CDB1501-250W

CS1501 250W, High-efficiency PFC Demonstration Board

Features

- Variable On Time, Variable Frequency, DCM PFC Controller
- Line Voltage Range: 90 to 265VAC RMS
- Output voltage: 400V
- Rated Pout: 250W
- Efficiency: 96.5% @ 250W, 220VAC
- No-load Power Dissipation: <0.3W
- Low Component Count
- Supports Cirrus Logic Product CS1501

General Description

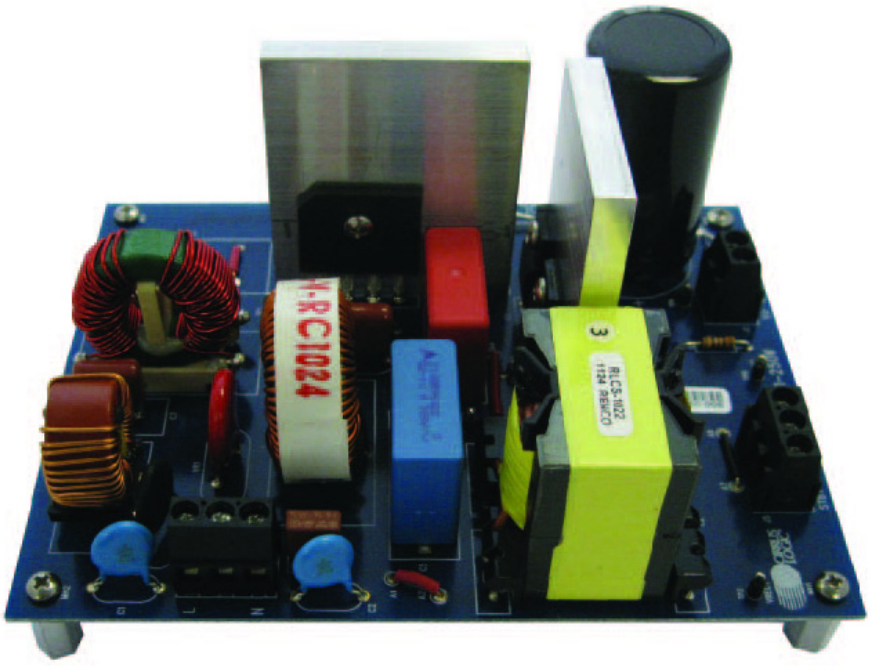
The CDB1501-250W board demonstrates the performance of the CS1501 digital PFC controller with a 250 Watt output at a link voltage of 400 volts.

DIMENSIONS

5.125″(*length*) × 4″(*width*) × 2.5″(*height*)

ORDERING INFORMATION

CDB1501-250W-Z	PFC Demonstration Board Supports CS1501



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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, heat sinks or metallic parts may be extremely hot to touch when electrically active.

WARNING Heatsinking is required for Q1. The end product should use tar pitch or an equivalent compound for this purpose. For lab evaluation purposes, a fan is recommended to provide adequate cooling.

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

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1. INTRODUCTION

The CS1501 is a high-performance Variable Frequency Discontinuous Conduction Mode (VF-DCM), active Power Factor Correction (PFC) controller, optimized to deliver the lowest system cost in switched mode power supply (SMPS) applications. The CS1501 uses a digital control algorithm that is optimized for high efficiency and near-unity power factor over a wide input voltage range (90-265 VAC).

Using an adaptive digital control algorithm, both the ON time and the switching frequency are varied on a cycle-by-cycle basis over the entire AC line to achieve close-to-unity power factor. 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. Burst mode control minimizes the light-load/standby losses. Protection features such as overvoltage, overcurrent, overpower, open circuit, overtemperature, and brownout help protect the device during abnormal transient conditions. Details of these features are provided in the CS1501 data sheets.

The CDB1501-250W board demonstrates the performance of the CS1501 with input voltage range of 90-265 VAC, typically seen in universal input applications. This board has been designed for a V_{link} of 400V, 250 Watts, full load.

Extreme caution needs to be exercised while handling this board. This board is to be used by trained professionals only. Prior to applying AC power to the CDB1501-250W board, the CS1501 needs to be biased using an external 13 VDC power supply.

This document provides the schematic for the board. It includes oscilloscope screen shots that indicate operating waveforms. Graphs are also provided that document the performance of the board in terms of Efficiency vs. Load, Total Harmonic Distortion vs. Load, and Power Factor vs. Load for the CS1501 PFC controller IC.

2. SCHEMATIC

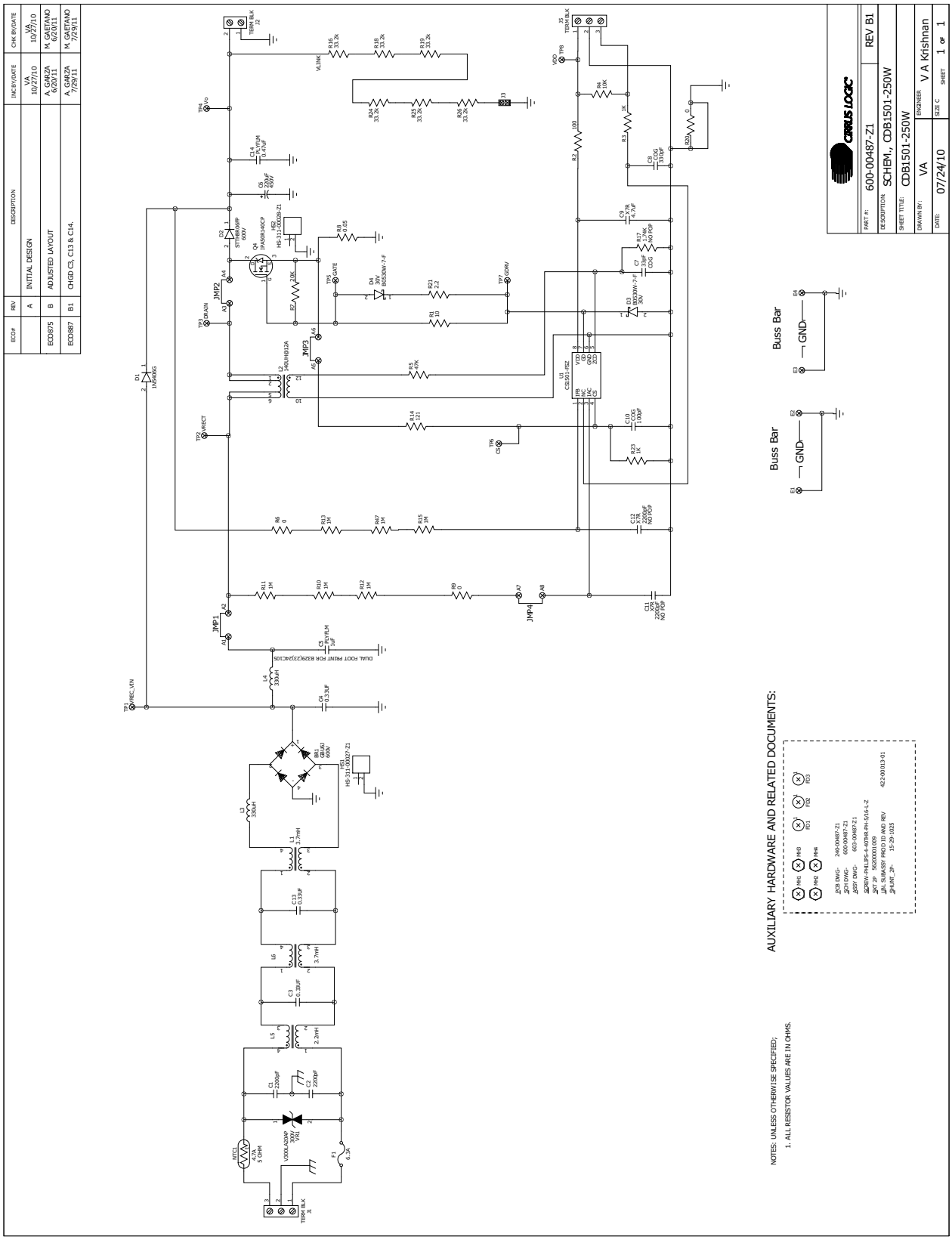


Figure 1. Schematic

3. BILL OF MATERIALS

CIRRUS LOGIC
CDB1501-250W_Rev_B1.bom

BILL OF MATERIAL

Item	Cirrus P/N	Rev	Description	Qty	Reference Designator	MFG	MFG P/N	Notes	Status
1	070-00164-Z1	A	DIODE RECT BRIDGE 600V 6A NPb GBU	1	BR1	DIODES INC	GBU6J-BP	SEE ASSEMBLY DRAWING TO ASSEMLBE BR1, ECO887	A
2	011-00042-Z1	A	CAP 2200pF ±10% 2000V CER NPb RAD	2	C1 C2	MURATA	DEBB33D222KA2B		A
3	013-00038-Z1	A	CAP 0.33uF ±5% 450V MTL PLY NPb RAD	2	C3 C13	PANASONIC	ECWF2W334JAQ	BEND LEADS TO ASSEMBLE, ECO887	A
4	013-00019-Z2	A	CAP 0.33uF ±10% 400V POLY NPb TH	1	C4	PANASONIC	ECQE4334KF	ECO887	A
5	011-00041-Z1	A	CAP 1uF ±20% 305V PLY FLM NPb TH	1	C5	EPCOS	B32923C3105M	DUAL FOOT PRINT FOR B329(23)24C105	A
6	012-00192-Z1	A	CAP 220uF ±20% 450V ELEC NPb TH	1	C6	PANASONIC	ECOS2WP221CX		A
7	001-10080-Z1	A	CAP 33pF ±5% 50V C0G NPb 0603	1	C7	KEMET	C0603C330J5GAC		A
8	001-05783-Z1	A	CAP 330pF ±10% 50V C0G NPb 1206	1	C8	KEMET	C1206C331K5GAC		A
9	001-10233-Z1	A	CAP 4.7uF ±20% 25V X7R NPb 1206	1	C9	TDK	C3216X7R1E475M		A
10	001-05542-Z1	A	CAP 100pF ±5% 50V C0G NPb 1206	1	C10	KEMET	C1206C101J5GAC		A
11	001-06276-Z1	A	CAP 2200pF ±10% 50V X7R NPb 1206	0	C11 C12	KEMET	C1206C222K5RAC	NO POP	A
12	013-00039-Z1	A	CAP 0.47uF ±5% 400V PLY 22 NPb RAD	1	C14	WIMA	MKP1G034705G00JYSD	ECO887	A
13	070-00057-Z2	A	DIODE RECT 600V 3A NPb TH	1	D1	ON SEMI	1N5406G		A
14	070-00176-Z2	A	DIODE FAST 600V 8A NPb TO220FPAC	1	D2	ST MICROELECTRONICS	STTH8R06FP		A
15	070-00149-Z1	A	DIODE SKY 30V .5A 410mW NPb SOD123	2	D3 D4	DIODES INC	B0530W-7-F		A
16	180-00026-Z1	A	FUSE 6.3A SLO BLO 250V NPb RAD	1	F1	LITTLE FUSE	40016300440	With Fuse Holder	A
17	311-00027-Z1	A	HTSNK CUSTOM 2.00X1.75X.25" NPb	1	HS1	CIRRUS LOGIC	311-00027-Z1	REQ'S QTY 3 #4-40 SCREWS P/N:300-00025-Z1	A
18	311-00028-Z1	A	HTSNK CUSTOM 2.00X1.50X.25" NPb	1	HS2	CIRRUS LOGIC	311-00028-Z1	REQ QTY 4 #4-40 PAN HEAD SCREWS P/N:300-00025-Z1	A
19	110-00301-Z1	A	CON 3POS TERM BLK 5.08mm SPR NPb RA	2	J1 J5	WEIDMULLER	1716030000		A
20	110-00302-Z1	A	CON 2POS TERM BLK 5.08mm SPR NPb RA	1	J2	WEIDMULLER	1716020000		A
21	115-00014-Z1	A	HDR 2x1 ML .1" 062BD ST GLD NPb TH	1	J3	SAMTEC	TSW-102-07-G-S		A
22	040-00132-Z1	A	IND 3.7uH 4A CM CHK NPb TH	0	L1	COILCRAFT	CMT1-3.7-4L	NO POP, SHORT PINS	A
23	040-00148-Z1	A	IND 140uH ±10% 12A PFC NPb TH	1	L2	RENCO	RLCS-1022		A
24	040-00136-Z1	A	IND 330uH 5.2A ±15% TOR NPb TH	2	L3 L4	JW MILLER	2318-V-RC		A
25	040-00124-Z1	A	IND 2.2mH 4A ±20% PWR NPb TH	1	L5	WURTH ELEKTRONIK	744823422		A
26	040-00132-Z1	A	IND 3.7uH 4A CM CHK NPb TH	1	L6	COILCRAFT	CMT1-3.7-4L		A

Figure 2. Bill of Materials (Page 1 of 2)

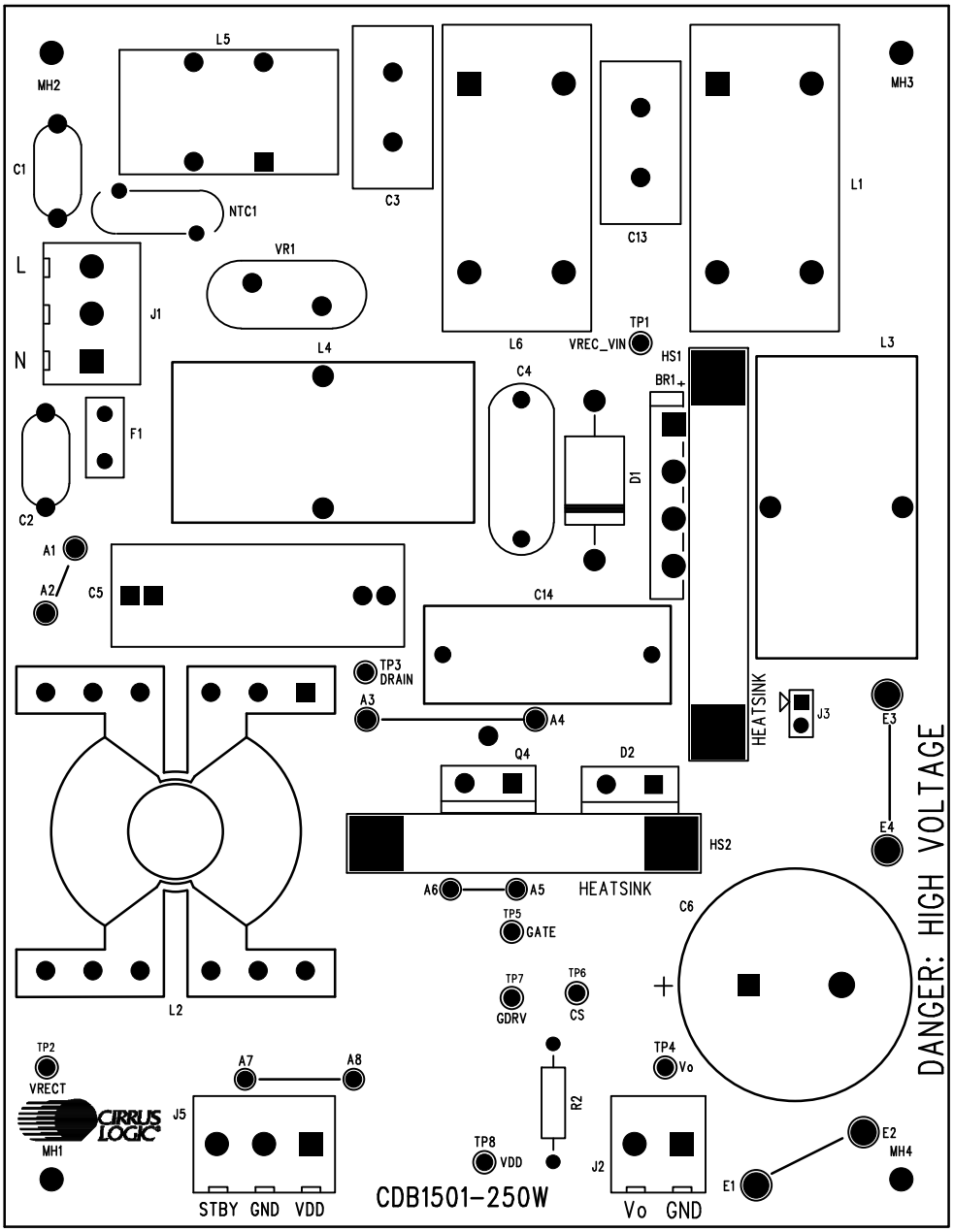
CIRRUS LOGIC
CDB1501-250W_Rev_B1.bom

BILL OF MATERIAL

Item	Cirrus P/N	Rev	Description	Qty	Reference Designator	MFG	MFG P/N	Notes	Status
27	304-00004-Z1	A	SPCR STANDOFF 4-40 THR .500"L NPb	4	MH1 MH2 MH3 MH4	KEYSTONE	2203	REQUIRES SCREW 4-40X5X16" PH STEEL 300-00025-Z1	A
28	036-00017-Z1	A	THERM 5 OHM 4.7A 5% NPb RAD	1	NTC1	GE SENSING	CL-150		A
29	071-00104-Z1	A	TRAN MOSFT nCH 550V 23A NPb TO220FP	1	Q4	INFINEON	IPA50R140CP		A
30	020-02388-Z1	A	RES 10 OHM 1/4W ±1% NPb 1206 FILM	1	R1	DALE	CRCW120610R0FKEA		A
31	030-00009-Z1	A	RES 100 OHM 1/4W ±1% METAL NPb AXL	1	R2	VISHAY	CCF55100RFKE36		A
32	020-02616-Z1	A	RES 1k OHM 1/4W ±1% NPb 1206 FILM	2	R3 R23	DALE	CRCW12061K00FKEA		A
33	021-00435-Z1	A	RES 10k OHM 1/8W ±5% NPb 0805 FILM	1	R4	DALE	CRCW080510K0JNEA		A
34	020-06382-Z1	A	RES 47k OHM 1/4W ±1% NPb 1206	1	R5	DALE	CRCW120647K0FKEA		A
35	020-02273-Z1	A	RES 0 OHM 1/4W NPb 1206 FILM	2	R6 R9	DALE	CRCW12060000Z0EA		A
36	020-06310-Z1	A	RES 20K OHM 1/4W ±1% NPb 1206 FILM	1	R7	DALE	CRCW120620K0FKEA		A
37	020-06302-Z1	A	RES 0.05 OHM 1/2W ±1% NPb 2010	1	R8	VISHAY	WSL2010R0500FEA		A
38	020-06374-Z1	A	RES 1M OHM 1/4W ±1% NPb 1206	6	R10 R11 R12 R13 R15 R47	DALE	CRCW12061M00FKEA		A
39	020-02511-01	A	RES 121 OHM 1/4W ±1% 1206 FILM	1	R14	DALE	CRCW12061210F		A
40	020-06346-Z1	A	RES 33.2K OHM 1/4W ±1% NPb 1206	6	R16 R18 R19 R24 R25 R26	DALE	CRCW120633K2FKEA		A
41	020-06377-Z1	A	RES 1.74k OHM 1/4W ±1% NPb 1206	0	R17	DALE	CRCW12061K74FKEA	NO POP	A
42	021-01439-Z1	A	RES 0 OHM 1/16W ±5% NPb 0402 FILM	1	R20	YAGEO	RC0402JR-070RL		A
43	021-00347-Z1	A	RES 2.2 OHM 1/8W ±5% NPb 0805 FILM	1	R21	DALE	CRCW08052R20JNEA		A
44	110-00045-Z1	A	CON TEST PT .1"CTR TIN PLAT NPb BLK	8	TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8	KEYSTONE	5001		A
45	065-00328-Z3	A2	IC CRUS LPWR FACTOR CORR NPb SOIC8	1	U1	CIRRUS LOGIC	CS1501-FSZ/A2		A
46	036-00006-Z1	A	VARISTOR 300V 400pF 14mm NPb RAD	1	VR1	LITTELFUSE	V300LA20AP		A
47	303-00009-Z1	A	FUSE MOUNT TR5/TE5 NPb TH	1	XF1	LITTELFUSE	56200001009	MOUNT FOR F1	A
48	300-00025-Z1	A	SCREW 4-40X5/16" PH MACH SS NPb	11	XMH1 XMH2 XMH3 XMH4 XHS1 XHS2	BUILDING FASTENERS	PMSSS 440 0031 PH	SCREWS FOR STANDOFFS AND HEATSINKS	A
49	603-00487-Z1	B1	ASSY DWG CDB1501-250W-Z-NPb	REF		CIRRUS LOGIC	603-00487-Z1	ECO875, ECO887	A
50	240-00487-Z1	B	PCB CDB1501-250W-Z-NPb	1		CIRRUS LOGIC	240-00487-Z1	ECO875	A
51	600-00487-Z1	B1	SCHEM CDB1501-250W-Z-NPb	REF		CIRRUS LOGIC	600-00487-Z1	ECO875, ECO887	A
52	110-00013-Z1	D	CON SHUNT 2P .1"CTR BLK NPb	1		MOLEX	15-29-1025	SHUNT FOR J3	A
53	422-00013-Z1	D	LBL SUBASSY PRODUCT ID AND REV	1		CIRRUS LOGIC	422-00013-01		A

Figure 3. Bill of Materials (Page 2 of 2)

4. BOARD LAYOUT



SILKSCREEN TOP

Figure 4. Top Silkscreen

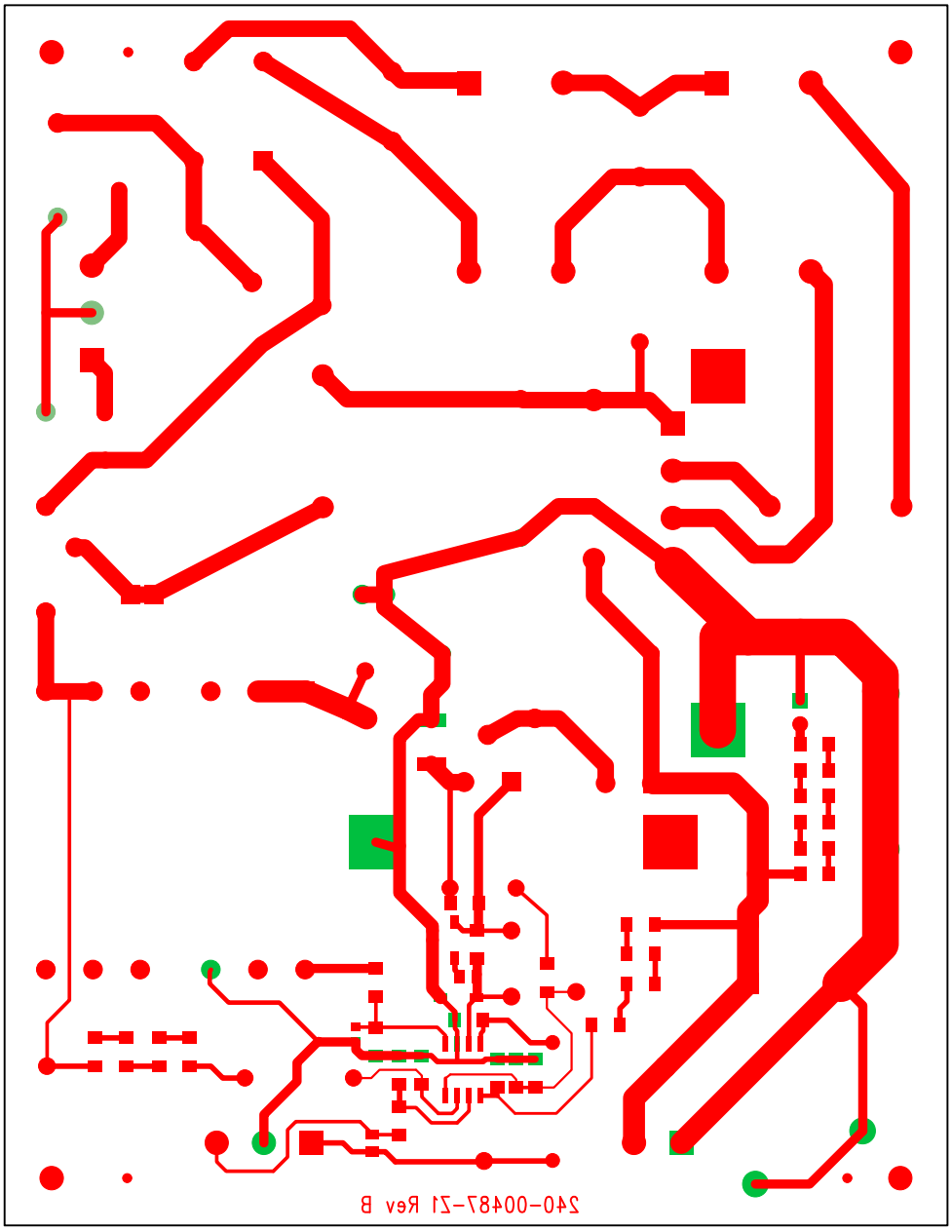
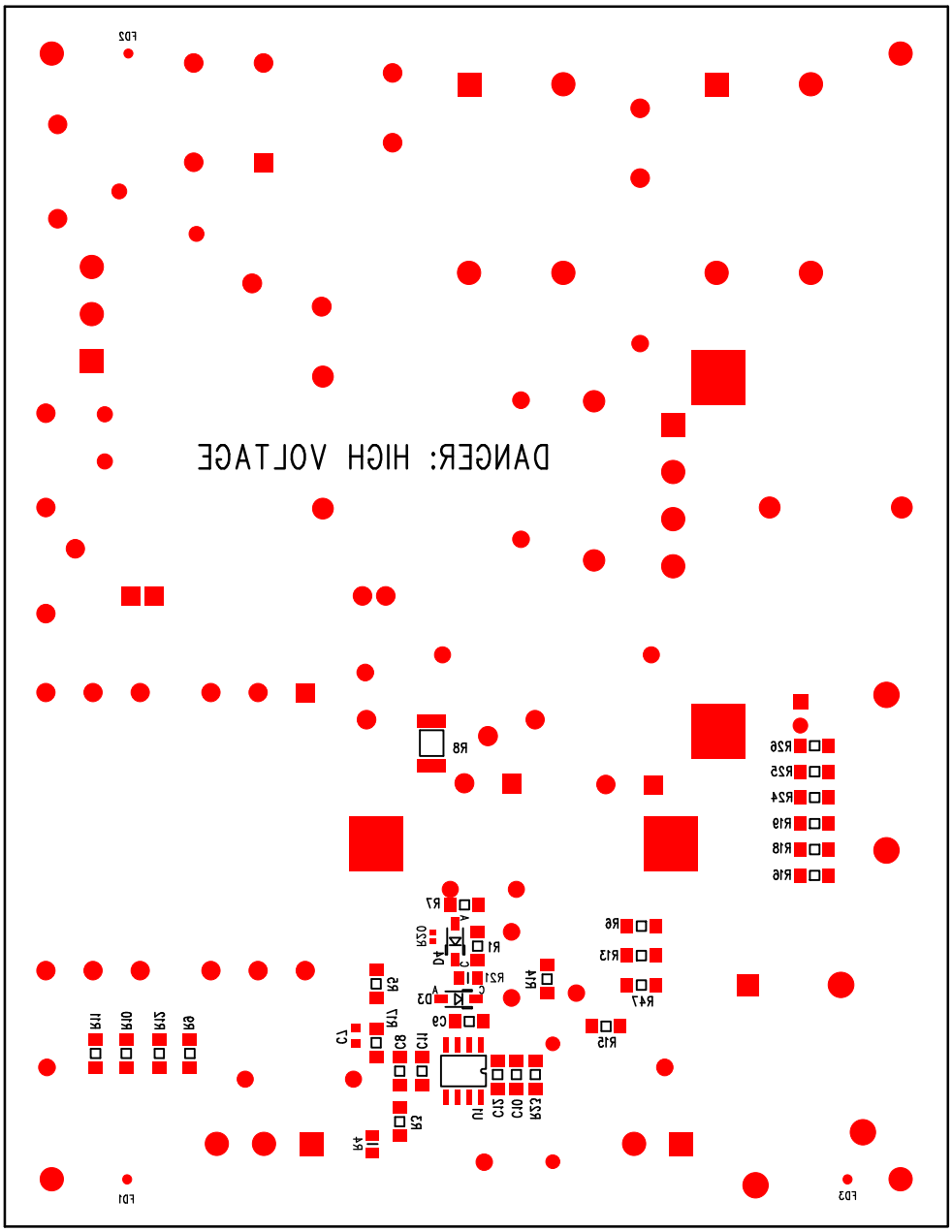


Figure 5. Bottom Routing



SILKSCREEN BOTTOM

Figure 6. Bottom Silkscreen

5. PERFORMANCE PLOTS

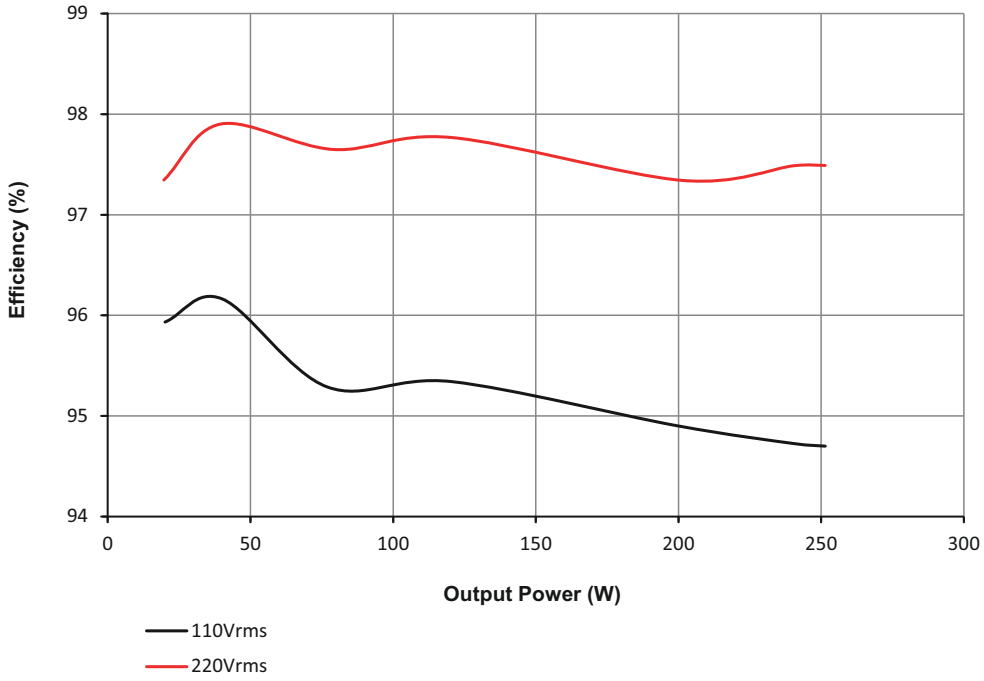


Figure 7. Efficiency vs. Load at 110 VAC, 220 VAC

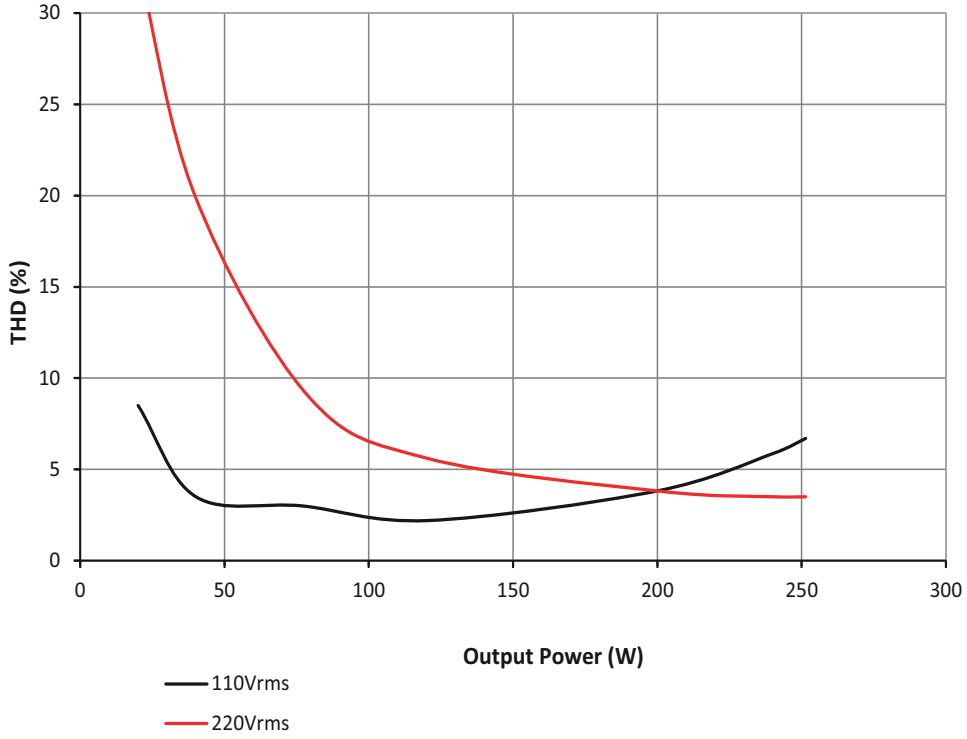


Figure 8. Distortion vs. Load at 110 VAC, 220 VAC

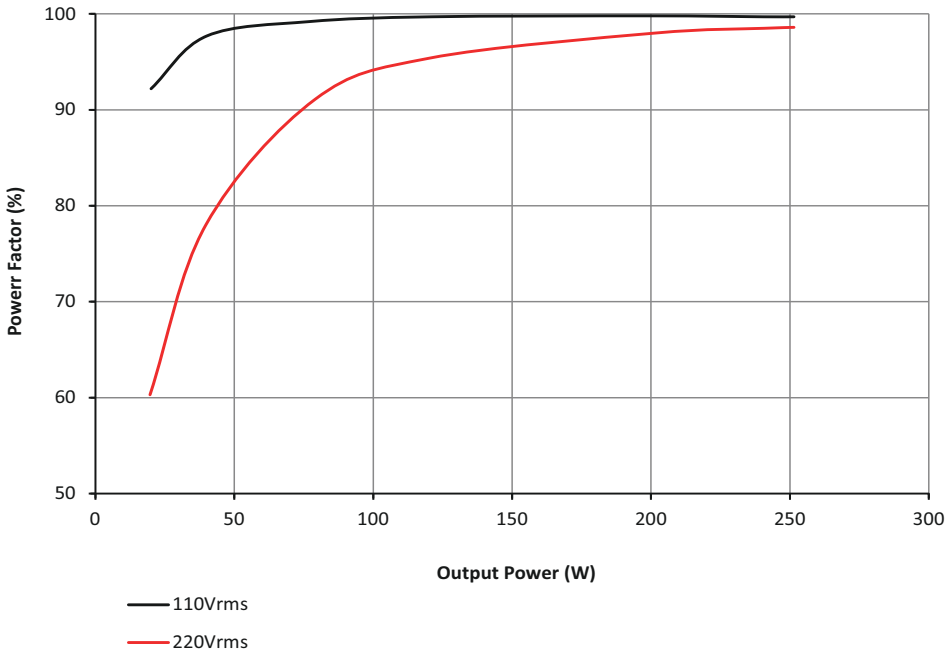


Figure 9. Power Factor vs. Load at 110 VAC, 220 VAC

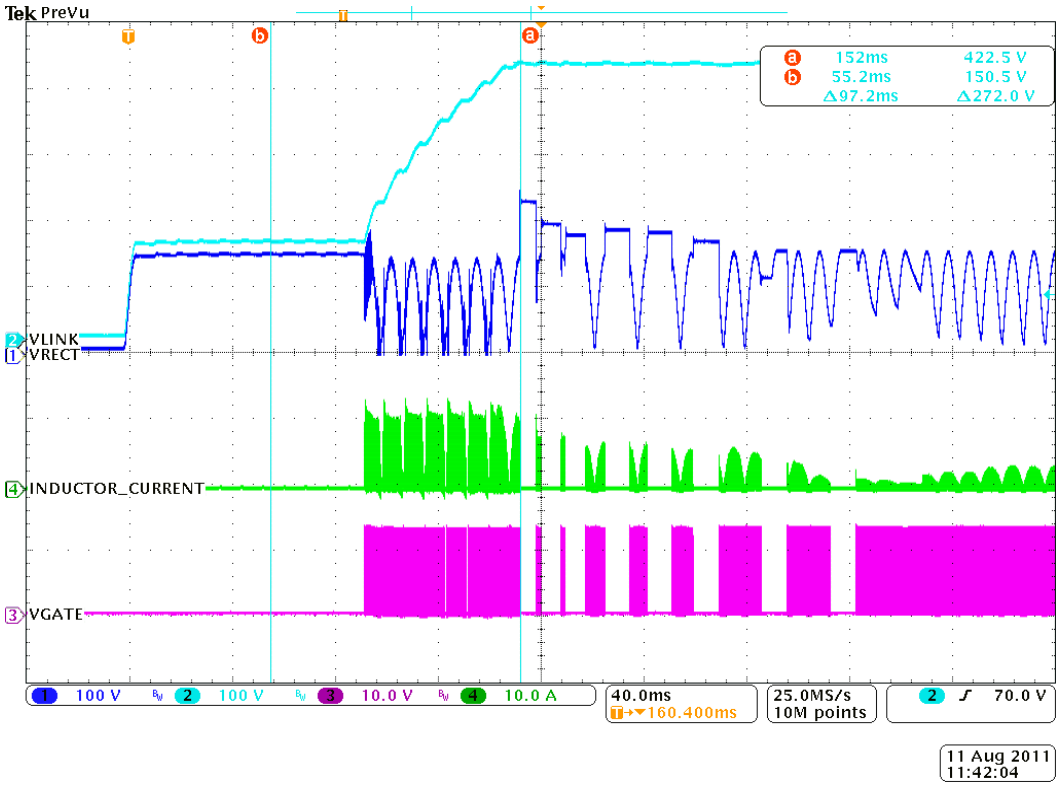


Figure 10. Startup — 110 VAC

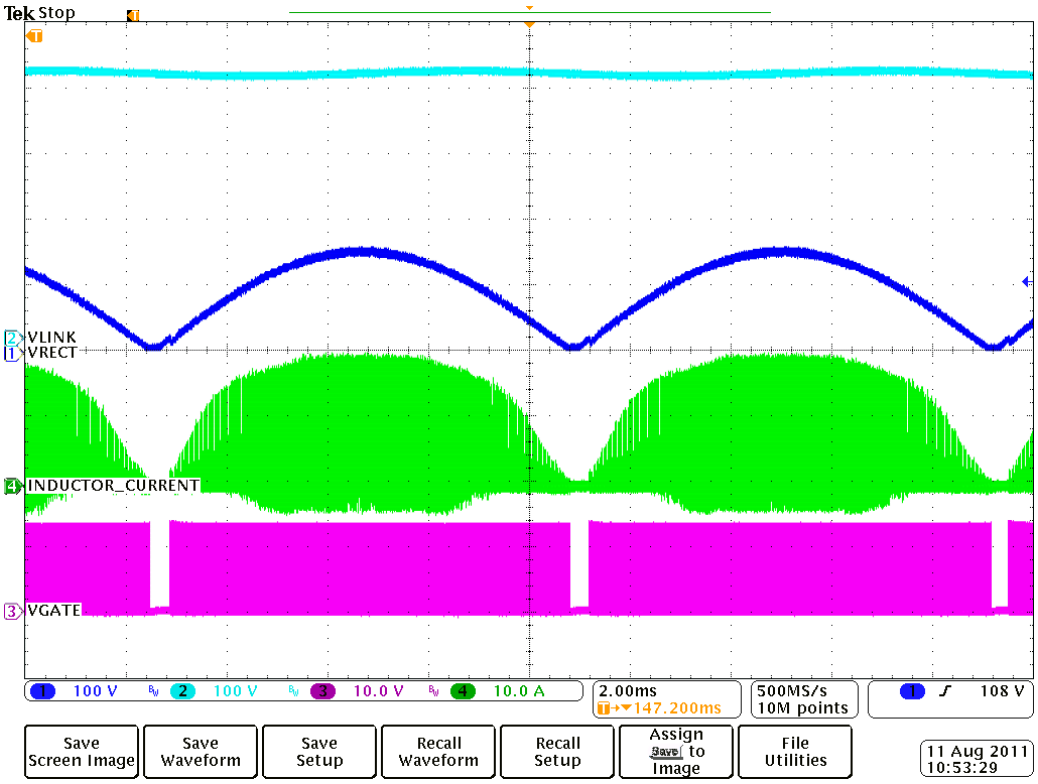


Figure 11. Steady State Waveforms — 110VAC

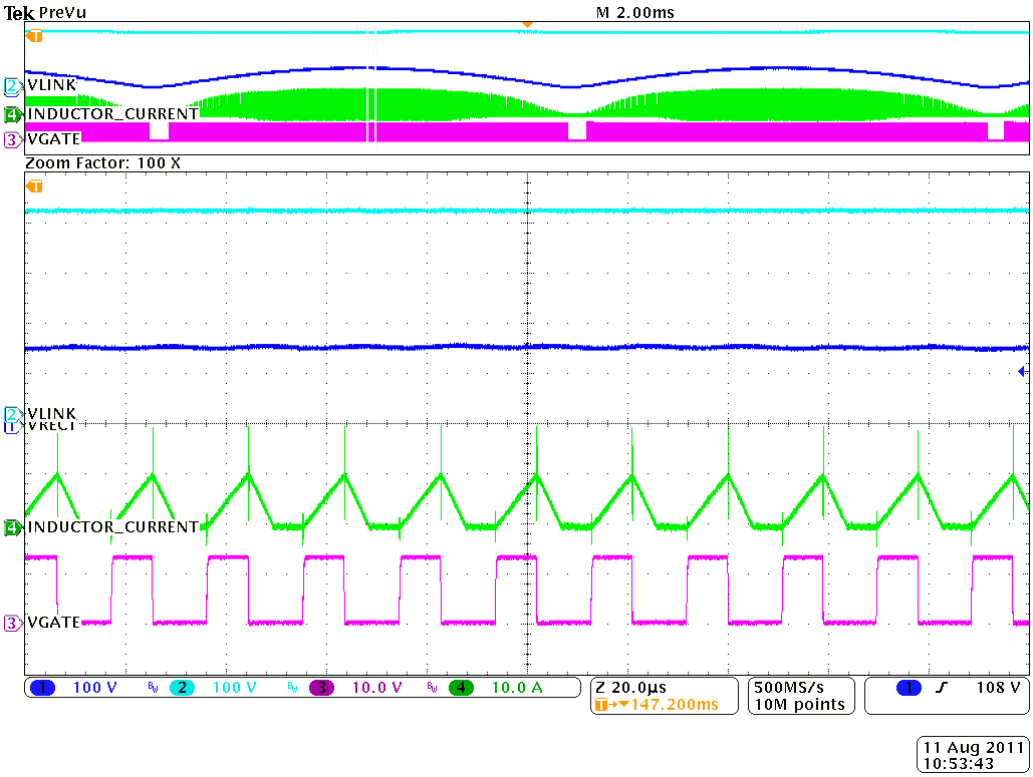


Figure 12. Switching Frequency Profile at Peak of AC Line Voltage — 110VAC

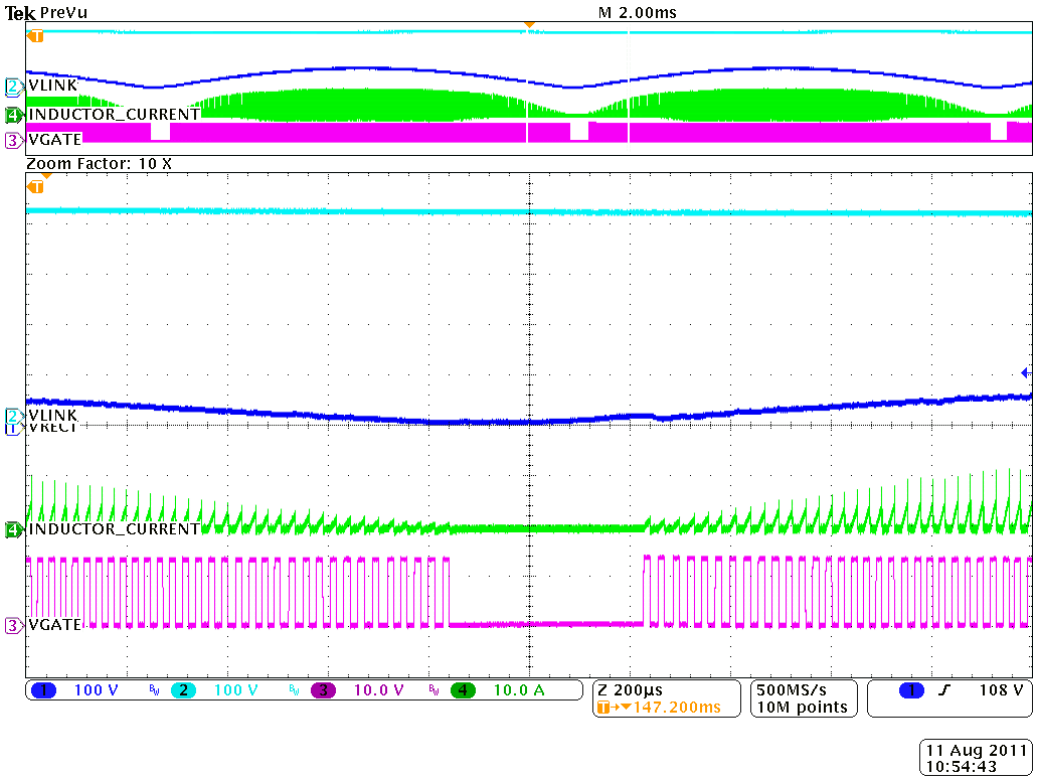


Figure 13. Switching Frequency Profile at Trough of AC Line Voltage — 110VAC

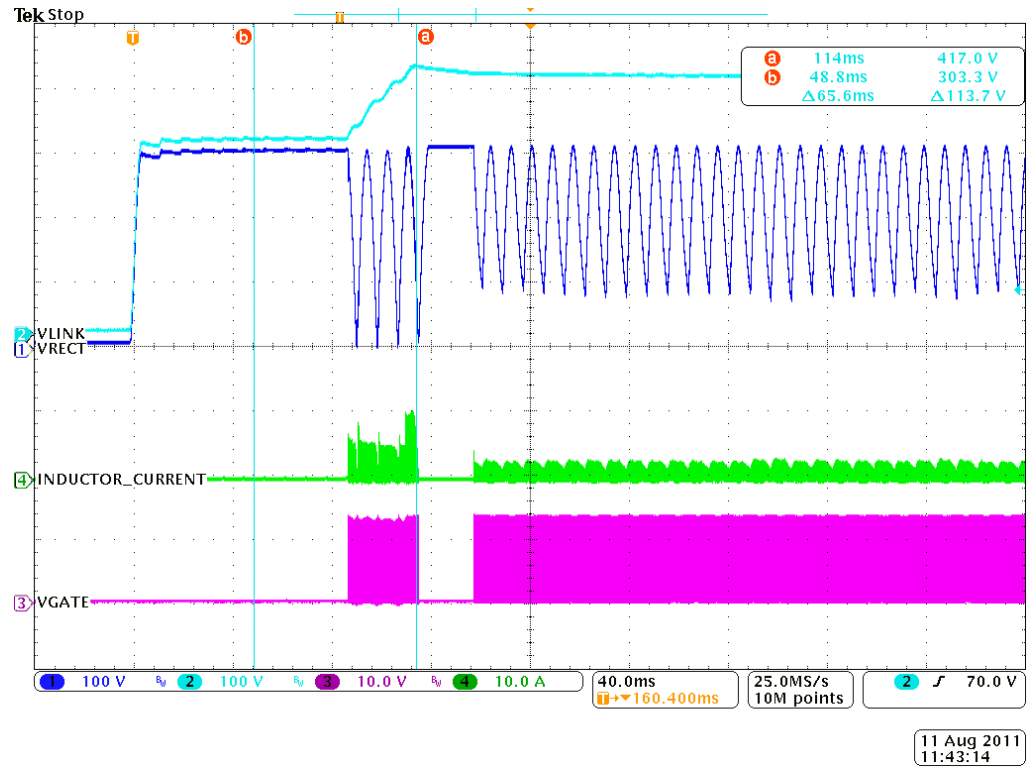


Figure 14. Startup — 220 VAC

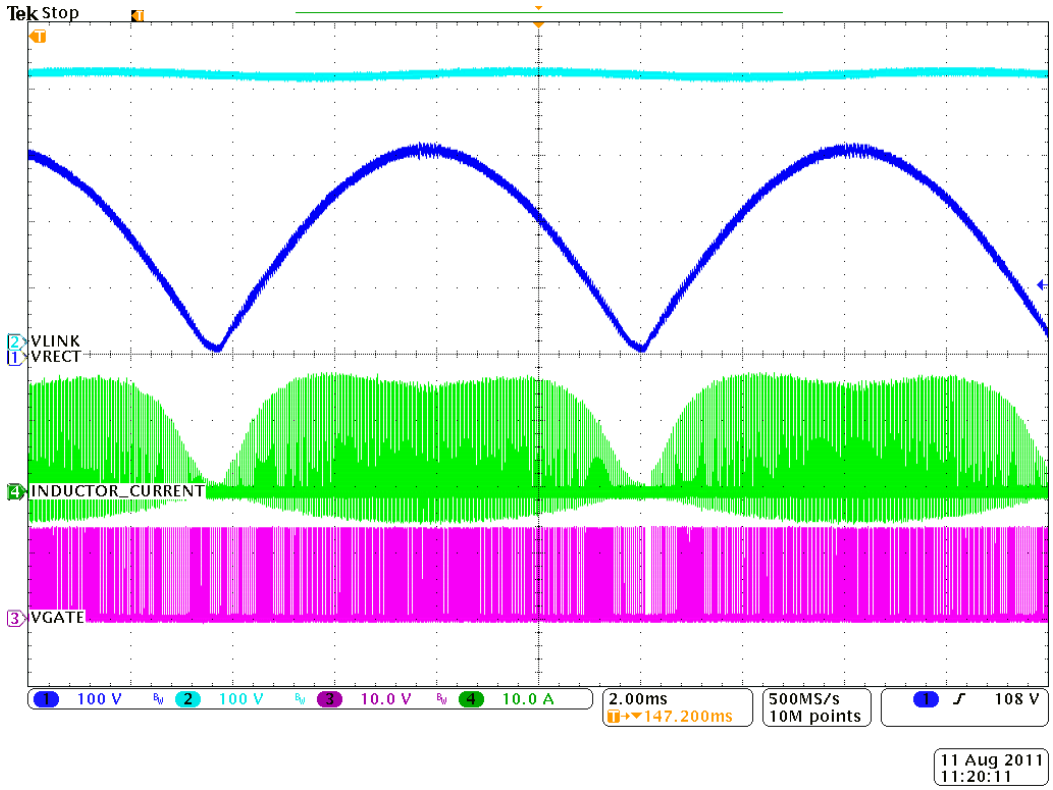


Figure 15. Steady State Waveforms — 220 VAC

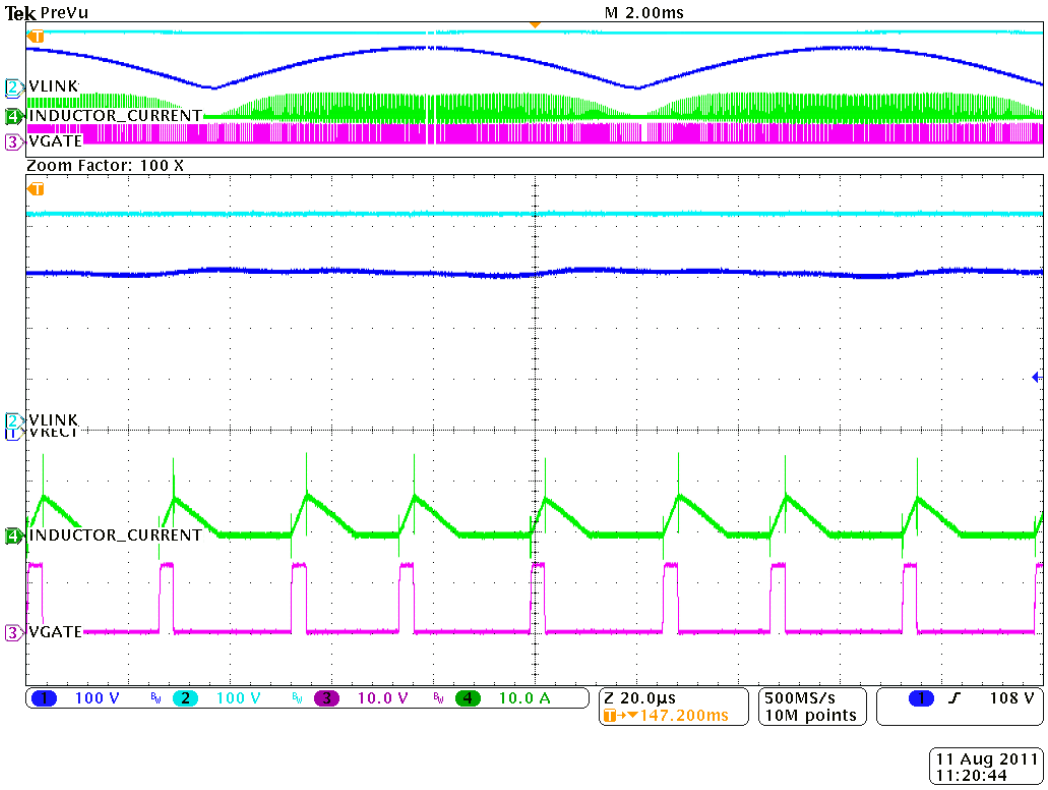


Figure 16. Switching Frequency Profile at Peak of AC Line Voltage — 220 VAC

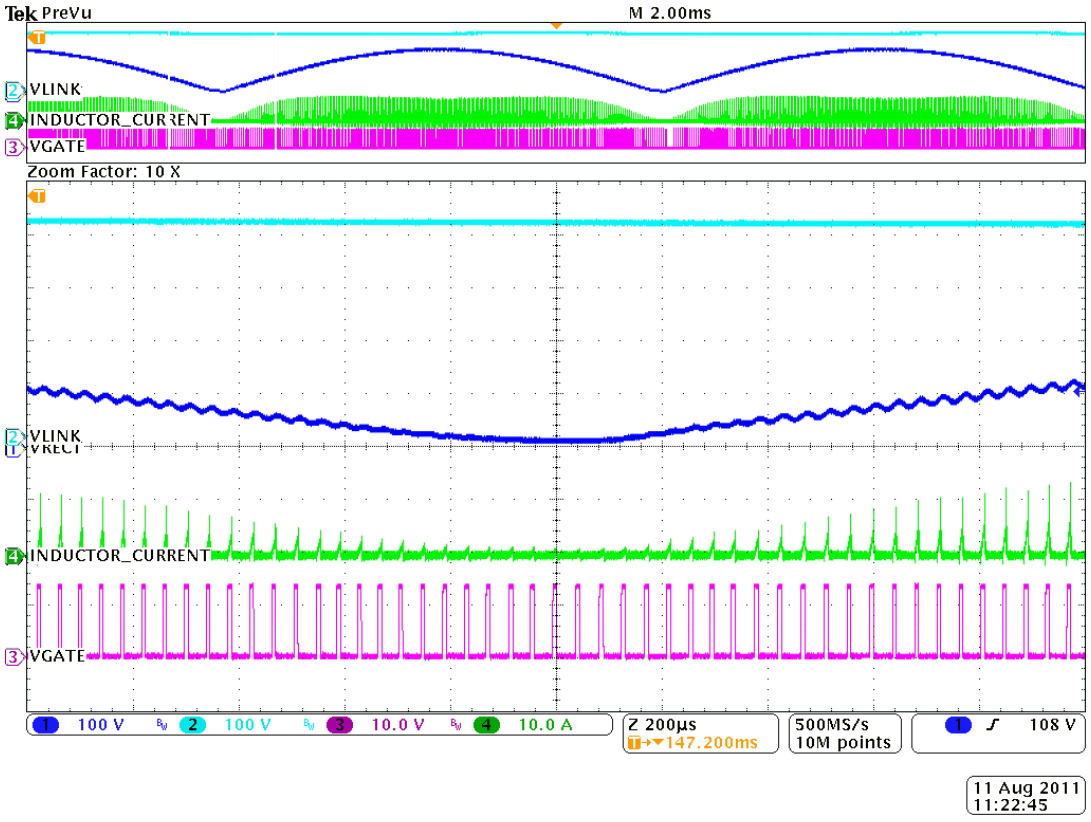


Figure 17. Switching Frequency Profile at Trough of AC Line Voltage — 220 VAC

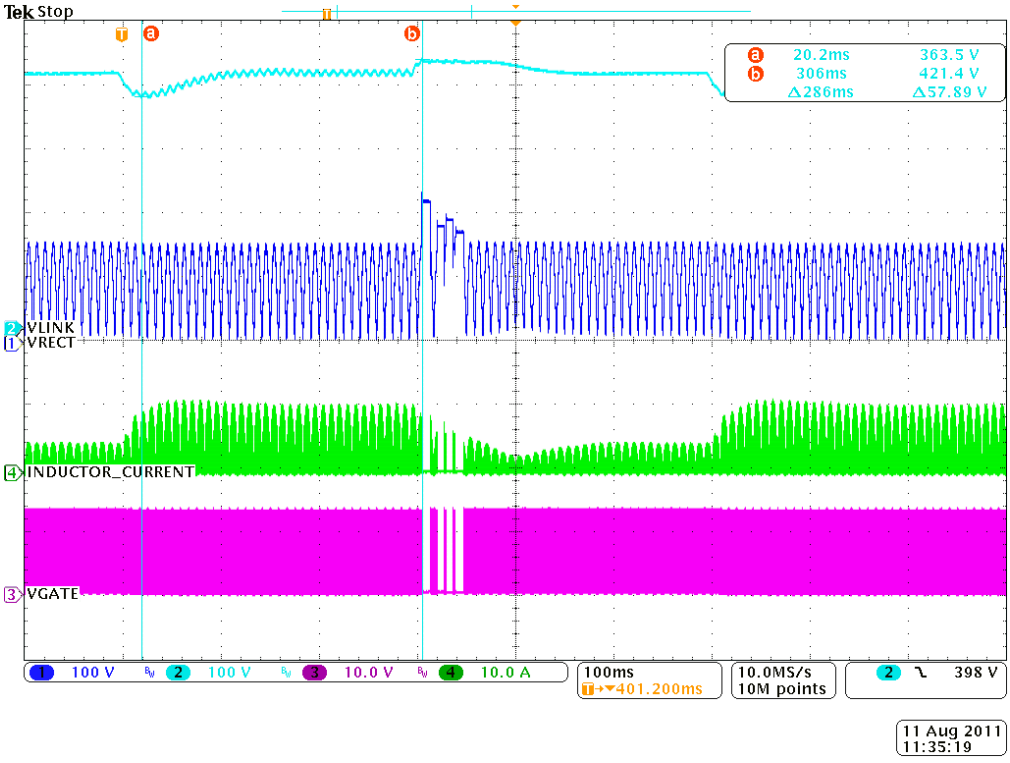


Figure 18. Load Transient - 25W to 250W to 25W, 1W/µs, 110VAC

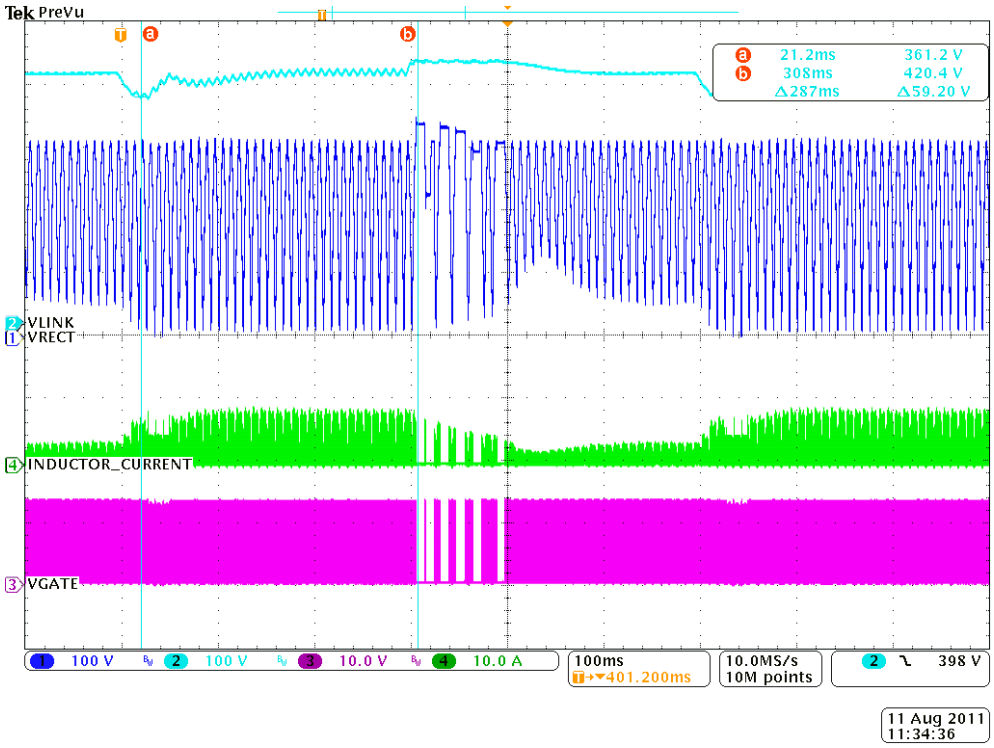


Figure 19. Load Transient - 25W to 250W to 25W, 1W/µs, 220VAC

6. REVISION HISTORY

Revision	Date	Changes
DB1	OCT 2011	Initial Release.