



STB18NM60N, STF18NM60N, STP18NM60N, STW18NM60N

N-channel 600 V, 0.26 Ω typ., 13 A MDmesh™ II Power MOSFET
in D²PAK, TO-220FP, TO-220 and TO-247

Datasheet — production data

Features

Order codes	V _{DSS} (@T _{jmax})	R _{DS(on)} max.	I _D	P _{TOT}
STB18NM60N	650 V	< 0.285 Ω	13 A	110 W
STF18NM60N				30 W
STP18NM60N				110
STW18NM60N				

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

Applications

- Switching applications

Description

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

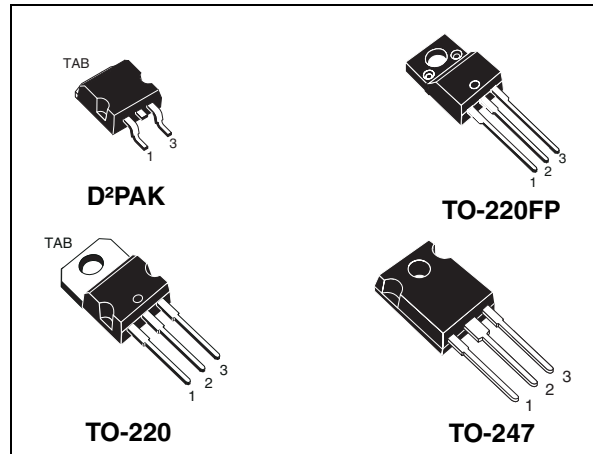


Figure 1. Internal schematic diagram

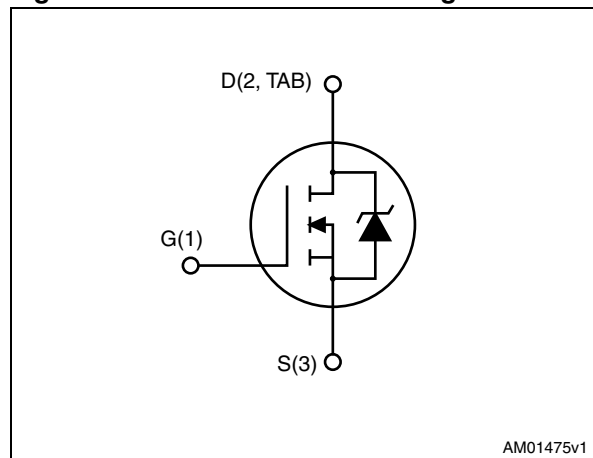


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB18NM60N	18NM60N	D ² PAK	Tape and reel
STF18NM60N	18NM60N	TO-220FP	Tube
STP18NM60N	18NM60N	TO-220	Tube
STW18NM60N	18NM60N	TO-247	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D ² PAK, TO-220,TO-247	TO-220FP	
V _{DS}	Drain-source voltage	600		V
V _{GS}	Gate- source voltage	± 25		
I _D	Drain current (continuous) at T _C = 25 °C	13	13 ⁽¹⁾	A
I _D	Drain current (continuous) at T _C = 100 °C	8.2	8.2 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	52	52 ⁽¹⁾	A
P _{TOT}	Total dissipation at T _C = 25 °C	110	30	W
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _J max)	4.5		A
E _{AS}	Single pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	350		mJ
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 _J T _{stg}	Operating junction temperature Storage temperature	-55 to 150		°C

- Limited by maximum junction temperature.
- Pulse width limited by safe operating area.
- I_{SD} ≤ 13 A, di/dt ≤ 400 A/μs, V_{DD} ≤ 80 % V_{(BR)DSS}, V_{DS(peak)} ≤ V_{(BR)DSS}

Table 3. Thermal data

Symbol	Parameter	D ² PAK	TO-220	TO-247	TO-220FP	Unit
R _{thj-case}	Thermal resistance junction-case max	1.14			4.17	°C/W
R _{thj-amb}	Thermal resistance junction-amb max		62.5	50	62.5	
R _{thj-pcb} ⁽¹⁾	Thermal resistance junction-pcb max	30				

- When mounted on 1inch² 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	$I_D = 1\text{ mA}$, $V_{GS} = 0$	600			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 600\text{ V}$ $V_{DS} = 600\text{ V}$, $T_J=125\text{ °C}$			1 10	μA μA
I_{GSS}	Gate body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			± 100	nA
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}$, $I_D = 6.5\text{ A}$		0.260	0.285	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	1000	-	pF
C_{oss}	Output capacitance			60		pF
C_{rss}	Reverse transfer capacitance			3		pF
$C_{oss\text{ eq.}}^{(1)}$	Output equivalent capacitance	$V_{DS} = 0$, to 480 V , $V_{GS} = 0$	-	225	-	pF
R_g	Intrinsic resistance	$f = 1\text{ MHz}$ open drain	-	3.5	-	Ω
Q_g	Total gate charge	$V_{DD} = 480\text{ V}$, $I_D = 13\text{ A}$	-	35	-	nC
Q_{gs}	Gate-source charge	$V_{GS} = 10\text{ V}$		6		nC
Q_{gd}	Gate-drain charge	(see Figure 19)		20		nC

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 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 6.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 18)	-	12	-	ns
t_r	Rise time			15		ns
$t_{d(off)}$	Turn-off delay time			55		ns
t_f	Fall time			25		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		13	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		52	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 13 \text{ A}$, $V_{GS} = 0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 13 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$ (see Figure 20)	-	300		ns
Q_{rr}	Reverse recovery charge		-	4.0		μC
I_{RRM}	Reverse recovery current		-	25		A
t_{rr}	Reverse recovery time	$V_{DD} = 60 \text{ V}$ $di/dt = 100 \text{ A}/\mu\text{s}$, $I_{SD} = 13 \text{ A}$ $T_j = 150^\circ\text{C}$ (see Figure 20)	-	360		ns
Q_{rr}	Reverse recovery charge		-	4.5		μC
I_{RRM}	Reverse recovery current		-	25		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 and D²PAK

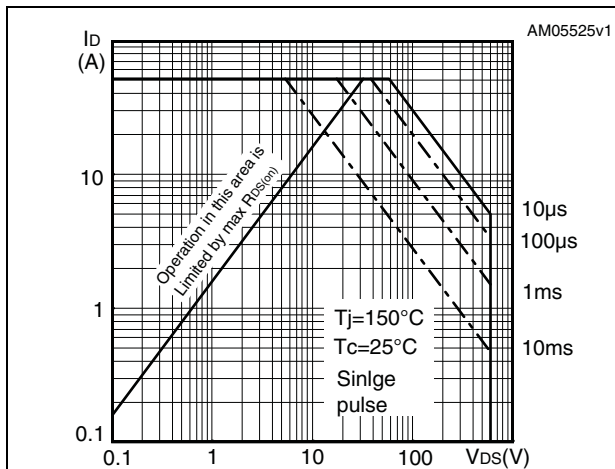


Figure 3. Thermal impedance for TO-220 and D²PAK

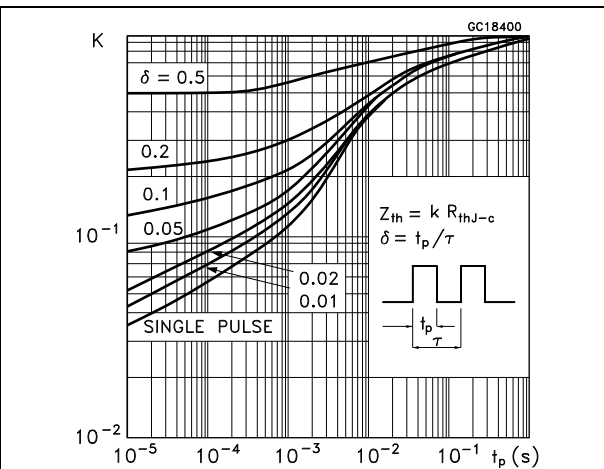


Figure 4. Safe operating area for TO-220FP

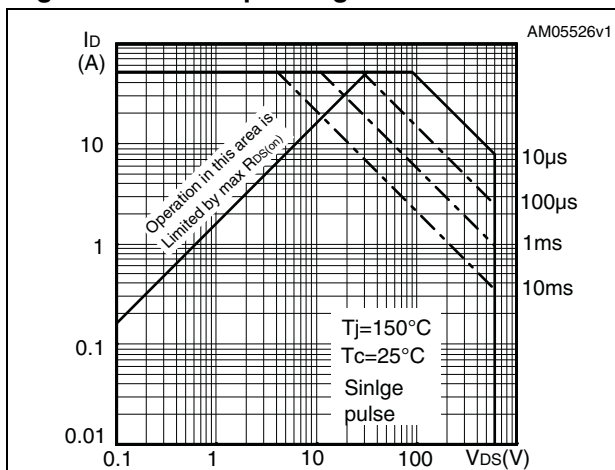


Figure 5. Thermal impedance for TO-220FP

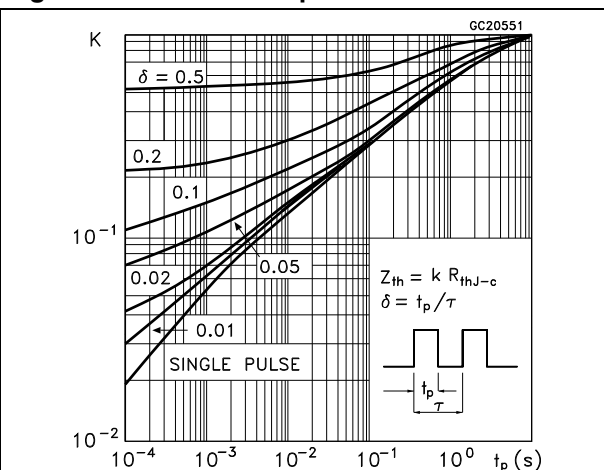


Figure 6. Safe operating area for TO-247

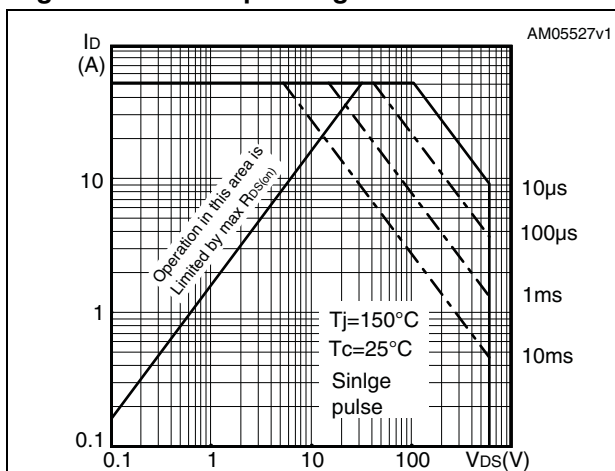


Figure 7. Thermal impedance for TO-247

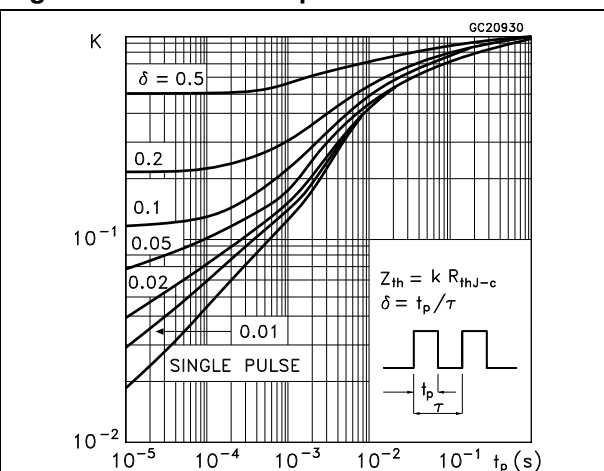


Figure 8. Output characteristics

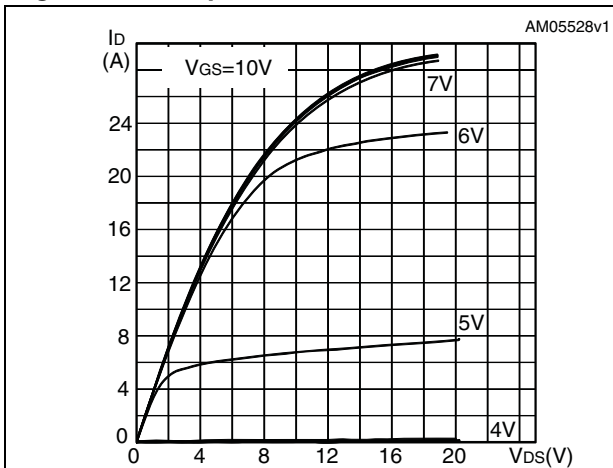


Figure 9. Transfer characteristics

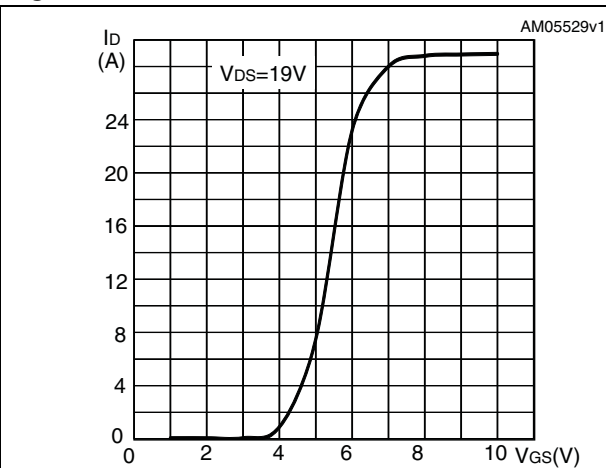


Figure 10. Static drain-source on resistance

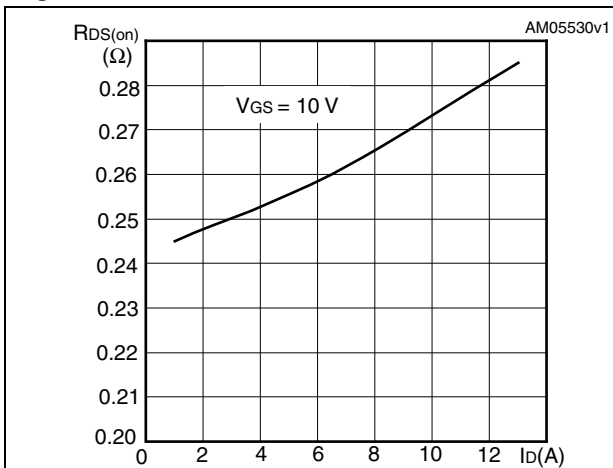


Figure 11. Gate charge vs gate-source voltage

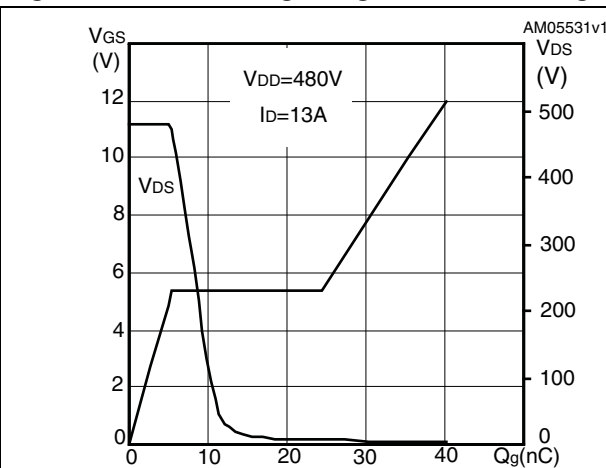


Figure 12. Capacitance variations

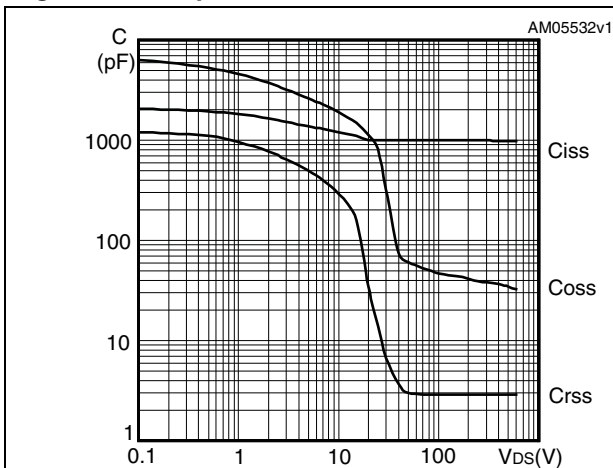


Figure 13. Output capacitance stored energy

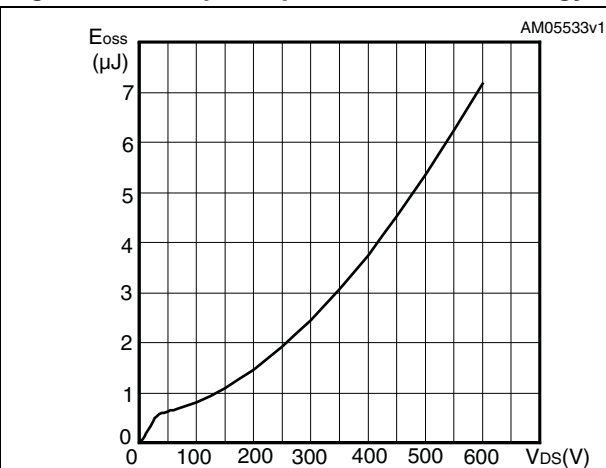


Figure 14. Normalized gate threshold voltage vs temperature

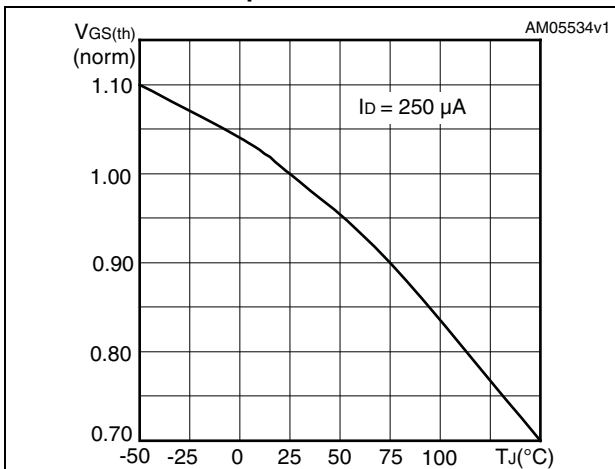


Figure 15. Normalized on resistance vs temperature

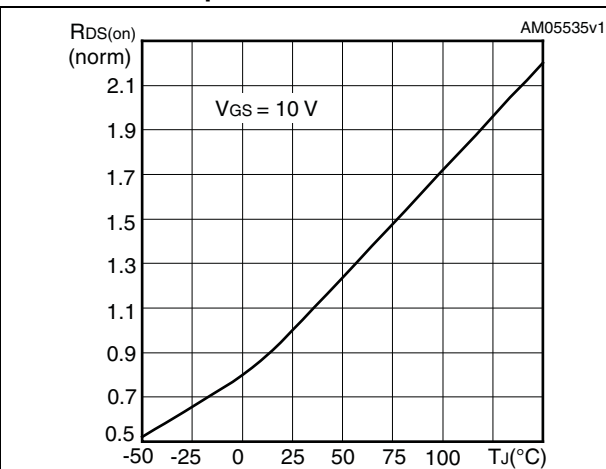


Figure 16. Normalized B_{VDS} vs temperature

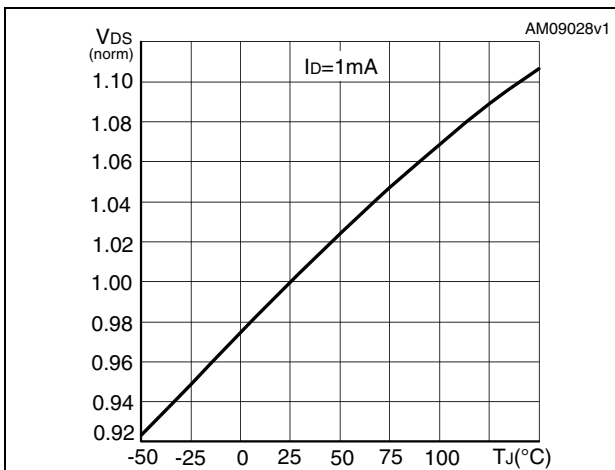
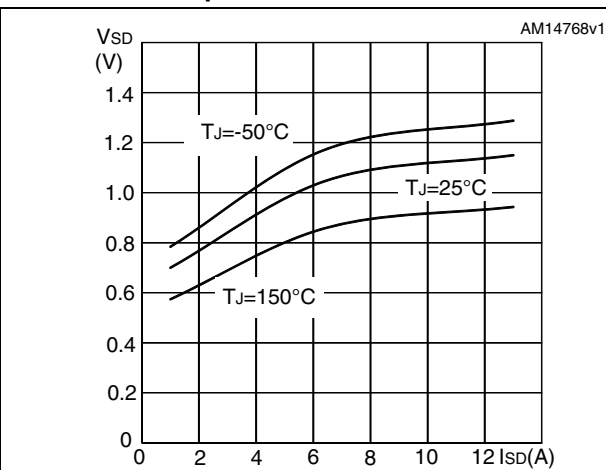
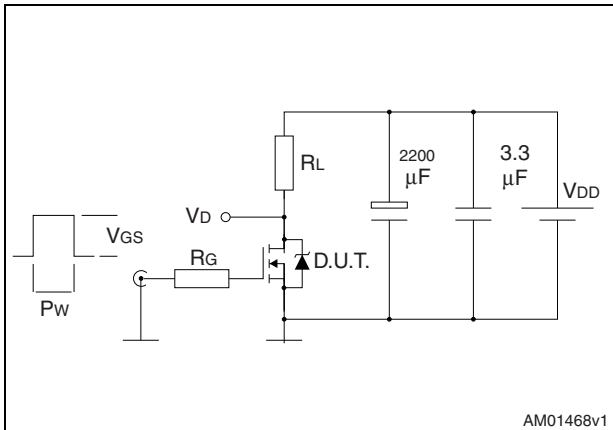


Figure 17. Source-drain diode forward vs temperature



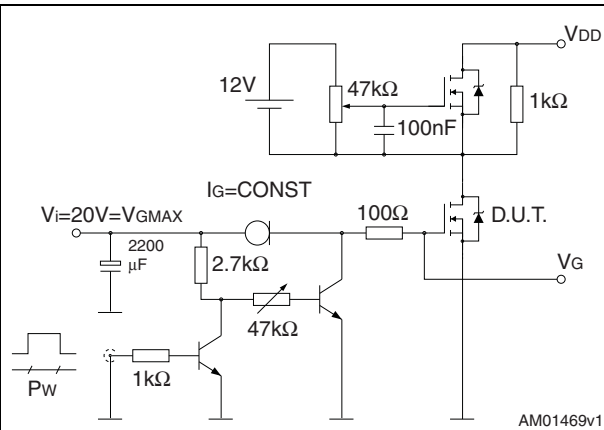
3 Test circuits

Figure 18. Switching times test circuit for resistive load



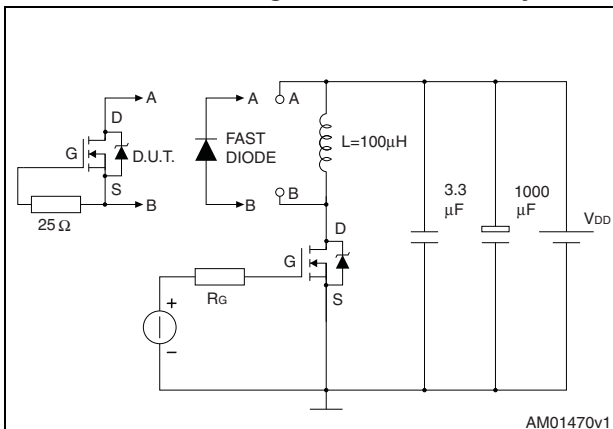
AM01468v1

Figure 19. Gate charge test circuit



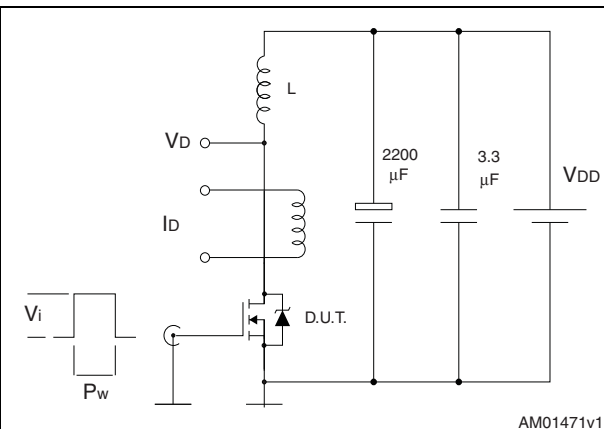
AM01469v1

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



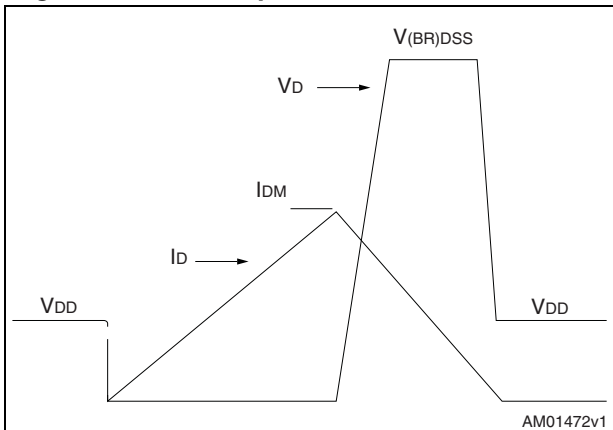
AM01470v1

Figure 21. Unclamped inductive load test circuit



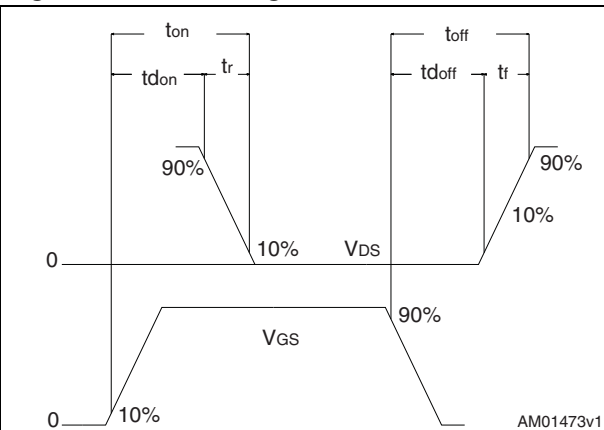
AM01471v1

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 8. 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

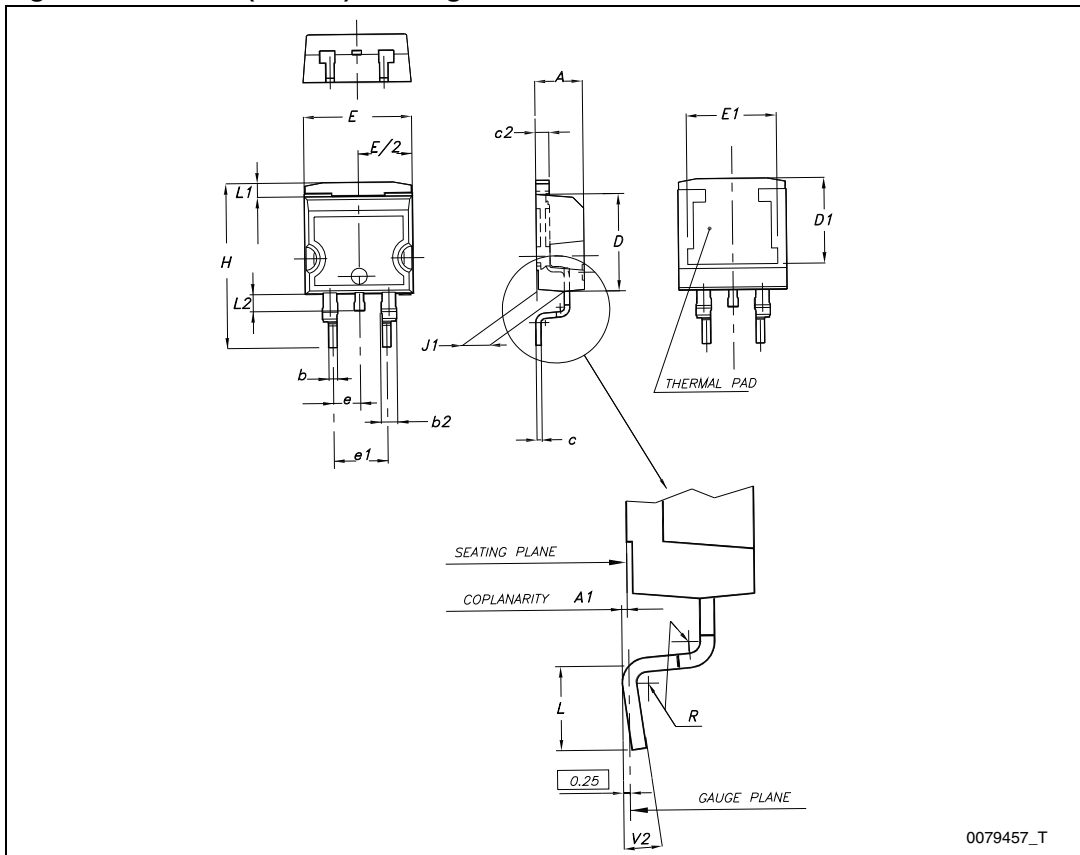
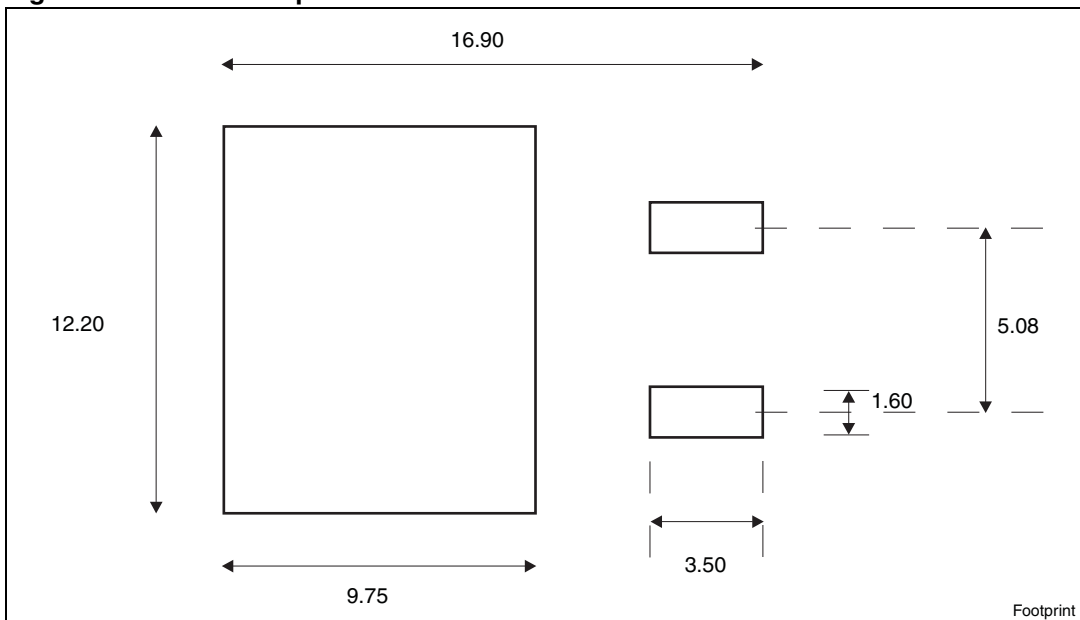


Figure 25. D²PAK footprint^(a)



a. All dimension are in millimeters

Table 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 26. TO-220FP drawing

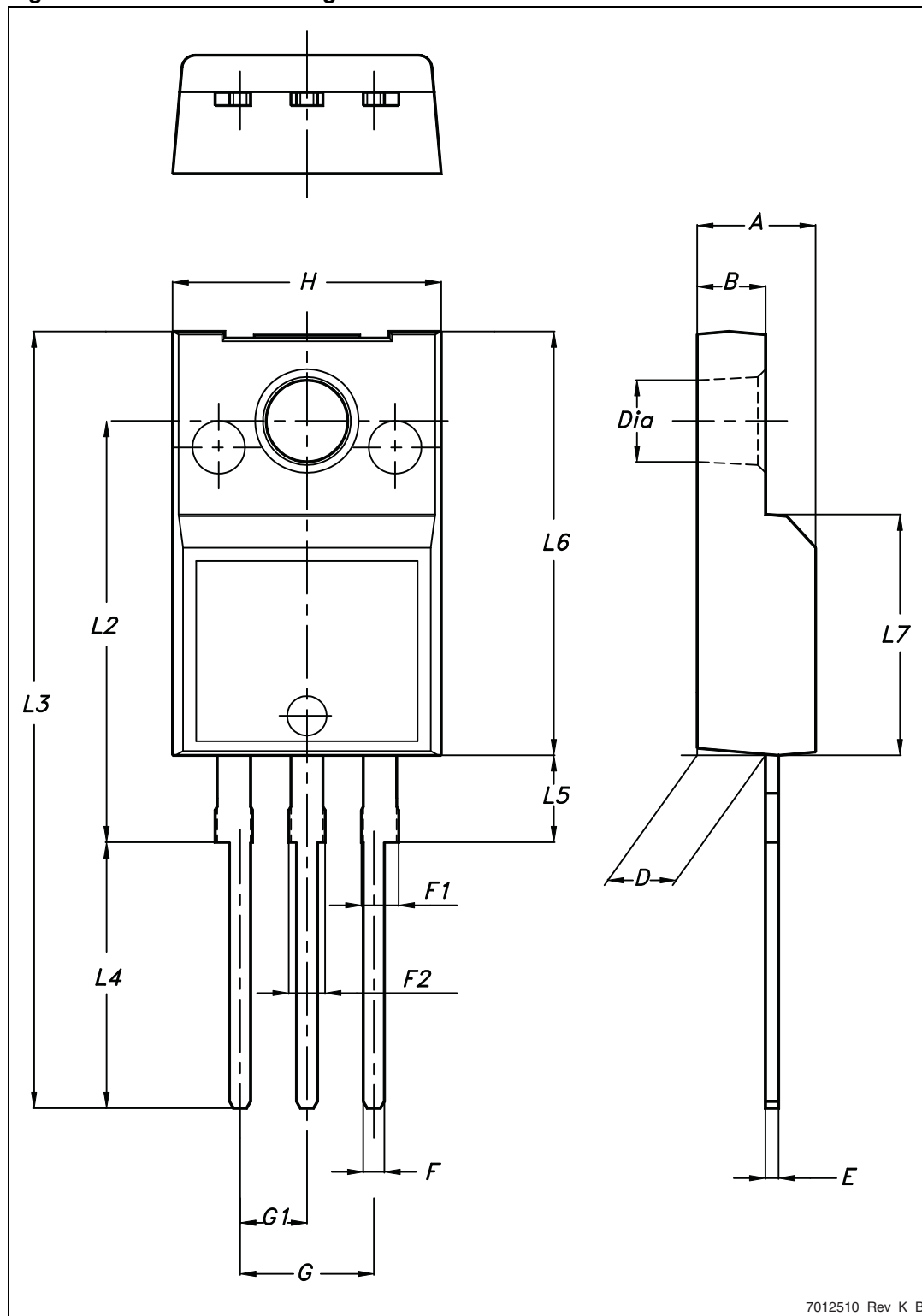


Table 10. TO-220 type A mechanical data

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 27. TO-220 type A drawing

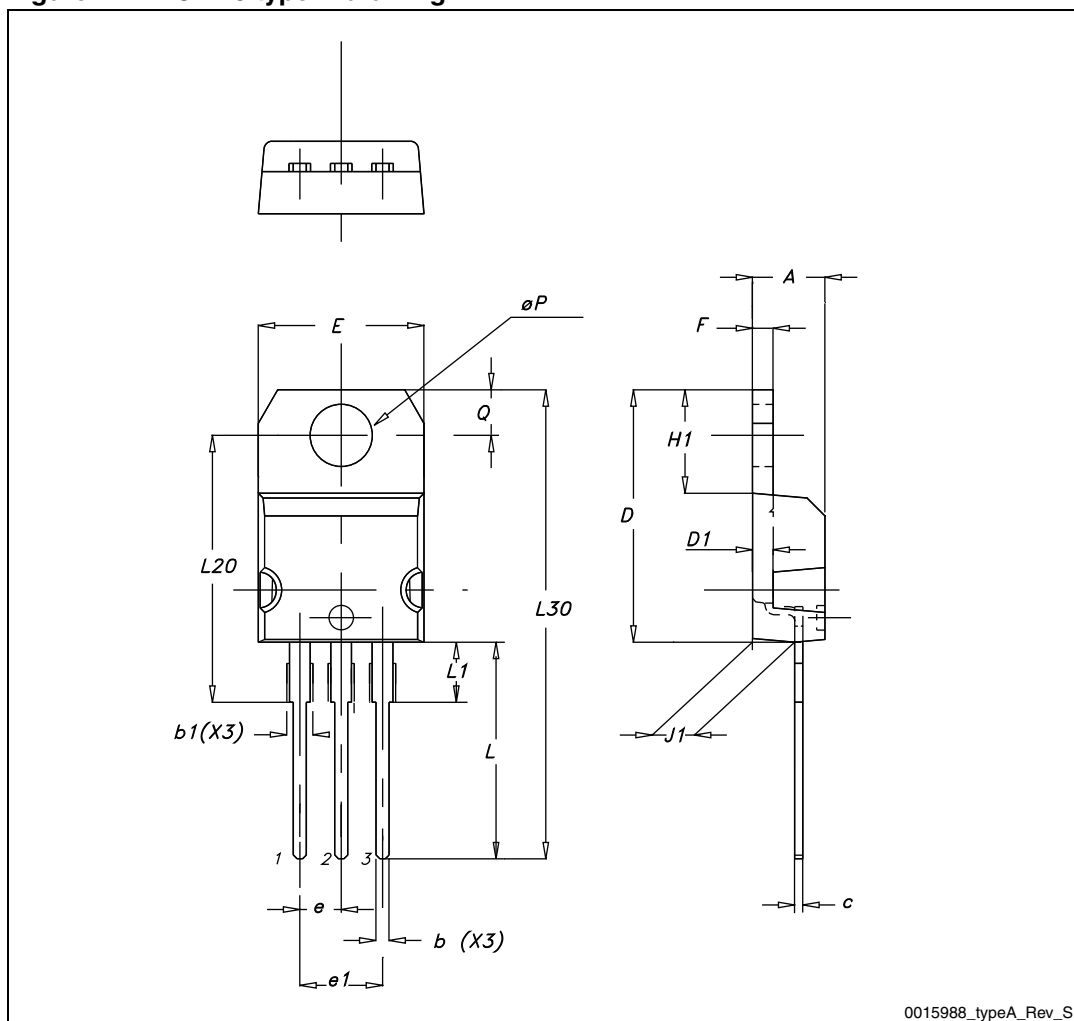
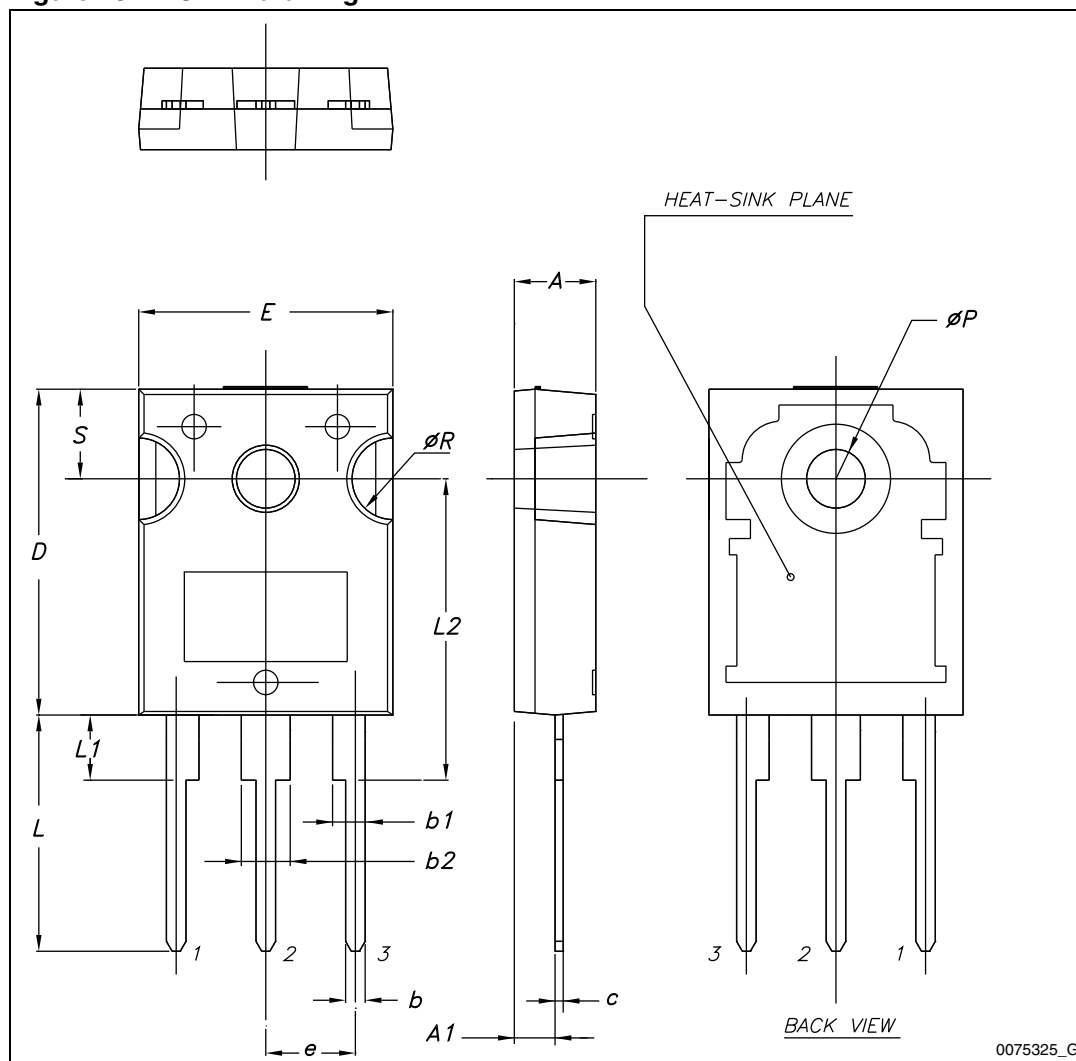


Table 11. TO-247 mechanical data

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	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

Figure 28. TO-247 drawing



5 Packaging mechanical data

Table 12. 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

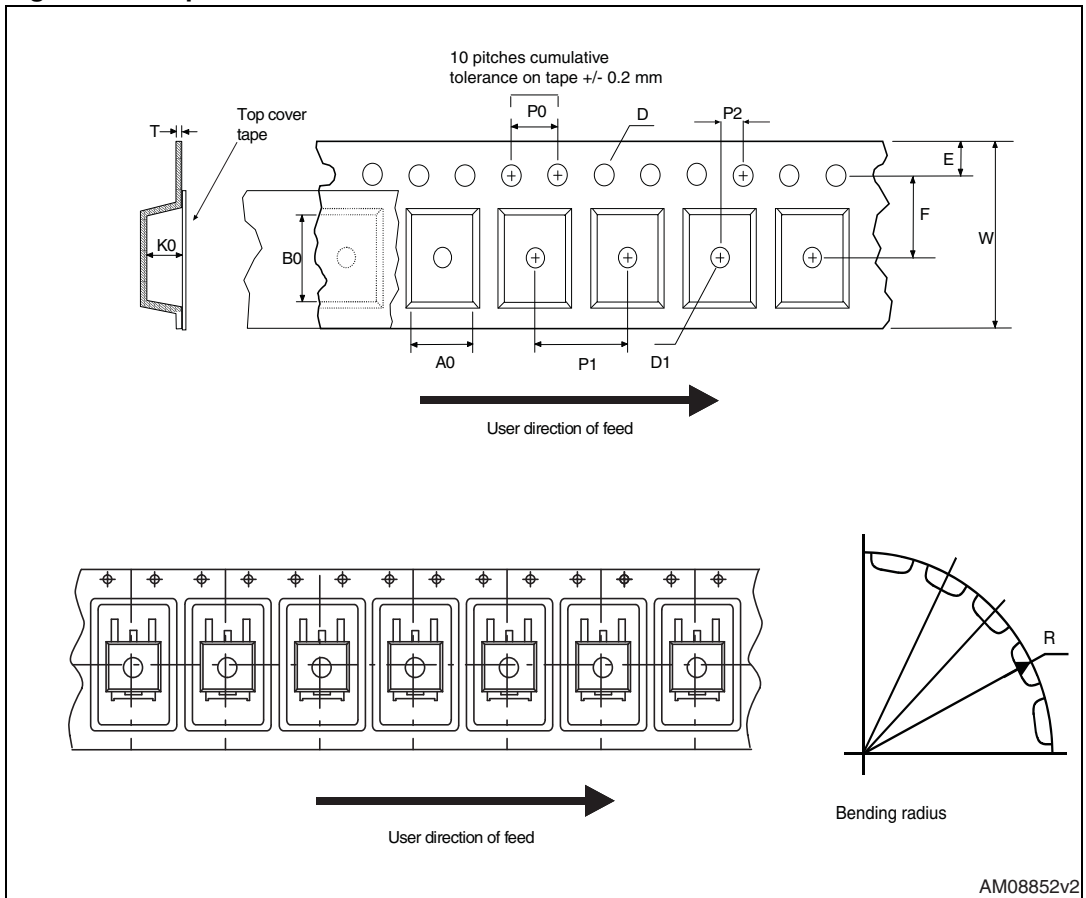
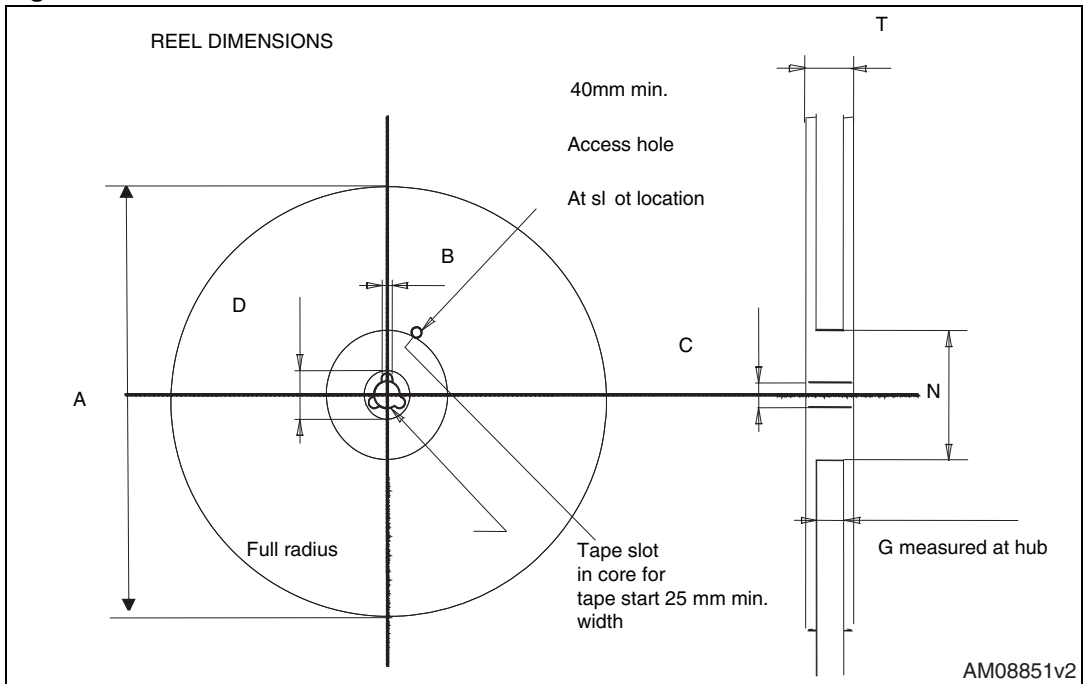


Figure 30. Reel



6 Revision history

Table 13. Document revision history

Date	Revision	Changes
15-Jun-2009	1	First release
11-Nov-2009	2	<ul style="list-style-type: none">– Added $R_{DS(on)}$ typical value– Added new package, mechanical data: I²PAK– Document status promoted from preliminary data to datasheet
06-Oct-2010	3	Inserted new value in Table 5 .
01-Oct-2012	4	Updated title and description on the cover page. Updated figures 10 , 11 , 14 , 15 and 16 . Updated Section 4: Package mechanical data and Section 5: Packaging mechanical data .

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