360mA Single channel LED Driver

Features

- Up to 360mA single channel constant current regulator
- Current set by an external resistor
- 1.6V ~ 16V wide supply voltage range supports self-power structure in lighting application
- Low dropout voltage (1V/350mA)
- 100kHz OE dimming support
- 10kHz V_{DD} dimming support
- -40℃ ~ 85℃ operating temperature
- Less than ±5% Chip to Chip current skew
- Less than 1%/V load (or line) regulation
- 160°C half power / 115°C recovery thermal protect

Product Description

NU513 is a medium/high power linear current regulation component that can be easily used in various LED lighting applications. It has good load/line regulation characteristic, minimized chip current skew, stable output current in high power or load voltage fluctuating environment. Thus NU513 can be used in large dimension LED lighting source that has good lighting uniformity. NU513 also can be used in the digital PWM controlled circuit to achieve more precise current adjusting in gray level applications.

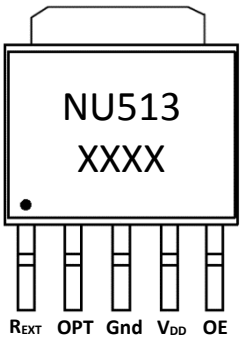
With the feature of wide power supply range design and ultra-low I_{DD} consumption, the NU513 supports the self-powered structure in LED lighting applications. In this structure, the NU513 no need to be provided a dedicate power circuit even the system power voltage is much higher than the maximum operation voltage of NU513. The V_{DD} power can be gotten from the proper position in LED streams of the system.

Applications

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

Package Type

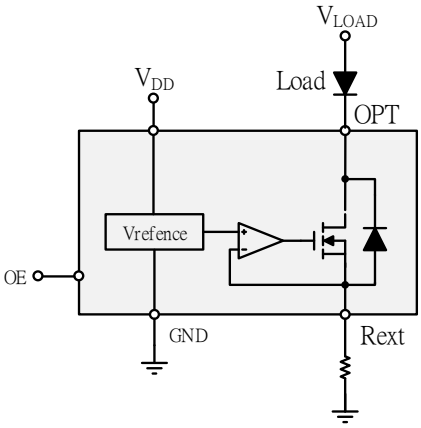
- TO252-5L
  (Part No. : NU513T2)



Terminal Description

Pin name	Function
V_{DD}	Power supply
OPT	Current sink
R_{EXT}	Current setting Resistor
OE	Output enable
GND	Ground

Block Diagram



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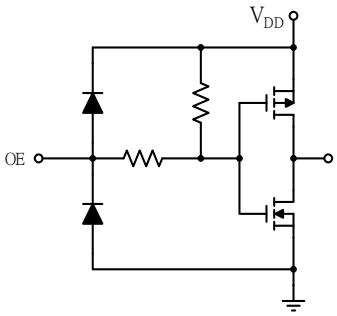
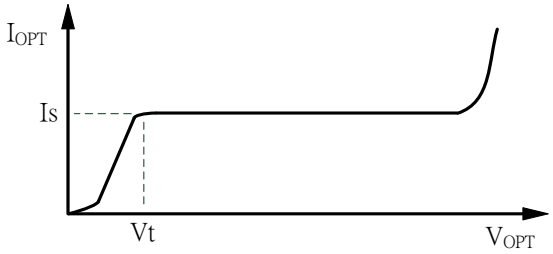
Equivalent Circuits for Inputs



Ideal IV characteristic



Maximum Ratings (T = 25°C)

Characteristic	Symbol	Rating	Unit
Supply voltage	V_{DD}	0 ~ 20	V
Input voltage (Digital I/O)	V_{OE}	-0.2 ~ V_{DD}	V
Output voltage	V_{OPT}	-0.2 ~ 20	V
Output current	I_{PN}	0 ~ 400	mA
Power Dissipation (Ta=25°C)	PD_{MAX}	3.2	W
Thermal Resistance (On PCB, Ta=25°C)	$R_{TH(j-a)}$	42	°C /W
Operating temperature	T_{OPR}	-40 ~ +85	°C
Storage temperature	T_{STG}	-55 ~ +150	°C

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Electrical Characteristics and Recommended Operating Conditions

Characteristic	Symbol	Condition		Min.	Typ.	Max.	Unit
Supply voltage	V_{DD}	Room Temp. V_{OPT} = 1V		1.5	1.6	16	V
Output voltage	V_{OPT}	PD ≤ PD_{RMP}		-	-	17	V
Supply current	I_{DD}	V_{DD} ≤ 13V		40	80	150	uA
		V_{DD} ≤ 16V		-	-	2	mA
Minimum dropout voltage	V_{OPT}	V_{DD} ≥ 4.5V	I_S ≤ 20mA	-	0.15	0.2	V
			I_S ≤ 100mA	0.35	0.4	0.45	
			I_S ≤ 200mA	0.55	0.6	0.65	
			I_S ≤ 360mA	-	1	1.1	
Output current	I_{OPT}	PD ≤ PD_{RMP}		-	-	360	mA
Recommended Maximum Operating Power Dissipation	PD_{RMP}	(Ta=25˚C)		-	-	1.8	W
Leakage	$I_{Leakage}$	V_{OPT} = 10V	1.5V ≤ V_{DD} ≤ 16V OE = 0V	-	-	0.5	uA
			V_{DD} ≤ 0.2V				
Line regulation	%/V_{DD}	13V > V_{DD} > 1.6V		-	-	±1	%/V
Load regulation	%/V_P	8V>V_{OPT}>0.4V		-	-	±1	%/V
Thermal regulation	%/10℃	V_{DD} = V_P = 3V		-	-	±0.5	%/10℃
Input voltage	V_{IH}	V_{DD} ≥ 5V		3.2	-	-	V
		V_{DD} < 5V		0.7*V_{DD}	-	-	V
	V_{IL}	V_{DD} ≥ 5V		-	-	2	V
		V_{DD} < 5V		-	-	0.3*V_{DD}	V
Half power temperature	T_{half}	$I_{OPT} \cong \frac{I_{NORMAL}}{2}$		-	160	-	℃
Half power recovery temperature	T_{recov}	I_{OPT} recover to I_{NORMAL}		-	115	-	
Chip current skew	I_{Skew}	V_{DD} = V_P = 3V		-	3	5	%

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_{OPT}=1V, I_{OPT}=120mA, OE= 0V → 4V	140	200	260	nS
Output current rising time (OE from “L” to “H”)	t_{OERise}	V_{DD}=4V, V_{OPT} =1V, I_{OPT} =120mA, OE= 0V → 4V	30	40	60	nS
Propagation Delay Time (OE from “H” to “L”)	t_{pHL}	V_{DD}=4V, V_{OPT} =1V, I_{OPT} =120mA, OE= 4V → 0V	260	320	380	nS
Output current falling time (OE from “H” to “L”)	t_{OEFall}	V_{DD}=4V, V_{OPT} =1V, I_{OPT} =120mA, OE= 4V → 0V	30	50	80	nS

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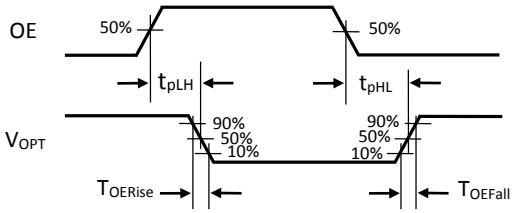
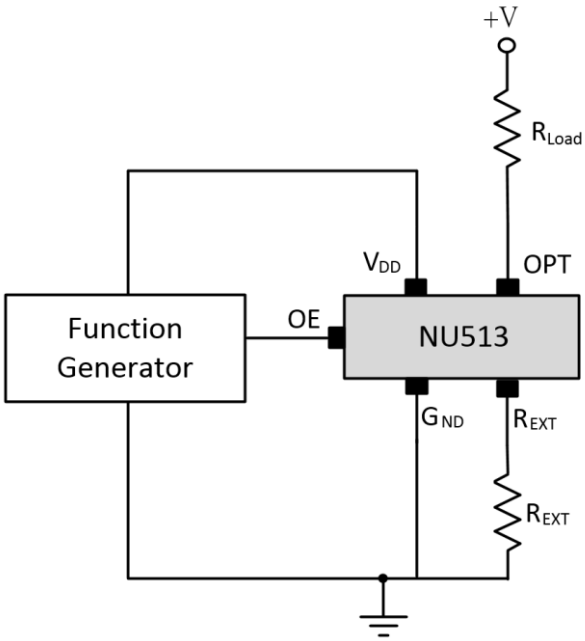
Timing Waveform



OE timing diagram

Test Circuit



Output Current Setting

The output current of NU513 is set by an external resistor (R_{EXT}). The output current can be figured out by following equation.

$$Iout \cong \frac{0.195V}{R_{EXT} + 0.2\Omega}$$

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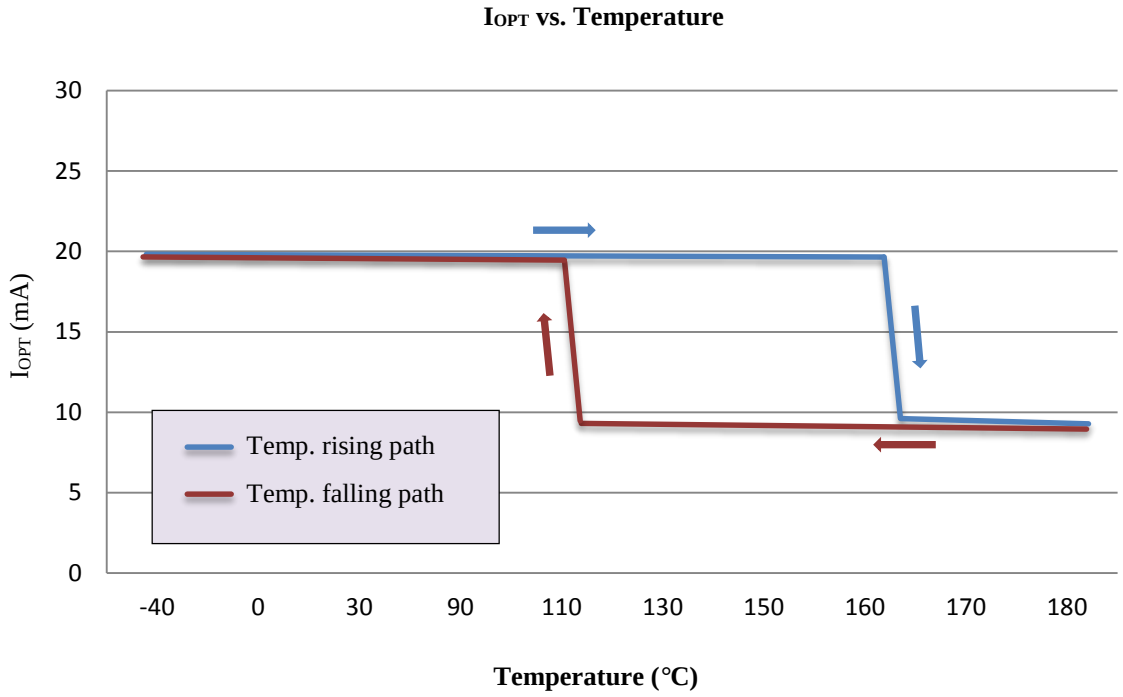
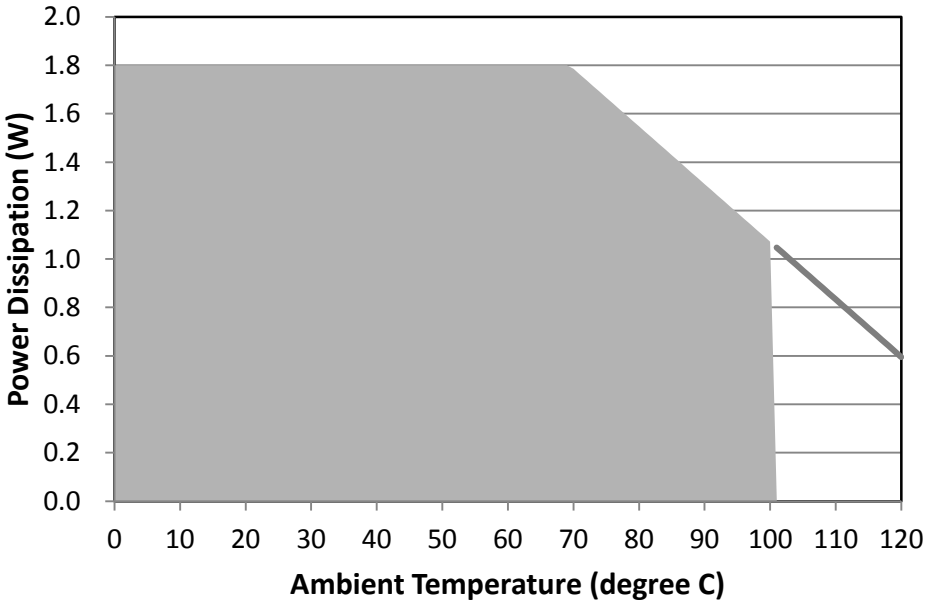
Thermal protection

When NU513 is working normally and junction temperature is more than half power temperature (~160˚C), the output current of NU513 will decrease about 50% to lower down the power dissipation on chip. This lower power state will be recovered when the junction temperature is lower than recovery temperature (~115˚C).



Power Dissipation and Recommended I_{OPT} - V_{OPT} Table



Iopt (A)	Max. Vopt (V) recommended
0.12	15
0.2	9
0.3	6
0.4	4.5

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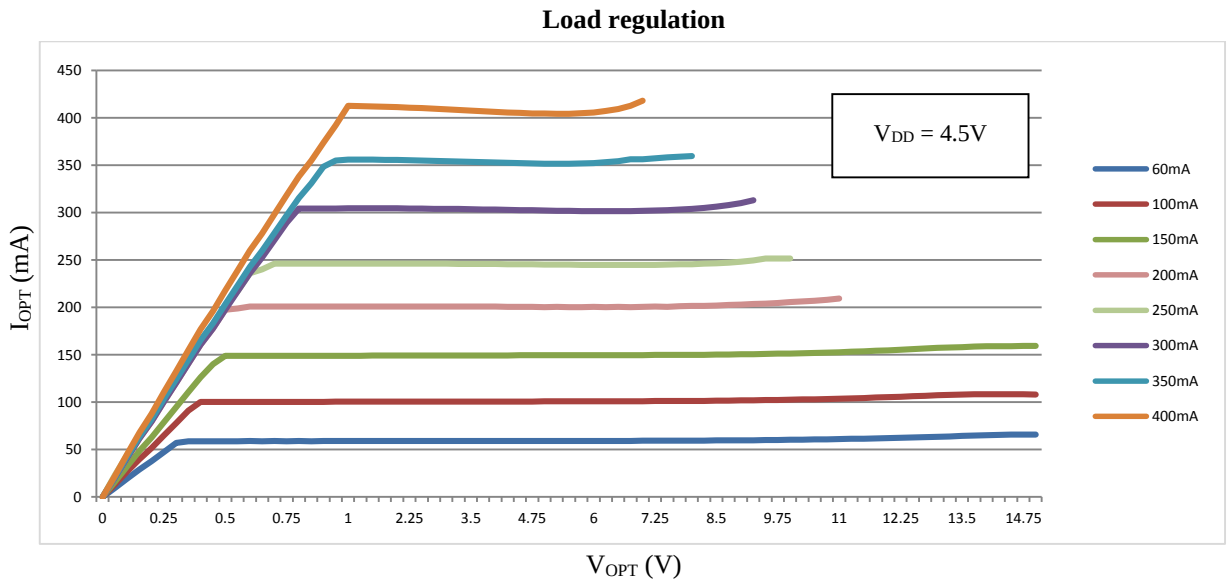
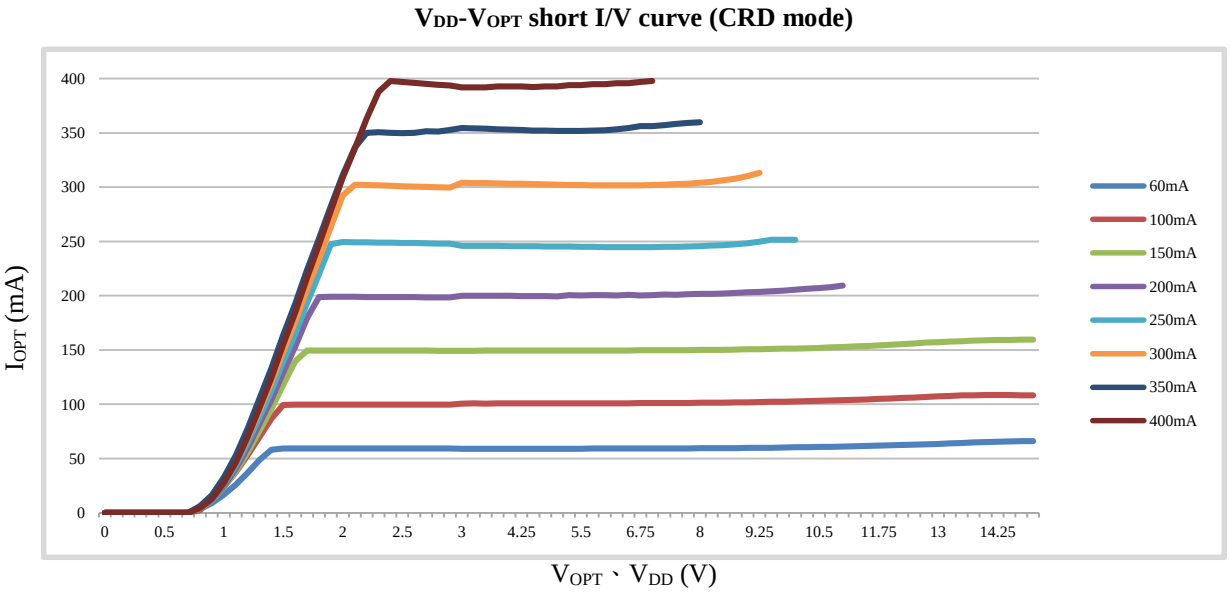
Output I/V Curve





Minimum dropout voltage

IOPT(mA) / Condition	60mA	100mA	150mA	200mA	250mA	300mA	350mA	400mA
VDD=4.5V VOPT	0.35V	0.4V	0.5V	0.6V	0.7V	0.8V	0.95V	1.05V
VDD=VOPT	1.45V	1.5V	1.65V	1.8V	1.95V	2.05V	2.2V	2.35V

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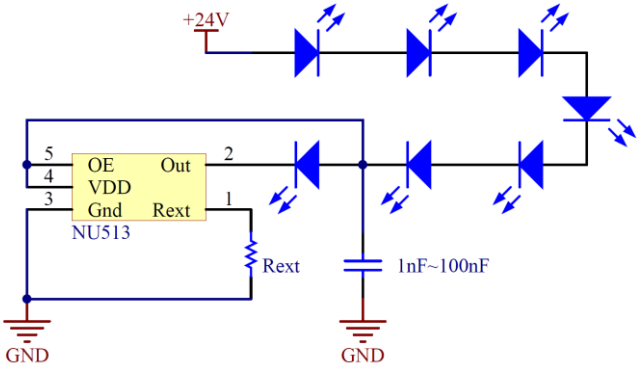
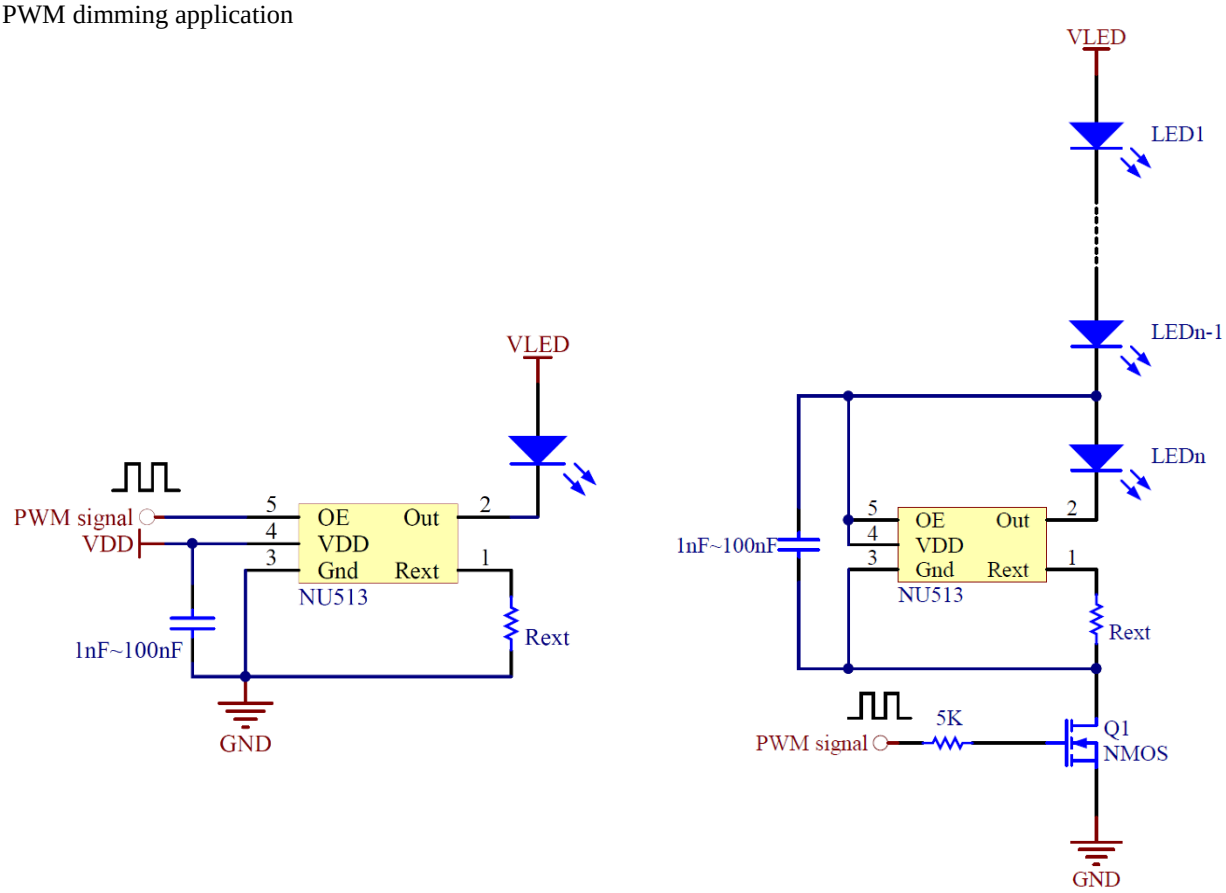
Typical Application Circuit

- 24V General lighting



- PWM dimming application



Note: Generally, The capacitance of V_{DD} capacitor when self-power structure is used is about the same as LED typical current. For example, if the typical current of LED is 100mA, the capacitance is about 100nF. The capacitance can be adjusted according to the requirement of real applications.

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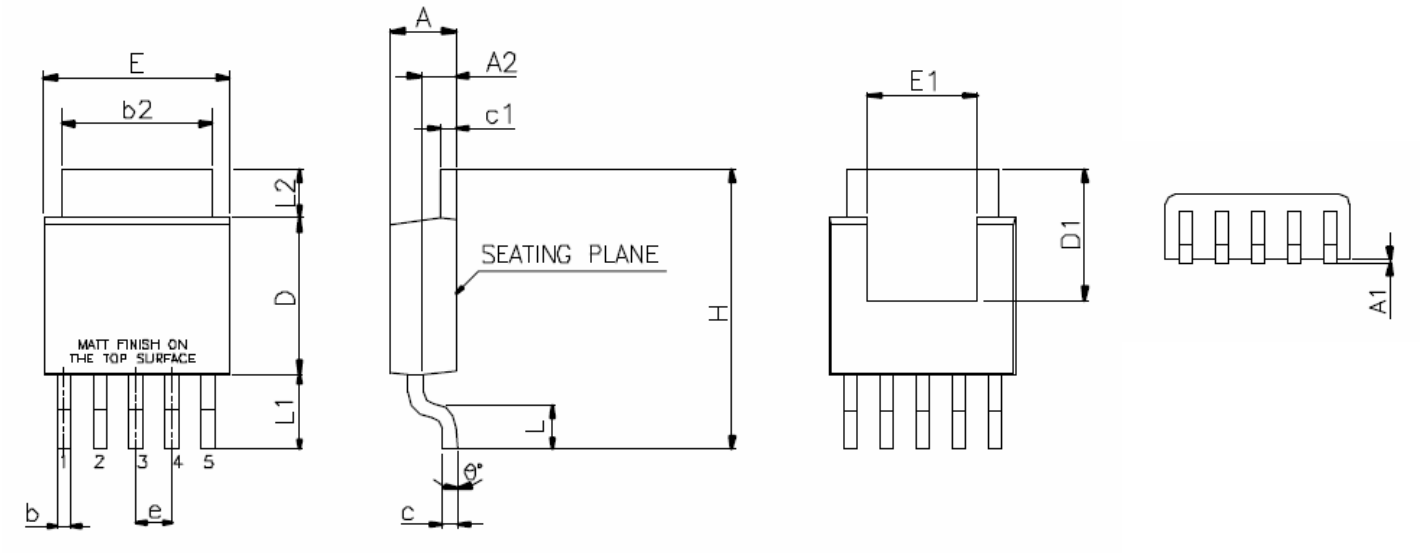
Package Dimensions



SYMBOLS	DIMENSIONS IN INCH		DIMENSIONS IN MILLIMETER	
	MIN.	MAX.	MIN.	MAX.
A	0.086	0.094	2.18	2.39
A1	0.000	0.005	0.00	0.13
A2	0.040	0.050	1.02	1.27
b	0.020 TYP.		0.51 TYP.	
b2	0.205	0.215	5.21	5.46
c	0.018	0.023	0.46	0.58
c1	0.018	0.023	0.46	0.58
D	0.210	0.220	5.33	5.59
D1	0.180	—	4.57	—
E	0.250	0.265	6.35	6.73
E1	0.150	—	3.81	—
e	0.050 BSC.		1.27 BSC.	
H	0.370	0.410	9.40	10.41
L	0.055	0.070	1.40	1.78
L1	0.105 REF.		2.67 REF.	
L2	0.06	0.08	1.52	2.03
θ	0°	4°	0°	4°

NOTES:
1. JEDEC OUTLINE : N/A

Taping Specification

Part No.	PACKAGE	Q'TY/REEL
NU513T2	TO252-5	3,000 ea

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