

Single Channel LED Driver (Preliminary)

Features

- The most easy used linear constant current LED driver
- Strong bond pad design
- V_{DDH} 7V~60V supply voltage
- V_{DD} 1.8V~14V supply voltage
- 0.3~15V output working voltage
- 10~200mA constant current regulator
- Fast response time, support power supply PWM dimming function
- Less than 1%/V line/load regulation
- 130~160°C junction temperature current ramp down thermal protect
- -40~85°C operating temperature

Product Description

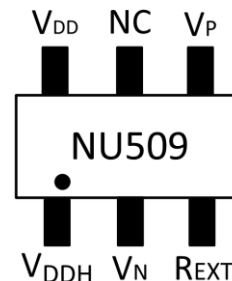
NU509 is a small/medium power linear current regulation component that can be easily used in various LED lighting applications. It is equipped the excellent feature of good load/line regulation capability, minimized chip current skew, stable output current in high power or load voltage fluctuating environment that can be used in wide area of LED lighting source to maintain the uniformity of light intensity.

Except for the power supply function, the VDD pin of NU509 is output enable (OE), and can be used in digital PWM controlled circuits for more precise current adjustment in gray level applications.

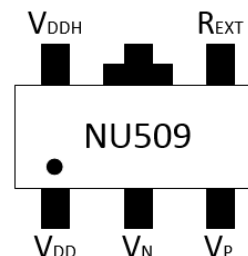
With the feature of wide power supply range design and ultra low I_{DD} consumption, the NU509 supports the self powered structure in LED lighting applications. In this structure, the NU509 no need to be provided a dedicate power circuit even the system power voltage is much higher than the maximum operation voltage of NU509. The V_{DD} power can be gotten from the proper position in LED series of system.

Package Type

- SOT23-6



- SOT89-5



Applications

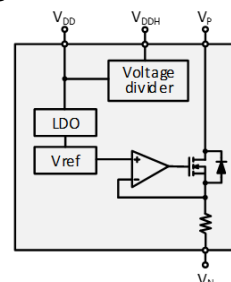
- General LED lighting
- Decoration lighting for architecture
- LED torch / flash light
- RGB lighting
- RGB display / indicator

Ideal IV characteristic

IV curve



Block Diagram



Maximum Ratings (T = 25°C)

Characteristic	Symbol	Rating	Unit	
Supply voltage	V_{DD}	-0.2 ~ 15	V	
Supply voltage	V_{DDH}	-60~120		
Output voltage(Output enable)	V_{PN_Enable}	-0.2 ~ 14		
Output voltage(Output disable)	$V_{PN_Disable}$	-0.2 ~ 20		
Output current	I_{PN}	10 ~ 200	mA	
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		

Electrical Characteristics and Recommended Operating Conditions

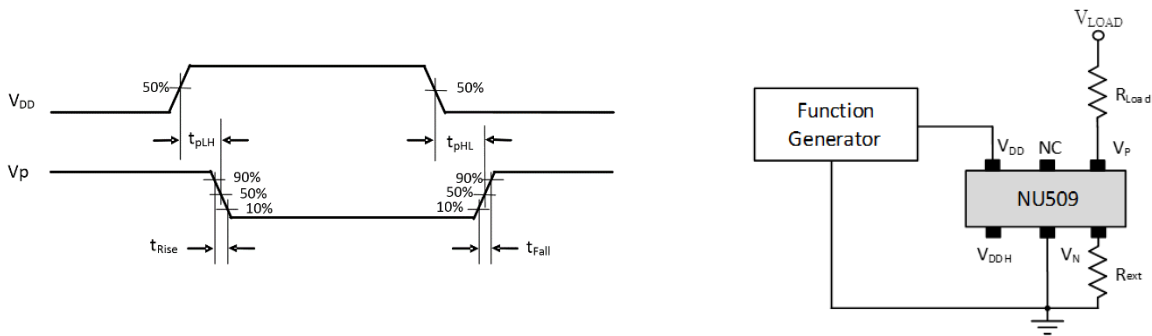
Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit	
Supply voltage	V_{DD}	Room Temp. $V_{PN} = 1.5V$	1.8	-	15	V	
	V_{DDH}^{*1}	Room Temp. $V_{PN} = 1.5V$	7	-	60	V	
Output voltage	V_{PN_Enable}	$V_{DD} > 1.6V, P_D \leq P_{D_recomd}$	-	-	14	V	
	$V_{PN_Disable}$	$V_{DD} < 0.8V$	-	-	20	V	
Supply current	I_{DD}	$V_{DD} \leq 15V$	-	100	120	uA	
		$15V \leq V_{DDH} \leq 60V$	0.09	-	2	mA	
Minimum dropout voltage	V_{PN}	$V_{DD} \geq 4V$	$I_S^* \leq 40mA$	-	-	0.5	V
			$I_S \leq 160mA$	-	-	1	
Output current	I_{PN}	$V_{DD} \geq 4V$	10	-	160	mA	
Leakage	$I_{Leakage}$	$V_{DD} = 0V, V_{PN} = 15V$	-	-	0.5	uA	
Line regulation	$\%/V_{DD}$	$13V > V_{DD} > 3V$	-	-	± 0.5	$\%/V$	
Load regulation	$\%/V_P$	$9V > V_{PN} > 0.4V$	-	-	± 0.5	$\%/V$	
Thermal regulation	$\%/10^\circ C$	$V_{DD} = 4V, V_{PN} = 1.5V,$ Junction temp. $< 125^\circ C$	-	-	-0.4	$\%/10^\circ C$	
Output ramp down temperature	T1	Output enabled	-	130	-	°C	
Shutdown temperature	T2	$I_{PN} < 10mA$	-	160	-		
Chip current skew	I_{skew}	$V_{DD} = 4V, V_{PN} = 1.5V$	-	2	4	%	
Power Dissipation	P_{D_recomd}	Room Temp.	SOT23	-	-	0.25	W
			SOT89	-	-	0.6	

*1 V_{DDH} pin is used for non-dimmable lighting.

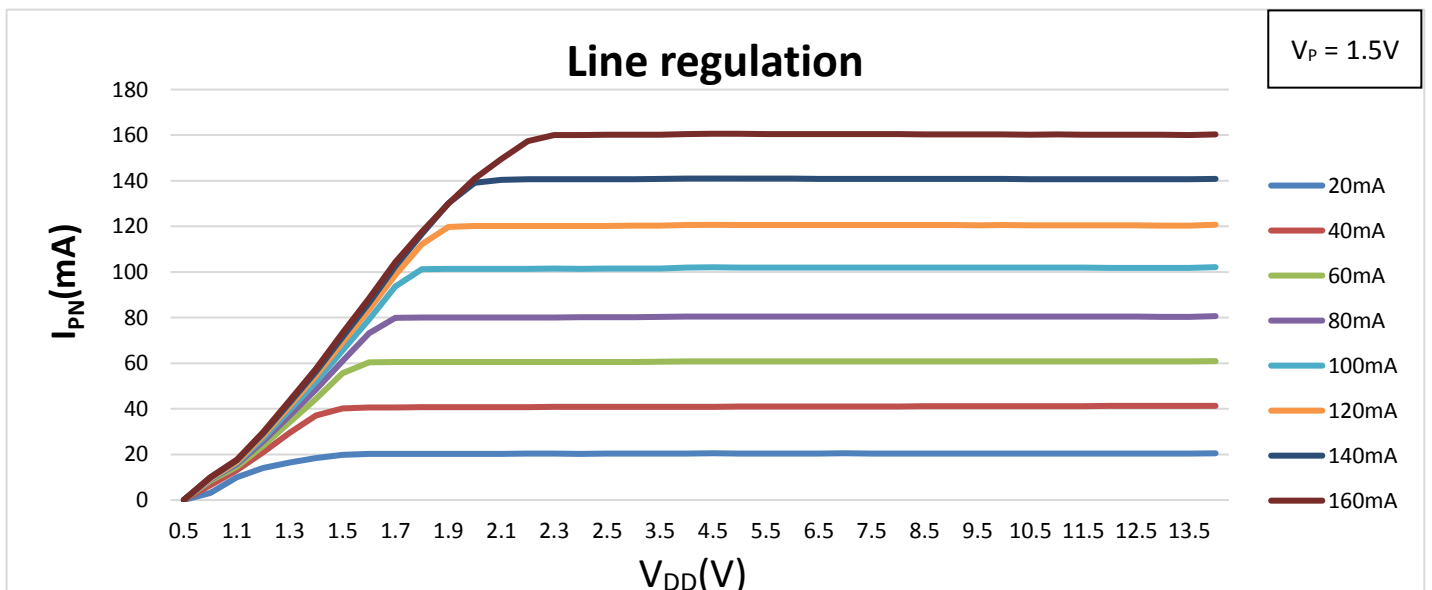
Switching Characteristics (T = 25°C)

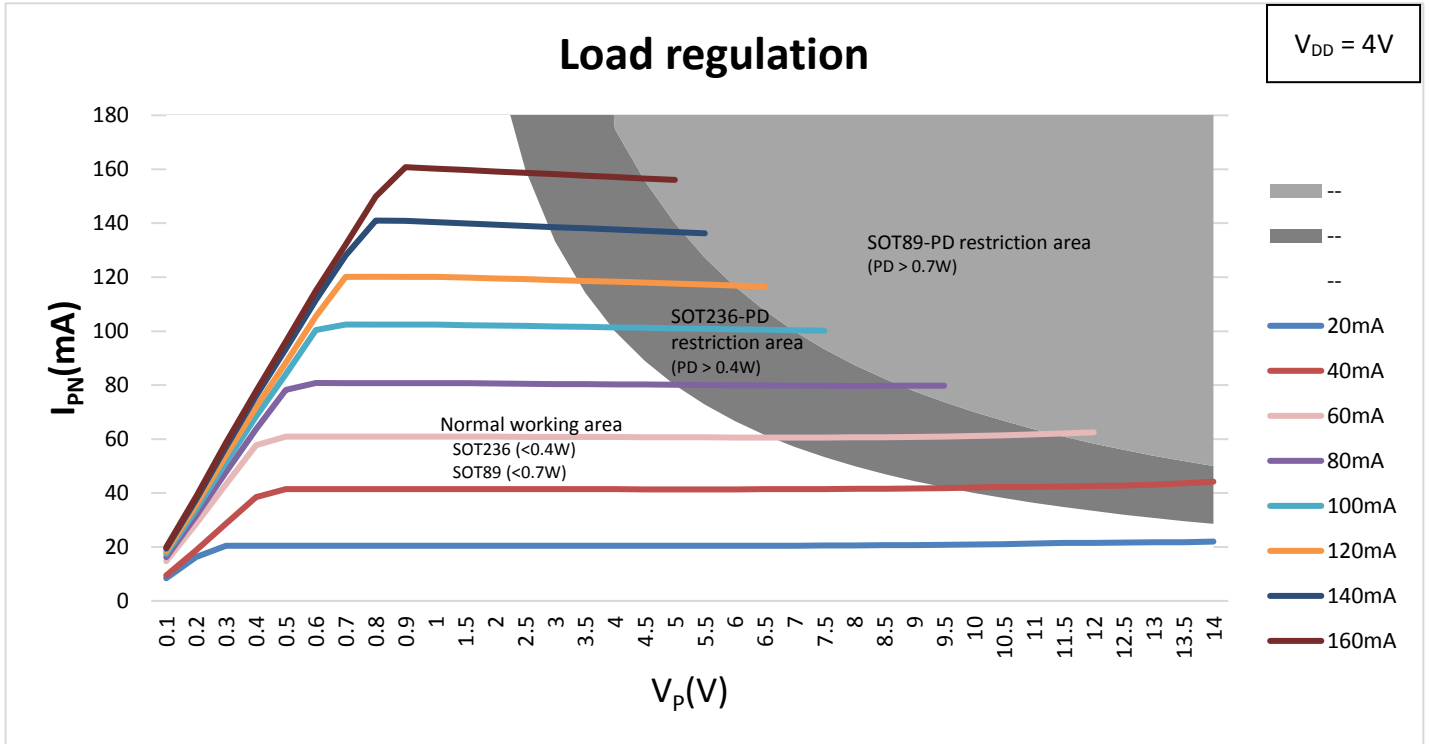
Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Propagation Delay Time V _{DD} /V _{DDH} from "L" to "H"	t _{pLH_H}	V _{PN} =1.5V, V _{DD} = 0V → 3.3V	-	300	-	ns
		V _{PN} =1.5V, V _{DDH} = 0V → 12V				
Output current rising time	t _{Rise_H}	V _{PN} = 1.5V, V _{DD} = 0V → 3.3V	-	300	-	
		V _{PN} = 1.5V, V _{DDH} = 0V → 12V				
Propagation Delay Time V _{DD} /V _{DDH} from "H" to "L"	t _{pHL_H}	V _{PN} =1.5V, V _{DD} = 3.3V → 0V	-	50	-	
		V _{PN} =1.5V, V _{DDH} = 12V → 0V				
Output current falling time	t _{Fall_H}	V _{PN} = 1.5V, V _{DD} = 3.3V → 0V	-	100	-	
		V _{PN} = 1.5V, V _{DDH} = 12V → 0V				

Timing Waveform



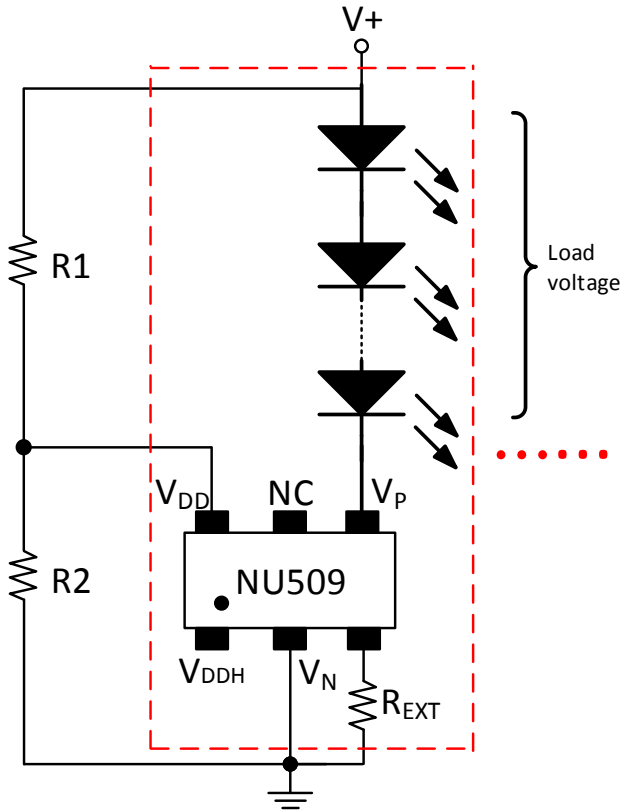
I/V curve





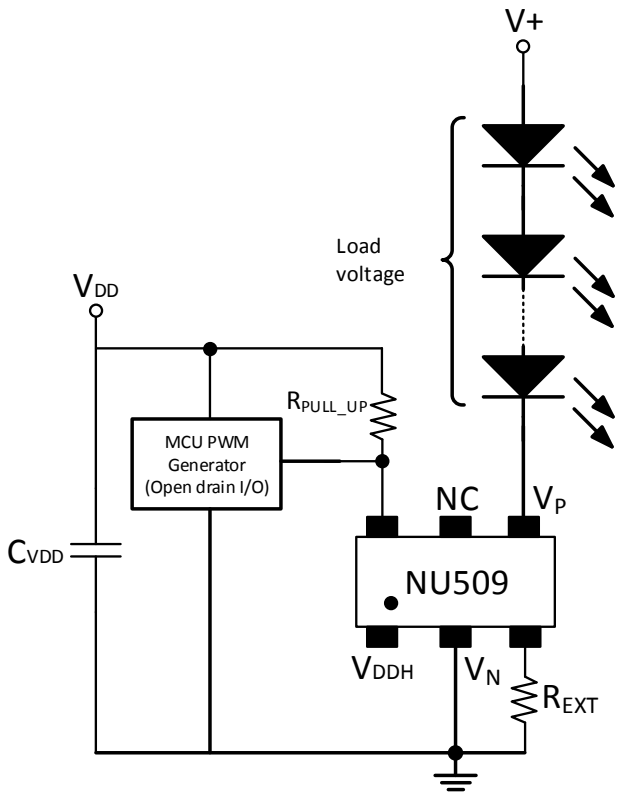
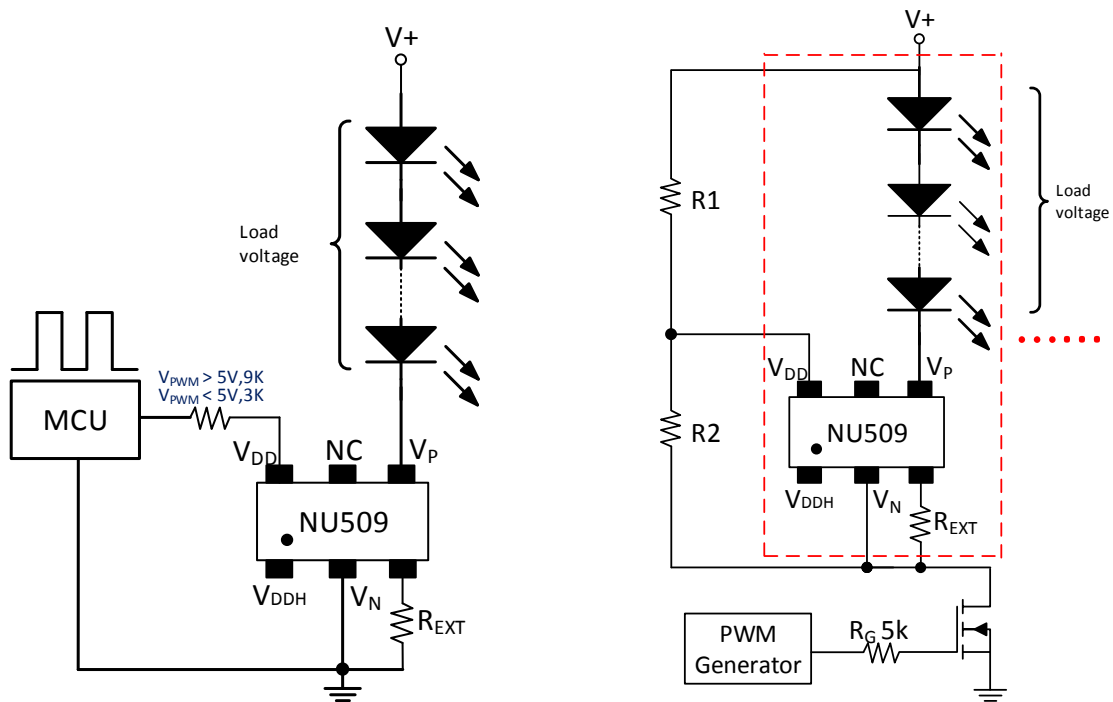
Application Circuits

- DC power general lighting - Low V_{PN} dropout (0.2V~0.8V)



Resistance	R1	R2
12V	36K	-
24V	36K	7K
36V	54K	7K
48V	70K	7K

- DC PWM dimming application



Note 2: The voltage of V_{LED} should follow all the following restrictions:

1. $V_{LED} \leq \frac{P_{D_recmd}}{I_{PN}} + V_{f_all}$
2. $V_{LED} \leq V_{f_all} + 14$
3. $V_{LED} \leq 60V$

※ V_{f_all} is total V_f of all LEDs.

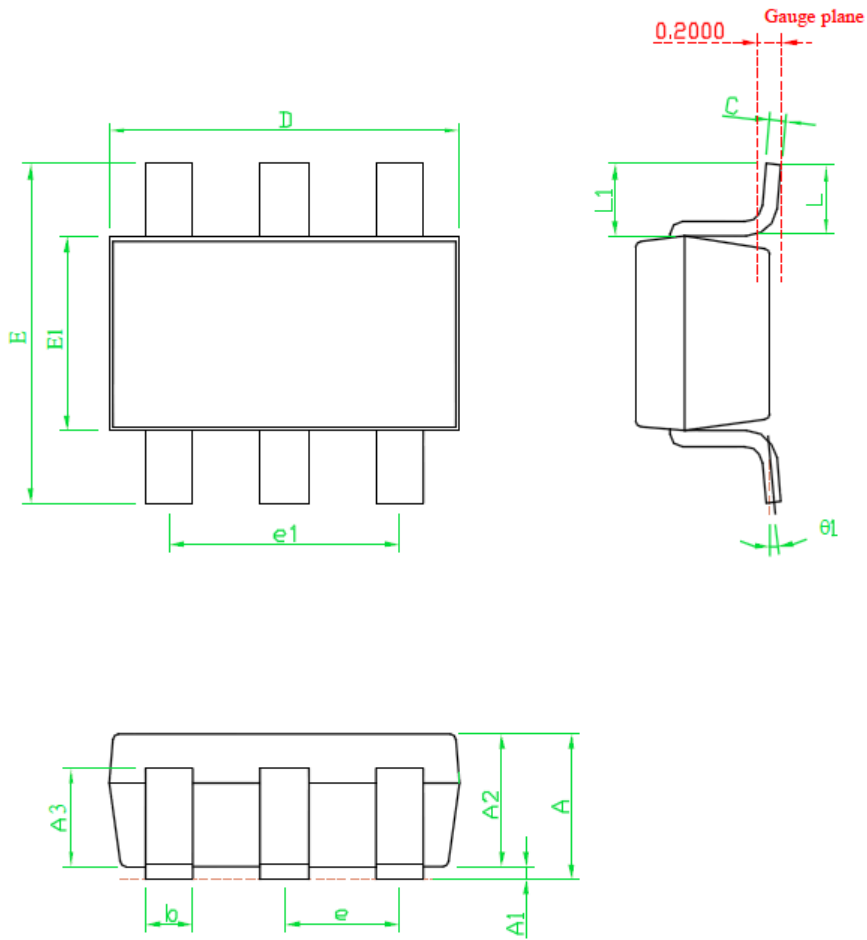
Output Current Setting

The output current of NU509 is set by an external resistor (R_{EXT}). The output current can be figured out by following equation.

$$I_{OPT} \cong \frac{0.157V}{R_{EXT} + 0.19\Omega}$$

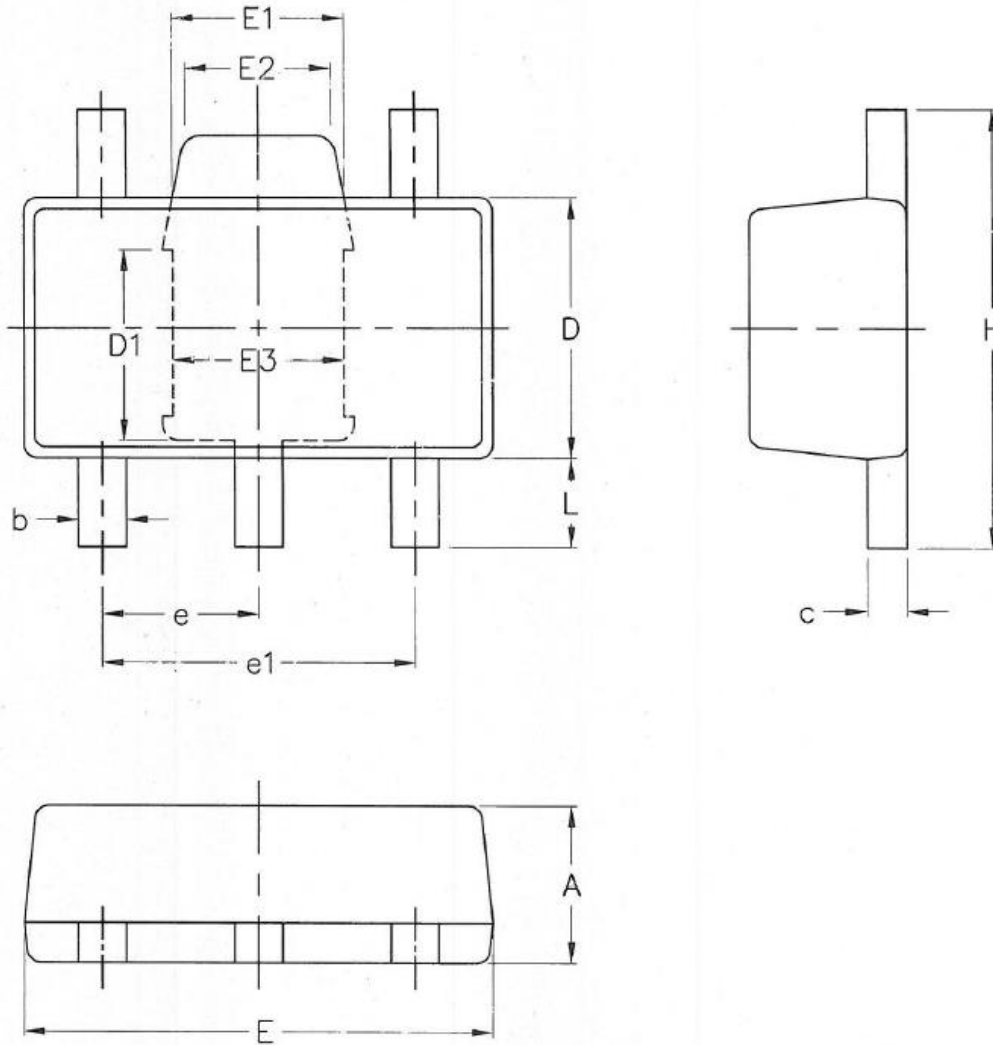
Package Dimensions

- SOT23-6



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
e1	---	1.90(TYP)	---
E	2.60	2.80	3.00
L	0.37	---	---
$\theta1$	1°	5°	9°
e	---	0.95(TYP)	---
L1	0.5	0.6	0.7

- SOT89-5



SYMBOLS	COMMON			
	MM		INCH	
	MIN.	MAX.	MIN.	MAX.
A	1.41	1.59	0.056	0.063
b	0.43	0.54	0.017	0.021
c	0.35	0.44	0.014	0.017
D	2.41	2.59	0.095	0.102
D1	1.83 REF		0.072 REF	
E	4.41	4.59	0.174	0.181
E1	1.65 REF		0.065 REF	
E2	1.40 REF		0.055 REF	
E3	1.64 REF		0.065 REF	
e	1.50 BSC		0.059 BSC	
e1	3.00 BSC		0.118 BSC	
H	4.10	4.25	0.161	0.167
L	0.80	0.93	0.031	0.037

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