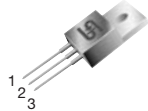




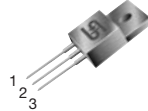
TS7900

3-Terminal Negative Output Voltage Regulators

TO-220



TO-220F



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

Voltage Range
-5 to -24 Volts
Current
1 Ampere

Features

- ✧ Output Current up to 1 Ampere
- ✧ No External Components Required
- ✧ Internal Thermal Overload Protection
- ✧ Internal Short-Circuit Current Limiting
- ✧ Output Transistor Safe-Area Compensation
- ✧ Available in 4% Voltage Tolerance

Ordering Informations

Device	Operating Temperature (Ambient)	Package
TS79xxCZ	-20°C ~ +85°C	TO-220
TS79xxCI		TO-220F

Maximum Ratings (Ta=25°C)

Rating	Symbol	TS7900 Series	Unit
Input Voltage	Vin *1	-35	V
Input Voltage	Vin *2	-40	V
Power Dissipation TO-220 TO-220F	P _D	15 10	W
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

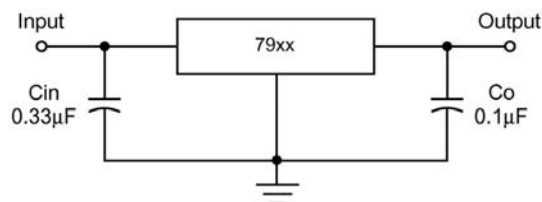
Note: *1: TS7905 to TS7918
*2: TS7924

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

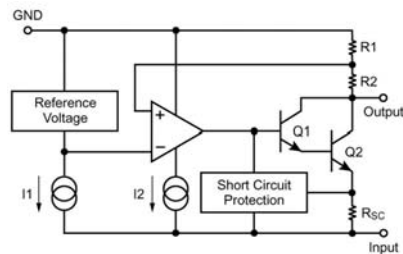
Standard Application

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.
Cin is required if regulator is located an appreciable distance from power supply filter. Co improves stability and transient response.



Internal Block Diagram



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TS7905 Electrical Characteristics

($V_{in} = -10V$, $I_{out} = 500mA$, $C_{in} = 2\mu F$, $C_{out} = 1\mu F$; $T_j = 0^\circ C$ to $125^\circ C$, unless otherwise specified.)

Characteristic	Symbol	Test Circuit	Condition	Min	Typ	Max	Unit
Output Voltage	V_o	1	$T_j = 25^\circ C$	-4.80	-5.0	-5.20	V
Output Voltage Tolerance	V_o	1	$V_i = -7$ to $-20V$, $I_o = 5mA$ to $1A$, $P_D < 15W$	-4.75	-5.0	-5.25	V
Line Regulation	REGline	1	$T_j = 25^\circ C$, $V_i = -7$ to $-25V$	--	3	100	mV
			$V_i = -8$ to $-12V$	--	1	50	mV
Load Regulation	REGload	1	$T_j = 25^\circ C$, $I_o = 5mA$ to $1.5A$	--	10	100	mV
			$I_o = 250mA$ to $750mA$	--	3	50	mV
Quiescent Current	I_q	3	$T_j = 25^\circ C$	--	2	4	mA
Quiescent Current Change	ΔI_q	3	$V_{in} = -7$ to $-25V$	--	--	1.3	mA
			$I_o = 5mA$ to $1.5A$	--	--	0.5	mA
Output Noise Voltage	V_n	1	$f = 10Hz$ to $100KHz$, $T_a = 25^\circ C$	--	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}		$I_o = 1A$, $T_j = 25^\circ C$	--	1.1	--	V
Peak Output Current	I_{o-peak}	1	$T_j = 25^\circ C$	--	2.1	--	A
Output Voltage Temperature Coefficient	$\Delta V_o / \Delta T_a$	1	$I_o = 5mA$, $T_j = 0$ to $125^\circ C$	--	-0.4	--	mV/ $^\circ C$

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	$T_j = 25^\circ C$	-5.75	-6.0	-6.25	V
Output Voltage Tolerance	V_o	1	$V_i = -8$ to $-21V$, $I_o = 5mA$ to $1A$, $P_D < 15W$	-5.70	-6.0	-6.30	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 $1.5A$, $T_j = 25^\circ C$	--	--	0.5	mA
Output Noise Voltage	V_n	1	$f = 10Hz$ to $100KHz$, $T_a = 25^\circ C$	--	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	$\Delta V_o / \Delta T_a$	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.

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TS7908 Electrical Characteristics

(Vin = -14V, Iout = 500mA, Cin = 2μF, Cout = 1μF; Tj = 0°C to 125°C, unless otherwise specified.)

Characteristic	Symbol	Test Circuit	Condition	Min	Typ	Max	Unit
Output Voltage	Vo	1	Tj=25°C	-7.69	-8.0	-8.32	V
Output Voltage Tolerance	Vo	1	Vi=-10.5 to -23V, Io=5mA to 1A, PD<15W	-7.61	-8.0	-8.40	V
Line Regulation	REGline	1	Tj=25°C	Vi=-10.5 to -25V	--	6	160 mV
				Vi=-11 to -17V	--	2	80 mV
Load Regulation	REGload	1	Tj=25°C	Io=5mA to 1.5A	--	12	160 mV
				Io=250mA to 750mA	--	4	80 mV
Quiescent Current	Iq	3	Tj=25°C	--	2	4	mA
Quiescent Current Change	OIq	3	Vi=-10.5 to -25V, Tj=25°C	--	--	1	mA
			Io=5mA to 1.5A	--	--	0.5	mA
Output Noise Voltage	Vn	1	f=10Hz to 100KHz, Ta=25°C	--	52	--	μV
Ripple Rejection Ratio	RR	2	Vi=-11 to -21V, Io=100mA, f=120Hz	56	71	--	dB
Min. I/O Voltage Difference	Vdif		Io=1A, Tj=25°C	--	2	--	V
Peak Output Current	Io-peak	1	Tj=25°C	--	2.1	--	A
Output Voltage Temperature Coefficient	OVo/Ta	1	Io=5mA, Tj=0 to 125°C	--	-0.6	--	mV/°C

TS7909 Electrical Characteristics

(Vin = -15V, Iout = 500mA, Cin = 2μF, Cout = 1μF; Tj = 0°C to 125°C, unless otherwise specified.)

Characteristic	Symbol	Test Circuit	Condition	Min	Typ	Max	Unit
Output Voltage	Vo	1	Tj=25°C	-8.65	-9.0	-9.36	V
Output Voltage Tolerance	Vo	1	Vi=-11.5 to -24V, Io=5mA to 1A, PD<15W	-8.57	-9.0	-9.45	V
Line Regulation	REGline	1	Tj=25°C	Vi=-11.5 to -26V	--	7	180 mV
				Vi=-12 to -18V	--	2	90 mV
Load Regulation	REGload	1	Tj=25°C	Io=5mA to 1.5A	--	12	180 mV
				Io=250mA to 750mA	--	4	90 mV
Quiescent Current	Iq	3	Tj=25°C	--	2.2	4.5	mA
Quiescent Current Change	OIq	3	Vi=-11.5 to -26V, Tj=25°C	--	--	1	mA
			Io=5mA to 1.5A	--	--	0.5	mA
Output Noise Voltage	Vn	1	f=10Hz to 100KHz, Ta=25°C	--	58	--	μV
Ripple Rejection Ratio	RR	2	Vi=-12 to -22V, Io=100mA, f=120Hz	56	71	--	dB
Min. I/O Voltage Difference	Vdif		Io=1A, Tj=25°C	--	1.1	--	V
Peak Output Current	Io-peak	1	Tj=25°C	--	2.1	--	A
Output Voltage Temperature Coefficient	OVo/Ta	1	Io=5mA, Tj=0 to 125°C	--	-0.6	--	mV/°C

Note: The specified condition Tj=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.

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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	$T_j = 25^\circ C$	-11.53	-12	-12.48	V
Output Voltage Tolerance	V_o	1	$V_i = -14.5$ to $-27V$, $I_o = 5mA$ to $1A$, $P_D < 15W$	-11.42	-12	-12.60	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 $-30V$, $T_j = 25^\circ C$	--	--	1	mA
			$I_o = 5mA$ to $1.5A$	--	--	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-peak}	1	$T_j = 25^\circ C$	--	2.1	--	A
Output Voltage Temperature Coefficient	$\Delta V_o / \Delta T_a$	1	$I_o = 5mA$, $T_j = 0$ to $125^\circ C$	--	-0.8	--	mV/ $^\circ C$

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	$T_j = 25^\circ C$	-14.42	-15	-15.60	V
Output Voltage Tolerance	V_o	1	$V_i = -17.5$ to $-30V$, $I_o = 5mA$ to $1A$, $P_D < 15W$	-14.28	-15	-15.75	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 $1.5A$	--	--	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-peak}	1	$T_j = 25^\circ C$	--	2.1	--	A
Output Voltage Temperature Coefficient	$\Delta V_o / \Delta T_a$	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.

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TS7918 Electrical Characteristics

(Vin = -27V, Iout = 500mA, Cin = 2μF, Cout = 1μF; Tj = 0°C to 125°C, unless otherwise specified.)

Characteristic	Symbol	Test Circuit	Condition	Min	Typ	Max	Unit
Output Voltage	Vo	1	Tj=25°C	-17.30	-18	-18.72	V
Output Voltage Tolerance	Vo	1	Vi=-21 to -33V, Io=5mA to 1A, PD<15W	-17.14	-18	-18.90	V
Line Regulation	REGline	1	Tj=25°C	Vi=-21 to -33V	--	15	360 mV
				Vi=-24 to -30V	--	5	180 mV
Load Regulation	REGload	1	Tj=25°C	Io=5mA to 1.5A	--	12	360 mV
				Io=250mA to 750mA	--	4	180 mV
Quiescent Current	Iq	3	Tj=25°C	--	2.5	5	mA
Quiescent current Change	O Iq	3	Vi=-21 to -33V, Tj=25°C	--	--	1	mA
			Io=5mA to 1.5A, Tj=25°C	--	--	0.5	mA
Output Noise Voltage	Vn	1	f=10Hz to 100KHz, Ta=25°C	--	110	--	μV
Ripple Rejection Ratio	RR	2	Vi=-22 to -32V, Io=100mA, f=120Hz	53	68	--	dB
Min. I/O Voltage Difference	Vdif		Io=1A, Tj=25°C	--	1.1	--	V
Peak Output Current	Io-peak	1	Tj=25°C	--	2.1	--	A
Output Voltage Temperature Coefficient	O Vo/Ta	1	Io=5mA, Tj=0 to 125°C	--	-1	--	mV/°C

TS7924 Electrical Characteristics

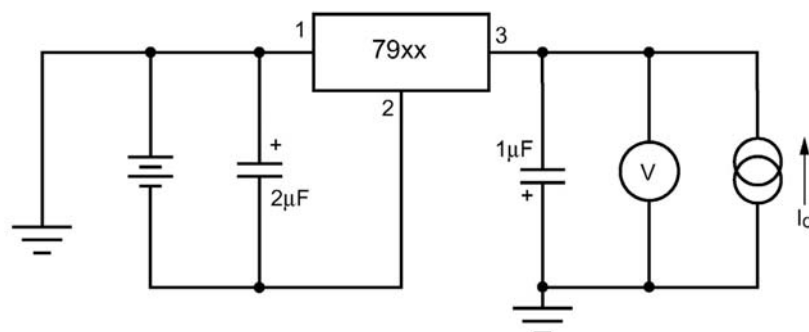
(Vin = -33V, Iout = 500mA, Cin = 2μF, Cout = 1μF; Tj = 0°C to 125°C, unless otherwise specified.)

Characteristic	Symbol	Test Circuit	Condition	Min	Typ	Max	Unit
Output Voltage	Vo	1	Tj=25°C	-23.07	-24	-24.96	V
Output Voltage Tolerance	Vo	1	Vi=-27 to -38V, Io=5mA to 1A, PD<15W	-22.85	-24	-25.20	V
Line Regulation	REGline	1	Tj=25°C	Vi=-27 to -38V	--	18	480 mV
				Vi=-30 to -36V	--	6	240 mV
Load Regulation	REGload	1	Tj=25°C	Io=5mA to 1.5A	--	12	480 mV
				Io=250mA to 750mA	--	4	240 mV
Quiescent Current	Iq	3	Tj=25°C	--	3	5	mA
Quiescent current Change	O Iq	3	Vi=-27 to -38V, Tj=25°C	--	--	1	mA
			Io=5mA to 1.5A, Tj=25°C	--	--	0.5	mA
Output Noise Voltage	Vn	1	f=10Hz to 100KHz, Ta=25°C	--	170	--	μV
Ripple Rejection Ratio	RR	2	Vi=-28 to -38V, Io=100mA, f=120Hz	50	65	--	dB
Min. I/O Voltage Difference	Vdif		Io=1A, Tj=25°C	--	1.1	--	V
Peak Output Current	Io-peak	1	Tj=25°C	--	2.1	--	A
Output Voltage Temperature Coefficient	O Vo/Ta	1	Io=5mA, Tj=0 to 125°C	--	-1	--	mV/°C

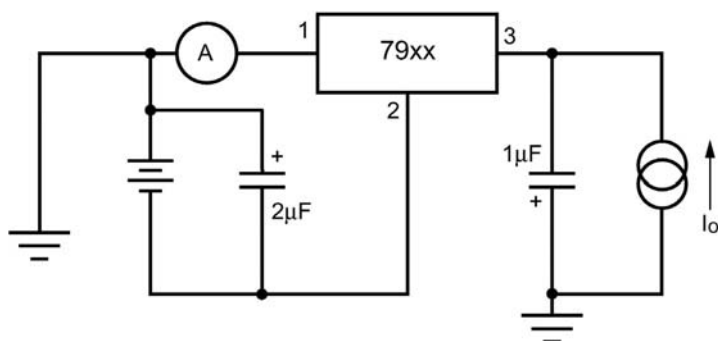
Note: The specified condition Tj=25°C means that the test should be carried out with the test time so short (within 10mS), that the drift in characteristic value due to the rise in chip junction temperature can be ignored.

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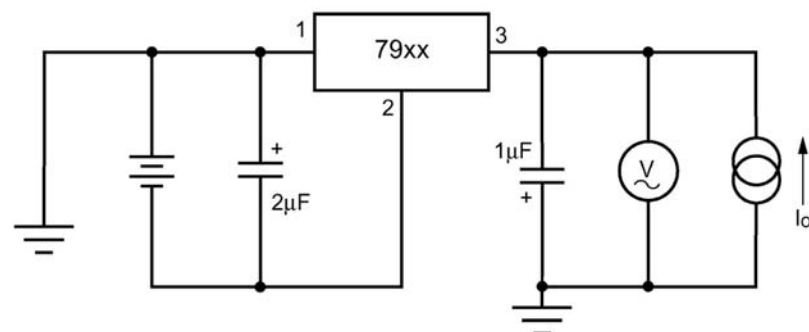
Test Circuit 1



Test Circuit 2



Test Circuit 3





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

FIG. 1 - Power Dissipation vs. Ambient Temperature

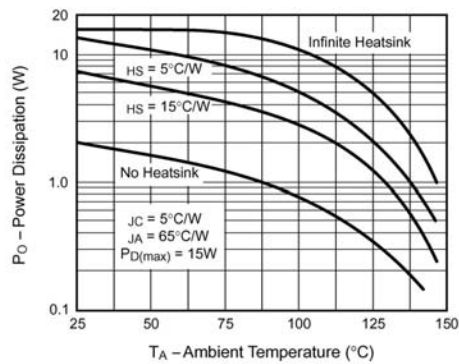


FIG. 2 - Quiescent Current

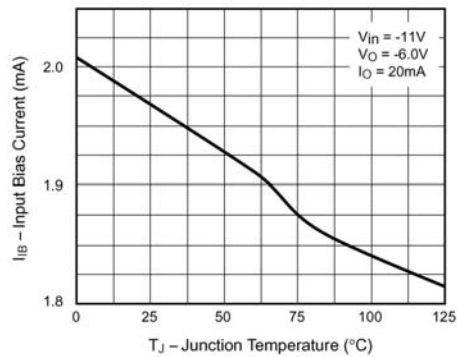


FIG. 3 - Peak Output Current

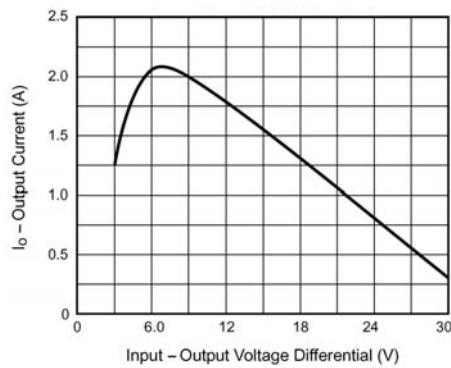


FIG. 4 - Ripple Rejection Ratio vs. Frequency

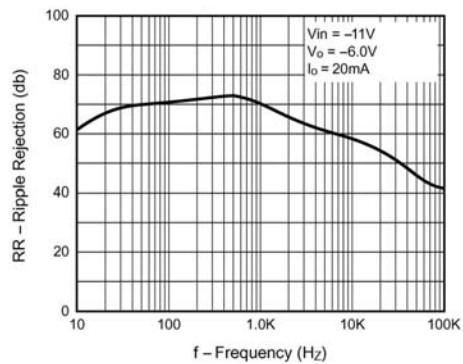


FIG. 5 - Ripple Rejection vs. Output Voltage

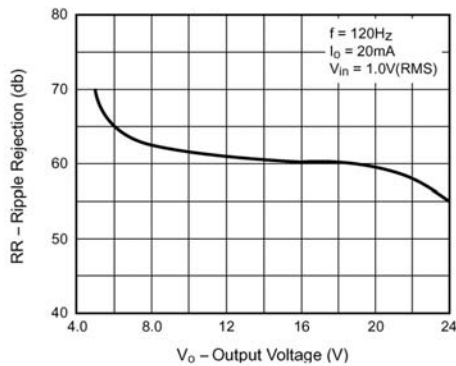
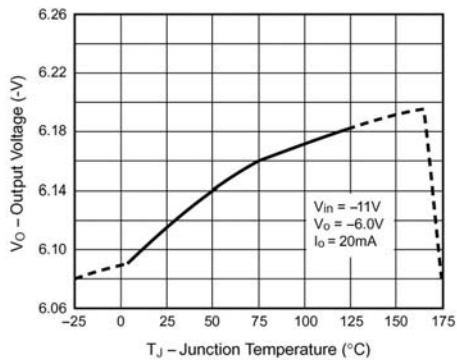


FIG. 6 - Output Voltage vs. Junction Temperature



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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

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