



IML8683 AC STEP DRIVER

June 2014



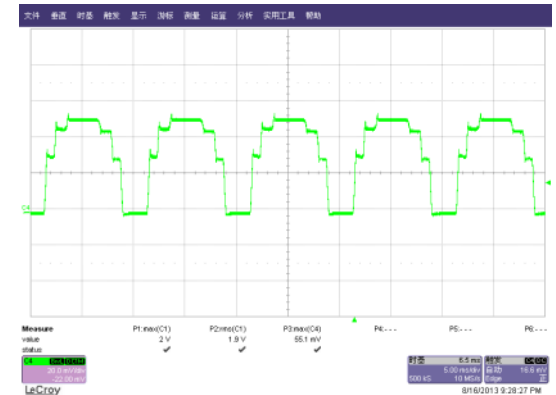
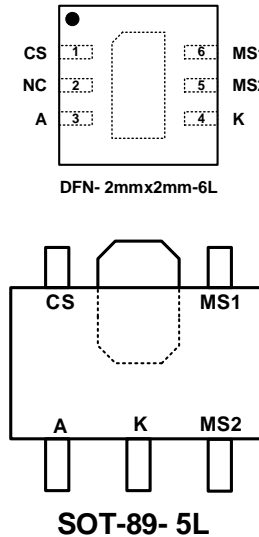
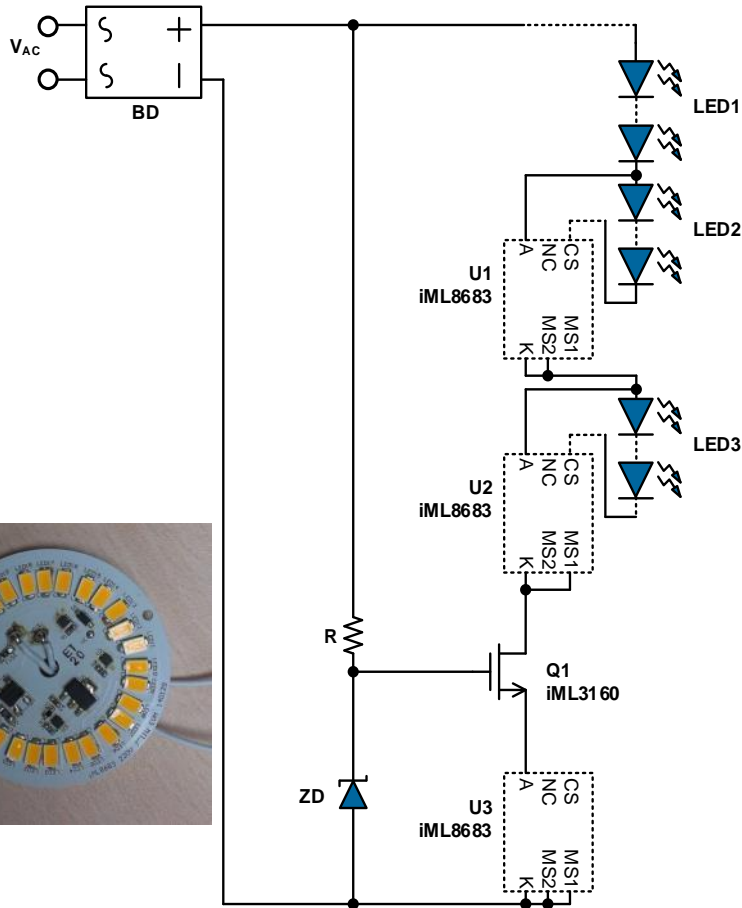
代理商：深圳市鑫宝宏电子有限公司 联系电话：13670037219 咨询QQ：1561451328 网站：www.driveic.com

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iML8683- AC Step Driver

- Suitable for various kinds of applications (bulb/ tube/ down light/ spot light/ high bay, street lamp...)
- PF > 0.98, THD < 20% (3 steps)
- TRIAC dimmable
- Compliance with regulations (EMI, THD, Surge test)
- Compact size, no E-cap required



1. Compact size to minimize mechanical cost.
2. No electrolytic capacitor required
→ high reliability.
3. Driver on board which minimize process flow and assembly cost.
4. Low driver cost to achieve high PF and TRIAC dimmable.

AC Step Driver Solution



Switching AC-DC Driver Solution



Low Voltage Solution

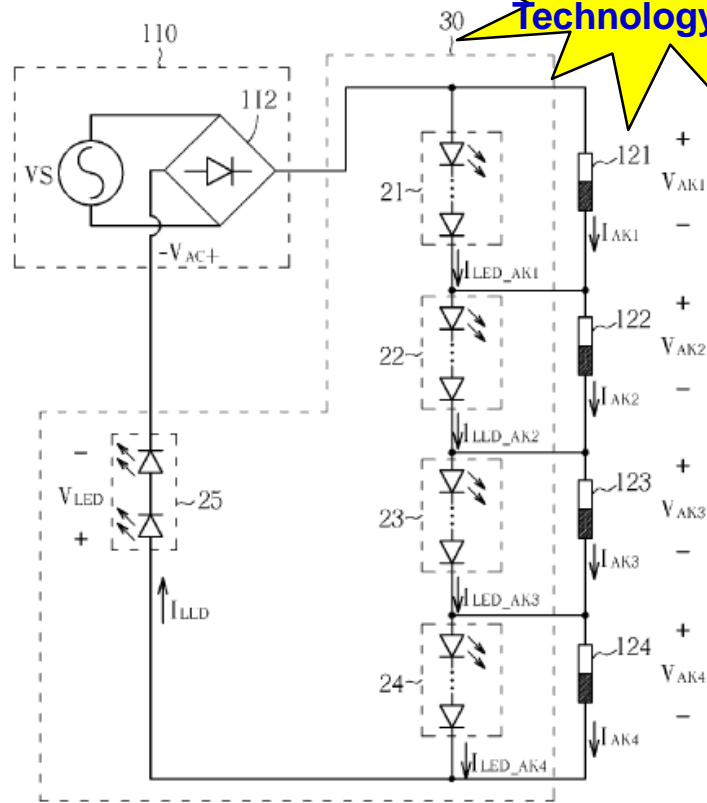
Use Normal High Voltage Wafer Process (60V~80V)

US Patent: 8,288,960

Filed: Apr 15, 2010

Assignee: **iML International**

iML's Proprietary Technology



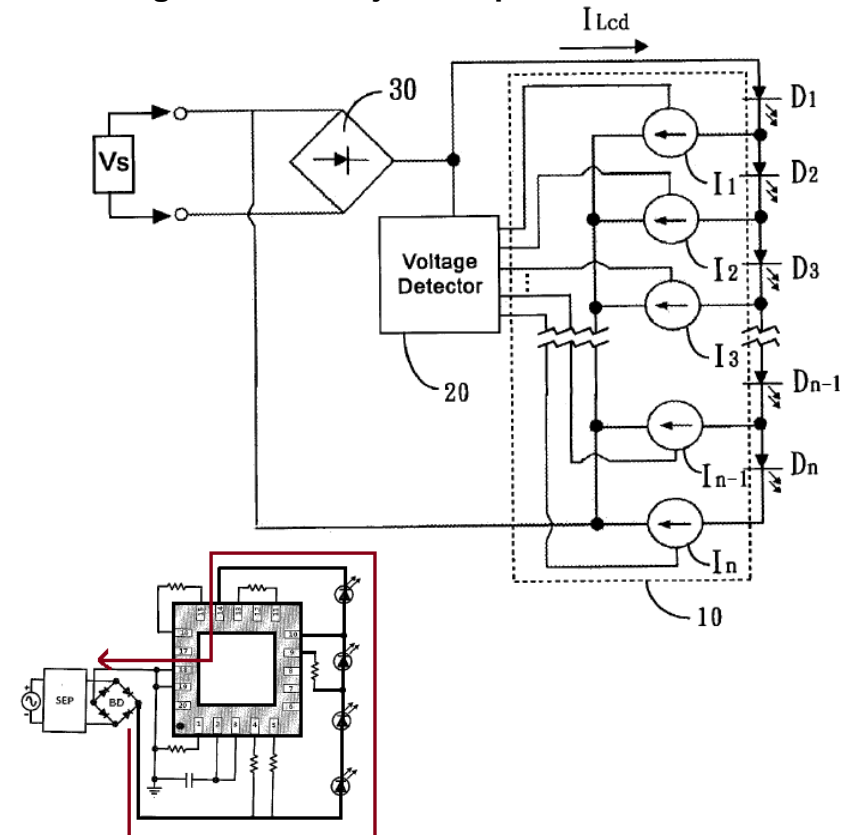
High Voltage Solution

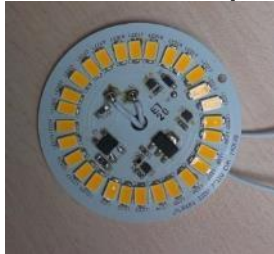

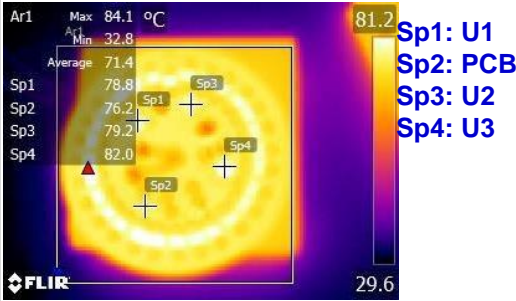
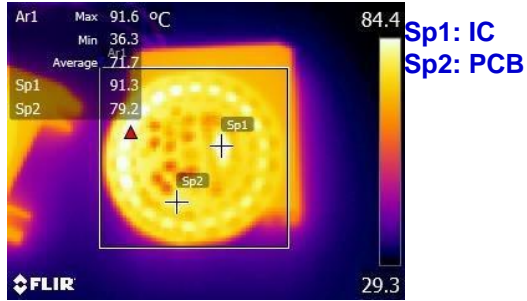
Use Ultra High Voltage Wafer Process (400V~600V)

US Patent: 6,989,807

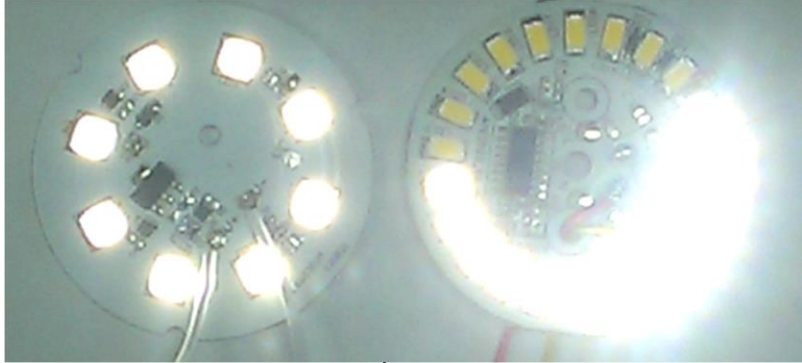
Filed: May 19, 2003

Assignee: Koninklijke Philips Electronics



| | iML8683 | Other HV Solutions |
|---|---|--|
| LED Utilization (LED output power/ LED nominal power) | ~88%* | ~72% |
| Low Flicker Solution | Flicker index equivalent to CFL with high PF (>0.9) | Improved by sacrificing PF (PF<0.9) |
| Surge Capability | >750V (No MOV required)  | <500V Need MOV  |
| Thermal Management | Easy (distributed to ICs)  Sp1: U1 Sp2: PCB Sp3: U2 Sp4: U3 | Difficult (concentrated on single IC)  Sp1: IC Sp2: PCB |

* :With Low Flicker Solution

| | | iML8683 | Other HV Solutions |
|---------------------------------|------------------|---|---|
| Light Output Uniformity | Normal Operation | Good** (~85%) | Poor (50%~60%) |
| | TRIAC Dimming | All LED remains light-up.  | Some LED might not be able to light-up. |
| PCB layout for L-tube | | Easy | Difficult |
| Driver BOM Cost (based on 10W) | | USD 0.5 | USD 0.5 ~ 0.7 |
| IP | | Proprietary Technology | Potential risk for IP infringement |

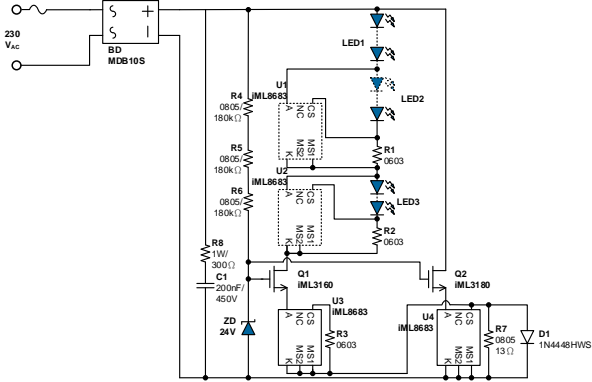
** : With Balance Structure



iML8683 for Different Application Needs

TRIAC Dimmable

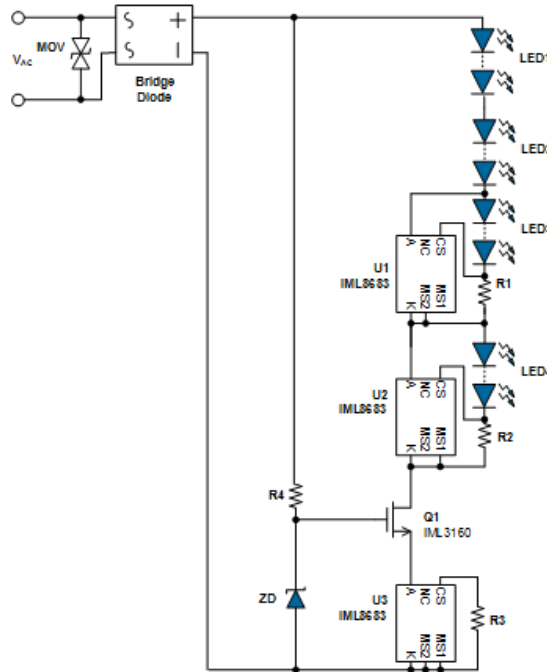
Active load to improve compatibility



Simple & Flexible

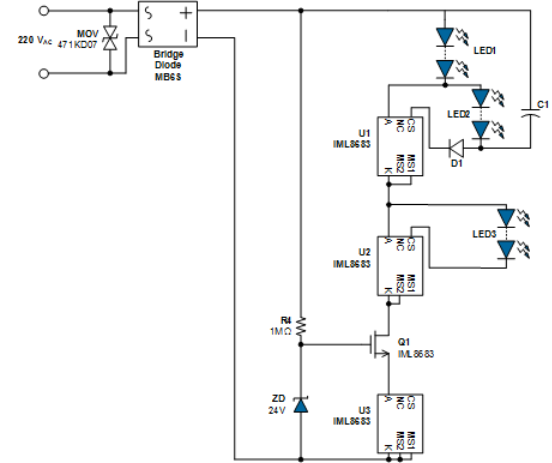
Fundamental Structure

7W~14W, Efficiency 85~90%
 PF=0.98, THD <20%
 Surge 750V, System ESD 4000V
 Pass EMI, Current Harmonics



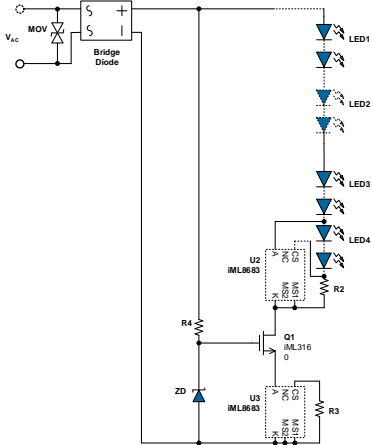
Low Flicker, Higher Im/W

Percent Flicker 30%, Flicker Index 0.1



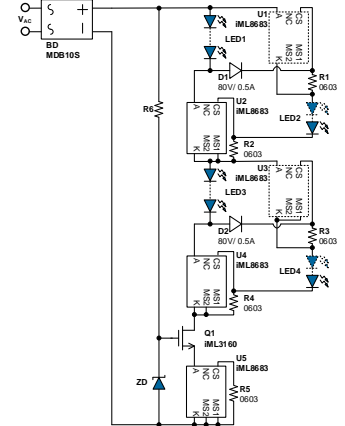
Low Cost

PF=0.96, THD <30%



Balance LED usage

Lumens difference between LED <20%





iML8683 Applications

120VAC



220VAC

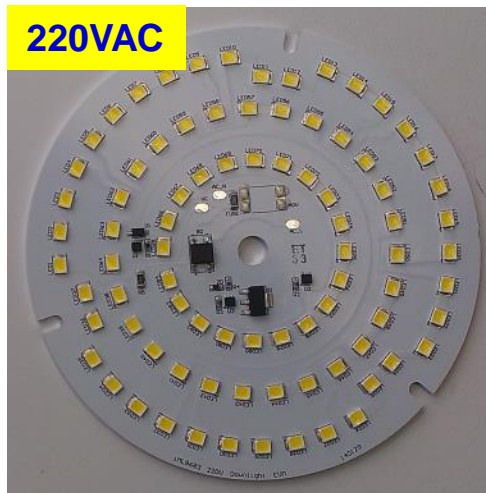


- 7~12W LED Bulbs

120VAC



220VAC



- 3" ~ 8" LED Downlights

120VAC



220VAC

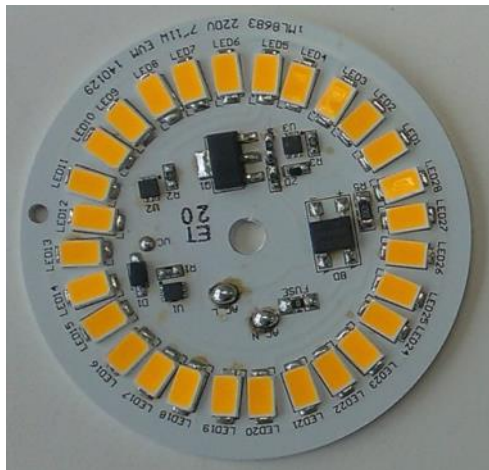


- 0.6m ~ 1.5m T8/ T5 Tubes

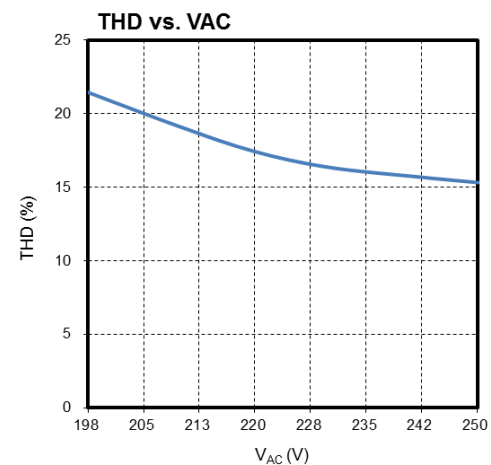
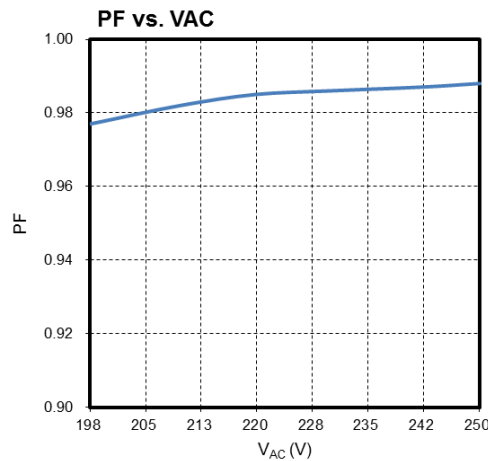
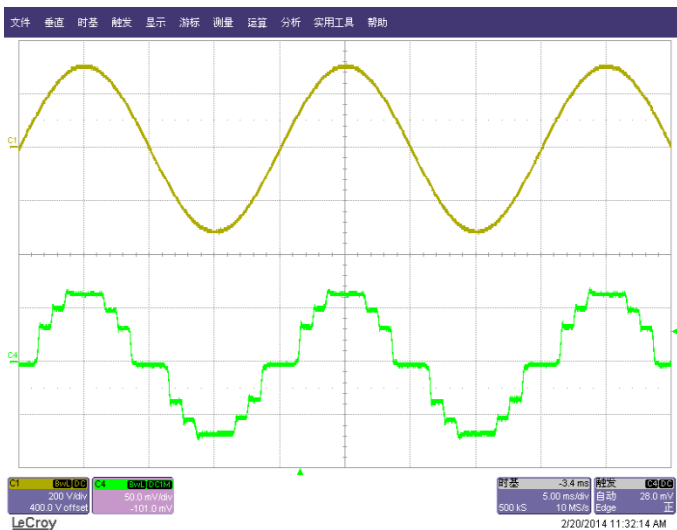


IML8683 System Performance (230VAC)

$V_{AC}=230V$, LED = 24V x 28pcs, 11W Bulb, 3 steps

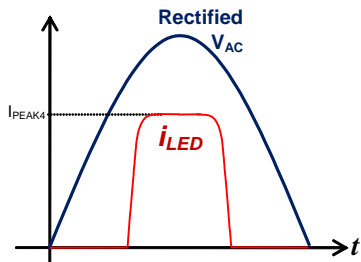
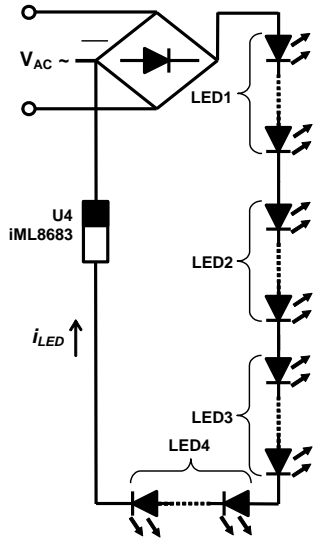


| V_{AC} (V) | I_{IN} (mA) | PF | THD | P_{IN} (W) |
|--------------|---------------|-------|-------|--------------|
| 198 | 43.18 | 0.977 | 21.45 | 8.400 |
| 210 | 46.11 | 0.982 | 19.16 | 9.552 |
| 220 | 47.84 | 0.985 | 17.46 | 10.416 |
| 230 | 49.27 | 0.986 | 16.36 | 11.234 |
| 242 | 50.57 | 0.987 | 15.71 | 12.097 |
| 250 | 51.48 | 0.988 | 15.32 | 12.773 |

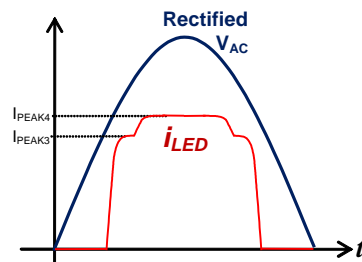
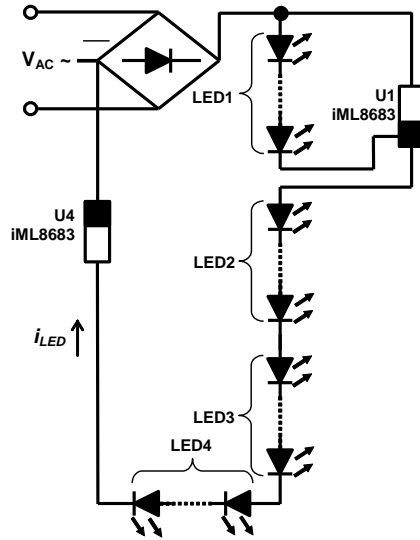




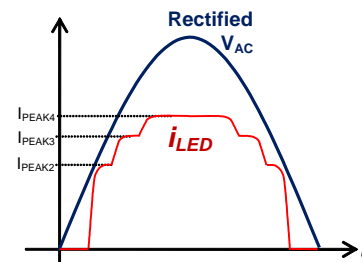
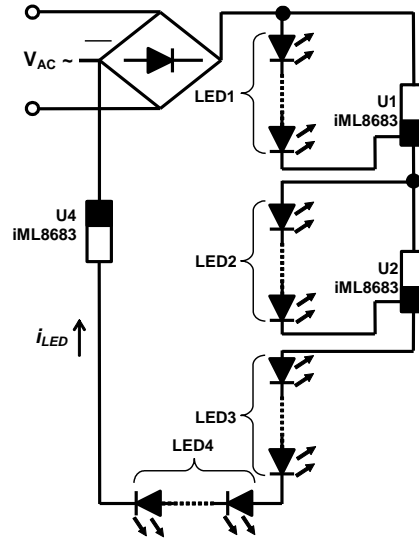
iML8683 Quantity vs. Bulb Performance



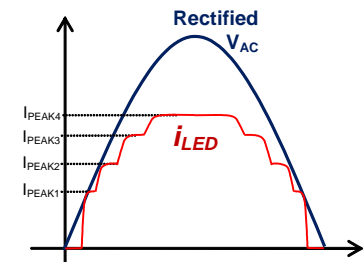
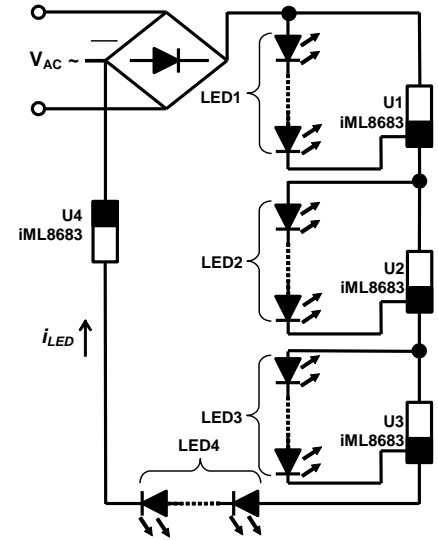
1 Step
PF=0.88
THD=53%
Power=7.1W



2 Steps
PF=0.96
THD=29%
Power=9.1W



3 Steps
PF=0.98
THD=16%
Power=9.8W



4 Steps
PF=0.99
THD=10%
Power=10W



Standard EVMs



Standard Evaluation Modules

Standard EVMs as reference design for small customers.

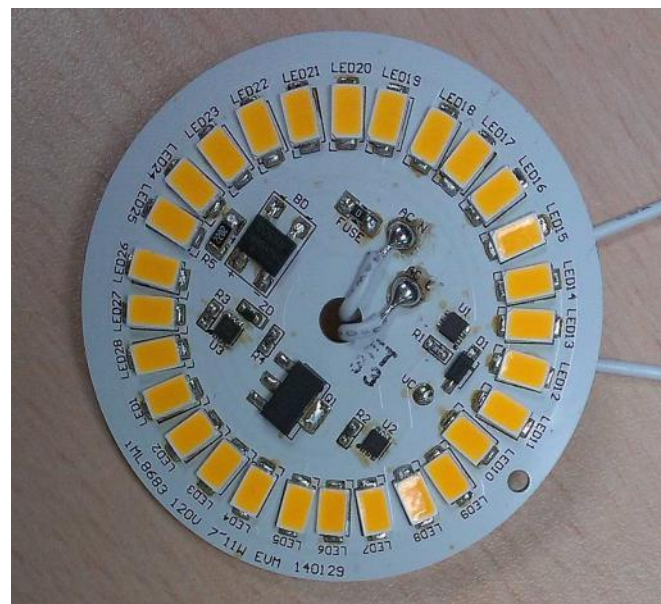
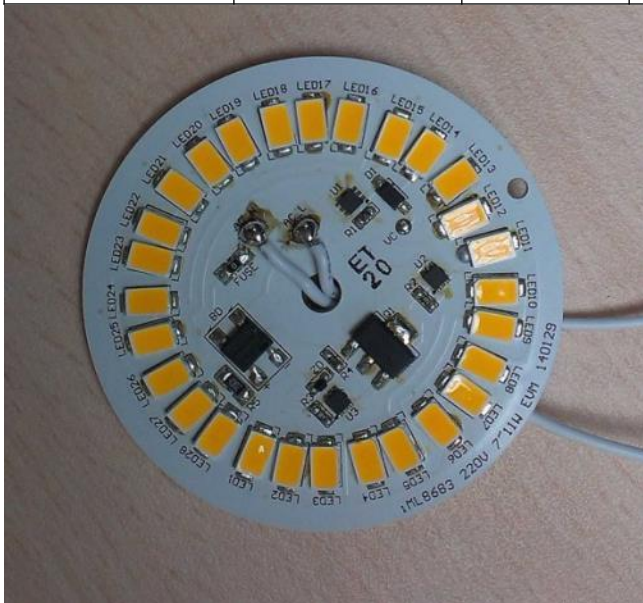
- iML8683 Datasheet
- iML8683 Application Note
- Standard EVMs
- Test report
 - Power
 - Power Factor
 - THD
 - Current Harmonic IEC61000-3-2
 - EMI
 - ESD test IEC61000-4-2
 - EFT test IEC61000-4-4
 - Surge test IEC61000-4-5
 - BOM list
 - Layout Gerber file

| Item | Application | Structure | VAC (V) | Power(W) | | | LED Qty | LED string structure | Flicker reduction |
|------|-------------|-----------------|---------|----------|--------|---------------|---------|--------------------------|-------------------|
| | | | | | Vf (V) | Color | | | |
| 1 | Bulb | Typical 3 steps | 220 | 7~11 | 24 | Warm White | 28 | 6S3P+3S2P+2S2P | Yes |
| 2 | Bulb | Typical 3 steps | 120 | 7~11 | 16 | Warm White | 28 | 4S4P+2S3P+2S3P | Yes |
| 3 | Downlight | Typical 3 steps | 220 | 14 | 3 | Warm White | 84 | 22S1P+22S1P+20S1P+20S1P | Yes |
| 4 | Downlight | Typical 3 steps | 120 | 14 | 3 | Warm White | 84 | 11S2P+11S2P+10S2P+10S2P | Yes |
| 5 | T5 tube | Balance 3 steps | 220 | 8 | 16 | Neutral White | 18 | 4S1P+4S1P+4S1P+4S1P+1S2P | |
| 6 | T5 tube | Balance 3 steps | 120 | 8 | 3 | Neutral White | 44 | 11S1P+11S1P+11S1P+11S1P | |



11W LED Bulb

| Vin(V _{AC}) | Iin (mA) | PF | THD | Pin(W) | Flux (lm) | Efficacy(lm/W) |
|-----------------------|----------|-------|--------|--------|-----------|----------------|
| 220 | 47.84 | 0.985 | 17.46% | 10.416 | 936 | 89.9 |



| Vin(V _{AC}) | Iin (mA) | PF | THD | Pin(W) | Flux (lm) | Efficacy(lm/W) |
|-----------------------|----------|-------|--------|--------|-----------|----------------|
| 120 | 93.10 | 0.984 | 17.54% | 11.17 | 1012 | 90.6 |



14W (4") Downlight

| Vin(V _{AC}) | Iin (mA) | PF | THD | Pin(W) | Flux (lm) | Efficacy(lm/W) |
|-----------------------|----------|-------|--------|--------|-----------|----------------|
| 220 | 63.12 | 0.985 | 17.32% | 13.75 | 1,225 | 89.1 |



| Vin(V _{AC}) | Iin (mA) | PF | THD | Pin(W) | Flux (lm) | Efficacy(lm/W) |
|-----------------------|----------|-------|--------|--------|-----------|----------------|
| 120 | 120.30 | 0.988 | 15.80% | 14.34 | 1,249 | 87.1 |



8W (60 cm x 0.9 cm) Tube

| Vin(V _{AC}) | Iin (mA) | PF | THD | Pin(W) |
|-----------------------|----------|-------|--------|--------|
| 220 | 39.21 | 0.985 | 17.35% | 8.53 |



| Vin(V _{AC}) | Iin (mA) | PF | THD | Pin(W) |
|-----------------------|----------|-------|--------|--------|
| 120 | 68.32 | 0.987 | 15.86% | 8.14 |

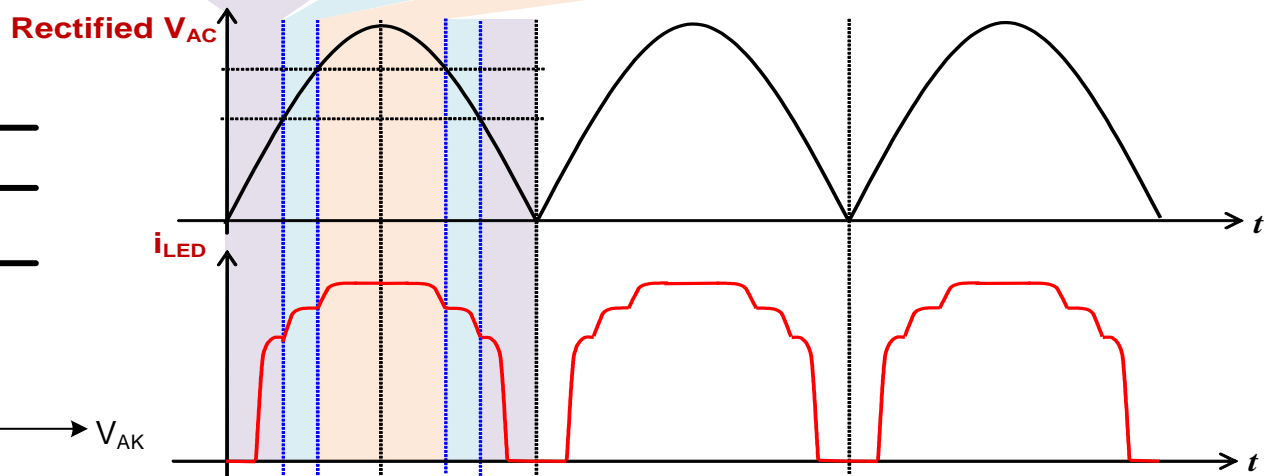
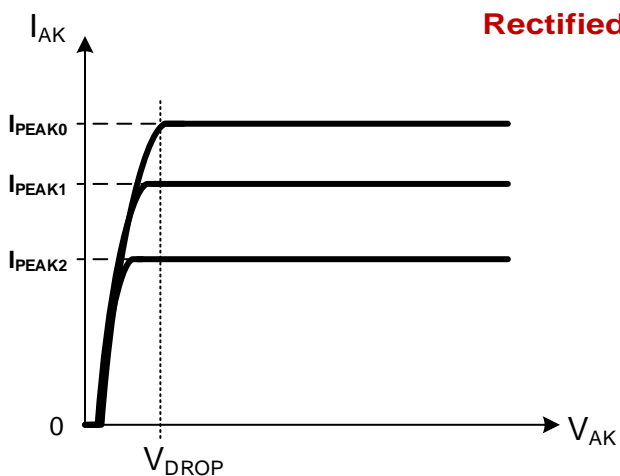
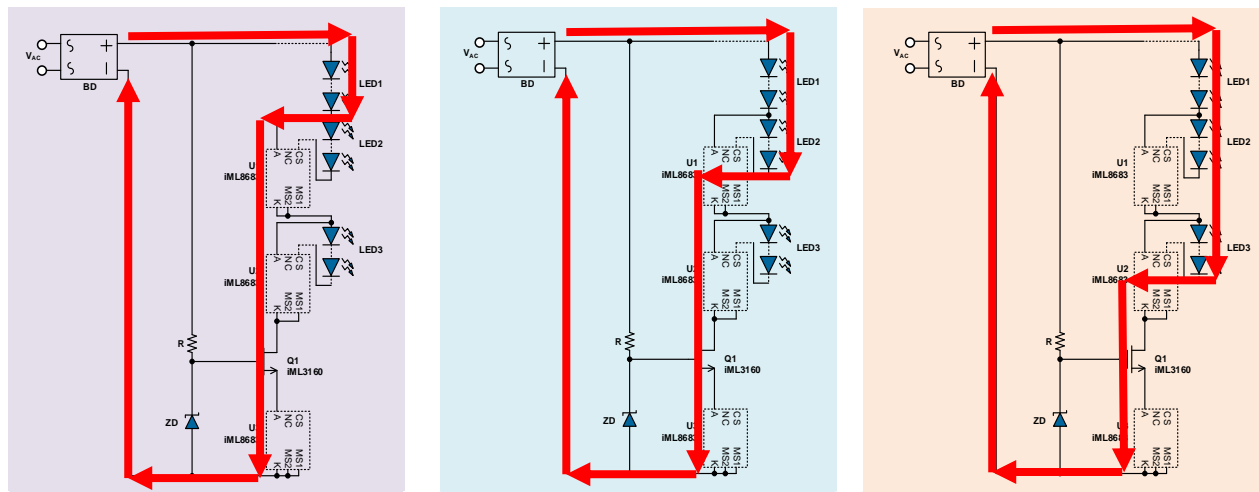




Thank You for Your Attention!

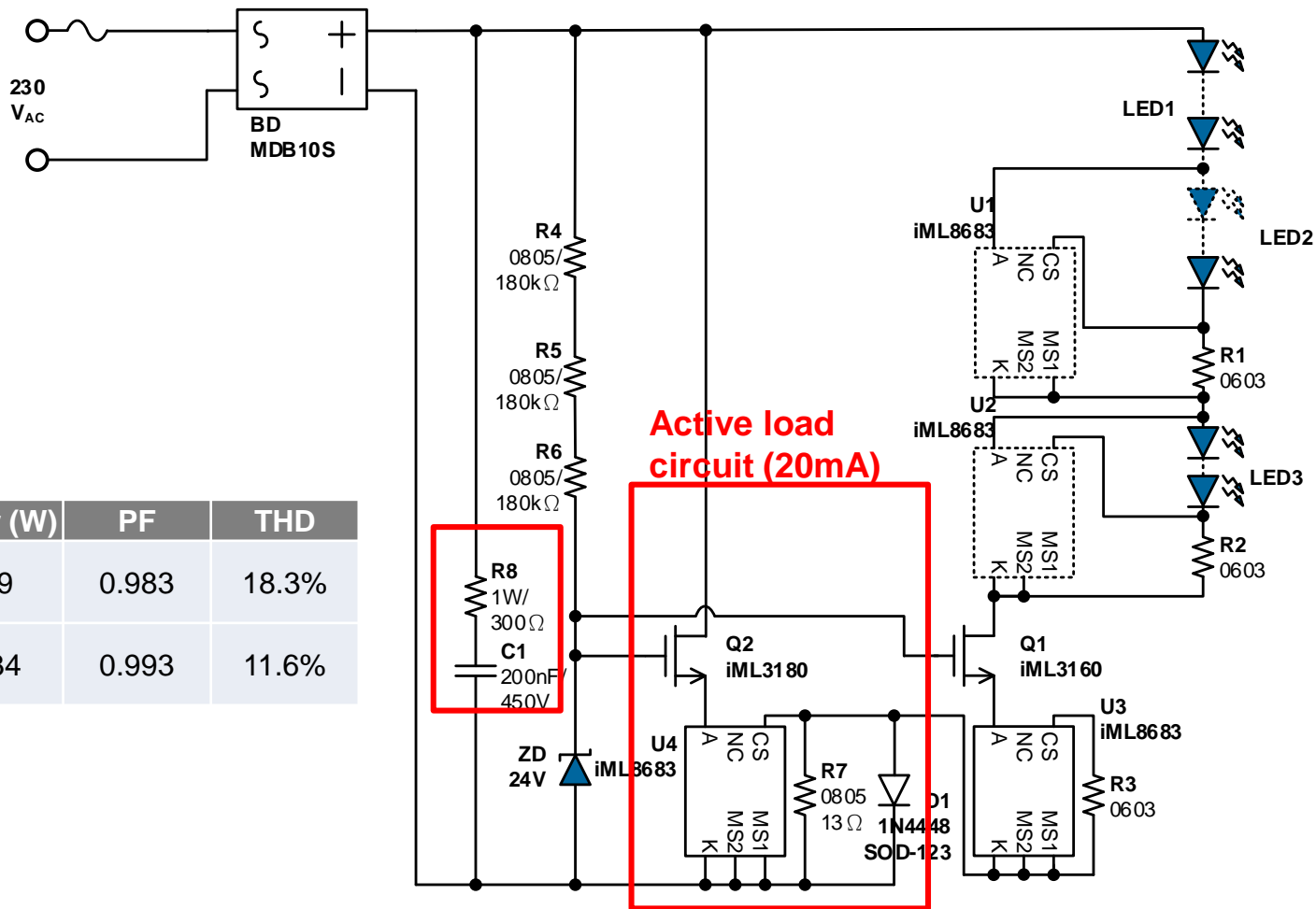


iML8683 Operation Theory





Advanced Applications of iML8683



| | Power (W) | PF | THD |
|-------------------------|-----------|-------|-------|
| With Active load (20mA) | 9.79 | 0.983 | 18.3% |
| Without Active load | 10.34 | 0.993 | 11.6% |

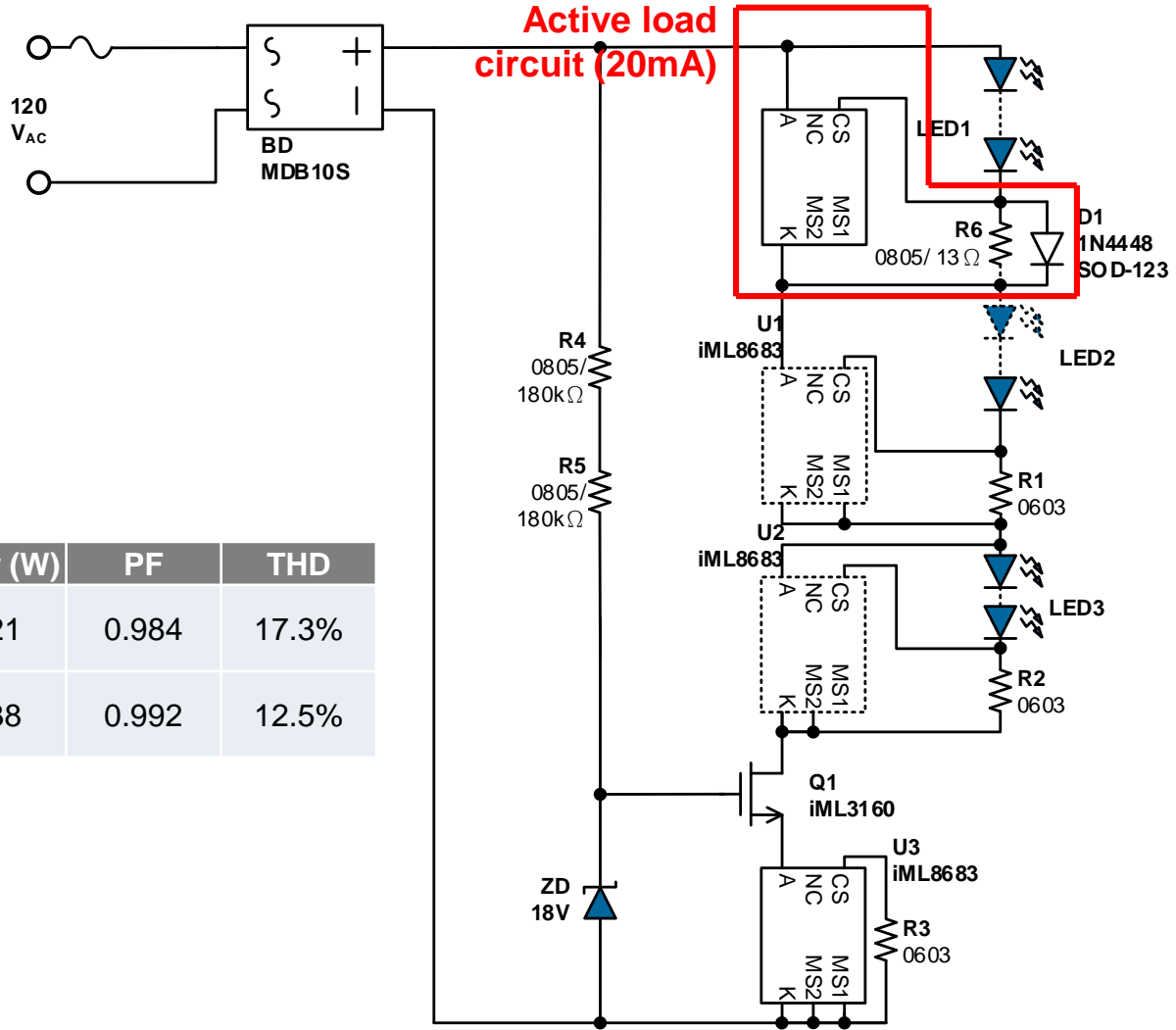


Compatible 230VAC Dimmer List

| Dimmer | Type | Min. Power | Max. Power |
|-------------|----------|------------|------------|
| Busch 2250U | Leading | 0.785W | 10.425W |
| Busch 2247U | Leading | 0.797W | 10.635W |
| Busch 6513U | Trailing | 2.298W | 10.200W |
| Busch 6519U | Trailing | 2.334W | 10.269W |
| NAM ASW3701 | Leading | 3.532W | 10.440W |
| NAM ASW3000 | Leading | 4.380W | 10.482W |
| GIRA 0300 | Leading | 4.48W | 10.482W |
| GIRA 0307 | Trailing | 1.754W | 10.020W |
| SIEMENS | Leading | 1.603W | 10.471W |



120VAC TRIAC Dimmable System



| | Power (W) | PF | THD |
|-------------------------|-----------|-------|-------|
| With Active load (20mA) | 11.21 | 0.984 | 17.3% |
| Without Active load | 11.38 | 0.992 | 12.5% |



Compatible 120VAC Dimmer List

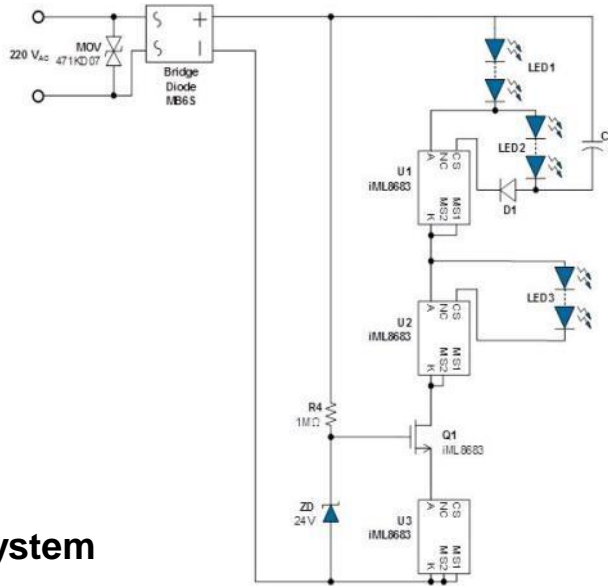
| Dimmer | Type | Min Power | Max Power |
|-------------------|---------|-----------|-----------|
| Leviton IP106-1LZ | Leading | 1.430W | 11.168W |
| Leviton 6683 | Leading | 0.066W | 11.304W |
| LUTRON DVCL-153P | Leading | 0.348W | 10.224W |
| LUTRON DV-600P-IV | Leading | 0.837W | 10.507W |
| LUTRON AY-600P-IV | Leading | 0.813W | 10.753W |
| LUTRON S-600P | Leading | 0.614W | 10.477W |
| LUTRON S-603PG | Leading | 0.636W | 8.777W |
| LUTRON N-600-AL* | Leading | 0.609W | 11.060W |
| LUTRON CT-600P | Leading | 0.643W | 10.556W |
| LUTRON CTCL-153P | Leading | 0.341W | 10.205W |

* Slight flicker due to asymmetric duty of TRIAC dimmer

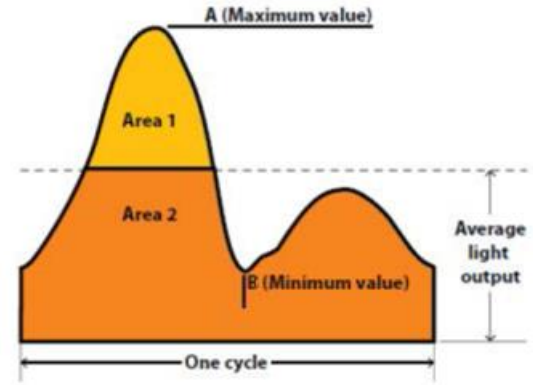


Low Flicker Solution

Add E-caps parallel connected to LED without influence PF and THD. The efficacy is also improved.



220V/ 10W system



Source: IESNA Lighting Handbook, 10th Edition

- Percent Flicker = $100\% \times \frac{A-B}{A+B}$
- Flicker Index = $\frac{\text{Area 1}}{\text{Area 1} + \text{Area 2}}$

| C1 | VAC (V) | Power (W) | PF | THD (%) | Flux (lm) | Efficacy (lm/W) | Percent Flicker | Flicker Index |
|--------------|------------|--------------|---------------|--------------|------------|-----------------|-----------------|---------------|
| 0 uF | 221 | 10.09 | 0.9853 | 17.05 | 812 | 80.5 | 100% | 0.32 |
| 1 uF | 221 | 10.11 | 0.9819 | 18.69 | 829 | 82.0 | 92% | 0.28 |
| 4.7 uF | 221 | 10.07 | 0.9805 | 19.39 | 853 | 84.7 | 60% | 0.17 |
| 10 uF | 221 | 10.08 | 0.9803 | 19.59 | 855 | 84.8 | 40% | 0.12 |
| 20 uF | 221 | 10.00 | 0.9801 | 19.70 | 862 | 86.2 | 31% | 0.10 |
| 30 uF | 221 | 10.00 | 0.9801 | 19.70 | 870 | 87.0 | 28% | 0.10 |

➔ Equivalent to CFL.

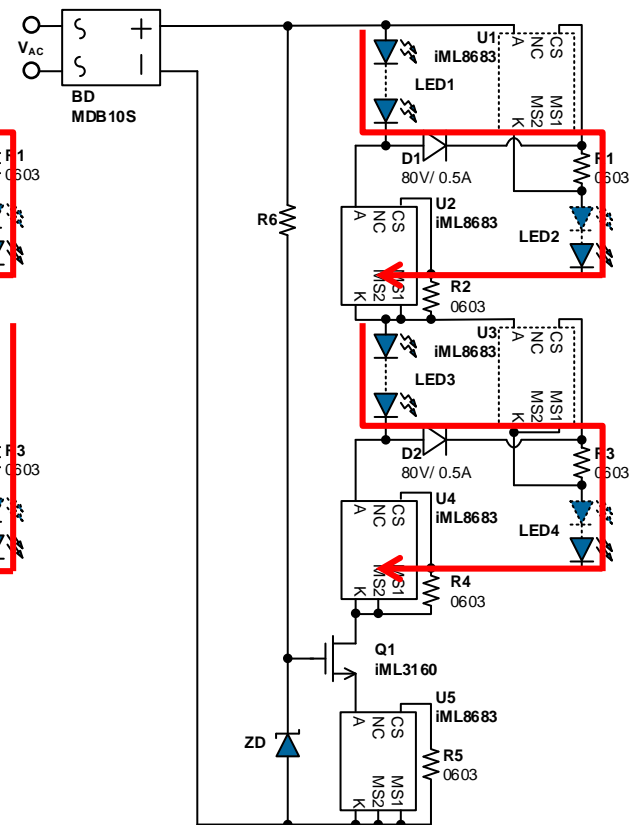
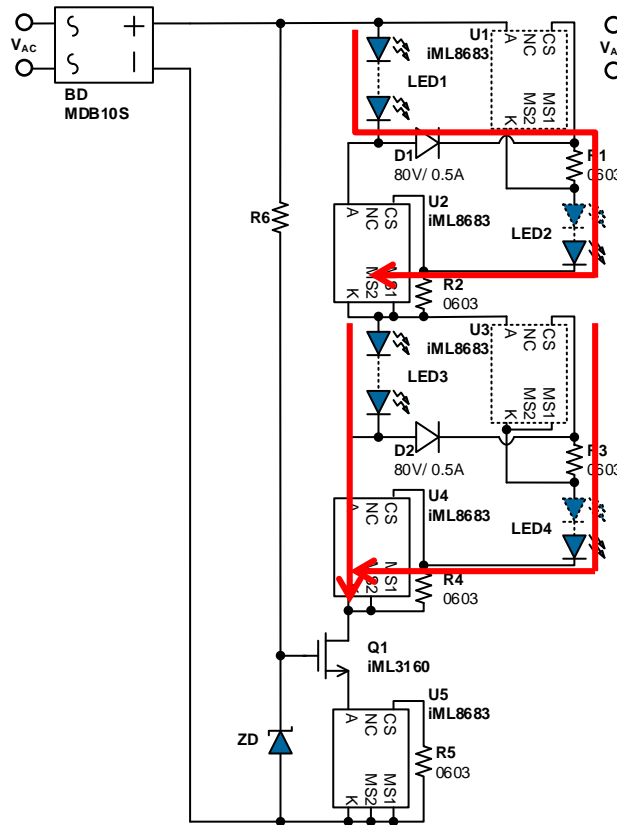
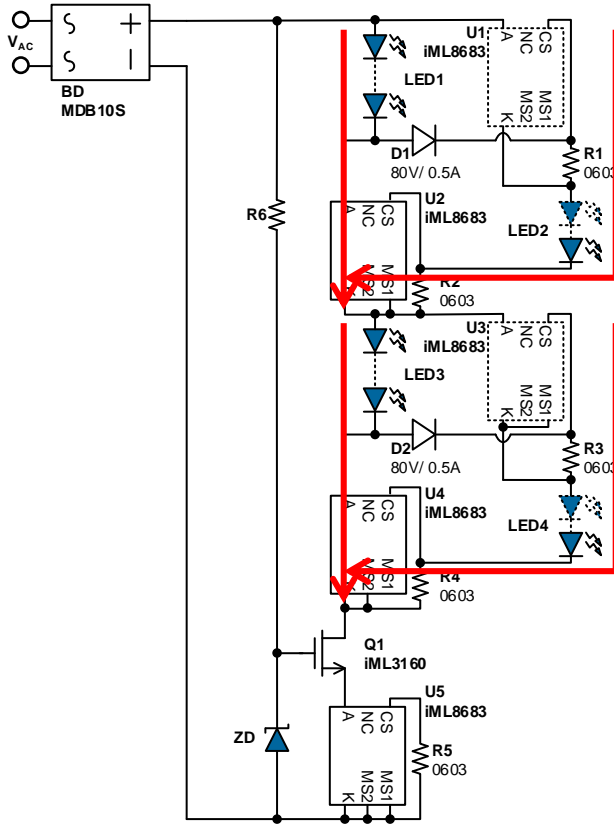


Balance Structure

VAC Low

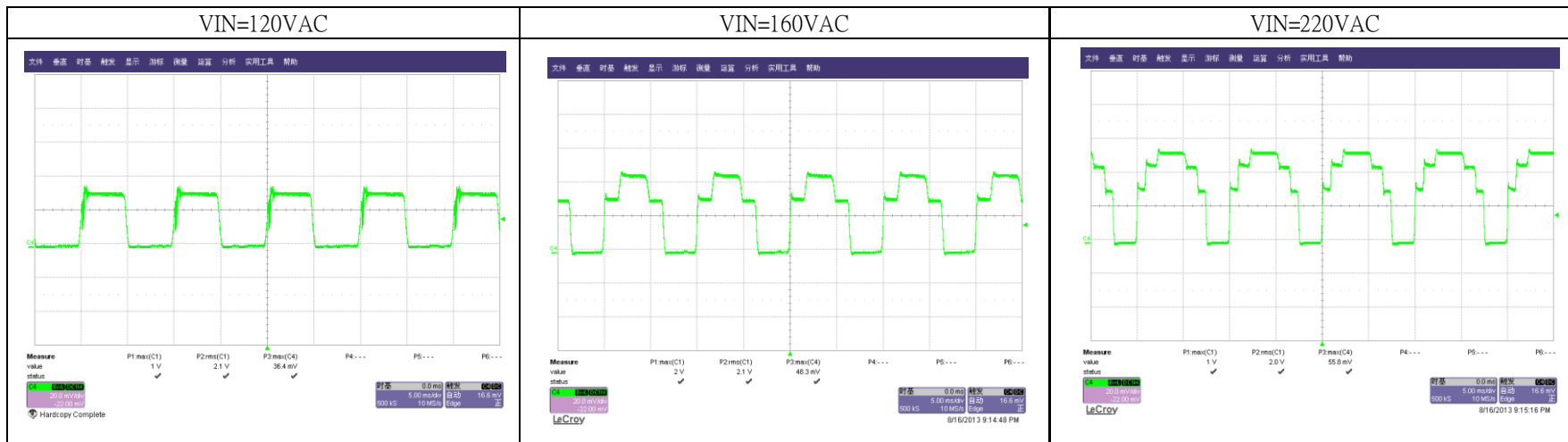


VAC High





Test Result of Balance Structure



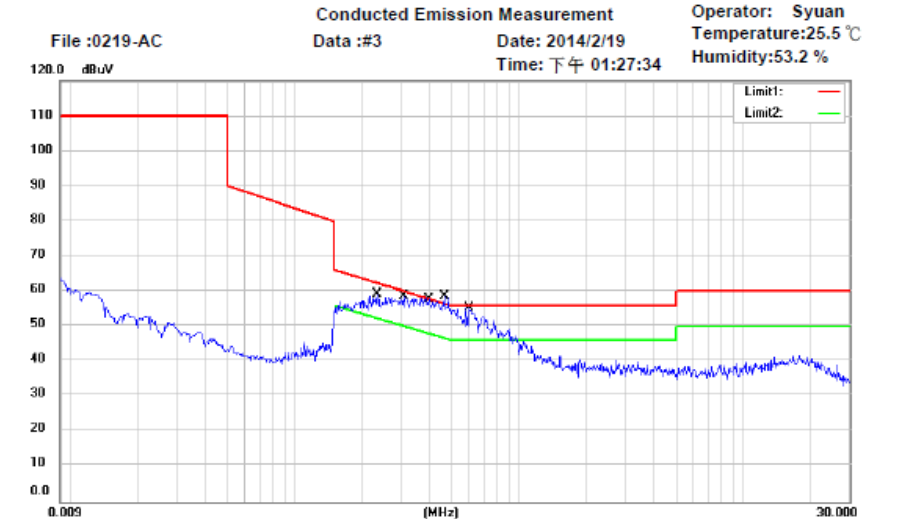
| Vin(V _{AC}) | Iin (mA) | PF | THD | Pin(W) | Line Reg. (Iin) | Line Reg. (W) |
|-----------------------|----------|-------|-------|--------|-----------------|---------------|
| 110 | 18.30 | 0.844 | 62.55 | 1.721 | -55.58% | -80.83% |
| 120 | 21.80 | 0.911 | 45.17 | 2.402 | -47.09% | -73.24% |
| 140 | 24.60 | 0.946 | 34.41 | 3.270 | -40.29% | -63.57% |
| 160 | 31.80 | 0.965 | 27.15 | 4.946 | -22.82% | -44.90% |
| 180 | 34.70 | 0.975 | 22.45 | 6.125 | -15.78% | -31.77% |
| 198 | 37.60 | 0.981 | 19.41 | 7.354 | -8.74% | -18.08% |
| 220 | 41.20 | 0.986 | 16.44 | 8.977 | 0.00% | 0.00% |
| 242 | 43.10 | 0.987 | 15.79 | 10.357 | 4.61% | 15.37% |
| 250 | 43.70 | 0.987 | 15.95 | 10.841 | 6.07% | 20.76% |
| 260 | 44.40 | 0.986 | 16.34 | 11.437 | 7.77% | 27.40% |



iML8683 System Test Results



iML8683 System EMI Performance (Without X-Cap)



Site : Chamber_03
 Condition : EN55015 Conduction(QP) Phase: L1
 EUT : Power : 220 V.a.c.
 M/N: iML 8683 220V/10W LED Bulb Module
 Test Mode :
 Note :

| Mk. | Frequency (MHz) | Reading (dBuV) | Detector | Corrected factor(dB) | Result (dBuV) | Limit (dBuV) | Margin (dB) | Comment |
|-----|-----------------|----------------|----------|----------------------|---------------|--------------|-------------|---------|
| | 0.2360 | 40.76 | QP | 9.65 | 50.41 | 62.24 | -11.83 | |
| | 0.2360 | 27.26 | AVG | 9.65 | 36.91 | 52.24 | -15.33 | |
| | 0.3096 | 40.78 | QP | 9.65 | 50.43 | 59.98 | -9.55 | |
| | 0.3096 | 27.22 | AVG | 9.65 | 36.87 | 49.98 | -13.11 | |
| | 0.3917 | 40.40 | QP | 9.65 | 50.05 | 58.03 | -7.98 | |
| | 0.3917 | 26.45 | AVG | 9.65 | 36.10 | 48.03 | -11.93 | |
| * | 0.4658 | 39.37 | QP | 9.57 | 48.94 | 56.59 | -7.65 | |
| | 0.4658 | 25.62 | AVG | 9.57 | 35.19 | 46.59 | -11.40 | |
| | 0.6058 | 37.52 | QP | 9.67 | 47.19 | 56.00 | -8.81 | |
| | 0.6058 | 23.32 | AVG | 9.67 | 32.99 | 46.00 | -13.01 | |

Still have -7~ -10 dB margin



Current Harmonic Performance (IEC61000-3-2 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 Test Performance (IEC61000-4-5)



220V 10 W System

Worldwide Testing Services(Taiwan) Co., Ltd.

Surge

Applicant: Integrated Memory Logic, Inc.

Standard: EN 61000 - 4 - 5

Device: iML8683 220V/ 10W LED Bulb Module

Date: 2014.03.05

| | |
|---------------|-----------|
| Temperature | : 24.8 °C |
| Pressure | : 990 hPa |
| Rel. humidity | : 47.6 % |

| Model | Test mode | Voltage Angle | Waveform T _r / T _b | Repetition | Number of Tests/ Total | Performance criteria |
|-----------------------------|---------------------|---------------|--|------------|------------------------|----------------------|
| #1 600V Bridge | 220VAC-line to line | +500V 90° | 1.2/50 μs | 30s | 5/5 | A |
| | | -500V 270° | 1.2/50 μs | 30s | 5/5 | A |
| #2 1000V Bridge | 220VAC-line to line | +750V 90° | 1.2/50 μs | 30s | 5/5 | A |
| | | -750V 270° | 1.2/50 μs | 30s | 5/5 | A |
| #3 600V Bridge MOV471 | 220VAC-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 Bulb Module

Date: 2014.03.04

| | |
|---------------|-----------|
| Temperature | : 22.4 °C |
| Pressure | : 990 hPa |
| Rel. humidity | : 49.4 % |

| Model | Test mode | Voltage Angle | Waveform T _r / T _b | Repetition | Number of Tests/ Total | Performance criteria |
|--------------|---------------------|---------------|--|------------|------------------------|----------------------|
| #1 | 120VAC-line to line | +500V 90° | 1.2/50 μs | 30s | 5/5 | A |
| | | -500V 270° | 1.2/50 μs | 30s | 5/5 | A |
| #2 | 120VAC-line to line | +750V 90° | 1.2/50 μs | 30s | 5/5 | A |
| | | -750V 270° | 1.2/50 μs | 30s | 5/5 | A |
| #3 MOV221 | 120VAC-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



Surge Test Performance (IEC61000-4-5)

220V 10 W



Worldwide Testing Services(Taiwan) Co., Ltd.

Surge

Applicant: Integrated Memory Logic, Inc.

Standard: EN 61000 - 4 - 5

Device: iML8683 220V/ 10W LED Bulb Module

Date: 2014.04.02

| | | |
|---------------|--------|-----|
| Temperature | : 25.7 | °C |
| Pressure | : 990 | hPa |
| Rel. humidity | : 40.1 | % |

| Model | Test mode | Voltage Angle | Waveform T _r / T _b | Repetition | Number of Tests/ Total | Performance criteria |
|---------------------------------|-----------------|---------------|---|------------|------------------------|----------------------|
| #1 1000V Bridge 800V NMOS | 220V | +750V 90° | 1.2/50 μs | 30s | 5/5 | A |
| | AC-line to line | -750V 270° | 1.2/50 μs | 30s | 5/5 | A |
| #2 1000V Bridge 800V NMOS | 220V | +1000V 90° | 1.2/50 μs | 30s | 5/5 | A |
| | AC-line to line | -1000V 270° | 1.2/50 μs | 30s | 5/5 | A |
| #3 1000V Bridge 800V NMOS | 220V | +1100V 90° | 1.2/50 μs | 30s | 5/5 | A |
| | AC-line to line | -1100V 270° | 1.2/50 μs | 30s | 5/5 | A |
| #4 1000V Bridge 800V NMOS | 220V | +1250V 90° | 1.2/50 μs | 30s | 5/5 | A |
| | AC-line to line | -1250V 270° | 1.2/50 μs | 30s | 5/5 | A |