Description

This reference design uses a single UCC25800-Q1 device to drive two LLC transformers with 600-kHz switching frequency. This design uses the 750319177 transformer. The 750319177 is an off-the-shelf, catalog transformer featuring a low interwinding capacitance of 0.68 pF (typical) which is beneficial for minimizing common-mode current in gate driver bias applications with high slew rates. This design generates two isolated 18-V rails. Each output can be loaded to 1.5 W.

Features

- 78.8% peak efficiency
- Catalog transformer with low interwinding capacitance of 0.68 pF
- Input power limiting
- Converters can be paralleled for increased power

Applications

- Single phase online UPS

Top Photo
1 Test Prerequisites

1.1 Voltage and Current Requirements

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>+12-V input, ±5%</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>+18 V, +18 V</td>
</tr>
<tr>
<td>Max Current</td>
<td>85 mA per output</td>
</tr>
</tbody>
</table>

1.2 Required Equipment

- AC power supply
- Electronic load
- Digital multimeter
- Oscilloscope

1.3 Considerations

- Unless noted, all waveforms were captured at full load with a 12-V<sub>DC</sub> input

1.4 Dimensions

The PCB is a two-layer, 1-oz per layer design. The dimensions are 1.5 in × 2.21 in, with a maximum component height of 0.47 in.

1.5 Test Setup

- DC source capable of 25 V, 1 A
- Resistive loads rated for at least 1 W
2 Testing and Results

2.1 Load Regulation Graph

*Figure 2-1* shows the respective positive and negative voltage regulation graphs.

![Voltage Regulation Graph](image)

*Figure 2-1. Voltage Regulation*
2.2 Efficiency Graphs

Figure 2-2 shows the efficiency graph.

![Efficiency Graph]

2.3 Efficiency Data

Efficiency data is shown in the following table.

<table>
<thead>
<tr>
<th>Input Voltage Setting</th>
<th>Input Current (mA)</th>
<th>V&lt;sub&gt;OUT1&lt;/sub&gt; Voltage (V)</th>
<th>V&lt;sub&gt;OUT1&lt;/sub&gt; Current (mA)</th>
<th>V&lt;sub&gt;OUT2&lt;/sub&gt; Voltage (V)</th>
<th>V&lt;sub&gt;OUT2&lt;/sub&gt; Current (mA)</th>
<th>Total Input Power (W)</th>
<th>Total Output Power (W)</th>
<th>Efficiency (%)</th>
<th>Power Loss (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 V&lt;sub&gt;DC&lt;/sub&gt;</td>
<td>183.3</td>
<td>18.64</td>
<td>23.79</td>
<td>18.72</td>
<td>0.075</td>
<td>2.1996</td>
<td>0.4448</td>
<td>20.22</td>
<td>1.7548</td>
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<td>196.5</td>
<td>18.49</td>
<td>42.93</td>
<td>18.85</td>
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<td>2.3580</td>
<td>0.7952</td>
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<td>213.3</td>
<td>18.37</td>
<td>62.16</td>
<td>18.62</td>
<td>0.075</td>
<td>2.5596</td>
<td>1.1433</td>
<td>44.67</td>
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<td>231</td>
<td>18.61</td>
<td>86.55</td>
<td>18.18</td>
<td>0.08</td>
<td>2.7720</td>
<td>1.6121</td>
<td>58.16</td>
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<td>178</td>
<td>18.75</td>
<td>0.016</td>
<td>18.67</td>
<td>18.47</td>
<td>2.1360</td>
<td>0.3440</td>
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<td>191.1</td>
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<td>0.017</td>
<td>18.53</td>
<td>38.7</td>
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<td>58.8</td>
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<td>1.0822</td>
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<td>210.5</td>
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<td>252.3</td>
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<td>17.93</td>
<td>83.68</td>
<td>3.8616</td>
<td>3.0443</td>
<td>78.83</td>
<td>0.8173</td>
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2.4 Thermal Images

The following images show the thermal performance of the board after 15-min soak.

Figure 2-3. Thermal Image Full Load

Figure 2-4. Thermal Image No Load
3 Waveforms

Unless noted, all waveforms were captured at full load with a 12-V DC input.

3.1 Switching

Figure 3-1 shows the primary switch node with full load.

Figure 3-1. Switch Node Full Load

Figure 3-2 shows the primary switch node at no load.

Figure 3-2. Switch Node No Load
3.2 Output Voltage Ripple

The following waveforms shows the PMP23240 output voltage ripple of $V_{OUT1}$ and $V_{OUT2}$.

Figure 3-3. $V_{OUT1}$ Output Ripple

Figure 3-4. $V_{OUT2}$ Output Ripple
3.3 Load Transients

Figure 3-5 illustrates the no-load to full-load transient response of $V_{OUT1}$. $V_{OUT2}$ is loaded with 40 mA during the test.

Channel 2 (blue) = $V_{OUT2}$ AC coupled, Channel 3 (red) = $V_{OUT1}$ AC coupled, Channel 4 (green) = load current of $V_{OUT1}$

Figure 3-5. $V_{OUT1}$ Load Transient

Figure 3-6 illustrates the no-load to full-load transient response of $V_{OUT1}$. $V_{OUT1}$ is loaded with 40 mA during the test.

Channel 2 (blue) = $V_{OUT2}$ AC coupled, Channel 3 (red) = $V_{OUT1}$ AC coupled, Channel 4 (green) = load current of $V_{OUT2}$

Figure 3-6. $V_{OUT2}$ Load Transient
3.4 Start-up Sequence

Figure 3-7 shows the start-up with no load. Figure 3-8 shows the start-up with full load.

**Figure 3-7. Start-up No Load**

Channel 2 (blue) = Input voltage, Channel 3 (red) = \( V_{OUT1} \), Channel 4 (green) = \( V_{OUT2} \)

**Figure 3-8. Start-Up With \( V_{IN} \)**

Channel 2 (blue) = Input voltage, Channel 3 (red) = \( V_{OUT1} \), Channel 4 (green) = \( V_{OUT2} \)
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