

Pb Free Plating Product

## TSD78xxE



1 Ampere Surface Mount Positive Three Terminal Voltage Regulators

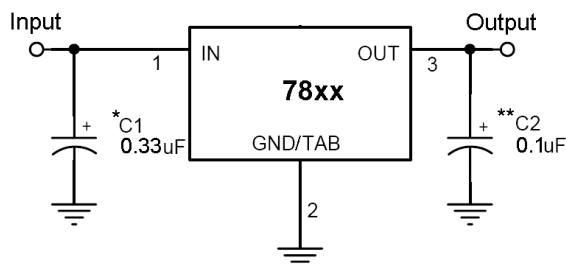
### Features

- 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



DPAK/TO-252

### 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.

\* = C<sub>in</sub> is required if regulator is located an appreciable distance from power supply filter.

\*\* = C<sub>o</sub> is not needed for stability; however, it does improve transient response.

### Absolute Maximum Rating (T<sub>a</sub> = 25°C unless otherwise noted)

Parameter	Symbol	Limit	Unit
Input Voltage	V <sub>IN</sub>	V <sub>OUT</sub> =5~18V	35
		V <sub>OUT</sub> =24V	40
Output Current	I <sub>OUT</sub>	Internal Limited	
Power Dissipation	P <sub>D</sub>	Internal Limited	
Operating Junction Temperature	T <sub>J</sub>	0~+125	°C
Storage Temperature Range	T <sub>STG</sub>	-65~+150	°C
Thermal Resistance - Junction to Case	R <sub>θJC</sub>	TO-220	5
		TO-252	5
Thermal Resistance - Junction to Ambient	R <sub>θJA</sub>	TO-220	50
		TO-252	60

**Note:** Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

## TSD7805E Electrical Characteristics

(Vin=10V, Iout=500mA, 0°C≤Tj≤125°C, Cin=0.33uF, Cout=0.1uF; unless otherwise specified.)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output voltage	Vout	Tj=25°C	4.80	5	5.20	V
		7.5V≤Vin≤20V, 10mA≤Iout≤1A, PD≤15W	4.75	5	5.25	
Line Regulation	REGline	Tj=25°C	--	3	100	mV
		C	7.5V≤Vin≤25V	--	1	
Load Regulation	REGload	Tj=25°C	--	15	100	
		C	10mA≤Iout≤1A 250mA≤Iout≤750mA	--	5	
Quiescent Current	Iq	Iout=0, Tj=25°C	--	4.2	8	mA
Quiescent Current Change	ΔIq	7.5V≤Vin≤25V	--	--	1.3	
		10mA≤Iout≤1A	--	--	0.5	
Output Noise Voltage	Vn	10Hz≤f≤100KHz, Tj=25°C	--	40	--	μV
Ripple Rejection Ratio	RR	f=120Hz, 8V≤Vin≤18V	62	78	--	dB
Voltage Drop	Vdrop	Iout=1.0A, Tj=25°C	--	2	--	V
Output Resistance	Rout	f=1KHz	--	17	--	mΩ
Output Short Circuit Current	Ios	Tj=25°C	--	750	--	mA
Peak Output Current	I <sub>o peak</sub>	Tj=25°C	--	2.2	--	A
Temperature Coefficient of Output Voltage	ΔVout/ΔTj	Iout=10mA, 0°C≤Tj≤125°C	--	-0.6	--	mV/°C

## TSD7806E Electrical Characteristics

(Vin=11V, Iout=500mA, 0°C≤Tj≤125°C, Cin=0.33uF, Cout=0.1uF; unless otherwise specified.)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output Voltage	Vout	Tj=25°C	5.75	6	6.25	V
		8.5V≤Vin≤21V, 10mA≤Iout≤1A, PD≤15W	5.7	6	6.3	
Line Regulation	REGline	Tj=25°C	--	5	120	mV
		C	8.5V≤Vin≤25V	--	1.5	
Load Regulation	REGload	Tj=25°C	--	14	120	
		C	10mA≤Iout≤1A 250mA≤Iout≤750mA	--	4	
Quiescent Current	Iq	Iout=0, Tj=25°C	--	4.3	8	mA
Quiescent Current Change	ΔIq	8.5V≤Vin≤25V	--	--	1.3	
		10mA≤Iout≤1A	--	--	0.5	
Output Noise Voltage	Vn	10Hz≤f≤100KHz, Tj=25°C	--	45	--	uV
Ripple Rejection Ratio	RR	f=120Hz, 9V≤Vin≤19V	59	75	--	dB
Voltage Drop	Vdrop	Iout=1.0A, Tj=25°C	--	2	--	V
Output Resistance	Rout	f=1KHz	--	19	--	mΩ
Output Short Circuit Current	Ios	Tj=25°C	--	550	--	mA
Peak Output Current	I <sub>o peak</sub>	Tj=25°C	--	2.2	--	A
Temperature Coefficient of Output Voltage	ΔVout/ΔTj	Iout=10mA, 0°C≤Tj≤125°C	--	-0.7	--	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.

## TSD7808E 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	Vout	$T_j=25^{\circ}C$	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	REGline	$T_j=25^{\circ}C$	--	6	160	mV
		C	$10.5V \leq V_{in} \leq 25V$	--	2	
Load Regulation	REGload	$T_j=25^{\circ}C$	--	12	160	
		C	$10mA \leq I_{out} \leq 1A$ $250mA \leq I_{out} \leq 750mA$	--	4	
Quiescent Current	Iq	$I_{out}=0$ , $T_j=25^{\circ}C$	--	4.3	8	mA
Quiescent Current Change	$\Delta Iq$	$10.5V \leq V_{in} \leq 25V$	--	--	1	
		$10mA \leq I_{out} \leq 1A$	--	--	0.5	
Output Noise Voltage	Vn	$10Hz \leq f \leq 100KHz$ , $T_j=25^{\circ}C$	--	52	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$ , $11V \leq V_{in} \leq 21V$	56	72	--	dB
Voltage Drop	Vdrop	$I_{out}=1.0A$ , $T_j=25^{\circ}C$	--	2	--	V
Output Resistance	Rout	$f=1KHz$	--	16	--	$m\Omega$
Output Short Circuit Current	Ios	$T_j=25^{\circ}C$	--	450	--	mA
Peak Output Current	I <sub>o peak</sub>	$T_j=25^{\circ}C$	--	2.2	--	A
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out}=10mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-0.8	--	$mV / ^{\circ}C$

## TSD7809E 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	Vout	$T_j=25^{\circ}C$	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	REGline	$T_j=25^{\circ}C$	--	6	180	mV
		C	$11.5V \leq V_{in} \leq 26V$	--	2	
Load Regulation	REGload	$T_j=25^{\circ}C$	--	12	180	
		C	$10mA \leq I_{out} \leq 1A$ $250mA \leq I_{out} \leq 750mA$	--	4	
Quiescent Current	Iq	$I_{out}=0$ , $T_j=25^{\circ}C$	--	4.3	8	mA
Quiescent Current Change	$\Delta Iq$	$11.5V \leq V_{in} \leq 26V$	--	--	1	
		$10mA \leq I_{out} \leq 1A$	--	--	0.5	
Output Noise Voltage	Vn	$10Hz \leq f \leq 100KHz$ , $T_j=25^{\circ}C$	--	52	--	$\mu V$
Ripple Rejection Ratio	RR	$f=120Hz$ , $12V \leq V_{in} \leq 22V$	55	72	--	dB
Voltage Drop	Vdrop	$I_{out}=1.0A$ , $T_j=25^{\circ}C$	--	2	--	V
Output Resistance	Rout	$f=1KHz$	--	16	--	$m\Omega$
Output Short Circuit Current	Ios	$T_j=25^{\circ}C$	--	450	--	mA
Peak Output Current	I <sub>o peak</sub>	$T_j=25^{\circ}C$	--	2.2	--	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.

## TSD7810E 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.)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit	
Output voltage	Vout	$T_j=25^{\circ}C$	9.6	10	10.4	V	
		$12.5V \leq V_{in} \leq 25V$ , $10mA \leq I_{out} \leq 1A$ , $PD \leq 15W$	9.5	10	10.5		
Line Regulation	REGline	$T_j=25^{\circ}C$	$12.5V \leq V_{in} \leq 28V$	--	7	200	mV
			$13V \leq V_{in} \leq 17V$	--	2	100	
Load Regulation	REGload	$T_j=25^{\circ}C$	$10mA \leq I_{out} \leq 1A$	--	12	200	
			$250mA \leq I_{out} \leq 750mA$	--	4	100	
Quiescent Current	Iq	$I_{out}=0$ , $T_j=25^{\circ}C$	--	4.3	8	mA	
Quiescent Current Change	$\Delta Iq$	$12.5V \leq V_{in} \leq 28V$	--	--	1		
		$10mA \leq I_{out} \leq 1A$	--	--	0.5		
Output Noise Voltage	Vn	$10Hz \leq f \leq 100KHz$ , $T_j=25^{\circ}C$	--	70	--	$\mu V$	
Ripple Rejection Ratio	RR	$f=120Hz$ , $13V \leq V_{in} \leq 23V$	55	71	--	dB	
Voltage Drop	Vdrop	$I_{out}=1.0A$ , $T_j=25^{\circ}C$	--	2	--	V	
Output Resistance	Rout	$f=1KHz$	--	18	--	$m\Omega$	
Output Short Circuit Current	Ios	$T_j=25^{\circ}C$	--	400	--	mA	
Peak Output Current	I <sub>o peak</sub>	$T_j=25^{\circ}C$	--	2.2	--	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	--	$mV / ^{\circ}C$	

## TSD7812E 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	Vout	$T_j=25^{\circ}C$	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	REGline	$T_j=25^{\circ}C$	$14.5V \leq V_{in} \leq 30V$	--	10	240	mV
			$15V \leq V_{in} \leq 19V$	--	3	120	
Load Regulation	REGload	$T_j=25^{\circ}C$	$10mA \leq I_{out} \leq 1A$	--	12	240	
			$250mA \leq I_{out} \leq 750mA$	--	4	120	
Quiescent Current	Iq	$T_j=25^{\circ}C$ , $I_{out}=0$	--	4.3	8	mA	
Quiescent Current Change	$\Delta Iq$	$14.5V \leq V_{in} \leq 30V$	--	--	1		
		$10mA \leq I_{out} \leq 1A$	--	--	0.5		
Output Noise Voltage	Vn	$10Hz \leq f \leq 100KHz$ , $T_j=25^{\circ}C$	--	75	--	$\mu V$	
Ripple Rejection Ratio	RR	$f=120Hz$ , $15V \leq V_{in} \leq 25V$	55	71	--	dB	
Voltage Drop	Vdrop	$I_{out}=1.0A$ , $T_j=25^{\circ}C$	--	2	--	V	
Output Resistance	Rout	$f=1KHz$	--	18	--	$m\Omega$	
Output Short Circuit Current	Ios	$T_j=25^{\circ}C$	--	350	--	mA	
Peak Output Current	I <sub>o peak</sub>	$T_j=25^{\circ}C$	--	2.2	--	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	--	$mV / ^{\circ}C$	

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- This specification applies only for DC power dissipation permitted by absolute maximum ratings.

## TSD7815E 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	REGline	$T_j=25^{\circ}C$	$17.5V \leq V_{in} \leq 30V$	--	12	300	mV
			$18V \leq V_{in} \leq 22V$	--	3	150	
Load Regulation	REGload	$T_j=25^{\circ}C$	$10mA \leq I_{out} \leq 1A$	--	12	300	
			$250mA \leq I_{out} \leq 750mA$	--	4	150	
Quiescent Current	$I_q$	$T_j=25^{\circ}C$ , $I_{out}=0$	--	4.3	8	mA	
Quiescent Current Change	$\Delta I_q$	$17.5V \leq V_{in} \leq 30V$	--	--	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	--	$\mu V$	
Ripple Rejection Ratio	RR	$f=120Hz$ , $18V \leq V_{in} \leq 28V$	54	70	--	dB	
Voltage Drop	$V_{drop}$	$I_{out}=1.0A$ , $T_j=25^{\circ}C$	--	2	--	V	
Output Resistance	$R_{out}$	$f=1KHz$	--	19	--	$m\Omega$	
Output Short Circuit Current	$I_{os}$	$T_j=25^{\circ}C$	--	230	--	mA	
Peak Output Current	$I_{o peak}$	$T_j=25^{\circ}C$	--	2.2	--	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	--	$mV / ^{\circ}C$	

## TSD7818E 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	REGline	$T_j=25^{\circ}C$	$21V \leq V_{in} \leq 33V$	--	15	360	mV
			$22V \leq V_{in} \leq 26V$	--	5	180	
Load Regulation	REGload	$T_j=25^{\circ}C$	$10mA \leq I_{out} \leq 1A$	--	12	360	
			$250mA \leq I_{out} \leq 750mA$	--	4	180	
Quiescent Current	$I_q$	$T_j=25^{\circ}C$ , $I_{out}=0$	--	4.5	8	mA	
Quiescent Current Change	$\Delta I_q$	$21V \leq V_{in} \leq 33V$	--	--	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	--	$\mu V$	
Ripple Rejection Ratio	RR	$f=120Hz$ , $21V \leq V_{in} \leq 31V$	54	70	--	dB	
Voltage Drop	$V_{drop}$	$I_{out}=1.0A$ , $T_j=25^{\circ}C$	--	2	--	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	$I_{o peak}$	$T_j=25^{\circ}C$	--	2.2	--	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	--	$mV / ^{\circ}C$	

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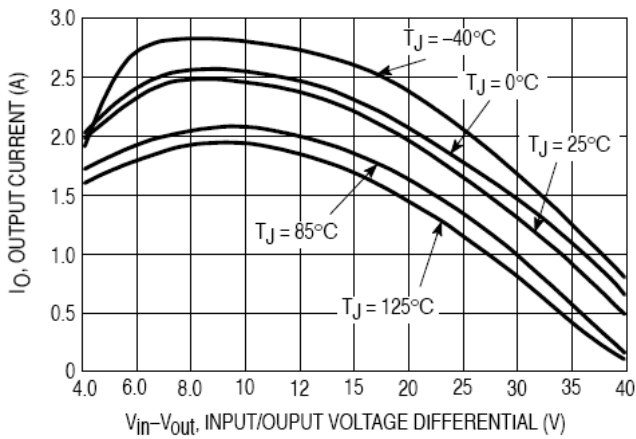
## TSD7824E Electrical Characteristics

$V_{in}=33V$ ,  $I_{out}=500mA$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ ; unless otherwise specified.)

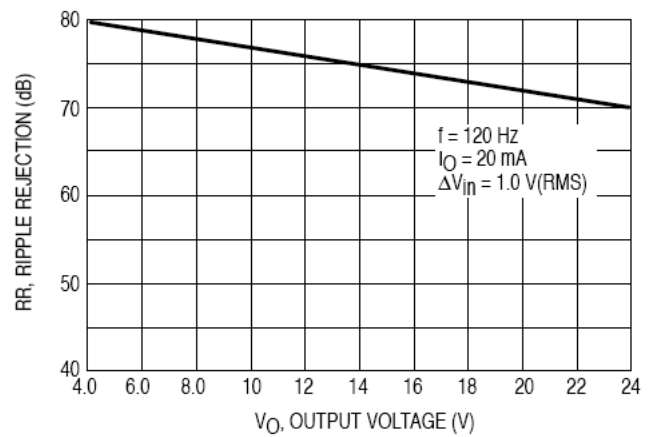
Parameter	Symbol	Test Condition	Min	Typ	Max	Unit	
Output voltage	$V_{out}$	$T_j=25^{\circ}C$	23.07	24	24.96	V	
		$27V \leq V_{in} \leq 38V$ , $10mA \leq I_{out} \leq 1A$ , $PD \leq 15W$	22.85	24	25.20		
Line Regulation	REG <sub>line</sub>	$T_j=25^{\circ}C$	$27V \leq V_{in} \leq 38V$	--	18	480	mV
			$28V \leq V_{in} \leq 32V$	--	6	240	
Load Regulation	REG <sub>load</sub>	$T_j=25^{\circ}C$	$10mA \leq I_{out} \leq 1A$	--	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	$\Delta I_q$	$27V \leq V_{in} \leq 38V$	--	--	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	--	$\mu V$	
Ripple Rejection Ratio	RR	$f=120Hz$ , $27V \leq V_{in} \leq 37V$	54	70	--	dB	
Voltage Drop	$V_{drop}$	$I_{out}=1.0A$ , $T_j=25^{\circ}C$	--	2	--	V	
Output Resistance	$R_{out}$	$f=1KHz$	--	28	--	$m\Omega$	
Output Short Circuit Current	$I_{os}$	$T_j=25^{\circ}C$	--	150	--	mA	
Peak Output Current	$I_{o peak}$	$T_j=25^{\circ}C$	--	2.2	--	A	
Temperature Coefficient of Output Voltage	$\Delta V_{out} / \Delta T_j$	$I_{out}=10mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$	--	-1.5	--	$mV / ^{\circ}C$	

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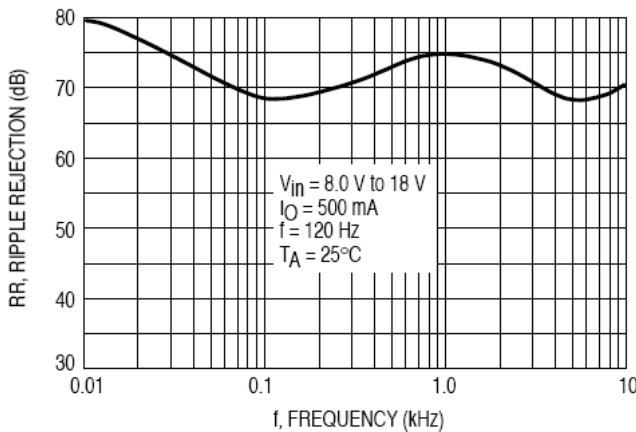
## Electrical Characteristics Curve



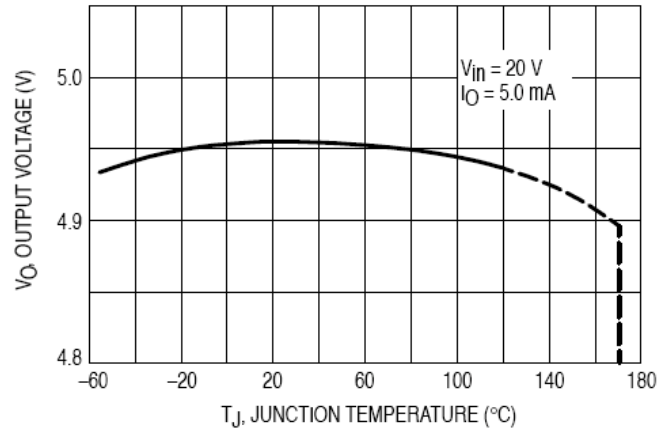
**Figure 1. Peak Output Current as a Function of Input-Output Differential Voltage**



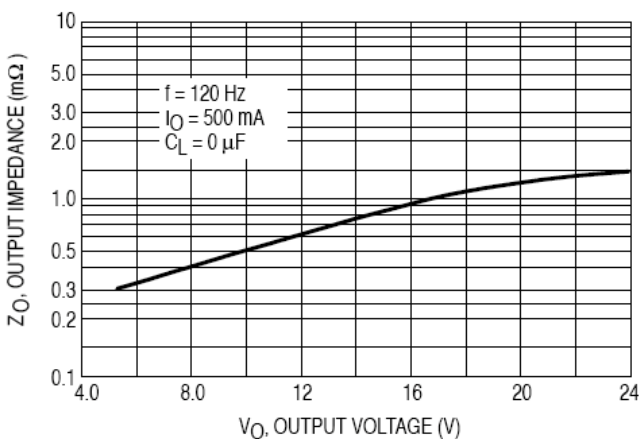
**Figure 2. Ripple Rejection as a Function of Output Voltage**



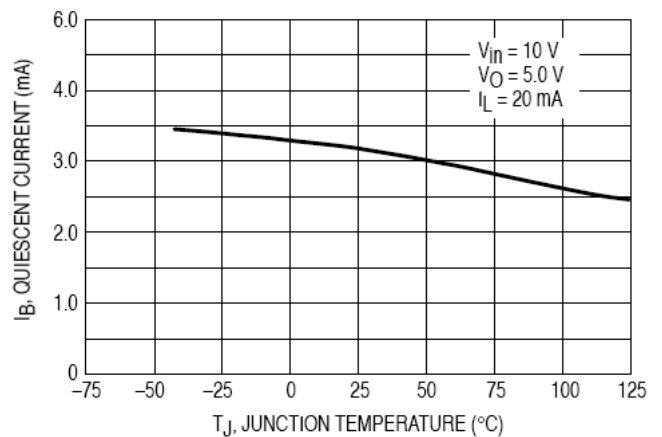
**Figure 3. Ripple Rejection as a Function of Frequency**



**Figure 4. Output Voltage as a Function of Junction Temperature**



**Figure 5. Output Impedance as a Function of Output Voltage**



**Figure 6. Quiescent Current as a Function of Temperature**