Applications Note: SY59103N

Dimmable, high Efficiency Linear Driver With Integrated 350V MOSFET

General Description

The SY59103N is a dimmable linear AC/DC driver with integrated 350V MOSFET for LED lighting. It's compatible with Leading/Trailing edge dimmer. The patented technique results in high efficiency and power factor.

Ordering Information

SY59103□(□□)□

- Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package type	Note
SY59103NFCC	SO8E	----

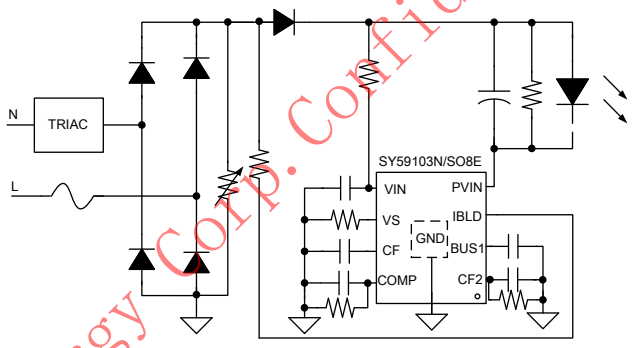
Features

- Compatible with Leading/Trailing Edge Dimmer
- Integrated 350V MOSFET
- Power Factor >0.7
- Up to 84% High Efficiency
- SMT Assembly
- Eliminate Magnetic Components
- Compact Package: SO8E

Applications

- LED Lighting
- Down Light/Bulb/Spot Lamp

Typical Applications



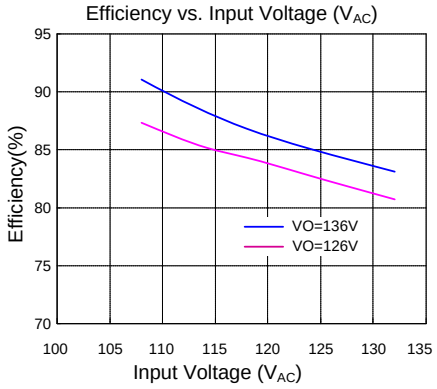
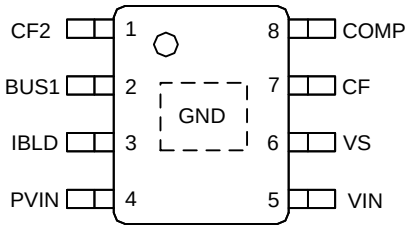


Fig1.Typical application

Pinout (top view)



(SO8E)

Top Mark: BWT*xyz* (device code: BWT, ***x=year code, y=week code, z= lot number code***)

Pin	Name	Description
1	CF2	TRIAC or Non TRIAC mode detection.
2	BUS1	Connect a 2.2nF to GND.
3	IBLD	Bleeding current from BUS to achieve good compatibility.
4	PVIN	Drain of integrated power MOSFET.
5	VIN	IC power supply.
6	VS	Source of integrated power MOSFET integrate, sense output current.
7	CF	TRIAC angle detection.
8	COMP	Loop compensation Pin.
Bottom	GND	GND of IC.

Block Diagram

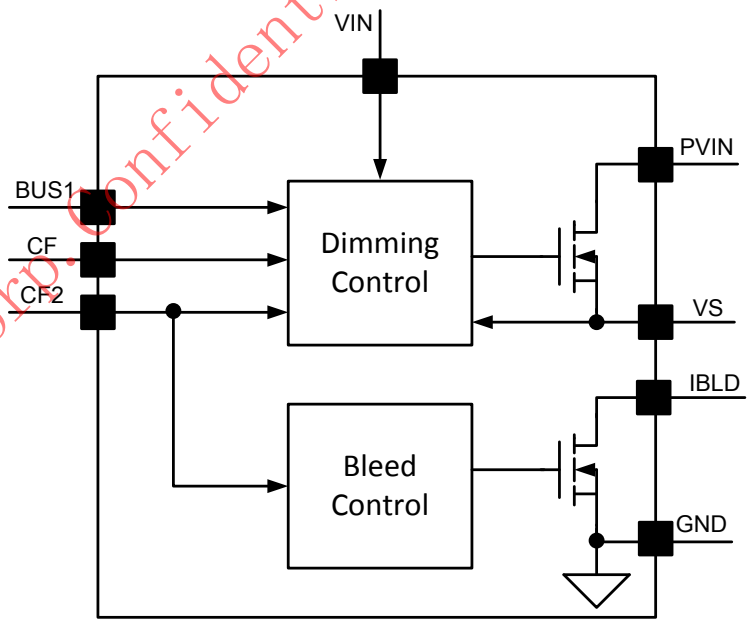


Fig2. IC block diagram

Absolute Maximum Ratings (Note 1)

PVIN ---------- -0.3V to 350V
IBLD ---------- -0.3V to 600V
COMP, BUS1 ---------- -0.3V to 25V
CF, CF2, VS ---------- -0.3V to 3.6V
VIN ---------- -0.3V to 21V
Supply current I_{VIN} ---------- 10mA
Power Dissipation, @ T_A = 25°C SO8E ---------- 3.3W
Package Thermal Resistance (Note 2)
SO8E, θ_{JA} ---------- 30°C/W
SO8E, θ_{JC} ---------- 10°C/W
Temperature Range ---------- -40°C to 150°C
Lead Temperature (Soldering, 10 sec.) ---------- 260°C
Storage Temperature Range ---------- -65°C to 150°C

Recommended Operating Conditions (Note 3)

VIN ---------- 12V~18V

Electrical Characteristics

(V_{IN} = 15V (Note 3), T_A = 25°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Power Supply Section						
VIN Turn-on Threshold	V_{VIN_ON}		15	17.5	20	V
VIN Turn-off Threshold	V_{VIN_OFF}		9.5	11.5	13.5	V
Quiescent Current	I_Q		210	255	320	μA
Internal Reference Voltage	V_{REF}		275	284	293	mV
BV of Integrated MOSFET	V_{Drain}		350			V
Thermal Section						
Thermal Fold Back Temperature	T_{FB}			150		℃
Thermal Shutdown Temperature	T_{SD}			160		℃

Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Note 2: θ_{JA} is measured in the natural convection at T_A = 25°C on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard. Test condition: Device mounted on 2" x 2" FR-4 substrate PCB, 2oz copper, with minimum recommended pad on top layer and thermal vias to bottom layer ground plane.

Note 3: Increase VIN pin voltage gradually higher than $V_{VIN,ON}$ voltage then turn down to 15V.

Operation

The SY59103N is a dimmable linear AC/DC driver with integrated 350V MOSFET for LED lighting.

It's compatible with Leading/Trailing edge dimmer.

With the constant current control, SY59103N can achieve good line regulation and load regulation.

The patented technique leads to high power efficiency and PF (>0.7).

SY59103N provides reliable protections such as over temperature protection (Thermal fold-back), etc.

SY59103N is available with SO8E package.

Applications Information

Start Up and IC Power Supply

After AC supply is powered on, C_{VIN} is charged up by BUS voltage through a start up resistor R_{ST}. Once V_{VIN} exceeds V_{VIN_ON}, IC starts to work and R_{ST} supplies IC operation current.

The startup procedure is shown in Fig.3.

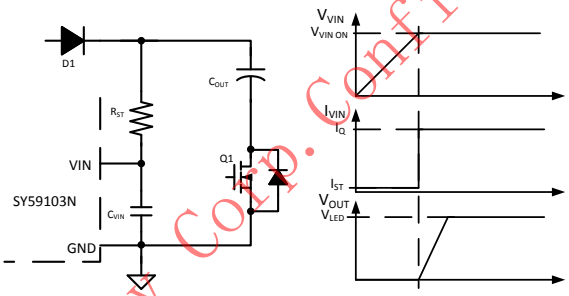


Fig.3 Start up

Shut Down

After AC supply is powered off, the energy stored in the output capacitor will be discharged. When V_{VIN} is below V_{VIN_UVLO}, the IC will stop working and V_{COMP} will be discharged to zero.

Constant-Current Control

The output current I_{OUT} can be represented by

$$I_{OUT} = \frac{V_{REF}}{R_S}$$

Where V_{REF} is the internal reference voltage; R_S is the current sense resistor.

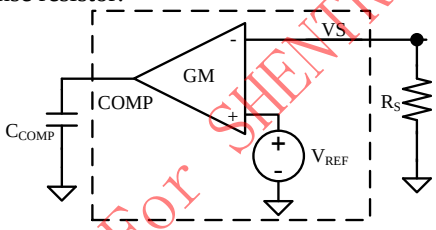


Fig.4 Closed loop

Output capacitor C_{COMP} need to be big enough to keep average output current is equal to V_{REF}.

Special Design for Current Compensation

To have a better efficiency, special design is integrated in SY59103N.

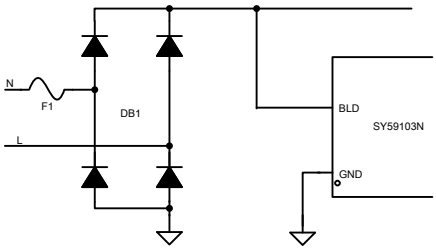


Fig.5 The patented technology of compensation

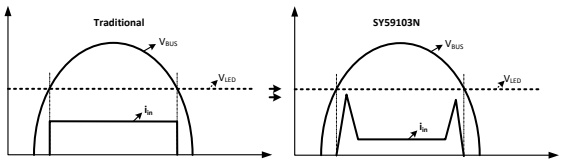


Fig.6 Shape of current compensation

With traditional LDO, when V_{BUS}>V_{LED}, I_{IN} is constant. The loss power is high when V_{BUS} is higher than V_{LED}. The SY59103N adopt the compensation from BUS voltage. When V_{BUS} is close to V_{LED}, increase input current, and when around the peak of V_{BUS}, decrease input current. The total output current is constant by closed loop.

TRIAC Dimming

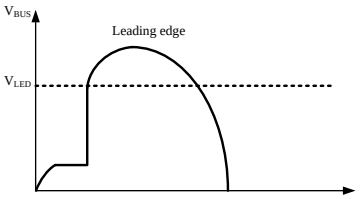


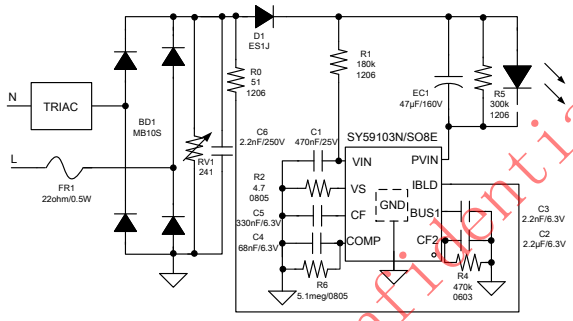
Fig.7 BUS voltage with TRIAC

When cooperate with dimmer, IC will provide enough latching current and holding to keep dimmer working normally.

Thermal Fold-back Function

SY59103N have thermal fold-back function.

Design Guide:



Fib.8 Schematic

1: Power Supply Module:

R1 and C1 is start up and power supply module:

(a) Power supply of SY59103N is from R_1 (by D1 and EC1), and maximum operation current is I_{Q_MAX}. Consider of operating condition and power loss, 180KΩ is recommended.

$$R_S < \frac{V_{OUT\_MIN} - V_{VIN\_UVLO}}{I_{Q\_MAX}} = \frac{80V - 11.5V}{320uA} = 214K$$

(b) Consider ripple on C_{VIN} and IC supply voltage is about 18V, C_{VIN} is recommended 470nF/25V.

2: Sense Resistor

Inter Ref is 284mV, R_S=284mV/I_{OUT}. As connect a 5.1meg resistor between COMP and GND, RS need to reelect around the result calculated.

3: Output Electrolytic Capacitor

According to output current ripple requirement, usually, when select 47μF electrolytic capacitor, output ripple is around ± 25%I_{OUT}, when select 22μF electrolytic capacitor, output ripple is around ±45%I_{OUT}.

4: C_{COMP} Selection

Consider of PF and loop response speed, C_{COMP} is suggested 68nF～100nF.

5: C_{CF} Selection

CF is use for TRIAC angle detection, on other way, the duty V_S>V_{S_LOW}, by filtering the angle and change reference inter according to V_{CF}. C_{CF} is suggested 220nF～470nF.

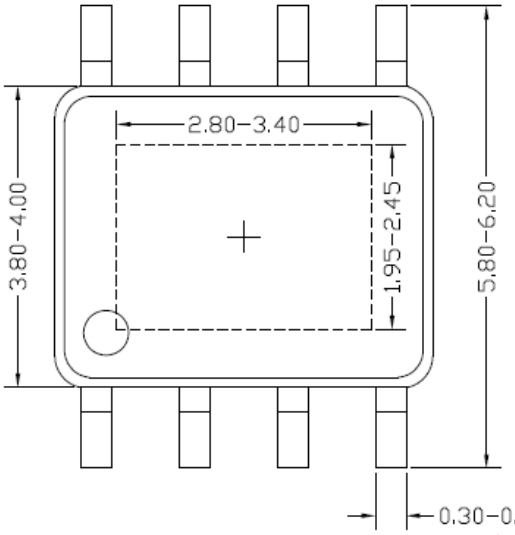
6: C_{CF2} Selection

CF2 is use for TRIAC or non TRIAC detection, 1uF~2.2μF is recommended for C_{CF2}, usually a resistor is paralleled between CF2 and GND.

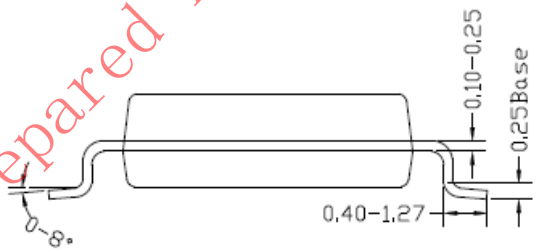
7: C_{BUS1} Selection

BUS1 is an internal compensation PIN, a 2.2nF compensatory capacitor is recommended to connect between BUS1 and GND.

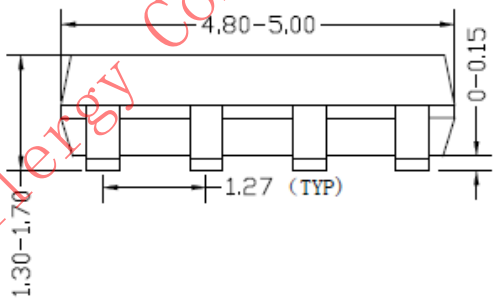
SO8E Package Outline & PCB layout



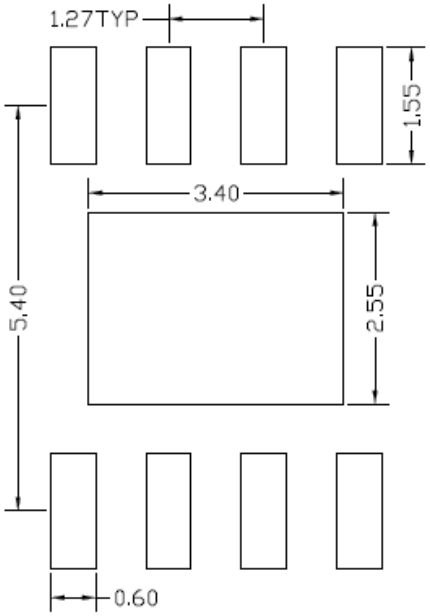
Top view



Side view



Front view



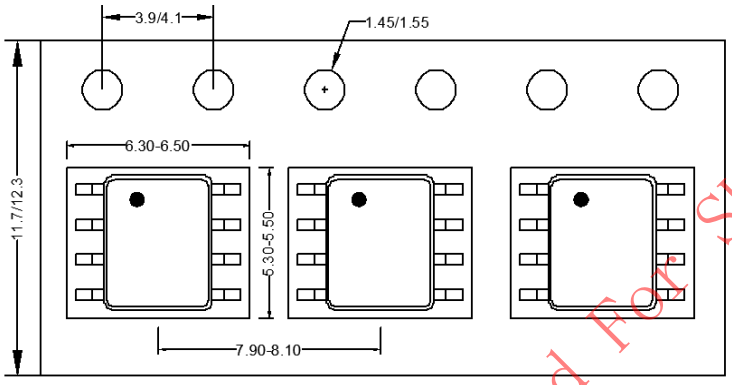
Recommended PCB Layout
(Reference Only)

Notes: All dimension in millimeter and exclude mold flash & metal burr.

Taping & Reel Specification

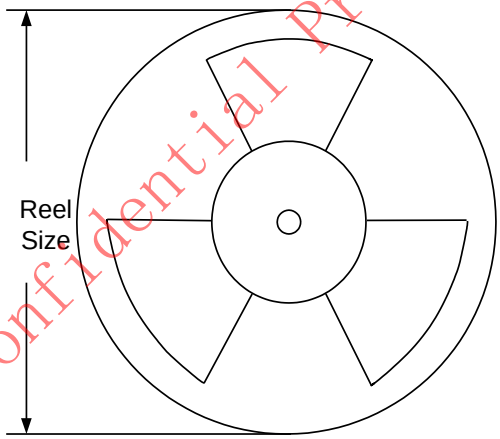
1. Taping orientation

SO8E



Feeding direction ⟶

2. Carrier Tape & Reel specification for packages



Package types	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer * length(mm)	Leader * length (mm)	Qty per reel (pcs)
SO8E	12	8	13"	400	400	2500

Others: NA

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