Design Idea DI-89
LinkSwitch®-XT Low Cost 2 W CV Power Adapter

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
Adapter	LNK362P	2 W	85-265 VAC	6.2 V	Flyback

Design Highlights

- Low-cost, low parts-count CV solution: 20 components
- Proprietary IC design and winding techniques enable a *Clampless*™ drain-node
- ± 5% over-temperature threshold – with hysteretic recovery – keeps PCB temperatures below safety limits
- Auto-restart: output short circuit and open loop protection
- IC creepage > 3.2 mm: no arcing in humid environments
- Easily meets all EPS energy efficiency standards
- Meets CISPR-22 Class B EMI with sufficient margin

Operation

This *LinkSwitch-XT* based flyback converter (Figure 1) provides 2 W of tightly regulated constant voltage (CV) output power, while meeting the active-mode efficiency and no-load power consumption requirements of all harmonized energy efficiency (EPA, CEC) standards (see Figure 2 and Figure 3).

Diodes D1–D4 rectify the AC input. The resulting DC is filtered by bulk storage capacitors C1 and C2. Components L1, L2, C1 and C2 form a conducted EMI noise filter. Resistor R1 dampens the ringing of the filter. Switching frequency jitter and PI's *E-Shield* transformer construction technology enable this design to meet EN55022 Class-B conducted EMI with good margin (see Figure 4). Y capacitor C4 (optional) can improve the unit-to-unit repeatability of EMI scans.

This supply also takes advantage of PI's *Clampless* transformer techniques, which uses T1's primary winding capacitance to clamp the voltage spike that its leakage inductance causes, each time the MOSFET in U1 turns off. Therefore, this converter has no primary clamp components connected to the drain-node.

From no-load until maximum output power (2 W) is delivered, the LNK362P (U1) regulates the output voltage by skipping switching cycles, based on the current delivered into the feedback (FB) pin. If the output is over loaded and no feedback (<49 µA) is received within a 40 ms period, U1 goes into auto-restart mode. In auto-restart, MOSFET switching is enabled for about 40 ms approximately every 800 ms if no feedback is received within the 40 ms window of enabled switching.

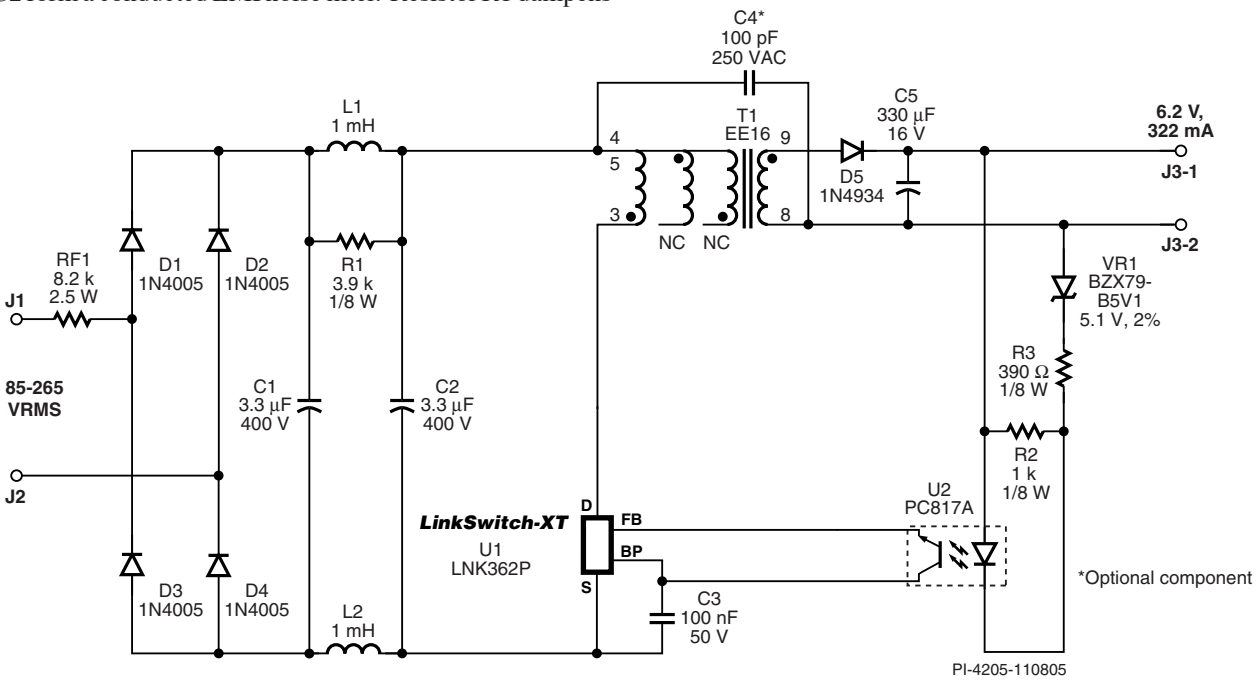

Figure 1. LNK362 Based 6.2 V, 322 mA, 2 W, Low-cost, Flyback CV Output Power Adapter.

Key Design Points

- The *PI Xls* spreadsheet calculates all of the parameters required to specify and build transformer T1.
- The power transformer must have a two layer primary winding to ensure that its intra-winding capacitance is sufficient for *Clampless* operation.
- The reflected output voltage (V_{OR}) of this design was kept < 90 V (74 V) for *Clampless* operation.
- Since this supply has a Clampless drain node, it must be verified that the maximum drain voltage does not exceed 650 V when the flyback voltage spike occurs.
- The primary current ripple-to-peak ratio (K_p) factor should be > 1 (ensures discontinuous conduction mode operation) to minimize conducted EMI.
- The maximum operating flux density (B_M) was kept < 1500 Gauss to eliminate audible.

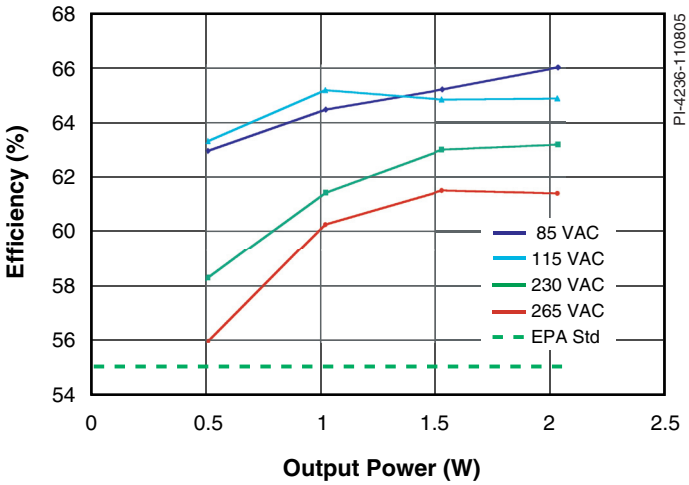

Figure 3. Harmonized (EPA, CEC) Active-Mode Efficiency vs. Output Power (25, 50, 75 & 100%).

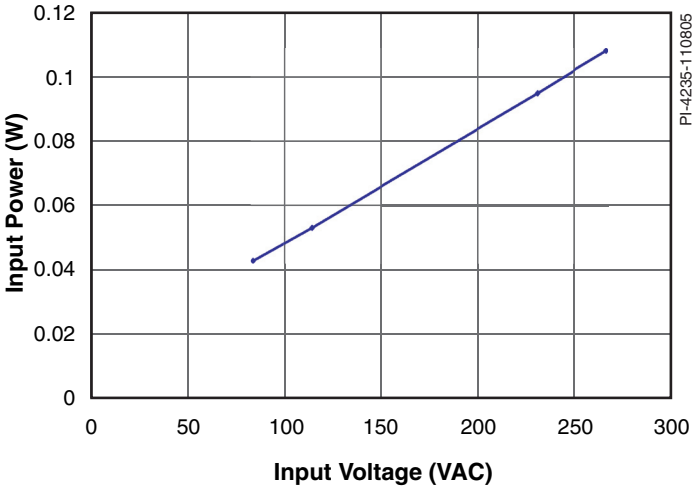

Figure 2. No-load Input Power Consumption vs. Input Voltage.

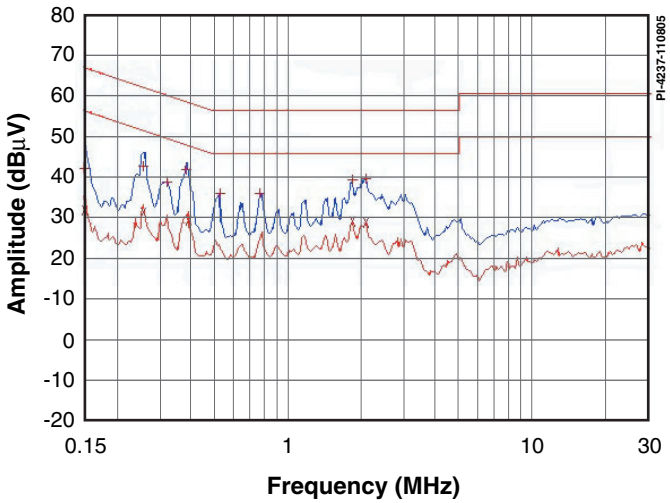

Figure 4. Conducted EMI Scan to EN55022B Limits: Full-Load, 115 VAC, 60 Hz Input, with Artificial Hand.

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