Low cost, E-Dimming Control, Linear AC LED Driver

General Description

The EMD2181 is a non-isolated linear LED driver for general purpose LED lighting applications. It is capable of driving LEDs in multiple series connections. With larger output power, the EMD2181 could also drive external power MOS to conduct larger current.

Using wall switch, the EMD2181 provide a simple dimming control without others device or controller. Build-in e-dimming function that drives 10 types difference current level to product 100*0.75$^{(n-1)}$% brightness (n=1~10).

The EMD2181 is based on a patented architecture that allows minimal external components to greatly enhance the lighting system reliability and drastically reduce system cost. Due to its non-switching behavior, the system is never an EMI issue.

Features

- Non-isolated, Linear Application.
- AC 110V/220V or DC 20V~100V Adaption.
- High Power Factor.
- Low EMI.
- Adjustable LED Current.
- Power compensation.
- Dimming Function.
  - E-Dimming control with wall switch.
- Over Temperature Protection (OTP).
- Over Voltage Protection (OVP).
- UVLO.

Applications

- E27/E14/E12/G9 Compatible Lamp.
- LED Strings.
- General Illumination.

Typical Application

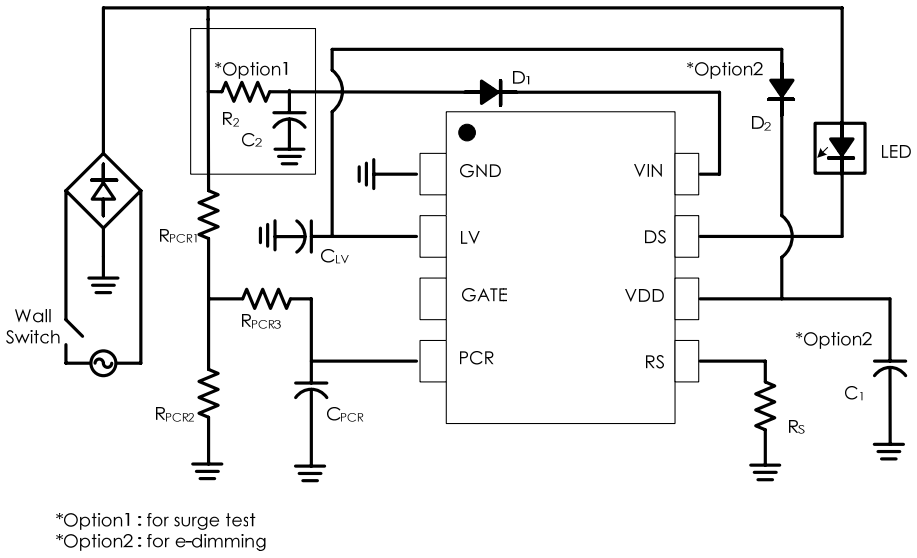
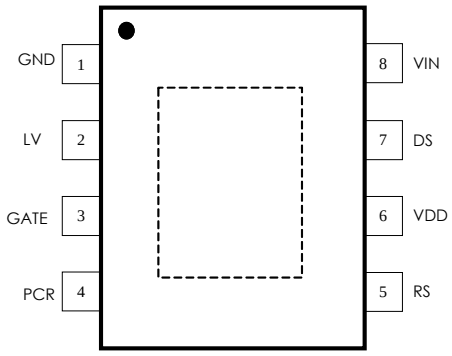


Fig. 1 Typical application with E-dimming

Connection Diagram



Order Information

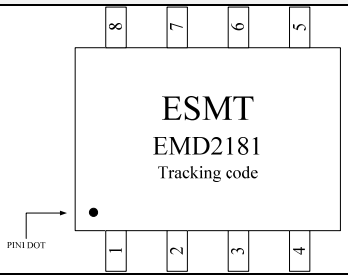
EMD2181-XXSG08NRR

XX Input voltage
00: 100 ~ 240VAC

SG08 E-SOP-8L Package

NRR RoHS & Halogen free package
Rating: -40 to 85°C
Package in Tape & Reel

Order, Marking & Packing Information

Package	Vout	Product ID	Marking	Packing
E-SOP-8L	**Adjustable**	**EMD2181-00SG08NRR**		**Tape & Reel 3Kpcs**

Function Block

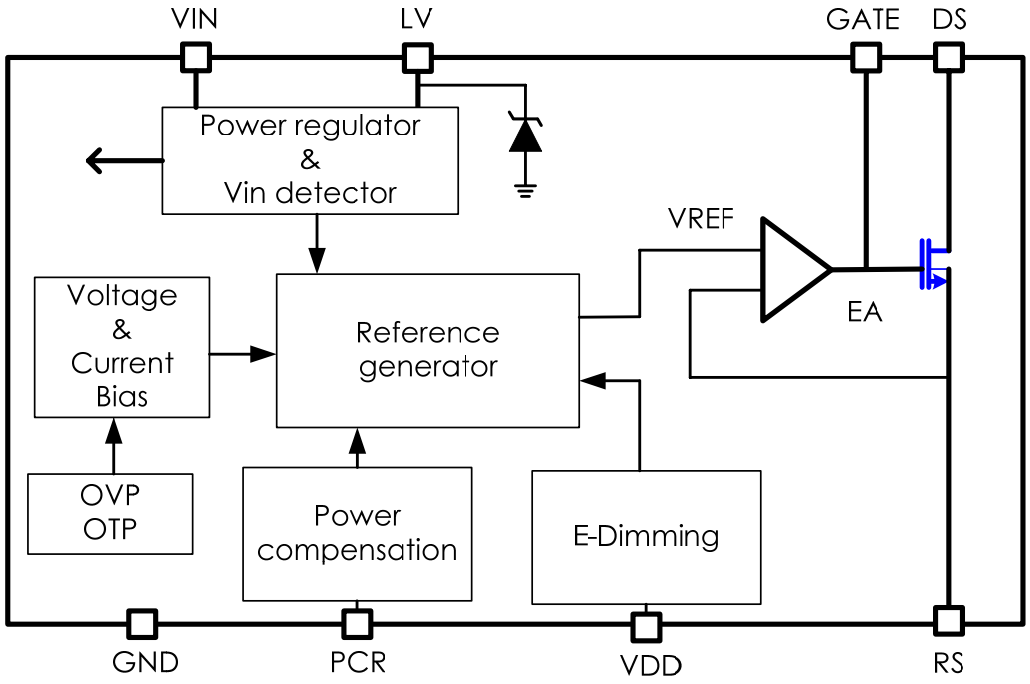


Fig. 2 EMD2181 Function block

Pin Functions

E-SOP-8L Pin #	Pin Name	Function
1	GND	**Ground Pin.**
2	LV	**Internal power Pin.** Power for internal circuit which is regulated by an internal power regulator. Connect capacitor directly to stable the internal power. **Don't use this power pin to supply others device.**
3	GATE	**GATE Pin.** Connects an external power MOS to drive larger current. Maximum output load is 1000pF
4	PCR	**PCR Pin.** Connects a resistor between PCR pin and GND to set the power compensation ratio.
5	RS	**RS Pin.** Connects a resistor between RS pin and GND to set the LED current.
6	VDD	**VDD Pin.** Internal power of e-dimming logic sub-block. **Don't use this power pin to supply others device.**
7	DS	**DS Pin.** Drain terminal of internal power MOS. Connects to the cathode of HV LEDs.
8	VIN	**Power Supply Input Pin.** Sustains the peak voltage of 240VAC power which is rectified by a bridge rectified. Un-rectified power is NOT allowed to connect with this terminal.

Absolute Maximum Ratings

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

VIN	<500V	Operating Temperature Range	–25°C to 125°C
DS	<500V	Storage Temperature	–65°C to 150°C
GATE	<10V	Junction Temperature	150°C
LV	<5.8V(Note 1)	Lead Temperature (Soldering, 10 sec)	260°C
PCR, RS, VDD	<LV		
ESD Susceptibility	HBM 2kV		
	MM 200V		

Note 1: Zener diode that built in EMD2181, Don't connect extra power source to LV pin.

Thermal data

Package	Thermal resistance	Parameter	Value
E-SOP-8L	θ_{JA} (Note 2)	Junction-to-ambient	50°C/W
	θ_{JT} (Note 3)	Junction-to-top surface of package	39°C/W
	θ_{JC} (Note 4)	Junction-to-case	10°C/W

Note 1: T_J is a function of the ambient temperature T_A and power dissipation P_D ($T_J = T_A + (P_D) * \theta_{JA}$)).

Note 2: θ_{JA} is simulated in the natural convection at T_A=25℃ on a highly effective thermal conductivity (thermal land area completed with >3x3cm^2 area) board (2 layers , 2S0P) according to the JEDEC 51-7 thermal measurement standard.

Note 3: θ_{JT} represents the heat resistance between the chip junction and the top surface of package.

Note 4: θ_{JC} represents the heat resistance between the chip junction and the center of the exposed pad on the underside of the package.

Electrical Characteristics

T_A = 25°C. V_{IN} = 110VAC unless otherwise specified.

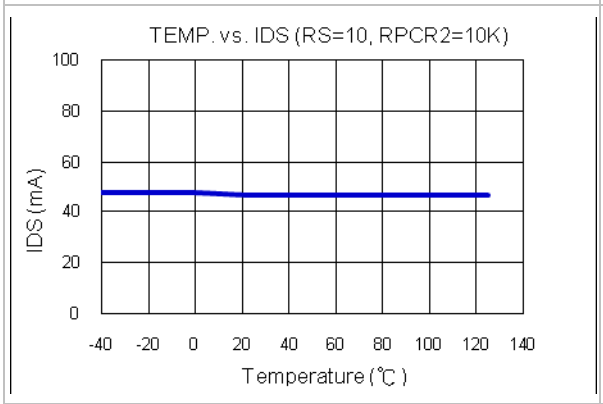
Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{IN}	Input Voltage Range	VDS = 15V	90		260	Vac
I_{IN}	IC Supply Current	AC:260Vrms>V_{IN} > 35Vrms , C_{LV} =1uF DC: 300V>V_{IN}>50V	1	2.1	3	mA
V_{OVP}	Over Voltage Protect		380	400		V
V_{LV}	LV Voltage Range	VIN = 40V~260V	4.5	5.6	5.8	V
V_{UVLO}	Rising		4.5	5	5.5	V
	Falling		3.5	4	4.5	V
V_{LV-DD}	VLV-VDD Threshold Voltage			0.5	0.8	V
DS_leak	DS Pin Leakage	V_{GATE} = 0V , V_{IN}=50V~300V , V_{DS} =10V			10	uA
PCR_leak	PCR Pin Leakage	V_{PCR} = V_{LV}			1	uA
V_{PCR}	PCR Voltage range		0.3		1	V
V_{GATE}	Gate Pin voltage			7.8	8.5	V
V_{RS}	RS Pin Voltage Range	V_{IN} = 97V(DC),V_{PCR} = 0.483V(DC),V_{DS} =15V, I_{RS}= 10mA , For 110v system.	0.426	0.474	0.521	V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{RS}	RS Pin Voltage Range	V_{IN} = 197V(DC),V_{PCR} = 0.980V(DC),V_{DS} =15V, I_{RS}= 10mA, for 220v system	0.234	0.276	0.317	V
OTP	Over Temperature Protection		127.5	150	172.5	°C
	hysteresis		42.5	50	57.5	°C

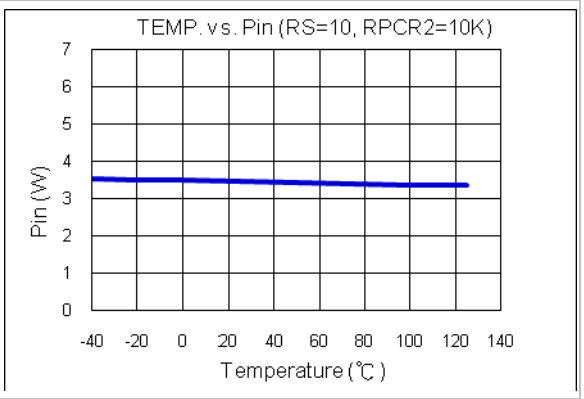
Typical Performance Characteristics

VIN=110VAC, VLED=128V, TA=25℃, unless otherwise specified

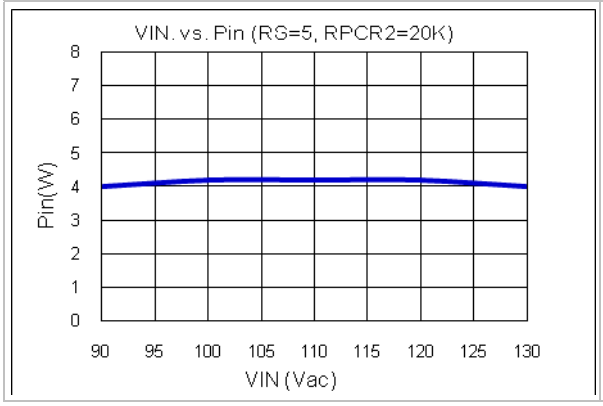
Temperature Compensation



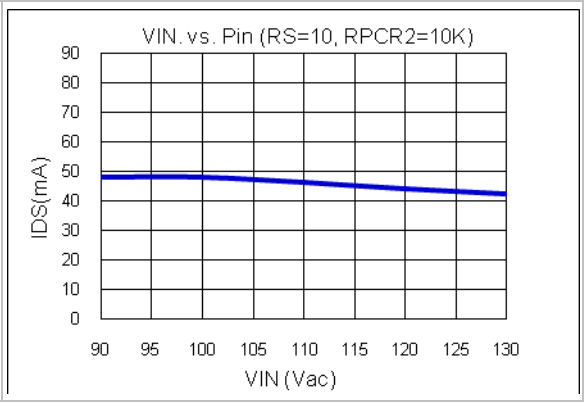
Temperature vs PIN



VIN vs PIN



VIN vs IDS



Applications

Detailed Description

The EMD2181 is a low cost non-isolated linear LED driver for general purpose LED lighting applications. In simple low power application as Fig.3, EMD2181 only need 5 external components that provide one channel LED sinking current with power compensation. Gate pin drives output switching MOS for high power lighting application.

The EMD2181 can be adjusted LED current with RS pin which meets difference power application.

Capacitor Selection

For best performance, low ESR X5R or X7R ceramic capacitor are recommended.

The capacitor on LV pin (CLV) is for stabilizing the internal power. The CLV value of a least 10uF is recommended to minimize start-up current. The C1 value of a least 1uF is recommended fixing e-dimming power which is between VDD and GND.

A ceramic capacitor placed as close as possible to the LV/VDD and GND pin of the IC is recommended.

Power Compensation

The EMD2181 detects Vin through low-pass filter, RPCR1, RPCR2 and CPCR. The compensates for the LED current based on the voltage of Vin. The LED current, set by RS, is seen as EMD2181 supplied by 110Vac. If Vin dropped (increased) to 90 (130) Vac, the LED current is increased (decreased) to compensate LED power.

RS & PCR Selection

The LED current can be set by the RS pin, connecting with external resistors to GND. The value of the external resistor of RS should not be left floating.

For difference LED numbers of LED segments application. User can adjust RPCR2 to adjust power compensation ratio. This feature can broaden LED's application range. The PCR pin operation voltage range is from 0.3V~1.4V. With typical application, the recommended typical RPCR1 resistor value is 1M~2MΩ, the value of RPCR2 is recommended 5K~10KΩ.

Table 1 lists the recommended component value for typical application.

Table 1

Input power	LED Total Vf	RS	RPCR1	RPCR2	RPCR3	CPCR1	CLV
3.5W/ AC110V	120V	10Ω	2MΩ	10K	10K	1uF	4.7uF
4W/ AC220V	240V	10Ω	2MΩ	10K	10K	1uF	4.7uF

E-Dimming Control

For dimming control, the EMD2181 supports a simple dimming control with-out others controller, Reference Fig.1. And, there are three states, state0 to state2 as showed in Fig.4. The maximum current of LED is set by RS and PCR at state0 or initial state. The wall SW (see Fig.1) drives MCU going to next state phase. At state1, the LED current keep decreasing with ten steps ,0.5s per step and each step decrease 25% current until zero current, after 0.5s, LED current reset to maximum current if SW doesn't go to next state phase. During state2 phase, the LED current will hold at the current of the latest step of state1 until the SW switches again or SW off-time longer than MCU reset time, EMD2181 sets at initial state.

Protection Circuit

To improve the lighting system reliability, some protection circuits are designed in to protect both EMD2181 and LEDs from damage under the following unexpected conditions.

- OVP (Over Voltage Protection):

The EMD2181 will be shut down if Vin is over 400V(typ.). The EMD2181 will remain in shut down mode until Vin drops below 40V(typ.).

Applications (cont.)

- OTP (Over Temperature Protection):

The EMD2181 will be shut down if the ambient temperature is over 150°C(typ.).. The EMD2181 will remain in shut down mode until the ambient temperature drops below 100°C(typ.)..

- UVLO:

The EMD2181 will be shut down when the internal supply voltage is lower than 4V(typ.). The EMD2181 will remain in shut down mode until the internal supply voltage is increased higher than 5V(typ.).

Application Circuit

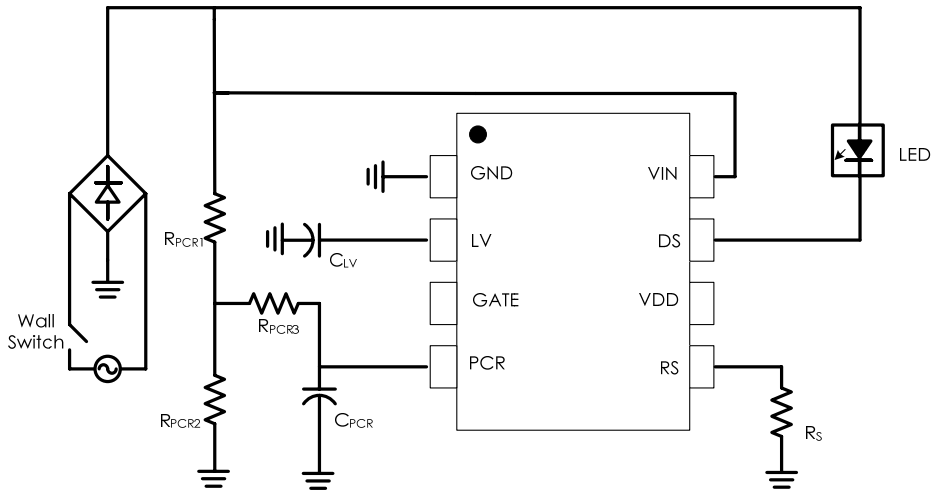


Fig. 3 Low power application

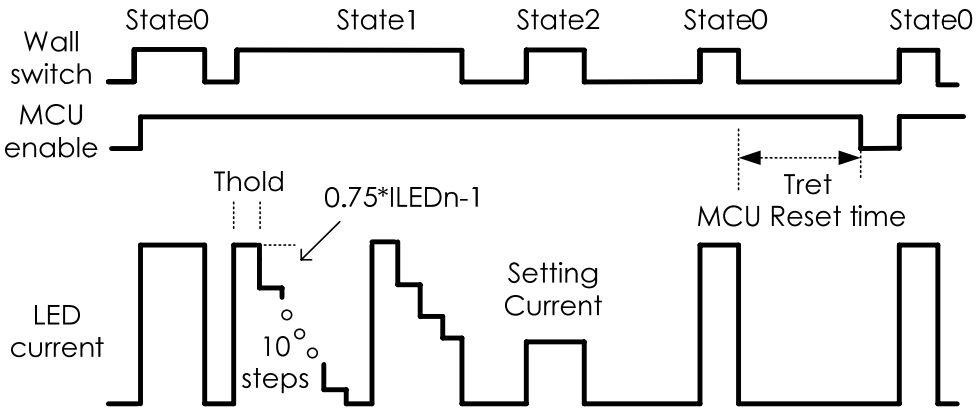
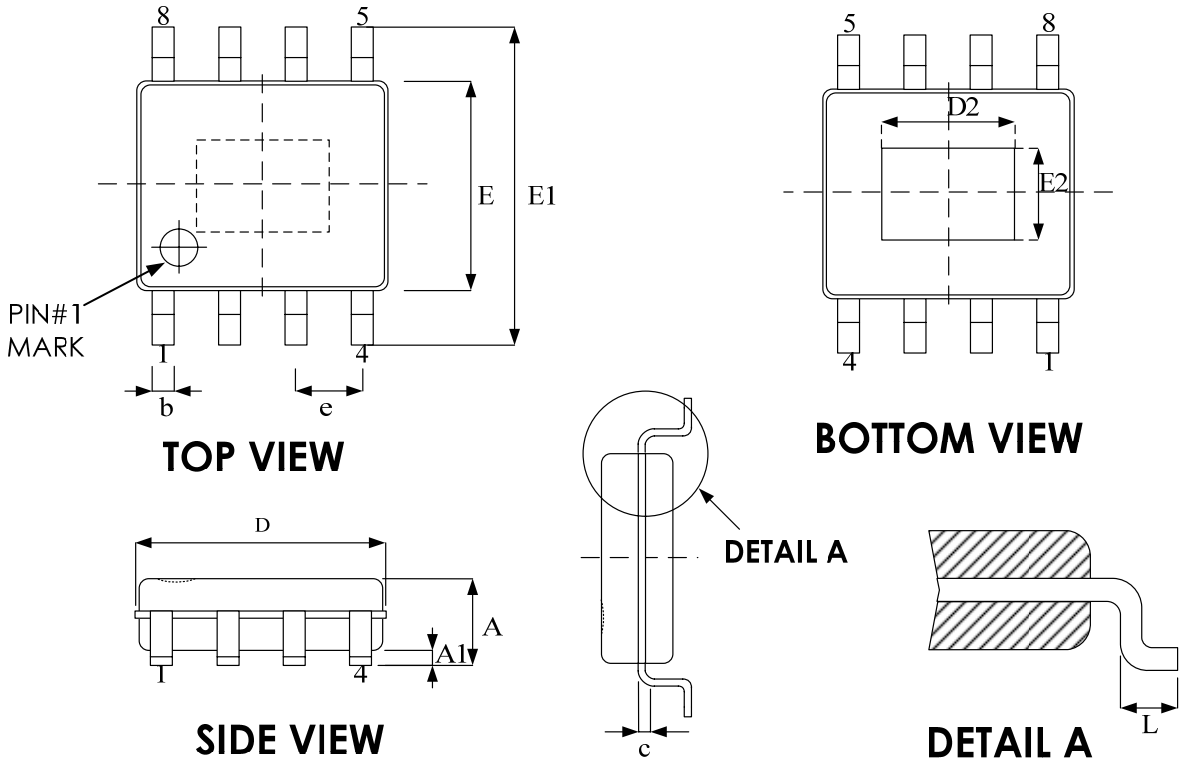


Fig. 4 E-dimming control sequence

Package Outline Drawing

E-SOP-8 (150 mil)



Symbol	Dimension in mm	
	Min	Max
A	1.35	1.75
A1	0.00	0.25
b	0.33	0.51
c	0.17	0.25
D	4.80	5.00
E	3.81	4.00
E1	5.79	6.20
e	1.27 BSC	
L	0.41	1.27

Exposed pad

	Dimension in mm	
	Min	Max
D2	2.84	3.10
E2	2.06	2.31

Revision History

Revision	Date	Description
1.0	2016.02.17	Original version
1.1	2016.04.18	Modify: 1. Application circuit: add RPCR3 2. Update Table1

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