Design Example Report

Title	***2 W Non-isolated Power Supply using LinkSwitch™-TN LNK305P***
Specification	Input: 85 VAC - 265 VAC Output: 15 V / 130 mA (220 mApk)
Application	Motor Control
Author	Power Integrations Applications Department
Document Number	DER-47
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Revision	1.1

Summary and Features

- Highly integrated solution
- Lowest possible component count
- No optocoupler or Zener diode required for regulation
- Thermal overload protection with automatic recovery
- Less than 300 mW no-load consumption
- Very high efficiency at full load

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Important Note:
This board is designed to be non-isolated. Please take necessary safety precautions.

Design Reports contain a power supply design specification, schematic, bill of materials, and transformer documentation. Performance data and typical operation characteristics are included. Typically only a single prototype has been built.

1 Introduction

This document is a prototype engineering report describing a 15 V, 130 mA non-isolated power supply using a LNK305P from Power Integrations.

This document contains the power supply specification, schematic, bill of materials and measurements results.

2 Power Supply Specification

Description	Symbol	Min	Typ	Max	Units	Comment
Input						
Voltage	V_{IN}	85		265	V_{AC}	
Frequency	f_{LINE}	47	50/60	63	Hz	
Outputs						
Output Voltage	V_{OUT}		15		V	[±3%]
Output Ripple Voltage	V_{RIPPLE}			150	mV	20 MHz Bandwidth
Output Current	I_{OUT}		130	220	mA	
Total Output Power						
Continuous Output Power	P_{OUT}		1.95		W	
Peak Output Power	P_{OUT_PEAK}			3.3	W	
Ambient Temperature	T_{AMB}	0		70	^{o}C	Open frame

Table 1 - Power Supply Specification

3 Schematic

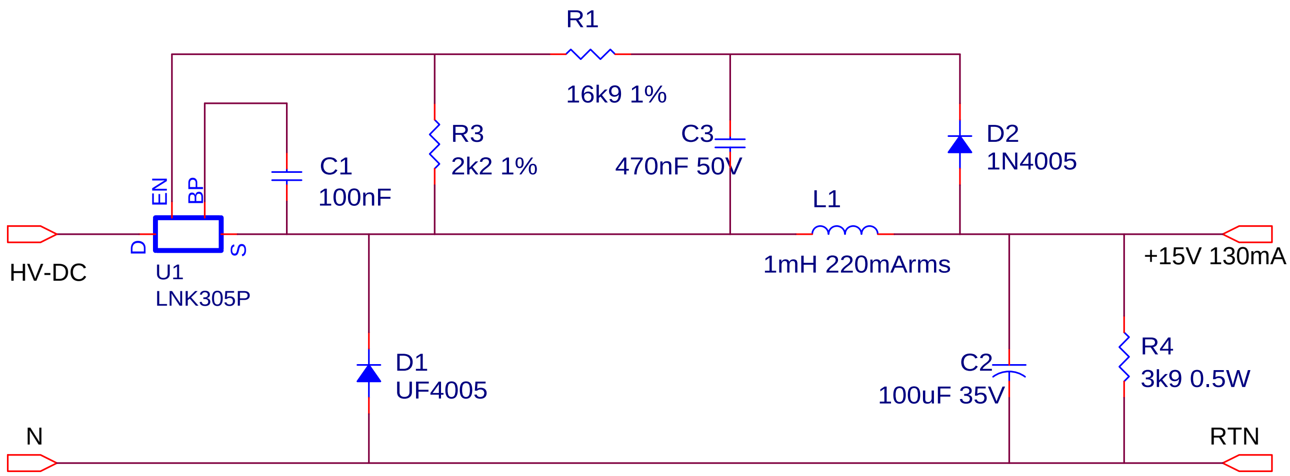

Figure 1 - Schematic after AC rectification

4 Circuit Description

The tested power supply had an input stage including one diode for the rectification and a π filter (4.7 μF, 1 mH, 4.7 μF), but this stage is not included in the schematic, and may not be needed in other systems if EMI filtering is present.

The voltage across L1 is rectified and smoothed by D1 and C2 during U1's off-time. To a first order, the forward voltage drop of D2 (slow diode used in the tests) and D1 (must be an ultrafast) can be considered similar. Therefore the voltage across C3 tracks the output voltage. The voltage across C3 is sensed and regulated via the resistor divider R1-R3 connected to U1's EN-pin. Resistor R4 provides a small pre-load current (3.8mA) for operation down to 0mA output current.

4.1 Bill of Materials

Item	Ref Des	Description/part number	Manufacturer
1	R1	16.9 kΩ, 1%, 0.25 W	
2	R3	2.2 kΩ, 1%, 0.25 W	
3	R4	3.9 kΩ, 5%, 0.5 W	
4	L1	1 mH, 220mArms	Tokin
5	C1	100 nF	
6	C2	100 μF, 35 V, low ESR	
7	C3	0.47 μF, 50 V	
8	D1	UF4005 (ultrafast diode)	Vishay
9	D2	1N4005 (normal p/n diode)	Vishay
10	U1	LNK305	Power Integrations

Table 2 - SMPS Bill of Materials

5 Performance Data

All measurements performed at room temperature, 50 Hz input frequency.

5.1 Efficiency

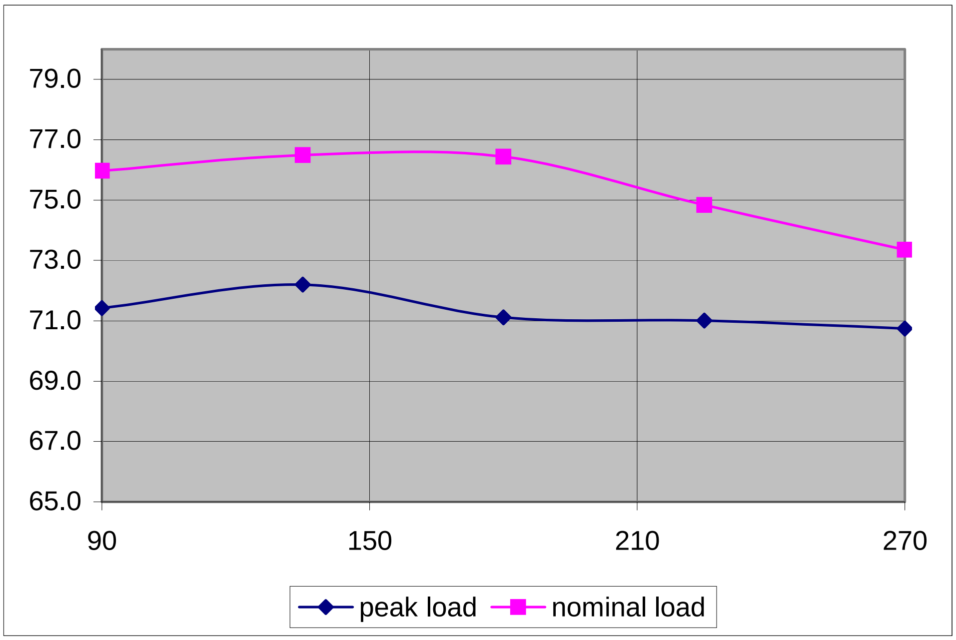

Figure 2 – Efficiency measurements vs input voltage (@130mA and 220mA load)

5.2 Regulation

5.2.1 Line regulation

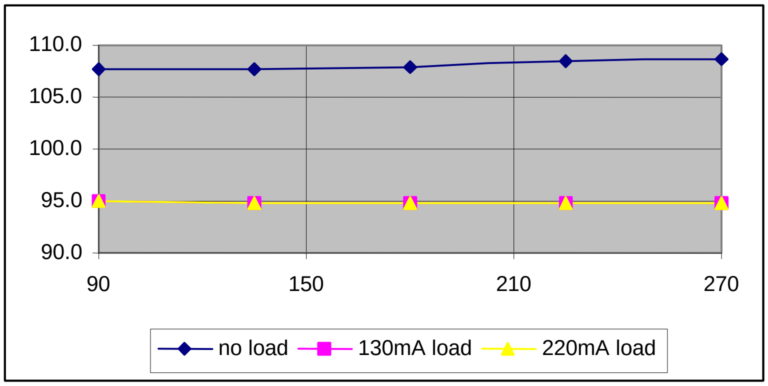

Figure 3 – Output voltage tolerance (in % of the nominal output voltage level) vs input voltage, at 0, 130mA and 220 mA load

5.2.2 Load regulation

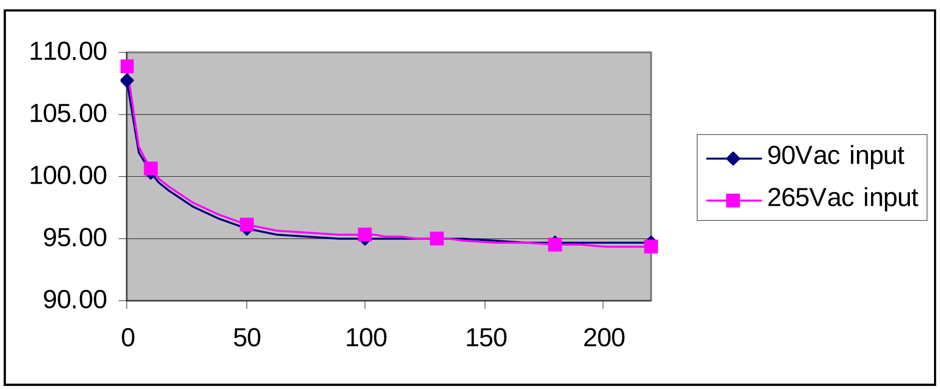

Figure 4 - Load regulation (in % of the nominal output voltage level)

5.2.3 No-load input power

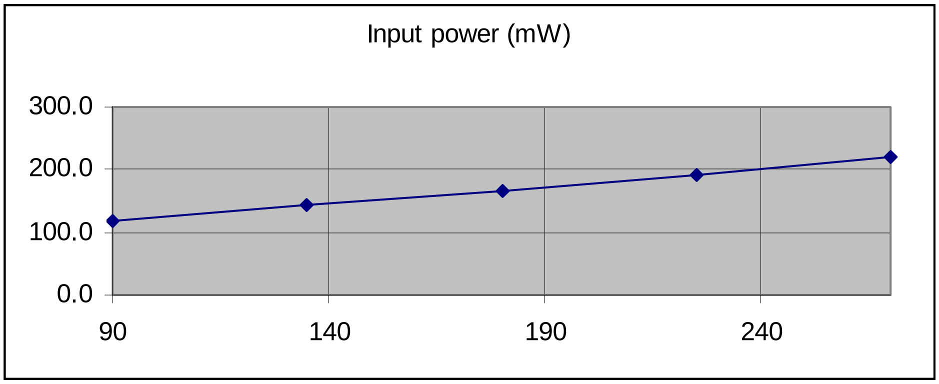

Figure 5 - No-load input power vs input voltage

6 Output noise measurements

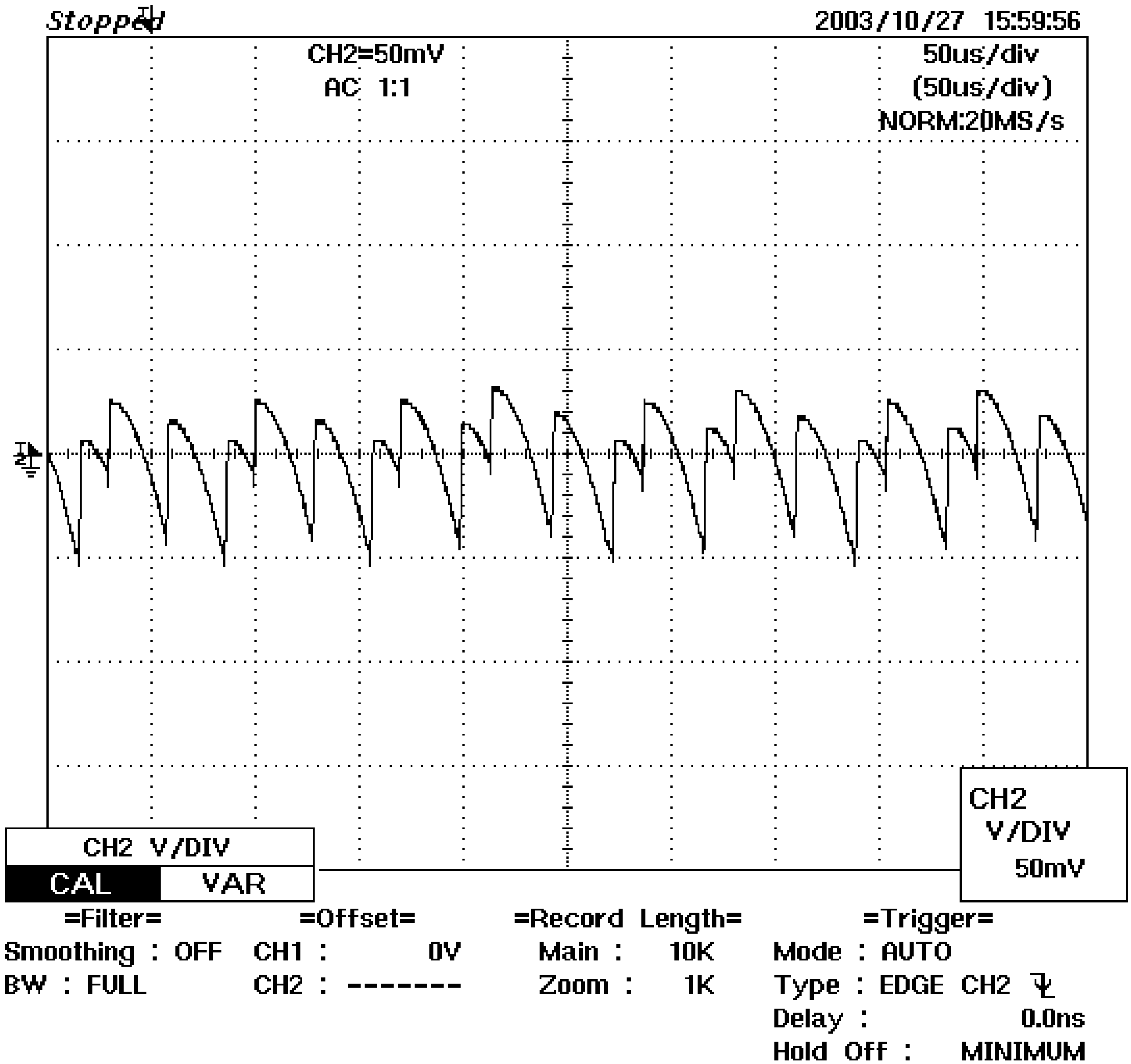

Figure 6 - Output ripple at 230 Vac input and 130 mA load

7 Revision History

Date	Author	Revision	Description & changes	Reviewed
20-Apr-05	TP	1.0	Initial release	VC/JC / AM
07-Apr-14	KM	1.1	Fix Circuit Description Text	

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