SD6857_AN03

Silan

Hangzhou Silan Microelectronics Co., Ltd

SD6857_AN03

SD6857 DEMO BOARD USER MANUAL

(18W LED DAYLIGHT LAMP(T8) DRIVER)

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CONTENTS

1. FEATURES

- **Primary Side Constant Current Control**
  No optocoupler, No 431 and other feedback components
  Simplify the system design and low cost
  Tight output current line regulation and load regulation
- **PFC function and THD optimization**
  Single stage FLYBACK topology
  PF>0.95, THD<10%at 265Vac input
- **Very Low start-up current for fast start and low power loss**
- **Integrated protections for safety design**
  Vcc OVP and UVLO
  Open loop protection
  FB grounded protection
  Output short circuit protection and auto-recovery
  Over temperature protection and auto-recovery
- **Constant Voltage control when output is open circuit**
  Output voltage keeps stable and no over-shoot when output is open from full load.

2. INTRODUCTION FOR THE DEMO BOARD

This document introduces a high power-factor with primary side control LED driver designed to drive a LED string with 42V voltage and 430mA current. The output current accuracy is within +/-3% when the input voltage is widely changing from 85V to 265Vac. The main topology of this power supply is an isolated FLYBACK operating in discontinuous conduction mode. The output current is fully sensed and controlled from the primary side, which allows the circuit to remove all the components in feedback loop to reduce the total cost of the power supply.

Besides the main output voltage of 42V, it can also drive multiple different LED strings with a total voltage of range from 28V to 42V. When the LED voltage is beyond 43V, the output current will decrease and shut down.

This document includes the LED driver specification, Bill of materials, Schematic diagram, PCB, transformer design reference, test data and key waveforms.

3. LED DRIVER SPECIFICATION

Table 1 Specifications of single-stage isolated 18W LED driver

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Remark
Input Voltage	V_{IN}	85	220	265	VAC	
Input Frequency	f	47	50	63	Hz	
Output Voltage Range	Vo	28	--	42	V	8 to 12 LED strings
Output Over Voltage Protection		--	43	--	V	Auto-recover
Output Current	Io	--	0.43	--	A	
Output Current Ripple (pk-to-pk)	Ipk_pk	--	0.15	--	A	At Io=420mA, can be lower if more cap used.

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Remark
Output Current Line Regulation		--	--	+/-3%		Vin varies from 85v to 265v
Output Current Load Regulation		--	--	+/-3%		8 to 12 LEDs
Conversion Efficiency	η	87	--	--	%	Ta=25℃, Vin==230Vac, 12LED
Power Factor	PF	0.95	--	--		
THD		--	--	10	A%	
Switching frequency		--	47	--	KHz	
Standby power		--	--	0.3	W	@ Vin=230Vac
Output short circuit protection			Yes			Auto-recovery
Tune-on Delay		--	0.5	--	S	@ Vin=230Vac
Demo Dimension	L*W	**23.7*1.8**			cm	Max

4. SINGLE STAGE SCHEMATIC DIAGRAM

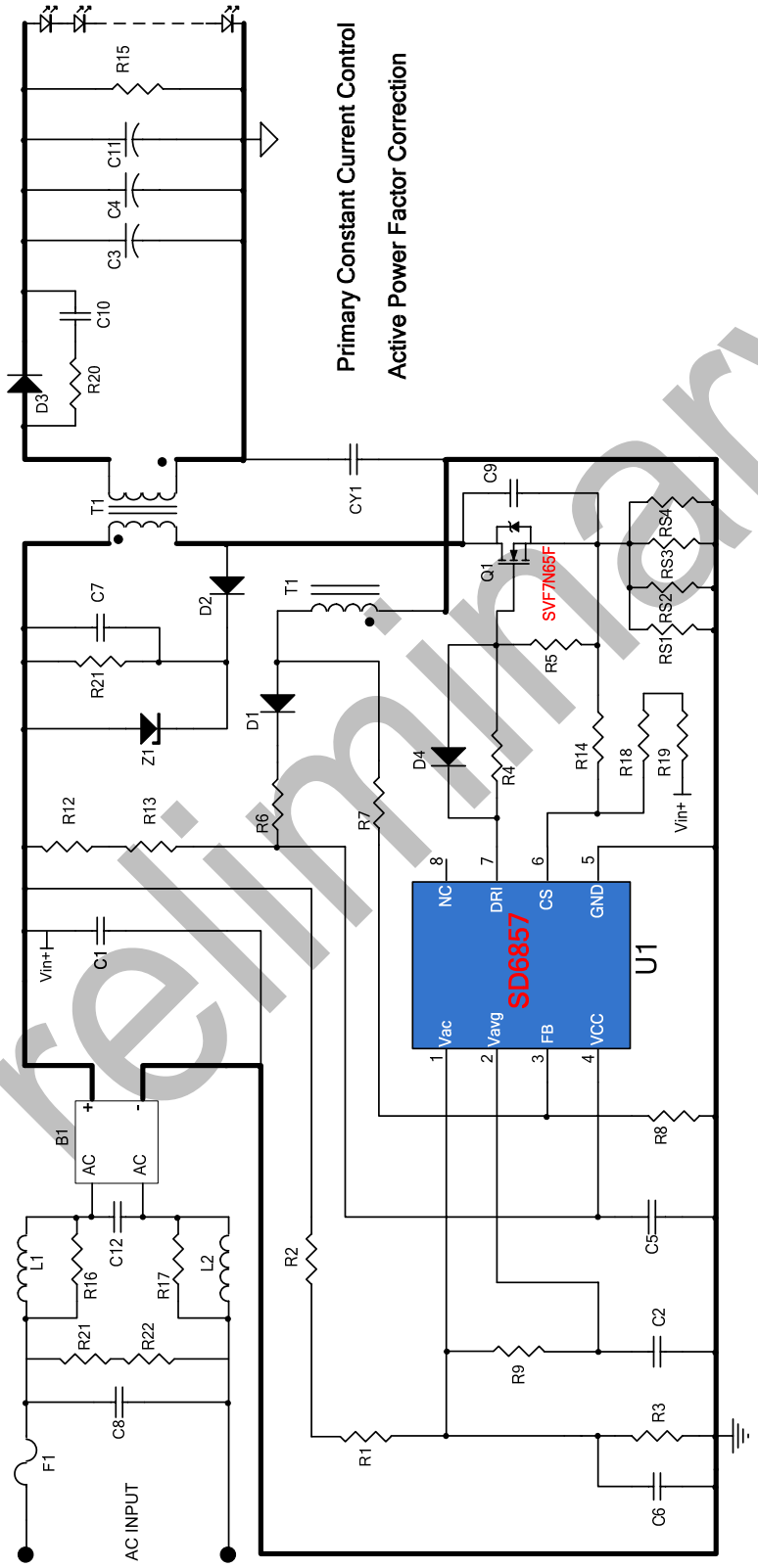
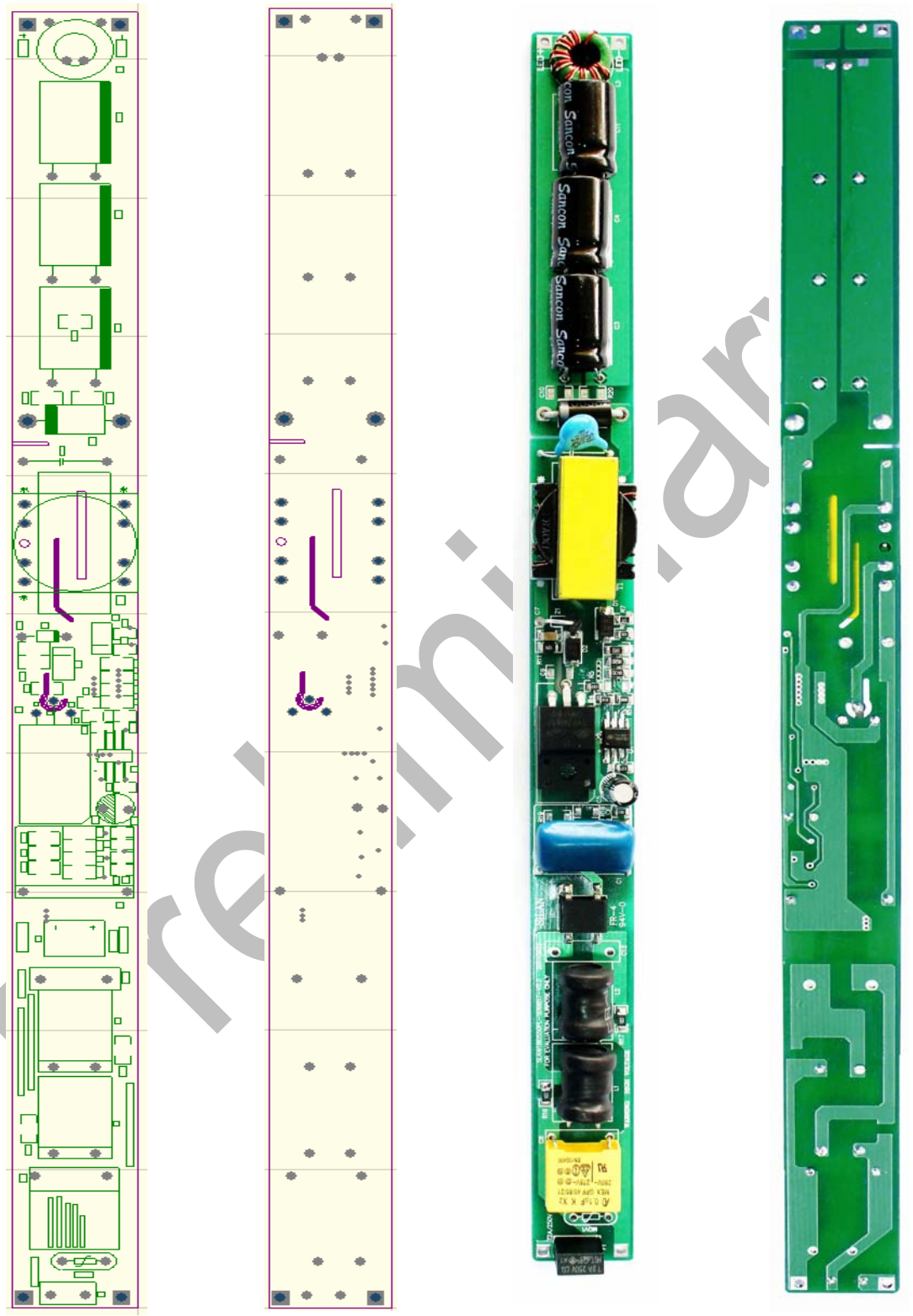


Figure 1 Schematic Diagram

5. BILL OF MATERIAL (BOM)

No.	Symbol	Qty.	Description	Vendor
1	R1,R2,R12,R13	4	750K 1206 0.25W	SEI
2	R21,R22	2	1M 1206 0.25W	SEI
3	R18,R19	2	5.1M 1206 0.25W	SEI
4	R16,R17	2	5.1K 1206 0.25W	SEI
5	R15	1	18K 1206 0.25W	SEI
6	R11	1	100K 1206 0.25W	SEI
7	RS1	1	0.27R 1206 0.25W	SEI
8	R4,R6	2	47R 0805 0.125W	SEI
9	R3	1	12K 0805 0.125W	SEI
10	R8	1	13K 0805 0.125W	SEI
11	R9	1	510K 0805 0.125W	SEI
12	R7	1	120K 0805 0.125W	SEI
13	R5	1	20K 0805 0.125W	SEI
14	R14	1	680R 0805 0.125W	SEI
15	R20,RS2,RS3,RS4	4	NIL	
16	C1	1	100nF 400V Film	Panasonic
17	C8	1	100nF 275Vac Film	Panasonic
18	C3,C4,C11	3	330μF 50V Aluminium Electrolytic Capacitor	SANCON
29	C2	1	0.1μF X7R 0805	Panasonic
20	C6	1	680pF X7R 0805	Murata
21	C7	1	2.2nF X7R 1000V 1206	Murata
22	C5	1	10uF X7R 25V 1206	Murata
23	CY1	1	2.2nF 2000V	N/A
24	C9,C10,C12	2	NIL	
25	B1	1	DF06S RECTIFIER BRIDGE	FAIRCHILD
26	D1,D2	2	1A 1000V FR107 fast recovery diode	DIODES
27	D3	1	4A 400V MUR440 rectifier diode	ONSEMI
28	D4	1	BAS21	ONSEMI
29	Z1	1	220V 680W TVS P6KE220	VISHAY
30	L1,L2	2	1mH 0.5A inductor	N/A
31	L3	1	300uH common inductor	N/A
32	T1	1	Transformer, EC2510	Ferroxcube
33	U1	1	**SD6857** PSR Constant current with PFC	**SILAN**
34	Q1	1	high-voltage MOSFET **SVF7N65F**	**SILAN**
35	F1	1	2A FUSE	N/A

6. DEMO BOARD PHOTOGRAPH AND ASSEMBLY DRAWING



TOP SILK BOTTOM SILK TOP SILK BOTTOM SILK

Figure 2 DEMO Board show

7. TRANSFORMER DESIGN REFERENCES

7.1 TRANSFORMER STRUCTURE AND BOBBIN

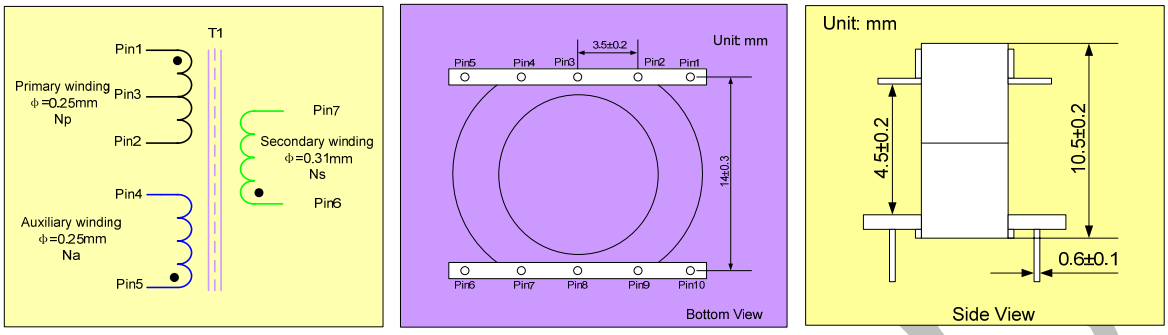


Figure 3 Transformer structure

7.2 INDUCTANCE VALUE TEST

Characteristics	Test method
Primary inductance (Lm)	Lm=0.53mH(+/-5%), test between Pin1 and Pin2, f=10KHz, Vrms=0.5V
Primary Leakage inductance (Lk)	Lk<30μH, test between Pin1 and Pin2, secondary winding is short-circuit, f=10KHz, Vrms=0.5V, airgap center leg

7.3 WINDING METHOD

Winding	Diameter	Start pin	Turns	End pin	Insulation
Primary winding (Np1)	℄0.25mm*1	1	30T	3	2
Secondary winding (Ns)	℄0.31mm*1	6	23T	7	2
Primary winding (Np2)	℄0.25mm*1	3	28T	2	2
Auxiliary winding (Na)	℄0.25mm*1	5	11T	4	2

8. TEST REPORT

8.1 TEST TOOLS LIST

The test tools are shown in table below.

Test tools	Type
LED driver	SLAW18I0430PL-SD6857
Digital oscilloscope	Tektronix TDS2024B
Current probe	TCPA300/TCP312
Electronic load	PRODIGIT 3311F/12 LED string
Multimeter	MASTECH MY65
Power meter	YOKOGAWA WT210
AC Power source	APC-500W

8.2 KEY WAVEFORMS

The following experimental waveforms are tested @ Vin=220Vac/50HZ and with 12LED strings if not marked specially.

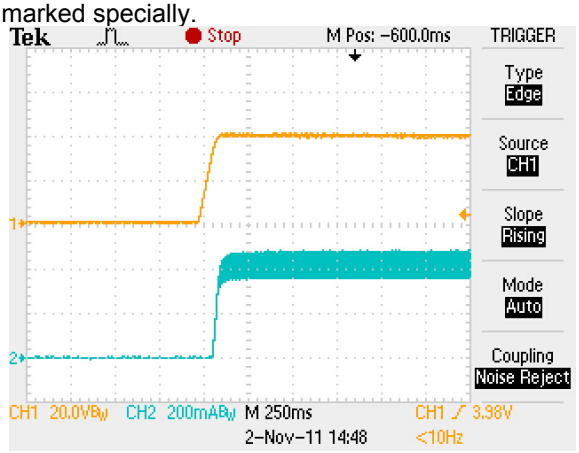


Figure 4. Start up

Ch1: LED voltage 20V/div

Ch2: LED current 200mA /div

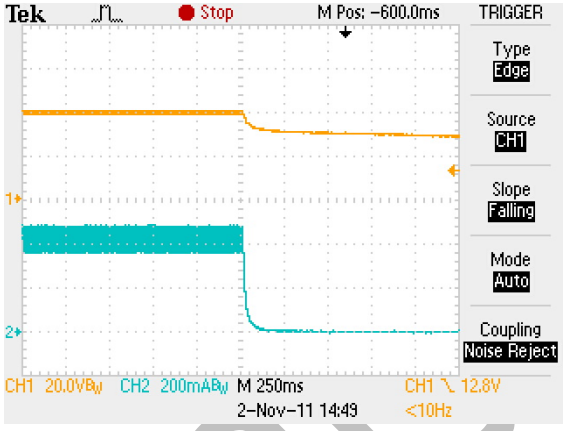


Figure 5. Shut down

Ch1: LED voltage 20V/div

Ch2: LED current 200mA /div

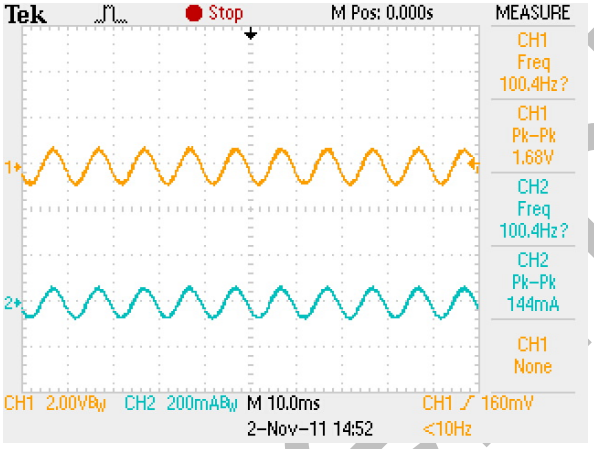


Figure 6. Output LED ripple

Ch1: LED voltage ripple 2/div

Ch2: LED current ripple 200mA/div

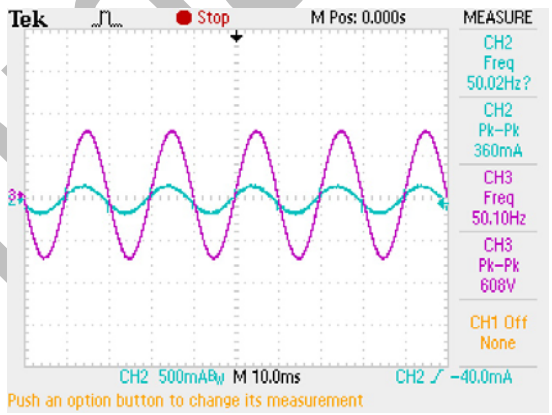


Figure 7. Input line ripple

Ch2: Input current ripple 500mA/div

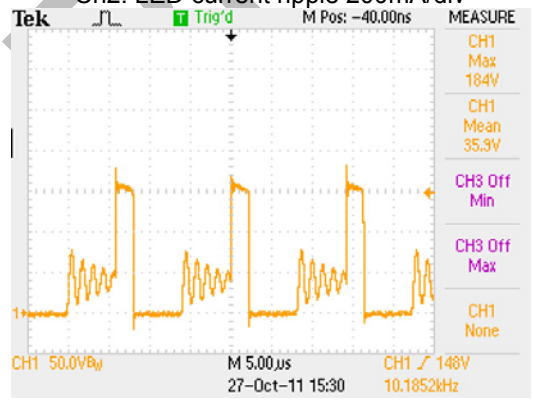


Figure 8. Reverse voltage on Diode

Ch1:Reverse voltage 50/div

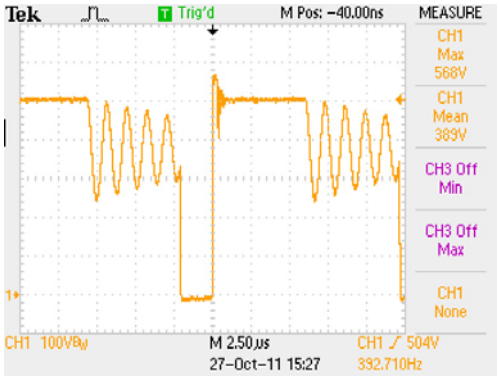


Figure 9. Vds of MOSFET

Ch1: Mosfet Vds 100V/div

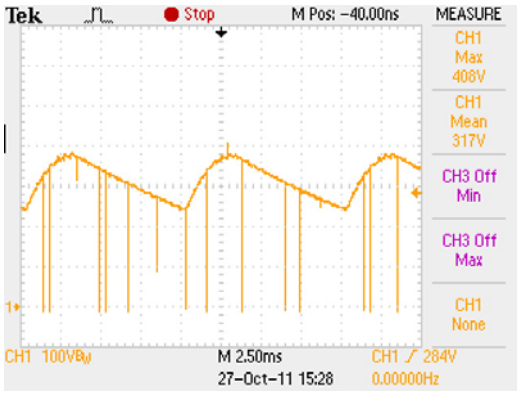


Figure 10 Vds @ short circuit
CH1: Vds of MOSFET

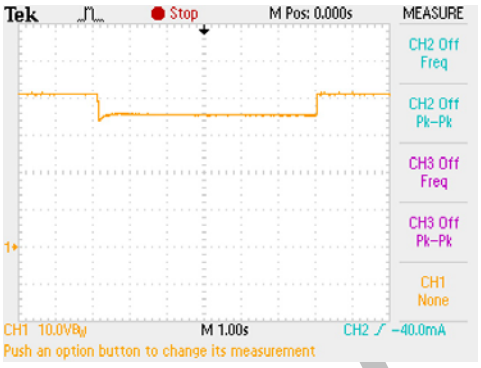


Figure 11. Dynamic response
CH1:output voltage(open-load-open)

8.3 EFFICIENCY TEST DATA

The following data is tested with 12 LED string connected at the output of the Driver. And INPUT AC POWER SOURCE is APC-500W. The THD and PF are tested with WT210 POWER METER.

Fre(HZ)	Vin(Vac)	Pin(W)	PF	THD(A%)	Vo(V)	Io(mA)	Po(W)	Efficiency
50	85	19.14	0.993	8.48	39.25	425	16.68	87.15%
	115	19.19	0.995	6.89	39.26	429	16.84	87.77%
	135	19.16	0.994	5.71	39.35	430	16.92	88.31%
	185	19.14	0.989	4.19	39.25	432	16.96	88.59%
	220	19.17	0.982	3.49	39.23	433	16.99	88.61%
	265	19.20	0.972	3.16	39.21	433	16.98	88.43%

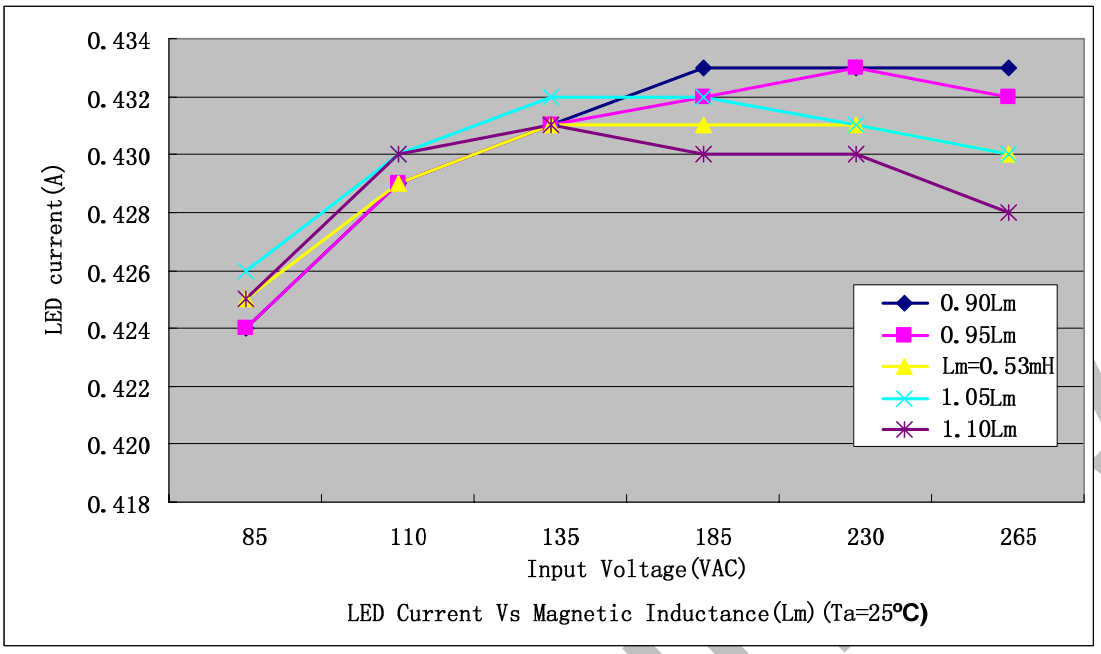
8.4 LOAD CAPABILITY (Vin=230Vac)

Number of LEDs	8	9	10	11	12
LED current(mA)	442	439	437	435	433
THD	4.96	4.55	4.05	3.78	3.49

8.5 STANDBY POWER

Vin(AC)	85	115	135	185	230	265
Pin(W)	0.18	0.20	0.22	0.24	0.25	0.32

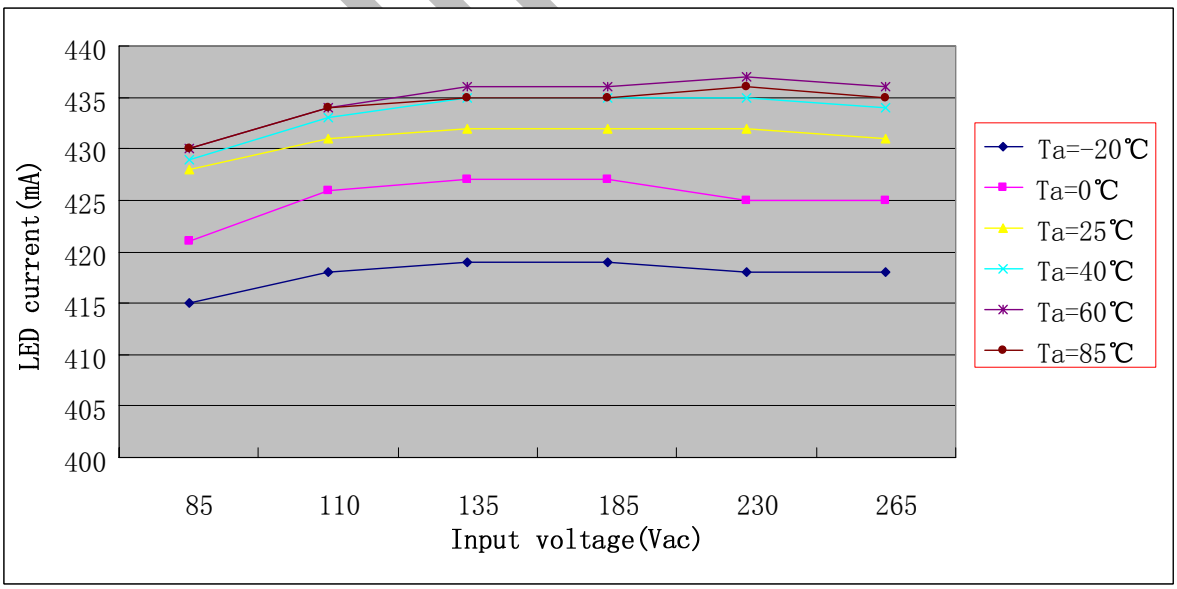
8.6 INDUCTANCE DEPENDENCY TEST



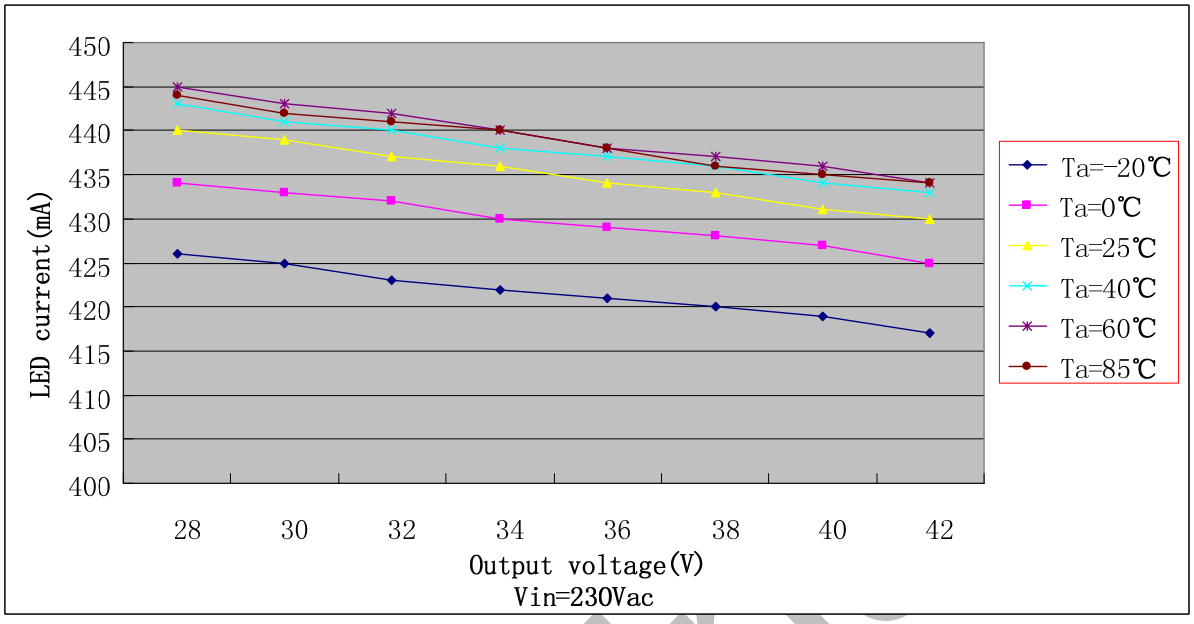
LED Current Vs Magnetic Inductance(Lm) (Ta=25℃)

8.7 LED CURRENT TEST UNDER DIFFERENT AMBIENT TEMPERATURE

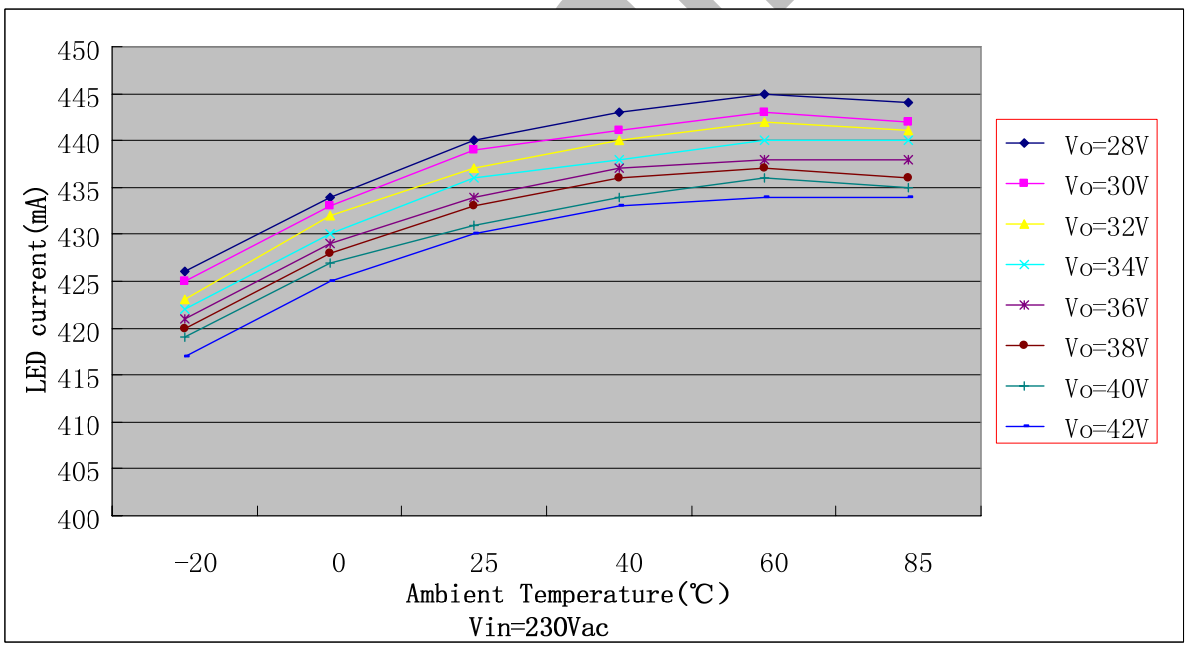
8.7.1 Line regulation under different ambient temperature



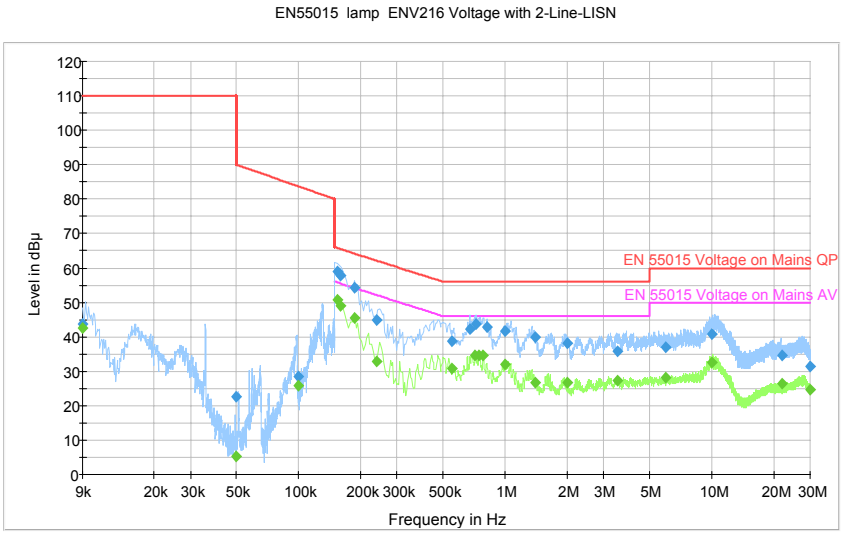
8.7.2 Load regulation under different ambient temperature



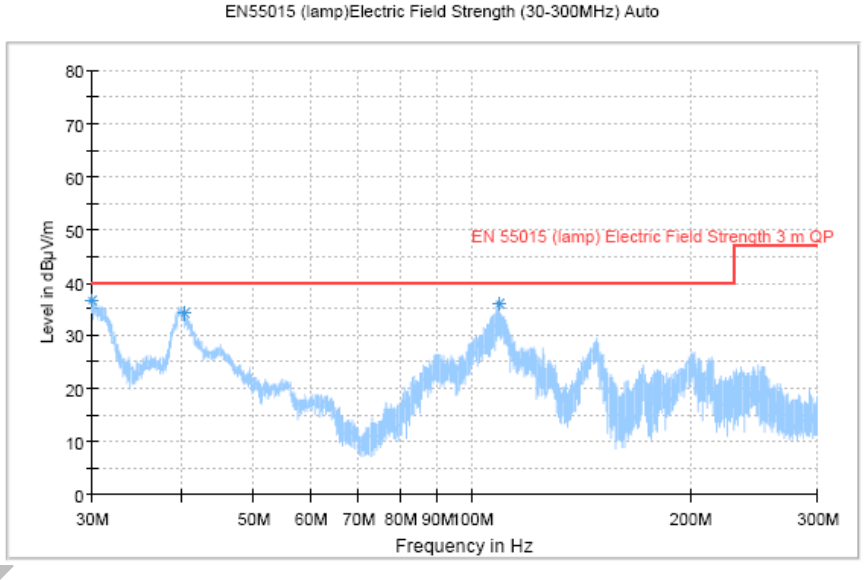
8.7.3 Temperature regulation with different loads



8.8 CONDUCTED EMI TEST



8.9 RADIATION EMI TEST



Note: *The efficiency will drop by 1.5% if meeting the EN55015 requirement.*

9. ATTACHMENT

Revision history

Date	REV	Description	Page
2011.12.22	1.0	Initial release	

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