Design Example

Using STR3A453D

24 W (24 V, 1 A)

Off-line Buck Converter

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1. Introduction

STR3A400 series are a power IC incorporating a power MOSFET and a current mode PWM controller IC. They are for the flyback converters, but also they can be configured the non-isolated buck converter.

This document describes a design example for a universal input, 24 W (24 V, 1 A), non-isolated buck converter. For this design example, STR3A453D is used.

This document contains a power supply design specification, a component list, a PCB layout and typical performance data.

2. Features

- Non-isolation
- Buck Converter
- High Accuracy Load Reguration
- High efficiency in All Load
  The oscillation mode of the STR3A400 series automatically changes according to load (Green mode and burst oscillation mode).

3. Applications

- Small Home Appliance
- White Goods
- Auxiliary Power Supply
- Motor Control
- Other Switching Mode Power Supply

4. Power Supply Appearance of Design Example

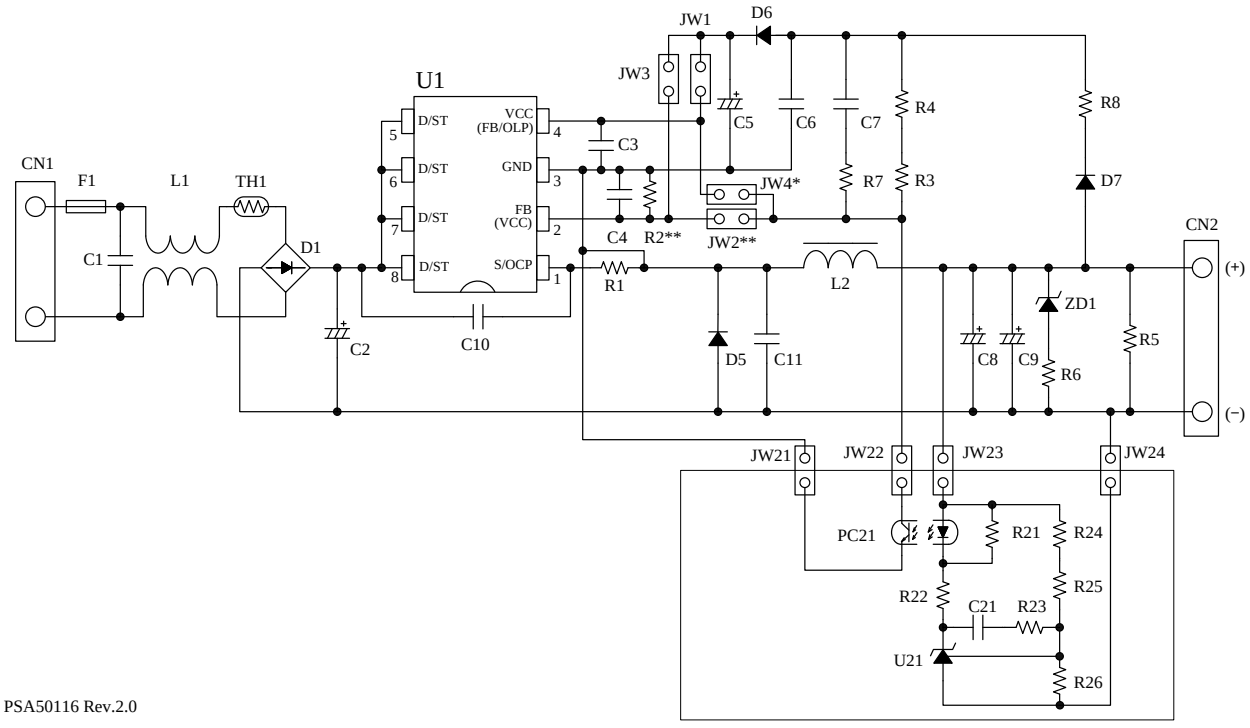
◆Top View

5. Design Example

5.1 Power Supply Design Specification

Description	Symbol	Min	Typ.	Max.	Unit	Remarks
Input						
Input Voltage	V_{IN}	85		265	V	
Frequency	f_{LINE}	47	50/60	63	Hz	
Output						
Name Plate Voltage	V_{NP}		24		V	
Name Plate Current	I_{NP}		1		A	
Output Power	P_{OUT}		24		W	
Efficiency						
Average Efficiency	η		86.6		%	T_A = 25 °C, 230VAC
Efficiency at 10% Load	$\eta_{(10)}$		83.1		%	T_A = 25 °C, 230VAC
Input Power at No Load	P_0		49.7		mW	T_A = 25 °C, 230VAC

5.2 Circuit

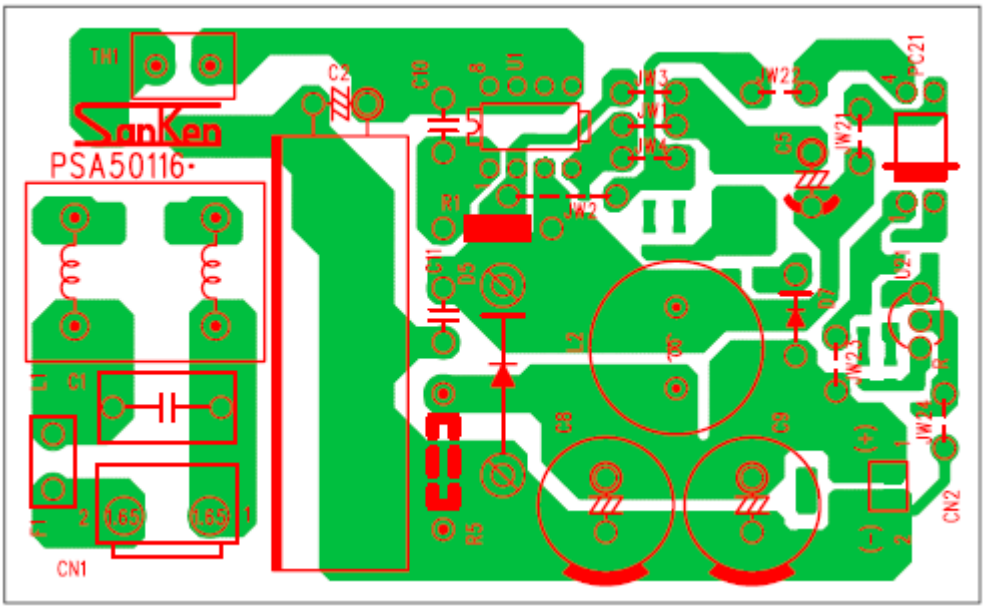


5.3 Component List

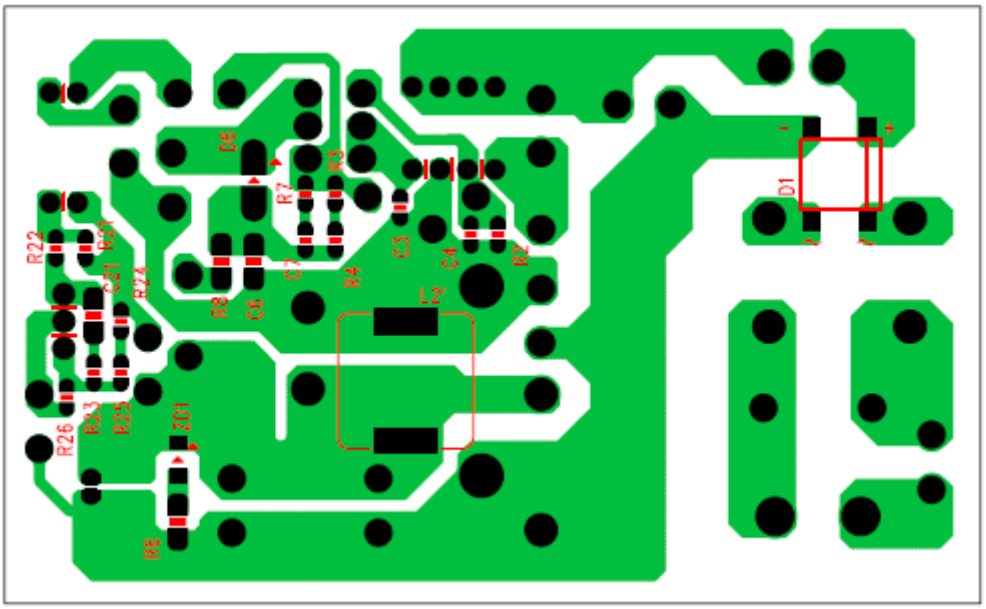
Symbol	Component	Characteristics	Product	Manufacture
F1	Fuse	250 V, 2 A		
TH1	Power Thermistor	Short		
C1	Film capacitor	275 V, 0.1µF	FTX2	WURTH
C2	Electrolytic capacitor	400 V, 68 µF	QXW	Rubycon
C3	Ceramic capacitor	50 V, 1000 pF, 2012	X7R	WURTH
C4	Ceramic capacitor	Open		
C5	Electrolytic capacitor	50 V, 22 µF	RS	AiSHi
C6	Ceramic capacitor	Open		
C7	Ceramic capacitor	Open		
C8	Electrolytic capacitor	Open		
C9	Electrolytic capacitor	50 V, 330 µF	ZLH	Rubycon
C10	Ceramic capacitor	Open		
C11	Ceramic capacitor	2 kV, 22 pF		
C21	Ceramic capacitor	50 V, 0.1 µF, 2012	X7R	WURTH
D1	Diode bridge	600 V, 1 A	S1NBC60	SHINDENGEN
D5	Fast recovery diode	600 V, 3 A	RL4A	Sanken
D6	Fast recovery diode	Short		
D7	Fast recovery diode	600 V, 0.5 A	AG01A	Sanken
ZD1	Zener diode	V_Z = 33 V	SJPZ-E33	Sanken
L1	CM inductor	10 mH	WE-FC	WURTH
L2	Inductor	180 µH	16RHBP	TOKO
R1	Resistor	0.36 Ω, 1 W	RSMF	AKAHANE
R2	Resistor	Open		
R3	Resistor	Open		
R4	Resistor	Open		
R5	Resistor	Open		
R6	Resistor	0 Ω, 1/8 W, 1608		
R7	Resistor	Open		
R8	Resistor	0 Ω, 1/8 W, 1608		
R21	Resistor	1.5 kΩ, 1/8 W, 1608		
R22	Resistor	3.9 kΩ, 1/8 W, 1608		
R23	Resistor	100 kΩ, 1/8 W, 1608		
R24	Resistor	1.5 kΩ, 1/8 W, 1608		
R25	Resistor	47 kΩ, 1/8 W, 1608		
R26	Resistor	5.6 kΩ, 1/8 W, 1608		
U1	AC/DC convertor IC	650 V, 1.9 Ω	STR3A453D	Sanken
U21	Shunt regulator	V_{REF} = 2.5 V	KIA431A	KEC
PC21	Photo-coupler		PS2561	Renesas
JW1, JW2		Open		
JW3, JW4		Short		
JW21 ~ JW24		Short		

6. PCB Layout Example

See Section 5.2 about the circuit of PCB layout example.



(a) Top View



(b) Bottom View

Figure 6-1. PCB Layout Example

7. Performance Data

All data in this document was measured at room temperature and 50 Hz line frequency.

7.1 Load Regulation

Since the buck converter controls output voltage using external shunt regulator and photocoupler, the load regulation characteristic is flat.

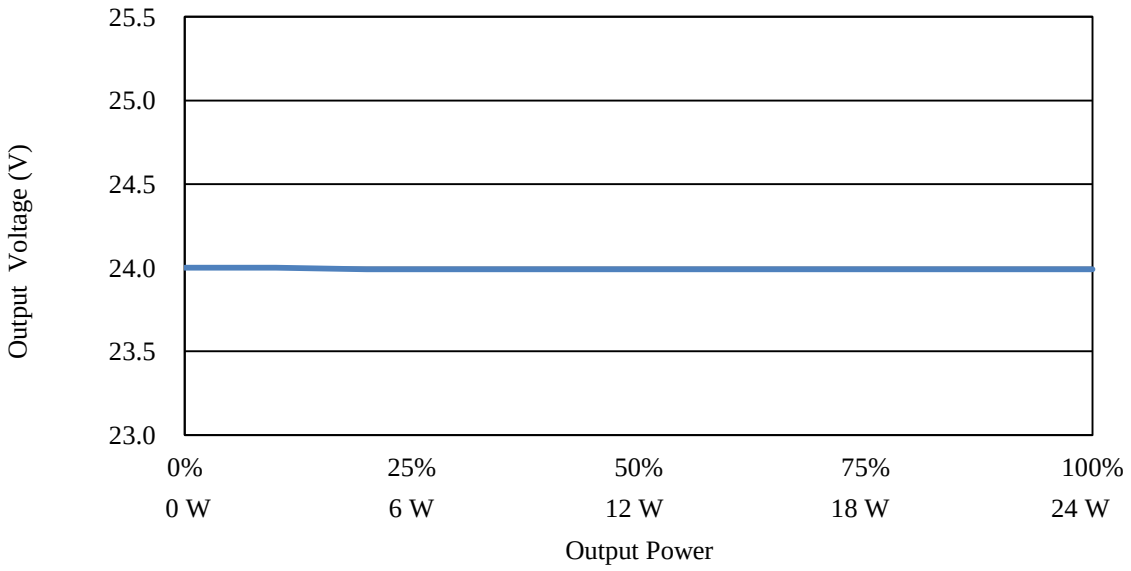


Figure 7-1. Load Regulation (100 VAC)

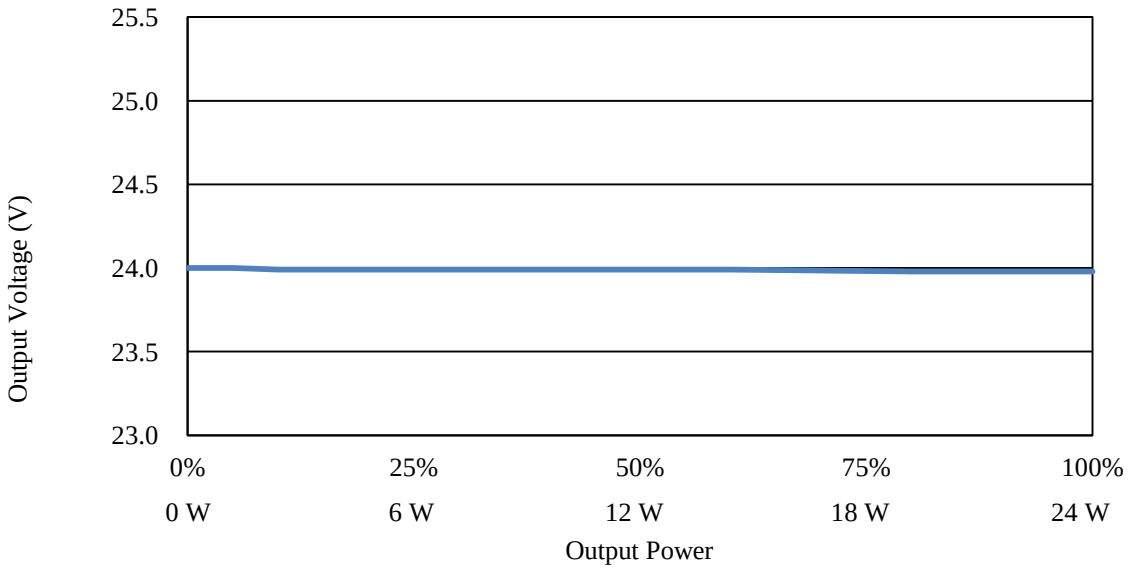


Figure 7-2. Load Regulation (230 VAC)

7.2 Efficiency

Figure 7-3 and Figure 7-4 show the efficiency depending on output power in normal operation.

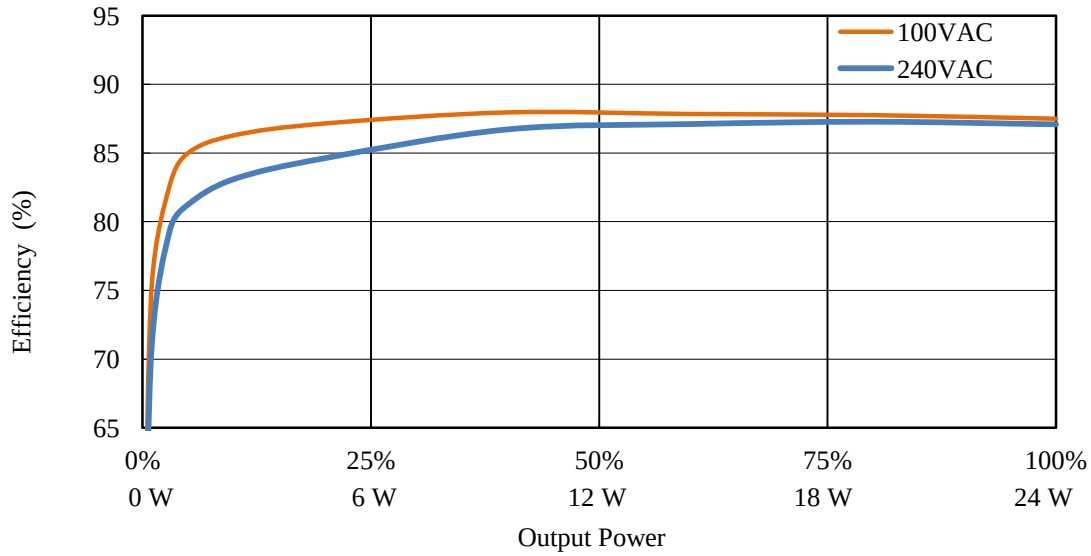


Figure 7-3. Efficiency vs. Output Power

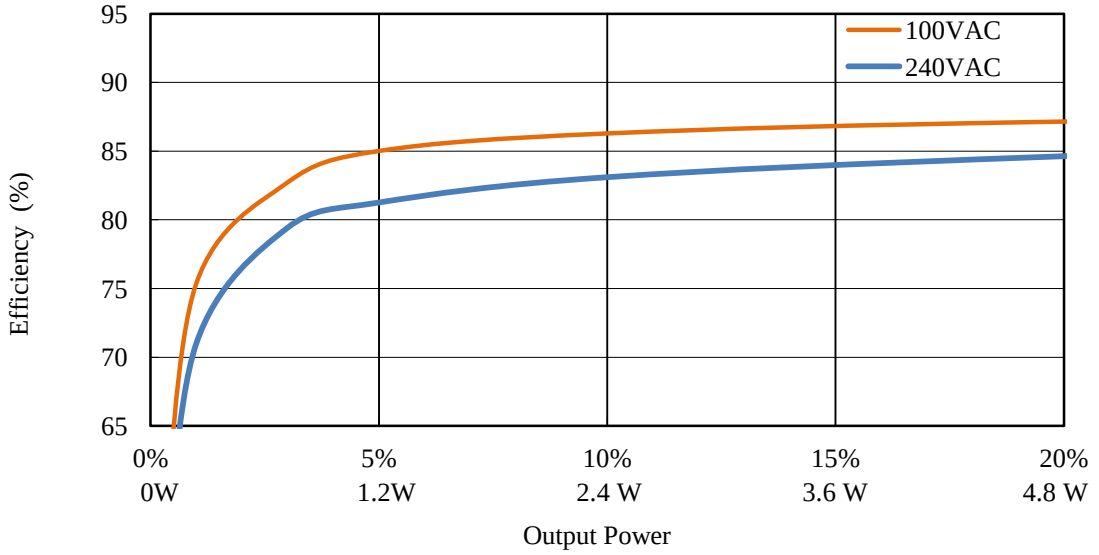


Figure 7-4. Efficiency vs. Output Power in Light Load

7.3 Input Power at No Load

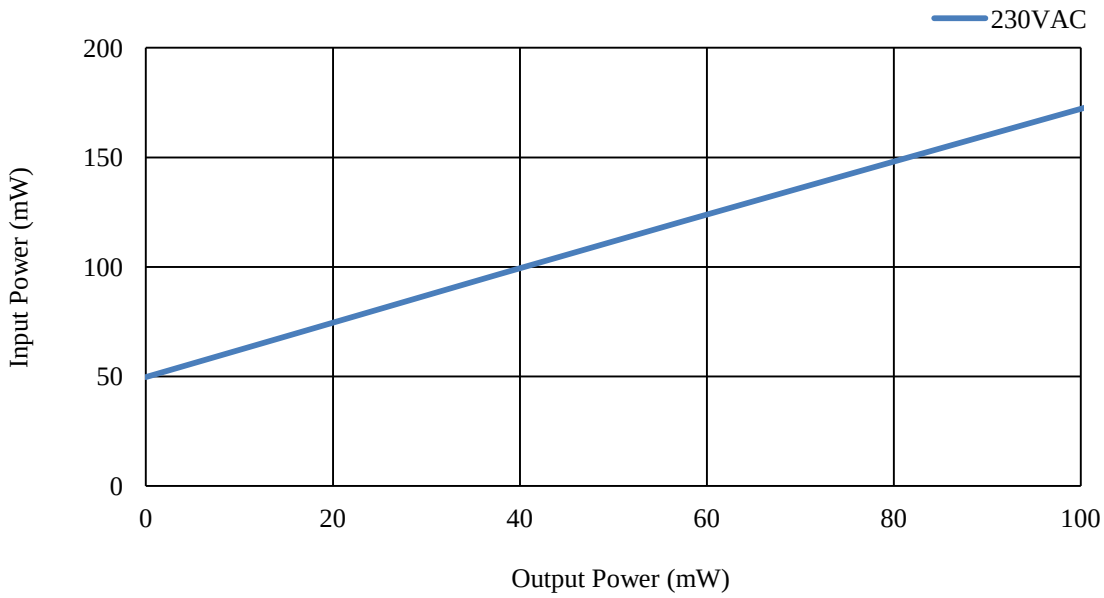


Figure 7-5. Input Power vs. Output Power

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