

## Ultra Low-Dropout, Constant-Current White LED Bias

### Features

- Ultra Low 150mV 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
- SOT-23-6 Package (G5920)
- MSOP-8 Package (G5921)

### Applications

- Mobile Phones
- White LED backlighting

### General Description

The G5920/G5921 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. Each white LED bias current is matching to 0.6%.

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.

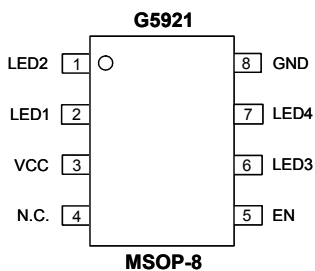
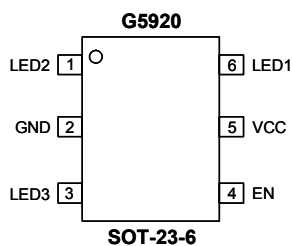
The G5920/G5921 is suitable for single cell Li-ion battery power device that using low forward voltage white LEDs. The white LEDs can be powered directly from battery without extra external components. This takes an advantage of highest efficiency and creates no EMI problem.

### Ordering Information

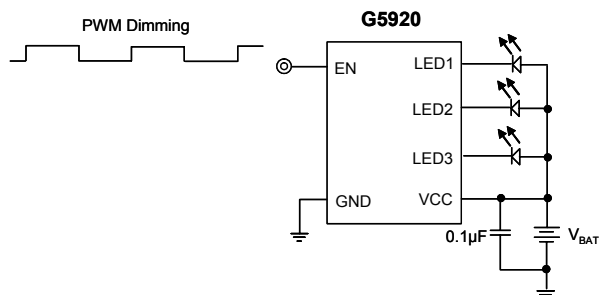
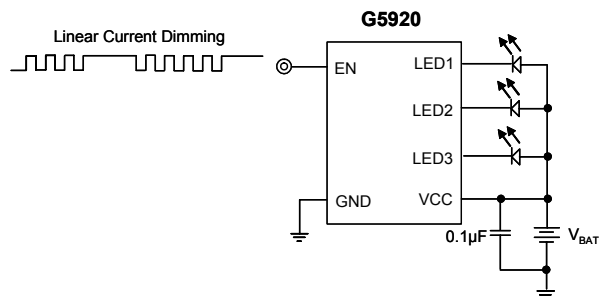
| ORDER NUMBER | ORDER NUMBER (Pb free) | MARKING | TEMP. RANGE   | PACKAGE  |
|--------------|------------------------|---------|---------------|----------|
| G5920TB1U    | G5920TB1Uf             | 5920x   | -40°C to 85°C | SOT-23-6 |
| G5921P8U     | G5921P8Uf              | 5921x   | -40°C to 85°C | MSOP-8   |

Note:TB : SOT23-6  
P8: MSOP-8  
U: Tape & Reel

### Pin Configuration



### Typical Application Circuit



**Absolute Maximum Ratings**

VCC to GND.....-0.3V to +7.0V  
 EN, LED1, LED2, LED3 to GND.....-0.3V to VCC+0.3V  
 Operating Temperature Range.....-40 to 85°C

Junction Temperature.....125°C  
 Storage Temperature.....-65°C to 150°C  
 Reflow Temperature (soldering, 10sec).....260°C

Stress beyond those listed under "Absolute Maximum Rating" may cause permanent damage to the device.

**Electrical Characteristics**

$V_{CC} = V_{EN} = 3.6V$ ,  $T_A = 25^\circ C$

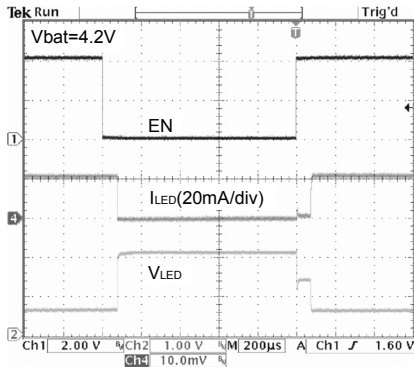
| PARAMETER                      | CONDITION                           | MIN  | TYP       | MAX  | UNIT    |
|--------------------------------|-------------------------------------|------|-----------|------|---------|
| Input Voltage Range            | $V_{CC}$                            | 2.5  | ---       | 5.5  | V       |
| Quiescent Current              | $I_Q$                               | ---  | 180       | 230  | $\mu A$ |
| Shutdown Current               | $I_{Q(OFF)}$ , $V_{EN} = 0V$        | -1   | ---       | +1   | $\mu A$ |
| Input Voltage UVLO Threshold   | $V_{UVLO}$                          | ---  | 2         | ---  | V       |
| Output Current                 | Max $I_{LED}$                       | 18   | 20        | 22   | mA      |
| Output Current Line Regulation | $V_{LED} = 0.5V \sim 2V$            | -0.5 | ---       | +0.5 | %/V     |
| Current Matching               | $V_{LED} = 0.5V$                    | -4   | $\pm 0.6$ | +4   | %       |
| LED Pin Voltage Dropout        | $V_{LED(DROP)}$ , 90% Max $I_{LED}$ | ---  | ---       | 0.15 | V       |
| 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   | $\mu A$ |
| EN Pin Off Timeout             | $T_{OFF}$                           | 40   | 80        | 200  | $\mu S$ |
| EN Pin End of Pulse Timeout    | $T_{EOP}$                           | 40   | 80        | 200  | $\mu S$ |
| EN Pin Pulse High Time         | $T_{HIGH}$                          | 5    | ---       | 30   | $\mu S$ |
| EN Pin Pulse Low Time          | $T_{LOW}$                           | 5    | ---       | 30   | $\mu S$ |



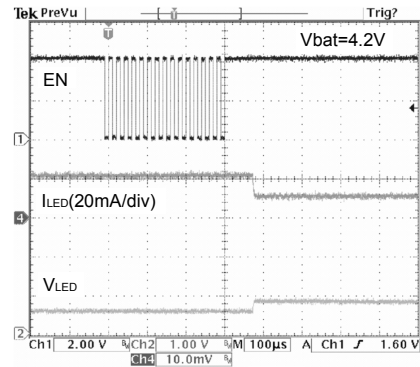
Typical Performance Characteristics

$V_{CC} = V_{EN} = 3.6V$ ,  $V_{LED} = 0.5V$ ,  $T = 25^{\circ}C$ , unless otherwise noted.

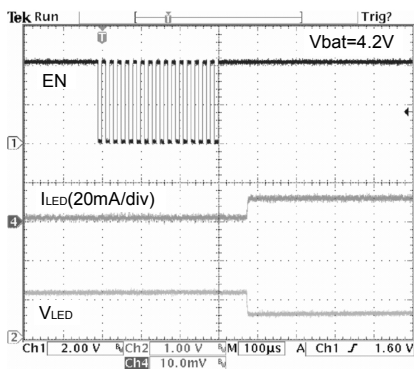
PWM Dimming Waveform



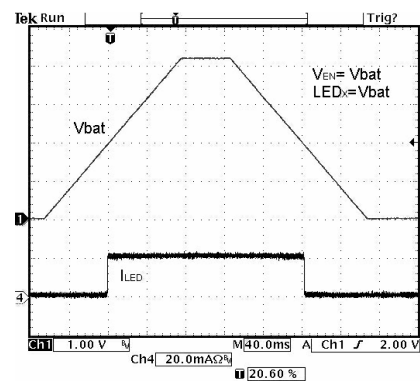
Linear Dimming Waveform I



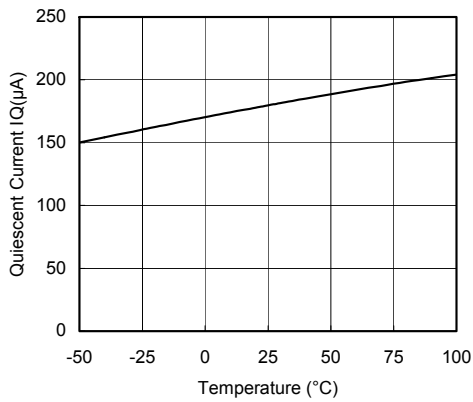
Linear Dimming Waveform II



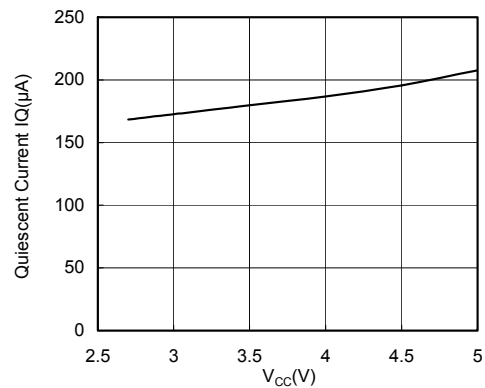
Input Voltage UVLO



Quiescent Current vs. Temperature

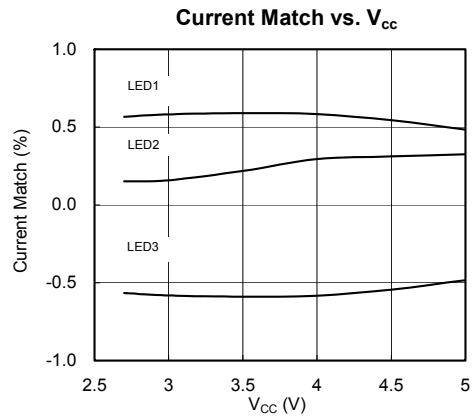
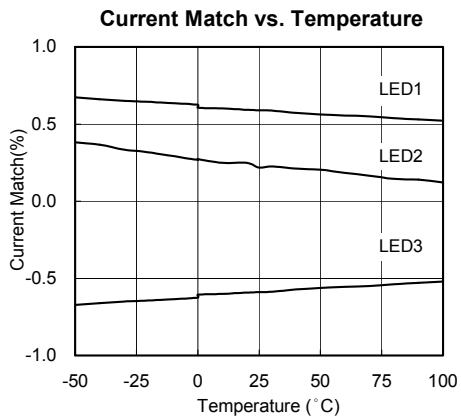
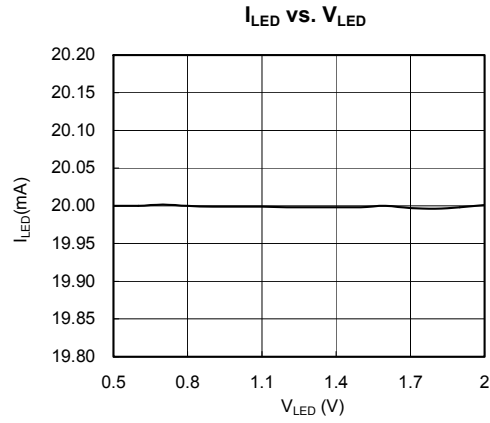
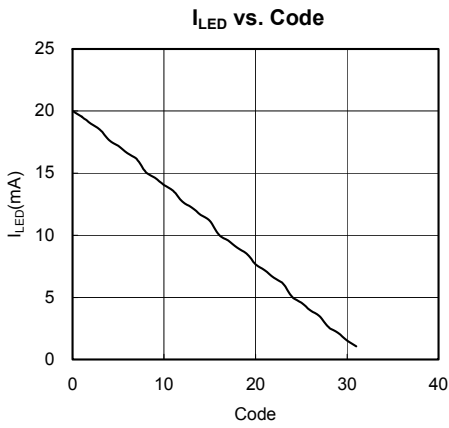
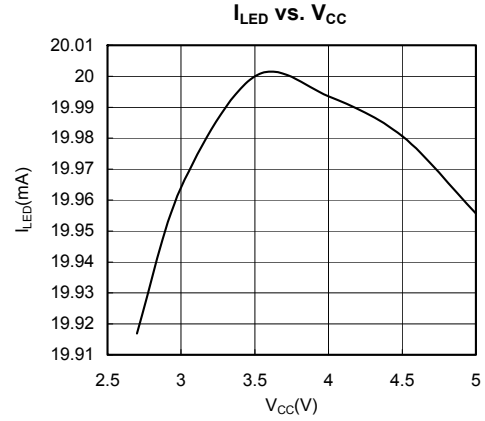
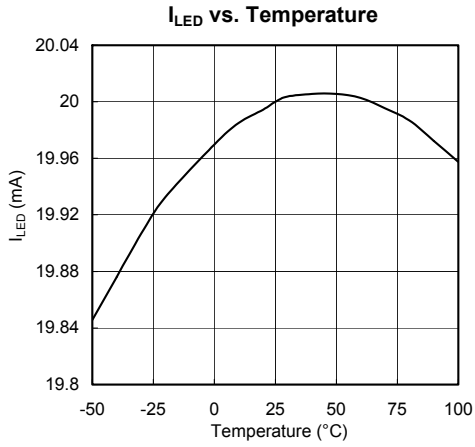


Quiescent Current vs. VCC



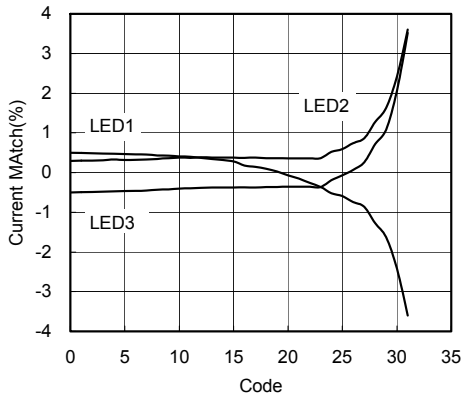


Typical Performance Characteristics (continued)

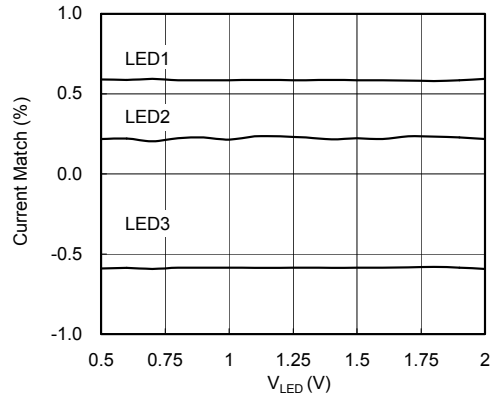


Typical Performance Characteristics (continued)

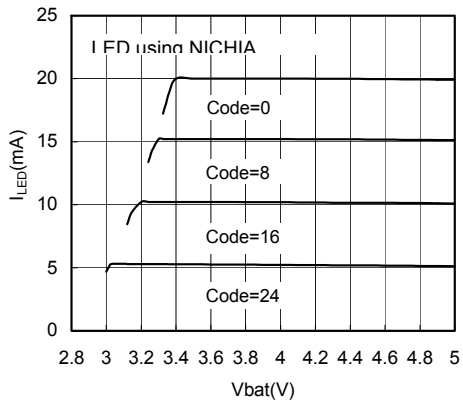
Current Match vs. Code



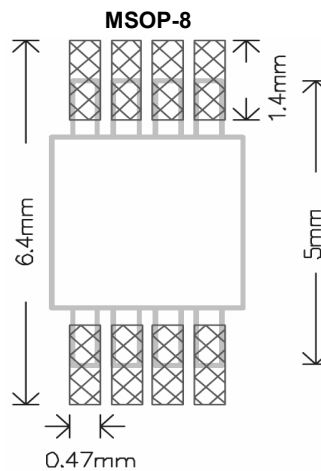
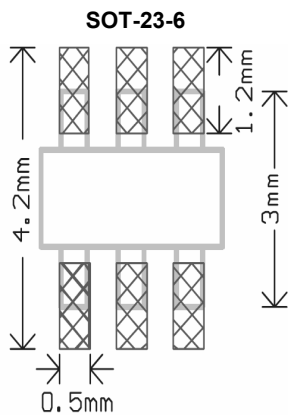
Current Match vs.  $V_{LED}$



$I_{LED}$  vs.  $V_{bat}$



Recommend Minimum Footprint

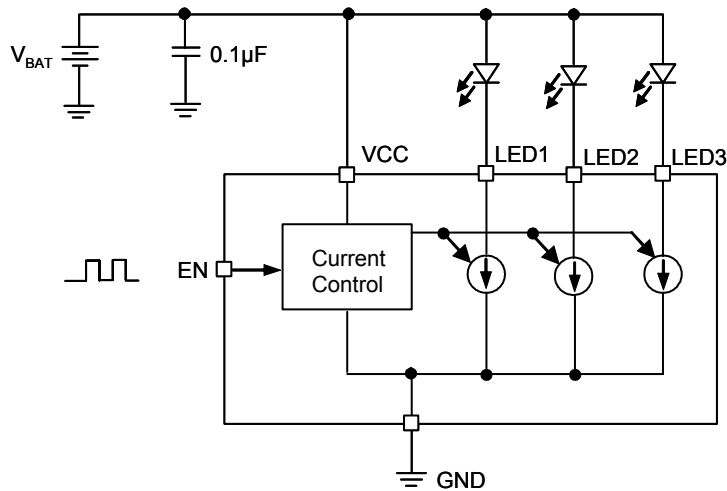




Pin Descriptions

| PIN      |        | NAME | FUNCTION                 |
|----------|--------|------|--------------------------|
| G5920    | G5921  |      |                          |
| SOT-23-6 | MSOP-8 |      |                          |
| 1        | 1      | LED2 | LED2 bias current input. |
| 2        | 8      | GND  | Ground.                  |
| 3        | 6      | LED3 | LED3 bias current input. |
| 4        | 5      | EN   | Enable Dimming control.  |
| 5        | 3      | VCC  | Power supply.            |
| 6        | 2      | LED1 | LED1 bias current input. |
|          | 7      | LED4 | LED4 bias current input. |
|          | 4      | N.C. | Not Connected.           |

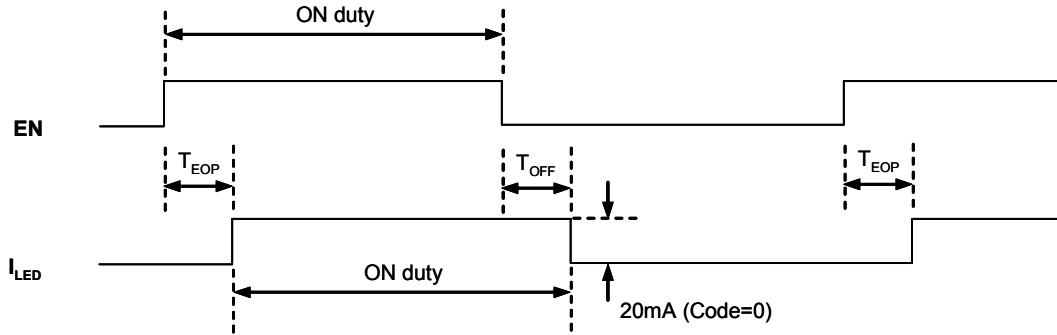
Block Diagram



**Function Description**

G5920/G5921 LED pins act as well matched current source driving LED diode to ground. An EN pin is used to turn on and turn off G5920/G5921.

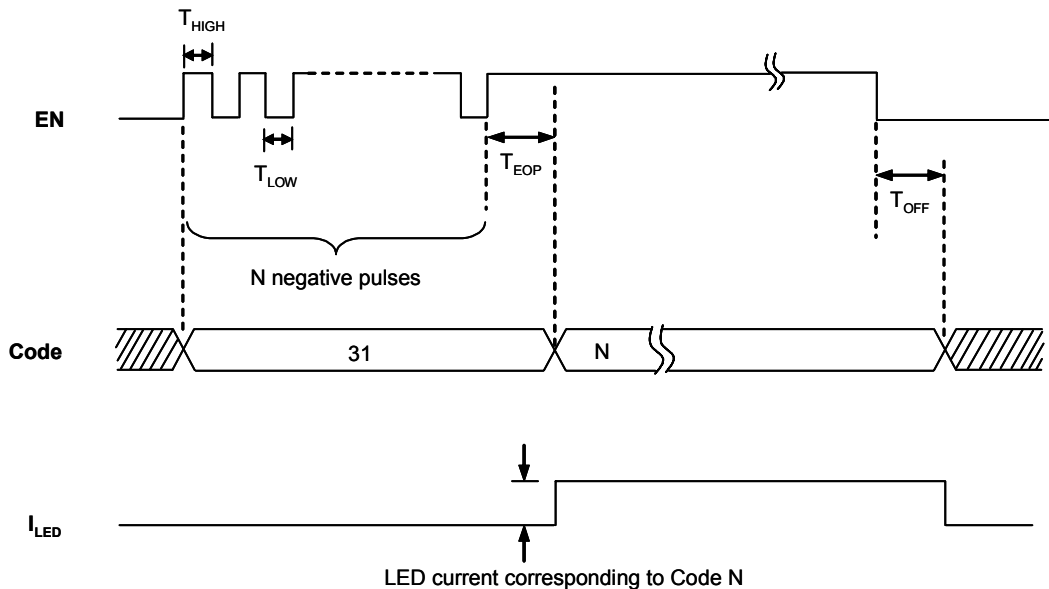
When applying a lower frequency (less than 2kHz) PWM waveform to EN pin, the average LED current will be duty\*20mA(typical). Refer to Fig.1



**Fig.1 Turn ON to PWM dimming**

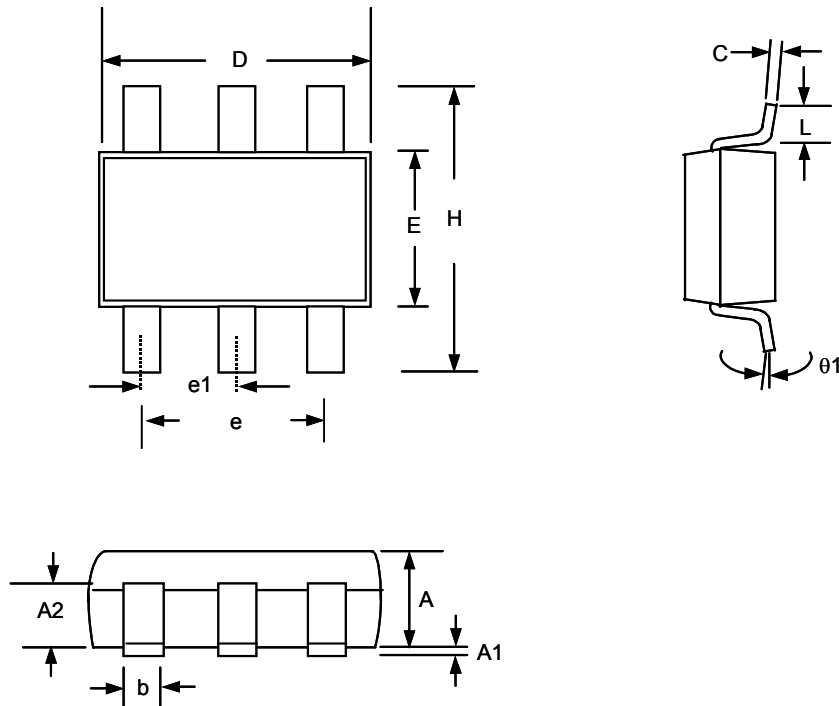
If the application is not suitable to apply such a low frequency PWM dimming waveform, this EN pin can be negatively pulsed to set continuous LED current. When no negative pulse is input to EN pin (Code=0), the internal register will latched to set the maximum

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 be changed from previous value to new value after the last pulse for typical 80μs (T<sub>EOP</sub>). Please refer to Fig.2



**Fig.2 Turn ON and config Code N**

Package Information



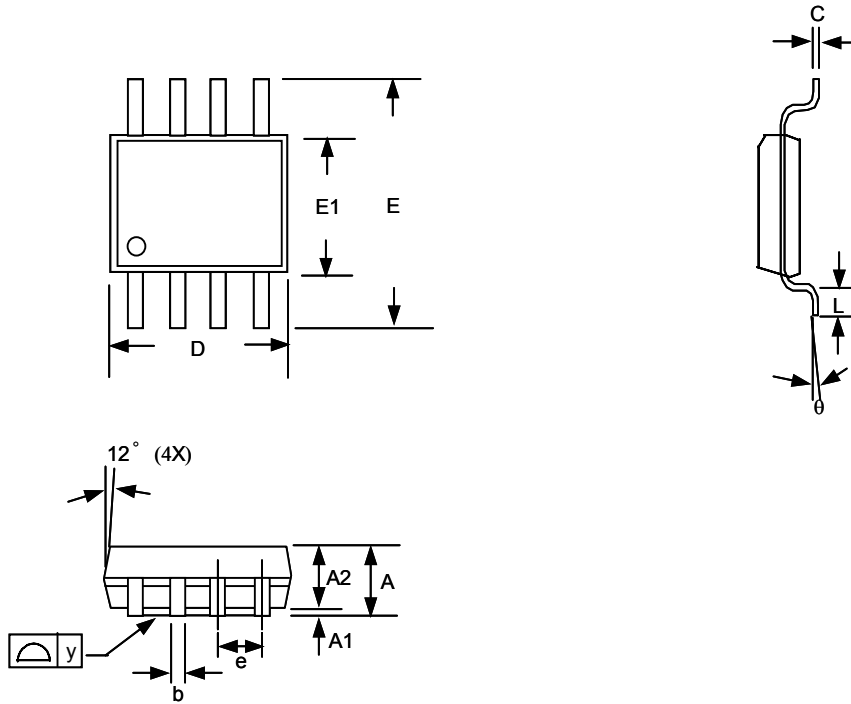
SOT-23-6 (TB) Package

Note:

1. Package body sizes exclude mold flash protrusions or gate burrs
2. Tolerance  $\pm 0.1000$  mm (4mil) unless otherwise specified
3. Coplanarity: 0.1000mm
4. Dimension L is measured in gage plane

| SYMBOL     | DIMENSIONS IN MILLIMETER |           |       |
|------------|--------------------------|-----------|-------|
|            | MIN                      | NOM       | MAX   |
| A          | 1.00                     | 1.10      | 1.30  |
| A1         | 0.00                     | -----     | 0.10  |
| A2         | 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  |
| E          | 1.40                     | 1.60      | 1.80  |
| e          | -----                    | 1.90(TYP) | ----- |
| e1         | -----                    | 0.95      | ----- |
| H          | 2.60                     | 2.80      | 3.00  |
| L          | 0.37                     | -----     | ----- |
| $\theta 1$ | 1°                       | 5°        | 9°    |





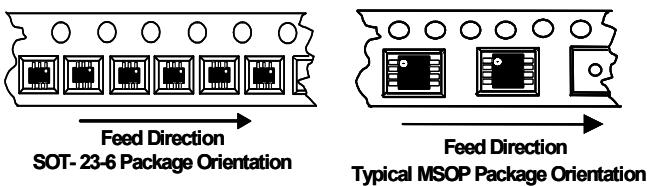
**MSOP-8 (P8) Package**

**Note:**

1. Package body sizes exclude mold flash and gate burrs
2. Dimension L is measured in gage plane
3. Tolerance 0.10mm unless otherwise specified
4. Controlling dimension is millimeter converted inch dimensions are not necessarily exact.
5. Followed from JEDEC MO-137

| SYMBOL   | DIMENSION IN MM |      |      | DIMENSION IN INCH |       |       |
|----------|-----------------|------|------|-------------------|-------|-------|
|          | MIN.            | NOM. | MAX. | MIN.              | NOM.  | MAX.  |
| A        | 0.81            | 1.02 | 1.22 | 0.032             | 0.040 | 0.048 |
| A1       | 0.00            | ---- | 0.20 | 0.000             | ----  | 0.008 |
| A2       | 0.76            | 0.86 | 0.97 | 0.030             | 0.034 | 0.038 |
| b        | 0.28            | 0.30 | 0.38 | 0.011             | 0.012 | 0.015 |
| C        | 0.13            | 0.15 | 0.23 | 0.005             | 0.006 | 0.009 |
| D        | 2.90            | 3.00 | 3.10 | 0.114             | 0.118 | 0.122 |
| E        | 4.80            | 4.90 | 5.00 | 0.189             | 0.193 | 0.197 |
| E1       | 2.90            | 3.00 | 3.10 | 0.114             | 0.118 | 0.122 |
| e        | ----            | 0.65 | ---- | ----              | 0.026 | ----  |
| L        | 0.40            | 0.53 | 0.66 | 0.016             | 0.021 | 0.026 |
| y        | ----            | ---- | 0.10 | ----              | ----  | 0.004 |
| $\theta$ | 0°              | ---- | 6°   | 0°                | ----  | 6°    |

**Taping Specification**



| PACKAGE  | Q'TY/REEL |
|----------|-----------|
| SOT-23-6 | 3,000 ea  |
| MSOP-8   | 2,500 ea  |

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