TIDA-00356: Automotive Door Switch Test Data

Abstract

The following report details the procedures and results for testing the TIDA-00356/SAT0099 reference design, “BLE Door Switch”.

Contents

The following sections are included in this report:

A. Operation Modes

TIDA-00356 demonstrates two modes of operation – 12VDC supply for car battery demonstration and 3V Li-Ion for handheld demonstration. Supplies are selectable via jumper J2. Switch backlight LEDs are only operational from the 12V supply, and can be disabled via software or jumper J3.

B. Typical current consumption with 3V battery

Figure 1 contains voltage level of the system supplied by a CR123A 3V Li-Ion battery (Measured from J2.2 to GND) and typical system current consumption. Figure 2 demonstrates the system current variation during a BLE connection event with 3V source.

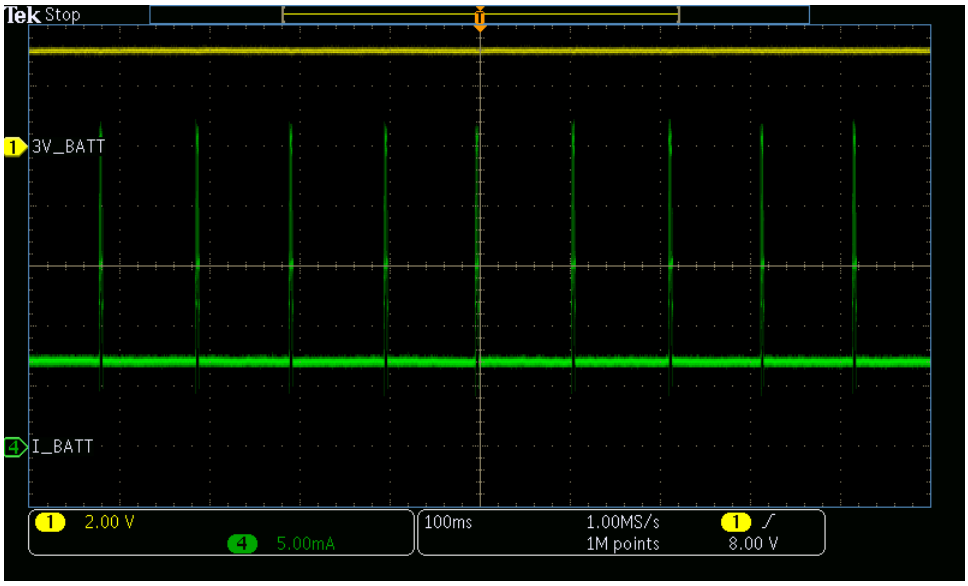

Figure 1: Current consumption with 3V Supply

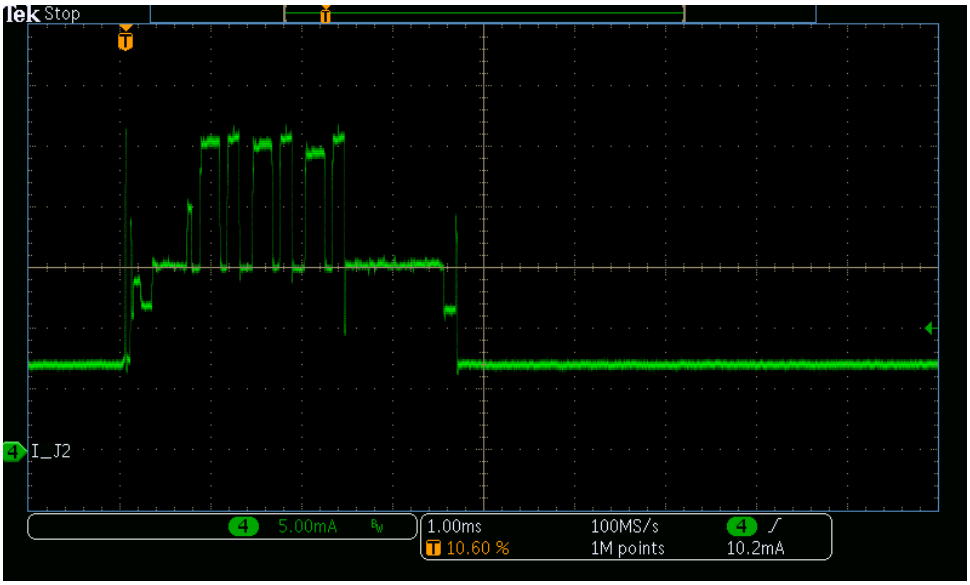

Figure 2: SimpleBLEPeripheral – Current in J2 from connection event with 3V supply

C. Reverse Polarity Protection – 3V Battery

For reverse polarity testing shown in Figure 3, voltage is measured across the battery terminals while current is monitored via an inductive clamp.

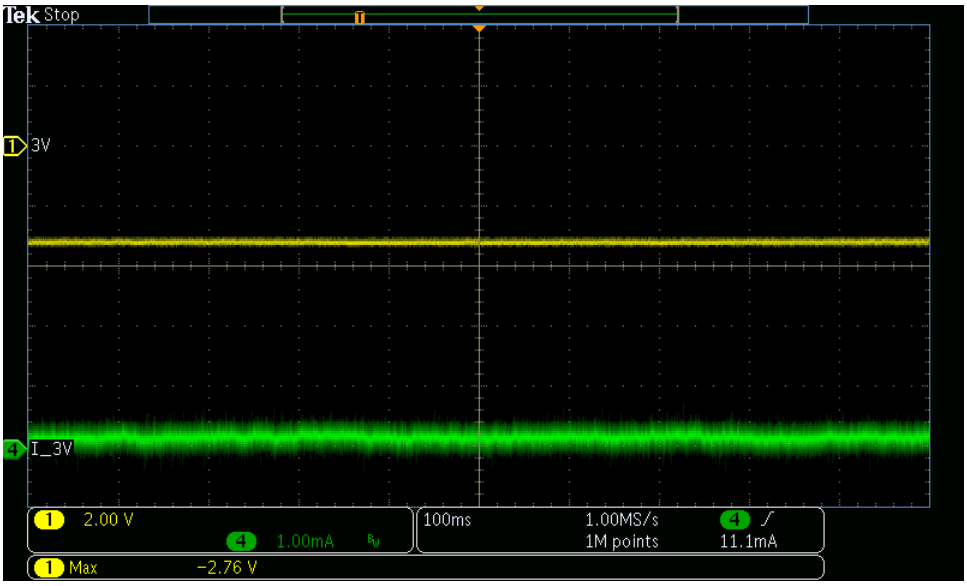

Figure 3: Reverse polarity current on BT1 (3V)

D. Dual Supply Protection

To prevent shorting between the 3V LDO output and the Li-Ion battery, the system is designed with a switched DC jack to disconnect the battery when a 12V plug is present. Figure 4 demonstrates this behavior with a battery present while a DC plug is inserted. Traces labeled 12V, 3V LDO, and 3V_Batt represent voltage measurements on pin 1 of the DC jack (J1), pin 3 of the power jumper (J2), and pin 2 of J2 respectively.

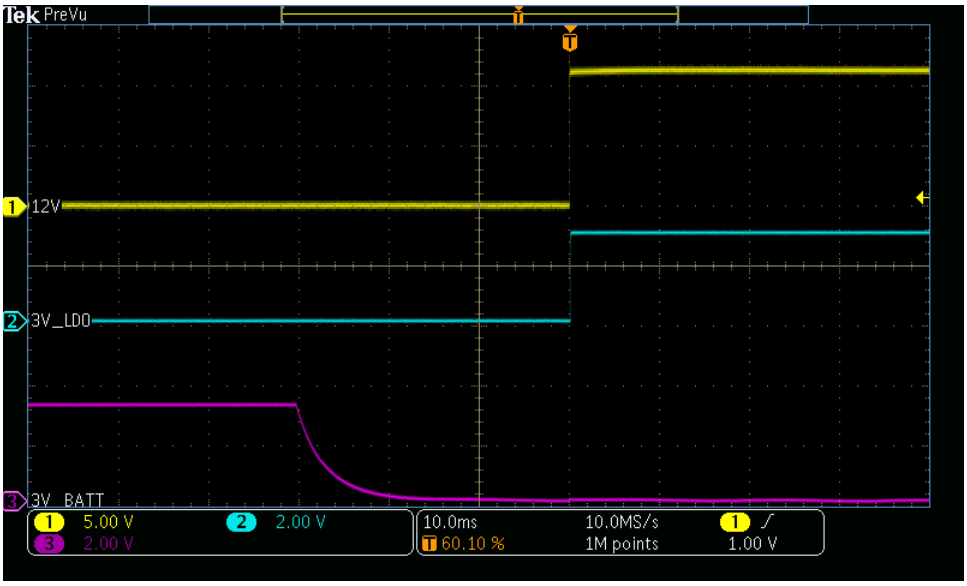

Figure 4: Single Supply Operation

E. 12V Startup Sequence

Figure 5 demonstrates light load startup on the LDO when the LED driver is disabled.

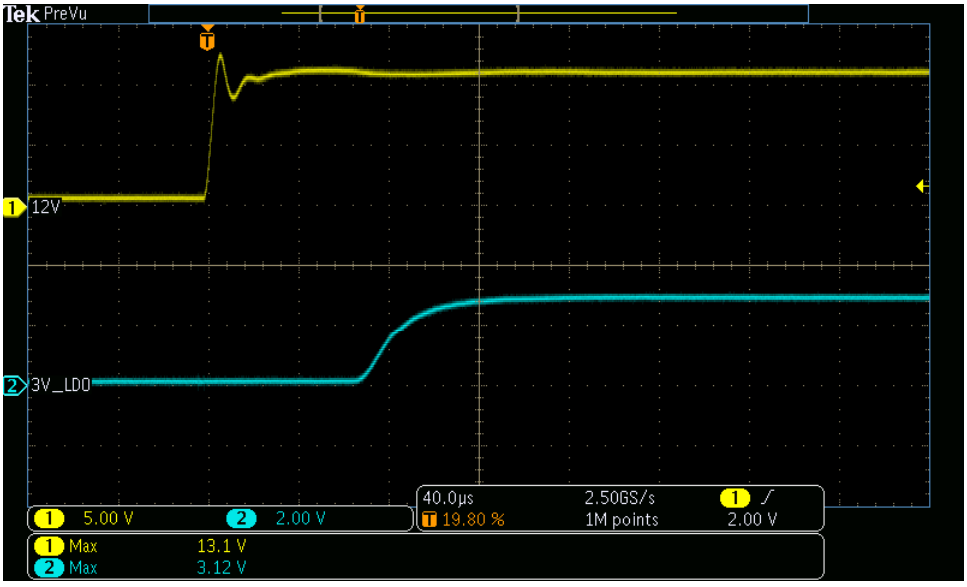

Figure 5: LDO Startup with LED Driver Disabled

Figure 6 demonstrates heavy load startup on the LDO when the LED driver is set to maximum output current (limited to 20mA per channel).

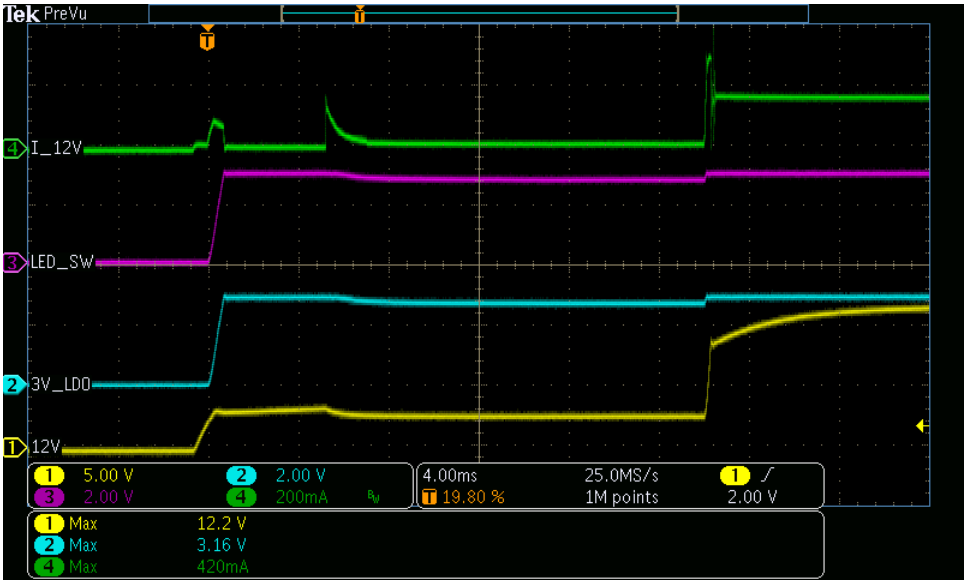

Figure 6: LDO Startup with 100% PWM on LED Driver

F. 12V Supply Operation

Figure 7 contains voltage level of the system supplied by a 12V supply (Measured from J1.1 to GND) and typical system current consumption. Figure 8 demonstrates the system current variation during a BLE connection event with 12V source.

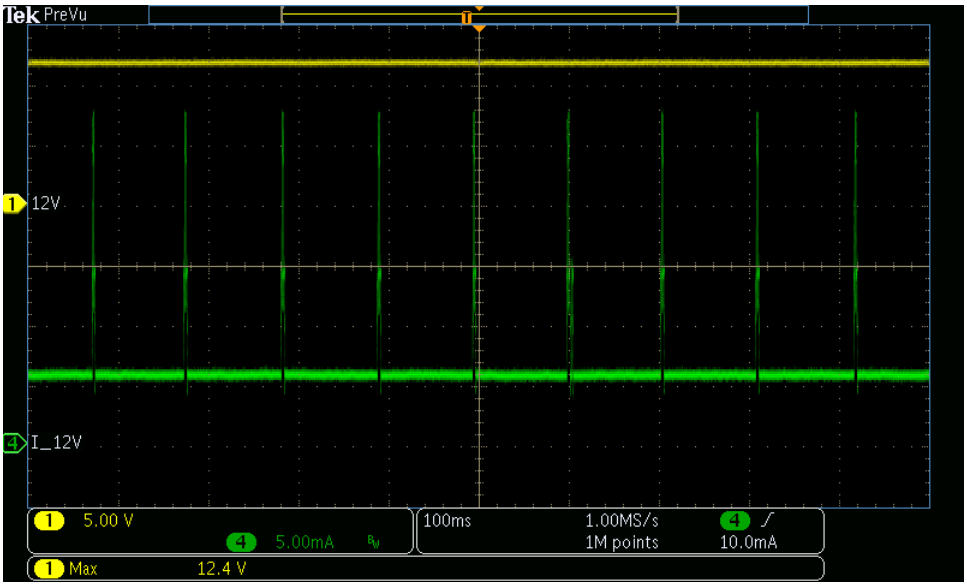

Figure 7: Typical Current Consumption from 12V Supply - LED Driver Disabled

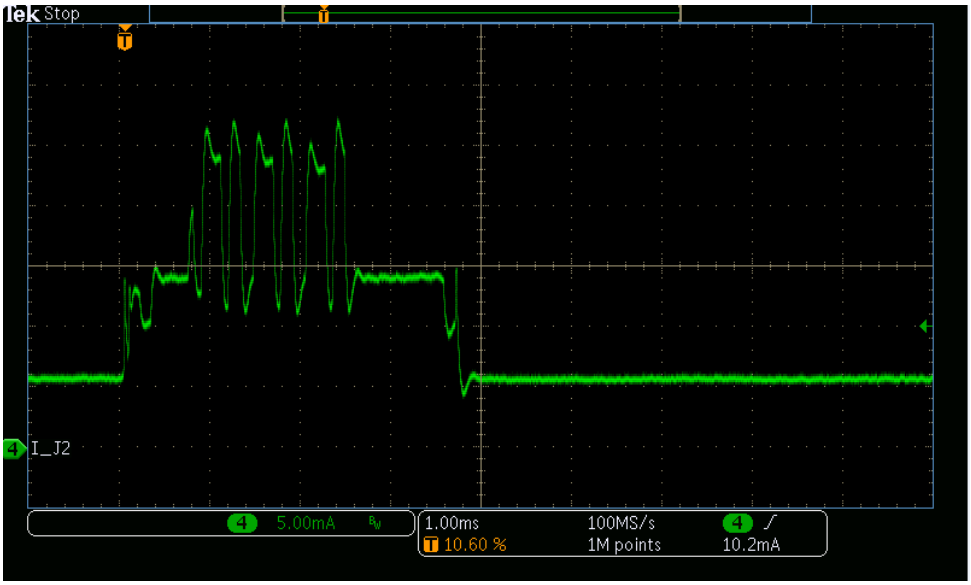

Figure 8: Current Consumption from BLE Connection Event with 12V Supply

G. Reverse Polarity Protection – 12V Supply

For reverse polarity testing shown in Figure 9, voltage is measured across the pins J1.1 and J1.2 while current is monitored via an inductive clamp.

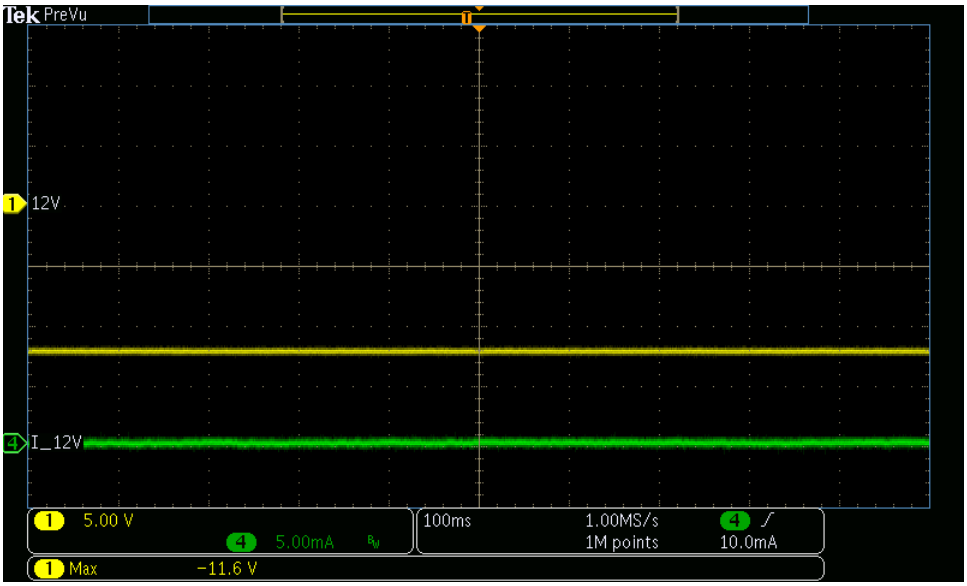

Figure 9: Reverse polarity current on J1 (12V)

H. GPIO Switch Waveforms

Figure 10 demonstrates the rising edge of from a tactile switch, with debounce capacitors to prevent multiple interrupts per user input.

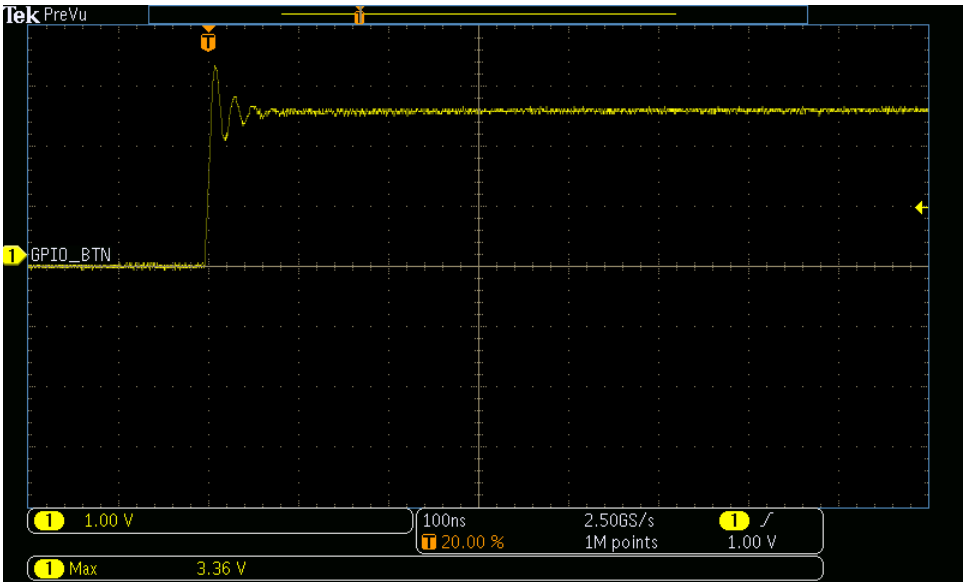

Figure 10: Ripple on GPIO Input

Figure 12 demonstrates the current consumption of the CC2541 after an interrupt is triggered. Two packets are evident in the current trace – first the interrupt routine followed by the periodic connection event.

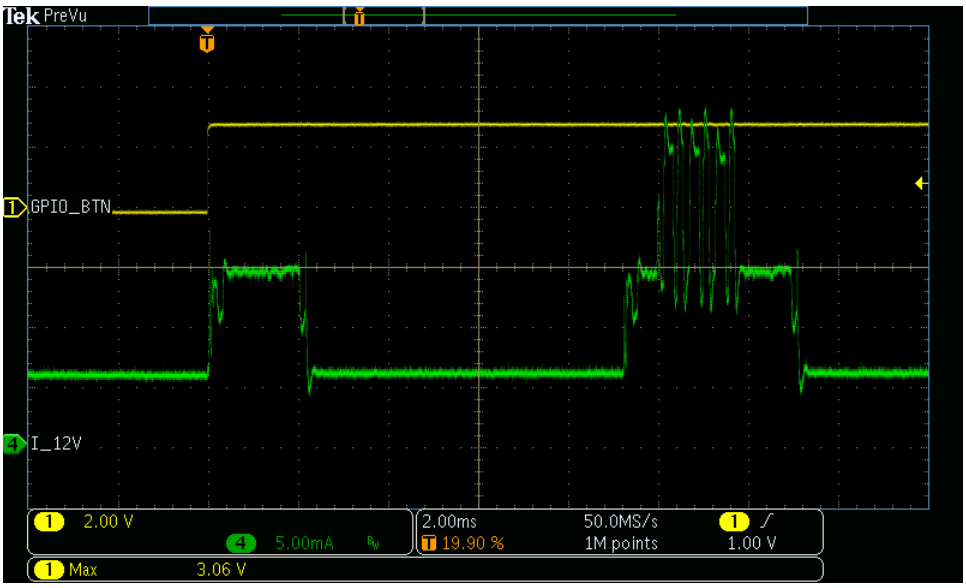

Figure 11: System response to interrupt

I. Thermal Imaging

Thermal images of the reference design are shown in figure blah. For thermal testing, the LED driver continuously operated at 100% PWM demonstrating full output power (limited to 20mA per channel, 160mA total).

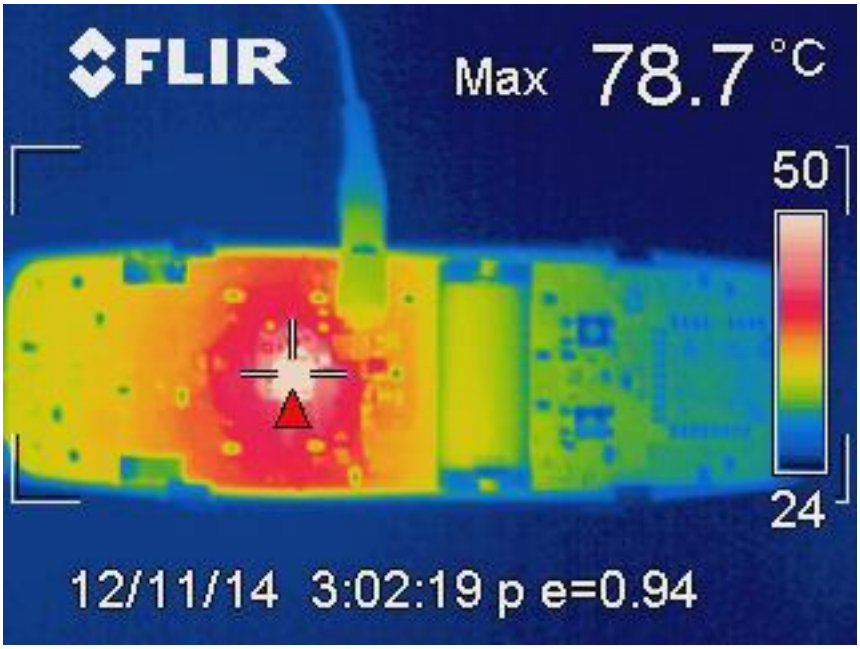

Figure 12: Thermal Capture with LED Driver Maximum Output Current

J. Switch Tests

Simple continuity checking and alignment, designed to fit within Dodge Door Switch Panel.

Pin	Name	Switch Functionality	Housing Alignment with Mopar Door Switch
P0_0	MIRROR_RIGHT	GOOD	GOOD
P0_1	MIRROR_LEFT	GOOD	GOOD
P0_2	RIGHT_SEL	GOOD	GOOD
P0_3	MIRROR_UP	GOOD	GOOD
P0_4	MIRROR_DOWN	GOOD	GOOD
P0_5	W1_UP	GOOD	GOOD
P0_6	W1_DOWN	GOOD	GOOD
P0_7	W2_UP	GOOD	GOOD
P1_0	LEFT_SEL	GOOD	GOOD
P1_1	W2_DOWN	GOOD	GOOD
P1_2	W3_UP	GOOD	BAD

P1_3	W3_DOWN	GOOD	BAD
P1_4	W4_UP	GOOD	BAD
P1_5	W4_DOWN	GOOD	BAD
P1_6	W_LOCK_HEAT	GOOD	BAD
P1_7	DOOR_UNLOCK	GOOD	GOOD
P2_0	DOOR_LOCK	GOOD	GOOD
P2_1	MORROR_FOLD	GOOD	GOOD
P2_2	PAIR_SW	GOOD	GOOD
P2_3			
P2_4			

K. ESD Testing

Each GPIO pin connected to a TPD4E001 or TPD2E001 channel passed ESD testing up to Level 4 contact discharge, withstanding 10 pulses 1 second apart at +8kV and -8kV.

L. System Summary:

Test			**Results**
DC Plug Voltage			11.77V
LDO Output Voltage			2.949V
LDO Status			GOOD
Battery Voltage			3.29
Battery no load current			<1mA
Battery no load reverse current			<1mA
Battery-to-GND resistance normal polarity			.5Ω
Battery-to-GND resistance reverse polarity			>600kΩ
Battery-to-GND resistance with DC plug present			>600kΩ
12V Reverse Polarity Protection			GOOD
3V Reverse Polarity Protection			GOOD
LED Driver Status			GOOD
BLE Module Status			GOOD
ESD Protection			GOOD

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