TOSHIBA
Leading Innovation

System Catalog July 2013

LED Lighting Solutions

SEMICONDUCTOR & STORAGE PRODUCTS

http://www.semicon.toshiba.co.jp/eng

Semiconductor Devices for LED Lighting Applications

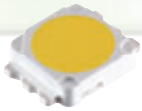
LED lamps are rapidly replacing fluorescent and other conventional lamps. This is being spurred by increasing demand for environmentally friendly lighting. Toshiba offers a wide variety of semiconductor devices for LED lighting applications, ranging from LED light sources to LED drivers, as well as total system solutions.
Moreover, Toshiba provides suggestions for improving LED lighting system designs. Design considerations encompass energy saving, feature enhancements such as dimming control and color matching, form factor reduction and system design simplification.

Toshiba Semiconductor Devices for LED Lighting Applications

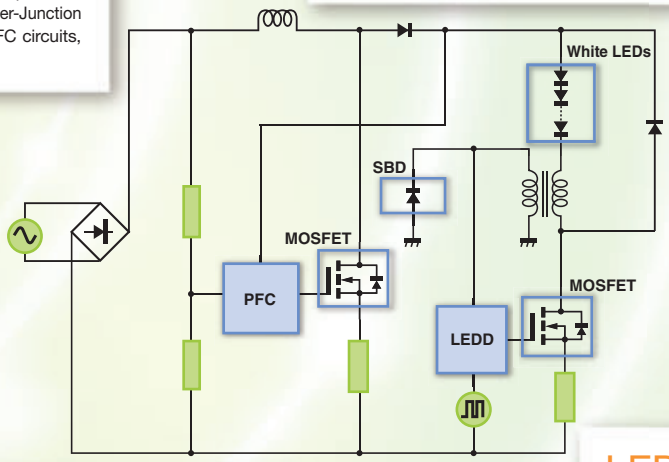
Power MOSFETs

Toshiba offers newly designed Power-MOSFETs with a V_{DSS} ranging from 250 V to 600 V in small surface-mount and through-hole packages. These Power-MOSFETs are ideal for LED dimming control. Toshiba provides the DTMOS IV Series with the Super-Junction structure that is ideal for use in PFC circuits, etc.

White LEDs



Toshiba's white LEDs are fabricated using the latest GaN-on-Si process that epitaxially grows a gallium nitride (GaN) layer on top of large silicon (Si) wafers with a diameter of 8 inches (200 mm). These white LEDs are available in a wide range of packages suitable for various lighting applications.



PFC Control ICs

PFC control ICs help reduce possible power factor degradation caused by harmonic current and prevent introduction of electrical noise onto the AC mains.

LED Drivers

Toshiba offers LED drivers for both isolated and non-isolated applications. The LED driver provides stable current and high efficiency to LEDs in conjunction with external parts.

Contents

White LEDs

Toshiba's white LEDs LETERAS™ are fabricated using a state-of-the-art 8-inch silicon wafer process technology. Toshiba is expanding its LETERAS portfolio to meet diverse customer needs.

LETERAS™

Migrating from Sapphire LEDs to Silicon GaN-on-Si, a Source of Light for the World

Application Examples (Light Sources)

GaN-on-Si Process Technology Ideal for Lighting Applications

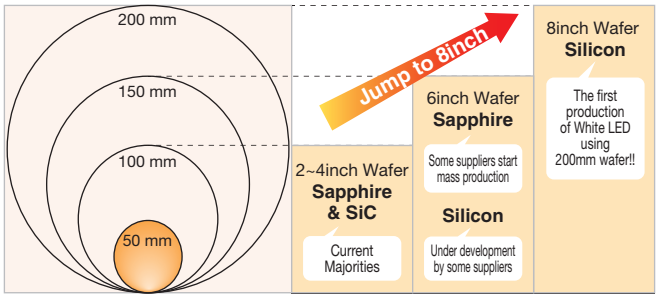
New technologies aimed at the lighting market

GaN-on-Si technology
Mass production using large-diameter (200-mm) wafers

Silicon (Si) wafers
Replacement of sapphire wafers with silicon wafers

LETERAS™ leverages Toshiba's core technologies in the fields of silicon process, assembly and simulation. Our GaN-on-Si technology will help accelerate the replacement of conventional lighting systems with LED lights.

Wafer Size Comparisons



Packaging

	1 W	0.6 W	0.2 W
Applications			
Packages	▸Available  6.4 x 5.0 mm	▸Under development  3.5 x 3.5 mm	▸Under development  3.0 x 3.0 mm	▸Under development  3.0 x 1.4 mm

Product Lineup

Power Output	Recommended Series	Package Size	Status	Key Applications
1 W	TL1F1-xx Series	6.4 × 5.0 mm	▸Available	Streetlights, outdoor security lights, downlights, etc.
	TL1L1-xx Series	3.5 × 3.5 mm	▸Under development	Road lights, outdoor security lights, LED bulbs, etc.
0.6 W	TL3GA-xx Series	3.0 × 3.0 mm	▸Under development	LED bulbs, ceiling lights, etc.
0.2 W	TL2FK-xx Series	3.0 × 1.4 mm	▸Under development	Straight-tube LED lamps, base lights, etc.

For details of these products, contact your local Toshiba sales representative.

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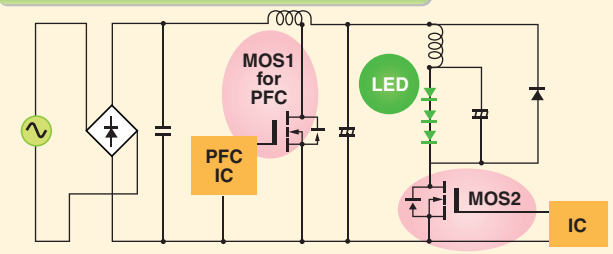
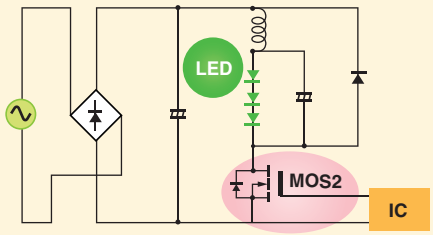
LED Light Circuit Examples

Non-isolated circuit example 1



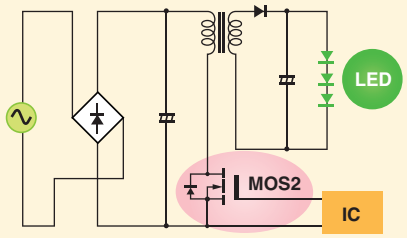
MOS1 for PFC: DT-MOS of TK7P60W or TK8P60W
MOS2: π-MOSVII of TK4P60DA
Driver IC: TB62D901FNG
PFC IC: TB6819AFG
LED: TL1F1-xxx Series

Non-isolated circuit example 2



MOS2 for AC100V: π-MOSVII of TK8P25DA
AC100~200V: π-MOSVII of TK5P53D
Driver IC: TB62D901FNG
LED: TL1F1-xxx Series

Isolated circuit example 3



MOS2: π-MOSVII of TK5P65D
Driver IC: TB62D902FG
LED: TL1F1-xxx Series

DPAK / New Power Mold

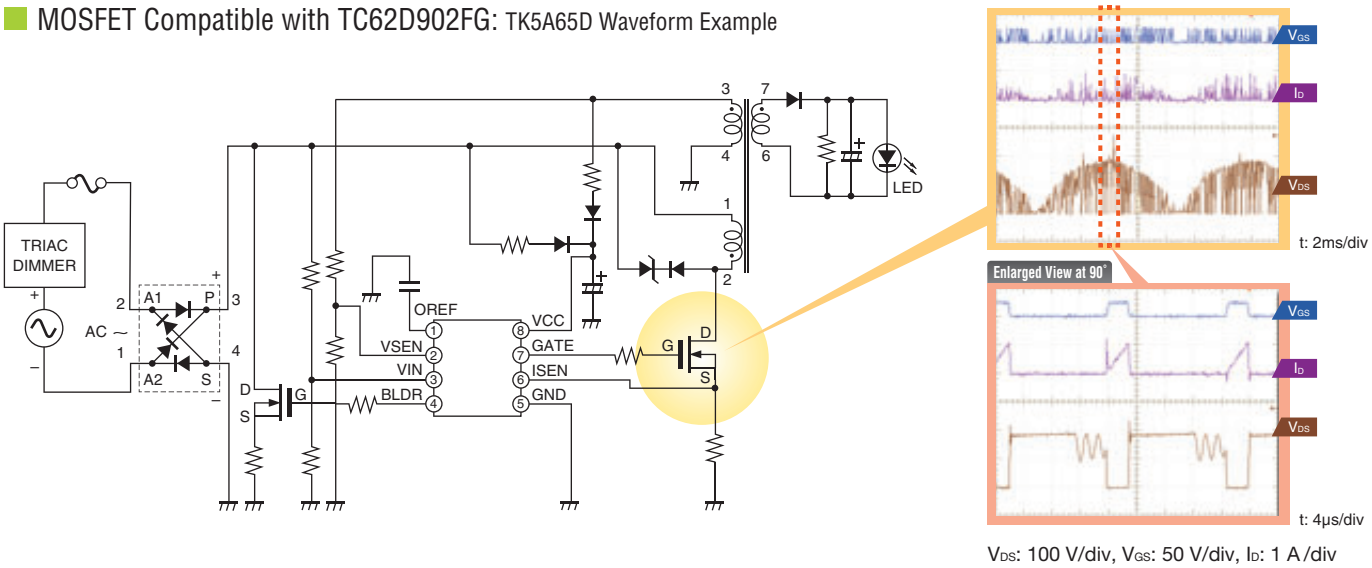
TO-220SIS

Product Lineup

Part Number	$R_{DS\ (ON)}$ (Ω) max	I_D (A)	V_{DSS} (V)	Package	Design
TK8P25DA	0.5	7.5	250	DPAK	π-MOS VII
TK13P25D	0.25	13			
TK2P60D	4.3	2	600	New Power Mold	
TK4P60DA	2.2	3.5		DPAK	
TK4P60DB	2.0	3.7			
TK4P60D	1.7	4			
TK10A60D	0.75	10		TO-220SIS	
TK12A60D	0.55	12			
TK2A65D	3.26	2	650		
TK5A65D	1.43	5			
TK7A65D	0.98	7			
TK12A65D	0.54	12			

Part Number	$R_{DS\ (ON)}$ (Ω) max	I_D (A)	V_{DSS} (V)	Package	Design
TK5P60W	0.9	5.4	600	DPAK	DT-MOS IV
TK6P60W	0.82	6.2			
TK7P60W	0.6	7			
TK8P60W	0.5	8			
TK10P60W	0.43	9.7			
TK12P60W	0.34	11.5			
TK7A60W	0.6	7		TO-220SIS	
TK8A60W	0.5	8			
TK10A60W	0.38	9.7			
TK12A60W	0.3	11.5			
TK16A60W	0.19	15.8			
TK20A60W	0.155	20			

MOSFET Compatible with TC62D902FG: TK5A65D Waveform Example



VDS: 100 V/div, VGS: 50 V/div, ID: 1 A/div

Diodes

Toshiba has added Power Schottky Barrier Diode (SBDs) fabricated with a new process to the small- to medium-power lineup. The new SBDs provide low V_{FM} and low I_{RRM} due to a new process. These SBDs are ideal for use as a FWD and for the protection of the sensor circuit in a control IC.

US-FLAT™ S-FLAT™ USC

Product Lineup

1 Rectifier

Part Number	Feature Low V_{FM}, low I_{RRM}	Forward current (AV) $I_{F(AV)}$	Repetitive peak reverse voltage V_{RRM}	Package
CRG04	1.1 V (max) / 10 μA (max)	1 A @Ta = 66°C	600 V	S-FLAT™

2 Schottky Barrier Diodes

Part Number	Feature Low V_F, low I_R	Average rectified current I_O	Reverse voltage V_R	Package
CUS551V30	0.47 V (max) / 0.1 mA (max)	0.5 A	30 V	USC
Part Number	**Feature Low V_{FM}, low I_{RRM}**	**Forward current (AV) $I_{F(AV)}$**	**Repetitive peak reverse voltage V_{RRM}**	**Package**
CUS10I30A	0.39 V (max) / 0.06 mA (max)	1 A @Ta = 44°C	30 V	US-FLAT™
CUS10I40A	0.49 V (max) / 0.06 mA (max)	1 A @Tℓ = 118°C	40 V	US-FLAT™
CUS04	0.58 V (max) / 0.1 mA (max)	0.7 A @Ta = 27°C	60 V	US-FLAT™

3 Zener Diodes

Part Number	Feature	Power dissipation P	Zener Voltage V_Z (Min/Max)	Package
CRY62 ~ CRZ47	Extensive lineup 6.2 V to 47 V (22 products)	700 mW	—	S-FLAT™
(example) CRZ18	V_Z=18.0 V (typ.)		16.2 V ~ 19.8 V	

4 High-Efficiency Diodes

Part Number	Reverse recovery time T_{rr}	Average forward current $I_{F(AV)}$	Repetitive peak reverse voltage V_{RRM}	Package
CMH05	50 ns (max)	1 A @Tℓ = 131°C	400 V	M-FLAT™
CMH02		3 A @Tℓ = 87°C		

5 Switching Diodes

Part Number	Reverse recovery time T_{rr}	Average forward current I_O	Reverse voltage V_R	Package
1SS403	10 ns (typ.)	0.1 A	200 V	USC

TB62D901FNG Non-isolated AC/DC step-down converter

Features

Suitable for various kinds of applications

(1) Can be used for various applications with constant-current control
Supports Frequency self-adjustment systems, critical-conduction-mode (CRM) systems, and constant off-time systems

(2) Stable LED current
Frequency self-adjustment systems eliminates the need to change the constants of external parts according to the number of LEDs and the input voltage.

Reduces the external part count

Constant off-time systems

Supports various dimming control methods

PWM dimming, linear dimming

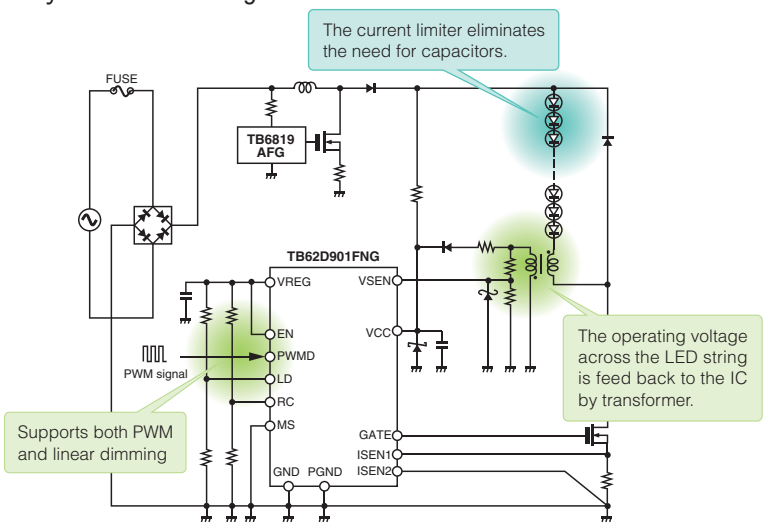
Protection features

Thermal shutdown, overcurrent detection, overvoltage detection, undervoltage lockout, ISEN terminal open detection

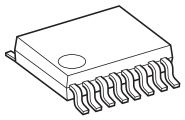
The IC standby function reduces current consumption when LEDs are off.

Setting the EN signal Low disables IC operation.
Standby current consumption: 0.8 mA (max)

System Circuit Diagram



External Appearance

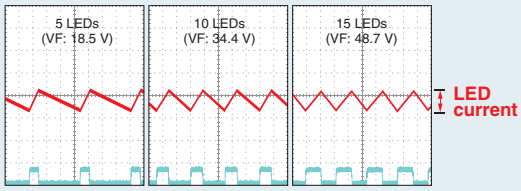


SSOP16-P-225-0.65B

Stable LED current

Frequency self-adjustment system

A frequency self-adjustment system delivers stable LED current, regardless of the number of driven LEDs.



An automatic frequency control system provides a low switching swing whose peak is close to the average LED current.
(LEDs with low rated values can be used.)

TC62D902FG Offline isolated flyback LED controller

Features

Isolated flyback LED controller

Triac dimmable

Built-in PFC function

1 converter PFC

Photocoupler-less

Requires fewer external components and provides improved current accuracy

Valley switch

Improves efficiency and reduces EMI noise

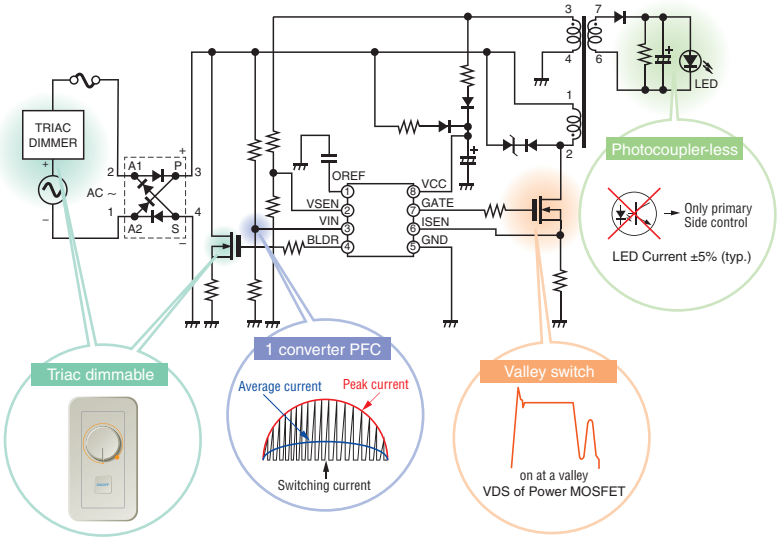
Protection features

Undervoltage lockout overcurrent detection, VIN overvoltage detection, sense resistor short detection at startup, sense wiring open detection, overtemperature detection, output LED open/short detection

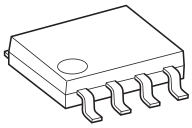
Small package

SOP8-P-225-1.27

System Circuit Diagram



External Appearance



SOP8-P-225-1.27

TB6818FG PFC control for Continuous-Conduction Mode (CCM)

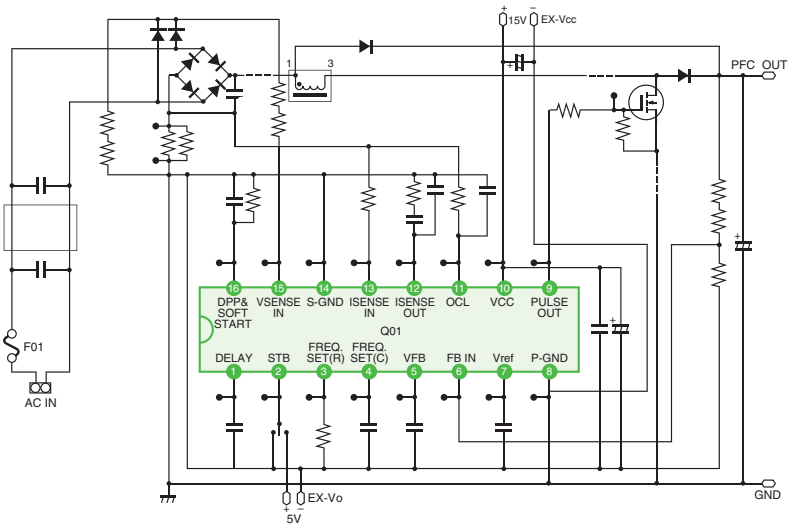
Designed for large-screen LCD/PDP and general power supply board applications	• Recommended for a power supply of over 200 W
Allows fast start-up while protecting the FET	• The TB6818FG has a soft-start circuit synchronous to the rectified voltage. This offers the combination of FET protection and fast start-up • Helps reduce the humming noise emitted by the PFC transformer

Features

- **Operating Voltage Range** 8.4 V (min) ~ 26 V (max)
- **Starting voltage** 10.0 V (typ.)
- **Mutes output pulse at startup**
- **Reduces the humming noise emitted by the PFC transformer**
- **Maximum drive current** 1.0 A (typ.)
- **Current consumption in standby mode** 250 μA (typ.)
- **Remembers operation status in the event of a power interrupt**
- **Various protection circuits**

  DC input overvoltage protection (OVP-1),
  PFC output overvoltage protection (OVP-2), undervoltage lockout (UVLO), feedback loop open detection (FOD), thermal shutdown (TSD)
- **Package** SOP16 (1.0-mm lead pitch)

System Circuit Diagram



The detectable AC power interrupt period is freely programmable via the capacitor connected to pin 1.

TB6819AFG PFC control for Critical-Conduction Mode (CRM)

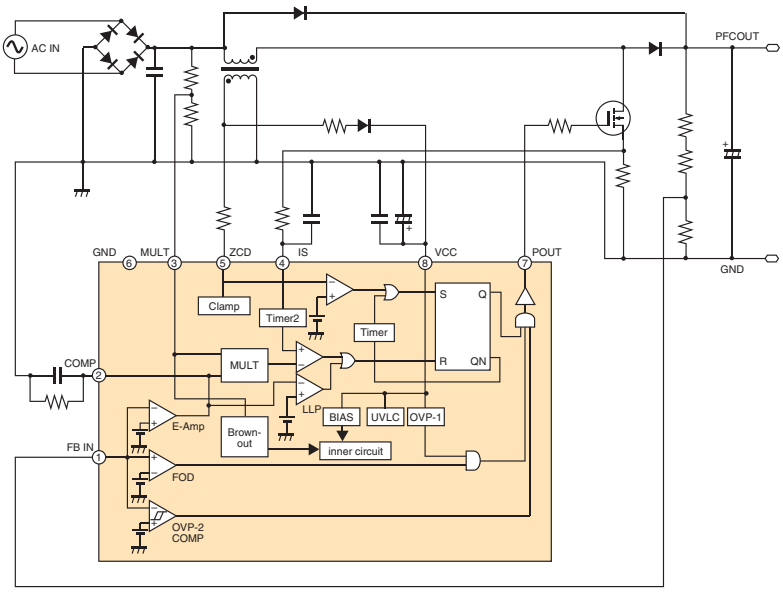
Designed for small- to medium-screen LCD, general and lighting power supply board applications	• Recommended for a power supply of less than 200 W

Features

- **Maximum rated supply voltage** 25 V
- **Operating voltage range** 10 V (min) to 25 V (max)
- **Operating current** 4 mA (typ.)
- **Industry-standard pin assignment**
- **Output voltage control under light-load conditions**
- **Various protection circuits**
- **DC Input overvoltage protection Limited to 25 V**
- **PFC Output overvoltage protection (OVP-2)**
- **Undervoltage lockout (UVLO)**
- **Feedback-loop open detection (FOD)**
- **Thermal shutdown (TSD)**
- **Brownout protection (BOP)**

  The TB6819AFG can be put in standby mode by lowering the voltage at the MULT pin to save system standby power.
- **Package** SOP8 (1.27-mm lead pitch)

System Circuit Diagram



When the AC input voltage is lower than a threshold, the TB6819AFG enters standby mode, reducing standby power consumption.

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LED Lighting Solutions