



# STB11NM80, STF11NM80 STI11NM80, STP11NM80, STW11NM80

N-channel 800 V, 0.35  $\Omega$ , 11 A MDmesh™ Power MOSFET  
in D<sup>2</sup>PAK, TO-220FP, I<sup>2</sup>PAK, TO-220, TO-247

## Features

Order codes	V <sub>DSS</sub>	R <sub>DS(on) max</sub>	R <sub>DS(on)</sub> *Q <sub>g</sub>	I <sub>D</sub>
STB11NM80	800 V	< 0.40 $\Omega$	14 $\Omega$ *nC	11 A
STF11NM80				
STI11NM80				
STP11NM80				
STW11NM80				

- Low input capacitance and gate charge
- Low gate input resistance
- Best R<sub>DS(on)</sub>\*Q<sub>g</sub> in the industry

## Applications

- Switching applications

## Description

These N-channel Power MOSFETs are developed using STMicroelectronics' revolutionary MDmesh™ technology, which associates the multiple drain process with the company's PowerMESH™ horizontal layout. These devices offer extremely low on-resistance, high dv/dt and excellent avalanche characteristics. Utilizing ST's proprietary strip technique, these Power MOSFETs boast an overall dynamic performance which is superior to similar products on the market.

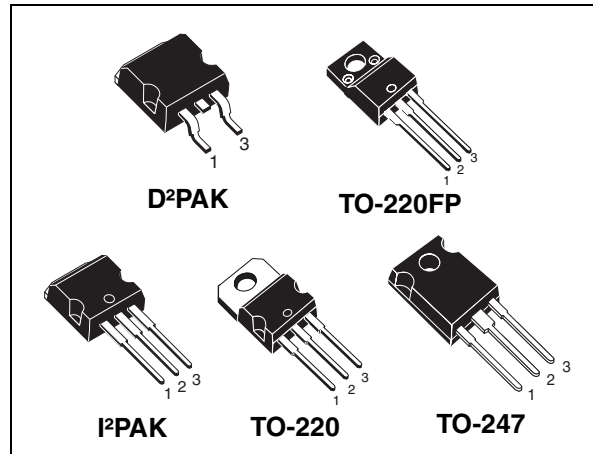


Figure 1. Internal schematic diagram

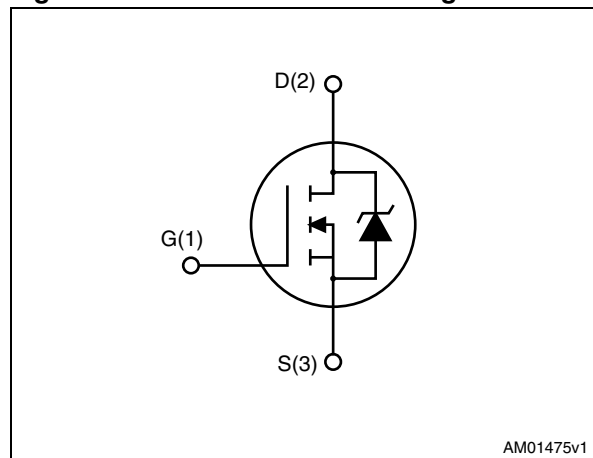


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB11NM80	B11NM80	D <sup>2</sup> PAK	Tape and reel
STF11NM80	F11NM80	TO-220FP	Tube
STI11NM80	I11NM80	I <sup>2</sup> PAK	
STP11NM80	P11NM80	TO-220	
STW11NM80	W11NM80	TO-247	

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		D <sup>2</sup> PAK, I <sup>2</sup> PAK TO-220, TO-247	TO-220FP	
V <sub>DS</sub>	Drain-source voltage (V <sub>GS</sub> = 0)	800		V
V <sub>GS</sub>	Gate-source voltage	±30		V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	11	11 <sup>(1)</sup>	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> =100 °C	8	8 <sup>(1)</sup>	A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	44	44 <sup>(1)</sup>	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	150	35	W
	Derating factor	1.2	0.28	W/°C
V <sub>ISO</sub>	Insulation withstand voltage (DC)		2500	V
T <sub>J</sub> T <sub>stg</sub>	Operating junction temperature Storage temperature	-65 to 150		°C

- Limited only by the maximum temperature allowed
- Pulse width limited by safe operating area

**Table 3. Thermal data**

Symbol	Parameter	Value					Unit
		D <sup>2</sup> PAK	TO-220FP	I <sup>2</sup> PAK	TO-220	TO-247	
R <sub>thj-case</sub>	Thermal resistance junction-case max	0.83	3.6	0.83			°C/W
R <sub>thj-a</sub>	Thermal resistance junction-ambient max		62.5		50		°C/W
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb max	30					°C/W
T <sub>l</sub>	Maximum lead temperature for soldering purpose		300				°C

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

**Table 4. Avalanche characteristics**

Symbol	Parameter	Value	Unit
I <sub>AS</sub>	Avalanche current, repetitive or not-repetitive (pulse width limited by T <sub>J</sub> max)	2.5	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)	400	mJ

## 2 Electrical characteristics

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

**Table 5. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage ( $V_{GS} = 0$ )	$I_D = 250\ \mu\text{A}$	800			V
$dv/dt^{(1)}$	Drain source voltage slope	$V_{DD} = 640\text{ V}$ , $I_D = 11\text{ A}$ , $V_{GS} = 10\text{ V}$	30			V/ns
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 800\text{ V}$ , $V_{DS} = 800\text{ V @ }125\text{ °C}$			10 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 30\text{ V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 5.5\text{ A}$		0.35	0.40	$\Omega$

1. Characteristic value at turn off on inductive load

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$ , $I_D = 7.5\text{ A}$	-	8	-	S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	1630 750 30	-	pF pF pF
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 640\text{ V}$ , $I_D = 11\text{ A}$ $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 18</a> )	-	43.6 11.6 21	-	nC nC nC
$R_g$	Gate input resistance	$f = 1\text{ MHz}$ Gate DC Bias = 0 Test signal level = 20 mV open drain	-	2.7	-	$\Omega$
$t_{d(on)}$ $t_r$ $t_{d(off)}$ $t_f$	Turn-on delay time Rise time Turn-off delay time Fall time	$V_{DD} = 400\text{ V}$ , $I_D = 5.5\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 17</a> )	-	22 17 46 15	-	ns ns ns ns

1. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		11	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				44	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=11\text{ A}$ , $V_{GS}=0$	-		0.86	V
$t_{rr}$	Reverse recovery time	$I_{SD}=11\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD}= 50\text{ V}$	-	612		ns
$Q_{rr}$	Reverse recovery charge			7.22		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			23.6		A
$t_{rr}$	Reverse recovery time	$I_{SD}=11\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD}= 50\text{ V}$ , $T_j=150\text{ }^\circ\text{C}$	-	970		ns
$Q_{rr}$	Reverse recovery charge			11.25		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			23.2		A

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for D<sup>2</sup>PAK, I<sup>2</sup>PAK, TO-220, TO-247

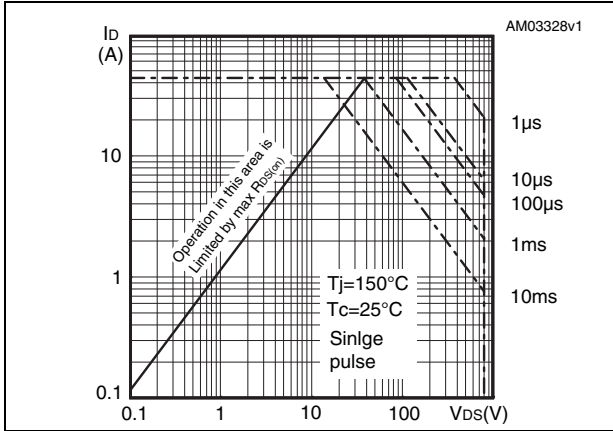


Figure 3. Thermal impedance for D<sup>2</sup>PAK, I<sup>2</sup>PAK, TO-220, TO-247

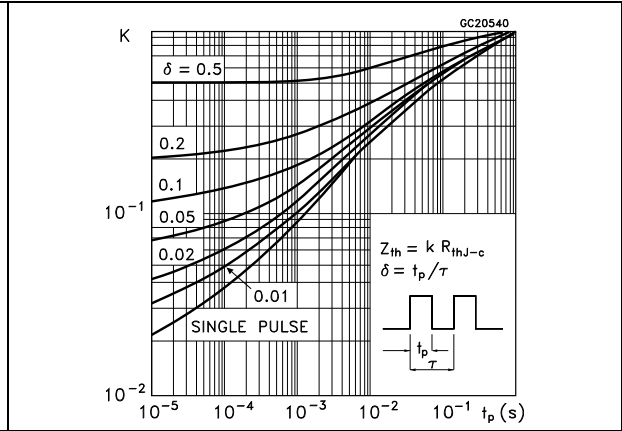


Figure 4. Safe operating area for TO-220FP

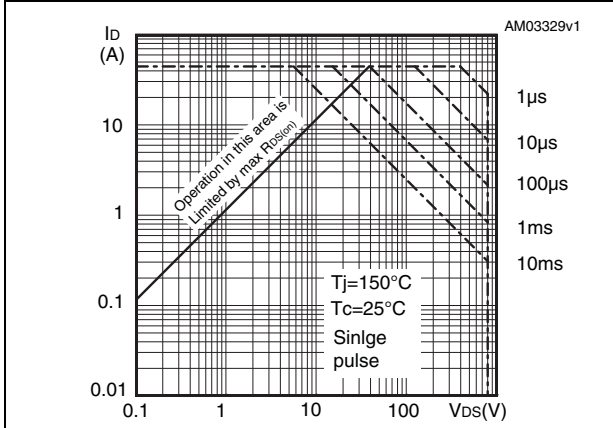


Figure 5. Thermal impedance for TO-220FP

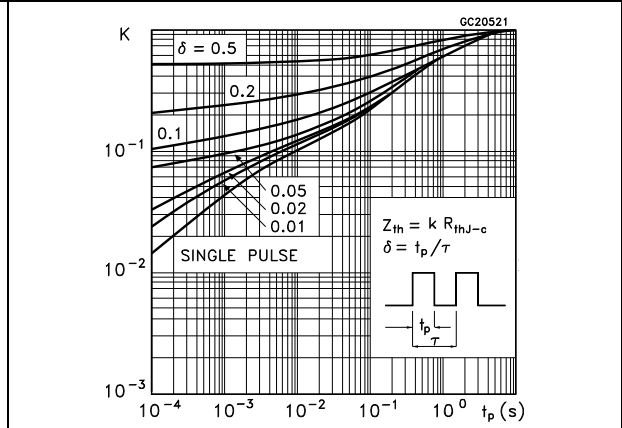


Figure 6. Output characteristics

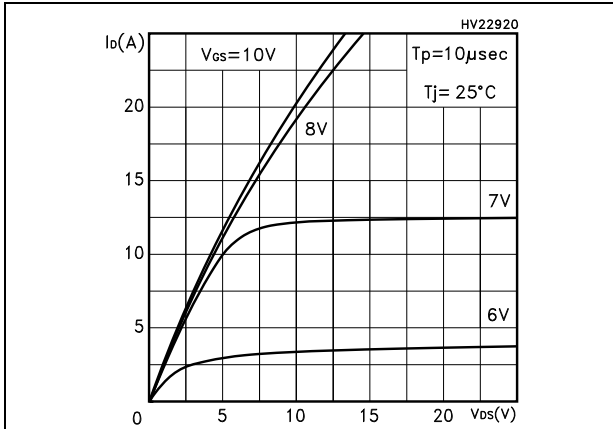


Figure 7. Output characteristics @ Tj=150 °C

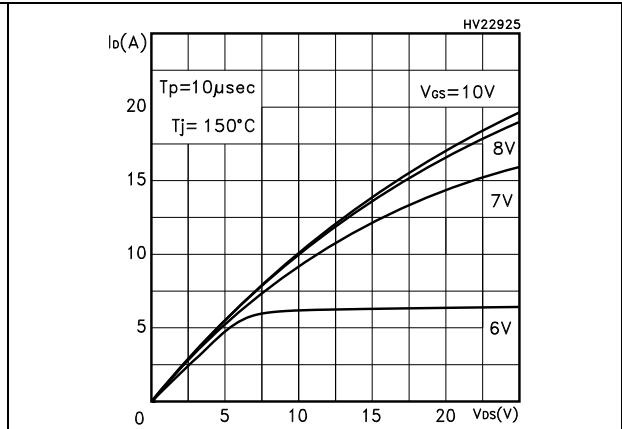


Figure 8. Transfer characteristics

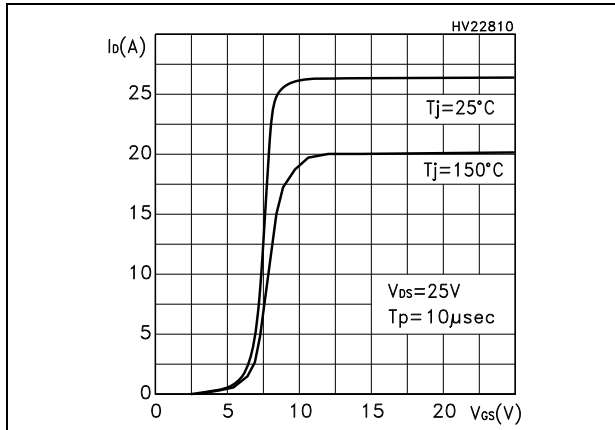


Figure 9. Transconductance

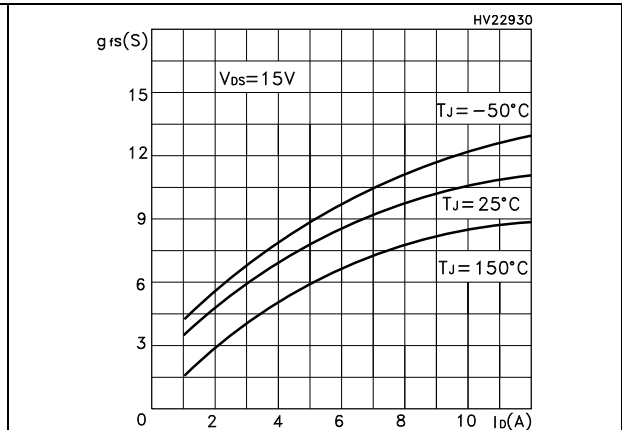


Figure 10. Gate charge vs gate-source voltage Figure 11. Capacitance variations

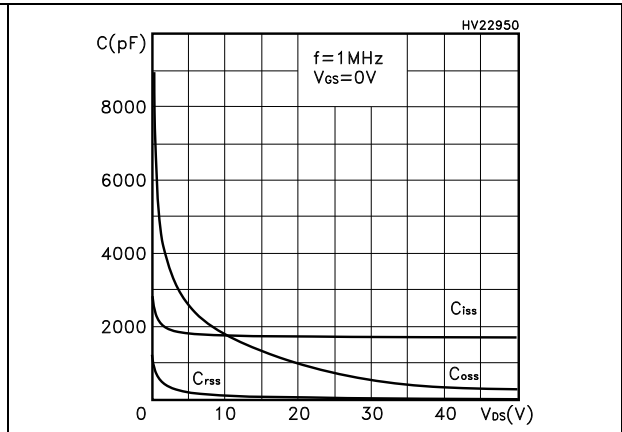
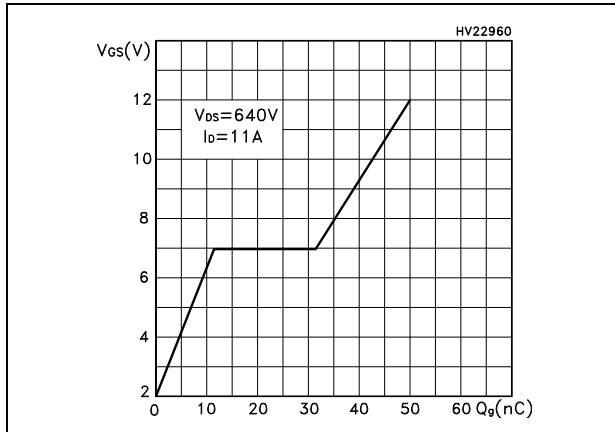


Figure 12. Normalized gate threshold voltage vs temperature Figure 13. Static drain-source on resistance vs temperature

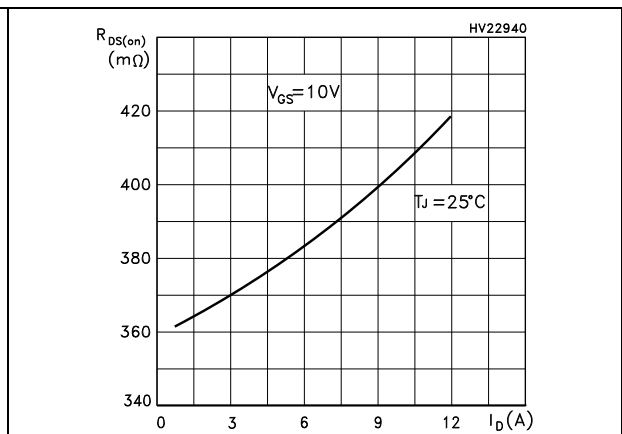
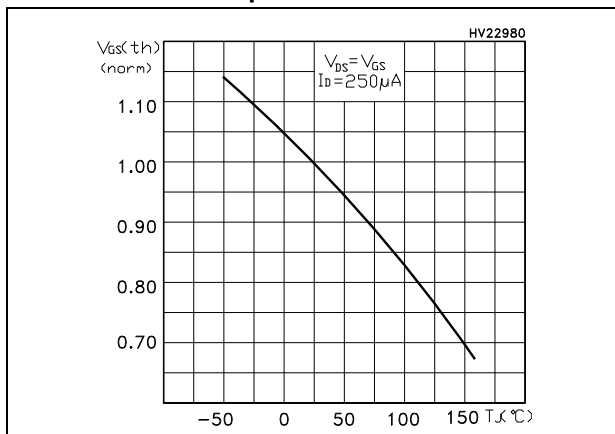


Figure 14. Source-drain diode forward characteristics

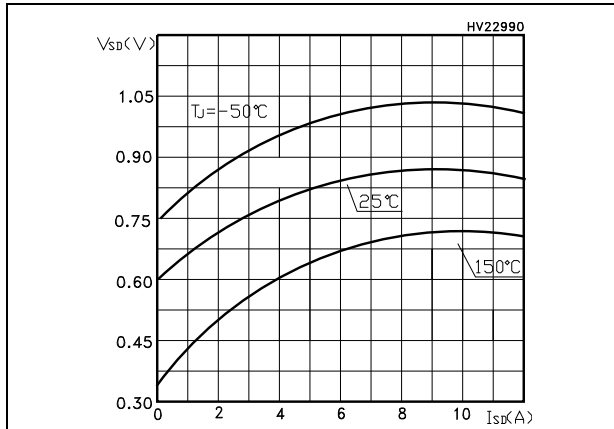


Figure 15. Normalized on resistance vs temperature

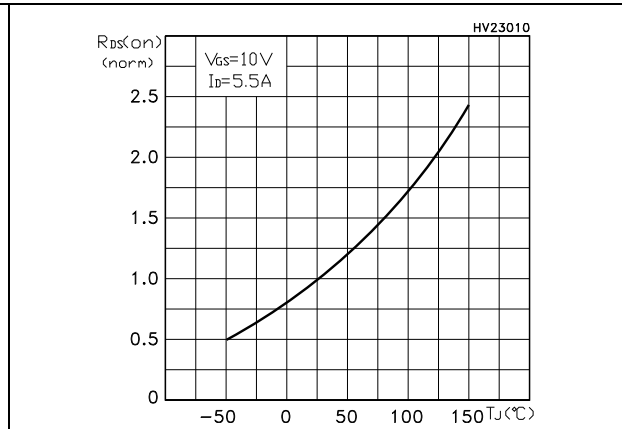
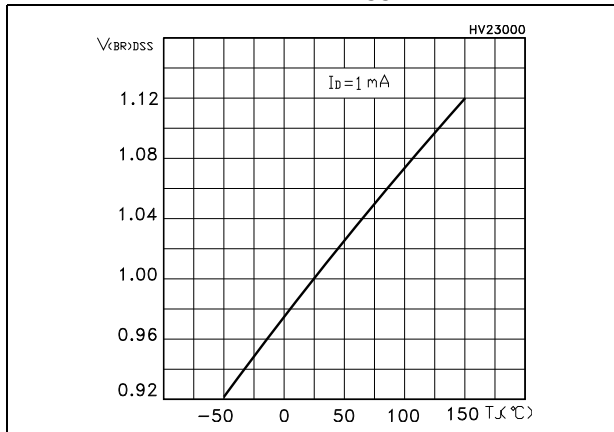


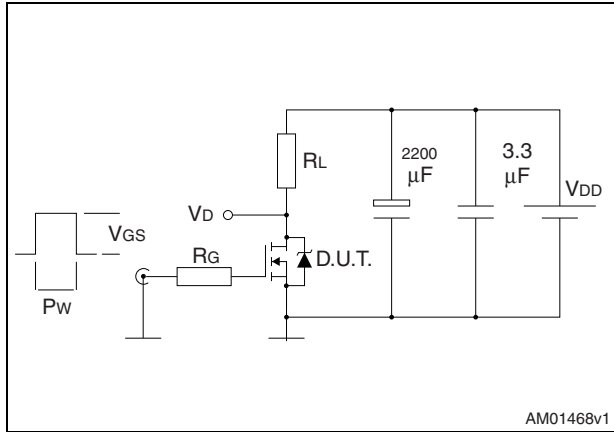
Figure 16. Normalized  $B_{V_{DSS}}$  vs temperature



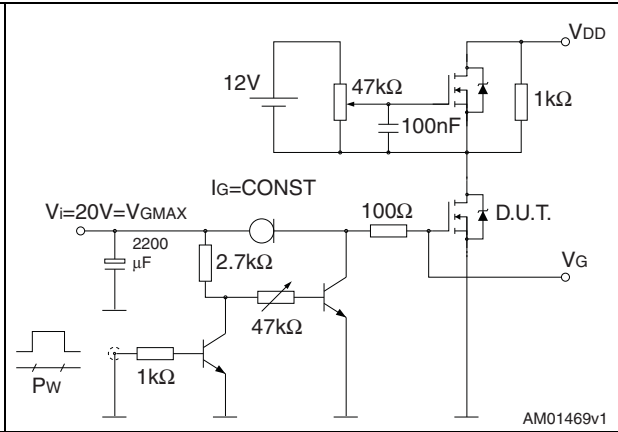


### 3 Test circuits

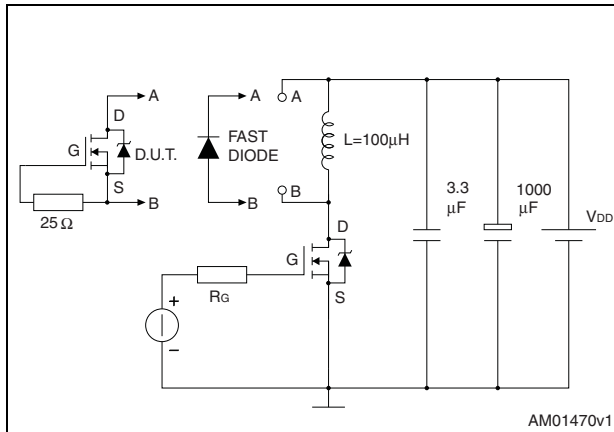
**Figure 17. Switching times test circuit for resistive load**



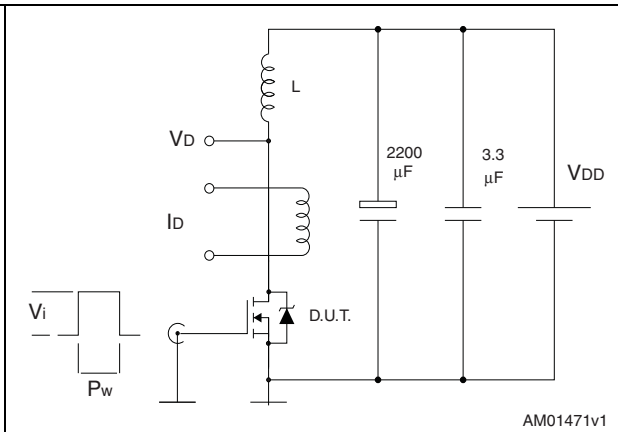
**Figure 18. Gate charge test circuit**



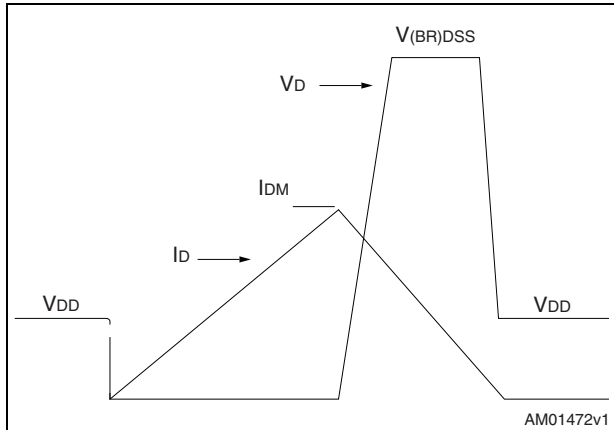
**Figure 19. Test circuit for inductive load switching and diode recovery times**



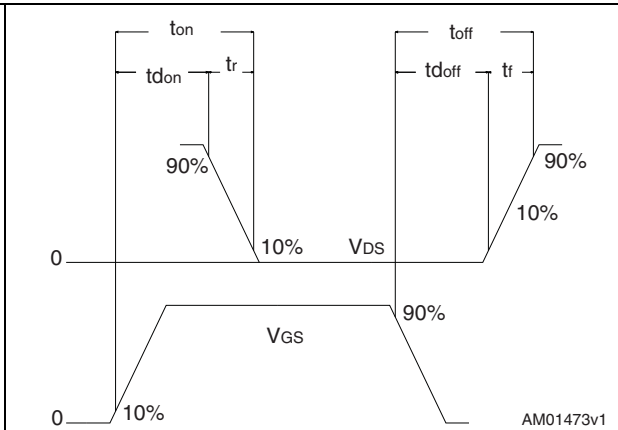
**Figure 20. Unclamped inductive load test circuit**



**Figure 21. Unclamped inductive waveform**



**Figure 22. Switching time waveform**



## 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.

Table 8. 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		
E	10		10.40
E1	8.50		
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 23. D<sup>2</sup>PAK (TO-263) drawing

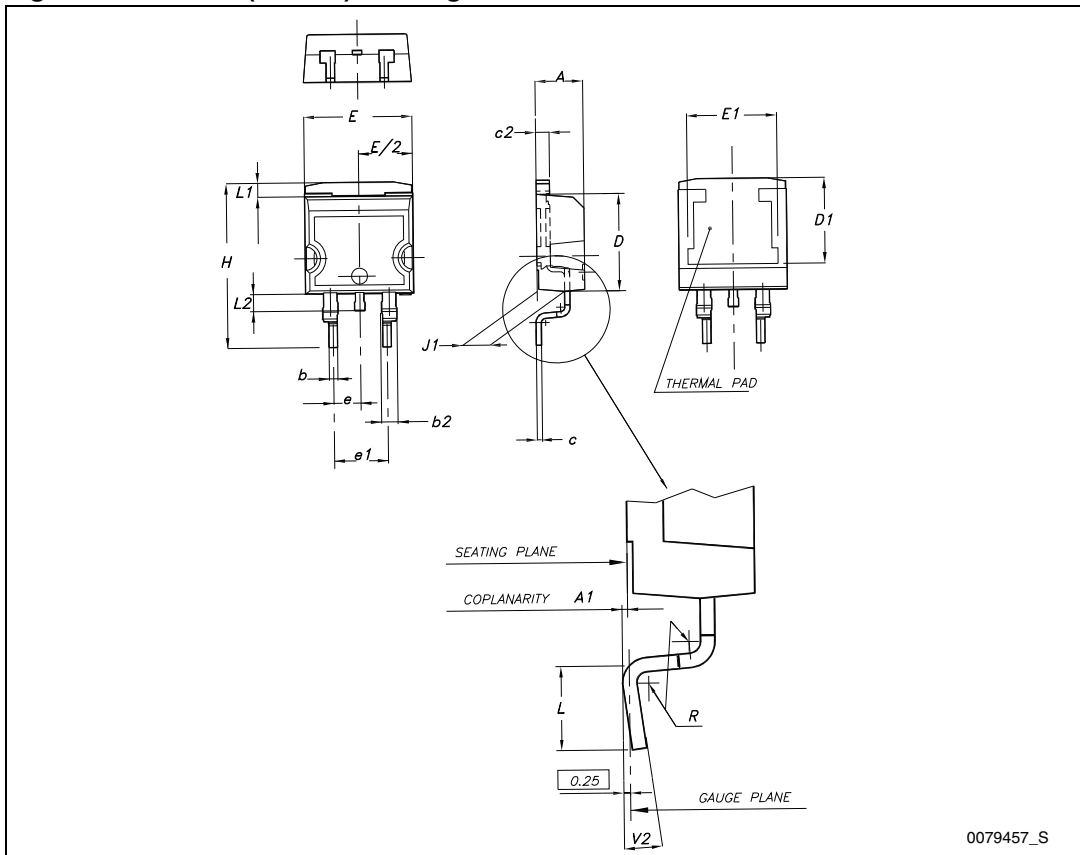


Figure 24. D<sup>2</sup>PAK footprint<sup>(a)</sup>



a. All dimension are in millimeters

Table 9. TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 25. TO-220FP drawing

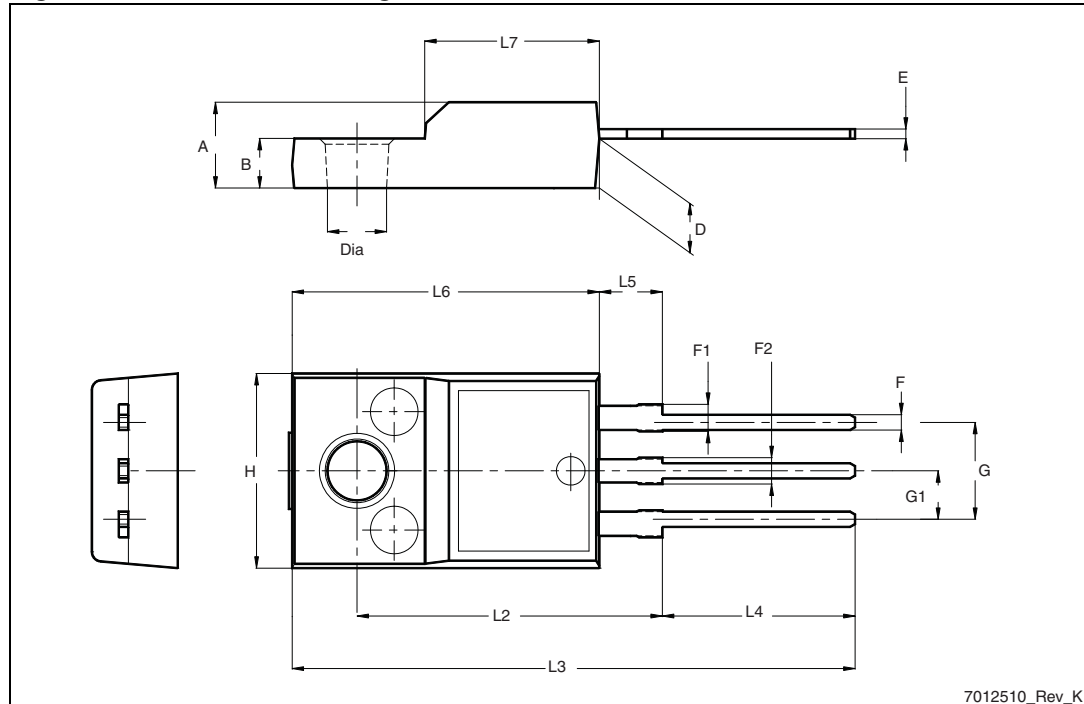
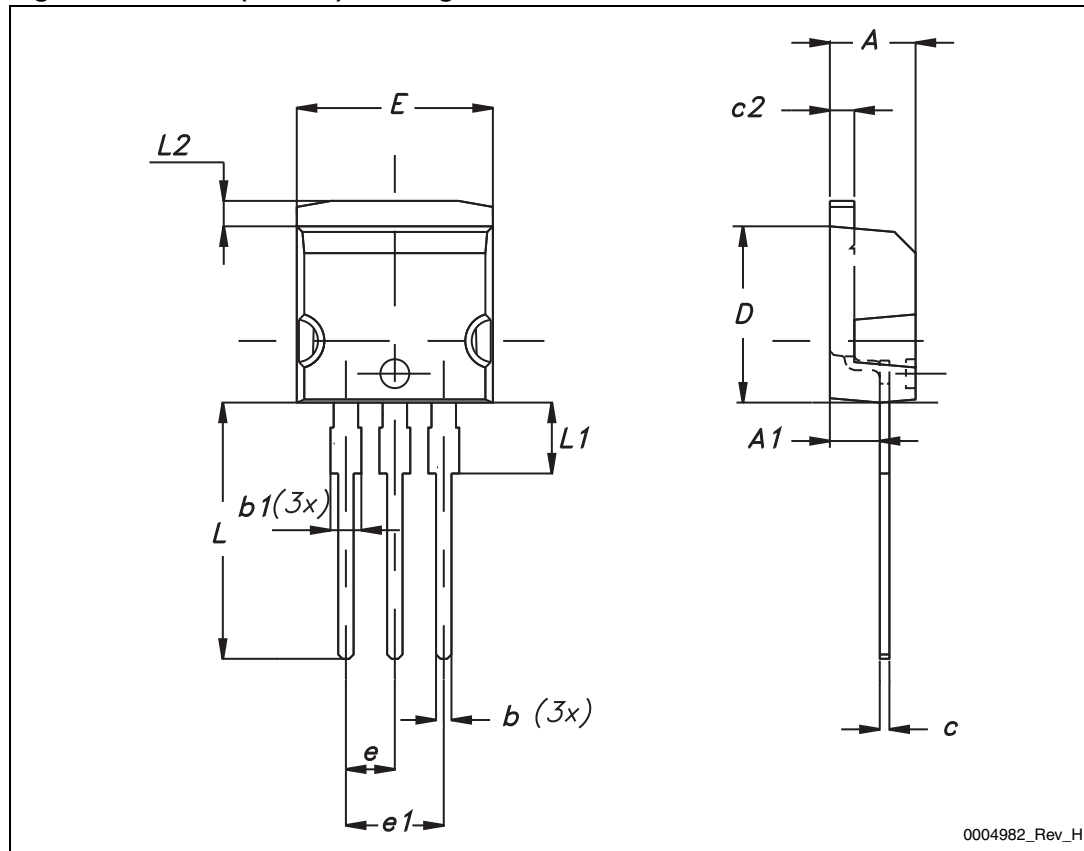


Table 10. I<sup>2</sup>PAK (TO-262) mechanical data

DIM.	mm.		
	min.	typ	max.
A	4.40		4.60
A1	2.40		2.72
b	0.61		0.88
b1	1.14		1.70
c	0.49		0.70
c2	1.23		1.32
D	8.95		9.35
e	2.40		2.70
e1	4.95		5.15
E	10		10.40
L	13		14
L1	3.50		3.93
L2	1.27		1.40

Figure 26. I<sup>2</sup>PAK (TO-262) drawing

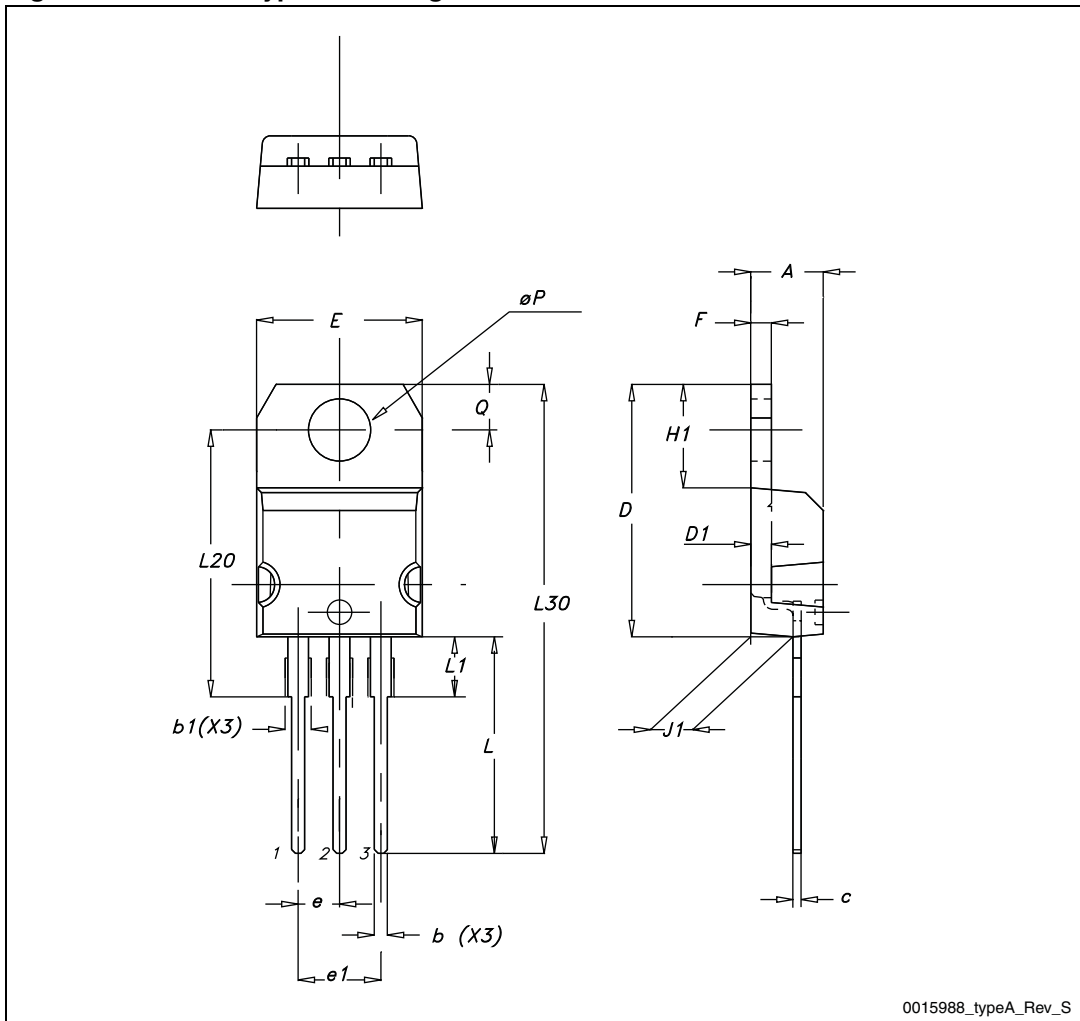


0004982\_Rev\_H

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

Figure 27. TO-220 type A drawing



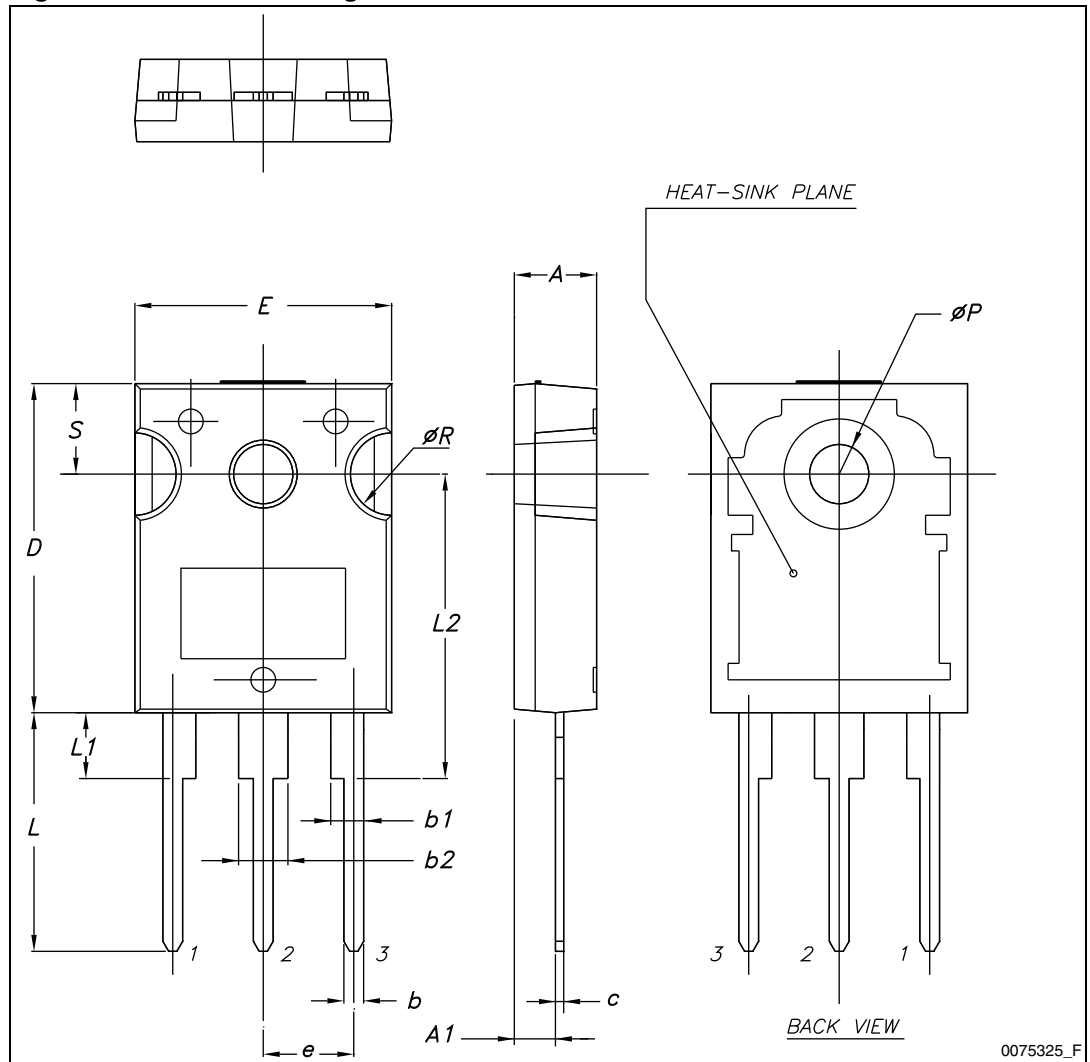
0015988\_typeA\_Rev\_S



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		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S		5.50	

Figure 28. TO-247 drawing



## 5 Packaging mechanical data

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			

Figure 29. Tape

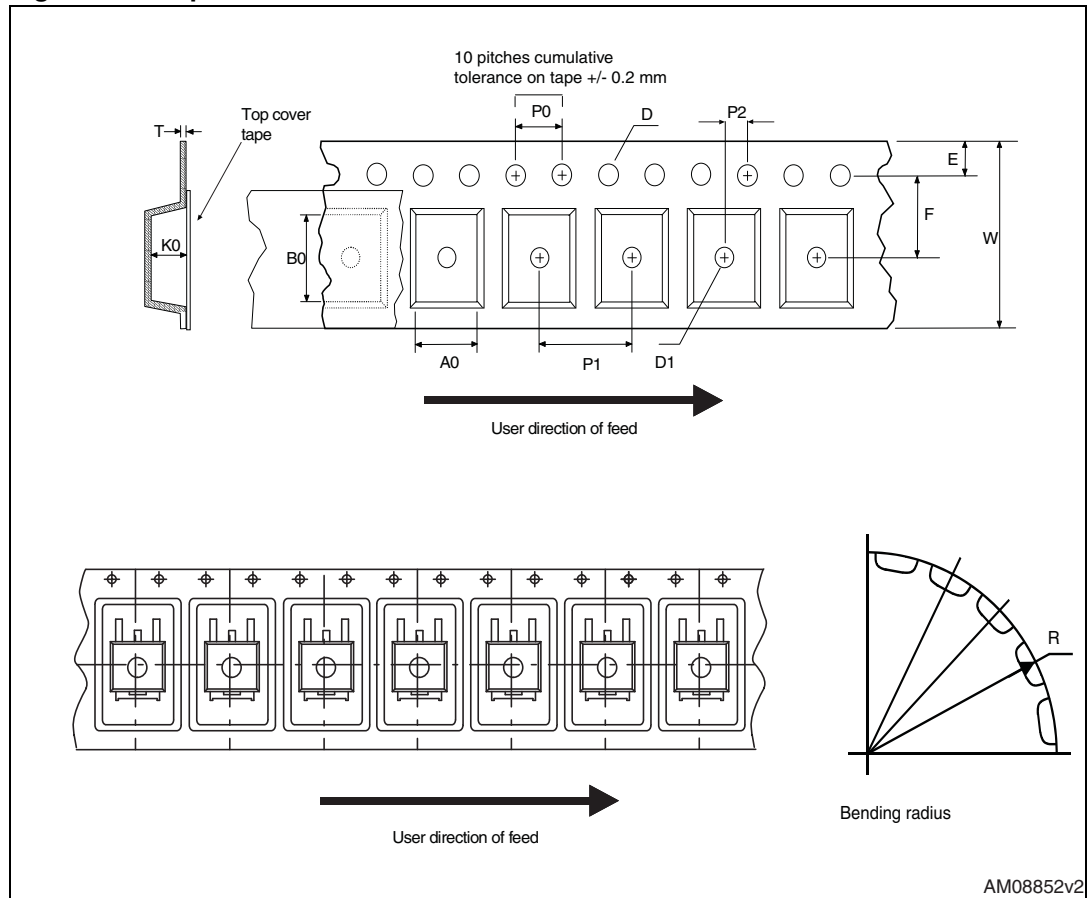
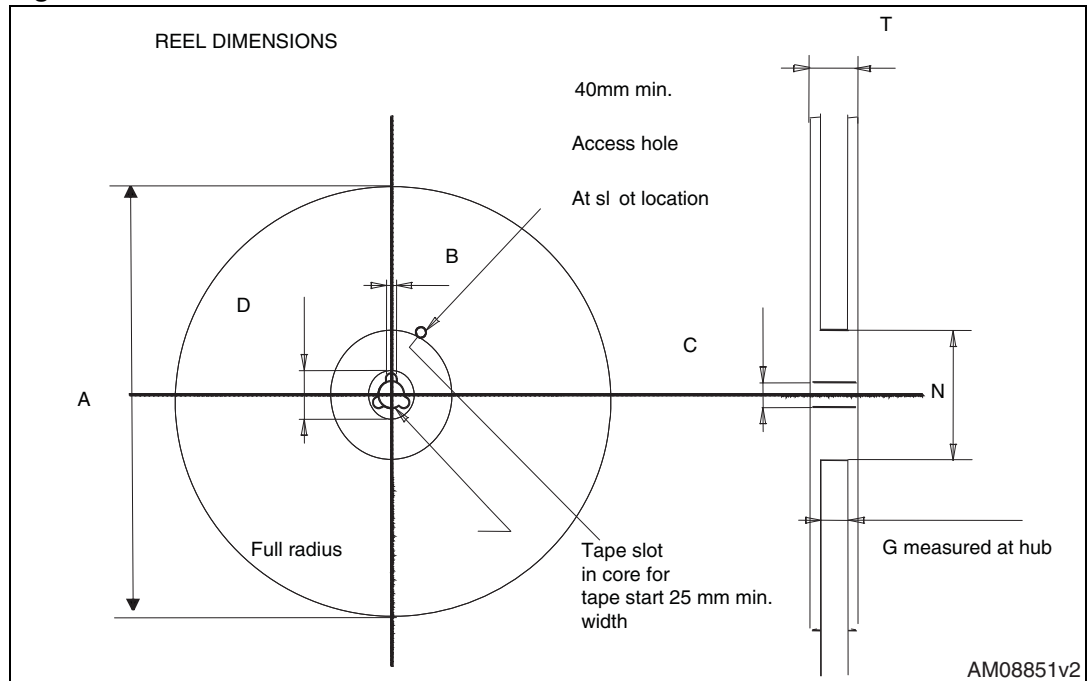


Figure 30. Reel



## 6 Revision history

Table 14. Document revision history

Date	Revision	Changes
30-Sep-2004	4	Preliminary version
26-Nov-2005	5	Complete version
07-Apr-2006	6	Modified value on <a href="#">Figure 8</a>
15-May-2006	7	New dv/dt value on <a href="#">Table 5</a>
20-Jul-2006	8	The document has been reformatted
20-Dec-2007	9	Updated I <sub>D</sub> value on <a href="#">Table 2: Absolute maximum ratings</a>
24-Mar-2010	10	Inserted dv/dt value in <a href="#">Table 2: Absolute maximum ratings</a>
12-Sep-2011	11	Added new package and mechanical data : I <sup>2</sup> PAK Minor text changes

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