STB33N60DM2, STP33N60DM2, STW33N60DM2

N-channel 600 V, 0.105 Ω typ., 25 A MDmesh™ DM2 Power MOSFETs in D²PAK, TO-220 and TO-247 packages

Datasheet – preliminary data

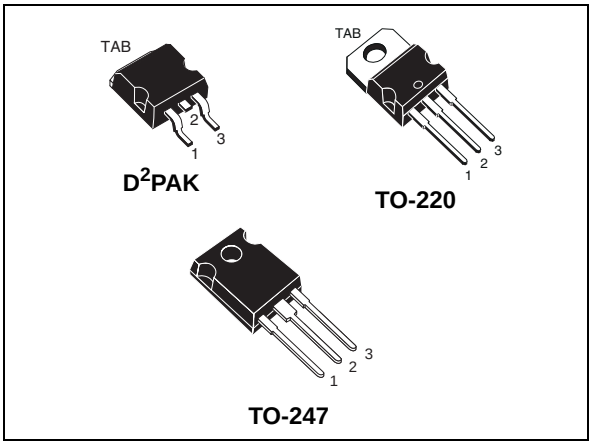
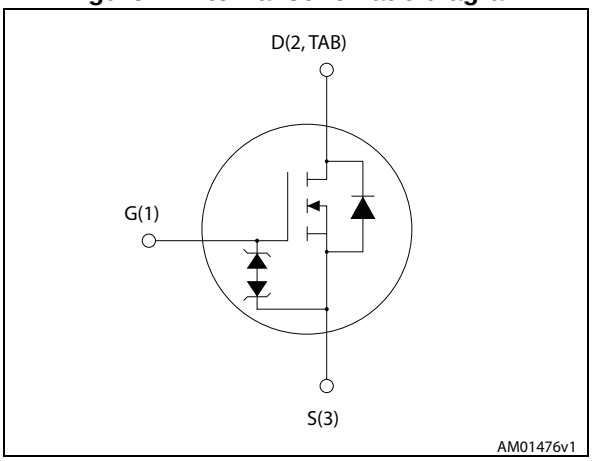


Figure 1. Internal schematic diagram



Features

Order code	V_{DS} @ T_{Jmax}	$R_{DS(on)}$ max	I_D
STB33N60DM2	650 V	0.130 Ω	25 A
STP33N60DM2			
STW33N60DM2			

- Fast-recovery body diode
- Extremely low gate charge and input capacitance
- Low on-resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

Applications

- Switching applications

Description

These high voltage N-channel Power MOSFETs are part of the MDmesh DM2 fast recovery diode series. They offer very low recovery charge and time (Q_{rr}, t_{rr}) combined with low $R_{DS(on)}$, rendering them suitable for the most demanding high efficiency converters and ideal for bridge topologies and ZVS phase-shift converters.

Table 1. Device summary

Order code	Marking	Package	Packaging
STB33N60DM2	33N60DM2	D²PAK	Tape and reel
STP33N60DM2		TO-220	Tube
STW33N60DM2		TO-247	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at T_C = 25 °C	25	A
I_D	Drain current (continuous) at T_C = 100 °C	15.5	A
I_{DM} (1)	Drain current (pulsed)	100	A
P_{TOT}	Total dissipation at T_C = 25 °C	190	W
dv/dt (2)	Peak diode recovery voltage slope	40	V/ns
dv/dt(3)	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature	- 55 to 150	°C
T_j	Max. operating junction temperature		

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 20$ A, di/dt ≤ 400 A/µs; $V_{DS\ peak} < V_{(BR)DSS}$, V_{DD}=400 V.
3. $V_{DS} \leq 480$ V

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		D²PAK	TO-220	TO-247	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	0.66			°C/W
$R_{thj\text{-}pcb}$	Thermal resistance junction-pcb max(1)	30			°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max		62.5	50	°C/W

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

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	TBD	A
E_{AS}	Single pulse avalanche energy (starting T_j=25°C, I_D= I_{AR}; V_{DD}=50)	TBD	mJ

2 Electrical characteristics

(T_C = 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	I_D = 1 mA, V_{GS} = 0	600			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 600 V			1.5	µA
		V_{DS} = 600 V, T_C=125 °C			100	µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 25 V			±10	µA
$V_{GS(th)}$	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 = 10 A		0.105	0.130	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0	-	TBD	-	pF
C_{oss}	Output capacitance		-	TBD	-	pF
C_{rss}	Reverse transfer capacitance		-	TBD	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 480 V, V_{GS} = 0	-	TBD	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0	-	2.6	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 25 A, V_{GS} = 10 V (see *Figure 3*)	-	47	-	nC
Q_{gs}	Gate-source charge		-	TBD	-	nC
Q_{gd}	Gate-drain charge		-	TBD	-	nC

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. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 12.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 2* and *7*)	-	TBD	-	ns
t_r	Rise time		-	TBD	-	ns
$t_{d(off)}$	Turn-off delay time		-	TBD	-	ns
t_f	Fall time		-	TBD	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} (1)	Source-drain current		-		25	A
I_{SDM} (2)	Source-drain current (pulsed)		-		100	A
V_{SD} (3)	Forward on voltage	I_{SD} = 25 A, V_{GS} = 0	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 25 A, di/dt = 100 A/µs V_{DD} = 60 V (see *Figure 4*)	-	150		ns
Q_{rr}	Reverse recovery charge		-	TBD		nC
I_{RRM}	Reverse recovery current		-	TBD		A
t_{rr}	Reverse recovery time	I_{SD} = 25 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j = 150 °C (see *Figure 4*)	-	TBD		ns
Q_{rr}	Reverse recovery charge		-	TBD		nC
I_{RRM}	Reverse recovery current		-	TBD		A

1. Limited by maximum junction temperature
2. Pulse width limited by safe operating area.
3. Pulsed: pulse duration = 300 µs, duty cycle 1.5%

3 Test circuits

Figure 2. Switching times test circuit for resistive load

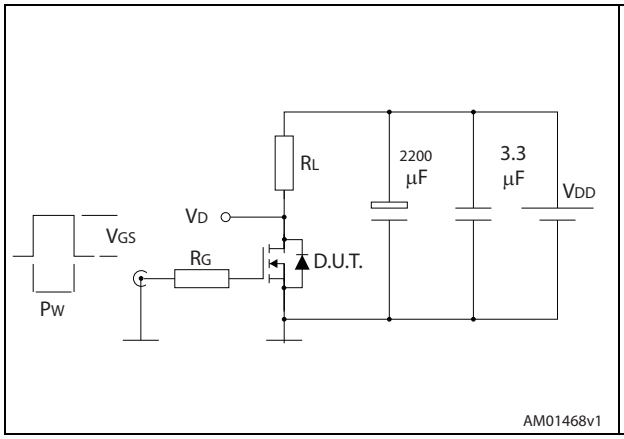


Figure 3. Gate charge test circuit

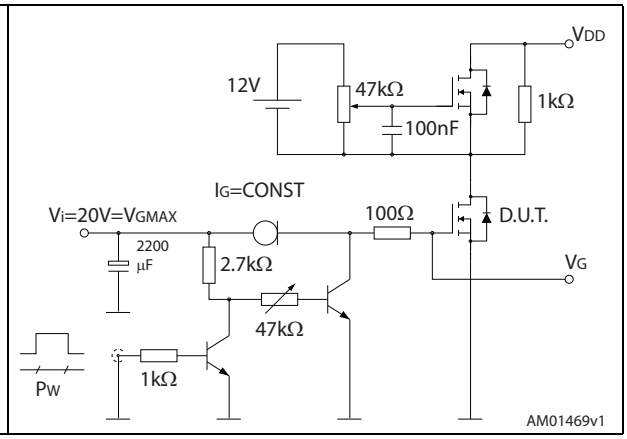


Figure 4. Test circuit for inductive load switching and diode recovery times

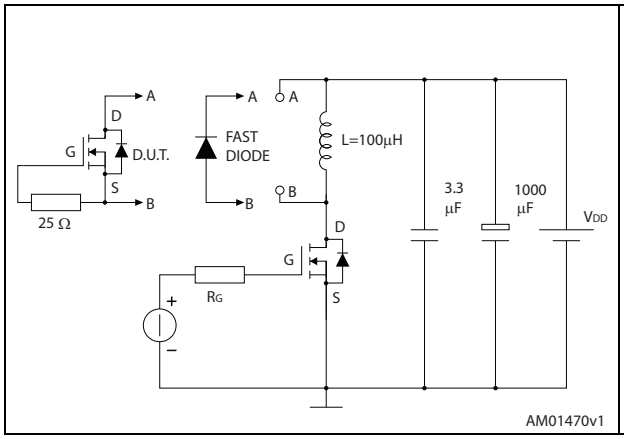


Figure 5. Unclamped inductive load test circuit

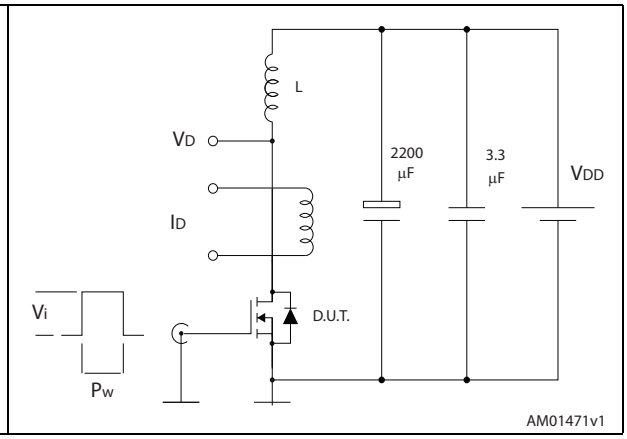


Figure 6. Unclamped inductive waveform

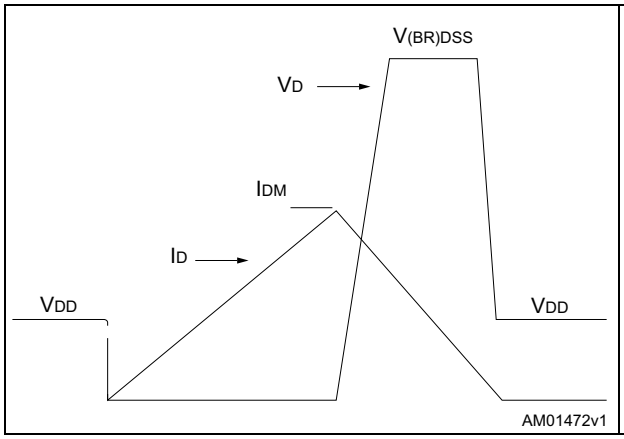
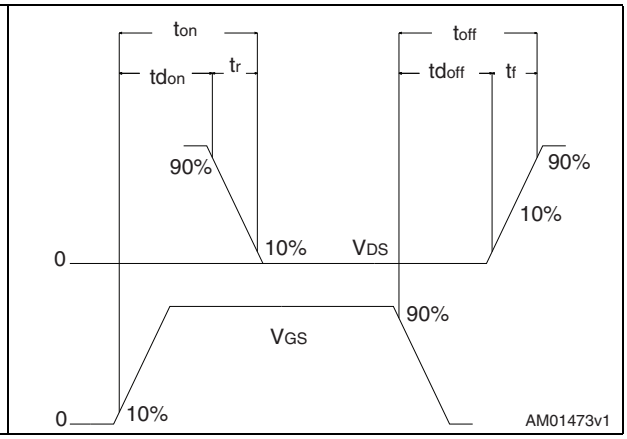


Figure 7. Switching time waveform



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.

4.1 D²PAK, STB33N60DM2

Figure 8. D²PAK (TO-263) drawing

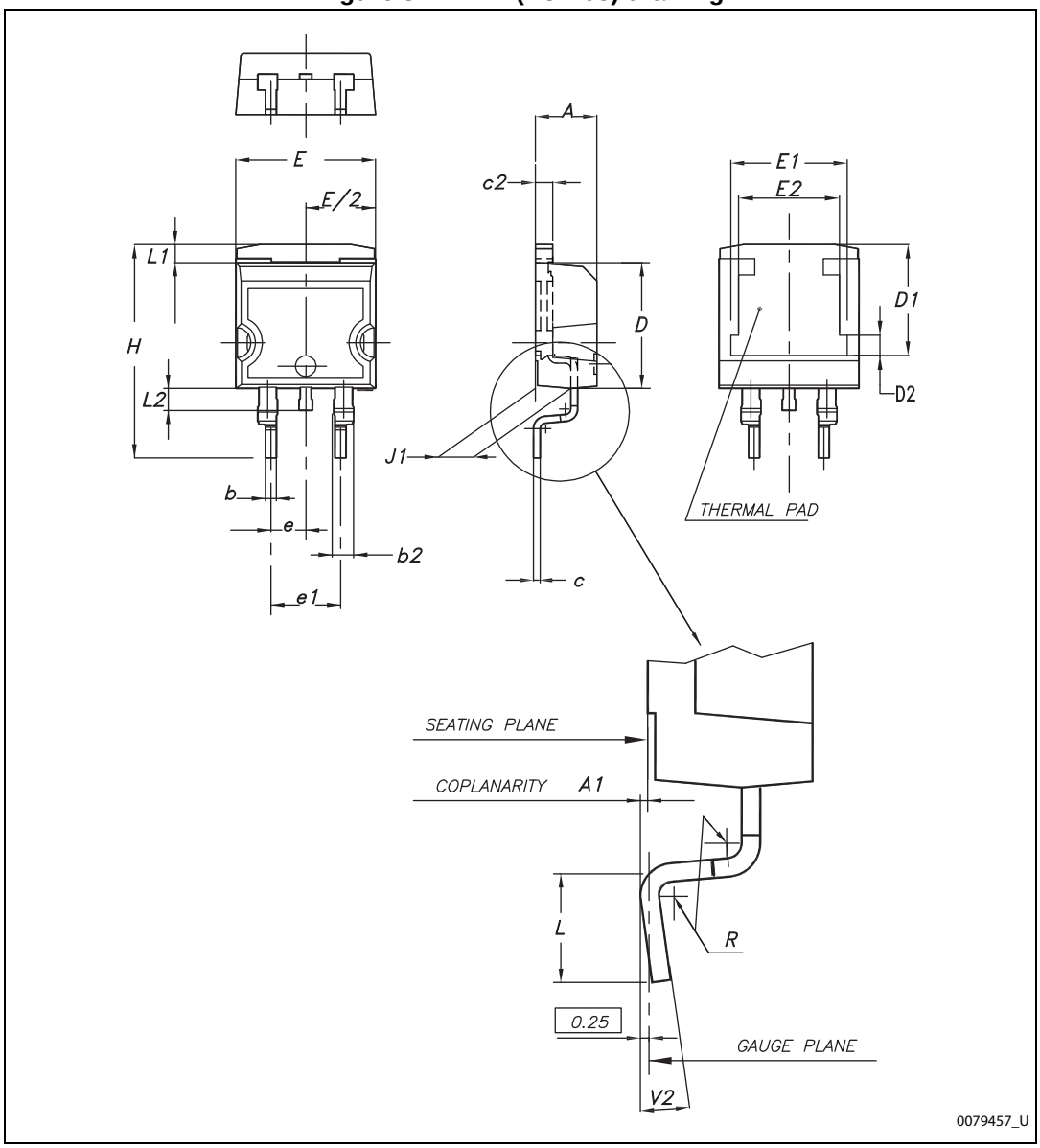
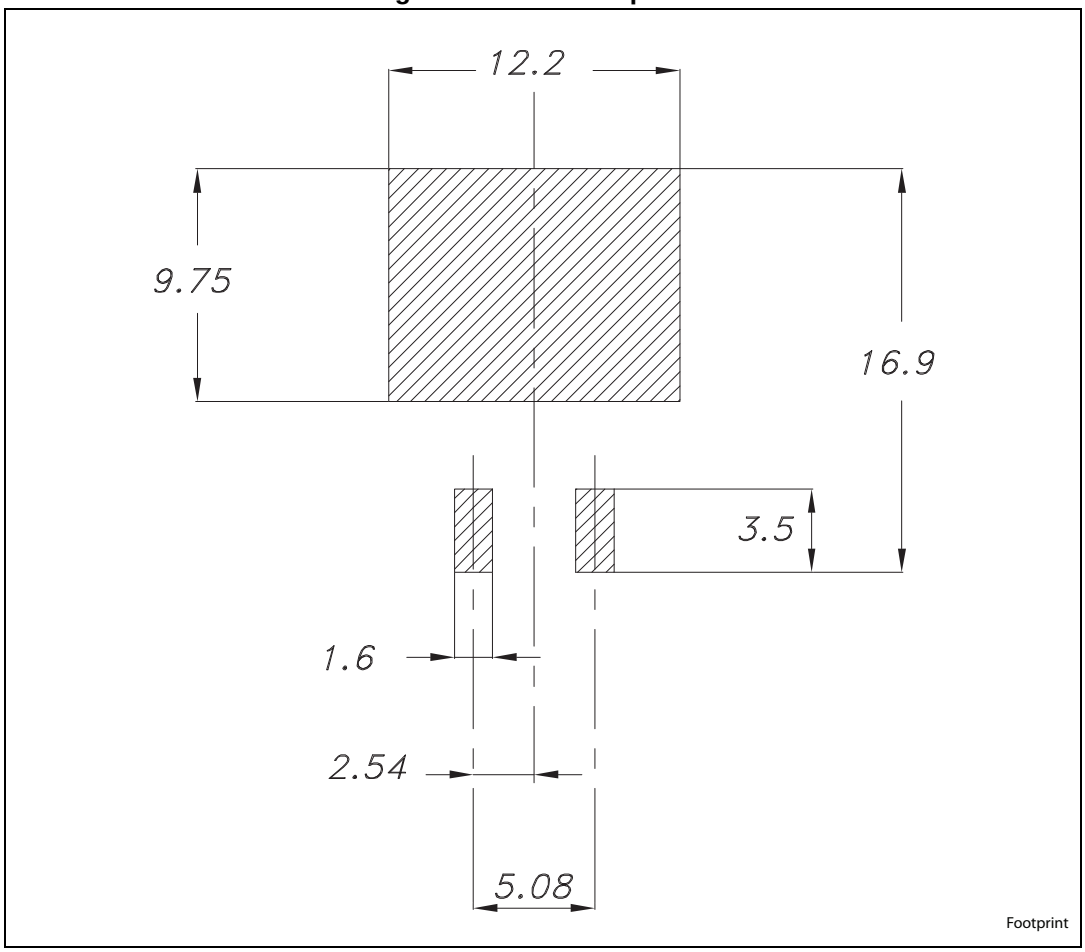


Table 9. D²PAK (TO-263) mechanical data

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 9. D²PAK footprint(a)



a. All dimension are in millimeters

4.2 TO-220, STP33N60DM2

Figure 10. TO-220 type A drawing

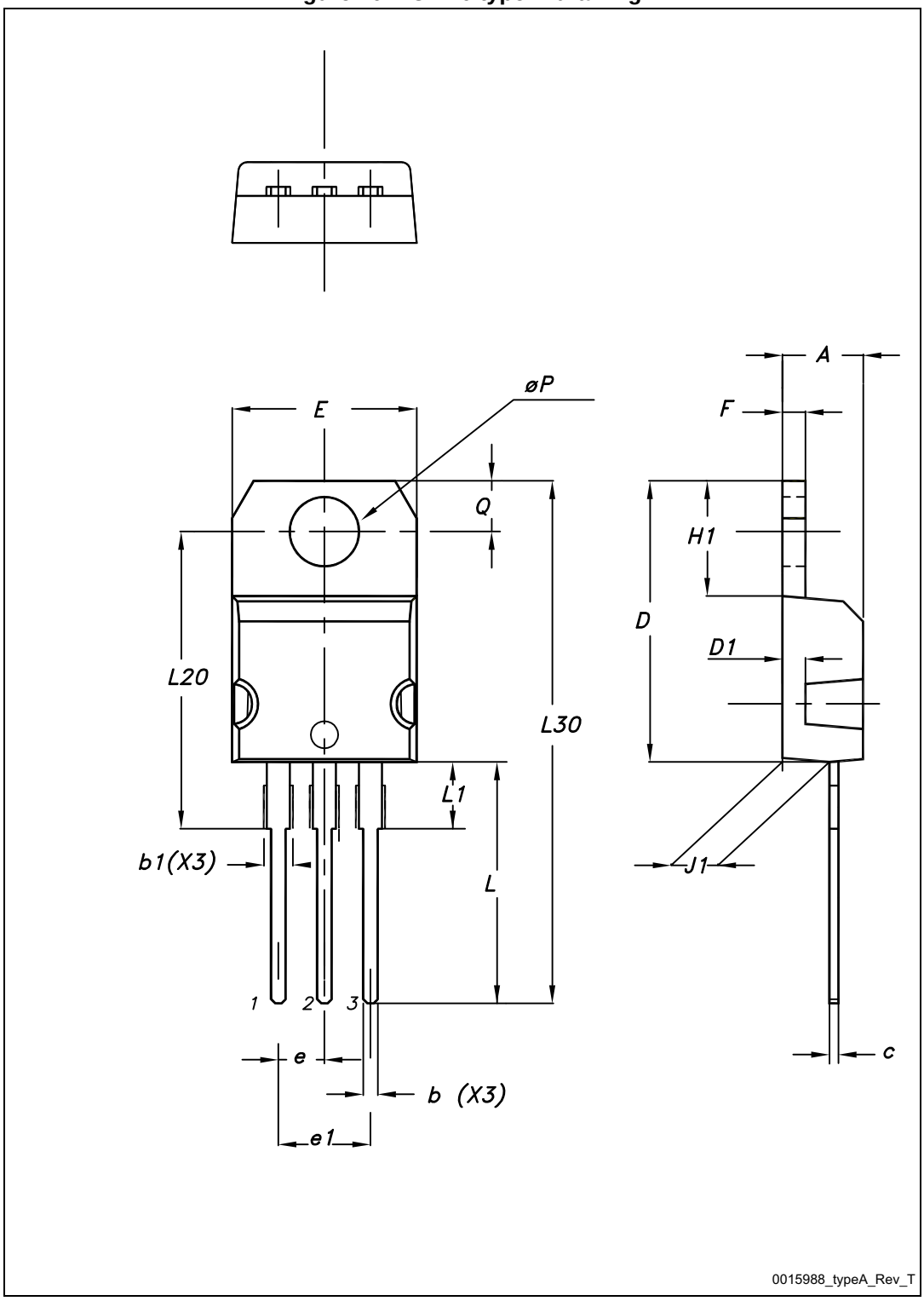


Table 10. TO-220 type A mechanical data

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

4.3 TO-247, STW33N60DM2

Figure 11. TO-247 drawing

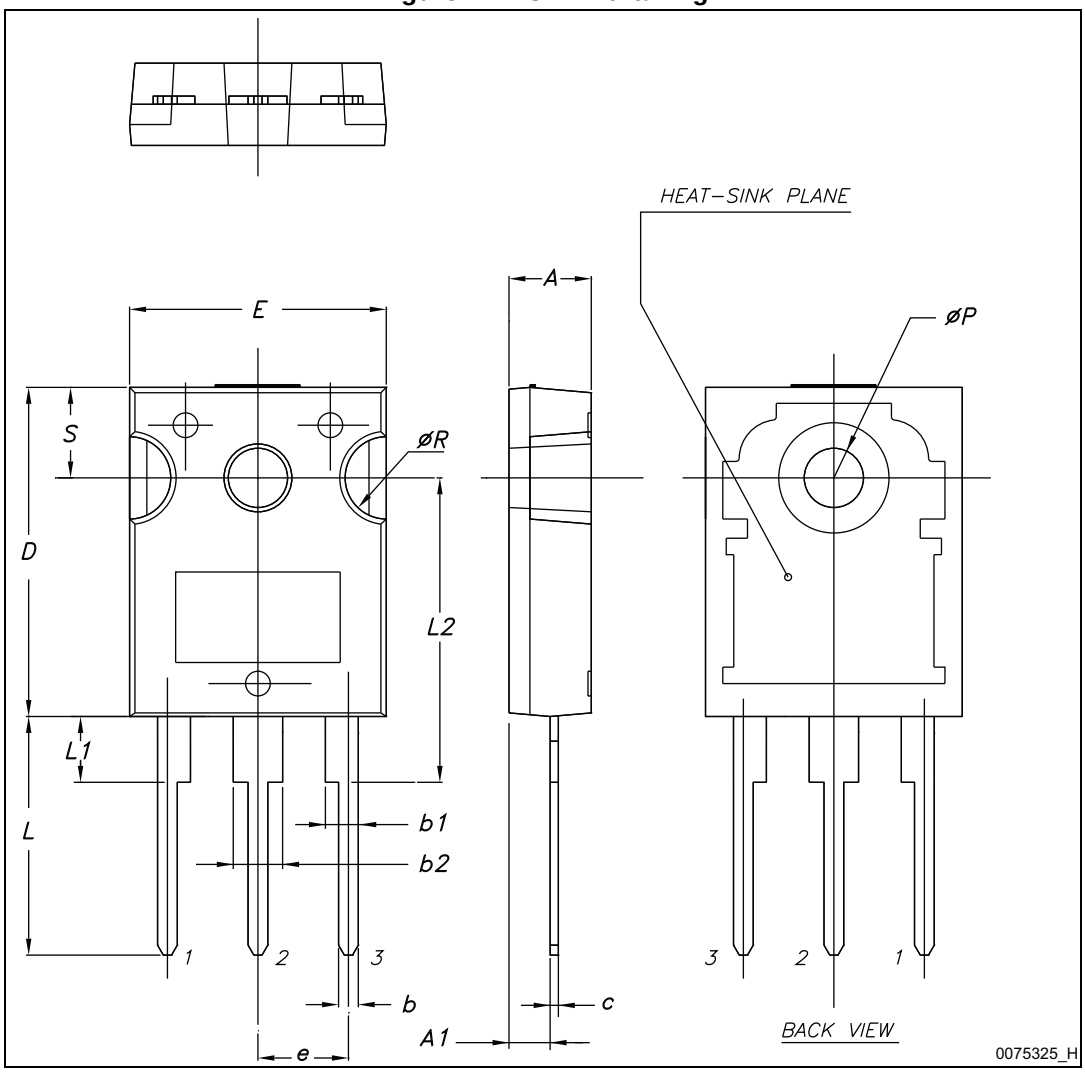


Table 11. TO-247 mechanical data

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

5 Packaging mechanical data

Figure 12. Tape for D²PAK (TO-263)

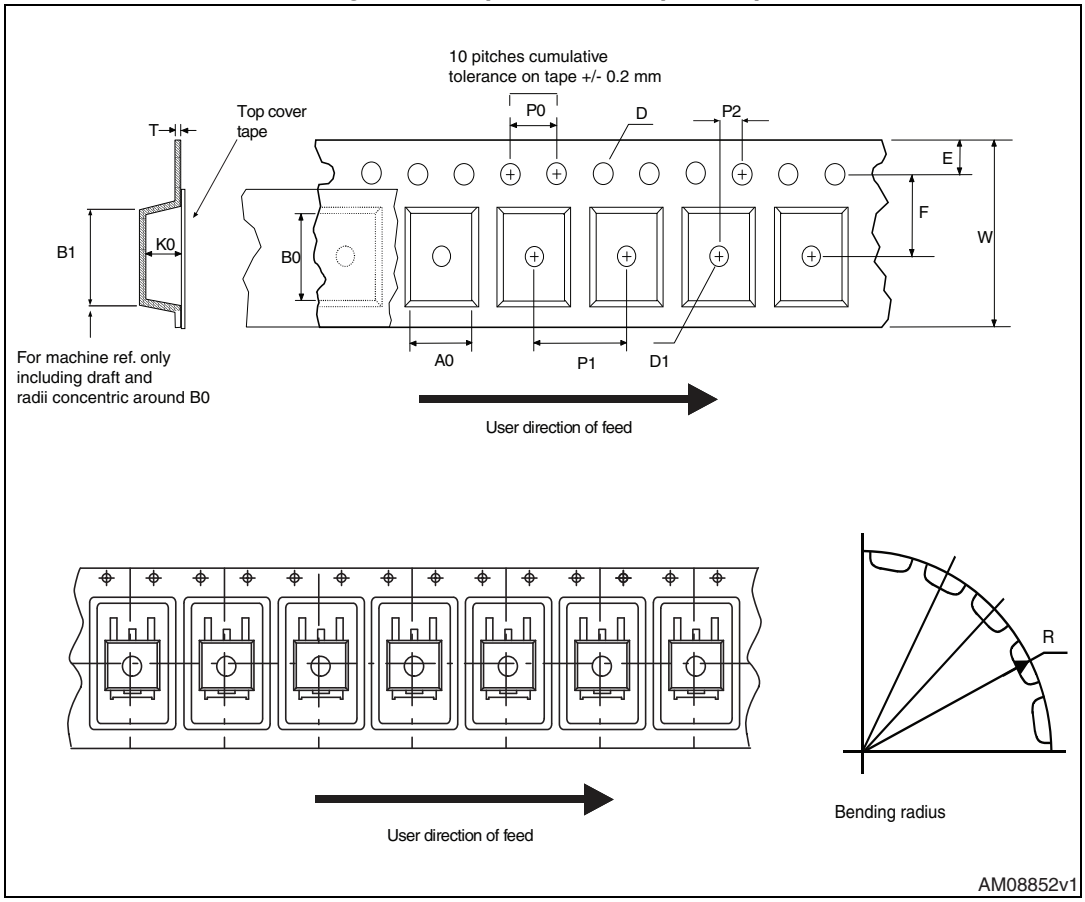


Figure 13. Reel for D²PAK (TO-263)

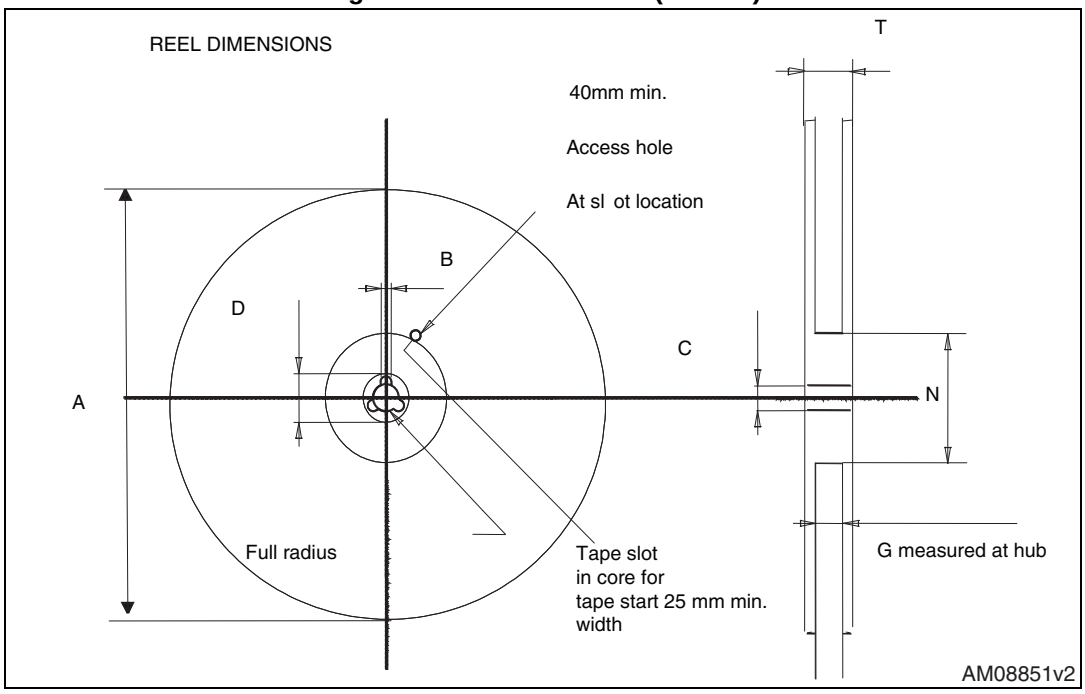


Table 12. D²PAK (TO-263) tape and reel mechanical data

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			

6 Revision history

Table 13. Document revision history

Date	Revision	Changes
16-Oct-2014	1	First release.

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