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I. Overview

The TIDA-00781 is a 12W SEPIC power supply reference design for industrial applications. It takes 12V nominal input voltage, and generates a 12V @ 1A output with 92% peak efficiency. The SEPIC converter topology allows voltage step-up and step-down conversion. The design covers a wide input range of 2.5V to 20V with a minimum start-up input voltage of 3.5V. When using a noisy 12V supply, the design can operate uninterrupted while maintaining a regulated 12V output. The reference design features the LM3481 as the SEPIC controller and uses a single coupled inductor to achieve compact solution size. The component area of the SEPIC is about 39 x 26 mm (1.5 x 1 inch). The reference board is layout-optimized for improved EMI performance.

The design can also use the output voltage to operate, which means after the output voltage reaches 12V under normal operating conditions, the input voltage can be reduced to as low as 2.5V with the system still maintaining output voltage regulation within 5%. Note that at input voltage of 2.5V, the high input current causes the inductor to heat up to over 130 °C so this is not a recommended operating condition.

II. Power Specification

Input Voltage: 12V nominal, 2.5V – 20V (minimum start-up Vin of 3.5V)
Output: 12V @ 1A
Total output power: 12W
Switching frequency: 500 kHz
III. Reference Board

The board size is 76.2 x 54.8 mm (3 x 2.16 inch). The SEPIC component area is 38.989 x 26.035 mm (1.535 x 1.025 inch).

Figure 1 Reference board top view

Figure 2 Reference board bottom view
IV. Efficiency and Regulation

The efficiency and output regulation was measured at different input voltage conditions.

![Figure 3 Power efficiency](image)

![Figure 4 Output regulation](image)
V. Thermal

The thermal image was taken at 23°C room temperature, no air flow. The board was operating at 12V input, full load.

**Figure 5 Thermal image from top view**

**Figure 6 Thermal image from bottom view**
VI. Power Up

The reference board was tested under no load and full load at 12V input. C1 (yellow) is the input voltage, and C2 (pink) is the output voltage.

Figure 7 Power up into no load at 12V input

Figure 8 Power up into full load at 12V input
VII. Switching Waveforms

The switch node voltage was measured at the drain terminal of the Q1 FET. C1 (yellow) is the switch node voltage.

Figure 9 Switch node voltage at full load, 4.5V input

Figure 10 Switch node voltage at full load, 12V input
The voltages across the output diode D2 was measured at full load and 20V input, where the diode had the highest voltage pulses. The result shows that the max voltage across the diode is lower than its 40V rating. C1 (yellow) shows the voltage across the diode.

![Graph](image-url)

**Figure 11 Output diode anode (+) to cathode (-) voltage at full load, 20V input**
VIII. Load Transients

The load transient responses were tested by applying output load steps from 50% to 100% at different input voltages. C1 (yellow) is the output current, and C2 (pink) is the output voltage in AC mode.

Figure 12 Output load transient response at 4.5V input

Figure 13 Output load transient response at 12V input
Figure 14 Output load transient response at 20V input
IX. Output Voltage Ripples

The output ripples were measured directly at the output capacitors at full load condition. C1 (yellow) is the output voltage ripple in AC mode.

Figure 15 Output ripple at full load, 4.5Vin

Figure 16 Output ripple at full load, 12Vin
Figure 17 Output ripple at full load, 20Vin
Appendix: Efficiency and Regulation Test Data

4.5V input

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<th>Vin (V)</th>
<th>Iin (A)</th>
<th>Vout (V)</th>
<th>Iout (A)</th>
<th>Pin (W)</th>
<th>Pout (W)</th>
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<th>Vout Variation (%)</th>
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12V input

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<th>Iout (A)</th>
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Note: 2.5Vin is not a recommended operating condition for long periods of time due to high component and board temperature caused by the large input current.
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