Flyback Current-Fed Push-Pull Converter for Telecom Applications

- “Weinberg” converter
- Input filter with inrush current limitation and protection
- 36.0 … 72.0V input voltage
- 28.0V @ 12.0A

1 Startup
The startup waveform is shown in Figure 1. The input voltage is set at 48.0V, with no load on the output.

Channel C1: **input voltage**
10V/div, 50ms/div

Channel C2: **output voltage**
10V/div, 50ms/div

![Figure 1](image-url)
2 Shutdown

The shutdown waveform is shown in Figure 2. The input voltage is set at 48.0V with a 12.0A load on the output.

Channel C1: input voltage
10V/div, 5ms/div

Channel C2: output voltage
10V/div, 5ms/div

Figure 2
3 Efficiency

The efficiency of the converter without the input filter and protection is shown in Figure 3.

![Efficiency Graph](image_url)
4 Load regulation

The load regulation is shown in Figure 4.

![Load regulation graph](Image)
5 Output ripple voltage

The output ripple voltage at 12.0A load at 36.0V, 48.0V and 72.0V input voltage is shown in Figure 5.

Channel C1: output voltage
100mV/div, 5μs/div, AC coupled

Due to the noise picked up by the probe the very small ripple can’t be measured.

Figure 5
6 Load transients

The response to a load step and a load dump at an input voltage of 48.0V is shown in Figure 6 and Figure 7.

Channel C2: **output voltage**, -253mV undershoot, 43mV overshoot
200mV/div, 1ms/div, AC coupled

Channel C1: **load current**, load step 6.0A to 12.0A
5A/div, 1ms/div

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![Figure 6](image-url)
Channel C2: **output voltage**, 243mV overshoot, -27mV undershoot
200mV/div, 1ms/div, AC coupled

Channel C1: **load current**, load dump 12.0A to 6.0A
5A/div, 1ms/div

Figure 7
7 Frequency response

Figure 8 shows the loop response with 36.0V, 48.0V and 72.0V input voltage and a 12.0A load.

92 deg phase margin @ crossover frequency 2.68 kHz

Figure 8
8 Miscellaneous waveforms

The voltage on the center tap of the push-pull transformer is shown in Figure 9. The image was captured with 72.0V input voltage and a 12.0A load.

Channel C2: center tap voltage
50V/div, 2us/div

![Figure 9]
The voltage on the drain of Q3 and Q8 are shown in Figure 10 and Figure 11. The image was captured with 72.0V input voltage and a 12.0A load.

Channel C2: **drain-source voltage**, -5.0V minimum voltage, 196.0V maximum voltage
50V/div, 2us/div

**Figure 10**

drain-source voltage Q3

**Figure 11**

drain-source voltage Q8
The anode-cathode voltage of D8 and D9 (push-pull) are shown in Figure 12 and Figure 13. The image was captured with 72.0V input voltage and a 12.0A load.

Channel C2: anode-cathode, -75.2V minimum voltage, 3.5V maximum voltage
20V/div, 2us/div

Figure 12
drain-source voltage D8

Figure 13
drain-source voltage D9
The anode-cathode voltage of D4 (flyback) is shown in Figure 14. The image was captured with 72.0V input voltage and a 12.0A load.

Channel C2: **anode-cathode**, -119.8V minimum voltage, 5.7V maximum voltage
20V/div, 2μs/div

![Figure 14](image-url)
9 Thermal measurement

The thermal image (Figure 15) shows the circuit at an ambient temperature of 23 °C with an input voltage of 48.0V and a load of 12.0A.

![Thermal Image](image)

**Figure 15**

### Markers

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<th>Label</th>
<th>Temperature</th>
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<th>Background</th>
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<td>23.0 °C</td>
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<td>D2</td>
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<tr>
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<tr>
<td>Q8</td>
<td>51.9 °C</td>
<td>0.95</td>
<td>23.0 °C</td>
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