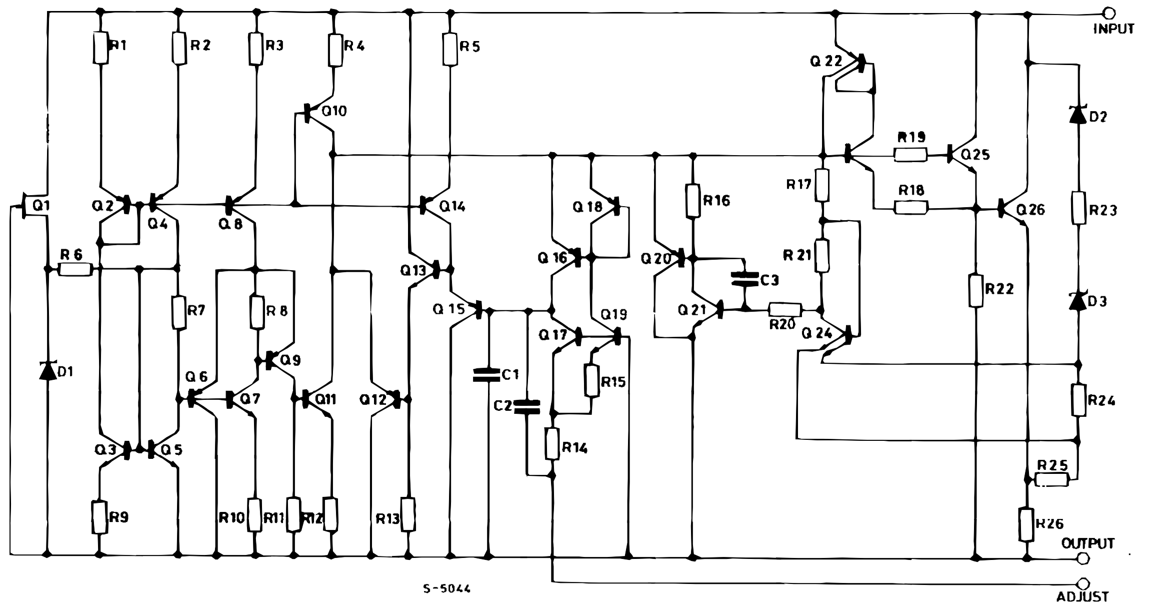
Contents

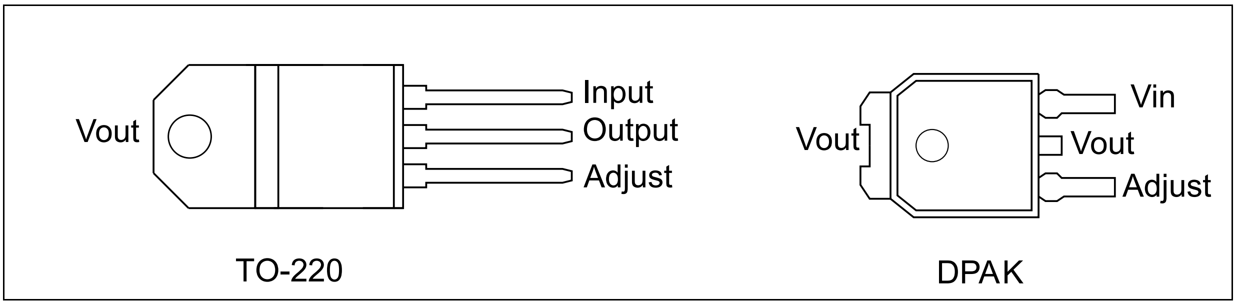
1 Diagram

Figure 1. Schematic diagram



2 Pin configuration

Figure 2. Pin connections (top view)



3 Maximum ratings

Table 2. Absolute maximum ratings

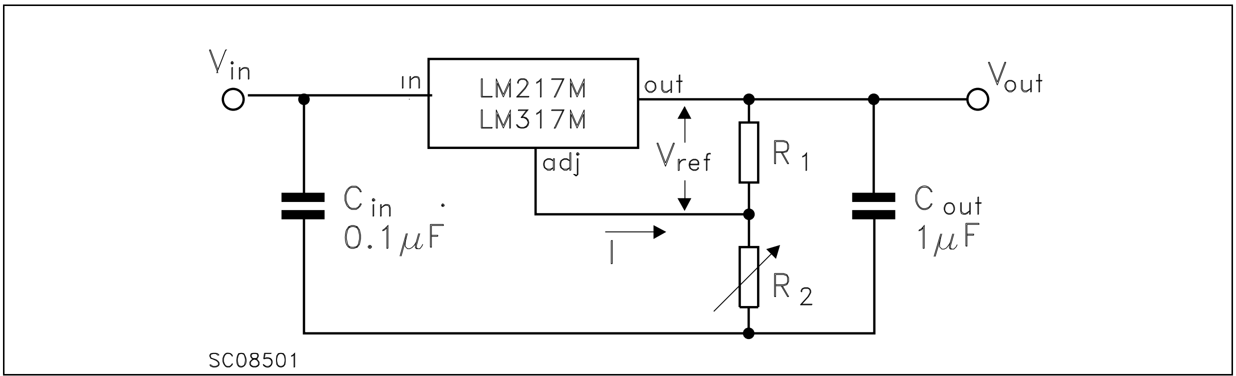
Symbol	Parameter		Value	Unit
V_I-V_O	Input-to-output differential voltage		40	V
P_D	Power dissipation		Internally limited	mW
T_{OP}	Operating junction temperature range (1)	LM217M	-40 to 125	°C
		LM317M	0 to 125	
T_{STG}	Storage temperature range		-55 to 150	°C

1. Reboot is not guaranteed for $T_J \geq 85$ °C.

Table 3. Thermal data

Symbol	Parameter	TO-220	DPAK	Unit
R_{thJC}	Thermal resistance junction-case	3	8	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	100	°C/W

Figure 3. Test circuit



4 Electrical characteristics

Refer to the test circuits, T_J = - 40 to 125 °C, $V_I - V_O$ = 5 V, I_O = 100 mA, $P_D \leq$ 7.5 W, unless otherwise specified.

Table 4. LM217M electrical characteristics

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
ΔV_O	Line regulation	$V_I - V_O$ = 3 to 40 V	T_J = 25 °C		0.01	0.02	%/V
					0.02	0.05	
ΔV_O	Load regulation	$V_O \leq 5$ V I_O = 10 to 500 mA	T_J = 25 °C		5	15	mV
					20	50	
		$V_O \geq 5$ V I_O = 10 to 500 mA	T_J = 25 °C		0.1	0.3	$\%/V_O$
					0.3	1	
I_{ADJ}	Adjustment pin current				50	100	µA
ΔI_{ADJ}	Adjustment pin current	$V_I - V_O$ = 3 to 40 V, I_O = 10 to 500 mA			0.2	5	µA
V_{REF}	Reference voltage	$V_I - V_O$ = 3 to 40 V, I_O = 10 to 500 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	$V_I - V_O \leq 15$ V		500	1000		mA
		$V_I - V_O$ = 40 V, $P_d < P_{DMAX}$, T_J = 25 °C			200		
eN	Output noise voltage (percentage of V_O)	B = 10 Hz to 100 kHz, T_J = 25 °C			0.003		%
SVR	Supply voltage rejection (1)	T_J = 25 °C f = 120 Hz	C_{ADJ} = 0		65		dB
			C_{ADJ} = 10 µF	66	80		

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

Refer to the test circuits, T_J = 0 to 125 °C, V_I - V_O = 5 V, I_O = 100 mA, $P_D \leq$ 7.5 W, unless otherwise specified.

Table 5. LM317M electrical characteristics

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
ΔV_O	Line regulation	V_I - V_O = 3 to 40 V	T_J = 25 °C		0.01	0.04	%/V
					0.02	0.07	
ΔV_O	Load regulation	$V_O \leq$ 5 V I_O = 10 to 500 mA	T_J = 25 °C		5	25	mV
					20	70	
		$V_O \geq$ 5 V I_O = 10 to 500 mA	T_J = 25 °C		0.1	0.5	%/V_O
					0.3	1.5	
I_{ADJ}	Adjustment pin current				50	100	µA
ΔI_{ADJ}	Adjustment pin current	V_I - V_O = 3 to 40 V, I_O = 10 to 500 mA			0.2	5	µA
V_{REF}	Reference voltage	V_I - V_O = 3 to 40 V, I_O = 10 to 500 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 - $V_O \leq$ 15 V		500	1000		mA
		V_I - V_O = 40 V, $P_D < P_{DMAX}$, T_J = 25 °C			200		
eN	Output noise voltage (V_O percentage)	B = 10 Hz to 100 kHz, T_J = 25 °C			0.003		%
SVR	Supply voltage rejection (1)	T_J = 25 °C f = 120 Hz	C_{ADJ} = 0		65		dB
			C_{ADJ} = 10 µF	66	80		

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

5 Typical performance

Figure 4. Current limit

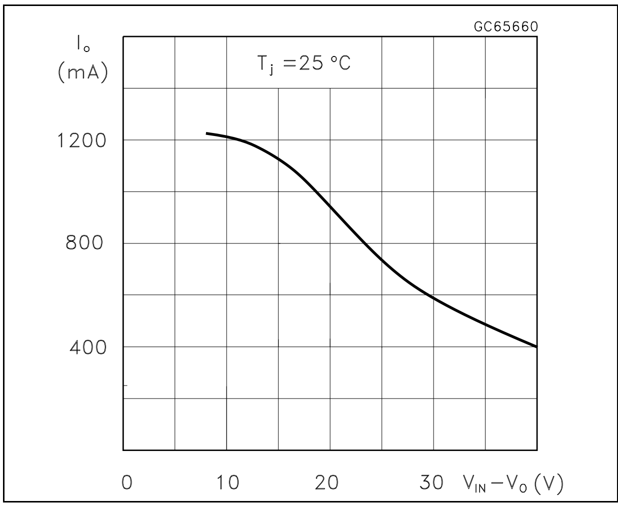


Figure 5. Minimum operating current

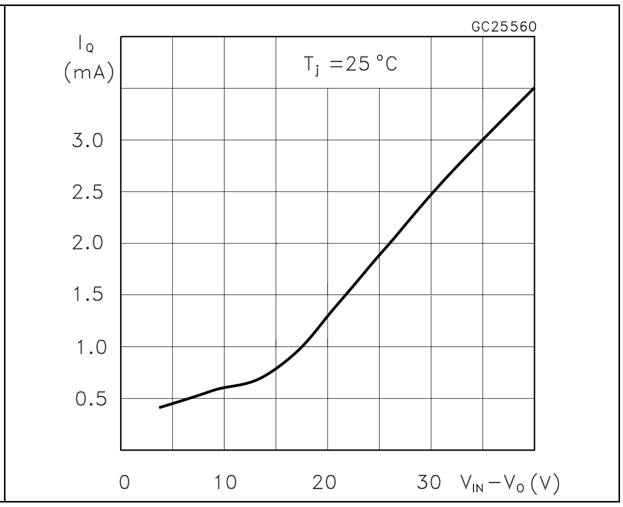


Figure 6. Basic adjustable regulator

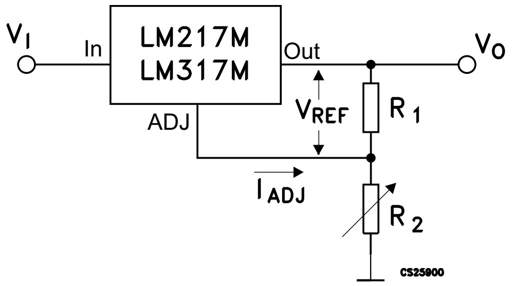
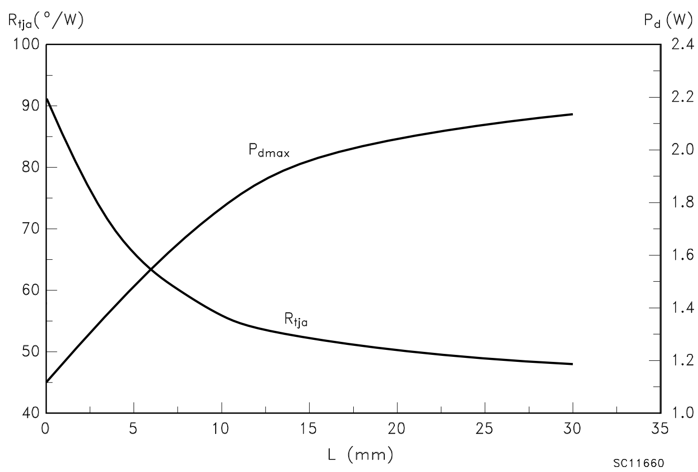


Figure 7. Thermal resistance and maximum power dissipation vs. PCB copper length for DPAK



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

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*), giving the following output voltage:

Equation 1

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

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*) 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 µF 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 µF solid tantalum or 25 µF 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 shows the devices with the recommended protection diodes for output voltages in excess of 25 V or high capacitance values (C_3 > 25 µF, C_2 > 10 µF). 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.

7 Application circuits

Figure 8. Voltage regulator with protection diodes

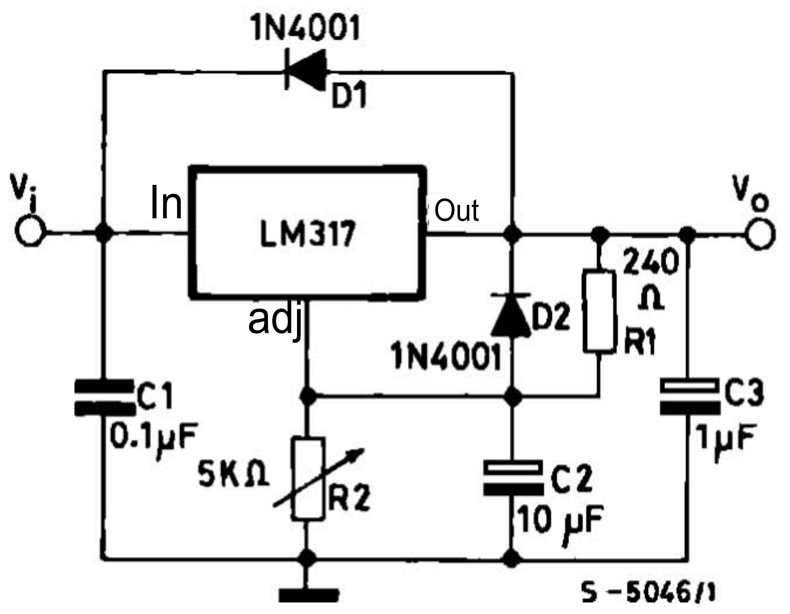


Figure 9. Slow turn-on 15 V regulator

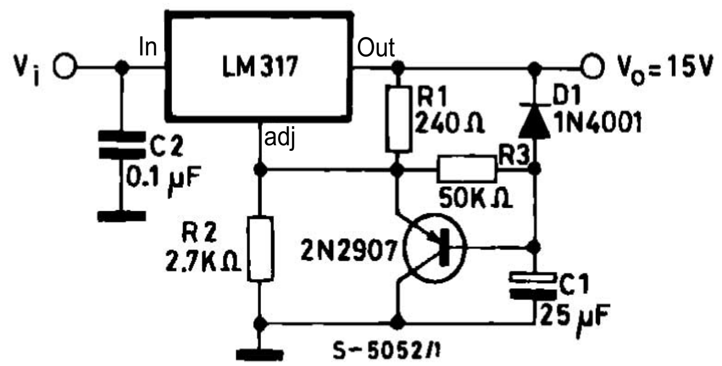
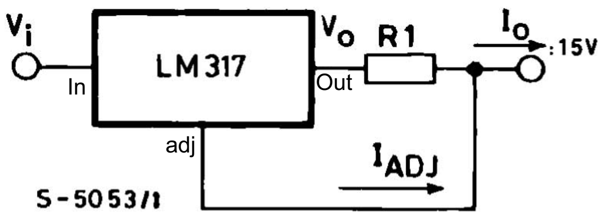


Figure 10. Current regulator



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

Figure 11. 5 V electronic shutdown regulator

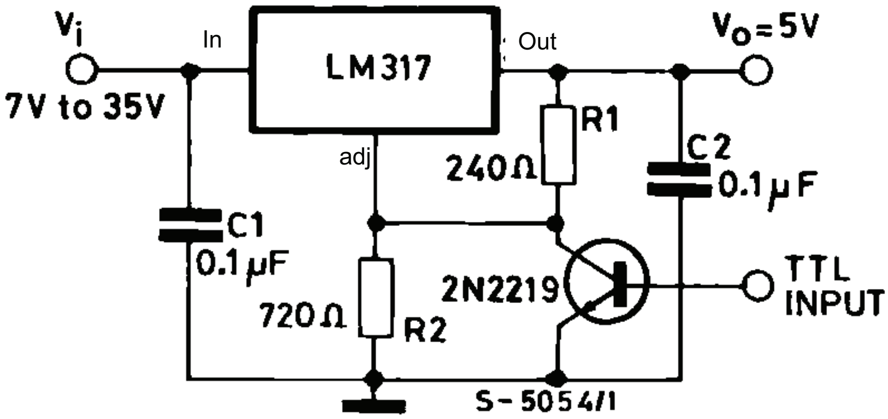
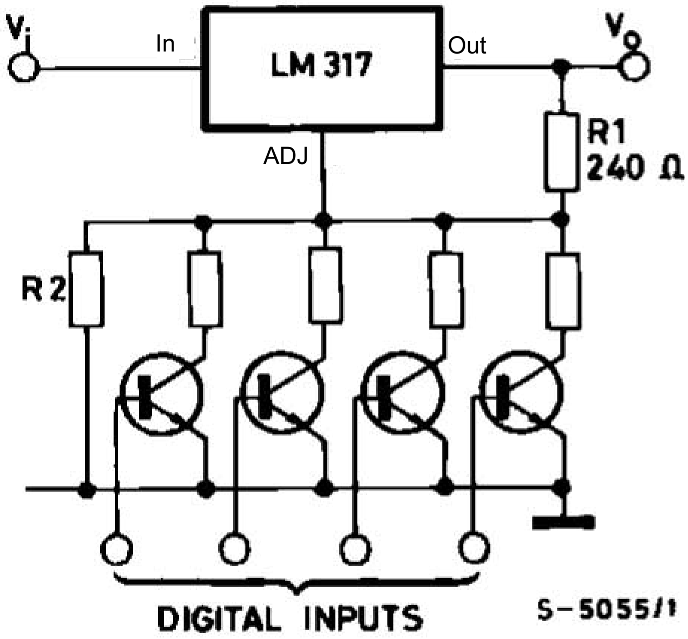


Figure 12. Digitally selected outputs



(R2 sets maximum VO)

8 Package mechanical data

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.

8.1 TO-220

Figure 13. TO-220 (single gauge) drawings

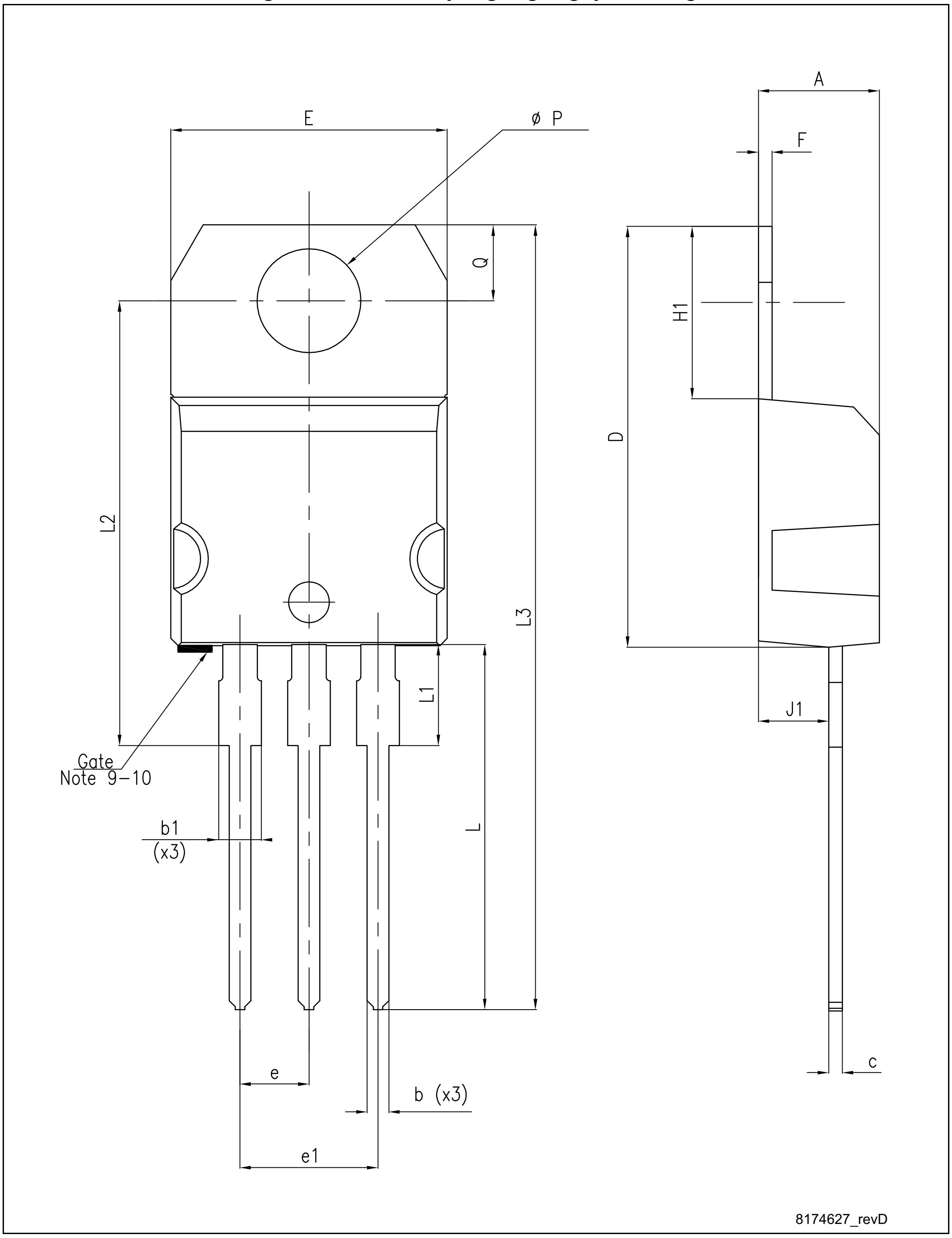


Table 6. TO-220 mechanical data (type STD-ST single gauge)

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	0.51		0.60
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95

8.2 DPAK

Figure 14. DPAK drawings

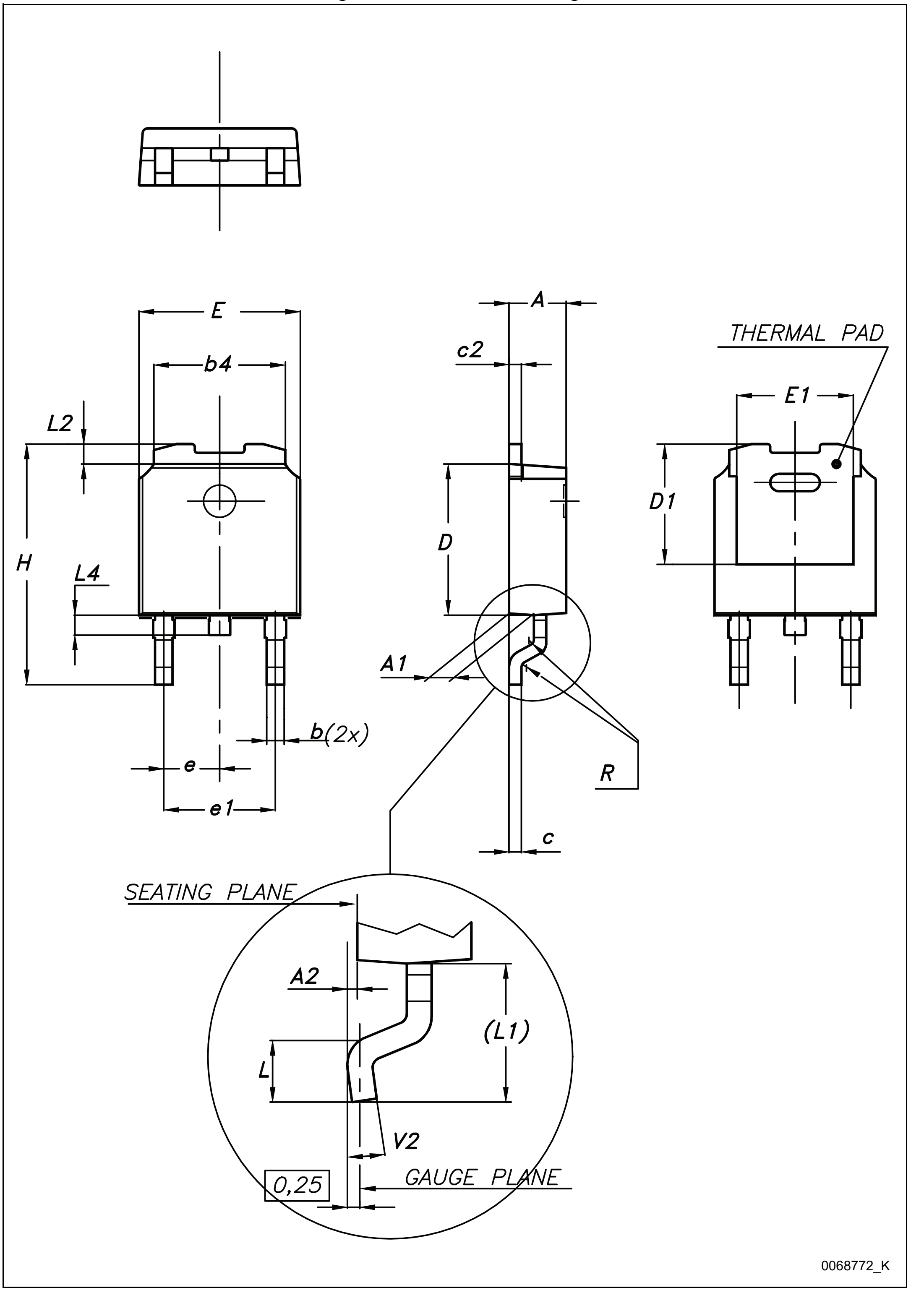
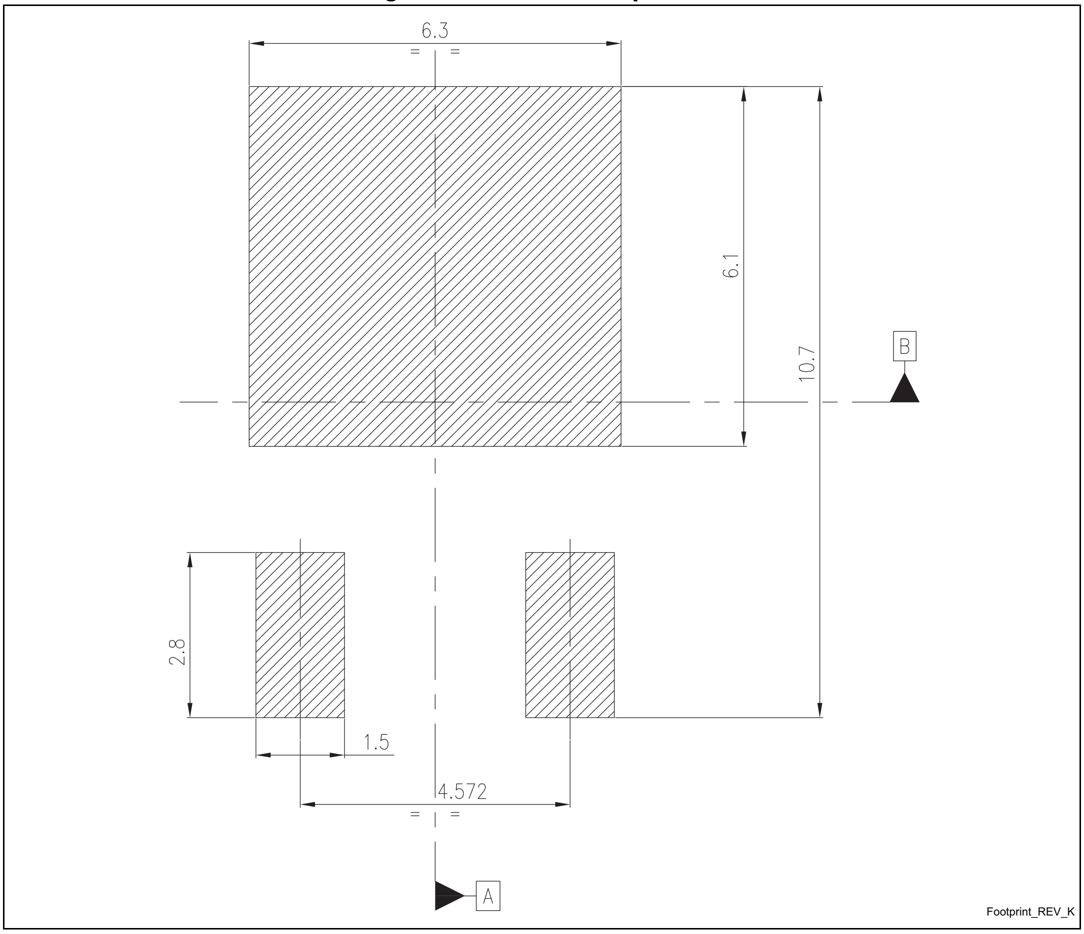


Table 7. DPAK mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 15. DPAK footprint [(a)]



a. All dimensions are in millimeters.

9 Packaging mechanical data

9.1 Tape and reel for DPAK

Figure 16. Tape drawings

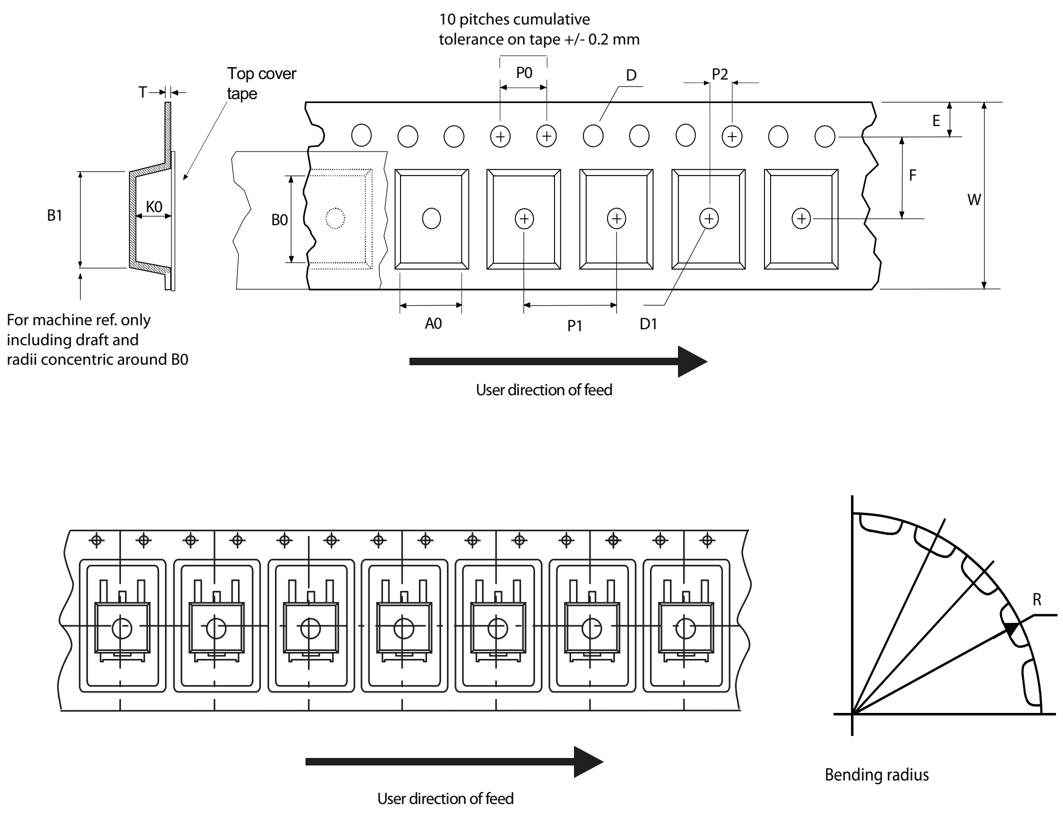


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Figure 17. Reel drawings

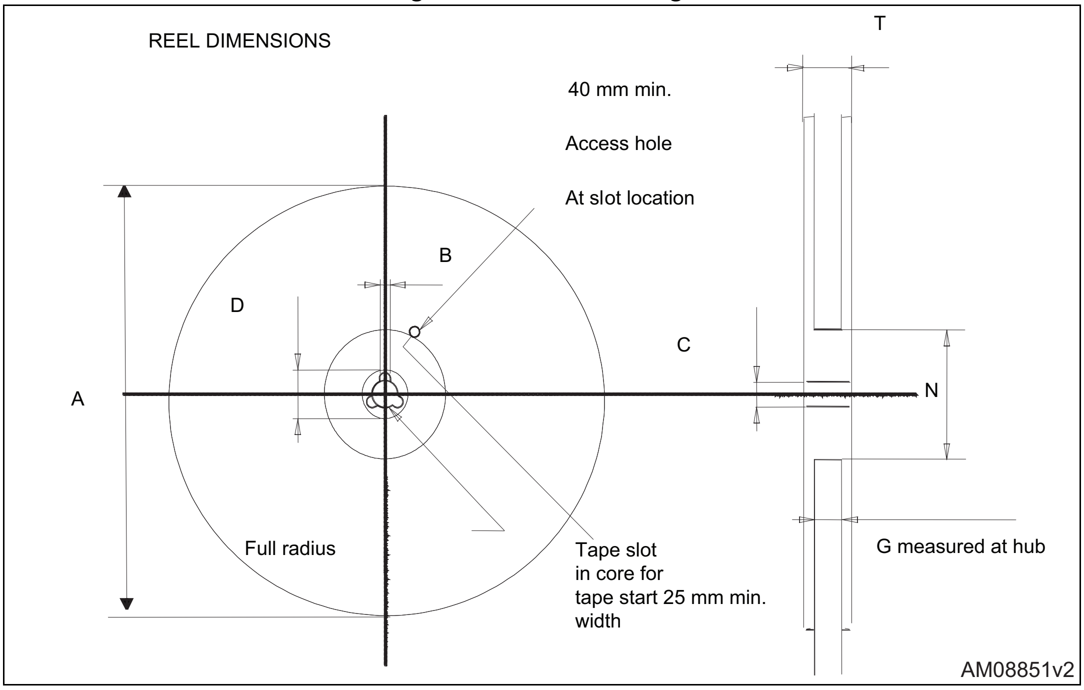

Table 8. Tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

10 Revision history

Table 9. 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*.
07-Jul-2014	8	Updated *Table 1: Device summary* Updated *Section 8.1: TO-220* and *Section 8.2: DPAK*. Updated *Figure 3*, *Figure 6*, *Figure 8*, *Figure 9*, *Figure 10*, *Figure 11*, *Figure 12*. Minor text changes.