



# THE DATASHEET OF STB10N60M2



N-channel 600 V, 0.55  $\Omega$  typ., 7.5 A MDmesh™ M2 Power MOSFETs in D<sup>2</sup>PAK, DPAK, TO-220 and IPAK packages

Datasheet - production data

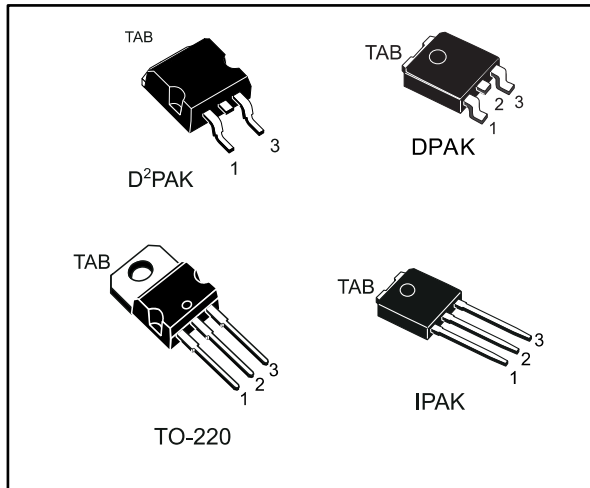
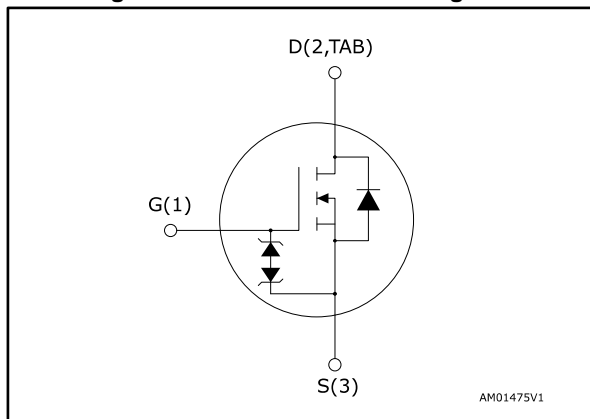


Figure 1: Internal schematic diagram



## Features

Order code	V <sub>DS@T<sub>Jmax.</sub></sub>	R <sub>DS(on) max.</sub>	I <sub>D</sub>
STB10N60M2	650 V	0.60 $\Omega$	7.5 A
STD10N60M2			
STP10N60M2			
STU10N60M2			

- Extremely low gate charge
- Excellent output capacitance (C<sub>oss</sub>) profile
- 100% avalanche tested
- Zener-protected

## Applications

- Switching applications

## Description

These devices are N-channel Power MOSFETs developed using MDmesh™ M2 technology. Thanks to their strip layout and improved vertical structure, these devices exhibit low on-resistance and optimized switching characteristics, rendering them suitable for the most demanding high efficiency converters.

Table 1: Device summary

Order code	Marking	Package	Packing
STB10N60M2	10N60M2	D <sup>2</sup> PAK	Tape and reel
STD10N60M2		DPAK	
STP10N60M2		TO-220	Tube
STU10N60M2		IPAK	

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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>case</sub> = 25 °C	7.5	A
	Drain current (continuous) at T <sub>case</sub> = 100 °C	4.9	
I <sub>DM</sub> <sup>(1)</sup>	Drain current (pulsed)	30	A
P <sub>TOT</sub>	Total dissipation at T <sub>case</sub> = 25 °C	85	W
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	15	V/ns
dv/dt <sup>(3)</sup>	MOSFET dv/dt ruggedness	50	
T <sub>stg</sub>	Storage temperature range	-55 to 150	°C
T <sub>j</sub>	Operating junction temperature range		

**Notes:**

- (1) Pulse limited by safe operating area.
- (2) I<sub>SD</sub> ≤ 7.5 A, di/dt ≤ 400 A/μs; V<sub>DS</sub> peak < 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	DPAK	TO-220	IPAK	
R <sub>thj-case</sub>	Thermal resistance junction-case	1.47				°C/W
R <sub>thj-pcb</sub>	Thermal resistance junction-pcb <sup>(1)</sup>	30	50			
R <sub>thj-amb</sub>	Thermal resistance junction-ambient			62.5	100	

**Notes:**

- (1) When mounted on 1 inch<sup>2</sup> FR-4, 2 Oz copper board.

**Table 4: Avalanche characteristics**

Symbol	Parameter	Value	Unit
I <sub>AR</sub> <sup>(1)</sup>	Avalanche current, repetitive or not repetitive	1.5	A
E <sub>AS</sub> <sup>(2)</sup>	Single pulse avalanche energy	110	mJ

**Notes:**

- (1) Pulse width limited by T<sub>jmax</sub>.
- (2) Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = I<sub>AR</sub>, V<sub>DD</sub> = 50 V.

## 2 Electrical characteristics

( $T_{\text{case}} = 25\text{ °C}$  unless otherwise specified)

**Table 5: Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{\text{GS}} = 0\text{ V}$ , $I_{\text{D}} = 1\text{ mA}$	600			V
$I_{\text{DSS}}$	Zero gate voltage drain current	$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 600\text{ V}$			1	$\mu\text{A}$
		$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 600\text{ V}$ , $T_{\text{case}} = 125\text{ °C}^{(1)}$			100	
$I_{\text{GSS}}$	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$ , $V_{\text{GS}} = \pm 25\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{\text{GS(th)}}$	Gate threshold voltage	$V_{\text{DS}} = V_{\text{GS}}$ , $I_{\text{D}} = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{\text{DS(on)}}$	Static drain-source on-resistance	$V_{\text{GS}} = 10\text{ V}$ , $I_{\text{D}} = 3\text{ A}$		0.55	0.60	$\Omega$

**Notes:**

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

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{\text{ISS}}$	Input capacitance	$V_{\text{DS}} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{\text{GS}} = 0\text{ V}$	-	400	-	$\text{pF}$
$C_{\text{OSS}}$	Output capacitance		-	22	-	
$C_{\text{RSS}}$	Reverse transfer capacitance		-	0.84	-	
$C_{\text{OSS eq.}}^{(1)}$	Equivalent output capacitance	$V_{\text{DS}} = 0\text{ to }480\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$	-	83	-	$\text{pF}$
$R_{\text{G}}$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_{\text{D}} = 0\text{ A}$	-	6.4	-	$\Omega$
$Q_{\text{g}}$	Total gate charge	$V_{\text{DD}} = 480\text{ V}$ , $I_{\text{D}} = 7.5\text{ A}$ , $V_{\text{GS}} = 0\text{ to }10\text{ V}$ (see <a href="#">Figure 17</a> : "Test circuit for gate charge behavior")	-	13.5	-	$\text{nC}$
$Q_{\text{gs}}$	Gate-source charge		-	2.1	-	
$Q_{\text{gd}}$	Gate-drain charge		-	7.2	-	

**Notes:**

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

**Table 7: Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{\text{d(on)}}$	Turn-on delay time	$V_{\text{DD}} = 300\text{ V}$ , $I_{\text{D}} = 3.75\text{ A}$ $R_{\text{G}} = 4.7\text{ }\Omega$ , $V_{\text{GS}} = 10\text{ V}$ (see <a href="#">Figure 16</a> : "Test circuit for resistive load switching times" and <a href="#">Figure 21</a> : "Switching time waveform")	-	8.8	-	$\text{ns}$
$t_{\text{r}}$	Rise time		-	8	-	
$t_{\text{d(off)}}$	Turn-off delay time		-	32.5	-	
$t_{\text{f}}$	Fall time		-	13.2	-	

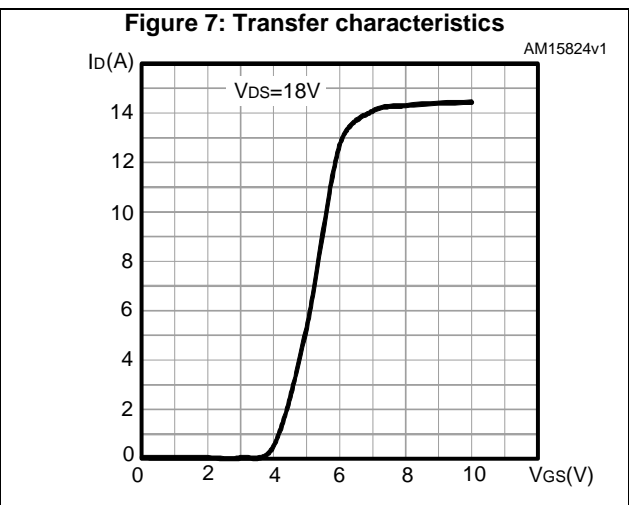
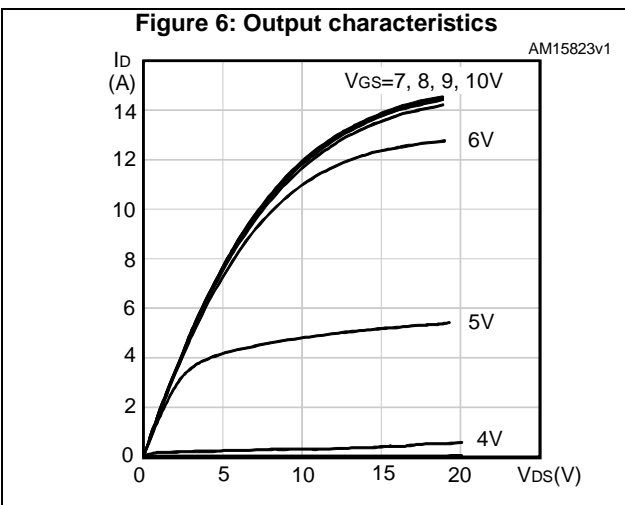
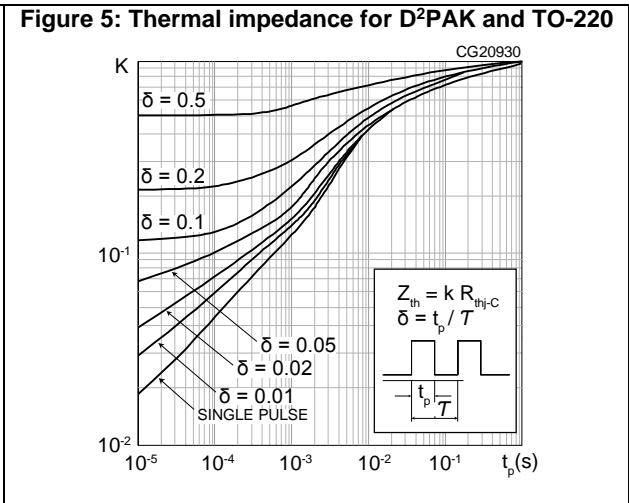
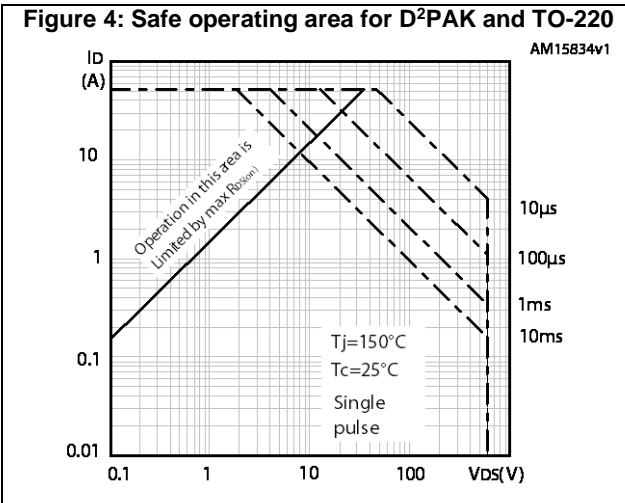
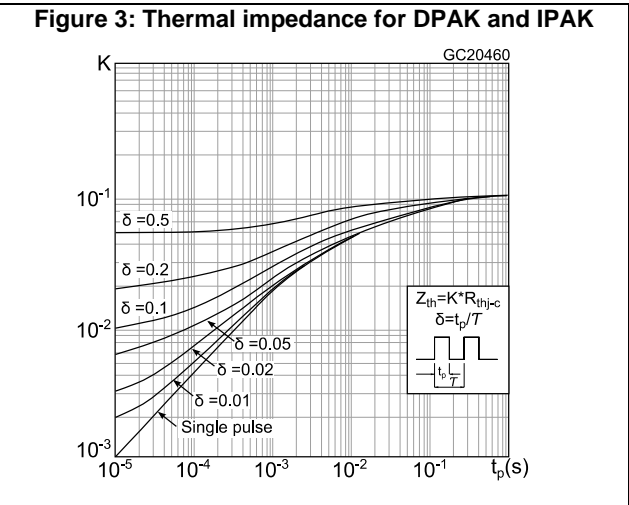
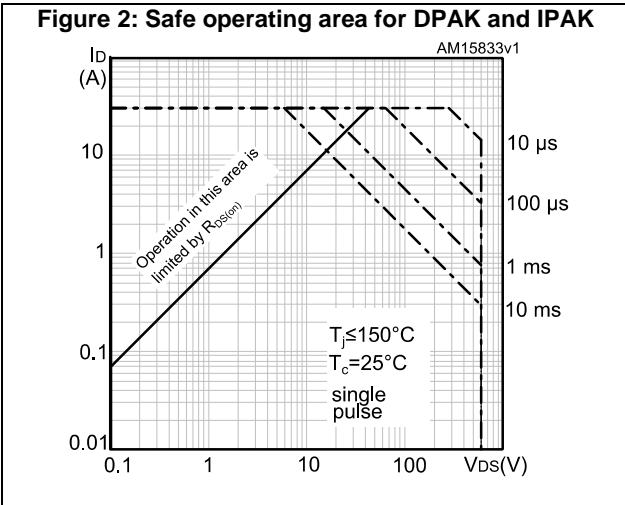
Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		7.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		30	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 7.5\text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 7.5\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ (see <a href="#">Figure 18</a> : "Test circuit for inductive load switching and diode recovery times")	-	270		ns
$Q_{rr}$	Reverse recovery charge		-	2		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	14.4		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 7.5\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 18</a> : "Test circuit for inductive load switching and diode recovery times")	-	376		ns
$Q_{rr}$	Reverse recovery charge		-	2.8		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	15		A

**Notes:**

- (1) Pulse width is limited by safe operating area.  
 (2) Pulse test: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)



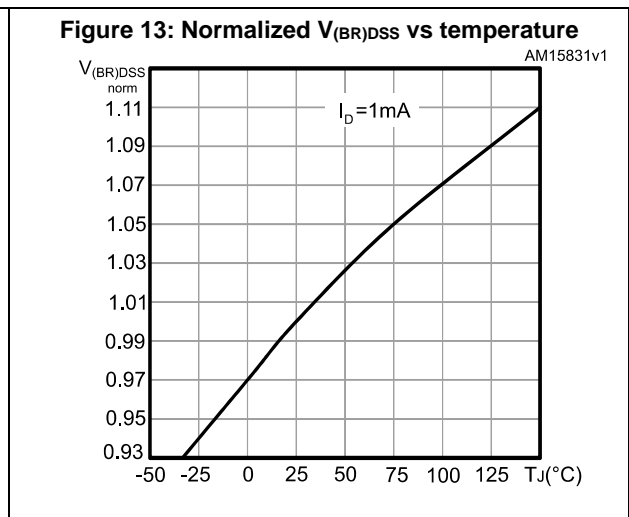
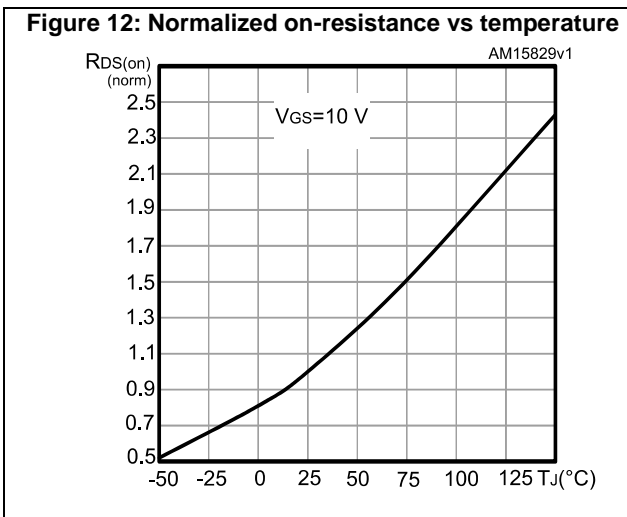
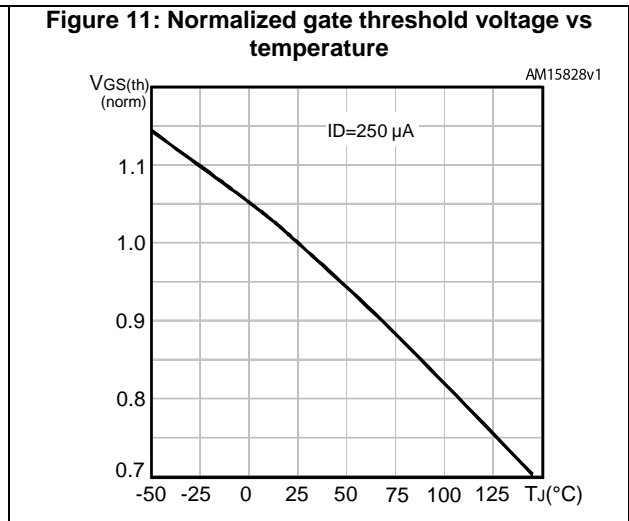
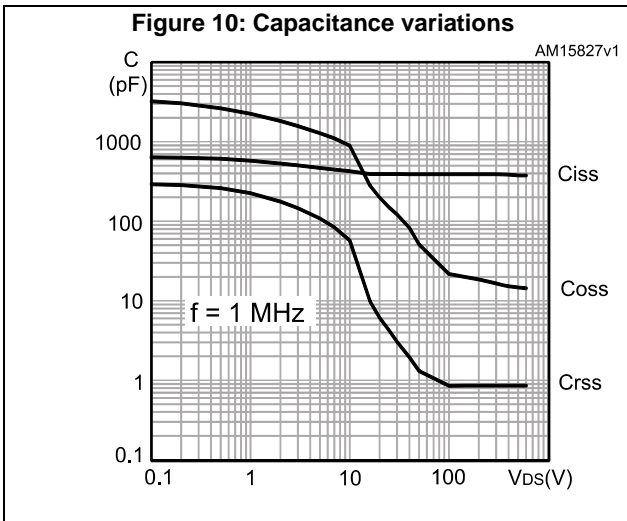
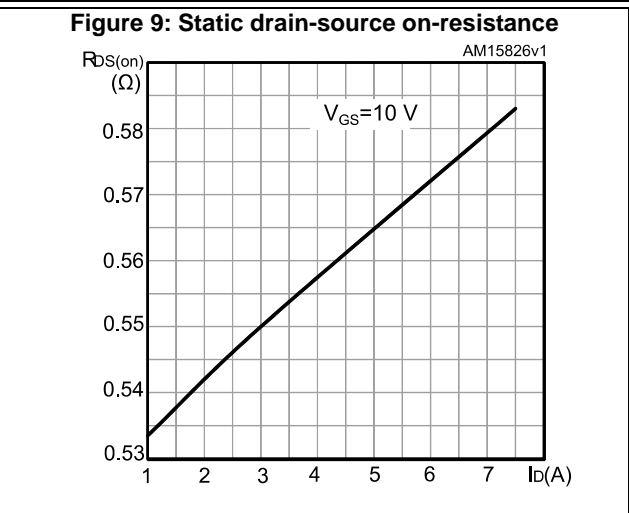
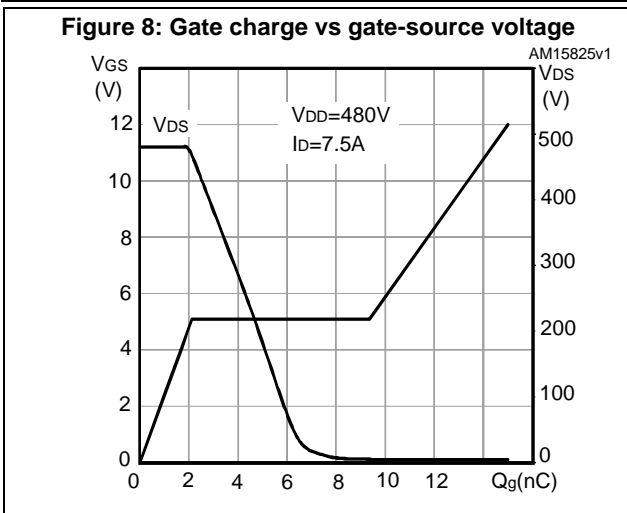


Figure 14: Source-drain diode forward characteristics

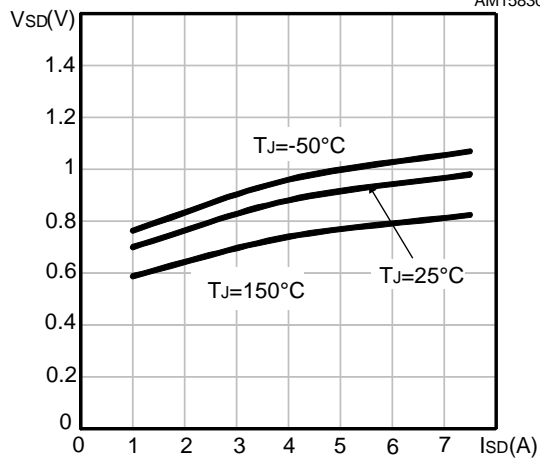
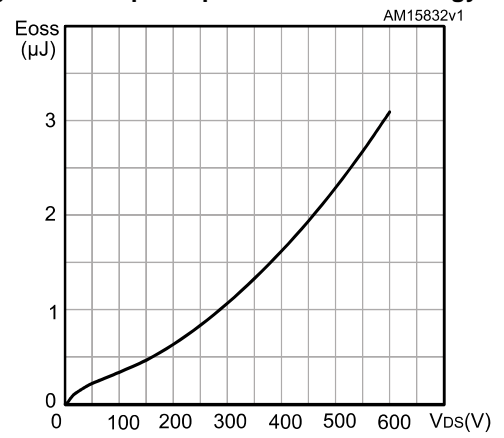
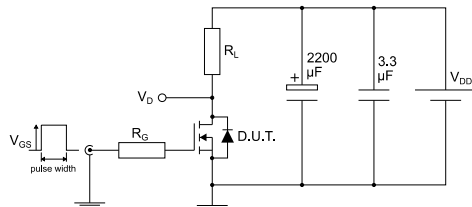


Figure 15: Output capacitance stored energy



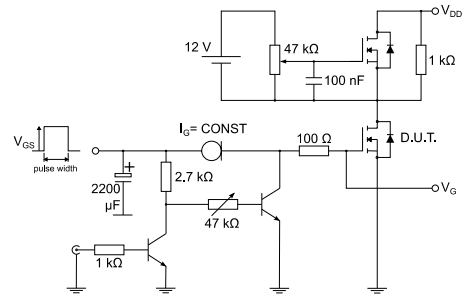
### 3 Test circuits

**Figure 16: Test circuit for resistive load switching times**



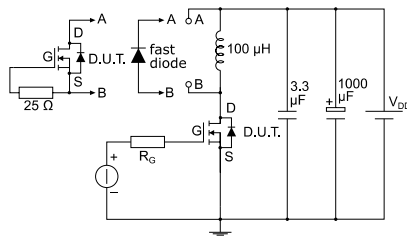
AM01468v1

**Figure 17: Test circuit for gate charge behavior**



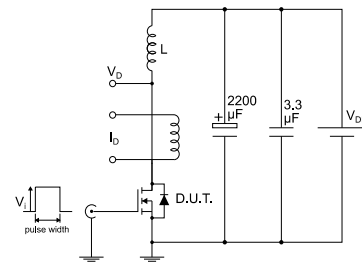
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**Figure 18: Test circuit for inductive load switching and diode recovery times**



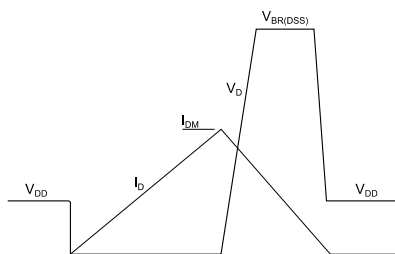
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**Figure 19: Unclamped inductive load test circuit**



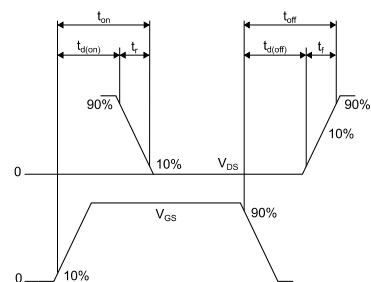
AM01471v1

**Figure 20: Unclamped inductive waveform**



AM01472v1

**Figure 21: Switching time waveform**



AM01473v1

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

### 4.1 D<sup>2</sup>PAK (TO-263) type A package information

Figure 22: D<sup>2</sup>PAK (TO-263) type A package outline

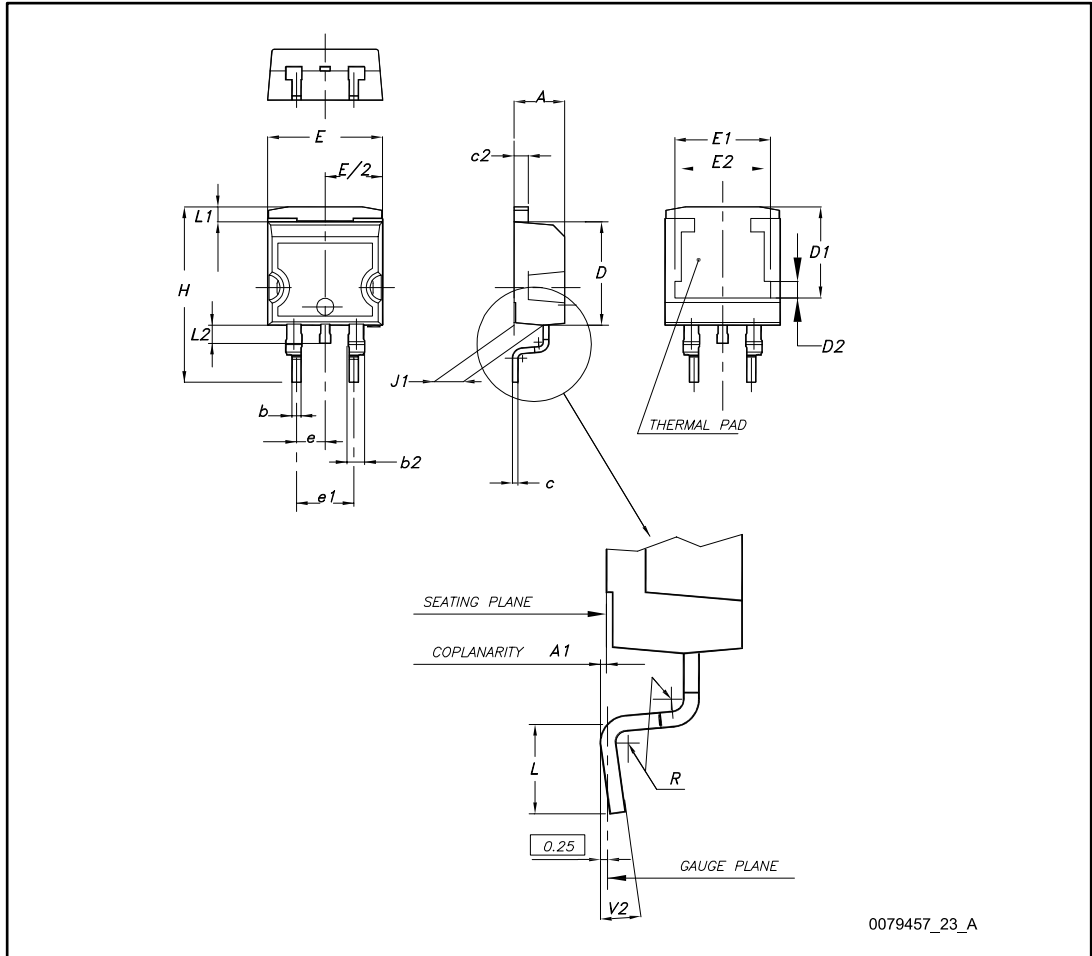
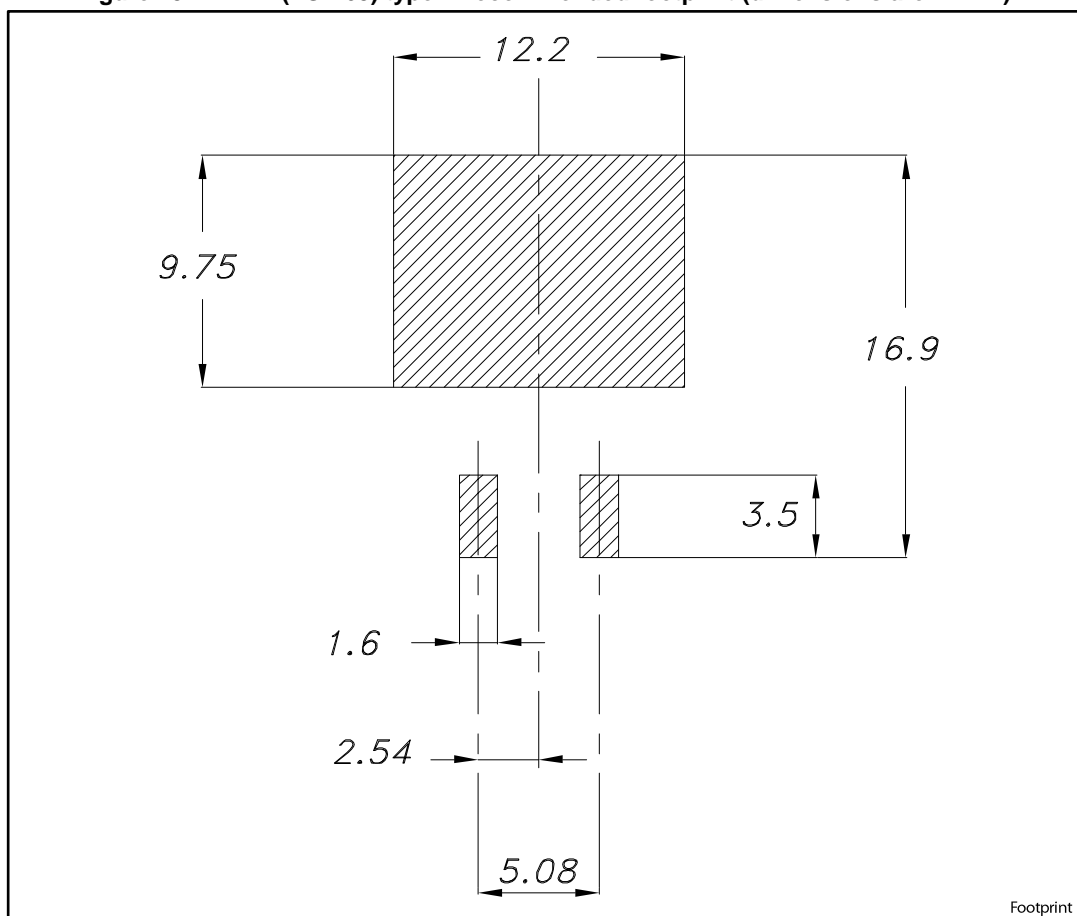


Table 9: D<sup>2</sup>PAK (TO-263) type A package mechanical data

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	8.50	8.70	8.90
E2	6.85	7.05	7.25
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 23: D<sup>2</sup>PAK (TO-263) type A recommended footprint (dimensions are in mm)



## 4.2 DPAK (TO-252) type A package information

Figure 24: DPAK (TO-252) type A package outline

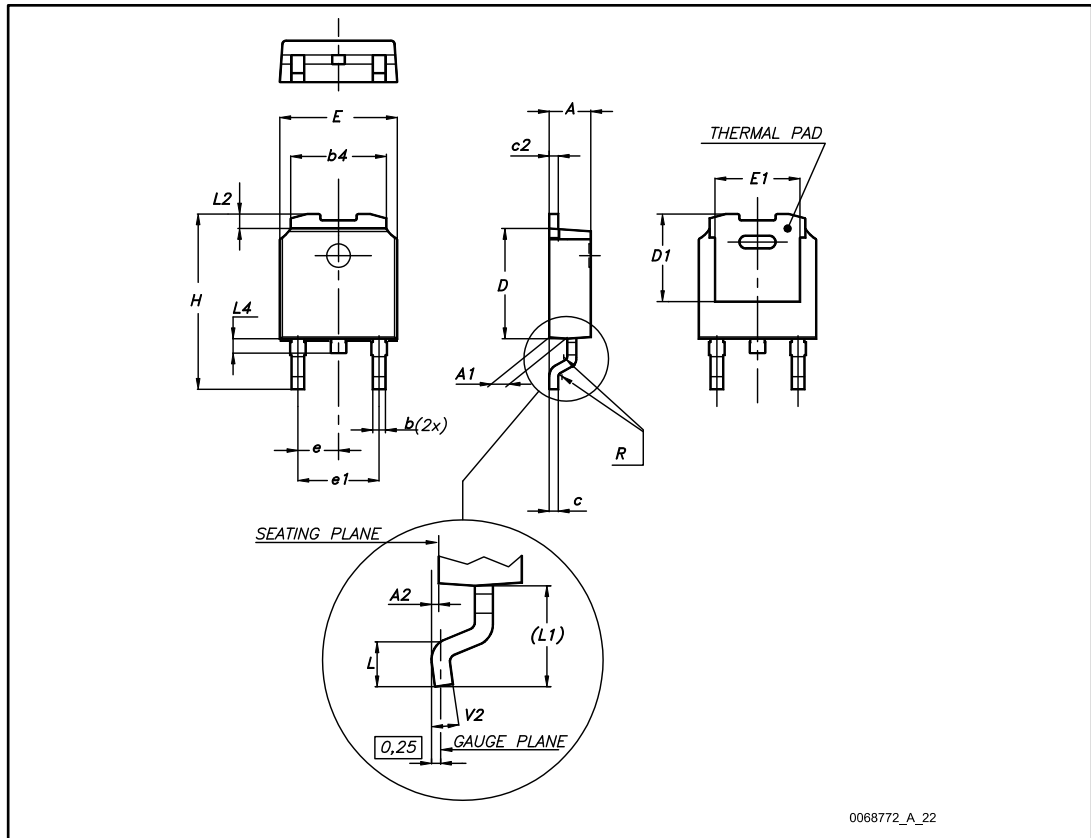


Table 10: DPAK (TO-252) type A mechanical data

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	4.95	5.10	5.25
E	6.40		6.60
E1	4.60	4.70	4.80
e	2.16	2.28	2.40
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)	2.60	2.80	3.00
L2	0.65	0.80	0.95
L4	0.60		1.00
R		0.20	
V2	0°		8°

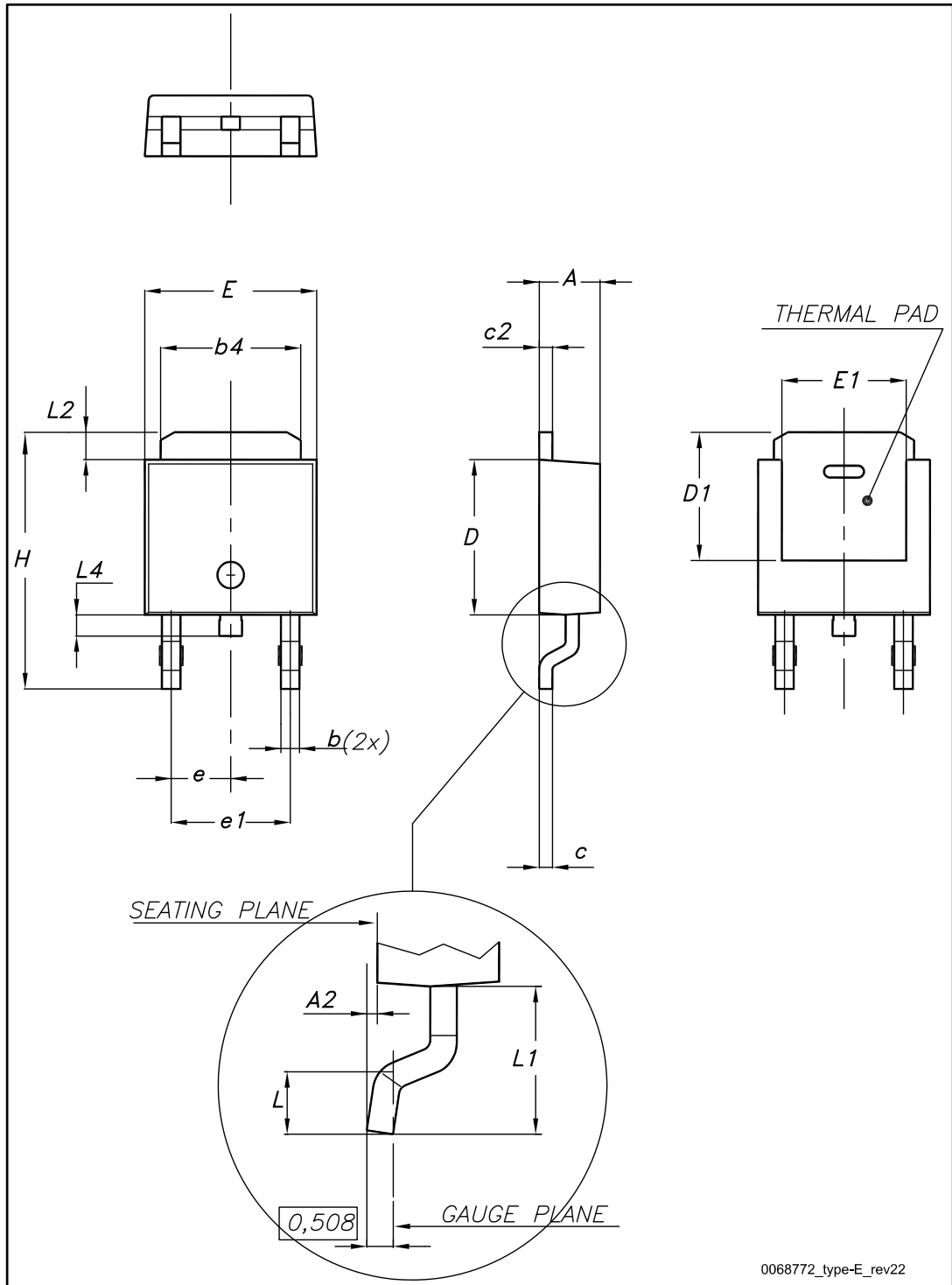


Table 11: DPAK (TO-252) type C mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.38
A1	0.90	1.01	1.10
A2	0.00		0.10
b	0.72		0.85
b4	5.13	5.33	5.46
c	0.47		0.60
c2	0.47		0.60
D	6.00	6.10	6.20
D1	5.25		
E	6.50	6.60	6.70
E1	4.70		
e	2.186	2.286	2.386
H	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
L6	1.80 BSC		
θ1	5°	7°	9°
θ2	5°	7°	9°
V2	0°		8°

### 4.4 DPAK (TO-252) type E package information

Figure 26: DPAK (TO-252) type E package outline

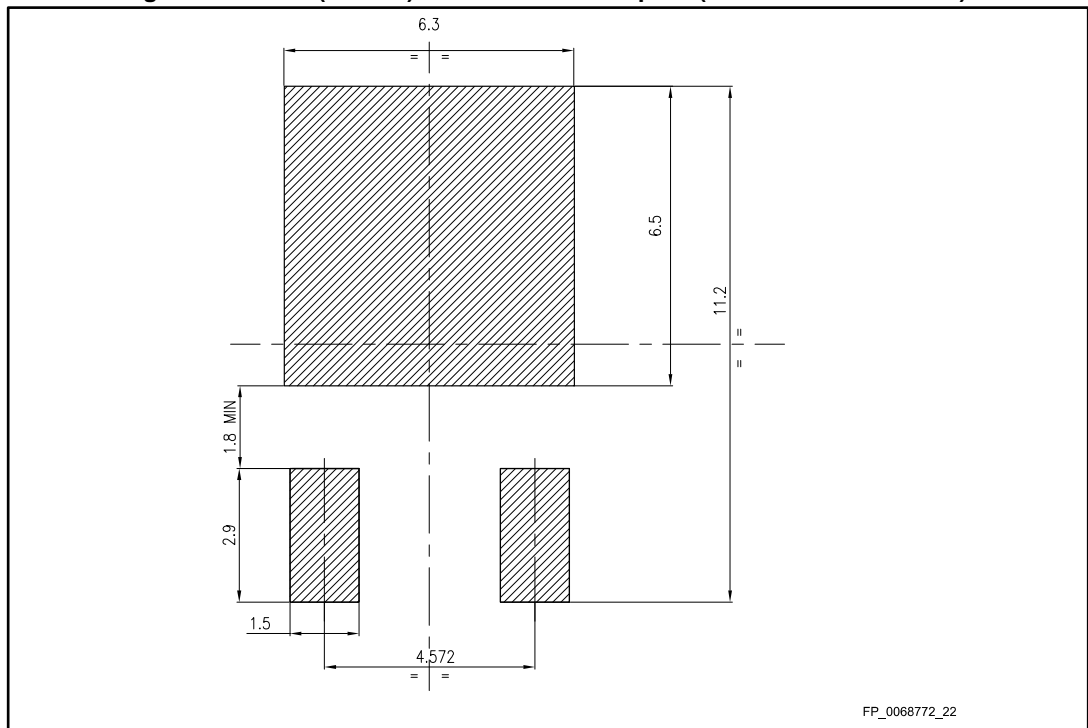


0068772\_type-E\_rev22

Table 12: DPAK (TO-252) type E mechanical data

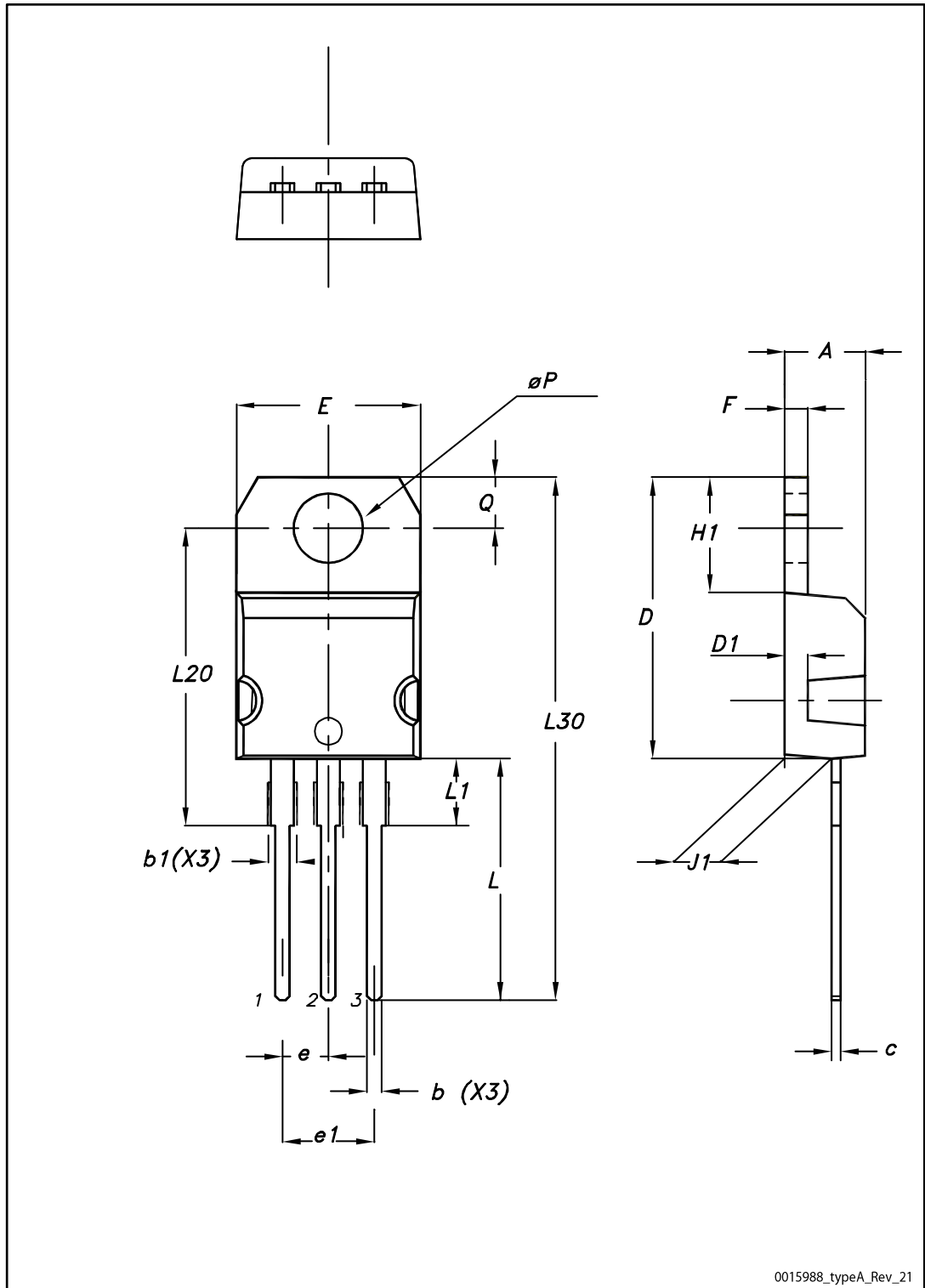
Dim.	mm		
	Min.	Typ.	Max.
A	2.18		2.39
A2			0.13
b	0.65		0.884
b4	4.95		5.46
c	0.46		0.61
c2	0.46		0.60
D	5.97		6.22
D1	5.21		
E	6.35		6.73
E1	4.32		
e		2.286	
e1		4.572	
H	9.94		10.34
L	1.50		1.78
L1		2.74	
L2	0.89		1.27
L4			1.02

Figure 27: DPAK (TO-252) recommended footprint (dimensions are in mm)



### 4.5 TO-220 type A package information

Figure 28: TO-220 type A package outline



0015988\_typeA\_Rev\_21

Table 13: TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
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

### 4.6 IPAK (TO-251) type A package information

Figure 29: IPAK (TO-251) type A package outline

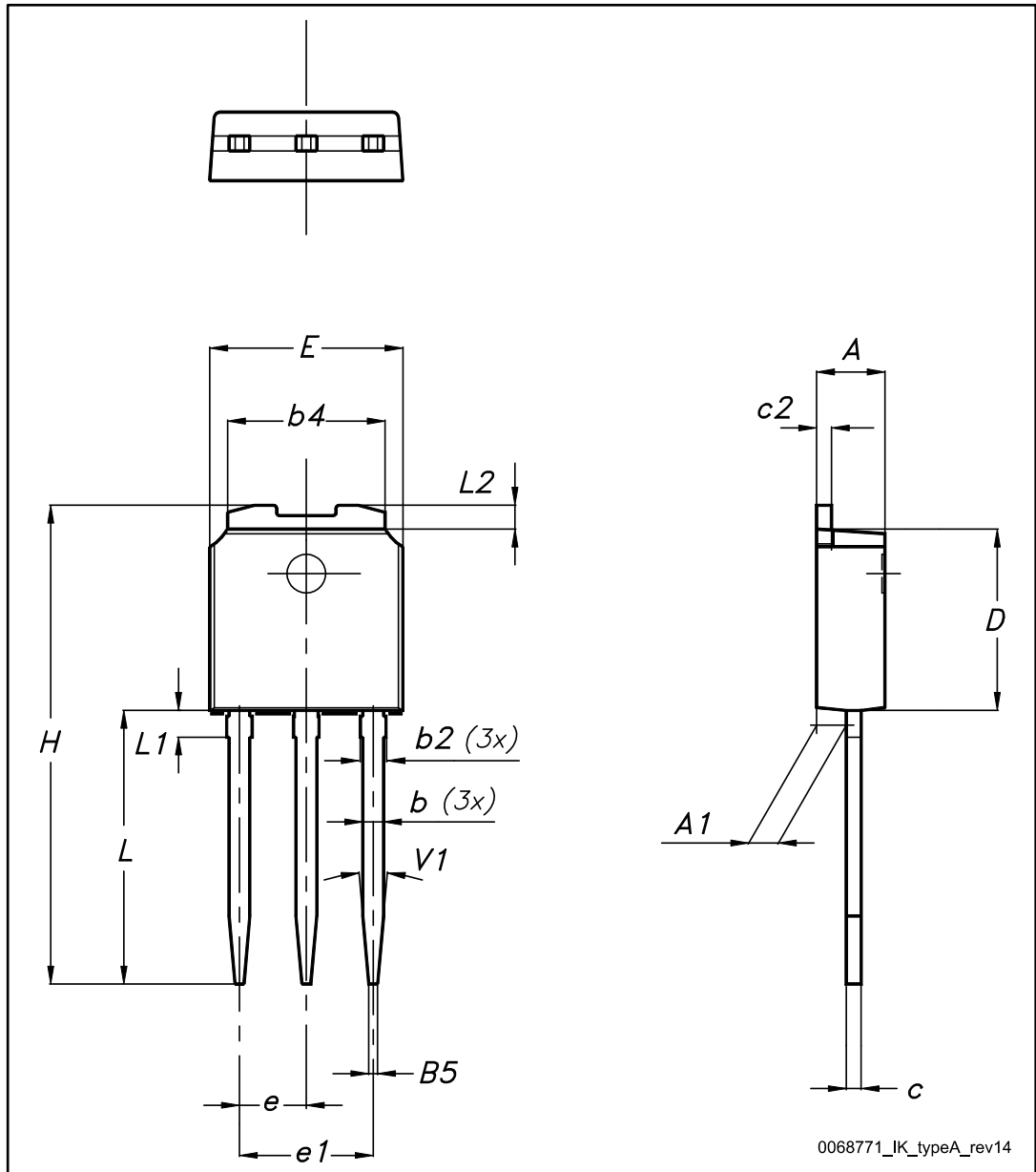
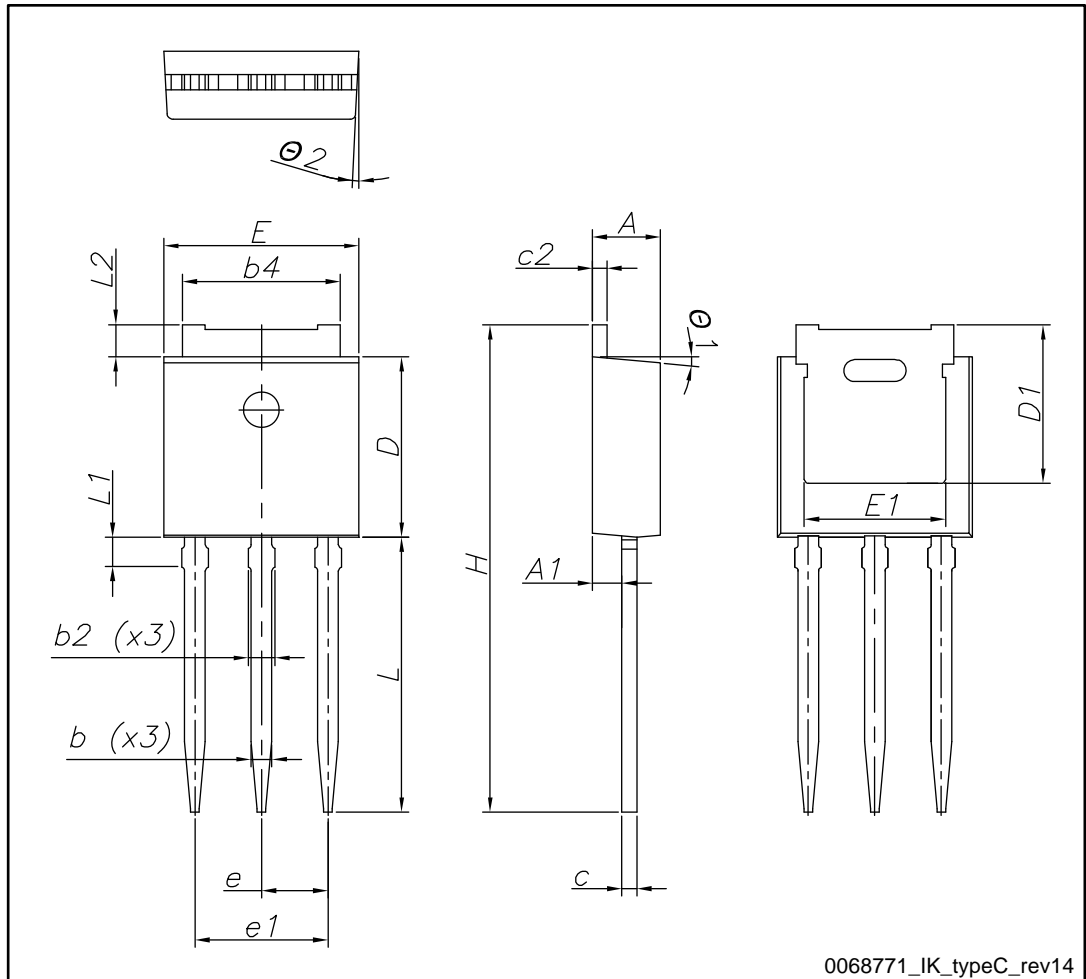


Table 14: IPAK (TO-251) type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
B5		0.30	
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
L1	0.80		1.20
L2		0.80	1.00
V1		10°	

### 4.7 IPAK (TO-251) type C package information

Figure 30: IPAK (TO-251) type C package outline



0068771\_IK\_typeC\_rev14

Table 15: IPAK (TO-251) type C package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.35
A1	0.90	1.00	1.10
b	0.66		0.79
b2			0.90
b4	5.23	5.33	5.43
c	0.46		0.59
c2	0.46		0.59
D	6.00	6.10	6.20
D1	5.20	5.37	5.55
E	6.50	6.60	6.70
E1	4.60	4.78	4.95
e	2.20	2.25	2.30
e1	4.40	4.50	4.60
H	16.18	16.48	16.78
L	9.00	9.30	9.60
L1	0.80	1.00	1.20
L2	0.90	1.08	1.25
$\theta 1$	3°	5°	7°
$\theta 2$	1°	3°	5°

### 4.8 D<sup>2</sup>PAK and DPAK packing information

Figure 31: Tape outline

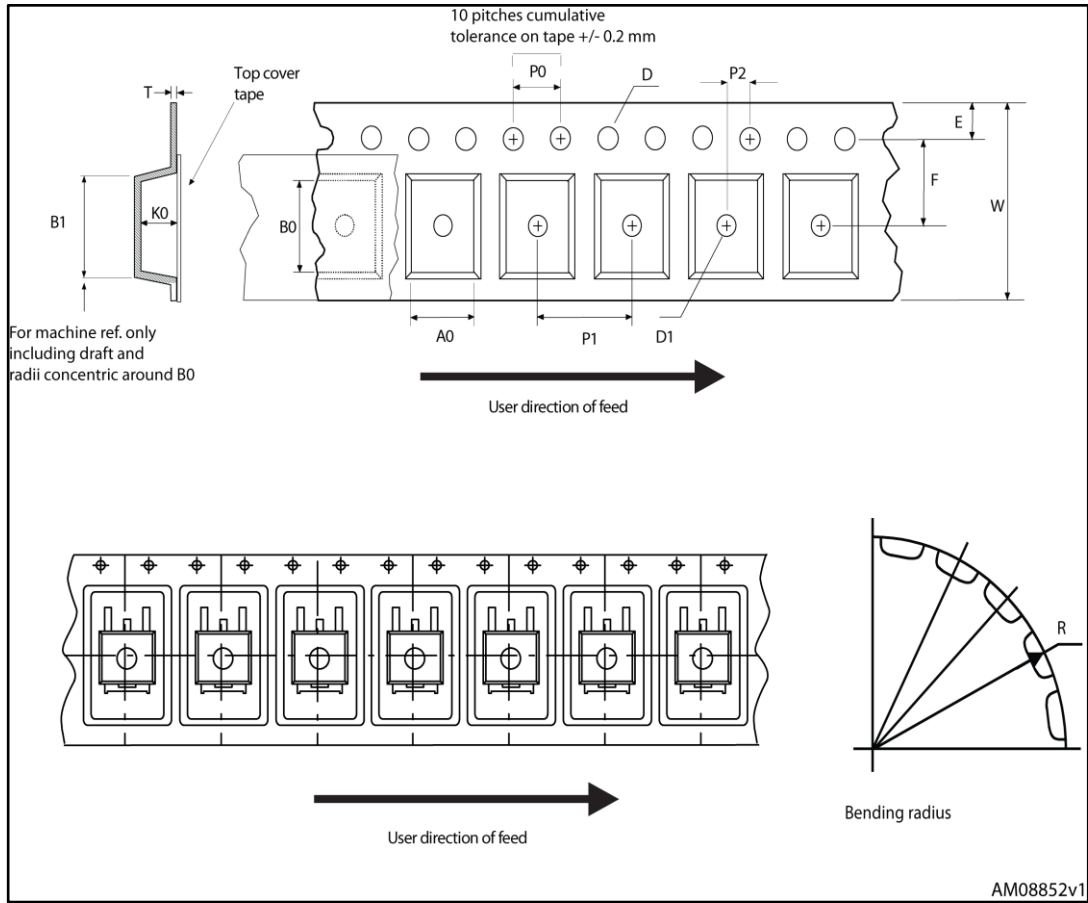


Figure 32: Reel outline

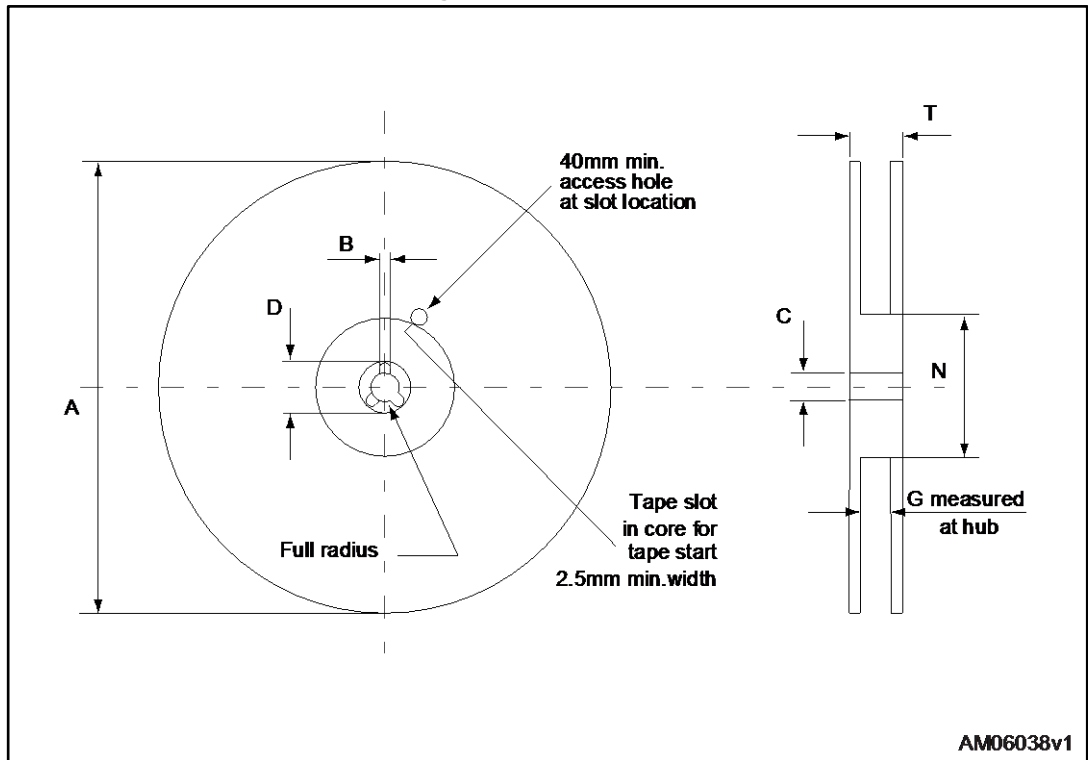


Table 16: D<sup>2</sup>PAK tape and reel mechanical data

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			

Table 17: DPAK 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			

## 5 Revision history

Table 18: Document revision history

Date	Revision	Changes
29-May-2013	1	First release.
06-Dec-2013	2	<ul style="list-style-type: none"> <li>– Added: D<sup>2</sup>PAK package</li> <li>– Modified: title and R<sub>DS(on)</sub> values in cover page</li> <li>– Modified: R<sub>DS(on)</sub> values in <i>Table 5</i></li> <li>– Modified: R<sub>G</sub> value in <i>Table 6</i></li> <li>– Modified: <i>Figure 9</i> and I<sub>D</sub> value in <i>Figure 12</i></li> <li>– Added: <i>Table 9, 13, Figure 22 and 23</i></li> <li>– Updated: <i>Table 10, 11, Figure 24, 25 and 26</i></li> <li>– Minor text changes</li> </ul>
13-Mar-2017	3	<p>Updated the title and the description in cover page.  Updated <a href="#">Table 4: "Avalanche characteristics"</a>.  Updated <a href="#">Section 4.2: "DPAK (TO-252) type A package information"</a>.  Added <a href="#">Section 4.4: "DPAK (TO-252) type E package information"</a> and  <a href="#">Section 4.7: "IPAK (TO-251) type C package information"</a>.  Minor text changes.</p>

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