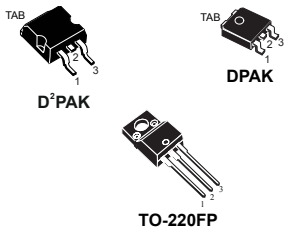
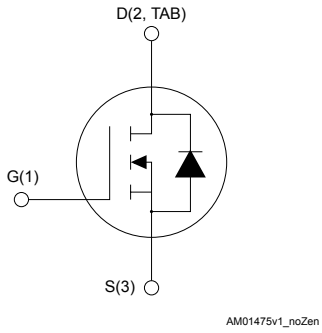
STB8N65M5, STD8N65M5, STF8N65M5

Datasheet

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





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

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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		D²PAK	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} ≤ 7 A, di/dt ≤ 400 A/µs; V_{DS} (peak) < $V_{(BR)DSS}$, V_{DD} = 400 V.*

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		D²PAK	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
		D²PAK	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

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2 Electrical characteristics

T_C = 25 °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 mA, V_{GS} = 0 V	650			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 650 V			1	µA
		V_{GS} = 0 V, V_{DS} = 650 V, T_C = 125 °C(1)			100	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ±25 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 = 3.5 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 V, f = 1 MHz, V_{GS} = 0 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 to 520 V, V_{GS} = 0 V		17		pF
$C_{o(er)}$ (2)	Equivalent output capacitance energy related			52		pF
R_g	Gate input resistance	f = 1 MHz open drain	2	5	8	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 3.5 A, V_{GS} = 0 to 10 V (see Figure 18. Test circuit for gate charge behavior)		15		nC
Q_{gs}	Gate-source charge			3.6		
Q_{gd}	Gate-drain charge			6		

1. *$C_{o(tr)}$ is an equivalent capacitance that provides the same charging time as Coss 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 V, I_D = 4 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 19. Test circuit for inductive load switching and diode recovery times and Figure 22. Switching time waveform)	-	50	-	ns
$t_{r(v)}$	Voltage rise time		-	14	-	
$t_{c(off)}$	Crossing time off		-	20	-	
$t_{f(i)}$	Current fall time		-	11	-	

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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 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 7 A, di/dt = 100 A/µs	-	200		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 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 A, di/dt = 100 A/µs	-	263		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V, T_J = 150 °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%.*

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2.1 Electrical characteristics (curves)

Figure 1. Safe operating area for D²PAK

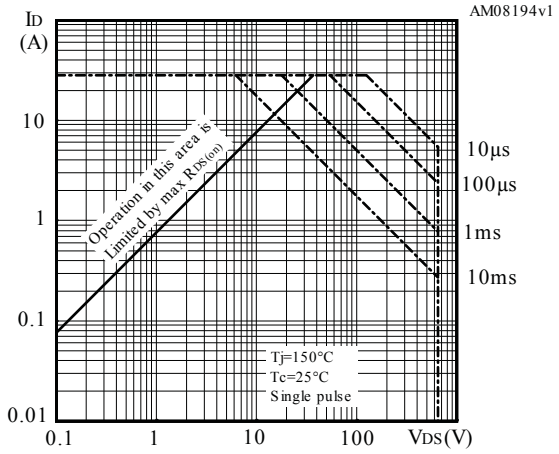

Figure 2. Thermal impedance for D²PAK

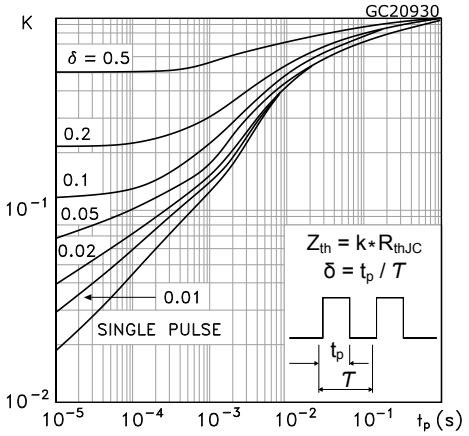

Figure 3. Safe operating area for DPAK

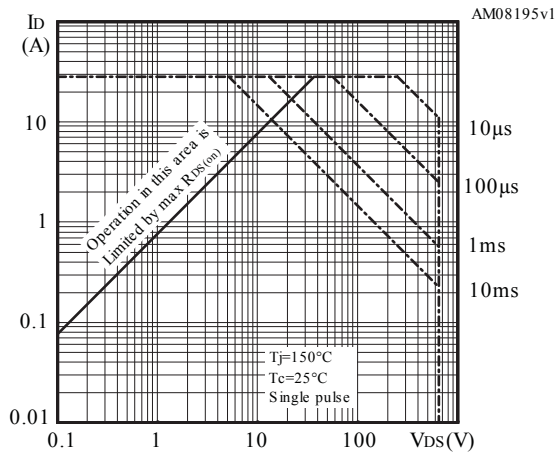

Figure 4. Thermal impedance for DPAK

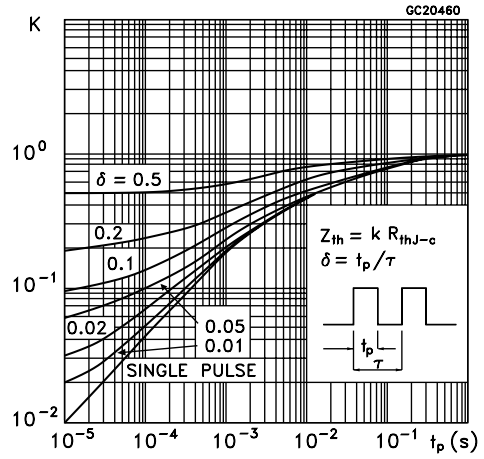

Figure 5. Safe operating area for TO-220FP

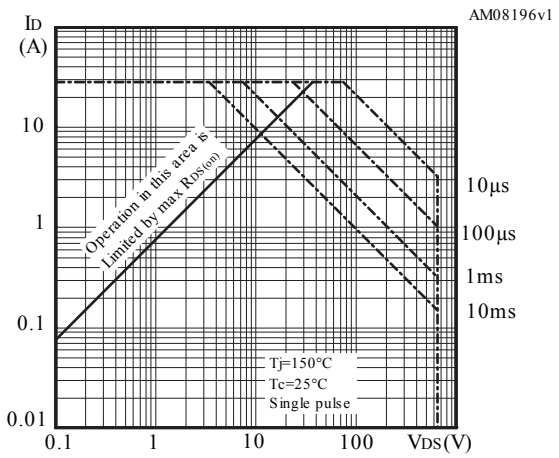

Figure 6. Thermal impedance for TO-220FP

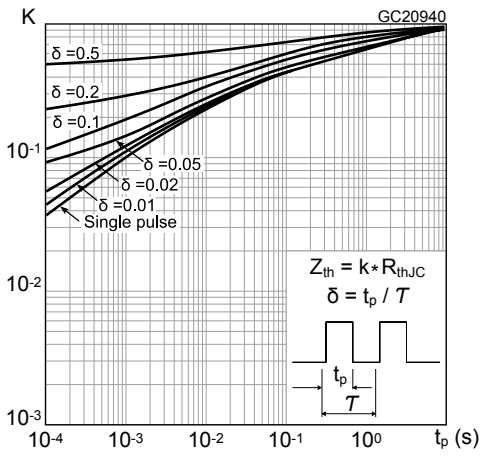

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Figure 7. Output characterisics

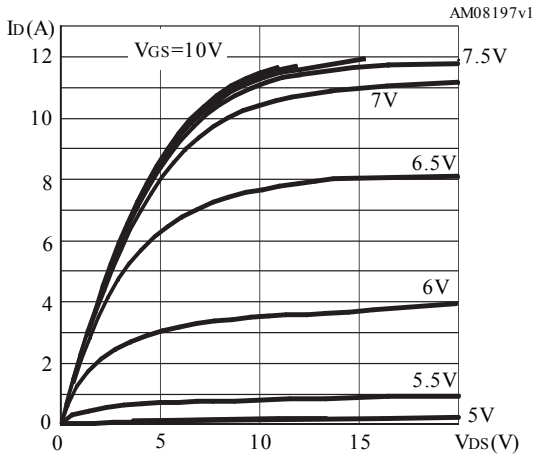

Figure 8. Transfer characteristics

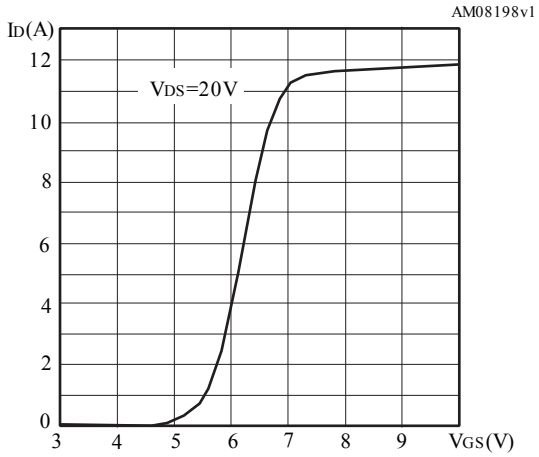

Figure 9. Gate charge vs gate-source voltage

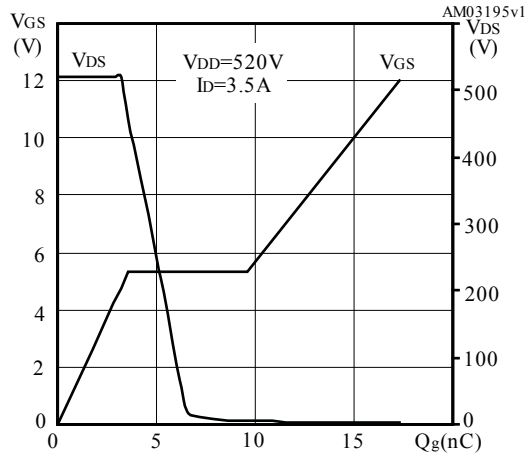

Figure 10. Static drain-source on-resistance

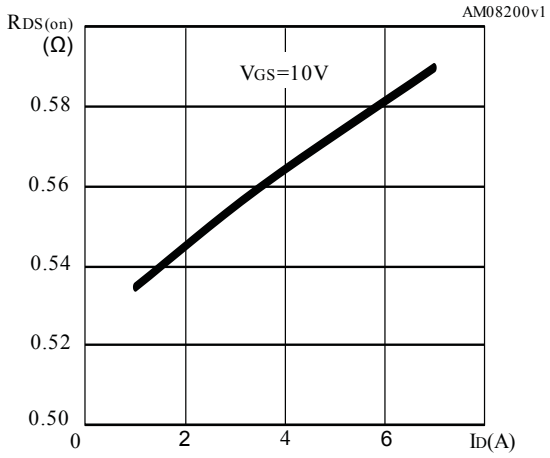

Figure 11. Capacitance variations

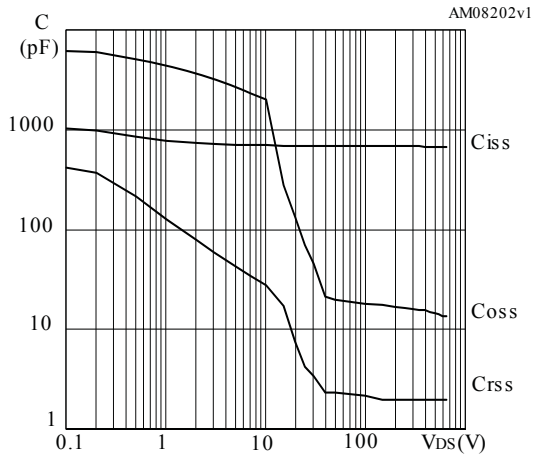

Figure 12. Output capacitance stored energy

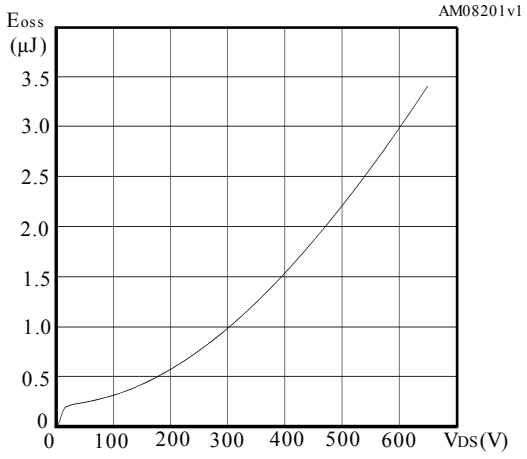

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Figure 13. Normalized gate threshold voltage vs temperature

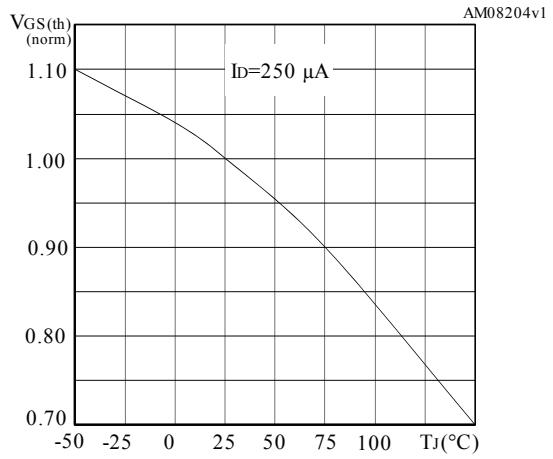


Figure 14. Normalized on-resistance vs temperature

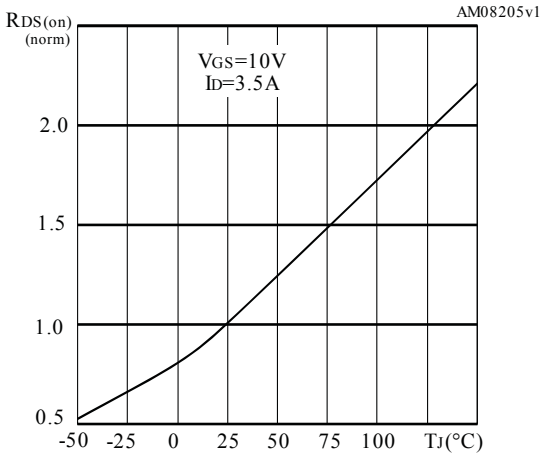


Figure 15. Switching energy vs gate resistance

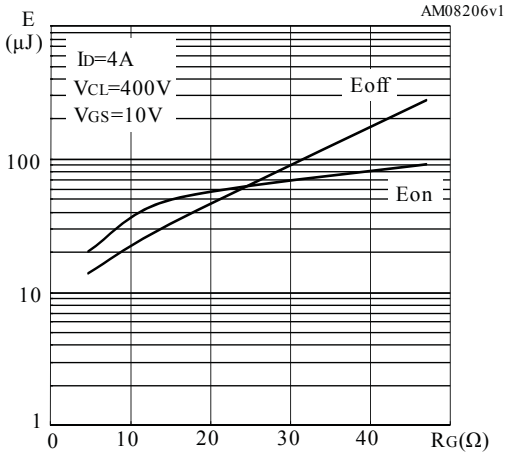
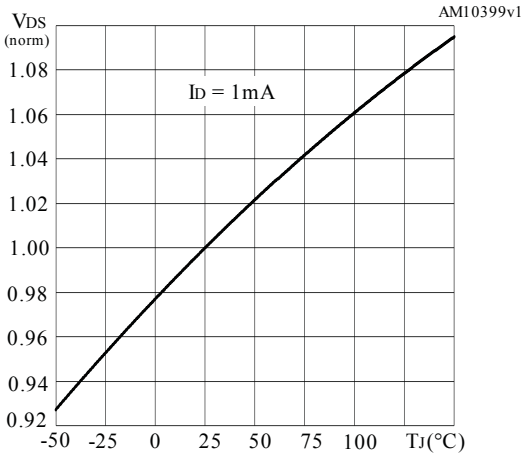


Figure 16. Normalized $V_{(BR)DSS}$ vs temperature



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

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3 Test circuits

Figure 17. Test circuit for resistive load switching times

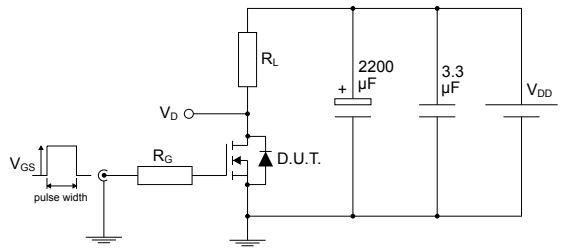

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Figure 18. Test circuit for gate charge behavior

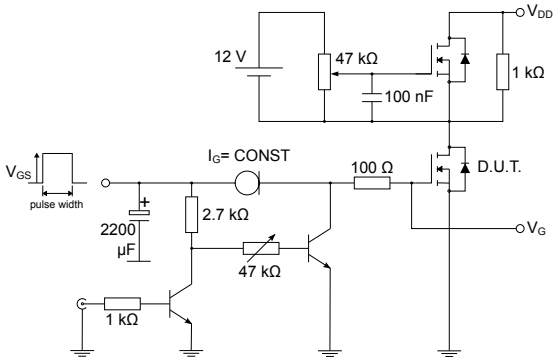

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Figure 19. Test circuit for inductive load switching and diode recovery times

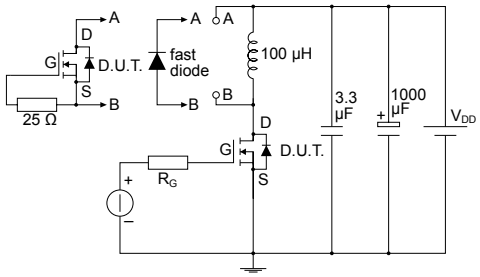

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Figure 20. Unclamped inductive load test circuit

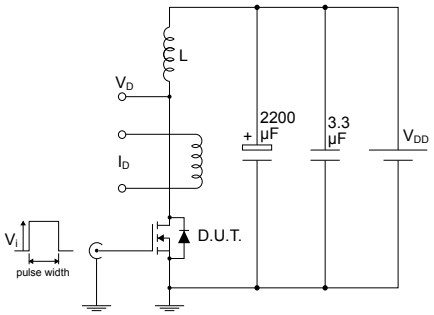

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Figure 21. Unclamped inductive waveform

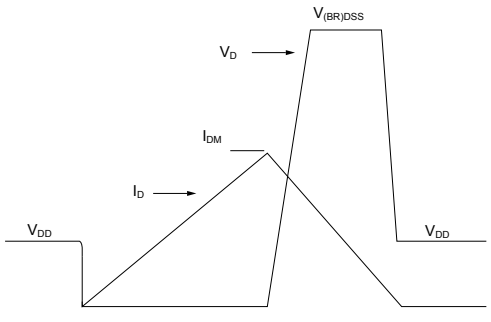

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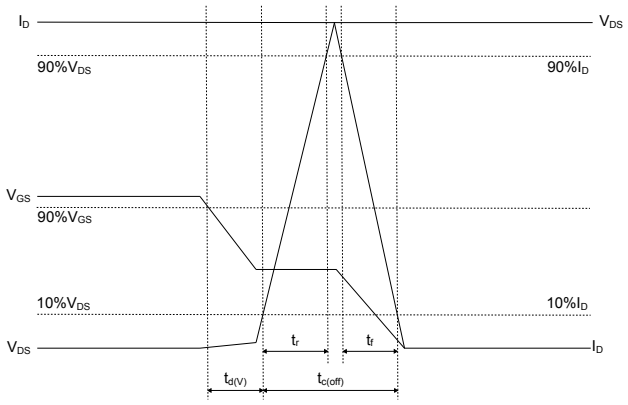
Figure 22. Switching time waveform



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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**

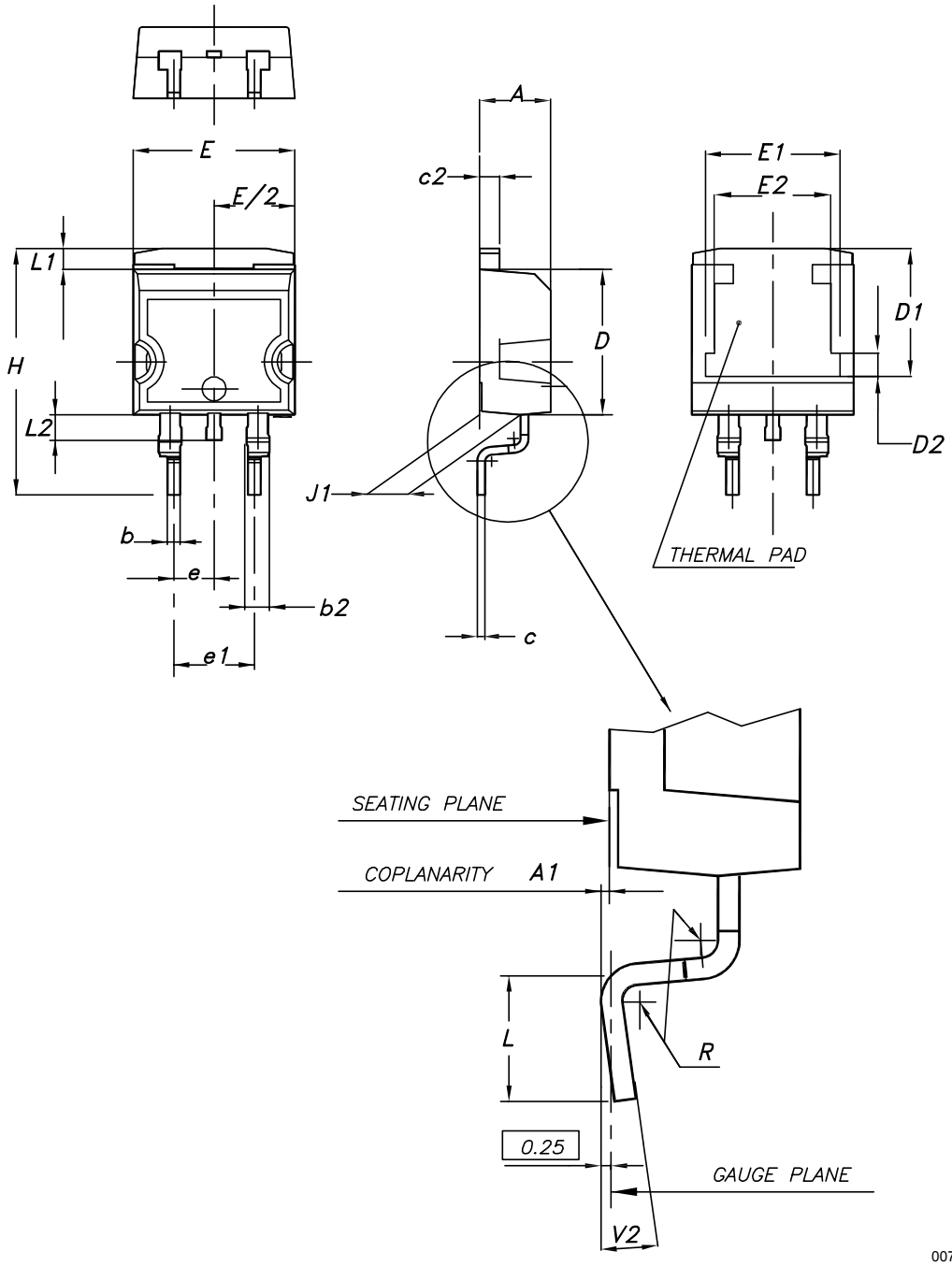

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Table 8. D²PAK (TO-263) type A package mechanical data

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°

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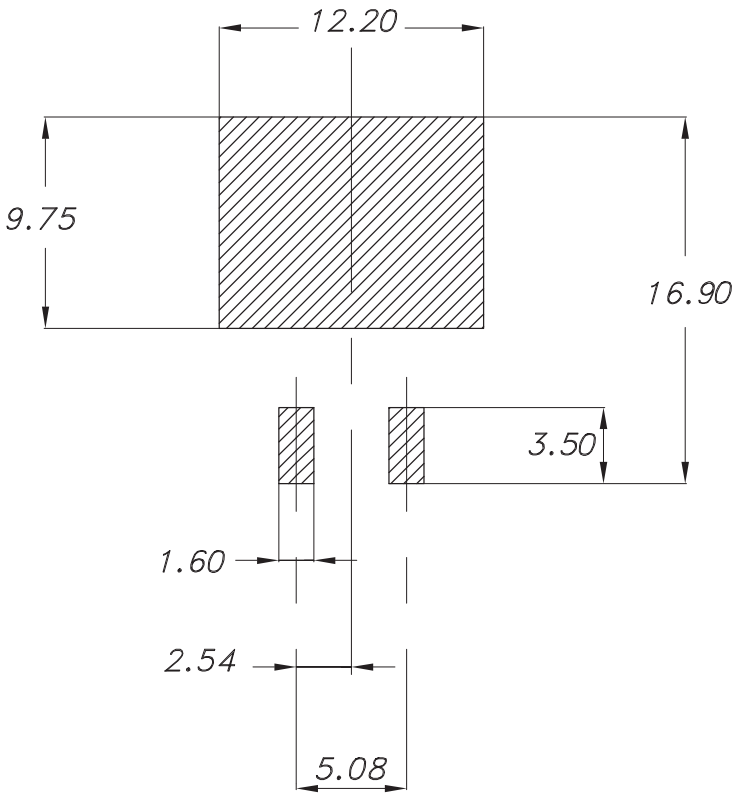
Figure 24. **D²PAK (TO-263) recommended footprint (dimensions are in mm)**



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4.2 DPAK (TO-252) type A package information

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

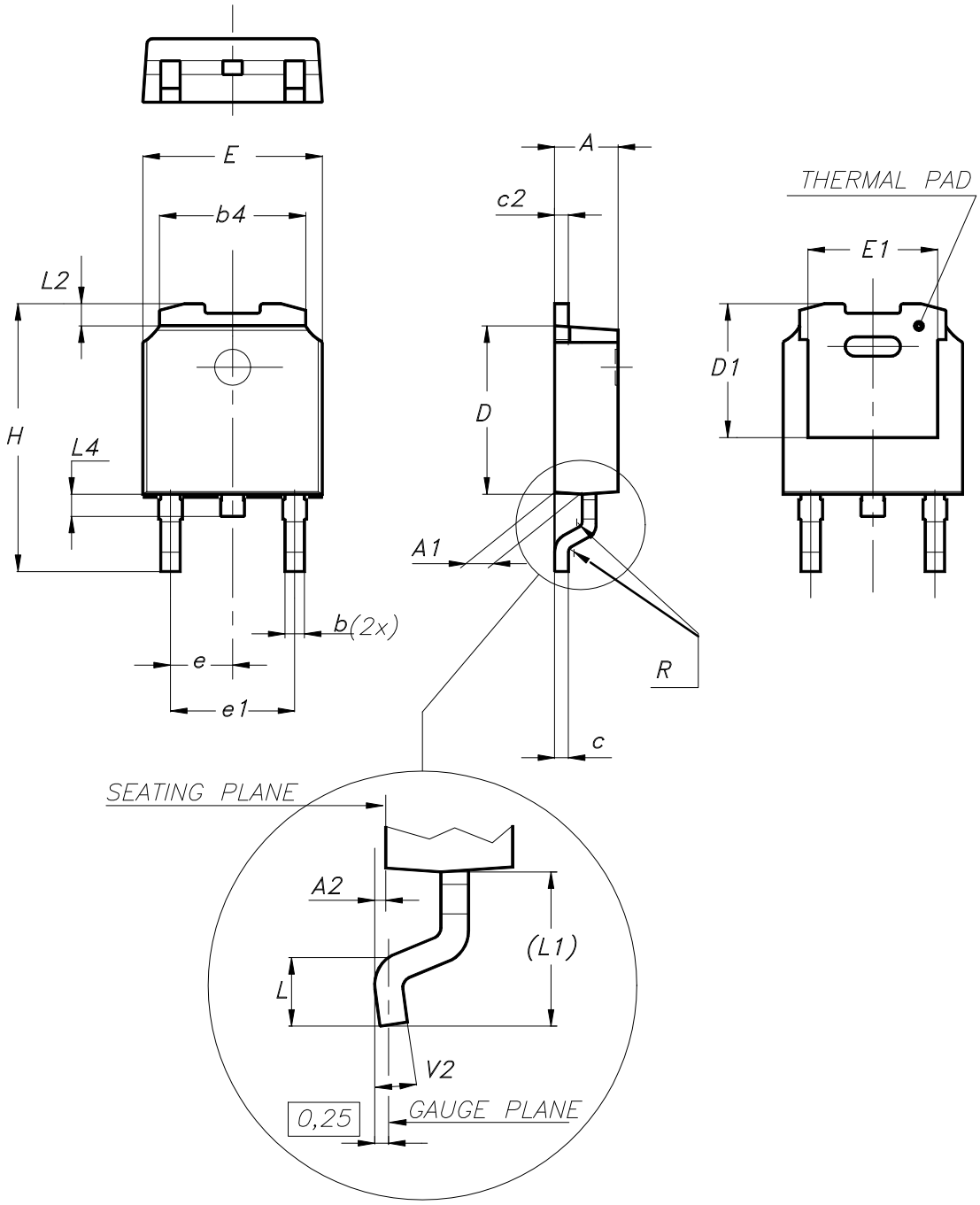

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Table 9. **DPAK (TO-252) type A mechanical data**

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°

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4.3 DPAK (TO-252) type C package information

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

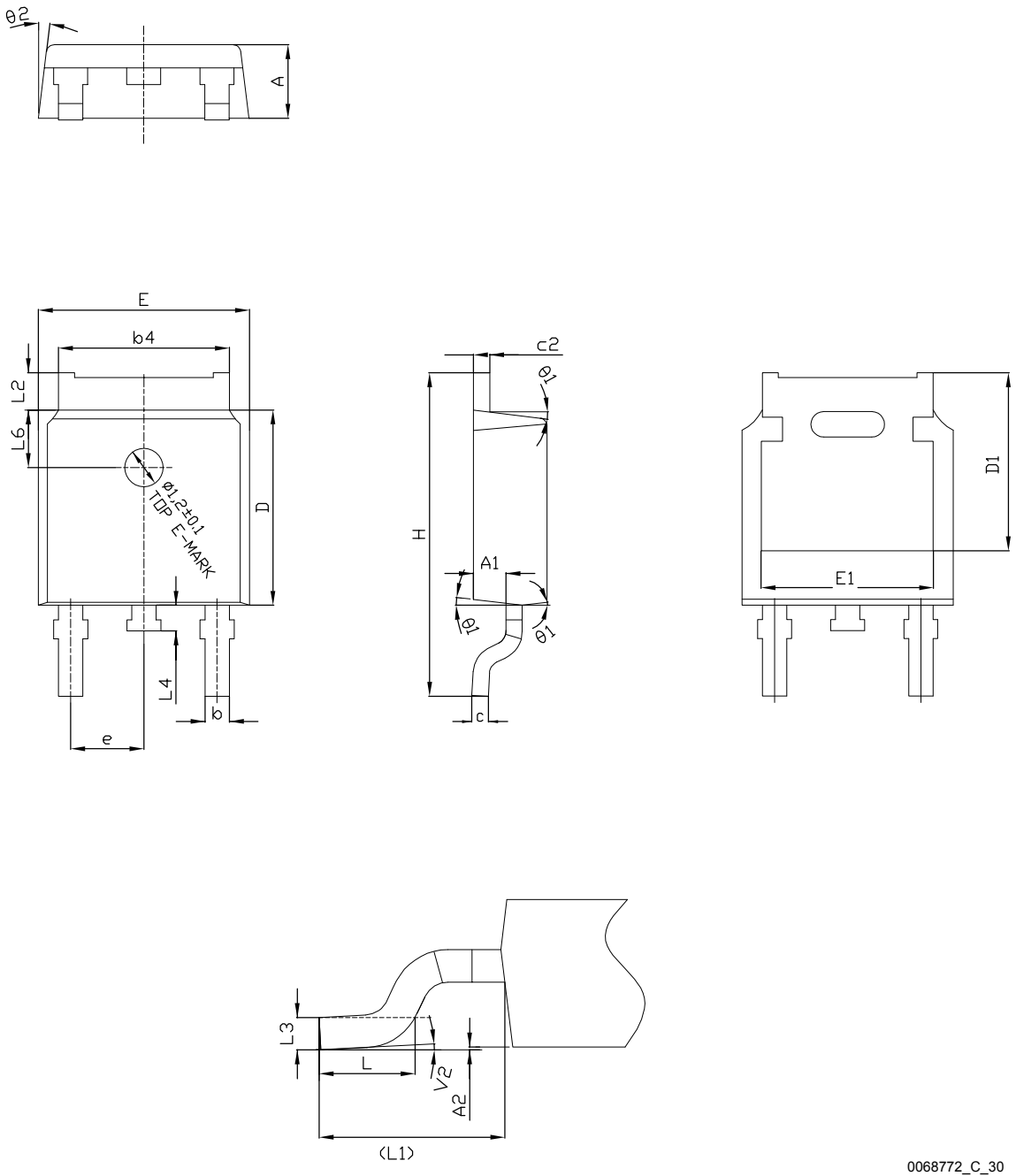

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Table 10. **DPAK (TO-252) type C mechanical data**

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°

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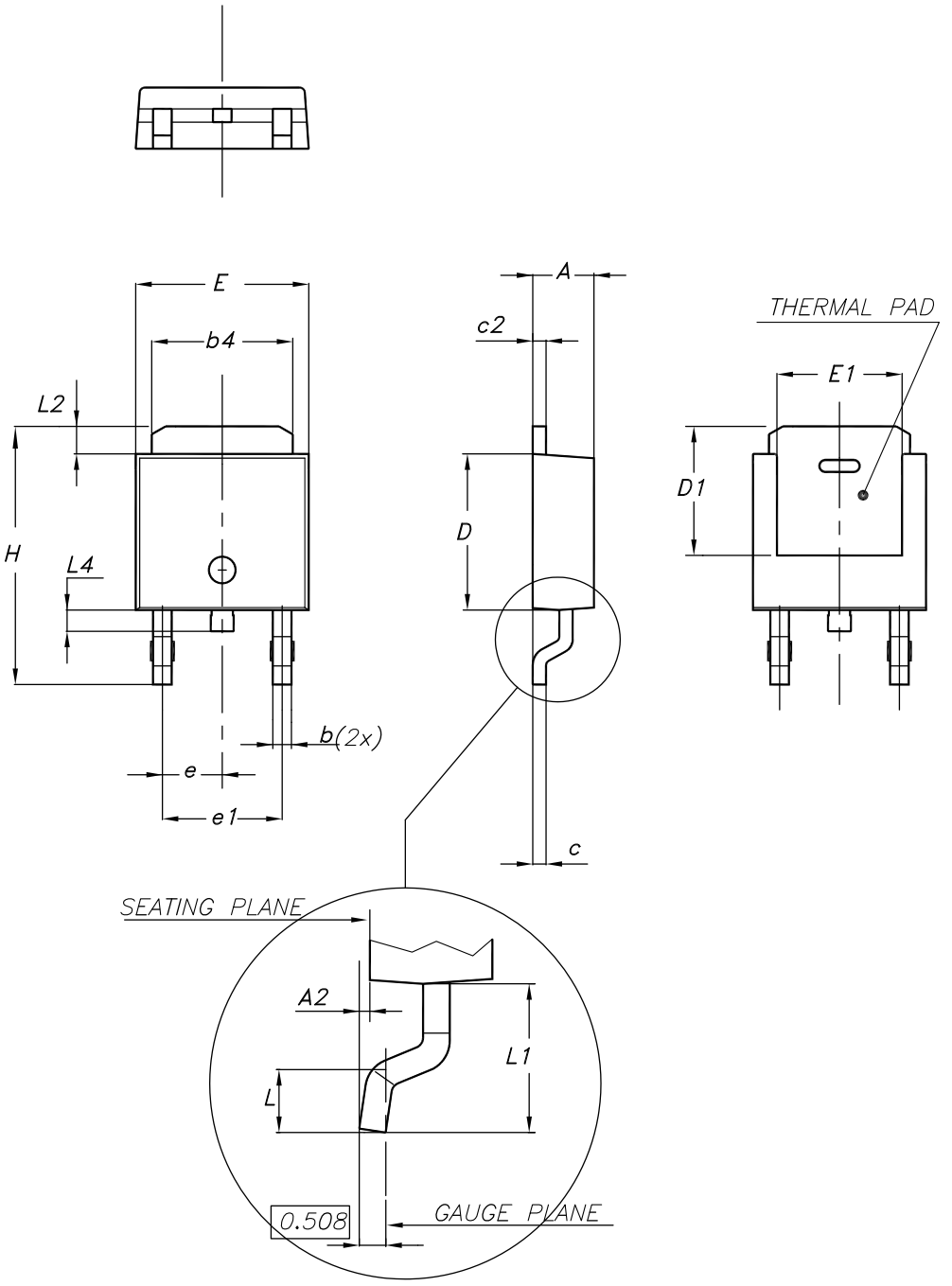
4.4 DPAK (TO-252) type E package information

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



0068772_typeE_rev.30

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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

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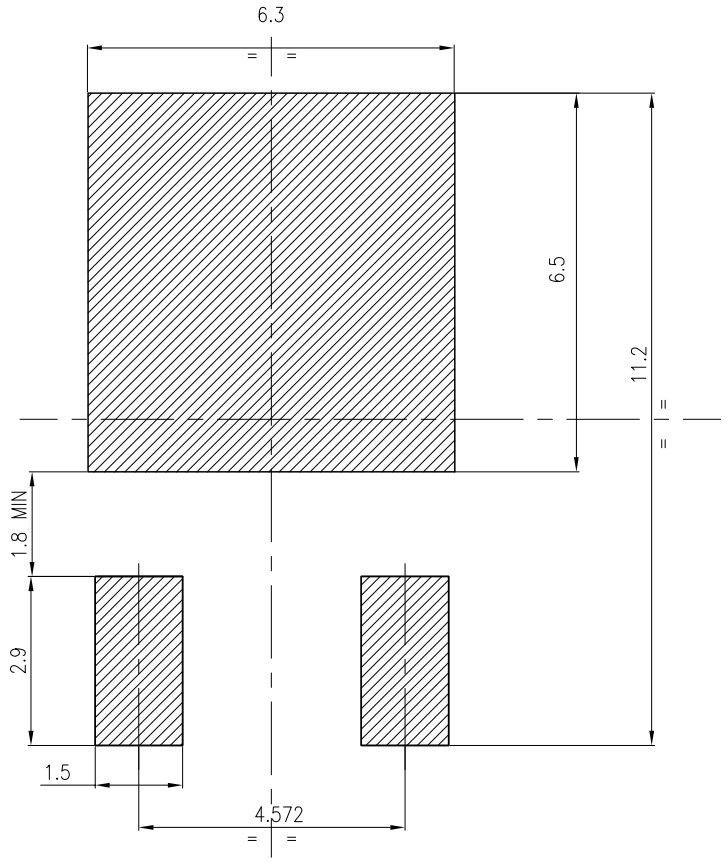
Figure 28. **DPAK (TO-252) recommended footprint (dimensions are in mm)**



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4.5 TO-220FP package information

Figure 29. **TO-220FP package outline**

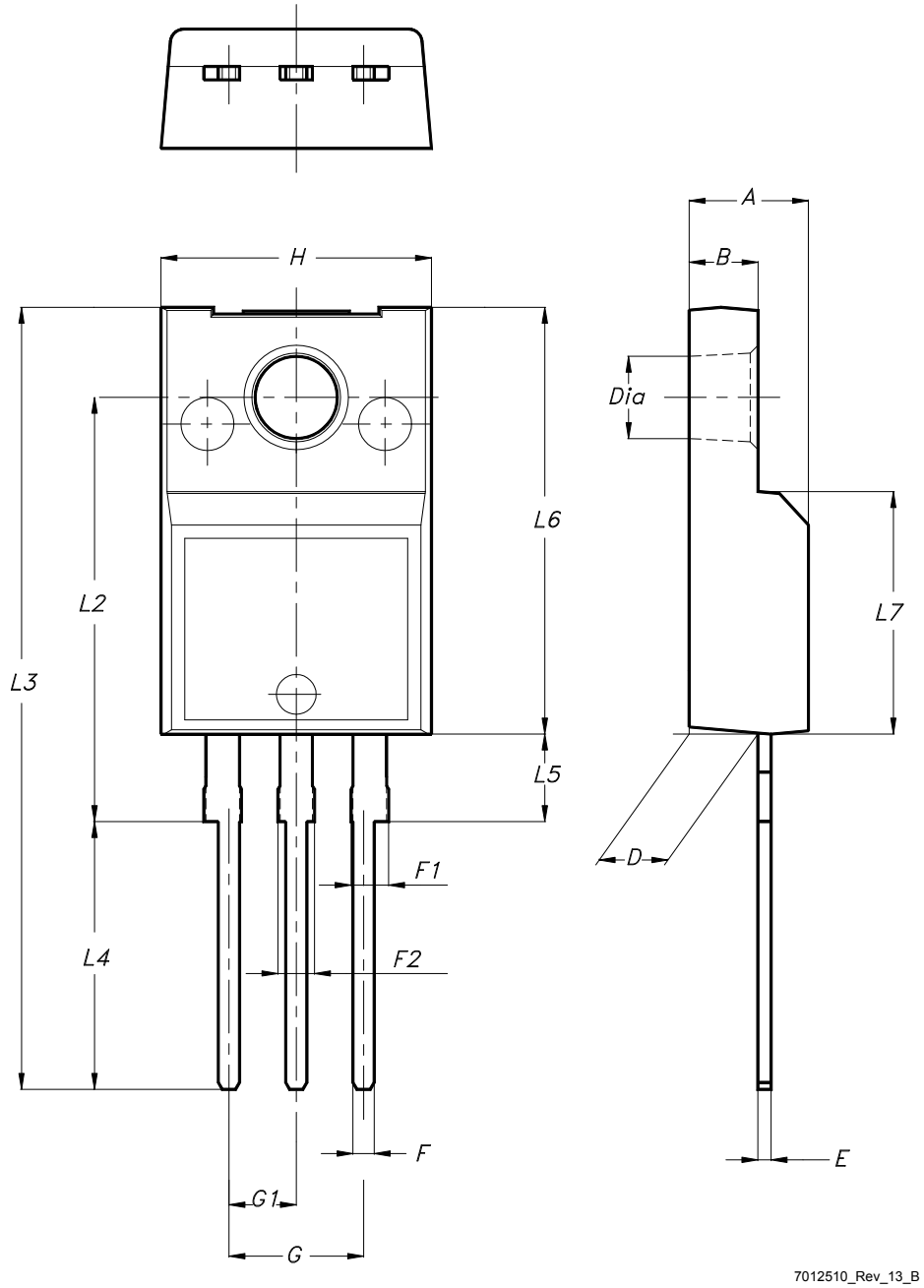

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Table 12. **TO-220FP package mechanical data**

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

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4.6 D²PAK and DPAK packing information

Figure 30. **Tape outline**

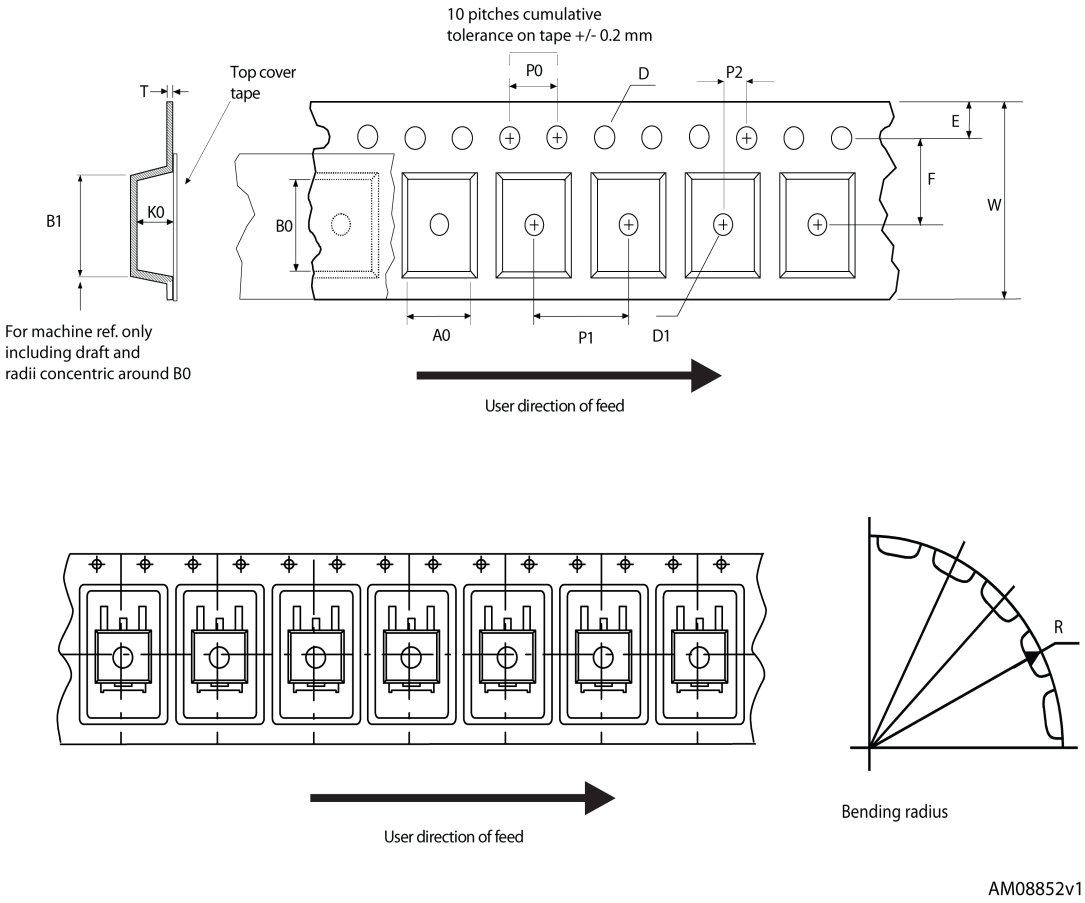

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Figure 31. **Reel outline**

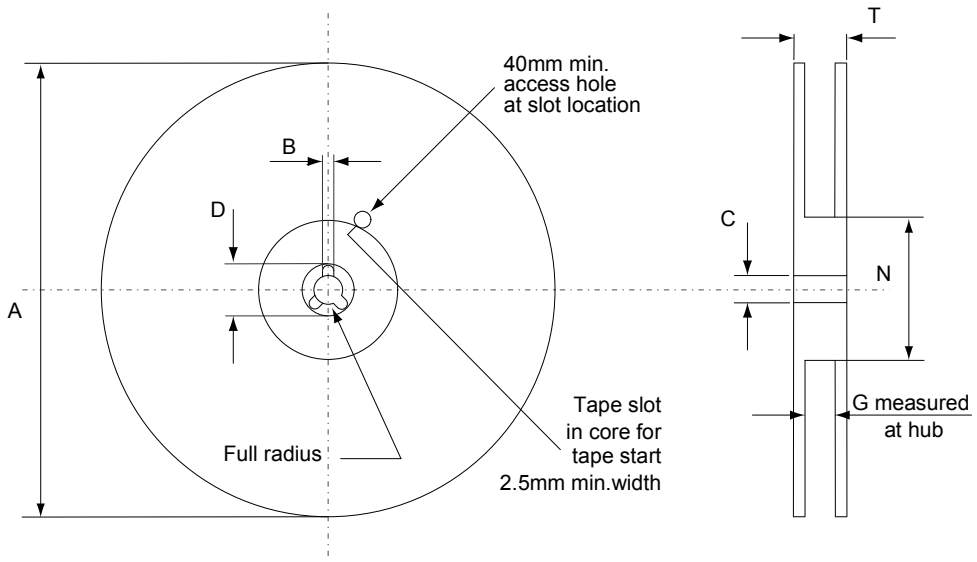

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Table 13. **D²PAK tape and reel mechanical data**

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			

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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			

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5 Ordering information

Table 15. **Order codes**

Order codes	Marking	Package	Packing
STB8N65M5	8N65M5	D²PAK	Tape and reel
STD8N65M5		DPAK	Tape and reel
STF8N65M5		TO-220FP	Tube

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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	*Table 7: Source drain diode* has been updated.
04-Oct-2012	4	– Updated: *Figure 1, 10, 14* and *17*. – Updated: *note1* and *3* below *the Table 2* – Updated the entire *Section 4: Package mechanical data.* – Updated title and description on the cover page.
29-Oct-2012	5	– Updated R_g values in *Table 5*.
03-Mar-2022	6	The part numbers STI8N65M5, STP8N65M5, STU8N65M5 have been moved to a separate datasheet and the document has been updated accordingly. Modified R_g value in Table 5. Dynamic. Updated Section 4 Package information. Minor text changes.

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