STB34NM60ND, STF34NM60ND, STP34NM60ND, STW34NM60ND

N-channel 600 V, 0.097 Ω typ., 29 A FDmesh™ II Power MOSFET (with fast diode) in D^2PAK, TO-220FP, TO-220 and TO-247

Datasheet — production data

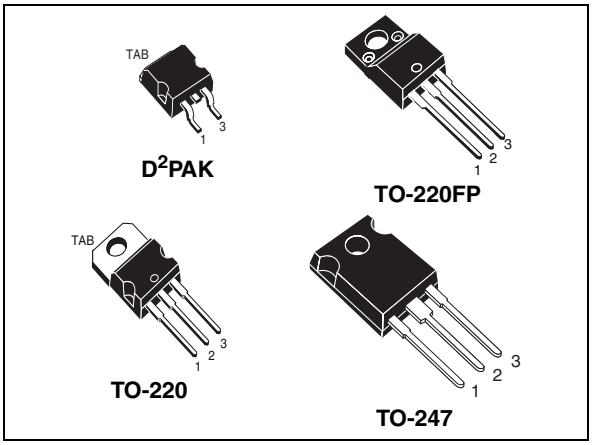
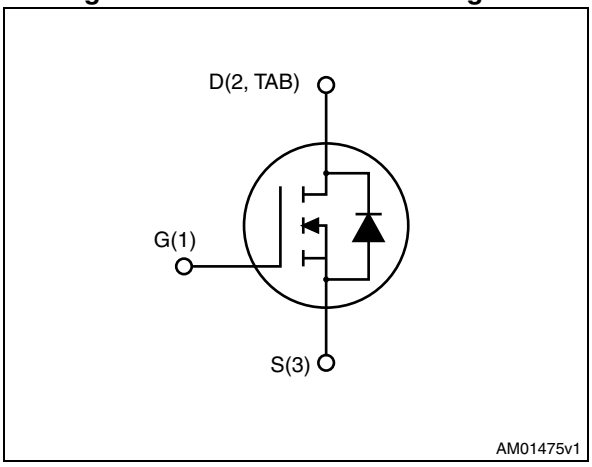


Figure 1. Internal schematic diagram



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^2PAK	Tape and reel
STF34NM60ND		TO-220FP	Tube
STP34NM60ND		TO-220	
STW34NM60ND		TO-247	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D^2PAK, 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. $I_{SD} \leq 29$ A, di/dt $\leq$ 600 A/µs, V_{DD} = 80% $V_{(BR)DSS}$,$V_{DSPeak} < V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	TO-220	TO-247	D^2PAK	TO-220FP	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case max	0.66			3.1	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	62.5	50		62.5	°C/W
$R_{thj\text{-}pcb}$(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 °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 mA	600			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 600 V			1	µA
		V_{DS} = 600 V, T_C=125 °C			100	µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 25 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 14.5 A		0.097	0.110	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0	-	2785	-	pF
C_{oss}	Output capacitance		-	168	-	pF
C_{rss}	Reverse transfer capacitance		-	5	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{GS} = 0, V_{DS} = 0 to 480 V	-	438	-	pF
$t_{d(on)}$	Turn-on delay time	V_{DD} =300 V, I_D = 14.5 A R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 18* and *23*)	-	30	-	ns
t_r	Rise time		-	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 V, I_D = 29 A, V_{GS} = 10 V, *(see Figure 19)*	-	80.4	-	nC
Q_{gs}	Gate-source charge		-	16	-	nC
Q_{gd}	Gate-drain charge		-	41.4	-	nC
R_g	Gate input resistance	f=1 MHz, open drain	-	2.87	-	Ω

1. $C_{oss\ eq.}$ 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 A, V_{GS} = 0	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 29 A, V_{DD} = 60 V di/dt=100 A/µs *(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 A,V_{DD} = 60 V di/dt=100 A/µs, T_J = 150 °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

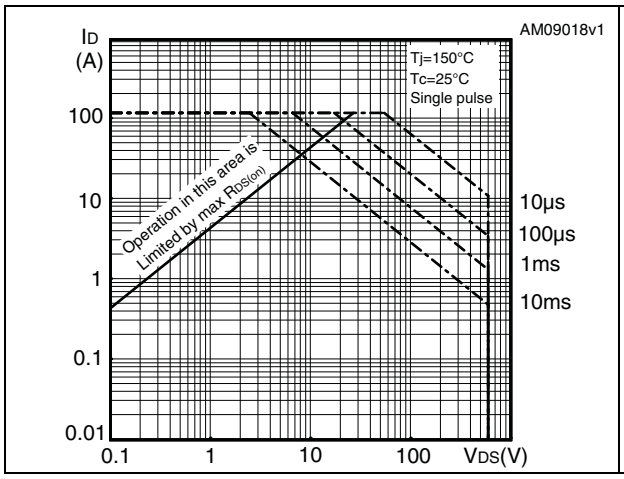


Figure 3. Thermal impedance for TO-220FP

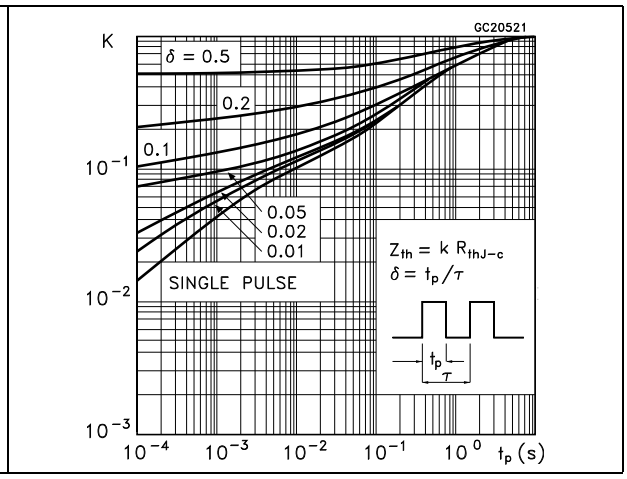


Figure 4. Safe operating area for TO-220 and D²PAK

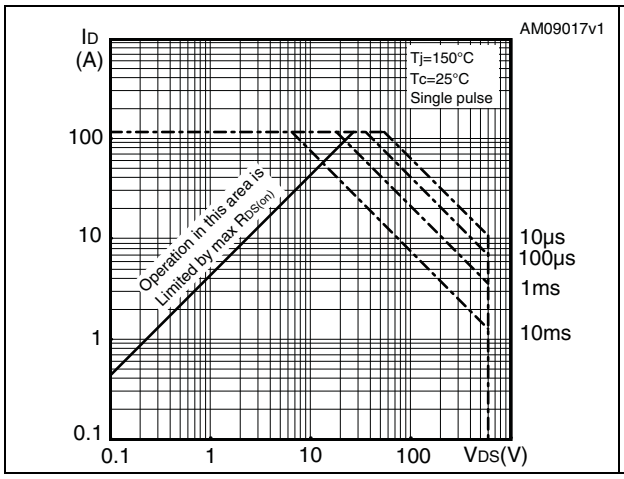


Figure 5. Thermal impedance for TO-220 and D²PAK

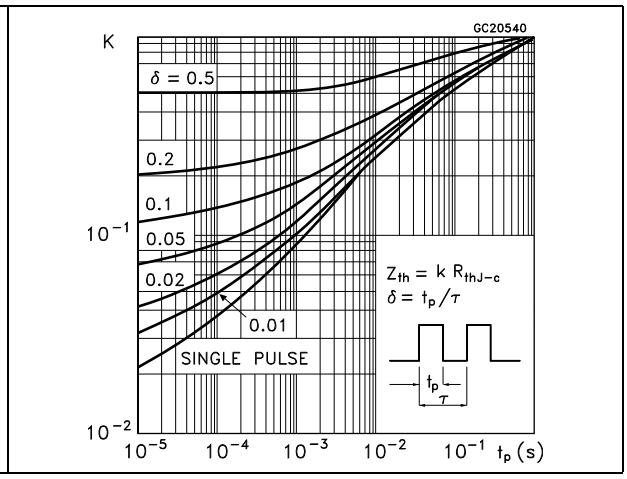


Figure 6. Safe operating area for TO-247

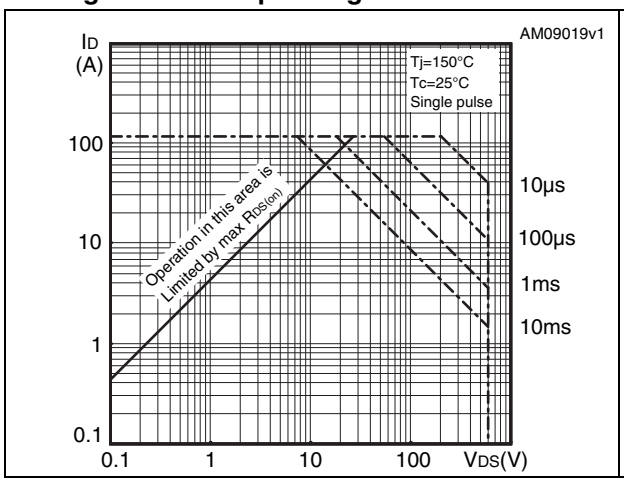


Figure 7. Thermal impedance for TO-247

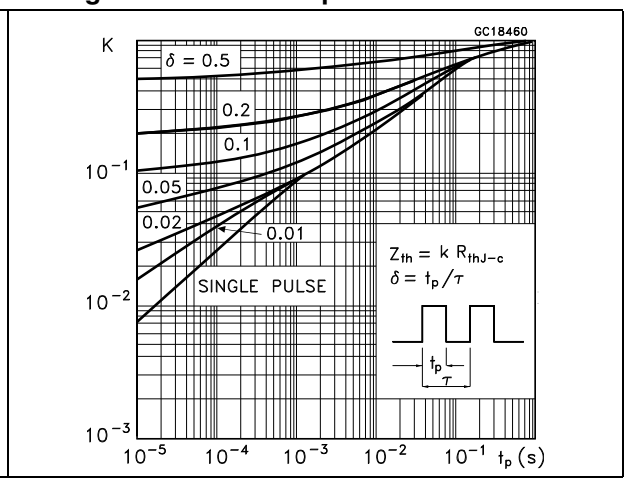


Figure 8. Output characteristics

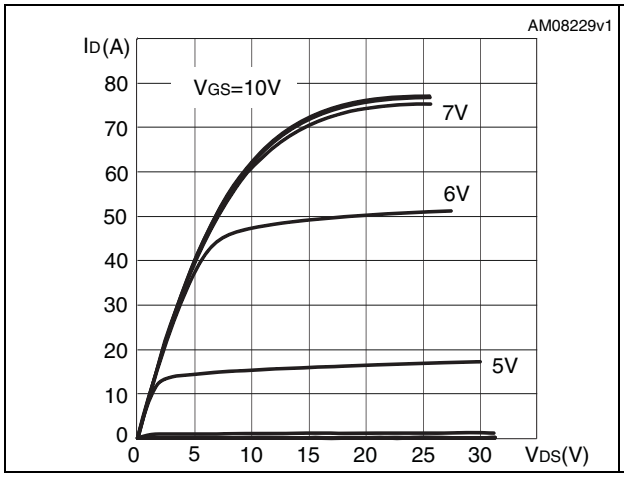


Figure 9. Transfer characteristics

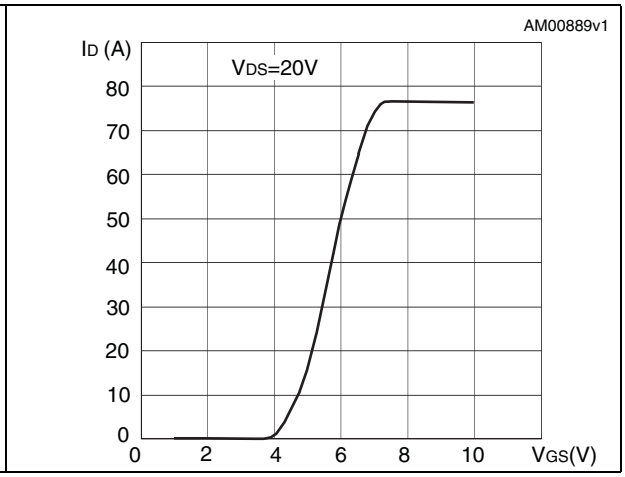


Figure 10. Gate charge vs gate-source voltage

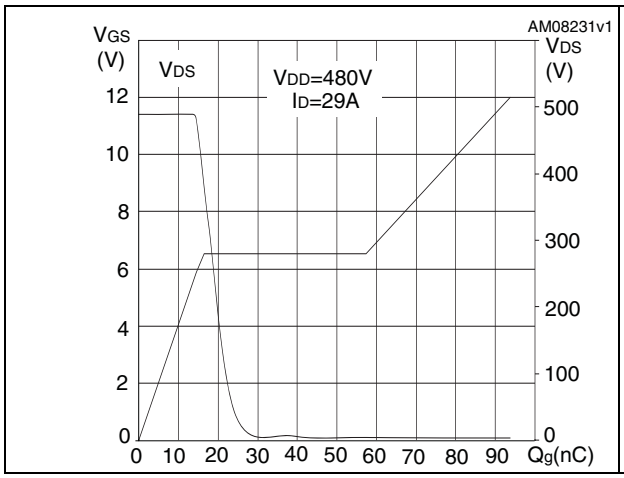


Figure 11. Static drain-source on-resistance

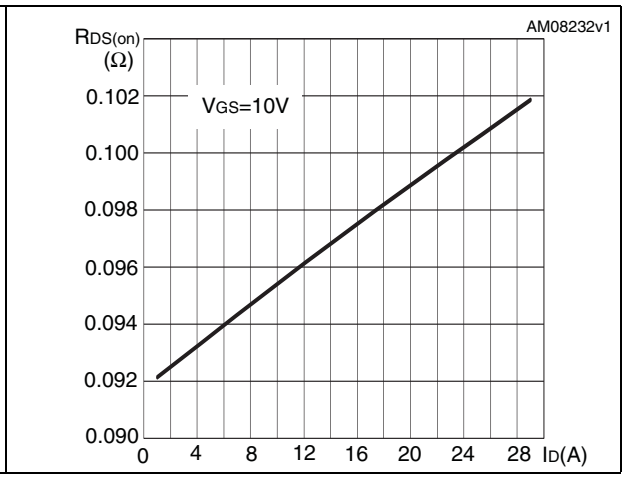


Figure 12. Capacitance variations

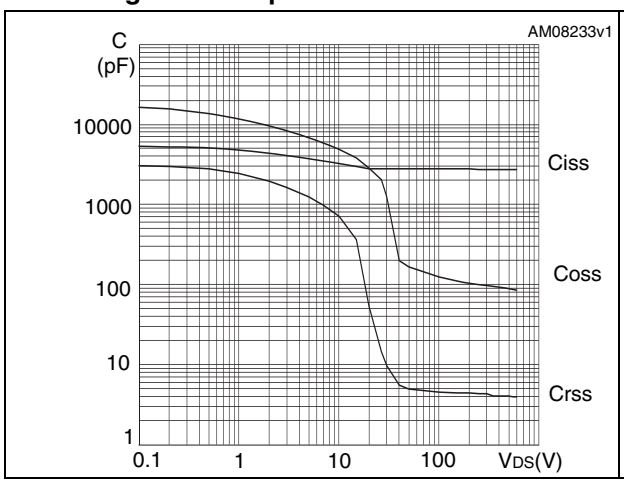


Figure 13. Output capacitance stored energy

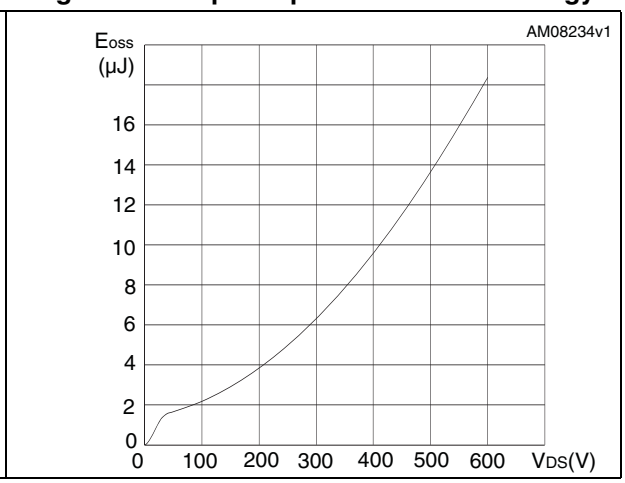


Figure 14. Normalized gate threshold voltage vs temperature

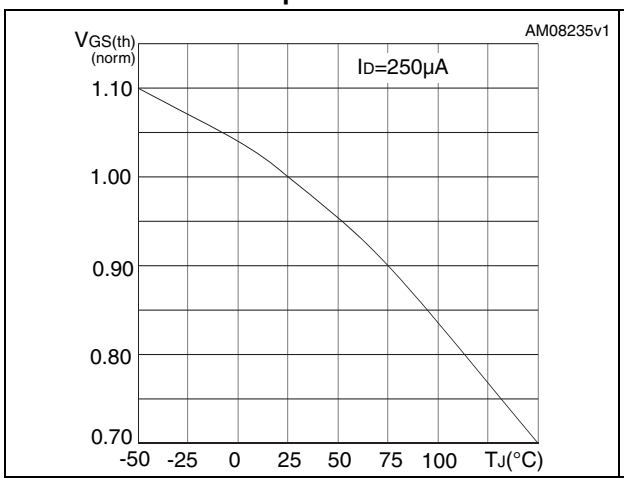


Figure 15. Normalized on-resistance vs temperature

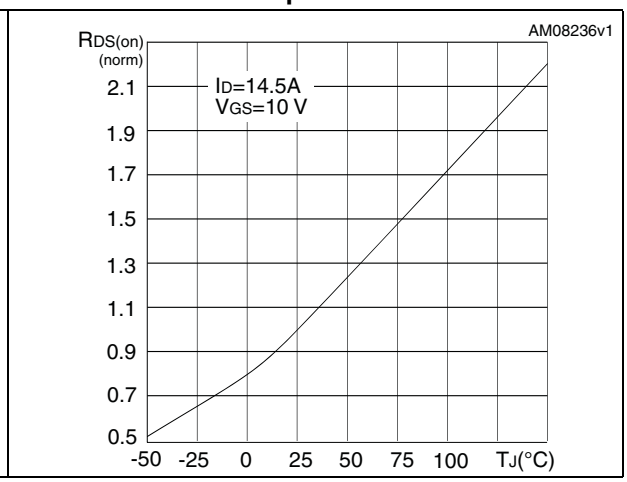


Figure 16. Normalized V_{DS} vs temperature

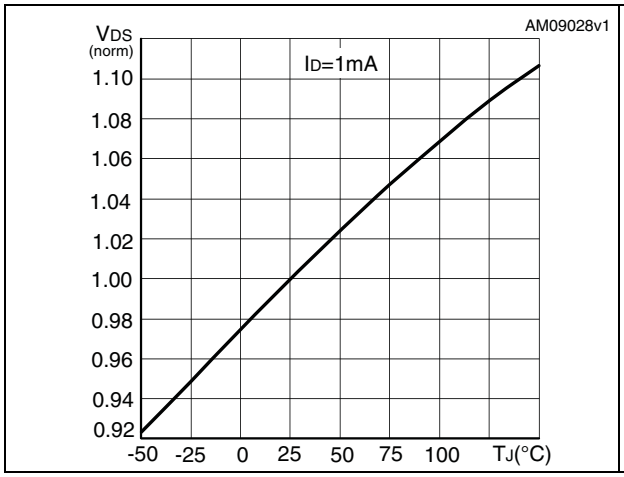
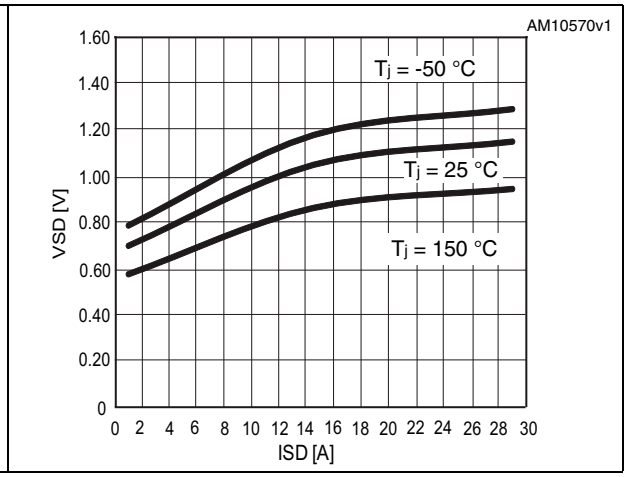


Figure 17. Source-drain diode forward vs temperature



3 Test circuits

Figure 18. Switching times test circuit for resistive load

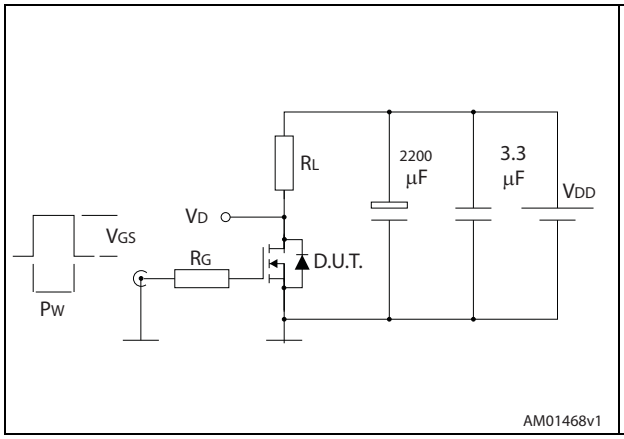


Figure 19. Gate charge test circuit

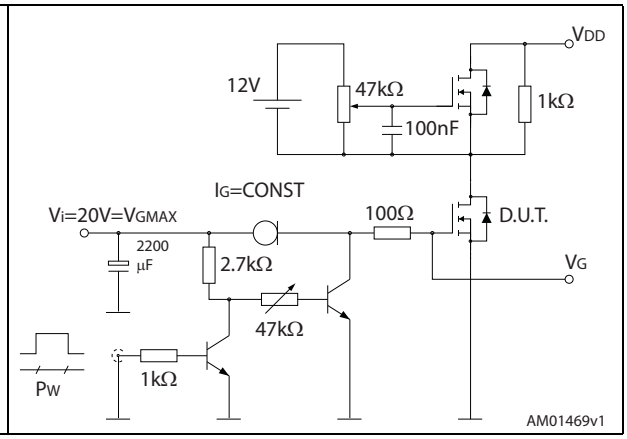


Figure 20. Test circuit for inductive load switching and diode recovery times

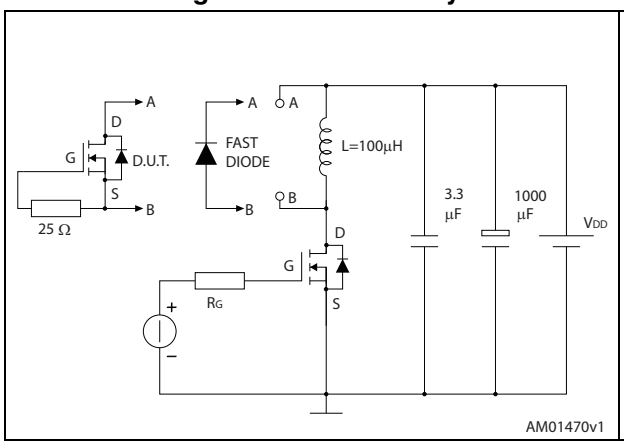


Figure 21. Unclamped inductive load test circuit

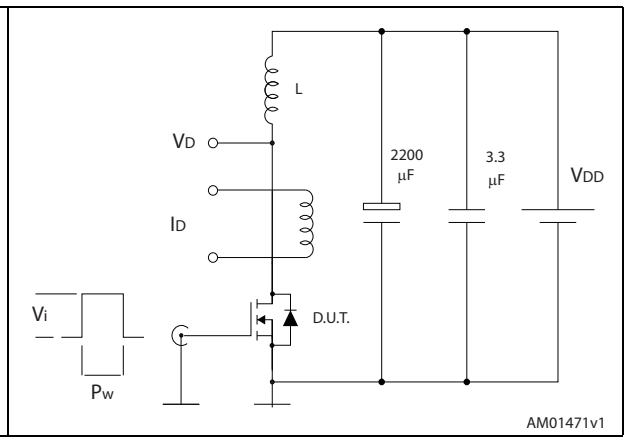


Figure 22. Unclamped inductive waveform

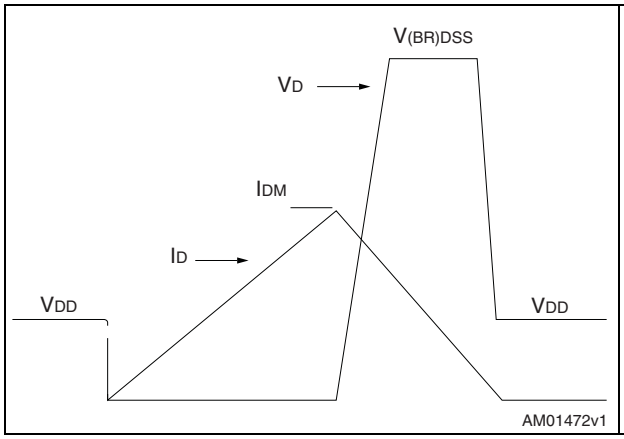
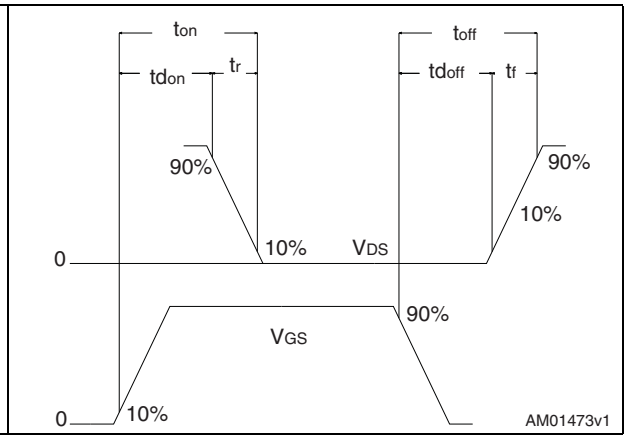


Figure 23. Switching time waveform



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

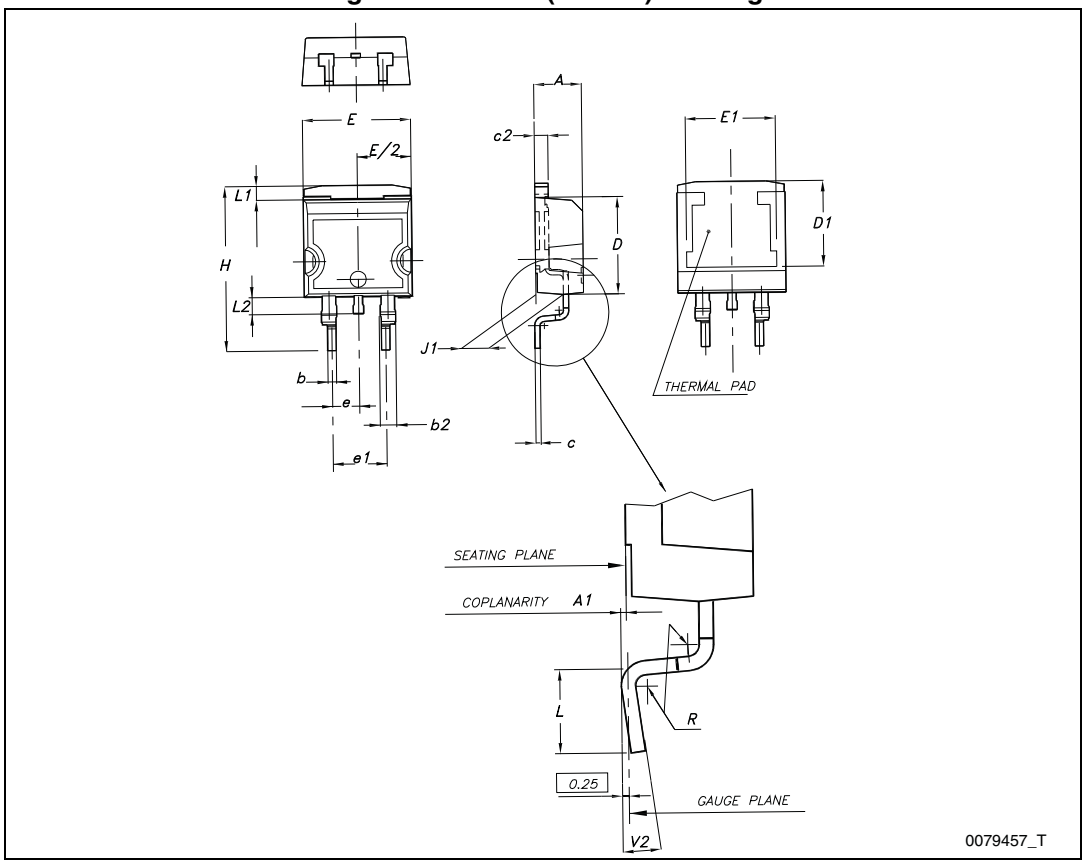
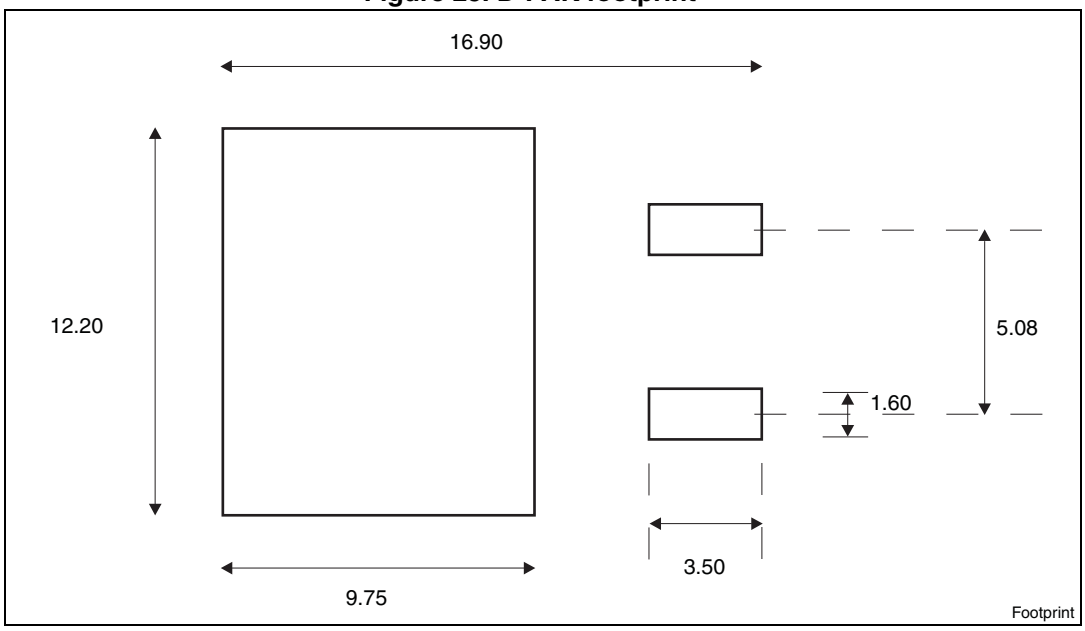


Figure 25. D²PAK footprint[a]



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

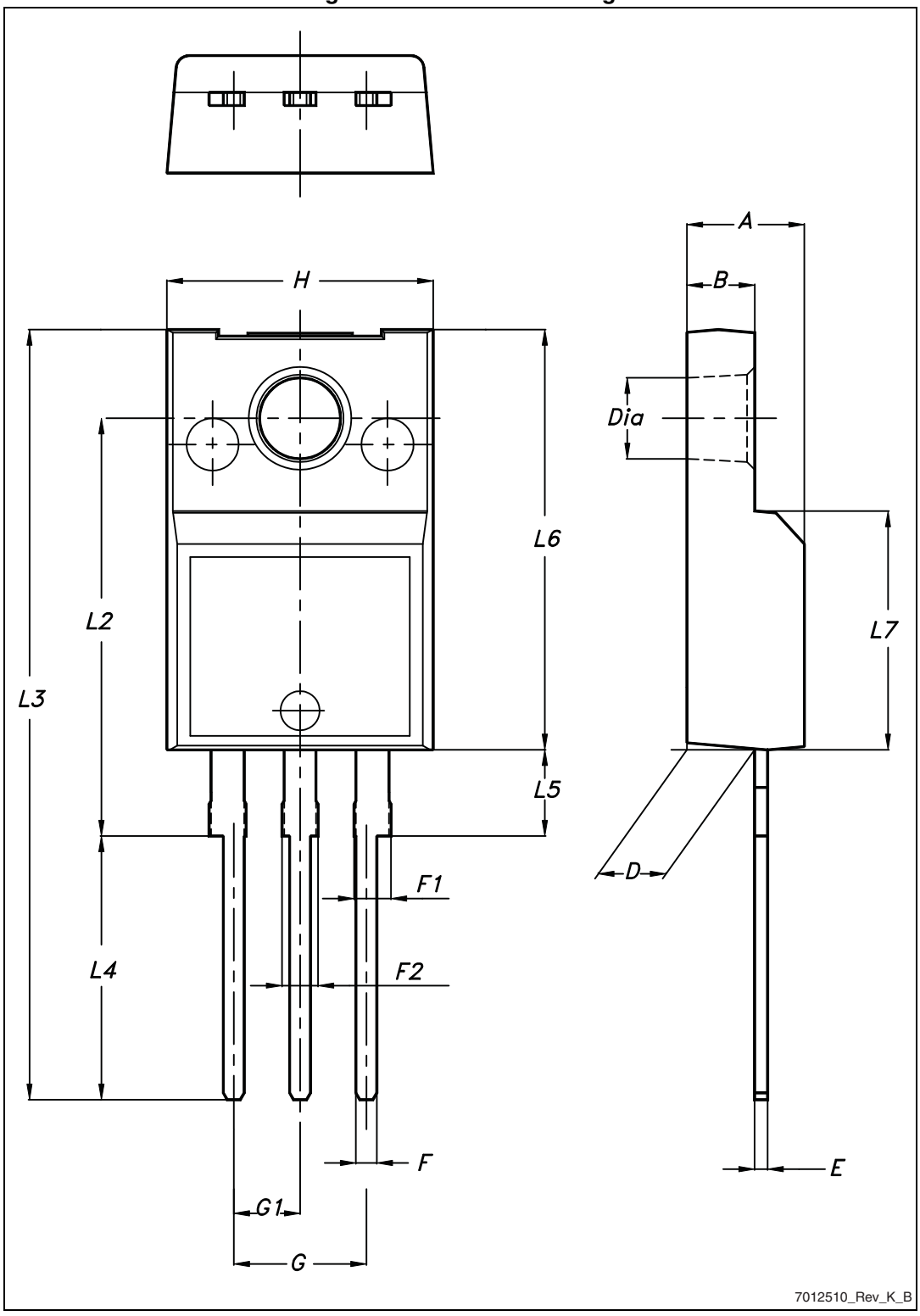


Table 10. TO-220 type A mechanical data

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	
∅P	3.75		3.85
Q	2.65		2.95

Figure 27. TO-220 type A drawing

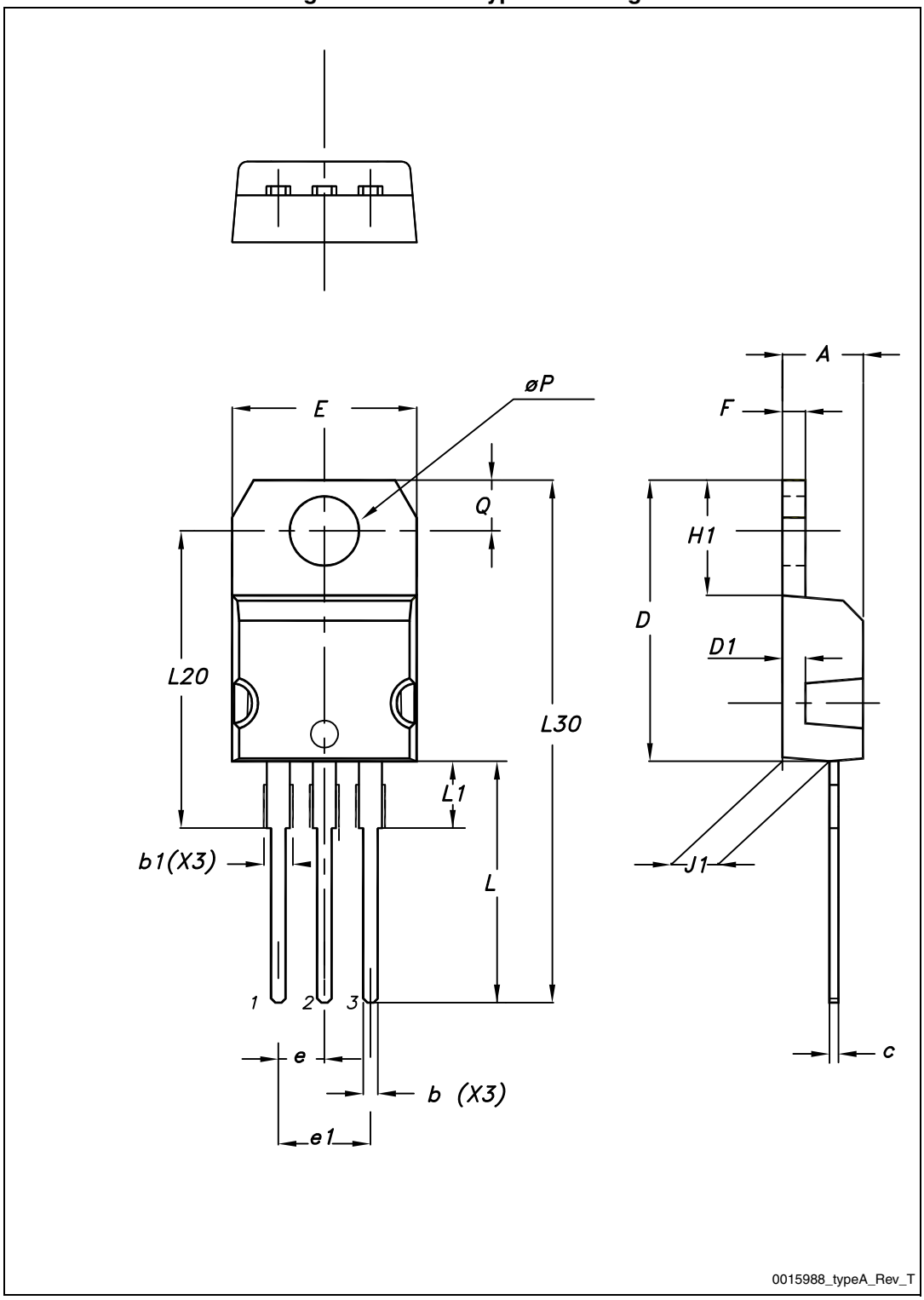
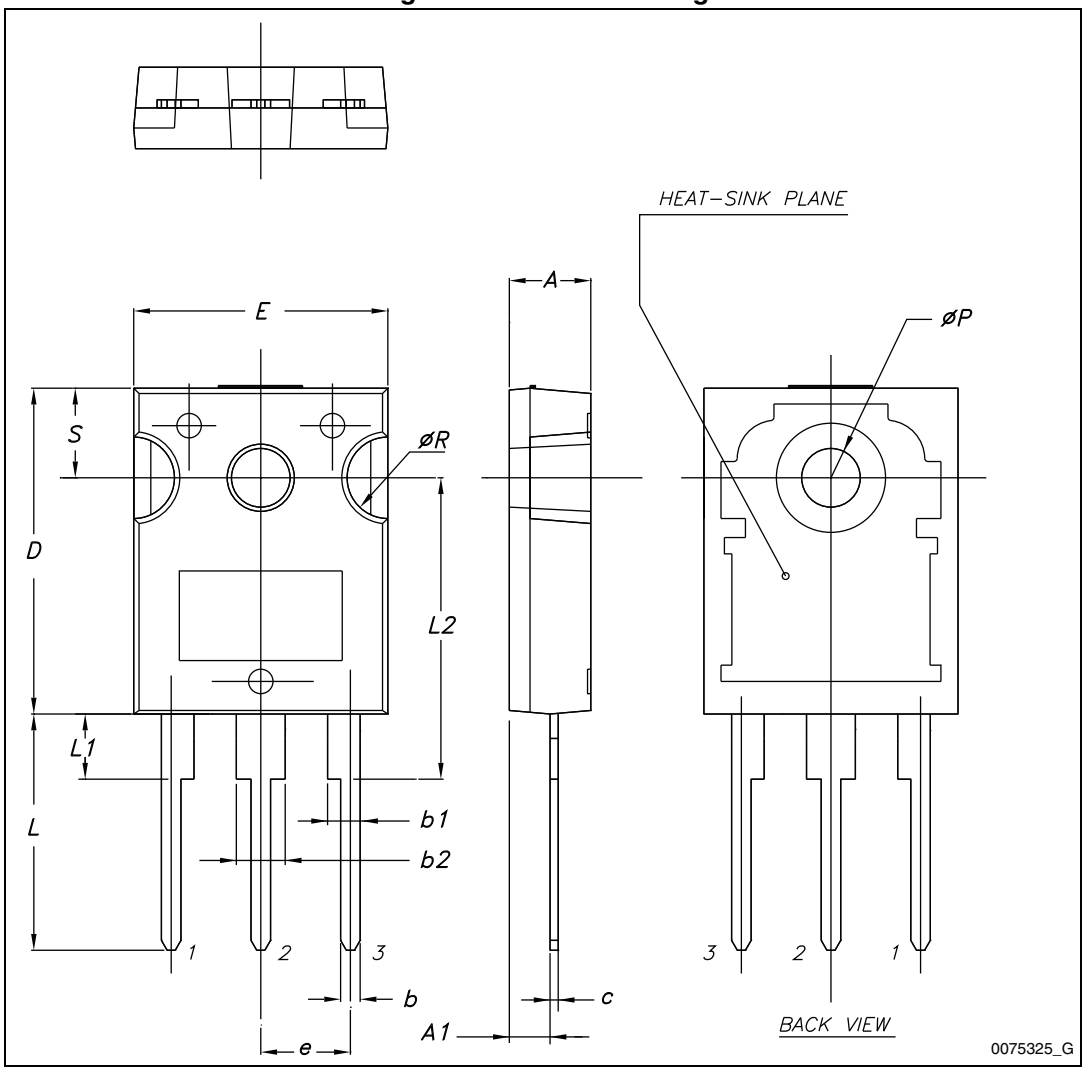


Table 11. TO-247 mechanical data

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	
∅P	3.55		3.65
∅R	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

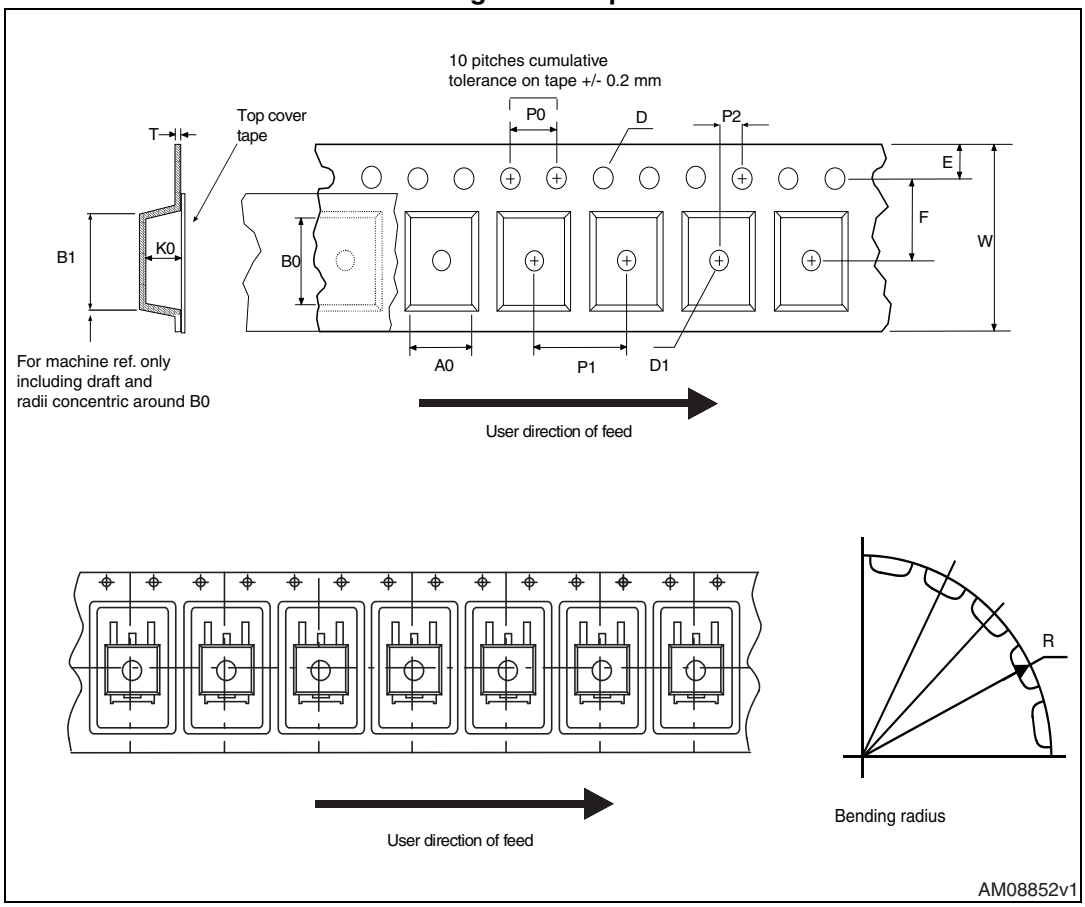
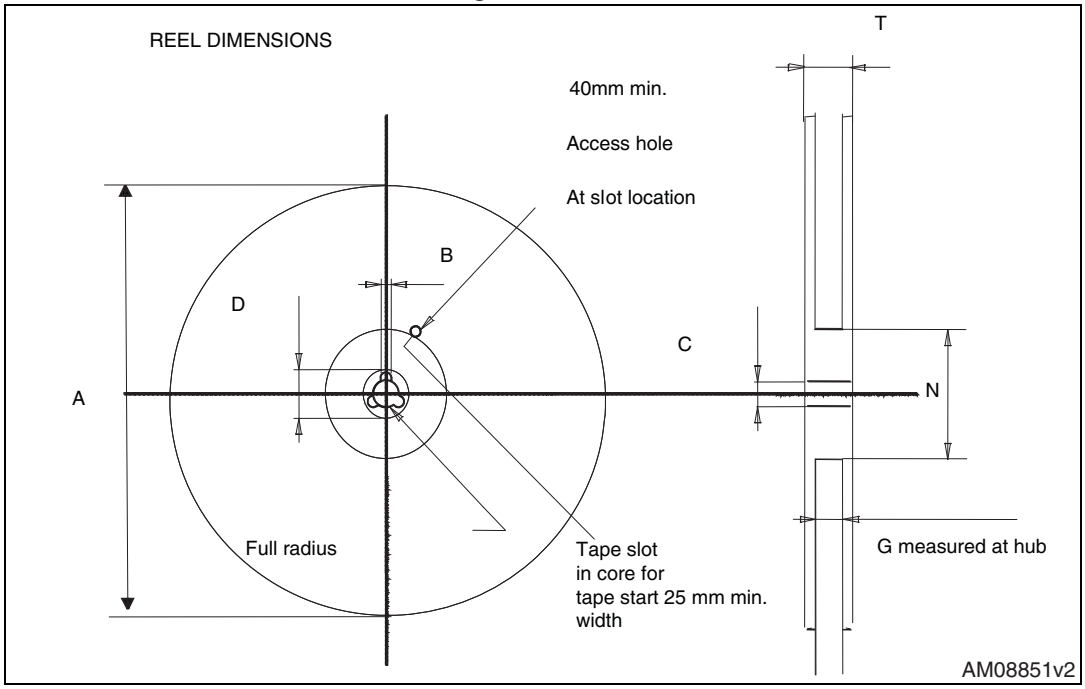


Figure 30. Reel



6 Revision history

Table 13. Document revision history

Date	Revision	Changes
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^2PAK 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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