

# Dimmable LED Driver With iW3688-01

## General Design Specification:

1. AC Input Range 180-264Vac, Isolated ac-dc offline, 12LEDS, Output 430mA
2. Intelligent wall dimmer detections(Leading-edge dimmer , Trailing-edge dimmer , No-dimmer)
3. Multiple dimming control scheme
4. Wide dimming range from 1% up to 100%
5. Resonant control to achieve high efficiency
6. High Power Factor, 0.95 without dimmer

...personal  
...portable  
...connected

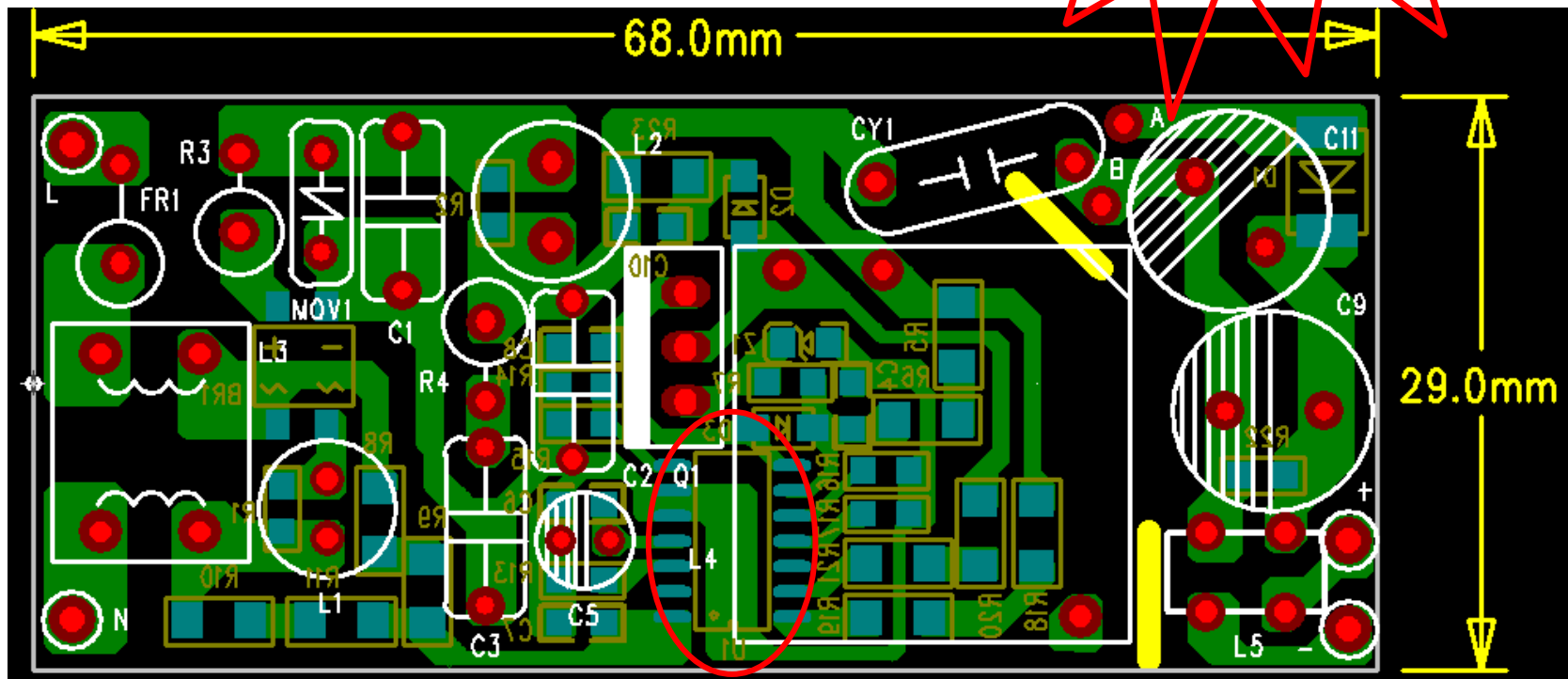
# 1. Specification

Description	Symbol	Min	Typ	Max	Units	Comment
Input						
Voltage	$V_{IN}$	180		264	V <sub>AC</sub>	2 Wire
Frequency	$f_{LINE}$	47	50/60	63	Hz	
Output						
Output Voltage	$V_{OUT}$		36		V	Measured at the end of PCB
Output Current	$I_{OUT}$		0.43		A	
Output Ripple Current	$I_{RIPPLE}$				mA <sub>P_P</sub>	Set oscilloscope at 20MHz bandwidth.
Total Output Power						
Continuous Output Power	$P_{OUT}$		15.5		W	
Performance Factor	$PF$		0.95			$V_{IN} = 230VAC$
Active Mode Efficiency (EPA2.0 Requirement)	$\eta$		85		%	Measured at end of PCB, $V_{IN} = 230VAC$ ( $T_{AMB} = 25\text{ }^{\circ}C$ ).
Environmental						
THD	THD			10	%	$V_{IN} = 230VAC$
Conducted EMI		Meets CISPR22B / EN55022B				
Safety		Designed to meet IEC950, UL1950 Class II				
Ambient Temperature	$T_{AMB}$	0		40	$^{\circ}C$	Free convection, sea level



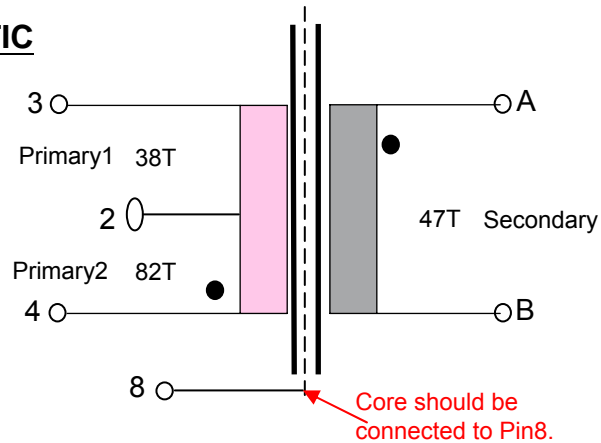


### 3. PCB Layout



# 4. Transformer Design

## SCHMATIC



## ELECTRICAL SPECIFICATIONS:

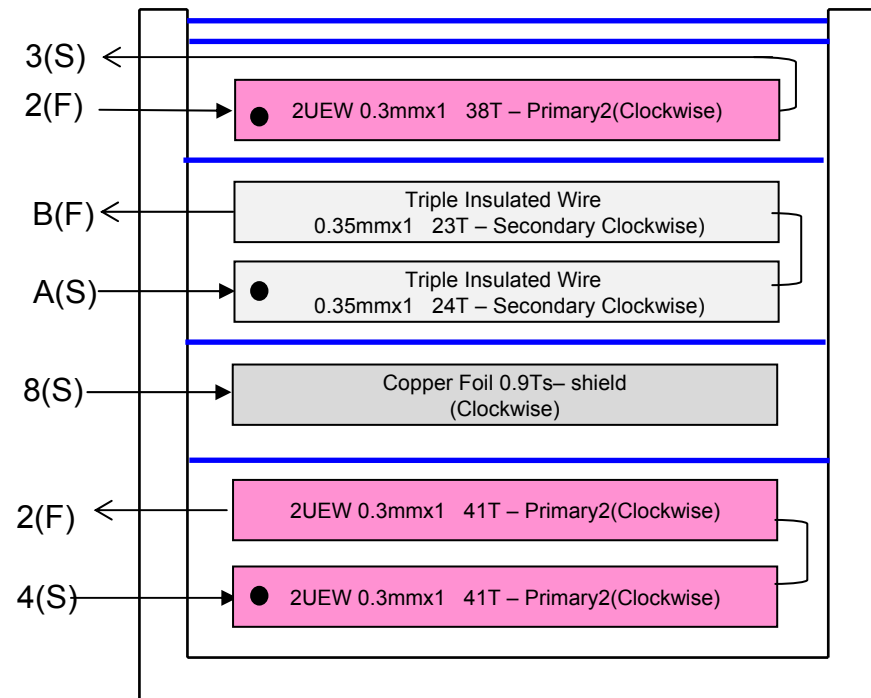
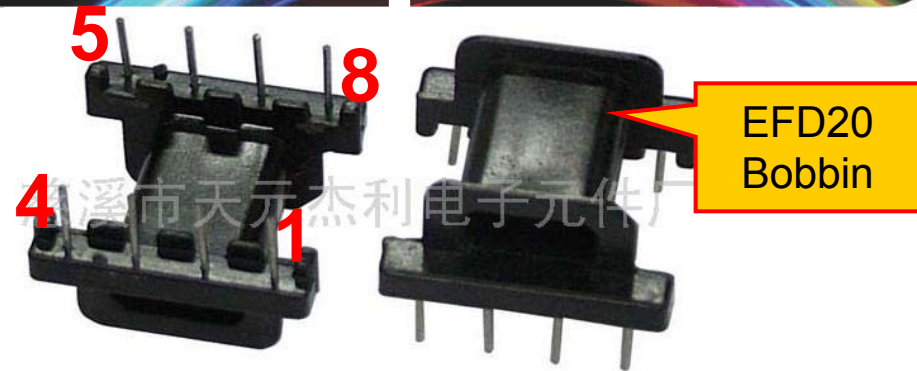
1. Primary Inductance ( $L_p$ ) = 1.3mH @10KHz
2. Electrical Strength = 3KV, 50/60Hz, 1Min

## MATERIALS:

1. Core: EFD20  $A_e=31\text{mm}^2$  (Ferrite Material TDK PC40 or equivalent)
2. Bobbin : EFD20 Horizontal
3. Magnet Wires (Pri) : Type 2-UEW
4. Magnet Wire (Sec) : Triple Insulated Wires
5. Layer Insulation Tape : 3M1298 or equivalent.

## FINISHED :

1. Shield core to Pin8 with bare tin-coated wire
2. Varnish the complete assembly



# 5. BOM COST

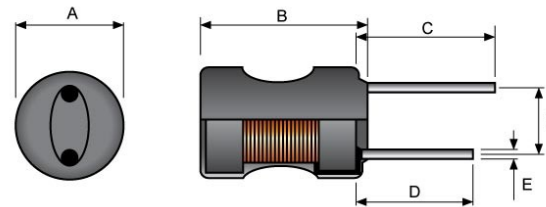
Qty	Ref.	Description			Size	Part Number	Manufacturer
1	U1				SO-14	Iw3688-01	iWatt, Inc.
1	C3	0.22uF	400V	CL21	PIN=7.5MM	CL21X-400V-224P7.5KA	Faratronic
1	C1	0.033uF	400V	CL21	PIN=7.5MM	CL21X-400V-333P7.5KA	Faratronic
1	C2	0.068uF	400V	CL21	PIN=7.5MM	CL21X-400V-683P7.5KA	Faratronic
1	C7	2.2nF	50V		SMD-0603	C1608COGX7R1H223KT	TDK Corp.
1	C8	470pF	50V		SMD-0603	C1608COGX7R1H471KT	TDK Corp.
1	C4	0.22uF	50V		SMD-0603	C1608COGX7R1H104KT	TDK Corp.
1	C6	100nF	50V		SMD-0603	C1608COGX7R1H223KT	TDK Corp.
1	C10	1nF	250V		SMD-0805	C1608COGX7R2E102KT	TDK Corp.
2	C9,C11	330UF	50V	E-CAP,105°C	10X16MM	50LK330M	Yongming
1	C5	47UF	10V	E-CAP,105°C	5X11MM	10LK47M	Yongming
1	BR1	1A	800V	B8S		B8S	PANJIT Semiconductor
1	D1	2A	600V	ES2J	SMA	ES2J	PANJIT Semiconductor
1	Q1	4A	600V	MOSFET	TO-220F	SPA4N60B	ARK
1	Z1		18V		SOD-323	18V	ST
1	D3			1N4148	SOD-123	1N4148	ST
1	D4	1A	1000V	FR107	SOD-123	FR107	PANJIT Semiconductor
1	R22	22KΩ	+/-5%		SMD-0805	RC0805JR-0722KL	YAGEO
2	R1,R2	4.7KΩ	+/-1%		SMD-0805	RC0805FR-074K7L	YAGEO
1	R7	47R	+/-1%		SMD-0805	RC0805FR-0747RL	YAGEO
2	R18,R20	1MΩ	+/-5%		SMD-1206	RC1206JR-071ML	YAGEO
2	R19,R21	1.3MΩ	+/-5%		SMD-1206	RC1206JR-071ML	YAGEO
2	R5,R6	1MΩ	+/-5%		SMD-1206	RC1206JR-071M3L	YAGEO
2	R14,R15	1.6Ω	+/-1%		SMD-0805	RC0805FR-071R6L	YAGEO
1	R3	56Ω	+/-1%		2W		YAGEO
1	R4	560Ω	+/-1%		2W		YAGEO
1	R13	7.5KΩ	+/-1%		SMD-0805	RC0805FR-077K5L	YAGEO
1	R16	3KΩ	+/-1%		SMD-0805	RC0805FR-073KL	YAGEO
1	R17	3KΩ	+/-1%		SMD-0805	RC0805FR-073KL	YAGEO
2	R10,R11	300KΩ	+/-1%		SMD-1206	RC1206FR-07300KRL	YAGEO
2	R8,R9	300KΩ	+/-1%		SMD-1206	RC1206FR-07300KRL	YAGEO
1	R23	100KΩ	+/-1%		SMD-1206	RC1206FR-07100KRL	YAGEO
1	L1	2MH			6X8MM		
1	L2	3MH			8X10MM		
1	T1	Transformer			EFD20		TDK Corp.
1	L3	EE10					TDK Corp.
1	FR1	10Ω	+/-1%		1WS	KNP1/2WT-52J10R	Shunchi
1	MOV1	07D471				07D471	TKS
1	CY1	1NF	400V				TKS
1	PCB	FR-1				Single layer	





## 6. Differential Mode Inductor L1

### Differential Mode Inductor\_L1



**Ferrite core size : AxB 6x8mm**

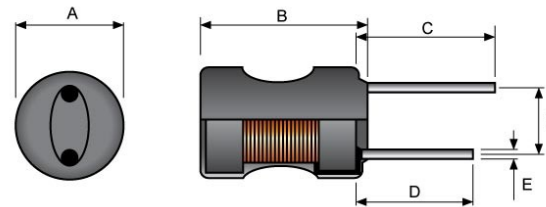
**Wire gauge: 0.14mm, 270Turns**

**Inductance @10kHz, 1V: 2mH +/-10%**

**DCR: 7.5 OHM +/-20%**

## 7. Differential Mode Inductor L2

### Differential Mode Inductor\_L2



**Ferrite core size : AxB 8x10mm**

**Wire gauge: 0.16mm, 350Turns**

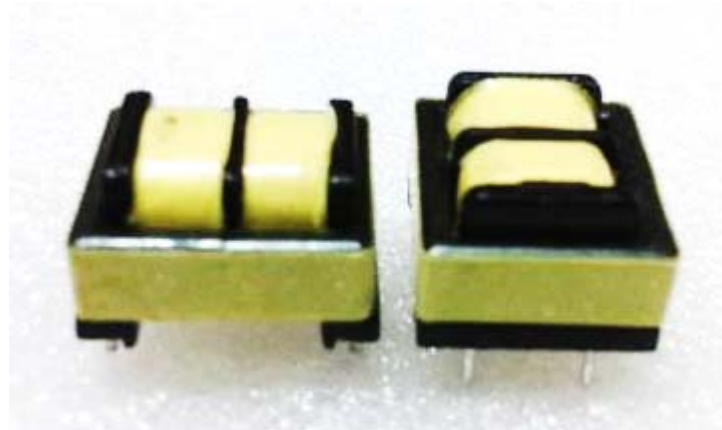
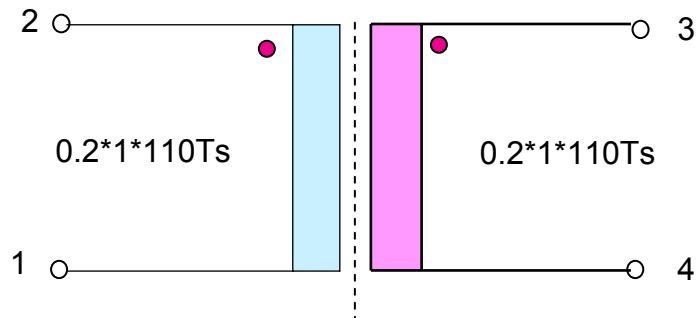
**Inductance @10kHz, 1V:  $\geq 3\text{mH}$**

**DCR: 10 OHM +/-20%**



## 8. Common Choke L3 for EMI

### SCHEMATIC



### ELECTRICAL SPECIFICATIONS:

1. Inductance ( $L_{p2-1}$ ) = 25mH @10KHz
2. Core : EE12.4  $\mu \geq 10k$
3. Bobbin : EE12.4 Vertical
4. DCR: 1.2OHM +/-20%
5. Varnish the complete assembly

# 9. Common Mode Inductor L5

## Properties of B&F Ferrite - Nickel Zinc (Ni-Zn)

Material	$\mu_i$	Bms(Gs)	Hc(Oe)	Br(Gs)	Tc(°C)	$\rho$ ( $\Omega$ -cm)	Frequency (MHz)	$\alpha$ ur x $10^{-4}/^{\circ}\text{C}$
B29	800	2900	0.30	1420	150	$1 \times 10^{-7}$	0.1-0.7	25-45

## EMI Toroidal Core ( T Type )



Dimensions 尺寸 ( mm )

Core Size	Conf.	A	D	C	Fig
T 8.0x4.0x3.0		8.0±0.3	4.0±0.3	3.0±0.2	1,2,3

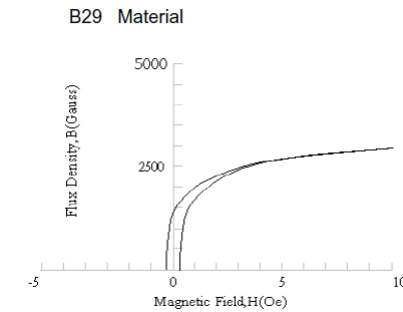
Ferrite core : Ni -Zn T8\*4\*3

Wire gauge: 0.3mm, 6Turns (Triple Insulated Wire)

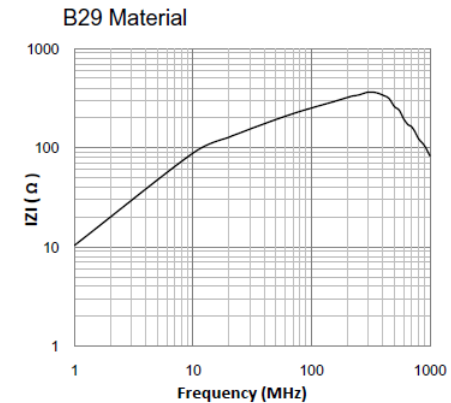
Inductance @10kHz, 1V: 15uH +/-10%

DCR: 0.12 OHM +/-20%

## Saturation Flux Density (Ni-Zn)



## Impedance Vs Frequency Curve (Ni-Zn)



**B.F.**

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