

# STD2N105K5, STP2N105K5, STU2N105K5

N-channel 1050 V, 6  $\Omega$  typ., 1.5 A MDmesh™ K5  
Power MOSFETs in DPAK, TO-220 and IPAK packages

Datasheet - production data

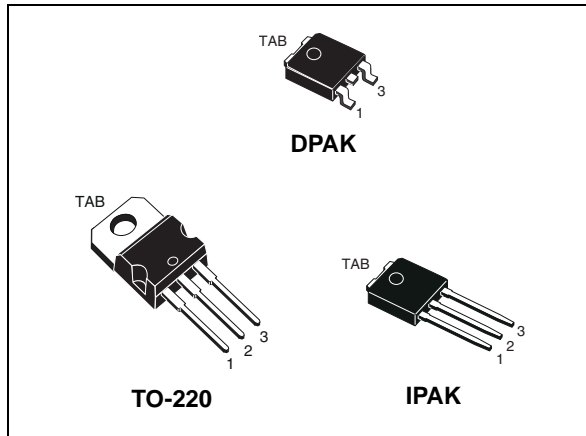
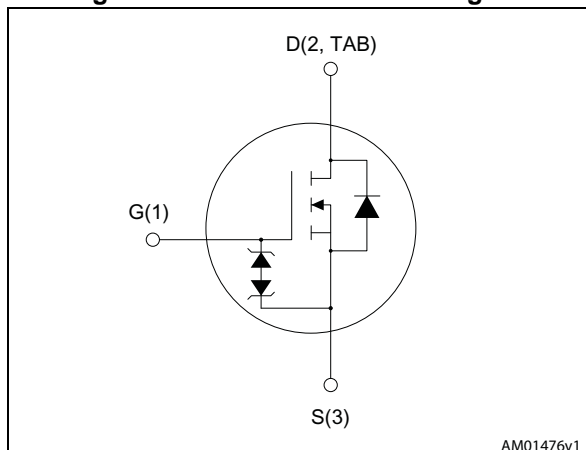


Figure 1. Internal schematic diagram



## Features

Order codes	$V_{DS}$	$R_{DS(on)}$ max	$I_D$	$P_{TOT}$
STD2N105K5	1050 V	8 $\Omega$	1.5 A	60 W
STP2N105K5				
STU2N105K5				

- Industry's lowest  $R_{DS(on)}$  x area
- Industry's best figure of merit (FoM)
- Ultra low gate charge
- 100% avalanche tested
- Zener-protected

## Applications

- Switching applications

## Description

These very high voltage N-channel Power MOSFETs are designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STD2N105K5	2N105K5	DPAK	Tape and reel
STP2N105K5		TO-220	Tube
STU2N105K5		IPAK	

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate- source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	1.5	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	0.95	A
$I_{DM}^{(1)}$	Drain current (pulsed)	6	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	60	W
$I_{AR}$	Max current during repetitive or single pulse avalanche	0.5	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D=0.5\text{ A}$ , $V_{DD}= 50\text{ V}$ )	90	mJ
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	50	V/ns
$T_j$ $T_{stg}$	Operating junction temperature Storage temperature	-55 to 150	$^\circ\text{C}$

1. Pulse width limited by safe operating area.
2.  $I_{SD} \leq 1.5\text{ A}$ ,  $di/dt \leq 100\text{ A}/\mu\text{s}$ ,  $V_{DS(\text{peak})} \leq V_{(BR)DSS}$ .
3.  $V_{DS} \leq 840\text{ V}$

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj\text{-case}}$	Thermal resistance junction-case max	2.08	$^\circ\text{C}/\text{W}$
$R_{thj\text{-amb}}$	Thermal resistance junction-ambient max	62.50	$^\circ\text{C}/\text{W}$

## 2 Electrical characteristics

(T<sub>case</sub> = 25 °C unless otherwise specified)

**Table 4. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source breakdown voltage	I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0	1050			V
I <sub>DSS</sub>	Zero gate voltage, drain current (V <sub>GS</sub> = 0)	V <sub>DS</sub> = 1050 V			1	μA
		V <sub>DS</sub> = 1050 V, T <sub>C</sub> = 125 °C			50	μA
I <sub>GSS</sub>	Gate-body leakage current	V <sub>GS</sub> = ± 20 V; V <sub>DS</sub> = 0			±10	μA
V <sub>GS(th)</sub>	Gate threshold voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 100 μA	3	4	5	V
R <sub>DS(on)</sub>	Static drain-source on-resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 0.75 A		6	8	Ω

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C <sub>ISS</sub>	Input capacitance	V <sub>DS</sub> = 100 V, f = 1 MHz, V <sub>GS</sub> = 0	-	115	-	pF
C <sub>OSS</sub>	Output capacitance		-	15	-	pF
C <sub>rSS</sub>	Reverse transfer capacitance		-	0.5	-	pF
C <sub>o(tr)</sub> <sup>(1)</sup>	Equivalent capacitance time related	V <sub>GS</sub> = 0, V <sub>DS</sub> = 0 to 840 V	-	17	-	pF
C <sub>o(er)</sub> <sup>(2)</sup>	Equivalent capacitance energy related		-	6	-	pF
R <sub>G</sub>	Intrinsic gate resistance	f = 1 MHz open drain	-	20	-	Ω
Q <sub>g</sub>	Total gate charge	V <sub>DD</sub> = 840 V, I <sub>D</sub> = 1.5 A V <sub>GS</sub> = 10 V (see <a href="#">Figure 18</a> )	-	10	-	nC
Q <sub>gs</sub>	Gate-source charge		-	1.5	-	nC
Q <sub>gd</sub>	Gate-drain charge		-	8	-	nC

1. Time related is defined as a constant equivalent capacitance giving the same charging time as C<sub>OSS</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>
2. energy related is defined as a constant equivalent capacitance giving the same stored energy as C<sub>OSS</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 525\text{ V}$ , $I_D = 0.75\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ <i>(see Figure 17)</i>	-	14.5	-	ns
$t_r$	Rise time		-	8.5	-	ns
$t_{d(off)}$	Turn-off-delay time		-	35	-	ns
$t_f$	Fall time		-	38.5	-	ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$I_{SD}$	Source-drain current		-		1.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		6	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 1.5\text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 1.5\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ <i>(see Figure 19)</i>	-	326		ns
$Q_{rr}$	Reverse recovery charge		-	1.19		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	7.3		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 1.5\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$ <i>(see Figure 19)</i>	-	525		ns
$Q_{rr}$	Reverse recovery charge		-	1.83		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	7		A

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

**Table 8. Gate-source Zener diode**

Symbol	Parameter	Test conditions	Min	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1\text{ mA}$ , $I_D = 0$	30	-	-	V

The built-in back-to-back Zener diodes have specifically been designed to enhance the device's ESD capability. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for DPAK and IPAK

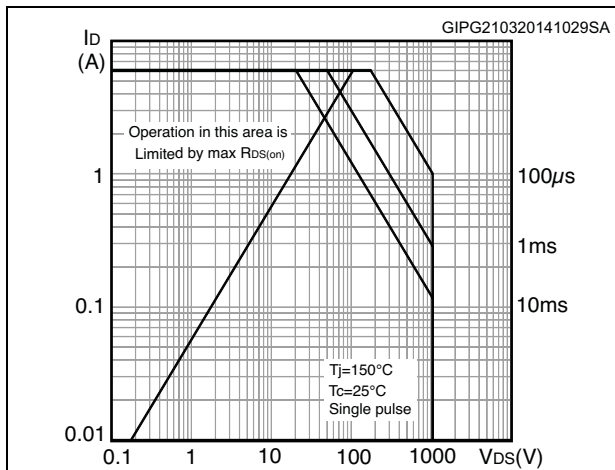


Figure 3. Thermal impedance for DPAK and IPAK

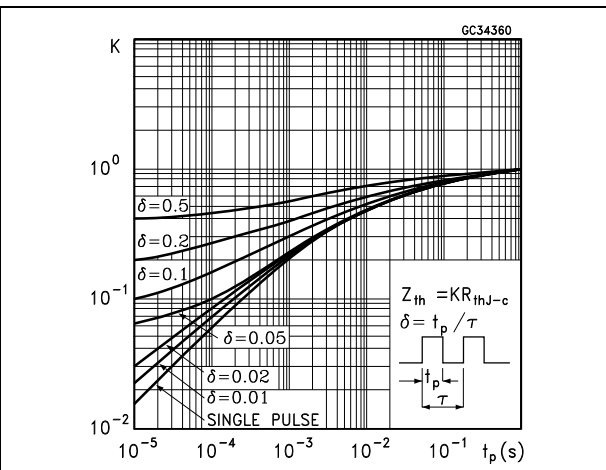


Figure 4. Safe operating area for TO-220

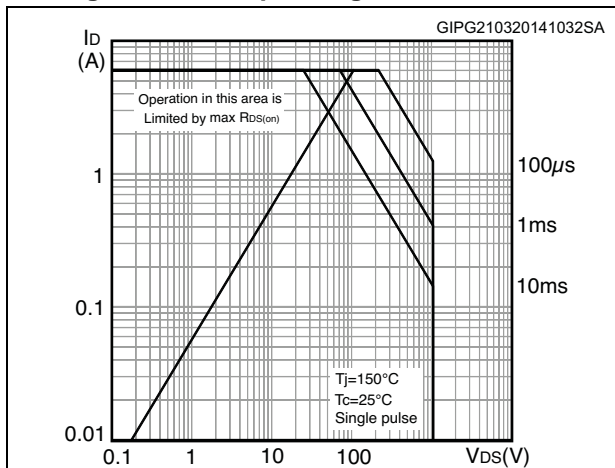


Figure 5. Thermal impedance for TO-220

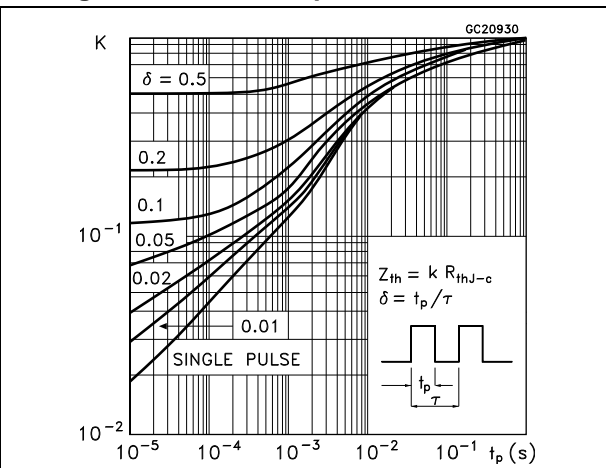


Figure 6. Output characteristics

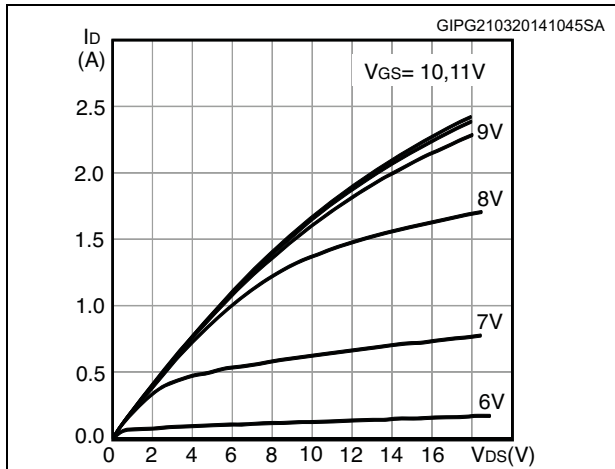


Figure 7. Transfer characteristics

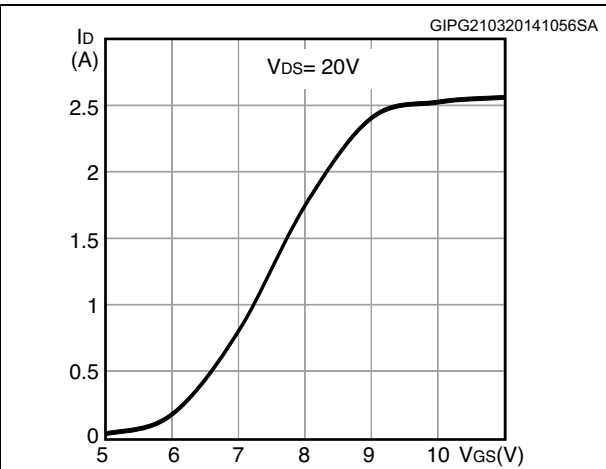


Figure 8. Gate charge vs gate-source voltage

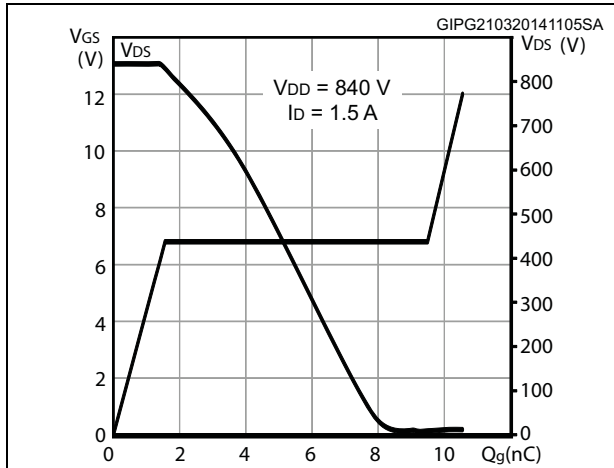


Figure 9. Static drain-source on-resistance

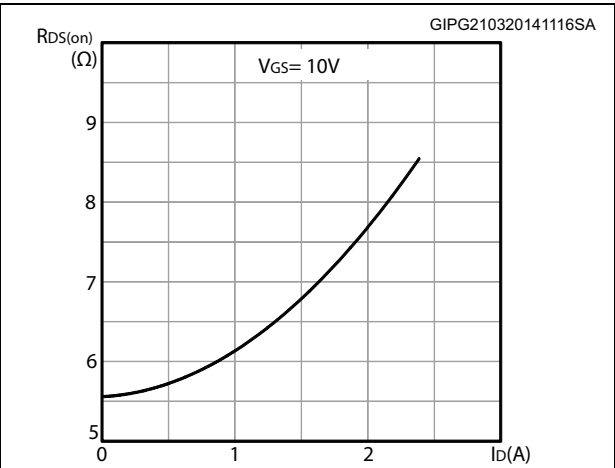


Figure 10. Capacitance variations

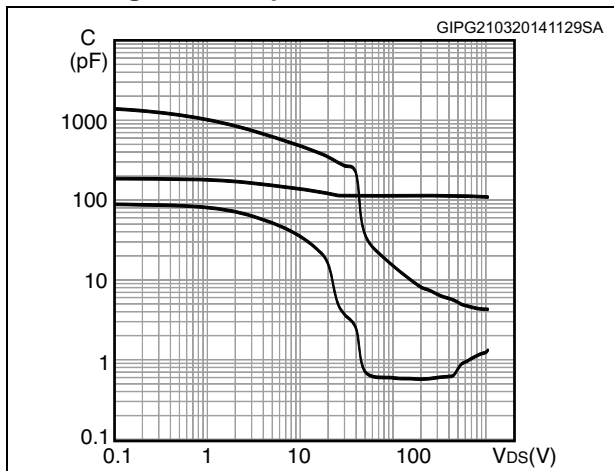


Figure 11. Output capacitance stored energy

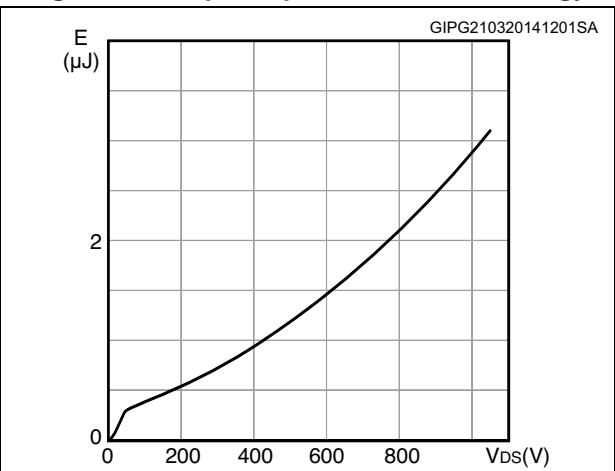


Figure 12. Normalized gate threshold voltage vs temperature

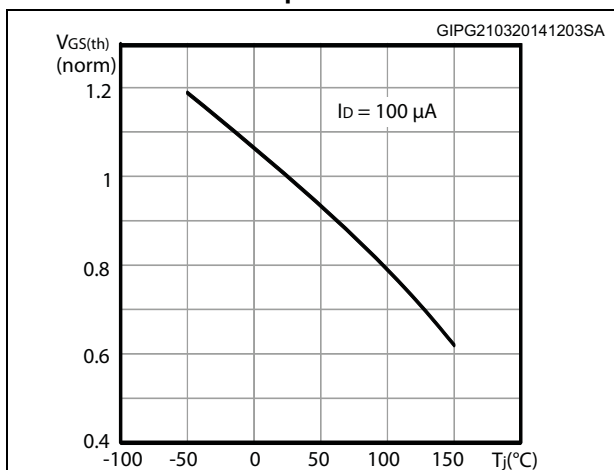


Figure 13. Normalized on-resistance vs temperature

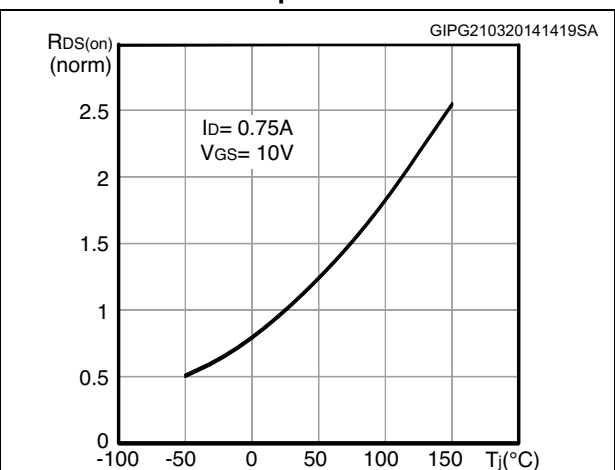


Figure 14. Source-drain diode forward characteristics

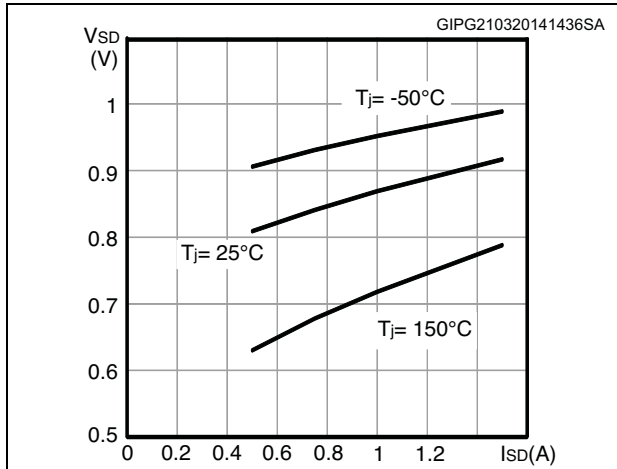


Figure 15. Normalized V<sub>(BR)DSS</sub> vs temperature

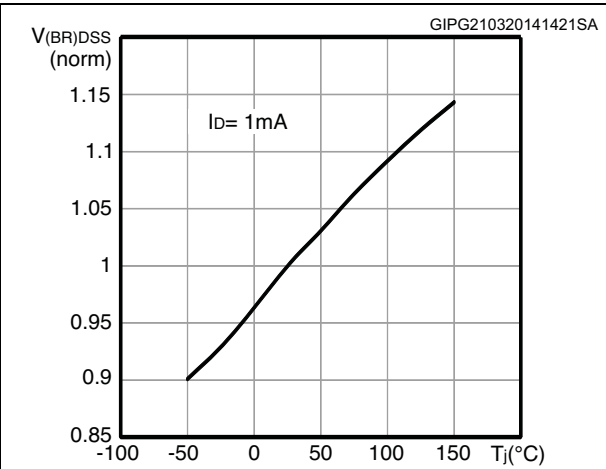
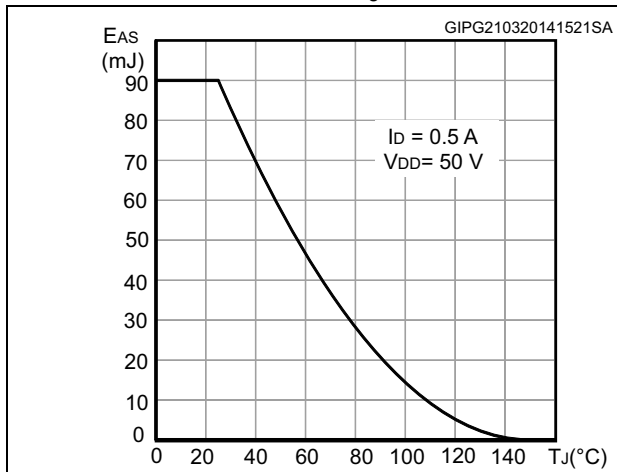


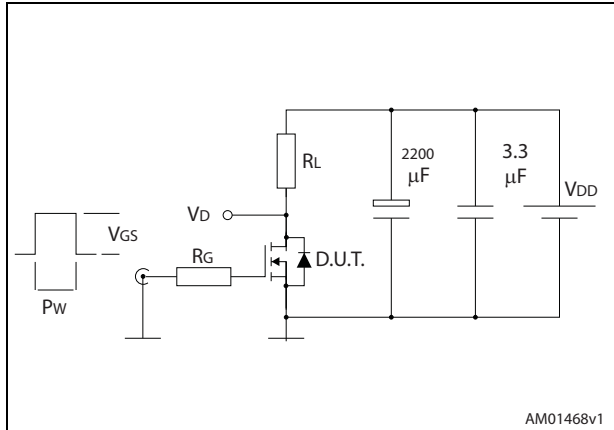
Figure 16. Maximum avalanche energy vs starting T<sub>J</sub>





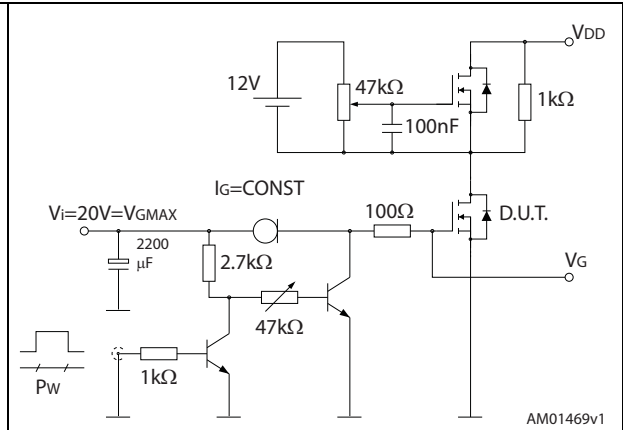
### 3 Test circuits

Figure 17. Switching times test circuit for resistive load



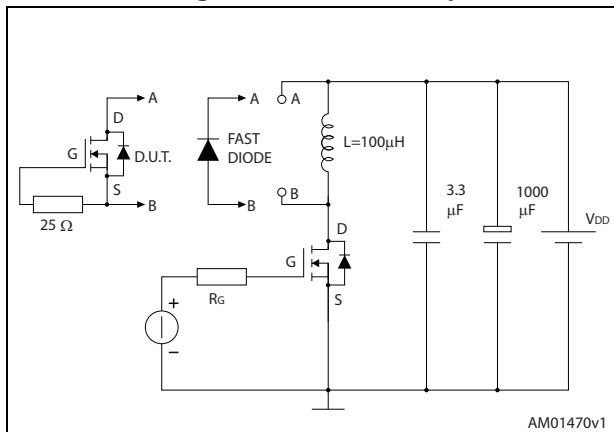
AM01468v1

Figure 18. Gate charge test circuit



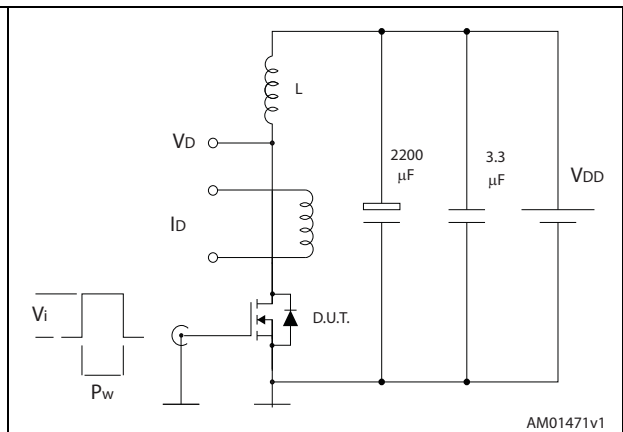
AM01469v1

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



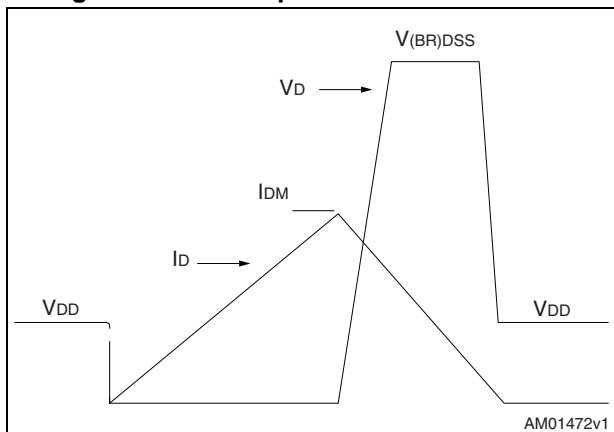
AM01470v1

Figure 20. Unclamped inductive load test circuit



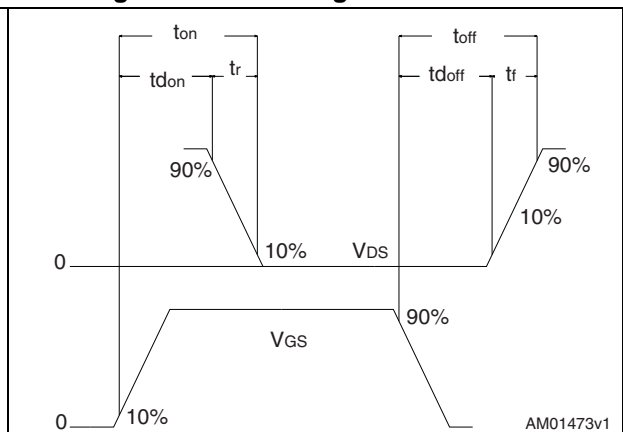
AM01471v1

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<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

4.1 DPAK, STD2N105K5

Figure 23. DPAK (TO-252) type A drawing

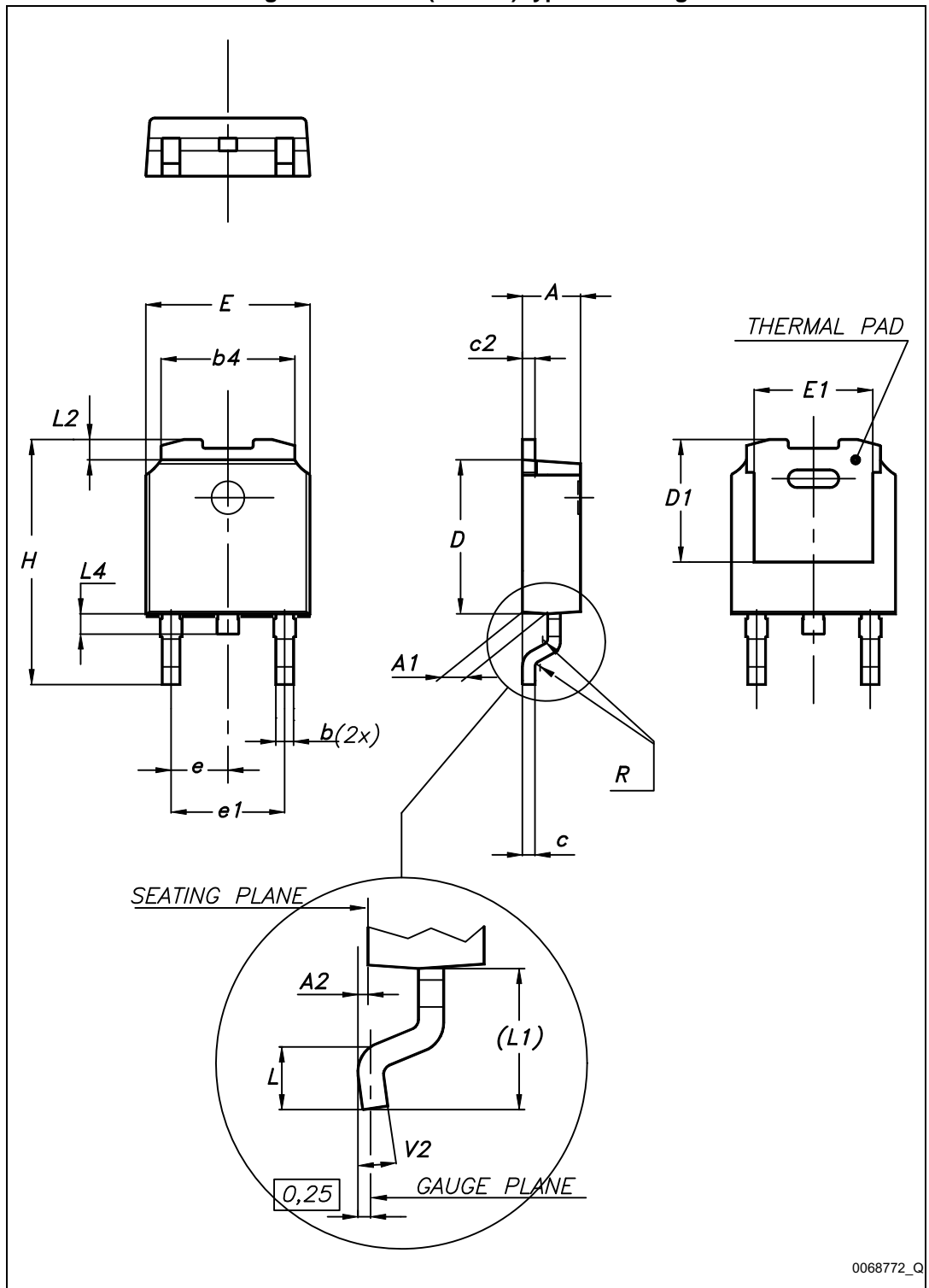
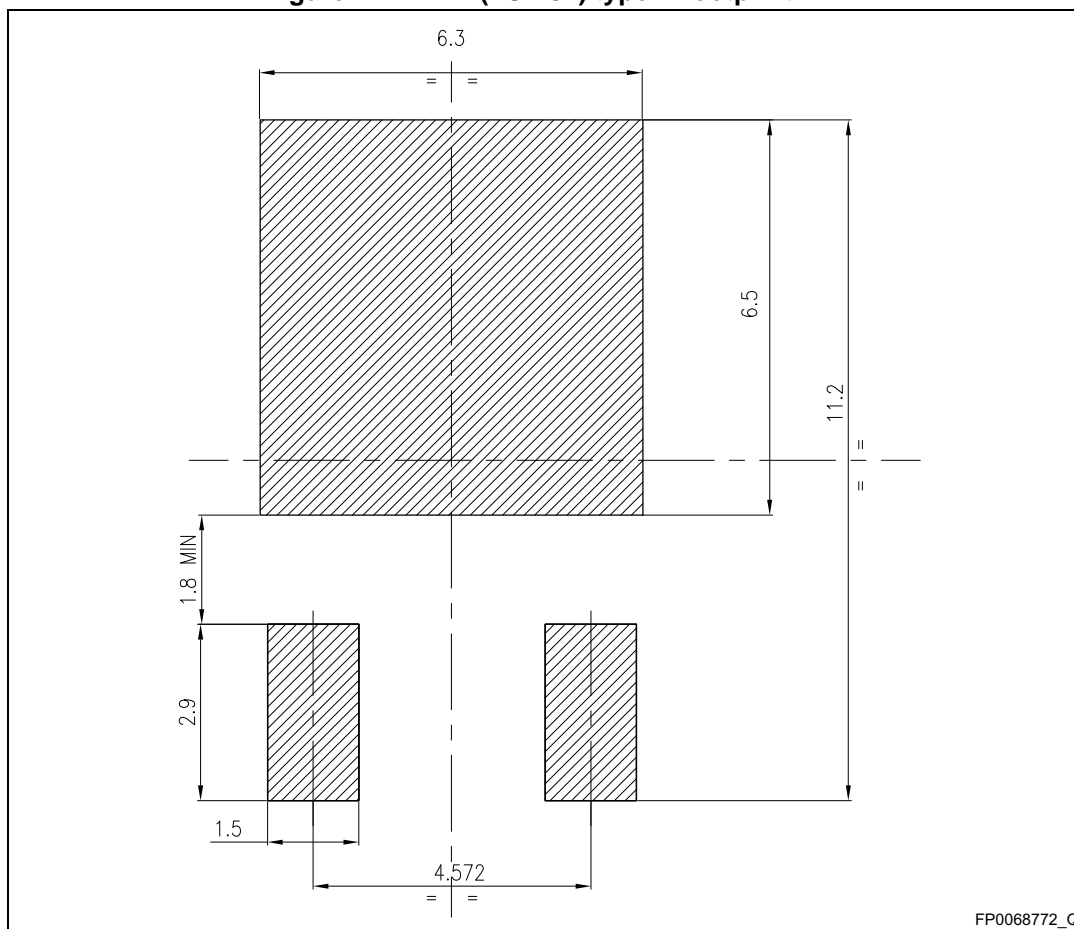


Table 9. DPAK (TO-252) type A mechanical data

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		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°

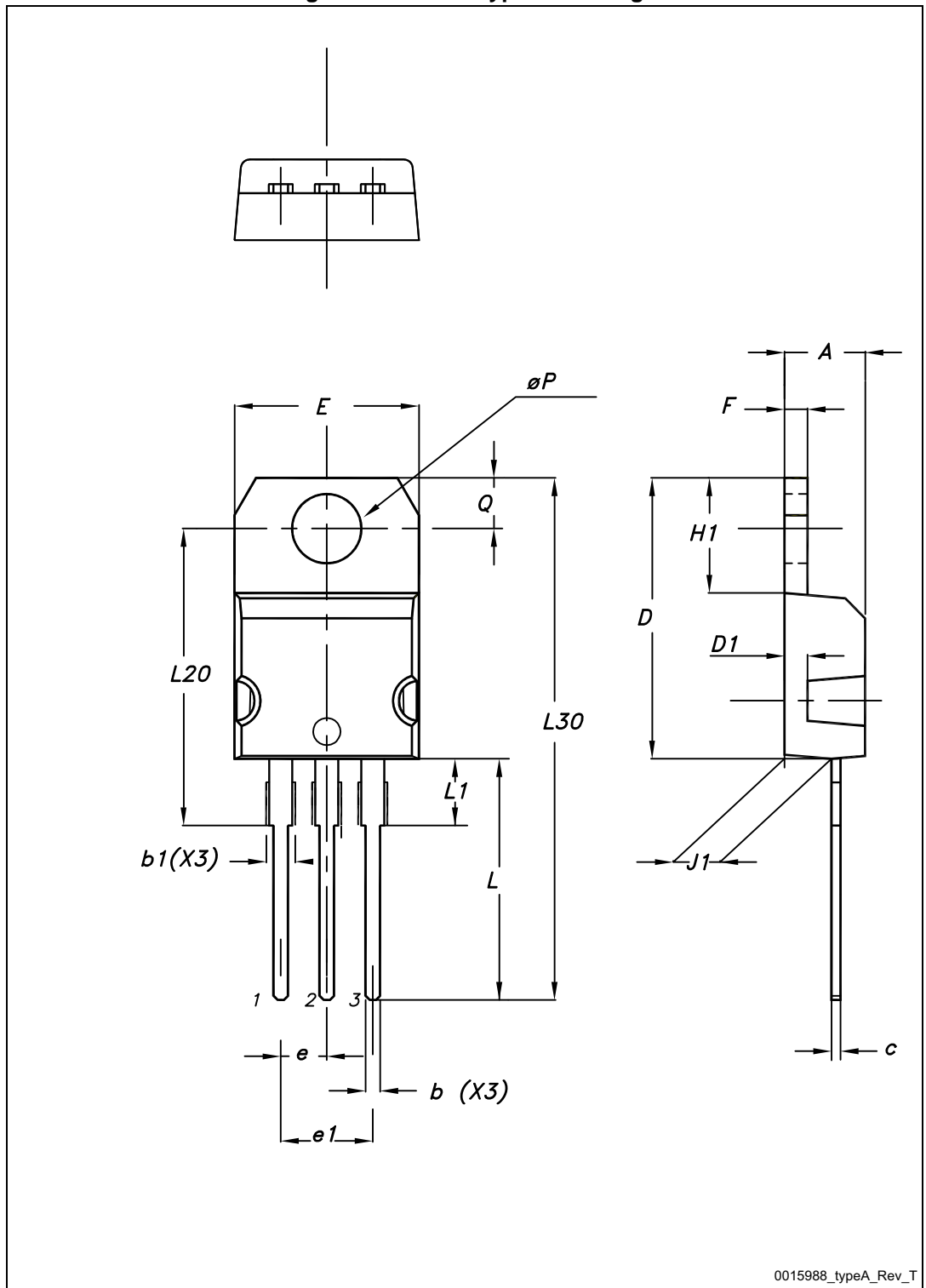
Figure 24. DPAK (TO-252) type A footprint (a)



a. All dimensions are in millimeters

### 4.2 TO-220, STP2N105K5

Figure 25. TO-220 type A drawing



0015988\_typeA\_Rev\_T

Table 10. 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 IPAK, STU2N105K5

Figure 26. IPAK (TO-251) drawing

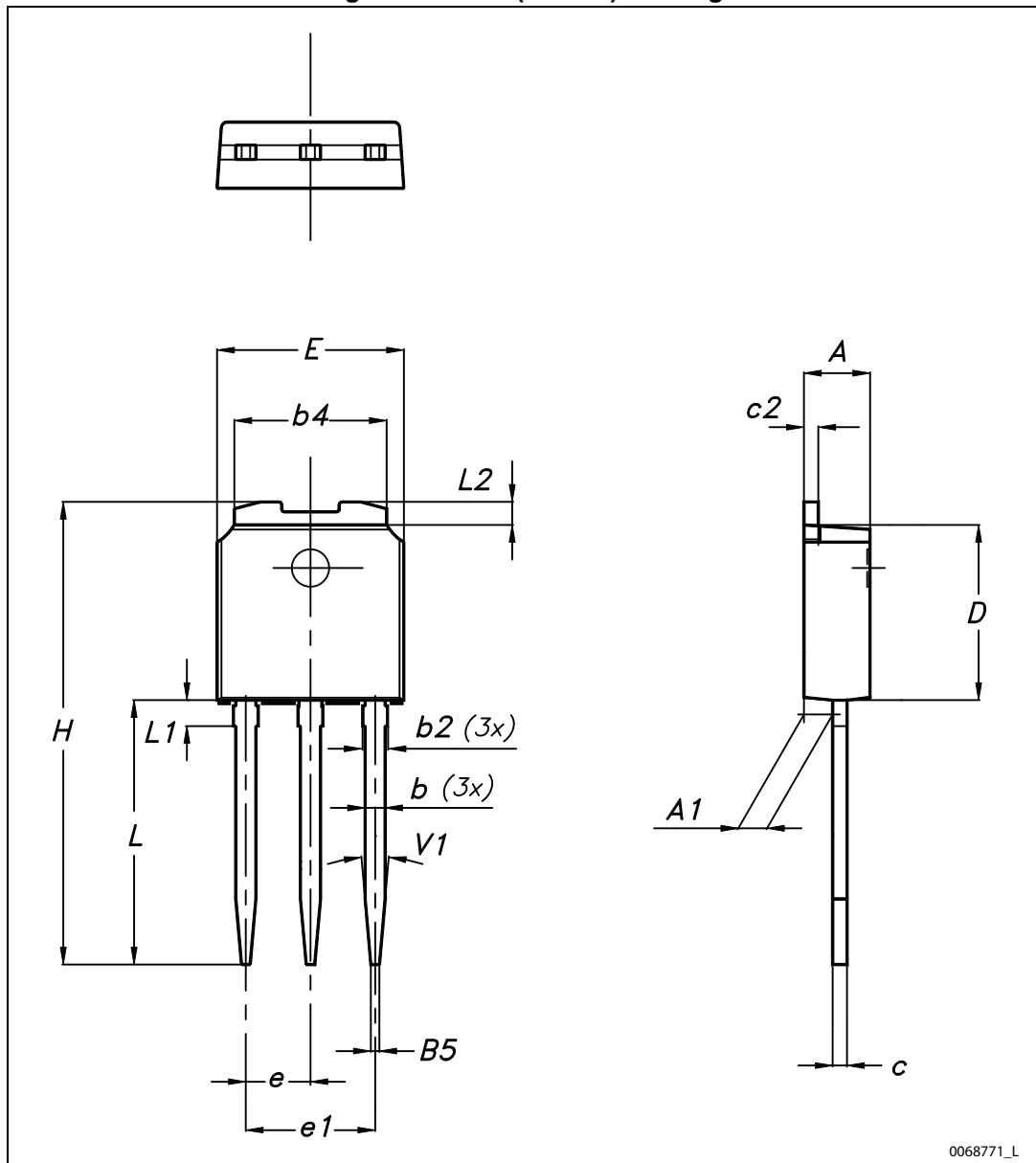




Table 11. IPAK (TO-251) type A mechanical data

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°	

# 5 Packaging mechanical data

Figure 27. Tape

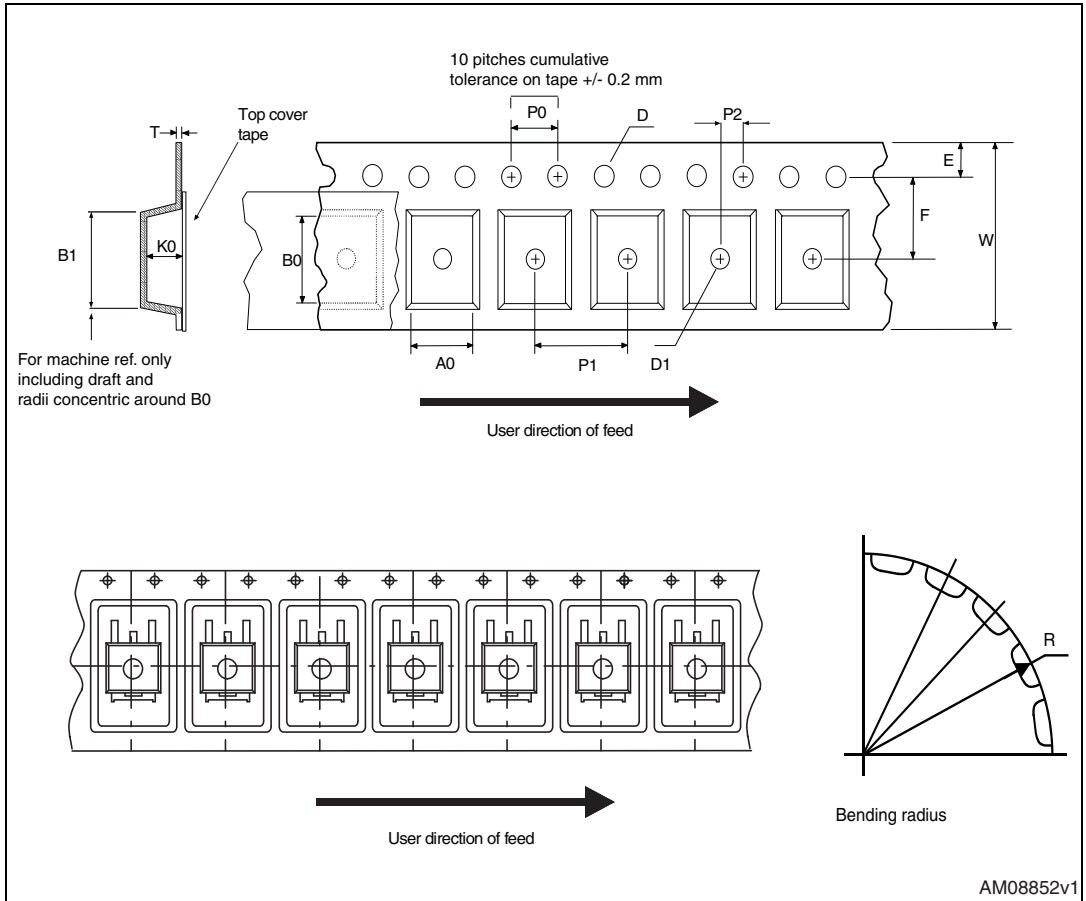


Figure 28. Reel

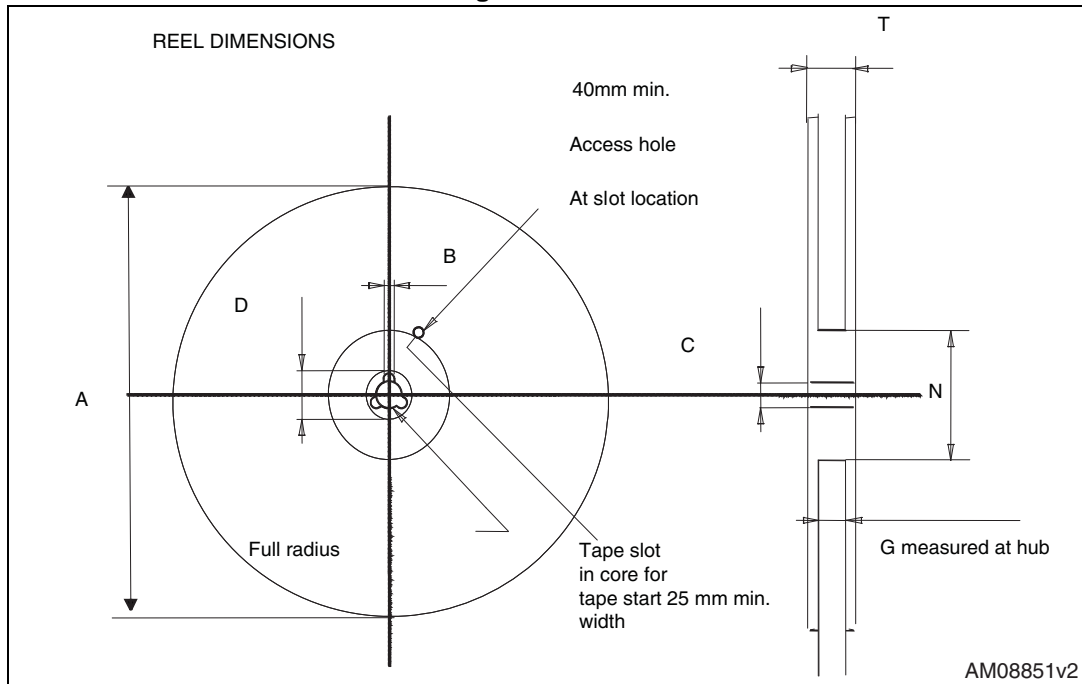


Table 12. DPAK (TO-252) tape and reel mechanical data

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			

## 6 Revision history

Table 13. Document revision history

Date	Revision	Changes
08-May-2014	1	First release.
14-Nov-2014	2	Document status promoted from preliminary to production data. Updated title, features and description in cover page. Updated <a href="#">Figure 9: Static drain-source on-resistance</a> , <a href="#">Section 4.1: DPAK, STD2N105K5</a> and <a href="#">Section 4.3: IPAK, STU2N105K5</a> . Minor text changes.
19-Nov-2004	3	Updated $V_{GS}$ in <a href="#">Table 2: Absolute maximum ratings</a> and $I_{GSS}$ in <a href="#">Table 4: On /off states</a> .

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