PMP10449 Test Report
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Specification</td>
<td>4</td>
</tr>
<tr>
<td>2.0</td>
<td>Test Setup</td>
<td>4</td>
</tr>
<tr>
<td>3.0</td>
<td>Test Results</td>
<td>4</td>
</tr>
<tr>
<td>3.1</td>
<td>Start-up and Shut-down Behavior</td>
<td>4</td>
</tr>
<tr>
<td>3.1.1</td>
<td>Turn-on and Turn-off from VIN</td>
<td>4</td>
</tr>
<tr>
<td>3.1.2</td>
<td>Turn-on and Turn-off in presence of pre-bias on output</td>
<td>5</td>
</tr>
<tr>
<td>3.2</td>
<td>Voltage ripple and switch-node waveforms</td>
<td>5</td>
</tr>
<tr>
<td>3.2.1</td>
<td>Output Ripple Voltage</td>
<td>5</td>
</tr>
<tr>
<td>3.2.2</td>
<td>Maximum Phase Node Voltage Stress</td>
<td>7</td>
</tr>
<tr>
<td>3.3</td>
<td>Efficiency</td>
<td>7</td>
</tr>
<tr>
<td>3.4</td>
<td>Thermal Stress</td>
<td>8</td>
</tr>
<tr>
<td>3.5</td>
<td>Loop Gain Measurement</td>
<td>8</td>
</tr>
<tr>
<td>3.5.1</td>
<td>Bode plots at VIN = 7.5V and VOUT = 1.5V</td>
<td>8</td>
</tr>
<tr>
<td>3.5.2</td>
<td>Bode plots at VIN = 12V and VOUT = 1.5V</td>
<td>9</td>
</tr>
<tr>
<td>3.6</td>
<td>Load transient response</td>
<td>9</td>
</tr>
<tr>
<td>3.7</td>
<td>Load and Line Regulation</td>
<td>10</td>
</tr>
<tr>
<td>3.8</td>
<td>Short circuit protection and recovery</td>
<td>10</td>
</tr>
</tbody>
</table>
Table of Figures
Figure 1 Test Setup of the TPS53355, PMP10449 REV. A .................................................................4
Figure 2 Start Up, No Load ..................................................................................................................5
Figure 3 Shutdown, 25% Load ............................................................................................................5
Figure 4 Prebias Turn-on, 7.5Vin, 1.5Vout .......................................................................................5
Figure 5 Prebias Turn-on, 12Vin, 1.5Vout .........................................................................................5
Figure 6 12Vin, 1.5Vout, No Load, Phase and Vout ........................................................................6
Figure 7 12Vin, 1.5Vout, 20A, Phase and Vout ................................................................................6
Figure 8 12Vin, 1.5Vout, 0A, Phase and Vout ..................................................................................6
Figure 9 12Vin, 1.5Vout, 20A, Phase and Vout ................................................................................6
Figure 10 14Vin, 1.5Vout, 20A, Phase Node ....................................................................................7
Figure 11 Efficiency vs. Load at different VIN, VO= 1.5V ................................................................7
Figure 12 Thermal image of PMP10449 .........................................................................................8
Figure 13 Bode plots of Voltage Loop at VIN = 7.5V .................................................................8
Figure 14 Bode plots of Voltage Loop at VIN = 12V .................................................................9
Figure 15 7.5Vin, 1.5Vout, 5A to 10A Load Step ...........................................................................9
Figure 16 7.5Vin, 1.5Vout, 15A to 20A Load Step .........................................................................9
Figure 17 12Vin, 1.5Vout, 5A to 10A Load Step ...........................................................................10
Figure 18 12Vin, 1.5Vout, 15A to 20A Load Step ........................................................................10
Figure 19 Output Regulation with R5 = 20Ω for VOUT = 1.5V ...................................................10
Figure 20 12Vin, Short circuit applied ...........................................................................................11
Figure 21 12Vin, Short circuit released ..........................................................................................11
1.0 Specification

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIN, input voltage range</td>
<td>7.5</td>
<td>10</td>
</tr>
<tr>
<td>VOUT, output voltage</td>
<td>1.44</td>
<td>1.5</td>
</tr>
<tr>
<td>Iout, output current range</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Fsw, switching frequency</td>
<td>400</td>
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</tr>
</tbody>
</table>

2.0 Test Setup

![Test Setup Diagram]

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

<table>
<thead>
<tr>
<th>Figure 2 Start Up, No Load</th>
<th>Figure 3 Shutdown, 25% Load</th>
</tr>
</thead>
</table>

+ 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.

<table>
<thead>
<tr>
<th>Figure 4 Prebias Turn-on, 7.5Vin, 1.5Vout</th>
<th>Figure 5 Prebias Turn-on, 12Vin, 1.5Vout</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>Voltage Ripple and Switch-node waveforms</th>
<th>Figure 6 12Vin, 1.5Vout, No Load, Phase and Vout</th>
<th>Figure 7 12Vin, 1.5Vout, 20A, Phase and Vout</th>
</tr>
</thead>
</table>

#### 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

<table>
<thead>
<tr>
<th>Voltage Ripple with Broadband Noise</th>
<th>Figure 8 12Vin, 1.5Vout, 0A, Phase and Vout</th>
<th>Figure 9 12Vin, 1.5Vout, 20A, Phase and Vout</th>
</tr>
</thead>
</table>

#### 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](image)

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.

![Efficiency vs. Load -- VO = 1.5V](image)

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

![Thermal image of PMP10449](image)

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

![Bode plots](image)

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

![Bode plots](image)

**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

![Scope waveform](image)

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

**Figure 16** 7.5Vin, 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.

LOAD, LINE Regulation

![LOAD, LINE Regulation graph]

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

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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