

**Dimmable LED Driver with iW3602**  
(AC Input 90V–135V<sub>AC</sub>, Output 3 LEDs)

# Dimmable LED Driver with iW3602 (AC Input 90–135V<sub>AC</sub>, Output 3 LEDs) EBC894

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## 1.0 Introduction

This reference design describes a 3 LEDs output at 350mA current, low line input (90–135V<sub>AC</sub>) power supply for phase-cut dimmable LED applications. For this design the iW3602-00 is used. This document contains the design features of the phase-cut dimmable 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.

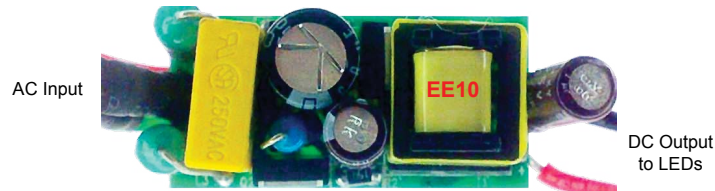


Figure 1.1 PCB Top View

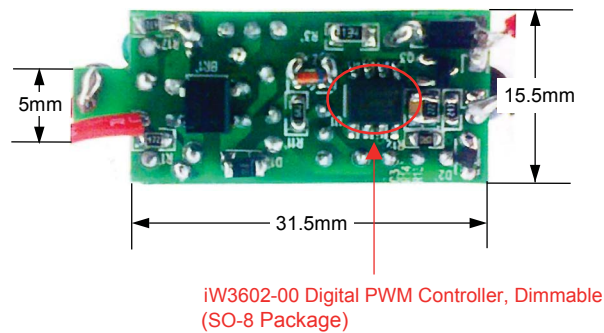


Figure 1.2 PCB Bottom View

## 2.0 Design Features

- Non-isolated AC/DC offline, input 120 V<sub>AC</sub>
- Output 3 LEDs at 350mA
- Intelligent wall dimmer detection
  - » Leading-edge dimmer
  - » Trailing-edge dimmer
  - » No dimmer
- Multiple dimming control scheme
  - » Hybrid dimming scheme
  - » PWM dimming scheme, 900Hz
  - » Amplitude dimming scheme
- Wide dimming range from 2% to 100%
- No visible flicker
- Resonant control to achieve high efficiency
- Power Factor, 0.6 without dimmer
- Temperature degradation control to adjust the LED current
- Primary-only sensing simplifies design

### 3.0 Schematic

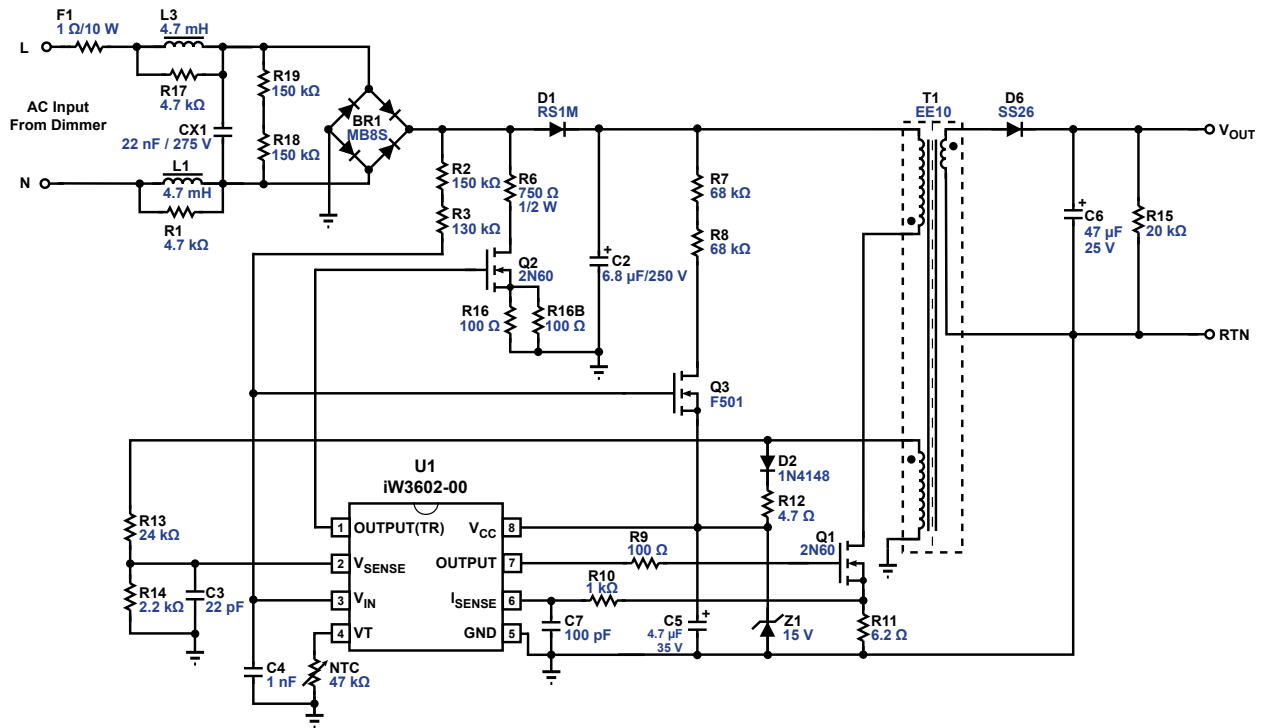


Figure 3.1 Design Schematic

### 4.0 PCB Layout

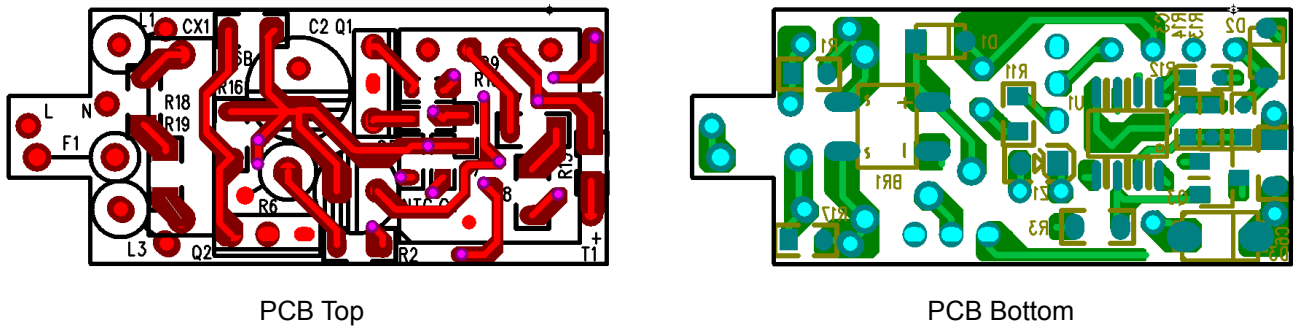


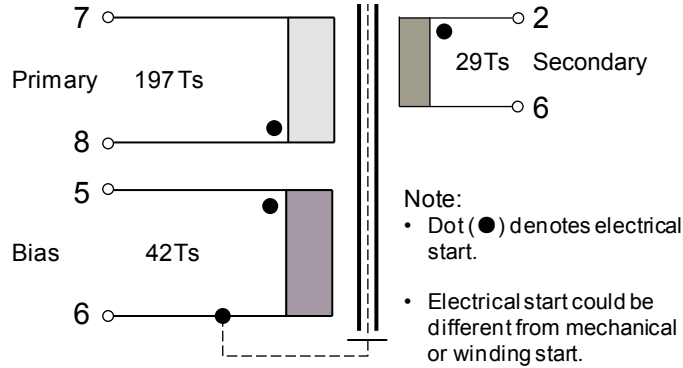
Figure 4.1 PCB Layout 31.5 mm x 15.5 mm

## 5.0 Bill of Materials

Item	Qty.	Ref.	Description	Manufacturer P/N	Manufacturer
1	1	U1	iW3602-00, off-line digital&primary VMS controller, dimmable, SO-8	iW13602-00	iWatt, Inc
2	1	CX1	22nF, 275V, X2, P=10mm	PX223K3IC1	Carli
3	1	C2	6.8μF, 250V, E-CAP, (Φ10mm×12.5mm)	250BXC6.8MEFC10X12.5	Rubycon
4	1	C3	22pF, 50V, X7R, SMD-0603	06035C220JAT2A	AVX Corporation
5	1	C4	1nF, 50V, X7R, SMD-0603	06035C102KAT2A	AVX Corporation
6	1	C5	47μF, 35V, E-CAP, (Φ5mm×11mm)	35ZLH47MEFC5X11	Rubycon
7	1	C6	47μF, 25V, X5R, SMD-1206	C3216X5R1E476M	TDK Corporation
8	2	R1, R17	4.7KΩ ±5%, SMD-0805	ERJ-6GEYJ472V	Panasonic - ECG
9	1	R2	150KΩ ±5%, SMD-1206	ERJ-8GEYJ154V	Panasonic - ECG
10	1	R3	130KΩ ±5%, SMD-1206	ERJ-8GEYJ134V	Panasonic - ECG
11	1	R6	750Ω ±5%, 1/2W	RSMF12JT750R	Stackpole Electronics Inc
12	2	R7, R8	68KΩ ±5%, SMD-1206	ERJ-8GEYJ683V	Panasonic - ECG
13	1	R9	1.1KΩ ±5%, SMD-0805	ERJ-6GEYJ112V	Panasonic - ECG
14	1	R10	1KΩ ±1%, SMD-0805	ERJ-6ENF1001V	Panasonic - ECG
15	1	R11	6.2Ω ±1%, SMD-0805	RC0805FR-076R2L	Yageo
16	1	R12	4.7Ω ±1%, SMD-0603	ERJ-3RQF4R7V	Panasonic - ECG
17	1	R13	24KΩ ±1%, SMD-0805	ERJ-6ENF2402V	Panasonic - ECG
18	1	R14	2.2KΩ ±5%, SMD-0603	ERJ-3GEYJ222V	Panasonic - ECG
19	1	R15	20KΩ ±5%, SMD-0805	ERJ-6GEYJ203V	Panasonic - ECG
20	2	R16, R16B	100Ω ±5%, SMD-1206	ERJ-8GEYJ101V	Panasonic - ECG
21	2	R18, R19	150KΩ ±5%, SMD-1206	ERJ-8GEYJ154V	Panasonic - ECG
22	1	NTC	47KΩ ±5%, SMD-0805	NCP21WB473J03RA	Murata
23	1	BR1	1A, 800V, bridge rectifier, ABS	LMB8S-TP	Micro Commercial Co
24	1	D1	1A, 1000V, fast rectifier, SMA	RS1M-13-F	Diodes Inc
25	1	D2	150MA, 75V, rectifier, SOD323F	1N4148WS	Fairchild Semiconductor
26	1	D3	2A, 60V, schokkty diode, SMB	SS26	Fairchild Semiconductor
27	1	Z1	Zener, 15V, SOD-323	BZT52C15S-7-F	Diodes Inc
28	1	F1	10Ω, fusible resistor, 1W	FRM1WJT-52-10R	Yageo
29	1	L1, L3	4.7mH, filter inductor, Axial	9250A-475-RC	Bourns Inc.
30	1	Q1, Q2	1.9A, 600V, N-Channel MOSFET, TO-251	FTU02N60B	ARK Microelectronics
31	1	Q3	12mA600V, depletion mode MOSFET, SOT23	DMZ6005	ARK Microelectronics
32	1	T1	EE10, Horizontal	CUSTOM	

## 6.0 Transformer Drawing

### Schematic:



### Electrical Specifications:

1. Primary inductance ( $L_p$ ) = 2.8mH @10KHz
2. Primary leakage inductance ( $L_k$ ) < 30 $\mu$ H @10KHz
3. Electrical strength = 3KV, 50/60Hz, 1min.

### Materials:

1. Core: EE10 (ferrite material TDK PC40 or equivalent)
2. Bobbin: EE10 Horizontal. Primary=4, Secondary=4
3. Magnet wires (pri): type 2-UEW

### Finished:

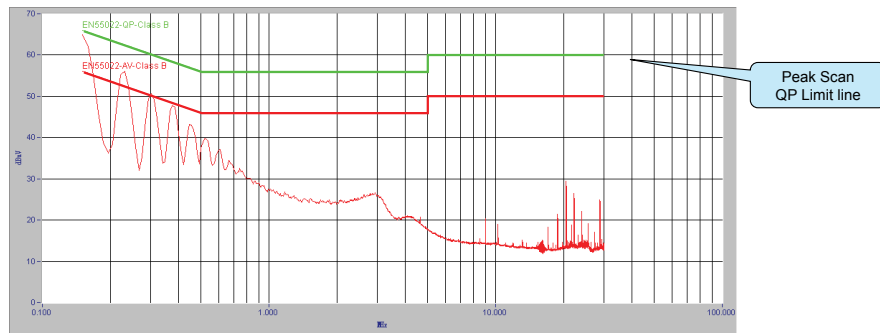
1. Varnish the complete assembly
2. Core should be connected to Pin 6

## 7.0 Performance

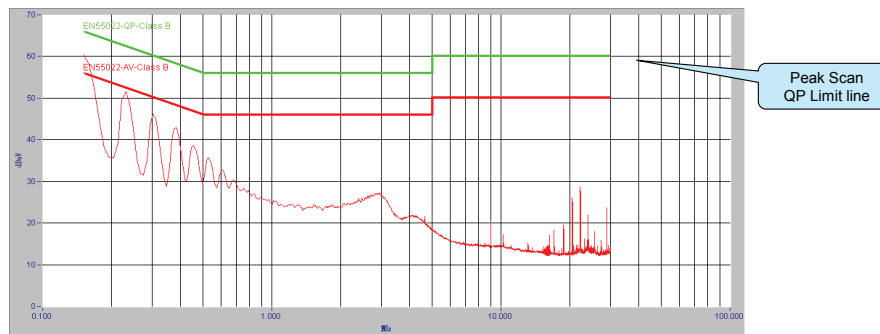
### 7.1 Constant Current and Efficiency

V <sub>IN</sub> (V <sub>AC</sub> )	P <sub>IN</sub> (W)	V <sub>OUT</sub> (V)	I <sub>OUT</sub> (A)	η (%)	Power Factor
90	4.48	9.84	0.336	73.81%	0.71
100	4.45	9.84	0.337	74.55%	0.70
110	4.40	9.85	0.338	75.65%	0.68
120	4.42	9.85	0.340	75.79%	0.67
130	4.41	9.86	0.341	76.22%	0.66
135	4.42	9.86	0.342	76.29%	0.66

### 7.2 Conducted EMI



a) Peak Scan L



b) Peak Scan N

Figure 7.1 EMI Results



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