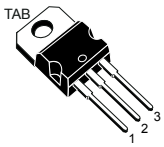
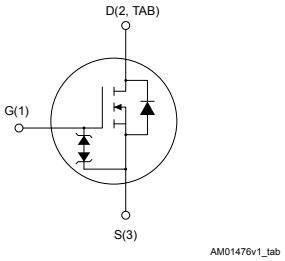
STB10N60M2, STD10N60M2, STP10N60M2

Datasheet

N-channel 600 V, 0.55 Ω typ., 7.5 A MDmesh M2 Power MOSFET in a D²PAK, DPAK and TO-220 packages



TO-220



Features

Order codes	V_{DS} @ T_J max.	$R_{DS(on)}$ max.	I_D	Package
STB10N60M2	650 V	0.60 Ω	7.5 A	D²PAK
STD10N60M2				DPAK
STP10N60M2				TO-220

- Extremely low gate charge
- Excellent output capacitance (C_{oss}) profile
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the MDmesh M2 technology. Thanks to their strip layout and improved vertical structure, these devices exhibit low on-resistance and optimized switching characteristics, rendering them suitable for the most demanding high-efficiency converters.

Product status links
STB10N60M2
STD10N60M2
STP10N60M2

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	±25	V
I_D	Drain current (continuous) at T_C = 25 °C	7.5	A
	Drain current (continuous) at T_C = 100 °C	4.9	
I_{DM}(1)	Drain current (pulsed)	30	A
P_{TOT}	Total power dissipation at T_C = 25 °C	85	W
dv/dt(2)	Peak diode recovery voltage slope	15	V/ns
dv/dt(3)	MOSFET dv/dt ruggedness	50	
T_{stg}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range		°C

1. *Pulse limited by safe operating area.*
2. *I_{SD} ≤ 7.5 A, di/dt ≤ 400 A/µs, V_{DS} peak < $V_{(BR)DSS}$, V_{DD} = 400 V.*
3. *V_{DS} ≤ 480 V.*

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		D^2PAK	DPAK	TO-220	
R_{thJC}	Thermal resistance, junction-to-case	1.47			°C/W
R_{thJB}(1)	Thermal resistance, junction-to-board	30	50		°C/W
R_{thJA}	Thermal resistance, junction-to-ambient			62.5	°C/W

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

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}(1)	Avalanche current, repetitive or not repetitive	1.5	A
E_{AS}(2)	Single pulse avalanche energy	110	mJ

1. *Pulse width limited by T_J max.*
2. *Starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V.*

2 Electrical characteristics

(T_C = 25 °C unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	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)			100	
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 3 A		0.55	0.60	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} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	400	-	pF
C_{oss}	Output capacitance		-	22	-	pF
C_{rss}	Reverse transfer capacitance		-	0.84	-	pF
$C_{oss\ eq.}$(1)	Equivalent output capacitance	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	83	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	6.4	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 7.5 A, V_{GS} = 0 to 10 V (see Figure 16. Test circuit for gate charge behavior)	-	13.5	-	nC
Q_{gs}	Gate-source charge		-	2.1	-	nC
Q_{gd}	Gate-drain charge		-	7.2	-	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 = 3.75 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 15. Test circuit for resistive load switching times and Figure 20. Switching time waveform)	-	8.8	-	ns
t_r	Rise time		-	8	-	ns
$t_{d(off)}$	Turn-off delay time		-	32.5	-	ns
t_f	Fall time		-	13.2	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		7.5	A
I_{SDM} (1)	Source-drain current (pulsed)		-		30	A
V_{SD} (2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 7.5 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 7.5 A, di/dt = 100 A/µs,	-	270		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V	-	2		µC
I_{RRM}	Reverse recovery current	(see Figure 17. Test circuit for inductive load switching and diode recovery times)	-	14.4		A
t_{rr}	Reverse recovery time	I_{SD} = 7.5 A, di/dt = 100 A/µs,	-	376		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V, T_J = 150 °C	-	2.8		µC
I_{RRM}	Reverse recovery current	(see Figure 17. Test circuit for inductive load switching and diode recovery times)	-	15		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 for D²PAK and TO-220

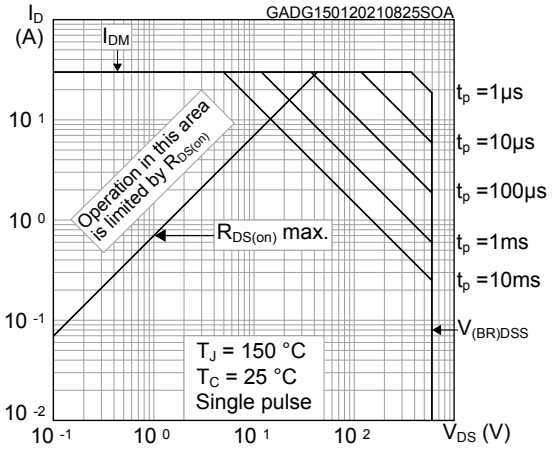


Figure 2. Maximum transient thermal impedance for D²PAK and TO-220

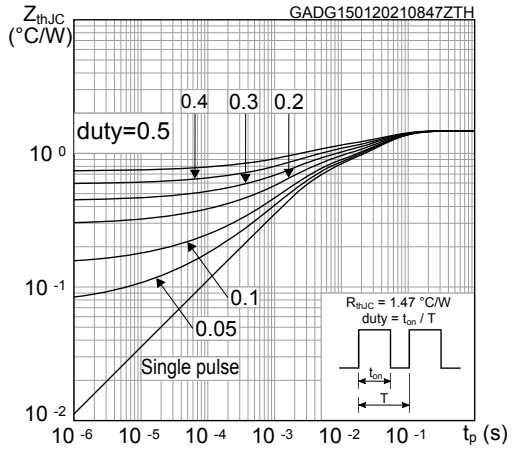


Figure 3. Safe operating area for DPAK

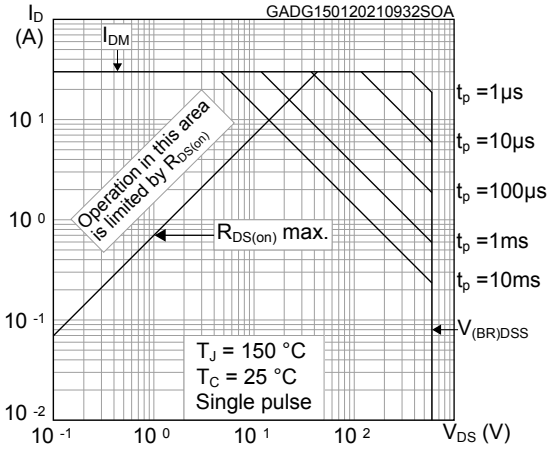


Figure 4. Maximum transient thermal impedance for DPAK

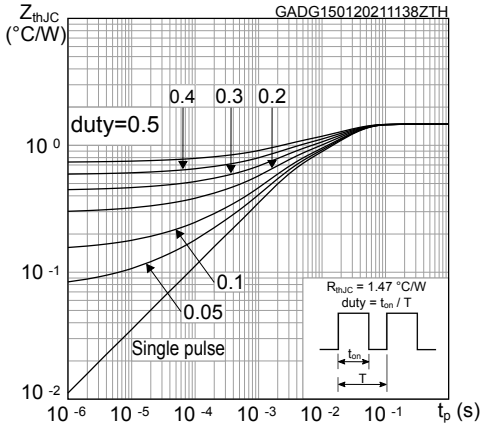


Figure 5. Output characteristics

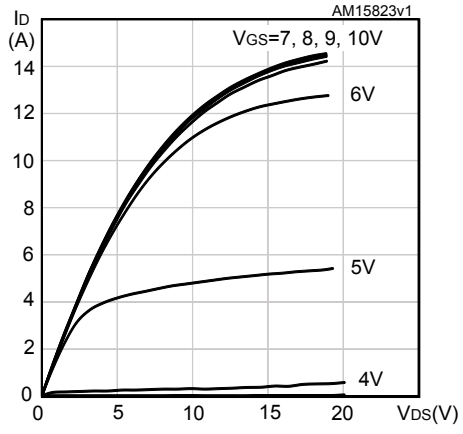


Figure 6. Transfer characteristics

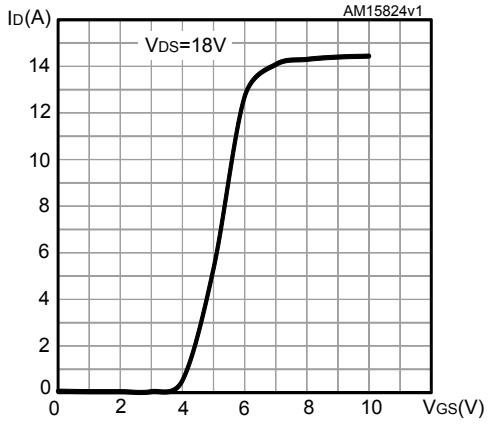


Figure 7. Gate charge vs gate-source voltage

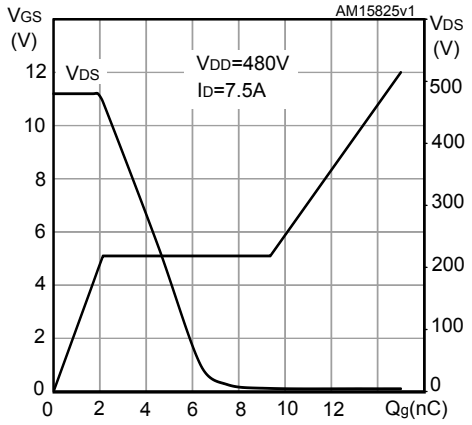


Figure 8. Static drain-source on-resistance

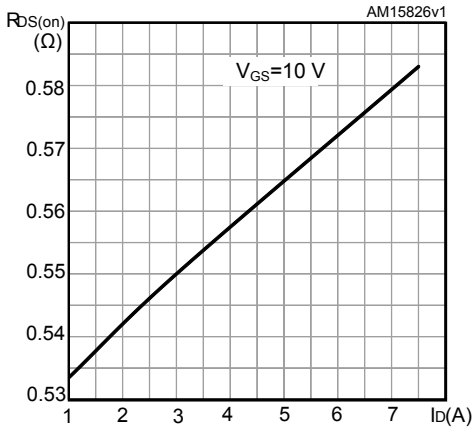


Figure 9. Capacitance variations

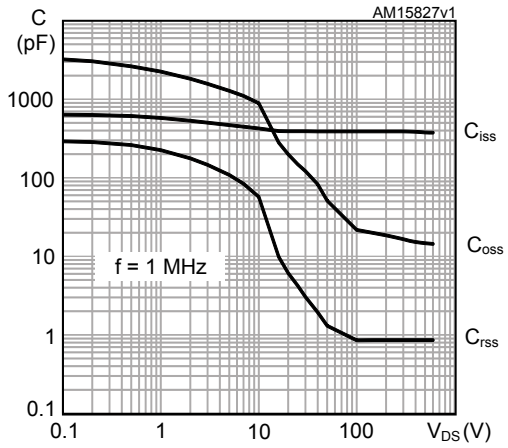


Figure 10. Normalized gate threshold voltage vs temperature

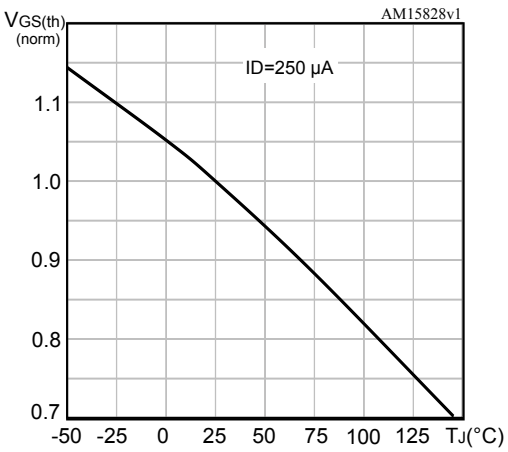


Figure 11. Normalized on-resistance vs temperature

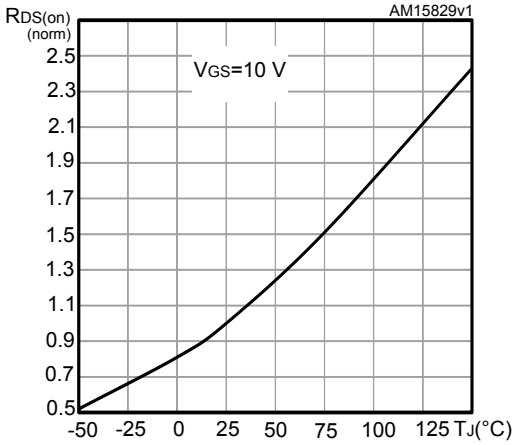


Figure 12. Normalized $V_{(BR)DSS}$ vs temperature

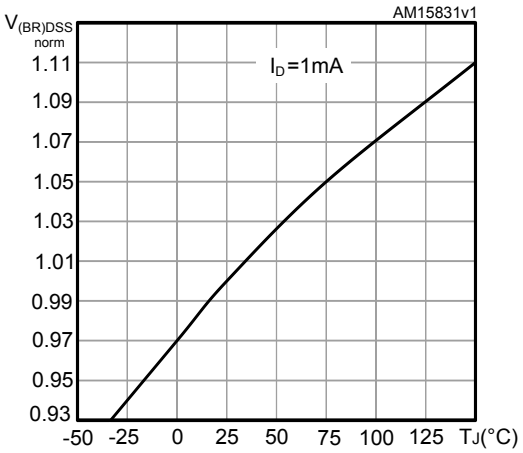


Figure 13. Source-drain diode forward characteristics

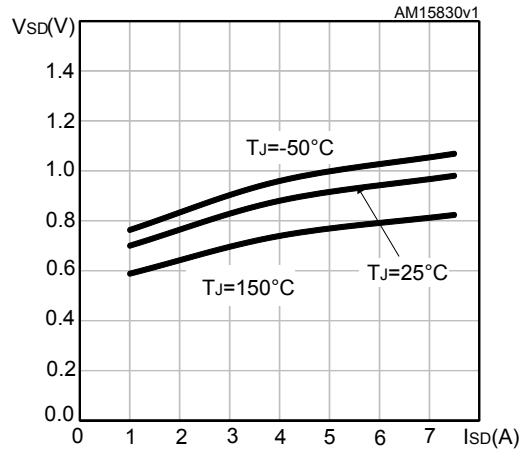
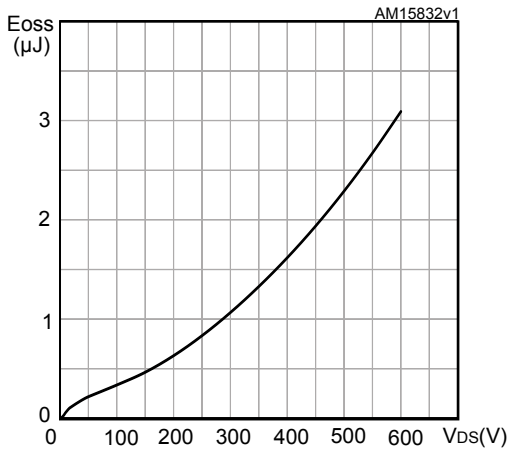


Figure 14. Output capacitance stored energy



3 Test circuits

Figure 15. Test circuit for resistive load switching times

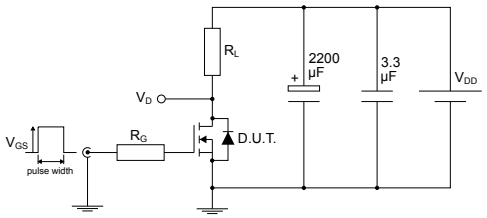


Figure 16. Test circuit for gate charge behavior

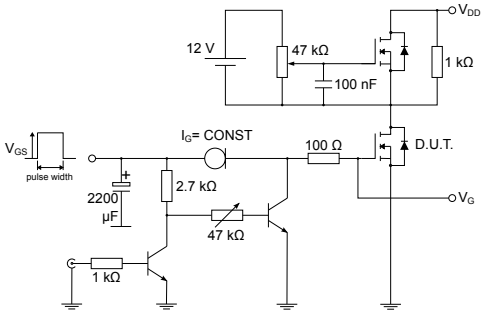


Figure 17. Test circuit for inductive load switching and diode recovery times

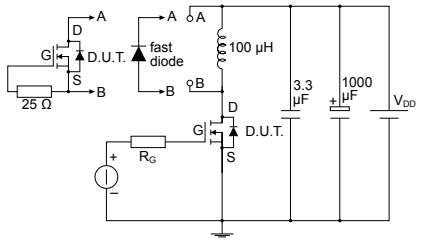


Figure 18. Unclamped inductive load test circuit

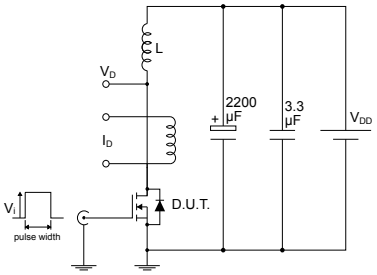


Figure 19. Unclamped inductive waveform

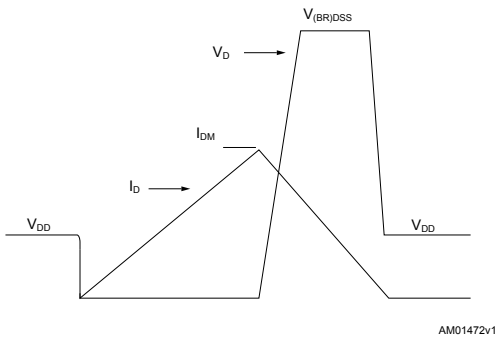
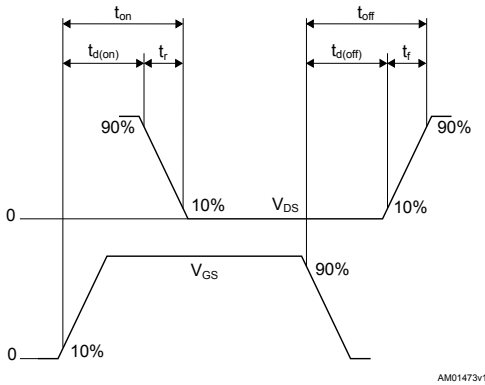


Figure 20. Switching time waveform



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 21. **D²PAK (TO-263) type A package outline**

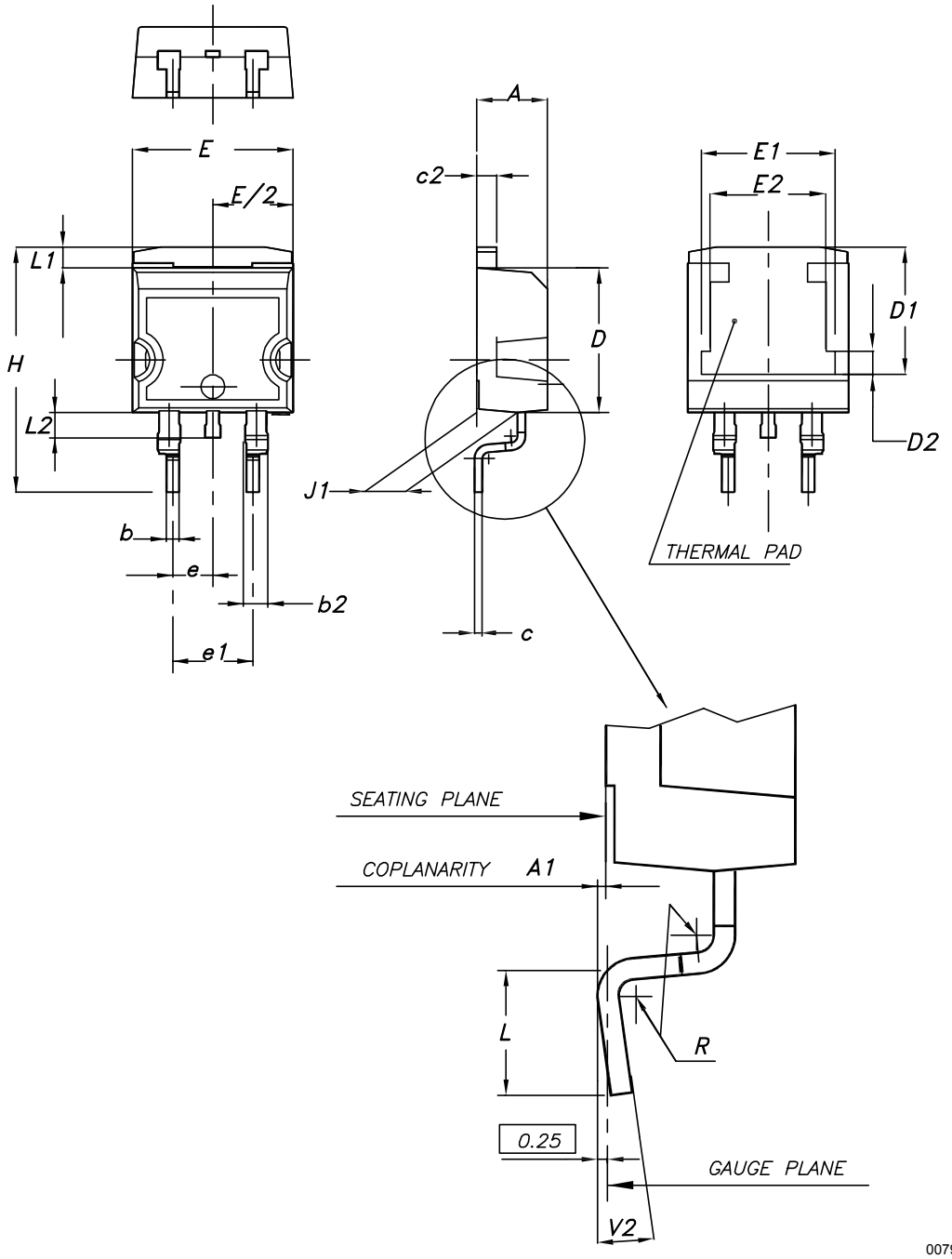
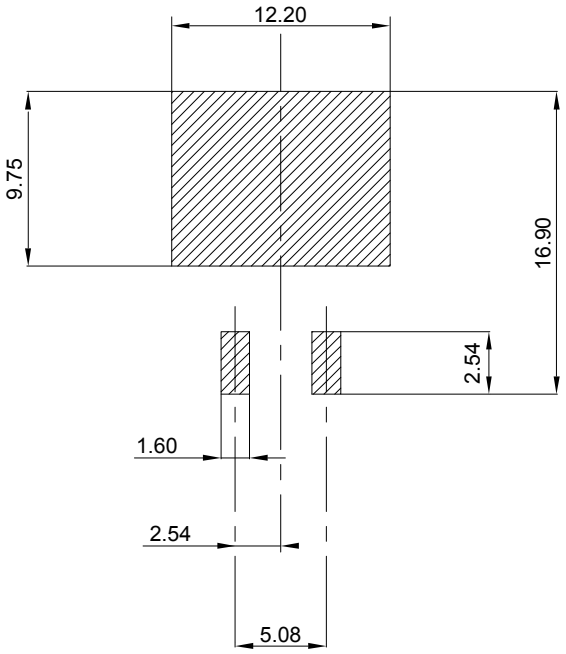


Table 8. D²PAK (TO-263) type A package mechanical data

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°

Figure 22. **D²PAK (TO-263) recommended footprint (dimensions are in mm)**



Footprint_26

4.2 DPAK (TO-252) type A package information

Figure 23. **DPAK (TO-252) type A package outline**

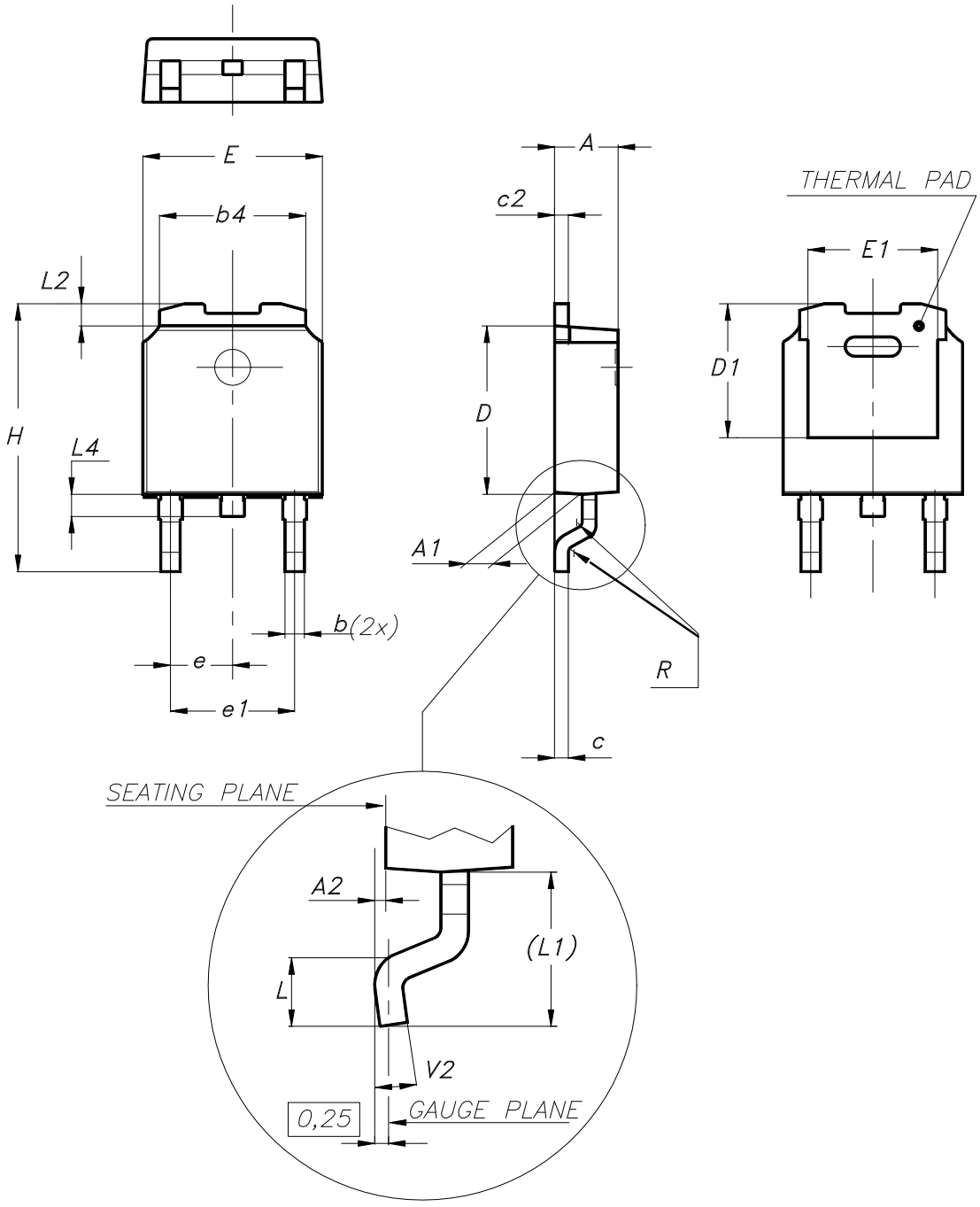


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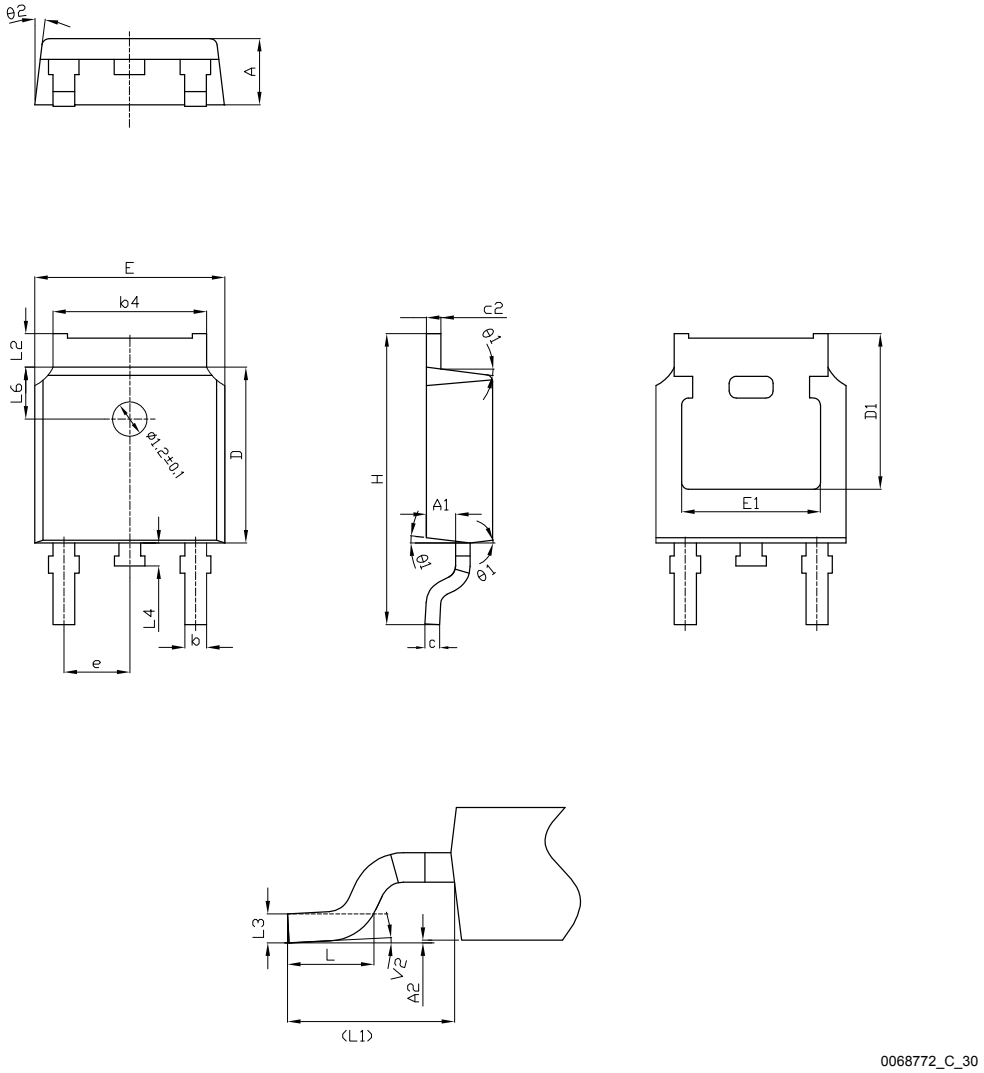
Table 9. **DPAK (TO-252) type A mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1	4.95	5.10	5.25
E	6.40		6.60
E1	4.60	4.70	4.80
e	2.159	2.286	2.413
e1	4.445	4.572	4.699
H	9.35		10.10
L	1.00		1.50
(L1)	2.60	2.80	3.00
L2	0.65	0.80	0.95
L4	0.60		1.00
R		0.20	
V2	0°		8°

4.3 DPAK (TO-252) type C package information

Figure 24. **DPAK (TO-252) type C package outline**



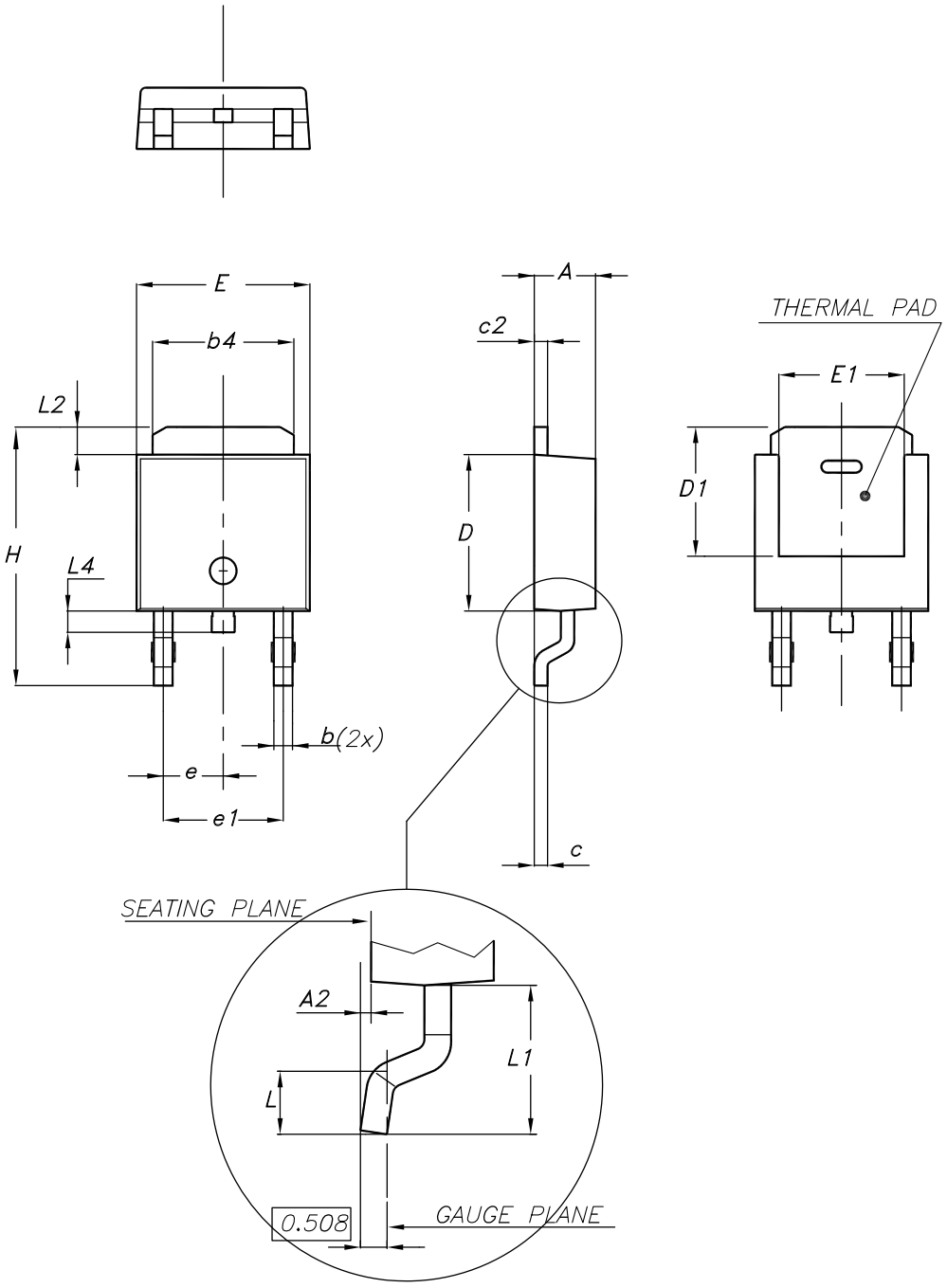
0068772_C_30

Table 10. **DPAK (TO-252) type C mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.38
A1	0.90	1.01	1.10
A2	0.00		0.10
b	0.72		0.85
b4	5.13	5.33	5.46
c	0.47		0.60
c2	0.47		0.60
D	6.00	6.10	6.20
D1	5.25		
E	6.50	6.60	6.70
E1	4.70		
e	2.186	2.286	2.386
H	9.80	10.10	10.40
L	1.40	1.50	1.70
L1		2.90 REF	
L2	0.90		1.25
L3		0.51 BSC	
L4	0.60	0.80	1.00
L6		1.80 BSC	
θ1	5°	7°	9°
θ2	5°	7°	9°
V2	0°		8°

4.4 DPAK (TO-252) type E package information

Figure 25. **DPAK (TO-252) type E package outline**

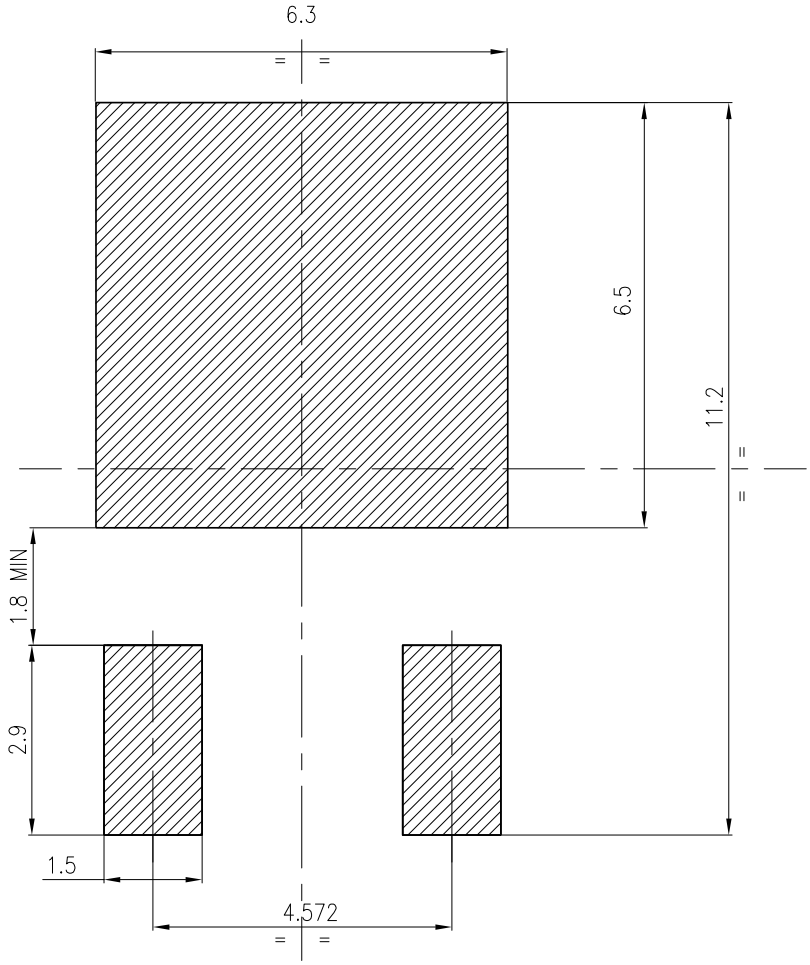


0068772_typeE_rev.30

Table 11. **DPAK (TO-252) type E mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.18		2.39
A2			0.13
b	0.65		0.884
b4	4.95		5.46
c	0.46		0.61
c2	0.46		0.60
D	5.97		6.22
D1	5.21		
E	6.35		6.73
E1	4.32		
e		2.286	
e1		4.572	
H	9.94		10.34
L	1.50		1.78
L1		2.74	
L2	0.89		1.27
L4			1.02

Figure 26. **DPAK (TO-252) recommended footprint (dimensions are in mm)**



4.5 TO-220 type A package information

Figure 27. **TO-220 type A package outline**

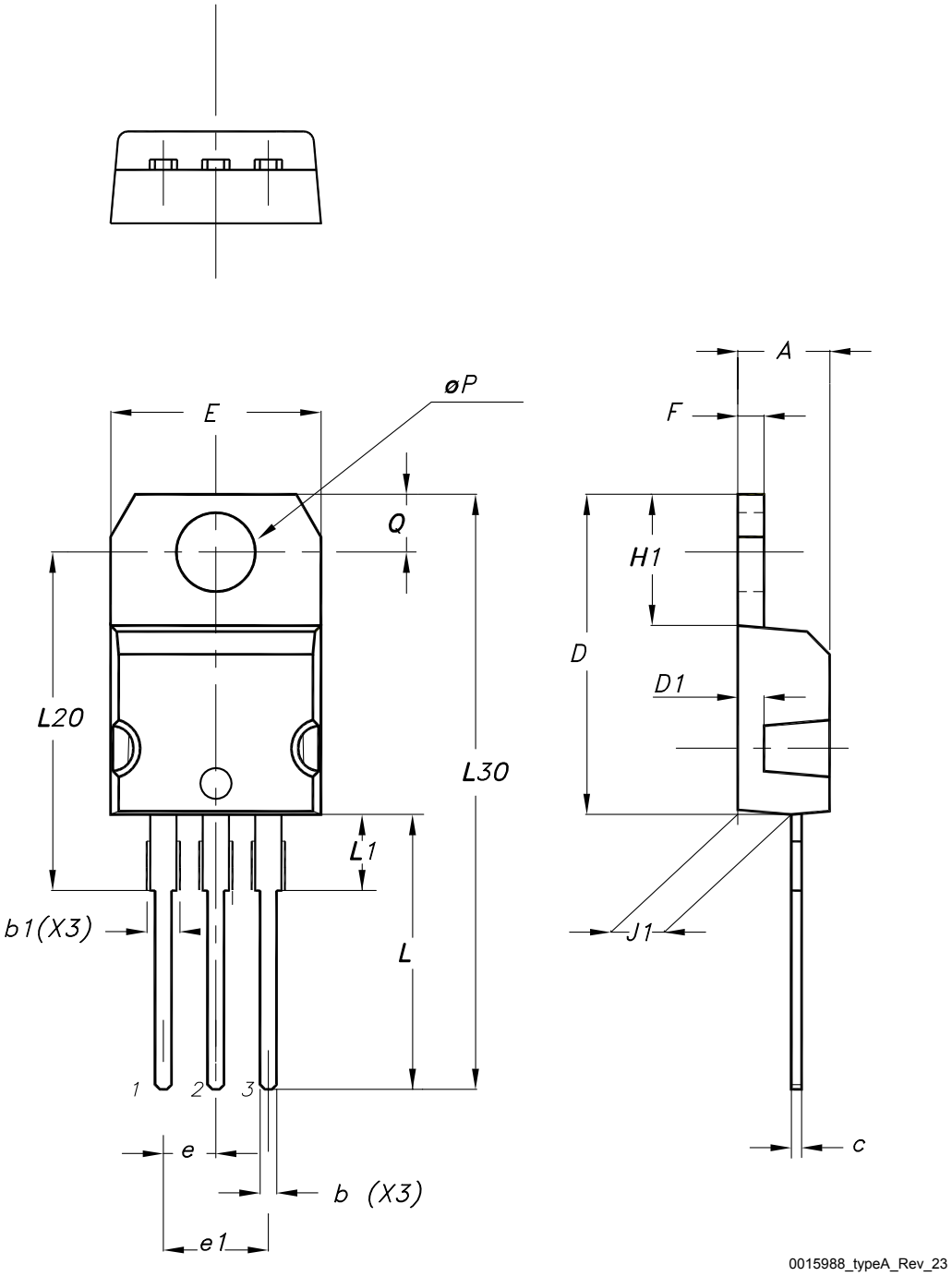


Table 12. **TO-220 type A package mechanical data**

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
Slug flatness		0.03	0.10

4.6 D²PAK and DPAK packing information

Figure 28. **Tape outline**

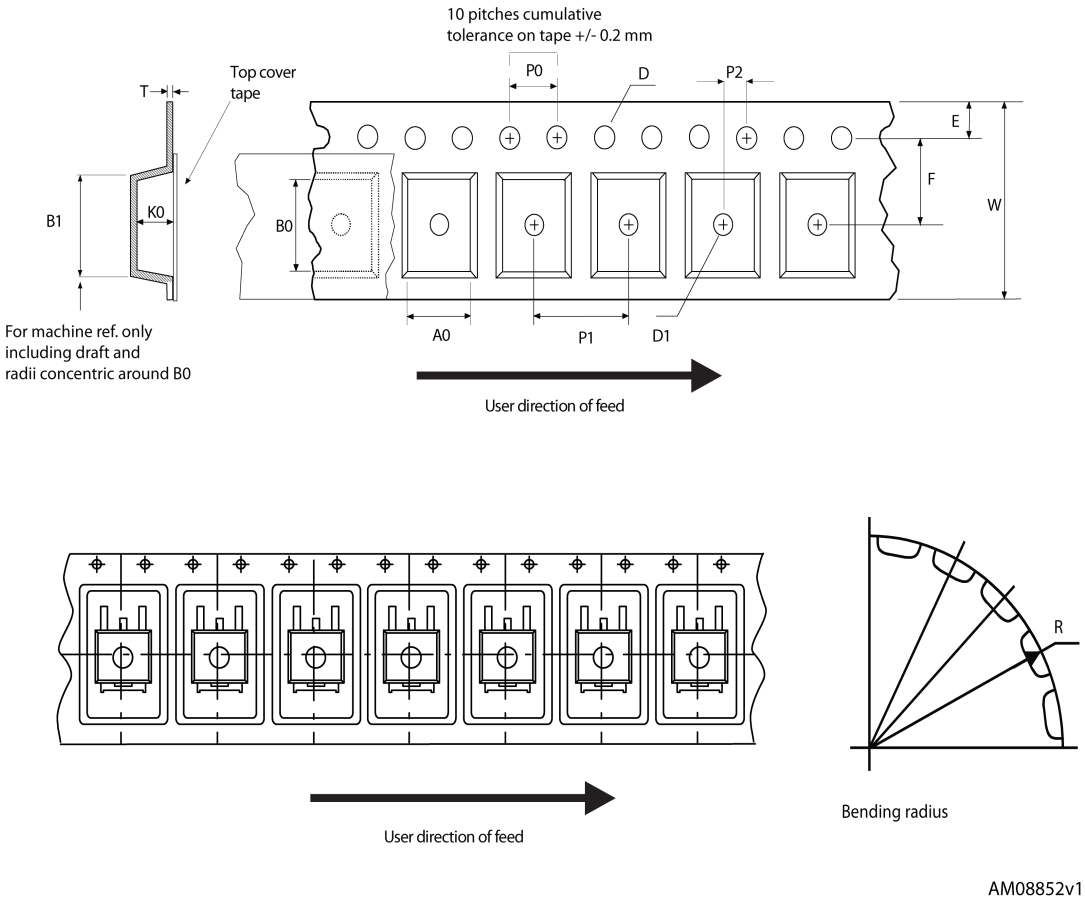
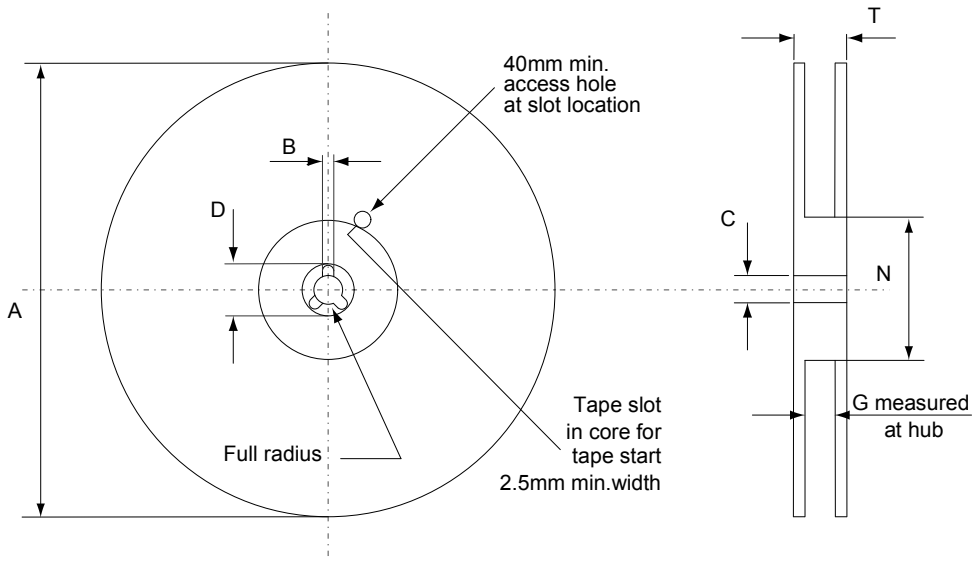


Figure 29. **Reel outline**



AM06038v1

Table 13. **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			

Table 14. **DPAK tape and reel mechanical data**

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

5 Order codes

Table 15. **Device summary**

Order code	Marking	Package	Packing
STB10N60M2	10N60M2	D²PAK	Tape and reel
STD10N60M2		DPAK	
STP10N60M2		TO-220	Tube

Revision history

Table 16. **Document revision history**

Date	Version	Changes
29-May-2013	1	First release.
06-Dec-2013	2	– Added: D²PAK package – Modified: title and $R_{DS(on)}$ values in cover page – Modified: $R_{DS(on)}$ values in *Table 5* – Modified: R_G value in *Table 6* – Modified: *Figure 9* and I_D value in *Figure 12* – Added: *Table 9*, *13*, *Figure 22* and *23* – Updated: *Table 10*, *11*, *Figure 24*, *25* and *26* Minor text changes.
08-Mar-2017	3	Updated the title and the description in cover page. Updated *Table 4: "Avalanche characteristics"*. Updated *Section 4.2: "DPAK (TO-252) type A package information"*. Added *Section 4.4: "DPAK (TO-252) type E package information"*, and *Section 4.7: "IPAK (TO-251) type C package information"*. Minor text changes.
19-Jan-2021	4	The part number STU10N60M2 have been removed and the document has been updated accordingly. Updated Figure 1. Safe operating area for D²PAK and TO-220, Figure 2. Maximum transient thermal impedance for D²PAK and TO-220, Figure 3. Safe operating area for DPAK and Figure 4. Maximum transient thermal impedance for DPAK. Minor text changes.

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