

DESCRIPTION

TP8556N is a step-down constant-current LED driver operating with a fixed off-time control scheme for high-efficiency driving of multiple LEDs. The device adopts closed-loop average current mode constant-current regulation, making the output current insensitive to inductance variations in system applications. This significantly improves the constant-current accuracy of the output current, and the IC is particularly suitable for non-isolated step-down LED constant-current driving circuits with an input voltage range of 5 V to 100 V.

TP8556N adopts an external power MOSFET. The average LED output current can be set via an external resistor. The high-brightness and low-brightness modes of LED output can be switched by applying a high or low level to the MODE pin. When the MODE pin is pulled high, the LED operates in 50% low-brightness mode; when the MODE pin is pulled low, the LED runs in 100% full-brightness mode. Only a small number of peripheral components are required to realize brightness mode switching, which saves system cost and PCB footprint.

TP8556N integrates an analog dimming function. The LED current can be adjusted via an external analog voltage level, providing a simple and convenient dimming interface. Meanwhile, TP8556N is equipped with multiple built-in protection functions to ensure stable and reliable system operation, including LED short-circuit protection, LED output over-current protection, intelligent thermal control, and VDD supply under-voltage lockout protection.

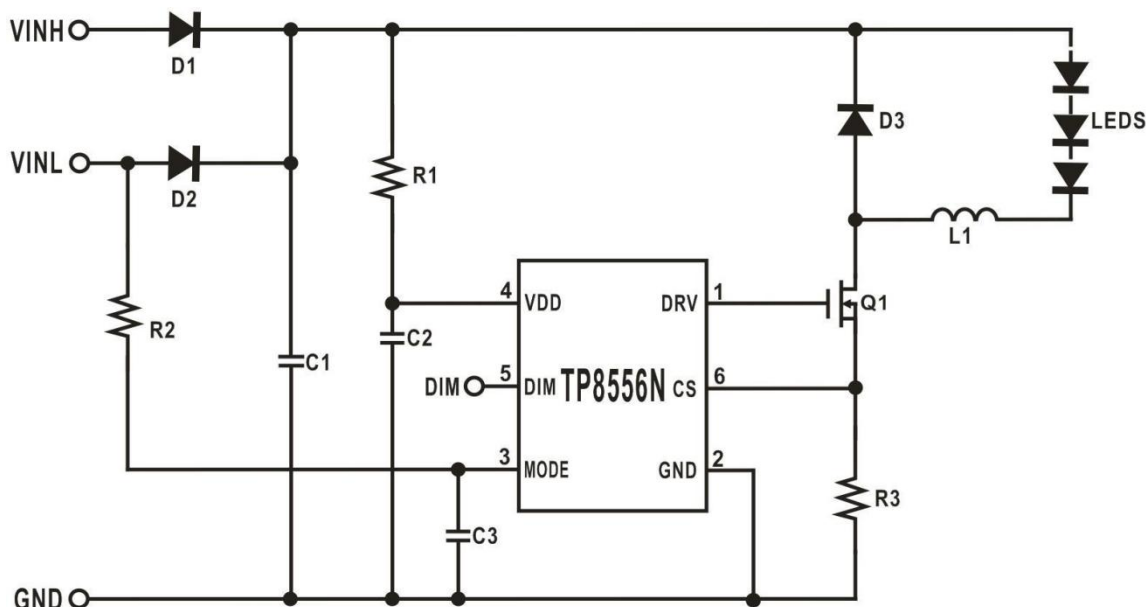
KEY FEATURES

- Wide system input voltage range: 5 V ~ 100 V
- Fixed Off-Time Control Mode
- Closed-Loop Average Current Mode Constant Current Control
- $\pm 5\%$ LED Output Current Accuracy
- LED High/Low Brightness Output Mode
- Insensitive to inductance variation
- High system operating efficiency
- Integrated analog dimming function
- Built-in 5.6 V Zener diode for VDD pin
- LED output short-circuit protection
- Intelligent IC thermal control
- Package Size: SOT23-6L

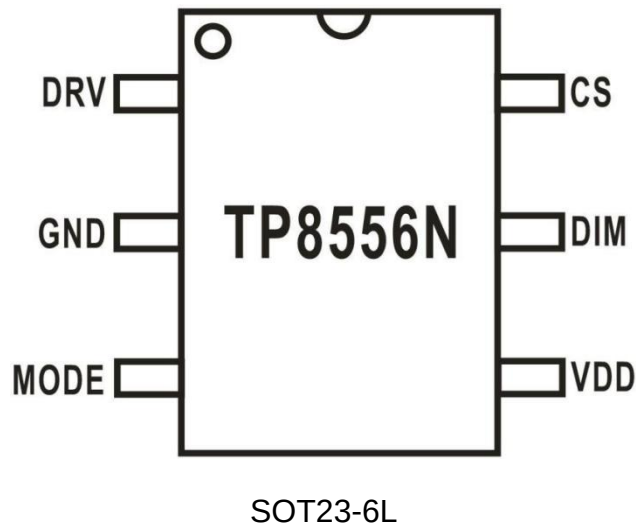
APPLICATION

- Automotive Lighting
- E-Bike Lighting
- High-Power Flashlight
- LED Backlight Driver

TYPICAL APPLICATION



PIN CONFIGURATION



ORDER INFORMATION

Order model	Product description
TP8556N	Package : SOT23-6L

PIN DESCRIPTION

Pin No.	Pin Name	Description
1	DRV	Gate driver pin for external power MOSFET
2	GND	IC ground reference
3	MODE	Input pin for high/low brightness mode switching. A 100 nF filter capacitor shall be connected from this pin to GND for brightness dimming applications. If the MODE function is not used, this pin cannot be left floating and must be tied to VDD or GND.
4	VDD	Power supply input pin with internal 5.6 V Zener diode
5	DIM	Analog dimming signal input pin
6	CS	Output current sense pin. The sense resistor is connected between CS and GND.

ABSOLUTE MAXIMUM RATINGS (NOTE 1)

Parameter	Rating	Unit
Voltage from VDD, CS, DRV, DIM to GND	-0.3 ~ +6	V
Voltage from MODE to GND	-0.3 ~ +7	V
Power Dissipation (Note 2)	0.5	W
Operating Junction Temperature Range	-40 ~ 190	°C
Storage Temperature Range	-40 ~ 190	°C
ESD Level (Human Body Model, HBM)	2000	V
ESD Level (Machine Model, MM)	200	V

RECOMMENDED OPERATING RANGE (NOTE 2)

Parameter	Symbol	Operating Condition	Recommended Value	Unit
Supply Voltage	V _{IN}	Normal operation	5 ~ 100	V
Output LED Current	I _{LED}	Normal operation	3 ~ 6	A

Note 1: Absolute maximum ratings define limits beyond which the IC may be permanently damaged. The recommended operating range ensures normal IC operation within this span, though not all performance specifications are fully guaranteed. Electrical characteristics specify DC and AC parameters under designated test conditions within the operating range that warrant targeted performance metrics. For parameters without specified upper/lower limits, accuracy is not guaranteed by this datasheet; typical values reasonably reflect device performance.

Note 2: The maximum power consumption decreases as the ambient temperature rises, determined by T_{JMAX}, θ _{JA}, and the ambient temperature T_A. The maximum allowable power consumption P_{DMAX} is equal to (T_{JMAX}-T_A)/ θ _{JA}, or the smaller value among the figures specified in the absolute maximum ratings.

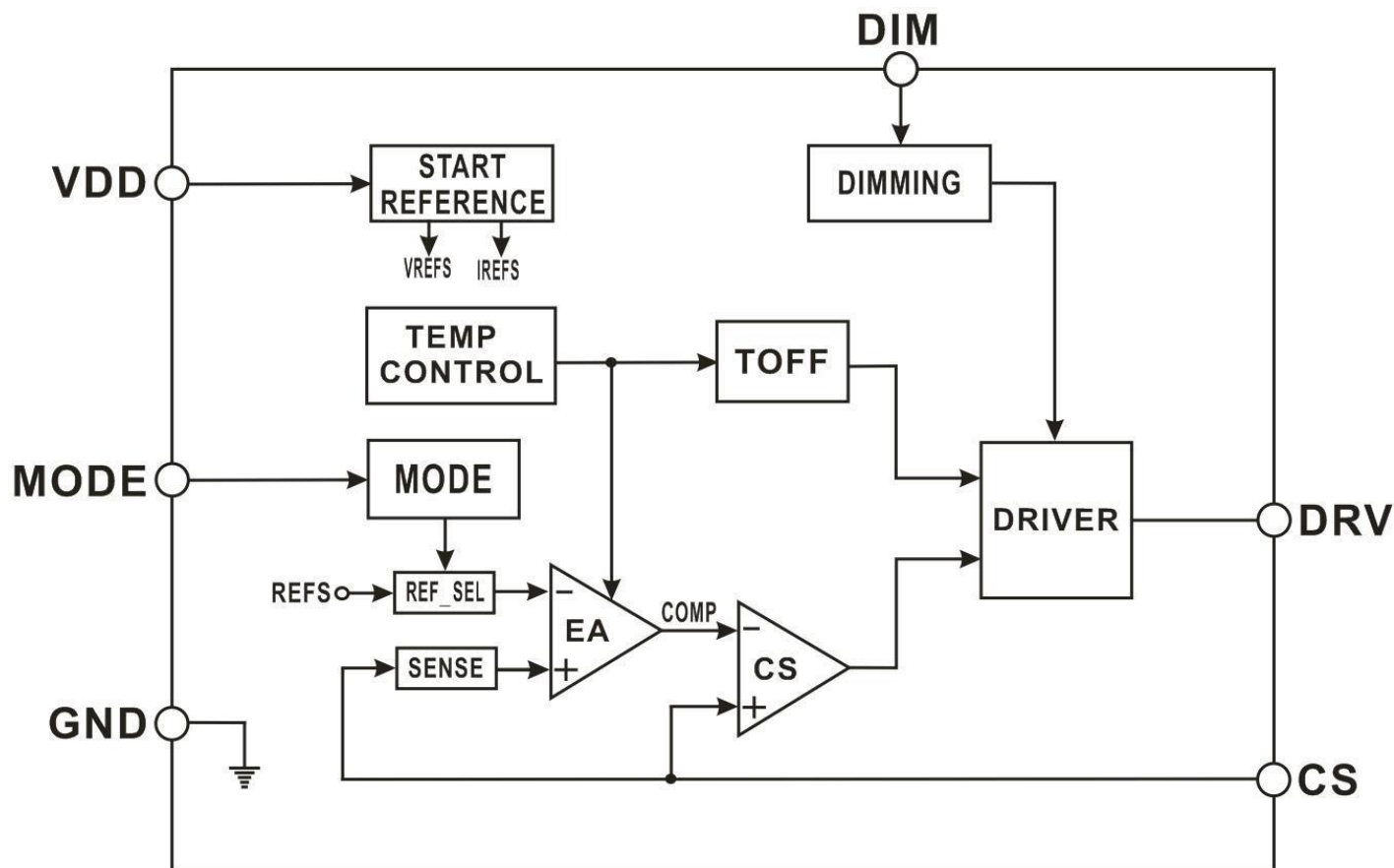
ELECTRICAL CHARACTERISTICS (NOTE 3)

Unless otherwise specified, V_{IN} = 5 V, T_a = 25°C

Symbol	Parameter	Test Condition	Min.	TYP.	MAX.	Unit
Input Voltage						
V _{DD_CLP}	VDD Input Clamp Voltage			5.6		V
I _{STB}	Quiescent Operating Current	VDD=5 V		405		μA
V _{UVLO}	UVLO Threshold	VDD Rising		3.1		V
V _{UVLO_HYS}	UVLO Hysteresis Voltage	VDD Falling		2.7		V
Current Sense						
V _{REF_100%}	Average Current Sense Voltage Threshold @ 100% Brightness			300		mV
V _{REF_50%}	Average Current Sense Voltage Threshold @ 50% Brightness			150		mV
Operation Timing						
T _{OFF}	Fixed Off-Time	100% brightness output		4.4		μs
T _{LEB}	Leading Edge Blanking Time for Power MOSFET Turn-On			200		ns
F _{SW_MAX}	Maximum Operating Switching Frequency			220		kHz
Input Mode						
R _{MODE}	MODE Pin Pull-Down Resistance			50		KΩ
V _{MODE_H}	MODE Input High-Level Voltage		2.0			V
V _{MODE_L}	MODE Input Low-Level Voltage				0.5	V
V _{MODE_CLP}	MODE Input Low-Level Voltage			6.5		V
Dimming Function						
I _{DIM}	DIM Pin Pull-Up Current			18		μA
V _{DIM}	Analog Dimming Voltage Range on DIM Pin		0.3		1.5	V
V _{DIM_OFF}	DIM Analog Shutdown Threshold Voltage			0.15		V
V _{DIM_ON}	DIM Analog Turn-On Threshold Voltage			0.2		V
Power MOSFET Driver						
I _{SOURCE}	Maximum Gate-Source Pull-Up Current			550		mA
I _{SINK}	Maximum Gate Sink Pull-Down Current			350		mA
Thermal Control						
T _{ST}	Intelligent Thermal Derating Start Temperature			150		°C
T _{SD}	Thermal Shutdown Temperature			180		°C
T _{HYS}	Thermal Shutdown Hysteresis Temperature			150		°C

Note 3: The minimum and maximum specification ranges of the datasheet are guaranteed by testing, while the typical values are guaranteed by design, testing, or statistical analysis.

BLOCK DIAGRAM



OPERATION DESCRIPTION

TP8556N is a step-down constant-current LED driver operating in a fixed off-time control topology for efficiently driving multiple LEDs. The device adopts closed-loop average constant-current regulation. High/low brightness switching of LED output can be realized by applying different logic levels to the MODE pin. It also integrates an analog dimming function and multiple protection mechanisms.

Operating Principle

TP8556N drives LEDs with constant current via fixed off-time control and closed-loop average current regulation. When the external power MOSFET turns on, input current flows through the LEDs, inductor, power MOSFET and current sense resistor to ground. The inductor current ramps up during the on-time. Once the voltage across the sense resistor reaches the reference threshold of the internal error amplifier, the power MOSFET is switched off. During the off-state, the inductor current freewheels through the freewheeling diode and LEDs. After an internally fixed off-time expires, the power MOSFET turns on again, and the above cycle repeats. During switching cycles, TP8556N continuously adjusts the peak LED current through closed-loop feedback to deliver a stable constant LED output current.

LED Average Current Setting

The average LED current is determined by the sense resistor RCS connected between CS and GND.

$$I_{OUT} = \frac{V_{REF}}{R_{CS}}$$

RCS serves as the output average current sense resistor; the internal reference threshold is 300 mV for 100% brightness and 150 mV for 50% brightness.

High/Low Brightness Mode Setting for LED

TP8556N integrates high and low brightness mode switching functionality, which can be configured for the high and low brightness mode functions through the MODE pin. The specific configuration method is as follows:

MODE=H	MODE=L
LED=50% Brightness	LED=100% Brightness

To suppress interference from power MOSFET switching noise on the MODE pin, a 100 nF filter capacitor shall be connected from the MODE pin to GND for high/low brightness dimming applications. If the MODE function is unused, this pin must not be left floating and shall be tied to VDD or GND.

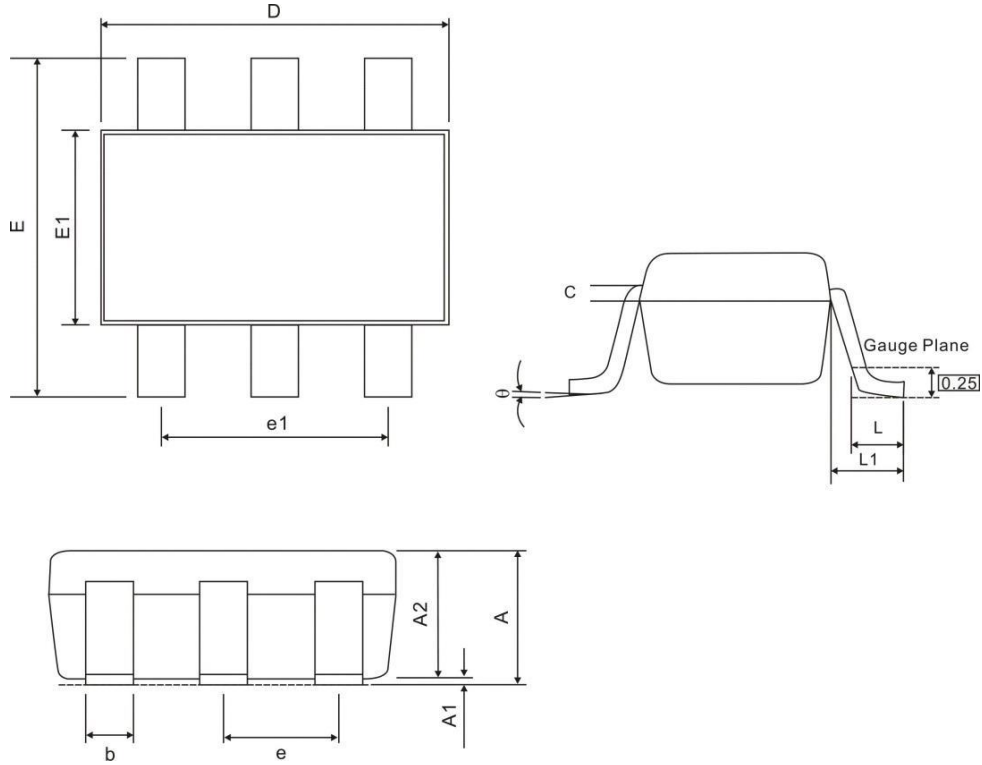
Selection of VDD Power Supply Resistors

When the input voltage of the application circuit exceeds 5.6 V, a power supply resistor should be added to the VDD pin. The resistance value of the power supply resistor can be selected by referring to the table below (actual applications may make minor adjustments based on this). For higher input voltages, transistors can also be used for power.

Input voltage (V)	12V	24V	36V	48V	60V
Resistors(Ω)	3K3	7K5	12K	16K	20K

PACKAGE DIMENSIONS

SOT-23-6



Symbol	Min (mm)	Nom (mm)	Max (mm)
A	1	—	1.45
A1	0	—	0.15
A2	0.9	—	1.3
b	0.31	—	0.5
c	0.08	—	0.22
D	—	2.90 BSC	—
E	—	2.80 BSC	—
E1	—	1.60 BSC	—
e	—	0.95 BSC	—
e1	—	1.90 BSC	—
L	0.3	0.45	0.6
θ	0°	—	8°

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