

4825898 INTEGRATED POWER

82D 00298 D

INTEGRATED POWER SEMICONDUCTORS, LTD.

3 Amp, 3-Terminal Positive Regulators

T-58-11-13

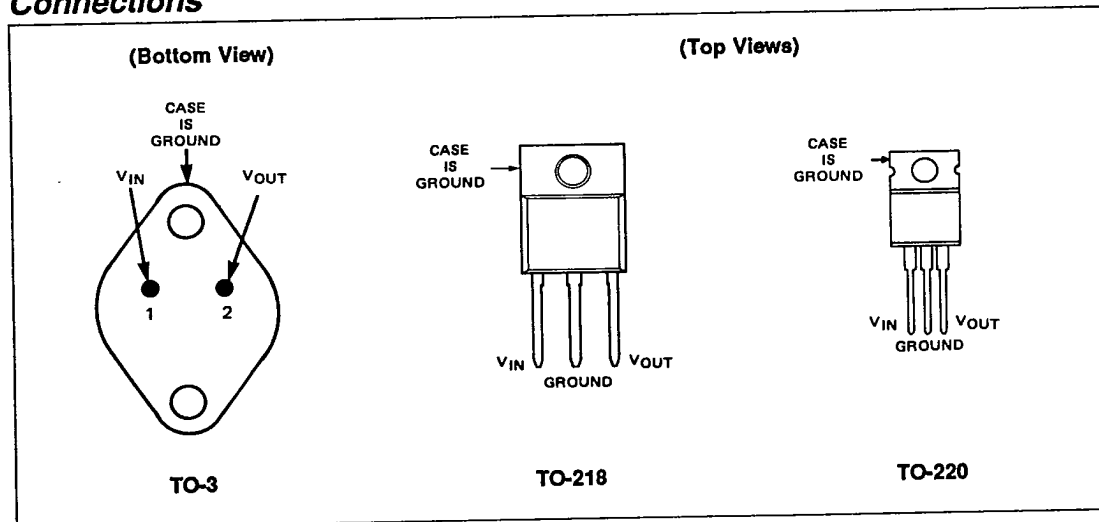
Description

The IP123A/ LM123/ IP223A/ LM223/ IP323A/ LM323 series of three terminal, three amp regulators is available with several fixed output voltages and three package options, greatly expanding the versatility of this product line. The A-suffix devices are trimmed to $\pm 1\%$ tolerance and provide $0.04\%/V$ line regulation and $0.3\%/A$ load regulation. Protection features include safe operating area current limiting and thermal shutdown. The entire series of regulators is available in the metal TO-3 power package and the IP323A/IP323 series is also available in the TO-218 and TO-220 plastic power packages.

Features

- 1% tolerance
- 5, 12 and 15V fixed output voltages available
- $0.04\%/V$ line regulation
- $0.3\%/A$ load regulation
- Thermal overload protection
- Short-circuit current limit protection
- Safe operating area protection
- 100% thermal limit burn-in
- Start-up with negative voltage ($\pm$ supplies) on output
- Selection of TO-3, TO-218, or TO-220 packages

Connections



IPS

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Section 5 - Voltage Regulators
IP123A, IP223A, IP323A
LM123, LM223, LM323

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Absolute Maximum Ratings

Input Voltage ($V_O = 5V, 12V, 15V$) 35V
 Internal Power Dissipation Internally Limited
 Storage Temperature Range -65°C to 150°C
 Lead Temperature (Soldering, 10 sec.) 300°C

Operating Temperature Range (T_j)
 IP123A, LM123 -55°C to $+150^\circ\text{C}$
 IP223A, LM223 -25°C to $+150^\circ\text{C}$
 IP323A, LM323 0°C to $+125^\circ\text{C}$

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.

Electrical Characteristics

$P_{MAX} = 30W$ for K (TO-3) and V (TO-218) Packages
 $P_{MAX} = 25W$ for T (TO-220) Packages

Parameter	Test Conditions	IP123A-S IP223A-S IP323A-S			LM123-S LM223-S LM323-S			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage, V_O	$I_O = 1A, V_{IN} = 7.5V$	4.95	5	5.05	4.8	5	5.2	V
	$5mA \leq I_O \leq 3A, P_{OUT} \leq P_{MAX}$	• 4.85		5.15	4.75		5.25	V
	$8V \leq V_{IN} \leq 15V$							
Line Regulation, ΔV_O	$I_O = 1A, 7.5V \leq V_{IN} \leq 15V$	•		15			25	mV
Load Regulation, ΔV_O	$5mA \leq I_O \leq 3A, V_{IN} = 8V$	•		50			100	mV
Quiescent Current, I_Q	$5mA \leq I_O \leq 3A, V_{IN} = 8V$	•		10			14	mA
Quiescent Current Change, ΔI_Q	$5mA \leq I_O \leq 3A, V_{IN} = 8V$	•		1.5			3.0	mA
	$I_O = 1A, 7.5V \leq V_{IN} \leq 15V$	•		1.5			3.0	mA
Output Noise Voltage, V_N	$10Hz \leq f \leq 100kHz$		40			40		μV_{rms}
Ripple Rejection, $\Delta V_{IN}/\Delta V_{OUT}$	$f = 120Hz, I_O = 1A$	66	80		60	80		dB
	$8V \leq V_{IN} \leq 18V$	• 60			56			dB
Short-Circuit Current, I_{SC}	$V_{IN} = 15V$		3			3		A
	$V_{IN} = 7.5V$		4			4		A
Long-Term Stability				35			35	mV
Thermal Resistance,	K, V Package		1.5	2.5		2		$^\circ\text{C}/W$
Junction to Case, θ_{JC}	T Package		3	4		4		$^\circ\text{C}/W$

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

Note: 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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Electrical Characteristics (Cont.)

Parameter	Test Conditions	IP123A-12 IP223A-12 IP323A-12			IP123-12 IP223-12 IP323-12			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage, V_O	$I_O = 1A, V_{IN} = 14.8V$	11.88	12	12.12	11.5	12	12.5	V
	$5mA \leq I_O \leq 3A, P_{OUT} \leq P_{MAX}$ $15.4V \leq V_{IN} \leq 22V$	11.64		12.36	11.4		12.6	V
Line Regulation, ΔV_O	$I_O = 1A, 14.8V \leq V_{IN} \leq 22V$			36			60	mV
Load Regulation, ΔV_O	$5mA \leq I_O \leq 3A, V_{IN} = 15.4V$			75			150	mV
Quiescent Current, I_Q	$5mA \leq I_O \leq 3A, V_{IN} = 15.4V$			10			14	mA
Quiescent Current Change, ΔI_Q	$5mA \leq I_O \leq 3A, V_{IN} = 15.4V$			1.5			3.0	mA
	$I_O = 1A, 14.8V \leq V_{IN} \leq 22V$			1.5			3.0	mA
Output Noise Voltage, V_N	$10Hz \leq f \leq 100kHz$		75			75		μV_{rms}
Ripple Rejection, $\Delta V_{IN}/\Delta V_{OUT}$	$f = 120Hz, I_O = 1A,$ $15.4V \leq V_{IN} \leq 25.4V$	58	72		52	72		dB
		52			48			dB
Short-Circuit Current, I_{SC}	$V_{IN} = 15.4V$		3			3		A
Peak Output Current, I_{pk}	$V_{IN} = 15.4V$		4			4		A
Long -Term Stability				84			84	mV
Thermal Resistance, Junction to Case, θ_{JC}	K, V Package		1.5	2.5		2		$^{\circ}C/W$
	T Package		3	4		4		$^{\circ}C/W$

Parameter	Test Conditions	IP123A-15 IP223A-15 IP323A-15			IP123-15 IP223-15 IP323-15			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage, V_O	$I_O = 1A, V_{IN} = 17.9V$	14.85	15	15.15	14.4	15	15.6	V
	$5mA \leq I_O \leq 3A, P_{OUT} \leq P_{MAX}$ $18.5V \leq V_{IN} \leq 25V$	14.55		15.45	14.25		15.75	V
Line Regulation, ΔV_O	$I_O = 1A, 17.9V \leq V_{IN} \leq 25V$			45			75	mV
Load Regulation, ΔV_O	$5mA \leq I_O \leq 3A, V_{IN} = 18.5V$			75			150	mV
Quiescent Current, I_Q	$5mA \leq I_O \leq 3A, V_{IN} = 18.5V$			10			14	mA
Quiescent Current Change, ΔI_Q	$5mA \leq I_O \leq 3A, V_{IN} = 18.5V$			1.5			3.0	mA
	$I_O = 1A, 17.9V \leq V_{IN} \leq 25V$			1.5			3.0	mA
Output Noise Voltage, V_N	$10Hz \leq f \leq 100kHz$		90			90		μV_{rms}
Ripple Rejection, $\Delta V_{IN}/\Delta V_{OUT}$	$f = 120Hz, I_O = 1A$ $18.5V \leq V_{IN} \leq 28.5V$	56	70		50	70		dB
		50			46			dB
Short-Circuit Current, I_{SC}	$V_{IN} = 18.5V$		2.5			2.5		A
Peak Output Current, I_{pk}	$V_{IN} = 18.5V$		4			4		A
Long -Term Stability				105			105	mV
Thermal Resistance, Junction to Case, θ_{JC}	K, V Package		1.5	2.5		2		$^{\circ}C/W$
	T Package		3	4		4		$^{\circ}C/W$

Section 5 - Voltage Regulators
 IP123A, IP223A, IP323A
 LM123, LM223, LM323

IPS

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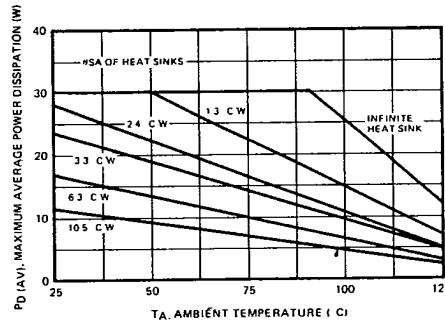
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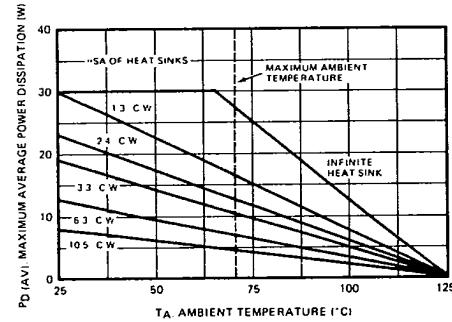
Typical Performance Characteristics

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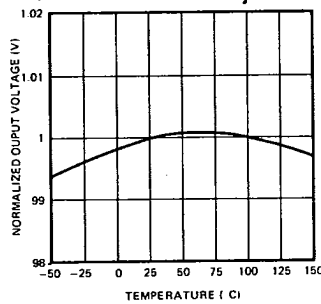
Maximum Average Power
Dissipation for IP123K,AK, 223K, AK



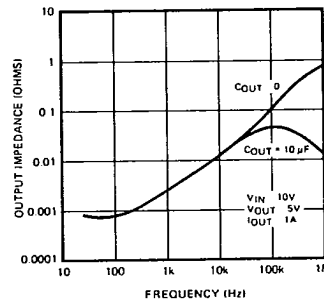
Maximum Average Power
Dissipation for 323K, AK, V, AV



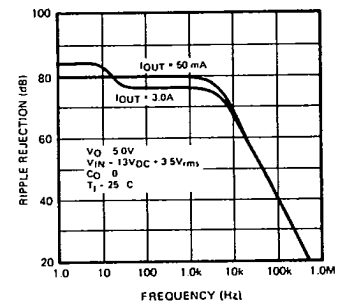
Output Voltage
(Normalized to 1V at $T_j = 25^\circ\text{C}$)



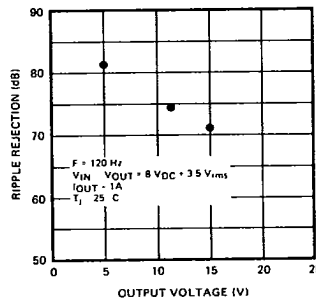
Output Impedance



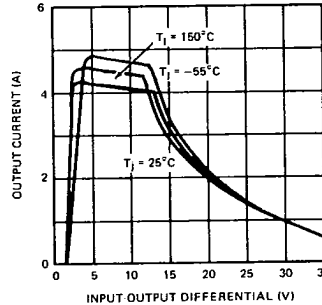
Ripple Rejection



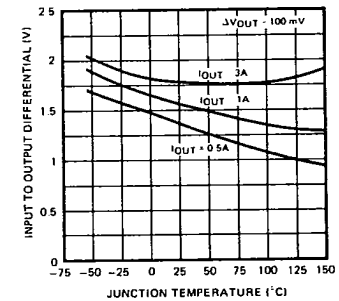
Ripple Rejection



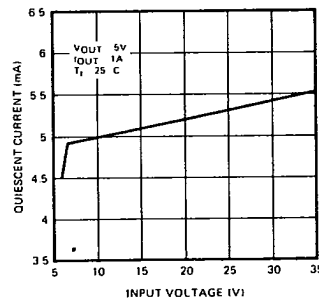
Current Limit



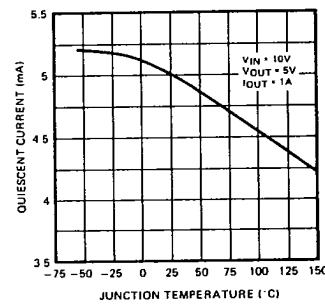
Dropout Voltage



Quiescent Current



Quiescent Current



Section 5 - Voltage Regulators
IP123A, IP223A, IP323A
LM123, LM223, LM323

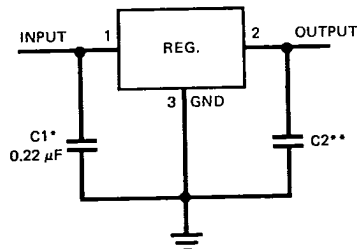
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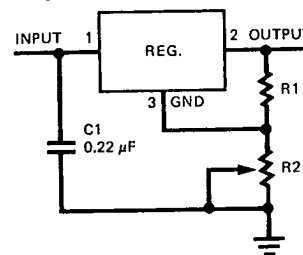
Applications Information

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)

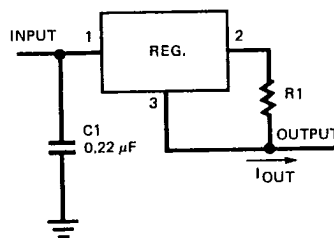
Adjustable Output Regulator



$$V_{OUT} = V_{REG} + (V_{REG}/R_1 + I_Q) R_2$$

$$V_{REG}/R_1 > 3 I_Q, \text{ load regulation } (L_r) \approx \left[\frac{(R_1 + R_2)}{R_1} \right] (L_r \text{ of Regulator})$$

Current Regulator



$$I_{OUT} = \frac{V_{REG}}{R_1} + I_Q$$

$$\Delta I_Q = 3.0 \text{ mA over line and load changes}$$

Section 5 - Voltage Regulators
IP123A, IP223A, IP323A
LM123, LM223, LM323



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Order Information

Part Number	Temperature Range	Package
IP123AK-5	-55°C to +150°C	TO-3
LM123K-5	-55°C to +150°C	TO-3
IP223AK-5	-25°C to +150°C	TO-3
LM223K-5	-25°C to +150°C	TO-3
IP323AK-5	0°C to +125°C	TO-3
LM323K-5	0°C to +125°C	TO-3
IP123AK-12	-55°C to +150°C	TO-3
IP123K-12	-55°C to +150°C	TO-3
IP223AK-12	-25°C to +150°C	TO-3
IP223K-12	-25°C to +150°C	TO-3
IP323AK-12	0°C to +125°C	TO-3
IP323K-12	0°C to +125°C	TO-3
IP123AK-15	-55°C to +150°C	TO-3
IP123K-15	-55°C to +150°C	TO-3
IP223AK-15	-25°C to +150°C	TO-3
IP223K-15	-25°C to +150°C	TO-3
IP323AK-15	0°C to +125°C	TO-3
IP323K-15	0°C to +125°C	TO-3
IP323AV-5	0°C to +125°C	TO-218
IP323V-5	0°C to +125°C	TO-218
IP323AV-12	0°C to +125°C	TO-218
IP323V-12	0°C to +125°C	TO-218
IP323AV-15	0°C to +125°C	TO-218
IP323V-15	0°C to +125°C	TO-218
IP323AT-5	0°C to +125°C	TO-220
LM323T-5	0°C to +125°C	TO-220
IP323AT-12	0°C to +125°C	TO-220
IP323T-12	0°C to +125°C	TO-220
IP323AT-15	0°C to +125°C	TO-220
IP323T-15	0°C to +125°C	TO-220

Section 5 - Voltage Regulators
 IP123A, IP223A, IP323A
 LM123, LM223, LM323

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