



Medium current 1.2 to 37 V adjustable voltage regulator



Features

- Output voltage range: 1.2 to 37 V
- · Output current in excess of 500 mA
- Line regulation typ. 0.01%
- Load regulation typ. 0.1%
- · Thermal overload protection
- · Short-circuit protection
- Output transition safe area compensation
- · Floating operation for high voltage applications

Description

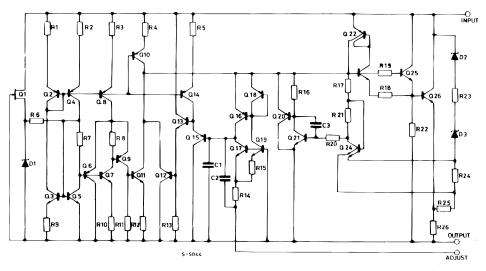
The LM217M and LM317M are monolithic integrated circuits in DPAK package used as positive adjustable voltage regulators. They are designed to supply until 500 mA of load current with an output voltage adjustable over a 1.2 to 37 V range. The nominal output voltage is selected by one resistive divider only, making the device exceptionally easy to configure and avoiding the use of several fixed regulators.

Product status link
LM217M
LM317M



1 Diagram

Figure 1. Schematic diagram



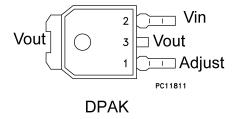
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Pin configuration

Figure 2. Pin connections (top view)



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3 Maximum ratings

Table 1. Absolute maximum ratings

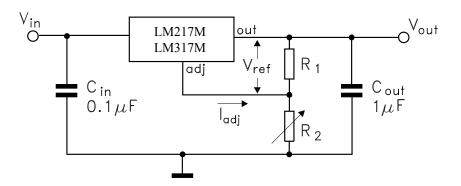
Symbol	Parameter	Value	Unit	
V _I -V _O	Input-to-output differential voltage	40	V	
P _D	Power dissipation	Internally limited	mW	
Т	On anothing in action to an another arms (1)	LM217M	-40 to 125	°C
T _{OP}	Operating junction temperature range (1)	LM317M		
T _{STG}	Storage temperature range		-55 to 150	°C

^{1.} Reboot is not guaranteed for $T_J \ge 85$ °C.

Table 2. Thermal data

Symbol	Parameter	DPAK	Unit
R _{thJC}	Thermal resistance junction-case	8	°C/W
R _{thJA}	Thermal resistance junction-ambient	100	°C/W

Figure 3. Test circuit



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4 Electrical characteristics

Table 3. LM217M electrical characteristics (refer to the test circuits, T_J = - 40 to 125 °C, V_I - V_O = 5 V, I_O = 100 mA, P_D ≤ 7.5 Ω , unless otherwise specified).

Symbol	Parameter	Test con	ditions	Min.	Тур.	Max.	Unit
ΔV_{O}	Line regulation	$V_1 - V_0 = 3 \text{ to } 40 \text{ V}$	T _J = 25 °C		0.01 0.02	0.02	%/V
700	Line regulation	v - v0 = 3 to 40 v			0.02	0.05	70/ V
		V _O ≤ 5 V	T _J = 25 °C		5	15	mV
ΔV_{O}	Load regulation	I_{O} = 10 to 500 mA			20	50	IIIV
ΔνΟ	Load regulation	V _O ≥ 5 V	T _J = 25 °C		0.1	0.3	%/V _O
		I _O = 10 to 500 mA			0.3	1	
I _{ADJ}	Adjustment pin current				50	100	μA
Δl _{ADJ}	Adjustment pin current	$V_{I} - V_{O} = 3 \text{ to } 40 \text{ V}, I_{O} = 10 \text{ to } 500 \text{ mA}$			0.2	5	μA
V_{REF}	Reference voltage	$V_{I} - V_{O} = 3 \text{ to } 40 \text{ V}, I_{O} = 10 \text{ to } 500 \text{ mA}$		1.2	1.25	1.3	V
$\Delta V_O/V_O$	Output voltage temperature stability				0.7		%
I _{O(min)}	Minimum load current	V _I - V _O = 40 V			3.5	5	mA
I _{O(max)}	Maximum output current	V _I - V _O ≤ 15 V		500	1000		
		$V_{I} - V_{O} = 40 \text{ V}, P_{d} < P_{DMAX},$ $T_{J} = 25 \text{ °C}$			200		mA
eN	Output noise voltage (percentage of V _O)	B = 10 Hz to 100 kHz, T _J = 25 °C			0.003		%
CV/D	Ourselve and the managing of the section (1)	T _J = 25 °C	C _{ADJ} = 0		65		40
SVR	Supply voltage rejection (1)	f = 120 Hz	C _{ADJ} = 10 μF	66	80		dB

^{1.} C_{ADJ} is connected between the adjustment pin and ground.

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Table 4. LM317M electrical characteristics (refer to the test circuits, T_J = 0 to 125 °C, V_I - V_O = 5 V, I_O = 100 mA, P_D ≤ 7.5 Ω , unless otherwise specified).

Symbol	Parameter	Test con	ditions	Min.	Тур.	Max.	Unit
ΔV _O	Line regulation	$V_1 - V_0 = 3 \text{ to } 40 \text{ V}$	T _J = 25 °C		0.01	0.04	%/V
Δν0	Line regulation	V - V - 3 to 40 V			0.02	0.07	70/ V
		V _O ≤ 5 V	T _J = 25 °C		5	25	mV
ΔV_{O}	Lood regulation	I _O = 10 to 500 mA			20	70	IIIV
Δν0	Load regulation	V _O ≥ 5 V	T _J = 25 °C		0.1	0.5	%/V _O
		I _O = 10 to 500 mA			0.3	1.5	707 🕻 🔾
I _{ADJ}	Adjustment pin current				50	100	μA
Δl _{ADJ}	Adjustment pin current	$V_{I} - V_{O} = 3 \text{ to } 40 \text{ V}, I_{O} = 10 \text{ to } 500 \text{ mA}$			0.2	5	μA
V_{REF}	Reference voltage	$V_{I} - V_{O} = 3 \text{ to } 40 \text{ V}, I_{O} = 10 \text{ to } 500 \text{ mA}$		1.2	1.25	1.3	V
$\Delta V_O/V_O$	Output voltage temperature stability				0.7		%
I _{O(min)}	Minimum load current	V _I - V _O = 40 V			3.5	10	mA
I _{O(max)}	Maximum output current	V _I - V _O ≤ 15 V		500	1000		
		V _I - V _O = 40 V, P _d < F	DMAX,		000		mA
		T _J = 25 °C			200		
eN	Output noise voltage (V _O percentage)	B = 10 Hz to 100 kHz, T _J = 25 °C			0.003		%
0) (D		T _J = 25 °C	C _{ADJ} = 0		65		
SVR Supp	Supply voltage rejection (1)	voltage rejection (1) f = 120 Hz		66	80		dB

^{1.} C_{ADJ} is connected between the adjustment pin and ground.

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5 Typical performance

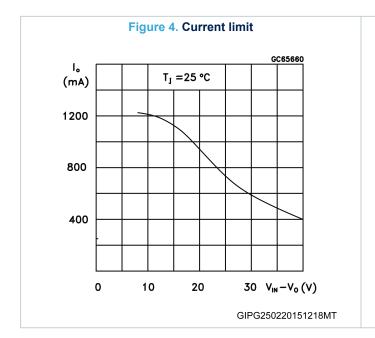


Figure 5. Minimum operating current

GC25560

(mA)

T_J = 25 °C

3.0

2.5

2.0

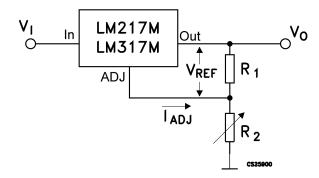
1.5

1.0

0.5

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Figure 6. Basic adjustable regulator

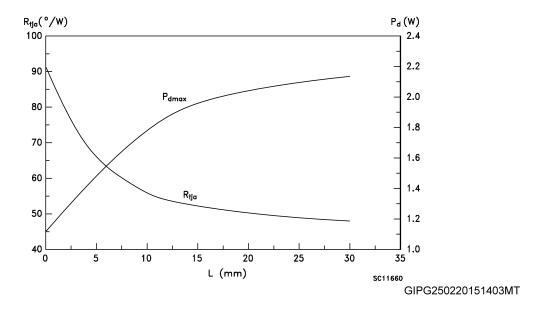


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Figure 7. Thermal resistance and maximum power dissipation vs. PCB copper length for DPAK



Note: P_{dmax} calculated for $T_a = 50$ °C.

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6 Application information

The LM217M and LM317M provide an internal reference voltage (1.25 V) between the output and adjustment terminals. These devices set a constant current flow across an external resistor divider (see Figure 6. Basic adjustable regulator), giving the following output voltage:

Equation 1

 $V_0 = V_{REF} (1 + R_2 / R_1) + I_{ADJ} R_2$

These devices minimize the term I_{ADJ} (100 μA max.) and keep it constant with line and load changes. Usually, the error terms: $I_{ADJ} \times R_2$ can be neglected. To obtain the previous requirement, the regulator quiescent current is returned to the output terminal, imposing a minimum load current condition. If the load is insufficient, the output voltage rises.

Since the LM217M and LM317M devices are floating regulators and only "see" the input-to-output differential voltage, high voltage supplies can be regulated as long as the maximum input-to-output differential is not exceeded. Furthermore, programmable regulators are easily obtained and, by connecting a fixed resistor between the adjustment and output, the devices can be used as precision current regulators. In order to optimize the load regulation, R_1 , the current set resistor (see Figure 6. Basic adjustable regulator) should be as closer as possible to the regulator, while R_2 , the ground terminal should be near the ground of the load to provide remote ground sensing.

6.1 External capacitors

Usually, capacitors are not necessary unless the devices are far from the input filter capacitors; in this case an input bypass is needed.

To reduce the sensitivity to input line impedance, a 0.1 μF disc or 1 μF tantalum input bypass capacitor (C_I) is recommended.

The adjustment terminal may be bypassed to ground to improve ripple rejection. This capacitor (C_{ADJ}) avoids the amplification of ripple as the output voltage rises. A 10 μ F capacitor should improve ripple rejection about 80 dB at 120 Hz in a 10 V application.

Although the devices are stable without any output capacitors, some external capacitance values can cause excessive ringing. A 1 μ F solid tantalum or 25 μ F aluminum electrolytic output capacitor swamps this effect and assures stability.

6.2 Protection diodes

When external capacitors are used with any IC regulator, sometimes some protection diodes have to be added to prevent the capacitors from discharging through low current points into the regulator.

Figure 8. Voltage regulator with protection diodes shows the devices with the recommended protection diodes for output voltages in excess of 25 V or high capacitance values ($C_3 > 25 \mu F$, $C_2 > 10 \mu F$). Diode D1 prevents C_3 from discharging through the IC during an input short-circuit. The combination of diodes D1 and D2 prevents C_2 from discharging through the regulator during an input or output short-circuit.

6.3 Start-up block

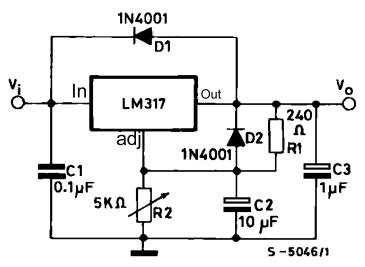
Reboot of the device is not guaranteed when the junction temperature is over 85 °C.

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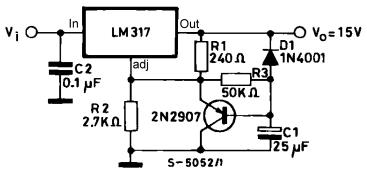
7 Application circuits

Figure 8. Voltage regulator with protection diodes



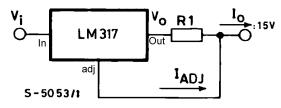
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Figure 9. Slow turn-on 15 V regulator



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Figure 10. Current regulator

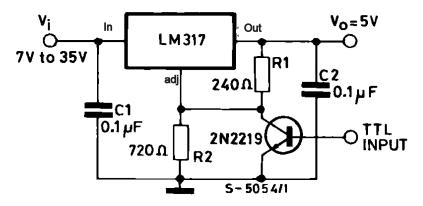


 $Io=V_{REF}/R1 + I_{ADJ} = 1.25 \text{ V} / R1$

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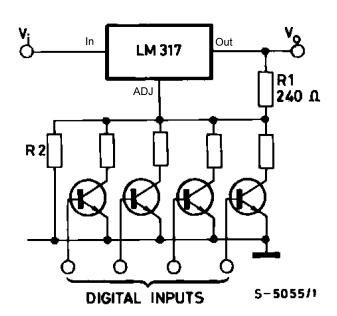
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Figure 11. 5 V electronic shutdown regulator



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Figure 12. Digitally selected outputs



(R2 sets maximum Vo)

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8 Device summary

Table 5. Device summary

Order code	Packing	
LM217MDT-TR	Tano and rool	
LM317MDT-TR	Tape and reel	

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9 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

9.1 DPAK (TO-252) package information

Table 6. DPAK (TO-252) mechanical data (type A)

Dim.		mm	
Dilli.	Min.	Тур.	Max.
Α	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
С	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1	4.95	5.10	5.25
E	6.40		6.60
E1	4.60	4.70	4.80
е	2.159	2.286	2.143
e1	4.445	4.572	4.699
Н	9.35		10.10
L	1.00		1.50
L1	2.60	2.80	1.50
L2			3.00
L4	0.60		1.00
R		0.20	
V2	0°		8°

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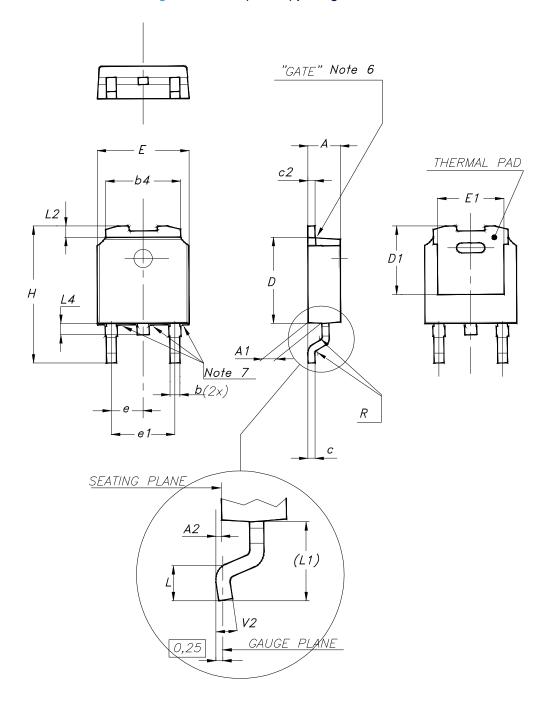


Figure 13. DPAK (TO-252) package outline A

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Table 7. DPAK(TO-252) mechanical data (type E)

Dim.		mm	
Dim.	Min.	Тур.	Max.
Α	2.18		2.39
A2			0.13
b	0.65		0.884
b4	4.95		5.46
С	0.46		0.61
c2	0.46		0.60
D	5.97		6.22
D1	5.21		
E	6.35		6.73
E1	4.32		
е		2.286	
e1		4.572	
Н	9.94		10.34
L	1.50		1.78
L1		2.74	
L2	0.89		1.27
L4			1.02

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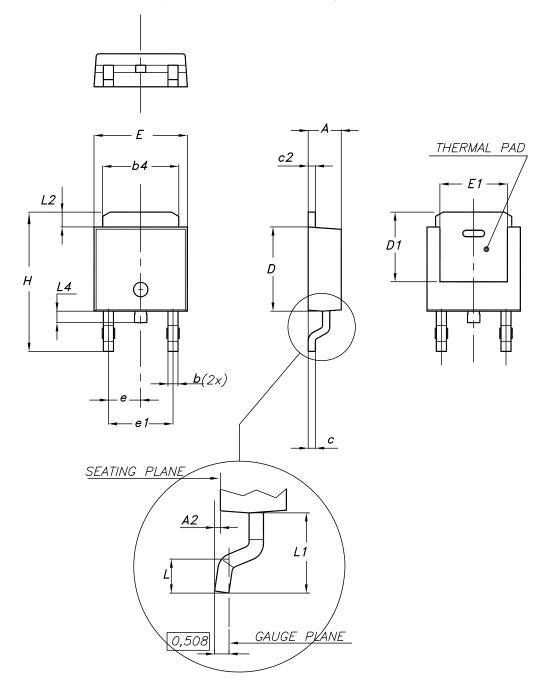


Figure 14. DPAK (TO-252) package outline E

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Table 8. DPAK (TO-252) mechanical data type I

Di	mm				
Dim.	Min.	Тур.	Max.		
А	2.20	2.30	2.38		
A1	0.90	1.01	1.10		
A2	0.00	-	0.10		
b	0.77	-	0.89		
b1	0.76	0.81	0.86		
b2	0.77	-	1.10		
b3	5.23	5.33	5.43		
С	0.47	-	0.60		
c1	0.46	0.51	0.56		
c2	0.47	-	0.60		
D	6.00	6.10	6.20		
D1	5.25	5.40	5.60		
E	6.50	6.60	6.70		
E1	4.70	4.85	5.00		
е		2.286 BSC			
Н	9.80	10.10	10.40		
L	1.40	1.50	1.70		
L1		2.90 REF			
L2	0.90	-	1.25		
L3		0.51 BSC			
L4	0.60	0.80	1.00		
L5	0.90	-	1.50		
L6	1.80 BSC				
Θ	0°	-	8°		
Θ1	3°	5°	7°		
Θ2	1°	3°	5°		

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BASE METAL DI

Figure 15. DPAK (TO-252) package outline I

Table 9. DPAK footprint data

SECTION C-C

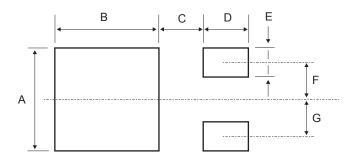
(L1)

Values				
	mm.	inch.		
Α	6.70	0.264		
В	6.70	0.64		
С	1.80	0.070		
D	3.00	0.118		
E	1.60	0.063		
F	2.30	0.091		
G	2.30	0.091		

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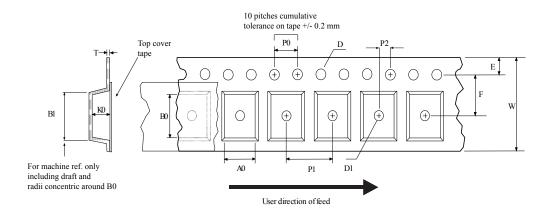


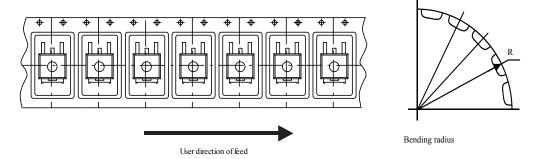
Figure 16. DPAK footprint recommended data



9.2 DPAK (TO-252) packing information

Figure 17. DPAK (TO-252) tape outline





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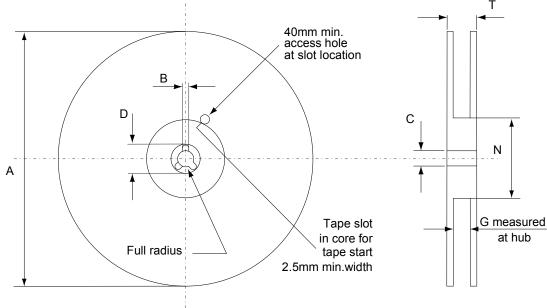


Figure 18. DPAK (TO-252) reel outline

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Table 10. DPAK (TO-252) tape and reel mechanical data

Таре				Reel	
Dim.	n	mm			mm
Dim.	Min.	Max.	Dim.	Min.	Max.
A0	6.8	7	А		330
В0	10.4	10.6	В	1.5	
B1		12.1	С	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
Е	1.65	1.85	N	50	
F	7.4	7.6	Т		22.4
K0	2.55	2.75			
P0	3.9	4.1	Bas	e qty.	2500
P1	7.9	8.1	Bul	k qty.	2500
P2	1.9	2.1			
R	40				
Т	0.25	0.35			
W	15.7	16.3			

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Revision history

Table 11. Document revision history

Date	Revision	Changes
21-Jun-2004	5	The document has been reformatted.
06-Dec-2006	6	DPAK mechanical data updated, added footprint data.
11-Feb-2008	7	Added: Table 1 on page 1.
		Updated Table 1: Device summary.
		Updated Section 8.1: TO-220 and Section 8.2: DPAK.
07-Jul-2014	8	Updated Figure 3, Figure 6, Figure 8, Figure 9, Figure 10, Figure 11, Figure 12.
		Minor text changes.
		Removed TO-220 package.
		Updated description in cover page, Table 1: "Device summary",
16- Oct-2015	9	Figure 2: "Pin connections (top view)", Table 3: "Thermal data" and
		Section 8: "Package information".
		Minor text changes.
19-Jun-2019	10	Updated Section 9.1 DPAK (TO-252) package information.
26-Nov-2019	11	Updated Section 9.1 DPAK (TO-252) package information.

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	Ω , unless otherwise specified)
Table 4.	LM317M electrical characteristics (refer to the test circuits, T_J = 0 to 125 °C, V_I - V_O = 5 V, I_O = 100 mA, $P_D \le 7.5 \Omega$,
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