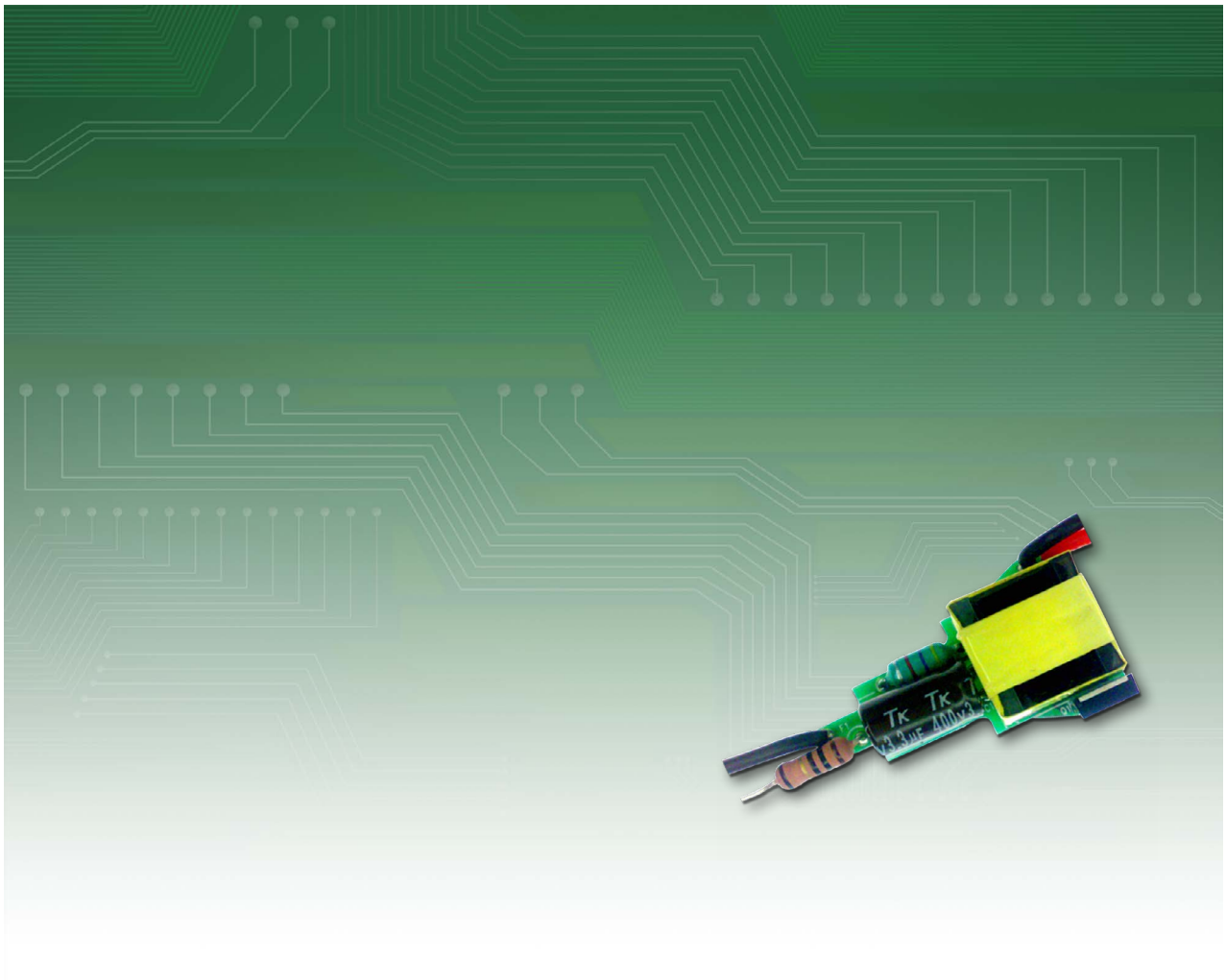
Reference Design

EBC883

iWatt
Power Management Simplified Digitally™



LED Driver Design with iW1678

(AC Input 180V–264V_{AC}, Output 10 LEDs)

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1.0 Introduction

This reference design describes a 10 LEDs output, high line input (180–264V_{AC}) power supply for non-dimmable LED applications. For this design the iW1678-00 is used. This document contains the complete specification of the LED driver, a detailed circuit diagram, an entire bill of materials required to build the LED driver, a drawing of the power transformer, and test data of the most important performance.

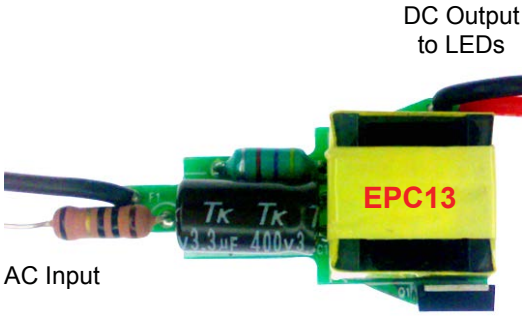


Figure 1.1 PCB Top View

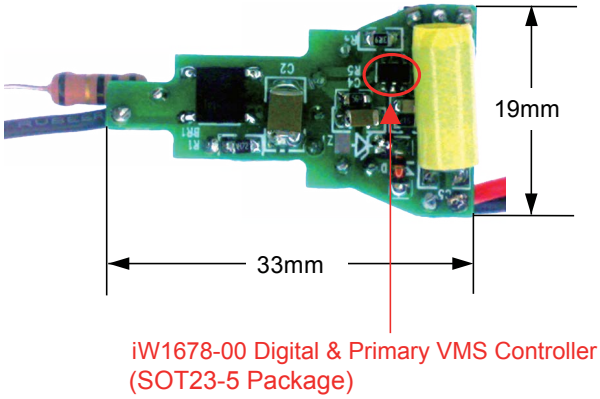


Figure 1.2 PCB Bottom View

2.0 Design Features

- For candle LED lamp
- AC input range 180-264V_{AC}
- Output 10 LEDs at 160mA
- Non-isolated applications
- High efficiency and minimum parts count
- Meet EMI EN55015B-QP limits

3.0 Design Specification

The information in the table below represents the minimum acceptable performance of the design.

Description	Symbol	Min	Typ	Max	Units	Comment
Input						
Voltage	V_{IN}	180	230	264	V_{AC}	2 wire
Frequency	f_{LINE}		50		Hz	
Output						
Constant output voltage	V_{OUT_CV}		32		V	Measured at end of PCB
Constant output current	I_{OUT_CC}		160		mA	
Total Output Power						
Continuous output power	P_{OUT}		5		W	
Efficiency	η		86		%	Measured at end of PCB, V_{IN}=230V_{AC} (T_{AMB}=25°C)
Power factor	*PF*		0.5			Harmonic meet IEC61000-3-2
Environmental						
Conducted EMI		Meets EN55015B				
Operation temperature	T_{OPR}		40		°C	Free convection, sea level

4.0 Schematic

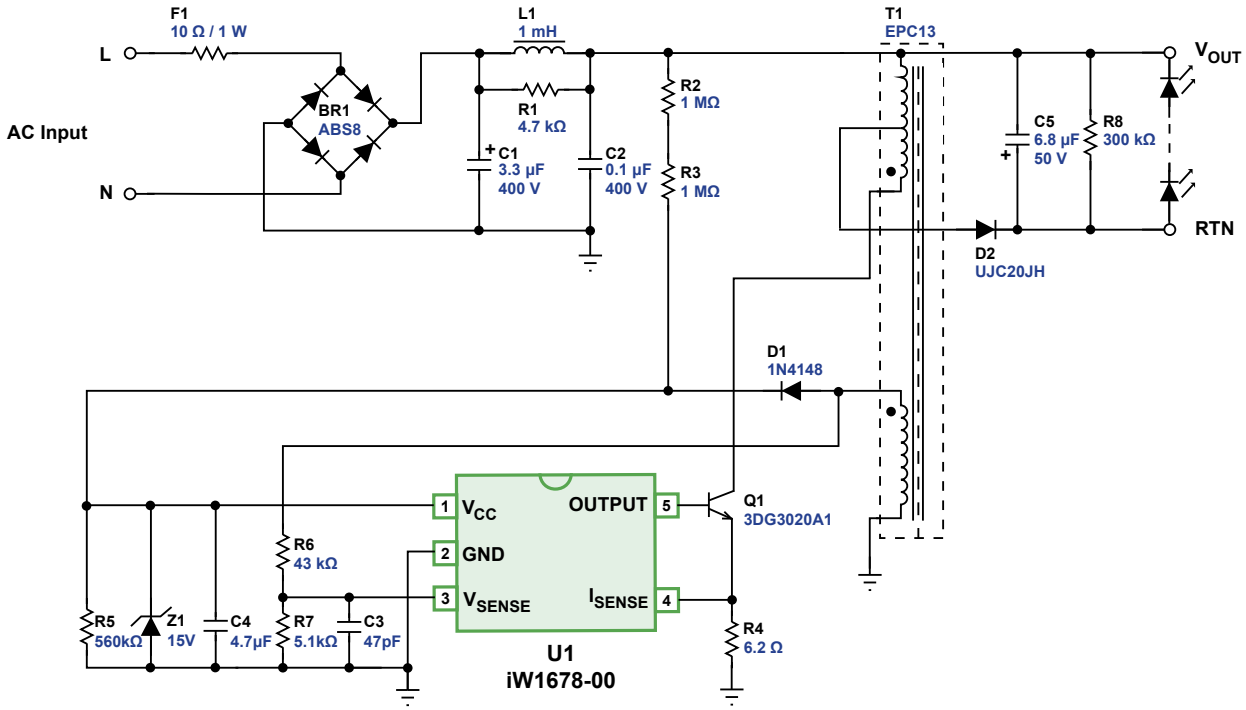
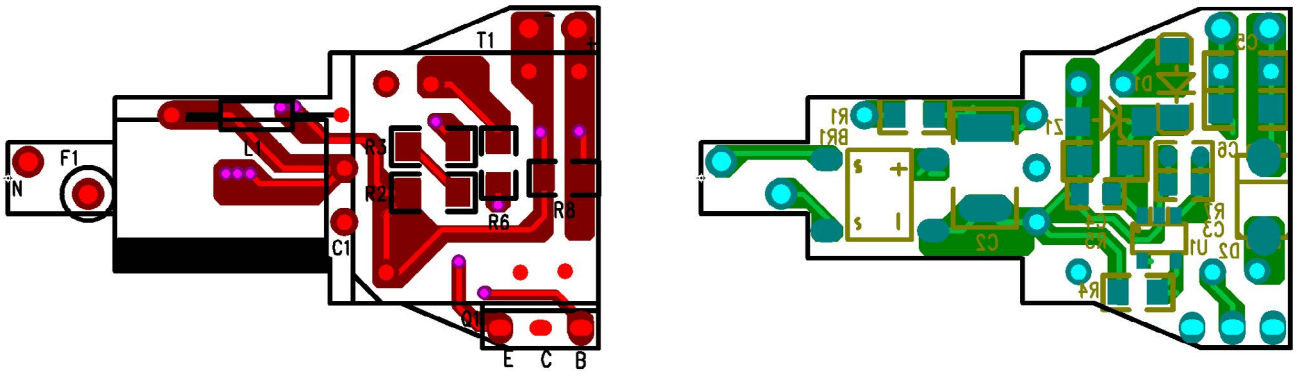


Figure 4.1 Design Schematic

5.0 PCB Layout



PCB Top PCB Bottom

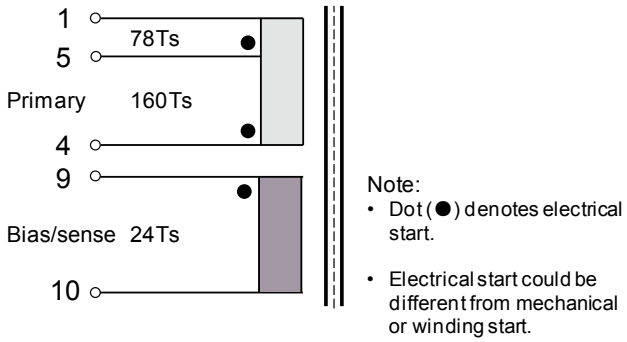
Figure 5.1 PCB Layout 33.0 mm x 19.0 mm

6.0 Bill of Materials

Item	Qty.	Ref.	Description	Manufacturer P/N	Manufacturer
1	1	U1	iW1678-00, off-line digital & primary VMS controller, SOT23-5	iW1678-00	iWatt, Inc
2	1	C1	3.3µF, 400V, E-CAP, (Φ6.3mm×11.5mm)	2GUTWHS3R3M0E12	TOSHIN KOGYO Co.
3	1	C2	0.1µF, 400V, CBB, P=5.5mm	MTF400V	Carli
4	1	C3	47pF, 50V, X7R, SMD-0603	06035C470KAT2A	AVX Corporation
5	1	C4	4.7µF, 25V, X7R, SMD-1206	CGA5L1X7R1E475K	TDK Corporation
6	1	C5	6.8µF, 50V, E-CAP, (Φ6.3mm×11.5mm)	KLH-050V6R8ME110	KOSHIN
7	1	R1	4.7KΩ ±5%, SMD-0805	ERJ-6GEYJ472V	Panasonic - ECG
8	2	R2, R3	1MΩ ±5%, SMD-1206	ERJ-8GEYJ105V	Panasonic - ECG
9	1	R4	3.9Ω ±5%, SMD-0805	ERJ-6GEYJ3R9V	Panasonic - ECG
10	1	R5	560KΩ ±5%, SMD-0805	ERJ-6GEYJ564V	Panasonic - ECG
11	1	R6	43KΩ ±1%, SMD-0805	ERJ-6ENF4302V	Panasonic - ECG
12	1	R7	5.1KΩ ±1%, SMD-0805	ERJ-6ENF5101V	Panasonic - ECG
13	1	R8	300KΩ ±5%, SMD-0805	ERJ-6GEYJ304V	Panasonic - ECG
14	1	BR1	1A, 800V, bridge rectifier, ABS	ABS8	Taiwan Semiconductor
15	1	D1	150MA, 75V, rectifier, SOD323F	1N4148WS	Fairchild Semiconductor
16	1	D2	2A, 200V, schottky diode, DO-214AC (SMA)	SM2200A	Eris Technology
17	1	Z1	Zener, 15V, SOD-323	BZT52C15S-7-F	Diodes Inc
18	1	F1	10Ω, fusible resistor, 1W	FRM1WJT-52-10R	Yageo
19	1	L1	1mH, filter inductor, Axial	8230-92-RC	Bourns Inc.
20	1	Q1	1.5A, 450V, NPN transistor, TO-251	3DD3020A1	HuaJing Mirco Co., Ltd
21	1	T1	EPC13, Horizontal	CUSTOM	

7.0 Transformer Drawing

Schematic:



Electrical Specifications:	
1.	Primary inductance (Lp) = 3.2mH @10KHz
2.	Primary leakage inductance (Lk) < 20μH @10KHz
3.	Electrical strength = 3KV, 50/60Hz, 1min.
Materials:	
1.	Core: EPC13 (ferrite material TDK PC40 or equivalent)
2.	Bobbin: EPC13 Horizontal. Primary=5, Secondary=5
3.	Magnet wires (pri): type 2-UEW
4.	Layer insulation tape: 3M1298 or equivalent
Finished:	
1.	Cut remained of pin 2,3,6,7,8
2.	Varnish the complete assembly

8.0 Performance

8.1 Constant Current and Efficiency

V_{IN} (V_{AC})	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (A)	η (%)	Power Factor
180	5.66	31.47	0.154	85.63%	0.606
190	5.64	31.43	0.154	85.82%	0.596
200	5.62	31.41	0.154	86.07%	0.589
210	5.61	31.39	0.154	86.17%	0.581
220	5.61	31.38	0.154	86.14%	0.573
230	5.60	31.37	0.154	86.27%	0.573
240	5.59	31.35	0.154	86.37%	0.559
250	5.59	31.34	0.154	86.06%	0.553
260	5.58	31.32	0.154	86.16%	0.546
264	5.58	31.31	0.153	85.85%	0.544

8.2 Current Harmonics

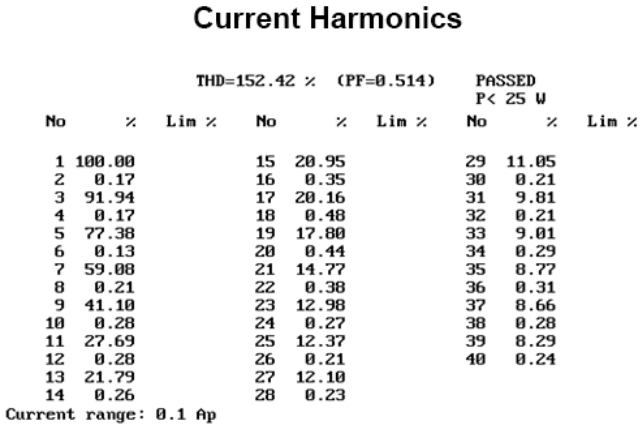


Figure 8.1 Current Harmonics

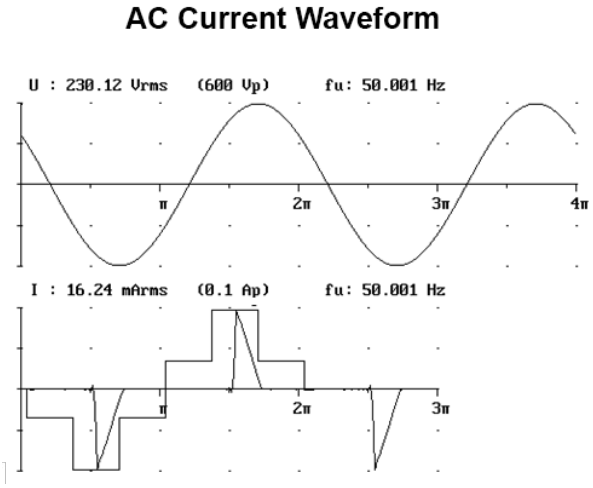
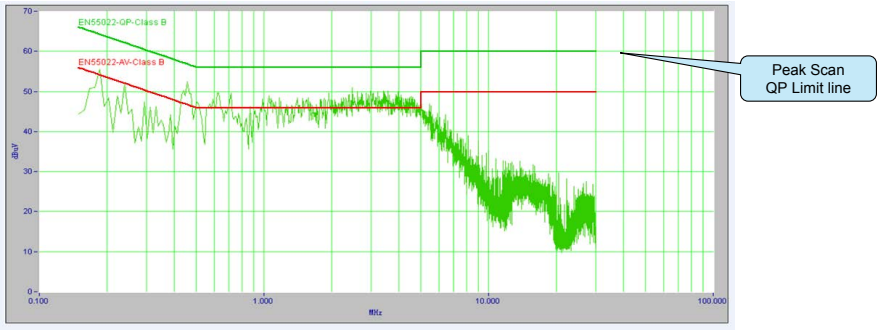


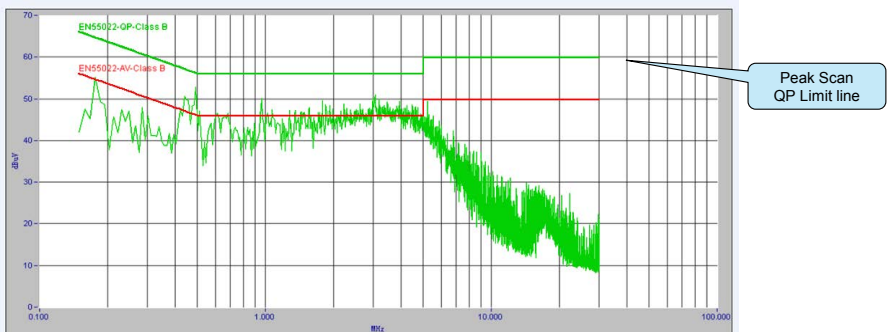
Figure 8.2 AC Current Waveform

8.0 Performance (Cont.)

8.3 Conducted EMI



a) Peak Scan L



b) Peak Scan N

Figure 8.3 EMI Results

Trademark Information

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