Test Report
For PMP15013
05/12/2016

TEXAS INSTRUMENTS
1. Design Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vin Min</td>
<td>18 VDC</td>
</tr>
<tr>
<td>Vin Normal</td>
<td>24 VDC</td>
</tr>
<tr>
<td>Vin Max</td>
<td>36 VDC</td>
</tr>
<tr>
<td>Vout</td>
<td>5 VDC</td>
</tr>
<tr>
<td>Iout</td>
<td>3 A</td>
</tr>
<tr>
<td>Wide Vin DCDC Switching Frequency</td>
<td>400 kHz</td>
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2. Circuit Description
The PMP15013 reference design is a 4-layer board 5V/3A output power supply using LMR16030 buck regulator for 24V bus in industry application. LMR16030 is a 4.5V to 60V input, 3A output capable, and 200 kHz to 2.5MHz non-sync buck regulator. This reference design has an input voltage range of 18V to 36V, covering the wide variation condition for the 24V bus in industry application. The reference board includes an input EMI filter section, and the layout is optimized for improved EMI performance on a 4-layers PCB. The board was tested under the Industry CISPR 22, and the conducted emissions (CE) and radiated emissions (RE) were compliance with the CISPR 22 Class B requirement with 10dB margin.

3. Board Photos

![Reference Design Board Top View (61x42mm²)](image)

Figure 1. Reference Design Board Top View (61x42mm²)
4. Efficiency and Load Regulation

![Efficiency and Load Regulation Graph](image)

**Figure 2. Reference Design Board Bottom View (61x42mm²)**

**Figure 3. Power Efficiency with 24V/36V Input Voltage**
5. EMI Test
5.1 Test Setup
The conducted and radiated emissions were tested under the CISPR 22 standards. The test setup is shown in Figure 5 and Figure 6. A 24V input voltage was from 220VAC and three 5Ohm resistors were soldered on the output terminals of the test board as a 3A load.

Figure 4. Load Regulation with 24V/36V Input Voltage

Figure 5. Conducted Emissions Test Setup
On the reference design board, the input EMI filter section (Figure 7) has a common mode filter stage and a differential mode filter stage. The common mode filter section is to further suppress the high frequency EMI noise (>30MHz) while the differential mode is to suppress the fundamental frequency or low-order harmonics. Both CE and RE were tested with and without the common mode filter. The test results show that the reference design board is compliance with CISPR 22 Class B with and without common mode filter (10dB margin). Adding the common mode filter has better CE performance at 30MHz. Note that all the other tests were done with the common mode filter.
The common mode filter section is optional

Figure 7. Input filter schematic

5.2 Test Results

Figure 8. Conducted EMI scan, with common mode filter

Figure 9. Conducted EMI scan, without common mode filter
Figure 10. Radiated EMI scan, with common mode filter

Figure 11. Radiated EMI scan, without common mode filter

6. Waveforms

(a) $V_{IN}=12V$, no load
(b) $V_{IN}=12V$, $I_O=3A$

Figure 12. Start up waveforms with 12V input voltage and different load current
Figure 13. Ripple waveforms with 12V input voltage and different load current

(a) $V_{IN}=12V$, no load

(b) $V_{IN}=12V$, $I_o=3A$

Figure 14. Switching waveforms with 12V input voltage and different load current

(a) $V_{IN}=12V$, no load

(b) $V_{IN}=12V$, $I_o=3A$

Figure 15. Load transient with 12V input voltage (0A-3A-0A, 0.1A/us)
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