High-Voltage Power Supply Using the Highly Integrated TPS61040

PMP Portable Power

ABSTRACT

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

1 Features

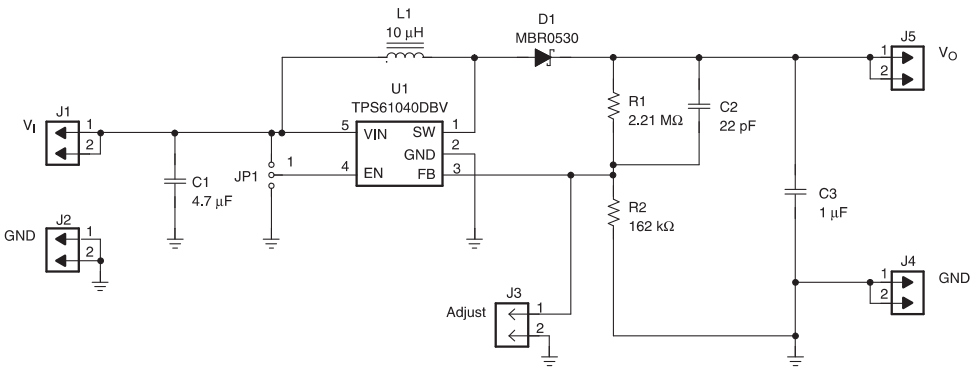
- 1.8 V to 6 V Input Voltage Range
- Adjustable Output Voltage Range up to 28 V
- 400 mA (TPS61040) and 250 mA (TPS61041) Internal Switch Current
- Up to 1 MHz Switching Frequency
- 28 µA Typical No Load Quiescent Current
- 1 µA Typical Shutdown Current
- Internal Softstart
- Available in a Tiny 5-Pin SOT23 Package

2 TPS61040 Reference Design

The reference design uses the TPS61040 boost converter to generate an 18-V output from a single-cell, Li-Ion battery (3 V to 4.2 V). The output voltage in the design can be adjusted up to 28 V by modifying the resistor values used in resistor divider R1 and R2.

3 TPS61040 Schematic and Bill of Materials

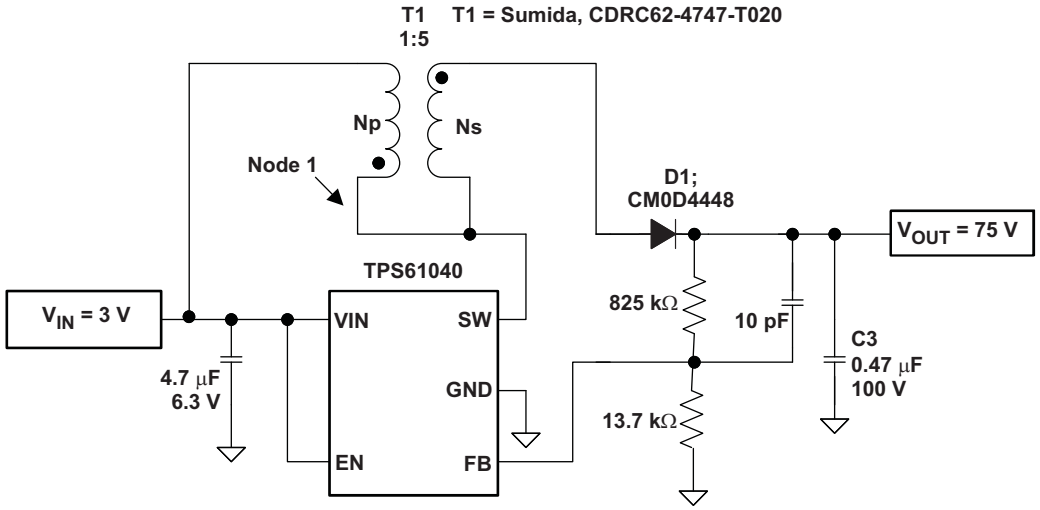
3.1 TPS61040 Schematic



3.2 Bill of Materials

QTY	Reference	Description	Size	MFG	Part Number
1	C1	Capacitor, ceramic, 4.7 µF, 6.3 V, X5R, 15%	0805	Murata	GRM21B60J475KA11
1	C2	Capacitor, ceramic, 22 pF, 50 V, C0G, 5%	0603	Murata	GRM1885C1H220JZ01
1	C3	Capacitor, ceramic, 1 µF, 25 V, X7R, 10%	1206	Murata	GRM31MR7E105KC01
1	D1	Diode, Schottky 0.5 A 30 V	SOD-123	On Semi	MBR0530T1
5	J1–J5	Header, 2-pin, 100-mil spacing (36-pin strip)	0.1 × 2"	Sullins	PTC36SAAN
1	JP1	Header, 3-pin, 100-mil spacing (36-pin strip)	0.1 × 3"	Sullins	PTC36SAAN
1	L1	Inductor, SMT, 10 µH, 0.76 A, 0.23 Ω	0.15 x 0.162	Sumida	CR32-100
1	R1	Resistor, chip, 2.21 MΩ, 1/16 W, 1%	0603	Standard	Standard
1	R2	Resistor, chip, 162 kΩ, 1/16 W, 1%	0603	Standard	Standard
1	U1	IC, high efficiency boost converter	SOT23-5 (DBV)	TI	TPS61040DBV
1		PCB, 1.5" x 1" x 0.062"		Any	SLVP209
1		Shunts, 100-mil, black	0,1 mm	3M	929950-00

4 Modified TPS61040EVM for Higher Voltages



By substituting the inductor with a 1-to-5 transformer, the TPS61040 can 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. This design generates a 75-V output that can supply up to 6 mA, depending on the input voltage.

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:

$$V_p = V_{in} = 3\ V \quad (1)$$

$$V_s = \frac{N_s}{N_p} \times V_p = \frac{5}{1} \times 3\ V = 15\ V \quad (2)$$

During this time, D1 is reverse biased, so that 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, through 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:

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

$$V_S = \frac{N_S}{N_p + N_S} \times \left(V_{out} - V_{in}\right) = \frac{5}{6} \times (75 - 3) = 60\ V \quad (4)$$

$$V_{sw} = V_{in} + V_p = 3\ V + 12\ V = 15\ V \quad (5)$$

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

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