

TO-220

ITO-220

**TO-263
(D²PAK)**

Pin Definition:

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

General Description

The TS7900 series of fixed output negative voltage regulators are intended as complements to the popular TS7800 series device. These negative regulators are available in the same seven-voltage options as the TS7900 devices. In addition, one extra voltage option commonly employed in MECL systems is also available in the negative TS7900A Series. Available in fixed output voltage options from -5.0 to -24 volts, these regulators employ current limiting, thermal shutdown, and safe-area compensation--making them remarkably rugged under most operating conditions. With adequate heat sinking they can deliver output currents in excess of 1 ampere. This series is offered in 3-pin TO-220, ITO-220 & TO-263 package.

Features

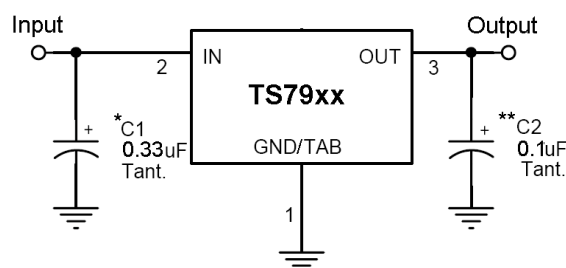
- Output Voltage Range -5 to -24V
- Output current up to 1A
- No external components required
- Internal thermal overload protection
- Internal short-circuit current limiting
- Output transistor safe-area compensation
- Output voltage offered in 4% tolerance

Ordering Information

Part No.	Package	Packing
TS79xxCZ C0	TO-220	50pcs / Tube
TS79xxCI C0	ITO-220	50pcs / Tube
TS79xxCM RN	TO-263	800pcs / 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: * TS7905 to TS7918

** TS7924

*** Follow the derating curve

TS7900 Series

3-Terminal Fixed Negative Voltage Regulator

TS7905 Electrical Characteristics

($V_{in} = -10V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; 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
		$-7.5V \leq V_{in} \leq -20V$, $10mA \leq I_{out} \leq 1A$, $PD \leq 15W$	-4.75	-5	-5.25	
Line Regulation	REG _{line}	$T_j = 25^{\circ}C$	--	3	100	mV
		$-7.5V \leq V_{in} \leq -25V$	--	1	50	
Load Regulation	REG _{load}	$T_j = 25^{\circ}C$	--	15	100	
		$10mA \leq I_{out} \leq 1A$	--	5	50	
Quiescent Current	I_q	$I_{out} = 0$, $T_j = 25^{\circ}C$	--	4	8	mA
Quiescent Current Change	ΔI_q	$-7.5V \leq V_{in} \leq -25V$	--	--	1.3	
		$10mA \leq I_{out} \leq 1A$	--	--	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	74	--	dB
Voltage Drop	V_{drop}	$I_{out} = 1A$, $T_j = 25^{\circ}C$	--	2	--	V
Output Short Circuit Current	I_{os}	$T_j = 25^{\circ}C$	--	750	--	mA
Peak Output Current	$I_{o peak}$	$T_j = 25^{\circ}C$	--	2.1	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out} = 10mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-0.1	--	mV/ $^{\circ}C$

TS7906 Electrical Characteristics

($V_{in} = -11V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; unless otherwise specified.)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output Voltage	V_{out}	$T_j = 25^{\circ}C$	-5.75	-6	-6.25	V
		$-8.5V \leq V_{in} \leq -21V$, $10mA \leq I_{out} \leq 1A$, $PD \leq 15W$	-5.7	-6	-6.3	
Line Regulation	REG _{line}	$T_j = 25^{\circ}C$	--	5	120	mV
		$-8.5V \leq V_{in} \leq -25V$	--	1.5	60	
Load Regulation	REG _{load}	$T_j = 25^{\circ}C$	--	14	120	
		$10mA \leq I_{out} \leq 1A$	--	4	60	
Quiescent Current	I_q	$I_{out} = 0$, $T_j = 25^{\circ}C$	--	4	8	mA
Quiescent Current Change	ΔI_q	$-8.5V \leq V_{in} \leq -25V$	--	--	1.3	
		$10mA \leq I_{out} \leq 1A$	--	--	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_j = 25^{\circ}C$	--	44	--	μV
Ripple Rejection Ratio	RR	$f = 120Hz$, $-9V \leq V_{in} \leq -19V$	60	73	--	dB
Voltage Drop	V_{drop}	$I_{out} = 1A$, $T_j = 25^{\circ}C$	--	2	--	V
Output Short Circuit Current	I_{os}	$T_j = 25^{\circ}C$	--	550	--	mA
Peak Output Current	$I_{o peak}$	$T_j = 25^{\circ}C$	--	2.1	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out} = 10mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-0.1	--	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.

TS7900 Series

3-Terminal Fixed Negative Voltage Regulator

TS7908 Electrical Characteristics

$V_{in} = -14V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; 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
		$-10.5V \leq V_{in} \leq -23V$, $10mA \leq I_{out} \leq 1A$, $PD \leq 15W$	-7.61	-8	-8.40	
Line Regulation	REG _{line}	$T_j = 25^{\circ}C$	--	6	160	mV
		$-10.5V \leq V_{in} \leq -25V$	--	2	80	
Load Regulation	REG _{load}	$T_j = 25^{\circ}C$	--	12	160	
		$10mA \leq I_{out} \leq 1A$	--	4	80	
Quiescent Current	I_q	$I_{out} = 0$, $T_j = 25^{\circ}C$	--	4.3	8	mA
Quiescent Current Change	ΔI_q	$10.5V \leq V_{in} \leq 25V$	--	--	1	
		$10mA \leq I_{out} \leq 1A$	--	--	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	72	--	dB
Voltage Drop	V_{drop}	$I_{out} = 1A$, $T_j = 25^{\circ}C$	--	2	--	V
Output Short Circuit Current	I_{os}	$T_j = 25^{\circ}C$	--	450	--	mA
Peak Output Current	$I_{o peak}$	$T_j = 25^{\circ}C$	--	2.1	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out} = 10mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-1	--	mV/ $^{\circ}C$

TS7909 Electrical Characteristics

($V_{in} = -15V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; 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
		$-11.5V \leq V_{in} \leq -23V$, $10mA \leq I_{out} \leq 1A$, $PD \leq 15W$	-8.57	-9	-9.45	
Line Regulation	REG _{line}	$T_j = 25^{\circ}C$	--	6	180	mV
		$-11.5V \leq V_{in} \leq -26V$	--	2	90	
Load Regulation	REG _{load}	$T_j = 25^{\circ}C$	--	12	180	
		$10mA \leq I_{out} \leq 1A$	--	4	90	
Quiescent Current	I_q	$I_{out} = 0$, $T_j = 25^{\circ}C$	--	4.3	8	mA
Quiescent Current Change	ΔI_q	$-11.5V \leq V_{in} \leq -26V$	--	--	1	
		$10mA \leq I_{out} \leq 1A$	--	--	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_j = 25^{\circ}C$	--	58	--	μV
Ripple Rejection Ratio	RR	$f = 120Hz$, $-12V \leq V_{in} \leq -22V$	56	71	--	dB
Voltage Drop	V_{drop}	$I_{out} = 1A$, $T_j = 25^{\circ}C$	--	2	--	V
Output Short Circuit Current	I_{os}	$T_j = 25^{\circ}C$	--	450	--	mA
Peak Output Current	$I_{o peak}$	$T_j = 25^{\circ}C$	--	2.1	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out} = 10mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-1	--	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.

TS7900 Series

3-Terminal Fixed Negative Voltage Regulator

TS7912 Electrical Characteristics

($V_{in} = -19V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; 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
		$-14.5V \leq V_{in} \leq -27V$, $10mA \leq I_{out} \leq 1A$, $PD \leq 15W$	-11.42	-12	-12.60	
Line Regulation	REG _{line}	$T_j = 25^{\circ}C$	$-14.5V \leq V_{in} \leq -30V$	--	10	mV
			$-15V \leq V_{in} \leq -19V$	--	3	
Load Regulation	REG _{load}	$T_j = 25^{\circ}C$	$10mA \leq I_{out} \leq 1A$	--	12	
			$250mA \leq I_{out} \leq 750mA$	--	4	
Quiescent Current	I_q	$T_j = 25^{\circ}C$, $I_{out} = 0$	--	4.3	8	mA
Quiescent Current Change	ΔI_q	$-14.5V \leq V_{in} \leq -30V$	--	--	1	
		$10mA \leq I_{out} \leq 1A$	--	--	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	70	--	dB
Voltage Drop	V_{drop}	$I_{out} = 1A$, $T_j = 25^{\circ}C$	--	2	--	V
Output Short Circuit Current	I_{os}	$T_j = 25^{\circ}C$	--	350	--	mA
Peak Output Current	$I_{o peak}$	$T_j = 25^{\circ}C$	--	2.1	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out} = 10mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-1	--	mV/ $^{\circ}C$

TS7915 Electrical Characteristics

($V_{in} = -23V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; unless otherwise specified.)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output voltage	V_{out}	$T_j = 25^{\circ}C$	-14.42	-15	-15.60	V
		$-17.5V \leq V_{in} \leq -30V$, $10mA \leq I_{out} \leq 1A$, $PD \leq 15W$	-14.28	-15	-15.75	
Line Regulation	REG _{line}	$T_j = 25^{\circ}C$	$-17.5V \leq V_{in} \leq -30V$	--	12	mV
			$-18V \leq V_{in} \leq -22V$	--	3	
Load Regulation	REG _{load}	$T_j = 25^{\circ}C$	$10mA \leq I_{out} \leq 1A$	--	12	
			$250mA \leq I_{out} \leq 750mA$	--	4	
Quiescent Current	I_q	$T_j = 25^{\circ}C$, $I_{out} = 0$	--	4.3	8	mA
Quiescent Current Change	ΔI_q	$-17.5V \leq V_{in} \leq -30V$	--	--	1	
		$10mA \leq I_{out} \leq 1A$	--	--	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_j = 25^{\circ}C$	--	90	--	μV
Ripple Rejection Ratio	RR	$f = 120Hz$, $-18V \leq V_{in} \leq -28V$	54	69	--	dB
Voltage Drop	V_{drop}	$I_{out} = 1A$, $T_j = 25^{\circ}C$	--	2	--	V
Output Short Circuit Current	I_{os}	$T_j = 25^{\circ}C$	--	230	--	mA
Peak Output Current	$I_{o peak}$	$T_j = 25^{\circ}C$	--	2.1	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out} = 10mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-1	--	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.

TS7900 Series

3-Terminal Fixed Negative Voltage Regulator

TS7918 Electrical Characteristics

$V_{in} = -24V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; unless otherwise specified.)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output voltage	V_{out}	$T_j = 25^{\circ}C$	-17.30	-18	-18.72	V
		$-21V \leq V_{in} \leq -33V$, $10mA \leq I_{out} \leq 1A$, $PD \leq 15W$	-17.14	-18	-18.90	
Line Regulation	REG _{line}	$T_j = 25^{\circ}C$	--	15	360	mV
		$-22V \leq V_{in} \leq -26V$	--	5	180	
Load Regulation	REG _{load}	$T_j = 25^{\circ}C$	--	12	360	
		$250mA \leq I_{out} \leq 750mA$	--	4	180	
Quiescent Current	I_q	$I_{out} = 0$, $T_j = 25^{\circ}C$	--	4.5	8	mA
Quiescent Current Change	ΔI_q	$-21V \leq V_{in} \leq -33V$	--	--	1	
		$10mA \leq I_{out} \leq 1A$	--	--	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_j = 25^{\circ}C$	--	110	--	μV
Ripple Rejection Ratio	RR	$f = 120Hz$, $-21V \leq V_{in} \leq -31V$	53	68	--	dB
Voltage Drop	V_{drop}	$I_{out} = 1A$, $T_j = 25^{\circ}C$	--	2	--	V
Output Short Circuit Current	I_{os}	$T_j = 25^{\circ}C$	--	200	--	mA
Peak Output Current	$I_{o peak}$	$T_j = 25^{\circ}C$	--	2.1	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out} = 10mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-1	--	mV/ $^{\circ}C$

TS7924 Electrical Characteristics

$V_{in} = -33V$, $I_{out} = 500mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{in} = 0.33\mu F$, $C_{out} = 0.1\mu F$; 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
		$-27V \leq V_{in} \leq -38V$, $10mA \leq I_{out} \leq 1A$, $PD \leq 15W$	-22.85	-24	-25.20	
Line Regulation	REG _{line}	$T_j = 25^{\circ}C$	--	18	480	mV
		$-28V \leq V_{in} \leq -32V$	--	6	240	
Load Regulation	REG _{load}	$T_j = 25^{\circ}C$	--	12	480	
		$250mA \leq I_{out} \leq 750mA$	--	4	240	
Quiescent Current	I_q	$I_{out} = 0$, $T_j = 25^{\circ}C$	--	4.6	8	mA
Quiescent Current Change	ΔI_q	$-27V \leq V_{in} \leq -38V$	--	--	1	
		$10mA \leq I_{out} \leq 1A$	--	--	0.5	
Output Noise Voltage	V_n	$10Hz \leq f \leq 100KHz$, $T_j = 25^{\circ}C$	--	170	--	μV
Ripple Rejection Ratio	RR	$f = 120Hz$, $-27V \leq V_{in} \leq -37V$	50	65	--	dB
Voltage Drop	V_{drop}	$I_{out} = 1A$, $T_j = 25^{\circ}C$	--	2	--	V
Output Short Circuit Current	I_{os}	$T_j = 25^{\circ}C$	--	150	--	mA
Peak Output Current	$I_{o peak}$	$T_j = 25^{\circ}C$	--	2.1	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out} = 10mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-1	--	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

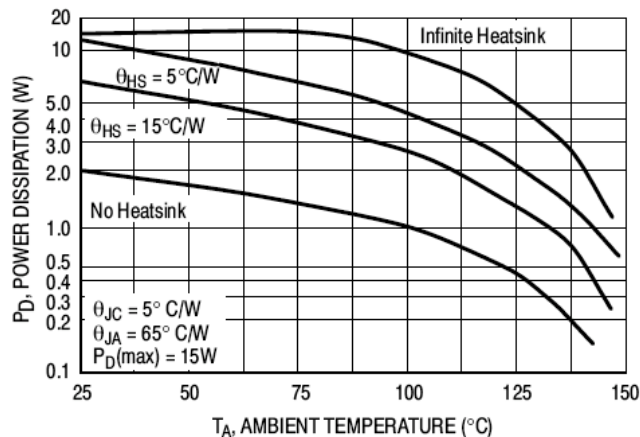


Figure 1. Worst Case Power Dissipation as a Function of Ambient Temperature

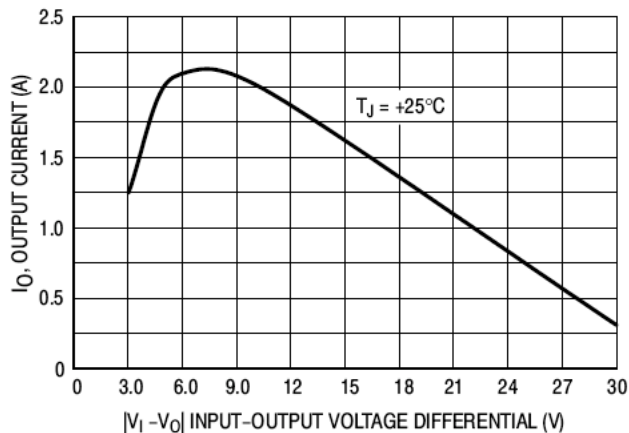


Figure 2. Peak Output Current as a Function of Input-Output Differential Voltage

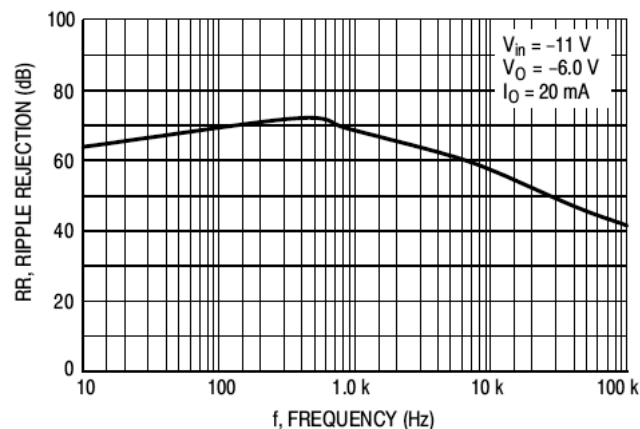


Figure 3. Ripple Rejection as a Function of Frequency

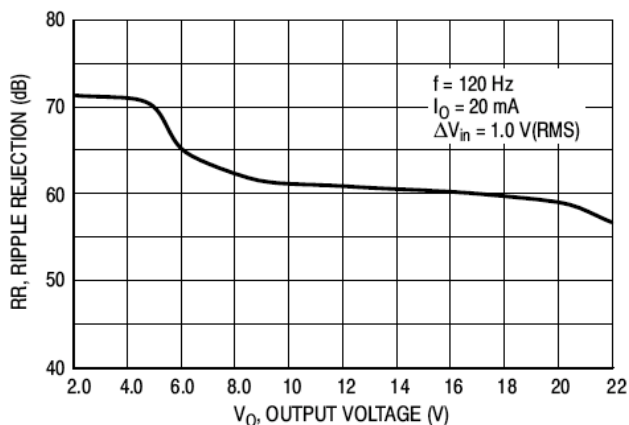


Figure 4. Ripple Rejection as a Function of Output Voltage

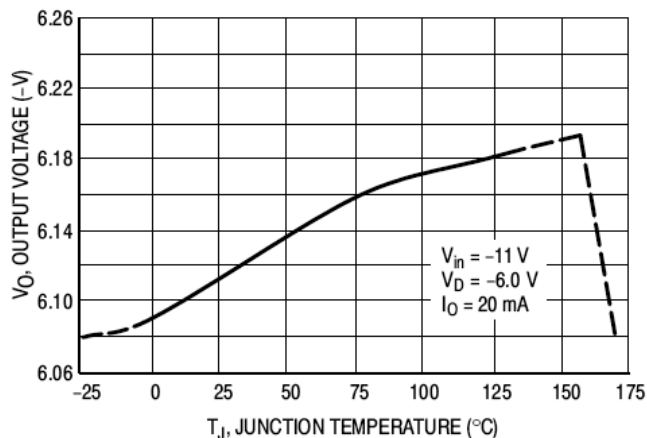


Figure 5. Output Voltage as a Function of Junction Temperature

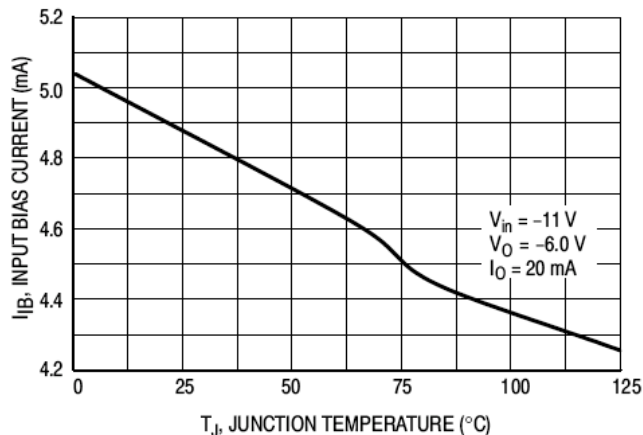


Figure 5. Output Voltage as a Function of Junction Temperature

Application Information

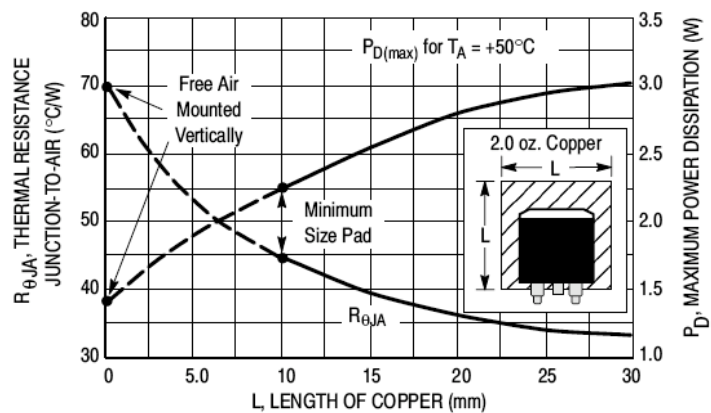
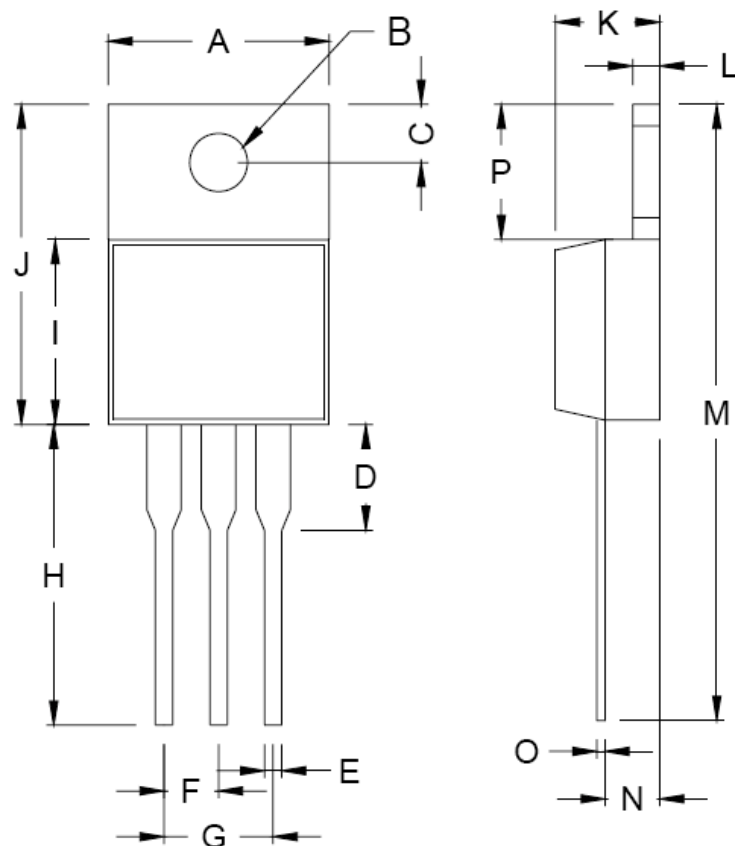


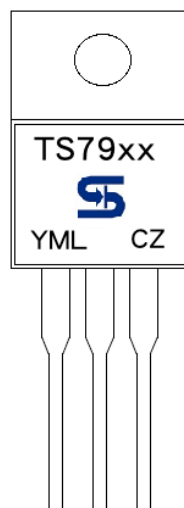
Figure 7. D²PAK Thermal Resistance and Maximum Power Dissipation vs. P.C.B Copper Length

TO-220 Mechanical Drawing



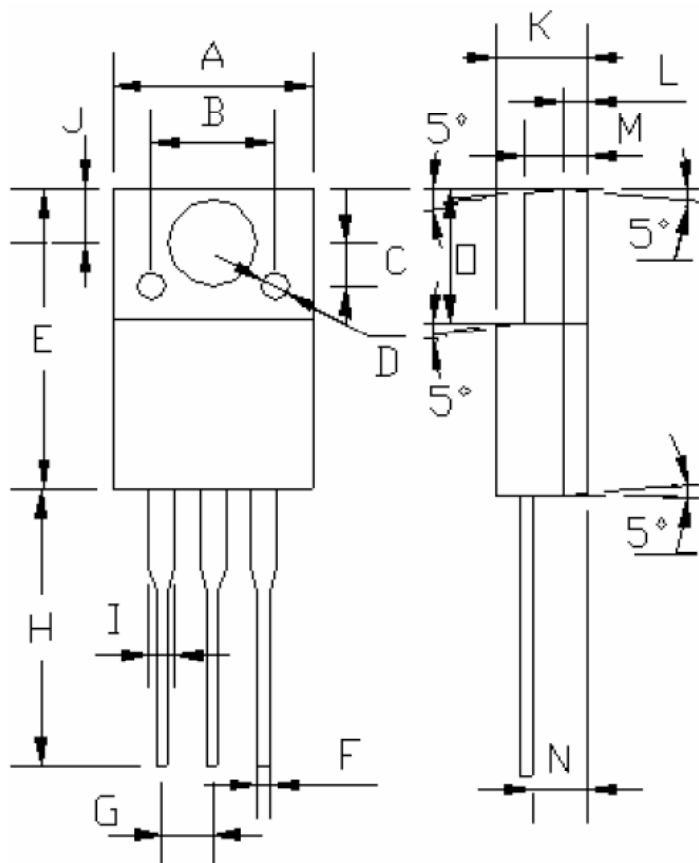
TO-220 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.000	10.500	0.394	0.413
B	3.740	3.910	0.147	0.154
C	2.440	2.940	0.096	0.116
D	-	6.350	-	0.250
E	0.381	1.106	0.015	0.040
F	2.345	2.715	0.092	0.058
G	4.690	5.430	0.092	0.107
H	12.700	14.732	0.500	0.581
I	8.382	9.017	0.330	0.355
J	14.224	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

Marking Diagram



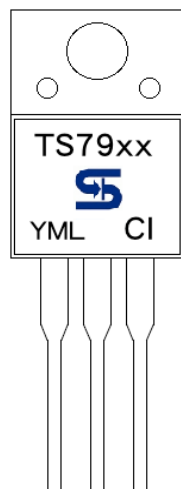
- XX** = Output Voltage
(05=-5V, 06=-6V, 08=-8V, 09=-9V, 12=-12V, 15=-15V, 18=-18V, 24=-24V)
- Y** = Year Code
- M** = Month Code
(A=Jan, B=Feb, C=Mar, D=Apr, E=May, F=Jun, G=Jul, H=Aug, I=Sep, J=Oct, K=Nov, L=Dec)
- L** = Lot Code
- CZ** = Package Code for TO-220

ITO-220 Mechanical Drawing



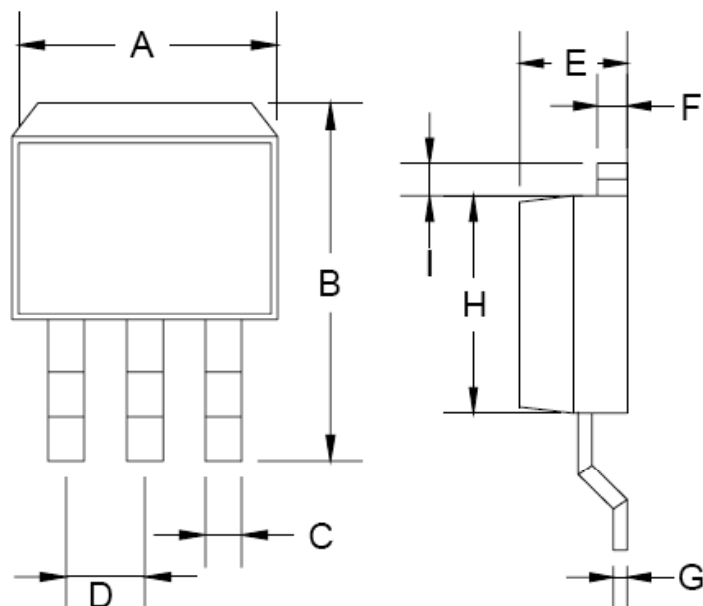
ITO-220 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.96	10.36	0.392	0.407
B	6.20 (typ.)		0.244 (typ.)	
C	2.20 (typ.)		0.087 (typ.)	
D	§ 1.40 (typ.)		§ 0.055 (typ.)	
E	15.07	16.07	0.593	0.632
F	0.80 (typ.)		0.031 (typ.)	
G	2.44	2.64	0.096	0.104
H	13.08	13.48	0.514	0.530
I	1.47 (max.)		0.057 (max.)	
J	3.20	3.40	0.125	0.133
K	4.60	4.80	0.181	0.188
L	1.15 (typ.)		0.045 (typ.)	
M	2.44	2.64	0.096	0.104
N	2.60	2.80	0.102	0.110
O	6.55	6.65	0.258	0.262

Marking Diagram



- XX** = Output Voltage
(05=-5V, 06=-6V, 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=Apl, E=May, F=Jun, G=Jul, H=Aug, I=Sep, J=Oct, K=Nov, L=Dec)
- L** = Lot Code
- CI** = Package Code for ITO-220

TO-263 Mechanical Drawing



DIM	TO-263 DIMENSION			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.000	10.500	0.394	0.413
B	14.605	15.875	0.575	0.625
C	0.508	0.991	0.020	0.039
D	2.420	2.660	0.095	0.105
E	4.064	4.830	0.160	0.190
F	1.118	1.400	0.045	0.055
G	0.450	0.730	0.018	0.029
H	8.280	8.800	0.325	0.346
I	1.140	1.400	0.044	0.055
J	1.480	1.520	0.058	0.060

Marking Diagram



- XX** = Output Voltage
(05=-5V, 06=-6V, 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=Apl, E=May, F=Jun, G=Jul, H=Aug, I=Sep, J=Oct, K=Nov, L=Dec)
- L** = Lot Code
- CM** = Package Code for TO-263

TS7900 Series

3-Terminal Fixed Negative Voltage Regulator

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