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Topology: Sync. Boost  
Device: LM5121  
RC snubber: OPEN / 4.7Ohm, 330pF

**Basic Data:**  
Fsw 400kHz, correct to a dot  
ON: 33.7V  
OFF: 30.5V  
CS threshold: trips at 6.0A input current, corresponding to 3.7A output current  
Total Efficiency: >97%

Output Voltage Ripple: 150mVpp (<0.5%)  
Transient Response: 300mVpk @ 500mA<->3A (<1%)  
Load Regulation: 20mV (<0.05%)
1 Startup
The startup waveform is shown in the Figure 1. The input voltage was set at 35V, with 3A load at the output. Power supply was switched on, ON at 33.7V input, startup 16ms:

![Figure 1](image1)

Ch1=> input voltage
10V/div
Ch2=> output voltage
10V/div
10ms/div

2 Shutdown
The shutdown waveform is shown in the Figure 2. The input voltage was set at 35V, with 3A load on the output. Power supply was switched off (input shorted):

![Figure 2](image2)

Ch1=> input voltage
10V/div
Ch2=> output voltage
10V/div
2ms/div
3 Efficiency

The efficiency is shown in the Figure 3 below. The input voltage was set to 35V:

\[
\begin{array}{cccccc}
Vin(V) & Iin(A) & Vout & Iout & Pin(W) & Pout & Effcy \\
35.003 & 4.926 & 55.448 & 3.021 & 172.42 & 167.51 & 0.9715 \\
35.005 & 4.103 & 55.447 & 2.522 & 143.63 & 139.84 & 0.9736 \\
35.006 & 3.277 & 55.449 & 2.009 & 114.71 & 111.4 & 0.9711 \\
35.006 & 2.477 & 55.449 & 1.511 & 86.71 & 83.783 & 0.9663 \\
35.006 & 1.675 & 55.451 & 1.0088 & 58.635 & 55.939 & 0.954 \\
35.007 & 0.8694 & 55.453 & 0.5003 & 30.435 & 27.743 & 0.9116 \\
\end{array}
\]

Effcy >97% in a load range 2A..3A (filter included); power losses 4.91W at full load 3A.
4 Load Regulation

The load regulation of the output is shown in the Figure 4 below. The input voltage was set to 35V. Load regulation 20mV (<0.05%):

![Figure 4](image-url)
5 Ripple Voltages

The output ripple voltage is shown in Figure 5. The image was taken with a 3A load 35V at the input, du = 150mVpp sinewave:

![Figure 5](image)

The output ripple voltage before filtering is shown in Figure 6. The image was taken with a 3A load 35V at the input, du 1500mV, filter attenuation 0.1 means -20dB:

![Figure 6](image)
The input ripple voltage is shown in Figure 7. The image was taken with a 3A load 35V at the input, 50mVpp sinewave (reflected voltage ripple depends on source impedance):
6 Control Loop Frequency Response

Figure 8 shows the loop response with 3A load and 35V input.

Table 1 summarizes the results from Figure 8

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandwidth (kHz)</td>
<td>2.88</td>
</tr>
<tr>
<td>Phasemargin</td>
<td>97°</td>
</tr>
<tr>
<td>slope (20dB/decade)</td>
<td>-0.872</td>
</tr>
<tr>
<td>gain margin (dB)</td>
<td>-13.7</td>
</tr>
<tr>
<td>slope (20dB/decade)</td>
<td>-0.618</td>
</tr>
<tr>
<td>freq (kHz)</td>
<td>75.3</td>
</tr>
</tbody>
</table>

Table 1
7 Load Transients

The Figure 9 shows the response to load transients. The load is switching from 0.5A to 3A. The input voltage was set to 35V, transient response du is 300mVpk, <1%:

![Figure 9](image)

<table>
<thead>
<tr>
<th>Ch1 =&gt; output voltage</th>
<th>200mV/div</th>
</tr>
</thead>
<tbody>
<tr>
<td>20MHz bandwidth setting</td>
<td></td>
</tr>
<tr>
<td>Ch2 =&gt; output current</td>
<td>1A/div</td>
</tr>
<tr>
<td>2ms/div</td>
<td></td>
</tr>
</tbody>
</table>

Figure 9
8 Miscellaneous Waveforms

8.1 Switch node (Low Side FET)

With input voltage set to 35V and 3A Iout results in the waveform shown in Figure 10.

![Waveform Diagram]

Figure 10
8.2 Gate Control of Low side MOS-FET Q2

Figure 11 shows the gate control Q2; with input voltage set to 35V and 3A $i_{out}$ results in the waveform shown below:

![Waveform of gate control Q2](image-url)
8.3 Hi Side MOS FET Q3 w/o RC snubber

The waveform is shown in Figure 12 (the same setup as above), OS 90V/100MHz:

![Waveform Diagram]

Figure 12
A RC snubber circuit 330pF / 4.7Ohm was implemented to reduce overshoot and RF ringing:

Figure 13

Figure 14
Gate Control of High Side MOS FET Q3

With input voltage set to 35V and 3A \( I_{\text{out}} \), results in the waveform shown in Figure 15:

![Waveform Diagram](image-url)
9 Thermal Image

Figure 16 shows the thermal image at 35V input and 2A output = 110W output power

<table>
<thead>
<tr>
<th>Name</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q3</td>
<td>61.0°C</td>
</tr>
<tr>
<td>Q2</td>
<td>60.0°C</td>
</tr>
<tr>
<td>D4</td>
<td>55.9°C</td>
</tr>
</tbody>
</table>

Table 2

Figure 17 shows the thermal image at 35V input and 3A output = 165W output power

<table>
<thead>
<tr>
<th>Name</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q2</td>
<td>77.0°C</td>
</tr>
<tr>
<td>Q3</td>
<td>71.6°C</td>
</tr>
<tr>
<td>D4</td>
<td>67.1°C</td>
</tr>
</tbody>
</table>

Table 3
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