

N-channel 600 V, 0.092 Ω , 31.5 A MDmesh™ II Power MOSFETs in D²PAK and TO-220 packages

Datasheet - production data

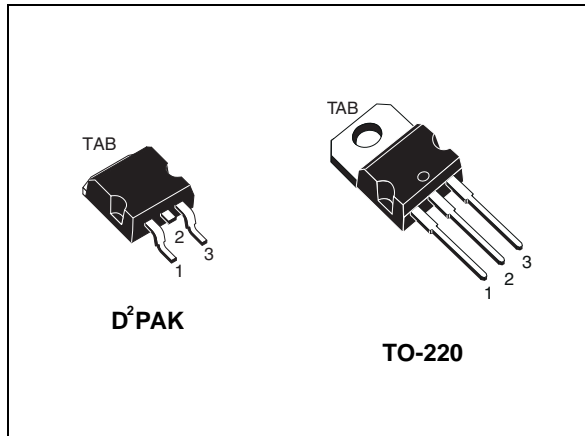
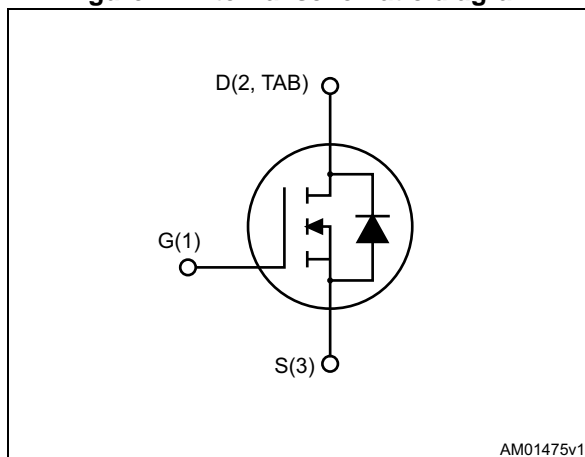


Figure 1. Internal schematic diagram



Features

Order codes	V _{DSS}	R _{DS(on)}	I _D	P _{TOT}
STB34NM60N	600 V	0.105 Ω	31.5 A	250 W
STP34NM60N				

- 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.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STB34NM60N	34NM60N	D ² PAK	Tape and reel
STP34NM60N		TO-220	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	600	V
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	31.5	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	20	A
$I_{DM}^{(1)}$	Drain current (pulsed)	126	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	250	W
I_{AR}	Max current during repetitive or single pulse avalanche (pulse width limited by T_{jmax})	7	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$)	345	mJ
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature	-55 to 150	$^\circ\text{C}$
T_j	Max. operating junction temperature	150	$^\circ\text{C}$

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 31.5\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS\text{ peak}} \leq V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$
3. $V_{DS} \leq 480\text{ V}$

Table 3. Thermal data

Symbol	Parameter	Value		Unit
		D ² PAK	TO-220	
$R_{thj-case}$	Thermal resistance junction-case max	0.5		$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-amb max		62.5	
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb max	30		

1. When mounted on 1 inch² FR-4, 2 Oz copper board.

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 ($V_{GS} = 0$)	$I_D = 1\text{ mA}$	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 capacitance time related	$V_{GS} = 0, V_{DS} = 0\text{ to }480\text{ V}$	-	458	-	pF
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}, I_D = 15.75\text{ A}, R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ (see Figure 19 and 14)	-	18	-	ns
t_r	Rise time		-	36	-	ns
$t_{d(off)}$	Turn-off delay time		-	104	-	ns
t_f	Fall time		-	73	-	ns
Q_g	Total gate charge	$V_{DD} = 480\text{ V}, I_D = 31.5\text{ A}$ $V_{GS} = 10\text{ V}$ (see Figure 15)	-	84	-	nC
Q_{gs}	Gate-source charge		-	14	-	nC
Q_{gd}	Gate-drain charge		-	45	-	nC
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}, \text{ gate DC Bias} = 0$ 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		-		31.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		126	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}= 31.5 \text{ A}, V_{GS}=0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD}= 31.5 \text{ A}, V_{DD}= 60 \text{ V}$ $di/dt = 100 \text{ A}/\mu\text{s}$, (see Figure 16)	-	412		ns
Q_{rr}	Reverse recovery charge		-	8		μC
I_{RRM}	Reverse recovery current		-	39		A
t_{rr}	Reverse recovery time	$I_{SD}= 31.5 \text{ A}, V_{DD}= 60 \text{ V}$ $di/dt=100 \text{ A}/\mu\text{s}$, $T_J=150 \text{ }^\circ\text{C}$ (see Figure 16)	-	490		ns
Q_{rr}	Reverse recovery charge		-	10		μC
I_{RRM}	Reverse recovery current		-	43		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

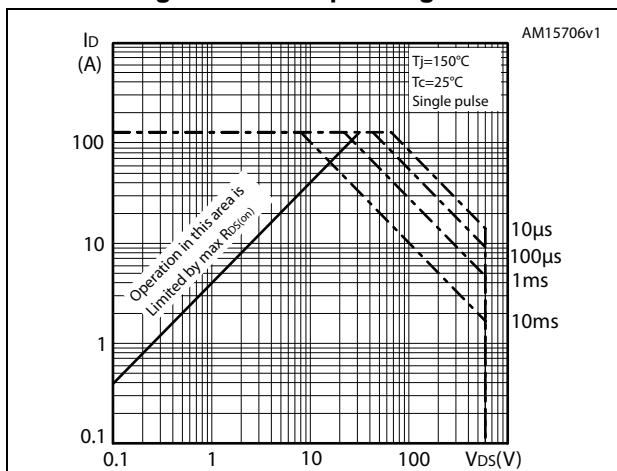


Figure 3. Thermal impedance

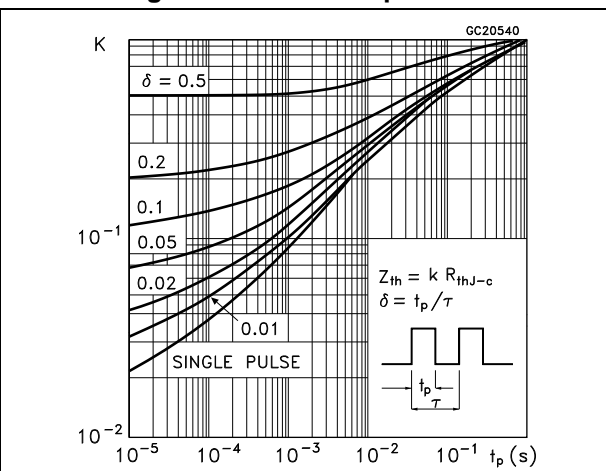


Figure 4. Output characteristics

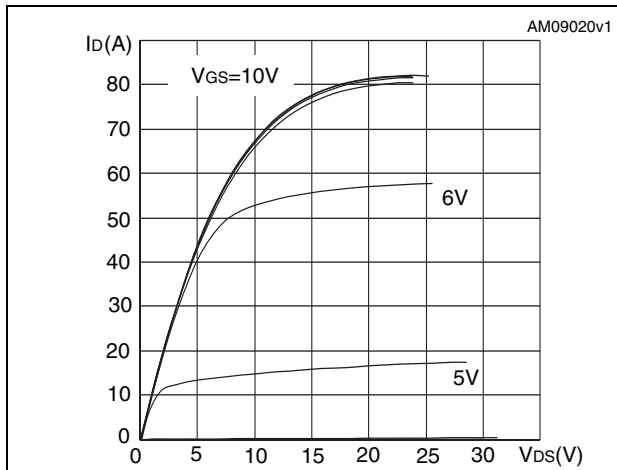


Figure 5. Transfer characteristics

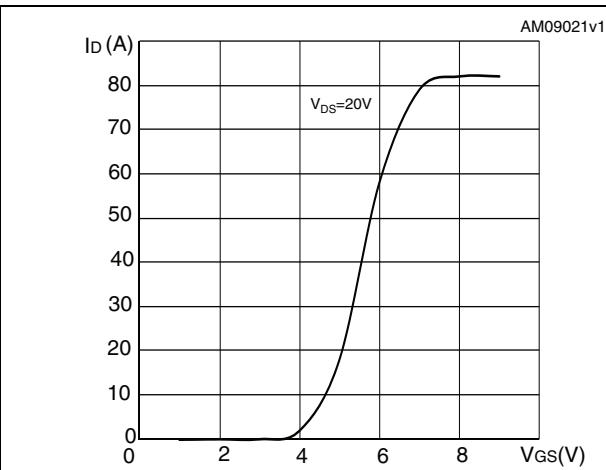


Figure 6. Gate charge vs gate-source voltage

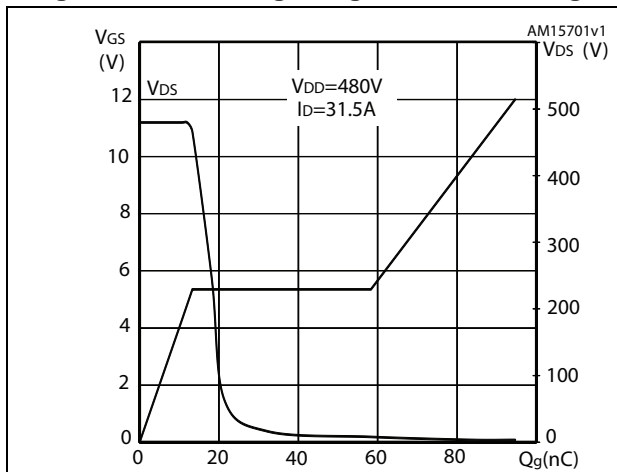


Figure 7. Static drain-source on-resistance

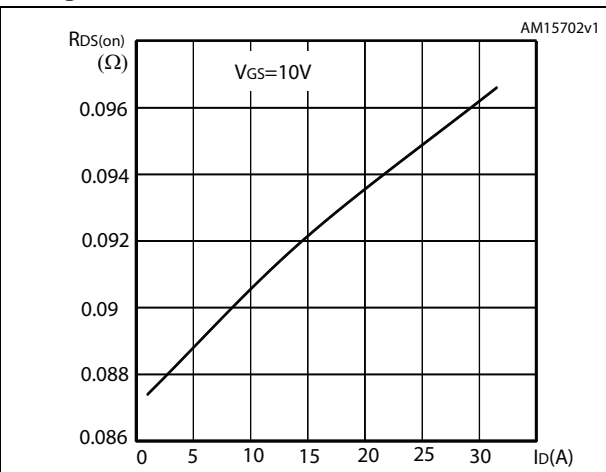


Figure 8. Capacitance variations

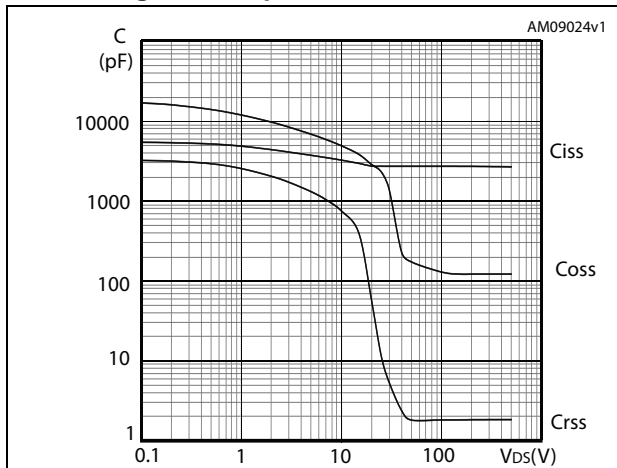


Figure 9. Output capacitance stored energy

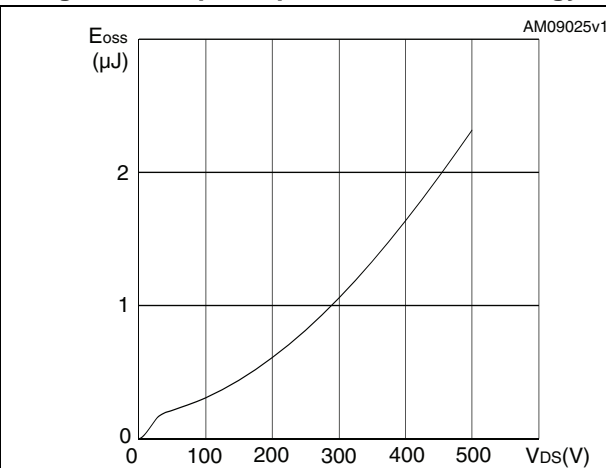


Figure 10. Normalized gate threshold voltage vs temperature

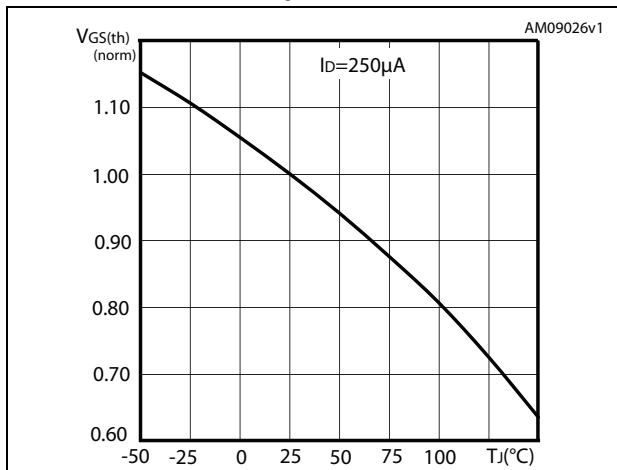


Figure 11. Normalized on-resistance vs temperature

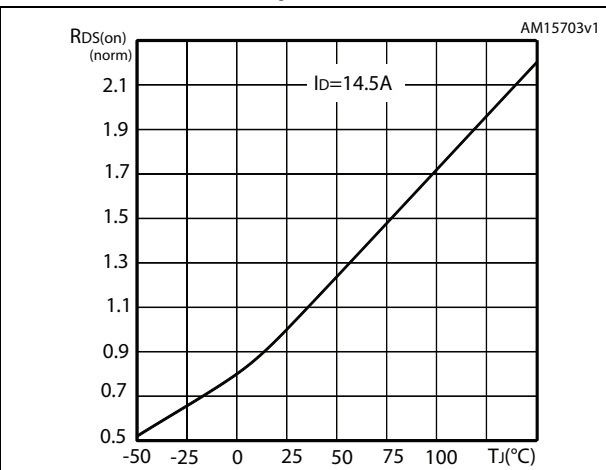


Figure 12. Normalized B_{VDS} vs temperature

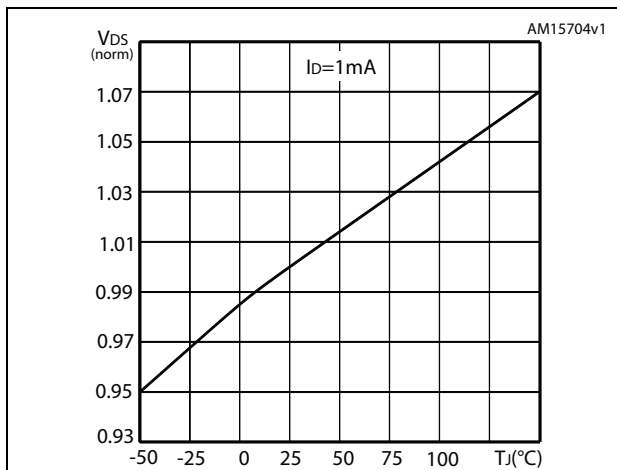
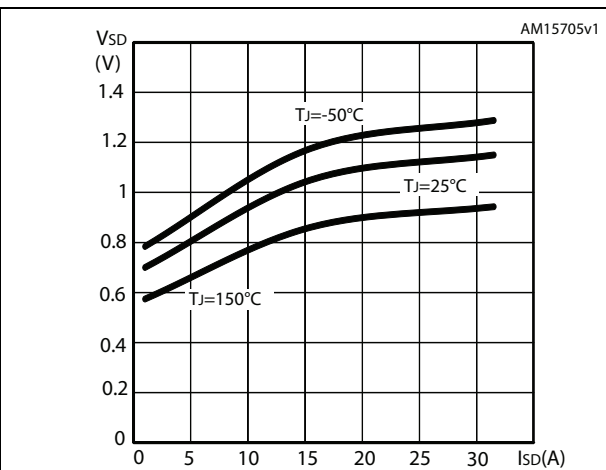


Figure 13. Source-drain diode forward characteristics



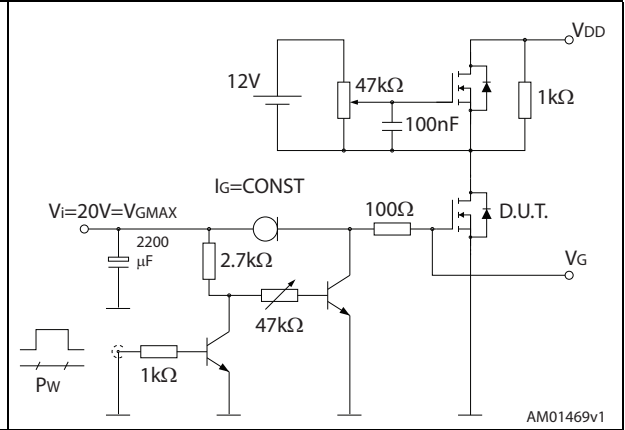
3 Test circuits

Figure 14. Switching times test circuit for resistive load



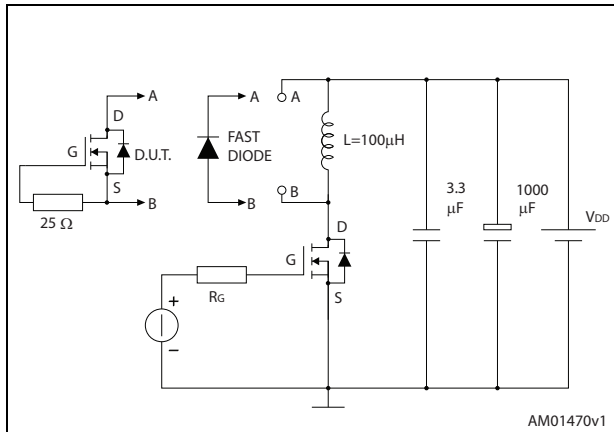
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Figure 15. Gate charge test circuit



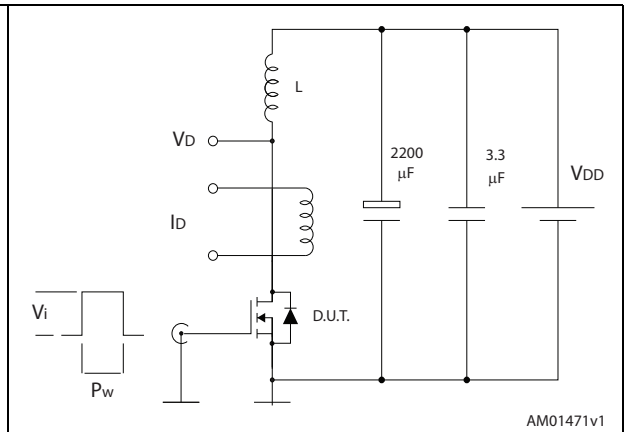
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Figure 16. Test circuit for inductive load switching and diode recovery times



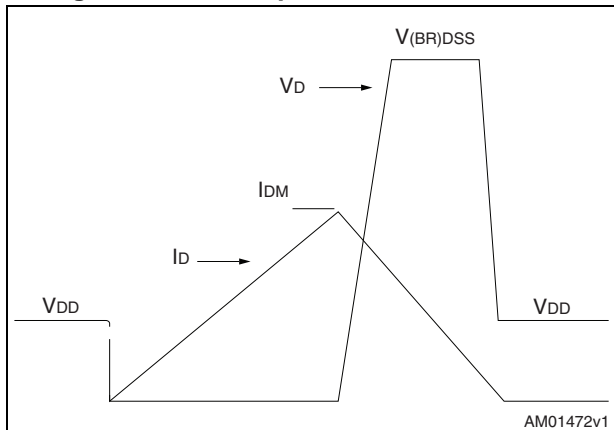
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Figure 17. Unclamped inductive load test circuit



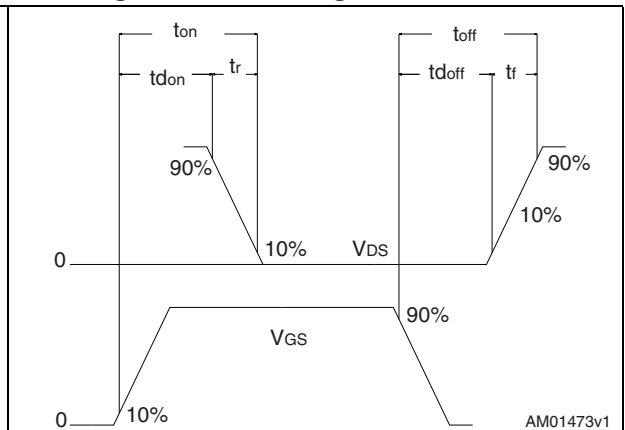
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Figure 18. Unclamped inductive waveform



AM01472v1

Figure 19. Switching time waveform



AM01473v1

4 Package information

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.

4.1 D²PAK package information

Figure 20. D²PAK (TO-263) outline

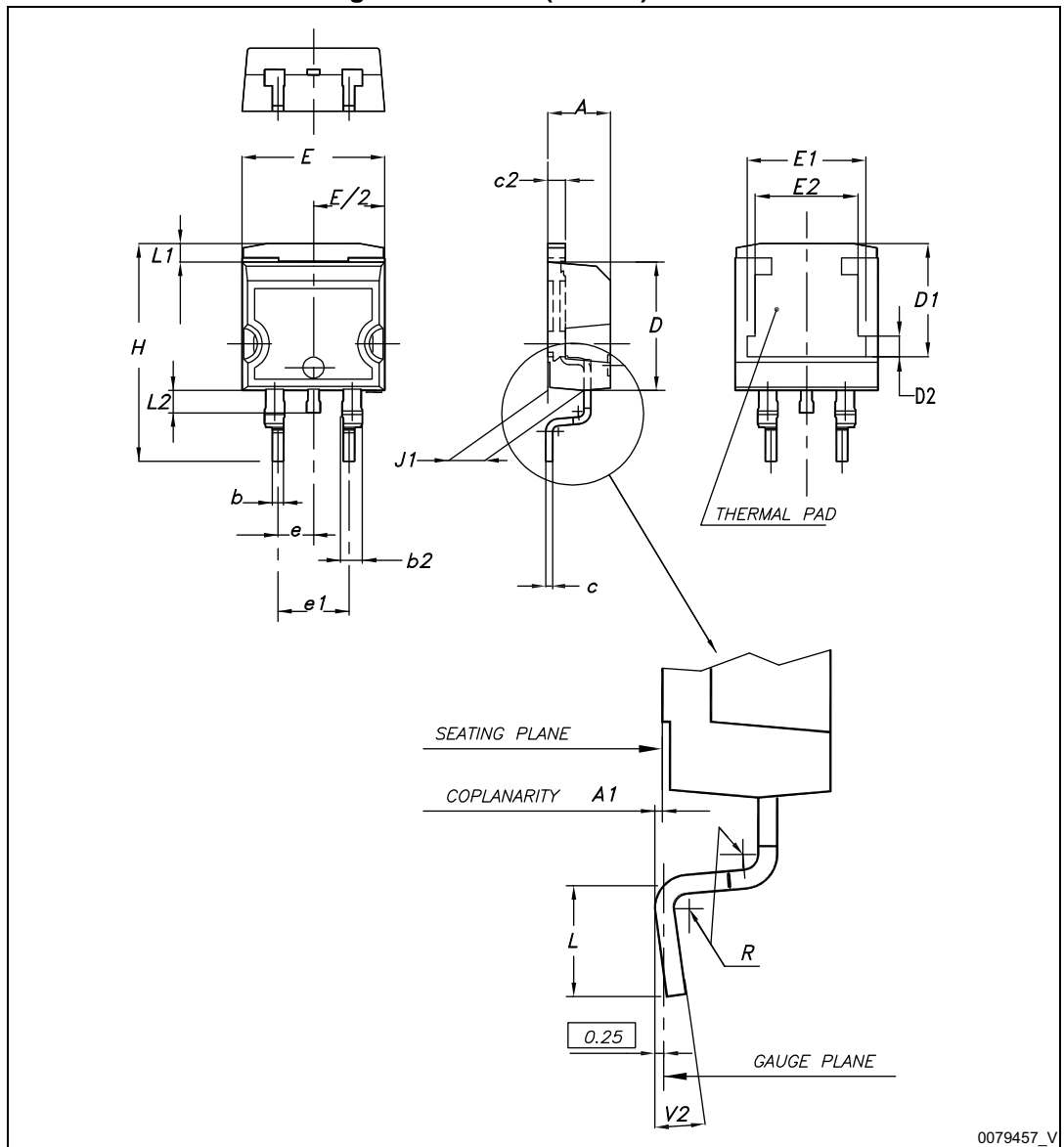
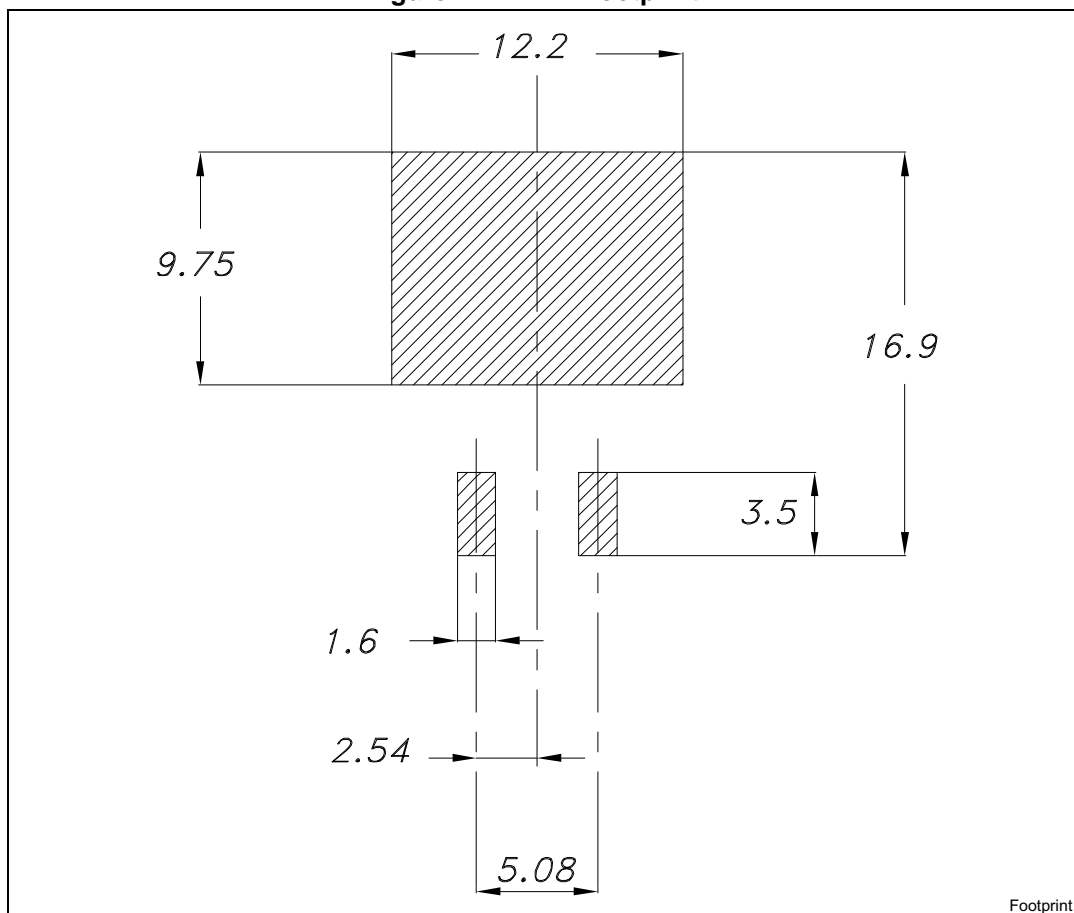


Table 7. D²PAK (TO-263) mechanical data

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	7.75	8.00
D2	1.10	1.30	1.50
E	10		10.40
E1	8.50	8.70	8.90
E2	6.85	7.05	7.25
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°

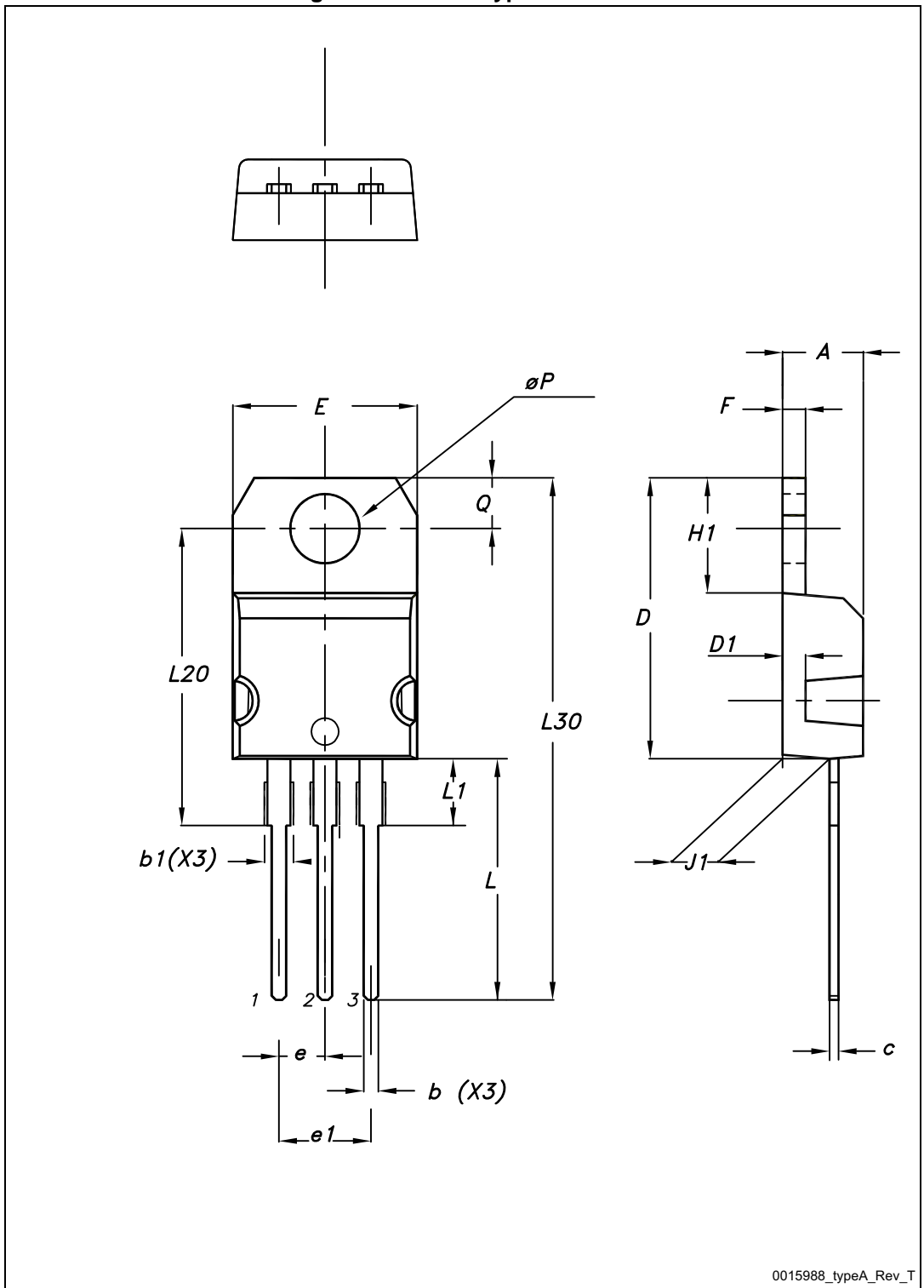
Figure 21. D²PAK footprint^(a)



a. All dimension are in millimeters

4.2 TO-220 package information

Figure 22. TO-220 type A outline



0015988_typeA_Rev_T

Table 8. 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

5 Packing information

Table 9. 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 23. Tape

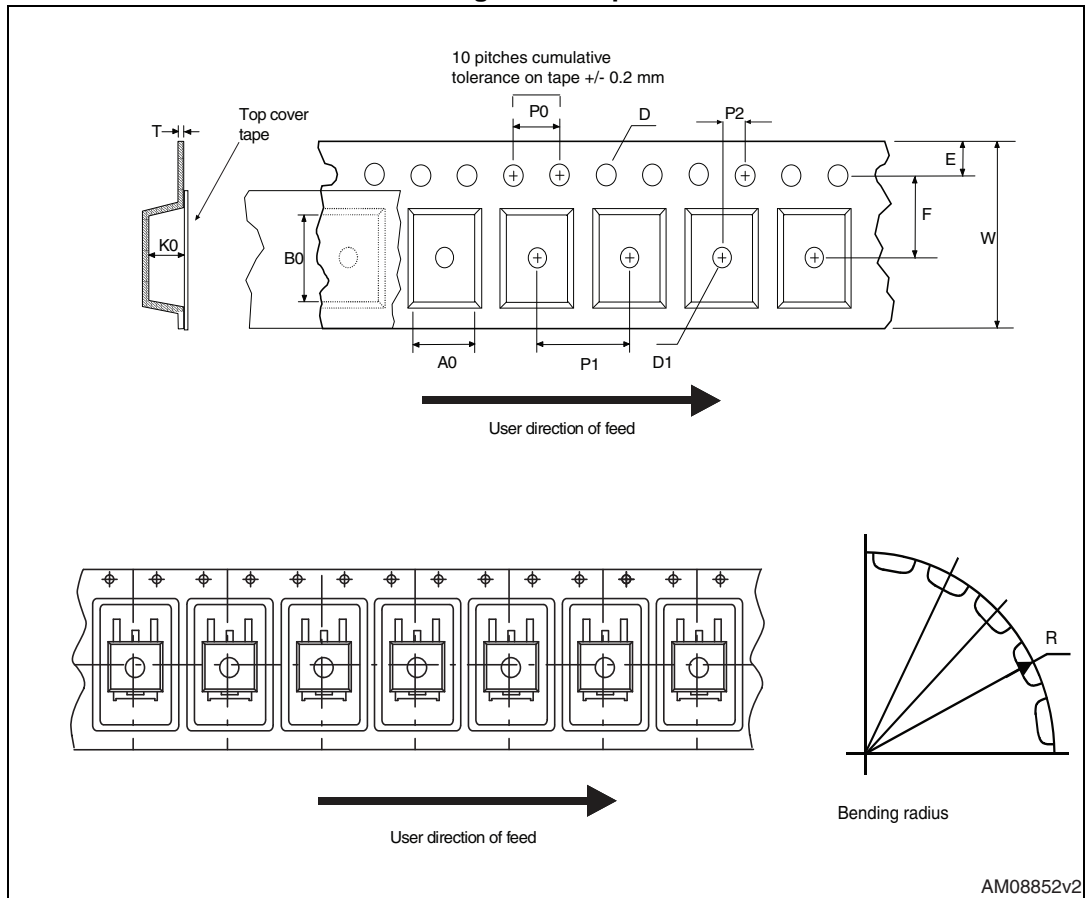
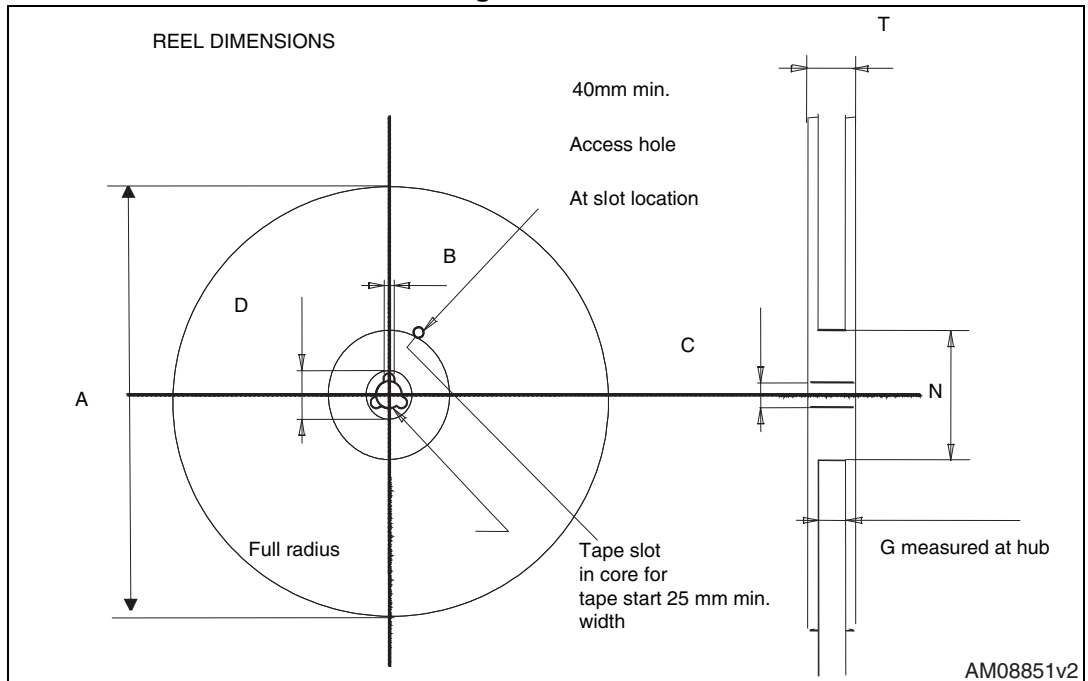


Figure 24. Reel



6 Revision history

Table 10. 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 information with the new device. Inserted Section 5: Packing information . Minor text changes.
12-Dec-2011	5	<ul style="list-style-type: none"> – Figure 9: Output capacitance stored energy has been updated. – Figure 10: Normalized gate threshold voltage vs temperature has been updated. – Figure 11: Normalized on-resistance vs temperature has been updated. – Figure 12: Normalized B_{VDSS} 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 6: Gate charge vs gate-source voltage has been updated.
01-Jul-2013	8	<ul style="list-style-type: none"> – The part number STP34NM60N has been moved to a separate datasheet. – Added: MOSFET ruggedness parameter and 3 on Table 2 – Modified: I_D value on Table 5 and typical values for $t_{d(on)}$, t_r, $t_{d(off)}$ and t_f, max values for I_{SD} and I_{SDM}, I_{SD} for V_{SD}, typical value and I_{SD} for t_{rr} – Modified: Figure 6, 7, 12 and 13 – Minor text changes
20-Mar-2015	9	<ul style="list-style-type: none"> – The part number STW34NM60N has been moved to a separate datasheet. – Updated Section 4: Package information. – Minor text changes.

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