



# STP120NF10, STB120NF10 STF120NF10, STW120NF10

N-channel 100 V, 0.009  $\Omega$ , 110 A STripFET™ II Power MOSFET  
in TO-247, TO-220, D<sup>2</sup>PAK, TO-220FP

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on) max</sub>	I <sub>D</sub>
STW120NF10	100V	<0.0105 $\Omega$	110 A
STP120NF10			110 A
STB120NF10			110 A
STF120NF10			41 A

- Exceptional dv/dt capability
- 100% avalanche tested
- Application oriented characterization

## Application

- Switching applications

## Description

These devices are N-channel Power MOSFET realized with STMicroelectronics unique STripFET™ process has specifically been designed to minimize the on-resistance. It is therefore suitable as primary switch in advanced high-efficiency, high-frequency isolated DC-DC converters for telecom and computer application. It is also intended for any applications with low gate drive requirements.

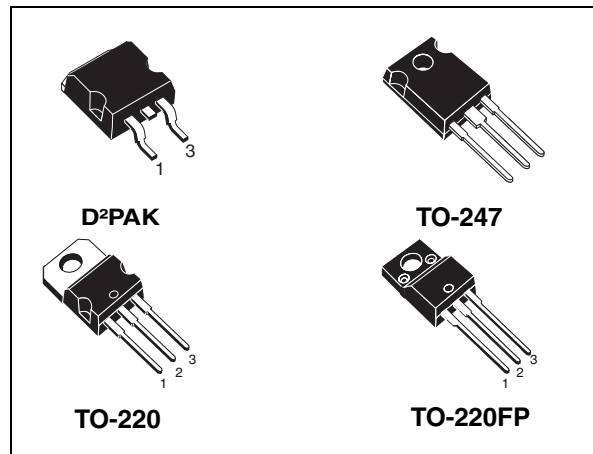


Figure 1. Internal schematic diagram

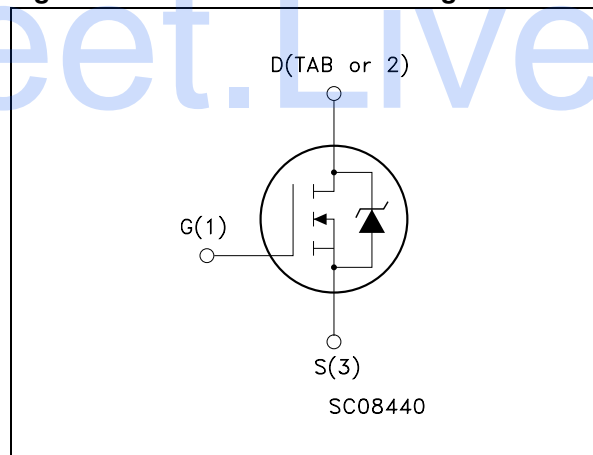


Table 1. Device summary

Order codes	Marking	Packages	Packaging
STB120NF10	B120NF10	D <sup>2</sup> PAK	Tape and reel
STF120NF10	120NF10	TO-220FP	Tube
STP120NF10	P120NF10	TO-220	
STW120NF10	W120NF10	TO-247	

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220, TO-247, D <sup>2</sup> PAK	TO-220FP	
V <sub>DS</sub>	Drain-source voltage (V <sub>GS</sub> = 0)	100		V
V <sub>GS</sub>	Gate-source voltage	± 20		V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	110	41 <sup>(1)</sup>	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	77	29 <sup>(1)</sup>	A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	440	164 <sup>(1)</sup>	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	312	45	W
	Derating factor	2.08	0.30	W/°C
dv/dt <sup>(3)</sup>	Peak diode recovery voltage slope	10		V/ns
E <sub>AS</sub> <sup>(4)</sup>	Single pulse avalanche energy	550		mJ
T <sub>J</sub> T <sub>stg</sub>	Operating junction temperature Storage temperature	-55 to 175		°C

- Limited only by maximum temperature allowed.
- Pulse width limited by safe operating area.
- I<sub>SD</sub> ≤ 120 A, di/dt ≤ 300 A/μs, V<sub>DD</sub> = 80%V<sub>(BR)DSS</sub>
- Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = 60 A, V<sub>DD</sub> = 50 V

**Table 3. Thermal resistance**

Symbol	Parameter	Value				Unit
		TO-220	TO-247	D <sup>2</sup> PAK	TO-220FP	
R <sub>thj-case</sub>	Thermal resistance junction-case max	0.48			3.33	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max	62.5			62.5	°C/W
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb max			35		°C/W
T <sub>L</sub>	Maximum lead temperature for soldering purpose	300			300	°C

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

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$	100			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ , $V_{DS} = \text{Max rating @ } 125\text{°C}$			1 10	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\ \text{V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$	2		4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{V}$ , $I_D = 60\ \text{A}$ <sup>(1)</sup>		0.009	0.0105	$\Omega$

1. For TO-220FP  $I_D = 40\ \text{A}$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}$ <sup>(1)</sup>	Forward transconductance	$V_{DS} = 25\ \text{V}$ , $I_D = 60\ \text{A}$	-	90		S
$C_{iss}$	Input capacitance	$V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$ , $V_{GS} = 0$	-	5200		pF
$C_{oss}$	Output capacitance					
$C_{rss}$	Reverse transfer capacitance					
$Q_g$	Total gate charge	$V_{DD} = 80\ \text{V}$ , $I_D = 120\ \text{A}$	-	172	233	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 10\ \text{V}$				
$Q_{gd}$	Gate-drain charge	<a href="#">(see Figure 16)</a>				

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

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
$t_{d(on)}$	Turn-on delay time	$V_{DD}=50\text{ V}$ , $I_D=60\text{ A}$ , $R_G=4.7\ \Omega$ , $V_{GS}=10\text{ V}$ <i>(see Figure 15)</i>		25		ns	
$t_r$	Rise time			90		ns	
$t_{d(off)}$	Turn-off delay time			-	132	-	ns
$t_f$	Fall time				68		ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		110	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		440	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=120\text{ A}$ , $V_{GS}=0$	-		1.3	V
$t_{rr}$	Reverse recovery time	$I_{SD}=120\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD}=40\text{ V}$ , $T_j=150\text{ }^\circ\text{C}$ <i>(see Figure 20)</i>		152		ns
$Q_{rr}$	Reverse recovery charge			760		nC
$I_{RRM}$	Reverse recovery current				10	

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

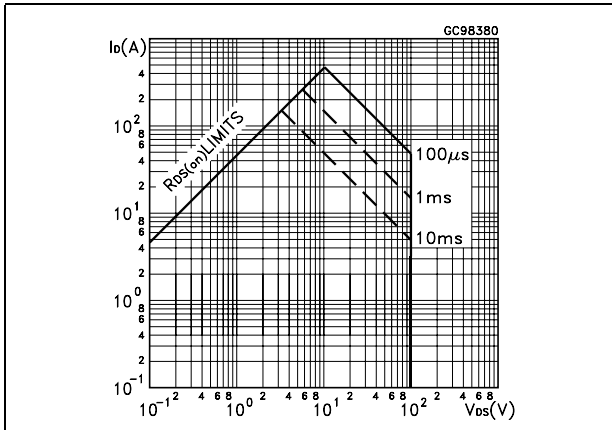


Figure 3. Thermal impedance

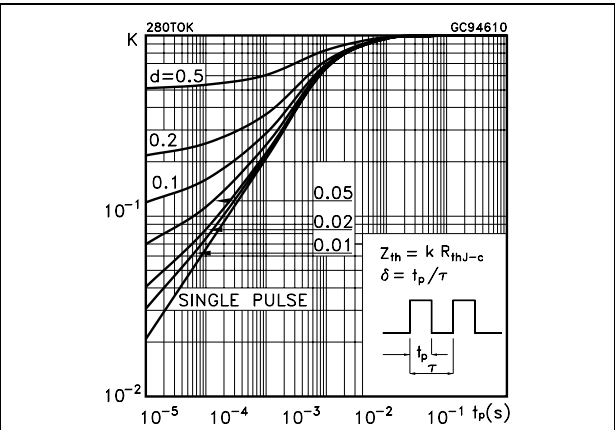


Figure 4. Safe operating area for TO-220FP

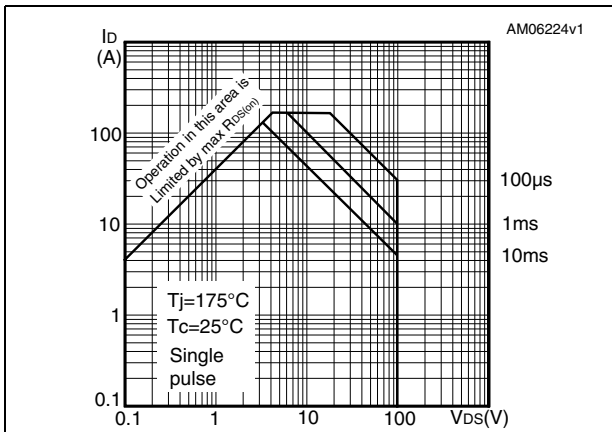


Figure 5. Thermal impedance for TO-220FP

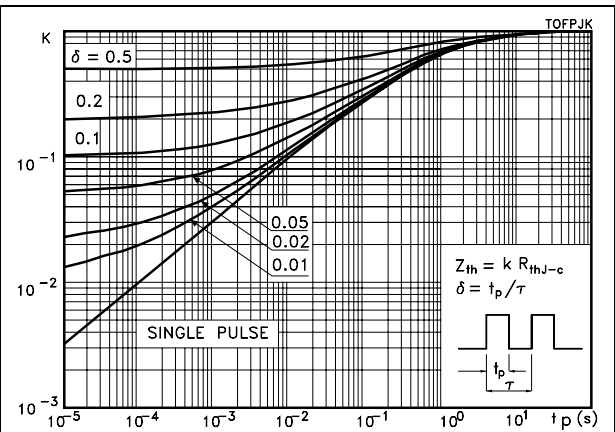


Figure 6. Output characteristics

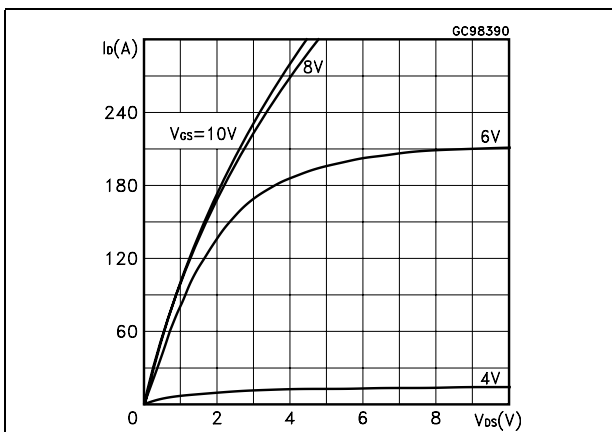


Figure 7. Transfer characteristics

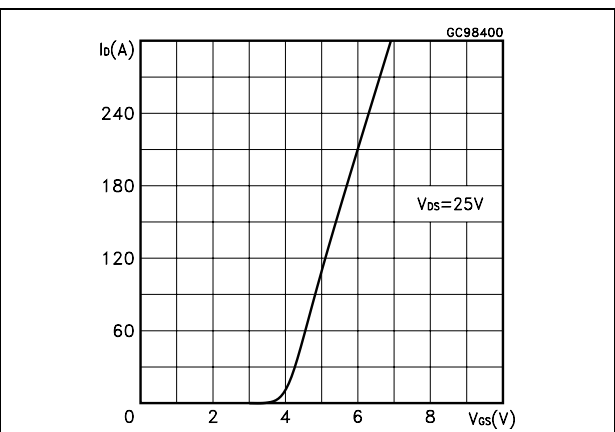


Figure 8. Normalized  $B_{VDSS}$  vs temperature

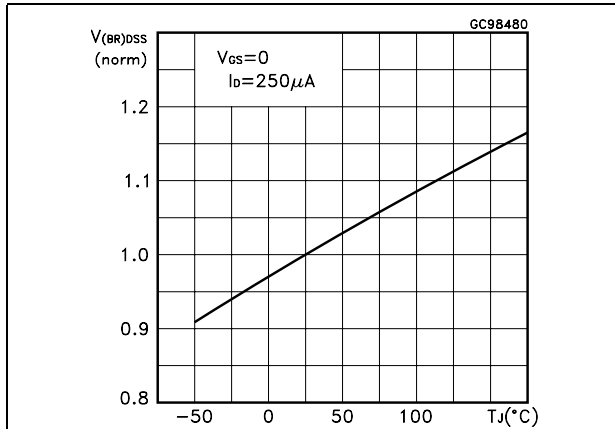


Figure 9. Static drain-source on resistance

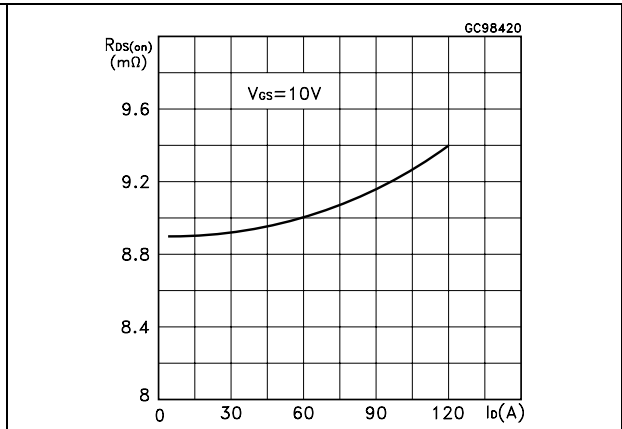


Figure 10. Gate charge vs gate-source voltage

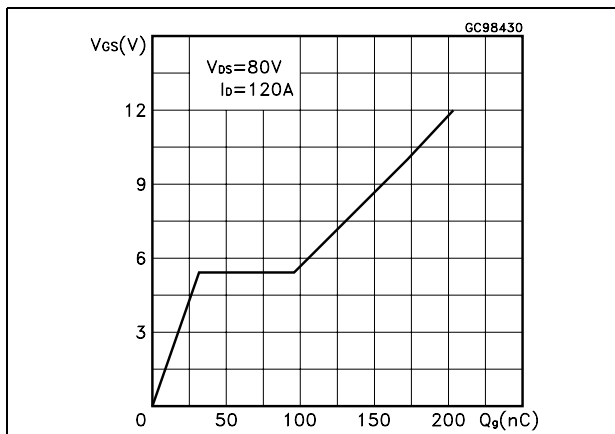


Figure 11. Capacitance variations

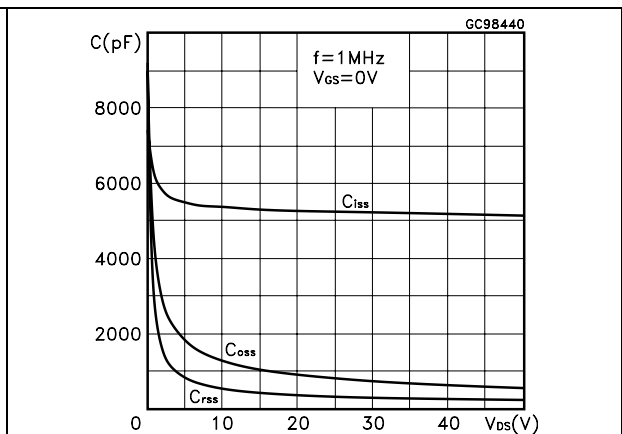


Figure 12. Normalized gate threshold voltage vs temperature

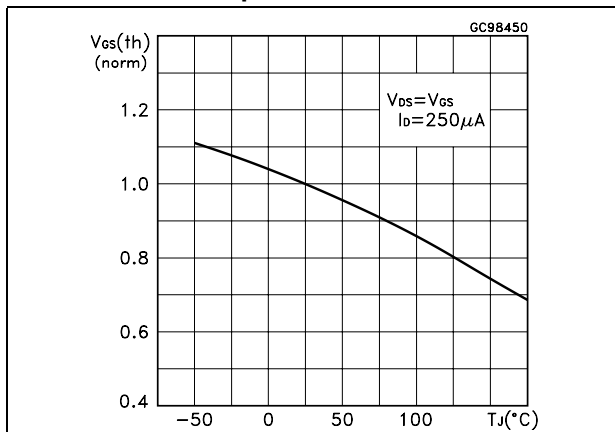


Figure 13. Normalized on resistance vs temperature

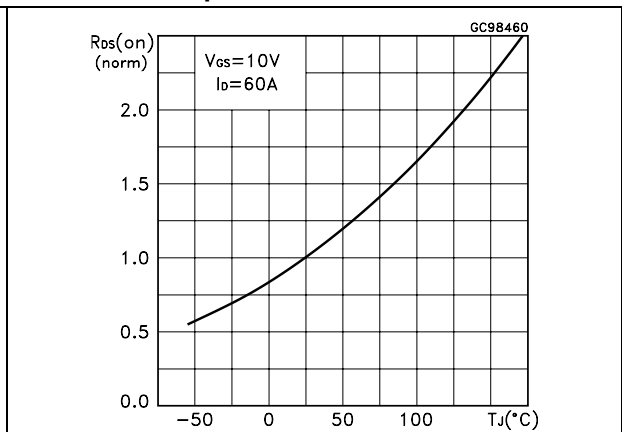
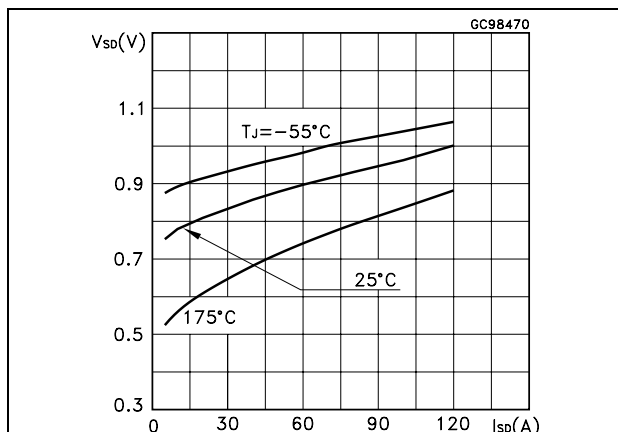


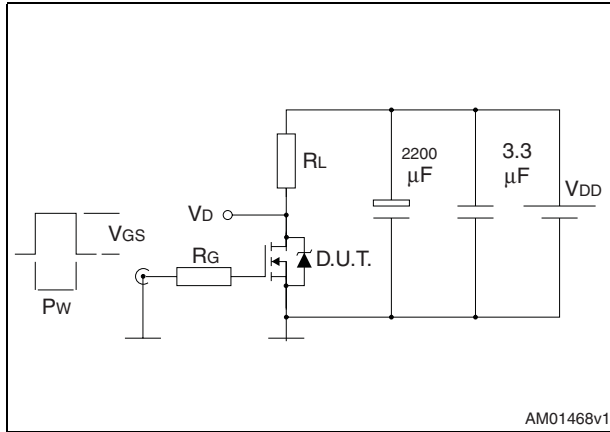
Figure 14. Source-drain diode forward characteristics



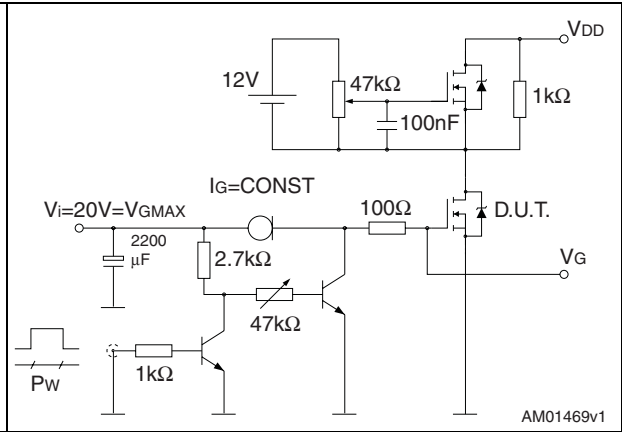


### 3 Test circuits

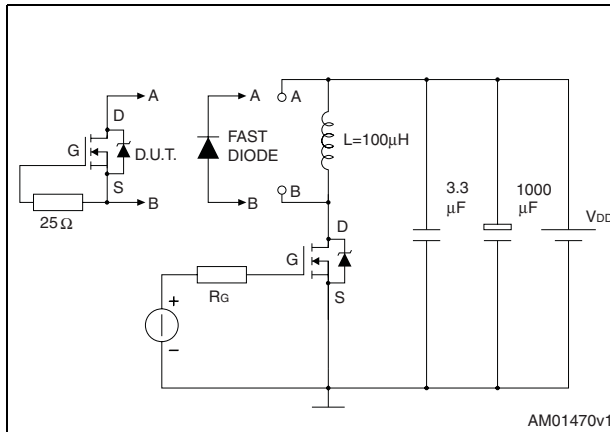
**Figure 15. Switching times test circuit for resistive load**



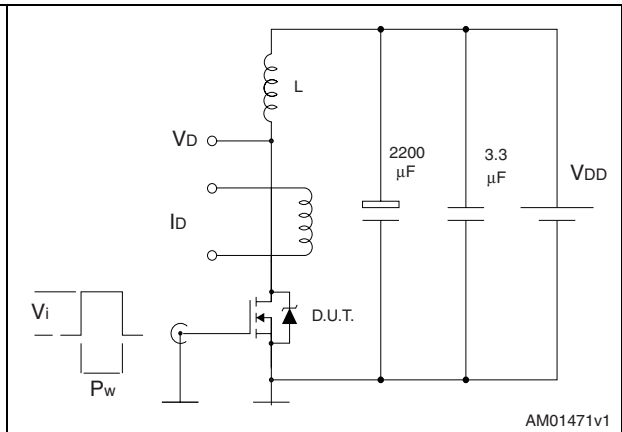
**Figure 16. Gate charge test circuit**



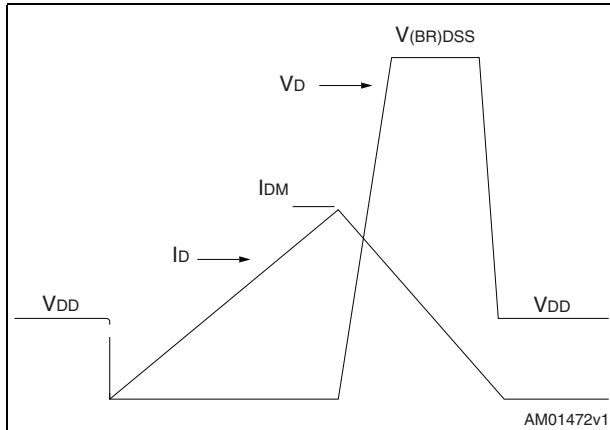
**Figure 17. Test circuit for inductive load switching and diode recovery times**



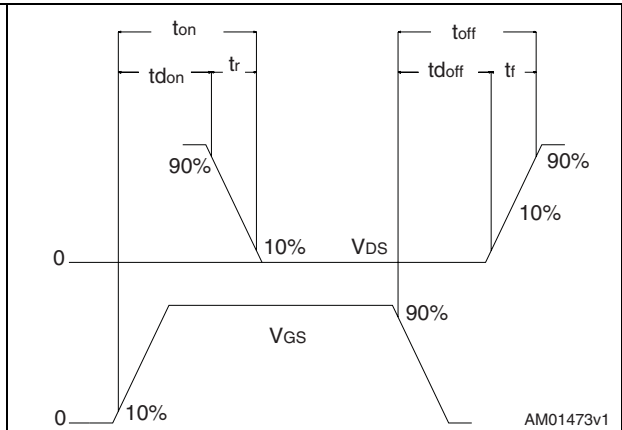
**Figure 18. Unclamped inductive load test circuit**



**Figure 19. Unclamped inductive waveform**



**Figure 20. Switching time waveform**



## 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 is an ST trademark.

Table 8. 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 21. TO-220FP drawing

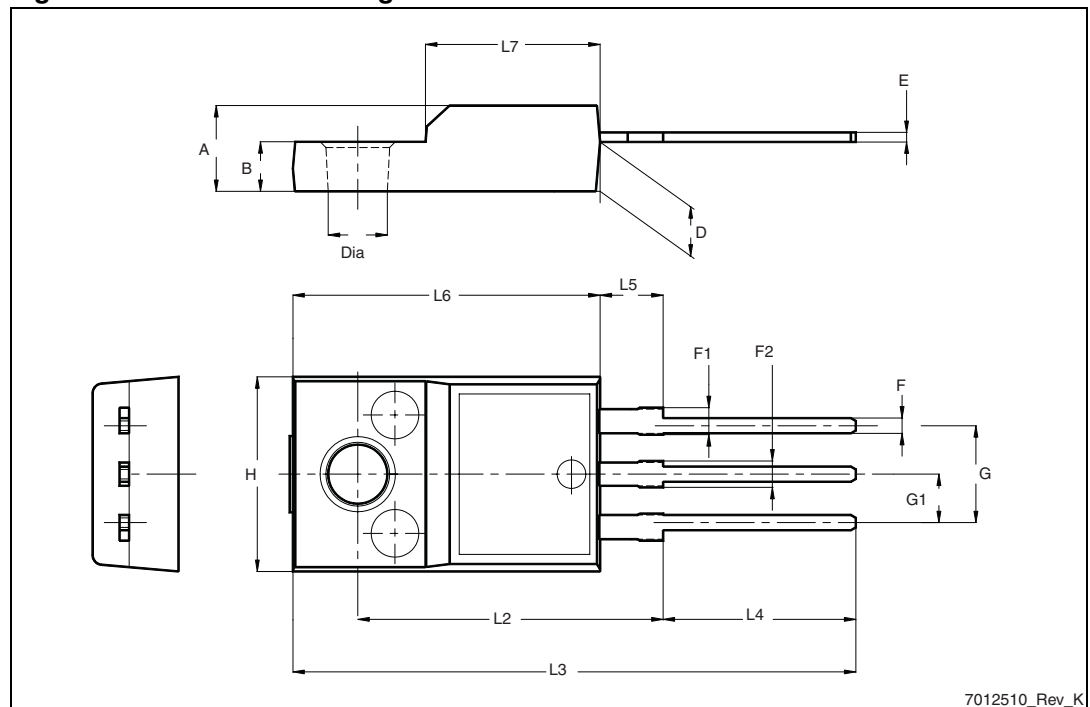


Table 9. D<sup>2</sup>PAK (TO-263) mechanical data

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 22. D<sup>2</sup>PAK (TO-263) drawing

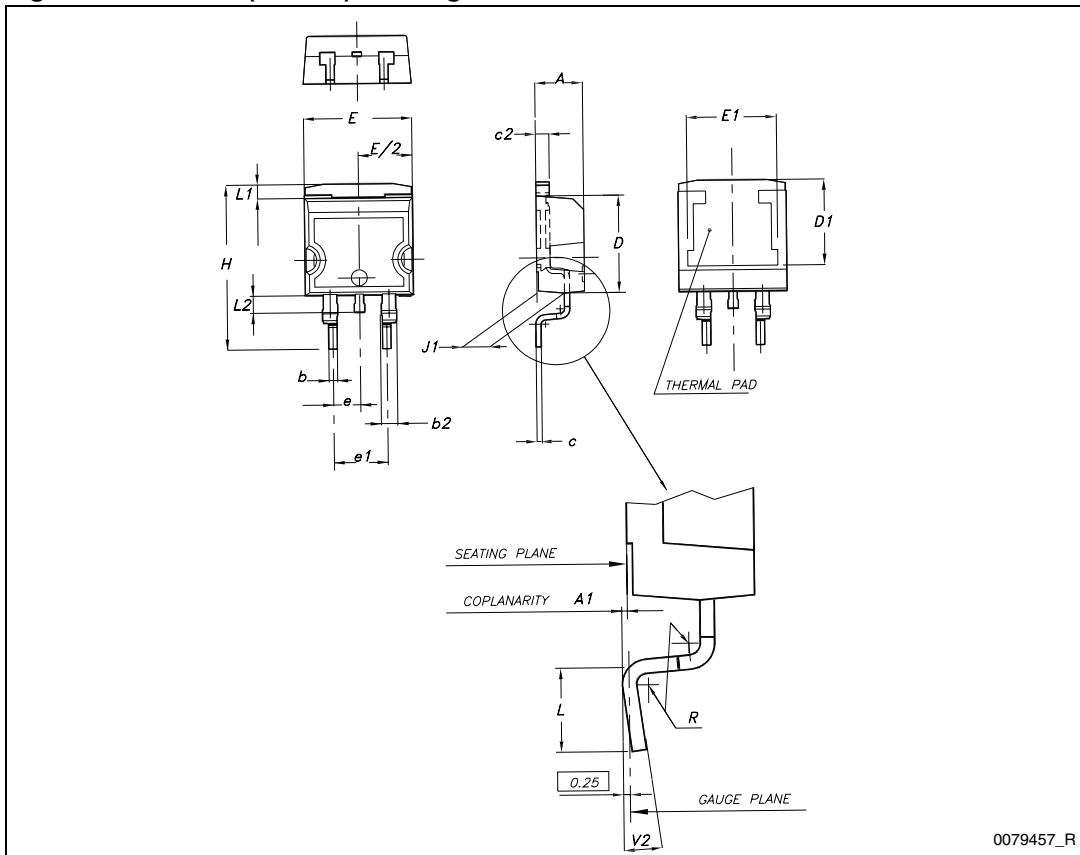
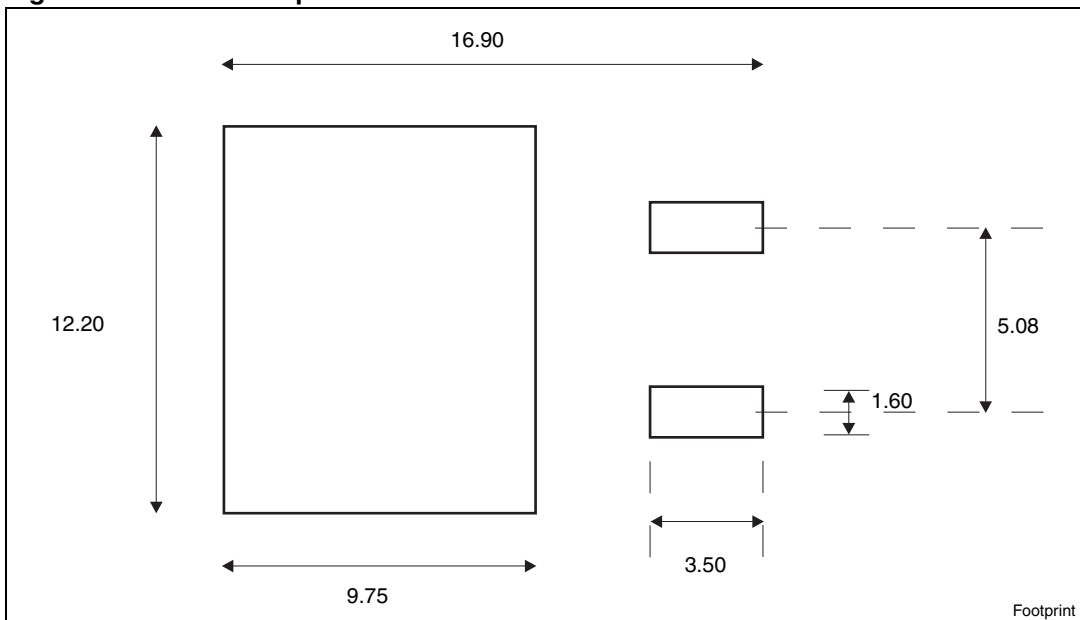


Figure 23. D<sup>2</sup>PAK footprint<sup>(a)</sup>



a. All dimension are in millimeters

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

Figure 24. TO-220 type A drawing

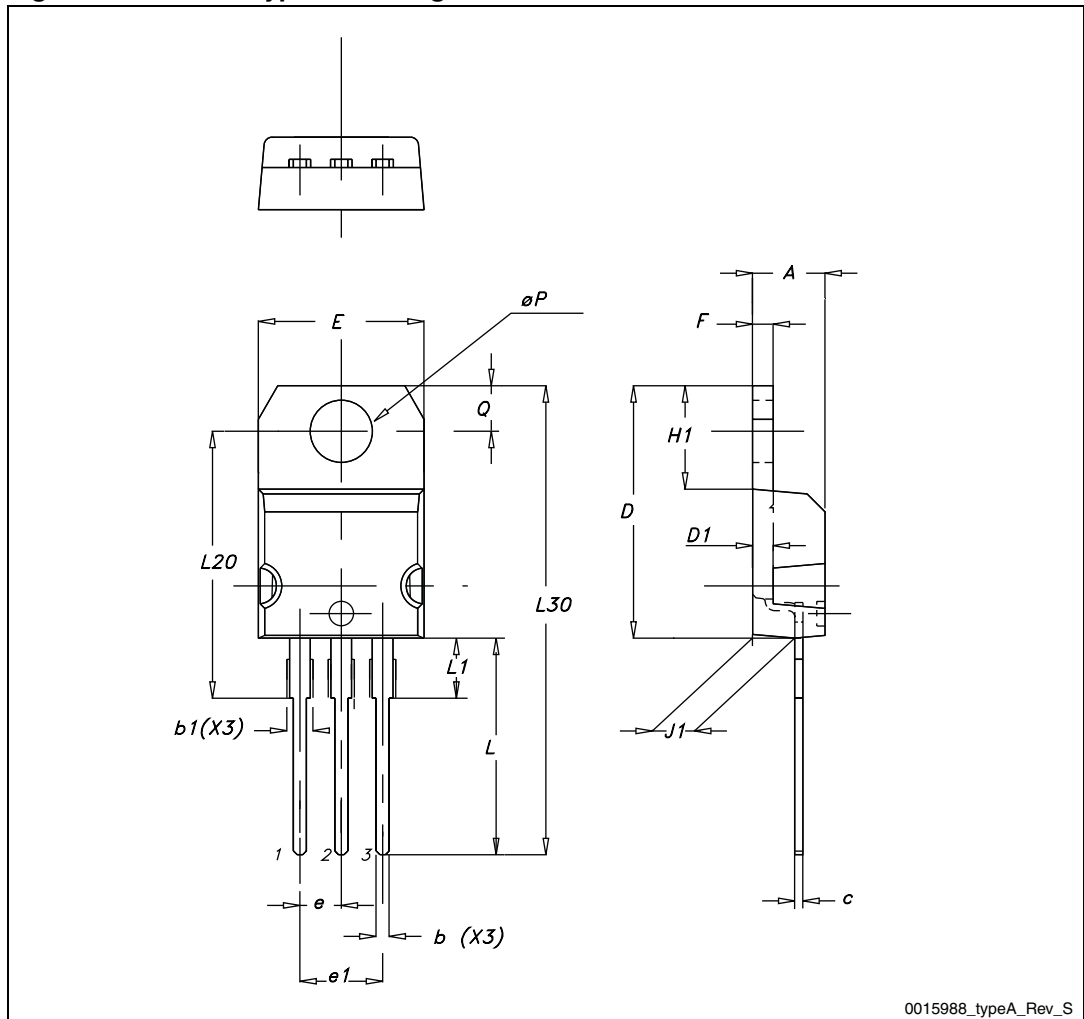
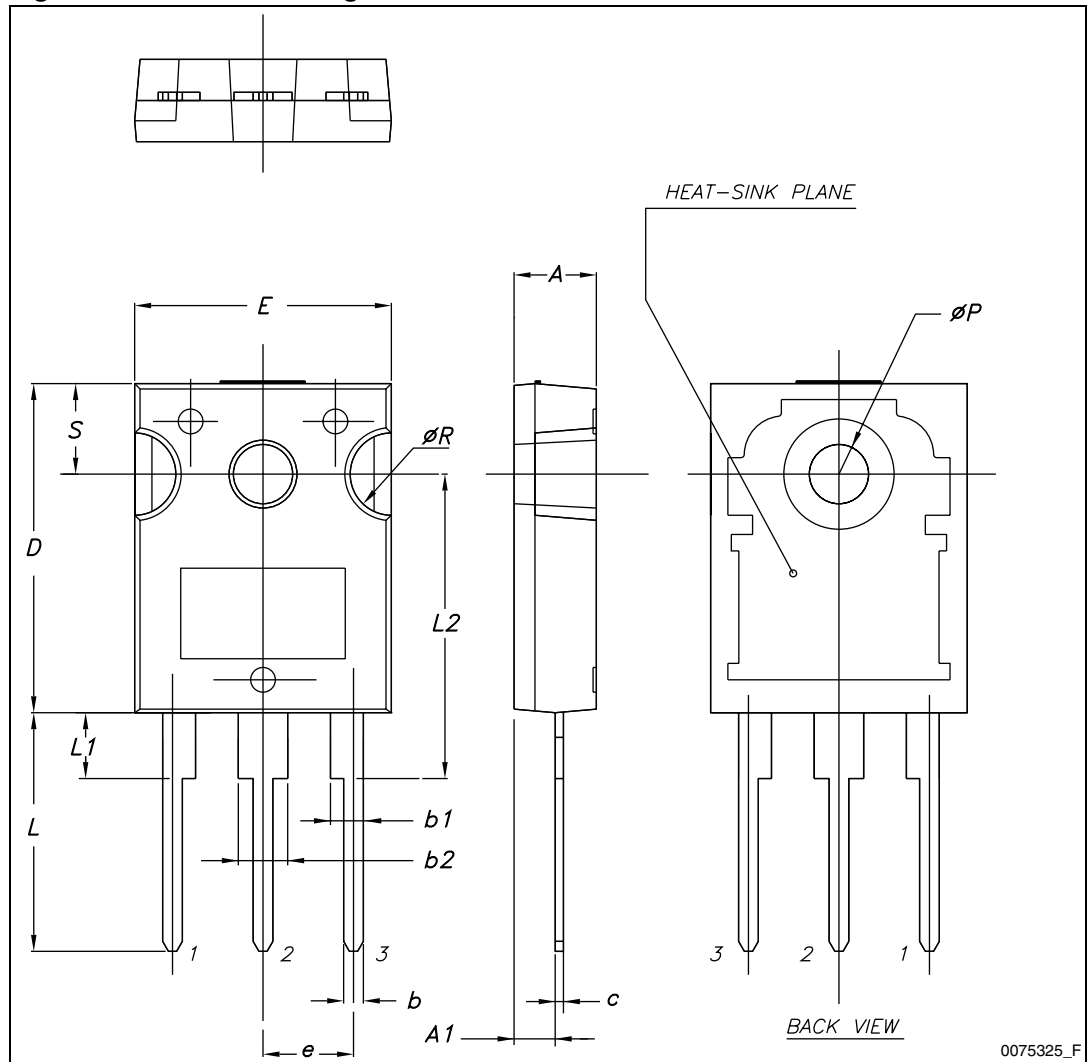


Table 11. TO-247 mechanical data

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 25. TO-247 drawing



0075325\_F

## 5 Packaging mechanical data

Table 12. 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 26. Tape

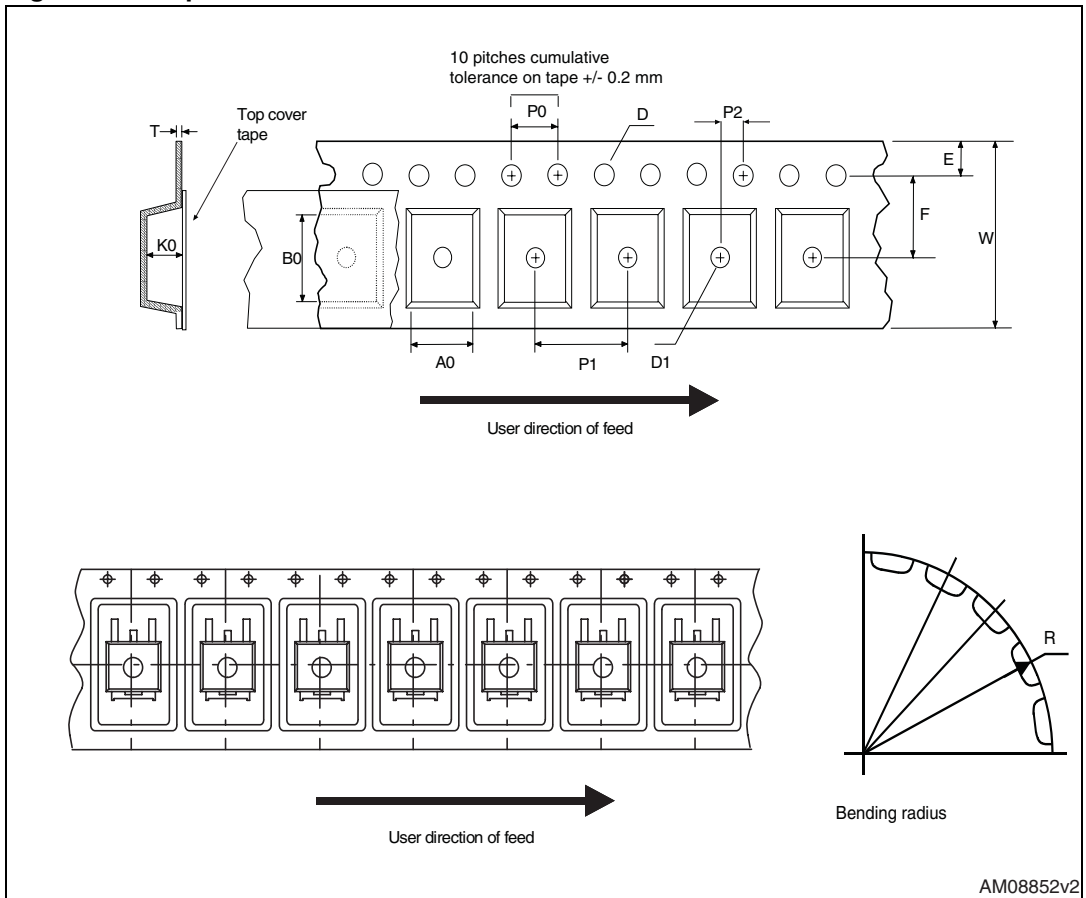
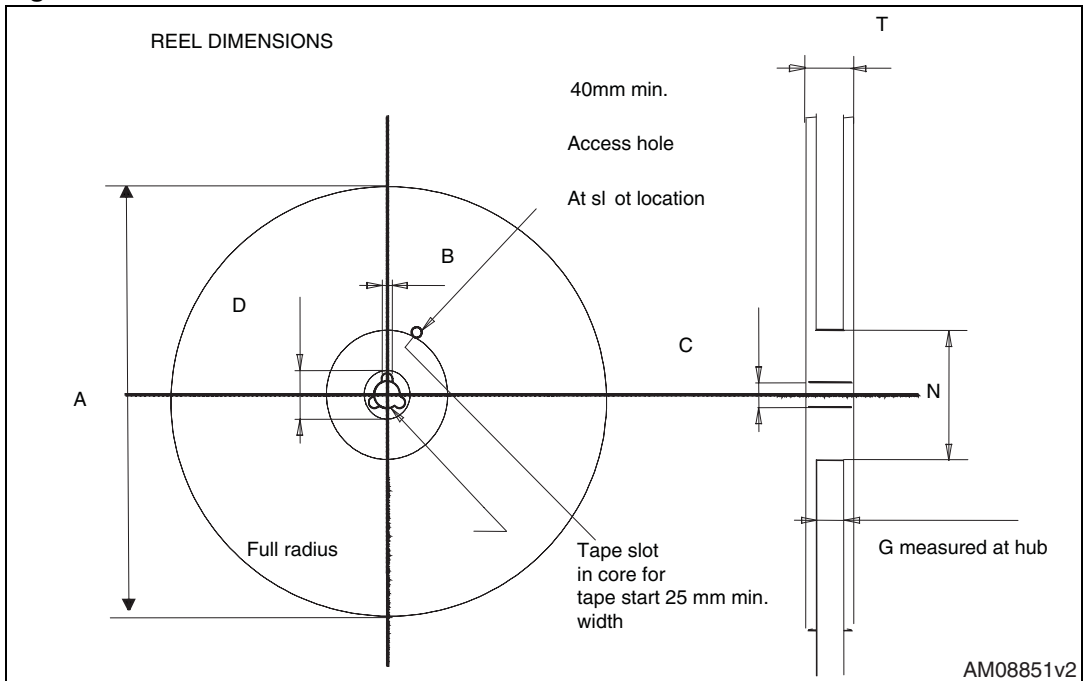


Figure 27. Reel



## 6 Revision history

**Table 13. Revision history**

Date	Revision	Changes
20-Mar-2006	2	Preliminary datasheet
31-Mar-2006	3	Typing error
19-Jun-2006	4	New template, no content change
28-Jun-2006	5	New $I_D$ value on <a href="#">Table 2</a>
05-Oct-2006	6	New value on <a href="#">Table 7</a>
11-May-2011	7	Added new package and mechanicala data: TO-220FP.

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