TI reference design number: PMP9367 Rev A1

Input: 6-40V
Nominal 12V

Output: 5V @ 3.5A

(USB CH 1: 5V @ 1A)

(USB CH 2: 5V @ 2.1A)

DC–DC Converter Test Results

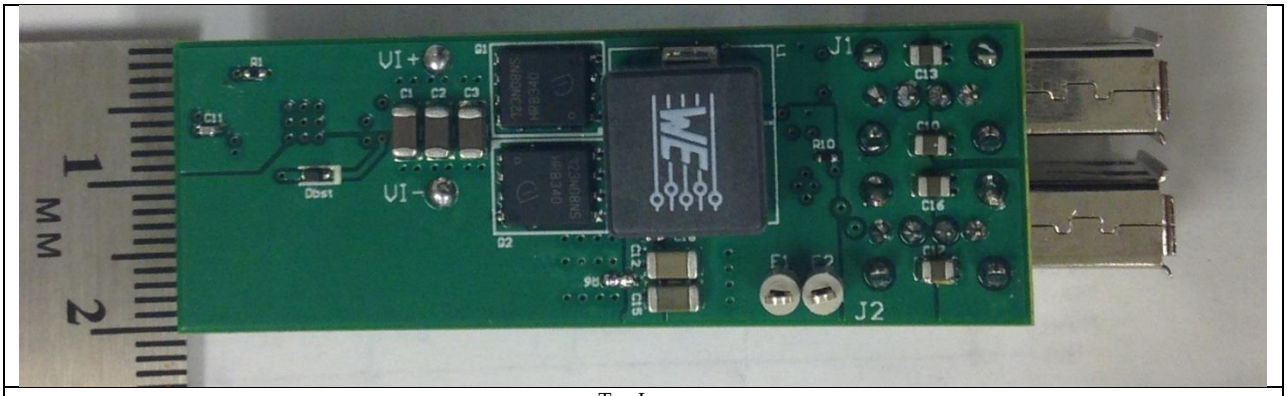
Table of Contents

1. Circuit Description

PMP9367 is a dual USB car charger. This design utilizes the LM3150, TPS2561 Dual Channel Power Switch and a TPS2513 USB Dedicated Charging Port Controller. This design operates from 6 to 40V in. The outputs is set to 5V, channel one has a 1A current limit and channel two has a 2.1A current limit. This design has a switching frequency of 300 kHz.

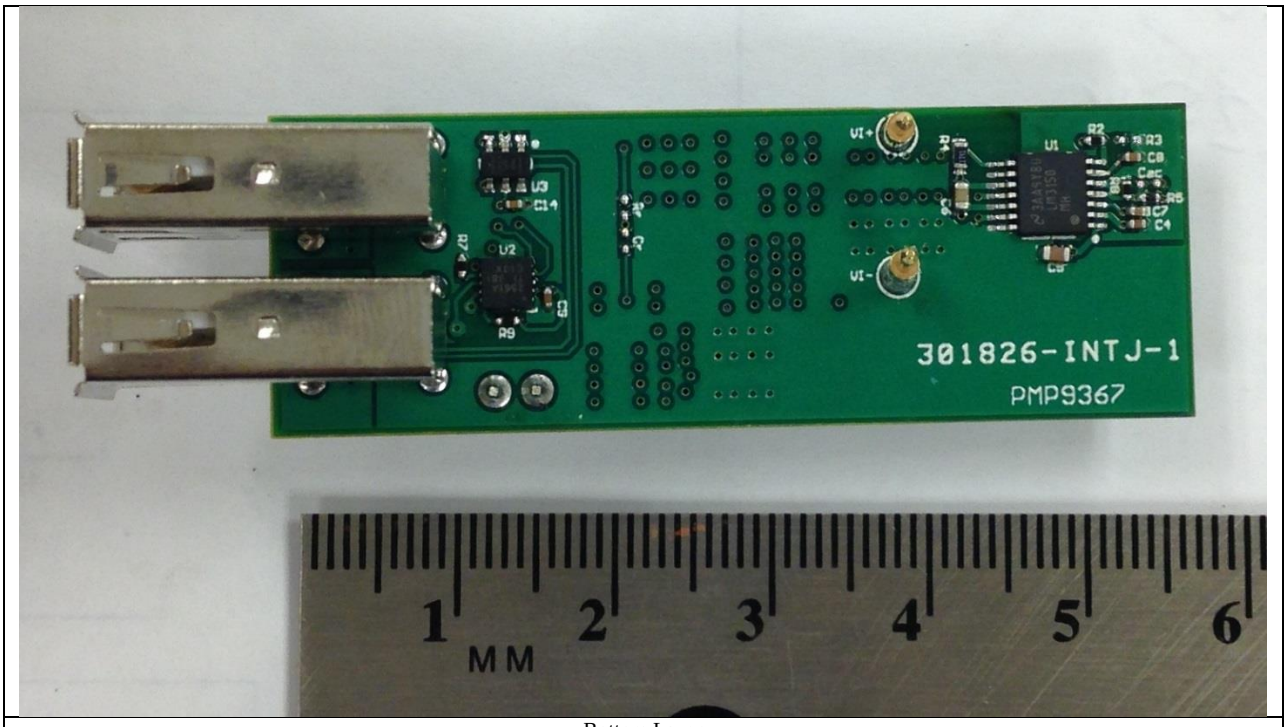
2. Fabrication

The PMP9367 is a four layer board with overall dimensions of 0.713” (18mm) x 2.2” (55mm). The copper weight is 1oz on the outer layers and 0.5oz the inner layers.



Top Layer

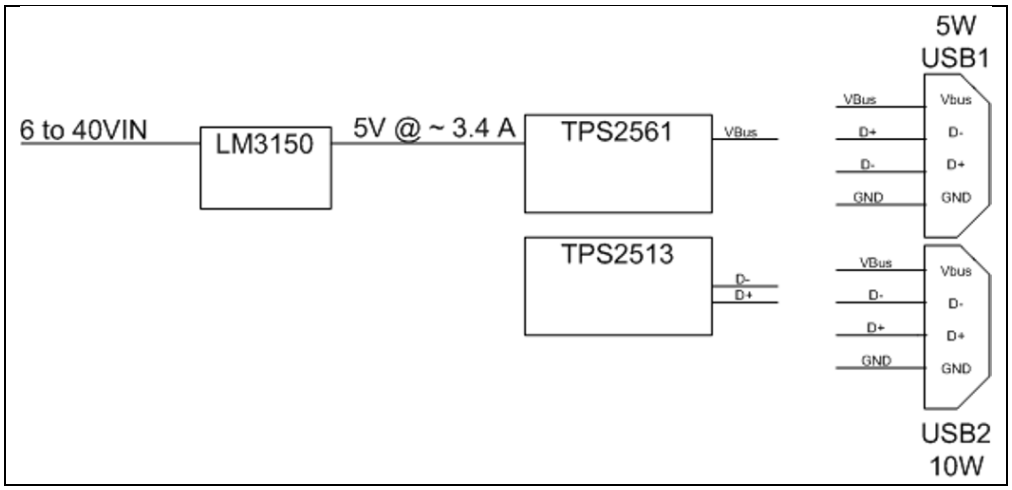
USB Direct Charging Port



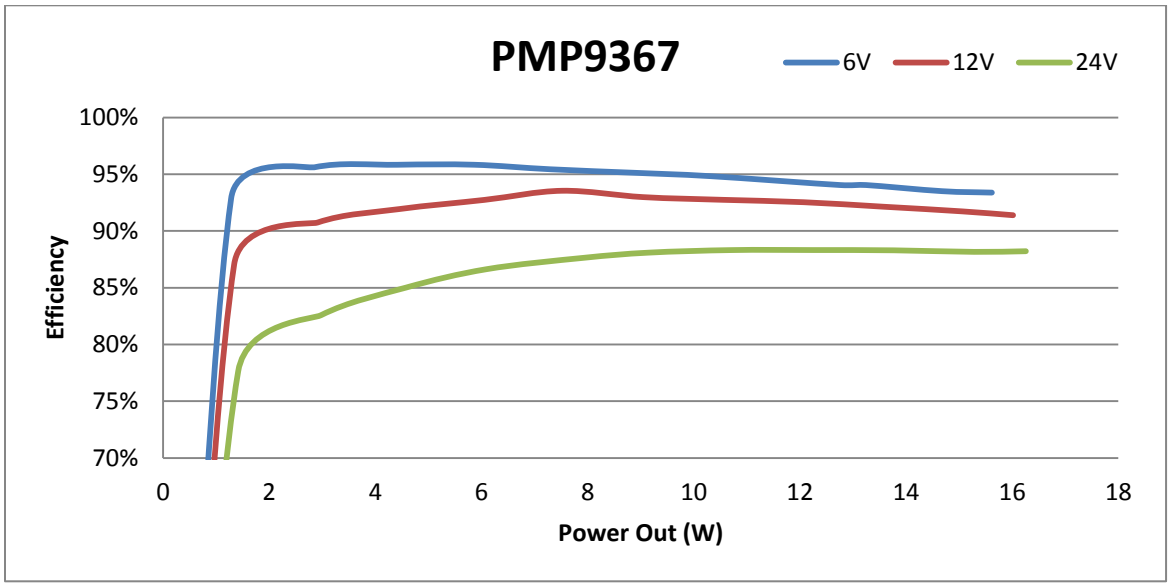
Bottom Layer

USB Direct Charging Port

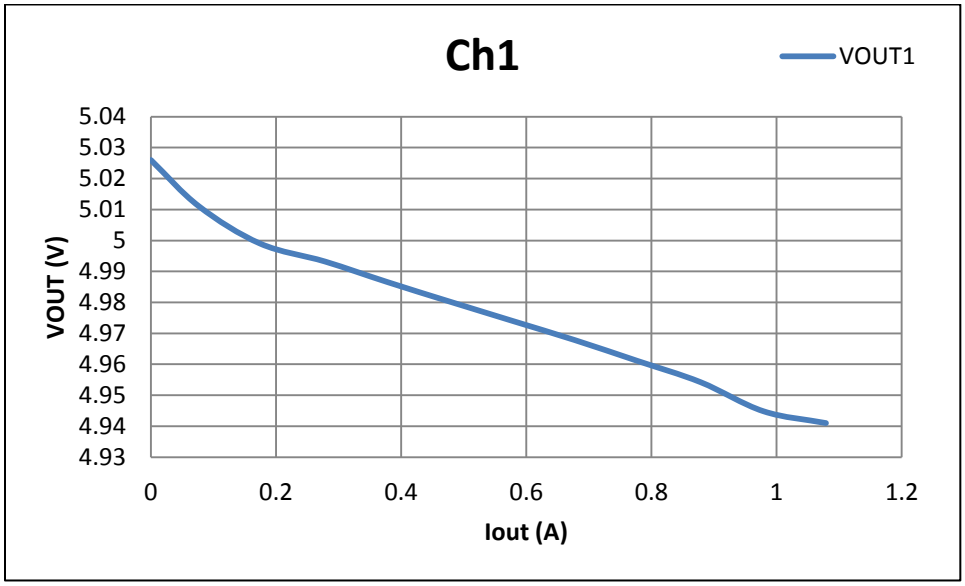
2.1 Block Diagram

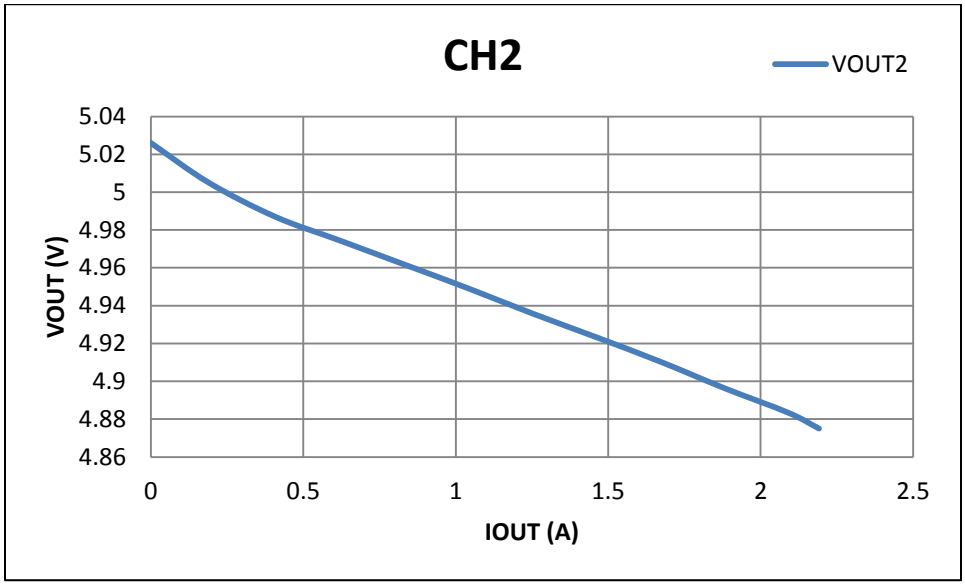


3. Efficiency



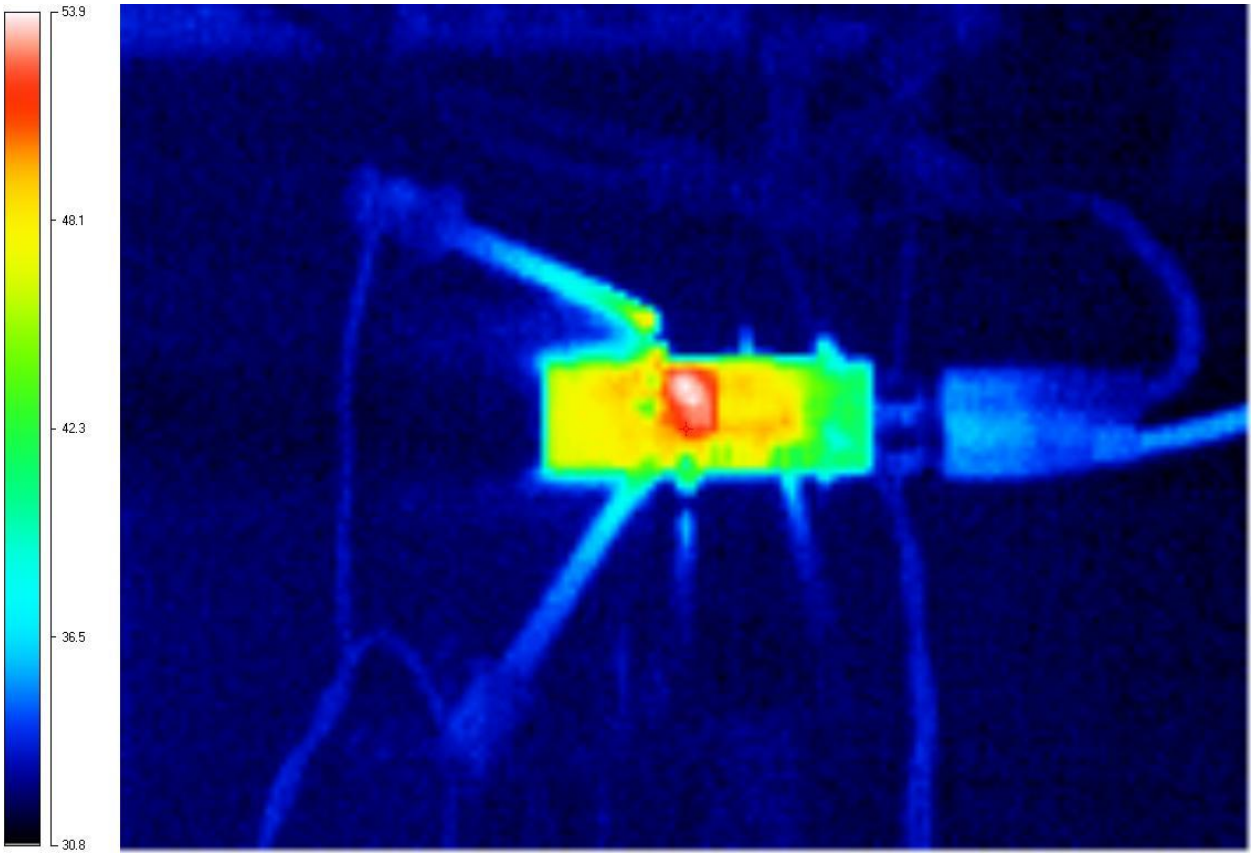
4. Load Regulation




CH2
VOUT2
5.04
5.02
5
4.98
4.96
4.94
4.92
4.9
4.88
4.86
VOUT (V)
0
0.5
1
1.5
2
2.5
IOUT (A)

5. Thermal

5.1 Steady State Temperature, 12Vin and 15.5W out.

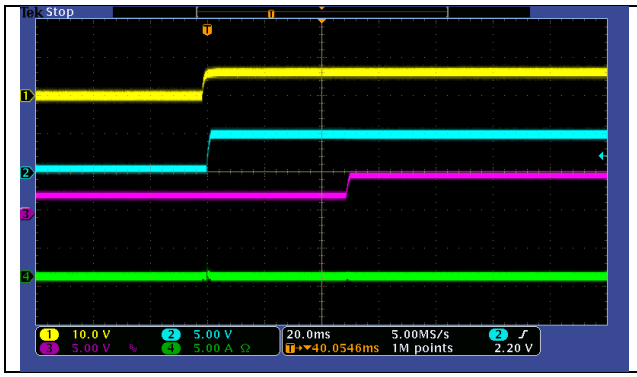


Top View

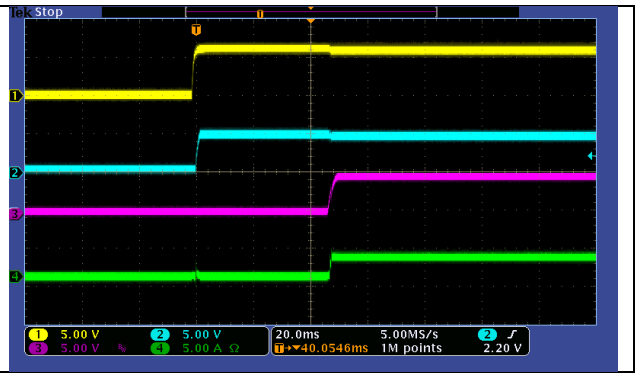
The warmest component on the module is the inductor. This image displays a 28°C temperature rise.

6. Power Up USB CH1

6.1 Power Up at 6V Input – No Load

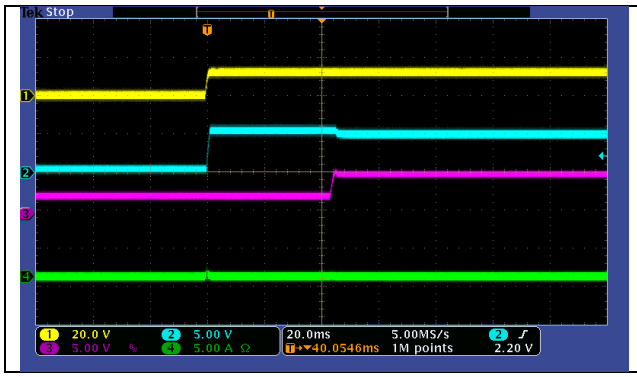


Power Up at 6V Input –1A Load

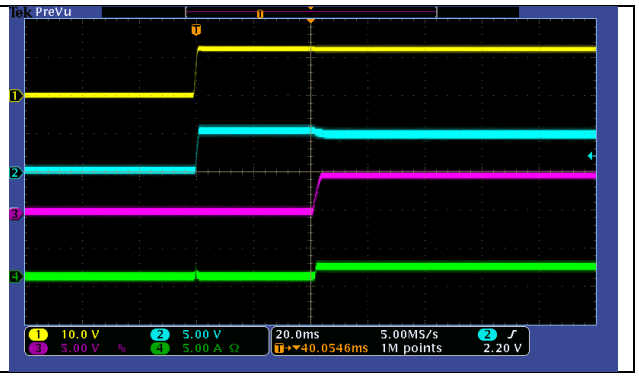


Channel 1 VIN
Channel 2 5Vout LM3150
Channel 3 J1 5Vout
Channel 4 IIN

6.2 Power Up at 12V Input – No Load



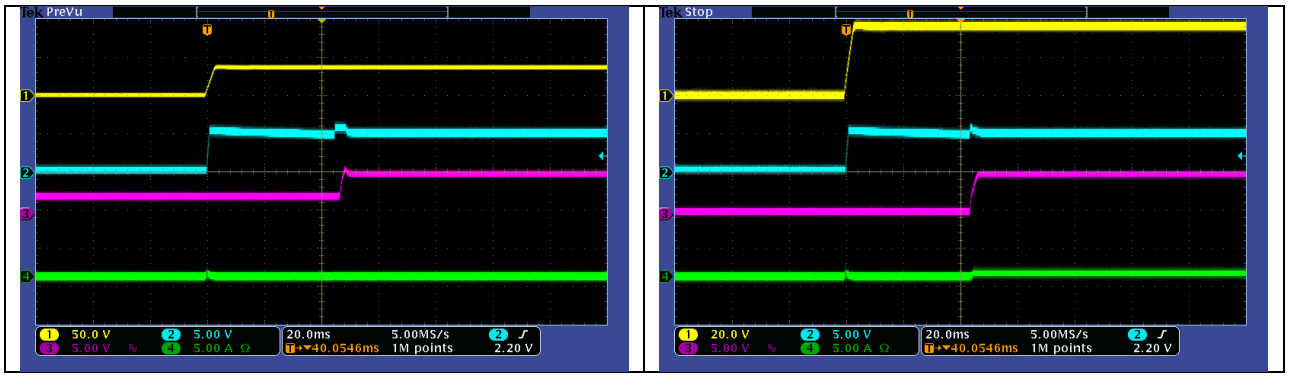
Power Up at 12V Input –1A Load



Channel 1 VIN
Channel 2 5Vout LM3150
Channel 3 J1 5Vout
Channel 4 IIN

6.3 Power Up at 36V Input – No Load

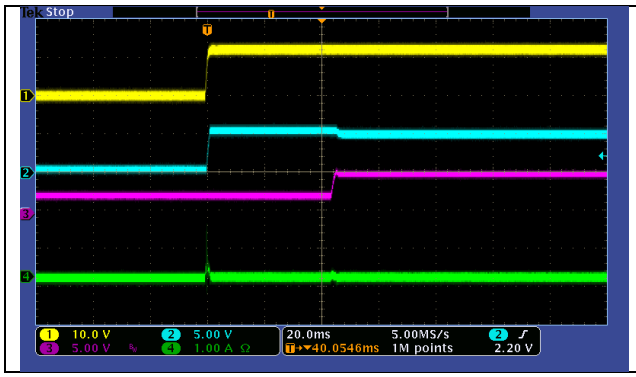
Power Up at 36V Input –1A Load



Channel 1 VIN
Channel 2 5Vout LM3150
Channel 3 J1 5Vout
Channel 4 IIN

Power Up USB CH2

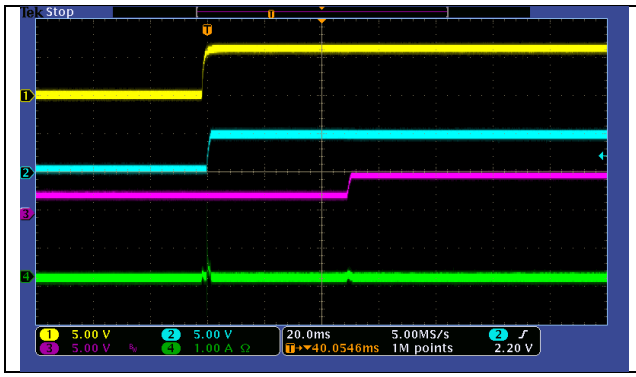
6.4 Power Up at 6V Input – No Load



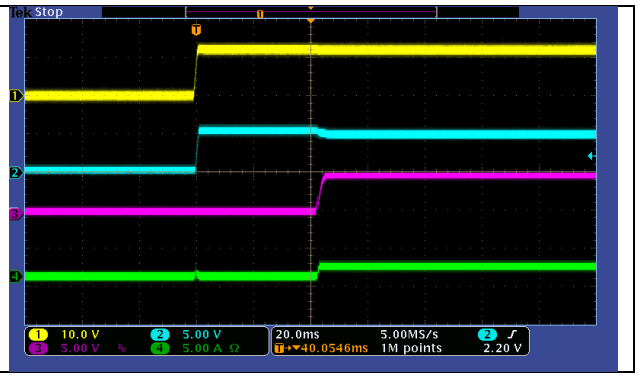
Power Up at 6V Input –2.1A Load

Channel 1 VIN
Channel 2 5Vout LM3150
Channel 3 J2 5Vout
Channel 4 IIN

6.5 Power Up at 12V Input – No Load



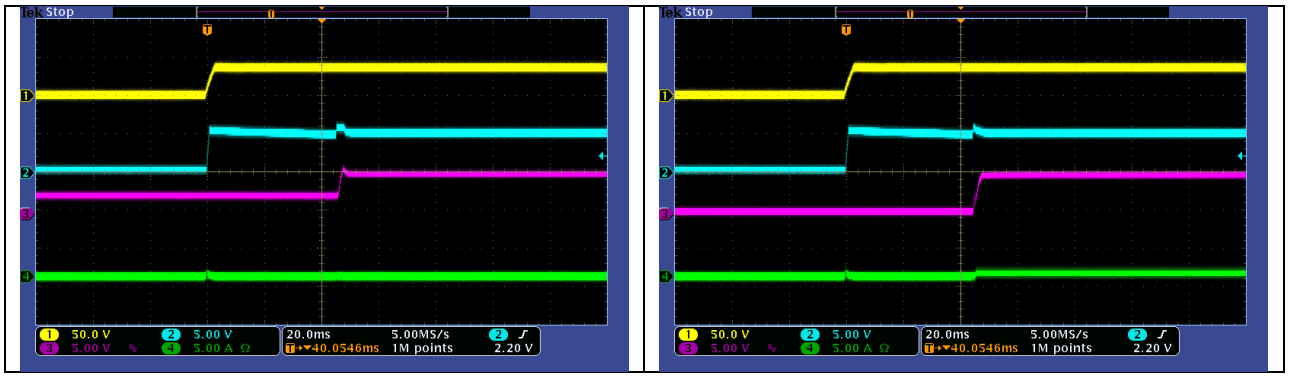
Power Up at 12V Input –2.1A Load



Channel 1 VIN
Channel 2 5Vout LM3150
Channel 3 J2 5Vout
Channel 4 IIN

6.6 Power Up at 36V Input – No Load

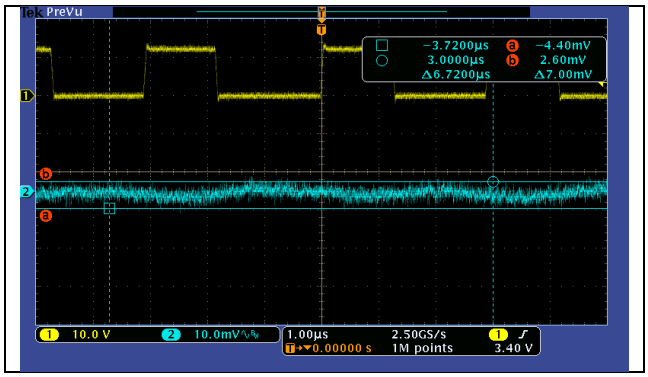
Power Up at 12V Input –2.1A Load



Channel 1 VIN
Channel 2 5Vout LM3150
Channel 3 J2 5Vout
Channel 4 IIN

7. Switching and Ripple

7.1 LM3150 5VOUT @ 3.1A



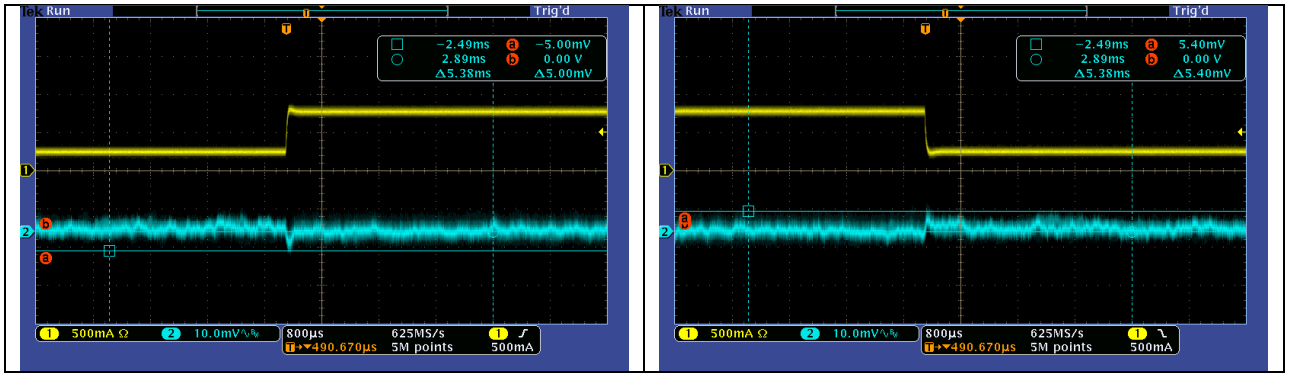
The cursors indicate 7mV ripple.

Channel 1 VSW
Channel 2 5Vout

8. Transient Response

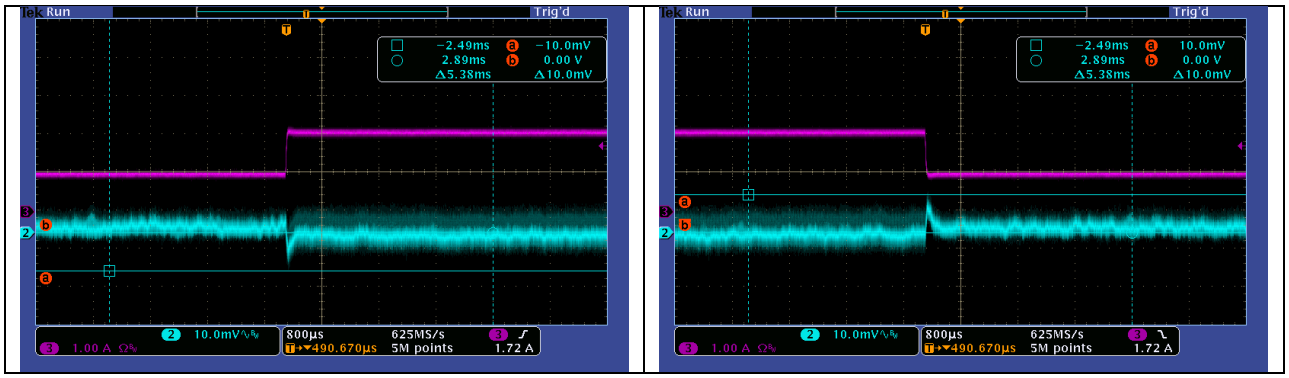
A load step was applied to each channel and the transient response of the controller was monitored.

8.1 12V Input – 0.5A to 1A Step, 100mA/µs, 100 Hz. USB Ch1



Cursors indicate ~5mV deviation across output capacitor.

8.2 12V Input – 1.05A to 2.1A Step, 100mA/µs, 100 Hz. USB Ch2

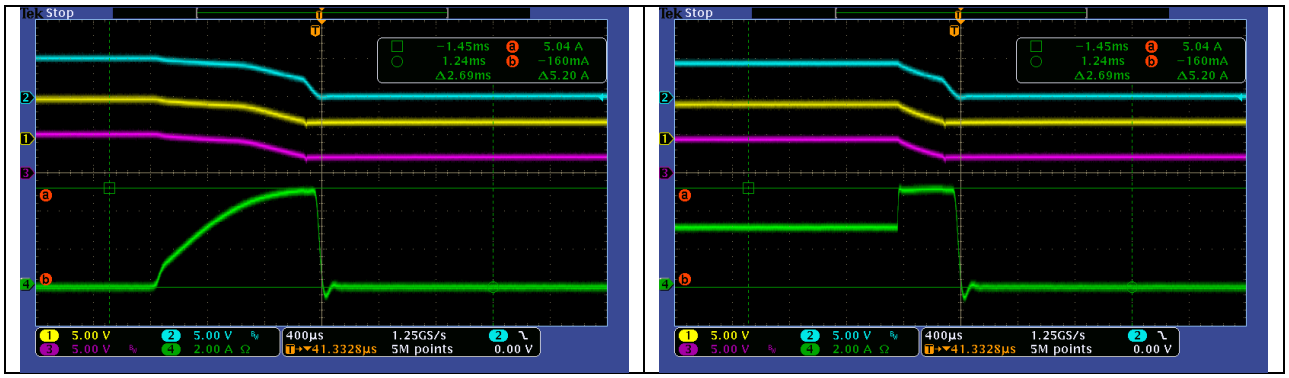


Cursors indicate ~10mV deviation across output capacitor.

9. Current Limit Tests 12V Input

9.1 LM3150

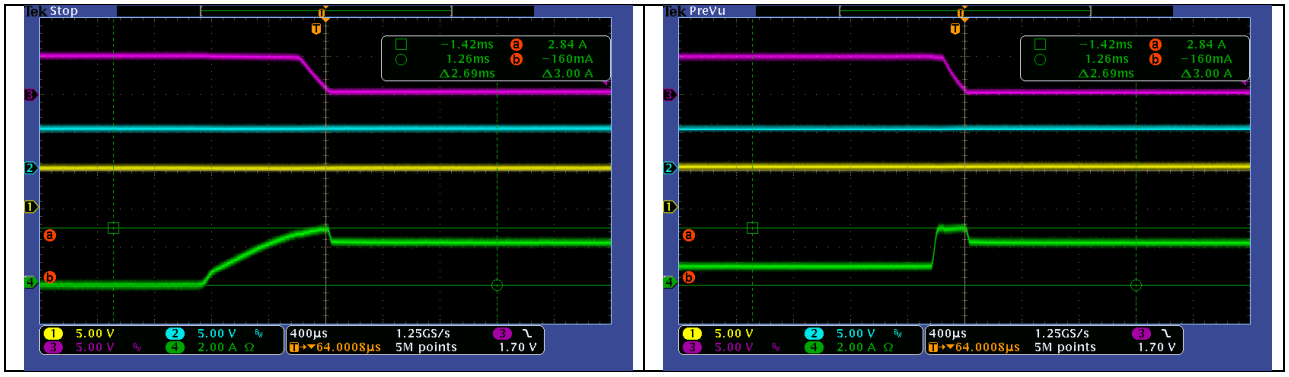
-12Vin - No Load **-12Vin - 3.5A Load**



Channel 1 USB CH2
Channel 2 LM3150
Channel 3 USB CH1
Channel 4 IOUT

9.2 USB CH1

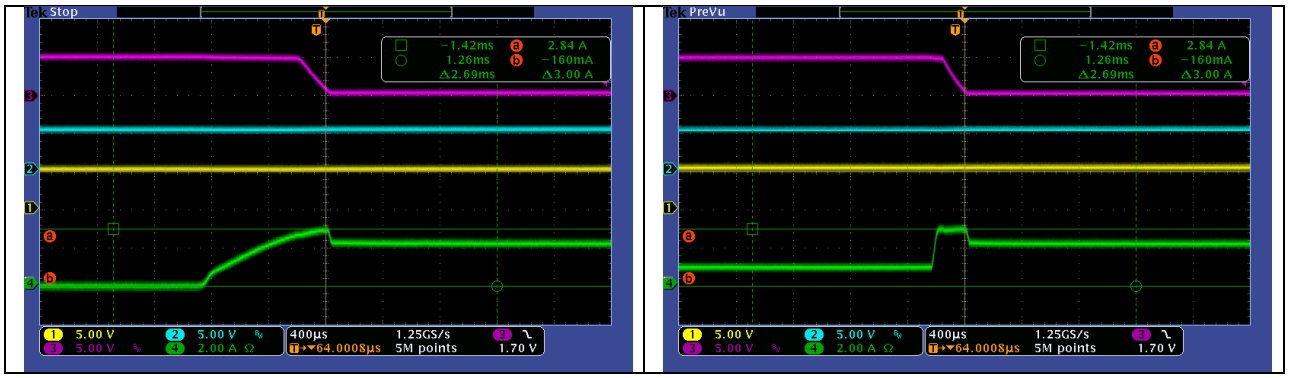
-12Vin - No Load **-12Vin - 1A Load**



Channel 1 USB CH 1
Channel 2 LM3150
Channel 3 USB CH 2
Channel 4 IOUT

9.3 USB CH2

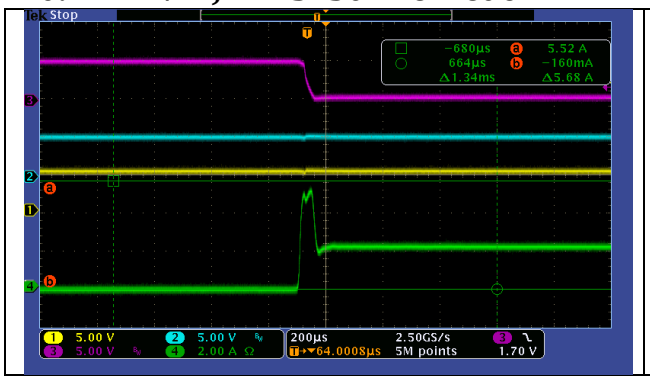
-12V in - No Load **-12Vin - 2.1A Load**



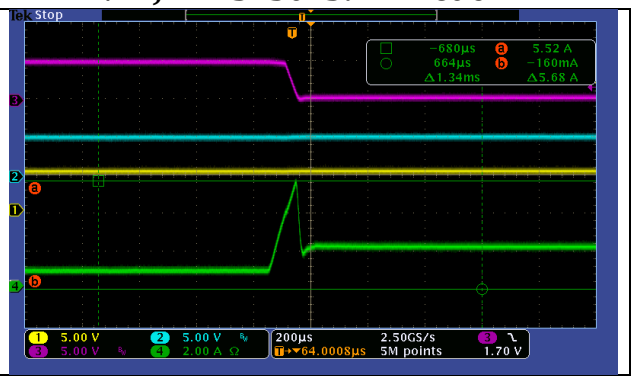
Channel 1 USB CH 1
Channel 2 LM3150
Channel 3 USB CH 2
Channel 4 IOUT

10.1 Short Circuit Tests

10.1 12Vin, LM3150 No Load

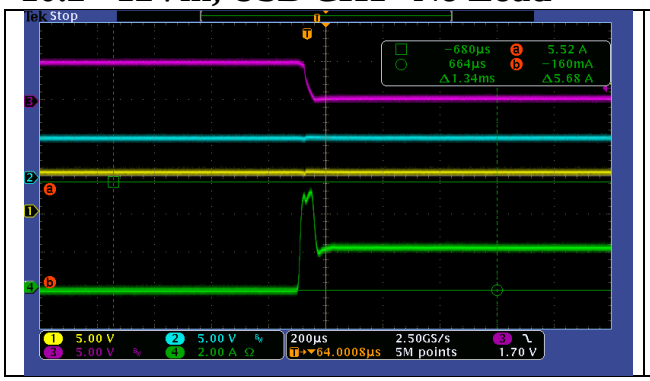


12Vin, LM3150 3.1A Load

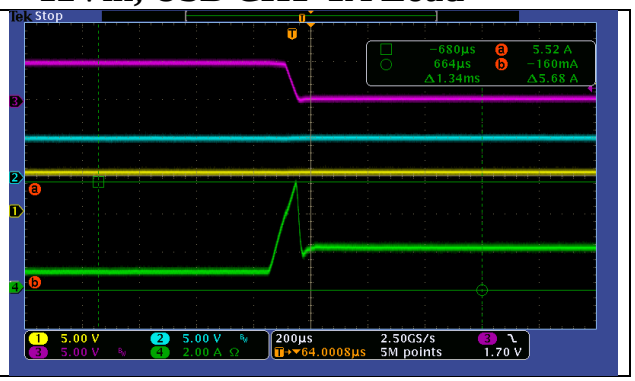


Channel 1 USB CH 1
Channel 2 LM3150
Channel 3 USB CH 2
Channel 4 IOUT

10.2 12Vin, USB CH1 No Load

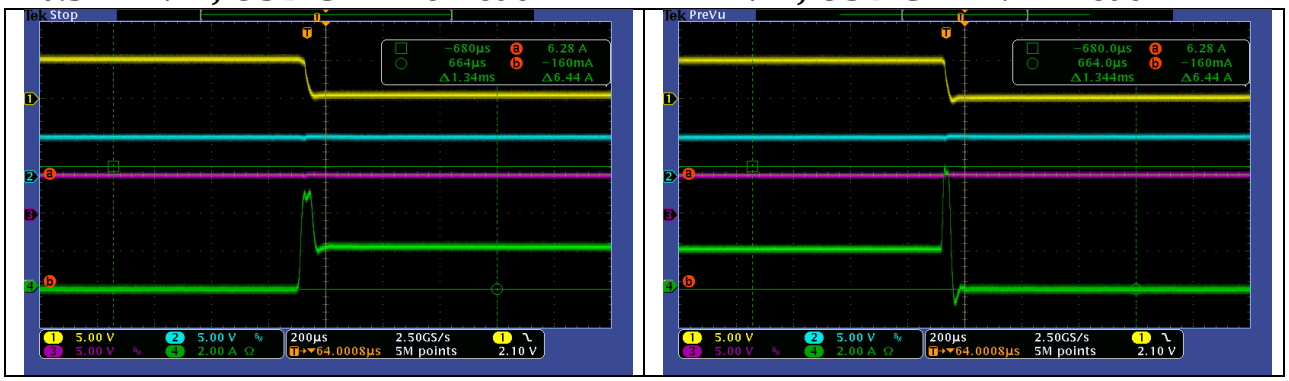


12Vin, USB CH1 1A Load



Channel 1 USB CH 1
Channel 2 LM3150
Channel 3 USB CH 2
Channel 4 IOUT

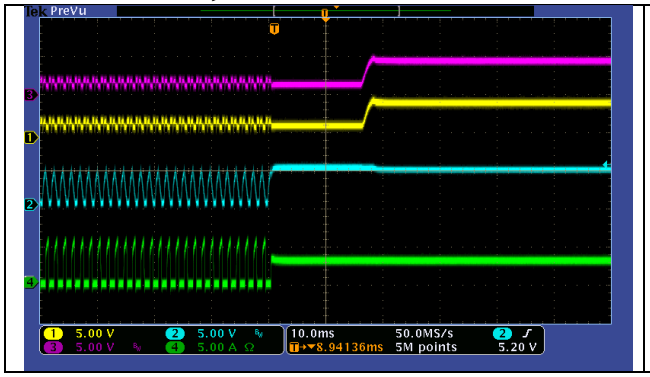
10.3 12Vin, USB CH2 No Load 12Vin, USB CH2 2.1A Load



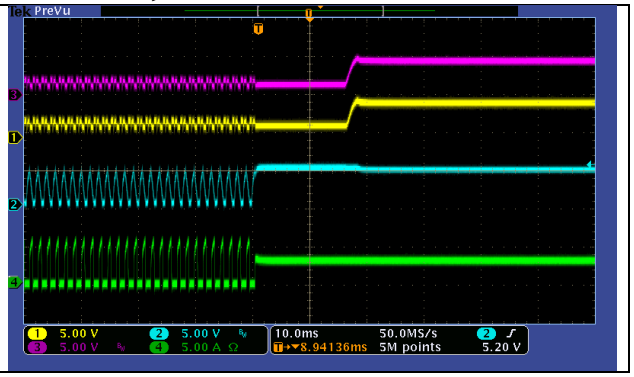
Channel 1 USB CH 1
Channel 2 LM3150
Channel 3 USB CH 2
Channel 4 IOUT

11. Short Circuit Recovery Tests

11.1 12Vin, LM3150 No Load

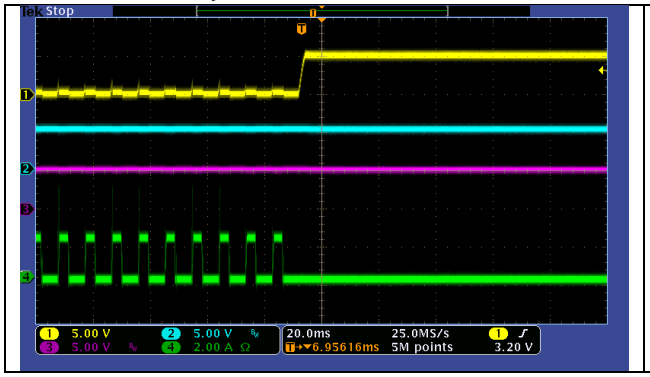


12Vin, LM3150 3.1A Load

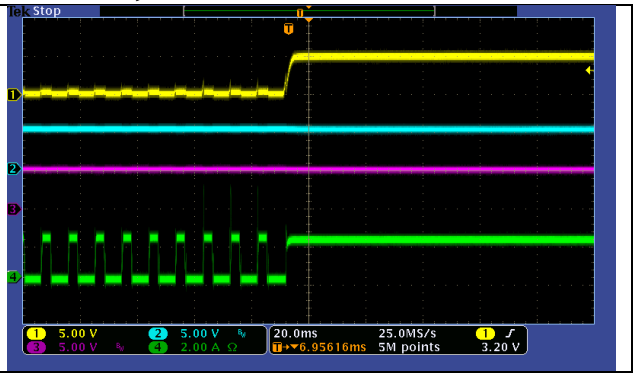


Channel 3 VOUT
Channel 4 IOUT

11.2 12Vin, USB CH1 No Load

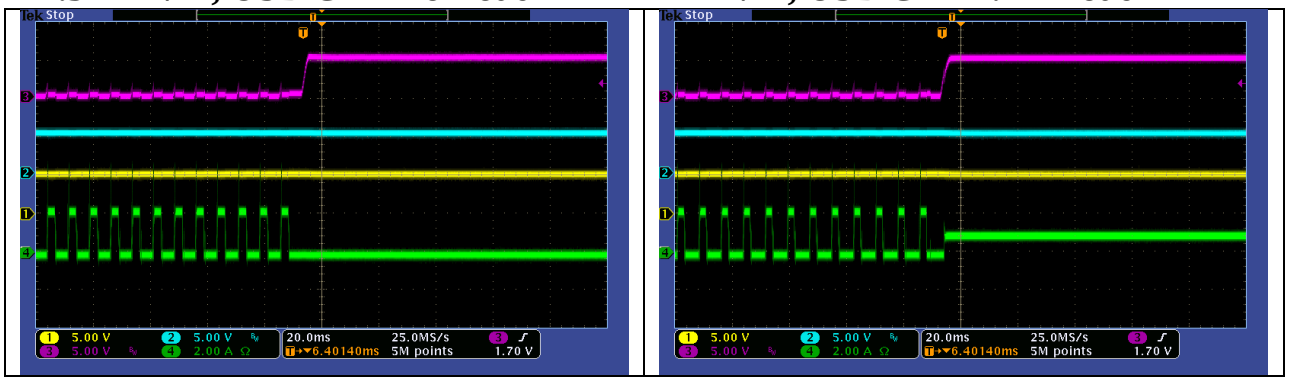


12Vin, USB CH1 1A Load



Channel 3 VOUT
Channel 4 IOUT

11.3 12Vin, USB CH2 No Load 12Vin, USB CH2 2.1A Load



Channel 3 VOUT
Channel 4 IOUT

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