

## ■ General Description

The AME1086 is a 1.5A low-dropout positive voltage regulator. It is available in fixed and adjustable output voltage versions. Overcurrent and thermal protection are integrated onto the chip. Output current will limit as it reaches the pre-set current or temperature limit. At full rated output current the dropout voltage is 1.4V (max.). AME1086 series regulators provide excellent regulation over line, load and temperature variations.

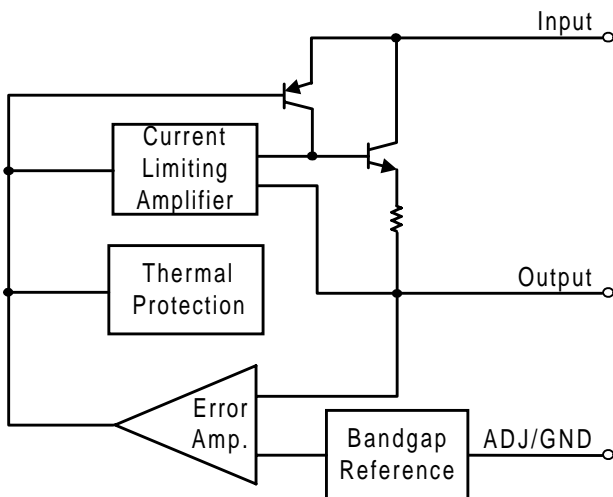
## ■ Key Features

- Low dropout voltage 1.2V typically at 1.5A
- Adjustable or 3.3V fixed voltage
- Line regulation typically 0.015%
- Load regulation typically 0.05%
- Adjust pin (ADJ) current less than 90 $\mu$ A
- Overcurrent protection
- Thermal protection
- Available in TO-220, TO-263, TO-252

## ■ Applications

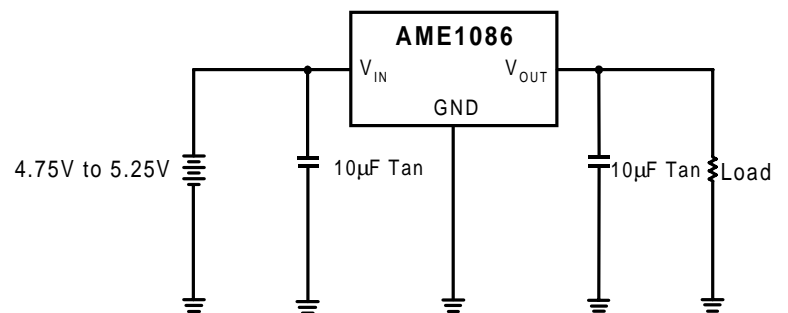
- High Efficiency Linear Regulators
- Post Regulators for Switching Supplies
- 5V to 3.3V Voltage Converter
- Battery Charger

## ■ Functional Block Diagram



**Figure 1**

## ■ Typical Application

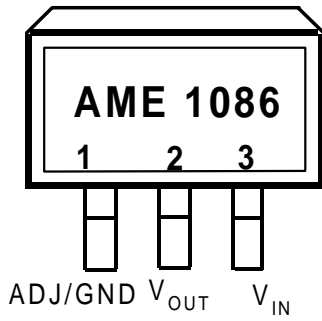


**Figure 2**

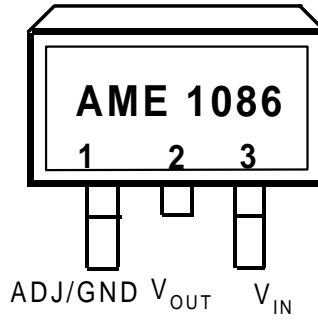


■ Pin Configuration

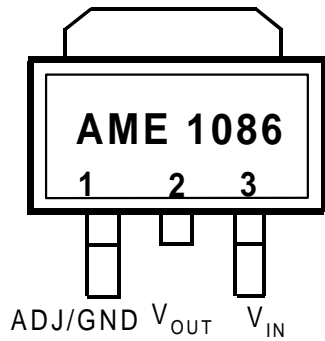
To-263 Front View



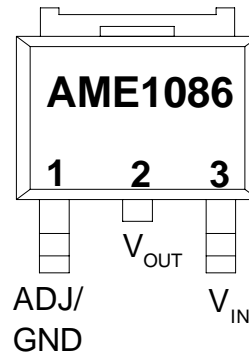
To-263-2 Front View



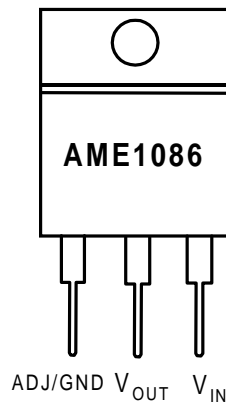
To-252-2 Front View



TO-252-2 Front view



To-220 Front View





■ Ordering Information

Part Number	Marking	Output Voltage	Package
AME1086ACBT	AME1086 ACBT YYWW	ADJ	TO-220
AME1086DCBT	AME1086 DCBT YYWW	3.3	TO-220
AME1086ACDT	AME1086 ACDT YYWW	ADJ	TO-263-3
AME1086DCDT	AME1086 DCDT YYWW	3.3	TO-263-3
AME1086ACDS	AME1086 ACDS YYWW	ADJ	TO-263-2
AME1086DCDS	AME1086 DCDS YYWW	3.3	TO-263-2
AME1086ACCS	AME1086 ACCS YYWW	ADJ	TO-252-2
AME1086DCCS	AME1086 DCCS YYWW	3.3	TO-252-2

\* This differs from our standard part numbering scheme due to historical precedent

■ Absolute Maximum Ratings

Parameter	Symbol	Maximum	Units
Input Voltage	$V_{IN}$	7	V
Thermal Resistance (Junction to Case)	TO-220	2.5	$^{\circ}\text{C}/\text{W}$
	TO-263	2.5	
	TO-252	15	
Thermal Resistance (Junction to Ambient)	TO-220	50	$^{\circ}\text{C}$
	TO-263	60	
	TO-252	90	
Operating Junction Temperature Range	$T_J$	0 to 125	$^{\circ}\text{C}$
Storage Temperature Range	$T_{STG}$	-65 to 150	
Lead Temperature ( 10 sec )	$T_{LEAD}$	260	

**■ Electrical Characteristics**
**AME1086AXXX**

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units	
Reference voltage (adjustable voltage)	$V_{REF}$	$V_{IN} = 5V$ $I_O = 10mA$	$T_J = 25^{\circ}C$	1.238	1.250	1.262	V
			Over temp.	1.225		1.275	
Line regulation	$Reg_{LINE}$	$V_{IN} = 2.75 - 7V$ $I_O = 10mA$	$T_J = 25^{\circ}C$	-	0.015	0.2	%
			Over temp.	-	0.035	0.2	
Load regulation	$Reg_{LOAD}$	$V_{IN} = 5V$ $I_O = 10mA - 1.5A$	$T_J = 25^{\circ}C$	-	0.05	0.3	%
			Over temp.	-	0.2	0.4	
Dropout voltage $\Delta V_{OUT}, \Delta V_{REF} = 1\%$	$V_D$	$V_{IN} = 2.75 - 7V$ $I_O = 10mA - 1.5A$	$T_J = 25^{\circ}C$	-	1.2	1.4	V
			Over temp.	-	1.3	-	
Current limit	$I_S$	$V_{IN} = 2.75 - 7V$ , Over temp.	1.5	-	-	A	
Temperature Coefficient	$T_C$	$V_{IN} = 2.75 - 7V$ , $I_O = 10mA - 1.5A$	-	0.005	-	$\%/^{\circ}C$	
Temperature stability	$T_S$	$V_{IN} = 5V$ , $I_O = 500mA$ , Over temp.	-	0.5	-	%	
Minimum load current	$I_O$	$V_{IN} = 5V$	-	5	10	mA	
RMS output noise	$V_N$	$T_J = 25^{\circ}C$	-	0.003	-	$\%V_O$	
Ripple rejection ratio	$R_A$	$V_{IN} = 5V$ , $I_O = 1.5A$ , Over temp.	60	72	-	dB	

**AME1086DXXX**

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units	
Output voltage (fixed voltage)	$V_O$	$V_{IN} = 5V$ $I_O = 0A$	$T_J = 25^{\circ}C$	3.267	3.300	3.333	V
			Over temp.	3.234		3.366	
Line regulation	$Reg_{LINE}$	$V_{IN} = 4.5 - 7V$ $I_O = 0A$	$T_J = 25^{\circ}C$	-	0.015	0.2	%
			Over temp.	-	0.035	0.2	
Load regulation	$Reg_{LOAD}$	$V_{IN} = 5V$ $I_O = 0A - 1.5A$	$T_J = 25^{\circ}C$	-	0.05	0.3	%
			Over temp.	-	0.2	0.4	
Dropout voltage $\Delta V_{OUT}, \Delta V_{REF} = 1\%$	$V_D$	$V_{IN} = 4.5 - 7V$ $I_O = 0A - 1.5A$	$T_J = 25^{\circ}C$	-	1.2	1.4	V
			Over temp.	-	1.3	-	
Current limit	$I_S$	$V_{IN} = 4.5 - 7V$ , Over temp.	1.5	-	-	A	
Quiescent current (fixed model)	$I_Q$	$V_{IN} = 5V$ , $I_O = 0A - 1.5A$ , Over temp.	-	12	13	mA	
Temperature Coefficient	$T_C$	$V_{IN} = 4.5 - 7V$ , $I_O = 0A - 1.5A$	-	0.005	-	$\%/^{\circ}C$	
Temperature stability	$T_S$	$V_{IN} = 5V$ , $I_O = 500mA$ , Over temp.	-	0.5	-	%	
RMS output noise	$V_N$	$T_J = 25^{\circ}C$	-	0.003	-	$\%V_O$	
Ripple rejection ratio	$R_A$	$V_{IN} = 5V$ , $I_O = 1.5A$ , Over temp.	60	72	-	dB	

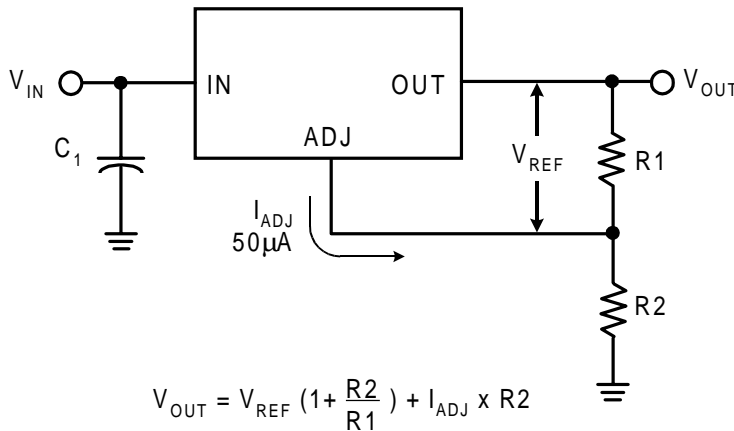
## ■ Application Description

### 1. Output voltage adjustment

Like most regulators, the AME1086 regulates the output by comparing the output voltage to an internally generated reference voltage. On the adjustable version, the  $V_{REF}$  is available externally as 1.25V between  $V_{OUT}$  and ADJ. The voltage ratio formed by R1 and R2 should be set to conduct 10mA (minimum output load). The output voltage is given by the following equation:

$$V_{OUT} = V_{REF} \left( 1 + \frac{R2}{R1} \right) + I_{ADJ} \times R2$$

On fixed versions of AME1086, the voltage divider is provided internally.



**Figure 3**

### 2. Thermal protection

AME1086 has thermal protection which limits junction temperature to 150°C. However, device functionality is only guaranteed to a maximum junction temperature of +125°C.

The power dissipation and junction temperature for AME1086 in TO-220 package are given by

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$$

$$T_{JUNCTION} = T_{AMBIENT} + (P_D \times \theta_{JA})$$

Note:  $T_{JUNCTION}$  must not exceed 125°C

### 3. Current limit protection

AME1086 is protected against overload conditions. Current protection is triggered at typically 3.0A.

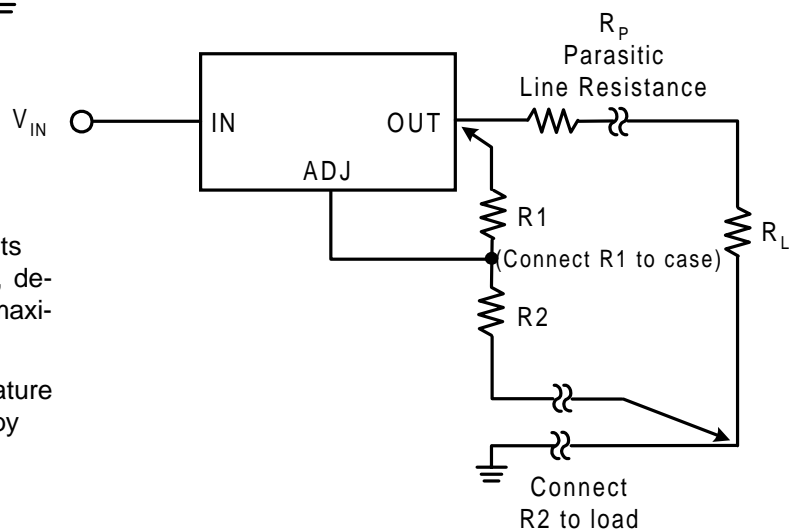
### 4. Stability and load regulation

AME1086 requires a capacitor from  $V_{OUT}$  to GND to provide compensation feedback to the internal gain stage. This is to ensure stability at the output terminal. Typically, a 10µF tantalum or 50µF aluminum electrolytic is sufficient.

Note: It is important that the ESR for this capacitor does not exceed 0.5Ω.

The output capacitor dose not have a theoretical upper limit and increasing its value will increase stability.  $C_{OUT} = 100\mu\text{F}$  or more is typical for high current regulator design.

For the adjustable version, the best load regulation is accomplished when the top of the resistor divider (R1) is connected directly to the output pin of the AME1086. When so connected,  $R_p$  is not multiplied by the divider ratio. For fixed output versions, the top of R1 is internally connected to the output and ground pin can be connected to low side of the load.



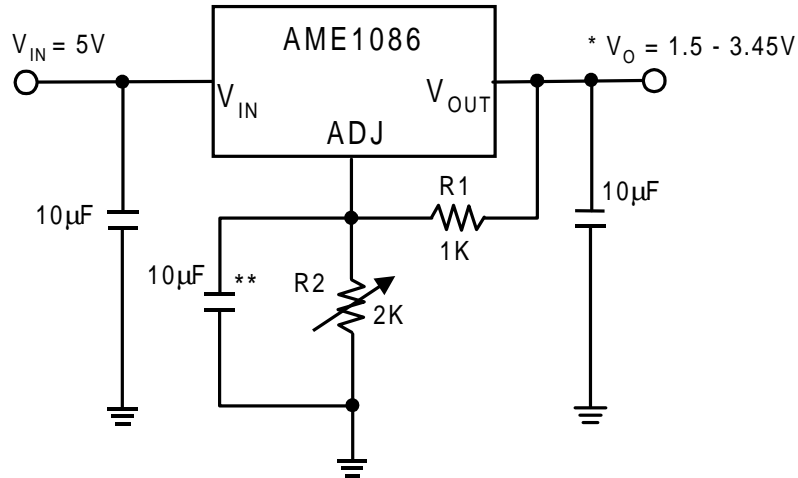
**Figure 4**



#### 5. Thermal consideration

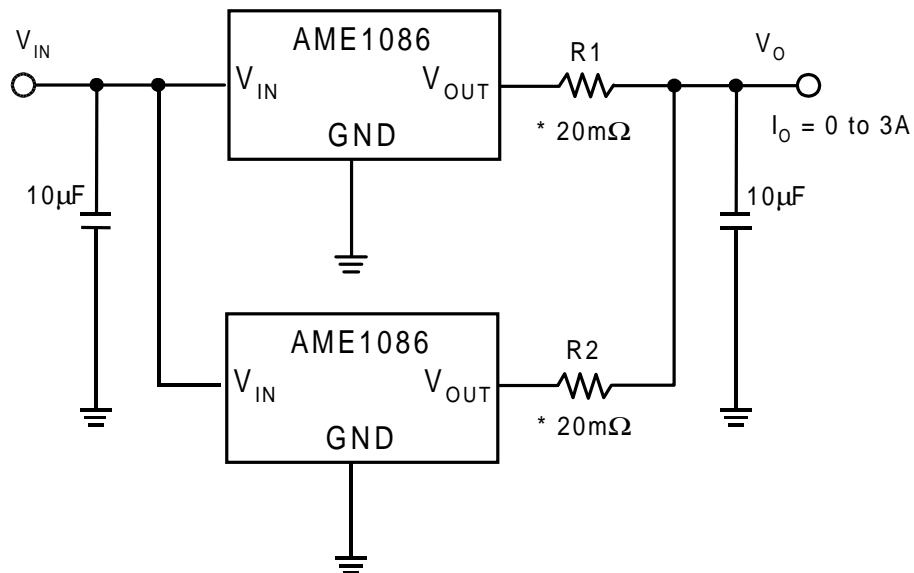
The AME1086 series contain thermal limiting circuitry designed to protect itself for over-temperature conditions. Even for normal load conditions, maximum junction temperature ratings must not be exceeded. As mentioned in the thermal protection section, we need to consider all sources of thermal resistance between junction and ambient. It includes junction-to-case, case-to-heat-sink interface and heat sink thermal resistance itself.

Junction-to-case thermal resistance is specified from the IC junction to the bottom of the case directly below the die. Proper mounting is required to ensure the best possible thermal flow from this area of the package to the heat sink. The case of all devices in this series is electrically connected to the output. Therefore, if the case of the device must be electrically isolated, a thermally conductive spacer is recommended.

**■ Advanced Applications**


$$* V_O = V_{REF} \left( 1 + \frac{R2}{R1} \right) + I_{ADJ} \times R2$$

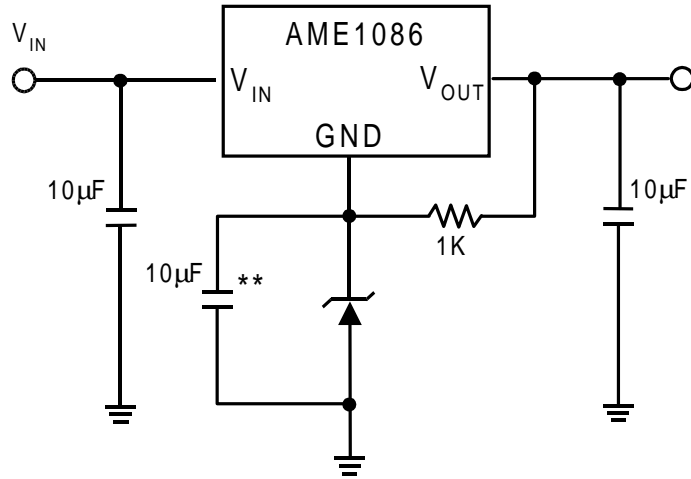
\*\* Optional for improved ripple rejection

**Figure 5 Adjustable output voltage**


\* 20mΩ is ballast resistance

The inter - connection of #18 wire could act as ballast resistance

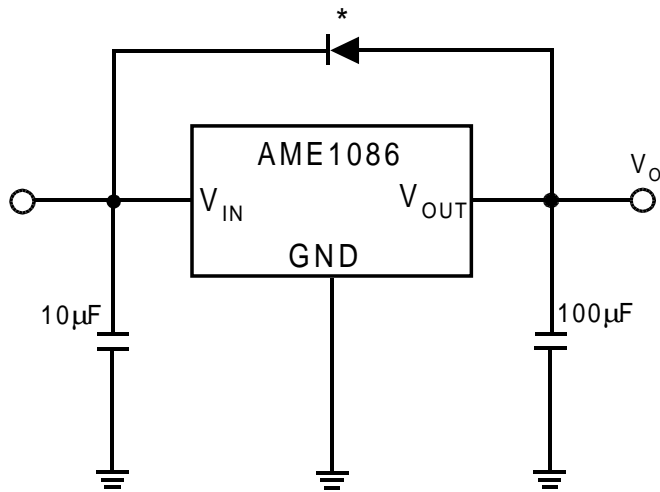
**Figure 6 Paralleling Regulators**

**■ Advanced Applications (Cont.)**


\*  $V_O = V_{REF} + V_Z$  ( $V_Z$ : breakdown voltage of Zener diode)

\*\* Optional for improved ripple rejection

**Figure 7 Regulator with reference**



**Figure 8 Regulator with reverse diode protection**





■ External Resistor Divider Table for Customized Voltage

R1(ohm)	100	102	105	107	110	113	115	118	121	124
Vout	$R2(ohm)=(Vout-1.25)*R1/(1.25+50u*R1)$									
1.25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.30	3.984	4.063	4.182	4.262	4.381	4.500	4.579	4.698	4.817	4.936
1.35	7.968	8.127	8.365	8.524	8.761	8.999	9.158	9.396	9.633	9.871
1.40	11.95	12.19	12.55	12.79	13.14	13.50	13.74	14.09	14.45	14.81
1.45	15.94	16.25	16.73	17.05	17.52	18.00	18.32	18.79	19.27	19.74
1.50	19.92	20.32	20.91	21.31	21.90	22.50	22.89	23.49	24.08	24.68
1.55	23.90	24.38	25.09	25.57	26.28	27.00	27.47	28.19	28.90	29.61
1.60	27.89	28.44	29.28	29.83	30.67	31.50	32.05	32.88	33.72	34.55
1.65	31.87	32.51	33.46	34.09	35.05	36.00	36.63	37.58	38.53	39.48
1.70	35.86	36.57	37.64	38.36	39.43	40.50	41.21	42.28	43.35	44.42
1.75	39.84	40.63	41.82	42.62	43.81	45.00	45.79	46.98	48.17	49.36
1.80	43.82	44.70	46.01	46.88	48.19	49.50	50.37	51.68	52.98	54.29
1.85	47.81	48.76	50.19	51.14	52.57	54.00	54.95	56.37	57.80	59.23
1.90	51.79	52.82	54.37	55.40	56.95	58.50	59.53	61.07	62.62	64.16
1.95	55.78	56.89	58.55	59.66	61.33	63.00	64.11	65.77	67.43	69.10
2.00	59.76	60.95	62.74	63.93	65.71	67.49	68.68	70.47	72.25	74.03
2.05	63.75	65.01	66.92	68.19	70.09	71.99	73.26	75.17	77.07	78.97
2.10	67.73	69.08	71.10	72.45	74.47	76.49	77.84	79.86	81.88	83.90
2.15	71.71	73.14	75.28	76.71	78.85	80.99	82.42	84.56	86.70	88.84
2.20	75.70	77.21	79.47	80.97	83.23	85.49	87.00	89.26	91.52	93.77
2.25	79.68	81.27	83.65	85.24	87.61	89.99	91.58	93.96	96.33	98.71
2.30	83.67	85.33	87.83	89.50	92.00	94.49	96.16	98.65	101.2	103.6
2.35	87.65	89.40	92.01	93.76	96.38	98.99	100.7	103.4	106.0	108.6
2.40	91.63	93.46	96.20	98.02	100.8	103.5	105.3	108.1	110.8	113.5
2.45	95.62	97.52	100.4	102.3	105.1	108.0	109.9	112.7	115.6	118.5
2.50	99.60	101.6	104.6	106.5	109.5	112.5	114.5	117.4	120.4	123.4
2.55	103.6	105.6	108.7	110.8	113.9	117.0	119.1	122.1	125.2	128.3
2.60	107.6	109.7	112.9	115.1	118.3	121.5	123.6	126.8	130.1	133.3
2.65	111.6	113.8	117.1	119.3	122.7	126.0	128.2	131.5	134.9	138.2
2.70	115.5	117.8	121.3	123.6	127.0	130.5	132.8	136.2	139.7	143.1
2.75	119.5	121.9	125.5	127.9	131.4	135.0	137.4	140.9	144.5	148.1
2.80	123.5	126.0	129.7	132.1	135.8	139.5	141.9	145.6	149.3	153.0
2.85	127.5	130.0	133.8	136.4	140.2	144.0	146.5	150.3	154.1	157.9
2.90	131.5	134.1	138.0	140.6	144.6	148.5	151.1	155.0	159.0	162.9
2.95	135.5	138.2	142.2	144.9	148.9	153.0	155.7	159.7	163.8	167.8
3.00	139.4	142.2	146.4	149.2	153.3	157.5	160.3	164.4	168.6	172.7
3.05	143.4	146.3	150.6	153.4	157.7	162.0	164.8	169.1	173.4	177.7
3.10	147.4	150.3	154.8	157.7	162.1	166.5	169.4	173.8	178.2	182.6



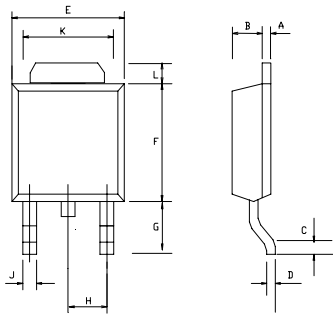
External Resistor Divider Table for Customized Voltage (Cont.)

R1(ohm)	100	102	105	107	110	113	115	118	121	124
Vout	$R2(ohm)=(Vout-1.25)*R1/(1.25+50u*R1)$									
3.15	151.4	154.4	158.9	161.9	166.5	171.0	174.0	178.5	183.0	187.5
3.20	155.4	158.5	163.1	166.2	170.8	175.5	178.6	183.2	187.9	192.5
3.25	159.4	162.5	167.3	170.5	175.2	180.0	183.2	187.9	192.7	197.4
3.30	163.3	166.6	171.5	174.7	179.6	184.5	187.7	192.6	197.5	202.4
3.35	167.3	170.7	175.7	179.0	184.0	189.0	192.3	197.3	202.3	207.3
3.40	171.3	174.7	179.8	183.3	188.4	193.5	196.9	202.0	207.1	212.2
3.45	175.3	178.8	184.0	187.5	192.8	198.0	201.5	206.7	211.9	217.2
3.50	179.3	182.9	188.2	191.8	197.1	202.5	206.1	211.4	216.8	222.1
3.55	183.3	186.9	192.4	196.0	201.5	207.0	210.6	216.1	221.6	227.0
3.60	187.3	191.0	196.6	200.3	205.9	211.5	215.2	220.8	226.4	232.0
3.65	191.2	195.0	200.8	204.6	210.3	216.0	219.8	225.5	231.2	236.9
3.70	195.2	199.1	204.9	208.8	214.7	220.5	224.4	230.2	236.0	241.8
3.75	199.2	203.2	209.1	213.1	219.0	225.0	228.9	234.9	240.8	246.8
3.80	203.2	207.2	213.3	217.3	223.4	229.5	233.5	239.6	245.7	251.7
3.85	207.2	211.3	217.5	221.6	227.8	234.0	238.1	244.3	250.5	256.6
3.90	211.2	215.4	221.7	225.9	232.2	238.5	242.7	249.0	255.3	261.6
3.95	215.1	219.4	225.9	230.1	236.6	243.0	247.3	253.7	260.1	266.5
4.00	219.1	223.5	230.0	234.4	240.9	247.5	251.8	258.4	264.9	271.5
4.05	223.1	227.6	234.2	238.7	245.3	252.0	256.4	263.1	269.7	276.4
4.10	227.1	231.6	238.4	242.9	249.7	256.5	261.0	267.8	274.6	281.3
4.15	231.1	235.7	242.6	247.2	254.1	261.0	265.6	272.5	279.4	286.3
4.20	235.1	239.7	246.8	251.4	258.5	265.5	270.2	277.2	284.2	291.2
4.25	239.0	243.8	250.9	255.7	262.8	270.0	274.7	281.9	289.0	296.1
4.30	243.0	247.9	255.1	260.0	267.2	274.5	279.3	286.6	293.8	301.1
4.35	247.0	251.9	259.3	264.2	271.6	279.0	283.9	291.3	298.6	306.0
4.40	251.0	256.0	263.5	268.5	276.0	283.5	288.5	296.0	303.5	310.9
4.45	255.0	260.1	267.7	272.8	280.4	288.0	293.1	300.7	308.3	315.9
4.50	259.0	264.1	271.9	277.0	284.7	292.5	297.6	305.4	313.1	320.8
4.55	262.9	268.2	276.0	281.3	289.1	297.0	302.2	310.1	317.9	325.7
4.60	266.9	272.2	280.2	285.5	293.5	301.5	306.8	314.8	322.7	330.7
4.65	270.9	276.3	284.4	289.8	297.9	306.0	311.4	319.5	327.5	335.6
4.70	274.9	280.4	288.6	294.1	302.3	310.5	315.9	324.2	332.4	340.6
4.75	278.9	284.4	292.8	298.3	306.7	315.0	320.5	328.8	337.2	345.5
4.80	282.9	288.5	297.0	302.6	311.0	319.5	325.1	333.5	342.0	350.4
4.85	286.9	292.6	301.1	306.8	315.4	324.0	329.7	338.2	346.8	355.4
4.90	290.8	296.6	305.3	311.1	319.8	328.5	334.3	342.9	351.6	360.3
4.95	294.8	300.7	309.5	315.4	324.2	333.0	338.8	347.6	356.4	365.2
5.00	298.8	304.8	313.7	319.6	328.6	337.5	343.4	352.3	361.3	370.2



■ Package Dimension

TO-252 (DPAK) -EIAJ



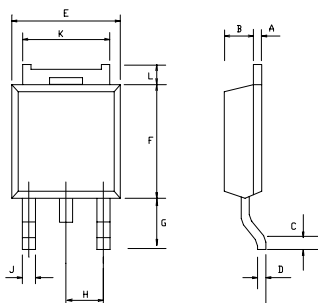
SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.45	0.58	0.0177	0.023
B	1.60	1.95	0.06	0.0768
C	0.51	-	0.02	-
D	0.45	0.60	0.0177	0.0236
E	6.40	6.80	0.252	0.2677
F	5.40	5.80	0.2126	0.2283
G	2.20	2.85	0.0866	0.1122
H	-	* 2.30	-	* 0.0906
I	-	0.90	-	0.0354
J	-	0.97	-	0.038
K	5.20	5.50	0.20	0.22
L	0.89	2.03	0.035	0.08

\* : Typical value

NOTES :

1. CONTROLLING DIMENSION : MILLIMETERS.
2. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS  
MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

TO-252 (DPAK) JDEC



SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.45	0.58	0.0177	0.023
B	1.60	1.95	0.06	0.0768
C	0.51	-	0.02	-
D	0.45	0.60	0.0177	0.0236
E	6.40	6.80	0.252	0.2677
F	5.40	5.80	0.2126	0.2283
G	2.20	2.85	0.0866	0.1122
H	-	* 2.30	-	* 0.0906
I	-	0.90	-	0.0354
J	-	0.97	-	0.038
K	5.20	5.50	0.20	0.22
L	0.89	2.03	0.035	0.08

\* : Typical value

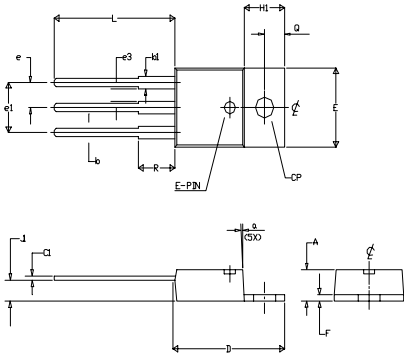
NOTES :

1. CONTROLLING DIMENSION : MILLIMETERS.
2. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS  
MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.



■ Package Dimension

TO-220

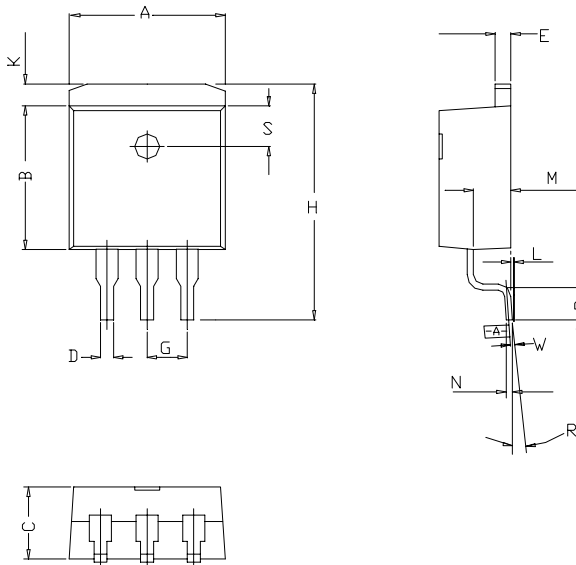


SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.06	4.83	0.160	0.190
b	0.63	1.02	0.025	0.040
C1	0.35	0.60	0.0138	0.0236
D	14.22	14.99	0.056	0.590
E	9.66	10.54	0.385	0.415
e	-	2.79	-	0.110
e1	4.83	5.33	0.190	0.210
e3	1.14	1.40	0.045	0.055
f	1.14	1.40	0.045	0.055
H1	5.94	6.55	0.234	0.258
K	2.29	2.92	0.090	0.115
CP	3.71	3.96	0.146	0.156
Q	2.62	2.87	0.103	0.113
L	12.70	14.27	0.500	0.5618
a	3D	7D	3D	7D
b1	1.14	1.52	0.0449	0.06
R	6.17 REF.		0.243 REF.	

Notes :

1. Dimension C1 apply for tin plate finish.
2. For solder dip lead finish dimension C1 should be 0.015"-0.027" (0.38-0.69)

TO-263-3 (D<sup>2</sup>PAK)



SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.65	10.41	0.380	0.410
B	8.28	9.65	0.326	0.380
C	4.06	4.83	0.160	0.190
D	0.51	1.02	0.020	0.040
E	1.14	1.40	0.045	0.055
G	* 2.54		* 0.100	
H	14.61	15.88	0.575	0.625
K	1.02	1.68	0.040	0.066
L	0.00	0.97	0.000	0.038
M	2.49	2.74	0.098	0.108
N	0.43	0.58	0.017	0.023
P	2.29	2.79	0.090	0.110
R	0°	8°	0°	8°
S	2.41	2.67	0.095	0.105
W	0.254	0.508	0.010	0.020

\* : Typical value

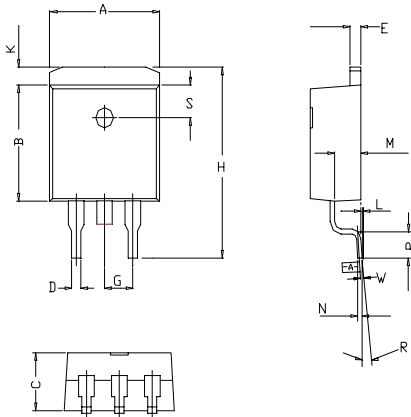
NOTES :

1. CONTROLLING DIMENSION : MILLIMETERS.
2. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS  
MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIA.



■ Package Dimension

TO-263-2 (D<sup>2</sup>PAK)



SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.65	10.41	0.380	0.410
B	8.28	9.65	0.326	0.380
C	4.06	4.83	0.160	0.190
D	0.51	1.02	0.020	0.040
E	1.14	1.40	0.045	0.055
G	*2.54		*0.100	
H	14.61	15.88	0.575	0.625
K	1.02	1.68	0.040	0.066
L	0.00	0.97	0.000	0.038
M	2.49	2.74	0.098	0.108
N	0.43	0.58	0.017	0.023
P	2.29	2.79	0.090	0.110
R	0°	8°	0°	8°
S	2.41	2.67	0.095	0.105
W	0.254	0.508	0.010	0.020

\* : Typical value

NOTES :

1. CONTROLLING DIMENSION : MILLIMETERS.
2. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS  
MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIA.



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