

Adaptive Current Ripple Removing Power Switch

FEATURES

- Adaptive Constant Current Operation with Large Ripple Input
- Internal HV LDO for VDD Supply
- Internal 150V Power MOSFET
- Fast Transient Response for Input On/OFF
- Compatible with Triac Dimming Condition
- Support No Overshoot Startup Operation
- Inrush Current Limiting Protection
- LED Short Protection with Auto Recovery
- Over Temperature Protection
- Available with ESOP-8 Package

GENERAL DESCRIPTION

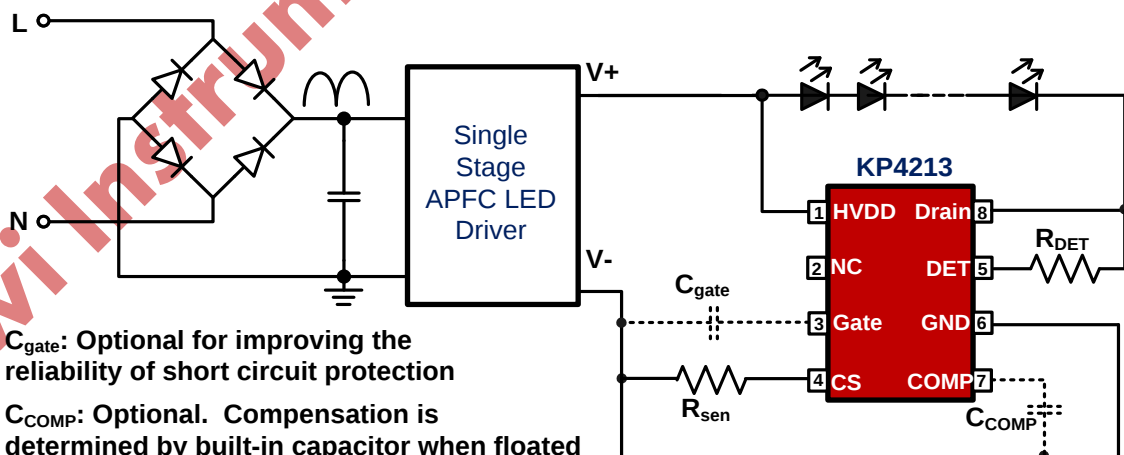
KP4213 is a current ripple removing power switch, which can remove 100Hz/120Hz current ripple produced by preceding stage LED controller. And no stroboscopic can be achieved with proper design. KP4213 integrates with adaptive current adjustment function to remove current ripple and minimize power loss. The control algorithm can ensure good steady and dynamic performance and can be compatible with Triac Dimming.

KP4213 integrates functions and protections of LED short circuit protection, OCP, LED open circuit protection and thermal foldback (OTP), etc.

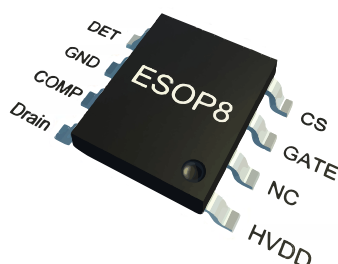
APPLICATIONS

- High PF LED Driver

TYPICAL APPLICATION CIRCUIT



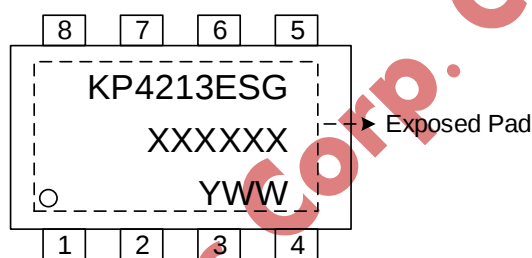
Pin Configuration



ESOP-8

Marking Information

XXXXXX: Wafer Lot Code
Y: Year, H for 2018
WW: Working Week, 01-52



ESOP-8

Pin Description

Pin Number	Pin Name	I/O	Description
1	HVDD	I	Power supply
2	NC	-	NO Function Pin, left float in use
3	Gate	O	GATE Driver Output Pin
4	CS	I	LED DC current sensing input
5	DET		MOSFET drain voltage detection pin
6	GND	I	The Ground reference for the IC.
7	COMP	I	Current ripple removing loop compensation. If COMP pin is floated, compensation parameter is determined internally (3uF capacitor).
8 Exposed Pad	Drain	I	Internal Power MOSFET Drain Pin

**Ordering Information**

Part Number	Description
KP4213ESGA	ESOP-8, Halogen free in T&R, 4000Pcs/Reel

Absolute Maximum Ratings (Note 1)

Parameter	Value	Unit
VDD Break Down Voltage	650	V
CS, DET Pin	-0.3 to 8	V
P _{Dmax} , Power dissipation @T _A =50°C(ESOP-8), (Note2)	1.0	W
θ _{JA} , Thermal Resistance---Junction to Ambient (ESOP-8), (Note2)	100	°C/W
Maximum Junction Temperature	150	°C
Storage Temperature Range	-65 to 150	°C
Lead Temperature (Soldering, 10sec.)	260	°C
ESD Capability, HBM (Human Body Model)	3000	V

Recommended Operation Conditions

Parameter	Value	Unit
Operating Junction Temperature	-40 to 125	°C

Electrical Characteristics (Ta = 25°C, if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
VDD Pin						
VDD _{ON}	VDD Under Voltage Lockout Exit		13.5	16	17	V
VDD _{OFF}	VDD Under Voltage Lockout Enter		8.5	9.5	10.5	V
IVDD _{ST}	VDD startup Current	VDD<VDD_ON	100	200	300	uA
IVDD _{Op}	VDD Operation Current		100	200	300	uA
CS Pin						



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V _{CS_MAX}	Current Limit for Hot-Plug		190	195	200	mV
V _{CS_MIN_L}	Output Open Detect Threshold		5	10	15	mV
V _{CS_MIN_H}	Output Open Detect Hysteresis		25	30	35	mV
DET Pin						
IDET_H	LED Short Protection Recovery Threshold		70	80	100	uA
IDET_L	LED Short Protection Threshold		36	40	44	uA
V _{DET_Clap}	DET Clamp Voltage			2		V
T _{DET1}	Short protection delay time			0.2		ms
T _{DET2}	Short protection hold time			500		ms
COMP Pin						
COMP _{max}	COMP Clamp Voltage for Hot-Plug		1.8	2	2.2	V
On-Chip Thermal Foldback						
T _{OTP}	Thermal Foldback Trigger Point			130		°C
Power MOSFET Section (Drain Pin)						
V _{BR}	Power MOSFET Drain Source Breakdown Voltage		150			V
R _{dson}	Static Drain-Source On Resistance			250		mΩ

Note 1. Stresses listed as the above "Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note2. Maximum Power dissipation $P_{Dmax} = (T_{Jmax} - T_A) / \theta_{JA}$. As ambient temperature rises, P_{Dmax} will decrease.

Operation Description

KP4213 is a current ripple removing power switch, which can remove 100Hz/120Hz current ripple produced by front stage LED driver. And the power loss can be minimized.

● Basic Operation Principle

KP4213 can suppress or basically eliminate LED current ripple by detecting front stage output voltage ripple to adjust MOSFET impedance in series in the LED current Loop. When preceding stage LED current increases, DET voltage and MOSFET impedance will increase. When preceding stage LED current decreases, DET voltage and MOSFET impedance will decrease.

KP4213 converts LED current ripple into voltage ripple and ensures constant voltage drop and current on LED load.

● Startup

When KP4213 starts up, COMP voltage will be charged to 2V rapidly. The MOSFET works in linear region. When preceding stage current increases and COMP voltage decreases, MOSFET works in saturation region finally.

● Shutdown

When preceding stage LED shuts down, COMP voltage will be pulled up to 2V and MOSFET will fully turn on, which can avoid preceding stage OVP falsely triggered and LED flash when preceding stage restarts again.

● LED Hot-plug and Inrush Current Limit

When LED is open, COMP voltage will be pulled up to 2V and MOSFET will turn on completely. COMP voltage is clamped to 2V and inrush current at hot-plug is limited at $0.2V/R_{sen}$.

● MOSFET Drain Voltage Limit and LED Short Circuit Protection

When LED is shorted, DET voltage increases rapidly. When DET is above limit voltage, KP4213 enter short circuit protection mode. Gate will be shut down. MOSFET turns off. The preceding stage enters OVP mode.

After entering short circuit protection mode, KP4213 will try to restart every 500ms. Once the fault is removed, it will enter normal startup. Otherwise it will continue to maintain in short circuit protection state.

● OTP

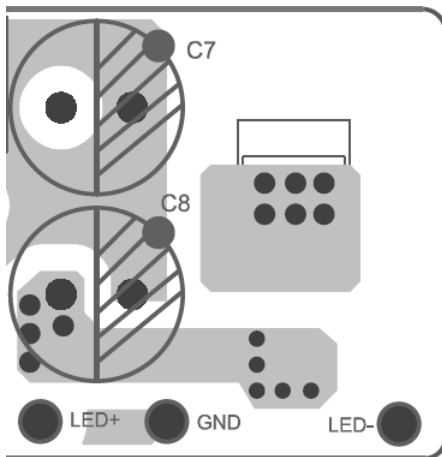
KP4213 integrates thermal foldback function. When IC junction temperature is above 130 °C, MOSFET drain voltage will decrease gradually and current ripple suppression function will be lost.

● Triac Dimming

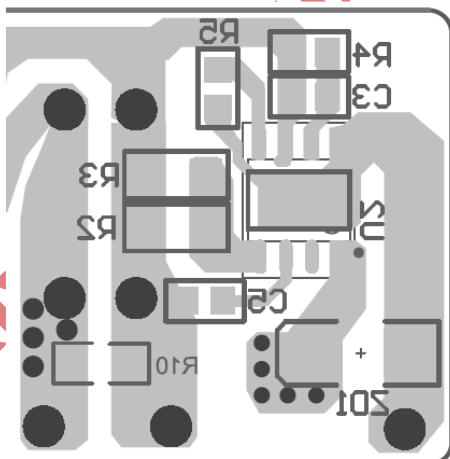
All the function of KP4213 is compatible with Triac dimming. When dimmer angle increases, LED current increase. COMP voltage will increase to adapt to Triac's angle change and avoid LED flash.

DET Resistor (R5) and DET pin should be short enough.

- (3) The IC should be far away from inductor and other magnetic devices to prevent the magnetic field from affecting the IC's normal operation.
- (4) If the anti-paralleled diode (ZD1) to the MOSFET is used to reduce the voltage spike on MOSFET when LED load is shorted, the path of MOSFET drain, diode and LED+ should be minimized for better protection performance.
- (5) if Cgate (C5) is used to reduce the short-circuit current stress, the path from Gate pin to Ground should be short enough.



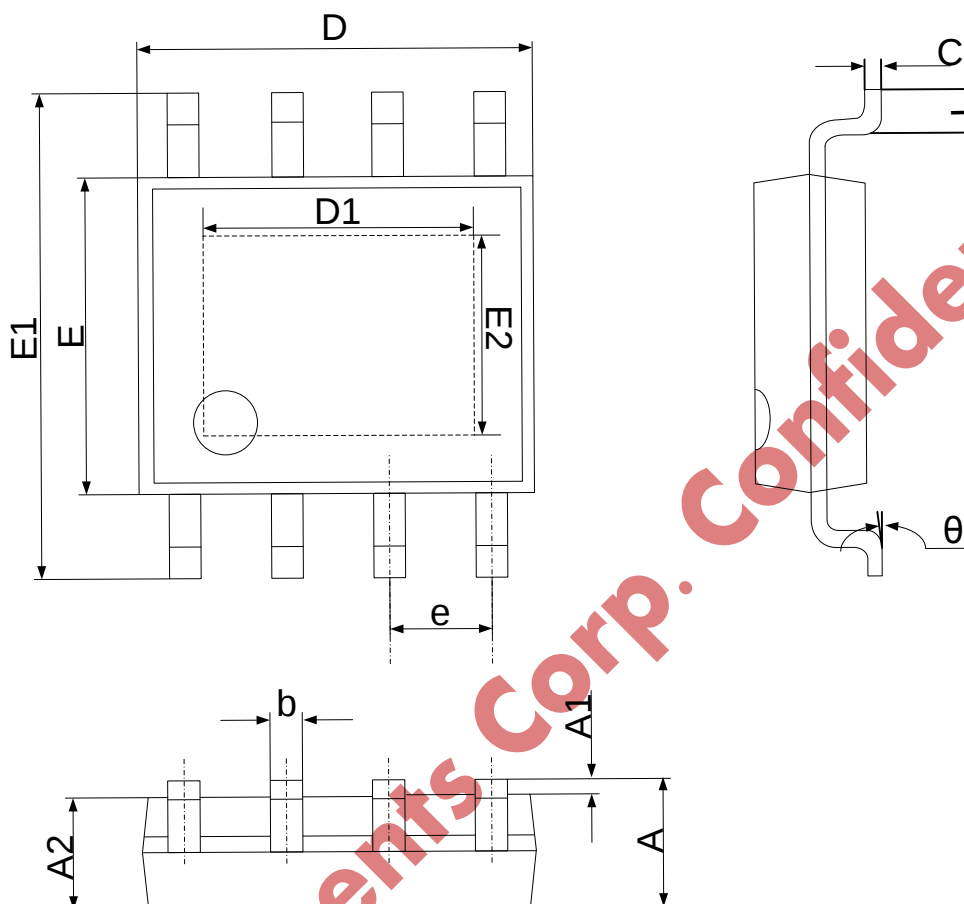
Top Layer Layout



Bottom Layer Layout

Package Dimension

ESOP-8



Symbol	Dimensions In Millimeters		Dimensions 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 (中心到中心)		0.050 (中心到中心)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

**Revision History**

DATE	REV.	DESCRIPTION
2018/07/30	1.0	First Release

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