CDB1611A-8W

CDB1611A-8W
8 Watt Demonstration Board

Features

- Quasi-resonant Flyback with Constant-current Output
- Flicker-free Dimming
- Line Voltage 230VAC, ±10%
- Rated Input Power: 7.7W
- Rated Output Power: 6.4W
- Efficiency: 83% at 550mA for 4×LEDs in Series
- Low Component Count
- Supports Cirrus Logic Product CS1611A

General Description

The CDB1611A-8W reference design demonstrates the performance of the CS1611A resonant mode AC/DC dimmable LED driver IC with a 550mA output driving 4×LEDs in series. It offers best-in-class dimmer compatibility with leading-edge, trailing-edge, center-cut, and digital dimmers.

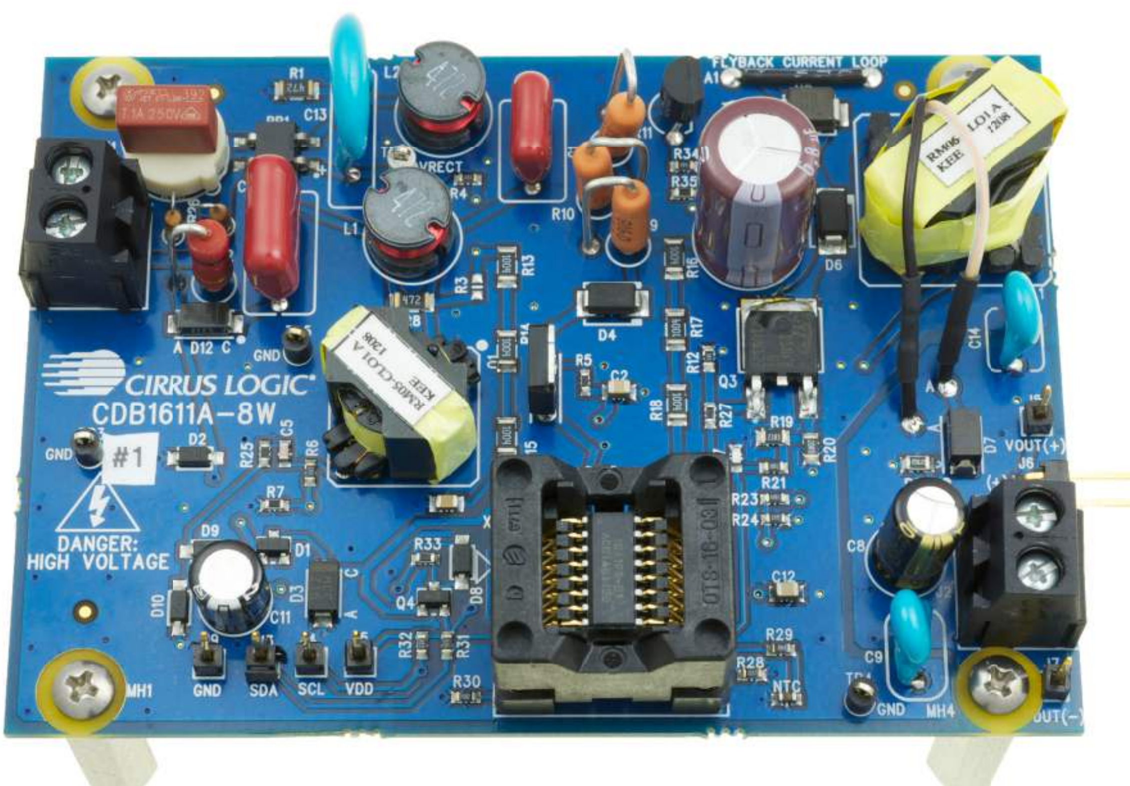
DIMENSIONS (OVERALL)

Length	Width	Height
3.62″(91.9mm) ×	2.54″(64.5mm) ×	0.971″(24.6mm)

For more information, see Figure 3 on page 6.

ORDERING INFORMATION

CDB1611A-8W-Z 8 Watt Reference Design
Supports CS1611A



IMPORTANT SAFETY INSTRUCTIONS

Read and follow all safety instructions prior to using this demonstration board.

This Engineering Evaluation Unit or Demonstration Board must only be used for assessing IC performance in a laboratory setting. This product is not intended for any other use or incorporation into products for sale.

This product must only be used by qualified technicians or professionals who are trained in the safety procedures associated with the use of demonstration boards.

DANGER Risk of Electric Shock

- The direct connection to the AC power line and the open and unprotected boards present a serious risk of electric shock and can cause serious injury or death. Extreme caution needs to be exercised while handling this board.
- Avoid contact with the exposed conductor or terminals of components on the board. High voltage is present on exposed conductor and it may be present on terminals of any components directly or indirectly connected to the AC line.
- Dangerous voltages and/or currents may be internally generated and accessible at various points across the board.
- Charged capacitors store high voltage, even after the circuit has been disconnected from the AC line.
- Make sure that the power source is off before wiring any connection. Make sure that all connectors are well connected before the power source is on.
- Follow all laboratory safety procedures established by your employer and relevant safety regulations and guidelines, such as the ones listed under, OSHA General Industry Regulations - Subpart S and NFPA 70E.

WARNING Suitable eye protection must be worn when working with or around demonstration boards. Always comply with your employer's policies regarding the use of personal protective equipment.

WARNING All components and metallic parts may be extremely hot to touch when electrically active.

Contacting Cirrus Logic Support

For all product questions and inquiries contact a Cirrus Logic Sales Representative. To find the one nearest to you go to www.cirrus.com

1. INTRODUCTION

The CS1611A is a 230VAC quasi-resonant flyback mode dimmable LED controller IC. The CS1611A uses a digital control algorithm that is optimized for high efficiency and >0.9 power factor over an input voltage range (207VAC to 253VAC). The CS1611A integrates a critical conduction mode (CRM) boost converter that provides power factor correction and dimmer compatibility with a constant output current, quasi-resonant flyback stage. An adaptive dimmer compatibility algorithm controls the boost stage and dimmer compatibility operation mode to enable flicker-free operation to <2% output current with leading-edge, trailing-edge, and digital dimmers.

The CDB1611A-8W board is optimized to deliver low system cost in a high-efficiency, flicker-free, phase-dimmable, solid-state lighting (SSL) solution for incandescent lamp replacement applications. The feedback loop is closed through an integrated digital control system within the IC. The variation in switching frequency also provides a spread-frequency spectrum, thus minimizing the conducted EMI filtering requirements. Protection algorithms such as output open/short, current-sense resistor open/short, and overtemperature thermistors protect the system during abnormal conditions. Details of these features are provided in the CS1610A/11A/12A/13A *TRIAC Dimmable LED Driver IC* data sheet.

The CDB1611A-8W board demonstrates the performance of the CS1611A. This reference board has been designed for an output load of 4×LEDs in series at 550mA (12.0V typical).

This document provides the schematic for the board. It includes oscilloscope screen shots that indicate various operating waveforms. Graphs are also provided that document the performance of the board in terms of Efficiency vs. Line Voltage, Output Current vs. Line Voltage, and Output Current vs. Dim Angle for the CS1611A dimmable LED controller IC.

Extreme caution needs to be exercised while handling this board. This board is to be used by trained professionals only.

2. SCHEMATIC

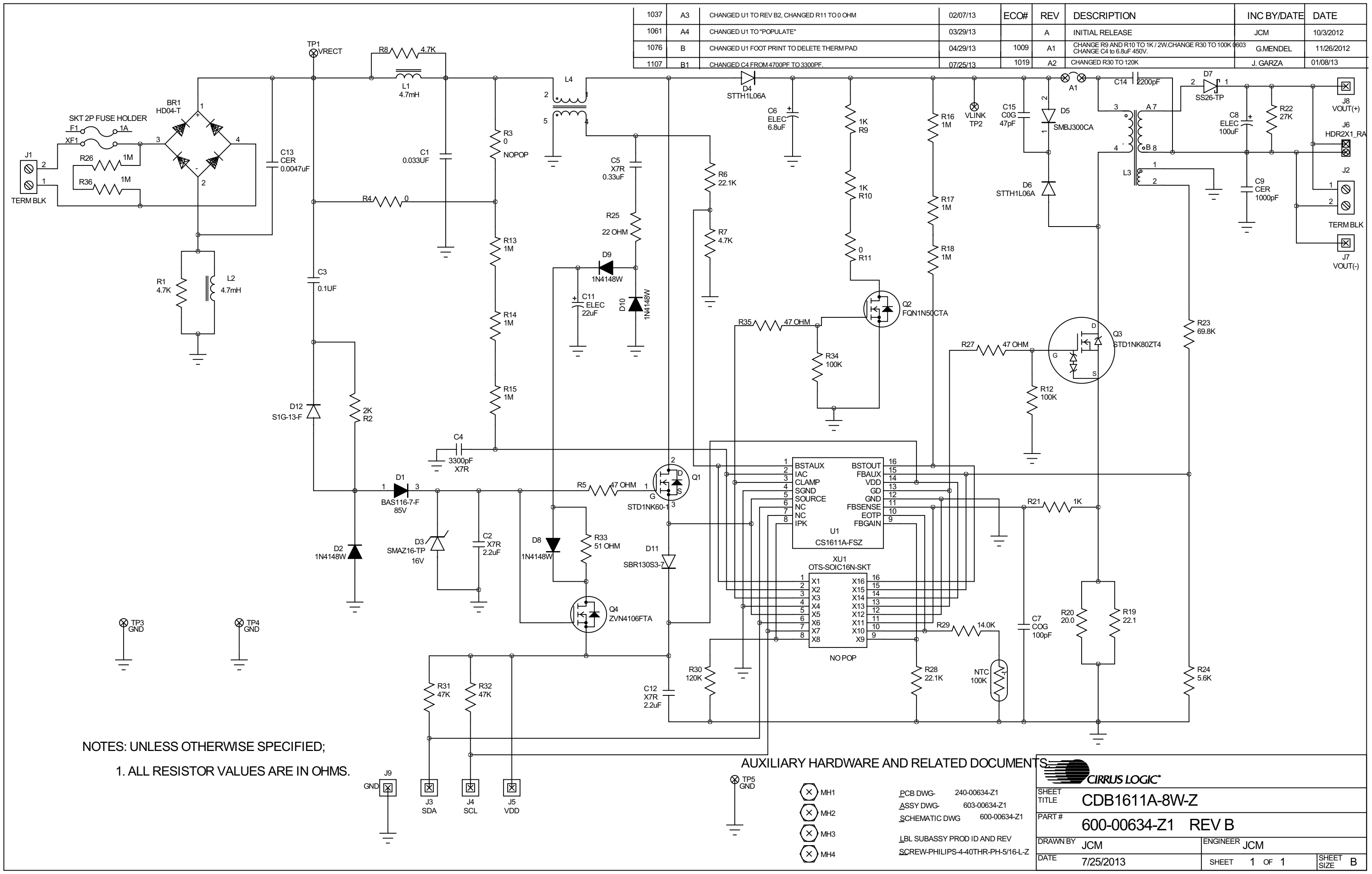


Figure 1. Schematic

3. BILL OF MATERIALS

Item	Rev	Description	Qty	Reference Designator	MFG	MFG P/N
1		WIRE JUMPER BLACK 24AWG SOLID	1	A1	ALPHA WIRE COMPANY	3050/1 BK005
2		DIODE RECT 400V 0.8A NPB MINIDIP	1	BR1	DIODES INC	HD04-T
3		CAP 0.033UF ±10% 400V MTL FLM RDL	1	C1	PANASONIC	ECQE4333KF
4		CAP 2.2uF ±10% 10V X7R NPb 0805	2	C2 C12	MURATA	GRM21BR71E225KA73L
5		CAP 0.1UF ±5% 400V MTL FLM RAD	1	C3	Panasonic	ECQE4104JF
6	A	CAP 3300pF ±5% 50V X7R NPb 0805	1	C4	KEMET	C0805C332J5RAC
7		CAP 0.33UF ±10% 50V X7R NPb 0603	1	C5	TDK	C1608X7R1H334K
8		CAP 6.8uF ±20% 450V ELEC NPb RAD	1	C6	UNITED CHEMI-CON	EKXG451ELL6R8MJ20S
9		CAP 100pF ±5% 50V C0G NPb 0603	1	C7	KEMET	C0603C101J5GAC
10		CAP 100uF ±20% 25V EL LO ESR NPb RD	1	C8	PANASONIC	EEUFM1E101
11		CAP 1000pF ±10% 2000V CER NPb RAD	1	C9	MURATA	DEBB33D102KA2B
12		CAP 22UF ±20% 35V ELEC RAD	1	C11	PANASONIC	EEA-GA1V220H
13		CAP 0.0047uF 10% 500V CER NPb RAD	1	C13	MURATA	DESD32H472KN7A
14		CAP 2200PF +80/-20% 2KV CER NPb RAD	1	C14	MURATA	DEBE33D222ZA2B
15		CAP 47pF ±5% 1000V C0G NPb 1206	1	C15	JOHANSON DIELECTRICS	102R18N470JV4E
16		DIODE SWT 85V 215mA NPb SOT-23	1	D1	DIODES INC	BAS116-7-F
17		DIODE FAST SW 75V 350mW NPb SOD123	4	D2 D8 D9 D10	DIODES INC	1N4148W-7-F
18		DIODE ZENER 16V 1W NPb DO-214AC	1	D3	MICRO COMMERCIAL	SMAZ16-TP
19		DIODE ULT FAST 600V 1A NPb SMA	2	D4 D6	ST MICROELECTRONICS	STTH1L06A
20		DIODE TVS 600W 300V BI 5% NPb SMB	1	D5	Littelfuse	SMBJ300CA
21		DIODE SKY RECT 60V 2A NPb DO-214AC	1	D7	MICRO COMMERCIAL(MCC)	SS26-TP
22		DIODE RECT 30V 1A NPb SOD-323	1	D11	DIODES INC	SBR130S3-7
23		DIODE RECT 400V 1A NPb SMA	1	D12	DIODES INC	S1G-13-F
24		FUSE 1A 250V TLAG NPb RAD	1	F1	LITTLE FUSE	39211000440
25		CON 2POS TERM BLK 5.08mm SPR NPb RA	2	J1 J2	WEIDMULLER	1716020000
26		HDR 1x1 ML .1 062 S NPb GLD	6	J3 J4 J5 J7 J8 J9	SAMTEC	TSW-101-07-G-S
27		HDR 2x1 ML .1"CTR RA GLD	1	J6	SAMTEC	TSW-102-08-G-S-RA
28		IND 4.7mH ±10% 17.6 OHM 350 DIA TH	2	L1 L2	COILCRAFT	RFB0807-472L
29		XFMR 14.5mH ±10% 10 KHZ TH	1	L3	KUNSHAN EAGERNESS	RM06-CL01
30		XFMR 6.8mH ±10% 10 KHZ TH	1	L4	KUNSHAN EAGERNESS	RM05-CL01
31		SPCR STANDOFF 4-40 THR .875L AL NPb	4	MH1 MH2 MH3 MH4	KEYSTONE	1809
32		THERM 100K OHM ±5% 0.10mA NPb 0603	1	NTC	MURATA	NCP18WF104J03RB
33		TRAN MOSFET nCH 1.0A 600V NPb IPAK	1	Q1	ST MICROELECTRONICS	STD1NK60-1
34		TRAN MOSFET nCH 0.38A 500V NPb TO-92	1	Q2	FAIRCHILD	FQN1N50CTA
35		TRAN MOSFET nCH 1A 800V NPb DPAK	1	Q3	ST MICROELECTRONICS	STD1NK80ZT4
36		TRAN MOSFET nCH 60V.2A NPb SOT23-3	1	Q4	DIODES INC	ZVN4106FTA
37		RES 4.7k OHM 1/4W ±5% NPb 1206 FILM	2	R1 R8	DALE	CRCW12064K70JNEA
38		RES PWR 2.0K OHM 2W ±5% NPb AXL	1	R2	VISHAY	PR02000202001JR500
39		RES 0 OHM 1/10W ±5% NPb 0603 FILM	0	R3	DALE	NP-CRCW06030000Z0EA
40		RES 0 OHM 1/10W ±5% NPb 0603 FILM	1	R4	DALE	CRCW06030000Z0EA
41		RES 47 OHM 1/10W ±1% NPb 0603	3	R5 R27 R35	PANASONIC	ERJ3EKF47R0V
42		RES 22.1k OHM 1/10W ±1% NPb 0603	2	R6 R28	DALE	CRCW060322K1FKEA
43		RES 4.70K OHM 1/10W ±1% NPb 0603	1	R7	PANASONIC	ERJ3EKF4701V
44		RES 1k OHM 2W ±5% MTL FLM NPb AXL	2	R9 R10	VISHAY	PR02000201001JR500
45		RES 0 OHM 1/4W JUMPER CF NPb AXL	1	R11	STACKPOLE	CD14ZT0R00
46		RES 100k OHM 1/10W ±5% NPb 0603 FLM	2	R12 R34	DALE	CRCW0603100KJNEA
47		RES 1M OHM 1/4W ±1% NPb 1206	6	R13 R14 R15 R16 R17 R18	DALE	CRCW12061M00FKEA
48		RES 22.1 OHM 1/8W ±1% NPb 0805 FILM	1	R19	DALE	CRCW080522R1FKEA
49		RES 20 OHM 1/8W ±1% NPb 0805 FILM	1	R20	DALE	CRCW080520R0FKEA
50		RES 1k OHM 1/10W ±1% NPb 0603 FILM	1	R21	DALE	CRCW06031K00FKEA
51		RES 27K OHM 1/8W ±1% NPb 0805	1	R22	PANASONIC	ERJ6ENF2702V
52		RES 69.8k OHM 1/10W ±1% NPb 0603	1	R23	DALE	CRCW060369K8FKEA
53		RES 5.6k OHM 1/10W ±5% NPb 0603 FILM	1	R24	DALE	CRCW06035K60JNEA
54		RES 22.0 OHM 1/10W ±1% NPb 0603	1	R25	PANASONIC	ERJ3EKF22R0V
55		RES 1M OHM 1/8W ±1% MTL NPb AXL	2	R26 R36	STACKPOLE	RNF18FTD1M00
56		RES 14k OHM 1/10W ±1% NPB 0603 FILM	1	R29	DALE	CRCW060314K0FKEA
57		RES 120K OHM 1/10W ±1% NPb 0603	1	R30	PANASONIC	ERJ3EKF1203V
58		RES 47k OHM 1/10W ±5% NPb 0603 FILM	2	R31 R32	DALE	CRCW060347K0JNEA
59		RES 51.0 OHM 1/10W ±1% NPb 0603	1	R33	PANASONIC	ERJ3EKF51R0V
60		CON TEST PT .1" TIN PLATE WHT NPb	2	TP1 TP2	KEYSTONE	5002
61		CON TEST PT .1"CTR TIN PLATE NPb BLK	3	TP3 TP4 TP5	KEYSTONE	5001
62	B2	IC CRUS DIM 230V LED DRV NPb SOIC16	1	U1	CIRRUS LOGIC	CS1611A-FSZ/B2
63		FUSE MOUNT TR5/TE5 3mm 2P NPb TH	1	XF1	Littelfuse	56000001319
64		SCREW 4-40X5/16" PH MACH SS NPb	1	XMH1	BUILDING FASTENERS	PMSSS 440 0031 PH
65		SKT PINCH CONTACT FOR SOIC16N	0	XU1	ENPLAS	OTS-16-1.27-03

Figure 2. Bill of Materials

4. BOARD LAYOUT

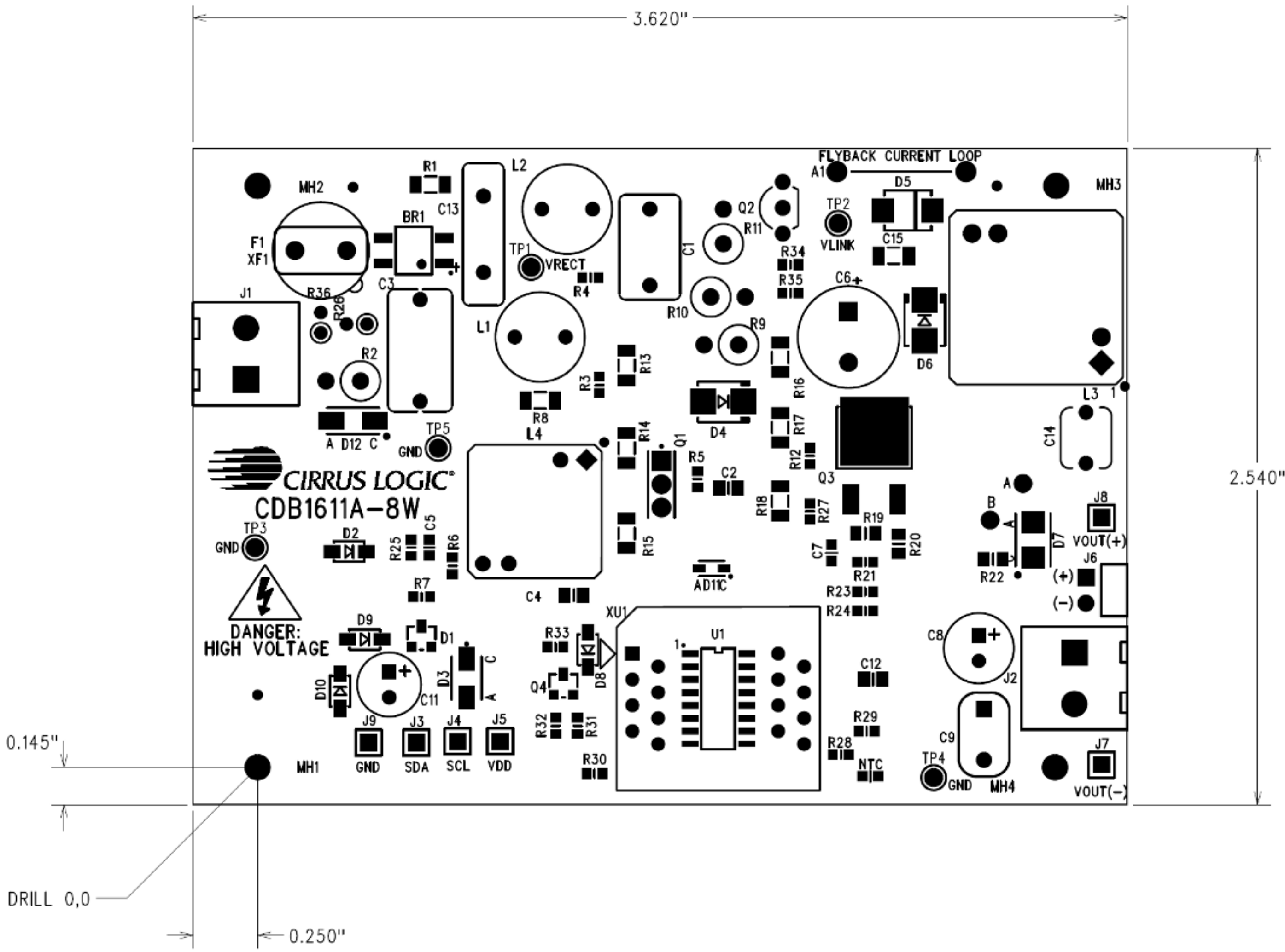


Figure 3. PCB Dimensions

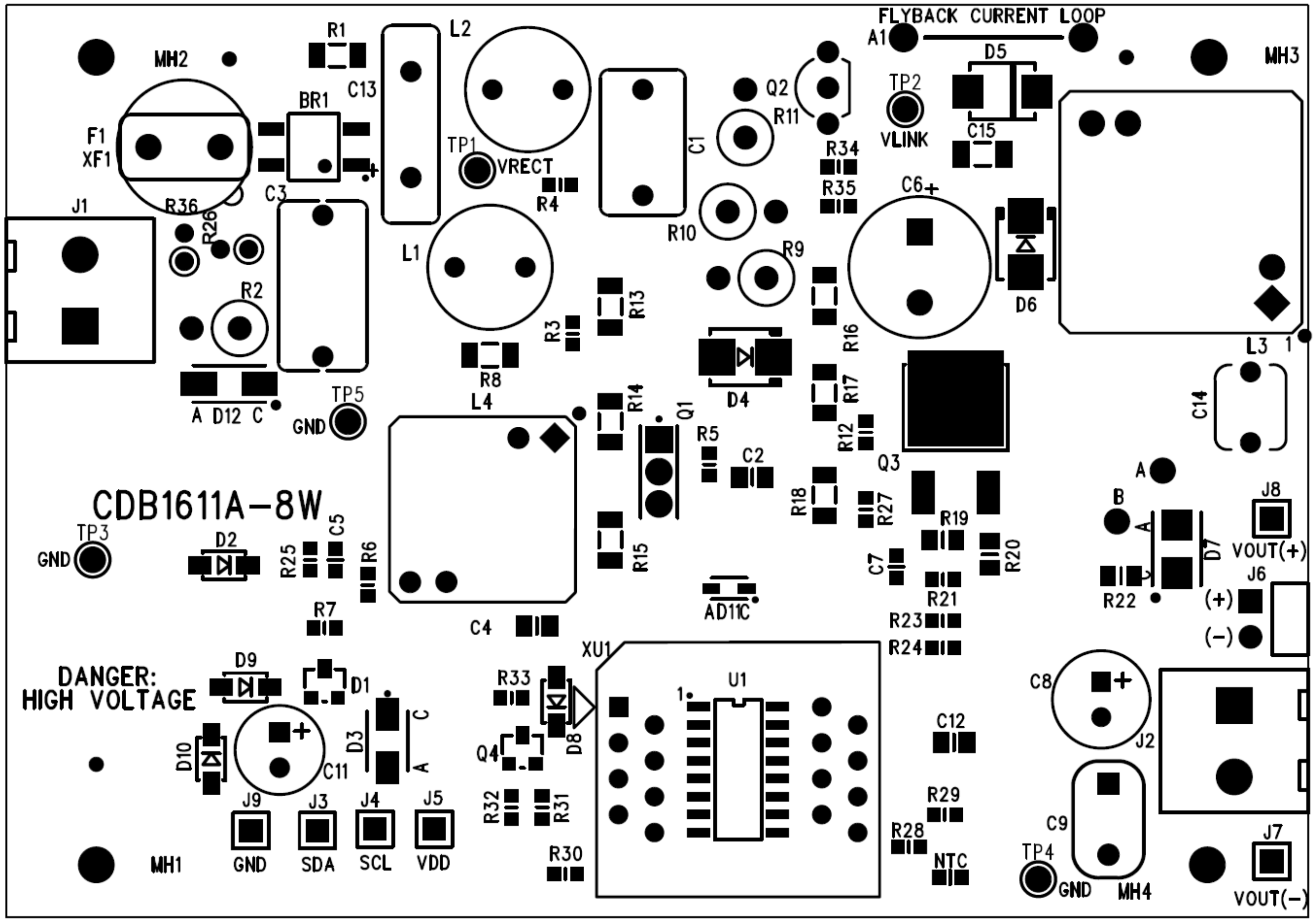


Figure 4. Top Silkscreen

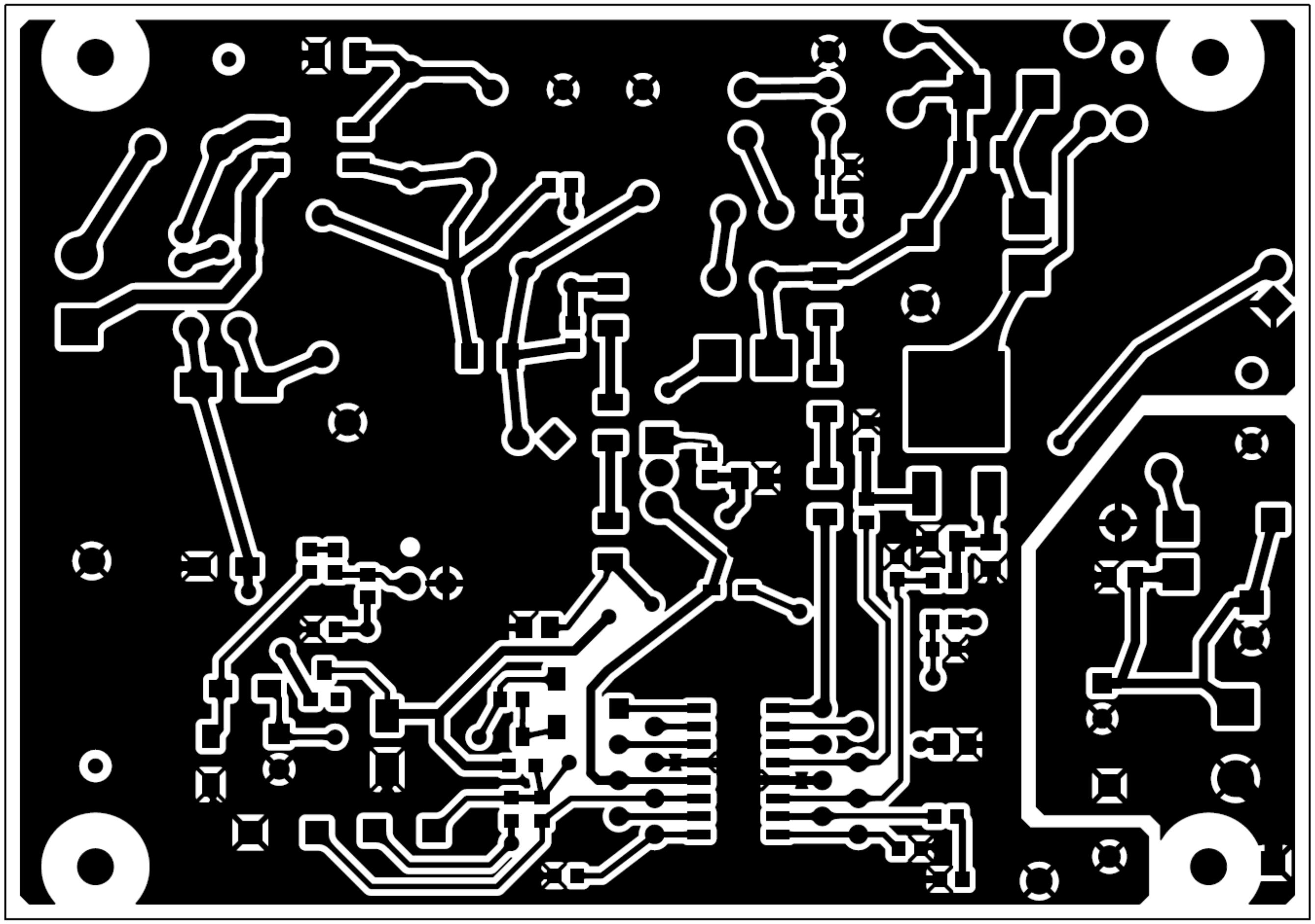


Figure 5. Top Routing

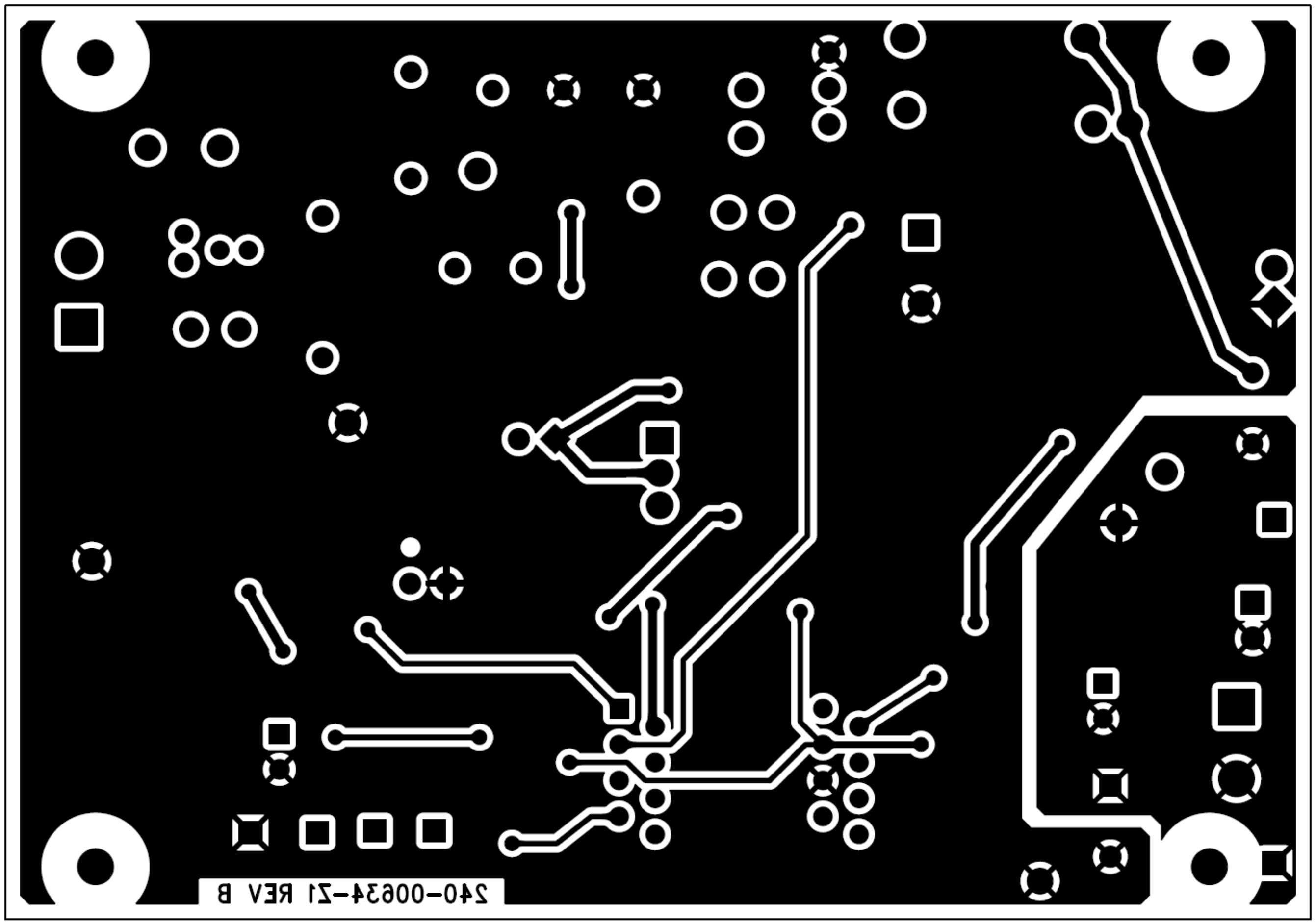


Figure 6. Bottom Routing

5. DIMMER COMPATIBILITY

PAR 16 Lamp with a CS1611A (230V/50Hz)			
Date	9/5/2013	**Power Factor**[1,5]	0.907
Vendor	Cirrus Logic	**IEC-61000-3-2 Compliant (Y/N)**[2,5]	Y
Input Voltage	230V/50Hz	**EN55015 Compliant (Y/N)**	Y
Form Factor	PAR 16	**Nominal Input Power (W)**[1,5]	7.55
Model #	CRD1611A-8W	**Maximum Input Power (W)**[1,5]	8.8
IC	CS1611A	**Output Voltage (V)**[1,3]	11.43
Topology	Boost/Flyback	**Output Current (mA)**[1,3]	542
Isolation (Y/N)	Y	**Output Current Ripple ≤ 120Hz (mA)**[1,4]	0
Efficiency (%)	82.1	**Output Power (W)**[1,5]	6.195

Dimmer[6]		Flicker Free Steady-State			Monotonic Dimming			Max I_{out} (%)			Min I_{out} (%)		
Manufacture	Type	# of lamps			# of lamps			# of lamps			# of lamps		
		1	5	10	1	5	10	1	5	10	1	5	10
Berker 286110	Universal	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	2.0	2.0	2.0
Bull 500W	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
Busch 2247U	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
Busch 6513U-102	Trailing Edge	Y	Y	Y	Y	Y	Y	99.8	99.8	99.8	1.8	1.8	1.8
Busch 6519U	Trailing Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
Busch 6591U-101	Universal	Y	Y	Y	Y	Y	Y	100.0	98.3	96.3	1.8	1.8	1.8
Chint New7-6305	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	99.8	100.0	1.8	2.0	1.8
Chisen	Trailing Edge	Y	N	N	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
Chisen 350W	Leading Edge	Y	N	Y	Y	N	N	100.0	100.0	100.0	1.8	2.0	1.8
Clipsal 32E450UDM	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	99.8	99.8	1.8	1.8	1.8
Clipsal EV51RD400	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
CLSEN QSY626W	Leading Edge	Y	N	N	Y	Y	Y	100.0	100.0	100.0	2.0	3.1	3.5
Cshyh 150W	Leading Edge	Y	Y	N	Y	Y	Y	100.0	100.0	100.0	2.6	4.1	4.2
Dbang	Leading Edge	Y	Y	N	Y	N	Y	100.0	100.0	100.0	2.0	2.8	2.0
Futina 250W	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	3.7	3.7	3.7
Gira 118400	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	2.0	2.0	2.0
HPM 1000L	Leading Edge	Y	Y	Y	Y	Y	Y	74.0	74.5	74.2	1.8	1.8	1.8
HPM 250L	Leading Edge	Y	Y	Y	Y	Y	Y	73.4	74.0	74.2	1.8	1.8	1.8
HPM 250LWE	Leading Edge	Y	Y	Y	Y	Y	Y	86.9	86.9	87.3	1.8	1.8	1.8
HPM 250T	Trailing Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
HPM 400T	Trailing Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
HPM 700L	Leading Edge	Y	Y	Y	Y	Y	Y	86.2	85.2	85.2	1.8	1.8	1.8

Dimmer[6]		Flicker Free Steady-State			Monotonic Dimming			Max I_{out} (%)			Min I_{out} (%)		
Manufacture	Type	# of lamps			# of lamps			# of lamps			# of lamps		
		1	5	10	1	5	10	1	5	10	1	5	10
HPM LN250T	Trailing Edge	Y	Y	Y	Y	Y	N	97.4	95.4	100.0	1.8	1.8	1.8
HPM LN400L	Leading Edge	Y	Y	Y	Y	Y	Y	76.9	76.8	86.7	1.8	1.8	1.8
HPM XL1000T	Trailing Edge	Y	Y	Y	Y	Y	Y	100.0	99.1	97.8	1.8	1.8	1.8
HPM XL250T	Trailing Edge	Y	Y	Y	Y	Y	Y	96.5	94.5	93.5	1.8	1.8	1.8
HPM XL700L	Leading Edge	Y	Y	Y	Y	Y	Y	83.0	83.0	82.5	1.8	1.8	1.8
KOPP 8078	Trailing Edge	Y	Y	N	Y	Y	N	100.0	100.0	-	1.8	1.8	-
Leiben 450W	Leading Edge	N	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
Lonon NB50.0TG	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
Lutron LLSI-502	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
Lutron LLSM-502	Leading Edge	Y	Y	Y	Y	Y	Y	88.6	89.7	89.3	1.8	1.8	1.8
Merten 5725	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
Merten 5771	Trailing Edge	Y	Y	Y	Y	Y	Y	87.5	83.0	81.0	1.8	1.8	1.8
MK 52471SL	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	2.0	1.8	1.8
N&L 28985	Trailing Edge	Y	Y	N	Y	Y	N	95.0	92.1	-	1.8	1.8	-
Opus 852.390	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	2.2	2.0	2.0
Opus 852.392	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	3.1	3.1	3.1
Siemens 5GT0200	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
T&J K211-1KM2	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	2.0	1.8	1.8
T&J K211-M2	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
TCL LM2	Leading Edge	Y	Y	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
TNC Z26-M12	Leading Edge	N	N	Y	Y	Y	Y	100.0	100.0	100.0	1.8	1.8	1.8
Wuyun W13-C162	Trailing Edge	Y	Y	N	Y	Y	N	100.0	100.0	-	1.8	1.8	-

Notes:
1. Tested at nominal input voltage, nominal input frequency and without a dimmer after soaking for 15 minutes
2. Compliant with IEC 61000-3-2 Class C < 25W
3. Average
4. Peak-to-peak
5. Measured with Chroma 66202 Power Analyzer
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6. INDUCTOR CONSTRUCTION

The CDB1611A-8W includes a critical conduction mode (CRM) boost converter that provides power factor correction and dimmer compatibility with a constant output current, quasi-resonant flyback stage. The following sections describe the boost and flyback inductors installed on the CDB1611A-8W.

6.1 Boost Inductor

The CS1611A uses an adaptive dimmer compatibility algorithm to control the boost inductor stage, which guarantees dimmer compatibility operation plus enables flicker-free operation with leading-edge, trailing-edge, and digital dimmers (dimmers with an integrated power supply). The boost auxiliary winding is used for zero-current detection (ZCD) and supplies power to the CS1611A.

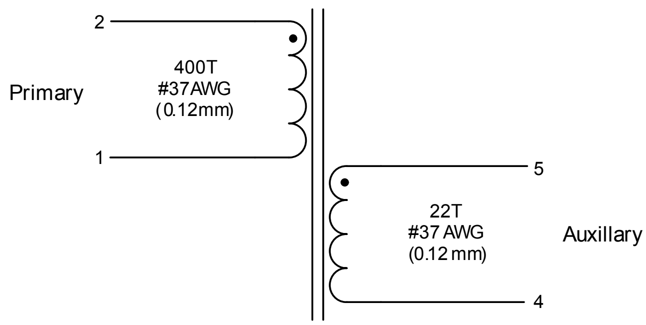

Figure 7. Boost Inductor Schematic

6.1.1 Electrical Specifications

Characteristics conditions:

- Operating temperature range: -25 °C to +120 °C (including coil heat)

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Boost Inductor						
Primary Inductance (Note 1)	$f_{resonant}$=10kHz, 0.3V at 20°C	L_P	6.12	6.8	7.48	mH
Primary DC Resistance (Note 1)	t_{DCR}=20°C		12	15	18	Ω
Auxiliary DC Resistance (Note 2)	t_{DCR}=20°C		0.84	1.05	1.26	Ω

Notes: 1. Measured across pins 1 and 2
2. Measured across pins 5 and 4

6.2 Flyback Transformer

The flyback transformer stage is a quasi-resonant peak current-regulated DC-DC converter capable of delivering the highest possible efficiency with constant current output while minimizing line frequency ripple. The auxiliary winding is used for zero-current detection and overvoltage protection.

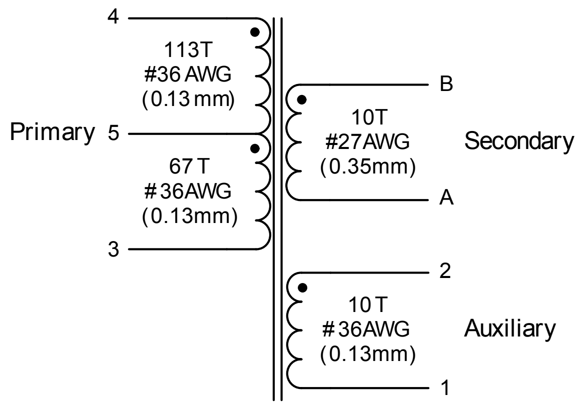

Figure 8. Flyback Transformer Schematic

6.2.1 Electrical Specifications

Characteristics conditions:

- Operating temperature range: -25 °C to +120 °C (including coil heat)

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Flyback Transformer						
Electrical Strength (Note 3)	$f_{operate}$=50/60 Hz		-	4K	-	V_{RMS}
Primary Inductance (Note 4)	$f_{resonant}$=10 kHz, 0.3 V at 20°C	L_P	13.05	14.5	15.95	mH
Primary Leakage Inductance (Note 4)	$f_{resonant}$=10 kHz, 0.3 V at 20°C	L_K	-	106	-	µH
Primary DC Resistance (Note 4)	t_{DCR}=20°C		5.25	7.0	8.75	Ω
Secondary DC Resistance (Note 5)	t_{DCR}=20°C		-	120	-	mΩ
Auxiliary DC Resistance (Note 6)	t_{DCR}=20°C		-	400	-	mΩ

Notes:
3. Time = 2s
4. Measured across pins 3 and 4
5. Measured across pins B and A
6. Measured across pins 2 and 1

7. PERFORMANCE PLOTS

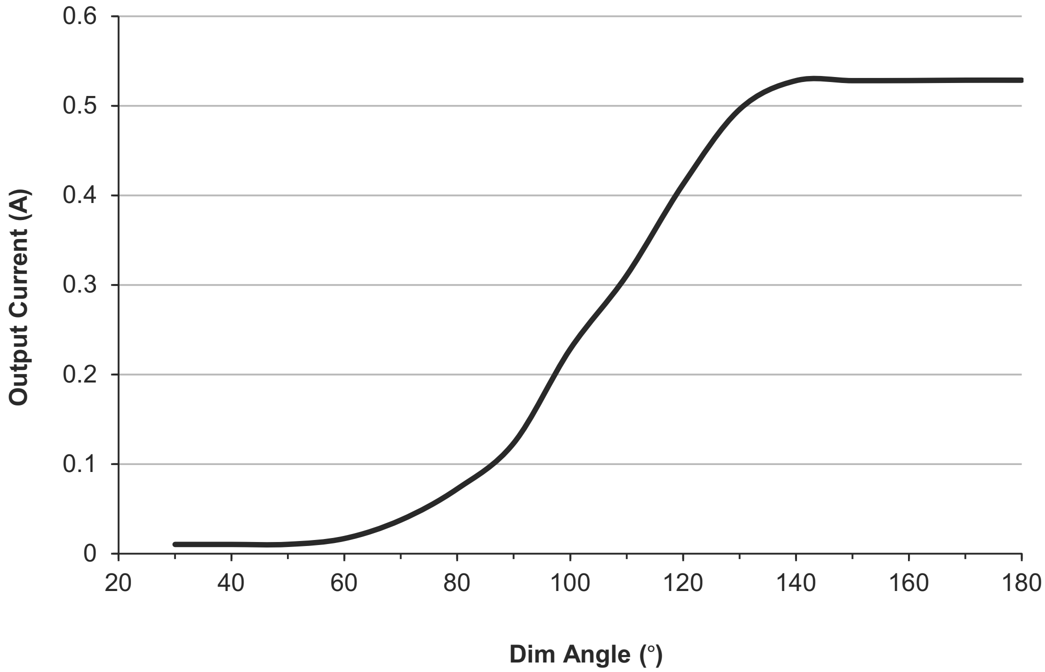

Figure 9. Typical Output Current vs. Dim Angle

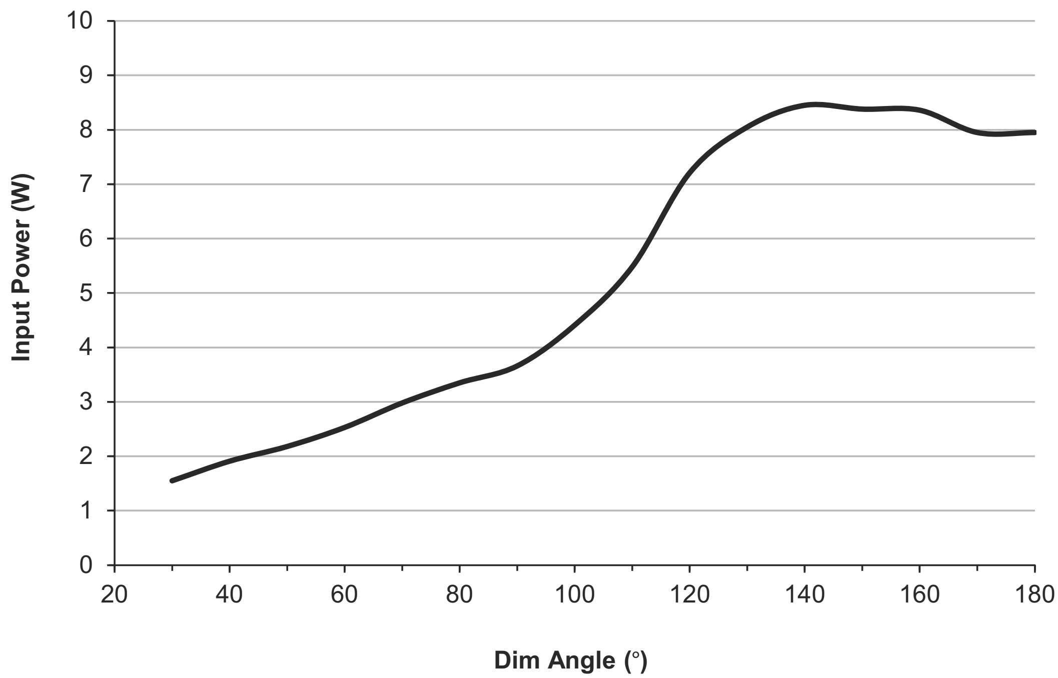

Figure 10. Typical Input Power vs. Dim Angle

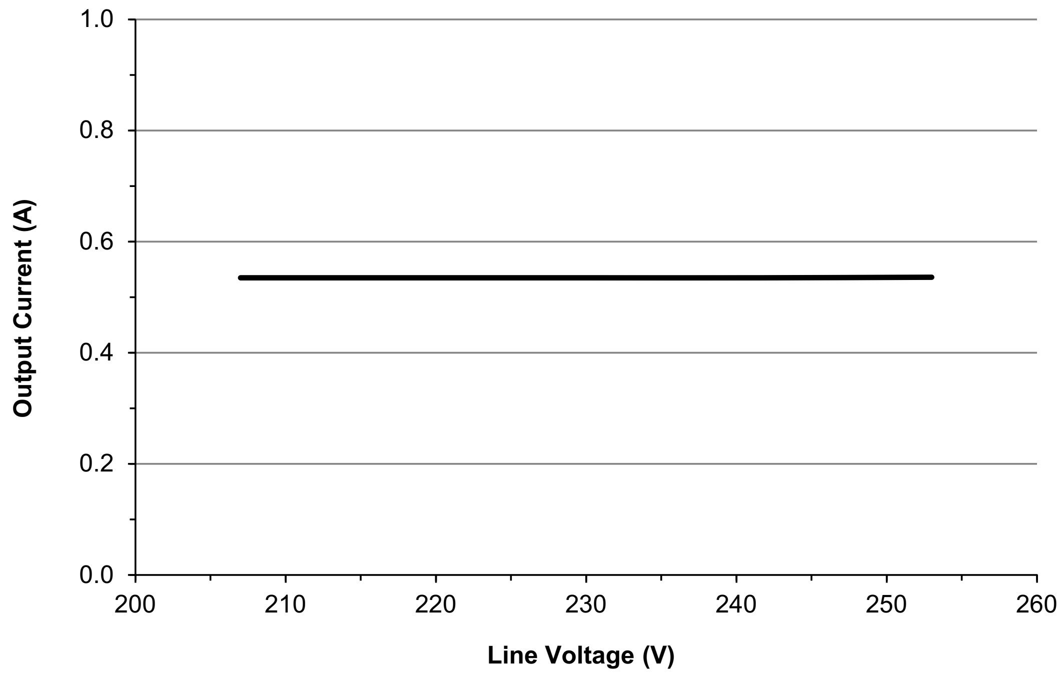

Figure 11. Output Current vs. Line Voltage, 207VAC to 253VAC

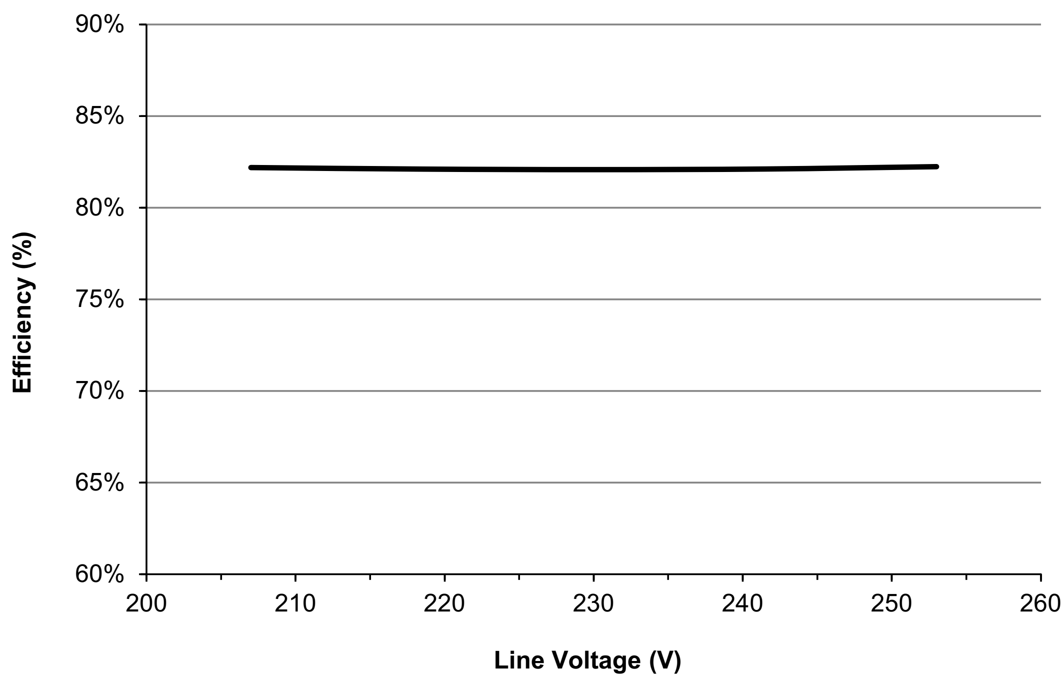

Figure 12. Typical Efficiency vs. Line Voltage, 207VAC to 253VAC

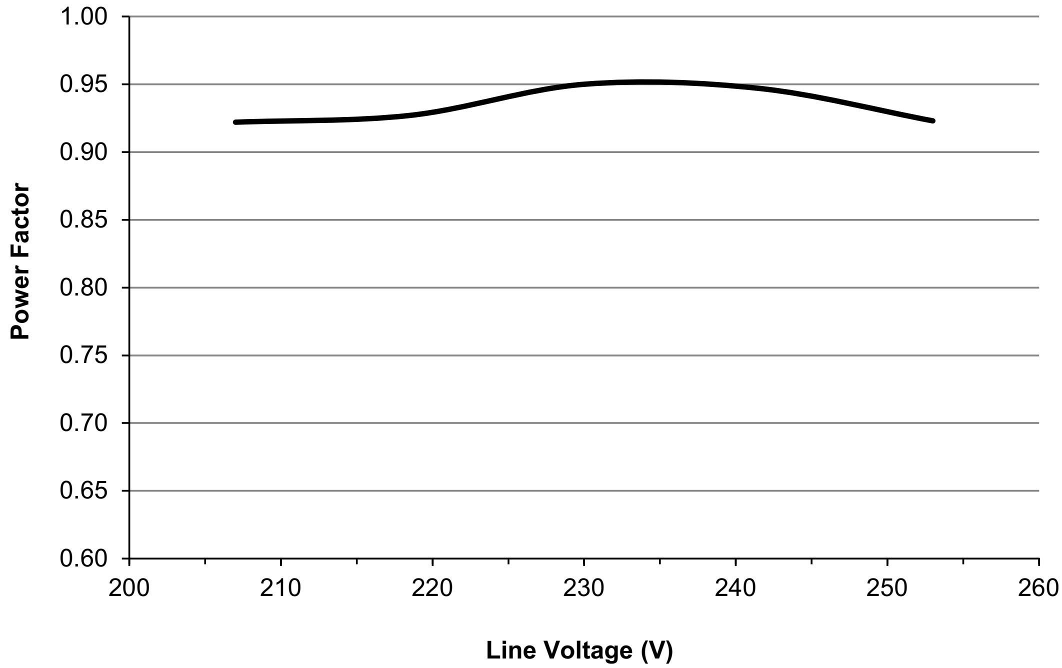

Figure 13. Power Factor vs. Line Voltage, 207VAC to 253VAC

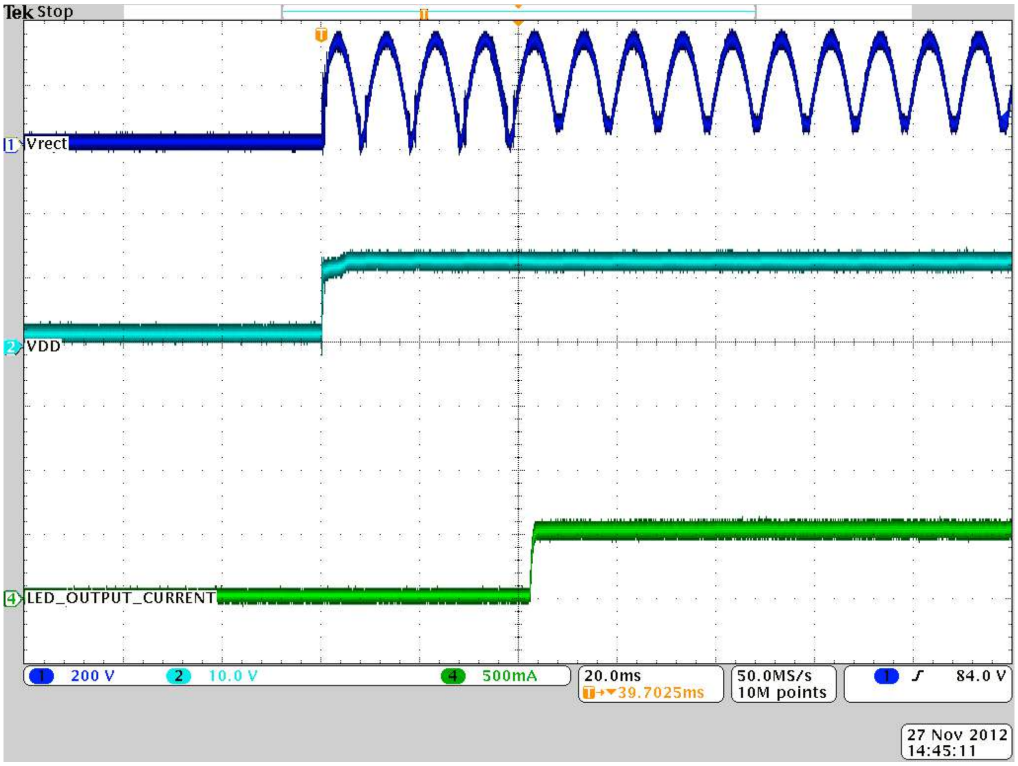

Figure 14. No-dimmer Mode, Startup, 230VAC

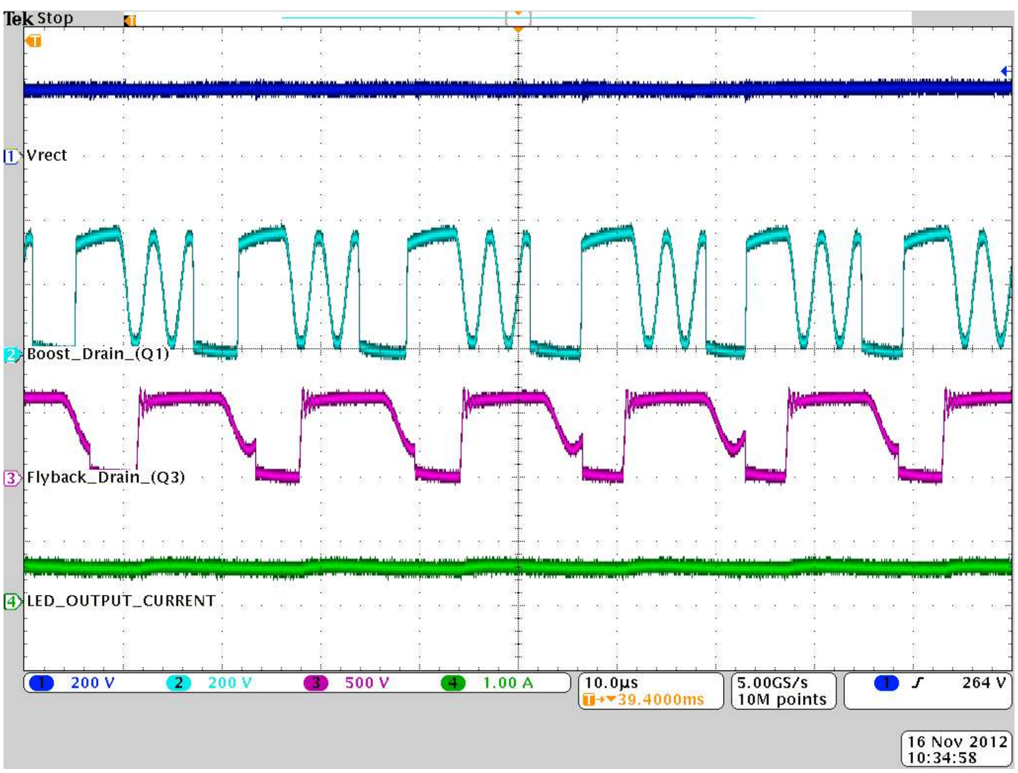

Figure 15. No-dimmer Mode, Steady-state, 230VAC

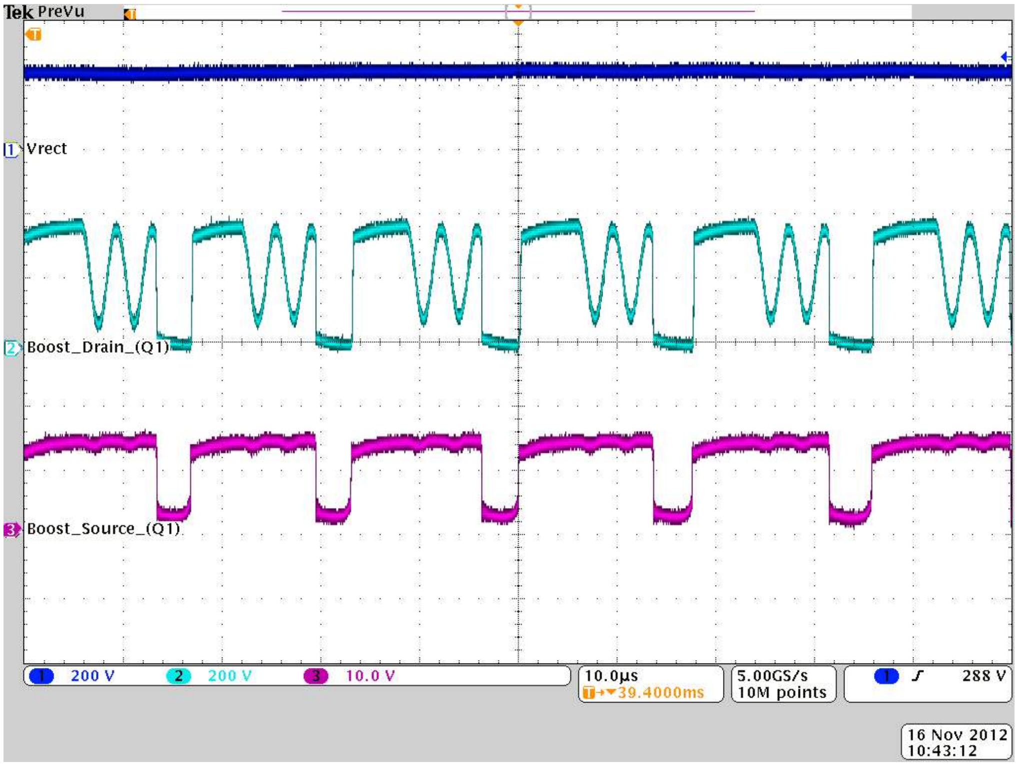

Figure 16. Boost FET Q1 Waveform

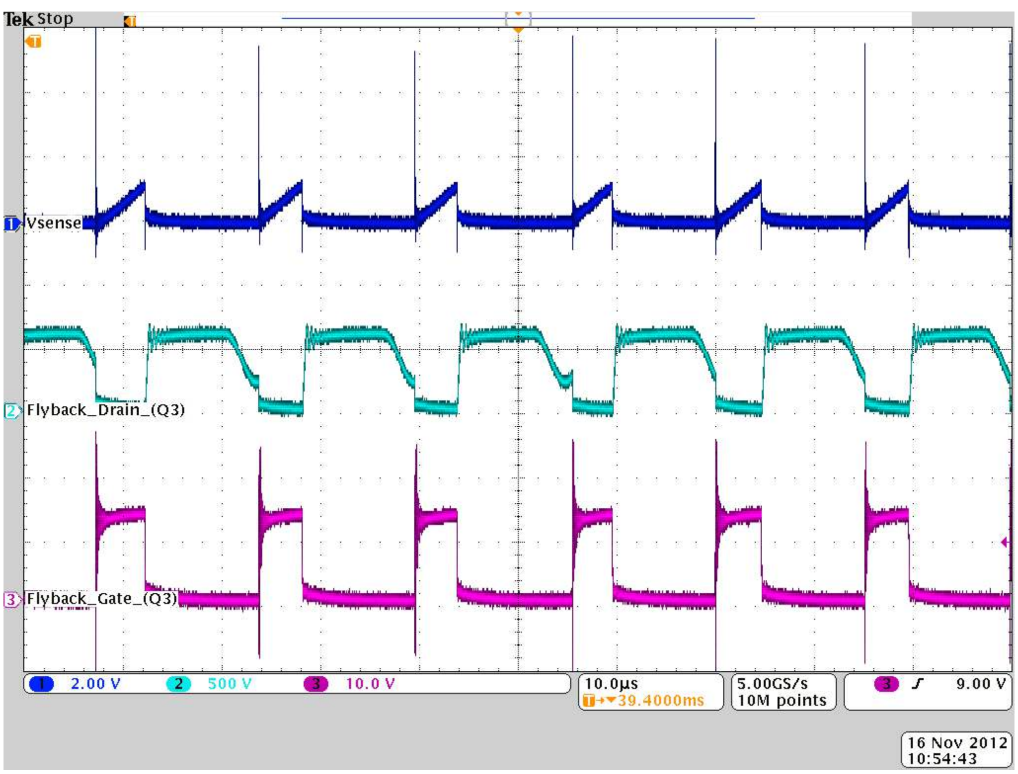

Figure 17. Flyback FET Q3 Waveform

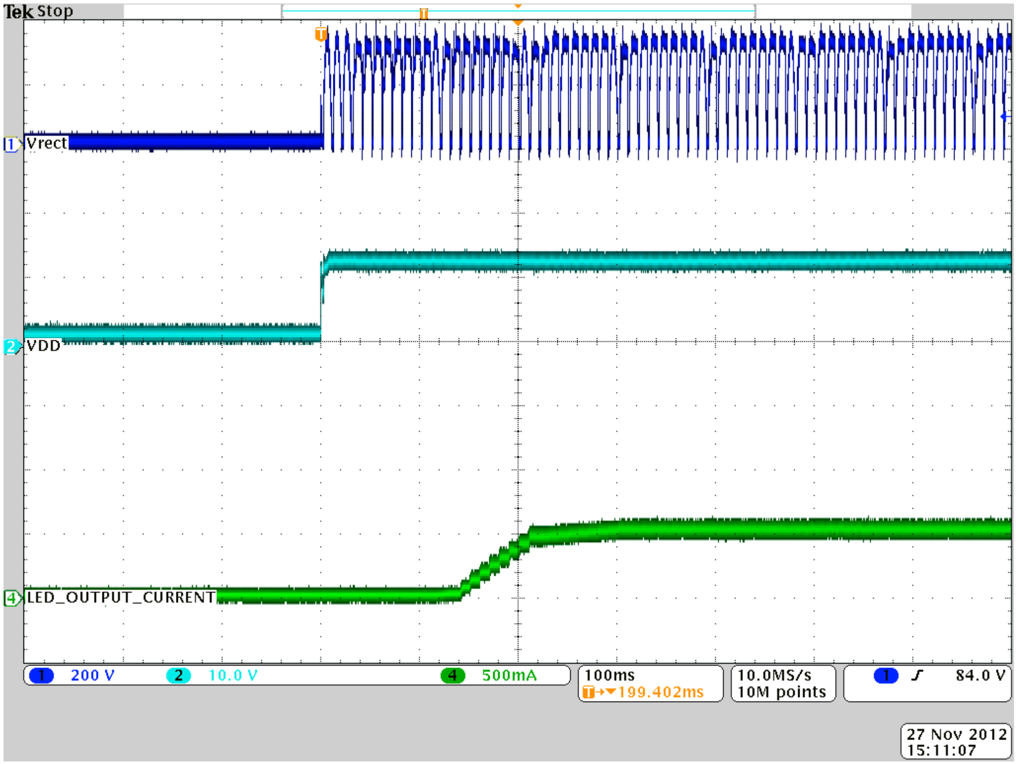

Figure 18. ILED at Maximum Dim Angle, Turn-on Waveforms

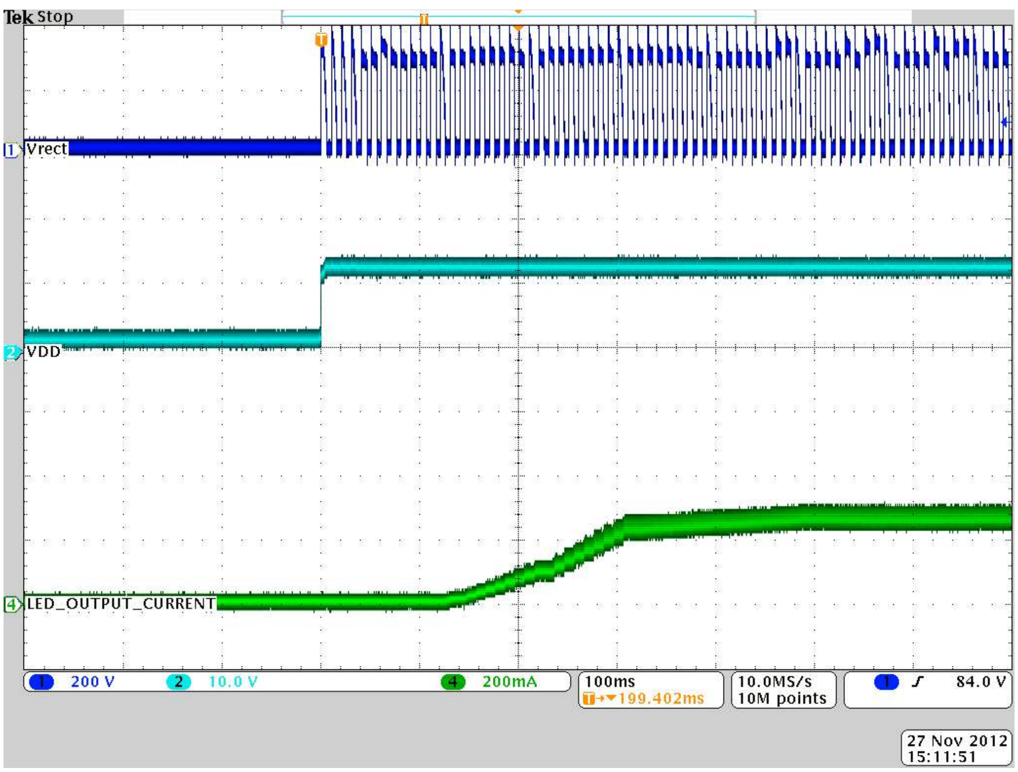

Figure 19. ILED at Medium Dim Angle, Turn-on Waveforms

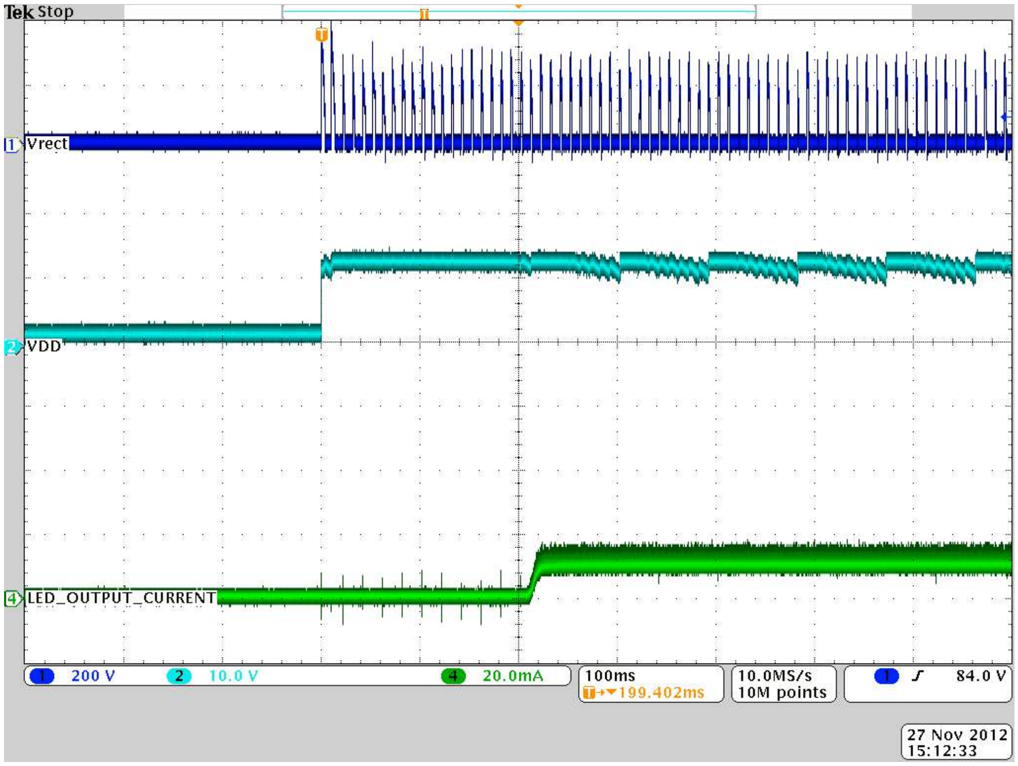

Figure 20. ILED at Minimum Dim Angle, Turn-on Waveforms

8. REVISION HISTORY

Revision	Date	Changes
DB1	FEB 2013	Initial release
DB2	MAR 2013	Context clarification
DB3	SEP 2013	PCBA revision B content clarification