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.

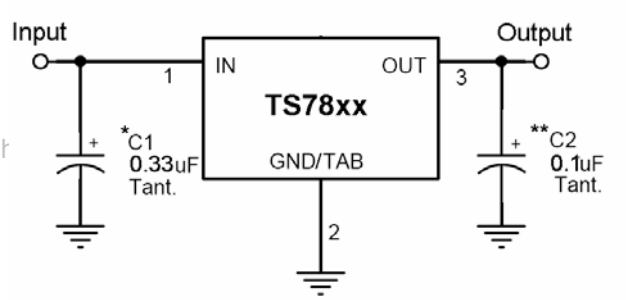
Internal current limiting, thermal shutdown circuitry and safe-area compensation for the internal pass transistor combine to make these devices remarkably rugged under most operating conditions. Maximum output current with adequate heatsink is 500mA

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		Vin *	35	V
Input Voltage		Vin **	40	V
Power Dissipation	TO-220	Without heatsink	2	W
	TO-220	Pt ***	15	
	TO-252	Without heatsink	1	
Operating Junction Temperature Range		T_J	0 ~ +150	°C
Storage Temperature Range		T_{STG}	-65 ~ +150	°C

Note : * TS78M05 to TS78M18
** TS78M24
*** Follow the derating curve

TS78M05 Electrical Characteristics

(Vin=10V, Iout=350mA, 0 °C≤Tj≤125 °C, Cin=0.33uF, Cout=0.1uF; unless otherwise specified.)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Output voltage	Vout	Tj=25 °C		4.80	5	5.20	V
		7.5V≤Vin≤20V, 5mA≤Iout≤350mA, PD≤5W		4.75	5	5.25	
Line Regulation	REGline	Tj=25 °C	7.5V≤Vin≤25V, Io=200mA	--	3	50	mV
Load Regulation	REGload	Tj=25 °C	5mA≤Iout≤500mA	--	20	100	
			5mA≤Iout≤200mA	--	10	50	
Quiescent Current	Iq	Iout=0, Tj=25 °C		--	3	6	mA
Quiescent Current Change	ΔIq	7.5V≤Vin≤25V		--	--	0.8	
		5mA≤Iout≤350mA		--	--	0.5	
Output Noise Voltage	Vn	10Hz≤f≤100KHz, Tj=25 °C		--	40	--	uV
Ripple Rejection Ratio	RR	f=120Hz, 8V≤Vin≤18V		62	80	--	dB
Voltage Drop	Vdrop	Iout=350mA, Tj=25 °C		--	2	--	V
Peak Output Current	Io peak	Tj=25 °C		--	0.7	--	A
Temperature Coefficient of Output Voltage	ΔVout/ ΔTj	Iout=5mA, 0 °C≤Tj≤125 °C		--	-0.2	--	mV/ °C

TS78M06 Electrical Characteristics

(Vin=11V, Iout=350mA, 0 °C≤Tj≤125 °C, Cin=0.33uF, Cout=0.1uF; unless otherwise specified.)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Output Voltage	Vout	Tj=25 °C		5.75	6	6.25	V
		8.5V≤Vin≤21V, 5mA≤Iout≤350mA, PD≤5W		6.3	6	6.3	
Line Regulation	REGline	Tj=25 °C	8.5V≤Vin≤25V, Io=200mA	--	3	50	mV
Load Regulation	REGload	Tj=25 °C	5mA≤Iout≤500A	--	20	120	
			5mA≤Iout≤200mA	--	10	60	
Quiescent Current	Iq	Iout=0, Tj=25 °C		--	3	6	mA
Quiescent Current Change	ΔIq	8.5V≤Vin≤25V		--	--	0.8	
		5mA≤Iout≤350mA		--	--	0.5	
Output Noise Voltage	Vn	10Hz≤f≤100KHz, Tj=25 °C		--	45	--	uV
Ripple Rejection Ratio	RR	f=120Hz, 9V≤Vin≤19V		59	80	--	dB
Voltage Drop	Vdrop	Iout=350mA, Tj=25 °C		--	2	--	V
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=5mA, 0 °C≤Tj≤125 °C		--	-0.2	--	mV/ °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

(Vin=14V, Iout=350mA, 0 °C≤Tj≤125 °C, Cin=0.33uF, Cout=0.1uF; unless otherwise specified.)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Output Voltage	Vout	Tj=25 °C		7.69	8	8.32	V
		10.5V≤Vin≤23V, 5mA≤Iout≤350mA, PD≤5W		7.61	8	8.40	
Line Regulation	REGline	Tj=25 °C	10.5V≤Vin≤25V, Io=200mA	--	6	50	mV
Load Regulation	REGload	Tj=25 °C	5mA≤Iout≤500mA	--	25	160	
			5mA≤Iout≤200mA	--	10	80	
Quiescent Current	Iq	Iout=0, Tj=25 °C		--	3	6	mA
Quiescent Current Change	ΔIq	10.5V≤Vin≤25V		--	--	0.8	
		5mA≤Iout≤350mA		--	--	0.5	
Output Noise Voltage	Vn	10Hz≤f≤100KHz, Tj=25 °C		--	52	--	uV
Ripple Rejection Ratio	RR	f=120Hz, 11V≤Vin≤21V		56	80	--	dB
Voltage Drop	Vdrop	Iout=350mA, Tj=25 °C		--	2	--	V
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=5mA, 0 °C≤Tj≤125 °C		--	-0.2	--	mV/ °C

TS78M09 Electrical Characteristics

(Vin=15V, Iout=350mA, 0 °C≤Tj≤125 °C, Cin=0.33uF, Cout=0.1uF; unless otherwise specified.)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Output Voltage	Vout	Tj=25 °C		8.65	9	9.36	V
		11.5V≤Vin≤23V, 5mA≤Iout≤350mA, PD≤5W		8.57	9	9.45	
Line Regulation	REGline	Tj=25 °C	11.5V≤Vin≤26V, Io=200mA	--	6	50	mV
Load Regulation	REGload	Tj=25 °C	5mA≤Iout≤500mA	--	25	180	
			5mA≤Iout≤200mA	--	10	90	
Quiescent Current	Iq	Iout=0, Tj=25 °C		--	3	6	mA
Quiescent Current Change	ΔIq	11.5V≤Vin≤26V		--	--	0.8	
		5mA≤Iout≤350mA		--	--	0.5	
Output Noise Voltage	Vn	10Hz≤f≤100KHz, Tj=25 °C		--	52	--	uV
Ripple Rejection Ratio	RR	f=120Hz, 12V≤Vin≤22V		55	80	--	dB
Voltage Drop	Vdrop	Iout=350mA, Tj=25 °C		--	2	--	V
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=5mA, 0 °C≤Tj≤125 °C		--	-0.2	--	mV/ °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

(Vin=19V, Iout=350mA, 0 °C≤Tj≤125 °C, Cin=0.33uF, Cout=0.1uF; unless otherwise specified.)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Output Voltage	Vout	Tj=25 °C		11.53	12	12.48	V
		14.5V≤Vin≤27V, 5mA≤Iout≤350mA, PD ≤5W		11.42	12	12.60	
Line Regulation	REGline	Tj=25 °C	14.5V≤Vin≤30V, Io=200mA	--	8	50	mV
Load Regulation	REGload	Tj=25 °C	5mA≤Iout≤500mA	--	25	240	
			0mA≤Iout≤200mA	--	10	120	
Quiescent Current	Iq	Tj=25 °C, Iout=0		--	3	6	mA
Quiescent Current Change	ΔIq	14.5V≤Vin≤30V		--	--	0.8	
		5mA≤Iout≤200mA		--	--	0.5	
Output Noise Voltage	Vn	10Hz≤f≤100KHz, Tj=25 °C		--	75	--	uV
Ripple Rejection Ratio	RR	f=120Hz, 15V≤Vin≤25V		55	80	--	dB
Voltage Drop	Vdrop	Iout=350mA, Tj=25 °C		--	2	--	V
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=5mA, 0 °C≤Tj≤125 °C		--	-0.3	--	mV/ °C

TS78M15 Electrical Characteristics

(Vin=23V, Iout=350mA, 0 °C≤Tj≤125 °C, Cin=0.33uF, Cout=0.1uF; unless otherwise specified.)

Parameter		Test Conditions		Min	Typ	Max	Unit
Output Voltage	Vout	Tj=25 °C		14.42	15	15.60	V
		17.5V≤Vin≤30V, 5mA≤Iout≤350mA, PD ≤5W		14.28	15	15.75	
Line Regulation	REGline	Tj=25 °C	17.5V≤Vin≤30V, Io=200mA	--	8	50	mV
Load Regulation	REGload	Tj=25 °C	5mA≤Iout≤500mA	--	25	300	
			5mA≤Iout≤200mA	--	10	150	
Quiescent Current	Iq	Tj=25 °C, Iout=0		--	3	6	mA
Quiescent Current Change	ΔIq	17.5V≤Vin≤30V		--	--	0.8	
		5mA≤Iout≤350mA		--	--	0.5	
Output Noise Voltage	Vn	10Hz≤f≤100KHz, Tj=25 °C		--	90	--	uV
Ripple Rejection Ratio	RR	f=120Hz, 18V≤Vin≤28V		54	70	--	dB
Voltage Drop	Vdrop	Iout=350mA, Tj=25 °C		--	2	--	V
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=5mA, 0 °C≤Tj≤125 °C		--	-0.3	--	mV/ °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

(Vin=27V, Iout=350mA, 0 °C≤Tj≤125 °C, Cin=0.33uF, Cout=0.1uF; unless otherwise specified.)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Output Voltage	Vout	Tj=25 °C		17.30	18	18.72	V
		21V≤Vin≤33V, 5mA≤Iout≤350mA, PD ≤5W		17.14	18	18.90	
Line Regulation	REGline	Tj=25 °C	21V≤Vin≤33V, Io=200mA	--	8	50	mV
Load Regulation	REGload	Tj=25 °C	5mA≤Iout≤500mA	--	25	360	
			5mA≤Iout≤200mA	--	10	180	
Quiescent Current	Iq	Tj=25 °C, Iout=0		--	3	6	mA
Quiescent Current Change	ΔIq	21V≤Vin≤33V		--	--	0.8	
		5mA≤Iout≤350nA		--	--	0.5	
Output Noise Voltage	Vn	10Hz≤f≤100KHz, Tj=25 °C		--	110	--	uV
Ripple Rejection Ratio	RR	f=120Hz, 21V≤Vin≤31V		54	70	--	dB
Voltage Drop	Vdrop	Iout=350mA, Tj=25 °C		--	2	--	V
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=5mA, 0 °C≤Tj≤125 °C		--	-0.5	--	mV/ °C

TS78M24 Electrical Characteristics

(Vin=33V, Iout=350mA, 0 °C≤Tj≤125 °C, Cin=0.33uF, Cout=0.1uF; unless otherwise specified.)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Output Voltage	Vout	Tj=25 °C		23.07	24	24.96	V
		27V≤Vin≤38V, 5mA≤Iout≤350mA, PD ≤5W		22.85	24	25.20	
Line Regulation	REGline	Tj=25 °C	27V≤Vin≤38V, Io=200mA	--	10	50	mV
Load Regulation	REGload	Tj=25 °C	5mA≤Iout≤500mA	--	30	480	
			5mA≤Iout≤200mA	--	10	240	
Quiescent Current	Iq	Iout=0, Tj=25 °C		--	4	7	mA
Quiescent Current Change	ΔIq	27V≤Vin≤38V		--	--	0.8	
		5mA≤Iout≤350mA		--	--	0.5	
Output Noise Voltage	Vn	10Hz≤f≤100KHz, Tj=25 °C		--	170	--	uV
Ripple Rejection Ratio	RR	f=120Hz, 27V≤Vin≤37V		50	70	--	dB
Voltage Drop	Vdrop	Iout=350mA, Tj=25 °C		--	2	--	V
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=5mA, 0 °C≤Tj≤125 °C		--	-0.5	--	mV/ °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

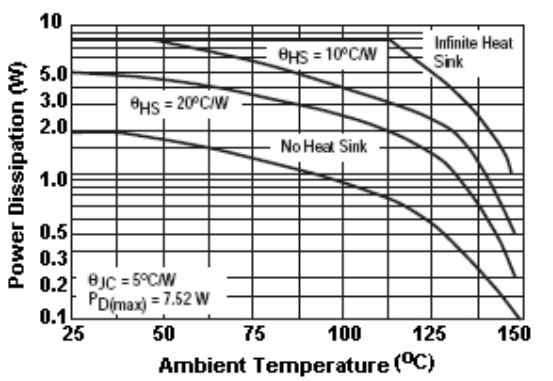


FIGURE 2 - Peak Output Current v.s. Dropout Voltage

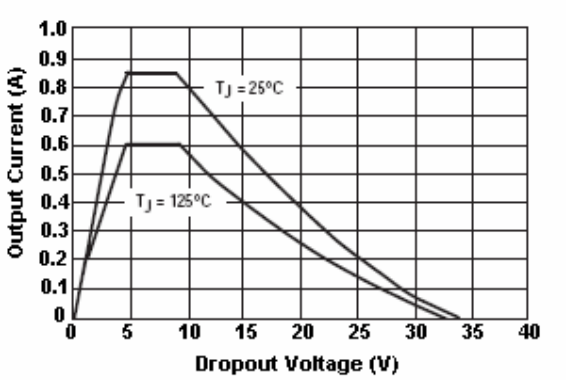


FIGURE 3 – Quiescent Current v.s. Input Voltage

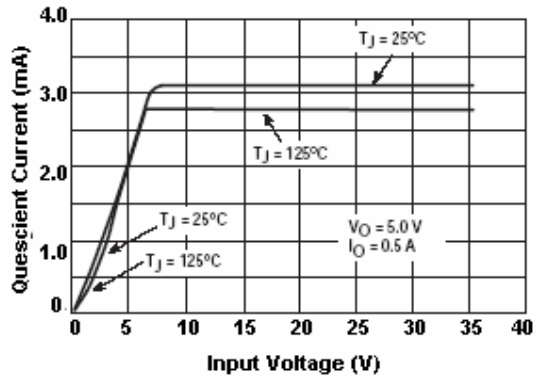


FIGURE 4 –Dropout Voltage v.s. Junction Temperature

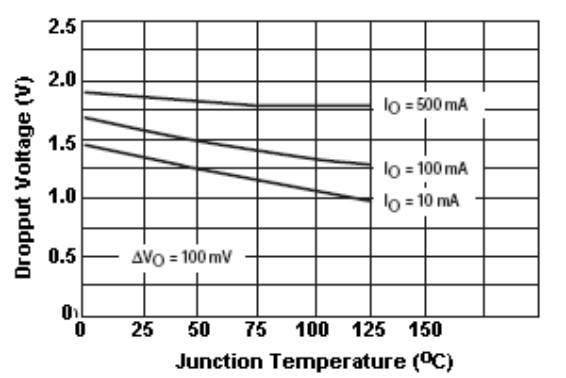


FIGURE 5 – Quiescent Current v.s. Output Current

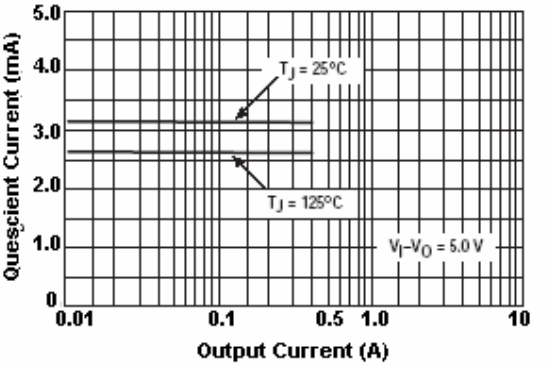
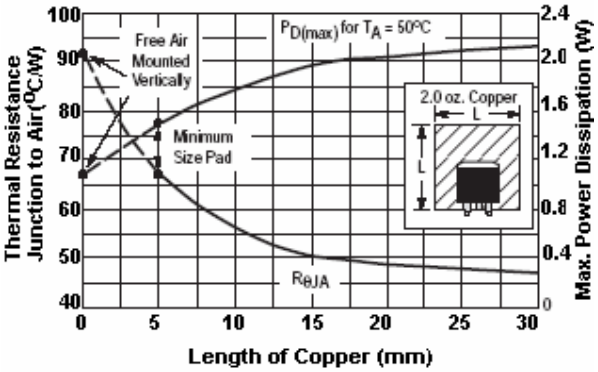


FIGURE 6 – TO-252 Thermal Resistance and Pd(max) v.s. P.C.B Copper Length



Electrical Characteristics Curve

FIGURE 7 – Ripple Rejection v.s. Frequency

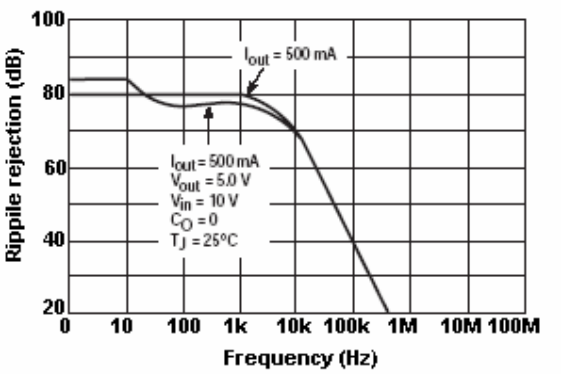
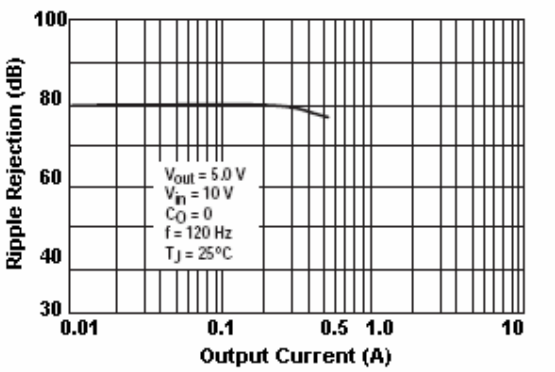


FIGURE 8 – Ripple Rejection v.s. Output Voltage



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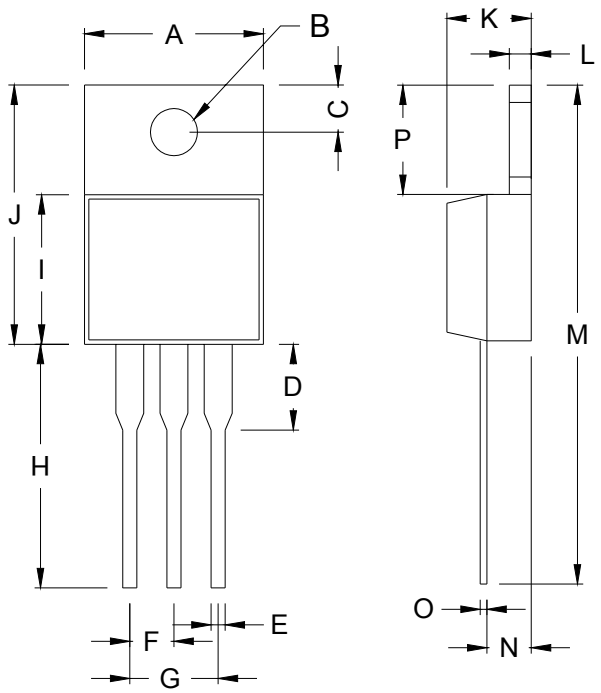
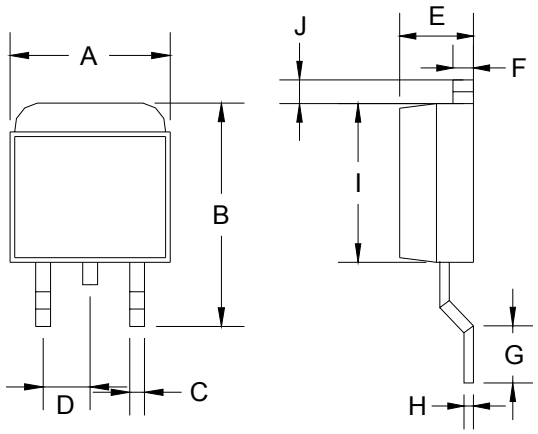
TO-220 Mechanical Drawing



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