

## DESCRIPTION

The EV44011HS+4689DN-00A is an evaluation board of MP44011 and MP4689 for 30W LED lighting driver.

The EV44011HS+4689DN-00A contains 2 stages: the first stage is Flyback PFC using MP44011; the second stage is 2-channel DC/DC using MP4689 and every channel can deliver 15W/350mA for LED.

MP44011 is a boundary conduction mode PFC controller with internal harmonic injection comparing with MP44010 which is a traditional Boundary mode PFC controller, MP44011 can bring benefits, such as decreased output cap of Flyback PFC and reduced transformer core size. (Please see details in MP44011 datasheet.)

MP4689 is a high voltage step-down switching regulator to deliver a constant current to LED. The hysteresis current mode control is applied for very fast response.

The EV44011HS+4689DN-00A can meet the 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

- Very Small Output Cap
- Reduced Transformer Core Size
- Meet EN55015 Standard
- Boundary Conduction Mode for PFC Stage
- Hysteresis Current Mode Control for DC/DC Stage
- $\pm 5\%$  LED Current Accuracy
- Up to 20kHz PWM Dimming Frequency
- Dedicated PWM Dimming Control Input
- Output Short Circuit Protection

## APPLICATIONS

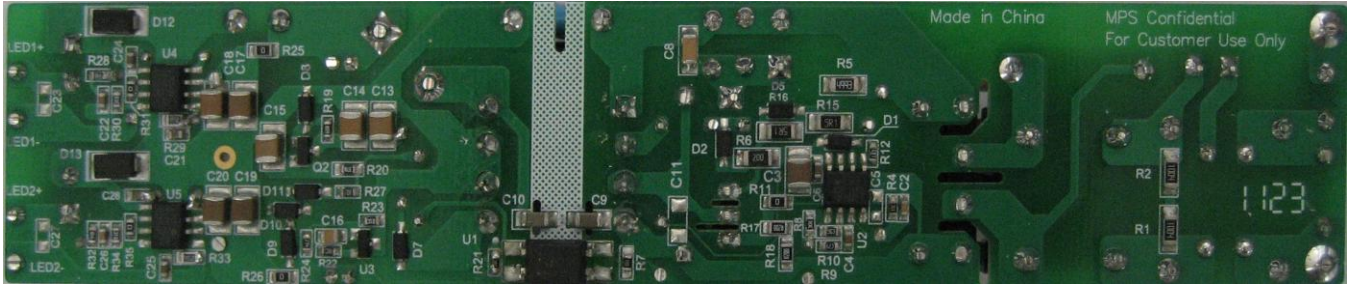
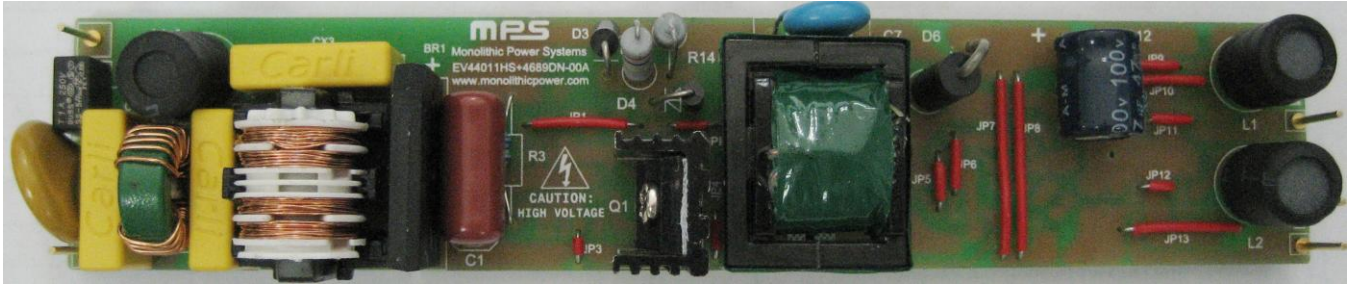
- Commercial LED lighting
- Automotive and Industry lighting
- Other LED lighting

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**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.

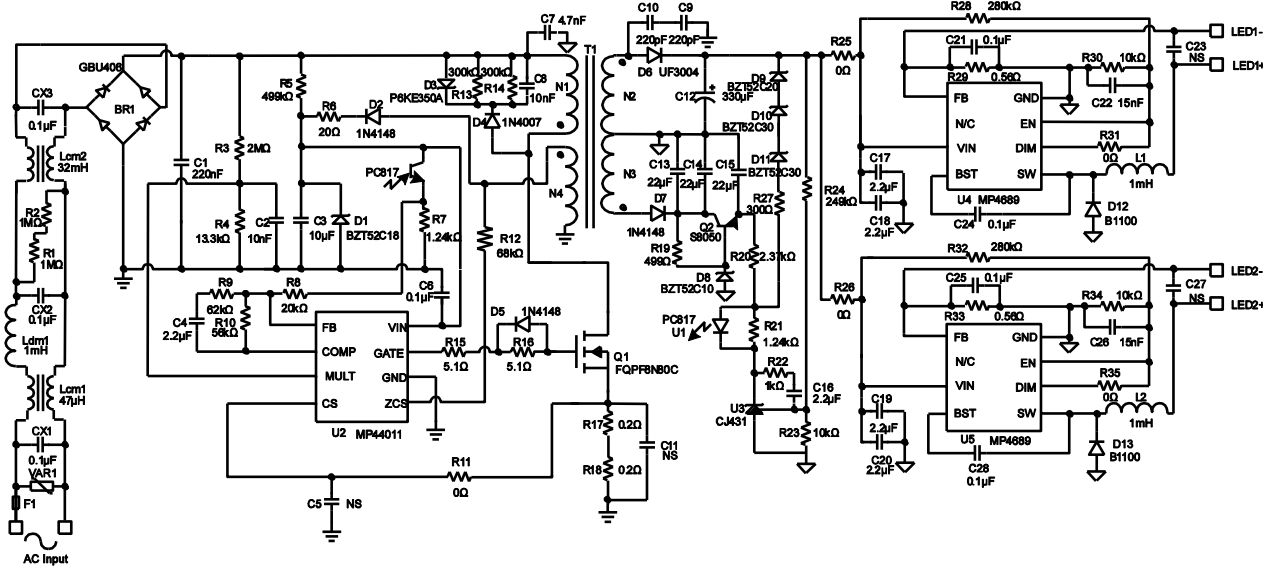
## EV44011HS+4689DN-00A EVALUATION BOARD



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

Board Number	MPS IC Number
EV44011HS+4689DN-00A	MP44011HS
	MP4689DN

## EVALUATION BOARD SCHEMATIC



## EV44011HS+4689DN-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Part Number
1	C1	0.22μF	CBB Cap.,630V	DIP	Panasonic	ECQE6224KF
1	C2	10nF	Ceramic Cap., 50V, X7R	0603	muRata	GRM188R71H103KA01D
1	C3	10μF	Ceramic Cap., 50V, X7R	1210	JiangHai	GRM32DR71E106KA12
1	C4	2.2μF	Ceramic Cap., 10V, X7R	0603	muRata	GRM188R71A225KE15D
0	C5, C11 C22, C27	NS				
5	C6, C21, C24 C25, C28	0.1μF	Ceramic Cap., 50V, X7R	0603	muRata	GRM188R71H104KA93D
1	C7	4.7nF	Y Cap., 2600V	DIP	HongKe	JYK12F472MY72N
1	C8	10nF	Ceramic Cap., 630V, X7R	1206	TDK	C3216X7R2J103K
2	C9, C10	220pF	Ceramic Cap., 1000V, X7R	1206	muRata	GRM31A7U3A221JW31D
1	C12	47μF	Electroytic Cap., 100V	DIP	JiangHai	CD263-100V47
3	C13, 14, C15	22μF	Ceramic Cap., 25V, X5R	1210	muRata	GRM32ER61E226KE15L
1	C16	2.2μF	Ceramic Cap., 16V, X5R	0805	muRata	GRM21BR61C225KA88L
4	C17, C18 C19, C20	2.2μF	Ceramic Cap., 100V, X7R	1210	muRata	GRM32ER72A225KA35L
2	C22, C26	15nF	Ceramic Cap., 50V, X7R	0603	TDK	C1608X7R1H153K
3	CX1, CX2 CX3	0.1μF	X Cap.,275V	DIP	KaiLi	PX104K3ID19L270D9R
1	D1		Diode, 5mA, 18V	SOD-123	Diodes	BZT52C18
3	D2, D5, D7		Diode, 0.15A, 75V	SOD-123	Diodes	1N4148W
1	D3		TVS, 1mA, 300V	Do-15	Brighting	P6KE350A
1	D4		Diode, 1A, 1000V	DIP	Diodes	1N4007
1	D6		Diode, 3A, 400V	SOD-123	Diodes	UF3004
1	D8		Diode, 5mA, 10V	SOD-123	Diodes	BZT52C10

**EV44011HS+4689DN-00A BILL OF MATERIALS (continued)**

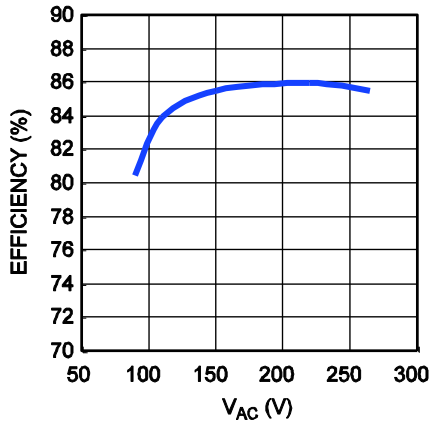
Qty	Ref	Value	Description	Package	Manufacturer	Part Number
1	D9		Diode, 2mA, 20V	SOD-123	Diodes	BZT52C20
2	D10, D11		Diode, 2mA, 30V	SOD-123	Diodes	BZT52C30
2	D12, D13		Diode, 1A, 100V	SMA	Diodes	B1100
1	BR1		Diode, 600V, 4A	DIP	Diodes	GBU406
3	L1, L2, Ldm1	1mH		DIP		
1	Lcm1	47μH		DIP	Würth	744841247
1	Lcm2	32mH		DIP		
1	VAR1	470V		DIP	Jingdian	TVR14471KS42Y
2	R1, R2	1MΩ	Film Res., 1%	1206	Yageo	RC1206FR-071ML
1	R3	2MΩ	5%	DIP	any	
1	R4	13.3kΩ	Film Res., 1%	0603	Yageo	RC0603FR-0713K3L
1	R5	499kΩ	Film Res., 1%	1206	Panasonic	ERJ8ENF4993V
1	R6	20Ω	Film Res., 5%	1206	Royalohm	1206J0200T5E
2	R7, R21	1.24kΩ	Film Res., 1%	0603	Yageo	RC0603FR-071K24L
1	R8	20kΩ	Film Res., 1%	0603	Royalohm	0603F2002T5E
1	R9	62kΩ	Film Res., 1%	0603	Yageo	RC0603FR-0762KL
1	R10	56kΩ	Film Res., 1%	0603	Yageo	RC0603FR-0756KL
3	R11,R25,R26	0Ω	Film Res., 5%	0805	Royalohm	0805S8J0000T5E
1	R12	68kΩ	Film Res., 1%	0603	Yageo	RC0603FR-0768KL
2	R13, R14	300kΩ	5%, 1W	DIP	Any	
2	R15, R16	5.1Ω	Film Res., 5%	1206	Yageo	RC1206JR-075R1L
2	R17, R18	0.2Ω	Film Res., 1%	0805	Yageo	RL0805FR-070R2L
1	R19	499Ω	Film Res., 1%	0603	Yageo	RC0603FR-07499RL
1	R20	2.37kΩ	Film Res., 1%	0603	Yageo	RC0603FR-072K37L
1	R22	1kΩ	Film Res., 1%	0603	Royalohm	0603F1001T5E
3	R23, R30,R34	10kΩ	Film Res., 1%	0603	Yageo	RC0603FR-0710KL
1	R24	270kΩ	Film Res., 1%	0603	Yageo	RC0603FR-07270KL
2	R27	300Ω	Film Res., 1%	0603	Yageo	RC0603FR-07300RL
2	R28, R32	280kΩ	Film Res., 1%	0603	Yageo	RC0603FR-07280KL
2	R29, R33	0.56Ω	Film Res., 1%	0805	Yageo	RL0805FR-070R56L
2	R31, R35	0Ω	Film Res., 5%	0603	Royalohm	0603J0000T5E
1	Q1		MOSFET, 8A, 800V	TO-220		FQPF8N80C
1	Q2		Transistor, 0.5V, 25V	SOT-23		S8050
1	F1	1A	250V	DIP	COOPER Bussmann	SS-5-1A
1	T1		EE25, 110:36:6:8			FX0209
1	U1		Photocoupler	SMD	Sharp	PC817B
1	U2		BCM PFC Controller	SO-8	MPS	MP44011HS
1	U3		2.5V	SOT-23	Changdian	CJ431
2	U4, U5		Step-Down Regulator	SO-8	MPS	MP4689DN

## EVB TEST RESULTS

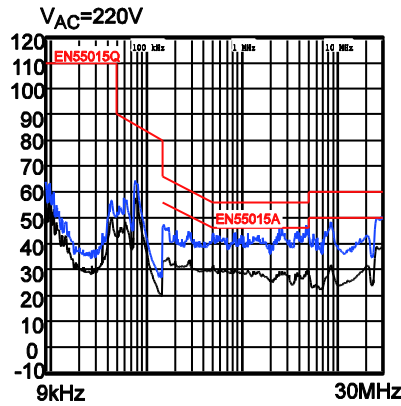
Performance waveforms are tested on the evaluation board.

$V_{AC}=85V-265V$ , 14 LEDs in series for each channel,  $I_{OUT1}=I_{OUT2}=350mA$ ,  $P_{OUT}=30W$ ,  $L_p=1.0mH$ ,  $N1:N2:N3:N4=110:36:6:8$ .

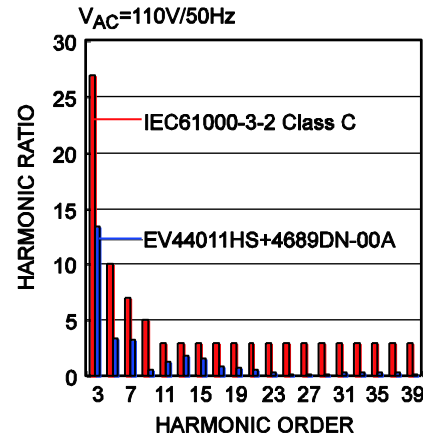
**Efficiency vs.  $V_{AC}$**



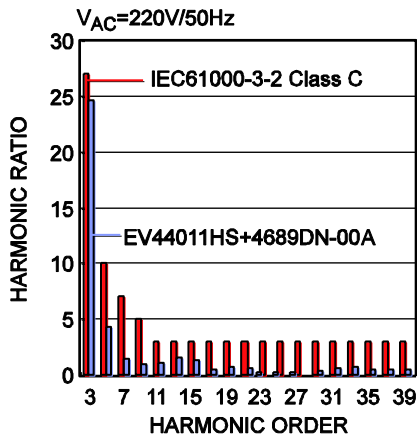
**Conducted EMI**



**Harmonics**



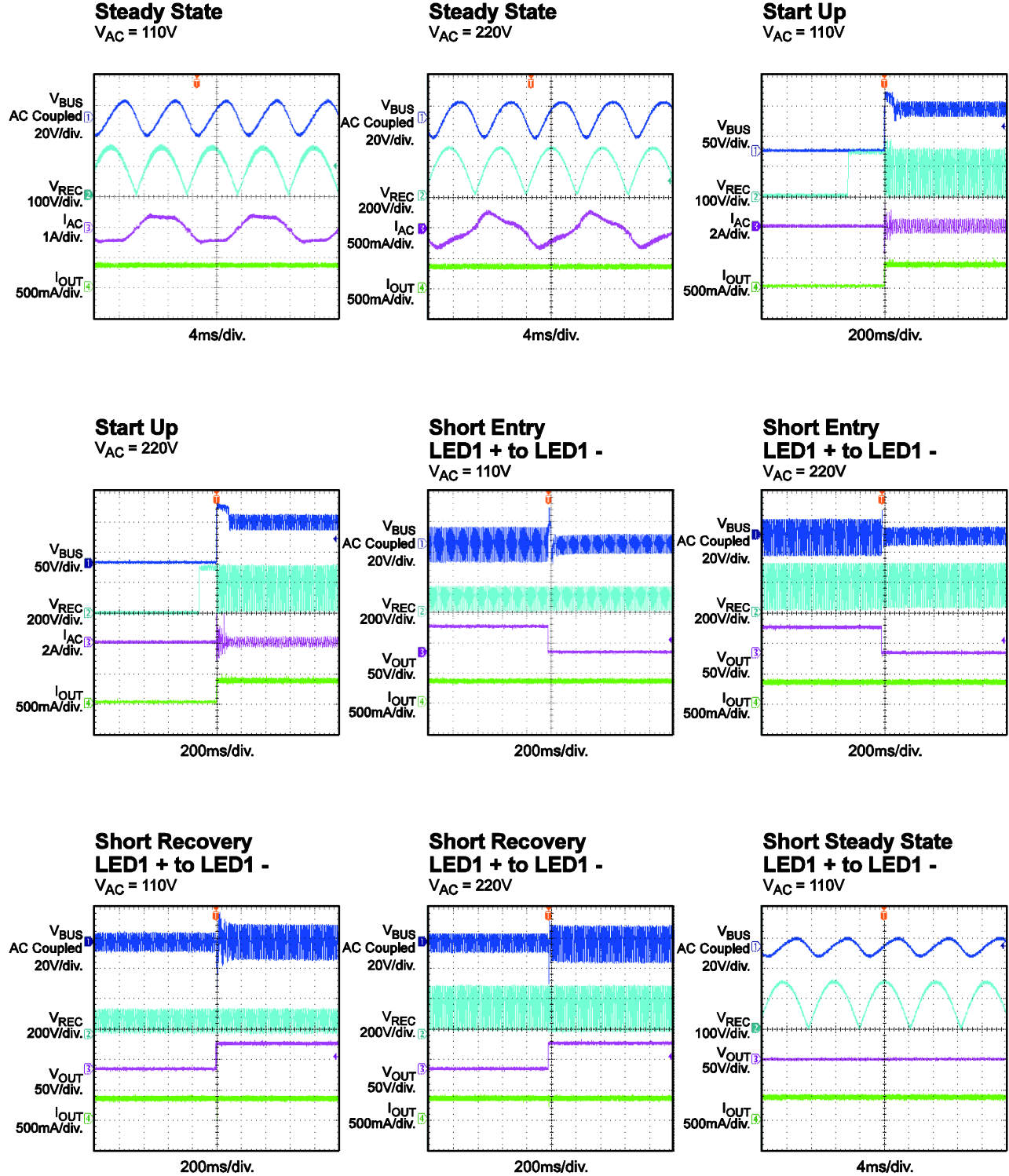
**Harmonics**



## EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

$V_{AC}=85V-265V$ , 14 LEDs in series for each channel,  $I_{OUT1}=I_{OUT2}=350mA$ ,  $P_{OUT}=30W$ ,  $L_p=1.0mH$ ,  $N1:N2:N3:N4=110:36:6:8$ .

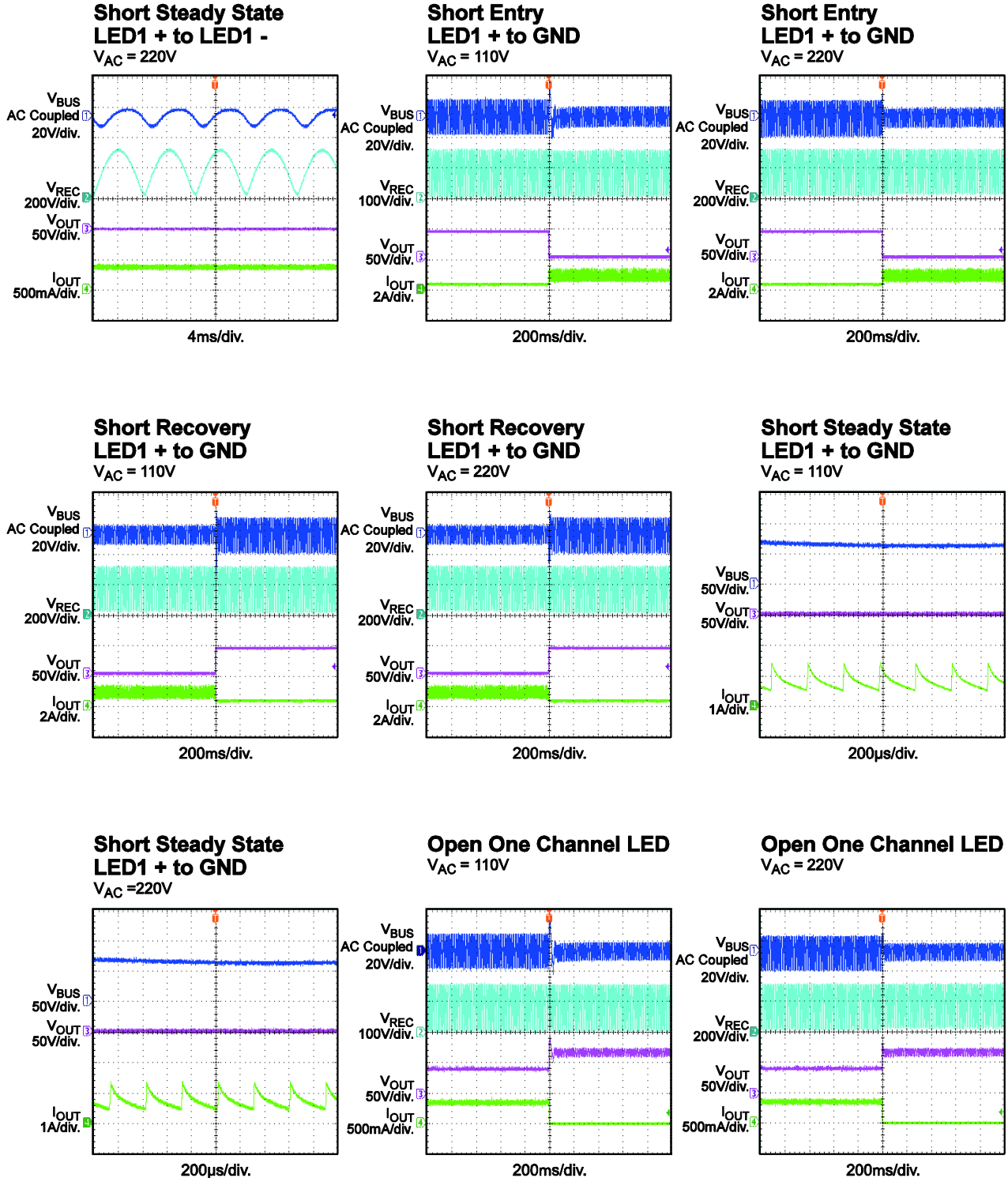




## EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

$V_{AC}=85V$  to  $265V$ , 14 LEDs in series for each channel,  $I_{OUT1}=I_{OUT2}=350mA$ ,  $P_{OUT}=30W$ ,  $L_p=1.0mH$ ,  $N1:N2:N3:N4=110:36:6:8$ .



## PRINTED CIRCUIT BOARD LAYOUT

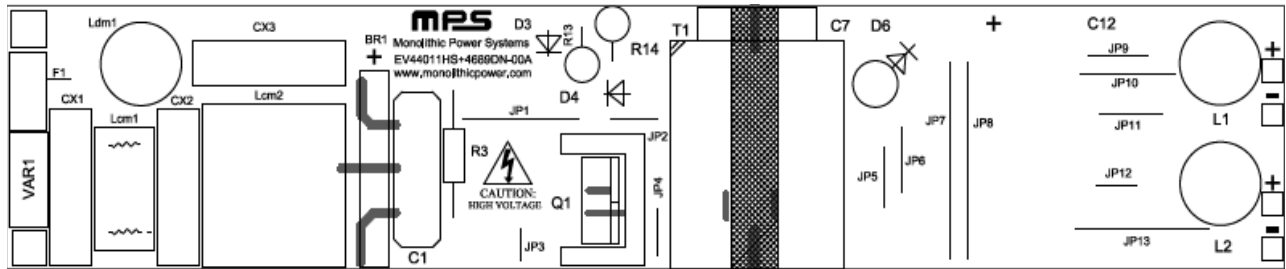


Figure 1—Top Silk Layer

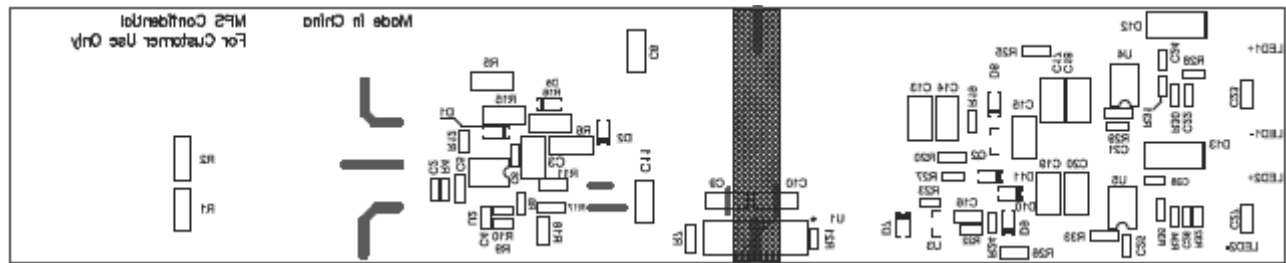


Figure 2—Bottom Silk Layer

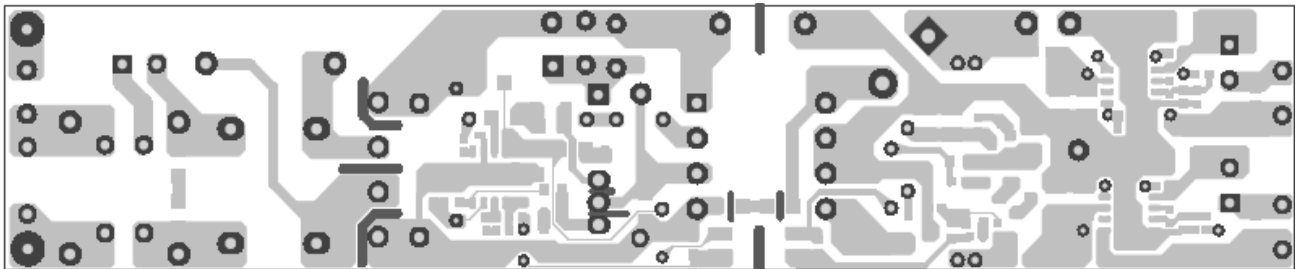


Figure 3—Bottom Layer

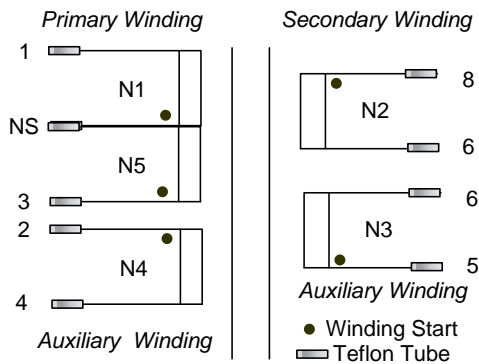


## **QUICK START GUIDE**

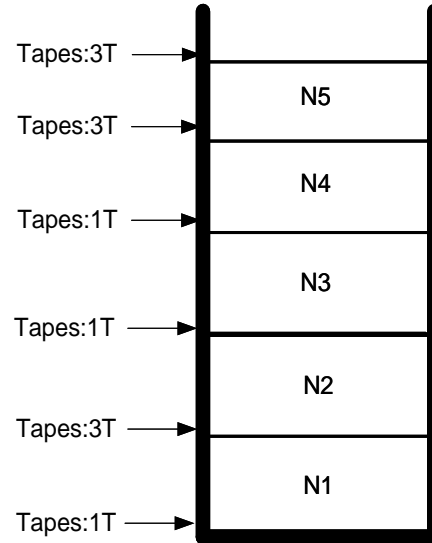
1. Preset AC input voltage between 85V and 265V. Then turn off AC power supply.
2. Connect the LED string to the LED+ and LED- pins on each channel.
3. Connect the Line and Neutral terminals of the power supply output to AC input.
4. Turn the power supply on. The board will automatically startup.

## APPENDIX: TRANSFORMER SPECIFICATION

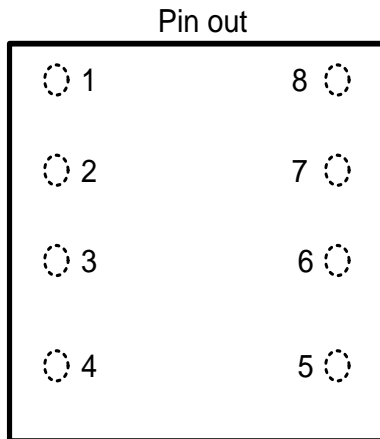
### Electrical Diagram



### Winding Diagram



### Pin Definition of Bobbin



View from the top

**Table 1. Electrical Characteristic**

Parameter	Condition	Value
Primary Inductance	Lp(4-1)	1.0mH±5%
Core		EE25
Bobbin		EE25
Core Material		3C85 or equivalent
Turn Ratio	N1:N2:N3:N4:N5	55:36:6:8:55

**Table 2. Winding Specification**

Tape Turns	Winding No.	Start & End	Wire Diameter (mm)	Turns
3	N1	3→NS	0.3×1	55
1	N2	8→6	0.3×2	36
1	N3	5→6	0.18×1	6
1	N4	2→4	0.18×1	8
3	N5	NS→1	0.3×1	55

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