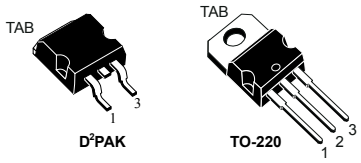
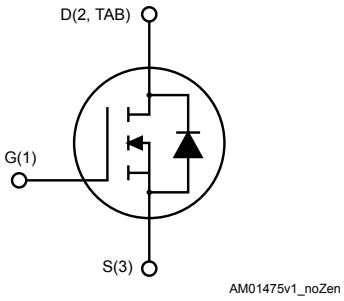
Datasheet

N-channel 600 V, 0.4 Ω typ., 11 A, MDmesh™ II Power MOSFETs in D²PAK and TO-220 packages





Features

Order codes	V_{DSS} (@ T_{Jmax})	$R_{DS(on)}$ max.	I_D	Package
STB11NM60T4	650 V	0.45 Ω	11 A	D²PAK
STP11NM60				TO-220

- 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. These revolutionary Power MOSFETs associate a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. They are therefore suitable for the most demanding high-efficiency converters.

Product status link
STB11NM60T4
STP11NM60

Product summary	
Order code	**STB11NM60T4**
Marking	B11NM60
Package	D²PAK
Packing	Tape and reel
Order code	**STP11NM60**
Marking	P11NM60
Package	TO-220
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Gate-source voltage	600	V
V_{GS}	Gate- source voltage	±30	V
I_D	Drain current (continuous) at T_C = 25 °C	11	A
I_D	Drain current (continuous) at T_C= 100 °C	7	
I_{DM} (1)	Drain current (pulsed)	44	A
P_{TOT}	Total dissipation at T_C = 25 °C	160	W
dv/dt (2)	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature range	-65 to 150	°C
T_j	Operating junction temperature range		

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 11 A, di/dt ≤ 400 A/µs, V_{DD} ≤ $V_{(BR)DSS}$, T_j ≤ T_{JMAX}.*

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D^2PAK	TO-220	
$R_{thj\text{-}case}$	Thermal resistance junction-case	0.78		°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient		62.5	
$R_{thj\text{-}pcb}$(1)	Thermal resistance junction-pcb	35		

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

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or non-repetitive (pulse width limited by T_{jmax})	5.5	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	350	mJ

2 Electrical characteristics

(T_C = 25 °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 V, I_D = 250 µA	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V			1	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_C = 125 °C(1)			10	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±30 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 = 5.5 A		0.4	0.45	Ω

1. *Defined by design, not subject to production test.*

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS}= 25 V, f = 1 MHz, V_{GS} = 0 V	-	1000	-	pF
C_{oss}	Output capacitance		-	230	-	pF
C_{rss}	Reverse transfer capacitance		-	25	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 V to 480 V, V_{GS} = 0 V	-	100	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	-	1.6	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 11 A, V_{GS} = 0 to 10 V (see Figure 12. Test circuit for gate charge behavior)	-	30	-	nC
Q_{gs}	Gate-source charge		-	10	-	nC
Q_{gd}	Gate-drain charge		-	15	-	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 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 5.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 11. Test circuit for resistive load switching times and Figure 16. Switching time waveform)	-	20	-	ns
t_r	Rise time		-	20	-	ns
$t_{r(Voff)}$	Off-voltage rise time	V_{DD} = 480 V, I_D = 11 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 13. Test circuit for inductive load switching and diode recovery times and Figure 16. Switching time waveform)	-	6	-	ns
t_f	Fall time		-	11	-	ns
t_c	Cross-over time		-	19	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		11	A
I_{SDM} (1)	Source-drain current (pulsed)		-		44	A
V_{SD} (2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 11 A	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 11 A, di/dt = 100 A/µs,	-	390		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V	-	3.8		µC
I_{RRM}	Reverse recovery current	(see Figure 13. Test circuit for inductive load switching and diode recovery times)	-	19.5		A
t_{rr}	Reverse recovery time	I_{SD} = 11 A, di/dt = 100 A/µs,	-	570		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V, T_j = 150 °C	-	5.7		µC
I_{RRM}	Reverse recovery current	(see Figure 13. Test circuit for inductive load switching and diode recovery times)	-	20		A

1. *Pulse width is limited by safe operating area*
2. *Pulse test: pulse duration = 300 µs, duty cycle 1.5%*

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

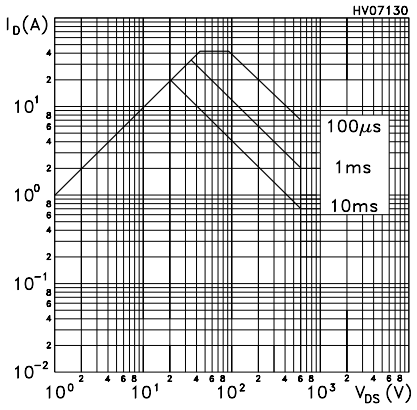


Figure 2. Thermal impedance

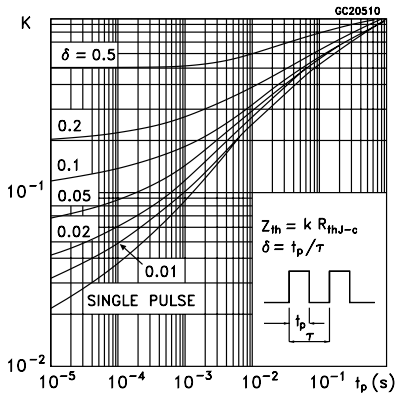


Figure 3. Output characteristics

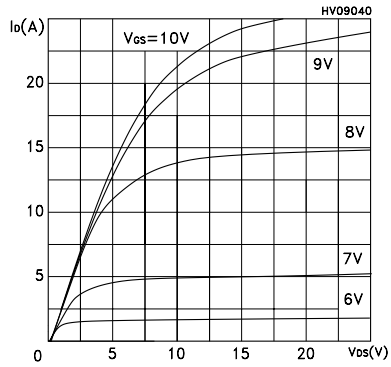


Figure 4. Transfer characteristics

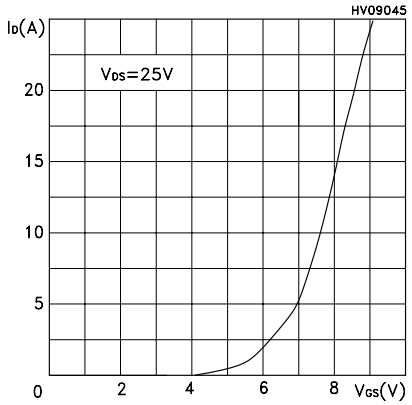


Figure 5. Normalized gate threshold voltage vs temperature

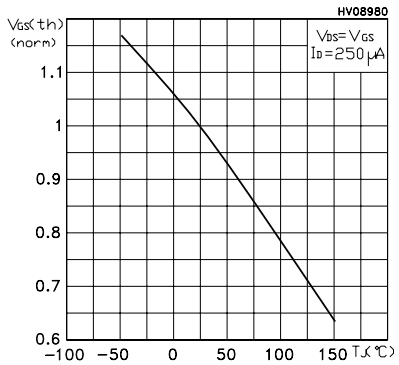


Figure 6. Static drain-source on-resistance

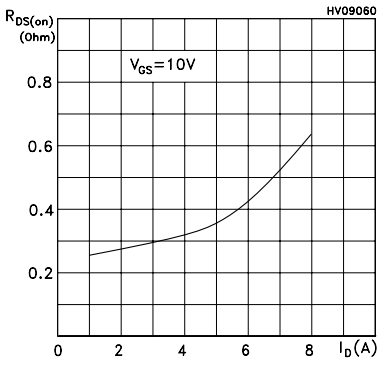


Figure 7. Normalized on-resistance vs temperature

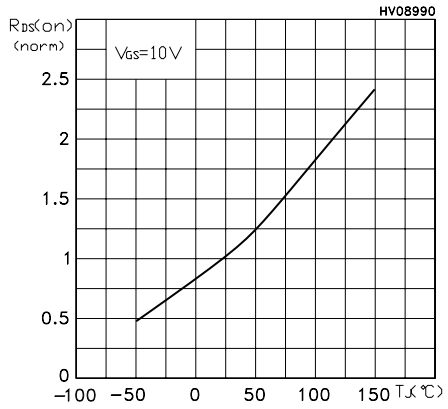


Figure 8. Gate charge vs gate-source voltage

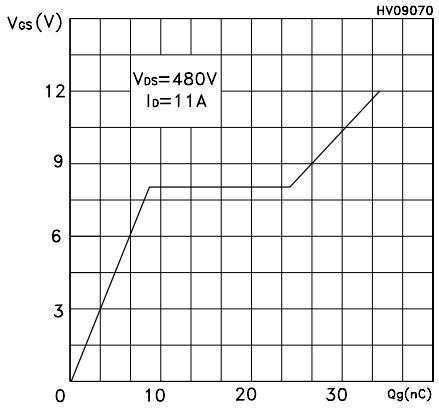


Figure 9. Capacitance variations

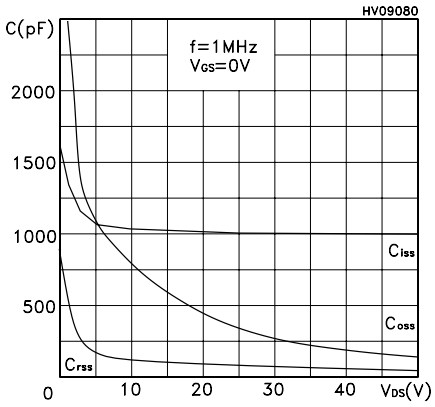
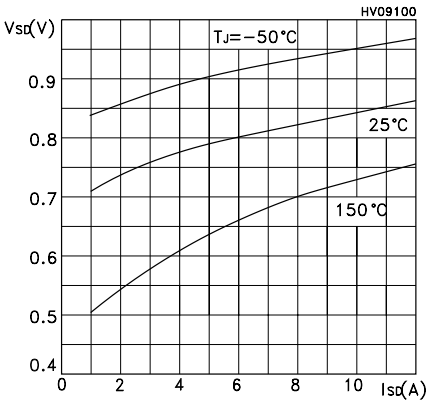


Figure 10. Source-drain diode forward characteristics



3 Test circuits

Figure 11. Test circuit for resistive load switching times

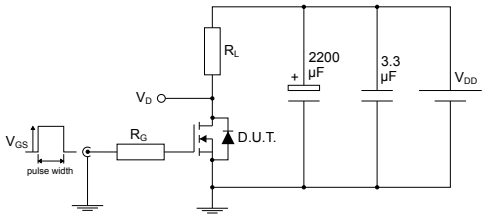


Figure 12. Test circuit for gate charge behavior

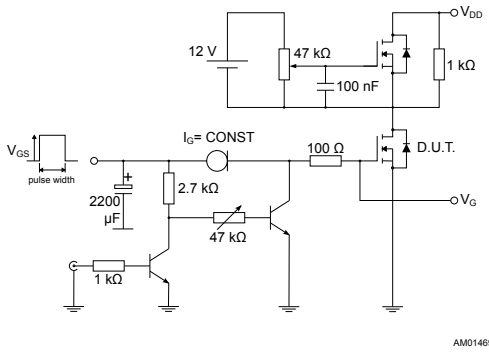


Figure 13. Test circuit for inductive load switching and diode recovery times

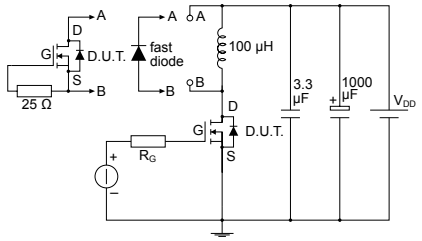


Figure 14. Unclamped inductive load test circuit

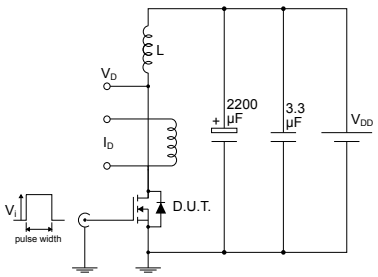


Figure 15. Unclamped inductive waveform

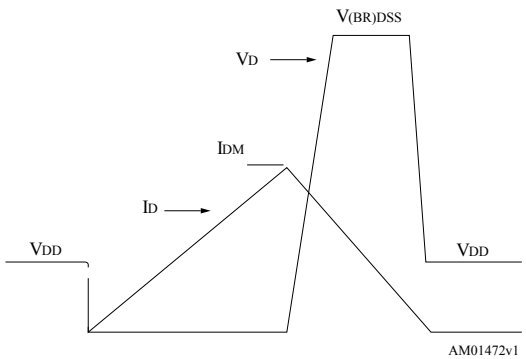
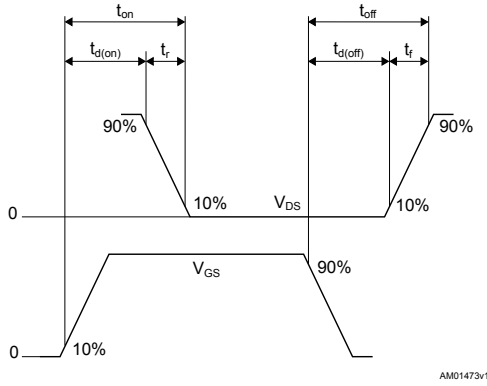


Figure 16. Switching time waveform



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 (TO-263) type A package information

Figure 17. D²PAK (TO-263) type A package outline

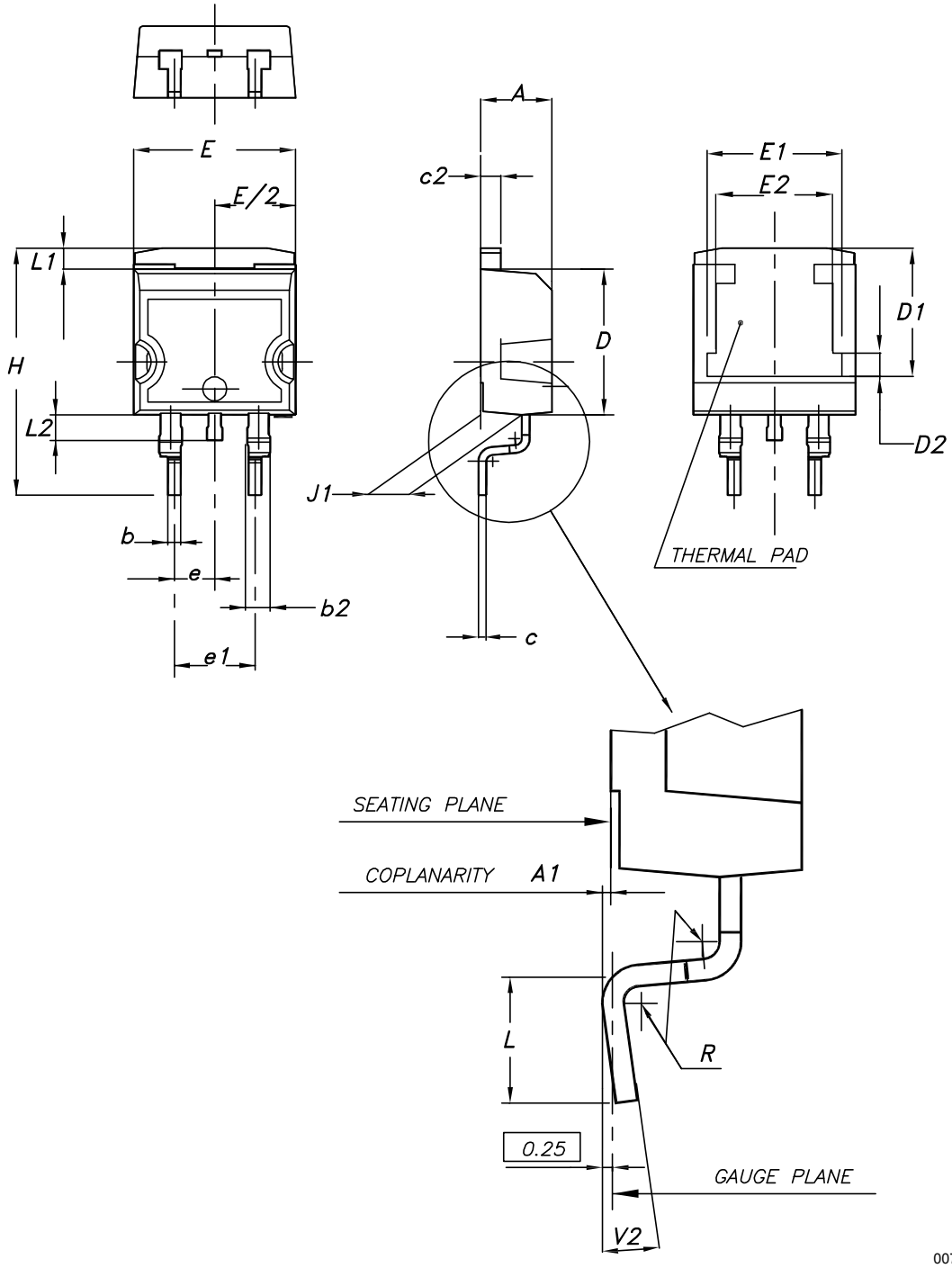


Table 8. D²PAK (TO-263) type A package mechanical data

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	10.00		10.40
E1	8.30	8.50	8.70
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

4.2 D²PAK packing information

Figure 18. D²PAK tape outline

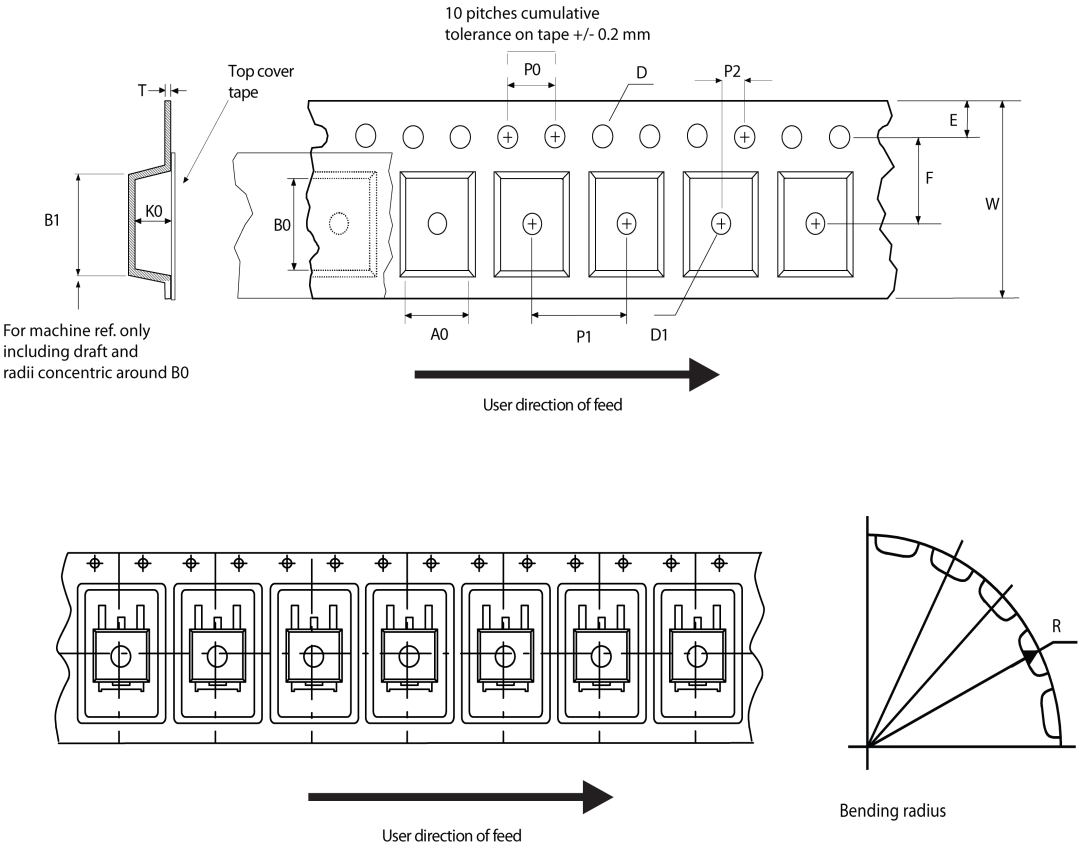


Figure 19. **D²PAK reel outline**

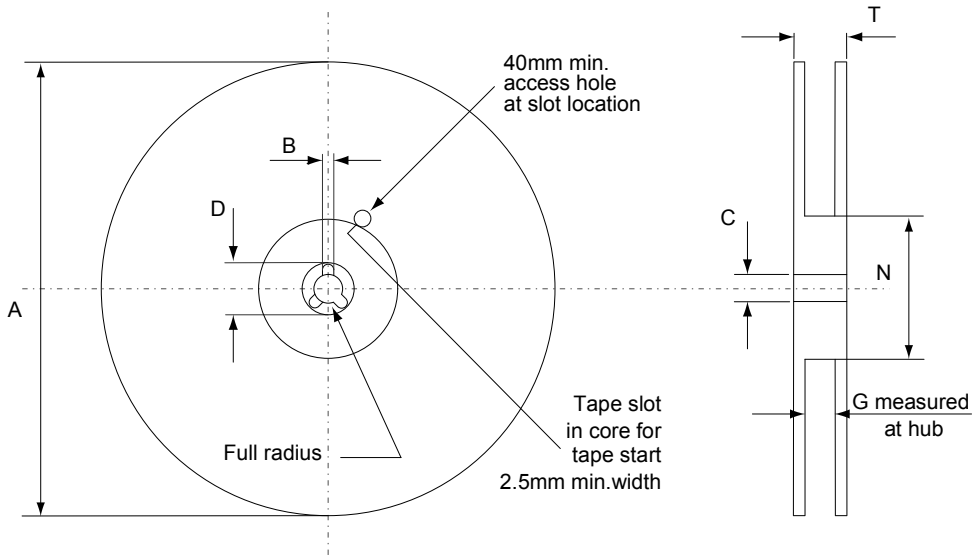


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Table 9. **D²PAK tape and reel mechanical data**

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 quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

4.3 D²PAK (TO-263) type B package information

Figure 20. D²PAK (TO-263) type B package outline

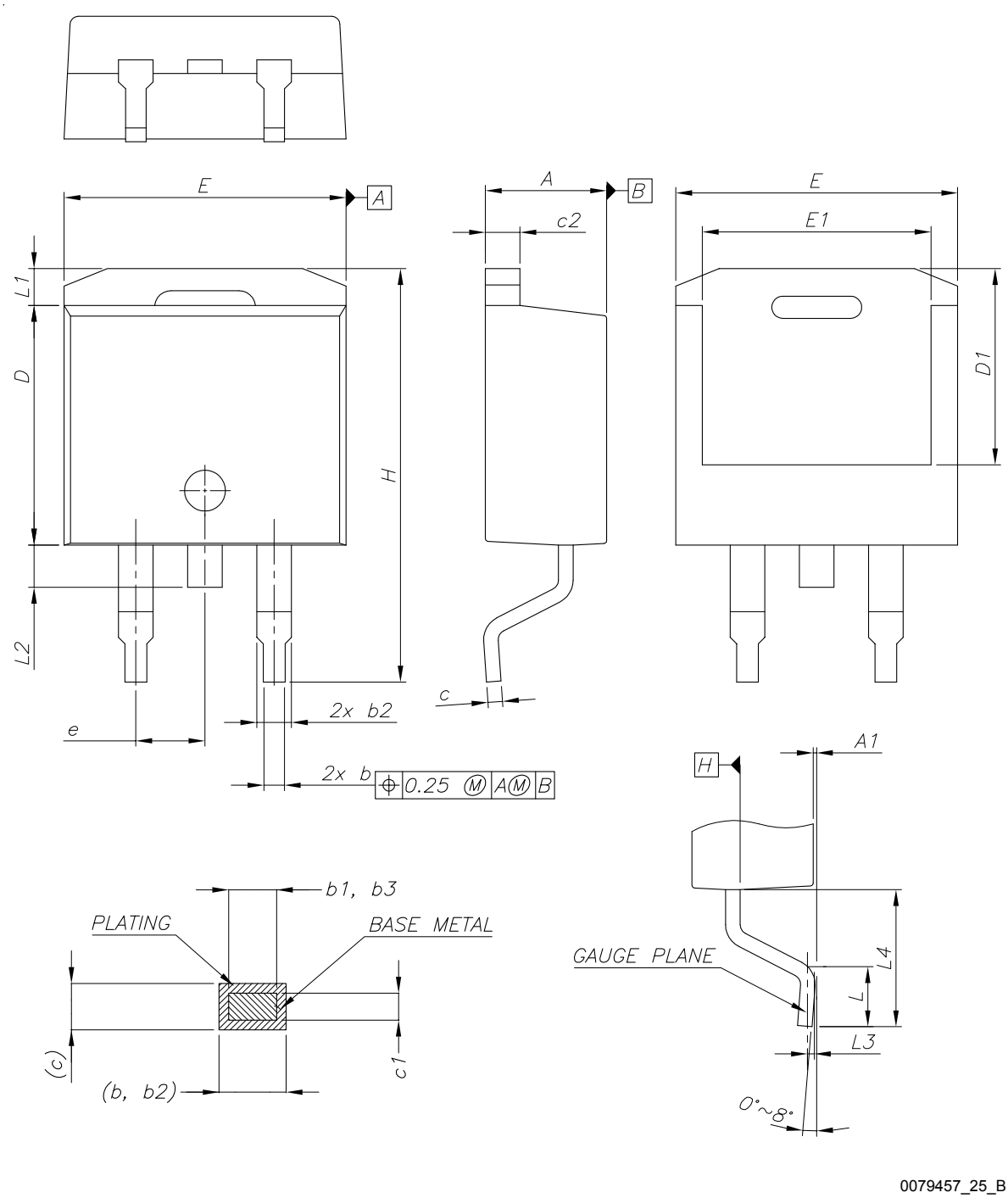

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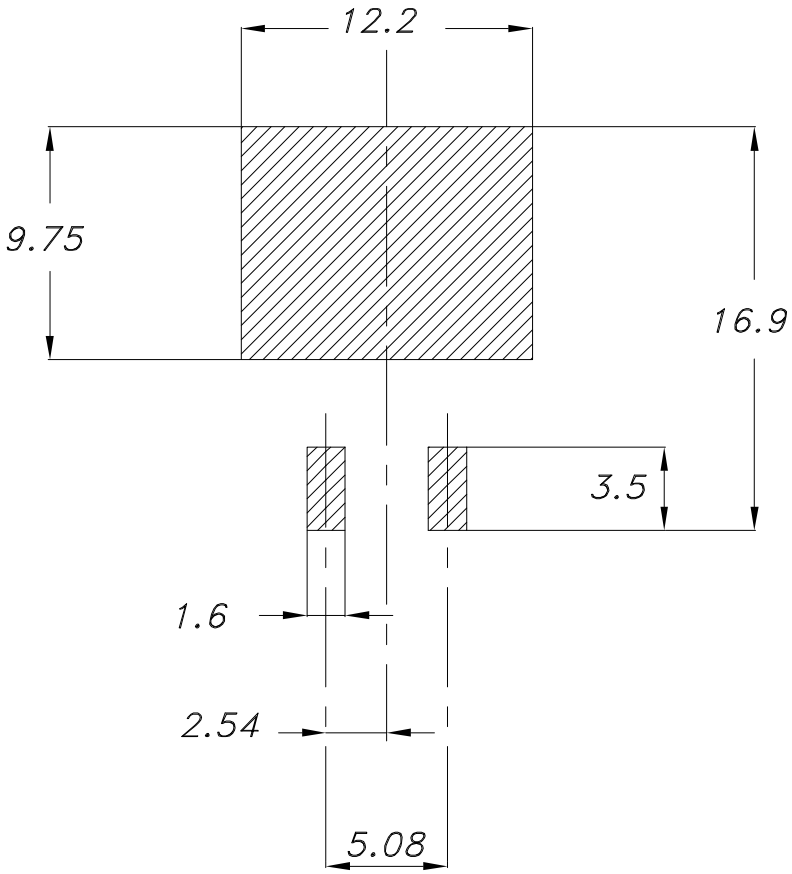
Table 10. D²PAK (TO-263) type B mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.36		4.56
A1	0		0.25
b	0.70		0.90
b1	0.51		0.89
b2	1.17		1.37
b3	1.36		1.46
c	0.38		0.694
c1	0.38		0.534
c2	1.19		1.34
D	8.60		9.00
D1	6.90		7.50
E	10.15		10.55
E1	8.10		8.70
e		2.54 BSC	
H	15.00		15.60
L	1.90		2.50
L1			1.65
L2			1.78
L3		0.25	
L4	4.78		5.28

Figure 21. D²PAK (TO-263) recommended footprint (dimensions are in mm)



Footprint

4.4 D²PAK type B packing information

Figure 22. D²PAK type B tape outline

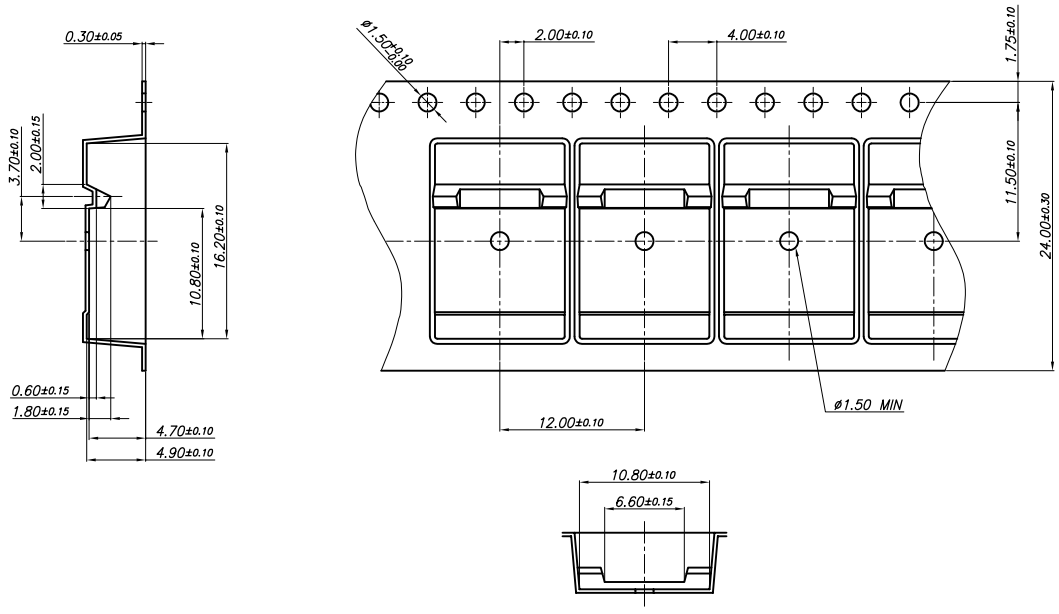


Figure 23. **D²PAK type B reel outline**

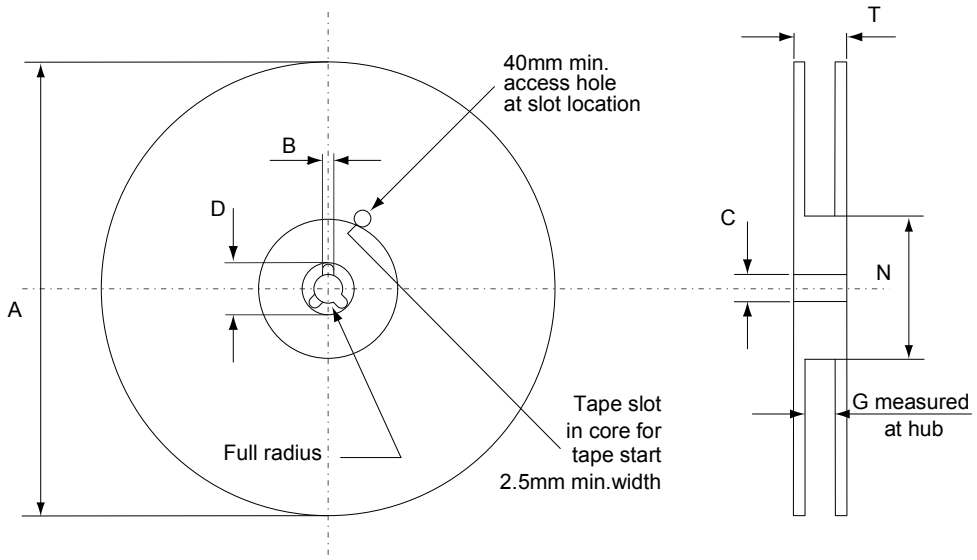


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Table 11. **D²PAK type B reel mechanical data**

Dim.	mm	
	Min.	Max.
A		330
B	1.5	
C	12.8	13.2
D	20.2	
G	24.4	26.4
N	100	
T		30.4

4.5 TO-220 type A package information

Figure 24. **TO-220 type A package outline**

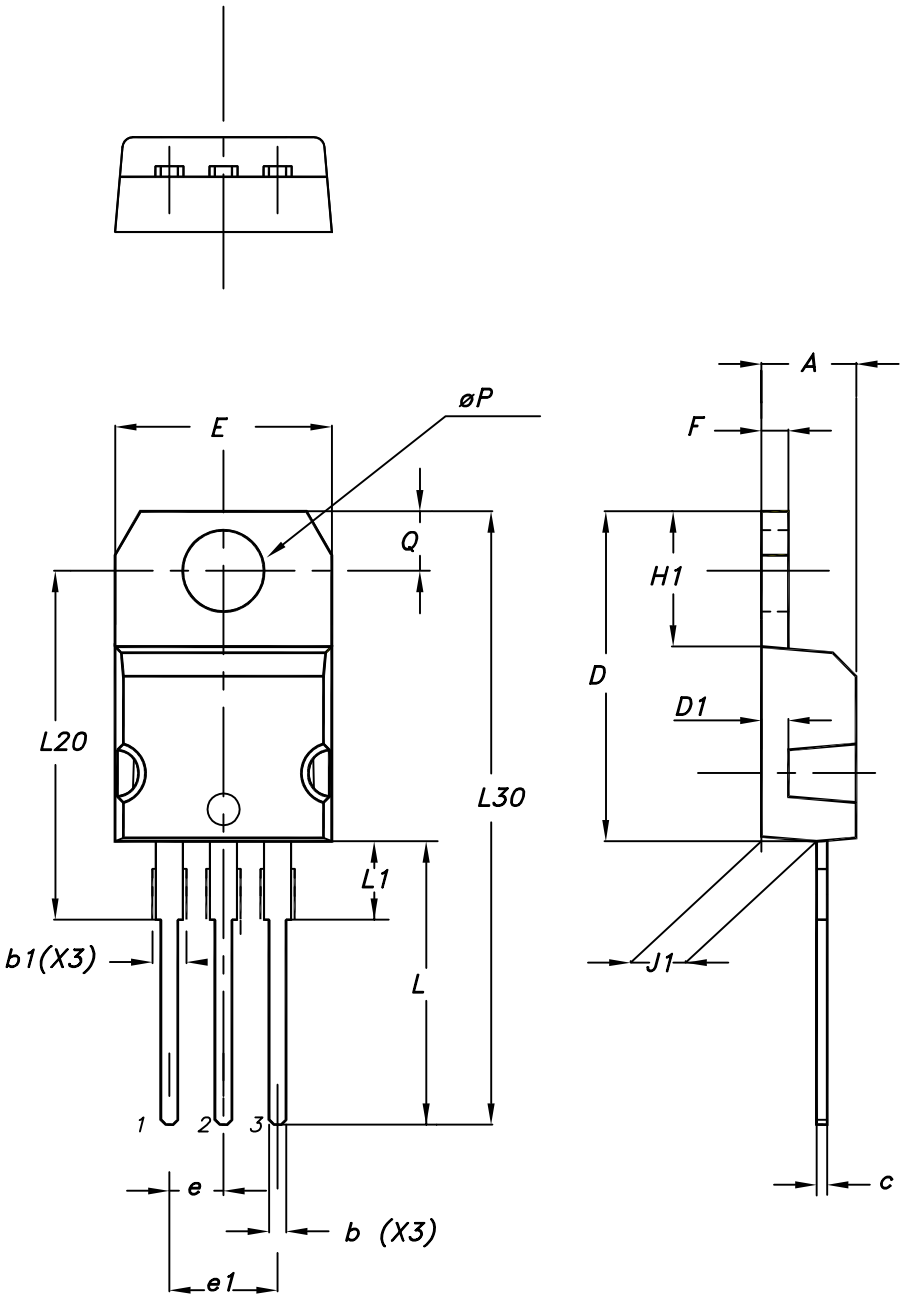

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Table 12. **TO-220 type A package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		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	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

Revision history

Table 13. **Document revision history**

Date	Version	Changes
09-Sep-2004	1	First release
10-Jun-2005	2	Typing error, wrong description
26-Jul-2006	3	The document has been reformatted, no content change
31-Aug-2006	4	Typo mistake on order code
21-Dec-2006	5	Various changes on *"Test conditions" for Table 5*. and *Table 6*.
12-Jan-2007	6	Order code has been corrected
01-Oct-2018	7	The part numbers STB11NM60-1 and STP11NM60FP have been moved to a separate datasheet and the document has been updated accordingly. Modified Table 1. Absolute maximum ratings, Table 2. Thermal data and Table 5. Dynamic. Modified Section 2.1 Electrical characteristics (curves). Updated Section 4 Package information. Minor text changes.

Contents

Mouser Electronics

Authorized Distributor

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STB11NM60T4 STP11NM60