

# DIO8904B

## Single Stage Boost & PFC driver

### Without Auxiliary Winding for LED Lighting

#### Features

- Internal HV JFET
- Without auxiliary winding
- Excellent Line and Load regulation
- Power factor >0.95 @230VAC
- Meet the criterion of IEC61000-3-2
- CCM operation to achieve lower switching losses and high efficiency
- Multiple protection features:
  - ✧ Reliable LED open protection
  - ✧ Reliable freewheeling diode open protection
  - ✧ Reliable thermal compensation
- Package: SOIC-8 package

#### Descriptions

The DIO8904B is a single stage Boost and PFC controller targeting at LED lighting applications.

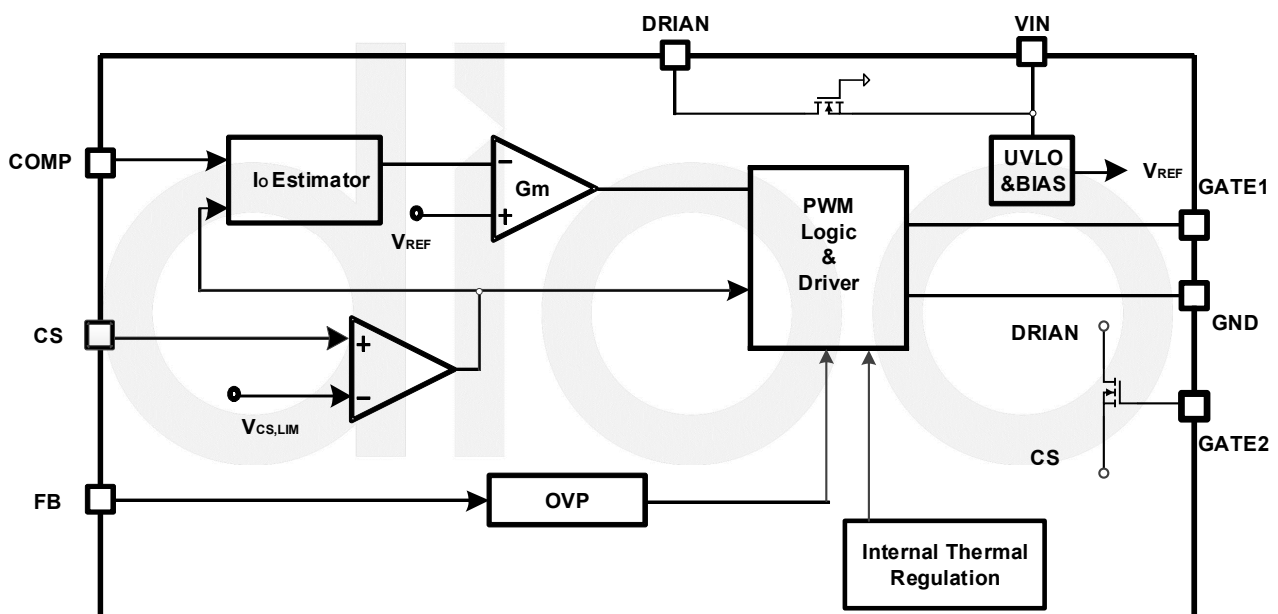
The DIO8904B is single stage Boost controller which integrates HV JFET and without auxiliary winding for low cost, and drives the Boost converter in CCM mode to achieve higher efficiency.

The DIO8904B integrates full protection features, including reliable LED open protection, freewheeling diode open protection, thermal compensation, ect., to ensure the system safe and reliable.

#### Applications

- T-tube LED Lighting
- Ceiling Lamp

#### Block Diagram



## Ordering Information

Order Part Number	Top Marking		T <sub>A</sub>	Package	
DIO8904BCS8	DIO890B	Green	-40 to 85°C	SOIC-8	Tape & Reel, 2500

## Pin Assignments

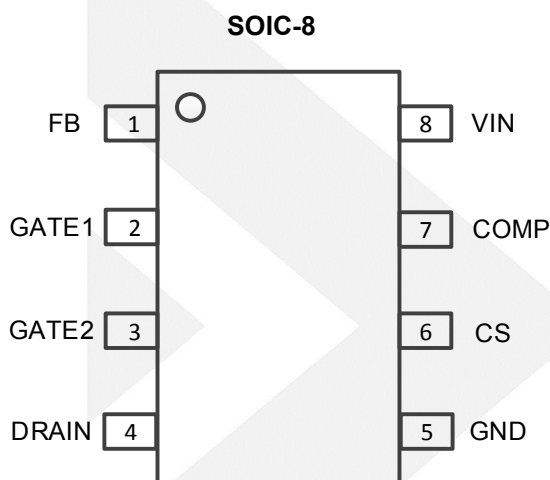


Figure 1 Pin Assignment (Top View)

## Pin Definitions

Pin Name	Description
FB	Output Voltage feedback pin. FB is used to detect LED open or output over voltage.
GATE1	Gate driver pin of controller.
GATE2	Gate of the MOSFET switch.
DRAIN	DRAIN of the MOSFET
GND	Ground pin.
CS	Current sense pin. Connect the sense resistor across the LEDN and the GND pin.
COMP	Loop compensation pin. Compensation for internal error amplifier. Connect a capacitor between the pin and GND to compensate the internal feedback loop.
VIN	Power supply pin. This pin supplies current to the internal circuit and must be locally bypassed with a capacitor.

## 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
DRAIN Voltage		600	V
VIN Voltage		30	V
GATE1, GATE2		20	V
CS, COMP,FB		-0.3 to 5	V
Thermal Performance <sup>(3)</sup>	$\Theta_{JA}$	100	°C/W
	$\Theta_{JC}$	50	
Junction Temperature <sup>(1) (2)</sup>		150	°C
Lead Temperature		260	°C
Storage Temperature		-65 to 150	°C

## 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
DRAIN Voltage	30 to 500	V
VIN Voltage	10 to 13.6	V
Operating Junction Temperature (T <sub>J</sub> )	-40 to 125	°C



# DIO8904B

Boost LED Driver With PFC and No Auxiliary Winding

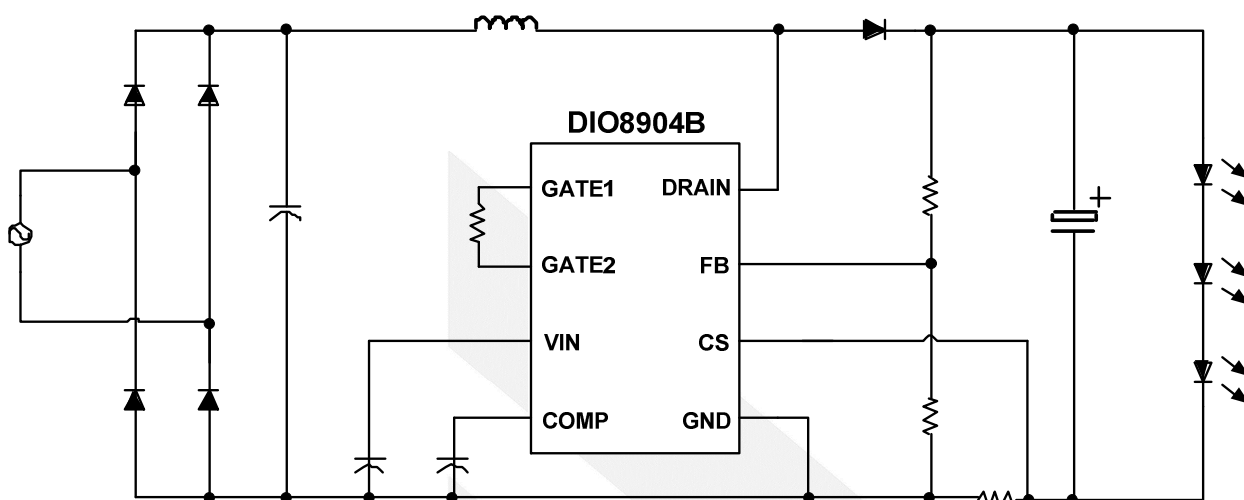
## Electrical Characteristics

$V_{IN} = 20V$ ,  $T_A = 25^\circ C$ , unless otherwise specified.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>VIN Section</b>						
$V_{VIN,ON}$	VIN turn-on threshold		12.8	13.8	14.8	V
$V_{VIN,OFF}$	VIN turn-off threshold		8	8.8	9.6	V
$V_{VIN,OVP}$	VIN OVP voltage		16.4	18.2	20	V
$I_Q$	Quiescent Current	$V_{IN}=6V$		130	150	$\mu A$
$I_{VIN}$	Operation current	$V_{IN}=15.5V, FB=2V$		350	400	$\mu A$
$I_{VIN,OVP}$	Shunt current in OVP mode	$V_{IN}=V_{VIN,OVP}-0.5V$	3	5	8	mA
<b>Error Amplifier Section</b>						
$V_{REF}$	Internal Reference Voltage		146	153	160	mV
<b>Current Regulation Section</b>						
$T_{ON,MAX}$	Max on time			35		$\mu s$
$I_{COMP}$	COMP Pull Up Current	$1.2V < COMP < 2.4V, CS=0V$	6	7	8	$\mu A$
$f_{MAX}$	Maximum switching frequency	$COMP < 1.2V$		110		kHz
$V_{CS,LIMIT}$	CS Maximum Voltage		3.6	3.8	4	V
<b>FB Section</b>						
$V_{FB,H}$	FB High Voltage Threshold		1.5	1.6	1.7	V
$V_{FB,L}$	FB Low Voltage Threshold		255	300	345	mV
$T_{LEB}$	OVP Blanking Time			1		$\mu s$
<b>HV Section</b>						
$R_{DSON}$	MOSFET $R_{DSON}$	$V_{GS}=10V$		1.8		$\Omega$
$V_{BDSS}$	Break-down Voltage	$I_{DS}=250\mu A, T_J=25^\circ C$	600			V
<b>Thermal Section</b>						
$T_{COMP}$	Thermal compensation Threshold			145		$^\circ C$

Specifications subject to change without notice.

## Typical Application



## Functional Description

The DIO8904B is a single stage Boost and PFC controller targeting at LED lighting applications. The DIO8904B integrates HV JFET and without auxiliary winding for low cost, and drives the Boost converter in CCM mode to achieve higher efficiency.

### Start up

After AC or DC supply is powered on, the capacitor  $C_{VIN}$  across VIN and GND pin is charged up by BUS voltage through a HV JEFT. Once  $V_{VIN}$  rises up to  $V_{VIN,ON}$ , the internal blocks start to work and PWM output is enabled. An internal clamp is attached to the VIN pin to prevent VIN from being too high. Once VIN exceeds  $V_{VIN,OVP}$ , system shut down and VIN is charged to  $V_{VIN,ON}$  again after it's pulled down to  $V_{VIN,OFF}$ . After 7 times, then system restarts.

### Shut down

After AC supply or DC BUS is powered off, the energy stored in the BUS capacitor will be discharged. When the BUS can't 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.

### Loop Compensation

An error amplifier is applied to the output current feedback loop with a capacitor connected to the COMP pin. For offline applications, the crossover frequency should be set much less than the line frequency. A capacitor of  $1\mu F$  connected to COMP pin is recommended to ensure the excellent PFC performance.

### Constant Current Control

The DIO8904B controls the output current from the information of the current sensing resistor voltage. The output

LED mean current can be calculated as:

$$I_{LED} = V_{REF} / R_S$$

Where

$V_{REF}$ —The internal reference voltage;

$R_S$ —The sensing resistor connected between CS and GND.

### **Critical Conduction Mode Operation**

DIO8904B works in the Critical conduction mode. When the power MOSFET is turned on, the inductor current begins to increase from zero. When the power MOSFET is turned off, the inductor current begins to decrease. The power MOSFET turns on again when the inductor current is zero.

### **Thermal compensation Regulation**

As the driver temperature is higher than the threshold temperature, it reduces the output current and then a balance is achieved between output power and temperature, thereby improve system reliability.

### **LED Open Protection**

The output voltage can be detected by the FB pin. When the FB voltage is higher than  $V_{FB,H}$ , the power MOSFET shutdown, and the HV power source is disconnected until  $V_{IN}$  decreases to  $V_{VIN,OFF}$ . When  $V_{IN}$  is charged to  $V_{VIN,ON}$  for 7 times, system restarts.

### **PCB Design**

1. The  $V_{IN}$  pin must be locally bypassed with a capacitor.
2. Make the area of the power loop as small as possible in order to reduce the EMI radiation.
3. The chip should be far away from the heating element, such as inductor and the freewheel diode.

## CONTACT US

Dioo is a professional design and sales corporation for high-quality and performance analog semiconductors. The company focuses on industry markets, such as, cell phone, handheld products, laptop, and medical equipment and so on. Dioo's product families include analog signal processing and amplifying, LED drivers and charger IC. Go to <http://www.dioo.com> for a complete list of Dioo product families.

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