PMP10449 Test Report

Table of Contents

Table of Figures

1.0 Specification

PARAMETER	VALUE			Unit
	Min.	Typ.	Max.	
VIN, input voltage range	7.5	10	14	V
VOUT, output voltage	1.44	1.5	1.56	V
Iout, output current range	0		20	A
Fsw, switching frequency		400		KHz

2.0 Test Setup

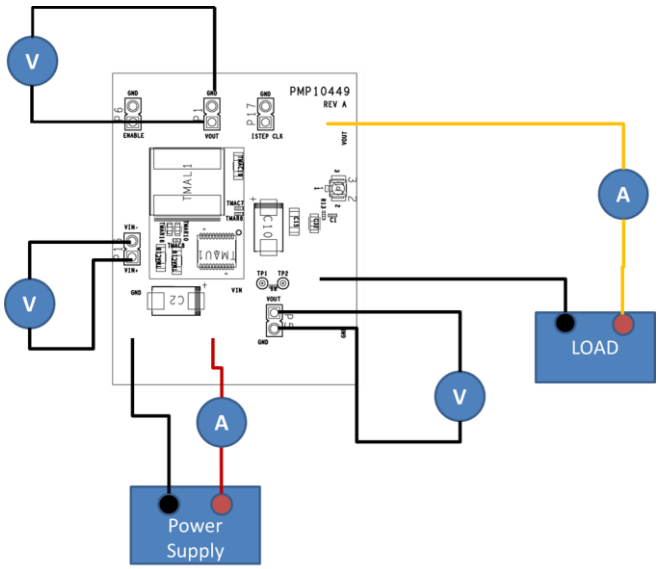

Figure 1 Test Setup of the TPS53355, PMP10449 REV. A.

3.0 Test Results

3.1 Start-up and Shut-down Behavior

3.1.1 Turn-on and Turn-off from VIN

Scope waveform will show:

- **Input voltage, 10V/DIV**
- **Output voltage, 1V/DIV**
- **Phase Node, 10V/DIV**
- **Time Scale, 5msec/DIV**

Table 1 Start-up and Shutdown Waveforms

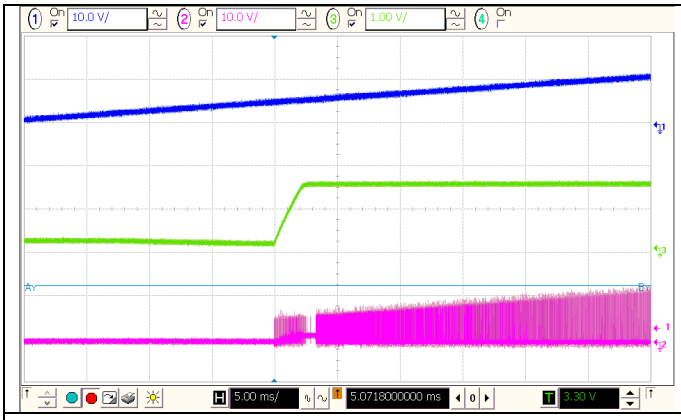	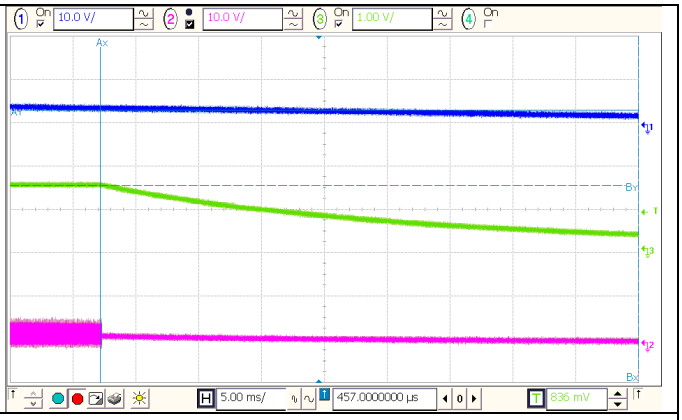
Figure 2 Start Up, No Load	**Figure 3 Shutdown, 25% Load**

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Comments:

- Measured soft-start ramp time is 2.4msec.
- Converter operates in Discontinuous Current Mode during start up to prevent any reverse current.

3.1.2 Turn-on and Turn-off in presence of pre-bias on output

- Supply is turned on and off via. enable control
- Scope waveform will show:
  - **Output voltage, 200mV/DIV**
  - **Phase node voltage, 10V/DIV**

Prebiased output at >1.2V.

Table 2 Prebiased Start-Up Waveforms.

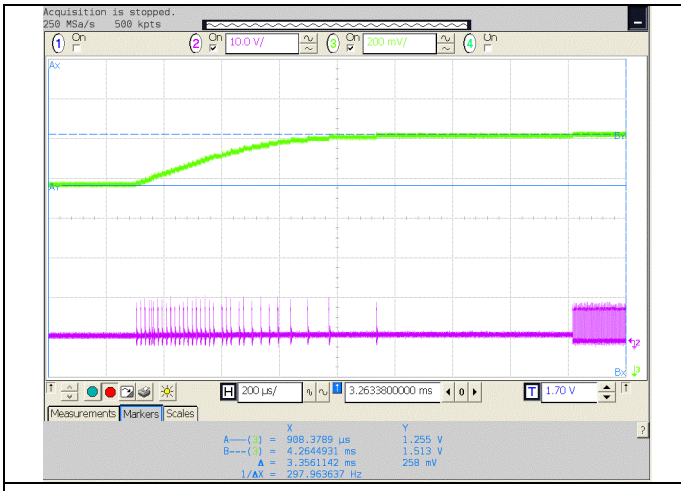	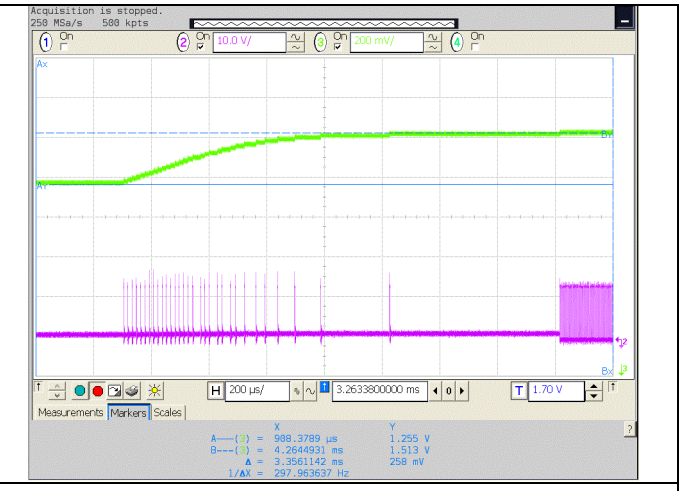
Figure 4 Prebias Turn-on, 7.5Vin, 1.5Vout	**Figure 5 Prebias Turn-on, 12Vin, 1.5Vout**

3.2 Voltage ripple and switch-node waveforms

3.2.1 Output Ripple Voltage

- 20MHz bandwidth mode on scope for Vout measurement
- Switch-node measurement was made directly across low-side FET
- Full bandwidth mode on scope for phase node.
- Trigger off of first switch-node and use infinite persistence of scope to show duty-cycle “jitter”
- Scope waveform will show:
  - **Output voltage, 10mV/DIV**
  - **Phase node voltage, 5V/DIV**
  - **Time scale, 1usec/DIV**

Table 3 Voltage Ripple and Switch-node waveforms

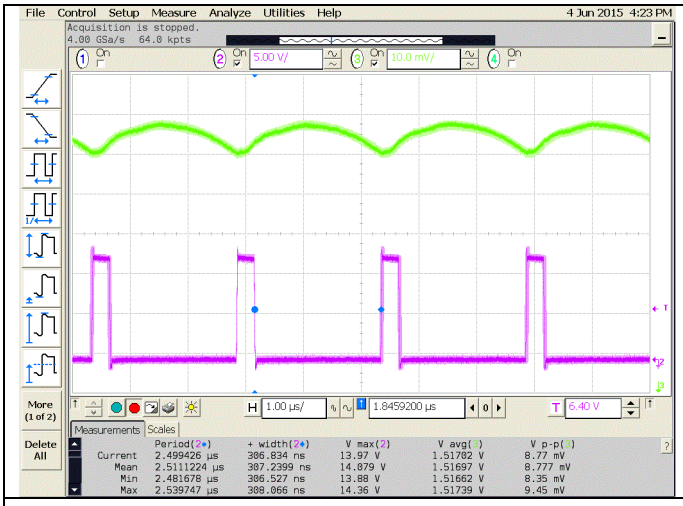

Figure 6 12Vin, 1.5Vout, No Load, Phase and Vout

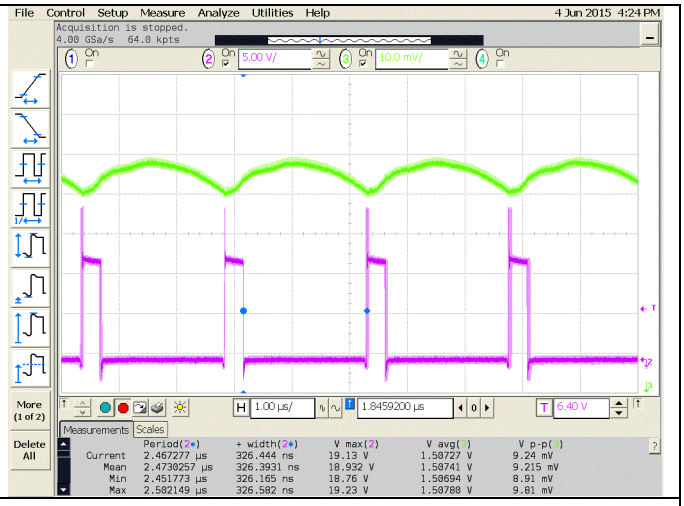

Figure 7 12Vin, 1.5Vout, 20A, Phase and Vout

Comments:

- Output peak to peak ripple voltage worst case happens at VIN = 12V and 100% load.
- The maximum ripple voltage measured was **9.81mV**, ±0.327% of VOUT.
- Measured maximum phase node jittering is 58nsec.

Table 4 Voltage Ripple with Broadband Noise

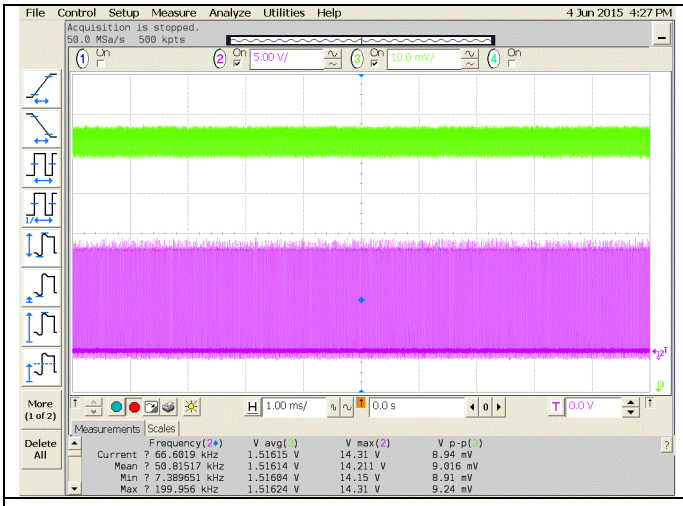

Figure 8 12Vin, 1.5Vout, 0A, Phase and Vout

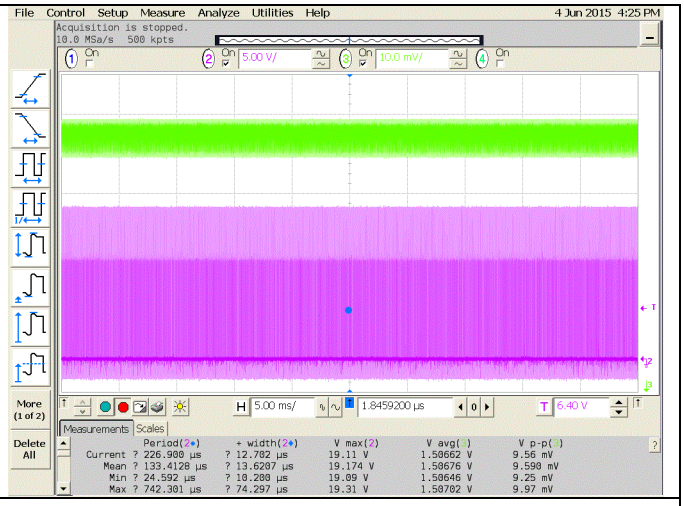

Figure 9 12Vin, 1.5Vout, 20A, Phase and Vout

Comments:

- Output peak to peak ripple voltage worst case happens at VIN = 12V and 100% load.
- The maximum ripple voltage including white noise measured was **9.97mV**. White noise contributes to output ripple by 0.16mV, 1.7% of the switching ripple.

3.2.2 Maximum Phase Node Voltage Stress

Test Conditions:

- **Inductor: XAL1010-681ME 0.68uH**
- **Fsw = 400KHz**
- **Snubber: 1000pF + 0.6Ω**
- **Bootstrap circuit: Rboot = 3.0Ω, Cboot = 0.22uF, 0402, X5R**

Figure 10 14Vin, 1.5Vout, 20A, Phase Node

Comments:

- TPS53355 Phase Pin Absolute Maximum Rating 27V , <20nsec
- Measured Maximum Phase Pin Voltage Stress at VIN = 14V is 21V, which is below 21.6V, 80% of the Absolute Maximum Rating.

3.3 Efficiency

VIN is measured at P16 and VOUT is measured at P1. Power dissipation of PCB traces is not included.

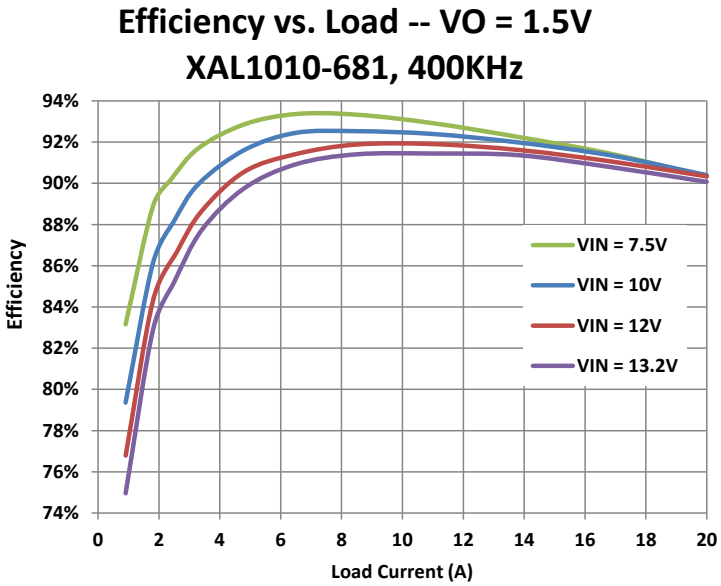

Figure 11 Efficiency vs. Load at different VIN, VO= 1.5V.

3.4 Thermal Stress

Test Conditions:

- VIN = 12V, IOUT = 20A
- No forced airflow
- Room temperature

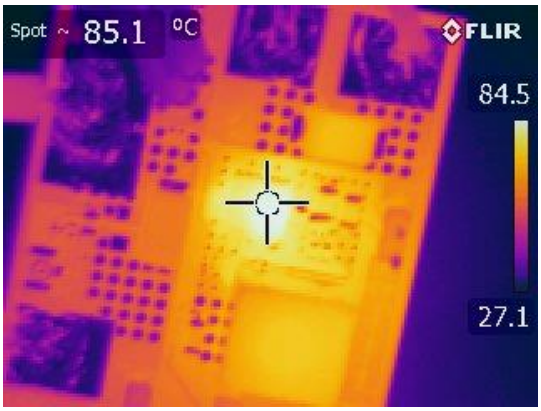

Figure 12 Thermal image of PMP10449

Comments:

- Board size: 1.5” X 1.8”
- Power solution size is 0.59” by 0.82”
- No direct contact between solution and top/bottom copper

3.5 Loop Gain Measurement

Compensation components Used for 1.2V output:
TMAR11 = 12.4KΩ, TMAC10 = 22nF, TMAC9 = 820pF
TMAR1 = 10KΩ, TMAR2 = 15KΩ and TMAR3 = 549 KΩ.

3.5.1 Bode plots at VIN = 7.5V and VOUT = 1.5V

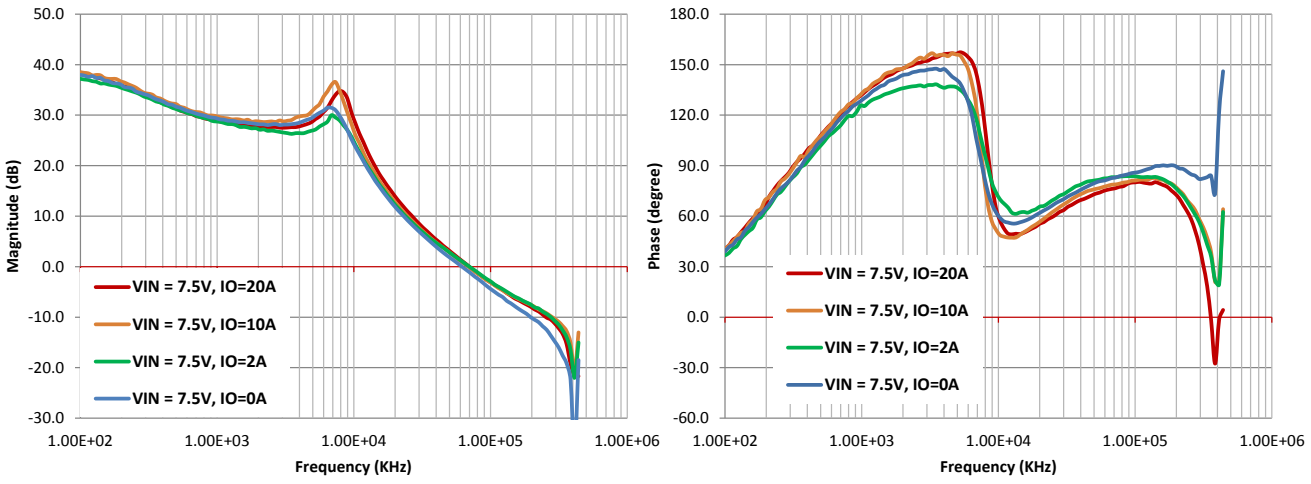

Figure 13 Bode plots of Voltage Loop at VIN = 7.5V.

Comments:

- Control Bandwidth is from 60 KHz to 70 KHz.
- Phase margin is greater than 75 degree and gain margin is greater than 10dB.

3.5.2 Bode plots at VIN = 12V and VOUT = 1.5V

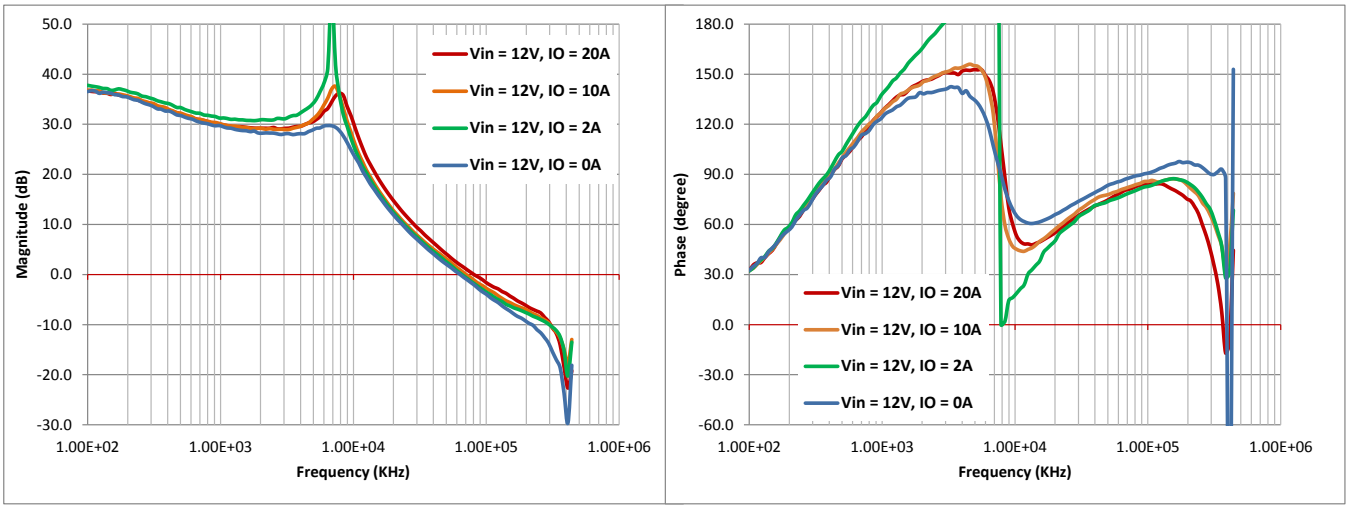

Figure 14 Bode plots of Voltage Loop at VIN = 12V.

Comments:

- Control Bandwidth is from 60 KHz to 80 KHz.
- Phase margin is greater than 75 degree and gain margin is greater than 10dB.

3.6 Load transient response

- Load step amplitude is 5A with di/dt = 5A/usec
- Scope waveform will show:
  - **Output voltage, 10mV/DIV (AC coupling)**
  - **Transient current, 2.5A/DIV, 2.5A/100mV**
  - **Time scale, 20usec/DIV**

Table 5 Load Transient Response for 1.5V output with 25% Load Step

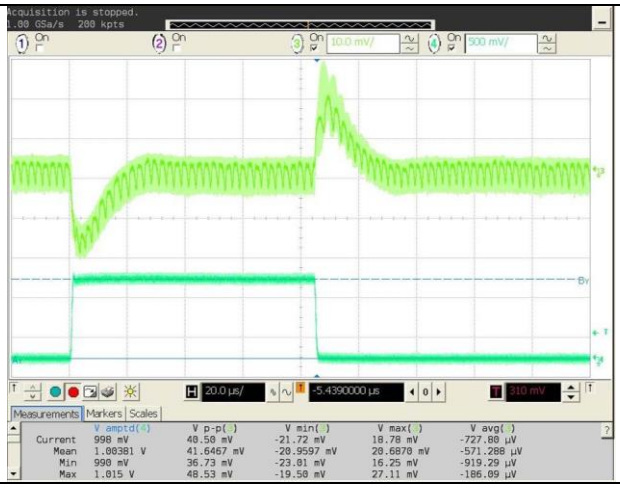

Figure 15 7.5Vin, 1.5Vout, 5A to 10A Load Step

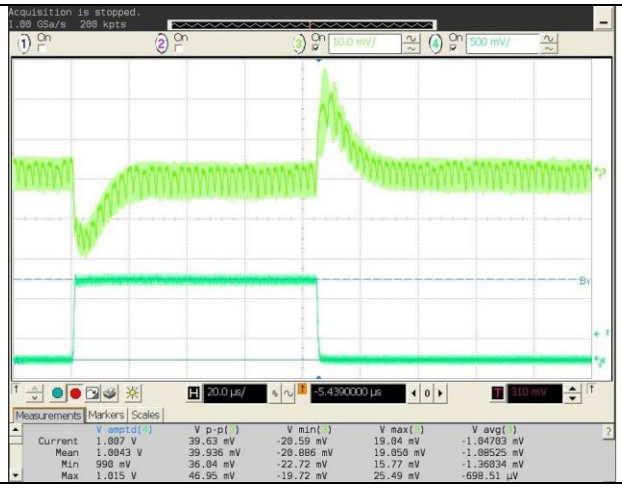

Figure 16 7.5Vin, 1.5Vout, 15A to 20A Load Step

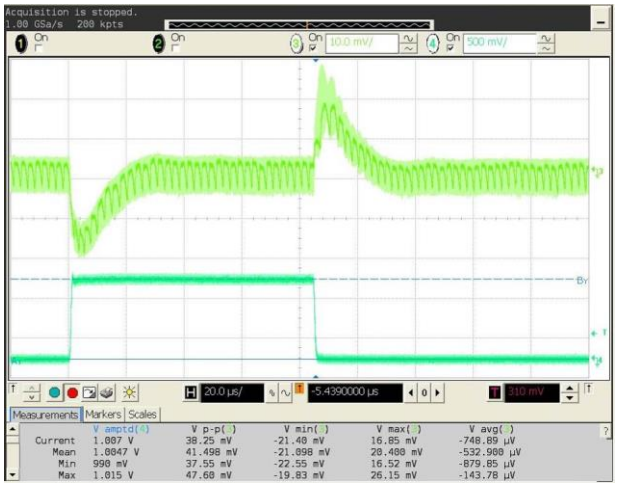

Figure 17 12Vin, 1.5Vout, 5A to 10A Load Step

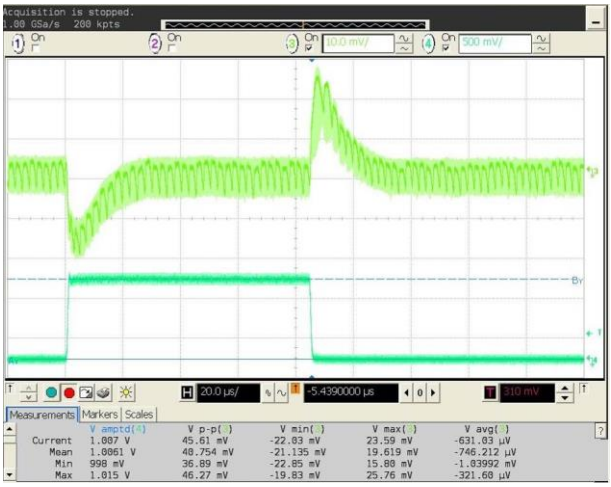

Figure 18 12Vin, 1.5Vout, 15A to 20A Load Step

Comments:

- Worst case undershoot is 23mV, 1.5%
- Worst case overshoot is 27.1mV, 1.8%

3.7 Load and Line Regulation

TMAR12 and TMAC11 are for remote sensing noise filtering and loop gain measurement.
When remote sensing is in place, it is recommended to set TMAR12 = 200Ω and TMAC11 = 0.22uF. **Connect Vsen to remote sensing point through a 20Ω resistor.**

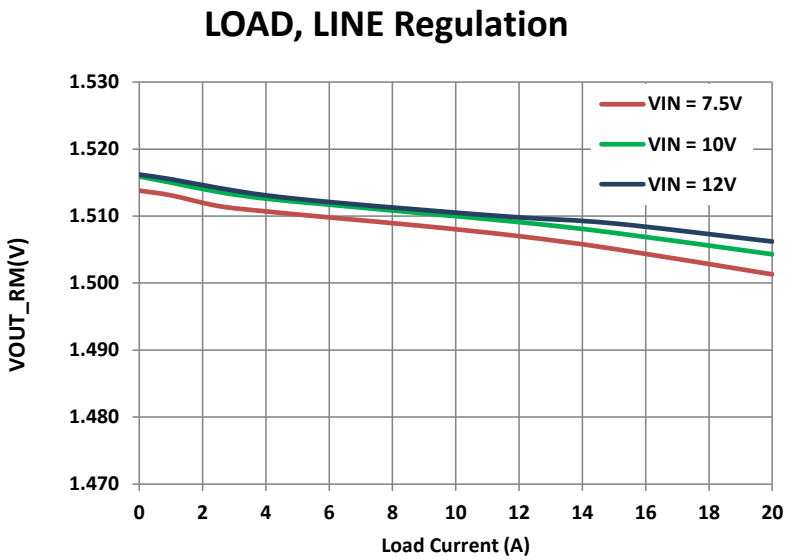

Figure 19 Output Regulation with R5 = 20Ω for VOUT = 1.5V

3.8 Short circuit protection and recovery

- Scope waveform will show:
  - **Output voltage, 1V/DIV**
  - **Output current, 10A/DIV**
  - **Phase node, 10V/DIV**
  - **Time Scale, 20msec/DIV**

Table 6 Short circuit protection entry and recovery, VOUT = 1.5V

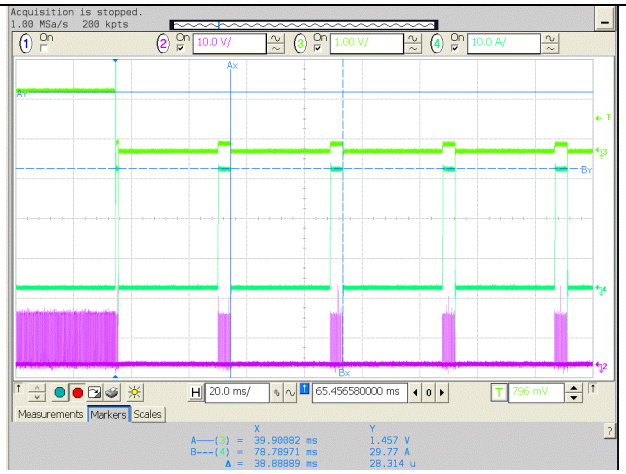

Figure 20 12Vin, Short circuit applied

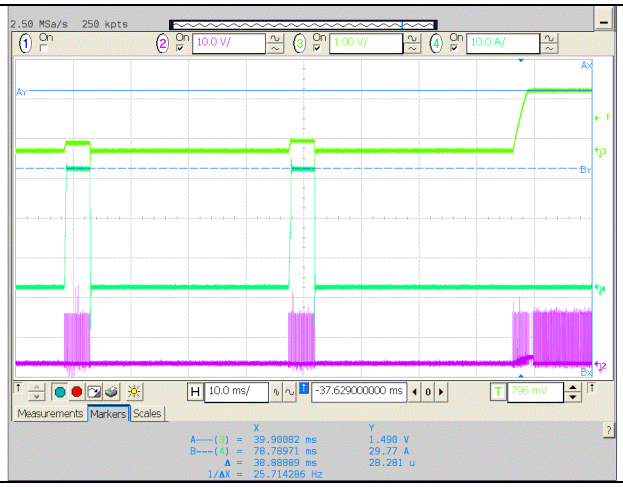

Figure 21 12Vin, Short circuit released

Comments:

- Typical overcurrent DC limit is set at 30.3A. Measured OC limit is 29.8A.
- Hiccup interval is 39msec.
- Current stress during hiccup is reduced to 10.6Arms.

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