

# LM7800 Series 3-Terminal Fixed Voltage Regulators



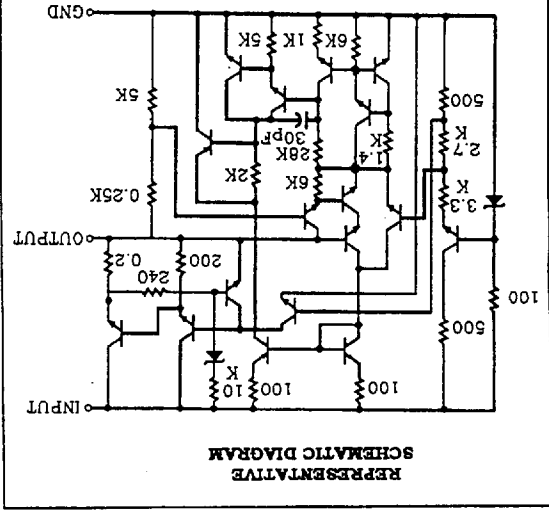
## THREE-TERMINAL POSITIVE VOLTAGE REGULATORS

These voltage regulators are monolithic integrated circuits designed as fixed-voltage regulators for a wide variety of applications including local, on-card regulation. These regulators employ internal current limiting, thermal shutdown, and safe-area

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

## FEATURES

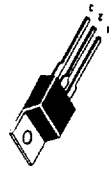
## CIRCUIT SCHEMATIC



REPRESENTATIVE SCHEMATIC DIAGRAM

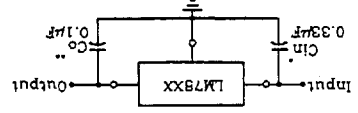
## PIN ARRANGEMENT

Although designed primarily as a fixed voltage regulator, these devices can be used with external components to obtain adjustable voltages and currents. Although designed primarily as a fixed voltage regulator, these devices can be used with external components to obtain adjustable voltages and currents. With adequate heatsinking they can deliver output currents in excess of 1.5 ampere.



- PIN 1. INPUT
  - PIN 2. GROUND
  - PIN 3. OUTPUT
- (Heatsink surface connected to Pin 2.)

## TYPICAL CONNECTING CIRCUIT



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 approximate ripple voltage.



**ABSOLUTE MAXIMUM RATINGS (T<sub>a</sub>=25°C)**

Item	Symbol	LM7800 Series	Unit
Input Voltage	V <sub>in</sub> *	30	V
Input Voltage	V <sub>in</sub> **	40	V
Power Dissipation	P <sub>d</sub> ***	15	W
Operating Ambient Temperature	T <sub>opr</sub>	-20 to +75	°C
Operating Junction Temperature	T <sub>j</sub>	-20 to +125	°C
Storage Temperature	T <sub>stg</sub>	-55 to +125	°C

Note: \*LM7805 to LM7818

\*\* LM7824

\*\*\*Follow the derating curve

**LM7805 ELECTRICAL CHARACTERISTICS**

(V<sub>in</sub>=10V, I<sub>out</sub>=500mA, 0°C ≤ T<sub>j</sub> ≤ 125°C, C<sub>in</sub>=0.33μF, C<sub>out</sub>=0.1μF; unless otherwise specified.)

Item	Symbol	Test Conditions			min.	typ.	max.	unit
Output Voltage	V <sub>out</sub>	7V ≤ V <sub>in</sub> ≤ 20V, 5mA ≤ I <sub>out</sub> ≤ 1.0A, P <sub>s</sub> ≤ 15W		4.85	--	5.15	V	
		T <sub>j</sub> = 25°C		4.90	5.0	5.10	V	
Line Regulation	REG <sub>line</sub>	T <sub>j</sub> = 25°C	7V ≤ V <sub>in</sub> ≤ 25V	--	3	100	mV	
			8V ≤ V <sub>in</sub> ≤ 12V	--	1	50	mV	
			5mA ≤ I <sub>out</sub> ≤ 1.5A	--	15	100	mV	
Load Regulation	REG <sub>load</sub>	T <sub>j</sub> = 25°C	250mA ≤ I <sub>out</sub> ≤ 750mA	--	5	50	mV	
			I <sub>out</sub> = 0	--	4.2	8.0	mV	
Quiescent Current	I <sub>q</sub>	T <sub>j</sub> = 25°C, I <sub>out</sub> = 0	7V ≤ V <sub>in</sub> ≤ 25V	--	--	1.3	mA	
			5mA ≤ I <sub>out</sub> ≤ 1.0A	--	--	0.5	mA	
Quiescent Current Change	Δ I <sub>q</sub>				--	--	40	μV
Output Noise Voltage	V <sub>n</sub>	T <sub>a</sub> = 25°C, 10Hz ≤ f ≤ 100KHz			--	62	78	dB
Ripple Rejection Ratio	RR	f = 120Hz			--	62	78	dB
Voltage Drop	V <sub>drop</sub>	I <sub>out</sub> = 1.0A, T <sub>j</sub> = 25°C			--	2.0	--	V
Output Resistance	R <sub>out</sub>	f = 1KHz			--	17	--	mΩ
Output Short Circuit Current	I <sub>os</sub>	T <sub>j</sub> = 25°C			--	750	--	mA
Peak Output Current	I <sub>o peak</sub>	T <sub>j</sub> = 25°C			--	2.2	--	A
Temperature Coefficient of Output Voltage	Δ V <sub>out</sub> / Δ T <sub>j</sub>	I <sub>out</sub> = 5mA, 0°C ≤ T <sub>j</sub> ≤ 125°C			--	-1.1	--	mV/°C

**LM7800 Series 3-Terminal Fixed Voltage Regulators**



**LM7806 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.)

Item	Symbol	Test Conditions			unit
		min.	typ.	max.	
Output Voltage	$V_{out}$	$8V \leq V_{in} \leq 21V$ , $5mA \leq I_{out} \leq 1.0A$ , $P_{D} \leq 15W$	5.83	--	6.17
		$T_J=25^\circ C$	5.88	6.0	6.12
Line Regulation	$\Delta$ REGline	$T_J=25^\circ C$	--	1.5	60
		$8V \leq V_{in} \leq 25V$	--	5	120
Load Regulation	$\Delta$ REGload	$T_J=25^\circ C$	--	4.0	60
		$250mA \leq I_{out} \leq 750mA$	--	4.3	8.0
Quiescent Current	$I_q$	$T_J=25^\circ C$ , $I_{out}=0$	--	4.3	8.0
		$8V \leq V_{in} \leq 25V$	--	--	1.3
Quiescent Current Change	$\Delta I_q$	$5mA \leq I_{out} \leq 1.0A$	--	--	0.5
		$T_a=25^\circ C$ , $10Hz \leq f \leq 100KHz$	--	45	--
Output Noise Voltage	$V_n$	$T_a=25^\circ C$ , $10Hz \leq f \leq 100KHz$	--	45	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$	59	75	dB
Voltage Drop	$V_{drop}$	$I_{out}=1.0A$ , $T_J=25^\circ C$	--	2.0	V
Output Resistance	$R_{out}$	$f=1KHz$	--	19	m $\Omega$
Output Short Circuit Current	$I_{os}$	$T_J=25^\circ C$	--	550	mA
Peak Output Current	$I_{o peak}$	$T_J=25^\circ C$	--	2.2	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_J$	$I_{out}=5mA$ , $0^\circ C \leq T_J \leq 125^\circ C$	--	-0.8	mV/ $^\circ C$

**LM7808 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.)

Item	Symbol	Test Conditions			unit
		min.	typ.	max.	
Output Voltage	$V_{out}$	$10.5V \leq V_{in} \leq 23V$ , $5mA \leq I_{out} \leq 1.0A$ , $P_{D} \leq 15W$	7.74	--	8.26
		$T_J=25^\circ C$	7.84	8.0	8.16
Line Regulation	$\Delta$ REGline	$T_J=25^\circ C$	--	2.0	80
		$10.5V \leq V_{in} \leq 25V$	--	6	160
Load Regulation	$\Delta$ REGload	$T_J=25^\circ C$	--	4	80
		$250mA \leq I_{out} \leq 750mA$	--	4.3	8.0
Quiescent Current	$I_q$	$T_J=25^\circ C$ , $I_{out}=0$	--	4.3	8.0
		$10.5V \leq V_{in} \leq 25V$	--	--	1.0
Quiescent Current Change	$\Delta I_q$	$5mA \leq I_{out} \leq 1.0A$	--	--	0.5
		$T_a=25^\circ C$ , $10Hz \leq f \leq 100KHz$	--	52	--
Output Noise Voltage	$V_n$	$T_a=25^\circ C$ , $10Hz \leq f \leq 100KHz$	--	52	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$	56	72	dB
Voltage Drop	$V_{drop}$	$I_{out}=1.0A$ , $T_J=25^\circ C$	--	2.0	V
Output Resistance	$R_{out}$	$f=1KHz$	--	16	m $\Omega$

LM7800 Series 3-Terminal Fixed Voltage Regulators



LM7809 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.)

Item	Symbol	Test Conditions	min.	typ.	max.	unit
Output Voltage	$V_{out}$	$10.5V \leq V_{in} \leq 27V$ , $5mA \leq I_{out} \leq 1.0A$ , $P_p \leq 15W$	8.77	--	9.23	V
Line Regulation	$\Delta$ REGline	$T_j=25^\circ C$ $11.5V \leq V_{in} \leq 30V$ $12V \leq V_{in} \leq 18V$	--	2.0	80	mV
Load Regulation	$\Delta$ REGload	$T_j=25^\circ C$ $5mA \leq I_{out} \leq 1.5A$ $250mA \leq I_{out} \leq 750mA$	--	4	80	mV
Quiescent Current	$I_q$	$T_j=25^\circ C$ , $I_{out}=0$	--	4.3	1.0	mA
Quiescent Current Change	$\Delta I_q$	$5mA \leq I_{out} \leq 1.0A$	--	--	0.5	mA
Output Noise Voltage	$V_n$	$T_a=25^\circ C$ , $10Hz \leq f \leq 100KHz$	--	52	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$	55	72	--	dB
Voltage Drop	$V_{drop}$	$I_{out}=1.0A$ , $T_j=25^\circ C$	--	2.0	--	V
Output Resistance	$R_{out}$	$f=1KHz$	--	16	--	m $\Omega$
Output Short Circuit Current	$I_{os}$	$T_j=25^\circ C$	--	450	--	mA
Peak Output Current	$I_{o peak}$	$T_j=25^\circ C$	--	2.2	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_j$	$I_{out}=5mA$ , $0^\circ C \leq T_j \leq 125^\circ C$	--	-1.8	--	mV/ $^\circ C$

LM7810 ELECTRICAL CHARACTERISTICS

( $V_{in}=16V$ ,  $I_{out}=500mA$ ,  $0^\circ C \leq T_j \leq 125^\circ C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ ; unless otherwise specified.)

Item	Symbol	Test Conditions	min.	typ.	max.	unit
Output Voltage	$V_{out}$	$17.5V \leq V_{in} \leq 30V$ , $5mA \leq I_{out} \leq 1.0A$ , $P_p \leq 15W$	9.75	-	12.25	V
Line Regulation	$\Delta$ REGline	$T_j=25^\circ C$ $10.5V \leq V_{in} \leq 30V$ $13V \leq V_{in} \leq 9V$	--	3.0	120	mV
Load Regulation	$\Delta$ REGload	$T_j=25^\circ C$ $5mA \leq I_{out} \leq 1.5A$ $250mA \leq I_{out} \leq 750mA$	--	4.0	120	mV
Quiescent Current	$I_q$	$T_j=25^\circ C$ , $I_{out}=0$	--	4.3	8.0	mA
Quiescent Current Change	$\Delta I_q$	$14.5V \leq V_{in} \leq 30V$ $5mA \leq I_{out} \leq 1.0A$	--	--	1.0	mA
Output Noise Voltage	$V_n$	$T_a=25^\circ C$ , $10Hz \leq f \leq 100KHz$	--	52	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$	54	72	--	dB
Voltage Drop	$V_{drop}$	$I_{out}=1.0A$ , $T_j=25^\circ C$	--	2.0	--	V

LM7800 Series 3-Terminal Fixed Voltage Regulators



LM7812 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.)

Item	Symbol	Test Conditions			min.	typ.	max.	unit
Output Voltage	$V_{out}$	$14.5V \leq V_{in} \leq 30V$ , $5mA \leq I_{out} \leq 1.0A$ , $P_{Diss} 15W$			11.76	12.0	12.24	V
					11.66	--	12.34	V
Line Regulation	$\Delta$ REG <sub>line</sub>	$T_j=25^\circ C$	$14.5V \leq V_{in} \leq 30V$		--	10	240	mV
			$16V \leq V_{in} \leq 22V$		--	3.0	120	mV
			$5mA \leq I_{out} \leq 1.5A$		--	12	240	mV
Load Regulation	$\Delta$ REG <sub>load</sub>	$T_j=25^\circ C$	$250mA \leq I_{out} \leq 750mA$		--	4.0	120	mV
					--	4.3	8.0	mA
Quiescent Current	$I_q$	$T_j=25^\circ C$ , $I_{out}=0$			--	8.0	1.0	mA
					--	4.3	8.0	mA
Quiescent Current Change	$\Delta I_q$		$5mA \leq I_{out} \leq 1.0A$		--	--	0.5	mA
Output Noise Voltage	$V_n$	$T_a=25^\circ C$ , $10Hz \leq f \leq 100KHz$			--	75	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$			55	71	--	dB
Voltage Drop	$V_{drop}$	$I_{out}=1.0A$ , $T_j=25^\circ C$			--	2.0	--	V
Output Resistance	$R_{out}$	$f=1KHz$			--	18	--	m $\Omega$
Output Short Circuit Current	$I_{os}$	$T_j=25^\circ C$			--	350	--	mA
Peak Output Current	$I_{o peak}$	$T_j=25^\circ C$			--	2.2	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_j$	$I_{out}=5mA$ , $0^\circ C \leq T_j \leq 125^\circ C$			--	-1.0	--	mV/ $^\circ C$

LM7815 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.)

Item	Symbol	Test Conditions			min.	typ.	max.	unit
Output Voltage	$V_{out}$	$17.5V \leq V_{in} \leq 30V$ , $5mA \leq I_{out} \leq 1.0A$ , $P_{Diss} 15W$			14.7	15.0	15.3	V
					14.55	--	15.45	V
Line Regulation	$\Delta$ REG <sub>line</sub>	$T_j=25^\circ C$	$17.5V \leq V_{in} \leq 30V$		--	11	300	mV
			$20V \leq V_{in} \leq 26V$		--	3.0	150	mV
			$5mA \leq I_{out} \leq 1.5A$		--	12	300	mV
Load Regulation	$\Delta$ REG <sub>load</sub>	$T_j=25^\circ C$	$250mA \leq I_{out} \leq 750mA$		--	4	150	mV
					--	4.4	8.0	mA
Quiescent Current	$I_q$	$T_j=25^\circ C$ , $I_{out}=0$			--	8.0	1.0	mA
					--	4.4	8.0	mA
Quiescent Current Change	$\Delta I_q$		$17.5V \leq V_{in} \leq 30V$		--	--	0.5	mA
			$5mA \leq I_{out} \leq 1.0A$		--	--	0.5	mA
Output Noise Voltage	$V_n$	$T_a=25^\circ C$ , $10Hz \leq f \leq 100KHz$			--	90	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$			54	70	--	dB
Voltage Drop	$V_{drop}$	$I_{out}=1.0A$ , $T_j=25^\circ C$			--	2.0	--	V
Output Resistance	$R_{out}$	$f=1KHz$			--	18	--	m $\Omega$
Output Short Circuit Current	$I_{os}$	$T_j=25^\circ C$			--	350	--	mA
Peak Output Current	$I_{o peak}$	$T_j=25^\circ C$			--	2.2	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out}/\Delta T_j$	$I_{out}=5mA$ , $0^\circ C \leq T_j \leq 125^\circ C$			--	-1.0	--	mV/ $^\circ C$

LM7800 Series 3-Terminal Fixed Voltage Regulators



LM7818 ELECTRICAL CHARACTERISTICS

( $V_{in}=27V$ ,  $I_{out}=500mA$ ,  $0^\circ C \leq T_j \leq 125^\circ C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ ; unless otherwise specified.)

Item	Symbol	Test Conditions	min.	typ.	max.	unit
Output Voltage	$V_{out}$	$T_j=25^\circ C$ $21.0V \leq V_{in} \leq 33V$ , $5mA \leq I_{out} \leq 1.0A$ , $P_o \leq 15W$	17.64	18.0	18.36	V
Output Voltage	$V_{out}$	$T_j=25^\circ C$ $21.0V \leq V_{in} \leq 33V$	15	15	360	mV
Line Regulation	$\Delta V_o$ line	$T_j=25^\circ C$ $24V \leq V_{in} \leq 30V$	--	5.0	180	mV
Line Regulation	$\Delta V_o$ line	$T_j=25^\circ C$ $5mA \leq I_{out} \leq 1.5A$	--	12	360	mV
Load Regulation	$\Delta V_o$ load	$T_j=25^\circ C$ $250mA \leq I_{out} \leq 750mA$	--	4.0	180	mV
Quiescent Current	$I_q$	$T_j=25^\circ C$ , $I_{out}=0$	--	4.5	8.0	mA
Quiescent Current Change	$\Delta I_q$	$5mA \leq I_{out} \leq 1.0A$	--	--	0.5	mA
Output Noise Voltage	$V_n$	$T_a=25^\circ C$ , $10Hz \leq f \leq 100KHz$	--	110	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$	53	69	--	dB
Voltage Drop	$V_{drop}$	$I_{out}=1.0A$ , $T_j=25^\circ C$	--	2.0	--	V
Output Resistance	$R_{out}$	$f=1KHz$	--	22	--	m $\Omega$
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	$\Delta V_{out} / \Delta T_j$	$I_{out}=5mA$ , $0^\circ C \leq T_j \leq 125^\circ C$	--	-1.0	--	mV/ $^\circ C$

LM7824 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.)

Item	Symbol	Test Conditions	min.	typ.	max.	unit
Output Voltage	$V_{out}$	$T_j=25^\circ C$ $27.0V \leq V_{in} \leq 38V$ , $5mA \leq I_{out} \leq 1.0A$ , $P_o \leq 15W$	23.32	24.8	24.68	V
Output Voltage	$V_{out}$	$T_j=25^\circ C$ $27.0V \leq V_{in} \leq 38V$	18	18	480	mV
Line Regulation	$\Delta V_o$ line	$T_j=25^\circ C$ $30V \leq V_{in} \leq 36V$	--	6.0	240	mV
Line Regulation	$\Delta V_o$ line	$T_j=25^\circ C$ $5mA \leq I_{out} \leq 1.5A$	--	12	480	mV
Load Regulation	$\Delta V_o$ load	$T_j=25^\circ C$ $250mA \leq I_{out} \leq 750mA$	--	4.0	240	mV
Quiescent Current	$I_q$	$T_j=25^\circ C$ , $I_{out}=0$	--	4.6	8.0	mA
Quiescent Current Change	$\Delta I_q$	$27.0V \leq V_{in} \leq 38V$	--	--	1.0	mA
Quiescent Current Change	$\Delta I_q$	$5mA \leq I_{out} \leq 1.0A$	--	--	0.5	mA
Output Noise Voltage	$V_n$	$T_a=25^\circ C$ , $10Hz \leq f \leq 100KHz$	--	170	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$	50	66	--	dB
Voltage Drop	$V_{drop}$	$I_{out}=1.0A$ , $T_j=25^\circ C$	--	2.0	--	V
Output Resistance	$R_{out}$	$f=1KHz$	--	28	--	m $\Omega$

LM7800 Series 3-Terminal Fixed Voltage Regulators



FIGURE 1 - WORST CASE POWER DISSIPATION versus AMBIENT TEMPERATURE (Case 221A)

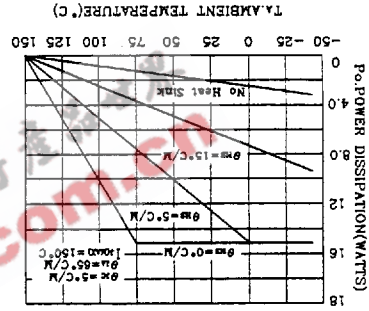


FIGURE 2 - WORST CASE POWER DISSIPATION versus AMBIENT TEMPERATURE (Case 1)

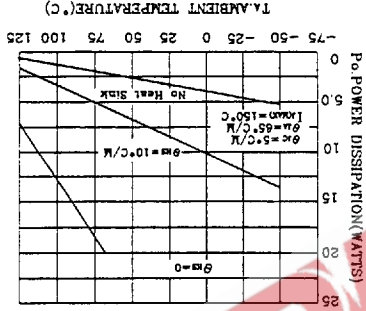


FIGURE 3 - INPUT OUTPUT DIFFERENTIAL AS A FUNCTION OF JUNCTION TEMPERATURE

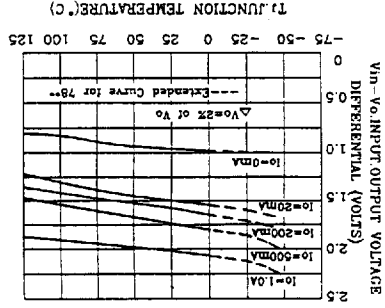


FIGURE 4 - INPUT OUTPUT DIFFERENTIAL AS A FUNCTION OF JUNCTION TEMPERATURE

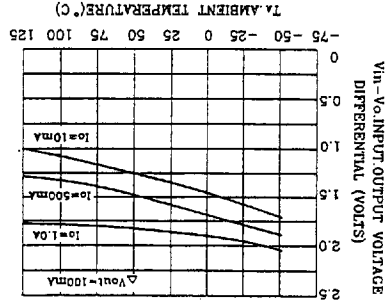


FIGURE 5 - PEAK OUTPUT CURRENT AS A FUNCTION OF INPUT-OUTPUT DIFFERENTIAL VOLTAGE

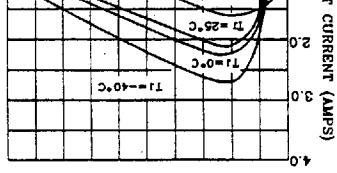
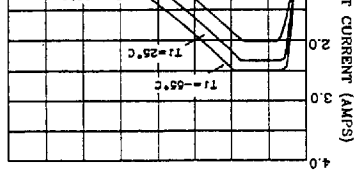
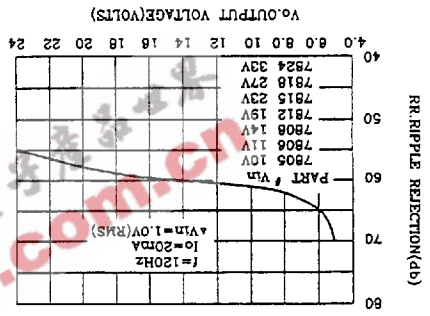


FIGURE 6 - PEAK OUTPUT CURRENT AS A FUNCTION OF INPUT-OUTPUT DIFFERENTIAL VOLTAGE

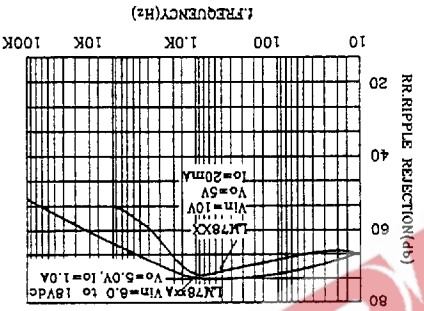




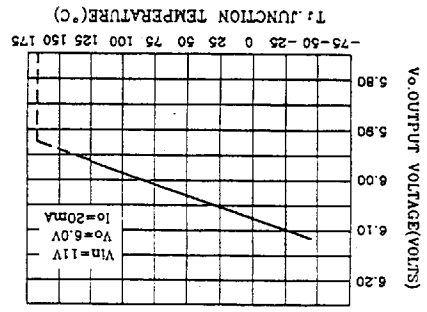
**FIGURE 7 - RIPPLE REJECTION AS A FUNCTION OF OUTPUT VOLTAGE**



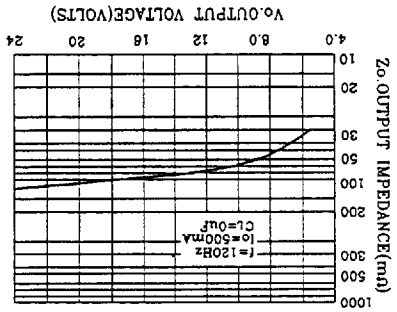
**FIGURE 8 - RIPPLE REJECTION AS A FUNCTION OF FREQUENCY**



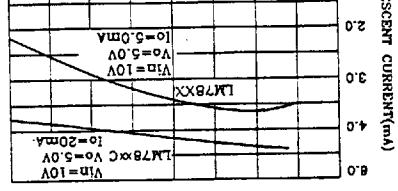
**FIGURE 9 - OUTPUT VOLTAGE AS A FUNCTION OF JUNCTION TEMPERATURE**



**FIGURE 10 - OUTPUT IMPEDANCE AS A FUNCTION OF OUTPUT VOLTAGE**



**FIGURE 11 - QUIESCENT CURRENT AS A FUNCTION OF TEMPERATURE**



**FIGURE 12 - DROPOUT CHARACTERISTICS**

