4825898 INTEGRATED POWER

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T-58-11-13

INTEGRATED POWER SEMICONDUCTORS, LTD.

1 Amp, 3-Terminal Positive Regulators

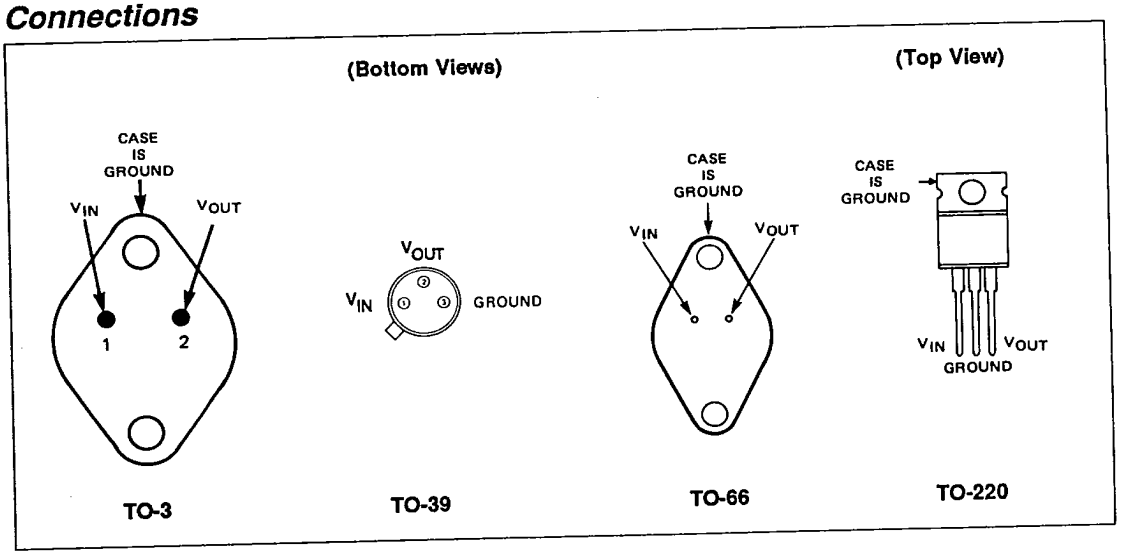
Description

The IP140A/ LM140/ IP240A/ LM240/ IP340A/ LM340/ IP7800A/ IP7800/ IP7800AC/ IP7800C 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 IP340A/ LM340/ IP7800AC/ IP7800C series is available in the TO-220 plastic power package and the IP140A/ LM140/ IP7800A/ IP7800 series is now available in a new hermetic TO-220 style power package, as well as the TO-39 metal can.

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 area protection
- 100% thermal limit burn-in
- Start-up with negative voltage (± supplies) on output

Connections



TO-3 TO-39 TO-66 TO-220

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	-55°C to +150°C
IP7800A, IP7800	-55°C to +150°C
IP240A, LM240	-25°C to +150°C
IP340A, LM340	0°C to +125°C
IP7800AC, IP7800C	0°C to +125°C

Maximum Junction Temperature

TO-3 Package K	150°C
TO-39 Package H	150°C
TO-66 Package R	150°C
Hermetic TO-220 Package G	150°C
TO-220 Package T	125°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 2W for the TO-39 and 20W for the TO-3, TO-66 and TO-220. I_{MAX} is 1.0A for the TO-3, TO-66 and TO-220 packages and 500mA for the TO-39 package.

Electrical Characteristics (See Note 2)

Parameter	Test Conditions			IP7805A IP7805AC IP140A-5 IP240A-5 IP340A-5 Min	Typ	Max	IP7805 IP7805C LM140-5 LM240-5 LM340-5 Min	Typ	Max	Units
Output Voltage, V_O	K, R, T Pkg, I_O = 1A, V_{IN} = 10V			4.95	5	5.05	4.8	5	5.2	V
	$P_D \le P_{MAX}$, 5 mA $\le I_O < I_{MAX}$, 7.5V $\le V_{IN} \le$ 20V		•	4.85		5.15	4.75		5.25	V
Low Supply, V_O	$P_D \le P_{MAX}$, 5 mA $\le I_O \le I_{MAX}$, 7V $\le V_{IN} \le$ 20V			4.75		5.15	4.75		5.25	V
Line Regulation, ΔV_O	I_O = 0.5 I_{MAX}	7V $\le V_{IN} \le$ 25V			3	10			50	mV
		7.5V $\le V_{IN} \le$ 20V	•		3	10			50	mV
	$I_O \le I_{MAX}$	7.3V $\le V_{IN} \le$ 20V			3	10			50	mV
		8V $\le V_{IN} \le$ 12V			1	4			20	mV
			•		2	12			25	mV
Load Regulation, ΔV_O	K, R, T Pkg., V_{IN} = 10V	5 mA $\le I_O \le$ 1.5A			10	25			50	mV
		250mA $\le I_O \le$ 750mA			4	15			25	mV
	5 mA $\le I_O \le I_{MAX}$, V_{IN} = 10V		•		7	25			50	mV
Quiescent Current, I_Q	$I_O \le I_{MAX}$, V_{IN} = 10V				4	6			6	mA
			•		4	6.5			7	mA
Quiescent Current Change, ΔI_Q	5 mA $\le I_O \le I_{MAX}$, V_{IN} = 10V		•		0.2	0.5			0.5	mA
	$I_O \le I_{MAX}$, 7.5V $\le V_{IN} \le$ 20V				0.1	0.8			0.8	mA
	$I_O \le$ 0.5 I_{MAX}, 8V $\le V_{IN} \le$ 25V		•		0.1	0.8			0.8	mA
	$I_O \le$ 0.5 I_{MAX}, 0°C $\le T_j \le$ +125°C, 7V $\le V_{IN} \le$ 25V				0.2	1.0			1.0	mA
Output Noise Voltage, V_N	10 Hz $\le f \le$ 100 kHz, V_{IN} = 10V				40	200		40		μV
Ripple Rejection, $\Delta V_{IN}/\Delta V_{OUT}$	f = 120Hz	$I_O \le I_{MAX}$		68	80		68			dB
	8V $\le V_{IN} \le$ 18V	$I_O \le$ 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, T Package			0.6	1.2		0.6	1.2	A
		H Package			0.4	0.6		0.4	0.6	A
Peak Output Current, I_{pk}	V_{IN} = 10V	K, R, T Package			2.4	3.3		2.4	3.3	A
		H Package			1.2	1.7		1.2	1.7	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}	$I_O \le I_{MAX}$			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.

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Electrical Characteristics (Cont.)

Parameter	Test Conditions			IP7812A IP7812AC IP140A-12 IP240A-12 IP340A-12 Min	Typ	Max	IP7812 IP7812C LM140-12 LM240-12 LM340-12 Min	Typ	Max	Units
Output Voltage, V_O	K, R, T Package, $I_O \le 1A$, $V_{IN} = 19V$			11.88	12	12.12	11.5	12	12.5	V
	$P_D \le P_{MAX}$, $5\ mA \le I_O \le I_{MAX}$ $14.8V \le V_{IN} \le 27V$		•	11.64		12.36	11.4		12.6	V
Low Supply, V_O	$P_D \le P_{MAX}$, $5\ mA \le I_O \le I_{MAX}$ $14.5V \le V_{IN} \le 27V$			11.40		12.36	11.4		12.6	V
Line Regulation, ΔV_O	$I_O = 0.5\ I_{MAX}$	$14.5V \le V_{IN} \le 30V$			4	18			120	mV
		$14.8V \le V_{IN} \le 27V$	•		4	18			120	mV
	$I_O \le I_{MAX}$	$14.5V \le V_{IN} \le 27V$			4	18			120	mV
		$16V \le V_{IN} \le 22V$			2	9			50	mV
			•		4	30			60	mV
Load Regulation, ΔV_O	K, R, T Pkg., $V_{IN} = 19V$	$5\ mA \le I_O \le 1.5A$			12	32			120	mV
		$250mA \le I_O \le 750mA$			4	19			60	mV
	$5\ mA \le I_O \le I_{MAX}$, $V_{IN} = 19V$		•		8	60			120	mV
Quiescent Current, I_Q	$I_O \le I_{MAX}$				4	6			6	mA
	$V_{IN} = 19V$		•		4	6.5			7	mA
Quiescent Current Change, ΔI_Q	$5\ mA \le I_O \le I_{MAX}$, $V_{IN} = 19V$		•		0.2	0.5			0.5	mA
	$I_O \le I_{MAX}$, $14.8V \le V_{IN} \le 27V$				0.1	0.8			0.8	mA
	$I_O \le 0.5\ I_{MAX}$, $15V \le V_{IN} \le 30V$		•		0.1	0.8			0.8	mA
	$I_O \le 0.5\ I_{MAX}$, $0°C \le T_J \le +125°C$ $14.5V \le V_{IN} \le 30V$				0.2	1.0			1.0	mA
Output Noise Voltage, V_N	$10\ Hz \le f \le 100\ kHz$, $V_{IN} = 19V$				75	480		75		μV
Ripple Rejection, $\Delta V_{IN}/\Delta V_{OUT}$	$f = 120Hz$ $15V \le V_{IN} \le 25V$	$I_O \le I_{MAX}$		61	72		61			dB
		$I_O \le 0.5\ I_{MAX}$	•	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, T Package			0.6	1.2		0.6	1.2	A
		H Package			0.4	0.6		0.4	0.6	A
Peak Output Current, I_{pk}	$V_{IN} = 19V$	K, R, T Package			2.4	3.3		2.4	3.3	A
		H Package			1.2	1.7		1.2	1.7	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}	$I_O \le I_{MAX}$			14.5			14.6			V

Electrical Characteristics (Cont.)

Parameter	Test Conditions			IP7815A IP7815AC IP140A-15 IP240A-15 IP340A-15 Min	Typ	Max	IP7815 IP7815C LM140-15 LM240-15 LM340-15 Min	Typ	Max	Units
Output Voltage, V_O	K, R, T Pkg., $I_O \le 1A$, $V_{IN} = 23V$			14.85	15	15.15	14.4	15	15.6	V
	$P_D \le P_{MAX}$, $5mA \le I_O \le I_{MAX}$, $17.9V \le V_{IN} \le 30V$		•	14.55		15.45	14.25		15.75	V
Low Supply, V_O	$P_D \le P_{MAX}$, $5mA \le I_O \le I_{MAX}$, $17.5V \le V_{IN} \le 30V$			14.25		15.45	14.25		15.75	V
Line Regulation, ΔV_O	$I_O = 0.5\ I_{MAX}$	$17.5V \le V_{IN} \le 30V$			4	22			150	mV
		$17.9V \le V_{IN} \le 30V$,	•		4	22			150	mV
	$I_O \le I_{MAX}$	$17.5V \le V_{IN} \le 30V$			4	22			150	mV
		$20V \le V_{IN} \le 26V$			2	10			60	mV
			•		5	30			75	mV
Load Regulation, ΔV_O	K, R, T Pkg., $V_{IN} = 23V$	$5mA \le I_O \le 1.5A$			12	35			150	mV
		$250mA \le I_O \le 750mA$			4	21			75	mV
	$5mA \le I_O \le I_{MAX}$, $V_{IN} = 23V$		•		9	75			150	mV
Quiescent Current, I_Q	$I_O \le I_{MAX}$, $V_{IN} = 23V$				4	6			6	mA
			•		4	6.5			7	mA
Quiescent Current Change, ΔI_Q	$5mA \le I_O \le I_{MAX}$, $V_{IN} = 23V$		•		0.2	0.5			0.5	mA
	$I_O \le I_{MAX}$, $17.9V \le V_{IN} \le 30V$				0.1	0.8			0.8	mA
	$I_O \le 0.5\ I_{MAX}$, $18.5V \le V_{IN} \le 30V$		•		0.1	0.8			0.8	mA
	$I_O \le 0.5\ I_{MAX}$, $0°C \le T_j \le +125°C$, $17.5V \le V_{IN} \le 30V$				0.2	1.0			1.0	mA
Output Noise Voltage, V_N	$10Hz \le f \le 100kHz$, $V_{IN} = 23V$				90	600		90		μV
Ripple Rejection, $\Delta V_{IN}/\Delta V_{OUT}$	f = 120Hz,	$I_O \le I_{MAX}$		60	70		60			dB
	$18.5V \le V_{IN} \le 28.5V$	$I_O \le 0.5\ I_{MAX}$	•	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, T Package			0.6	1.2		0.6	1.2	A
		H Package			0.4	0.6		0.4	0.6	A
Peak Output Current, I_{pk}	$V_{IN} = 23V$	K, R, T Package			2.4	3.3		2.4	3.3	A
		H Package			1.2	1.7		1.2	1.7	A
Average TC of V_{OUT}	$I_O = 5mA$				0.6	6.0		1.8		mV/°C
Input Voltage Required to Maintain Line Regulation, V_{IN}	$I_O \le I_{MAX}$			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 capacitor across the output of 0.1 μF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_W \le 10$ ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

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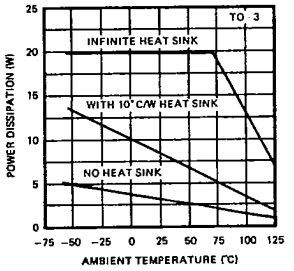
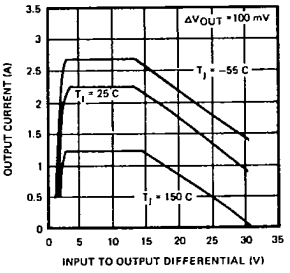
Typical Performance Characteristics

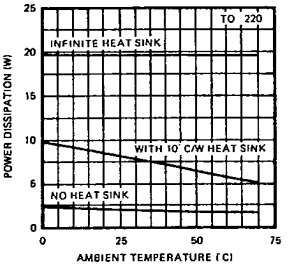
Maximum Average Power Dissipation



Peak Output Current

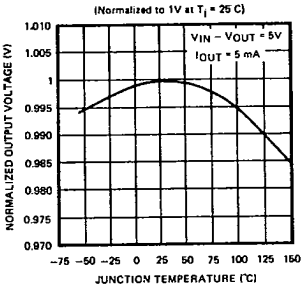


Maximum Average Power Dissipation

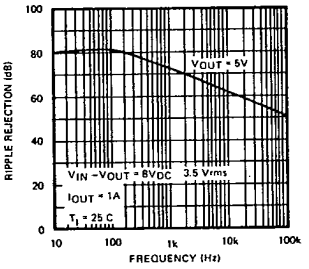


Output Voltage

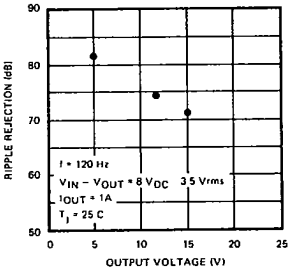
(Normalized to 1V at T_J = 25°C)



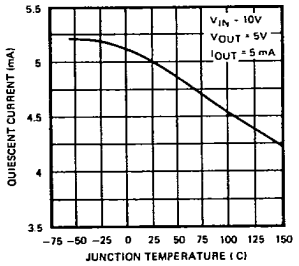
Ripple Rejection



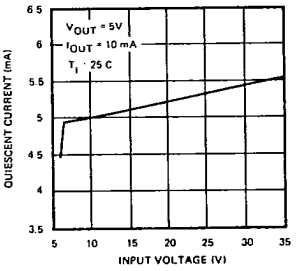
Ripple Rejection



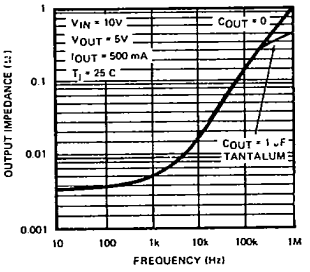
Quiescent Current



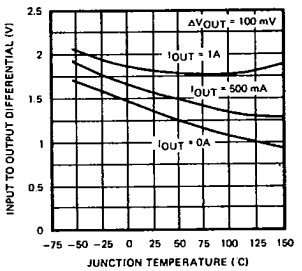
Quiescent Current



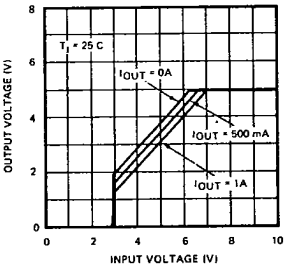
Output Impedence



Dropout Voltage

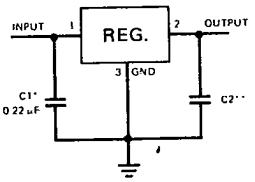


Dropout Characteristics



Applications Information

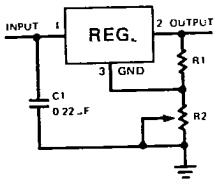
Fixed Output Regulator



*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

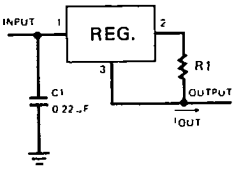


$V_{OUT} = 5V + (5V/R1 + I_Q)R2$

$5V/R1 > 3\ I_Q$, load regulation $(L_r) \approx$

$\left[\frac{(R1+R2)}{R1}\right]$ (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/LM140K-XX	-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	Hermetic TO-220
IP7800AG/IP7800G	-55°C to +150°C	Hermetic TO-220
IP140AH-XX/LM140H-XX	-55°C to +150°C	TO-39
IP7800AH/IP7800H	-55°C to +150°C	TO-39
IP240AK-XX/LM240K-XX	-25°C to +150°C	TO-3
IP240AR-XX/IP240R-XX	-25°C to +150°C	TO-66
IP340AK-XX/LM340K-XX	0°C to +125°C	TO-3
IP7800ACK/IP7800CK	0°C to +125°C	TO-3
IP340AR-XX/IP340R-XX	0°C to +125°C	TO-66
IP7800ACR/IP7800CR	0°C to +125°C	TO-66
IP340AT-XX/LM340T-XX	0°C to +125°C	TO-220
IP7800ACT/IP7800CT	0°C to +125°C	TO-220

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