

3-Terminal Fixed Negative Voltage Regulator

❖ GENERAL DESCRIPTION

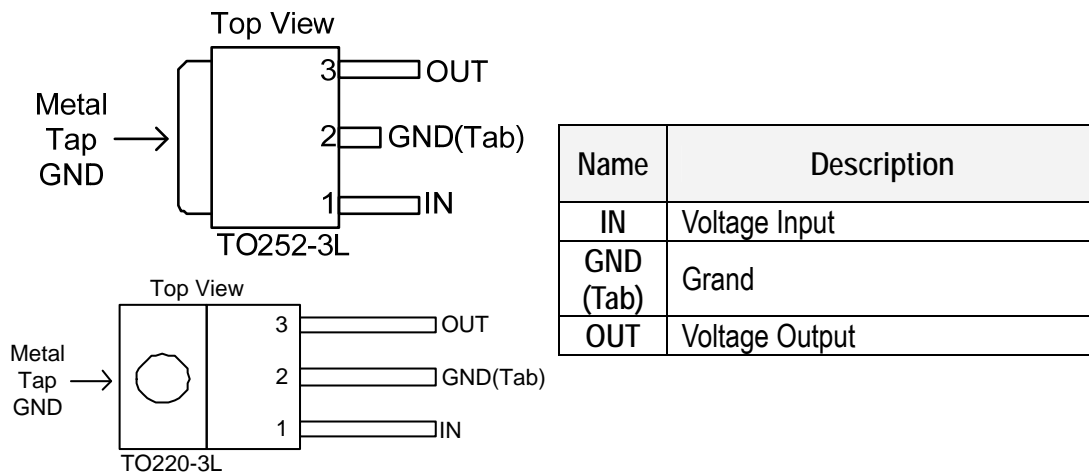
The AX7805/09/12 series voltage regulators are monolithic integrated circuits designed as fixed-voltage regulators for a wide variety of applications including local, on-card regulation. These regulators employ internal current limiting, thermal shutdown, and safe-area compensation. With adequate heatsink they can deliver output currents up to 1 ampere. Although designed primarily as a fixed voltage regulator, these devices can be used with external components to obtain adjustable voltages and currents.

❖ FEATURES

- Output Voltage Range 5 to 24V
- Output current up to 1A
- No external components required
- Internal thermal overload protection
- Internal short-circuit current limiting
- Output transistor safe-area compensation
- Output voltage offered in 4% tolerance

❖ PIN ASSIGNMENT

The packages of AX7805/09/12 are TO220-3L and TO252-3L; the pin assignment is given by:



❖ ORDER/MARKING INFORMATION

| Order Information | Top Marking |
|---|--|
| <p style="text-align: center;">AX78XX XX</p> <pre> graph TD A[AX78XX XX] --- B[Product] A --- C[Package] A --- D[Packing] B --- B1[05: AX7805] B --- B2[09: AX7809] B --- B3[12: AX7812] C --- C1[D : TO252-3L] C --- C2[T : TO220-3L] D --- D1[Blank : Tube] D --- D2[A : Taping] </pre> <p>Product 05: AX7805 09: AX7809 12: AX7812</p> <p>Package D : TO252-3L T : TO220-3L</p> <p>Packing Blank : Tube A : Taping</p> | <p>Logo ← AX 7 8 XX → Part number 05: AX7805 09: AX7809 12: AX7812</p> <p>YYWWX ID code: internal WW: 01~52 Year : 10 = 2010 11 = 2011</p> |

❖ ABSOLUTE MAXIMUM RATINGS

(T_A = 25°C unless otherwise noted)

| Characteristics | Symbol | Rating | Unit |
|--|------------------|-------------------------|------|
| Input Voltage | V _{IN} | V _{OUT} =5~18V | 35 |
| | | V _{OUT} =24V | 40 |
| Output Current | I _{OUT} | Internal Limited | |
| Power Dissipation | P _D | Internal Limited | |
| Operating Junction Temperature | T _J | 0~+125 | °C |
| Storage Temperature Range | T _{STG} | -65~+150 | °C |
| Thermal Resistance - Junction to Case | θ _{JC} | TO220-3L | 5 |
| | | TO252-3L | 10 |
| Thermal Resistance - Junction to Ambient | θ _{JA} | TO220-3L | 45 |
| | | TO252-3L | 55 |

Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied

❖ ELECTRICAL CHARACTERISTICS

| AX7805 Electrical Characteristics ($V_{IN}=10V$, $I_{OUT}=500mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{IN}=0.33\mu F$, $C_{OUT}=0.1\mu F$; unless otherwise specified.) | | | | | | | |
|--|-------------------------------|--|---------------------------------|------|------|------------------|----|
| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit | |
| Output voltage | V_{OUT} | $T_j=25^{\circ}C$ | 4.80 | 5 | 5.20 | V | |
| | | $7.5V \leq V_{IN} \leq 20V$, $10mA \leq I_{OUT} \leq 1A$, $PD \leq 15W$ | 4.75 | 5 | 5.25 | | |
| Line Regulation | RE_{Gline} | $T_j=25^{\circ}C$ | $7.5V \leq V_{IN} \leq 25V$ | - | 3 | 100 | mV |
| | | | $8V \leq V_{IN} \leq 12V$ | - | 1 | 50 | |
| Load Regulation | RE_{Gload} | $T_j=25^{\circ}C$ | $10mA \leq I_{OUT} \leq 1A$ | - | 15 | 100 | |
| | | | $250mA \leq I_{OUT} \leq 750mA$ | - | 5 | 50 | |
| Quiescent Current | I_q | $I_{OUT}=0$, $T_j=25^{\circ}C$ | - | 4.2 | 8 | mA | |
| Quiescent Current Change | ΔI_q | $7.5V \leq V_{IN} \leq 25V$ | - | - | 1.3 | | |
| | | $10mA \leq I_{OUT} \leq 1A$ | - | - | 0.5 | | |
| Output Noise Voltage | V_n | $10Hz \leq f \leq 100KHz$, $T_j=25^{\circ}C$ | - | 40 | - | μV | |
| Ripple Rejection Ratio | RR | $f=120Hz$, $8V \leq V_{IN} \leq 18V$ | 62 | 78 | - | dB | |
| Voltage Drop | V_{drop} | $I_{OUT}=1.0A$, $T_j=25^{\circ}C$ | - | 2 | - | V | |
| Output Resistance | R_{OUT} | $f=1KHz$ | - | 17 | - | $m\Omega$ | |
| Output Short Circuit Current | I_{os} | $T_j=25^{\circ}C$ | - | 750 | - | mA | |
| Peak Output Current | $I_o peak$ | $T_j=25^{\circ}C$ | - | 2.2 | - | A | |
| Temperature Coefficient of Output Voltage | $\Delta V_{OUT} / \Delta T_j$ | $I_{OUT}=10mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$ | - | -0.6 | - | $mV / ^{\circ}C$ | |

Note1: Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible, and thermal effects must be taken into account separately.

Note 2: This specification applies only for DC power dissipation permitted by absolute maximum ratings.

| AX7809 Electrical Characteristics ($V_{IN}=15V$, $I_{OUT}=500mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{IN}=0.33\mu F$, $C_{OUT}=0.1\mu F$; unless otherwise specified.) | | | | | | | |
|--|-------------------------------|---|---------------------------------|-----|------|------------------|----|
| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit | |
| Output Voltage | V_{OUT} | $T_j=25^{\circ}C$ | 8.65 | 9 | 9.36 | V | |
| | | $11.5V \leq V_{IN} \leq 23V$, $10mA \leq I_{OUT} \leq 1A$, $PD \leq 15W$ | 8.57 | 9 | 9.45 | | |
| Line Regulation | RE_{Gline} | $T_j=25^{\circ}C$ | $11.5V \leq V_{IN} \leq 26V$ | - | 6 | 180 | mV |
| | | | $12V \leq V_{IN} \leq 17V$ | - | 2 | 90 | |
| Load Regulation | RE_{Gload} | $T_j=25^{\circ}C$ | $10mA \leq I_{OUT} \leq 1A$ | - | 12 | 180 | |
| | | | $250mA \leq I_{OUT} \leq 750mA$ | - | 4 | 90 | |
| Quiescent Current | I_q | $I_{OUT}=0$, $T_j=25^{\circ}C$ | - | 4.3 | 8 | mA | |
| Quiescent Current Change | ΔI_q | $11.5V \leq V_{IN} \leq 26V$ | - | - | 1 | | |
| | | $10mA \leq I_{OUT} \leq 1A$ | - | - | 0.5 | | |
| Output Noise Voltage | V_n | $10Hz \leq f \leq 100KHz$, $T_j=25^{\circ}C$ | - | 52 | - | μV | |
| Ripple Rejection Ratio | RR | $f=120Hz$, $12V \leq V_{IN} \leq 22V$ | 55 | 72 | - | dB | |
| Voltage Drop | V_{drop} | $I_{OUT}=1.0A$, $T_j=25^{\circ}C$ | - | 2 | - | V | |
| Output Resistance | R_{OUT} | $f=1KHz$ | - | 16 | - | $m\Omega$ | |
| Output Short Circuit Current | I_{os} | $T_j=25^{\circ}C$ | - | 450 | - | mA | |
| Peak Output Current | $I_{o peak}$ | $T_j=25^{\circ}C$ | - | 2.2 | - | A | |
| Temperature Coefficient of Output Voltage | $\Delta V_{OUT} / \Delta T_j$ | $I_{OUT}=10mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$ | - | -1 | - | $mV / ^{\circ}C$ | |

Note1: Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible, and thermal effects must be taken into account separately.

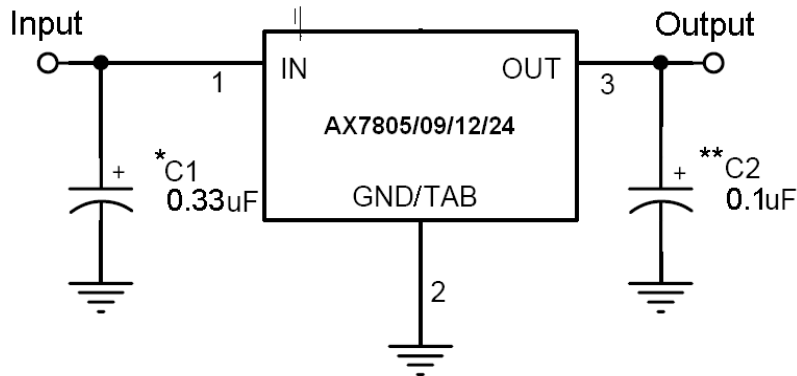
Note 2: This specification applies only for DC power dissipation permitted by absolute maximum ratings.

| AX7812 Electrical Characteristics ($V_{IN}=19V$, $I_{OUT}=500mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{IN}=0.33\mu F$, $C_{OUT}=0.1\mu F$; unless otherwise specified.) | | | | | | | |
|--|-------------------------------|---|---------------------------------|-----|-------|------------------|----|
| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit | |
| Output Voltage | V_{OUT} | $T_j=25^{\circ}C$ | 11.53 | 12 | 12.48 | V | |
| | | $14.5V \leq V_{IN} \leq 27V$, $10mA \leq I_{OUT} \leq 1A$, $PD \leq 15W$ | 11.42 | 12 | 12.60 | | |
| Line Regulation | RE_{Gline} | $T_j=25^{\circ}C$ | $14.5V \leq V_{IN} \leq 30V$ | - | 10 | 240 | mV |
| | | | $15V \leq V_{IN} \leq 19V$ | - | 3 | 120 | |
| Load Regulation | RE_{Gload} | $T_j=25^{\circ}C$ | $10mA \leq I_{OUT} \leq 1A$ | - | 12 | 240 | |
| | | | $250mA \leq I_{OUT} \leq 750mA$ | - | 4 | 120 | |
| Quiescent Current | I_q | $T_j=25^{\circ}C$, $I_{OUT}=0$ | - | 4.3 | 8 | mA | |
| Quiescent Current Change | ΔI_q | $14.5V \leq V_{IN} \leq 30V$ | - | - | 1 | | |
| | | $10mA \leq I_{OUT} \leq 1A$ | - | - | 0.5 | | |
| Output Noise Voltage | V_n | $10Hz \leq f \leq 100KHz$, $T_j=25^{\circ}C$ | - | 75 | - | μV | |
| Ripple Rejection Ratio | RR | $f=120Hz$, $15V \leq V_{IN} \leq 25V$ | 55 | 71 | - | dB | |
| Voltage Drop | V_{drop} | $I_{OUT}=1.0A$, $T_j=25^{\circ}C$ | - | 2 | - | V | |
| Output Resistance | R_{OUT} | $f=1KHz$ | - | 18 | - | $m\Omega$ | |
| Output Short Circuit Current | I_{OS} | $T_j=25^{\circ}C$ | - | 350 | - | mA | |
| Peak Output Current | $I_o \text{ peak}$ | $T_j=25^{\circ}C$ | - | 2.2 | - | A | |
| Temperature Coefficient of Output Voltage | $\Delta V_{OUT} / \Delta T_j$ | $I_{OUT}=10mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$ | - | -1 | - | $mV / ^{\circ}C$ | |

Note1: Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible, and thermal effects must be taken into account separately.

Note 2: This specification applies only for DC power dissipation permitted by absolute maximum ratings

❖ APPLICATION CIRCUIT



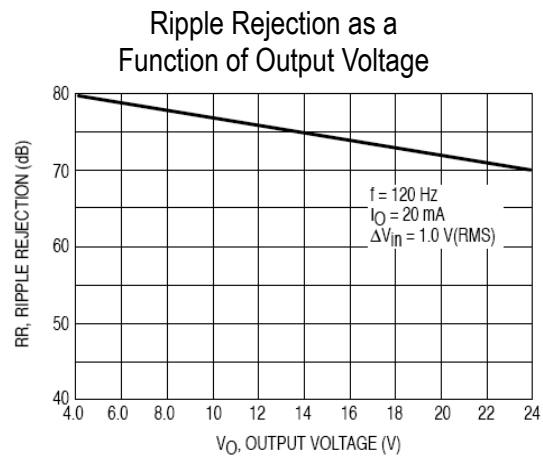
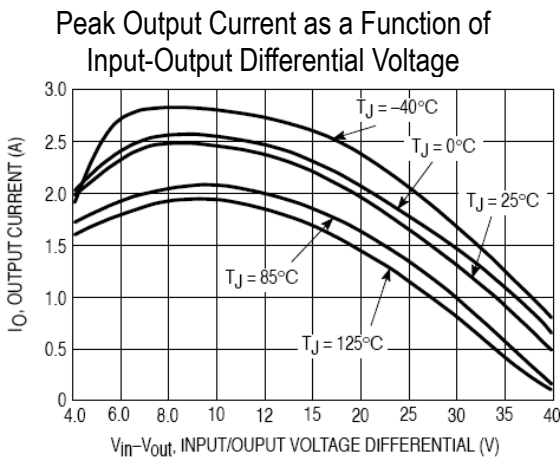
Note1: A common ground is required between the input and the output voltages. The input voltage must remain typically 2.0V above the output voltage even during the low point on the Input ripple voltage.

Note2: XX = these two digits of the type number indicate voltage.

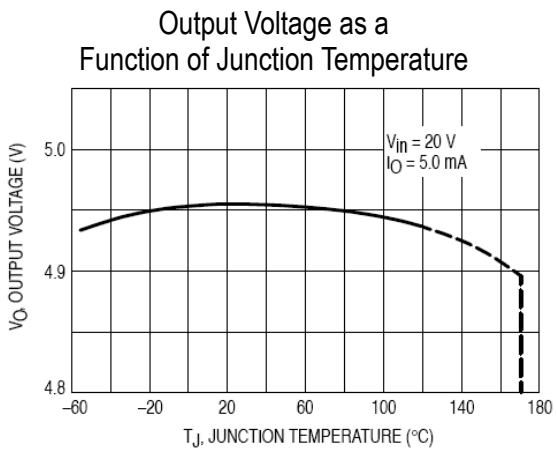
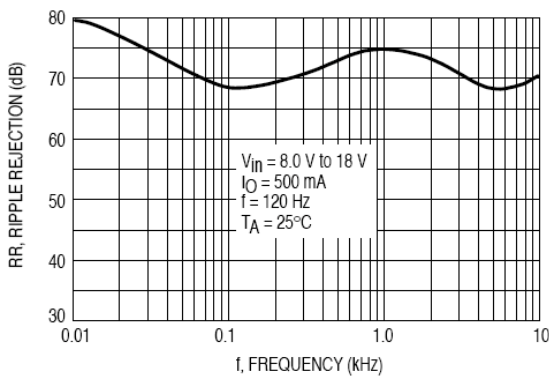
* = Cin is required if regulator is located an appreciable distance from power supply filter.

** = Co is not needed for stability; however, it does improve transient response.

❖ TYPICAL CHARACTERISTICS

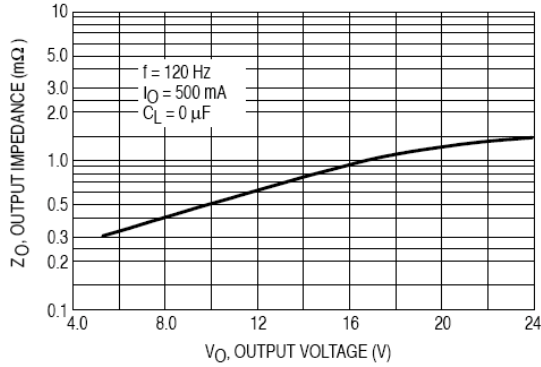


Ripple Rejection as a Function of Frequency

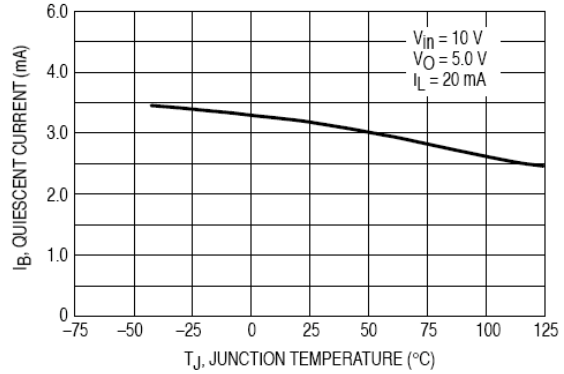


❖ TYPICAL CHARACTERISTICS

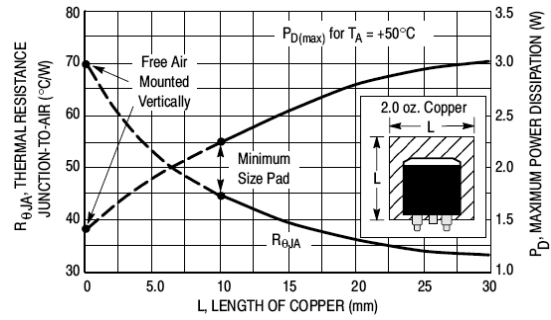
Output Impedance as a Function of Output Voltage



Quiescent Current as a Function of Temperature

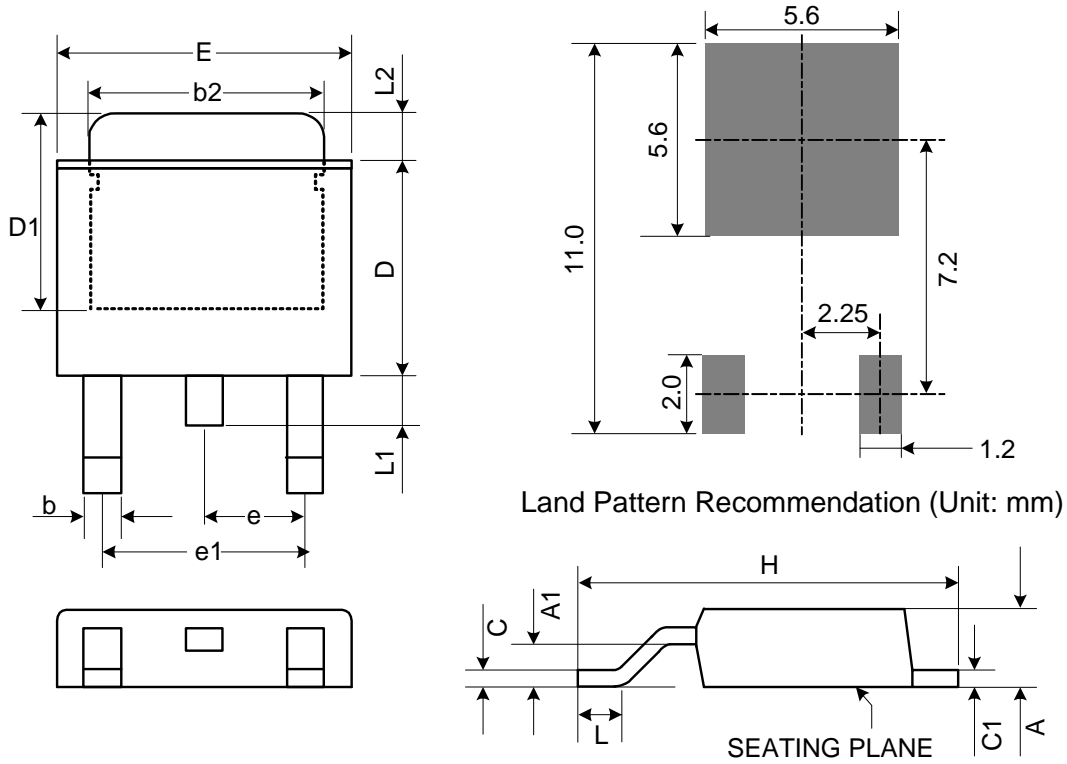


D²PAK Thermal Resistance and Maximum Power Dissipation vs. P.C.B Copper Length



❖ PACKAGE OUTLINES

(1) TO252-3L

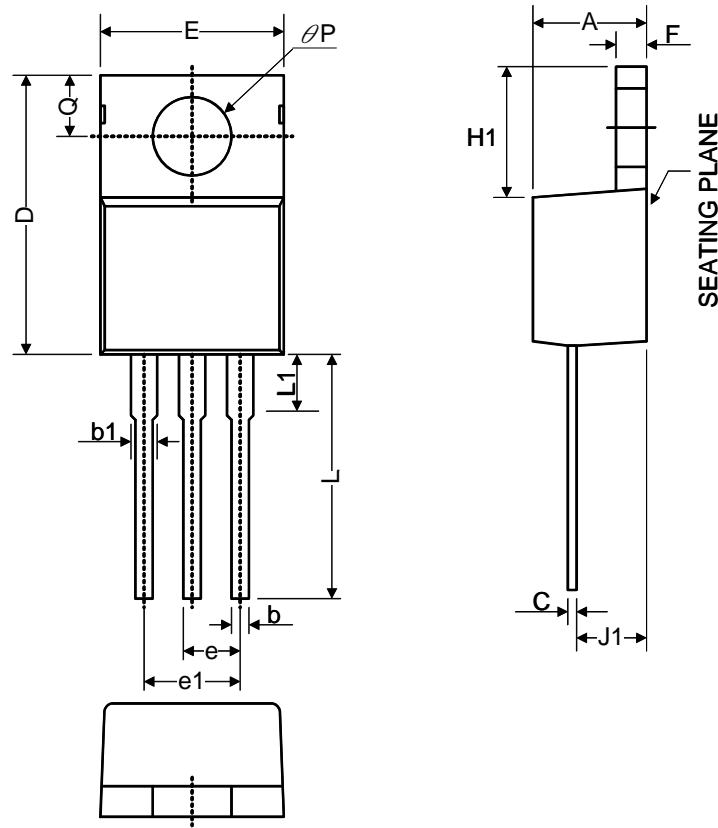


Notes:

1. JEDEC Outline: TO-252 AB
2. Mils suggested for positive contact at mounting.

| Symbol | Dimensions in Millimeters | | | Dimensions in Inches | | |
|--------|---------------------------|------|-------|----------------------|-------|-------|
| | Min. | Nom. | Max. | Min. | Nom. | Max. |
| A | 2.18 | 2.29 | 2.40 | 0.086 | 0.090 | 0.094 |
| A1 | 0.89 | - | 1.14 | 0.035 | - | 0.045 |
| b | 0.61 TYP. | | | 0.024 TYP. | | |
| b2 | 5.20 | 5.35 | 5.50 | 0.205 | 0.211 | 0.217 |
| C | 0.45 | 0.52 | 0.58 | 0.018 | 0.020 | 0.023 |
| C1 | 0.45 | 0.52 | 0.58 | 0.018 | 0.020 | 0.023 |
| D | 5.40 | 5.57 | 6.20 | 0.213 | 0.219 | 0.244 |
| D1 | 4.57 | 4.77 | 4.97 | 0.180 | 0.188 | 0.196 |
| E | 6.35 | 6.58 | 6.80 | 0.250 | 0.259 | 0.268 |
| e | 2.28 BSC. | | | 0.090 BSC. | | |
| e1 | 4.57 BSC. | | | 0.180 BSC. | | |
| H | 9.00 | 9.70 | 10.40 | 0.354 | 0.382 | 0.409 |
| L | 0.51 | - | - | 0.020 | - | - |
| L1 | 0.64 | 0.83 | 1.02 | 0.025 | 0.033 | 0.040 |
| L2 | 0.88 | - | 1.27 | 0.035 | - | 0.050 |

(2) TO220-3L



| Symbol | Dimensions in Millimeters | | | Dimensions in Inches | | |
|------------|---------------------------|-------|-------|----------------------|-------|-------|
| | Min. | Nom. | Max. | Min. | Nom. | Max. |
| A | 3.55 | 4.20 | 4.85 | 0.140 | 0.165 | 0.191 |
| b1 | 1.14 | 1.46 | 1.78 | 0.045 | 0.057 | 0.070 |
| b | 0.51 | 0.83 | 1.14 | 0.020 | 0.033 | 0.045 |
| C | 0.31 | 0.72 | 1.14 | 0.012 | 0.028 | 0.045 |
| D | 14.20 | 15.35 | 16.50 | 0.559 | 0.604 | 0.650 |
| E | 9.70 | 10.20 | 10.70 | 0.382 | 0.402 | 0.421 |
| e | 2.29 | 2.54 | 2.79 | 0.090 | 0.100 | 0.110 |
| e1 | 4.83 | 5.08 | 5.33 | 0.190 | 0.200 | 0.210 |
| F | 0.51 | 0.95 | 1.40 | 0.020 | 0.037 | 0.055 |
| H1 | 5.84 | 6.35 | 6.86 | 0.230 | 0.250 | 0.270 |
| J1 | 2.03 | 2.48 | 2.92 | 0.080 | 0.098 | 0.115 |
| L | 12.72 | 13.72 | 14.72 | 0.501 | 0.540 | 0.580 |
| L1 | 3.66 | 5.00 | 6.35 | 0.144 | 0.197 | 0.250 |
| θP | 3.53 | 3.81 | 4.09 | 0.139 | 0.150 | 0.161 |
| Q | 2.54 | 2.98 | 3.43 | 0.100 | 0.117 | 0.135 |