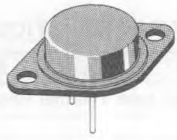
SGS-THOMSON MICROELECTRONICS

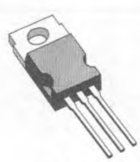
LM237
LM337

THREE-TERMINAL ADJUSTABLE NEGATIVE VOLTAGE REGULATORS

- OUTPUT VOLTAGE ADJUSTABLE DOWN TO V_{ref}
- 1.5A GUARANTEED OUTPUT CURRENT
- 0.3%/V TYPICAL LOAD REGULATION
- 0.01%/V TYPICAL LINE REGULATION
- CURRENT LIMIT CONSTANT WITH TEMPERATURE
- RIPPLE REJECTION : 77dB
- STANDARD 3-LEAD TRANSISTOR PACKAGES
- EXCELLENT THERMAL REGULATION : 0.002%/V
- 50ppm/°C TEMPERATURE COEFFICIENT



TO-3



TO-220

DESCRIPTION

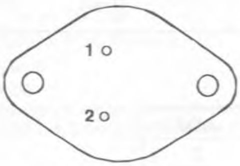
The LM237 series are adjustable 3-terminal negative voltage regulators capable of supplying in excess - 1.5A over a - 1.2 to - 37V output voltage range. They are exceptionally easy to use and require only two external resistors to set the output voltage. Further, both line and load regulation are better than standard fixed regulators. Also, LM237 regulators are supplied in standard transistor packages which are easily mounted and handled. In addition to higher performance than fixed regulators, the LM237 series offer full overload protection available only in integrated circuits. Included on the chip are current limit, thermal overload protection and safe area protection. All overload protection circuitry remains fully functional even if the adjustment terminal is disconnected.

ORDER CODES

Part Number	Temperature Range	Package	
		K	SP
LM237	– 25°C to + 150°C	•	
LM337	0°C to + 125°C	•	•

PIN CONNECTIONS

TO-3
(bottom view)



1 - Output
2 - Adj
Case is input

TO-220
(front view)

1 - Adj
2 - Output
3 - Input

Heatsink surface connected to input

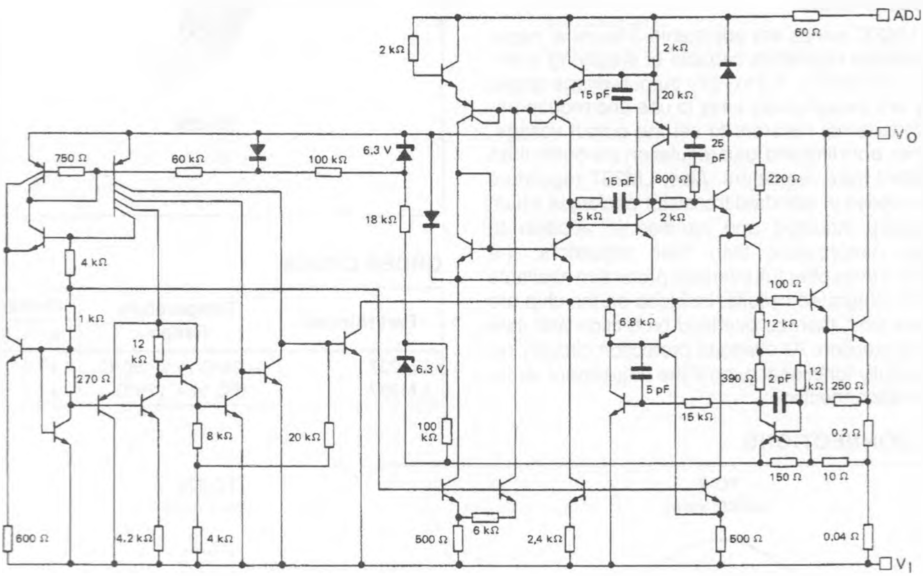
ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_I-V_O	Input-output Voltage Differential		40	V
I_O	Output Current		1.5	A
T_{oper}	Operating Junction Temperature Range	LM237 LM337	– 25 to + 150 0 to + 125	°C
T_{stg}	Storage Temperature Range		– 65 to + 150	°C
P_{tot}	Power Dissipation		Internally Limited	

THERMAL CHARACTERISTICS

Symbol	Parameter		Typ.	Max.	Unit
$R_{th(j-c)}$	Junction-case Thermal Resistance	TO-3 TO-220		4 3	°C/W
$R_{th(j-a)}$	Junction-ambient Thermal Resistance	TO-3 TO-220	35	 70	°C/W

SCHEMATIC DIAGRAM



Case	V_I	V_O	ADJ
TO-3	Case	1	2
TO-220	3	2	1

ELECTRICAL CHARACTERISTICS

LM237 : $-25°C < T_j < +150°C$
LM337 : $0°C < T_j < +125°C$
$|V_I - V_O| = 5V$, $I_O = 0.5A$
(unless otherwise specified)

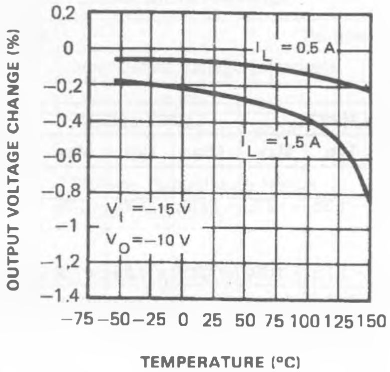
Symbol	Parameter	LM237			LM337-LM337I			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{ref}	Reference Voltage $T_{amb} = +25°C$ $T_{min} \leq T_j \leq T_{max}$ $3V \leq \lvert V_I - V_O \rvert \leq 40V$, $10mA \leq \lvert I_O \rvert \leq \lvert I_{O(max)} \rvert$, $P \leq P_{max}$	– 1.225 – 1.20	– 1.25 – 1.25	– 1.275 – 1.30	– 1.213 – 1.20	– 1.25 – 1.25	– 1.287 – 1.30	V
K_{VI}	Line Regulation ($T_{amb} = +25°C$, $3V \leq \lvert V_I - V_O \rvert \leq 40V$) - Note 2 $I_O = 0.1A$		0.01	0.02		0.01	0.04	%/V
K_{VO}	Load Regulation ($T_{amb} = +25°C$, $10mA \leq \lvert I_O \rvert \leq \lvert I_{O(max)} \rvert$) - Note 2 $\lvert V_O \rvert \leq 5V$ $\lvert V_O \rvert \geq 5V$		15 0.3	25 0.5		15 0.3	50 1	mV %
	Thermal Regulation ($T_{amb} = +25°C$, pulse 10ms)		0.002	0.02		0.003	0.04	%/W
I_{adj}	Adjustment Pin Current		65	100		65	100	µA
ΔI_{adj}	Adjustment Pin Current Change ($T_{amb} = +25°C$, $10mA \leq \lvert I_O \rvert \leq \lvert I_{O(max)} \rvert$, $3V \leq \lvert V_I - V_O \rvert \leq 40V$)		2	5		2	5	µA
K_{VI}	Line Regulation ($3V \leq \lvert V_I - V_O \rvert \leq 40V$) - Note 2		0.02	0.05		0.02	0.07	%/V
K_{VO}	Load Regulation ($10mA \leq \lvert I_O \rvert \leq \lvert I_{O(max)} \rvert$) - Note 2 $V_O \leq 5V$ $V_O \geq 5V$		20 0.3	50 1		20 0.3	70 1.5	mV %
$\lvert I_{O(min)} \rvert$	Minimum Load Current $\lvert V_I - V_O \rvert \leq 40V$ $\lvert V_I - V_O \rvert \leq 40V$		2.5 1.2	5 3		2.5 1.5	10 6	mA
I_{OS}	Short-circuit Output Current $\lvert V_I - V_O \rvert \leq 15V$ $\lvert V_I - V_O \rvert = 40V$, $T_j = +25°C$	1.5 0.24	2.2 0.4		1.5 0.15	2.2 0.4		A
V_{NO}	RMS Output Noise (% of V_O) ($T_{amb} = +25°C$, $10Hz \leq f \leq 10kHz$)		0.003			0.003		%
R_{vf}	Ripple Rejection Ratio $V_O = -10V$, $f = 120Hz$ $C_{adj} = 10\mu F$	66	60 77		66	60 77		dB
K_{VT}	Temperature Stability ($T_{min} \leq T_j \leq T_{max}$)		0.6			0.6		%
K_{VH}	Long Term Stability ($T_{amb} = +125°C$, 1000H)		0.3	1		0.3	1	%

Notes : 1. Although power dissipation is internally limited, these specifications are applicable for power dissipation of :
- 15W for TO-220
- 20W for TO-3 Package

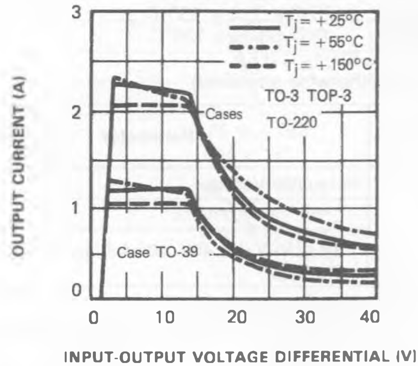
$I_{O(max)}$ is :
- 1.5A

2. Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under the specification for thermal regulation.

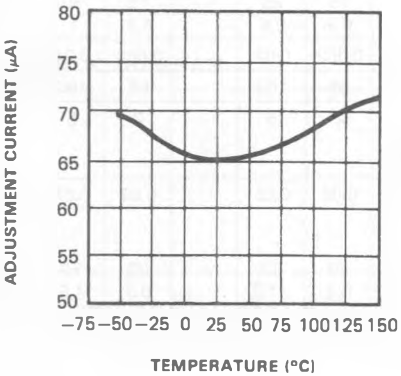
LOAD REGULATION



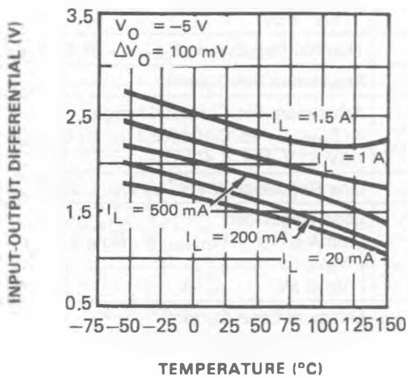
CURRENT LIMIT



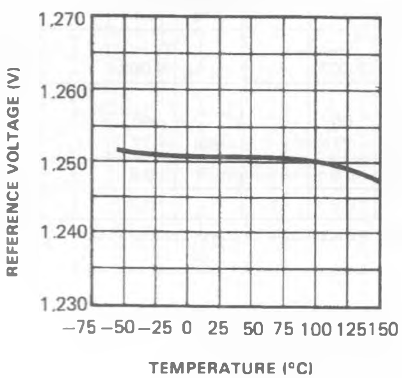
ADJUSTMENT CURRENT



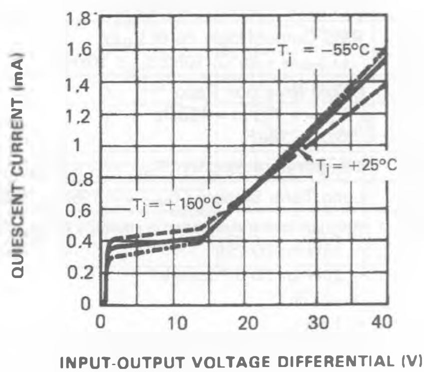
DROPOUT VOLTAGE

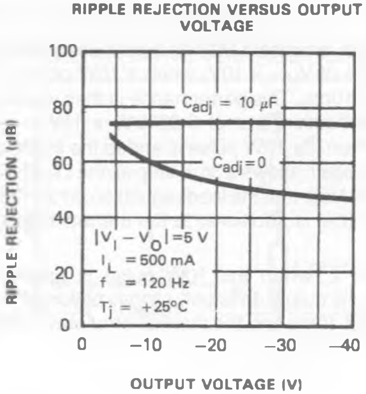


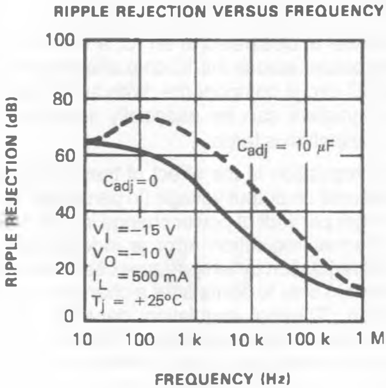
TEMPERATURE STABILITY

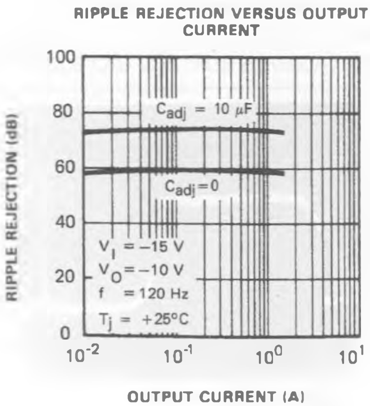


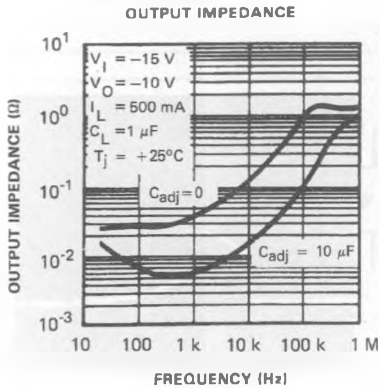
MINIMUM OPERATING CURRENT

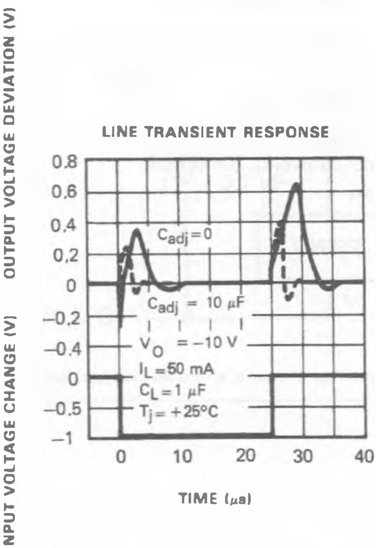


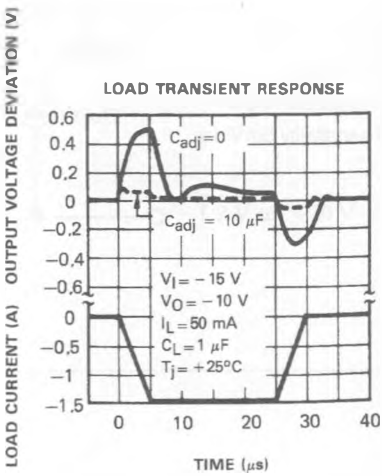

RIPPLE REJECTION VERSUS OUTPUT VOLTAGE
RIPPLE REJECTION (dB)
Cadj = 10 μF
Cadj = 0
|VI − VO| = 5 V
IL = 500 mA
f = 120 Hz
Tj = +25°C
OUTPUT VOLTAGE (V)


RIPPLE REJECTION VERSUS FREQUENCY
RIPPLE REJECTION (dB)
Cadj = 10 μF
Cadj = 0
VI = −15 V
VO = −10 V
IL = 500 mA
Tj = +25°C
FREQUENCY (Hz)


RIPPLE REJECTION VERSUS OUTPUT CURRENT
RIPPLE REJECTION (dB)
Cadj = 10 μF
Cadj = 0
VI = −15 V
VO = −10 V
f = 120 Hz
Tj = +25°C
OUTPUT CURRENT (A)


OUTPUT IMPEDANCE
OUTPUT IMPEDANCE (Ω)
VI = −15 V
VO = −10 V
IL = 500 mA
CL = 1 μF
Tj = +25°C
Cadj = 0
Cadj = 10 μF
FREQUENCY (Hz)


LINE TRANSIENT RESPONSE
OUTPUT VOLTAGE DEVIATION (V)
INPUT VOLTAGE CHANGE (V)
Cadj = 0
Cadj = 10 μF
VO = −10 V
IL = 50 mA
CL = 1 μF
Tj = +25°C
TIME (μs)


LOAD TRANSIENT RESPONSE
OUTPUT VOLTAGE DEVIATION (V)
LOAD CURRENT (A)
Cadj = 0
Cadj = 10 μF
VI = −15 V
VO = −10 V
IL = 50 mA
CL = 1 μF
Tj = +25°C
TIME (μs)

THERMAL REGULATION

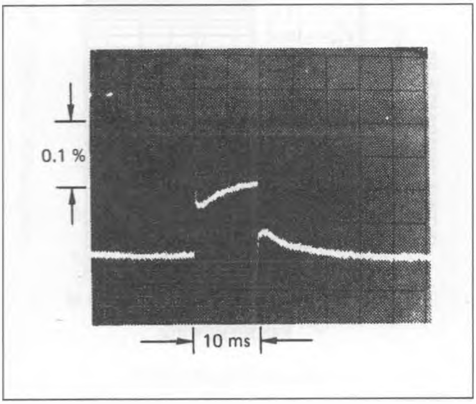
When power is dissipated in an IC, a temperature gradient occurs across the IC chip affecting the individual IC circuit components. With an IC regulator, this gradient can be especially severe since power dissipation is large.

Thermal regulation is the effect of these temperature gradients on output voltage (in percentage output change) per watt of power change in a specified time. Thermal regulation error is independent of electrical regulation or temperature coefficient, and occurs within 5ms to 50ms after a change in power dissipation. Thermal regulation depends on IC layout as well as electrical design. The thermal regulation of a voltage regulator is defined as the percentage change of V_O, per watt, within the first 10ms after a step of power, is applied.

In figure 1, a typical LM337's output drifts only 3mV for 0.03% of V_O = – 10V) when a 10W pulse is applied for 10ms. This performance is thus well inside the specification limit of 0.02%/W x 10W = 0.2% max. When the 10W pulse is ended the thermal regulation again shows a 3mV step as the LM337 chip cools off. Note that the load regulation error of about 8mV(0.08%) is additional to the thermal regulation error.

In figure 2, when the 10W pulse is applied for 100ms, the output drifts only slightly beyond the drift in the first 10ms and the thermal error stays well within 0.1% (10mV).

Figure 1.



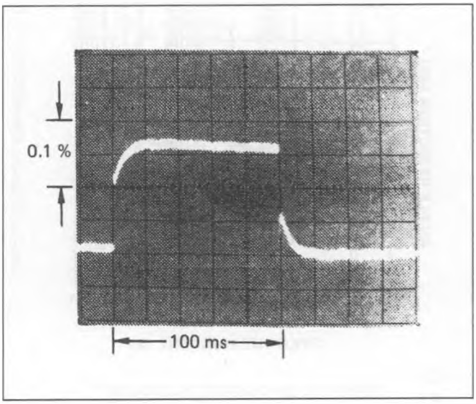
LM 337, V_0 = – 10V

$V_I - V_0$ = – 40V

I_L = 0A → 0.25A → 0A

Vertical sensitivity 5mV/div.

Figure 2.



LM 337, V_0 = – 10V

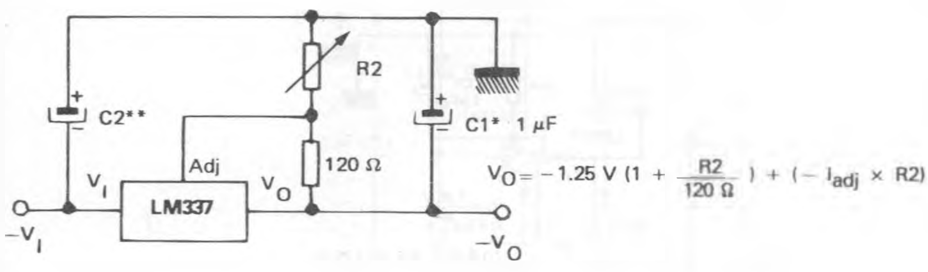
$V_I - V_0$ = – 40V

I_L = 0A → 0.25A → 0A

Horizontal sensitivity 20msN/div.

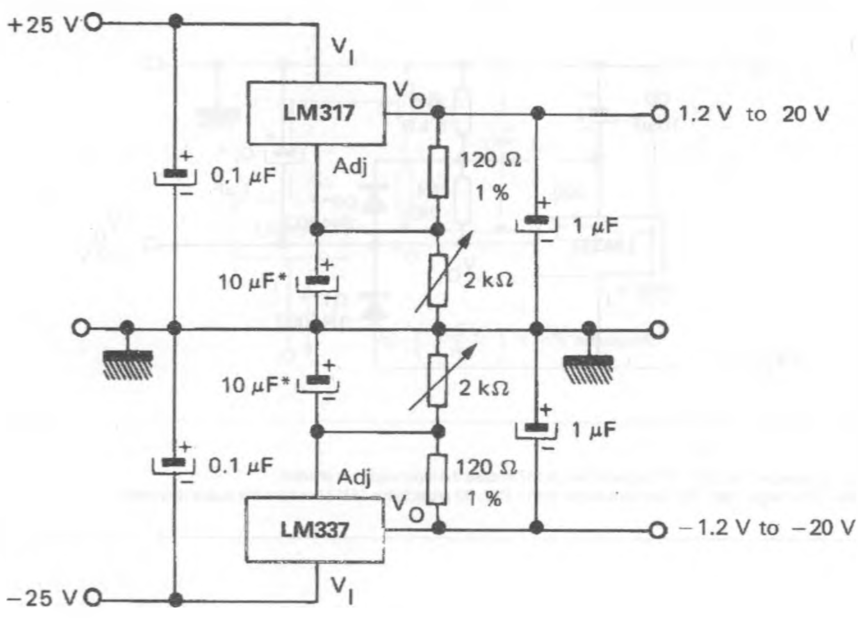
TYPICAL APPLICATIONS

ADJUSTABLE NEGATIVE VOLTAGE REGULATOR



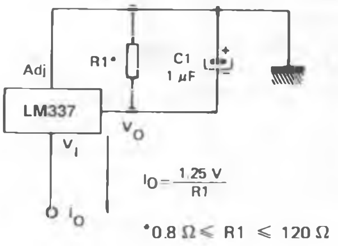
* C1 = 1µF solid tantalum or 10µF aluminium electrolytic required for stability.
** C2 = 1µF solid tantalum is required only if regulator is more than 10cm from power supply filter capacitor.

ADJUSTABLE LAB VOLTAGE REGULATOR

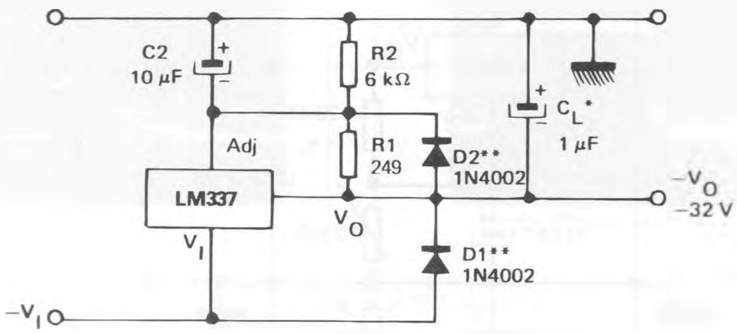


* The 10µF capacitors are optimal to improve ripple rejection.

CURRENT REGULATOR

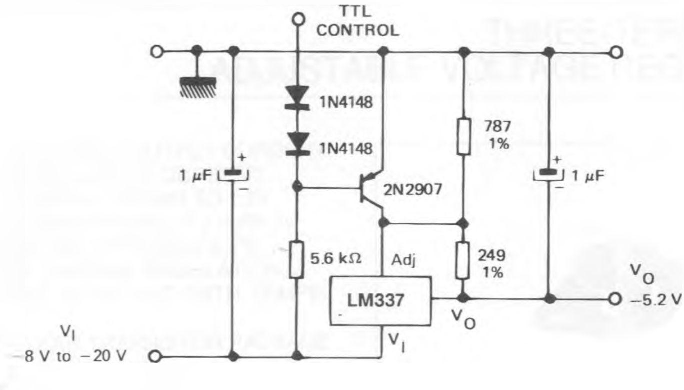


NEGATIVE REGULATOR WITH PROTECTION DIODES



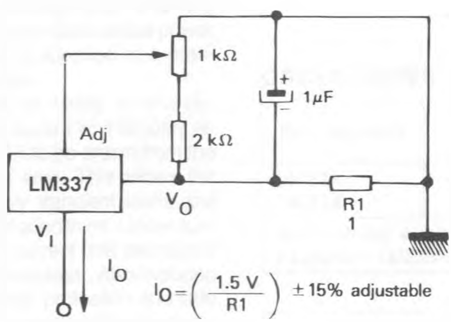
* When C_L is larger than 20μF, D1 protects the LM137 in case the input supply is shorted.
** When C2 is larger than 10μF and V_O is larger than – 25V, D2 protects the LM137 in case the output is shorted.

* – 5.2V REGULATOR WITH ELECTRONIC SHUTDOWN



* Minimum output = – 1.3V when control input is low.

ADJUSTABLE CURRENT REGULATOR



$$I_O = \left(\frac{1.5\ V}{R1}\right) \pm 15\%\ \text{adjustable}$$