



# TS78M00 series

## 3-Terminal Medium Current Positive Voltage Regulator

TO-220



TO-252



Pin assignment:  
 1. Input  
 2. Ground  
 3. Output  
 (Heatsink surface connected to Pin 2)

**Voltage Range 5V to 24V**  
**Output Current up to 0.5A**

### General Description

The TS78M00 Series positive voltage regulators are identical to the popular TS7800 Series devices, except that they are specified for only half the output current. Like the TS7800 devices, the TS78M00 Series 3-Terminal regulators are intended for local, on-card voltage regulation.

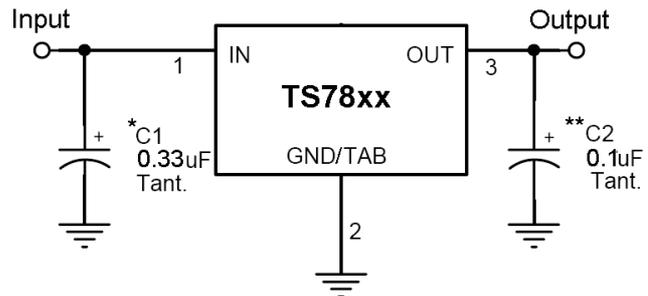
Internal current limiting, thermal shutdown circuitry and safe-area compensation for the internal pass transistor combine to make these devices remarkably rugged under most operating conditions. Maximum output current with adequate heatsink is 500mA

This series is offered in 3-pin TO-220, TO-252 package.

### Features

- ◇ Output current up to 0.5A
- ◇ No external components required
- ◇ Internal thermal overload protection
- ◇ Internal short-circuit current limiting
- ◇ Output transistor safe-area compensation
- ◇ Output voltage offered in 4% tolerance

### Standard Application



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.

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.

### Ordering Information

Part No.	Operating Temp. (Ambient)	Package
TS78MxxCZ	-20 ~ +85°C	TO-220
TS78MxxCP		TO-252

Note: Where xx denotes voltage option.

### Absolute Maximum Rating

Input Voltage	V <sub>in</sub> *	35	V
Input Voltage	V <sub>in</sub> **	40	V
Power Dissipation	TO-220	Without heatsink	2
	TO-220	Pt ***	15
	TO-252	Without heatsink	1
Operating Junction Temperature Range	T <sub>J</sub>	0 ~ +150	°C
Storage Temperature Range	T <sub>STG</sub>	-65 ~ +150	°C

Note : \* TS78M05 to TS78M18

\*\* TS78M24

\*\*\* Follow the derating curve



### TS78M05 Electrical Characteristics

( $V_{in}=10V$ ,  $I_{out}=350mA$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ ; unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output voltage	Vout	$T_j=25^{\circ}C$	4.80	5	5.20	V
		$7.5V \leq V_{in} \leq 20V$ , $5mA \leq I_{out} \leq 350mA$ , $P_D \leq 5W$	4.75	5	5.25	
Line Regulation	REGline	$T_j=25^{\circ}C$ $7.5V \leq V_{in} \leq 25V$ , $I_o=200mA$	--	3	50	mV
Load Regulation	REGload	$T_j=25^{\circ}C$	$5mA \leq I_{out} \leq 500mA$	--	20	
			$5mA \leq I_{out} \leq 200mA$	--	10	50
Quiescent Current	Iq	$I_{out}=0$ , $T_j=25^{\circ}C$	--	3	6	mA
Quiescent Current Change	$\Delta I_q$	$7.5V \leq V_{in} \leq 25V$	--	--	0.8	
		$5mA \leq I_{out} \leq 350mA$	--	--	0.5	
Output Noise Voltage	Vn	$10Hz \leq f \leq 100KHz$ , $T_j=25^{\circ}C$	--	40	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$ , $8V \leq V_{in} \leq 18V$	62	80	--	dB
Voltage Drop	Vdrop	$I_{out}=350mA$ , $T_j=25^{\circ}C$	--	2	--	V
Peak Output Current	$I_o$ peak	$T_j=25^{\circ}C$	--	0.7	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out}=5mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-0.2	--	mV/ $^{\circ}C$

### TS78M06 Electrical Characteristics

( $V_{in}=11V$ ,  $I_{out}=350mA$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ ; unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Voltage	Vout	$T_j=25^{\circ}C$	5.75	6	6.25	V
		$8.5V \leq V_{in} \leq 21V$ , $5mA \leq I_{out} \leq 350mA$ , $P_D \leq 5W$	6.3	6	6.3	
Line Regulation	REGline	$T_j=25^{\circ}C$ $8.5V \leq V_{in} \leq 25V$ , $I_o=200mA$	--	3	50	mV
Load Regulation	REGload	$T_j=25^{\circ}C$	$5mA \leq I_{out} \leq 500mA$	--	20	
			$5mA \leq I_{out} \leq 200mA$	--	10	60
Quiescent Current	Iq	$I_{out}=0$ , $T_j=25^{\circ}C$	--	3	6	mA
Quiescent Current Change	$\Delta I_q$	$8.5V \leq V_{in} \leq 25V$	--	--	0.8	
		$5mA \leq I_{out} \leq 350mA$	--	--	0.5	
Output Noise Voltage	Vn	$10Hz \leq f \leq 100KHz$ , $T_j=25^{\circ}C$	--	45	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$ , $9V \leq V_{in} \leq 19V$	59	80	--	dB
Voltage Drop	Vdrop	$I_{out}=350mA$ , $T_j=25^{\circ}C$	--	2	--	V
Output Short Circuit Current	$I_{os}$	$T_j=25^{\circ}C$	--	50	--	mA
Peak Output Current	$I_o$ peak	$T_j=25^{\circ}C$	--	0.7	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out}=5mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-0.2	--	mV/ $^{\circ}C$

- 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.
- This specification applies only for DC power dissipation permitted by absolute maximum ratings.



### TS78M08 Electrical Characteristics

( $V_{in}=14V$ ,  $I_{out}=350mA$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ ; unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Output Voltage	$V_{out}$	$T_j=25^{\circ}C$	7.69	8	8.32	V	
		$10.5V \leq V_{in} \leq 23V$ , $5mA \leq I_{out} \leq 350mA$ , $PD \leq 5W$	7.61	8	8.40		
Line Regulation	REG <sub>line</sub>	$T_j=25^{\circ}C$ $10.5V \leq V_{in} \leq 25V$ , $I_o=200mA$	--	6	50	mV	
Load Regulation	REG <sub>load</sub>	$T_j=25^{\circ}C$	$5mA \leq I_{out} \leq 500mA$	--	25		160
			$5mA \leq I_{out} \leq 200mA$	--	10		80
Quiescent Current	$I_q$	$I_{out}=0$ , $T_j=25^{\circ}C$	--	3	6	mA	
Quiescent Current Change	$\Delta I_q$	$10.5V \leq V_{in} \leq 25V$	--	--	0.8		
		$5mA \leq I_{out} \leq 350mA$	--	--	0.5		
Output Noise Voltage	$V_n$	$10Hz \leq f \leq 100KHz$ , $T_j=25^{\circ}C$	--	52	--	$\mu V$	
Ripple Rejection Ratio	RR	$f=120Hz$ , $11V \leq V_{in} \leq 21V$	56	80	--	dB	
Voltage Drop	$V_{drop}$	$I_{out}=350mA$ , $T_j=25^{\circ}C$	--	2	--	V	
Output Short Circuit Current	$I_{os}$	$T_j=25^{\circ}C$	--	50	--	mA	
Peak Output Current	$I_o$ peak	$T_j=25^{\circ}C$	--	0.7	--	A	
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out}=5mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-0.2	--	mV/ $^{\circ}C$	

### TS78M09 Electrical Characteristics

( $V_{in}=15V$ ,  $I_{out}=350mA$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ ; unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Output Voltage	$V_{out}$	$T_j=25^{\circ}C$	8.65	9	9.36	V	
		$11.5V \leq V_{in} \leq 23V$ , $5mA \leq I_{out} \leq 350mA$ , $PD \leq 5W$	8.57	9	9.45		
Line Regulation	REG <sub>line</sub>	$T_j=25^{\circ}C$ $11.5V \leq V_{in} \leq 26V$ , $I_o=200mA$	--	6	50	mV	
Load Regulation	REG <sub>load</sub>	$T_j=25^{\circ}C$	$5mA \leq I_{out} \leq 500mA$	--	25		180
			$5mA \leq I_{out} \leq 200mA$	--	10		90
Quiescent Current	$I_q$	$I_{out}=0$ , $T_j=25^{\circ}C$	--	3	6	mA	
Quiescent Current Change	$\Delta I_q$	$11.5V \leq V_{in} \leq 26V$	--	--	0.8		
		$5mA \leq I_{out} \leq 350mA$	--	--	0.5		
Output Noise Voltage	$V_n$	$10Hz \leq f \leq 100KHz$ , $T_j=25^{\circ}C$	--	52	--	$\mu V$	
Ripple Rejection Ratio	RR	$f=120Hz$ , $12V \leq V_{in} \leq 22V$	55	80	--	dB	
Voltage Drop	$V_{drop}$	$I_{out}=350mA$ , $T_j=25^{\circ}C$	--	2	--	V	
Output Short Circuit Current	$I_{os}$	$T_j=25^{\circ}C$	--	50	--	mA	
Peak Output Current	$I_o$ peak	$T_j=25^{\circ}C$	--	0.7	--	A	
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out}=5mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-0.2	--	mV/ $^{\circ}C$	

- 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.
- This specification applies only for DC power dissipation permitted by absolute maximum ratings.



### TS78M12 Electrical Characteristics

( $V_{in}=19V$ ,  $I_{out}=350mA$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ ; unless otherwise specified.)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Output Voltage	$V_{out}$	$T_j=25^{\circ}C$		11.53	12	12.48	V
		$14.5V \leq V_{in} \leq 27V$ , $5mA \leq I_{out} \leq 350mA$ , $PD \leq 5W$		11.42	12	12.60	
Line Regulation	REG <sub>line</sub>	$T_j=25^{\circ}C$	$14.5V \leq V_{in} \leq 30V$ , $I_o=200mA$	--	8	50	mV
Load Regulation	REG <sub>load</sub>	$T_j=25^{\circ}C$	$5mA \leq I_{out} \leq 500mA$	--	25	240	
			$0mA \leq I_{out} \leq 200mA$	--	10	120	
Quiescent Current	$I_q$	$T_j=25^{\circ}C$ , $I_{out}=0$		--	3	6	mA
Quiescent Current Change	$\Delta I_q$	$14.5V \leq V_{in} \leq 30V$		--	--	0.8	
		$5mA \leq I_{out} \leq 200mA$		--	--	0.5	
Output Noise Voltage	$V_n$	$10Hz \leq f \leq 100KHz$ , $T_j=25^{\circ}C$		--	75	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$ , $15V \leq V_{in} \leq 25V$		55	80	--	dB
Voltage Drop	$V_{drop}$	$I_{out}=350mA$ , $T_j=25^{\circ}C$		--	2	--	V
Output Short Circuit Current	$I_{os}$	$T_j=25^{\circ}C$		--	50	--	mA
Peak Output Current	$I_o$ peak	$T_j=25^{\circ}C$		--	0.7	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out}=5mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$		--	-0.3	--	mV/ $^{\circ}C$

### TS78M15 Electrical Characteristics

( $V_{in}=23V$ ,  $I_{out}=350mA$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ ; unless otherwise specified.)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Output Voltage	$V_{out}$	$T_j=25^{\circ}C$		14.42	15	15.60	V
		$17.5V \leq V_{in} \leq 30V$ , $5mA \leq I_{out} \leq 350mA$ , $PD \leq 5W$		14.28	15	15.75	
Line Regulation	REG <sub>line</sub>	$T_j=25^{\circ}C$	$17.5V \leq V_{in} \leq 30V$ , $I_o=200mA$	--	8	50	mV
Load Regulation	REG <sub>load</sub>	$T_j=25^{\circ}C$	$5mA \leq I_{out} \leq 500mA$	--	25	300	
			$5mA \leq I_{out} \leq 200mA$	--	10	150	
Quiescent Current	$I_q$	$T_j=25^{\circ}C$ , $I_{out}=0$		--	3	6	mA
Quiescent Current Change	$\Delta I_q$	$17.5V \leq V_{in} \leq 30V$		--	--	0.8	
		$5mA \leq I_{out} \leq 350mA$		--	--	0.5	
Output Noise Voltage	$V_n$	$10Hz \leq f \leq 100KHz$ , $T_j=25^{\circ}C$		--	90	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$ , $18V \leq V_{in} \leq 28V$		54	70	--	dB
Voltage Drop	$V_{drop}$	$I_{out}=350mA$ , $T_j=25^{\circ}C$		--	2	--	V
Output Short Circuit Current	$I_{os}$	$T_j=25^{\circ}C$		--	50	--	mA
Peak Output Current	$I_o$ peak	$T_j=25^{\circ}C$		--	0.7	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out}=5mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$		--	-0.3	--	mV/ $^{\circ}C$

- 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.
- This specification applies only for DC power dissipation permitted by absolute maximum ratings.



### TS78M18 Electrical Characteristics

( $V_{in}=27V$ ,  $I_{out}=350mA$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ ; unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Voltage	$V_{out}$	$T_j=25^{\circ}C$	17.30	18	18.72	V
		$21V \leq V_{in} \leq 33V$ , $5mA \leq I_{out} \leq 350mA$ , $PD \leq 5W$	17.14	18	18.90	
Line Regulation	REGline	$T_j=25^{\circ}C$ $21V \leq V_{in} \leq 33V$ , $I_o=200mA$	--	8	50	mV
Load Regulation	REGload	$T_j=25^{\circ}C$ $5mA \leq I_{out} \leq 500mA$	--	25	360	
		$5mA \leq I_{out} \leq 200mA$	--	10	180	
Quiescent Current	$I_q$	$T_j=25^{\circ}C$ , $I_{out}=0$	--	3	6	mA
Quiescent Current Change	$\Delta I_q$	$21V \leq V_{in} \leq 33V$	--	--	0.8	
		$5mA \leq I_{out} \leq 350nA$	--	--	0.5	
Output Noise Voltage	$V_n$	$10Hz \leq f \leq 100KHz$ , $T_j=25^{\circ}C$	--	110	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$ , $21V \leq V_{in} \leq 31V$	54	70	--	dB
Voltage Drop	$V_{drop}$	$I_{out}=350mA$ , $T_j=25^{\circ}C$	--	2	--	V
Output Short Circuit Current	$I_{os}$	$T_j=25^{\circ}C$	--	50	--	mA
Peak Output Current	$I_o \text{ peak}$	$T_j=25^{\circ}C$	--	0.7	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out}=5mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-0.5	--	mV/ $^{\circ}C$

### TS78M24 Electrical Characteristics

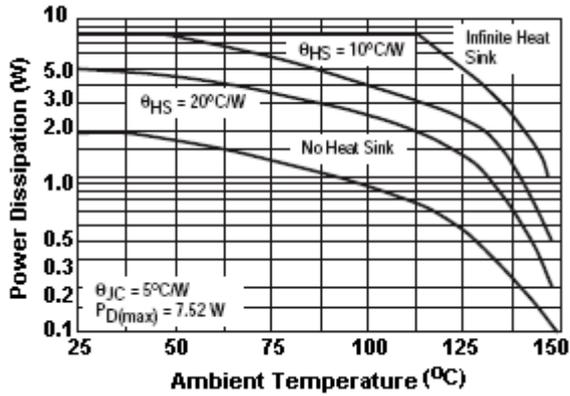
( $V_{in}=33V$ ,  $I_{out}=350mA$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ ; unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Voltage	$V_{out}$	$T_j=25^{\circ}C$	23.07	24	24.96	V
		$27V \leq V_{in} \leq 38V$ , $5mA \leq I_{out} \leq 350mA$ , $PD \leq 5W$	22.85	24	25.20	
Line Regulation	REGline	$T_j=25^{\circ}C$ $27V \leq V_{in} \leq 38V$ , $I_o=200mA$	--	10	50	mV
Load Regulation	REGload	$T_j=25^{\circ}C$ $5mA \leq I_{out} \leq 500mA$	--	30	480	
		$5mA \leq I_{out} \leq 200mA$	--	10	240	
Quiescent Current	$I_q$	$I_{out}=0$ , $T_j=25^{\circ}C$	--	4	7	mA
Quiescent Current Change	$\Delta I_q$	$27V \leq V_{in} \leq 38V$	--	--	0.8	
		$5mA \leq I_{out} \leq 350mA$	--	--	0.5	
Output Noise Voltage	$V_n$	$10Hz \leq f \leq 100KHz$ , $T_j=25^{\circ}C$	--	170	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$ , $27V \leq V_{in} \leq 37V$	50	70	--	dB
Voltage Drop	$V_{drop}$	$I_{out}=350mA$ , $T_j=25^{\circ}C$	--	2	--	V
Output Short Circuit Current	$I_{os}$	$T_j=25^{\circ}C$	--	50	--	mA
Peak Output Current	$I_o \text{ peak}$	$T_j=25^{\circ}C$	--	0.7	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out}=5mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-0.5	--	mV/ $^{\circ}C$

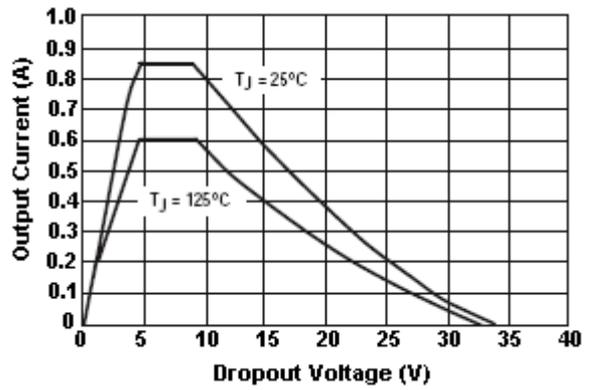
- Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible, and thermal effects must be taken into account separately.
- This specification applies only for DC power dissipation permitted by absolute maximum ratings.

## Electrical Characteristics Curve

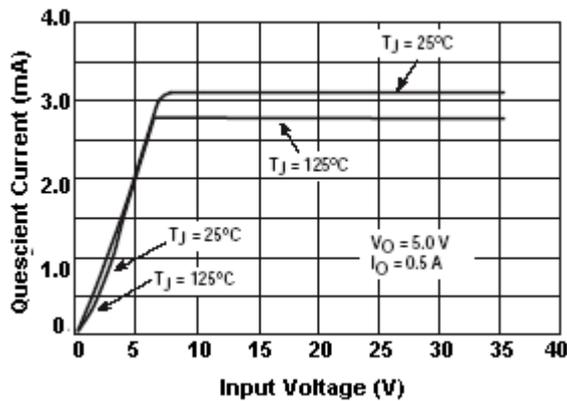
**FIGURE 1 - Worst Case Power Dissipation v.s. Ambient Temperature**



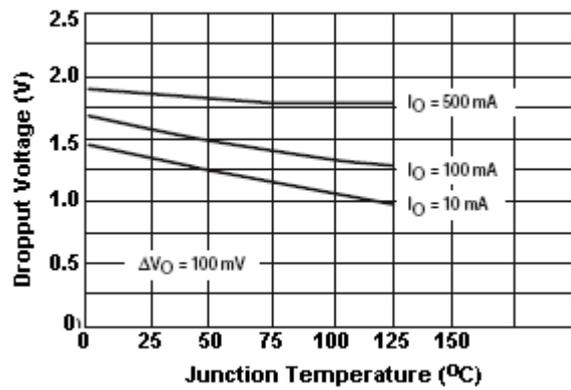
**FIGURE 2 - Peak Output Current v.s. Dropout Voltage**



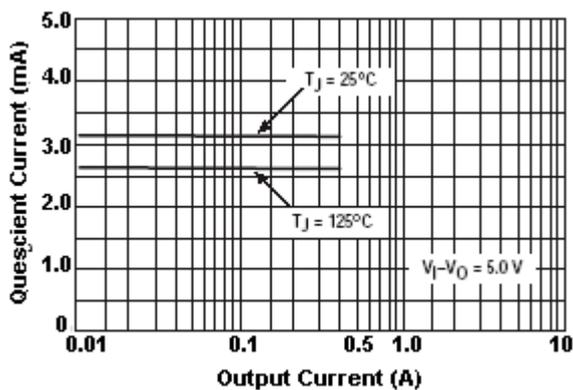
**FIGURE 3 - Quiescent Current v.s. Input Voltage**



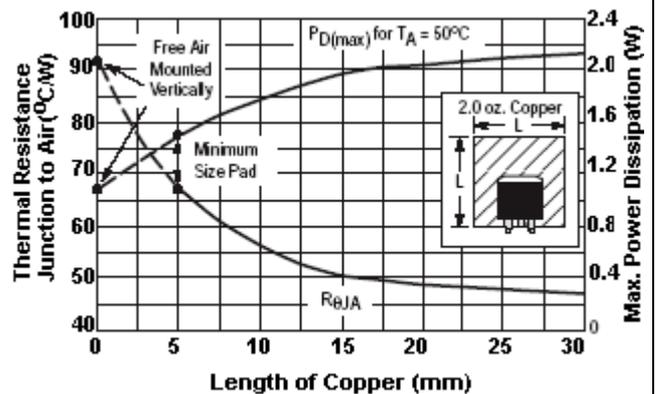
**FIGURE 4 - Dropout Voltage v.s. Junction Temperature**



**FIGURE 5 - Quiescent Current v.s. Output Current**

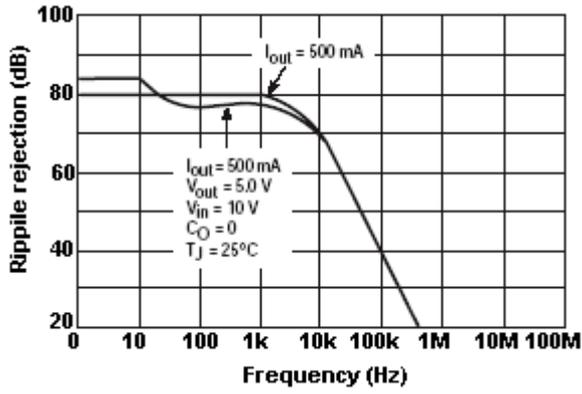


**FIGURE 6 - TO-252 Thermal Resistance and P<sub>D(max)</sub> v.s. P.C.B Copper Length**

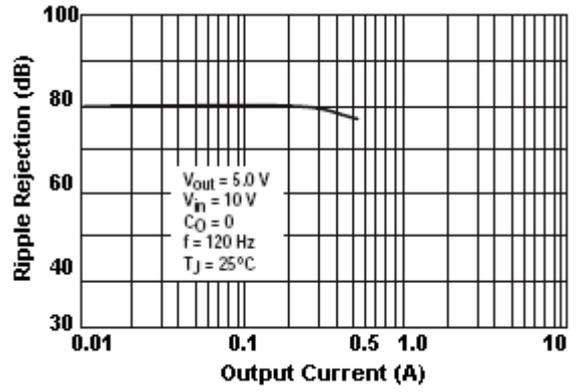


### Electrical Characteristics Curve

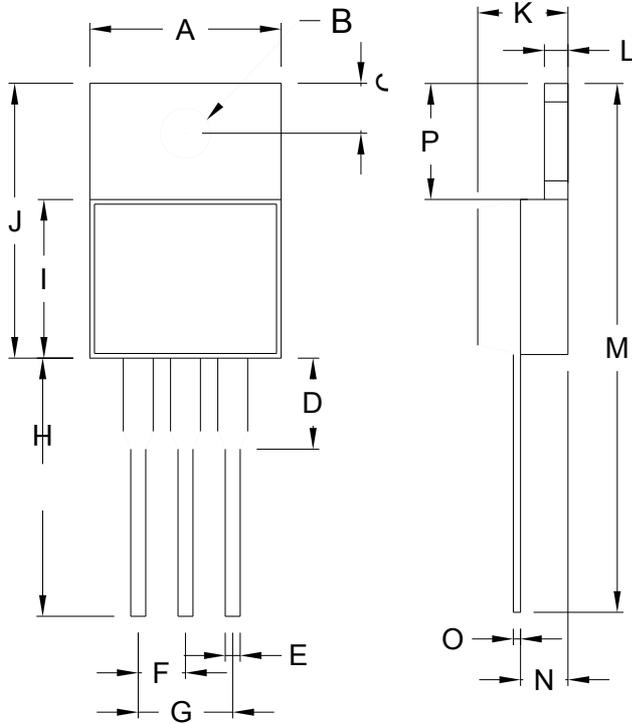
**FIGURE 7 – Ripple Rejection v.s. Frequency**



**FIGURE 8 – Ripple Rejection v.s. Output Voltage**

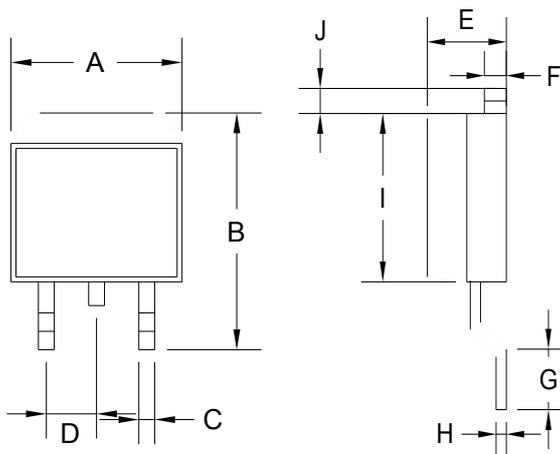


## TO-220 Mechanical Drawing



TO-220 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.000	10.500	0.394	0.413
B	3.240	4.440	0.128	0.175
C	2.440	2.940	0.096	0.116
D	-	6.350	-	0.250
E	0.381	1.106	0.015	0.040
F	2.345	2.715	0.092	0.058
G	4.690	5.430	0.092	0.107
H	12.700	14.732	0.500	0.581
I	8.382	9.017	0.330	0.355
J	14.224	16.510	0.560	0.650
K	3.556	4.826	0.140	0.190
L	0.508	1.397	0.020	0.055
M	27.700	29.620	1.060	1.230
N	2.032	2.921	0.080	0.115
O	0.255	0.610	0.010	0.024
P	5.842	6.858	0.230	0.270

## TO-252 Mechanical Drawing



TO-252 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.570	6.840	0.259	0.269
B	9.250	10.400	0.364	0.409
C	0.550	0.700	0.022	0.028
D	2.560	2.670	0.101	0.105
E	2.300	2.390	0.090	0.094
F	0.490	0.570	0.019	0.022
G	1.460	1.580	0.057	0.062
H	0.520	0.570	0.020	0.022
I	5.340	5.550	0.210	0.219
J	1.460	1.640	0.057	0.065