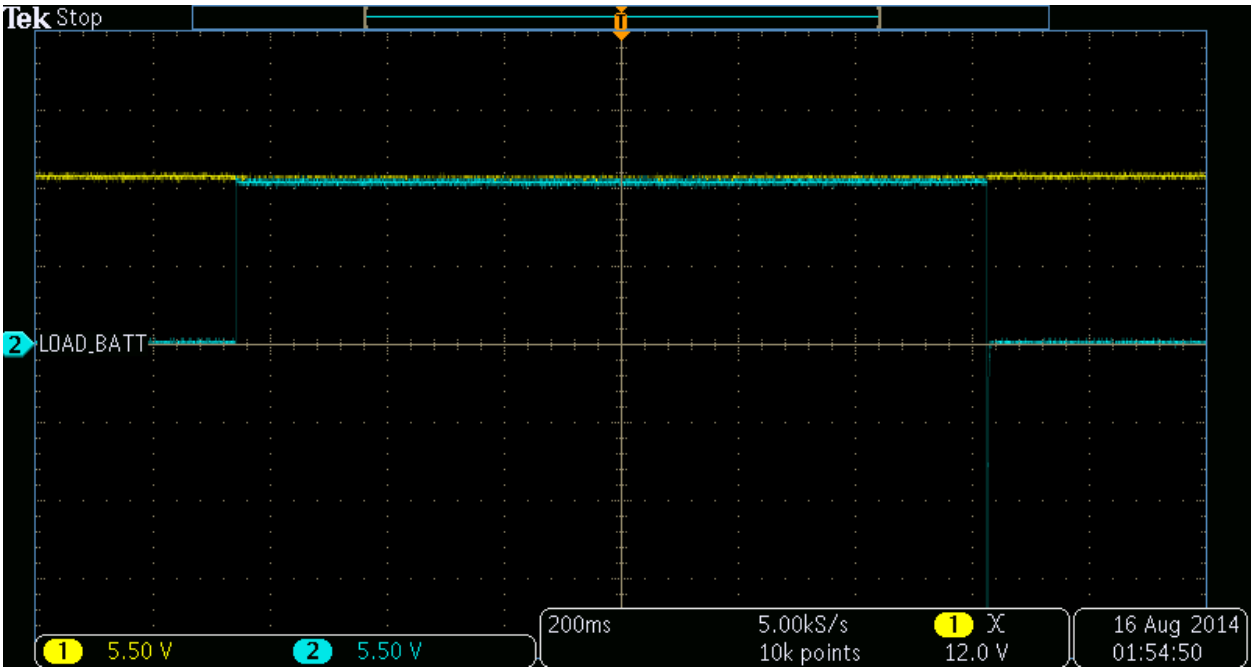

Figure 7 – High side drive test

H. TPIC44H01 drive test

The TPIC44H01 was driven on an approximate 1s period/50% duty cycle input, with the output plotted against the system power and shown in Figure 8. Note that this test was conducted on the first FET output; all other channels perform identical to this plot.

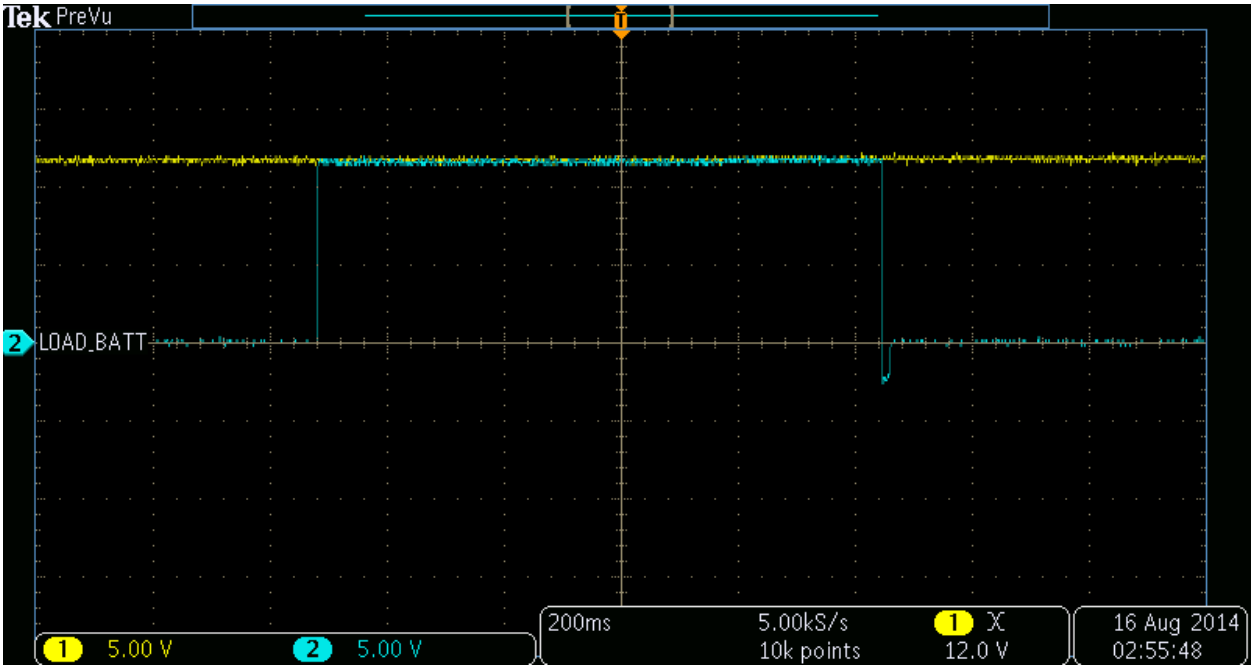

Figure 8 – TPIC44H01 drive test

I. High side/low side drive test

The device was driven on an approximate 1s period/50% duty cycle input, with both high-side and low-side outputs plotted respectively against the system power and shown in Figure 9 and 10 respectively. Note that this test was doncuted on the first channel of both high and low sides; all other channels perform identical to this plot.

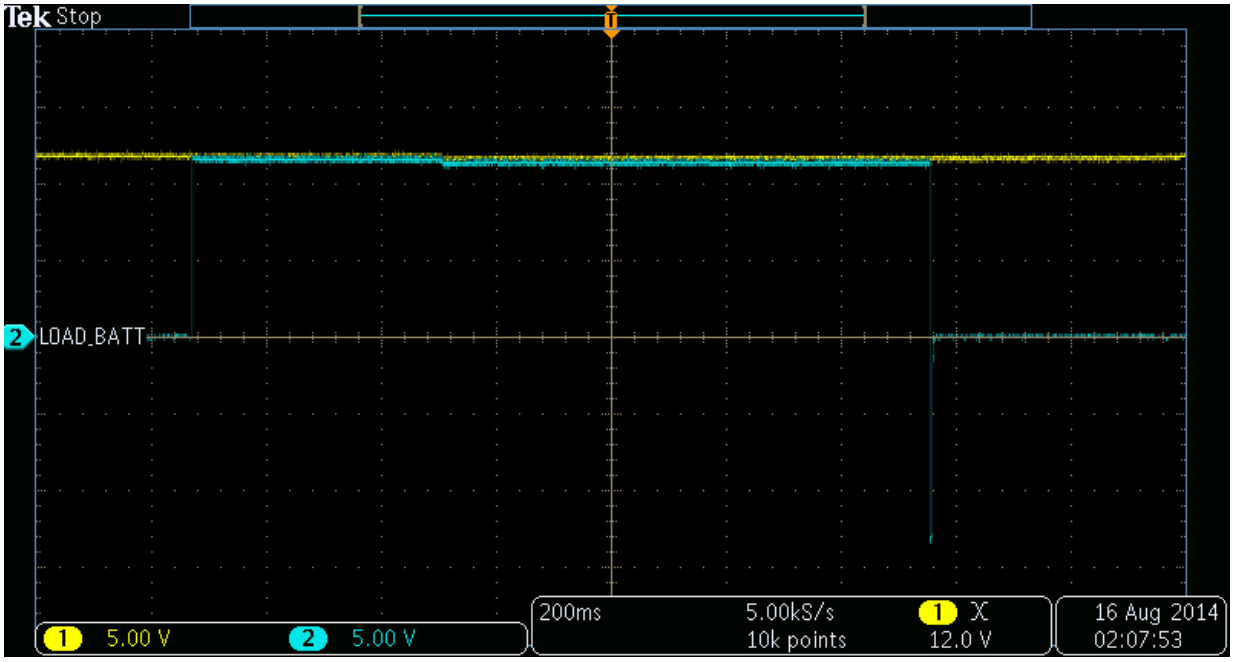

Figure 9 –High-side drive test

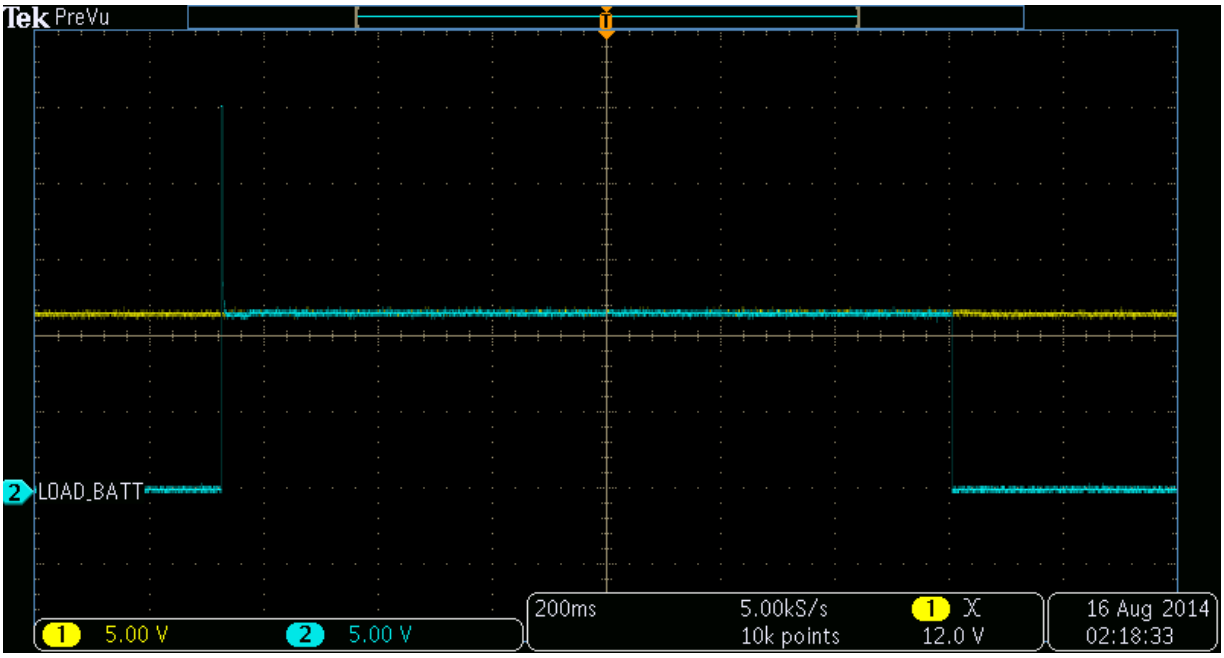

Figure 10 –Low-side drive test

J. Thermal Imaging

Thermal images of the reference design are seen in Figures 11 and 12. Images were captured at regular 12V operation and maximum stress 20V operation.

Note at 20V, the seat heater load draws just enough current to trigger the designed LM9061 over-current protection threshold of 5.5A, disabling the load until the seat heater cools down enough to draw lesser current momentarily.

Figure 11 – PCB thermal image @ 12V

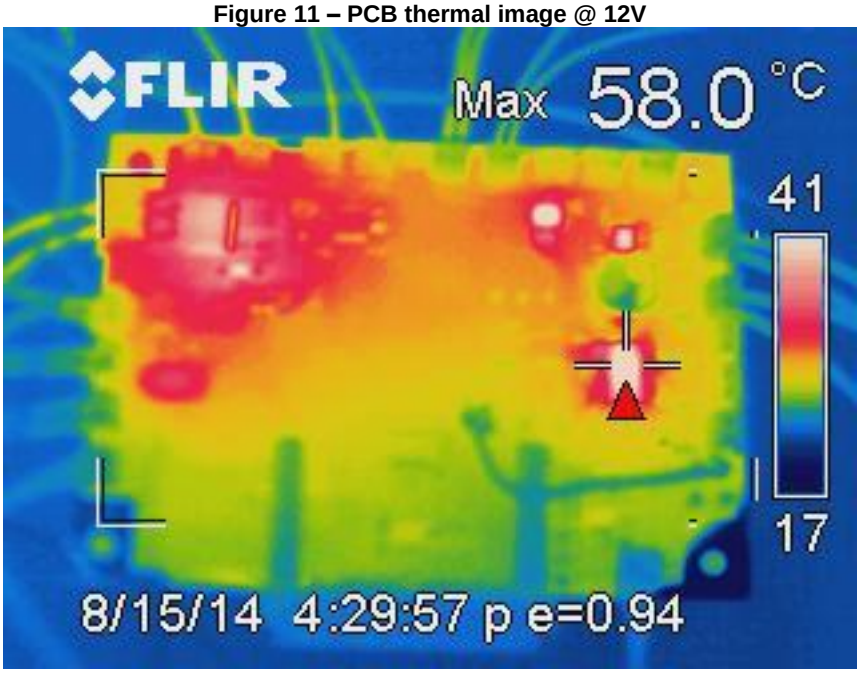

Figure 12 – PCB thermal image @ 20V

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

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