SY22633

Single Stage LED driver
Dimmable, High PF and Low BOM Cost

General Description

SY22633 is a single-stage driver for LED lighting applications.

SY22633 adopts proprietary techniques to identify whether dimmer applied and dimmer types. Good compatibility is achieved with Leading/Trailing edge dimmer and high PF is achieved without any dimmer.

SY22633 drives the converter in Quasi-Resonant mode to achieve high efficiency. Reliable Open/Short LED protections are integrated.

SY22633 integrates high voltage power FET inside to save driver space further.

SY22633 is available in SO8 package.

Features

- Compatible with Leading Edge/Trailing Edge Dimmer
- Active Break to Achieve Low Power Application
- High PF without Any Dimmer, PF>0.9
- Internal Dimming Curve 5%~100%
- 600V FET Integrated
- Quasi-Resonant Operation
- Reliable Open/Short LED Protection
- Thermal Fold Back
- Low BOM Cost
- RoHS Compliant and Halogen Free
- Compact Package: SO8

Applications

- LED Lighting
- Leading Edge Dimming
- Trailing Edge Dimming

Ordering Information

SY22633□(□□)□
- Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package type	Note
SY22633FAC	SO8	--

Typical Applications

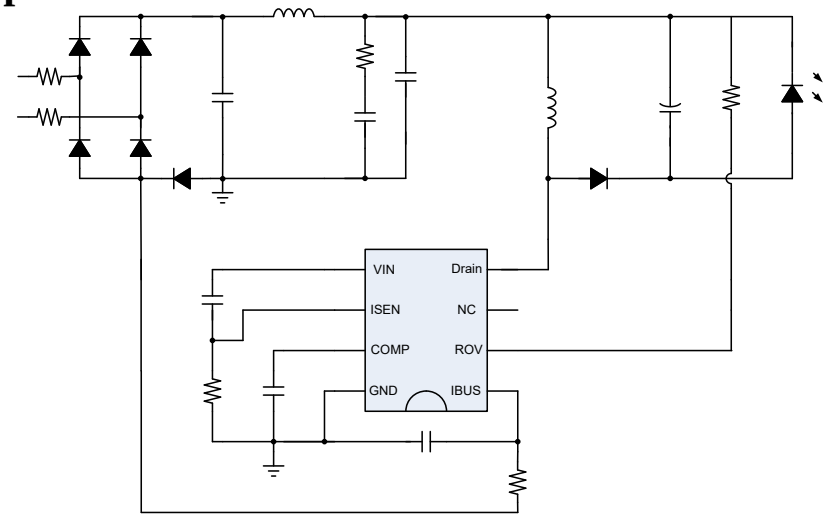
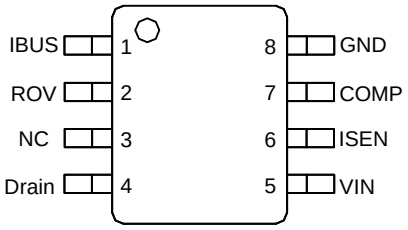


Figure .Schematic Diagram

Pinout (top view)

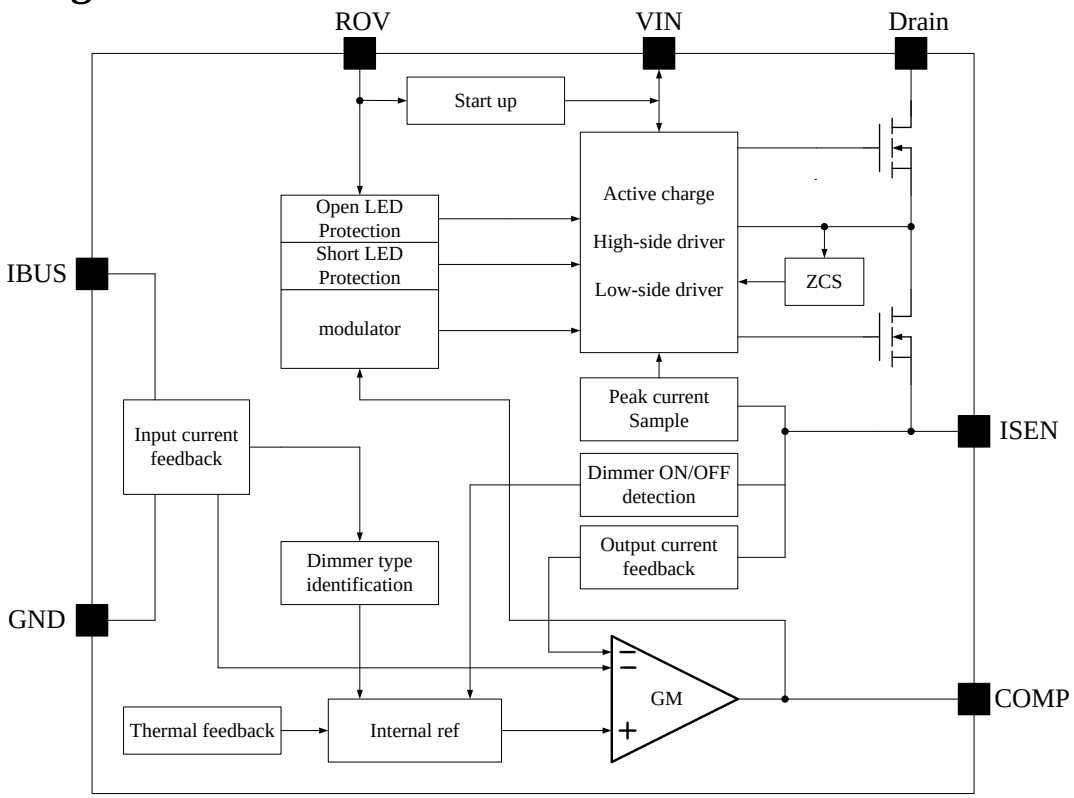


(SO8)

Top Mark: **BJC*xyz*, (**Device code: BJC; ***x=year code, y=week code, z= lot number code***)

Pin Name	Pin Number	Pin Description
IBUS	1	Input current sense pin.
ROV	2	Over voltage protection set pin.
NC	3	Leave it float.
Drain	4	Internal FET drain node.
VIN	5	Bias supply pin.
ISEN	6	FET current sense pin.
COMP	7	Output of internal Gain Modulator. Generally, a capacitor is connected across COMP and GND
GND	8	Ground pin.

Block Diagram



Absolute Maximum Ratings (Note 1)

ISEN, COMP ---------- -0.3V~3.6V
IBUS ---------- -1V~0.6V
VIN ---------- -0.3V~20V
ROV ---------- -0.3V~V_{VIN}+3V
Drain ---------- -1V~600V
Power Dissipation, @ T_A = 25°C SO8 ---------- 1.1W
Package Thermal Resistance (Note 2)
SO8, θ_{JA} ---------- 88°C/W
SO8, θ_{JC} ---------- 45°C/W
Junction Temperature Range ---------- -40°C to 165°C
Lead Temperature (Soldering, 10 sec.) ---------- 260°C
Storage Temperature Range ---------- -65°C to 150°C

Recommended Operating Conditions (Note 3)

Ambient Temperature Range ---------- -40°C to 105°C

Electrical Characteristics

(V_{IN}= 10V, 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}		13	14	15	V
VIN Turn-off Threshold	V_{VIN_OFF}		7	7.8	8.5	V
Start up Current	I_{ST}		3	9	16	μA
Operation Current	I_Q	V_{ISEN}=0	360	475	590	μA
VIN Shunt Current When Protection	I_{VIN_Shunt}		4	5.7	7	mA
ISEN Pin Section						
Internal Reference Voltage	V_{REF_IO}		294	300	306	mV
Current Limit Voltage	V_{ISEN_LIM}		275	300	325	mV
Threshold for Conduction Duty Detection	V_{ISEN_TH}		40	50	60	mV
Coefficient for Output Current Calculation	K_{IO}			3		
ROV Pin Section						
OVP Coefficient	K_{OVP}		79	85	90	μA
IBUS Pin Section						
Regulated input current	I_{IBUS_REF}		29	33	37	mA
PWM Logic Section						
Minimum PWM ON Time	T_{ON_MIN}			430		ns
Minimum PWM OFF Time	T_{OFF_MIN}			2		μs
Maximum PWM ON Time	T_{ON_MAX}	dimmer ON/dimmer OFF		6.5/13		μs
Maximum PWM OFF Time	T_{OFF_MAX}	dimmer ON/dimmer OFF		140/7		μs
Integrated MOSFET Section						
BV of MOSFET	V_{BV}		600			V
Thermal Section						
Thermal Fold Back Threshold	T_{FB}			150		°C
Thermal Shut Down Temperature	T_{SD}			165		°C

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.

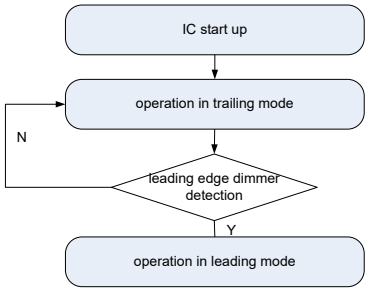
Note 2: θ_{JA} is measured in the natural convection at T_A = 25°C on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard. Test condition: Device mounted on 2" x 2" FR-4 substrate PCB, 2oz copper, with minimum recommended pad on top layer and thermal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

Note 3: The device is not guaranteed to function outside its operating conditions.

Operation

Operation flow

The IC provides different operation modes for different dimmer types.



Dimmer type detection:

IC detects input current variation to identify the dimmer type.

Trailing mode:

The IC discharges the input capacitor quickly when dimmer OFF is detected, which ensures the compatibility for trailing edge dimmer. Active break scheme is applied to achieve low power applications.

Leading mode:

The IC guarantees the input current higher than the latching current and holding current of leading edge dimmer, which ensures the compatibility for leading edge dimmer. Active break scheme is applied to achieve low power applications.

Start up

After AC supply is powered on, the capacitor C_{VIN} across VIN and GND pin is charged up by BUS voltage through the resistor R_{ROV}. Once V_{VIN} rises up to V_{VIN_ON}, the internal blocks start to work and V_{COMP} is pre-charged to certain value. After start up, V_{VIN} is sustained by internal active charge block.

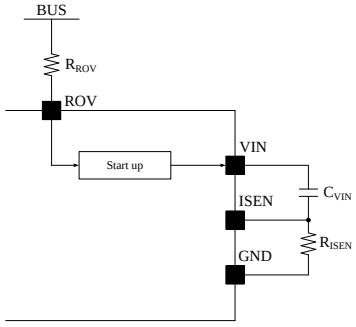


Fig. Start up

C_{VIN} is selected to obtain an ideal start up time t_{ST}, the recommended formula is as below:

$$C_{VIN} = \frac{(\frac{V_{BUS}}{R_{ROV}} - I_{ST}) \times t_{ST}}{V_{VIN\_ON}}$$

Shut down

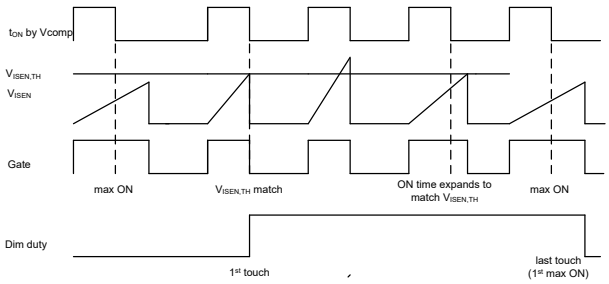
After AC supply is powered off, the energy stored in the BUS capacitor will be discharged. When the internal active charge block cannot supply enough energy to VIN pin, V_{VIN} will drop down. Once V_{VIN} is below V_{VIN_OFF}, the IC will stop working and V_{COMP} will be discharged to zero.

LED current setting

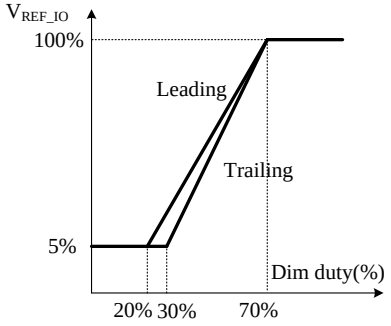
The LED current is set by the resistor R_{ISEN} across ISEN and GND. The relationship is as below:

$$I_{LED} = \frac{V_{REF}}{2 \times K_{IO} \times R_{ISEN}}$$

Conduction angle detection



The threshold V_{ISEN_TH} on ISEN pin is applied to detect the conduction duty. t_{ON} is controlled by V_{COMP} generally to achieve high PF, which is relatively stable. If V_{ISEN} cannot reach V_{ISEN_TH} by V_{COMP}, t_{ON} will expand to reach V_{ISEN_TH} till max t_{ON}. When V_{ISEN} is higher than V_{ISEN_TH}, dimmer ON is identified; when V_{ISEN} is lower than V_{ISEN_TH}, although max t_{ON} is output, dimmer OFF is identified. The dim duty is transferred to output current by the curve below.



Open LED

The protection voltage V_{OVP} for open LED is set by the resistor R_{ROV} across BUS and ROV pin.

$$V_{OVP} = K_{OVP} \times R_{ROV}$$

If Over Voltage is triggered, the PWM output is stopped and V_{VIN} is discharged by I_{VIN_shunt}. The IC operates in hiccup mode.

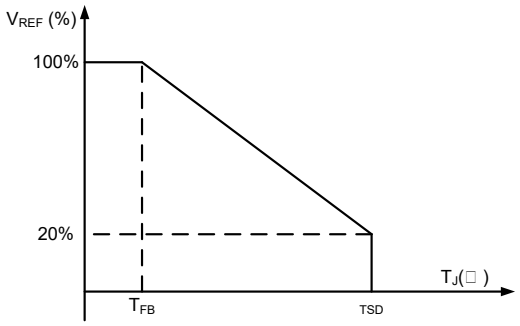
Short LED

If LED is short, the PWM output is stopped and V_{VIN} is discharged by I_{VIN_shunt}. The IC operates in hiccup mode.

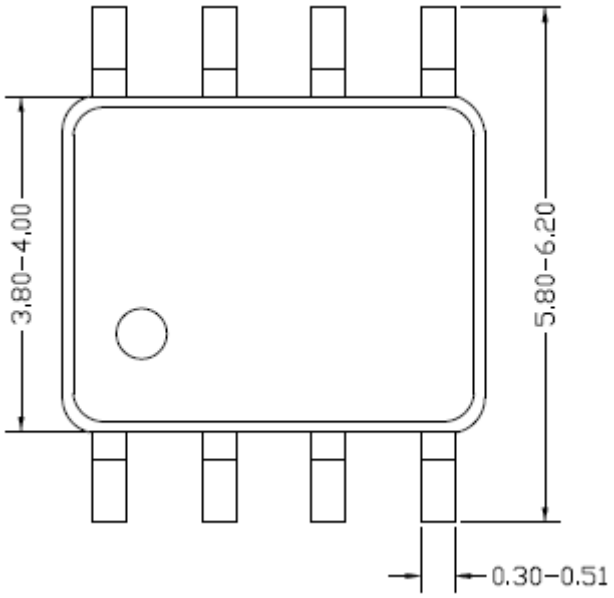
Thermal treatment

Thermal fold back is adopted in this IC. Thermal fold back curve is shown as below.

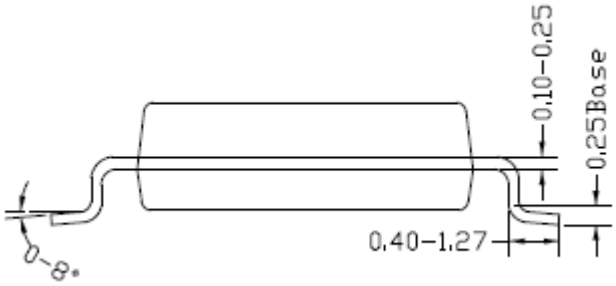
When the junction temperature rises high, internal current reference decreases first; if the junction temperature still rises up over T_{SD}, IC will be shut down.



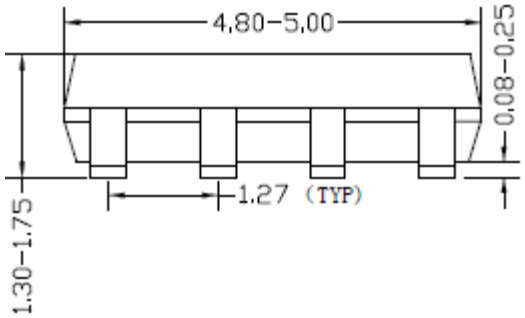
SO8 Package outline & PCB layout design



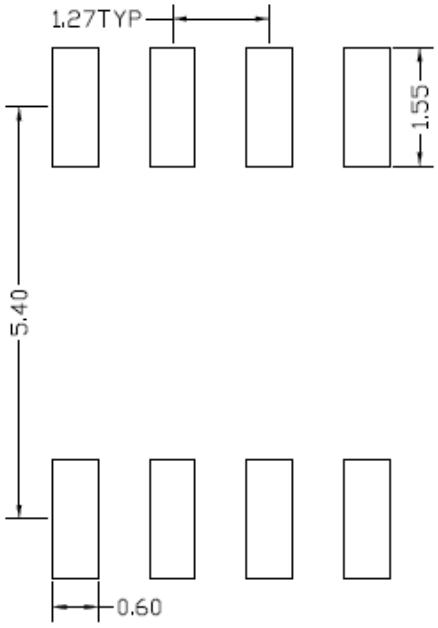
Top view



Side view



Front view

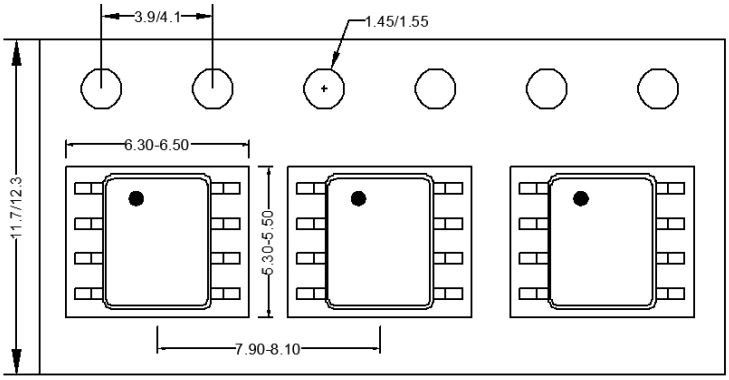


Recommended Pad Layout
(Reference only)

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

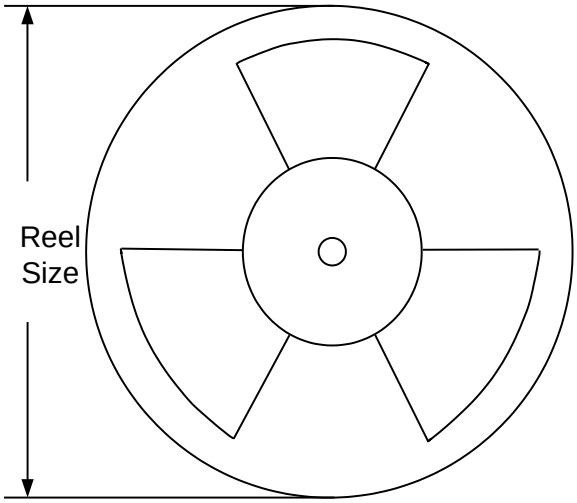
Taping & Reel Specification

1. Taping orientation for packages（SO8）



Feeding direction ⟶

2. Carrier Tape & Reel specification for packages



Package type	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer length(mm)	Leader length (mm)	Qty per reel
SO8	12	8	13"	400	400	2500

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