

1 AMP, 3-TERMINAL POSITIVE REGULATORS

IP140A, IP140, LM140, IP7800A Series, IP7800 Series

DESCRIPTION

The IP140A/ LM140/ IP7800A/ IP7800 series of three-terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. The A-suffix devices are fully specified at 1.0A, provide 0.01%/V line regulation, 0.3%/A load regulation, and $\pm 1\%$ output voltage tolerance at room temperature. Protection features include safe operating area current limiting and thermal shutdown. The entire series of regulators is available in the metal TO-3 and TO-66 power packages. The IP140A/ LM140/ IP7800A/IP7800 series is now available in a new TO-257 (Hermetic TO-220 style) power package.

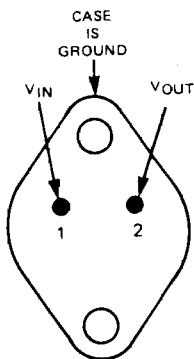
FEATURES

- 1% Tolerance
- 5, 12 and 15V fixed output voltages available
- 0.01%/V line regulation
- 0.3%/A load regulation
- Thermal overload protection
- Short-circuit current limit protection
- Safe operating area protection
- Start-up with negative voltage (\pm supplies) on output

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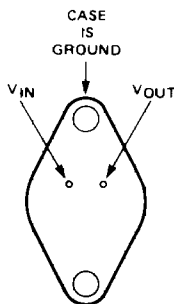
CONNECTIONS

(Bottom View)



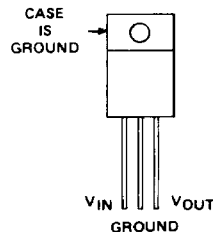
TO-3

(Bottom View)



TO-66

(Top View)



TO-257



1 AMP, 3-TERMINAL POSITIVE REGULATORS

ABSOLUTE MAXIMUM RATINGS

Input Voltage ($V_O = 5V, 12V, 15V$)	35V	Maximum Junction Temperature	
Internal Power Dissipation (Note 1)	Internally Limited	TO-3 Package K	150°C
		TO-66 Package R	150°C
		TO-257 (Hermetic TO-220 style) Package G	150°C
Operating Temperature Range (T_j)		Storage Temperature Range	-65°C to 150°C
IP140A, LM140, IP140	-55°C to +150°C	Lead Temperature (Soldering, 10 sec.)	300°C
IP7800A, IP7800	-55°C to +150°C		

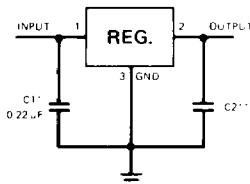
Absolute maximum ratings are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the device should be operated at these limits. The electrical characteristics provide conditions for actual device operation.

Note 1. Although power dissipation is internally limited, these specifications are applicable for maximum power dissipation P_{MAX} of 20W for the TO-3, TO-66 and TO-257. I_{MAX} is 1.0A for the TO-3, TO-66, TO-257.

APPLICATIONS INFORMATION

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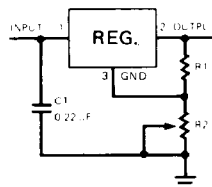
Fixed Output Regulator



* Required if the regulator is located far from the power supply filter.

** Although no output capacitor is needed for stability, it does help transient response. (if needed, use 0.1 μF, ceramic disc)

Adjustable Output Regulator

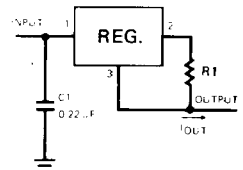


$$V_{OUT} = 5V + (5V/R1) \cdot I_Q/R2$$

$$5V/R1 \geq 3 I_Q \text{ (load regulation (L1) } \approx$$

$$\left[\frac{(R1-R2)}{R1} \right] I_Q \text{ (Load Regulator)}$$

Current Regulator



$$I_{OUT} = \frac{V_2 - V_3}{R1} + I_Q$$

$$\Delta I_Q = 1.3 \text{ mA over line and load changes}$$

ORDER INFORMATION

Part Number

IP140AK-XX
 IP140K/LM140K
 IP7800AK/IP7800K
 IP140AR-XX/IP140R-XX
 IP7800AR/IP7800R
 IP140AG-XX/IP140G-XX
 IP7800AG/IP7800G

Temperature Range

-55°C to +150°C
 -55°C to +150°C
 -55°C to +150°C
 -55°C to +150°C
 -55°C to +150°C
 -55°C to +150°C
 -55°C to +150°C

Package

TO-3
 TO-3
 TO-3
 TO-66
 TO-66
 TO-257 (Hermetic TO-220 style)
 TO-257 (Hermetic TO-220 style)



IP140A, IP140, LM140, IP7800A Series, IP7800 Series

1 AMP, 3-TERMINAL POSITIVE REGULATORS

ELECTRICAL CHARACTERISTICS (SEE NOTE 2)

Parameter	Test Conditions	IP7805A IP140A-5			IP7805 LM140-5			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage, V_O	K, R, G Pkg., $I_O = 1A$, $V_{IN} = 10V$	4.95	5	5.05	4.8	5	5.2	V
	$P_D \leq P_{MAX}$, $5mA \leq I_O \leq I_{MAX}$ $7.5V \leq V_{IN} \leq 20V$	• 4.85		5.15	4.75		5.25	V
Low Supply, V_O	$P_D \leq P_{MAX}$, $5mA \leq I_O \leq I_{MAX}$ $7V \leq V_{IN} \leq 20V$	4.75		5.15	4.75		5.25	V
Line Regulation, ΔV_O	$I_O = 0.5 I_{MAX}$	$7V \leq V_{IN} \leq 25V$		3	10		50	mV
		$7.5V \leq V_{IN} \leq 25V$	•	3	10		50	mV
	$I_O \leq I_{MAX}$	$7.3V \leq V_{IN} \leq 20V$		3	10		50	mV
		$8V \leq V_{IN} \leq 12V$	•	2	12		25	mV
Load Regulation, ΔV_O	K, R, G Pkg.	$5mA \leq I_O \leq 1.5A$		10	25		50	mV
		$V_{IN} = 10V$		4	15		25	mV
	$5mA \leq I_O \leq I_{MAX}$, $V_{IN} = 10V$	•	7	25		50	mV	
Quiescent Current, I_Q	$I_O \leq I_{MAX}$		4	6		6	mA	
	$V_{IN} = 10V$	•	4	6.5		7	mA	
Quiescent Current Change, ΔI_Q	$5mA \leq I_O \leq I_{MAX}$, $V_{IN} = 10V$			0.2	0.5		0.5	mA
		$I_O \leq I_{MAX}$, $7.5V \leq V_{IN} \leq 20V$	•	0.1	0.8		0.8	mA
	$I_O \leq 0.5 I_{MAX}$, $8V \leq V_{IN} \leq 25V$			0.1	0.8		0.8	mA
		$I_O \leq 0.5 I_{MAX}$, $7V \leq V_{IN} \leq 25V$	•	0.2	1.0		1.0	mA
Output Noise Voltage, V_N	$10Hz \leq f \leq 100kHz$, $V_{IN} = 10V$		40	200		40	μV	
Ripple Rejection, $\Delta V_{IN}/\Delta V_{OUT}$	$f = 120Hz$	$I_O \leq I_{MAX}$		68	80		68	dB
		$8V \leq V_{IN} \leq 18V$	•	68	80		68	dB
Dropout Voltage	$I_{OUT} = I_{MAX}$		2.0	2.5		2.0	V	
Output Resistance, R_O	$f = 1kHz$		5			5	$m\Omega$	
Short-Circuit Current, I_{SC}	$V_{IN} = 35V$	K, R, G Package		0.6	1.2		0.6	A
Peak Output Current, I_{pk}	$V_{IN} = 10V$	K, R, G Package		2.4	3.3		2.4	A
Average TC of V_{OUT}	$I_O = 5mA$			0.2	2		0.6	$mV/^\circ C$
Input Voltage Required to Maintain Line Regulation, V_{IN}	$I_O \leq I_{MAX}$		7.3			7.3		V

The • denotes the specifications which apply over the full operating temperature range, all others apply at $T_j = 25^\circ C$ unless otherwise specified.

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1 AMP, 3-TERMINAL POSITIVE REGULATORS

ELECTRICAL CHARACTERISTICS (CONTINUED)

Parameter	Test Conditions	IP7812A IP140A-12			IP7812 LM140-12			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage, V_O	K, R, G Pkg., $I_O = 1A, V_{IN} = 19V$	11.88	12	12.12	11.5	12	12.5	V
	$P_D \leq P_{MAX}, 5mA \leq I_O \leq I_{MAX}$ $14.8V \leq V_{IN} \leq 27V$	• 11.64		12.36	11.4		12.6	V
Low Supply, V_O	$P_D \leq P_{MAX}, 5mA \leq I_O \leq I_{MAX}$ $14.5V \leq V_{IN} \leq 27V$	11.40		12.36	11.4		12.6	V
Line Regulation, ΔV_O	$I_O = 0.5 I_{MAX}$	$14.5V \leq V_{IN} \leq 30V$		4	18		120	mV
		$14.8V \leq V_{IN} \leq 30V$	•	4	18		120	mV
	$I_O \leq I_{MAX}$	$14.5V \leq V_{IN} \leq 27V$		4	18		120	mV
		$16V \leq V_{IN} \leq 22V$		2	9		50	mV
Load Regulation, ΔV_O	K, R, G Pkg.		12	32		120	mV	
	$V_{IN} = 19V$		4	19		60	mV	
	$5mA \leq I_O \leq I_{MAX}, V_{IN} = 19V$	•	8	60		120	mV	
Quiescent Current, I_Q	$I_O \leq I_{MAX}$		4	6		6	mA	
	$V_{IN} = 19V$	•	4	6.5		7	mA	
Quiescent Current Change, ΔI_Q	$5mA \leq I_O \leq I_{MAX}, V_{IN} = 19V$		0.2	0.5		0.5	mA	
	$I_O \leq I_{MAX}, 14.8V \leq V_{IN} \leq 27V$	•	0.1	0.8		0.8	mA	
	$I_O \leq 0.5 I_{MAX}, 15V \leq V_{IN} \leq 30V$		0.1	0.8		0.8	mA	
	$I_O \leq 0.5 I_{MAX}, 14.5V \leq V_{IN} \leq 30V$	•	0.2	1.0		1.0	mA	
Output Noise Voltage, V_N	$10Hz \leq f \leq 100kHz, V_{IN} = 19V$		75	480		75	μV	
Ripple Rejection, $\Delta V_{IN}/\Delta V_{OUT}$	$f = 120Hz$		61	72		61	dB	
	$15V \leq V_{IN} \leq 25V$		61	72		61	dB	
Dropout Voltage	$I_{OUT} = I_{MAX}$		2.0	2.5		2.0	V	
Output Resistance, R_O	$f = 1kHz$		8			8	m Ω	
Short-Circuit Current, I_{sc}	$V_{IN} = 35V$	K, R, G Package	0.6	1.2	0.6	1.2	A	
Peak Output Current, I_{pk}	$V_{IN} = 19V$	K, R, G Package	2.4	3.3	2.4	3.3	A	
Average TC of V_{OUT}	$I_O = 5mA$		0.5	4.8	1.5		mV/ $^{\circ}C$	
Input Voltage Required to Maintain Line Regulation, V_{IN}	$I_O \leq I_{MAX}$		14.5		14.6		V	

The • denotes the specifications which apply over the full operating temperature range, all others apply at $T_j = 25^{\circ}C$ unless otherwise specified.



1 AMP, 3-TERMINAL POSITIVE REGULATORS

ELECTRICAL CHARACTERISTICS (CONTINUED)

Parameter	Test Conditions	IP7815A IP140A-15			IP7815 LM140-15			Units	
		Min	Typ	Max	Min	Typ	Max		
Output Voltage, V_O	K, R, G Pkg., $I_O = 1A$, $V_{IN} = 23V$	14.85	15	15.15	14.4	15	15.6	V	
	$P_D \leq P_{MAX}$, $5mA \leq I_O \leq I_{MAX}$ $17.9V \leq V_{IN} \leq 30V$	• 14.55		15.45	14.25		15.75	V	
Low Supply, V_O	$P_D \leq P_{MAX}$, $5mA \leq I_O \leq I_{MAX}$ $17.5V \leq V_{IN} \leq 30V$	14.25		15.45	14.25		15.75	V	
Line Regulation, ΔV_O	$I_O = 0.5 I_{MAX}$	$17.5V \leq V_{IN} \leq 30V$		4	22		150	mV	
		$17.9V \leq V_{IN} \leq 30V$	•	4	22		150	mV	
	$I_O \leq I_{MAX}$	$17.5V \leq V_{IN} \leq 30V$		4	22		150	mV	
		$20V \leq V_{IN} \leq 26V$		2	10		60	mV	
Load Regulation, ΔV_O	K, R, G Pkg., $5mA \leq I_O \leq 1.5A$		12	35			150	mV	
	$V_{IN} = 23V$, $250mA \leq I_O \leq 750mA$		4	21			75	mV	
	$5mA \leq I_O \leq I_{MAX}$, $V_{IN} = 23V$	•	9	75			150	mV	
Quiescent Current, I_Q	$I_O \leq I_{MAX}$		4	6			6	mA	
	$V_{IN} = 23V$	•	4	6.5			7	mA	
Quiescent Current Change, ΔI_Q	$5mA \leq I_O \leq I_{MAX}$, $V_{IN} = 23V$		0.2	0.5			0.5	mA	
	$I_O \leq I_{MAX}$, $17.9V \leq V_{IN} \leq 30V$	•	0.1	0.8			0.8	mA	
	$I_O \leq 0.5 I_{MAX}$, $18.5V \leq V_{IN} \leq 30V$		0.1	0.8			0.8	mA	
	$I_O \leq 0.5 I_{MAX}$, $17.5V \leq V_{IN} \leq 30V$	•	0.2	1.0			1.0	mA	
Output Noise Voltage, V_N	$10Hz \leq f \leq 100kHz$, $V_{IN} = 23V$		90	600		90		μV	
Ripple Rejection, $\Delta V_{IN}/\Delta V_{OUT}$	$f = 120Hz$	$I_O \leq I_{MAX}$	60	70		60		dB	
	$18.5V \leq V_{IN} \leq 28.5V$	$I_O \leq 0.5 I_{MAX}$	• 60	70		60		dB	
Dropout Voltage	$I_{OUT} = I_{MAX}$		2.0	2.5		2.0		V	
Output Resistance, R_O	$f = 1kHz$		9			9		$m\Omega$	
Short-Circuit Current, I_{SC}	$V_{IN} = 35V$	K, R, G Package		0.6	1.2		0.6	1.2	A
Peak Output Current, I_{pk}	$V_{IN} = 23V$	K, R, G Package		2.4	3.3		2.4	3.3	A
Average TC of V_{OUT}	$I_O = 5mA$			0.6	6.0		1.8		$mV/^\circ C$
Input Voltage Required to Maintain Line Regulation, V_{IN}	$I_O \leq I_{MAX}$		17.5			17.7		V	

The • denotes the specifications which apply over the full operating temperature range, all others apply at $T_j = 25^\circ C$ unless otherwise specified.

Note 2. All characteristics are measured with a capacitor across the input of $0.22 \mu F$ and a capacitor across the output of $0.1 \mu F$. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_W \leq 10ms$, duty cycle $\leq 5\%$). Output voltage changes due to changes in internal temperature must be taken into account separately.

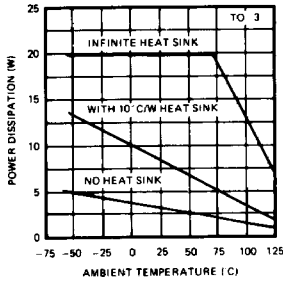
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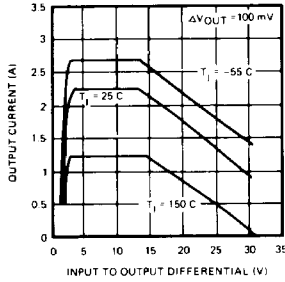
1 AMP, 3-TERMINAL POSITIVE REGULATORS

TYPICAL PERFORMANCE CHARACTERISTICS

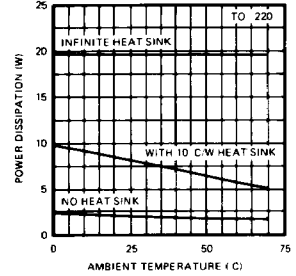
Maximum Average Power Dissipation



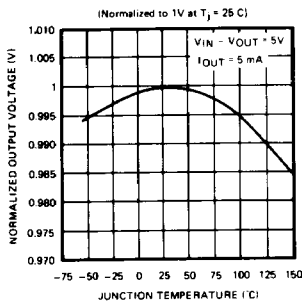
Peak Output Current



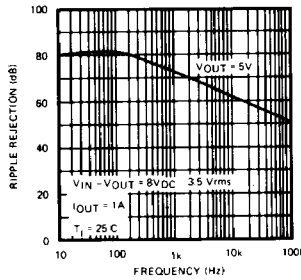
Maximum Average Power Dissipation



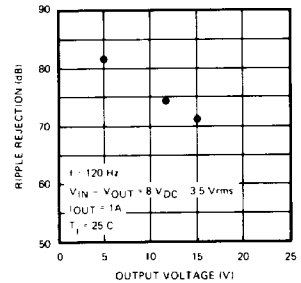
Output Voltage



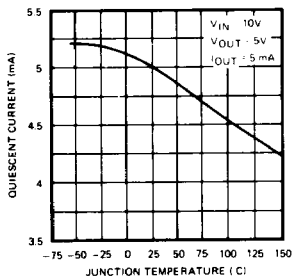
Ripple Rejection



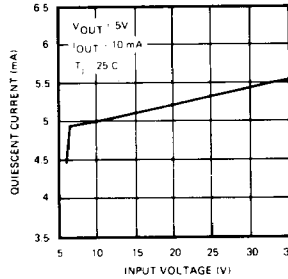
Ripple Rejection



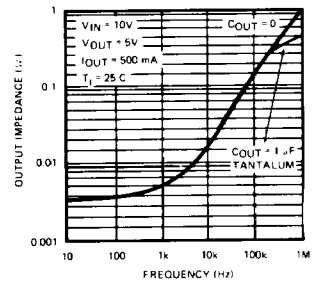
Quiescent Current



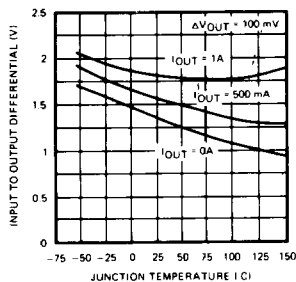
Quiescent Current



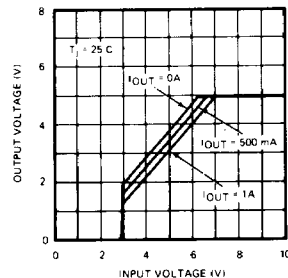
Output Impedance



Dropout Voltage



Dropout Characteristics



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