



TS7900

3-Terminal Negative Output Voltage Regulators

These voltage regulators are intended as complements to the popular TS7900 Series devices. 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 TS7900 Series.

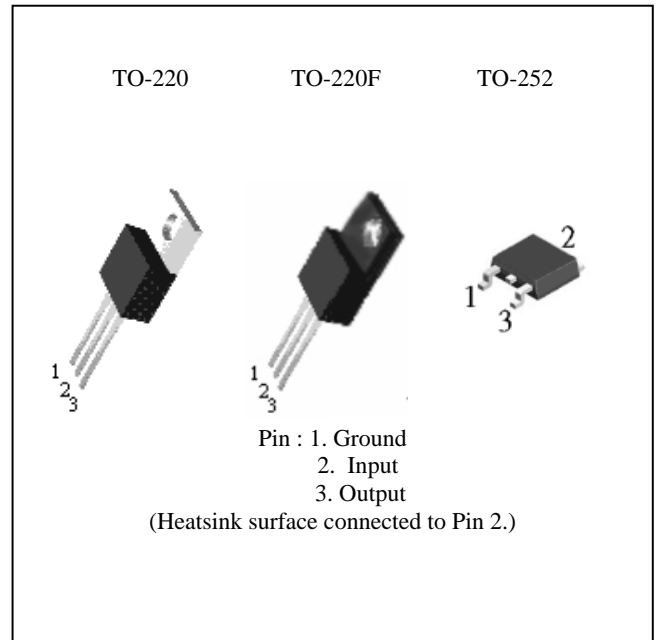
Available in fixed output voltage options from -5.0 to -24 volts, these regulators employ current limiting, thermal shutdown, and safe-area compensation--making them remarkably rugged under most operating conditions. With adequate heatsinking they can deliver output currents up to 1.5 ampere.

FEATURES

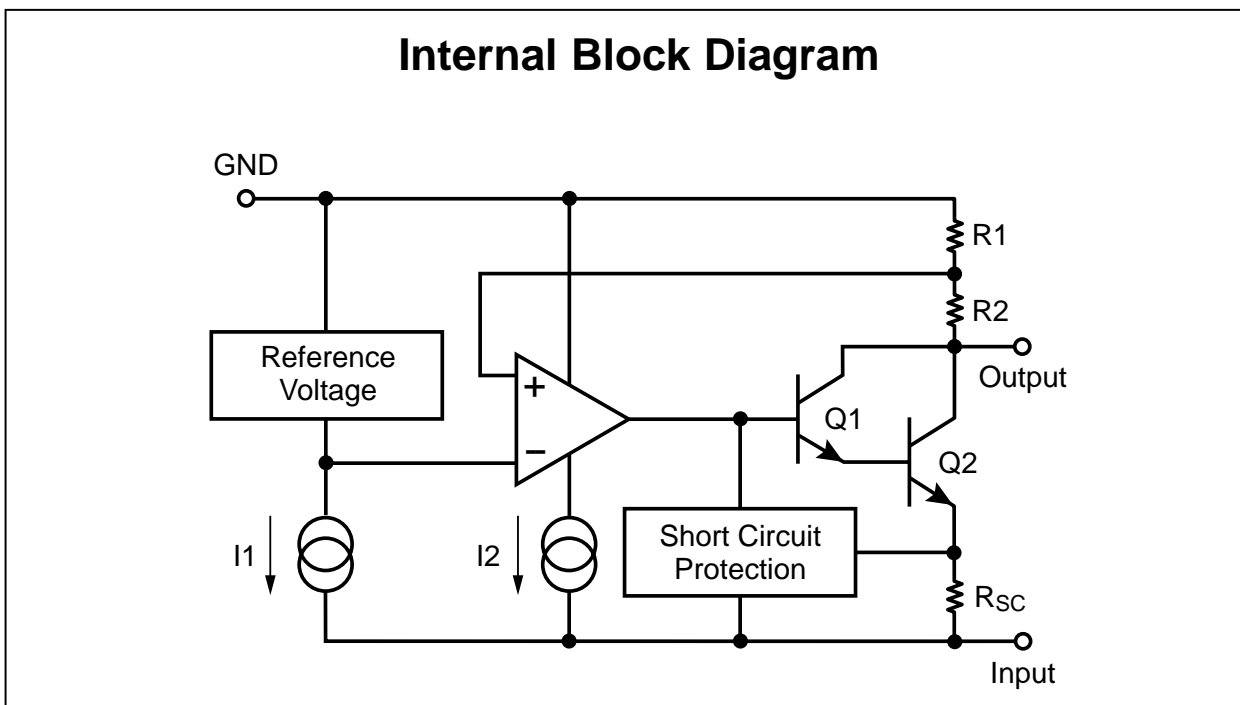
- Output Current up to 1.5 Ampere
- No External Components Required
- Internal Thermal Overload Protection
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation
- Available in 2% Voltage Tolerance

ORDERING INFORMATION

Device	Operating Temperature (Ambient)	Package
TS79xxCZ	-20 to +85	TO-220
TS79xxCI		TO-220F
TS79xxCP		TO-252



INTERNAL BLOCK DIAGRAM





TS7900

3-Terminal Negative Output Voltage Regulators

ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

RATING	SYMBOL	PJ7900 Series	UNIT
Input Voltage	V _{in} *1	-35	V
Input Voltage	V _{in} *2	-40	V
Power Dissipation TO-220	P _D	15	W
TO-220F		10	
TO-252		10	
Operating Ambient Temperature	T _{opr}	-20 to +85	°C
Operating Junction Temperature	T _j	0 to +125	°C
Storage Temperature	T _{stg}	-25 to +125	°C

Note: *1: TS7905 to TS7918

*2: TS7924

*3: Follow the derating curve. When T_j exceeds 150°C, the internal circuit cuts off the output.

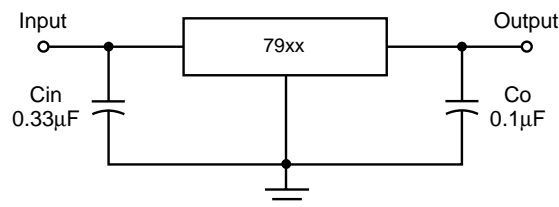
• TS7905 ELECTRICAL CHARACTERISTICS

(V_{in}=-10V, I_{out}=500mA, C_{in}=2 μF, C_{out}=1 μF; T_j=0°C to 125°C, unless otherwise specified.)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN.	TYP	MAX	UNIT	
Output Voltage	V _o	1	T _j =25°C	-4.9	-5.0	-5.1	V	
Output Voltage Tolerance	V _o		V _i =-7 to -20V, I _o =5mA to 1A, P _D <15W	-4.85	--	-5.15	V	
Line Regulation	REG _{line}	1	T _j =25°C	V _i =-7 to -25V	--	3	100	mV
				V _i =-8 to -12V	--	1	50	mV
Load Regulation	REG _{load}	1	T _j =25°C	I _o =5mA to 1.5A	--	10	100	mV
				I _o =250mA to 750mA	--	3	50	mV
Quiescent Current	I _q	3	T _j =25°C	--	2	4	mA	
Quiescent current Change	Δ I _q	3	V _{IN} =-7 to -25V	--	--	1.3	mA	
			I _o =5mA to 1.5A			0.5		
Output Noise Voltage	V _n	1	f=10Hz to 100KHz, T _a =25°C	--	40	--	μV	
Ripple Rejection Ratio	RR	2	V _i =-8 to -18V, I _o =100mA, f=120Hz	62	74	--	dB	
Min. I/O Voltage Difference	V _{dif}		I _o =1A, T _j =25°C	--	1.1	--	V	
Peak Output Current	I _{o-peak}	1	T _j =25°C	--	2.1	--	A	
Output Voltage Temperature Coefficient	Δ V _o /T _a	1	I _o =5mA, T _j =0 to 125°C	--	-0.4	--	mV/°C	

Note: The specified condition T_j=25°C means that the test should be carried out with the test time so short (within 10mS), that the drift in characteristic value due to the rise in chip junction temperature can be ignored.

STANDARD APPLICATION



A common ground is required between the input and the output voltages. The input voltage must remain typically 2.0 V more negative even during the high point on the input ripple voltage.

XX = these two digits of the type number indicate voltage.

C_{in} is required if regulator is located an appreciable distance from power supply filter.

C_o improves stability and transient response.



TS7900

3-Terminal Negative Output Voltage Regulators

• TS7906 ELECTRICAL CHARACTERISTICS

($V_{in}=-11V$, $I_{out}=500mA$, $C_{in}=2\mu F$, $C_{out}=1\mu F$; $T_j=0^\circ C$ to $125^\circ C$, unless otherwise specified.)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN.	TYP	MAX.	UNIT	
Output Voltage	V_o	1	$T_j=25^\circ C$	-5.88	-6	-6.12	V	
Output Voltage Tolerance	V_o	1	$V_i=-8$ to $-21V$, $I_o=5mA$ to $1A$, $P_D<15W$	-5.83	--	-6.17	V	
Line Regulation	REGline	1	$T_j=25^\circ C$	$V_i=-8$ to $-25V$	--	4	120	mV
				$V_i=-9$ to $-13V$	--	1.5	60	mV
Load Regulation	REGload	1	$T_j=25^\circ C$	$I_o=5mA$ to $1.5A$	--	10	120	mV
				$I_o=250mA$ to $750mA$	--	3	60	mV
Quiescent Current	I_q	3	$T_j=25^\circ C$	--	2	4	mA	
Quiescent Current Change	ΔI_q	3	$V_i=-8$ to $-25V$, $T_j=25^\circ C$	--	--	1.3	mA	
			$I_o=5mA$ to $1A$, $T_j=25^\circ C$	--	--	0.5	mA	
Output Noise Voltage	V_n	1	$f=10Hz$ to $100KHz$, $T_a=25^\circ C$	--	44	--	μV	
Ripple Rejection Ratio	RR	2	$V_i=-9$ to $-19V$, $I_o=100mA$, $f=120Hz$	60	73	--	dB	
Min. I/O Voltage Difference	V_{dif}		$I_o=1A$, $T_j=25^\circ C$	--	1.1	--	V	
Peak Output Current	I_{o-peak}	1	$T_j=25^\circ C$	--	2.1	--	A	
Output Voltage Temperature Coefficient	$\Delta V_o/T_a$	1	$I_o=5mA$, $T_j=0$ to $125^\circ C$	--	-0.5	--	mV/ $^\circ C$	

Note: The specified condition $T_j=25^\circ C$ means that the test should be carried out with the test time so short (within 10mS), that the drift in characteristic value due to the rise in chip junction temperature can be ignored.

• TS7908 ELECTRICAL CHARACTERISTICS

($V_{in}=-14V$, $I_{out}=500mA$, $C_{in}=2\mu F$, $C_{out}=1\mu F$; $T_j=0^\circ C$ to $125^\circ C$, unless otherwise specified.)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN.	TYP	MAX.	UNIT	
Output Voltage	V_o	1	$T_j=25^\circ C$	-7.84	-8	-8.16	V	
Output Voltage Tolerance	V_o	1	$V_i=-10.5$ to $-23V$, $I_o=5mA$ to $1A$, $P_D<15W$	-7.74	--	-8.26	V	
Line Regulation	REGline	1	$T_j=25^\circ C$	$V_i=-10.5$ to $-25V$	--	6	160	mV
				$V_i=-11$ to $-17V$	--	2	80	mV
Load Regulation	REGload	1	$T_j=25^\circ C$	$I_o=5mA$ to $1.5A$	--	12	160	mV
				$I_o=250mA$ to $750mA$	--	4	80	mV
Quiescent Current	I_q	3	$T_j=25^\circ C$	--	2	4	mA	
Quiescent Current Change	ΔI_q	3	$V_i=-10.5$ to $-25V$, $T_j=25^\circ C$	--	--	1	mA	
			$I_o=5mA$ to $1A$	--	--	0.5	mA	
Output Noise Voltage	V_n	1	$f=10Hz$ to $100KHz$, $T_a=25^\circ C$	--	52	--	μV	
Ripple Rejection Ratio	RR	2	$V_i=-11$ to $-21V$, $I_o=100mA$, $f=120Hz$	56	71	--	dB	
Min. I/O Voltage Difference	V_{dif}		$I_o=1A$, $T_j=25^\circ C$	--	2	--	V	
Peak Output Current	I_{o-peak}	1	$T_j=25^\circ C$	--	2.1	--	A	
Output Voltage Temperature Coefficient	$\Delta V_o/T_a$	1	$I_o=5mA$, $T_j=0$ to $125^\circ C$	--	-0.6	--	mV/ $^\circ C$	

Note: The specified condition $T_j=25^\circ C$ means that the test should be carried out with the test time so short (within 10mS), that the drift in characteristic value due to the rise in chip junction temperature can be ignored.



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3-Terminal Negative Output Voltage Regulators

• TS7909 ELECTRICAL CHARACTERISTICS

($V_{in}=-15V$, $I_{out}=500mA$, $C_{in}=2\mu F$, $C_{out}=1\mu F$; $T_j=0^\circ C$ to $125^\circ C$, unless otherwise specified.)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN.	TYP	MAX.	UNIT	
Output Voltage	V_o	1	$T_j=25^\circ C$	-8.82	-9	-9.18	V	
Output Voltage Tolerance	V_o	1	$V_i=-11.5$ to $-24V$, $I_o=5mA$ to $1A$, $P_D<15W$	-8.72	--	-9.28	V	
Line Regulation	REGline	1	$T_j=25^\circ C$	$V_i=-11.5$ to $-26V$	--	7	180	mV
				$V_i=-12$ to $-18V$	--	2	90	mV
Load Regulation	REGload	1	$T_j=25^\circ C$	$I_o=5mA$ to $1.5A$	--	12	180	mV
				$I_o=250mA$ to $750mA$	--	4	90	mV
Quiescent Current	I_q	3	$T_j=25^\circ C$	--	2.2	4.5	mA	
Quiescent Current Change	ΔI_q	3	$V_i=-11.5$ to $-26V$, $T_j=25^\circ C$ $I_o=5mA$ to $1.5A$	--	--	1	mA	
				--	--	0.5	mA	
Output Noise Voltage	V_n	1	$f=10Hz$ to $100KHz$, $T_a=25^\circ C$	--	58	--	μV	
Ripple Rejection Ratio	RR	2	$V_i=-12$ to $-22V$, $I_o=100mA$, $f=120Hz$	56	71	--	dB	
Min. I/O Voltage Difference	V_{dif}		$I_o=1A$, $T_j=25^\circ C$	--	1.1	--	V	
Peak Output Current	$I_o\text{-peak}$	1	$T_j=25^\circ C$	--	2.1	--	A	
Output Voltage Temperature Coefficient	$\Delta V_o/T_a$	1	$I_o=5mA$, $T_j=0$ to $125^\circ C$	--	-0.6	--	mV/ $^\circ C$	

Note: The specified condition $T_j=25^\circ C$ means that the test should be carried out with the test time so short (within 10mS), that the drift in characteristic value due to the rise in chip junction temperature can be ignored.

• TS7912 ELECTRICAL CHARACTERISTICS

($V_{in}=-19V$, $I_{out}=500mA$, $C_{in}=2\mu F$, $C_{out}=1\mu F$; $T_j=0^\circ C$ to $125^\circ C$, unless otherwise specified.)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN.	TYP	MAX.	UNIT	
Output Voltage	V_o	1	$T_j=25^\circ C$	-11.76	-12	-12.24	V	
Output Voltage Tolerance	V_o	1	$V_i=-14.5$ to $-27V$, $I_o=5mA$ to $1A$, $P_D<15W$	-11.66	--	-12.34	V	
Line Regulation	REGline	1	$T_j=25^\circ C$	$V_i=-14.5$ to $-30V$	--	10	240	mV
				$V_i=-16$ to $-22V$	--	3	120	mV
Load Regulation	REGload	1	$T_j=25^\circ C$	$I_o=5mA$ to $1.5A$	--	12	240	mV
				$I_o=250mA$ to $750mA$	--	4	120	mV
Quiescent Current	I_q	3	$T_j=25^\circ C$	--	2.5	5	mA	
Quiescent Current Change	ΔI_q	3	$V_i=-14.5$ to $-30V$, $T_j=25^\circ C$ $I_o=5mA$ to $1.5A$	--	--	1	mA	
				--	--	0.5	mA	
Output Noise Voltage	V_n	1	$f=10Hz$ to $100KHz$, $T_a=25^\circ C$	--	75	--	μV	
Ripple Rejection Ratio	RR	2	$V_i=-15$ to $-25V$, $I_o=100mA$, $f=120Hz$	55	70	--	dB	
Min. I/O Voltage Difference	V_{dif}		$I_o=1A$, $T_j=25^\circ C$	--	1.1	--	V	
Peak Output Current	$I_o\text{-peak}$	1	$T_j=25^\circ C$	--	2.1	--	A	
Output Voltage Temperature Coefficient	$\Delta V_o/T_a$	1	$I_o=5mA$, $T_j=0$ to $125^\circ C$	--	-0.8	--	mV/ $^\circ C$	

Note: The specified condition $T_j=25^\circ C$ means that the test should be carried out with the test time so short (within 10mS), that the drift in characteristic value due to the rise in chip junction temperature can be ignored.



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3-Terminal Negative Output Voltage Regulators

• TS7915 ELECTRICAL CHARACTERISTICS

($V_{in}=-23V$, $I_{out}=500mA$, $C_{in}=2\mu F$, $C_{out}=1\mu F$; $T_j=0^\circ C$ to $125^\circ C$, unless otherwise specified.)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN.	TYP	MAX.	UNIT	
Output Voltage	V_o	1	$T_j=25^\circ C$	-14.7	-15	-15.3	V	
Output Voltage Tolerance	V_o	1	$V_i=-17.5$ to $-30V$, $I_o=5mA$ to $1A$, $P_D<15W$	-14.55	--	-15.45	V	
Line Regulation	REGline	1	$T_j=25^\circ C$	$V_i=-17.5$ to $-30V$	--	11	300	mV
				$V_i=-20$ to $-26V$	--	3	150	mV
Load Regulation	REGload	1	$T_j=25^\circ C$	$I_o=5mA$ to $1.5A$	--	12	300	mV
				$I_o=250mA$ to $750mA$	--	4	150	mV
Quiescent Current	I_q	3	$T_j=25^\circ C$	--	2.5	5	mA	
Quiescent Current Change	ΔI_q	3	$V_i=-17.5$ to $-30V$	--	--	1	mA	
			$I_o=5mA$ to $1A$	--	--	0.5	mA	
Output Noise Voltage	V_n	1	$f=10Hz$ to $100KHz$, $T_a=25^\circ C$	--	90	--	μV	
Ripple Rejection Ratio	RR	2	$V_i=-18.5$ to $-28.5V$, $I_o=100mA$, $f=120Hz$	54	69	--	dB	
Min. I/O Voltage Difference	V_{dif}		$I_o=1A$, $T_j=25^\circ C$	--	1.1	--	V	
Peak Output Current	$I_o\text{-peak}$	1	$T_j=25^\circ C$	--	2.1	--	A	
Output Voltage Temperature Coefficient	$\Delta V_o/T_a$	1	$I_o=5mA$, $T_j=0$ to $125^\circ C$	--	-0.9	--	mV/ $^\circ C$	

Note: The specified condition $T_j=25^\circ C$ means that the test should be carried out with the test time so short (within 10mS), that the drift in characteristic value due to the rise in chip junction temperature can be ignored.

• TS7918 ELECTRICAL CHARACTERISTICS

($V_{in}=-27V$, $I_{out}=500mA$, $C_{in}=2\mu F$, $C_{out}=1\mu F$; $T_j=0^\circ C$ to $125^\circ C$, unless otherwise specified.)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN.	TYP	MAX.	UNIT	
Output Voltage	V_o	1	$T_j=25^\circ C$	17.64	-18	18.36	V	
Output Voltage Tolerance	V_o	1	$V_i=-21$ to $-33V$, $I_o=5mA$ to $1A$, $P_D<15W$	-17.54	--	-18.46	V	
Line Regulation	REGline	1	$T_j=25^\circ C$	$V_i=-21$ to $-33V$	--	15	360	mV
				$V_i=-24$ to $-30V$	--	5	180	mV
Load Regulation	REGload	1	$T_j=25^\circ C$	$I_o=5mA$ to $1.5A$	--	12	360	mV
				$I_o=250mA$ to $750mA$	--	4	180	mV
Quiescent Current	I_q	3	$T_j=25^\circ C$	--	2.5	5	mA	
Quiescent Current Change	ΔI_q	3	$V_i=-21$ to $-33V$, $T_j=25^\circ C$	--	--	1	mA	
			$I_o=5mA$ to $1.5A$, $T_j=25^\circ C$	--	--	0.5	mA	
Output Noise Voltage	V_n	1	$f=10Hz$ to $100KHz$, $T_a=25^\circ C$	--	110	--	μV	
Ripple Rejection Ratio	RR	2	$V_i=-22$ to $-32V$, $I_o=100mA$, $f=120Hz$	53	68	--	dB	
Min. I/O Voltage Difference	V_{dif}		$I_o=1A$, $T_j=25^\circ C$	--	1.1	--	V	
Peak Output Current	$I_o\text{-peak}$	1	$T_j=25^\circ C$	--	2.1	--	A	
Output Voltage Temperature Coefficient	$\Delta V_o/T_a$	1	$I_o=5mA$, $T_j=0$ to $125^\circ C$	--	-1	--	mV/ $^\circ C$	

Note: The specified condition $T_j=25^\circ C$ means that the test should be carried out with the test time so short (within 10mS), that the drift in characteristic value due to the rise in chip junction temperature can be ignored.

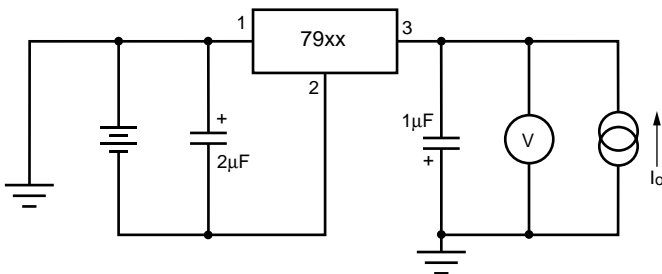
• TS7924 ELECTRICAL CHARACTERISTICS

($V_{in}=-33V$, $I_{out}=500mA$, $C_{in}=2\mu F$, $C_{out}=1\mu F$; $T_j=0^\circ C$ to $125^\circ C$, unless otherwise specified.)

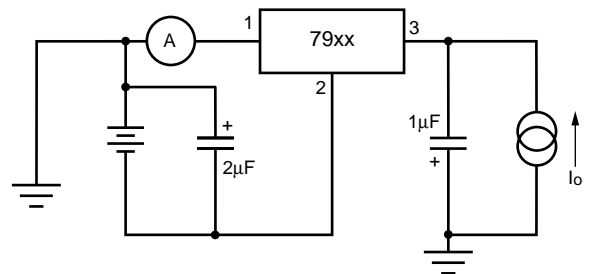
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	CONDITION	MIN.	TYP	MAX.	UNIT	
Output Voltage	V_o	1	$T_j=25^\circ C$	-23.52	-24	-24.48	V	
Output Voltage Tolerance	V_o	1	$V_i=-27$ to $-38V$, $I_o=5mA$ to $1A$, $P_D<15W$	-23.42	--	-24.58	V	
Line Regulation	REG _{line}	1	$T_j=25^\circ C$	$V_i=-27$ to $-38V$	--	18	480	mV
				$V_i=-30$ to $-36V$	--	6	240	mV
Load Regulation	REG _{load}	1	$T_j=25^\circ C$	$I_o=5mA$ to $1.5A$	--	12	480	mV
				$I_o=250mA$ to $750mA$	--	4	240	mV
Quiescent Current	I_q	3	$T_j=25^\circ C$	--	3	5	mA	
Quiescent Current Change	ΔI_q	3	$V_i=-27$ to $-38V$, $T_j=25^\circ C$	--	--	1	mA	
			$I_o=5mA$ to $1.5A$, $T_j=25^\circ C$	--	--	0.5	mA	
Output Noise Voltage	V_n	1	$f=10Hz$ to $100KHz$, $T_a=25^\circ C$	--	170	--	μV	
Ripple Rejection Ratio	RR	2	$V_i=-28$ to $-38V$, $I_o=100mA$, $f=120Hz$	50	65	--	dB	
Min. I/O Voltage Difference	V_{dif}		$I_o=1A$, $T_j=25^\circ C$	--	1.1	--	V	
Peak Output Current	I_o -peak	1	$T_j=25^\circ C$	--	2.1	--	A	
Output Voltage Temperature Coefficient	$\Delta V_o/T_a$	1	$I_o=5mA$, $T_j=0$ to $125^\circ C$	--	-1	--	mV/ $^\circ C$	

Note: The specified condition $T_j=25^\circ C$ means that the test should be carried out with the test time so short (within 10mS), that the drift in characteristic value due to the rise in chip junction temperature can be ignored.

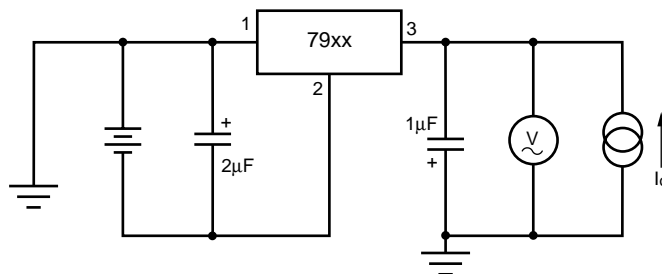
Test Circuit 1



Test Circuit 2



Test Circuit 3





TS7900

3-Terminal Negative Output Voltage Regulators

Ratings and

Characteristic Curves ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Fig. 1 – Power Dissipation vs. Ambient Temperature

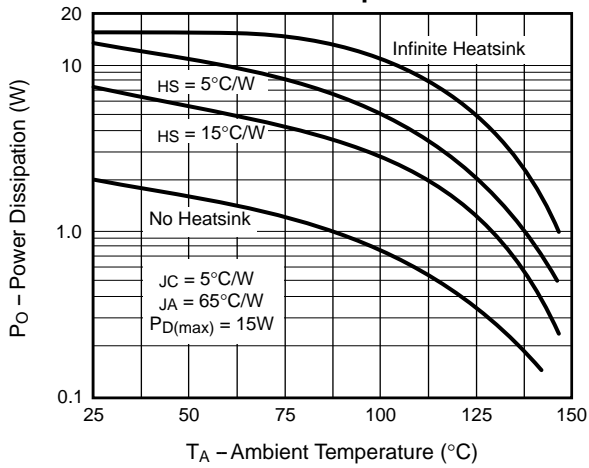


Fig. 2 – Quiescent Current

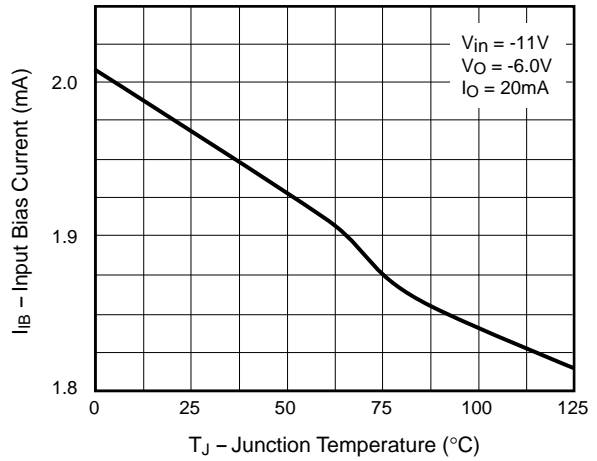


Fig. 3 – Peak Output Current

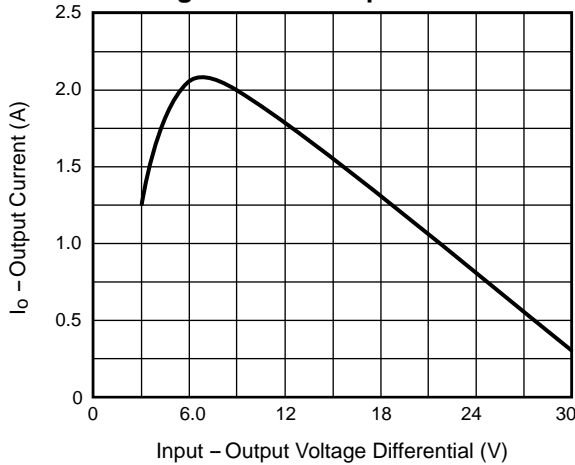


Fig. 4 – Ripple Rejection Ratio vs. Frequency

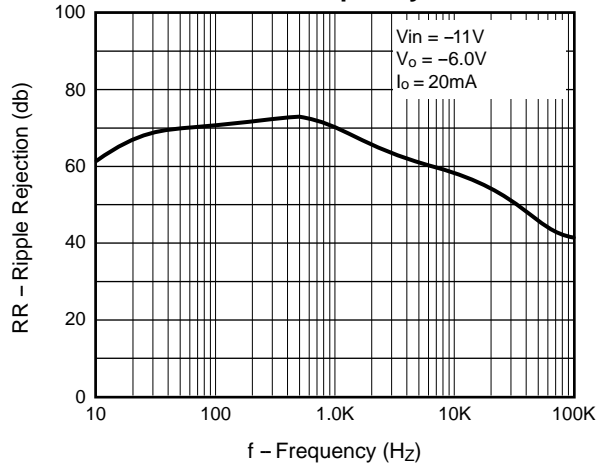


Fig. 5 – Ripple Rejection vs. Output Voltage

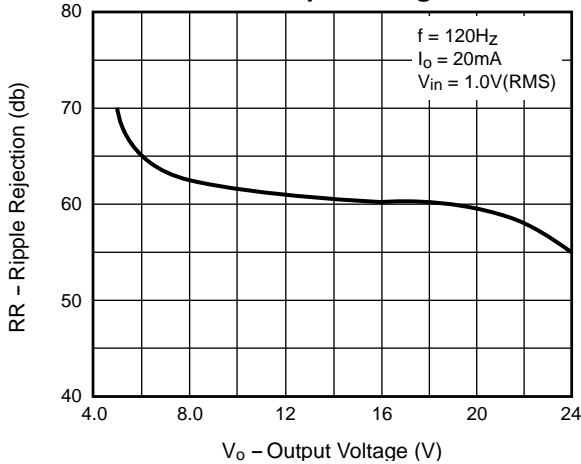
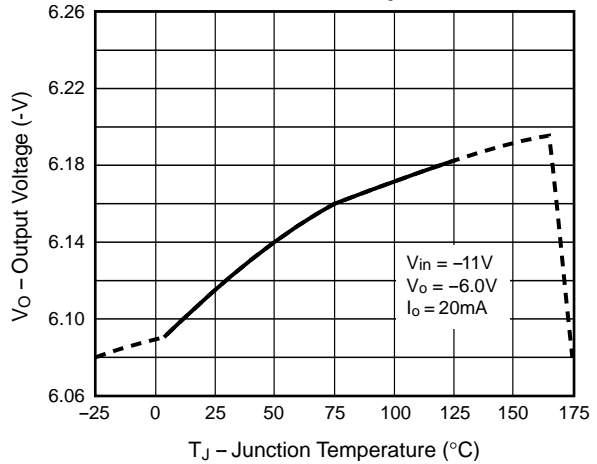
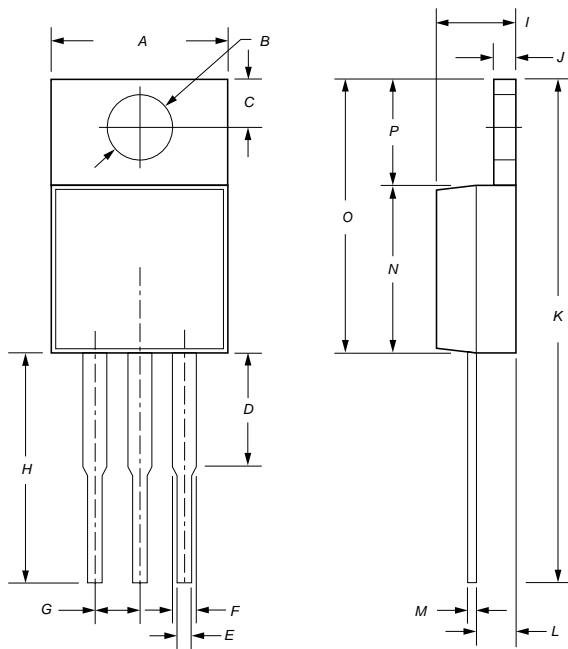


Fig. 6 – Output Voltage vs. Junction Temperature

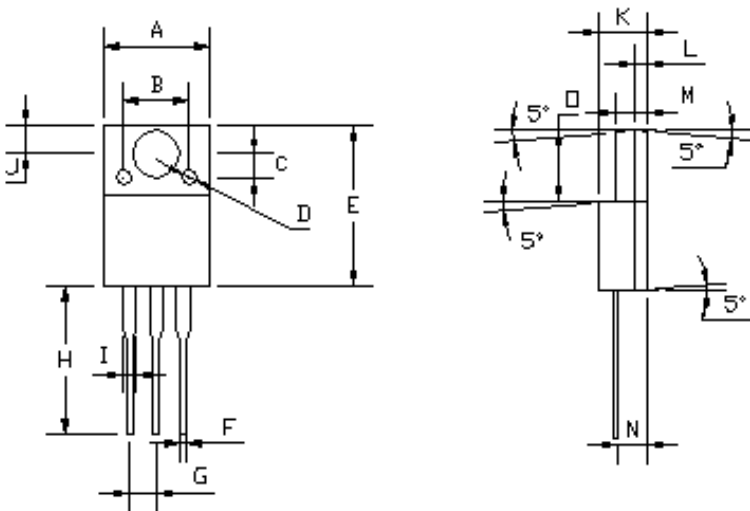


TO-220 Mechanical drawing



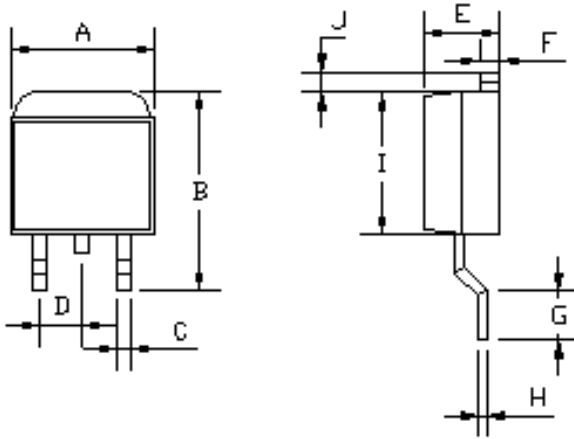
TO-220 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.00	10.50	0.394	0.413
B	3.24	4.44	0.128	0.175
C	2.44	2.94	0.096	0.116
D	3.565	4.315	0.140	0.170
E	0.68	0.92	0.027	0.036
F	1.115	1.485	0.044	0.058
G	2.345	2.715	0.092	0.107
H	13.49	14.31	0.531	0.563
I	4.475	5.225	0.176	0.206
J	1.15	1.39	0.045	0.055
K	27.78	29.62	1.094	1.166
L	2.175	2.925	0.086	0.115
M	0.297	0.477	0.012	0.019
N	8.28	8.80	0.326	0.346
O	14.29	15.31	0.563	0.603
P	6.01	6.51	0.237	0.256

TO-220F Mechanical drawing



TO-220F DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.9	10.1	0.390	0.398
B	6.2	6.2	0.244	0.244
C	2.2	2.2	0.087	0.087
D	1.4	1.4	0.055	0.055
E	15.0	15.2	0.591	0.598
F	0.48	0.72	0.019	0.028
G	2.355	2.725	0.093	0.107
H	13.49	14.31	0.531	0.563
I	1.115	1.485	0.044	0.058
J	2.6	2.8	0.102	0.110
K	4.4	4.6	0.173	0.181
L	1.115	1.15	0.045	0.045
M	2.95	3.15	0.116	0.124
N	2.6	2.8	0.102	0.110
O	6.55	6.65	0.258	0.262

TO-252 Mechanical drawing



TO-252 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.45	6.55	0.254	0.258
B	9.74	10.7	0.383	0.421
C	0.55	0.65	0.022	0.026
D	2.25	2.35	0.089	0.093
E	1.80	2.80	0.071	0.110
F	0.45	0.56	0.018	0.022
G	0.95	1.45	0.037	0.057
H	0.40	0.60	0.016	0.024
I	5.32	5.57	0.209	0.219
J	1.52	2.03	0.06	0.080