



深度调光且高PF值的LED电源驱动

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Agenda

- ▶ LED lighting technology and market trends
- ▶ NXP Products Introduction
- ▶ NXP's leading lighting solutions and target applications
- ▶ Conclusion



LED Lighting Technology and Market Trends

Multi and rapid development of lighting technology

The main application areas



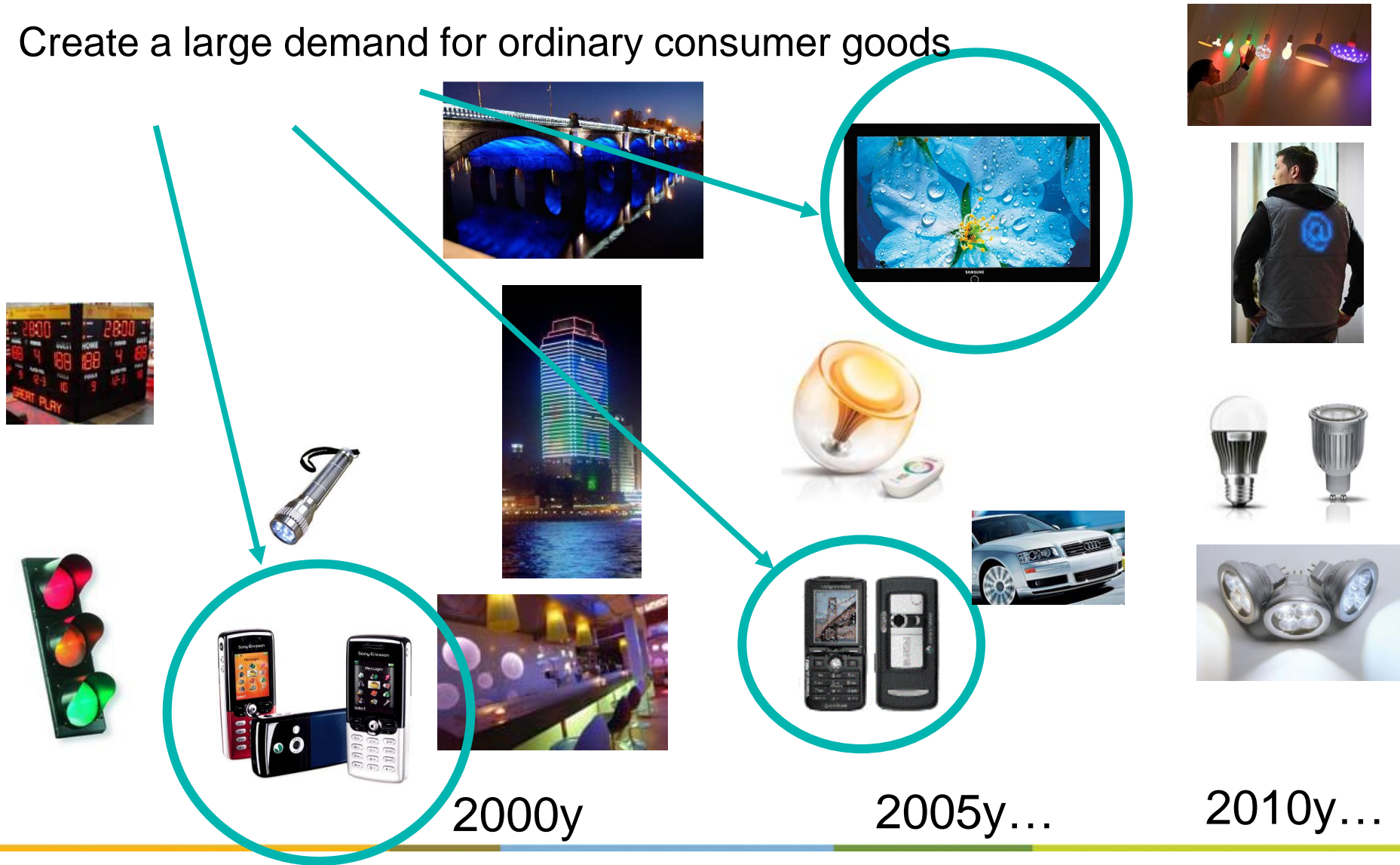
2000y

2005y...

2010y...

Multi and rapid development of lighting technology

Create a large demand for ordinary consumer goods



NXP full support innovative lighting technology for energy efficiency in lighting industry

Replacement of traditional bulbs



Philips Solid-State Lighting Solutions



Lemnis Lighting

Cree Lighting Fixtures Inc.



Retail Lighting



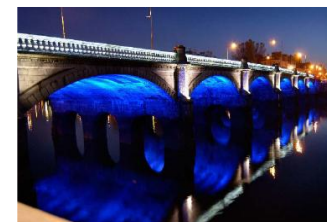
Indoor Lighting



Decorative Lighting



Building lighting



Outdoor Lighting



Beta LED



NXP Products Introduction



one solution for isolated and non-isolated
deep dimming <1%
fully integrated switches



The next step in retrofit LED lighting

- ▶ LED driver available that matches LED lifetimes
- ▶ High integration and small footprint, supports retrofit lamps
- ▶ Adjustable natural dimming curve integrated, deep dimming <1%
- ▶ Supports most TRIAC and transistor dimmers
- ▶ Great efficiency thanks to valley detection
- ▶ One solution for both isolated and non isolated designs (flyback/ buck)
- ▶ Naturally high Power Factor

Mains LED drivers

Overview



SSL Mains LED driver product range

For Fixed output or PWM dimming

SSL1522T	7W Fly-back	500mA Buck
SSL1523P	12W Fly-back	1A Buck
SSL1623PH	24W Fly-back	1A Buck
TEA1752T	25 – 250W Fly-back with integrated PFC	

For AC Mains dimming (triac/transistor)

SSL2101	15W Fly-back / 8W retrofit	0.5A Buck
SSL2102	25W Fly-back / 15W retrofit	1A Buck

Product Portfolio Versus Applications

Power range	Fixed / PWM Dim	Mains Dim	Application
3-7W	SSL1522	SSL2101	Retrofit lamps
8-15W	SSL1523	SSL2101	Retrofit lamps, modules,
15-25W	SSL1623	SSL2102	Down-lights, office lighting
25-150W	SSL1750	SSL1750	Streetlighting, architectural lighting
10-100W	UBA3070+ TEA1742		Backlighting, LED-strings, color variable systems

SSL152X & SSL1623PH

SSL152X & SSL1623PH is a family of integrated switching converters, combining a PWM controller and a high voltage power Mosfet.

- 3 members
- 3 types of packages
- 4 different versions

			DIP8(P)	SO14(T)	DIP16 (PH)
	Ron	I_{max}			
SSL1522	12ϕ	1A	<input type="checkbox"/>	<input type="checkbox"/>	
SSL1523	6.5ϕ	2A	<input type="checkbox"/>		
SSL1623	6.5ϕ	2A			<input type="checkbox"/>

SSL152X & SSL1623PH features

- ▶ High voltage start-up current source
 - SSL152x series - self supplying
 - SSL1623PH - auxiliary winding take over needed
- ▶ Adjustable switching frequency
- ▶ **“True” valley switching**
- ▶ Internal error amplifier enabling primary sensing
- ▶ Adjustable primary peak current and SWP level
- ▶ Wide VCC operating range
- ▶ **High protection level** (transformer demagnetization, OVP, SWP, OCP, OTP, UVLO)

A bright idea for LED luminaires ...

SSL1522/23



For high efficient isolated and non-isolated LED drivers.

Key Features

- ▶ Integrated 650V power switch (SSL1522:120Ohm, SSL1523: 6.5Ohm), self supplying (operates from 80 – 276VAC).
- ▶ Valley switching and demagnetization protection.
- ▶ Frequency reduction at low power
- ▶ Temperature protection, Under voltage lock-out, Short winding protection, adjustable over-current protection.

Key Benefits

- ▶ Small form factor
- ▶ High efficiency (85%), slower output rectifier can be used.
- ▶ Low stand-by power (< 100mW)
- ▶ Safety

**Dimmable Mains LED drivers
SSL2101 / SSL2102**

Support Tools

SSL2101
SSL2102



▶ **Samples** (available via NXP sample store)

▶ **Application notes**

- SSL2101 Mains dimmable LED driver (AN10754)
- SSL2102 30W flyback Triac Dimmable Mains LED driver (AN10831)



▶ **Demoboards** (available via eTools)

- 230V/12-15W SSL2101 mains dimmable LED driver (flyback).
- 120V/12-15W SSL2101 mains dimmable LED driver (flyback).
- 230V/9-12W SSL2101 mains dimmable LED driver (buck).¹⁾
- 120V/9-12W SSL2101 mains dimmable LED driver (buck).¹⁾

- 230V/21W SSL2102 mains dimmable LED driver (flyback)¹⁾
- 120V/21W SSL2102 mains dimmable LED driver (flyback).¹⁾



SSL2101 Buck



SSL2101 Flyback

▶ **Calculation Tool**



SSL2101 tod

Support Tools

SSL2101
SSL2102



12W Mains isolated triac dimmable LED driver

Specifications

- ▶ Operates from 85 – 276VAC
 - Optimized for 230V or 120V
- ▶ Output voltage: 9 – 23V DC
- ▶ LED current: 400 – 800mA
- ▶ Efficiency: 78%
- ▶ Power Factor: 0.99 (120V) ; 0.94 (230V)
- ▶ Isolation voltage: 4kV



Comparison 60W incandescent – 12W LED lamp
Energy saving Up to 80%
C02 saving 70 kg C02 per lamp/yr

A bright idea for LED luminaries ...



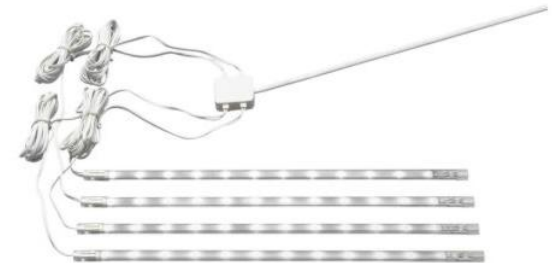
SSL2101
SSL2102

For high efficient isolated and non-isolated mains dimmable LED drivers.

Applications for the SSL2101 and SSL2102

Retrofit LED Lamps

- ▶ SSL2101: to 8W for GU10/E27;
- ▶ SSL2102: up to 18W for PAR38



LED Modules (Mains Isolation / non Isolated)

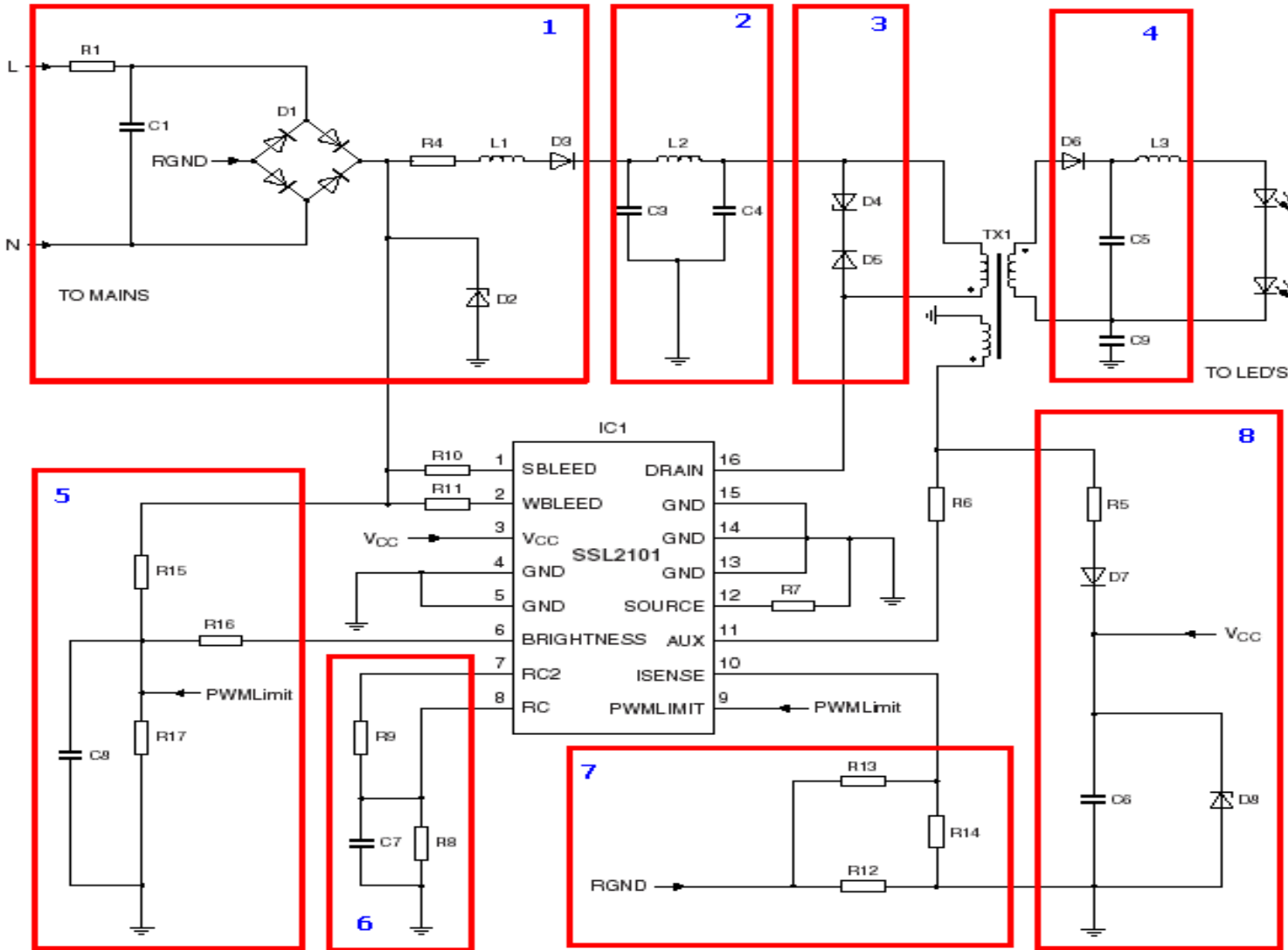
- ▶ SSL2101: up to 15W mains isolated, 0.5A buck convertor (non-isolated)
- ▶ SSL2102: up to 30W mains isolated, 1A buck convertor (non-isolated)

Application schematics LED drivers

Contents

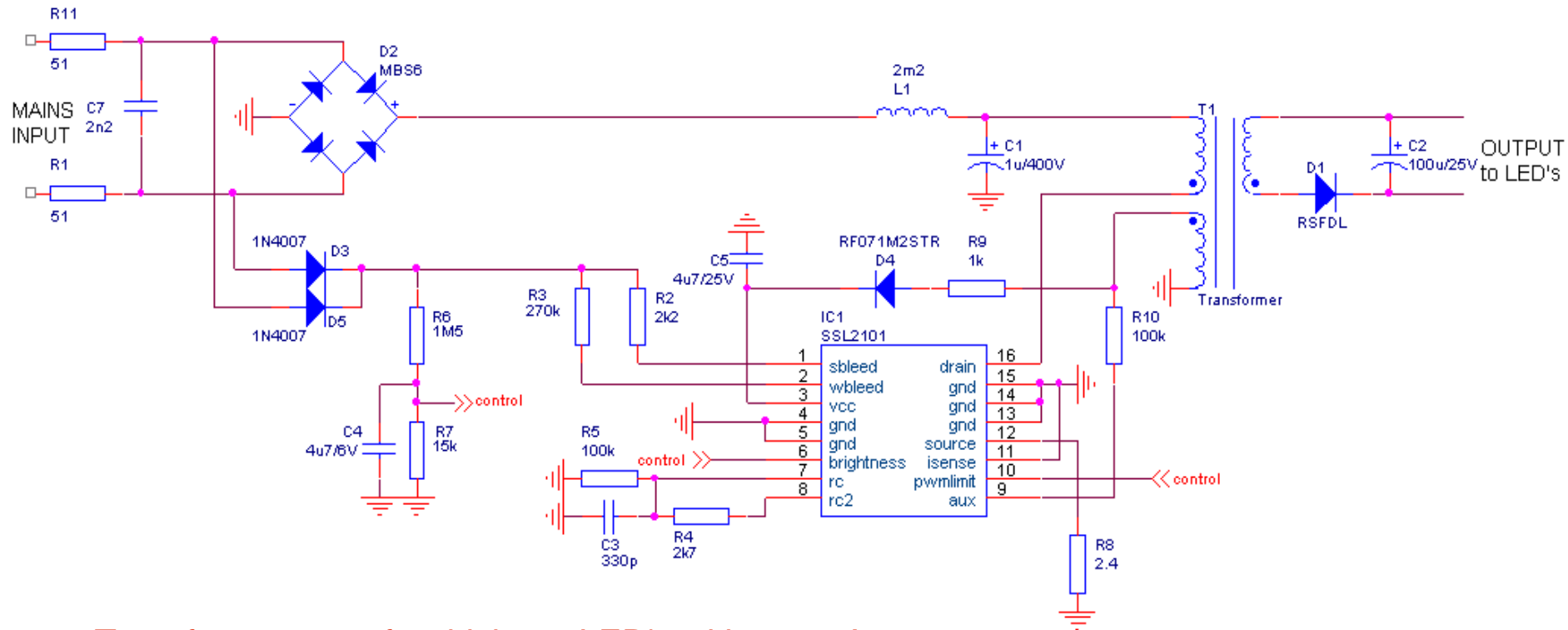
- ▶ Key features
- ▶ Added value
- ▶ Comparison BOM with SSL1523
- ▶ Block and Application diagram
- ▶ SSL2102 versus SSL2101
- ▶ Efficiency features
- ▶ Topologies
- ▶ Feedforward control
- ▶ Current ripple
- ▶ Control inputs
- ▶ Dimmer types

Typical Application Diagram SSL2101



1. Input Circuit
2. Mains Buffer
3. Snubber
4. Output Circuit
5. Dimming
6. Oscillator
7. Bleeder settings
8. Vcc generation

Example 7W mains isolated dimmable LED driver.

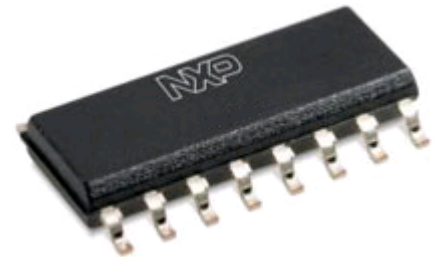


► Transformer spec for driving 4 LED's with 450mA.

- Lprim: 1700 μ H,
- Lsec: 50 μ H
- Ltert: 64 μ H

SSL2101/SSL2102 – Key features

- ▶ Phase cut Dimmable LED driver
- ▶ High integration level, built-in switches
- ▶ High efficient (demo board 77%-73%) at low powers
- ▶ Built-in smart bleeders logic
- ▶ Logarithmic control of light output
- ▶ Based on the robust Starplug series
- ▶ Supports both Flyback and Buck topologies





Added value SSL210x series

- ▶ Efficient current control for dimmable mains LED driving SSL2101 is a voltage controlled IC
- ▶ Incorporating the good parts of the SSL152x family:
 - Valley switching (for minimal switch-on losses)
 - Extensive range of built in protections (e.g. demagnetization - NXP patented)
- ▶ Intelligent bleeder functionality integrated into SSL2101 supporting dimming performance
- ▶ With SSL2101 (plus ext. components) we aim to realize same # of components as with non-dimmable lamp based on SSL152x same form factor could be used for dimmable version
- ▶ Improved Power Factor option on board **pending on selection buffer/filter capacitors**

Dimmable SSL1523 versus Dimmable SSL2101

Comp	Type
K1	Conn 2pin
K2	Conn 2pin
D1	600V 0.8A SDIP4
D2	FR107
D3	8ETH06
D4	FR107
D5	1N4148
D6	P6KE400A
D7	BZX85C6V8
D8	BZX85C15
Q1	STD2N60V
Q2	BC847B SOT223
Q3	BC847B SOT223
C1	100pF 1KV
C2	220nF 400V
C3	470nF 400V
C4	470nF 400V
C5	2U2 63V
C6	2U2 50V 1212
C7	2U2 50V 1212
C8	1N5 50V 0805
R1	Fuse 0.4A 1212
R2	470E 1W
R3	82E 3W
R4	22E 1206
R5	390K 0603
R6	1E 1206
R7	1E 1206
R8	2M2 0603
R9	2K7 0603
R10	1M 1206
R11	220K 0603
R12	150K 0603
R13	1M 1206
R14	6K2 0603
R15	1M 1206
R17	100E 1281
R18	100E 1281
L1	Ferr 6 Turn
L2	220u RM6
L3	Ferr 2x bead
L4	4M7 Toko
IC1	SSL1523 DIP8

Buck topology
 Deep dimmable
 Input = 230VAC
 Output = 12VDC
 LED current = 700mA
 4 LED's = 8.8W

Comparison on eBOM:



SSL1523	SSL2101
43 comp.	30 comp
1.86 Euro	1.90 Euro

Dimming with small size electronics at almost the same total cost !!

Qty	Comp	Type	Volume (mm ³)	Price Estimation (USD/100 pcs)
1	K1	Conn 2pin	2619.5	nn
1	K2	Conn 2pin	2619.5	nn
1	D1	600V 0.8A SDIP	135	4
1	D2	FR107	121.5	2
1	D3	8ETH06	1080	8
1	D4	FR107	121.5	2
1	D5	1N4148	64	0.1
1	D6	P6KE400A	162	8
1	C1	100pF 1KV	126	1
1	C3	470nF 400V	693	14
1	C4	470nF 400V	693	14
1	C5	2U2 63V	270	5
1	C6	2U2 50V 1212	27	2
1	C8	1N5 50V 0805	6	0.3
1	R1	Fuse 0.4A 1212	27	3
1	R3	82E 3W	773.5	1
1	R4	22E 1206	9	0.05
1	R5	390K 0603	1.875	0.04
1	R6	1E 1206	9	0.05
1	R7	1E 1206	9	0.05
1	L1	Ferr 6 Turn	686	5
1	L2	220u RM6	2925	35
1	L3	Ferr 2x bead	256	3
1	L4	4M7 Toko	324	14
1	IC1	SSL2101 SO16	88	70
1	R10	1M 1206	9	0.05
1	R11	10K 0603	1.875	0.04
1	C7	2U2 50V 1212	27	2
1	R3	40K 1W	90	1
1		PMBT5401	12	0.2

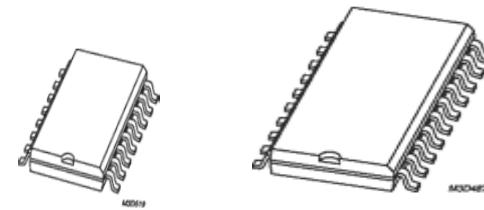
Package selection for SSL2101/SSL2102 :

Package suitable for wave soldering process and for 1.6W power dissipation within customer conditions:

Existing packages :

SO16L / SOT162DA19 : no fused lead

SO20 / SOT163EA42 : no fused leads



SO16L

SO20

Packages definition for thermal performances target :

SO16L / SOT162DA19 basis + **thermal optimization**

SO20 / SOT163EA42 basic + **thermal optimization**

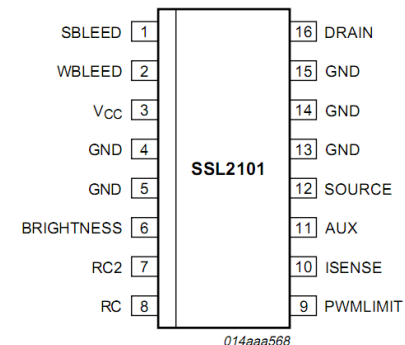
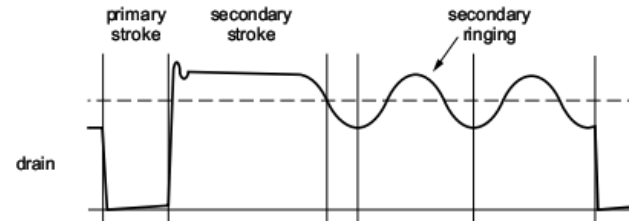


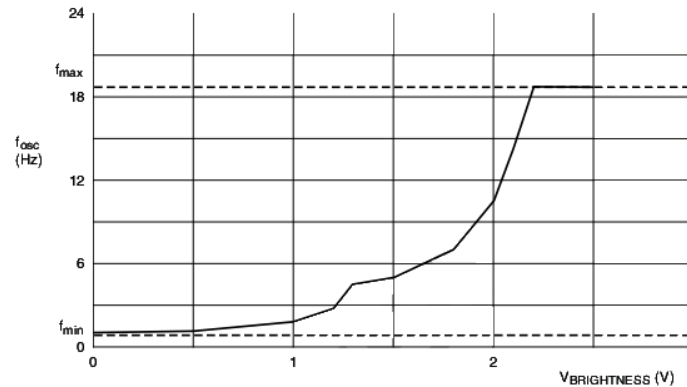
Fig 2. Pin configuration SO16

High Efficiency - Features

- ▶ High Efficiency due to:
 - Valley switching:

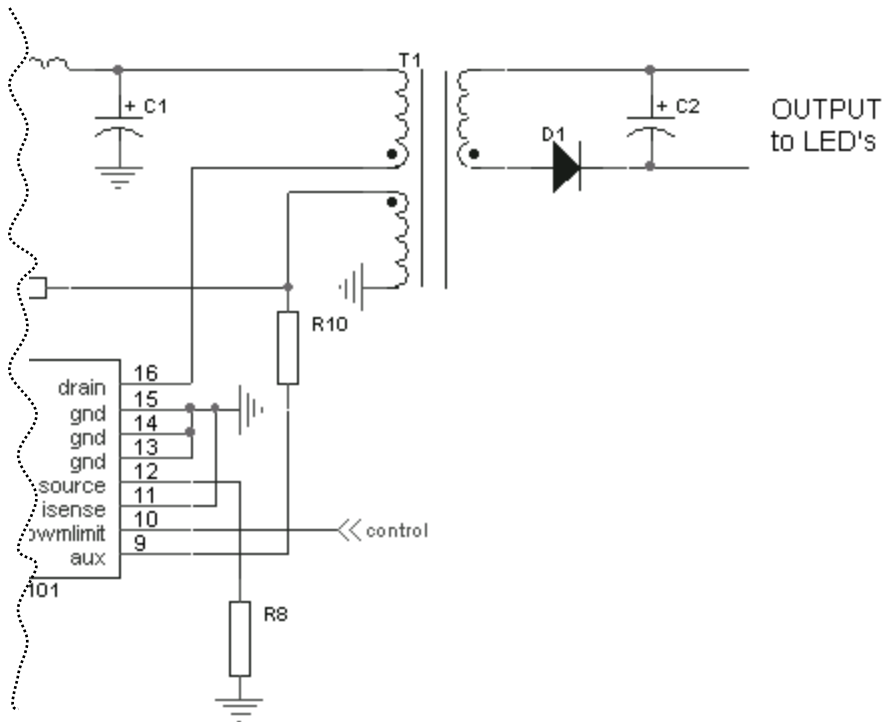


- Demag detection → avoids continuous mode
- Internal Vcc Startup → current switches off when externally powered
- **Frequency reduction mode**

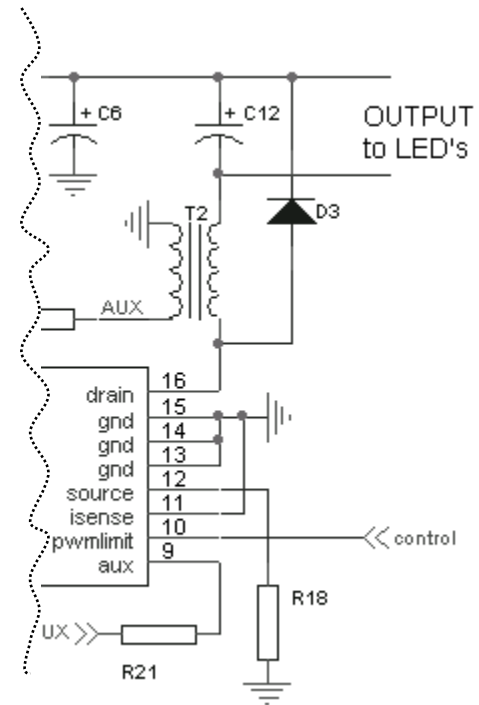


Supported topologies

Flyback



Buck

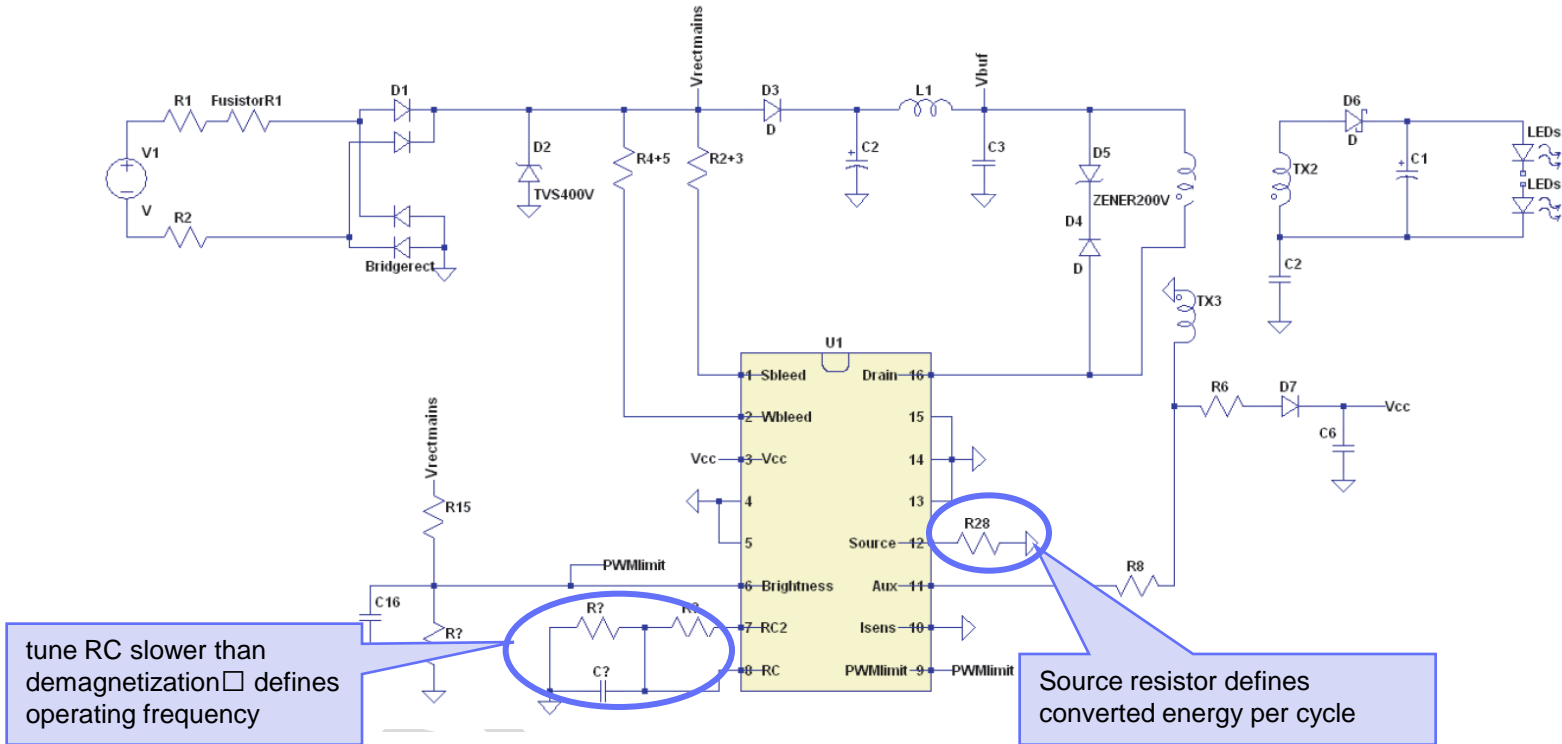


Feed forward control

- ▶ Feed forward control eliminates the need for opto coupler, at the cost of output accuracy
- ▶ Design for constant Power or constant Current
- ▶ Design for High Power Factor

Feed Forward Control: Constant Power

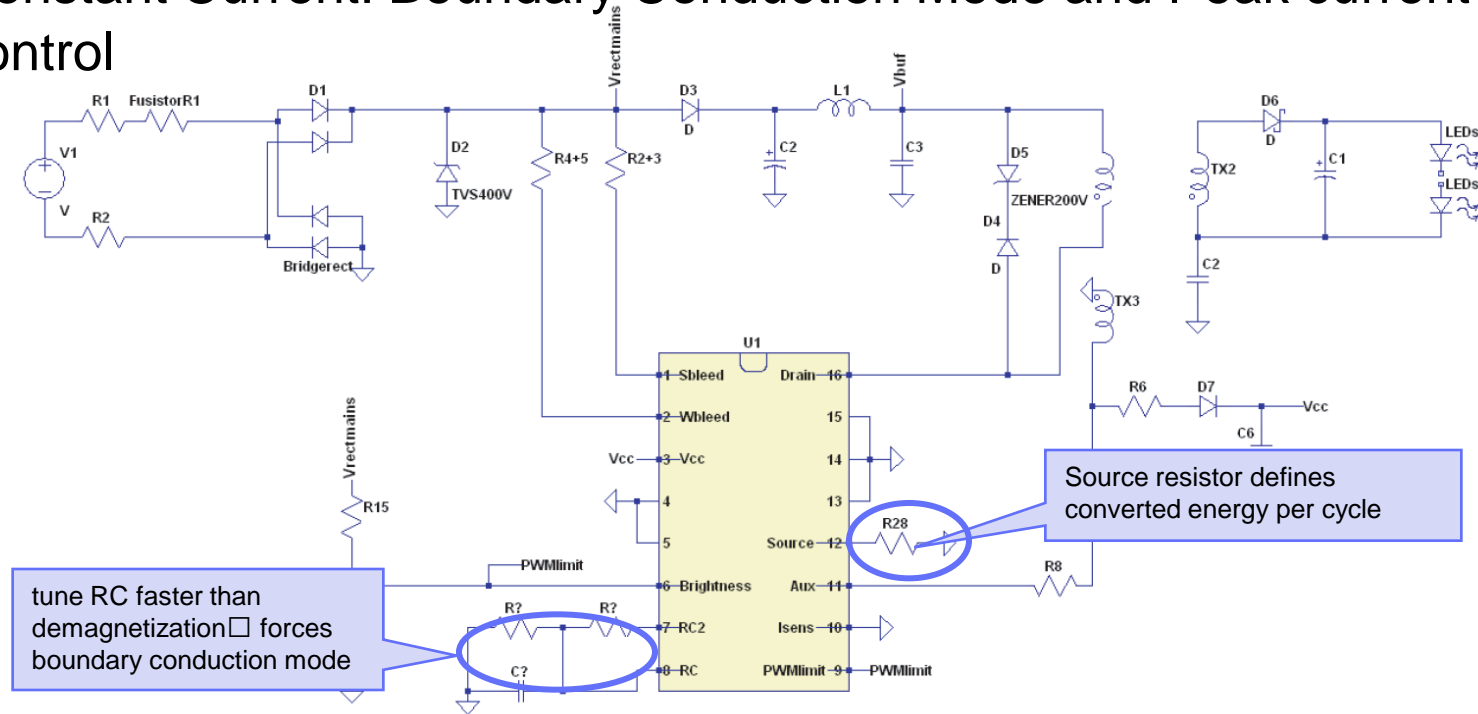
- Constant Power: Fixed frequency and Peak current control



- Output power:
$$P_{out} = f_{operating} \cdot \frac{1}{2} \cdot L \cdot I_{pk}^2$$

Feed Forward Control: Constant Current

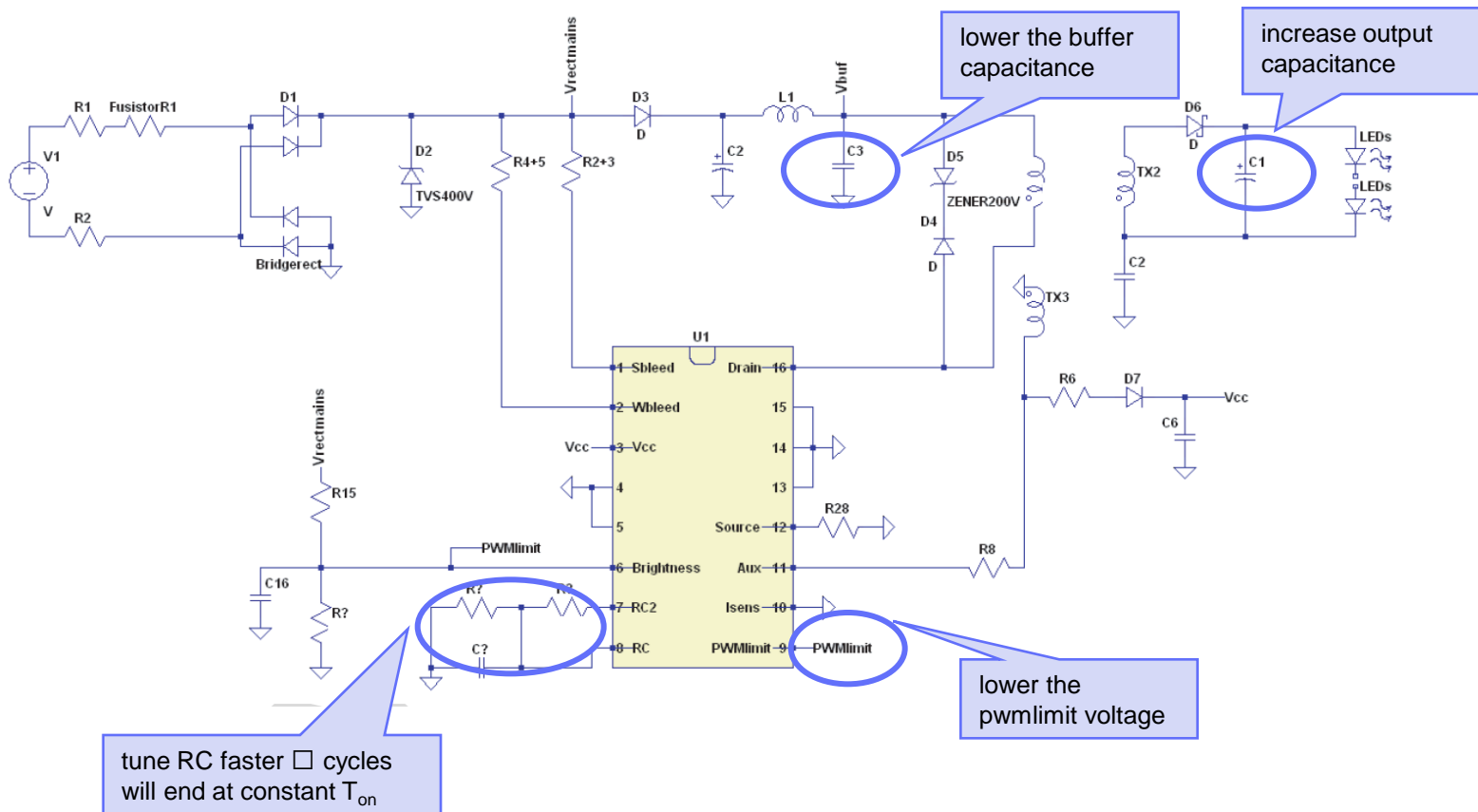
- ▶ Constant Current: Boundary Conduction Mode and Peak current control



- ▶ Output current is partly independent of V_{out} (ratio t_2/T)
- ▶ Output power is limited by source resistor

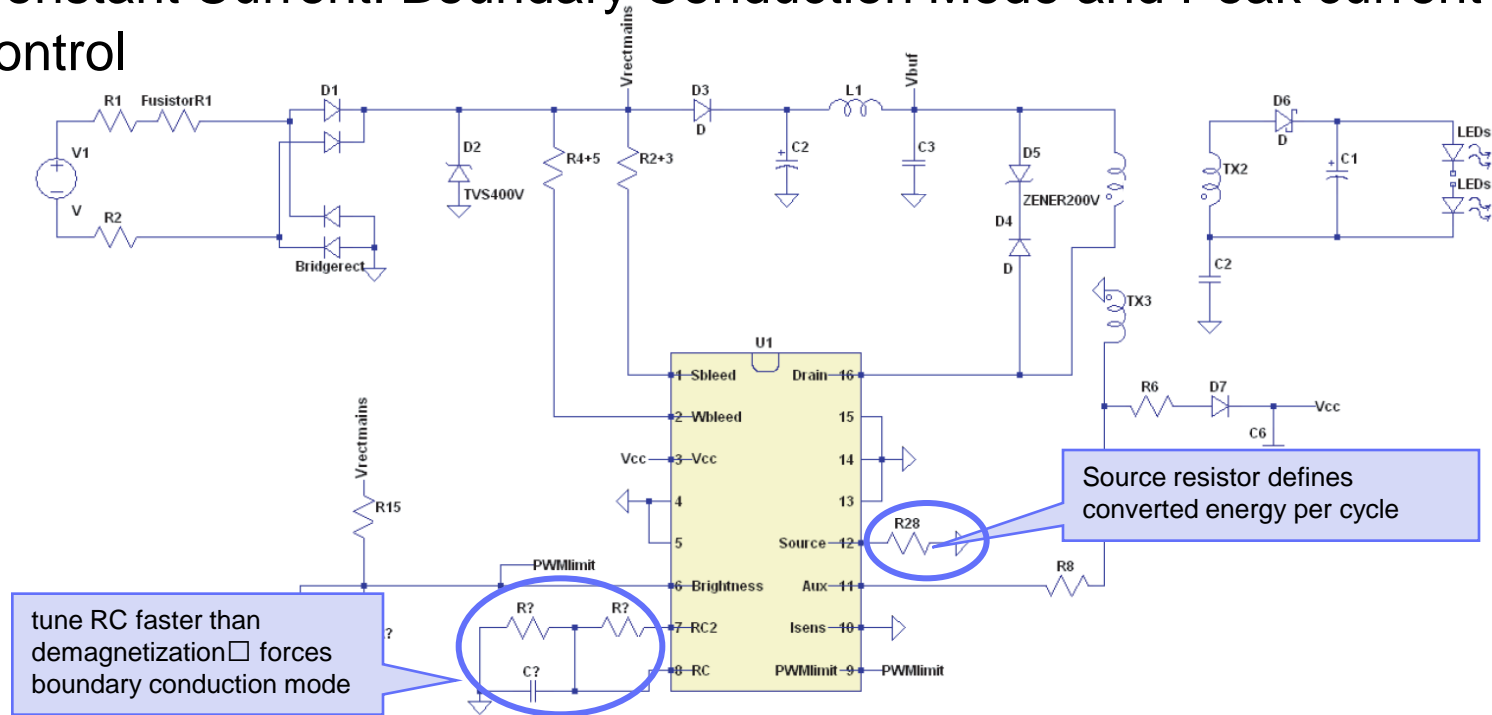
Feed Forward Control: High Power Factor

- ▶ Constant Current: Boundary Conduction Mode and Peak current control



Feed Forward Control: Constant Current

- Constant Current: Boundary Conduction Mode and Peak current control



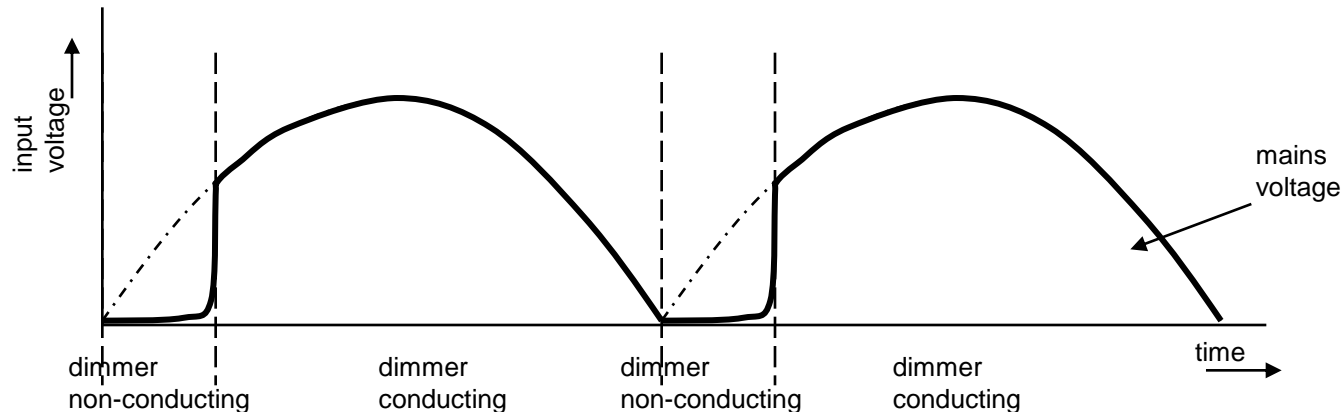
- Output current is partly independent of V_{out} , however dependent on V_{in}



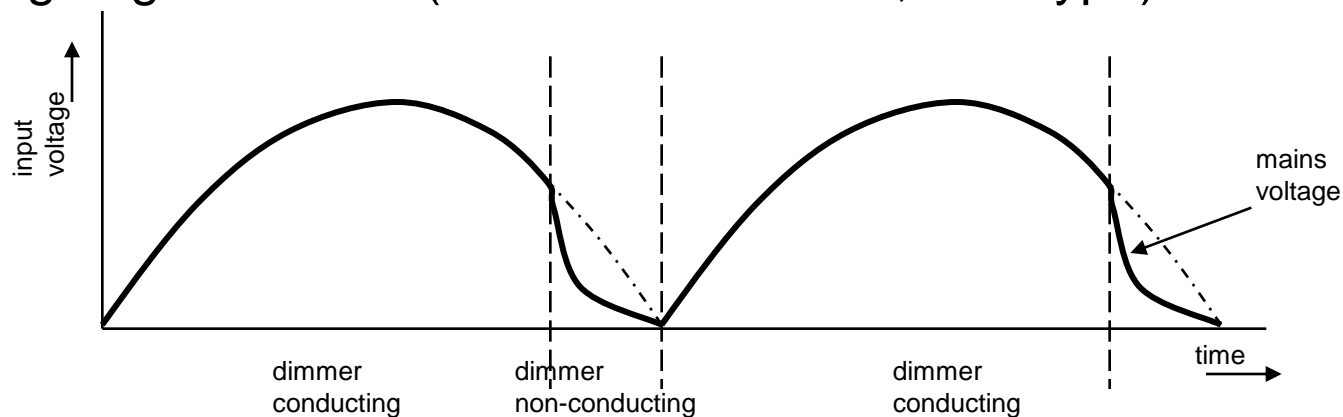
Dimmable

Dimmer types

- ▶ Leading edge dimmers (Triac, or R and L type)

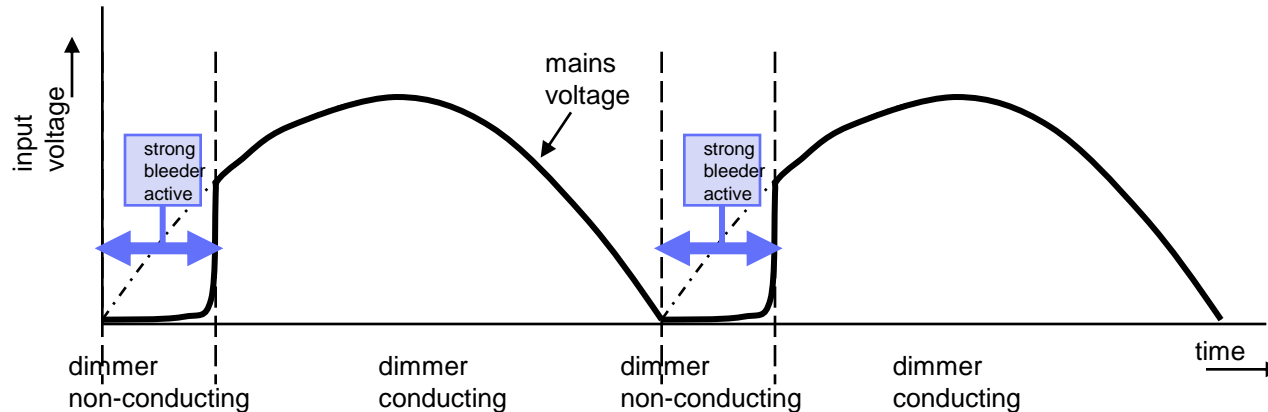


- ▶ Trailing edge dimmers (Transistor dimmers, or C type)

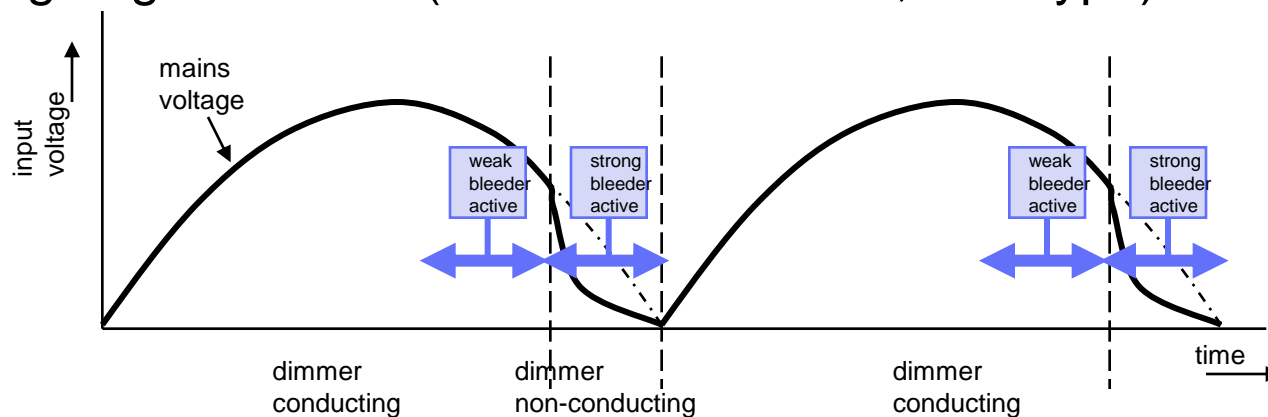


Smart bleeders operation

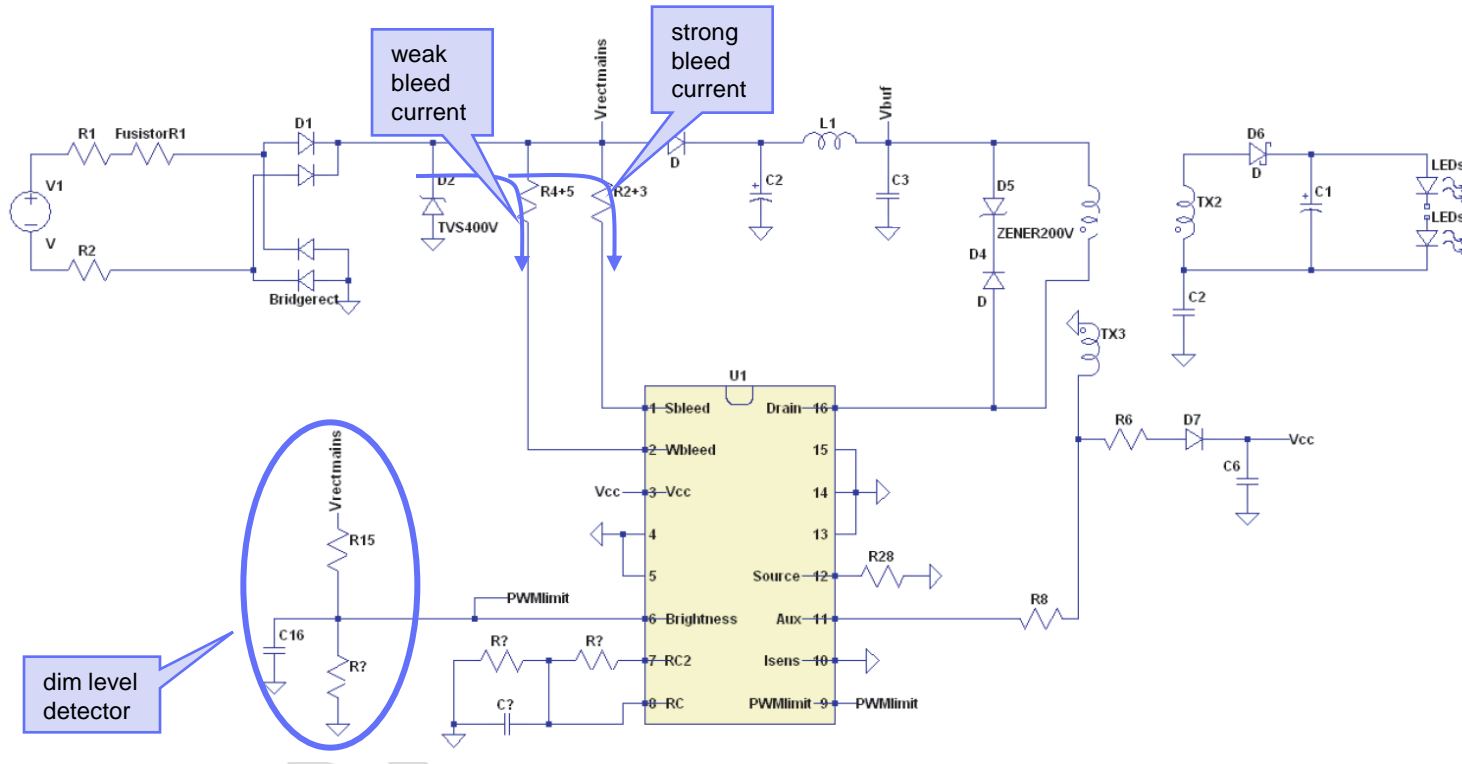
- ▶ Leading edge dimmers (Triac, or R and L type)



- ▶ Trailing edge dimmers (Transistor dimmers, or C type)

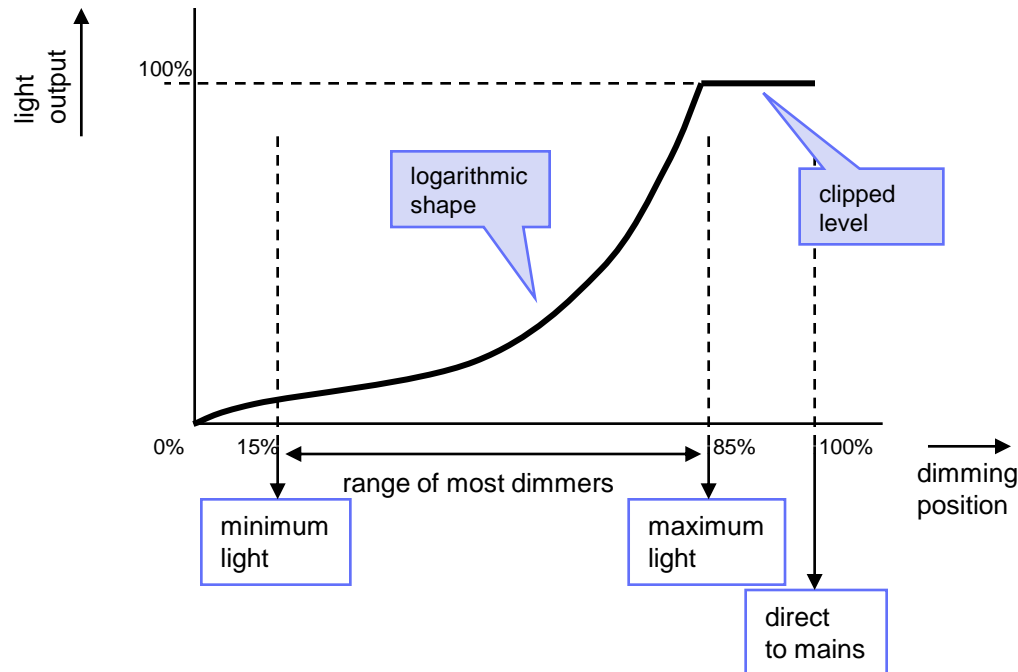


Smart bleeders in circuit



Dimming curves

- ▶ Logarithmic shape is compatible with human eye perception
- ▶ Clipped upper level avoids difference between dimmer @ max position and “direct to mains”
- ▶ Great flexibility in choice of curves, by tuning dim level detector network



Dimmer list

230VAC types			
Brand	Type	Max. Watts	Min. Watts
Japen	FD25	300	?
Dimtronic	MNN303	300	60
Gertronic	EF700	300	20
Ehmann	T20	200	40
Ehmann	T21	200	20
Busch-Jaeger	UJ-212	400	60
Everflourish	EF-O700A	300	50
Ehmann	T10	300	60
Ehmann	T39.01	500	20
Ehmann	T46	315	20
Opus	852.390	400	60
Opus	852.392	500	20
Bush-Jaeger	2250U	600	20
Bush-Jaeger	2247U	500	20
Bush-Jaeger	6519Y	550	40
Gira	1184	400	60
Drespa	0817	315	20
Drespa	815	500	20
Peha	433	300	60
BG	881P	400	60
Legrand	Neptune	300	40
Self	CSD908	300	40

120VAC types		
Brand	Type	Max Watts
Lutron	TG-600PH-WH	600
Leviton	L12-6641-W	600
Leviton	L02-700W	600
Leviton	6602-IW	600
Leviton	6683-W	800
Leviton	R12-6631-LW	600
Cooper	6001	600
Lutron	MIR-600THW-WH	600
Lutron	S-600PH-WH	600
GE	DI61-271	600
GE	DITC61-S71	600
GE	DIT61-71	600
GE	DIB61-71	600

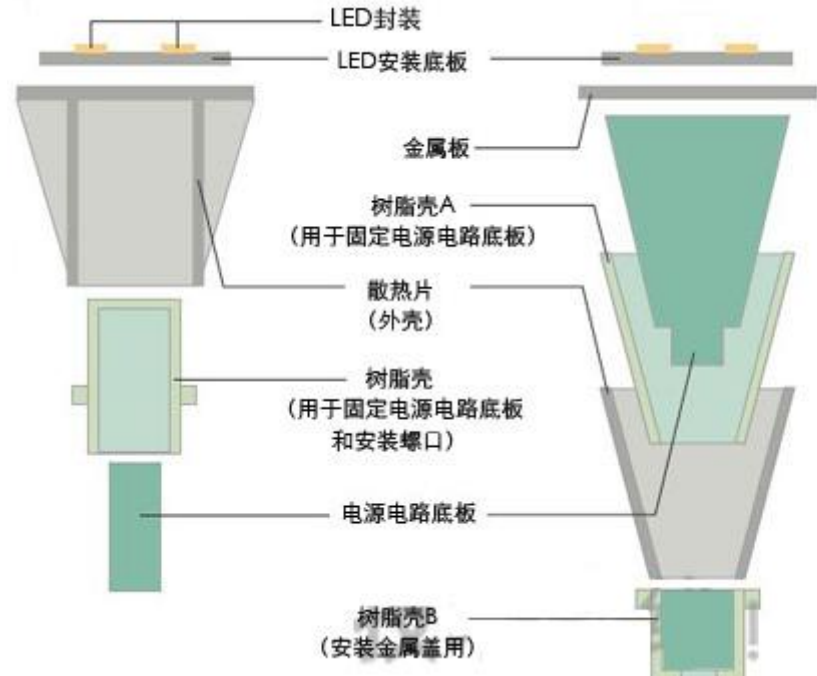
Dimmer list



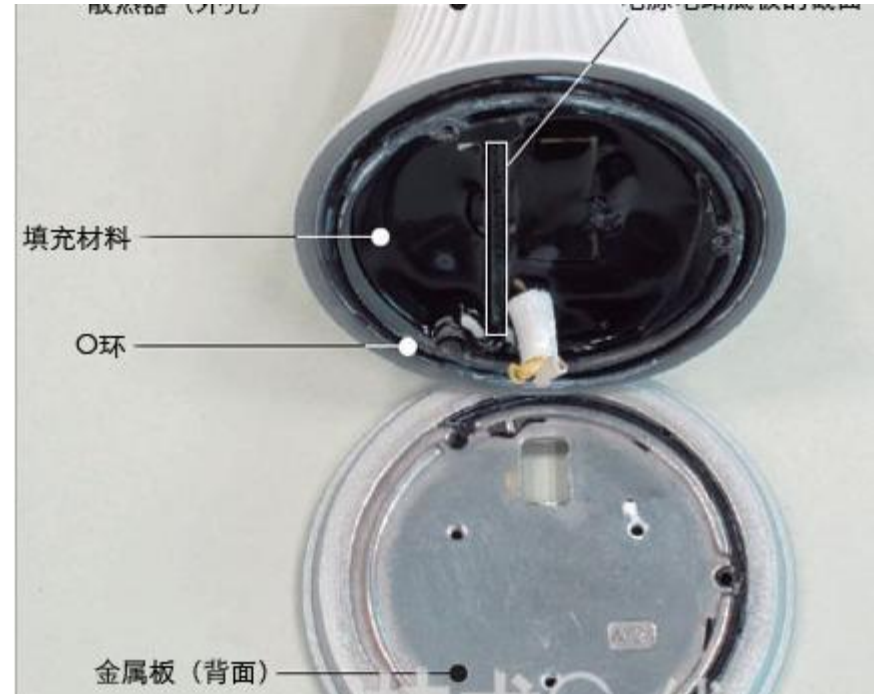
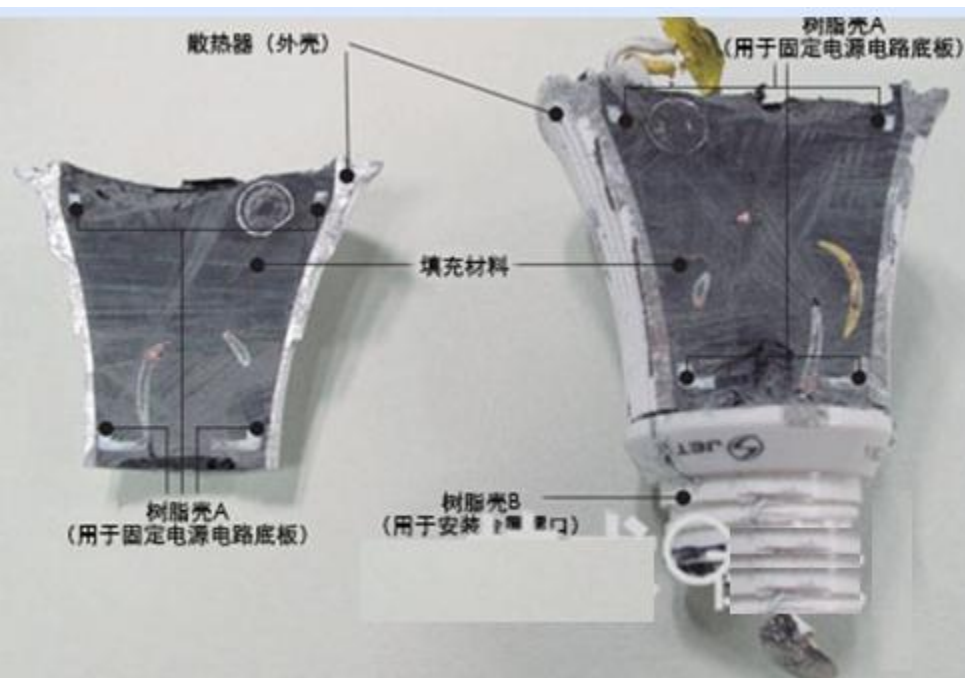


Internal structure

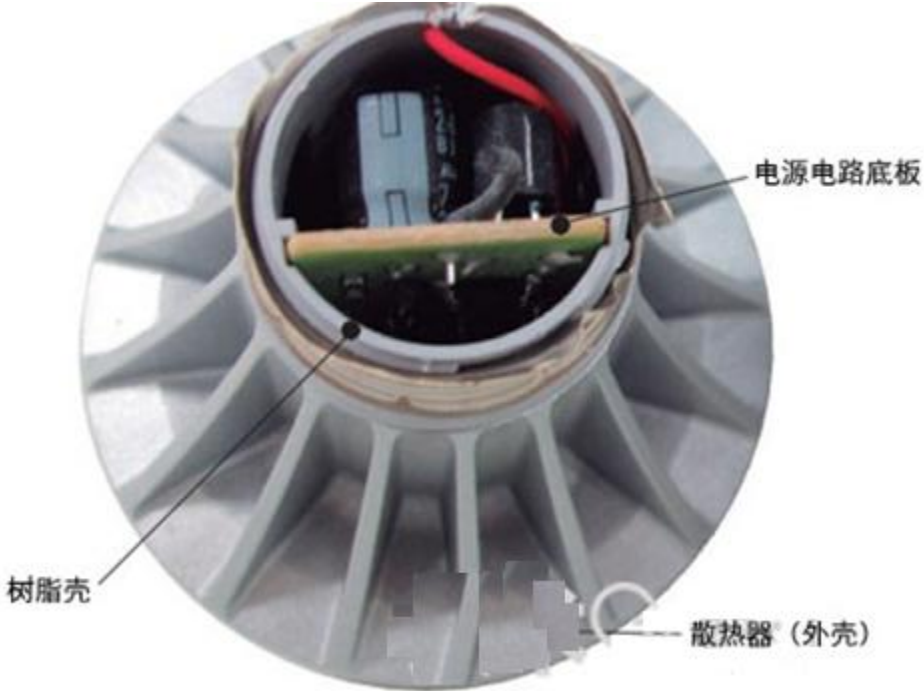
Internal structure-1



Internal structure- 2



Internal structure-3



Street Lighting Solution & Application

The power behind vibrant solid-state lighting

Isolated LED driver with integrated power factor controller



Key features

- ▶ Integrated power factor controller, start-up from mains (70 - 276 VAC)
- ▶ Start-up from mains (no HV bleeder resistor required), Valley switching and demagnetization detection (Fly-back & PFC) to minimize switching losses.
- ▶ Protections: eg. over-voltage, open current control loop, temperature,..

Key Benefits

- ▶ Small form factor
- ▶ High efficiency
- ▶ High safety level

TEA1752T: Street Lighting Solution

Distinctive features

- ▶ PFC and flyback controller integrated in one SO-16 package.
- ▶ Switching frequency of PFC and flyback independent of each other.
- ▶ No external hardware needed **for communication** between the two controllers.
- ▶ High level of integration, resulting in a very low external component count.
- ▶ Fast latch reset function implemented
- ▶ Universal mains support
- ▶ Secondary current regulation and/or voltage regulation

75W TEA1752 reference board



Triac Dimmable 75W TEA1752

Current output:	24 LEDS * 3 strings @350mA/string = 1050 mA	
Input Voltage	210V	230 V
Input Current	0.46 A	0.43 A
Input Power	92.8 W	94 W
Output Power	75 W	77 W
Power Factor	0.96	0.95
Efficiency	81%	82 %

Note: Experimental setup with non-optimized transformer and PFC coil.

Conclusion

▶ Strategy


- To grow the IC solution market share by new features and adjusted lower system cost
- Focus on CFL, SSL, TL, & HID.

▶ LED lighting(SSL2101/02) highlights

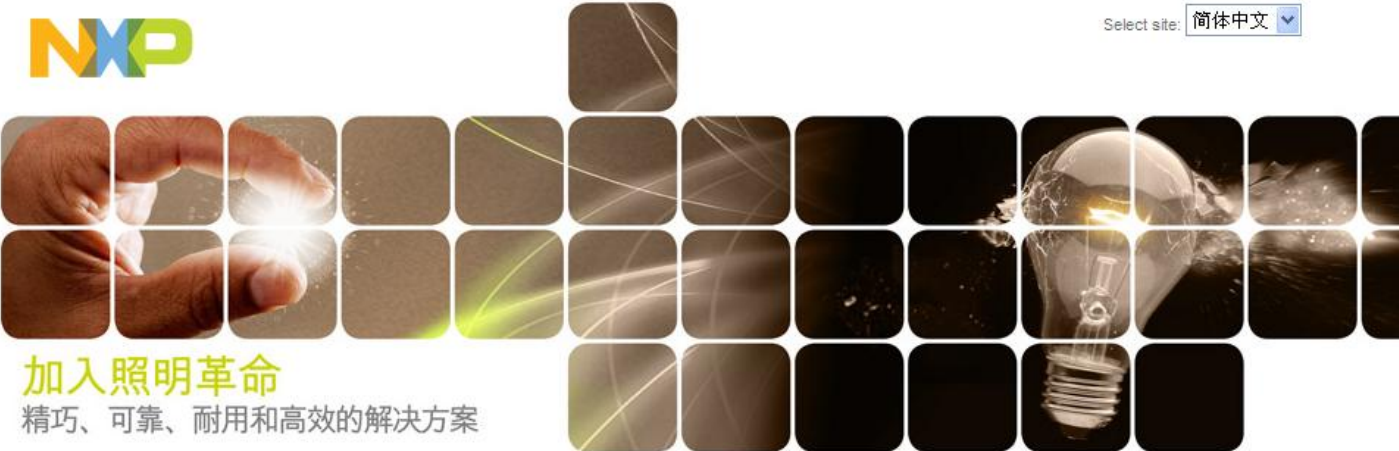
- Deep Dimming (down to 1%) without noise
- Very compact Size – meets Part 20 form factor
- Fewer external components due to high integration level, ideal for small form-factor applications with closed casing.
- Human eye corrected linear dimming curve
- High-efficiency (up to 80%) & high PF value (up to 0.9)

Join the Lighting Revolution

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加入照明革命
精巧、可靠、耐用和高效的解决方案

▼ 主页 ▶ 节能荧光灯 ▶ 固态照明 ▶ 高强度放电/管灯

精巧、可靠、耐用和高效的解决方案

100多年来，白炽灯一直是人类照明的主力军。然而，它们正逐步退出历史舞台，因为在全球气候变化和能源紧张背景下，寻求更节能的照明方案已是众心所向。不过，新方案需要有更精密的驱动和控制电子产品。

于是，恩智浦有了大展身手的舞台——推出满足消费需求的集成芯片解决方案，为开发高品质紧凑型荧光灯(CFL)和改良LED灯提供可能，让大家都能享受这场照明革命带来的成果。



观看欢迎视频

免费样品和资料

设计问答

顺畅地实现绿色环保

