



Design Example Report

Title	<i>1.8W non-isolated Power Supply using LNK304</i>
Specification	Input: 85-265V _{AC} Output: 12V/150mA
Application	Home Appliance
Author	Power Integrations Applications Department
Document Number	DER-45
Date	April 8, 2005
Revision	1.0

Objective

This report lists a design for a single output offline non-isolated power supply for white goods low cost applications.

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

The products and applications illustrated herein (including circuits external to the products and transformer construction) may be covered by one or more U.S. and foreign patents or potentially by pending U.S. and foreign patent applications assigned to Power Integrations. A complete list of Power Integrations' patents may be found at www.powerint.com.

Table Of Contents

1	Introduction.....	3
2	Power Supply Specification.....	3
3	Schematic.....	4
4	Circuit Description	4
5	Bill Of Materials	5
6	Performance Data	6
6.1	Efficiency.....	6
6.1.1	Full load efficiency.....	6
6.1.2	No load consumption	6
6.2	Regulation	7
6.2.1	Line regulation.....	7
6.2.2	Load regulation	7
7	Revision History	8

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 an engineering report describing a 12V, 150mA non-isolated power supply using a LNK304 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}		12		V	[±10%]
Output Ripple Voltage	V_{RIPPLE}			n.sp.	mV	20 MHz Bandwidth
Output Current	I_{OUT}		150		mA	
Total Output Power						
Continuous Output Power	P_{OUT}		1.8		W	
Peak Output Power	P_{OUT_PEAK}				W	
Ambient Temperature	T_{AMB}	0		70	°C	Open frame

Table 1 – Power Supply Specifications



3 Schematic

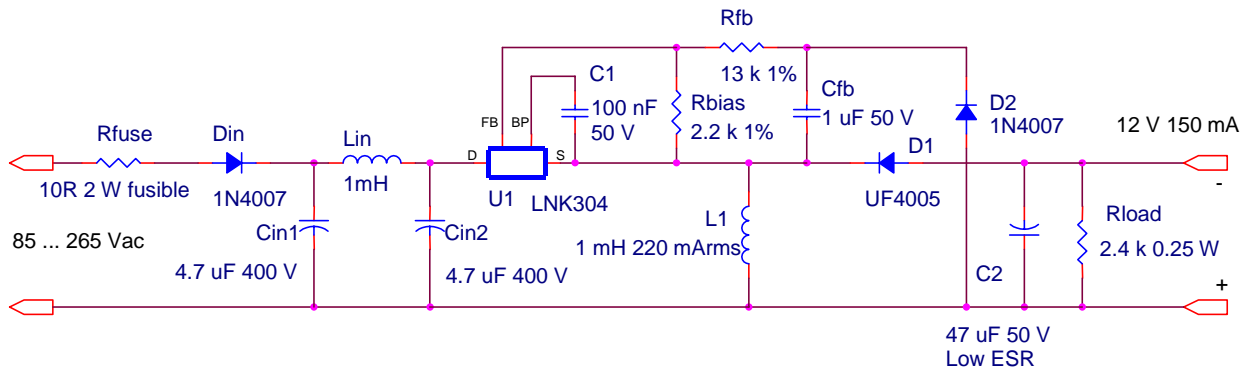


Figure 1 – Complete Schematic

4 Circuit Description

The LNK304 is used in a non-isolated buck-boost topology. 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 Cfb tracks the output voltage. The voltage across Cfb is sensed and regulated via the resistor divider Rfb-Rbias connected to U1's FB pin. The LNK304 switching algorithm regulates the FB pin to 1.65V +/- 7% over temperature. A small pre-load resistor has been added (Rload with 5mA current consumption) for operation down to 0mA output current.



5 Bill Of Materials

Ref	Description	Uprice	QTY
Rfuse	10R 2W fusible	0.0400	1
Din	1N4007	0.0072	1
Cin1, Cin2	4u7 400V	0.0570	2
Lin	1mH	0.0290	1
C1	100nF	0.0100	1
D1	UF4005	0.0450	1
Rbias	2K2 1%	0.0033	1
Rfb	13K 1%	0.0033	1
Cfb	1uF 50V	0.0100	1
D2	1N4007	0.0072	1
Rload	2K4 5% 0.25W	0.0015	1
L1	1mH 220mArms	0.0700	1
C2	47uF 50V	0.0450	1
U1	LNK304P	0.0000	1

Table 2 - Bill of Materials



6 Performance Data

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

6.1 Efficiency

6.1.1 Full load efficiency

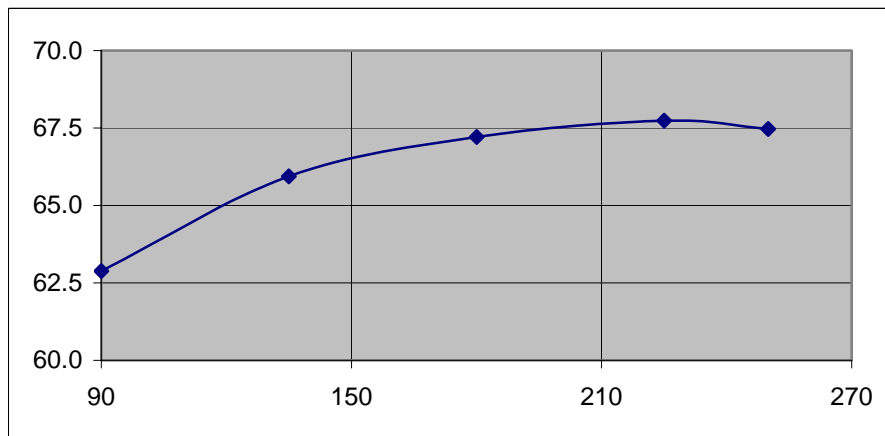


Figure 2 – Efficiency measurements vs. input voltage (@150mA load)

6.1.2 No load consumption

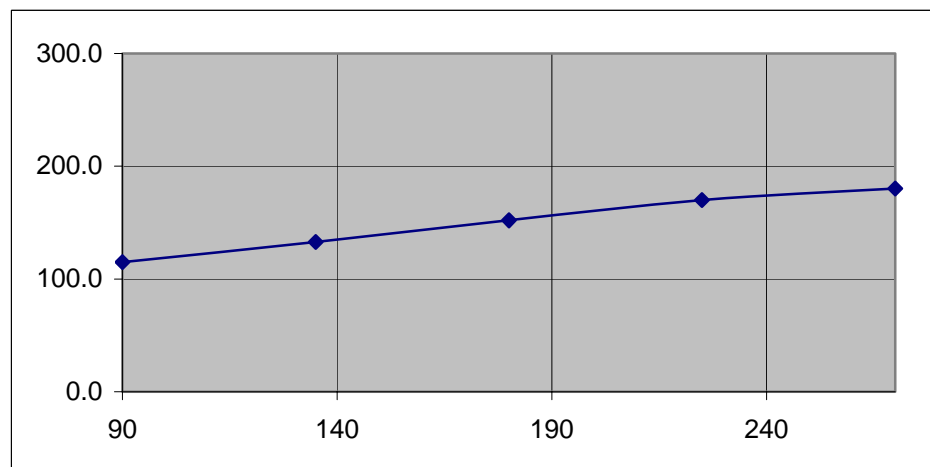


Figure 3 - Input power in mW at no load output



6.2 Regulation

6.2.1 Line regulation

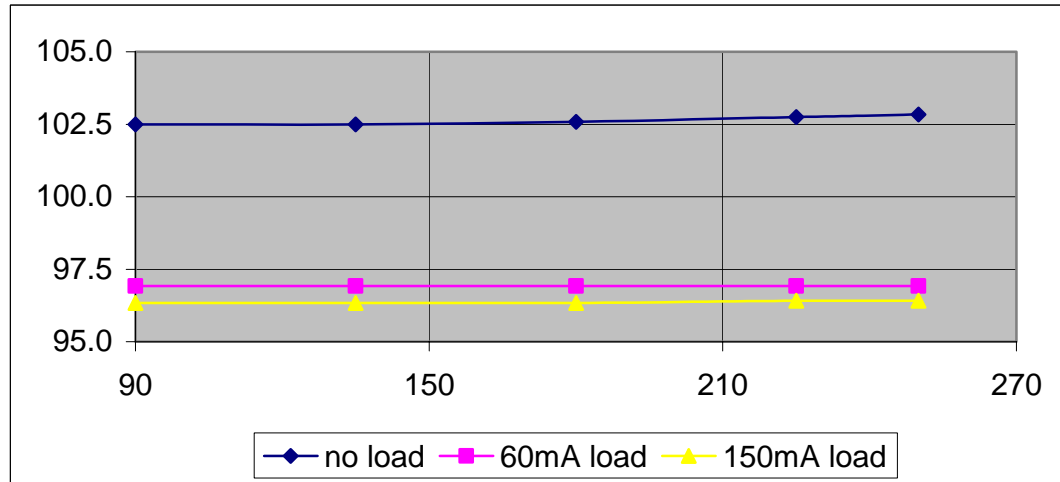


Figure 4 – Output voltage tolerance (in % of the nominal output voltage level)

Vs. input voltage, @ 0.150mA load

6.2.2 Load regulation

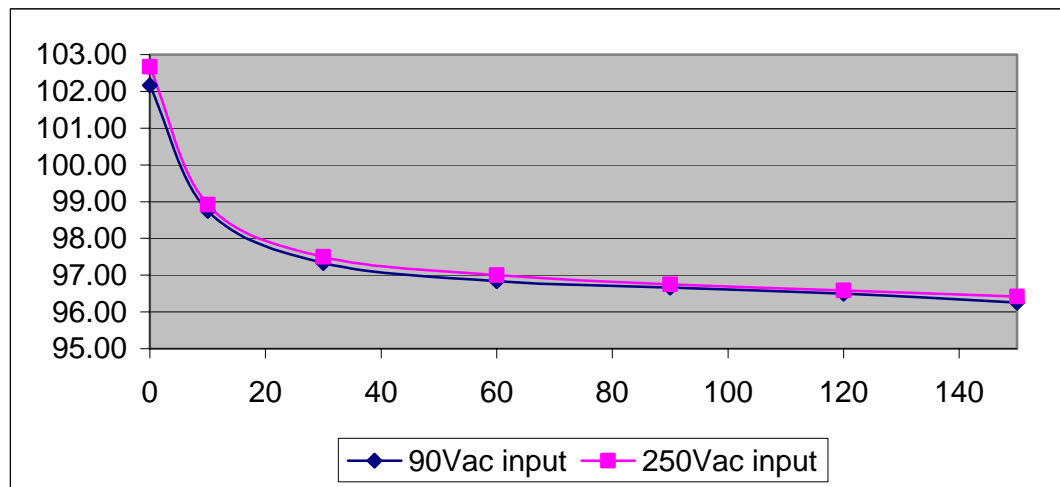


Figure 5 - Load regulation (in % of the nominal output voltage level)



7 Revision History

Date	Author	Revision	Description & changes	Reviewed
4/8/05	TP	1.0	Initial release	VC/JC / AM



For the latest updates, visit our Web site: www.powerint.com

PATENT INFORMATION

Power Integrations reserves the right to make changes to its products at any time to improve reliability or manufacturability. Power Integrations does not assume any liability arising from the use of any device or circuit described herein, nor does it convey any license under its patent rights or the rights of others.

The products and applications illustrated herein (including circuits external to the products and transformer construction) may be covered by one or more U.S. and foreign patents or potentially by pending U.S. and foreign patent applications assigned to Power Integrations. A complete list of Power Integrations' patents may be found at www.powerint.com.

The PI Logo, **TOPSwitch**, **TinySwitch**, **LinkSwitch**, and **EcoSmart** are registered trademarks of Power Integrations. **PI Expert** and **DPA-Switch** are trademarks of Power Integrations.
© Copyright 2003, Power Integrations.

WORLD HEADQUARTERS

Power Integrations
5245 Hellyer Avenue,
San Jose, CA 95138, USA
Main: +1-408-414-9200
Customer Service:
Phone: +1-408-414-9665
Fax: +1-408-414-9765
e-mail:
usasales@powerint.com

AMERICAS

Power Integrations, Inc.
4335 South Lee Street,
Suite G,
Buford, GA 30518, USA
Phone: +1-678-714-6033
Fax: +1-678-714-6012
e-mail:
usasales@powerint.com

CHINA (SHANGHAI)

Power Integrations
International Holdings, Inc.
Rm 807, Pacheer,
Commercial Centre,
555 Nanjing West Road,
Shanghai, 200041, China
Phone: +86-21-6215-5548
Fax: +86-21-6215-2468
e-mail:
chinasales@powerint.com

APPLICATIONS HOTLINE

World Wide +1-408-414-9660

CHINA (SHENZHEN)

Power Integrations
International Holdings, Inc.
Rm# 1705, Bao Hua Bldg.
1016 Hua Qiang Bei Lu,
Shenzhen, Guangdong,
518031, China
Phone: +86-755-8367-5143
Fax: +86-755-8377-9610
e-mail: chinasales@powerint.com

GERMANY

Power Integrations, GmbH
Rueckerstrasse 3,
D-80336, Munich, Germany
Phone: +49-895-527-3910
Fax: +49-895-527-3920
e-mail: eurossales@powerint.com

INDIA (TECHNICAL SUPPORT)

Innovatech
261/A, Ground Floor
7th Main, 17th Cross,
Sadashivanagar
Bangalore, India, 560080
Phone: +91-80-5113-8020
Fax: +91-80-5113-8023
e-mail: indiasales@powerint.com

APPLICATIONS FAX

World Wide +1-408-414-9760

ITALY

Power Integrations s.r.l.
Via Vittorio Veneto 12,
Bresso, Milano,
20091, Italy
Phone: +39-028-928-6001
Fax: +39-028-928-6009
e-mail:
eurossales@powerint.com

JAPAN

Power Integrations, K.K.
Keihin-Tatemono 1st Bldg.
12-20 Shin-Yokohama,
2-Chome,
Kohoku-ku, Yokohama-shi,
Kanagawa 222-0033, Japan
Phone: +81-45-471-1021
Fax: +81-45-471-3717
e-mail:
japansales@powerint.com

KOREA

Power Integrations
International Holdings, Inc.
8th Floor, DongSung Bldg.
17-8 Yoido-dong,
Youngdeungpo-gu,
Seoul, 150-874, Korea
Phone: +82-2-782-2840
Fax: +82-2-782-4427
e-mail:
koreasales@powerint.com

SINGAPORE (ASIA PACIFIC HEADQUARTERS)

Power Integrations, Singapore
51 Newton Road,
#15-08/10 Goldhill Plaza,
Singapore, 308900
Phone: +65-6358-2160
Fax: +65-6358-2015
e-mail:
singaporeales@powerint.com

TAIWAN

Power Integrations
International Holdings, Inc.
17F-3, No. 510,
Chung Hsiao E. Rd., Sec. 5,
Taipei, Taiwan 110, R.O.C.
Phone: +886-2-2727-1221
Fax: +886-2-2727-1223
e-mail:
taiwansales@powerint.com

UK (EUROPE & AFRICA HEADQUARTERS)

1st Floor, St. James's House
East Street
Farnham, Surrey GU9 7TJ
United Kingdom
Phone: +44-1252-730-140
Fax: +44-1252-727-689
e-mail: eurossales@powerint.com

