Offline LED Driver With High PSRR

General Description

The VAS1103 is designed to drive a long string of LEDs directly from the AC mains. It provides a constant current for high voltage illuminating LEDs. The VAS1103 include a delay circuit to prevent LED flashing in instant boot.

A string of series/parallel LEDs is tapped at four locations, four integrated high voltage switches track the input sine wave voltage and turn on/off automatically. Voltage across each switch is minimized when conducting, providing high efficiency.

VAS1103 is available in a SOP8-e package.

Application

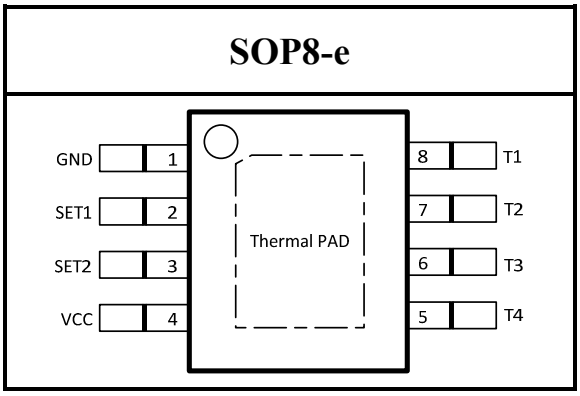
- LED Lighting

Features

- High PSRR
- Low conducted EMI without filters
- Automatically detect LED forward voltage
- Automatically adapt 1~4 segments LEDs
- Up to 8W output
- 85% efficiency
- > 0.95 power factor
- Temperature Compensation
- SOP8-e package

Pin Configuration

SOP8-e

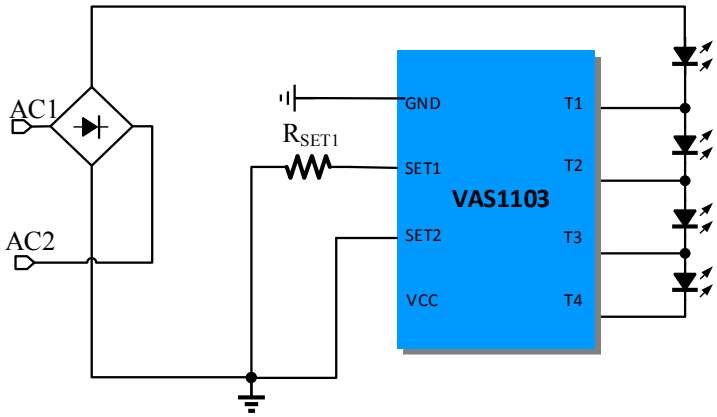


Ordering Information

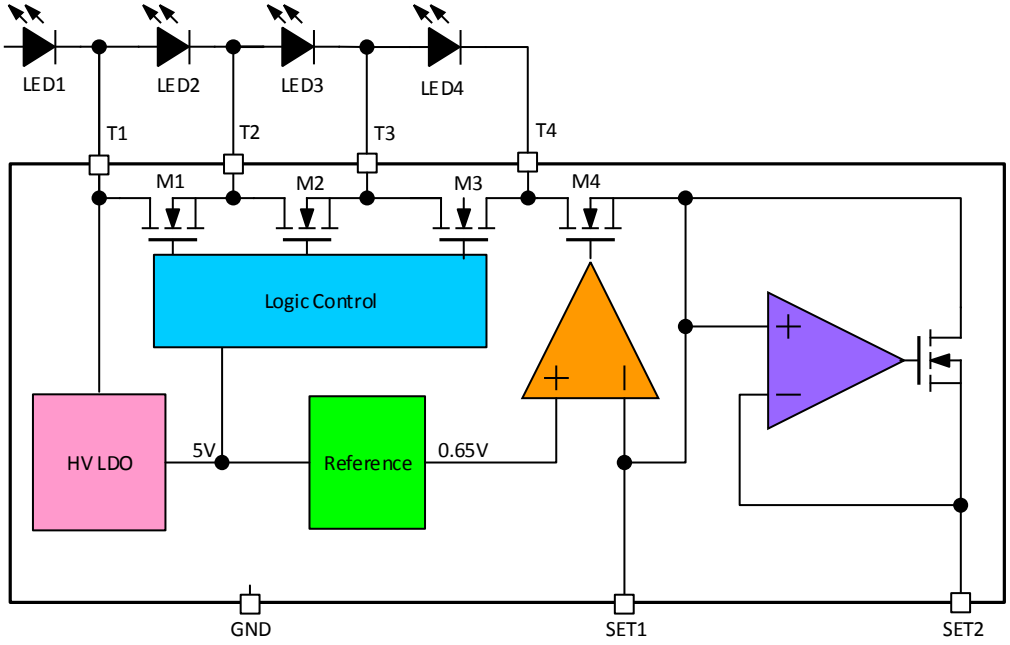
Order Number	Package Type	Temp. Range
VAS1103ID08E	SOP8-e	-40°C to 105°C

I: Industry, -40~85°C
08 : Pin Number
D: SOP
E: ROHS

Typical Application Circuit



Block Diagram



PIN Description

PIN NO.	Name	Description
1	GND	Ground
2	SET1	Current set for current regulator, connect a resistor to M1 to set the LED current. $I_{LED} = \frac{V_{SET1}}{R_{SET1}}$, V_{SET1}=650mV. If the IC temperature rises up to 120°C, the SET1 voltage will drop to reduce current. The SET1 voltage will drop to 350mV @160°C.
3	SET2	For matching with SET1
4	VCC	5V voltage regular. Floating or bypass a capacitor to ground.
5	T4	Current regulator outputs. Connect to taps along the LED string
6	T3	
7	T2	
8	T1	
EP	GND	Connect to Ground

Absolute Maximum Ratings (Note1)

Parameters	Maximum Ratings
T1~T4 to GND	-0.3V to 500V
SET1,SET2,VCC to GND	-0.3V to 6V
Operating temperature range	-40°C to +105°C
Junction temperature	-40°C to +150°C
Storage temperature range	-65°C to +150°C

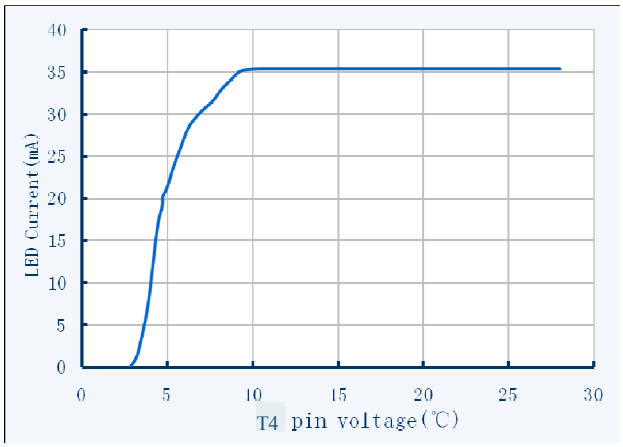
Note1: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Electrical Characteristics (Note2)

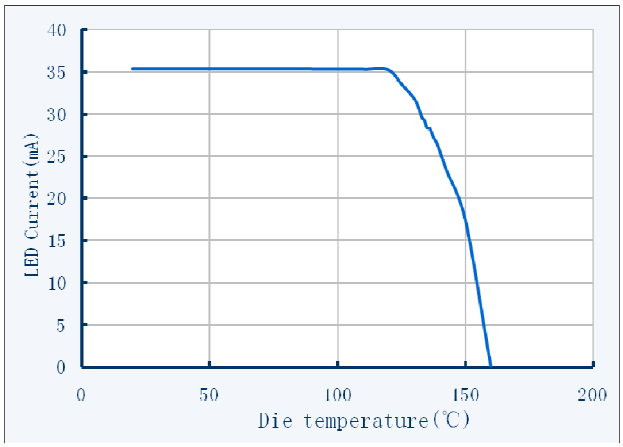
Symbol	Parameter	Condition	SPEC			Unit
			Min.	Typ.	Max.	
VSUP	Input voltage range				500	V
ICC	Quiescent current	VT1=310V		300		μA
V_{SET1}	SET1 pin voltage			0.65		V
I_{ACCU}	Current accuracy	VT1=310V		±5		%
T_{SD}	OTP threshold			160		°C
$R_{\Theta JA}$	Thermal resistance	SOP8-e		60		°C/W

Note 2: Production testing of the device is performed at 25°C. Functional operation of the device and parameters specified over other temperature range, are guaranteed by design, characterization and process control.

Typical Performance Characteristics



LED current vs. T4 pin voltage



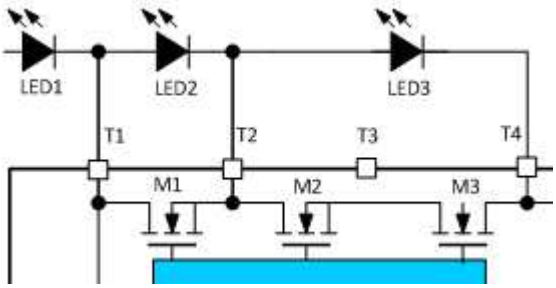
LED current vs. Die temperature

Application Information

1. Operating Theory

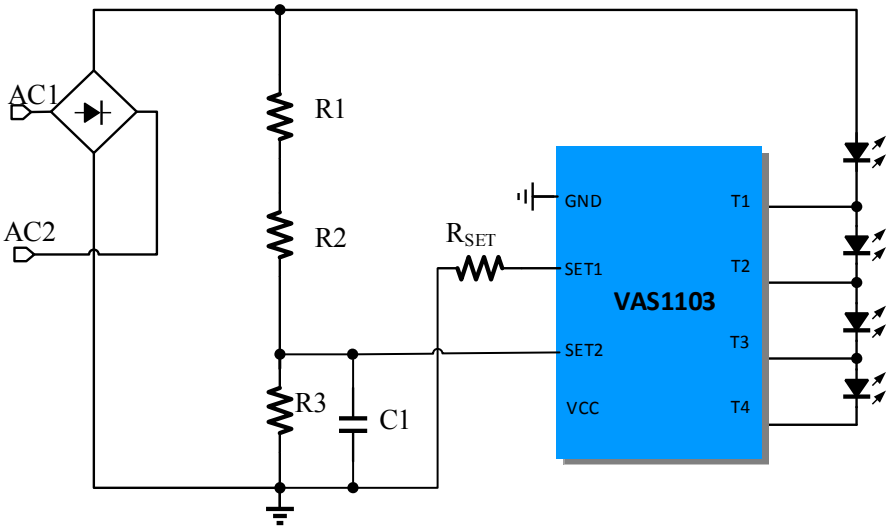
The voltage after rectifier bridge is half-wave with 310V peak voltage for 220V AC (155V for 110V AC).

The VAS1103 integrated 4 high voltage switches, named M1 to M4, each of their drain and source connect one LED string except M3, named LED1 to LED3. Initially, all the switches are on. If the half-wave voltage is higher than the LED1+LED2 forward voltage, M1 turn off, thus the current flow through LED1 and LED2. If the half-wave voltage is higher than the LED1+LED2+LED3 forward voltage, M2 turns off, thus the current flow through LED1, LED2 and LED3… and so on. Each segment equal 65V is recommended for 220V AC main.



2. High PSRR Operation

Formerly, the AC mains may vary from 180Vrms to 265Vrms, this may cause significant difference on the output power. That means LED may be brighter when the voltage of AC mains rises. VAS1103 can solve this problem elegantly by applying a divider voltage of the AC mains to the SET2 PIN. Choose suitable resistors to set the SET2 voltage 1.2V at 220V AC and the output power variation may keep in ±10% when the AC mains varies.



3. Set LED Current

The VAS1103 feature a programmable LED current using a resistor connected between SET1 and M1.SET2 is used for matching with SET1, R_{SET2} is reconmended to equal R_{SET1}. Use the following equation to calculate the sense resistor:

$$I_{LED} = \frac{0.65V}{R_{SET1}}$$

Change the value of R_{SET1} can obtain the required constant current. The chip power consumption is $I_{LED} * V_D$, VD is LED cathode voltage.

In order to get the higher accuracy of the LED output current ,a 1% or more high precision resistor is commented. If the environment temperature changes a lot, such as change in -25°C to 85°C, use the low temperature coefficient resistance to ensure that the resistance value is almost constant.

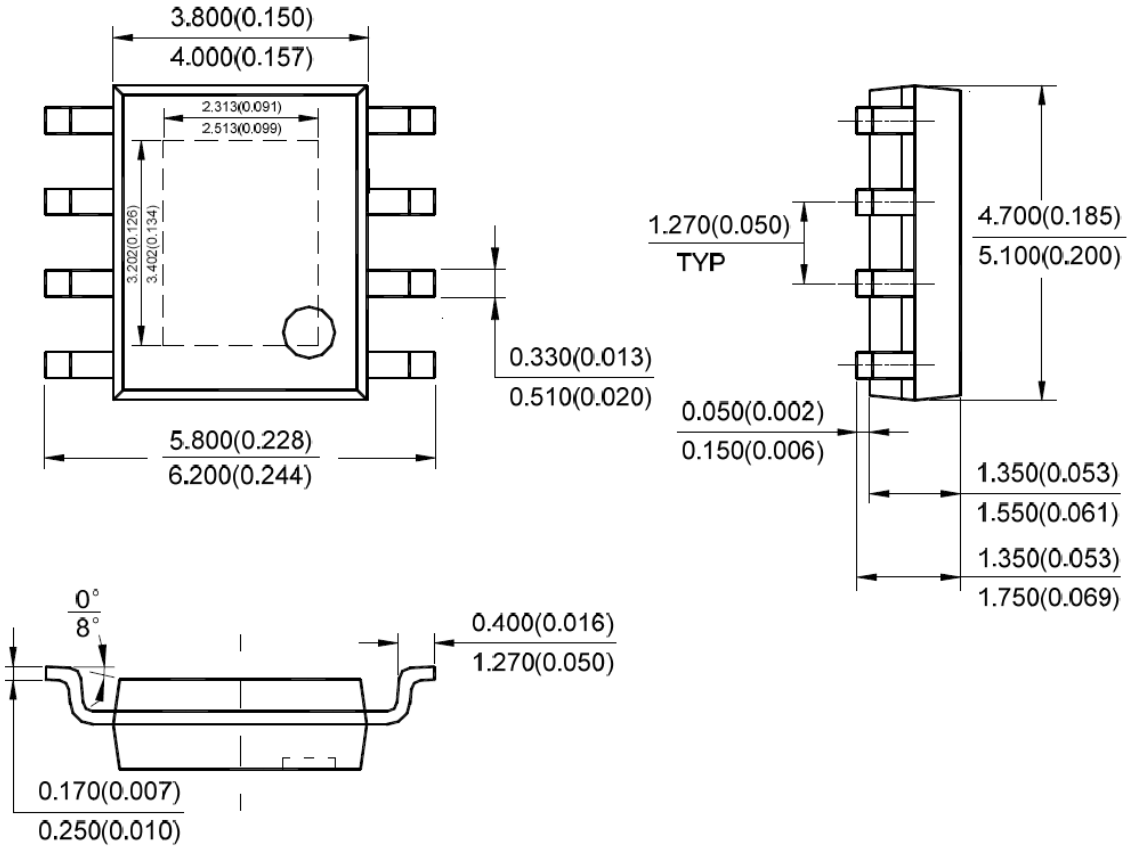
4. Over-Heating Issue

As the AC main voltage rises, the LED cathode voltage will follow up, this will cause the chip overheating. The VAS1103 solve the issue by:

1) If the VAS1103 die temperature rise to 120°C (IC surface temperature is about 90°C), LED current started to decrease gradually, as the temperature reaches 160°C, LED current dropped by half, this feature avoid the LED blinking.

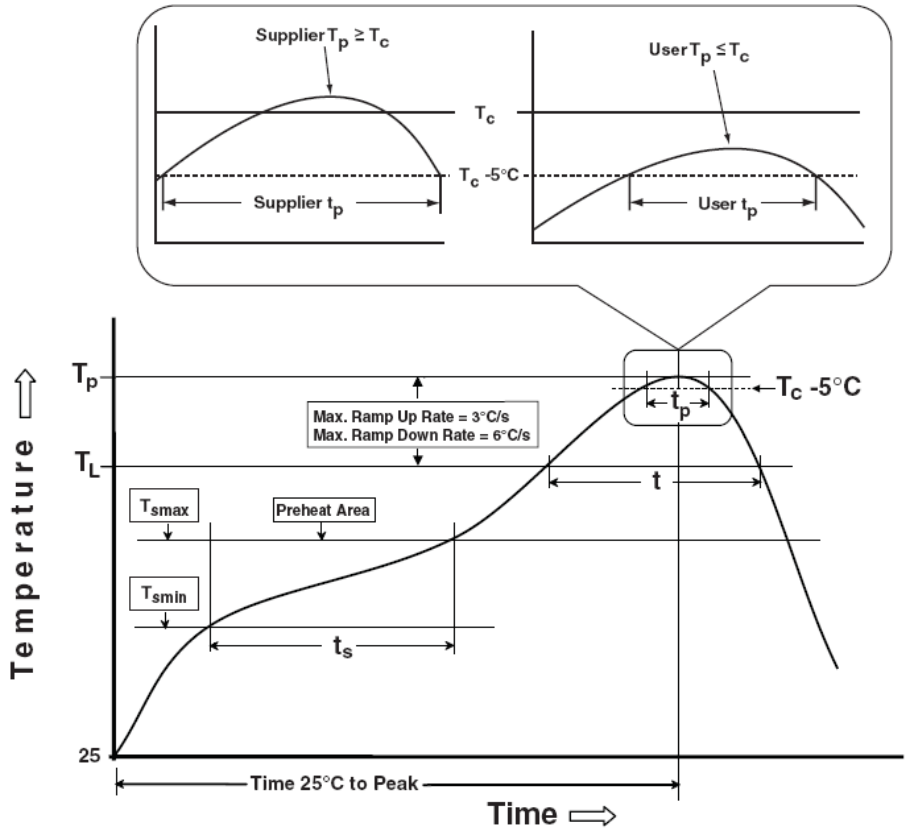
2) If the temperature continues to increase to 160°C, VAS1103 enter thermal shutdown mode. When the temperature dropped to 120°C, VAS1103 re-starts to work.

Package Information (SOP8-e)



Classification Reflow Profiles

Profile Feature	Pb-Free Assembly
Preheat & Soak Temperature min (Tsmin) Temperature max (Tsmax) Time (Tsmin to Tsmax) (ts)	150°C 200°C 60-120 seconds
Average ramp-up rate (Tsmax to Tp)	3°C/second max.
Liquidous temperature (TL) Time at liquidous (tL)	217°C 60-150 seconds
Peak package body temperature (Tp)*	Max 260°C
Time (tp)** within 5°C of the specified classification temperature (Tc)	Max 30 seconds
Average ramp-down rate (Tp to Tsmax)	6°C/second max.
Time 25°C to peak temperature	8 minutes max.



Classification Profile

⚠CAUTION

Storage Conditions

1) This product should be used within 12 months after delivered. Store in manufacturer's package keeping the seal of aluminum coated baggage or tightly re-closed box with the following conditions. [Temperature:8°C...30°C,Humidity:30%...70% R.H.]

2) Keep the seal of aluminum coated baggage immediately before usage.

3) After breaking the seal of aluminum coated baggage, this product should be used within 1 week on the following conditions.
[Temperature:≤30°C, Humidity: ≤60% R.H.]