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 ±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.

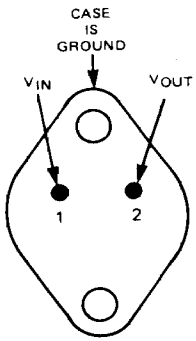
FEATURES

- 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 (± supplies) on output

4

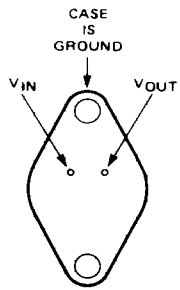
CONNECTIONS

(Bottom View)



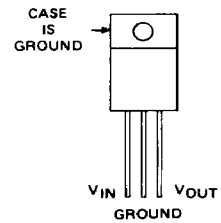
TO-3

(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

Internal Power Dissipation
(Note 1) Internally Limited

Operating Temperature Range (T_j)
IP140A, LM140, IP140 −55°C to +150°C
IP7800A, IP7800 −55°C to +150°C

Maximum Junction Temperature
TO-3 Package K 150°C
TO-66 Package R 150°C
TO-257 (Hermetic TO-220 style) Package G 150°C

Storage Temperature Range −65°C to 150°C

Lead Temperature (Soldering, 10 sec.) 300°C

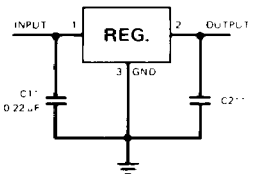
Absolute maximum ratings are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the device should be operated at these limits. The electrical characteristics provide conditions for actual device operation.

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

4

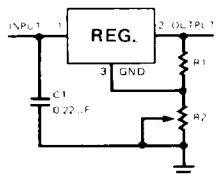
Fixed Output Regulator



*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)

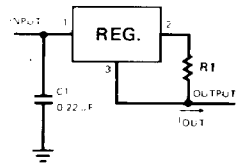
Adjustable Output Regulator



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

5V/R1 > 3 I_Q, load regulation (L_R) ≈ $\left[\frac{(R1+R2)}{R1}\right]$ (L_R of Regulator)

Current Regulator



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

ΔI_Q = 1.3 mA over line and load changes

ORDER INFORMATION

Part Number	Temperature Range	Package
IP140AK-XX	−55°C to +150°C	TO-3
IP140K/LM140K	−55°C to +150°C	TO-3
IP7800AK/IP7800K	−55°C to +150°C	TO-3
IP140AR-XX/IP140R-XX	−55°C to +150°C	TO-66
IP7800AR/IP7800R	−55°C to +150°C	TO-66
IP140AG-XX/IP140G-XX	−55°C to +150°C	TO-257 (Hermetic TO-220 style)
IP7800AG/IP7800G	−55°C to +150°C	TO-257 (Hermetic TO-220 style)

1 AMP, 3-TERMINAL POSITIVE REGULATORS

ELECTRICAL CHARACTERISTICS (SEE NOTE 2)

Parameter	Test Conditions			IP7805A IP140A-5 Min	IP7805A IP140A-5 Typ	IP7805A IP140A-5 Max	IP7805 LM140-5 Min	IP7805 LM140-5 Typ	IP7805 LM140-5 Max	Units
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, $\triangle V_O$	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			1	4			20	mV
			•		2	12			25	mV
Load Regulation, $\triangle V_O$	K, R, G Pkg.	5 mA $\leq I_O \leq$ 1.5A			10	25			50	mV
	V_{IN} = 10V	250mA $\leq I_O \leq$ 750mA			4	15			25	mV
	5 mA $\leq I_O \leq I_{MAX}$, 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, $\triangle I_Q$	5 mA $\leq I_O \leq I_{MAX}$, 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	10 Hz $\leq f \leq$ 100 kHz, V_{IN} = 10V				40	200		40		μV
Ripple Rejection, $\triangle V_{IN}/\triangle V_{OUT}$	f = 120 Hz	$I_O \leq I_{MAX}$		68	80		68			dB
	8 V $\leq V_{IN} \leq$ 18V	$I_O \leq$ 0.5 I_{MAX}	•	68	80		68			dB
Dropout Voltage	$I_{OUT} = I_{MAX}$				2.0	2.5		2.0		V
Output Resistance, R_O	f = 1 kHz				5			5		mΩ
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} = 10V	K, R, G Package			2.4	3.3		2.4	3.3	A
Average TC of V_{OUT}	I_O = 5 mA				0.2	2		0.6		mV/°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°C unless otherwise specified.

1 AMP, 3-TERMINAL POSITIVE REGULATORS

ELECTRICAL CHARACTERISTICS (CONTINUED)

Parameter	Test Conditions			IP7812A IP140A-12 Min	Typ	Max	IP7812 LM140-12 Min	Typ	Max	Units
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, $\triangle V_O$	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
			•		4	30			60	mV
Load Regulation, $\triangle V_O$	K, R, G Pkg.	5 mA $\leq I_O \leq$ 1.5A			12	32			120	mV
	V_{IN} = 19V	250mA $\leq I_O \leq$ 750mA			4	19			60	mV
	5 mA $\leq I_O \leq I_{MAX}$, 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, $\triangle I_Q$	5 mA $\leq I_O \leq I_{MAX}$, 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	10 Hz $\leq f \leq$ 100 kHz, V_{IN} = 19V				75	480		75		μV
Ripple Rejection, $\triangle V_{IN}/\triangle V_{OUT}$	f = 120 Hz	$I_O \leq I_{MAX}$		61	72		61			dB
	15 V $\leq V_{IN} \leq$ 25V	$I_O \leq$ 0.5 I_{MAX}	•	61	72		61			dB
Dropout Voltage	$I_{OUT} = I_{MAX}$				2.0	2.5		2.0		V
Output Resistance, R_O	f = 1 kHz				8			8		mΩ
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 = 5 mA				0.5	4.8		1.5		mV/°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°C unless otherwise specified.

1 AMP, 3-TERMINAL POSITIVE REGULATORS

ELECTRICAL CHARACTERISTICS (CONTINUED)

Parameter	Test Conditions			IP7815A IP140A-15 Min	Typ	Max	IP7815 LM140-15 Min	Typ	Max	Units
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, $\triangle V_O$	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
			•		5	30			75	mV
Load Regulation, $\triangle V_O$	K, R, G Pkg.	5 mA $\leq I_O \leq$ 1.5A			12	35			150	mV
	V_{IN} = 23V	250mA $\leq I_O \leq$ 750mA			4	21			75	mV
	5 mA $\leq I_O \leq I_{MAX}$, 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, $\triangle I_Q$	5 mA $\leq I_O \leq I_{MAX}$, 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	10 Hz $\leq f \leq$ 100 kHz, V_{IN} = 23V				90	600		90		μV
Ripple Rejection, $\triangle V_{IN}/\triangle V_{OUT}$	f = 120 Hz	$I_O \leq I_{MAX}$		60	70		60			dB
	18.5 V $\leq V_{IN} \leq$ 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 = 1 kHz				9			9		mΩ
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 = 5 mA				0.6	6.0		1.8		mV/°C
Input Voltage Required to Maintain Line Regulation, V_{IN}	$I_O \leq I_{MAX}$			17.5			17.7			V

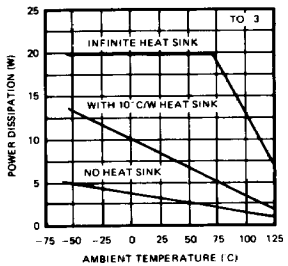
The • denotes the specifications which apply over the full operating temperature range, all others apply at T_j = 25°C unless otherwise specified.

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

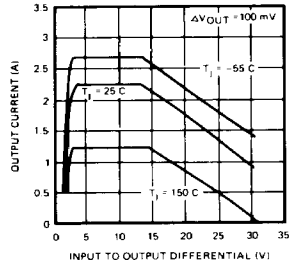
1 AMP, 3-TERMINAL POSITIVE REGULATORS

TYPICAL PERFORMANCE CHARACTERISTICS

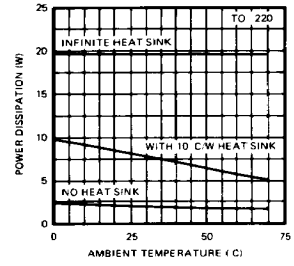
Maximum Average Power Dissipation



Peak Output Current

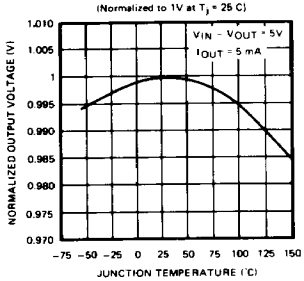


Maximum Average Power Dissipation

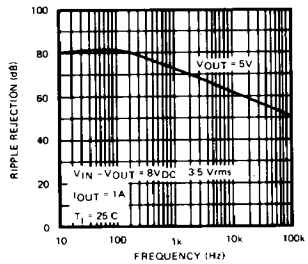


Output Voltage

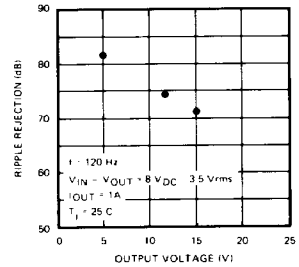
(Normalized to 1V at T_J = 25°C)



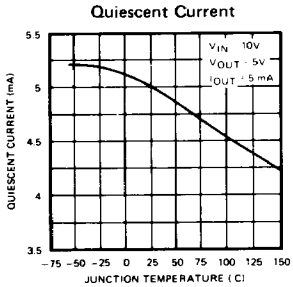
Ripple Rejection



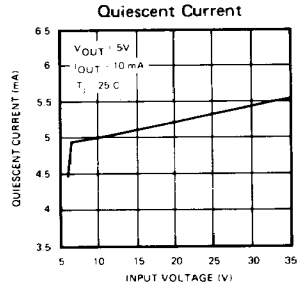
Ripple Rejection



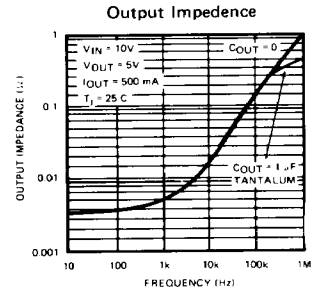
Quiescent Current



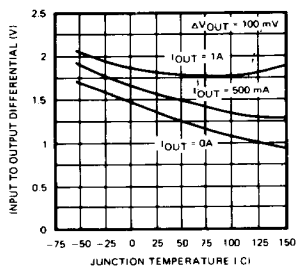
Quiescent Current



Output Impedence



Dropout Voltage



Dropout Characteristics