Design Idea DI-61

TinySwitch-II® 3 W Charger: <200 mW No-load Consumption

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
Charger	TNY264P	3 W	85-265 VAC	5 V, 600 mA	Flyback

Design Highlights

- Less than 200 mW no-load power consumption (for 115 or 230 VAC input)
- Meets CISPR-22 Class B without Y capacitor
- Low cost, low component count solution

Operation

The *TinySwitch-II* flyback converter in Figure 1 generates a constant voltage, constant current (CV/CC) 5 V, 600 mA output. Typical applications include wall-mounted chargers for cell phones, PDAs and other battery powered portable equipment.

The key performance characteristic of the circuit shown is the extremely low no-load consumption of <200 mW. A linear transformer charger of similar rating will typically consume 1 W to 4 W at no-load. At $0.12/kWh, the *TinySwitch-II* can therefore reduce energy costs by $1 to $4 per year.

The no-load performance is achieved by use of *TinySwitch-II*, and by careful transformer design.

The circuit meets CISPR-22 Class B conducted EMI limits without a Y capacitor, and therefore has very low AC leakage current. This EMI performance is achieved via the *TinySwitch-II* internal jitter, use of a shield winding, an output RC snubber, and the primary RCD clamp.

Key Design Points

- Minimize secondary circuit bias currents. Use low current feedback Zeners for best tolerance. The very low Zener bias current in this design will provide approximately ±10% output voltage tolerance. A precision reference (e.g. TL431) can be used if higher precision is required.
- Design transformer with low reflected voltage to minimize clamp losses. A larger device (TNY266) may allow further reduction in V_{OR}.
- Wind transformer for lowest leakage inductance. Choose wire gauges to completely fill winding layers.
- Winding the transformer with tape between primary layers further reduces intra-winding capacitance and no-load consumption.
- Resistor R7 limits the peak current into the optocoupler LED to prevent damage during unusual transients.

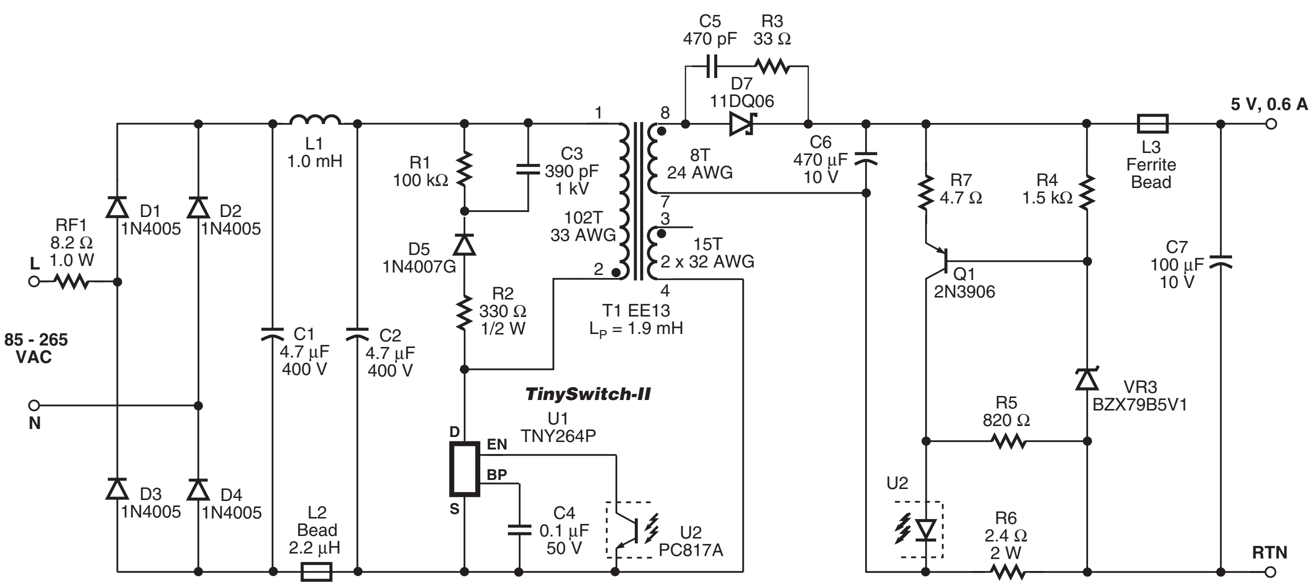

Figure 1. TinySwitch-II 3.0 W Cell Phone Charger.

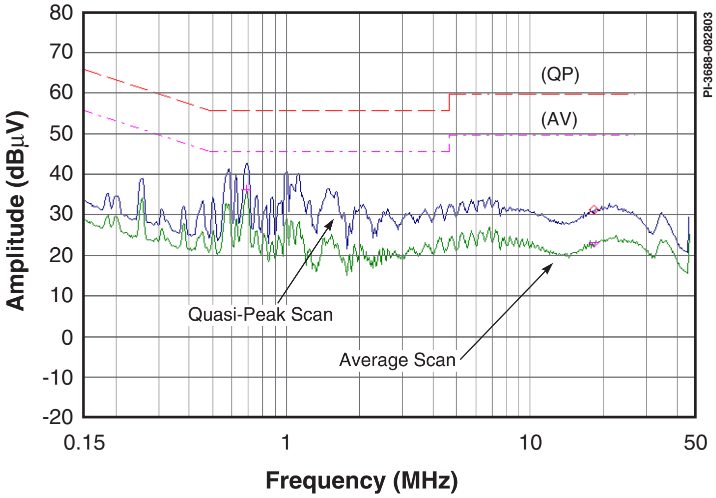

Figure 2. Conducted EMI, Full Load, 230 VAC, Grounded to "Artificial Hand" of LISN.

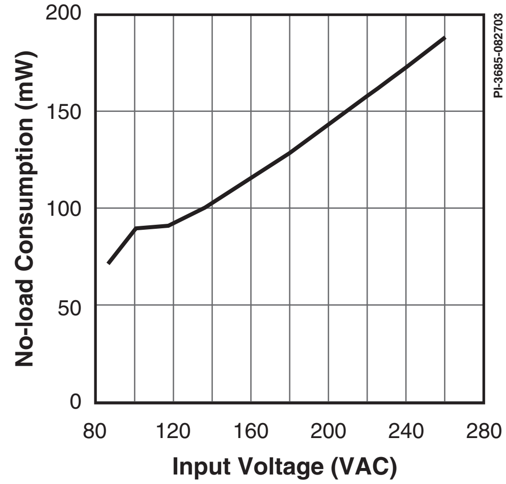

Figure 3. No-load Input Power vs. Line Voltage.

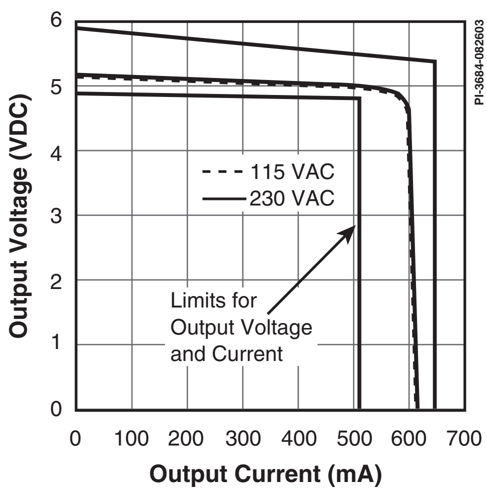

Figure 4. 5.0 VDC, 600 mA CV/CC Curve.

TRANSFORMER PARAMETERS	
Core Material	EE13 TDK PC40, or equivalent A_L of 128 nH/T[2]
Bobbin	EE13, 8 pin
Winding Order (pin numbers)	Primary (1-2), tape, Bias (3-4), tape, Secondary (7-8), 5 V, tape
Primary Inductance	1.9 mH ±10%
Primary Resonant Frequency	500 kHz (minimum)
Leakage Inductance	50 µH (maximum)

Table 1. Transformer Construction Information.

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