

N-channel 600 V, 0.076  $\Omega$  typ., 34 A MDmesh™ M2 EP Power MOSFETs in D<sup>2</sup>PAK, TO-220 and TO-247 packages

Datasheet - production data

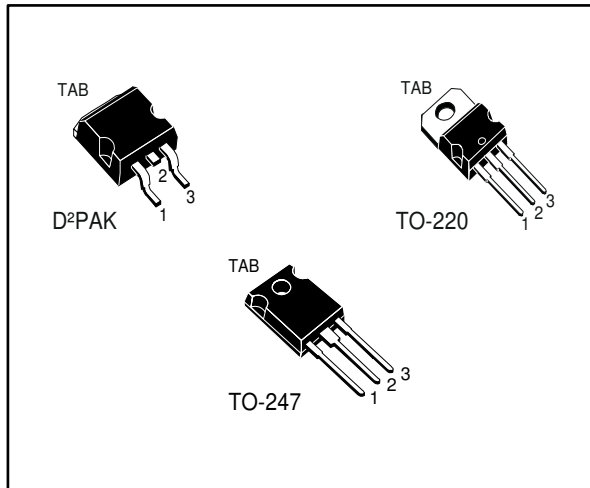
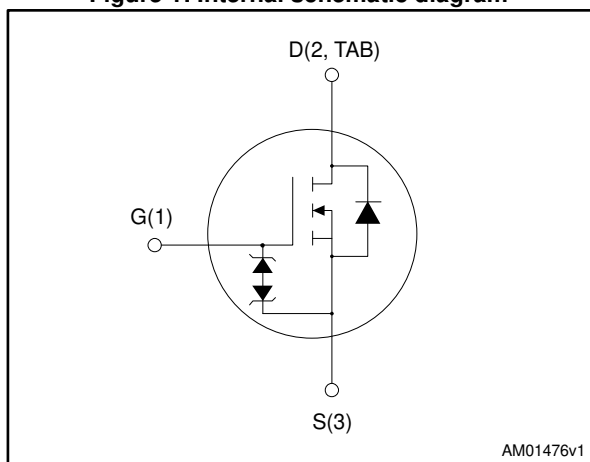


Figure 1: Internal schematic diagram



## Features

Order code	V <sub>DS</sub> @ T <sub>Jmax</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STB42N60M2-EP	650 V	0.087 $\Omega$	34 A
STP42N60M2-EP			
STW42N60M2-EP			

- Extremely low gate charge
- Excellent output capacitance (C<sub>OSS</sub>) profile
- Very low turn-off switching losses
- 100% avalanche tested
- Zener-protected

## Applications

- Switching applications
- Tailored for very high frequency converters (f > 150 kHz)

## Description

These devices are N-channel Power MOSFETs developed using MDmesh™ M2 EP enhanced performance technology. Thanks to their strip layout and improved vertical structure, the devices exhibit low on-resistance and optimized switching characteristics with very low turn-off switching losses, rendering them suitable for the most demanding very high frequency converters.

Table 1: Device summary

Order code	Marking	Package	Packaging
STB42N60M2-EP	42N60M2EP	D <sup>2</sup> PAK	Tape and reel
STP42N60M2-EP		TO-220	Tube
STW42N60M2-EP		TO-247	

## Contents

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# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 25$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	34	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	22	A
$I_{DM}^{(1)}$	Drain current (pulsed)	136	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	250	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	50	V/ns
$T_{stg}$	Storage temperature	- 55 to 150	$^\circ\text{C}$
$T_j$	Max. operating junction temperature	150	$^\circ\text{C}$

**Notes:**

<sup>(1)</sup>Pulse width limited by safe operating area.

<sup>(2)</sup> $I_{SD} \leq 34\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ;  $V_{DS(\text{peak})} < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$ .

<sup>(3)</sup> $V_{DS} \leq 480\text{ V}$

**Table 3: Thermal data**

Symbol	Parameter	Value			Unit
		D <sup>2</sup> PAK	TO-220	TO-247	
$R_{thj\text{-case}}$	Thermal resistance junction-case max	0.50			$^\circ\text{C}/\text{W}$
$R_{thj\text{-pcb}}^{(1)}$	Thermal resistance junction-pcb max	30			$^\circ\text{C}/\text{W}$
$R_{thj\text{-amb}}$	Thermal resistance junction-ambient max		62.5	50	$^\circ\text{C}/\text{W}$

**Notes:**

<sup>(1)</sup>When mounted on FR-4 board of  $\text{inch}^2$ , 2oz Cu.

**Table 4: Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width limited by $T_{j\text{max}}$ )	6	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ ; $V_{DD} = 50\text{ V}$ )	800	mJ

## 2 Electrical characteristics

$T_C = 25\text{ °C}$  unless otherwise specified

**Table 5: On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	600			V
$I_{DSS}$	Zero gate voltage Drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$ , $T_C = 125\text{ °C}$			100	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 25\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 17\text{ A}$		0.076	0.087	$\Omega$

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	2370	-	pF
$C_{oss}$	Output capacitance		-	112	-	pF
$C_{rss}$	Reverse transfer capacitance		-	2.5	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }480\text{ V}$ , $V_{GS} = 0\text{ V}$	-	454	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	4.5	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 480\text{ V}$ , $I_D = 34\text{ A}$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 18</a> : "Gate charge test circuit")	-	55	-	nC
$Q_{gs}$	Gate-source charge		-	8.5	-	nC
$Q_{gd}$	Gate-drain charge		-	25	-	nC

**Notes:**

<sup>(1)</sup> $C_{oss\text{ eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

**Table 7: Switching energy**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{(off)}$	Turn-off energy (from 90% $V_{GS}$ to 0% $I_D$ )	$V_{DD} = 400\text{ V}$ , $I_D = 2.5\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	13	-	$\mu\text{J}$
		$V_{DD} = 400\text{ V}$ , $I_D = 5\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	14.5	-	$\mu\text{J}$

Table 8: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300 \text{ V}$ , $I_D = 17 \text{ A}$ , $R_G = 4.7 \text{ } \Omega$ , $V_{GS} = 10 \text{ V}$ (see <a href="#">Figure 17</a> : "Switching times test circuit for resistive load" and <a href="#">Figure 22</a> : "Switching time waveform" )	-	16.5	-	ns
$t_r$	Rise time		-	9.5	-	ns
$t_{d(off)}$	Turn-off-delay time		-	96.5	-	ns
$t_f$	Fall time		-	8	-	ns

Table 9: Source drain diode

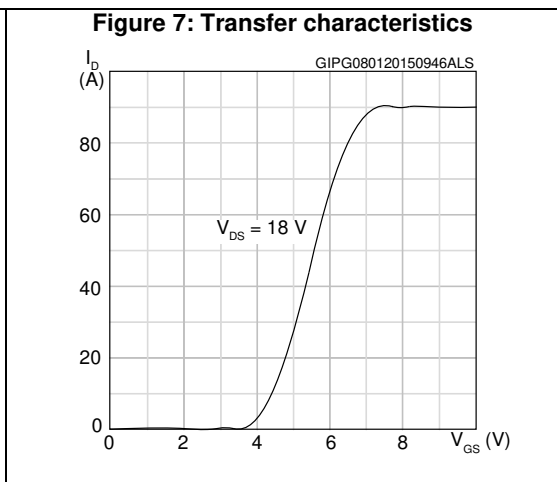
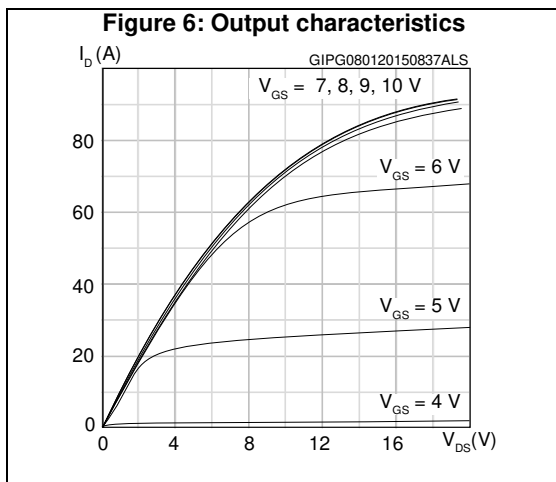
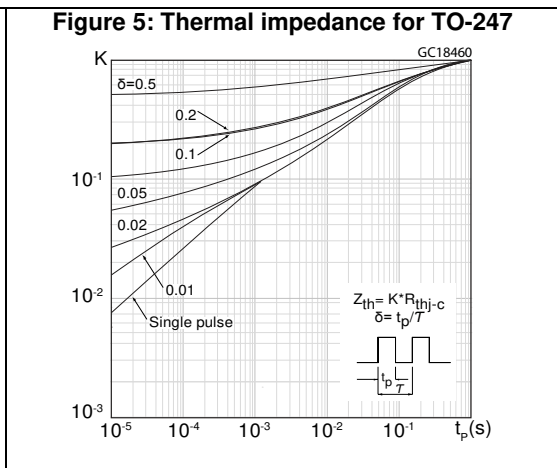
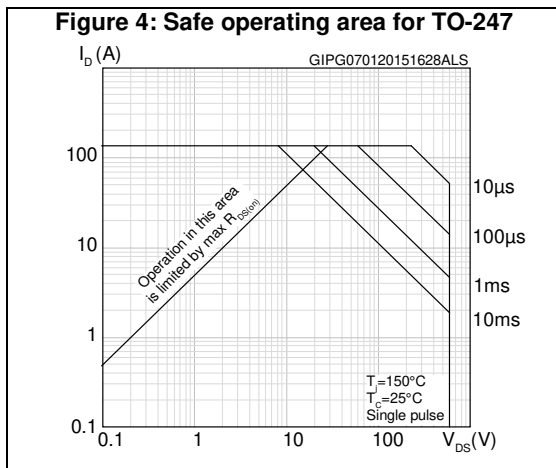
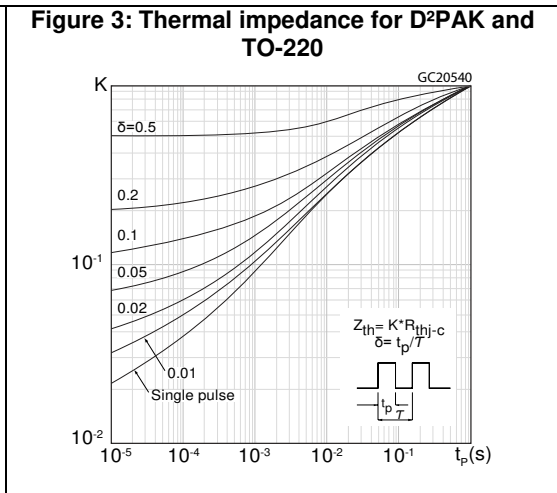
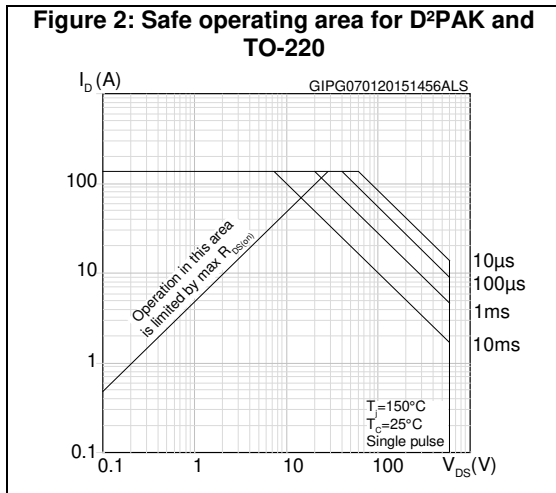
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		34	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		136	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0 \text{ V}$ , $I_{SD} = 34 \text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 34 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ , $V_{DD} = 60 \text{ V}$ (see <a href="#">Figure 22</a> : "Switching time waveform")	-	438		ns
$Q_{rr}$	Reverse recovery charge		-	9		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	41.5		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 34 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ , $V_{DD} = 60 \text{ V}$ , $T_j = 150 \text{ }^\circ\text{C}$ (see <a href="#">Figure 22</a> : "Switching time waveform")	-	538		ns
$Q_{rr}$	Reverse recovery charge		-	12		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	44.5		A

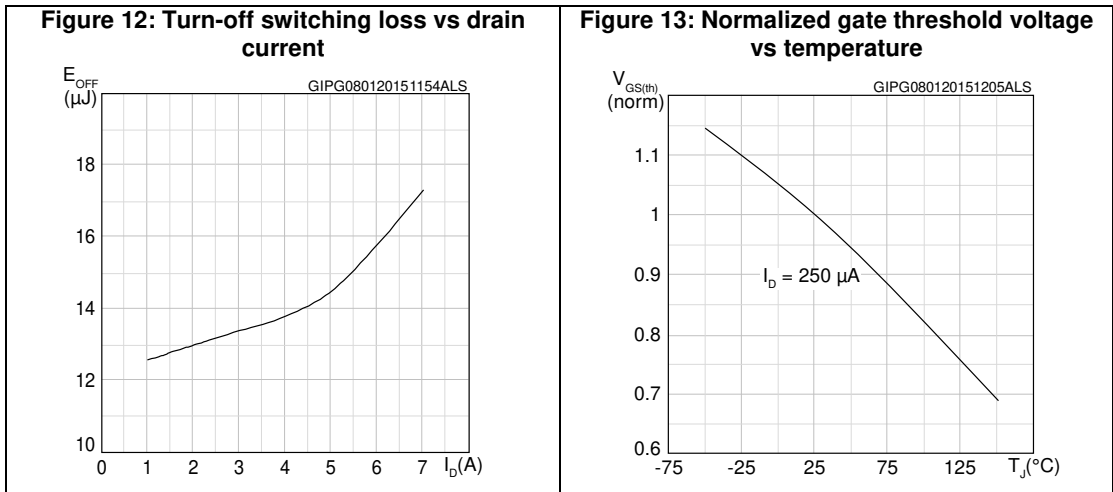
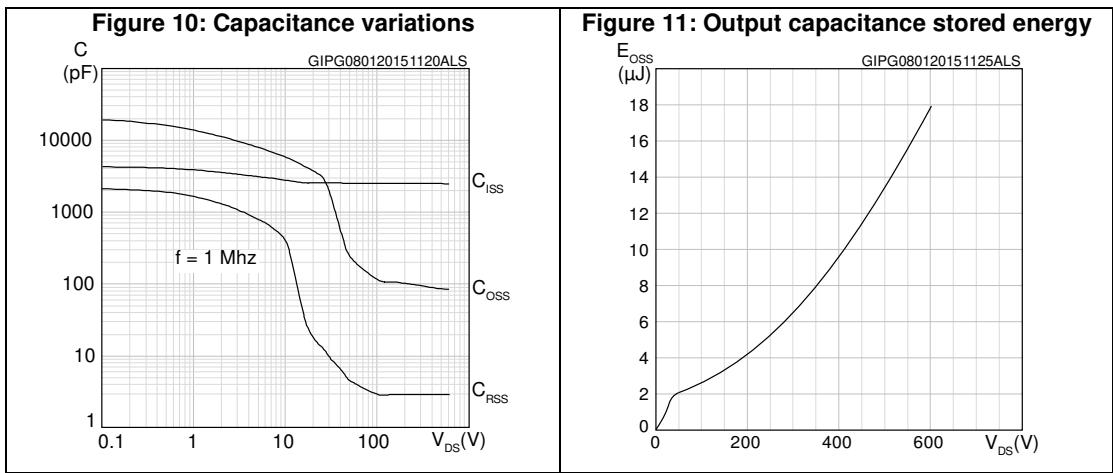
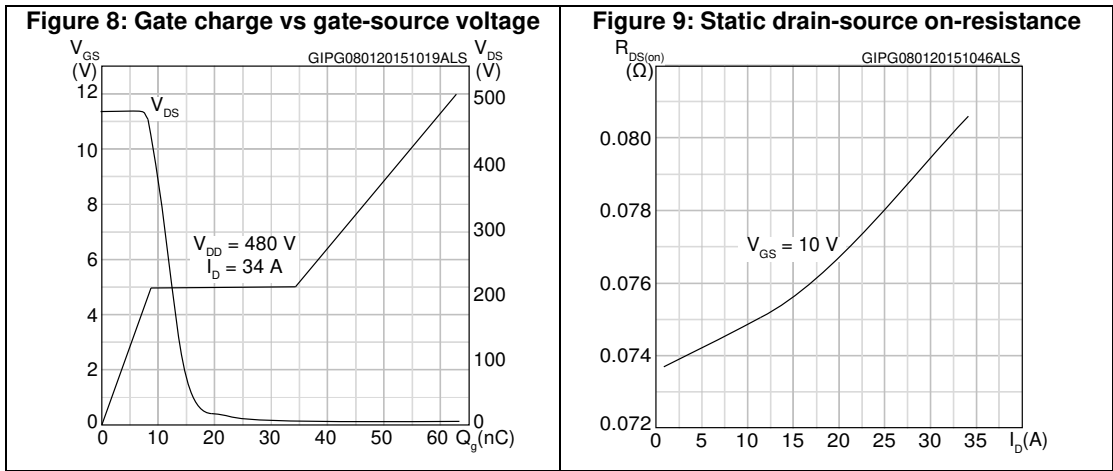
**Notes:**

<sup>(1)</sup>Pulse width is limited by safe operating area

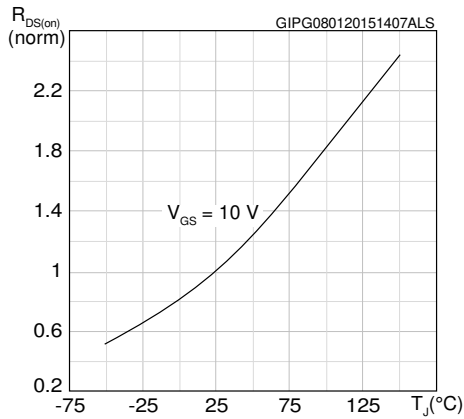
<sup>(2)</sup>Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.2 Electrical characteristics (curves)

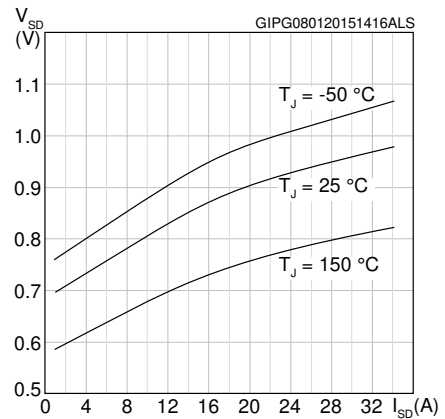




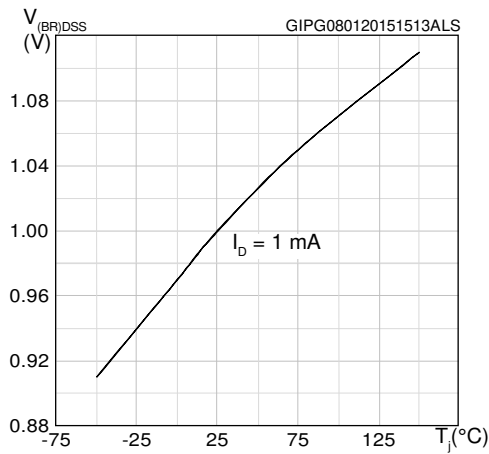
**Figure 14: Normalized on-resistance vs temperature**



**Figure 15: Source-drain diode forward characteristics**

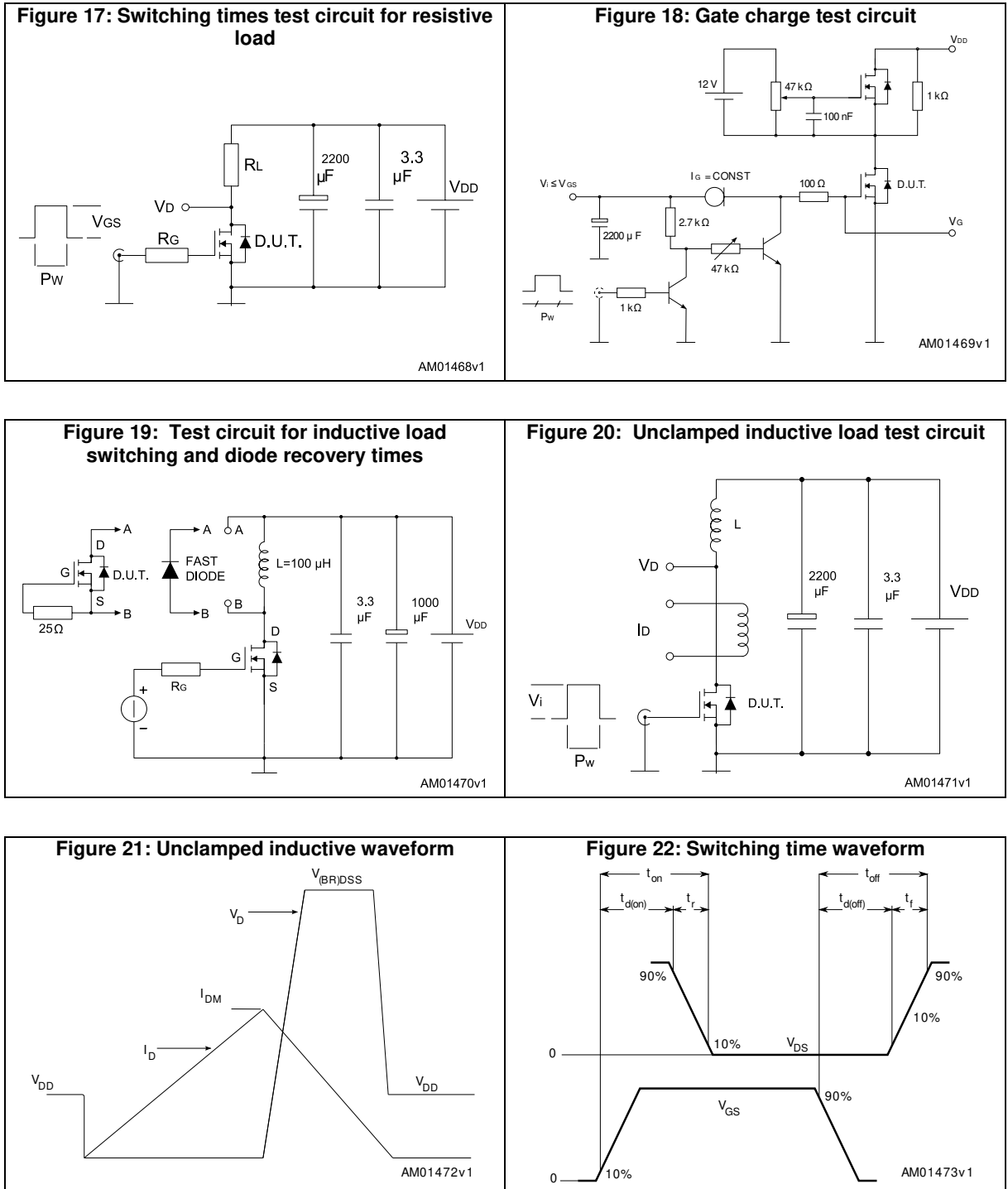


**Figure 16: Normalized  $V_{(BR)DSS}$  vs temperature**





### 3 Test circuits



## 4 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](http://www.st.com). ECOPACK® is an ST trademark.

### 4.1 D<sup>2</sup>PAK package information

Figure 23: D<sup>2</sup>PAK (TO-263) drawing

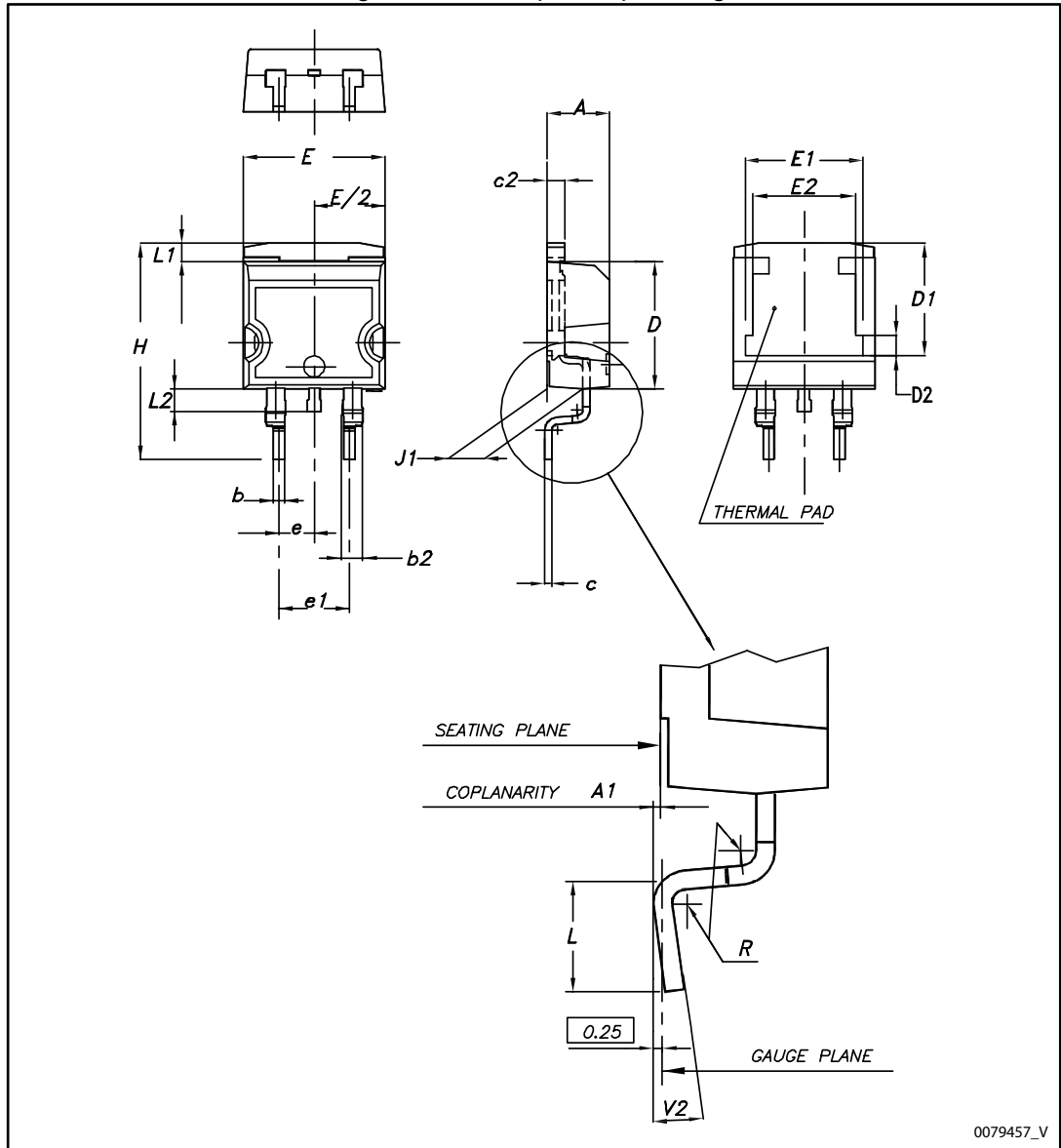
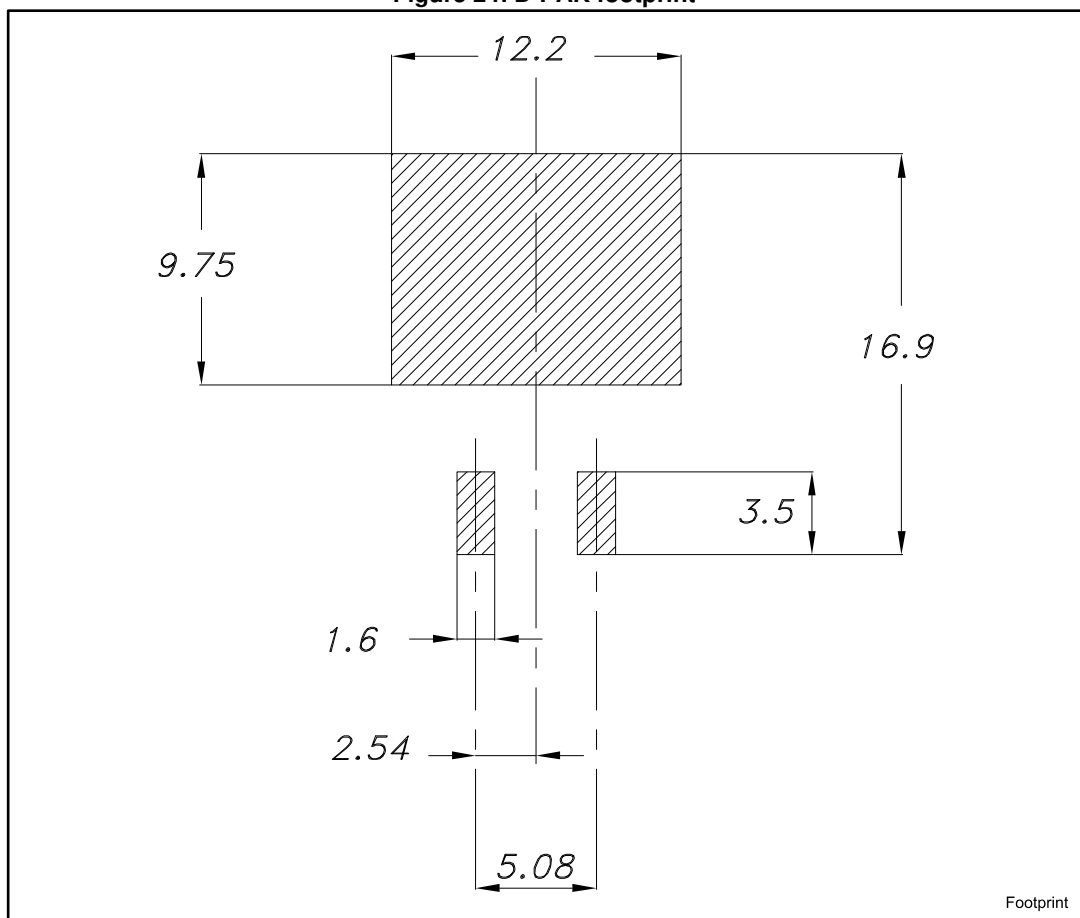


Table 10: D<sup>2</sup>PAK (TO-263) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10		10.40
E1	8.50	8.70	8.90
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

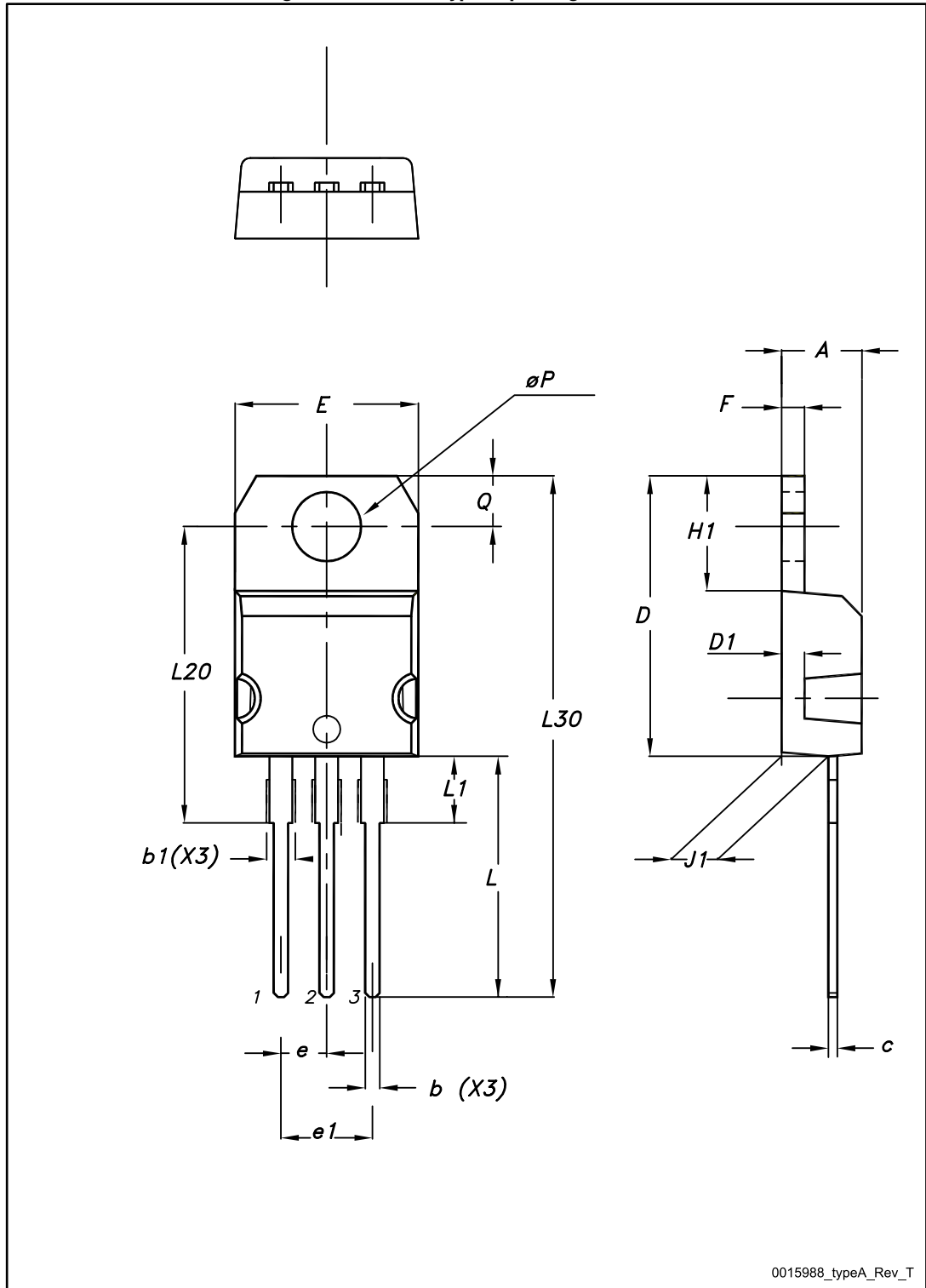
Figure 24: D<sup>2</sup>PAK footprint



All the dimensions are in millimeters.

## 4.2 TO-220 type A package information

Figure 25: TO-220 type A package outline



0015988\_typeA\_Rev\_T

Table 11: TO-220 type A mechanical data

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
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
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

### 4.3 TO-247 package information

Figure 26: TO-247 drawing

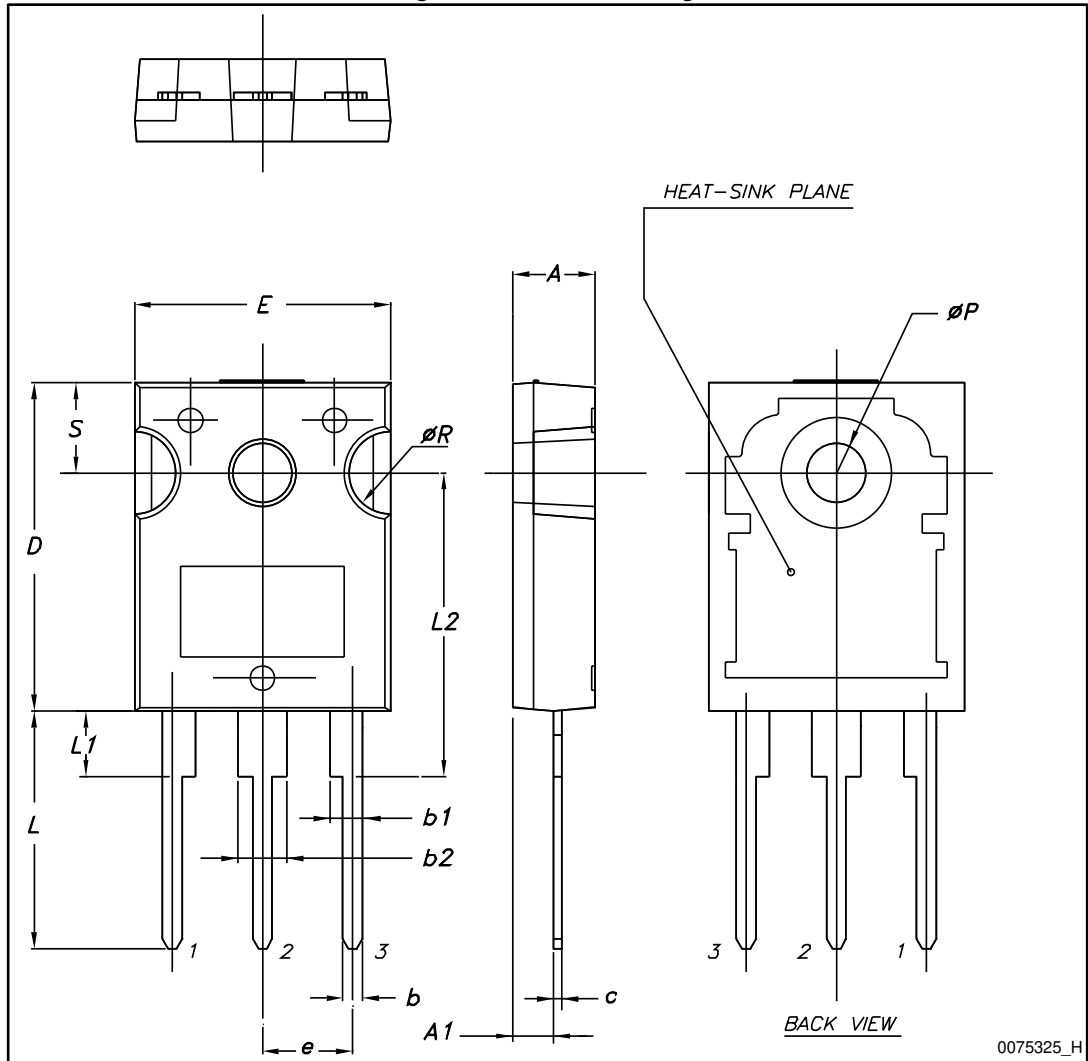


Table 12: TO-247 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70



## 5 Packaging mechanical data

**Figure 27: Tape**

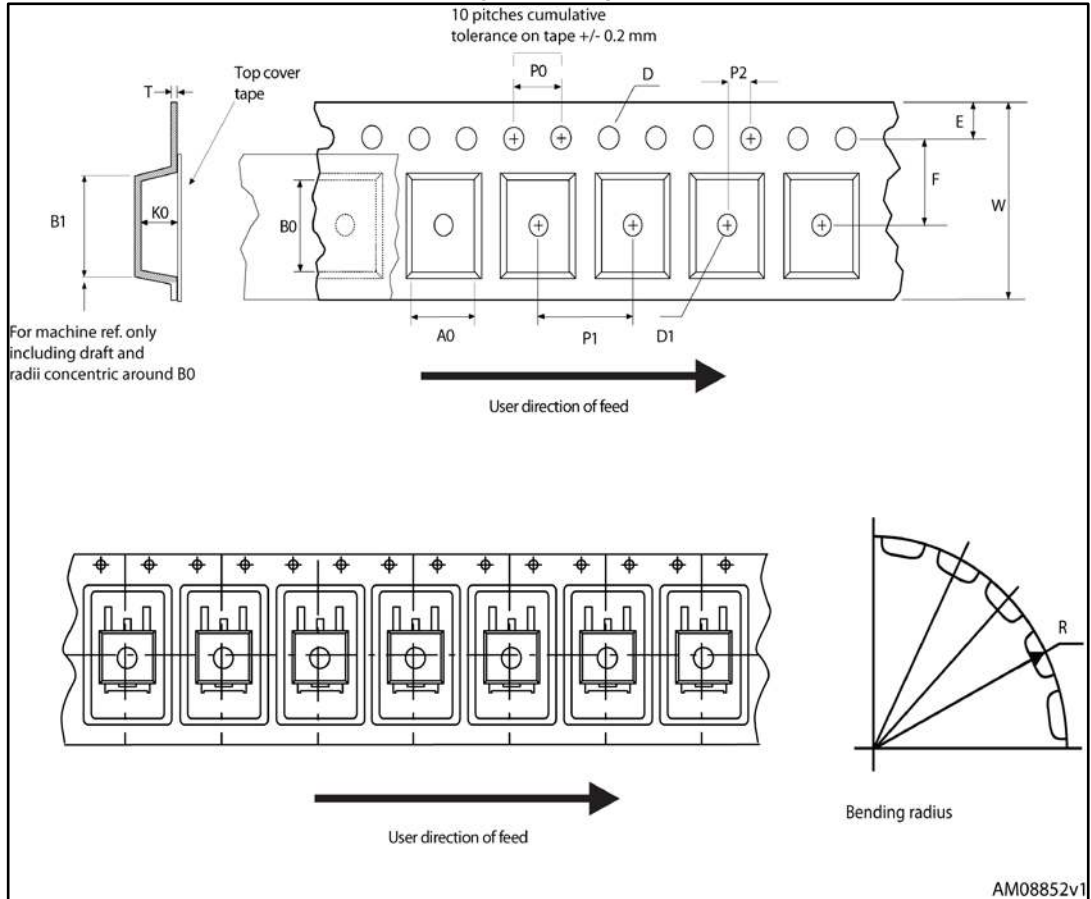


Figure 28: Reel

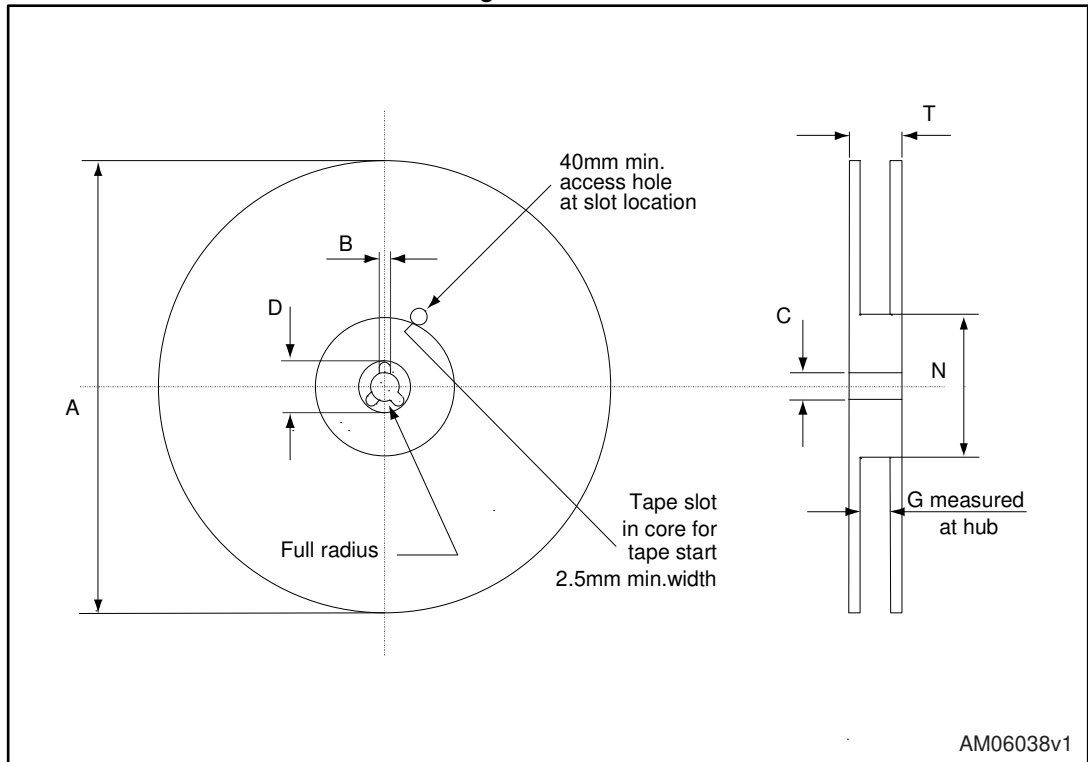


Table 13: D<sup>2</sup>PAK (TO-263) tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base qty		1000
P2	1.9	2.1	Bulk qty		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

## 6 Revision history

Table 14: Document revision history

Date	Revision	Changes
20-Jan-2015	1	First release.

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