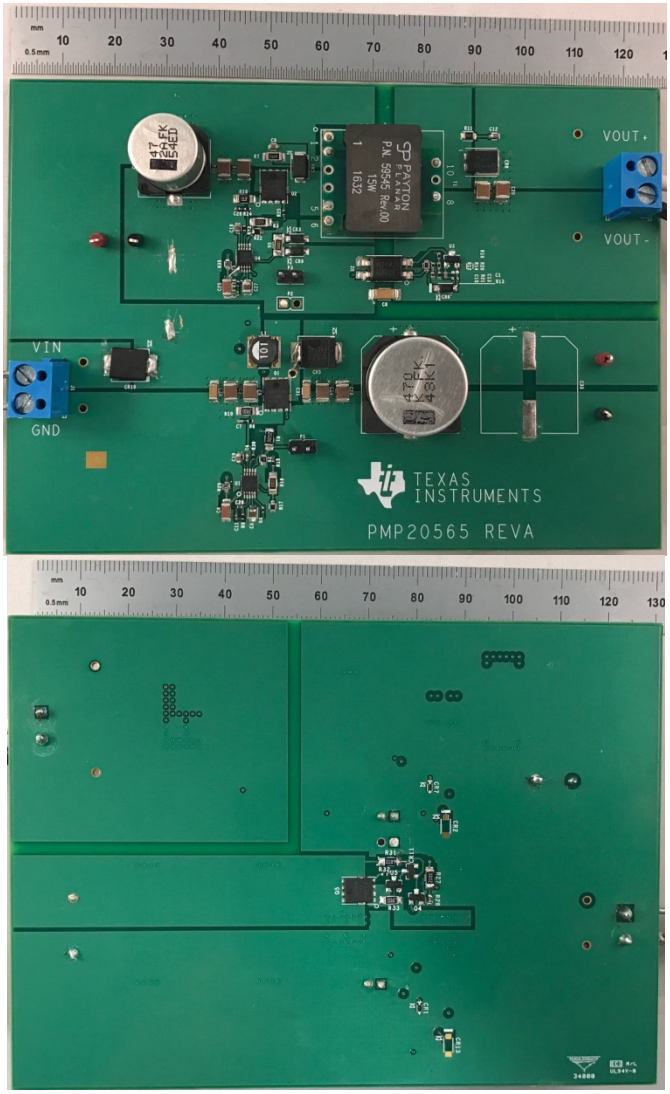
Test Report: PMP20565
Hold-Up Time Beyond 10 ms Using Flyback Converter and Smaller Solution Size Reference Design

Description

This reference design significantly extends the holdup time beyond 10 ms without bulky output capacitor bank. A 60-V high voltage energy storage capacitor is utilized on the input side. It instantaneously connects to a flyback converter when a line interruption is detected, charges up the input capacitor and extends the holdup time. The active switch circuitry is fast-acting and current-limiting. By removing the bulky output capacitor bank, it further reduces the total solution size. It is a compact solution for isolated power supply where a long hold-up time is required.



1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
Input voltage, Vin	9V~60V
Output Voltage, Vo	12V/2A

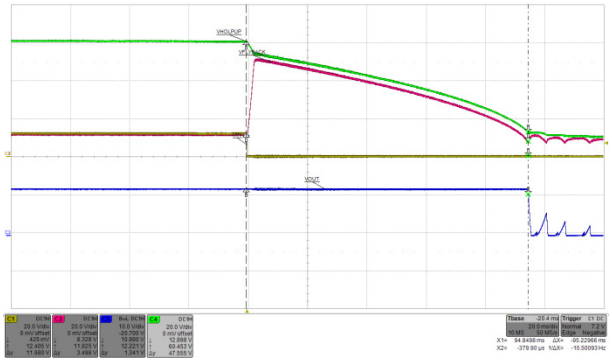
1.2 Required Equipment

- Power Supply, 9~60V, 0~5A
- Load: 12V/2A

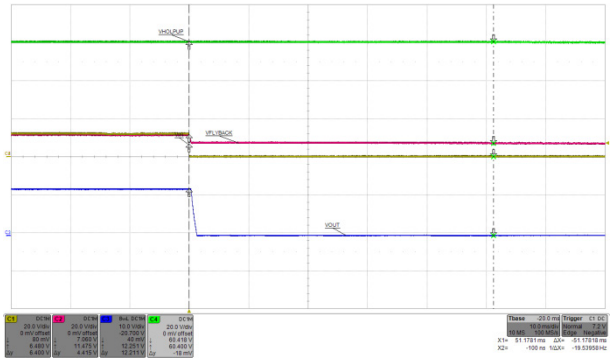
2 Hot-unplug test

The hold-up circuitry was first tested by unplugging the input from the power supply. The input is suddenly disconnected; the flyback input voltage is then connected to the holdup cap instantaneously. The hold-up cap charges the flyback input cap, then decays with the flyback input cap, extending the hold-up time.
For comparison purpose, the same circuitry was tested with hold-up circuitry disabled.

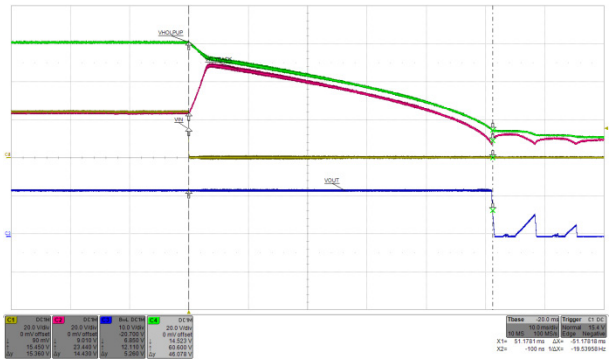
- The green curve is holdup cap voltage, 20V/div
- The pink curve is flyback input voltage, 20V/div
- The yellow curve is input voltage Vin, 20V/div
- The blue curve is flyback output voltage, 10V/div



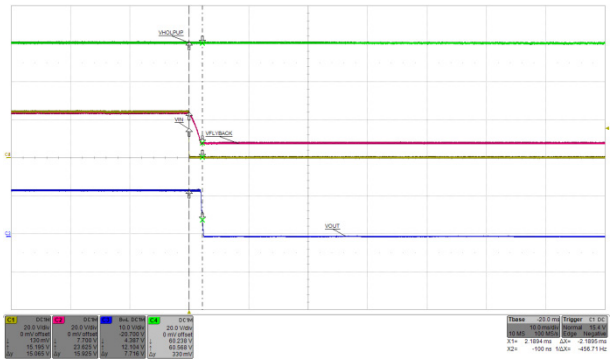
12Vin, 12Vout/0.5A, hot-unplug, hold-up enabled, 95ms holdup time.



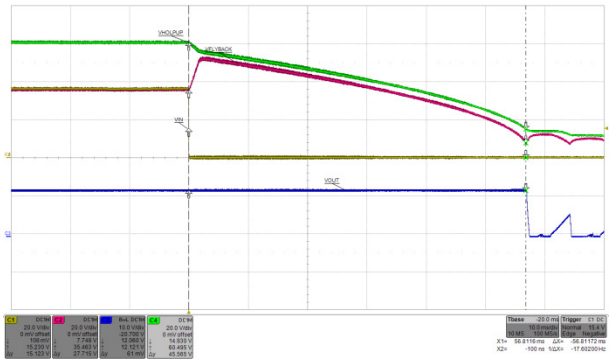
12Vin, 12Vout/0.5A, hot-unplug, hold-up disabled, ~1ms holdup time.



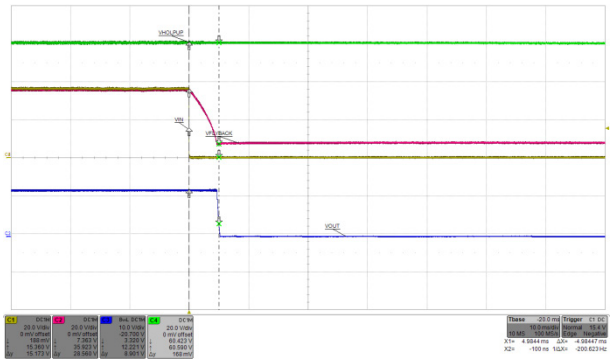
24Vin, 12Vout/1A, hot-unplug, hold-up enabled, 51ms holdup time.



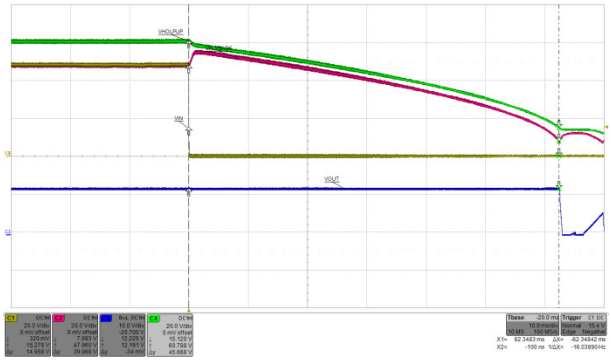
24Vin, 12Vout/1A, hot-unplug, hold-up disabled, 2ms holdup time.



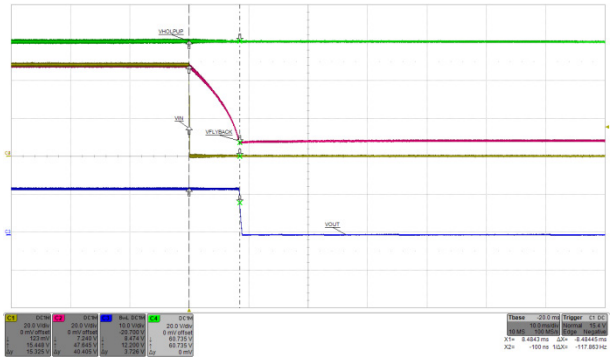
36Vin, 12Vout/1A, hot-unplug, hold-up enabled, 57ms holdup time.



36Vin, 12Vout/1A, hot-unplug, hold-up disabled, 5ms holdup time.



48Vin, 12Vout/1A, hot-unplug, hold-up enabled, 62ms holdup time.

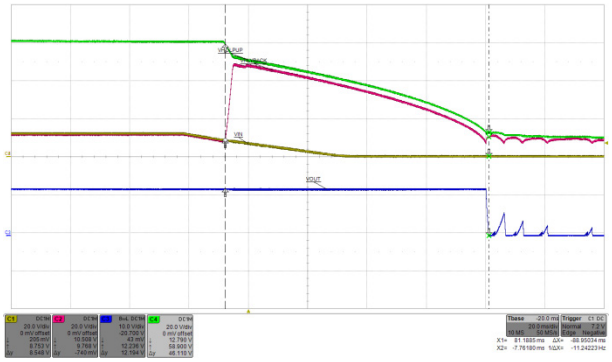


48Vin, 12Vout/1A, hot-unplug, hold-up disabled, 8.5ms holdup time.

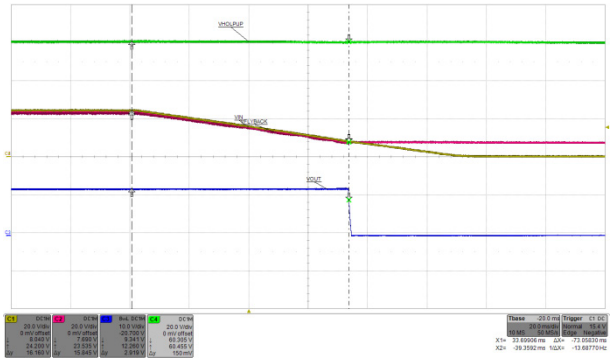
3 Soft power-down test

The hold-up circuitry was then tested by turning-off the power supply with a slow ramp. The input is slowly power down. When it passes the detection threshold, the hold-up cap is quickly connected to the flyback input, charges the flyback input cap, thus extending the hold-up time.
For comparison purpose, the same circuitry was tested with hold-up circuitry disabled.

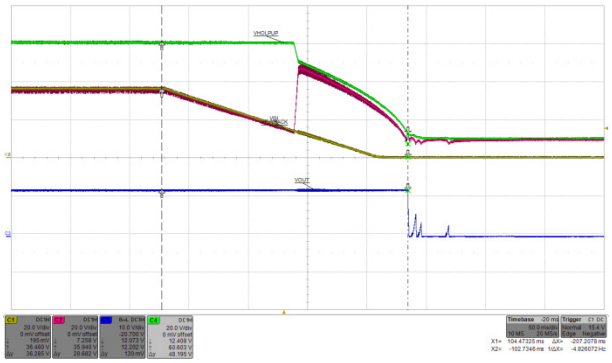
- The green curve is holdup cap voltage, 20V/div
- The pink curve is flyback input voltage, 20V/div
- The yellow curve is input voltage Vin, 20V/div
- The blue curve is flyback output voltage, 10V/div



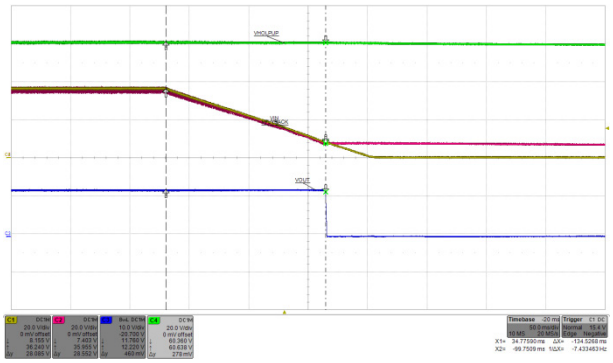
24Vin, 12Vout/0.5A, slow power down, hold-up enabled, 143ms holdup time.



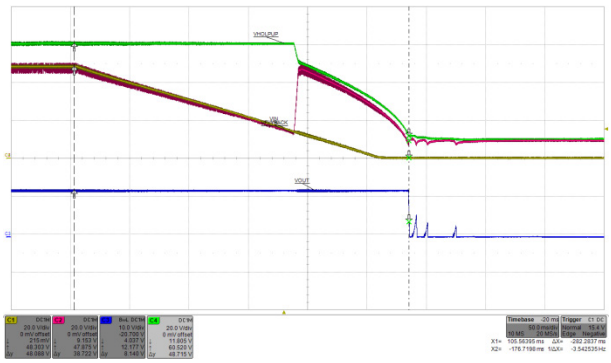
24Vin, 12Vout/0.5A, slow power down, hold-up disabled, 73ms holdup time.



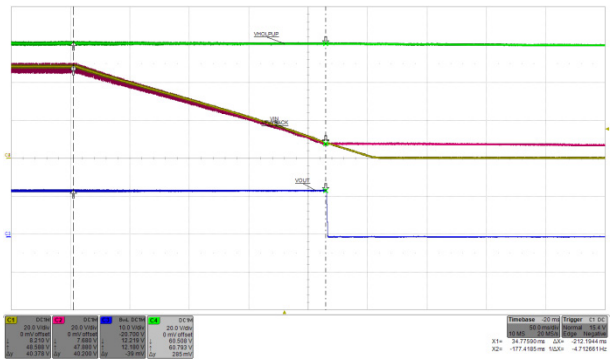
36Vin, 12Vout/0.5A, slow power down, hold-up enabled, 207ms holdup time.



36Vin, 12Vout/0.5A, slow power down, hold-up disabled, 134ms holdup time.



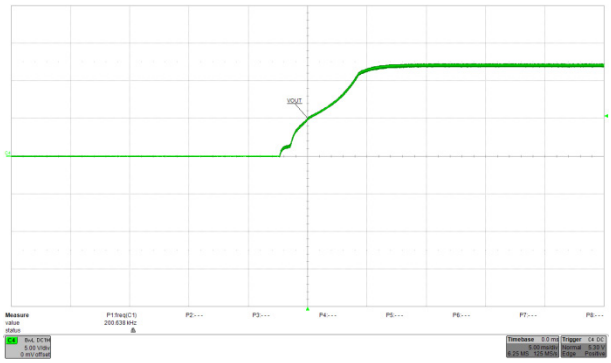
48Vin, 12Vout/0.5A, slow power down, hold-up enabled, 282ms holdup time.



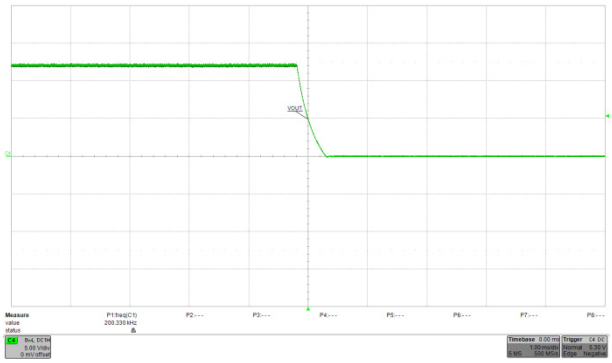
48Vin, 12Vout/0.5A, slow power down, hold-up disabled, 212ms holdup time.

Below sections detail the basic characteristics of the 9V to 60Vin flyback converter with 12V/2A output.

4 Startup and Shutdown

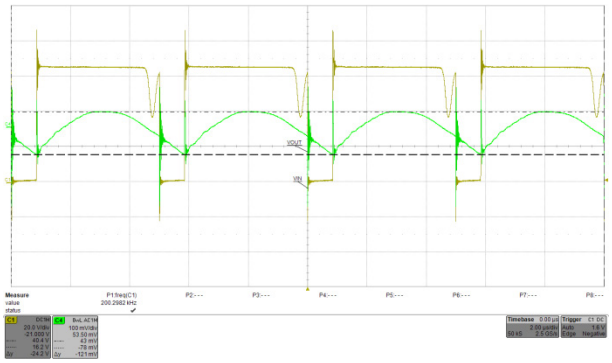


54Vin, 12Vout/2A

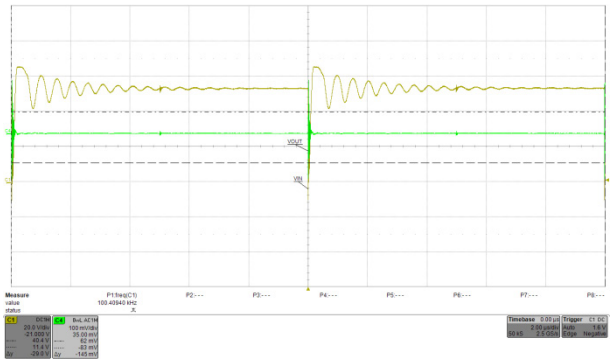


54Vin, 12Vout/2A

5 Ripple

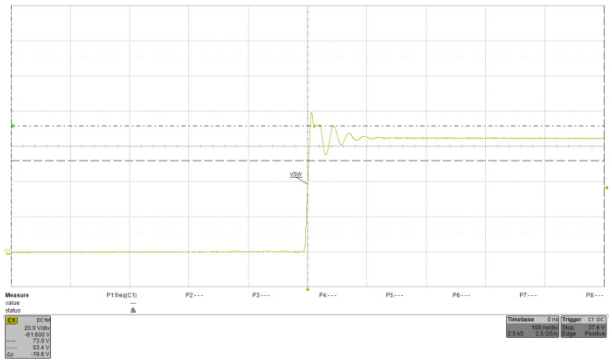


54Vin, 12Vout/2A, 121mVpp (+/-0.5%)

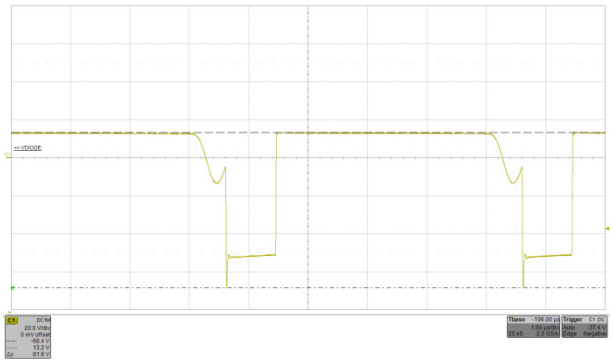


54Vin, 12Vout/0A

6 Switching node waveform

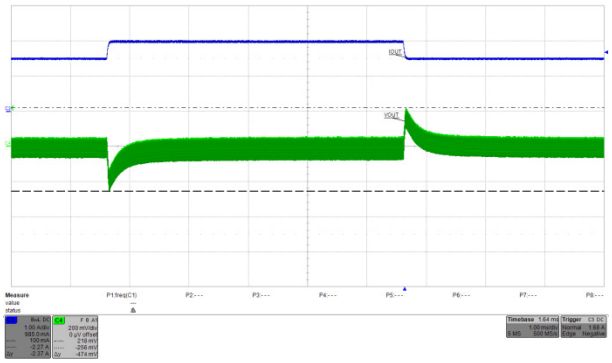


54Vin, 12Vout/2A, 80Vmax, switch stress



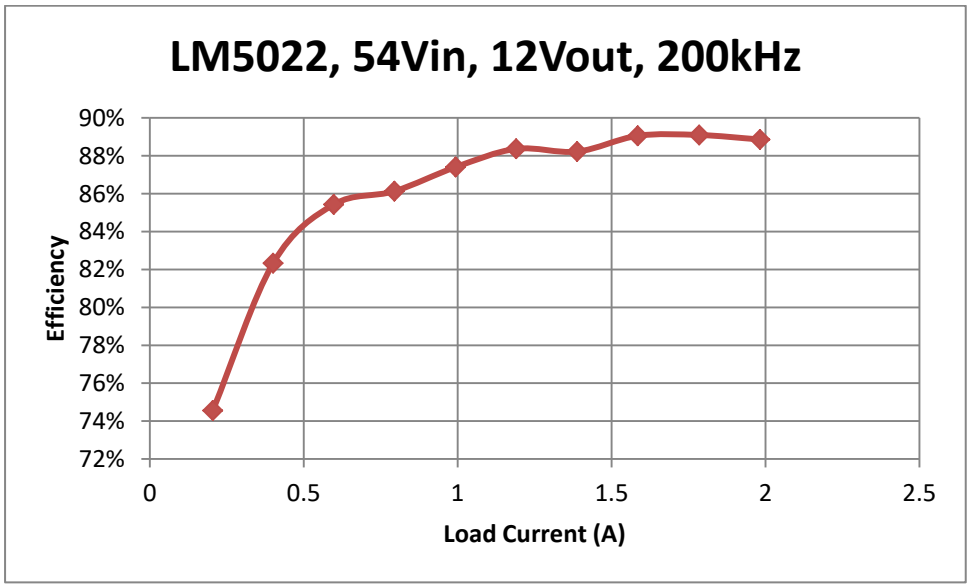
54Vin, 12Vout/2A, 82Vmax, diode stress (10ohm+1000pF)

7 Transient

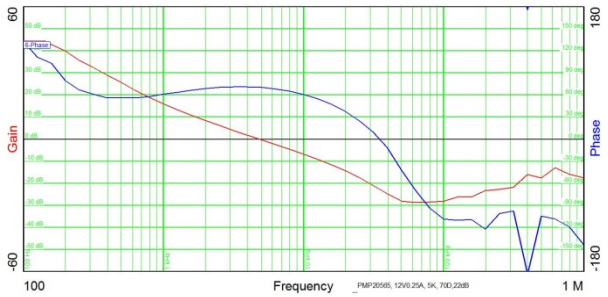


54Vin, 12V/1.5A->2A->1.5A, 474mVpp (+/-2%)

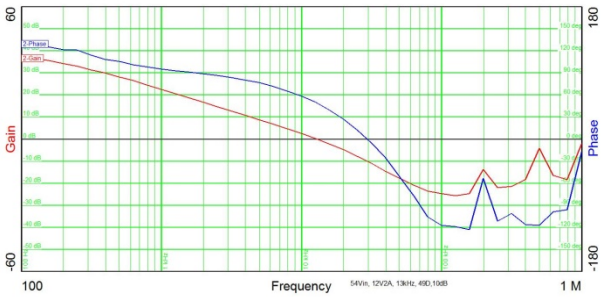
8 Efficiency



9 Bode plot

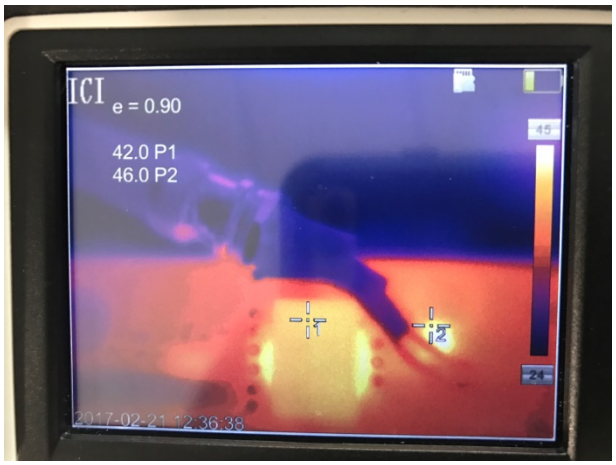


54Vin, 12V/0.25A, BW=5kHz, PM=70D, GM=22dB



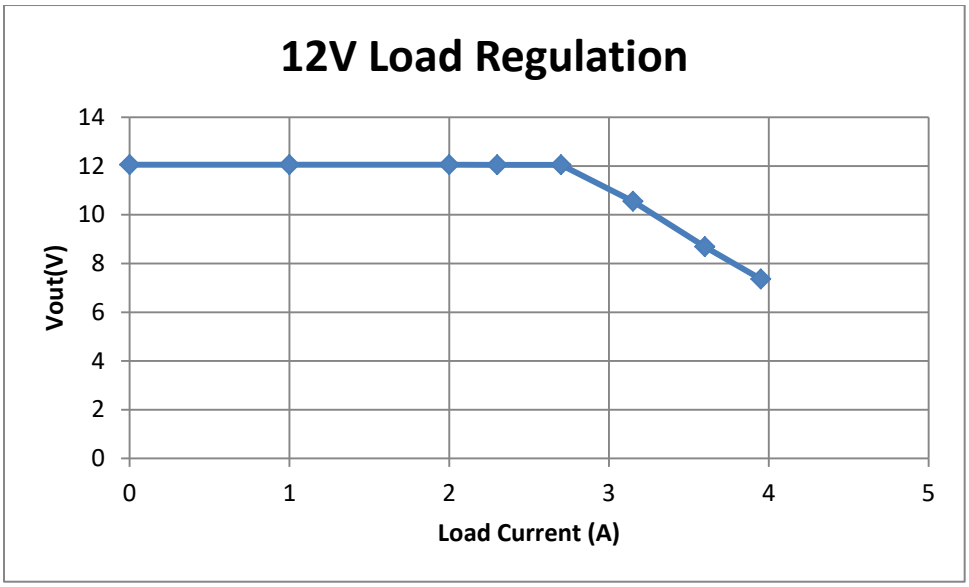
54Vin, 12V/2A, BW=13kHz, PM=49D, GM=10dB

10 Thermal

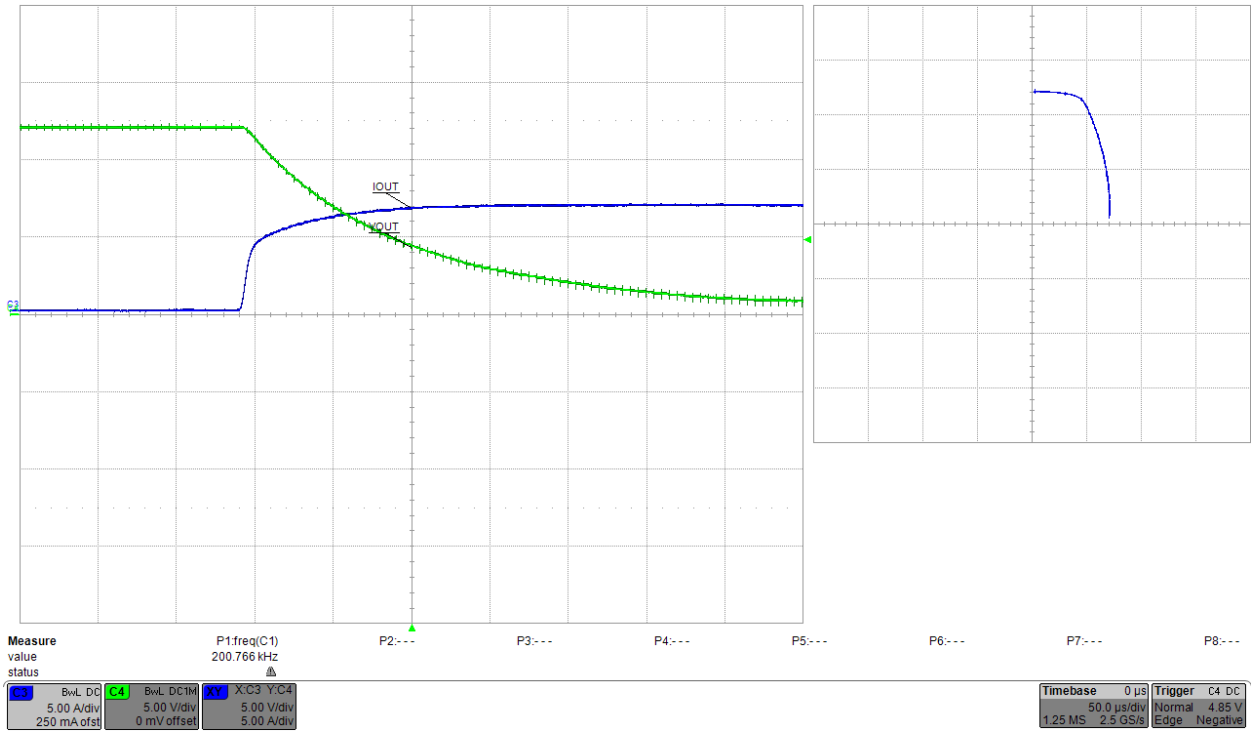


54Vin, 12V/2A, natural convection, T_{XFMR}=42C, T_{DIODE}=46C.

11 Load Regulation



12 Over-Current Protection



54Vin, 12V, OCP=7A

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