General Description

The EC4329 is a high precision non-isolated buck driver with APFC, specially designed for universal input offline constant current LED lighting, and reach out low THD. Operating in critical conduction mode, the power MOSFET switching loss is reduced and the inductor is fully utilized. Withthe fewest external components, and cutting- edge circuit design, output ability can be precisely controlled in the most competitive method of all kinds.

EC4329 adopts floating ground structure, inductor current is hence sensed during the whole switching cycle, which generates precise output current, line and load regulation when being applied in system.

EC4329 also features full protection function to enhance Reliability on board, including LED Open/ Short circuit Protection, OVP/ UVP/ OTP(Self- reduce)/ OCP Current Sensing Open protection, Soft start and so on.

EC4329 performed in compact SOT23-6 package.

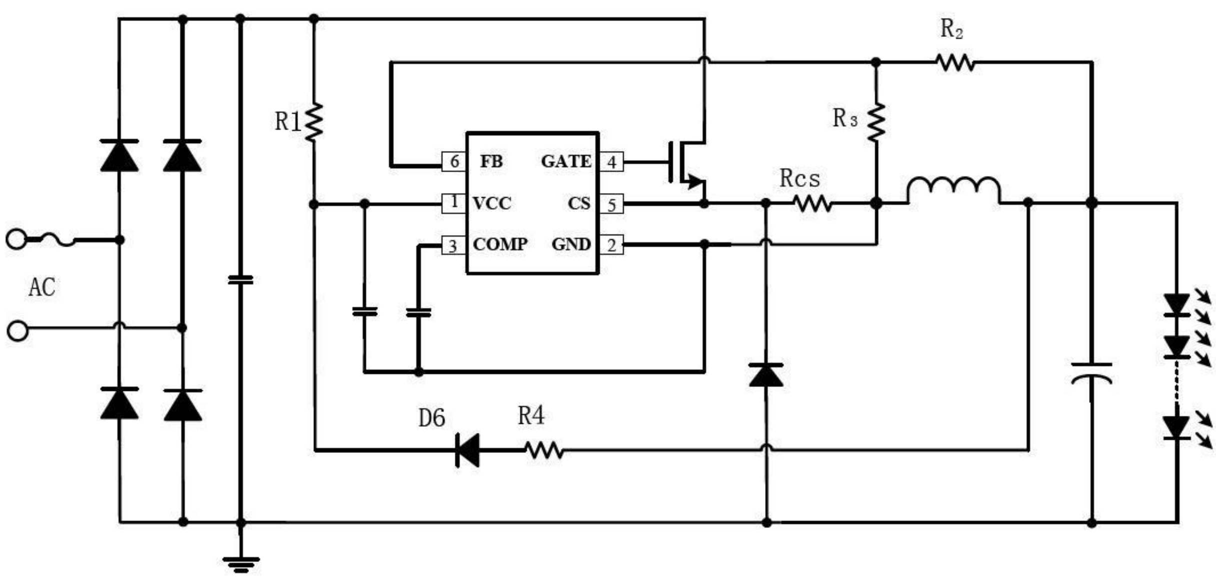
Features

- High Power Factor, ultra- low THD
- Valley Switch, High Efficiency, LOW EMI
- Soft Start
- Thermal Regulation Compensation
- ±3% Output Current Accuracy
- Universal AC input
- Auto Induction Compensate
- Auto Output Voltage adaption
- Full Protection Features: (LED O/S CKT; OTP OCP; OVP/UVP)
- Auto Recovery to default
- Fewest external components required on board

Applications

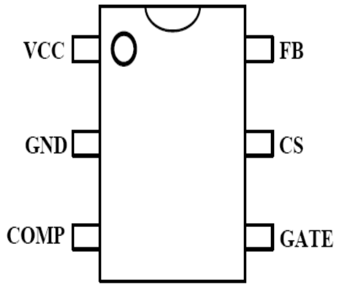
- LED High Brightness Lighting
- Light Bulb, Light Tube

Typical Application



Pin Configuration

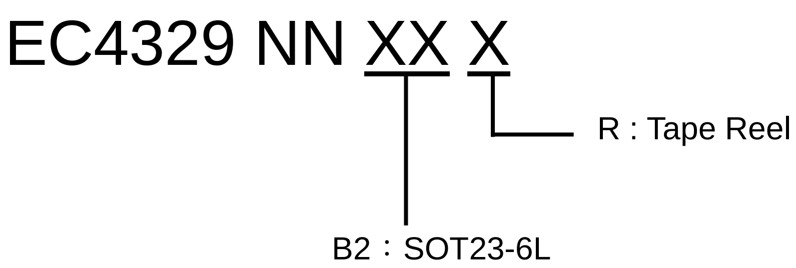
EC4329 performed in SOT23-6 Package shown as below：



Pin Definition

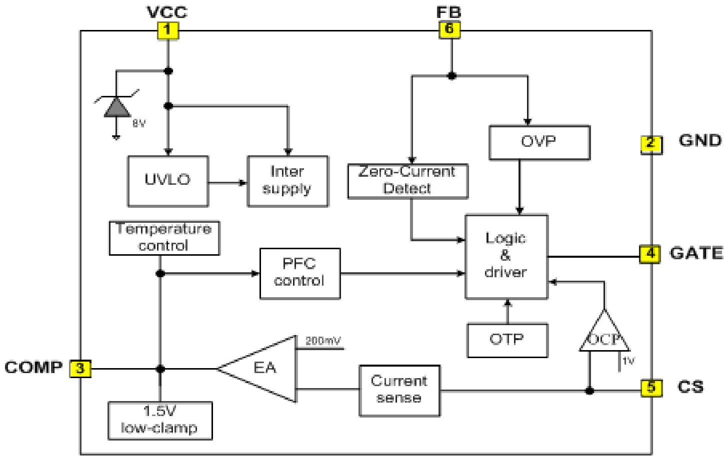
Pin Name	Pin #	Feature Description
VCC	1	Chip Power supply pPin
GND	2	Ground Pin of Chip
COMP	3	Loop Compensation node
GATE	4	Driving Pin to the external Power MOSFET(Gate)
CS	5	Current Sensing Pin. Connect a resistor to GND
FB	6	Feedback Voltage Input Pin

Ordering Information



Part No.	Package type	Marking	Remark
EC4329NNB3R	SOT23-6L	4329 LLLL	1. LLLL：LOT NO.

Block Diagram



Absolute Maximun Rating（ Note 1）

Symbol	Parameter	Range	Unit
V_{CC}	Input Voltage	-0.3~8.5	V
V_{CS}	Current Sensing Pin input Voltage	-0.3~7	V
V_{FB}	Feedback Pin Input Voltage	-0.3~7	V
V_{COMP}	Compensation Pin Voltage	-0.3~7	V
P_{DMAX}	Power Dissipation（Note 2）	0.25	W
T_J	Maximum Junction Temperature	160	℃
T_{STG}	Storage Temperature	-55~150	℃

Note 1: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. Under "recommended operating conditions" the device operation is assured, but some particular parameter may not be achieved. The electrical characteristics table defines the operation range of the device, the electrical characteristics is assured on DC and AC voltage by test program. For the parameters without minimum and maximum value in the EC table, the typical value defines the operation range, the accuracy is not guaranteed by spec

Note 2: The maximum power dissipation decrease if temperature rise, it is decided by TJMAX, θJA, and environment temperature (TA). The maximum power dissipation is the lower one between PDMAX = (TJMAX - TA)/ θJA and the number listed in the maximum table. Parameter shown in column is not including external Power MOSFET.

Recommended Operating Condition

	Parameter	Range	Unit
V_{CC}	Vcc Voltage	7.5~8.5	V
T_A	Operating Temperature	-20~85	℃

Electrical Characteristics (Unless otherwise specified, VCC=8V and TA =25 ℃)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
Supply Voltage Section						
V_{cc_clamp}	VCC clamp Voltage		7.5	8.0	8.5	V
I_{cc_clamp}	VCC clamp Current				5	mA
V_{CC_ST}	Start-up Voltage	VCC rising	7.07	7.57	8.07	V
V_{uvlo_HYS}	UVLO Hysteresis Voltage	VCC falling		1.32		V
I_{st}	Start-up Current	VCC<VCC_ST-0.5V		70	100	uA
I_{op}	Operating Current			400	600	uA
Current Sensing Section						
Vocp	OCP Peak Voltage Limitation			1		V
T_{LEB}	Leading Edge Blanking Time for Current Sense			350		ns
Td	Switch off Delay Time			200		ns
Compensation Section						
V_{REF}	Internal Reference Voltage		194	200	206	mV
V_{CL}	COMP Low Clamp Voltage			1.5		V
V_{CH}	COMP High Clamp Voltage			4.0		V
Internal Driving Section						
T_{OFF_MIN}	Minimum Off Time			3		us
T_{ON_MAX}	Maximum On Time			20		us
T_{OFF_Max}	Maximum Off Time			100		us
Feedback Section						
V_{FB}	FB Over Voltage Protection			1.6		V
V_{ZCD}	FB Falling Edge Threshold Voltage			0.2		V
Over Temp. Protection Section						
T_{comp}	Thermal regulation Temp.			150		℃
T_{SD}	OTP Shut Down Temp.			160		℃
T_{SD_HYS}	Shut Down Hysteresis Temp.			30		℃

Application Info.

EC4329 is a high precision Active PFC driver which specifically designed for non-isolated buck offline constant current LED lighting. Even when switching in critical conduction condition, EC4329 achieves high power factor, high efficiency and ultra- low THD.

Start- up

With ultra- low start- up power(Typ.@70uA, Max. @ 100uA)，when it is applied at Vac = 85V to start- up，the start- up Resistance can be calculated in below ：

$$R = \frac{85 * \sqrt{2}}{100} = 1.2M$$

Chip Power supply and consumption

After EC4318 being started-up，the rectifier D6 is crucial to adopt fast recovery Diode. The formula of Current- limit resistance R4 would be：

$$R_4 = (1-D) * \frac{V_{LED} - 9}{400uA}$$

In which “D” stands for duty Cycle，and 400uA is normal operating current of EC4329， V_{LED} is output loading voltage. Power consumption of this certain Resistor can be calculated at：

$$P_{R4} = \frac{(V_{LED} - 9)^2}{R4} * (1-D)$$

For instance：when Solution requires：
Vac in= 180~260V，Vout= 36~80V，Iout= 240mA Then, in low range of Vac in=180V; Vout =36V => R4 could be generated in the following calculation:
D=36/180/1.414=0.141, R4=(1-0.141)*(36-9)/400uA=58K;
In high range of Vac in= 260V，Vout= 80V，then
D=80/260/1.414=0.218，and the power consumption of resistance is：
P=（80-9）*（80-9）/58 * (1-0.218)=68 mW。

Output Current control

The EC4329 utilizes floating ground structure. The inductor current is sensed during the whole switching cycle, hence it achieves high precision output current and perfect line and load regulation. The current in LED can be calculated by equation of:

$$I_{LED} = \frac{0.2V}{Rcs}$$

Where 200mV is the internal reference voltage, and Rcs is the value of current- sensing resistor.

Feedback Voltage measurement (OVP)

Voltage on FB pin determines operating state on board，when it reaches over 1.6V(Typ.) , EC4318 would sense and turn into Over- Voltage Protection mode， and system is thus jump to power- saving “ hiccup mode”， OVP voltage is generated by：

$$V_{OVP} = 1.6 * \frac{R_2 + R_3}{R_3}$$

Please refer to typical application schematic to find R2 & R3, in which R_3=10K,（15K Max., and 8.2K Min.）， in above formula, the Constant 1.6 can be put 1.3 when designing systems, Set Vovp= 90V, we can come out R_2=552K from above equation, herewith, we adopt 560K resistor instead. As VFB is between 1.3-1.9, when choosing the withstand voltage of C4, It is recommended to set @ 1.9，hence， Vovp =1.9*（10+560）/10 =108V，moreover, the Withstand Voltage of C4 must be over Vovp，herein We choose C4 @ 200V. After EC4329 falls in “hiccup mode”, the output voltage is automatically sensed constantly in working cycles. When output voltage is beneath Vovp, system would recover to normal function state.

LED Open/ Short Protection

When the LED is open circuit, the output voltage will gradually rise up. The output voltage is sensed by the FB pin when power MOSFET is turned off. When FB voltage reaches the OVP threshold, it will trigger fault logic and the system stops switching. When the LED is shorted circuit, the system will work under 10kHz switching frequency. Meanwhile, the output voltage is low and the V_{CC} pin cannot be charged up by the output voltage, so the V_{CC} pin voltage will gradually decrease and finally reaches the UVLO threshold.

Thermal Regulation (Over Temp. Protection)

The EC4329 integrates thermal regulation function. When the system is over temperature, the output current is gradually reduced; the output power and thermal dissipation are also reduced. The system temperature is regulated and the system reliability is improved. The thermal regulation temperature is set to 150℃ internally.

Filtering input Capacitor

With purposes to gain higher power factor, this Cap. Is suggested to set @ 10-100nF

PCB Layouts

The following guidelines is recommended in EC4329 PCB layout:

Bypass Capacitor:

The bypass capacitor on V_{CC} pin should be as close as possible to the V_{CC} and GND pins.

Ground Path:

The power ground path for current sense resistor should be short and wide, and it should be as close as possible to the IC ground pins, otherwise the LED output current accuracy may be affected. The IC signal ground for COMP and FB components should be connected to the IC GND pins with short traces, and should be away from the power ground path.

The Area of Power Loop

The area of main current loop should be as small as possible to reduce EMI radiation.

FB Pin

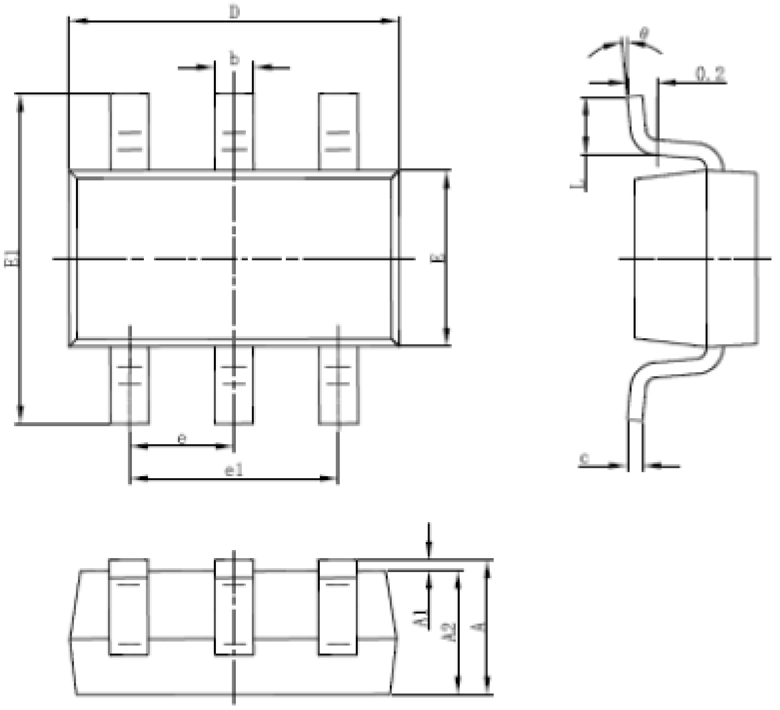
The feedback resistor divider should be as close as possible to the FB pin, and the trace must keeps away from dynamic node of the inductor (DRAIN Pin trace), otherwise the FB pin OVP function might have risk to be mis-triggered by noise in system.

DRAIN Pin

To increase the copper area of DRAIN pin for better thermal dissipation. However, over- enlarged copper pad might also compromise EMI performance. Please leverage.

Package Information

SOT-23-6L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°