Design Idea DI-11
TinySwitch®-II
Buck Converter

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
General Purpose	TNY264P	1.2 W	85-265 VAC	12 V	Buck

Design Highlights

- Lowest cost non-isolated switch mode converter
- Entirely producible in SMD (13 components)
- No transformer required
- Meets 2005 European 300 mW no-load consumption requirement
- Meets EN55022B/CISPR22
- Universal input voltage range (85–265 VAC)
- Short circuit and thermally protected
- Excellent line and load regulation
- Less than 10 ms startup time

Operation

The *TinySwitch-II* buck converter supply provides a non-isolated 12 V output rated at 100 mA. The design shown takes advantage of many of the built-in features of the TNY264.

AC input voltage is rectified and filtered by D1, C1 and C2 to create a high voltage DC bus which is connected to the input of the buck stage. The fusible, flameproof resistor R1 is used in place of a fuse to reduce system cost and it also provides differential mode noise filtering. With the integrated frequency jitter it is possible to meet international conducted EMI requirements with a simple PI-filter formed by C1, L1 and C2.

The freewheeling diode D2, the inductance L2 and the output capacitor C4 form the buck stage. Zener diode VR1 and the forward drop of the optocoupler diode U2 determine the output voltage.

The built-in auto-restart function of *TinySwitch-II* protects the output in case of short circuit or an open control loop condition by reducing the delivered power to less than 6% of the nominal output power.

Key Design Points

- Preferred discontinuous mode of operation is accomplished by limiting the output current to 50% of the minimum internal current limit.
- $L_2 \geq \left| \begin{matrix} L_{MIN\_PWR} \\ L_{MIN\_SOA} \end{matrix} \right.$ (see Table 1)
- The voltage rating of L2 has to be greater than $\sqrt{2} \times V_{ACMAX}$.
- Size capacitors C1 and C2 according to the output power and surge withstand requirements.
- Optocoupler U2 provides level shifting only and therefore doesn't need to be safety rated.
- Select output capacitor C4 according to the ripple requirement: $ESR_{C4} \leq V_{OUT\_RIPPLE} / I_{LIMIT}$.
- Minimum recommended output voltage is 5 V (smaller voltages may cause non-preferred continuous mode operation.)
- Diode D2 must be an ultrafast type $t_{rr} \leq 35$ ns.

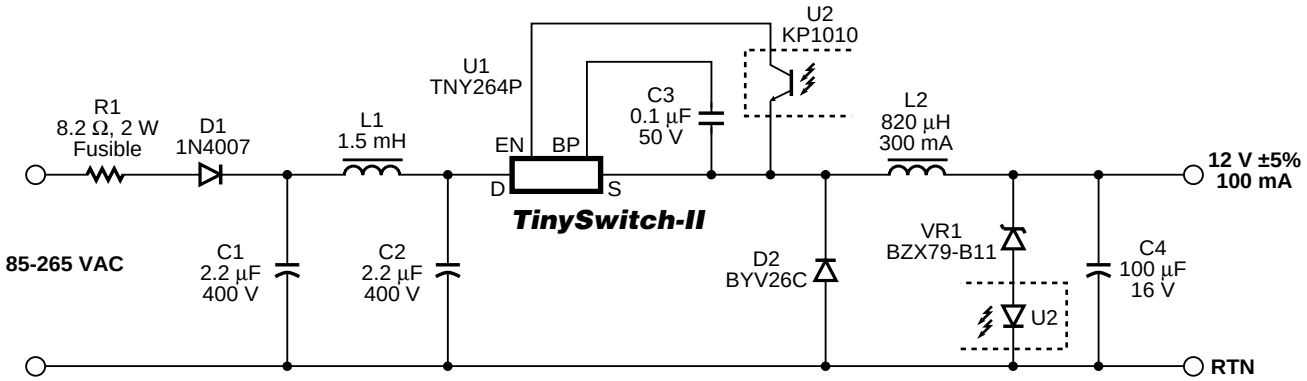

Figure 1. TinySwitch-II 12 V, 1.2 W Buck Converter.

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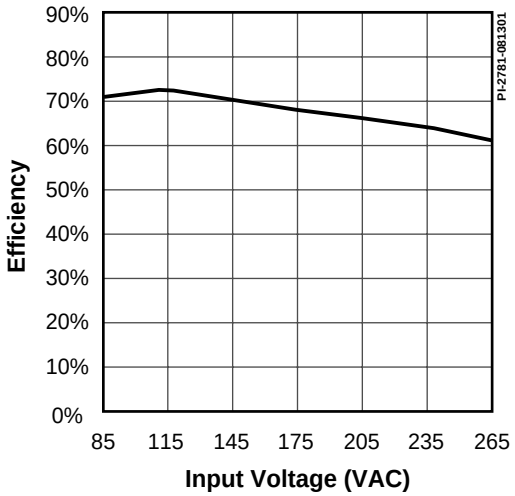

Figure 2. Efficiency vs. input voltage.

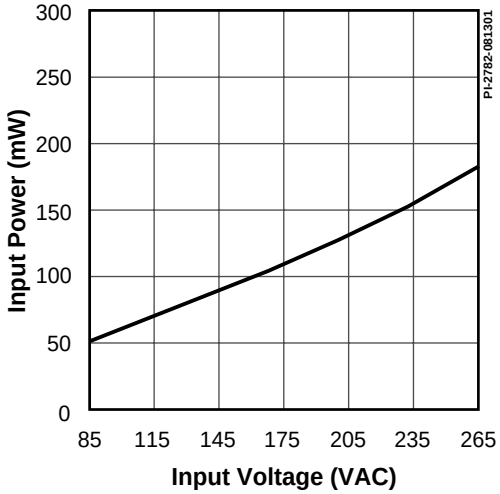

Figure 3. No-load input power vs. input voltage.

$$L_{MIN\_PWR} \geq \frac{2 \cdot P_O \cdot \left(\sqrt{2} \cdot V_{ACMAX} - V_{DS} - V_O\right)}{I^2_{LIMIT\_MIN} \cdot f_{SW\_MIN} \cdot \left(\sqrt{2} \cdot V_{ACMAX} - V_{DS}\right)}$$

Part No.	I_{O_MAX}	85-265 VAC L_{MIN_SOA}	85-132 VAC L_{MIN_SOA}
TNY264	115 mA	820 µH	470 µH
TNY266	162 mA	680 µH	330 µH
TNY267	210 mA	560 µH	330 µH
TNY268	256 mA	470 µH	220 µH

Table 1. L_{MIN_S0A} and I_{O_MAX} (discontinuous mode).

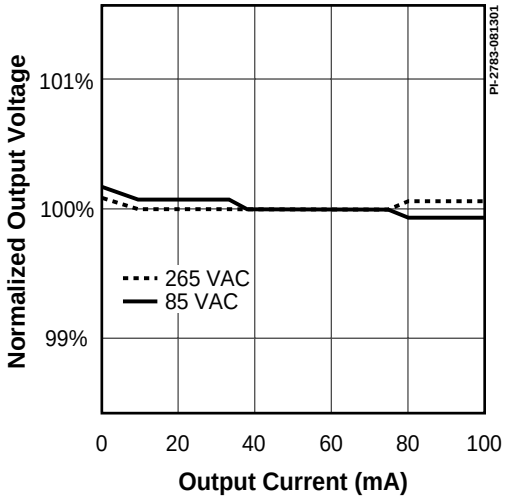

Figure 4. Load regulation at 85 VAC and 265 VAC.

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