# 1A 3-Terminal Positive Voltage Regulator

## ❖ GENERAL DESCRIPTION

The AX7805/09/12 series are three terminal positive voltage regulators designed for a wide variety of applications including local, on-card regulation.

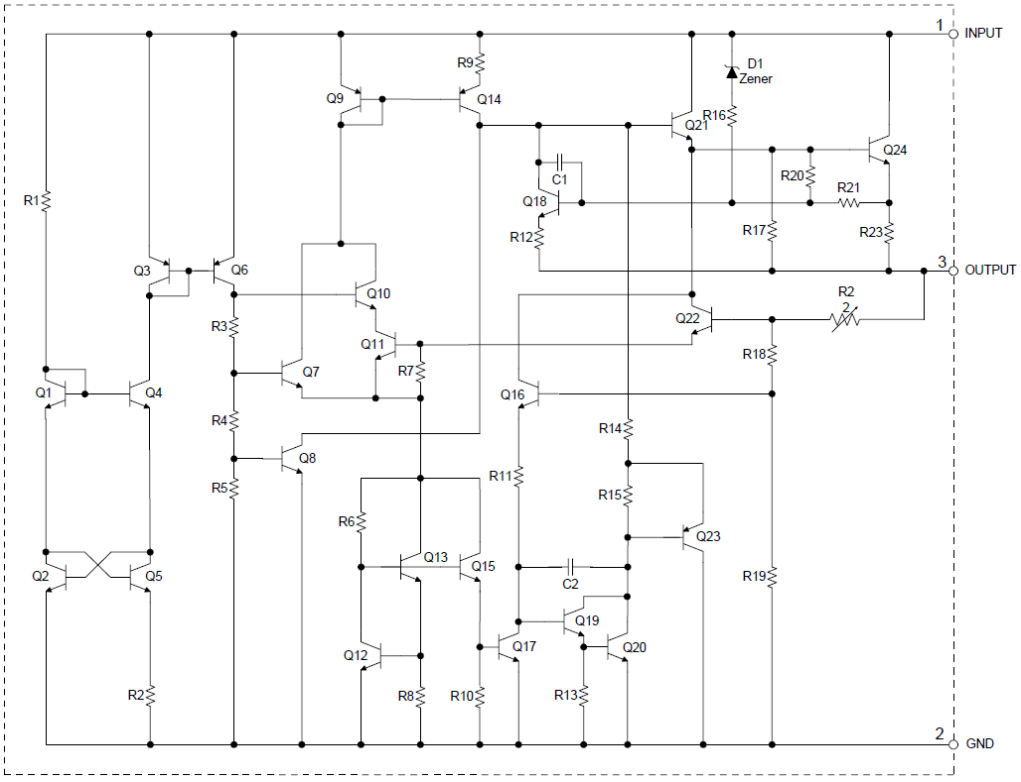
The AX7805/09/12 is complete with internal current limiting, thermal shutdown protection, and safe-area compensation which make them virtually immune from output overload. If adequate heat sinking is provided, these regulators can deliver output currents up to 1A.

The AX7805/09/12 are available in TO220-3L and TO252-3L packages.

## ❖ FEATURES

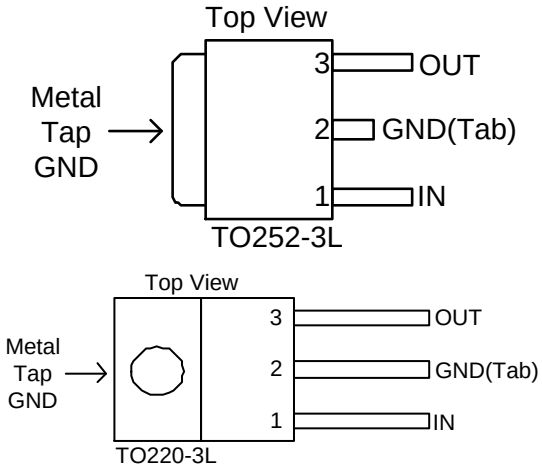
- Output Current up to 1A
- Fixed Output Voltages of 5V, 9V and 12V
- Output Voltage Accuracy of ±4% over the Full Temperature Range
- Internal Short Circuit Current Limiting
- Internal Thermal Overload Protection
- Output Transistor Safe-area Protection
- Low Load Regulation
- Stable Performance in High Temperature

## ❖ BLOCK DIAGRAM



## ❖ PIN ASSIGNMENT

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




| Name | Description |
|---|---|
| **IN** | Voltage Input |
| **GND (Tab)** | Grand |
| **OUT** | Voltage Output |

## ❖ ORDER/MARKING INFORMATION

| Order Information | Top Marking |
|---|---|
| **AX78XX X X**<br>**Prduct**<br>05: AX7805<br>09: AX7809<br>12: AX7812<br>**Package**<br>D : TO252-3L<br>T : TO220-3L<br>**Packing**<br>Blank : Tube<br>A : Taping | Logo ← **AX** 7 8 X X → Part number<br>05: AX7805<br>09: AX7809<br>12: AX7812<br>Y Y W W X<br>ID code: internal<br>WW: 01~52<br>Year : 11 = 2011<br>12 = 2012 |

## ❖ ABSOLUTE MAXIMUM RATINGS

($T_A$ = 25°C unless otherwise noted)

| Characteristics | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Input Voltage | | $V_{IN}$ | 36 | V |
| Lead Temperature (Soldering, 10sec) | | $T_{LEAD}$ | 260 | °C |
| Power Dissipation | | $P_D$ | Internal Limited | W |
| Operating Junction Temperature | | $T_J$ | 150 | °C |
| Storage Temperature Range | | $T_{STG}$ | -65~+150 | °C |
| Thermal Resistance - Junction to Case | TO220-3L | $\theta_{JC}$ | 5 | °C/W |
| | TO252-3L | | 10 | |
| Thermal Resistance - Junction to Ambient | TO220-3L | $\theta_{JA}$ | 45 | °C/W |
| | 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, $I_{OUT}$=1A, Tj=-40 to 125°C; unless otherwise specified.)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output voltage | $V_{OUT}$ | Tj=25°C | 4.9 | 5 | 5.1 | V |
| | | $I_{OUT}$=5mA to 1A, $V_{IN}$=7.5V to 20V, PD≤15W | 4.8 | - | 5.2 | |
| Line Regulation | $V_{RLINE}$ | $V_{IN}$=7.5V to 20V, $I_{OUT}$=500mA, $T_J$=25°C | - | 25 | 50 | mV |
| Load Regulation | $V_{RLOAD}$ | $V_{IN}$=10V, $I_{OUT}$=5mA to 1A, $T_J$=25°C | - | 20 | 50 | |
| Quiescent Current | Iq | $V_{IN}$=10V, $I_{OUT}$=0 | - | 3.2 | 6 | mA |
| Quiescent Current Change | ΔIq | $V_{IN}$=8V to 25V, $I_{OUT}$=500mA, $T_J$=25°C | - | 0.3 | 0.8 | mA |
| | | $I_{OUT}$=5mA to 1A, $T_J$=25°C | - | 0.08 | 0.5 | mA |
| Ripple Rejection | PSRR | $V_{IN}$=8V to 18V, f=120Hz, $I_{OUT}$=500mA | - | 70 | - | dB |
| Dropout Voltage | $V_{DROP}$ | △$V_{OUT}$=1%, $I_{OUT}$=1A, $T_J$=25°C | - | 2 | - | V |
| Output Noise Voltage | $N_{OUT}$ | f=10Hz to 100kHz, $T_A$=25°C | - | 10 | - | μV/$V_O$ |
| Output Resistance | $R_{OUT}$ | f=1KHz | - | 10 | - | mΩ |
| Short Circuit Current | $I_{SC}$ | $V_{IN}$=35V, $T_A$=25°C | - | 0.05 | - | A |
| Peak Output Current | $I_{PK}$ | $V_{IN}$=10V, $T_J$=25°C | - | 2.2 | - | A |
| Temperature Coefficient of Output Voltage | $\Delta V_{OUT}/\Delta T$ | | - | 0.4 | - | mV/°C |
| | $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | - | 80 | - | ppm/°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.

## ❖ ELECTRICAL CHARACTERISTICS (CONTINUE)

**AX7809 Electrical Characteristics**
($V_{IN}$=15V, $I_{OUT}$=1A, Tj=-40 to 125°C; unless otherwise specified.)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output voltage | $V_{OUT}$ | Tj=25°C | 8.82 | 9 | 9.18 | V |
| | | $I_{OUT}$=5mA to 1A, $V_{IN}$=11.5V to 23V, PD≤15W | 8.65 | - | 9.35 | |
| Line Regulation | $V_{RLINE}$ | $V_{IN}$=11.5V to 23V, $I_{OUT}$=500mA, $T_J$=25°C | - | 25 | 90 | mV |
| Load Regulation | $V_{RLOAD}$ | $V_{IN}$=14V, $I_{OUT}$=5mA to 1A, $T_J$=25°C | - | 25 | 100 | |
| Quiescent Current | Iq | $V_{IN}$=15V, $I_{OUT}$=0 | - | 3.2 | 6 | mA |
| Quiescent Current Change | ΔIq | $V_{IN}$=11.5V to 23V, $I_{OUT}$=500mA, $T_J$=25°C | - | 0.3 | 0.8 | mA |
| | | $I_{OUT}$=5mA to 1A, $T_J$=25°C | - | 0.08 | 0.5 | mA |
| Ripple Rejection | PSRR | $V_{IN}$=11.5V to 21.5V, f=120Hz, $I_{OUT}$=500mA | - | 61 | - | dB |
| Dropout Voltage | $V_{DROP}$ | △$V_{OUT}$=1%, $I_{OUT}$=1A, $T_J$=25°C | - | 2 | - | V |
| Output Noise Voltage | $N_{OUT}$ | f=10Hz to 100kHz, $T_A$=25°C | - | 10 | - | μV/$V_O$ |
| Output Resistance | $R_{OUT}$ | f=1KHz | - | 10 | - | mΩ |
| Short Circuit Current | $I_{SC}$ | $V_{IN}$=35V, $T_A$=25°C | - | 0.2 | - | A |
| Peak Output Current | $I_{PK}$ | $V_{IN}$=15V, $T_J$=25°C | - | 2.2 | - | A |
| Temperature Coefficient of Output Voltage | $\Delta V_{OUT}/\Delta T$ | | - | 0.72 | - | mV/°C |
| | $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | - | 80 | - | ppm/°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.

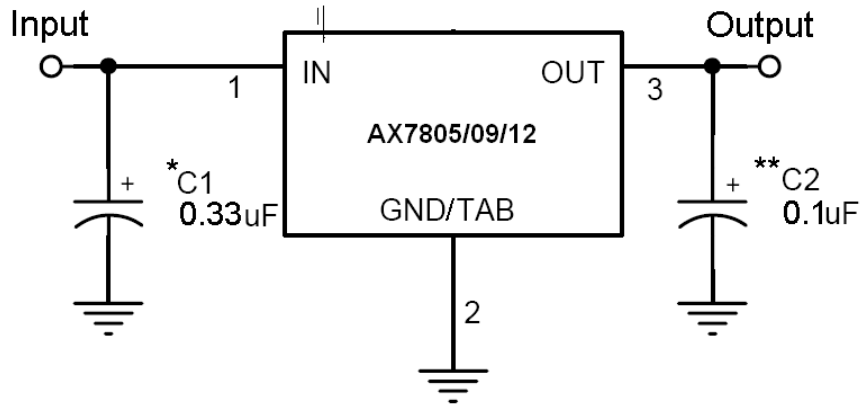
## ❖ ELECTRICAL CHARACTERISTICS (CONTINUE)

**AX7812 Electrical Characteristics**
($V_{IN}$=19V, $I_{OUT}$=1A, Tj=-40 to 125°C; unless otherwise specified.)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output voltage | $V_{OUT}$ | Tj=25°C | 11.75 | 12 | 12.25 | V |
| | | $I_{OUT}$=5mA to 1A, $V_{IN}$=14.8V to 27V, PD≤15W | 11.5 | - | 12.5 | |
| Line Regulation | $V_{RLINE}$ | $V_{IN}$=14.8V to 27V, $I_{OUT}$=500mA, $T_J$=25°C | - | 25 | 120 | mV |
| Load Regulation | $V_{RLOAD}$ | $V_{IN}$=19V, $I_{OUT}$=5mA to 1A, $T_J$=25°C | - | 40 | 120 | |
| Quiescent Current | Iq | $V_{IN}$=19V, $I_{OUT}$=0 | - | 3.4 | 6 | mA |
| Quiescent Current Change | ΔIq | $V_{IN}$=14.8V to 30V, $I_{OUT}$=500mA, $T_J$=25°C | - | 0.3 | 0.8 | mA |
| | | $I_{OUT}$=5mA to 1A, $T_J$=25°C | - | 0.08 | 0.5 | mA |
| Ripple Rejection | PSRR | $V_{IN}$=15V to 25V, f=120Hz, $I_{OUT}$=500mA | - | 60 | - | dB |
| Dropout Voltage | $V_{DROP}$ | △$V_{OUT}$=1%, $I_{OUT}$=1A, $T_J$=25°C | - | 2 | - | V |
| Output Noise Voltage | $N_{OUT}$ | f=10Hz to 100kHz, $T_A$=25°C | - | 10 | - | μV/$V_O$ |
| Output Resistance | $R_{OUT}$ | f=1KHz | - | 11 | - | mΩ |
| Short Circuit Current | $I_{SC}$ | $V_{IN}$=35V, $T_A$=25°C | - | 0.2 | - | A |
| Peak Output Current | $I_{PK}$ | $V_{IN}$=18V, $T_J$=25°C | - | 2.2 | - | A |
| Temperature Coefficient of Output Voltage | $\Delta V_{OUT}/\Delta T$ | | - | 0.96 | - | mV/°C |
| | $(\Delta V_{OUT}/V_{OUT})/\Delta T$ | | - | 80 | - | ppm/°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

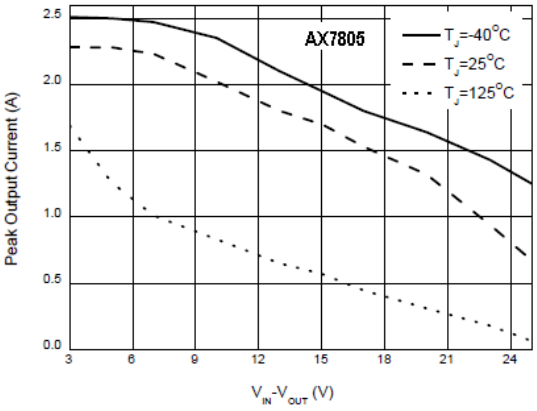
## ❖ APPLICATION CIRCUIT



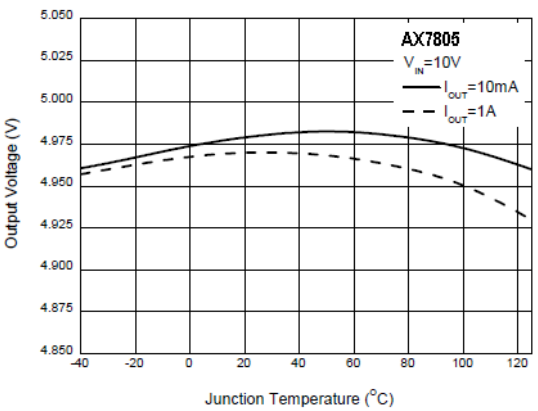

**Note1**: A common ground is required between the input and the output voltages. The input voltage must remain typically 2.0V above the output voltage even during the low point on the Input ripple voltage.
**Note2**: XX = these two digits of the type number indicate voltage.
* = Cin is required if regulator is located an appreciable distance from power supply filter.
** = Co is not needed for stability; however, it does improve transient response.

## ❖ TYPICAL CHARACTERISTICS

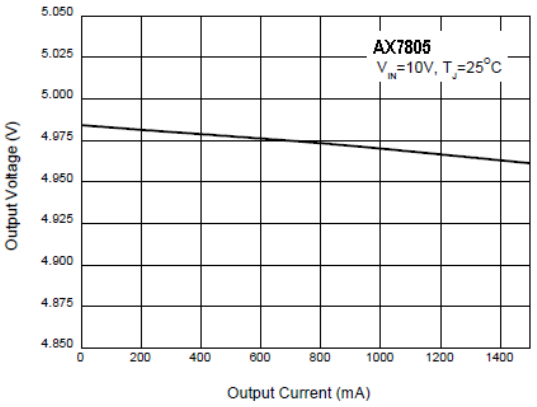
Peak Output Current vs. Input/Output Differential Voltage



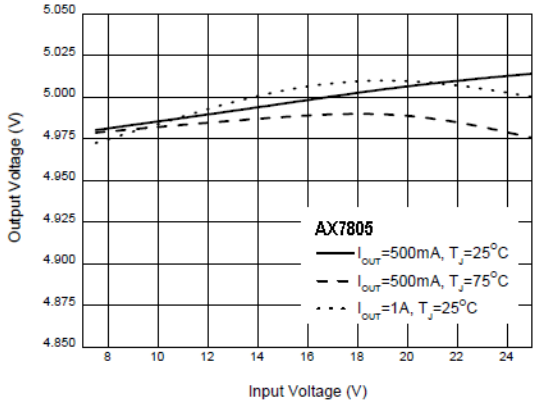

Output Voltage vs. Junction Temperature




Output Voltage vs. Output Current

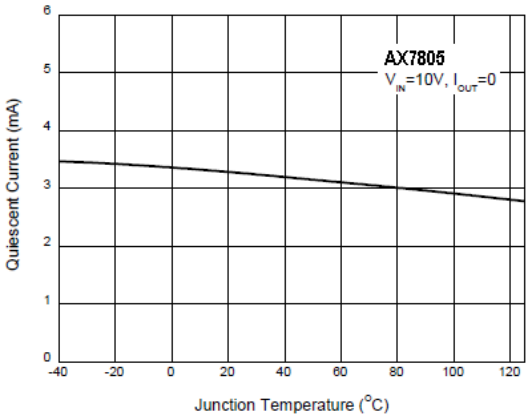



Output Voltage vs. Input Voltage

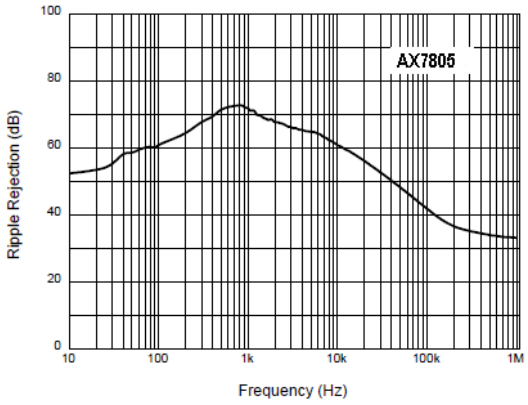


## ❖ TYPICAL CHARACTERISTICS (CONTINUE)

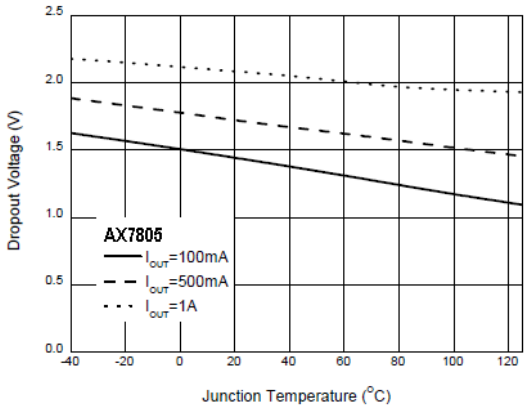
Quiescent Current vs. Junction Temperature



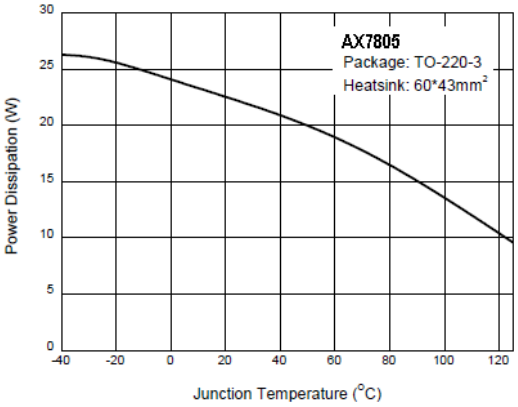

Ripple Rejection vs. Frequency



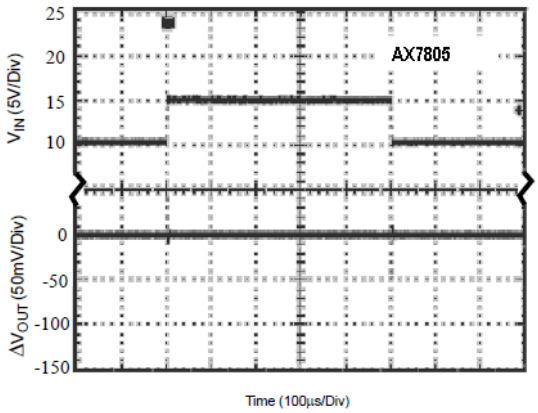

Dropout Voltage vs. Junction Temperature



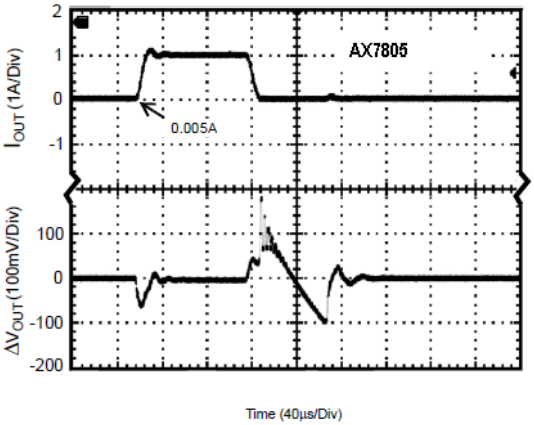

Power Dissipation vs. Junction Temperature




Line Transient
(Conditions: $I_{OUT}$=500mA, $C_{OUT}$=0.1μF)

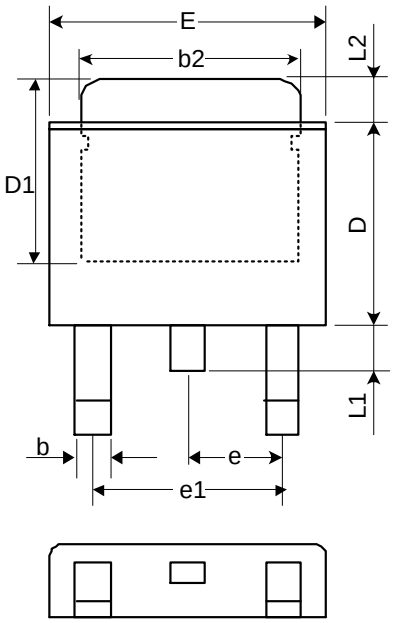


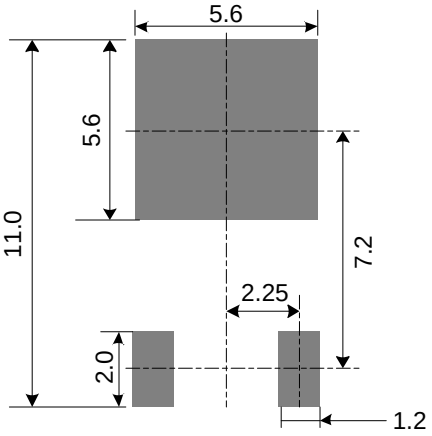

Load Transient
(Conditions: $V_{IN}$=10V, $C_{IN}$=0.33μF, $C_{OUT}$=0.1μF)



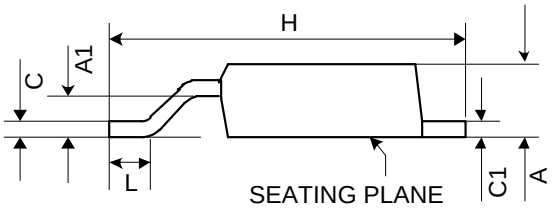
## ❖ PACKAGE OUTLINES

### (1) TO252-3L



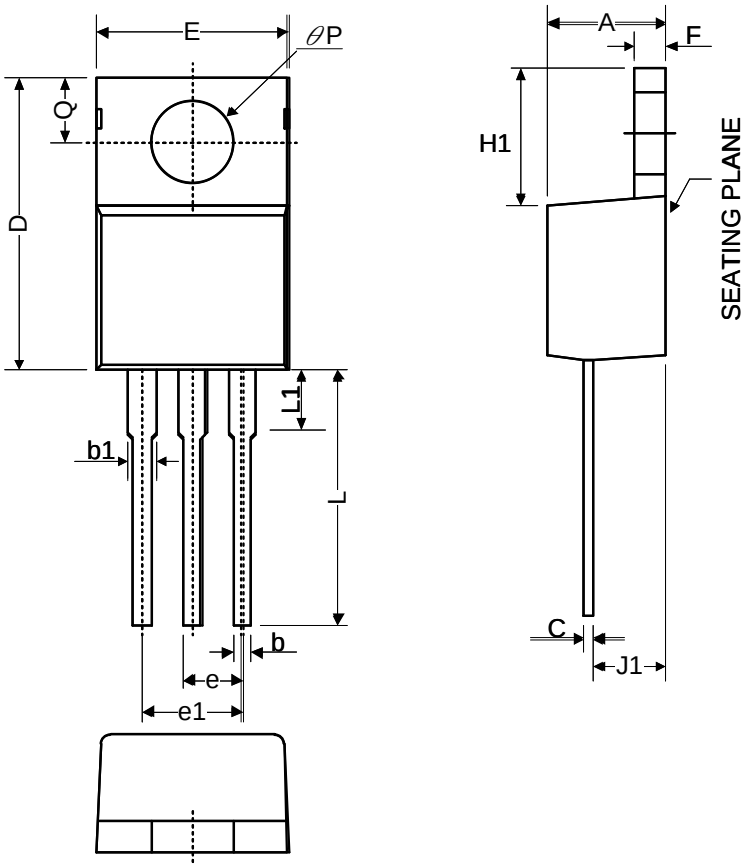

Land Pattern Recommendation (Unit: mm)




| Symbol | Dimensions in Millimeters | | | Dimensions in Inches | | |
|---|---|---|---|---|---|---|
| | Min. | Nom. | Max. | Min. | Nom. | Max. |
| A | 2.18 | 2.29 | 2.39 | 0.086 | 0.09 | 0.094 |
| A1 | - | - | 0.13 | - | - | 0.005 |
| b | 0.51 | 0.71 | 0.89 | 0.02 | 0.028 | 0.035 |
| b2 | 4.95 | 5.21 | 5.46 | 0.195 | 0.205 | 0.215 |
| C | 0.46 | 0.53 | 0.61 | 0.018 | 0.021 | 0.024 |
| C1 | 0.46 | 0.53 | 0.58 | 0.018 | 0.021 | 0.023 |
| D | 5.33 | 5.46 | 6.22 | 0.21 | 0.215 | 0.245 |
| D1 | 4.57 | - | - | 0.18 | - | - |
| E | 6.35 | 6.55 | 6.73 | 0.25 | 0.258 | 0.265 |
| e | 2.29 BSC | | | 0.090 BSC. | | |
| e1 | 4.58 BSC | | | 0.180 BSC. | | |
| H | 9.4 | 9.7 | 10.4 | 0.37 | 0.382 | 0.41 |
| L | 1.4 | 1.6 | 1.78 | 0.055 | 0.063 | 0.07 |
| L1 | - | - | 1.02 | - | - | 0.04 |
| L2 | 1.52 | 1.78 | 2.03 | 0.06 | 0.07 | 0.08 |

Mold flash shall not exceed 0.005inch per side
JEDEC outline: TO-252

## (2) TO220-3L




| Symbol | Dimensions in Millimeters | | | Dimensions in Inches | | |
|---|---|---|---|---|---|---|
| | Min. | Nom. | Max. | Min. | Nom. | Max. |
| A | 3.55 | 4.19 | 4.83 | 0.14 | 0.165 | 0.19 |
| b1 | 1.14 | 1.45 | 1.78 | 0.045 | 0.057 | 0.07 |
| b | 0.38 | 0.69 | 1.02 | 0.015 | 0.027 | 0.04 |
| C | 0.36 | 0.48 | 0.61 | 0.014 | 0.019 | 0.024 |
| D | 14.2 | 15.4 | 16.5 | 0.56 | 0.605 | 0.65 |
| E | 9.7 | 10.2 | 10.7 | 0.38 | 0.4 | 0.42 |
| e | | 2.54BSC | | | 0.1BSC | |
| e1 | | 5.08BSC | | | 0.2BSC | |
| F | 0.51 | 0.95 | 1.397 | 0.02 | 0.038 | 0.055 |
| H1 | 5.84 | 6.35 | 6.86 | 0.23 | 0.25 | 0.27 |
| J1 | 2.03 | 2.48 | 2.92 | 0.08 | 0.098 | 0.115 |
| L | 12.7 | 13.7 | 14.73 | 0.5 | 0.54 | 0.58 |
| L1 | | | 6.35 | | | 0.25 |
| θP | 3.53 | 3.81 | 4.09 | 0.139 | 0.15 | 0.161 |
| Q | 2.54 | 2.98 | 3.43 | 0.1 | 0.118 | 0.135 |

Mold flash shall not exceed 0.005inch per side
JEDEC outline: TO-220 AB