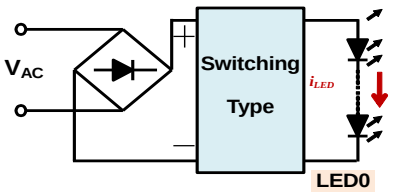
IML8683

Three Terminal Current Controller with Mode Selection Pins

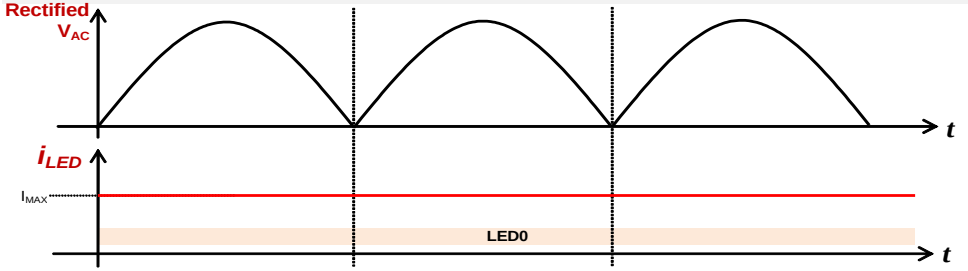
2013/11/05

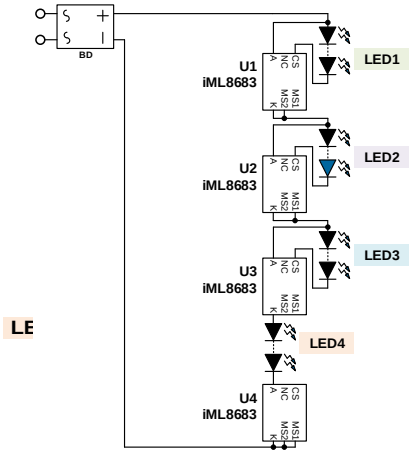
AC Voltage and LED Current

NEW!!

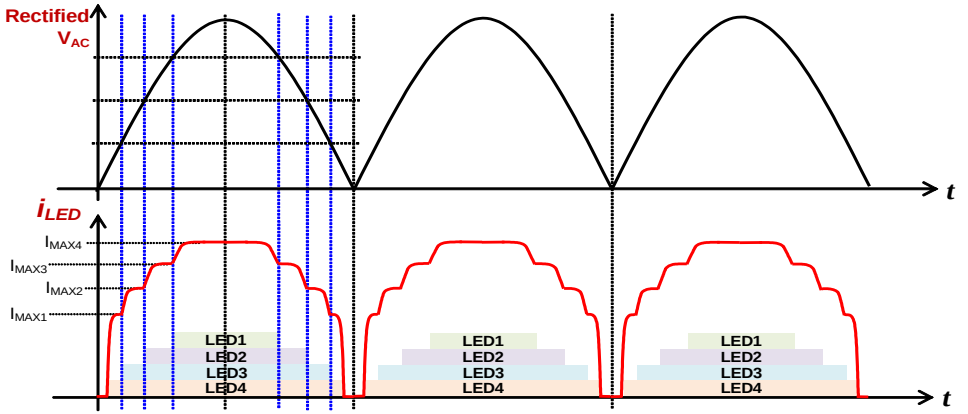


Switching Type: All LEDs conduct all the time.

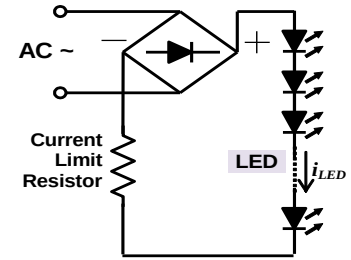


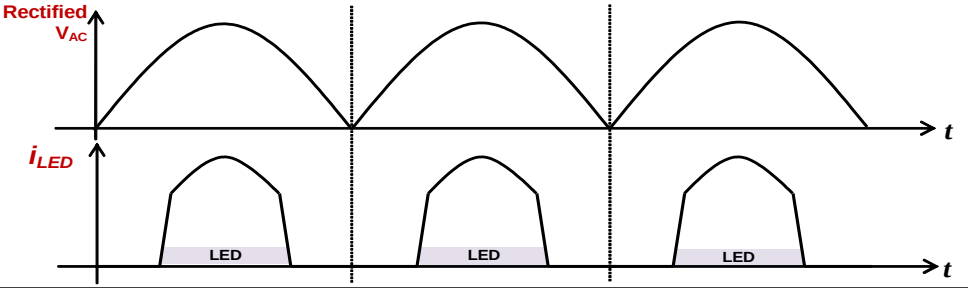


TTCC: The conducting time of different LED sets are not the same.



Traditional AC LED Driving: The LED conducting time is very short.



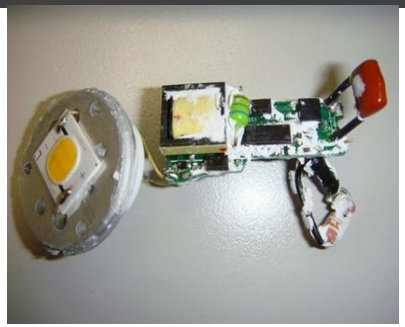


LED Light Bulb Market Trend

Requirement \ Solutions		Switching Type		Linear Type	
		Non-Isolation	Isolation	AC LED	iML 8683
1	Cost	○	△	◎	○
2	Compact Size (Area, Height)	○	△	◎	◎
3	Component Counts	△	△	◎	○
4	Power Factor > 0.9	◎	◎	△	◎
5	No Electrolytic Cap	○	△	◎	◎
6	Efficiency >80%	○	△	△	○
7	TRIAC Dimmable	◎	◎	○	○
8	THD < 30%	○	◎	△	○
9	Flicker	△	○	△	△
10	Line Regulation	◎	◎	△	△

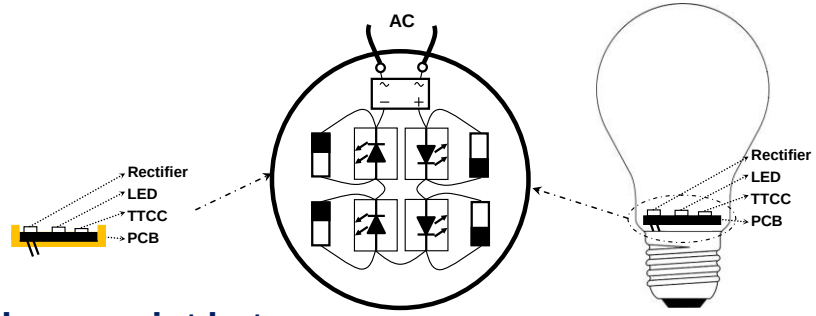
◎: Excellent ○ : OK △: Poor

Technical Merits of TTCC



- **Compared to switching type driver:**

1. LED and the driver system are all solid state components. It is real solid-state-Lighting.
2. The LED & Driver Module can be very thin and small.
3. No electrolytic capacitor needed.
4. The cost for the driver module is low.



- **Compared to HV AC step driver:**

1. Easier for Chip-On-Board process.
2. The flexibility is higher. User can determine the balance point between the performance and the cost.
3. The PCB layout is flexible, especially in linear light tube.
4. The heat is distributed to the discrete components.
5. The chips can be parallel connected to enlarge the driving capability.
6. iML got 5 USA patents issued, 1 China patent issued, and more patents pending.
7. THD is low and PF is high.

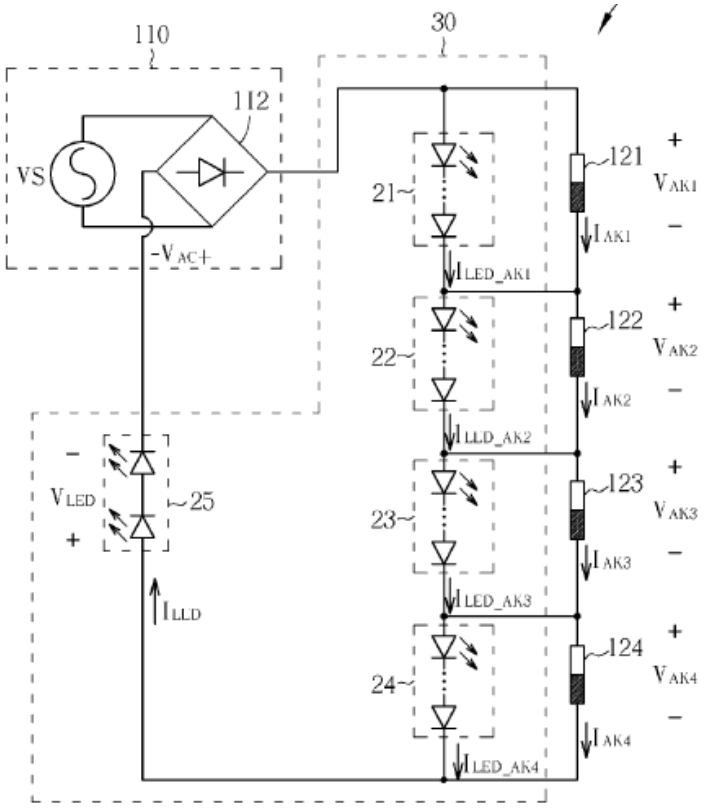
iML LED Driver ICs on Light Engine

AC Step Driver Patents

Low Voltage Solution

Use Normal High Voltage Wafer Process (60V~80V)

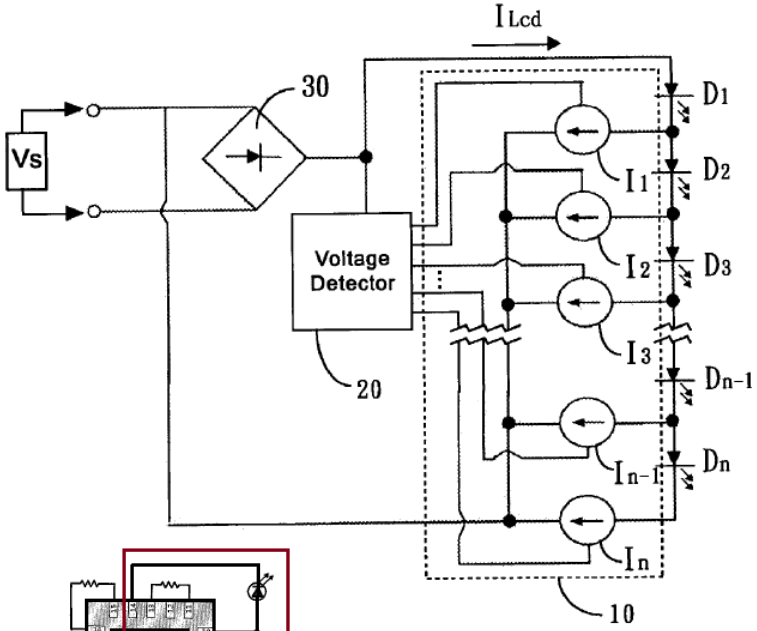
US Patent: 8,288,960
Filed: Apr 15, 2010
Assignee: IML International

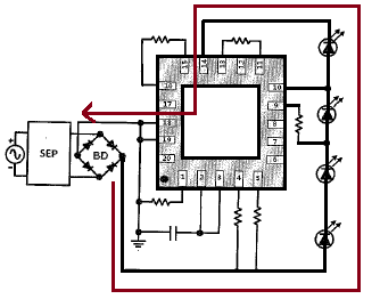


High Voltage Solution

Use Ultra High Voltage Wafer Process (500V~700V)

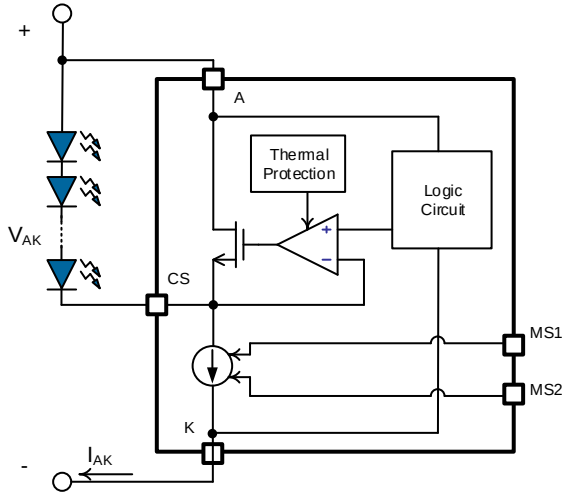
US Patent: 6,989,807
Filed: May 19, 2003
Assignee: Koninklijke Philips Electronics



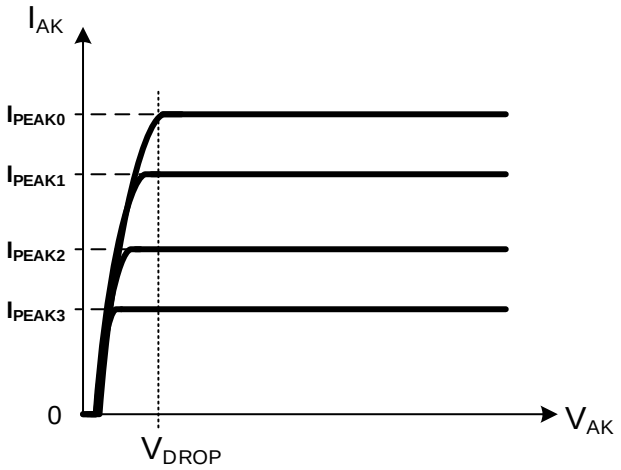


iML8683 Block Diagram and Packages

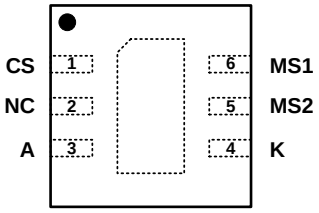
✓ Block Diagram



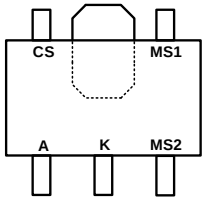
✓ I-V Curve



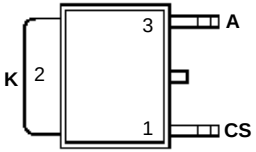
✓ Package and Pin Out



DFN- 2mmx2mm-6L



SOT-89- 5L

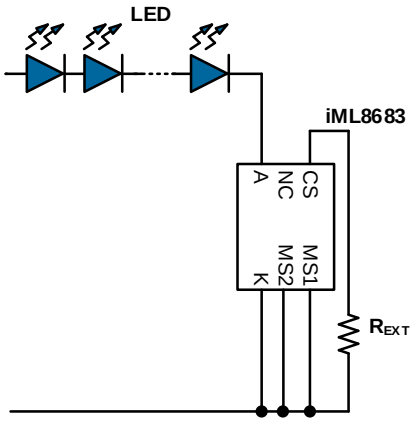


TO-252-2L

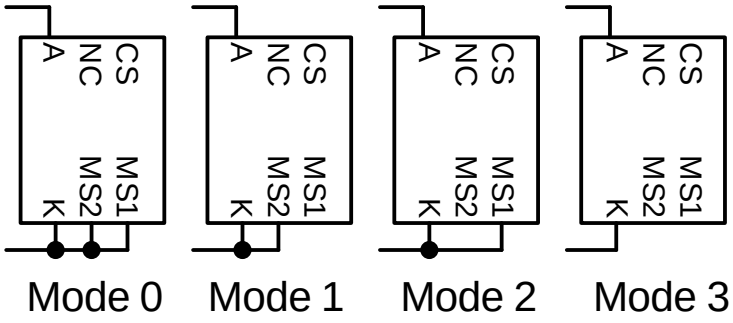
iML8683 Options

Part Number	Tape and Reel	1st Line Marking	Regulating Current (mA) (Mode 0, MS1 and MS2 connected to pin K)
iML8683NL-C1	**iML8683NL-C1-TR**	83C1	40
iML8683NL-C2	**iML8683NL-C2-TR**	83C2	66
iML8683NL-C3	**iML8683NL-C3-TR**	83C3	52
iML8683NL-D1	**iML8683NL-D1-TR**	83D1	80
iML8683NL-D2	**iML8683NL-D2-TR**	83D2	130
iML8683NL-D3	**iML8683NL-D3-TR**	83D3	104
iML8683NL-ADJ	**iML8683NL-ADJ-TR**	83AD	Determined by external resistor only

Remark: Available to add an external resistance between pin CS and pin K to modify the regulating current of chip in Mode 0.



Mode Selection



Mode	MS2	MS1	I_{PEAK}
3	1	1	35%
2	1	0	55%
1	0	1	80%
0	0	0	100%

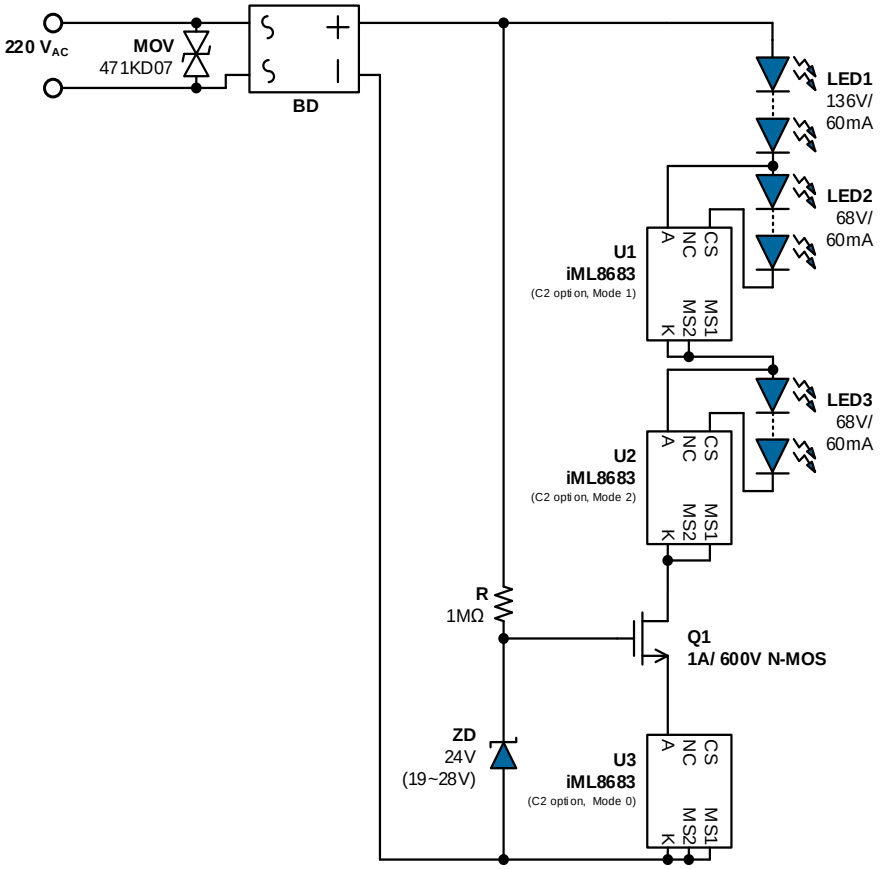
MS1 & MS2 pins connection in Mode 0 ~ 3

Settings of current and on/off voltage in Mode 0 ~ 3

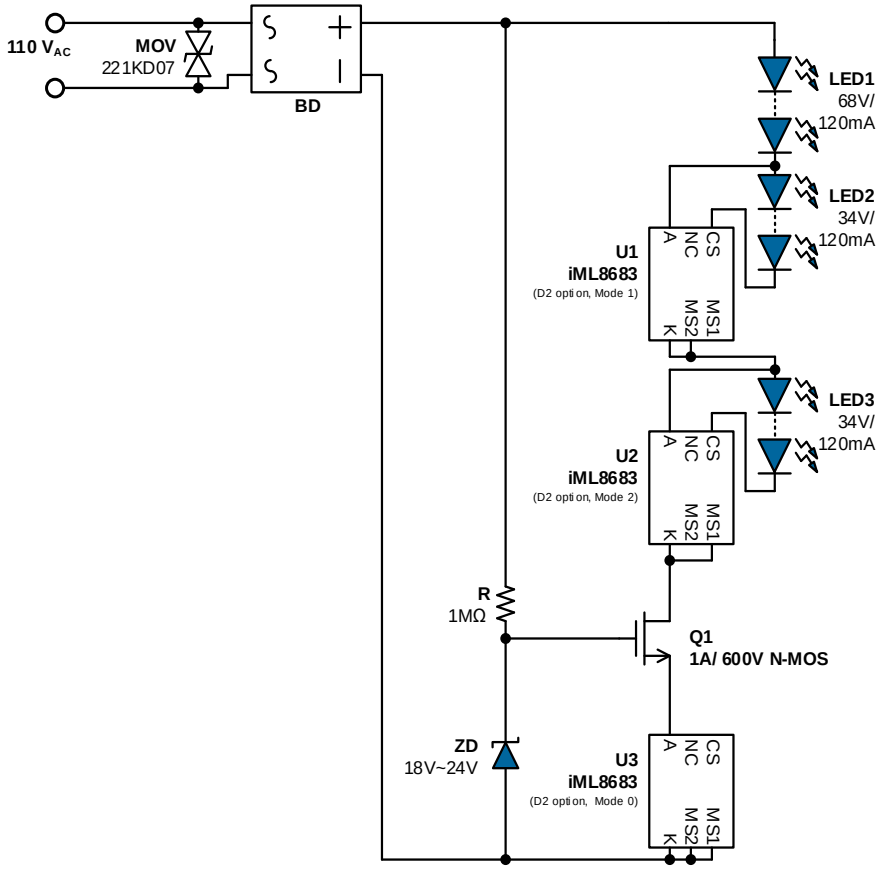
By using PCB layout to perform mode selection. Customer can use single option to design their product, which facilitate the mass production.

iML8683 Typical Application Circuit

220VAC/ 10W



110VAC/ 10W



Remark: To pass 1KV surge test (IEC61000-4-5), MOV is required.
Without MOV, it can pass 750V surge test only.

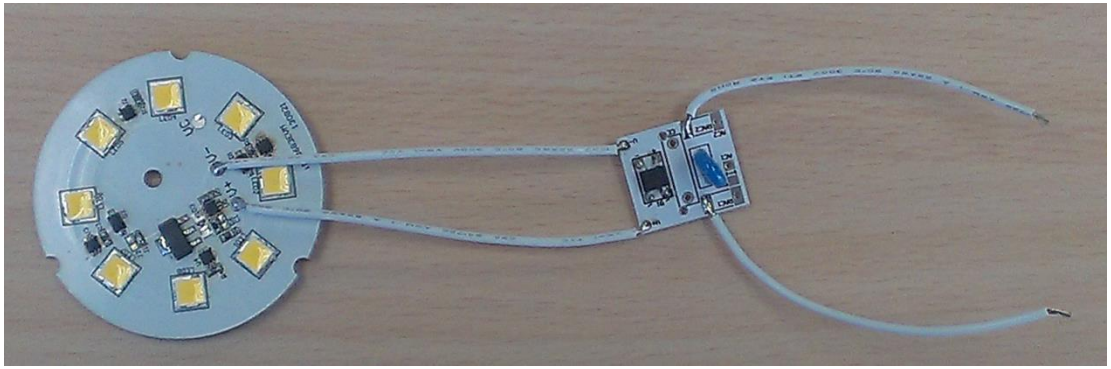
Criteria for LED Total V_F

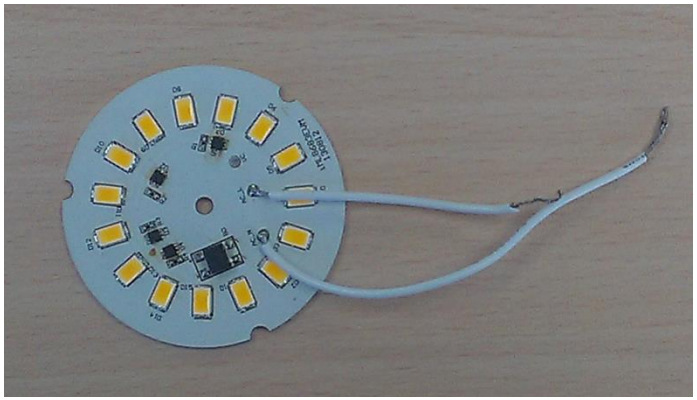
Total Vf selection guideline:

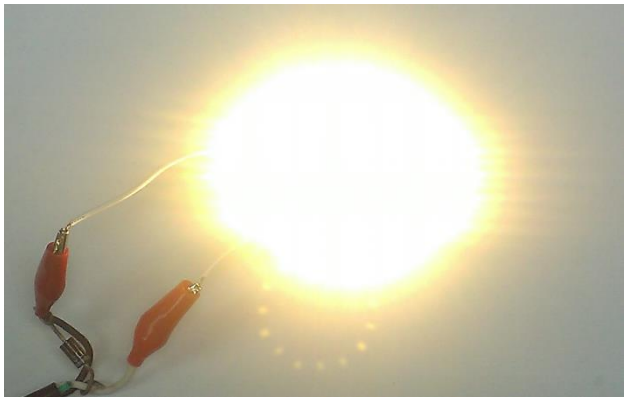
Rectified VAC,Nominal x 83% < LED Total VF < Rectified VAC,Nominal x 89%

AC Input Voltage (rms)		DC Peak Voltage	Recommended Total V_F	Maximum Voltage Drop on U4
$100V_{AC}$ Power system	110V (MAX.)	156V	117~125V	39V
	100V (TYP.)	141V		24V
	90V (MIN.)	127V		10V
$110V_{AC}$ Power system	121V (MAX.)	171V	129~138V	42V
	110V (TYP.)	156V		27V
	99V (MIN.)	140V		11V
$120V_{AC}$ Power system	132V (MAX.)	187V	140~151V	47V
	120V (TYP.)	170V		30V
	108V (MIN.)	153V		13V
$220V_{AC}$ Power System	242V (MAX.)	342V	258~277V	84V
	220V (TYP.)	311V		53V
	198V (min.)	280V		22V

iML8683 Applications

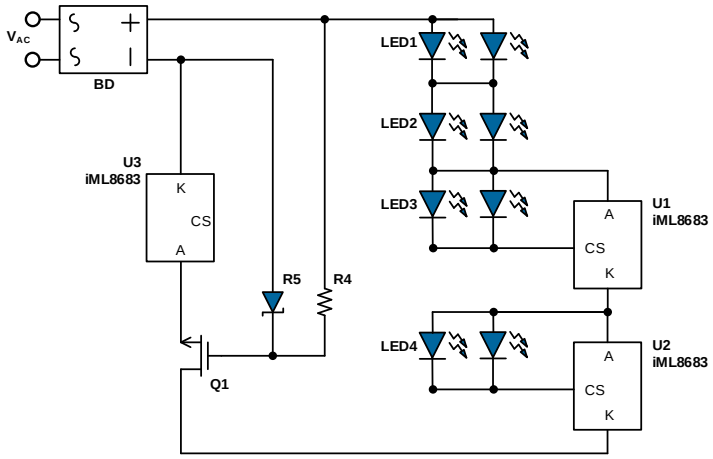




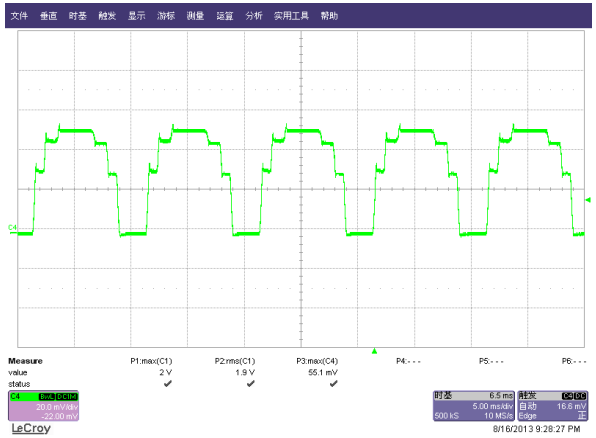


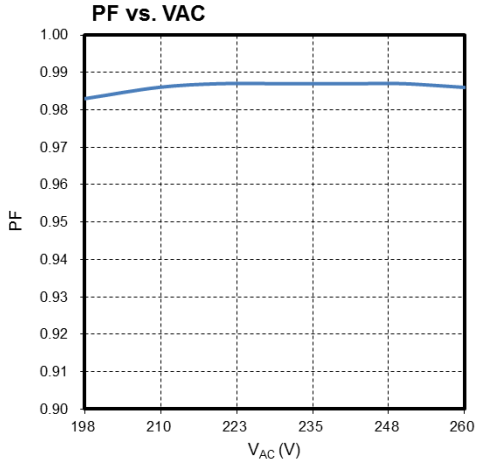
IML8683 System Test Results (220VAC)

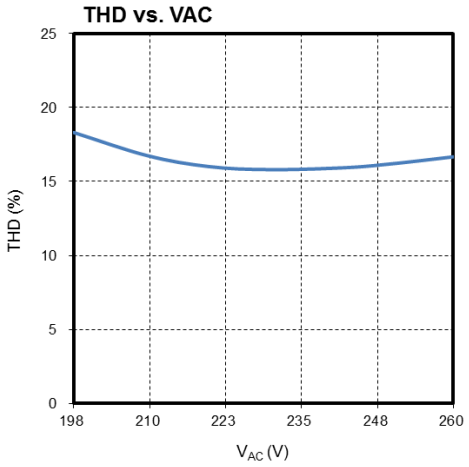
V_{AC}=220V, LED = 67V x 8pcs, 10W Bulb, 3 steps



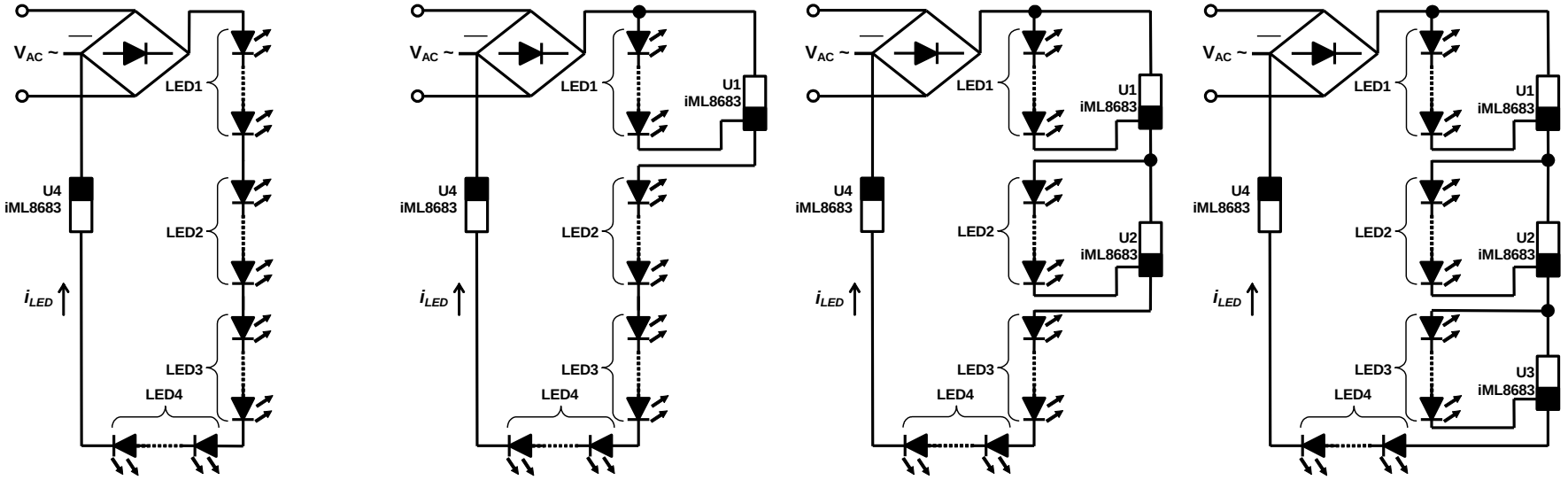
V_{AC} (V)	I_{IN} (mA)	PF	THD	P_{IN} (W)
198	42.5	0.983	18.31	8.323
210	44.4	0.986	16.75	9.246
220	45.6	0.987	16.01	9.965
230	46.6	0.987	15.80	10.647
242	47.6	0.987	15.93	11.439
250	48.2	0.987	16.20	11.950
260	48.9	0.986	16.67	12.590





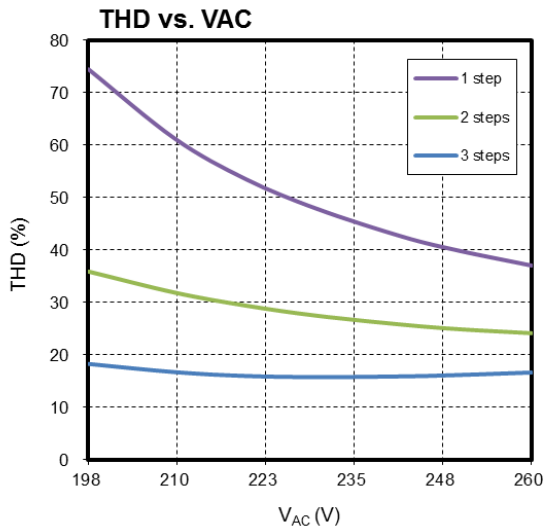


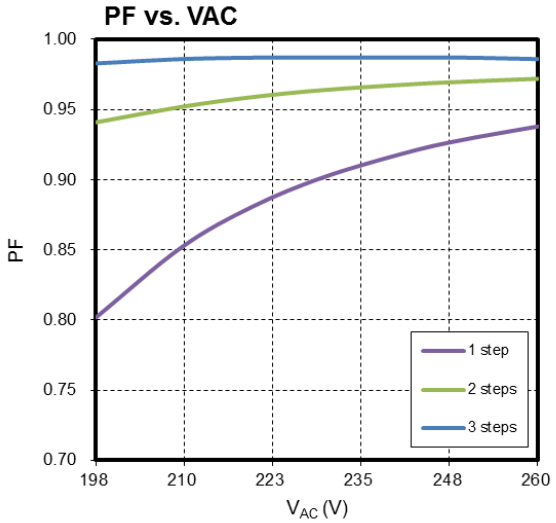
iML8683 Quantity vs. Bulb Performance

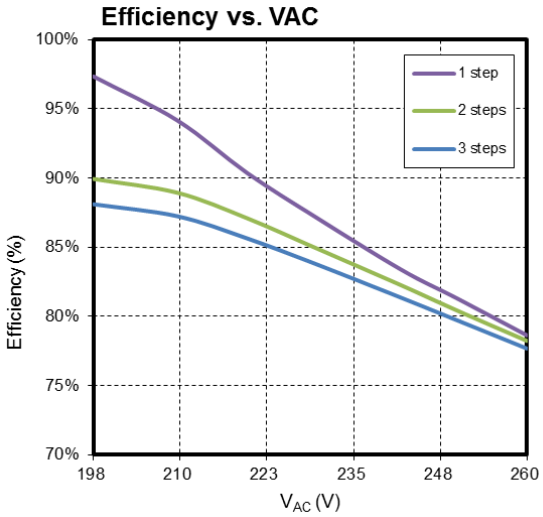


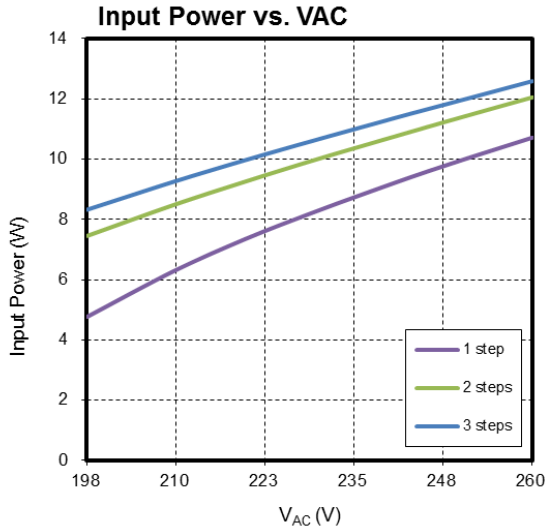
1 Step	2 Steps	3 Steps	4 Steps
PF=0.88	PF=0.96	PF=0.98	PF=0.99
THD=53%	THD=29%	THD=16%	THD=10%
Power=7.1W	Power=9.1W	Power=9.8W	Power=10W

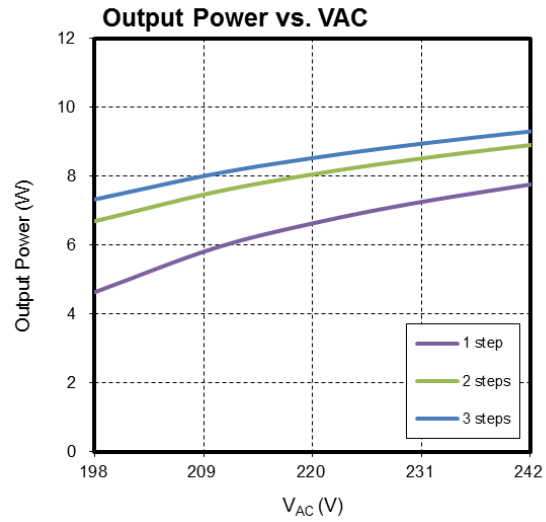
iML8683 Quantity vs. Bulb Performance





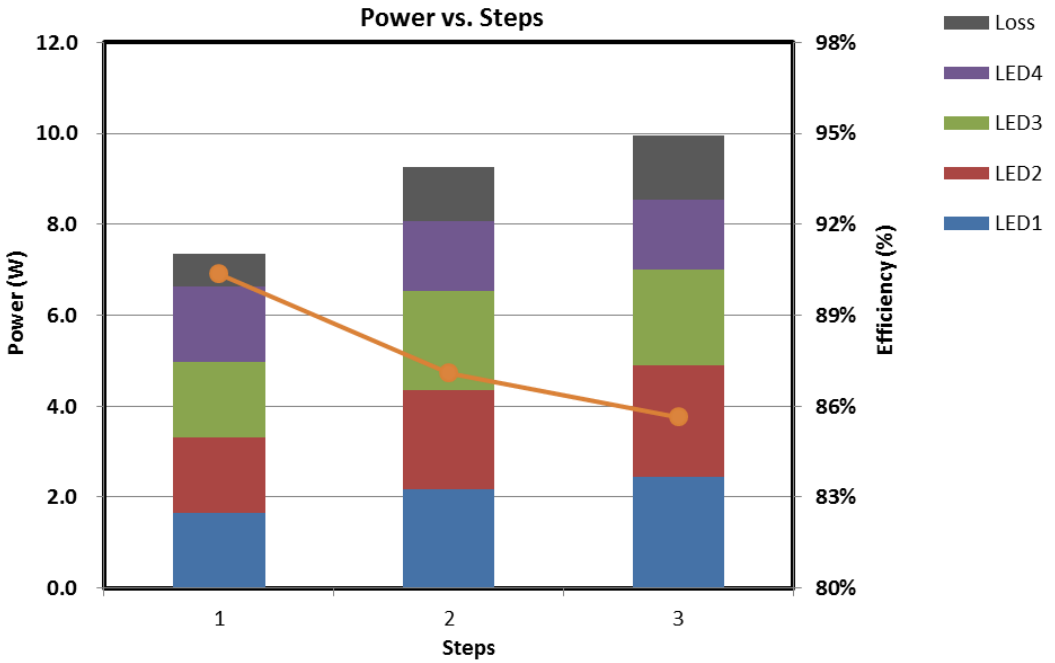




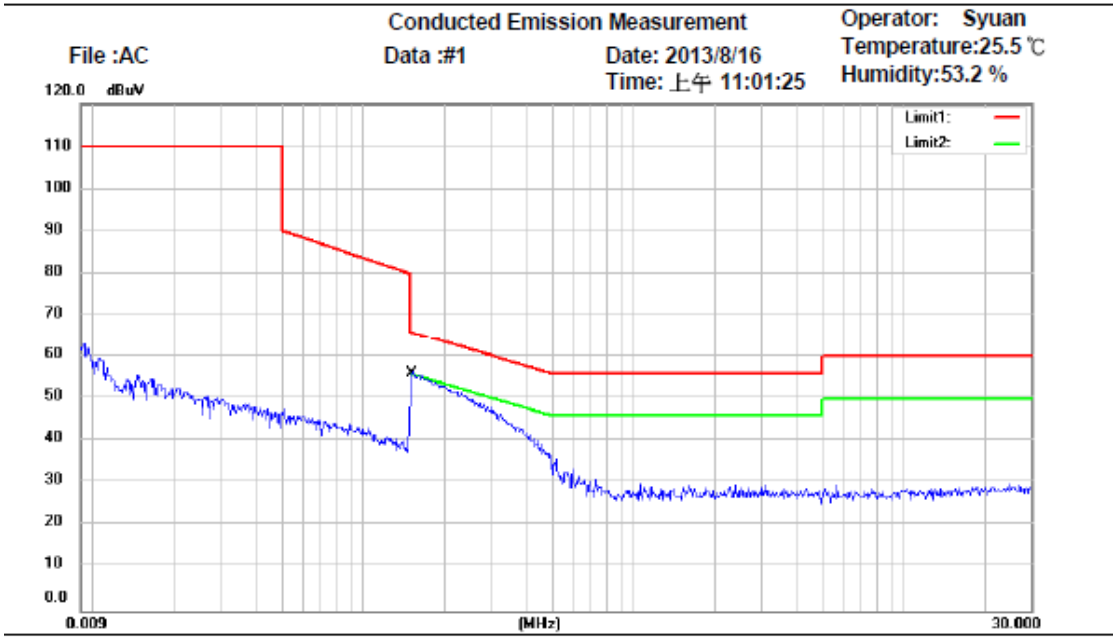


iML8683 Quantity vs. Power

Input = 220V_{AC}								
Steps	**P_{IN} (W)**	**LED1**	**LED2**	**LED3**	**LED4**	**Loss**	**All LED P_{OUT} (W)**	**Efficiency**
1	**7.346**	1.660	1.660	1.660	1.660	0.708	**6.638**	90.36%
2	**9.253**	2.178	2.178	2.178	1.525	1.194	**8.059**	87.10%
3	**9.965**	2.444	2.444	2.107	1.540	1.431	**8.534**	85.64%



iML8683 System EMI Performance (Without X-Cap)



Site : Chamber_03
Condition : EN55015 Conduction(QP)
EUT :
M/N: 8683 10W LED
Test Mode :
Note :

Phase: *L1*
Power : 220VAC

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corrected factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Comment
*	0.1500	35.74	QP	10.12	45.86	66.00	-20.14	
	0.1500	19.78	AVG	10.12	29.90	56.00	-26.10	

Current Harmonic Performance (IEC1000-3-2 Class D)

V(V)	220.9	I(A)	0.0403
P(W)	8.80	PF	0.986
F(Hz)	50.0	**THDi(%)**	**16.6**
I_Fund(A)	0.0398	V_Fund(V)	220.9
Current Harmoic **(A)**			
No.	Value	Limit	Pass/Fail
3	0.0022	0.0299	Pass
5	0.0035	0.0167	Pass
7	0.0029	0.0088	Pass
9	0.0025	0.0044	Pass
11	0.0002	0.0031	Pass
13	0.0007	0.0026	Pass
15	0.0006	0.0023	Pass
17	0.0019	0.002	Pass
19	0.0007	0.0018	Pass
21	**0.0014**	**0.0016**	**Pass**
23	0.0012	0.0015	Pass
25	0.0005	0.0014	Pass
27	**0.0001**	**0.0013**	**Pass**
29	**0.0009**	**0.0012**	**Pass**
31	0.0004	0.0011	Pass
33	0	0.001	Pass
35	0.0002	0.001	Pass
37	0.0001	0.0009	Pass
39	0.0007	0.0009	Pass

Surge Performance

220V 10 W System

Worldwide Testing Services(Taiwan) Co., Ltd.

Surge

Applicant: **Integrated Memory Logic, Inc.**
Standard : EN 61000 - 4 – 5
Device : **iML8683 10W LED**
Date : 2013.08.27

Temperature	:	23.7 °C
Pressure	:	990 hPa
Rel. humidity	:	41 %

Model	Test mode	Voltage Angle	Waveform T_r / T_h	Repetition	Number of Tests/ Total	Performance criteria
#1 MOV471 R6=24V Zener NMOS=3N40	AC-line to line	+1000V 90°	1.2/50 µs	30s	5/5	A
		-1000V 270°	1.2/50 µs	30s	5/5	A

Performance criteria:

A : No loss of performance or function
B : Temporary loss of function or performance which is self recoverable
C : Temporary loss of function or perform. which req. operate. intervention or system reset
D : Loss of function which is not recoverable

120V/ 10W System

Worldwide Testing Services(Taiwan) Co., Ltd.

Surge

Applicant: **Integrated Memory Logic, Inc.**
Standard : EN 61000 - 4 – 5
Device : **iML8683 120V/ 10W LED Module**
Date : 2013.09.05

Temperature	:	24.8 °C
Pressure	:	990 hPa
Rel. humidity	:	46 %

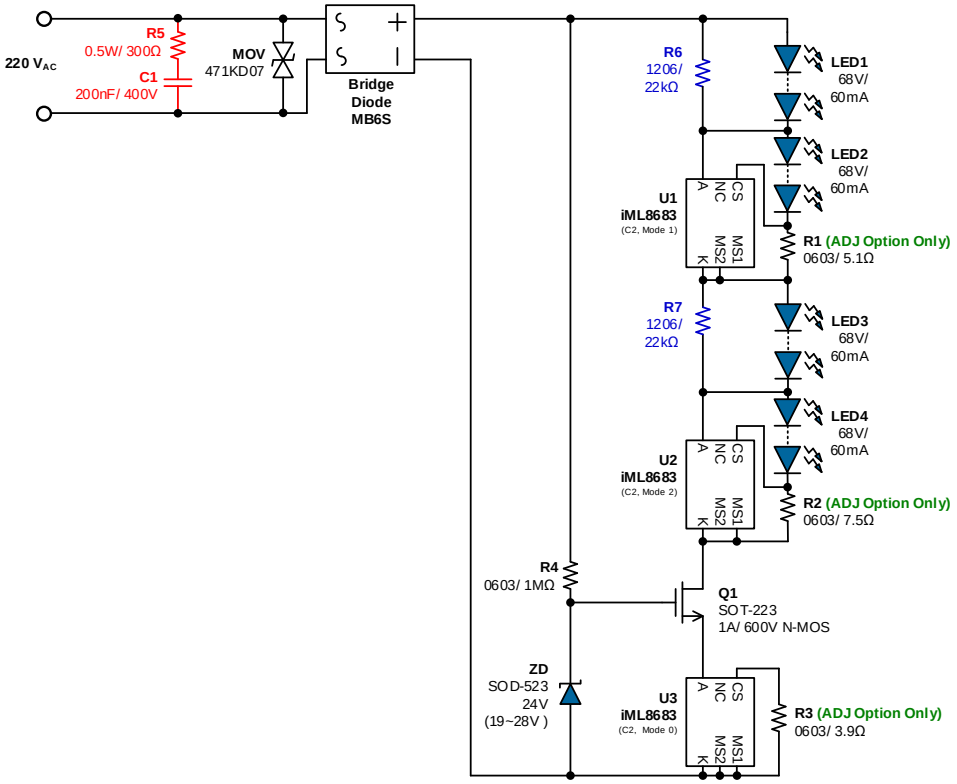
Model	Test mode	Voltage Angle	Waveform T_r / T_h	Repetition	Number of Tests/ Total	Performance criteria
#1 NMOS 1N60	120VAC-line to line	+500V 90°	1.2/50 µs	30s	5/5	A
		-500V 270°	1.2/50 µs	30s	5/5	A
		+750V 90°	1.2/50 µs	30s	5/5	A
		-750V 270°	1.2/50 µs	30s	5/5	A
#2 NMOS + MOV 1N60 221	120VAC-line to line	+750V 90°	1.2/50 µs	30s	5/5	A
		-750V 270°	1.2/50 µs	30s	5/5	A
		+1000V 90°	1.2/50 µs	30s	5/5	A
		-1000V 270°	1.2/50 µs	30s	5/5	A

Performance criteria:

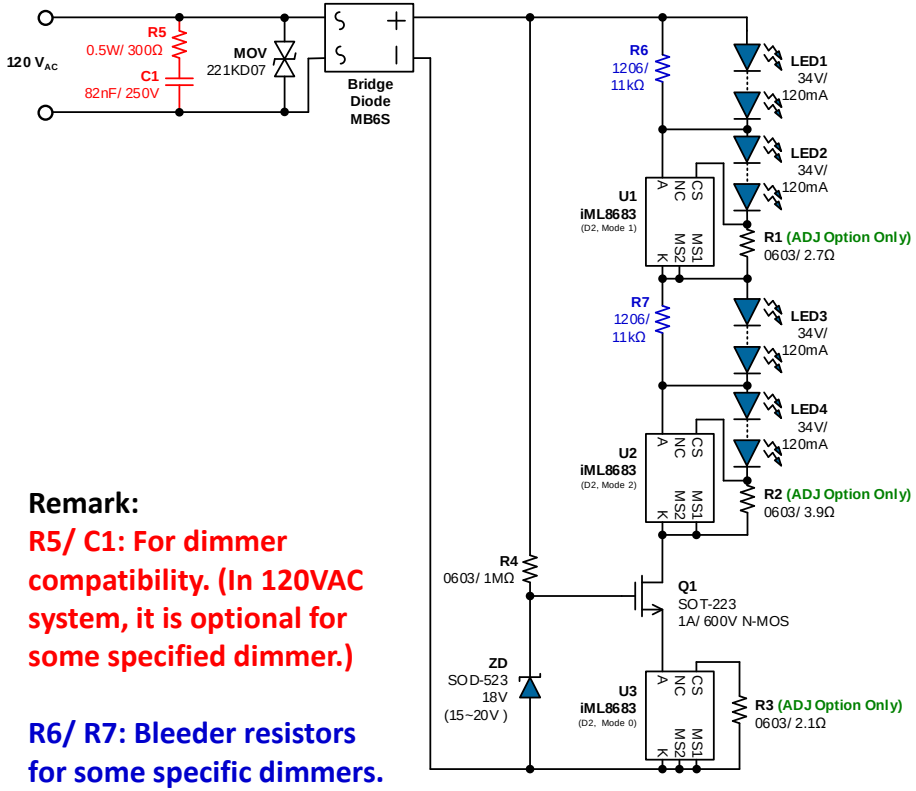
A : No loss of performance or function
B : Temporary loss of function or performance which is self recoverable
C : Temporary loss of function or perform. which req. operate. intervention or system reset
D : Loss of function which is not recoverable

Application Circuit for Traic Dimming

220VAC System



120VAC System



Remark:

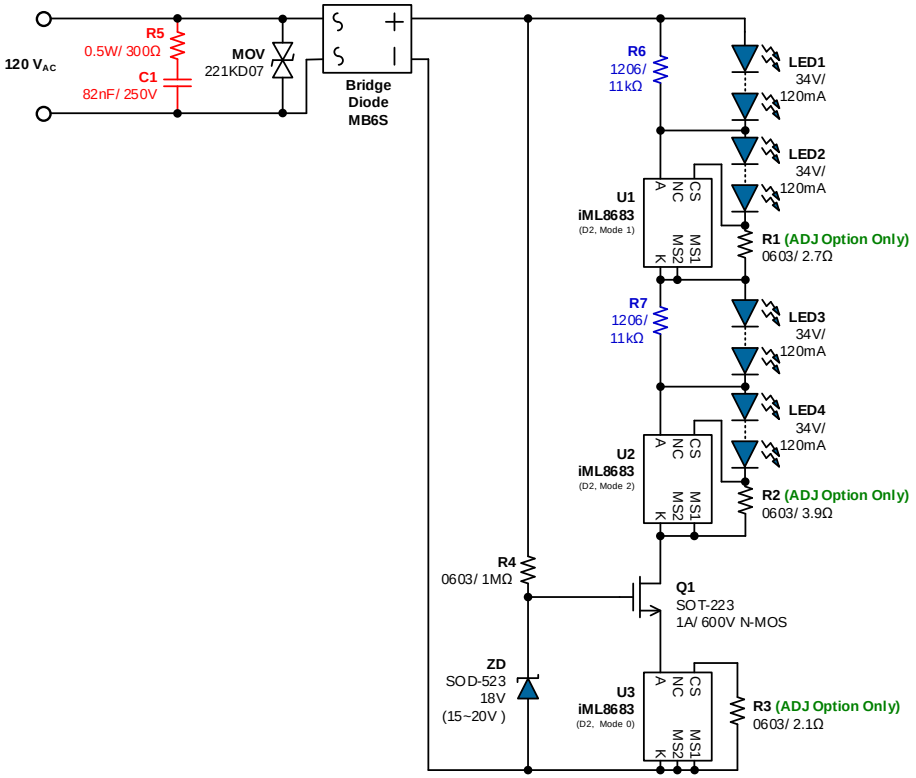
R5/ C1: For dimmer compatibility. (In 120VAC system, it is optional for some specified dimmer.)

R6/ R7: Bleeder resistors for some specific dimmers.

Compatible Dimmers (110/ 120V)

Dimmer Specification						Dimming Performance	
Brands	Series	Model	Voltage	Power	Type	Compatibility (×: Unstable operation, Δ: Flickering slightly, ○: Compatible)	
Leviton	Trimatron	6684	120V	600W	Leading	without R/C	○
Leviton	Decora	6615	120V	300W	Trailing	without R/C	○
						R5=300Ω/ C1=82nF	○
Leviton	Sureslide	6615-P0W	120V	300W	Trailing	without R/C	○
						R5=300Ω/ C1=82nF	○
Leviton	Illumatech	IP106-1LZ	120V	600W	Leading	without R/C	○
						R5=300Ω/ C1=82nF	○
LUTRON	DIVA	DVCL-153P	120V	600W	Leading	without R/C	Δ
						R5=300Ω/ C1=82nF	○
LUTRON	DIVA	DV-600P-IV	120V	600W	Leading	without R/C	○
						R5=300Ω/ C1=82nF	○
LUTRON	DIVA	DVELV-300P	120V	300W	Trailing	without R/C	○
						R5=300Ω/ C1=82nF	○
LUTRON	Credenza	TT-300	120V	300W	Leading	without R/C	○
LUTRON	Ariadni	AY-600P-IV	120V	600W	Leading	without R/C	○
						R5=300Ω/ C1=82nF	○
LUTRON	Skylark	S-600P	120V	600W	Leading	without R/C	○
						R5=300Ω/ C1=82nF	○
LUTRON	Skylark	S-603PG	120V	600W	Leading	without R/C	Δ
						R5=300Ω/ C1=82nF	○
LUTRON	Nova	N-600-AL	120V	600W	Leading	without R/C	Δ
						R5=300Ω/ C1=82nF	○

System Performance w/o Dimmer (120V)



	VAC(V)	I_{IN}(mA)	Power(W)	PF	THD
without R/C	120	86.0	10.24	0.9869	16.10%
R5=300Ω/ C1=82nF	120	86.3	10.26	0.9857	16.00%

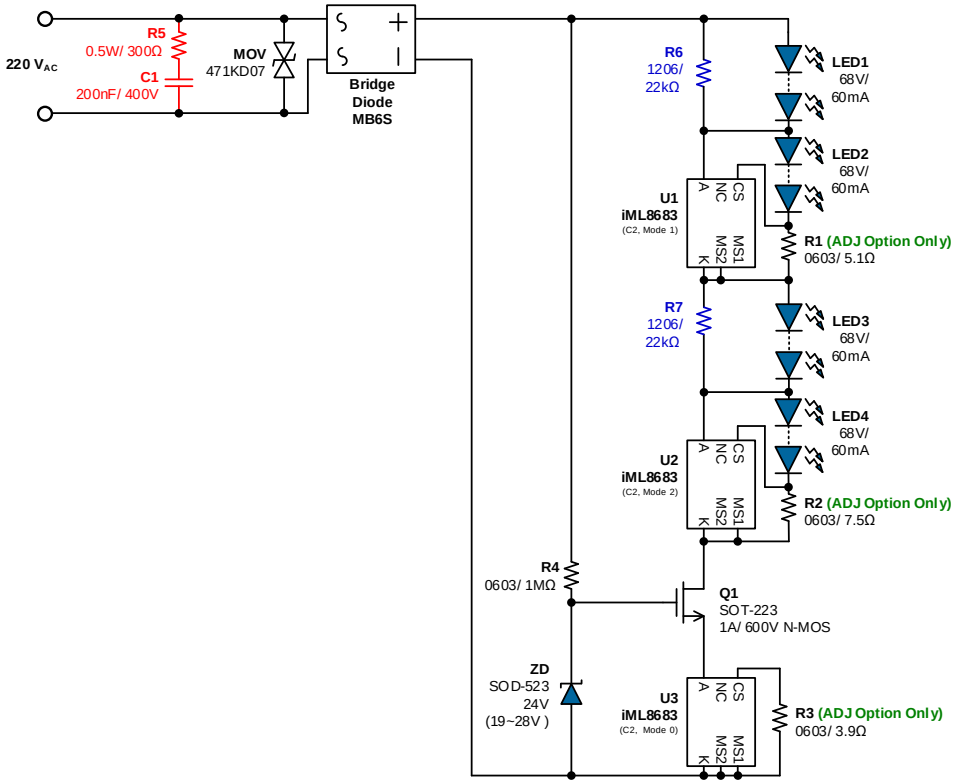
It is recommended to use 300Ω/ 82nF.

Compatible Dimmers (220V)

Dimmer Specification					Dimming Performance	
Brand	Model	Voltage	Power	Type	Compatibility (×: Unstable operation, Δ: Flickering slightly, ○: Compatible)	
Busch-Jaeger	2250U	220V	600W	Leading	without R/C	×
					R5=300Ω/ C1=200nF	Δ
					R5=300Ω/ C1=300nF	○
Busch-Jaeger	2247U	220V	500W	Leading	without R/C	○
					R5=300Ω/ C1=200nF	○
					R5=300Ω/ C1=300nF	○
Busch-Jaeger	6519U	220V	550W	Trailing	without R/C	○
					R5=300Ω/ C1=200nF	○
					R5=300Ω/ C1=300nF	○
Busch-Jaeger	6513U	220V	420W	Trailing	without R/C	○
					R5=300Ω/ C1=200nF	○
					R5=300Ω/ C1=300nF	○
GIRA	0300-00	220V	400W	Leading	without R/C	×
					R5=300Ω/ C1=200nF	○
					R5=300Ω/ C1=300nF	○
GIRA	0307-00/I02	220V	400W	Trailing	without R/C	○
					R5=300Ω/ C1=200nF	○
					R5=300Ω/ C1=300nF	○
NAM	ASW 3501	220V	500W	Leading	without R/C	×
					R5=300Ω/ C1=200nF	Δ
					R5=300Ω/ C1=300nF	○
NAM	ASW 3701	220V	700W	Leading	without R/C	×
					R5=300Ω/ C1=200nF	Δ
					R5=300Ω/ C1=300nF	○
NAM	ASW 3000	220V	1000W	Leading	without R/C	×
					R5=300Ω/ C1=200nF	Δ
					R5=300Ω/ C1=300nF	○

For different R/C, the compatibility is different.

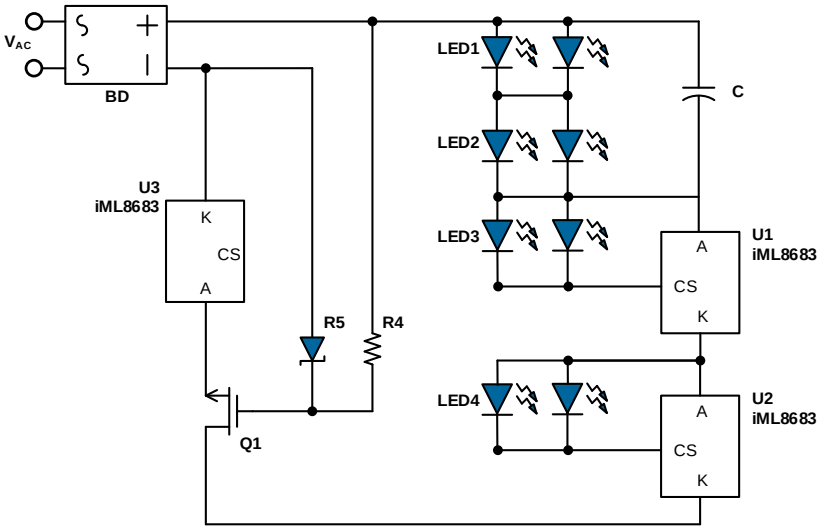
System Performance w/o Dimmer (220V)



	VAC(V)	I_{IN}(mA)	Power(W)	PF	THD
without R/C	221	49.1	10.73	0.9884	15.10%
R5=300Ω/ C1=200nF	221	51.7	10.76	0.9402	14.30%
R5=300Ω/ C1=300nF	221	54.4	10.86	0.9022	13.60%

It is recommended to use 300Ω/ 200nF.

Solution of Flicker Reduction



Solution: Add an E-cap parallel connected to LED3 and LED4.

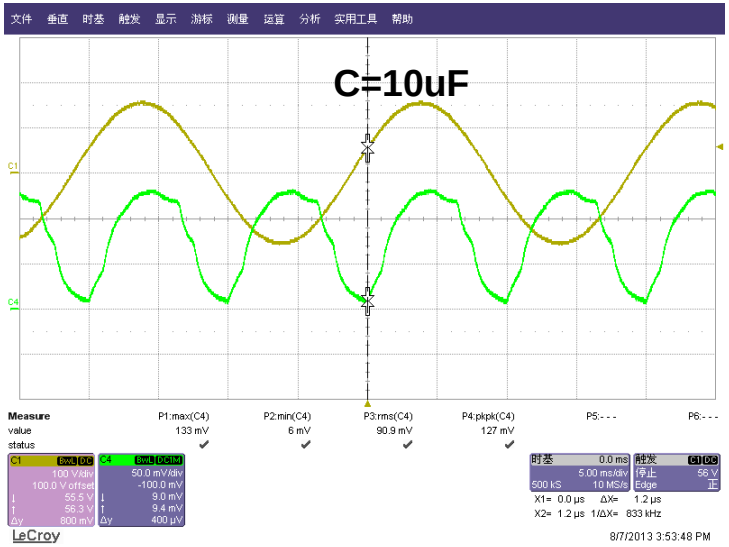
C (uF)	Input Voltage (V)	Input Current (mA)	Power (W)	PF	THD (%)	Flicker Index*
0	110.5	95.7	10.4	0.9870	16.07	**1.48**
10	110.5	95.6	10.4	0.9854	16.79	**1.40**
20	110.5	95.6	10.4	0.9839	17.5	**1.22**
30	110.5	95.7	10.4	0.9835	17.8	**1.06**
40	110.5	95.7	10.4	0.9832	18.0	**0.93**

***Flicker index=$(I_{MAX}-I_{MIN})/(I_{AVE})$**

Test Waveform of Flicker Reduction

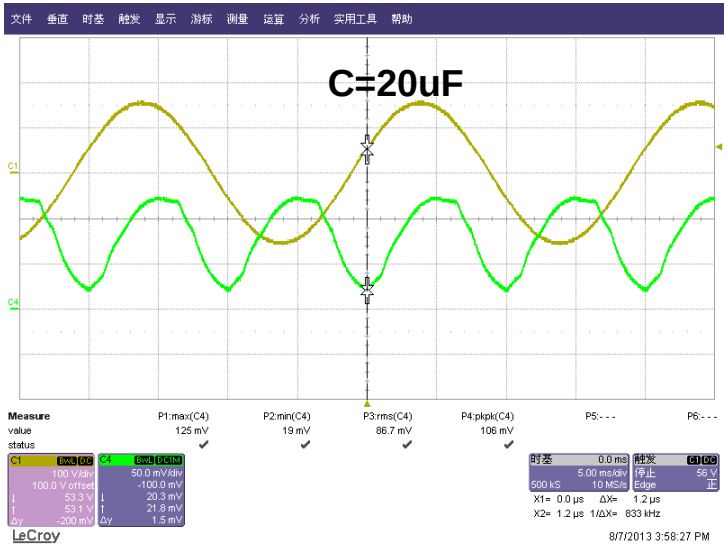
VAC

I_{LED}



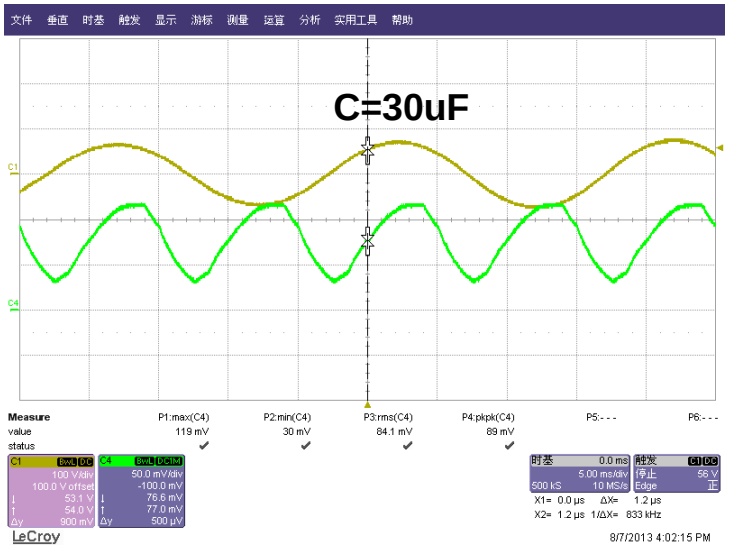
VAC

I_{LED}



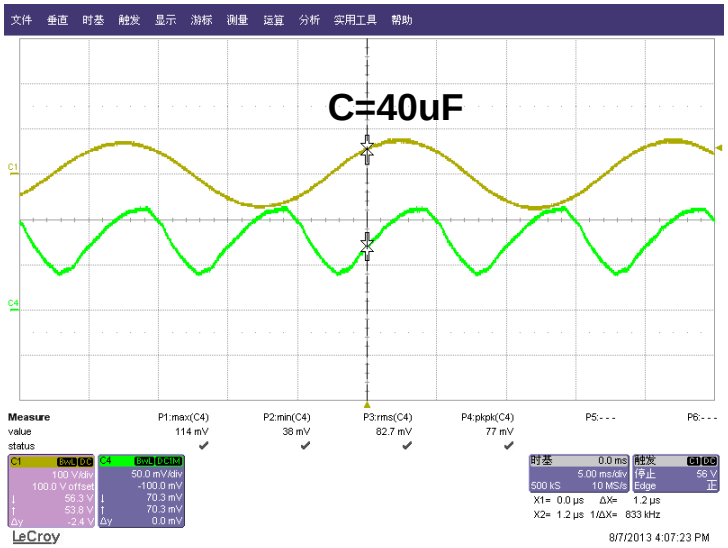
VAC

I_{LED}



VAC

I_{LED}



Thank You