

DESCRIPTION

The MT7282 is a constant current white LED driver designed for wide input voltage range from 2.5V to 40V system rail. The MT7282 can be configured as Buck, Boost and Buck-Boost topology. The MT7282 drives up to 10W with AC12V/DC12V input voltage. Current mode and fixed frequency operation provides fast transient response and eases loop stabilization. With a current sense amplifier threshold of 205mV, the LED current is programmable with one external current sense resistor and the power loss is minimized. The 450kHz operating frequency minimizes external inductor, input and output capacitor.

The MT7282 supports both PWM and analog dimming by a single control pin. Fault condition protection includes over voltage protection(OVP), cycle-by-cycle peak current limiting and thermal shutdown.

The MT7282 is available in ESOP8 packages.

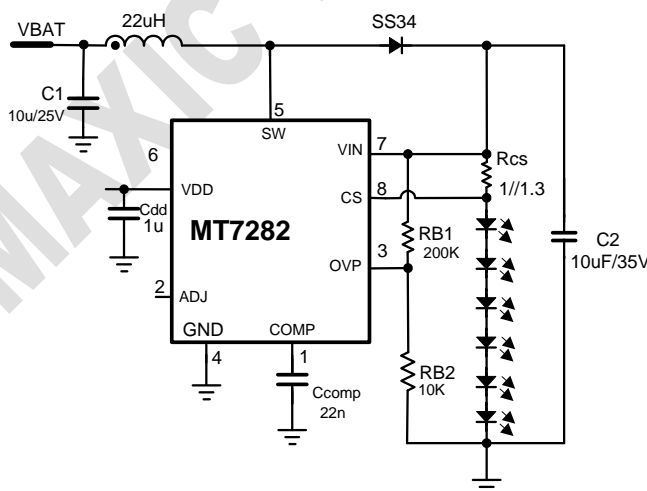
FEATURES

- 2.5V to 40V input/output voltage range
- High efficiency up to 95%
- Cycle by Cycle Over Current Protection
- Internal 0.2ohm power MOSFET
- Support Boost ,Buck-Boost ,Buck topology
- LED temperature protection
- Stable with Low ESR Ceramic Capacitor
- OTP and OVP protection
- External setting over voltage protection
- Fixed switching frequency: 450kHz
- Frequency jittering for reduced EMI
- Low feedback voltage: 205mV
- Adjustable soft-start
- Support one pin analog dimming and up to 10kHz PWM dimming
- Available in ESOP8 package

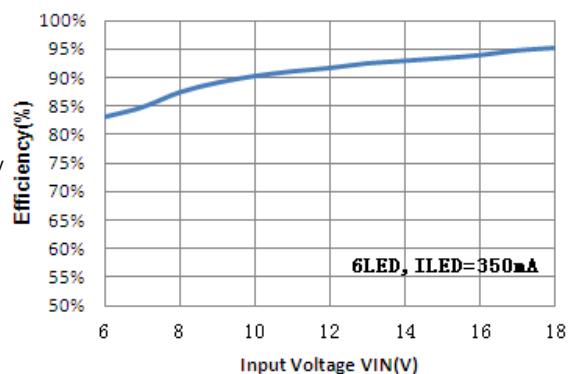
APPLICATION

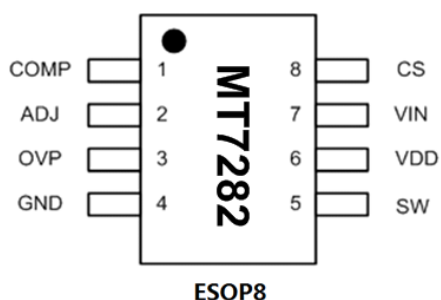
- Automotive and Marine Lighting
- High Power LED Driver
- Torch Driver
- Low Voltage LED Lighting (Landscape, Desk, Room, MR16 lighting)
- LED backlighting

TYPICAL APPLICATION (STEP-UP/BOOST APPLICATION)



Efficiency VS. Input Voltage



PIN CONFIGURATIONS

Chip Mark

MT7282

YY WW xxxx

Manufacture code

Week code

Year code

Pin description

Name	Pin No.	Description
COMP	1	Compensation Pin. Connect a 22nF ceramic capacitor (C_{COMP}) from COMP to GND. This capacitor stabilizes the loop, controls soft-start time.
ADJ	2	Brightness and On/Off Control Pin. A voltage greater than 0.4V will turn on the chip. When ADJ pin voltage varying from 0.4V to 1.6V, the LED current will change from 0% to 100% of the maximum current. Any voltage above 1.6V will clamp to 100% maximum current. To use PWM dimming, apply a 200Hz to 10kHz square wave signal with amplitude greater than 1.6 V to this pin. Hold ADJ below 200mV for 3.5mS to shut down the IC .
OVP	3	Over voltage protection Pin. OVP happening in Boost or Buck-Boost converter turns off the chip after OVP pin voltage higher than 1.2V, OVP comparator have internal 100mV hysteresis.
GND	4	Ground
SW	5	Switch Output. SW is the source of the internal MOSFET switch. Connect to the power inductor and cathode of the Schottky rectifier. Keep the traces to the switching components as short as possible to minimize radiation and voltage spikes.
VDD	6	5V Reference Output. Bypass VDD to GND with a 1 μ F or greater ceramic capacitor.
VIN	7	Supply voltage. Bypass VIN to GND with 10u ceramic capacitor. MT7282 operates from a 2.5V to 40V unregulated input.
CS	8	LED current sense pin, the voltage between VIN and CS is 205mV.

ABSOLUTE MAXIMUM RATINGS

SW/VIN/CS/OVP pin	-0.3V to +40V
All other pins	+0.3V to 6V
Storage Temperature	-55°C to 150°C
Junction to ambient (R θ JA)	120°C/W

RECOMMENDED OPERATING CONDITIONS

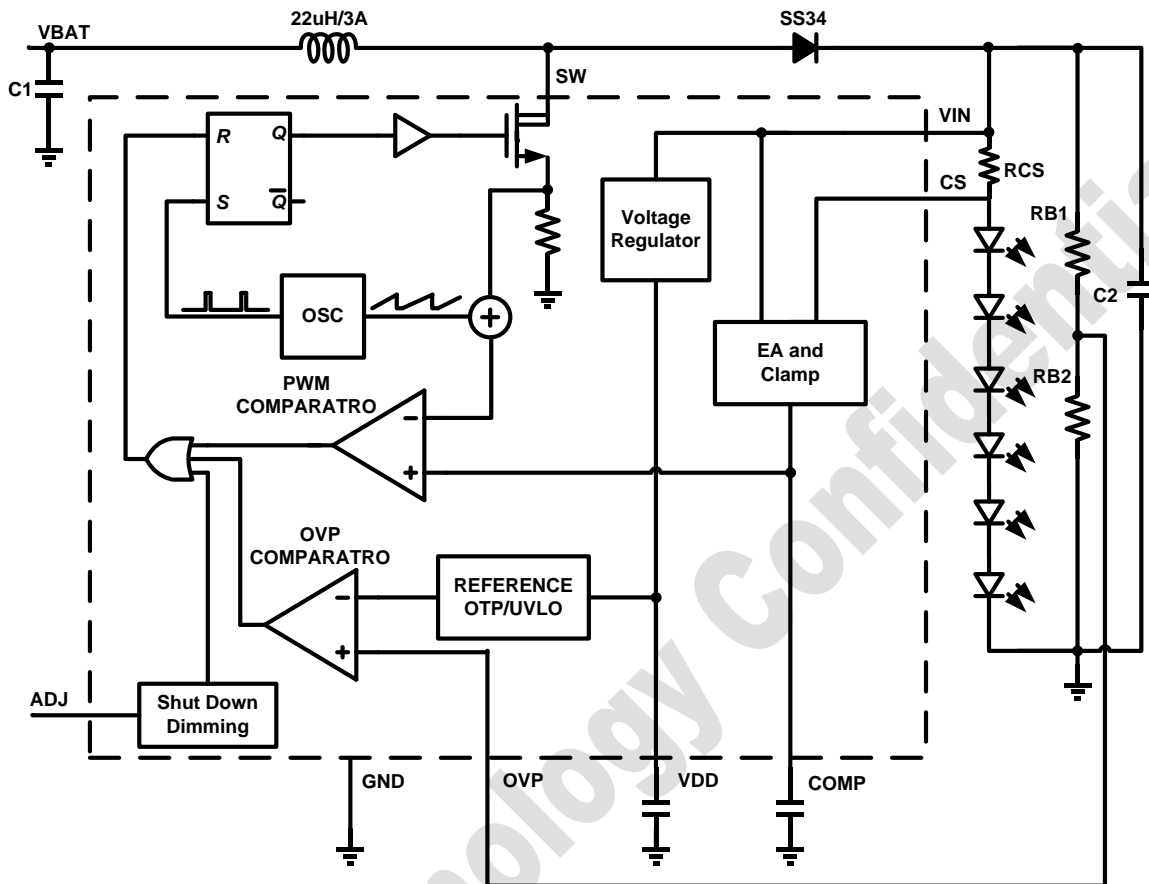
Supply voltage	2.5V to 40V
Output Voltage	V _{in} to 40V
Operating Temperature	-40°C to 105°C
Maximum Driving LEDs in series	10 LEDs in series

ELECTRICAL CHARACTERISTICS

 (Test conditions: V_{BAT}=5V, T_A=25°C unless otherwise stated.)

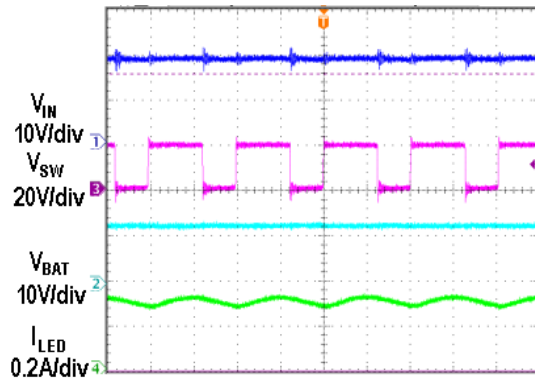
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{BAT}	Input (Battery) Voltage		2.5		40	V
I _{shutdown}	Supply current (Shutdown)	V _{ADJ} =0V		40		μA
I _Q	Supply current (No Switching)	V _{comp} =0V		270		μA
f _{SW}	Switching frequency			450		kHz
D _{max}	Maximum duty cycle	V _{IN} -V _{CS} =0.1V	85	95		%
Over Voltage lockout (Pin3: OVP)						
OV	Over voltage protection reference			1.2		V
	OV reference hysteresis			100		mV
Enable/Dimming (Pin2: ADJ)						
V _{EN}	Enable Threshold	ADJ rising		0.4		V
	ADJ Pin pull up current	ADJ=0V		1		uA
	Analog dimming voltage range		0.4		1.6	V
	PWM dimming frequency	<i>Note 1</i>	0.2		10	kHz
	ADJ shutdown delay	ADJ pin keep low		3.5		mS
Current Sense (Pin8: CS)						
V _{IN} -V _{CS}	Current sense voltage			205		mV
Output Switch (Pin5: SW)						
R _{on}	SW On-resistance	<i>Note 1</i>		0.2		Ω
I _{lim}	Current limit	<i>Note 1</i>		3.6		A
OTP	Thermal protection threshold			160		°C
	OTP hysteresis			30		°C

Note 1: Guaranteed by design

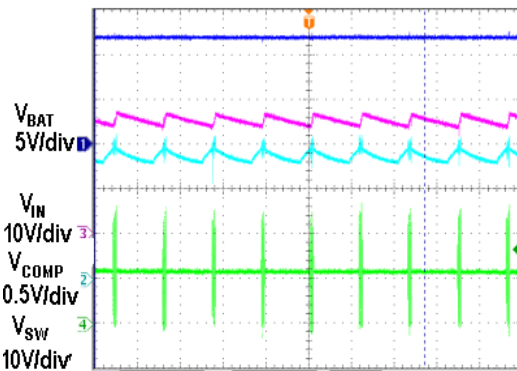
BLOCK DIAGRAM

Figure 1—Function Block Diagram

TYPICAL OPERATING CHARACTERISTICS

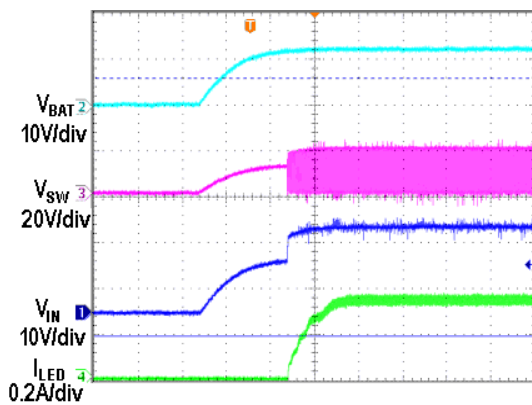
($V_{BAT} = 12V$, 6 LEDs, Boost Topology, I_{out} set as 350mA, unless otherwise noted.)

Steady State Operation


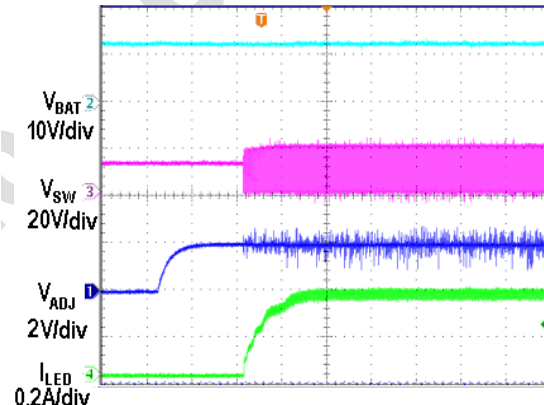
1uS/div

Open LED Protection


4mS/div

Start up with VBAT


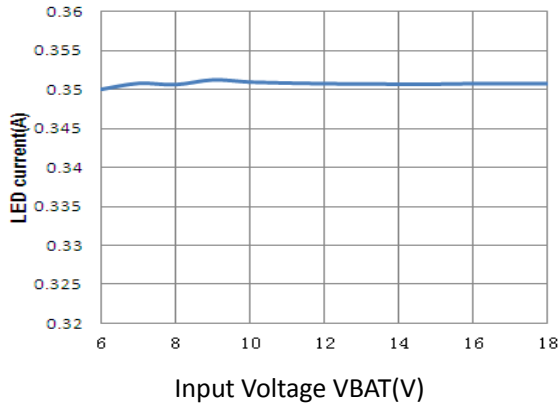
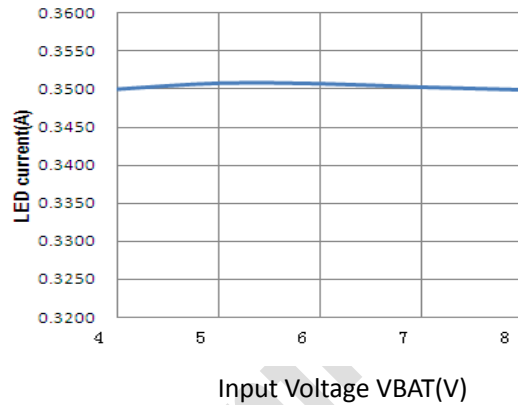
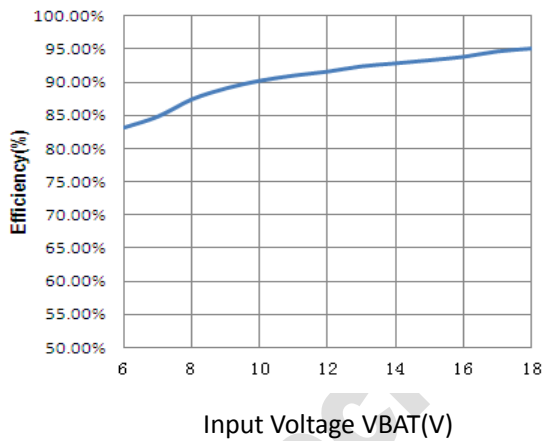
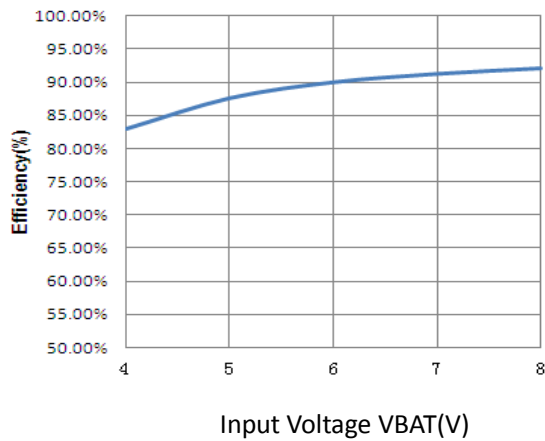
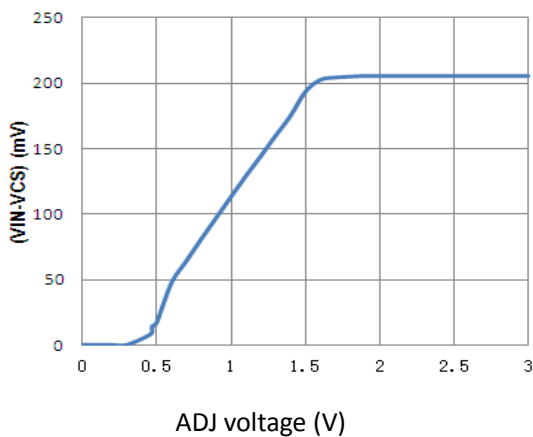
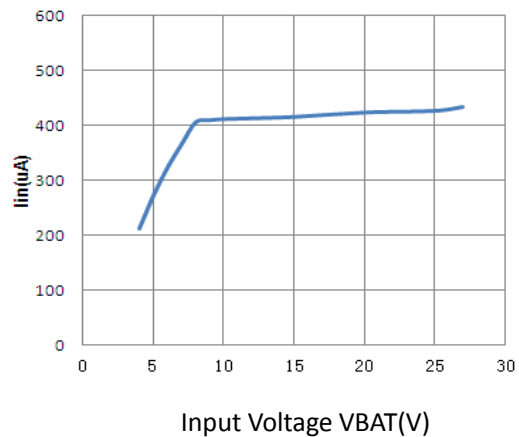
4mS/div

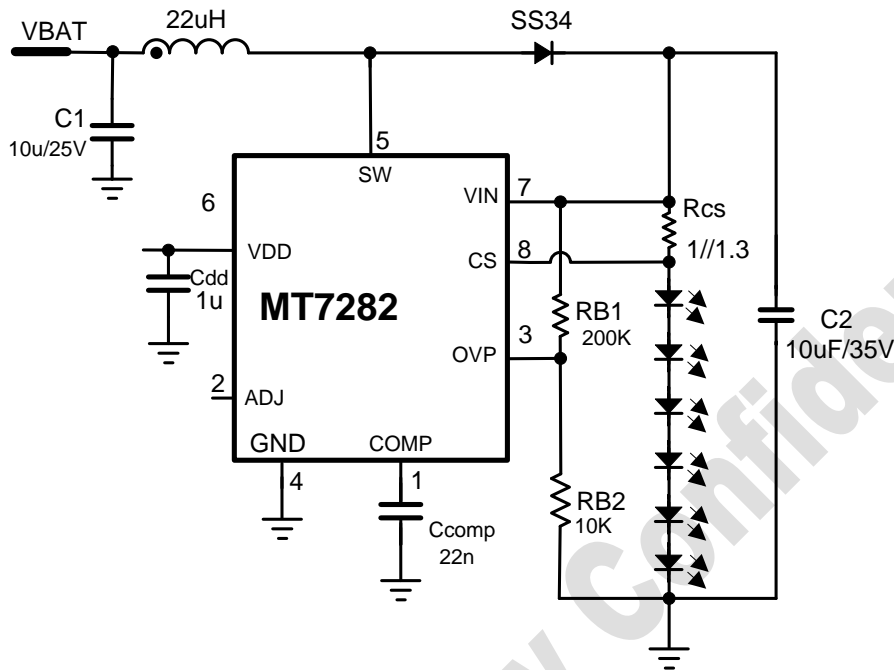
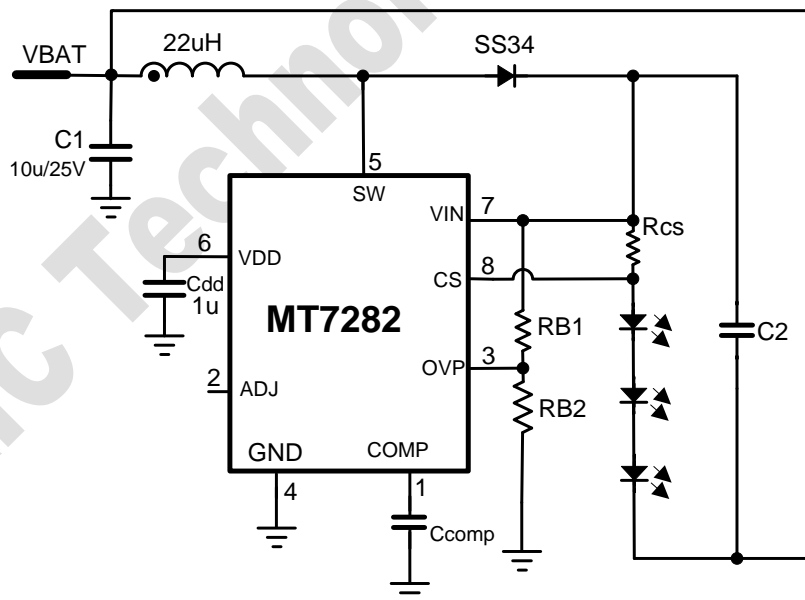
Start up with ADJ


4mS/div

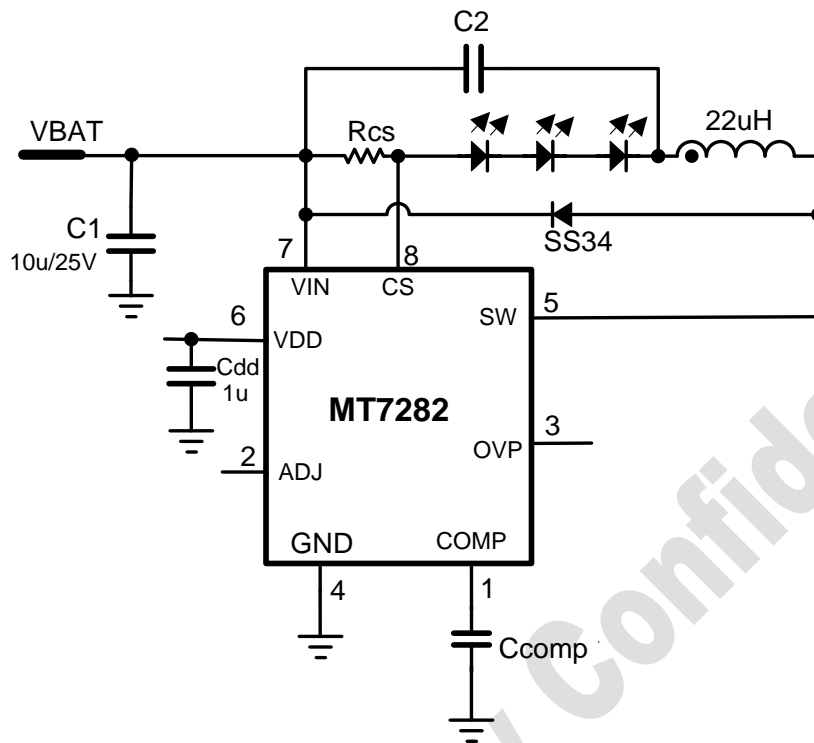
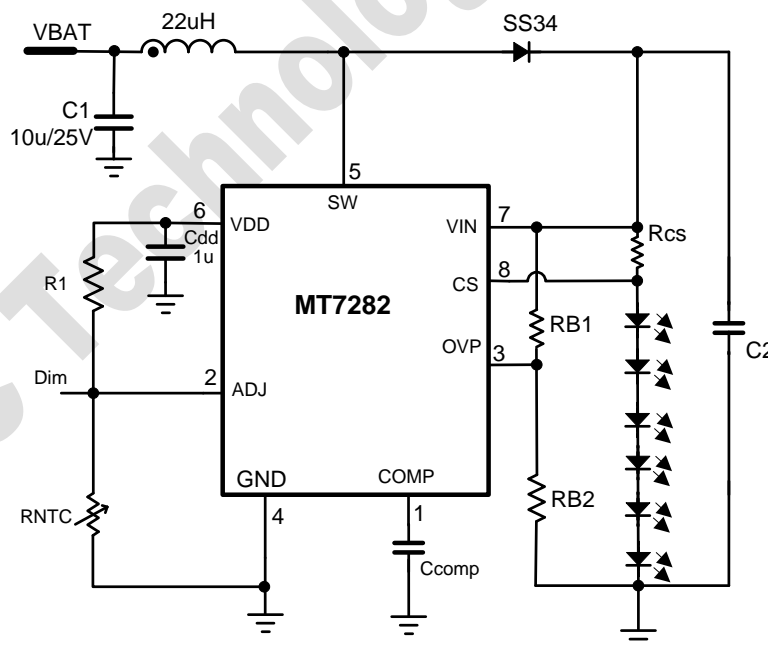
TYPICAL OPERATING CHARACTERISTICS (CONTINUED)

($V_{BAT} = 12V$, 6 LEDs, Boost Topology, I_{out} set as 350mA, unless otherwise noted.)

LED Current VS. Input Voltage(6LEDs)

LED Current VS. Input Voltage(3LEDs)

Efficiency VS. Input Voltage(6LEDs)

Efficiency VS. Input Voltage(3LEDs)

(VIN-VCS) Voltage VS. ADJ Voltage

No Switching Current VS. VIN


TYPICAL APPLICATION CIRCUITS

Figure 2— BOOST application for $V_{BAT} < V_{LED}$

Figure 3— BUCK-BOOST application for $V_{BAT} > V_{LED}$ and/or $V_{BAT} < V_{LED}$

Note: When set up as BUCK-BOOST topology, the sum of input voltage V_{BAT} and output voltage V_{LED} MUST NOT exceed 40V.


Figure 4— BUCK application for $V_{BAT} > V_{LED}$

Figure 5— BOOST application with NTC resistor to protect LED

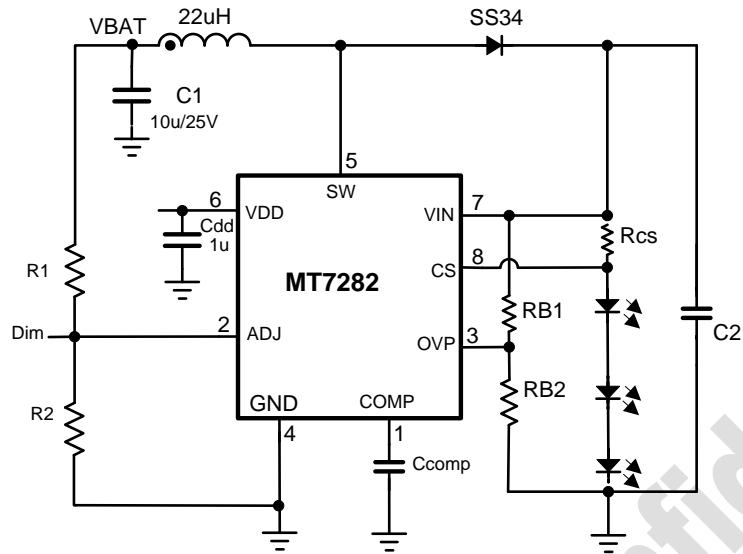


Figure 6— LED torch application with battery voltage detection

TYPICAL APPLICATION INFORMATION

Soft-Start

The MT7282 attains soft-start by charging C_{COMP} gradually with a current source (8uA). When V_{COMP} rises above 1.3V, the internal MOSFET begins switching with an incremental duty cycle. Use 22nF ceramic capacitor is enough for stabilizing the loop and the soft start function.

Shutdown

The MT7282 enters shutdown mode when V_{ADJ} is less than 200mV for more than 3.5ms. In shutdown mode, supply current is reduced to 40uA by powering down the entire IC except the ADJ voltage-detection circuitry. C_{COMP} is discharged to zero during shutdown period, allowing the device to re-initiate a soft-start procedure when the chip is enabled.

Over-Voltage Protection

Over Voltage Protection (OVP) occurs when the LED is open in Boost and Buck-Boost application. The LED open will breakdown the chip if there is no OVP protection circuitry. (Refer to waveform of Open LED protection in TYPICAL OPERATING CHARACTERISTICS Section). The over voltage protection threshold can be set according to actual number of LEDs by the external resistor ratio. The OVP comparator reference is 1.2V with 100mV hysteresis.

In normal operation, MT7282 over voltage protection threshold voltage calculates as:
 $V_{IN} = 205mV + V_{BAT} + V_{LED} \times K < V_{OVP} = 1.2 \times (1 + R_{B1}/R_{B2})$

Where

K -- Number of LEDs in each string

V_{BAT} -- Input battery voltage, if used in Boost mode, $V_{BAT}=0$,

V_{LED} -- one LED forward voltage

The recommended OVP point is about 1.3~1.5 times higher than the normal output voltage.

Setting the LED Current

The LED current is programmed by the external current sense resistor R_{CS} through the following equation

$$I_{LED} = \frac{205}{R_{CS}(ohm)} (mA)$$

Analog and PWM Dimming

The MP7282 allows both DC and PWM dimming. When V_{ADJ} is less than 0.2V, the chip is turned off. For analog dimming, when V_{ADJ} rises from 0.4V to 1.6V, the LED current will change from 0% to 100% of the maximum LED current. If V_{ADJ} is higher than 1.6V, maximum LED current is generated. If a PWM signal is used, its amplitude V_{ADJ} must exceed 1.6V. Apply a 200Hz to 10kHz PWM signal to ADJ pin, the LED current will change from 5% to 100% according to the duty cycle.

Capacitor Selection

The typical value for the input capacitor is 10uF and the typical value for the output capacitor is 1uF. Larger value capacitors can be used to further reduce input and output ripple. Keep the capacitor impedance low at switching frequency is important, ceramic capacitors with X5R or X7R dielectrics are highly recommended. C_{COMP} stabilizes the loop and controls soft-start time. Connect a 22nF capacitor from COMP pin to GND.

Inductor Selection

Inductor value ranges from 10 μ H to 47 μ H. A 22 μ H inductor optimizes the efficiency for most applications. To prevent core saturation, ensure that the inductor-saturation current rating exceeds about 30%-40% of the peak inductor current for the application.

Schottky Diode Selection

The MT7282's high switching frequency demands a high-speed rectification diode for optimum efficiency. A Schottky diode is recommended due to its fast recovery time and low forward-voltage drop. Ensure that the diode's average and peak current rating exceed the average output current and peak

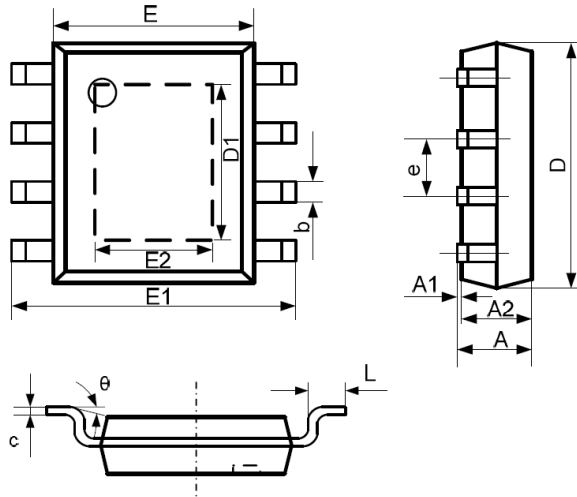
inductor current. In addition, the diode's reverse breakdown voltage must exceed the maximum output voltage.

PC Board Layout

Due to fast switching waveform and high-current paths (VIN, SW), careful PC board layout is required. An evaluation kit is available to speed design. When laying out a board, minimize trace lengths between the chip and Rcs, the inductor, the diode, the input capacitor, and the output capacitor. Keep traces short, direct, and wide. Keep noisy traces, such as the SW node trace, away from Rcs. The ground connections of input capacitor C1 and output capacitor C2 should be as close as possible.

PACKAGE INFORMATION

SOP-8/EP PACKAGE OUTLINE AND DIMENSIONS



SYMBOL	DIMENSION IN MILLIMETERS		DIMENSION IN INCHES	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.150	0.002	0.006
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.200
D1	3.202	3.402	0.126	0.134
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
E2	2.313	2.513	0.091	0.099
e	1.270 TYP		0.050 TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

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Maximizing IC Performance

MT7282

**Boost/Buck-Boost/Buck White LED Driver
With High Frequency PWM Dimming**

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