5A Low Dropout Linear Regulator

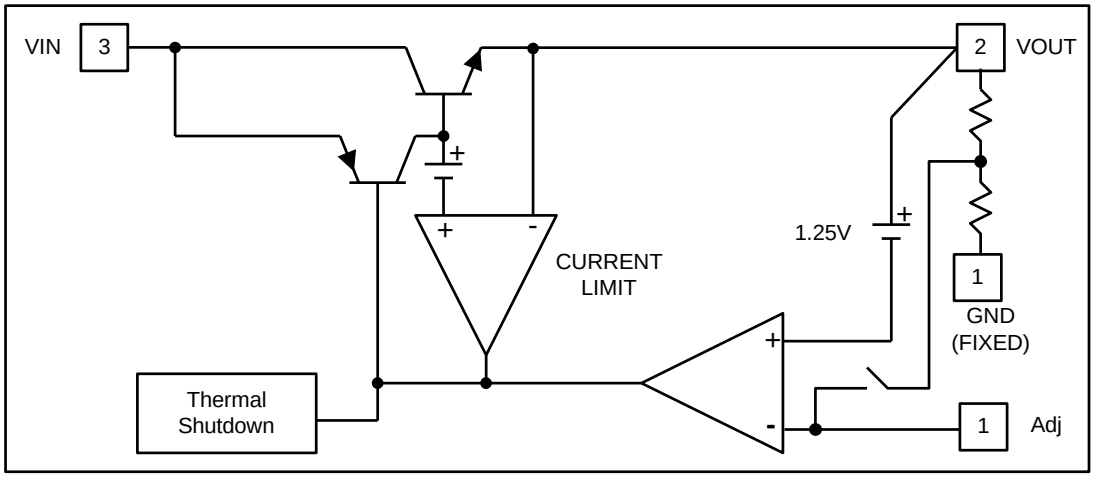
❖ GENERAL DESCRIPTION

AX1084 is a low dropout positive adjustable or fixed-mode regulator with minimum of 5.0A output current capability. The product is specifically designed to provide well-regulated supply for low voltage IC applications such as high-speed bus termination and low current 3.3V logic supply. AX1084 is also well suited for other applications such as VGA cards. AX1084 is guaranteed to have lower than 1.5V dropout at full load current making it ideal to provide well-regulated outputs of 1.25V to 3.3V with 4.8V to 12V input supply.

❖ FEATURES

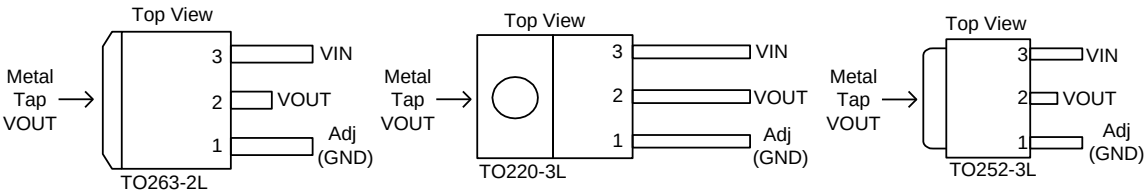
- 1.5V maximum dropout at full load current
- Built-in thermal shutdown
- Output current limiting
- Adjustable and 1.5V/1.8V/2.5V/3.3V/5.0V fixed output voltages
- Fast transient response
- Good noise rejection
- Package: TO252-3L, TO263-2L, TO220-3L

❖ BLOCK DIAGRAM



❖ PIN ASSIGNMENT

The packages of AX1084 are TO263-2L, TO220-3L and TO252-3L; the pin assignment is given by:



Name	Pin No. TO263/252/220	Description
Adj (GND)	1	Adjustable (Ground only for fixed version) A resistor divider from this pin to the V_{OUT} pin and ground sets the output voltage.
VOUT	2	The output of the regulator. A minimum of 100uF (0.15Ω ≤ ESR ≤ 10Ω) capacitor must be connected from this pin to ground to insure stability.
VIN	3	The input pin of regulator. Typically a large storage capacitor (0.15Ω ≤ ESR ≤ 10Ω) is connected from this pin to ground to insure that the input voltage does not sag below the minimum dropout voltage during the load transient response. This pin must always be 1.4V higher than V_{OUT} in order for the device to regulate properly.

❖ ORDER/MARKING INFORMATION

Order Information

AX1084 X XX X

Package	Vout	Packing
D : TO252-3L	Blank : Adj	Blank : Tube
M : TO263-2L	15 = 1.5V	A : Taping
T : TO220-3L	18 = 1.8V	
	25 = 2.5V	
	33 = 3.3V	
	50 = 5.0V	

Top Marking

ADJ Version

Logo AX1084 → Part number
YYWWX → ID code : internal
WW : 01~52
Year : 10 = 2010
11 = 2011

Fixed Version

Logo AX1084-VV → Part number / Output Voltage
YYWWX → ID code: internal
15 = 1.5V
18 = 1.8V
25 = 2.5V
33 = 3.3V
50 = 5.0V
WW: 01~52
Year : 10 = 2010
11 = 2011

❖ ABSOLUTE MAXIMUM RATINGS (at T_A=25°C)

Characteristics	Symbol	Rating	Unit
DC Supply Voltage	V_{IN}	-0.3 to 12	V
Power Dissipation	P_D	Internally Limited	
Storage Temperature	T_{ST}	-65 to +150	°C
Operating Junction Temperature Range	T_{OPJ}	-40 to +125	°C

❖ ELECTRICAL CHARACTERISTICS

(V_{IN} = V_{EN}=3.6V, T_A =25°C, unless otherwise specified)

Characteristics	Symbol	Conditions (Notes)	Min.	Typ.	Max.	Units
Reference Voltage	V_{REF}	I_{OUT}=10mA, T_J=25°C, (V_{IN}- V_{OUT}) =1.5V	1.225	1.250	1.275	V
Output Voltage (Fixed Version)	V_{OUT}	I_{OUT} = 10mA, T_J = 25°C, 3V≦V_{IN}≦12V	1.470	1.500	1.530	V
		I_{OUT} = 10mA, T_J = 25°C, 3.3V≦V_{IN}≦12V	1.764	1.800	1.836	V
		I_{OUT} = 10mA, T_J = 25°C, 4V≦V_{IN}≦12V	2.450	2.500	2.550	V
		I_{OUT} = 10mA, T_J = 25°C, 4.8V≦V_{IN}≦12V	3.235	3.300	3.365	V
		I_{OUT} = 10mA, T_J = 25°C, 6.5V≦V_{IN}≦12V	4.900	5.000	5.100	V
Line Regulation		I_{OUT}=10mA, V_{OUT}+1.5V<V_{IN}<12V, T_J =25°C	-	0.2	0.5	%
Load Regulation		V_{IN}=3V, 10mA I_{OUT}<5A, T_J =25°C **(Note 1,2)**, ADJ Version	-	-	1	%
		V_{IN}=3V, 10mA<I_{OUT} <5A, T_J =25°C **(Note 1,2)**, V_{OUT}=1.5V Fixed Version	-	12	15	mV
		V_{IN}=3.3V, 10mA<I_{OUT}<5A, T_J =25°C **(Note 1,2)**, V_{OUT}=1.8V Fixed Version	-	15	18	mV
		V_{IN}=4V, 10mA<I_{OUT}<5A, T_J =25°C **(Note 1,2)**, V_{OUT}=2.5V Fixed Version	-	20	25	mV
		V_{IN} =5V, 10mA<I_{OUT}<5A , T_J=25°C **(Note 1,2)** , V_{OUT}=3.3V Fixed Version	-	26	33	mV
		V_{IN} =6.5V,10mA<I_{OUT}<5A, T_J=25°C **(Note 1,2)** , V_{OUT}=5V Fixed Version	-	40	50	mV
Dropout Voltage	ΔVo	I_{OUT}=5.0A (ΔV_{OUT}=1% V_{OUT})	-	1.3	1.5	V
Current Limit		V_{IN}-V_{OUT}=3V	5.1	-	-	A

❖ ELECTRICAL CHARACTERISTICS (CONTINUED)

Minimum Load Current			-	5	10	mA
Temperature Stability		I_{OUT}=10mA	-	0.5	-	%
Thermal Resistance Junction-to-Ambient (No heat sink ;No air flow)	θ_{JA}	TO-252 TO-263 TO-220	-	98 83 83	-	°C/W
Thermal Resistance Junction-to-Ambient **(Note 3)**		TO-252 TO-263 TO-220	-	55 45 45	-	
Thermal Resistance Junction-to-Case	θ_{JC}	TO-252: Control Circuitry/Power Transistor TO-263: Control Circuitry/Power Transistor TO-220: Control Circuitry/Power Transistor	-	10 0.65/2.7 0.65/2.7	-	°C/W

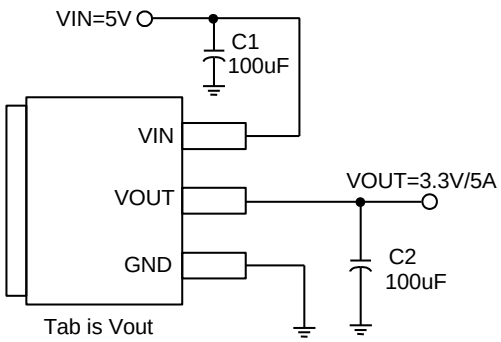
Note 1: See thermal regulation specifications for changes in output voltage due to heating effects. Line and load regulation are measured at a constant junction temperature by low duty cycle pulse testing. Load regulation is measured at the output lead = 1/18" from the package.

Note 2: Line and load regulation are guaranteed up to the maximum power dissipation of 15W. Power dissipation is determined by the difference between input and output and the output current. Guaranteed maximum power dissipation will not be available over the full input/output range.

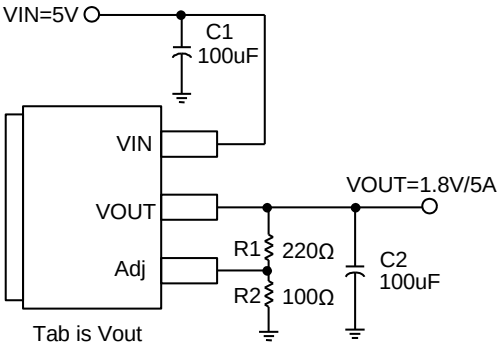
Note 3: Output is connected to the multi-layer PCB cupper area 10mm*5.5mm separately. If you need large PD or lower Tc and Tj, please connect to the large cupper area >>10mm*5.5mm (like 10mm*10mm).

❖ APPLICATION CIRCUIT

5.0V to 3.3V Fixed Mode Regulator



Adjustable Regulator



$$V_{OUT} = V_{REF} * (1 + \frac{R_2}{R_1})$$

❖ FUNCTION DESCRIPTIONS

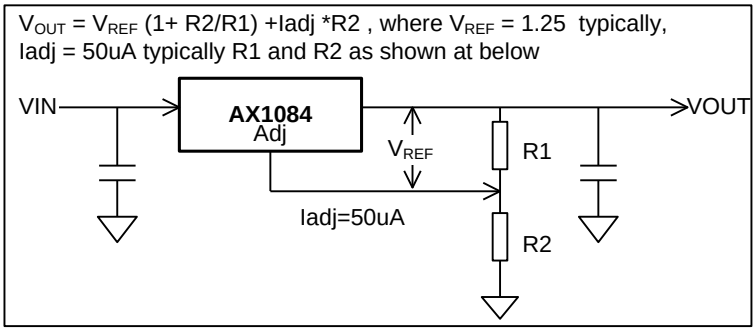
Introduction

The AX1084 adjustable Low Dropout (LDO) regulator is a 3 terminal device that can easily be programmed with the addition of two external resistors to any voltages within the range of 1.25V to V_{IN}-1.5V. The AX1084 only needs 1.5V differential between V_{IN} and V_{OUT} to maintain output regulation. In addition, the output voltage tolerances are also extremely tight and they include the transient response as part of the specification. For example, Intel VRE specification calls for a total of +/- 100mV including initial tolerance, load regulation and 0 to 5.0A load step.

The AX1084 is specifically designed to meet the fast current transient needs as well as providing an accurate initial voltage, reducing the overall system cost with the need for fewer output capacitors.

Output Voltage Setting

The AX1084 can be programmed to any voltages in the range of 1.25V to V_{IN}-1.5V with the addition of R1 and R2 external resistors according to the following formula:



The AX1084 keeps a constant 1.25V between the output pin and the adjust pin. By placing a resistor R1 across these two pins a constant current flows through R1, adding to the Iadj current and into the R2 resistor producing a voltage equal to the (1.25/R1)*R2+Iadj*R2 which will be added to the 1.25V to set the output voltage. This is summarized in the above equation. Since the minimum load current requirement of the AX1084 is 10mA, R1 is typically selected to be 121Ω resistor so that it automatically satisfies the minimum current requirement. Notice that since Iadj is typically in the range of 50uA it only adds a small error to the output voltage and should only be considered when a very precise output voltage setting is required. For example, in a typical 3.3V application where R1=121Ω and R2=200Ω the error due to Iadj is only 0.3% of the nominal set point.

Load Regulation

Since the AX1084 is only a 3 terminal device, it is not possible to provide true remote sensing of the output voltage at the load. The best load regulation is achieved when the bottom side of R2 is connected to the load and the top-side of R1 resistor is connected directly to the case or the V_{OUT} pin of the regulator and not to the load. It is important to note that for high current applications, this can re-present a significant percentage of the overall load regulation and one must keep the path from the regulator to the load as short as possible to minimize this effect.

Stability

The AX1084 requires the use of an output capacitor as part of the frequency compensation in order to make the regulator stable. For most applications a minimum of 100uF aluminum electrolytic capacitor insures both stability and good transient response.

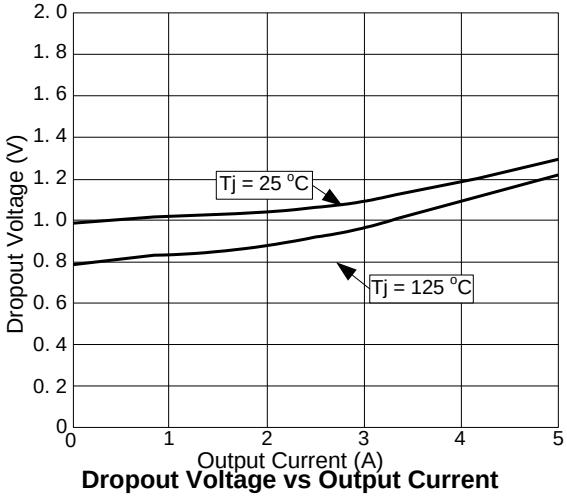
Thermal Design

The AX1084 incorporates an internal thermal shutdown that protects the device when the junction temperature exceeds the maximum allowable junction temperature. Although this device can operate with junction temperatures in the range of 150°C, it is recommended that the selected heat sink be chosen such that during maximum continuous load operation the junction temperature is kept below the temperature.

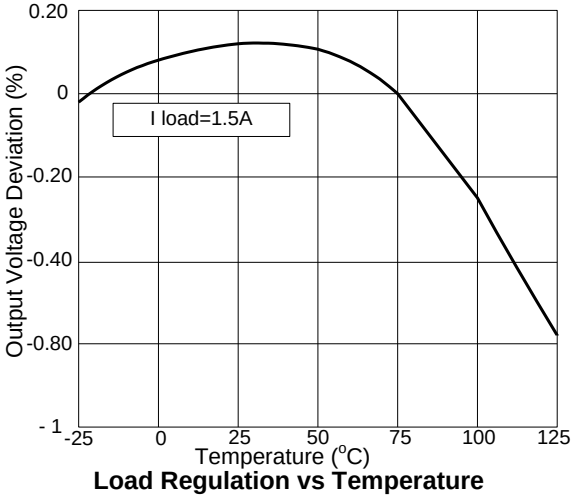
Layout Consideration

The output capacitors must be located as close to the V_{OUT} terminal of the device as possible. It is recommended to use a section of a layer of the PC board as a plane to connect the V_{OUT} pin to the output capacitors to prevent any high frequency oscillation that may result due to excessive trace inductance.

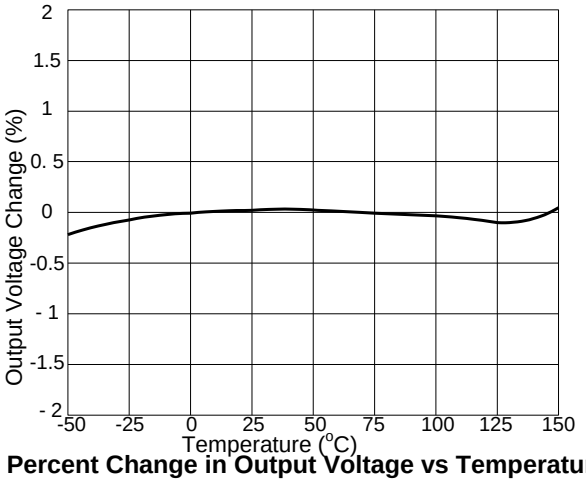
❖ TYPICAL CHARACTERISTICS



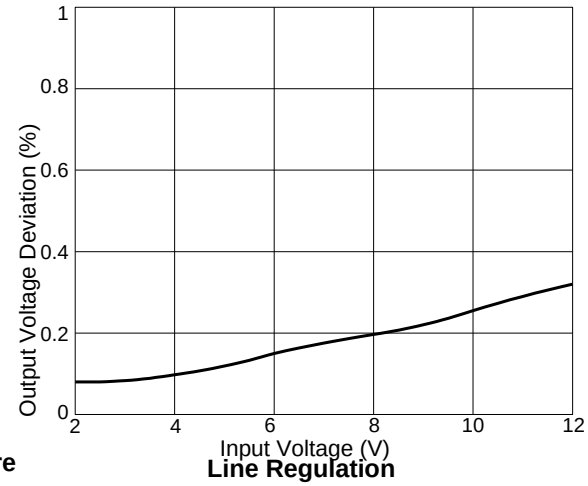
Dropout Voltage vs Output Current



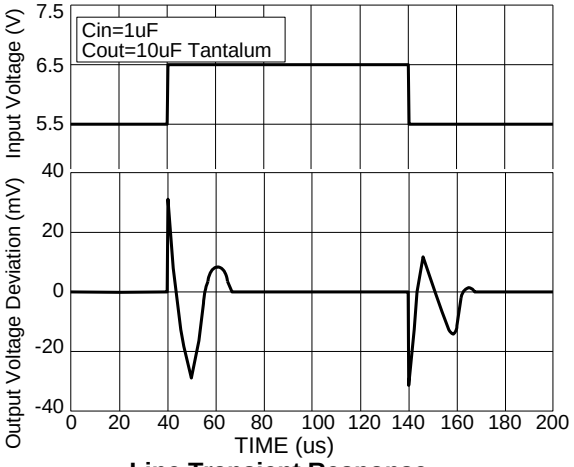
Load Regulation vs Temperature



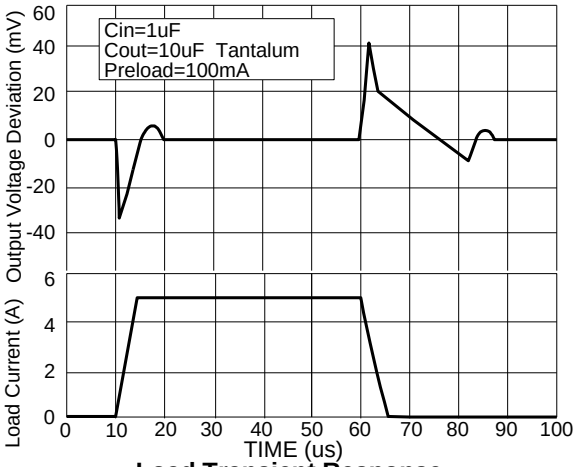
Percent Change in Output Voltage vs Temperature



Line Regulation



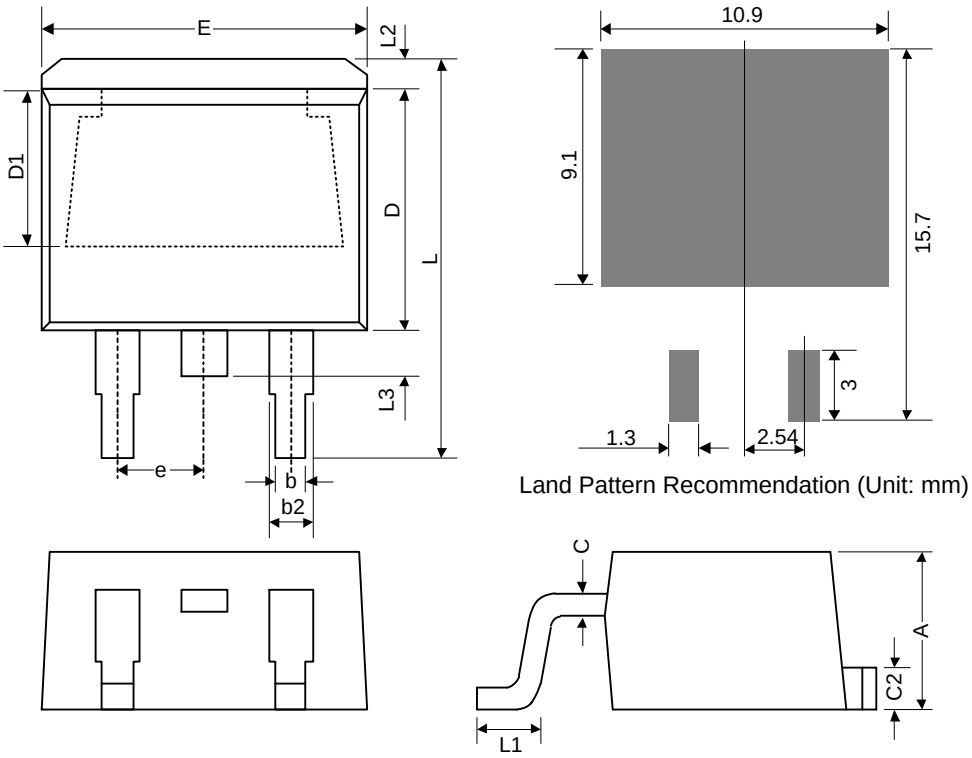
Line Transient Response



Load Transient Response

❖ PACKAGE OUTLINES

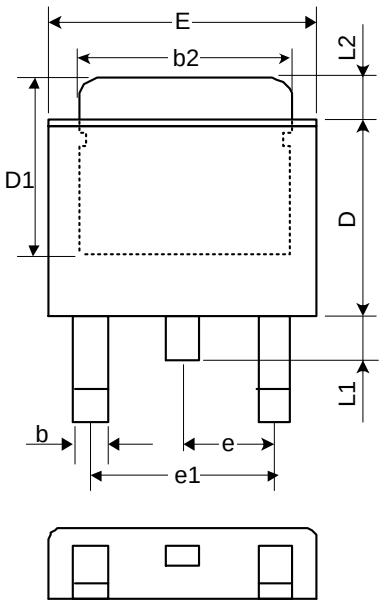
(1) TO263-2L

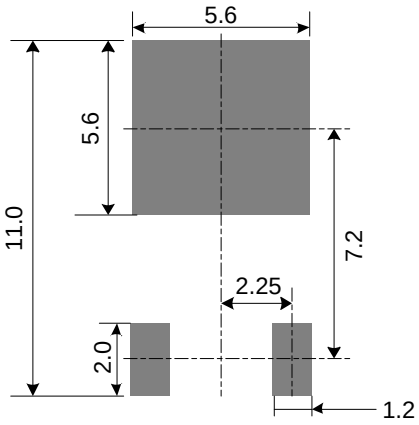


Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	4.06	4.45	4.83	0.16	0.175	0.19
b	0.51	0.76	0.99	0.02	0.03	0.039
b2	1.14	1.47	1.78	0.045	0.058	0.07
C	0.38	0.56	0.74	0.015	0.022	0.029
C2	1.14	1.4	1.65	0.045	0.055	0.065
D	8.38	9.02	9.65	0.33	0.355	0.38
D1	5.08	-	-	0.2	-	-
E	9,65	10.2	10.7	0.38	0.4	0.42
e	2.54 BSC			0.1 BSC		
L	14.6	15.2	15.9	0.575	0.6	0.625
L1	1.78	2.29	2.79	0.07	0.09	0.11
L2	-	-	1.68	-	-	0.066
L3	-	-	1.78	-	-	0.07

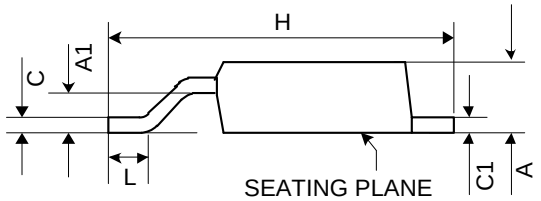
Mold flash shall not exceed 0.005inch per side
JEDEC outline: TO-263 AB

(2) TO252-3L





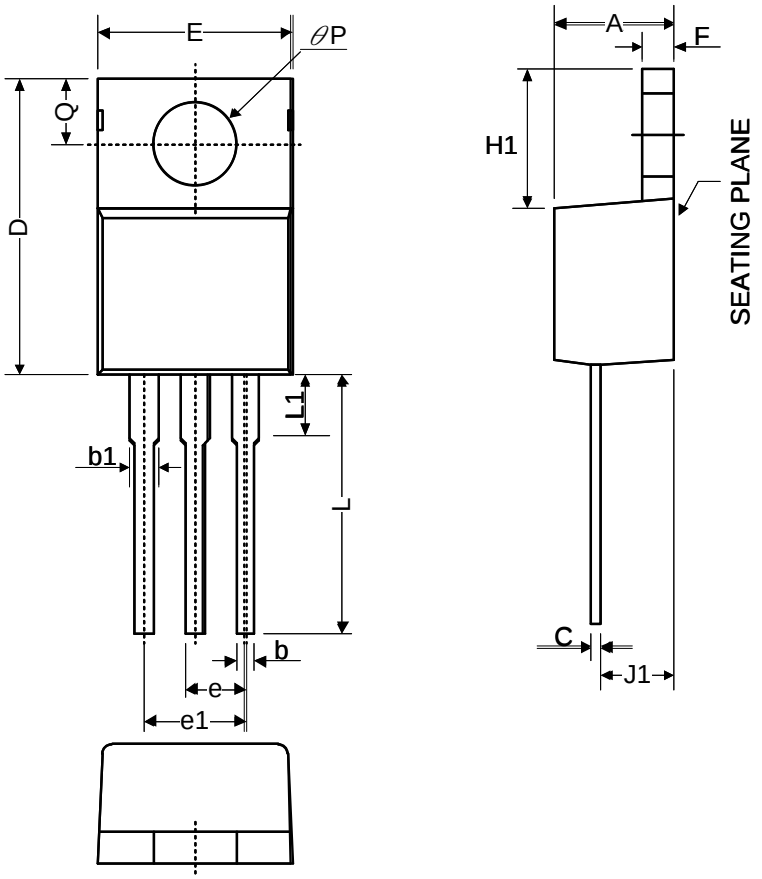
Land Pattern Recommendation (Unit: mm)



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

(3) 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