Test Report – 24VACin/15VDCCout
Isolated Forward Converter Power Supply

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Summary

The board works well over the entire range of load (0 to 3A) and line (16 to 32VAC). Switching frequency is around 250KHz. When load is lighter than 0.7A, the converter enters Discontinuous Conduction Mode when the duty cycle decreases with load.

Soft start works reasonably well except that there is a small overshoot (about 1.5V) when starting into heavy load under high line condition. This behavior may be corrected by tweaking the compensation network.

The converter survived short-circuit test without being damaged. Overall efficiency is around 82% when the load is above 1.5A over the complete Vin range. The input diode bridge may need more heat sinking due to the heavy power loss under low line full load condition. If lower loss is desirable for the input bridge rectifier, consider discrete Schottky diodes.

Snubber resistor for the freewheeling diode D1 can dissipate some power, especially under high line condition so use two or three 1210 size resistors to help lower the temperature. Currently the board is using two 220 ohm resistors in parallel.

The custom transformer is rated for 3KV based on previous estimate. It should be reasonably effortless to upgrade it to 4KV without worrying about changes in the converter behavior. During the test, we see about 40°C rise under room temperature, at full load.

The preliminary report consists mainly of scopeshots and thermal images.
Picture of Assembled Board
Efficiency

Input power is measured on the AC side using an oscilloscope. See oscilloscope image below.

Efficiency Plot

![Efficiency Plot](image-url)
Steady State Operation

High-Line Full-Load Waveforms

Vin_{dc}=44.4V, \ Vo=14.9V, \ Io=3A

\textbf{V_{q1}\_drain}

\textbf{V_{d1}\_cathode}

\textbf{l_{transformer\_secondary}}

Vin_{dc}=44.2V, \ Vo=14.9V, \ Io=3A

\textbf{V_{q1}\_drain}

\textbf{l_{transformer\_primary}}
Vin_ac \_rms=32V, I_o=3A

Vin_ac

lin_ac
High-Line Light-Load Waveforms

Vin_{dc}=42.5V, Vo=14.9V, Io=0.1A

V_{q1}\_drain

V_{d1}\_cathode

I_{transformer\_secondary}

Vin_{dc}=42.5V, Vo=14.9V, Io=0.1A

V_{q1}\_drain

I_{transformer\_primary}
Vin_ac rms=33V, I_o=0.1A
Low-Line Light-Load Waveforms
Vin_ac rms = 16V, Io = 0.1A
Low-Line Heavy-Load Waveforms

Vin_dc=21V, Vo=14.9V, Io=3A
V_q1_drain

Vin_dc=19.1V, Vo=14.9V, Io=3A
V_q1_drain

I_transformer_primary

I_transformer_primary
Startup

Starting into No Load (Low Line)

Starting into 41Ω of Resistive Load (Low Line)
Starting into 12Ω of Resistive Load (Low Line)

Starting into 12Ω of Resistive Load (High Line)
Starting into 41Ω of Resistive Load (High Line)
Thermal

Diode Bridge under Low Line and Full Load
(Vin_{dc}=18.4V, Io=3A, after 40 minutes, room temperature, no air flow)
D1 Diode under Full Load
(Vin_{dc}=21V, Io=3A, after 40 minutes, room temperature, no air flow)
Transformer under Low Line and Full Load
(Vin_dc=21V, Io=3A, room temp, no air flow)
LM5025A and MOSFETs under Low Line and Full Load
(Vin dc=21V, Io=3A, room temp, no air flow)

Note: the LM5025A = 53°C, Sense Resistor R6= 73.6°C, Q1 FET=57.9°C, Q2 PFET=57.3°C.
**Snubber of Diode D1 under Low Line Full Load**
(Vin\_dc=21V, Io=3A, room temp, no air flow, snubber resistor R1=two 1206 100ohm in parallel)

Note: the two snubber resistors = 55.1°C.
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