INTEGRATED POWER SEMICONDUCTORS, LTD.

5 Amp Positive Adjustable Regulators

Description

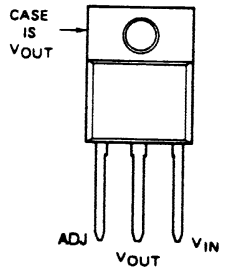
The IP138A series are 3-terminal positive adjustable voltage regulators capable of supplying in excess of 5A over a 1.25V to 35V output range. These regulators are exceptionally easy to use and require only two external resistors to set the output voltage. In addition to improved line and load regulation, a major feature of the "A" series is the initial output voltage tolerance, which is guaranteed to be less than 1%. Over full operating conditions, including load, line and power dissipation, the reference voltage is guaranteed not to vary more than 2%. These devices exhibit current limit, thermal overload protection, and improved power device safe operating area protection, making them essentially indestructible.

Features

- **Available in low cost TO-218**
- **Guaranteed 1% output voltage tolerance**
- **Guaranteed 0.3% load regulation**
- **Guaranteed 0.01%/V line regulation**
- **Internal current limiting constant with temperature**
- **Internal thermal overload protection**
- **Improved output transistor safe operating area compensation**
- **Output adjustable between 1.25V and 35V**
- **100% thermal limit burn-in**

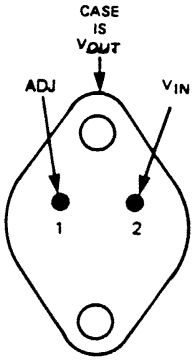
Connections

(Top View)



TO-218 Plastic

(Bottom View)



TO-3 Metal Can

Absolute Maximum Ratings

Power Dissipation Internally Limited

Input to Output Voltage Differential 35V

Operating Junction Temperature Range

IP138A, LM138	–55°C to +150°C
IP238A, LM238	–25°C to +150°C
IP338A, LM338	0°C to +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.

Electrical Characteristics (Note1)

Parameter	Test Conditions			IP138A IP238A			LM138 LM238			Units
				Min	Typ	Max	Min	Typ	Max	
Reference Voltage, V_{REF}	I_{OUT} = 10 mA			1.238	1.250	1.262				V
	3V ≤ (V_{IN} - V_{OUT}) ≤ 35V 10mA ≤ I_{OUT} ≤ 5A , P ≤ 50W		•	1.225	1.250	1.270	1.19	1.24	1.29	V
Line Regulation, $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	3V ≤ (V_{IN} - V_{OUT}) ≤ 35V (See Note 2)				0.005	010		0.005	0.01	%/V
			•		0.020	0.04		0.020	0.04	%/V
Load Regulation, $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	10 mA ≤ I_{OUT} ≤ 5A (See Note 2)	V_O ≤ 5V			5	15		5	15	mV
		V_O ≥ 5V			0.1	0.3		0.1	0.3	%
		V_O ≤ 5V	•		20	30		20	30	mV
		V_O ≥ 5V	•		0.3	0.6		0.3	0.6	%
Thermal Regulation	20 msec Pulse				0.002	0.01		0.002	0.01	%/W
Ripple Rejection	V_{OUT} = 10V, f = 120 Hz	C_{ADJ} = 0	•		60			60		dB
		C_{ADJ} = 10µF	•	60	75		60	75		dB
Adjust Pin Current, I_{ADJ}			•		45	100		45	100	µA
Adjust Pin Current Change, ΔI_{ADJ}	10 mA ≤ I_{OUT} ≤ 5A 3V ≤ (V_{IN} - V_{OUT}) ≤ 35V		•		0.2	5		0.2	5	µA
Minimum Load Current, I_{MIN}	(V_{IN} - V_{OUT}) = 35V		•		3.5	5		3.5	5	mA
Current Limit, I_{SC}	(V_{IN} - V_{OUT}) ≤ 10V	DC	•	5	8		5	8		A
		0.5ms peak	•	7	12		7	12		A
	(V_{IN} - V_{OUT}) = 30V				1			1		A
Temperature Stability, $\frac{\Delta V_{OUT}}{\Delta TEMP}$			•		1	2		1		%
Long Term Stability, $\frac{\Delta V_{OUT}}{\Delta TIME}$	T_A = 125°C, 1000 Hrs				0.3	1		0.3	1	%
RMS Output Noise (% of V_{OUT}), e_n	10Hz ≤ f ≤ 10khz				0.001			0.001		%
Thermal Resistance Junction to Case, Θ_{jc}	K Package					1			1	°C/W

Electrical Characteristics (Note 1)

Parameter	Test Conditions			IP338A Min	IP338A Typ	IP338A Max	LM338 Min	LM338 Typ	LM338 Max	Units
Reference Voltage, V_{REF}	I_{OUT} = 10 mA			1.238	1.250	1.262				V
	3V ≤ (V_{IN} - V_{OUT}) ≤ 35V		•	1.225	1.250	1.270	1.19	1.24	1.29	V
	10mA ≤ I_{OUT} ≤ 5A, P≤ 50W									
Line Regulation, $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	3V ≤ (V_{IN} - V_{OUT} ≤ 35V				0.005	0.01		0.005	0.03	%/V
	(See Note 2)		•		0.02	0.04		0.020	0.06	%/V
Load Regulation, $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	10 mA ≤ I_{OUT} ≤ 5A	V_O ≤ 5V			5	15		5	25	mV
	(See Note 2)	V_O ≥ 5V			0.1	0.3		0.1	0.5	%
		V_O ≤ 5V	•		20	30		20	50	mV
		V_O ≥ 5V	•		0.3	0.6		0.3	1	%
Thermal Regulation	20 msec Pulse				0.002	0.02		0.002	0.02	%/W
Ripple Rejection	V_{OUT} = 10V,	C_{ADJ} = 0	•		60			60		dB
	f = 120 Hz	C_{ADJ} = 10μF	•	60	75		60	75		dB
Adjust Pin Current, I_{ADJ}			•		45	100		45	100	μA
Adjust Pin Current Change, ΔI_{ADJ}	10 mA ≤ I_{OUT} ≤ 5A,		•		0.2	5		0.2	5	μA
	3V ≤ (V_{IN} - V_{OUT}) ≤ 35V									
Minimum Load Current, I_{MIN}	(V_{IN} - V_{OUT}) = 35V		•		3.5	10		3.5	10	mA
Current Limit, I_{SC}	(V_{IN} - V_{OUT}) ≤ 10V	DC	•	5	8		5	8		A
		0.5ms peak	•	6	12		6	12		A
	(V_{IN} - V_{OUT}) = 30V				1			1		A
Temperature Stability, $\frac{\Delta V_{OUT}}{\Delta TEMP}$			•		1	2		1		%
Long Term Stability, $\frac{\Delta V_{OUT}}{\Delta TIME}$	T_A = 125°C, 1000 hrs				0.3	1		0.3	1	%
RMS Output Noise (% of V_{OUT}), e_n	10Hz ≤ f ≤ 10khz				0.001			0.003		%
Thermal Resistance Junction	K Package					1			1	°C/W
to Case, θ_{jc}	V Package					1			1	°C/W

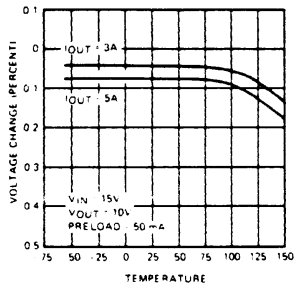
The • denotes the specifications which apply over the full operating temperature range, all others apply at T_j = 25°C unless otherwise specified.

Note 1. Unless otherwise specified, these specifications apply for V_{IN} - V_{OUT} = 5V, I_{OUT} = 2.5A. Although power dissipation is internally limited, these specifications apply for dissipations of 50W and I_{MAX} = 5A.

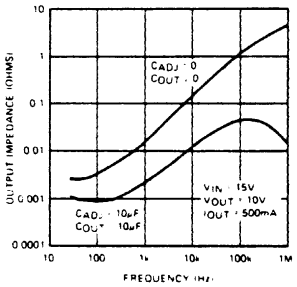
Note 2. Regulation is measured at constant junction temperature, using pulse testing at a low duty cycle. Changes in output voltage due to heating effects are covered under thermal regulation specifications. Load regulation is measured from the bottom of the package for the TO-3, and at the junction of the wide and narrow portion of the output lead for the TO-218.

Typical Performance Characteristics

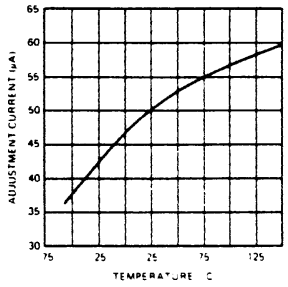
Load Regulation



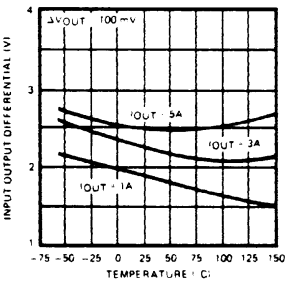
Output Impedance



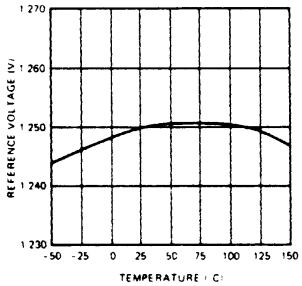
Adjustment Current



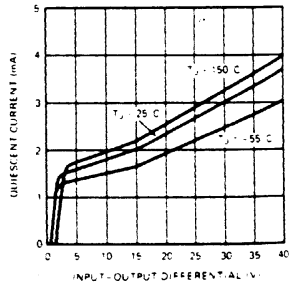
Dropout Voltage



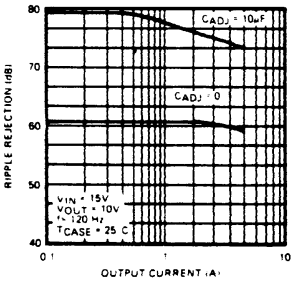
Temperature Stability



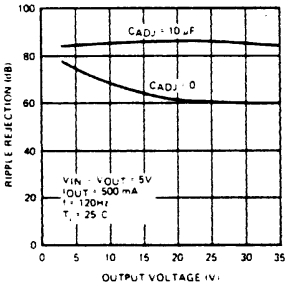
Minimum Operating Current



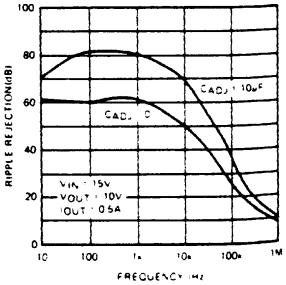
Ripple Rejection



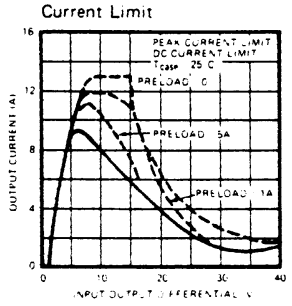
Ripple Rejection



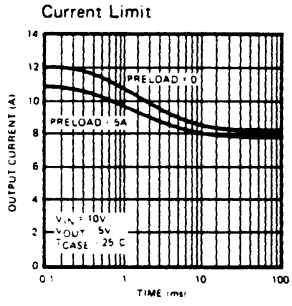
Ripple Rejection



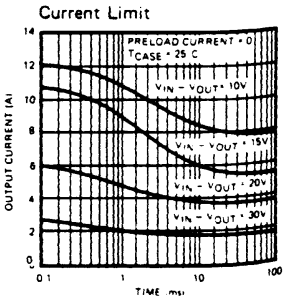
Current Limit



Current Limit

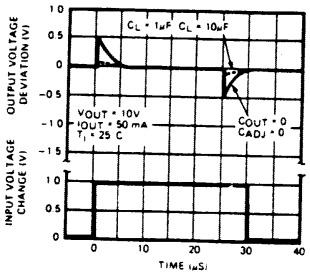


Current Limit

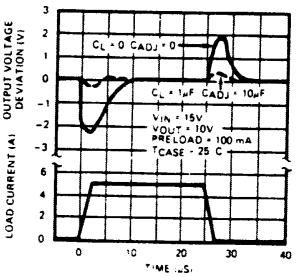


Typical Performance Characteristics (Cont.)

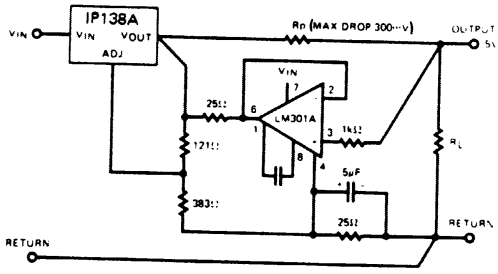
Line Transient Response



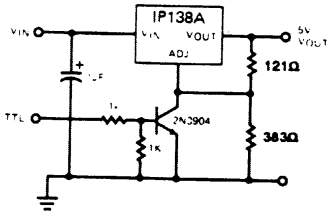
Load Transient Response



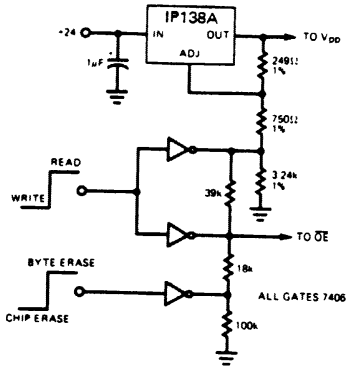
Typical Applications



Remote Sensing

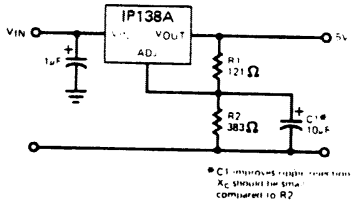


5V Regulator with Shut Down

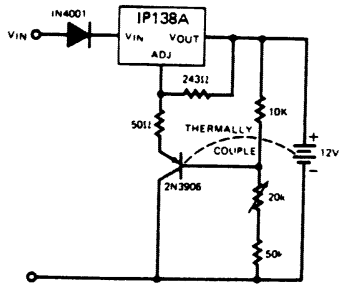


	$\overline{OE}$	V_{PP}
READ	0V	5V
WRITE		
BYTE	5V	21V
CHIP ERASE	12V	21V

2816 EEPROM Supply Programmer for Read/Write Control



Improving Ripple Rejection



Temperature Compensated Lead Acid Battery Charger