SY22698

High Efficiency Linear AC/DC Driver With Integrated 500V MOSFET

General Description

The SY22698 is a linear AC/DC driver with integrated 500V MOSFET. Constant current control leads to good line regulation and load regulation. The patented technique is used to achieve high efficiency and high power factor. Multi-chip in parallel is available for higher output current application. The compact package and less peripheral components make it available for small structure lamps application.

Features

- Integrated 500V MOSFET
- Power Factor >0.5 or >0.7
- Up to 88% High Efficiency
- ±3% Output Current Precision
- SMT Assembly
- Eliminate Magnetic Components
- Adjustable Thermal Fold Back
- Compact Package: SO8E

Ordering Information

SY22698 □(□□)□

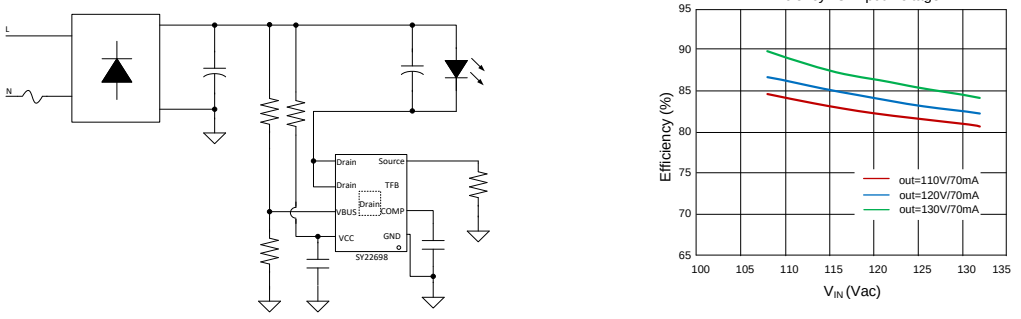
- Temperature Code
- Package Code
- Optional Spec Code

Ordering Number	Package type	Note
SY22698FCC	SO8E	----

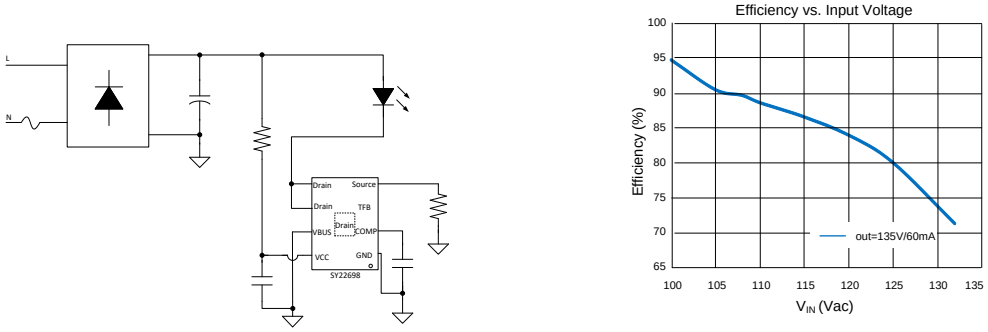
Applications

- LED Lighting

Typical Applications



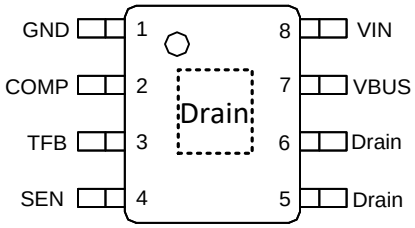
(a)With V_{BUS} compensation



(b)Without V_{BUS} compensation

Fig. 1 Schematic Diagram and Efficiency Vs Input Voltage

Pinout (top view)



(SO8E)

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

Pin	Name	Description
1	GND	Ground PIN.
2	COMP	Compensation PIN, connect a cap to GND.
3	TFB	Adjust thermal fold back by changing the resistor between TFB and GND
4	SEN	Source PIN of integrated MOSFET, sense output current.
5,6	Drain	Drain PIN of integrated MOSFET.
7	VBUS	Sense BUS voltage, and compensate to COMP.
8	VIN	IC power supply PIN
Bottom	Drain	Drain of integrated MOSFET.

Block Diagram

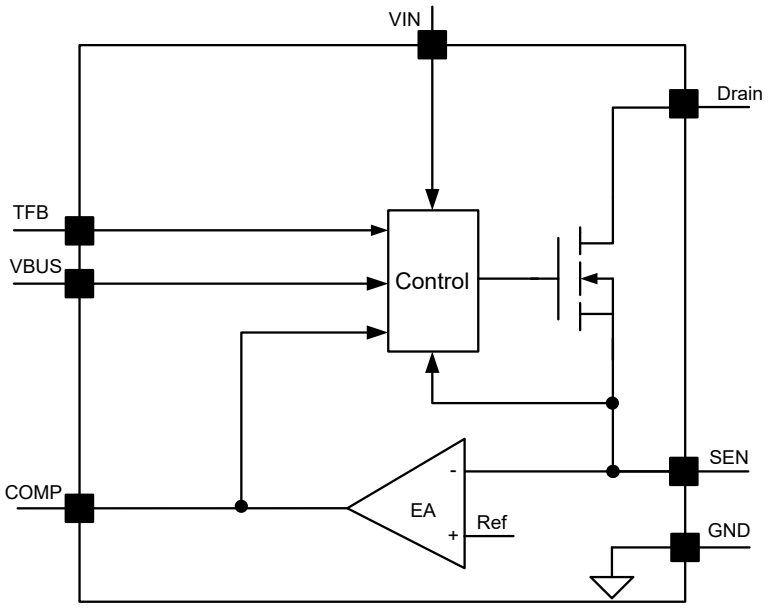


Fig.2 Block Diagram

Absolute Maximum Ratings (Note 1)

Drain---------- 0.3V to 500V
Supply Current I_{VIN} ---------- 1.0mA
VIN---------- -0.3V to 18V
VBUS---------- -0.3V to VIN+0.3V
COMP, TFB, SEN---------- -0.3V to 3.6V
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---------- 9V~15.5V
Absolute maximum range---------- -40°C to 150°C

Electrical Characteristics

(V_{IN} = 12V (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}		12.7	14	15.5	V
VIN Turn-off Threshold	V_{VIN_OFF}		6.3	7.5	8.3	V
Start up Current	I_{ST}	$V_{VIN}<V_{VIN\_OFF}$		30		μA
Quiescent Current	I_Q			210		μA
Internal Reference Voltage	V_{REF}		194	200	206	mV
Protection Current Limit Voltage of Source PIN	V_{S_EX}		2	2.3	2.6	V
BV of Integrated MOSFET	V_{DRAIN}		500			V
Thermal Section						
Thermal Fold-back Temperature	T_{FB}	R_{TFB}=0		106		℃
		R_{TFB}=10k		120		℃
		$R_{TFB}\geqslant$100k		150		℃

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 12V.

Operation

The SY22698 is a linear AC/DC driver targeting at LED lighting applications.

It integrates a MOSFET with 500V breakdown voltage to decrease external component.

With the constant current control, SY22698 can achieve good line regulation and load regulation.

The patented technology is used to compensate the output current. With this method the SY22698 can use a small capacitance after rectifier bridge, and the high efficiency and high PF>0.7 are achieved.

SY22698 provides reliable protections such as short circuit protection (SCP), over current protection (OCP), open LED protection (OLP), over temperature protection (Thermal fold-back), etc.

SY22698 is available with SO8E package.

Applications Information

Start Up

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

The startup procedure is shown in Fig.3.

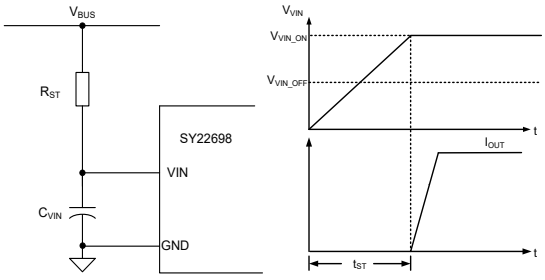


Fig.3 Start up

Shut Down

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

Special Design for Current Compensation

To have a better efficiency, special design is integrated into SY22698.

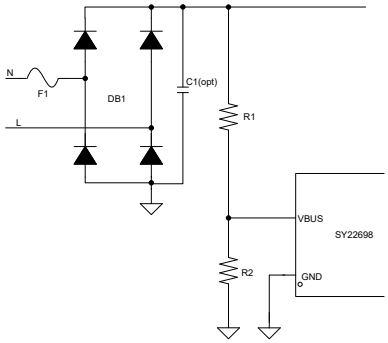


Fig.4 The patented technology of compensation

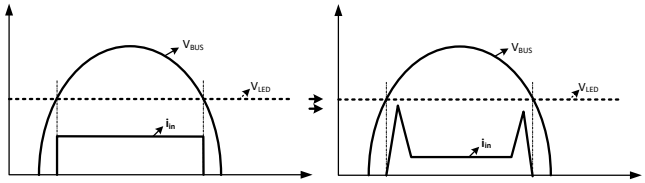


Fig.5 Shape of current compensation

With the traditional LDO, when $V_{BUS}>V_{LED}$, i_{LED} is constant. The loss power is high when V_{BUS} is higher than V_{LED}. The SY22698 adopt the compensation from BUS voltage. When V_{BUS} is close to V_{LED}, increase input current, and when around peak V_{BUS}, decrease input current. The total output current is constant by closed loop. In this way, the C1 is not necessary or just a small CBB.

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.

With the constant-current control, the SY22698 has a good line regulation and load regulation.

Thermal Fold-back Function (TFB)

The thermal fold-back temperature can be adjusted by R_{TFB}. The thermal fold-back point is increasing with the decreasing of R_{TFB}. When T_j reaches the point, the V_{COMP} will be pulled down and output current drops.

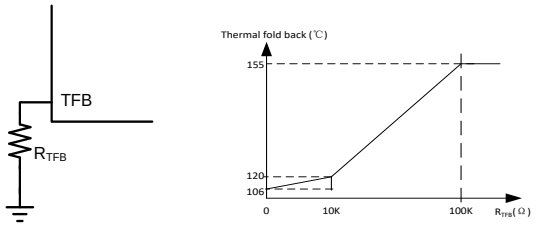


Fig.6 Thermal fold-back circuit and curve

Single fault design

When LED is short, there will be a high overshoot current on sense resistor, if IC detect V_S is higher than V_{S_EX}, MOSFET is turned off, COMP will be discharge to zero and V_{VIN} drops to V_{VIN_OFF}.

External Component Design Guide

VIN Resistor and Capacitor

Recommended a 470nF ceramic capacitor between VIN and GND;
If input AC voltage is 90~132Vac, recommended R_{ST} 470kΩ;
If input AC voltage is 176~264Vac, recommended R_{ST} 680kΩ;

Sense Resistor

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

Where V_{REF} is the internal reference voltage, I_{OUT} is average output current.

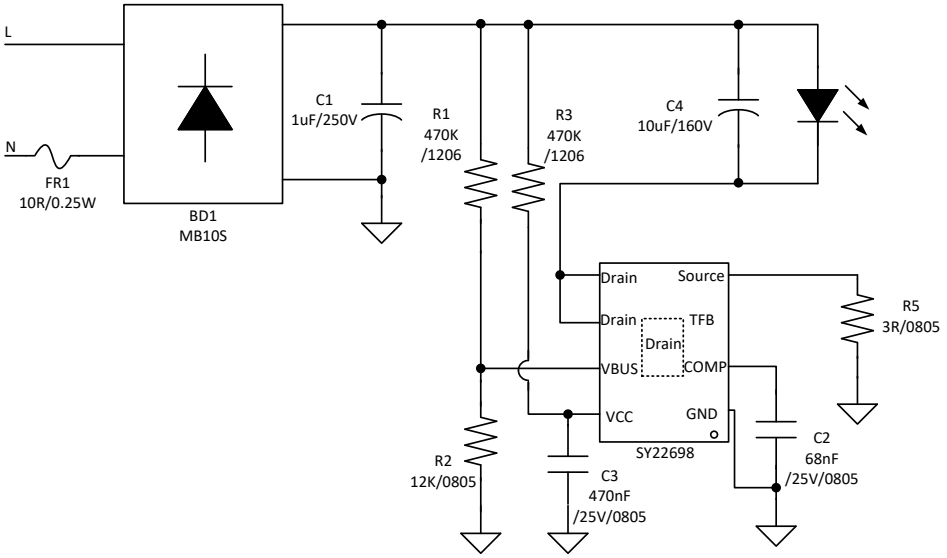
V_{BUS} Compensation Resistor

The compensation coefficient is obtained from V_{BUS}. Set $R_{\_BUS\_UP}$ =510kΩ and adjust $R_{\_BUS\_DOWN}$ based on PF requirement. If without V_{BUS} compensation, connect BUS PIN to GND.

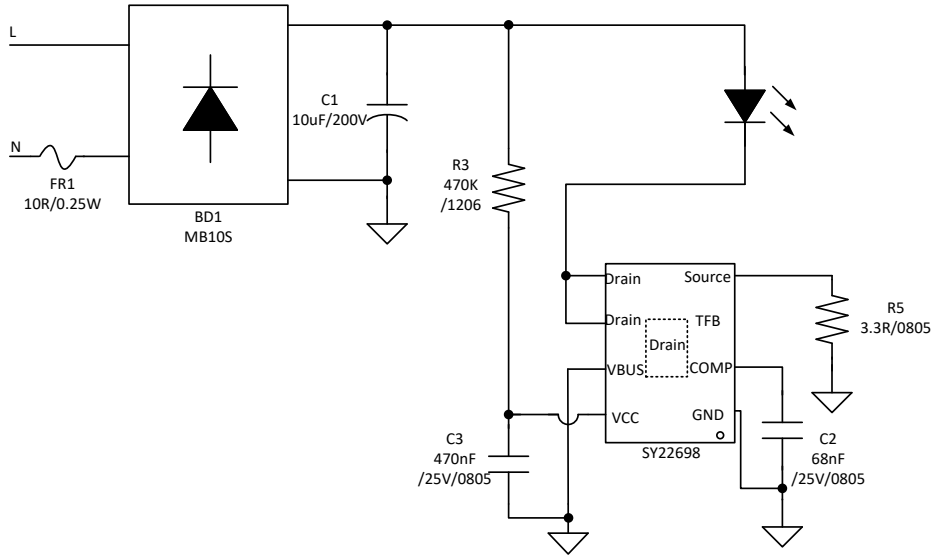
COMP Capacitor

Recommended a 47~100nF ceramic capacitor between COMP and GND;

Typical Application



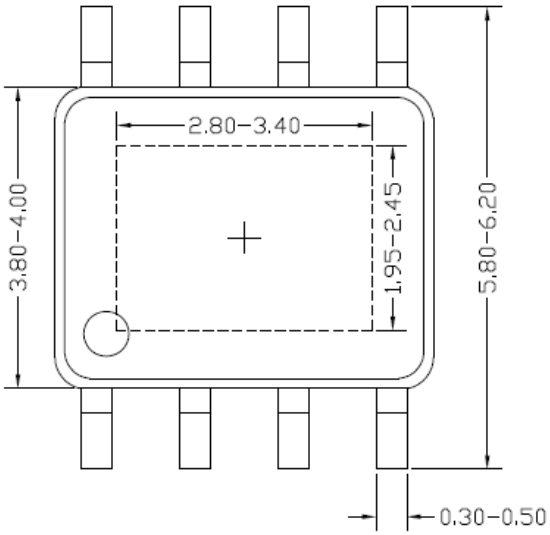
(a) With V_{BUS} compensation @ 100-132Vac Input, 126V/66.7mA Output, DOB application



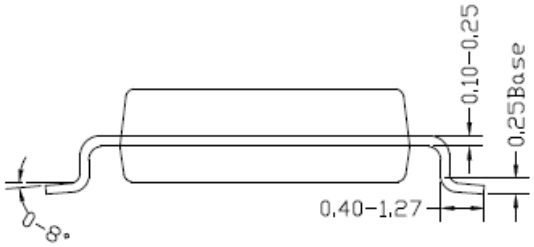
(b) Without V_{BUS} compensation @ 100-132Vac Input, 135V/60mA Output

Fig.7 Typical Application Circuit

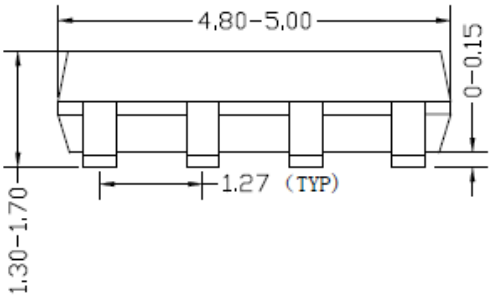
SO8E Package Outline & PCB layout



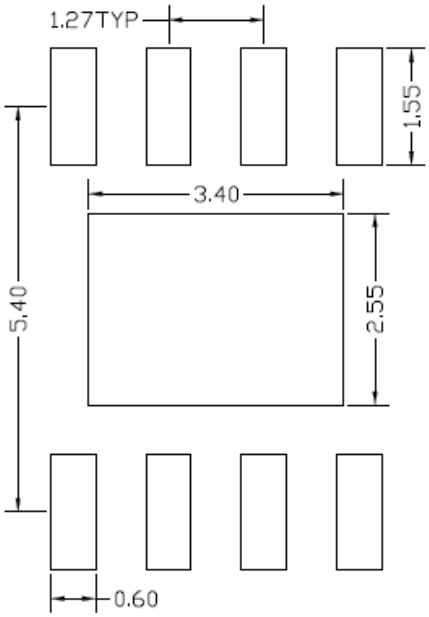
Top view



Side view



Front view



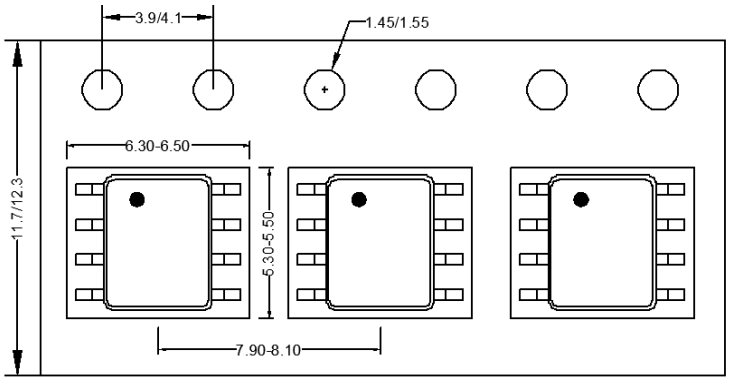
Recommended PCB Layout (Reference Only)

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

Taping & Reel Specification

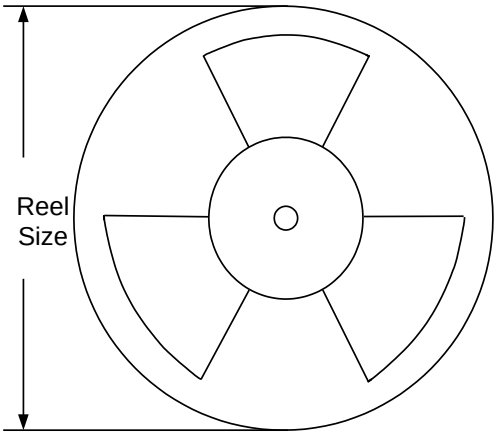
1. Taping orientation

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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