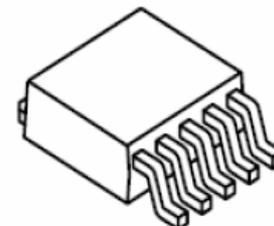
**1.2A DC/DC Converter****Features**

- I Only 4 External Components Required
- I 1.2A Constant Output Current
- I 90% Efficiency @ 1A Output Current
- I Hysteretic PFM Improves Efficiency at Light Loads
- I Adjustable Output Current
- I Integrated Power Switch
- I 9~36V Input Voltage Range
- I Full Protection: Thermal/UVLO/Soft Start/LED Open-/Short- Circuit

Surface Mount Device

PSD: TO-252-5L

Product Description

The MBI6650 is a constant current power LED driver specially designed for applications using high power LEDs. The MBI6650 offers low quiescent current and high efficient operation ranging from a few milliamps up to 1.2A. Output current can be programmed by an external resistor.

Additionally, to ensure the system reliability, the MBI6650 is built with the thermal protection (TP) function and a thermal pad. The TP function protects IC from over temperature (140°C). Also, the thermal pad enhances the power dissipation. As a result, a large amount of current can be handled safely in one package.

Applications

- I Signage and Decorative Lighting
- I Automotive Lighting
- I High Power LED Lighting
- I Constant Current Source

Typical Application Circuit

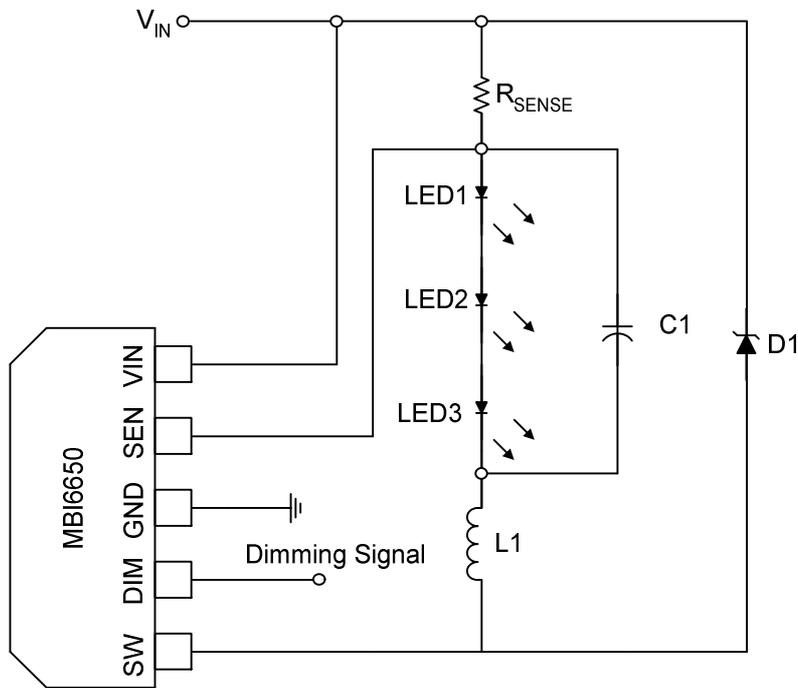
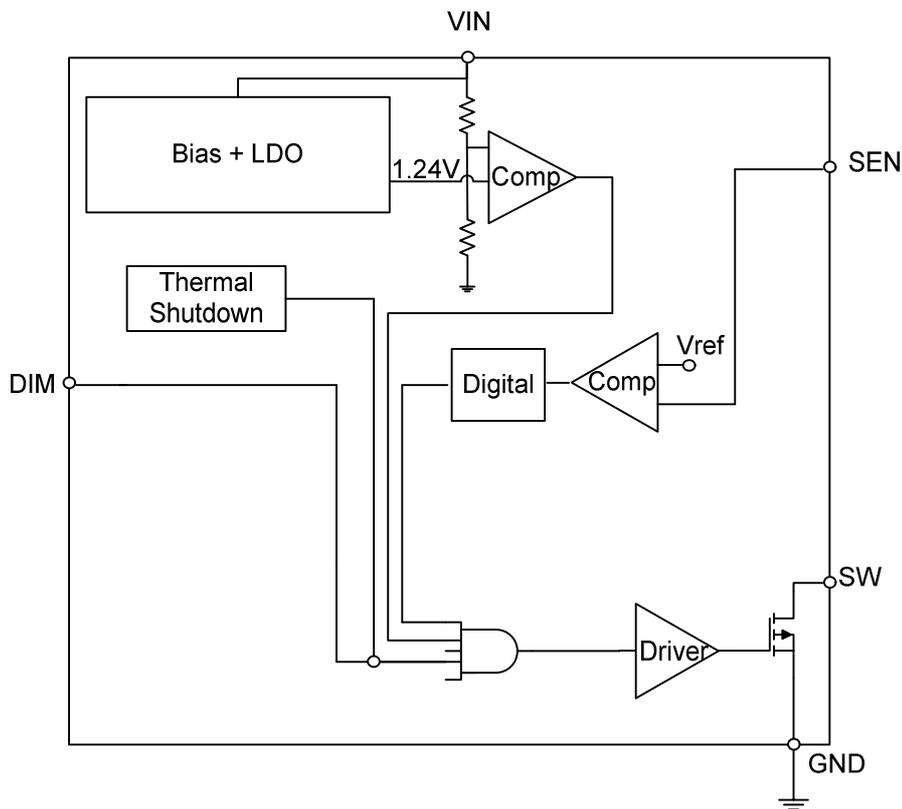
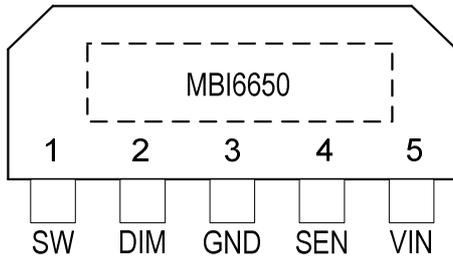


Figure 1

Functional Diagram



Pin Configuration



Pin Description

Pin Name	Function
GND	Ground terminal for control logic and current sink
SW	Driver output terminal
DIM	Dimming control terminal
SEN	Output current sense terminal
VIN	Supply voltage terminal
Thermal Pad	Power dissipation terminal connected to GND*

*To eliminate the noise influence, the thermal pad is suggested to be connected to GND on PCB.

In addition, desired thermal conductivity will be improved, if a heat-conducting copper foil on PCB is soldered with thermal pad.

Maximum Ratings

Characteristic	Symbol	Rating	Unit			
Supply Voltage	V_{IN}	0~40	V			
Output Current	I_{OUT}	1.2	A			
Sustaining Voltage	$V_{SW} \cdot V_{DIM}$	-0.5~40	V			
GND Terminal Current	I_{GND}	1.2	A			
Power Dissipation (On PCB, $T_a=25^\circ\text{C}$)	P_D	3.80	W			
Thermal Resistance (By simulation)				TO-252-5L	$R_{th(j-a)}$	$^\circ\text{C/W}$
Empirical Thermal Resistance (On PCB, $T_a=25^\circ\text{C}$)						
Operating Junction Temperature	$T_{j,max}$	125	$^\circ\text{C}$			
Operating Temperature	T_{opr}	-40~+85	$^\circ\text{C}$			
Storage Temperature	T_{stg}	-55~+150	$^\circ\text{C}$			

Electrical Characteristics (Ta=25°C)

Characteristics		Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage		V_{IN}		9	12	36	V
Supply Current		I_{DD}	Temp=25°C, $V_{IN}=9V\sim 36V$	-	1	4	mA
Output Current		I_{OUT}	$V_{IN}=12V$	-	1	-	A
Output Current Setting Accuracy		dI_{OUT}/I_{OUT}	150mA< I_{OUT} <750mA, $V_{IN}=12V$, L=47uH	-	±5	±10	%
			75mA< I_{OUT} <1200mA, $V_{IN}=12V$, L=47uH	-	±5	±10	%
SW Dropout Voltage		ΔV_{SW}	$I_{OUT}=1.2A$ ($V_{IN}=12V$)	-	0.3	0.6	V
Line Regulation		$\%/\Delta V_{IN}$	12V< V_{IN} <24V, $V_{OUT}=3.6V$, $I_{OUT}=350mA$, L=47uH	-	±5	±10	%
			9V < V_{IN} < 36V, $V_{OUT}=3.6V$, $I_{OUT}=350mA$, L=47uH	-	±5	±10	%
Load Regulation		$\%/\Delta V$	$V_{IN}=24V$, $I_{OUT}=350mA$, 3.6V< V_{OUT} <18V, L=47uH	-	±5	±10	%
			$V_{IN}=24V$, $I_{OUT}=700mA$, 3.6V< V_{OUT} <18V, L=47uH	-	±5	±10	%
			$V_{IN}=24V$, $I_{OUT}=1200mA$, 3.6V< V_{OUT} <18V, L=47uH	-	±5	±10	%
Efficiency		-	$V_{IN}=12V$, $I_{OUT}=350mA$, L=47uH, $V_{OUT}=7.2V$		88	-	%
Input Voltage	“H” level	V_{IH}	-	3.5	-	-	V
	“L” level	V_{IL}	-	-	-	1.5	V
Switch ON resistance		$R_{DS(ON)}$	$V_{IN}=12V$	-	0.8	-	Ω
CURRENT SENSE							
Regulated Rsense Voltage		V_{SENSE}	-	-	0.3	-	V
THERMAL OVERLOAD							
Thermal Shutdown Threshold		T_{SD}	-	+130	+140	+155	°C
Thermal Shutdown Hysteresis		T_{SD-HYS}	-	40	45	55	°C
UNDER VOLTAGE LOCK OUT							
UVLO Voltage		-	Ta=-40~85°C	7.25	7.4	7.5	V
UVLO Hysteresis		-	-	-	0.6	-	V
Start Up Voltage		-	-	7.85	8.0	8.1	V
DIMMING							
PWM Dimming Frequency		f_{DIM}	$V_{IN}=9\sim 36V$	-	-	40	KHz
Duty Cycle		-	-	0	-	100	%

Application Information

The MBI6650 step down DC/DC converter embedded all the features to implement a simple, cost effective and high efficient buck converter to drive more than 1A of loading. MBI6650 contains an N-Channel switch, is easy to implement, and is available in the thermally enhanced TO252-5L package. MBI6650's operation is based on a hysteretic PFM control scheme resulting in the operating frequency remaining relatively constant with load and input voltage variations. The hysteretic PFM control requires no loop compensation resulting in very fast load transient response and achieving excellent efficiency performance at light loading.

Setting Output Current

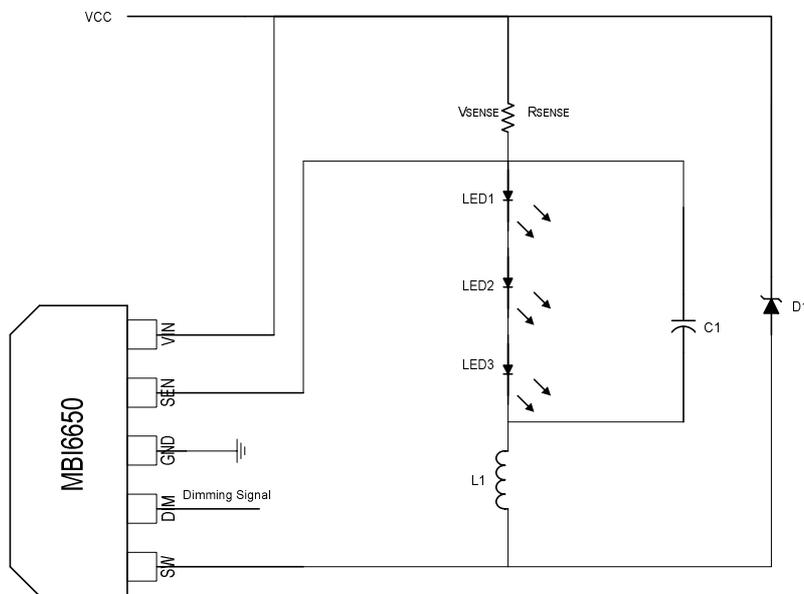
The output current (I_{OUT}) is set by an external resistor, R_{SENSE} . The relationship between I_{OUT} and R_{SENSE} is

$$V_{SENSE} = 0.3V;$$

$$R_{SENSE} = (V_{SENSE} / I_{OUT}) = (0.3V / I_{OUT});$$

$$I_{OUT} = (V_{SENSE} / R_{SENSE}) = (0.3V / R_{SENSE})$$

where R_{SENSE} is the resistance of the external resistor connected to SEN terminal and V_{SENSE} is the voltage of external resistor. The magnitude of current (as a function of R_{SENSE}) is around 1000mA at 0.3Ω.



Dimming

The DIM pin of the MBI6650 can support low frequency PWM dimming of the LED. A logic low (below 1.5V) at DIM will disable the internal MOSFET and shut off the current flow to the LED array. An internal pull-up circuit ensures that the MBI6650 is on when DIM pin is floated, eliminating the need for a pull-up resistor.

LED Open Circuit Protection

When any LED connected to MBI6650 is open-circuit, output current of MBI6650 will be turned off.

LED Short Circuit Protection

When any LED connected to MBI6650 is short-circuit, output current of MBI6650 will not change.

Under Voltage Lock Out Protection

When VIN voltage of MBI6650 is below 7.4V, output current of MBI6650 will be turned off. When VIN voltage of MBI6650 resumes to 8.0V, output current of MBI6650 will be turned on again.

Internal Soft Start Protection

With embedded soft start function inside MBI6650, output ripple of MBI6650 can be eliminated.

TP Function (Thermal Protection)

When the junction temperature exceeds the threshold, T_{SD} (140°C), TP function turns off the output current. Thus, the junction temperature starts to decrease. As soon as the temperature is below 95°C, the output current will be turned on again. The on-state and off-state switch at a high frequency; thus, the blinking is imperceptible. However, the average output current is limited, and therefore, the driver is protected from being overheated.

Inductor Selection

A 10 μ H inductor is recommended for MBI6650 applications. Small size and high efficiency are the major concerns for most MBI6650 applications. Inductor with low core losses and small DCR (cooper wire resistance) are good choice for MBI6650 applications.

Capacitor Selection

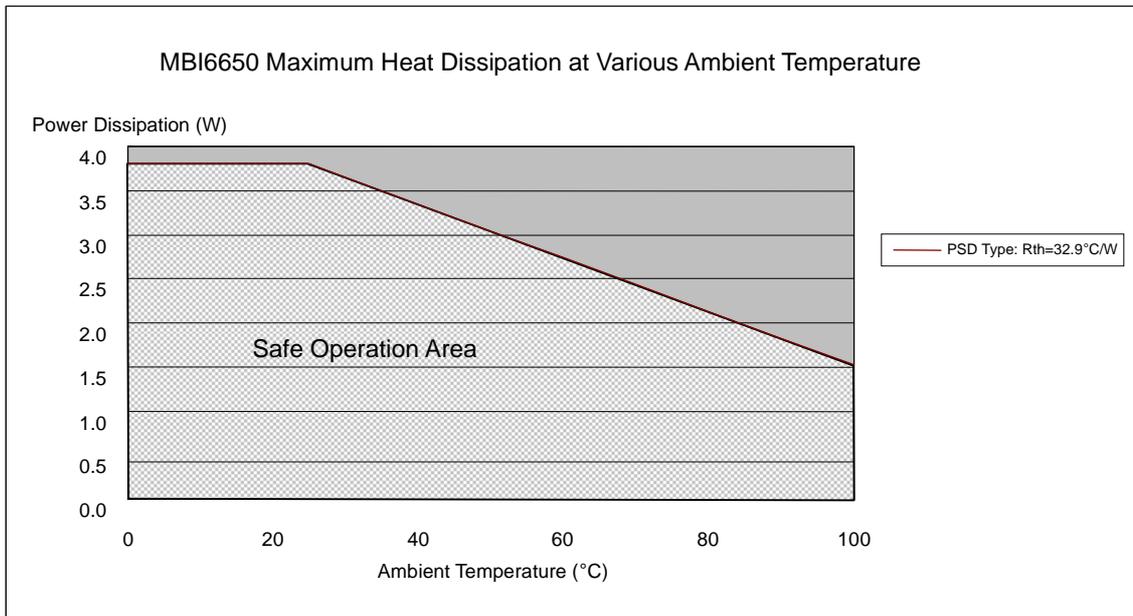
The small size of ceramic capacitors makes them suitable for MBI6650 applications. A minimum 1 μ F capacitor for output is required for most applications. A larger output capacitor minimizes output ripple.

Diode Selection

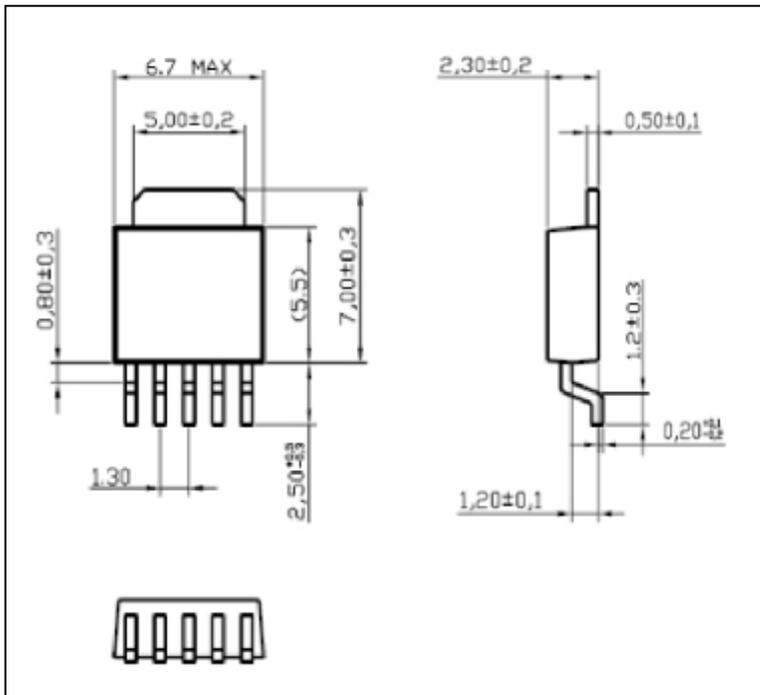
Schottky diodes, with their low forward voltage drop and fast reverse recovery, are the ideal choices for MBI6650 applications. The forward voltage drop of a Schottky diode represents the conduction losses in the diode, while the diode capacitance (CT or CD) represents the switching losses. For diode selection, both forward voltage drop and diode capacitance need to be considered. Schottky diodes with higher current ratings usually have lower forward voltage drop and larger diode capacitance, which can cause significant switching losses. A Schottky diode rated at 2A is sufficient for most MBI6650 applications.

Package Power Dissipation (PD)

The maximum power dissipation, $P_D(max)=(T_j-T_a)/R_{th(j-a)}$, decreases as the ambient temperature increases.



Outline Drawing



MBI6650PSD Outline Drawing

Note: The unit for the outline drawing is mm.

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