Distribution Board testing log

10/7/2017 – Sean Poulter – Goal is to get a distribution switch to turn on and off. Independently confirm a .4 Amp power draw somewhere. And determine if removing the MSP is necessary.

Some initial off state tests

* Resistance between PPT\_EN and ground: 101KΩ
  + Matches expected value of pull down resistor on enable pin.

Setup:

* Arksen 3010D power supply serves as battery input, set at 6.6V and limited to .6 Amps
* Korad KA3005D power supply serves as 3.3v enable logic, limited to .6A
* Oscilisocpe on PPT switch output.

On initial hookup:

* After attaching the power supply to the battery input, WITHOUT connecting the 3.3v enable signal, the oscilloscope reads a 2 volt signal which, whether disconnected or not, decays after a very long time. ex: after about 20 seconds the output is still at .2 volts.
* Leaving the input power supply connected draws .5 amps from the Input, but triggers CC Protection so it could be drawing more. Voltage reading on the power supply goes to 0-.1V
* The MSP gets moderately warm.

Connecting 3v3 power supply WITHOUT the battery input power supply.

* ~~The 3v3 power supply also draws .5 amps at CC. through the enable pin.~~
* ~~After waiting some time and trying again, connecting the 3v3 to the enable pin does not short. Instead it just draws .015Amps, which would probably be the pull down resistor + LED.~~
* The PPT enable pin never caused the 3v3 power supply to short, as the above statement claims. Instead the ADCS2 Pin was causing the 3v3 to short. IT does this consistently regardless of giving it time.

Checking all 3v3 enable pins for similar behavior

* PPT\_EN: .011A
* 5v\_EN: .004A
* 3.3v enable: 0.6A(short)
* ESITMAT\_EN: 0.6A(Short)
* RAHS\_EN: 0.6A(Short)
* ADCS2\_EN: 0.6A(Short)
* COM2\_EN: 0.6A(Short)
* COM1\_EN: 0.6A(short)
* BOOT\_EN: 0.6A(short)
* 5VBUCK\_EN: .6A(Short)
* 3VBUCK\_EN: .6A(Short)

Because both the Power input and the enable pins short, it leads me to believe that there is a problem with the board not the msp, because the power input doesn’t go to the msp.

Testing resistance to ground of all the enable pins + power input:

* Power input: 3.3 MΩ
* PPT\_EN: 406Ω Note: this has reduced from 100k since the beginning of these tests, this was not one of the enable pins shorting, but it’s power input did go through the power input short.
* 5v\_EN: 100 kΩ Note: this pin did not short and is still the correct resistance. (it’s output was not monitored with the oscilloscope like the PPT was.
* 3.3v enable: 100 kΩ
* ESITMAT\_EN: 100 kΩ
* RAHS\_EN: 100kΩ
* ADCS2\_EN: 99kΩ
* COM2\_EN: 100k
* COM1\_EN: 100k
* BOOT\_EN: 100k
* 5VBUCK\_EN: 7MΩ and rising to 30MΩ when being measured….. Capacitor in path?
* 3VBUCK\_EN: same^ ….There are no pull down resistors on these lines. Capacitance might be buck converter’s, don’t worry about this.

All these pins exhibit shorts when in operation, but the correct resistance when not in operation. This leads me to believe that it might not actually be a board copper problem. Therefore I will remove the MSP to see if anything changes.

Notes about MSP removal:

* Removal was clean and easy with heat gun.
* There were no obvious shorted pads.
* Only pin #1 was slightly bent.

Notes about unpowered board after MSP removal.

* The PPT\_EN pin that dropped to 400Ω to ground is back up to 100kΩ. All other resistances are correct.
* Power input to ground resistance still 3.3MΩ

Enable pin behavior before powering the Battery rail:

* PPT\_EN: .003A
* 5v\_EN: .003A
* 3.3v enable: 0.003A
* ESITMAT\_EN: 0.003A
* RAHS\_EN: 0.003A
* ADCS2\_EN: 0.003A
* COM2\_EN: 0.003A
* COM1\_EN: 0.003A
* BOOT\_EN: 0.003A
* 5VBUCK\_EN: 0A
* 3VBUCK\_EN: 0A

The behavior of the enable pins without the MSP is obviously much better. It looks like the MSP GPIO Pins where the ones sinking the current.

Powering the battery rail with enable pins OFF:

* Battery rail is 6.54V
* PPT output is constant 6.08V
* 0A on input power supply.
* Removing the power input causes the output to jump down to about .5v then decay over many minutes.

This is better than with the MSP but still not great. With the MSP, the output would always start high then decay to 0 volts. In this case the output is constant and it does the decay thing if you remove the input. We still need the Output to remain 0V until the enable signal is applied. Additionally there is a .6V drop between the input and output. Even if the enable pin is falsely positive, this is too large of a drop.

MISTAKE: This entire day I have had the battery rail and the PPT output backwards. I have been powering the PPT output with the 6.6v power supply. This mistake explains a number of the problems listed above. The problems with, the Switches being on even when not enabled, and the .6V drop from input to output, where caused by this. There is a mosfet inside the switch IC. Therefore it also has a body diode which would have been allowing current to pass through the switch when powered in reverse, and the body diode would have about a .7V drop across it.

Testing the switches with the Power supply and output corrected, NO Enable.

* Battery rail powered: no voltage on PPT output, no current from power supply.

Testing every switch output:

* PPT: 13.7mV
* 5v: 1.21 mV
* 3v3: 1mV
* Estimat: 13mV after some time. Starts around .3V
* Reaction: 13mV after some time. Starts around .3V
* Mag: 13mV after some time. Starts around .3V
* Com2: 13mV after some time. Starts around .3V
* Com1: 13mV after some time. Starts around .3V
* Boot: 13mV after some time. Starts around .3V

This time all of the switches are closed and reach about 0 volts (actually .013V, probably due to noise) after some time, but the PPT switch reaches 0 volts almost instantaneously. That’s probably due to the “TIMER” pin, Daniel added a resistor in series to the capacitor that sets that pin.

Further investigation into timer pin function and best setting go here:

* Current setup has Rset = 1k Rsense = .002 ohms and Rimon = 42.2k. That puts the current limit at 7.99 amps.
* dV/dt should be found to determine the inrush current through the formula I\_inrush = C\_load \* dv/dt
* Compare the inrush current, the current limit, the timer’s limit, and the how long the inrush current is over the current limit, to see if the timer pin is supposed to be switching off the switch.
* See datasheet section 10.2.2.1.3

Testing PPT switch enable functionality:

* Input voltage: 6.77V
* Output voltage: 6.77V
* Current through enable pin: .003A
* Current through Battery rail Power supply: 0A
* LED Functions correctly.

Testing every switch’s enable:

* PPT: off: 55mv on: 6.78V
* 5v: off: on:
* 3v3: off: on:
* Estimat: off: 65mv on: 300mv
* Reaction: off: 65mv on: 300mv
* Mag: off: 65mv on: 300mv
* Com2: off: 50mv on: 300mv
* Com1: off: 50mv on: 300mv
* Boot: off: off: 50mv on: 300mv

10/26/17 - Sean Poulter - The Goal of today is to demonstrate over current protection and debig the Imon Pin

Setup:

* Generating triangle wave for current with the Rigol Digital load.
* Measure voltage on the IMON pin with an osciliscope

expected values:

*  Equation for Current Limit
* R\_imon = 42.2k R\_set = 1k R\_sense = .002
* Expected I\_lim = 7.99A

Test on PPT switch:

* Load is set to step from 7A to 9A in steps of .1A every second.
* The Switch survives the current, but the over current protection does not trigger.\
* There is never any voltage on the IMON pin.

Because the PPT switch has been manhandled the most, I will check other switches

Test of Comm2 switch:

* Initialy the switch attempts to turn on to 6.6 volts, but only reaches 4 volts before turning off.
* That was because the Timer CAP was still 4nF. I changed the timer cap to 1uF
* Running 7.004A through the comm 2 switch the voltage on the IMON pin is 602mV
* checking what 602 equates to:
* Steps of .1A
* 7 = 600
* 7.1 = 607
* 7.2 = 616
* 7.3 = 627
* 7.4 = 635
* 7.5 = 647
* 7.6 = 659
* 7.7 = 666
* 7.8 = OC triggers

OVER CURRENT TRIGGERED!

|  |  |  |
| --- | --- | --- |
| **Current (A) measured at digital load** | **Voltage at IMON pin** | **Current measured from IMON** |
| 7 | 600 | 7.09631728 |
| 7.1 | 607 | 7.179107649 |
| 7.2 | 616 | 7.285552408 |
| 7.3 | 627 | 7.415651558 |
| 7.4 | 635 | 7.510269122 |
| 7.5 | 647 | 7.652195467 |
| 7.6 | 659 | 7.794121813 |
| 7.7 | 666 | 7.876912181 |
| 7.8 | OC TRIGGERED | #VALUE! |