

DIO8210C

Adaptive 100/120Hz Current Ripple Remover

Max LED Current $\leq 350\text{mA}$

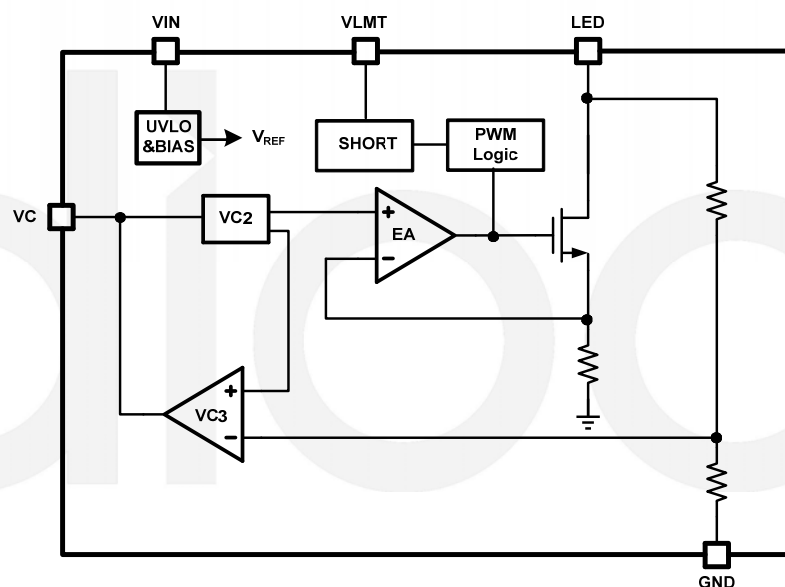
Features

- Wide input voltage range
- Internal 85V power MOSFET
- Adaptive 100/120Hz current ripple remover for dimmable LED luminaries with wide input current range from 50mA up to 350mA
- LED voltage low to 0.4V when LED current is 350mA
- Multiple protection features:
 - ✧ Reliable LED voltage limit
 - ✧ Reliable LED current limit
 - ✧ Reliable Short LED Protection (SLP)
 - ✧ Hot-plug protection
 - ✧ Over Temperature Protection (OTP)
- EP-SOIC8 package

Applications

- Flicker-less LED lighting

Block Diagram



Descriptions

DIO8210C is used to drive a LED string, and remove the 100/120Hz current ripple on AC/DC power by a capacitor between VC and GND.

If the voltage on LED pin exceeds 6V, the current ripple removing function is disabled, which could help limit the power dissipation on chip. DIO8210C provides short protection, open protection and HOT-PLUG protection.

The maximum LED current is internally limited at 0.5A.

DIO8210C provides over thermal protection. When the OTP is triggered, the function of current ripple removing is shielded and MOSFET is ON until VIN restart.

Ordering Information

| Order Part Number | Top Marking | | T _A | Package | |
|-------------------|-------------|-------|----------------|----------|-------------------|
| DIO8210CXS8 | DIO8210C | Green | -40 to +125°C | EP-SOIC8 | Tape & Reel, 2500 |

Pin Assignments

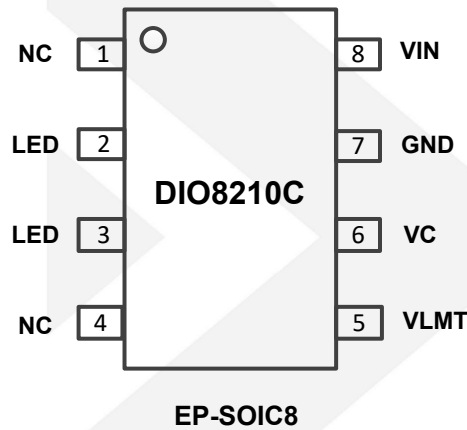


Figure 1 Pin Assignment (Top View)

Pin Definitions

| Pin Name | Description |
|----------|--|
| VIN | Power Supply voltage input |
| LED | Connect to Cathode of LED string |
| GND | Ground |
| VLMT | Adjustable LED Short Protection Threshold |
| VC | Adjustable LED Current Ripple. By connecting a capacitor between VC to GND to regulate the current ripple. |

Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Rating” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

| Parameter | Rating | Unit |
|------------------------------------|-------------|------|
| VIN | 85 | V |
| LED | -0.3 to 85 | V |
| VC, VLMT | -0.3 to 6 | V |
| Junction Temperature | 150 | °C |
| Lead Temperature | 260 | °C |
| Storage Temperature | -65 to +150 | °C |
| Thermal Resistance / θ_{JA} | 45 | °C/W |

Recommend Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended Operating conditions are specified to ensure optimal performance to the datasheet specifications. DIOO does not Recommend exceeding them or designing to Absolute Maximum Ratings.

| Parameter | Rating | Unit |
|-----------|----------|------|
| VIN | 10 to 75 | V |
| LED | <85 | V |



DIO8210C

Electrical Characteristics

$T_A = 25^\circ\text{C}$, $V_{IN} = 12\text{V}$, $C_C = 1\mu\text{F}$, unless otherwise specified.

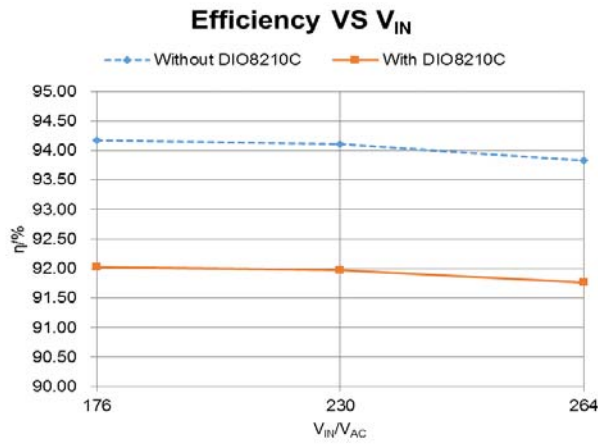
| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|------------------|--------------------------------------|---|-----|------|-----|------------------|
| V_{IN_ON} | V_{IN} Power On Voltage Threshold | | | 15.3 | | V |
| V_{IN_OFF} | V_{IN} Power Off Voltage Threshold | | | 9 | | V |
| I_{IN_OP} | V_{IN} Operation Current | $I_{LED} = 300\text{mA}$ | | 0.25 | | mA |
| V_{LED_LIMIT} | LED Voltage Limit Threshold | LED voltage when voltage limit is triggered | 5.4 | 6 | 6.6 | V |
| V_{TH_SHORT} | LED Short Protection Threshold | VLMT voltage when LED short protection is triggered | 1.8 | 2 | 2.2 | V |
| T_{SP} | LED Short Protection Delay Time | | | 60 | | μs |
| T_{SH} | LED Short Protection Hold Time | | | 10 | | ms |
| V_{LED_MIN} | Min LED Pin Voltage when operation | $I_{LED} = 300\text{mA}$ | | 0.60 | | V |
| I_{OPEN} | LED Current open Threshold | | | 0.03 | | A |
| I_{LIMIT} | LED Current Limit | | | 0.5 | | A |
| T_{SD} | Thermal Shutdown Threshold | | | 160 | | $^\circ\text{C}$ |

Adaptive 100/120Hz Current Ripple Remover, Max Input Current $\leq 350\text{mA}$

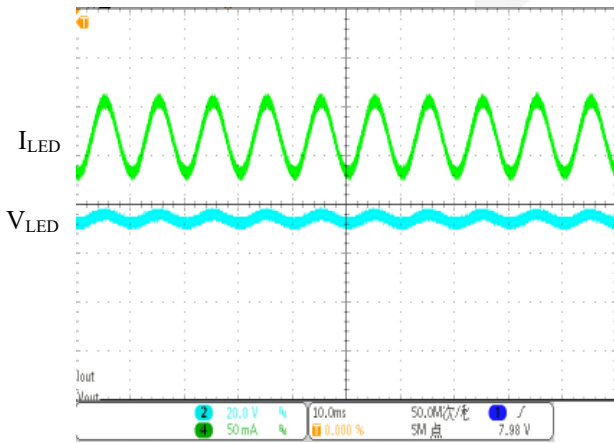


Typical System Characteristics

$V_{IN}=176V\sim 264Vac$, $V_{OUT}=72V$, $I_{OUT}=240mA$, $C_{OUT}=100\mu F/100V*2$, $T_A=25^\circ C$.



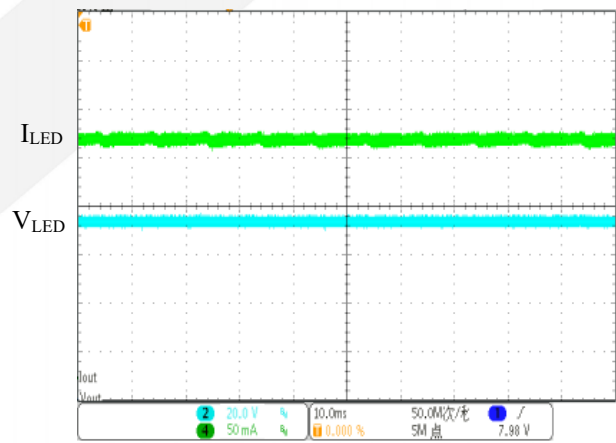
Current Ripple without DIO8210C



I_{LED} : 50mA/div

V_{LED} : 20V/div

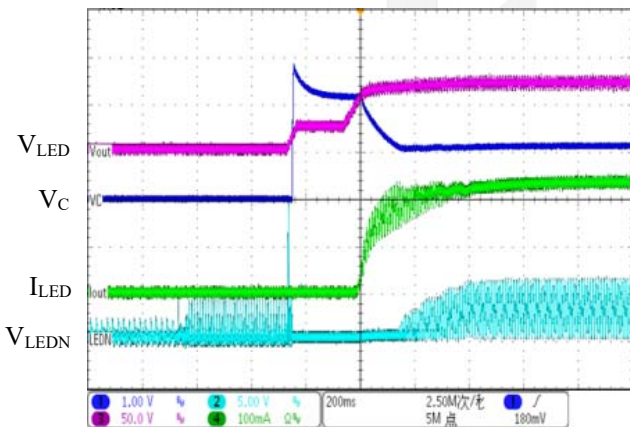
Current Ripple with DIO8210C



I_{LED} : 50mA/div

V_{LED} : 20V/div

Power ON



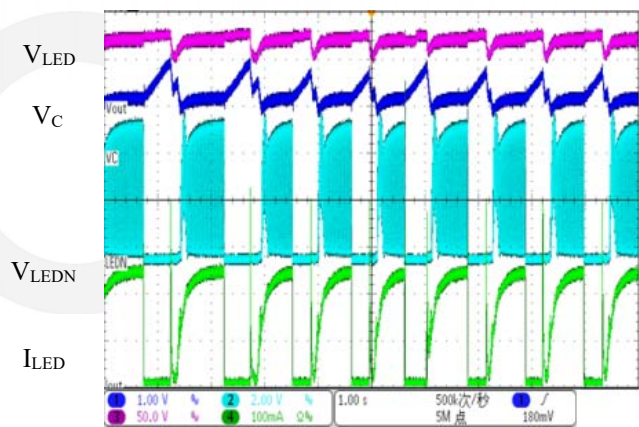
V_C : 1V/div

V_{LEDN} : 5V/div

I_{LED} : 100mA/div

V_{LED} : 50V/div

LED Hot plug test



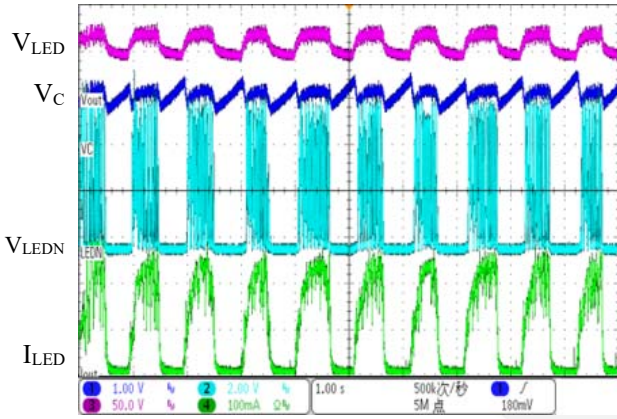
V_C : 1V/div

V_{LEDN} : 2V/div

I_{LED} : 100mA/div

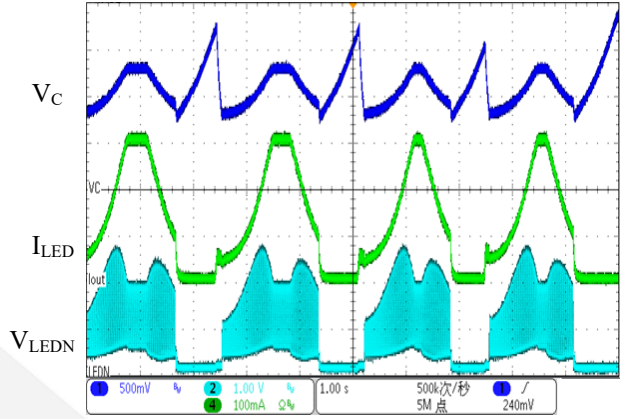
V_{LED} : 50V/div

Line Input arcing test



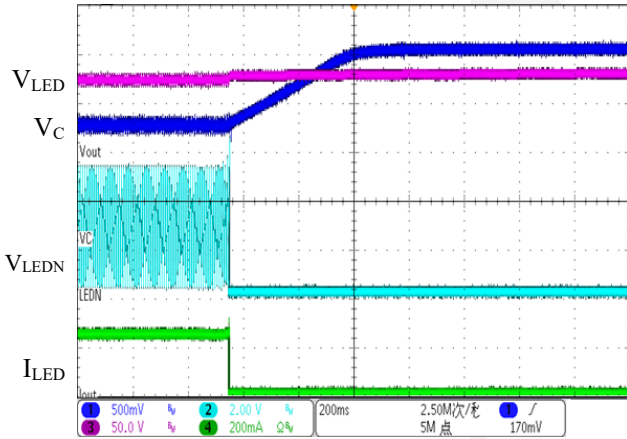
V_C : 1V/div V_{LEDN} : 2V/div
 V_{LED} : 100mA/div V_{LED} : 50V/div

Dimming application test



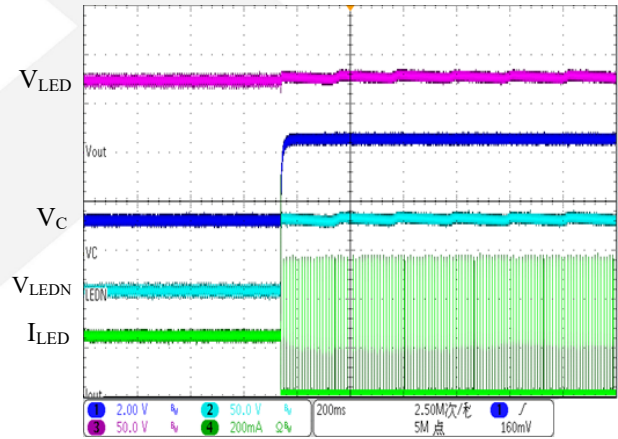
V_C : 500mV/div V_{LEDN} : 1V/div
 I_{LED} : 100mA/div

LED Open Protection test



V_C : 500mV/div V_{LEDN} : 2V/div
 I_{LED} : 200mA/div V_{LED} : 50V/div

LED Short Protection test



V_C : 2V/div V_{LEDN} : 50V/div
 I_{LED} : 200mA/div V_{LED} : 50V/div



Application Information

Theory of Operation

DIO8210C is a secondary side LED current ripple remover which is designed for single stage LED driver, supplied by an AC/DC current source with the LED string. The LED pin is connected to the cathode of LED string. DIO8210C transfers the LED current ripple to voltage ripple on chip, and ensures the constant voltage across LED string and the current flow through LED string.

The scalable adaptive function of DIO8210C can regulate the cathode voltage of LED string to minimum to improve the efficiency of the system.

Current Ripple Removing

The capacitor C_C between VC and GND is an integration capacitor. DIO8210C transform the voltage on C_C to a reference voltage. The current regulator regulates LED current via negative feedback control.

C_C should be large enough in order to remove the current ripple of the LED string. However, too large capacitor may slow down the dynamic response.

Adaptive Regulation

DIO8210C control the voltage on C_C by monitoring the operation state of built-in NMOSFET. The efficiency of system is relatively low when NMOSFET always work in the saturation region. DIO8210C detects it and charges C_C to raise the V_{VC} and I_{LED} , then the output voltage of power supply is reduced, and the voltage drop on NMOSFET decreases.

Conversely, when NMOSFET is working in the linear region, LED current regulation loop is open. DIO8210C detects it and discharges C_C to reduce the V_{VC} and I_{LED} , then the output voltage of power supply is raised, and the LED current regulation loop is close.

LED Pin Voltage Limit

The voltage ripple on LED pin is very large when the current ripple is removed, which would bring large power dissipation on chip. DIO8210C limit the voltage on LED pin as 6V internally. When the voltage on LED pin reaches 6V, the current ripple removing function is blocked.

LED Current Limit

The current of LED is limited to 0.5A internally. The current limitation can protect the chip when LED is short connected or HOT-PLUG.

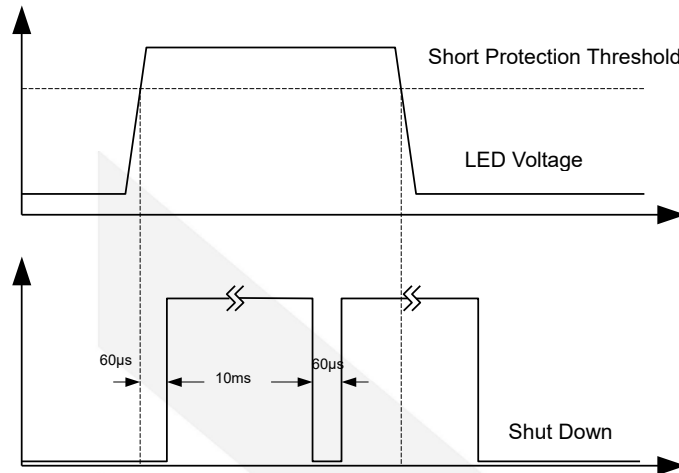
The function of current limit is higher priority than LED Pin voltage limit. It means that the voltage on LED Pin is limited when LED current exceed 0.5A.

LED Short Protection

The resistor divider connected between LED and GND can setup the Short protection threshold. When the voltage input to V_{LMT} Pin is exceed 2V and the state holds for more than 60 μ s, DIO8210C considers the LED

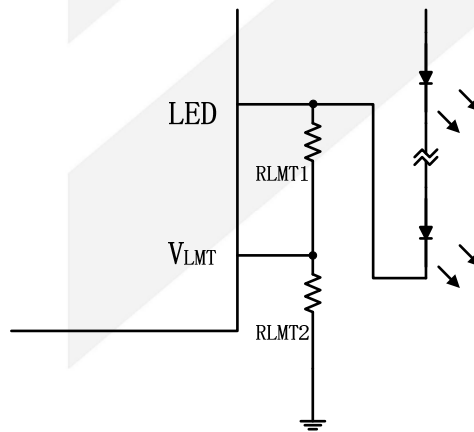
string is short connected, and shut down the internal MOSFET.

The shut down state is latched for 10ms hold time. After 10ms, the short state is reset, and the MOSFET restart.



The short protection threshold is calculated as below:

$$V_{TH_VLMT} = 2V * (R_1 + R_2) / R_2$$



Open and HOT-PLUG Protection

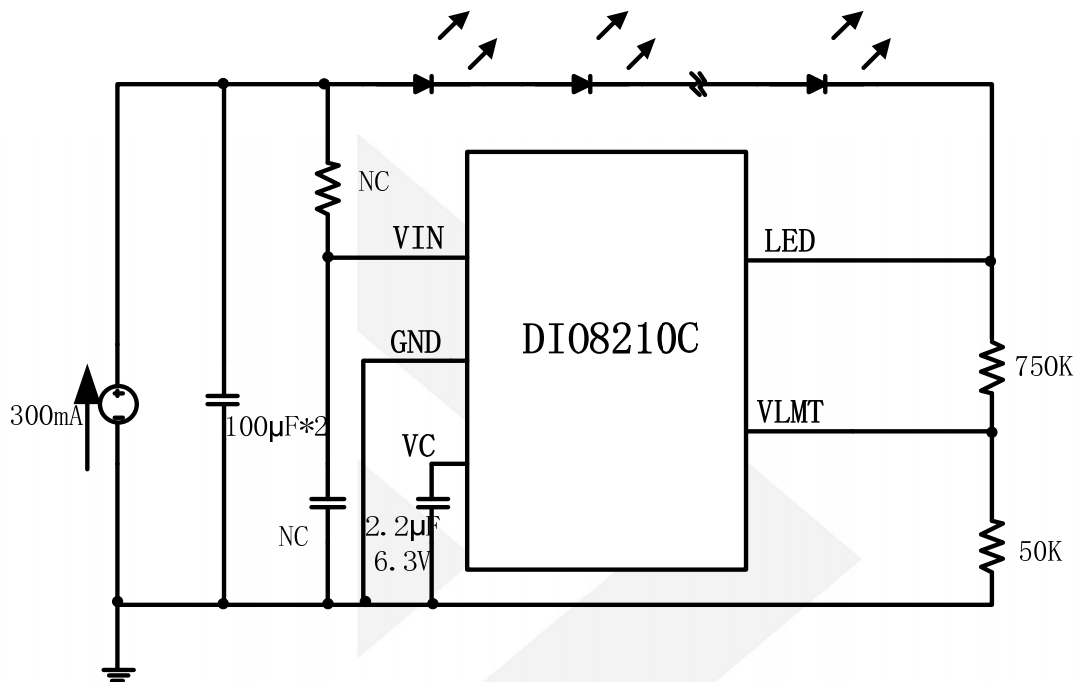
When DIO8210C detects that LED current is lower than 50mA, and the state holds for more than 60µs, DIO8210C considers the LED string is open connected, and shuts down the internal MOSFET. The shut down state is latched for 0.5ms hold time. The MOSFET restart after 0.5ms.

If the LED string is connected suddenly during MOSFET restart, the open state is reset, internal MOSFET is turned on and the LED current is limited at 0.5A.

Over Thermal Protection

DIO8210C monitors operation temperature. When the temperature is higher than 160°C, the function of current ripple removing is shielded and MOSFET is ON until VIN restart.

Application Reference





DIO8210C

Adaptive 100/120Hz Current Ripple Remover, Max Input Current \leq 350mA

CONTACT US

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