DIO8850

Single Stage Buck PFC Controller for LED Lighting

Features

- **Valley turn-on of the MOSFET to achieve low switching losses**
- **0.3V current sense reference voltage leads to a lower sense resistance thus a lower conduction loss**
- **Low start up current: 15µA typical**
- **Reliable short LED and Open LED protection**
- **Power factor >0.9**
- **Compact package: SOT23-6**

Descriptions

The DIO8850 is a single stage Buck PFC controller targeting at LED lighting applications. It drives the Buck converter in the quasi-resonant mode to achieve higher efficiency.

It keeps the Buck converter inconstant on time operation to achieve high power factor.

Applications

- **LED Lighting**
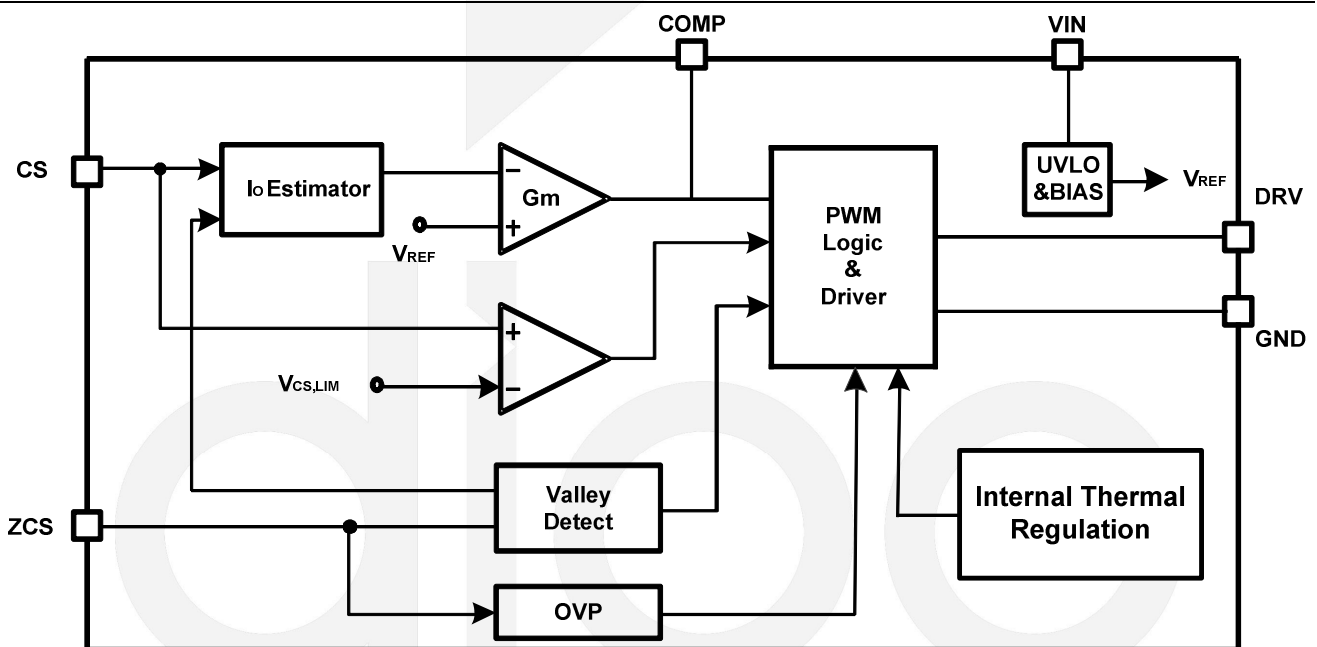- **Down light**
- **Tube lamp & PAR lamp &Bulb lamp**

Block Diagram

Figure1 Block Diagram

DIO8850

Ordering Information

Order Part Number	Top Marking		T_A		Package
DIO8850CST6	YW8A	Green	-40 to +85°C	SOT23-6	Tape & Reel, 3000

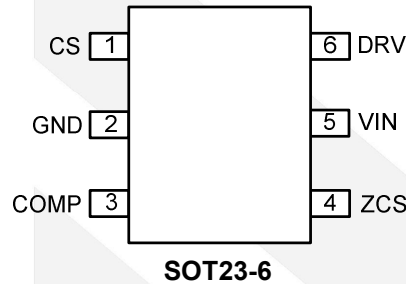## Pin Assignments

SOT23-6
Figure 2 Pin Assignment (Top View)

Pin Definitions

Pin Name	Description
CS	Current sense pin. Connect this pin to the source of the primary switch. Connect the sense resistor across the source of the primary switch and the GND pin. (current sense resister Resistor: $Rs = \frac{1}{2} \times \frac{Vref}{Iout}$) Also this pin used to detect transformer and secondary is short or not.
GND	Ground pin
COMP	Loop compensation pin. Connect a RC network across this pin and ground to stabilize the control loop.
ZCS	Inductor current zero-crossing detection pin. This pin receives the auxiliary winding voltage by a resister divider and detects the inductor current zero crossing point. This pin also provides over voltage protection and line regulation modification function simultaneously. If the voltage on this pin is above $V_{ZCS,OVP}$, the IC would enter overvoltage protection mode. Good line regulation can be achieved by adjusting the upper resistor of the divider.
VIN	Power supply pin. This pin also provides output over voltage protection along with ZCS pin.
DRV	Gate driver pin. Connect this pin to the gate of primary MOSFET.
NC	Not Connect.

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 maxim rating conditions for extended periods may affect device reliability.

Parameter		Rating	Unit
VIN, DRV		-0.3 to 33	V
Supply Current I_{VIN}		15	mA
ZCS		-0.3 to VIN+0.3	V
CS, COMP		-0.3 to 5	V
Power Dissipation, P_D @ T_A = 25°C, SOT23-6		0.6	W
Package Thermal Resistance, SOT23-6	Θ_{JA}	170	°C/W
	Θ_{JC}	130	
Power Dissipation, P_D @ T_A = 25°C, SOIC-8		1.1	W
Package Thermal Resistance, SOIC-8	Θ_{JA}	100	°C/W
	Θ_{JC}	50	
Storage Temperature Range		-65 to 150	°C
Junction Temperature Range		150	°C
Lead Temperature Range		260	°C
ESD	HBM, JEDEC: JESD22-A114	2000	V
	MM, JEDEC: JESD22-A115	200	

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
Supply Voltage	9.5 to 27	V
Junction Temperature Range	-40 to 125	°C
Ambient Temperature Range	-40 to 85	°C

Single Stage Buck PFC Controller For LED Lighting

Electrical Characteristics

V_{IN} = 12V, T_A = 25°C, unless otherwise specified.

| Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{VIN,ON}$	VIN turn-on threshold			25.3		V
$V_{VIN,OFF}$	VIN turn-off threshold			8.5		V
$V_{VIN,OVP}$	VIN OVP voltage			30		V
I_{ST}	Start up Current	V_{VIN}< $V_{IN,OFF}$		15		µA
I_{VIN_OVP}	Shunt current in OVP mode	After V_{VIN}>$V_{VIN,OVP}$, then set VIN=15V		2		mA
I_Q	Quiescent Current	No switching		0.26		mA
$I_{VIN.}$	Operation current	C_L=100pF,f=15kHz		0.36		mA
Error Amplifier Section						
V_{REF}	Internal reference voltage		0.294	0.3	0.306	V
ZCS pin Section						
$V_{ZCS, OVP}$	ZCS pin OVP voltage threshold			1.5		V
V_{FAST_ST}	Fast start up threshold			0.55		V
Current Sense Section(Source PIN of integrated MOSFET)						
$V_{CS.LMT}$	Current limit reference voltage			0.75		V
$V_{CS.TR}$	Protection limit for TR short			1.5		V
K_2	CC Feed forward coefficient			0.1		
R_{K2}	CC Feed forward resistor R_{K2}			1020		Ω
PWM Section						
$T_{ON.MAX}$	Max on time	COMP high clamp		27.15		µs
T_{LEB}	Leading edge blanking time			350		ns
$T_{OFF,MAX}$	Max OFF time			68		µs
$T_{LEB.ZCD}$	ZCD Blanking Time	After turn off		2		µs
f_{MAX}	Maximum switching frequency			115		kHz
Gate Driver						
V_{GATE_CLAMP}	Output Clamp Voltage	V_{CC}=20V		12		V
T_{RISING}	rising time from 10% to 90%	C_{LOAD}=1nF		210		ns
$T_{FALLING}$	falling time from 90% to 10%	C_{LOAD}=1nF		40		ns
Thermal Section						
TSD	Thermal Shutdown Temperature			150		°C

Typical Application
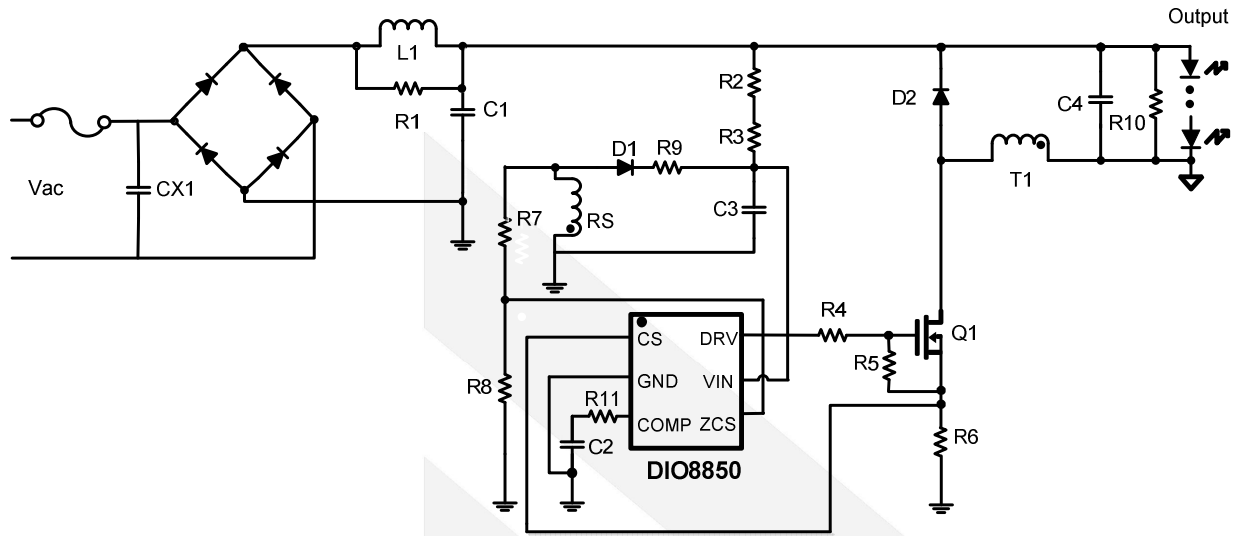
Figure 3 Typical Application

Application Information

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 start up resistor R_{ST}. Once V_{VIN} rises up to V_{VIN-ON}, the internal blocks start to work and PWM output is enabled.

Shut down

After AC supply or DC BUS is powered off, the energy stored in the BUS capacitor will be discharged. When the auxiliary winding of transformer 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.

Quasi-Resonant Operation

QR mode operation provides low turn-on switching losses for Buck converter.

Over Voltage Protection (OVP) & Open LED Protection (OLP)

The output voltage is reflected by the auxiliary winding voltage of the transformer, and both ZCS pin and VIN pin provide over voltage protection function. When the load is null or large transient happens, the output voltage will exceed the rated value. When V_{VIN} exceeds $V_{VIN,OVP}$ or V_{ZCS} exceeds $V_{ZCS,OVP}$, the over voltage protection is triggered and the IC will discharge V_{VIN} by an internal current source $I_{VIN,OVP}$. Once V_{VIN} is below $V_{VIN,OFF}$, the IC will shut down and be charged again by BUS voltage through start up resistor. If the overvoltage condition still

exists, the system will operate in hiccup mode.

Short Circuit Protection (SCP)

When the output is shorted, the output voltage is clamped to zero. The voltage of the auxiliary winding is proportional to the output winding, so V_{VIN} will drop down without auxiliary winding supply. Once V_{VIN} is below $V_{VIN,OFF}$, the IC will shut down and be charged again by the BUS voltage through the start up resistor. If the short circuit condition still exists, the system will operate in hiccup mode. In order to guarantee SCP function not effected by voltage spike of auxiliary winding, a filter resistor is needed (10Ω typically).

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Physical Dimensions: SOT-23-6
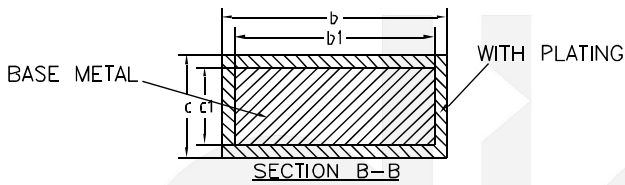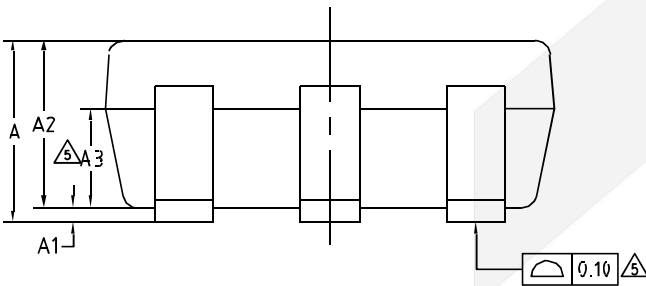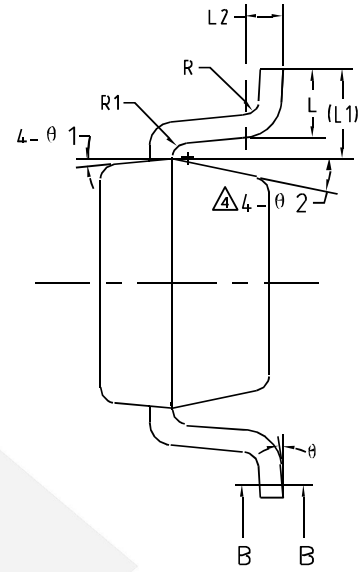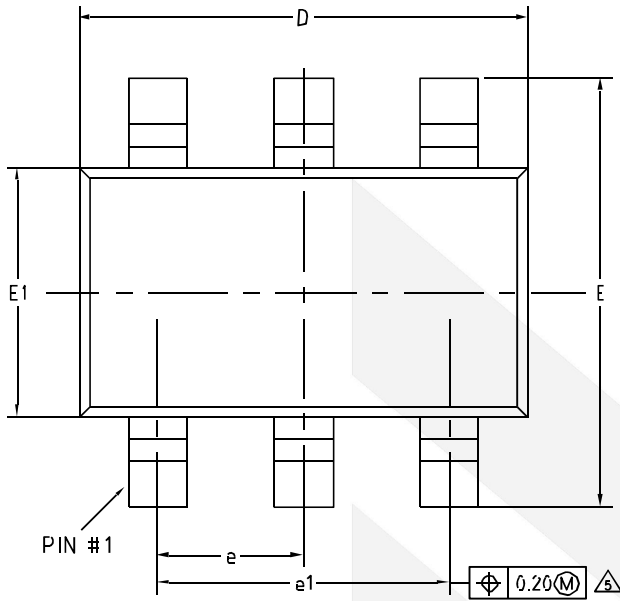
COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER)			
Symbol	MIN	NOM	MAX
A	-	-	1.25
A1	0	-	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	-	0.50
b1	0.36	0.38	0.45
c	0.14	-	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
L	0.35	0.45	0.60
L1	0.59REF		
L2	0.25BSC		
R	0.10	-	-
R1	0.10	-	0.25
Θ	0°	-	8°
Θ1	3°	5°	7°
Θ2	6°	-	14°

Single Stage Buck PFC Controller For LED Lighting

Physical Dimensions: SOIC-8
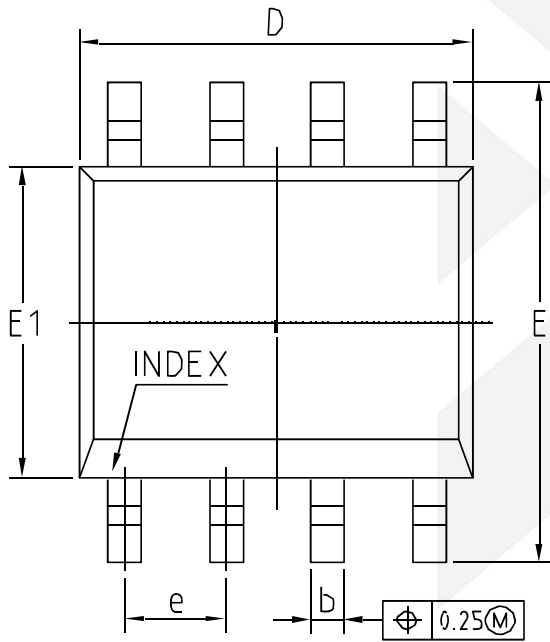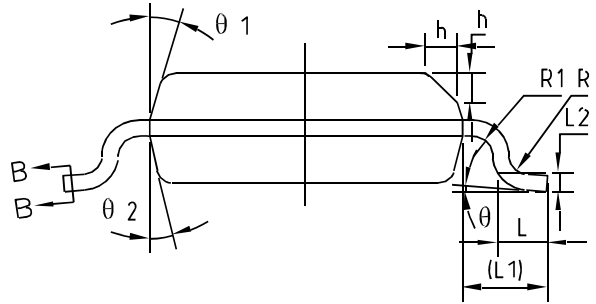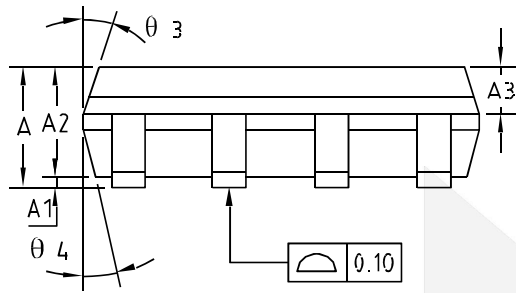
COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER)			
Symbol	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.10	0.15	0.25
A2	1.25	1.40	1.65
A3	0.50	0.60	0.70
b	0.38	-	0.51
b1	0.37	0.42	0.47
c	0.17	-	0.25
c1	0.17	0.20	0.23
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
L	0.45	0.60	0.80
L1	1.04REF		
L2	0.25BSC		
R	0.07	-	-
R1	0.07	-	-
h	0.30	0.40	0.50
Θ	0°	-	8°
Θ1	15°	17°	19°
Θ2	11°	13°	15°
Θ3	15°	17°	19°
Θ4	11°	13°	15°
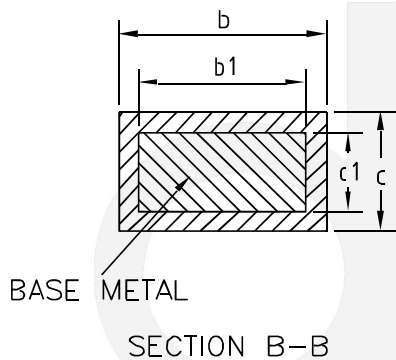
DIO8850

CONTACT US

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