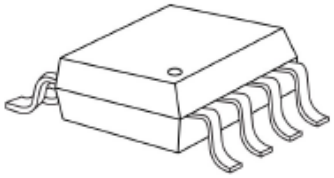
HIGH-POWER LED DRIVER

IK2802

FEATURES

- 2 constant-current output channels
- Constant output current invariant to load voltage change
- Maximum output constant current per channel: 360 mA
- Thermal protection and flag
- Output current adjusted through an external resistor
- Schmitt trigger input
- 5V supply voltage
- Package type: Pb-free package with thermal pad

Small Outline Package



SOP8

ORDERING INFORMATION

Device	Operating Temperature Range	Package	Shipping
IK2802DT	T_A = - 40 ... + 85 °C	SOP-8	Tape& Reel

Current Accuracy		Conditions
Between Channels	Between ICs	
<±3%	<±6%	I_{OUT} = 40mA ~ 360 mA @ V_{DS}= 0.6V

PRODUCT DESCRIPTION

IK2802 is an instant On/Off LED driver for high power LED applications and exploits to enhance its output characteristics.

IK2802 provides users with 2-channel constant current ports. Users may adjust the output current up to 360 mA through an external resistor, Rext, which gives users flexibility in controlling the light intensity of LEDs. Also, users can precisely adjust LED brightness from 0% to 100% via output control with Pulse Width Modulation. Alternatively, IK2802 provides one-step current adjustment to make 25% of the output current via enabling the quarter pin (QT) as “Low”.

Additionally, to ensure the system reliability, IK2802 is built with Thermal Protection (TP) function and thermal pad. The TP function protects IC from over temperature (165°C). Also, the thermal pad enhances the power dissipation. As a result, a large amount of current can be sunk safely in one package.

APPLICATIONS

- High-flux LED lighting
- Automotive interior lighting

TYPICAL APPLICATION CIRCUIT

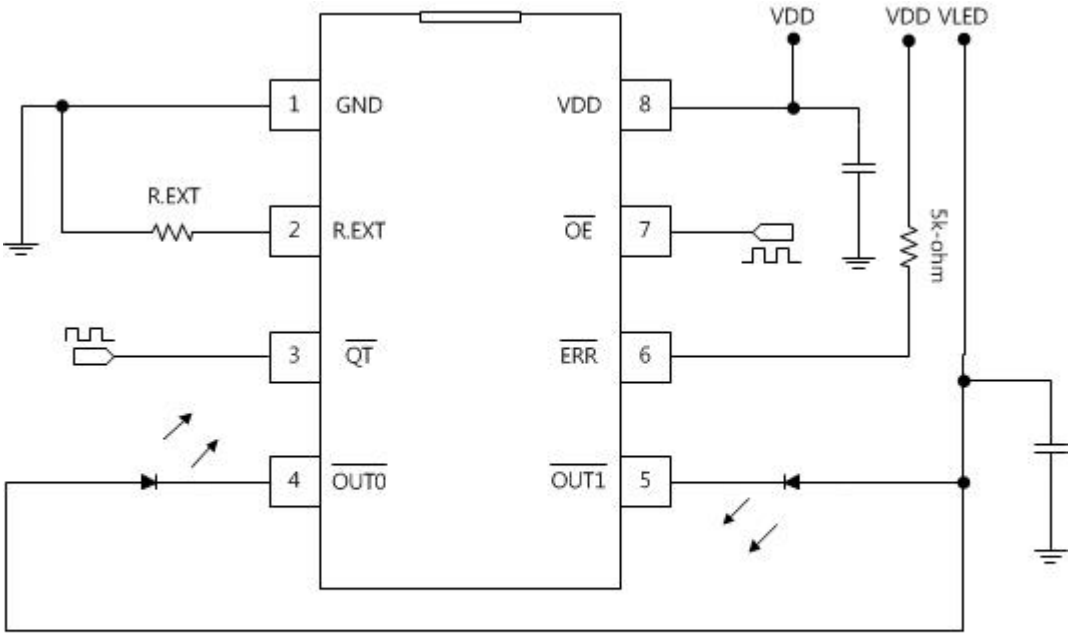
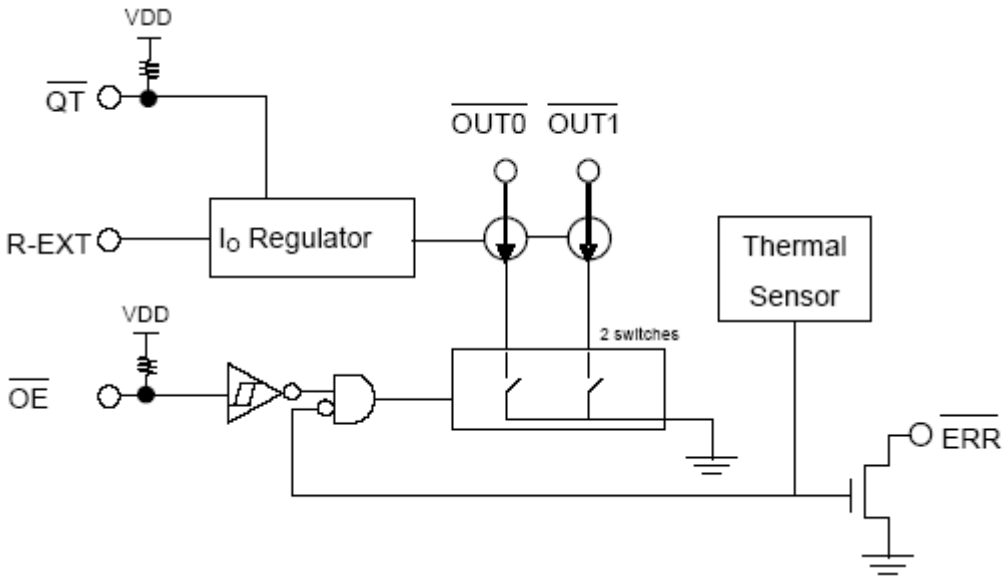
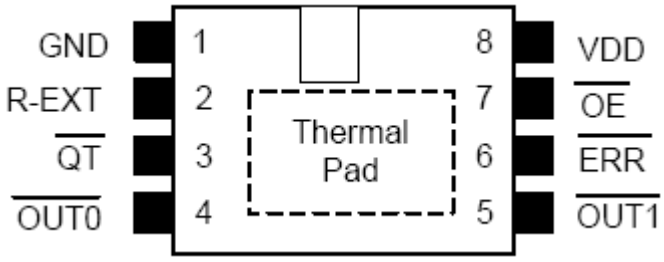


Figure 1

FUNCTIONAL DIAGRAM



PIN CONFIGURATION



PIN DESCRIPTION

Pin No.	Pin Name	Function
1	GND	Ground terminal for control logic and current sink
2	R-EXT	Terminal used to connect an external resistor (R_{ext}) for setting up output current for all output channels
3	$\overline{QT}$	Set all the output current to 25% of the pre-set current when $\overline{QT}$ is low. Default value is high.
4,5	$\overline{OUT0}$~$\overline{OUT1}$	Constant current output terminals
6	$\overline{ERR}$	Open drain thermal error flag, when junction temperature is over 165 ºC, $\overline{ERR}$ is going to low.
7	$\overline{OE}$	Output enable terminal when $\overline{OE}$ is active (low), the output pins are enabled; when $\overline{OE}$ is inactive (high), all output pins are turned OFF (blanked).
8	VDD	5V supply voltage terminal
-	Thermal Pad	Power dissipation terminals 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_{DD}	0~7.0	V
Input Voltage		V_{IN}	-0.4~V_{DD} + 0.4	V
Output Current		I_{OUT}	360*	mA
Sustaining Voltage		V_{DS}	-0.5~+27	V
GND Terminal Current		I_{GND}	720	mA
Power Dissipation* (On PCB, Ta=25 ºC)	SOP8	P_D	0.8	W
Thermal Resistance** (By simulation)	SOP8	$R_{th(j-a)}$	33.39	ºC/W
Empirical Thermal Resistance* (On PCB, Ta=25 ºC)	SOP8	$R_{th(j-a)}$	125	ºC/W
Operating Junction Temperature		$T_{j,max}$	125	ºC
Operating Temperature		T_{opr}	-40~+85	ºC
Storage Temperature		T_{stg}	-55~+150	ºC

*Users must notice that the power dissipation (almost equaling to I_{OUT} x V_{DS}) should be within the Safe Operation Area shown in Figure 7.
** Provided by factory.

*** Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device.
These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied.
Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Electrical Characteristics

Characteristics		Symbol	Condition		Min.	Typ.	Max.	Unit
Supply Voltage		V_{DD}	-		4.5	5.0	5.5	V
Sustaining Voltage at OUT pin		V_{DS}	OUT0~OUT1		-	-	27.0	V
Output Current		I_{OUT}	DC Test Circuit		40	-	360.0	mA
Input Voltage for OE, QT	"H" level	V_{IH}	Ta=-40~85 ºC		1.6	-	V_{DD}	V
	"L" level	V_{IL}	Ta=-40~85 ºC		GND	-	0.6	V
Output Leakage Current		I_{OH}	V_{OH}=27V		-	-	0.5	uA
ERR Output Voltage		V_{OL}	I_{OL}=+1.0mA		-	-	0.5	V
ERR Turn On Impedance		$R_{DS,(ON),ERR}$	Refer to the "Test Circuit for Electrical Characteristics"		300	600	800	Ohm
Output Current 1		I_{OUT1}	V_{DS}=0.8V	R_{ext}=1.8kOhm	-	340	-	mA
Current Skew 1		$dI_{OUT/IOUT}$	I_{OL}=340mA V_{DS}=0.8V	R_{ext}=1.8kOhm	-	±1	±3	%
Output Current 2		I_{OUT2}	V_{DS}=0.6V	R_{ext}=2.4kOhm	-	240	-	mA
Current Skew 2		$dI_{OUT/IOUT}$	I_{OL}=240mA V_{DS}=0.6V	R_{ext}=2.4kOhm	-	±1	±3	%
Regulation of Output Current vs. Sustaining Voltage		$\%/dV_{DS}$	V_{DS} within 1.0V and 3.0V		-	±0.1	-	%/V
Regulation of Output Current vs. Supply Voltage		$\%/dV_{DD}$	V_{DD} within 4.5V and 5.5V		-	±1	-	%/V
Pull-up Resistor		$R_{N(up)}$	OE, QT		300	600	800	kOhm
Thermal Shutdown temperature		T_{XI}	Shutdown Temp.increasing		-	165	-	ºC
		T_{XD}	Reset Temp.decreasing		-	155	-	ºC
Supply Current	"OFF"	I_{DD}(off) 1	R_{ext}=Open,OUT0~OUT1=Off		-	4	9	mA
		I_{DD}(off) 2	R_{ext}=2.4kOhm, OUT0~OUT1=Off		-	6	10	
		I_{DD}(off) 3	R_{ext}=1.8kOhm, OUT0~OUT1=Off		-	7	12	
	"ON"	I_{DD}(on) 1	R_{ext}=2.4kOhm, OUT0~OUT1=On		-	5	10	
		I_{DD}(on) 2	R_{ext}=1.8kOhm, OUT0~OUT1=On		-	6	10	

TEST CIRCUIT FOR ELECTRICAL CHARACTERISTICS

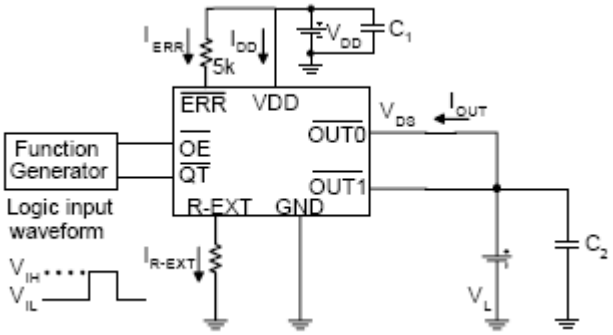


Figure 2

SWITCHING CHARACTERISTICS

Characteristics		Symbol	Condition	Min.	Typ.	Max.	Unit
Propagation Delay Time("L" to "H")	$\overline{OE}$-$\overline{OUTn}$	t_{pLH}	V_{DD}=5.0V V_{DS}=1.0V V_{IH}=V_{DD} V_{IL}=GND R_{ext}=1630Ohm (I_{OUTn}=360mA) V_L=4.0V R_L=8.5Ohm C_L=10pF	0.3	0.5	1	us
Propagation Delay Time("L" to "H")	$\overline{OE}$-$\overline{OUTn}$	t_{pHL}		0.3	0.5	1	us
Pulse width	OE	$t_{W(OE)}$		1	-	-	us
Output Rise Time of $\overline{OUT}$ (turn off)		t_{or}		0.3	0.5	1	us
Output Rise Time of $\overline{OUT}$ (turn on)		t_{of}		0.3	0.5	1	us

TEST CIRCUIT FOR SWITCHING CHARACTERISTICS

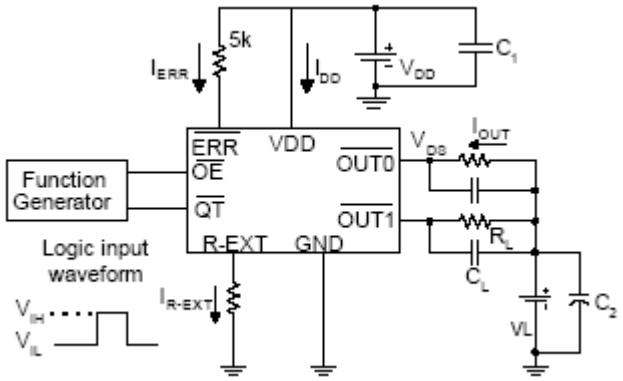
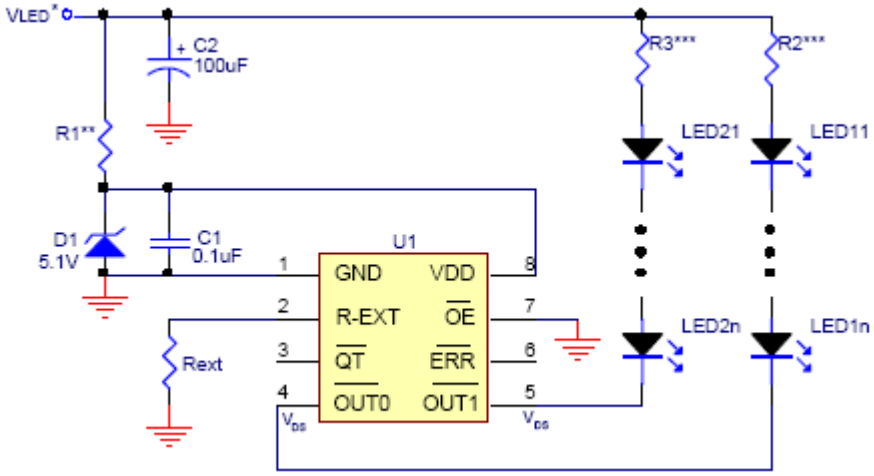


Figure 3

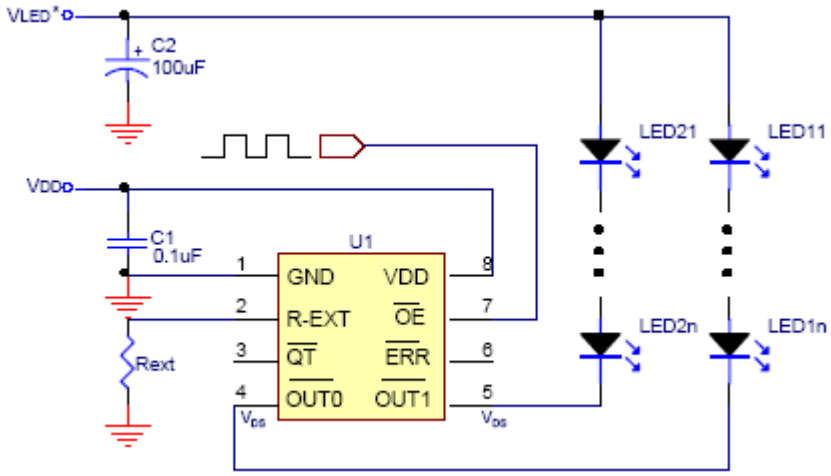
APPLICATION CIRCUITS

(a) IK2802 application circuit, where V_{LED} and V_{DD} share a single voltage source.



* $V_{LED} > V_{DS} + V_{F,LED}$ x n; $V_{F,LED}$: Forward voltage of LED; n: LED count
** R1 = (V_{LED} - 5.1V) / I_{DD}; refer to Electrical Characteristics for I_{DD}
*** R2 = R3 = [V_{LED} –V_{DS} – ($V_{F,LED}$ x n)] / I_{LED}

(b) IK2802 Application Circuit with dimming control by PWM signal, where V_{LED} and V_{DD} use voltage sources separately.



* $V_{LED} = V_{DS} + V_{F,LED}$ x n; $V_{F,LED}$: Forward voltage of LED; n: LED count

Figure 4

Constant Current

In LED lighting applications, IK2802 provides nearly no variation in current from channel to channel and from IC to IC. This can be achieved by:

1) The maximum current variation between channels is less than ±3%, and that between ICs is less than ±6%.

2) In addition, the current characteristic of output stage is flat and users can refer to the figure as shown below. The output current can be kept constant regardless of the variations of LED forward voltages (V_F). This guarantee s LED to be performed on the same brightness as user's specification.

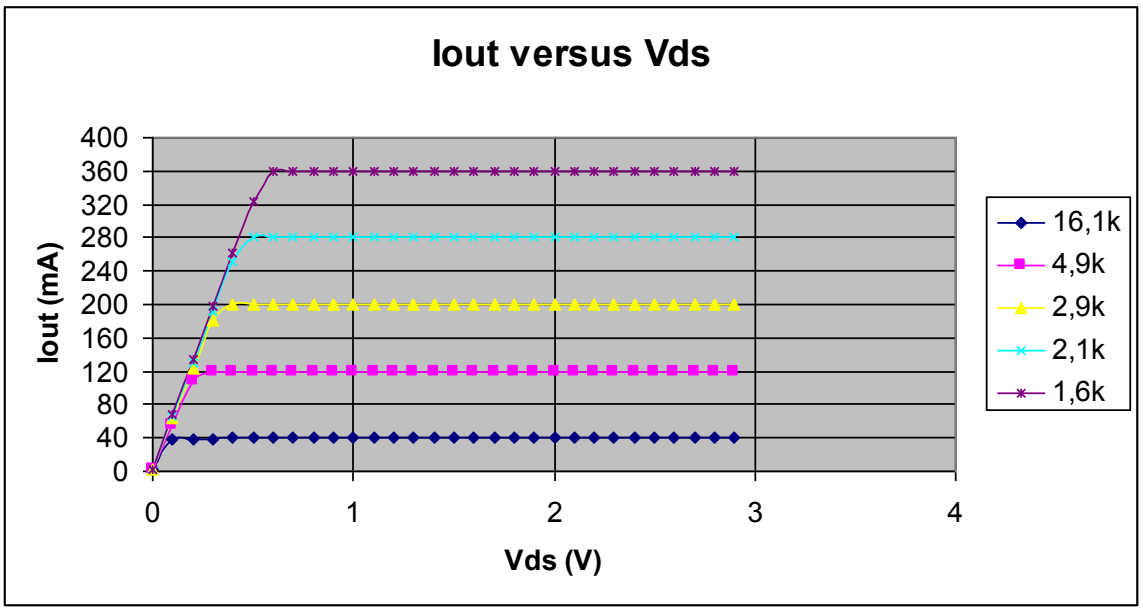


Figure 5

Setting Output Current

The output current of each channel (I_{OUT}) is set by an external resistor, R_{ext}. The relationship between I_{OUT} and R_{ext} is shown in the following Figure 6 and Table1.

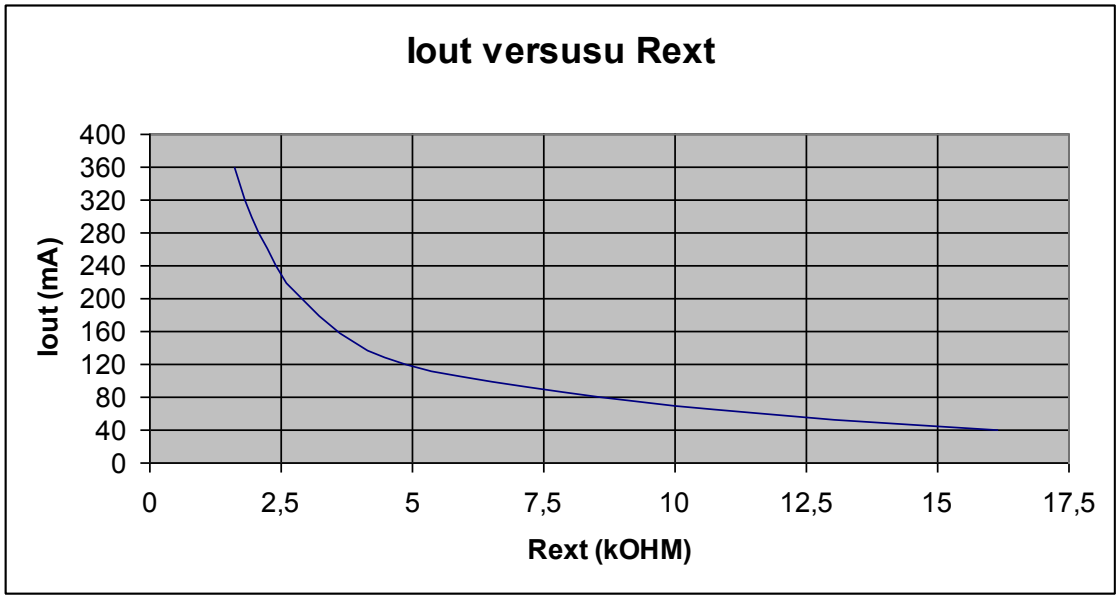


Figure 6

Iout(mA)	Rext(kohm)
360	1.60
280	2.07
200	2.89
120	4.88
40	16.14

Table1

Package Power Dissipation (PD)

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

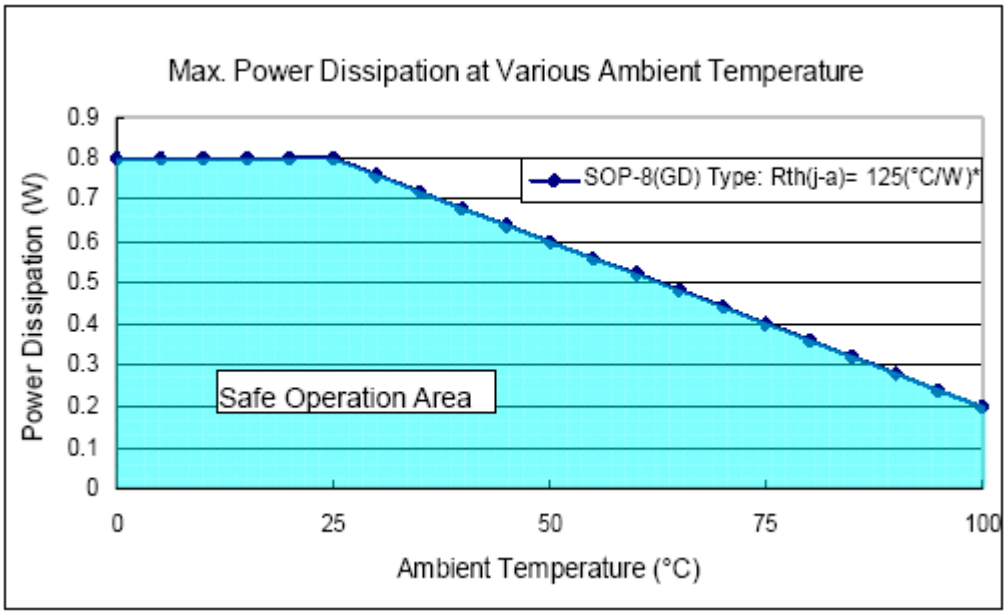


Figure 7

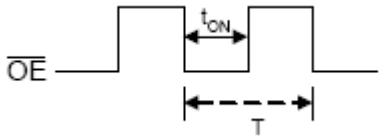
The maximum allowable package power dissipation is determined as $P_D(max) = (T_{j,max} – T_a) / R_{th(j-a)}$. When 2 output channels are turned on simultaneously, the actual package power dissipation is $P_D(act) = (I_{DD} \times V_{DD}) + (I_{OUT} \times Duty \times V_{DS} \times 2)$. Therefore, to keep $P_D(act) \le P_D(max)$, the allowable maximum output current as a function of duty cycle is:

$I_{OUT} = \{ [(Tj – Ta) / R_{th(j-a)}] – (I_{DD} \times V_{DD}) \} / V_{DS} / Duty / 2$,

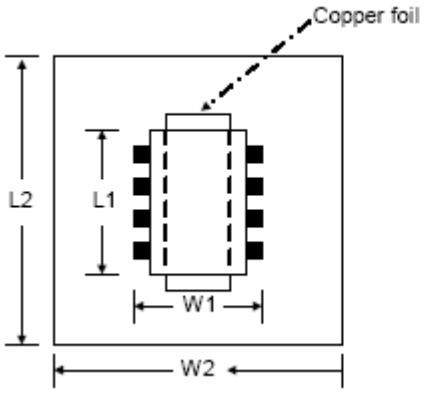
where Tj = 125°C;

$Duty = t_{ON} / T$;

t_{ON}: the time of LEDs turning on; T: $\overline{OE}$ signal period



*Note: The empirical thermal resistor $R_{th(j-a)}$ =125 °C/W is based on the following structure.



The PCB area L2xW2 is 4 times of the IC's area L1xW1.
The thickness of the PCB is 1.6mm, copper foil 1 Oz. The thermal pad on the IC's bottom has to be mounted on the copper foil.

TP Function (Thermal Protection)

Thermal protection turns off the output current when the junction temperature rises to approximately 165°C, allowing the device to cool and the thermal error flag, $\overline{ERR}$, goes low simultaneously. When the junction temperature cools to approximately 155°C, the output current is turned on again. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This limits the dissipation of the driver, protecting it from damage due to overheating.

Load Supply Voltage (VLED)

IK2802 is designed to operate with adequate V_{DS} to achieve constant current. V_{DS} together with I_{OUT} should not exceed the package power dissipation limit, $P_{D(max)}$.
As in Figure 8, $V_{DS} = V_{LED} – V_F$, and V_{LED} is the load supply voltage. $P_{D(act)}$ will be greater than $P_{D(max)}$, if V_{DS} drops too much voltage on the driver. In this case, it is recommended to use the lowest possible supply voltage or to set an external voltage reducer, V_{DROP}.
A voltage reducer lets $V_{DS} = (V_{LED} – V_F) – V_{DROP}$.
Resistors can be used in the applications as shown in Figure 8.

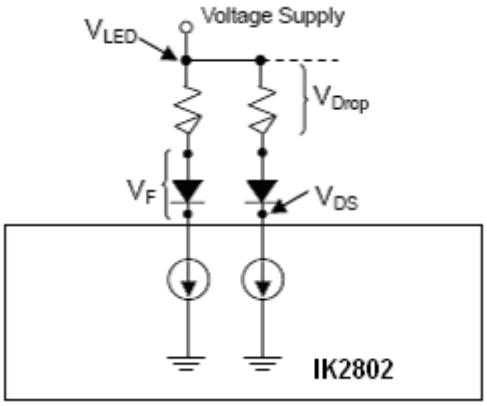
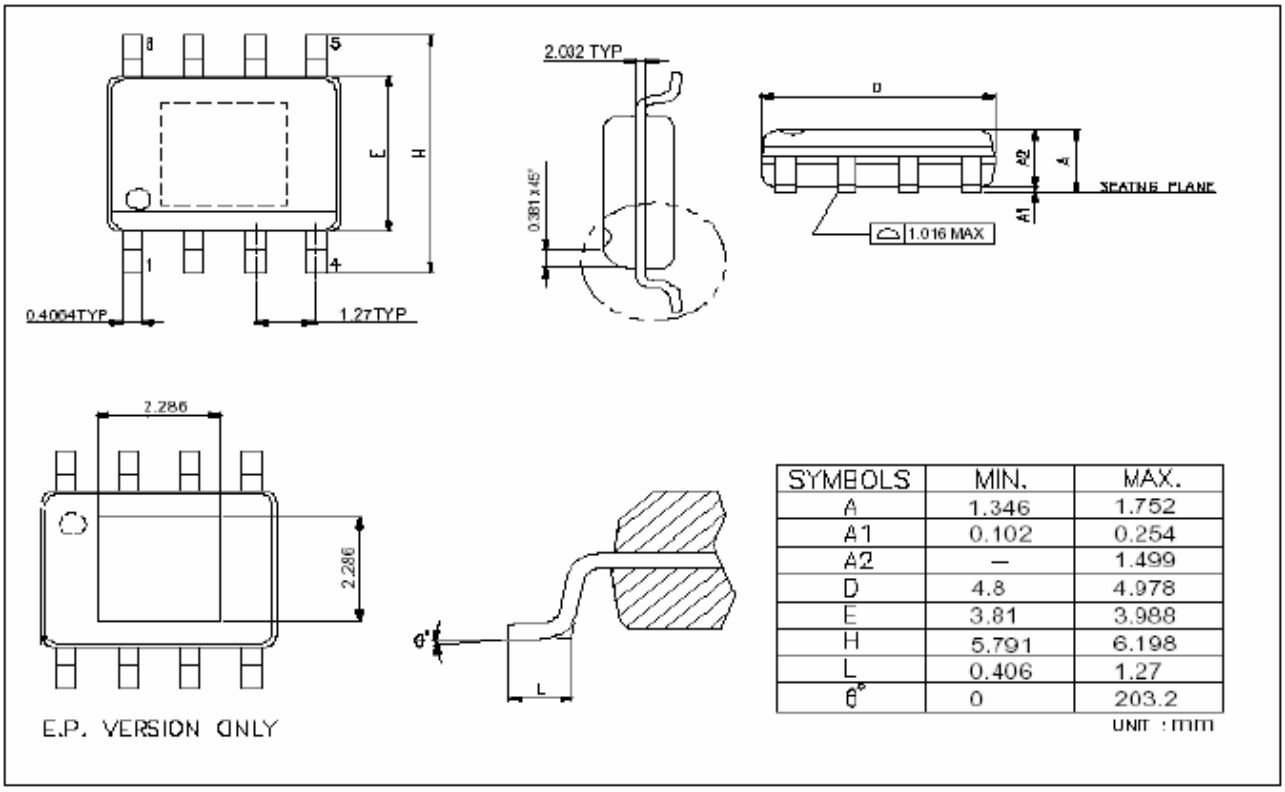


Figure 8

PACKAGE DIMENSIONS

SOP 8



SYMBOLS	MIN.	MAX.
A	1.346	1.752
A1	0.102	0.254
A2	—	1.499
D	4.8	4.978
E	3.81	3.988
H	5.791	6.198
L	0.406	1.27
θ°	0	203.2

UNIT : mm

Note: The unit for the outline drawing is mm.