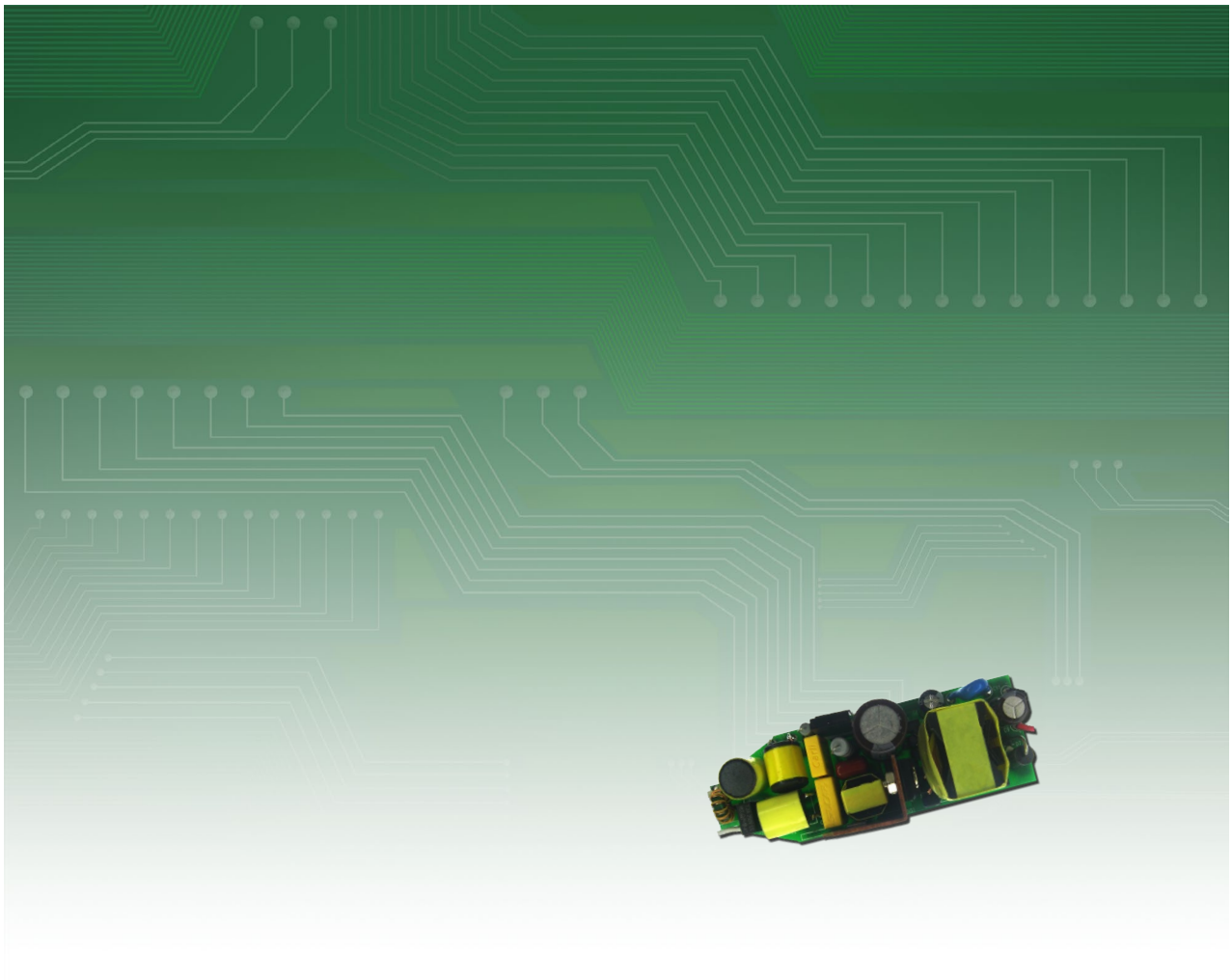
Reference Design

EBC903

iWatt
Power Management Simplified Digitally™



Dimmable LED Driver with iW3614-00

(AC Input 90-135V_{AC}, Output 21V 700mA)

Table of Contents

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1.0 Introduction

This reference design describes a 6 LEDs output, low line input (90–135V_{AC}) power supply for dimmable LED applications. For this design the iW3614-00 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

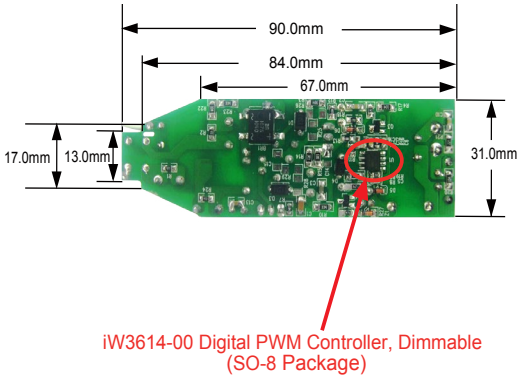


Figure 1.2 PCB Bottom View

2.0 Design Features

- Isolated AC/DC offline, input 115V_{AC}
- Output 6 LEDs at 700mA
- Intelligent wall dimmer detection:
  - » Leading-edge dimmer
  - » Trailing-edge dimmer
  - » No-dimmer
- Multiple dimming control schemes
  - » Hybrid dimming
  - » PWM dimming: 900Hz
  - » Amplitude dimming
- Wide dimming range from 1% to 100%
- Flickerless™ LED dimming technology: no visible flicker
- Resonant control to achieve high efficiency
- High power factor, 0.9-0.98 without dimmer
- Over-temperature protection and de-rating
- PrimAccurate™ primary-only sensing eliminates opto-isolator feedback and simplifies design

3.0 Design Specification

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

Description	Symbol	Min	Typ	Max	Units	Comment
Input						
Voltage	V_{IN}	90		135	V_{AC}	2 wire
Frequency	f_{LINE}	47	50	63	Hz	
Output						
Output voltage	V_{OUT}		21		V	Measured at the end of PCB
Output current	I_{OUT}		0.7		A	
Output ripple current	I_{RIPPLE}				mA_{P_P}	Set oscilloscope at 20MHz bandwidth
Total Output Power						
Continuous output power	P_{OUT}		14.7		W	
Power factor	*PF*	0.9				
Efficiency	η		74		%	Measured at end of PCB V_{IN}=115V_{AC}
Environmental						
Conducted EMI		Meets CISPR22B/EN55022B				
Safety		Designed to meet IEC950, UL1950 Class II				
Ambient temperature	T_{AMB}	0		40	°C	Free convection, sea level

4.0 Schematic

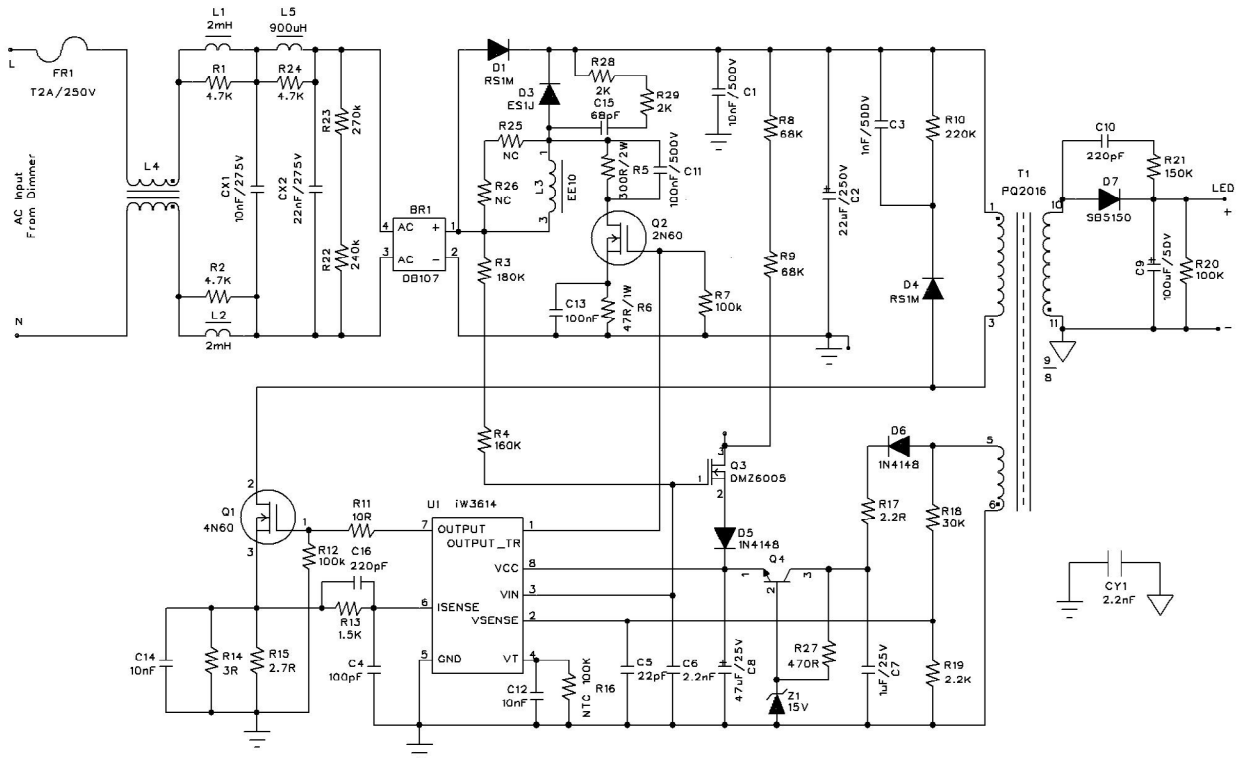
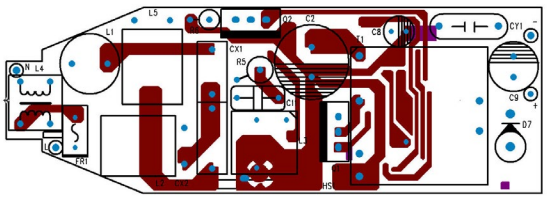
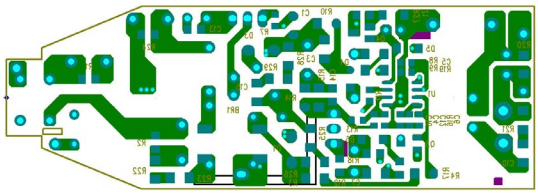


Figure 4.1 Design Schematic

5.0 PCB Layout



a) PCB Top



b) PCB Bottom

Figure 5.1 PCB Layout 90.0 mm x 31.0 mm

6.0 Bill of Materials

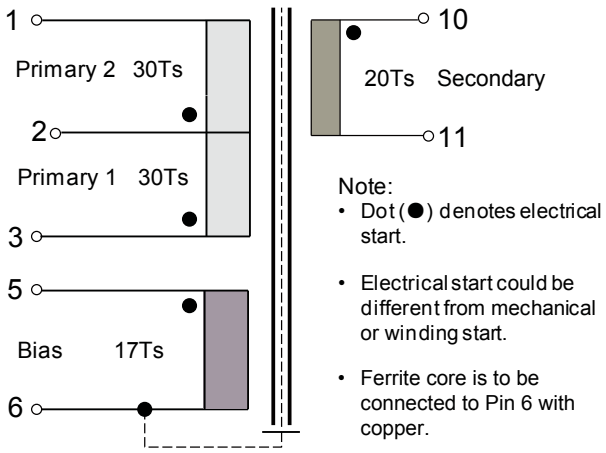
Item	Qty.	Ref.	Description	Manufacturer P/N	Manufacturer
1	1	U1	iW3614-00, Digital PWM Controller,Dimmable, SO-8	iW3614-00	iWatt, Inc.
2	1	CX1	0.01µF, 275V, X2 pin=7.5mm	PX103K3IB19H200D9R	CARLI
3	1	CX2	0.047µF, 275V, X2 pin=10mm	PX473K3IC39H200D9R	CARLI
4	1	C11	100nF, 250V, CL21 pin=7.5mm	AF104J2E079L230D9R	CARLI
5	1	C2	22µF, 250V, E-cap, 105°C	22UFLK250V	Yongming
6	1	C3	1nF, 250V, X7R, SMD1206	251R15W102KV4E	Johanson
7	1	C4	100pF, 50V, X7R, SMD 0805	CL10C101KB8NNNC	Samsung
8	1	C5	27pF, 50V, X7R, SMD 0805	CL10C27KB8NNNC	Samsung
9	1	C6	2.2nF, 50V, X7R, SMD 0805	CL10C222KB8NNNC	Samsung
10	1	C7	1µF, 50V, X7R, SMD 1206	CL10C105KB8NNNC	Samsung
11	1	C13	100nF, 50V, X7R, SMD 0805	CL10C104KB8NNNC	Samsung
12	1	C10	220pF, 250V, X7R, SMD1206	251R15W221KV4E	Johanson
13	1	C12	10nF, 50V, X7R, SMD 0805	CL10C103KB8NNNC	Samsung
14	1	C8	47µF, 25V, E-cap	47UFLK25V	Samsung
15	1	C9	100µF, 50V, E-cap	100UFLK50V	Samsung
16	3	R1, R2, R24	4.7KΩ ±5%, SMD-1206	RC1206JR-074K7L	Yongming
17	1	R3	180KΩ, ±1%, SMD-1206	RC1206JR-07180KL	Yongming
18	2	R4	160KΩ, ±1%, SMD-1206	RC1206JR-07160KL	YAGEO
19	1	R5	300Ω, ±5%, 2W	300R2W MOF	YAGEO
20	1	R6	47Ω, ±5%, 1W	47R1W MOF	YAGEO
21	1	R10	220KΩ, ±5%, SMD-1206	RC1206JR-07220KL	YAGEO
22	2	R7, R12	100KΩ, ±5%, SMD-0805	RC0805JR-07100KL	YAGEO
23	2	R8, R9	68KΩ, ±5%, SMD-1206	RC1206JR-07220KL	YAGEO
24	1	R13	1.5KΩ, ±1%, SMD-0603	RC0603JR-071K5L	YAGEO
25	1	R14	3Ω, ±1%, SMD-1206	RC1206JR-073RL	YAGEO
26	1	R15	2.7Ω, ±1%, SMD-1206	RC1206JR-072R7L	YAGEO
27	2	R22, R23	220kΩ, ±5%, SMD-1206	RC1206JR-07220KL	YAGEO
28	1	R27	470Ω, ±5%, SMD-0805	RC0805JR-07470RL	YAGEO
29	1	R16	100KΩ, ±5%, SMD-0603 (100K NTC)	RC0603JR-07100KL	YAGEO
30	1	R11	10Ω, ±5%, SMD-0805	RC0805JR-0710RL	YAGEO
31	1	R18	30KΩ, ±1%, SMD-0805	RC0805JR-0730KL	YAGEO
32	1	R19	2.2KΩ, ±1%, SMD-0603	RC0603JR-072K2L	YAGEO
33	1	R20	100KΩ, ±5%, SMD-1206	RC1206JR-07100KL	YAGEO
34	1	R21	150Ω, ±5%, SMD-1206	RC1206JR-07150RL	YAGEO
35	1	F1	T2A250V	MST2A250V	Conquer
36	1	BR1	DB107S, SMD	KBP1010S	PANJIT
37	1	D4	RS1M 1A1000V, SMD-1206S	SRGC10MH	ZOWIE
38	2	D1, D3	ES1J, SMA	ES1J	PANJIT
39	2	D5, D6	1N4148, 0.1A/100V, LL34	1N4148	PANJIT

6.0 Bill of Materials (Cont.)

Item	Qty.	Ref.	Description	Manufacturer P/N	Manufacturer
40	1	D7	MBR5150 5A/150V D0-201AD	MBR5150	PANJIT
41	1	Z1	Zener, 15V, SMD	ZVS15V	ST
42	1	CY1	Y1, 2.2nF250V	Y12.2NF250V	STF
43	1	Q1	FTA04N60B, TO-220F	FTA04N60B	ARK
44	1	Q2	FTA02N60B, TO-220F	FTA02N60B	ARK
45	1	Q3	DMZ6005, N-Depletion, 600V, SOT-23	DMZ6005,	ARK
46	1	Q4	MMBT4401, SOT-23	MMBT4401	NXP
47	2	L1, L2	2mH, Drum choke, 10X12mm, 0.26mm, 230Ts	10X12MM	xingyuangyang
48	1	L5	650μH, Drum choke, 10X12mm, 0.3mm, 120Ts	10X12MM	xingyuangyang
49	1	L3	860μH, EE10	EE10	xingyuangyang
50	1	L4	Common Mode Inductor T8*4*3 30μH	Common Mode Choke	Bead&Ferrite
51	1	T1	PQ2016, Transformer	PQ2016	xingyuangyang

7.0 Transformer Drawing

Schematic:



Electrical Specifications:

1.	Primary inductance (Lp) = 1.0mH @10KHz
2.	Primary leakage inductance (Lk) ≤70μH @10KHz

Materials:

1.	Core: PQ2016 (ferrite material TDK PC40 or equivalent)
2.	Bobbin: PQ2016
3.	Magnet wires (Pri): type 2-UEW
4.	Magnet wire (Sec): triple insulated wires
5.	Layer insulation tape: 3M1298 or equivalent

Finished:

1.	Remove pins 2, 4, 7, 8, 9, 12, 13, 14 from the bobbin
2.	Varnish the complete assembly
3.	Core is connected to primary pin 6

8.0 Performance

8.1 Constant Current and Efficiency

* Note: V_{IN}=90V_{AC}-135V_{AC}/60Hz; Loading with 6 LEDs 700mA

V_{IN} (V_{AC})	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (mA)	η (%)	Power Factor
90	21.14	21.92	0.728	75.44%	0.940
100	20.39	21.89	0.726	77.97%	0.956
110	19.64	21.86	0.725	80.67%	0.965
115	19.42	21.84	0.723	81.35%	0.967
120	19.26	21.84	0.723	82.01%	0.969
130	19.04	21.8	0.723	82.72%	0.974
135	18.93	21.78	0.723	83.14%	0.975

8.2 Current Harmonics

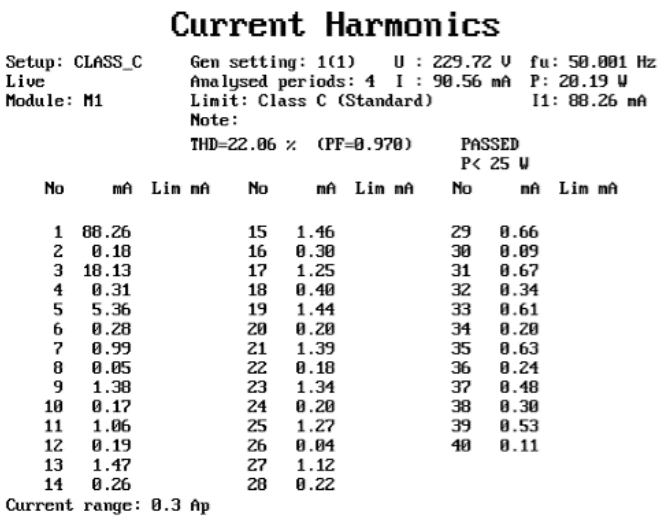


Figure 8.2.1 Current Harmonics

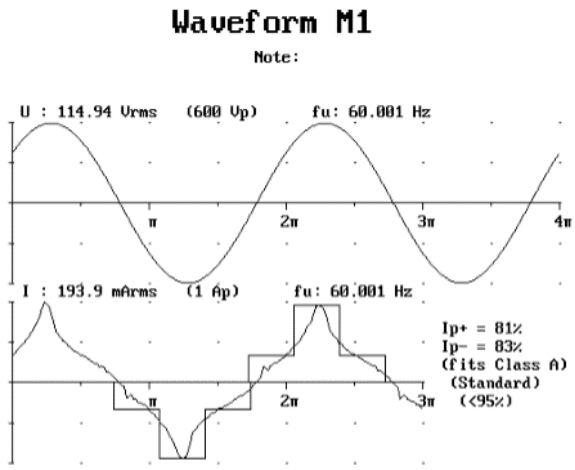
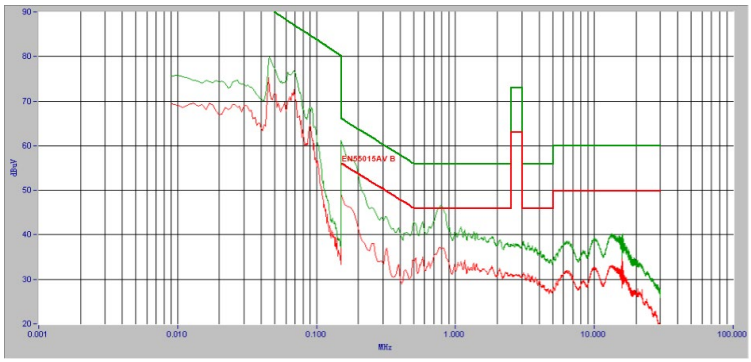


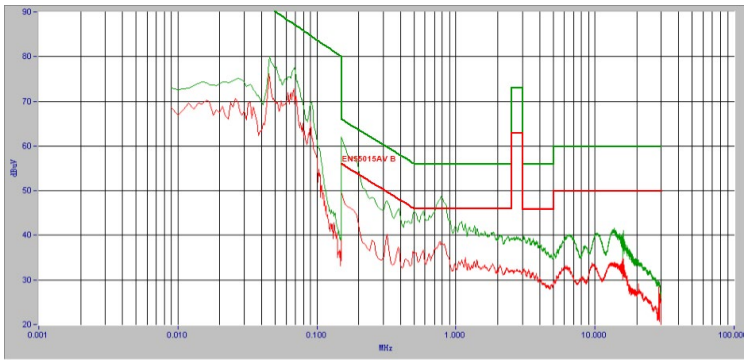
Figure 8.2.2 AC Current Waveform

8.0 Performance (Cont.)

8.3 Conducted EMI



a) QP & AV Scan L



b) QP & AV Scan N

Figure 8.3.1 EMI Results

Trademark Information

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