



**0-10V or Wireless Dimmable
LED Driver with iW3630**
(AC input 100-277V_{AC}, Output 30-55V 700mA)

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1.0 Introduction

This reference design describes a output at 30-55V 700mA, wide-range input (100–277V_{AC}) power supply for 0-10V or wireless dimmable LED applications. For this design the iW3630 is used. This document contains the design features of the 0-10V dimmable LED driver, a detailed circuit diagram, an entire bill of materials required to build the LED driver, a drawing of the power transformer, and test data of the most important performance.

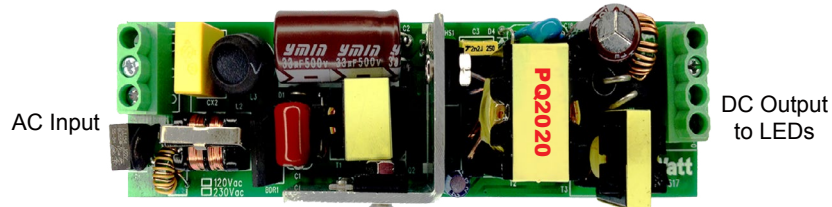
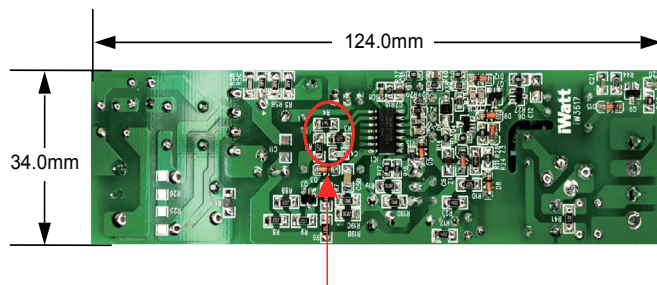


Figure 1.1 PCB Top View



iW3630 Digital Power Controller for High Power Factor Analog and 0-10V Dimmable
(SO-14 Package)

Figure 1.2 PCB Bottom View

2.0 Design Features

- High PF (>0.95)
- Low THD (<15%)
- Support IEC and ANSI analogue dimming system, 0-10V
- Support MCU PWM dimming, enable wireless remote control
- Flicker less lighting application, zero line-frequency ripple current
- Low standby power at remote control mode

3.0 Design Specification

The table below represents the minimum acceptable performance of the design.

Description	Symbol	Min	Typ	Max	Units	Comment
Input						
Voltage	V_{IN}	100		277	V _{AC}	2 wire
Frequency	f_{LINE}	47	50/60	63	Hz	
Output						
Output voltage	V_{OUT}		55		V	Measured at the end of PCB
Output current	I_{OUT}		0.7		A	
Output ripple current	I_{RIPPLE}		25		mA _{P-P}	Set oscilloscope at 20MHz bandwidth
Total Output Power						
Continuous output power	P_{OUT}		40		W	
Power factor	PF	0.9				
Efficiency	η		86		%	Measured at end of PCB $V_{IN}=230V_{AC}$ ($T_{AMB} = 25^{\circ}C$).
Environmental						
THD	THD			15	%	
Conducted EMI		Meets CISPR22B/EN55022B				
Safety		Designed to meet IEC950, UL1950 Class II				
Ambient temperature	T_{AMB}	0		40	°C	Free convection, sea level

4.0 Schematic

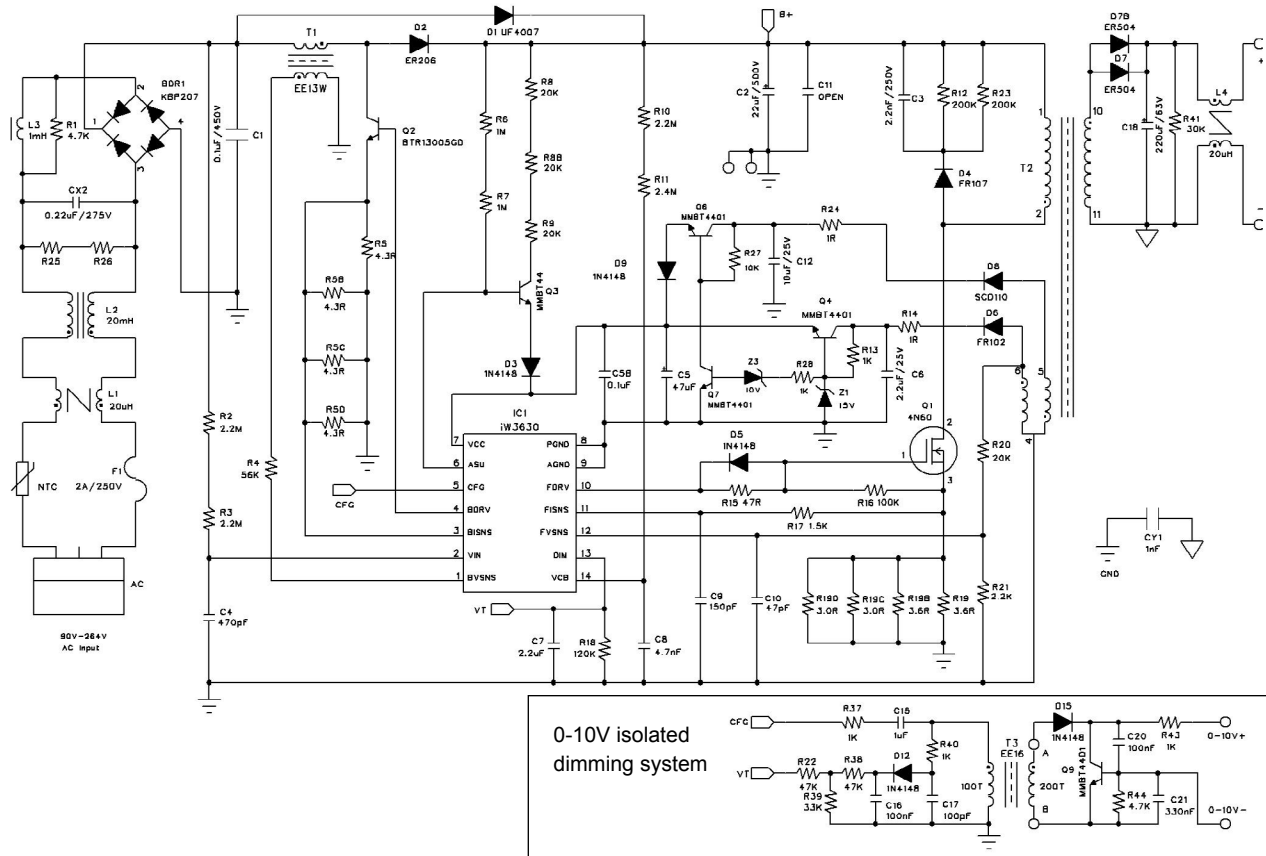
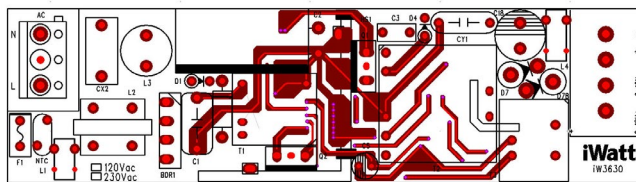
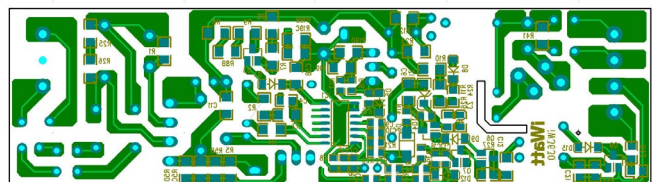


Figure 4.1 Design Schematic

5.0 PCB Layout



PCB Top



PCB Bottom

Figure 5.1 PCB Layout 124.0 mm x 34.0 mm

6.0 Bill of Materials

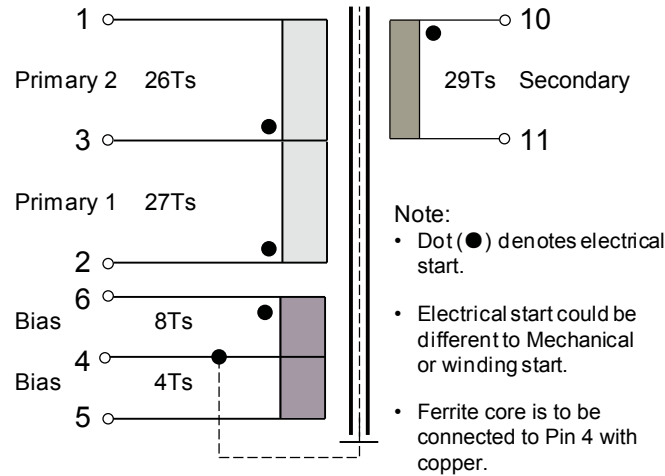
Item	Qty.	Ref.	Description	Manufacturer P/N	Manufacturer
1	1	IC1	iW3630, AC/DC Digital Power Controller for High Power Factor Analog and 0-10V Dimmable LED Drivers, SO-14	iW3630	iWatt, Inc.
2	1	CX2	100nF, 275V, X2, P=10.5mm	PX104K31C39H200D9R	Carli
3	1	C1	22nF, 450V, CL21, P=10.5mm	AF223J2G079L250D9R	Carli
4	1	C1	22μF, 500V, E-CAP	22UFLK500V	Yongming
5	1	C5	47μF, 25V, E-CAP	68UFLK25V	Yongming
6	1	C18	220μF, 65V, E-CAP	220UFLK63V	Yongming
7	1	C3	2.2nF, 250V, P=5mm, porcelain capacitor	2.2NF/250V	STE
8	1	C10	47pF, 25V, X7R, SMD-0805	CL10B470JB8NNNC	SAMSUNG
9	1	C9	150pF, 25V, X7R, SMD-0805	CL10B151JB8NNNC	SAMSUNG
10	1	C8	4.7nF, 25V, X7R, SMD-0805	CL10B472JB8NNNC	SAMSUNG
11	1	C5B	100nF, 50V, X7R, SMD-1206	CL10B104JB8NNNC	SAMSUNG
12	1	C4	470pF, 25V, X7R, SMD-0805	CL10B471JB8NNNC	SAMSUNG
13	3	C12, C6, C7	2.2μF, 25V, X7R, SMD-0805	CL31B225KAHNNNC	SAMSUNG
14	2	R14, R24	4.7Ω ±1%, SMD-0805	RC0805JR-074R7L	YAGEO
15	1	R15	47Ω ±1%, SMD-0805	RC0805JR-0747RL	YAGEO
16	3	R28, R13, R27	1KΩ ±1%, SMD-0805	RC0805JR-071KL	YAGEO
17	1	R16	100kΩ±1%, SMD-0805	RC0805JR-07100KL	YAGEO
18	2	R12, R23	200kΩ ±1%, SMD-1206	RC1206JR-07200KL	YAGEO
19	1	R1	4.7kΩ ±1%, SMD-1206	RC1206JR-0724K7L	YAGEO
20	1	R4	56kΩ±1%, SMD-1206	RC1206JR-0756KL	YAGEO
21	2	R6, R7	1MΩ±1%, SMD-1206	RC1206JR-071ML	YAGEO
22	3	R2, R3, R10	2.2MΩ±1%, SMD-1206	RC1206JR-072M2L	YAGEO
23	3	R8, R8B, R9	20kΩ±1%, SMD-1206	RC1206JR-0720KL	YAGEO
24	1	R11	2.4MΩ±1%, SMD-1206	RC1206JR-072M4L	YAGEO
25	1	R20	20kΩ ±1%, SMD-0805	RC0805JR-0720KL	YAGEO
26	1	R41	30kΩ ±1%, SMD-1206	RC1206JR-0730KL	YAGEO
27	1	R17	1.5kΩ ±1%, SMD-0805	RC0805JR-071K5L	YAGEO
28	1	R18	75kΩ ±1%, SMD-0805	RC0805JR-0775KL	YAGEO
29	1	R21	2.2kΩ ±1%, SMD-0805	RC0805JR-072K2L	YAGEO
30	2	R19D, R19C	3Ω ±1%, SMD-1206	RC1206JR-073RL	YAGEO
31	2	R19, R19B	3.6Ω ±1%, SMD-1206	RC1206JR-073R6L	YAGEO
32	4	R5, R5B, R5C, R5D	3.9Ω ±1%, SMD-1206	RC1206JR-073R9L	YAGEO
33	1	NTC	5D-9	5D-9	Shiheng
34	1	F1	T2A250V	CRUPMP2A250V	HONGDA
35	1	BDR1	KBP307G, 3A, 1000V, KBP	KBP307G	PANJIT Semiconductor
36	2	D6,D8	RS1D, 1A, 200V, SMA	RS1	PANJIT Semiconductor
37	1	D4	FR107, DO-41	FR10	PANJIT Semiconductor

6.0 Bill of Materials (Cont.)

Item	Qty.	Ref.	Description	Manufacturer P/N	Manufacturer
38	1	D1	UF4007, DO-41	UF4007	PANJIT Semiconductor
39	1	D2	ER206, 2A, 600V, DO-15	ER206	PANJIT Semiconductor
40	2	D7, D7B	SB504, 5A, 400V, DO-201AD	SB504	PANJIT Semiconductor
41	3	D3, D5, D9	LL4148, 0.15A, 100V, LL-34	LL4148	PANJIT Semiconductor
42	1	Z1	Zener, ZMM15B, 15V, LL-34	ZMM15B	ST
43	1	Z3	Zener, ZMM10B, 10V, LL-34	ZMM10B	ST
44	1	Q1	7N60.7A, 600V, TO-220F	FTA07N60	ARK
45	2	Q4, Q6, Q7	MMBT4401, NPN, SOT-23	MMBT4401	NXP
46	1	Q3	MMBT444, NPN, 0.3A, 500V, SOT-23	MMBT444	NXP
47	1	Q2	3DD13005ED, NPN, 4A 700V, TO-220HF	3DD13005ED	Huajing
48	1	L3	Drum choke, I-shaped 10X12mm,1mH	10X12MM1MH	XIN YUAN YANG
49	1	L2	UU9.5 20mH	UU9.5	XIN YUAN YANG
50	1	L1	Common Mode Inductor T8*4*3 15μH	T8*4*3 15uH	XIN YUAN YANG
51	1	L4	Common Mode Inductor T10*4*6 330μH	T10*4*6 330uH	XIN YUAN YANG
52	1	T1	EE13W, 0.6mH	EE13W	XIN YUAN YANG
53	1	T2	Transformer, PQ2020 L=0.5mH(Vcc=11Ts)	PQ2020	XIN YUAN YANG
54	1	CY1	Y1, 1000pF, 400V	1000PF400V	STE
55	1	HS1	Heat sink		
0-10V isolated dimming system					
56	1	T3	EE16	EE16	XIN YUAN YANG
57	1	Q9	MMBT4401, NPN, SOT-23	MMBT4401	NXP
58	2	D12, D15	LL4148, 0.15A, 100V, LL-34	LL4148	PANJIT Semiconductor
59	1	R38	47kΩ ±1%, SMD-0805	RC0805JR-0747KL	YAGEO
60	1	R44	4.7kΩ ±1%, SMD-0805	RC0805JR-074K7L	YAGEO
61	1	R22	47kΩ ±1%, SMD-0805	RC0805JR-0747KL	YAGEO
62	2	R43, R37	1kΩ ±1%, SMD-0805	RC0805JR-071KL	YAGEO
63	1	R39	120kΩ ±5%, SMD-0805	RC0805JR-07120KL	YAGEO
64	2	C16, C20	100nF, 50V, X7R SMD-0805	CL10B104JB8NNNC	SAMSUNG
65	1	C21	330nF, 50V, X7R SMD-0805	CL10B334JB8NNNC	SAMSUNG
66	1	C17	100pF, 25V, X7R, SMD-0805	CL10B101JB8NNNC	SAMSUNG
67	2	C15	1μF, 25V, X7R, SMD-0805	CL31B105KAHNNNC	SAMSUNG

7.0 Transformer Drawing

Schematic:



Electrical Specifications:

1. Primary inductance (L_p) = 0.5mH @10KHz
2. Primary leakage inductance (L_k) ≤ 40μH@10KHz

Materials:

1. Core : PQ2020 (ferrite material TDK PC40 or equivalent)
2. Bobbin : PQ2020 vertical primary=6, secondary=8
3. Magnet wires (Pri) : type 2-UEW
4. Magnet wire (Sec) : triple insulated wires
5. Layer insulation tape : 3M1298 or equivalent

Finished:

1. Core is connected to PRI-GND Pin 4
2. Varnish the complete assembly

8.0 Performance

8.1 Constant Current and Efficiency

* Note: $V_{OUT}=55V$

V_{IN} (V _{AC})	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (mA)	Ripple(PK) (mA)	η (%)	Power Factor	THD (%)
108	45.53	55.38	704	23.0	85.63%	0.999	4.60
120	44.85	55.38	704	23.0	86.93%	0.999	4.30
130	44.45	55.38	704	23.0	87.71%	0.999	3.05
140	44.22	55.38	704	23.0	88.17%	0.998	3.32
150	44.06	55.38	704	23.0	88.49%	0.997	3.33
160	43.88	55.38	706	21.0	89.10%	0.997	4.76
170	43.82	55.38	706	21.0	89.22%	0.997	4.23
180	43.72	55.38	708	21.0	89.68%	0.997	4.47
190	43.76	55.38	708	21.0	89.60%	0.996	4.50
200	43.81	55.38	708	21.0	89.50%	0.996	4.70
210	43.89	55.38	708	21.0	89.33%	0.991	4.30
220	43.95	55.38	709	21.0	89.34%	0.988	4.60
230	44.07	55.38	709	19.0	89.10%	0.988	4.30
240	44.21	55.38	711	19.0	89.06%	0.988	5.20
250	44.41	55.38	711	19.0	88.66%	0.986	5.70
264	44.55	55.38	712	19.0	88.51%	0.988	5.80
277	44.66	55.38	712	19.0	88.29%	0.986	6.20
305	44.47	55.38	712	19.0	88.67%	0.971	7.90

* Note: $V_{OUT}=28V$

V_{IN} (V _{AC})	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (mA)	Ripple(PK) (mA)	η (%)	Power Factor	THD (%)
108	23.52	28.10	718	23.0	85.78%	0.999	5.20
120	23.33	28.05	718	23.0	86.33%	0.998	5.70
130	23.20	28.00	718	23.0	86.66%	0.997	3.05
140	23.07	28.00	718	23.0	87.14%	0.996	3.32
150	23.05	28.00	718	23.0	87.22%	0.995	3.33
160	23.05	28.00	719	21.0	87.34%	0.993	4.71
170	23.05	28.00	719	21.0	87.34%	0.992	4.23
180	23.05	28.00	720	21.0	87.46%	0.992	4.47
190	23.12	28.00	720	21.0	87.20%	0.990	4.42
200	23.16	28.00	720	21.0	87.05%	0.989	4.67
210	23.25	28.00	720	21.0	86.71%	0.987	4.65
220	23.33	28.00	720	21.0	86.41%	0.985	4.30
230	23.44	28.00	722	19.0	86.25%	0.983	4.40
240	23.51	28.00	722	19.0	85.99%	0.980	4.67
250	23.62	28.00	724	19.0	85.83%	0.978	4.72
264	23.71	28.00	726	19.0	85.74%	0.972	6.20
277	23.88	28.00	727	19.0	85.24%	0.966	8.50
305	23.88	28.00	727	19.0	85.24%	0.934	14.20

8.0 Performance (Cont.)

8.2 Harmonic and Current Waveform

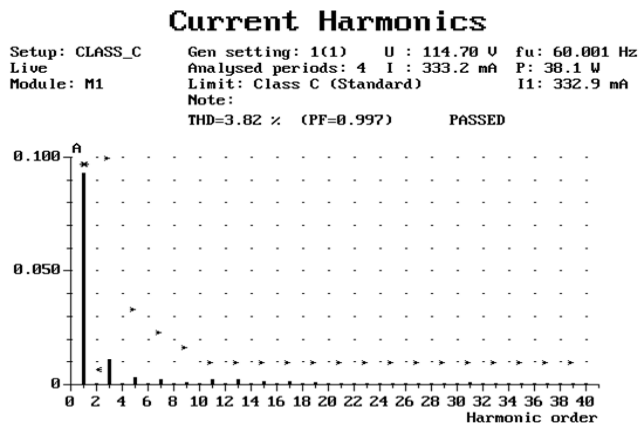


Figure 8.2.1 Current Harmonics

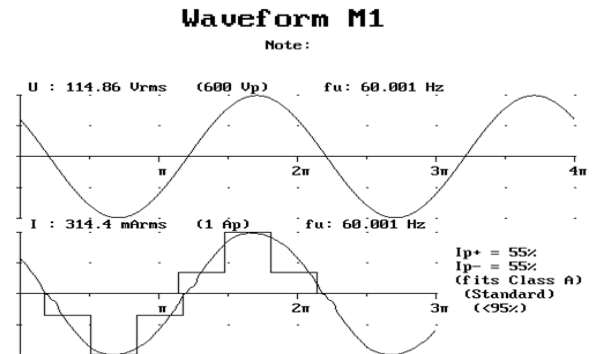


Figure 8.2.2 AC Current Waveform

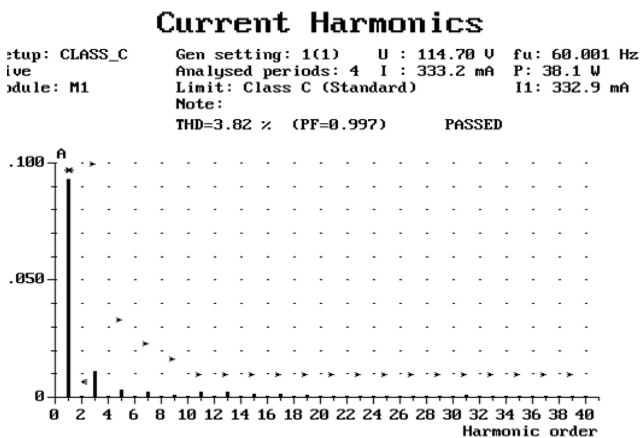


Figure 8.2.3 Current Harmonics

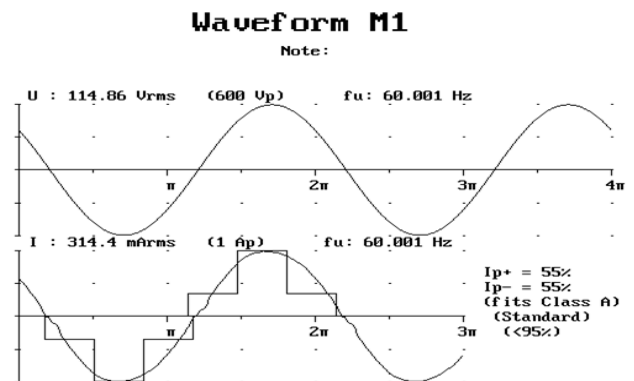
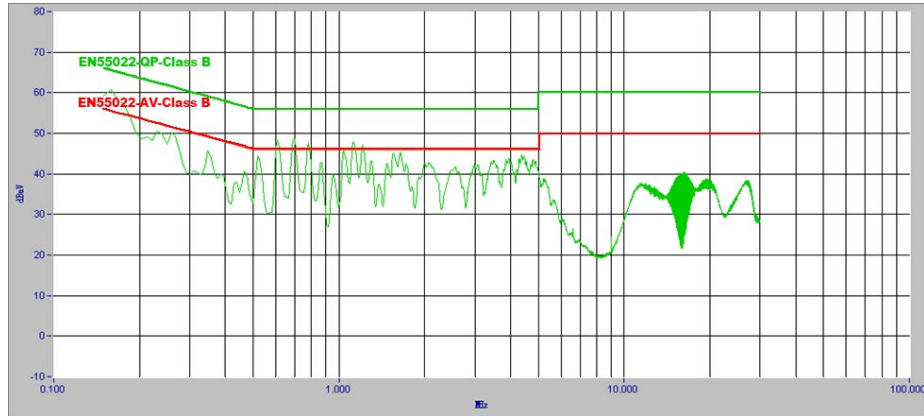


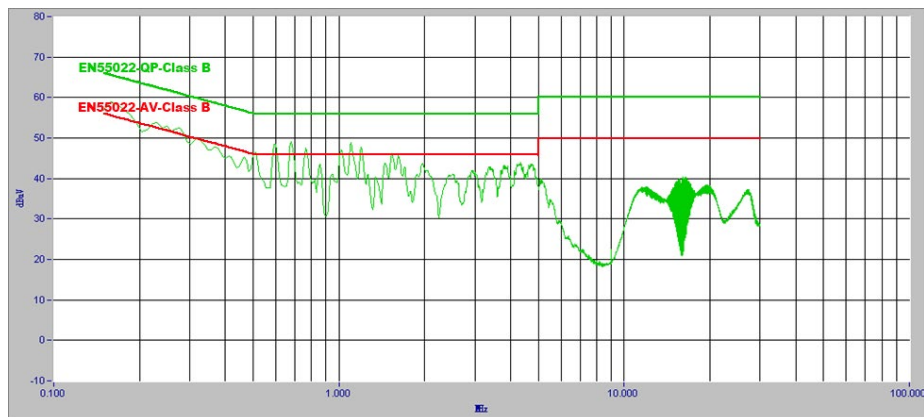
Figure 8.2.4 Current Harmonics

8.0 Performance (Cont.)

8.3 Conducted EMI



a) QP Scan L



b) QP Scan N

Figure 8.3.1 EMI Results



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Contact Information

Web: <http://www.iwatt.com>

E-mail: info@iwatt.com

Phone: +1 (408) 374-4200

Fax: +1 (408) 341-0455

iWatt Inc.

675 Campbell Technology Parkway, Suite 150
Campbell, CA 95008

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