

## 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

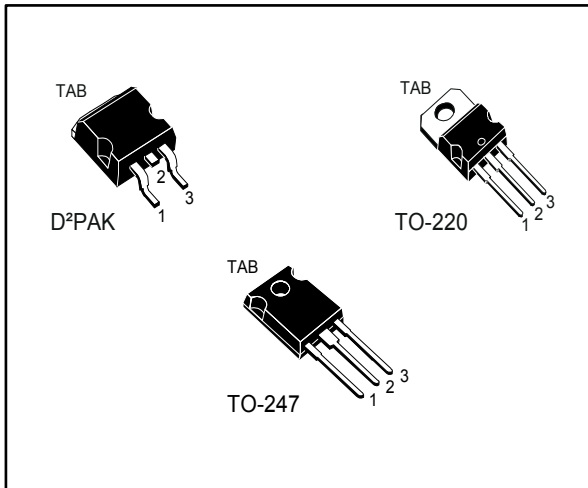
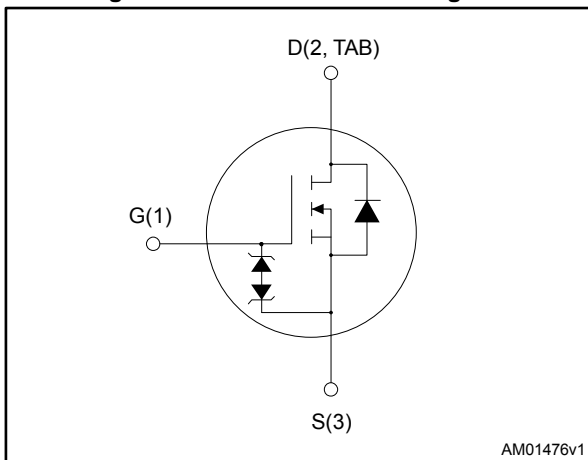


Figure 1: Internal schematic diagram



### 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	Packing
STB42N60M2-EP	42N60M2EP	D <sup>2</sup> PAK	Tape and reel
STP42N60M2-EP		TO-220	Tube
STW42N60M2-EP		TO-247	

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# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

Symbol	Parameter	Value	Unit
V <sub>GS</sub>	Gate-source voltage	± 25	V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	34	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	22	A
I <sub>DM</sub> <sup>(1)</sup>	Drain current (pulsed)	136	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	250	W
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	15	V/ns
dv/dt <sup>(3)</sup>	MOSFET dv/dt ruggedness	50	V/ns
T <sub>stg</sub>	Storage temperature range	- 55 to 150	°C
T <sub>j</sub>	Operating junction temperature range		°C

**Notes:**

(1)Pulse width limited by safe operating area.

(2)I<sub>SD</sub> ≤ 34 A, di/dt ≤ 400 A/μs; V<sub>DS(peak)</sub> < V<sub>(BR)DSS</sub>, V<sub>DD</sub> = 400 V.

(3)V<sub>DS</sub> ≤ 480 V

**Table 3: Thermal data**

Symbol	Parameter	Value			Unit
		D <sup>2</sup> PAK	TO-220	TO-247	
R <sub>thj-case</sub>	Thermal resistance junction-case	0.5			°C/W
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb	30			°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient		62.5	50	°C/W

**Notes:**

(1)When mounted on FR-4 board of inch<sup>2</sup>, 2oz Cu.

**Table 4: Avalanche characteristics**

Symbol	Parameter	Value	Unit
I <sub>AR</sub>	Avalanche current, repetitive or not repetitive (pulse width limited by T <sub>jmax</sub> )	6	A
E <sub>AS</sub>	Single pulse avalanche energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> ; V <sub>DD</sub> = 50 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	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$ , $T_C = 125\text{ °C}^{(1)}$			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	$\Omega$

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test

**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
$C_{oss\ eq.}^{(1)}$	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	$V_{DD} = 480\text{ V}$ , $I_D = 34\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ (see <a href="#">Figure 18: "Test circuit for gate charge behavior"</a> )	-	55	-	nC
$Q_{gs}$	Gate-source charge		-	8.5	-	nC
$Q_{gd}$	Gate-drain charge		-	25	-	nC

**Notes:**

<sup>(1)</sup> $C_{oss\ eq.}$  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	$V_{DD} = 300\text{ V}$ , $I_D = 17\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 17: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 22: "Switching time waveform"</a> )	-	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

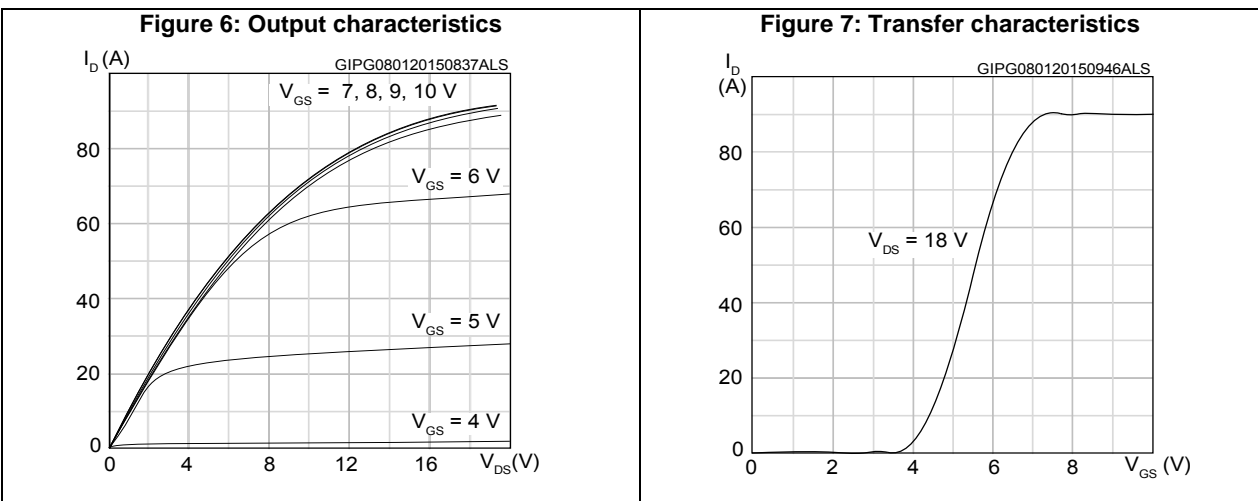
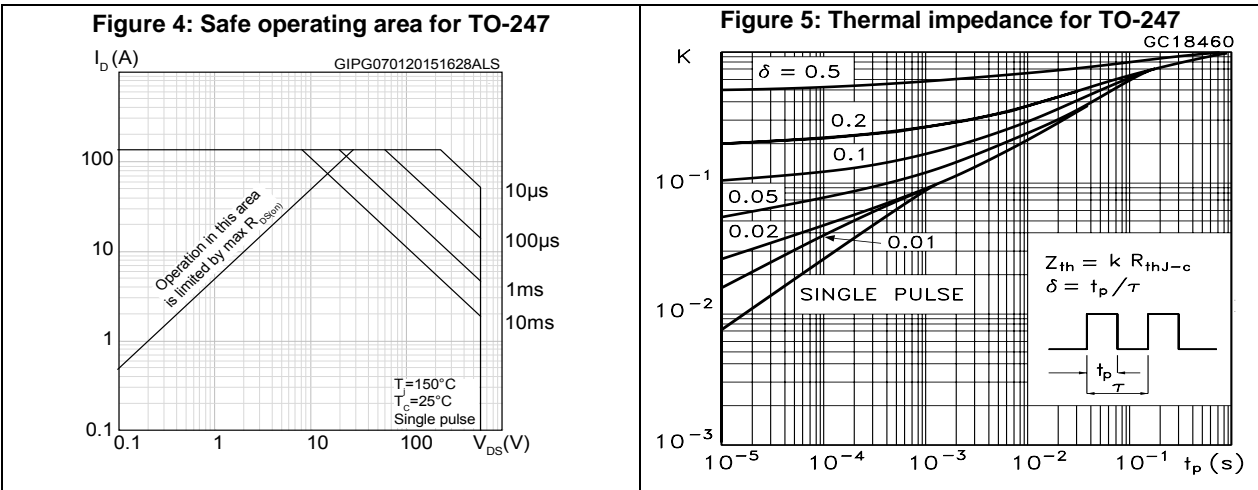
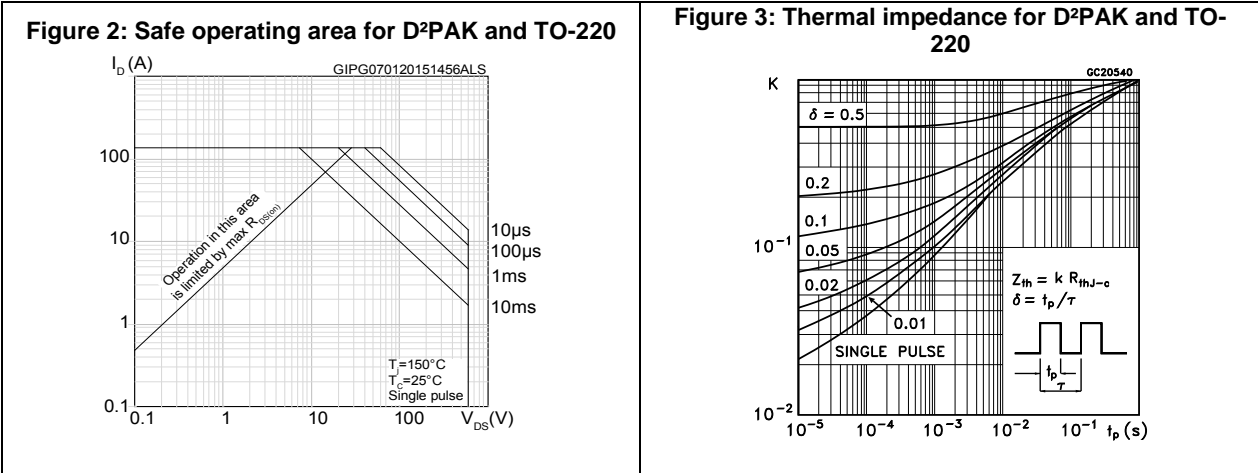
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		34	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		136	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 34\text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 34\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ (see <a href="#">Figure 19: "Test circuit for inductive load switching and diode recovery times"</a> )	-	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 19: "Test circuit for inductive load switching and diode recovery times"</a> )	-	538		ns
$Q_{rr}$	Reverse recovery charge		-	12		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	44.5		A

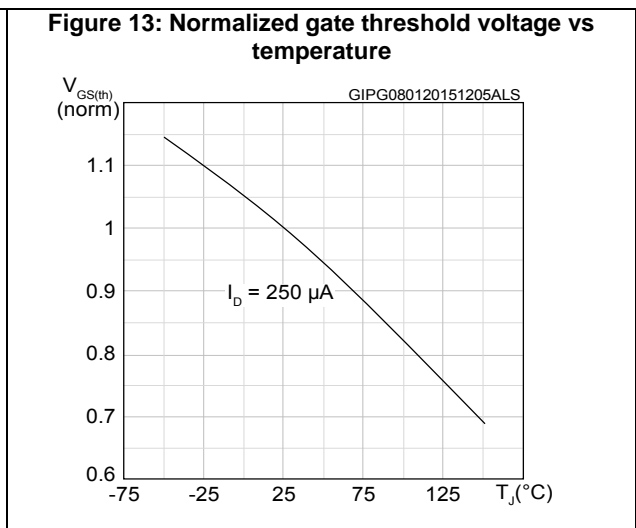
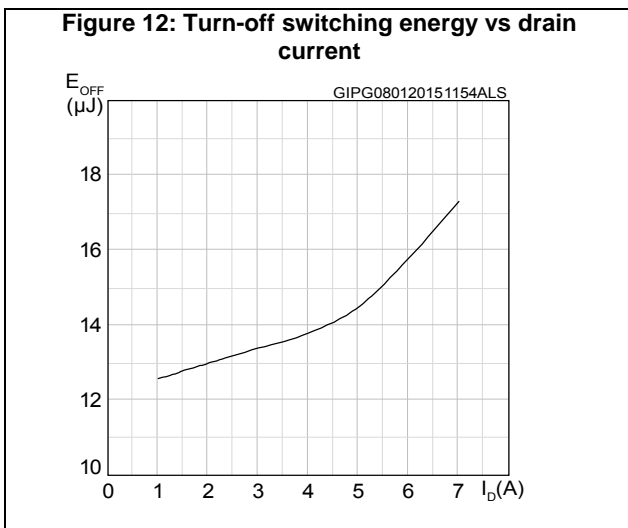
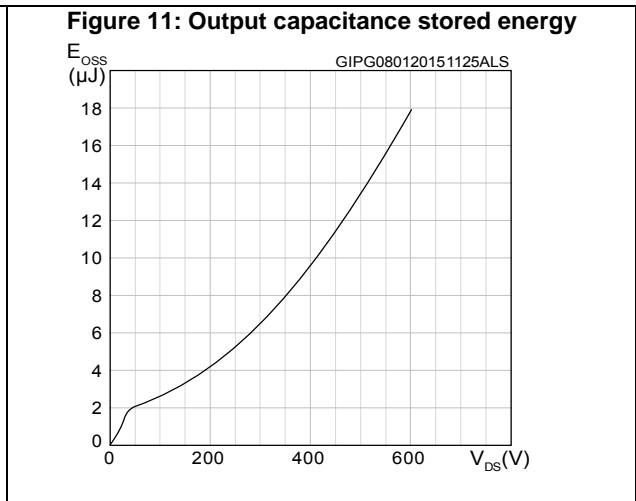
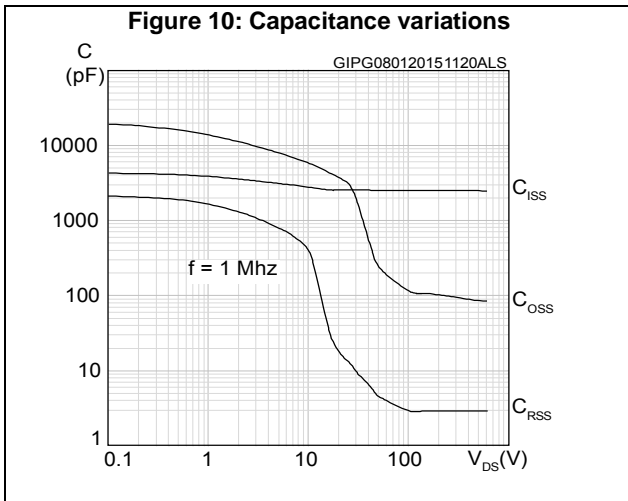
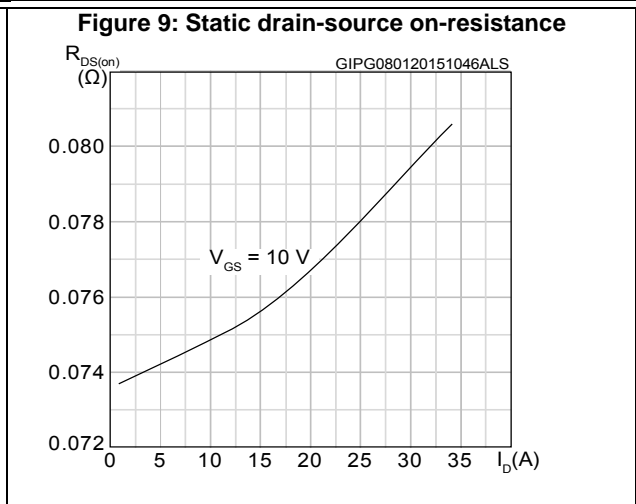
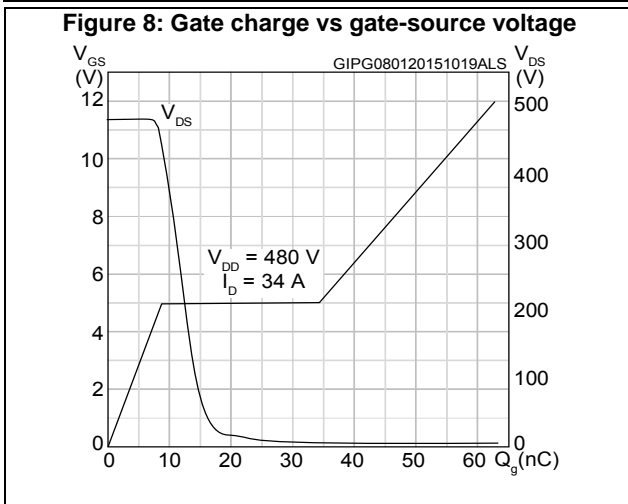
**Notes:**

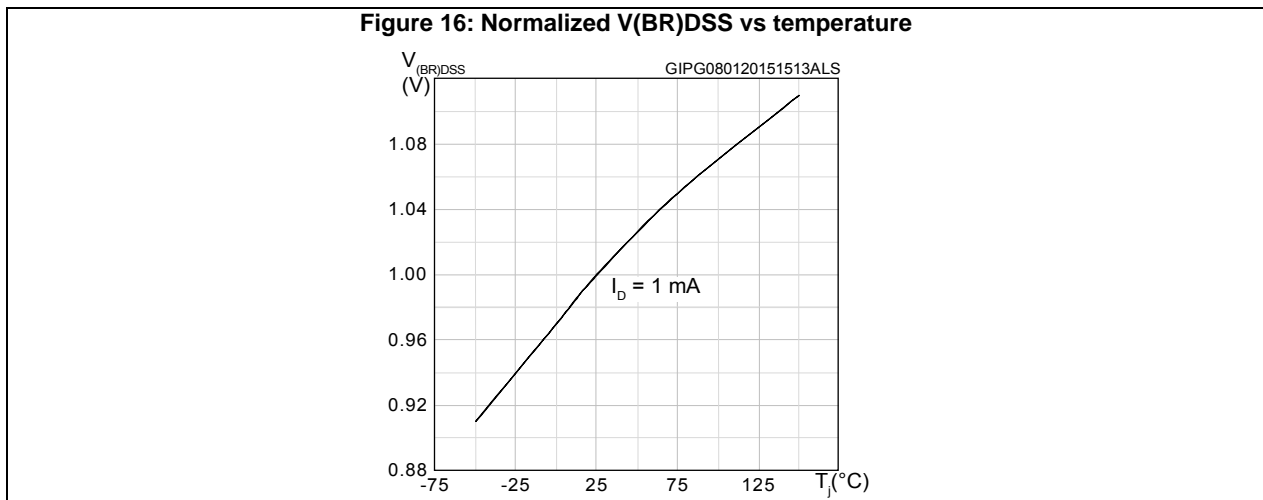
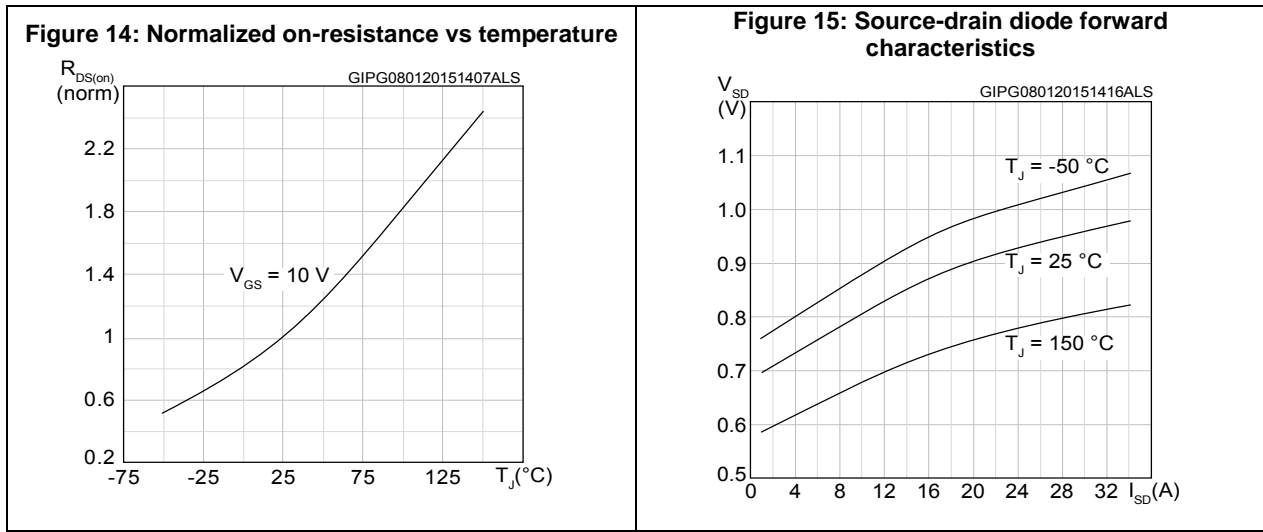
(1)Pulse width is limited by safe operating area

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

## 2.1 Electrical characteristics (curves)



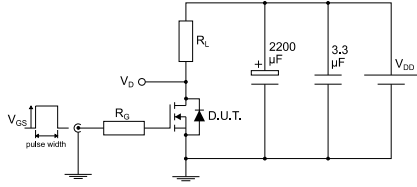






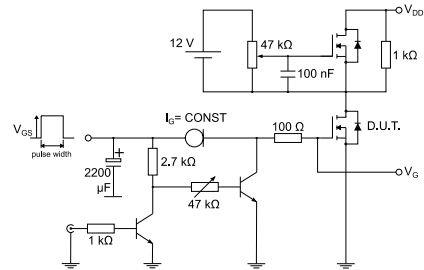
### 3 Test circuits

**Figure 17: Test circuit for resistive load switching times**



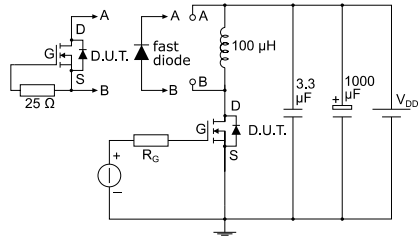
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**Figure 18: Test circuit for gate charge behavior**



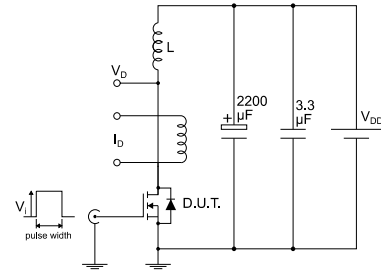
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**Figure 19: Test circuit for inductive load switching and diode recovery times**



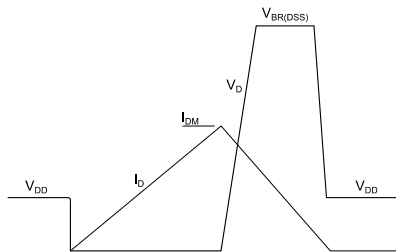
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**Figure 20: Unclamped inductive load test circuit**



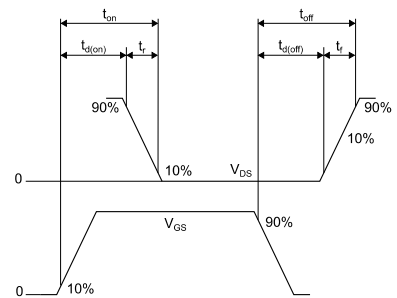
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**Figure 21: Unclamped inductive waveform**



AM01472v1

**Figure 22: Switching time waveform**



AM01473v1

## 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 (TO-263) type A2 package information

Figure 23: D<sup>2</sup>PAK (TO-263) type A2 package outline

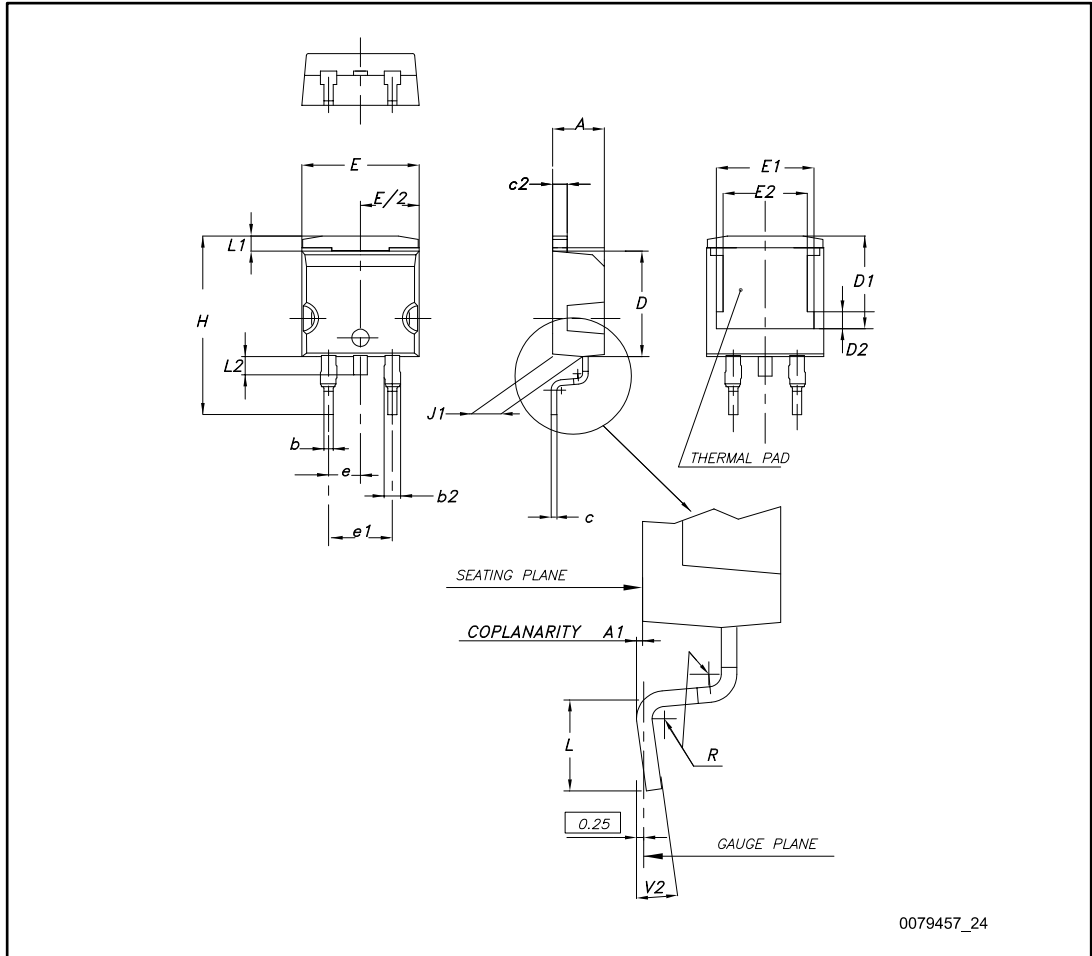
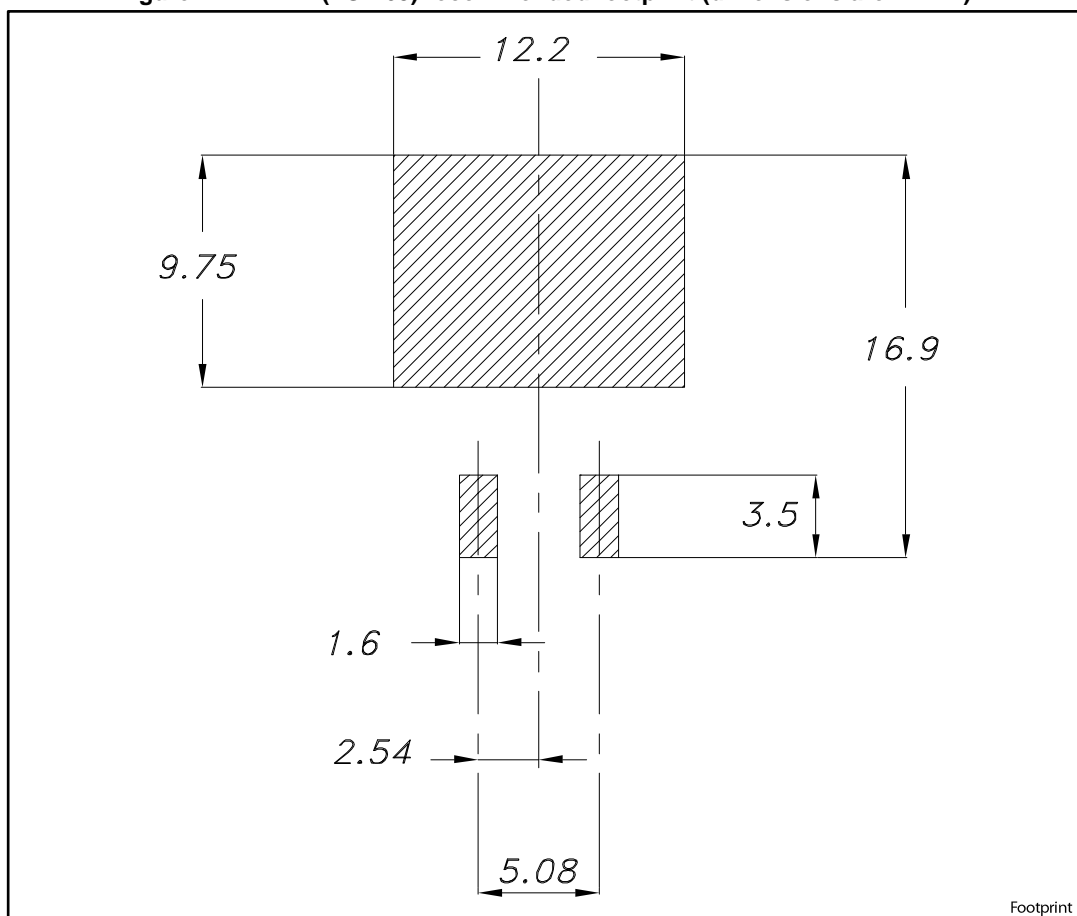


Table 10: D<sup>2</sup>PAK (TO-263) type A2 package mechanical data

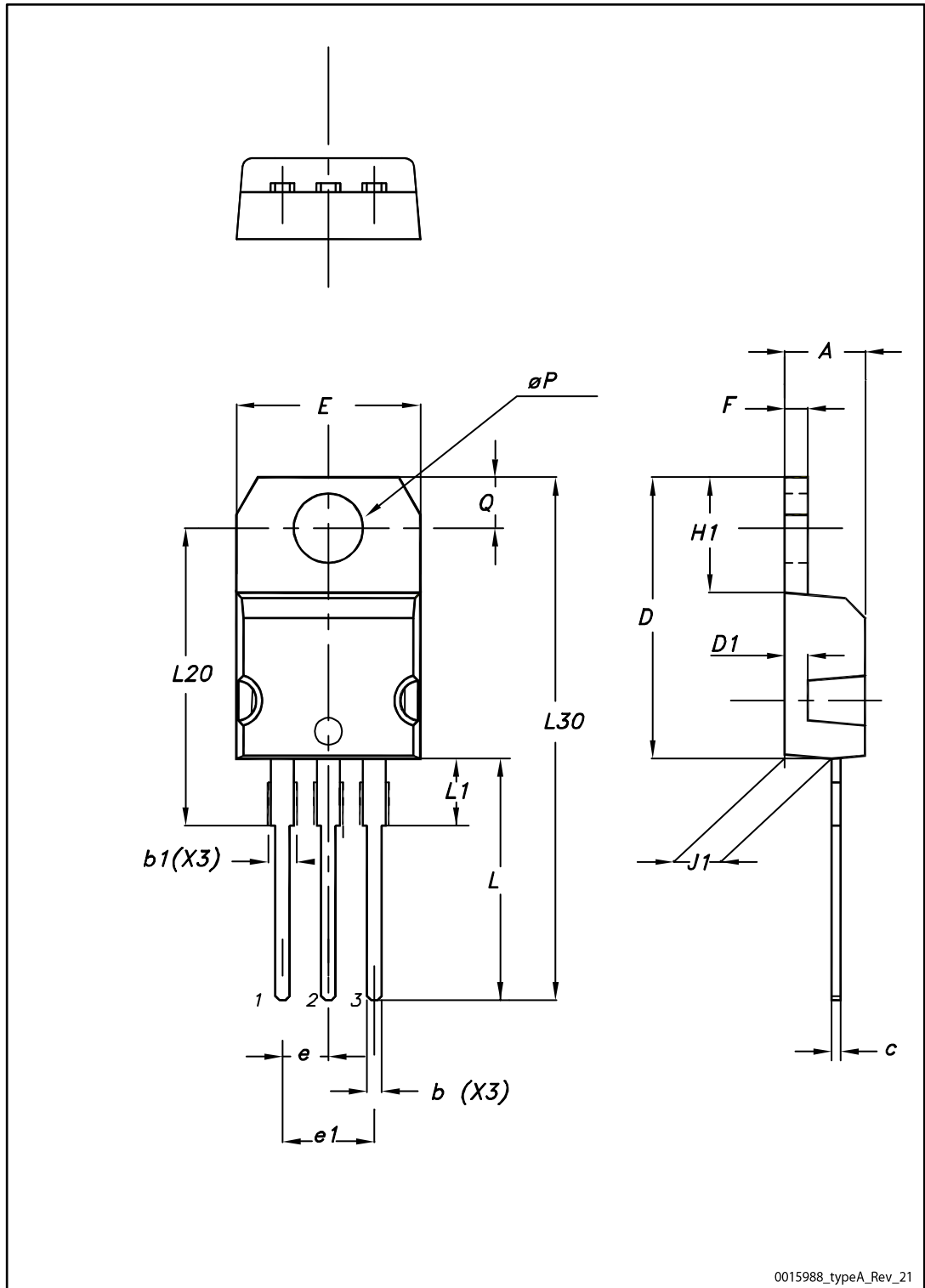
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.70	8.90	9.10
E2	7.30	7.50	7.70
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

Figure 24: D<sup>2</sup>PAK (TO-263) recommended footprint (dimensions are in mm)



## 4.2 TO-220 type A package information

Figure 25: TO-220 type A package outline



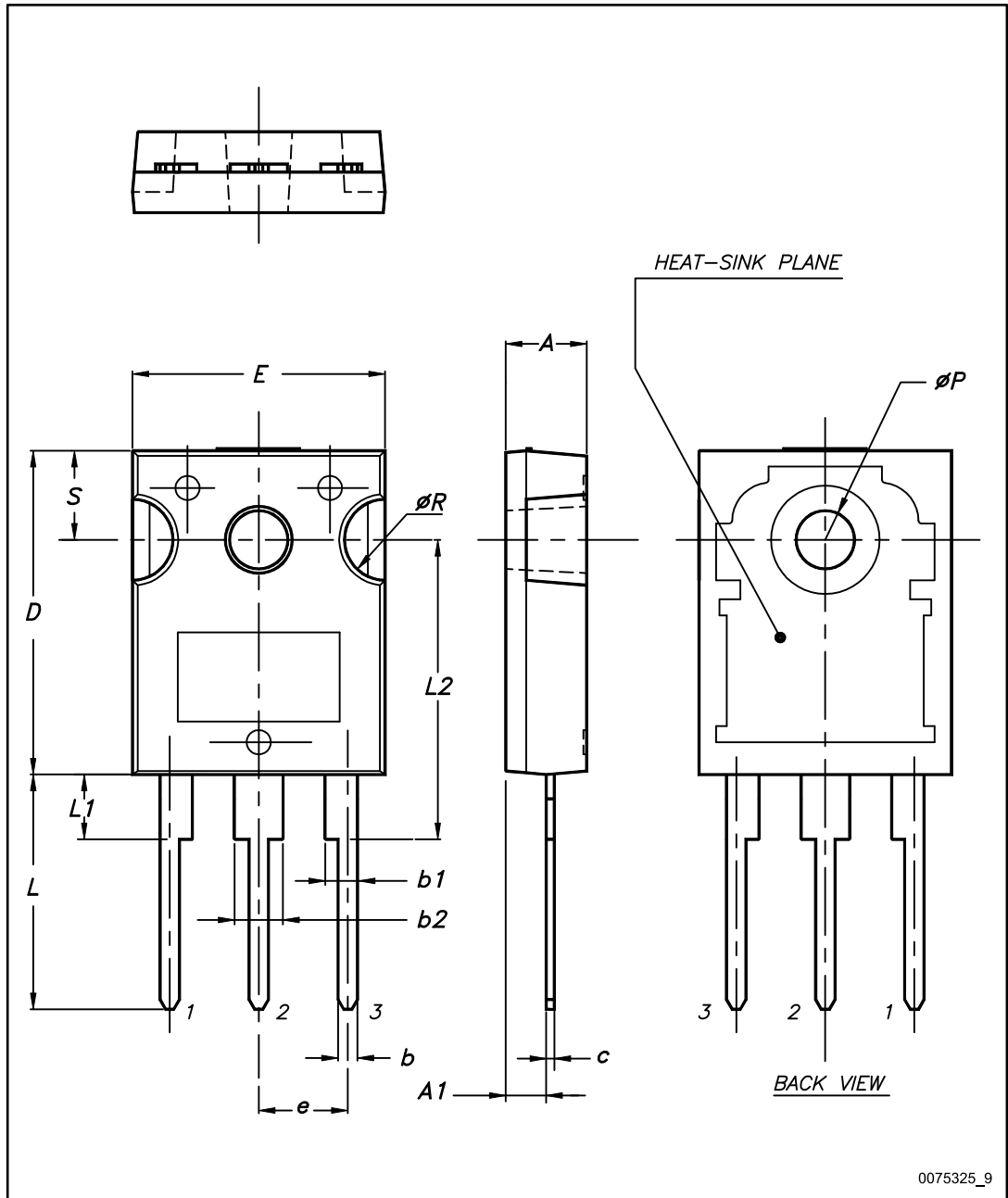
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Table 11: TO-220 type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		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	13.00		14.00
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 package outline



0075325\_9

Table 12: TO-247 package 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 D<sup>2</sup>PAK packing information

Figure 27: D<sup>2</sup>PAK tape outline

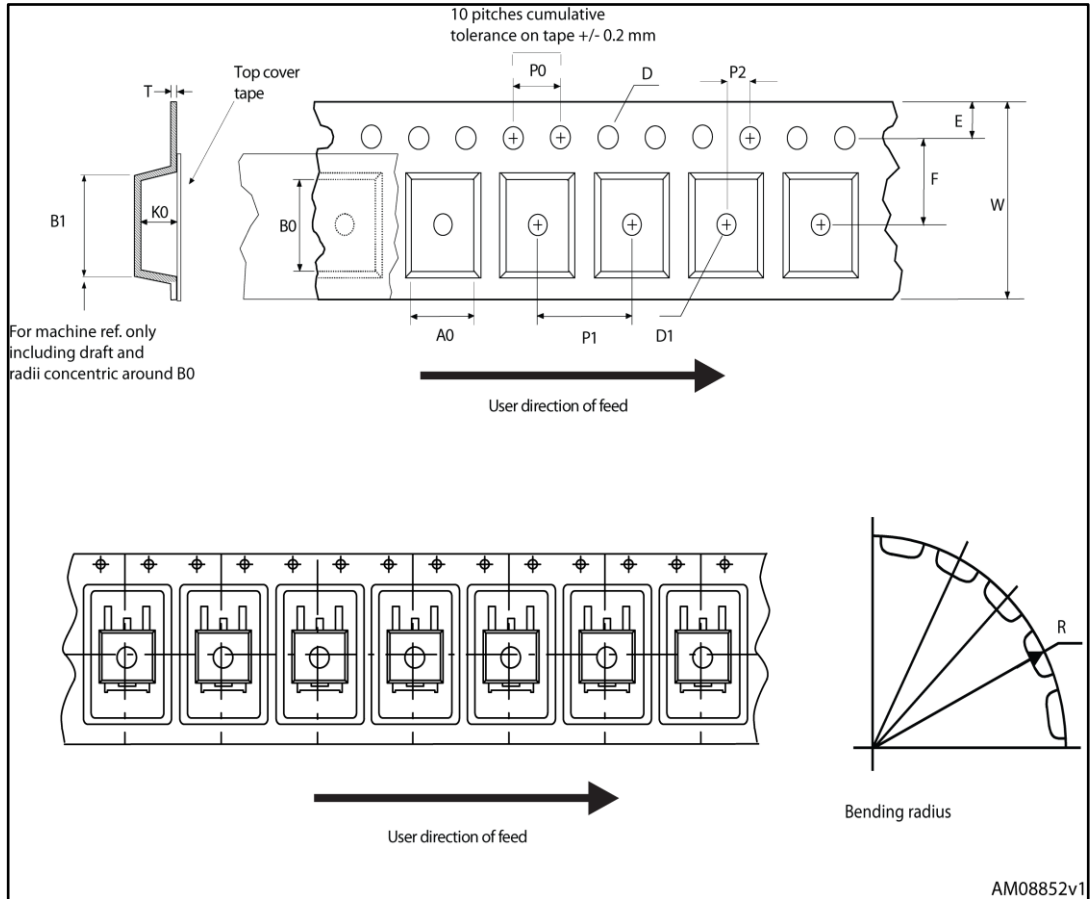


Figure 28: D<sup>2</sup>PAK reel outline

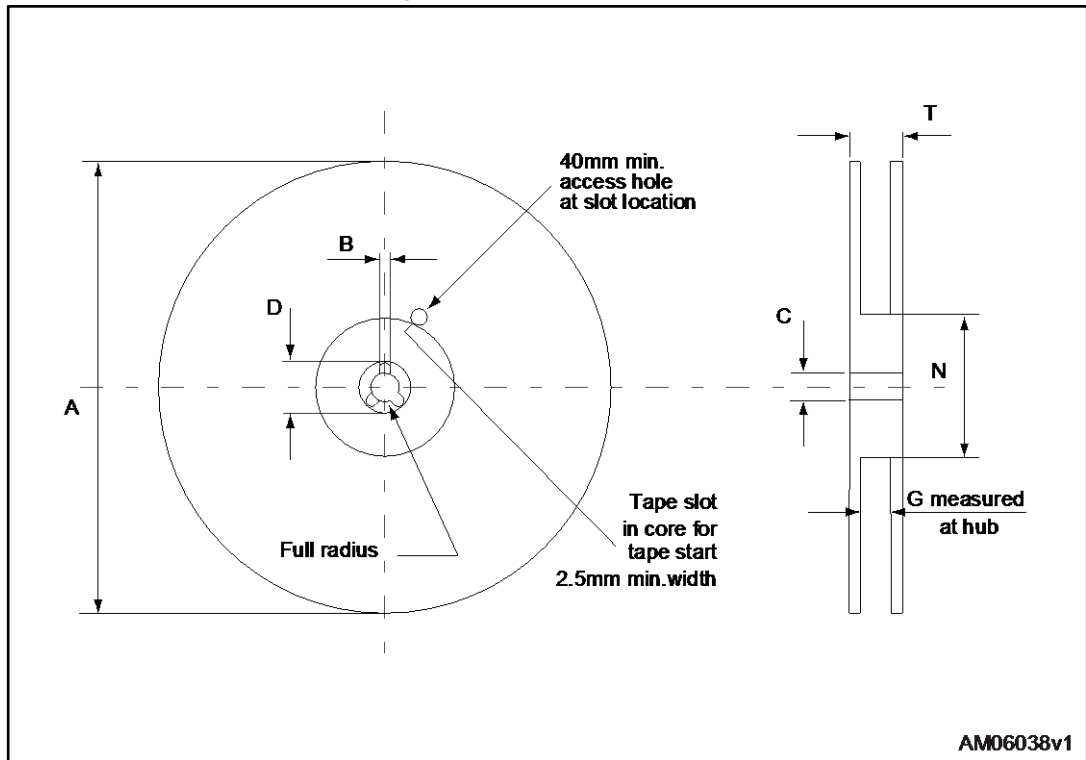


Table 13: D<sup>2</sup>PAK tape and reel mechanical data

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 quantity		1000
P2	1.9	2.1	Bulk quantity		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.
03-Nov-2017	2	Updated <i>Section 4.1: "D<sup>2</sup>PAK (TO-263) type A2 package information"</i> and <i>Section 5: "D<sup>2</sup>PAK packing information"</i> Minor text changes.

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