

TS78M00L Series

3-Terminal 500mA Positive Voltage Regulator

TO-220

**TO-252
(DPAK)**

Pin Definition:

1. Input
2. Ground (tab)
3. Output

General Description

The TS78M00L 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 TS78M00L 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

Features

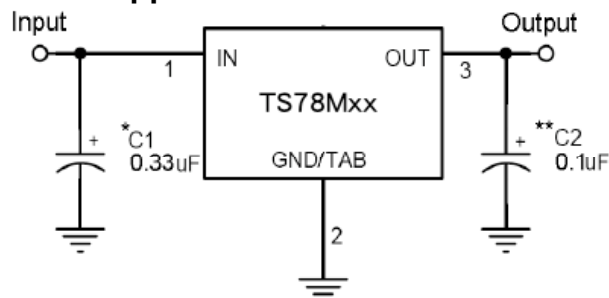
- Output Voltage Range 5 to 24V
- Output current up to 500mA
- No external components required
- Internal thermal overload protection
- Internal short-circuit current limiting
- Output transistor safe-area compensation
- Output voltage offered in 4% tolerance

Ordering Information

Part No.	Package	Packing
TS78MxxLCZ C0	TO-220	50pcs / Tube
TS78MxxLCP RO	TO-252	2.5Kpcs / 13" Reel

Note: Where **xx** denote voltage option

Standard Application Circuit



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.

Absolute Maximum Rating (Ta = 25°C unless otherwise noted)

Parameter	Symbol	Limit	Unit
Input Voltage	V _{IN} *	35	V
Input Voltage	V _{IN} **	40	V
Power Dissipation	P _D	Internal Limited	W
Operating Junction Temperature	T _J	0~+125	°C
Storage Temperature Range	T _{STG}	-65~+150	°C

Note: * TS78M05L to TS78M18L

** TS78M24L

*** Follow the derating curve

TS78M00L Series

3-Terminal 500mA Positive Voltage Regulator

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 Condition		Min	Typ	Max	Unit
Output voltage	V_{out}	$T_j=25^{\circ}C$		4.80	5	5.20	V
		$7.5V \leq V_{in} \leq 20V$, $5mA \leq I_{out} \leq 350mA$		4.75	5	5.25	
Line Regulation	REGline	$T_j=25^{\circ}C$	$7.5V \leq V_{in} \leq 25V$	--	3	100	mV
			$8V \leq V_{in} \leq 12V$	--	1	50	
Load Regulation	REGload	$T_j=25^{\circ}C$	$5mA \leq I_{out} \leq 500mA$	--	15	100	
			$5mA \leq I_{out} \leq 200mA$	--	5	50	
Quiescent Current	I_q	$I_{out}=0$, $T_j=25^{\circ}C$		--	3	6	mA
Quiescent Current Change	ΔI_q	$7.5V \leq V_{in} \leq 25V$		--	--	0.8	
		$5mA \leq I_{out} \leq 350mA$		--	--	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_j=25^{\circ}C$		--	40	--	μV
Ripple Rejection Ratio	RR	$f=120Hz$, $8V \leq V_{in} \leq 18V$		62	78	--	dB
Voltage Drop	V_{drop}	$I_{out}=500mA$, $T_j=25^{\circ}C$		--	2	--	V
Output Resistance	R_{out}	$f=1KHz$		--	17	--	$m\Omega$
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	--	$mV / ^{\circ}C$

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 Condition		Min	Typ	Max	Unit
Output voltage	V_{out}	$T_j=25^{\circ}C$		7.69	8	8.32	V
		$10.5V \leq V_{in} \leq 23V$, $5mA \leq I_{out} \leq 350mA$		7.61	8	8.40	
Line Regulation	REGline	$T_j=25^{\circ}C$	$10.5V \leq V_{in} \leq 25V$	--	6	160	mV
			$11V \leq V_{in} \leq 17V$	--	2	80	
Load Regulation	REGload	$T_j=25^{\circ}C$	$5mA \leq I_{out} \leq 500mA$	--	12	160	
			$5mA \leq I_{out} \leq 200mA$	--	4	80	
Quiescent Current	I_q	$I_{out}=0$, $T_j=25^{\circ}C$		--	3	6	mA
Quiescent Current Change	ΔI_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	--	μV
Ripple Rejection Ratio	RR	$f=120Hz$, $11V \leq V_{in} \leq 21V$		56	80	--	dB
Voltage Drop	V_{drop}	$I_{out}=500mA$, $T_j=25^{\circ}C$		--	2	--	V
Output Resistance	R_{out}	$f=1KHz$		--	16	--	$m\Omega$
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.
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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 Condition	Min	Typ	Max	Unit
Output Voltage	V_{out}	$T_j=25^{\circ}C$	8.65	9	9.36	V
		$11.5V \leq V_{in} \leq 23V$, $5mA \leq I_{out} \leq 350mA$	8.57	9	9.45	
Line Regulation	REGline	$T_j=25^{\circ}C$	$11.5V \leq V_{in} \leq 26V$	--	6	mV
			$12V \leq V_{in} \leq 17V$	--	2	
Load Regulation	REGload	$T_j=25^{\circ}C$	$5mA \leq I_{out} \leq 500mA$	--	12	
			$5mA \leq I_{out} \leq 200mA$	--	4	
Quiescent Current	I_q	$I_{out}=0$, $T_j=25^{\circ}C$	--	3	6	mA
Quiescent Current Change	ΔI_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	--	μV
Ripple Rejection Ratio	RR	$f=120Hz$, $12V \leq V_{in} \leq 22V$	55	80	--	dB
Voltage Drop	V_{drop}	$I_{out}=500mA$, $T_j=25^{\circ}C$	--	2	--	V
Output Resistance	R_{out}	$f=1KHz$	--	16	--	$m\Omega$
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	--	$mV / ^{\circ}C$

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 Condition	Min	Typ	Max	Unit
Output Voltage	V_{out}	$T_j=25^{\circ}C$	11.53	12	12.48	V
		$14.5V \leq V_{in} \leq 27V$, $5mA \leq I_{out} \leq 350mA$	11.42	12	12.60	
Line Regulation	REGline	$T_j=25^{\circ}C$	$14.5V \leq V_{in} \leq 30V$	--	10	mV
			$15V \leq V_{in} \leq 19V$	--	3	
Load Regulation	REGload	$T_j=25^{\circ}C$	$5mA \leq I_{out} \leq 500mA$	--	12	
			$5mA \leq I_{out} \leq 200mA$	--	4	
Quiescent Current	I_q	$T_j=25^{\circ}C$, $I_{out}=0$	--	3	6	mA
Quiescent Current Change	ΔI_q	$14.5V \leq V_{in} \leq 30V$	--	--	0.8	
		$5mA \leq I_{out} \leq 500mA$	--	--	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_j=25^{\circ}C$	--	75	--	μV
Ripple Rejection Ratio	RR	$f=120Hz$, $15V \leq V_{in} \leq 25V$	55	80	--	dB
Voltage Drop	V_{drop}	$I_{out}=500mA$, $T_j=25^{\circ}C$	--	2	--	V
Output Resistance	R_{out}	$f=1KHz$	--	18	--	$m\Omega$
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	--	$mV / ^{\circ}C$

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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 Condition		Min	Typ	Max	Unit
Output voltage	Vout	Tj=25°C		14.42	15	15.60	V
		17.5V≤Vin≤30V, 5mA≤Iout≤350mA		14.28	15	15.75	
Line Regulation	REGline	Tj=25°C	17.5V≤Vin≤30V	--	12	300	mV
			18V≤Vin≤22V	--	3	150	
Load Regulation	REGload	Tj=25°C	5mA≤Iout≤500mA	--	12	300	
			5mA≤Iout≤200mA	--	4	150	
Quiescent Current	Iq	Tj=25°C, Iout=0		--	3	6	mA
Quiescent Current Change	ΔIq	17.5V≤Vin≤30V		--	--	0.8	
		5mA≤Iout≤500mA		--	--	0.5	
Output Noise Voltage	Vn	10Hz≤f≤100KHz, Tj=25°C		--	90	--	μV
Ripple Rejection Ratio	RR	f=120Hz, 18V≤Vin≤28V		54	80	--	dB
Voltage Drop	Vdrop	Iout=500mA, Tj=25°C		--	2	--	V
Output Resistance	Rout	f=1KHz		--	19	--	mΩ
Output Short Circuit Current	Ios	Tj=25°C		--	50	--	mA
Peak Output Current	Io peak	Tj=25°C		--	0.7	--	A
Temperature Coefficient of Output Voltage	ΔVout/ ΔTj	Iout=10mA, 0°C≤Tj≤125°C		--	-0.3	--	mV/ °C

TS78M18 Electrical Characteristics

($V_{in}=24V$, $I_{out}=350mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{in}=0.33\mu F$, $C_{out}=0.1\mu F$; unless otherwise specified.)

Parameter	Symbol	Test Condition		Min	Typ	Max	Unit
Output Voltage	Vout	Tj=25°C		17.30	18	18.72	V
		21V≤Vin≤33V, 5mA≤Iout≤350mA		17.14	18	18.90	
Line Regulation	REGline	Tj=25°C	21V≤Vin≤33V	--	15	360	mV
			22V≤Vin≤26V	--	5	180	
Load Regulation	REGload	Tj=25°C	5mA≤Iout≤500mA	--	12	360	
			5mA≤Iout≤200mA	--	4	180	
Quiescent Current	Iq	Tj=25°C, Iout=0		--	3	6	mA
Quiescent Current Change	ΔIq	21V≤Vin≤33V		--	--	0.8	
		5mA≤Iout≤500mA		--	--	0.5	
Output Noise Voltage	Vn	10Hz≤f≤100KHz, Tj=25°C		--	110	--	uV
Ripple Rejection Ratio	RR	f=120Hz, 21V≤Vin≤31V		54	80	--	dB
Voltage Drop	Vdrop	Iout=500mA, Tj=25°C		--	2	--	V
Output Resistance	Rout	f=1KHz		--	22	--	mΩ
Output Short Circuit Current	Ios	Tj=25°C		--	50	--	mA
Peak Output Current	I _{o peak}	Tj=25°C		--	0.7	--	A
Temperature Coefficient of Output Voltage	ΔVout/ ΔTj	Iout= 5mA, 0°C≤Tj≤125°C		--	-0.5	--	mV/ °C

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TS78M00L Series

3-Terminal 500mA Positive Voltage Regulator

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 Condition	Min	Typ	Max	Unit
Output voltage	V_{out}	$T_j=25^{\circ}C$	23.07	24	24.96	V
		$27V \leq V_{in} \leq 38V$, $5mA \leq I_{out} \leq 350mA$	22.85	24	25.20	
Line Regulation	REG _{line}	$T_j=25^{\circ}C$	$27V \leq V_{in} \leq 38V$	--	18	mV
			$28V \leq V_{in} \leq 32V$	--	6	
Load Regulation	REG _{load}	$T_j=25^{\circ}C$	$5mA \leq I_{out} \leq 500mA$	--	12	
			$5mA \leq I_{out} \leq 200mA$	--	4	
Quiescent Current	I_q	$I_{out}=0$, $T_j=25^{\circ}C$	--	3	6	mA
Quiescent Current Change	ΔI_q	$27V \leq V_{in} \leq 38V$	--	--	0.8	
		$5mA \leq I_{out} \leq 500mA$	--	--	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_j=25^{\circ}C$	--	170	--	μV
Ripple Rejection Ratio	RR	$f=120Hz$, $27V \leq V_{in} \leq 37V$	54	80	--	dB
Voltage Drop	V_{drop}	$I_{out}=500mA$, $T_j=25^{\circ}C$	--	2	--	V
Output Resistance	R_{out}	$f=1KHz$	--	28	--	$m\Omega$
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	$\Delta V_{out} / \Delta T_j$	$I_{out}=5mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-0.5	--	$mV/^{\circ}C$

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TS78M00L Series

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Electrical Characteristics Curve

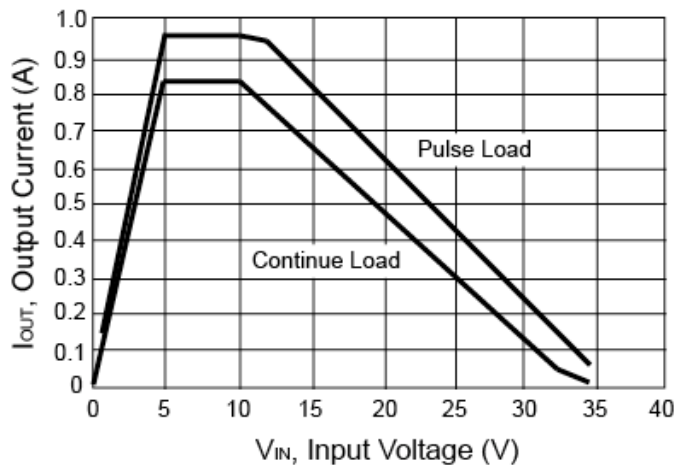


Figure 1. Input Voltage vs. Output Current (max.)

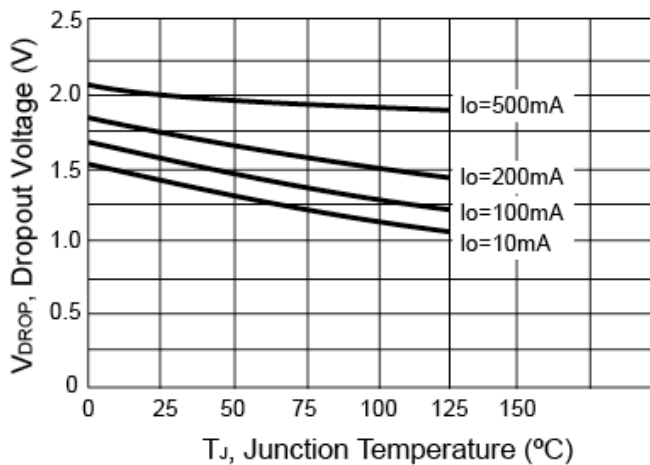


Figure 2. V_{drop} vs. Junction Temperature

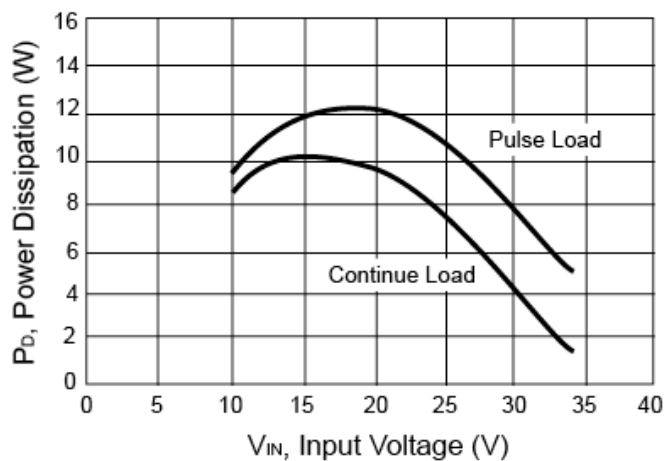


Figure 3. Input Voltage vs. Power Dissipation

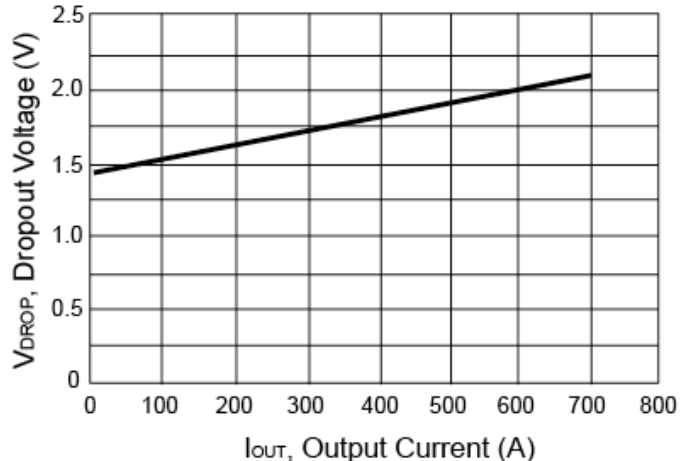


Figure 4. V_{drop} vs. Output Current

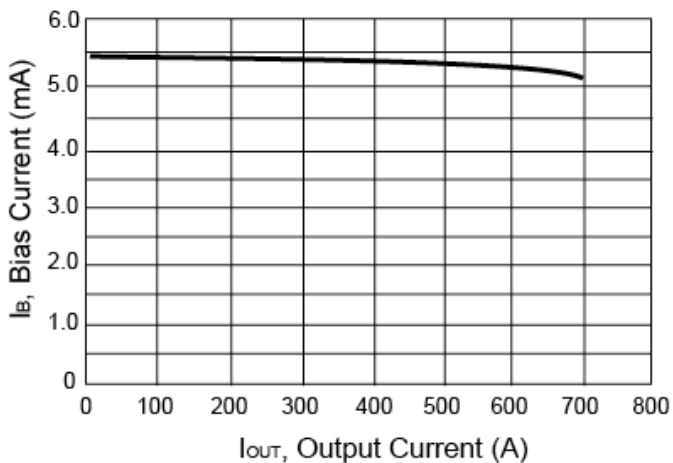


Figure 5. Bias Current vs. Output Current

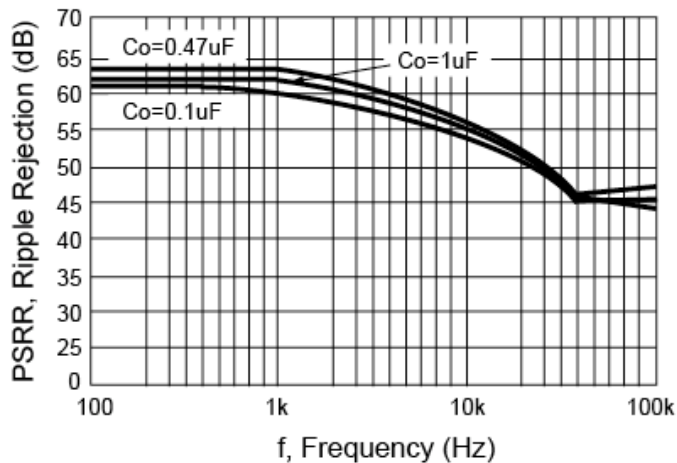


Figure 6. Ripple Rejection vs. Frequency

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Application information

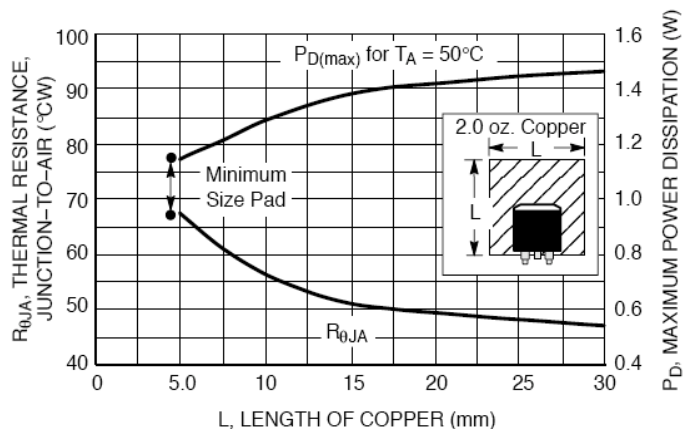
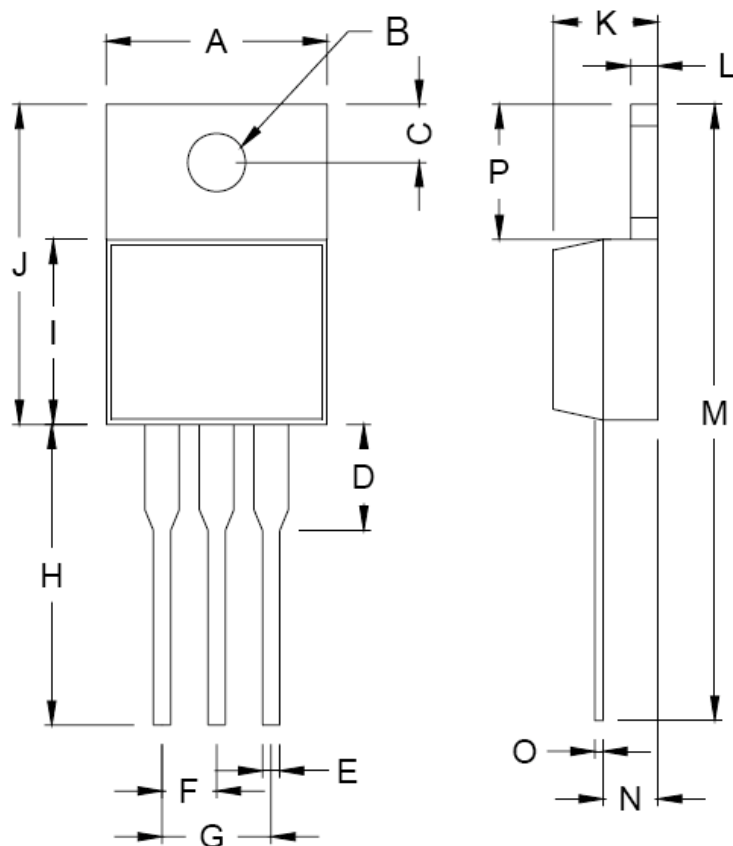


Figure 7. DPAK Thermal Resistance and Maximum Power Dissipation vs. P.C.B Copper Length

TS78M00L Series

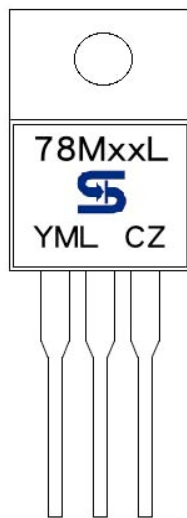
3-Terminal 500mA Positive Voltage Regulator

TO-220 Mechanical Drawing



DIM	TO-220 DIMENSION			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.31	10.550	0.366	0.415
B	3.740	3.910	0.147	0.154
C	2.440	2.940	0.096	0.116
D	2.22	3.22	0.087	0.127
E	0.78	0.98	0.030	0.038
F	2.34	2.65	0.092	0.104
G	4.69	5.31	0.184	0.209
H	12.32	13.88	0.485	0.546
I	8.74	9.26	0.344	0.364
J	15.07	16.07	0.593	0.632
K	4.35	4.65	0.171	0.183
L	1.16	1.40	0.045	0.055
M	27.39	30.35	1.078	1.194
N	1.785	2.675	0.070	0.105
O	1.50	1.75	0.059	0.068
P	5.75	7.65	0.226	0.301

Marking Diagram

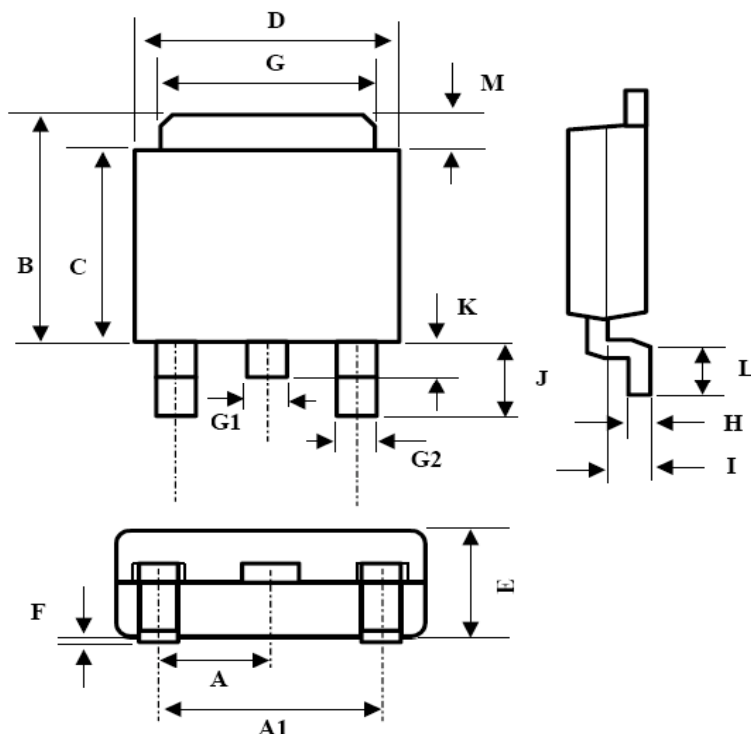


- XX** = Output Voltage
(05=5V, 08=8V, 09=9V, 12=12V, 15=15V, 18=18V, 24=24V)
- Y** = Year Code
- M** = Month Code
(A=Jan, B=Feb, C=Mar, D=Apr, E=May, F=Jun, G=Jul, H=Aug, I=Sep, J=Oct, K=Nov, L=Dec)
- L** = Lot Code
- CZ** = Package Code for TO-220

TS78M00L Series

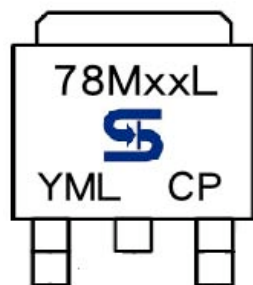
3-Terminal 500mA Positive Voltage Regulator

TO-252 Mechanical Drawing



DIM	TO-252 DIMENSION			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.3BSC		0.09BSC	
A1	4.6BSC		0.18BSC	
B	6.80	7.20	0.268	0.283
C	5.40	5.60	0.213	0.220
D	6.40	6.65	0.252	0.262
E	2.20	2.40	0.087	0.094
F	0.00	0.20	0.000	0.008
G	5.20	5.40	0.205	0.213
G1	0.75	0.85	0.030	0.033
G2	0.55	0.65	0.022	0.026
H	0.35	0.65	0.014	0.026
I	0.90	1.50	0.035	0.059
J	2.20	2.80	0.087	0.110
K	0.50	1.10	0.020	0.043
L	0.90	1.50	0.035	0.059
M	1.30	1.70	0.051	0.67

Marking Diagram



- XX** = Output Voltage
(05=5V, 08=8V, 09=9V, 12=12V, 15=15V, 18=18V, 24=24V)
- Y** = Year Code
- M** = Month Code
(A=Jan, B=Feb, C=Mar, D=Apr, E=May, F=Jun, G=Jul, H=Aug, I=Sep, J=Oct, K=Nov, L=Dec)
- L** = Lot Code
- CP** = Package Code for TO-252

TS78M00L Series

3-Terminal 500mA Positive Voltage Regulator

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