



BCT2038

Low Power, Low Dropout RF-Linear Regulators

BCT2038

Low Power, Low Dropout, RF-Linear Regulators

GENERAL DESCRIPTION

The BCT2038 series low-power, low-dropout, CMOS linear voltage regulators operate from a 1.6V to 5.5V input voltage and deliver up to 500mA output current. They are the perfect choice for low voltage, low power applications. A low ground current makes this part attractive for battery operated power systems. The BCT2038 series also offer low dropout voltage to prolong battery life in portable electronics. Systems requiring a quiet voltage source, such as RF applications, will benefit from the BCT2038 series low output noise and high PSRR.

Other features include a 10nA logic-controlled shutdown mode, short current limit and thermal shutdown protection.

The BCT2038 has auto-discharge function to quickly discharge VOUT in the disable status.

The BCT2038 is available in Green SOT23-3, SOT23-5, SC70-5, SOT89-3 packages. It operates over an ambient temperature range of -40°C to +85°C .

FEATURES

- Low Dropout Voltage
- Thermal Overload Protection
- Built-In Fold Back Protection Circuit
- 20µA Low Supply Current
- 10nA Logic-Controlled Shutdown
- 1.6V to 5.5V Input Voltage Range
- Fixed Outputs of 1.2V, 1.8V, 2.8V, 3.0V, and 3.3V
- Adjustable Output from 0.8V to 5.0V
- Short Auto-Discharge Function
- 500mA Output Current
- High Output Voltage Accuracy
- Quick Start-Up Time
- -40°C to +85°C Operating Temperature Range Available in Green SOT23-3, SOT23-5, SC70-5, SOT89-3 Packages.

APPLICATIONS

Cellular Telephones
Cordless Telephones
PCMCIA Cards
Modems
MP3 Player
Hand-Held Instruments
Palmtop Computers
Electronic Planners
Portable/Battery-Powered Equipment

ORDERING INFORMATION

| Order Number | V _{OUT} (V) | Package Type | Temperature Range | Marking | QTY/Reel |
|-----------------|----------------------|--------------|-------------------|---------------|----------|
| BCT2038EUR12-TR | 1.2 | SOT23-3 | -40°C to +85°C | U2XX | 3000 |
| BCT2038EUR18-TR | 1.8 | SOT23-3 | -40°C to +85°C | U8XX | 3000 |
| BCT2038EUR28-TR | 2.8 | SOT23-3 | -40°C to +85°C | U8XX | 3000 |
| BCT2038EUR30-TR | 3.0 | SOT23-3 | -40°C to +85°C | U0XX | 3000 |
| BCT2038EUR33-TR | 3.3 | SOT23-3 | -40°C to +85°C | U3XX | 3000 |
| BCT2038EUK12-TR | 1.2 | SOT23-5 | -40°C to +85°C | U2XX | 3000 |
| BCT2038EUK18-TR | 1.8 | SOT23-5 | -40°C to +85°C | U8XX | 3000 |
| BCT2038EUK28-TR | 2.8 | SOT23-5 | -40°C to +85°C | U8XX | 3000 |
| BCT2038EUK30-TR | 3.0 | SOT23-5 | -40°C to +85°C | U0XX | 3000 |
| BCT2038EUK33-TR | 3.3 | SOT23-5 | -40°C to +85°C | U3XX | 3000 |
| BCT2038EUKAJ-TR | ADJ | SOT23-5 | -40°C to +85°C | UJXX | 3000 |
| BCT2038EXK12-TR | 1.2 | SC70-5 | -40°C to +85°C | U2XX | 3000 |
| BCT2038EXK18-TR | 1.8 | SC70-5 | -40°C to +85°C | U8XX | 3000 |
| BCT2038EXK28-TR | 2.8 | SC70-5 | -40°C to +85°C | U8XX | 3000 |
| BCT2038EXK30-TR | 3.0 | SC70-5 | -40°C to +85°C | U0XX | 3000 |
| BCT2038EXK33-TR | 3.3 | SC70-5 | -40°C to +85°C | U3XX | 3000 |
| BCT2038EXKAJ-TR | ADJ | SC70-5 | -40°C to +85°C | UJXX | 3000 |
| BCT2038EJR12-TR | 1.2 | SOT89-3 | -40°C to +85°C | 2038 12XXX | 3000 |
| BCT2038EJR18-TR | 1.8 | SOT89-3 | -40°C to +85°C | 2038 18XXX | 3000 |
| BCT2038EJR28-TR | 2.8 | SOT89-3 | -40°C to +85°C | 2038 28XXX | 3000 |
| BCT2038EJR30-TR | 3.0 | SOT89-3 | -40°C to +85°C | 2038 30XXX | 3000 |
| BCT2038EJR33-TR | 3.3 | SOT89-3 | -40°C to +85°C | 2038 33XXX | 3000 |

Note:

"U in Marking is product short code for BCT2038

"XXX" in Marking will be appeared as the batch code.



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ABSOLUTE MAXIMUM RATINGS

| | |
|---------------------------------------------------------|----------------------|
| IN to GND..... | -0.3V to 6.0V |
| Output Short-Circuit Duration..... | Infinite |
| EN to GND..... | -0.3V to 6.0V |
| OUT,BP/FB to GND..... | -0.3V to (VIN +0.3V) |
| Power Dissipation, P _D @T _A =25°C | |
| SOT23-3..... | 0.42W |
| SOT23-5..... | 0.48W |
| SC70-5..... | 0.38W |
| SOT89-3..... | 1.25W |
| Package Thermal Resistance | |
| SOT23-3..... | 300°C/W |
| SOT23-5, θ _{JA} | 260°C/W |
| SC70-5, θ _{JA} | 330°C/W |
| SOT89-3, θ _{JA} | 100°C/W |
| Junction Temperature..... | 150°C |
| Storage Temperature Range..... | -65°C to 150°C |
| Lead Temperature (Soldering, 10 sec)..... | 260°C |
| ESD Susceptibility | |
| HBM..... | 4000V |
| MM..... | 400V |

RECOMMENDED OPERATING CONDITIONS

| | |
|-----------------------------------|----------------|
| Operating Voltage Range..... | 1.6V to 5.5V |
| Operating Temperature Range | -40°C to +85°C |

OVERSTRESS CAUTION

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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

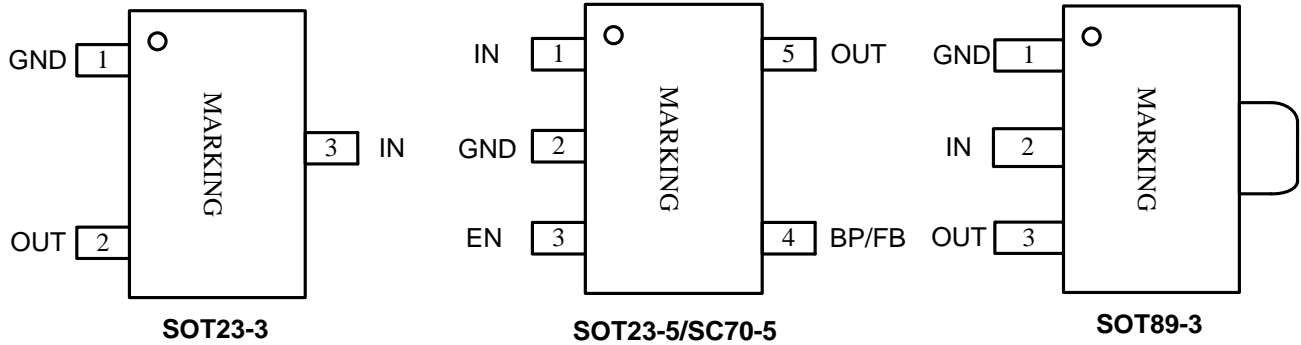
ESD SENSITIVITY CAUTION

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. Broadchip recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

DISCLAIMER

Broadchip reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact Broadchip sales office to get the latest datasheet.

PIN CONFIGURATION (TOP VIEW)



PIN DESCRIPTION

| PIN | | | NAME | FUNCTION |
|---------|-------------------|---------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SOT23-3 | SOT23-5 SC70-5 | SOT89-3 | | |
| 1 | 2 | 1 | GND | Ground. |
| 2 | 5 | 3 | OUT | Regulator Output. |
| 3 | 1 | 2 | IN | Regulator Input. Supply voltage can range from 1.6V to 5.5V. Bypass with a 1 μ F capacitor to GND. |
| - | 3 | - | EN | Enable Pin. This pin has an internal pull-down resistor. A logic low reduces the supply current to less than 1 μ A. Connect to IN for normal operation. |
| - | 4 | - | BP | Reference-Noise Bypass Pin (fixed voltage version only). Bypass with a low-leakage 0.01 μ F ceramic capacitor for reduced noise at the output. The capacitor is recommended to be placed very close to the pin for high PSRR. |
| - | | | FB | Adjustable Voltage Version Only. This is used to set the output voltage of the device. |

ELECTRICAL CHARACTERISTICS

($V_{IN} = V_{OUT(NOMINAL)} + 0.5V$ or $1.6V$, whichever is greater, Full = $-40^{\circ}C$ to $+85^{\circ}C$, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | TEMP | MIN | TYP | MAX | UNITS |
|--------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|----------------|------|------|------------------|
| Input Voltage | V_{IN} | | $+25^{\circ}C$ | 1.6 | | 5.5 | V |
| Output Voltage Accuracy | | $I_{OUT} = 0.1mA$ | $+25^{\circ}C$ | -2.5 | | +2.5 | % |
| Feedback Voltage | V_{FB} | $I_{OUT} = 0.1mA$, BCT2038-ADJ | $+25^{\circ}C$ | 0.78 | 0.8 | 0.82 | V |
| Maximum Output Current (1) | | | $+25^{\circ}C$ | 500 | | | mA |
| Current Limit | I_{LIM} | | $+25^{\circ}C$ | 560 | 800 | | mA |
| Ground Pin Current | I_Q | No Load, $V_{EN} = V_{IN}$ | $+25^{\circ}C$ | | 20 | 26 | μA |
| Dropout Voltage (2) | V_{DROP} | $I_{OUT} = 500mA$ | $1.2V \leq V_{OUT} < 1.8V$ | $+25^{\circ}C$ | 945 | 1280 | mV |
| | | | $1.8V \leq V_{OUT} < 2.5V$ | $+25^{\circ}C$ | 510 | 670 | |
| | | | $2.5V \leq V_{OUT} < 3.0V$ | $+25^{\circ}C$ | 345 | 450 | |
| | | | $3.0V \leq V_{OUT} < 3.6V$ | $+25^{\circ}C$ | 305 | 400 | |
| Line Regulation | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$ | $V_{IN} = 1.6V$ or ($V_{OUT} + 0.5V$) to $5.5V$, $I_{OUT} = 1mA$ | $1.8V \leq V_{OUT} \leq 3.3V$ | $+25^{\circ}C$ | 0.01 | 0.06 | %V |
| | | | $V_{OUT} < 1.8V$ or $V_{OUT} > 3.3V$ | $+25^{\circ}C$ | 0.01 | 0.1 | |
| Load Regulation | ΔV_{OUT} | $I_{OUT} = 0.1mA$ to $500mA$ | $+25^{\circ}C$ | | 12 | 40 | mV |
| Short Current Limit | I_{SHORT} | $V_{OUT} = 0V$ | $+25^{\circ}C$ | | 320 | | mA |
| Power Supply Rejection Ratio | PSRR | $C_{BP} = 0\mu F$, $I_{OUT} = 30mA$, $C_{OUT} = 1\mu F$, $V_{IN} = 2.8V$, $V_{OUT} = 1.8V$, $\Delta V_{RIPPLE} = 0.2V_{P-P}$ | $f = 217Hz$ | $+25^{\circ}C$ | 80 | | dB |
| | | | $f = 1kHz$ | $+25^{\circ}C$ | 70 | | |
| | | $C_{BP} = 0.01\mu F$, $I_{OUT} = 30mA$, $C_{OUT} = 1\mu F$, $V_{IN} = 2.8V$, $V_{OUT} = 1.8V$, $\Delta V_{RIPPLE} = 0.2V_{P-P}$ | $f = 217Hz$ | $+25^{\circ}C$ | 82 | | |
| | | | $f = 1kHz$ | $+25^{\circ}C$ | 75 | | |
| Output Voltage Noise | e_n | $C_{BP} = 0\mu F$, $f = 10Hz$ to $100kHz$, $C_{OUT} = 1\mu F$, $V_{IN} = 2.8V$, $V_{OUT} = 1.8V$ | $I_{OUT} = 0mA$ | $+25^{\circ}C$ | 70 | | μV_{RMS} |
| | | | $I_{OUT} = 30mA$ | $+25^{\circ}C$ | 100 | | |
| | | $C_{BP} = 0.01\mu F$, $f = 10Hz$ to $100kHz$, $C_{OUT} = 1\mu F$, $V_{IN} = 2.8V$, $V_{OUT} = 1.8V$ | $I_{OUT} = 0mA$ | $+25^{\circ}C$ | 25 | | |
| | | | $I_{OUT} = 30mA$ | $+25^{\circ}C$ | 65 | | |
| Output Voltage Temperature Coefficient (3) | $\frac{\Delta V_{OUT}}{\Delta T_A \times V_{OUT}}$ | $I_{OUT} = 0.1mA$ | Full | | 30 | | ppm/ $^{\circ}C$ |



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ELECTRICAL CHARACTERISTICS

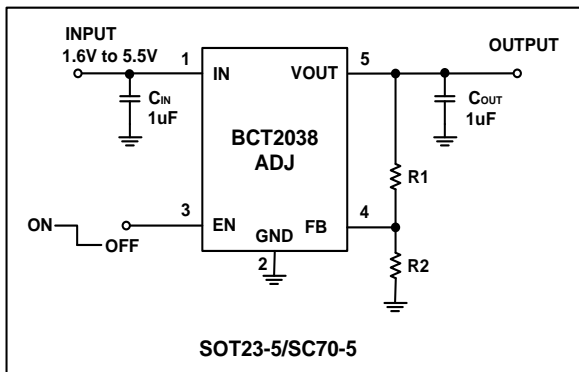
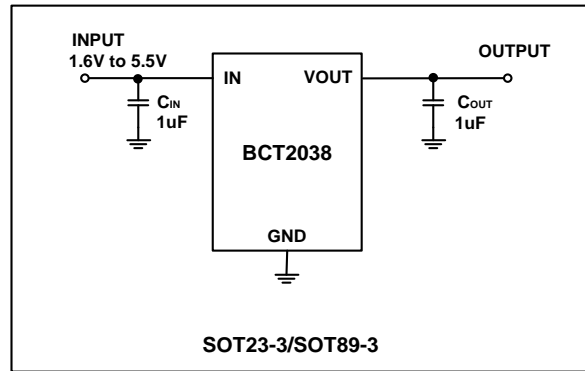
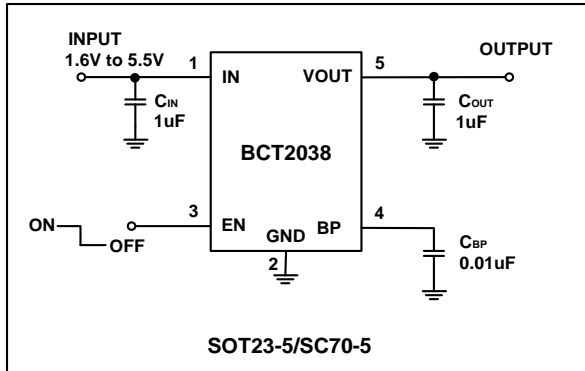
($V_{IN} = V_{OUT(NOMINAL)} + 0.5V$ or $1.6V$, whichever is greater, Full = $-40^{\circ}C$ to $+85^{\circ}C$, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | TEMP | MIN | TYP | MAX | UNITS |
|------------------------------|-------------------|-------------------------------------------------|----------------|-----|------|-----|-------------|
| SHUTDOWN | | | | | | | |
| EN Input Threshold | V_{IH} | $V_{IN} = 1.6V$ to $5.5V$ | Full | 1.5 | | | V |
| | V_{IL} | | Full | | | 0.4 | |
| EN Input Bias Current | I_{BH} | $V_{EN} = 5.5V$ | Full | | 0.8 | 2 | μA |
| | I_{BL} | $V_{EN} = 0V$ | Full | | 0.01 | 1 | |
| Shutdown Supply Current | I_{SHDN} | $V_{EN} = 0V$ | Full | | 0.01 | 1 | μA |
| Start-Up Time ⁽⁴⁾ | t_{STR} | $C_{OUT} = 1\mu F$, No Load, $C_{BP} = 0\mu F$ | $+25^{\circ}C$ | | 30 | | μs |
| R_{ON} of Discharge MOSFET | | $V_{IN} = 4.0V$, $V_{EN} = 0V$ | $+25^{\circ}C$ | | 50 | | Ω |
| THERMAL PROTECTION | | | | | | | |
| Thermal Shutdown Temperature | T_{SHDN} | | | | 140 | | $^{\circ}C$ |
| Thermal Shutdown Hysteresis | ΔT_{SHDN} | | | | 15 | | $^{\circ}C$ |

NOTES:

- Maximum output current is affected by the PCB layout, size of metal trace, the thermal conduction path between metal layers, ambient temperature and the other environment factors of system. Attention should be paid to the dropout voltage when $V_{IN} < V_{OUT} + V_{DROP}$.
- The dropout voltage is defined as $V_{IN} - V_{OUT}$, when V_{OUT} is 100mV below the value of V_{OUT} .
- Output voltage temperature coefficient is defined as the worst-case voltage change divided by the total temperature range.
- Time needed for V_{OUT} to reach 90% of final value.

TYPICAL APPLICATION CIRCUIT

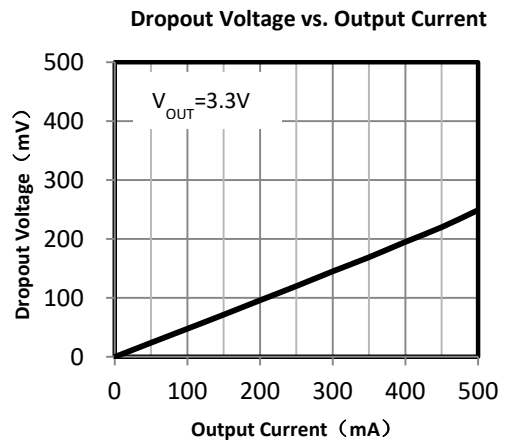
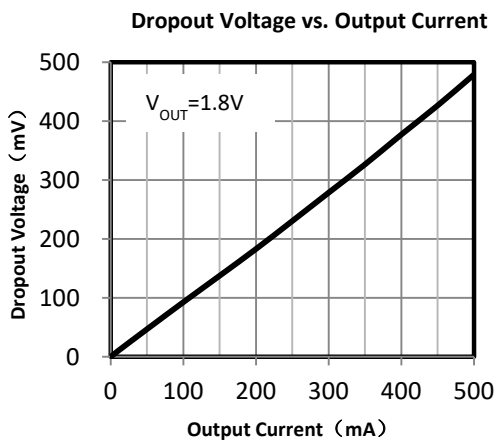
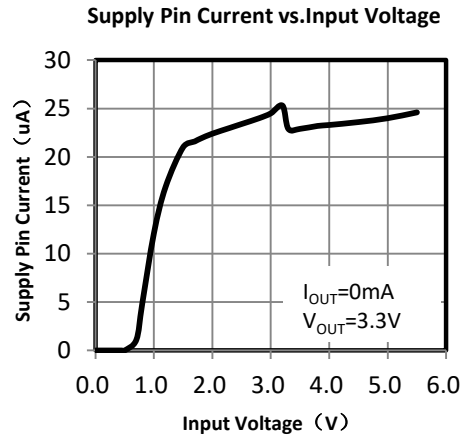
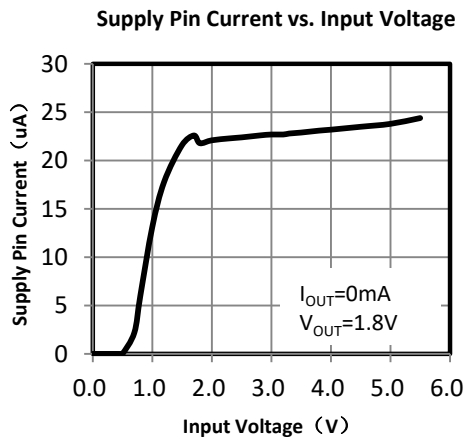
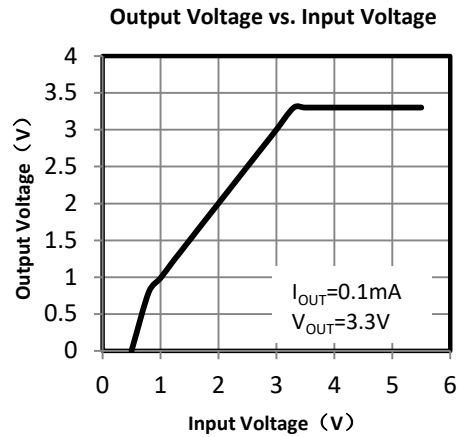
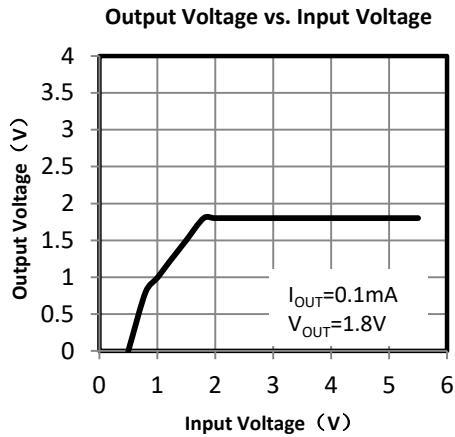


NOTES: Choose R2 = 160kΩ to maintain a 5μA minimum load.
Calculate the value for R1 using the following equation:

$$R_1 = R_2 \times \left(\frac{V_{OUT}}{0.8V} - 1 \right)$$

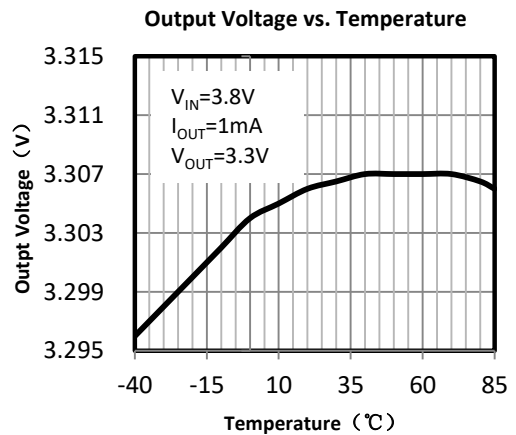
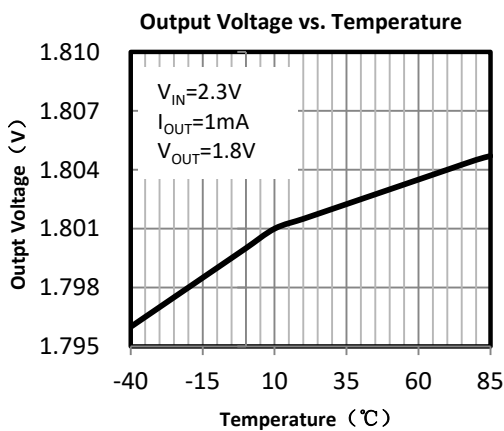
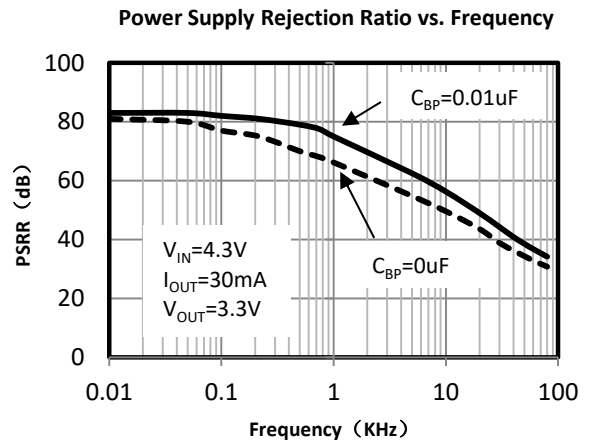
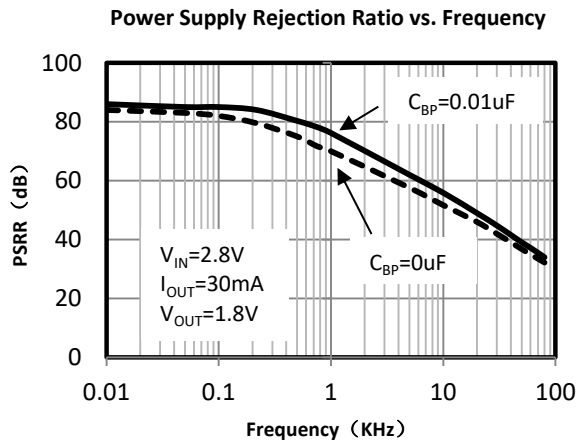
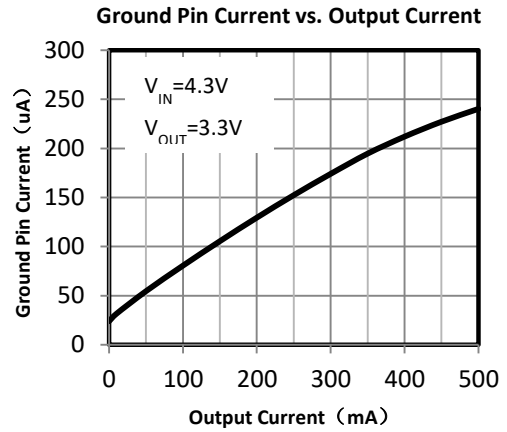
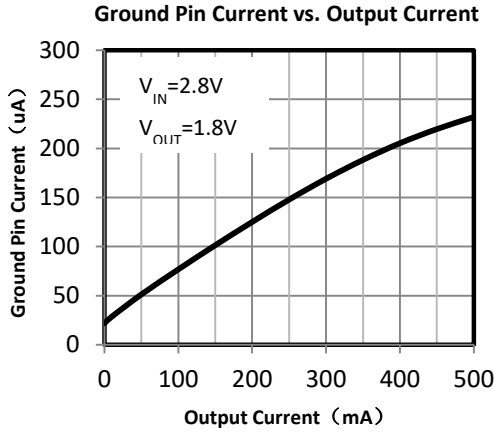
TYPICAL PERFORMANCE CHARACTERISTICS

$V_{EN} = V_{IN}$, $C_{IN} = 1\mu F$, $C_{OUT} = 1\mu F$, $C_{BP} = 0\mu F$, $T_A = +25^\circ C$, unless otherwise noted.



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

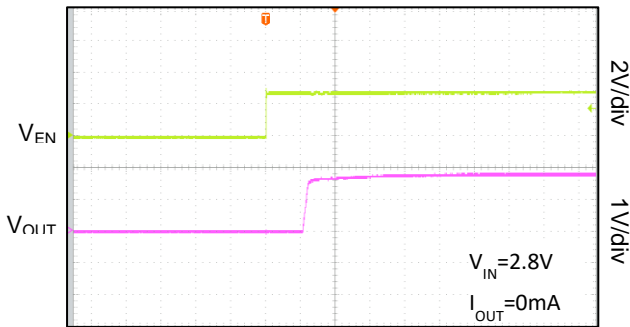
$V_{EN} = V_{IN}$, $C_{IN} = 1\mu F$, $C_{OUT} = 1\mu F$, $C_{BP} = 0\mu F$, $T_A = +25^\circ C$, unless otherwise noted.



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

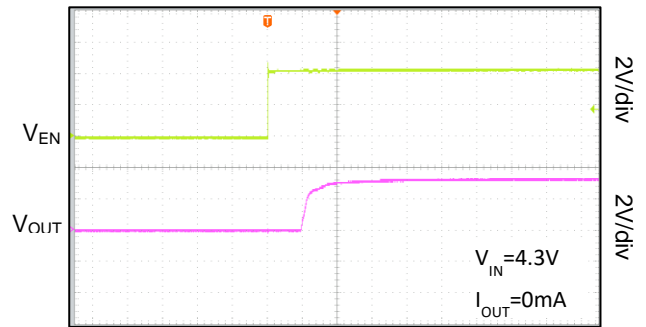
$V_{EN} = V_{IN}$, $C_{IN} = 1\mu F$, $C_{OUT} = 1\mu F$, $C_{BP} = 0\mu F$, $T_A = +25^\circ C$, unless otherwise noted.

Start up from EN ($V_{OUT}=1.8V$)



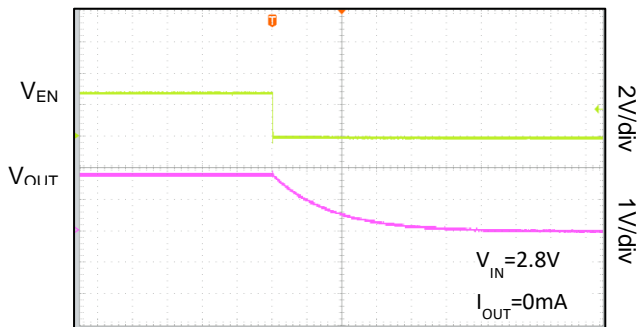
Time 20us/div

Start up from EN ($V_{OUT}=3.3V$)



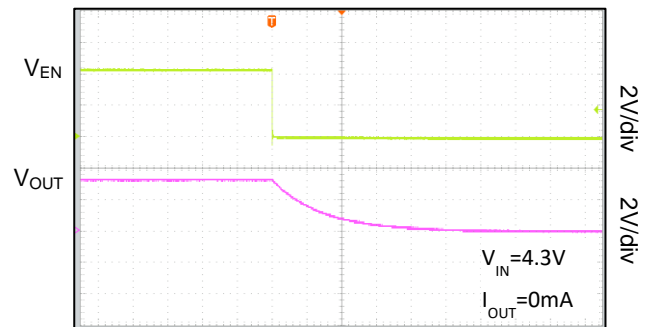
Time 20us/div

Shutdown from EN ($V_{OUT}=1.8V$)



Time 40us/div

Shutdown from EN ($V_{OUT}=3.3V$)

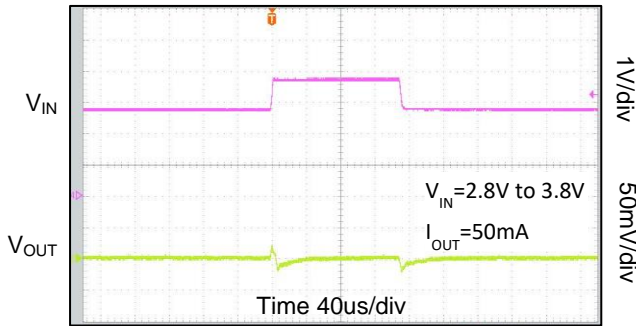


Time 40us/div

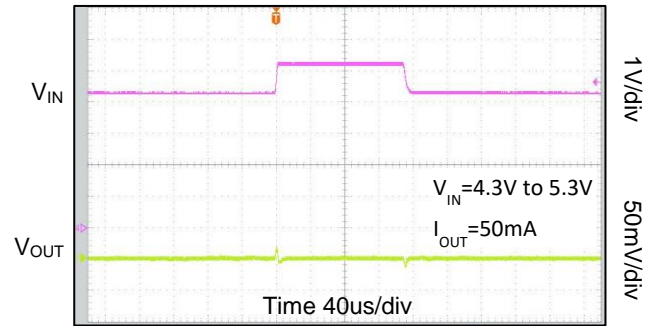
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{EN} = V_{IN}$, $C_{IN} = 1\mu F$, $C_{OUT} = 1\mu F$, $C_{BP} = 0\mu F$, $T_A = +25^\circ C$, unless otherwise noted.

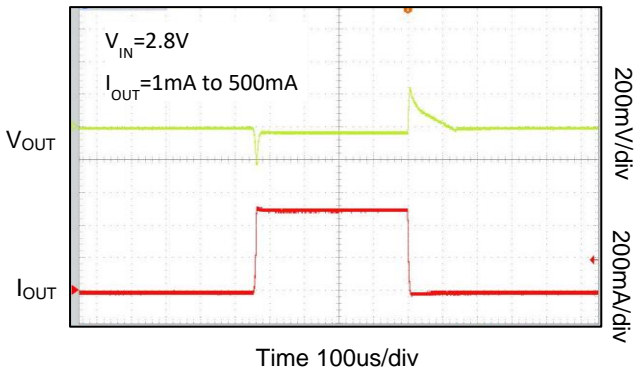
Line Transient Response ($V_{OUT}=1.8V$)



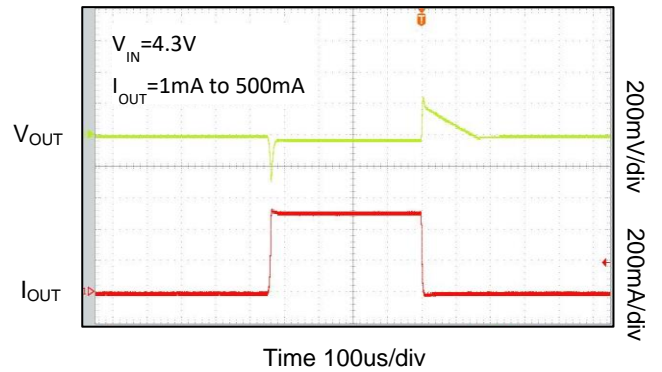
Line Transient Response ($V_{OUT}=3.3V$)



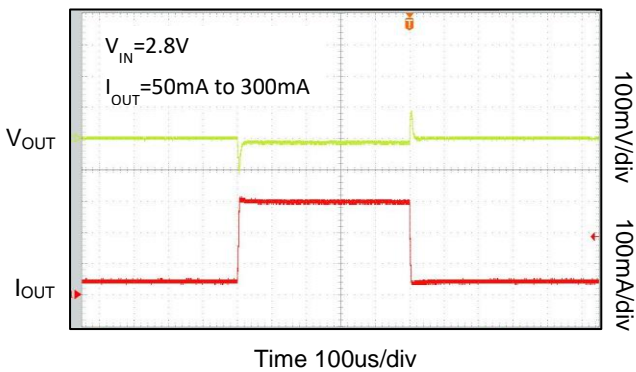
Load Transient Response ($V_{OUT}=1.8V$)



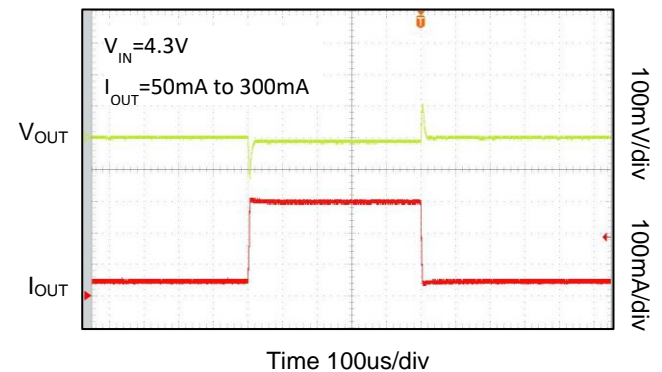
Load Transient Response ($V_{OUT}=3.3V$)



Load Transient Response ($V_{OUT}=1.8V$)

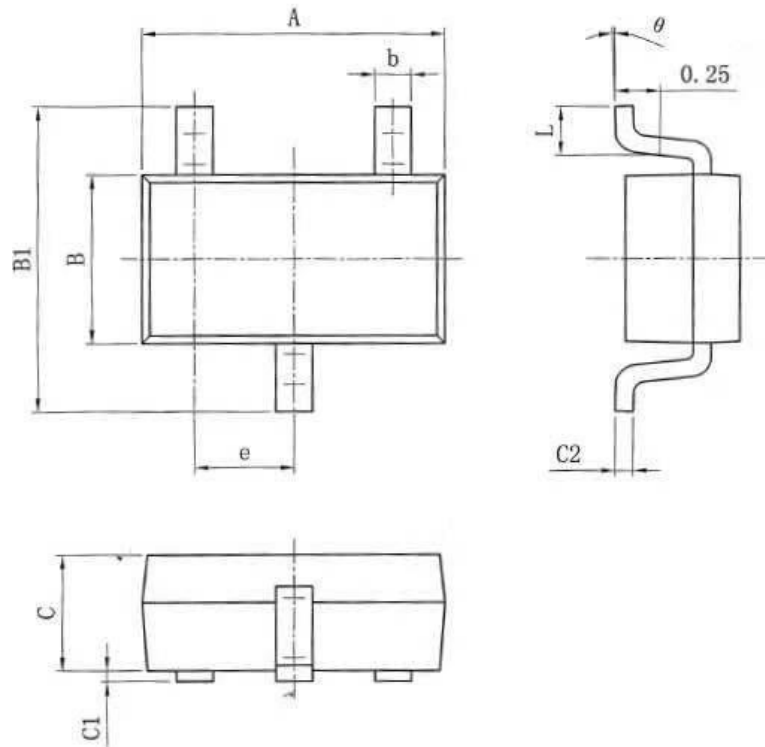


Load Transient Response ($V_{OUT}=3.3V$)



PACKAGE OUTLINE DIMENSIONS

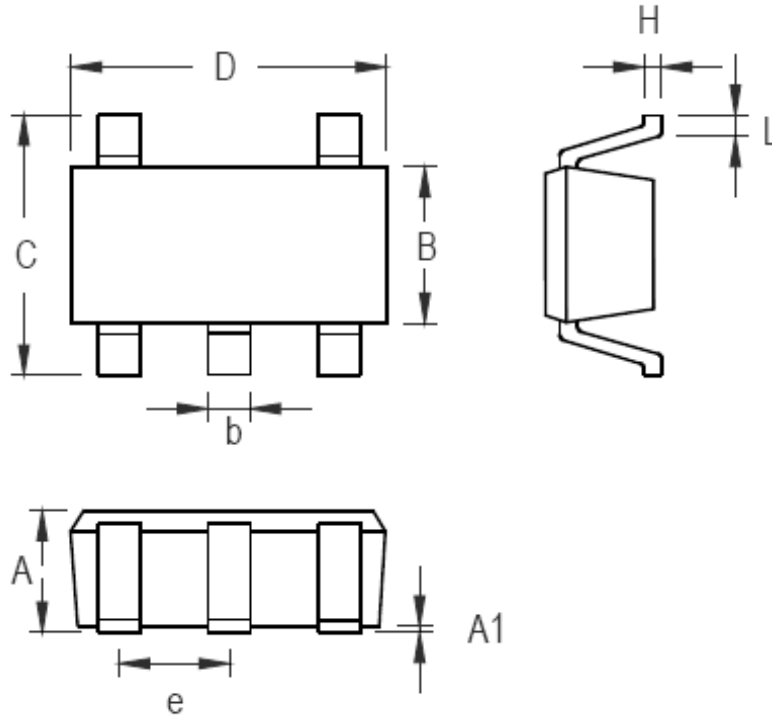
SOT23-3



| Symbol | Dimensions In Millimeters | |
|--------|---------------------------|------|
| | Min | Max |
| A | 2.82 | 3.02 |
| e | 0.95(BSC) | |
| b | 0.28 | 0.45 |
| B | 1.50 | 1.70 |
| B1 | 2.75 | 3.05 |
| C | 1.05 | 1.15 |
| C1 | 0.03 | 0.15 |
| C2 | 0.12 | 0.23 |
| L | 0.35 | 0.55 |
| θ | 0° | 8° |

SOT23-3 Surface Mount Package

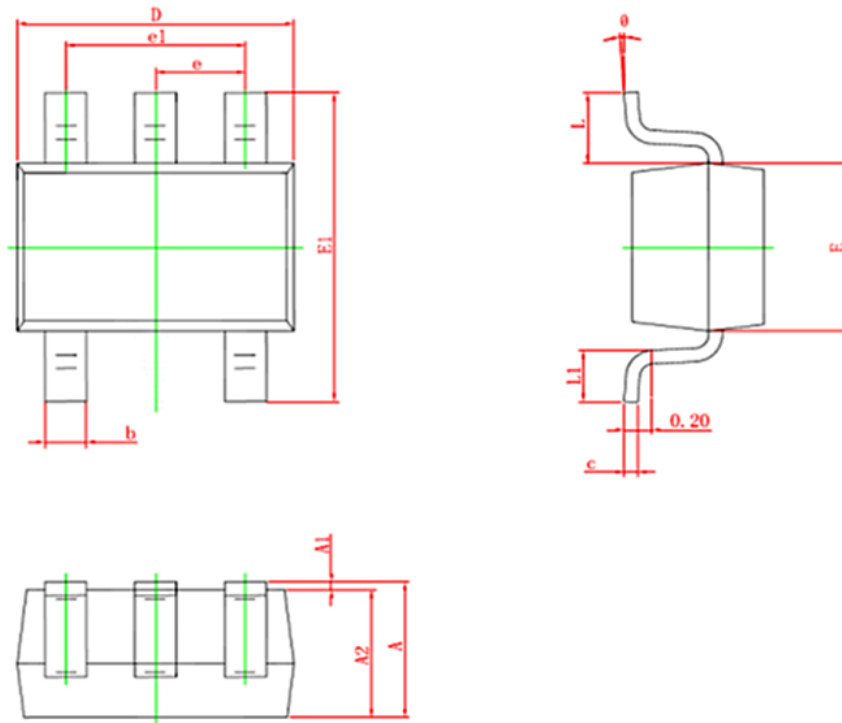
SOT23-5



| Symbol | Dimensions In Millimeters | |
|--------|---------------------------|------|
| | Min | Max |
| A | 1.05 | 1.15 |
| A1 | 0.03 | 0.15 |
| B | 1.5 | 1.7 |
| b | 0.28 | 0.45 |
| C | 2.75 | 3.05 |
| D | 2.82 | 3.02 |
| e | 0.95(BSC) | |
| H | 0.12 | 0.23 |
| L | 0.35 | 0.55 |

SOT23-5 Surface Mount Package

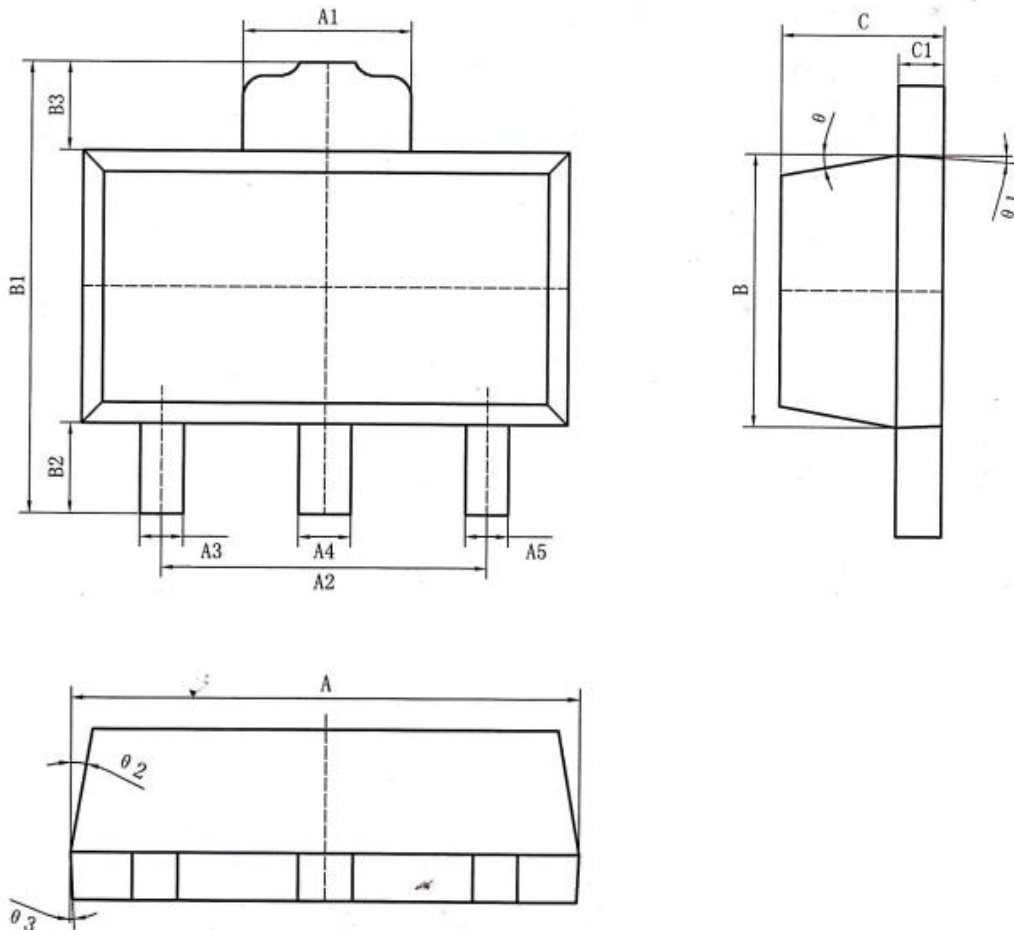
SC70-5



| Symbol | Dimensions In Millimeters | |
|----------|---------------------------|-------|
| | Min. | Max. |
| A | 0.900 | 1.100 |
| A1 | 0.000 | 0.100 |
| A2 | 0.900 | 1.000 |
| b | 0.150 | 0.350 |
| c | 0.110 | 0.175 |
| D | 2.000 | 2.200 |
| E | 1.150 | 1.350 |
| E1 | 2.150 | 2.450 |
| e | 0.650 TYP. | |
| e1 | 1.200 | 1.400 |
| L | 0.525 REF. | |
| L1 | 0.260 | 0.460 |
| θ | 0° | 8° |

SC70-5 Surface Mount Package

SOT89-3

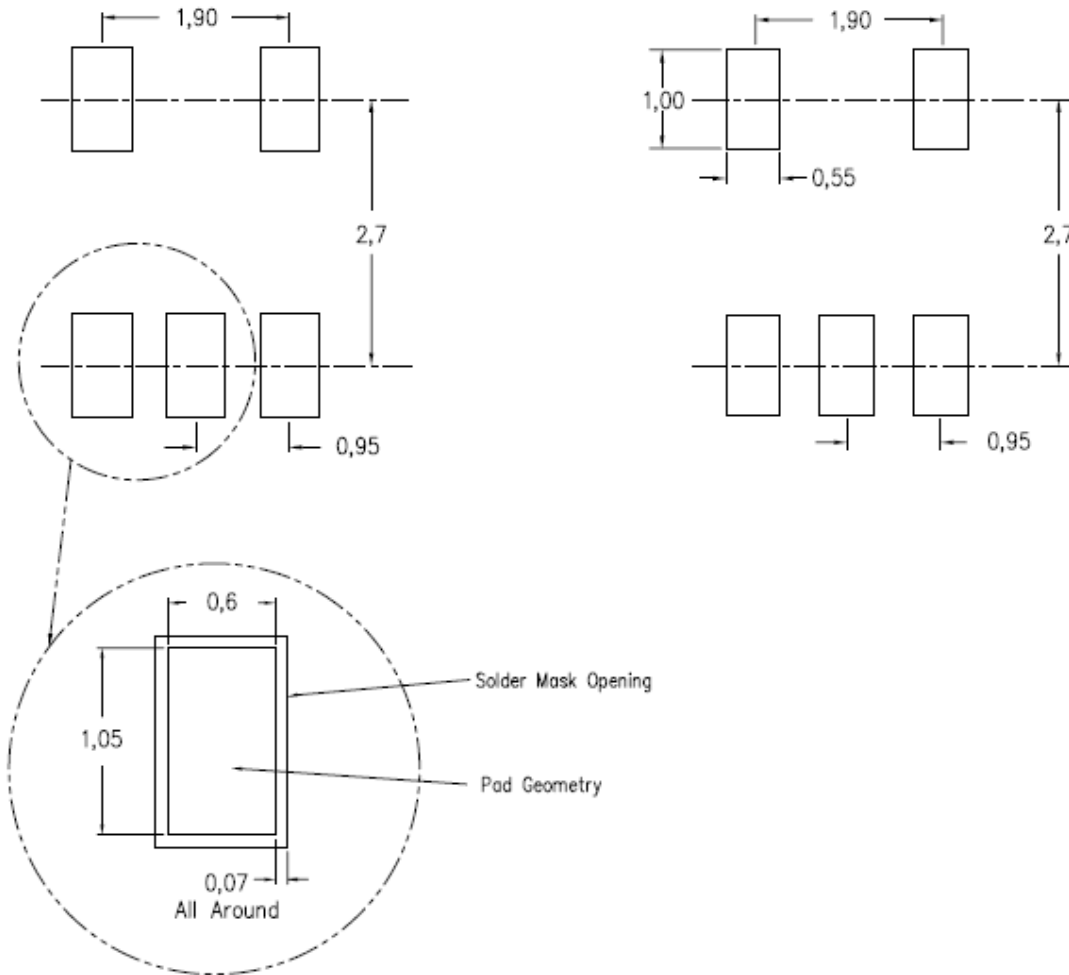


| 标注 | 尺寸 | 最小 (mm) | 最大 (mm) | 标注 | 尺寸 | 最小 (mm) | 最大 (mm) |
|----|----|---------|---------|-----|----|---------|---------|
| A | | 4.40 | 4.60 | B3 | | 0.82 | 0.83 |
| A1 | | 1.65 | 1.75 | C | | 1.40 | 1.60 |
| A2 | | 2.95 | 3.05 | C1 | | 0.35 | 0.45 |
| A3 | | 0.35 | 0.45 | θ | | 6° TYP4 | |
| A4 | | 0.43 | 0.53 | θ 1 | | 3° TYP4 | |
| A5 | | 0.35 | 0.45 | θ 2 | | 6° TYP4 | |
| B | | 2.40 | 2.60 | θ 3 | | 3° TYP4 | |
| B1 | | 4.05 | 4.25 | | | | |
| B2 | | 0.82 | 0.83 | | | | |

SOT89-3 Surface Mount Package

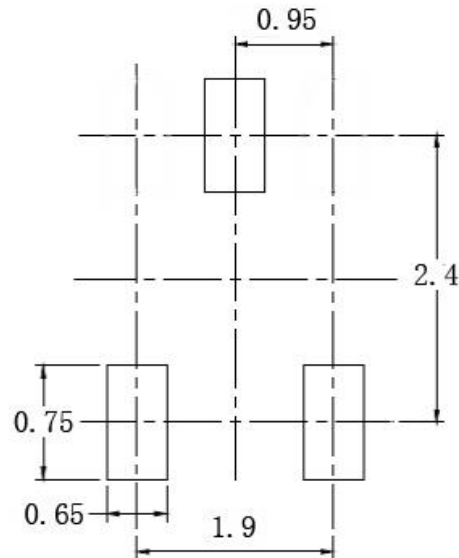
LAND PATTERN DATA

SOT23-5



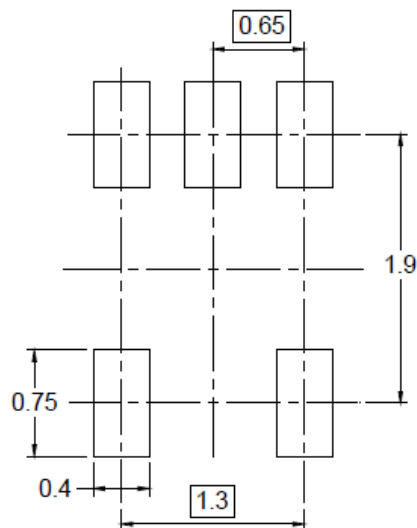
RECOMMENDED PCB LAYOUT PATTERN (Unit: mm)

SOT23-3



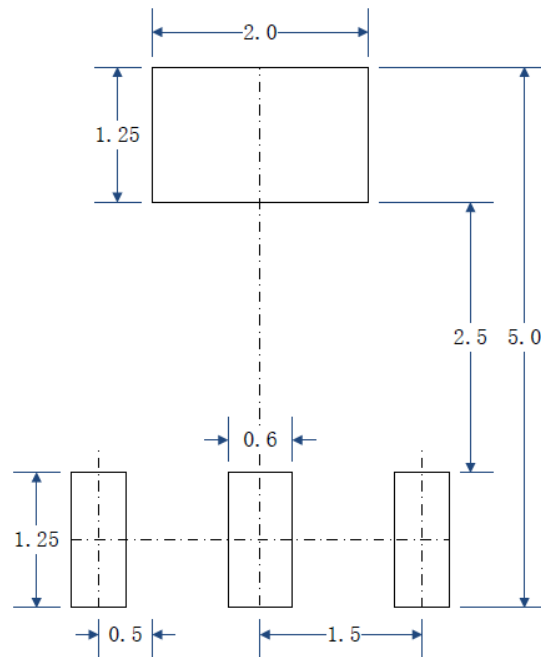
RECOMMENDED PCB LAYOUT PATTERN (Unit: mm)

SC70-5



RECOMMENDED PCB LAYOUT PATTERN (Unit: mm)

SOT89-3



RECOMMENDED PCB LAYOUT PATTERN (Unit: mm)