**Test Report: PMP21404**

**High-Efficiency Boost Converter Power Supply Reference Design for Automotive DC/AC Inverter**

**Description**

This single-phase boost converter operates over an input voltage range of 120 V-350 V and provides a non-isolated output of 221 V/0.87 A. Input voltages above 221 V are passed through to the output. With an efficiency of greater than 97%, component losses are reduced which result in lowers operating temperatures and minimal heat sink requirements.
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>Input voltage range</td>
<td>120 V – 350 V</td>
</tr>
<tr>
<td>Output voltage</td>
<td>221 V, for Vin &lt; 221 V</td>
</tr>
<tr>
<td></td>
<td>Vin, for Vin &gt; 221 V</td>
</tr>
<tr>
<td>Output current</td>
<td>0.87 A</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>125 kHz</td>
</tr>
<tr>
<td>External bias voltage</td>
<td>12 V</td>
</tr>
</tbody>
</table>

1.2 Required Equipment

- Power supply capable of 400 V and 3 A
- 12 V / 0.1 A bias power supply
- 250 Ohm/200 W resistive or 400 V/1 A active load
- Digital Multimeters
- 500 MHz oscilloscope and probes
- Stability measurement device (Venable or Bode)
2 Testing and Results

2.1 Efficiency and Regulation Graphs

The boost converter efficiency is shown below with the input voltage set to 150 V and 200 V.
2.2 SEPIC Loop Gain

The plot below shows the boost converters loop gain with the input voltage set to 150 V and 205 V while loaded at 0.9 A.

Loop Gain (Vin = 150 V) BW: 3.46 kHz PM: 85 degrees
Loop Gain (Vin = 205 V) BW: 2.25 kHz PM: 69 degrees

The plot below shows the boost converters loop gain with the input voltage set to 150 V and 205 V while loaded at 0.18 A.

Loop Gain (Vin = 150 V) BW: 392 Hz PM: 91 degrees
Loop Gain (Vin = 205 V) BW: 416 Hz PM: 102 degrees
2.3  **Thermal Image**

A thermal image is shown below with the boost converter operating at 150 V input and 221 V/0.9 A output (room temp, no airflow).
3 Waveforms

3.1 Startup

The photo below shows the startup of the 221 V output voltage (Blue) after the input voltage (RED) crosses the UVLO threshold of 142 V. Iout = 0 A. (50 V/DIV, 5 mS/DIV)

The photo below shows the startup of the 221 V output voltage (Blue) after the input voltage (RED) crosses the UVLO threshold of 142 V. Iout = 0.9 A. (50 V/DIV, 5 mS/DIV)
3.2 Output Ripple Voltage

The output ripple voltage (AC coupled) is shown in the figure below. BWL = 20 MHz, Vin = 142 V, Vout = 221 V, Iout = 0.9 A

(1 V/DIV, 5 uS/DIV)

The output ripple voltage (AC coupled) is shown in the figure below. BWL = 20 MHz, Vin = 205 V, Vout = 221 V, Iout = 0.9 A

(1 V/DIV, 5 uS/DIV)
3.3 **Switch Node Waveforms**

The photo below shows the FET switching voltage at TP2 and the input voltage.  
Vin = 142 V, Vout = 221 V, Iout = 0.9 A.  
(50 V/DIV, 2 uS/DIV)

![Waveform 1](image1)

The photo below shows the FET switching voltage at TP2 and the input voltage.  
Vin = 142 V, Vout = 221 V, Iout = 0.019 A.  
(50 V/DIV, 2 uS/DIV)

![Waveform 2](image2)
The photo below shows the FET switching voltage at TP2 and the input voltage. Vin = 205 V, Vout = 221 V, Iout = 0.9 A. (50 V/DIV, 2 uS/DIV)

The photo below shows the FET switching voltage at TP2 and the input voltage. Vin = 205 V, Vout = 221 V, Iout = 0.18 A. (50 V/DIV, 2 uS/DIV)
3.4 Load Transient

The photo below shows the 221 V output voltage (ac coupled) when the load current is stepped from 0.45 A to 0.9 A. Vin = 150 V. (1 V/DIV, 5 mS/DIV)

The photo below shows the 221 V output voltage (ac coupled) when the load current is stepped from 0.9 A to 0.45 A. Vin = 150 V. (1 V/DIV, 5 mS/DIV)
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