



Resistor R16, R17 and C9 set the frequency compensation of the feedback loop. Resistor R25 is the gain limiting resistor which controls the DC gain of the loop. The system bandwidth at 100 VDC is 2 kHz with a phase margin of 45°. At 400 VDC the bandwidth is 3.6 kHz with a phase margin of 60°.

### Key Design Points

- Clamp capacitor C4 in conjunction with fast diode D5 (FR106,  $t_{RR} = 500$  ns) recycles some of the leakage inductance energy. The observed efficiency gain over a regular Zener clamp is approximately 0.4%. The capacitor also reduces the peak drain voltage by approximately 20 V.
- Optocoupler U2 has a high CTR of 300-600%. This reduces the current drawn from the secondary required to move the TOPSwitch-HX into variable frequency, low frequency mode or MCM mode during light load, standby load and no-load conditions.
- The transformer T1 is designed such that the design runs in the continuous conduction mode throughout the input voltage operating range. This helps minimizing MOSFET RMS current and thus improves efficiency.
- Transformer T1 uses a split two layer primary winding which is wrapped around the bias winding and the secondary winding. This minimizes leakage inductance and primary winding capacitance to improve no-load and standby performance.
- To minimize no load consumption, the bias winding turns are selected such that under worst case conditions of load and line the bias voltage is 8 V.
- Option:  
Using a TLV431 (U3) reduces minimum cathode current for regulation from 400  $\mu$ A to 55  $\mu$ A and would remove the need for R15. This would save an additional 10 mW from no-load requirement.

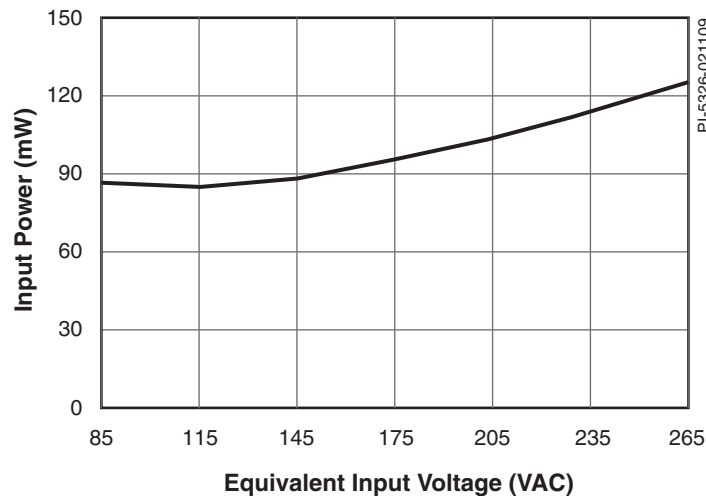


Figure 2. No Load Power Consumption Over Line.

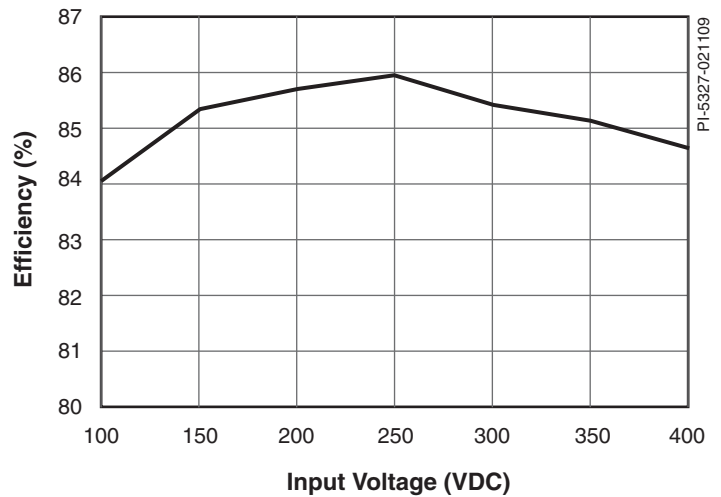


Figure 3. Full Load Efficiency Measured Over Line.

### Transformer Parameters

<b>Core Material</b>	EEL25 NC-2H or equivalent, gapped for ALG of 265 nH/t <sup>2</sup>
<b>Bobbin</b>	EEL25, 12 pin Vertical
<b>Winding Details</b>	3 mm margins on both sides of bobbin to meet safety Primary-1: 47T × 1, 0.25 mm, tape Bias: 12T × 1, 0.45 mm, 3 layers, tape 5 V: 5T × 4, 0.45 mm, 3 layers, tape Primary-2: 47T × 1, 0.25 mm, tape
<b>Winding Order</b>	Primary (4-3), Bias (6-5), 5 V (11,12-8,9), Primary (3-2)
<b>Primary Inductance</b>	2200 $\mu$ H, $\pm$ 10%
<b>Primary Resonant Frequency</b>	1600 kHz (minimum)
<b>Leakage Inductance</b>	20 $\mu$ H (maximum)

Table 1. Transformer Parameters. (NC = No Connection)

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