

CRD1680-7W

7 Watt Reference Design

Features

- Constant-current Output
- Flicker-free Dimming
- Line Voltage 12VAC/VDC, $\pm 10\%$
- Rated Input Power: 7.0W
- Rated Output Power: 5.6W
- Output Voltage: <15V
- High Efficiency with Magnetic and Electronic Transformers
- Low Component Count
- Supports Cirrus Logic Product CS1680

General Description

The CRD1680-7W reference design demonstrates the performance of the CS1680 dimmable LED driver for low-voltage lighting with a target output of 430mA driving 4xLEDs in series. It provides exceptional single-lamp and multi-lamp transformer compatibility for non-dimmer systems and dimmer systems paired with electronic and magnetic low-voltage transformers. The form factor is targeted to fit into MR16 LED lamp applications.

DIMENSIONS (OVERALL)

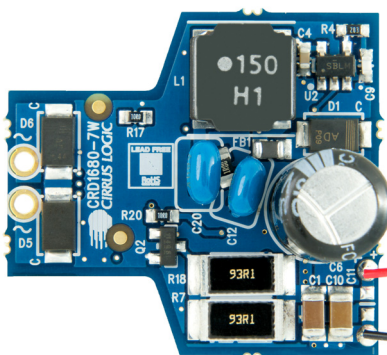
Length	Width	Height
1.102" (28mm)	1.024" (26mm)	0.672" (17mm)

1.102" (28mm) $\times$ 1.024" (26mm) $\times$ 0.672" (17mm)

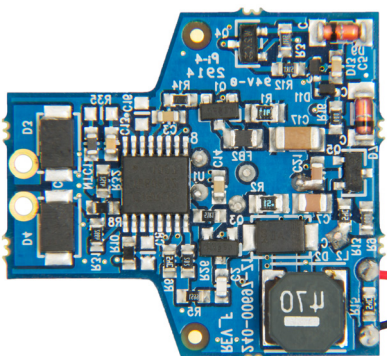
For more information, see Figure 3 on page 6.

ORDERING INFORMATION

CRD1680-7W-Z 7 Watt Reference Design Supports CS1680



Top



Bottom



IMPORTANT SAFETY INSTRUCTIONS

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

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

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

DANGER Risk of Electric Shock

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

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

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

Contacting Cirrus Logic Support

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

IMPORTANT NOTICE

Cirrus Logic, Inc. and its subsidiaries ("Cirrus") believe that the information contained in this document is accurate and reliable. However, the information is subject to change without notice and is provided "AS IS" without warranty of any kind (express or implied). Customers are advised to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgment, including those pertaining to warranty, indemnification, and limitation of liability. No responsibility is assumed by Cirrus for the use of this information, including use of this information as the basis for manufacture or sale of any items, or for infringement of patents or other rights of third parties. This document is the property of Cirrus and by furnishing this information, Cirrus grants no license, express or implied under any patents, mask work rights, copyrights, trademarks, trade secrets or other intellectual property rights. Cirrus owns the copyrights associated with the information contained herein and gives consent for copies to be made of the information only for use within your organization with respect to Cirrus integrated circuits or other products of Cirrus. This consent does not extend to other copying such as copying for general distribution, advertising or promotional purposes, or for creating any work for resale.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). CIRRUS PRODUCTS ARE NOT DESIGNED, AUTHORIZED OR WARRANTED FOR USE IN PRODUCTS SURGICALLY IMPLANTED INTO THE BODY, AUTOMOTIVE SAFETY OR SECURITY DEVICES, LIFE SUPPORT PRODUCTS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF CIRRUS PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK AND CIRRUS DISCLAIMS AND MAKES NO WARRANTY, EXPRESS, STATUTORY OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE, WITH REGARD TO ANY CIRRUS PRODUCT THAT IS USED IN SUCH A MANNER. IF THE CUSTOMER OR CUSTOMER'S CUSTOMER USES OR PERMITS THE USE OF CIRRUS PRODUCTS IN CRITICAL APPLICATIONS, CUSTOMER AGREES, BY SUCH USE, TO FULLY INDEMNIFY CIRRUS, ITS OFFICERS, DIRECTORS, EMPLOYEES, DISTRIBUTORS AND OTHER AGENTS FROM ANY AND ALL LIABILITY, INCLUDING ATTORNEYS' FEES AND COSTS, THAT MAY RESULT FROM OR ARISE IN CONNECTION WITH THESE USES.

Cirrus Logic, Cirrus, the Cirrus Logic logo designs, EXL Core, and the EXL Core logo design are trademarks of Cirrus Logic, Inc. All other brand and product names in this document may be trademarks or service marks of their respective owners.

1. INTRODUCTION

The CS1680 is a cascade boost-buck dimmable LED controller IC. The CS1680 uses a Cirrus Logic proprietary intelligent digital control that provides exceptional single-lamp and multi-lamp transformer compatibility for non-dimmer systems and dimmer systems paired with electronic and magnetic low-voltage transformers. The CS1680 integrates a continuous conduction mode (CCM) boost converter that provides transformer compatibility and dimmer compatibility with a constant output current buck stage. An adaptive digital algorithm controls the boost stage and dimmer compatibility operation mode to enable flicker-free operation down to 5% output current with leading-edge and trailing-edge dimmers. For in-depth implementation of the CS1680, please consult documents in Further Reading on page 3 for IC and reference design details.

The CRD1680-7W board is optimized to deliver low system cost in a high-efficiency, flicker-free, phase-dimmable, solid-state lighting (SSL) solution for incandescent lamp replacement applications. The feedback loop is closed through an integrated digital control system within the IC. Protection algorithms such as output open/short, overcurrent detection, boost overvoltage, and overtemperature thermistors protect the system during abnormal conditions. Details of these features are provided in the CS1680 *Dimmable LED Driver IC for Low-voltage Lighting* data sheet.

The CRD1680-7W board demonstrates the performance of the CS1680. This reference board has been designed for an output load of 4×LEDs in series at a target output current of 430mA (12.0V typical).

This document provides the schematic for the board. It includes oscilloscope screen shots that indicate various operating waveforms. Graphs are also provided that document the performance of the board in terms of Efficiency vs. Line Voltage, Output Current vs. Line Voltage, and Output Current vs. Dim Angle for the CS1680 dimmable LED controller IC.

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

Further Reading

- Cirrus Logic, 2014. "Dimmable LED Driver IC for Low-voltage Lighting," DS1055F1, AUG 2014.
- Cirrus Logic, 2014. "Design Guide for a CS1680 Dimmable LED Driver IC for Low-voltage Lighting," AN379REV3, AUG 2014.

NOTE

If any other Cirrus Logic document contains information conflicting with the device data sheet, the device data sheet is considered to have the most current and correct data.

2. SCHEMATIC

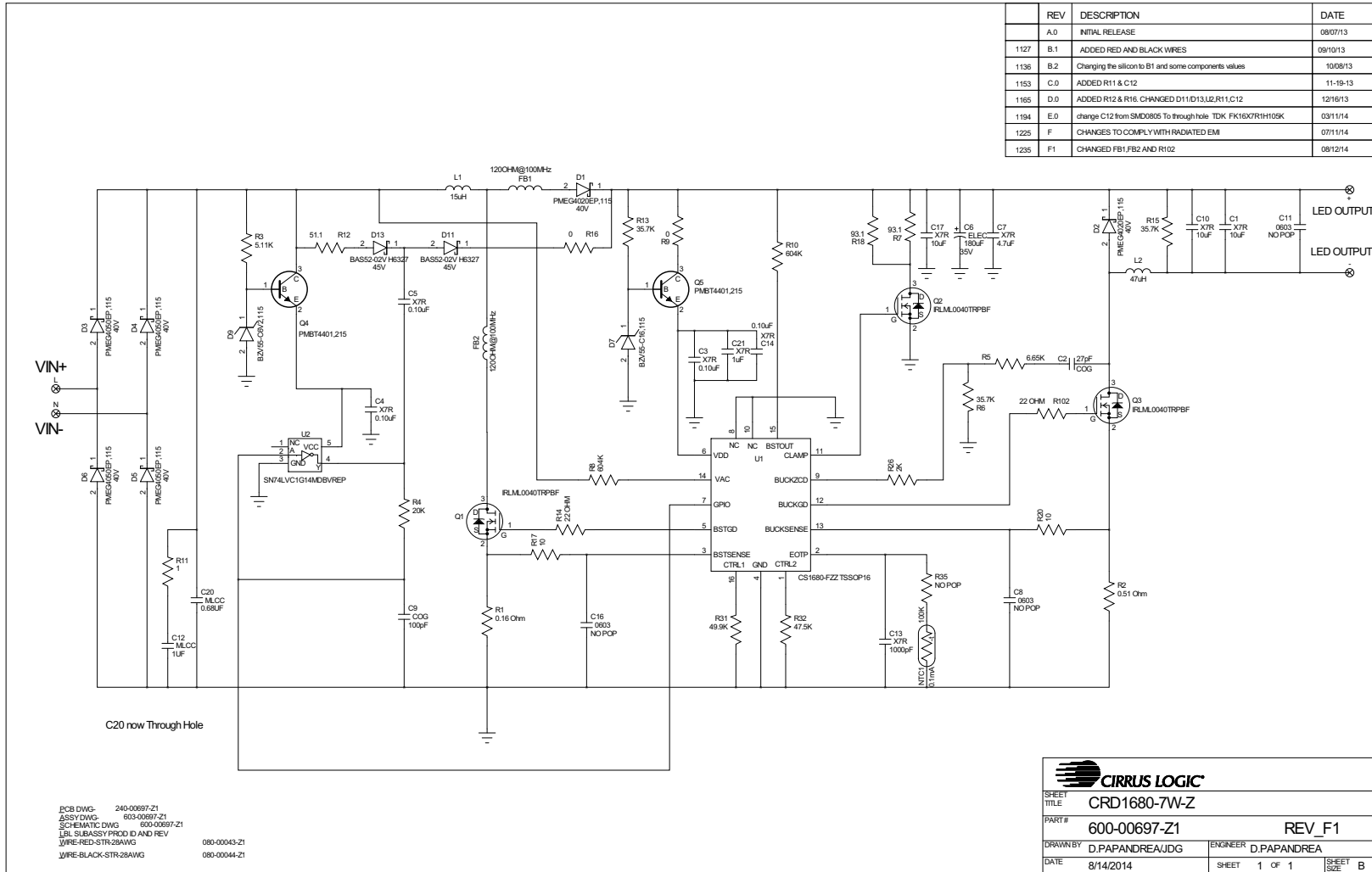


Figure 1. Schematic

3. BILL OF MATERIALS

BOM: CRD1680-7W-Z Rev: F1						
Date Generated: 08/14/2014						
Line Item	Description	Qty	UM	Reference Designator	Manufacturer	Manufacturer Part Number
0002	CAP 10uF ±10% 25V X7R NPb 1206	2	EA	C1 C10	TAIYO YUDEN	TMK316B7106KL-TD
0003	CAP 27pF ±5% 50V C0G NPb 0603	1	EA	C2	KEMET NIC COMPONENTS	C0603C270J5GAC NMC0603NPO270J50TRPF
0004	CAP 0.10uF 10% 25V X7RLESR NPb 0603	4	EA	C3 C4 C5 C14	MURATA	GRM188R71E104KA01D
0005	CAP 180uF ±20% 35V AL ELEC NPb RAD	1	EA	C6	PANASONIC PANASONIC	EEUFR1V181B EEUFR1V181
0006	CAP 4.7uF ±10% 35V X7R NPb 0805	1	EA	C7	TDK	C2012X7R1V475K125AC
0008	CAP 100pF ±5% 50V C0G NPb 0603	1	EA	C9	KEMET Walsin	C0603C101J5GAC 0603N101J500LT
0009	CAP 1uF ±10% 50V X7R NPb RAD	1	EA	C12	TDK	FK16X7R1H105K
0010	CAP 1000pF ±10% 50V X7R NPb 0603	1	EA	C13	KEMET KOA PANASONIC NIC COMPONENTS	C0603C102K5RAC X7R0603HTTD102K ECJ1VB1H102K NMC0603X7R102K50TRPF
0011	CAP 10uF ±10% 35V X7R MLC NPb 1206	1	EA	C17	TAIYO YUDEN	GMK316AB7106KL-TR
0012	CAP 0.68uF ±10% 50V X7R NPb RAD	1	EA	C20	TDK	FK16X7R1H684K
0013	CAP 1uF ±10% 25V X7R CER NPb 0603	1	EA	C21	TDK	CGA3E1X7R1E105K080AC
0014	DIODE SKY BARR 2A 40V NPb SOD128	2	EA	D1 D2	NXP	PMEG4020EP,115
0015	DIODE SKY BARR 5A 40V NPb SOD128	4	EA	D3 D4 D5 D6	NXP	PMEG4050EP,115
0016	DIODE ZENER 500mW 16V NPb SOD80C	1	EA	D7	NXP	BZV55-C16,115
0017	DIODE ZENER 500mW 6.2V NPb SOD80C	1	EA	D9	NXP	BZV55-C6V2,115
0018	DIODE SHKY 750mA 45V NPb SC79-2	2	EA	D11 D13	INFINEON	BASS5-02V H6327
0019	FE BEAD 3.0A 120ohm@100MHz NPb 0805	2	EA	FB1 FB2	WURTH ELECTRONICS	742792023
0021	IND PWR 15uH 2.4A ±20% SHLD NPb SM	1	EA	L1	TAIYO YUDEN	NRS8040T150MJGJ
0022	IND PWR 47uH 1.3A ±20% SHLD NPb SM	1	EA	L2	TAIYO YUDEN	NR6045T470M
0023	THERM 100K OHM ±5% 0.10mA NPb 0603	1	EA	NTC1	MURATA	NCP18WF104J03RB
0024	TRAN MOSFET N-CH 40V 3.6A NPb SOT23	3	EA	Q1 Q2 Q3	INTERNATIONAL RECTIFIER	IRLML0040TRPBF
0025	TRAN NPN SW 40V 600mA NPb SOT-23	2	EA	Q4 Q5	NXP	PMBT4401,215
0026	RES 0.16 OHM 1/4W ±1% NPb 0805	1	EA	R1	PANASONIC	ERJ56SFR16V
0027	RES 0.51 OHM 1/4W ±1% NPb 0805	1	EA	R2	PANASONIC	ERJ56QFR51V
0028	RES 5.11k OHM 1/10W ±1% NPb 0603	1	EA	R3	DALE KOA PANASONIC WALSIN	CRCW06035K11FKEA RK73H1JTTD5111F ERJ3EKF5111V WR06X5111FTL
0029	RES 20k OHM 1/10W ±5% NPb 0603 FILM	1	EA	R4	DALE KOA PANASONIC	CRCW060320K0JNEA RK73B1JTTD203J ERJ3GEYJ203V
0030	RES 6.65k OHM 1/10W ±1% NPb 0603	1	EA	R5	DALE	CRCW06036K65FKEA
0031	RES 35.7K OHM 1/10W ±1% NPb 0603	3	EA	R6 R13 R15	YAGEO	RC0603FR-0735K7L
0032	RES 93.1 OHM 1W ±1% FILM NPb 2512	2	EA	R7 R18	ROHM	MCR100JZH93R1
0033	RES 604K OHM 1/10W ±1% NPb 0603	2	EA	R8 R10	YAGEO	RC0603FR-07604KL
0034	RES 0 OHM 1/10W ±5% NPb 0603 FILM	2	EA	R9 R16	DALE NIC COMPONENTS PANASONIC VENKEL WALSIN	CRCW06030000Z0EA NRC0606ZOTRF ERJ3EKF0R00V CR0603-10W-000T WR06X000PTL
0035	RES 1 OHM 1/4W ±1% NPb 0805	1	EA	R11	STACKPOLE	RNCP0805FTD1R00
0036	RES 51.1 OHM 1/10W ±1% NPb 0603 FILM	1	EA	R12	DALE KOA PANASONIC VENKEL	CRCW060351R1FKEA RK73H1JTTD51R1F ERJ3EKF51R1V CR0603-10W-51R1FT
0037	RES 22.0 OHM 1/10W ±1% NPb 0603	2	EA	R14 R102	PANASONIC	ERJ3EKF22R0V
0038	RES 10 OHM 1/10W ±1% NPb 0603 FILM	2	EA	R17 R20	DALE VENKEL PANASONIC WALSIN	CRCW060310R0FKEA C0603-10W-10R0FT ERJ3EKF10R0V ER06X10R0FTL
0039	RES 2k OHM 1/10W ±5% NPb 0603 FILM	1	EA	R26	DALE KOA PANASONIC WALSIN	CRCW06032K00JNEA RK73B1JTTD202J ERJ3GEYJ202V WR06X202JTL
0040	RES 49.9k OHM 1/10W ±1% NPb 0603	1	EA	R31	DALE KOA PANASONIC WALSIN	CRCW060349K9FKEA RK73H1JTTD4992F ERJ3EKF4992V WR06X4992FTL
0041	RES 47.5k OHM 1/10W ±1% NPb 0603	1	EA	R32	DALE KOA PANASONIC WALSIN	CRCW060347K5FKEA RK73H1JTTD4752F ERJ3EKF4752V WR06X4752FTL
0043	IC CRUS TRIAC DIM LV 12V NPb TSOP16	1	EA	U1	CIRRUS LOGIC	CS1680-FZZ/B1
0044	IC INV SNGL SCHMIT-TRIG NPb SOT23-5	1	EA	U2	TEXAS INSTRUMENTS	SN74LVC1G14MDBVREP
0045	WIRE 28AWG PTFE INSULATED STRND RED	3	IN	W1	ANY SOURCE	080-00043-Z1
0046	WIRE 28AWG PTFE INSUL STRND BLACK	3	IN	W2	ANY SOURCE	080-00044-Z1

Figure 2. Bill of Materials

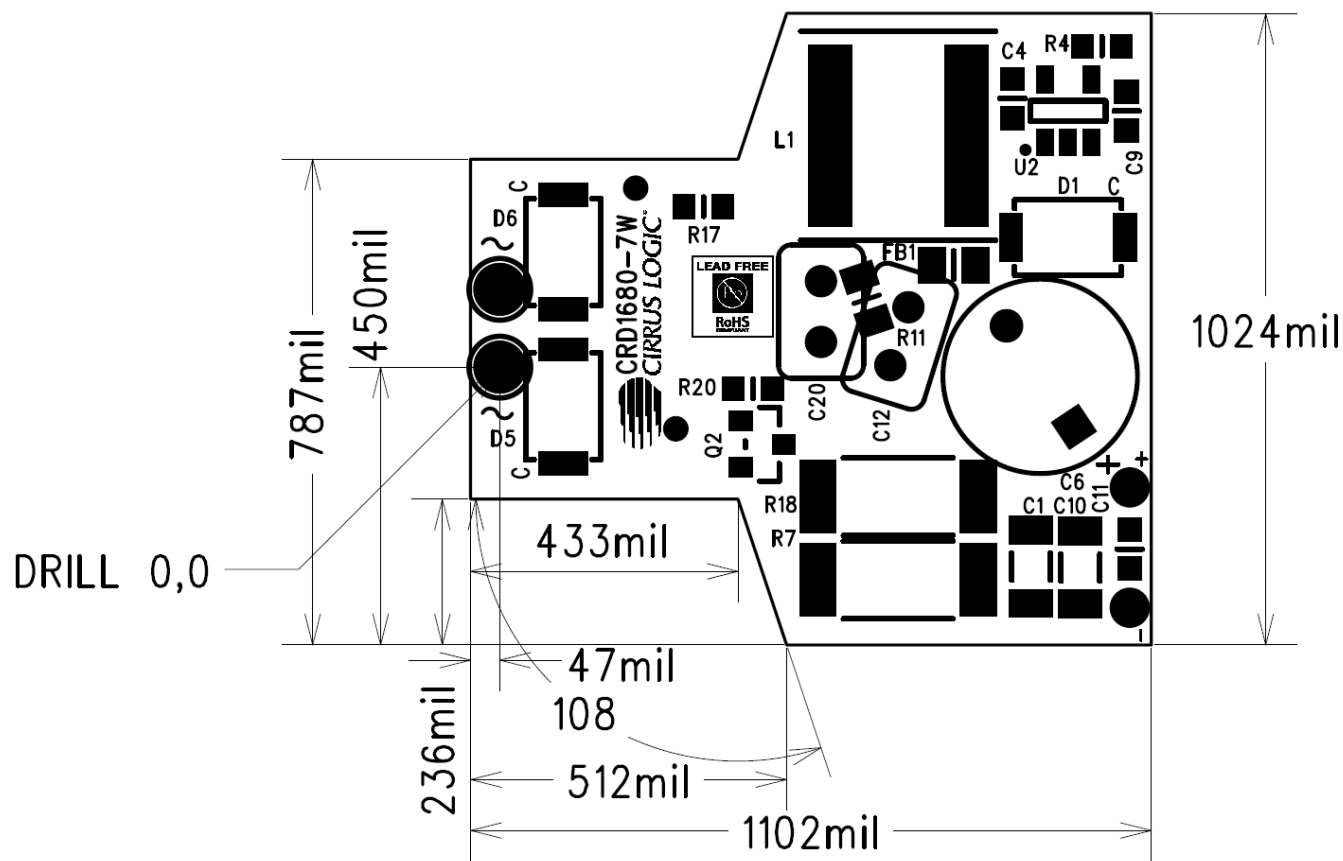


Figure 3. PCB Dimensions



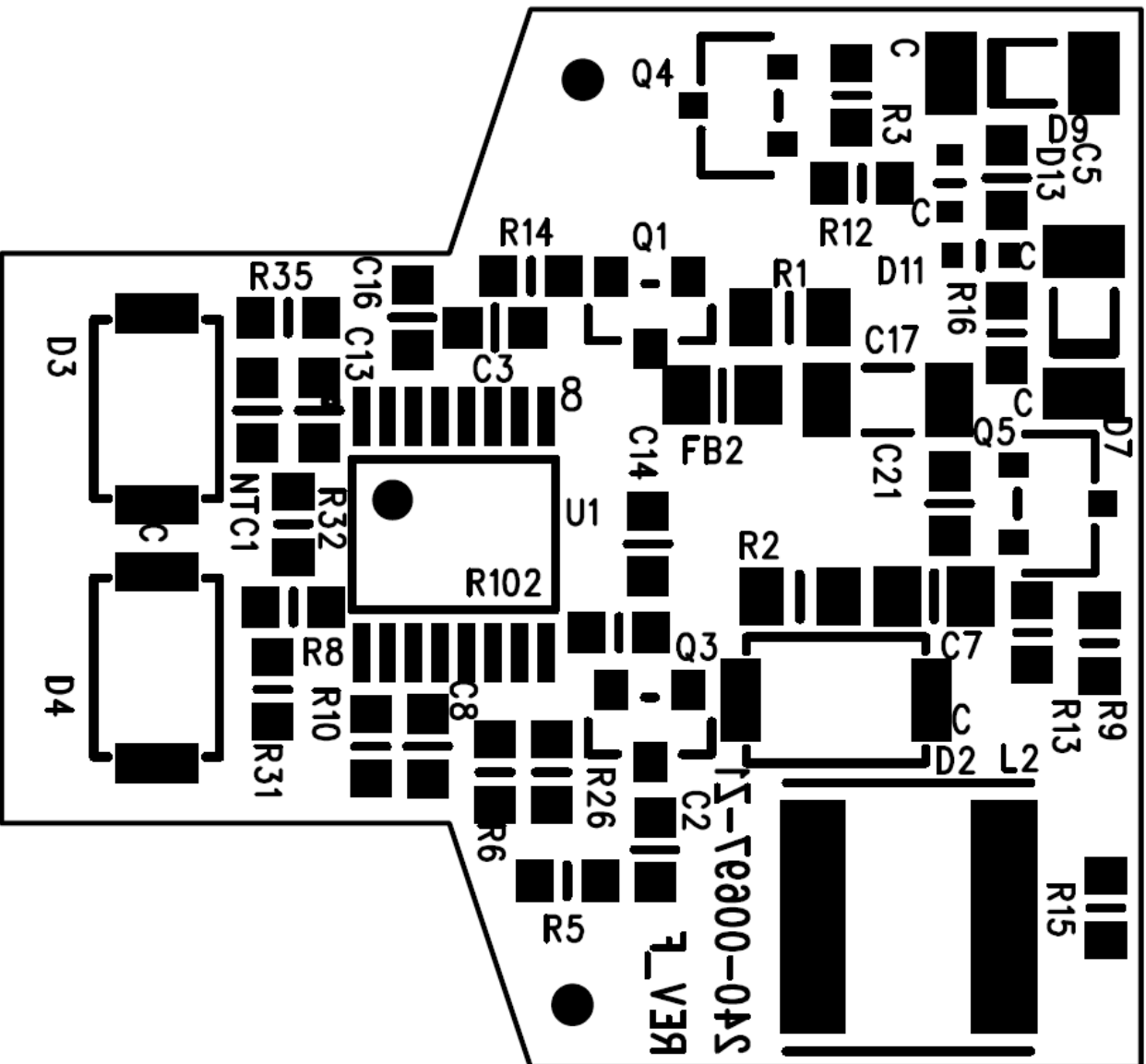


Figure 5. Bottom Silkscreen

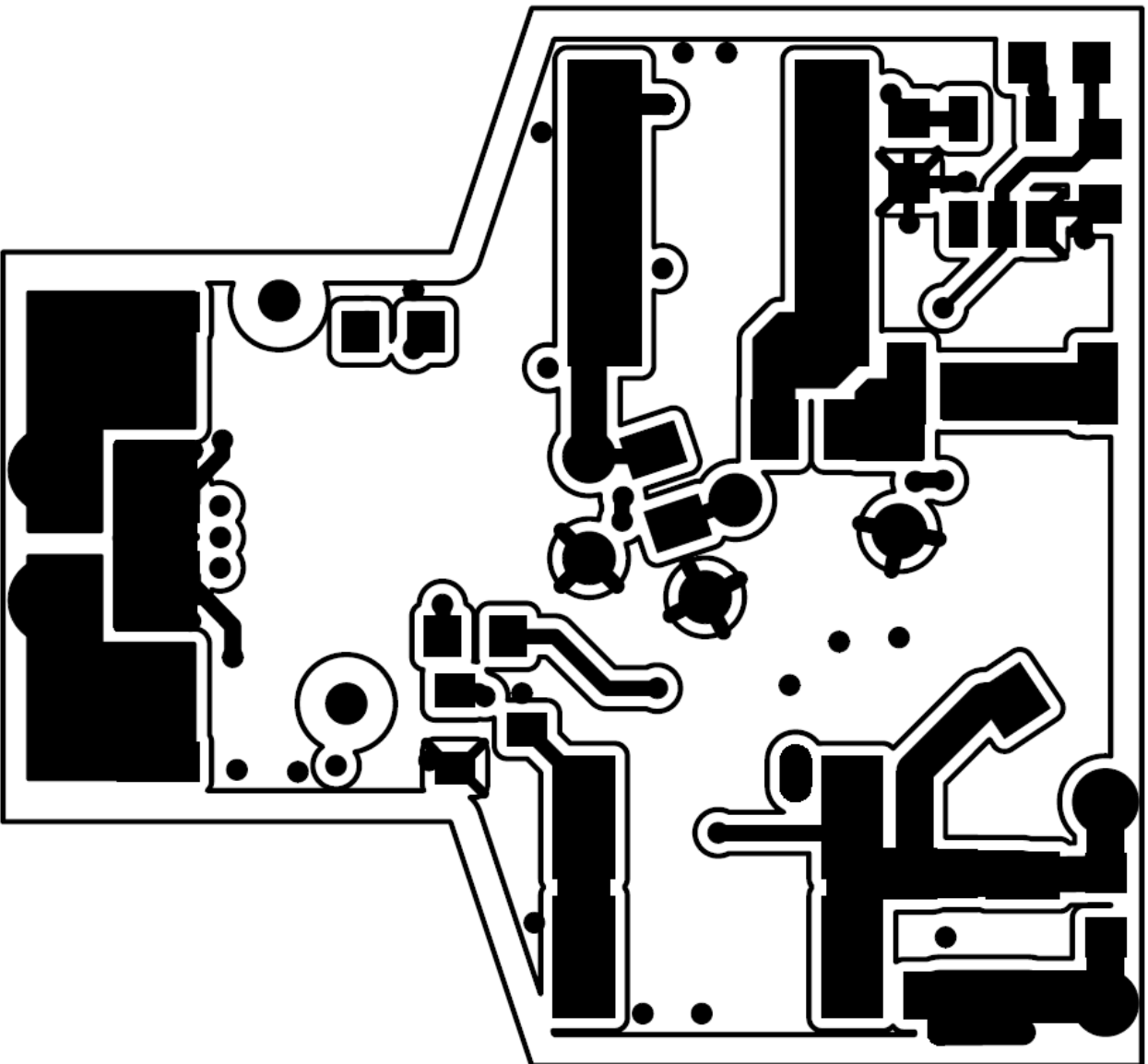


Figure 6. Top Routing, Layer 1

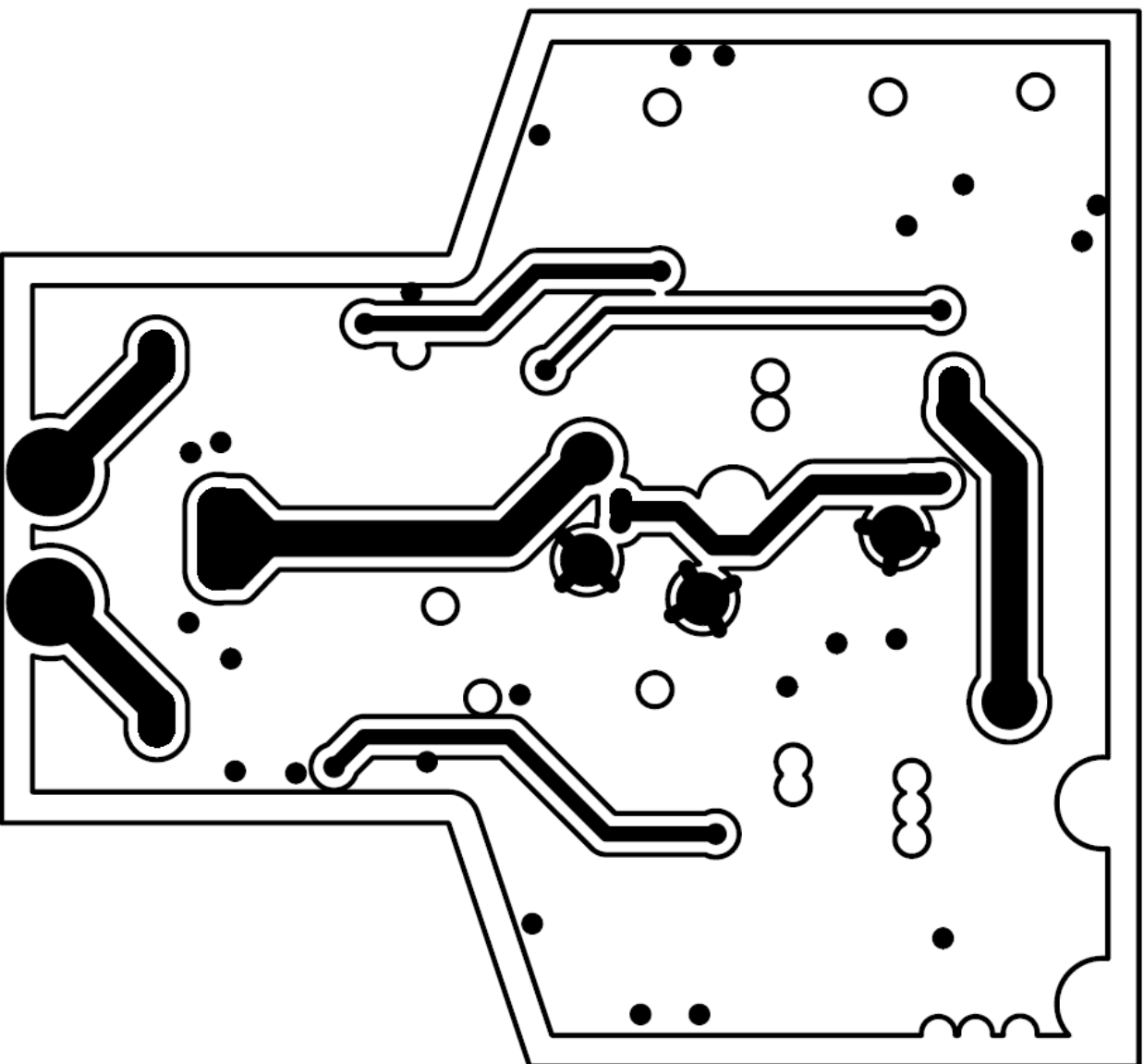


Figure 7. Power Plane, Layer 2

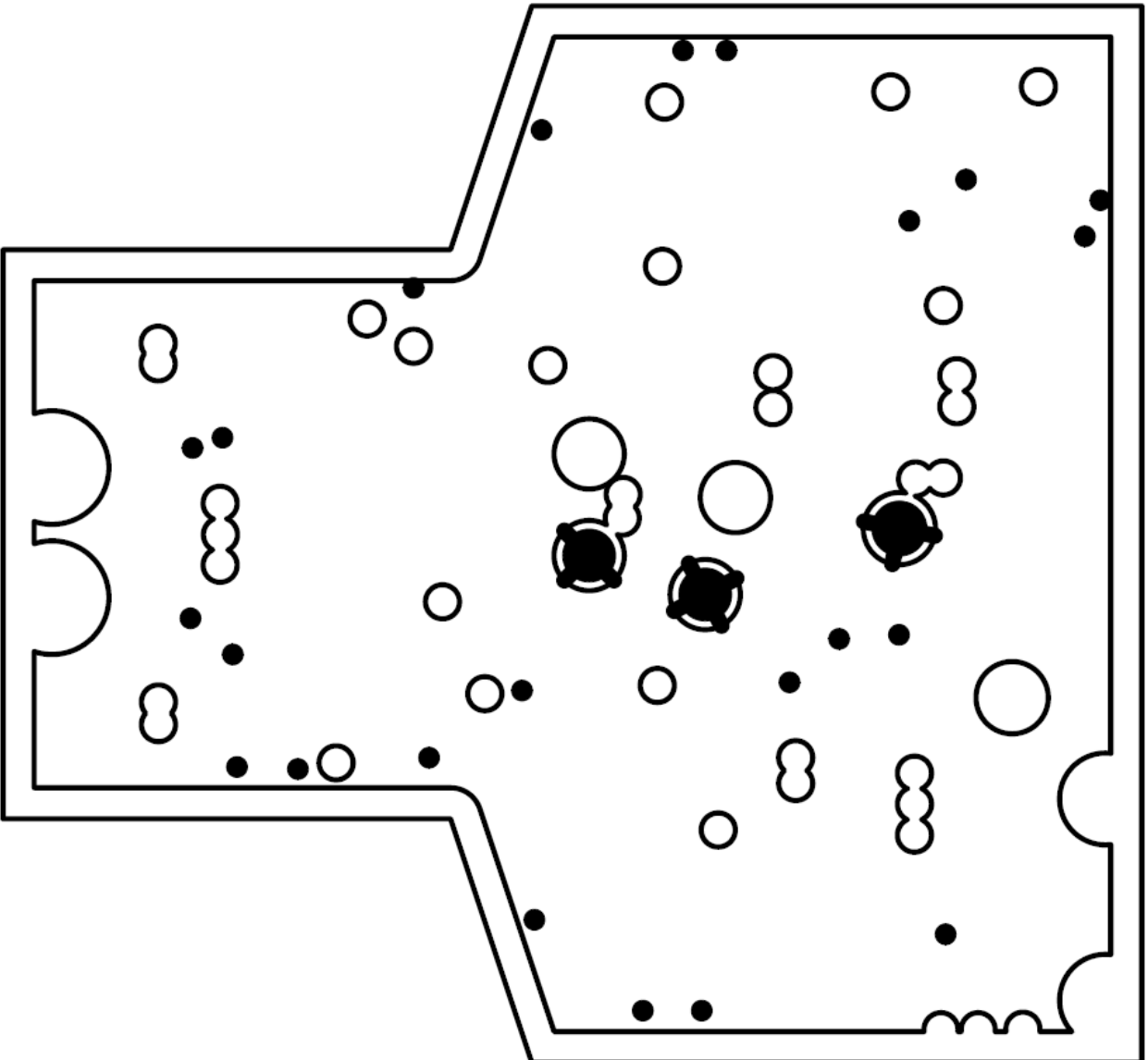


Figure 8. Ground Plane, Layer 3

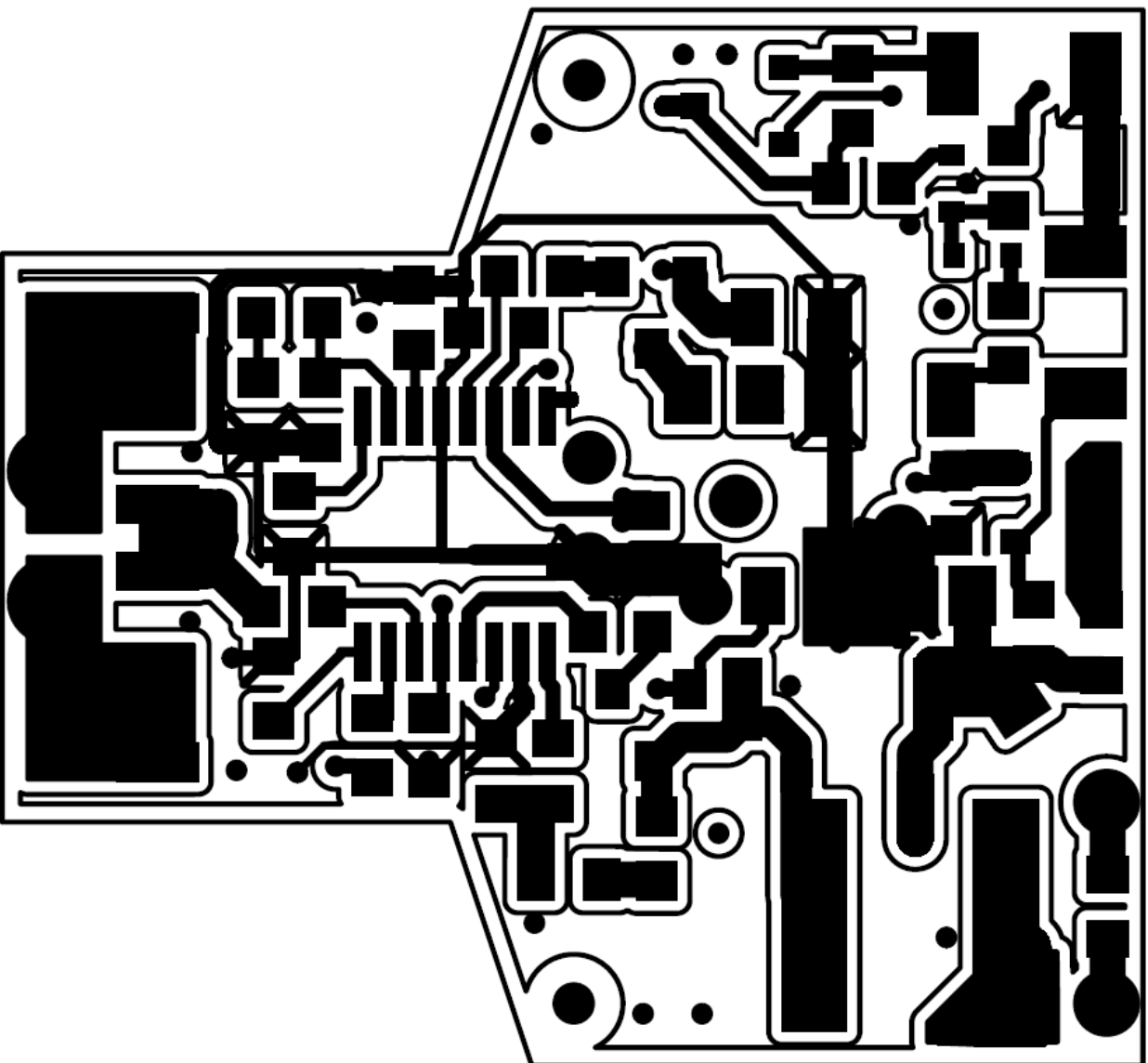


Figure 9. Bottom Routing, Layer 4

5. THERMAL IMAGING

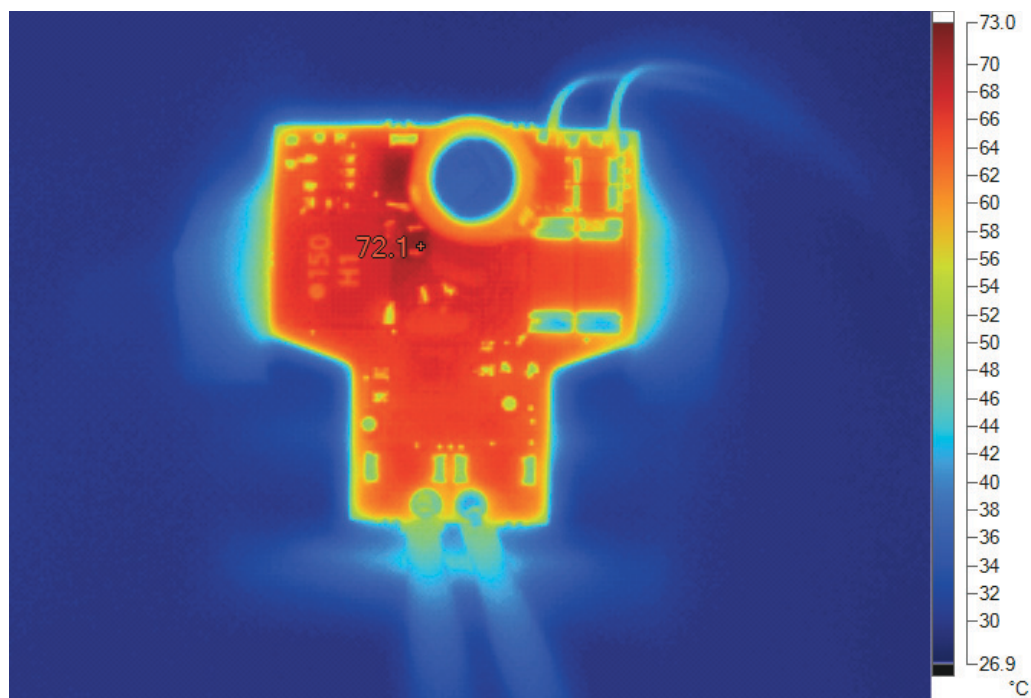


Figure 10. Top Thermal

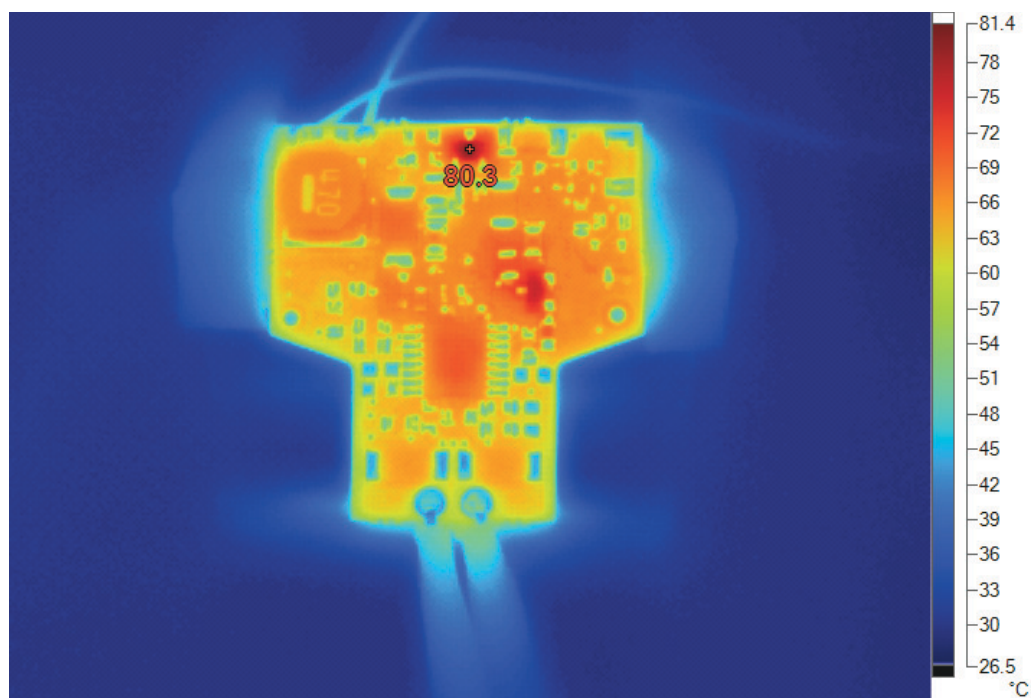


Figure 11. Bottom Thermal

6. DIMMER COMPATIBILITY

The boost stage is a low-side asynchronous boost converter. Once the CS1680 reaches its UVLO start threshold and begins normal operation, the CS1680 controller executes a dimmer switch detection algorithm to set the operating state of the IC. Table 1 summarizes the system operating state that produced the empirical dimmer compatibility results.

MR16 Lamp with a CS1680 (12VAC)			
Date	09/09/2013	Power Factor^{1,6}	0.98
Vendor	Cirrus Logic	IEC-61000-3-2 Compliant (Y/N)^{3,6}	Y
Input Voltage (RMS)	12	EN55015 Compliant (Y/N)	Y
Form Factor	MR16	Nominal Input Power (W)^{1,6}	6.79
Model #	CRD1680-7W	Maximum Input Power (W)^{2,6}	7.0
IC	CS1680	Output Voltage (V)^{1,4}	12.27
Topology	Boost/Buck	Output Current (mA)^{1,4}	424
Isolation (Y/N)	N	Output Current Ripple $\leq$ 120Hz (mA)^{1,5}	0
Efficiency⁷ (%)	76.6 %	Output Power (W)^{1,6}	5.21

- Notes:
1. Tested at nominal input voltage, nominal input frequency and without a dimmer
 2. Tested over input voltage tolerances for steady-state operation
 3. Compliant with IEC 61000-3-2 Class C < 25W
 4. Average
 5. Peak-to-peak
 6. Measured with Chroma 66202 Power Analyzer
 7. MR16 lamp efficiency is dependent on LED output voltage V_{OUT}

6.1 120VAC Dimmer Compatibility

Table 1 reports the empirical dimmer compatibility results when detectable inputs to the dimmer compatibility circuit are generated using a 120VAC transformer paired with a leading-edge or trailing-edge dimmer.

Table 1: 120VAC, 60Hz Mains Power System

Dimmer ¹	Lutron DVLV-600P Leading Edge						Lutron DVELV-300P Trailing Edge						Lutron SELV-300P Trailing Edge						Levitron 6615 Trailing Edge					
	Flicker Free ² Steady-State			I _{out} (%)		Min Max	Flicker Free ² Steady-State			I _{out} (%)		Min Max	Flicker Free ² Steady-State			I _{out} (%)		Min Max	Flicker Free ² Steady-State			I _{out} (%)		Min Max
Transformer ³	# of lamps			# of lamps			# of lamps			# of lamps			# of lamps			# of lamps			# of lamps			# of lamps		
	1	3	6	1	3	6	1	3	6	1	3	6	1	3	6	1	3	6	1	3	6	1	3	6
Hatch LS1250EN	Y	Y	Y	5.2	5.2	5.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
				80	80	70																		-
Lightech LET60	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	20	10	5.2
				100	100	100				100	100	90				100	100	80				100	100	100
Hatch RS12-80M	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	30	10	10
				100	100	100				100	100	100				100	80	100				100	80	100
Hatch VS12-60WD	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	10	5.2	5.2
				100	100	100				100	100	80				100	90	80				100	100	90
Osram ET-MZ 60	Y	Y	N	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	10	5.2	5.2
				100	100	100				100	100	70				100	90	70				100	100	80
Eurofase	Y	N	N	5.2	5.2	5.2	Y	Y	N	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	Y	Y	N	10	10	10
				100	90	70				100	100	80				100	100	70				100	100	90

- Notes:
1. This document includes trademarks, trade names, brands, logos, product names and/or product identifiers of companies other than Cirrus Logic, Inc. All such trademarks, trade names, brands, logos, product names, and product identifiers are for identification purposes only and are the property of their respective owners, who are not affiliated with Cirrus Logic. Please visit the respective sites of those owners to obtain a listing or understanding of their trademark rights. This document also includes results from testing performed by Cirrus Logic for its own purposes and for which there are currently no industry standards. While this testing was applied objectively, its results may include at least some degree of subjectivity. The testing or test results should not be interpreted as any comment on the overall quality or suitability of any tested products.
 2. Flicker-free results are reported at different conduction angle ranges and dependent on transformer and dimmer pairing.
 3. Empirical results are recorded only with a magnetic transformer paired with a lead-edge dimmer.

6.2 230VAC Dimmer Compatibility

Table 2 reports the empirical dimmer compatibility results when detectable inputs to the dimmer compatibility circuit are generated using a 230VAC transformer paired with a leading-edge or trailing-edge dimmer.

Table 2: 230VAC, 50Hz Mains Power System

Dimmer ¹	HPM CAT400L Leading Edge					Busch 2247U Leading Edge					HPM CAT400T Trailing Edge					Clipsal 32E450TM Trailing Edge								
	Flicker Free ² Steady-State			I _{out} (%)		Min Max	Flicker Free ² Steady-State			I _{out} (%)		Min Max	Flicker Free ² Steady-State			I _{out} (%)		Min Max	Flicker Free ² Steady-State			I _{out} (%)		Min Max
Transformer ³	# of lamps			# of lamps			# of lamps			# of lamps			# of lamps			# of lamps			# of lamps			# of lamps		
	1	3	6	1	3	6	1	3	6	1	3	6	1	3	6	1	3	6	1	3	6	1	3	6
Niko 320-00001	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	-	-	-	-	-	-	-	-	-	-	-	
				100	90	100				100	100	100												-
Osram Parrot 105	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	Y	Y	N	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2
				100	100	40				100	100	80				80	80	60				100	100	80
Philips S60	Y	Y	Y	5.2	5.2	5.2	Y	N	Y	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2
				100	90	80				100	100	100				100	90	80				100	100	100
Primaline 105	Y	Y	Y	5.2	5.2	5.2	Y	Y	N	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2
				100	100	90				100	100	40				100	80	90				100	100	100
Tridonic Possum	Y	Y	Y	5.2	5.2	5.2	N	Y	Y	5.2	5.2	5.2	Y	Y	N	5.2	5.2	5.2	Y	Y	Y	5.2	5.2	5.2
				100	100	80				100	100	100				80	70	60				100	100	60

Notes: 1. This document includes trademarks, trade names, brands, logos, product names and/or product identifiers of companies other than Cirrus Logic, Inc. All such trademarks, trade names, brands, logos, product names, and product identifiers are for identification purposes only and are the property of their respective owners, who are not affiliated with Cirrus Logic. Please visit the respective sites of those owners to obtain a listing or understanding of their trademark rights. This document also includes results from testing performed by Cirrus Logic for its own purposes and for which there are currently no industry standards. While this testing was applied objectively, its results may include at least some degree of subjectivity. The testing or test results should not be interpreted as any comment on the overall quality or suitability of any tested products.

2. Flicker-free results are reported at different conduction angle ranges and dependent on transformer and dimmer pairing.

3. Empirical results are recorded only with a magnetic transformer paired with a lead-edge dimmer.

7. INDUCTOR CONSTRUCTION

The CS1680 integrates a continuous conduction mode (CCM) boost converter that provides transformer compatibility and dimmer compatibility with a constant output current buck stage. The following sections describe the boost and buck inductors installed on the CRD1680-7W.

7.1 Boost Inductor

The CS1680 uses an adaptive digital algorithm to control the boost stage and dimmer compatibility operation mode, which enables flicker-free operation down to 5% output current with leading-edge and trailing-edge dimmers. Boost inductor L1 is selected to be a standard TAIYO YUDEN power inductor.

7.1.1 Electrical Specifications

Characteristics conditions:

- Operating temperature range: -25 °C to +125 °C (including coil heat)

Parameter	Condition	Symbol	Value	Unit
TAIYO YUDEN Boost Inductor #NRS8040T150MJGJ				
Inductance (Note 1)	$f_{\text{measured}}=100\text{kHz}$		15 ($\pm 20\%$)	μH
DC Resistance (Note 1)	Maximum		0.065	Ω
Saturation Current	Rated Current		2900	mA

Notes: 1. Measured across pins 1 and 2

7.2 Buck Inductor

The CS1680 buck stage is a constant current-regulated DC-DC converter capable of delivering the highest possible efficiency with constant current output while minimizing line frequency ripple. Buck inductor L2 is selected to be a standard TAIYO YUDEN power inductor.

7.2.1 Electrical Specifications

Characteristics conditions:

- Operating temperature range: -25 °C to +125 °C (including coil heat)

Parameter	Condition	Symbol	Value	Unit
TAIYO YUDEN Buck Inductor #NR6045T470M				
Inductance (Note 1)	$f_{\text{measured}}=100\text{kHz}$		47 ($\pm 20\%$)	μH
DC Resistance (Note 1)	$t_{\text{DCR}}=20^\circ\text{C}$		0.286	Ω
Saturation Current	Rated Current		1300	mA

Notes: 1. Measured across pins 1 and 2

8. PERFORMANCE PLOTS (120VAC)

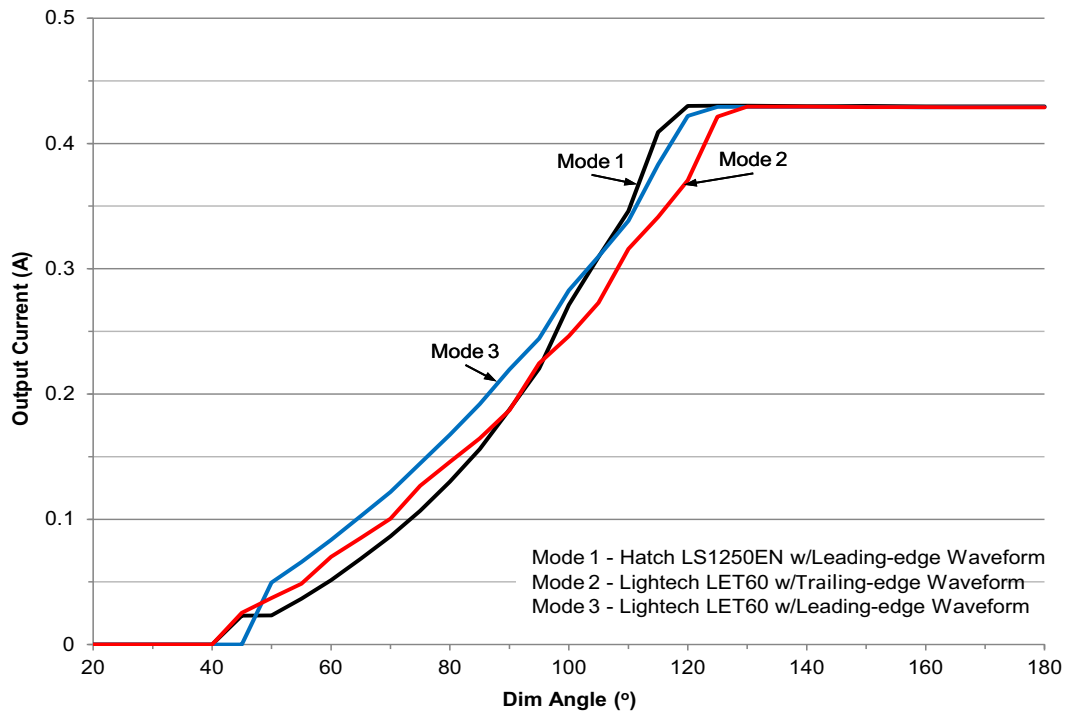


Figure 12. Typical CRD1680-7W Output Current vs. Dim Angle, 120VAC

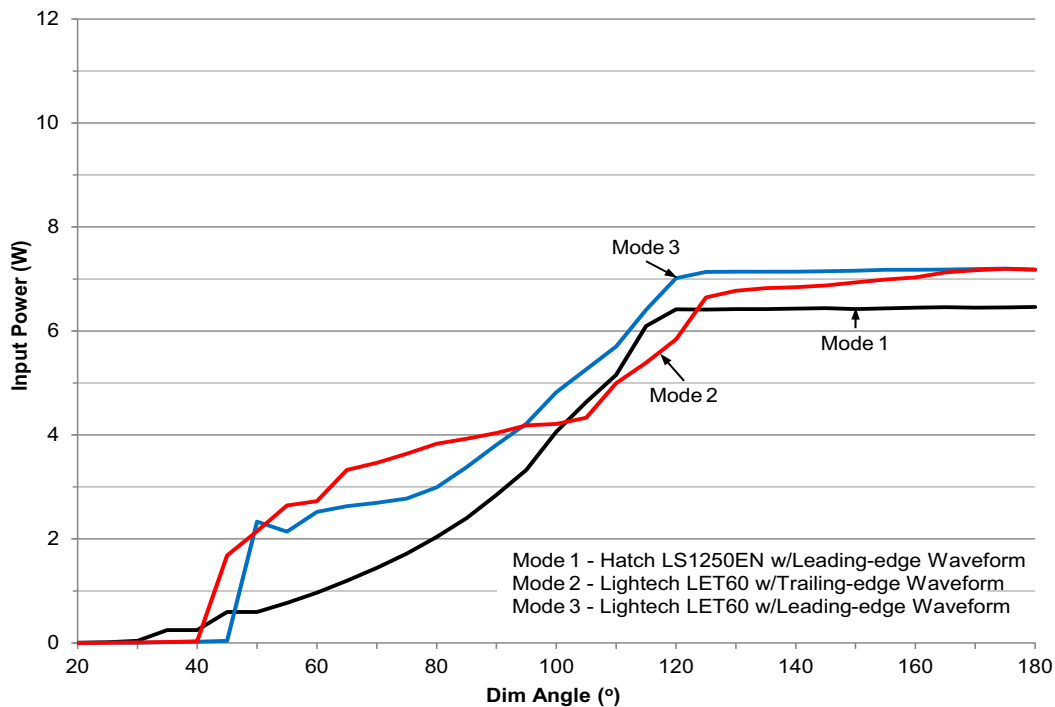


Figure 13. Typical CRD1680-7W Input Power vs. Dim Angle, 120VAC

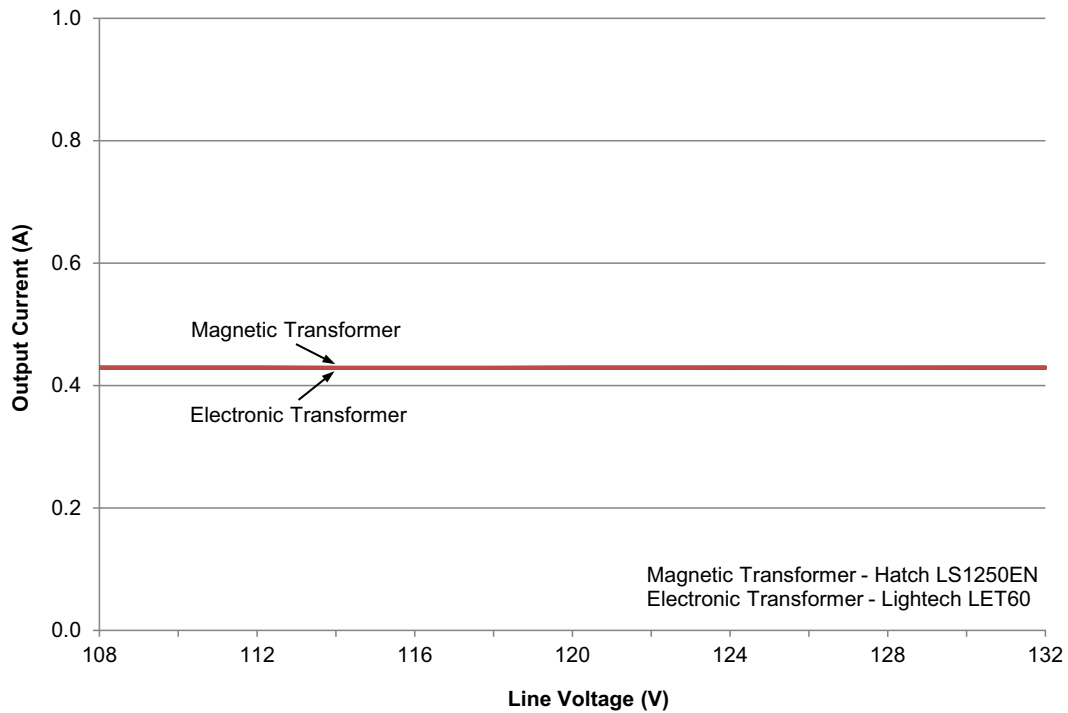


Figure 14. CRD1680-7W Output Current vs. Line Voltage, 108VAC to 132VAC

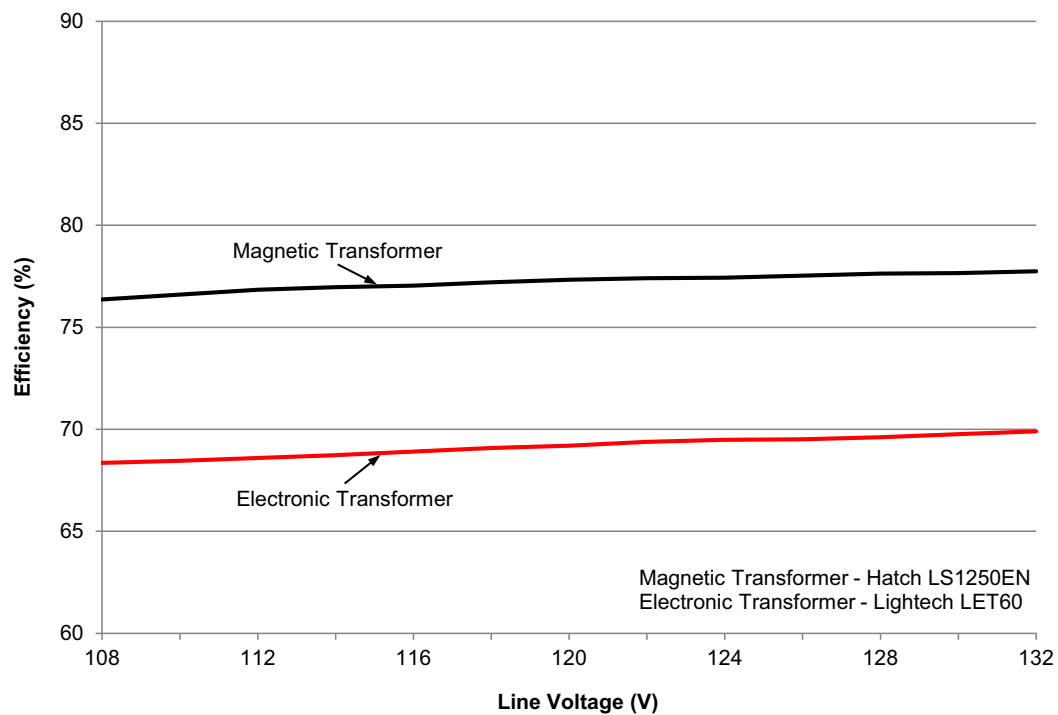


Figure 15. Typical CRD1680-7W Efficiency vs. Line Voltage, 108VAC to 132VAC

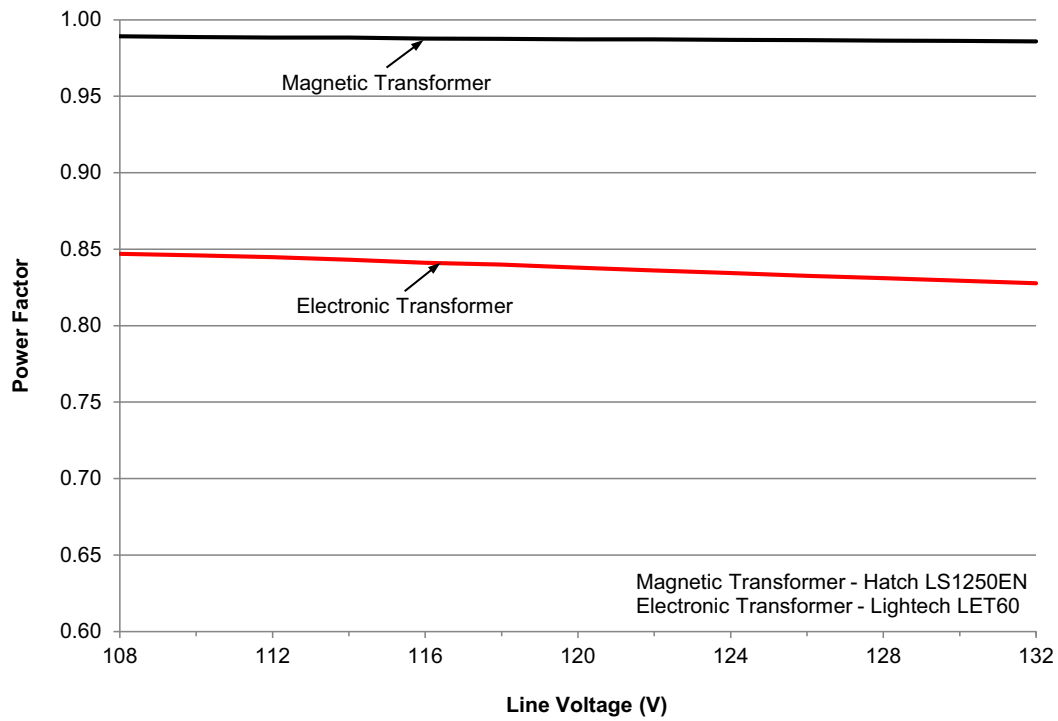


Figure 16. CRD1680-7W Power Factor vs. Line Voltage, 108VAC to 132VAC

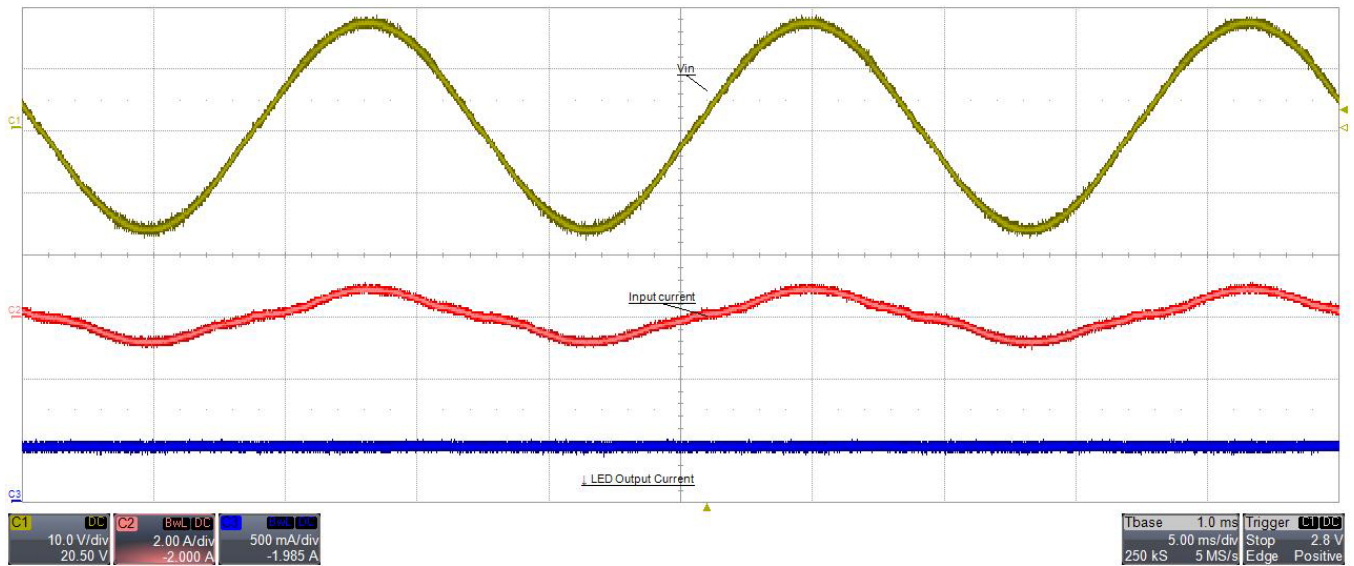


Figure 17. No-dimmer CRD1680-7W Output Mode1, Steady-state

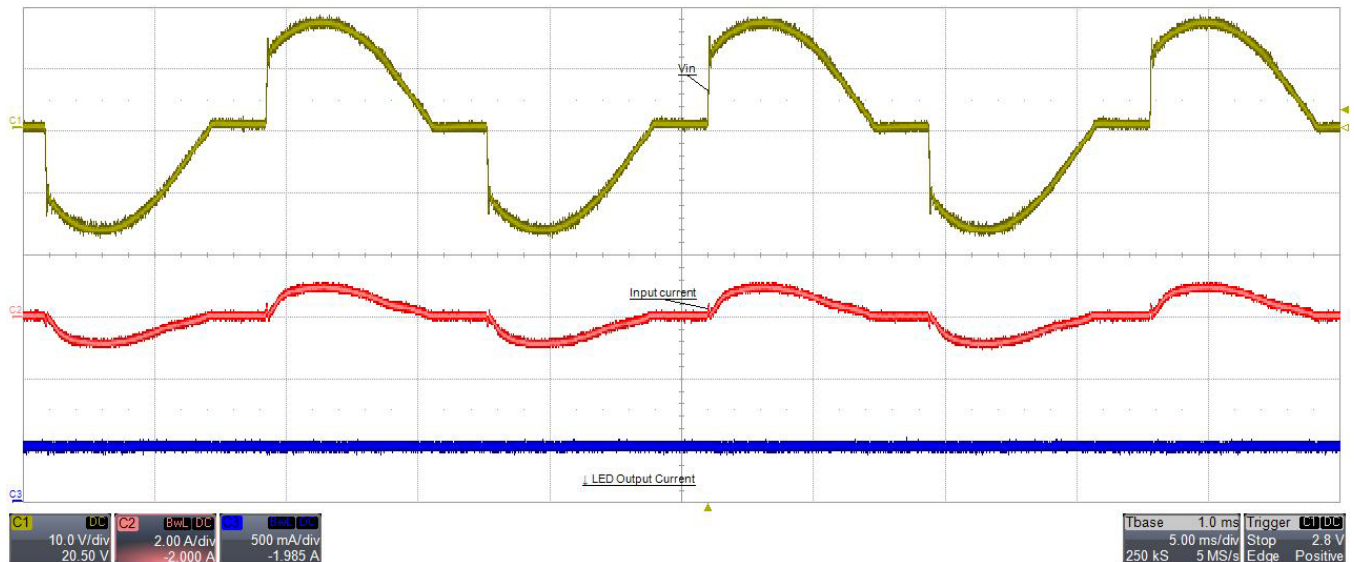


Figure 18. Maximum CRD1680-7W Output Mode1, Steady-state

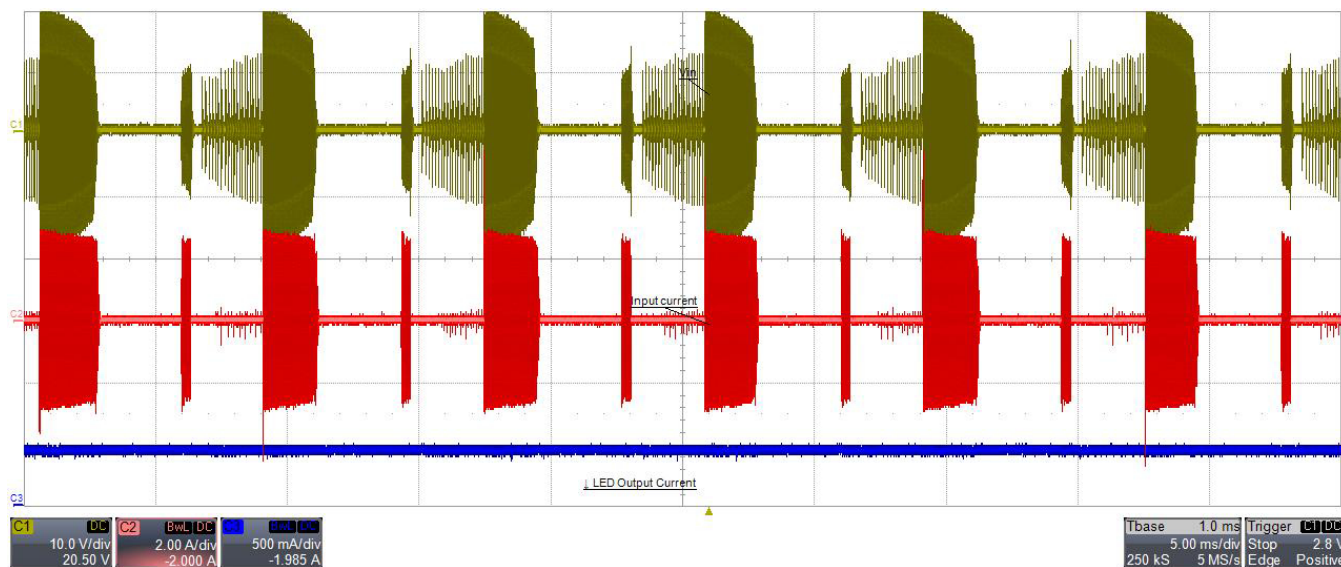


Figure 19. Maximum CRD1680-7W Output Mode2, Steady-state

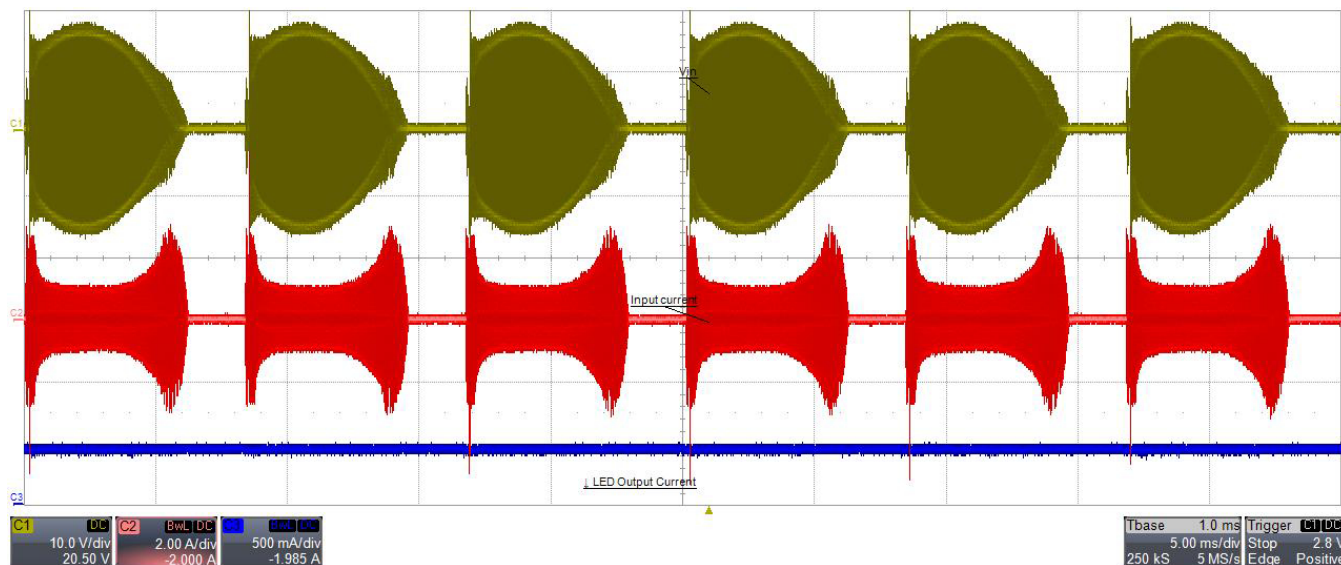


Figure 20. Maximum CRD1680-7W Output Mode3, Steady-state

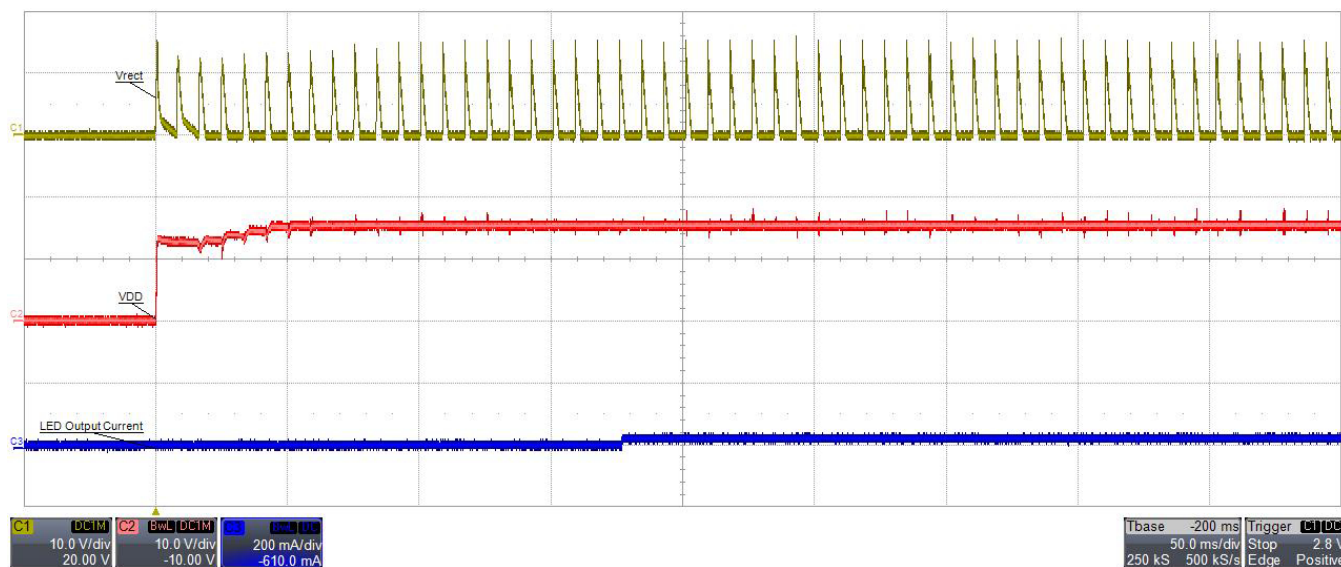


Figure 21. CRD1680-7W Output Current at Minimum Dim Angle, Mode1, Turn-on Waveforms

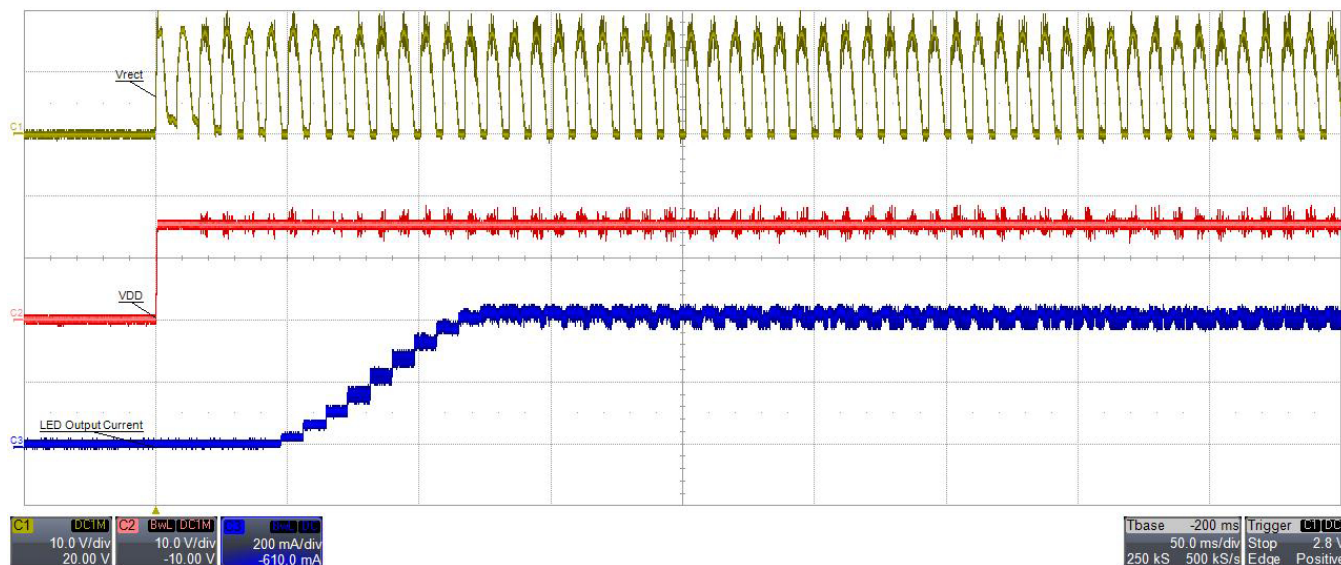


Figure 22. CRD1680-7W Output Current at Maximum Dim Angle, Mode1, Turn-on Waveforms

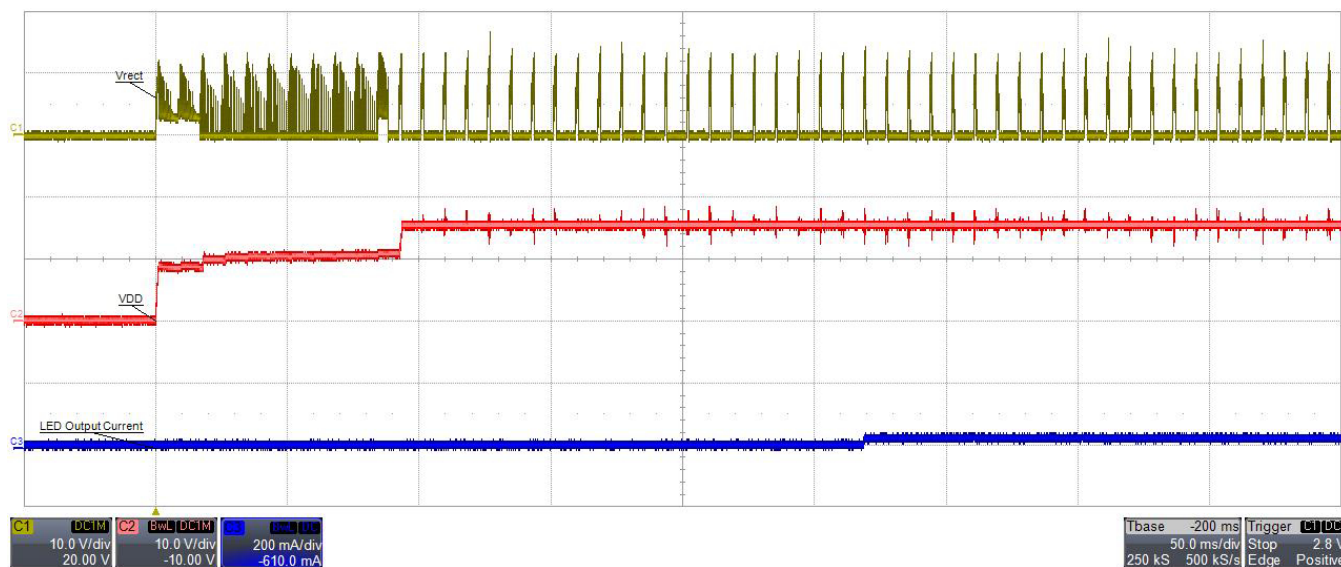


Figure 23. CRD1680-7W Output Current at Minimum Dim Angle, Mode2, Turn-on Waveforms

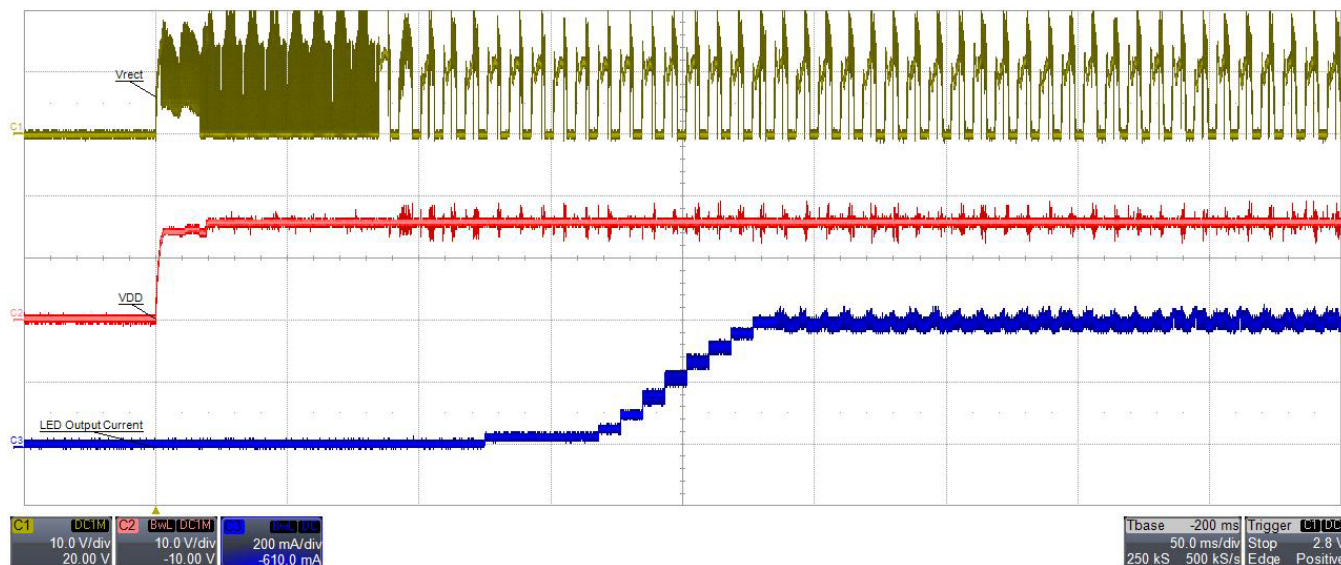


Figure 24. CRD1680-7W Output Current at Maximum Dim Angle, Mode2, Turn-on Waveforms

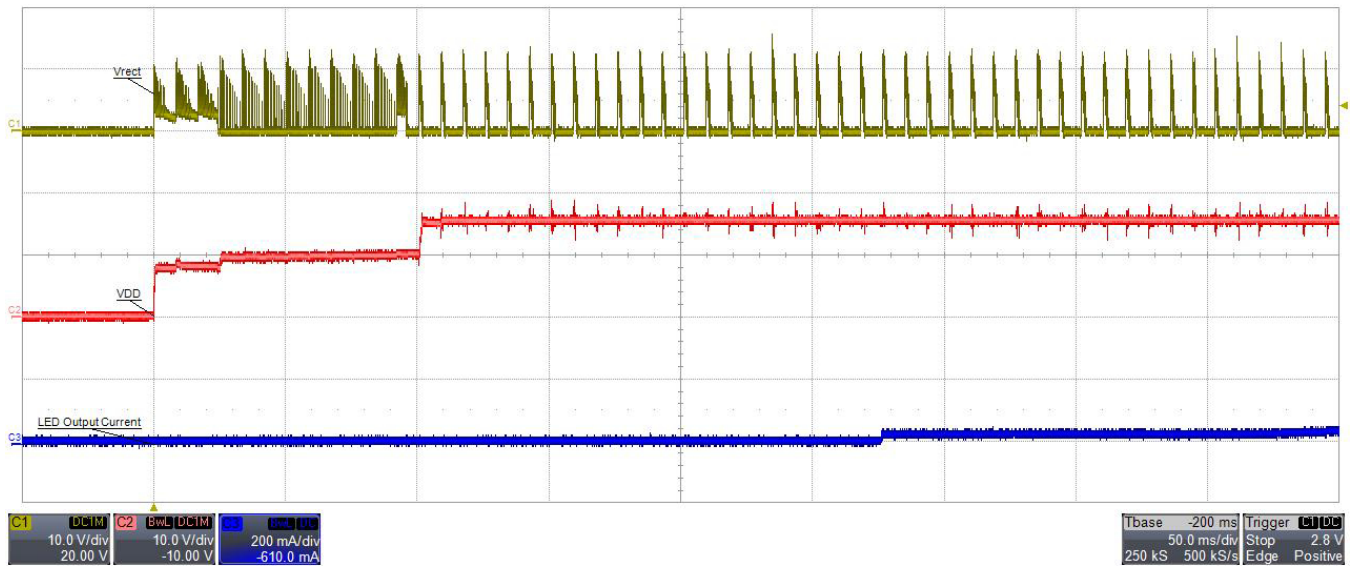


Figure 25. CRD1680-7W Output Current at Minimum Dim Angle, Mode3, Turn-on Waveforms

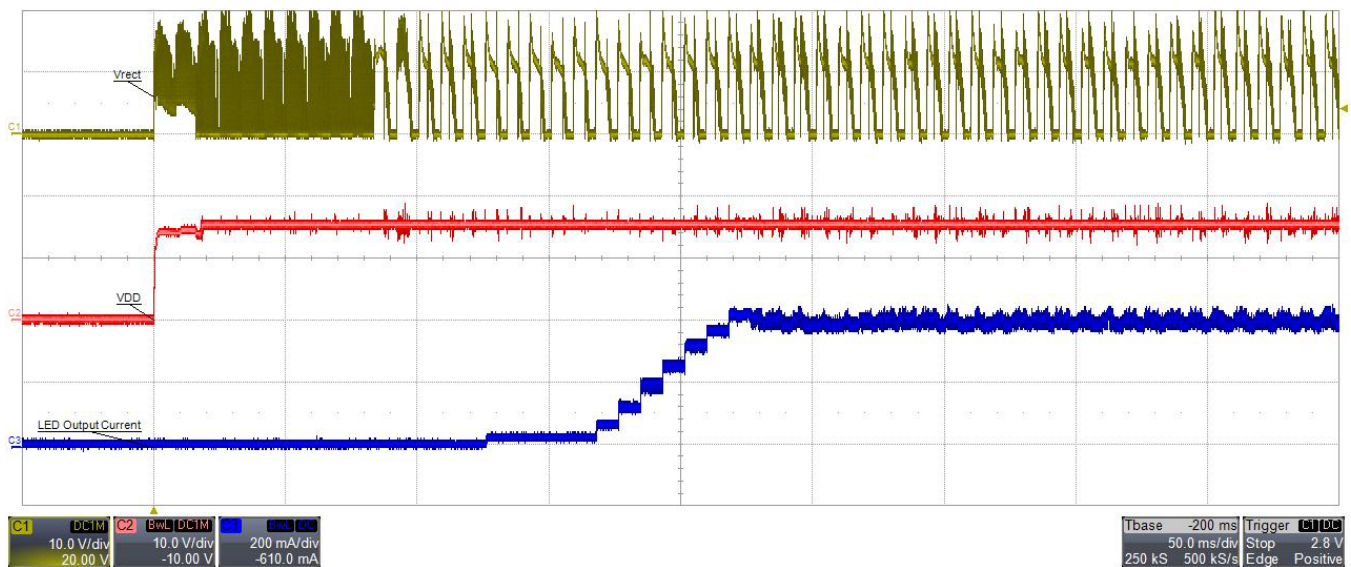


Figure 26. CRD1680-7W Output Current at Maximum Dim Angle, Mode3, Turn-on Waveforms

9. PERFORMANCE PLOTS (230VAC)

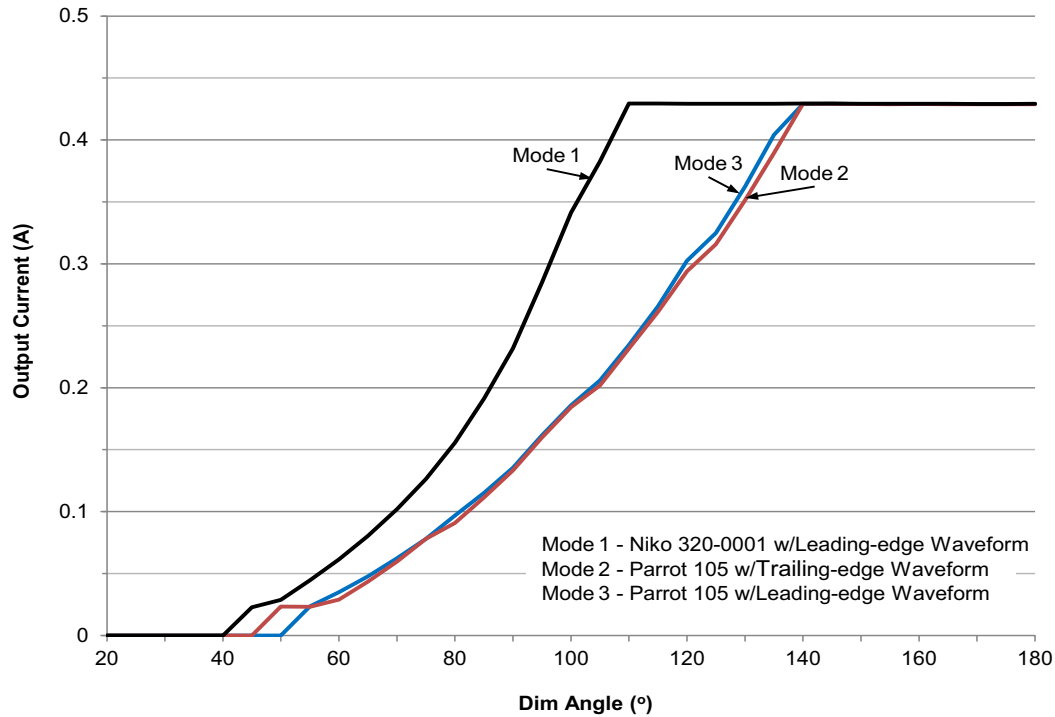


Figure 27. Typical CRD1680-7W Output Current vs. Dim Angle, 230VAC

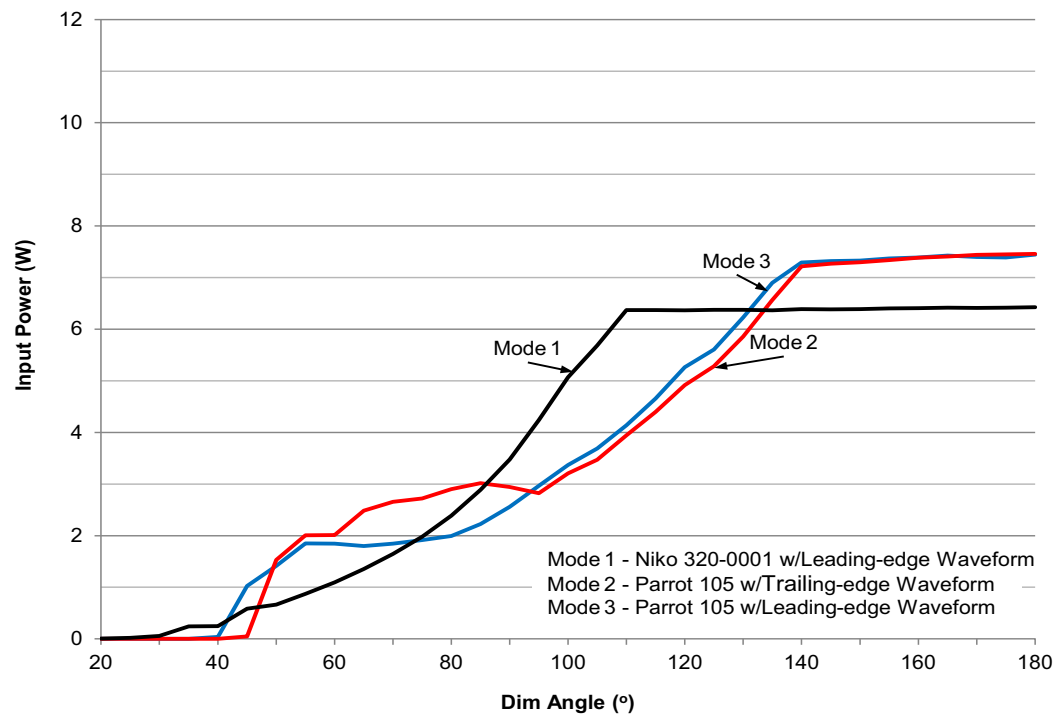


Figure 28. Typical CRD1680-7W Input Power vs. Dim Angle, 230VAC

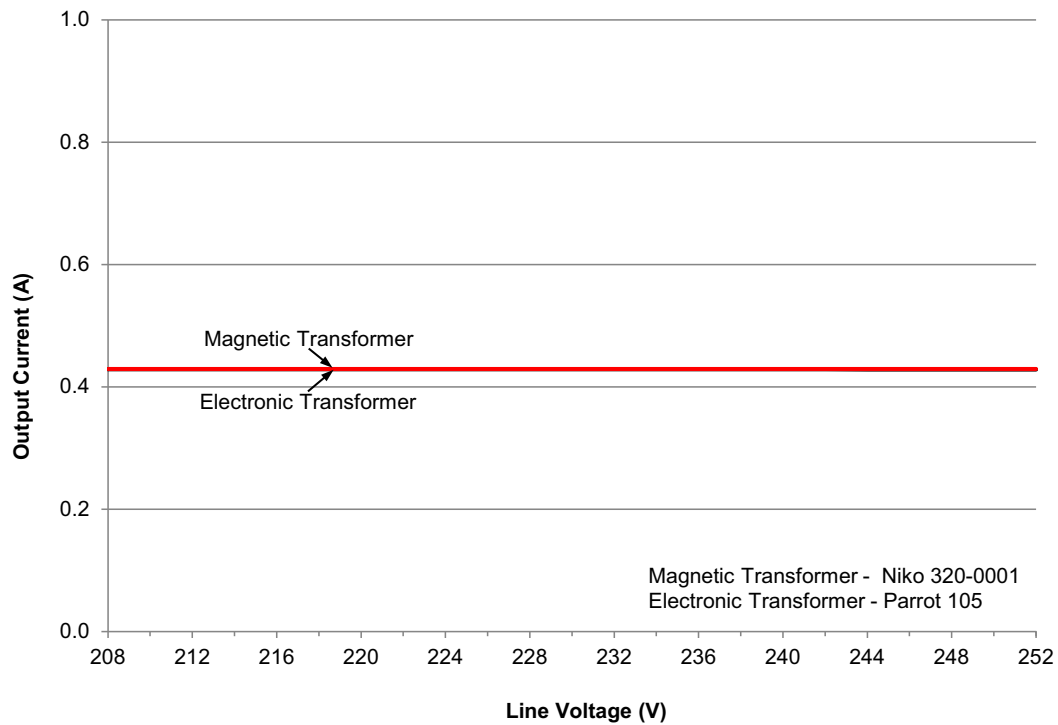


Figure 29. CRD1680-7W Output Current vs. Line Voltage, 208VAC to 252VAC

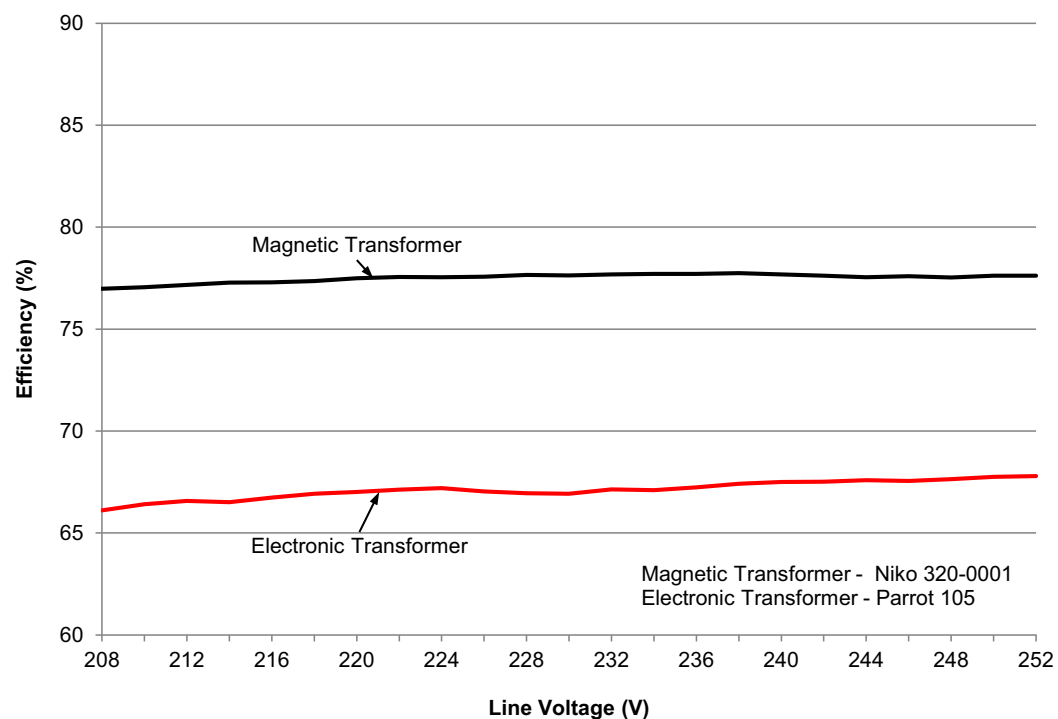


Figure 30. Typical CRD1680-7W Efficiency vs. Line Voltage, 208VAC to 252VAC

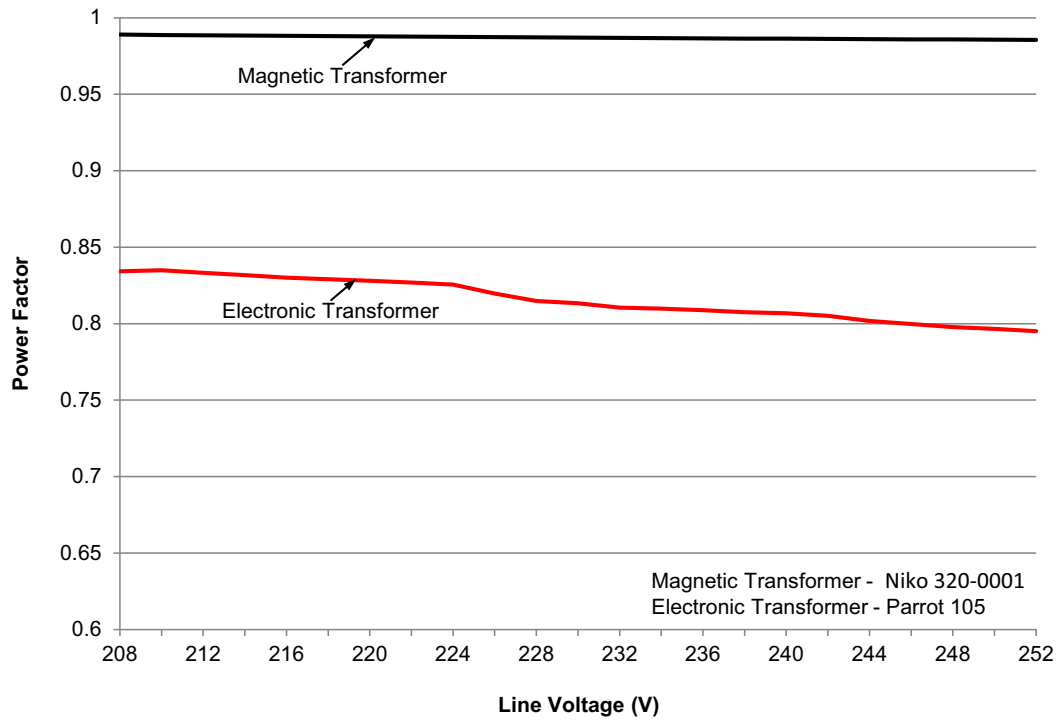


Figure 31. CRD1680-7W Power Factor vs. Line Voltage, 208VAC to 252VAC

10. CONDUCTED EMI

Device Under Test: CRD1680-7W-Z

Operating Conditions: 230V 50Hz

Test Specification: IEC 61000-3-2

Operator Name: DLP

Scan Settings (1 Range)

Frequencies			Receiver Settings			
Start	Stop	Step	Res BW	M-Time	Atten	Preamp
150kHz	30MHz	4.5kHz	9kHz (6dB)	50ms	Auto	Off

Final Measurement

Detectors: PK+, AV

Peaks: 8

Meas Time: 1s

Acc. Margin: 12dB

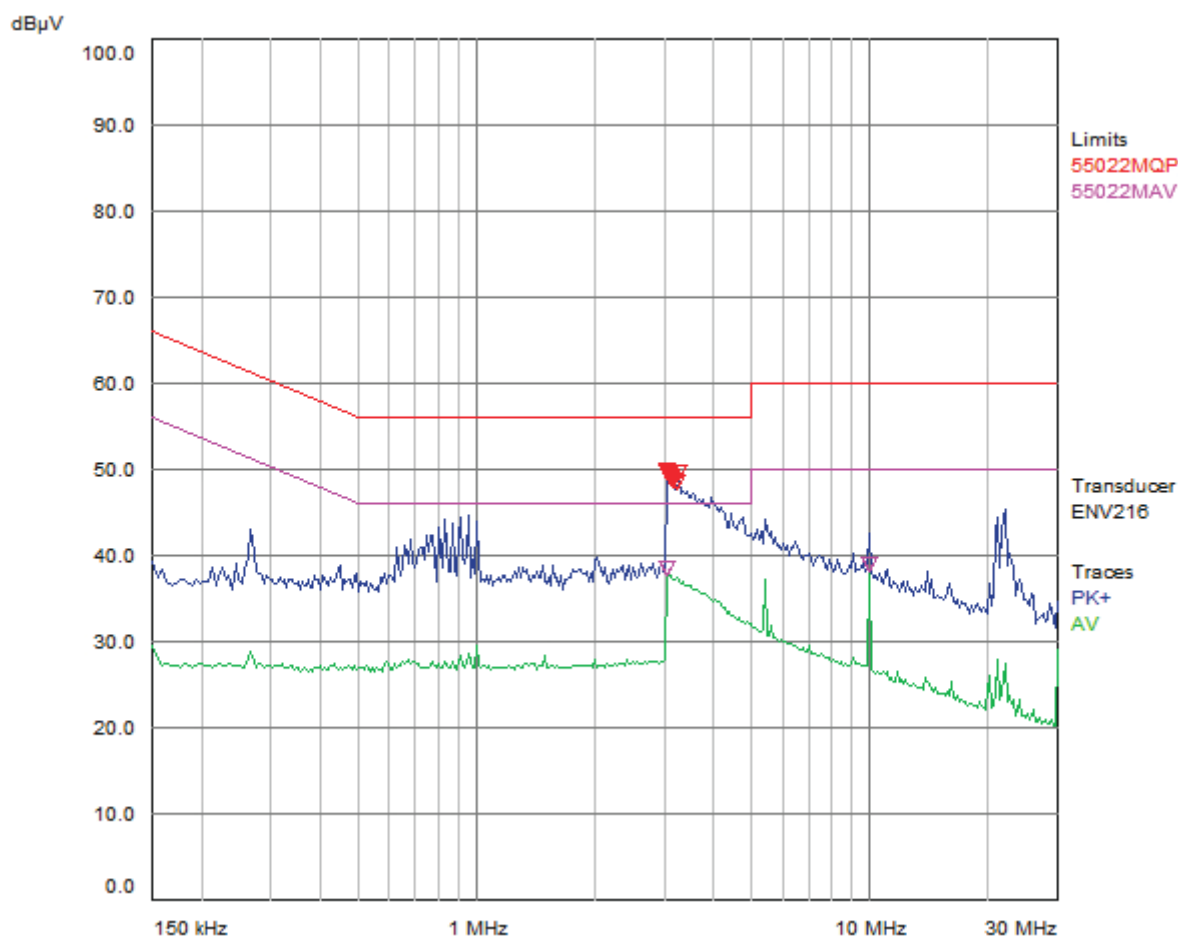


Figure 32. CRD1680-7W Conducted EMI

11. RADIATED EMI

Device Under Test: CRD1680-7W-Z

Operator Name: DLP

Test Specification: CISPR 16-1-4:2007

EN55022 Compliant (Y/N): Y

Antenna Orientation: Horizontal/Vertical

Frequency Range: 30MHz to 1GHz

EUT Line Voltage: 230 VAC

EUT Power Frequency: 50Hz

Final Measurement

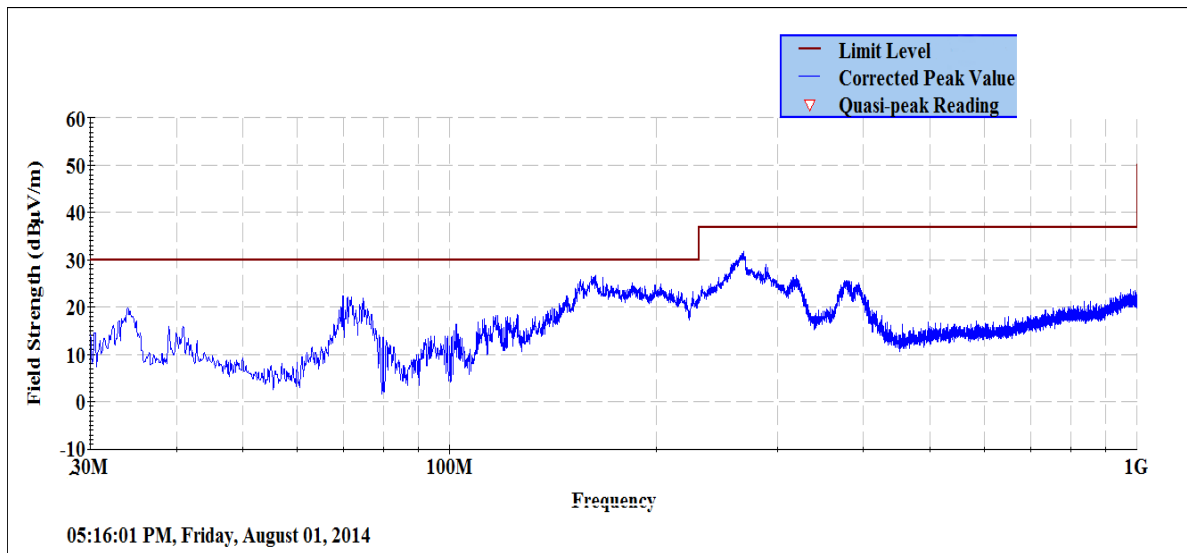


Figure 33. CRD1680-7W Radiated EMI - Horizontal Polarity

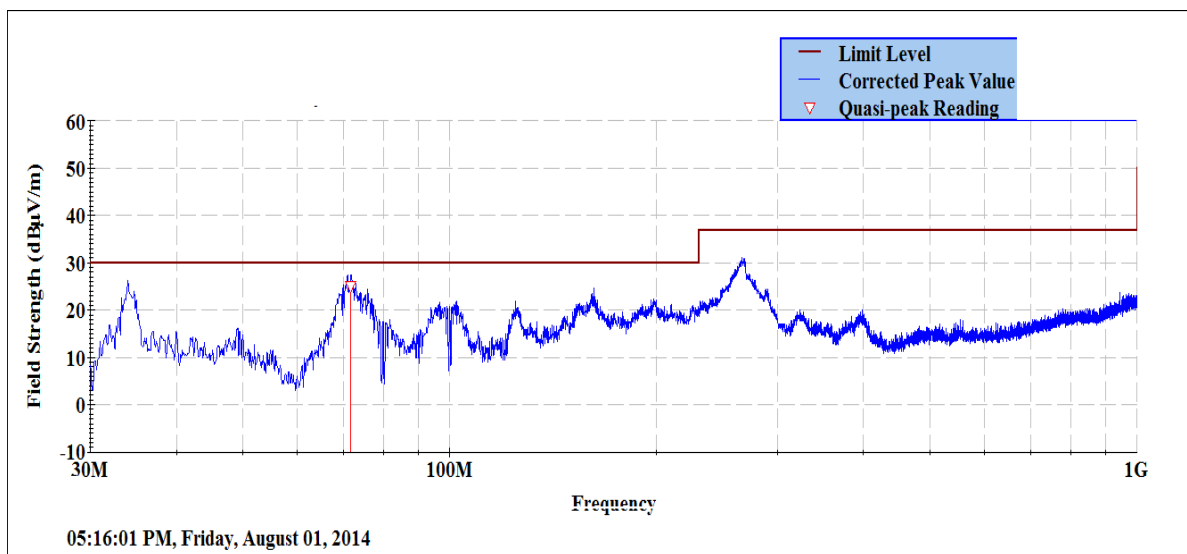


Figure 34. CRD1680-7W Radiated EMI - Vertical Polarity

12. REVISION HISTORY

Revision	Date	Changes
RD1	SEP 2013	Initial release
RD2	NOV 2013	Content addition and clarification for revision B silicon
RD3	JAN 2014	Content clarification for PCBA revision D
RD4	SEP 2014	Content addition

AMEYA360

Components Supply Platform

Authorized Distribution Brand :



Website :

Welcome to visit www.ameya360.com

Contact Us :

➤ Address :

401 Building No.5, JiuGe Business Center, Lane 2301, Yishan Rd
Minhang District, Shanghai , China

➤ Sales :

Direct +86 (21) 6401-6692
Email amall@ameya360.com
QQ 800077892
Skype ameyasales1 ameyasales2

➤ Customer Service :

Email service@ameya360.com

➤ Partnership :

Tel +86 (21) 64016692-8333
Email mkt@ameya360.com