

Introduction

The 78M series is a group of three terminal positive voltage linear regulators with multiple fixed output voltages. In the case of good heat dissipation, it can provide an output current of 500mA, and has internal short-circuit protection and thermal shutdown protection, which makes it not affected by overload. In addition to being used as fixed voltage regulators, these devices can also be used with external components to obtain adjustable output voltage and current, and can also be used as power transmission elements in precision regulators.

Features

- Available Output Voltage:
5.0V, 6.0V, 8.0V, 9.0V and 12V
- Maximum Output Current:
Exceed 500mA
- Line Regulation:
3.0 ~ 10mV (Typ.) at $T_J = 25^\circ \text{C}$
- Load Regulation:
15 ~ 25mV (Typ.) at $T_J = 25^\circ \text{C}$
- Output Tolerances:
 $\pm 3\%$ at $T_J = 25^\circ \text{C}$
 $\pm 5\%$ over the Operating T_J
- Build-in Current Limit
- Thermal Shutdown Protection
- Short Circuit Protection

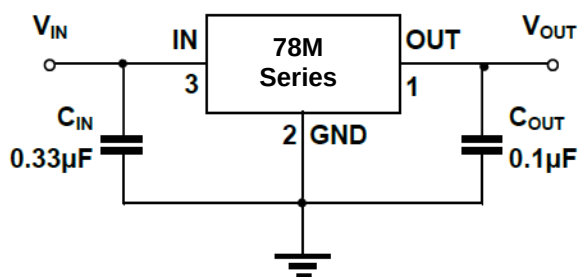
Available Packages

PART NUMBER	PACKAGES
78M Series	TO-220
	TO-220F
	TO-252
	TO-251
	SOT-223
	SOT-89-3L

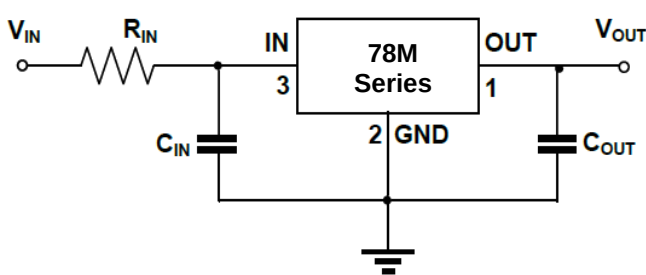
Note: For more detailed packaging information, see the part Pin Configuration and Function and the part Mechanical Information.

Applications

- Appliances and White Goods
- Building Automation
- Computing & Servers
- Electronic Point-of-sale
- Motor Drives
- On-Card Regulation
- Portable Devices
- Telecommunications
- TVs and Set-top Boxes



(1) Conventional Circuit



(2) Resistance are used at IN

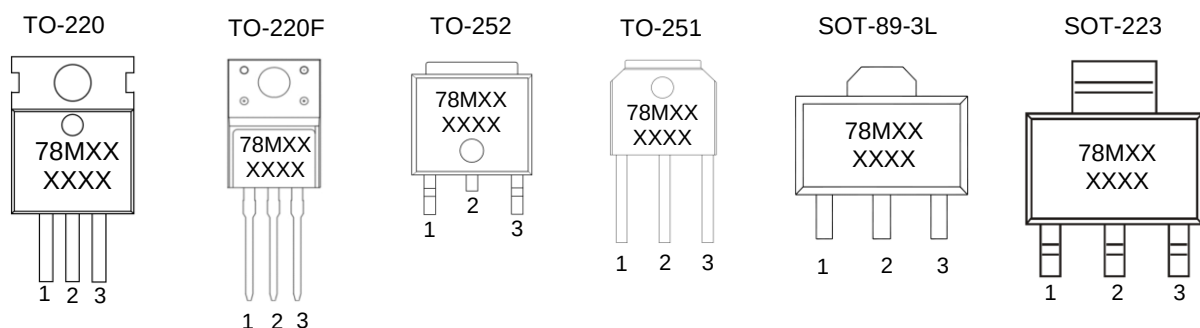
Typical Application Circuit

Ordering Information

Model	Device	Package	Minimum Package(pcs)	Inner Box Quantity(pcs)	Outer Carton Quantity(pcs)	Delivery Mode
78MXX	78MXX	TO-252	2,500	5,000	35,000	13"reel
78MXX	78MXX	TO-220	50	1,000	5,000	/
78MXX	78MXX	TO-220F	50	1,000	5,000	/
78MXX	78MXX	SOT-223	2,500	5,000	35,000	13"reel
78MXX	78MXX	TO-251	80	4,000	20,000	/
78MXX	78MXX	SOT-89-3L	1,000	10,000	40,000	7"reel

Pin Configuration and Marking Information

Pin Configuration and Function



Package Top View

Pin Name	78M Series						I/O	Description
	TO-252	TO-220	TO-220F	TO-251	SOT-89-3L	SOT-223		
IN	1	1	1	1	3	1	I	Input to the device.
GND	2	2	2	2	2	2	-	Regulator ground.
OUT	3	3	3	3	1	3	O	Output of the regulator.

78MXX : Product number, the "XX" in the "78MXX" represents the output voltage, for example, if $V_{OUT} = 5.0V$, "XX" is "05".
 XXXX : Code

Specifications

Absolute Maximum Ratings⁽¹⁾

Characteristic	Symbol	Value	Unit
Maximum input voltage ⁽²⁾	V_{IN}	35	V
Maximum power dissipation	$P_{D\ Max}$	Internally Limited ⁽³⁾	W
Maximum junction temperature	$T_{J\ Max}$	150	°C
Storage temperature	T_{stg}	- 65 ~ 150	°C
Soldering temperature & time	T_{solder}	260°C, 10s	-

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.

(2) All voltages are with respect to network ground terminal.

(3) Refer to Thermal Information for details.

Recommended Operating Conditions⁽⁴⁾

Parameter	Symbol	Min.	Nom.	Max.	Unit
Operating junction temperature	T_J	-40	-	125	°C
Operating ambient temperature	T_a	-	- ⁽⁵⁾	-	°C

(4) Recommends that users should not exceed the rated value in the Recommended Operating Conditions for the application conditions of the equipment, so as to ensure the stability of normal operation and reliability of long-term operation of the equipment. Operation beyond the recommended rated conditions does not mean that the product will fail. The consumers need to evaluate the risks that may be caused by the operation of the product beyond the recommended rated conditions.

(5) It is necessary to ensure that the operating junction temperature of the equipment does not exceed the rated value of the recommended operating conditions when using the device for design.

ESD Ratings

ESD Ratings		Symbol	Value	Unit
Electrostatic discharge ⁽⁶⁾	Human body model	$V_{ESD-HBM}$	2000	V
	Machine model	V_{ESD-MM}	200	

(6) ESD testing is conducted in accordance with the relevant specifications formulated by the Joint Electronic Equipment Engineering Commission (JEDEC). The human body mode (HBM) electrostatic discharge test is based on the JESD22-114D test standard, using a 100pF capacitor and discharging to each pin of the device through a resistance of 1.5kΩ. The electrostatic discharge test in mechanical mode (MM) is based on the JESD22-115-A test standard and uses a 200pF capacitor to discharge directly to each pin of the device.

Thermal Information

Thermal Metric	Symbol	MLS78M Series	Unit
Junction-to-ambient thermal resistance	$R_{\theta JA}$	80	$^{\circ}\text{C}/\text{W}$
Reference maximum power dissipation for continuous operation	$P_{D \text{ Ref}}$	1.25	W

Electrical Characteristics

78M05 ($V_{OUT} = 5.0\text{V}$, $V_{IN} = 10\text{V}$, $I_{OUT} = 350\text{mA}$, $C_{IN} = 0.33\mu\text{F}$, $C_{OUT} = 0.1\mu\text{F}$, $T_J = 25^{\circ}\text{C}$, unless otherwise specified)

Characteristic	Symbol	Test Ccnditions ⁽⁷⁾	Min	Typ ⁽⁸⁾	Max	Uuit
Output voltage ⁽⁹⁾	V_{OUT}	$V_{IN}=10\text{V}$, $I_O = 350\text{mA}$	4.85	5.0	5.15	V
		$V_{IN} = 7$ to 20V , $I_{OUT} = 5$ to 350mA	4.75	5.0	5.25	V
Line regulation	ΔV_{LINE}	$V_{IN} = 7$ to 25V , $I_{OUT} = 200\text{mA}$	-	-	100	mV
		$V_{IN} = 8$ to 25V , $I_{OUT} = 200\text{mA}$	-	-	50	mV
Load regulation	ΔV_{LOAD}	$I_{OUT} = 5$ to 500mA	-	-	100	mV
Quiescent current	I_Q	-	-	2.2	5.0	mA
Quiescent current change	ΔI_Q	$V_{IN} = 8$ to 25V , $I_{OUT} = 200\text{mA}$	-	-	0.8	mA
		$I_{OUT} = 5$ to 350mA	-	-	0.5	mA
Short circuit current	I_{SC}	$V_{IN} = 10\text{V}$, OUT short to GND	-	300	-	mA
Peak current	I_{Peak}	-	-	700	-	mA
Dropout voltage ⁽¹⁰⁾	V_{DO}	$I_{OUT} = 350\text{mA}$	-	2	2.2	V
		$I_{OUT} = 500\text{mA}$	-	2.1	2.5	V
Output noise voltage	V_N	$f = 10$ to 100kHz	-	40	-	μV
Ripple rejection	RR	$V_{IN} = 8$ to 18V , $I_{OUT} = 300\text{mA}$, $f = 120\text{Hz}$	62	78	-	dB

78M06 ($V_{OUT} = 6.0\text{V}$, $V_{IN} = 11\text{V}$, $I_{OUT} = 350\text{mA}$, $C_{IN} = 0.33\mu\text{F}$, $C_{OUT} = 0.1\mu\text{F}$, $T_J = 25^{\circ}\text{C}$, unless otherwise specified)

Characteristic	Symbol	Test Ccnditions ⁽⁷⁾	Min	Typ ⁽⁸⁾	Max	Uuit
Output voltage ⁽⁹⁾	V_{OUT}	-	5.82	6.0	6.18	V
		$V_{IN} = 8$ to 21V , $I_{OUT} = 5$ to 350mA	5.70	6.0	6.30	V
Line regulation	ΔV_{LINE}	$V_{IN} = 8$ to 25V , $I_{OUT} = 200\text{mA}$	-	5	100	mV
		$V_{IN} = 9$ to 25V , $I_{OUT} = 200\text{mA}$	-	1.5	50	mV
Load regulation	ΔV_{LOAD}	$I_{OUT} = 5$ to 500mA	-	18	100	mV
		$I_{OUT} = 5$ to 200mA	-	10.0	50	mV
Quiescent current	I_Q	-	-	4.3	6	mA
Quiescent current change	ΔI_Q	$V_{IN} = 9$ to 25V , $I_{OUT} = 200\text{mA}$	-	-	0.8	mA
		$I_{OUT} = 5$ to 350mA	-	-	0.5	mA
Short circuit current	I_{SC}	$V_{IN} = 11\text{V}$, OUT short to GND	-	270	-	mA
Peak current	I_{Peak}	-	-	0.5	-	A
Dropout voltage ⁽¹⁰⁾	V_{DO}	$I_{OUT} = 350\text{mA}$	-	2	-	V
Output noise voltage	V_N	$f = 10$ to 100kHz	-	45	-	μV
Ripple rejection	RR	$V_{IN} = 9$ to 19V , $I_{OUT} = 300\text{mA}$, $f = 120\text{Hz}$	59	80	-	dB

78M08 ($V_{OUT} = 8.0V$, $V_{IN} = 14V$, $I_{OUT} = 350mA$, $C_{IN} = 0.33\mu F$, $C_{OUT} = 0.1\mu F$, $T_J = 25^\circ C$, unless otherwise specified)

Characteristic	Symbol	Test Ccnditions ⁽⁷⁾	Min	Typ ⁽⁸⁾	Max	Unit
Output voltage ⁽⁹⁾	V_{OUT}	-	7.76	8.0	8.24	V
		$V_{IN} = 10.5$ to $23V$, $I_{OUT} = 5$ to $350mA$	7.60	8.0	8.40	V
Line regulation	ΔV_{LINE}	$V_{IN} = 10.5$ to $25V$, $I_{OUT} = 200mA$	-	6	100	mV
		$V_{IN} = 11$ to $25V$, $I_{OUT} = 200mA$	-	2	50	mV
Load regulation	ΔV_{LOAD}	$I_{OUT} = 5$ to $500mA$	-	20	160	mV
		$I_{OUT} = 5$ to $200mA$	-	10	80	mV
Quiescent current	I_Q	-	-	4.3	6	mA
Quiescent current change	ΔI_Q	$V_{IN} = 10.5$ to $25V$, $I_{OUT} = 200mA$	-	-	0.8	mA
		$I_{OUT} = 5$ to $350mA$	-	-	0.5	mA
Short circuit current	I_{SC}	$V_{IN} = 14V$, OUT short to GND	-	250	-	mA
Peak current	I_{Peak}	-	-	0.5	-	A
Dropout voltage ⁽¹⁰⁾	V_{DO}	$I_{OUT} = 350mA$	-	2	-	V
Output noise voltage	V_N	$f = 10$ to $100kHz$	-	52	-	μV
Ripple rejection	RR	$V_{IN} = 11.5$ to $21V$, $I_{OUT} = 300mA$, $f = 120Hz$	56	80	-	dB

78M09 ($V_{OUT} = 9.0V$, $V_{IN} = 16V$, $I_{OUT} = 350mA$, $C_{IN} = 0.33\mu F$, $C_{OUT} = 0.1\mu F$, $T_J = 25^\circ C$, unless otherwise specified)

Characteristic	Symbol	Test Ccnditions ⁽⁷⁾	Min	Typ ⁽⁸⁾	Max	Unit
Output voltage ⁽⁹⁾	V_{OUT}	-	8.73	9.0	9.27	V
		$V_{IN} = 11.5$ to $24V$, $I_{OUT} = 5$ to $350mA$	8.55	9.0	9.45	V
Line regulation	ΔV_{LINE}	$V_{IN} = 11.5$ to $26V$, $I_{OUT} = 200mA$	-	6	100	mV
		$V_{IN} = 12$ to $26V$, $I_{OUT} = 200mA$	-	2	50	mV
Load regulation	ΔV_{LOAD}	$I_{OUT} = 5$ to $500mA$	-	20	180	mV
		$I_{OUT} = 5$ to $200mA$	-	10	90	mV
Quiescent current	I_Q	-	-	4.6	6	mA
Quiescent current change	ΔI_Q	$V_{IN} = 11.5$ to $26V$, $I_{OUT} = 200mA$	-	-	0.8	mA
		$I_{OUT} = 5$ to $350mA$	-	-	0.5	mA
Short circuit current	I_{SC}	$V_{IN} = 16V$, OUT short to GND	-	250	-	mA
Peak current	I_{Peak}	-	-	0.5	-	A
Dropout voltage ⁽¹⁰⁾	V_{DO}	$I_{OUT} = 350mA$	-	2	-	V
Output noise voltage	V_N	$f = 10$ to $100kHz$	-	60	-	μV
Ripple rejection	RR	$V_{IN} = 13$ to $23V$, $I_{OUT} = 300mA$, $f = 120Hz$	56	80	-	dB

78M12 ($V_{OUT} = 12.0V$, $V_{IN} = 19V$, $I_{OUT} = 350mA$, $C_{IN} = 0.33\mu F$, $C_{OUT} = 0.1\mu F$, $T_J = 25^\circ C$, unless otherwise specified)

Characteristic	Symbol	Test Cnditions ⁽⁷⁾	Min	Typ ⁽⁸⁾	Max	Unit
Output voltage ⁽⁹⁾	V_{OUT}	$V_{IN}=17V$, $I_O=350mA$	11.64	12.0	12.36	V
		$V_{IN} = 14$ to $27V$, $I_{OUT} = 5$ to $350mA$	11.40	12.0	12.60	V
Line regulation	ΔV_{LINE}	$V_{IN} = 14$ to $32V$, $I_{OUT} = 200mA$	-	-	100	mV
		$V_{IN} = 15$ to $32V$, $I_{OUT} = 200mA$	-	-	50	mV
Load regulation	ΔV_{LOAD}	$I_{OUT} = 5$ to $500mA$	-	-	100	mV
Quiescent current	I_Q	-	-	2.2	5.0	mA
Quiescent current change	ΔI_Q	$V_{IN} = 15$ to $32V$, $I_{OUT} = 200mA$	-	-	0.8	mA
		$I_{OUT} = 5$ to $350mA$	-	-	0.5	mA
Short circuit current	I_{SC}	$V_{IN} = 19V$, OUT short to GND	-	240	-	mA
Peak current	I_{Peak}	-	-	0.7	-	A
Dropout voltage ⁽¹⁰⁾	V_{DO}	$I_{OUT} = 350mA$	-	1.8	2.2	V
		$I_{OUT} = 500mA$	-	2.1	2.5	V
Output noise voltage	V_N	$f = 10$ to $100kHz$	-	40	-	μV
Ripple rejection	RR	$V_{IN} = 15$ to $25V$, $I_{OUT} = 300mA$, $f = 120Hz$	62	78	-	dB

Note:

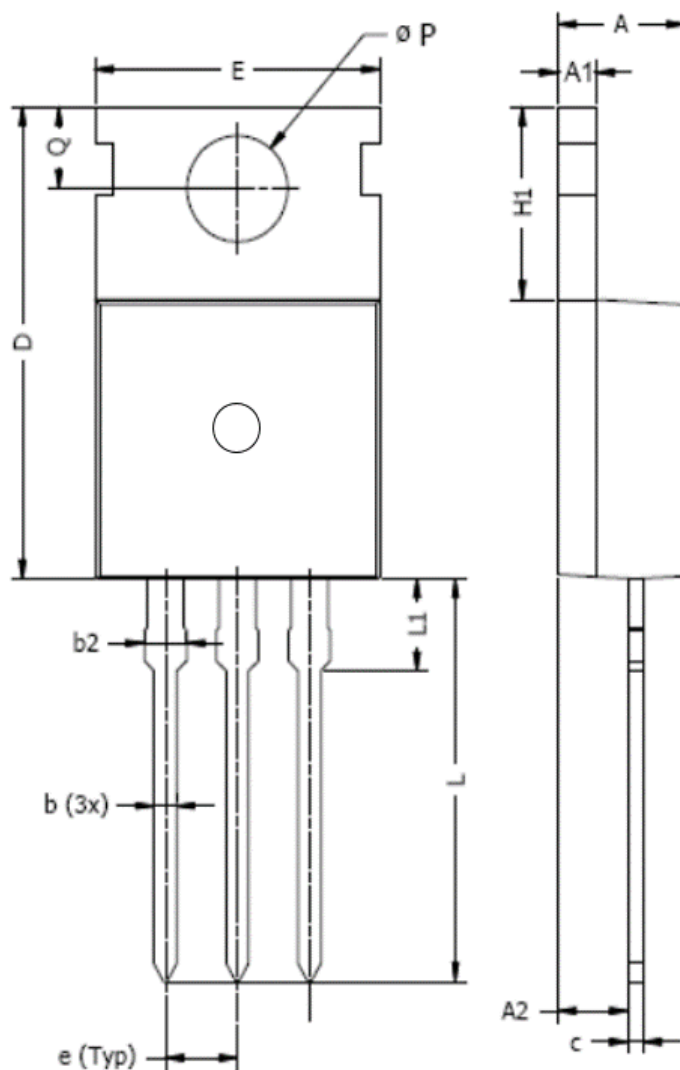
(7) Pulse test technology is used to make T_J as close to T_A as possible. Thermal effects must be considered separately.

(8) Typical numbers are at $25^\circ C$ (T_J) and represent the most likely norm.

(9) This specification only applies to the DC power consumption allowed by the absolute maximum rating.

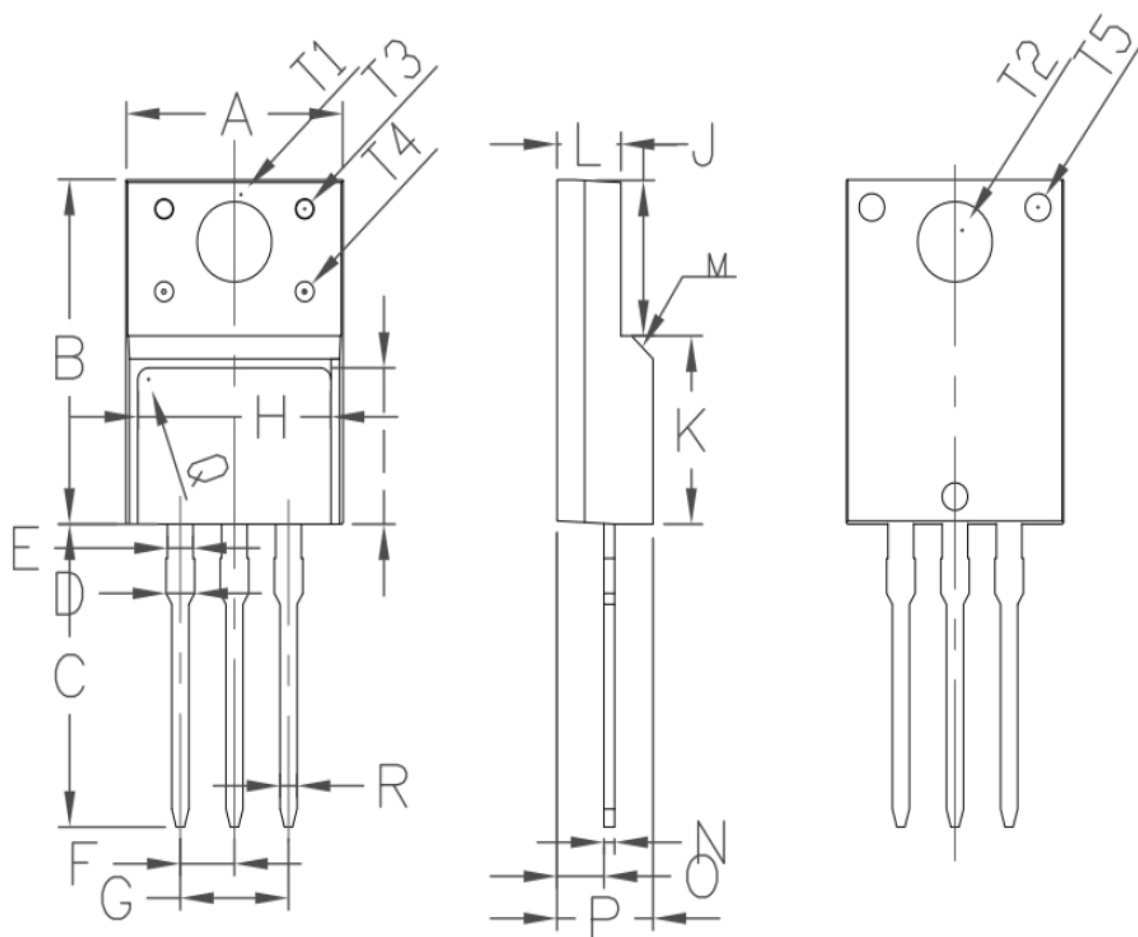
(10) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of V_{OUT} .

TO-220 Package information



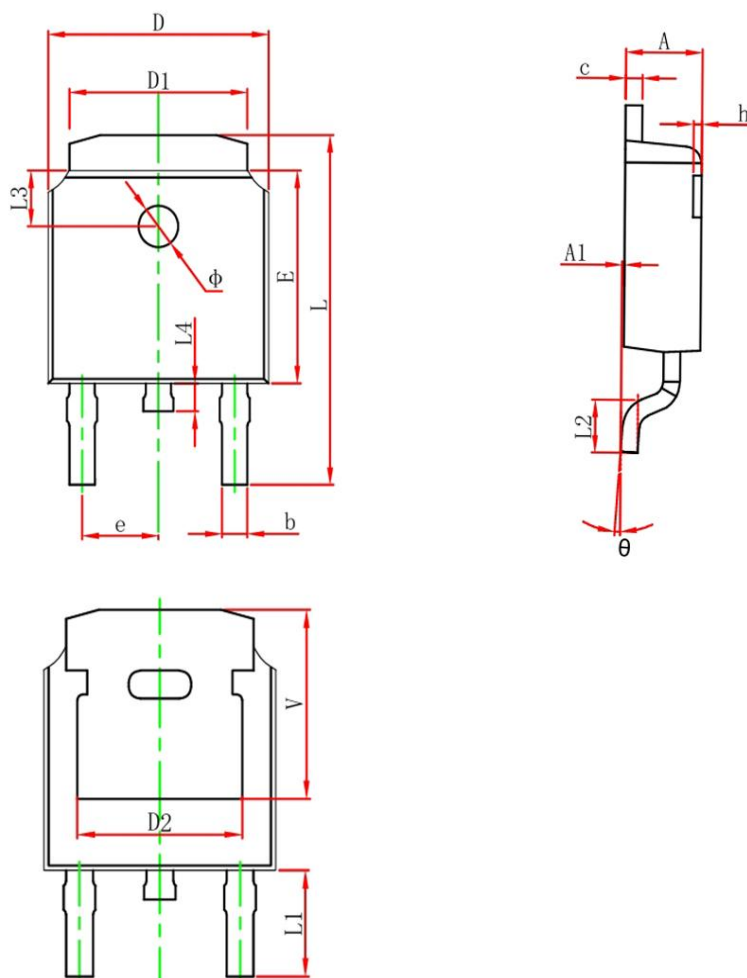
Symbol	Dimensions in Millimeters(mm)		Dimensions In Inches	
	Min	Max	Min	Max
A	3.600	4.800	0.142	0.189
A1	1.200	1.400	0.047	0.055
A2	2.030	2.900	0.080	0.114
b	0.400	1.000	0.016	0.039
b2	1.200	1.780	0.047	0.070
c	0.360	0.600	0.014	0.024
D	14.220	16.500	0.561	0.651
e	2.340	2.740	0.092	0.108
E	9.700	10.600	0.383	0.418
H1	5.840	6.850	0.230	0.270
L	12.700	14.700	0.501	0.580
L1	2.700	3.300	0.106	0.130
$\varnothing P$	3.500	4.000	0.138	0.158
Q	2.540	3.400	0.100	0.134

TO-220F Package information

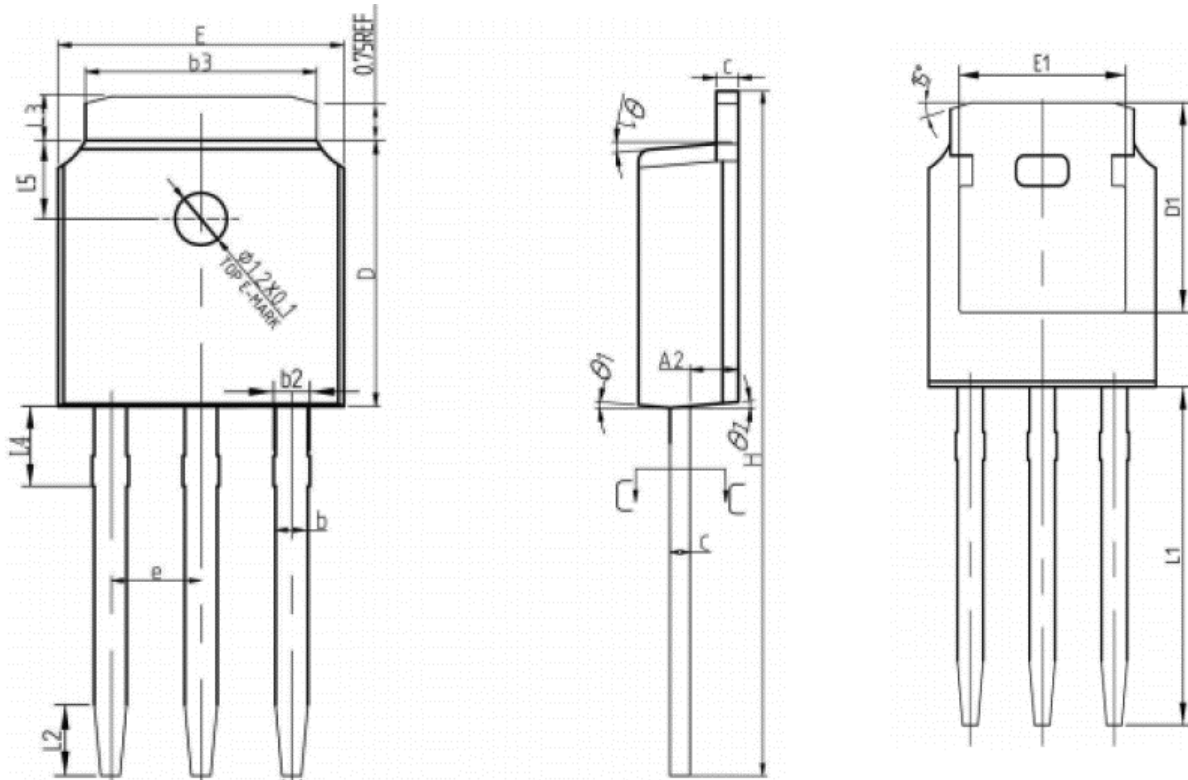


Symbol	Dimensions in Millimeters(mm)		Dimensions In Inches	
	Min	Max	Min	Max
A	9.960	10.360	0.392	0.407
B	15.670	16.070	0.616	0.632
C	13.140	13.540	0.517	0.533
D	1.200	1.400	0.047	0.055
E	1.200TYP		0.047TYP	
F	2.540TYP		0.100TYP	
G	5.080TYP		0.200TYP	
H	7.600	8.000	0.299	0.314
I	7.100	7.500	0.279	0.295
J	6.480	6.880	0.255	0.270
K	8.990	9.390	0.353	0.369
L	2.340	2.740	0.092	0.107
M	45°TYP		45°TYP	
N	0.490	0.520	0.019	0.020
O	2.150	2.550	0.084	0.100
P	4.500	4.900	0.177	0.192
Q	0.500TYP		0.019TYP	
S	4.5°TYP		4.5°TYP	
T1	3.450TYP		0.135TYP	
T2	3.180TYP		0.125TYP	
T3	1.500TYP		0.059TYP	
T4	1.200TYP		0.047TYP	
T5	1.500TYP		0.059TYP	
R	0.770	0.830	0.030	0.032

TO-252 Package information

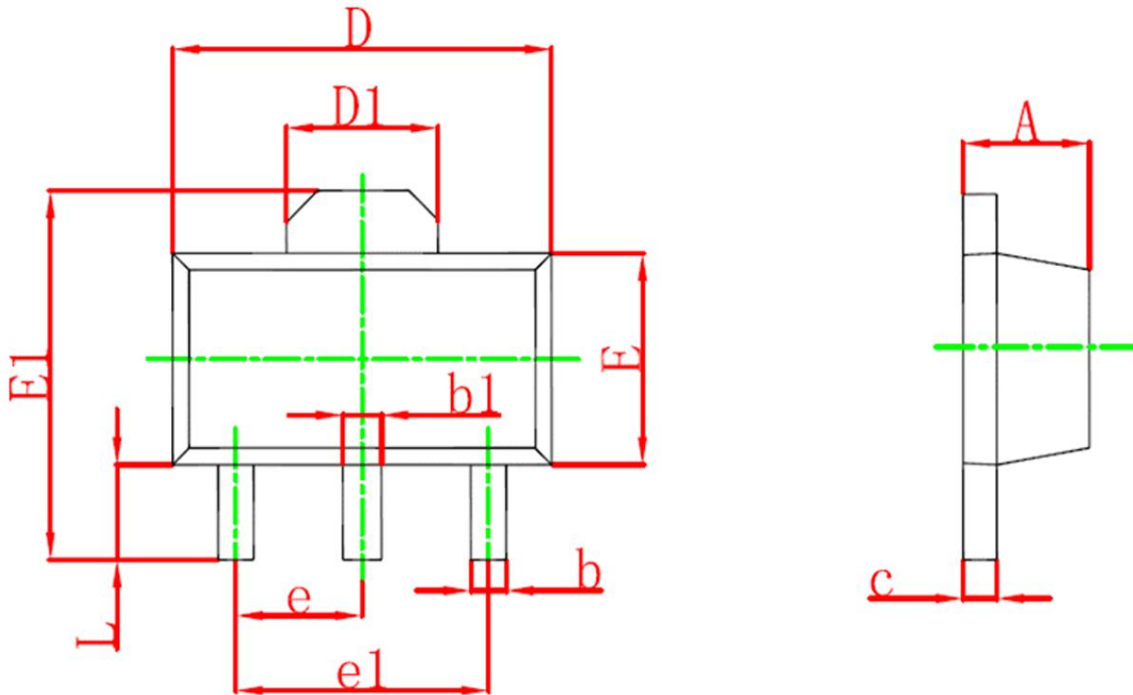


Symbol	Dimensions in Millimeters(mm)		Dimensions In Inches	
	Min	Max	Min	Max
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
b	0.635	0.770	0.025	0.030
c	0.450	0.580	0.018	0.023
D	6.500	6.700	0.256	0.264
D1	5.100	5.460	0.201	0.215
D2	4.830 REF.		0.190 REF.	
E	6.000	6.200	0.236	0.244
e	2.186	2.386	0.086	0.094
L	9.712	10.312	0.386	0.406
L1	2.900 REF.		0.114 REF.	
L2	1.400	1.700	0.055	0.067
L3	1.600 REF.		0.063 REF.	
L4	0.600	1.000	0.024	0.039
Φ	1.100	1.300	0.043	0.051
θ	0°	8°	0°	8°
h	0.000	0.300	0.000	0.012
V	5.250 REF.		0.207 REF.	

TO-251 Package information


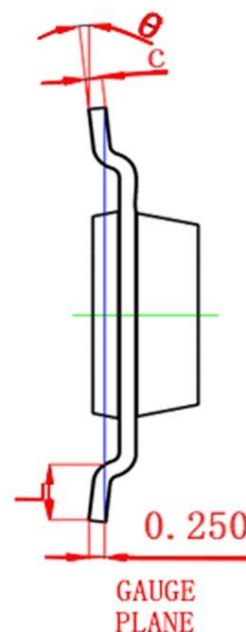
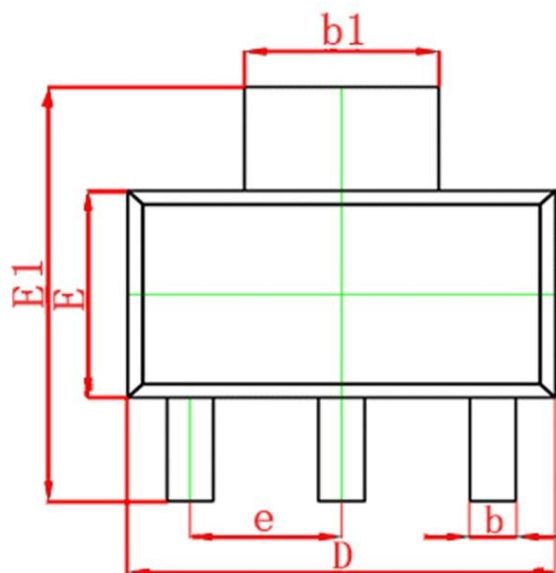
Symbol	Dimensions in Millimeters(mm)		Dimensions In Inches	
	Min	Max	Min	Max
A	2.200	2.380	0.087	0.094
A2	0.970	1.170	0.038	0.046
b	0.720	0.850	0.028	0.034
b2	0.720	0.950	0.028	0.038
b3	5.230	5.460	0.207	0.216
c	0.470	0.580	0.019	0.023
D	6.000	6.200	0.237	0.245
D1	5.300 REF		0.210 REF	
E	6.500	6.700	0.257	0.265
E1	4.700	4.920	0.186	0.195
e	2.286 REF.		0.114 REF.	
H	16.100	16.600	0.637	0.656
L1	9.200	9.600	0.364	0.380
L2	1.250	1.460	0.049	0.058
L3	0.900	1.220	0.036	0.048
L4	0.950	1.150	0.038	0.045
L5	1.700	1.900	0.067	0.075
Ø 1	5°	7°	5°	7°

SOT-89-3L Package information



Symbol	Dimensions in Millimeters(mm)		Dimensions in Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF		0.061 REF	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP		0.060 TYP	
e1	3.000 TYP		0.118 TYP	
L	0.900	1.200	0.035	0.047

SOT-223 Package information



Symbol	Dimensions in Millimeters(mm)		Dimensions In Inches	
	Min	Max	Min	Max
A	--	1.800	--	0.071
A1	0.020	0.100	0.001	0.004
A2	1.500	1.700	0.059	0.067
b	0.660	0.840	0.026	0.033
b1	2.900	3.100	0.114	0.122
c	0.230	0.350	0.009	0.014
D	6.300	6.700	0.248	0.264
E	3.300	3.700	0.130	0.146
E1	6.700	7.300	0.264	0.287
e	2.300(BSC)		0.091(BSC)	
L	0.750	--	0.030	--
θ	0°	10°	0°	10°