

# LM117/217 LM317

# 1.2V TO 37V VOLTAGE REGULATOR

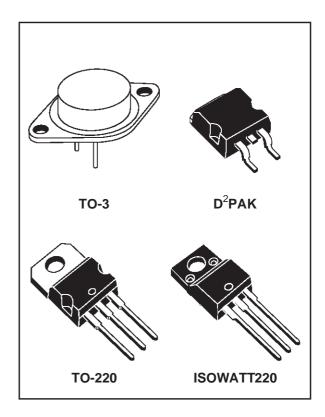
- OUTPUT VOLTAGE RANGE : 1.2 TO 37V
- OUTPUT CURRENT IN EXCESS OF 1.5A
- 0.1% LINE AND LOAD REGULATION
- FLOATING OPERATION FOR HIGH VOLTAGES
- COMPLETE SERIES OF PROTECTIONS : CURRENT LIMITING, THERMAL SHUTDOWN AND SOA CONTROL

#### DESCRIPTION

The LM117/LM217/LM317 are monolithic integrated circuit in TO-220, ISOWATT220, TO-3 and  $D^2PAK$  packages intended for use as positive adjustable voltage regulators.

They are designed to supply more than 1.5A of load current with an output voltage adjustable over a 1.2 to 37V range.

The nominal output voltage is selected by means of only a resistive divider, making the device exceptionally easy to use and eliminating the stocking of many fixed regulators.

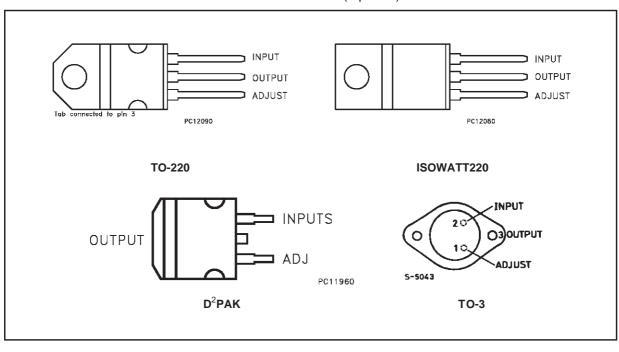


#### **ABSOLUTE MAXIMUM RATING**

Symbol	Parameter	Value	Unit
V <sub>i-o</sub>	Input-output Differential Voltage	40	V
I <sub>0</sub>	Output Current	Intenrally Limited	
T <sub>op</sub>	Operating Junction Temperature for: LM117 LM217 LM317	-55 to 150 -25 to 150 0 to 125	ဂိဂိဂ
P <sub>tot</sub>	Power Dissipation	Internally Limited	
T <sub>stg</sub>	Storage Temperature	- 65 to 150	°C

#### THERMAL DATA

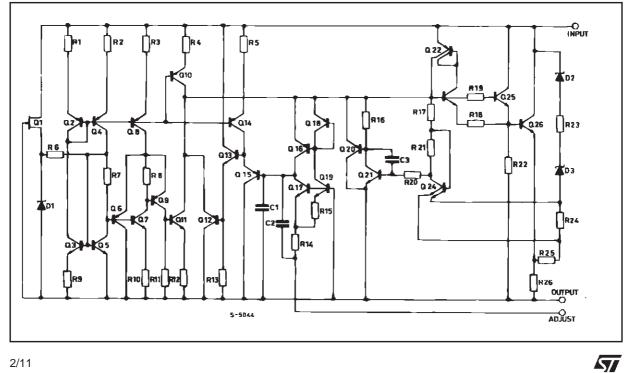
Symbol	Parameter		TO-3	TO-220	ISOWATT220	D <sup>2</sup> PAK	Unit
R <sub>thj-case</sub>	Thermal Resistance Junction-case	Max	4	3	4	3	°C/W
$R_{thj-amb}$	Thermal Resistance Junction-ambient	Max	35	50	60	62.5	°C/W



#### CONNECTION DIAGRAM AND ORDERING NUMBERS (top view)

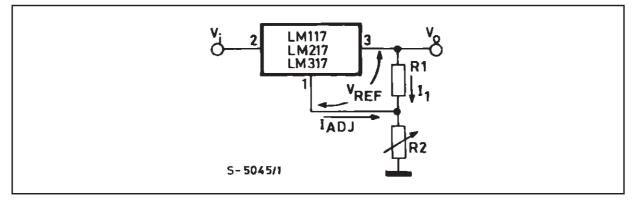
Туре	TO-3	TO-220	ISOWATT220	D <sup>2</sup> PAK
LM117	LM117K			
LM217	LM217K	LM217T		LM217D2T
LM317	LM317K	LM317T	LM317P	LM317D2T

#### SCHEMATIC DIAGRAM



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#### **BASIC ADJUSTABLE REGULATOR**



#### **ELECTRICAL CHARACTERISTICS** (V<sub>i</sub> - V<sub>o</sub> = 5 V, I<sub>o</sub> = 500 mA, I<sub>MAX</sub> = 1.5A and P<sub>MAX</sub> = 20W, unless otherwise specified)

Symbol	Parameter	Test Condit	ions	LM	117/LM	217		LM317		Unit
				Min.	Тур.	Max.	Min.	Тур.	Max.	
$\Delta V_{o}$	Line Regulation	$V_i - V_o = 3 \text{ to } 40 \text{ V}$	T <sub>j</sub> = 25 °C		0.01	0.02		0.01	0.04	%/V
					0.02	0.05		0.02	0.07	%/V
$\Delta V_{o}$	Load Regulation	$V_o \leq 5V$	$T_j = 25 \ ^{o}C$		5	15		5	25	mV
		$I_o = 10 \text{ mA to } I_{MAX}$			20	50		20	70	mV
		$V_o \ge 5V$	T <sub>j</sub> = 25 °C		0.1	0.3		0.1	0.5	%
		$I_o = 10 \text{ mA to } I_{MAX}$			0.3	1		0.3	1.5	%
I <sub>ADJ</sub>	Adjustment Pin Current				50	100		50	100	μA
$\Delta I_{ADJ}$	Adjustment Pin Current	$V_i - V_o = 2.5 \text{ to } 40 \text{ V}$ $I_o = 10 \text{ mA to } I_{MAX}$			0.2	5		0.2	5	μΑ
V <sub>REF</sub>	Reference Voltage (between pin 3 and pin 1)			1.2	1.25	1.3	1.2	1.25	1.3	V
$\frac{\Delta V_o}{V_o}$	Output Voltage Temperature Stability				1			1		%
l <sub>o(min)</sub>	Minimum Load Current	$V_i - V_o = 40 V$			3.5	5		3.5	10	mA
I <sub>o(max)</sub>	Maximum Load Current	$V_i - V_o \le 15 V$ $P_D < P_{MAX}$		1.5	2.2		1.5	2.2		А
		$V_i - V_o = 40 V$ $P_D < P_{MAX}$ $T_j = 25 °C$			0.4			0.4		A
θN	Output Noise Voltage (percentance of V <sub>O</sub> )	$B = 10Hz \text{ to } 10KHz$ $T_j = 25 \text{ °C}$			0.003			0.003		%
SVR	Supply Voltage	$T_j = 25 \ ^{\circ}C$	C <sub>ADJ</sub> =0		65			65		dB
	Rejection (*)	f = 120 Hz	$C_{ADJ}=10\mu F$	66	80		66	80		dB

(\*) CADJ is connected between pin 1 and ground. Note:

(1) Unless otherwise specified the above specs, apply over the following conditions : LM 117  $T_j = -55$  to 150°C; LM 217  $T_j = -25$  to 150°C ; LM 317  $T_j = 0$  to 125°C.



**Figure 1**: Output Current vs. Input-output Differential Voltage.

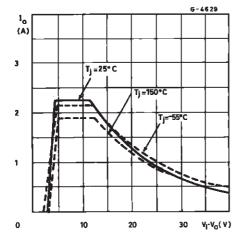
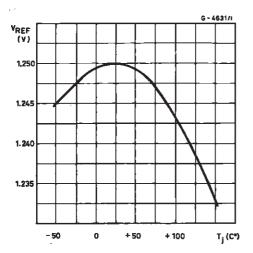


Figure 3 : Reference Voltage vs. Junction



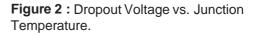
#### **APPLICATION INFORMATION**

The LM117/217/317 provides an internal reference voltage of 1.25V between the output and adjustments terminals. This is used to set a constant current flow across an external resistor divider (see fig. 4), giving an output voltage Vo of:

$$V_0 = V_{REF} \left(1 + \frac{R_2}{R_1}\right) + I_{ADJ} R_2$$

The device was designed to minimize the term  $I_{ADJ}$  (100µA max) and to maintain it very constant with line and load changes. Usually, the error term  $I_{ADJ} \cdot R_2$  can be neglected. To obtain the previous requirement, all the regulator quiescent current is returned to the output terminal, imposing a minimum load current condition. If the load is insufficient, the output voltage will rise.

Since the LM117/217317 is a floating regulator and "sees" only the input-to-output differential



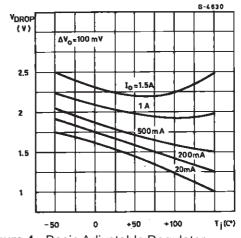
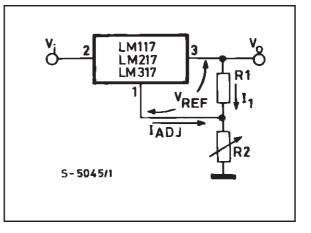


Figure 4 : Basic Adjustable Regulator.



voltage, supplies of very high voltage with respect to ground can be regulated as long as the maximum input-to-output differential is not exceeded. Furthermore, programmable regulator are easily obtainable and, by connecting a fixed resistor between the adjustment and output, the device can be used as a precision current regulator.

In order to optimise the load regulation, the current set resistor R1 (see fig. 4) should be tied as close as possible to the regulator, while the ground terminal of R2 should be near the ground of the load to provide remote ground sensing.

Performance may be improved with added capacitance as follow:

An input bypass capacitor of  $0.1 \mu F$ 

An adjustment terminal to ground 10µF capacitor

to improve the ripple rejection of about 15 dB (C\_{ADJ}).

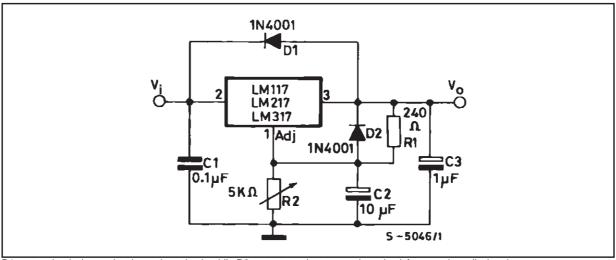
An  $1\mu$ F tantalium (or  $25\mu$ FAluminium electrolitic) capacitor on the output to improve transient response.

In additional to external capacitors, it is good

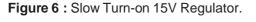
Figure 5 : Voltage Regulator with Protection Diodes.

practice to add protection diodes, as shown in fig.5.

D1 protect the device against input short circuit, while D2 protect against output short circuit for capacitance discharging.



D1 protect the device against input short circuit, while D2 protects against output short circuit for capacitors discharging



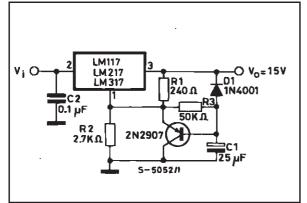
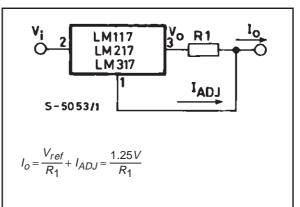


Figure 7 : Current Regulator.



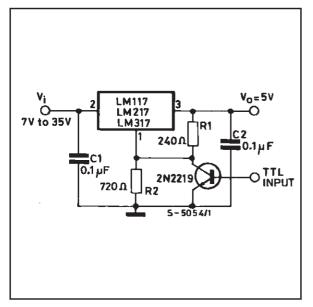


Figure 8 : 5V Electronic Shut-down Regulator

Figure 10 : Battery Charger (12V)

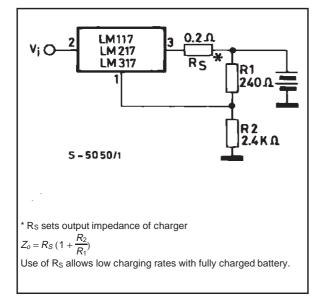


Figure 9 : Digitally Selected Outputs

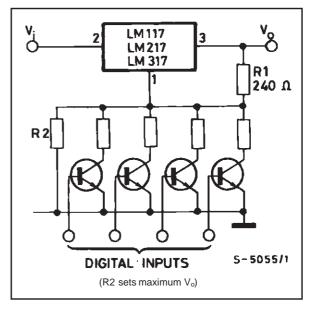
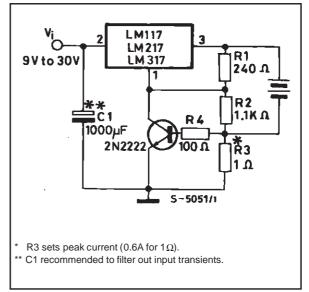
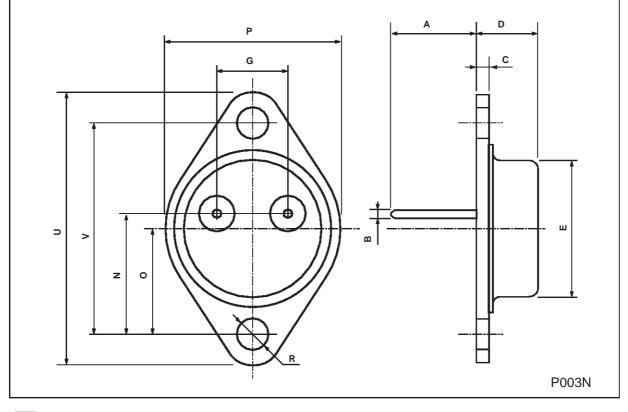


Figure 11 : Current Limited 6V Charger



DIM.		mm		inch				
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
А		11.7			0.460			
В	0.96		1.10	0.037		0.043		
С			1.70			0.066		
D			8.7			0.342		
Е			20.0			0.787		
G		10.9			0.429			
Ν		16.9			0.665			
Р			26.2			1.031		
R	3.88		4.09	0.152		0.161		
U			39.50			1.555		
V		30.10			1.185			

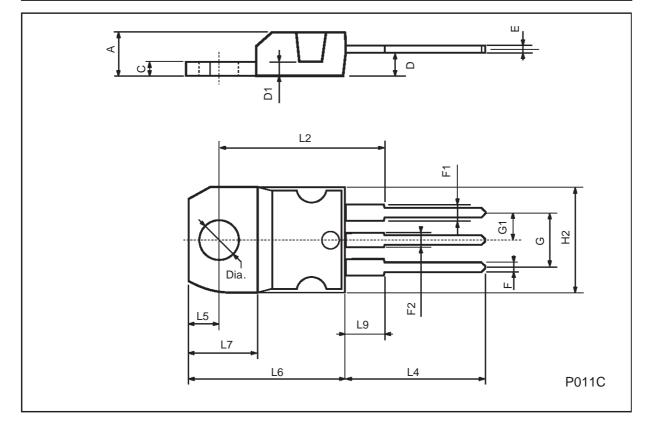
## TO-3 (R) MECHANICAL DATA



### LM117/217/317

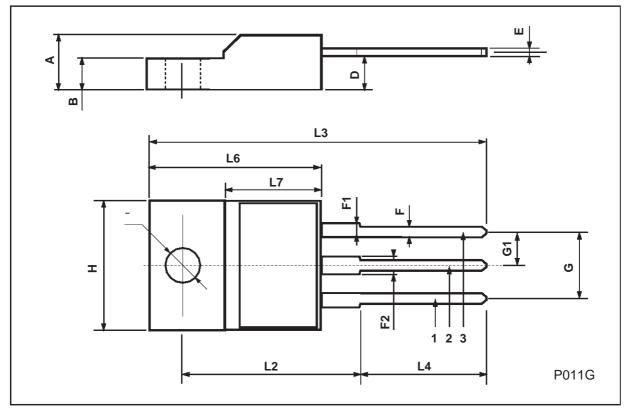
DIM.	mm			inch			
Diwi.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
А	4.40		4.60	0.173		0.181	
С	1.23		1.32	0.048		0.051	
D	2.40		2.72	0.094		0.107	
D1		1.27			0.050		
Е	0.49		0.70	0.019		0.027	
F	0.61		0.88	0.024		0.034	
F1	1.14		1.70	0.044		0.067	
F2	1.14		1.70	0.044		0.067	
G	4.95		5.15	0.194		0.203	
G1	2.4		2.7	0.094		0.106	
H2	10.0		10.40	0.393		0.409	
L2		16.4			0.645		
L4	13.0		14.0	0.511		0.551	
L5	2.65		2.95	0.104		0.116	
L6	15.25		15.75	0.600		0.620	
L7	6.2		6.6	0.244		0.260	
L9	3.5		3.93	0.137		0.154	
DIA.	3.75		3.85	0.147		0.151	





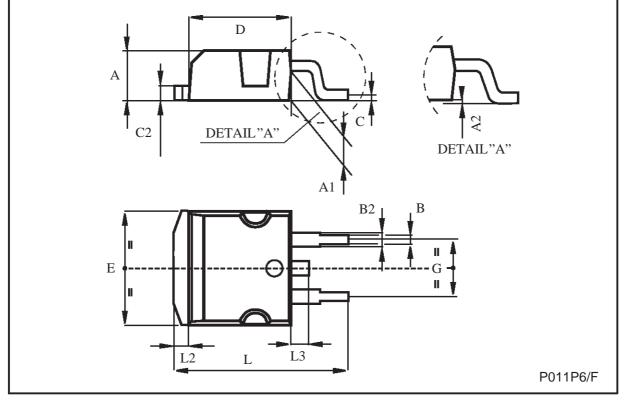
DIM.		mm			inch	
DIN.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
А	4.4		4.6	0.173		0.181
В	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.4		0.7	0.015		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
Н	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	0.385		0.417
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126

## ISOWATT220 MECHANICAL DATA



DIM.		mm		inch			
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
А	4.4		4.6	0.173		0.181	
A1	2.49		2.69	0.098		0.106	
В	0.7		0.93	0.027		0.036	
B2	1.14		1.7	0.044		0.067	
С	0.45		0.6	0.017		0.023	
C2	1.23		1.36	0.048		0.053	
D	8.95		9.35	0.352		0.368	
E	10		10.4	0.393		0.409	
G	4.88		5.28	0.192		0.208	
L	15		15.85	0.590		0.624	
L2	1.27		1.4	0.050		0.055	
L3	1.4		1.75	0.055		0.068	





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