



STB34NM60N, STF34NM60N, STP34NM60N, STW34NM60N

N-channel 600 V, 0.092 Ω , 29 A MDmesh™ II Power MOSFET
in D²PAK, TO-220FP, TO-220, TO-247 packages

Datasheet — production data

Features

Order codes	V _{DS}	R _{DS(on)} max.	I _D	P _{TOT}
STB34NM60N	600 V	0.105 Ω	29 A	210 W
STF34NM60N	600 V	0.105 Ω	29 A	40 W
STP34NM60N	600 V	0.105 Ω	29 A	210 W
STW34NM60N	600 V	0.105 Ω	29 A	210 W

- 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.

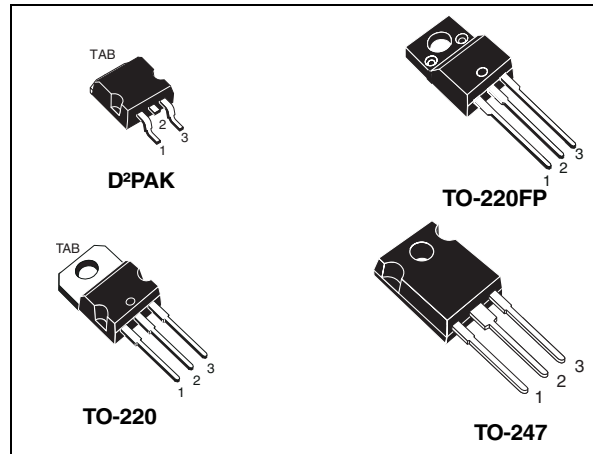


Figure 1. Internal schematic diagram

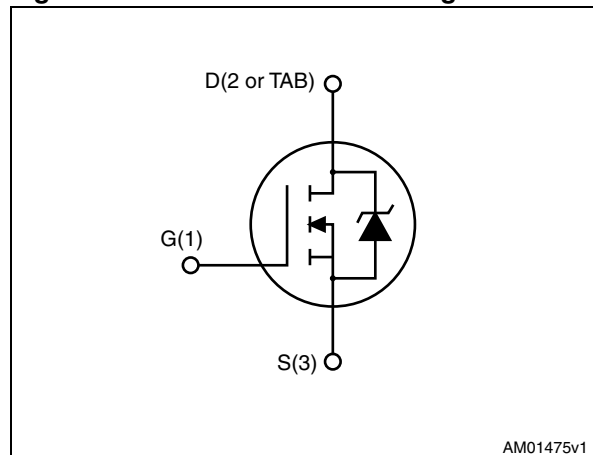


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB34NM60N	34NM60N	D ² PAK	Tape and reel
STF34NM60N		TO-220FP	Tube
STP34NM60N		TO-220	Tube
STW34NM60N		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		V
I _D	Drain current (continuous) at T _C = 25 °C	29	29 ⁽¹⁾	A
I _D	Drain current (continuous) at T _C = 100 °C	18	18 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	116	116	A
P _{TOT}	Total dissipation at T _C = 25 °C	210	40	W
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _J max)	10.5		A
E _{AS}	Single pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	345		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 _{stg}	Storage temperature	- 55 to 150		°C
T _J	Max. operating junction temperature	150		

1. Limited by maximum junction temperature.
2. Pulse width limited by safe operating area.
3. I_{SD} ≤ 29 A, di/dt ≤ 400 A/μs, V_{DS} peak ≤ V_{(BR)DSS}, V_{DD} = 80% V_{(BR)DSS}

Table 3. Thermal data

Symbol	Parameter	D ² PAK	TO-220FP	TO-220	TO-247	Unit
R _{thj-case}	Thermal resistance junction-case max	0.6	3.1	0.6		°C/W
R _{thj-amb}	Thermal resistance junction-ambient max		62.5	50		
R _{thj-pcb} ⁽¹⁾	Thermal resistance junction-pcb max	30				

1. When mounted on FR-4 board of 1 inch², 2 oz Cu.

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$V_{(BR)DSS}$	Drain-source breakdown voltage ($V_{GS} = 0$)	$I_D = 1\text{ mA}$	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 ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			± 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	$V_{GS} = 10\text{ V}, I_D = 14.5\text{ A}$		0.092	0.105	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0$	-	2722	-	pF
C_{oss}	Output capacitance			173		pF
C_{rss}	Reverse transfer capacitance			1.75		pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0, V_{DS} = 0\text{ to }480\text{ V}$	-	458	-	pF
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}, I_D = 14.5\text{ A}$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ (see Figure 23), (see Figure 18)	-	17	-	ns
t_r	Rise time			34		ns
$t_{d(off)}$	Turn-off delay time			106		ns
t_f	Fall time			70		ns
Q_g	Total gate charge	$V_{DD} = 480\text{ V}, I_D = 29\text{ A},$ $V_{GS} = 10\text{ V},$ (see Figure 19)	-	84	-	nC
Q_{gs}	Gate-source charge			14		nC
Q_{gd}	Gate-drain charge			45		nC
R_g	Gate input resistance	f=1MHz Gate DC Bias=0 Test signal level=20 mV Open drain	-	2.9	-	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_{DSS}

Table 6. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		29	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		116	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 29\text{ A}, V_{GS} = 0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 29\text{ A}, V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 20)	-	408		ns
Q_{rr}	Reverse recovery charge			8		μC
I_{RRM}	Reverse recovery current			39		A
t_{rr}	Reverse recovery time	$I_{SD} = 29\text{ A}, V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$, $T_J = 150\text{ }^\circ\text{C}$ (see Figure 20)	-	480		ns
Q_{rr}	Reverse recovery charge			10		μC
I_{RRM}	Reverse recovery current			42		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 D²PAK and TO-220

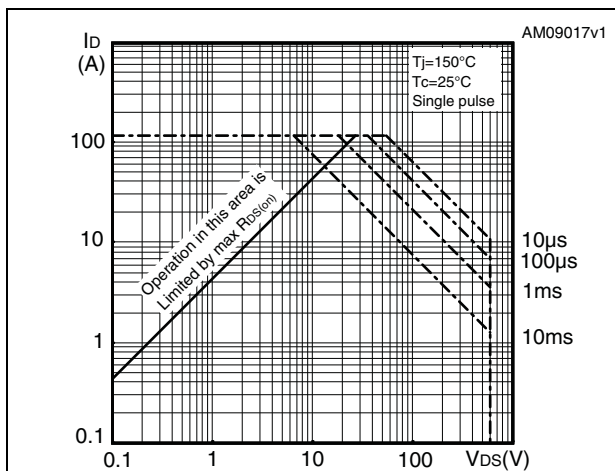


Figure 3. Thermal impedance for for D²PAK and TO-220

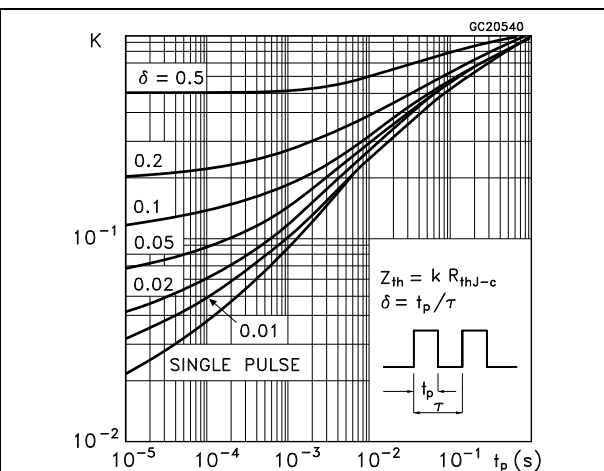


Figure 4. Safe operating area for TO-220FP

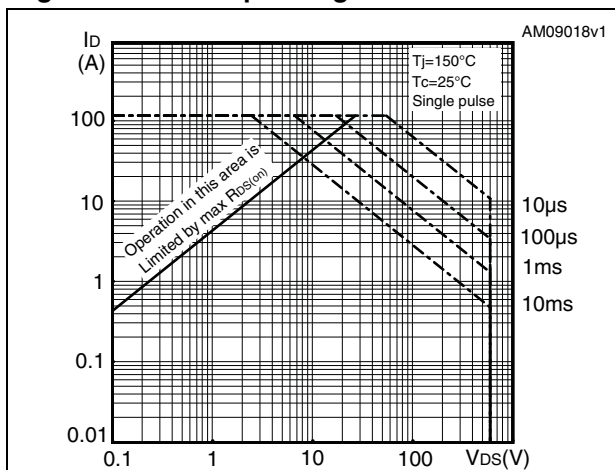


Figure 5. Thermal impedance for TO-220FP

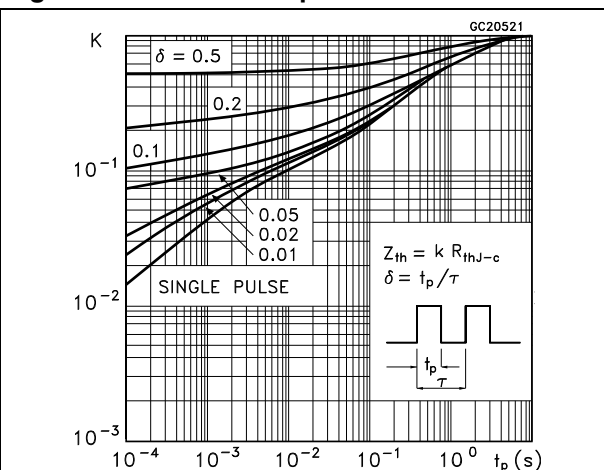


Figure 6. Safe operating area for TO-247

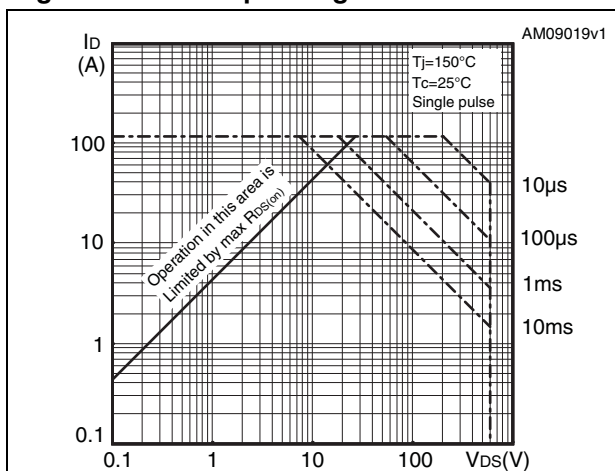


Figure 7. Thermal impedance for TO-247

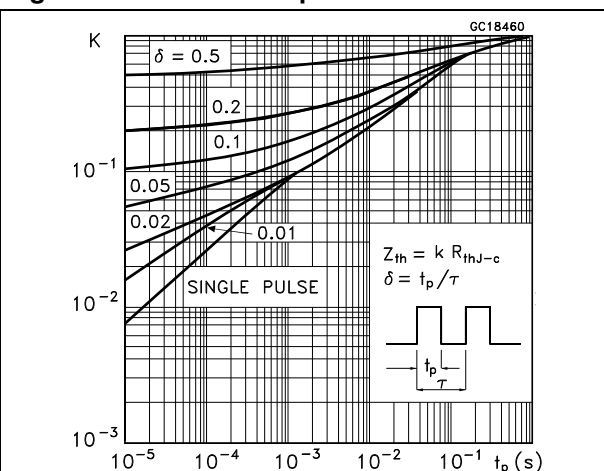


Figure 8. Output characteristics

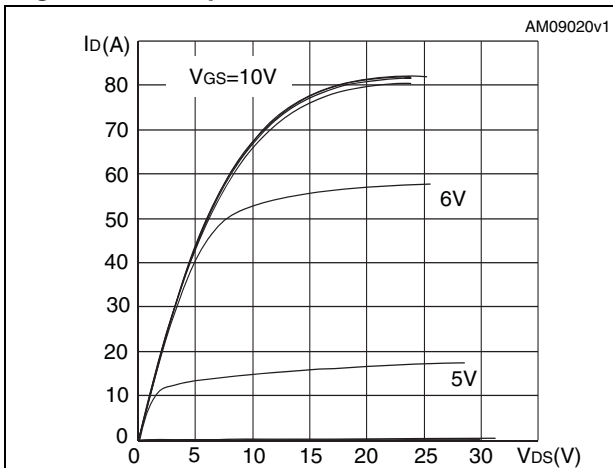


Figure 9. Transfer characteristics

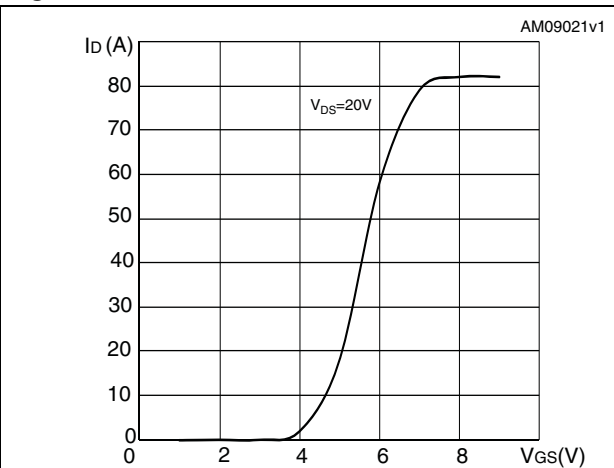


Figure 10. Gate charge vs gate-source voltage

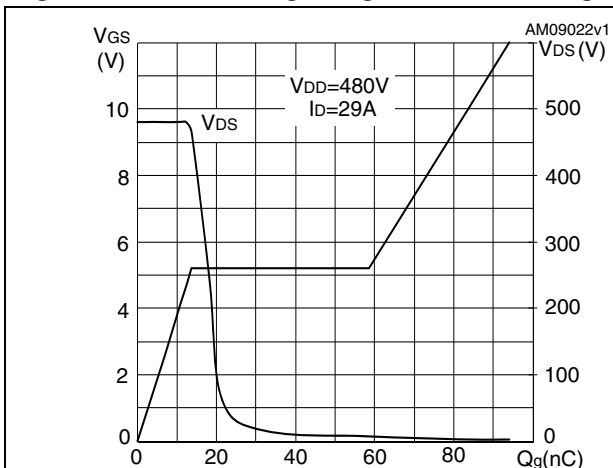


Figure 11. Static drain-source on-resistance

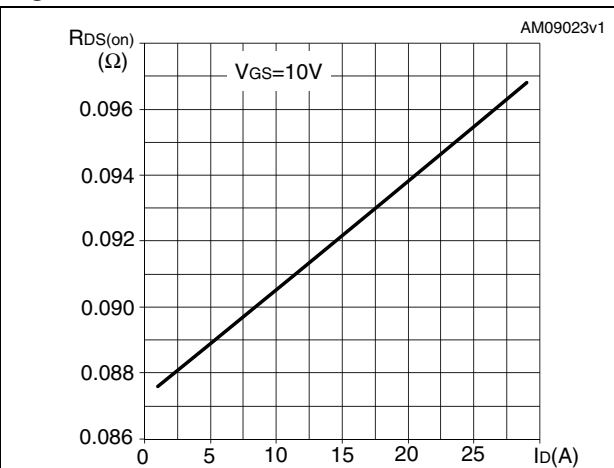


Figure 12. Capacitance variations

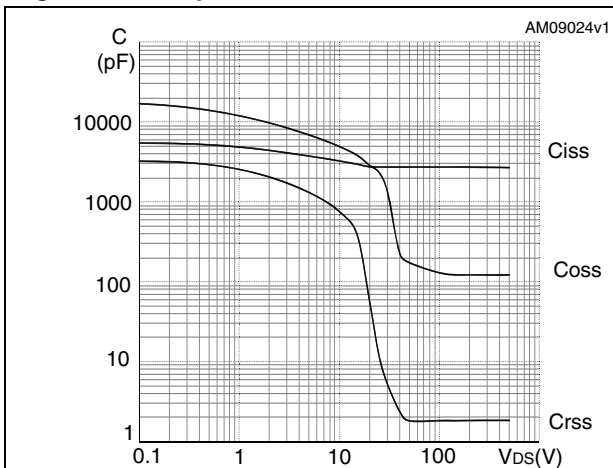


Figure 13. Output capacitance stored energy

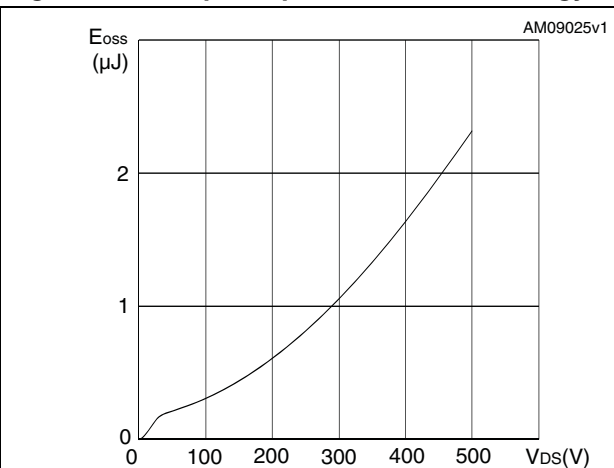


Figure 14. Normalized gate threshold voltage vs temperature

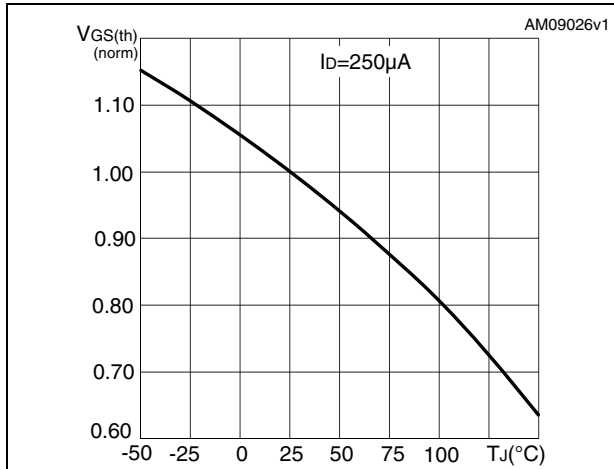


Figure 15. Normalized on-resistance vs temperature

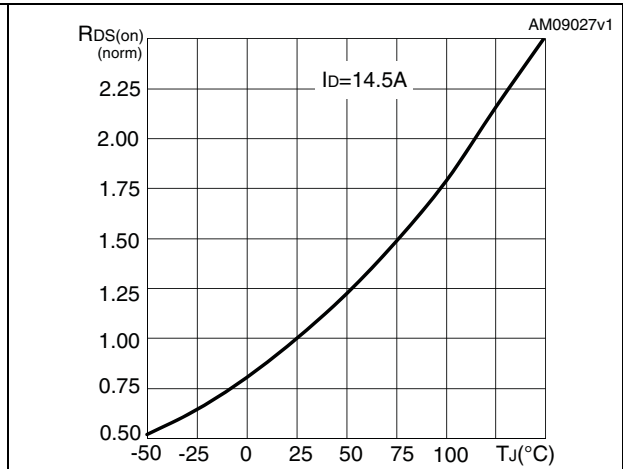


Figure 16. Normalized V_{DS} vs temperature

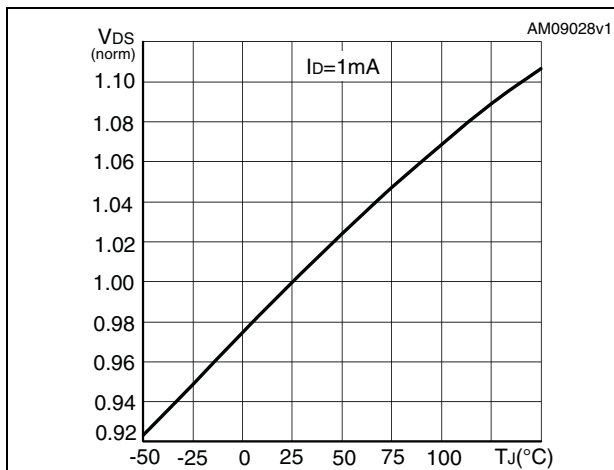
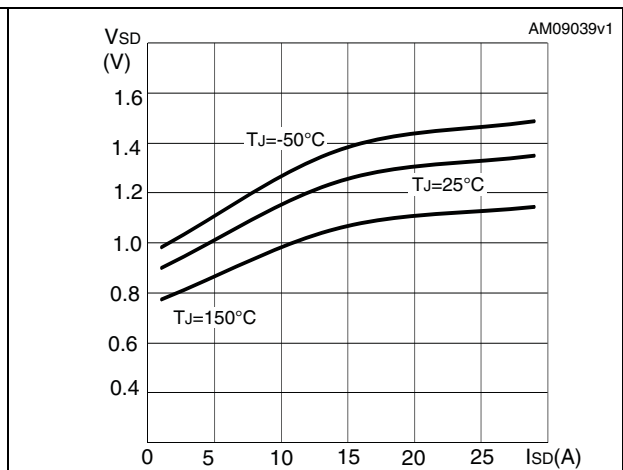
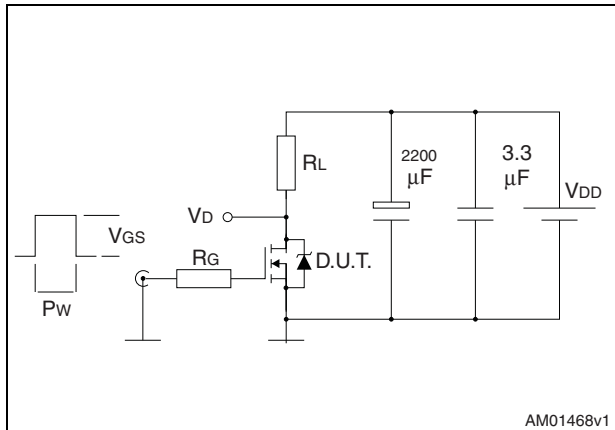


Figure 17. Source-drain diode forward characteristics



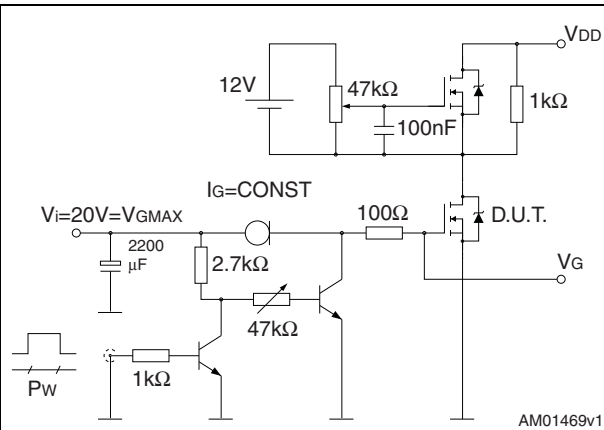
3 Test circuits

Figure 18. Switching times test circuit for resistive load



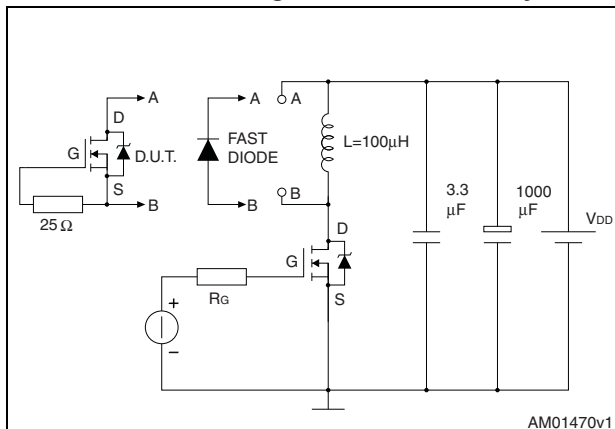
AM01468v1

Figure 19. Gate charge test circuit



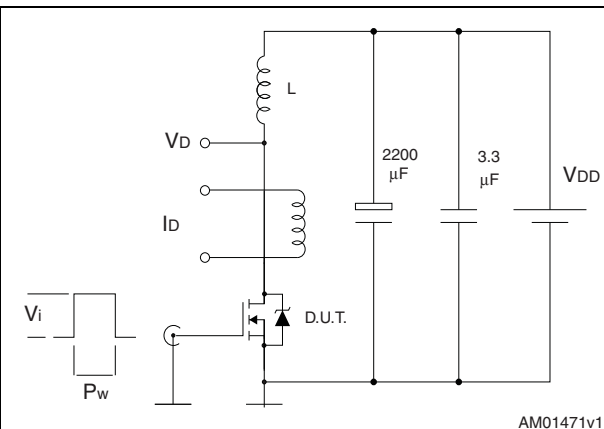
AM01469v1

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



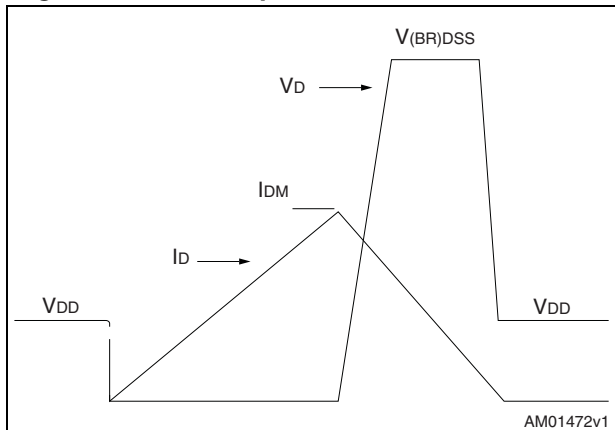
AM01470v1

Figure 21. Unclamped inductive load test circuit



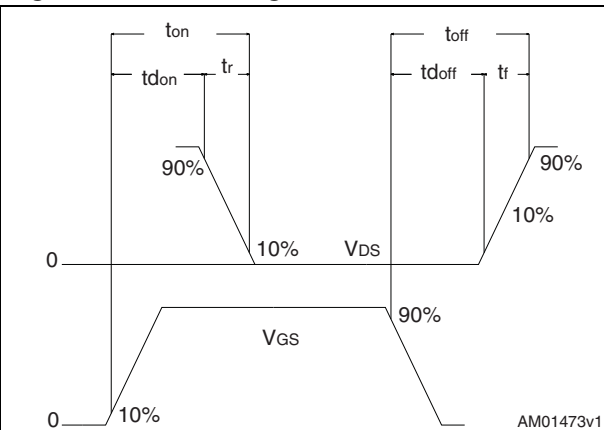
AM01471v1

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 7. 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

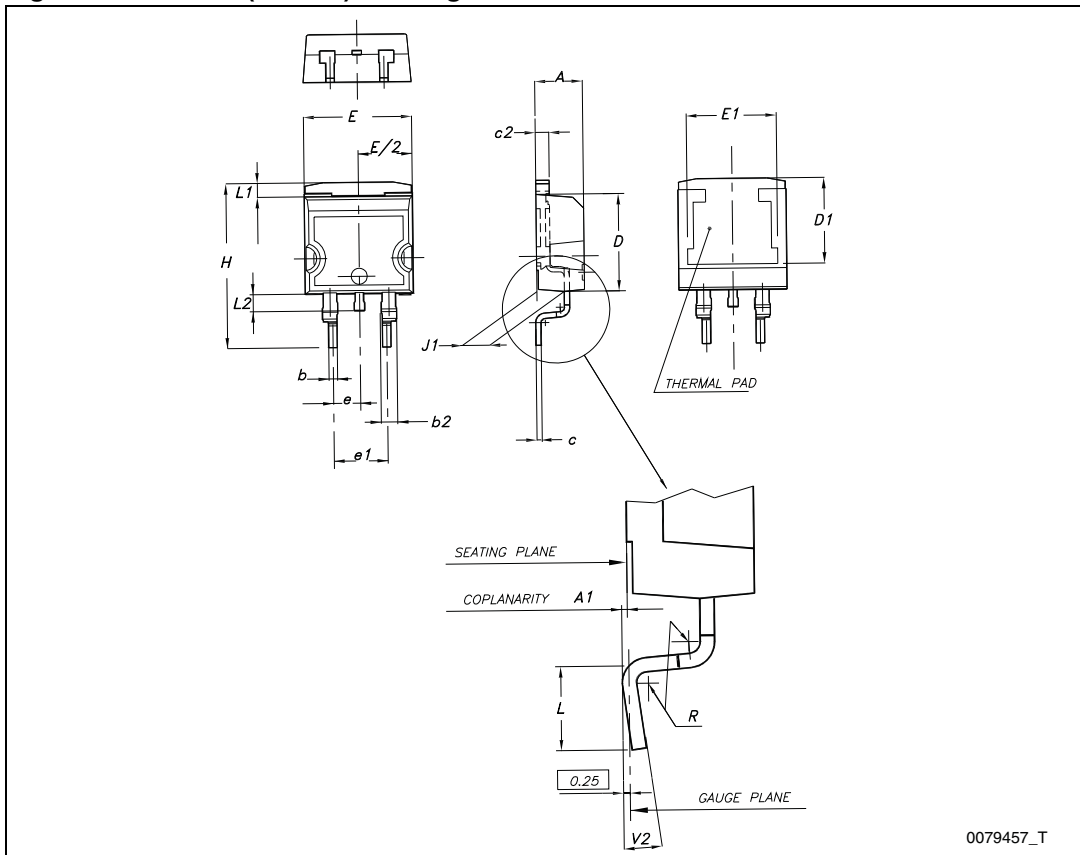
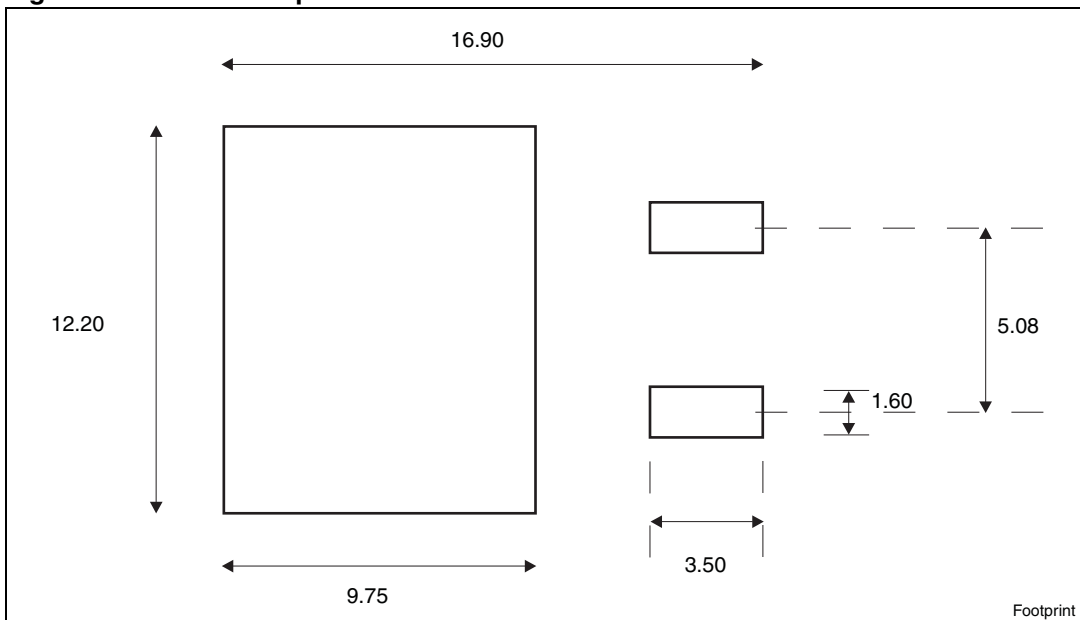


Figure 25. D²PAK footprint^(a)



a. All dimensions are in millimeters

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 26. TO-220FP drawing

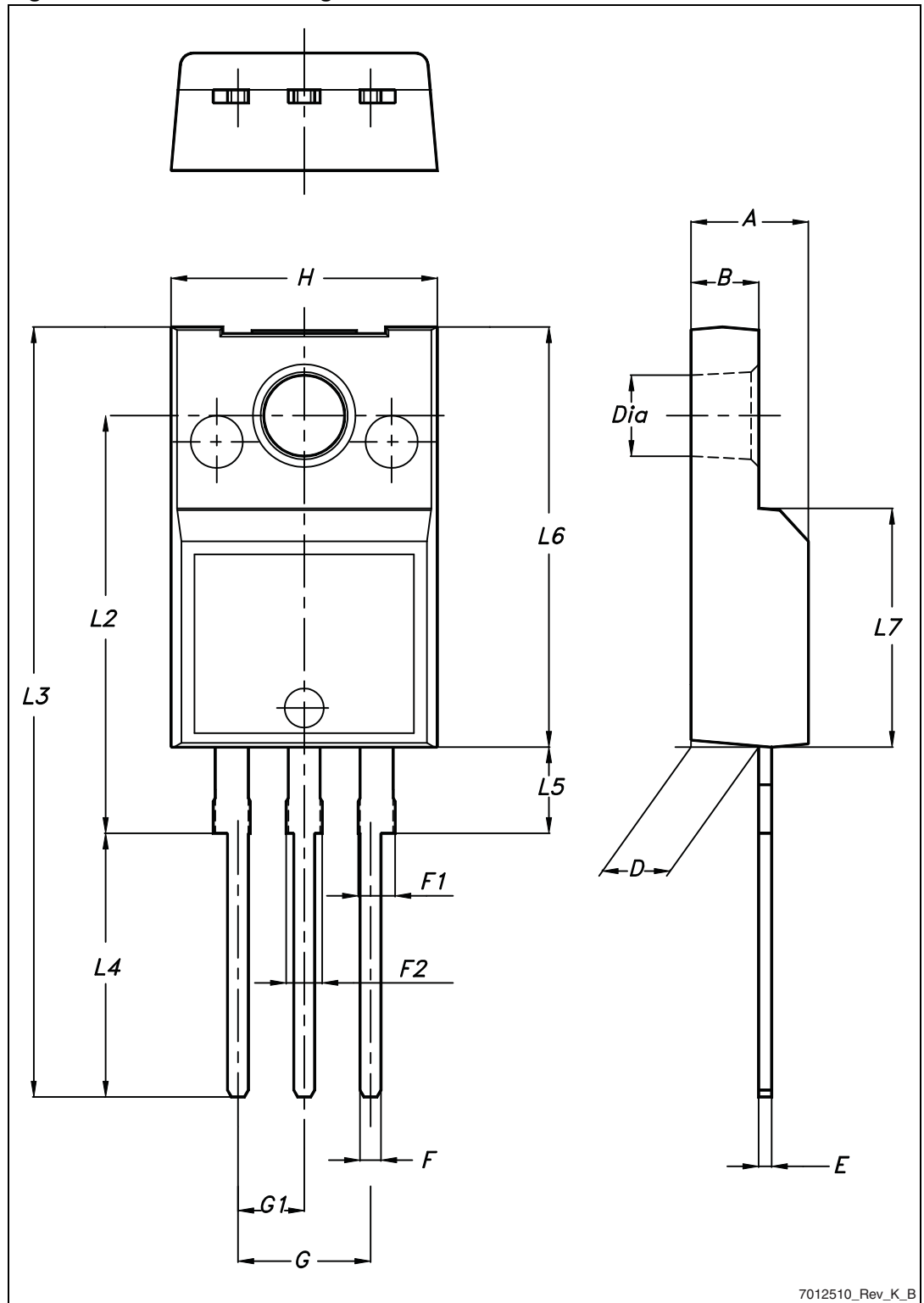


Table 9. TO-220 type A mechanical data

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

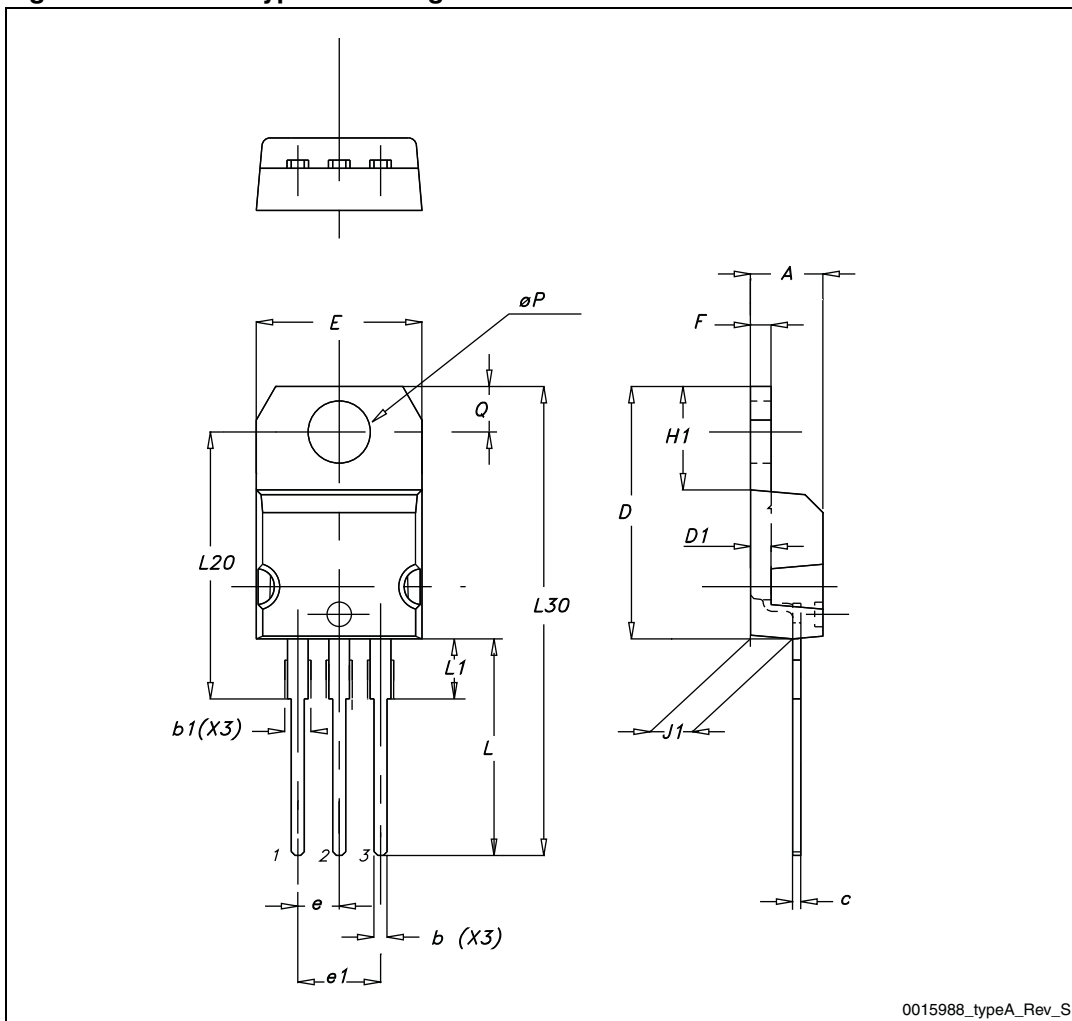
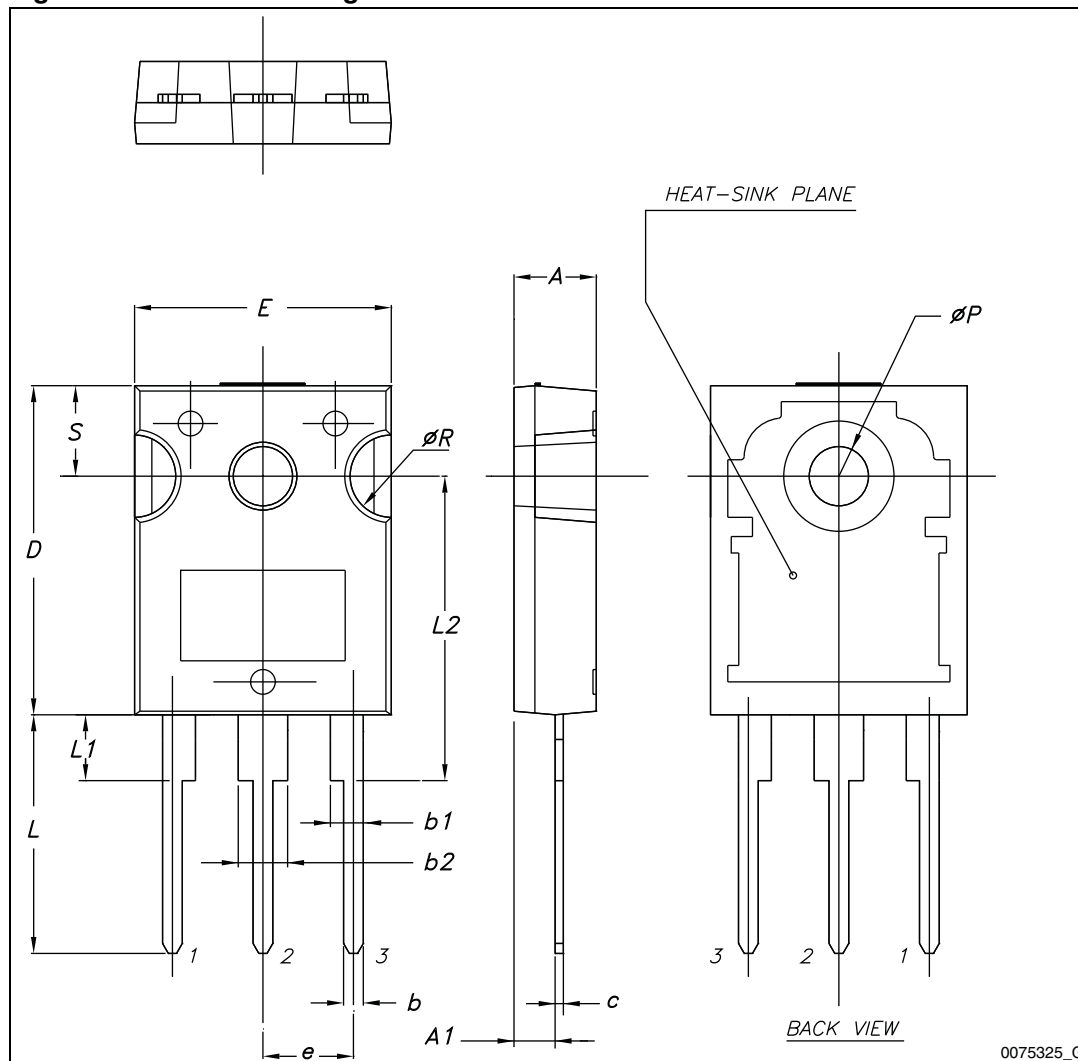


Table 10. TO-247 mechanical data

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 11. 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

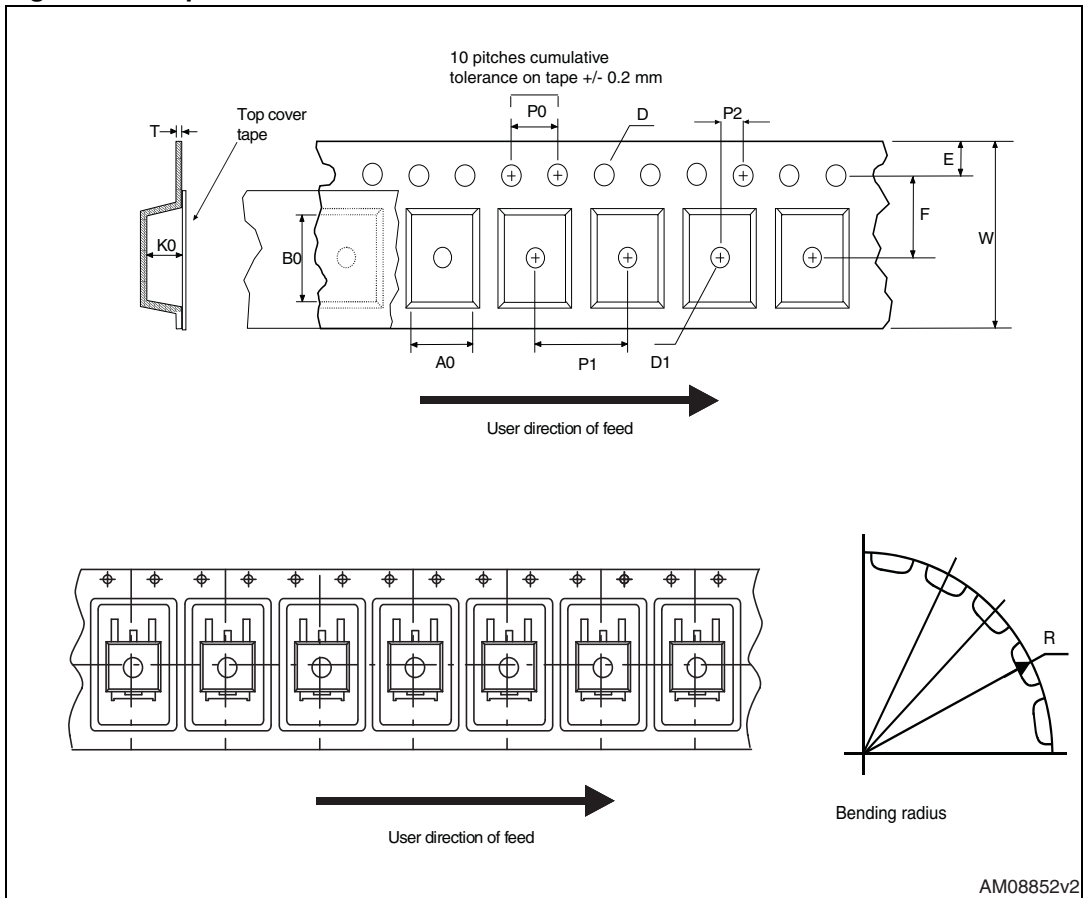
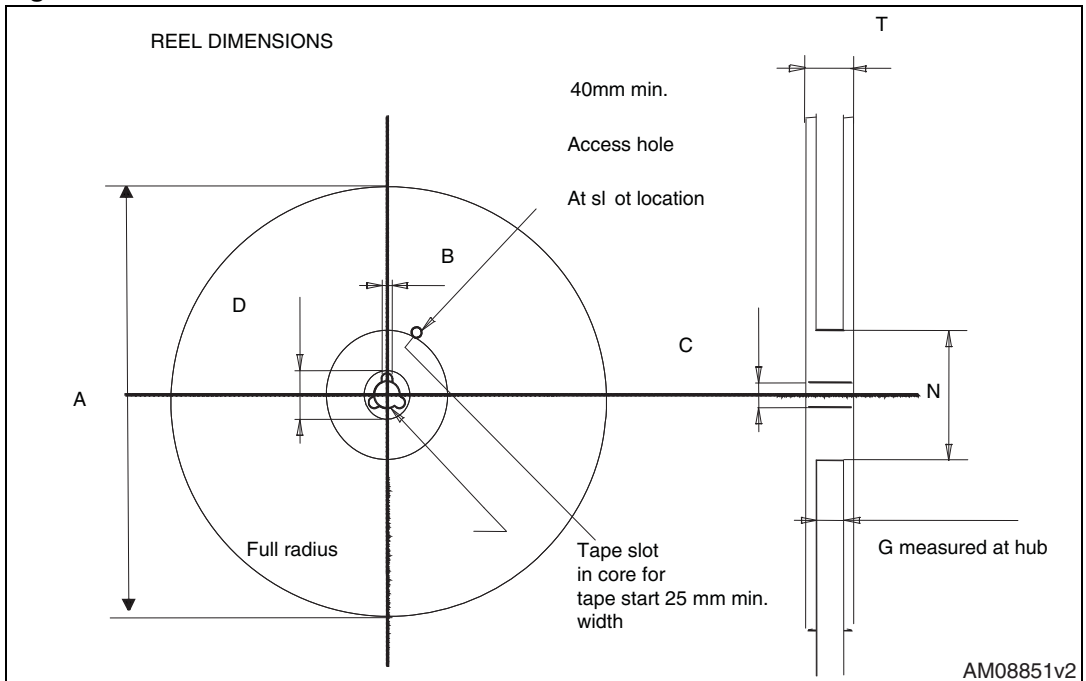


Figure 30. Reel



6 Revision history

Table 12. Document revision history

Date	Revision	Changes
05-Aug-2010	1	Initial release.
02-Sep-2010	2	Updated title on cover page and Table 4: On/off states .
07-Apr-2011	3	Document status promoted from preliminary data to datasheet.
10-Oct-2011	4	Inserted new device in D ² PAK: Updated: Table 2: Absolute maximum ratings , Table 3: Thermal data and Section 4: Package mechanical data with the new device. Inserted Section 5: Packaging mechanical data . Minor text changes.
12-Dec-2011	5	<ul style="list-style-type: none"> – Figure 11: Static drain-source on-resistance has been updated. – Figure 14: Normalized gate threshold voltage vs temperature has been updated. – Figure 15: Normalized on-resistance vs temperature has been updated. – Figure 16: Normalized V_{DS} vs temperature has been updated.
21-Dec-2011	6	Updated: Table 2: Absolute maximum ratings (V_{ISO} value for TO-220FP)
10-May-2012	7	Figure 10: Gate charge vs gate-source voltage has been updated.

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