

Constant Current LED Lighting Driver With PWM Dimming Control

General Description

The EMD2080 was designed with high efficiency step up DC/DC converter with constant current source for driving lighting LEDs. Wide input voltage range makes the application more flexible. LED dimming can be achieved with pulse width modulation dimming on DIM pin. The EMD2080 switches at 1.2MHz and allows using small inductor and both of input/output capacitors. An internal compensation can reduce external component.

The EMD2080 include current limit, over voltage and thermal shutdown protection. The EMD2080 is available in MSOP-10 package.

Features

- Supply Voltage: 6V ~ 30V
- Driving Current:
 - Up to 500mA @VIN=12V, VOUT=22.4V
- Over Voltage Protection: 36V
- Shutdown Current < 1μA
- Reference Voltage 0.245V
- Internal Soft Start and Compensation
- 1.4A Internal power MOSFET Switch
- Thermal Shutdown Protection

Applications

- Mood and Accent Lighting
- Automotive Lighting
- Ambient Lighting
- RGB LED Driver

Typical Application

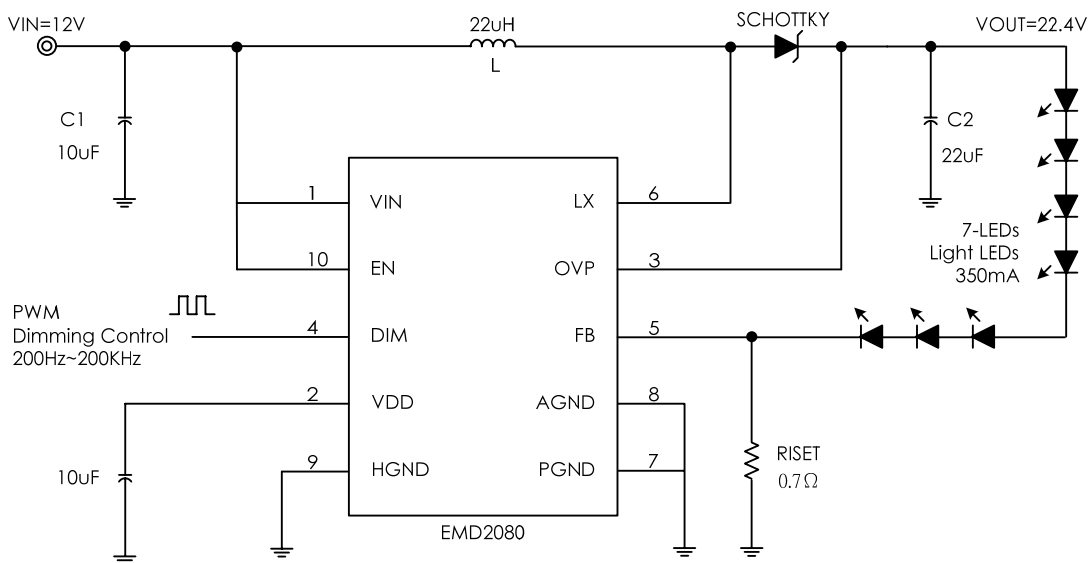
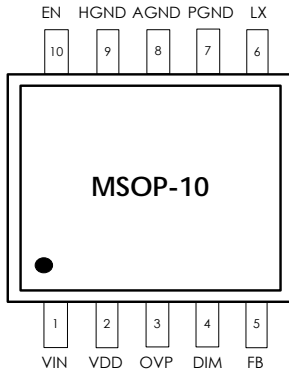


Fig. 1

Connection Diagram



Order Information

EMD2080-00MA10NRR
 00 Option Code
 MA10 MSOP-10 Package
 NRR RoHS & Halogen free package
 Rating: -40 to 85°C
 Package in Tape & Reel

Order, Mark & Packing Information

Package	Vout	Product ID	Marking	Packing
MSOP-10	Adjustable	EMD2080-00MA10NRR		Tape & Reel 3Kpcs

Pin Functions

Pin Name	Pin #	Function
VIN	1	Power Supply Voltage Pin.
VDD	2	Regulated 5V.
OVP	3	Over voltage protection.
DIM	4	PWM dimming control pin by applying 200HZ – 200KHZ PWM signal. Active pin when dimming is not used.
FB	5	Feedback sense pin. Reference voltage is 0.245V.
LX	6	Switch pin.
PGND	7	Power ground of the IC.
AGND	8	Analog ground of the IC.
HGND	9	Analog ground of the IC.
EN	10	The enable pin.

Absolute Maximum Ratings

Devices are subjected to failure if they stay above absolute maximum ratings

VIN Voltage	36V	Storage Temperature	-65°C to 150°C
LX, OVP Voltages	38V	Junction Temperature	150°C
EN Voltage	36V	Lead Temperature (Soldering, 10 sec)	260°C
VDD Voltage	6.0V	ESD Susceptibility	HBM 2kV
DIM Voltage	< pin of VDD		
FB Voltage	6.0V		

Operating Ratings

VIN, EN Voltages	6V to 30V	Thermal Resistance (θ_{JA})	
VDD, DIM Voltages	3.0V to 5.5V	MSOP-10 (Single layer PCB)	200°C/W
Operating junction Temperature	-40°C to 125°C	MSOP-10 (4-layer PCB)	120°C/W

Electrical Characteristics

(VIN = 12V, TA = 25°C, unless otherwise specified.)

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
Supply Voltage VIN		6		30	V
Supply Current	Continuously Switching			1	mA
Quiescent Current	No Switching, VFB = 1V		100		μA
Shutdown Current	EN, DIM = "L"		2		μA
Operation Frequency		0.9	1.2	1.5	MHz
Maximum Duty Cycle		93	95		%
Feedback Voltage		0.2205	0.245	0.2695	V
Thermal Shutdown Protection			160		°C
Thermal Shutdown Hysteresis			30		°C
BOOST internal NMOS Ron	Isw = 200mA		0.5	0.8	ohm
Current Limit			1.4		A
Shutdown Voltage Low	EN			0.35	V
	DIM			0.4	
Enable Voltage High	EN	1			V
	DIM	1.2			
EN Leakage Current	EN		0.1		μA
	DIM		1.3		
Maximum Output Voltage				35	V
OVP		36			V
OVP Hysteresis		0.2	1	3	V

Function block

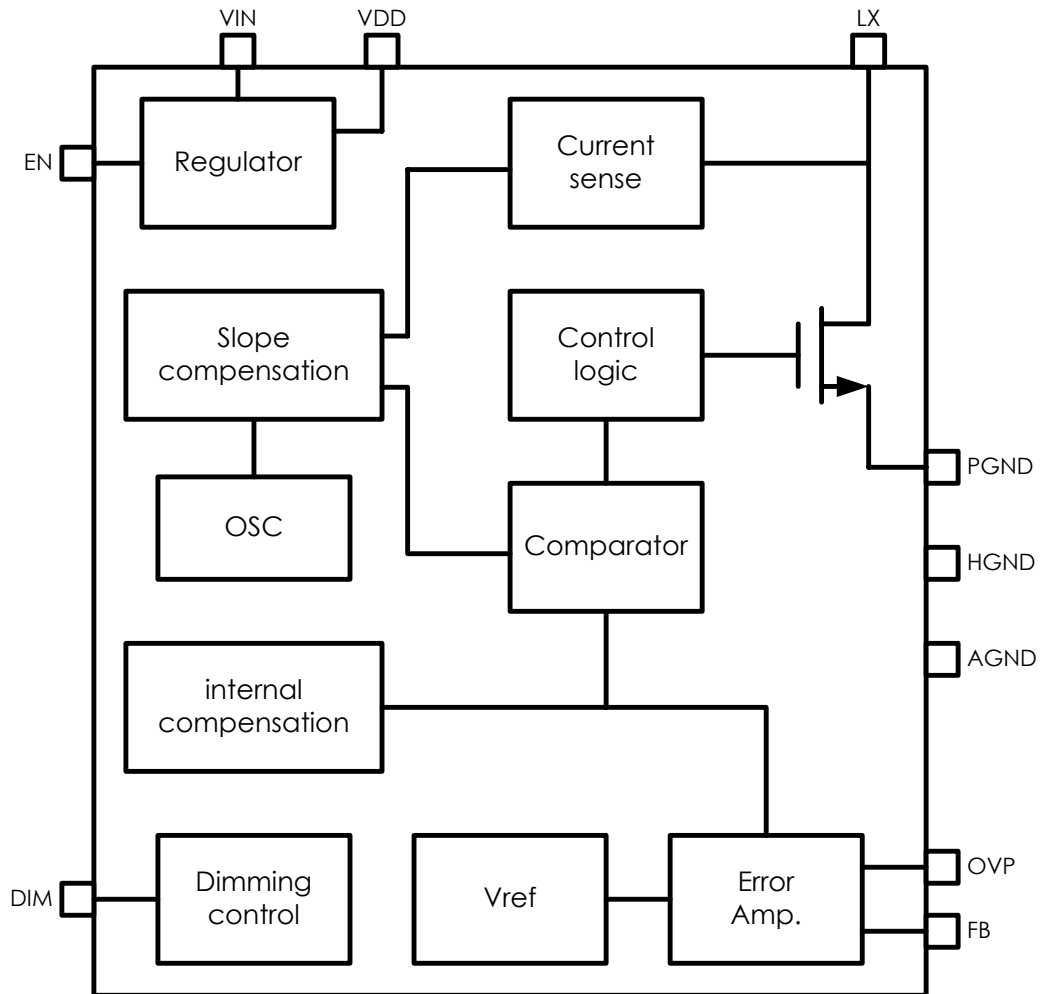
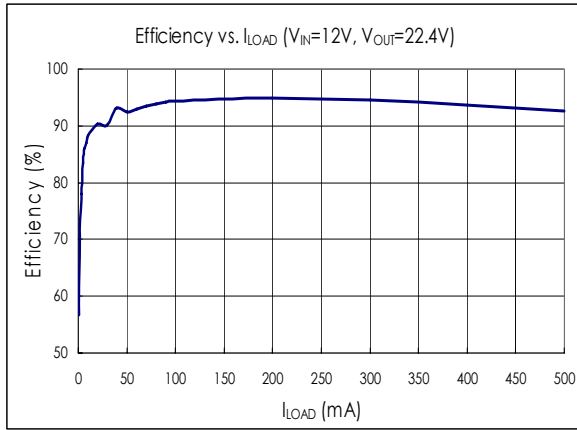


Fig. 2

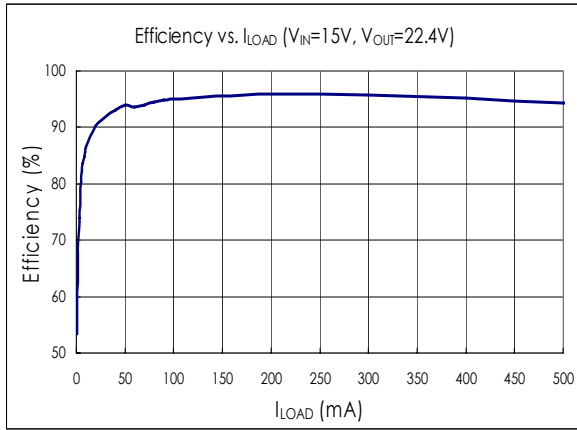
Typical Performance Characteristics

VIN = 12V, unless otherwise specified

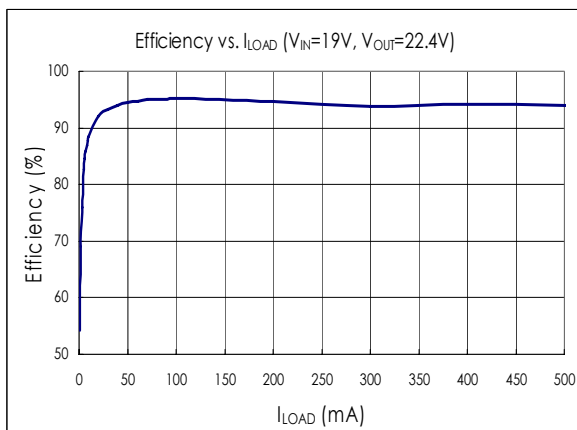
Load vs. Efficiency (VIN=12V, VOUT=22.4V)



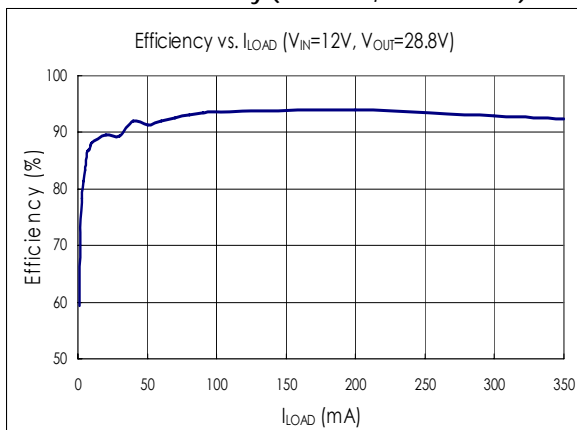
Load vs. Efficiency (VIN=15V, VOUT=22.4V)



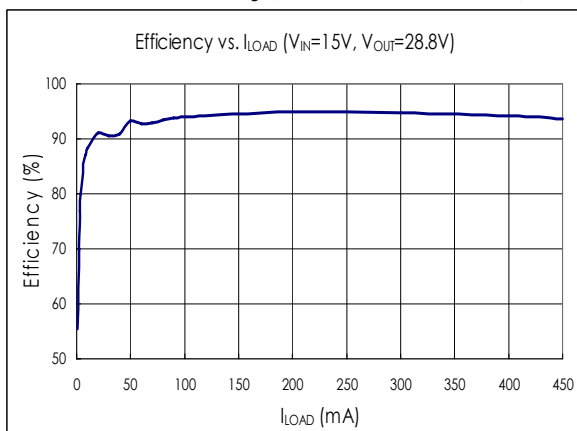
Load vs. Efficiency (VIN=19V, VOUT=22.4V)



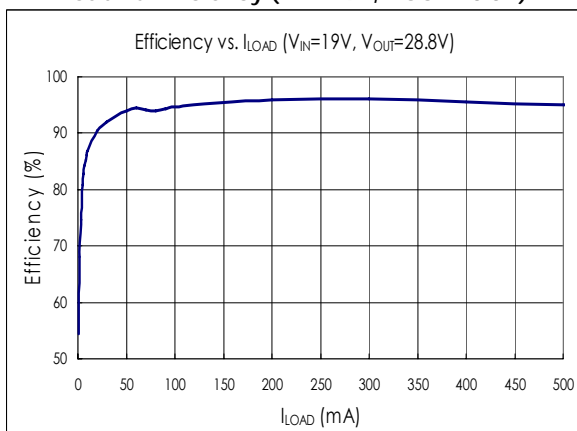
Load vs. Efficiency (VIN=12V, VOUT=28.8V)



Load vs. Efficiency (VIN=15V, VOUT=28.8V)

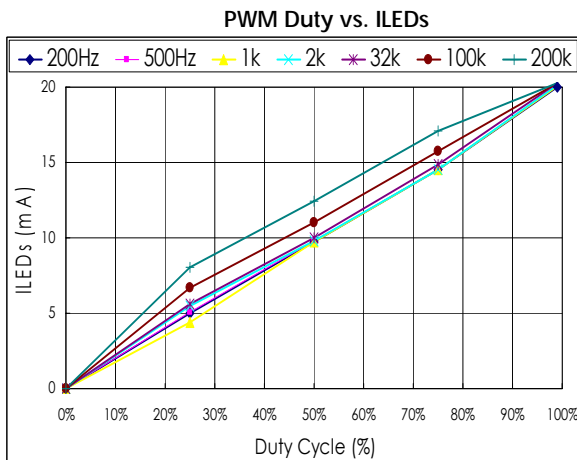
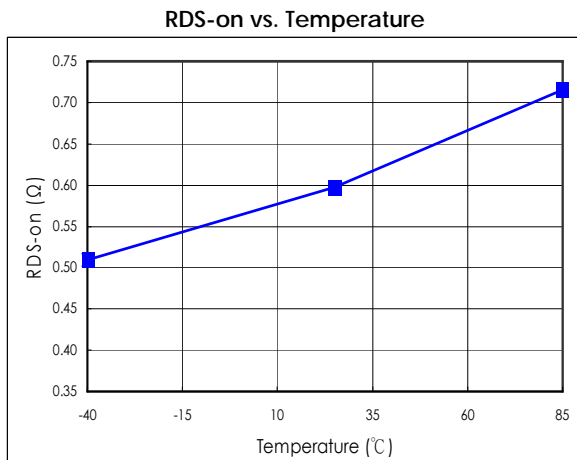
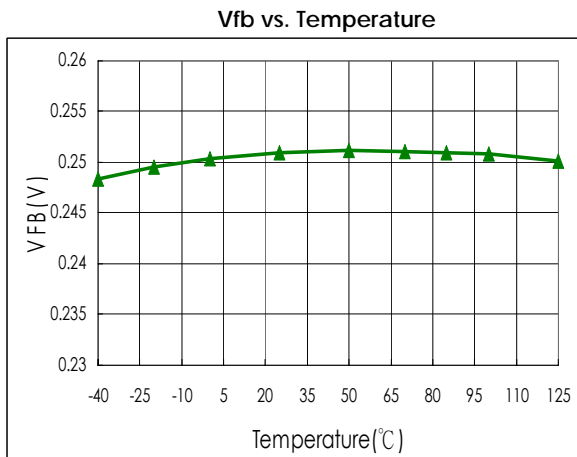
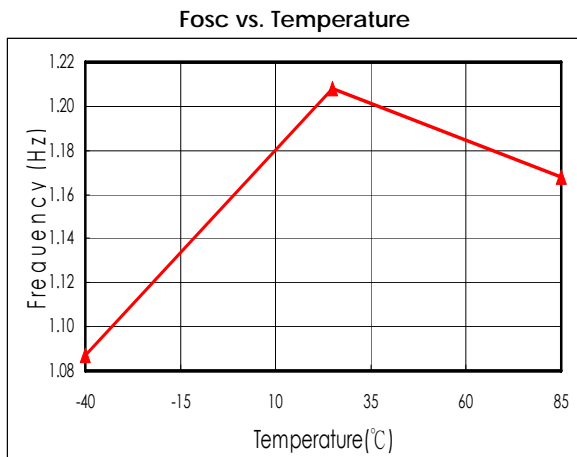
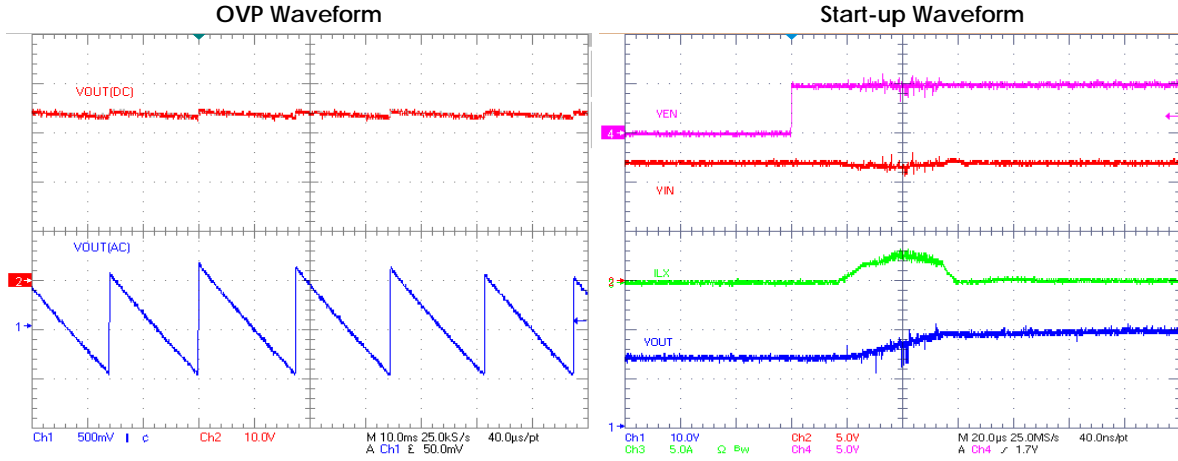


Load vs. Efficiency (VIN=19V, VOUT=28.8V)



Typical Performance Characteristics

VIN = 12V, unless otherwise specified



Application Information

Detailed Description

The EMD2080 is a constant frequency current-mode boost converter with constant current source and is designed for WLEDs driver. This device provides the same output current through each WLED that get even illumination. The fast operation frequency allows for small inductor and input/output capacitors.

During normal operation, the internal oscillators send a pulse signal to set latch and turn on internal MOSFET each duty circle. A current sense voltage sums MOSFET current and slope signal connected to the negative terminal of the PWM comparator. When this signal voltage exceeds output voltage of error amplifier, the PWM comparator will send a signal to reset latch and turn off internal MOSFET. The output voltage of error amplifier is magnified from the difference between reference voltage and feedback voltage. If reference voltage is higher than feedback voltage, more current is delivered to the output, the other way, less current is delivered.

Enable / Disable

The EMD2080 enters shutdown mode when EN and DIM pins voltage are less 0.35V. When in shutdown mode, all internal circuits of the EMD2080 are turn off and quiescent current is reduced to less than 1uA. When EN and DIM pins voltage are higher than 1.2V, start-up begins.

DIM pin can be used for dimming control, the PWM frequency range is from 200Hz to 200kHz. The average LED current is proportional to the PWM duty cycle, while 0% duty cycle triggers zero WLEDs current and 100% duty cycle triggers full WLEDs current set by Riset (Eq.1).

OVP

When WLEDs are open, the boost control loop just like open loop operation, it may causes over voltage damage on LX pin. In order to prevent this damage, the EMD2080 provides OVP function to protect it from damage. The protection threshold is set at 36V.

OTP

The internal thermal sensor turn off power MOSFET when junction temperature is exceeded 160°C, the OTP is designed with a 30°C hysteresis.

LED Current Setting

Referring to Figure 1 of the typical application, adjusting the output current changes the brightness of WLEDs, the EMD2080 regulates output current by sense resistor (RISET). The output current is given by:

$$\text{LED current (mA)} = 245 \text{ mV} / \text{RISET } (\Omega) \tag{Eq. 1}$$

Cin and Cout Selection

It is recommended to use the X5R or X7R which have best temperature and voltage characteristics of all the ceramics for a give value and size. A minimum input capacitance of 10µF is required for the EMD2080, the capacitor value may be increased without limit. The typical output capacitor value is 10µF, higher capacitance can be used to reduce voltage ripple.

Inductor Selection

The inductor values range from 10µH to 33µH. The typical inductor value is 22µH. The low DCR inductor is preferred. In addition, the limit saturation current of inductor must exceed current limit of the EMD2080.

Diode Selection

Referring to Figure 1 of the typical application, the EMD2080 is high switching control devise which demands a high speed rectification diode for optimum efficiency. The schottky diode is preferred, for high efficiency, schottky diode provide fast recovery time and low forward voltage that reduce power loss. The breakdown voltage of schottky diode must exceed output voltage.

Application Circuit

- Application circuit for 9S4P (S: Series ; P: Parallel)

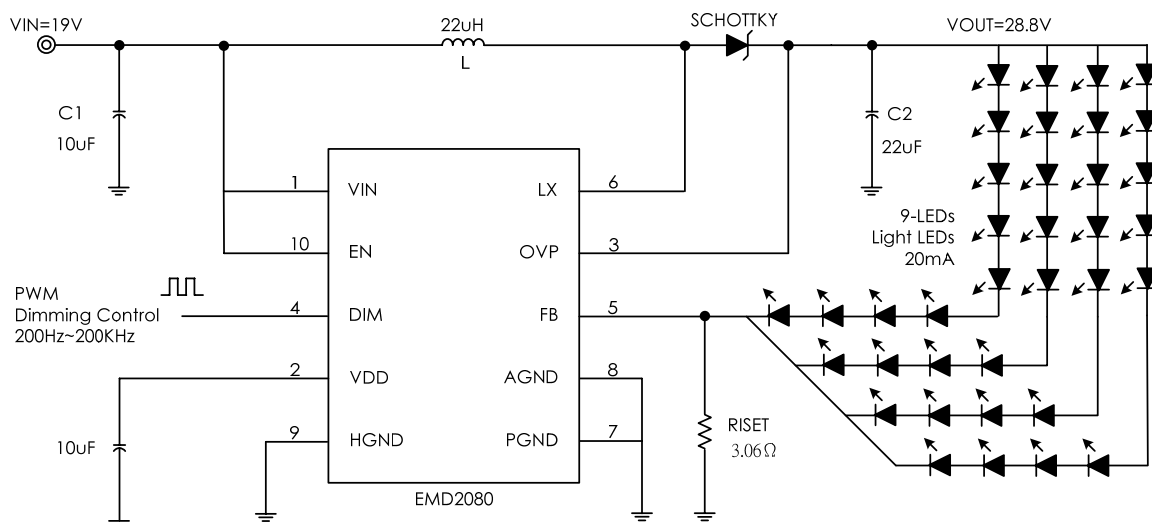
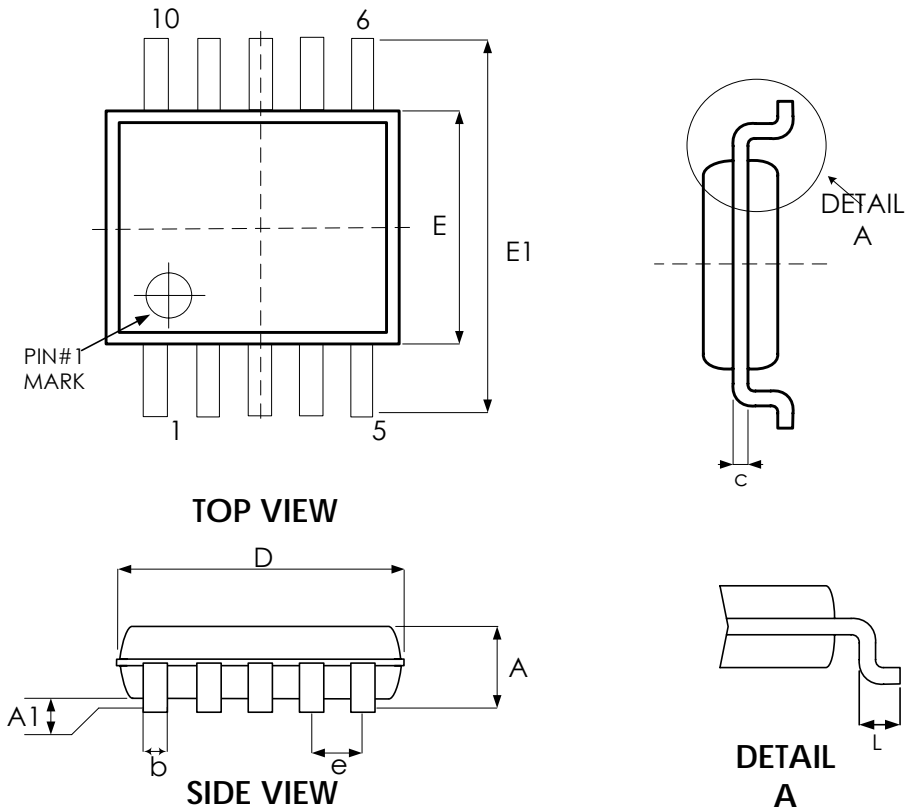


Fig. 3

Package Outline Drawing
MSOP-10 (118 mil)



Symbol	Dimension in mm	
	Min	Max
A	0.81	1.10
A1	0.00	0.15
b	0.17	0.33
c	0.08	0.23
D	2.90	3.10
E	4.80	5.00
E1	2.90	3.10
e	0.50 BSC	
L	0.40	0.80

Revision History

Revision	Date	Description
0.1	2011.11.01	Original
0.2	2011.12.15	Modify VIN Operating Ratings Remove Pin VDD source 50mA Modify AMR of VIN, LX and OVP Modify Enable Leakage Current Modify Package Outline Information
0.3	2011.02.20	Modified the OVP spec. from 32V to 36V.

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