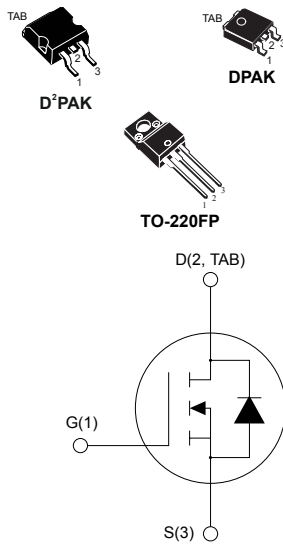


N-channel 650 V, 0.56 Ω typ., 7 A MDmesh M5 Power MOSFETs in a D²PAK, DPAK and TO-220FP packages



AM01475v1_noZen



Features

Order codes	V_{DS} @ T_J max.	$R_{DS(on)}$ max.	I_D	P_{TOT}
STB8N65M5	710 V	0.60 Ω	7 A	70 W
STD8N65M5				70 W
STF8N65M5				25 W

- Extremely low $R_{DS(on)}$
- Low gate charge and input capacitance
- Excellent switching performance
- 100% avalanche tested

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs based on the MDmesh M5 innovative vertical process technology combined with the well-known PowerMESH horizontal layout. The resulting products offer extremely low on-resistance, making them particularly suitable for applications requiring high power and superior efficiency.

Product status links

[STB8N65M5](#)
[STD8N65M5](#)
[STF8N65M5](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		D ² PAK	DPAK	TO-220FP	
V _{GS}	Gate-source voltage	±25			V
I _D	Drain current (continuous) at T _C = 25 °C	7		7 ⁽¹⁾	A
I _D	Drain current (continuous) at T _C = 100 °C	4.4		4.4 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	28		28 ⁽¹⁾	A
P _{TOT}	Total power dissipation at T _C = 25 °C	70		25	W
dv/dt ⁽³⁾	Peak diode recovery voltage slope	15			V/ns
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T _C = 25 °C)	2500			V
T _J	Operating junction temperature range	-55 to 150			°C
T _{stg}	Storage temperature range				

1. Limited by maximum junction temperature.
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq 7 \text{ A}$, $di/dt \leq 400 \text{ A}/\mu\text{s}$; $V_{DS} (\text{peak}) < V_{(BR)DSS}$, $V_{DD} = 400 \text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		D ² PAK	DPAK	TO-220FP	
R _{thJC}	Thermal resistance, junction-to-case	1.79		5	°C/W
R _{thJA}	Thermal resistance, junction-to-ambient			62.5	°C/W
R _{thJB} ⁽¹⁾	Thermal resistance, junction-to-board	30	50		°C/W

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

Table 3. Avalanche characteristics

Symbol	Parameter	Value			Unit
		D ² PAK	DPAK	TO-220FP	
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _J max.)	2			A
E _{AS}	Single pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	120			mJ

2 Electrical characteristics

$T_C = 25\text{ °C}$ unless otherwise specified.

Table 4. On/off states

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$	650			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$, $T_C = 125\text{ °C}^{(1)}$			100	μA
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 3.5\text{ A}$		0.56	0.60	Ω

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$		690		pF
C_{oss}	Output capacitance			18		
C_{rss}	Reverse transfer capacitance			2		
$C_{o(tr)}^{(1)}$	Equivalent output capacitance time related	$V_{DS} = 0\text{ to }520\text{ V}$, $V_{GS} = 0\text{ V}$		17		pF
$C_{o(er)}^{(2)}$	Equivalent output capacitance energy related				52	
R_g	Gate input resistance	$f = 1\text{ MHz}$ open drain	2	5	8	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}$, $I_D = 3.5\text{ A}$,		15		nC
Q_{gs}	Gate-source charge	$V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 18. Test circuit for gate charge behavior)		3.6		
Q_{gd}	Gate-drain charge			6		

1. $C_{o(tr)}$ is an equivalent capacitance that provides the same charging time as C_{oss} while V_{DS} is rising from 0 V to the stated value.

2. $C_{o(er)}$ is an equivalent capacitance that provides the same stored energy as C_{oss} while V_{DS} is rising from 0 V to the stated value.

Table 6. Switching times

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off delay time	$V_{DD} = 400\text{ V}$, $I_D = 4\text{ A}$,	-	50	-	ns
$t_{r(v)}$	Voltage rise time	$R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	14	-	
$t_{c(off)}$	Crossing time off	(see Figure 19. Test circuit for inductive load switching and diode recovery times and Figure 22. Switching time waveform)	-	20	-	
$t_{f(i)}$	Current fall time		-	11	-	

Table 7. Source-drain diode

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		7	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		28	
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 7\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 7\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	200		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 100\text{ V}$ (see Figure 19. Test circuit for inductive load switching and diode recovery times)	-	1.6		μC
I_{RRM}	Reverse recovery current		-	16		A
t_{rr}	Reverse recovery time	$I_{SD} = 7\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	263		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 100\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (see Figure 19. Test circuit for inductive load switching and diode recovery times)	-	1.9		μC
I_{RRM}	Reverse recovery current		-	15		A

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

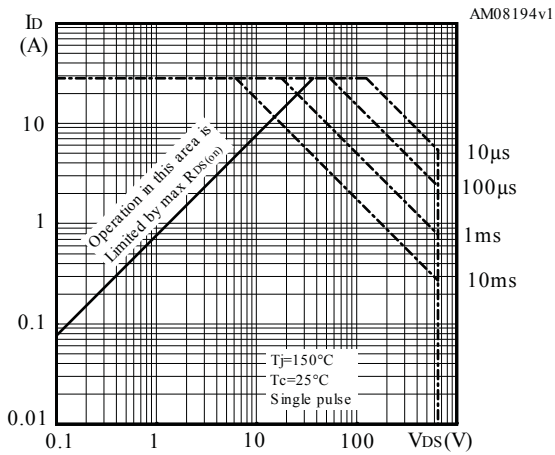
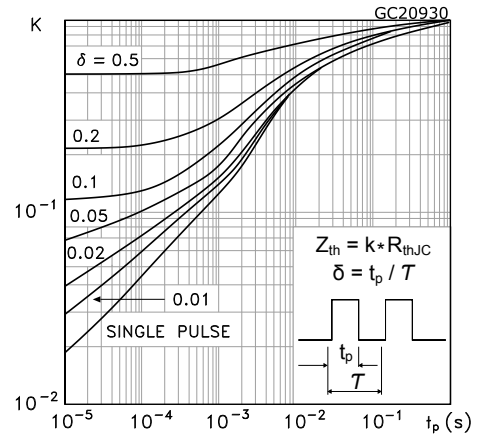
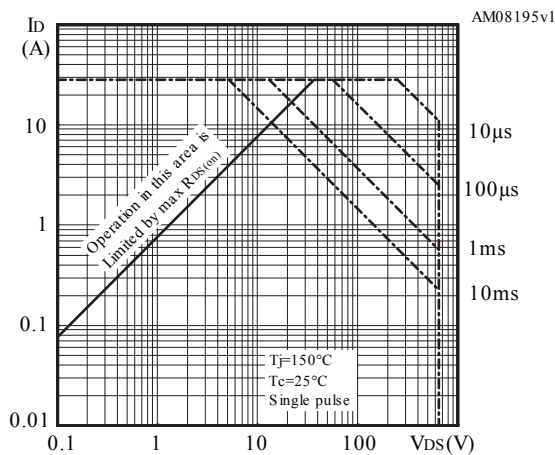
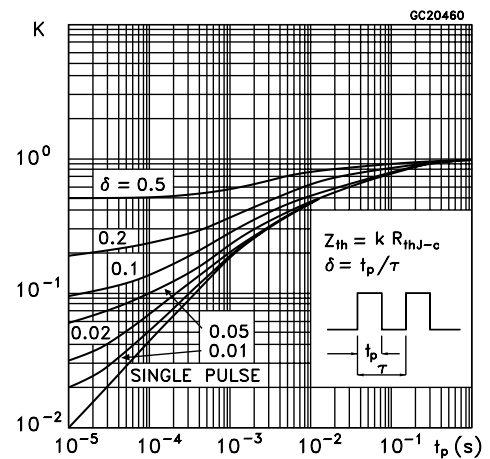
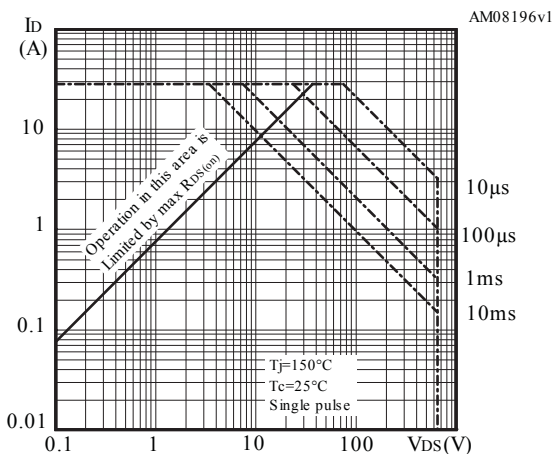
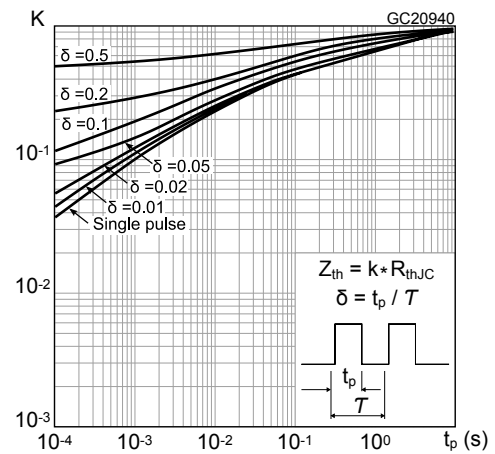
2.1 Electrical characteristics (curves)
Figure 1. Safe operating area for D²PAK

Figure 2. Thermal impedance for D²PAK

Figure 3. Safe operating area for DPAK

Figure 4. Thermal impedance for DPAK

Figure 5. Safe operating area for TO-220FP

Figure 6. Thermal impedance for TO-220FP


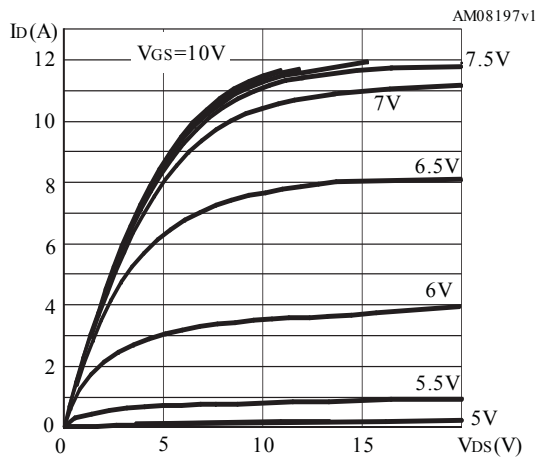
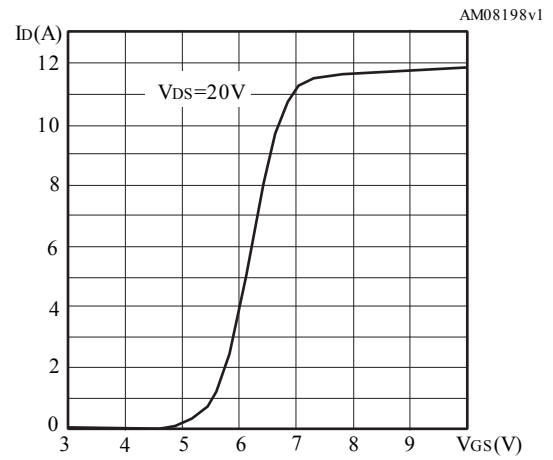
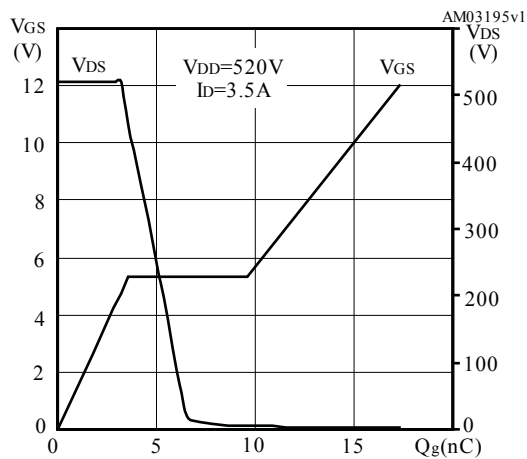
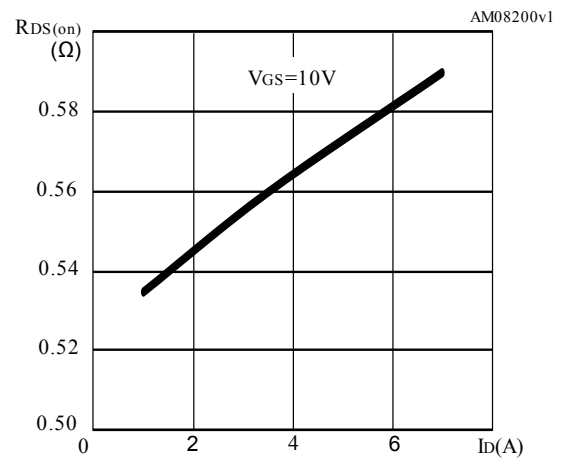
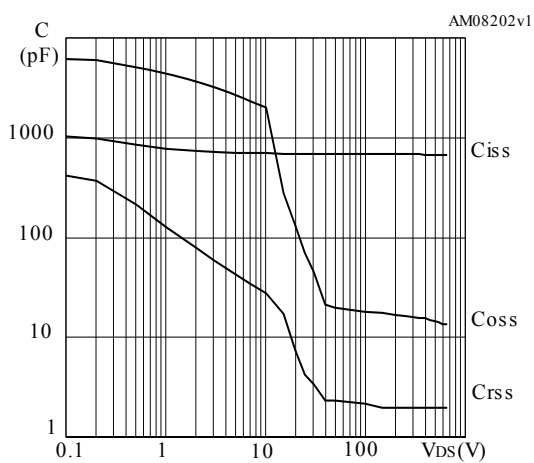
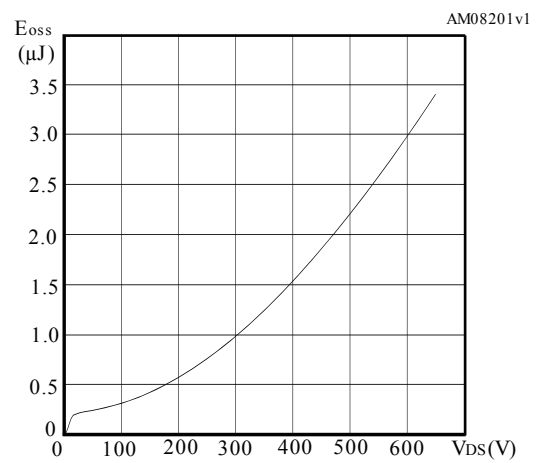
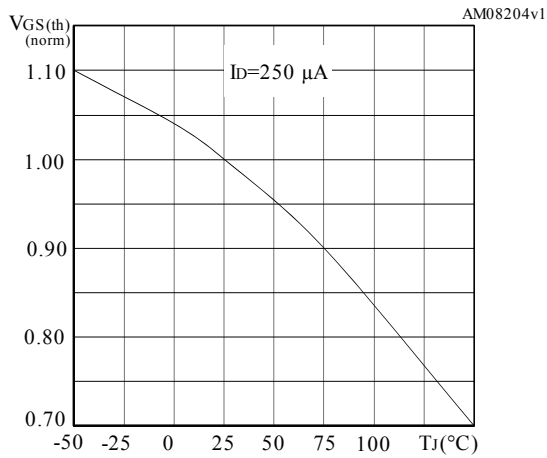
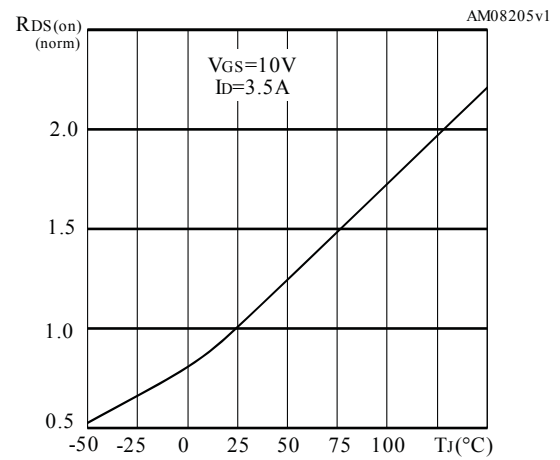
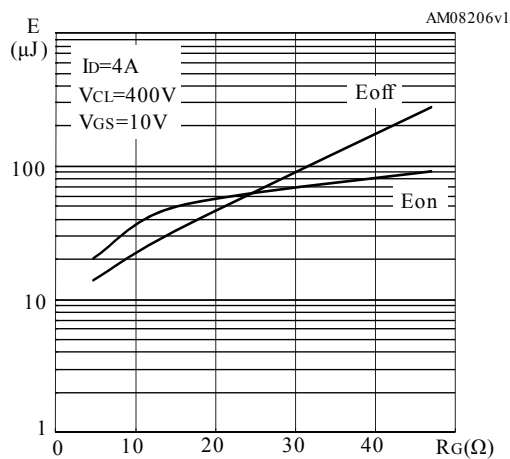
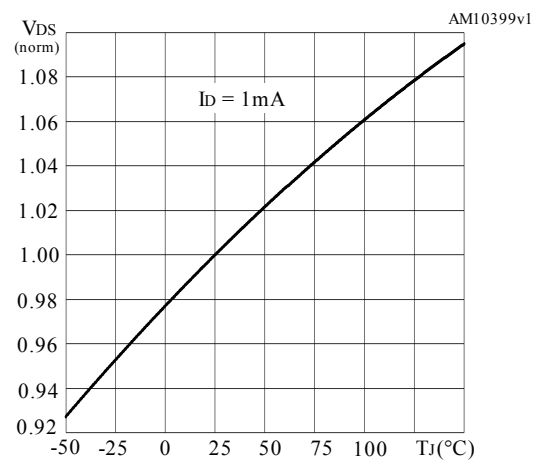
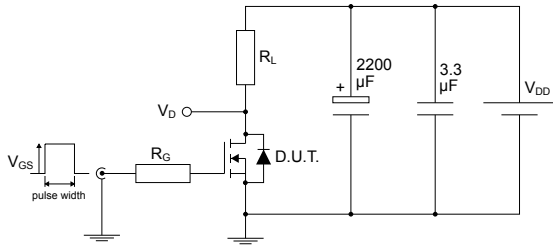
Figure 7. Output characteristics

Figure 8. Transfer characteristics

Figure 9. Gate charge vs gate-source voltage

Figure 10. Static drain-source on-resistance

Figure 11. Capacitance variations

Figure 12. Output capacitance stored energy


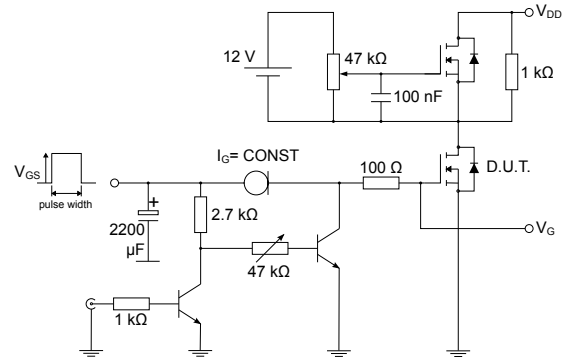
Figure 13. Normalized gate threshold voltage vs temperature

Figure 14. Normalized on-resistance vs temperature

Figure 15. Switching energy vs gate resistance

Figure 16. Normalized V_{(BR)DSS} vs temperature


Note: E_{on} including reverse recovery of a SiC diode.

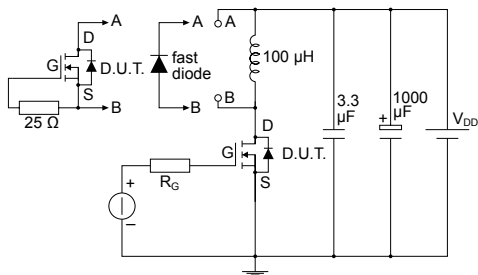
3 Test circuits

Figure 17. Test circuit for resistive load switching times


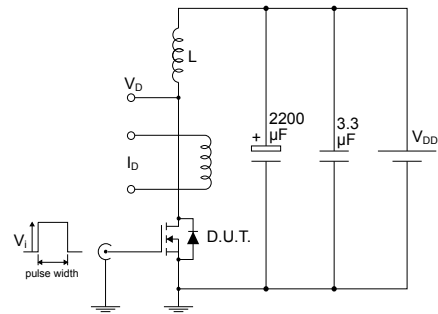
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Figure 18. Test circuit for gate charge behavior


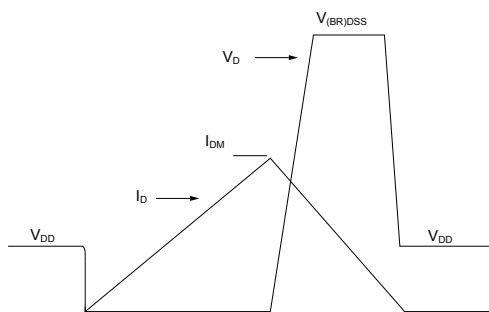
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Figure 19. Test circuit for inductive load switching and diode recovery times


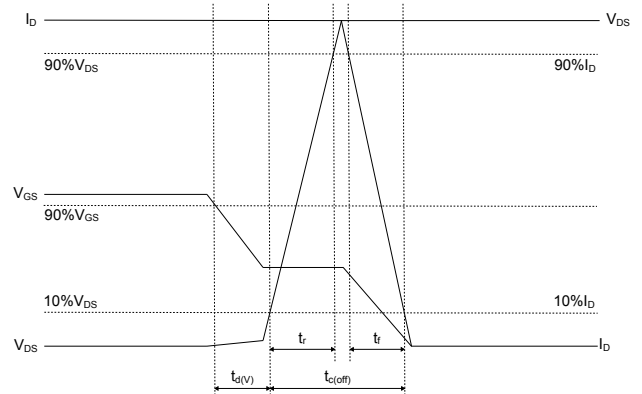
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Figure 20. Unclamped inductive load test circuit


AM01471v1

Figure 21. Unclamped inductive waveform


AM01472v1

Figure 22. Switching time waveform


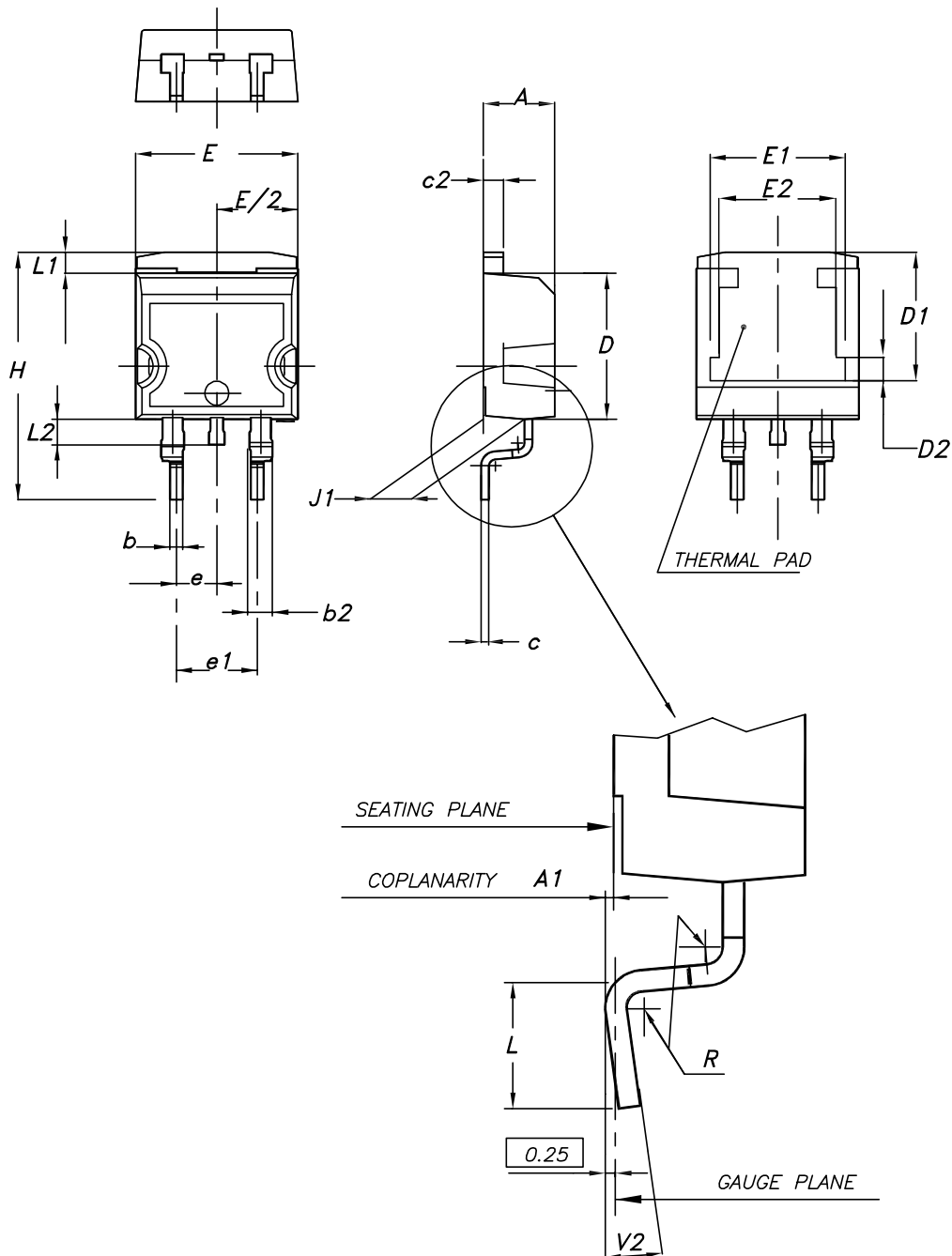
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4 Package information

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 23. D²PAK (TO-263) type A package outline

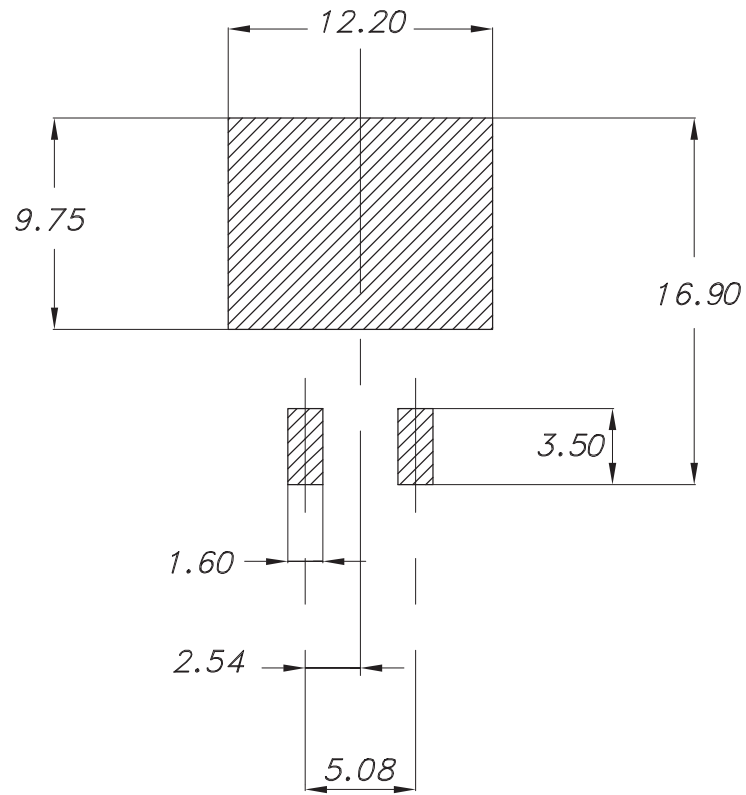


0079457_26

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°

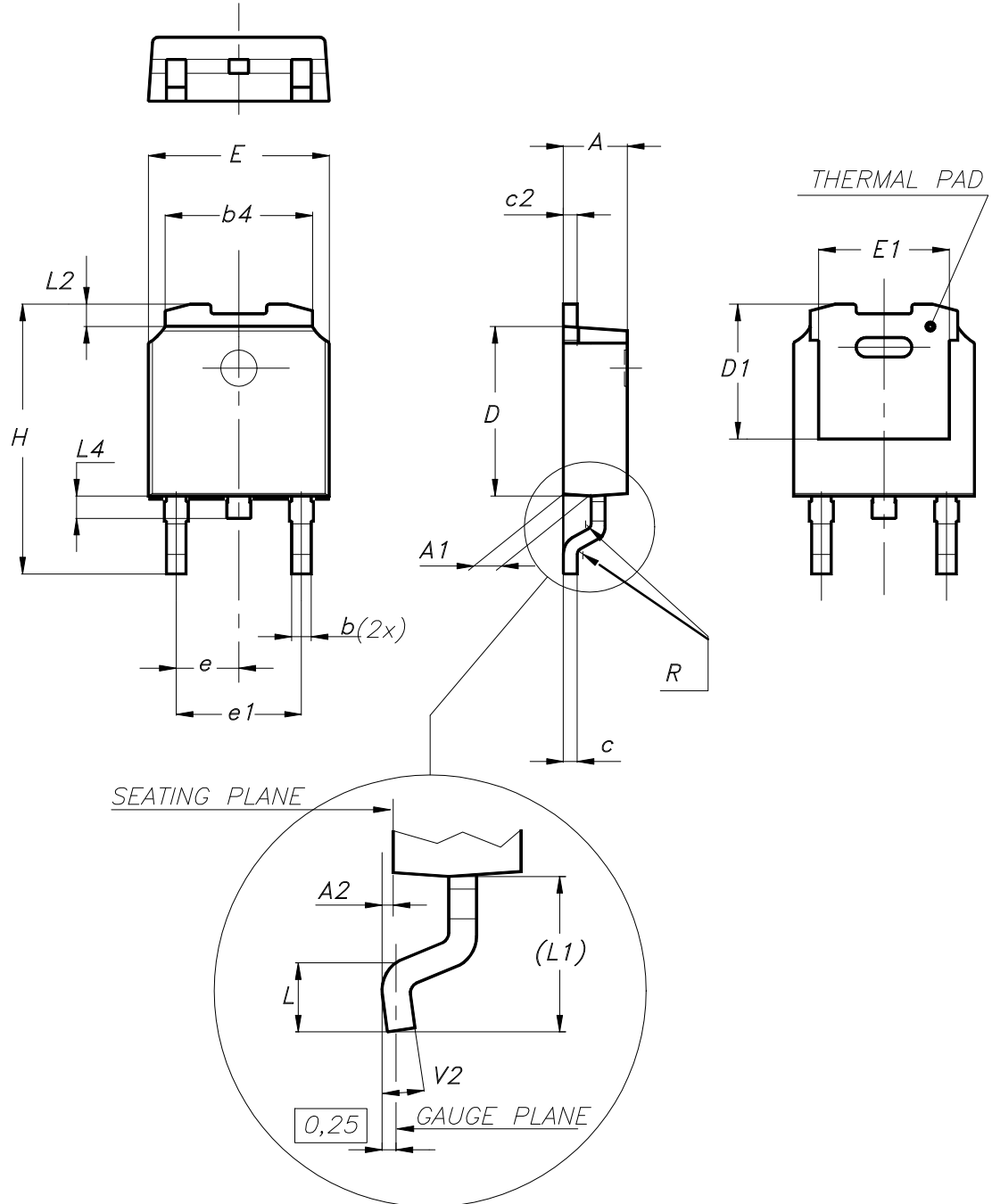
Figure 24. D²PAK (TO-263) recommended footprint (dimensions are in mm)



0079457_Rev26_footprint

4.2 DPAK (TO-252) type A package information

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



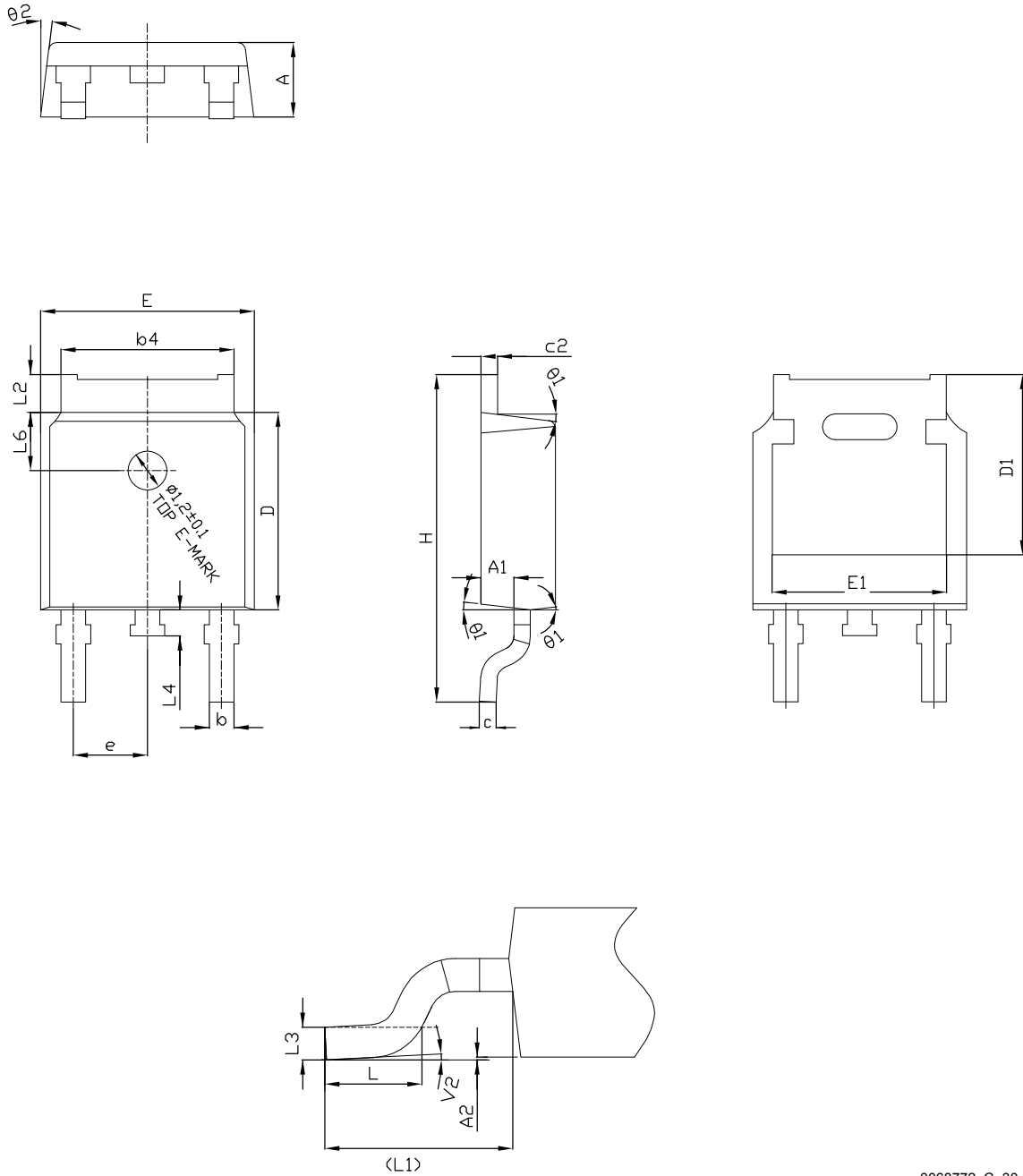
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Table 9. DPAK (TO-252) type A mechanical data

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 26. DPAK (TO-252) type C package outline



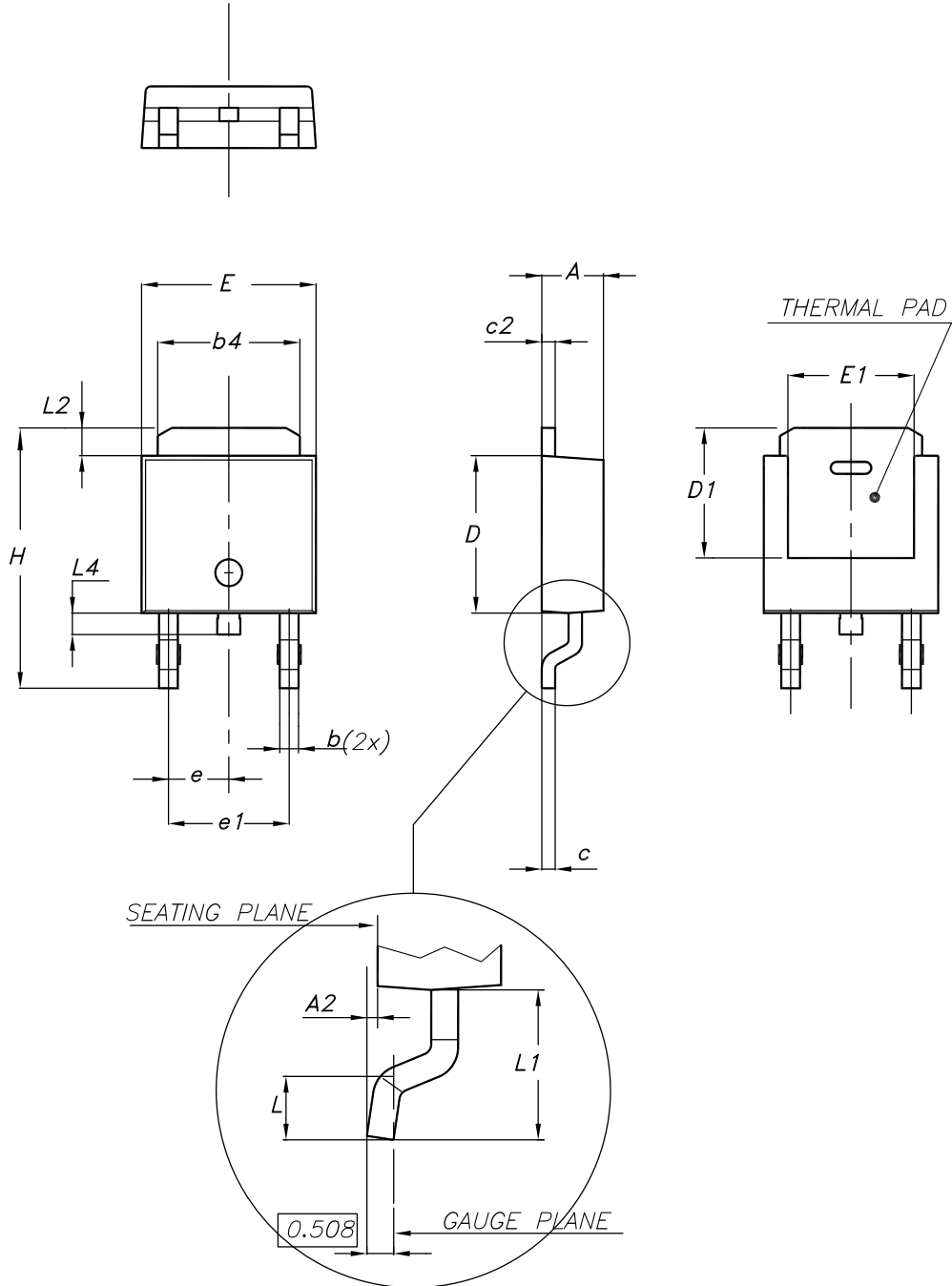
0068772_C_30

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 27. DPAK (TO-252) type E package outline

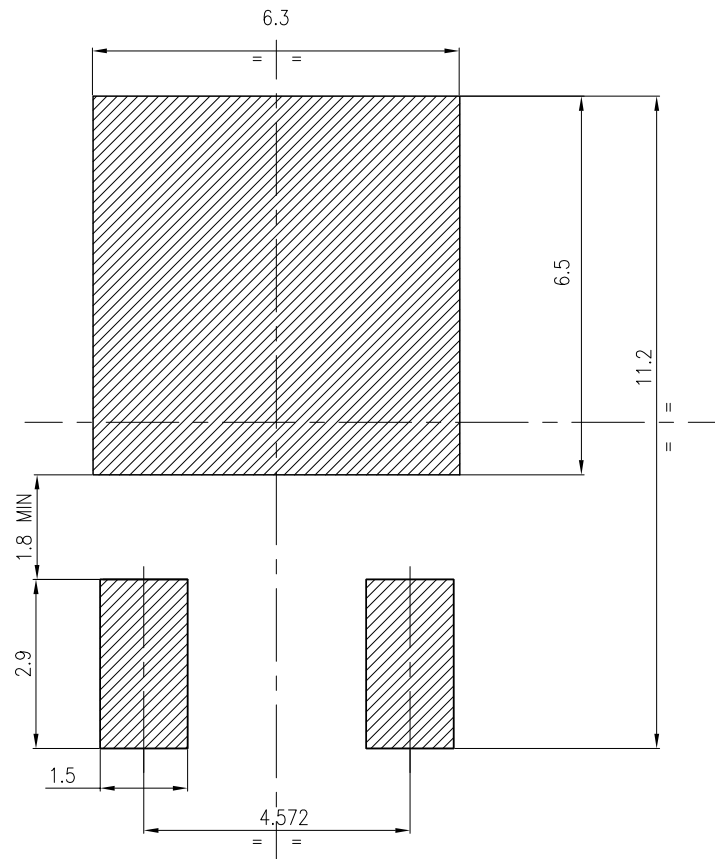


0068772_typeE_rev.30

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

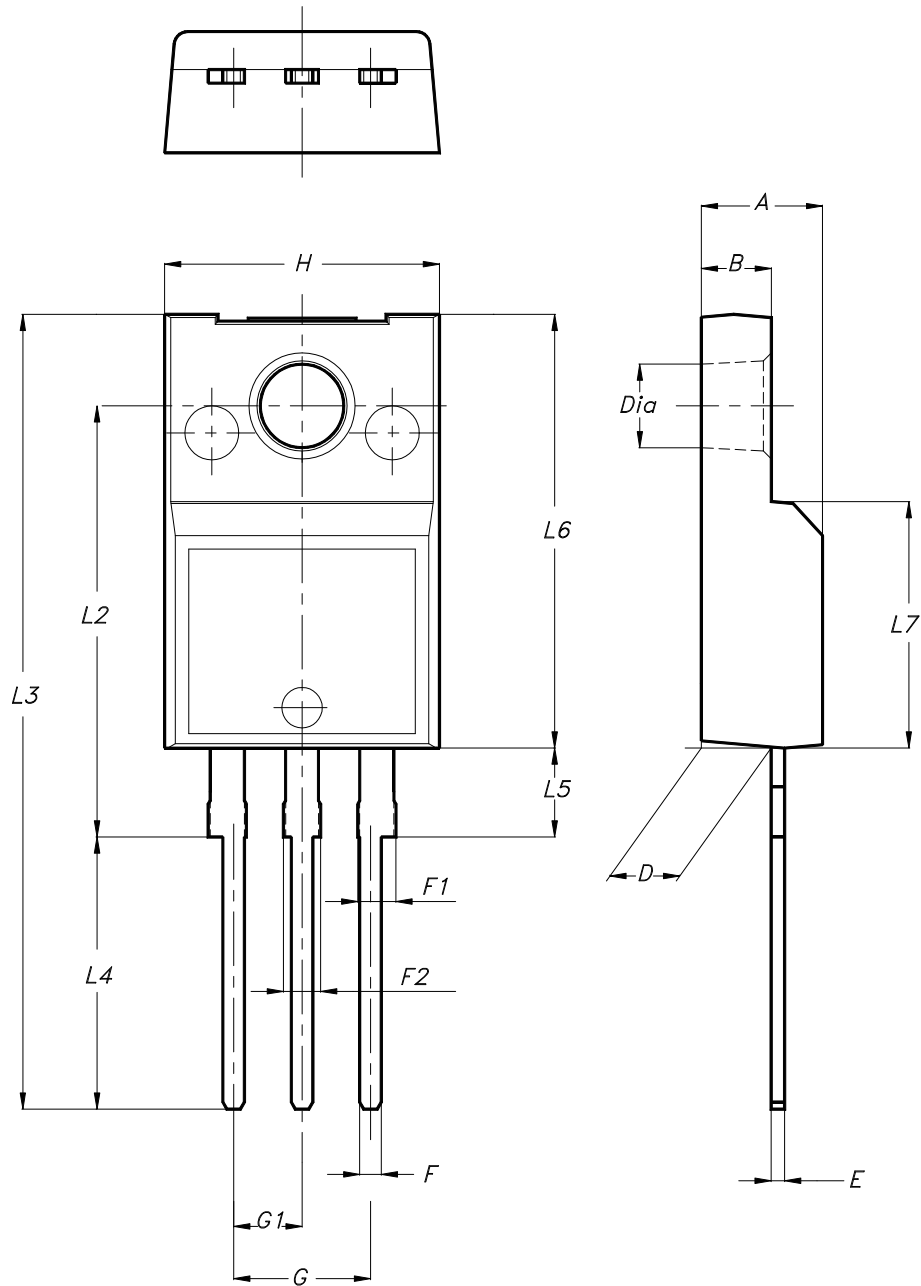
Figure 28. DPAK (TO-252) recommended footprint (dimensions are in mm)



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4.5 TO-220FP package information

Figure 29. TO-220FP package outline



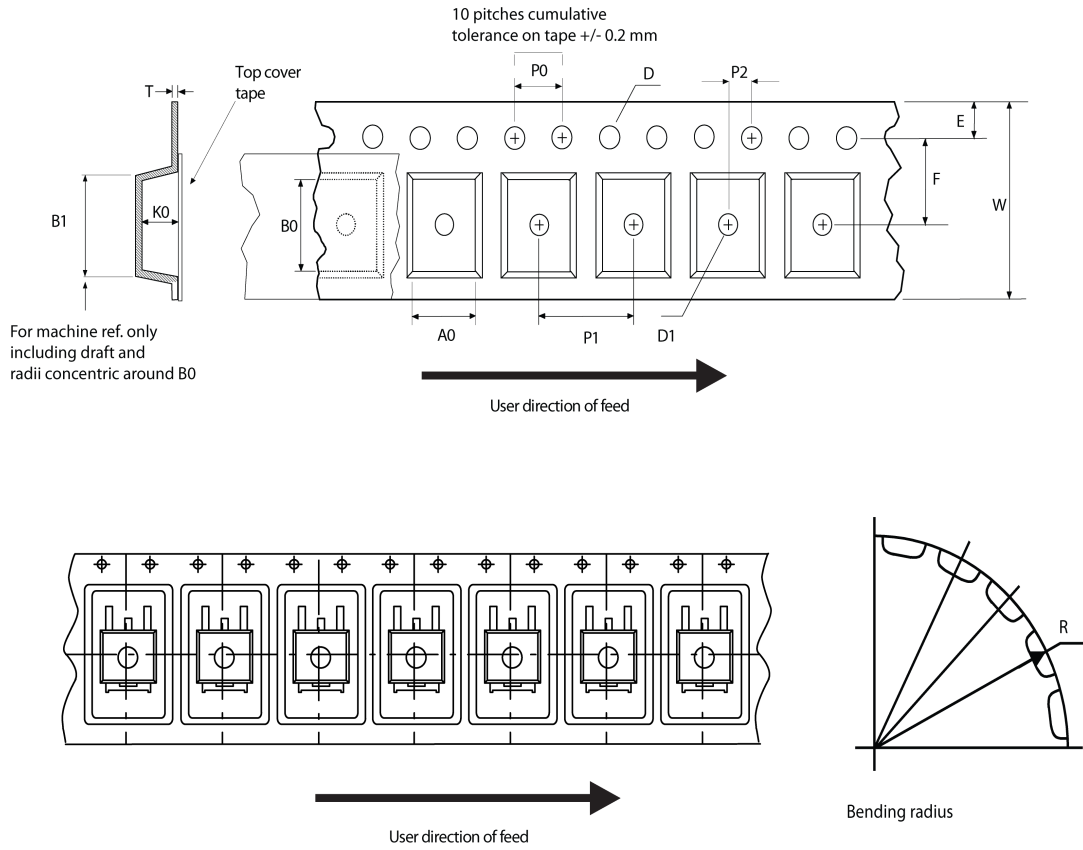
7012510_Rev_13_B

Table 12. TO-220FP package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.50		2.70
D	2.50		2.75
E	0.45		0.70
F	0.75		1.00
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.20
G1	2.40		2.70
H	10.00		10.40
L2		16.00	
L3	28.60		30.60
L4	9.80		10.60
L5	2.90		3.60
L6	15.90		16.40
L7	9.00		9.30
Dia	3.00		3.20

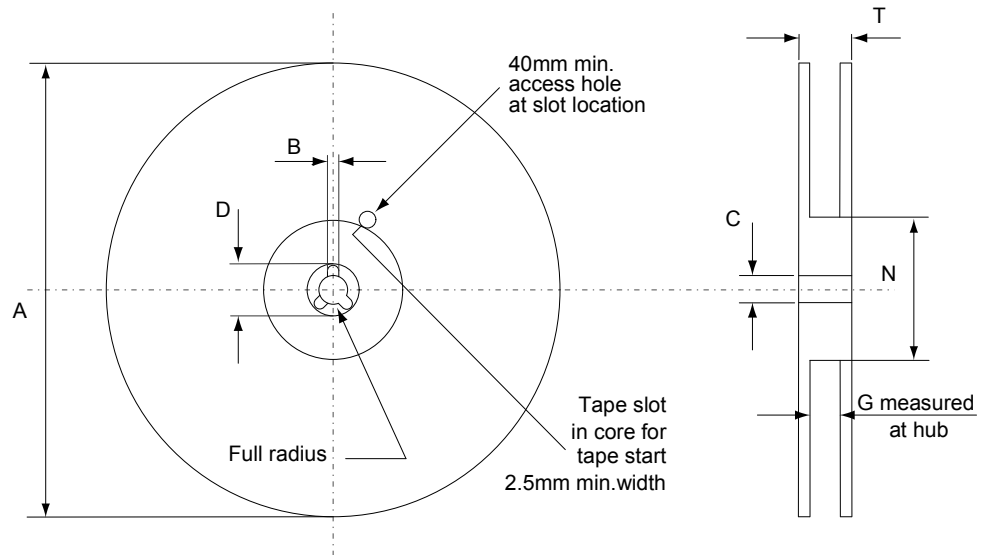
4.6 D²PAK and DPAK packing information

Figure 30. Tape outline



AM08852v1

Figure 31. 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 Ordering information

Table 15. Order codes

Order codes	Marking	Package	Packing
STB8N65M5	8N65M5	D ² PAK	Tape and reel
STD8N65M5		DPAK	Tape and reel
STF8N65M5		TO-220FP	Tube

Revision history

Table 16. Document revision history

Date	Revision	Changes
23-Oct-2009	1	First release.
14-Oct-2010	2	Document status promoted from preliminary data to datasheet.
05-Jul-2011	3	<i>Table 7: Source drain diode</i> has been updated.
04-Oct-2012	4	<ul style="list-style-type: none"> – Updated: <i>Figure 1, 10, 14 and 17.</i> – Updated: <i>note1</i> and 3 below <i>the Table 2</i> – Updated the entire <i>Section 4: Package mechanical data.</i> – Updated title and description on the cover page.
29-Oct-2012	5	– Updated R_g values in <i>Table 5.</i>
03-Mar-2022	6	<p>The part numbers STI8N65M5, STP8N65M5, STU8N65M5 have been moved to a separate datasheet and the document has been updated accordingly.</p> <p>Modified R_g value in <i>Table 5. Dynamic.</i></p> <p>Updated Section 4 Package information.</p> <p>Minor text changes.</p>

Contents

1	Electrical ratings	2
2	Electrical characteristics	3
2.1	Electrical characteristics (curves)	5
3	Test circuits	8
4	Package information	9
4.1	D ² PAK (TO-263) type A package information	9
4.2	DPAK (TO-252) type A package information	12
4.3	DPAK (TO-252) type C package information	14
4.4	DPAK (TO-252) type E package information	16
4.5	TO-220FP package information	19
4.6	D ² PAK and DPAK packing information	21
5	Ordering information	24
	Revision history	25



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