Analog Microelectronics, Inc.

AME1084

5A Low Dropout
Positive Voltage Regulator

■ General Description

The AME1084 is a 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.). AME1084 series regulators provide excellent regulation over line, load and temperature variations.

■ Key Features

- Low dropout voltage ··· 1.4V at 5A
- Adjustable or 3.3V fixed voltage
- Line regulation typically 0.015%
- Load regulation typically 0.05%
- Adjust pin (ADJ) current less than 90µA
- 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

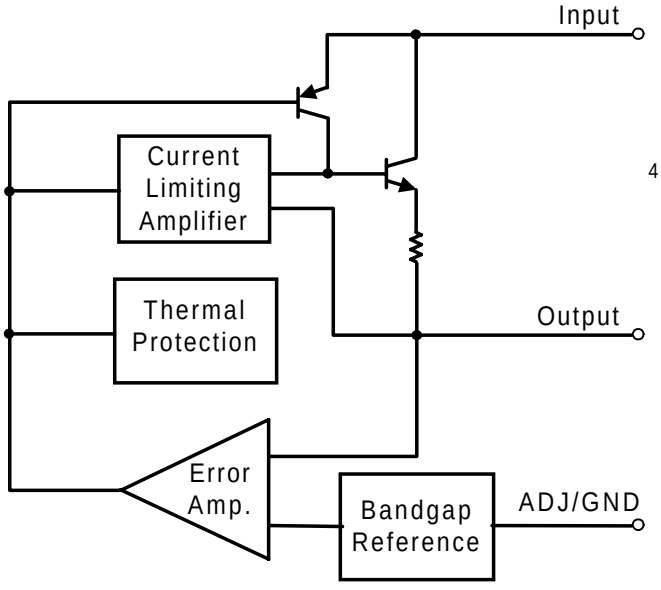


Figure 1

■ Typical Application

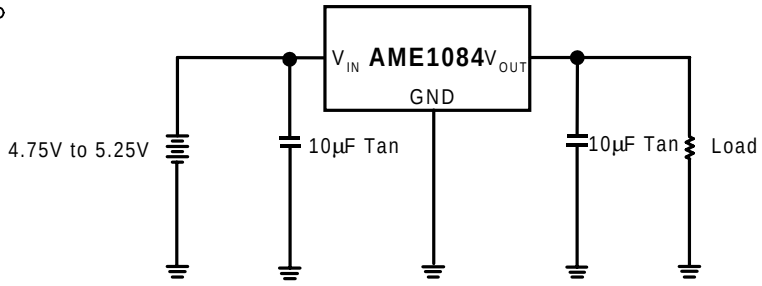
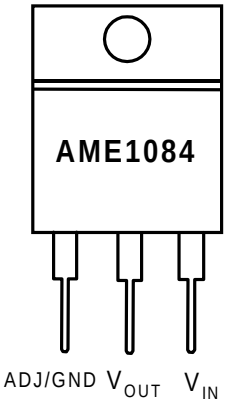
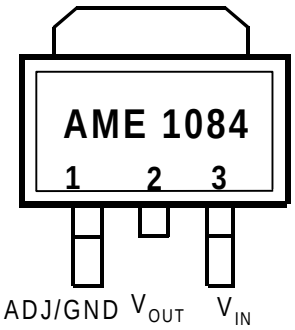


Figure 2

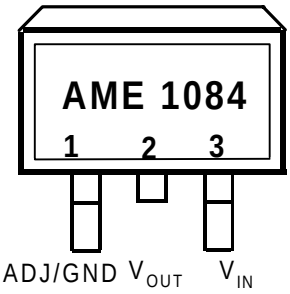
■ Pin Configuration



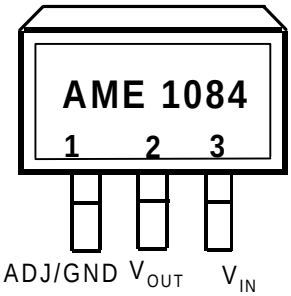
TO-220 Front View



To-252 Front View



TO-263-2 Front View



TO-263-3 Front View

■ Ordering Information

Part Number	Marking	Output Voltage	Package
AME1084ACBT	AME1084 ACBT yyww	ADJ	TO-220
AME1084BCBT	AME1084 BCBT yyww	1.5	TO-220
AME1084CCBT	AME1084 CCBT yyww	2.5	TO-220
AME1084DCBT	AME1084 DCBT yyww	3.3	TO-220
AME1084ACDT-3	AME1084 ACDT-3 yyww	ADJ	TO-263-3
AME1084BCDT-3	AME1084 BCDT-3 yyww	1.5	TO-263-3
AME1084CCDT-3	AME1084 CCDT-3 yyww	2.5	TO-263-3
AME1084DCDT-3	AME1084 DCDT-3 yyww	3.3	TO-263-3
AME1084ACDT	AME1084 ACDT yyww	ADJ	TO-263-2
AME1084BCDT	AME1084 BCDT yyww	1.5	TO-263-2
AME1084CCDT	AME1084 CCDT yyww	2.5	TO-263-2
AME1084DCDT	AME1084 DCDT yyww	3.3	TO-263-2
AME1084ACCS	AME1084 ACCS yyww	ADJ	TO-252
AME1084BCCS	AME1084 BCCS yyww	1.5	TO-252
AME1084CCCS	AME1084 CCCS yyww	2.5	TO-252
AME1084DCCS	AME1084 DCCS yyww	3.3	TO-252

■ Absolute Maximum Ratings

Parameter		Symbol	Maximum	Unit
Input Voltage		V_{IN}	7	V
Thermal Resistance (Junction to Case)	TO-220	θ_{JC}	3	°C/W
	TO-252		5	
	TO-263		3	
Thermal Resistance (Junction to Ambient)	TO-220	θ_{JA}	50	
	TO-252		90	
	TO-263		50	
Operating Junction Temperature Range		T_J	0 to 125	°C
Storage Temperature Range		T_{STG}	-65 to 150	
Lead Temperature (10 sec)		T_{LEAD}	260	

■ Electrical Characteristics

1. 1084AXXX

Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Units
Reference voltage (adjustable voltage)	V_{REF}	V_{IN} = 5V, I_O = 10mA	T_J =25°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°C	-	0.015	0.2	%
			Over temp.	-	0.035	0.2	
Load regulation	Reg_{LOAD}	V_{IN} = 5V, I_O = 10mA - 5A	T_J =25°C	-	0.05	0.3	%
			Over temp.	-	0.2	0.4	
Dropout voltage ΔV_{OUT}, ΔV_{REF} = 1%	V_D	V_{IN} = 2.75 - 7V, I_O = 10mA - 5A	T_J =25°C	-	1.2	1.4	V
			Over temp.	-	1.3	-	
Current limit	I_S	V_{IN} = 2.75 - 7V, Over temp.		5.0	-	-	A
Temperature Coefficient	T_C	V_{IN} = 2.75 - 7V, I_O = 10mA - 5A		-	0.005	-	%/°C
Adjust pin current	I_{ADJ}	V_{IN} = 2.75 - 7V, I_O = 10mA - 5A	T_J = 25°C	-	55	-	μA
			Over temp.	-	-	90	
Adjust pin current change	ΔI_{ADJ}	V_{IN} = 2.75 - 7V, I_O = 10mA - 5A Over temp.		-	0.2	5	
Temperature stability	T_S	V_{IN} = 5V, I_O = 500mA, Over temp.		0.5	0.5	-	%
Minimum load current	I_O	V_{IN} = 5V		-	5	10	mA
RMS output noise	V_N	T_J = 25°C		-	0.003	-	%V_O
Ripple rejection ratio	R_A	V_{IN} = 5V, I_O = 5A, Over temp.		60	72	-	dB

2. 1084DXXX

Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Units
Output voltage (fixed voltage)	Vo	V_{IN} = 5V, I_O = 0A	T_J =25°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°C	-	0.015	0.2	%
			Over temp.	-	0.035	0.2	
Load regulation	Reg_{LOAD}	V_{IN} = 5V, I_O = 0A - 5A	T_J =25°C	-	0.05	0.3	%
			Over temp.	-	0.2	0.4	
Dropout voltage ΔV_{OUT}, ΔV_{REF} = 1%	V_D	V_{IN} = 4.5 - 7V, I_O = 0A - 5A	T_J =25°C	-	1.2	1.4	V
			Over temp.	-	1.3	-	
Current limit	I_S	V_{IN} = 4.5 - 7V, Over temp.		5.0	-	-	A
Quiescent current (fixed model)	I_Q	V_{IN}=5V, Io=0-5A, Over temp.		-	12	13	mA
Temperature Coefficient	T_C	V_{IN} = 4.5 - 7V, I_O = 0A - 5A		-	0.005	-	%/°C
Temperature stability	T_S	V_{IN} = 5V, I_O = 500mA, Over temp.		0.5	0.5	-	%
RMS output noise	V_N	T_J = 25°C		-	0.003	-	%V_O
Ripple rejection ratio	R_A	V_{IN} = 5V, I_O = 5A, Over temp.		60	72	-	dB

Application Description

1. Output voltage adjustment

Like most regulators, the AME1084 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 AME1084, the voltage divider is provided internally.

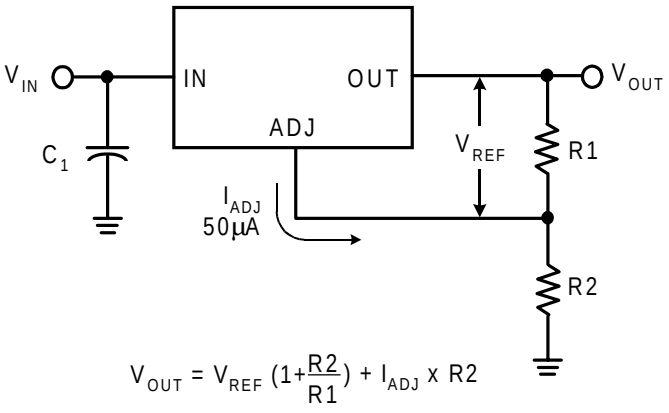


Figure 3

2. Thermal protection

AME1084 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 AME1084 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

AME1084 is protected against overload conditions. Current protection is triggered at typical 7.5A.

4. Stability and load regulation

AME1084 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} = 100µF or more is typical for high current regulator design.

For the adjustable version, the best load regulation is accomplished when the top of theresistor divider (R1) is connected directly to theoutput pin of the AME1084. 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. The ground pin can be connected to low side of the load to eliminate ground loop errors.

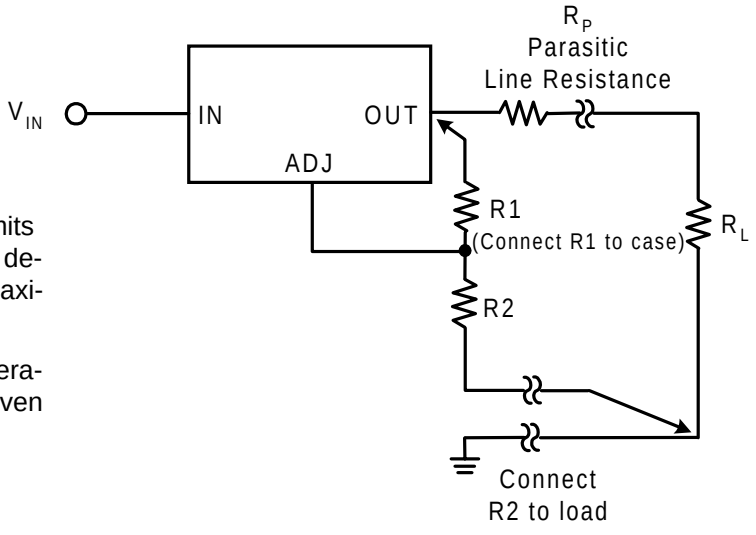


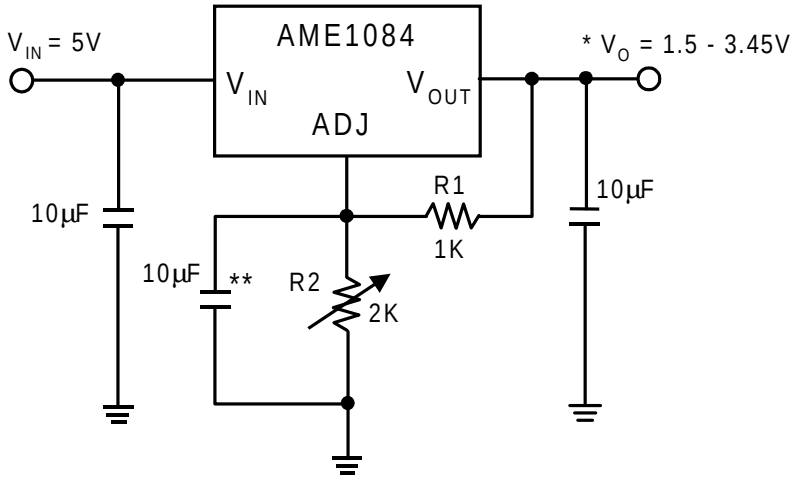
Figure 4

5. Thermal consideration

The AME1084 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 exceed. As mention in 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.

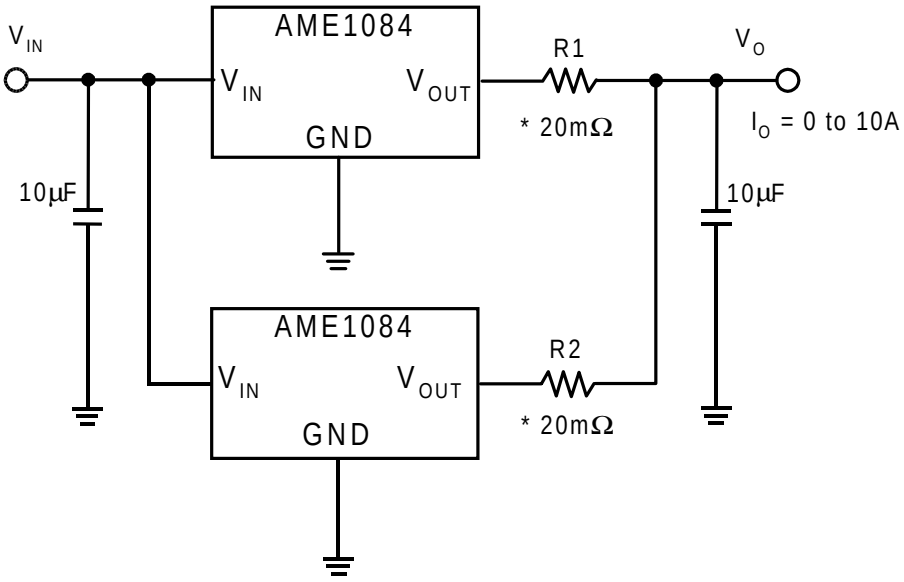
■ Advanced Applications



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

** Optional for improved ripple rejection

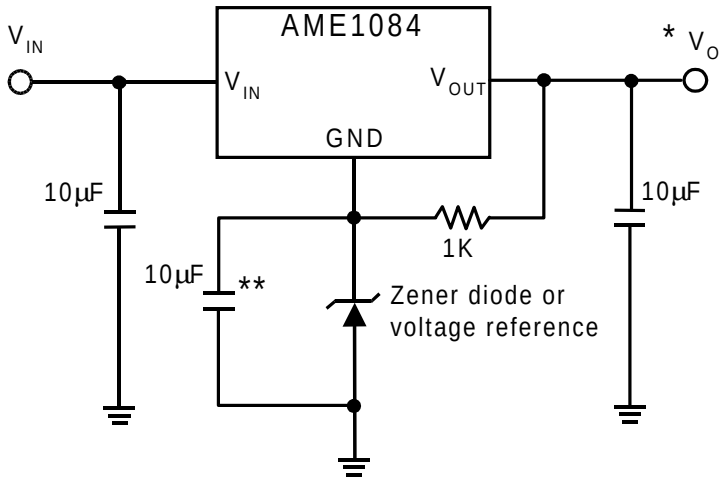
Figure 5 Adjustable Output Voltage



* 20mW 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

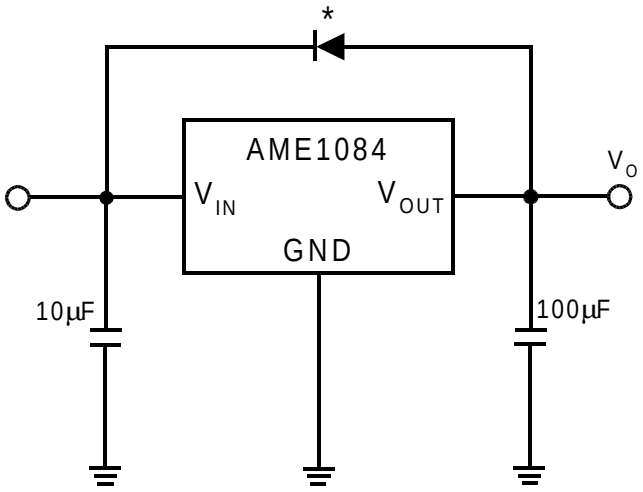
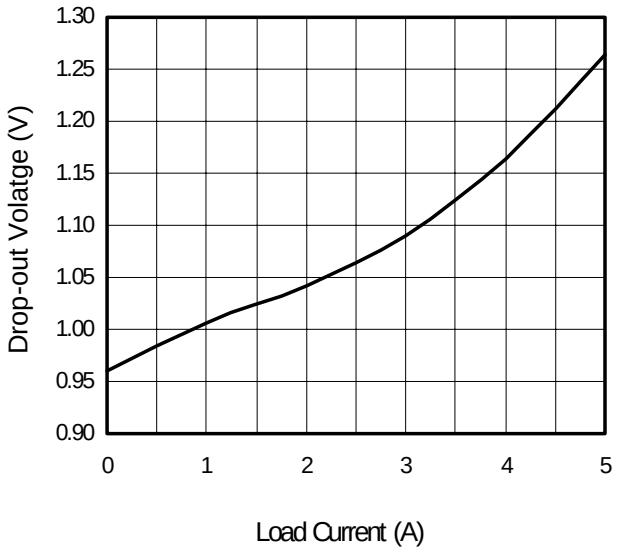


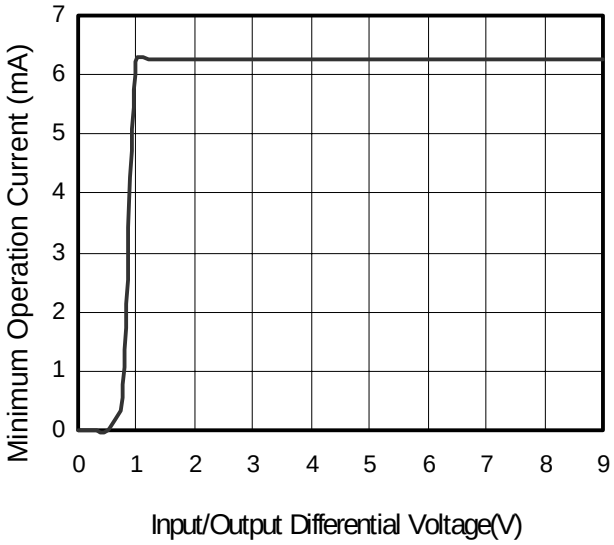
Figure 8 Regulator with Reverse Diode Protection

■ Performance Characteristics

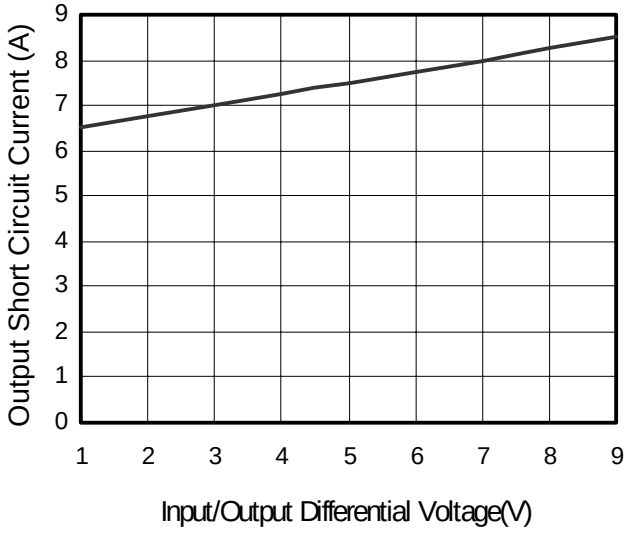
Drop-out Voltage vs. Load Current



Minimum Operation Current vs Input/Output Differential Voltage



Output Short circuit Current vs Input/Output Differential Voltage



■ External Resistor Divider Table for Customized Voltage

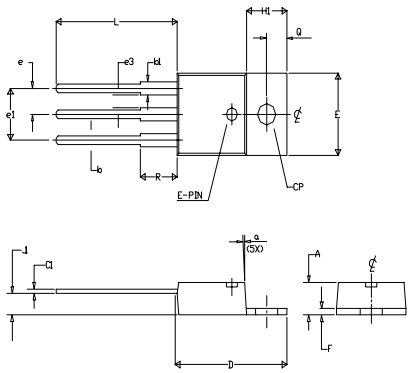
R1(ohm)	100	102	105	107	110	113	115	118	121	124
Vout	R2(ohm)=(Vout-1.25)*R1/(1.25+50u*R1)									
1.25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.30	3.984	4.063	4.182	4.262	4.381	4.500	4.579	4.698	4.817	4.936
1.35	7.968	8.127	8.365	8.524	8.761	8.999	9.158	9.396	9.633	9.871
1.40	11.95	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

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

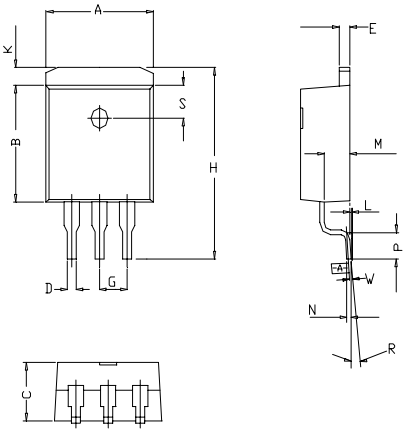
TO-220



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



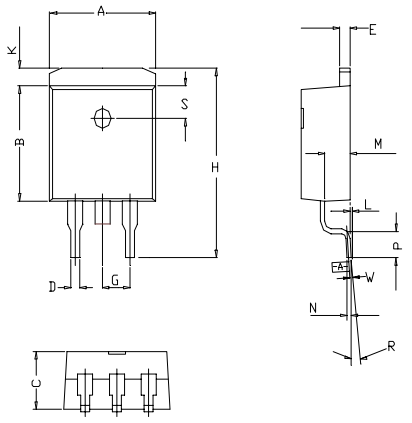
SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.65	10.41	0.380	0.410
B	8.28	9.65	0.326	0.380
C	4.06	4.83	0.160	0.190
D	0.51	1.02	0.020	0.040
E	1.14	1.40	0.045	0.055
G	*2.54		*0.100	
H	14.61	15.88	0.575	0.625
K	1.02	1.68	0.040	0.066
L	0.00	0.97	0.000	0.038
M	2.49	2.74	0.098	0.108
N	0.43	0.58	0.017	0.023
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.
2MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS
MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIA.

■ Package Dimension

TO-263-2



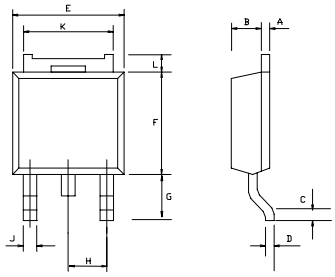
SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.65	10.41	0.380	0.410
B	8.28	9.65	0.326	0.380
C	4.06	4.83	0.160	0.190
D	0.51	1.02	0.020	0.040
E	1.14	1.40	0.045	0.055
G	*2.54		*0.100	
H	14.61	15.88	0.575	0.625
K	1.02	1.68	0.040	0.066
L	0.00	0.97	0.000	0.038
M	2.49	2.74	0.098	0.108
N	0.43	0.58	0.017	0.023
P	2.29	2.79	0.090	0.110
R	0^o	$8^?$	0^o	$8^?$
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.
2MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS
MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIA.

■ Package Dimension

TO-252 (DPAK)

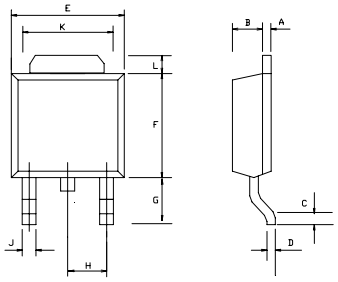


SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.45	0.58	0.0177	0.023
B	1.60	1.95	0.06	0.0768
C	0.51	-	0.02	-
D	0.45	0.60	0.0177	0.0236
E	6.40	6.80	0.252	0.2677
F	5.40	5.80	0.2126	0.2283
G	2.20	2.85	0.0866	0.1122
H	-	* 2.30	-	* 0.0906
I	-	0.90	-	0.0354
J	-	0.97	-	0.038
K	5.20	5.50	0.20	0.22
L	0.89	2.03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



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.

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