EV44010-S+4688-N-01A

Flyback PFC+2 Channel DC/DC 30W Offline WLED Driver

DESCRIPTION

The EV44010-S+4688-N-01A is an evaluation board of MP44010 and MP4688 for 30W LED lighting driver.

The EV44010-S+4688-N-01A contains 2 stages: the first stage is Flyback PFC using MP44010 which can provide high power factor; the second stage is 2-channel DC/DC using MP4688 and every channel can deliver 15W/350mA for LED.

MP44010 is a boundary conduction mode PFC controller which can provide simple and high performance active power factor correction using minimum external components.

MP4688 is a high voltage input step-down switching regulator to deliver a constant current to LED. The hysteresis current mode control is applied for very fast response.

The EV44010-S+4688-N-01A can meet the Class C standard of IEC61000-3-2 and EN55015 standard.

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Value	Units
Input AC Voltage	V_{AC}	85 to 265	V
Output current / Channel	I_{OUT}	350	mA
Output Power	P_{OUT}	30	W

FEATURES

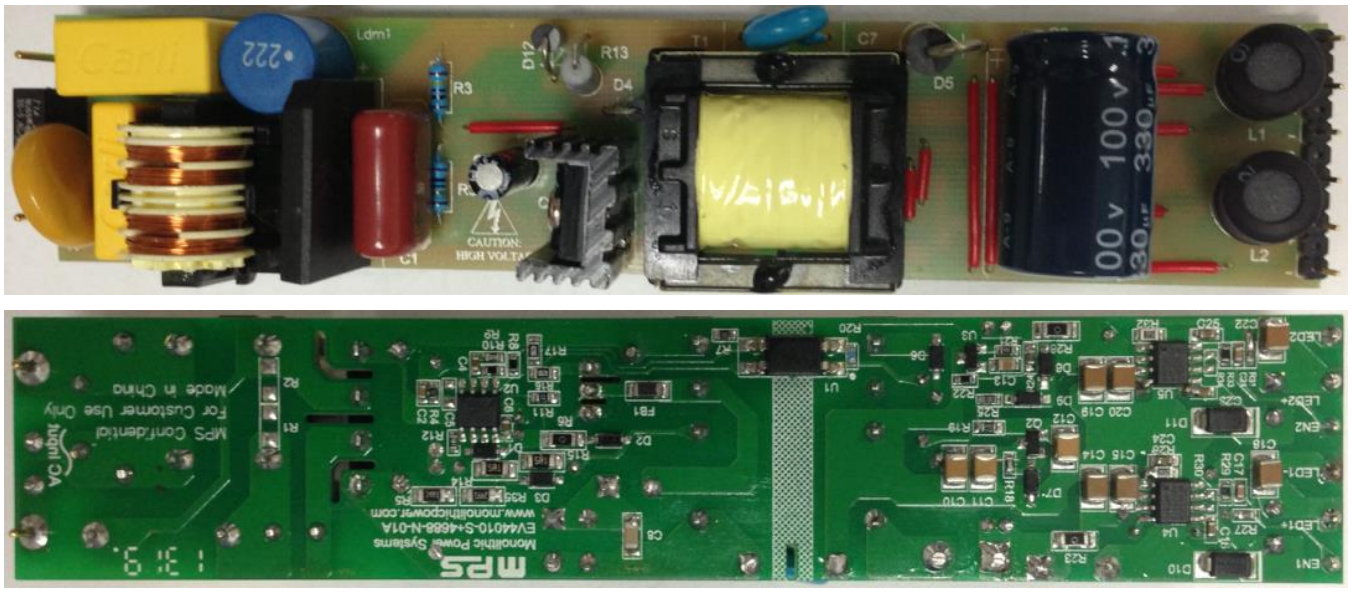
- Wide Operating Input Range(from 85V to 265V)
- Meet Class C Standard of IEC61000-3-2
- Meet EN55015 Standard
- Boundary Conduction Mode for PFC Stage
- Hysteresis Current Mode Control for DC/DC Stage
- ±5% LED Current Accuracy
- Up to 20kHz PWM Dimming Frequency
- Dedicated PWM Dimming Control Input
- Output Short Circuit Protection

APPLICATIONS

- Commercial LED lighting
- Automotive and Industry lighting
- Other LED lighting

Warning: Although this board is designed to satisfy safety requirements, the engineering prototype has not been agency approved. Therefore, all testing should be performed using an isolation transformer to provide the AC input to the prototype board.

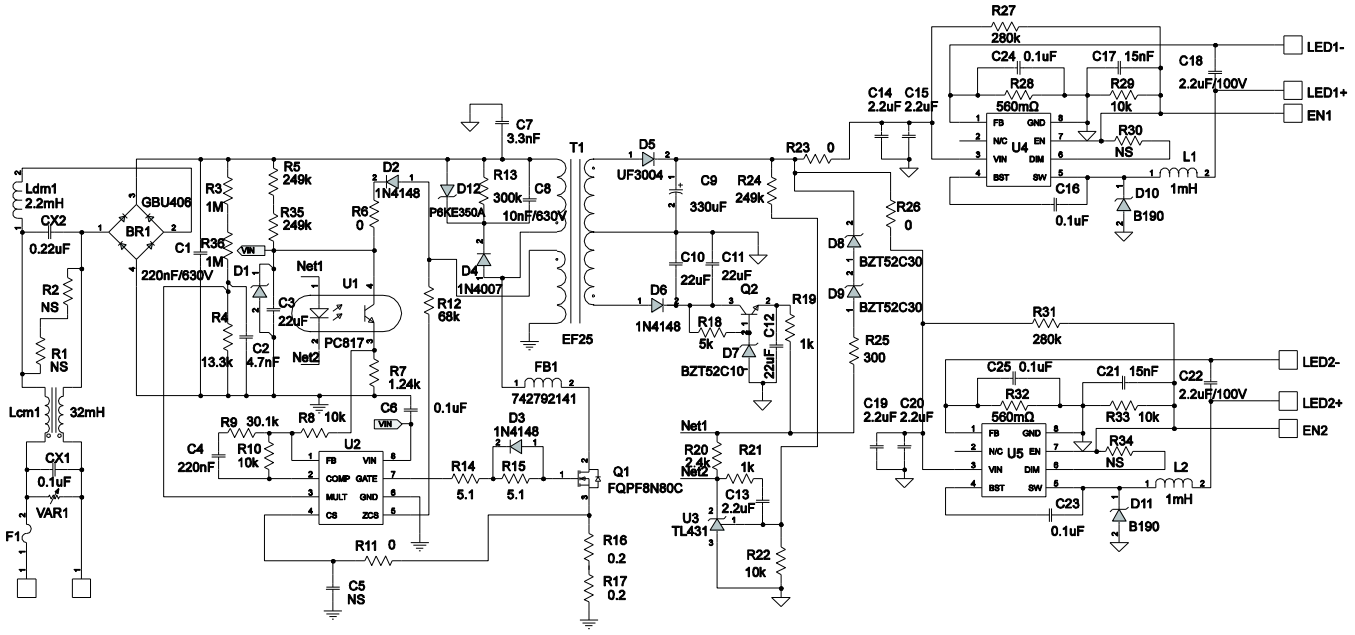
EV44010-S+4688-N-01A EVALUATION BOARD



(L x W x H) (15cm x 3cm x 2.78cm)

Board Number	MPS IC Number
EV44010-S+4688-N-01A	MP44010HS
	MP4688DN

EVALUATION BOARD SCHEMATIC



EV44010-S+4688-N-01A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Part Number
1	VAR1	400V		DIP		TVR14471KS42Y
1	BR1	GBU406	600V/4A	DIP	Diodes	GBU406
1	C1	220nF/630V	CBB CAP	DIP		ECQE6224KF
1	C2	4.7nF	Ceramic Cap., 50V, X7R	0603	Murata	GRM188R71H472KA0
1	C3	22μF/50V	Electrolytic Cap., 50V	DIP	JiangHai	CD281L-50V22
1	C4	220nF	Ceramic Cap., 25V, X7R	0603	Murata	GRM188R71C224KA0
2	C18, C22	2.2μF/100V	Ceramic Cap., 100V, X7R	1210	Murata	GRM32ER61E225KE1
0	C5	NS				
5	C6, 16, C23,C24, C25	0.1μF	Ceramic Cap., 50V, X7R	0603	Murata	GRM188R71H104KA0
1	C7	4.7nF/2600V	Y-Cap	DIP	HongKe	JYK12F472MY72N
1	C8	10nF/630V	Ceramic Cap., 630V, X7R	1206	TDK	C3216X7R2J103K
1	C9	330μF	Electrolytic Cap., 100V	DIP	JiangHai	CD263-100V330
3	C10,C11, C12	22μF	Ceramic Cap., 25V, X5R	1210	Murata	GRM32ER61E226KE1
1	C13	2.2μF	Ceramic Cap., 16V, X5R	0805	Murata	GRM21BR61C225KA8

EV44010-S+4688-N-01A BILL OF MATERIALS *(continued)*

Qty	Ref	Value	Description	Package	Manufacturer	Part Number
4	C14, 15, C19, C20	2.2μF	Ceramic Cap., 100V, X7R	1210	Murata	GRM32ER72A225KA3
2	C17,C21	15nF	Ceramic Cap., 50V, X7R	0603	TDK	C1608X7R1H153K
1	CX1	0.1μF/275V	X-CAP	DIP	KaiLi	PX104K3ID19L270D
1	CX2	0.22μF/275V	X-CAP	DIP	KaiLi	PX224K3ID49L270D
1	D1	BZT52C20	Diode, 20V/5mA	SOD-123	Diodes	BZT52C20
3	D2, D3, D6	1N4148W	Diode, 75V/0.15A	SOD-123	Diodes	1N4148W
1	D4	1N4007	Diode	DIP	Diodes	1N4007
1	D5	UF3004	400V/3A	DIP	Diodes	UF3004
1	D7	BZT52C10	Diode, 10V/5mA	SOD-123	Diodes	BZT52C10
2	D8, D9	BZT52C30	Diode, 30V/2mA	SOD-123	Diodes	BZT52C30
2	D10, D11	B190A	Diode, 90V/1A	SMA	Diodes	B190A
1	D12	P6KE350A	TVS, 1mA, 300V	DO-15	Brightking	P6KE350A
1	FB1	742792141	Magnetic Bead	1206	Wurth	742792141
1	F1	Fuse	1A,250V	DIP	Cooper	SS-5-1A
2	L1, L2	1mH	Inductor	DIP	Any	
1	Lcm1	33mH	Inductor	DIP	Wurth	7448640418
1	Ldm1	2.2mH	Inductor	DIP	Any	
1	Q1	FQPF8N80C	800V/8A	TO-220		FQPF8N80C
1	Q2	S8050	Transistor, 25V/0.5A	SOT-23		S8050
0	R1, R2, R30, R34	NS				
1	R3,R36	1M	Film Res., 5%	DIP	Any	
1	R4	13.3k	Film Res., 1%	0603	Yageo	RC0603FR-0713K3L
2	R5,R35	249k	Film Res., 1%	1206	Panasonic	ERJ8ENF2493V
1	R6	0	Film Res., 5%	1206	Yageo	RC1206JR-070RL
1	R7	1.24k	Film Res., 1%	0603	Yageo	RC0603FR-071K24L
5	R8,R10, R22,R29, R33	10k	Film Res., 1%	0603	Royalohm	0603F1002T5E
1	R9	30.1k	Film Res., 1%	0603	Yageo	RC0603FR-0730K1L
1	R11	0	Film Res., 5%	0603	Yageo	RC0603JR-070RL
1	R12	68k	Film Res., 1%	0603	Yageo	RC0603FR-0768KL
1	R13	300k/1W	Film Res., 1%	DIP	Any	300Kohm 直插电阻
2	R14, R15	5.1	Film Res., 5%	1206	Yageo	RC1206JR-075R1L
2	R16,R17	0.2	Film Res., 1%	0805	Any	RL1220T-R200-FN
1	R18	5k	Film Res., 1%	0603	Yange	RC0603FR-075kL

EV44010-S+4688-N-01A BILL OF MATERIALS *(continued)*

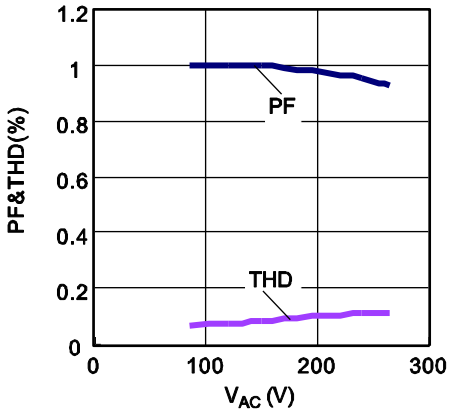
Qty	Ref	Value	Description	Package	Manufacturer	Part Number
1	R20	2.4k	Film Res., 1%	0603	LIZ	CR0603JA0242G
2	R19,R21	1k	Film Res., 1%	0603	Royalohm	0603F1001T5E
2	R23,R26	0	Film Res., 5%	1206	Royalohm	1206J0000T5E
1	R24	249k	Film Res., 1%	0805	Yageo	RC0805FR-07249KL
1	R25	300	Film Res., 1%	0603	Yageo	RC0603FR-07300RL
2	R27, R31	280k	Film Res., 1%	0603	Yageo	RC0603FR-07280KL
2	R28, R32	560mΩ	Film Res., 1%	0805	Yageo	RL0805FR-070R56L
1	T1	EF25	Transformer	DIP		FX0148
1	U1	PC817	Photocoupler	SMD	Sharp	PC817B
1	U2	MP44010	PFC Controller	SO-8	MPS	MP44010HS-R3
1	U3	TL431K		SOT-23	ANY	TL431K
2	U4, U5	MP4688	Step-Down Regulator	SO-8	MPS	MP4688DN-R1

EVB TEST RESULTS

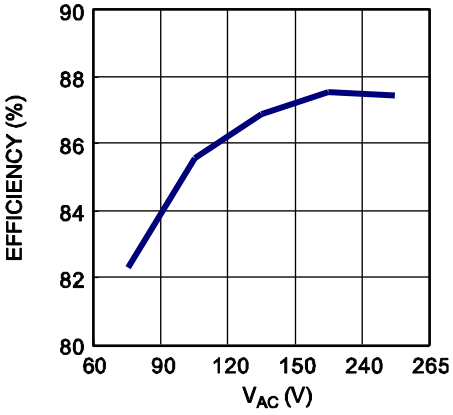
Performance waveforms are tested on the evaluation board.

V_{AC}=85V to 265V, 14 LEDs in series for each channel, I_{OUT1}= I_{OUT2}=350mA, P_{OUT}=30W, L_p=1.15mH, N1:N2:N3:N4=100:9:33:8.

PF&THD vs. V_{AC}



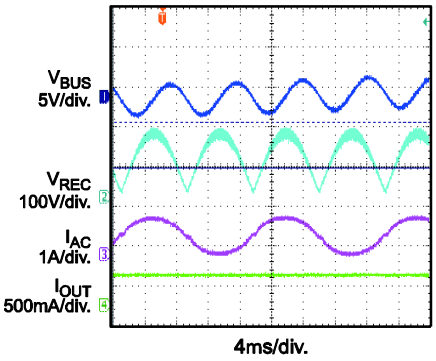
Efficiency vs. V_{AC}



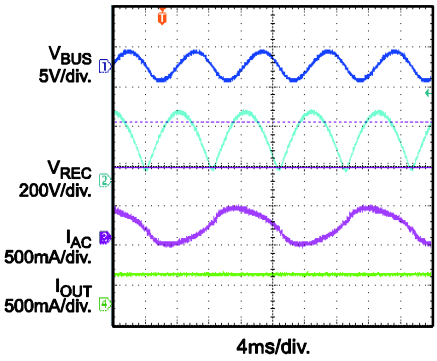
EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.
V_{AC}=85V to 265V, 14 LEDs in series for each channel, I_{OUT1}= I_{OUT2}=350mA, P_{OUT}=30W, L_p=1.15mH, N1:N2:N3:N4=100:9:33:8.

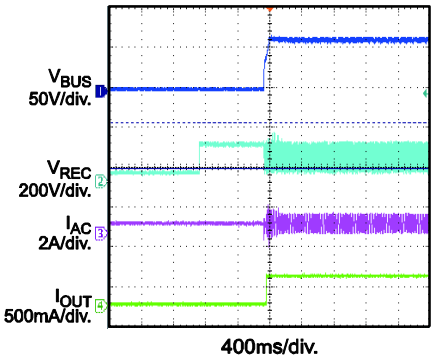
Steady State
V_{AC}=110V



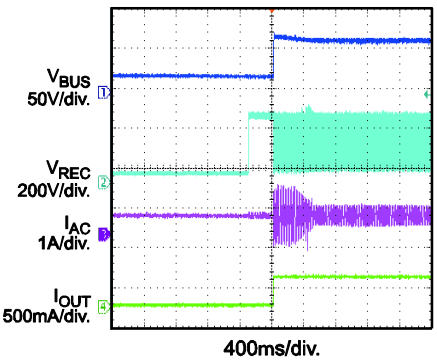
Steady State
V_{AC}=220V



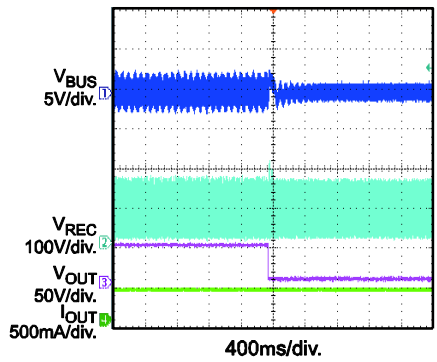
Start Up
V_{AC}=110V



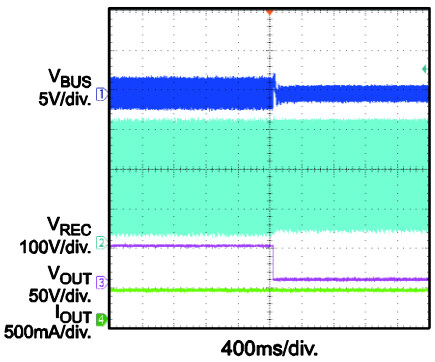
Start Up
V_{AC}=220V



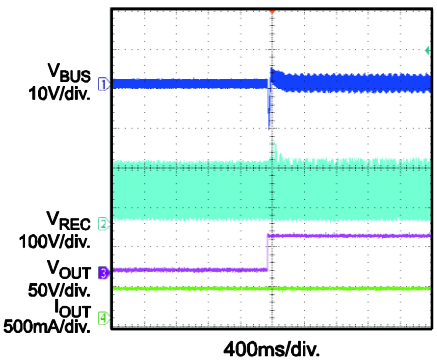
Short Entry
V_{AC}=110V
LED1+ to LED-



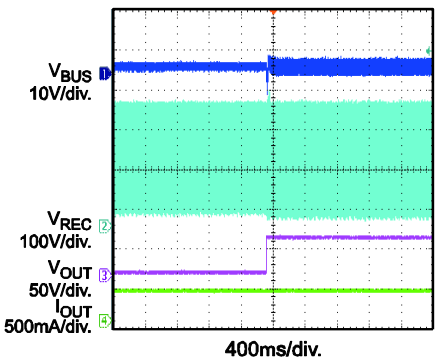
Short Entry
V_{AC}=220V
LED1+ to LED-



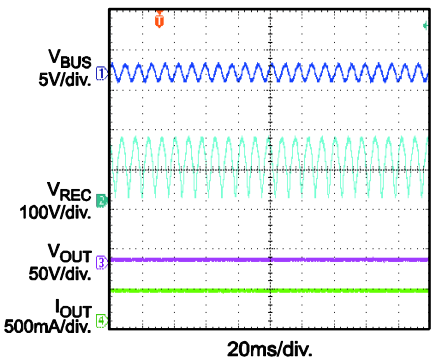
Short Recovery
V_{AC}=110V
LED1+ to LED-



Short Recovery
V_{AC}=220V
LED1+ to LED-



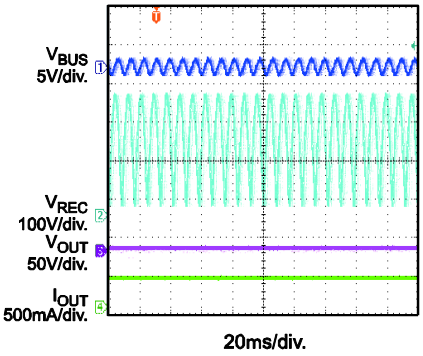
Short Steady State
V_{AC}=110V
LED1+ to LED-



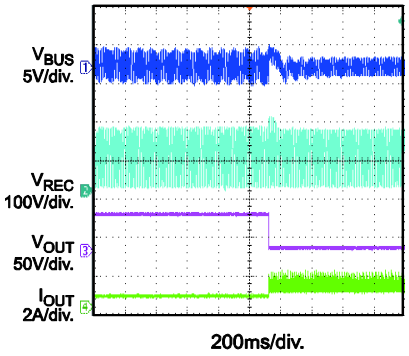
EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.
V_{AC}=85V to 265V, 14 LEDs in series for each channel, I_{OUT1}= I_{OUT2}=350mA, P_{OUT}=30W, L_p=1.15mH, N1:N2:N3:N4=100:9:33:8.

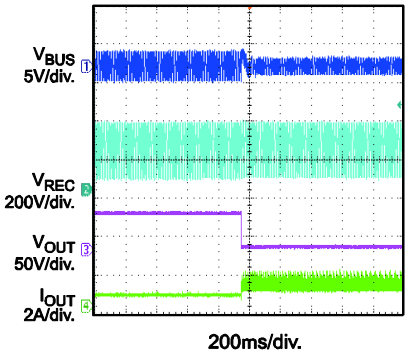
Short Steady State
V_{AC}=220V
LED1+ to LED-



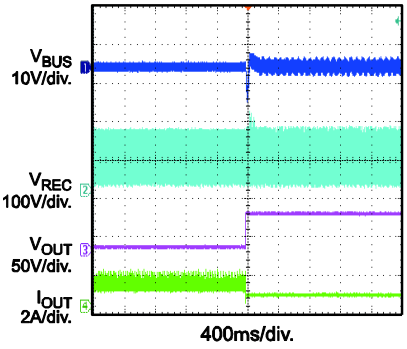
Short Entry
V_{AC}=110V
LED1+ to GND



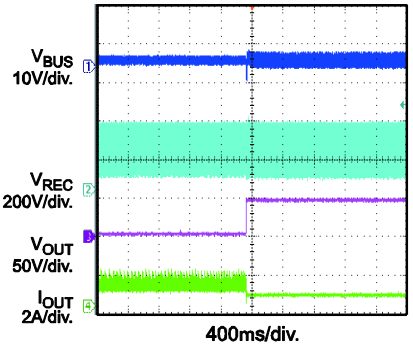
Short Entry
V_{AC}=220V
LED1+ to GND



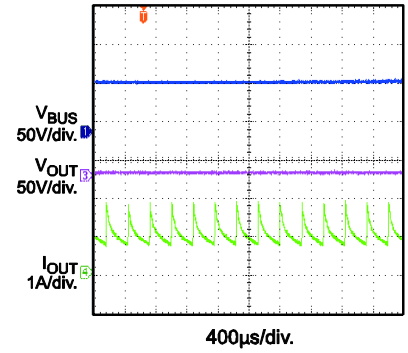
Short Recovery
V_{AC}=110V
LED1+ to GND



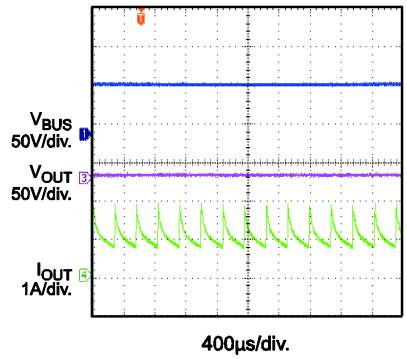
Short Recovery
V_{AC}=220V
LED1+ to GND



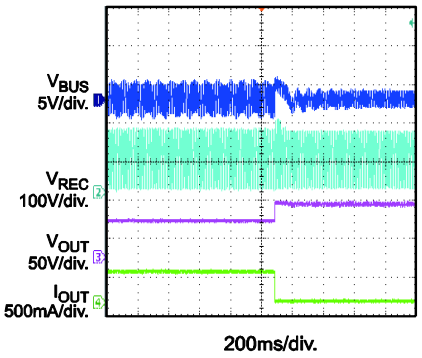
Short Steady State
V_{AC}=110V
LED1+ to GND



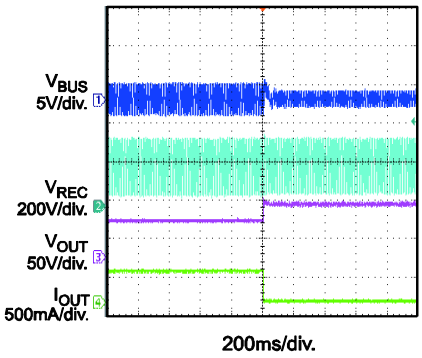
Short Steady State
V_{AC}=220V
LED1+ to GND



Open One Channel LED
V_{AC}=110V



Open One Channel LED
V_{AC}=220V



PRINTED CIRCUIT BOARD LAYOUT

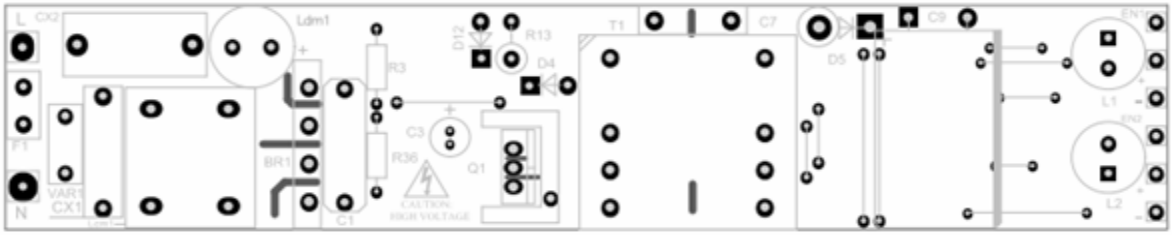


Figure 1—Top Silk Layer

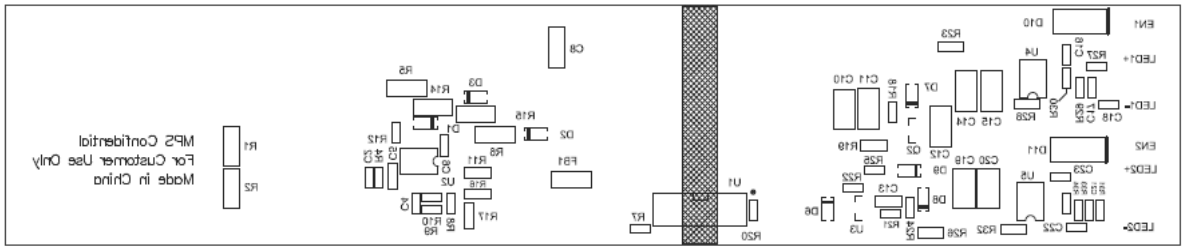


Figure 2—Bottom Silk Layer

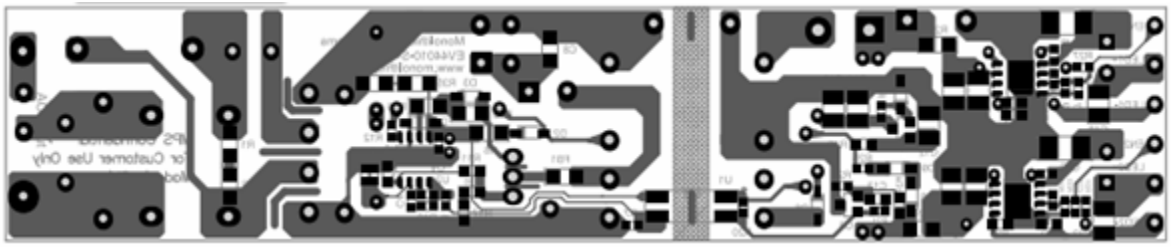


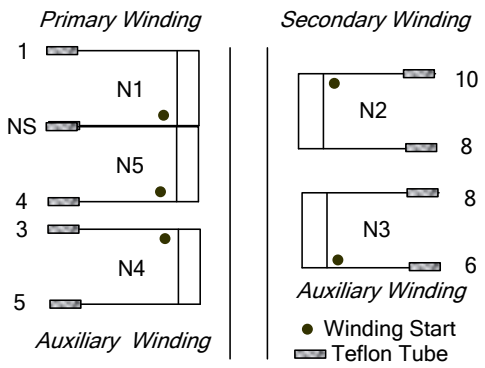
Figure 3—Bottom Layer

QUICK START GUIDE

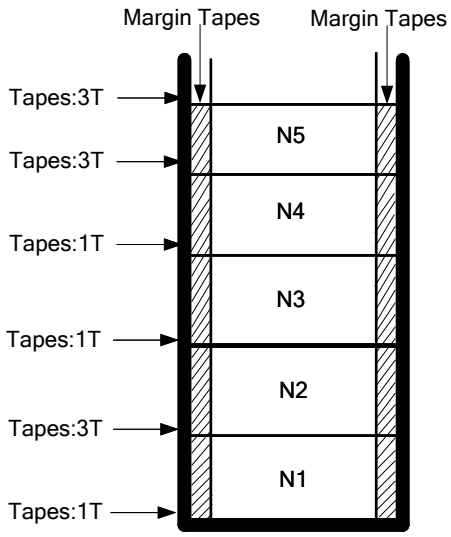
1. Preset AC input voltage between 85V and 265V. Then turn off AC power supply.
2. Connect the LED string to the LED+ and LED- pins on each channel.
3. Connect the Line and Neutral terminals of the power supply output to AC input.
4. Turn the power supply on. The board will automatically startup.

APPENDIX: TRANSFORMER SPECIFICATION

Electrical Diagram



Winding Diagram



Pin Definition of Bobbin

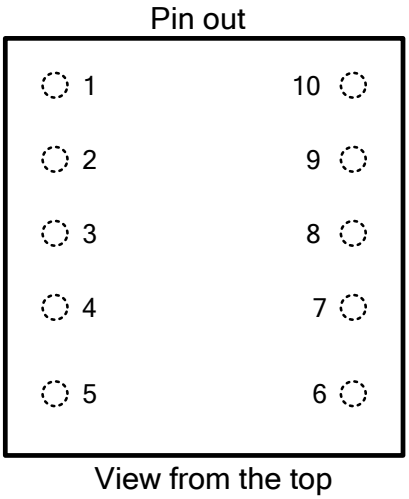


Table 1. Electrical Characteristic

Parameter	Condition	Value
Primary Inductance	Lp(4-1)	1.15mH±5%
Core		EF25
Bobbin		EF25
Core Material		3C85 or equivalent
Turn Ratio	N1:N2:N3:N4:N5	50:9:33:8:50

Table 2. Winding Specification

Tape Turns	Winding No.	Margin Tapes	Start& End	Wire Diameter (mm)	Turns
3	N1	2mm	4→NS	0.33×1	50
1	N2	2mm	3→5	0.18×5	9
1	N3	2mm	10→8	0.33×2	33
1	N4	2mm	6→8	0.18×1	8
3	N5	2mm	NS→1	0.33×1	50