Test Report: PMP30428
85-VAC - 400-VAC Input Multiple Output Flyback Reference Design

Description
The PMP30428_RevB reference design uses the UCC28700 valley switching flyback controller to generate 12V@1.1A. The controller provides accurate voltage and constant current regulation with primary-side feedback, eliminating the need for opto-coupler feedback circuits.

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1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1. Voltage and Current Requirements

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{IN}$</td>
<td>85VAC-400VAC</td>
</tr>
<tr>
<td>$V_{OUT}$</td>
<td><a href="mailto:12V@1.1A">12V@1.1A</a>; -3.3V@10mA</td>
</tr>
<tr>
<td>Nominal switching frequency</td>
<td>90kHz</td>
</tr>
</tbody>
</table>
2 Testing and Results

2.1 Efficiency Graphs

Figure 1. Efficiency

2.2 Load Regulation

Figure 2. Load Regulation 12Vout

2.3 Thermal Images

The images below show the infrared images taken from the FlexCam after 15min at full load output power.
Figure 3. Thermal Pic Top View

<table>
<thead>
<tr>
<th>Name</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mosfet Q1</td>
<td>75.1°C</td>
</tr>
<tr>
<td>Diode D1</td>
<td>64.8°C</td>
</tr>
<tr>
<td>Transformer T1</td>
<td>61.1°C</td>
</tr>
</tbody>
</table>

110VAC I_{12}V_{out}=1.1A I_{3.3}V_{out}=10mA
Top.is2

Input voltage = 110VAC
Output power = full load
Ambient temperature = 25°C
No heatsink, no airflow

Figure 4. Thermal Pic Bottom View

<table>
<thead>
<tr>
<th>Name</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode D101</td>
<td>88.6°C</td>
</tr>
<tr>
<td>Rectifier D3</td>
<td>52.1°C</td>
</tr>
</tbody>
</table>

110VAC I_{12}V_{out}=1.1A I_{3.3}V_{out}=10mA
Bottom.is2

Input voltage = 110VAC
Output power = full load
Ambient temperature = 25°C
No heatsink, no airflow
**Figure 5. Thermal Pic Top View**

<table>
<thead>
<tr>
<th>Name</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformer T1</td>
<td>60.9°C</td>
</tr>
<tr>
<td>Diode D1</td>
<td>64.3°C</td>
</tr>
<tr>
<td>Mosfet Q1</td>
<td>74.1°C</td>
</tr>
</tbody>
</table>

230VAC | 1.2Vout=1.1A | 3.3Vout=10mA
Top.is2

Input voltage = 230VAC
Output power = full load
Ambient temperature = 25°C
No heatsink, no airflow

**Figure 6. Thermal Pic Bottom View**

<table>
<thead>
<tr>
<th>Name</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode D101</td>
<td>83.4°C</td>
</tr>
<tr>
<td>Rectifier D3</td>
<td>42.3°C</td>
</tr>
</tbody>
</table>

230VAC | 1.2Vout=1.1A | 3.3Vout=10mA
Bottom.is2

Input voltage = 230VAC
Output power = full load
Ambient temperature = 25°C
No heatsink, no airflow
3 Waveforms

3.1 Switching

Figure 7. Switchnode

Input voltage = 325VDC
Output power = full load
Figure 8. Switchnode

Input voltage = 565VDC
Output power = full load
3.2  **Output Voltage Ripple**

**Figure 9. Output Voltage Ripple**

Input voltage = 325VDC  
Load current 12Vout = 1.1A  
Load current -3.3V = 10mA
3.3 Load Transients

Figure 10. Load Transient Response 12Vout

Input voltage = 110VAC
Load current 12Vout = 0.5A to 1.1A
Figure 11. Load Transient Response 12Vout

Input voltage = 230VAC
Load current 12Vout = 0.5A to 1.1A
3.4 Start-up Sequence

Figure 12. Start-up

Input voltage = 85VAC
Load current 12Vout = 1.1A
Load current -3.3V = 10mA
Figure 13. Start-up

Input voltage = 273VAC
Load current 12Vout = 1.1A
Load current -3.3V = 10mA
Figure 14. Start-up

Input voltage = 565VDC
Load current 12Vout = 1.1A
Load current -3.3V = 10mA
3.5 Input Ripple

Figure 15. Input Bulk Voltage

Input voltage = 85VAC
Load current 12Vout = 1.1A
Load current -3.3V = 10mA
### 3.6 Short Circuit Recovery

#### Figure 16. Short Circuit Test

<table>
<thead>
<tr>
<th>input voltage [VAC]</th>
<th>output 12Vout [V]</th>
<th>output 1-12Vout[A]</th>
<th>power [W]</th>
</tr>
</thead>
<tbody>
<tr>
<td>230</td>
<td>12.01</td>
<td>1.154</td>
<td>13.86</td>
</tr>
<tr>
<td>230</td>
<td>10.94</td>
<td>1.165</td>
<td>12.75</td>
</tr>
<tr>
<td>230</td>
<td>8.52</td>
<td>1.176</td>
<td>10.02</td>
</tr>
<tr>
<td>230</td>
<td>7.35</td>
<td>1.179</td>
<td>8.66</td>
</tr>
<tr>
<td>230</td>
<td>5.58</td>
<td>1.181</td>
<td>6.59</td>
</tr>
<tr>
<td>230</td>
<td>0.01</td>
<td>&gt;1.19</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>11.99</td>
<td>1.144</td>
<td>13.71</td>
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<tr>
<td>110</td>
<td>11.50</td>
<td>1.149</td>
<td>13.21</td>
</tr>
<tr>
<td>110</td>
<td>9.59</td>
<td>1.160</td>
<td>11.12</td>
</tr>
<tr>
<td>110</td>
<td>7.32</td>
<td>1.168</td>
<td>8.55</td>
</tr>
<tr>
<td>110</td>
<td>5.60</td>
<td>1.171</td>
<td>6.55</td>
</tr>
<tr>
<td>110</td>
<td>0.01</td>
<td>&gt;1.18</td>
<td></td>
</tr>
</tbody>
</table>
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