0.5A Two Channel LED Driver

Features

- 50mA~0.5A, two channel constant current regulator
- Output current adjustable by external resistor
- 3V ~ 12V wide range supply voltage
- 1MHz OE dimming support
- 400Hz V_{DD} dimming support
- 0V ~ 17V output sustain voltage
- low output voltage dropout
  0.2V dropout at 80mA output
  0.6V dropout at 0.5A output
- Minimized I_{DD} consumption
- 160℃ half power thermal protect
- Less than ±4% chip/channel current skew
- Less than 0.5%/V line regulation
- Less that 1%/V load regulation
- Green package

Applications

- General LED Lighting
- Decoration lighting for architecture
- LCD back lighting
- Street lamp

Package Type

- SOP8

Product Description

The NU512 is a two channel, open drain, linear constant current LED driver. With up to 0.5A/channel driving current and maximum 1Mhz PWM dimming control support, NU512 can be used for 0.5W to 3W high power LED string in general or architecture decoration lighting applications.

The wide power supply range capability makes NU512 work stably in uncertain power supply applications. When the power supply voltage is changed or fluctuating, the output current still remains unchanged. With this dedicate designed function, the V_{DD} power can be derived easily from the whole lighting system.

The output current of NU512 is set by an external resistor. While in full current output, the NU512 only need about 0.6V drop on output channel. The minimized voltage drop will increase the working range that limited by LED forward voltage variation in lighting system, to enhance the system efficiency and lower the heat generation from NU512.

Terminal Description

Pin #	Pin name	Function
1	V_{DD}	Power
2	OE	Output enable
3	NC	
4	OUT0	Output channel 0
5	OUT1	Output channel 1
6	NC	
7	REXT	R external
8	Gnd	Ground

Protection Circuit

- 8KV output channel ESD protection

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Maximum Ratings (T = 25°C)

Characteristic	Symbol	Rating	Unit
Supply voltage	V_{DD}	3.0 ~ 16	V
Output voltage	V_{OUTn}	-0.2 ~ 20	V
Input voltage	V_{OE}	-0.2 ~ V_{DD}	V
Output current / Channel	I_{OUTn}	0.6	A
Ground terminal current	I_{GND}	1.2	A
Power Dissipation (On PCB)	P_D	1	W
Thermal Resistance	$R_{TH(j-a)}$	100	°C /W
Operating temperature	T_{OPR}	-40 ~ +85	°C
Storage temperature	T_{STG}	-55 ~ +150	°C

Electrical Characteristics and Recommended Operating Conditions

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{DD}	Room Temp.	3	-	12	V
Output sustain voltage	Vomax	I_{OUTn} = 0A	-	-	17	V
Output current / Channel	I_{OUTn}	-	50	-	500	mA
Output drop out voltage	V_{OUTn}	V_{DD} = 5V, I_{OUTn} = 80mA	0.2	-	-	V
		V_{DD} = 5V, I_{OUTn} = 175mA	0.3	-	-	V
		V_{DD} = 5V, I_{OUTn} = 500mA	0.6	-	-	V
Power dissipation	P_D	Room Temp.	-	-	0.65	W
Chip to chip current skew / Channel to channel skew	dI_{OUT}	V_{DD} >=3V, I_{OUTn} = 150mA	-	-	±4	%
Leakage	$I_{Leakage}$	V_{OUT} = 7V	-	-	1	uA
OE Input voltage	V_{IH}	V_{DD} < 5V	-	0.7*V_{DD}	-	V
		V_{DD} >= 5V	-	-	3.5	
	V_{IL}	V_{DD} < 5V	-	0.3*V_{DD}	-	
		V_{DD} >= 5V	-	-	1.5	
Pull down resistor (OE)	R_{PD}	On small area PCB	400	500	700	KΩ
Line regulation	%/V_{DD}	3V < V_{DD} < 12V	-	-	0.5	△%/V
Load regulation	%/V_{OUT}	0.5V < V_{OUTn} < 8V	-	-	1	△%/V
Operating Temperature	T_{OPR}	Ambient temperature	-40	-	85	°C
Thermal protect (Junction temperature)	T_{HalfP}	Half current output	-	160	-	°C
Thermal regulation	%/10℃	-	-	-	0.5	△%/10℃
Supply current	I_{DD}	R_{EXT} = Open, Output off	-	0.3	1	mA
		I_{OUTn} = 180mA, Output on	2	4	4.5	mA
		I_{OUTn} = 350mA, Output on	-	4.7	-	mA
		I_{OUTn} = 500mA, Output on	-	5.0	-	mA

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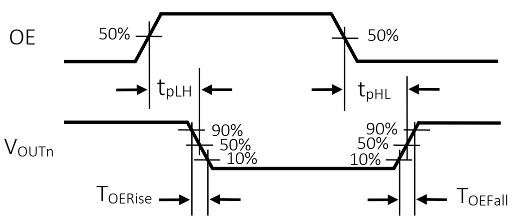
System voltage	V_{LED}	V_{DD} < 12V	5	-	24	V

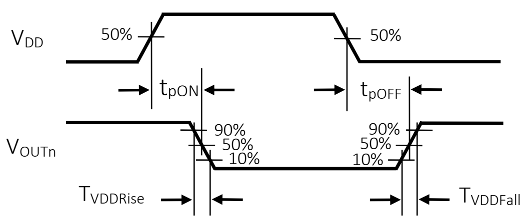
Switching Characteristics (T = 25°C)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Propagation Delay Time (OE from "L" to "H")	t_{pLH}	V_{DD}=4V, V_{OUTn}=1V, I_{OUTn}=120mA, OE= 0V → 4V	200	280	360	nS
Output current rising time (OE from "L" to "H")	t_{OERise}	V_{DD}=4V, V_{OUTn}=1V, I_{OUTn}=120mA, OE= 0V → 4V	30	50	80	nS
Propagation Delay Time (OE from "H" to "L")	t_{pHL}	V_{DD}=4V, V_{OUTn}=1V, I_{OUTn}=120mA, OE= 4V → 0V	560	620	680	nS
Output current falling time (OE from "H" to "L")	t_{OEFall}	V_{DD}=4V, V_{OUTn}=1V, I_{OUTn}=120mA, OE= 4V → 0V	60	90	130	nS
Propagation Delay Time (V_{DD} from "L" to "H")	t_{pON}	V_{OUTn}=1V, I_{OUTn}=120mA, V_{DD}=OE= 0V → 3V	-	30	-	uS
Output current rising time (V_{DD} from "L" to "H")	$t_{VDDRise}$	V_{OUTn}=1V, I_{OUTn}=120mA, V_{DD}=OE= 0V → 3V	-	5		uS
Propagation Delay Time (V_{DD} from "H" to "L")	t_{pOFF}	V_{OUTn}=1V, I_{OUTn}=120mA, V_{DD}=OE= 3V → 0V	-	3	-	uS
Output current falling time (V_{DD} from "H" to "L")	$t_{VDDFall}$	V_{OUTn}=1V, I_{OUTn}=120mA, V_{DD}=OE= 3V → 0V	-	5		uS

Timing Waveform



OE timing diagram



V_{DD} timing diagram (V_{DD}=V_{OE})

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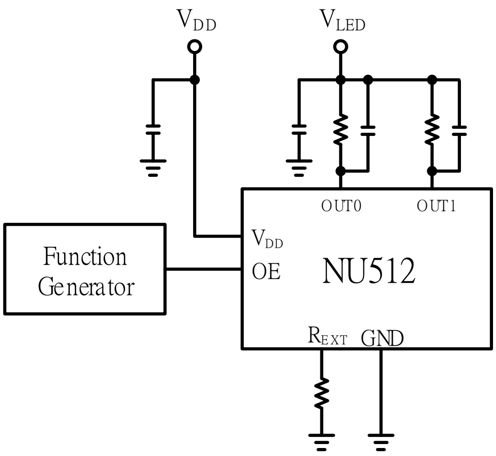
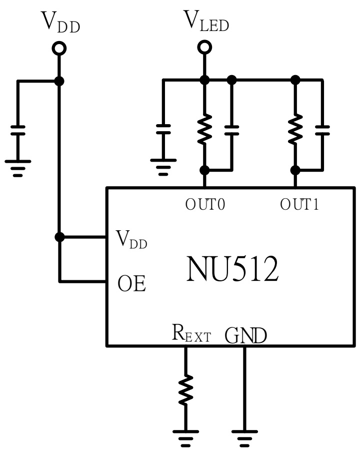
Test Circuit

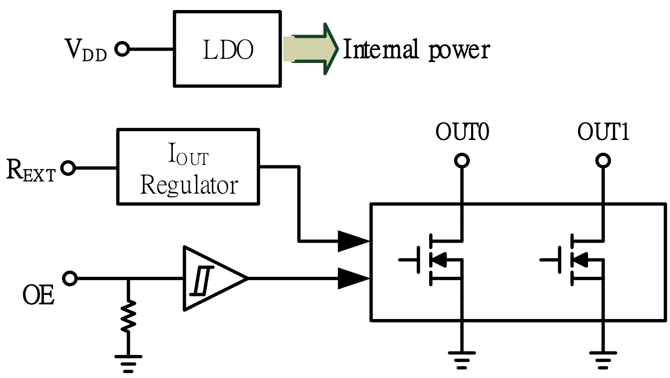


OE dimming and I_{OUT} test circuit



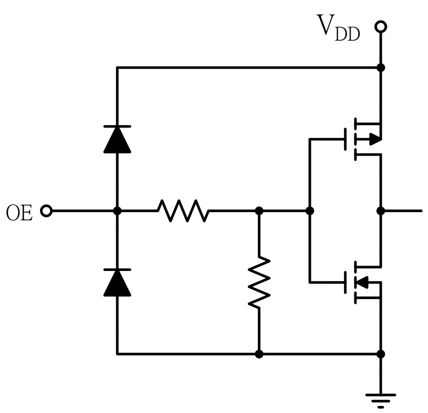
V_{DD} dimming test circuit

Block Diagram



Equivalent Circuits for Inputs

There is only one OE input terminal to which a pull down resistor is connected. While OE is high voltage, both output channels are turned on.



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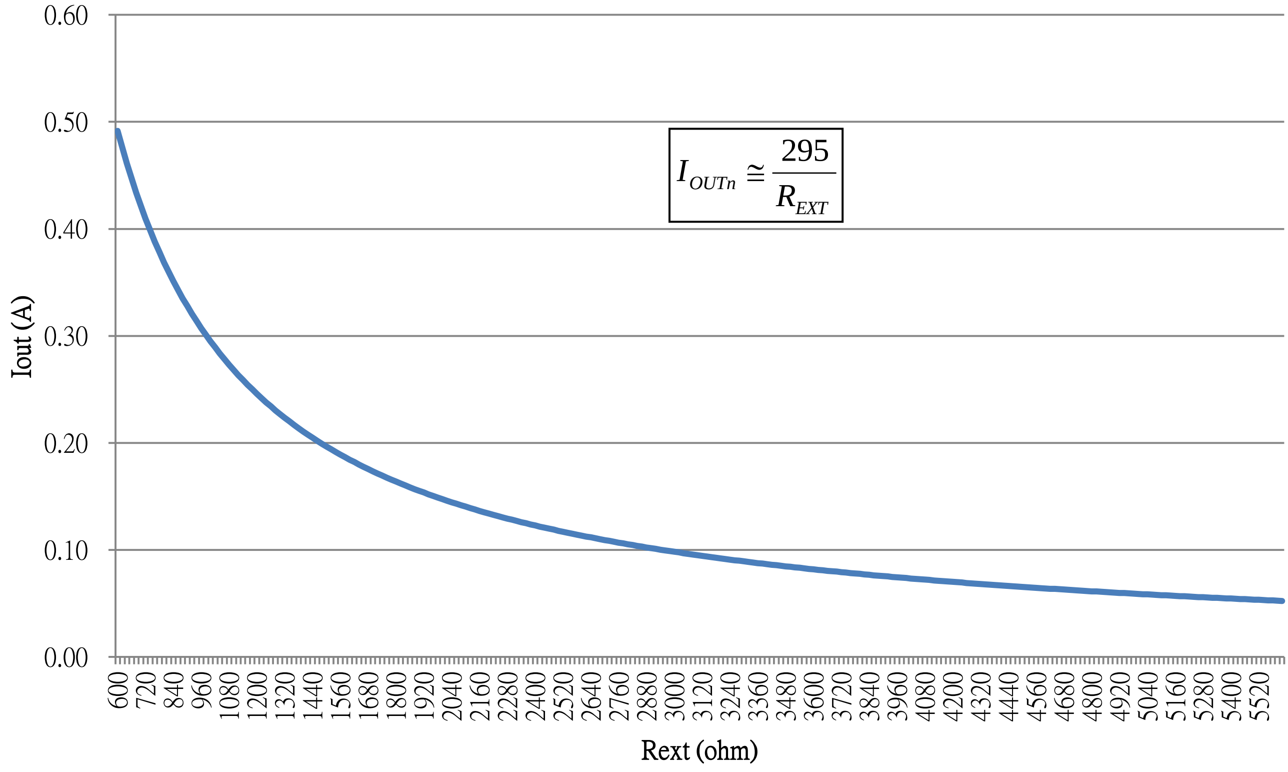
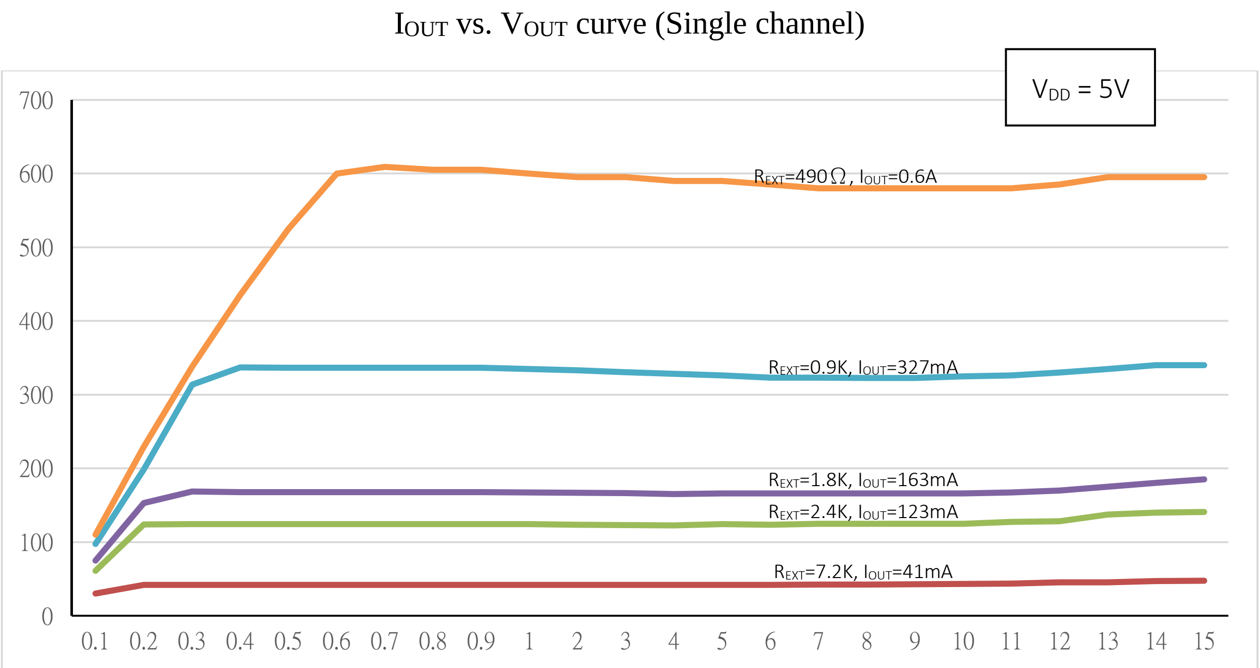
Output Current Setting

The output current of each channel of NU512 is set by an external resistor (R_{EXT}). The relationship between channel output current and external resistor is shown in the figure or calculated from the equation following.



I/V Curve



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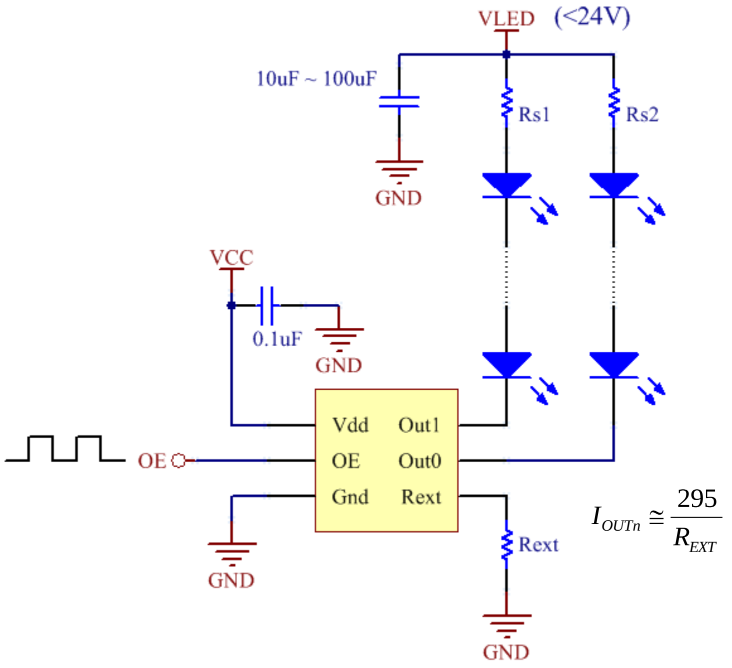
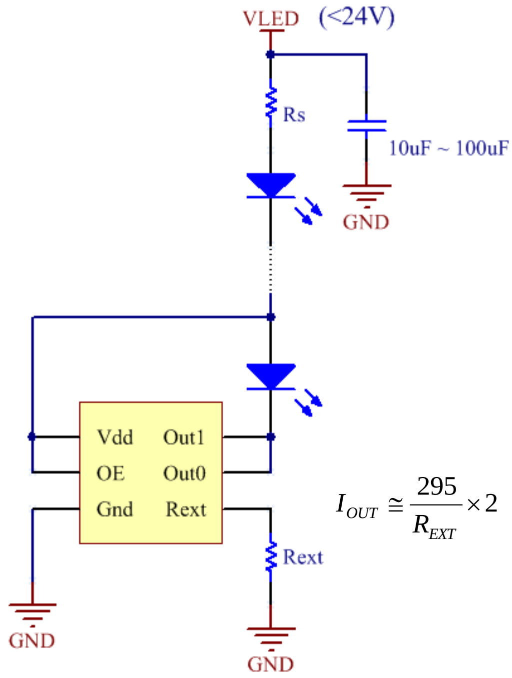
Typical Application Circuit

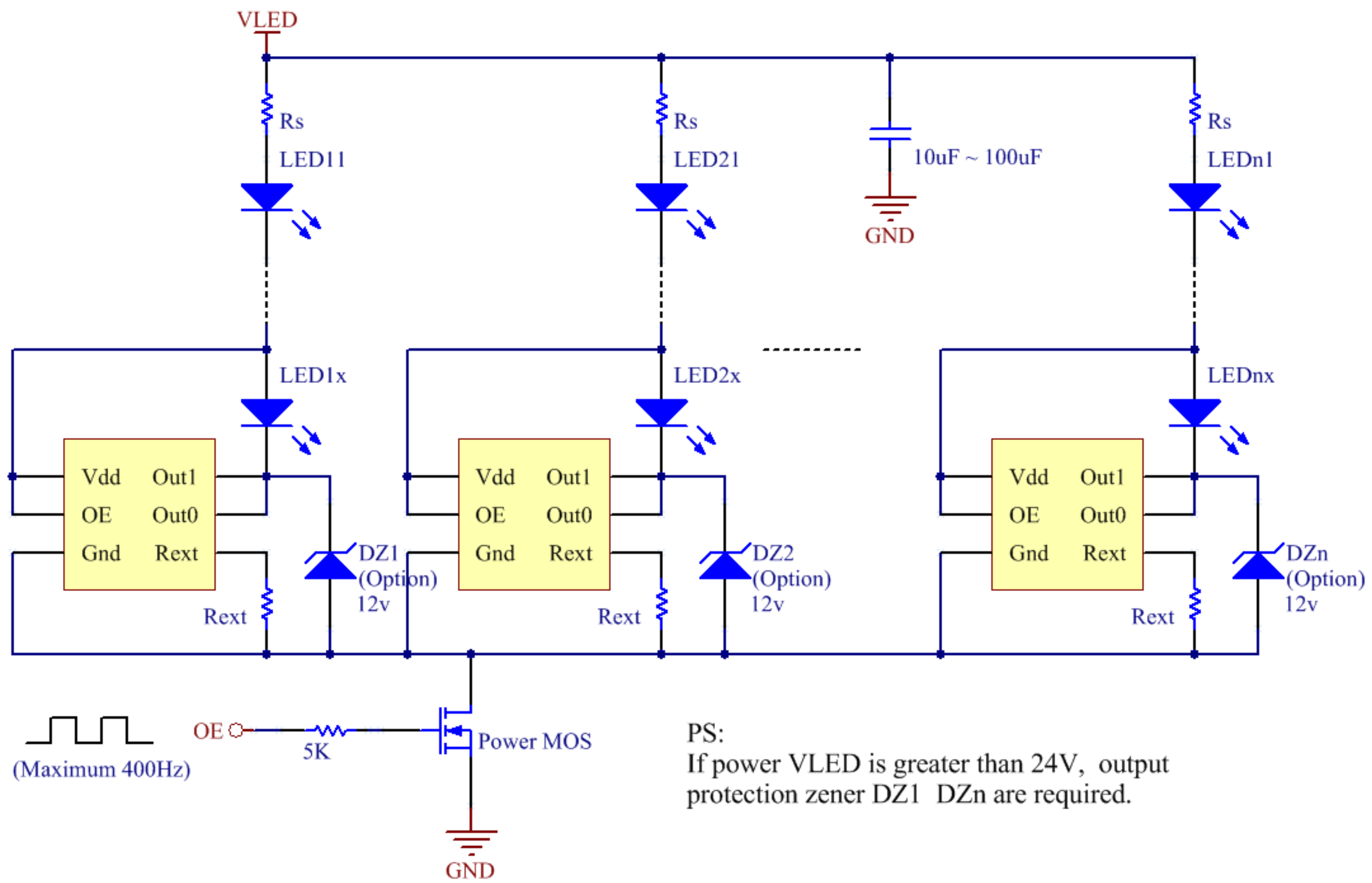
- Dimming application



- General lighting application 1



- General lighting application 2



PS:
If power VLED is greater than 24V, output protection zener DZ1 DZn are required.

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Note:

1. For the heat consideration on driver, V_{OUT} of NU512 should be minimized. The power calculation equation is shown as bellow.

   V_{OUT} = VLED – V_F * n

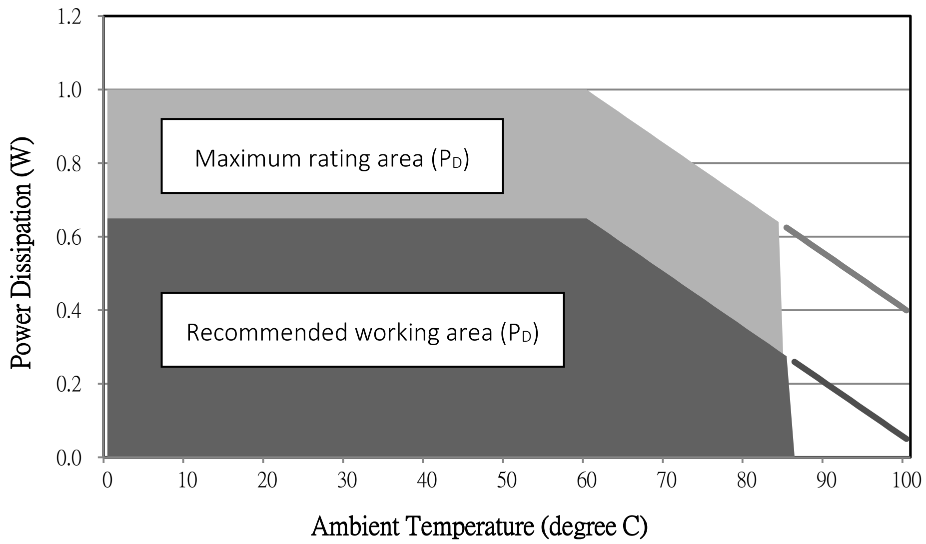
   P_D = V_{OUT} * I_{OUT} * 2

   Where V_{OUT} is the voltage on output pins, I_{OUT} is channel output current of NU512, V_F is voltage drop of LED and **n** is the number of LEDs. In some higher V_{OUT} applications, to series a proper resistor in output current path can decrease the V_{OUT} and get less heat generation from NU512.

2. For the efficiency consideration, higher VLED voltage and more LEDs in current path will get higher electrical efficiency. With the wide range supply voltage design and self powering structure like the lighting application circuit on previous page, NU512 can be used in maximum 24V (VLED) power system directly. If higher than 24V power is adopted, a 12V Zener diode connected between output and ground for voltage protection is required.

3. More LED in series, the total voltage drop variation on LEDs will increase. This variation is derived from the different V_F bins of LEDs and LED temperature rising while system is working. That probably increases P_D. So, it is another trade off to select the proper VLED voltage and the number of LEDs in system. The more output current is driving, the less LED in series is better.

Power Dissipation and Recommend Iout-Vout Table



Iout	Max. Vout (V) recommended	Max. Vout (V)
50mA * 2	6.5	10
100mA * 2	3.25	5
200mA * 2	1.63	2.5
300mA * 2	1.1	1.67
400mA * 2	0.82	1.25
500mA * 2	0.65	1

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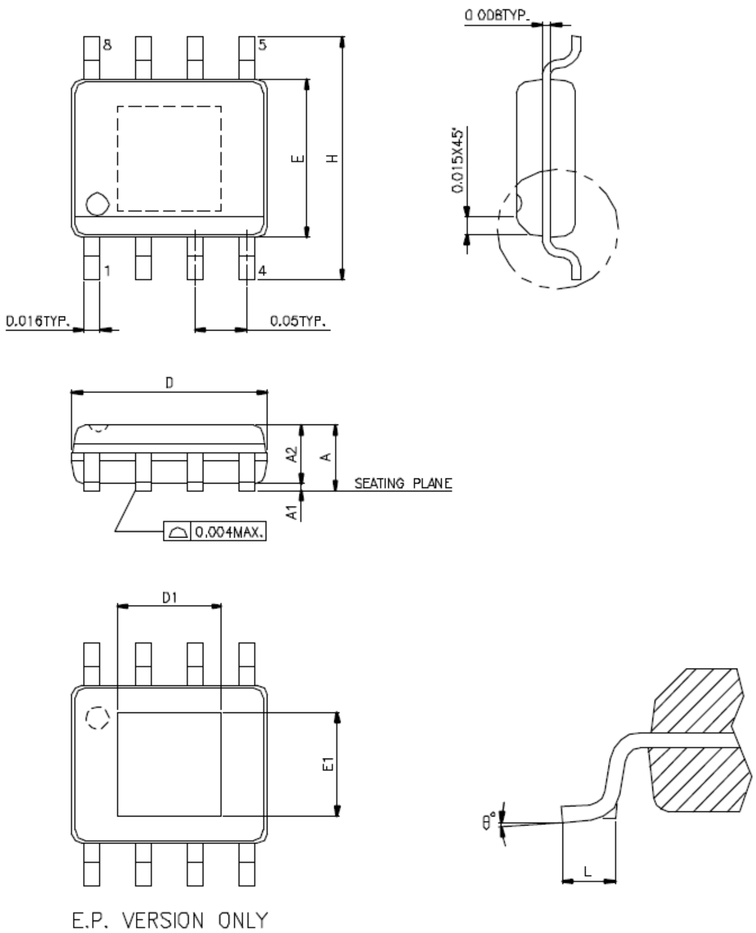
Package Dimensions



Taping Specification

PACKAGE	Q'TY/REEL
SOP8	3,000 ea

SYMBOLS	MIN.	MAX.
A	0.053	0.069
A1	0.002	0.006
A2	–	0.059
D	0.189	0.196
E	0.150	0.157
H	0.228	0.244
L	0.016	0.050
θ°	0	8

UNIT : INCH

THERMALLY ENHANCED DIMENSIONS

PAD SIZE	E1	D1
90X90E	0.081 REF	0.081 REF
95X130E	0.086 REF	0.117 REF

UNIT : INCH

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