AMC Doc. #: AMC7587_C
January 2002

ADD MICROTECH CORP.

# AMC7587

## 1.5A Low Dropout Regulator

### DESCRIPTION

The AMC7587 is a high performance low dropout regulator rated for 1.5A output current with fixed 1.8V/2.5V/3.3V/5.0V and adjustable output. It is designed for use in applications requiring low dropout characteristics over the rated current range.

On chip trimming adjusts the reference voltage to 1%. These features are ideal for low voltage microprocessor applications requiring a regulated 2.5V to 3.6V power supply.

In addition, the AMC7587 provides the device protections including over current and thermal shutdown. Also, reverse battery protection scheme limits the reverse current when the input voltage falls below the output.

### FEATURES

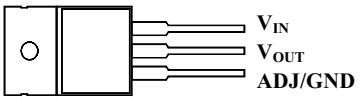
- **Input-Output differential of typical 1.1V at 1.5A and low quiescent current**
- **Output current is excess of 1.5A**
- Fast transient response
- Reverse battery protection
- Short circuit protection
- Internal thermal overload protection
- Available in 3L plastic TO-220, surface mount 3L TO-263/252, and SOT223 packages
- Pin assignment identical to EZ1585B and LT1585A series.

### APPLICATIONS

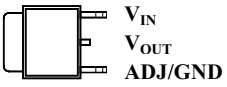
- Pentium® Processor Supplies
- PowerPC™ Supplies
- Computer Add-On Cards
- Other Applications Requiring Low Dropout Voltage Over Rated Current.

AMC7587-1.8 – 1.8V Fixed
AMC7587-2.5 – 2.5V Fixed
AMC7587-3.3 – 3.3V Fixed
AMC7587-5.0 – 5.0V Fixed
AMC7587-ADJ – Adjustable

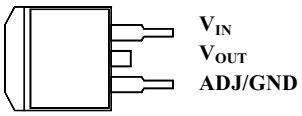
### PACKAGE PIN OUT



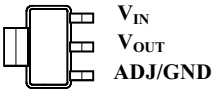

3-Pin Plastic TO-220 (T)
(Top View)




3-Pin Plastic TO-252(SJ)
Surface Mount
(Top View)




3-Pin Plastic TO-263(ST)
Surface Mount
(Top View)



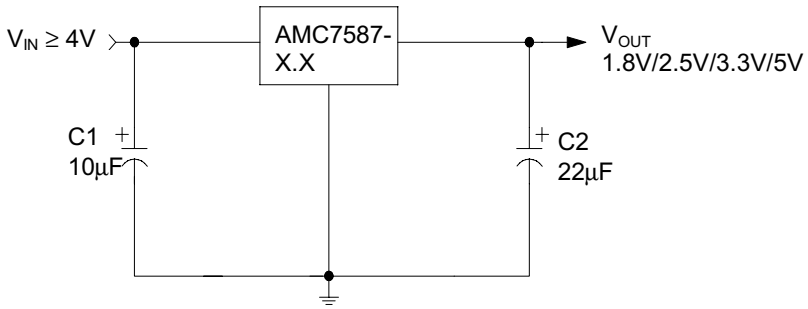

3-Pin Plastic SOT-223(SK)
Surface Mount
(Top View)

### ORDER INFORMATION

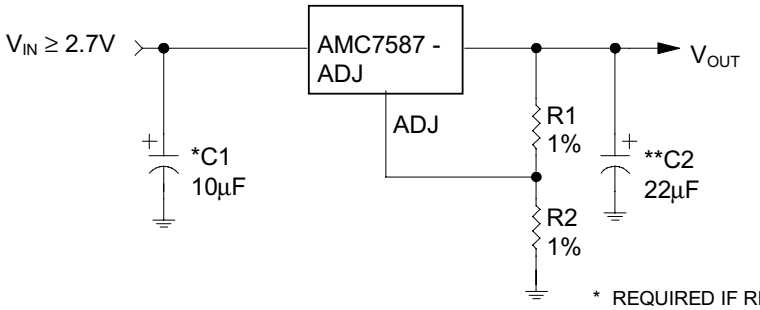
| $T_A$ (°C) | T TO-220 3-pin | ST TO-263 3-pin | SK SOT-223 3-pin | SJ TO-252 3-pin |
|---|---|---|---|---|
| 0 to 70 | **AMC7587-X.XT** | **AMC7587-X.XST** | **AMC7587-X.XSK** | **AMC7587-X.XSJ** |
| 0 to 70 | **AMC7587-ADJT** | **AMC7587-ADJST** | **AMC7587-ADJSK** | **AMC7587-ADJSJ** |

Note: All surface-mount packages are available in Tape & Reel. Append the letter "T" to part number (i.e., AMC7587-X.XSTT, AMC7587-X.XSKT, AMC7587-X.XSJT).

## TYPICAL APPLICATION




AMC7587-X.X application schematic




$V_{OUT} = V_{REF} (1+(R2/R1)) + I_{ADJ}R2$

* REQUIRED IF REGULATOR IS LOCATED FAR FROM POWER SUPPLY FILTER
** DESIGN C2 AS CLOSE TO $V_{OUT}$ PIN AS POSSIBLE

AMC7587-ADJ application schematic

| ABSOLUTE MAXIMUM RATINGS (Note 1) | |
|---|---|
| Input Voltage ($V_{IN}$) | 10.5V |
| Operating Junction temperature | 150℃ |
| Storage Temperature Range | -65℃ to 150℃ |
| Lead temperature (Soldering, 10 seconds) | 300℃ |

Note 1: Exceeding these ratings could cause damage to the device. All voltages are with respect to Ground. Currents are positive into, negative out of the specified terminal.

**POWER DISSIPATION TABLE**

| Package | $\theta_{JA}$ (℃/W ) | Derating factor ( mW/℃ ) $T_A \geqq 25$℃ | $T_A \leqq 25$℃ Power rating(mW) | $T_A$=70℃ Power rating(mW) | $T_A$= 85℃ Power rating (mW) |
|---|---|---|---|---|---|
| T | 45 | 22.2 | 2775 | 1776 | 1443 |
| ST/ST3 | 45 | 22.2 | 2775 | 1776 | 1443 |
| SJ | 80 | 12.5 | 1562 | 1000 | 812 |
| SK | 136 | 7.35 | 919 | 588 | 478 |

Note :

1. $\theta_{JA:}$ Thermal Resistance-Junction to Ambient, $D_F$ : Derating factor, Po: Power consumption.
   Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$, $Po = D_F \times (T_J - T_A)$
   The $\theta_{JA}$ numbers are guidelines for the thermal performance of the device/PC-board system.
   All of the above assume no ambient airflow.

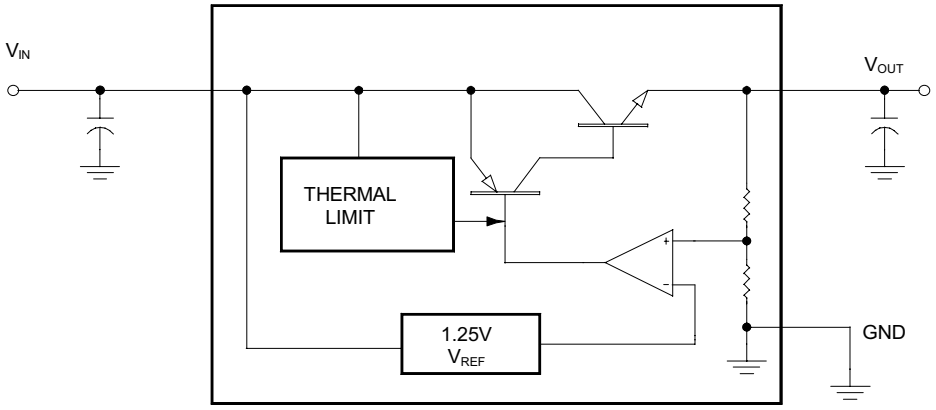
2. $\theta_{JT:}$ Thermal Resistance-Junction to Ambient, $T_C$: case(Tab) temperature, $T_J = T_C + (P_D \times \theta_{JT})$
   For T and ST/ST3 packages, $\theta_{JT}$ = 3.0℃/W.
   For SJ package, $\theta_{JT}$ = 7.0℃/W.
   For SJ package, $\theta_{JT}$ = 15.0℃/W

3. If power consumption is over above rating, adequate heat sink is required to dissipate heat.

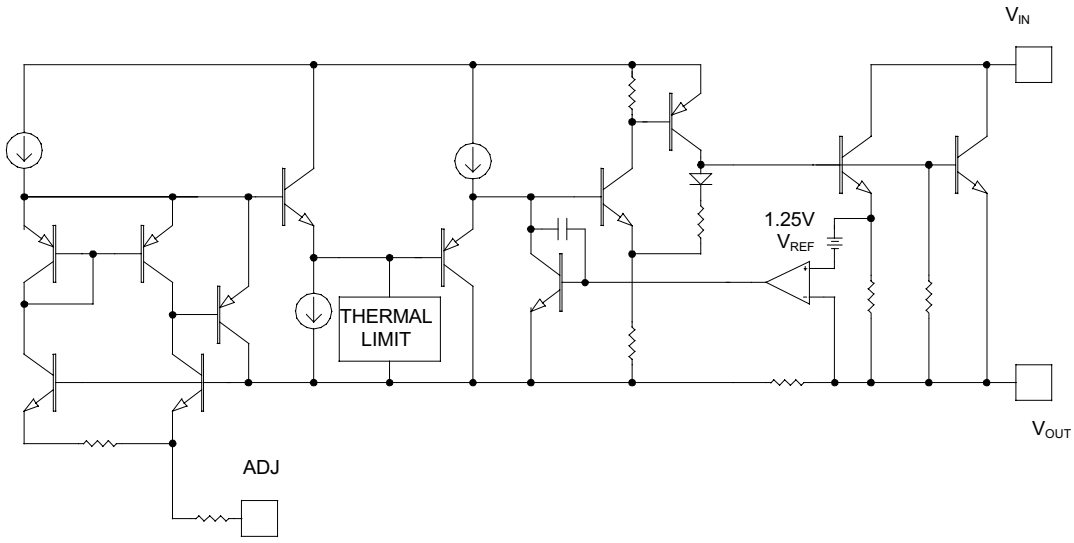
**RECOMMENDED OPERATING CONDITIONS**

| Parameter | Symbol | Recommended Operating Conditions | | | Units |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Input Voltage | $V_{IN}$ | 2.7 | | 10 | V |
| Load Current (with adequate heatsinking) | $I_o$ | 0.010 | | 1.5 | A |
| Input Capacitor ($V_{IN}$ to GND) | | 1 | | | µF |
| Output Capacitor with ESR of 10Ω max., ($V_{OUT}$ to GND) | | 10 | | | µF |
| Operating Ambient Temperature Range | | 0 | | 70 | ℃ |

## BLOCK DIAGRAM




AMC7587-X.X circuit schematic




AMC7587-ADJ circuit schematic

## ELECTRICAL CHARACTERISTICS

Unless otherwise specified, $V_{IN} = V_{OUT} + 2V$, $I_O = 10mA$. These specifications apply operating ambient temperature range, and are for DC characteristics only. (Low duty cycle pulse testing techniques are used which maintains junction and case temperatures equal to the ambient temperature.)

| Parameter | | Symbol | Test Conditions | | AMC7587 Min. | AMC7587 Typ. | AMC7587 Max. | Units |
|---|---|---|---|---|---|---|---|---|
| Output Voltage | AMC7587-1.8 | $V_{OUT}$ | $T_A = 25℃$ | | 1.782 | 1.800 | 1.818 | V |
| | AMC7587-2.5 | | $T_A = 25℃$ | | 2.475 | 2.500 | 2.525 | |
| | AMC7587-3.3 | | $T_A = 25℃$ | | 3.267 | 3.300 | 3.333 | |
| | AMC7587-5.0 | | $T_A = 25℃$ | | 4.950 | 5.000 | 5.050 | |
| Output Voltage | AMC7587-1.8 | $V_{OUT}$ | $I_O$ = 10mA to 1.5A | | 1.771 | 1.800 | 1.829 | V |
| | AMC7587-2.5 | | | | 2.460 | 2.500 | 2.540 | |
| | AMC7587-3.3 | | | | 3.247 | 3.300 | 3.353 | |
| | AMC7587-5.0 | | | | 4.920 | 5.000 | 5.080 | |
| Reference Voltage | AMC7587-ADJ | $V_{REF}$ | (Note 1) | | 1.238 | 1.250 | 1.262 | V |
| | | | $I_O$ = 10mA to 1.5A, (Note 1) | | 1.230 | 1.250 | 1.270 | |
| Line Regulation (Note 2) | | $\triangle V_{OI}$ | $(1.5V + V_{OUT}) \le V_{IN} \le 10V$ | | | 0.04 | 0.2 | % |
| Load regulation (Note 2) | | $\triangle V_{OL}$ | $I_O$ = 10mA to 1.5A | | | 0.08 | 0.3 | % |
| Dropout Voltage | | $\triangle V$ | (Note 3) | $I_O$ = 10mA | | 1.00 | 1.15 | V |
| | | | | $I_O$ = 1.5A | | 1.15 | 1.30 | |
| Quiescent Current ( for AMC7587-X.X) | | $I_Q$ | $V_{IN} \le 10V$, $I_O$ = 10mA to 1.5A | | | 8 | 13 | mA |
| Adjust Pin Current ( for AMC7587-ADJ) | | $I_{ADJ}$ | | | | 50 | 120 | µA |
| Current Limit | | $I_{CL}$ | $(V_{IN} - V_{OUT}) = 2V$ | | 1.5 | 3 | | A |
| Minimum Load Current (Note 4) | | Imin | | | | 5 | 10 | mA |
| Ripple Rejection (Note 5) | | $R_R$ | $V_{RIPPLE} = 1V_{PP}$, $I_O$ = 100mA, fo=120 HZ | | 60 | 80 | | dB |

Note 1 Output voltage is set to be 2.5V.

Note 2: Line and load regulations are guaranteed up to maximum power dissipation determined by input/output differential and the output current. However, the maximum power will not be available over the full input/output voltage range.

Note 3: The specifications represent the minimum input/output voltage required to maintain 1% regulation.

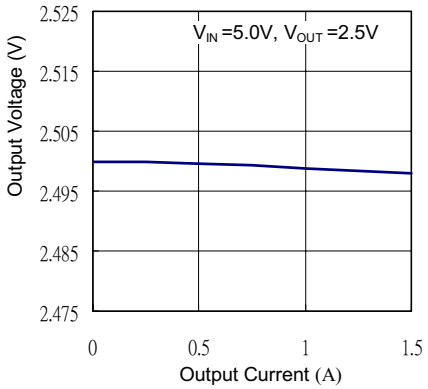
Note 4: The minimum load current is the minimum current required to maintain regulation. Normally the current in the resistor divider used to set the output voltage is selected to meet the minimum load current requirement.

Note 5: These parameters, although guaranteed, are not tested in production prior to shipment

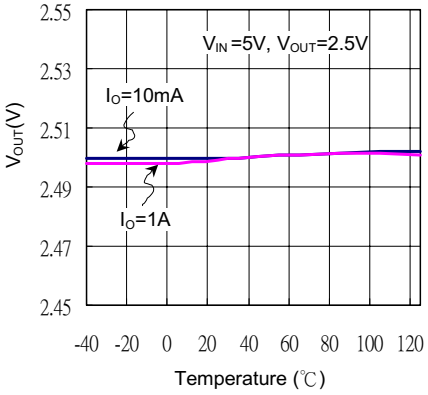
## CHARACTERISTICS CURVES

$C_{IN}$=10uF, $C_{OUT}$=22uF, $T_A$=25℃, unless otherwise specified.

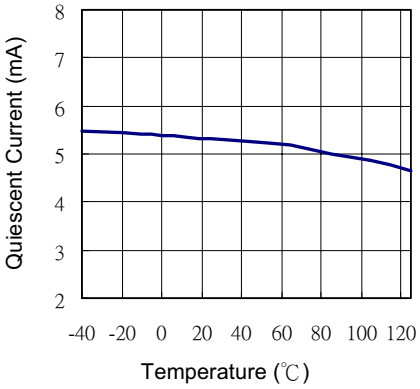
### Load Regulation



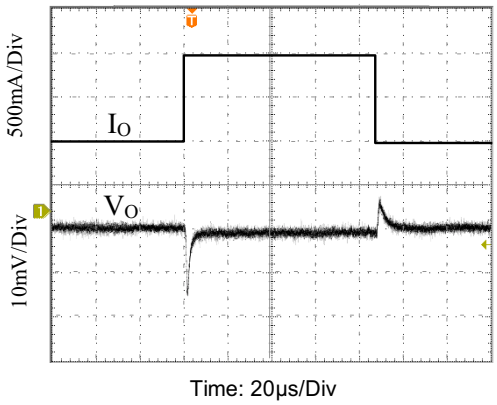

### Output Voltage v.s. Temperature




### Quiescent Current vs. Temperature




### Load Transient Response with $I_O$=1A



## APPLICATION INFORMATION:

- **Thermal Consideration**

**Maximum Power Calculation:**

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_{A(MAX)}}{\theta_{JA}}$$

$T_J$(℃): Maximum recommended junction temperature

$T_A$(℃): Ambient temperature of the application

$\theta_{JA}$(℃/W): Junction-to-junction temperature thermal resistance of the package, and other heat dissipating materials.

**The maximum power dissipation of a single-output regulator** :

$$P_{D(MAX)} = [(V_{IN(MAX)} - V_{OUT(NOM)})] \times I_{OUT(NOM)} + V_{IN(MAX)} \times I_Q$$

Where: $V_{OUT(NOM)}$ = the nominal output voltage
$I_{OUT(NOM)}$ = the nominal output current, and
$I_Q$ = the quiescent current the regulator consumes at $I_{OUT(MAX)}$
$V_{IN(MAX)}$ = the maximum input voltage

Then $\theta_{JA} = (150℃ - T_A)/P_D$

**Thermal consideration:**

When power consumption is over about 1.2W for the devices using TO-220/263 packages ( 687 mW for TO-252 package, 404mW for SOT223 package ) at an environment of 70°C ambient temperature, additional heat sink is required to control the junction temperature below 125℃.

The junction temperature is: $Tj = P_D ( \theta_{JT} + \theta_{CS} + \theta_{SA} ) + T_A$

$P_D \equiv$ Dissipated power.

$\theta_{JT} \equiv$ Thermal resistance from the junction to the mounting tab of the package.

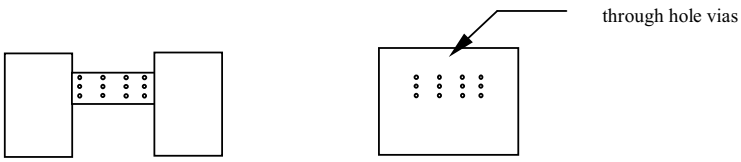
$\theta_{CS} \equiv$ Thermal resistance through the interface between the IC and the surface on which it is mounted. (typically, $\theta_{CS} < 1.0$℃/W)

$\theta_{SA} \equiv$ Thermal resistance from the mounting surface to ambient (thermal resistance of the heat sink).

If PC Board copper is going to be used as a heat sink, below table can be used to determine the appropriate size of copper foil required. For multi-layered PCB, these layers can also be used as a heat sink. They can be connected with several through hole vias.

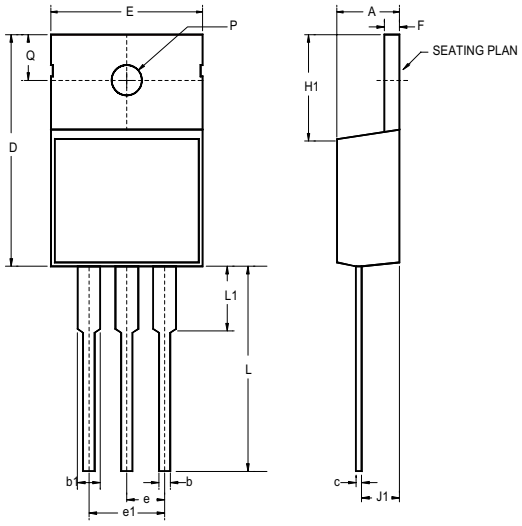
| PCB $\theta_{SA}$ (℃/W ) | 59 | 45 | 38 | 33 | 27 | 24 | 21 |
|---|---|---|---|---|---|---|---|
| PCB heat sink size ($mm^2$) | 500 | 1000 | 1500 | 2000 | 3000 | 4000 | 5000 |

Recommended figure of PCB area used as a heat sink.



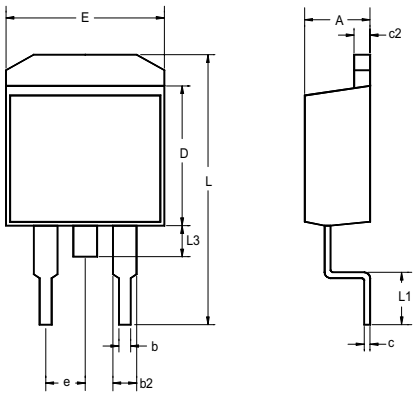

(Top View) (Bottom View)

## 3-Pin Plastic TO-220 (T)



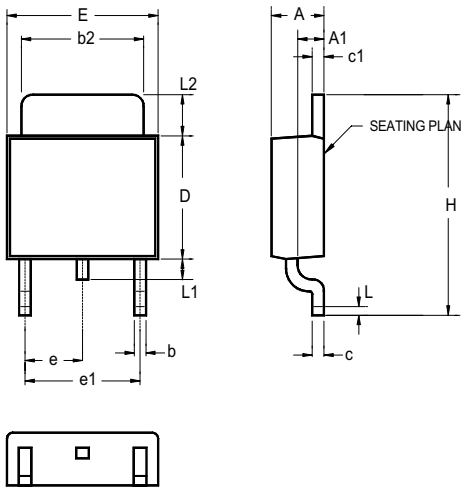

| | INCHES | | | MILLIMETERS | | |
|---|---|---|---|---|---|---|
| | MIN | TYP | MAX | MIN | TYP | MAX |
| A | 0.140 | - | 0.190 | 3.56 | - | 4.83 |
| b1 | 0.045 | - | 0.070 | 1.14 | - | 1.78 |
| b | 0.020 | - | 0.045 | 0.51 | - | 1.14 |
| c | 0.012 | - | 0.045 | 0.30 | - | 1.14 |
| D | 0.560 | - | 0.650 | 14.22 | - | 16.51 |
| E | 0.380 | - | 0.420 | 9.65 | - | 10.67 |
| e | 0.090 | - | 0.110 | 2.29 | - | 2.79 |
| e1 | 0.190 | - | 0.210 | 4.83 | - | 5.33 |
| F | 0.020 | | 0.055 | 0.51 | - | 1.40 |
| H1 | 0.230 | - | 0.270 | 5.84 | - | 6.86 |
| J1 | 0.080 | - | 0.115 | 2.03 | - | 2.92 |
| L | 0.500 | - | 0.580 | 12.7 | - | 14.73 |
| P | 0.139 | - | 0.161 | 3.53 | - | 4.09 |
| Q | 0.100 | - | 0.135 | 2.54 | - | 3.43 |
| L1 | - | - | 0.250 | - | - | 6.35 |

## 3-Pin Surface Mount TO-263 (ST)



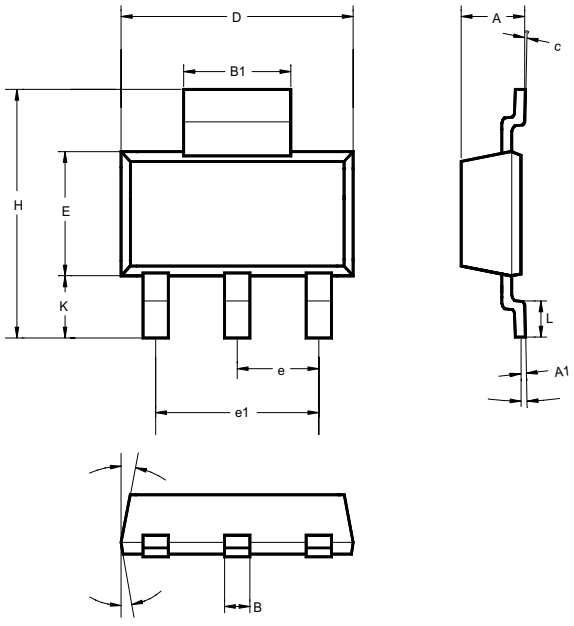

| | INCHES | | | MILLIMETERS | | |
|---|---|---|---|---|---|---|
| | MIN | TYP | MAX | MIN | TYP | MAX |
| A | 0.160 | - | 0.190 | 4.06 | - | 4.83 |
| b | 0.020 | - | 0.039 | 0.51 | - | 0.99 |
| b2 | 0.045 | - | 0.055 | 1.14 | - | 1.40 |
| c | 0.015 TYP. | | | 0.38 TYP. | | |
| c2 | 0.045 | - | 0.055 | 1.14 | - | 1.40 |
| D | 0.340 | - | 0.380 | 8.64 | - | 9.65 |
| E | 0.380 | - | 0.405 | 9.65 | - | 10.29 |
| e | 0.100 BSC | | | 2.54 BSC | | |
| L | 0.575 | - | 0.625 | 14.61 | - | 15.88 |
| L1 | 0.090 | - | 0.110 | 2.29 | - | 2.79 |
| L2 | - | - | 0.115 | - | - | 2.92 |
| L3 | 0.050 | - | 0.070 | 1.27 | - | 1.78 |

## 3-Pin Surface Mount TO-252 (SJ)




| | INCHES | | | MILLIMETERS | | |
|---|---|---|---|---|---|---|
| | MIN | TYP | MAX | MIN | TYP | MAX |
| A | 0.086 | - | 0.094 | 2.18 | - | 2.39 |
| A1 | 0.040 | - | 0.050 | 1.02 | - | 1.27 |
| b | - | 0.024 | - | - | 0.61 | - |
| b2 | 0.205 | - | 0.215 | 5.21 | - | 5.46 |
| c | 0.018 | - | 0.023 | 0.46 | - | 0.58 |
| c1 | 0.018 | - | 0.023 | 0.46 | - | 0.58 |
| D | 0.210 | - | 0.220 | 5.33 | - | 5.59 |
| E | 0.250 | - | 0.265 | 6.35 | - | 6.73 |
| e | 0.090 BSC | | | 2.29 BSC | | |
| e1 | 0.180 BSC | | | 4.58 BSC | | |
| H | 0.370 | - | 0.410 | 9.40 | - | 10.41 |
| L | 0.020 | - | - | 0.51 | - | - |
| L1 | 0.025 | - | 0.040 | 0.64 | - | 1.02 |
| L2 | 0.060 | - | 0.080 | 1.52 | - | 2.03 |

## 3-Pin Surface Mount SOT-223 ( SK )




| | MILLIMETERS | | |
|---|---|---|---|
| | MIN | TYP | MAX |
| A | 1.50 | 1.65 | 1.80 |
| A1 | 0.02 | 0.05 | 0.08 |
| B | 0.60 | 0.70 | 0.80 |
| B1 | 2.90 | - | 3.15 |
| c | 0.28 | 0.30 | 0.32 |
| D | 6.30 | 6.50 | 6.70 |
| E | 3.30 | 3.50 | 3.70 |
| e | 2.3 BSC | | |
| e1 | 4.6 BSC | | |
| H | 6.70 | 7.00 | 7.30 |
| L | 0.91 | 1.00 | 1.10 |
| K | 1.50 | 1.75 | 2.00 |
| α | 0° | 5° | 10° |
| β | | 3° | |

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