8 Channel High Power Constant Current LED Driver

Features

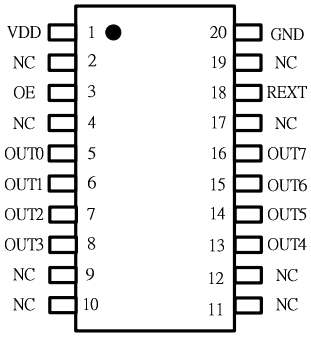
- 20mA~150mA, 8 channels constant current regulator
- Output current adjustable by external resistor
- 3V ~ 12V wide range supply voltage
- 1MHz OE PWM dimming support
- 0V ~ 17V output sustain voltage
- low output voltage dropout
  0.4V @ 40mA/ch (total 320mA output)
  0.7V @ 150mA/ch (total 1.2A output)
- Minimized I_{DD} consumption
- Low speed V_{DD} dimming support
- 160℃ half power thermal protect
- Less than ±4% chip current skew
- Less than ±4% channel to channel current skew
- Less than 0.5%/V line regulation
- Less that 1%/V load regulation
- 25nS channel stagger output
- Green package

Applications

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

Package Type

- TSSOP 173 mil 20 pin



Product Description

The NU508 is a dedicated designed constant current LED driver for general lighting. It can drive 8 channel LEDs simultaneously and provide each channel sink current up to 150mA.

The wide range of power supply capability makes the NU508 be driven easily by a simple circuit. For example, using a zener diode lowers down the V_{LED} voltage for V_{DD} or just routing V_{DD} pin into the LED loading loop gets popper voltage for NU508.

In the application of dimming function, the OE pin can switch all output channels on or off simultaneously with 25nS time stagger between odd and even channels. The fast transient speed of OE function in NU508 is best for most of dimming requirements and the stagger function will lower the EMI generation in fast dimming situation.

While in full current output, the NU508 only need about 0.6V drop on each output channel. This makes NU508 to be the lowest power lost LED driver that compared with the other types of LED drivers. The minimized voltage drop in NU508 will increase the efficiency of entire lighting system and lower the heat generation from LED driver.

Terminal Description

Pin #	Pin name	Function
1	VDD	Power supply
2	NC	
3	OE	Output enable
4	NC	
5	OUT0	Output channel 1
6	OUT1	Output channel 2
7	OUT2	Output channel 3
8	OUT3	Output channel 4
9	NC	
10	NC	
11	NC	
12	NC	
13	OUT4	Output channel 5
14	OUT5	Output channel 6
15	OUT6	Output channel 7
16	OUT7	Output channel 8
17	NC	
18	REXT	R external
19	NC	
20	GND	Ground

Maximum Ratings (T = 25°C)

Characteristic	Symbol	Rating	Unit
Supply voltage	V_{DD}	3.0 ~ 16	V
Output sustain voltage (Output off)	V_{OUT}	-0.2 ~ 20	V
Input voltage	V_{OE}	-0.2 ~ V_{DD}	V
Output current per channel	I_{OUT}	20 ~ 200	mA
Ground terminal current	I_{GND}	1.2	A
Power Dissipation (On PCB)	PD	1	W
Thermal Resistance	$R_{TH(j-a)}$	33.3	°C /W
Operating temperature	T_{OPR}	-40 ~ +130	°C
Storage temperature	T_{STG}	-55 ~ +150	°C

Electrical Characteristics and Recommended Operating Conditions

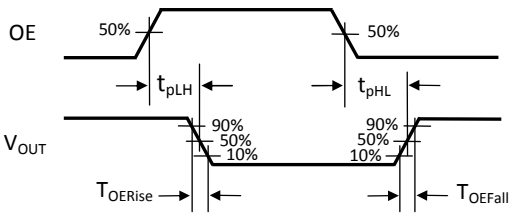
Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{DD}	Room Temp.	3	-	12	V
Output drop out voltage (Due to P_D limitation, drop out voltage is not sustaining voltage)	V_{OUT}	V_{DD} = 5V, I_{OUT} = 20mA * 8	0.3	-	6.3	V
		V_{DD} = 5V, I_{OUT} = 40mA * 8	0.4	-	3.2	V
		V_{DD} = 5V, I_{OUT} = 80mA * 8	0.5	-	1.6	V
		V_{DD} = 5V, I_{OUT} = 150mA * 8	0.6	-	1	V
Output current/channel	I_{OUTn}	-	20	-	150	mA
Bit current skew V_{DD} >=3V	dI_{OUT1}	I_{OUTn} = 20mA	-	-	±4	%
		I_{OUTn} = 150mA	-	-	±4	
Chip average current skew V_{DD} >=3V	dI_{OUT2}	I_{OUTn} = 20mA	-	±2	±4	%
		I_{OUTn} = 150mA	-	±2	±4	
Leakage	$I_{Leakage}$	V_{OUT} = 10V	-	-	0.5	uA
OE Input voltage	V_{IH}	V_{DD} < 5V	-	0.7*V_{DD}	-	V
		V_{DD} >= 5V	-	3.5	-	
	V_{IL}	-	-	0.3*V_{DD}	1.5	
Pull down resistor (OE)	R_{PD}	-	400	500	700	KΩ
Line regulation	%/V_{DD}	3V < V_{DD} < 12V	-	-	0.5	△%/V
Load regulation	%/V_{OUT}	0.5V < V_{OUT} < 8V	-	-	1	△%/V
Operating Temperature	T_{OPR}	Ambient temperature	-40	-	85	°C
Thermal protect (Junction temperature)	T_{HalfP}	Half current output	-	160	-	°C

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Thermal regulation	%/10℃	-	-	-	0.5	△%/10℃
Supply current	I_{DD1}	R_{EXT} = Open, All output off	-	0.3	1	mA
	I_{DD2}	R_{EXT} = 900Ω, All output off	-	3	4	mA
	I_{DD3}	R_{EXT} = 900Ω, All output on	-	3	4	mA
	I_{DD4}	R_{EXT} = 600Ω, All output on	-	5	6	mA

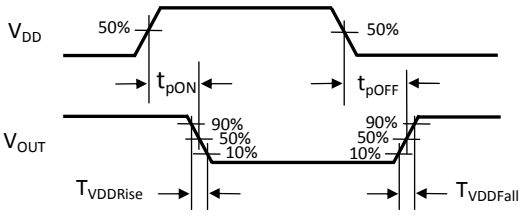
Switching Characteristics (T = 25℃)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Propagation Delay Time (OE from "L" to "H")	t_{pLH}	V_{DD}=4V, V_{OUT}=1V, I_{OUT}=120mA, OE= 0V → 4V	300	380	440	nS
Output current rising time (OE from "L" to "H")	t_{OERise}	V_{DD}=4V, V_{OUT}=1V, I_{OUT}=120mA, OE= 0V → 4V	100	120	160	nS
Propagation Delay Time (OE from "H" to "L")	t_{pHL}	V_{DD}=4V, V_{OUT}=1V, I_{OUT}=120mA, OE= 4V → 0V	300	380	440	nS
Output current falling time (OE from "H" to "L")	t_{OEFall}	V_{DD}=4V, V_{OUT}=1V, I_{OUT}=120mA, OE= 4V → 0V	100	120	160	nS
Propagation Delay Time (V_{DD} from "L" to "H")	t_{pON}	V_{OUT}=1V, I_{OUT}=120mA, V_{DD}=OE= 0V → 3V	-	90	-	uS
Output current rising time (V_{DD} from "L" to "H")	$t_{VDDRise}$	V_{OUT}=1V, I_{OUT}=120mA, V_{DD}=OE= 0V → 3V	-	120		uS
Propagation Delay Time (V_{DD} from "H" to "L")	t_{pOFF}	V_{OUT}=1V, I_{OUT}=120mA, V_{DD}=OE= 3V → 0V	-	70	-	nS
Output current falling time (V_{DD} from "H" to "L")	$t_{VDDFall}$	V_{OUT}=1V, I_{OUT}=120mA, V_{DD}=OE= 3V → 0V	-	120		nS

Timing Waveform

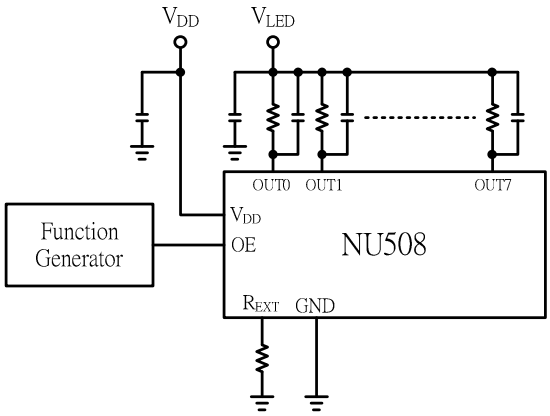


OE timing diagram

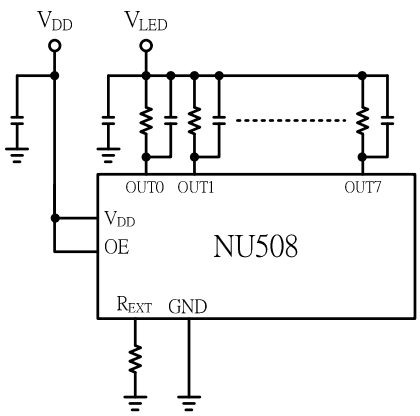


V_{DD} timing diagram

Test Circuit

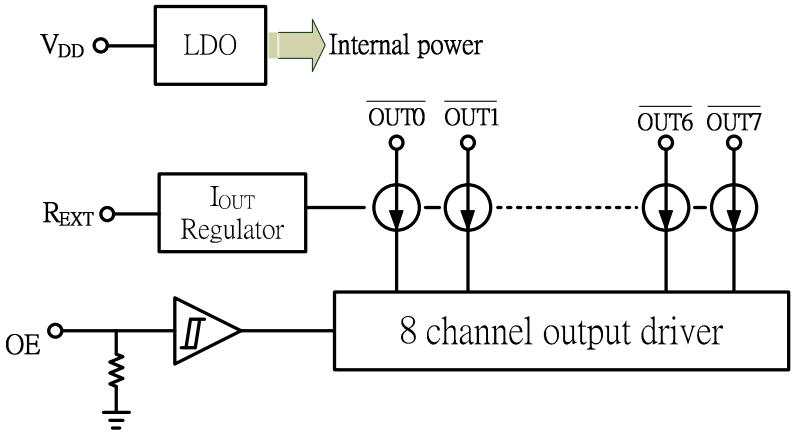


OE dimming and I_{OUT} test circuit



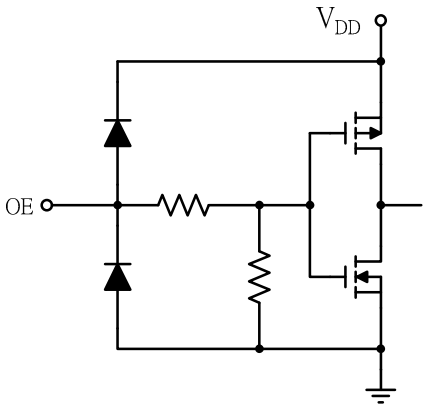
V_{DD} dimming test circuit

Block Diagram



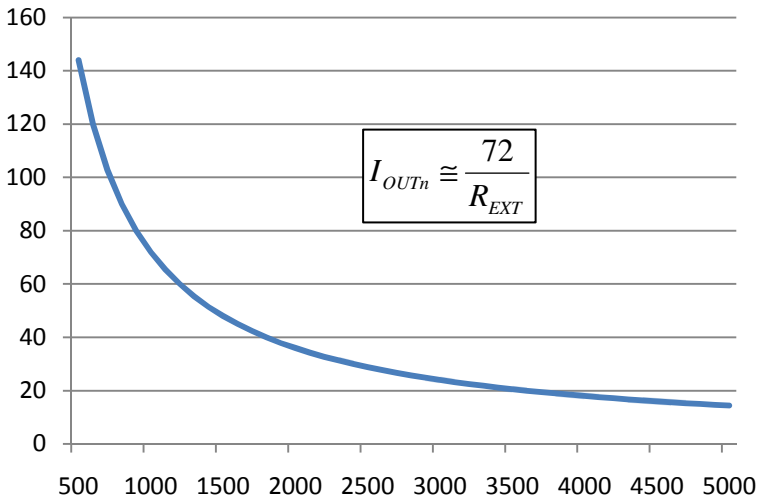
Equivalent Circuits for Inputs

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



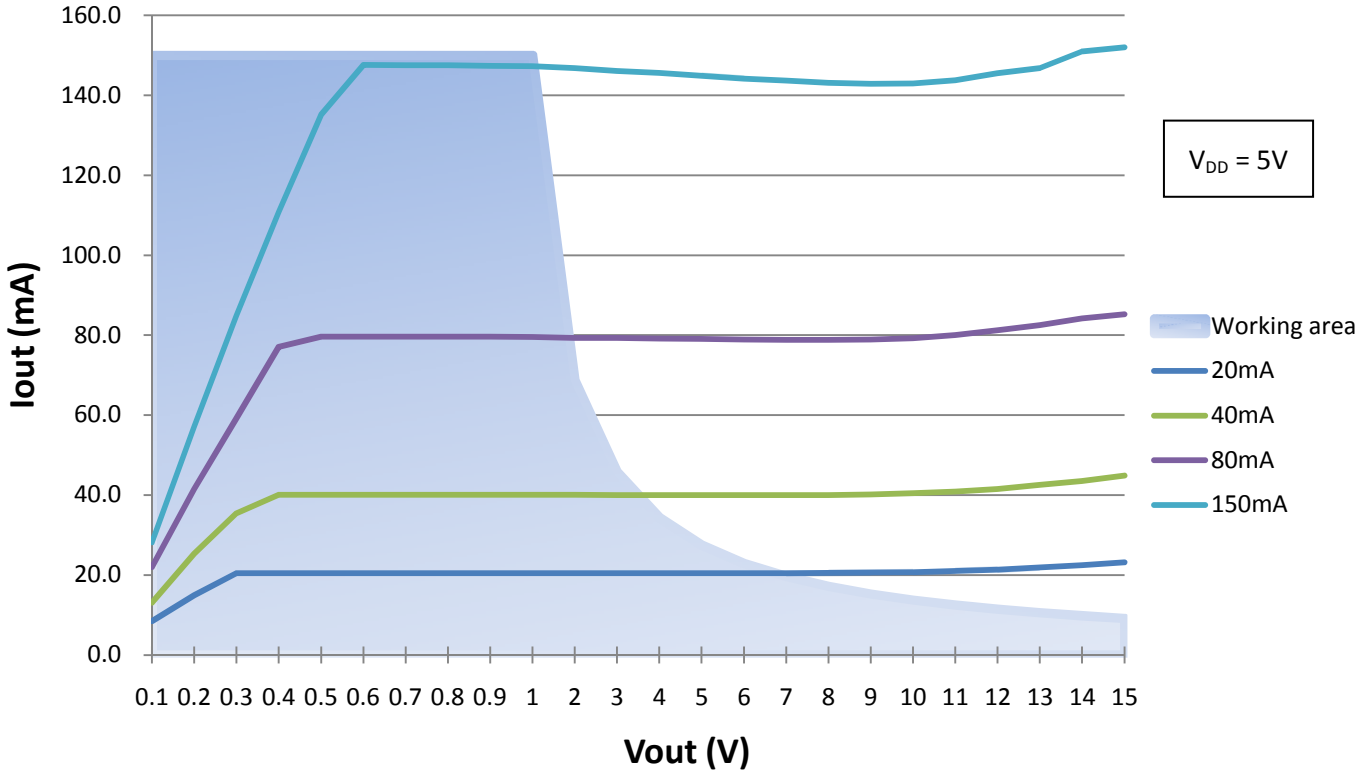
Output Current Setting

The output current of each channel of NU508 is set by an external resistor (R_{EXT}). The relationship between output current and external resistor is shown in the figure or calculated from the equation following.



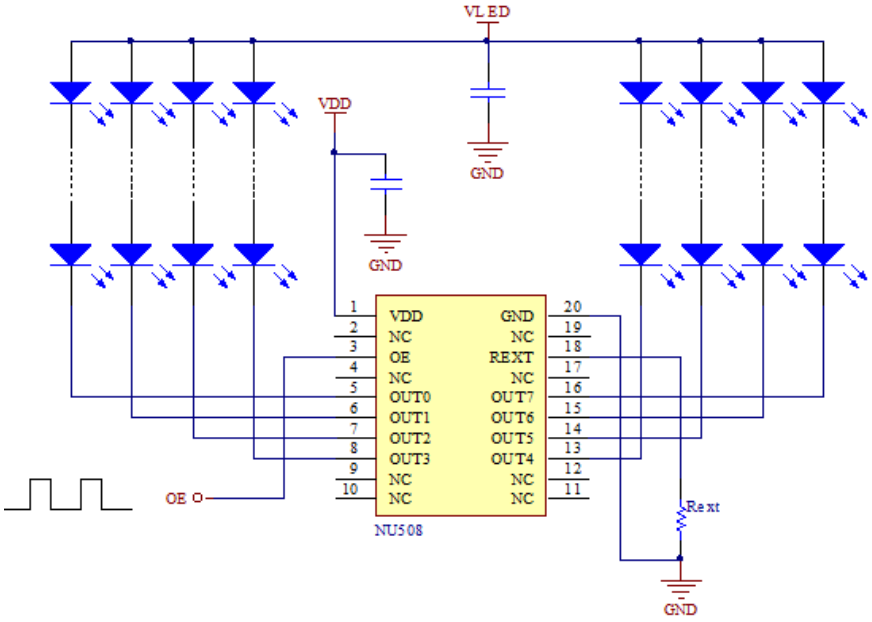
I/V Curve

I_{OUT} vs. V_{OUT} curve (Single channel)

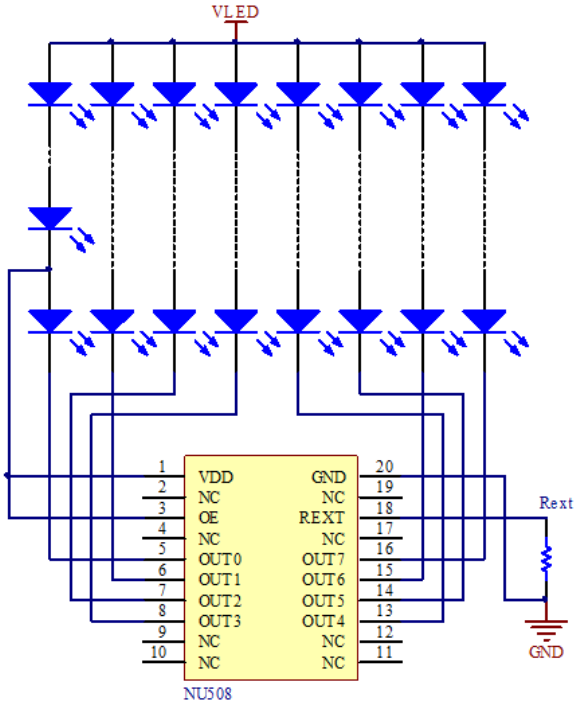


Typical Application Circuit

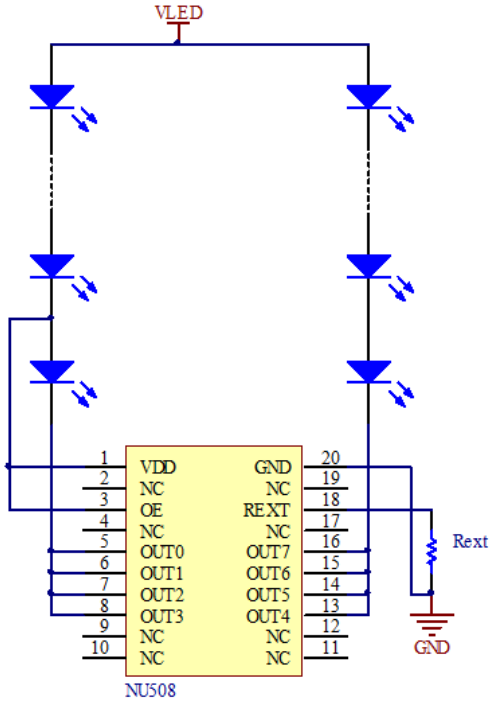
- Dimming application



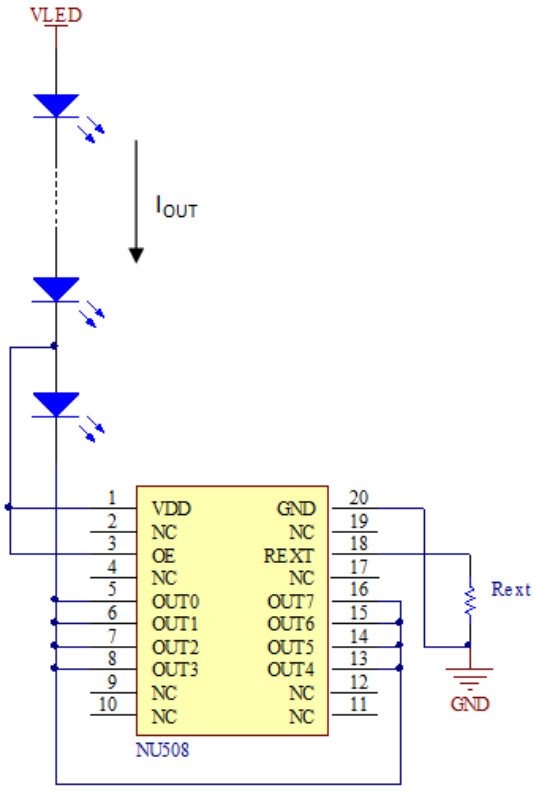
- General lighting application



1/2 W LEDs driving circuit



1W LEDs driving circuit



3 W LEDs driving circuit

Note:

1. For the heat consideration on driver, V_{OUT} of NU508 should be minimized. The power calculation equation is shown as bellow.

   $$\mathbf{V_{OUT} = VLED - V_F * n}$$

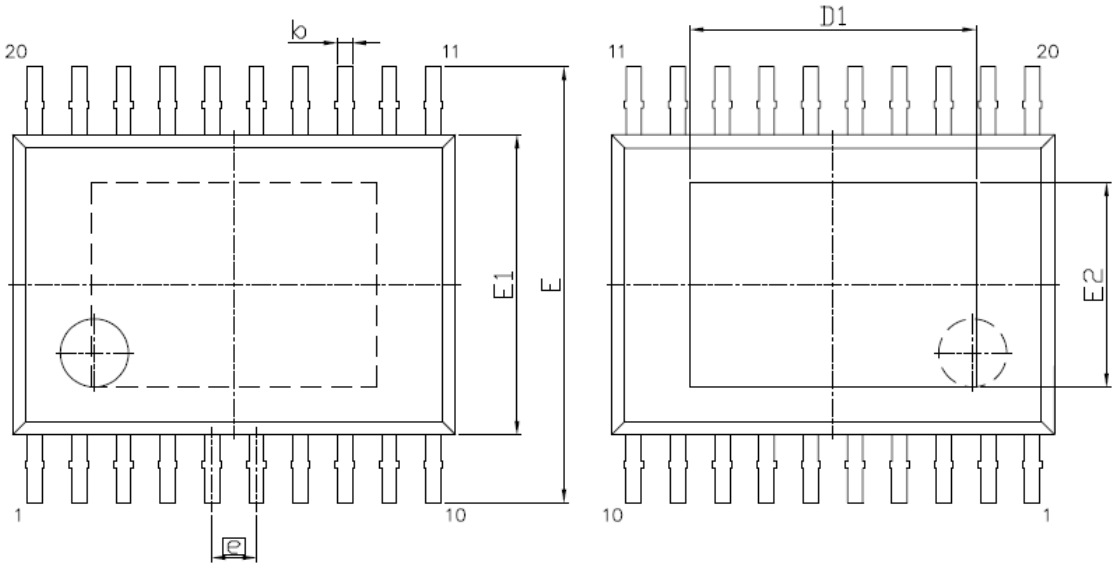
   $$\mathbf{P_D = V_{OUT} * I_{OUT}}$$

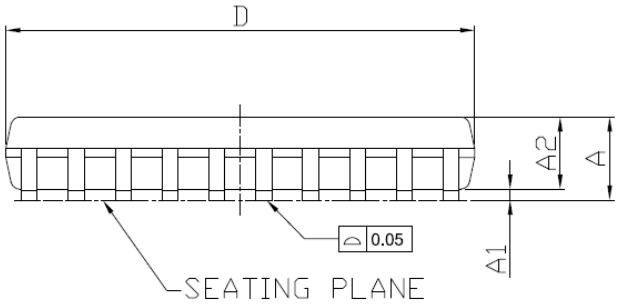
   Where $\mathbf{V_{OUT}}$ is the average voltage on output pins, $\mathbf{I_{OUT}}$ is total output current of NU508, $\mathbf{V_F}$ is voltage drop of LED and **n** is the number of LEDs.
   In some higher V_{OUT} applications, to series a proper resistor in output current path can decrease the V_{OUT} and get less heat generation from NU508.

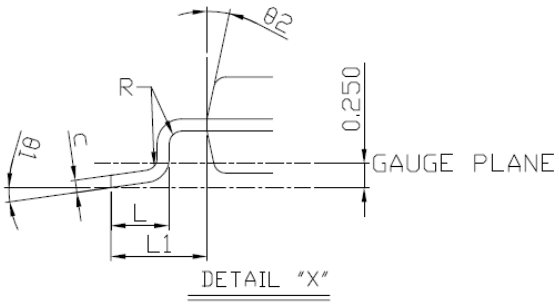
2. For the efficiency consideration, higher VLED voltage and more LEDs in current path will get higher electrical efficiency. With the wide range supply voltage design and self powering structure like the lighting application circuit on this page, NU508 can be used in high voltage power system. Even the system power voltage is much higher than the maximum voltage of NU508, it works well.

3. More LED in series, the total voltage drop variation on LEDs will increase. This variation is derived from the different $\mathbf{V_F}$ bins of LEDs and LED temperature increasing while system is working. That probably increases $\mathbf{P_D}$. 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.

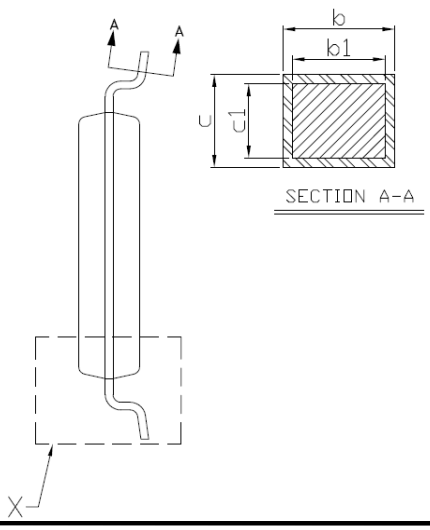
Package Dimensions







SYMBOL	DIMENSION (MM)			DIMENSION (MIL)		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	–	–	1.20	–	–	47.0
A1	0.00	–	0.15	0.0	–	5.9
A2	0.80	1.00	1.05	31.5	39.4	41.3
b	0.19	–	0.30	7.5	–	11.8
b1	0.19	0.22	0.25	7.5	8.7	9.8
c	0.09	–	0.20	3.5	–	7.9
c1	0.09	–	0.16	3.5	–	6.3
D	6.40	6.50	6.60	252.0	256.0	260.0
D1	3.80	4.00	4.20	149.6	157.0	165.0
E	6.40 BSC			252.0 BSC		
E1	4.30	4.40	4.50	169.3	173.2	177.2
E2	2.60	2.80	3.00	102.3	110.0	118.0
e	0.65 BSC			25.6 BSC		
L	0.45	0.60	0.75	17.7	23.6	29.5
L1	1.00 REF			39.4 REF		
R	0.127	–	–	5.0	–	–
θ1	0°	–	8°	0°	–	8°
θ2	12° REF			12° REF		



ɔecification

Q'TY/REEL
2,500 ea