

N-channel 600 V, 0.097 Ω typ., 29 A FDmesh™ II Power MOSFET
(with fast diode) in D²PAK, TO-220FP, TO-220 and TO-247

Datasheet — production data

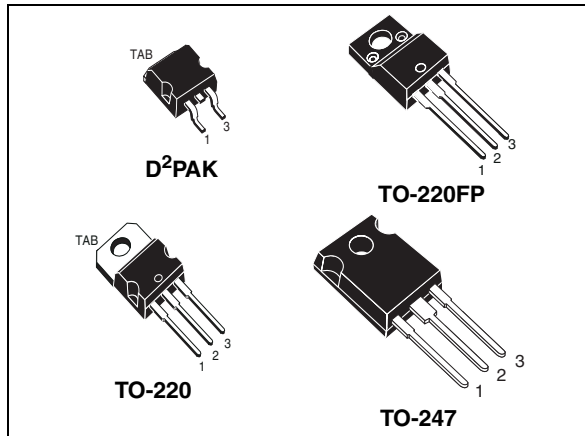
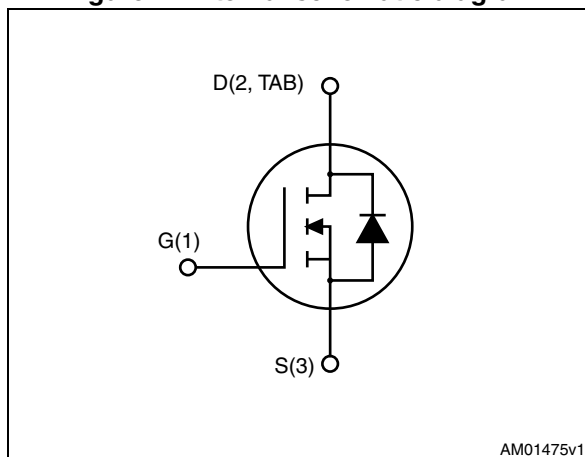


Figure 1. Internal schematic diagram



Features

Order codes	V_{DS} @ T_J max.	$R_{DS(on)}$ max.	I_D
STB34NM60ND	650 V	0.110 Ω	29 A
STF34NM60ND			
STP34NM60ND			
STW34NM60ND			

- The world's best $R_{DS(on)}$ in TO-220 amongst the fast recovery diode devices
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- Extremely high dv/dt and avalanche capabilities

Applications

- Switching applications

Description

These devices are N-channel FDmesh™ V Power MOSFETs produced using ST's MDmesh™ V technology, which is based on an innovative proprietary vertical structure. The resulting product boasts an extremely low on-resistance that is unrivaled among silicon-based Power MOSFETs, and superior switching performance with intrinsic fast-recovery body diode.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STB34NM60ND	34NM60ND	D ² PAK	Tape and reel
STF34NM60ND		TO-220FP	Tube
STP34NM60ND		TO-220	
STW34NM60ND		TO-247	

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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 ⁽¹⁾	A
P _{TOT}	Total dissipation at T _C = 25 °C	190	40	W
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T _C =25 °C)		2500	V
dv/dt ⁽³⁾	Peak diode recovery voltage slope	40		V/ns
T _{stg}	Storage temperature	- 55 to 150		°C
T _J	Max. operating junction temperature	150		

1. Current limited by package
2. Pulse width limited by safe operating area
3. $I_{SD} \leq 29 \text{ A}$, $di/dt \leq 600 \text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$, $V_{DSPeak} < V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	TO-220	TO-247	D ² PAK	TO-220FP	Unit
R _{thj-case}	Thermal resistance junction-case max	0.66			3.1	°C/W
R _{thj-amb}	Thermal resistance junction-ambient max	62.5	50		62.5	°C/W
R _{thj-pcb} ⁽¹⁾	Thermal resistance junction-pcb max			30		°C/W

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

Table 4. Avalanche characteristics

Symbol	Parameter	Max value	Unit
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _J max)	7	A
E _{AS}	Single pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	110	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 ($V_{GS} = 0$)	$I_D = 1\text{ mA}$	600			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 600\text{ V}$			1	μA
		$V_{DS} = 600\text{ V}, T_C = 125\text{ °C}$			100	μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}, I_D = 14.5\text{ A}$		0.097	0.110	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance		-	2785	-	pF
C_{oss}	Output capacitance	$V_{DS} = 50\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$	-	168	-	pF
C_{rss}	Reverse transfer capacitance		-	5	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0, V_{DS} = 0\text{ to }480\text{ V}$	-	438	-	pF
$t_{d(on)}$	Turn-on delay time		-	30	-	ns
t_r	Rise 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 18 and 23)	-	53.4	-	ns
$t_{d(off)}$	Turn-off delay time		-	111	-	ns
t_f	Fall time		-	61.8	-	ns
Q_g	Total gate charge		$V_{DD} = 480\text{ V}, I_D = 29\text{ A}, V_{GS} = 10\text{ V},$ (see Figure 19)	-	80.4	-
Q_{gs}	Gate-source charge	-		16	-	nC
Q_{gd}	Gate-drain charge	-		41.4	-	nC
R_g	Gate input resistance	$f = 1\text{ MHz}, \text{open drain}$		-	2.87	-

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 7. 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)	-	175		ns
Q_{rr}	Reverse recovery charge		-	1.4		μC
I_{RRM}	Reverse recovery current		-	16		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)	-	255		ns
Q_{rr}	Reverse recovery charge		-	2.6		μC
I_{RRM}	Reverse recovery current		-	20		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-220FP

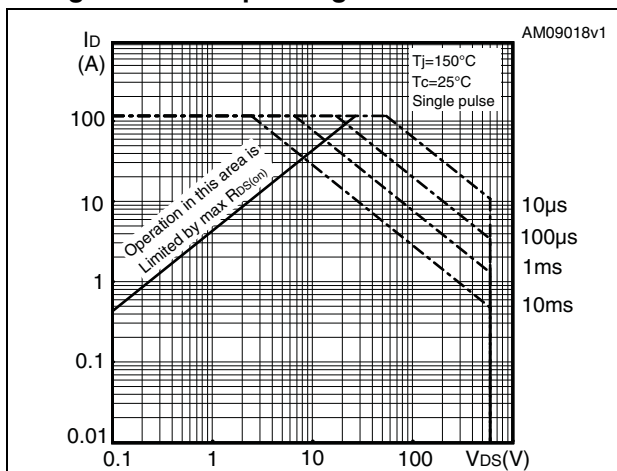


Figure 3. Thermal impedance for TO-220FP

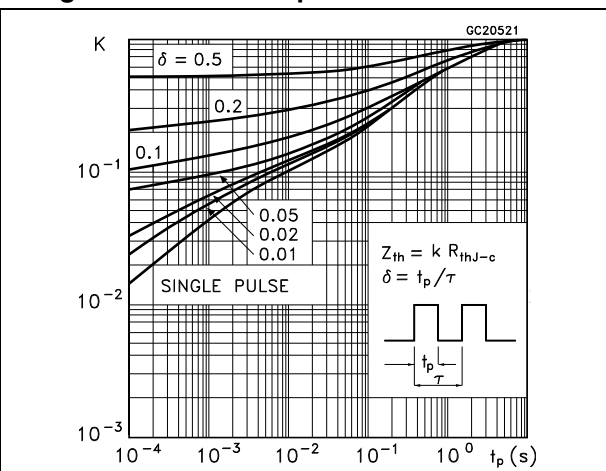


Figure 4. Safe operating area for TO-220 and D²PAK

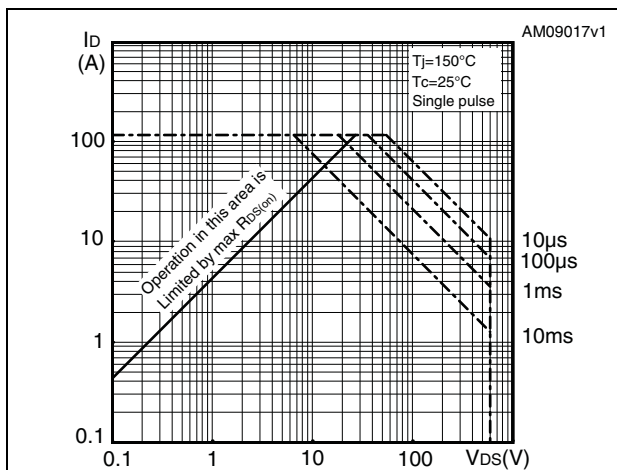


Figure 5. Thermal impedance for TO-220 and D²PAK

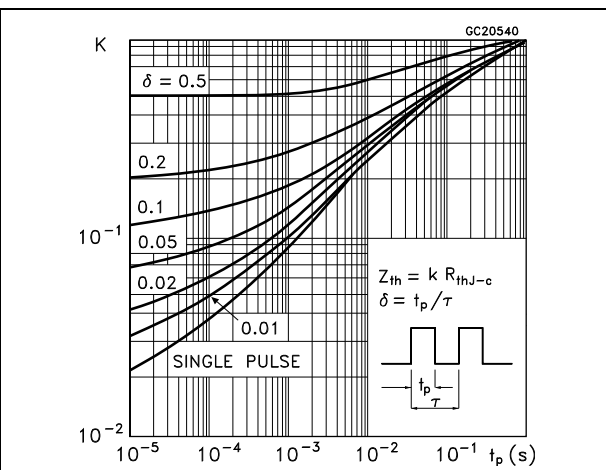


Figure 6. Safe operating area for TO-247

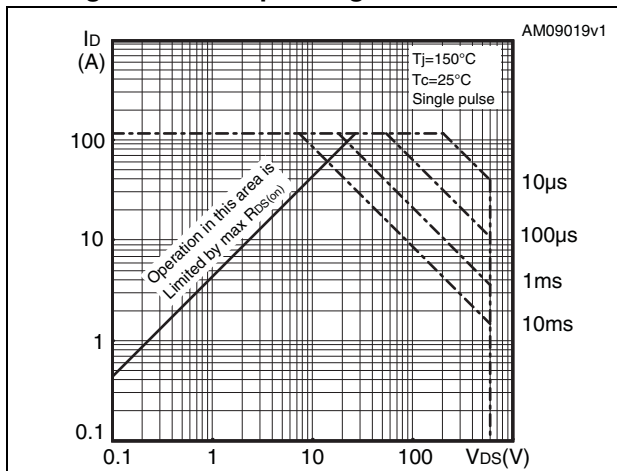


Figure 7. Thermal impedance for TO-247

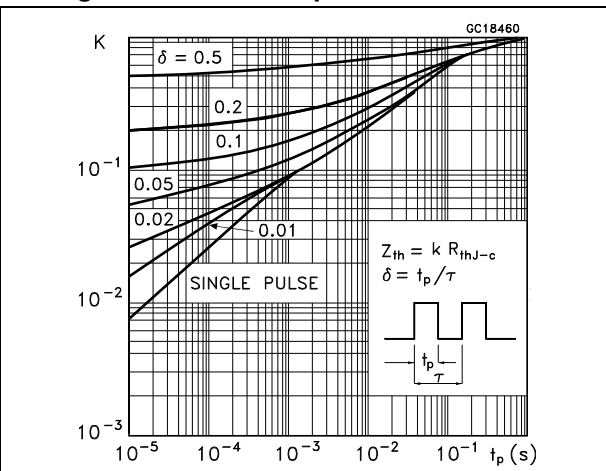


Figure 8. Output characteristics

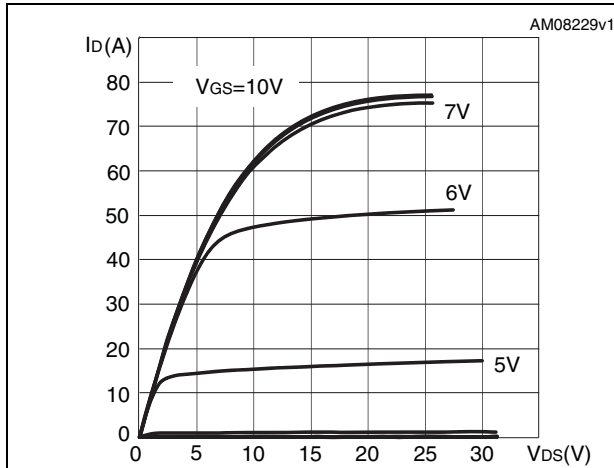


Figure 9. Transfer characteristics

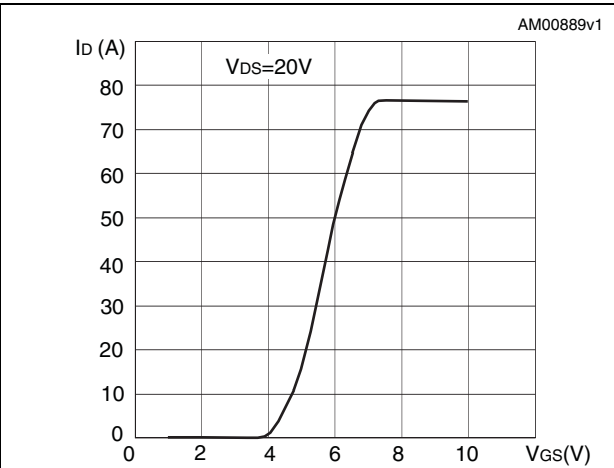


Figure 10. Gate charge vs gate-source voltage

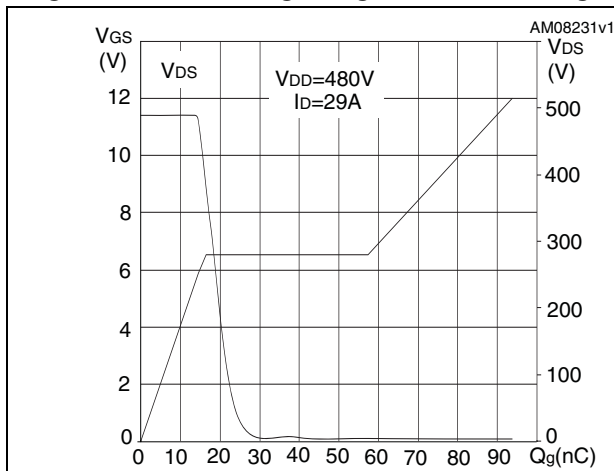


Figure 11. Static drain-source on-resistance

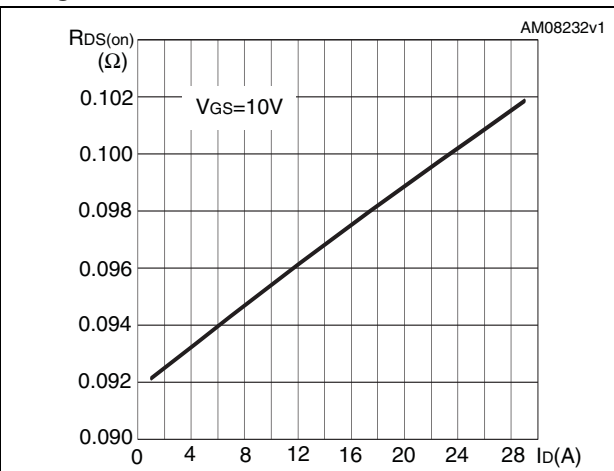


Figure 12. Capacitance variations

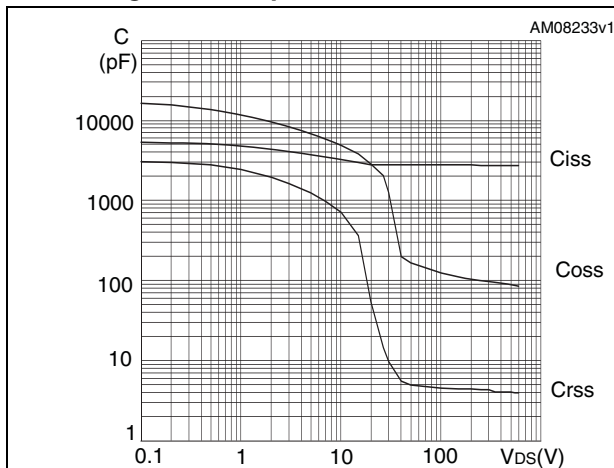


Figure 13. Output capacitance stored energy

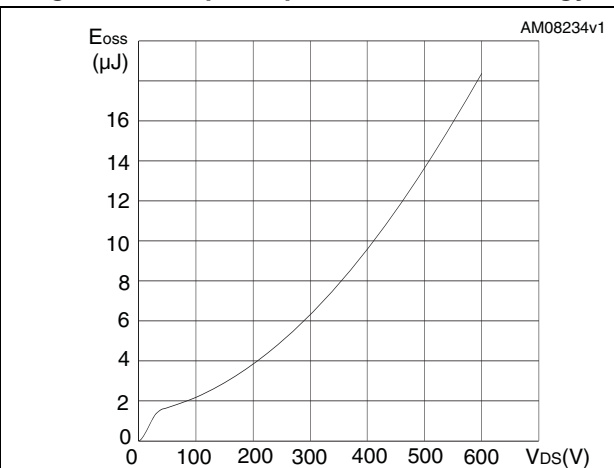


Figure 14. Normalized gate threshold voltage vs temperature

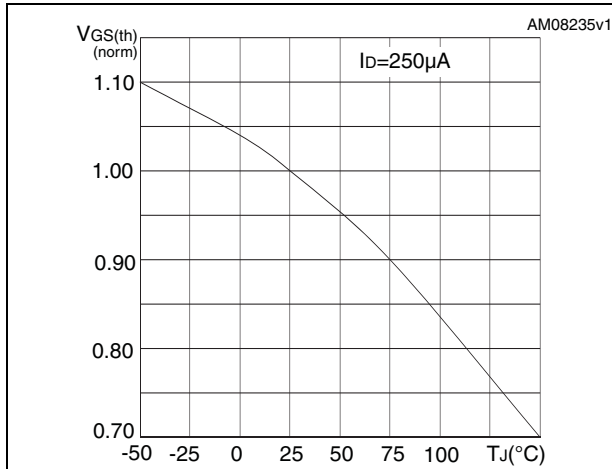


Figure 15. Normalized on-resistance vs temperature

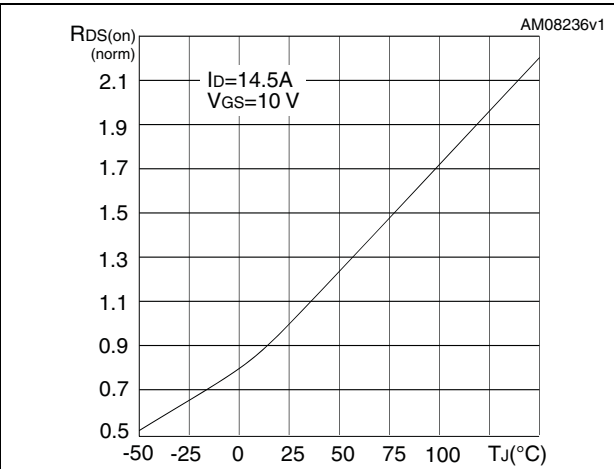


Figure 16. Normalized V_{DS} vs temperature

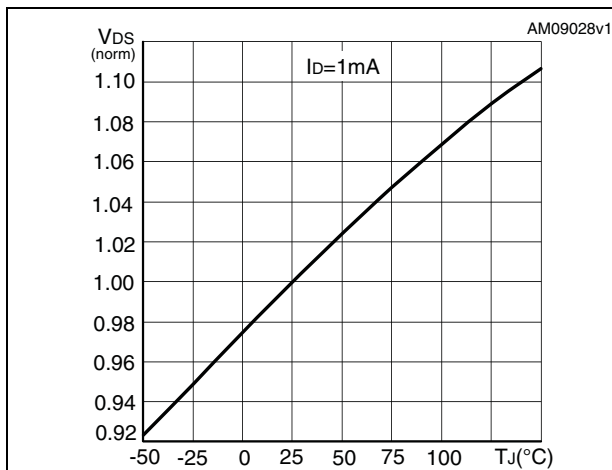
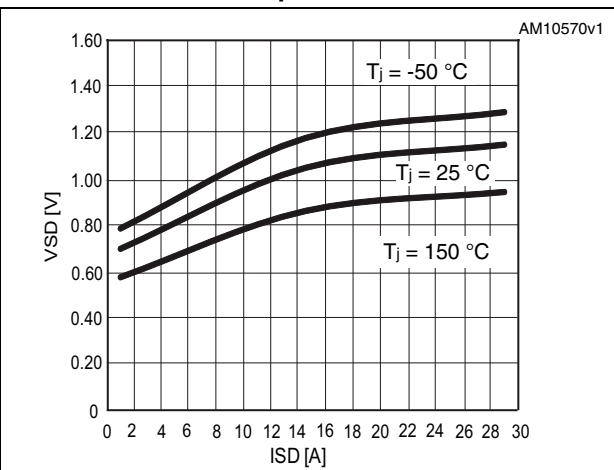


Figure 17. Source-drain diode forward vs temperature



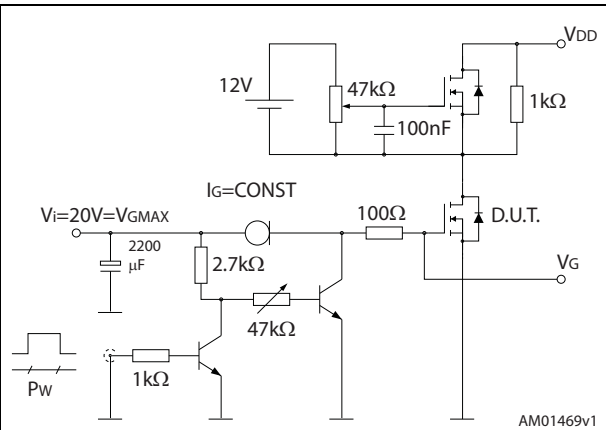
3 Test circuits

Figure 18. Switching times test circuit for resistive load



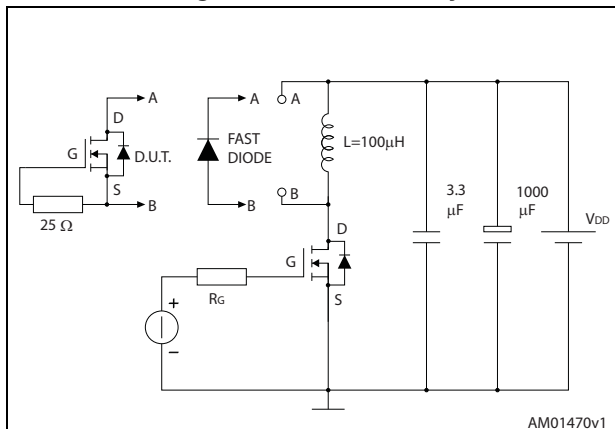
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Figure 19. Gate charge test circuit



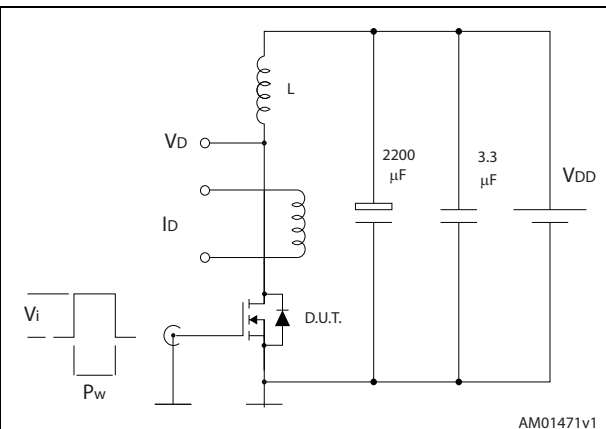
AM01469v1

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



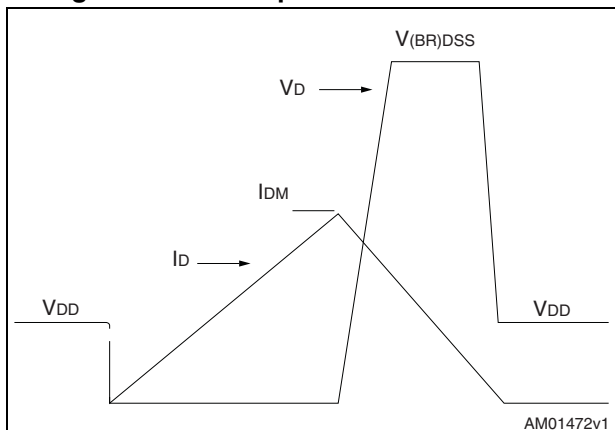
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Figure 21. Unclamped inductive load test circuit



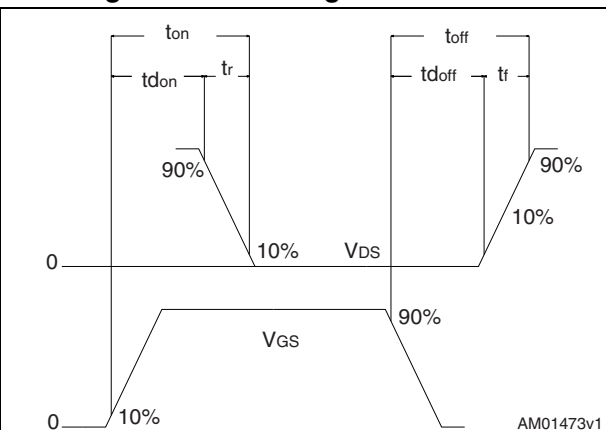
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Figure 22. Unclamped inductive waveform



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

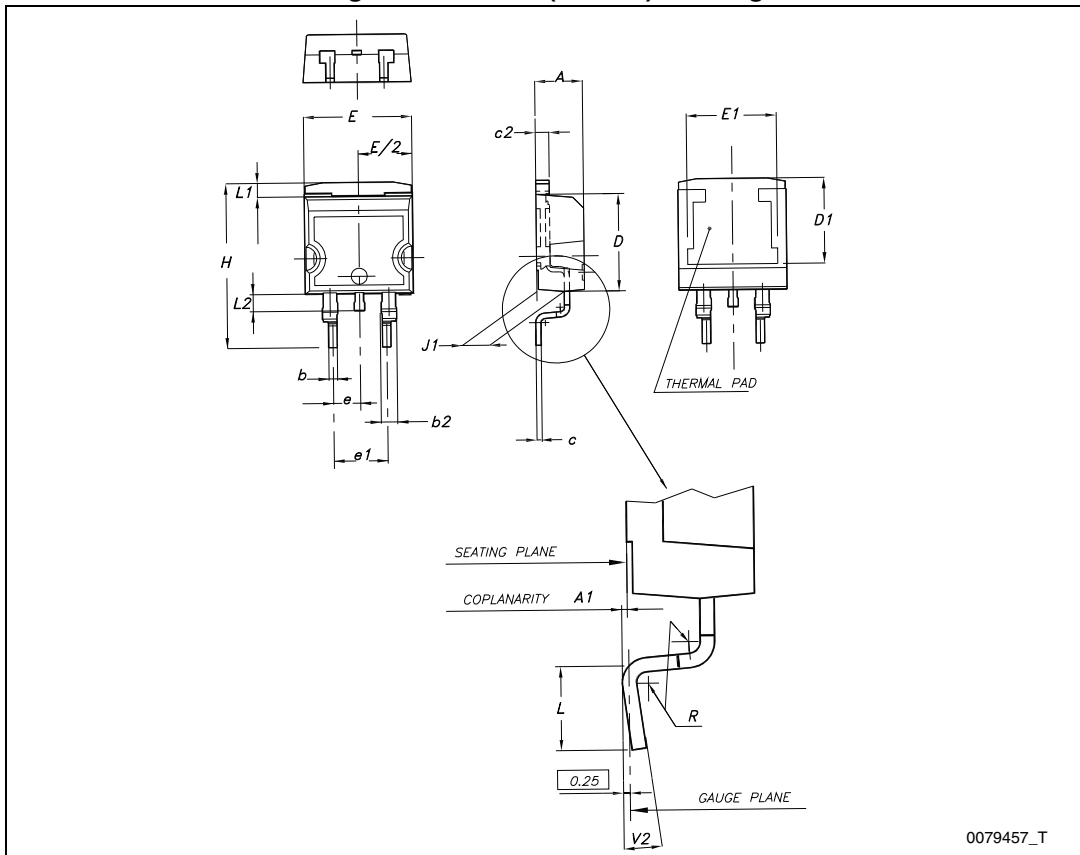
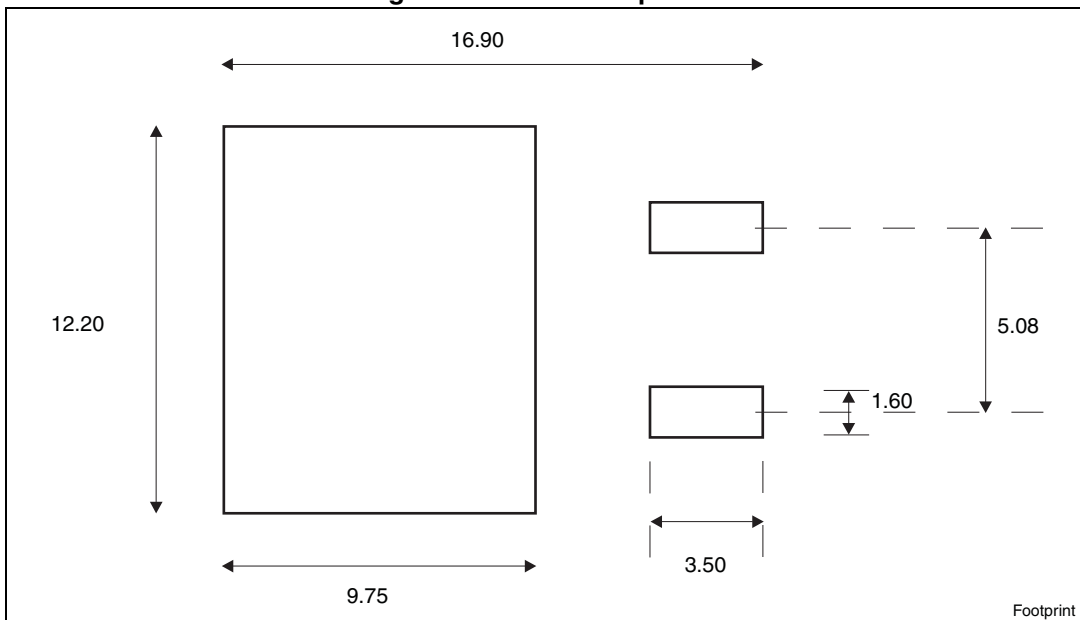


Figure 25. D²PAK footprint^(a)

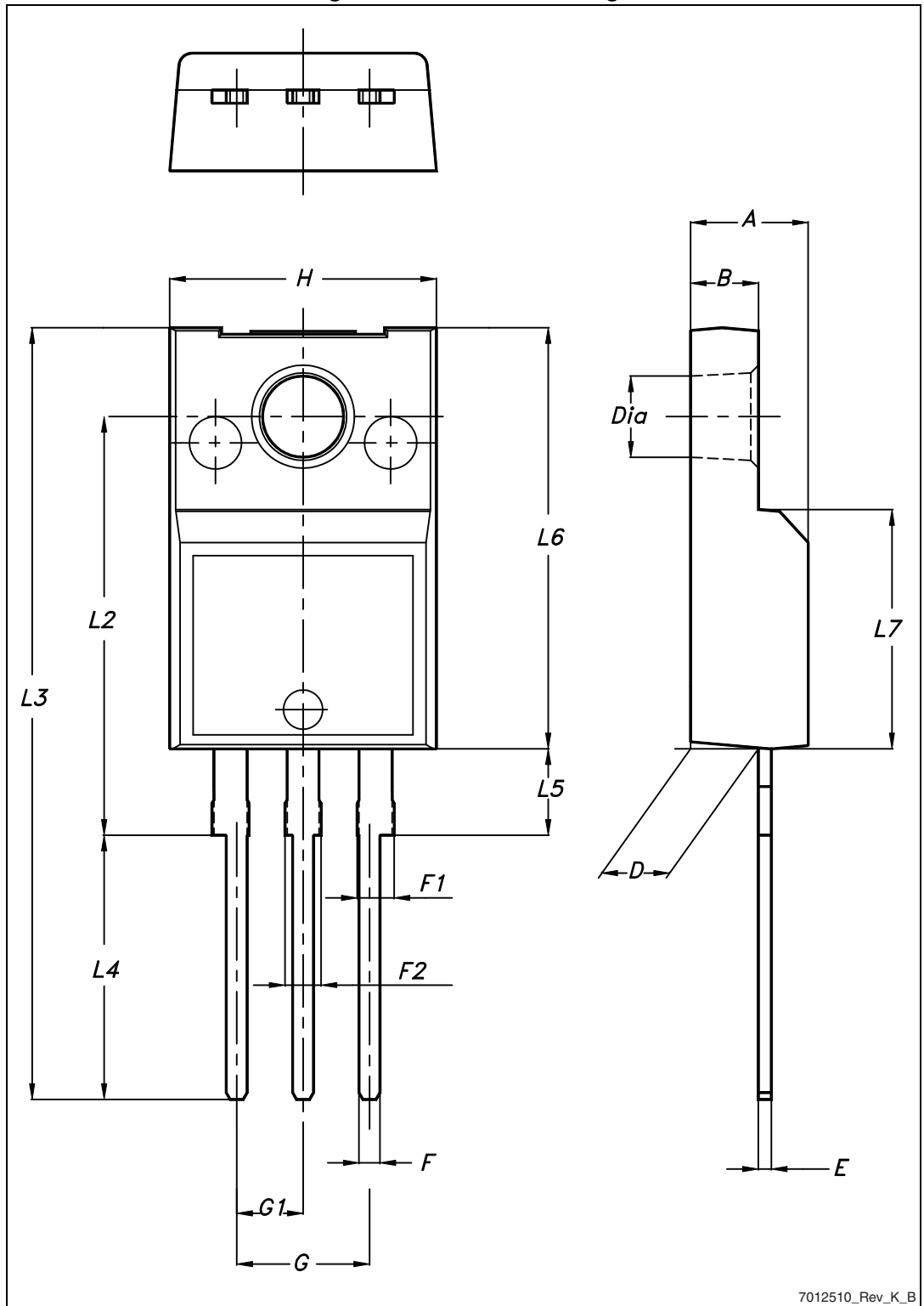


a. All dimension are in millimeters

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

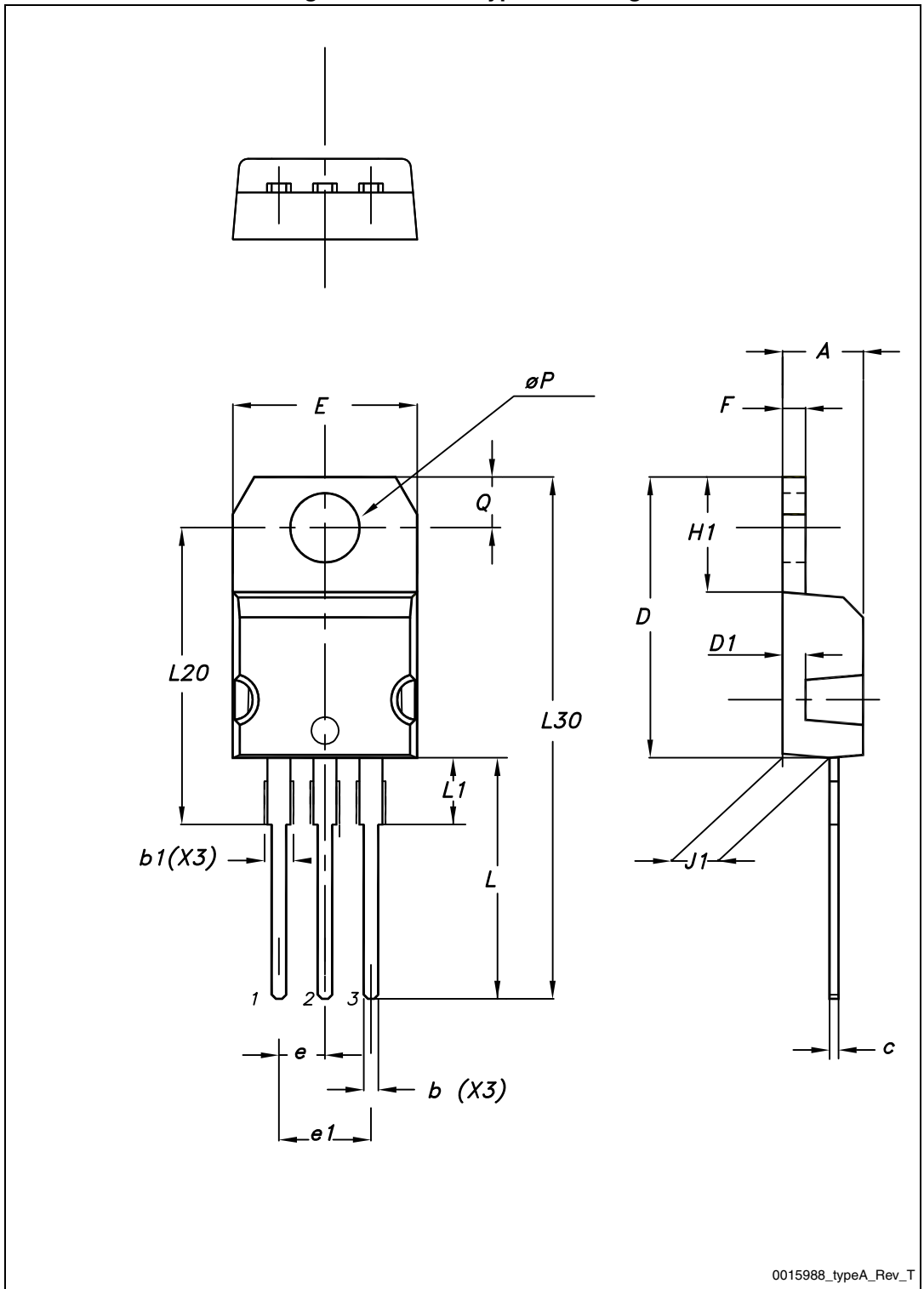


7012510_Rev_K_B

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

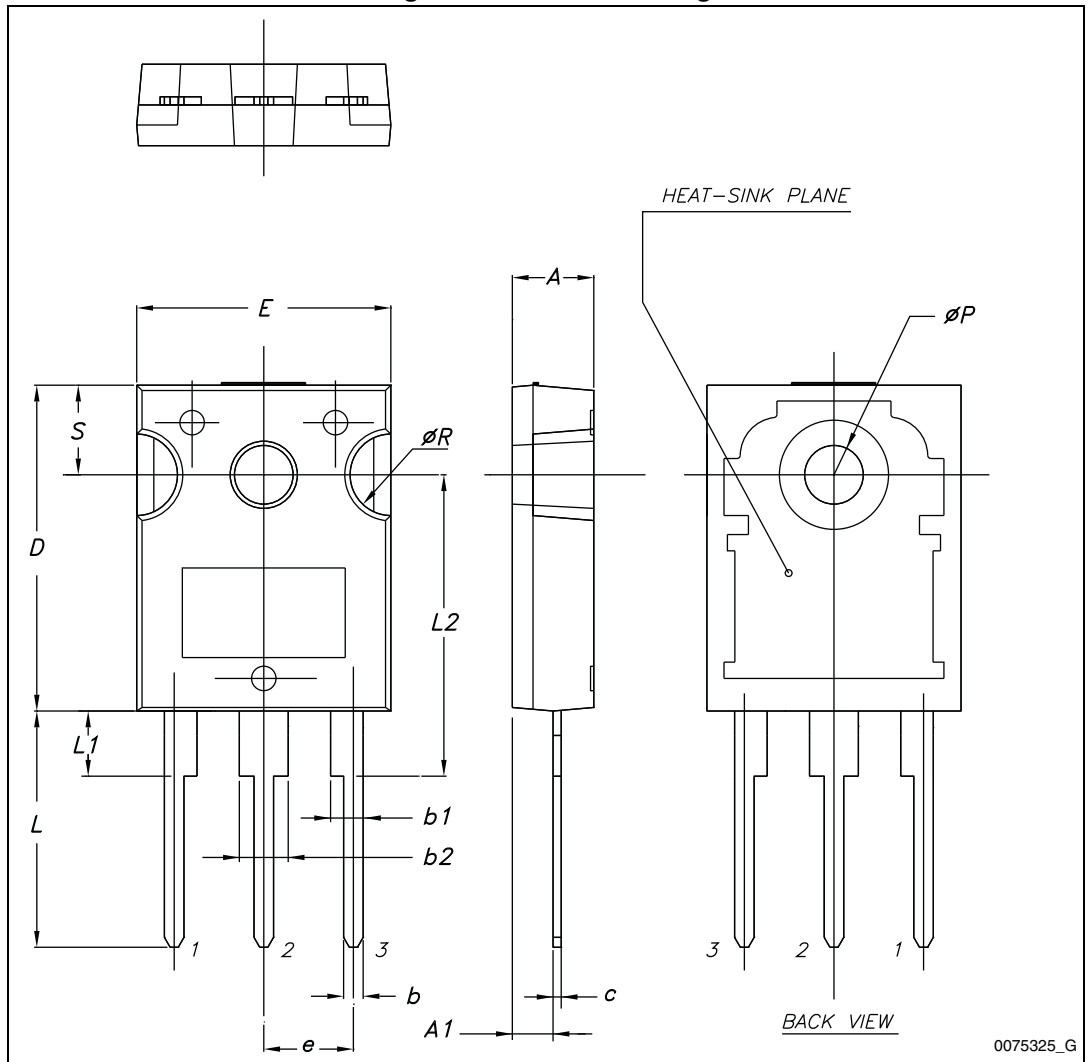


0015988_typeA_Rev_T

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

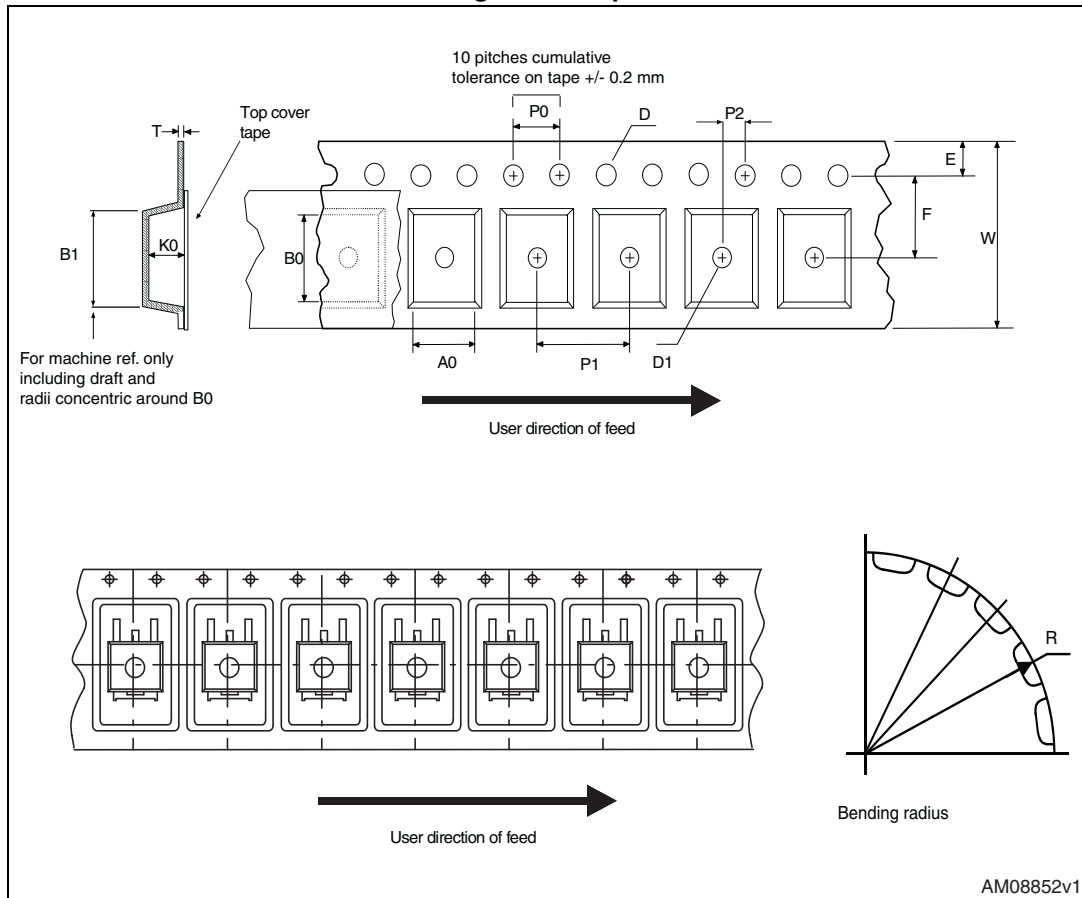


5 Packaging mechanical data

Table 12. D²PAK (TO-263) tape and reel mechanical data

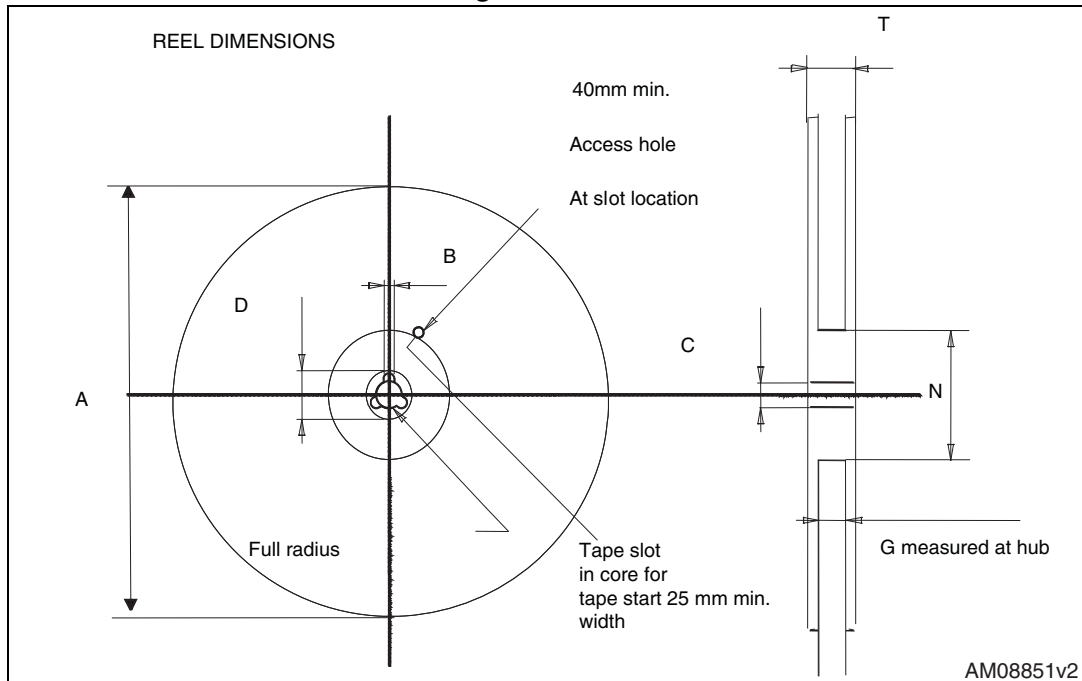
Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1		Base qty	1000
P2	1.9	2.1		Bulk qty	1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

Figure 29. Tape



AM08852v1

Figure 30. Reel



AM08851v2

6 Revision history

Table 13. Document revision history

Date	Revision	Changes
04-Nov-2010	1	Initial release.
18-Apr-2011	2	Corrected E _{AS} value in Table 4: Avalanche characteristics
14-Sep-2011	3	Added order code in D ² PAK and TO-220FP Updated Table 1: Device summary , Table 2: Absolute maximum ratings and Table 3: Thermal data . Updated Section 4: Package mechanical data . Added Section 5: Packaging mechanical data . Minor text changes.
29-Dec-2011	4	Updated description in cover page.
01-Oct-2012	5	Updated title on the cover page. Updated figures 10 , 11 , 16 and 17 . Updated Section 4: Package mechanical data . Minor text changes.
02-Oct-2013	6	– Modified: E _{AS} in Table 4 , C _{oss eq.} typical value in Table 6 , Figure 13 – Modified: Figure 18 , 19 , 20 and 21 – Minor text changes

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