

LZC821

Active LED Current Ripple Filter Controller

General Description

LZC821 is a high efficiency active LED current ripple filter controller optimized for LED general lighting applications.

In order to achieve high input power factor, small form factor and low bill of material cost, single stage Power Factor Correction (PFC) flyback topology is widely adopted in LED general lighting applications. But this topology has an intrinsic weakness, it is the output LED current always has the 100Hz or 120Hz line frequency ripple, which may cause visible flickering or interference with video devices.

LZC821 is secondary side adaptive LED current regulator controller which automatically compensate the output voltage ripple from single stage PFC flyback converter and regulates the forward current flow through LED string always to be in constant level regardless the absolute amplitude level of the LED current.

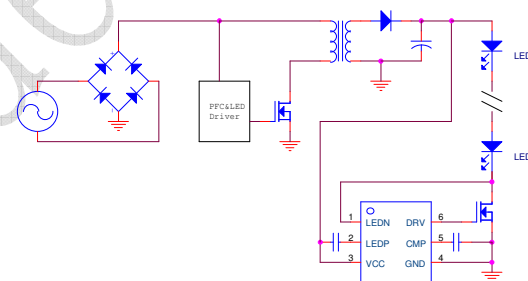
With Lozen's proprietary output voltage ripple detection and LED current regulation technology, LZC821 adaptively adjust the on resistance of the LED current regulation switch to make the power loss in LED current regulation circuit always at the minimum level. Therefore, high power efficiency is still maintain for LED lighting system with LED current ripple free.

Under LED string short circuit condition, LZC821 automatically turns the LED current regulation switch into fully on condition to minimize the power consumption on the switch. It avoid the LED current regulation switch from overheat damage.

Features

- Automatic PFC output voltage ripple compensation
- Removes line frequency ripple from LED current
- Adaptive LED current switch on resistance control
- High power efficiency
- Support LED String hot plug in and out
- Very few external components
- Small SOT23 package
- Protection Features
 - Over temperature protection
 - VCC voltage clamping function
 - LED Short Circuit Protection

Simplified Application circuit

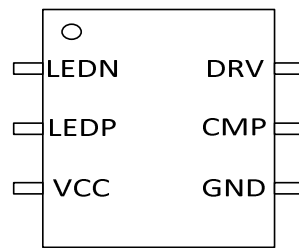


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Pin Diagram



LZC821 Pin Assignment

Absolute Maximum Rating

Symbol	Parameter	Rating
VCC	Maximum supply voltage on VCC pin	28.0V
V _{LEDP}	Input Voltage to LEDP Pin	-0.3V to 6.0V
V _{LEDN}	Input Voltage to LEDN Pin	-0.3V to 6.0V
V _{CMP}	Input Voltage to CMP Pin	-0.3V to 6.0V
ESD Capability	HBM Model	>2000V
	Machine Model	>200V
T _{Max}	Maximum Operating Junction Temperature ³	125°C
T _{STG}	Storage Temperature Range	-55°C to 150°C

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Block Diagram

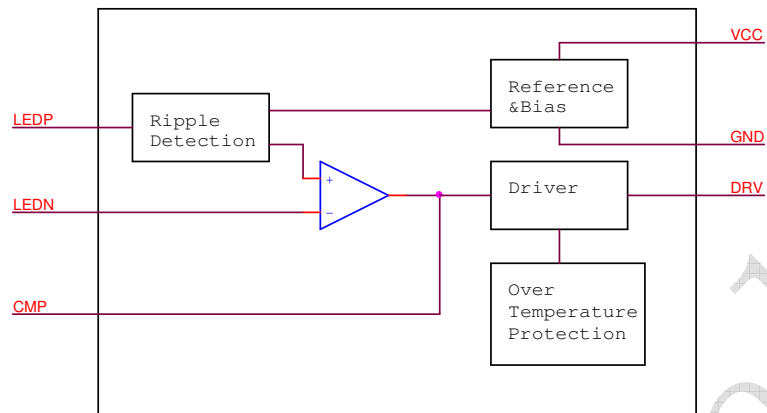


Figure 1

Pin Functions Description

Name	I/O	Pin No.	Description
LEDN	I	1	LED string cathode voltage feedback pin.
LEDP	I/O	2	LED power line ripple voltage and frequency detection input.
VCC	Power	3	Power Supply of IC
GND	Power	4	GND of IC
CMP	I	5	Loop compensation for constant current regulation.
DRV	O	6	Driver output for external LED current regulation transistor.

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Electrical Characteristics

($T_A=25^\circ\text{C}$ and $V_{CC}=15\text{V}$ if not otherwise noted)

Symbol	Parameter	Test Conditions	Limits			Unit
			Min.	Typ.	Max.	
VCC pin						
I_{VCC}	Operating Current			1.5		mA
$V_{CC_{ON}}$	Turn-on Threshold Voltage			4.5		V
$V_{CC_{OFF}}$	Turn-off Threshold Voltage			3.5		V
$V_{CC_{CLAMP}}$	VCC starts to sink current voltage			13		V
$I_{VCC_{CLAMP}}$	Clamp current when VCC is over 13V			5		mA
LEDP pin						
Low level clamp	Lowest clamping voltage of LEDP pin			0.1		V
High level clamp	Highest clamping voltage of LEDP pin			5		V
DRV pin						
High level				VCC		V
OTP¹						
$T_{PROTECT}$	Protection threshold when temperature rising		124	126	130	$^\circ\text{C}$
$T_{RELEASE}$	Protection threshold when temperature rising		107	110	116	$^\circ\text{C}$

Note ¹: Parameters are guaranteed by design, not tested during production test.

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Detail Functions Description

Refer the block diagram in figure 1, page 3 and reference application circuit in figure 2, page 7. All the parameters discussed below are typical values.

Startup

When voltage on VCC pin is higher than approximately 4.5V, LZC821 starts operation. When voltage at VCC pin drops below approximately 3.5V.

Active LED Current Filter Operation

LZC821 is a secondary side LED current filter controller. It drives an external power MOSFET (Q2) to regulate the the voltage across the LED string always in constant level under all LED current level conditions.

The ripple voltage and frequency is detected at LEDP pin through capacitor C3 connected between this pin and Cathode of the LED string. To effectively detect the 100Hz or 120Hz low frequency line ripple, 1.0uF or higher value capacitor is recommended for C3.

The voltage at cathode of the LED string is detected through LEDN pin. LZC821 automatically adjust the on resistance of the the external power MOSFET to make the voltage at LEDN always follows it at LEDP. Therefore, the voltage across the LED string is always in near constant level regardless the amplitude of the LED. LED current is effectively filtered out by adaptive on resistance of the external LED current switch. To avoid LEDN pin get over voltage stress under LED string hot plug in and out condition or short circuit condition, an approximately 100kΩ resistor (R8) is recommended connect between LEDN pin and cathode of the LED string.

LED String Short Circuit Protection

Under LED string short circuit condition , LZC821 turns the LED current regulation switch into fully on condition to minimize the power consumption on the switch. To speedup the protection response time, a 10kΩ resistor(R12) is recommended connect between gate and drain of the external LED current switch(Q2). LZC821 will resume normal operation once the short circuit condition is removed.

Over Temperature Protection

When the junction temperature of LZC821 exceeds approximately 126°C, it turns the LED current regulation switch into fully on condition to minimize the power consumption on the switch. When the junction temperature drops below approximately 110°C, LZC821 resumes normal operation.

VCC Voltage Clamping Function Protection

To protect VCC pin from over voltage damage, LZC821 feature VCC pin voltage clamping function. When voltage at VCC pin exceeds approximately 13V, LZC821 starts to sink current into IC in order to

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clamp the voltage at VCC pin. The maximum sink current capability is approximately 5mA.

To effectively clamp the VCC pin voltage at 13V, a current limit resistor R5 should be selected properly to limit the maximum current into VCC pin. But the resistor value too high will limit the current supply to maintain the IC normal operation. To have proper operation, the current limit resistor value can be selected approximately according to the equation:

$$\frac{V_{LED+} - 8V}{1.5mA} > R_{LIMIT} > \frac{V_{LED+} - 13V}{5mA}$$

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Reference Application Schematic

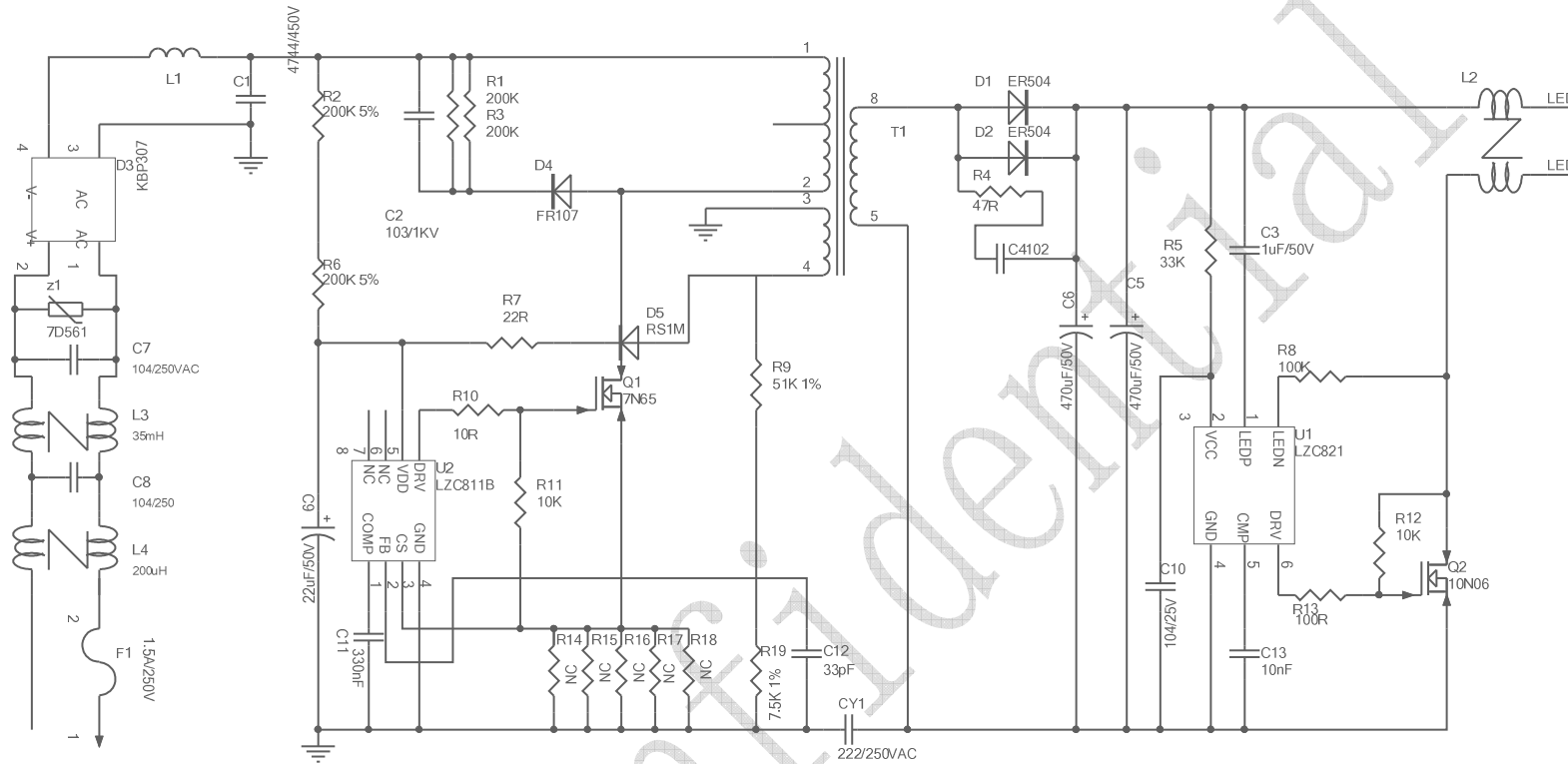
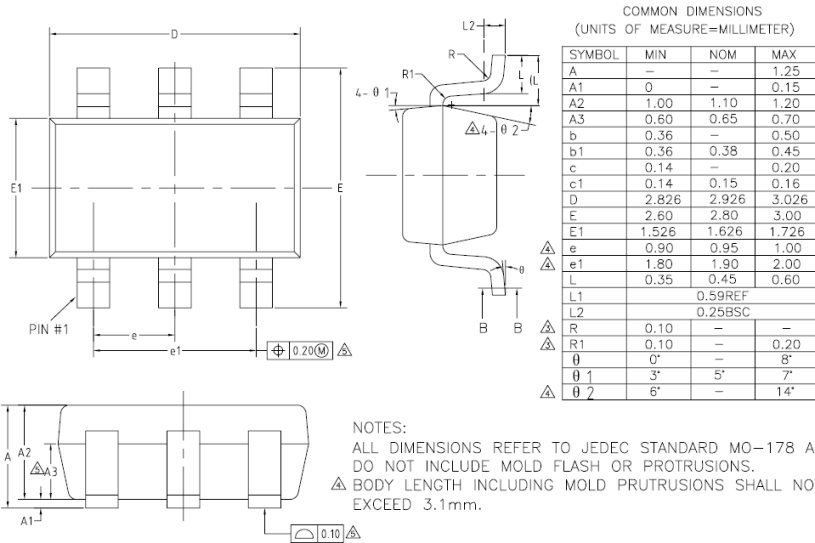


Figure 2

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Package information



Compliant to JEDEC Standard MS12F

Controlling dimensions are in inches; millimeter dimensions are for reference only
This product is RoHS compliant and Halide free.

Soldering Temperature Resistance:

[a] Package is IPC/JEDEC Std 020D Moisture Sensitivity Level 1

[b] Package exceeds JEDEC Std No. 22-A111 for Solder Immersion Resistance; package can withstand 10 s immersion < 270°C

Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm per end.

Dimension E1 does not include inter-lead flash or protrusion. Inter-lead flash or protrusion shall not exceed 0.25 mm per side. D and E1 dimensions are determined at datum H. The package top may be smaller than the package bottom. Dimensions D and E1 are determined at the outer most extremes of the plastic body exclusive of mold flash, tie bar burrs, gate burrs and inter-lead flash, but including any mismatch between the top and bottom of the plastic body.

Ordering Information

Part Number	Package	Top Marking	Free Air Temperature (T _A)
LZC821	SOT23-6	LZC821	-40°C~+105°C

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