T-58-11-13

1.5 Amp, 3-Terminal Negative Regulators

INTEGRATED POWER SEMICONDUCTORS, LTD.

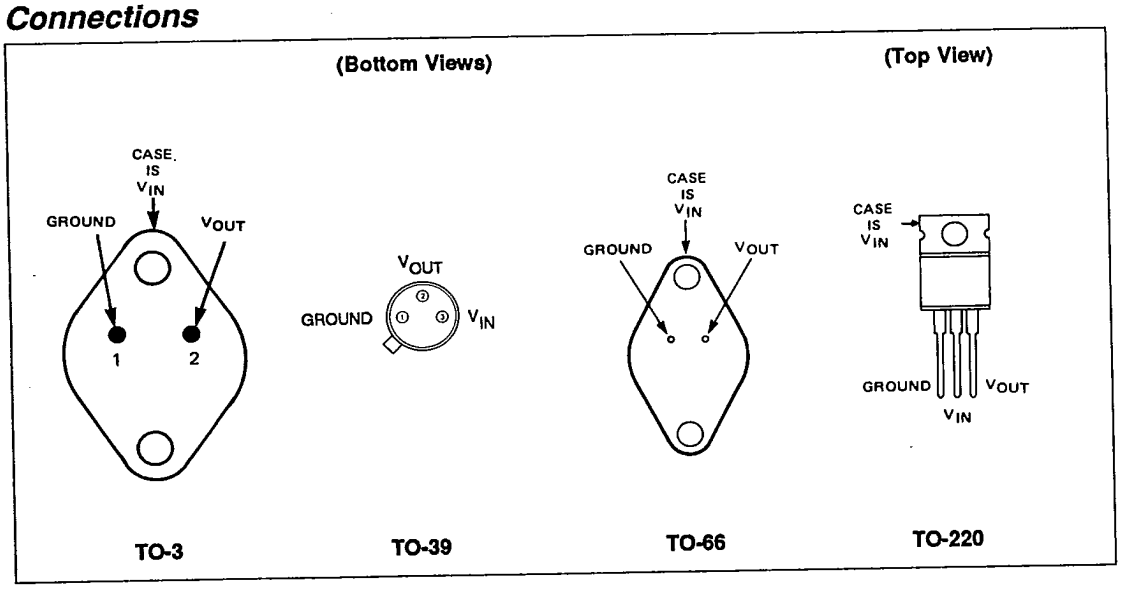
Description

The IP120A/ IP220A/ IP320A/ IP7900A/ IP7900/ IP7900AC/ IP7900C 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 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 IP320A/ IP7900AC/ IP7900C series is also available in the TO-220 plastic power package. The IP120A/ LM120/ IP7900A/ IP7900 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 positive voltage (± supplies) on output

Connections



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Absolute Maximum Ratings

Input Voltage (V_O = –5V, –12V, –15V) 35V

Internal Power Dissipation (Note 1) Internally Limited

Operating Temperature Range (T_j)

IP120A, LM120,	-55°C to +150°C
IP7900A, IP7900	-55°C to +150°C
IP220A, LM220	-25°C to +150°C
IP320A, LM320,	0°C to +125°C
IP7900AC, IP7900C	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
TO-220 Hermetic 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.

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Electrical Characteristics (Note 2)

Parameter	Test Conditions			IP7905A IP7905AC IP120A-5 IP220A-5 IP320A-5 Min	Typ	Max	IP7905 IP7905C Min	Typ	Max	Units
Output Voltage, V_O	K, R, T Pkg., I_O = 500mA, V_{IN} = -10V			-4.95	-5	-5.05	-4.8	-5	-5.2	V
	$P_D \le P_{MAX}$, 5 mA $\le I_O \le I_{MAX}$, -7.5V $\ge V_{IN} \ge$ -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 $\ge V_{IN} \ge$ -20V			-4.75		-5.15	-4.75		-5.25	V
Line Regulation, ΔV_O	I_O = 0.5 I_{MAX}	-7V $\ge V_{IN} \ge$ -25V			3	10			50	mV
		-7.5V $\ge V_{IN} \ge$ -20V	•		3	10				mV
	$I_O \le I_{MAX}$	-8V $\ge V_{IN} \ge$ -12V			1	4			25	mV
			•		2	12				mV
Load Regulation, ΔV_O	K, R, T Pkg,	5 mA $\le I_O \le$ 1.5A			10	25			100	mV
	V_{IN} = -10V	250mA $\le I_O \le$ 750mA			4	15			50	mV
	5 mA $\le I_O \le I_{MAX}$, V_{IN} = -10V		•		7	25				mV
Quiescent Current, I_Q	$I_O \le$ 0.5 I_{MAX},				1	1.9			8	mA
	V_{IN} = -10V		•		1	2				mA
Quiescent Current Change, ΔI_Q	5 mA $\le I_O \le I_{MAX}$				0.2	0.4			0.5	mA
	V_{IN} = -10V		•		0.2	0.5				mA
	$I_O \le$ 0.5 I_{MAX}, -7V $\ge V_{IN} \ge$ -25V				0.1	0.4			1.0	mA
	$I_O \le$ 0.5 I_{MAX}, -8V $\ge V_{IN} \ge$ -25V		•		0.1	0.5				mA
Output Noise Voltage, V_N	10 Hz $\le f \le$ 100 kHz, V_{IN} = -10V				40	400		40		μV
Ripple Rejection, $\Delta V_{IN}/\Delta V_{OUT}$	f = 120 Hz	$I_O \le I_{MAX}$		66	80			80		dB
	-8 V $\ge V_{IN} \ge$ -18V	$I_O \le$ 0.5 I_{MAX}	•	66	80			80		dB
Dropout Voltage	$I_{OUT} = I_{MAX}$				1.1	2.3		1.1		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		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			IP7912A IP7912AC IP120A-12 IP220A-12 IP320A-12 Min	Typ	Max	IP7912 IP7912C Min	Typ	Max	Units
Output Voltage, V_O	K, R, T Pkg., I_O=500mA, V_{IN} = -19V			-11.88	-12	-12.12	-11.5	-12	-12.5	V
	$P_D \le P_{MAX}$, 5 mA ≤ $I_O \le I_{MAX}$, -14.8V ≥ V_{IN} ≥ -27V		•	-11.64		-12.36	-11.4		-12.6	V
Low Supply, V_O	$P_D \le P_{MAX}$, 5 mA ≤ $I_O \le I_{MAX}$, -14.5V ≥ V_{IN} ≥ -27V			11.40		-12.36	-11.4		-12.6	V
Line Regulation, ΔV_O	I_O = 0.5 I_{MAX}	-14.5V ≥ V_{IN} ≥ -30V			4	18			120	mV
		-14.8V ≥ V_{IN} ≥ -27V	•		4	18				mV
	$I_O \le I_{MAX}$	-16V ≥ V_{IN} ≥ -22V			2	9			60	mV
			•		4	30				mV
Load Regulation, ΔV_O	K, R, T Package	5 mA ≤ I_O ≤ 1.5A			12	32			240	mV
	V_{IN} = -19V	250mA ≤ I_O ≤ 750mA			4	19			120	mV
	5 mA ≤ $I_O \le I_{MAX}$, V_{IN} = -19V		•		8	60				mV
Quiescent Current, I_Q	$I_O \le 0.5\ I_{MAX}$				1	1.9			8	mA
	V_{IN} = -19V		•		1	2				mA
Quiescent Current Change, ΔI_Q	5 mA ≤ $I_O \le I_{MAX}$				0.2	0.4			0.5	mA
	V_{IN} = -19V		•		0.2	0.5				mA
	$I_O \le 0.5\ I_{MAX}$, -14.5V ≥ V_{IN} ≥ -30V				0.1	0.4			1.0	mA
	$I_O \le 0.5\ I_{MAX}$, -15V ≥ V_{IN} ≥ -30V		•		0.1	0.5				mA
Output Noise Voltage, V_N	10 Hz ≤ f ≤ 100 kHz, V_{IN} = -19V				75	960		75		µV
Ripple Rejection, $\Delta V_{IN}/\Delta V_{OUT}$	f = 120Hz	$I_O \le I_{MAX}$		58	72			72		dB
	-15V ≥ V_{IN} ≥ -25V	$I_O \le 0.5\ I_{MAX}$	•	58	72			72		dB
Dropout Voltage	$I_{OUT} = I_{MAX}$				1.1	2.3		1.1		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			IP7915A IP7915AC IP120A-15 IP220A-15 IP320A-15 Min	Typ	Max	IP7915 IP7915C Min	Typ	Max	Units
Output Voltage, V_O	K, R,T Pkg., I_O =500mA, V_{IN} = -23V			-14.85	-15	-15.15	-14.4	-15	-15.6	V
	$P_D \le P_{MAX}$, 5 mA $\le I_O \le I_{MAX}$ -17.9V $\ge V_{IN} \ge$ -30V		•	-14.55		-15.45	-14.25		-15.75	V
Low Supply, V_O	$P_D \le P_{MAX}$, 5 mA $\le I_O \le I_{MAX}$ -17.5V $\ge V_{IN} \ge$ -30V			-14.25		-15.45	-14.25		-15.75	V
Line Regulation, ΔV_O	I_O = 0.5 I_{MAX}	-17.5V $\ge V_{IN} \ge$ -30V			4	22			150	mV
		-17.9V $\ge V_{IN} \ge$ -30V	•		4	22				mV
	$I_O \le I_{MAX}$	-20V $\ge V_{IN} \ge$ -26V			2	10			75	mV
			•		5	30				mV
Load Regulation, ΔV_O	K, R, T Pkg.	5 mA $\le I_O \le$ 1.5A			12	35			300	mV
	V_{IN} = -23V	250mA $\le I_O \le$ 750mA			4	21			150	mV
	5 mA $\le I_O \le I_{MAX}$, V_{IN} = -23V		•		9	75				mV
Quiescent Current, I_Q	$I_O \le$ 0.5 I_{MAX}				1	1.9			8	mA
	V_{IN} = -23V		•		1	2				mA
Quiescent Current Change, ΔI_Q	5 mA $\le I_O \le I_{MAX}$				0.2	0.4			0.5	mA
	V_{IN} = -23V		•		0.2	0.5				mA
	$I_O \le$ 0.5 I_{MAX}, -17.5V $\ge V_{IN} \ge$ -30V				0.1	0.4			1.0	mA
	$I_O \le$ 0.5 I_{MAX}, -18.5V $\ge V_{IN} \ge$ -30V		•		0.1	0.5				mA
Output Noise Voltage, V_N	10 Hz $\le f \le$ 100 kHz, V_{IN} = -23V				90	1200		90		µV
Ripple Rejection, $\Delta V_{IN}/\Delta V_{OUT}$	f = 120Hz	$I_O \le I_{MAX}$		56	70			70		dB
	-18.5V $\ge V_{IN} \ge$ -28.5V	$I_O \le$ 0.5 I_{MAX}	•	56	70			70		dB
Dropout Voltage	$I_{OUT} = I_{MAX}$				1.1	2.3		1.1		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 = 5 mA				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 2.2 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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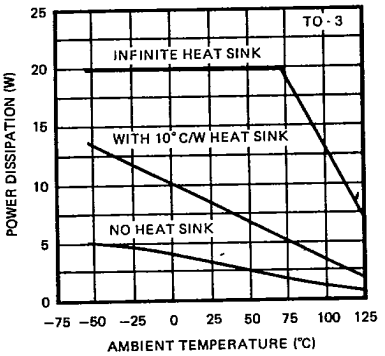
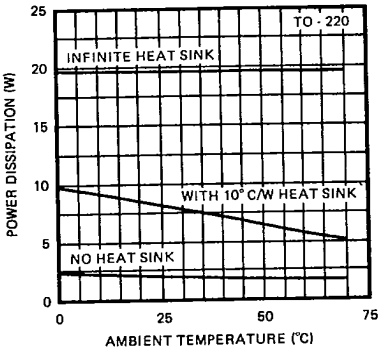
Typical Performance Characteristics

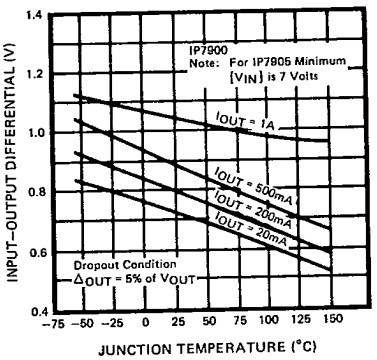
Maximum Average Power Dissipation



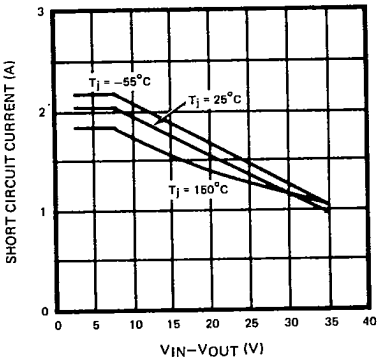
Maximum Average Power Dissipation



Dropout Voltage

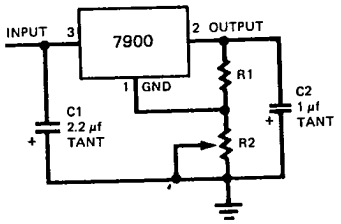


Peak Output Current



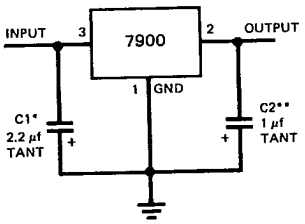
Application Information

Adjustable Output Regulator



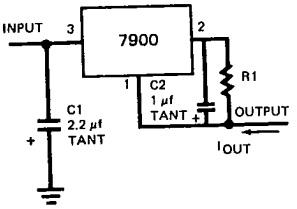
$$V_{out} \approx V_{reg} \frac{(R_1 + R_2)}{R_1}$$

Fixed Output Regulator



*Required if the regulator is located far from the power supply filter.
**Required for stability. 25 µf electrolytic may be substituted.

Current Regulator



$$I_{out} = \frac{V_{reg}}{R1} + I_Q$$

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Order Information

Part Number	Temperature Range	Package
IP120AK-XX/LM120K-XX	-55°C to +150°C	TO-3
IP7900AK/IP7900K	-55°C to +150°C	TO-3
IP120AR-XX/IP120R-XX	-55°C to +150°C	TO-66
IP7900AR/IP7900R	-55°C to +150°C	TO-66
IP120AG-XX/IP120G-XX	-55°C to +150°C	Hermetic TO-220
IP7900AG/IP7900G	-55°C to +150°C	Hermetic TO-220
IP120AH-XX/LM120H-XX	-55°C to +150°C	TO-39
IP7900AH/IP7900H	-55°C to +150°C	TO-39
IP220AK-XX/LM220K-XX	-25°C to +150°C	TO-3
IP220AR-XX/IP220R-XX	-25°C to +150°C	TO-66
IP320AK-XX/LM320K-XX	0°C to +125°C	TO-3
IP7900ACK/IP7900CK	0°C to +125°C	TO-3
IP320AR-XX/IP320R-XX	0°C to +125°C	TO-66
IP7900ACR/IP7900CR	0°C to +125°C	TO-66
IP320AT-XX/LM320T-XX	0°C to +125°C	TO-220
IP7900ACT/IP7900CT	0°C to +125°C	TO-220

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