Automotive Sepic with 8.0V @ 1.5A / 2.5A peak

- **Input** 2..20V DC
- **Output**
  - 5..20V input: 8.0V @ 1.5A continuous / 2.5A peak
  - 2..5V input: 8.0V @ 0.75A / 1.0A peak
- **Controller** TPS40210-Q1
- Free-Running switching frequency of 300 kHz
- Built on PCB 5171 Rev.A
1 Startup

The startup waveform is shown in Figure 1. The input voltage is set at 14V, with no load on the 8V output.

Channel C2: **14V Input voltage**
5V/div, 10ms/div

Channel C1: **8V Output voltage**
5V/div, 10ms/div

![Startup waveform graph](image_url)
2 Shutdown

The shutdown waveform is shown in Figure 2. The input voltage is set at 14V with a 1.5A load on the 8V output.

Channel C2: **14V Input voltage**
5V/div, 10ms/div

Channel C1: **8V Output voltage**
5V/div, 10ms/div

![Figure 2](image-url)
3 Efficiency

The efficiency and load regulation for 5..20V input voltage range are shown in Figure 3 and Figure 4.

![Figure 3](chart1.png)

**Figure 3**

![Figure 4](chart2.png)

**Figure 4**
The efficiency and load regulation for the 2..5V input voltage range are shown in Figure 5 and Figure 6.

**Figure 5**

**Figure 6**
4 Load step

The response to a load step and a load dump for the 8V output at an input voltage of 14V is shown in Figure 7.

Channel C2: **Output voltage**, -616mV undershoot, 600mV overshoot
500mV/div, 1ms/div, AC coupled

Channel C1: **Load current**, load step 1.5A to 2.5A and vice versa
500mA/div, 1ms/div

![Figure 7](image-url)
5 Frequency response

Figure 8 shows the loop response at 5V, 14V and 20V input voltage and a load of 2.5A.

5V input
- 80 deg phase margin @ crossover frequency 2.1 kHz
- -12 db gain margin

14V input
- 72 deg phase margin @ crossover frequency 3.5 kHz
- -17 db gain margin

20V input
- 72 deg phase margin @ crossover frequency 4.0 kHz
- -18 db gain margin
Figure 9 shows the loop response at 2V and 5V input voltage and a load of 1.0A.

2V input
- 54 deg phase margin @ crossover frequency 1.0 kHz
- -10 db gain margin

5V input
- 79 deg phase margin @ crossover frequency 2.2 kHz
- -19 db gain margin
6 Switching Node

The drain-source voltage on the switching node is shown in Figure 10. The image was captured with 20V input and 2.5A load.

Channel C2: **Drain-source voltage**, -2.3V minimum voltage, 36.4V maximum voltage
10V/div, 2us/div

![Figure 10](image-url)
7 Thermal measurement

The thermal image (Figure 11) shows the circuit at an ambient temperature of 21 °C with an input voltage of 14V and a load of 2.5A.

Figure 11

<table>
<thead>
<tr>
<th>Markers</th>
<th>Temperature</th>
<th>Emissivity</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>62.9 °C</td>
<td>0.95</td>
<td>21.0 °C</td>
</tr>
<tr>
<td>L1</td>
<td>64.0 °C</td>
<td>0.95</td>
<td>21.0 °C</td>
</tr>
<tr>
<td>R5</td>
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<td>0.95</td>
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<tr>
<td>U1</td>
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<td>0.95</td>
<td>21.0 °C</td>
</tr>
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</table>
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