

## Ultra Low Current Consumption 300mA CMOS Voltage Regulator

### ■ INTRODUCTION

The HG1303 series are a group of positive voltage regulators manufactured by CMOS technologies with ultra low power consumption and low dropout voltage, which provide large output currents even when the difference of the input-output voltage is small. The HG1303 series can deliver 300mA output current and allow an input voltage as high as 8V. The series are very suitable for the battery-powered equipments, such as RF applications and other systems requiring a quiet voltage source.

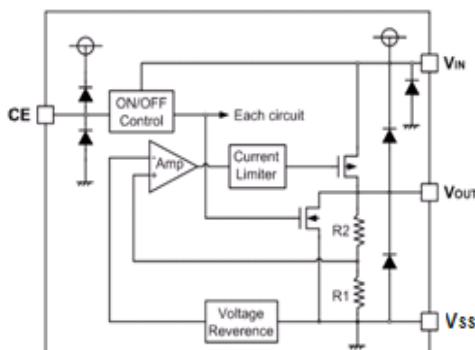
### ■ FEATURES

- Low Quiescent Current: 0.8μA
- Operating Voltage Range: 1.8V~8V
- Output Current: 300mA
- Low Dropout Voltage:  
110mV@100mA( $V_{OUT}=3.3V$ )
- Output Voltage: 1.2~ 5.0V
- High Accuracy:  $\pm 2\%/\pm 1\%$  (Typ.)
- High Power Supply Rejection Ratio:  
50dB@1kHz
- Low Output Noise:  
 $27 \times V_{OUT} \mu V_{RMS}$  (10Hz~100kHz)
- Excellent Line and Load Transient Response
- Built-in Current Limiter, Short-Circuit Protection

### ■ APPLICATIONS

- Portable consumer equipments
- Radio control systems
- Laptop, Palmtops and PDAs
- Wireless Communication Equipments
- Portable Audio Video Equipments
- Ultra Low Power Microcontroller

### ■ BLOCK DIAGRAM

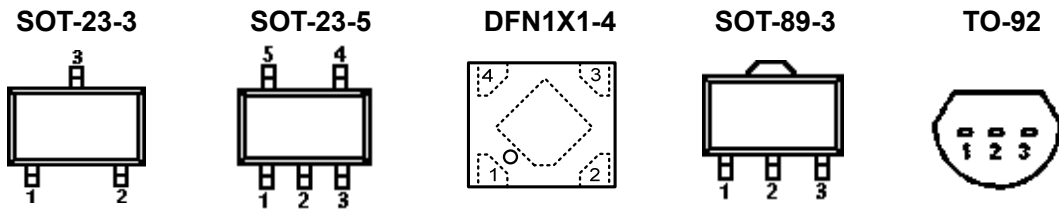


### ■ ORDER INFORMATION

#### HG1303 ①②③④⑤

| DESIGNATOR | SYMBOL    | DESCRIPTION                                                                 |
|------------|-----------|-----------------------------------------------------------------------------|
| ①          | A         | Standard                                                                    |
|            | B         | High Active, pull-down resistor built in, with $C_{OUT}$ discharge resistor |
| ②③         | Integer   | Output Voltage<br>e.g. 1.8V=②:1, ③:8                                        |
| ④          | F         | Package: DFN1X1-4                                                           |
|            | M/ MC/ MY | Package: SOT-23-3                                                           |
|            | M         | Package: SOT-23-5                                                           |
|            | P/PT/PL   | Package: SOT-89-3                                                           |
|            | T/TA/TB   | Package: TO-92                                                              |
| ⑤          | -         | 2% Accuracy                                                                 |
|            | 1         | 1% Accuracy                                                                 |

## PIN CONFIGURATION



| PIN NUMBER |    |    |          |    |    |       |    |    | PIN<br>NAME      | FUNCTION    |
|------------|----|----|----------|----|----|-------|----|----|------------------|-------------|
| SOT-23-3   |    |    | SOT-89-3 |    |    | TO-92 |    |    |                  |             |
| M          | MC | MY | P        | PT | PL | T     | TA | TB |                  |             |
| 1          | 3  | 3  | 1        | 2  | 2  | 1     | 2  | 2  | V <sub>SS</sub>  | Ground      |
| 2          | 2  | 1  | 3        | 1  | 3  | 3     | 3  | 1  | V <sub>OUT</sub> | Output      |
| 3          | 1  | 2  | 2        | 3  | 1  | 2     | 1  | 3  | V <sub>IN</sub>  | Power input |

### SOT-23-5

| PIN NUMBER | SYMBOL           | FUNCTION        |
|------------|------------------|-----------------|
| 1          | V <sub>IN</sub>  | Power Input Pin |
| 2          | V <sub>SS</sub>  | Ground          |
| 3          | CE               | Chip Enable Pin |
| 4          | NC               | No Connection   |
| 5          | V <sub>OUT</sub> | Output Pin      |

### DFN1X1-4

| PIN NUMBER | SYMBOL           | FUNCTION        |
|------------|------------------|-----------------|
| F          |                  |                 |
| 1          | V <sub>OUT</sub> | Output Pin      |
| 2          | V <sub>SS</sub>  | Ground          |
| 3          | CE               | Chip Enable Pin |
| 4          | V <sub>IN</sub>  | Power Input Pin |

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

(Unless otherwise specified, T<sub>A</sub>=25°C)

| PARAMETER                            |          | SYMBOL              | RATINGS                   | UNITS |
|--------------------------------------|----------|---------------------|---------------------------|-------|
| Input Voltage <sup>(2)</sup>         |          | V <sub>IN</sub>     | -0.3~9                    | V     |
| Output Voltage <sup>(2)</sup>        |          | V <sub>OUT</sub>    | -0.3~V <sub>IN</sub> +0.3 | V     |
| Output Current                       |          | I <sub>OUT</sub>    | 600                       | mA    |
| Power Dissipation                    | SOT-23   | P <sub>D</sub>      | 0.4                       | W     |
|                                      | DFN1X1-4 |                     | 0.4                       | W     |
|                                      | SOT-89   |                     | 0.6                       | W     |
|                                      | TO-92    |                     | 0.6                       | W     |
| Operating Junction Temperature Range |          | T <sub>j</sub>      | -40~125                   | °C    |
| Storage Temperature                  |          | T <sub>stg</sub>    | -40~125                   | °C    |
| Lead Temperature(Soldering, 10 sec)  |          | T <sub>solder</sub> | 260                       | °C    |

Note:

(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 may affect device reliability.

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

## RECOMMENDED OPERATING CONDITIONS

| PARAMETER                                   | MIN. | NOM. | MAX. | UNITS |
|---------------------------------------------|------|------|------|-------|
| Supply voltage at $V_{IN}$                  | 1.8  |      | 8    | V     |
| Operating junction temperature range, $T_j$ | -40  |      | 125  | °C    |
| Operating free air temperature range, $T_A$ | -40  |      | 85   | °C    |

## ELECTRICAL CHARACTERISTICS

**HG1303 Series** ( $V_{IN}=V_{OUT}+1V$ ,  $C_{IN}=C_{OUT}=1\mu F$ ,  $T_A=25^\circ C$ , unless otherwise specified)

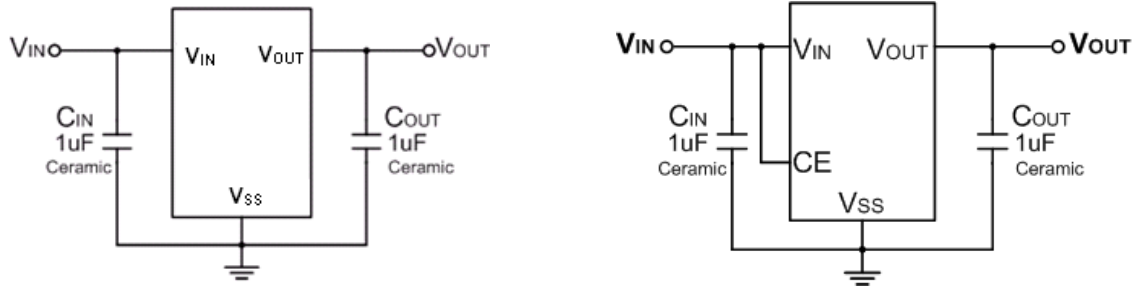
| PARAMETER                    | SYMBOL                                                | CONDITIONS                                             | MIN.   | TYP. <sup>(3)</sup> | MAX.     | UNITS         |
|------------------------------|-------------------------------------------------------|--------------------------------------------------------|--------|---------------------|----------|---------------|
| Input Voltage                | $V_{IN}$                                              |                                                        | 1.8    | —                   | 8        | V             |
| Output Voltage Range         | $V_{OUT}$                                             |                                                        | 1.2    | —                   | 5        | V             |
| DC Output Accuracy           |                                                       | $I_{OUT}=1mA$                                          | -2     | —                   | 2        | %             |
|                              |                                                       |                                                        | -1     | —                   | 1        | %             |
| Dropout Voltage              | $V_{dif}^{(4)}$                                       | $I_{OUT}=100mA, V_{OUT}=3.3V$                          | —      | 110                 | —        | mV            |
| Supply Current               | $I_{SS}$                                              | $I_{OUT}=0, 1.2V \leq V_{OUT} \leq 3.3V$               | —      | 0.8                 | 1.3      | $\mu A$       |
|                              |                                                       | $3.3V < V_{OUT} \leq 5.0V$                             | —      | 1.0                 | 1.5      | $\mu A$       |
| Standby Current              | $I_{STBY}$                                            | $CE=V_{SS}$                                            | —      | —                   | 0.1      | $\mu A$       |
| Line Regulation              | $\frac{\Delta V_{OUT}}{V_{OUT} \times \Delta V_{IN}}$ | $I_{OUT}=10mA$<br>$V_{OUT}+1V \leq V_{IN} \leq 8V$     | —      | 0.05                | 0.3      | %/V           |
| Load Regulation              | $\Delta V_{OUT}$                                      | $V_{IN}=V_{OUT}+1V$ ,<br>$1mA \leq I_{OUT} \leq 100mA$ | —      | 10                  | —        | mV            |
| Temperature Coefficient      | $\frac{\Delta V_{OUT}}{V_{OUT} \times \Delta T_A}$    | $I_{OUT}=10mA$ ,<br>$-40^\circ C < T_A < 125^\circ C$  | —      | 100                 | —        | ppm           |
| Output Current Limit         | $I_{LIM}$                                             | $V_{OUT}=0.5 \times V_{OUT(Normal)}$ ,<br>$V_{IN}=5V$  | 550    | 700                 | 850      | mA            |
| Short Current                | $I_{SHORT}$                                           | $V_{OUT}=V_{SS}$                                       | —      | 20                  | —        | mA            |
| Power Supply Rejection Ratio | PSRR                                                  | $I_{OUT}=50mA$                                         | 100Hz  | 70                  | —        | dB            |
|                              |                                                       |                                                        | 1kHz   | 50                  | —        |               |
|                              |                                                       |                                                        | 10kHz  | 40                  | —        |               |
|                              |                                                       |                                                        | 100kHz | 35                  | —        |               |
| Output Noise Voltage         | $V_{ON}$                                              | $BW=10Hz$ to $100kHz$                                  | —      | $27 \times V_{OUT}$ | —        | $\mu V_{RMS}$ |
| CE "High" Voltage            | $V_{CE"H"}$                                           |                                                        | 1.5    | —                   | $V_{IN}$ | V             |
| CE "Low" Voltage             | $V_{CE"L"}$                                           |                                                        | —      | —                   | 0.3      | V             |

Note:

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

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

## ■ TYPICAL APPLICATION CIRCUIT



## ■ APPLICATION INFORMATION

### Selection of Input/ Output Capacitors

In general, all the capacitors need to be low leakage. Any leakage the capacitors have will reduce efficiency, increase the quiescent current.

A recent trend in the design of portable devices has been to use ceramic capacitors to filter DC-DC converter inputs. Ceramic capacitors are often chosen because of their small size, low equivalent series resistance (ESR) and high RMS current capability. Also, recently, designers have been looking to ceramic capacitors due to shortages of tantalum capacitors.

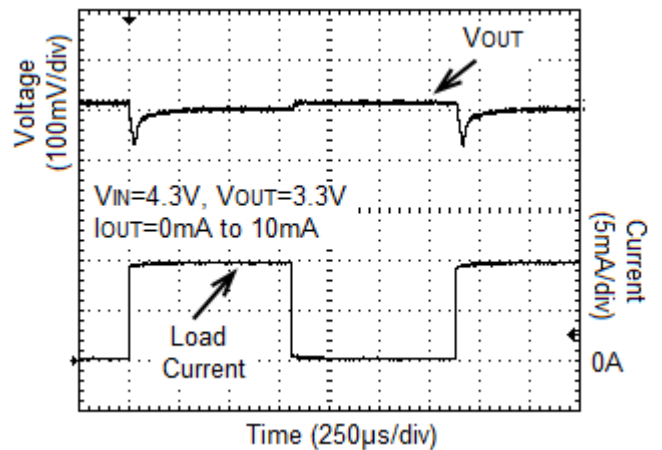
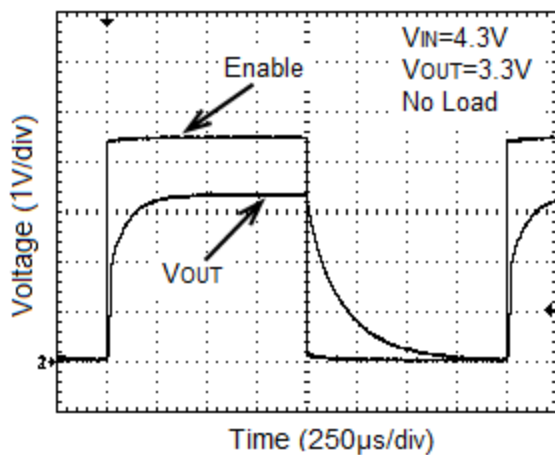
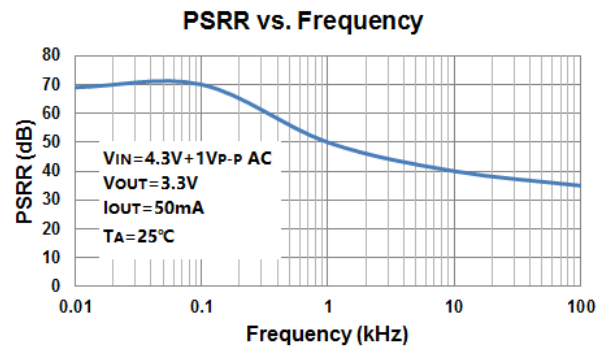
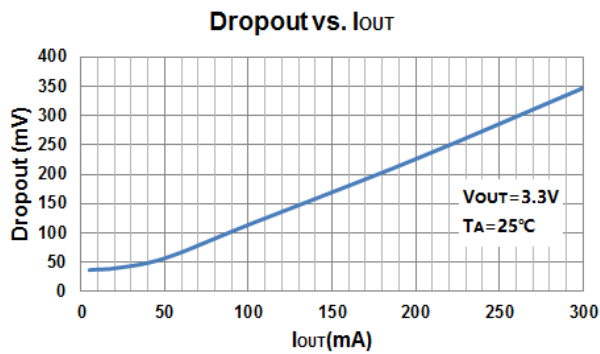
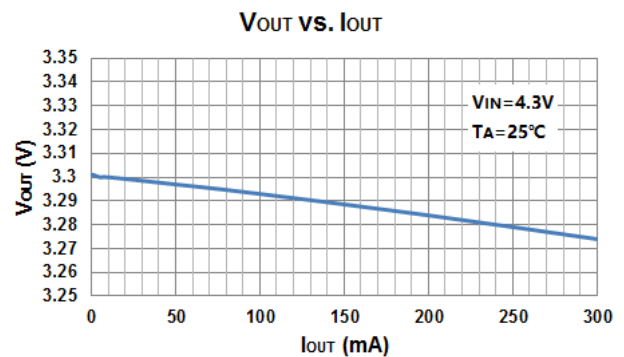
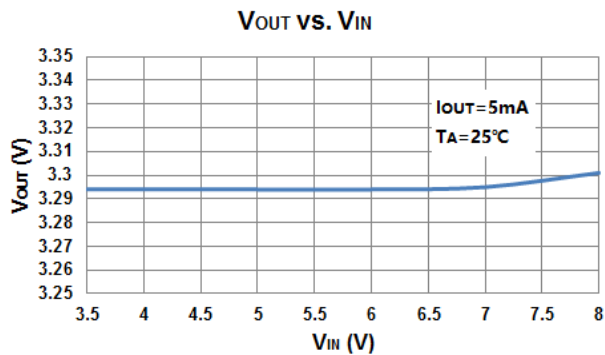
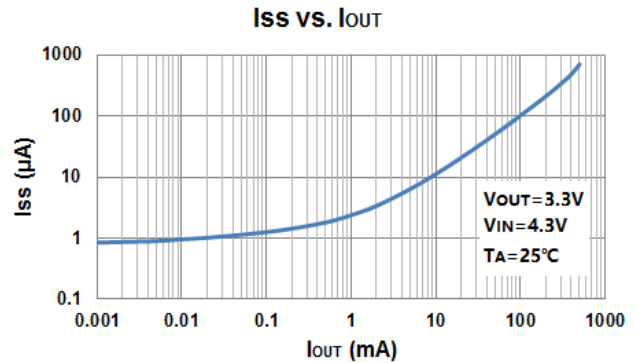
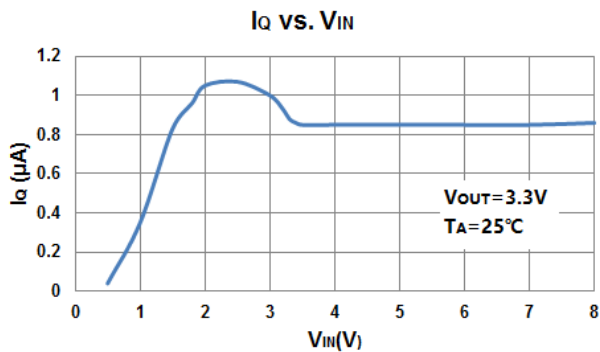
Unfortunately, using ceramic capacitors for input filtering can cause problems. Applying a voltage step to a ceramic capacitor causes a large current surge that stores energy in the inductances of the power leads. A large voltage spike is created when the stored energy is transferred from these inductances into the ceramic capacitor. These voltage spikes can easily be twice the amplitude of the input voltage step.

Many types of capacitors can be used for input bypassing, however, caution must be exercised when using multilayer ceramic capacitors (MLCC). Because of the self-resonant and high Q characteristics of some types of ceramic capacitors, high voltage transients can be generated under some start-up conditions, such as connecting the LDO input to a live power source. Adding a 3Ω resistor in series with an X5R ceramic capacitor will minimize start-up voltage transients.

The LDO also requires an output capacitor for loop stability. Connect a 1μF tantalum capacitor from OUT to GND close to the pins. For improved transient response, this output capacitor may be ceramic.

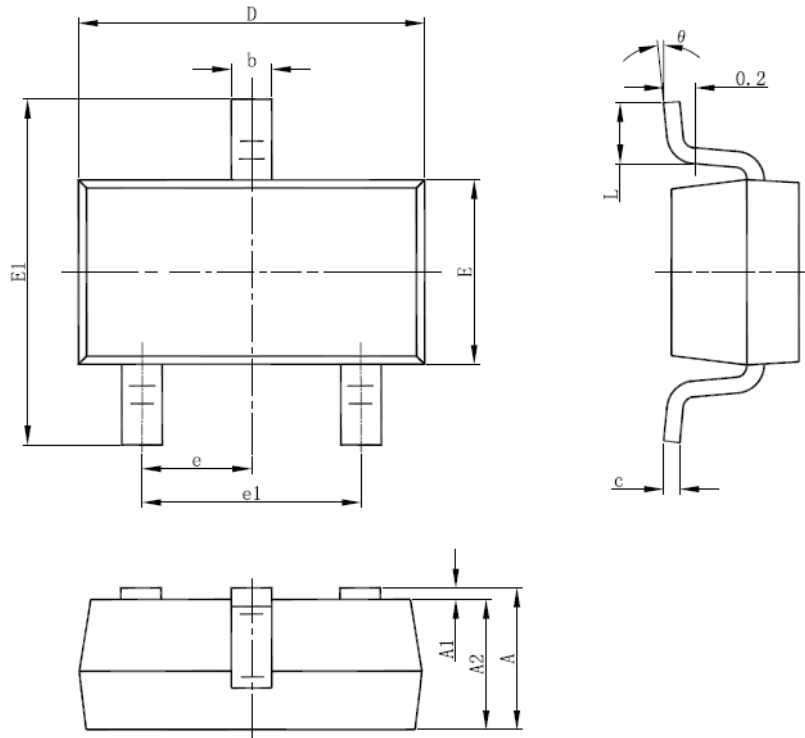
## ■ TYPICAL PERFORMANCE CHARACTERISTICS

( $V_{IN}=V_{OUT}+1V$ ,  $C_{IN}=C_{OUT}=1\mu F$ ,  $T_A=25^\circ C$ , unless otherwise specified)



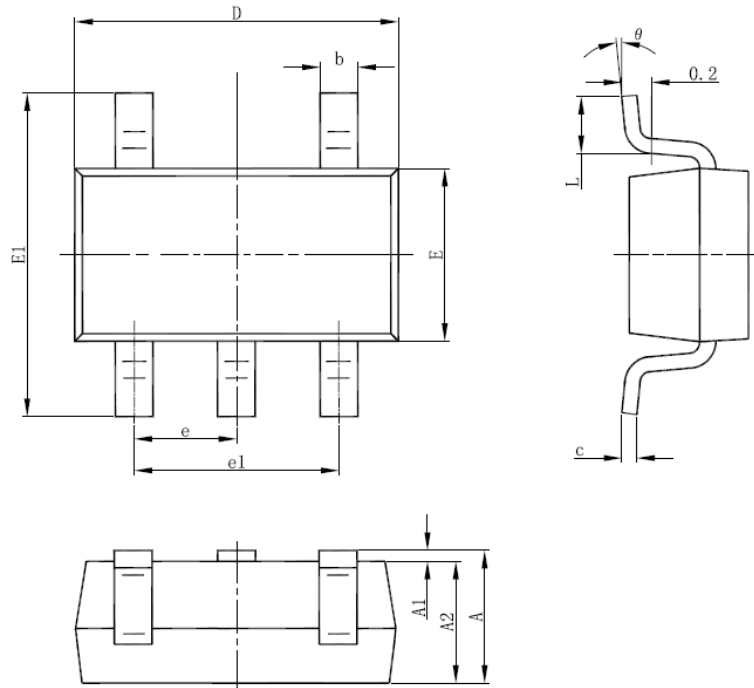
## ■ PACKAGING INFORMATION

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



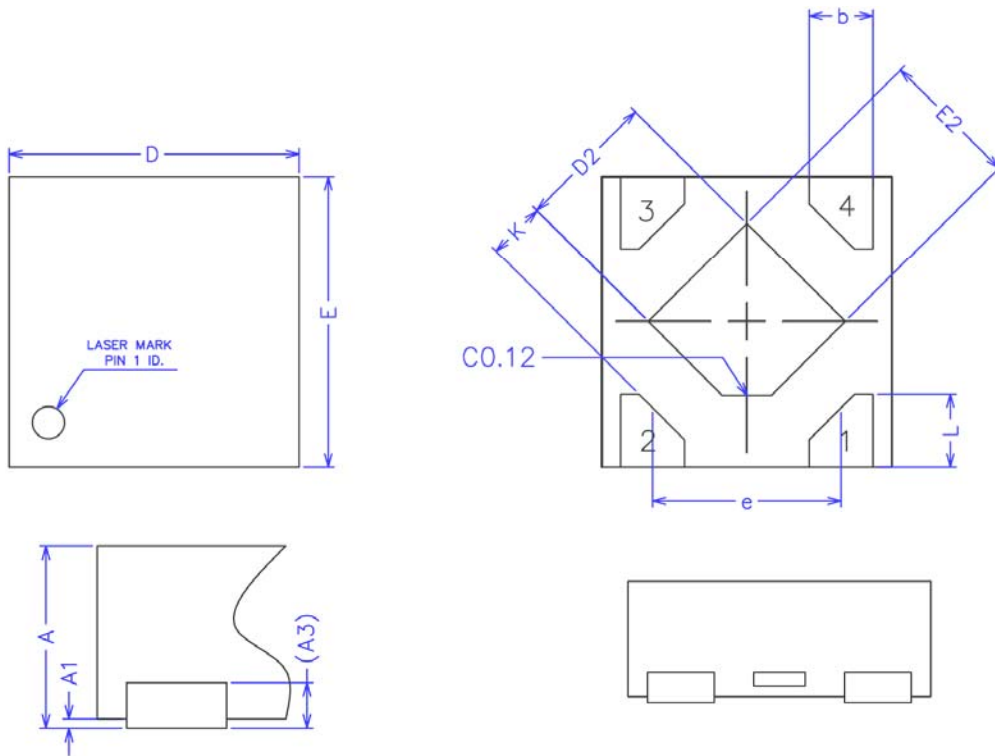
| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min.                      | Max.  | Min.                 | Max.  |
| A      | 1.050                     | 1.250 | 0.041                | 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°    |

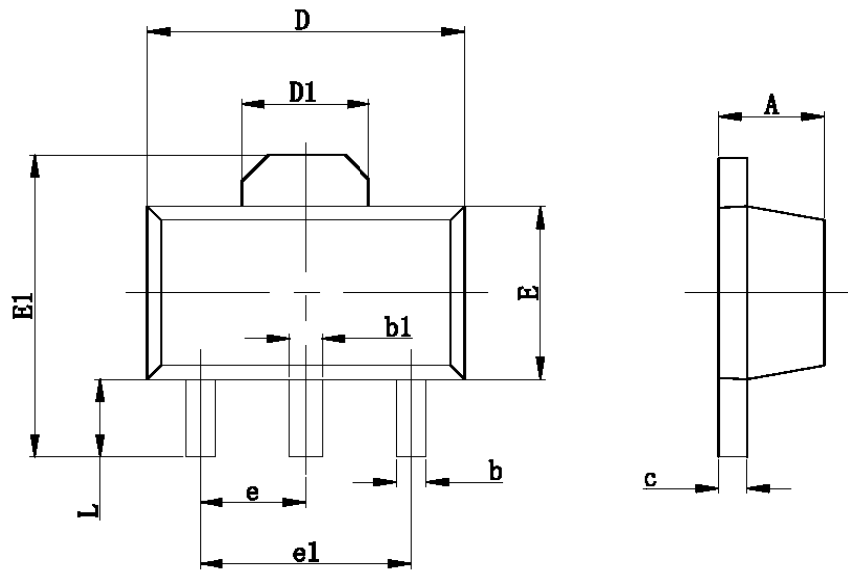
## ● DFNXX1-4 PACKAGE OUTLINE DIMENSIONS



COMMON DIMENSIONS  
(UNITS OF MEASURE=MILLIMETER)

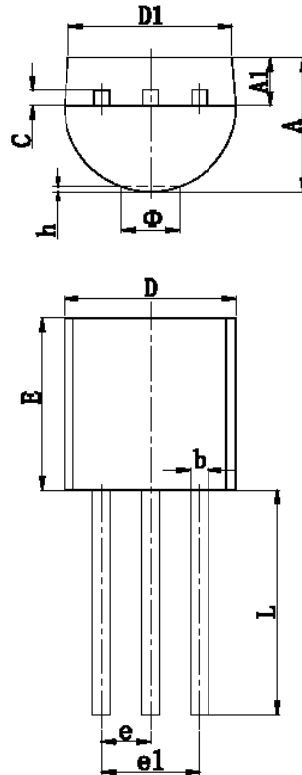
| SYMBOL | MIN      | NOM  | MAX  |
|--------|----------|------|------|
| A      | 0.34     | 0.37 | 0.40 |
| A1     | 0.00     | 0.02 | 0.05 |
| A3     | 0.100REF |      |      |
| b      | 0.17     | 0.22 | 0.27 |
| D      | 0.95     | 1.00 | 1.05 |
| E      | 0.95     | 1.00 | 1.05 |
| D2     | 0.43     | 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                 |       | 0.060 TYP            |       |
| e1     | 3.000 TYP                 |       | 0.118 TYP            |       |
| L      | 0.900                     | 1.200 | 0.035                | 0.047 |

## ● TO-92 PACKAGE OUTLINE DIMENSIONS



| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min.                      | Max.   | Min.                 | Max.  |
| A      | 3.300                     | 3.700  | 0.130                | 0.146 |
| A1     | 1.100                     | 1.400  | 0.043                | 0.055 |
| b      | 0.380                     | 0.550  | 0.015                | 0.022 |
| c      | 0.360                     | 0.510  | 0.014                | 0.020 |
| D      | 4.400                     | 4.700  | 0.173                | 0.185 |
| D1     | 3.430                     |        | 0.135                |       |
| E      | 4.300                     | 1.400  | 0.169                | 0.185 |
| e      | 1.270 TYP                 |        | 0.050 TYP            |       |
| e1     | 2.440                     | 2.640  | 0.096                | 0.104 |
| L      | 14.100                    | 14.500 | 0.555                | 0.571 |
| Φ      |                           | 1.600  |                      | 0.063 |
| h      | 0.000                     | 0.380  | 0.000                | 0.015 |