



## Low Power Lighting LED Driver Data sheet

# NU501

### 10 ~ 240mA Single/Dual channel LED Driver

#### Features

- The easiest used linear constant current LED driver
- 10mA~240mA, single channel constant current regulator
- No external current setting resistor is needed
- 3V ~ 24V wide supply voltage range
- Very low dropout voltage  
 $I_{PN} = 20mA \rightarrow V_{PN} \approx 0.3V$   
 $I_{PN} = 60mA \rightarrow V_{PN} \approx 0.35V$
- Less than  $\pm 4\%$  Chip to Chip current skew
- 3kHz PWM dimming support
- Less than 1%/V load (or line) regulation
- 130 °C ~160 °C junction temperature current ramp down thermal protect
- SOT23-3/SOT89-3 green package

#### Product Description

NU501 is a simple general-purpose current regulation component that can be easily used in various LED lighting applications. With the excellent load/line regulation and minimized chip current skew, NU501 keep LED's current very stable even when power or load fluctuate in a wide range and make light intensity very uniform in large area of LED light source.

Except power supply function, the  $V_{DD}$  pin of NU501 is output enable (OE) also, and can be used in digital PWM controlled circuit to achieve more precise current adjusting in gray level applications.

#### Applications

- General LED lighting
- LCD back lighting
- Commercial lighting
- LED torch / flashlight
- RGB lighting

#### Ordering Information

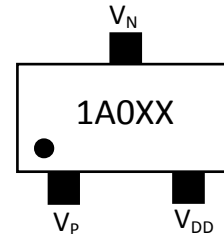
Part Number: NU501-1A xxx

Top marking

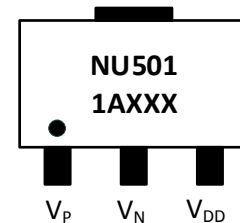
↑ Output current (mA)

#### Package Type

- SOT 23-3L (output current < 100mA)



- OT89-3L (output current > 60mA)

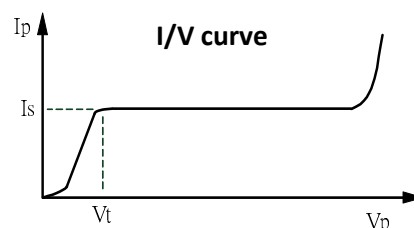
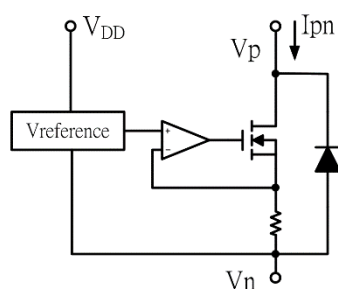


#### Terminal Description

Pin name	Function
$V_{DD}$	Power supply
$V_P$	Current in
$V_N$	Current out

**PS:** Before you issue your P.O., please contact your agent or NUMEN technology to make sure the type of output current is available.

## Block Diagram and IV characteristic



## Maximum Ratings (T = 25°C)

Characteristic	Symbol		Rating	Unit
Supply voltage	$V_{DD}$		-0.3 ~ 28	V
Output voltage	$V_P$		-0.3 ~ 28	V
Power Dissipation (Ta=25°C)	PD	SOT 23	0.4	W
		SOT 89	0.7	
Thermal Resistance (On PCB, Ta=25°C)	$R_{TH(j-a)}$	SOT 23	300	°C /W
		SOT 89	180	
Operating temperature	$T_{OPR}$		-40 ~ +85	°C
Storage temperature	$T_{STG}$		-55 ~ +150	°C

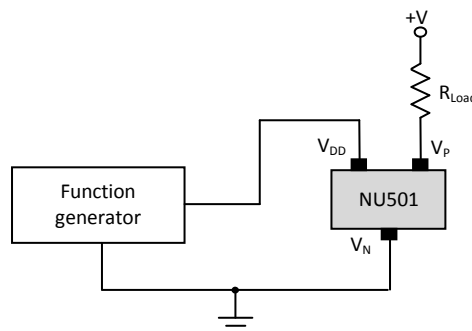
## Electrical Characteristics and Recommended Operating Conditions

Characteristic	Symbol	Condition		Min.	Typ.	Max.	Unit
Supply voltage	$V_{DD}$	Room Temp.		3	-	24	V
Supply current	$I_{DD}$	-		200	225	250	uA
Minimum dropout voltage	$V_{PNmin}$	$V_{DD} \geq 5V$	$I_{PN}=20mA$	-	0.3	-	V
			$I_{PN}=60mA$	-	0.35	-	
Output breakdown voltage	$V_{PNBD}$	$I_{PN} = 0, V_{DD} = 0V$		-	-	24	V
Output current	$I_S^{*2}$	Spec.		10	-	240	mA
Line regulation	%/ $V_{DD}$	$5V > V_{DD} > 24V$		-	0.1	-	%/V
Load regulation	%/ $V_P$	$8V > V_P > 1.6V$		-	0.1	-	%/V
Thermal regulation	%/10°C	$V_{DD} = V_P = 2V$		-	0.1	-	%/10°C
Chip current skew	$I_{skew}$	-		-	-	±4	%

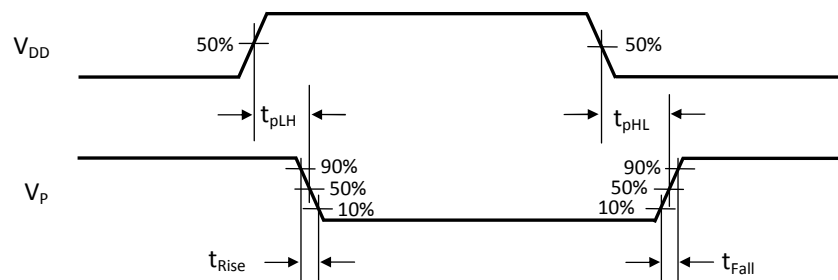
Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Propagation Delay Time $V_{DD}$ from "L" to "H"	$t_{pLH}$	$V_P=1V, V_{DD}=0V \rightarrow 5V$	-	2.2	-	$\mu S$
Output current rising time	$t_{Rise}$	$V_P=1V, V_{DD}=0V \rightarrow 3V$	-	1.8	2	$\mu S$
Propagation Delay Time $V_{DD}$ from "H" to "L"	$t_{pHL}$	$V_P=1V, V_{DD}=3V \rightarrow 0V$	-	500	-	nS
Output current falling time	$t_{Fall}$	$V_P=1V, V_{DD}=3V \rightarrow 0V$	-	80	120	nS

## Switching Characteristics (T = 25°C)

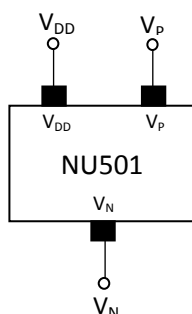
## Test Circuit



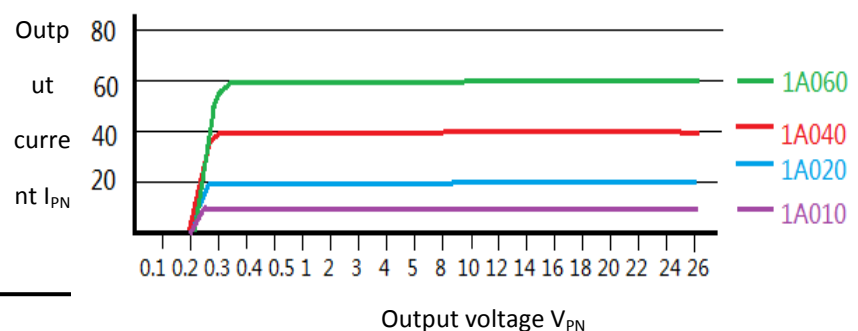
## Timing Waveform



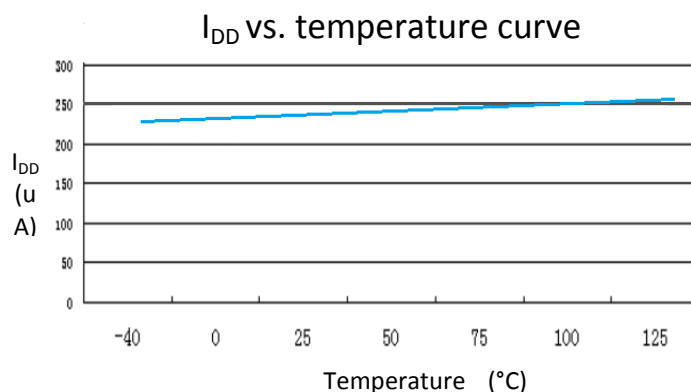
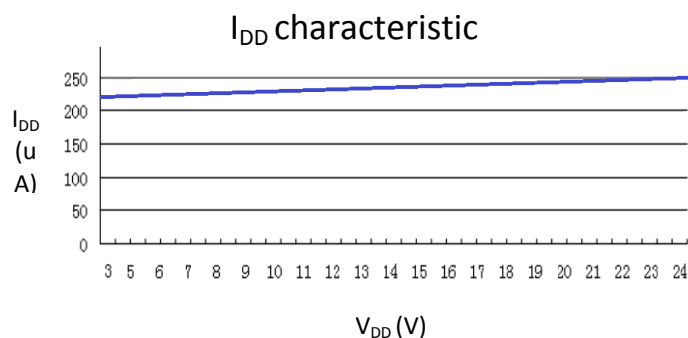
## I/V curve



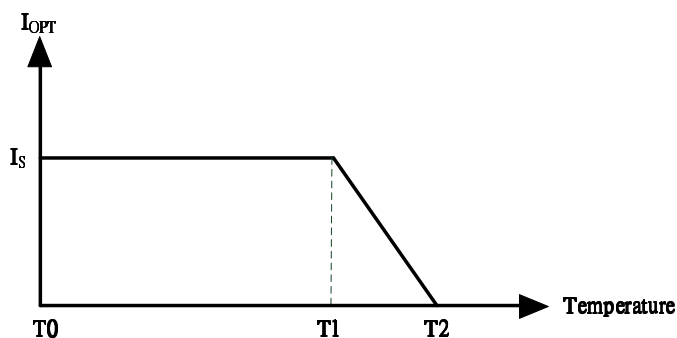
## Load regulation characteristic



## I<sub>DD</sub> Consumption



## Thermal protection



State	Normal (T0 ↔ T1)	Thermal protect (T1 ↔ T2)	Unit
Temperature	-40 ↔ 130	130 ↔ 160	°C
I <sub>PN</sub> variation	±0.4	-33	%/10°C

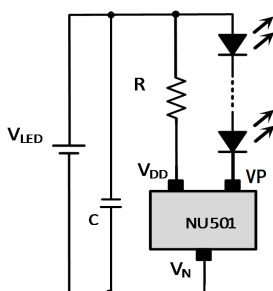
## Application design consideration

NU501 is a linear constant current driver. While this device is designed in lighting system, the heat generation should be considered. Generally, the higher current designed in system, the higher power will suffer by this device. To reduce the power consuming by NU501 and to increase the whole system efficiency, the drop voltage across NU501 should be minimized. The following design note can reduce the heat generation from NU501 in the condition of keeping the required output constant current and the needed supply voltage (normal operation condition).

1. Drop the power supply voltage as low as possible in the normal operation condition.
2. Get the LEDs in current loop as many as possible in the normal operation condition.
3. Get a voltage sharing resistor in series in current loop.
4. It is suggested to connect a small SMD type capacitor (1nF~100nF) between  $V_{DD}$  and  $V_N$  pin. That will greatly improve the stability of system.
5. If  $V_{pn}$  is greater than 8V, it is necessary to connect a capacitor between  $V_P$  and  $V_N$  pin for chip protection. The capacitance is about 100pF ~ 1nF.

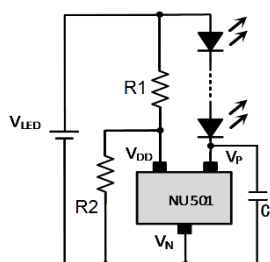
## Application Circuits

### ● Basic lighting application 1



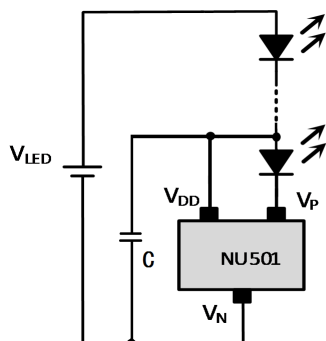
$V_{LED}$ 电压	R 值
12V	9k $\Omega$
24V	20k $\Omega$

### ● Basic lighting application 2

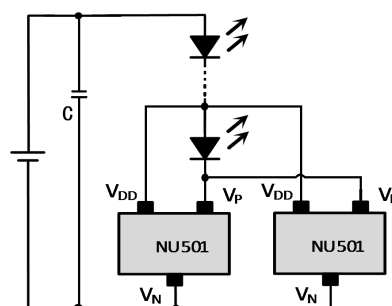


$V_{LED}$ 电压	R1 值	R2 值
36V	36~51k $\Omega$	9.1k $\Omega$
48V	48~72k $\Omega$	9.1k $\Omega$

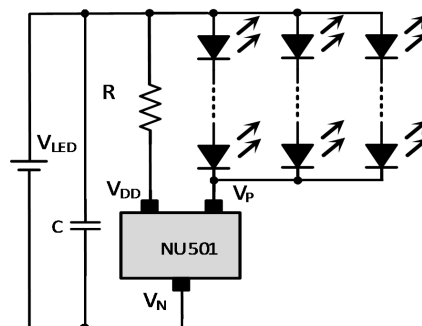
### ● Self-bias application



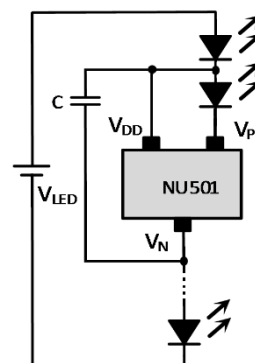
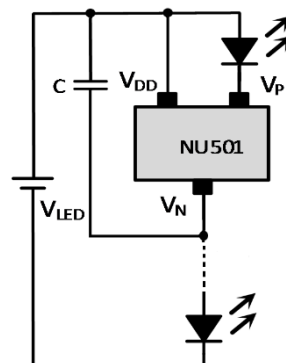
### ● Multi driver parallel application



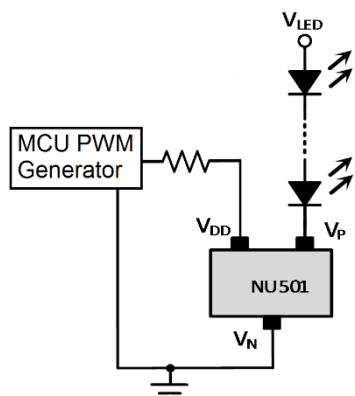
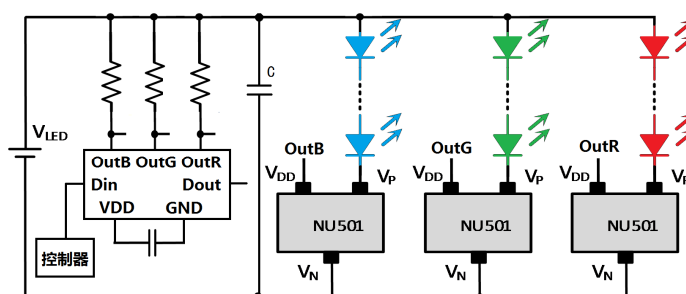
### ● Multi LED path parallel application



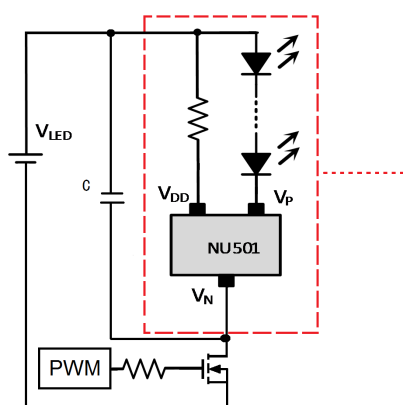
### ● Driver in circuit application



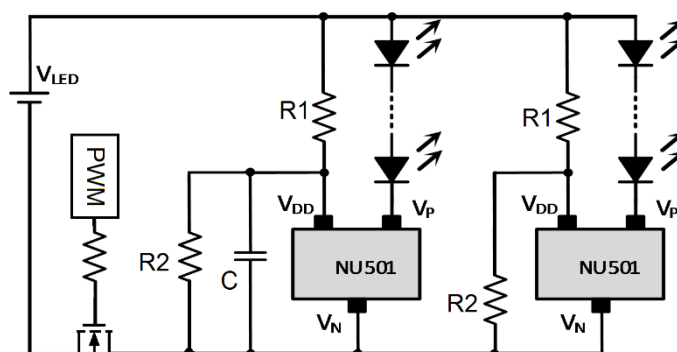
- PWM dimming application

V<sub>DD</sub> pin dimming application

Controller I/O output current expansion application



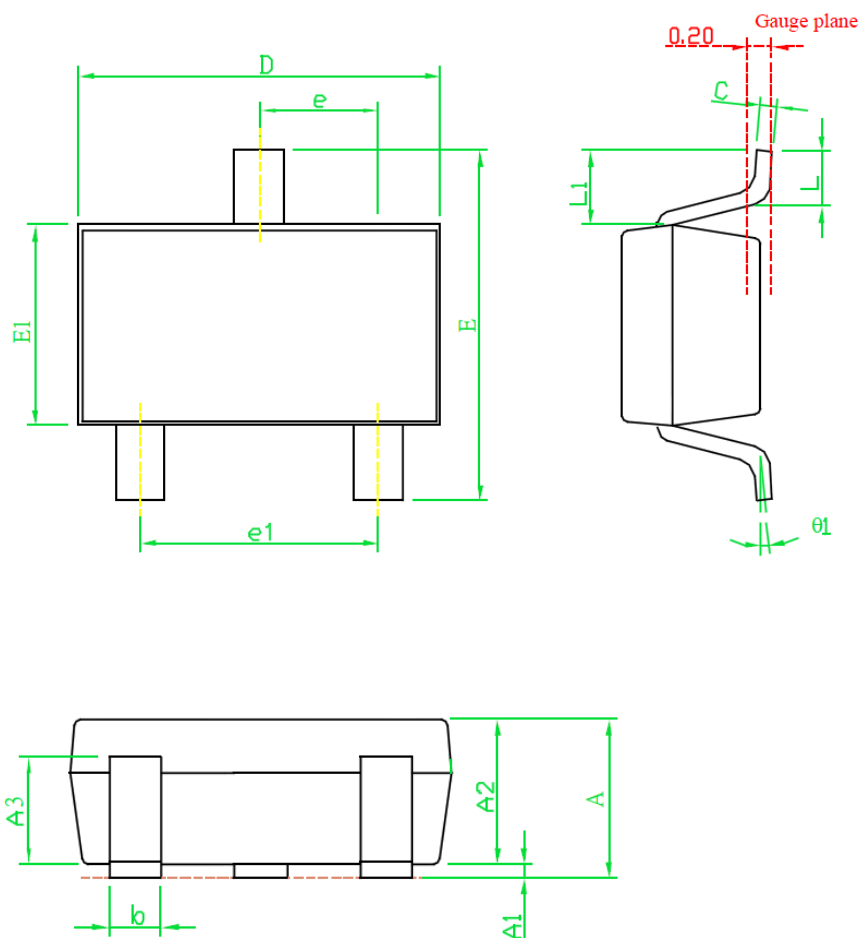
Power line dimming application



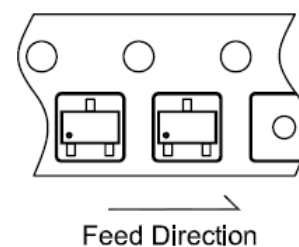
Auto dual color temperature dimming application

## Package Dimensions

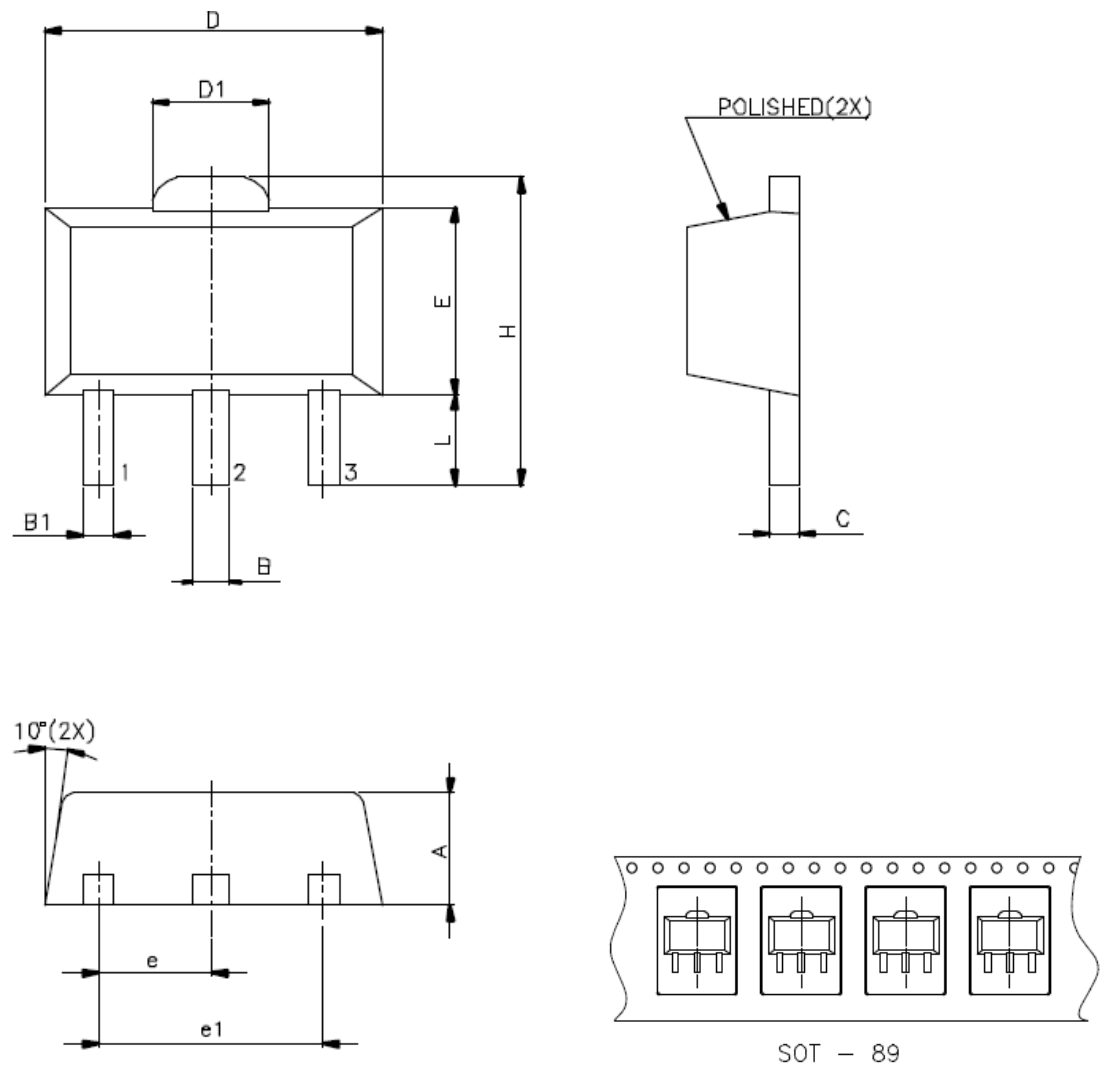
### ● SOT23-3L



SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	1.00	1.10	1.40
A1	0.00	----	0.10
A2	1.00	1.10	1.30
A3	0.70	0.80	0.90
b	0.35	0.40	0.50
C	0.10	0.15	0.25
D	2.70	2.90	3.10
E1	1.40	1.60	1.80
e	----	0.95(TYP)	----
e1	----	1.90(TYP)	----
E	2.60	2.80	3.00
L	0.37	----	----
$\theta1$	1°	5°	9°
L1	0.5	0.6	0.7



## ● SOT89L



SYMBOLS	MIN.	MAX.
A	1.40	1.60
B	0.44	0.56
B1	0.36	0.48
C	0.35	0.44
D	4.40	4.60
D1	1.35	1.83
E	2.29	2.60
H	3.94	4.25
e	1.50 BSC	
e1	3.00 BSC	
L	0.89	1.2

UNIT : mm





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