



THE DATASHEET OF STI26NM60N





STB26NM60N, STF26NM60N, STI26NM60N STP26NM60N, STW26NM60N

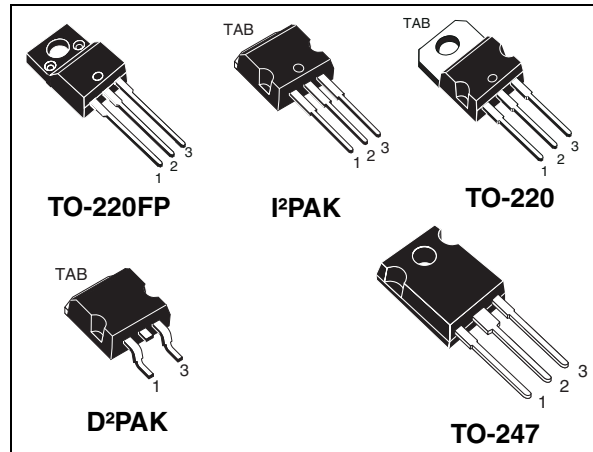
N-channel 600 V, 0.135 Ω typ., 20 A MDmesh™ II Power MOSFET
in D²PAK, I²PAK, TO-220, TO-220FP and TO-247 packages

Datasheet — production data

Features

Type	V _{DSS}	R _{DS(on) max}	I _D
STB26NM60N	600 V	< 0.165 Ω	20 A
STF26NM60N	600 V	< 0.165 Ω	20 A
STI26NM60N	600 V	< 0.165 Ω	20 A
STP26NM60N	600 V	< 0.165 Ω	20 A
STW26NM60N	600 V	< 0.165 Ω	20 A

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance



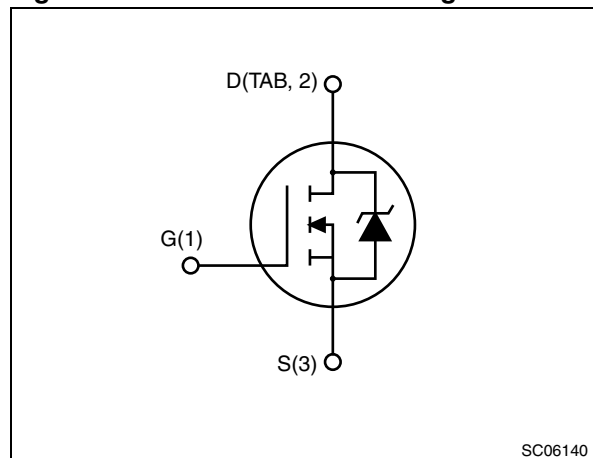
Application

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET applies a new vertical structure to the company's strip layout to yield a device with one of the world's lowest on-resistance and gate charge, making it suitable for the most demanding high-efficiency converters.

Figure 1. Internal schematic diagram



SC06140

Table 1. Device summary

Order codes	Marking	Package	Packaging
STB26NM60N	26NM60N	D ² PAK	Tape and reel
STF26NM60N		TO-220FP	Tube
STI26NM60N		I ² PAK	
STP26NM60N		TO-220	
STW26NM60N		TO-247	

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D ² PAK, I ² PAK, TO-220, TO-247	TO-220FP	
V _{DS}	Drain-source voltage	600		V
V _{GS}	Gate-source voltage	± 25		V
I _D	Drain current (continuous) at T _C = 25 °C	20	20 ⁽¹⁾	A
I _D	Drain current (continuous) at T _C = 100 °C	12.6	12.6 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	80	80 ⁽¹⁾	A
P _{TOT}	Total dissipation at T _C = 25 °C	140	35	W
	Derating factor	1.12	0.28	W/°C
dv/dt ⁽³⁾	Peak diode recovery voltage slope	15		V/ns
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T _C =25 °C)		2500	V
T _{stg}	Storage temperature	-55 to 150		°C
T _j	Max. operating junction temperature	150		°C

- Limited by maximum junction temperature.
- Pulse width limited by safe operating area.
- I_{SD} ≤ 20 A, di/dt ≤ 400 A/μs, V_{DSpeak} ≤ V_{(BR)DSS}, V_{DD} = 80% V_{(BR)DSS}

Table 3. Thermal data

Symbol	Parameter	Value					Unit
		TO-247	TO-220	I ² PAK	D ² PAK	TO-220FP	
R _{thj-case}	Thermal resistance junction-case max	0.89				3.6	°C/W
R _{thj-amb}	Thermal resistance junction-ambient max	50	62.5			62.5	°C/W
R _{thj-pcb} ⁽¹⁾	Thermal resistance junction-pcb max				30		°C/W

- When mounted on FR-4 board of 1inch², 2oz Cu, t < 10 sec.

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J max)	6	A
E_{AS}	Single pulse avalanche energy (starting $T_J=25\text{ °C}$, $I_D=I_{AS}$, $V_{DD}=50\text{ V}$)	610	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	$I_D = 1\text{ mA}, V_{GS} = 0$	600			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 600\text{ V}$ $V_{DS} = 600\text{ V}, T_C = 125\text{ °C}$			1 100	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			± 0.1	μA
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$		0.135	0.165	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0$	-	1800	-	pF
C_{oss}	Output capacitance			115		pF
C_{rss}	Reverse transfer capacitance			1.1		pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0, V_{DS} = 0\text{ to }480\text{ V}$	-	310	-	pF
Q_g	Total gate charge	$V_{DD} = 480\text{ V}, I_D = 20\text{ A},$ $V_{GS} = 10\text{ V},$ <i>(see Figure 19)</i>	-	60	-	nC
Q_{gs}	Gate-source charge			8.5		nC
Q_{gd}	Gate-drain charge			30		nC
R_g	Gate input resistance	$f=1\text{ MHz}$ Gate DC Bias=0 Test signal level = 20 mV open drain	-	2.8	-	Ω

1. $C_{oss\text{ eq.}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DS}

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}, I_D = 10\text{ A}$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ <i>(see Figure 18)</i>	-	13	-	ns
t_r	Rise time			25		ns
$t_{d(off)}$	Turn-off delay time			85		ns
t_f	Fall time			50		ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
I_{SD}	Source-drain current		-		20	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		80	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 20\text{ A}, V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 20\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$	-	370		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60\text{ V}$	-	5.8		μC
I_{RRM}	Reverse recovery current	(see Figure 20)	-	31.6		A
t_{rr}	Reverse recovery time	$I_{SD} = 20\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$	-	450		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60\text{ V}, T_j = 150\text{ }^\circ\text{C}$	-	7.5		μC
I_{RRM}	Reverse recovery current	(see Figure 20)	-	32.5		A

1. Pulse width limited by safe operating area
2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220, D²PAK and I²PAK

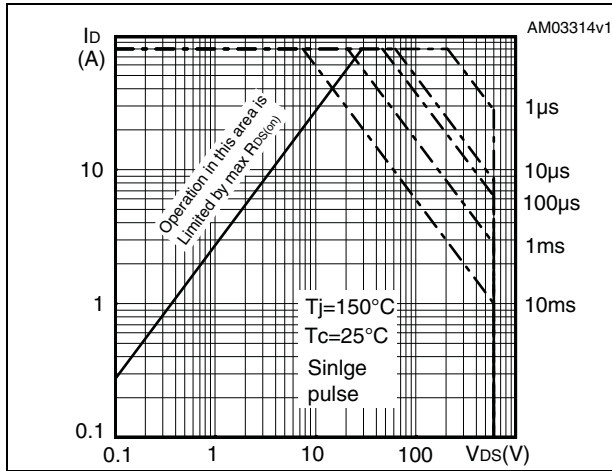


Figure 3. Thermal impedance for TO-220, D²PAK and I²PAK

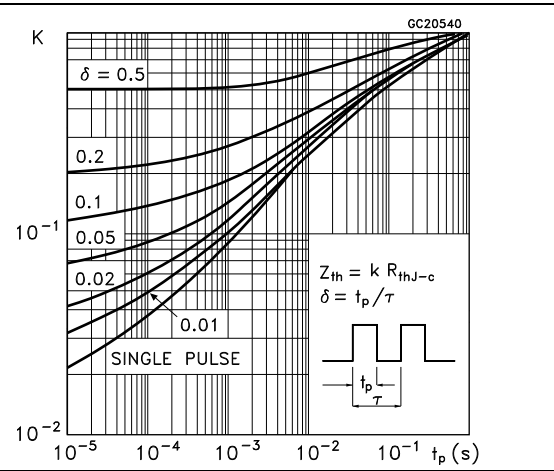


Figure 4. Safe operating area for TO-220FP

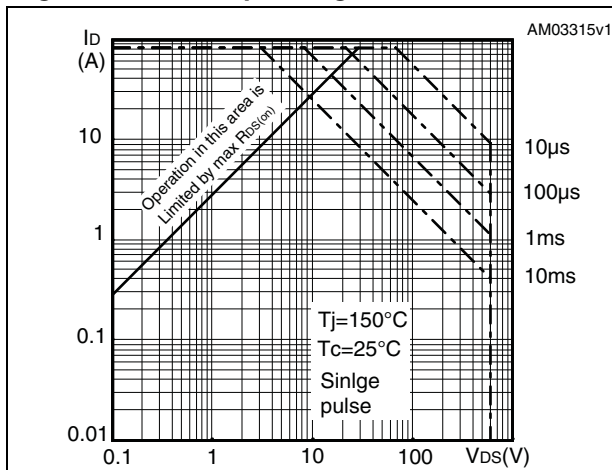


Figure 5. Thermal impedance for TO-220FP

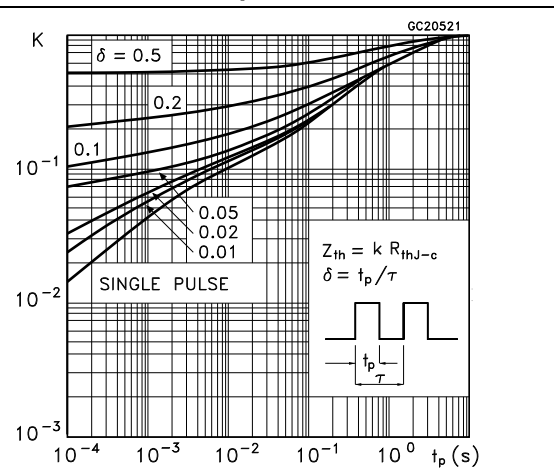


Figure 6. Safe operating area for TO-247

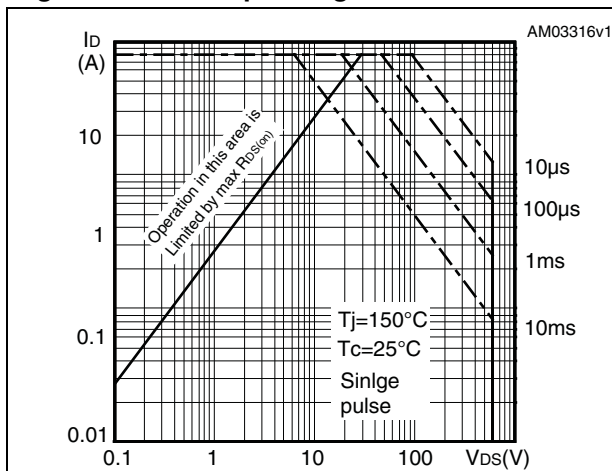


Figure 7. Thermal impedance for TO-247

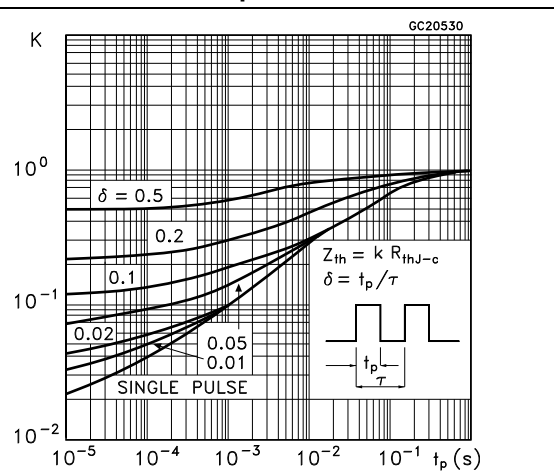


Figure 8. Output characteristics

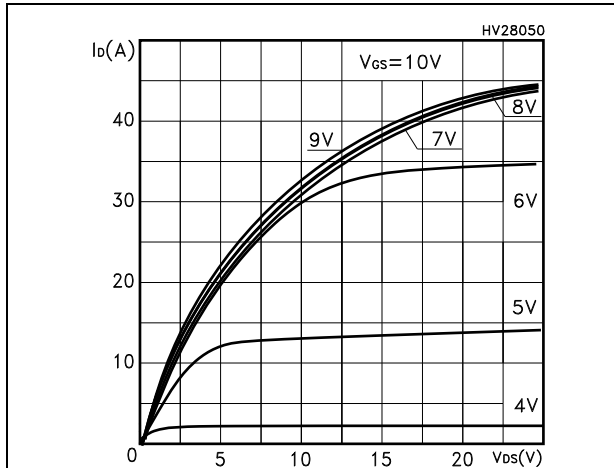


Figure 9. Transfer characteristics

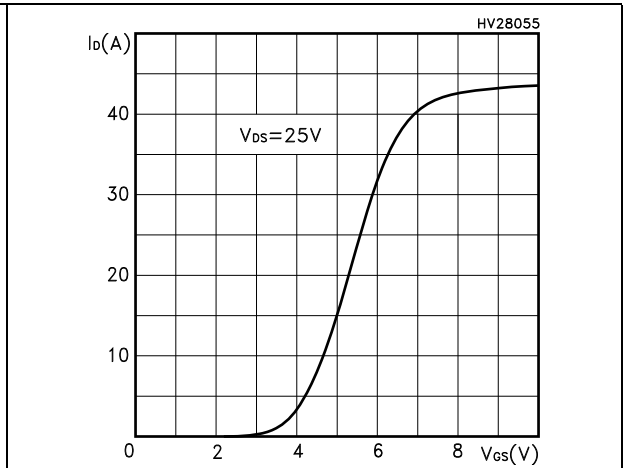


Figure 10. Transconductance

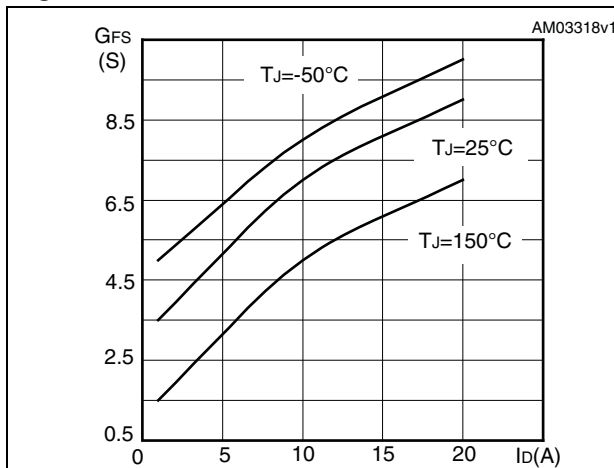


Figure 11. Static drain-source on-resistance

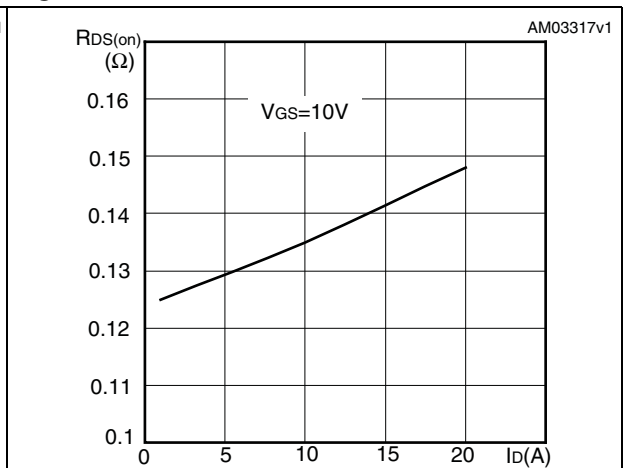


Figure 12. Gate charge vs gate-source voltage

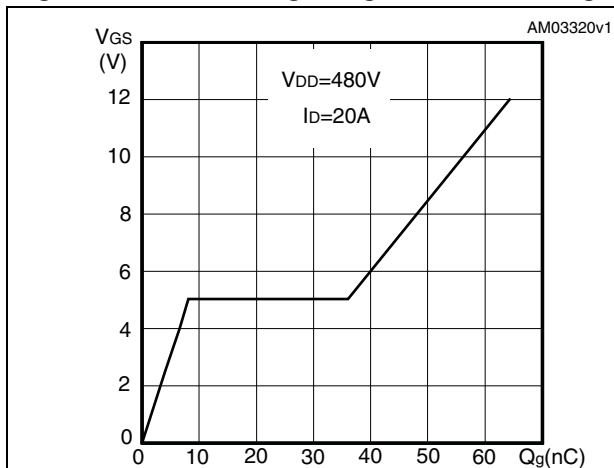


Figure 13. Capacitance variations

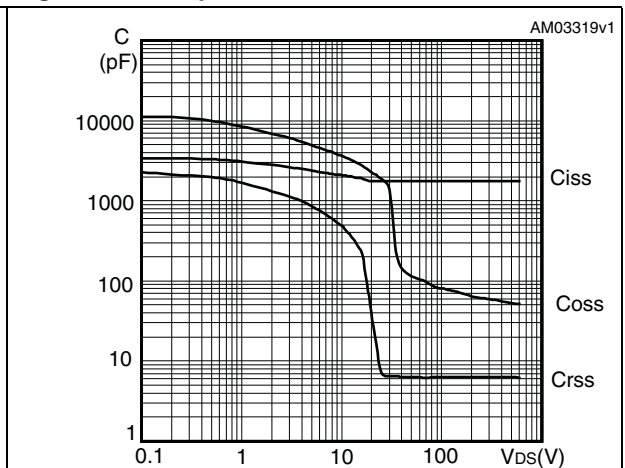


Figure 14. Normalized gate threshold voltage vs temperature

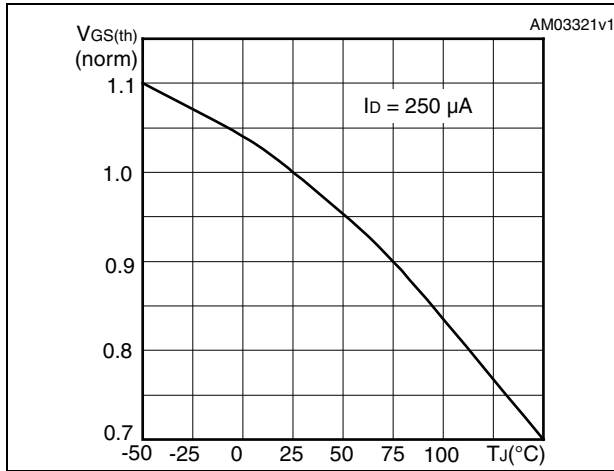


Figure 15. Normalized on resistance vs temperature

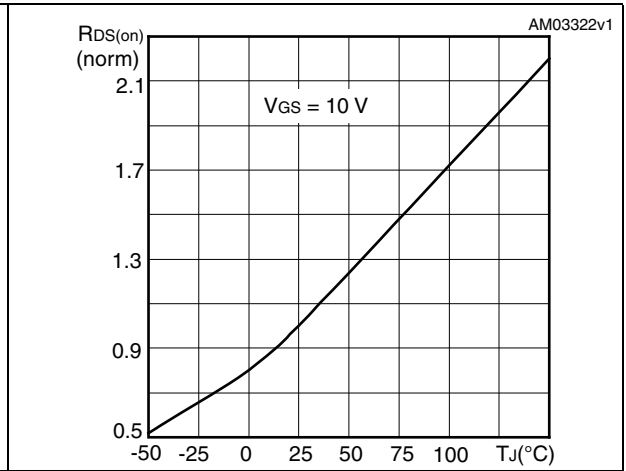


Figure 16. Source-drain diode forward characteristics

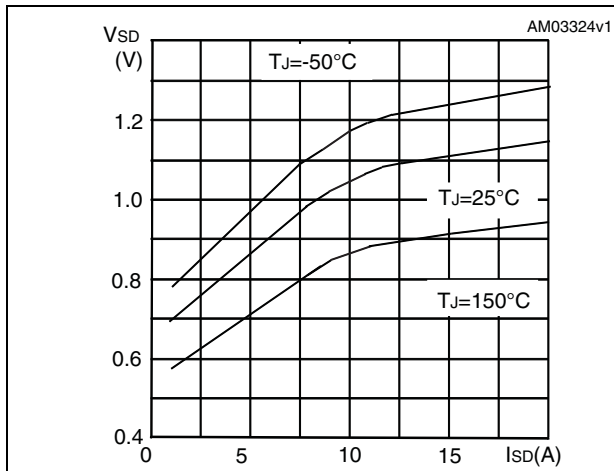
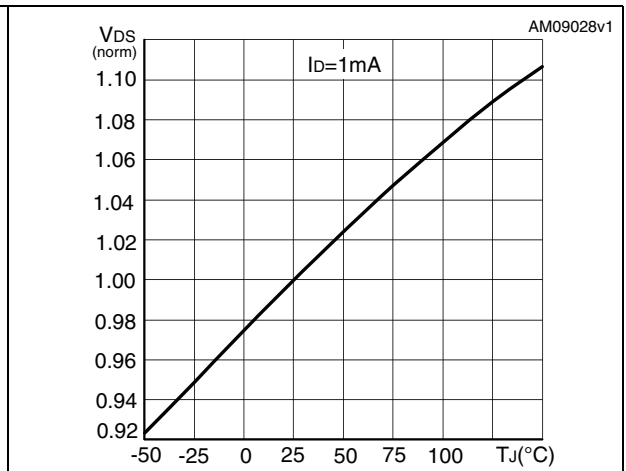
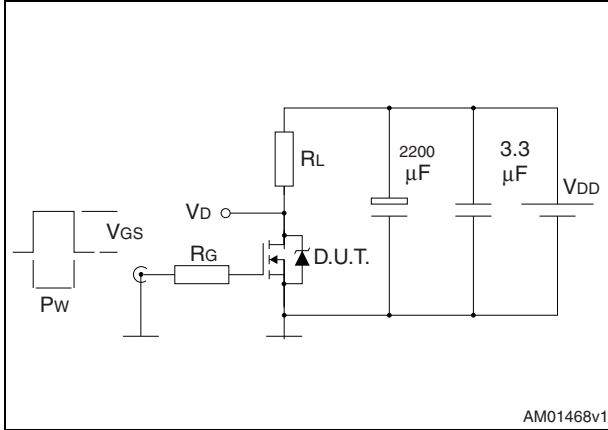


Figure 17. Normalized B_{VDSS} vs temperature



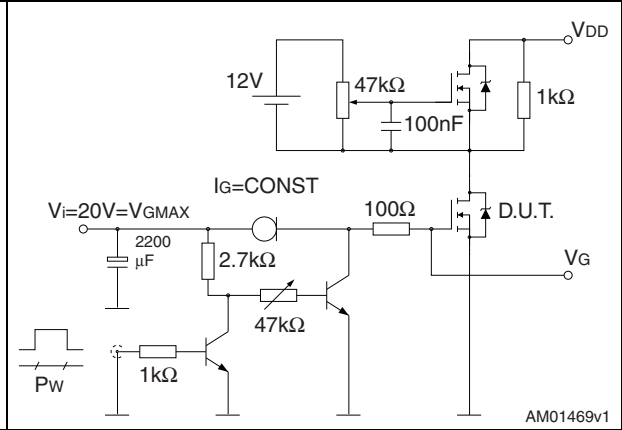
3 Test circuits

Figure 18. Switching times test circuit for resistive load



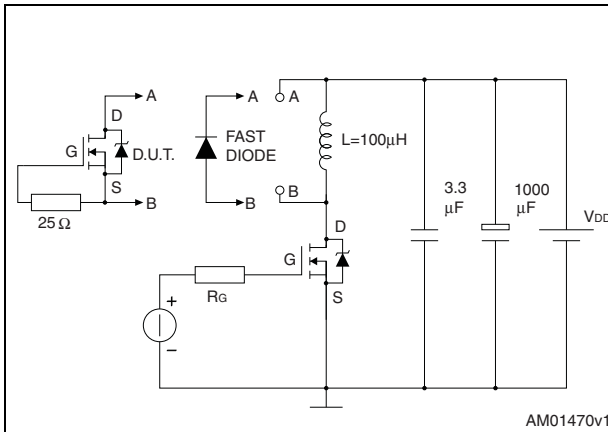
AM01468v1

Figure 19. Gate charge test circuit



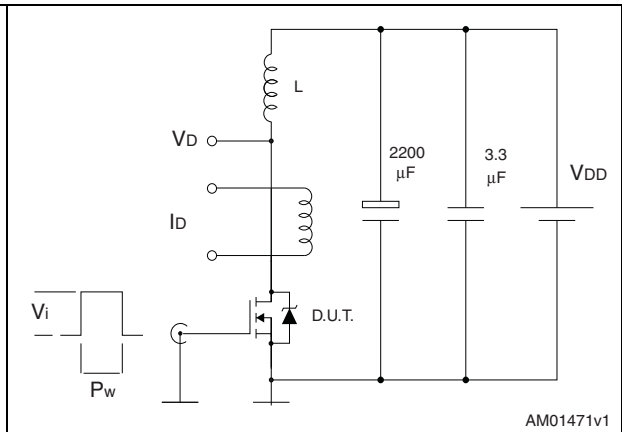
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Figure 20. Test circuit for inductive load switching and diode recovery times



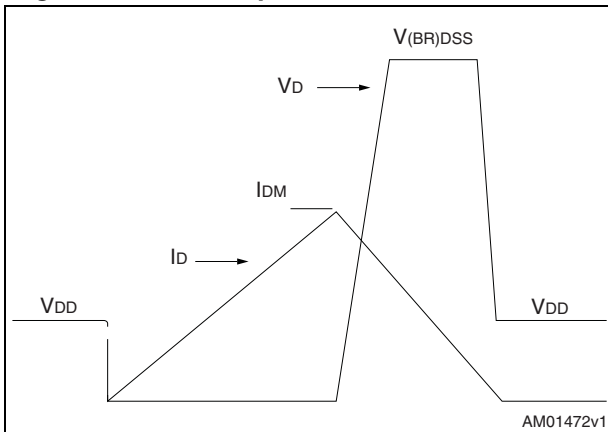
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Figure 21. Unclamped inductive load test circuit



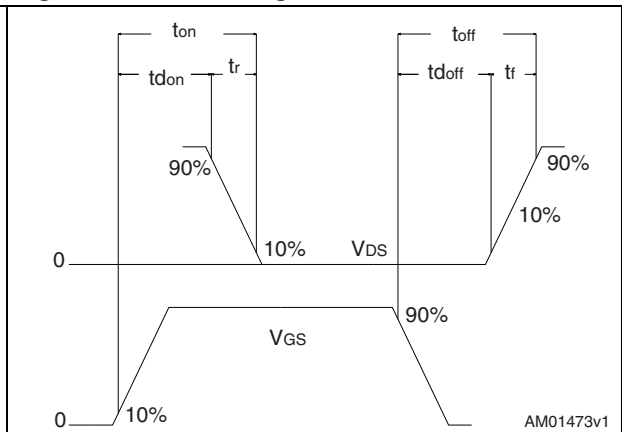
AM01471v1

Figure 22. Unclamped inductive waveform



AM01472v1

Figure 23. 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. ECOPACK is an ST trademark.

Table 9. D²PAK (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 24. D²PAK (TO-263) drawing

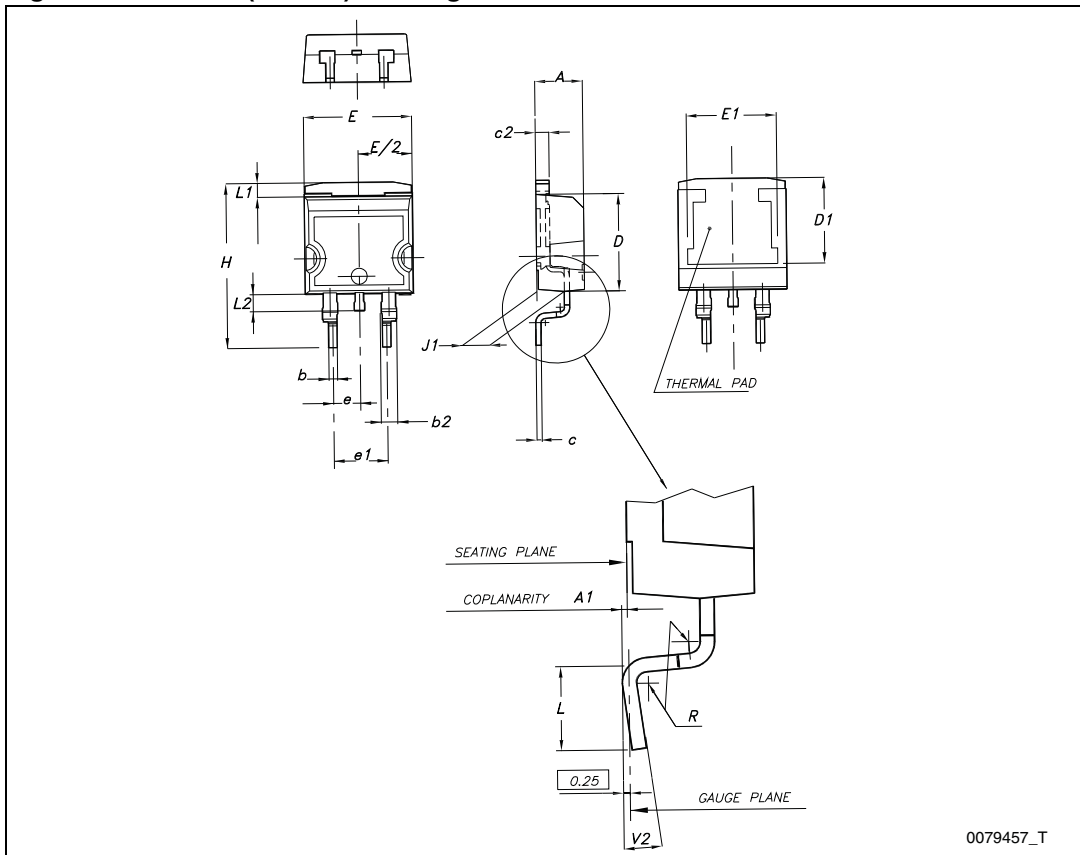
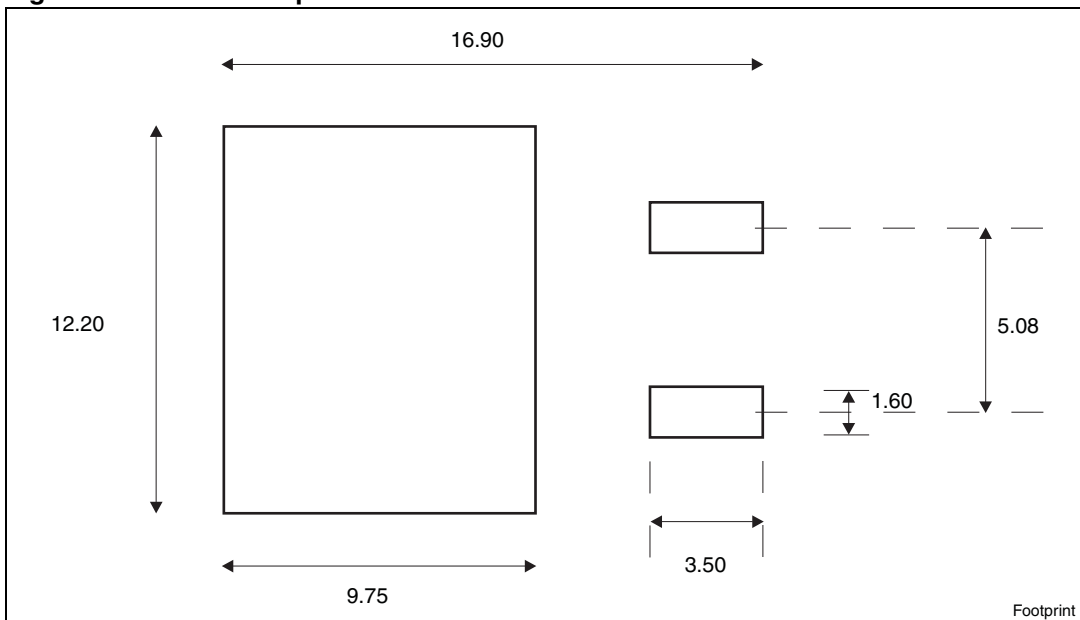


Figure 25. D²PAK footprint^(a)



a. All dimension are in millimeters

Table 10. I²PAK (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. I²PAK (TO-262) drawing

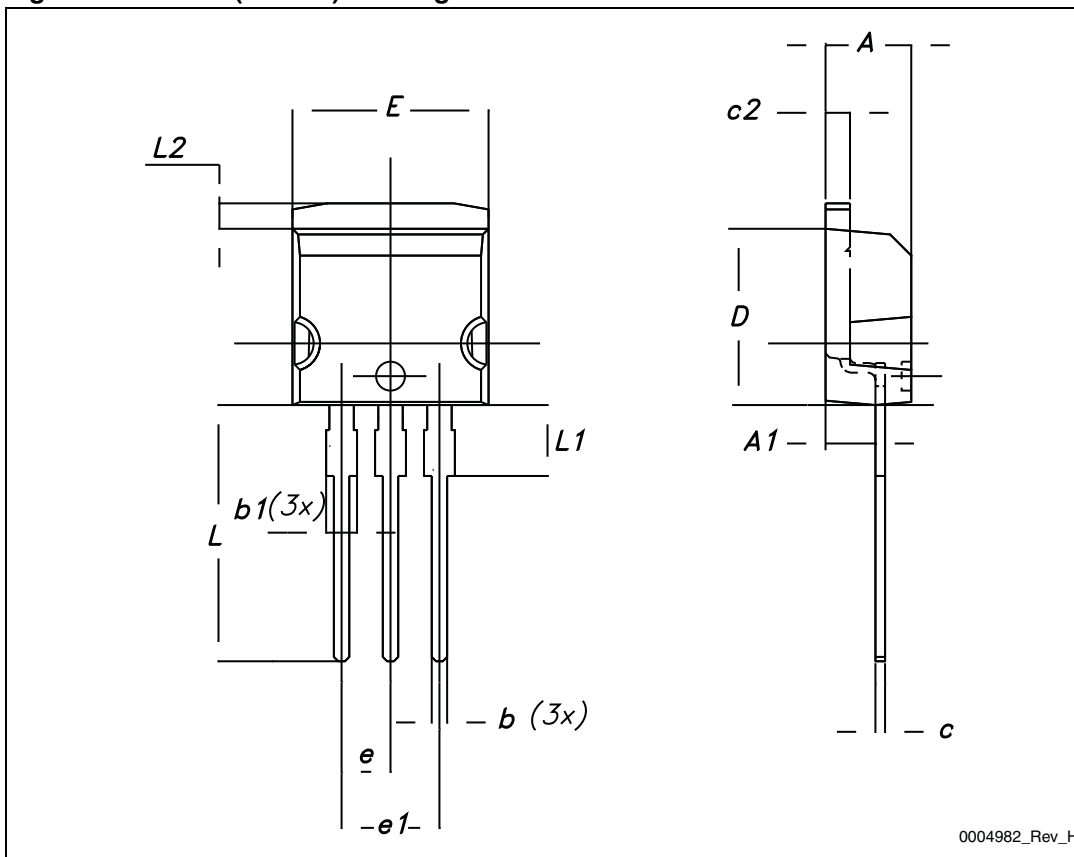


Table 11. TO-220 type A mechanical data

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

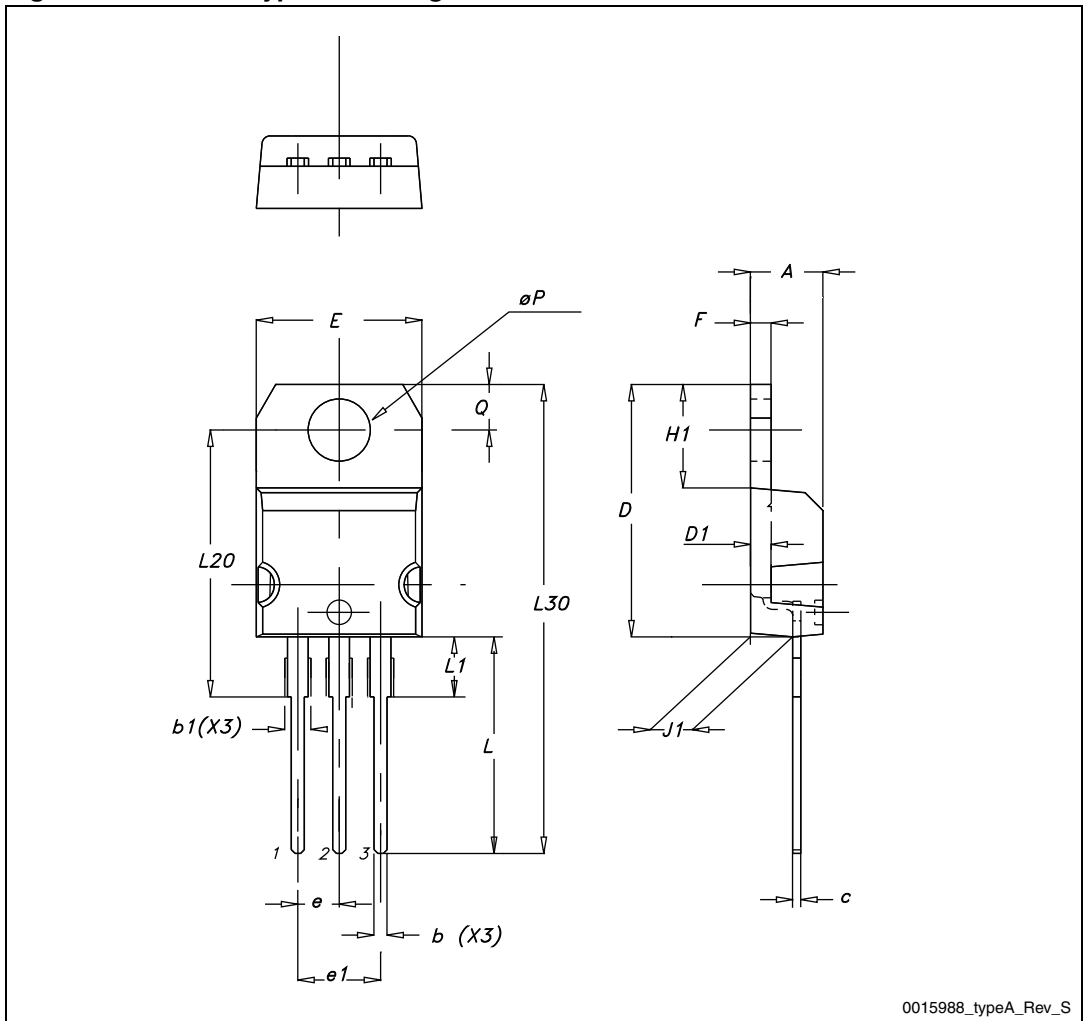
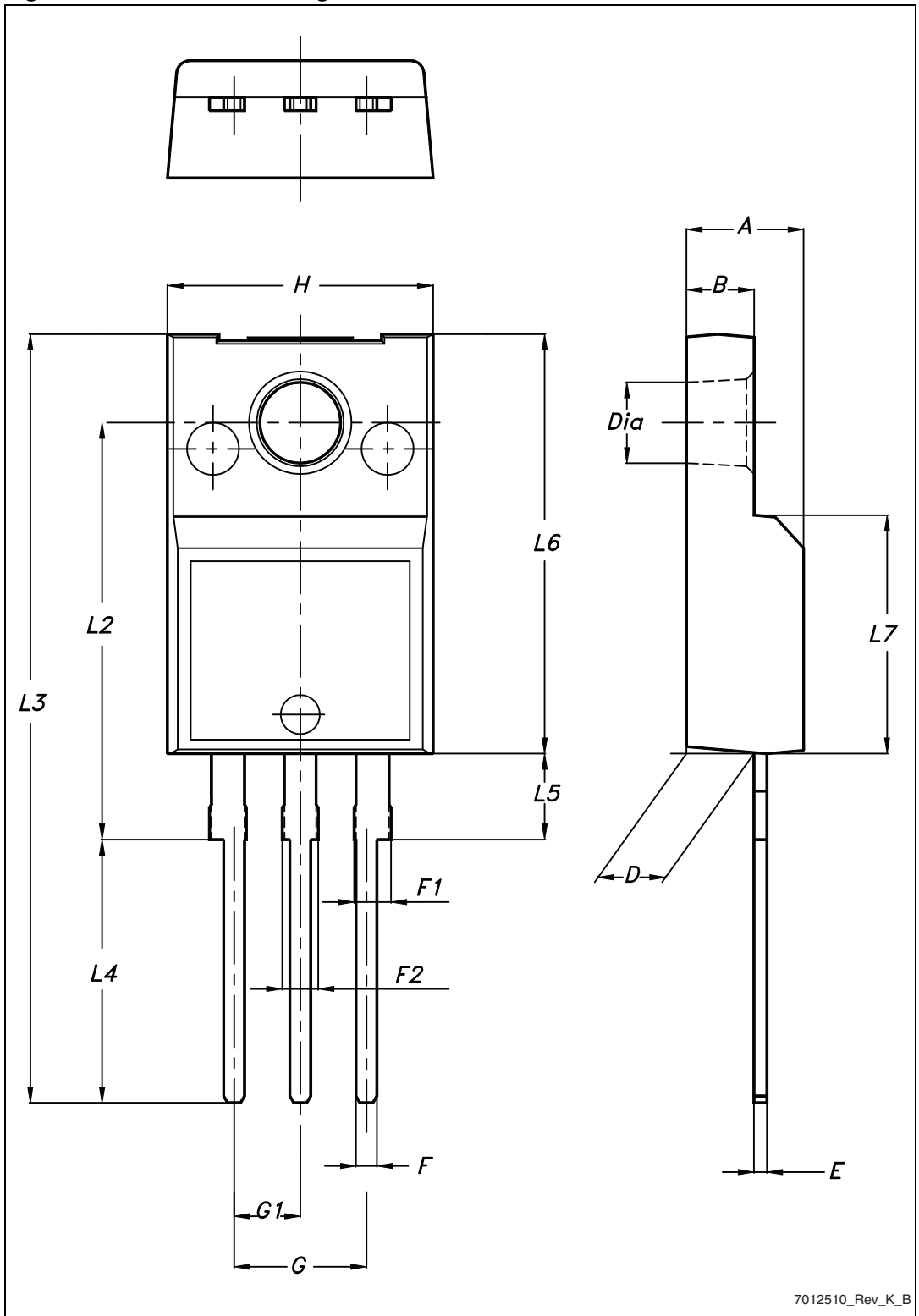


Table 12. TO-220FP mechanical data

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 28. TO-220FP drawing



5 Packaging mechanical data

Table 13. D²PAK (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

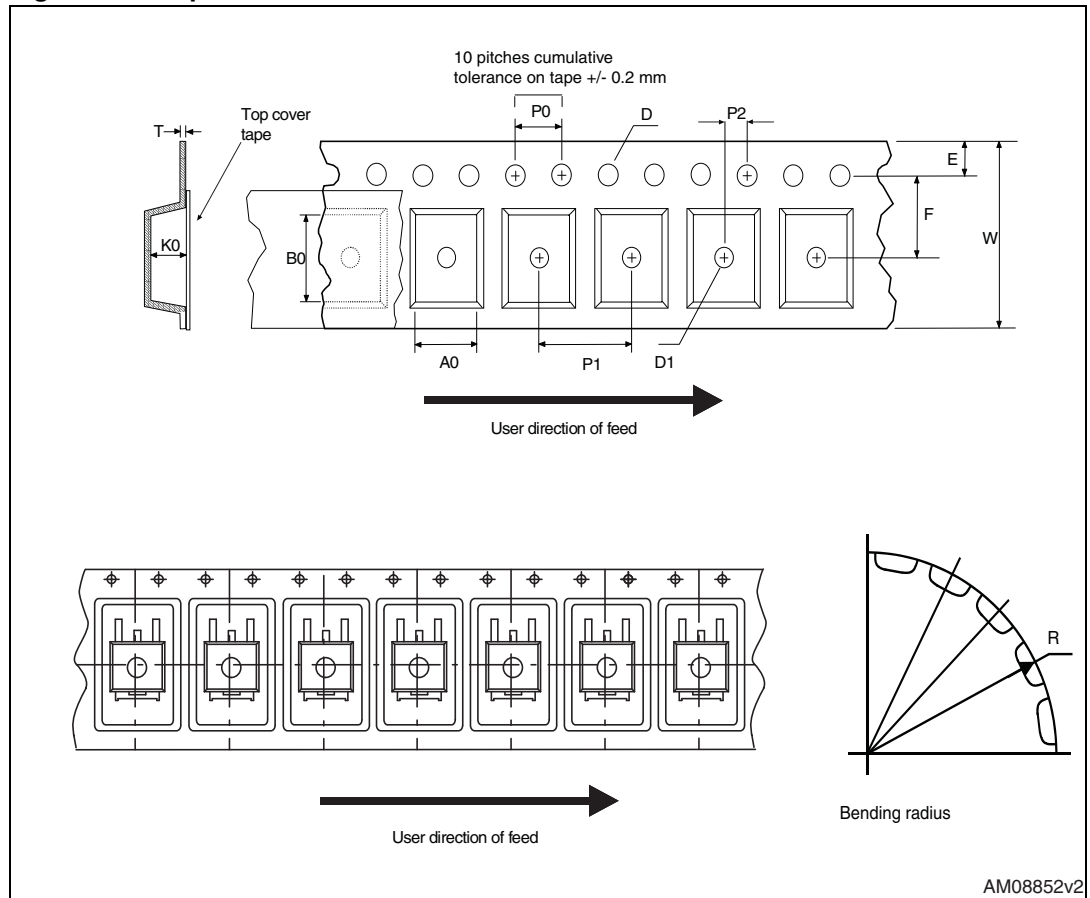
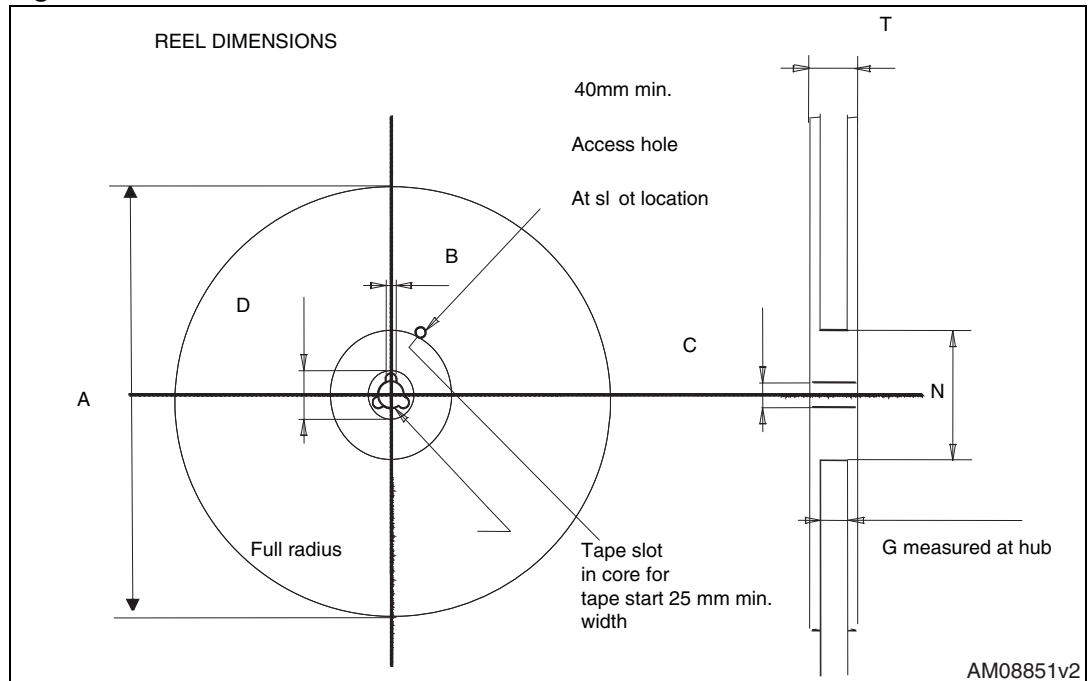


Figure 30. Reel



6 Revision history

Table 14. Document revision history

Date	Revision	Changes
29-Apr-2009	1	First release
17-Dec-2009	2	Added new package, mechanical data: D ² PAK
20-Jun-2011	3	Inserted device in I ² PAK.
13-Mar-2012	4	Updated P _{TOT} and derating factor in Table 2 . Update R _{thj-case} for TO-220FP in Table 3 . Update Figure 12 and Figure 17 . Update Section 5: Packaging mechanical data .
20-Jun-2012	5	Updated title on the coverpage. Minor text changes.

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