High Voltage Power Supply Using a Highly Integrated DC/DC Converter (TPS61040)

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ABSTRACT

The TPS61040 is a highly integrated, low power, boost converter capable of delivering output voltages up to 28 V. However, using a coupled inductor enables the TPS61040 to be used in applications where higher voltages are required. Output voltages up to 75 V are achieved using this technique.

In the typical application circuit for the TPS61040, the maximum allowable voltage on the SW pin limits the output voltage to 28 V. Substituting the inductor with a 1 to 5 transformer allows the TPS61040 to deliver output voltages over 75 V. In this configuration, the output voltage can be achieved at any voltage as long as Vsw is kept below 28 V. The corresponding output current capability is given in the TPS61040 data sheet. The circuit shown in Figure 1 generates a 75-V output that can supply up to 6 mA, depending upon the input voltage.

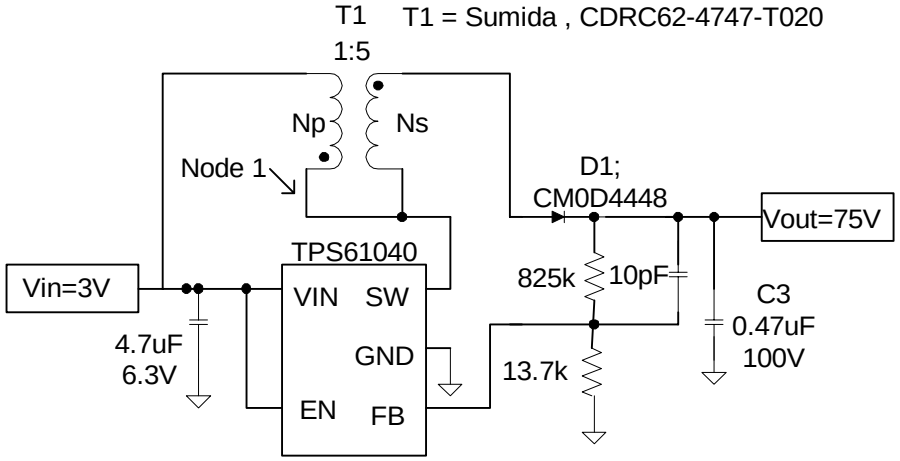

Figure 1. Application Circuit Using the TPS61040

When the internal power switch of the TPS61040 is closed, current flows from the input, through the primary winding of T1, through the internal switch, to ground. During this time, the voltage at node 1 (Vsw) is 0 V. The primary voltage (Vp) and the secondary voltage (Vs) are given by the following equations:

$$V_p = V_{in} = 3V$$

$$V_s = \frac{N_s}{N_p} \cdot V_p = \frac{5}{1} \cdot 3V = 15V$$

During this time, D1 is reverse biased, so the output current is supplied by the output capacitor, C3. When the internal power switch of the TPS61040 is open, current flows from the input, though the primary and secondary of T1, through D1, to the output. During this time, the voltage at node 1 (Vsw), the primary voltage (Vp), and the secondary voltage (Vs) can be calculated by the following equations:

$$V_p = \frac{N_p}{N_p + N_s} \cdot (V_{out} - V_{in}) = \frac{1}{6} \cdot (75 - 3) = 12V$$

$$V_s = \frac{N_s}{N_p + N_s} \cdot (V_{out} - V_{in}) = \frac{5}{6} \cdot (75 - 3) = 60V$$

$$V_{sw} = V_{in} + V_p = 3V + 12V = 15V$$

The output is regulated to 75 V through the feedback divider that goes back to the FB pin of the TPS61040.

References

1. TPS61040 data sheet (Texas Instruments literature number SLVS413)
2. TPS61040EVM-001 User's Guide (Texas Instruments literature number SLVU065)
3. TPS61040 and TPS61041 Worksheet Software Tool (Texas Instruments literature number SLVC007)

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