DI-199 Design Idea
TOPSwitch®-HX

40 W Standard Notebook Adapter

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
Notebook Adapter	TOP256EN	40 W	90 – 265 VAC	19.0 V	Flyback

Design Highlights
- Low component count
- Meets ENERGY STAR 2.0 Efficiency Requirements:
  - Very low no-load input power: <210 mW at 230 VAC
  - Very high efficiency in both standby and sleep modes
  - >85% average efficiency
- Excellent transient load response
- Hysteretic thermal overload protection with automatic recovery
- Configurable hysteretic or latching open-loop protection
- Meets limited power source requirements (<100 VA)
  - Eliminates need for secondary current-sense circuitry
- Power Integrations eSIP™ low-profile package
- Design uses low cost EE25 transformer

Operation
Figure 1 shows a Power Integrations TOPSwitch-HX in a flyback configuration. This adapter power supply employs the TOP256EN (U1) with its integrated high-voltage MOSFET and multi-mode controller. Output voltage is regulated via shunt regulator U2 and optocoupler U3.

TOPSwitch-HX employs EcoSmart® technology to provide maximum efficiency over the entire load range. The proprietary multi-mode control seamlessly transitions between different operating modes to ensure maximum efficiency, greatly simplifying circuit design.

Resistors R3 and R4 control the current applied to the VOLTAGE (V) pin of the TOP256EN. Once current exceeds 25 μA (the UV threshold current level) U1 begins to switch. 25 μA corresponds to a line voltage of 100 VDC. The UV lockout also prevents glitches on the output during power down. During power down the supply operates until regulation is lost and restart is inhibited until the UV threshold is exceeded.

To provide constant output power with varying line voltage resistors R7, R8, and R9 form a potential divider which reduces the current limit as line voltage increases by applying a bias to the X pin. This limits the outputing power to <100 VA within the input voltage range, whilst still delivering the rated output at low line.

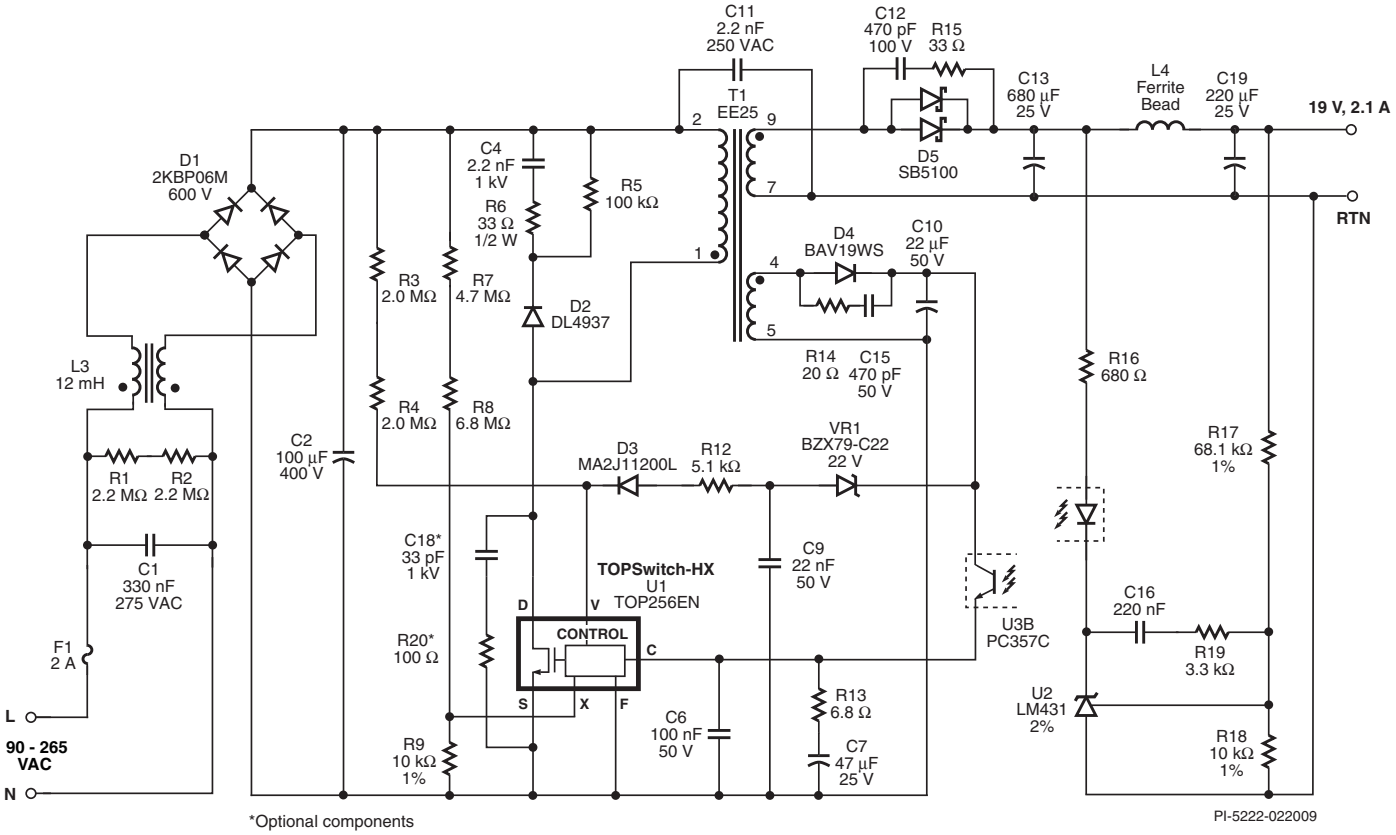

Figure 1. Schematic of a 40 W Notebook Power Supply Using TOP256EN.

Open-loop faults cause the output voltage to exceed the specified maximum value. A simple latching shutdown function performed by VR1, R12 and the V pin keeps output voltage from exceeding the specified maximum. If the voltage across C10 reaches approximately 22 V, VR1 conducts and allows current to flow into the V pin. This shuts the supply down and keeps it in a latched condition until the energy stored in the bulk capacitor discharges to less than approximately 20 V.

The TOPSwitch-HX has an integrated, accurate hysteretic thermal-overload protection feature. If the junction temperature reaches +142 °C (during a fault condition), the TOP256EN shuts down. It automatically recovers once the junction temperature has decreased by approximately 75 °C.

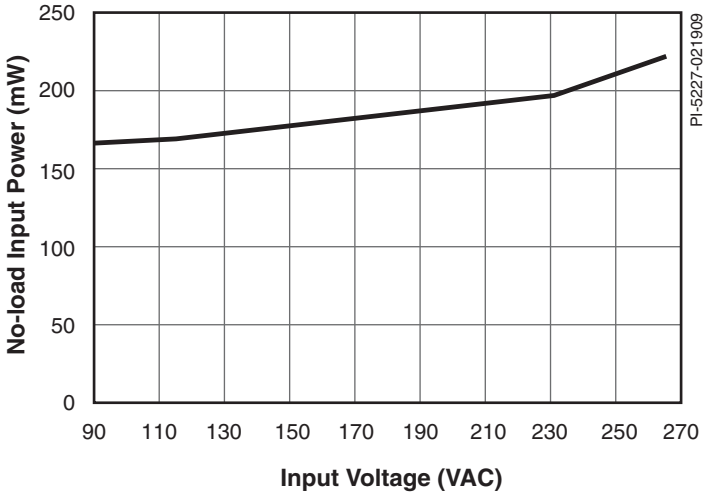

Figure 2: No-load Power Consumption.

Key Design Points

- Power limit is independent of line voltage (via R3, R4, R9) and meets limited power source (LPS) requirements without additional circuitry.
- Maximized use of TOPSwitch-HX protection features dramatically reduces component count.
- Using a resistor with a value greater than 5 kΩ in the R12 position changes the shutdown from latching to hysteretic.

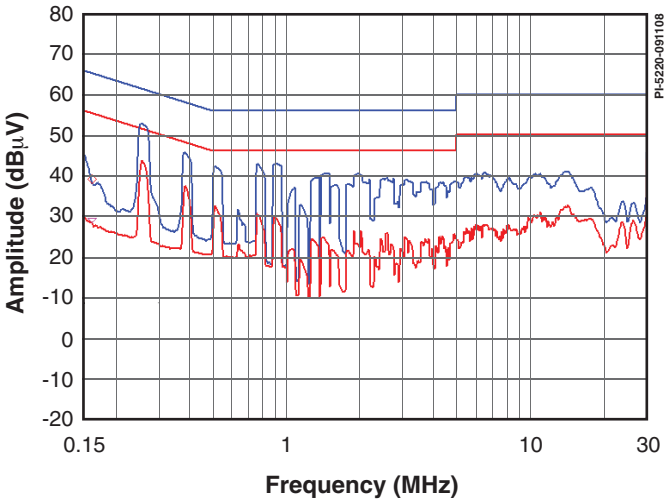

Figure 3: Conducted EMI, EN55022 B Limits: 230 VAC Input, 10 Ω Resistive Load, Output Return Connected to PE.

Transformer Parameters

Core Material	EE25, gapped for ALG of 180 nH/t²
Bobbin	EE25, 5–5 pins, Vertical
Winding Details	Primary 1st Half: 23T, 26 AWG Shield 1: 1T, Cu foil Secondary: 8T × 2, 25 TIW Shield 2: 1T, Cu foil Primary 2nd Half: 23T, 26 AWG Feedback/Bias: 5T, 26 AWG
Winding Order	Primary 1st (1–3), Shield (2), Secondary (9–7), Shield (2), Primary 2nd Half (3–1), Feedback/Bias (4–5)
Primary Inductance	369 μH–406 μH
Primary Resonant Frequency	1000 kHz (minimum)
Leakage Inductance	6 μH (maximum)

Table 1. Transformer Parameters. (AWG = American Wire Gauge, TIW = Triple Insulated Wire)

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