Ultra Low-Dropout, Constant-Current White LED Bias

■ General Description

The LN5920 is a high performance ultra low- dropout constant current bias supply for white LEDs. It can be used as an alternative to the simple ballast resistors in conventional parallel white LEDs applications. For dimming control, an enable input pin is controlled by processor GPIO output pulses for 32 level linear current. Using a low frequency PWM waveform to this enable input pin also controls the average LED current which is proportional to the PWM duty.

The LN5920 is suitable for single cell Li-ion battery power device that using low forward voltage white LEDs. The white LEDs can be powered directly from battery without extra external components. This takes an advantage of highest efficiency and creates no EMI problem.

■ Applications

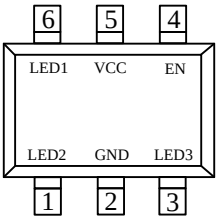
- Mobile Phones
- White LED backlighting
- Camera Flash LED Lighting

■ Features

- Ultra Low 200mV Dropout at 20mA
- 0.6% High Accuracy Current Matching
- 20mA Full Scale Current
- 32 Level Linear Current Brightness Control
- PWM Brightness Control
- 2.5V to 5.5V Supply Voltage Range
- Thermal shutdown function
- Under-voltage protection function

■ Package

- SOT-23-6L



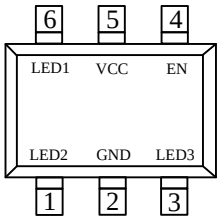
SOT-23-6L
(Top View)

■ Ordering Information

LN5920 ①②③④⑤⑥⑦ **(Eg:** LN5920A32DSR**)**

Item	Symbol	Function
①	0	Type: LN5920
②	A	EN active high
	B	EN active low
③ ④	32	32 Level Linear Current Brightness Control
	16	16 Level Linear Current Brightness Control
	06	32 Level Linear Current Brightness Control
	00	No linear brightness Control function
⑤	C	NO level brightness cycle
	D	Brightness not circulation, maintain minimum brightness after out of range
⑥	S	Denotes Package Type: SOT-23-6L
⑦	R	Embossed Tape :Standard Feed
	L	Embossed Tape :Reverse Feed

■ Functional Pin Description

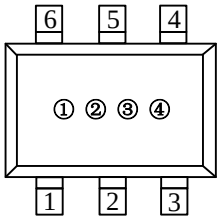


SOT-23-6L
(Top View)

Pin Number	Pin Name	Function
1	LED2	LED2 bias current input.
2	GND	Ground.
3	LED3	LED3 bias current input.
4	EN	Enable Dimming control.
5	VCC	Power supply.
6	LED1	LED1 bias current input.

■ Marking Rule

- **SOT-23-6L**

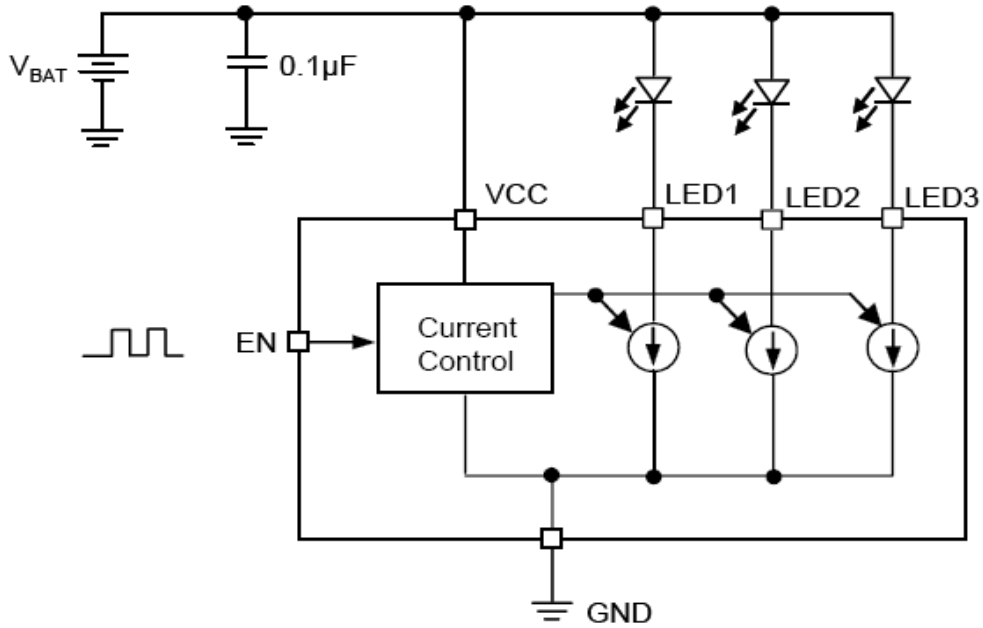


SOT-23-6L
(Top View)

Marking	Representative Meanings	Common Character	
①	Product Series	5	LN5920 series
②	EN	A	EN active high
		B	EN active low
③	Product Features	C	32 Level , Brightness not cycle
		D	16 Level , Brightness not cycle
		E	6 Level , Brightness not cycle
		N	NO level brightness cycle
		H	32 Level Brightness cycle
		K	16 Level Brightness cycle
		L	6 Level Brightness cycle
④	Product Batch	0～9,A～Z except (G，I，J，O，Q，W)	Production batch According to the need to write or repetition

(**Eg**: 5AC9, Other forms of marking information, please call our marketing department)

■ Function Block Diagram



■ Absolute Maximum Ratings

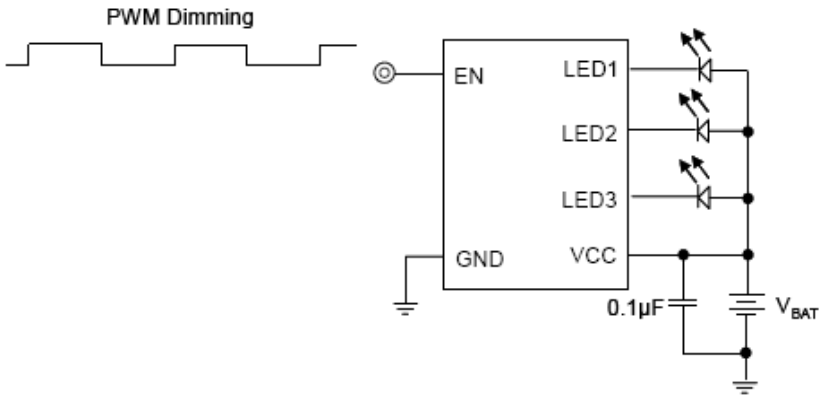
(Ta=25°C)

Item	Symbol		Absolute maximum ratings	Unit
VCC to GND	V_{CC}		GND-0.3～GND+7	V
EN to GND	V_{EN}		GND-0.3～V_{CC}+0.3	V
LED1,LED2,LED3 to GND	V_{LED}		GND-0.3～GND+0.3	V
Power Dissipation	P_D	SOT-23-6	250	mW
Operating Temperature range	Topr		-40～＋85	℃
Junction Temperature	Tjun		125	
Storage Temperature range	Tstg		-65～＋150	
Reflow Temperature (soldering, 10sec)	Tref		260	

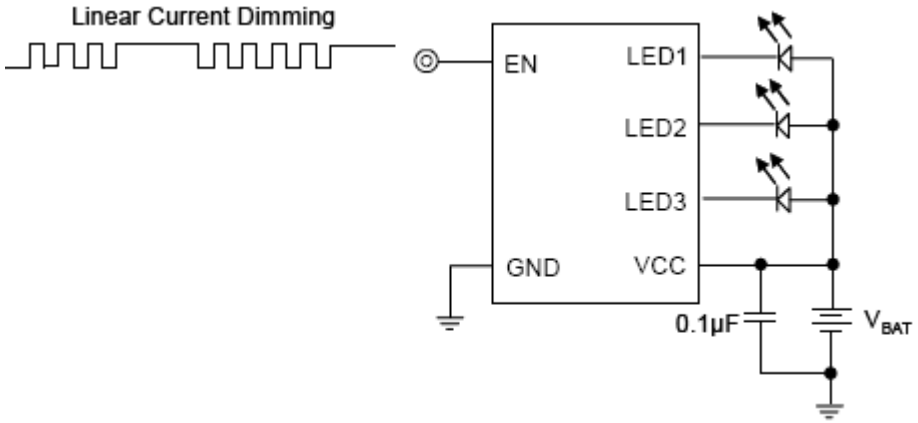
Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

■ Typical Application Circuit

- **PWM brightness mode:**



- **32 linear current brightness adjustment mode:**



■ Function Description

LN5920 LED pins act as well matched current source driving LED diode to ground. An EN pin is used to turn on and turn off LN5920.When applying a lower frequency (less than 2kHz) PWM waveform to EN pin, the average LED current will be duty*20mA(typical). Refer to Fig.1

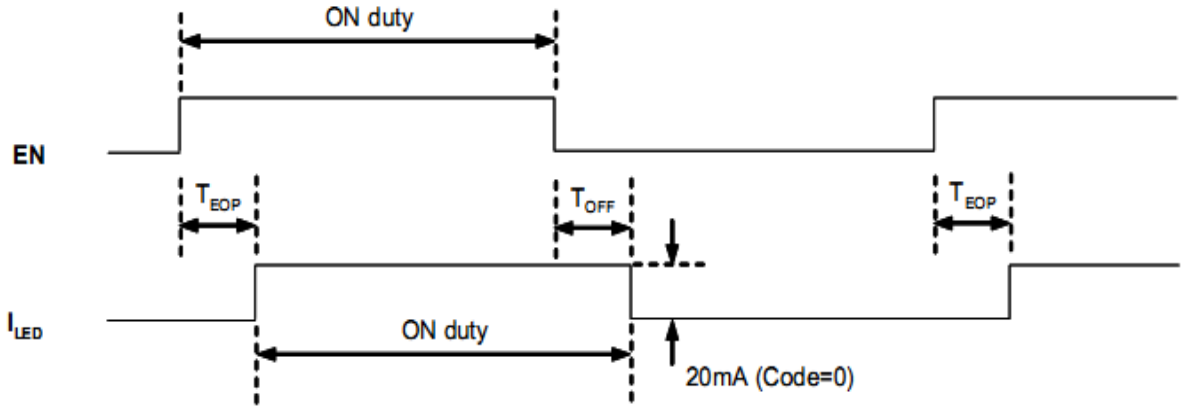


Fig1. Turn On To PWM Dimming

If the application is not suitable to apply such a low frequency PWM dimming waveform, this EN pin can be negatively pulsed to set continuous LED current. When no negative pulse is input to EN pin (Code=0), the internal register will latched to set the maximum LED current, typically 20mA. Whenever input N negative pulses to the EN pin, it will get a LED current corresponding to Code N. In this manner, LED current will changed from previous value to new value after the last pulse for typical 80μs (TEOP). Please refer to Fig.2

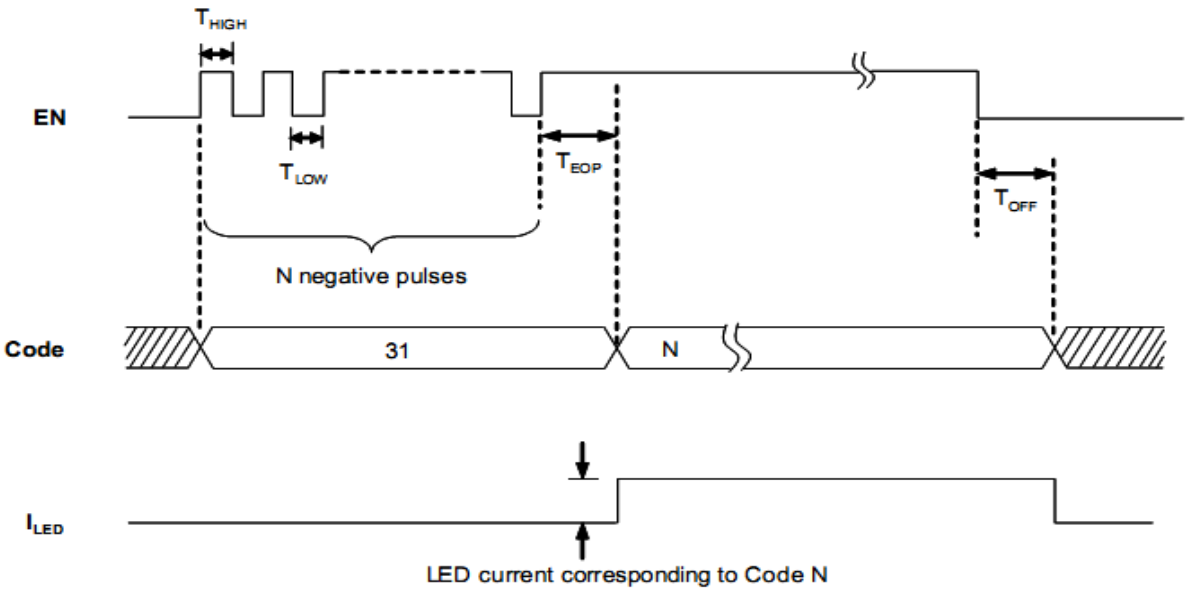


Fig2. Turn On And Config Code N

■ Electrical Characteristics

VIN= 3.6V，EN=3.6v (Ta=25℃, unless otherwise noted)

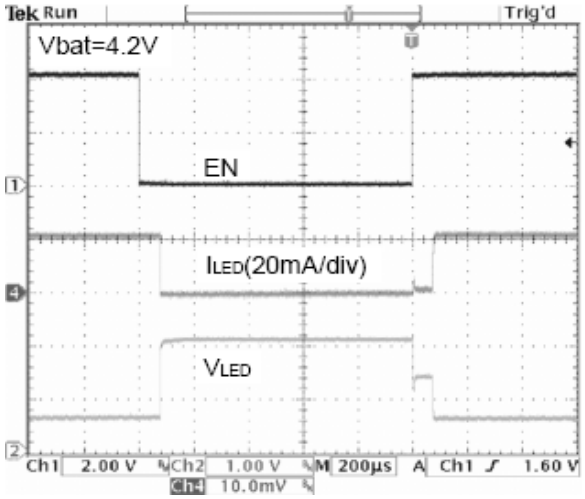
Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Input Supply Voltage	V_{IN}		2.5		5.5	V
Under voltage Lockout Threshold	V_{UVLO}		-	1.8	-	V
Current into LED 1,2,3 and 4	I_{LED}	MAX I_{LED}	18	20	22	mA
Shutdown Current	I_{SHDN}	V_{IN}=5V, EN=0V	-1	-	+1	uA
Quiescent Current	I_Q			180	230	μA
LED Pin Voltage Dropout	$V_{LED-DROP}$	V_{LED}(DROP), 90% Max I_{LED}		150	200	mV
Output Current Line Regulation	$I_{LED-LINEAR}$	V_{LED} = 0.5V~2V	-0.6	-	+0.6	%/V
Current Matching	$I_{LED-LED-ERR}$	2mA<I_{LED}<30mA	-4	-	+4	%
Thermal Shutdown Threshold				150		℃
EN Pin Input Voltage High	V_{IH}		2	-	-	V
EN Pin Input Voltage Low	V_{IL}		-	-	0.8	V
EN Pin Input Current	I_{EN}		-1	-	+1	uA
EN Pin Off Timeout	T_{OFF}		40	80	200	uS
EN Pin End of Pulse Timeout	T_{EOP}		40	80	200	uS
EN Pin Pulse High Time	T_{HIGH}		5	-	30	uS
EN Pin Pulse Low Time	T_{LOW}		5	-	30	uS

(*1) Vfbt may take between 0.01V-1.49V certain value, now a major center value 0.01V, 0.2V,0.23V,0.25V

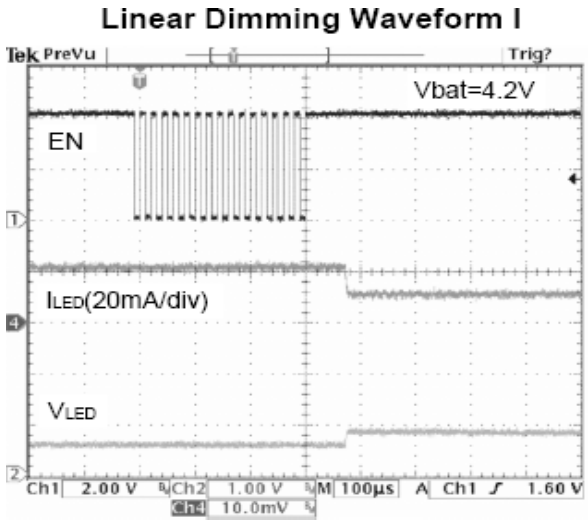
■ Typical Performance Characteristics

(VCC =VEN =3.6V, VLED=0.5V, T=25°C, unless otherwise noted.)

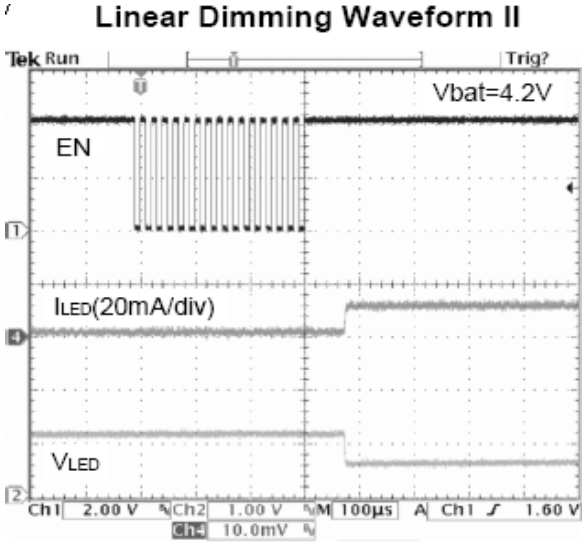
PWM Diming Waveform



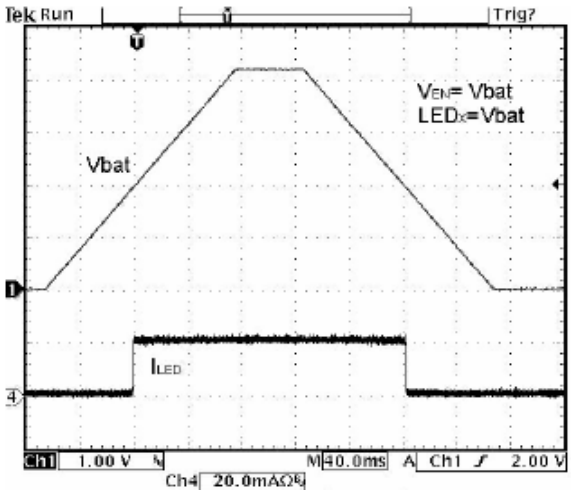
Linear Dimming Waveform I



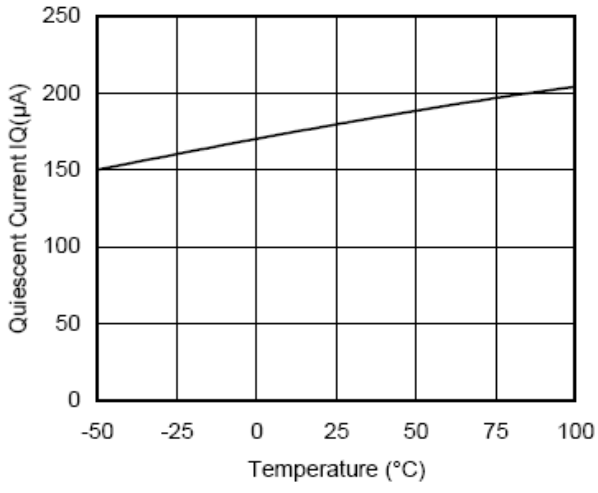
Linear Dimming Waveform II



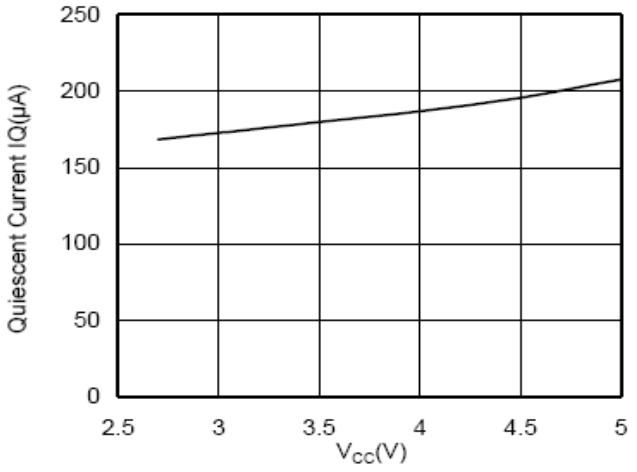
Input Voltage UVLO

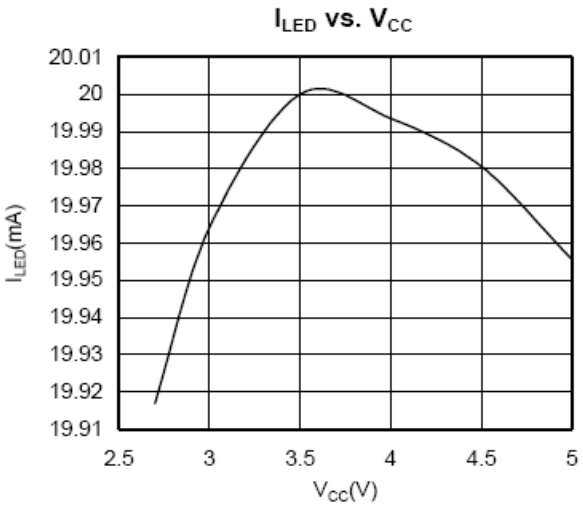


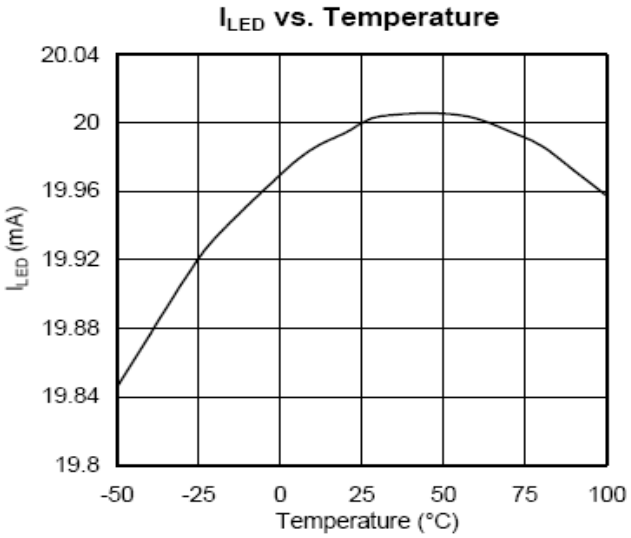
Quiescent Current vs. Temperature

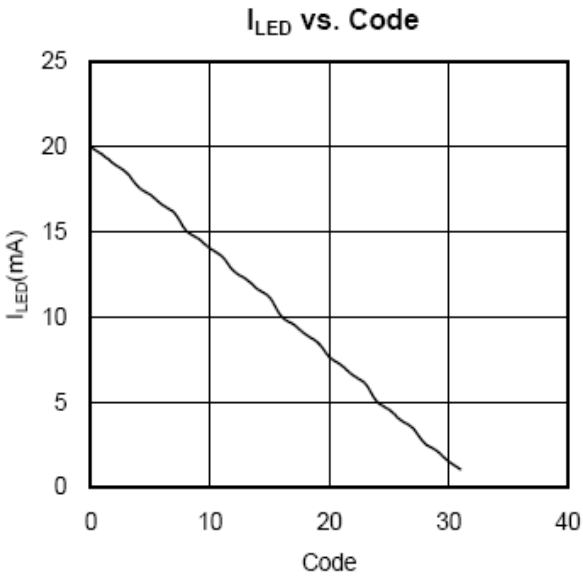


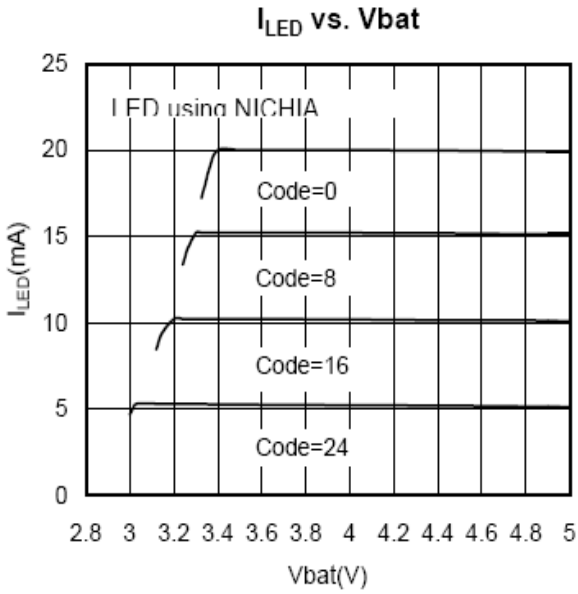
Quiescent Current vs. V_{CC}




I_{LED} vs. V_{CC}
20.01
20
19.99
19.98
19.97
19.96
19.95
19.94
19.93
19.92
19.91
I_{LED}(mA)
2.5
3
3.5
4
4.5
5
V_{CC}(V)

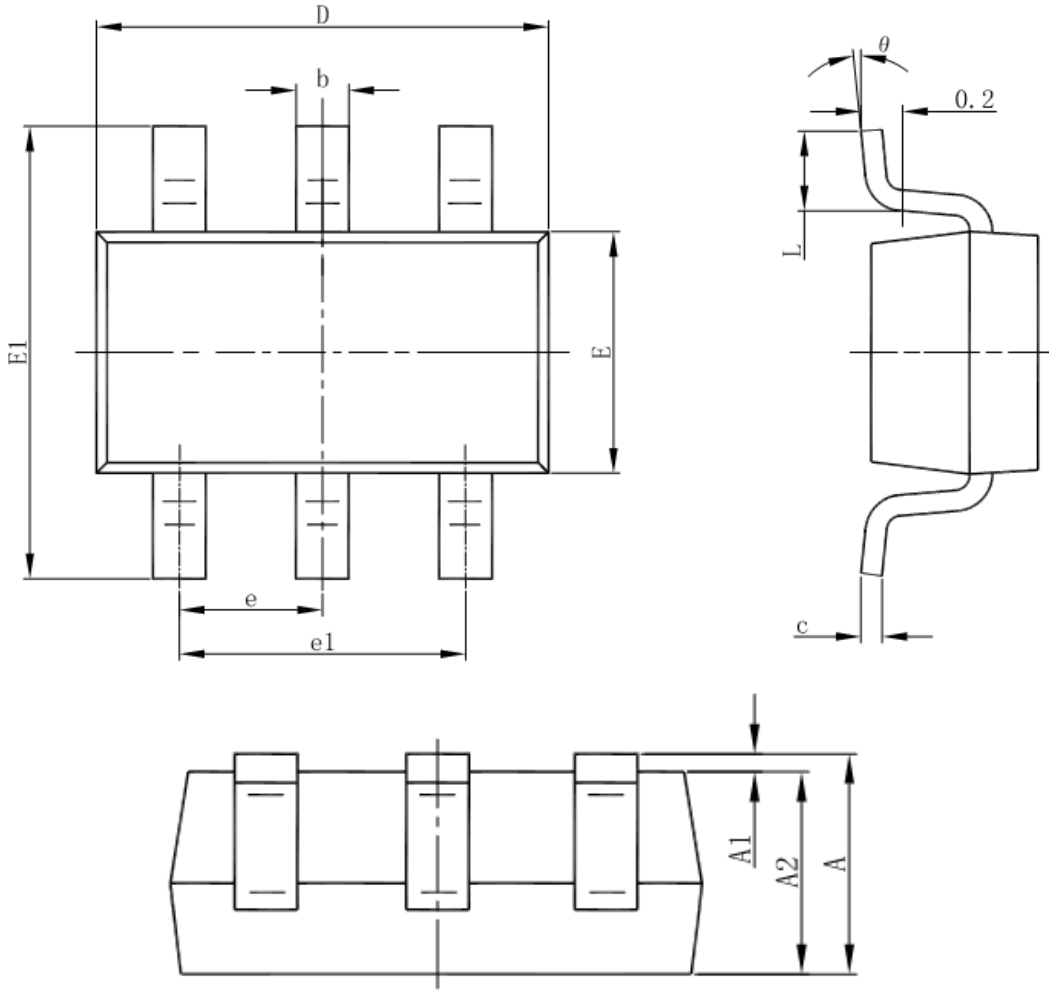

I_{LED} vs. Temperature
20.04
20
19.96
19.92
19.88
19.84
19.8
I_{LED} (mA)
-50
-25
0
25
50
75
100
Temperature (°C)


I_{LED} vs. Code
25
20
15
10
5
0
I_{LED}(mA)
0
10
20
30
40
Code


I_{LED} vs. Vbat
LED using NICHIA
Code=0
Code=8
Code=16
Code=24
25
20
15
10
5
0
I_{LED}(mA)
2.8
3
3.2
3.4
3.6
3.8
4
4.2
4.4
4.6
4.8
5
Vbat(V)

■ Package Information

- **SOT-23-6L**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°