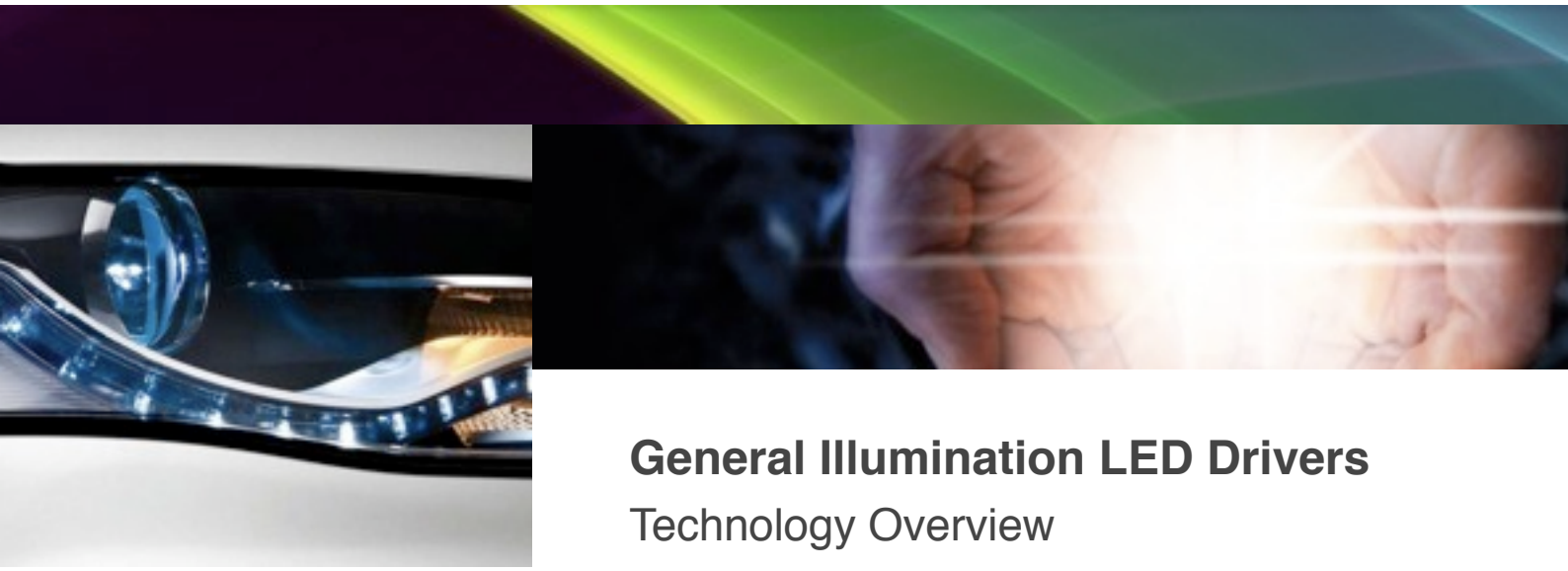
LED LIGHTING APPLICATION SOLUTION

2009. V01



General Illumination LED Drivers

Technology Overview

Product Highlights

Application Information

Design Examples

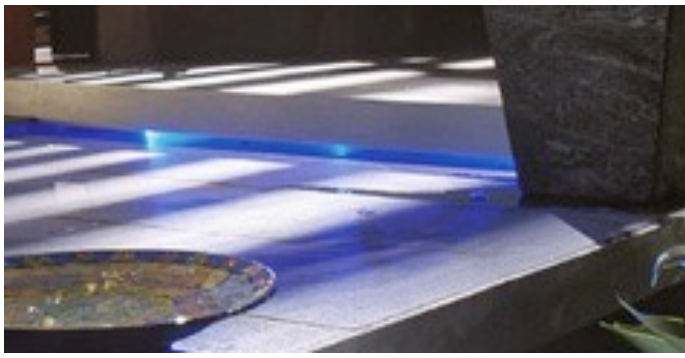
www.taiwansemi.com.tw

Overview

Regardless of type, color, size or power, all LEDs work best when driven with a constant current. LED manufactures specify the characteristics such as lumens, beam pattern, color of their devices at a specified forward current not a specific forward voltage.

Most power supply ICs are designed to provide constant voltage output over a range of current, hence it can be difficult to ascertain which parts will work for a given application from the device datasheet information.

With an array of LEDs, the main challenge is to ensure every LED in the array is driven with the same current. Placing all the LEDs in a series string ensures that exactly the same current flows through each device.



LED Drivers Select Table

Boost (Step-up) WLED Drivers

Part Number	VIN Range (V)	VOUT Range (V)	ISW (A)	Frequency	Dimming	Package	
TS1937	2.5 ~ 20	Up to 36	0.32	1.2MHz	YES	SOT-25	
TS19370	2.5 ~ 20	Up to 30	0.32	1.2MHz	YES	SOT-26	
TS19371	2.5 ~ 20	Up to 30	0.65	1.2MHz	YES	SOT-26	

Buck (Step-down) WLED Drivers

Part Number	VIN Range (V)	VOUT Range (V)	ISW (A)	Frequency	Dimming	Package	
TS19372	6 ~ 40	Up to 36	0.3	180kHz	NO	SOT-25	
TS19373	6 ~ 40	Up to 36	0.8	180kHz	NO	SOT-25	

AC to DC WLED Drivers

Part Number	VIN Range (V)	IOUT	ISW (A)	Frequency	Dimming	Package	
✱ TS19450	8 ~ 450	External MOSFET	0.165	120kHz	YES	SOP-8	
✱ TS19451	20 ~ 400	Internal MOSFET	0.03	120kHz	NO	SOT-89	

✱ Under Development

Application Field Information

TS1937CX5

TS19370CX6, TS19371CX6

TS19372CX5, TS19373CX5

TS19450CS, TS19451CY

Boost (Step-up) WLED Driver

Boost (Step-up) WLED Drivers

Part Number	VIN Range (V)	VOUT Range (V)	ISW (A)	Frequency	Dimming	Package	
TS1937	2.5 ~ 20	Up to 36	0.32	1.2MHz	YES	SOT-25	
TS19370	2.5 ~ 20	Up to 30	0.32	1.2MHz	YES	SOT-26	
TS19371	2.5 ~ 20	Up to 30	0.65	1.2MHz	YES	SOT-26	

Products Overview

TS1937CX5
Boost (Step-up) WLED Driver

Description:

The TS1937 is a step-up DC/DC converter specifically designed to drive white LEDs with a constant current. The device can drive 2 ~ 12 LEDs in series from a Li-Ion cell. Series connection of the LEDs provides identical LED currents resulting in uniform brightness and eliminating the need for ballast resistors. The output capacitor can be as small as 0.22μF which can saving spaces.

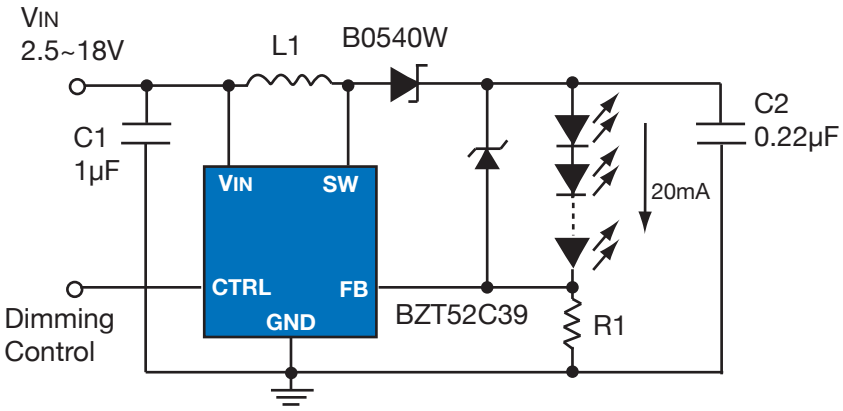
A low 95mV feedback voltage minimizes power loss for better efficiency. Additional feature include over output voltage limiting when LEDs are disconnected.

The TS1937 switches at a fixed frequency of 1.2MHz, allowing the use of tiny, low profile inductors and capacitors to minimize footprint and cost in space consideration applications for cellular phone backlighting or other hand held equipment.

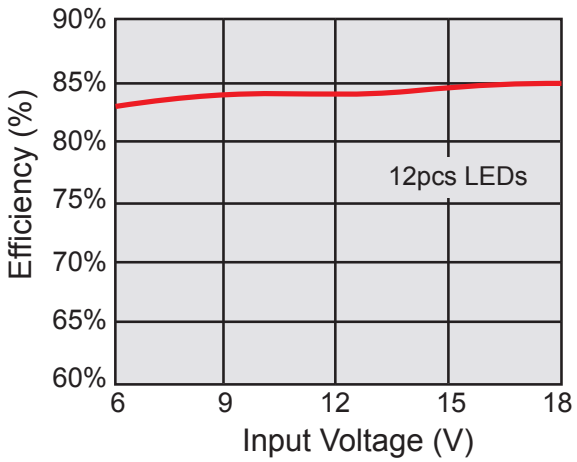
Features:

- Inherently Matched LED Current
- High Efficiency: 88% Typical
- Drives Up to 6 LEDs @ Vin 5V
- Drives Up to 11 LEDs @ Vin 9V
- Drives Up to 12 LEDs @ Vin 12~15V
- 36V Rugged Bipolar Switch
- Fast 1.2MHz Switching Frequency
- Requires Only 0.22μF Output Capacitor
- PWM dimming control 1KHz to 10KHz
- Analog dimming control

Typical Application Circuit



Input Voltage vs. Efficiency



Reference Design Information

VIN Range (V)	VOUT Max. (V)	L (uH)	LED (Series)	Current (mA)	Resistor (Ω)	Efficiency (%)
5	36	22	6pcs	20	4.75	83.5
9	36	33	11pcs	20	4.75	84.2
12	36	47	12pcs	20	4.75	84.3
15	36	68	12pcs	20	4.75	84.6

Products Overview

TS19370CX6
Boost (Step-up) WLED Driver with OVP

Description:

The TS19370 is a step-up DC/DC converter specifically designed to drive white LEDs with a constant current. The device can drive 2 ~ 9 LEDs in series from a Li-Ion cell. Series connection of the LEDs provides identical LED currents resulting in uniform brightness and eliminating the need for ballast resistors. The output capacitor can be as small as 0.22μF, which can saving spaces.

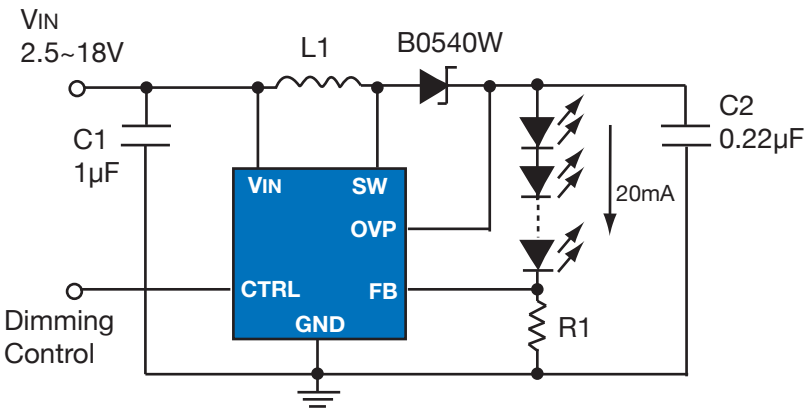
A low 95mV feedback voltage minimizes power loss for better efficiency. Additional feature include over output voltage limiting when LEDs are disconnected.

The TS19370 switches at a fixed frequency of 1.2MHz, allowing the use of tiny, low profile inductors and capacitors to minimize footprint and cost in space consideration applications for cellular phone backlighting or other hand held equipment.

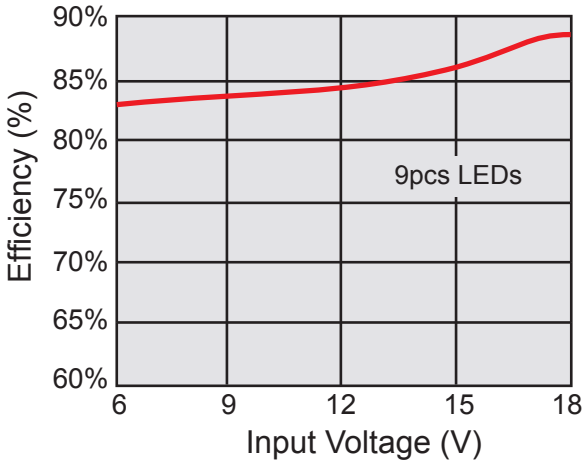
Features:

- Inherently Matched LED Current
- High Efficiency: 88% Typical
- Drives Up to 6 LEDs @ Vin 5V
- Drives Up to 9 LEDs @ Vin 9~15V
- 30V Rugged Bipolar Switch
- Fast 1.2MHz Switching Frequency
- Requires Only 0.22μF Output Capacitor
- PWM dimming control 1KHz to 10KHz
- Analog dimming control

Typical Application Circuit



Input Voltage vs. Efficiency



Reference Design Information

VIN Range (V)	VOUT Max. (V)	L (uH)	LED (Series)	Current (mA)	Resistor (Ω)	Efficiency (%)
5	30	22	6pcs	20	4.75	84.7
9	30	33	9pcs	20	4.75	85.1
12	30	47	9pcs	20	4.75	87.1
15	30	68	9pcs	20	4.75	88.1

Products Overview

TS19371CX6
Boost (Step-up) WLED Driver with OVP

Description:

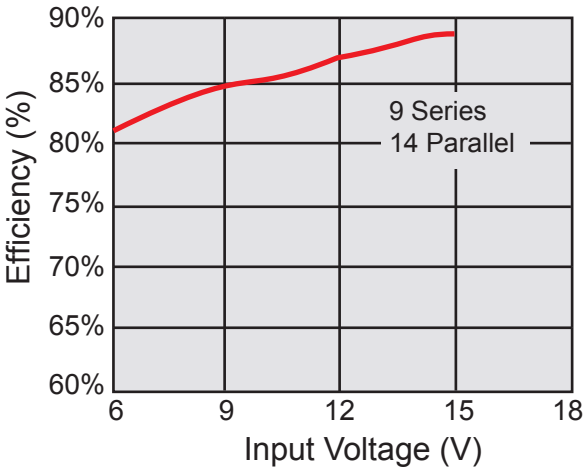
The TS19371 is a step-up DC/DC converter specifically designed to drive white LEDs with a constant current. The device can drive up to 126 LEDs (9S14P) from a 12V supply. The output capacitor can be as small as 4.7μF which can saving spaces. A low 95mV feedback voltage minimizes power loss for better efficiency. Additional feature include over output voltage limiting when LEDs are disconnected.

The TS19371 switches at a fixed frequency of 1.2MHz, allowing the use of tiny, low profile inductors and capacitors to minimize footprint and cost in space consideration applications for cellular phone backlighting or other hand held equipment.

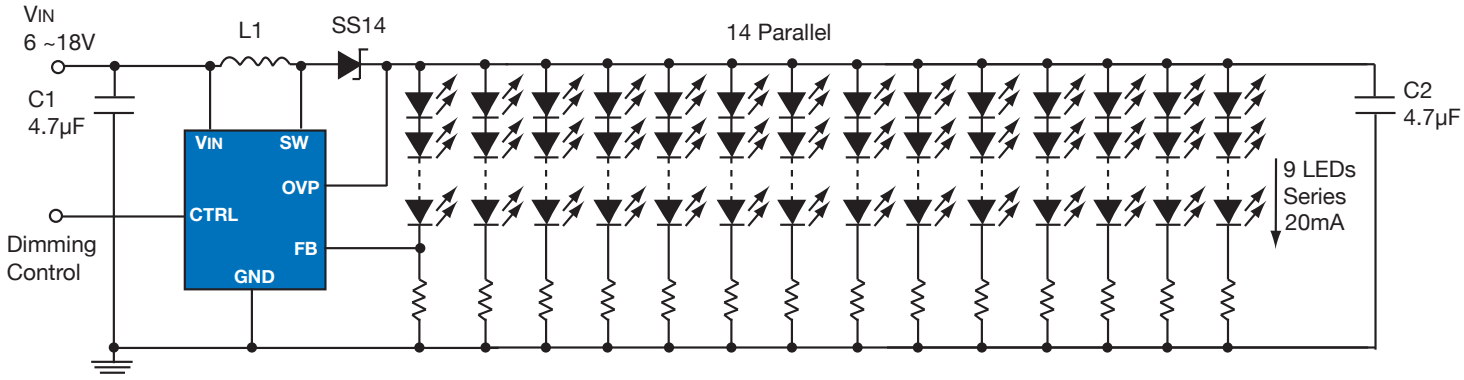
Features:

- Inherently Matched LED Current
- High Efficiency: 89% Typical
- Drives Up to 9 LEDs Series @ Vin 9~15V
- Drivers Up to 6 (1W) LEDs Series @ Vin 12V
- 30V Rugged Bipolar Switch
- Fast 1.2MHz Switching Frequency
- Requires Only 0.22μF Output Capacitor
- PWM dimming control 1KHz to 10KHz
- Analog dimming control

Input Voltage vs. Efficiency



Typical Application Circuit - 1

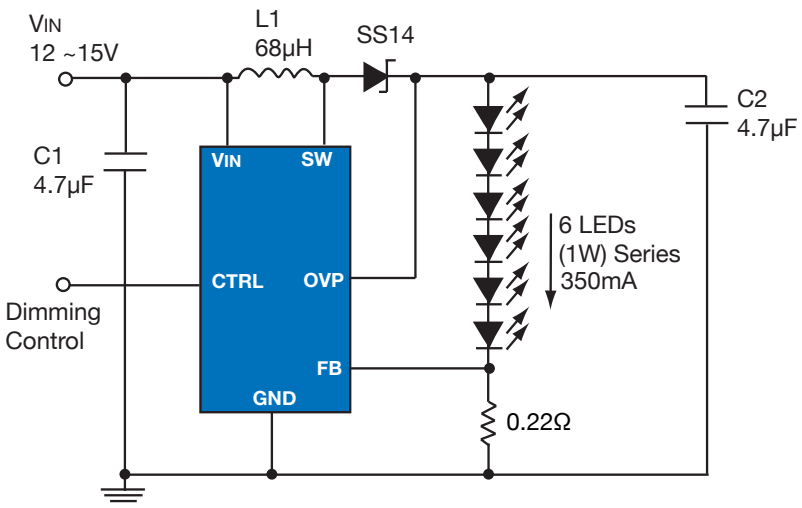


Reference Design Information

VIN Range (V)	VOUT Max. (V)	L (uH)	LED (Series)	LED (Parallel)	Current (mA)	Resistor (Ω)	Efficiency (%)
5	30	22	6pcs	14	20	4.75	81.2
9	30	33	9pcs	14	20	4.75	83.6
12	30	47	9pcs	14	20	4.75	87.2
15	30	68	9pcs	14	20	4.75	88.4

TS19371CX6
Boost (Step-up) WLED Driver with OVP

Typical Application Circuit - 2



Reference Design Information

VIN Range (V)	VOUT Max. (V)	L (uH)	1W LED (Series)	Current (mA)	Resistor (Ω)	Efficiency (%)
12 ~ 15	30	68	6pcs	350	0.22	88

Buck (Step-down) WLED Driver

Buck (Step-down) WLED Drivers

Part Number	VIN Range (V)	VOUT Range (V)	ISW (A)	Frequency	Dimming	Package	
TS19372	6 ~ 40	Up to 36	0.3	180kHz	NO	SOT-25	
TS19373	6 ~ 40	Up to 36	0.8	180kHz	NO	SOT-25	

Products Overview

TS19372CX5

Buck (Step-down) WLED Driver with External Switch

Description:

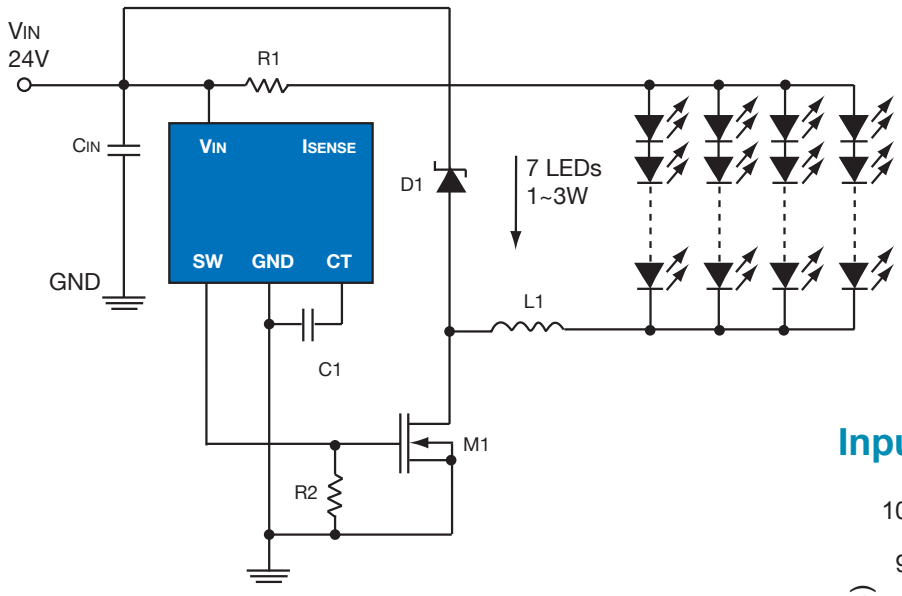
The TS19372 is a continuous mode inductive step-down converter, designed for driving single or multiple series connected LEDs efficiently from a voltage source higher than the LED voltage. The device operates from an input supply between 6V and 40V and provides 300mA output current to drive external N-channel MOSFET

TS19372 includes the output switch and a high-side output current sensing circuit, which uses an external resistor to set the nominal average output current.

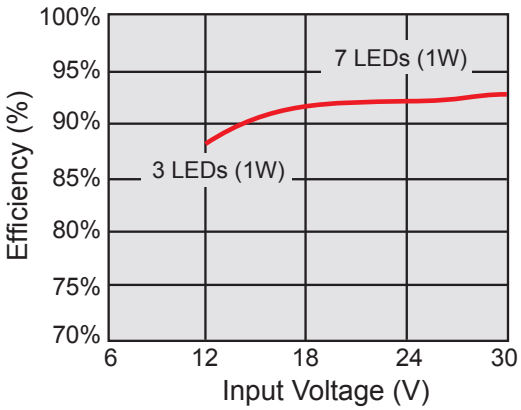
Features:

- Wide Input voltage range: 6~40V
- 300mA output current
- High Efficiency up to 92%
- Drives Up to 3 (1~3W) LEDs @ Vin 12V
- Drives Up to 7 (1~3W) LEDs @ Vin 24V
- 180kHz Switching Frequency
- Internal PWM filter

Typical Application Circuit



Input Voltage vs. Efficiency



Reference Design Information

VIN Range (V)	L (uH)	LED (Series)	LED (Parallel)	Current (mA)	Efficiency (%)
12	68	3pcs	4	300	88
24	100	7pcs	4	300	92

Bill of Materials:

Designation	Description	Package	Manufacture	Remark
LED Driver	TS19372CX5	SOT-25	TSC	--
D1	SS34	SMB	TSC	3A, 40V
M1	TSM2318CX	SOT-23	TSC	N-CH 40V / 3.9A
L1	100uH	--	Generic	Isat >1.5A
R1	0.22Ω	1206	Generic	--
R2	1kΩ	1206	Generic	--
Cin	10uF	805	Generic	Ceramic
C1	820pF	805	Generic	Ceramic

Products Overview

TS19373CX5
800mA Buck (Step-down) WLED Driver

Description:

The TS19373 is a continuous mode inductive step-down converter, designed for driving single or multiple series connected LEDs efficiently from a voltage source higher than the LED voltage. The device operates from an input supply between 6V and 40V and provides an externally adjustable output current of up to 800mA.

TS19373 includes the output switch and a high-side output current sensing circuit, which uses an external resistor to set the nominal average output current.

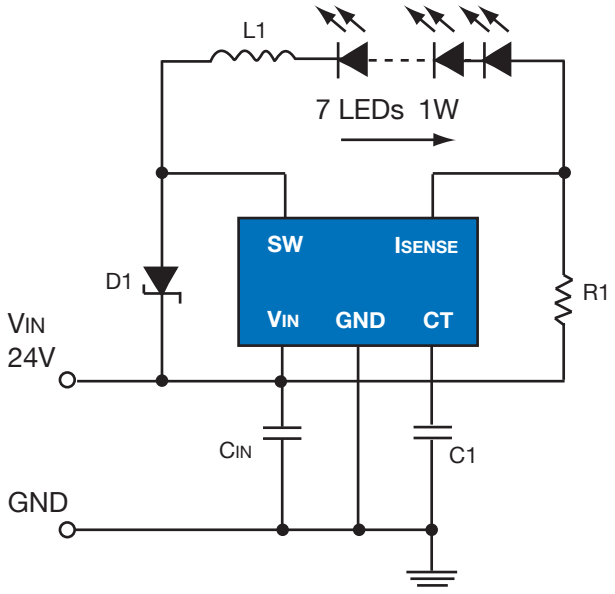
Features:

- Wide Input voltage range: 6~40V
- 800mA output current
- High Efficiency up to 90%
- Drives Up to 3 (1~3W) LEDs Series @ Vin 12V
- Drives Up to 7 (1~3W) LEDs Series @ Vin 24V
- 180kHz Switching Frequency
- Internal PWM filter

Applications:

- DC/DC or AC/DC LED driver applications
- Back lighting of flat panel displays
- Signage and decorative LED lighting
- Chargers

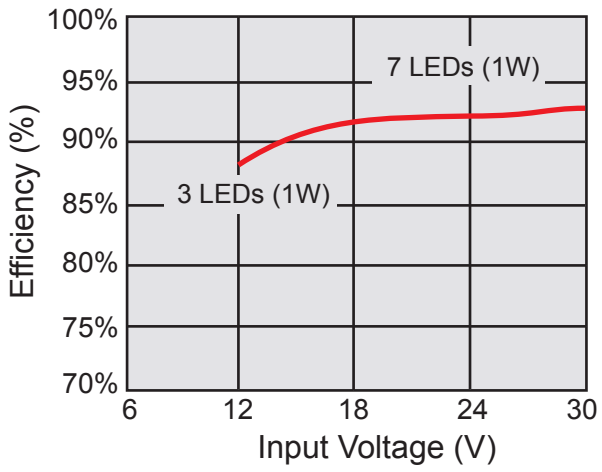
Typical Application Circuit



Reference Design Information

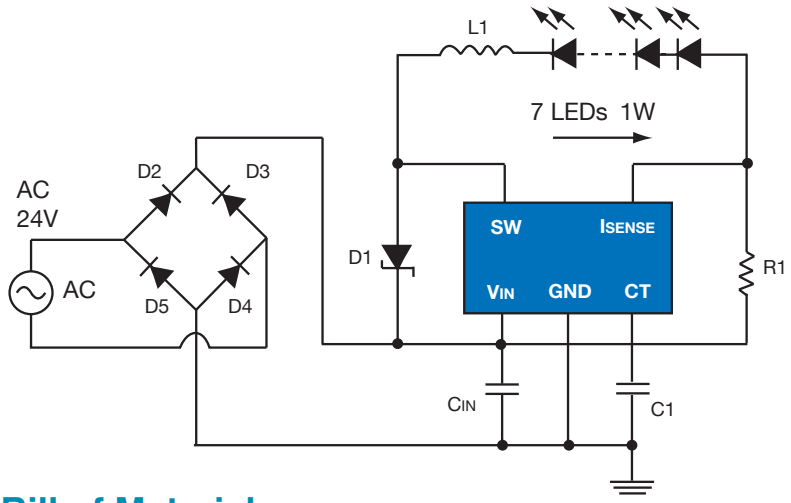
VIN Range (V)	L (uH)	LED (Series)	Current (mA)	Efficiency (%)
12	68	3pcs	300	89
24	100	7pcs	300	90

Input Voltage vs. Efficiency



TS19373CX5
800mA Buck (Step-down) WLED Driver

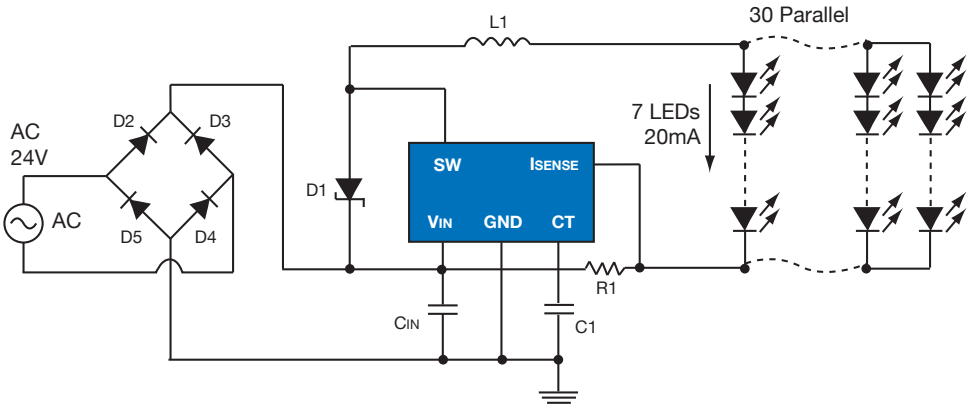
Application Circuit for MR16

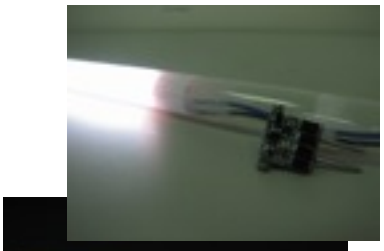


Bill of Materials:

Designation	Description	Package	Manufacture	Remark
LED Driver	TS19373CX5	SOT-25	TSC	--
D1,2,3,4,5	SS14	SMA	TSC	1A, 40V
L1	100uH	--	Generic	Isat >500mA
R1	0.5Ω	1206	Generic	--
Cin	10uF	805	Generic	Ceramic
C1	200pF	805	Generic	Ceramic

Application Circuit for LED TUBE





Bill of Materials:

Designation	Description	Package	Manufacture	Remark
LED Driver	TS19373CX5	SOT-25	TSC	--
D1,2,3,4,5	SS14	SMA	TSC	1A, 40V
L1	100uH	--	Generic	Isat >500mA
R1	0.5Ω	1206	Generic	--
Cin	10uF	805	Generic	Ceramic
C1	200pF	805	Generic	Ceramic

AC to DC WLED Driver

AC to DC WLED Drivers

Part Number	VIN Range (V)	IOUT	ISW (A)	Frequency	Dimming	Package	
* TS19450	8 ~ 450	External MOSFET	0.165	120kHz	YES	SOP-8	
* TS19451	20 ~ 400	Internal MOSFET	0.03	120kHz	NO	SOT-89	

* Under Development

Products Overview

UNDER DEVELOPMENT

TS19450CS

AC/DC WLED Driver with External MOSFET

Universal High Brightness LED Driver

Description:

The TS19450 is an open loop, current mode, control LED driver IC. it can be programmed to operate in either a constant frequency or constant off-time mode. It includes 8V~450V linear regulator which allows it to work from a wide range of input voltage without the need for an external low voltage supply.

The TS19450 includes a PWM dimming input that can accept an external control signal with a duty ration of 0~100% and a frequency up to few kHz. It also includes a 0~250mA linear dimming input which can be used for linear dimming of the LED current.

Since the TS19450 operates in open loop curretn mode control, the controller achieves good output current regulation without need any loop compensation. PWM dimming response is limited on by the rate of rise and all of the inductor current, enabling very fast rise and fall time. TS19450 requires few external components to produce a controlled LED current making it an ideal solution for low cost LED drivers.

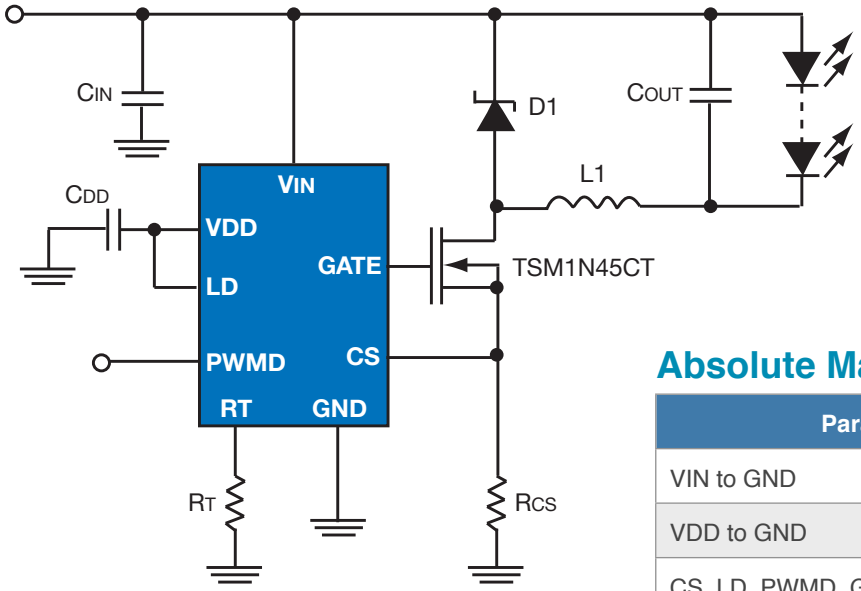
Features:

- Switch mode controller for single switch LED drivers
- Open loop peak current controller
- Internal 8V ~ 450V linear regulator
- Constant frequency or constant off-time operation
- Linear and PWM dimming capability
- Requires few external components for operation
- PWM & Linear dimming control

Applications:

- DC/DC or AC/DC LED driver applications
- RGB backlighting LED driver
- Back lighting of flat panel displays
- General purpose constant current source
- Signage and decorative LED lighting
- Chargers

Typical Application Circuit



Absolute Maximum Ratings

Parameter	Value
VIN to GND	-0.5V ~ +470V
VDD to GND	12V
CS, LD, PWMD, Gate, RT to GND	-0.3V to (VDD+0.3V)
Operating junction temperature	-40°C ~ +125°C
Storage temperature range	-65°C ~ +150°C
Power dissipation @ TA=25°C	630mW

Products Overview

UNDER DEVELOPMENT

TS19451CY

AC/DC WLED Driver with Internal MOSFET

Universal Switch Mode LED Lamp Driver

Description:

The TS19451 is a PWM high efficient LED driver control IC. It allows efficient operation of LED string from voltage source rang up to 400VDC. It includes an internal high voltage switching MOSFET controlled with fixed off-time approximately 10.5μS.

The LED string is driven at constant current, thus providing constant light output and enhanced reliability.

The output current is internally fixed at 50mA for TS19451. The peak current control scheme provides good regulation of the output current throughout the universal AC line voltage range 85~264VAC or DC input voltage 20~400V.

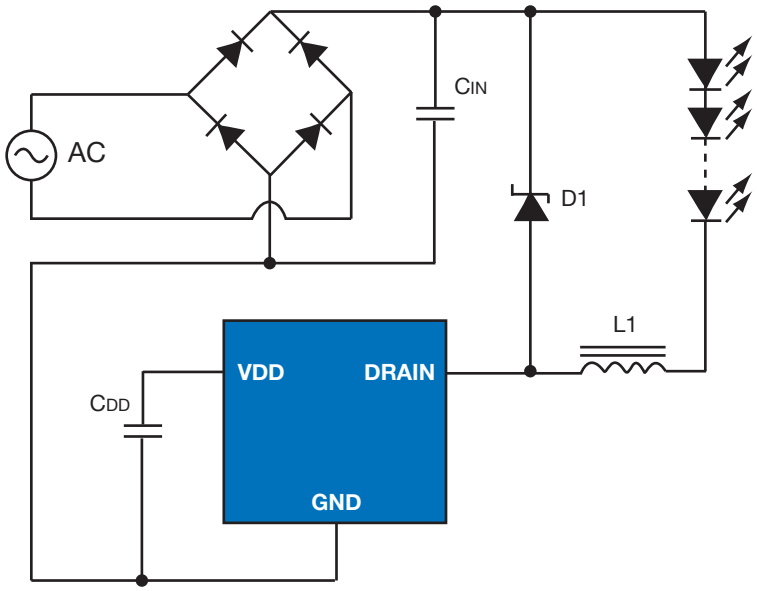
Features:

- Constant output current: 50mA
- Universal 85~264VAC operation
- Fixed off-time buck converter
- Internal 475V Power MOSFET

Applications:

- Decorative lighting
- Low power lighting fixtures

Typical Application Circuit



Absolute Maximum Ratings

Parameter	Value
Breakdown Voltage	475V
Output Current	50mA
Operating ambient temperature	-40°C ~ +85°C
Operating junction temperature	-40°C ~ +125°C
Storage temperature range	-65°C ~ +150°C
Power dissipation @ Tc=25°C	1300mW