

4825898 INTEGRATED POWER

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T-58-11-23

1.5A, 3-Terminal, Negative Adjustable Regulators

INTEGRATED POWER SEMICONDUCTORS, LTD.

Description

The IP137A family of negative adjustable regulators will deliver up to 1.5 amps output current over an output voltage range of -1.2V to -47V. Integrated Power has made significant improvements in these regulators compared to previous devices, such as better line and load regulation, and a maximum output voltage error of 1%.

Internal current and power limiting coupled with true thermal limiting prevents device damage due to overloads or shorts, even if the regulator is not fastened to a heat sink.

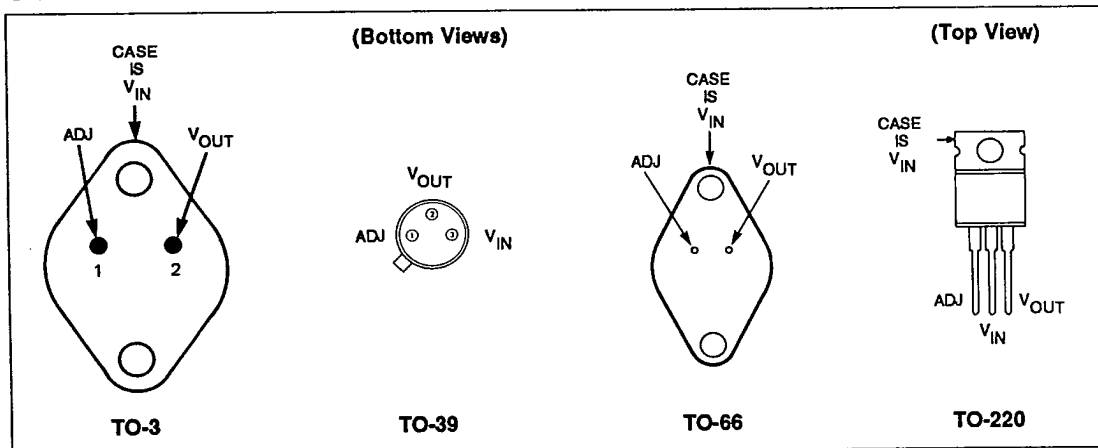
Maximum reliability is attained with Integrated Power's advanced processing techniques combined with a 100% burn-in in the thermal limit mode. This assures that all device protection circuits are working and eliminates field failures experienced with other regulators that receive only standard electrical testing.

Features

- 1% initial voltage tolerance
- 0.01%/V line regulation
- 0.5% load regulation
- 0.02%/W thermal regulation
- 100% thermal limit burn-in

Section 5 - Voltage Regulators
 IP137A, IP237A, IP337A, LM137, LM237, LM337
 IP137AHV, IP237AHV, IP337AHV,
 LM137HV, LM237HV, LM337HV

Connections



Support

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Absolute Maximum Ratings

Power Dissipation	Internally Limited
Input to output voltage differential	40V
Input to output voltage differential(HV)	50V
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	300°C

Operating Junction Temperature Range	
IP137AHV, IP137A	-55°C to +150°C
LM137HV, LM137	-55°C to +150°C
IP237AHV, IP237A	-25°C to +150°C
LM237HV, LM237	-25°C to +150°C
IP337AHV, IP337A	0°C to +125°C
LM337HV, LM337	0°C to +125°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.

Preconditioning: 100% Thermal Limit Burn-in

Electrical Characteristics (Notes 1 and 3)

Parameter	Test Conditions	IP137A IP237A IP137AHV IP237AHV			LM137 LM237 LM137HV LM237HV			Units	
		Min	Typ	Max	Min	Typ	Max		
Reference Voltage, V _{REF}	I _{OUT} = 10 mA	-1.238	-1.250	-1.262	-1.225	-1.250	-1.275	V	
	3V ≤ [V _{IN} - V _{OUT}] ≤ V _{MAX} 10 mA ≤ I _{OUT} ≤ I _{MAX} , P ≤ P _{MAX}	-1.220	-1.250	-1.280	-1.200	-1.250	-1.300	V	
Line Regulation, ΔV _{OUT} /ΔV _{IN}	3V ≤ [V _{IN} - V _{OUT}] ≤ V _{MAX} (See Note 2)		0.005	0.010		0.010	0.020	%/V	
			0.010	0.030		0.020	0.050	%/V	
Load Regulation, ΔV _{OUT} /ΔI _{OUT}	10 mA ≤ I _{OUT} ≤ I _{MAX} (See Note 2 and 3)	[V _O] ≤ 5V		5	25		15	25	mV
		[V _O] ≥ 5V		0.1	0.5		0.3	0.5	%
		[V _O] ≤ 5V		10	50		20	50	mV
		[V _O] ≥ 5V		0.2	1.0		0.3	1.0	%
Thermal Regulation	T _A = 25°C, 10 msec Pulse		0.002	0.02		0.002	0.02	%/W	
Ripple Rejection	V _{OUT} = -10V, f = 120 Hz	C _{ADJ} = 0	60	66		60		dB	
		C _{ADJ} = 10μF	70	80		66	77	dB	
Adjust Pin Current, I _{ADJ}			65	100		65	100	μA	
Adjust Pin Current Change, ΔI _{ADJ}	10 mA ≤ I _{OUT} ≤ I _{MAX} 3V ≤ [V _{IN} - V _{OUT}] ≤ 40V		0.2	2		0.5	5	μA	
	3V ≤ [V _{IN} - V _{OUT}] ≤ 50V, HV Series		1.0	5		2	5	μA	
	3V ≤ [V _{IN} - V _{OUT}] ≤ 50V, HV Series		2.0	6		3	6	μA	
Minimum Load Current, I _{MIN}	[V _{IN} - V _{OUT}] ≤ 40V		2.5	5.0		2.5	5.0	mA	
	[V _{IN} - V _{OUT}] ≤ 10V		1.2	3.0		1.2	3.0	mA	
Current Limit, I _{CL}	[V _{IN} - V _{OUT}] ≤ 15V	K, R, T Package	1.5	2.2	3.2	1.5	2.2	3.2	A
		H Package	0.5	0.8	1.5	0.5	0.8	1.5	A
	[V _{IN} - V _{OUT}] = 40V	K, R, T Package	0.24	0.4		0.24	0.4		A
		H Package	0.15	0.17		0.15	0.17		A
	[V _{IN} - V _{OUT}] = 50V HV Series	K, R, T Package	0.2	0.4	0.8	0.2	0.4	0.8	A
		H Package	0.1	0.17	0.5	0.1	0.17	0.5	A
Temperature Stability, ΔV _{OUT} /ΔTEMP			0.6	1.5		0.6		%	
Long Term Stability, ΔV _{OUT} /ΔTIME	T _A = 125°C, 1000 Hrs		0.3	1		0.3	1	%	
RMS Output Noise (% of V _{OUT}), e _n	T _A = 25°C, 10Hz ≤ f ≤ 10kHz		0.003			0.003		%	
Thermal Resistance Junction to Case, θ _{jc}	K Package		2.3	3		2.3	3	°C/W	
	R Package		5	7		5	7	°C/W	
	H Package		12	15		12	15	°C/W	

Section 5 - Voltage Regulators
 IP137A, IP237A, IP337A, LM137, LM237, LM337,
 IP137AHV, IP237AHV, IP337AHV,
 LM137HV, LM237HV, LM337HV



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Parameter	Test Conditions	IP337A IP337AHV			LM337 LM337HV			Units	
		Min	Typ	Max	Min	Typ	Max		
Reference Voltage, V_{REF}	$I_{OUT} = 10\text{ mA}$	-1.238	-1.250	-1.262	-1.213	-1.250	-1.287	V	
	$3\text{V} \leq [V_{IN} - V_{OUT}] \leq V_{MAX}$ $10\text{ mA} \leq I_{OUT} \leq I_{MAX}$, $P \leq P_{MAX}$	-1.220	-1.250	-1.280	-1.200	-1.250	-1.300	V	
Line Regulation, $\Delta V_{OUT}/\Delta V_{IN}$	$3\text{V} \leq [V_{IN} - V_{OUT}] \leq V_{MAX}$ (See Note 2)		0.005	0.010		0.010	0.040	%/V	
			0.010	0.03		0.020	0.070	%/V	
Load Regulation, $\Delta V_{OUT}/\Delta I_{OUT}$	$10\text{ mA} \leq I_{OUT} \leq I_{MAX}$, (See Note 2 and 3)	$[V_O] \leq 5\text{V}$		5	25		15	50	mV
		$[V_O] \geq 5\text{V}$		0.1	0.5		0.3	1.0	%
		$[V_O] \leq 5\text{V}$	*	10	50		20	70	mV
		$[V_O] \geq 5\text{V}$	*	0.2	1.0		0.3	1.5	%
Thermal Regulation	$T_A = 25^\circ\text{C}$, 10 msec Pulse		0.002	0.020		0.003	0.04	%/W	
Ripple Rejection	$V_{OUT} = -10\text{V}$, $f = 120\text{ Hz}$	$C_{ADJ} = 0$	60	66		60		dB	
		$C_{ADJ} = 10\mu\text{F}$	70	80		66	77	dB	
Adjust Pin Current, I_{ADJ}			65	100		65	100	μA	
Adjust Pin Current Change, ΔI_{ADJ}	$10\text{ mA} \leq I_{OUT} \leq I_{MAX}$ $3\text{V} \leq [V_{IN} - V_{OUT}] \leq 40\text{V}$ $3\text{V} \leq [V_{IN} - V_{OUT}] \leq 50\text{V}$	*	0.2	2		0.5	5	μA	
Minimum Load Current, I_{MIN}	$[V_{IN} - V_{OUT}] \leq 40\text{V}$	*	2.5	5		2.5	10	mA	
	$[V_{IN} - V_{OUT}] \leq 10\text{V}$	*	1.2	3.0		1	6	mA	
Current Limit, I_{CL}	$[V_{IN} - V_{OUT}] \leq 15\text{V}$	K, R, T Package	1.5	2.2	3.5	1.5	2.2	3.5	A
		H Package	0.5	0.8	1.8	0.5	0.8	1.8	A
	$[V_{IN} - V_{OUT}] = 40\text{V}$	K, R, T Package	0.24	0.5	1.0	0.15	0.4		A
		H Package	0.15	0.17		0.10	0.17		A
	$[V_{IN} - V_{OUT}] = 50\text{V}$	K, R, T Package	0.2	0.4	0.8	0.1	0.4	0.8	A
		H Package	0.1	0.17	0.5	0.05	0.17	0.5	A
Temperature Stability, $\Delta V_{OUT}/\Delta T_{EMP}$		*	0.6	1.5		0.6		%	
Long Term Stability, $\Delta V_{OUT}/\Delta T_{IME}$	$T_A = 125^\circ\text{C}$, 1000 Hrs		0.3	1		0.3	1	%	
RMS Output Noise (% of V_{OUT}), e_n	$T_A = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 10\text{ kHz}$		0.003			0.003		%	
Thermal Resistance Junction to Case, θ_{JC}	K Package		2.3	3		2.3	3	$^\circ\text{C/W}$	
	R Package		5	7		5	7	$^\circ\text{C/W}$	
	T Package		4	5		4		$^\circ\text{C/W}$	
	H Package		12	15		12	15	$^\circ\text{C/W}$	

Section 5 - Voltage Regulators
 IP137A, IP237A, IP337A, LM137, LM237, LM337
 IP137AHV, IP237AHV, IP337AHV,
 LM137HV, LM237HV, LM337HV

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 1:** Unless otherwise specified, $[V_{IN} - V_{OUT}] = 5\text{V}$, $I_{OUT} = 0.1\text{A}$ for the TO-39 (H) Package, and $I_{OUT} = 0.5\text{A}$ for the TO-3 (K), TO-66 (R), and TO-220 (T) Packages. Although power dissipation is internally limited, these specifications apply for dissipations up to 2W for the TO-39, and 20W for the TO-3, TO-66 and TO-220. $I_{MAX} = 0.5\text{A}$ for the TO-39 and 1.5A for the TO-3, TO-66 and TO-220.
- 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 at a point 1/8" from the bottom of the package for the TO-3 and TO-66, at the junction of the wide and narrow portion of the output lead for the TO-220, and 1/8" below the base of the package on the output pin of the TO-39.
- Note 3:** $V_{MAX} = 40\text{V}$, IP137A, IP237A, IP337A, LM137, LM237, LM337.
 $V_{MAX} = 50\text{V}$ for IP137AHV, IP237AHV, IP337AHV, LM137HV, LM237HV, LM337HV.

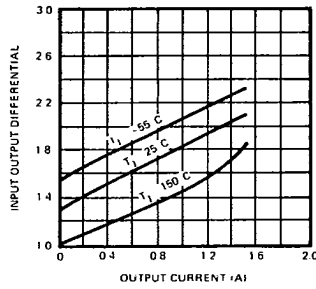


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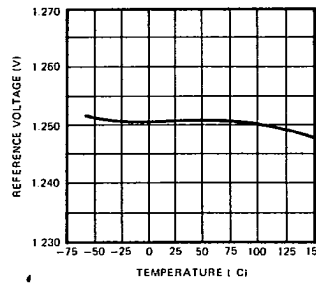
Typical Performance Characteristics

Section 5 - Voltage Regulators
 IP137A, IP237A, IP337A, LM137, LM237, LM337
 IP137AHV, IP237AHV, IP337AHV,
 LM137HV, LM237HV, LM337HV

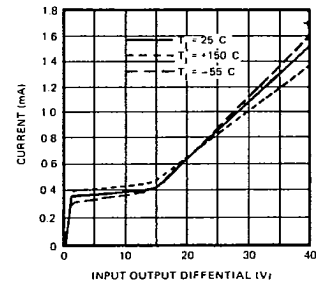
Dropout Voltage



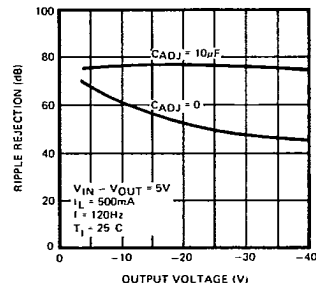
Temperature Stability



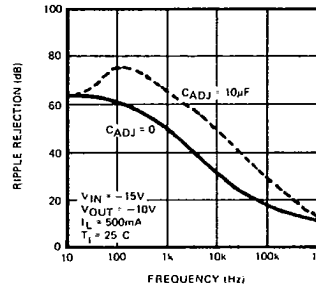
Minimum Load Current



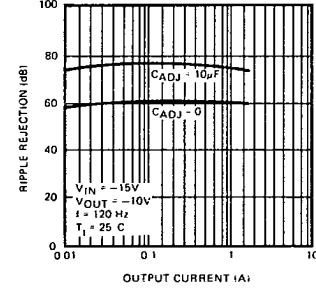
Ripple Rejection



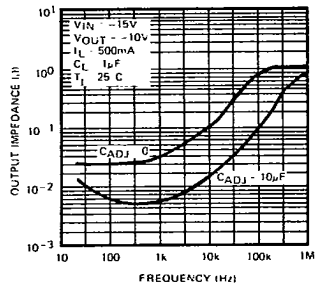
Ripple Rejection



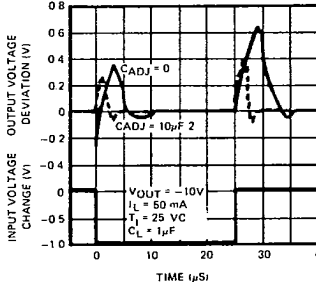
Ripple Rejection



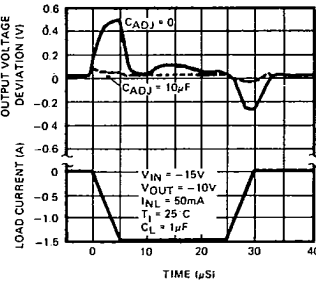
Output Impedance



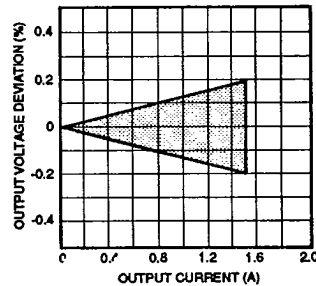
Line Transient Response



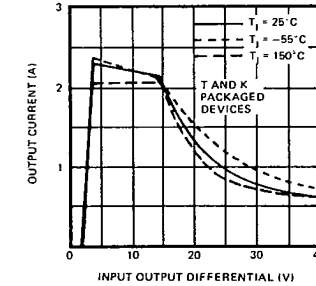
Load Transient Response



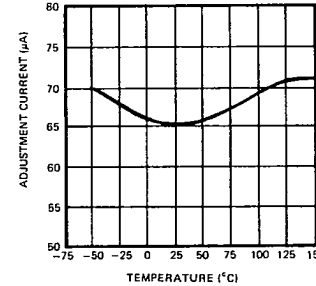
Load Regulation*



Current Limit



Adjustment Current



*The IP137A/AHV, IP237A/AHV, IP337A/AHV series has load compensation which makes the typical unit read close to zero. This band represents the typical production spread.

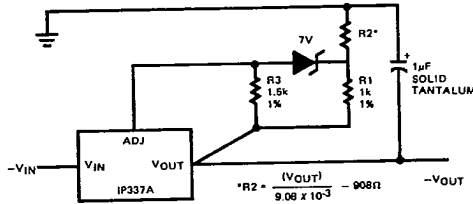


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Applications Information

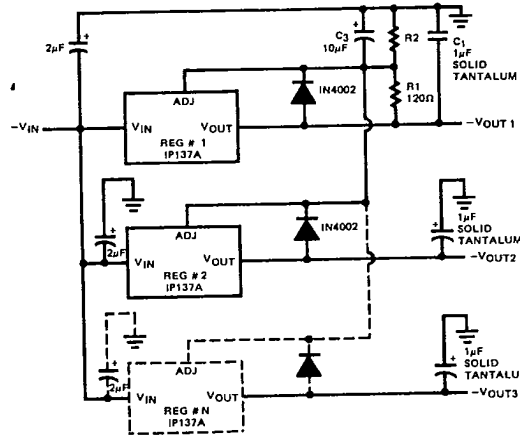
High Stability Regulator:

The output stability, load regulation, line regulation, thermal regulation, temperature drift, long term drift, and noise, can be improved by a factor of 6.6 over the standard regulator configuration. This assumes a zener has 20PPM/°C maximum drift and about 10 times lower noise than the regulator.

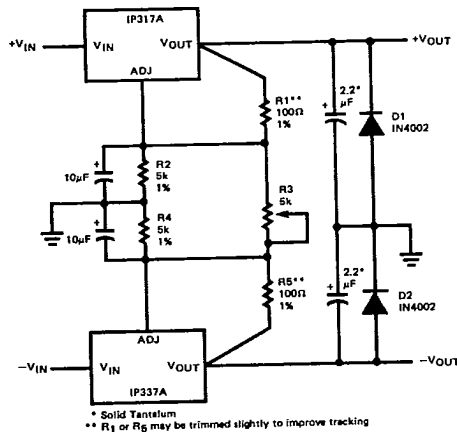


Multiple Tracking Regulators

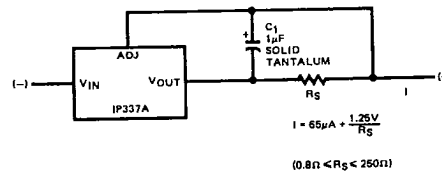
In the application shown below, regulator #2 to "N" will track regulator #1 to within ±24mV initially, and to ±60mV over all load, line, and temperature conditions. If any regulator output is shorted to ground, all other outputs will drop to ~2V. Load regulation of regulators 2 to "N" will be improved by $V_{OUT}/1.25V$ compared to a standard regulator, so regulator #1 should be the one which has the lowest load current.



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 IP137A, IP237A, IP337A, LM137, LM237, LM337
 IP137AHV, IP237AHV, IP337AHV,
 LM137HV, LM237HV, LM337HV



Dual Tracking Supply ±1.25V to ±20V



Current Regulator



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Order Information

Part Number	Temperature Range	Package
IP137AK/IP137AHVK/LM137K/LM137HVK	-55°C to +150°C	TO-3
IP137AH/IP137AHVH/LM137H/LM137HVH	-55°C to +150°C	TO-39
IP137AR/IP137AHVR/IP137R/IP137HVR	-55°C to +150°C	TO-66
IP137AG/IP137AHVG/IP137G/IP137HVG	-55°C to +150°C	Hermetic TO-220
IP237AK/IP237AHVK/LM237K/LM237HVK	-25°C to +150°C	TO-3
IP237AR/IP237AHVR/IP237R/IP237HVR	-25°C to +150°C	TO-66
IP337AK/IP337AHVK/LM337K/LM337HVK	0°C to +125°C	TO-3
IP337AR/IP337AHVR/IP337R/IP337HVR	0°C to +125°C	TO-66
IP337AT/IP337AHVT/LM337T/LM337HVT	0°C to +125°C	TO-220

Section 5 - Voltage Regulators
 IP137A, IP237A, IP337A, LM137, LM237, LM337
 IP137AHV, IP237AHV, IP337AHV,
 LM137HV, LM237HV, LM337HV

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