1 Photo

The photographs below show the PMP9176 Rev A assembly. This circuit was built on a PMP9176 Rev A PCB.

Top side

Bottom side
## 2 Converter Efficiency

The efficiency data is shown in the tables and graph below.

### V_{in}=50V_{AC}/60Hz

<table>
<thead>
<tr>
<th>Vin(V)</th>
<th>Iin(mA)</th>
<th>Pin(W)</th>
<th>Vout(V)</th>
<th>Iout(A)</th>
<th>Pout(W)</th>
<th>Losses(W)</th>
<th>Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.04</td>
<td>75.81</td>
<td>1.725</td>
<td>9.16</td>
<td>0.1208</td>
<td>1.106528</td>
<td>0.618472</td>
<td>64.15%</td>
</tr>
<tr>
<td>50</td>
<td>59.94</td>
<td>1.363</td>
<td>9.15</td>
<td>0.1</td>
<td>0.915</td>
<td>0.448</td>
<td>67.13%</td>
</tr>
<tr>
<td>50.02</td>
<td>47.45</td>
<td>1.06</td>
<td>9.16</td>
<td>0.08</td>
<td>0.7328</td>
<td>0.3272</td>
<td>69.13%</td>
</tr>
<tr>
<td>50.04</td>
<td>36.28</td>
<td>0.7841</td>
<td>9.16</td>
<td>0.06</td>
<td>0.546</td>
<td>0.2345</td>
<td>70.09%</td>
</tr>
<tr>
<td>50.07</td>
<td>31.04</td>
<td>0.6566</td>
<td>9.17</td>
<td>0.05</td>
<td>0.4585</td>
<td>0.1981</td>
<td>69.83%</td>
</tr>
<tr>
<td>50.06</td>
<td>25.83</td>
<td>0.5318</td>
<td>9.17</td>
<td>0.04</td>
<td>0.3668</td>
<td>0.165</td>
<td>68.97%</td>
</tr>
<tr>
<td>50.09</td>
<td>20.4</td>
<td>0.404</td>
<td>9.17</td>
<td>0.03009</td>
<td>0.275925</td>
<td>0.1280747</td>
<td>68.30%</td>
</tr>
<tr>
<td>50.12</td>
<td>14.45</td>
<td>0.2706</td>
<td>9.19</td>
<td>0.01935</td>
<td>0.177827</td>
<td>0.0927735</td>
<td>65.72%</td>
</tr>
<tr>
<td>50.15</td>
<td>8.732</td>
<td>0.15062</td>
<td>9.21</td>
<td>0.00971</td>
<td>0.089429</td>
<td>0.0611909</td>
<td>59.37%</td>
</tr>
<tr>
<td>50.18</td>
<td>1.974</td>
<td>0.02795</td>
<td>9.25</td>
<td>0</td>
<td>0</td>
<td>0.02795</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

![Diagram showing efficiency data](https://via.placeholder.com/150)
### Test Results

**V_{in}=230V_{AC}/50Hz**

<table>
<thead>
<tr>
<th>Vin(V)</th>
<th>Iin(mA)</th>
<th>Pin(W)</th>
<th>Vout(V)</th>
<th>Iout(A)</th>
<th>Pout(W)</th>
<th>Losses(W)</th>
<th>Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>230</td>
<td>22.96</td>
<td>1.613</td>
<td>9.16</td>
<td>0.12</td>
<td>1.0992</td>
<td>0.5138</td>
<td>68.15%</td>
</tr>
<tr>
<td>230</td>
<td>19.74</td>
<td>1.357</td>
<td>9.15</td>
<td>0.1</td>
<td>0.915</td>
<td>0.442</td>
<td>67.43%</td>
</tr>
<tr>
<td>230</td>
<td>16.543</td>
<td>1.11</td>
<td>9.15</td>
<td>0.08</td>
<td>0.732</td>
<td>0.378</td>
<td>65.95%</td>
</tr>
<tr>
<td>230</td>
<td>13.306</td>
<td>0.871</td>
<td>9.16</td>
<td>0.06</td>
<td>0.5496</td>
<td>0.3214</td>
<td>63.10%</td>
</tr>
<tr>
<td>230</td>
<td>11.51</td>
<td>0.7429</td>
<td>9.17</td>
<td>0.05</td>
<td>0.4585</td>
<td>0.2844</td>
<td>61.72%</td>
</tr>
<tr>
<td>230</td>
<td>9.67</td>
<td>0.6156</td>
<td>9.18</td>
<td>0.04</td>
<td>0.3672</td>
<td>0.2484</td>
<td>59.65%</td>
</tr>
<tr>
<td>230</td>
<td>7.598</td>
<td>0.4751</td>
<td>9.16</td>
<td>0.03011</td>
<td>0.275808</td>
<td>0.1992924</td>
<td>58.05%</td>
</tr>
<tr>
<td>230</td>
<td>5.386</td>
<td>0.3353</td>
<td>9.16</td>
<td>0.01938</td>
<td>0.177521</td>
<td>0.1577792</td>
<td>52.94%</td>
</tr>
<tr>
<td>230</td>
<td>3.247</td>
<td>0.2095</td>
<td>9.17</td>
<td>0.00973</td>
<td>0.089224</td>
<td>0.1202759</td>
<td>42.59%</td>
</tr>
<tr>
<td>230</td>
<td>0.7799</td>
<td>0.07597</td>
<td>9.25</td>
<td>0</td>
<td>0</td>
<td>0.07597</td>
<td>0.00%</td>
</tr>
</tbody>
</table>
3 Thermal Images
The thermal images below show a top view and bottom view of the board under 50V_{ac}/60Hz and 230V_{ac}/50Hz input conditions. The ambient temperature was 20°C with no forced air flow. The output was at full load: 9V/0.12A.

\[ V_{in} = 50V_{AC}/60Hz \]

Top Side

Bottom Side
$V_{in} = 230V_{AC}/50Hz$

**Top Side**

**Bottom Side**
4 Startup Waveforms
The output voltages at startup with constant current load are shown in the images below.

4.1 Start Up @ 50V_\text{ac}: 9V/0.12A.

4.2 Start Up @ 50V_\text{ac}: no load.
4.3 **Start Up @ 120V\textsubscript{ac}: 9V/0.12A.**

![Graph 1](image1.png)

4.4 **Start Up @ 120V\textsubscript{ac}: no load.**

![Graph 2](image2.png)
4.5 **Start Up @ 230V<sub>ac</sub>: 9V/0.12A.**

4.6 **Start Up @ 230V<sub>ac</sub>: no load.**
5 Turn off

The output voltage at turn off transient is shown in the image below at full load (9V/0.12A) and 120V_{ac}/60Hz input.

![Image of output voltage at turn off transient](image.png)
6 Output Ripple Voltages
The output ripple voltages are shown in the plots below.

6.1 50V$_{ac}$: 9V/0.12A.

6.2 50V$_{ac}$: No load.
6.3  **120V\text{ac}: 9V/0.12A.**

6.4  **120V\text{ac}: No load.**
6.5 230V_ac: 9V/0.12A.

6.6 230V_ac: No load.
7 Load Transient

The image below shows $9V_{\text{out}}$ voltage response to a \textbf{0.06A to 0.12A} load transient @ 120V$_{\text{ac}}$/60Hz.
8 Switching Waveforms

The images below show key switching waveforms of PMP9176RevA. The waveforms are measured with 0.12A full load.

8.1 Diode D4 @ 50V<sub>ac</sub>/60Hz

8.2 Diode D4 @ 120V<sub>ac</sub>/60Hz
8.3 Diode D4 @ 230V_{ac}/60Hz

8.4 Diode D4 @ 275V_{ac}/60Hz
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