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# Ultra Fast High PSRR Low Noise CMOS Voltage Regulator

# CE6200 Series

## ■ INTRODUCTION

The CE6200 series are a group of positive voltage regulators manufactured by CMOS technologies with high ripple rejection, ultra low noise, low power consumption and low dropout voltage, which can prolong battery life in portable electronics. The CE6200 series work with low-ESR ceramic capacitors, reducing the amount of board space necessary for power applications. The CE6200 series consume less than 0.1μA in shutdown mode and have fast turn-on time less than 50μS.The series are very suitable for the battery-powered equipments, such as RF applications and other systems requiring a quiet voltage source.

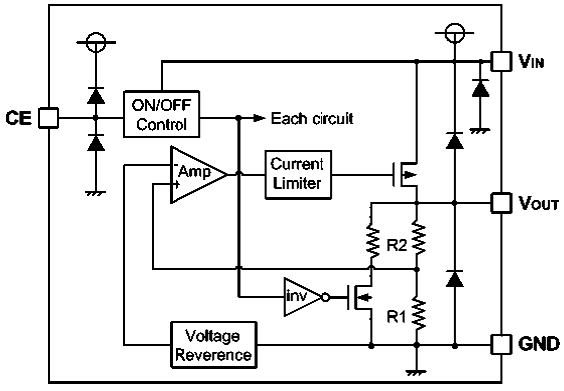
## ■ FEATURES

- Low Output Noise：40μ$V_{RMS}$ (10Hz~100kHz)
- Low Dropout Voltage：150mV@150mA
- Low Quiescent Current：50μA
- High Ripple Rejection：75dB@1kHz
- Excellent Line and Load Transient Response
- Operating Voltage Range：2.0V～6.0V
- Output Voltage Range：1.0V ~ 5.0V
- High Accuracy：±2%（Typ.）
- Built-in Current Limiter, Short-Circuit Protection
- TTL- Logic-Controlled Shutdown Input

## ■ APPLICATIONS

- Cellular and Smart Phones
- Laptop, Palmtops and PDA
- Digital Still and Video Cameras
- MP3, MP4 Player
- Radio control systems
- Battery-Powered Equipment

## ■ BLOCK DIAGRAM



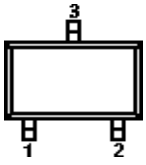

## ■ ORDER INFORMATION

**CE6200①②③④**

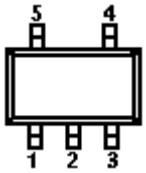
| DESIGNATOR | SYMBOL | DESCRIPTION |
|---|---|---|
| ① | A | Standard |
| | B | High Active, pull-down resistor built in, with $C_{OUT}$ discharge resistor |
| | C | High Active, No pull-down resistor, No $C_{OUT}$ discharge resistor |
| ②③ | Integer | Output Voltage e.g.1.8V=②:1, ③:8 |
| ④ | M | Package:SOT-23-3/5 |
| | U | Package:SOT-353 (SC70-5) |
| | P | Package:SOT-89-3/5 |
| | F | Package:DFN1×1-4 |

## ■ PIN CONFIGURATION

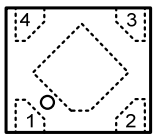
SOT-23-3



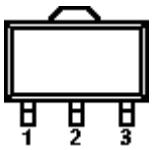

SOT-23-5/
SOT-353(SC70-5)



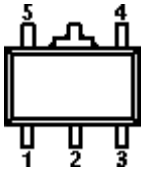

DFN1×1-4




SOT-89-3




SOT-89-5




**SOT-23-3**

| PIN NUMBER | | | | PIN NAME | FUNCTION |
|---|---|---|---|---|---|
| M | MA | MC | MY | | |
| 1 | 2 | 3 | 3 | $V_{SS}$ | Ground |
| 2 | 1 | 2 | 1 | $V_{OUT}$ | Output |
| 3 | 3 | 1 | 2 | $V_{IN}$ | Power input |

**SOT-23-5**

| PIN NUMBER | | | SYMBOL | FUNCTION |
|---|---|---|---|---|
| M | MF | ML | | |
| 1 | 1 | 5 | $V_{IN}$ | Power Input Pin |
| 2 | 2 | 2 | $V_{SS}$ | Ground |
| 3 | —— | 1 | CE | Chip Enable Pin |
| 4 | 3/4 | 3 | NC | No Connection |
| 5 | 5 | 4 | $V_{OUT}$ | Output Pin |

**SOT-353(SC70-5)**

| PIN NUMBER | SYMBOL | FUNCTION |
|---|---|---|
| U | | |
| 1 | $V_{IN}$ | Power Input Pin |
| 2 | $V_{SS}$ | Ground |
| 3 | CE | Chip Enable Pin |
| 4 | NC | No Connection |
| 5 | $V_{OUT}$ | Output Pin |

**DFN1×1-4**

| PIN NUMBER | SYMBOL | FUNCTION |
|---|---|---|
| F | | |
| 1 | $V_{OUT}$ | Output Pin |
| 2 | $V_{SS}$ | Ground |
| 3 | CE | Chip Enable Pin |
| 4 | $V_{IN}$ | Power Input Pin |

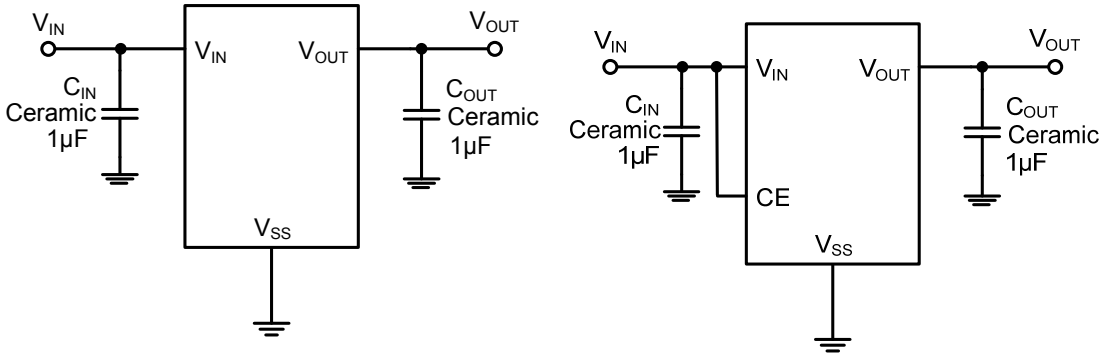
**SOT-89-3**

| PIN NUMBER | | PIN NAME | FUNCTION |
|---|---|---|---|
| P | PT | | |
| 1 | 2 | $V_{SS}$ | Ground |
| 3 | 1 | $V_{OUT}$ | Output |
| 2 | 3 | $V_{IN}$ | Power input |

**SOT-89-5**

| PIN NUMBER | SYMBOL | FUNCTION |
|---|---|---|
| P | | |
| 1 | $V_{OUT}$ | Output Pin |
| 2 | $V_{SS}$ | Ground |
| 3 | NC | No Connection |
| 4 | CE | Chip Enable Pin |
| 5 | $V_{IN}$ | Power Input Pin |

## ■ TYPICAL APPLICATION



## ■ ABSOLUTE MAXIMUM RATINGS(1)

**(Unless otherwise specified, $T_A$=25°C)**

| PARAMETER | | SYMBOL | RATINGS | UNITS |
|---|---|---|---|---|
| Input Voltage(2) | | $V_{IN}$ | -0.3~ 7 | V |
| Output Voltage(2) | | $V_{OUT}$ | -0.3~$V_{IN}$+0.3 | V |
| Output Current | | $I_{OUT}$ | 600 | mA |
| Power Dissipation | SOT-23 | $P_D$ | 0.4 | W |
| | SOT-353(SC70) | | 0.4 | W |
| | DFN1X1-4 | | 0.4 | W |
| | SOT-89 | | 0.6 | W |
| | TO-92 | | 0.6 | W |
| Operating free air temperature range(3) | | $T_A$ | -40~85 | °C |
| Operating Junction Temperature Range(4) | | $T_j$ | -40~125 | °C |
| Storage Temperature | | $T_{stg}$ | -40~125 | °C |
| Lead Temperature(Soldering, 10 sec) | | $T_{solder}$ | 260 | °C |
| ESD rating(5) | | Human Body Model -(HBM) | 4 | kV |
| | | Machine Model- (MM) | 200 | V |

(1) Stresses beyond those listed under *absolute maximum ratings may* cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods my affect device reliability.

(2) All voltages are with respect to network ground terminal.

(3) The CE6200 is guaranteed to meet performance specifications from 0°C to 85°C. Specifications over the –40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

(4) This IC includes over temperature protection that is intended to protect the device during momentary overload. Junction temperature will exceed 125°C when over temperature protection is active. Continuous operation above the specified maximum operating junction temperature may impair device reliability.

(5) ESD testing is performed according to the respective JESD22 JEDEC standard.

The human body model is a 100 pF capacitor discharged through a 1.5kΩ resistor into each pin. The machine model is a 200pF capacitor discharged directly into each pin.

## ■ RECOMMENDED OPERATING CONDITIONS

| PARAMETER | MIN. | NOM. | MAX. | UNITS |
|---|---|---|---|---|
| Supply voltage at $V_{IN}$ | 2 | | 6 | V |
| Operating junction temperature range, $T_j$ | 0 | | 125 | °C |
| Operating free air temperature range, $T_A$ | 0 | | 85 | °C |

## ■ ELECTRICAL CHARACTERISTICS

**CE6200 Series** **($V_{IN}$=$V_{OUT}$+1V, $C_{IN}$=$C_{OUT}$=1μF, $T_A$=25℃,unless otherwise specified)**

| PARAMETER | | SYMBOL | CONDITIONS | MIN. | TYP. (6) | MAX. | UNITS |
|---|---|---|---|---|---|---|---|
| Output Voltage | | $V_{OUT}$(E) (7) | $I_{OUT}$=1mA | $V_{OUT}$(8) *0.98 | $V_{OUT}$(8) | $V_{OUT}$(8) *1.02 | V |
| Supply Current | | $I_{SS}$ | $I_{OUT}$=0 | | 50 | 100 | μA |
| Standby Current | | $I_{STBY}$ | CE = $V_{SS}$ | | | 0.1 | μA |
| Output Current | | $I_{OUT}$ | — | 300 | | | mA |
| Dropout Voltage | | $V_{DO}$(9) | $I_{OUT}$ =150mA $V_{OUT}$≥2.8V | | 150 | | mV |
| Load Regulation | | $\Delta V_{OUT}$ | $V_{IN}$= $V_{OUT}$ +1V, 1mA≤$I_{OUT}$≤100mA | | 10 | | mV |
| Line Regulation | | $\frac{\Delta V_{OUT}}{V_{OUT} \times \Delta V_{IN}}$ | $I_{OUT}$ =10mA $V_{OUT}$ +1V≤$V_{IN}$≤6V | | 0.01 | 0.2 | %/V |
| Output Voltage Temperature Characteristics | | $\frac{\Delta V_{OUT}}{\Delta T \times V_{OUT}}$ | $I_{OUT}$ =10mA -40≤T≤+85 | | 100 | | ppm |
| Short Current | | $I_{Short}$ | $V_{OUT}$ =$V_{SS}$ | | 100 | | mA |
| Input Voltage | | $V_{IN}$ | — | 2.0 | | 6.0 | V |
| Power Supply Rejection Rate | 217Hz | PSRR | $I_{OUT}$=50mA | | 80 | | dB |
| | 1kHz | | | | 75 | | |
| | 10kHz | | | | 70 | | |
| CE "High" Voltage | | $V_{CE}$"H" | | 1.5 | | $V_{IN}$ | V |
| CE "Low" Voltage | | $V_{CE}$"L" | | | | 0.3 | V |
| $C_{OUT}$ Auto-Discharge Resistance | | $R_{DISCHRG}$ | $V_{IN}$=5V, $V_{OUT}$=3.0V, $V_{CE}$=$V_{SS}$ | | 80 | | Ω |

(6) Typical numbers are at 25°C and represent the most likely norm.

(7) $V_{OUT}$(E) : Effective Output Voltage ( Ie. The output voltage when $V_{IN}$ = ($V_{OUT}$ +1.0V) and maintain a certain $I_{OUT}$ Value).

(8) $V_{OUT}$ : Specified Output Voltage.

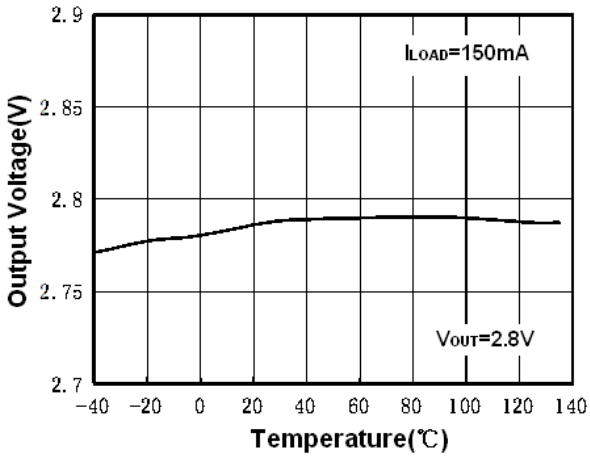
(9) $V_{DO}$ : The Difference Of Output Voltage And Input Voltage When Input Voltage Is Decreased Gradually Till Output Voltage Equals To 98% Of $V_{OUT}$ (E).

## ■ DROPOUT VOLTAGE CHART

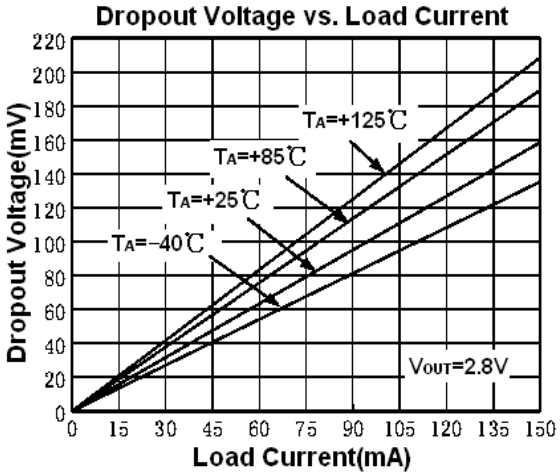
| Setting Output Voltage | Dropout Voltage(mV)@ $I_{OUT}$=150mA | |
|---|---|---|
| $V_{OUT}$(V) | Typ. | Max. |
| 1.2 | 380 | 600 |
| 1.5 | 270 | 600 |
| 1.8 | 230 | 600 |
| 2.5 | 180 | 400 |
| 2.8 | 160 | 220 |
| 3.0 | 155 | 220 |
| 3.3 | 150 | 220 |

## ■ TYPICAL PERFORMANCE CHARACTERISTICS

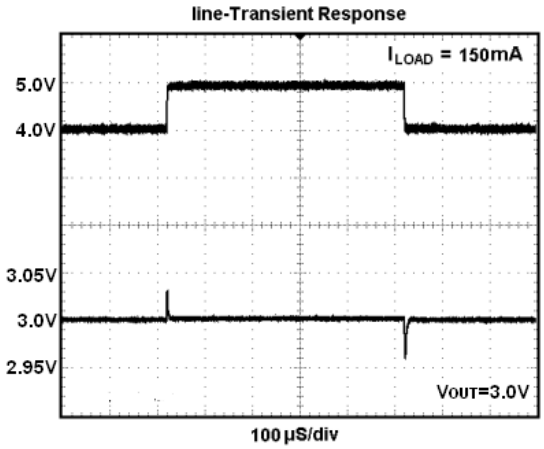
Output Voltage vs. Temperature



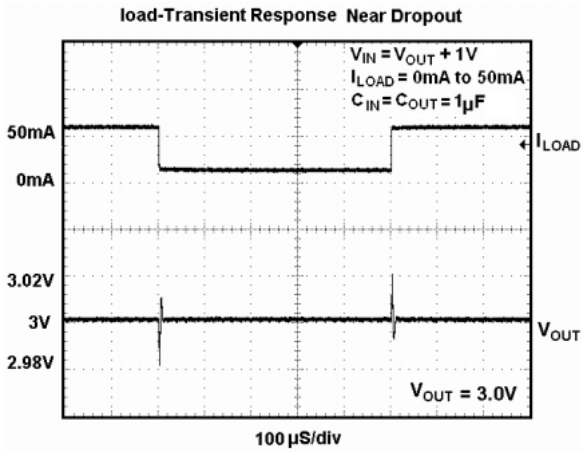

Dropout Voltage vs. Load Current



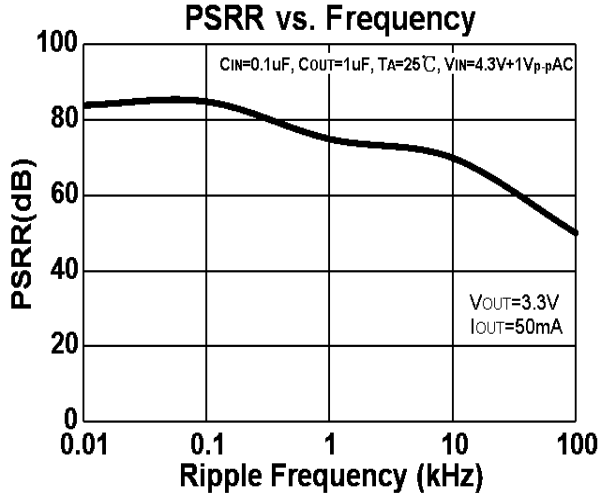

line-Transient Response



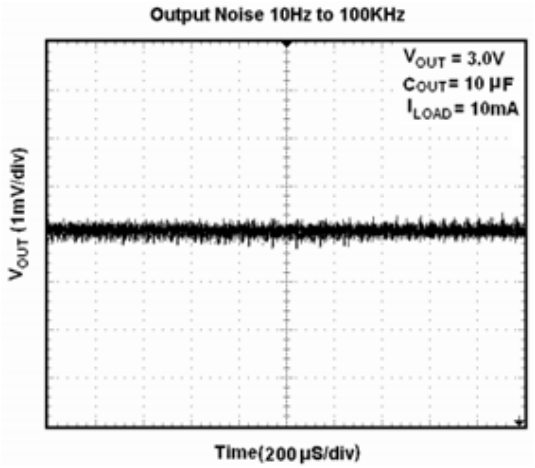

load-Transient Response Near Dropout



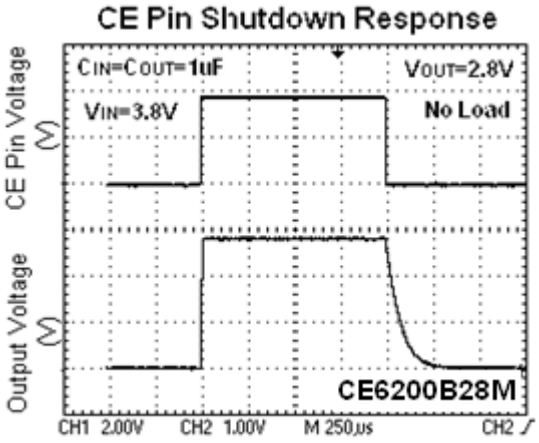

PSRR vs. Frequency

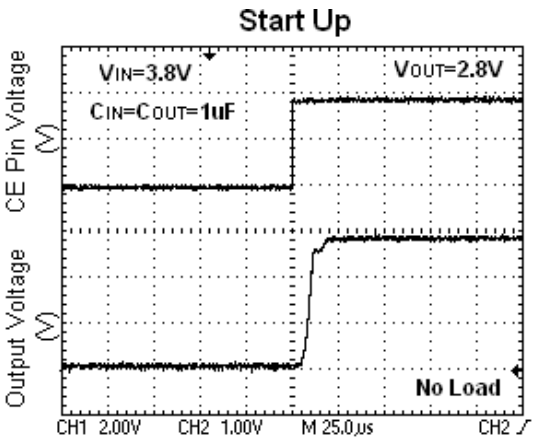



Output Noise 10Hz to 100KHz



## ■ TYPICAL PERFORMANCE CHARACTERISTICS




### $C_{OUT}$ Auto-Discharge Function

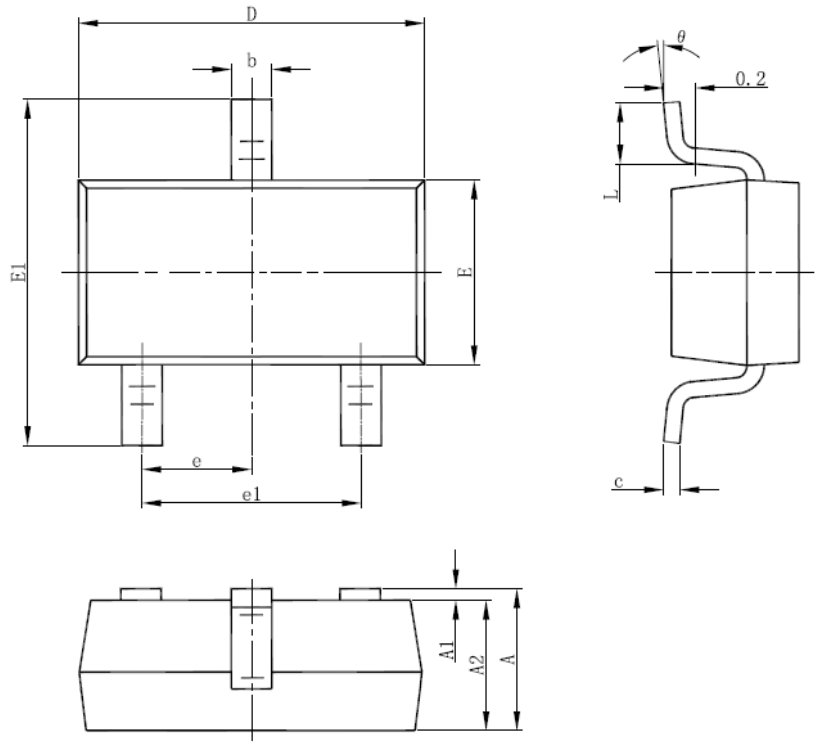
CE6200B series can discharge the electric charge in the output capacitor ($C_{OUT}$), when a low signal to the CE pin, which enables a whole IC circuit turn off, is inputted via the N-channel transistor located between the $V_{OUT}$ pin and the $V_{SS}$ pin (cf. BLOCK DIAGRAM). The $C_{OUT}$ auto-discharge resistance value is set at 80Ω ($V_{OUT}$=3.0V @ $V_{IN}$=5.0V at typical). The discharge time of the output capacitor ($C_{OUT}$) is set by the $C_{OUT}$ auto-discharge resistance (R) and the output capacitor ($C_{OUT}$). By setting time constant of a $C_{OUT}$ auto-discharge resistance value [$R_{DISCHRG}$] and an output capacitor value ($C_{OUT}$) as $\tau$ ($\tau$=C x $R_{DISCHRG}$), the output voltage after discharge via the N-channel transistor is calculated by the following formulas.

$$V = V_{OUT(E)} \times e^{-t/\tau}, \text{ or } t=\tau ln ( V / V_{OUT(E)} )$$

( V : Output voltage after discharge, $V_{OUT(E)}$ : Output voltage, t: Discharge time, $\tau$: $C_{OUT}$ auto-discharge resistance $R_{DISCHRG}$×Output capacitor ($C_{OUT}$) value C)

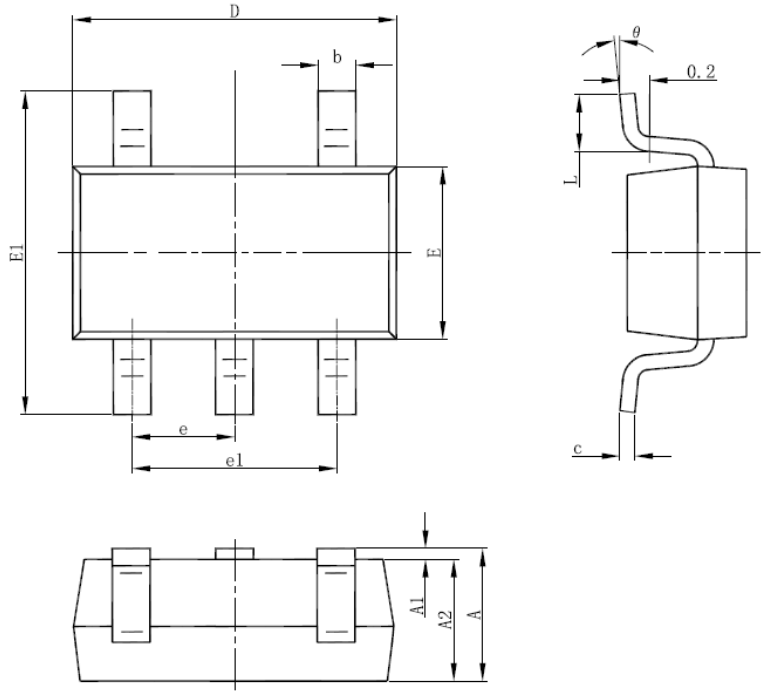
## ■ PACKAGING INFORMATION

### ● SOT-23-3 PACKAGE OUTLINE DIMENSIONS



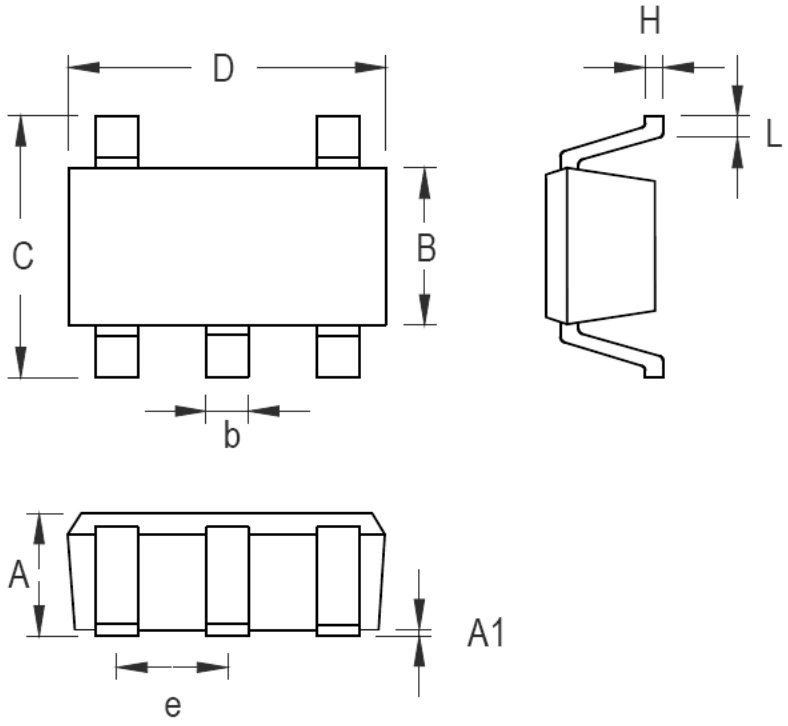

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| 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° |

## ● SOT-23-5 PACKAGE OUTLINE DIMENSIONS



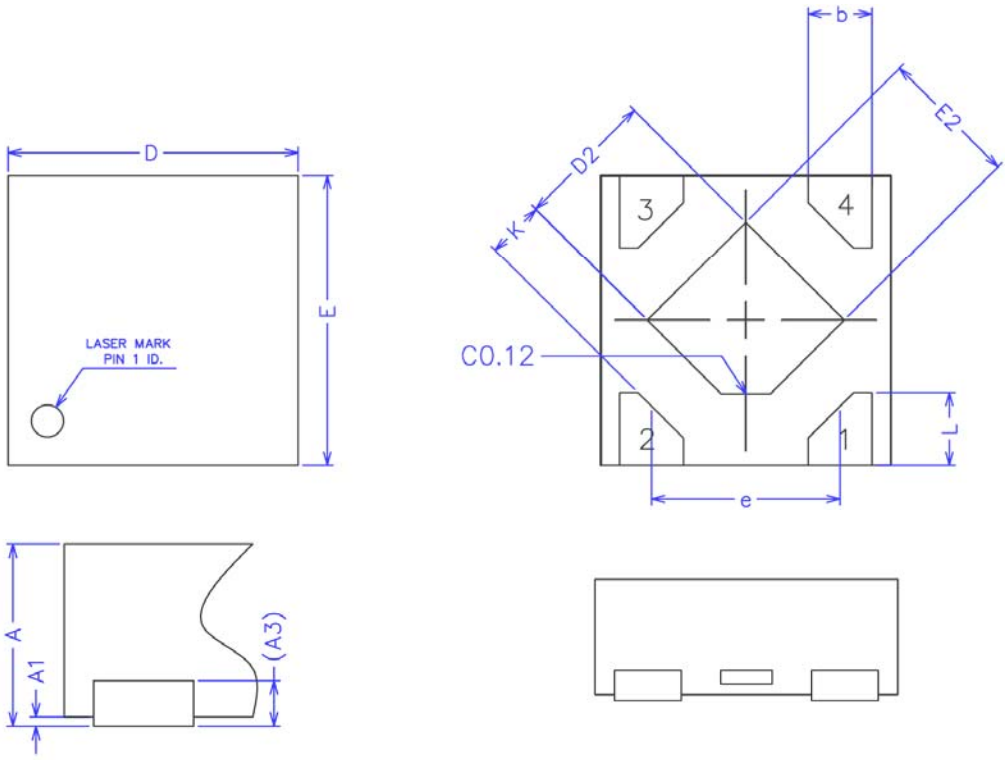

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| 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° |

● **SOT-353 (SC70-5) PACKAGE OUTLINE DIMENSIONS**




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.800 | 1.100 | 0.031 | 0.044 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| B | 1.150 | 1.350 | 0.045 | 0.054 |
| b | 0.150 | 0.400 | 0.006 | 0.016 |
| C | 1.800 | 2.450 | 0.071 | 0.096 |
| D | 1.800 | 2.250 | 0.071 | 0.089 |
| e | 0.650 | | 0.026 | |
| H | 0.080 | 0.260 | 0.003 | 0.010 |
| L | 0.210 | 0.460 | 0.008 | 0.018 |

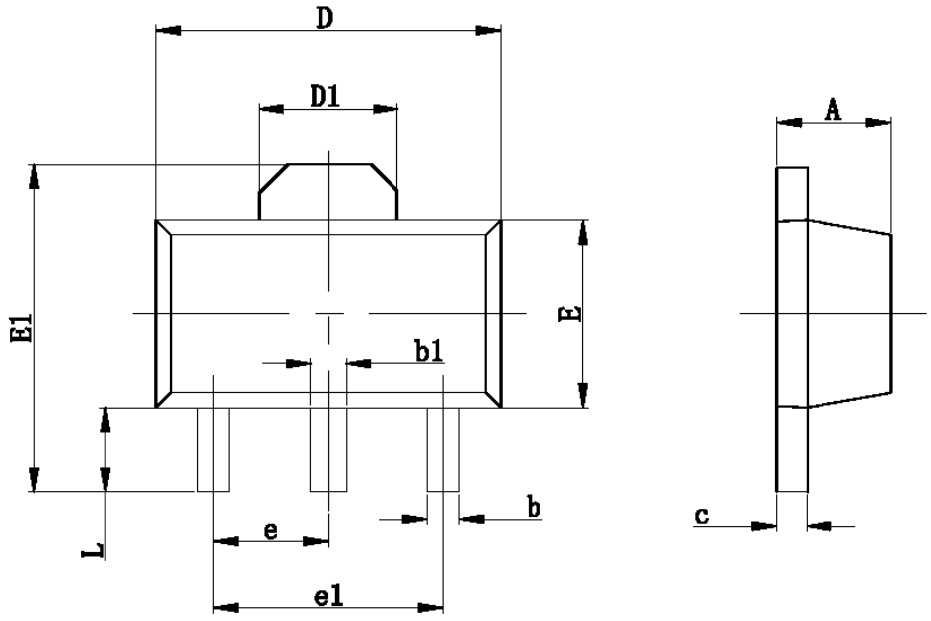
● **DFN1×1-4 PACKAGE OUTLINE DIMENSIONS**




COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

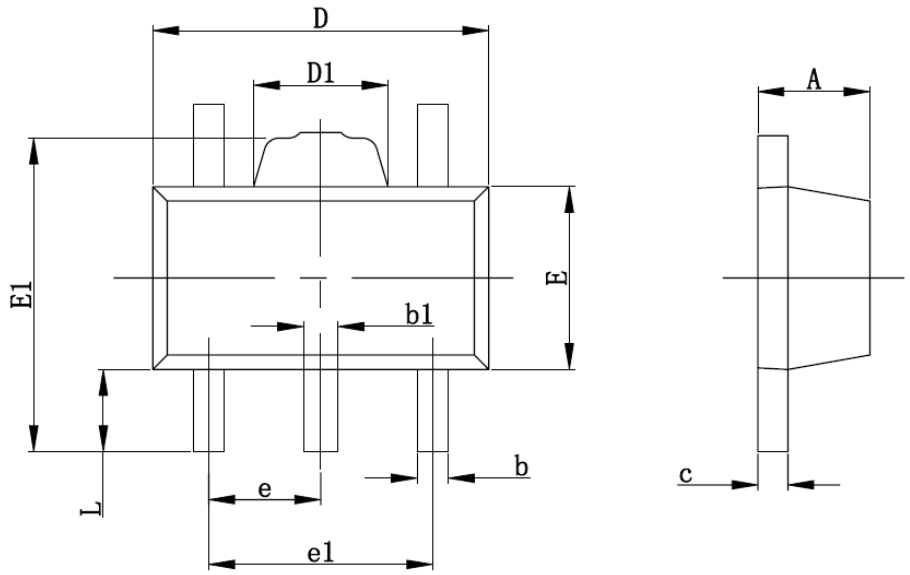
| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | 0.34 | 0.37 | 0.40 |
| A1 | 0.00 | 0.02 | 0.05 |
| A3 | | 0.100REF | |
| b | 0.17 | 0.22 | 0.27 |
| D | 0.95 | 1.00 | 1.05 |
| E | 0.95 | 1.00 | 1.05 |
| D2 | 0.43 | 0.48 | 0.53 |
| E2 | 0.43 | 0.48 | 0.53 |
| L | 0.20 | 0.25 | 0.30 |
| e | – | 0.65 | – |
| K | 0.15 | – | – |

● **SOT-89-3 PACKAGE OUTLINE DIMENSIONS**




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.400 | 1.600 | 0.055 | 0.063 |
| b | 0.320 | 0.520 | 0.013 | 0.197 |
| b1 | 0.400 | 0.580 | 0.016 | 0.023 |
| c | 0.350 | 0.440 | 0.014 | 0.017 |
| D | 4.400 | 4.600 | 0.173 | 0.181 |
| D1 | 1.550 REF | | 0.061 REF | |
| E | 2.300 | 2.600 | 0.091 | 0.102 |
| E1 | 3.940 | 4.250 | 0.155 | 0.167 |
| e | 1.500 TYP | | 0.060TYP | |
| e1 | 3.000 TYP | | 0.118TYP | |
| L | 0.900 | 1.200 | 0.035 | 0.047 |

● **SOT-89-5 PACKAGE OUTLINE DIMENSIONS**




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.400 | 1.600 | 0.055 | 0.063 |
| b | 0.320 | 0.520 | 0.013 | 0.020 |
| b1 | 0.360 | 0.560 | 0.014 | 0.022 |
| c | 0.350 | 0.440 | 0.014 | 0.017 |
| D | 4.400 | 4.600 | 0.173 | 0.181 |
| D1 | 1.400 | 1.800 | 0.055 | 0.071 |
| E | 2.300 | 2.600 | 0.091 | 0.102 |
| E1 | 3.940 | 4.250 | 0.155 | 0.167 |
| e | 1.500TYP | | 0.060TYP | |
| e1 | 2.900 | 3.100 | 0.114 | 0.122 |
| L | 0.900 | 1.100 | 0.035 | 0.043 |