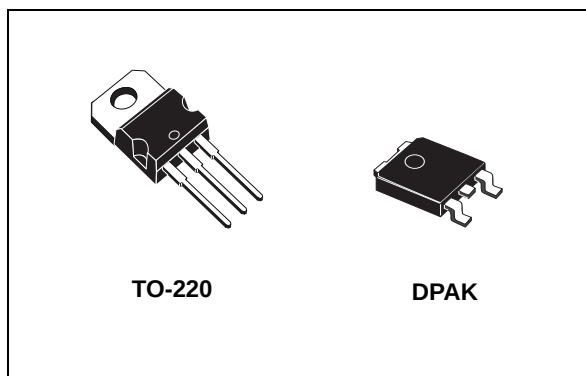


Medium current 1.2 to 37 V adjustable voltage regulator

Datasheet - production data



Description

The LM217M and LM317M are monolithic integrated circuits in TO-220 and DPAK packages 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.

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

Table 1. Device summary

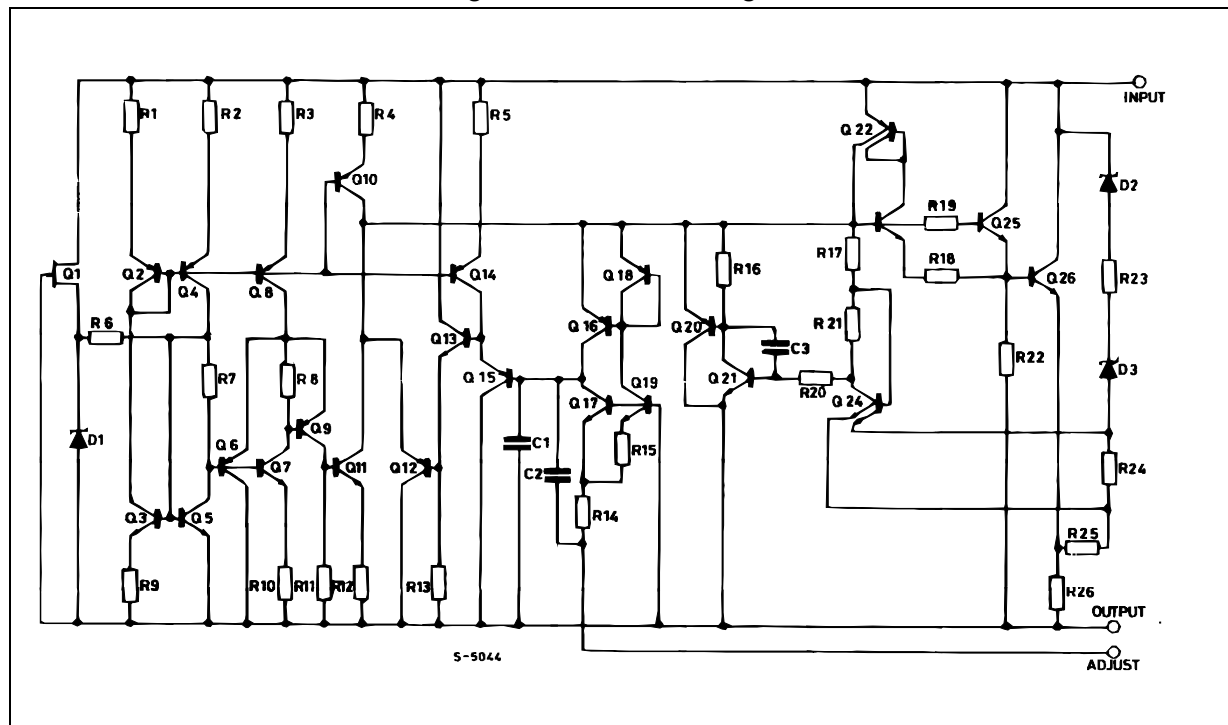
Order codes	
TO-220	DPAK (tape and reel)
	LM217MDT-TR
LM317MT	LM317MDT-TR

Contents

1	Diagram	3
2	Pin configuration	4
3	Maximum ratings	5
4	Electrical characteristics	6
5	Typical performance	8
6	Application information	9
6.1	External capacitors	9
6.2	Protection diodes	9
6.3	Start-up block	10
7	Application circuits	10
8	Package mechanical data	13
8.1	TO-220	14
8.2	DPAK	16
9	Packaging mechanical data	19
9.1	Tape and reel for DPAK	19
10	Revision history	21

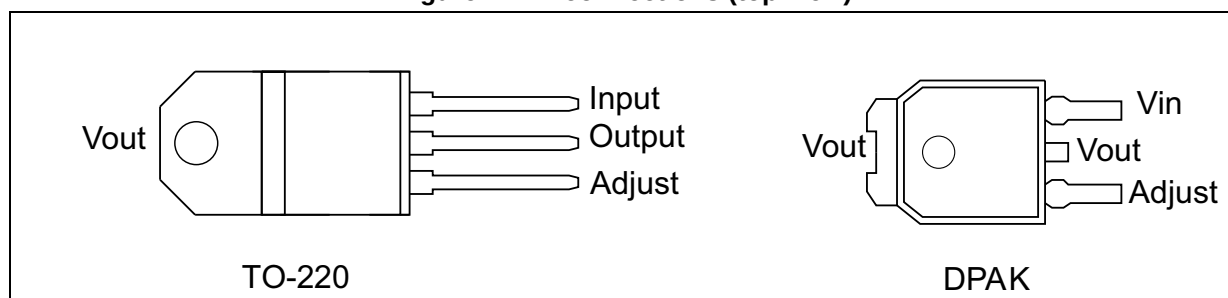
1 Diagram

Figure 1. Schematic diagram



2 Pin configuration

Figure 2. Pin connections (top view)



3 Maximum ratings

Table 2. Absolute maximum ratings

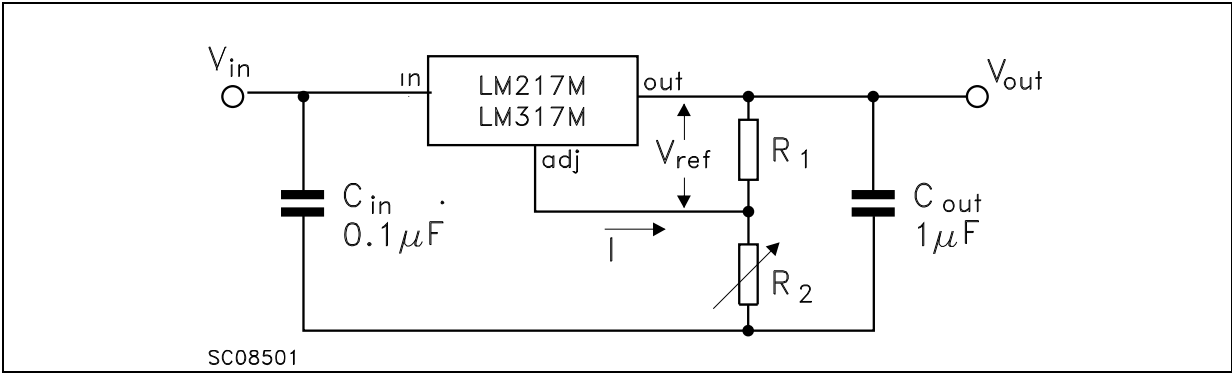
Symbol	Parameter	Value	Unit
V_I-V_O	Input-to-output differential voltage	40	V
P_D	Power dissipation	Internally limited	mW
T_{OP}	Operating junction temperature range ⁽¹⁾	LM217M	-40 to 125
		LM317M	0 to 125
T_{STG}	Storage temperature range	-55 to 150	°C

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 $125\text{ }^{\circ}\text{C}$, $V_I - V_O = 5\text{ V}$, $I_O = 100\text{ mA}$, $P_D \leq 7.5\text{ W}$, 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	$T_J = 25\text{ }^{\circ}\text{C}$		0.01	0.02	%V
					0.02	0.05	
ΔV_O	Load regulation	$V_O \leq 5\text{ V}$ $I_O = 10$ to 500 mA	$T_J = 25\text{ }^{\circ}\text{C}$		5	15	mV
					20	50	
		$V_O \geq 5\text{ V}$ $I_O = 10$ to 500 mA	$T_J = 25\text{ }^{\circ}\text{C}$		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	$V_I - V_O = 40\text{ V}$			3.5	5	mA
$I_{O(max)}$	Maximum output current	$V_I - V_O \leq 15\text{ V}$		500	1000		mA
		$V_I - V_O = 40\text{ V}$, $P_d < P_{DMAX}$, $T_J = 25\text{ }^{\circ}\text{C}$			200		
eN	Output noise voltage (percentage of V_O)	$B = 10\text{ Hz}$ to 100 kHz , $T_J = 25\text{ }^{\circ}\text{C}$			0.003		%
SVR	Supply voltage rejection ⁽¹⁾	$T_J = 25\text{ }^{\circ}\text{C}$ $f = 120\text{ Hz}$	$C_{ADJ} = 0$		65		dB
			$C_{ADJ} = 10\text{ }\mu\text{F}$	66	80		

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

Refer to the test circuits, $T_J = 0$ to $125\text{ }^{\circ}\text{C}$, $V_I - V_O = 5\text{ V}$, $I_O = 100\text{ mA}$, $P_D \leq 7.5\text{ W}$, 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	$T_J = 25\text{ }^{\circ}\text{C}$		0.01	0.04	%/ V
					0.02	0.07	
ΔV_O	Load regulation	$V_O \leq 5\text{ V}$ $I_O = 10$ to 500 mA	$T_J = 25\text{ }^{\circ}\text{C}$		5	25	mV
					20	70	
		$V_O \geq 5\text{ V}$ $I_O = 10$ to 500 mA	$T_J = 25\text{ }^{\circ}\text{C}$		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	$V_I - V_O = 40\text{ V}$			3.5	10	mA
$I_{O(max)}$	Maximum output current	$V_I - V_O \leq 15\text{ V}$		500	1000		mA
		$V_I - V_O = 40\text{ V}$, $P_D < P_{DMAX}$, $T_J = 25\text{ }^{\circ}\text{C}$			200		
eN	Output noise voltage (V_O percentage)	B = 10 Hz to 100 kHz, $T_J = 25\text{ }^{\circ}\text{C}$			0.003		%
SVR	Supply voltage rejection ⁽¹⁾	$T_J = 25\text{ }^{\circ}\text{C}$ $f = 120\text{ Hz}$	$C_{ADJ} = 0$		65		dB
			$C_{ADJ} = 10\text{ }\mu\text{F}$	66	80		

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

5 Typical performance

Figure 4. Current limit

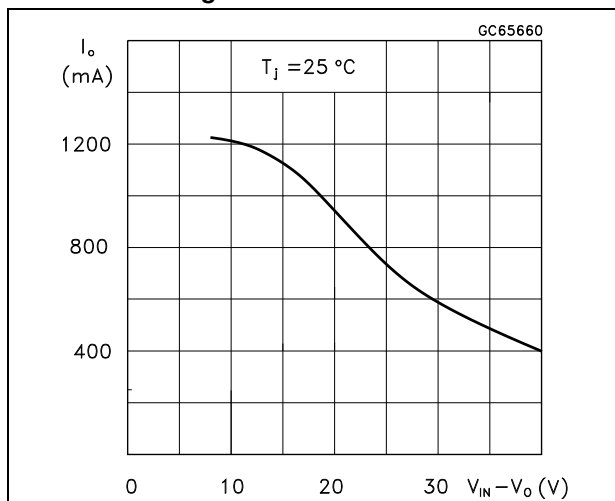


Figure 5. Minimum operating current

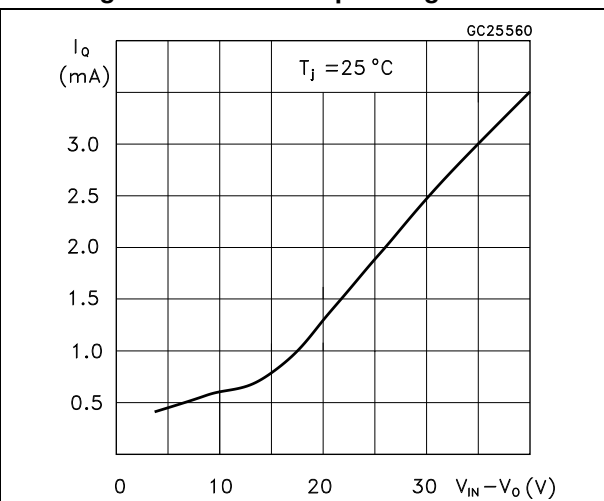


Figure 6. Basic adjustable regulator

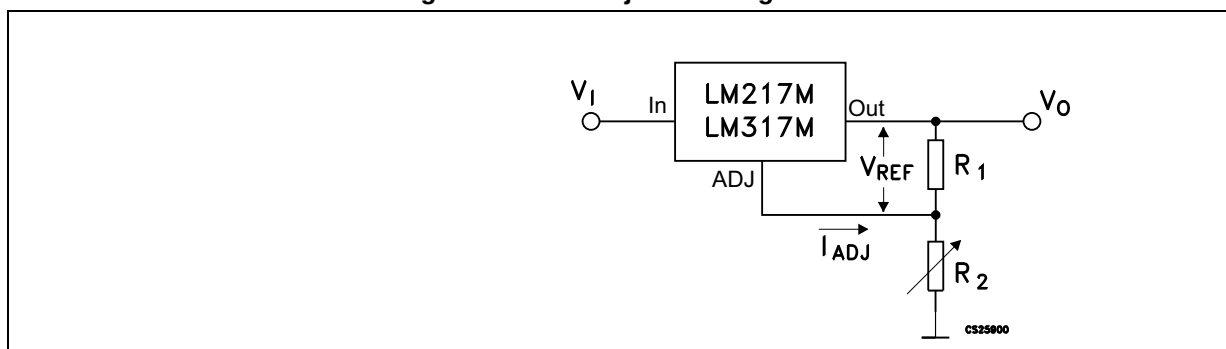
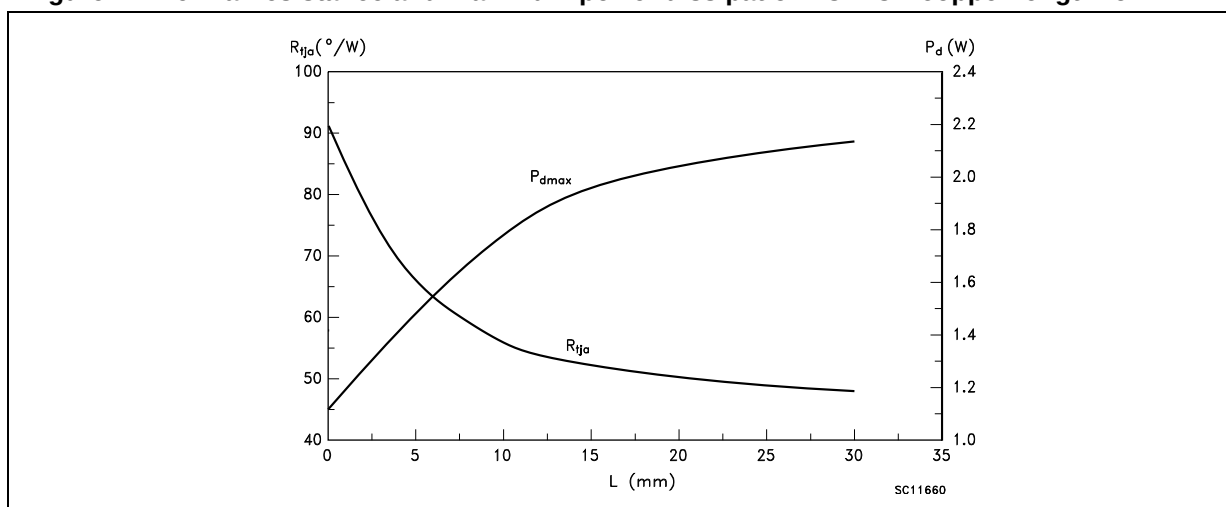


Figure 7. Thermal resistance and maximum power dissipation vs. PCB copper length for DPAK



Note: P_{dmax} calculated for $T_a = 50^\circ\text{C}$.

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 μ A 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 μ F disc or 1 μ F 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](#) 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.

7 Application circuits

Figure 8. Voltage regulator with protection diodes

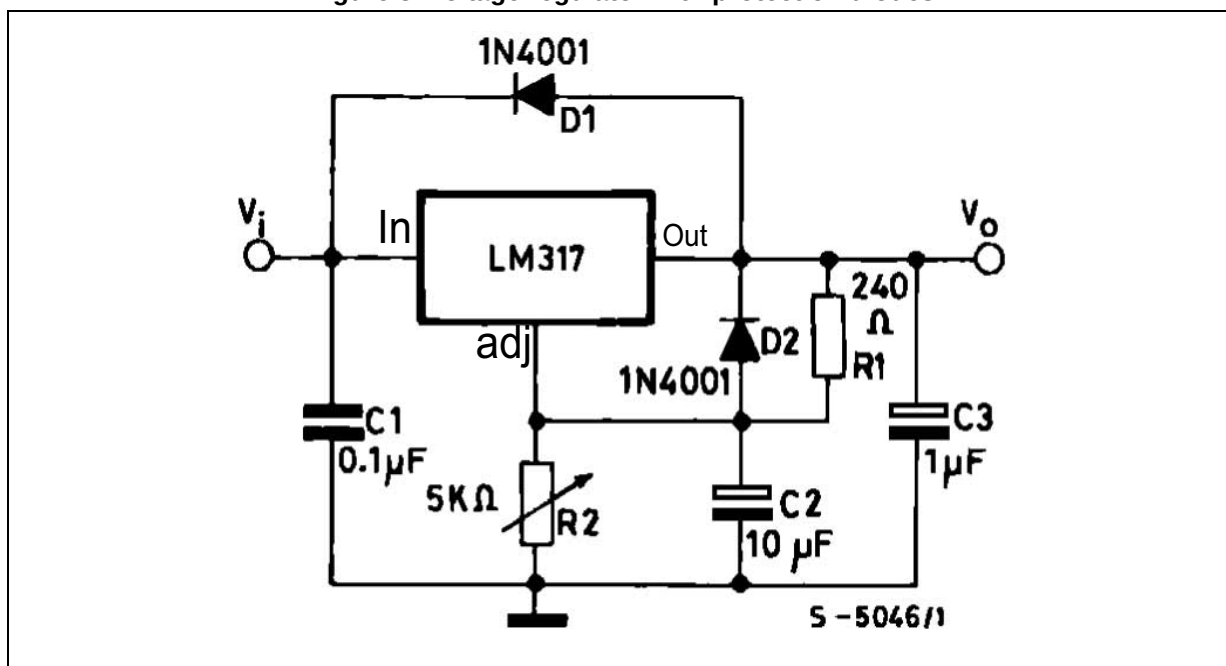


Figure 9. Slow turn-on 15 V regulator

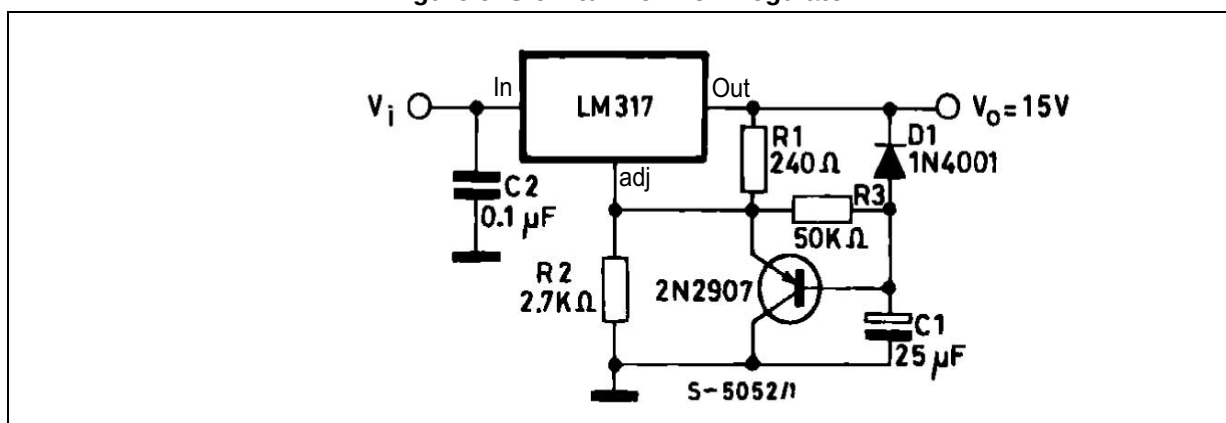


Figure 10. Current regulator

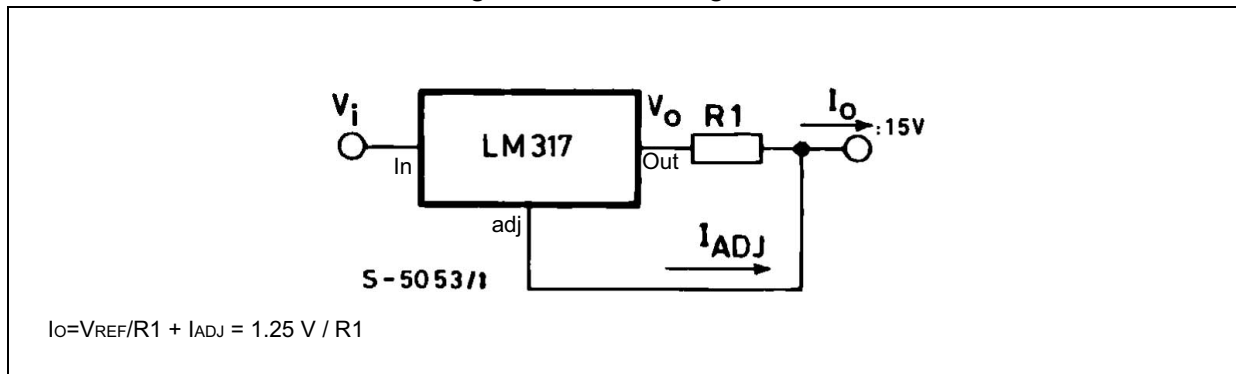


Figure 11. 5 V electronic shutdown regulator

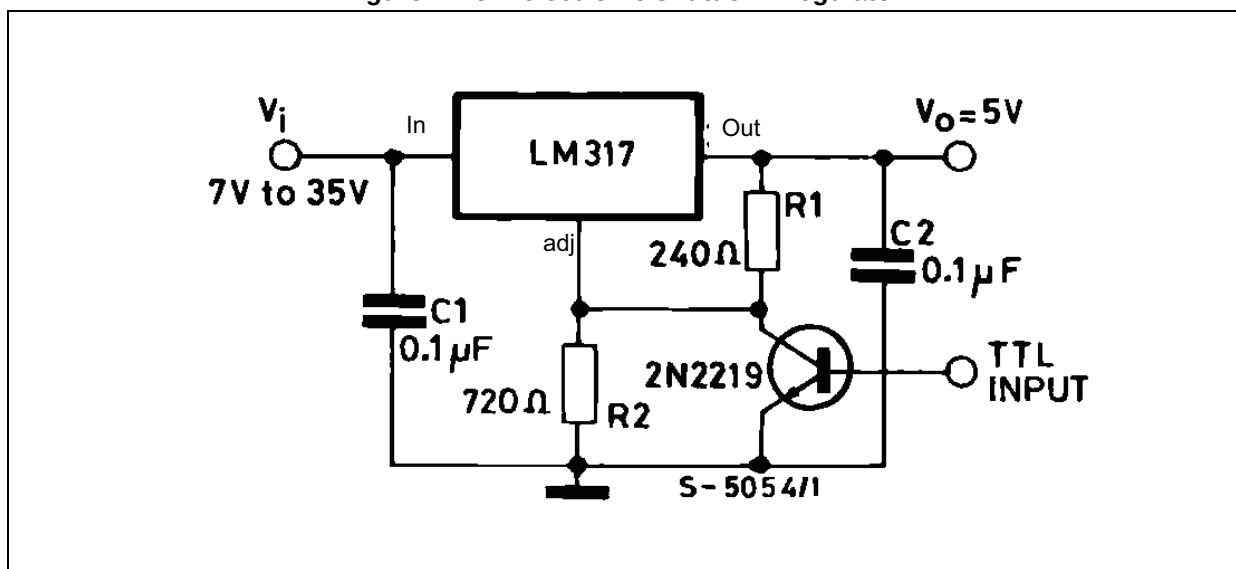
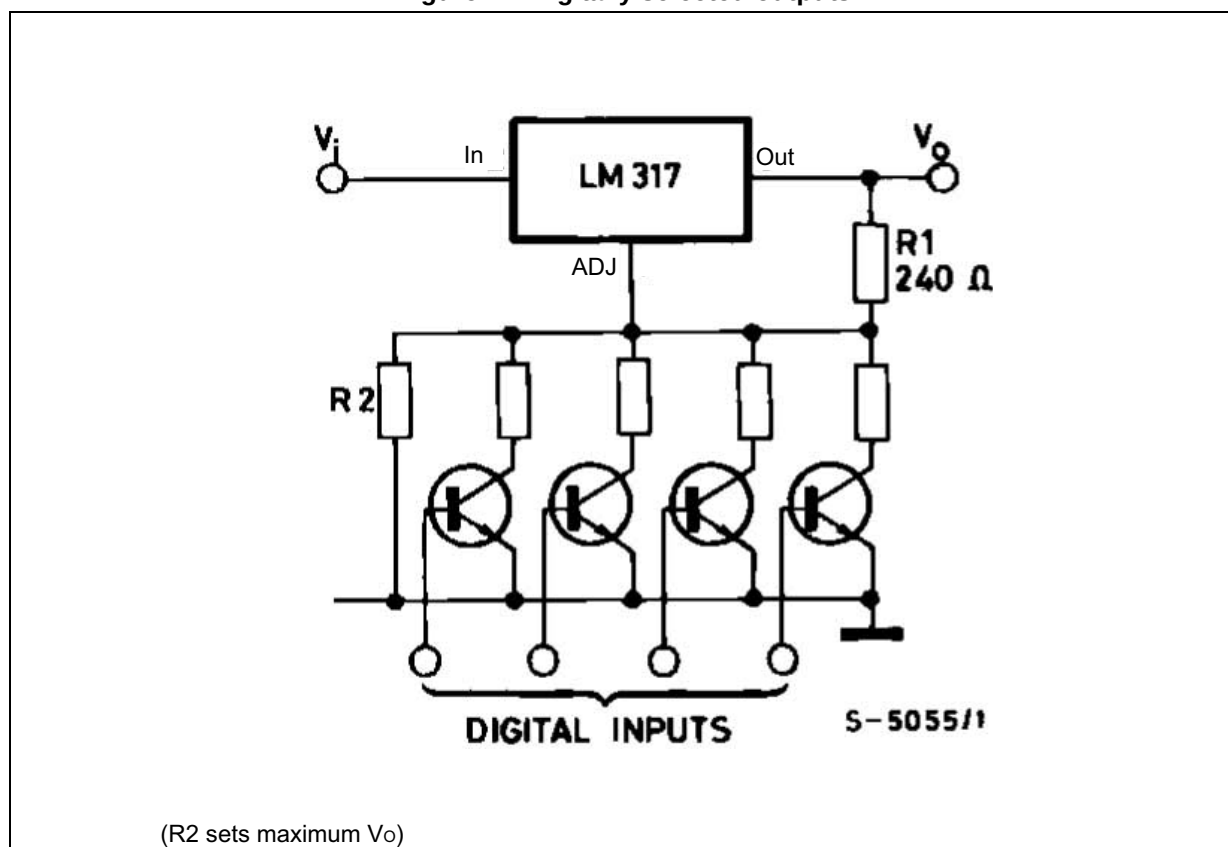


Figure 12. Digitally selected outputs



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

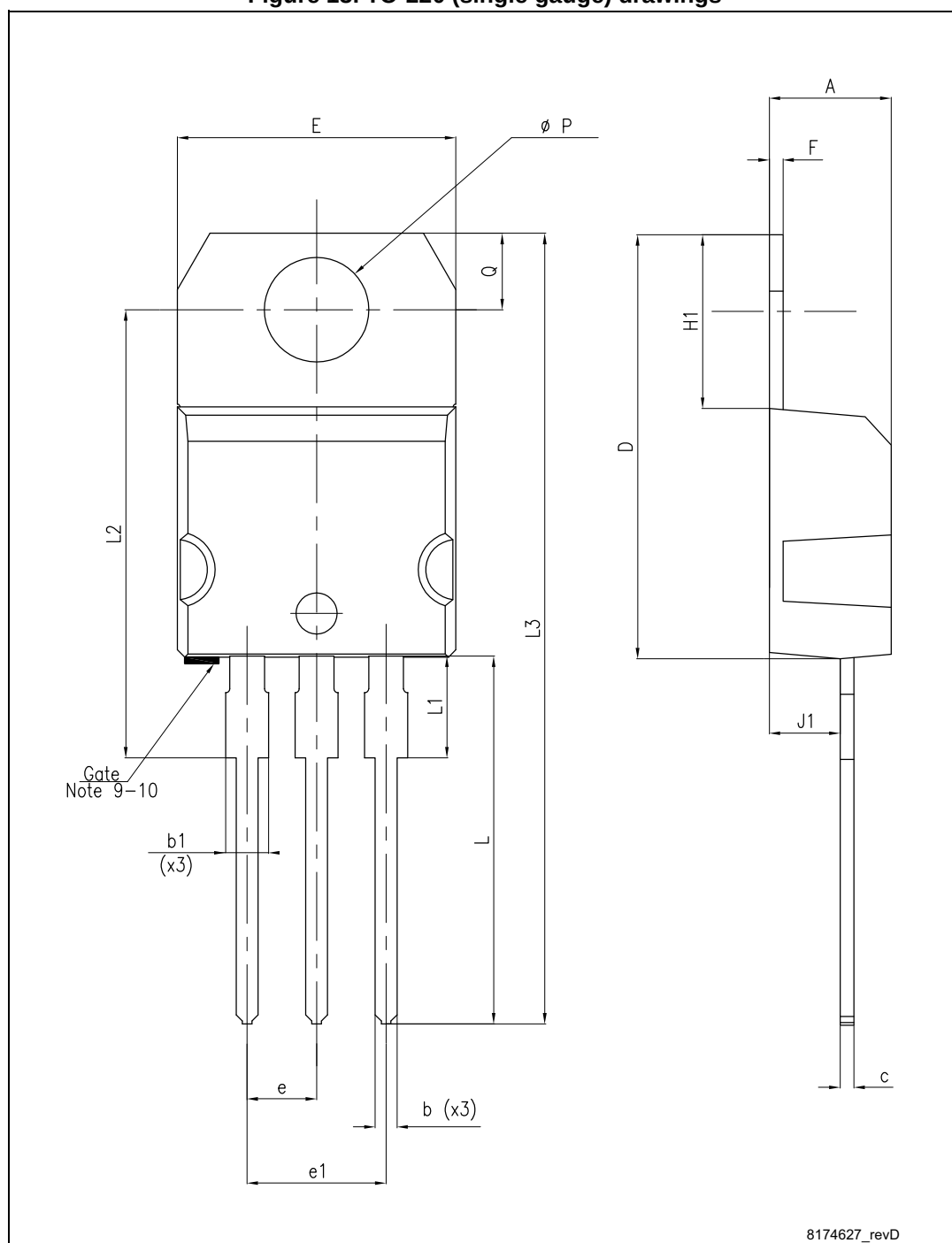


Table 6. TO-220 mechanical data (type STD-ST single gauge)

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	
ØP	3.75		3.85
Q	2.65		2.95

8.2 DPAK

Figure 14. DPAK drawings

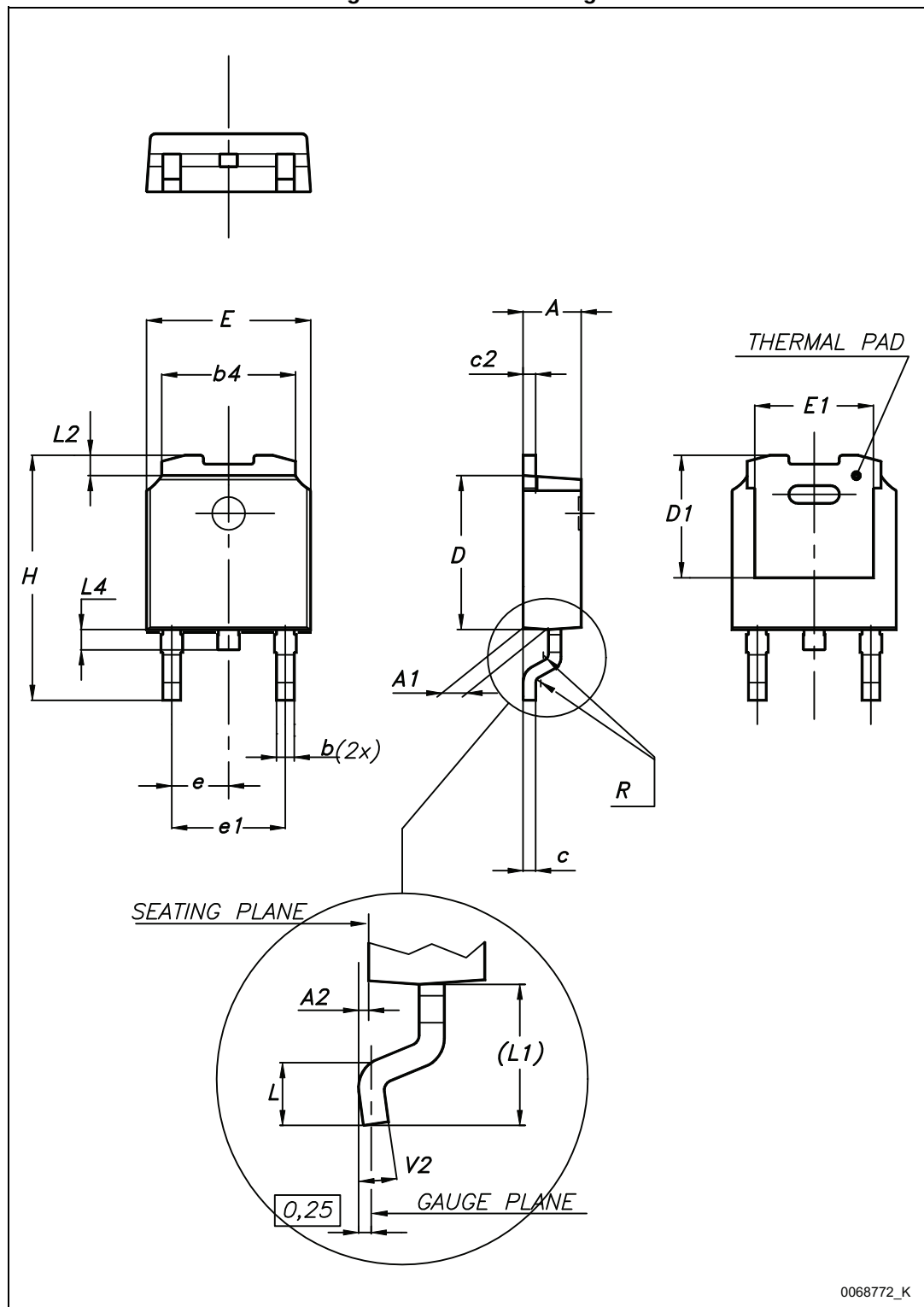
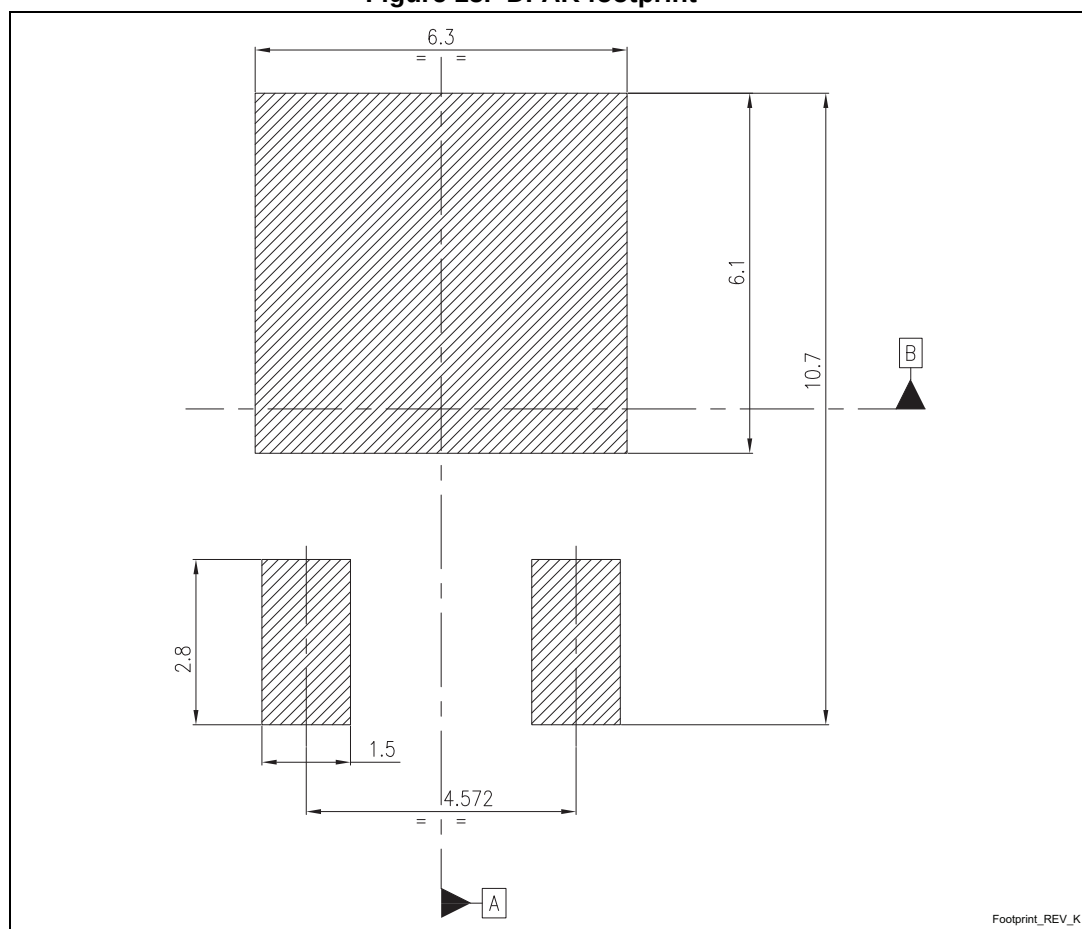


Table 7. DPAK mechanical data

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

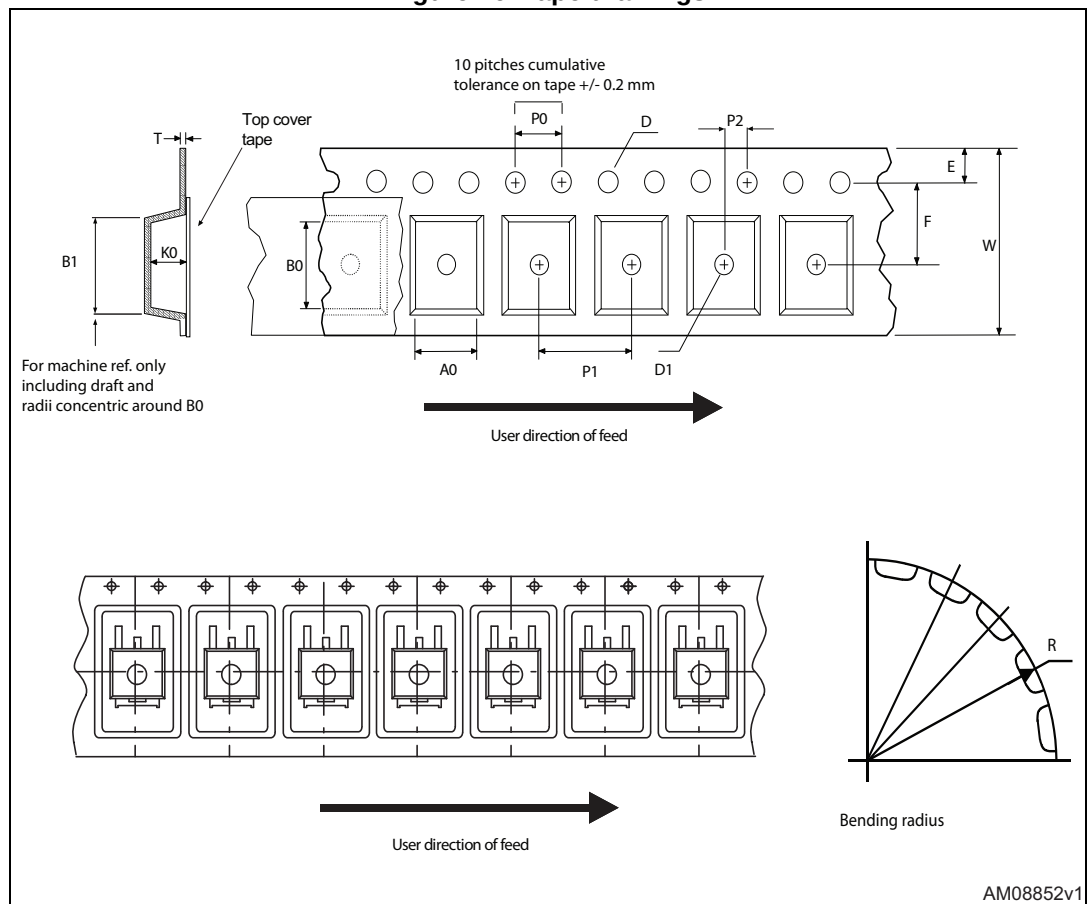


Figure 17. Reel drawings

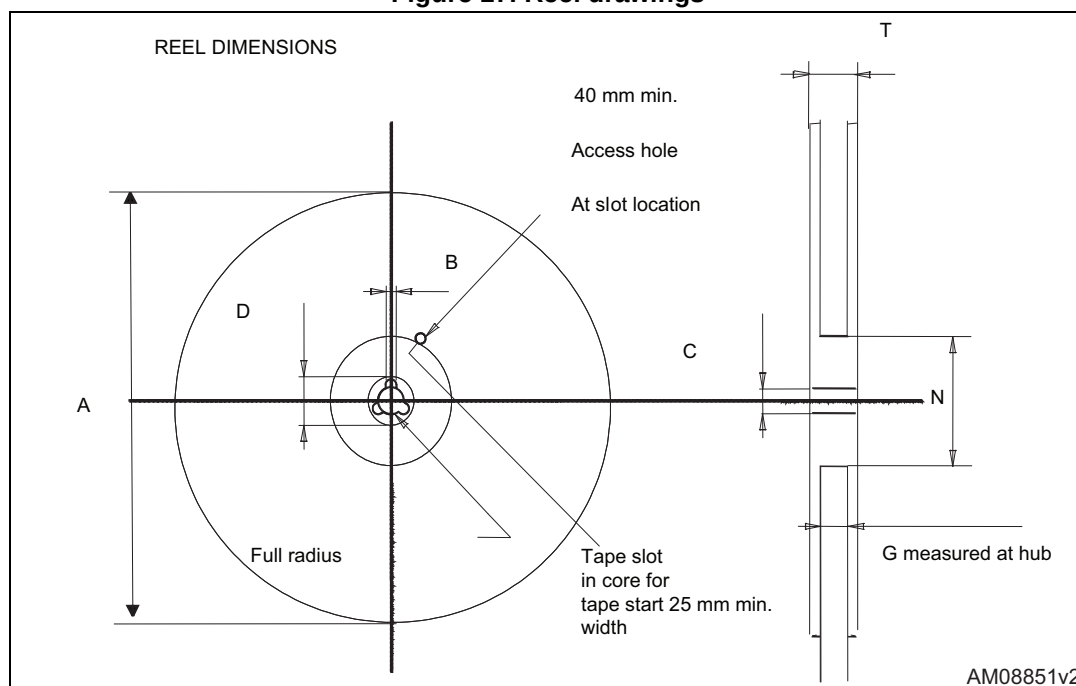


Table 8. Tape and reel mechanical data

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.

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2014 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com