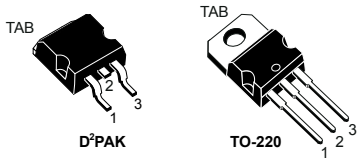
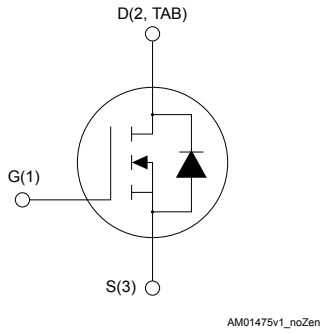
N-channel 600 V, 0.4 Ω typ., 11 A, MDmesh II Power MOSFETs in D²PAK and TO-220 packages





Features

Order codes	V_{DS} @ T_J max.	$R_{DS(on)}$ 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

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 power 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} ≤ $V_{(BR)DSS}$.*

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D^2PAK	TO-220	
R_{thJC}	Thermal resistance, junction-to-case	0.78		°C/W
R_{thJA}	Thermal resistance junction-to-ambient	35(1)	62.5	

1. *When mounted on a standard 1 inch² area of FR-4 PCB with 2-oz copper.*

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or non-repetitive (pulse width limited by T_J max.)	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. *Specified by design, not tested in production.*

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, V_{DD} = 100 V (see Figure 13. Test circuit for inductive load switching and diode recovery times)	-	390		ns
Q_{rr}	Reverse recovery charge		-	3.8		µC
I_{RRM}	Reverse recovery current		-	19.5		A
t_{rr}	Reverse recovery time	I_{SD} = 11 A, di/dt = 100 A/µs, V_{DD} = 100 V, T_J = 150 °C (see Figure 13. Test circuit for inductive load switching and diode recovery times)	-	570		ns
Q_{rr}	Reverse recovery charge		-	5.7		µC
I_{RRM}	Reverse recovery current		-	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

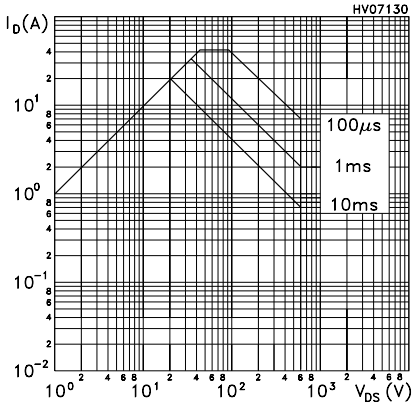


Figure 2. Thermal impedance

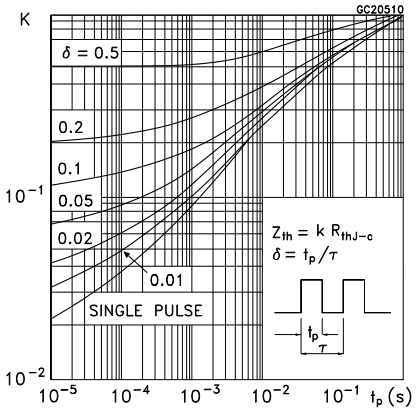


Figure 3. Output characteristics

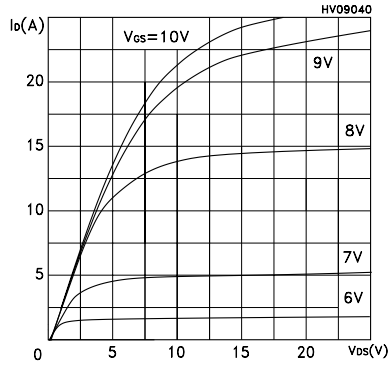


Figure 4. Transfer characteristics

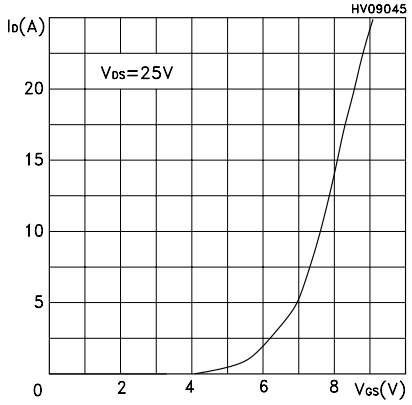


Figure 5. Normalized gate threshold voltage vs temperature

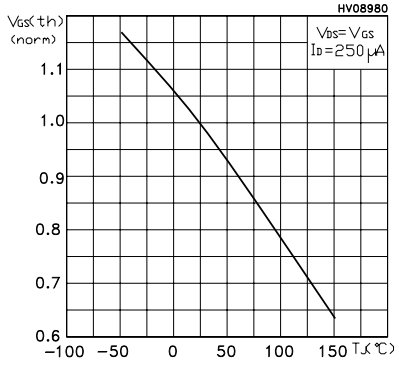


Figure 6. Static drain-source on-resistance

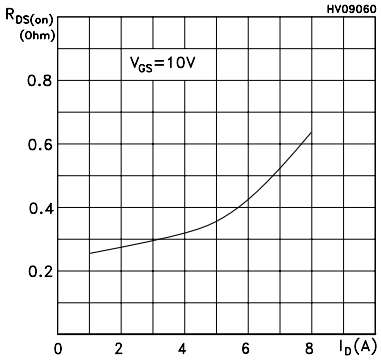


Figure 7. Normalized on-resistance vs temperature

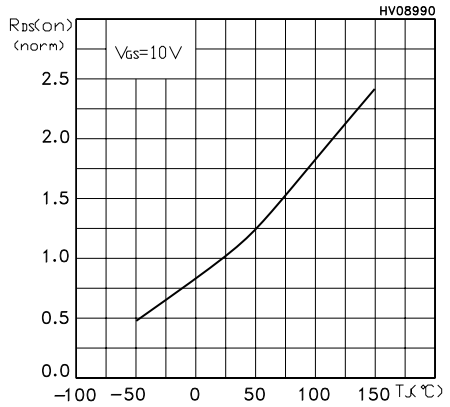


Figure 8. Gate charge vs gate-source voltage

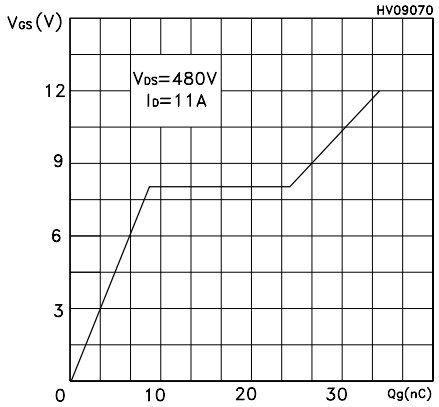


Figure 9. Capacitance variations

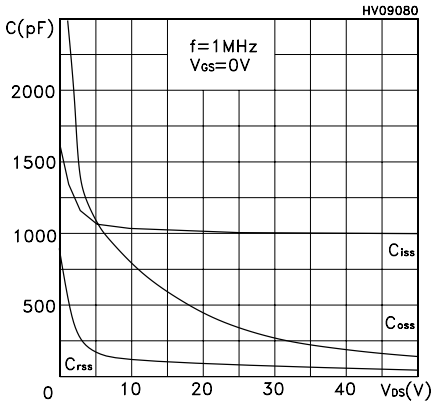
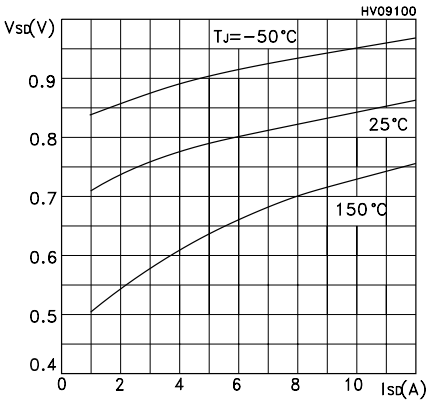


Figure 10. Source-drain diode forward characteristics



3 Test circuits

Figure 11. Test circuit for resistive load switching times

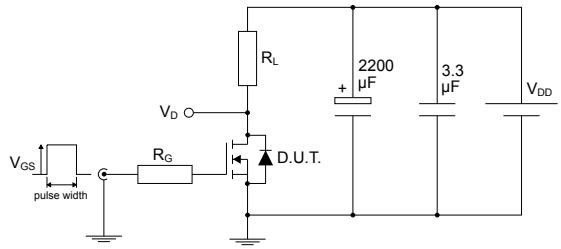


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Figure 12. Test circuit for gate charge behavior

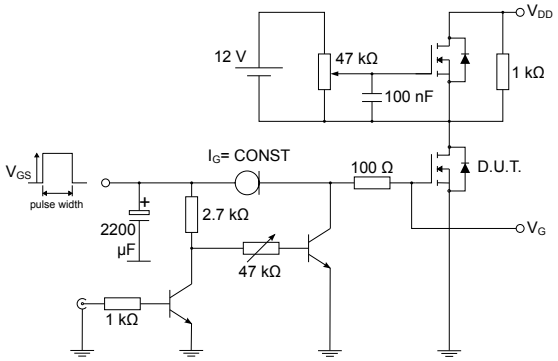

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Figure 13. Test circuit for inductive load switching and diode recovery times

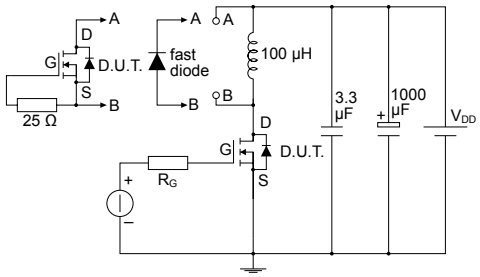

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Figure 14. Unclamped inductive load test circuit

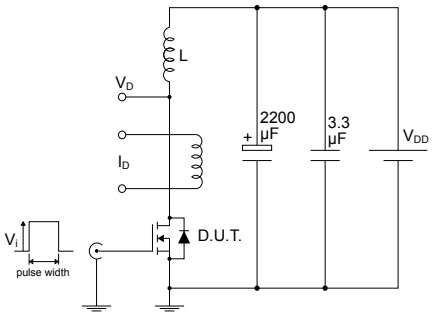

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Figure 15. Unclamped inductive waveform

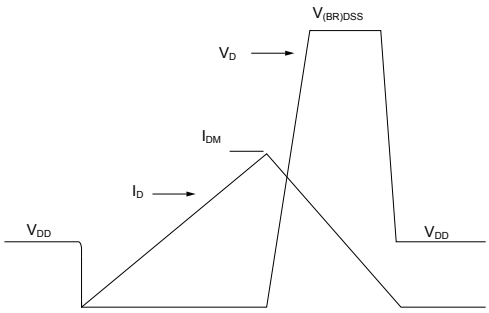

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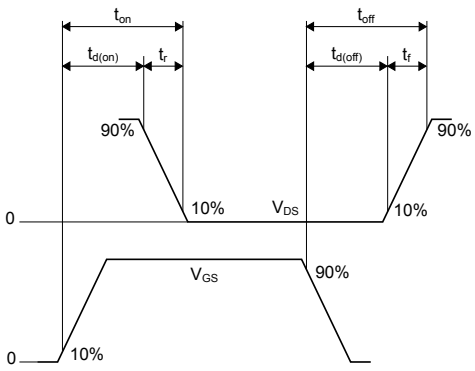
Figure 16. Switching time waveform



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4 Package information

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**

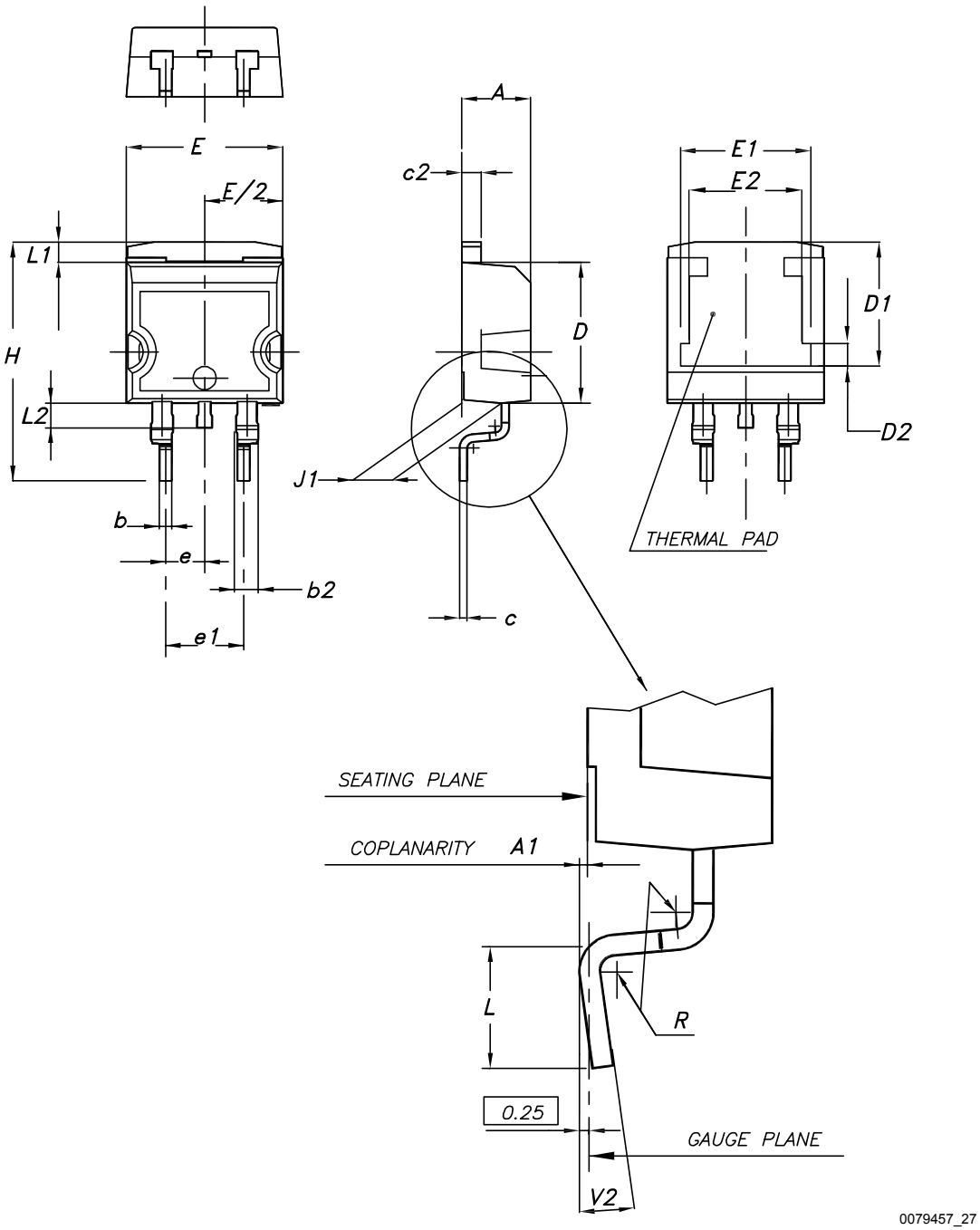

Table 8. D²PAK (TO-263) type A package mechanical data

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 (TO-263) type B package information

Figure 18. **D²PAK (TO-263) type B package outline**

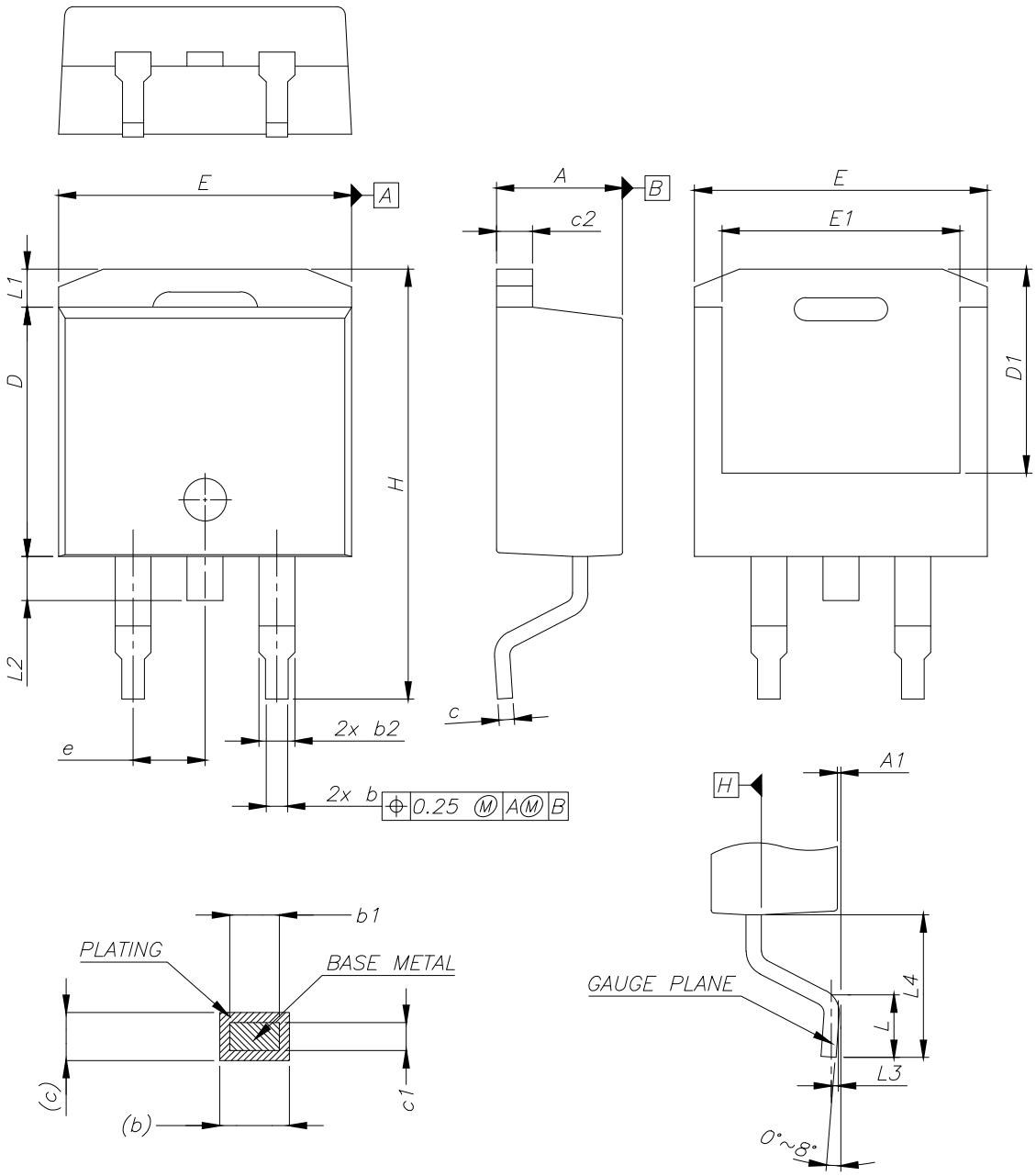

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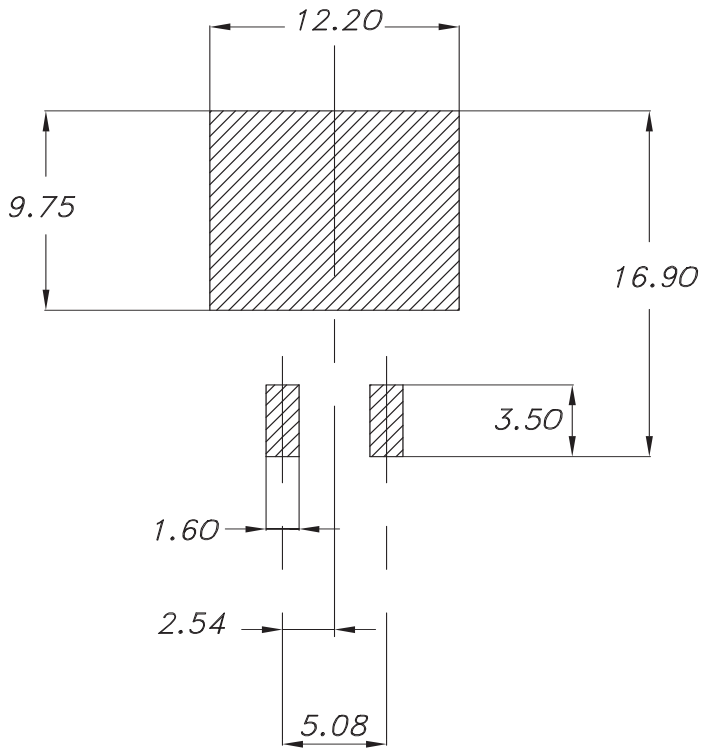
Table 9. **D²PAK (TO-263) type B mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.36		4.56
A1	0.00		0.25
b	0.70		0.90
b1	0.51		0.89
b2	1.17		1.37
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 19. **D²PAK (TO-263) recommended footprint (dimensions are in mm)**



4.3 TO-220 type A package information

Figure 20. **TO-220 type A package outline**

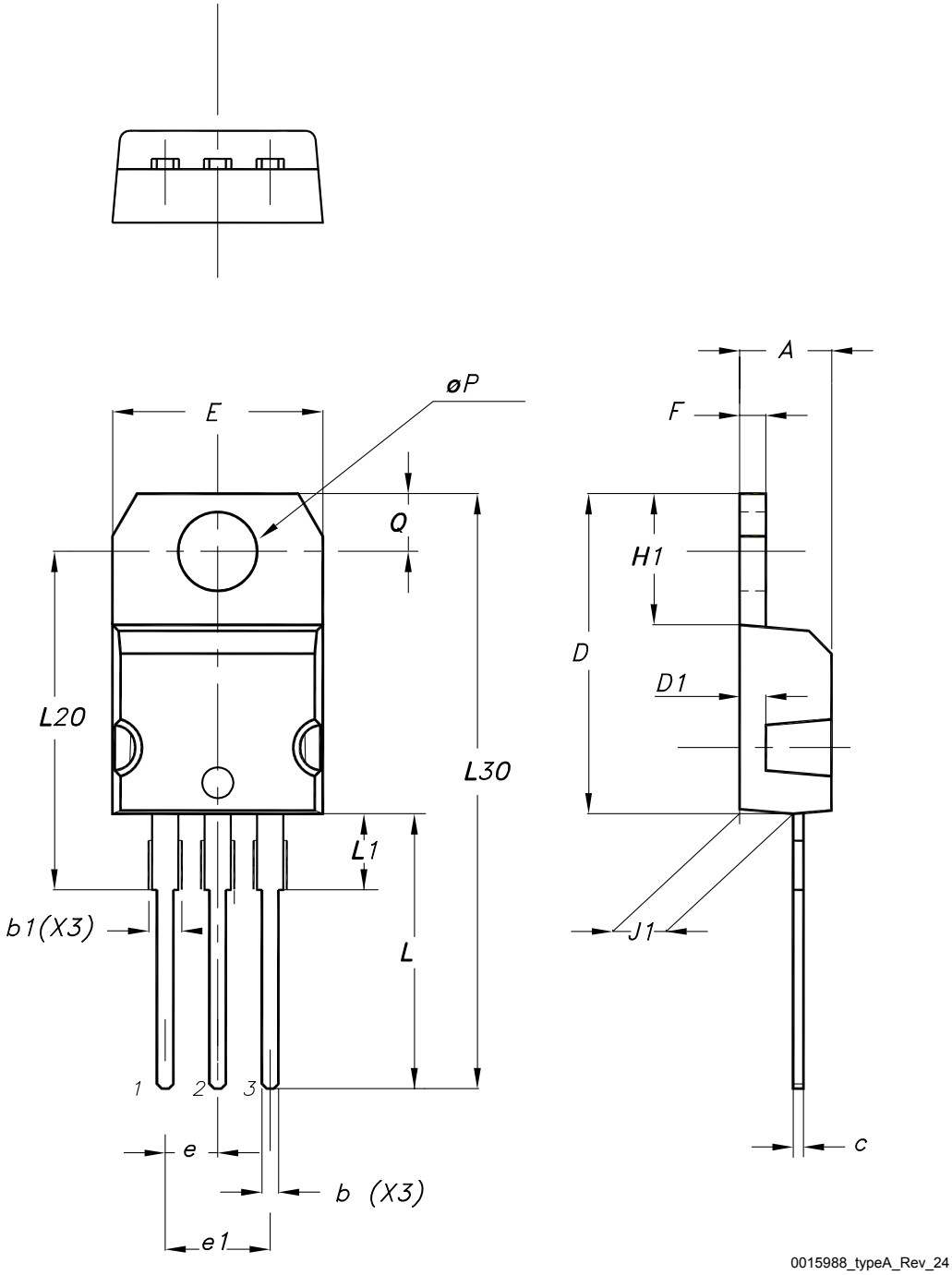
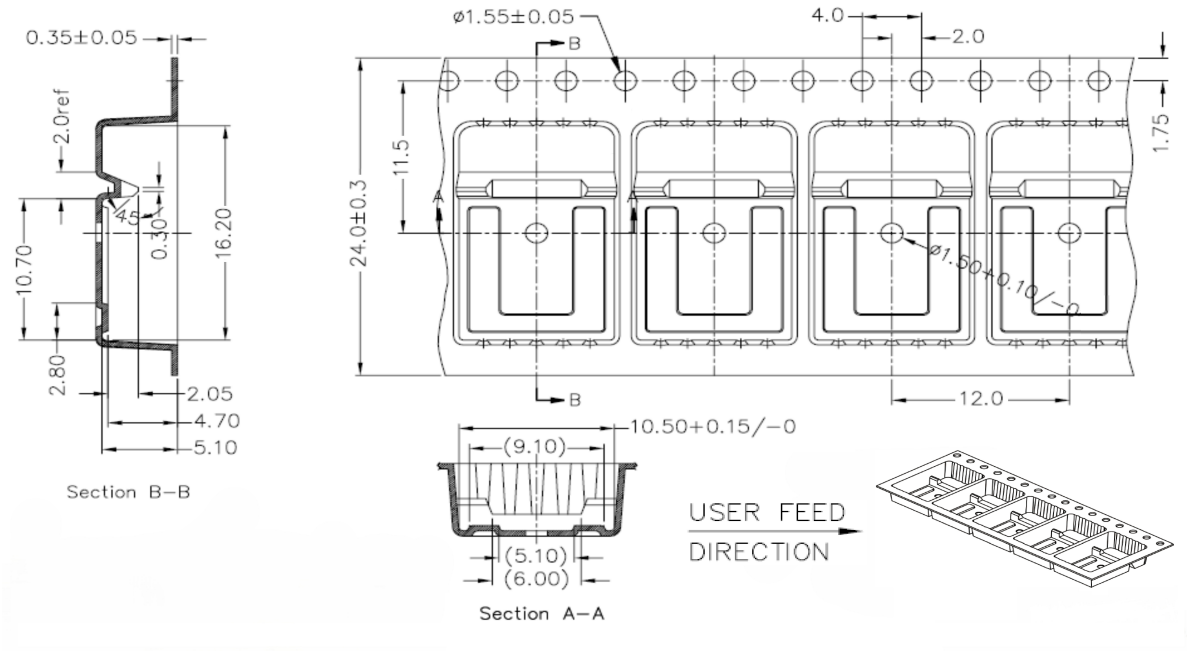


Table 10. **TO-220 type A package mechanical data**

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
Slug flatness		0.03	0.10

4.4 D²PAK packing information

Figure 21. **D²PAK tape drawing (dimensions are in mm)**



5 Order codes

Table 11. **Device summary**

Order code	Marking	Package	Packing
STB11NM60	B11NM60	D²PAK	Tape and reel
STP11NM60	P11NM60	TO-220	Tube

Revision history

Table 12. **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.
08-Jul-2025	8	Updated Section 4: Package information. Minor text changes.

Contents