

设计范例报告

标题	使用LYTSwitch™-4 LYT4322E设计的8 W可调光、非隔离、降压-升压式LED驱动器
规格	195 VAC – 265 VAC输入；72 V，115 mA输出
应用	A19 LED驱动器
作者	应用工程部
文档编号	DER-404
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修订版本	1.0

特色概述

- 单级功率因数校正（在230 V下PF >0.9）及精确恒流(CC)输出
- 具有高度兼容性的可调光性能
- 元件数量少、PCB占板面积小的低成本解决方案
- 极高能效，在240 VAC输入下效率>84 %
- 高功率因数和低THD
- 卓越的性能及最终用户体验
 - 快速启动时间(<150 ms) – 无可见延迟
- 集成的保护及可靠性能
 - 单脉冲空载保护、输出短路保护，带自动恢复功能
 - 更大迟滞的自动恢复热关断可同时保护元件和印刷电路板
 - 在AC电压跌落期间不会造成任何损坏
- 满足IEC振铃波、差模输入浪涌和EN55015传导EMI要求

专利信息

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重要说明:

虽然本电路板的设计满足安全隔离要求，但工程原型尚未获得机构认证。因此，必须使用隔离变压器向原型板提供AC输入，以执行所有测试。



1 简介

本文档介绍的是一款使用LYTSwitch-4系列器件(LYT4322E)设计的具有较高成本效益的LED可调光电源驱动器，该驱动器采用高度紧凑的降压-升压式拓扑结构以及单面PCB。

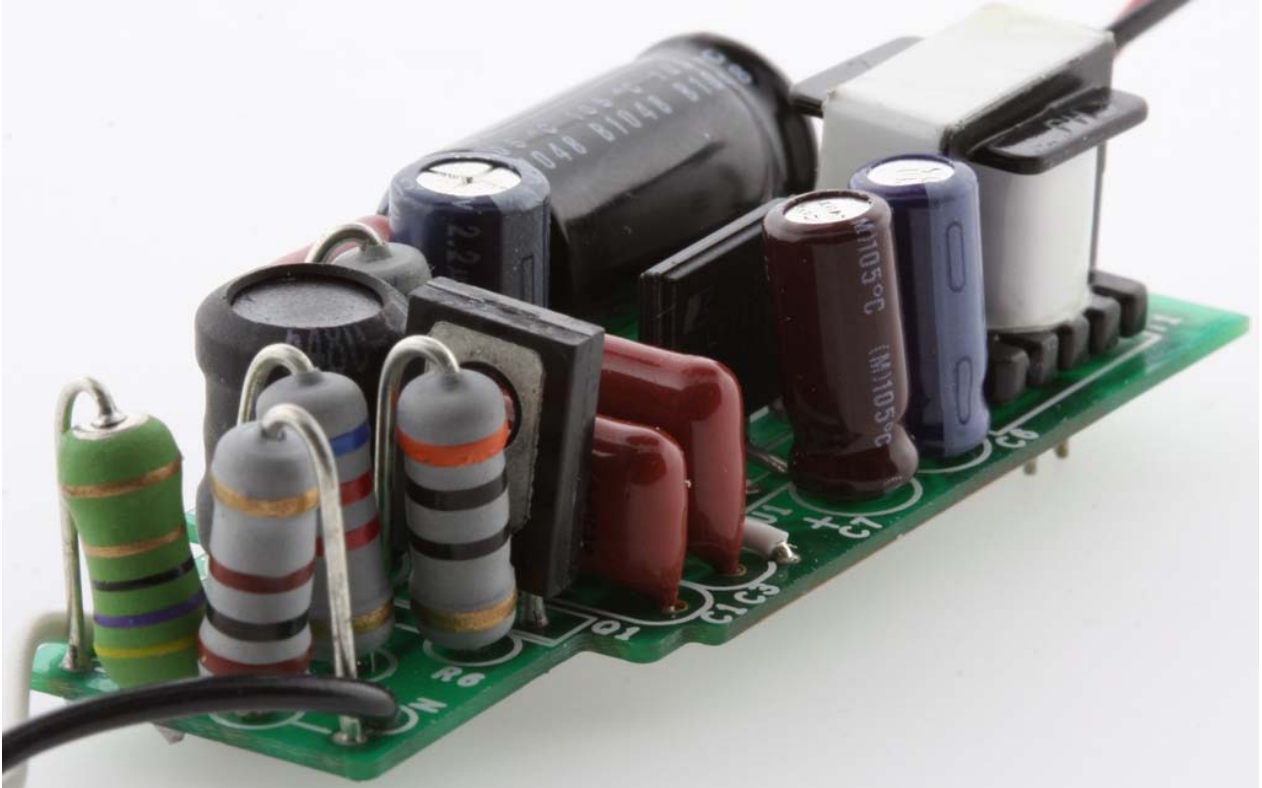


Figure 1 – Sample Unit.

该电源可以在195 VAC至265 VAC的输入电压范围内进行工作，同时提供单级有源功率因数校正并具有低谐波失真，因此适合商用和工业应用。该LED驱动器可采用前沿及后沿调光器进行调光，兼容德国、意大利、澳大利亚和中国品牌的调光器。

所采用的PI器件还集成了其他保护功能，例如针对开环和输出短路条件的自动重新启动、可提供增强的抗输入故障及浪涌能力的输入过压保护。此外，精确的迟滞热关断可确保PCB板平均温度在所有条件下均处于安全范围内。这种高集成度可将所需的分立元件数降至最少。

本文档包含LED驱动器规格、电路原理图、PCB信息、物料清单、变压器规格文件和典型性能特征。



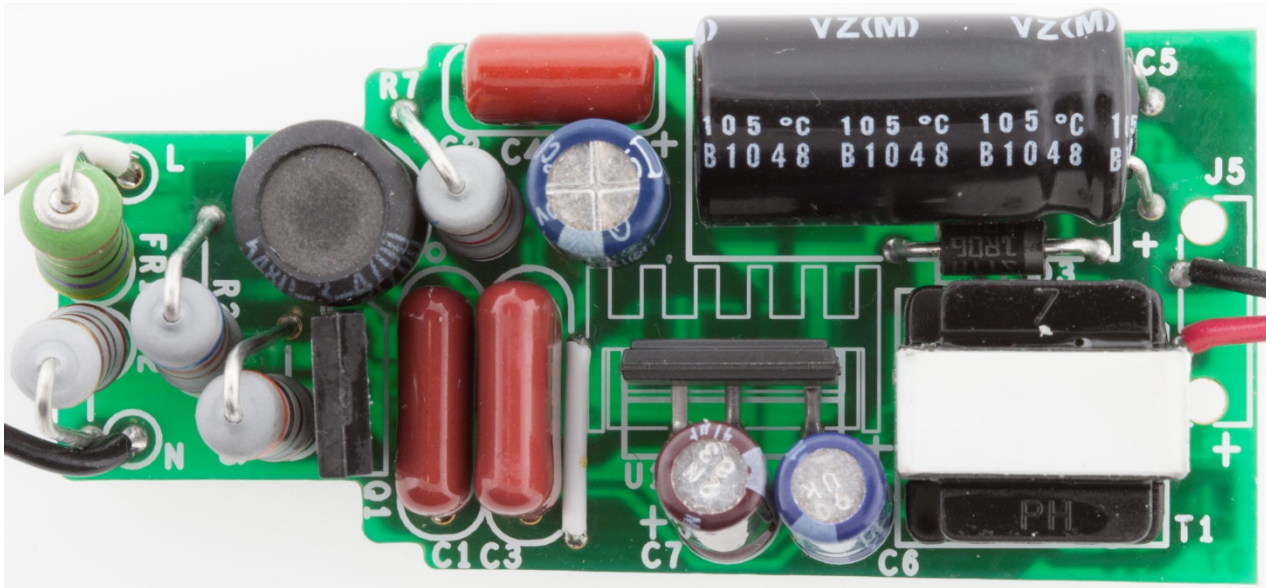


Figure 2 – Populated Circuit Board Photograph, Top.

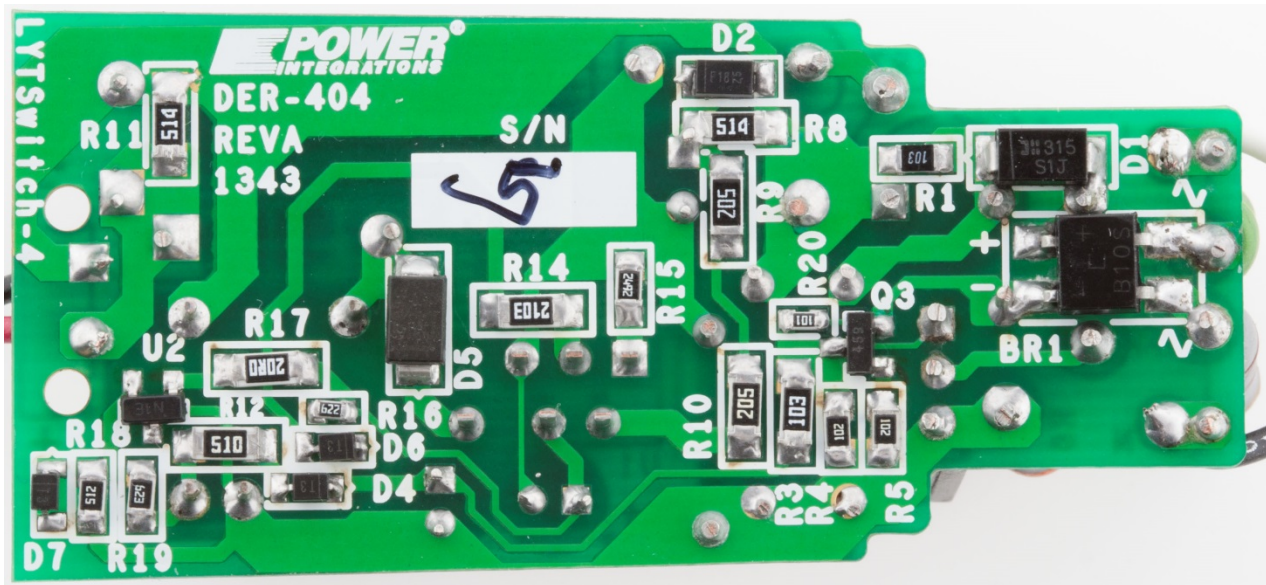


Figure 3 – Populated Circuit Board Photograph, Bottom.



2 电源规格

下表所列为设计的最低可接受性能。实际性能可参考测量结果部分。

说明	符号	最小值	典型值	最大值	单位	备注
输入 输入电压	V_{IN}	195		265	VAC	双导线 – 无P.E. 工作频率不受限制。如果应用 采用400 Hz线电压频率， 则请调整检测电阻。
频率	f_{LINE}	47	50/60		Hz	
输出 输出电压	V_{OUT}	68	72	76	V	在100 VAC - 240 VAC输入下 为±4%
输出电流	I_{OUT}		115		mA	
总输出功率 连续输出功率	P_{OUT}		8		W	
效率 240 VAC; 72 V LED	η	84			%	在 P_{OUT} 25 °C条件下测得
功率因数 240 VAC; 54 V LED	PF	0.9				在 P_{OUT} 25 °C条件下测得
环境 传导EMI		满足CISPR22B/EN55015B要求				1.2/50 μ s浪涌, IEC 1000-4-5, 串联电阻: 差模: 2 Ω 500 A短路 串联电阻: 差模: 12 Ω
输入浪涌 差模(L1-L2)			0.5		kV	
振铃波(100 kHz) 差模(L1-L2)			2.5		kV	
环境温度	T_{AMB}	-20	25		°C	自然对流, 海平面



3 电路原理图

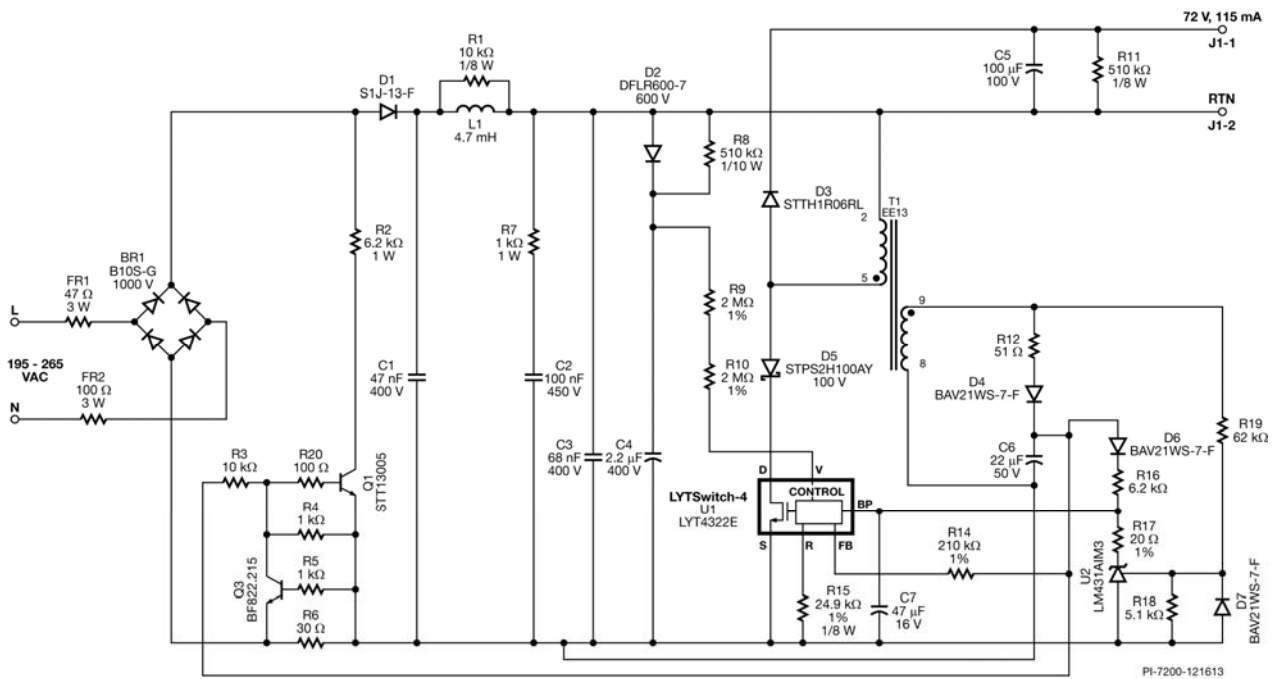


Figure 4 – Schematic.

4 电路描述

这款低成本可调光LED驱动器电源采用LYT4322E (U1)器件及降压-升压式配置，可以72 VDC额定输出电压提供115 mA恒流。该电源用于为LED提供非隔离驱动，而LED需要始终获得恒流(CC)驱动。非隔离驱动器要求对驱动器采取适当的绝缘，并对替换灯使用金属壳体，以满足安全法规。

4.1 输入EMI滤波

保险丝RF1提供短路保护。桥式整流管BR1提供全波整流，以获得更高的功率因数和更低的谐波含量。电容C1和C3以及共模扼流圈L1形成一个 π 滤波器，用以满足传导EMI标准。电容C1和C3还可用来储存能量，以降低线路噪声和提供输入浪涌保护。可熔电阻FR2是一种衰减电阻，可以在调光期间降低输入电流的振铃，并在输入浪涌期间充当限流阻抗。

4.2 调光兼容性 – 有源泄放电路、无源RC泄放电路和衰减电路

通过添加一个有源泄放电路来补偿~20 mA以下的瞬态电流，即可实现可调光LED驱动器与市场上大多数高压调光器之间的兼容。这样有助于保持前沿调光器所要求的维持电流，并在调光期间偏置后沿调光器的电源。这通过9个元件来控制：

- D1 – 串联阻断二极管，用来避免大容量电容（C1和C2）出现不需要的放电。
- R2 – 限制泄放电路电阻，用于在补偿输入电流时与Q1均分功率损耗。
- Q1 – 经线性偏置后，可补偿低于由检测-衰减电路电阻R6和Q3所设置阈值的电流。
- R20 – Q1的基极限流电阻，用于防止差模浪涌期间出现的雪崩。
- R3 – 来自LYTSwitch-4转换器辅助端的偏置电阻。
- R4 – Q1的基极电阻，用来提高响应速度和稳定性。
- Q3 – 来自检测-衰减电路电阻R6的阈值晶体管。
- R5 – Q3的基极限流电阻，用于防止差模浪涌期间出现的雪崩。
- R6 – 同时充当检测电阻和额外的衰减电路。

使用前沿调光器进行工作时会出现不需要的振铃和输入电流振荡。为了对这种振荡进行衰减，本设计采用了一个无源RC泄放电路（R7和C2）。将这些元件放置在L1后面可以更有效地降低高频率振荡。

无源衰减电路FR1、FR2和R6 (177 Ω)的总电阻能够降低前沿调光器导通时的峰值电流。无源衰减电路可用有源衰减电路取代，这样有助于以最低的成本实现2%的效率提高。



4.3 LYTSwitch-4

使用LYTSwitch-4能够设计出简单的高性价比可调光LED驱动器，在不同温度下均具有良好的线电压调整率。LYTSwitch-4产品系列具有内置的发热限制，可以在灯泡的工作温度过高时对电源提供保护。

降压-升压式转换器级包括LYTSwitch-4 (U1)内的集成功率MOSFET开关、续流二极管D3（选用快速续流二极管来降低开关损耗）、功率电感/变压器T1以及输出电容(C5)。转换器大部分时间都在连续导通模式(CCM)下工作，以便降低导通时的RMS损耗。

LYTSwitch-4峰值检测器电路C4、D2和R8为输入电压提供模拟信息，它可以抑制电源干扰期间的输入浪涌电压，以满足IEC 1000-4-5标准。

输入过压关断功能可使整流后的线电压承受能力（在浪涌和线电压陡升期间）达到高压产品系列内部功率MOSFET的额定725 BV_{DSS}。

4.4 输出整流

快速输出二极管(D3)用来实现良好的效率和进行热管理。对于LED应用，环境温度通常高于70°C，因此推荐使用具有较低 t_{RR} 值(<35 nS)的器件。经D3整流的电流由电容C5进行滤波。对于可以接受较高纹波且要求降低成本的设计，可降低输出电容值。

4.5 输出反馈

LYTSwitch-4不是通过检测电阻来调整输出电流，而是在控制输出电流方面拥有一种独特的方法，以此来实现更高的效率。这种方法就是通过T1的偏置绕组来测量等效输出电压。偏置绕组电压用来间接地反映输出电压的高低，而无需使用次级侧反馈元件。偏置绕组上的电压与输出电压成比例（由偏置绕组与次级绕组之间的匝数比决定）的。电阻R14将偏置电压转换为电流，馈入U1的FB引脚。U1中的内部引擎综合FB引脚电流、V_测引脚电流和内部漏极电流信息，提供恒定的输出电流，同时保持较高的输入功率因数。

4.6 短路负载保护

只要FB电流低于I_{FB(AR)}阈值超过~76 ms，元件就会进入自动重新启动。

4.7 空载保护

一旦发生空载工作，输出电压就会被限制到100 V。输出电压通过主绕组与偏置绕组的匝数比在偏置绕组上进行检测。IC U2将强制BP引脚进入自动重新启动模式，以调整输出电压。分压器R19和R18设置过压保护(OVP)阈值。二极管D7为U2提供反向电流保护，R17是U2的偏置电阻和限流电阻。



5 PCB布局

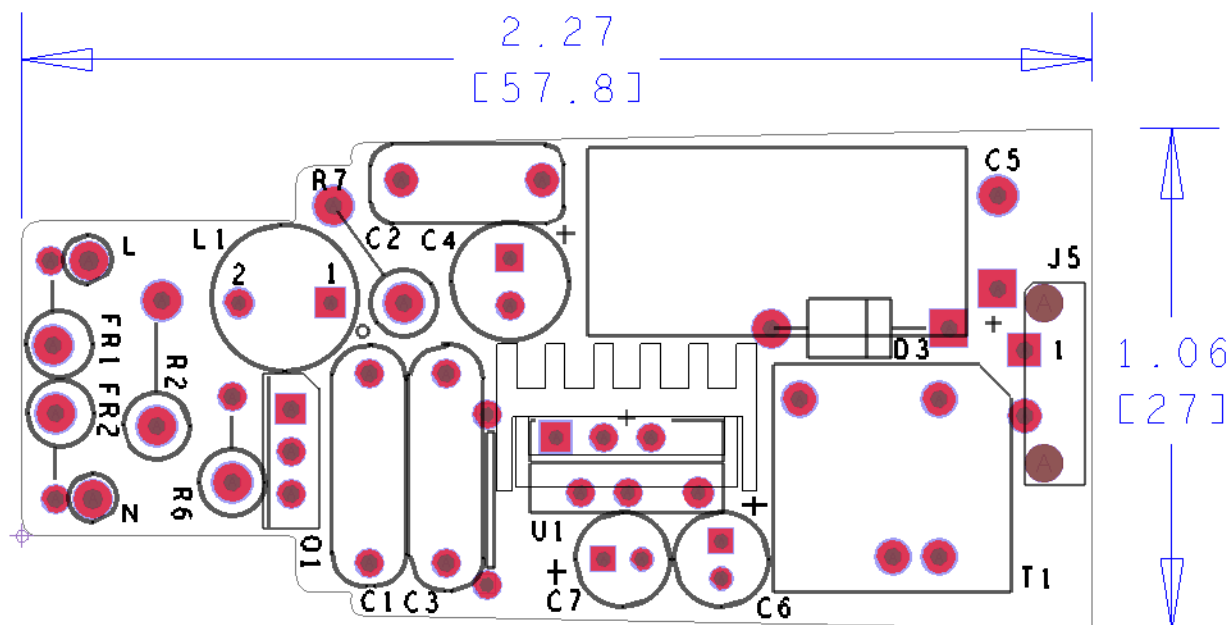


Figure 5 – Printed Circuit Layout. Top View.

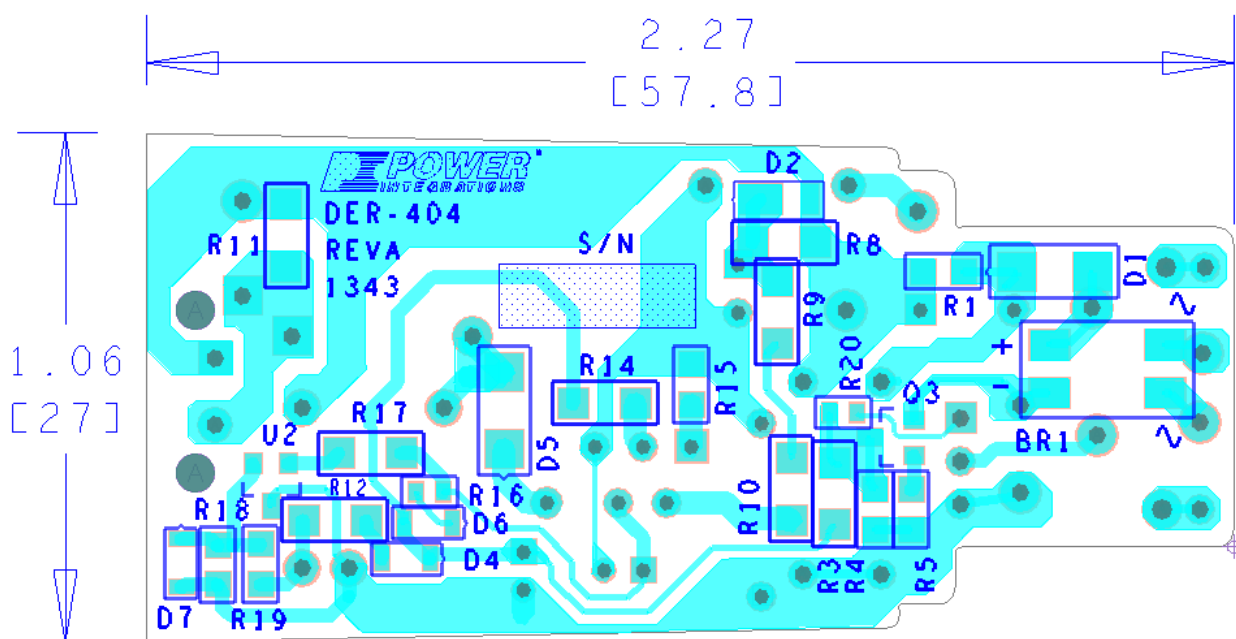
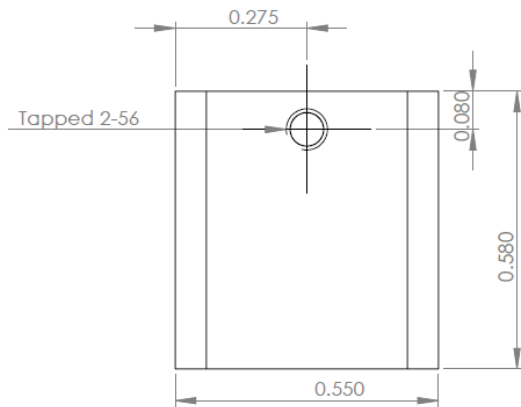


Figure 6 – Printed Circuit Layout. Bottom View.

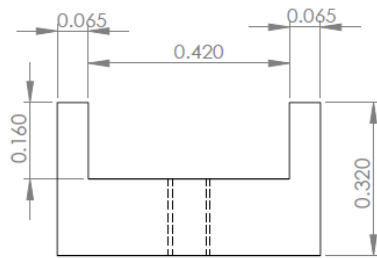


6 散热片设计

Heat sink is not required if the system design is potted.



TOP VIEW



FRONT VIEW

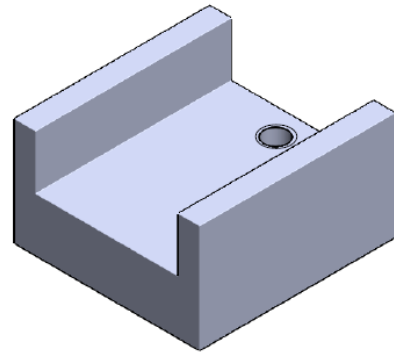


Figure 7 – U1 Heat Sink 1.



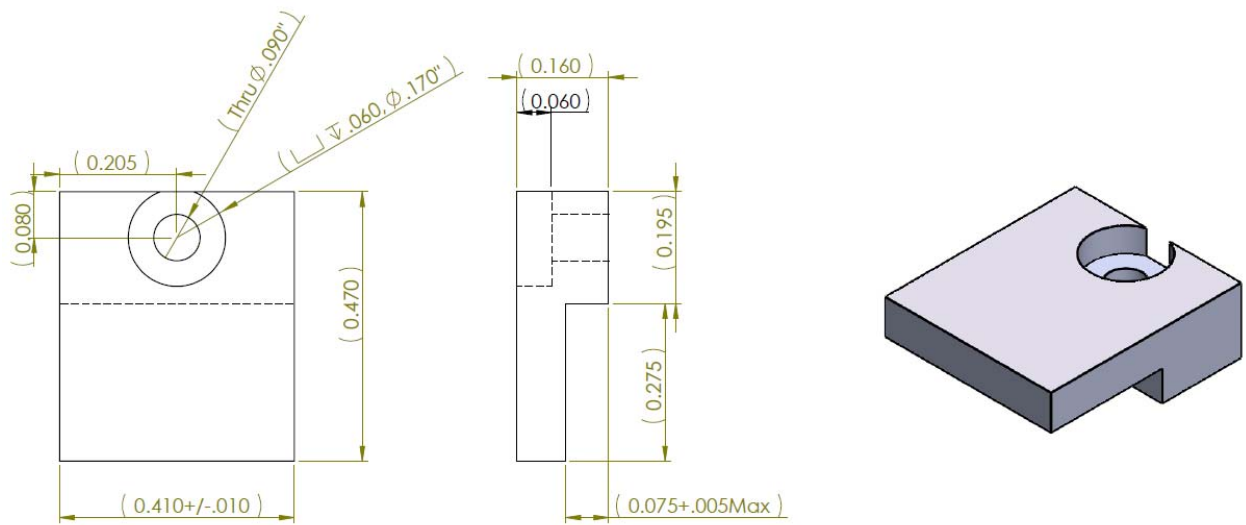


Figure 8 – U1 Heat Sink 2 for Clamping.

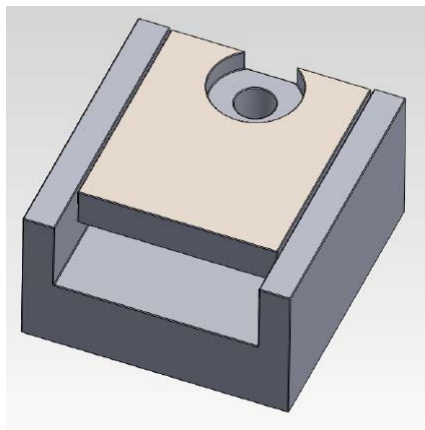


Figure 9 – U1 Heat Sink 2 Combination.



7 物料清单(BOM)

Below are the parts used in the build of the sample design. The design does not limits the selection of part, any alternative parts can be used for optimum cost in a given region.

Item	Qty	Ref Des	Description	Manufacturer P/N	Manufacturer
Electrical					
1	1	BR1	1000 V, 0.8 A, Bridge Rectifier, SMD, MBS-1, 4-SOIC	B10S-G	Comchip
2	1	C1	47 nF, 400 V, Film	ECQ-E4473KF	Panasonic
3	1	C2	100 nF, 450 V, Film	MEXXD31004JJ1	Duratech
4	1	C3	68 nF, 400 V, Film	ECQ-E4683KF	Panasonic
5	1	C4	2.2 μ F, 400 V, Electrolytic, (6.3 x 11)	TAB2GM2R2E110	Ltec
6	1	C5	100 μ F, 100 V, Electrolytic, Gen. Purpose, (10 x 20)	UVZ2A101MPD	Nichicon
7	1	C6	22 μ F, 50 V, Electrolytic, (5 x 11)	UPW1H220MDD	Nichicon
8	1	C7	47 μ F, 16 V, Electrolytic, Gen. Purpose, (5 x 11)	USV1C470MFD	Nichicon
9	1	D1	600 V, 1 A, Standard Recovery, SMA	S1J-13-F	Diodes, Inc.
10	1	D2	600 V, 1 A, Rectifier, Glass Passivated, POWERDI123	DFLR1600-7	Diodes, Inc.
11	1	D3	600 V, 1 A, Ultrafast Recovery, DO-41	STTH1R06RL	ST Micro
12	3	D4 D6 D7	250 V, 0.2 A, Fast Switching, 50 ns, SOD-323	BAV21WS-7-F	Diode, Inc.
13	1	D5	100 V, 2 A, Schottky, SMA	STPS2H100AY	ST Micro
14	2	FR1 FR2	75 R, 5%, 1 W, Metal Oxide	RSF100JB-75R	Yageo
15	1	L1	4.7 mH, 0.150 A, 20%	RL-5480-3-4700	Renco Elect, Inc
16	1	Q1	NPN, NPN FAST SW BIPO SOT-32, TO-126-3	STT13005	ST Micro
17	1	Q3	TRANS NPN 250V 50MA SOT23	BF822.215	NXP
18	1	R1	10 k Ω , 5%, 1/8 W, Thick Film, 0805	ERJ-6GEYJ103V	Panasonic
19	1	R2	6.2 k Ω , 5%, 1 W, Metal Oxide	RSF100JB-6K2	Yageo
20	1	R3	10 k Ω , 5%, 1/4 W, Thick Film, 1206	ERJ-8GEYJ103V	Panasonic
21	2	R4 R5	1 k Ω , 5%, 1/8 W, Thick Film, 0805	ERJ-6GEYJ102V	Panasonic
22	1	R6	30 Ω , 5%, 1 W, Metal Oxide	RSF100JB-30R	Yageo
23	1	R7	1 k Ω , 5%, 1 W, Metal Oxide	RSF100JB-1K0	Yageo
24	2	R8 R11	510 k Ω , 5%, 1/4 W, Thick Film, 1206	ERJ-8GEYJ514V	Panasonic
25	2	R9 R10	2 M Ω , 5%, 1/4 W, Thick Film, 1206	ERJ-8GEYJ205V	Panasonic
26	1	R12	51 Ω , 5%, 1/4 W, Thick Film, 1206	ERJ-8GEYJ510V	Panasonic
27	1	R14	221 k Ω , 1%, 1/4 W, Thick Film, 1206	ERJ-8ENF2213V	Panasonic
28	1	R15	24.9 k Ω , 1%, 1/8 W, Thick Film, 0805	ERJ-6ENF2492V	Panasonic
29	1	R16	6.2 k Ω , 5%, 1/10 W, Thick Film, 0603	ERJ-3GEYJ622V	Panasonic
30	1	R17	20 Ω , 1%, 1/4 W, Thick Film, 1206	ERJ-8ENF20R0V	Panasonic
31	1	R18	5.1 k Ω , 5%, 1/8 W, Thick Film, 0805	ERJ-6GEYJ512V	Panasonic
32	1	R19	62 k Ω , 5%, 1/8 W, Thick Film, 0805	ERJ-6GEYJ623V	Panasonic
33	1	R20	100 Ω , 5%, 1/10 W, Thick Film, 0603	ERJ-3GEYJ101V	Panasonic
34	1	T1	Custom, EE13, Vertical, 10 pins	Custom	Custom
35	1	U1	LYTSwitch, eSIP-7C	LYT4322E	Power Integrations
36	1	U2	IC, REG ZENER SHUNT ADJ SOT-23	LM431AIM3/NOPB	National Semi
Mechanical					
16	1	WIRE(V-)	Wire, UL1007, #24 AWG, Blk, PVC, 4"	1007-24/7-0	Anixter
17	1	WIRE (L)	Wire, UL1007, #24 AWG, Blu, PVC, 4"	1007-24/7-6	Anixter
18	1	WIRE(V+)	Wire, UL1007, #24 AWG, Red, PVC, 4"	1007-24/7-2	Anixter
19	1	WIRE(N)	Wire, UL1007, #24 AWG, Wht, PVC, 4"	1007-24/7-9	Anixter
20	1	PCB	FR4, 0.31, 1Oz Cu (0.51" X 2.1")		

Note: Reverse voltage <100 on the DRAIN pin. Diode D5 voltage rating is 100 V minimum.



8 电感设计表格

ACDC_LYTSwitch-4_HL_062013; Rev.1.0; Copyright Power Integrations 2013	INPUT	INFO	OUTPUT	UNIT	LYTSwitch-4_HL_062013: Flyback Transformer Design Spreadsheet
ENTER APPLICATION VARIABLES					
Dimming required	YES		YES		Select 'YES' option if dimming is required. Otherwise select 'NO'.
VACMIN			195	V	Minimum AC Input Voltage
VACMAX			265	V	Maximum AC input voltage
fL			50	Hz	AC Mains Frequency
VO	72.00		72	V	Typical output voltage of LED string at full load
VO_MAX			79.20	V	Maximum expected LED string Voltage.
VO_MIN			64.80	V	Minimum expected LED string Voltage.
V_OVP			87.12	V	Over-voltage protection setpoint
IO	0.12		0.12	A	Typical full load LED current
PO			8.6	W	Output Power
n			0.8		Estimated efficiency of operation
VB			25	V	Bias Voltage
ENTER LYTSwitch VARIABLES					
LYTSwitch	LYT4322		LYT4322		Selected LYTSwitch
Current Limit Mode	RED		RED		Select "RED" for reduced Current Limit mode or "FULL" for Full current limit mode
ILIMITMIN			0.65	A	Minimum current limit
ILIMITMAX			0.76	A	Maximum current limit
fS			132000	Hz	Switching Frequency
fSmin			124000	Hz	Minimum Switching Frequency
fSmax			140000	Hz	Maximum Switching Frequency
IV			80.6	uA	V pin current
RV			4	M-ohms	Upper V pin resistor
RV2			100000000000	M-ohms	Lower V pin resistor
IFB			114.7	uA	FB pin current (85 uA < IFB < 210 uA)
RFB1			191.9	k-ohms	FB pin resistor
VDS			10	V	LYTSwitch on-state Drain to Source Voltage
VD			0.50	V	Output Winding Diode Forward Voltage Drop (0.5 V for Schottky and 0.8 V for PN diode)
VDB			0.70	V	Bias Winding Diode Forward Voltage Drop
Key Design Parameters					
KP	1.00		1.00		Ripple to Peak Current Ratio (For PF > 0.9, 0.4 < KP < 0.9)
LP			815	uH	Primary Inductance
VOR	72.00		72	V	Reflected Output Voltage.
Expected IO (average)			0.12	A	Expected Average Output Current
KP_VNOM			0.96		Expected ripple current ratio at VACNOM
TON_MIN			1.22	us	Minimum on time at maximum AC input voltage
PCLAMP			0.07	W	Estimated dissipation in primary clamp
ENTER TRANSFORMER CORE/CONSTRUCTION VARIABLES					
Core Type	EF20		EF20		Select Core Size
Custom Core					Enter Custom core part number (if applicable)



AE	0.17		0.17	cm ²	Core Effective Cross Sectional Area
LE	3.02		3.02	cm	Core Effective Path Length
AL	1130.00		1130	nH/T ²	Ungapped Core Effective Inductance
BW	7.40		7.4	mm	Bobbin Physical Winding Width
M	0.00		0	mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
L	4.00		4		Number of Primary Layers
NS			106		Number of Secondary Turns
DC INPUT VOLTAGE PARAMETERS					
VMIN			276	V	Peak input voltage at VACMIN
VMAX			375	V	Peak input voltage at VACMAX
CURRENT WAVEFORM SHAPE PARAMETERS					
DMAX			0.21		Minimum duty cycle at peak of VACMIN
IAVG			0.05	A	Average Primary Current
IP			0.57	A	Peak Primary Current (calculated at minimum input voltage VACMIN)
IRMS			0.13	A	Primary RMS Current (calculated at minimum input voltage VACMIN)
TRANSFORMER PRIMARY DESIGN PARAMETERS					
LP			815	uH	Primary Inductance
LP_TOL			10		Tolerance of primary inductance
NP			105		Primary Winding Number of Turns
NB			38		Bias Winding Number of Turns
ALG			74	nH/T ²	Gapped Core Effective Inductance
BM			2582	Gauss	Maximum Flux Density at PO, VMIN (BM<3100)
BP			3459	Gauss	Peak Flux Density (BP<3700)
BAC			1291	Gauss	AC Flux Density for Core Loss Curves (0.5 X Peak to Peak)
ur			1597		Relative Permeability of Ungapped Core
LG			0.27	mm	Gap Length (Lg > 0.1 mm)
BWE			29.6	mm	Effective Bobbin Width
OD			0.28	mm	Maximum Primary Wire Diameter including insulation
INS			0.05	mm	Estimated Total Insulation Thickness (= 2 * film thickness)
DIA			0.23	mm	Bare conductor diameter
AWG			31	AWG	Primary Wire Gauge (Rounded to next smaller standard AWG value)
CM			81	Cmils	Bare conductor effective area in circular mils
CMA		Info	635	Cmils /Amp	!!! Info. Decrease CMA (200 < CMA < 600) Decrease L(primary layers),increase NS,smaller Core
TRANSFORMER SECONDARY DESIGN PARAMETERS (SINGLE OUTPUT EQUIVALENT)					
Lumped parameters					
ISP			0.56	A	Peak Secondary Current
ISRMS			0.22	A	Secondary RMS Current
IRIPPLE			0.19	A	Output Capacitor RMS Ripple Current
CMS			44	Cmils	Secondary Bare Conductor minimum circular mils
AWGS			33	AWG	Secondary Wire Gauge (Rounded up to next larger standard AWG value)
DIAS			0.18	mm	Secondary Minimum Bare Conductor Diameter
ODS			0.07	mm	Secondary Maximum Outside Diameter for Triple Insulated Wire
VOLTAGE STRESS PARAMETERS					
VDRAIN			529	V	Estimated Maximum Drain Voltage assuming maximum LED string voltage (Includes Effect of Leakage Inductance)
PIVS			464	V	Output Rectifier Maximum Peak Inverse Voltage (calculated at VOVP, excludes leakage inductance spike)
PIVB			164	V	Bias Rectifier Maximum Peak Inverse Voltage (calculated at



					VOVP, excludes leakage inductance spike)
FINE TUNING (Enter measured values from prototype)					
V pin Resistor Fine Tuning					
RV1	4.00		4.00	M-ohms	Upper V Pin Resistor Value
RV2			100000000 0000	M-ohms	Lower V Pin Resistor Value
VAC1	195.00		195.0	V	Test Input Voltage Condition1
VAC2	265.00		265.0	V	Test Input Voltage Condition2
IO_VAC1	0.11		0.11	A	Measured Output Current at VAC1
IO_VAC2	0.12		0.12	A	Measured Output Current at VAC2
RV1 (new)			3.32	M-ohms	New RV1
RV2 (new)			0.16	M-ohms	New RV2
V_OV			310.3	V	Typical AC input voltage at which OV shutdown will be triggered
V_UV			100.3	V	Typical AC input voltage beyond which power supply can startup
FB pin resistor Fine Tuning					
RFB1	210.00		210	k-ohms	Upper FB Pin Resistor Value
RFB2			100000000 0000	k-ohms	Lower FB Pin Resistor Value
VB1			22.4	V	Test Bias Voltage Condition1
VB2			27.6	V	Test Bias Voltage Condition2
IO1			0.12	A	Measured Output Current at Vb1
IO2			0.12	A	Measured Output Current at Vb2
RFB1 (new)			210.0	k-ohms	New RFB1
RFB2(new)			100000000 0000.0000	k-ohms	New RFB2
Input Current Harmonic Analysis					
Harmonic			Max Current (mA)	Limit (mA)	
1st Harmonic					
3rd Harmonic			12.43	317.26	PASS. 3rd Harmonic current content is lower than the limit
5th Harmonic			6.6	177.29	PASS. 5th Harmonic current content is lower than the limit
7th Harmonic			4.1	93.31	PASS. 7th Harmonic current content is lower than the limit
9th Harmonic			2.95	46.66	PASS. 9th Harmonic current content is lower than the limit
11th Harmonic			2.20	32.66	PASS. 11th Harmonic current content is lower than the limit
13th Harmonic			1.70	27.63	PASS. 13th Harmonic current content is lower than the limit
15th Harmonic			1.38	23.94	PASS. 15th Harmonic current content is lower than the limit
THD			31.7	%	Estimated total Harmonic Distortion (THD)



9 电感设计

9.1 电气原理图

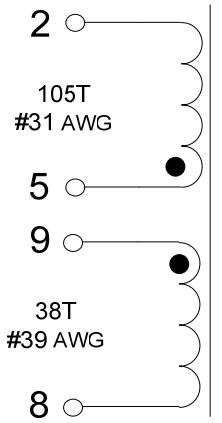


Figure 10 – Transformer Electrical Diagram.

9.2 电气规格

Primary Inductance	Pins 2-5, all other windings open, measured at 100 kHz, 0.4 V _{RMS}	815 μH ±7%
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9.3 材料

Item	Description
[1]	Core: EE13; NC2H or equivalent.
[2]	Bobbin: EE13;5/5 pin Vertical;Pin Shine, P-1302-2 or equivalent.
[3]	Magnet Wire: #31 AWG.
[4]	Magnet Wire: #39 AWG.
[5]	Transformer tape: 6.5 mm.



9.4 电感结构图

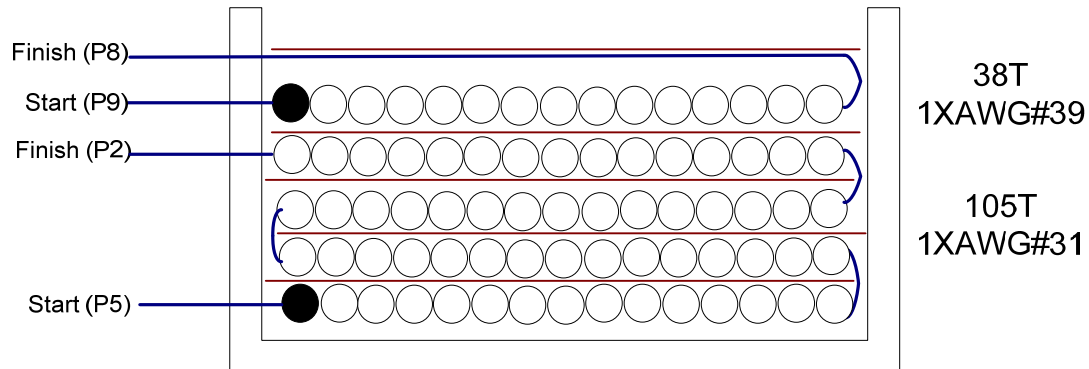


Figure 11 – Transformer Build Diagram.

9.5 电感构造

Bobbin Preparation	For the purpose of these instructions, bobbin is oriented on winder such that pin 1 side is on the left. Winding direction is counter-clockwise. Follow the pin number assignment in the specification.
WDG 1	Start at pin 5. Wind 105 turns of item [3] and terminate at pin 1. Note that there is one turn of transformer tape item[5] per layer
Insulation	Add 1 layer of tape of item [5].
WDG 2	Start at pin 9. Wind 38 turns of item [4] and terminate at pin 8.
Taping	Add 1 layer of tape to secure the winding.
Final Assembly	Grind the core to get the specified inductance. Secure the core with tape.



10 性能数据

All measurements performed at room temperature (~25 °C) otherwise specified.

Input		Input Measurement					LED Load Measurement			Efficiency (%)	Reg (%)
VAC (V _{RMS})	Freq (Hz)	V _{IN} (V _{RMS})	I _{IN} (mA _{RMS})	P _{IN} (W)	PF	% THD	V _{OUT} (V _{DC})	I _{OUT} (mA _{DC})	P _{OUT} (W)		
Vo min											
195	50	194.96	48.57	8.913	0.941	25.94	68.0	110.6	7.53	84.48	84.48
200	50	199.93	47.73	8.951	0.938	26.33	68.0	111.2	7.57	84.57	84.57
230	50	229.94	43.94	9.275	0.918	28.48	68.2	115.0	7.85	84.64	84.64
240	50	239.97	42.87	9.374	0.911	29.3	68.2	115.8	7.91	84.38	84.38
265	50	265.02	40.77	9.672	0.895	31.52	68.3	117.6	8.05	83.23	83.23
Vo nom											
195	50	194.96	51.78	9.548	0.946	25.35	72.0	111.8	8.06	84.42	84.42
200	50	199.94	50.69	9.549	0.942	25.81	72.0	112.0	8.08	84.62	84.62
230	50	229.94	46.28	9.819	0.923	27.85	72.2	115.3	8.34	84.94	84.94
240	50	239.97	45.03	9.893	0.916	28.6	72.2	116.0	8.40	84.91	84.91
265	50	265.03	42.59	10.148	0.899	30.66	72.3	117.7	8.52	83.96	83.96
Vo max											
195	50	194.96	54.91	10.162	0.949	24.97	76.0	112.6	8.57	84.33	84.33
200	50	199.93	53.79	10.177	0.946	25.33	75.9	113.0	8.60	84.50	84.50
230	50	229.94	48.72	10.385	0.927	27.33	76.1	115.9	8.84	85.12	85.12
240	50	239.97	47.30	10.446	0.920	27.97	76.1	116.5	8.88	85.01	85.01
265	50	265.02	44.55	10.669	0.904	29.77	76.2	118.0	9.01	84.45	84.45

Table 1 – Raw Data.



10.1 模式效率

Measured at 25 °C ambient, open frame.

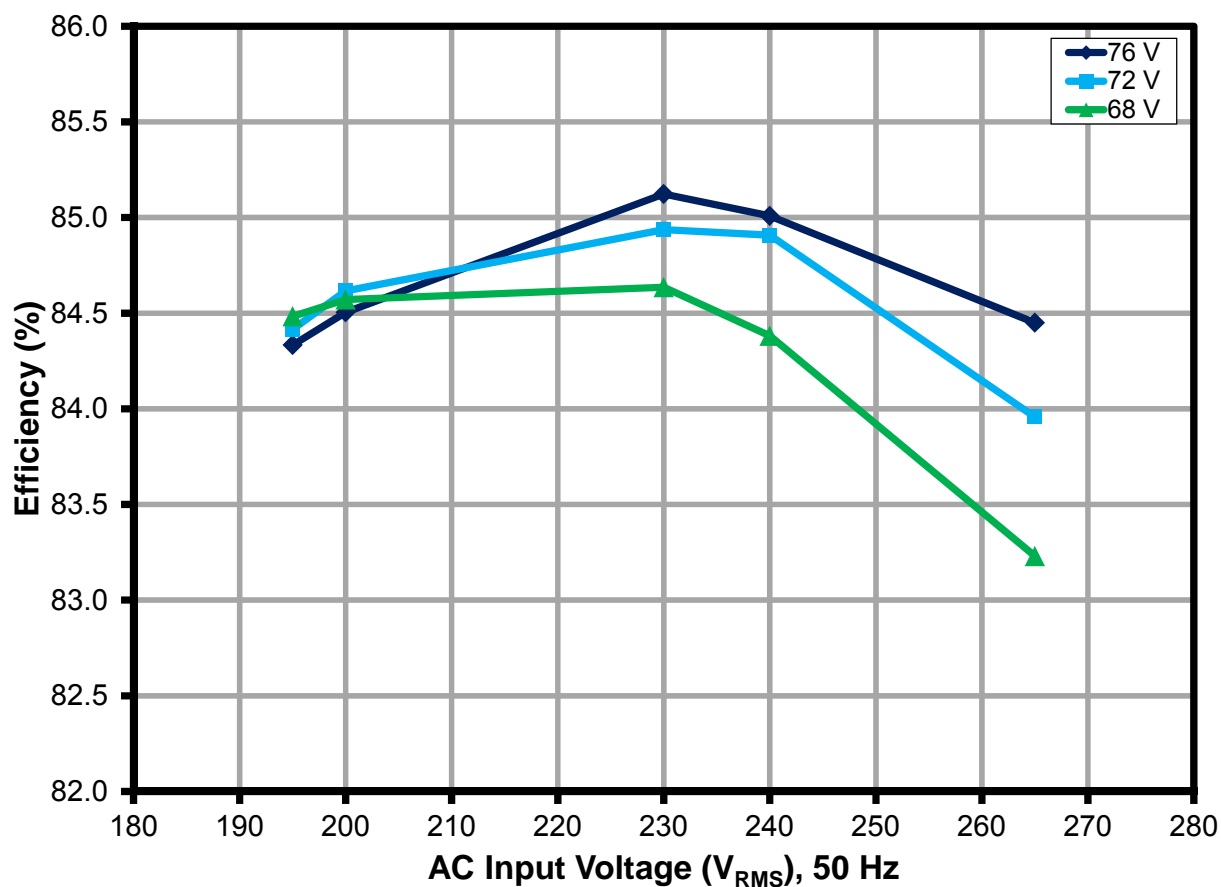


Figure 12 – Efficiency with Respect to AC Input Voltage. 195-265 VAC (60 Hz) Input.



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10.2 输出电流调整

10.2.1 输入线电压和负载电压到输出电流的调整

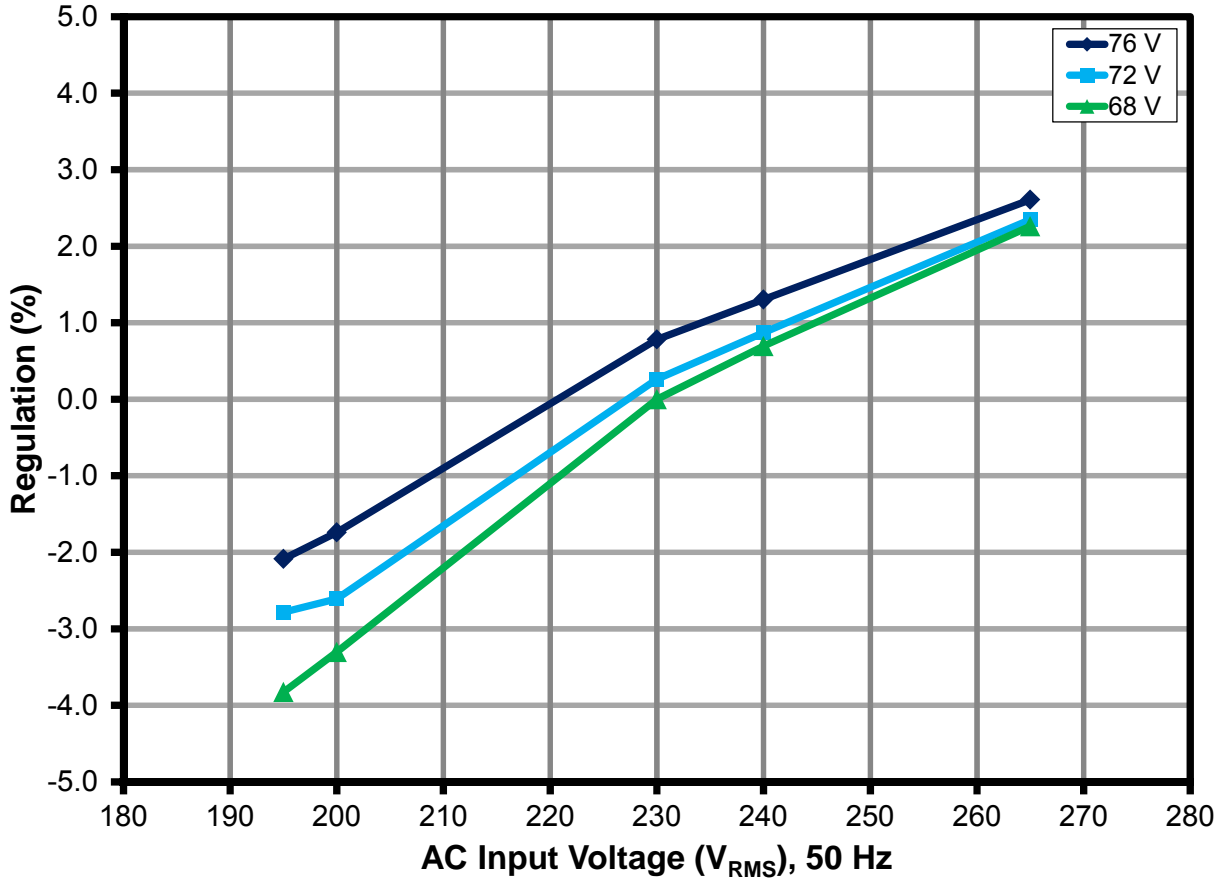


Figure 13 – Load Regulation, Room Temperature.



10.3 功率因数

Measured at 25 °C ambient, open frame.

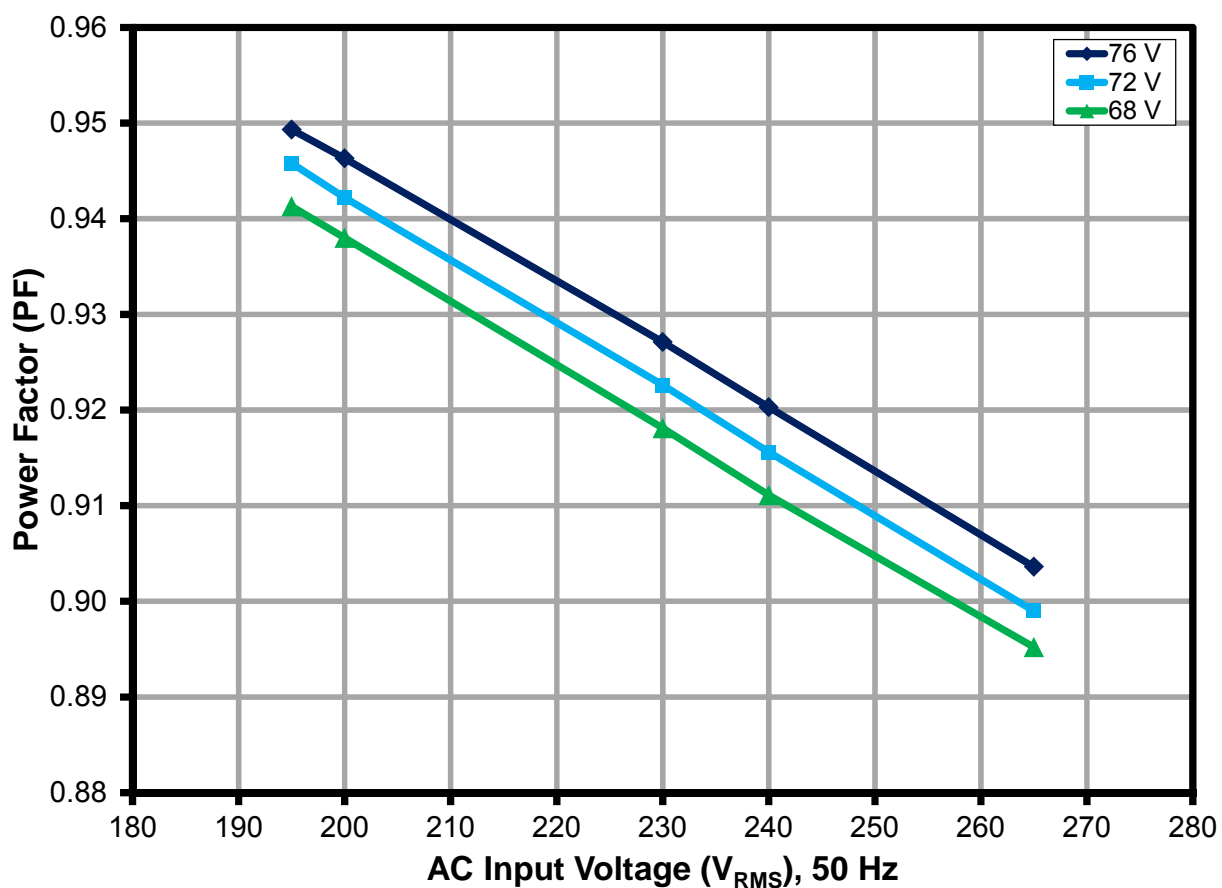


Figure 14 – Power Factor, Room Temperature.



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10.4 总谐波失真

Measured at 25 °C ambient, open frame.

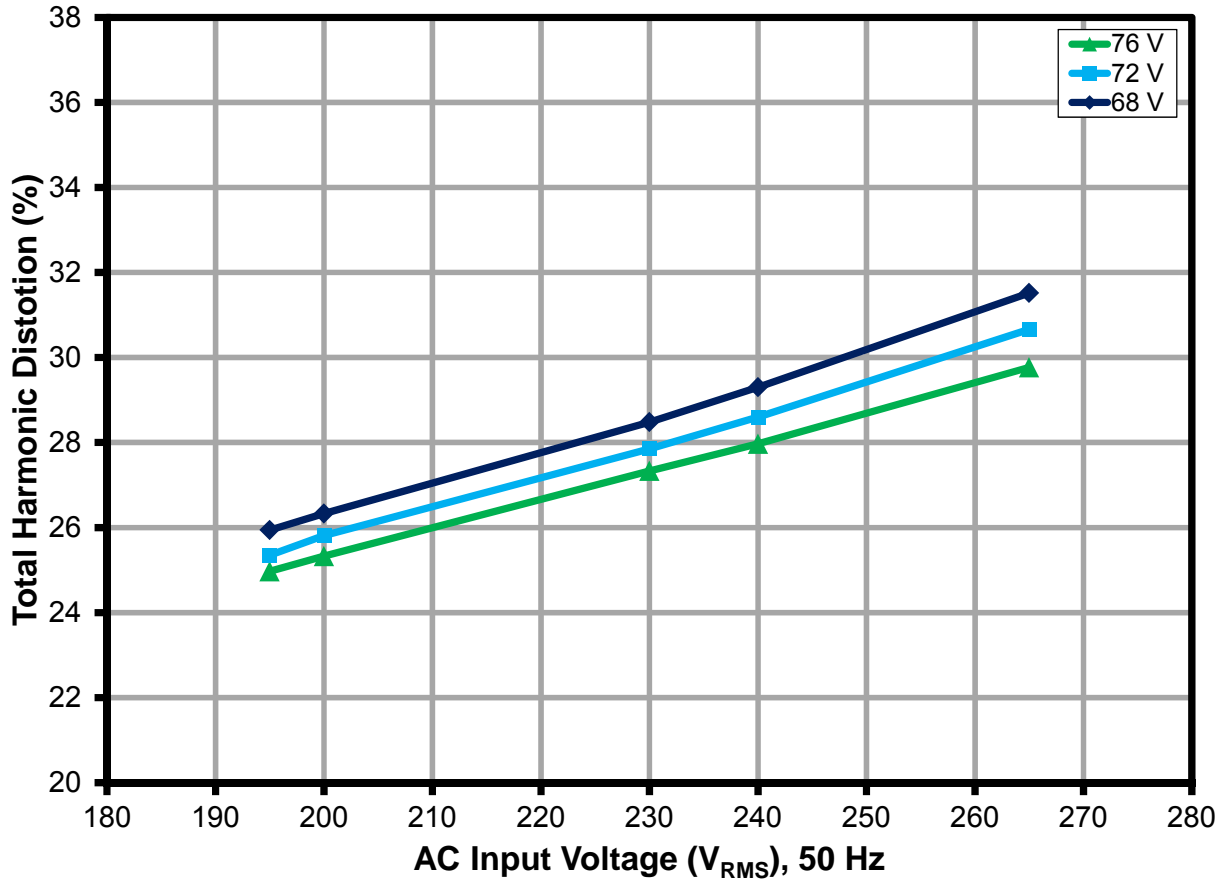


Figure 15 – %THD, Room Temperature.

10.5 谐波含量

Measured at 25 °C ambient, open frame. Load: 72 V LED

V	Freq	I (mA)	P	PF	%THD
240	50.00	45.03	9.8930	0.9156	28.6
nth Order	mA Content	% Content	Limit <25 W	Remarks	
1	43.29				
2	0.02	0.04			
3	9.45	21.84	33.64	Pass	
5	6.09	14.07	18.80	Pass	
7	3.27	7.55	9.89	Pass	
9	2.96	6.84	4.95	Pass	
11	1.28	2.95	3.46	Pass	
13	1.46	3.38	2.93	Pass	
15	0.62	1.43	2.54	Pass	
17	0.93	2.14	2.24	Pass	
19	0.48	1.10	2.00	Pass	
21	0.64	1.47	1.81	Pass	
23	0.46	1.05	1.66	Pass	
25	0.51	1.18	1.52	Pass	
27	0.48	1.10	1.41	Pass	
29	0.45	1.03	1.31	Pass	
31	0.42	0.97	1.23	Pass	
33	0.35	0.81	1.15	Pass	
35	0.33	0.75	1.09	Pass	
37	0.27	0.62	1.03	Pass	
39	0.28	0.64	0.98	Pass	
41	0.23	0.54			
43	0.23	0.53			
45	0.19	0.45			
47	0.18	0.42			
49	0.20	0.46			

Table 2 – Harmonic Content at 240 V, 72 V LED Load.



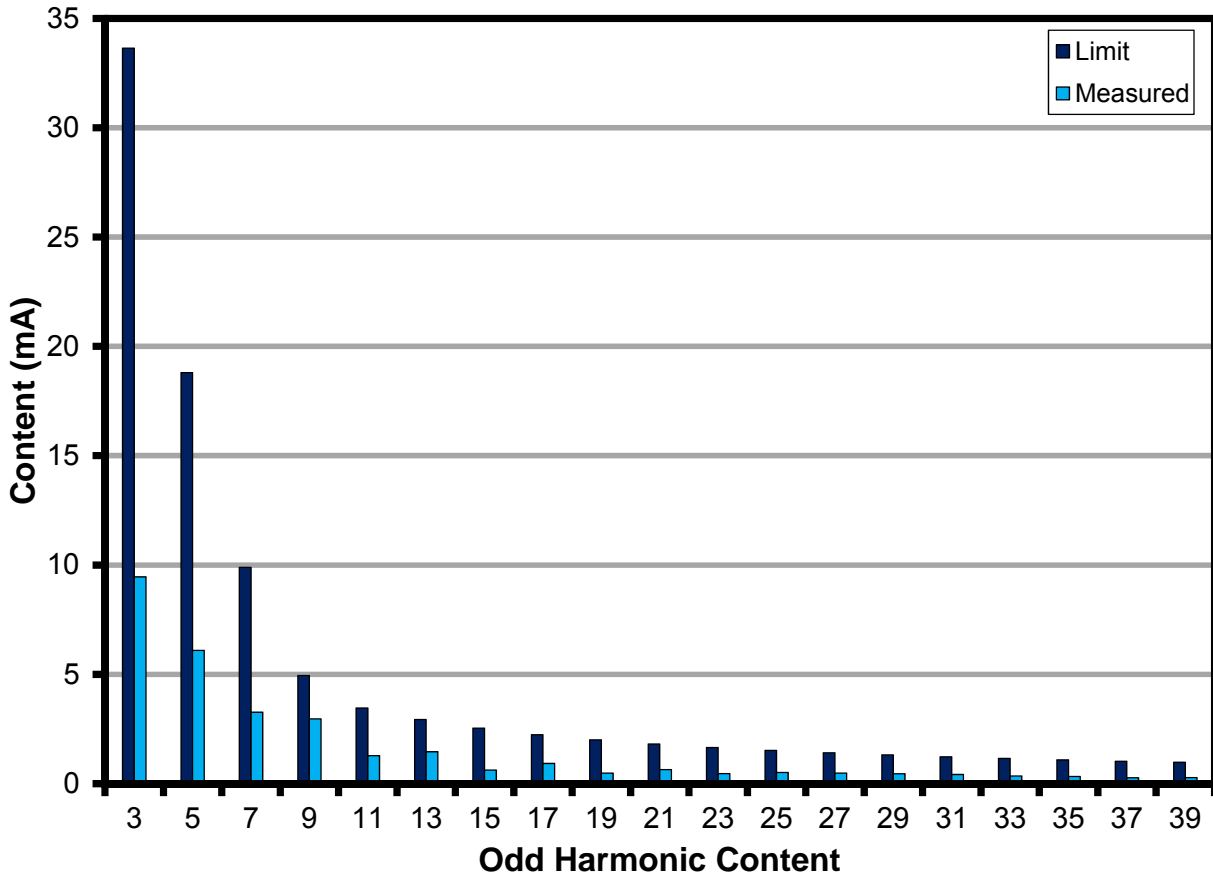


Figure 16 – Harmonic Content, Room Temperature.



11 热性能

11.1 所用设备

Chamber:	Tenney Environmental Chamber Model No: TJR-17 942	Wattmeter:	Yokogawa Power Meter Model No: WT2000
AC Source:	Chroma Programmable AC Source Model No: 6415	Data Logger:	Agilent



Figure 17 – Thermal Chamber Set-up Showing Box Used to Prevent Airflow Over UUT. Open Frame Set-up Measurement.



Figure 18 – Thermal Unit Thermocouple Measurement Set-up.

Note: Typical A19 enclosure is used in the verification.



11.2 热结果

Load: 72 V / 115 m A LED load in a standard A19.

Remarks	External Ambient °C	Internal Ambient °C	LYT4322E °C	L1;EMI Inductor °C	TRF °C	BR °C	Output Diode °C
Normal Operation Open Frame in the Thermal Chamber 195 V / 50 Hz	20	77.201	89.775	74.156	87.107	80.621	83.485
	30	85.214	98.664	81.992	95.039	88.324	91.526
	40	93.288	107.379	89.969	103.12	96.217	99.751
	50	101.436	115.298	98.268	111.483	104.187	108.028
	60	109.391	122.862	106.171	119.597	111.99	116.073
	70	117.048	132.062	113.899	127.464	119.386	124.062
Normal Operation Open Frame in the Thermal Chamber 195 V / 50 Hz	20	82.468	97.413	78.321	94.615	81.872	89.841
	30	90.235	105.86	86.31	102.329	89.556	97.674
	40	98.159	113.916	94.325	110.368	97.492	105.659
	50	106.465	121.373	102.681	118.875	105.811	113.94
	60	114.527	130.029	110.884	127.147	113.944	122.109
	65	118.451	133.979	114.843	131.103	118.042	126.044
OTP; 195 V / 50 Hz	76	122	137	118	132	124	129
OTP; 265 V / 50 Hz	66	120	137	116	133	119	127

Table 3 – Thermal Measurement, U1 with Heat Sink.

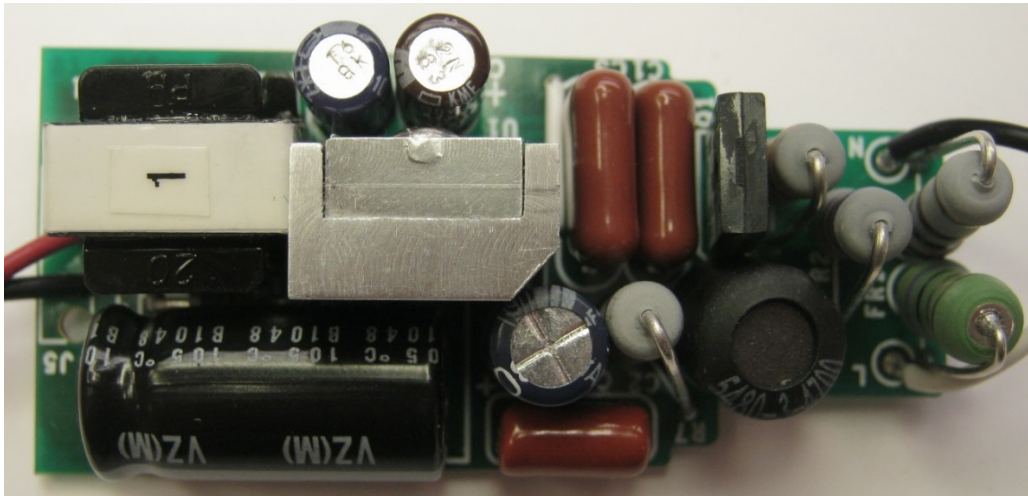


Figure 19 – Sample Design with Heat Sink.

Note: The heat sink is optional and depends on the end system design. In some applications the heat sink is not required or potting may be used.

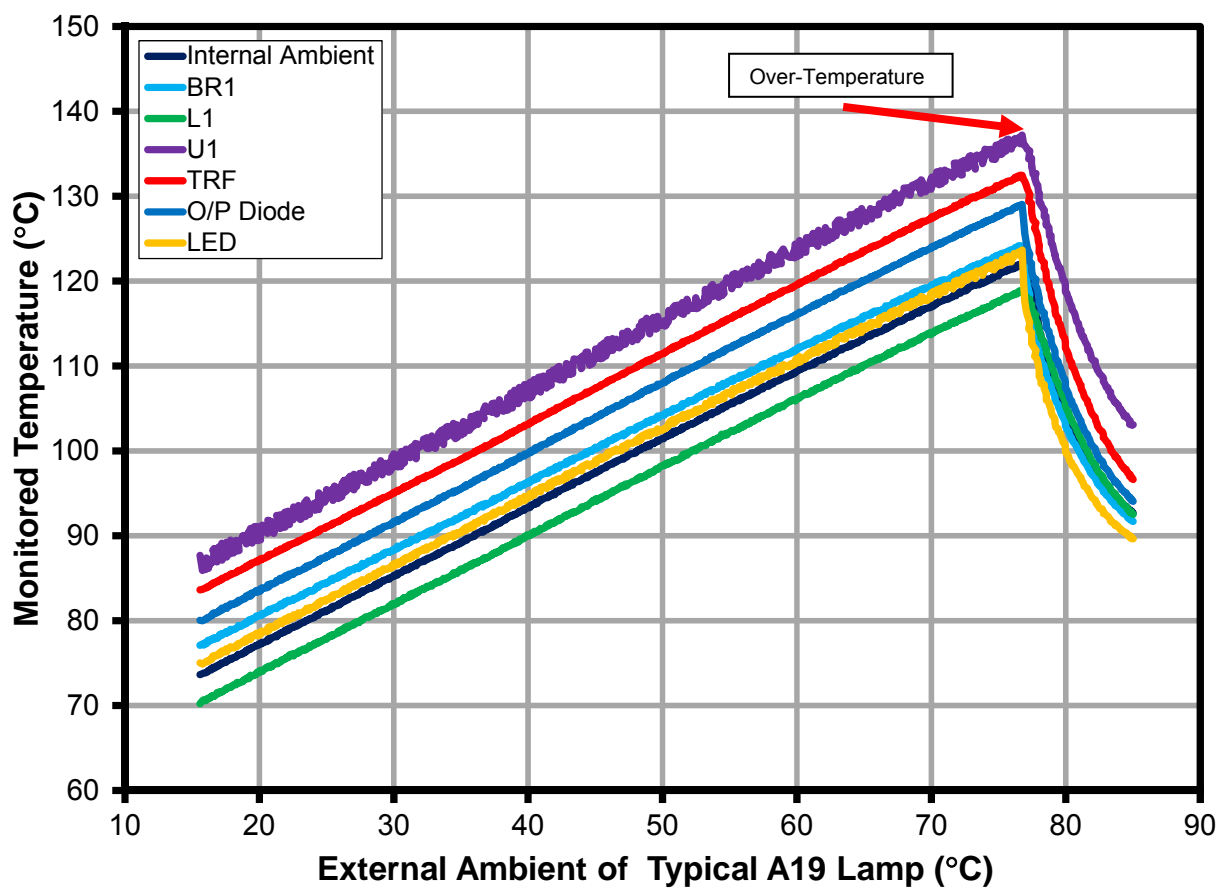


Figure 20 – Thermal Curve at 195 VAC / 50 Hz Input in Typical A19 Housing. LYT4322EG with heatsink.



11.3 热扫描

Open-frame thermal measurement at 25 °C ambient. UUT was soaked for 1 hour to achieve steady-state before the measurement.

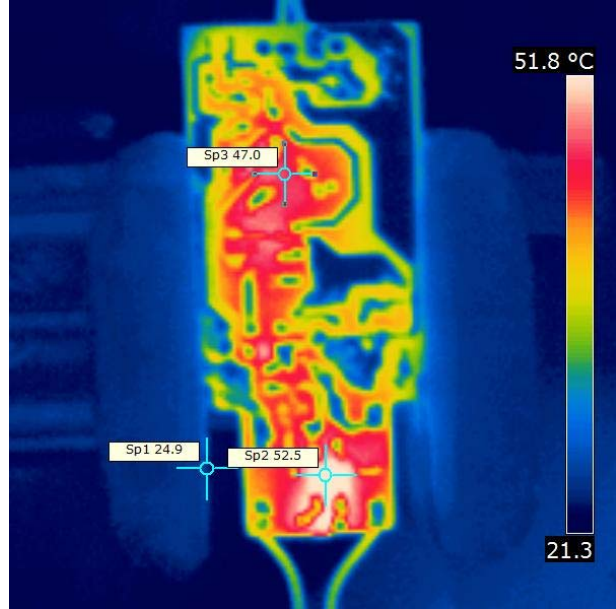
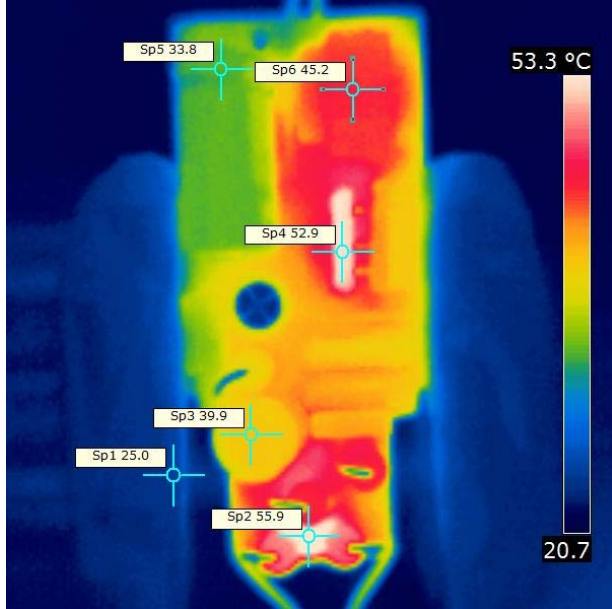


Figure 21 – Temperature (°C) at Top Side of PCB During Non-dimming Operation at 195 VAC.
 SP1 – Ambient.
 SP2 – L1, EMI Choke.
 SP3 – PCB, Temperature at BR1.
 SP4 – U1, LYT4322E Without Heat Sink.
 SP5 – C6, Output Capacitor.
 SP6 – T1, Power Inductor.

Figure 22 – Temperature (°C) at Bottom Side of PCB During Non-dimming Operation at 195 VAC.
 SP1 – Ambient.
 SP2 – BR1, Bridge Rectifier.
 SP3 – D5, Blocking Diode.

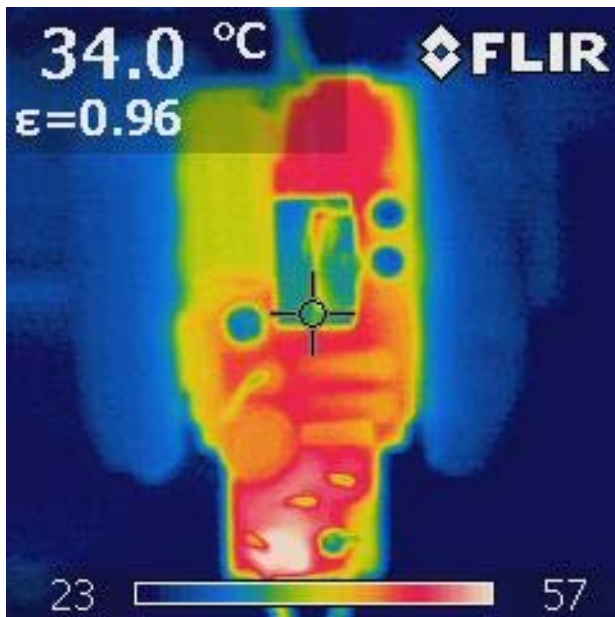


Figure 23 – Temperature (°C) at Top Side of PCB During Normal Operation at 195 VAC.
SP1 – U1, LYT4322E with Heat Sink.

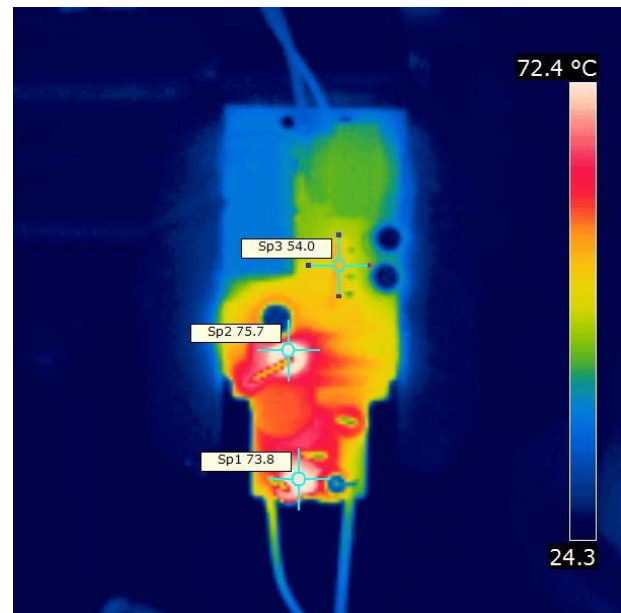


Figure 24 – Temperature (°C) at Top Side of PCB During Dimming Operation at 240 VAC at 90° Conduction Angle.
SP1 – FR2, Damper Resistor.
SP2 – R7, Bleeder Resistor.
SP3 – U1, LYT4322E Without Heat Sink.



12 波形

12.1 漏极电压和电流, 正常工作

The LYTswitch-4 optimized in continuous mode operation of inductor current that yields a high power factor and low harmonic distortion in the input current.

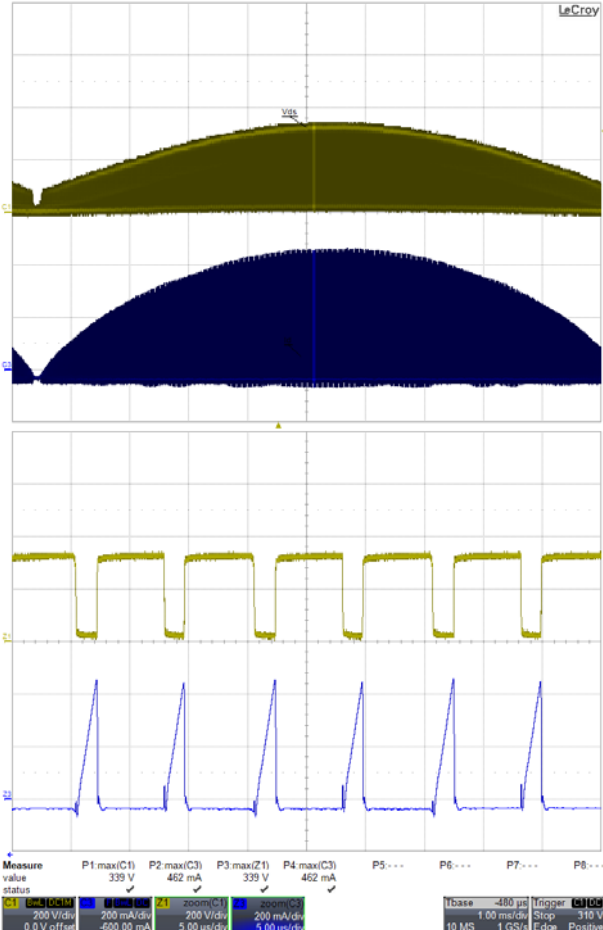


Figure 25 – 195 VAC, 50 Hz, Nominal V_{LED} Load.
 Ch1 (Yellow): $V_{DRAIN-SOURCE}$, 200 V / div.
 Ch3 (Blue): I_{DRAIN} , 200 mA / div.
 Time Scale: 1 ms / div.
 Zoom Time Scale: 5 μ s / div.

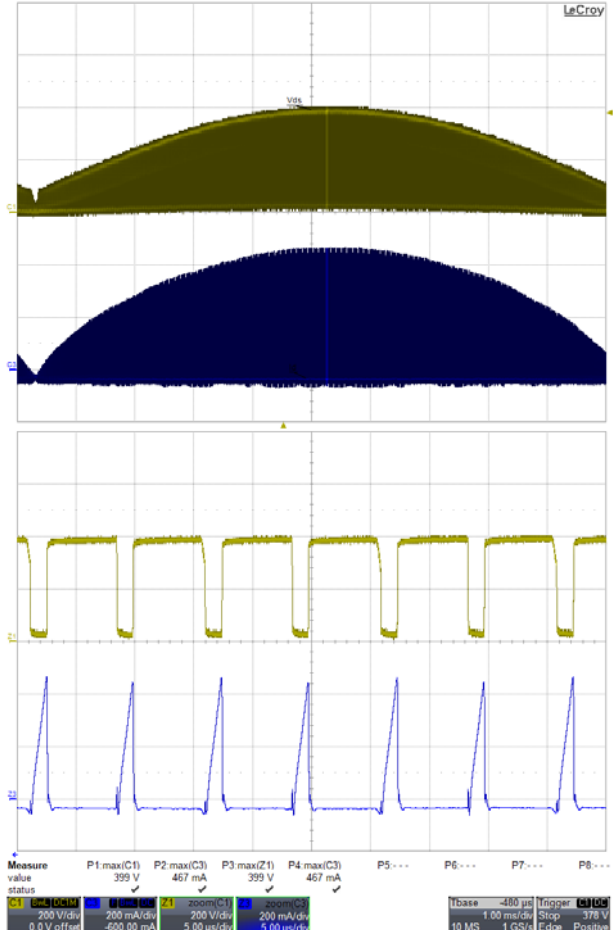


Figure 26 – 230 VAC, 50 Hz, Nominal V_{LED} Load.
 Ch1 (Yellow): $V_{DRAIN-SOURCE}$, 200 V / div.
 Ch3 (Blue): I_{DRAIN} , 200 mA / div.
 Time Scale: 1 ms / div.
 Zoom Time Scale: 5 μ s / div.

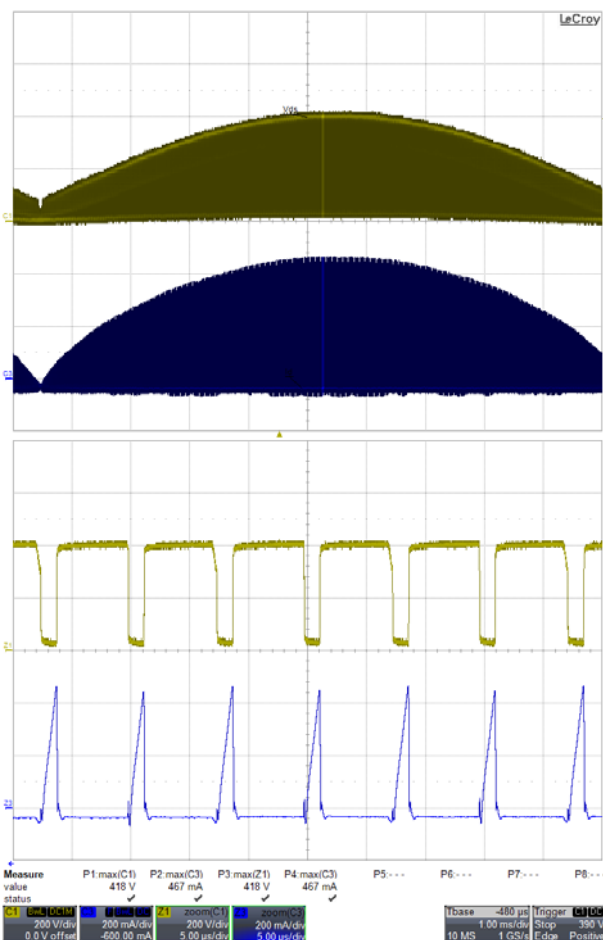


Figure 27 – 240 VAC, 50Hz, Nominal V_{LED} Load.
 Ch1 (Yellow): $V_{DRAIN-SOURCE}$, 200 V / div.
 Ch3 (Blue): I_{DRAIN} , 200 mA / div.
 Time Scale: 1 ms / div.
 Zoom Time Scale: 5 μ s / div.

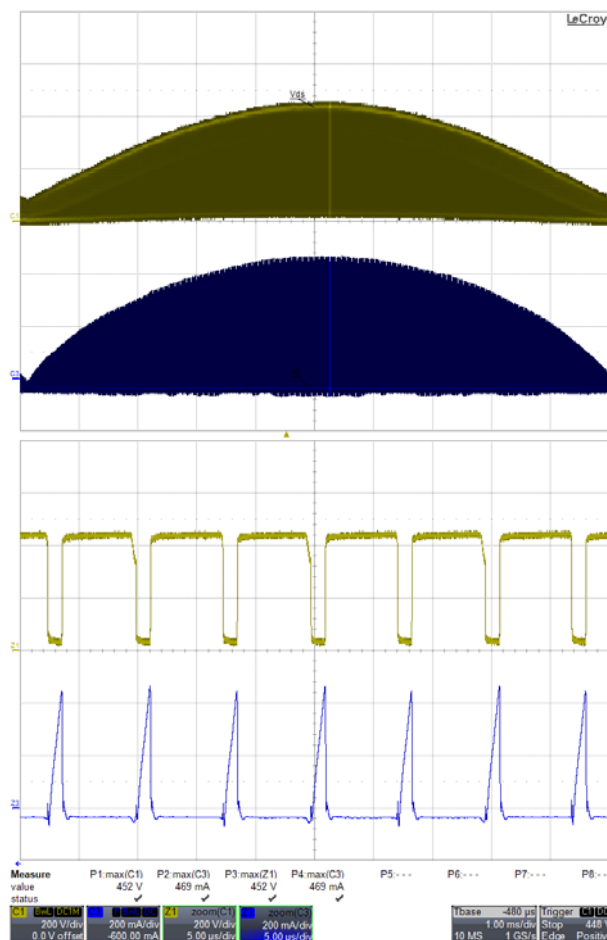


Figure 28 – 265 VAC, 50Hz, Nominal V_{LED} Load.
 Ch1 (Yellow): $V_{DRAIN-SOURCE}$, 200 V / div.
 Ch3 (Blue): I_{DRAIN} , 200 mA / div.
 Time Scale: 1 ms / div.
 Zoom Time Scale: 5 μ s / div.



12.2 输出短路时的漏极电压和电流

Device is operating within the range and no inductor saturation was observed.

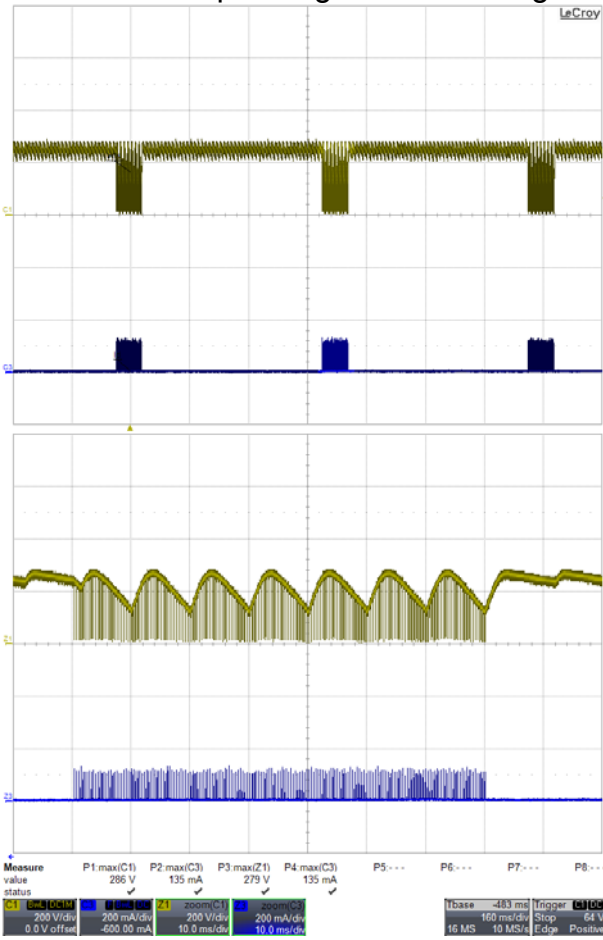


Figure 29 – LYT4322E Output Short. 195 VAC / 50 Hz.
 Ch1 (Yellow): $V_{DRAIN-SOURCE}$, 200 V / div.
 Ch3 (Blue): I_{DRAIN} , 200 mA / div.
 Time Scale: 160 ms / div.
 Zoom Time Scale: 10 ms / div.

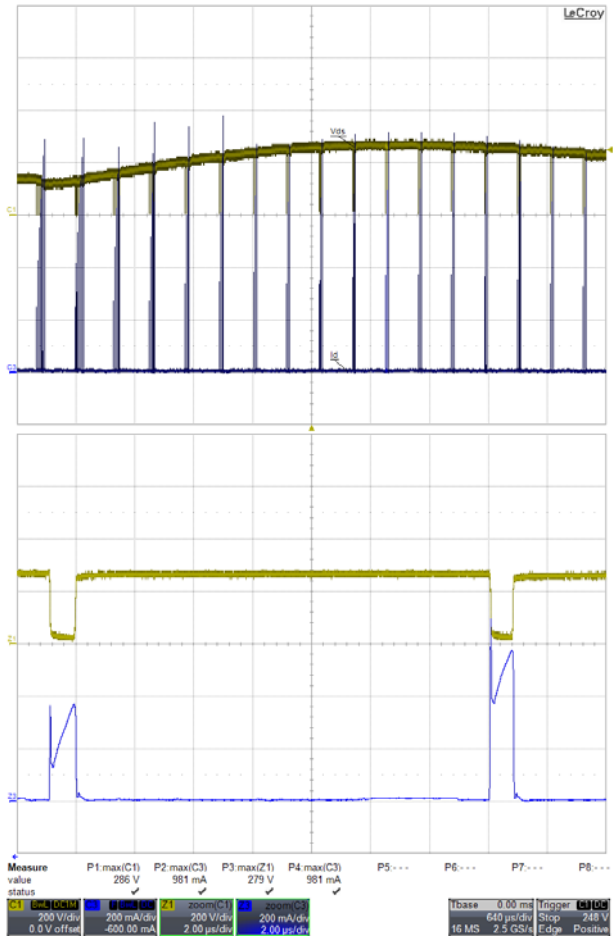


Figure 30 – LYT4322E Output Short. 195 VAC / 50 Hz.
 Ch1 (Yellow): $V_{DRAIN-SOURCE}$, 200 V / div.
 Ch3 (Blue): I_{DRAIN} , 200 mA / div.
 Time Scale: 640 μ s / div.
 Zoom Time Scale: 2 μ s / div.

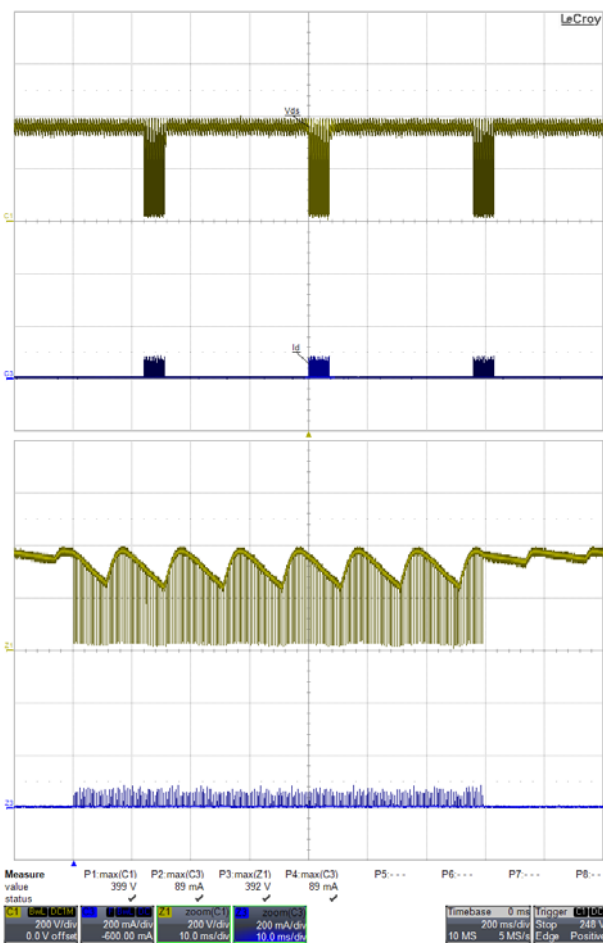


Figure 31 – LYT4322E Output Short. 265 VAC / 50 Hz.
 Ch1 (Yellow): $V_{DRAIN-SOURCE}$, 200 V / div.
 Ch3 (Blue): I_{DRAIN} , 200 mA / div.
 Time Scale: 200 ms / div.
 Zoom Time Scale: 10 ms / div

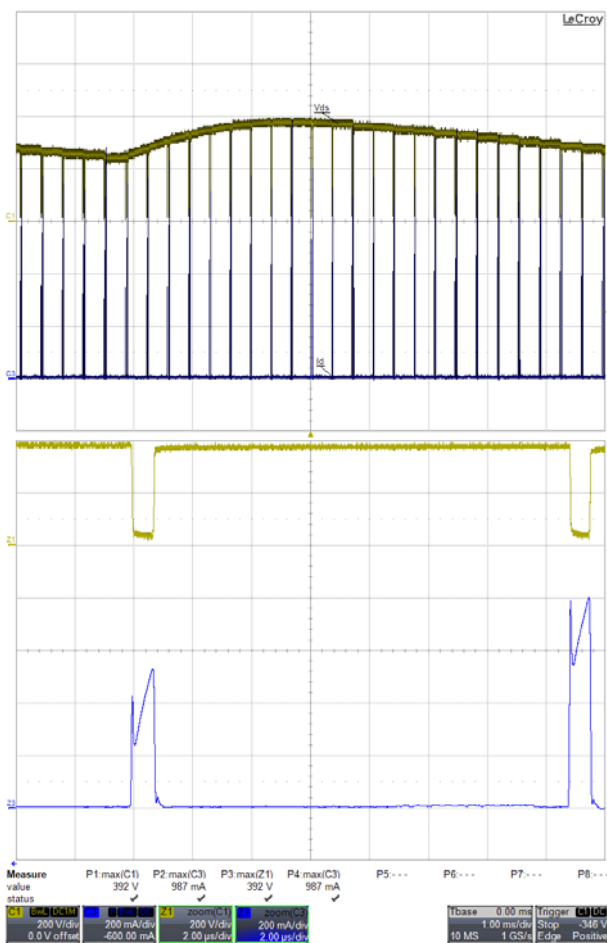


Figure 32 – LYT4322E Output Short. 195 VAC / 50 Hz.
 Ch1 (Yellow): $V_{DRAIN-SOURCE}$, 200 V / div.
 Ch3 (Blue): I_{DRAIN} , 200 mA / div.
 Time Scale: 1 ms / div.
 Zoom Time Scale: 2 μ s / div



12.3 漏极电压和电流启动特征

Device is operating within the range and no inductor saturation was observed.

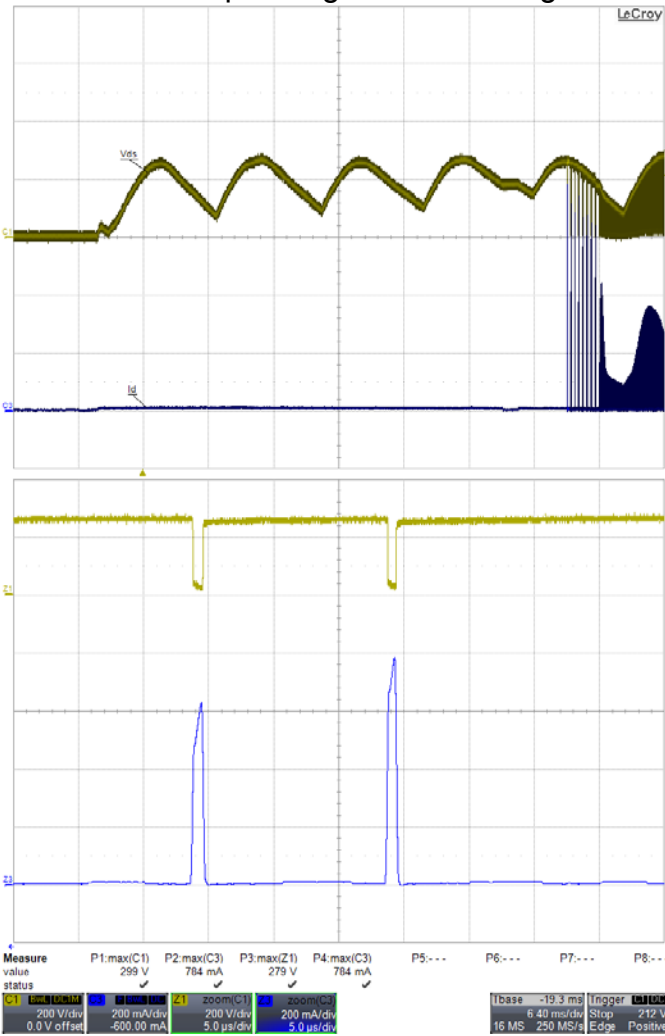


Figure 33 – 195 VAC / 50 Hz Start-up.

Ch1 (Yellow): $V_{DRAIN-SOURCE}$, 200 V / div.

Ch3 (Blue): I_{DRAIN} , 200 mA / div.

Time Scale: 1 ms / div.

Zoom Time Scale: 5 μ s / div.

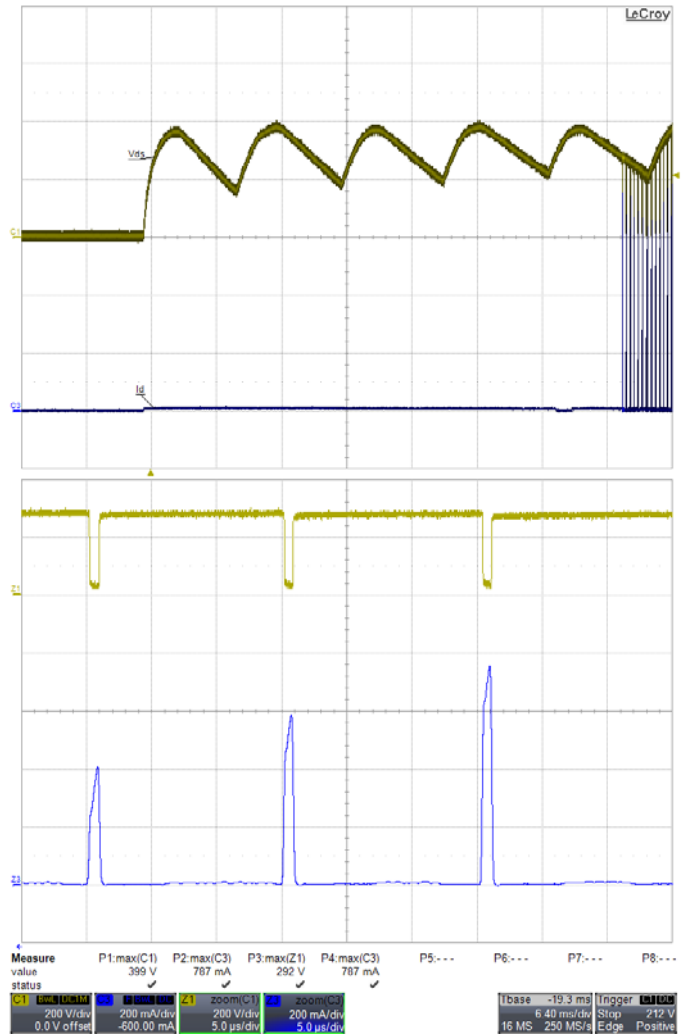


Figure 34 – 265 VAC / 50 Hz Start-up.

Ch1 (Yellow): $V_{DRAIN-SOURCE}$, 200 V / div.

Ch3 (Blue): I_{DRAIN} , 200 mA / div.

Time Scale: 1 ms / div.

Zoom Time Scale: 5 μ s / div.

12.4 输出电流启动特征

Output current is available in <150 ms.

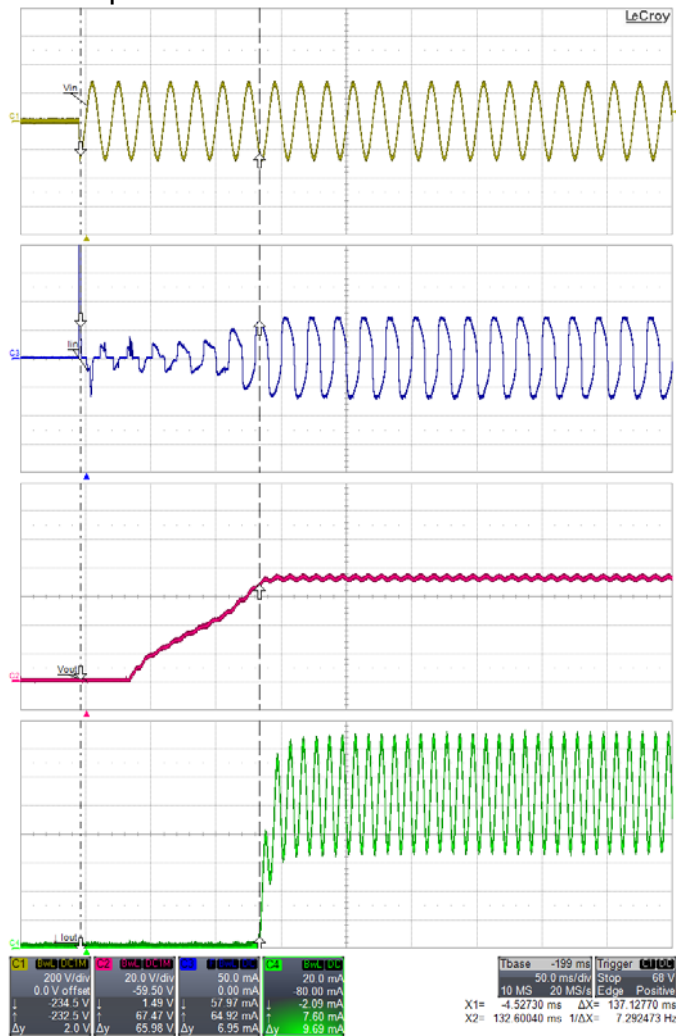


Figure 35 – 195 VAC, 50 Hz, Nominal V_{LED} Load.

Ch1 (Yellow): V_{IN} , 200 V / div.
 Ch2 (Red): V_{OUT} , 20 V.
 Ch3 (Blue): I_{IN} , 50 mA / div.
 Ch4 (Green): I_{OUT} , 20 mA / div.
 Time Scale: 20 ms / div.

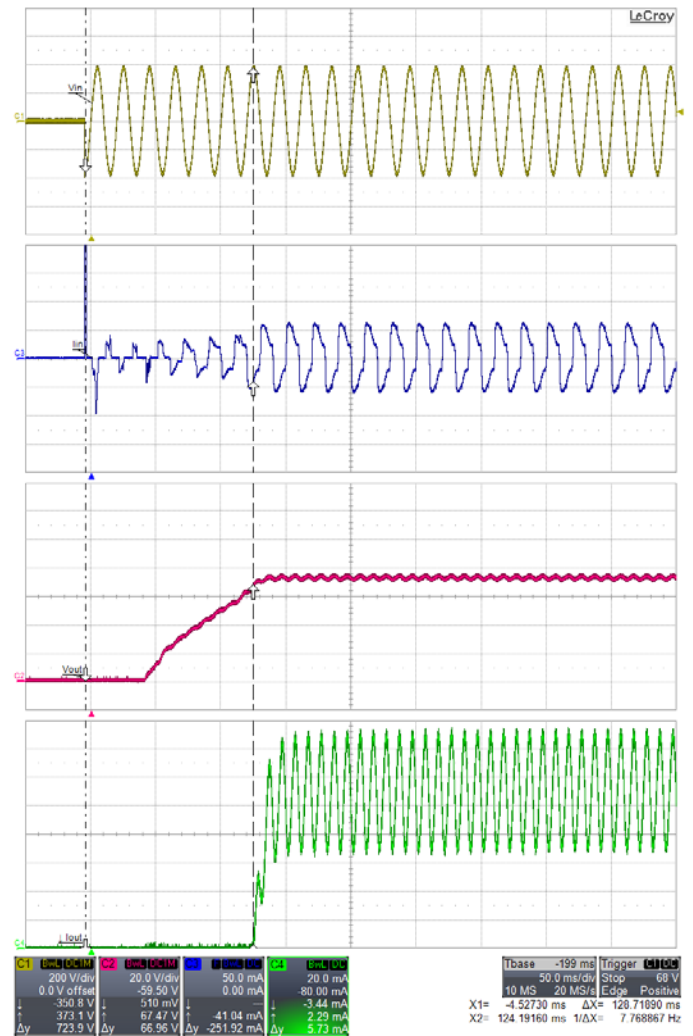


Figure 36 – 265 VAC, 50 Hz, Nominal V_{LED} Load.

Ch1 (Yellow): V_{IN} , 200 V / div.
 Ch2 (Red): V_{OUT} , 20 V.
 Ch3 (Blue): I_{IN} , 50 mA / div.
 Ch4 (Green): I_{OUT} , 20 mA / div.
 Time Scale: 20 ms / div.



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12.5 输入-输出特征

There is no limitation to the amount of output capacitance that can be added. If the application requires less output current ripple then increasing the output capacitance is straight forward. Note that the output current waveform below will vary depending on LED load impedance and will vary according to LED type.

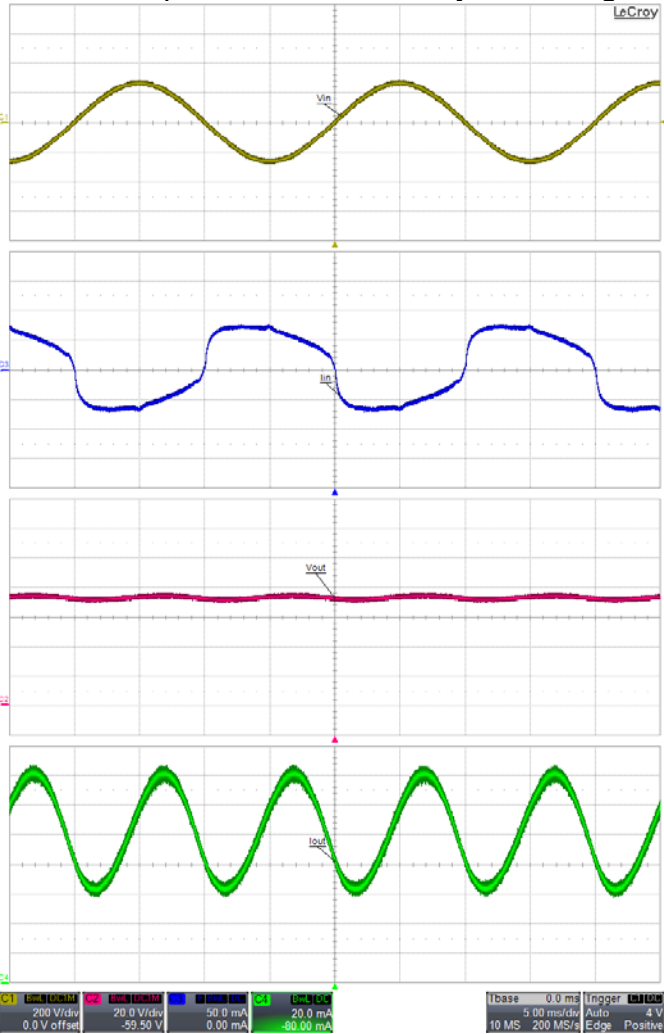


Figure 37 – 195 VAC / 50 Hz, Nominal V_{LED} Load.

- Ch1 (Yellow): V_{IN} , 200 V / div.
- Ch2 (Red): V_{OUT} , 20 V.
- Ch3 (Blue): I_{IN} , 50 mA / div.
- Ch4 (Green): I_{OUT} , 20 mA / div.
- Time Scale: 5 ms / div.

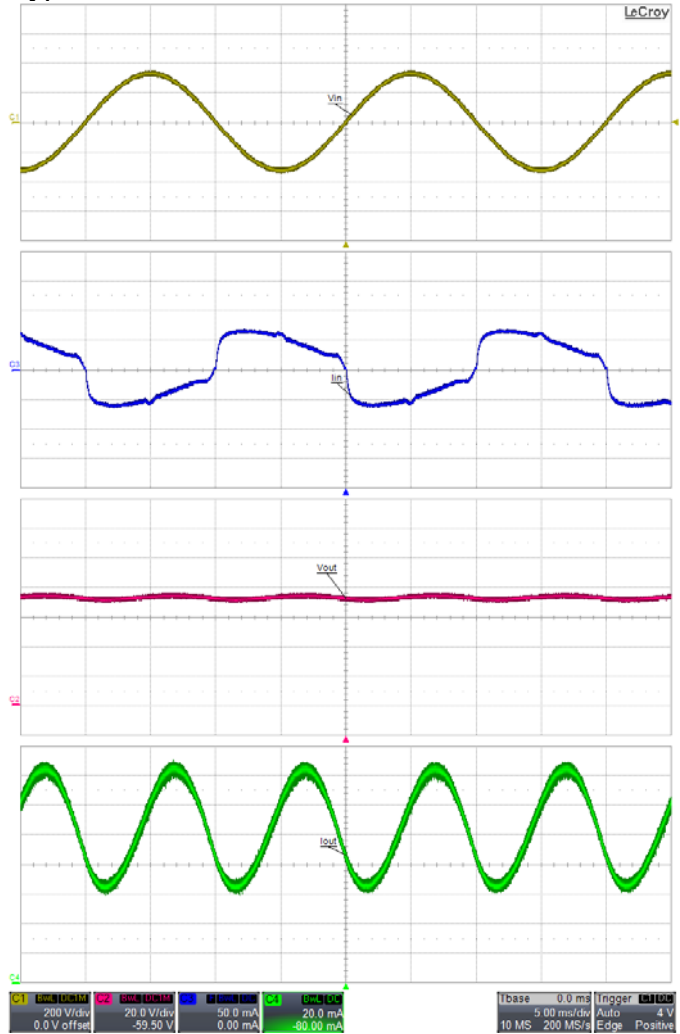


Figure 38 – 230 VAC / 50 Hz, Nominal V_{LED} Load.

- Ch1 (Yellow): V_{IN} , 200 V / div.
- Ch2 (Red): V_{OUT} , 20 V.
- Ch3 (Blue): I_{IN} , 50 mA / div.
- Ch4 (Green): I_{OUT} , 20 mA / div.
- Time Scale: 5 ms / div.

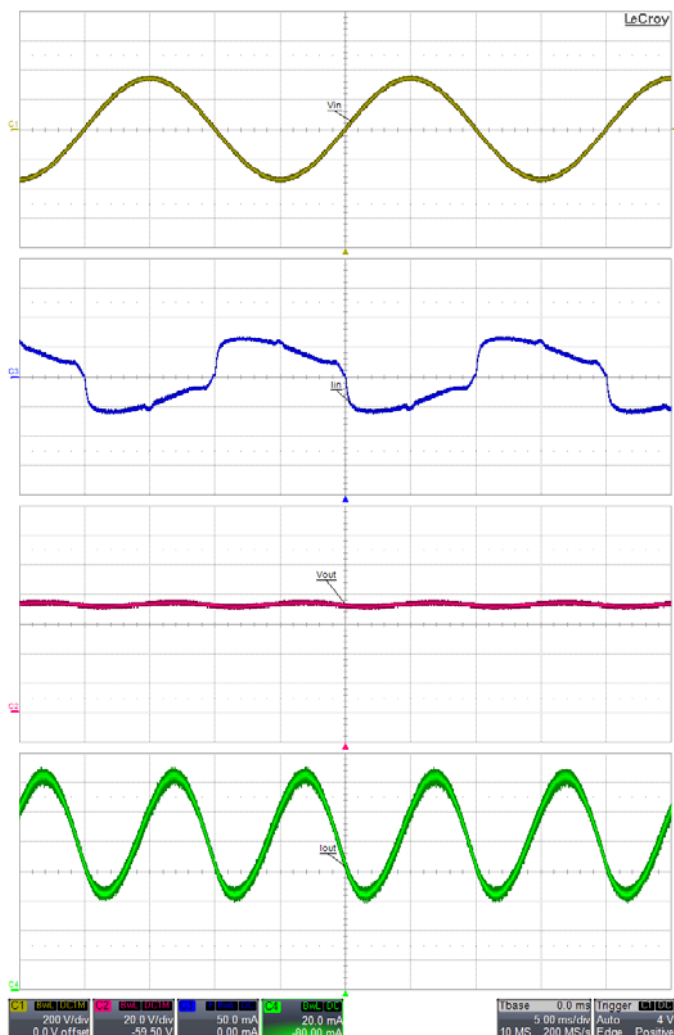


Figure 39 – 240 VAC / 50 Hz, Nominal V_{LED} Load.

Ch1 (Yellow): V_{IN} , 200 V / div.
 Ch2 (Red): V_{OUT} , 20 V.
 Ch3 (Blue): I_{IN} , 50 mA / div.
 Ch4 (Green): I_{OUT} , 20 mA / div.
 Time Scale: 5 ms / div.

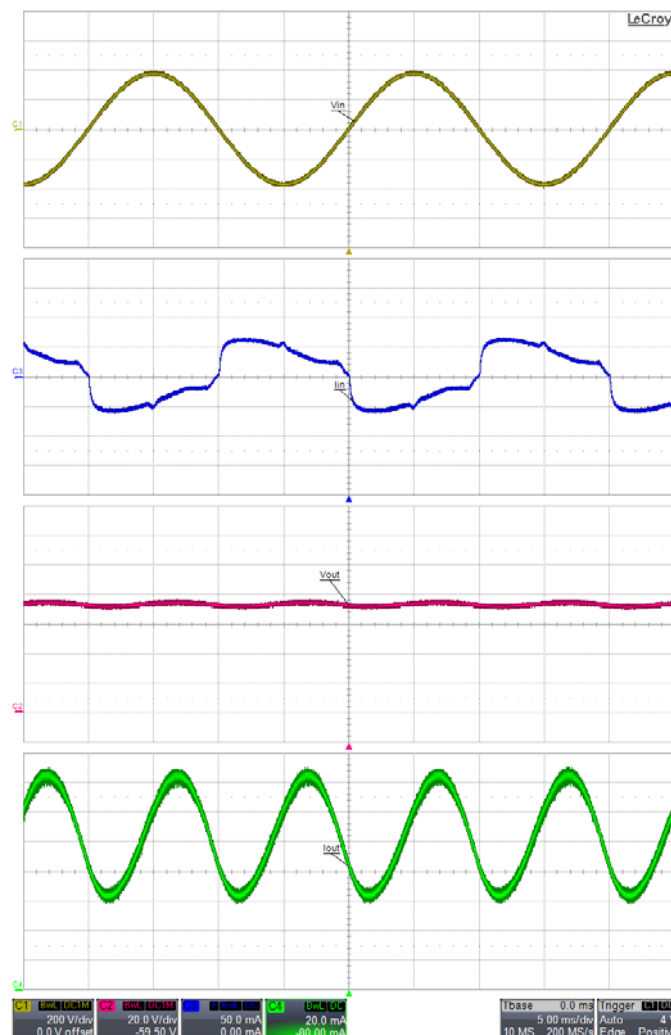


Figure 40 – 265 VAC / 50 Hz, Nominal V_{LED} Load.

Ch1 (Yellow): V_{IN} , 200 V / div.
 Ch2 (Red): V_{OUT} , 20 V.
 Ch3 (Blue): I_{IN} , 50 mA / div.
 Ch4 (Green): I_{OUT} , 20 mA / div.
 Time Scale: 5 ms / div.



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12.6 电压跌落和浪涌

The inherent advantage of the buck converter implemented with LYTSwitch-4 is the imperceptible start-up delay, the driver will turn-on within 100 ms as shown in the figures below. No failure of any component occurred during Line fluctuation tests.

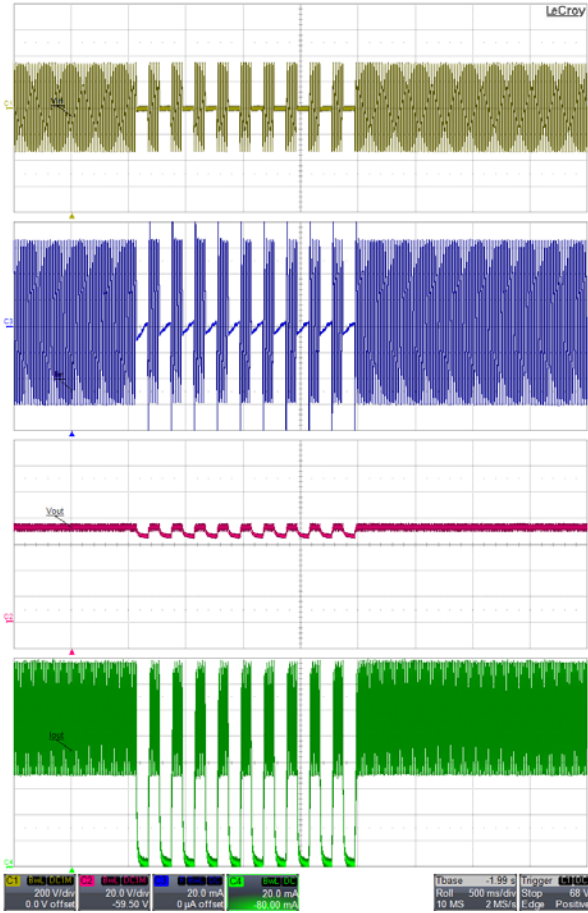


Figure 41 – Line Sag Test at 230 - 0 V at 0.1 sec Interval.
 Ch1: V_{IN} ; 200 V / div.
 Ch2: V_{OUT} ; 20 V / div.
 Ch3: I_{IN} ; 20 mA / div
 Ch4: I_{OUT} ; 20 mA / div.
 Time Scale: 500 ms / div.

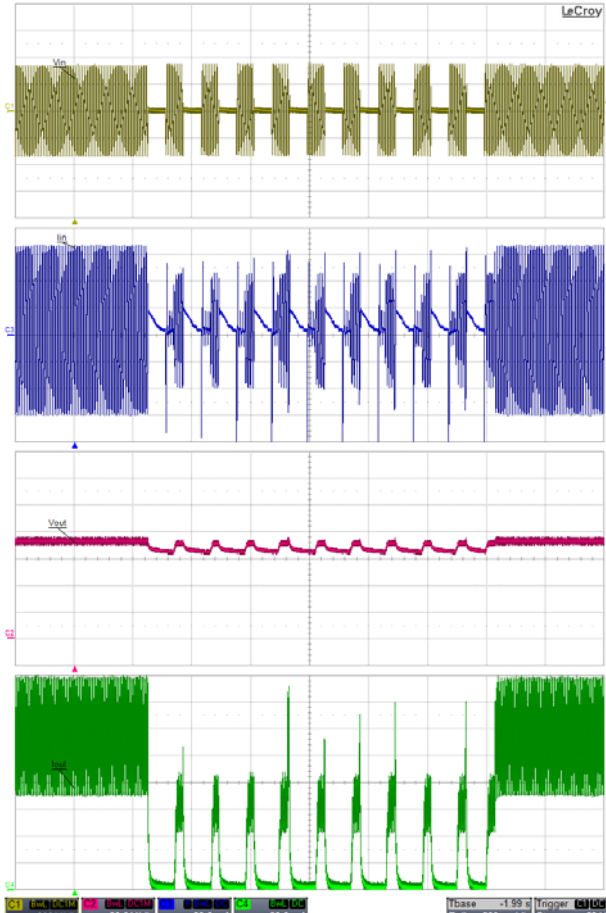


Figure 42 – Line Surge Test at 230 - 0 at 0.15 sec Interval.
 Ch1: V_{IN} ; 200 V / div.
 Ch2: V_{OUT} ; 20 V / div.
 Ch3: I_{IN} ; 20 mA / div
 Ch4: I_{OUT} ; 20 mA / div.
 Time Scale: 500 ms / div.

12.7 空载保护

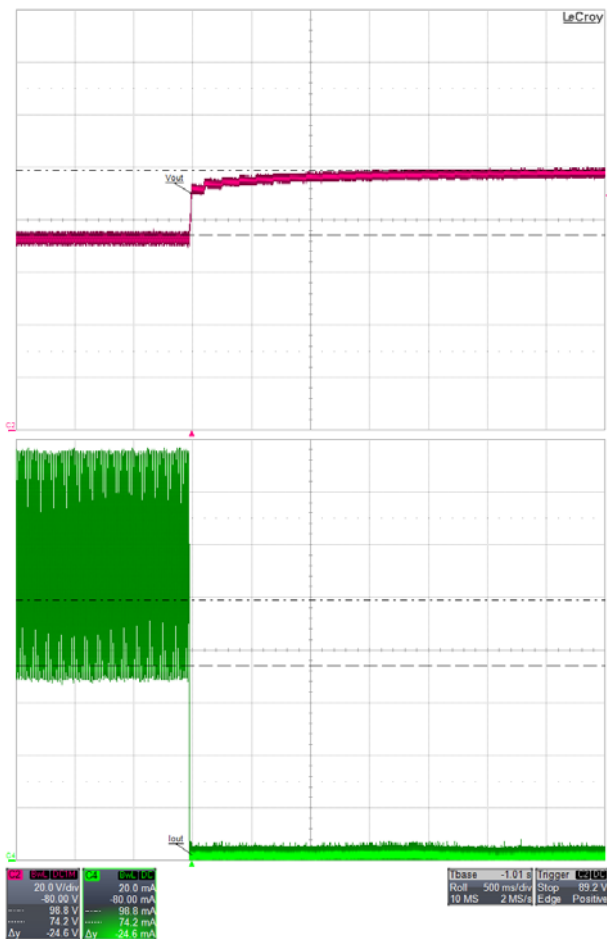


Figure 43 – No-load Protection when Load is Disconnected. 195 V / 50 Hz.
 Ch2: V_{OUT}; 20 V / div.
 Ch3: I_{OUT}; 50 mA / div.
 Time Scale: 500 ms / div.



Figure 44 – No-load Protection when Load is Disconnected. 265 V / 50 Hz.
 Ch2: V_{OUT}; 20 V / div.
 Ch3: I_{OUT}; 50 mA / div.
 Time Scale: 500 ms / div.



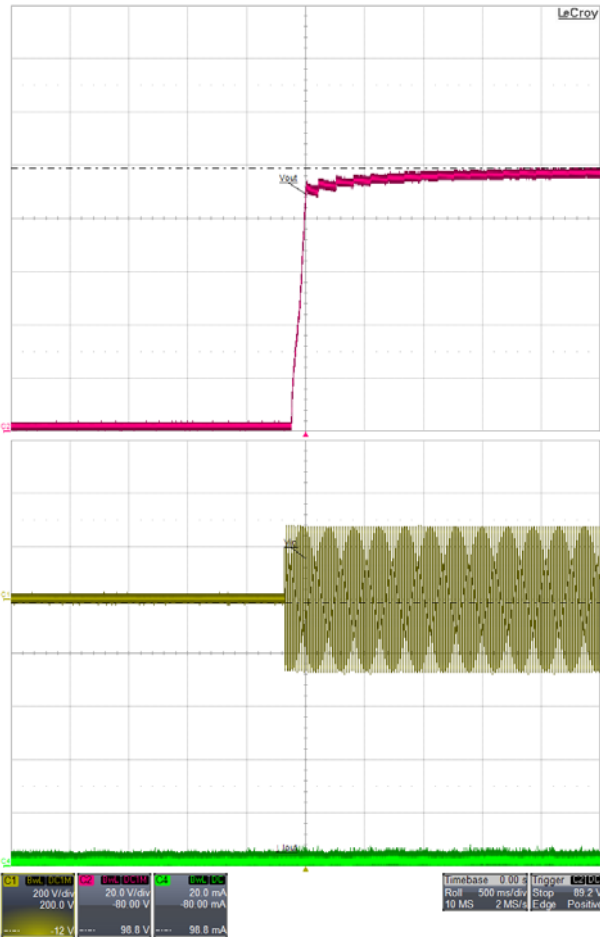


Figure 45 – No-load Start-up. 195 V / 50 Hz.
Ch2: V_{OUT} ; 20 V / div.
Ch3: I_{OUT} ; 50 mA / div.
Time Scale: 500 ms / div.

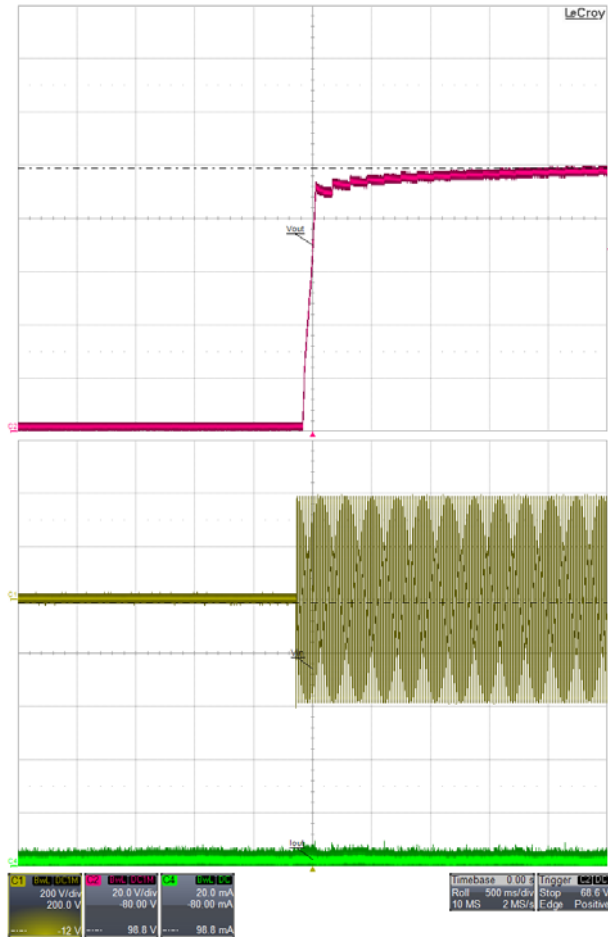


Figure 46 – No-load Start-up. 265 V / 50 Hz.
Ch2: V_{OUT} ; 20 V / div.
Ch3: I_{OUT} ; 50 mA / div.
Time Scale: 500 ms / div.

12.8 电压跌落/缓升

No failure of any component during brownout test of 0.5V / sec.



Figure 47 – Brown-out Test at 0.5 V / s. The Unit is Able to Operate Normally Without Any Failure and Without Flicker.
230 V-0-230 V
Ch1: V_{IN} ; 100 V / div.
Ch2: V_{OUT} ; 20 V / div.
Ch3: I_{OUT} ; 20 mA / div.
Time Scale: 50 s / div.

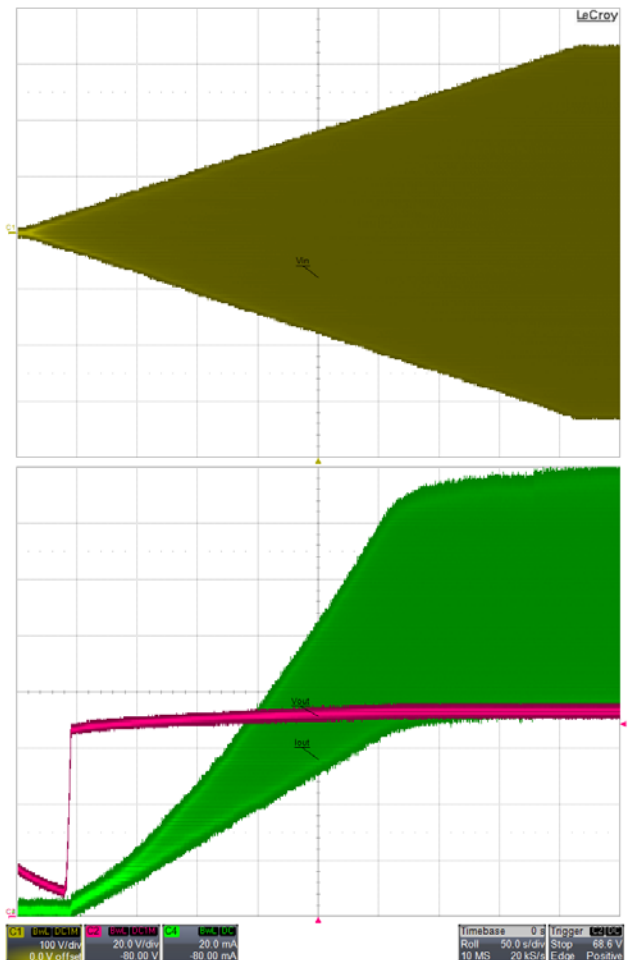


Figure 48 – Brown-out Test at 0.5 V / s. The Unit is Able to Operate Normally Without Any Failure and Without Flicker.
230 V-0-230 V
Ch1: V_{IN} ; 100 V / div.
Ch2: V_{OUT} ; 20 V / div.
Ch3: I_{OUT} ; 20 mA / div.
Time Scale: 50 s / div.



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13 调光

13.1 调光兼容性

List of Dimmers	Type	Max Iout	Min Iout	Ratio	Conduction Time (mS)				Compatibility
					Regulated AC Line		Distorted AC Line		
					Min	Max	Min	Max	
Berker KOPP 8033	L	102	16.37	6.23	7.64	2.54	7.51	1.95	Pass
Busch 6591-101	T	107.9	22.66	4.76	6.87	2.08	7.58	2.54	Pass
Busch 6513 U-102	T	110.9	24.74	4.48	7.64	2.02	7.97	2.28	Pass
PEHA 433HAB 0A	T	106.1	34.9	3.04	7.58	3.25	7.39	3.25	Pass
PEHA 433HAB 0A	T	99.2	19.56	5.07	6.93	2.6	7.06	2.6	Pass
Busch 2250	L	110.7	12.2	9.07	8.6	2.46	8.34	2.22	Pass
PEHA 400W	L	102.7	0.087	1180.46	7.91	0.73	7.58	0.606	Pass
Merten 572499	L	113.5	8.08	14.05	9.01	1.9	8.69	1.71	Pass
Busch 6513	T	110.8	25.07	4.42	7.91	1.9	7.91	2.35	Pass
Berker 2875	L	109.4	17.23	6.35	8.29	2.53	8.02	2.14	Pass
Berker 2830 10	L	104.7	26.19	4.00	8.4	3.37	8.25	3.04	Pass
Jung 225 NV DE	L	104.4	22.94	4.55	8.37	2.98	8.04	2.49	Pass
Jung 254 UDIE 1	T	104.8	31.1	3.37	7.67	2.65	7.78	2.65	Pass
Jung 266 G DE	L	105.9	24.27	4.36	8.6	3.16	8.45	2.8	Pass
Busch 2200 UJ-212	L	105.4	32.8	3.21	8.61	3.62	8.42	3.56	Pass
Busch 2250 U	L	106.3	24.95	4.26	8.64	3.29	8.28	2.81	Pass
Busch 2247 U	L	105.3	30.13	3.49	8.524	3.74	8.21	3.4	Pass
Gira 2262 00 I01	L	105.5	19.33	5.46	8.33	2.75	8.21	2.12	Pass
Busch 2247 U	L	105.2	28.87	3.64	8.39	3.45	8.02	3	Pass
Busch 2250 U	L	107.4	19.74	5.44	8.55	2.45	8.34	2.28	Pass
GIRA 1176 00 I03	T	103.4	30.2	3.42	7.06	2.27	7.56	2.51	Pass
Niko 310-013	L	108.9	27.61	3.94	8.79	3.29	8.35	2.85	Pass
Niko 310-017	T	99.8	33.8	2.95	7.21	3	7.44	3.24	Pass
Niko 310-014	L	108.7	33	3.29	8.76	3.78	8.49	3.45	Pass
Niko 310-016	L	107.6	29.91	3.60	8.3	3.44	8.3	2.93	Slight Shimmer for Distorted Line
Relco RM34DMA	L	113.6	24	4.73	8.87	2.79	8.81	2.59	Pass
Relco RTM34LED DAXS	L	95.1	9.37	10.15	7.18	2.08	7.12	2.08	Pass
Relco RM34DMA	L	115	22.22	5.18	9.13	3.11	9.18	2.46	Pass
Relco RTS34.43 RLI	L	114.6	3.77	30.40	9.26	1.5	9.06	1.75	Pass
Relco RT34DSL	L	115	20.48	5.62	9.26	2.85	9.13	2.53	Pass
TCL	L	109.5	11.85	9.24	9.23	2.12	9.04	1.67	Pass
SEN BO LANG	L	109.5	29.56	3.70	9.3	3.42	8.98	2.83	Pass
EBA HUANG	L	109.5	1.58	69.30	9.3	1.09	9.05	1.09	Pass
SB ELECT	L	107.1	1.78	60.17	8.47	0.906	8.08	0.38	Pass
MYONGBO	L	109.6	28.41	3.86	9.32	3.11	9.121	2.84	Pass
KBE	L	109	0.7	155.71	8.99	1.14	8.86	0.68	Pass
CLIPMEI	L	109.1	10.9	10.01	9.09	2.17	9.035	1.69	Pass
MANK	L	109.5	31.8	3.44	9.26	3.5	9.13	3.11	Pass
Clipsal 32E450LM	L	104.4	12.77	8.18	7.96	2.2	7.42	2.01	Pass
Clipsal 32E450TM	T	108.2	16.83	6.43	7.9	2.47	8.03	2.47	Pass
Clipsal 32E2CFLDM	T	106.6	16.14	6.60	7.53	2.28	7.94	2.44	Pass
Clipsal 32E450UDM	T	112	21.19	5.29	8.04	2.61	8.3	2.87	Pass



13.2 调光波形

Dimmer: Berker 2830 10

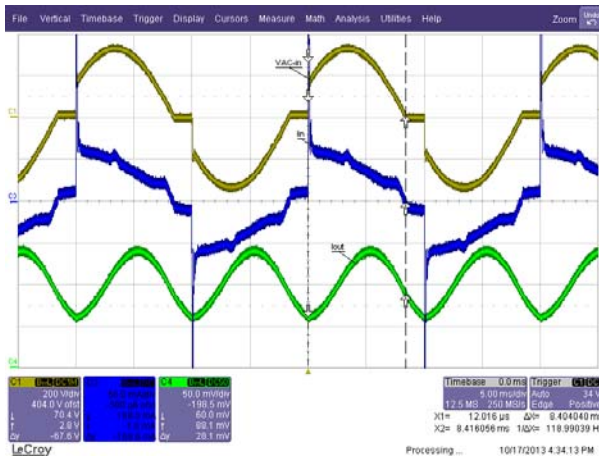


Figure 49 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
Ch1: V_{IN} ; 200 V / div.
Ch3: I_{IN} ; 50 mA / div.
Ch4: I_{OUT} ; 50 mA / div.
Time Scale: 5 ms / div.

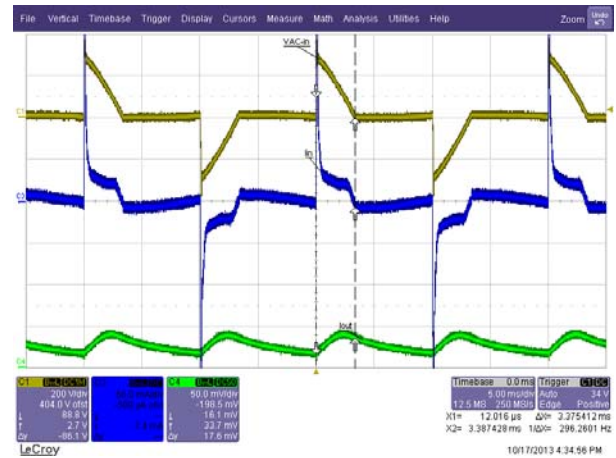


Figure 50 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
Ch1: V_{IN} ; 200 V / div.
Ch3: I_{IN} ; 50 mA / div.
Ch4: I_{OUT} ; 50 mA / div.
Time Scale: 5 ms / div.

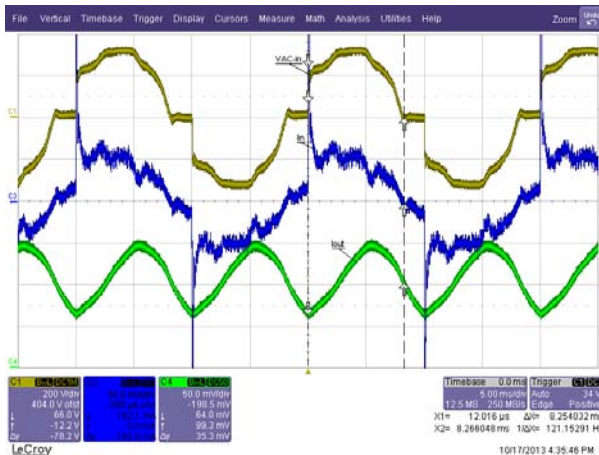


Figure 51 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
Ch1: V_{IN} ; 200 V / div.
Ch3: I_{IN} ; 50 mA / div.
Ch4: I_{OUT} ; 50 mA / div.
Time Scale: 5 ms / div.

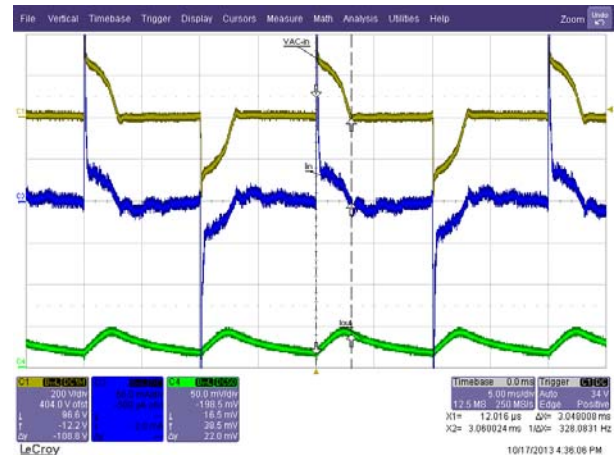


Figure 52 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
Ch1: V_{IN} ; 200 V / div.
Ch3: I_{IN} ; 50 mA / div.
Ch4: I_{OUT} ; 50 mA / div.
Time Scale: 5 ms /



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Dimmer: Jung 225 NV DE

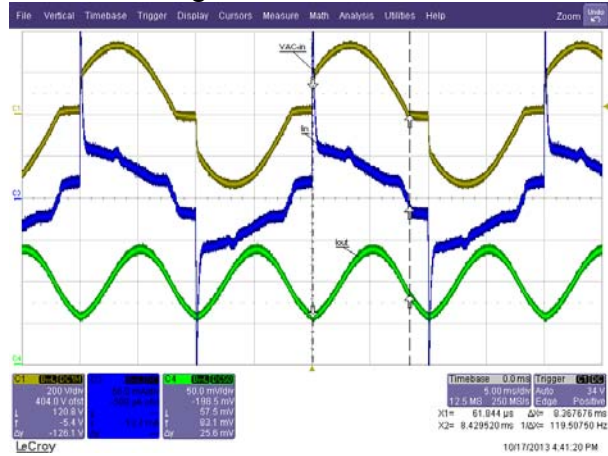


Figure 53 – Full Conduction from Regulated AC
 Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

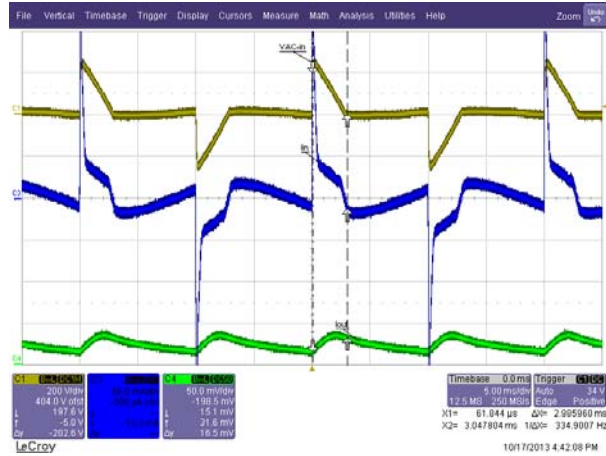


Figure 54 – Minimum Conduction from Regulated AC
 AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

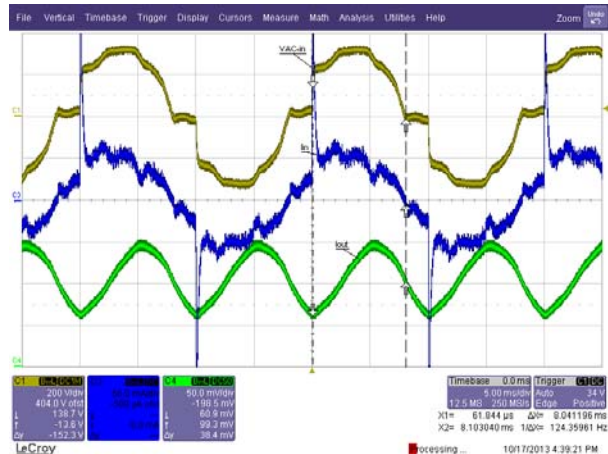


Figure 55 – Full Conduction from Distorted AC Line
 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

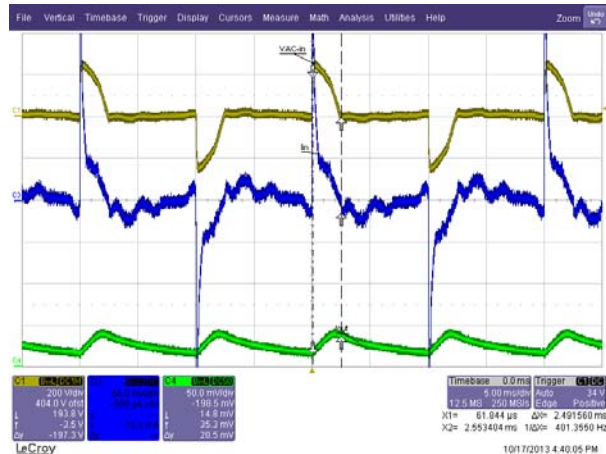


Figure 56 – Minimum Conduction from Distorted AC Line
 AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: Jung 254 UDIE 1

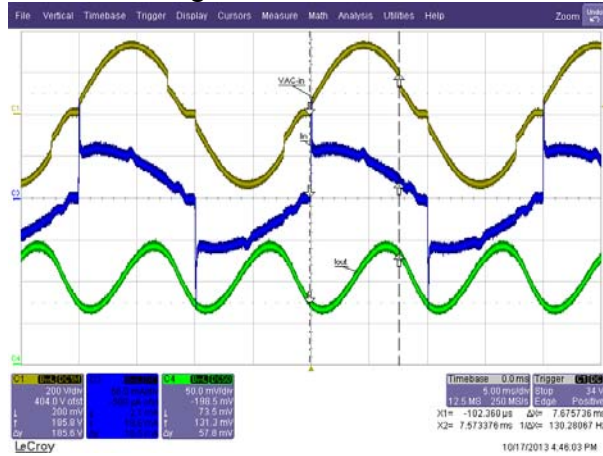


Figure 57 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

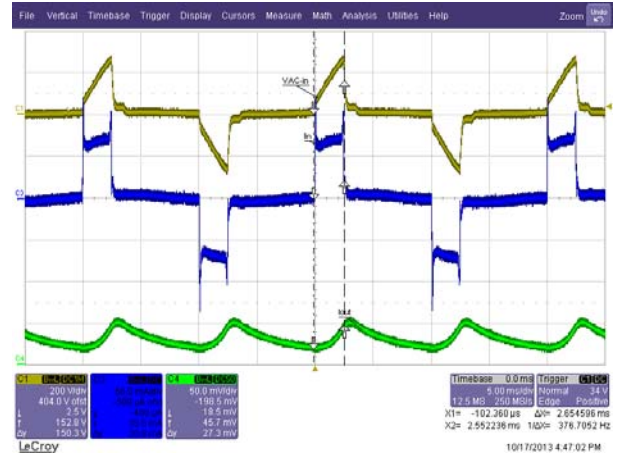


Figure 58 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

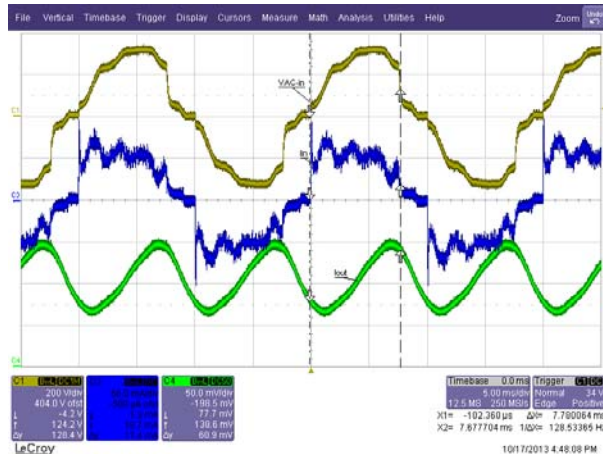


Figure 59 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

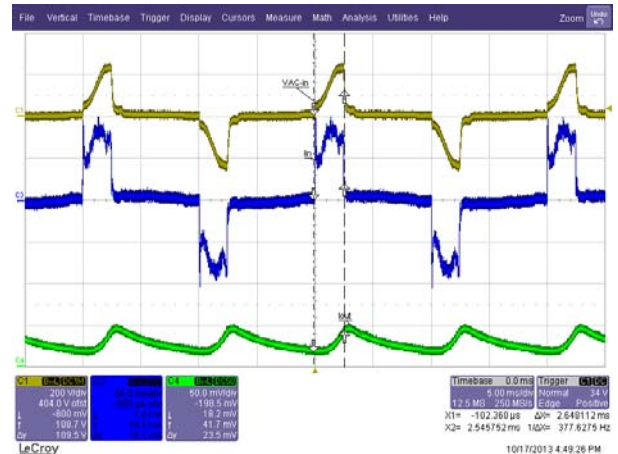


Figure 60 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms /



Dimmer: Jung 266 G DE

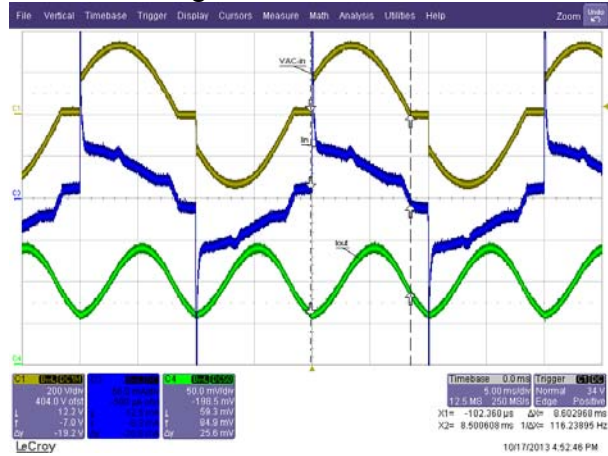


Figure 61 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

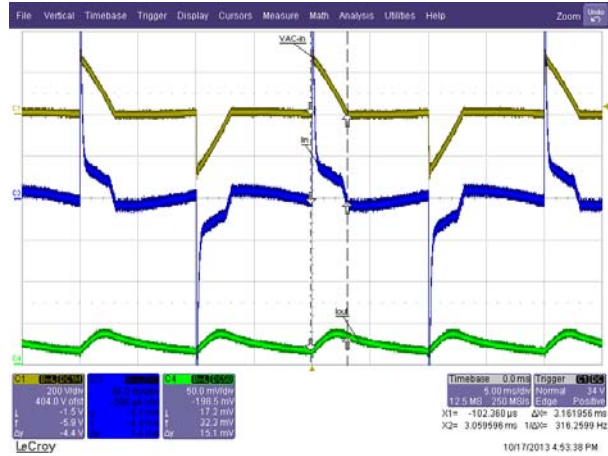


Figure 62 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

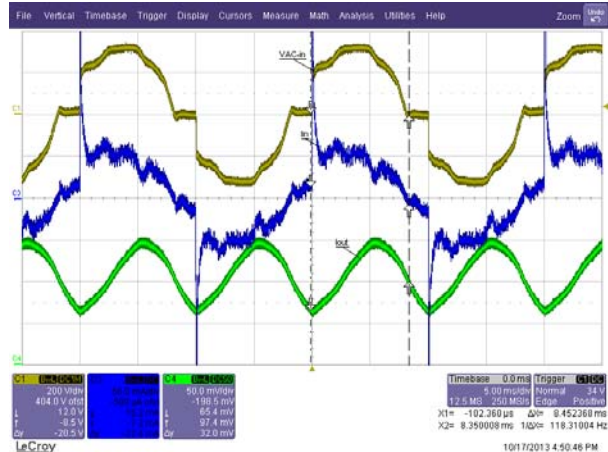


Figure 63 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

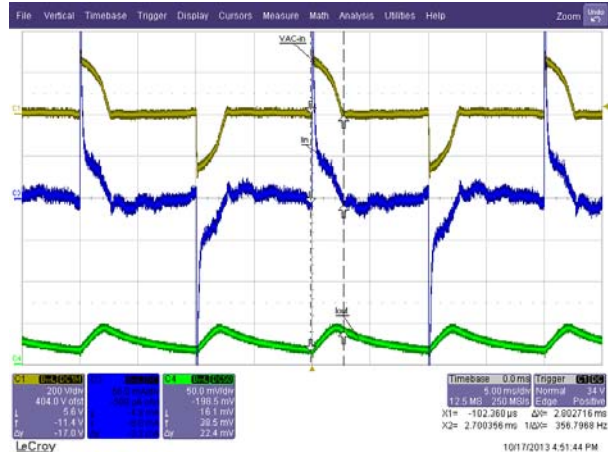


Figure 64 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: Busch 2200 UJ-212

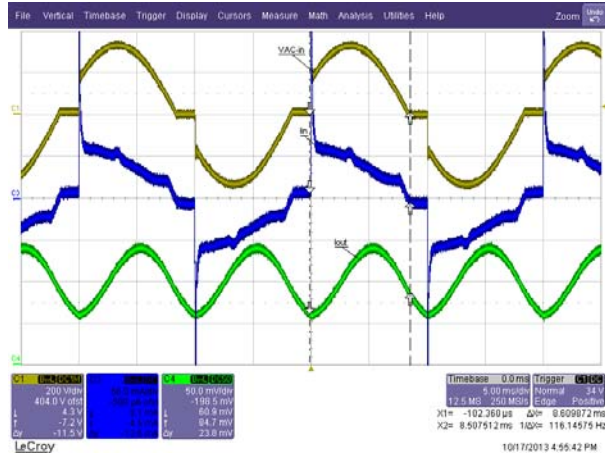


Figure 65 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

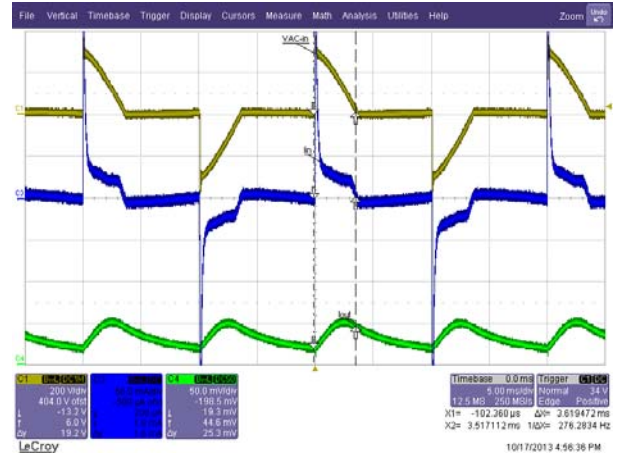


Figure 66 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

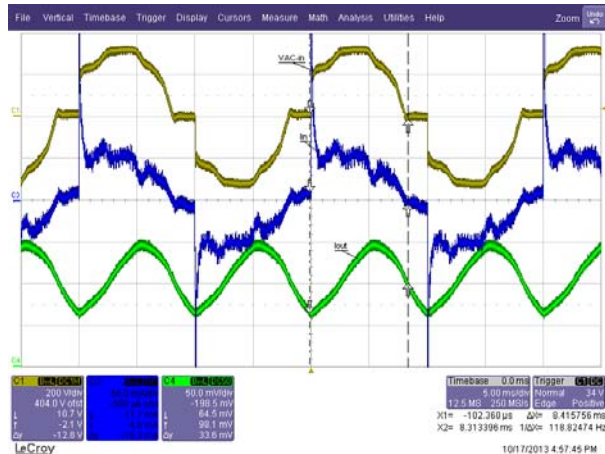


Figure 67 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

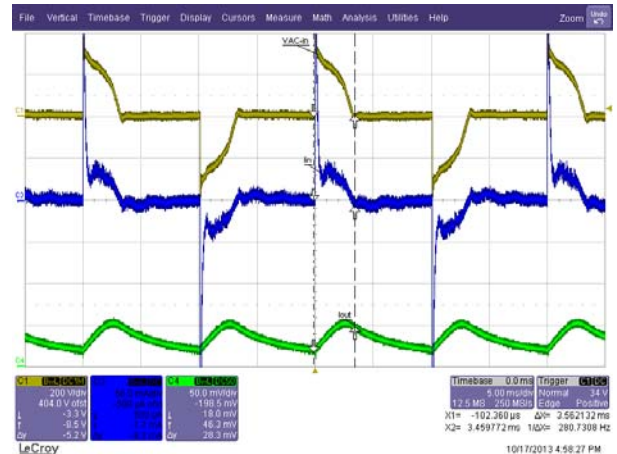


Figure 68 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Busch 2250 U

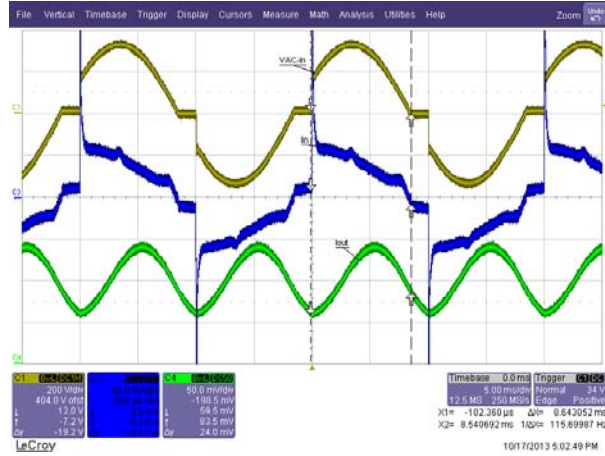


Figure 69 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

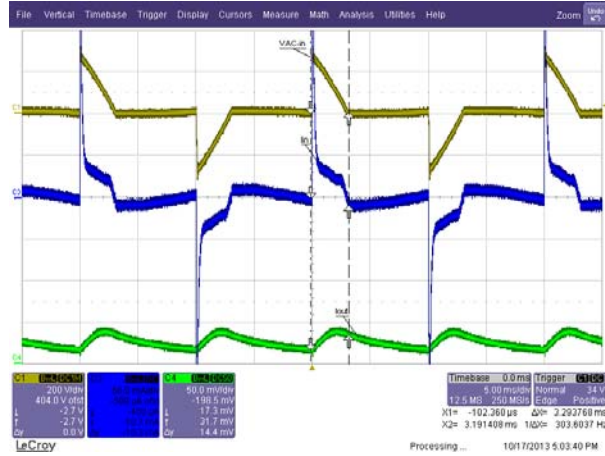


Figure 70 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

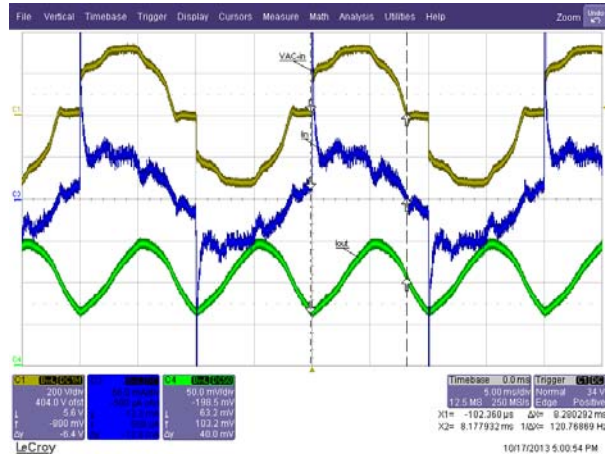


Figure 71 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

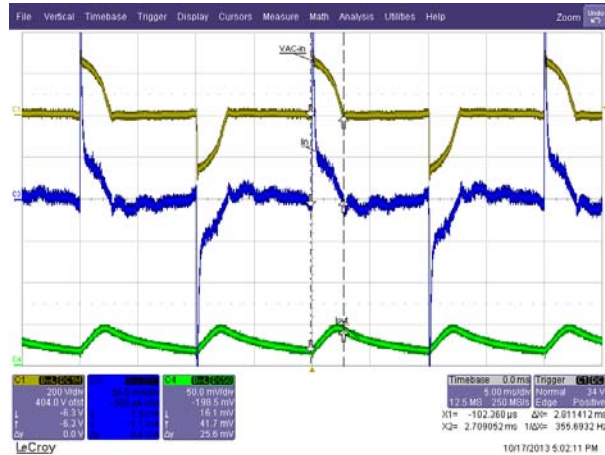


Figure 72 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: Busch 2247 U

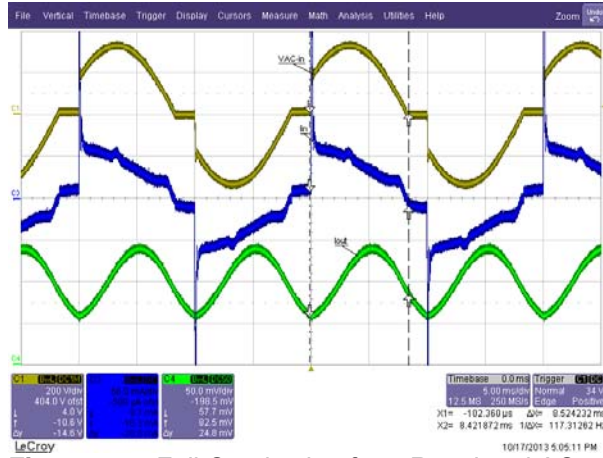


Figure 73 – Full Conduction from Regulated AC
 Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

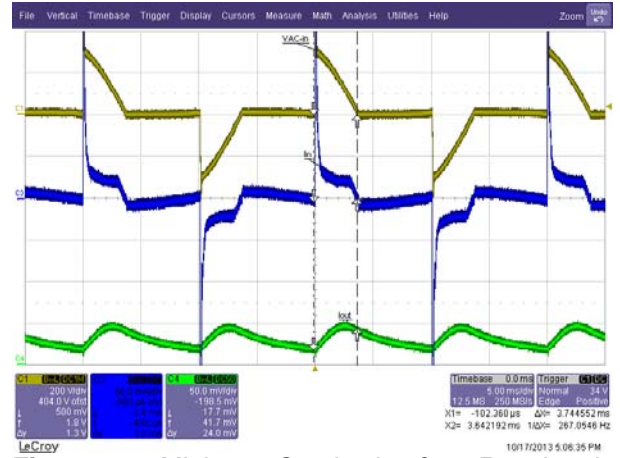


Figure 74 – Minimum Conduction from Regulated AC
 AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

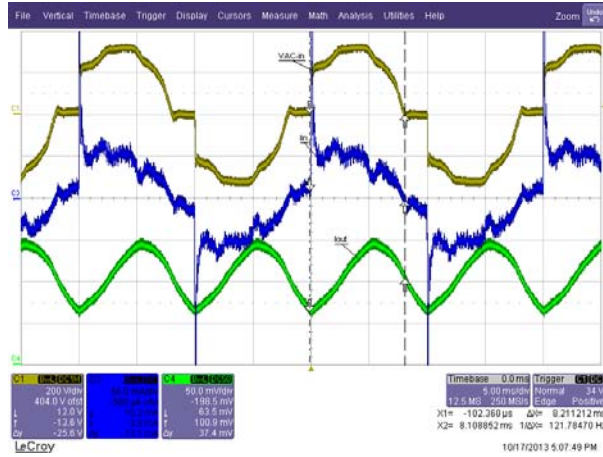


Figure 75 – Full Conduction from Distorted AC Line
 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

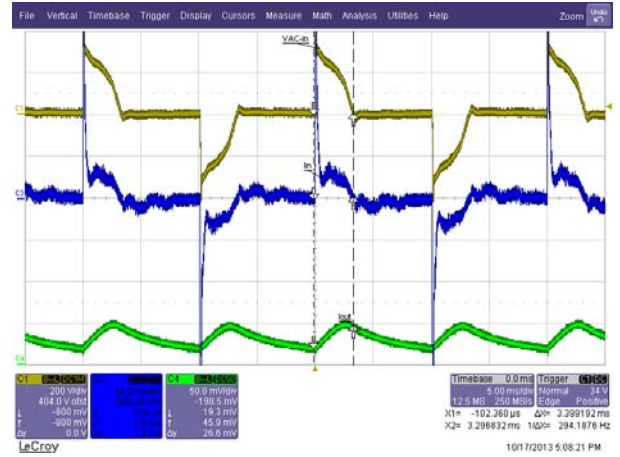


Figure 76 – Minimum Conduction from Distorted AC Line
 AC Line 230V/50Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Gira 2262 00 I01

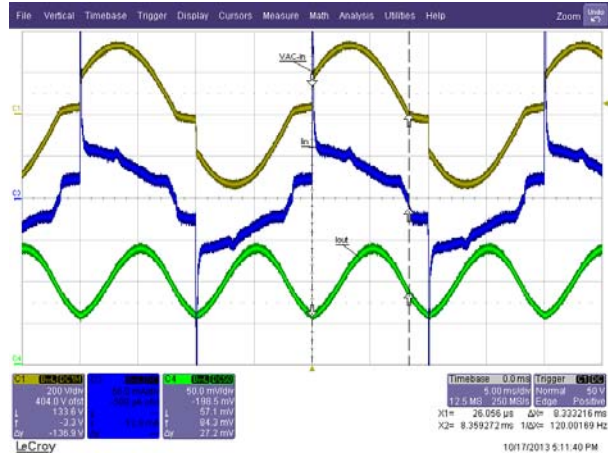


Figure 77 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

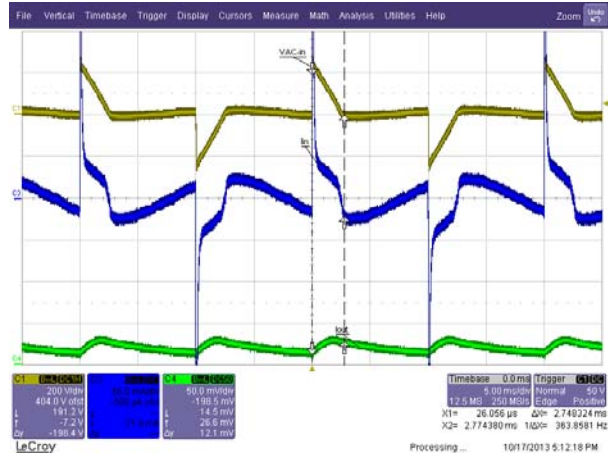


Figure 78 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

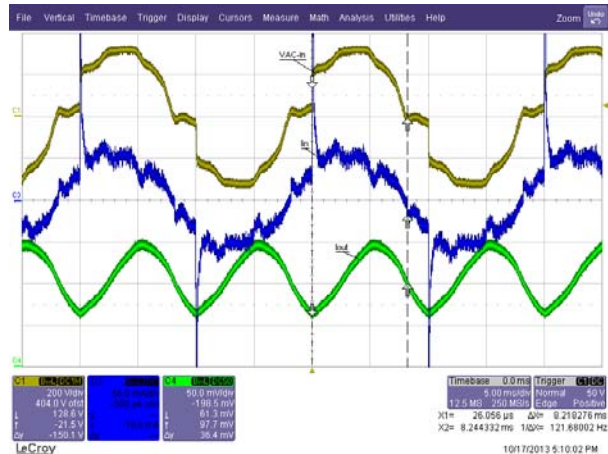


Figure 79 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

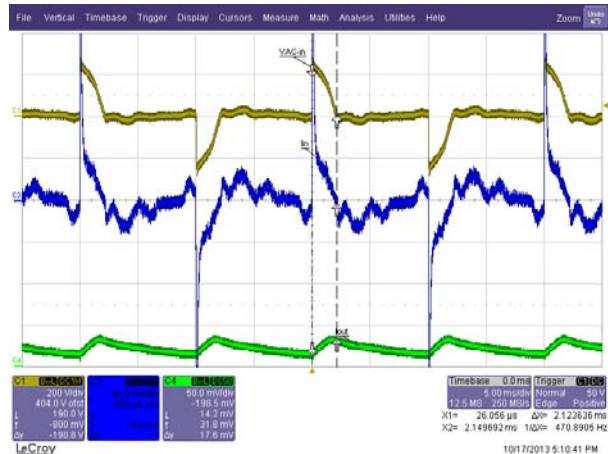


Figure 80 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: Gira 0300 00 I01

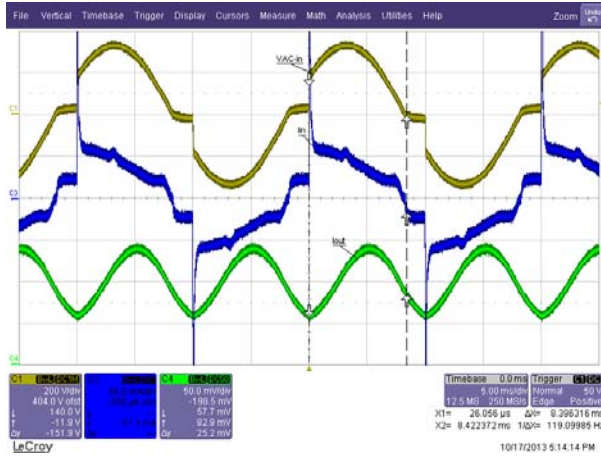


Figure 81 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

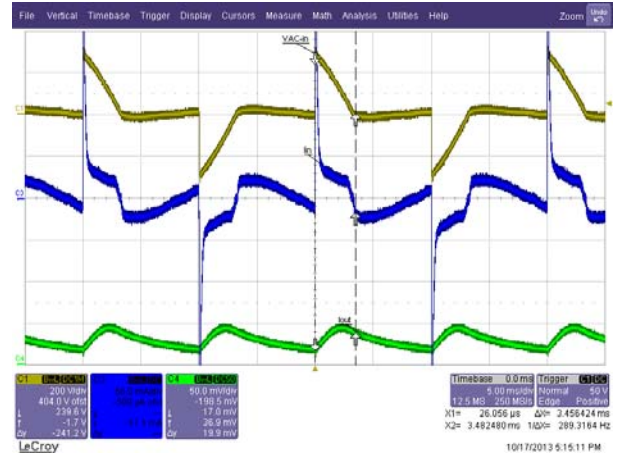


Figure 82 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

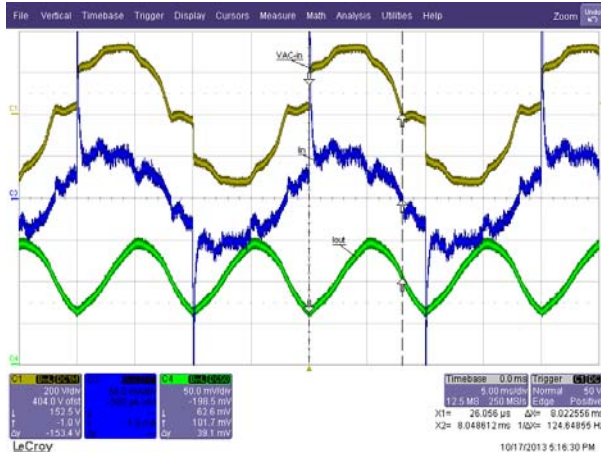


Figure 83 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

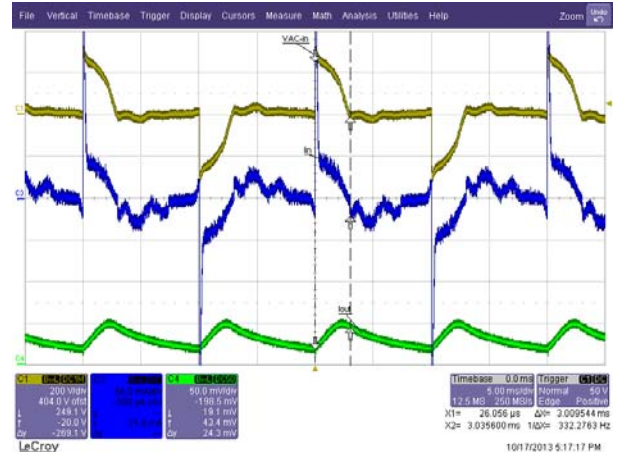


Figure 84 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Busch 2250 U

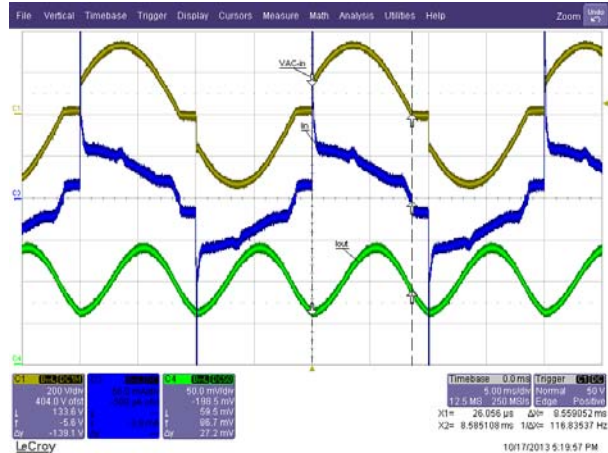


Figure 85 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

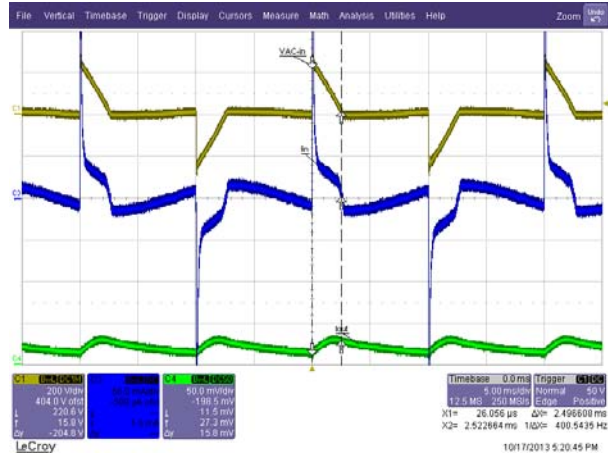


Figure 86 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

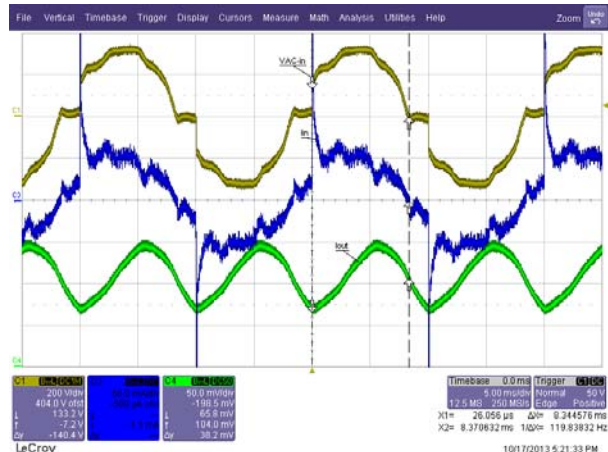


Figure 87 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

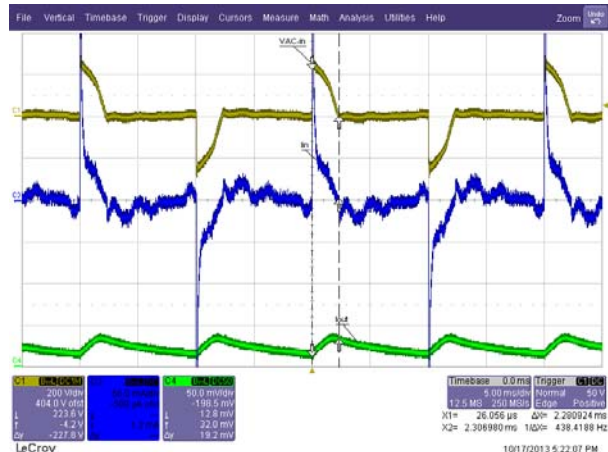


Figure 88 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: TCL

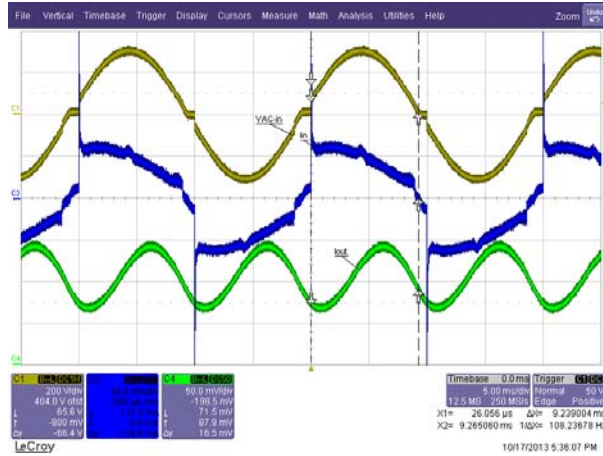


Figure 89 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

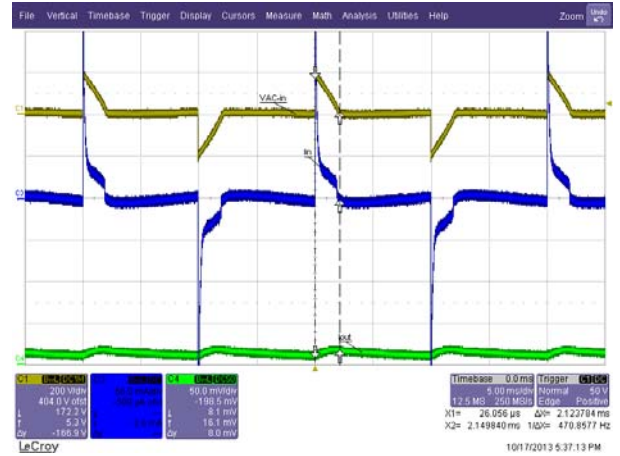


Figure 90 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

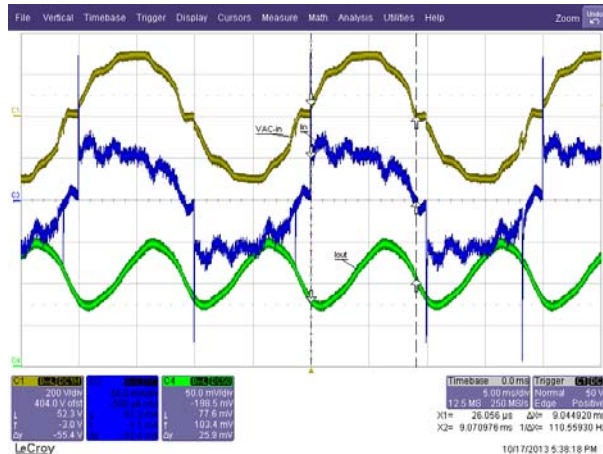


Figure 91 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

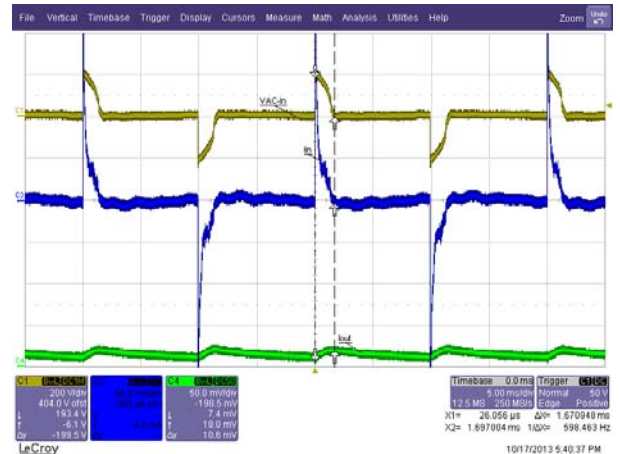


Figure 92 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: SEN BO LANG

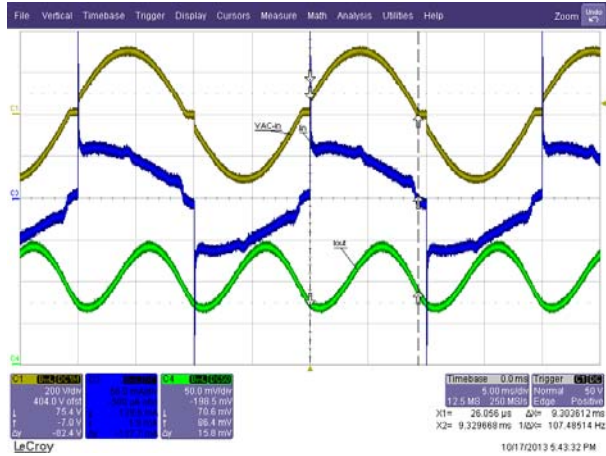


Figure 93 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

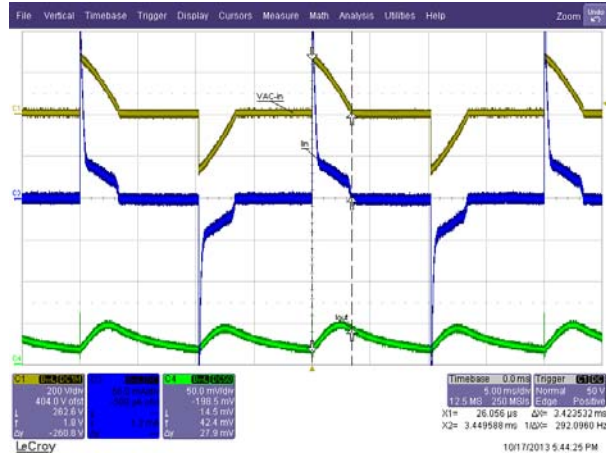


Figure 94 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

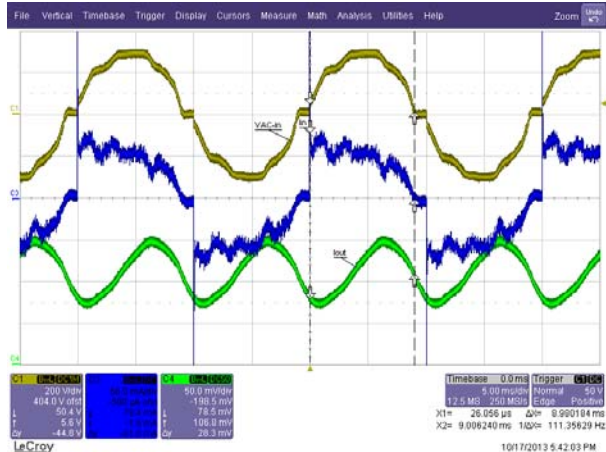


Figure 95 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

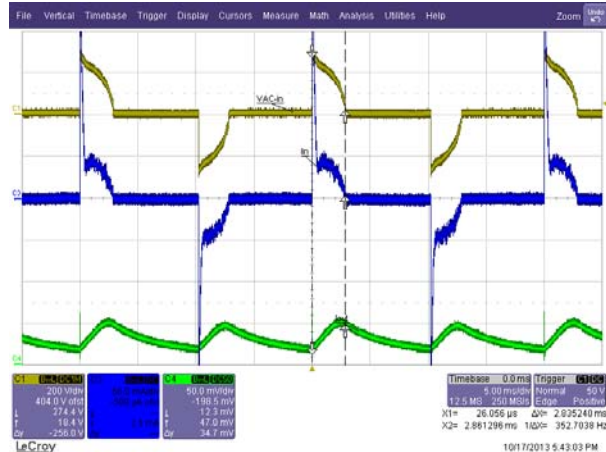


Figure 96 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: EBA HUANG

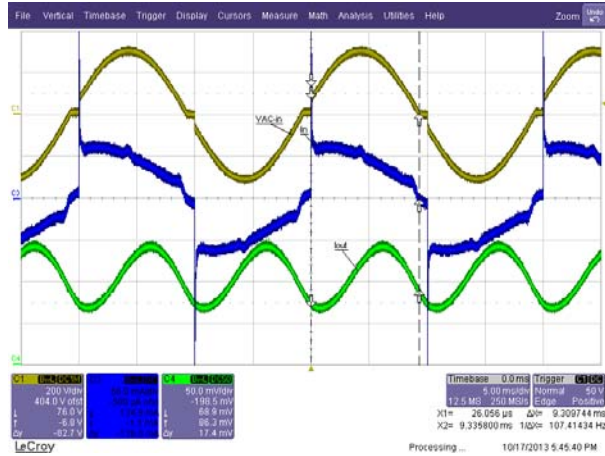


Figure 97 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

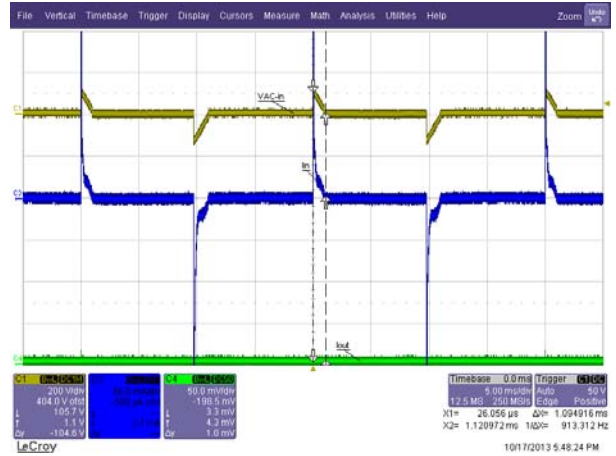


Figure 98 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

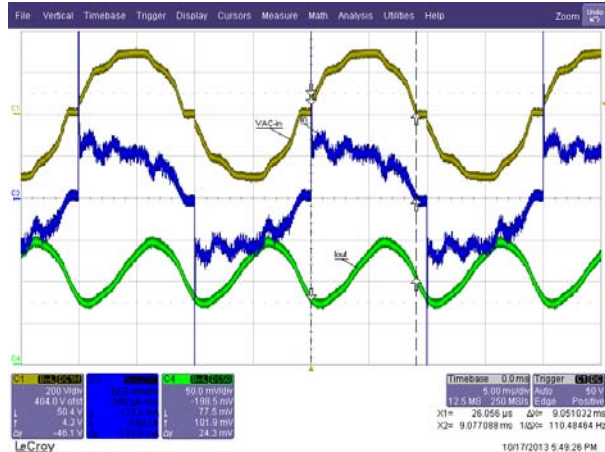


Figure 99 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

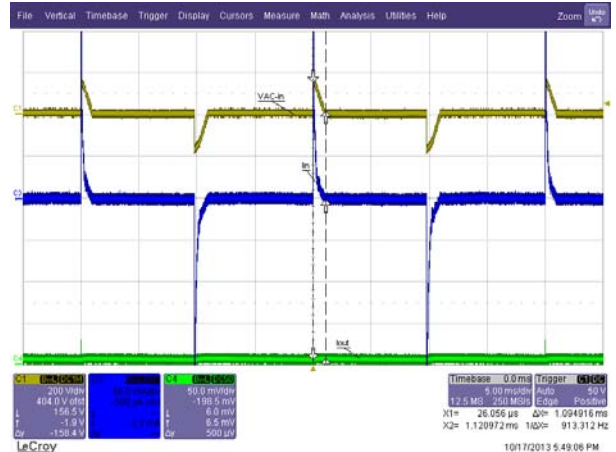


Figure 100 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: SB ELECT

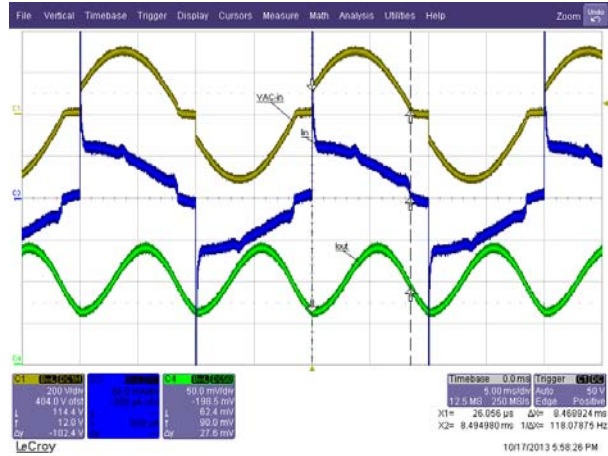


Figure 101 – Full Conduction from Regulated AC
 Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

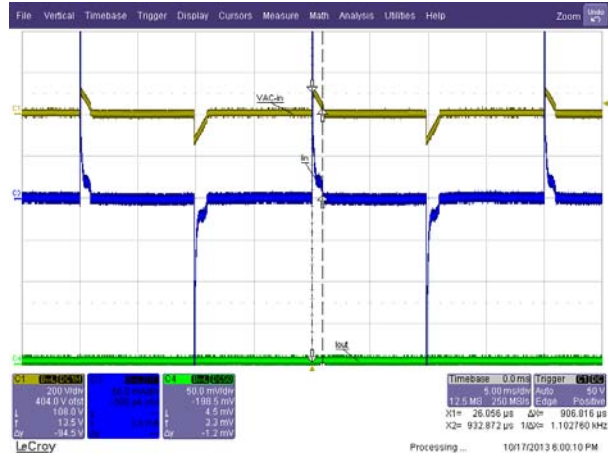


Figure 102 – Minimum Conduction from Regulated AC
 AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

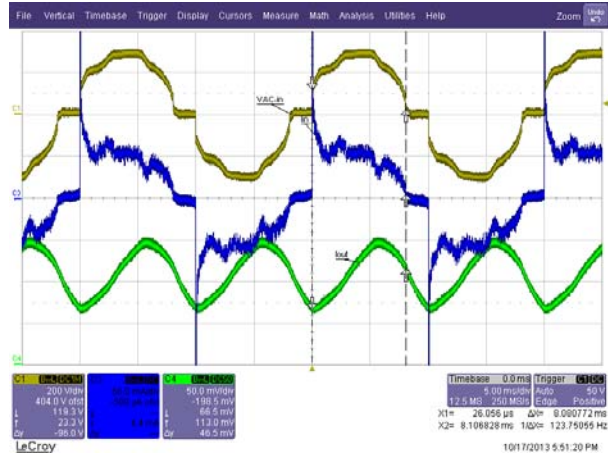


Figure 103 – Full Conduction from Distorted AC
 Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

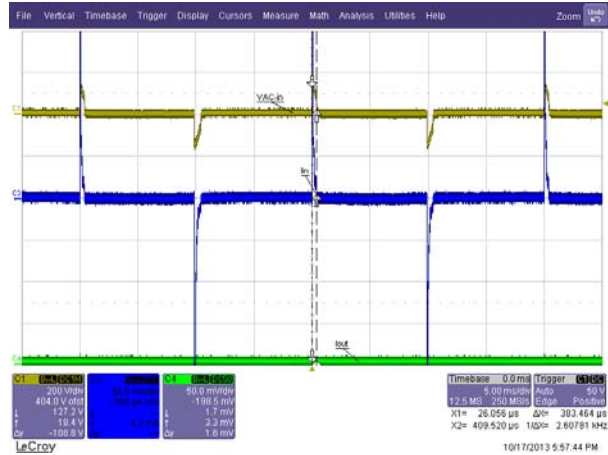


Figure 104 – Minimum Conduction from Distorted AC
 AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: MYONGBO

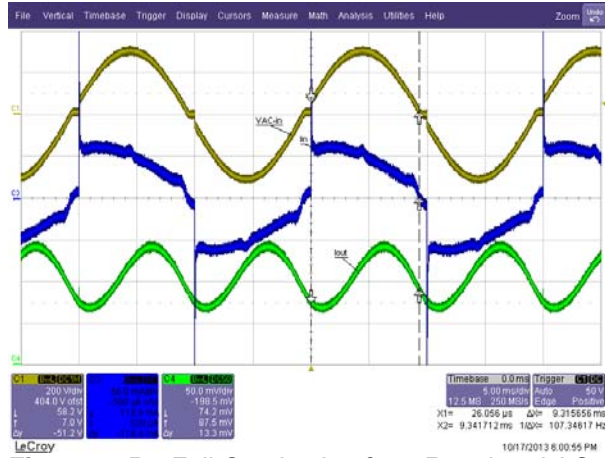


Figure 105 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

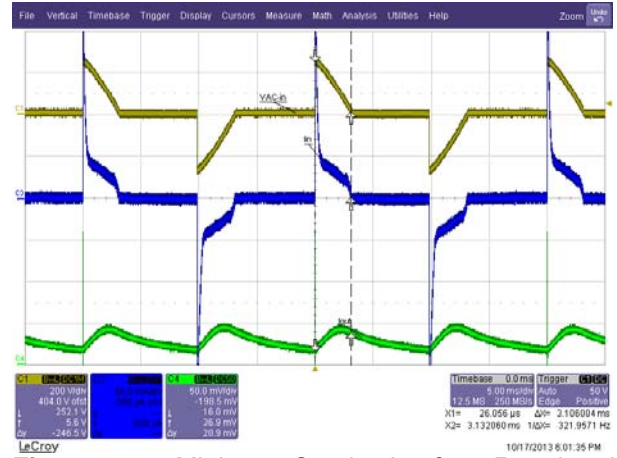


Figure 106 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

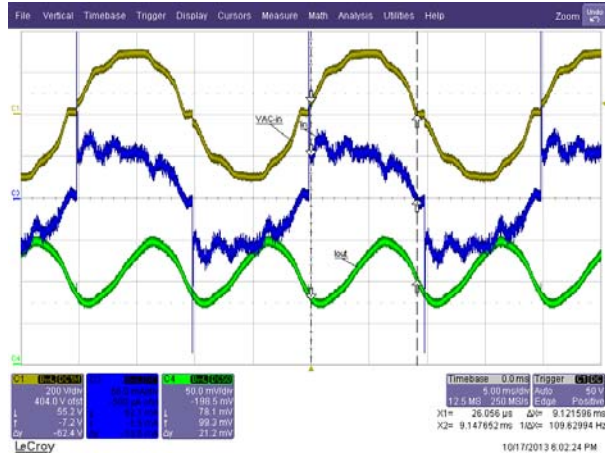


Figure 107 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

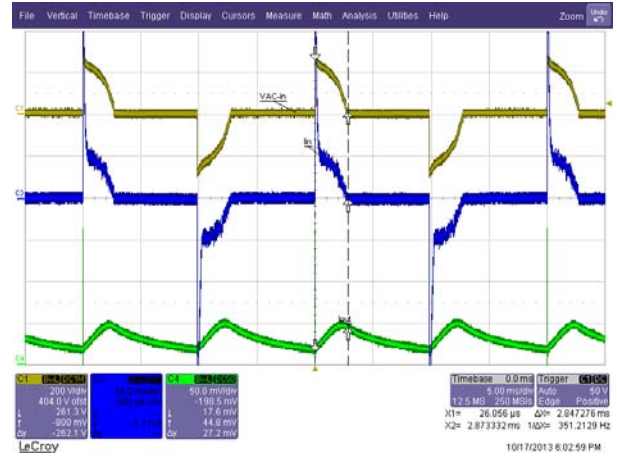


Figure 108 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: KBE

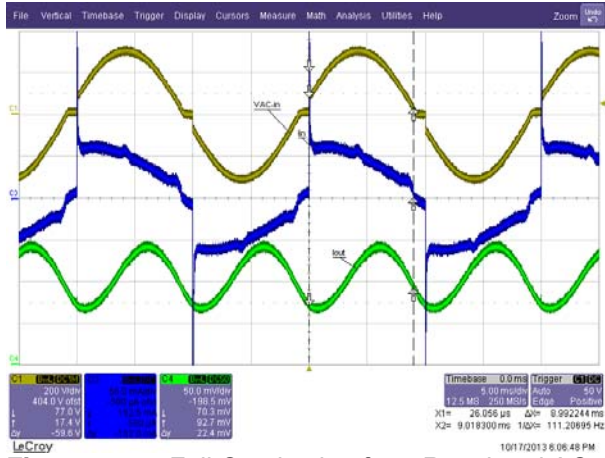


Figure 109 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

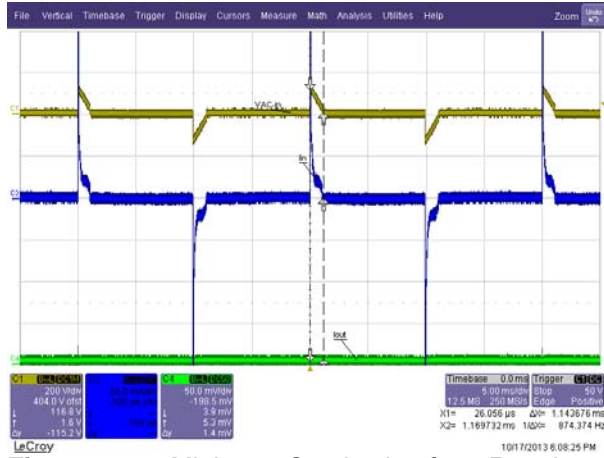


Figure 110 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

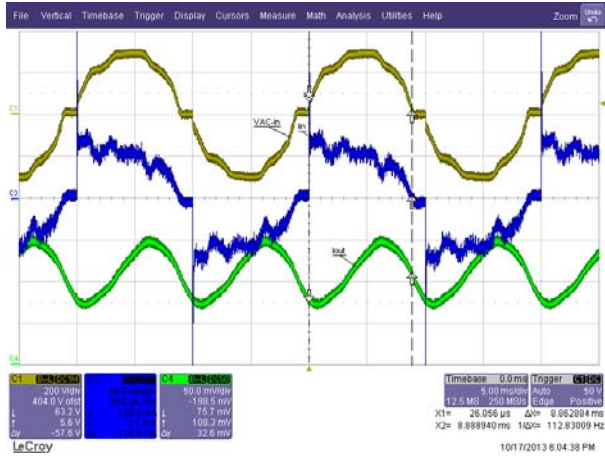


Figure 111 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

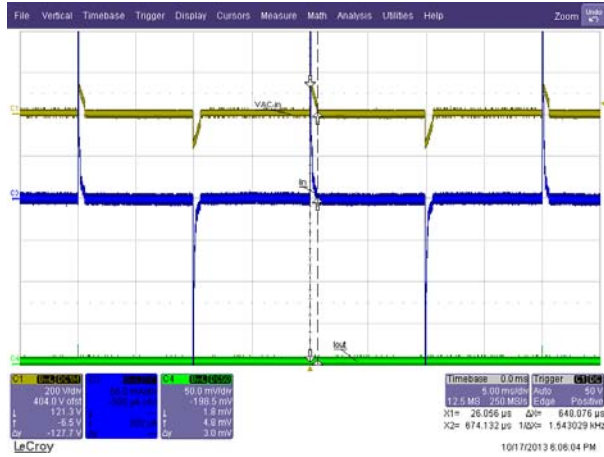


Figure 112 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: CLIPMEI

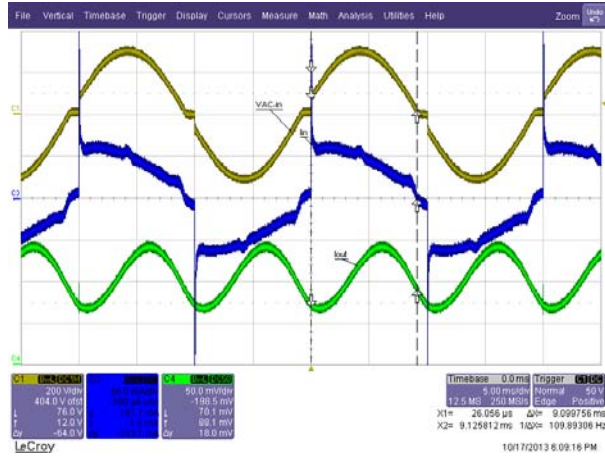


Figure 113 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

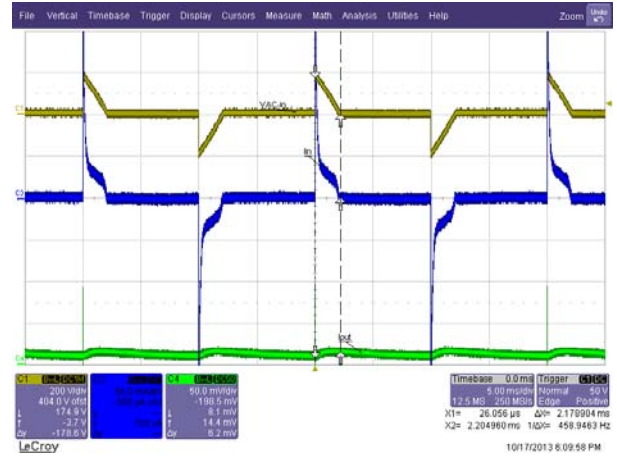


Figure 114 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

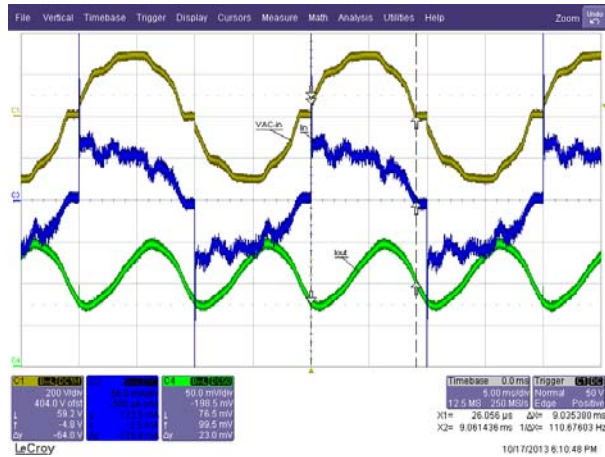


Figure 115 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

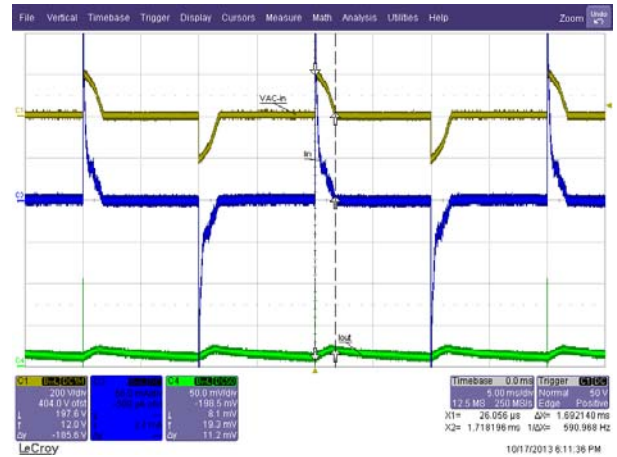


Figure 116 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms /



Dimmer: MANK

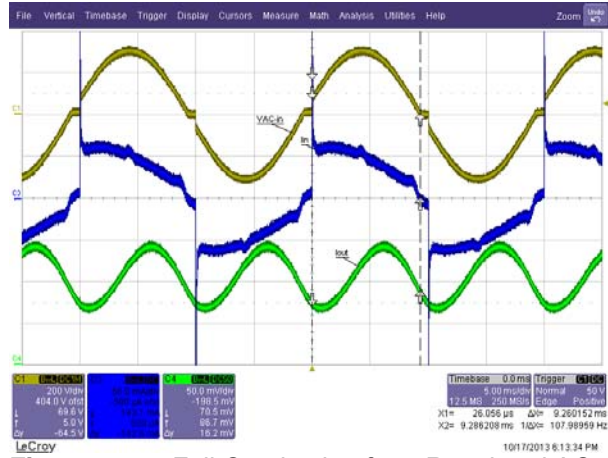


Figure 117 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

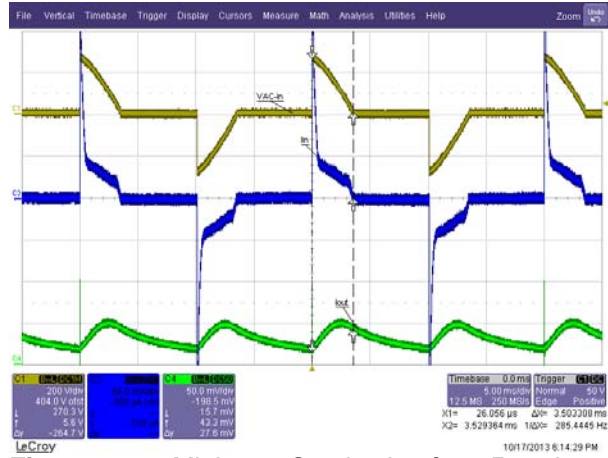


Figure 118 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

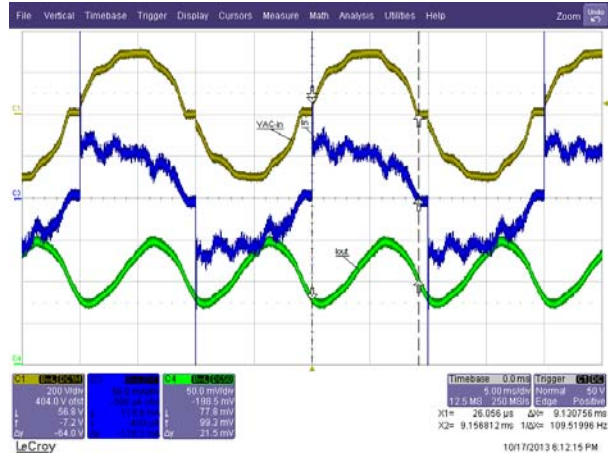


Figure 119 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

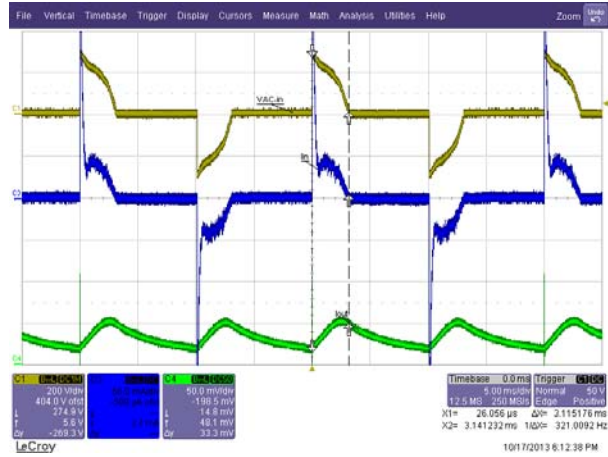


Figure 120 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: GIRA 1176 00 I03

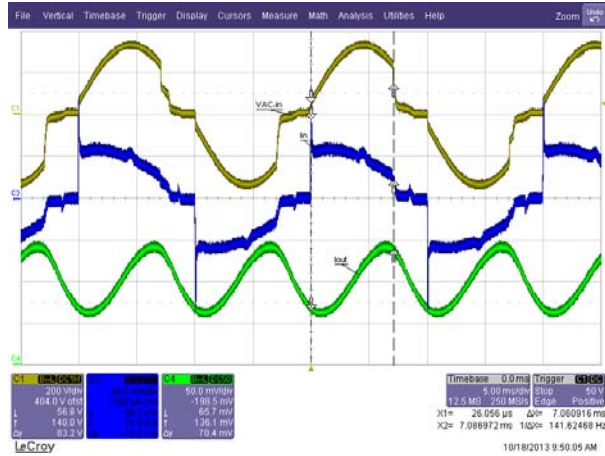


Figure 121 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

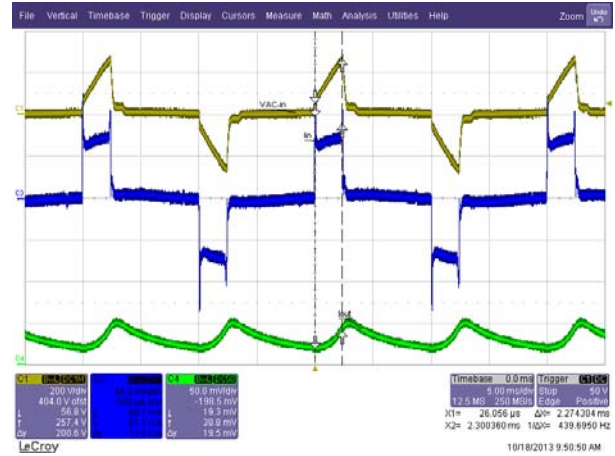


Figure 122 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

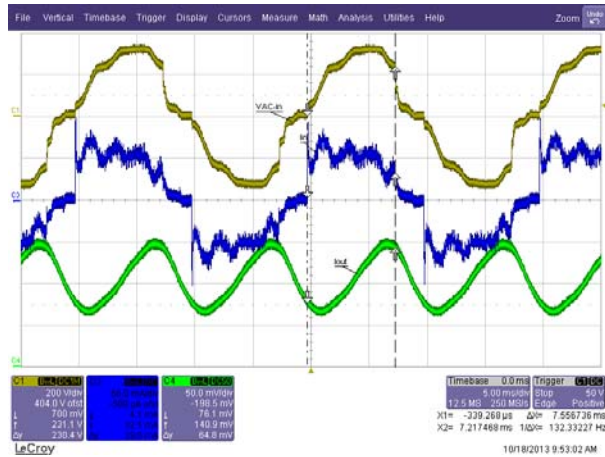


Figure 123 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

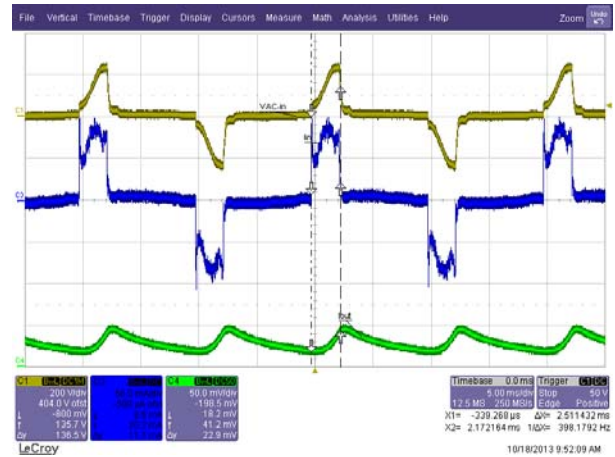


Figure 124 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Niko 310-013

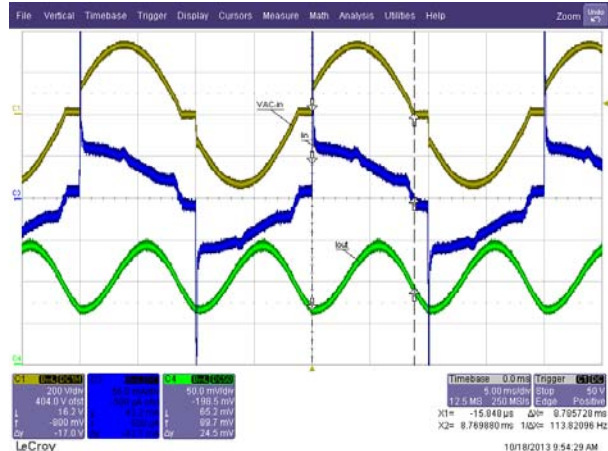


Figure 125 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

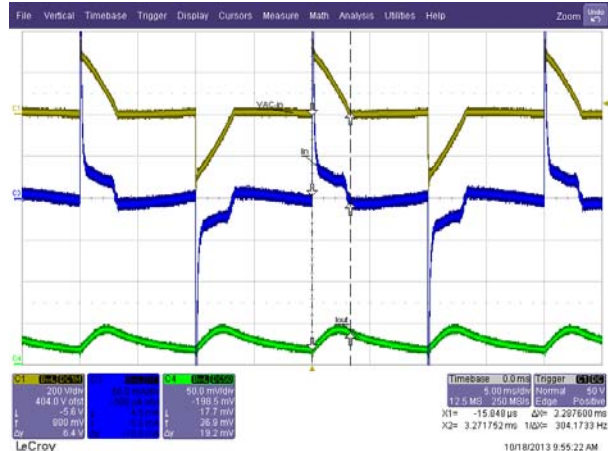


Figure 126 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

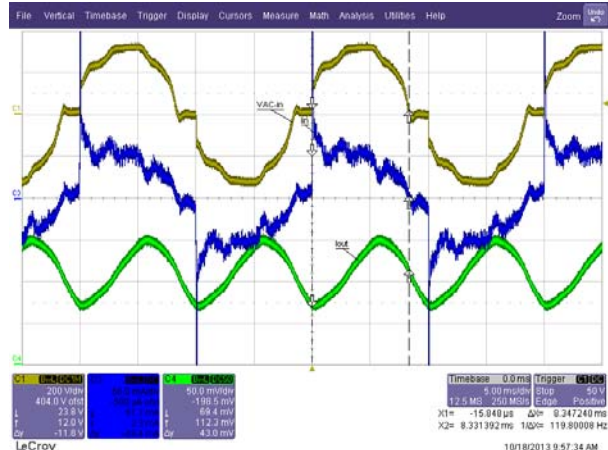


Figure 127 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

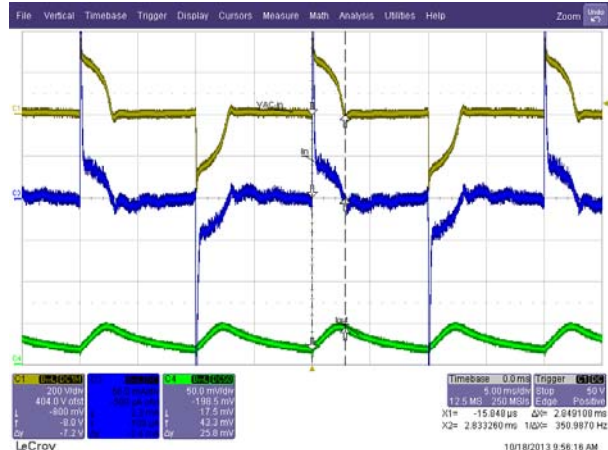


Figure 128 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: Niko 310-017

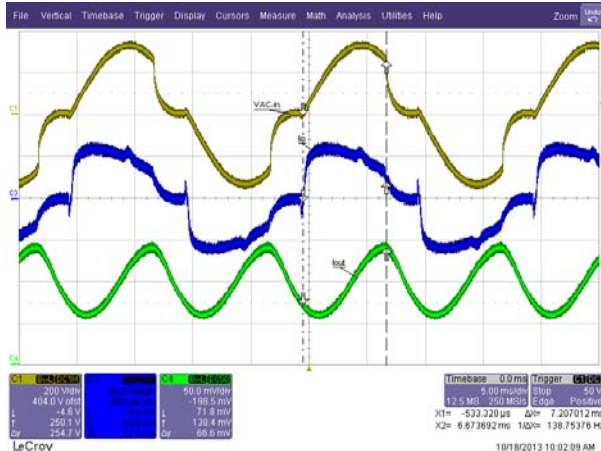


Figure 129 – Full Conduction from Regulated AC
 Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

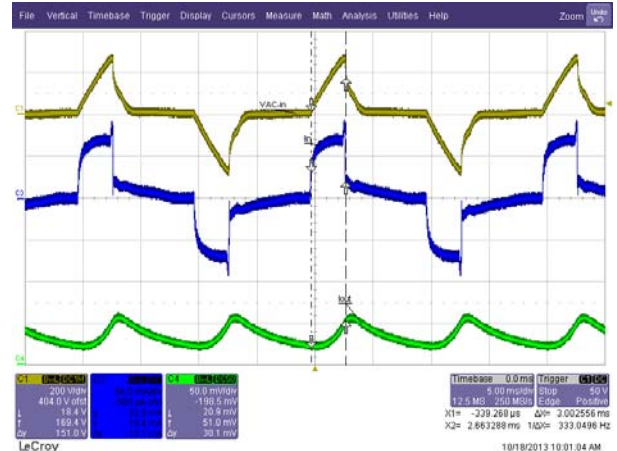


Figure 130 – Minimum Conduction from Regulated AC
 AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

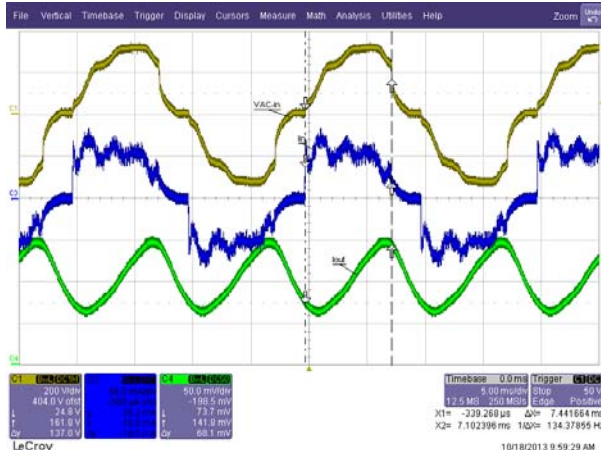


Figure 131 – Full Conduction from Distorted AC
 Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

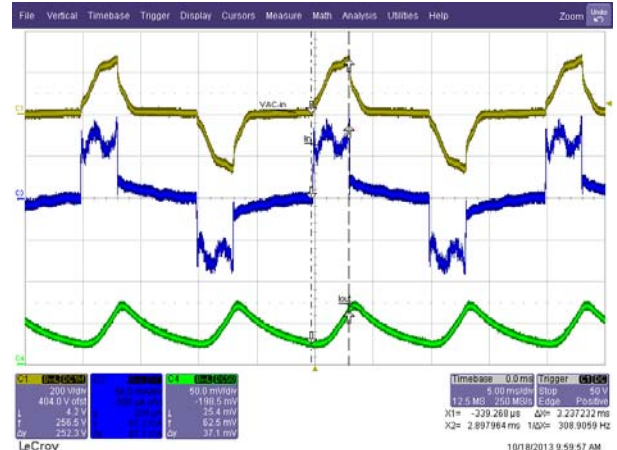


Figure 132 – Minimum Conduction from Distorted AC
 AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Niko 310-014

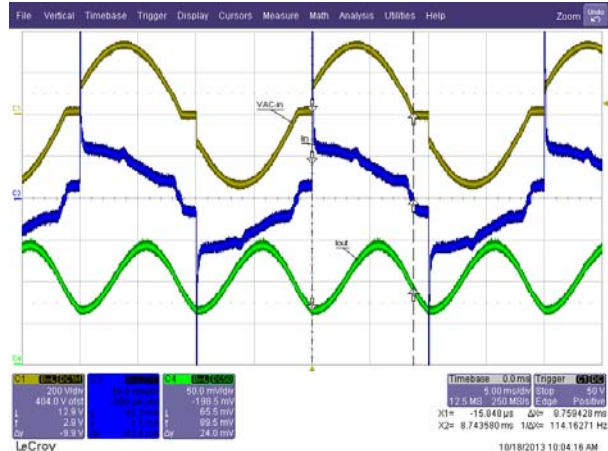


Figure 133 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

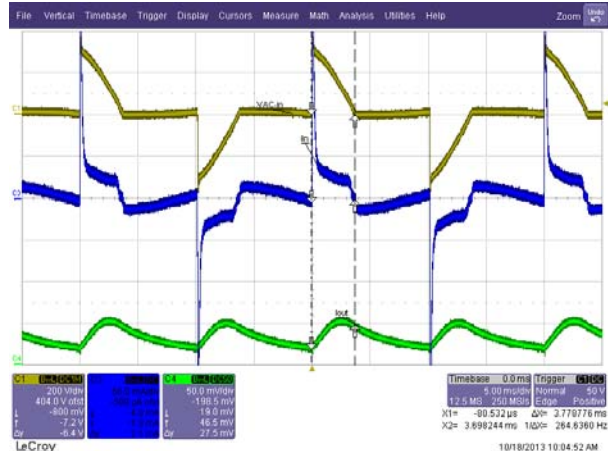


Figure 134 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

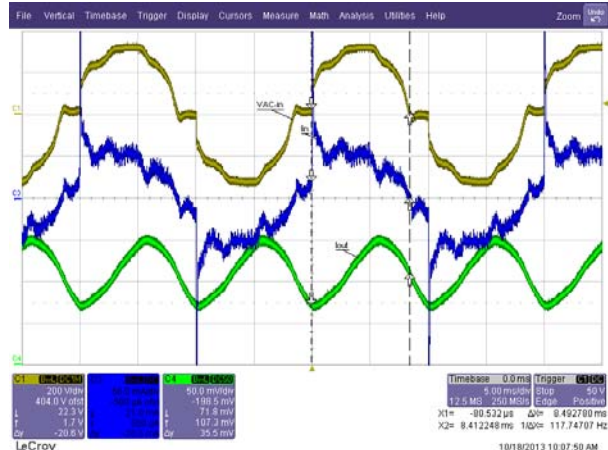


Figure 135 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

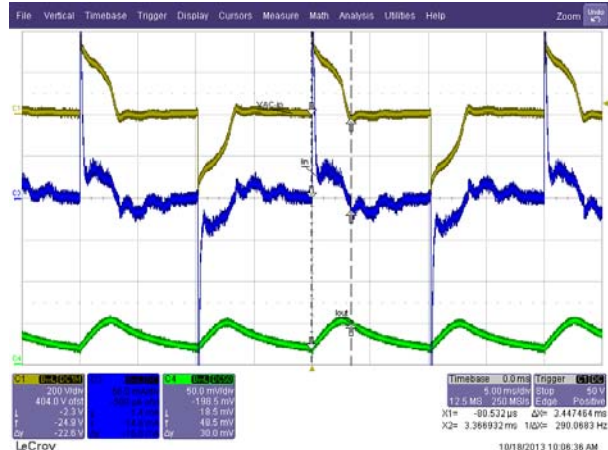


Figure 136 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: Niko 310-016

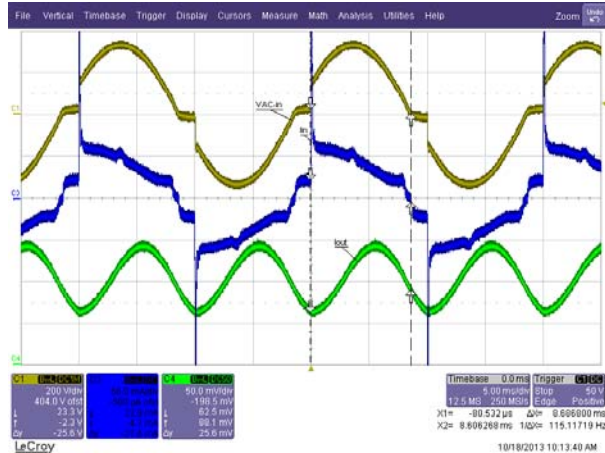


Figure 137 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

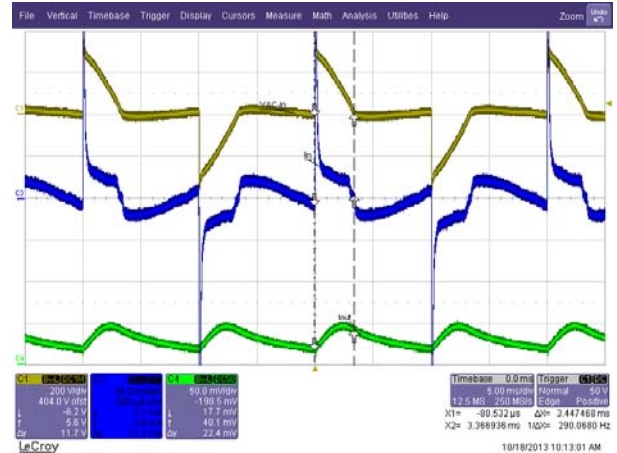


Figure 138 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

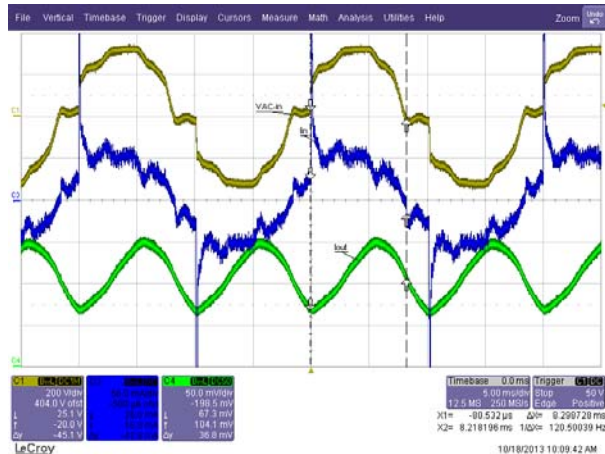


Figure 139 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

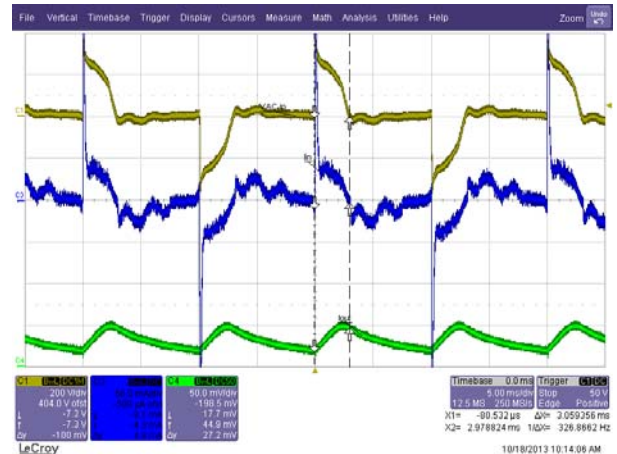


Figure 140 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Busch 2250

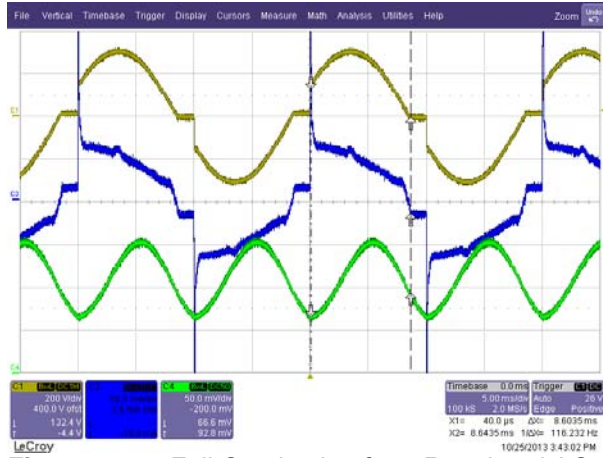


Figure 141 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

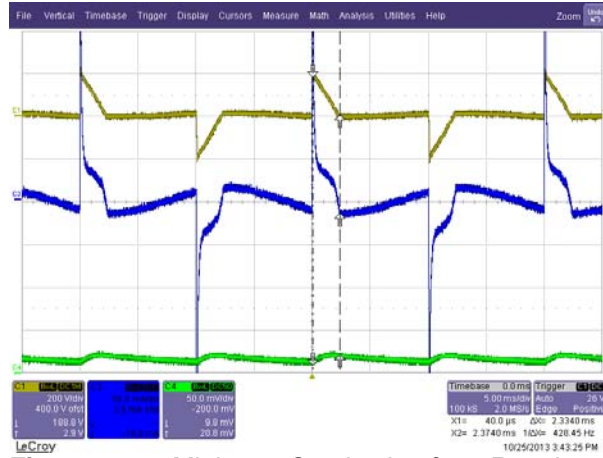


Figure 142 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

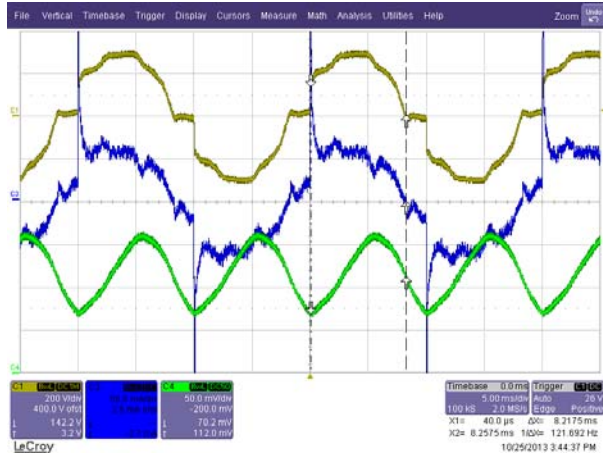


Figure 143 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

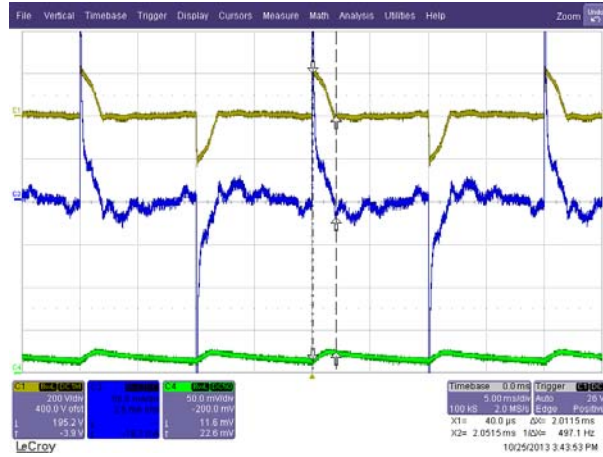


Figure 144 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: PEHA 400 W

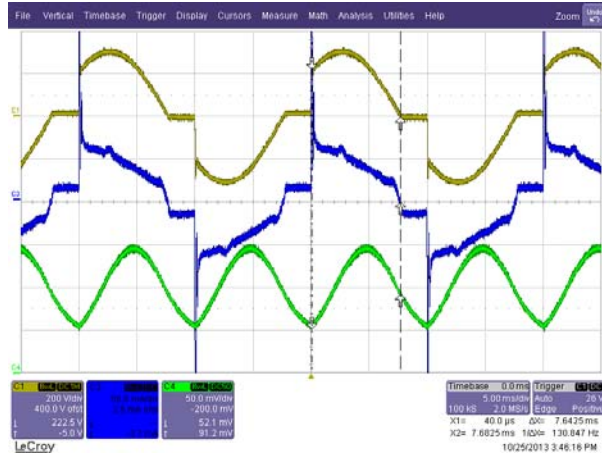


Figure 145 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

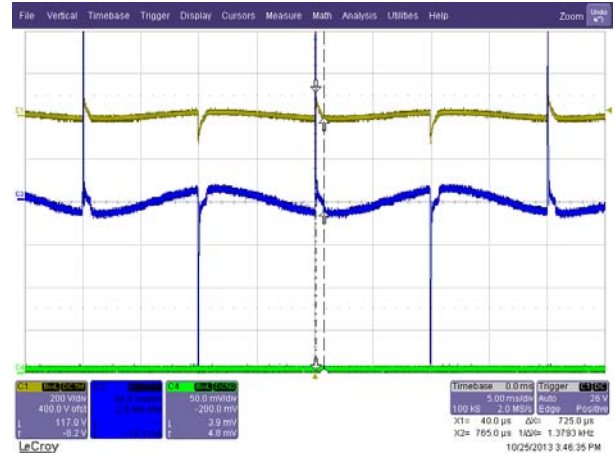


Figure 146 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

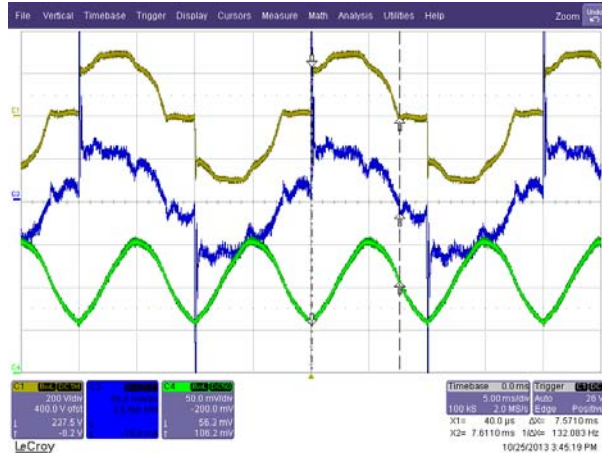


Figure 147 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

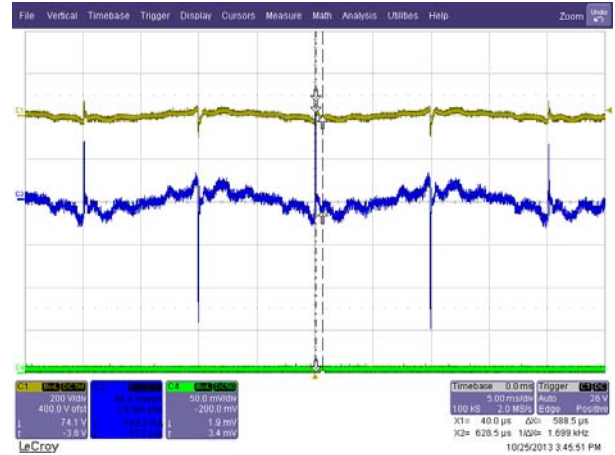


Figure 148 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Merten 572499

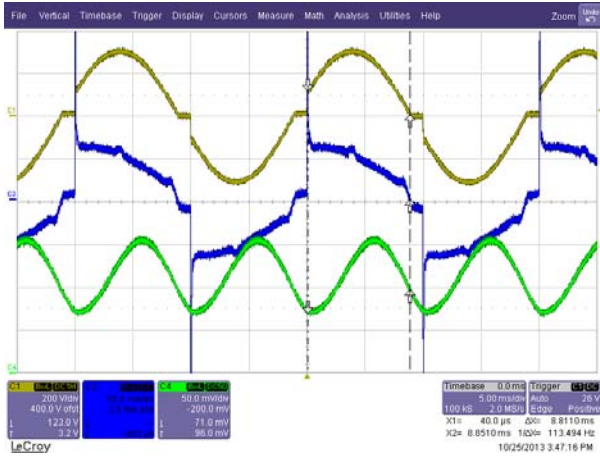


Figure 149 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

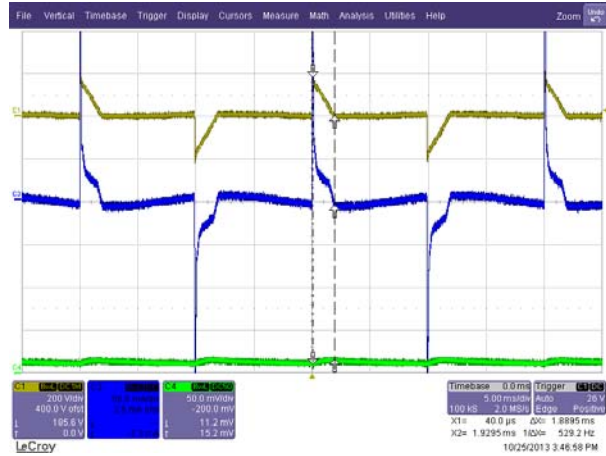


Figure 150 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

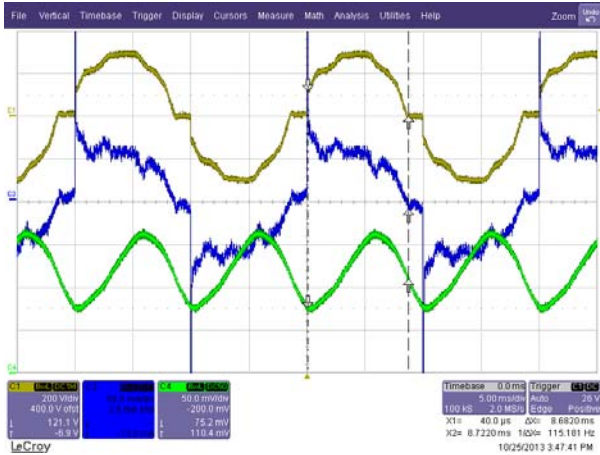


Figure 151 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

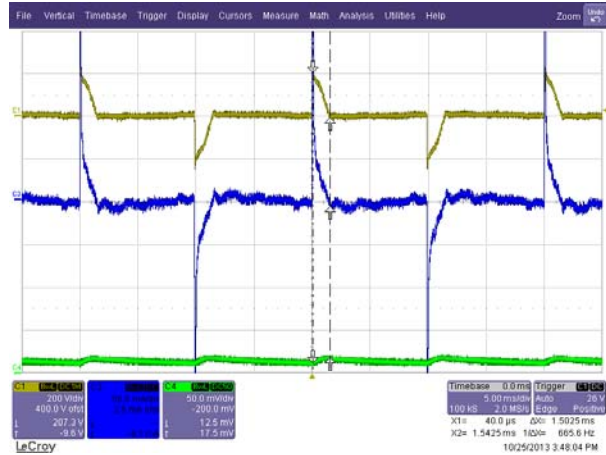


Figure 152 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: Busch 6513

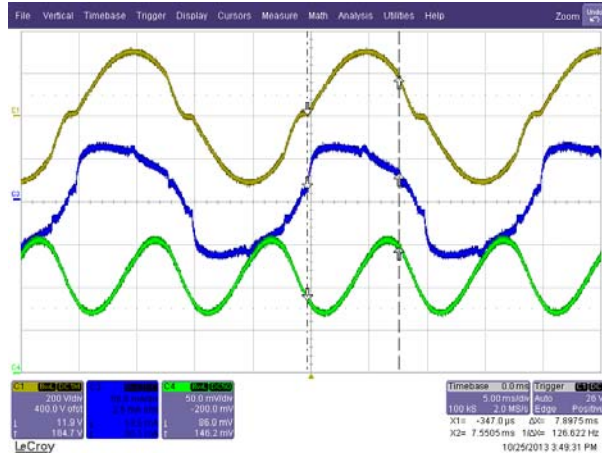


Figure 153 – Full Conduction from Regulated AC
 Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

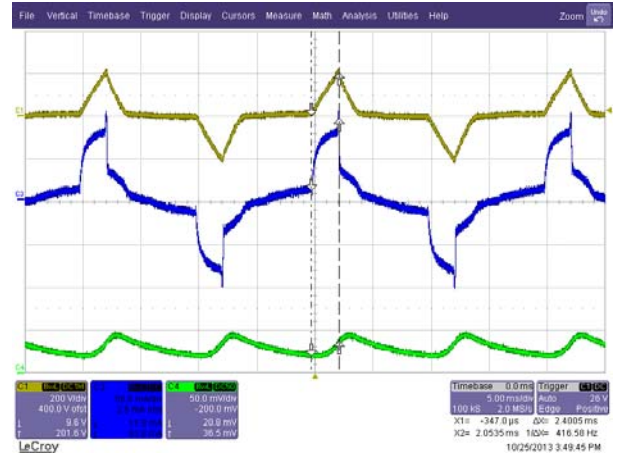


Figure 154 – Minimum Conduction from Regulated AC
 AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

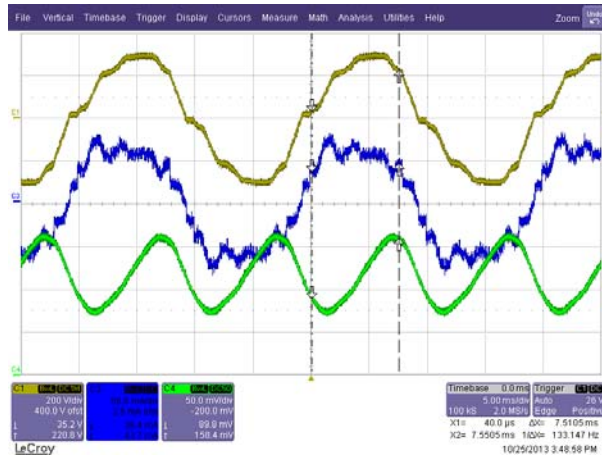


Figure 155 – Full Conduction from Distorted AC
 Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

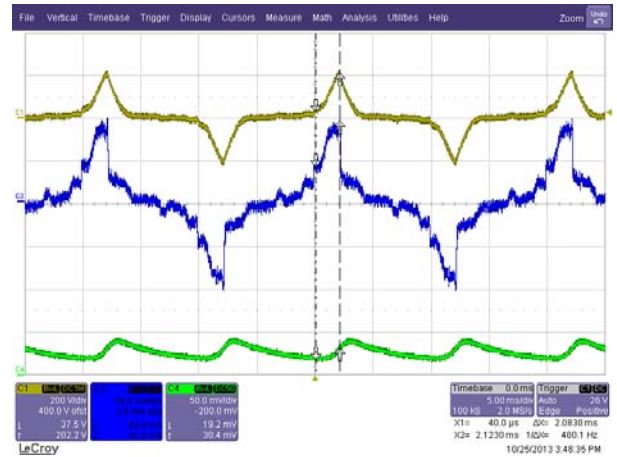


Figure 156 – Minimum Conduction from Distorted AC
 AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Berker 2875

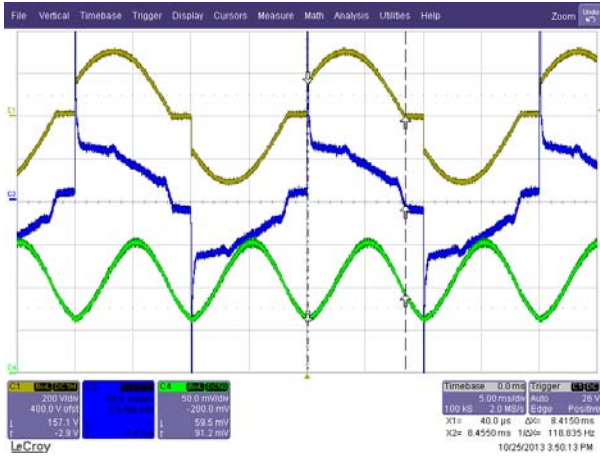


Figure 157 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

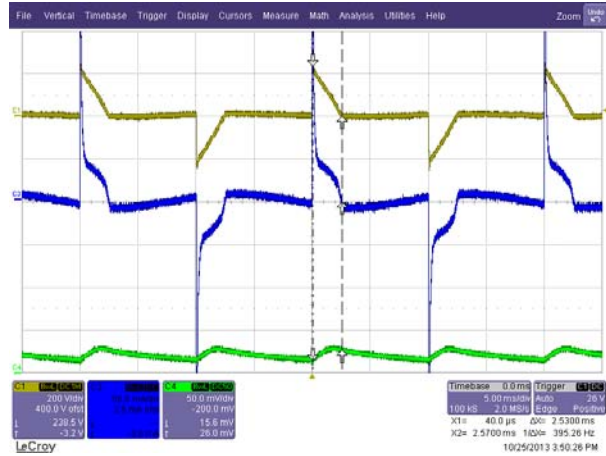


Figure 158 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

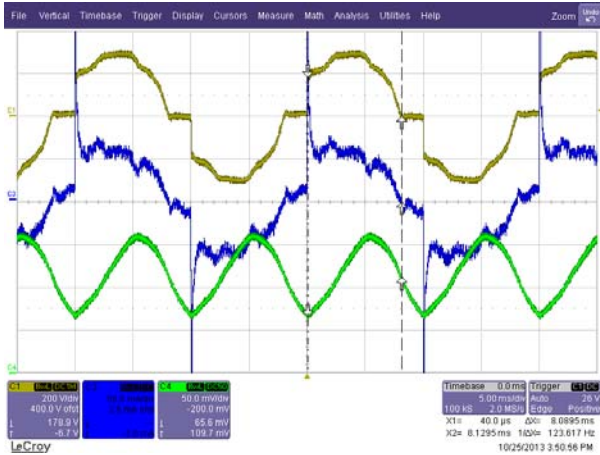


Figure 159 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

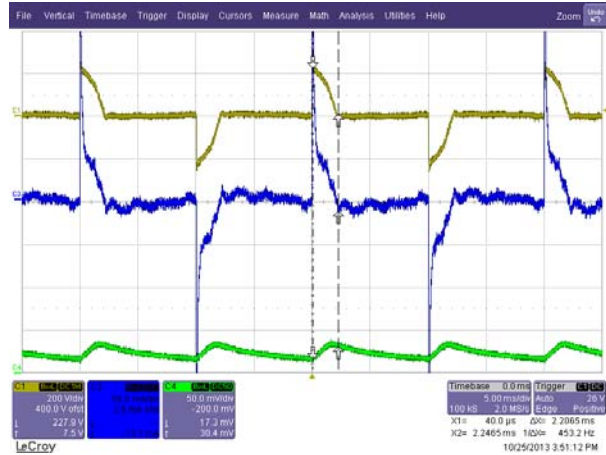


Figure 160 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: Berker 2830-10

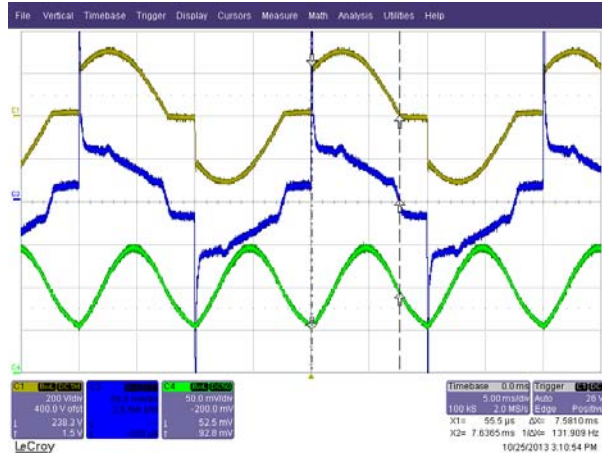


Figure 161 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

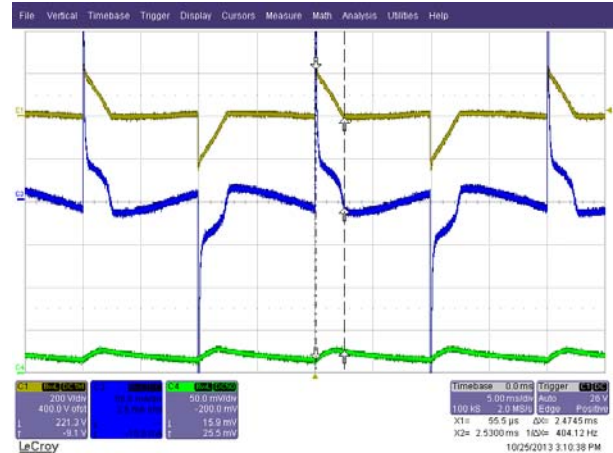


Figure 162 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

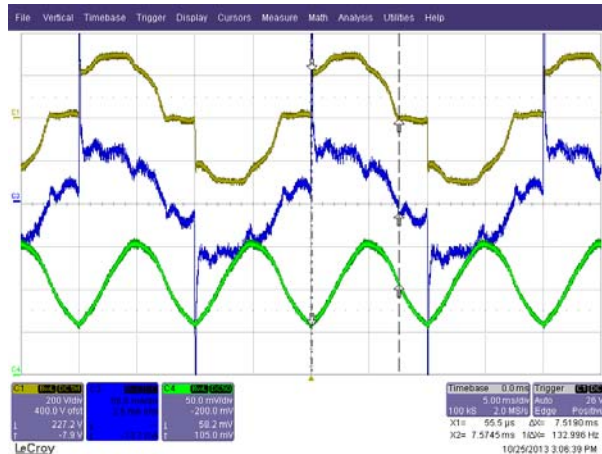


Figure 163 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

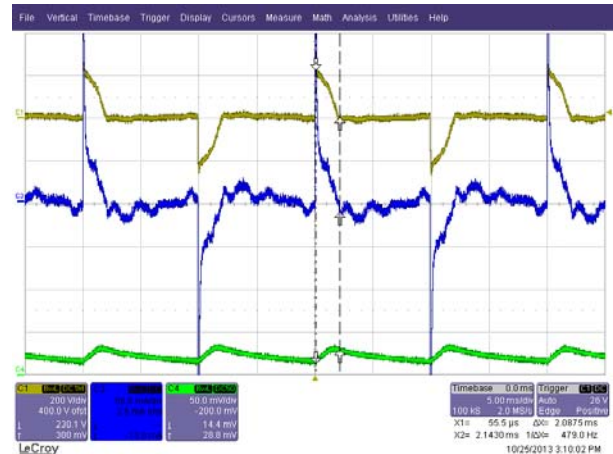


Figure 164 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Busch 6591-101

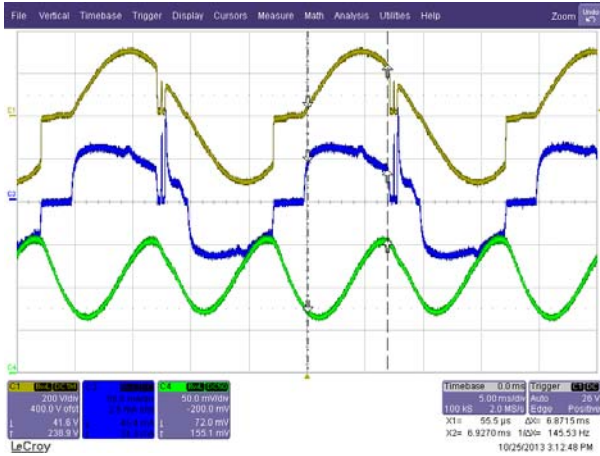


Figure 165 – Full Conduction from Regulated AC Input 230 V / 50 Hz. Natural characteristic of the dimmer is asymmetric.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

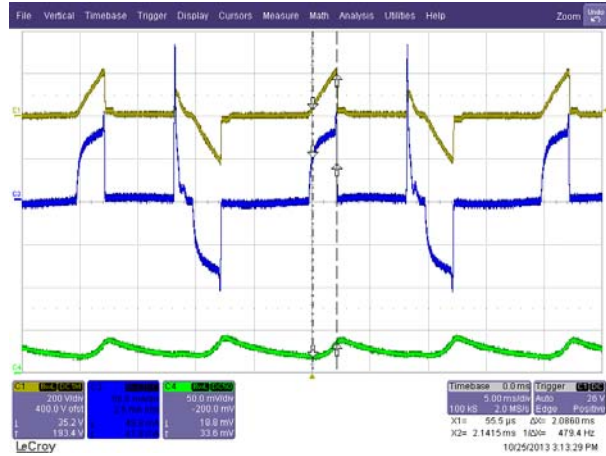


Figure 166 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

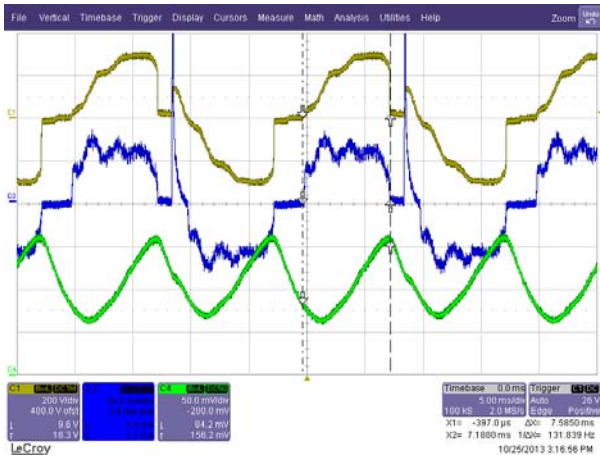


Figure 167 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

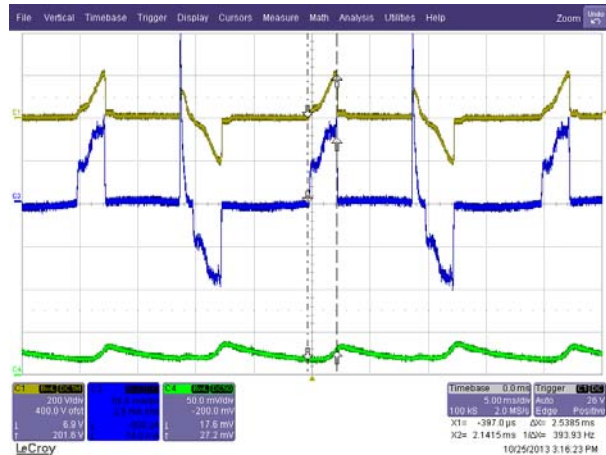


Figure 168 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: Busch 6513 U-102

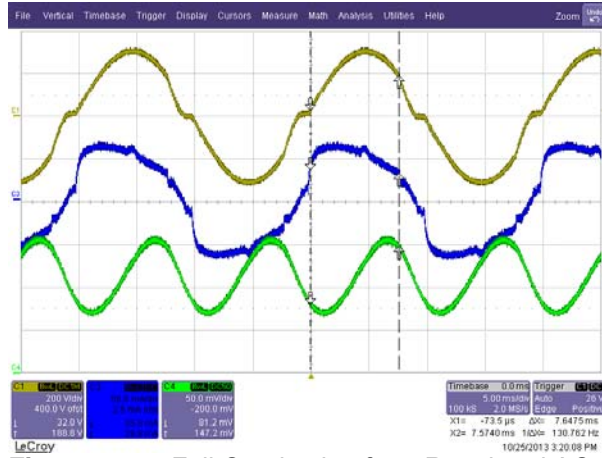


Figure 169 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

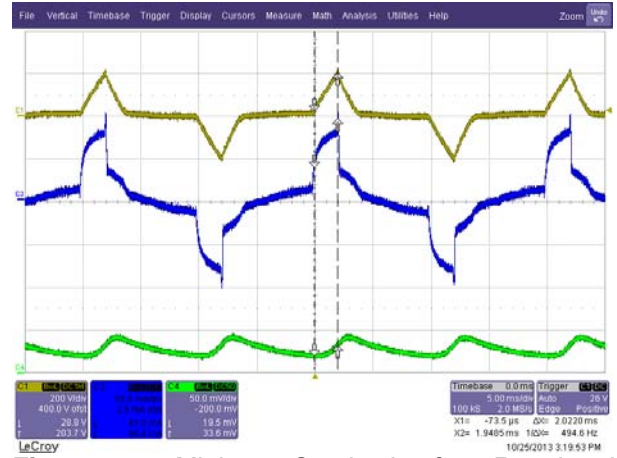


Figure 170 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

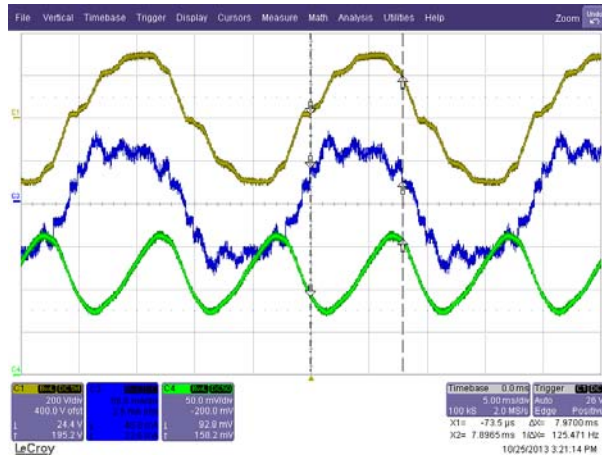


Figure 171 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

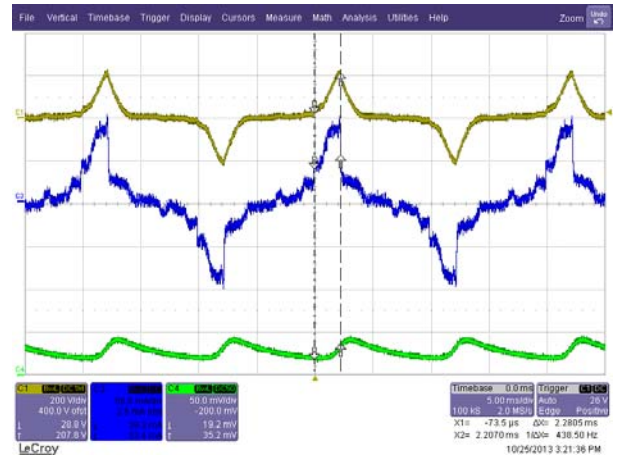


Figure 172 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: PEHA 433HAB 0A

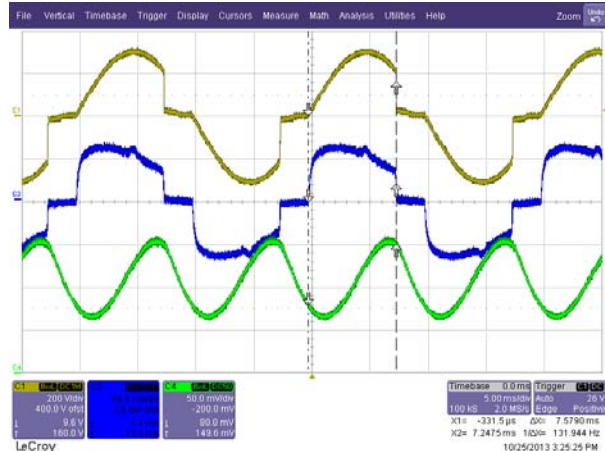


Figure 173 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

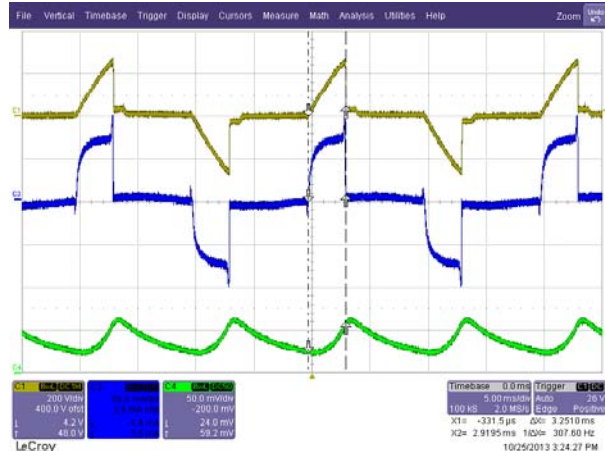


Figure 174 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

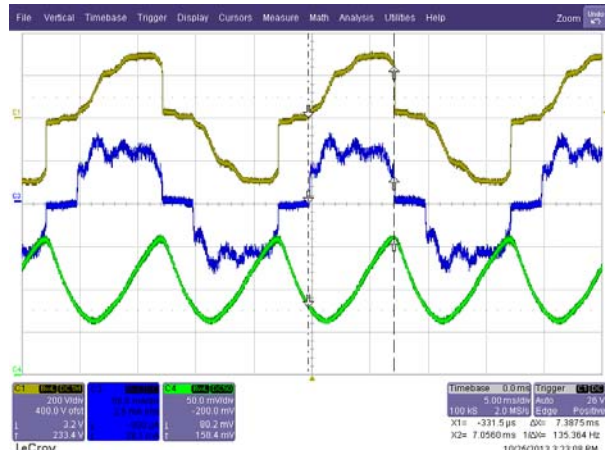


Figure 175 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

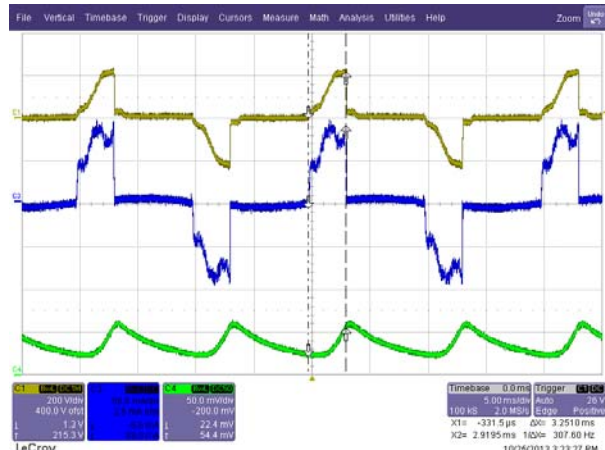


Figure 176 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: PEHA 433HAB 0A

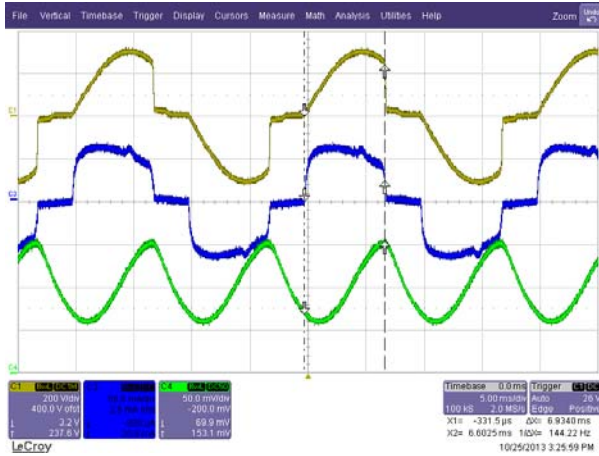


Figure 177 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

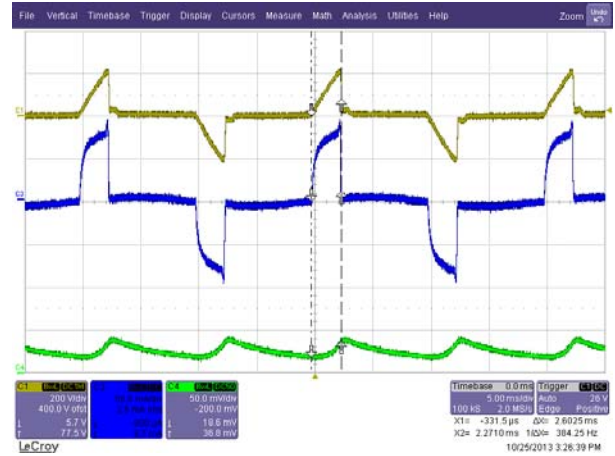


Figure 178 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

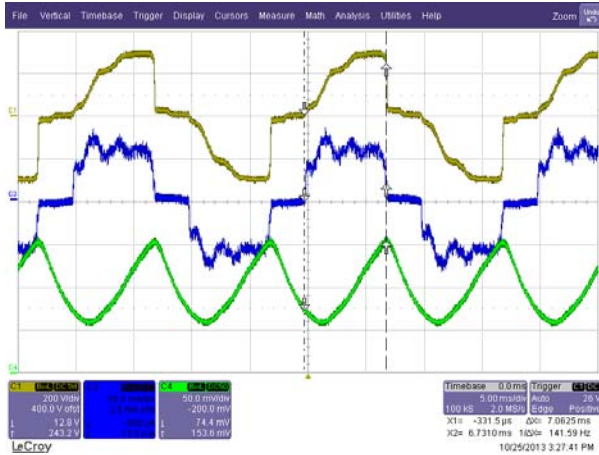


Figure 179 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

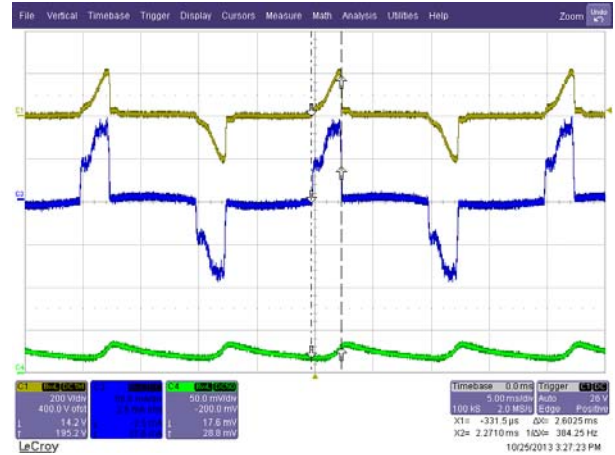


Figure 180 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Relco RM34DMA

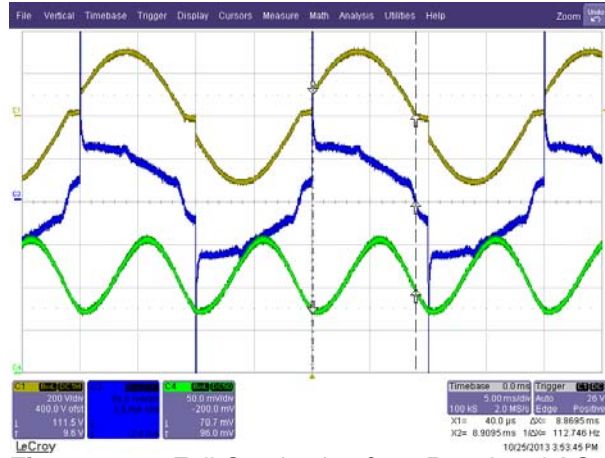


Figure 181 – Full Conduction from Regulated AC
 Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

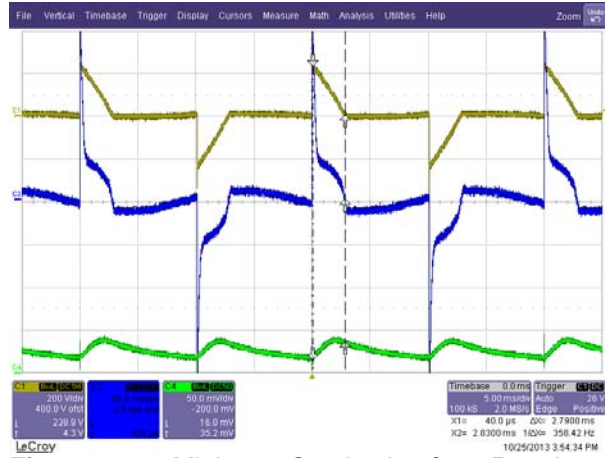


Figure 182 – Minimum Conduction from Regulated AC
 AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

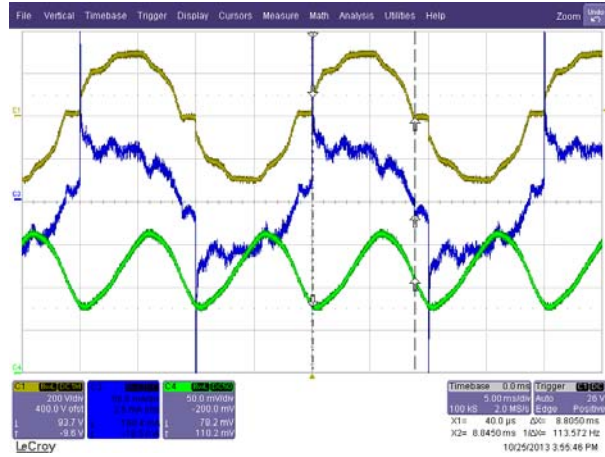


Figure 183 – Full Conduction from Distorted AC
 Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

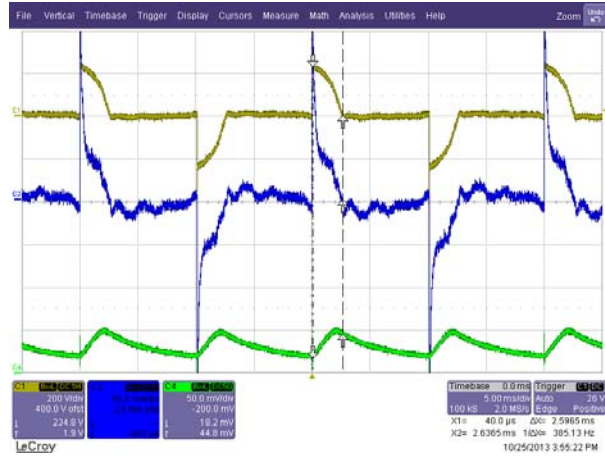


Figure 184 – Minimum Conduction from Distorted AC
 AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5ms / div.

Dimmer: Relco RTM34LED DAXS

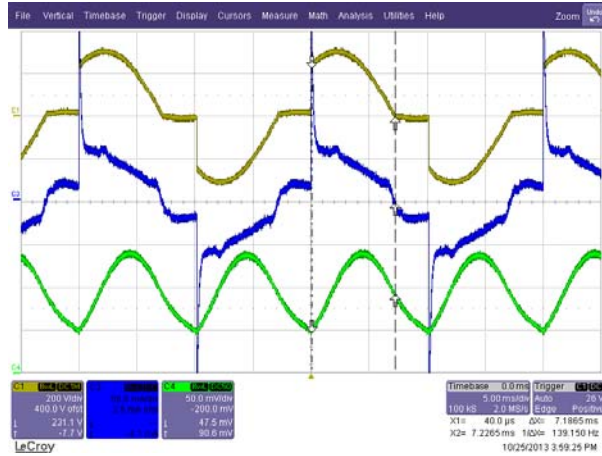


Figure 185 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

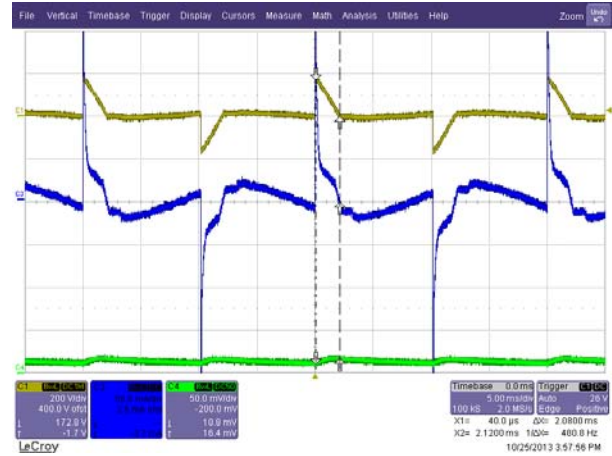


Figure 186 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

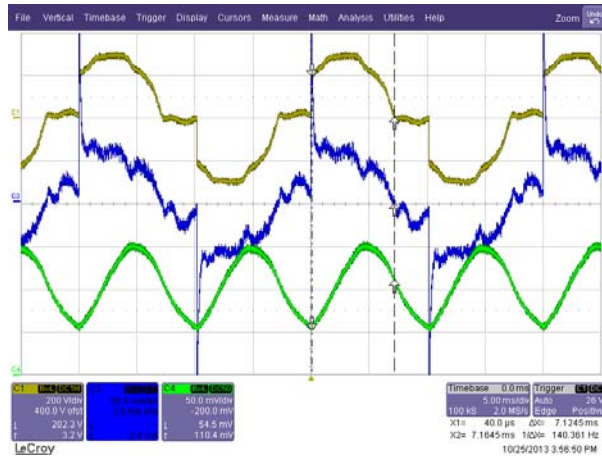


Figure 187 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

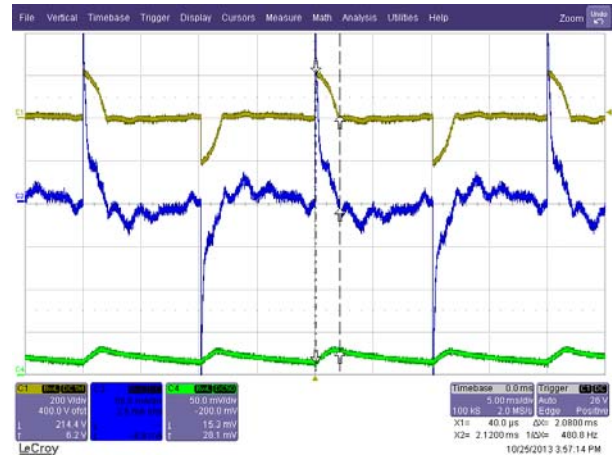


Figure 188 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Relco RM34DMA

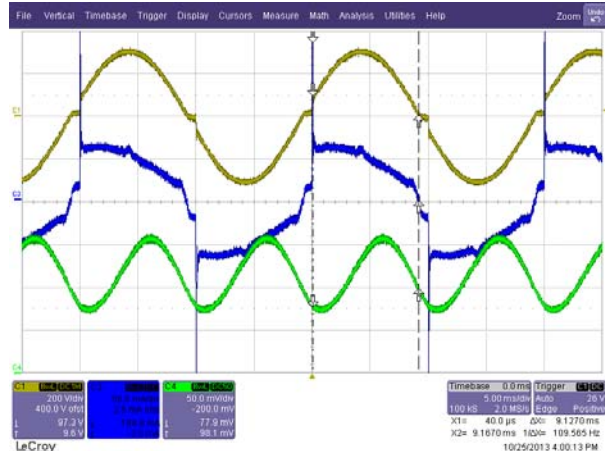


Figure 189 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

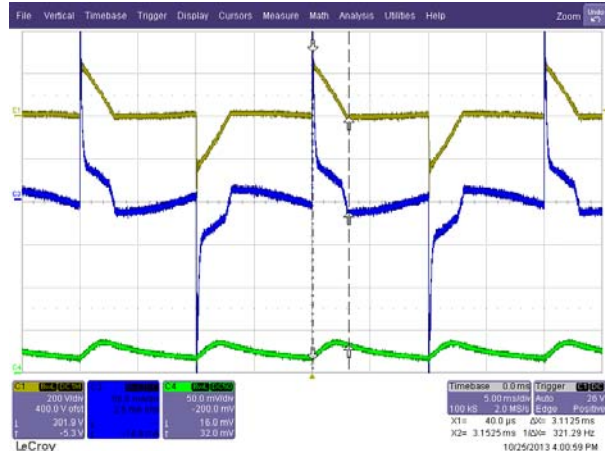


Figure 190 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

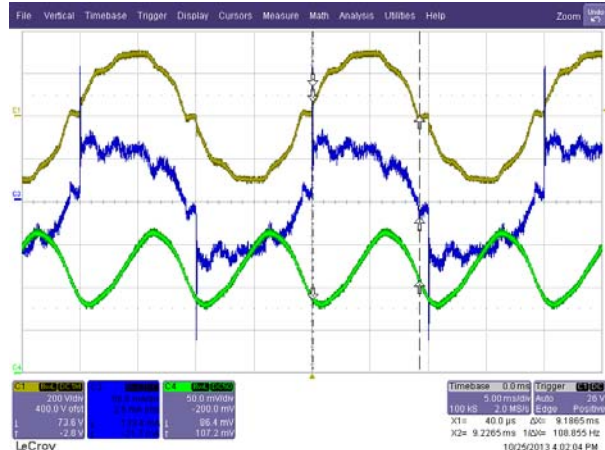


Figure 191 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

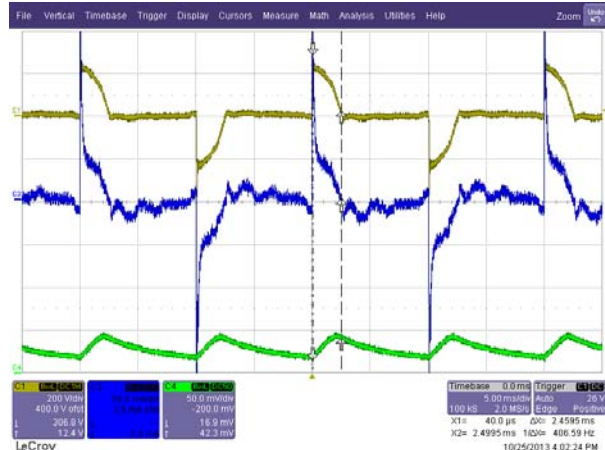


Figure 192 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: Relco RTS34.43 RLI

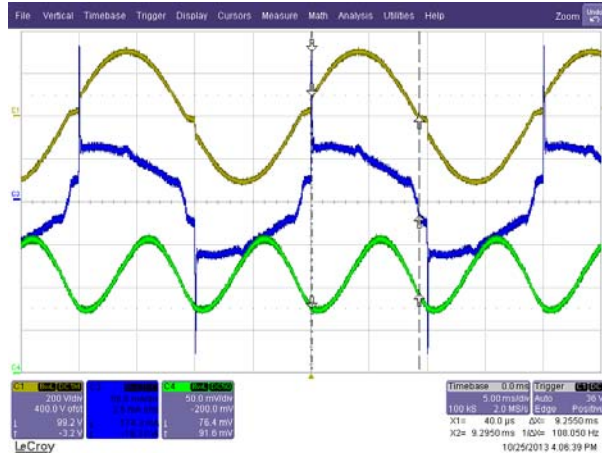


Figure 193 – Full Conduction from Regulated AC
 Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

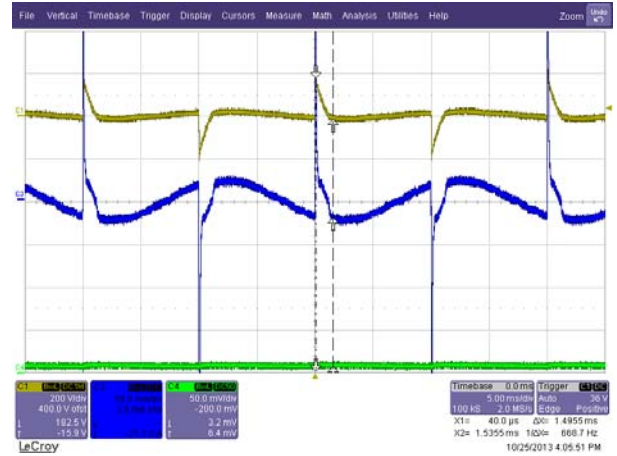


Figure 194 – Minimum Conduction from Regulated AC
 AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

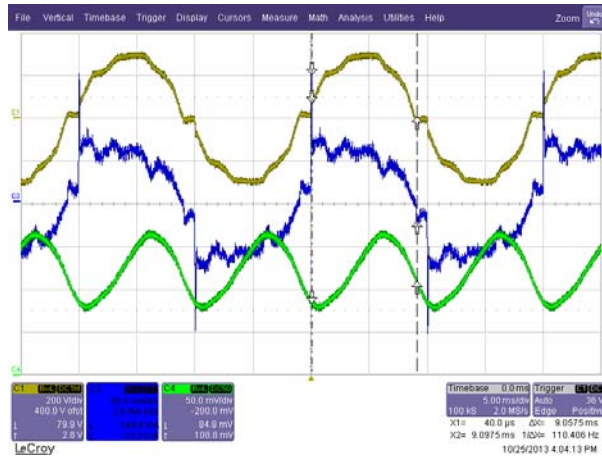


Figure 195 – Full Conduction from Distorted AC
 Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

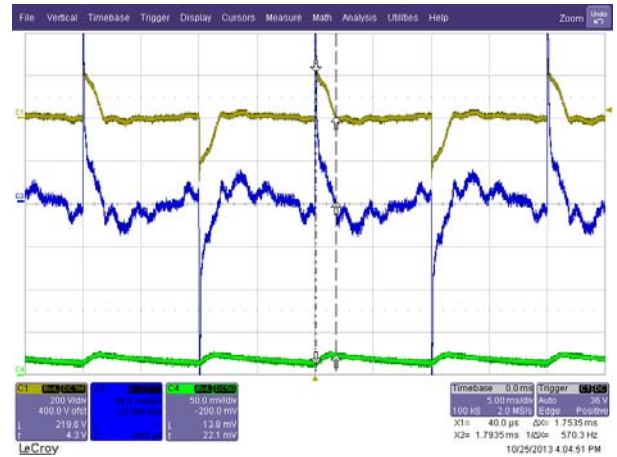


Figure 196 – Minimum Conduction from Distorted AC
 AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Relco RT34DSL

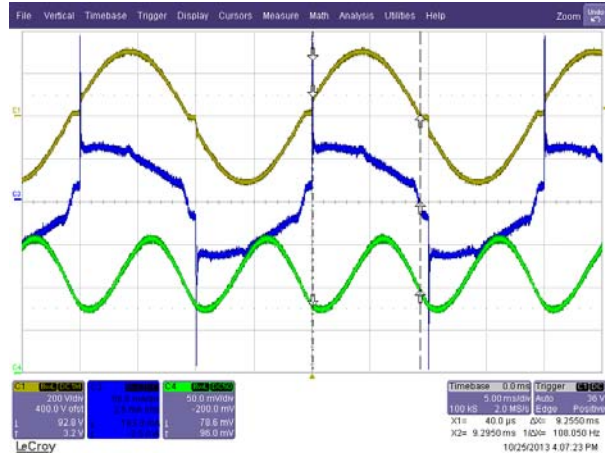


Figure 197 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

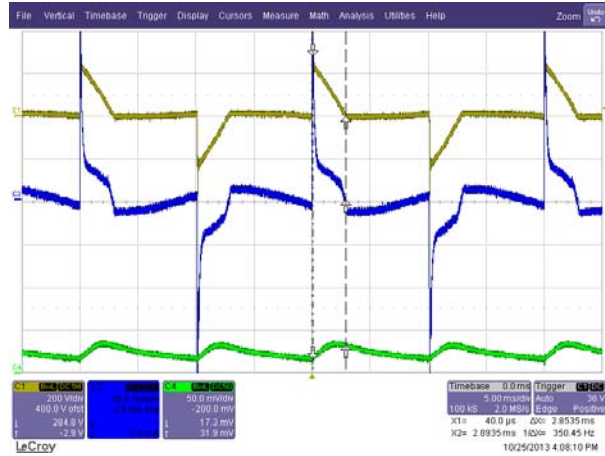


Figure 198 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

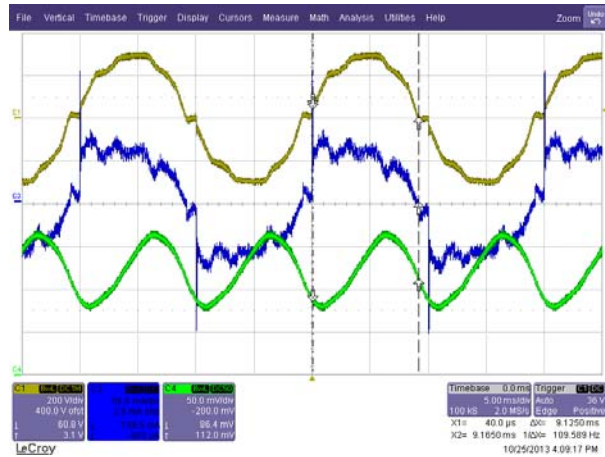


Figure 199 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

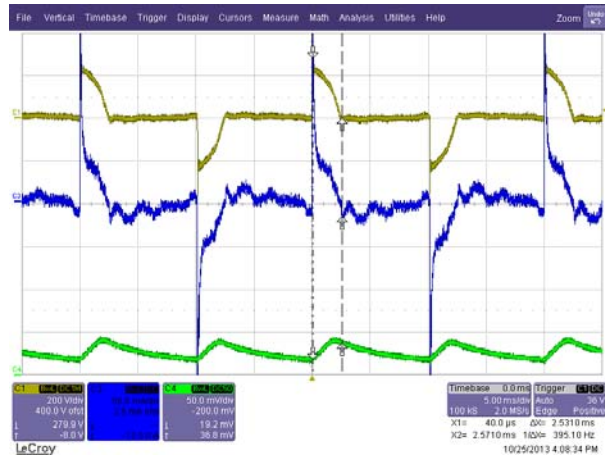


Figure 200 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: Clipsal 32E450LM

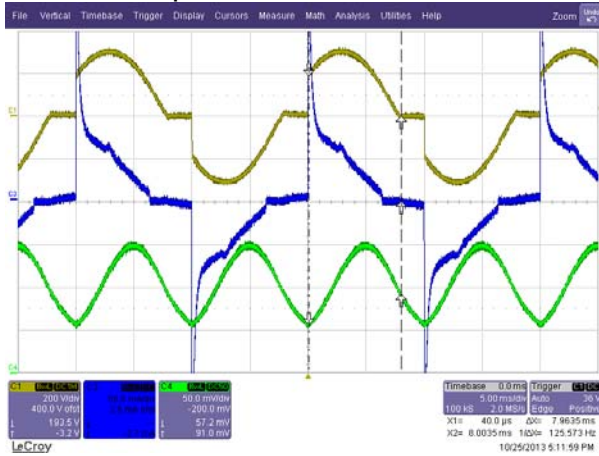


Figure 201 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN}; 200 V / div.
 Ch3: I_{IN}; 50 mA / div.
 Ch4: I_{OUT}; 50 mA / div.
 Time Scale: 5 ms / div.

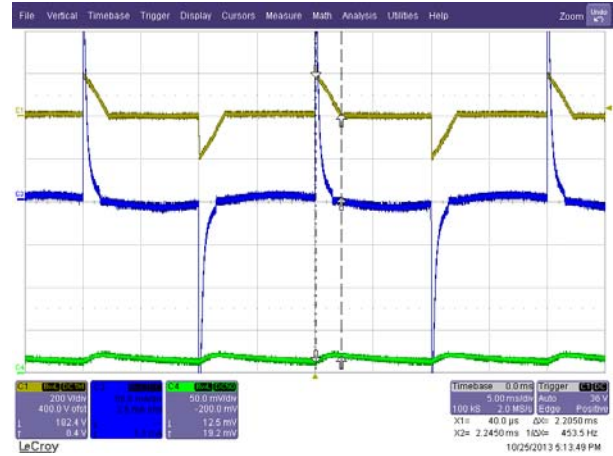


Figure 202 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN}; 200 V / div.
 Ch3: I_{IN}; 50 mA / div.
 Ch4: I_{OUT}; 50 mA / div.
 Time Scale: 5 ms / div.

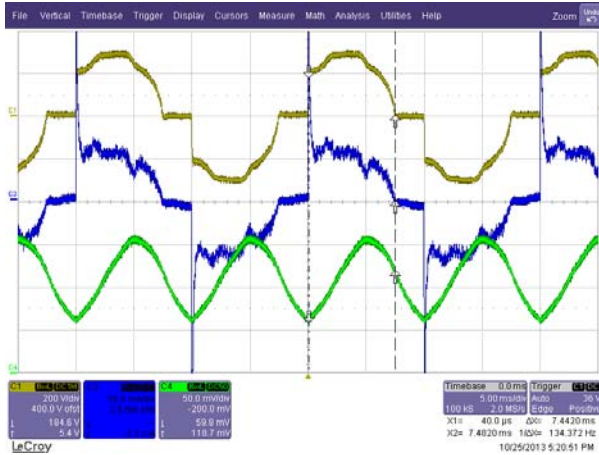


Figure 203 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN}; 200 V / div.
 Ch3: I_{IN}; 50 mA / div.
 Ch4: I_{OUT}; 50 mA / div.
 Time Scale: 5 ms / div.

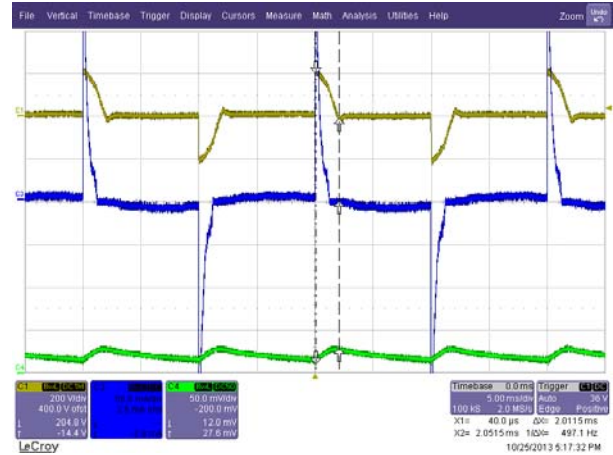


Figure 204 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN}; 200 V / div.
 Ch3: I_{IN}; 50 mA / div.
 Ch4: I_{OUT}; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Clipsal 32E450TM

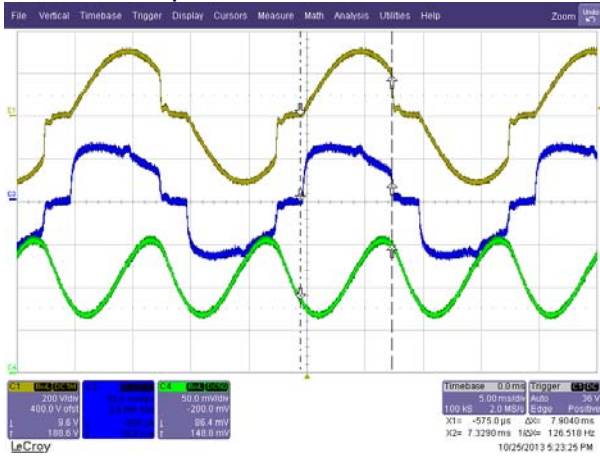


Figure 205 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

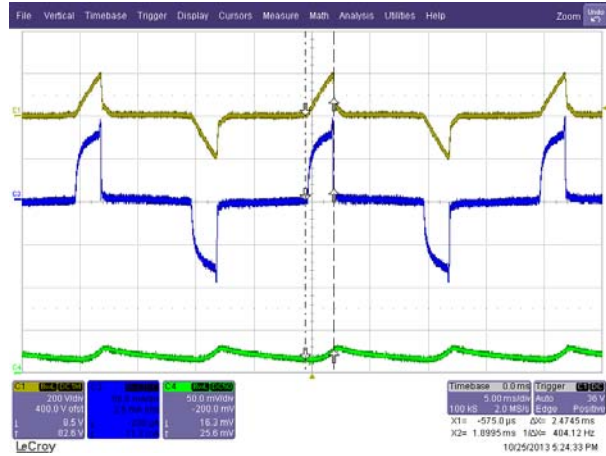


Figure 206 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

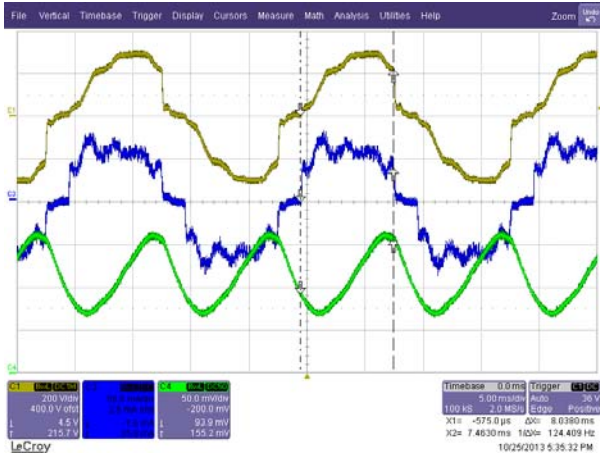


Figure 207 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

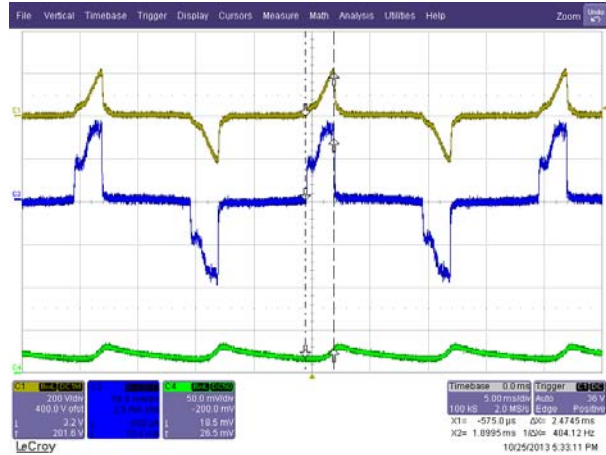


Figure 208 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

Dimmer: Clipsal 32E2CFLDM

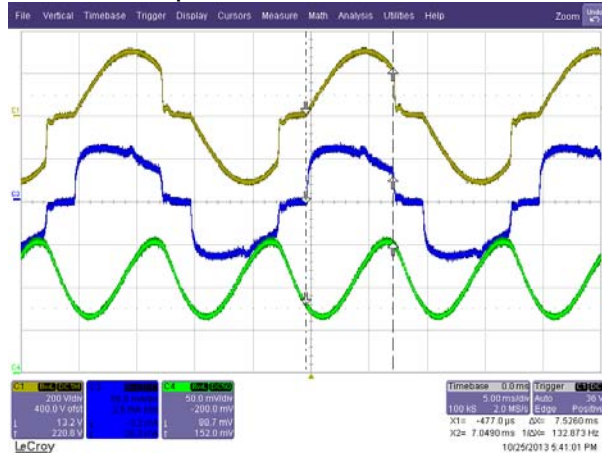


Figure 209 – Full Conduction from Regulated AC
 Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

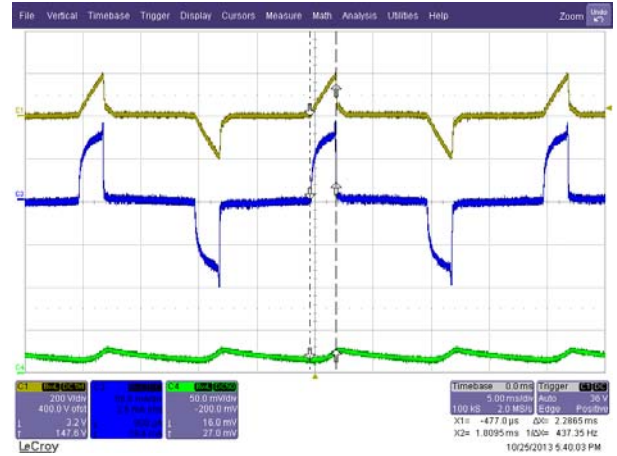


Figure 210 – Minimum Conduction from Regulated AC
 AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

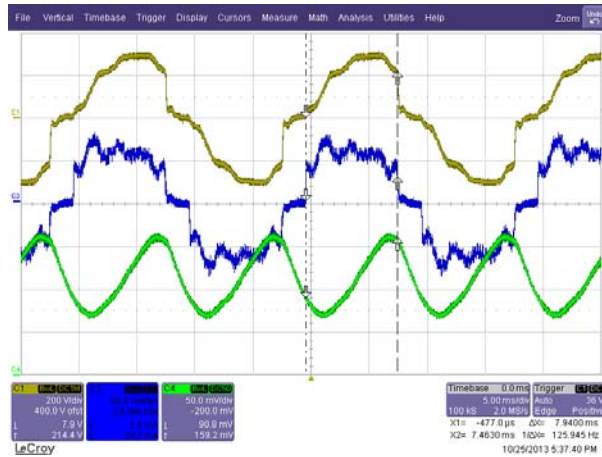


Figure 211 – Full Conduction from Distorted AC
 Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

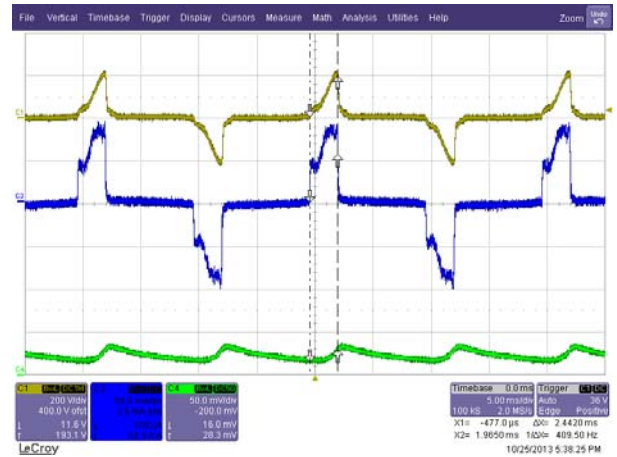


Figure 212 – Minimum Conduction from Distorted AC
 AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.



Dimmer: Clipsal 32E450UDM

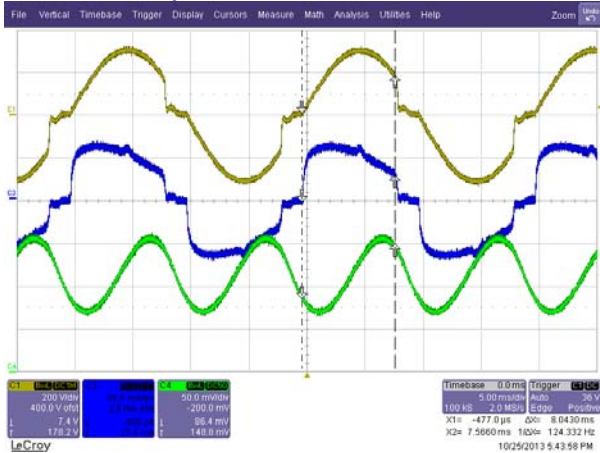


Figure 213 – Full Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

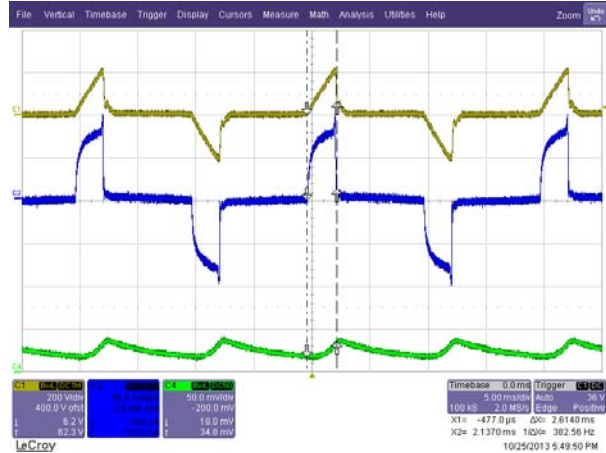


Figure 214 – Minimum Conduction from Regulated AC Input 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

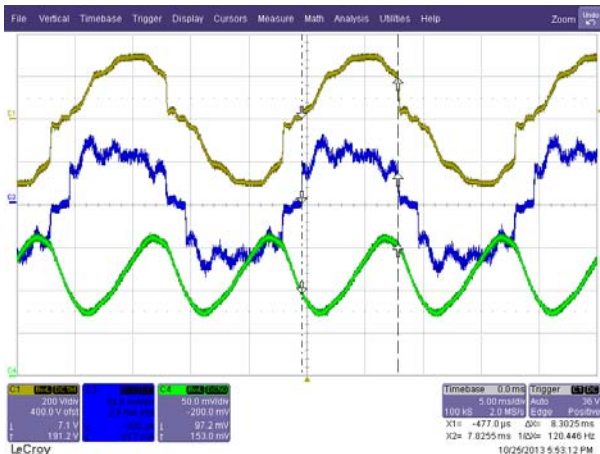


Figure 215 – Full Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

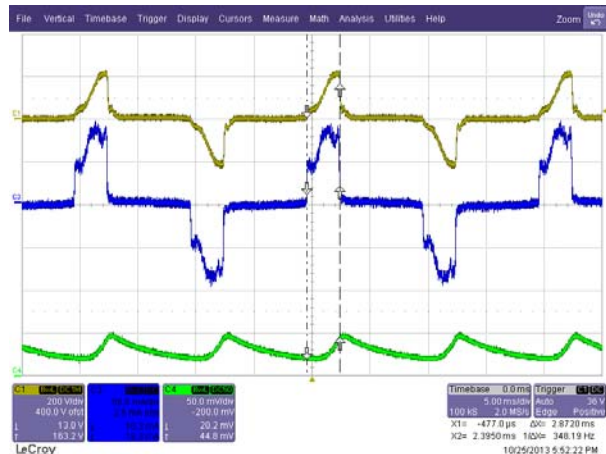


Figure 216 – Minimum Conduction from Distorted AC Line 230 V / 50 Hz.
 Ch1: V_{IN} ; 200 V / div.
 Ch3: I_{IN} ; 50 mA / div.
 Ch4: I_{OUT} ; 50 mA / div.
 Time Scale: 5 ms / div.

14 输入浪涌

Differential input Line 1.2/50 μ s surge testing was completed on a single test unit to IEC61000-4-5. Input voltage was set at 230 VAC / 60 Hz. Output was loaded at full load and operation was verified following each surge event.

Surge Level (V)	Input Voltage (VAC)	Injection Location	Injection Phase (°)	Test Result (Pass/Fail)
+500	230	L to N	90	Pass
-500	230	L to N	90	Pass
+500	230	L to N	270	Pass
-500	230	L to N	270	Pass
+500	230	L to N	0	Pass
-500	230	L to N	0	Pass

Unit passed under all test conditions.

Differential ring input Line surge testing was completed on a single test unit to IEC61000-4-5. Input voltage was set at 230 VAC / 60 Hz. Output was loaded at full load and operation was verified following each surge event.

Surge Level (V)	Input Voltage (VAC)	Injection Location	Injection Phase (°)	Test Result (Pass/Fail)
+2500	230	L to N	90	Pass
-2500	230	L to N	90	Pass
+2500	230	L to N	270	Pass
-2500	230	L to N	270	Pass
+2500	230	L to N	0	Pass
-2500	230	L to N	0	Pass

Unit passed under all test conditions.



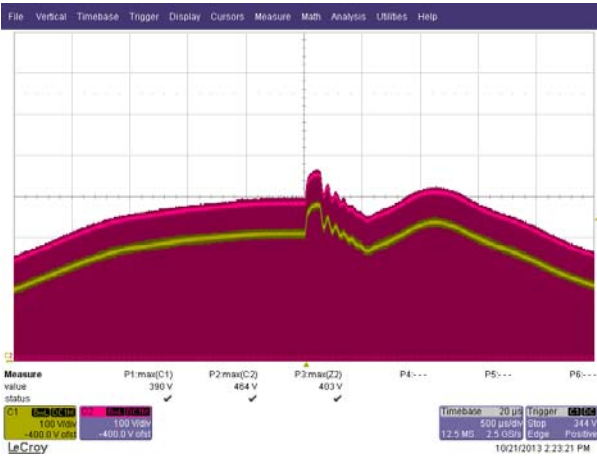


Figure 217 – Differential Line Surge at 500 V / 90°. Peak Drain Voltage Recorded is 464 V.
 Ch1: V_{BULK}; 100 V / div.
 F1: V_{DRAIN}; 200 V / div.
 Time Scale: 500 μs / div.



Figure 218 – Differential Line Surge at 500 V / 90°. Peak Drain Voltage Recorded is 464 V.
 Ch1: V_{BULK}; 100 V / div.
 F1: V_{DRAIN}; 200 V / div.
 Time Scale: 500 μs / div.
 Zoom time Scale: 50 μs / div.

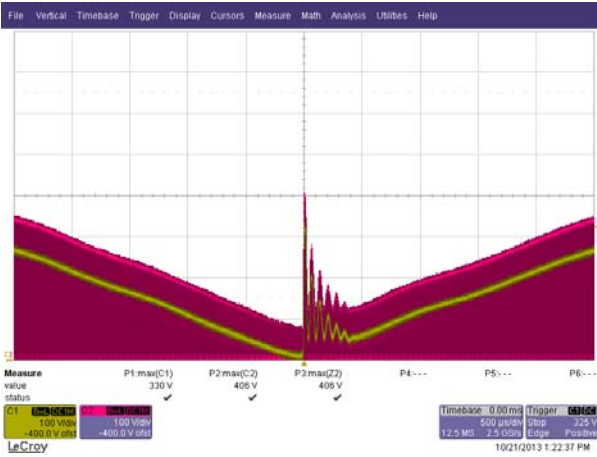


Figure 219 – Differential Ring Surge at 2500 V / 0°. Peak Drain Voltage Recorded is 406 V.
 Ch1: V_{BULK}; 100 V / div.
 F1: V_{DRAIN}; 100 V / div.
 Time Scale: 500 μs / div.

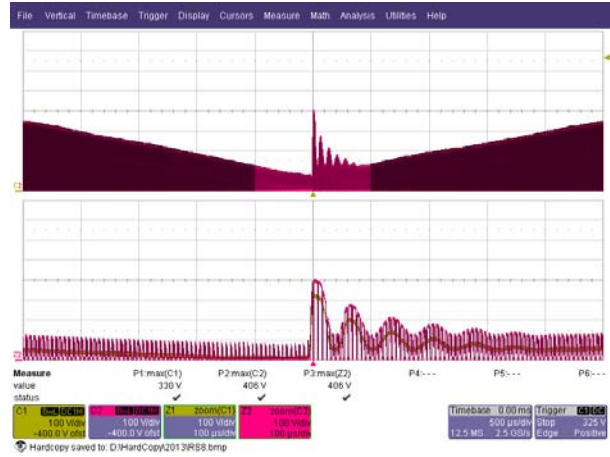


Figure 220 – Differential Ring Surge at 2500 V / 0°. Peak Drain Voltage Recorded is 406 V.
 Ch1: V_{BULK}; 100 V / div.
 F1: V_{DRAIN}; 100 V / div.
 Time Scale: 500 μs / div.
 Zoom time Scale: 100 μs / div.

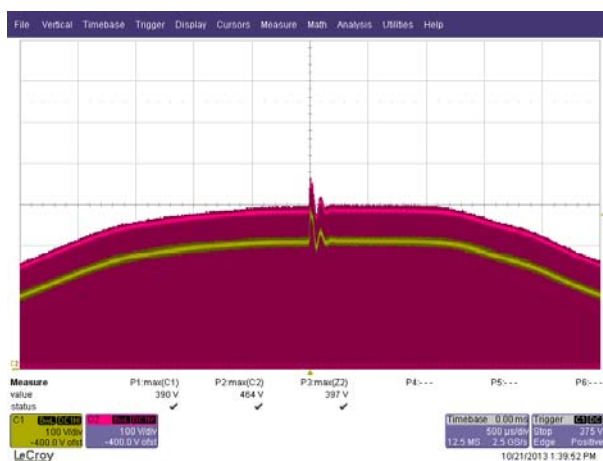


Figure 221 – Differential Ring Surge at 2500 V / 90°. Peak Drain Voltage Recorded is 464 V.
Ch1: V_{BULK} ; 100 V / div.
F1: V_{DRAIN} ; 100 V / div.
Time Scale: 500 μ s / div.

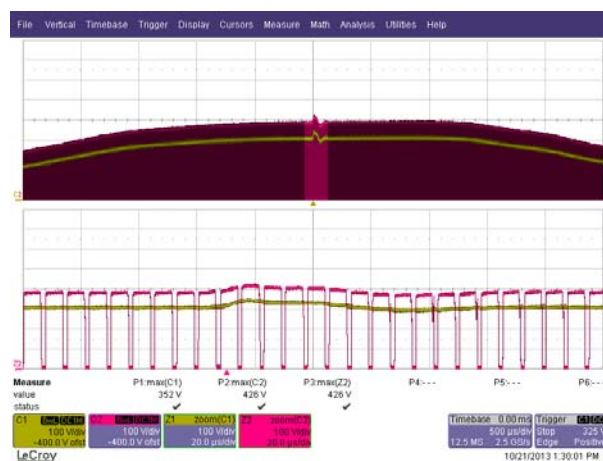


Figure 222 – Differential Ring Surge at 2500 V / 90°. Peak Drain Voltage Recorded is 426 V.
Ch1: V_{BULK} ; 100 V / div.
F1: V_{DRAIN} ; 100 V / div.
Time Scale: 500 μ s / div.
Zoom time Scale: 20 μ s / div.



15 传导EMI

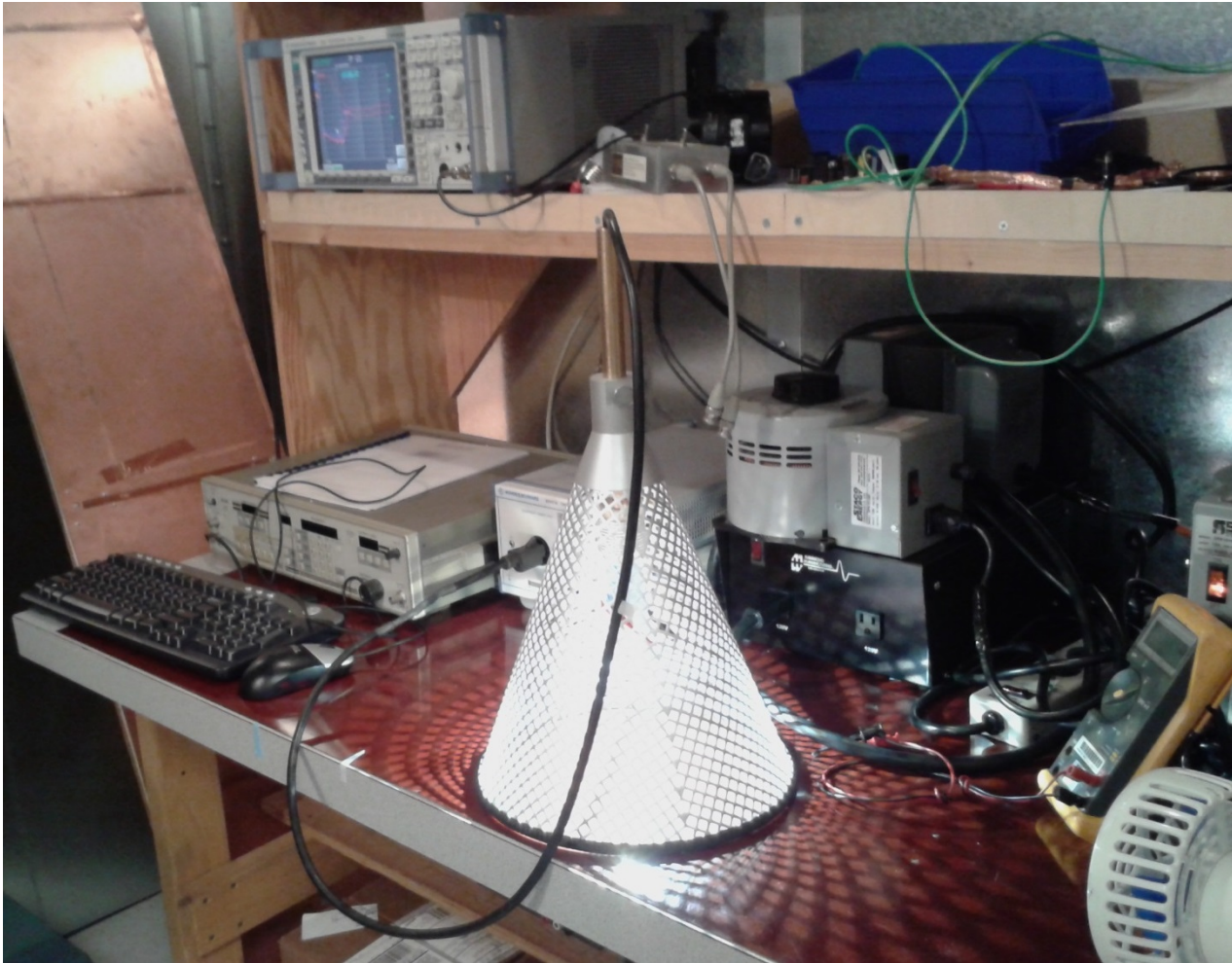


Figure 223 – The Retrofit Lamp was Verified in a Conical Cone as per EN55015.



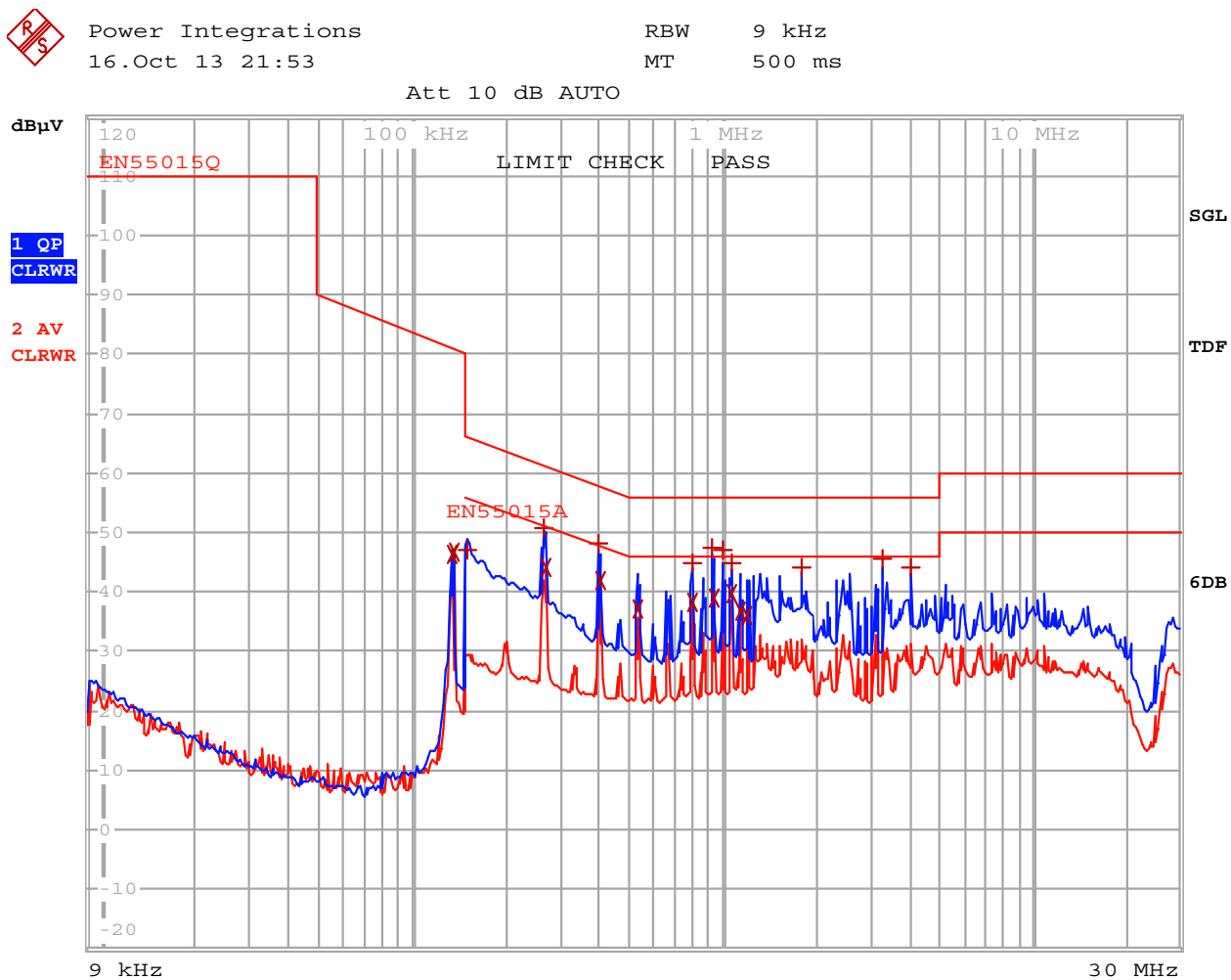


Figure 224 – Conducted EMI, Maximum Steady-State Load, 230 VAC, 60 Hz, and EN55015 B Limits. Enclosed Unit in A19 Bulb Replacement.



EDIT PEAK LIST (Final Measurement Results)						
Trace1:	EN55015Q					
Trace2:	EN55015A					
Trace3:	---					
	TRACE	FREQUENCY	LEVEL dB μ V			DELTA LIMIT dB
2	Average	133.454986145 kHz	46.49	L1	gnd	
2	Average	136.137431366 kHz	46.55	L1	gnd	
1	Quasi Peak	151.5 kHz	47.03	L1	gnd	-18.88
1	Quasi Peak	264.49018761 kHz	50.70	N	gnd	-10.58
2	Average	267.135089486 kHz	44.11	N	gnd	-7.09
1	Quasi Peak	397.727746704 kHz	48.11	N	gnd	-9.78
2	Average	401.705024172 kHz	41.76	N	gnd	-6.05
2	Average	530.769219795 kHz	37.13	N	gnd	-8.86
1	Quasi Peak	798.145472681 kHz	44.73	N	gnd	-11.26
2	Average	798.145472681 kHz	38.25	N	gnd	-7.74
1	Quasi Peak	926.622115652 kHz	47.49	N	gnd	-8.50
2	Average	935.888336808 kHz	39.00	N	gnd	-6.99
1	Quasi Peak	993.464328234 kHz	47.04	N	gnd	-8.95
1	Quasi Peak	1.06512822736 MHz	44.92	N	gnd	-11.07
2	Average	1.06512822736 MHz	39.75	N	gnd	-6.24
2	Average	1.13065507631 MHz	36.81	N	gnd	-9.18
2	Average	1.20021314689 MHz	36.19	N	gnd	-9.80
1	Quasi Peak	1.78695382697 MHz	44.28	N	gnd	-11.71
1	Quasi Peak	3.24635311795 MHz	45.49	N	gnd	-10.50
1	Quasi Peak	4.04078721227 MHz	44.26	N	gnd	-11.73

Table 4 – Conducted EMI, Maximum Steady-State Load, 2390VAC, 60 Hz, and EN55015 B Limits. Enclosed Unit in A19 Bulb Replacement.

16 版本历史

Date	Author	Revision	Description & changes	Reviewed
05-Dec-13	JDC	1.0	Initial Release	Apps & Mktg



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