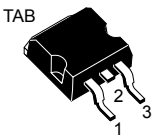
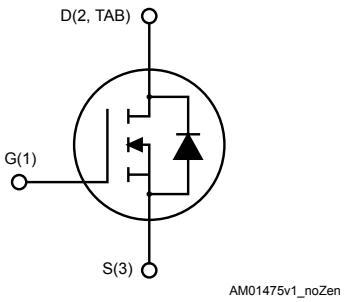
N-channel 650 V, 95 mΩ typ., 24 A MDmesh™ M5 Power MOSFET in D²PAK package



D²PAK



Features

Order codes	V_{DS} at $T_{jmax.}$	$R_{DS(on)}$ max.	I_D
STB32N65M5	710 V	119 mΩ	24 A

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

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET based on the MDmesh™ M5 innovative vertical process technology combined with the well-known PowerMESH™ horizontal layout. The resulting product offers extremely low on-resistance, making it particularly suitable for applications requiring high power and superior efficiency.

Product status link
STB32N65M5

Product summary	
Order code	STB32N65M5
Marking	32N65M5
Package	D²PAK
Packing	Tape and reel

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	24	A
I_D	Drain current (continuous) at T_C = 100 °C	15	A
I_{DM} (1)	Drain current (pulsed)	96	A
P_{TOT}	Total power dissipation at T_C = 25 °C	150	W
dv/dt (2)	Peak diode recovery voltage slope	15	V/ns
T_j	Operating junction temperature range	-55 to 150	°C
T_{stg}	Storage temperature range		

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 24 A, di/dt ≤ 400 A/µs, $V_{DS(peak)}$ ≤ $V_{(BR)DSS}$.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	0.83	°C/W
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb	30	°C/W

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

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j Max)	8	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	650	mJ

2 Electrical characteristics

(T_{CASE} = 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	I_D = 1 mA, V_{GS} = 0 V	650			V
I_{DSS}	Zero gate voltage drain current	V_{DS} = 650 V, V_{GS} = 0 V,			1	µA
		V_{DS} = 650 V, V_{GS} = 0 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 = 12 A		95	119	mΩ

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	-	3320	-	pF
C_{oss}	Output capacitance			75		
C_{rss}	Reverse transfer capacitance			5		
$C_{o(tr)}$ (1)	Equivalent capacitance time related	V_{GS} = 0 V, V_{DS} = 0 to 520 V	-	210	-	pF
$C_{o(er)}$ (2)	Equivalent capacitance energy related		-	70	-	pF
Rg	Gate input resistance	f = 1 MHz, I_D= 0 A	-	2	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 12 A, V_{GS} = 0 to 10 V (see Figure 15. Test circuit for gate charge behavior)	-	72	-	nC
Q_{gs}	Gate-source charge			17		
Q_{gd}	Gate-drain charge			29		

1. *$C_{o(tr)}$ time related 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}.*
2. *$C_{o(er)}$ energy related is defined as a constant equivalent capacitance giving the same stored energy 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
$t_{d(off)}$	Turn-off delay time	V_{DD} = 400 V, I_D = 15 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 16. Test circuit for inductive load switching and diode recovery times and Figure 19. Switching time waveform)	-	53	-	ns
t_r	Rise time			12		
t_c	Cross time			29		
t_f	Fall time			16		

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		24	A
I_{SDM} (1)	Source-drain current (pulsed)				96	
V_{SD} (2)	Forward on voltage	I_{SD} = 24 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 24 A, di/dt = 100 A/µs	-	375		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V (see Figure 16. Test circuit for inductive load switching and diode recovery times)		6		µC
I_{RRM}	Reverse recovery current			33		A
t_{rr}	Reverse recovery time	I_{SD} = 24 A, di/dt = 100 A/µs	-	440		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V, Tj = 150 °C		8		µC
I_{RRM}	Reverse recovery current	(see Figure 16. Test circuit for inductive load switching and diode recovery times)		36		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

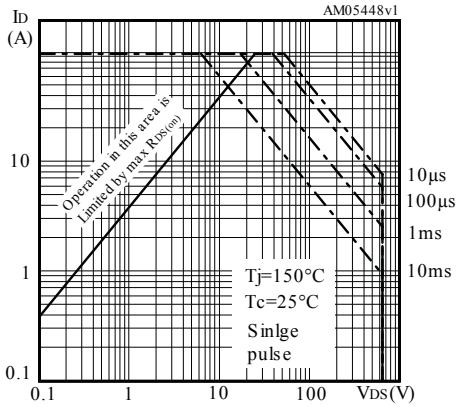


Figure 2. Thermal impedance

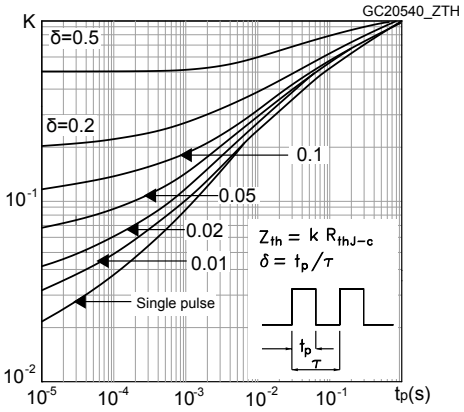


Figure 3. Output characterisics

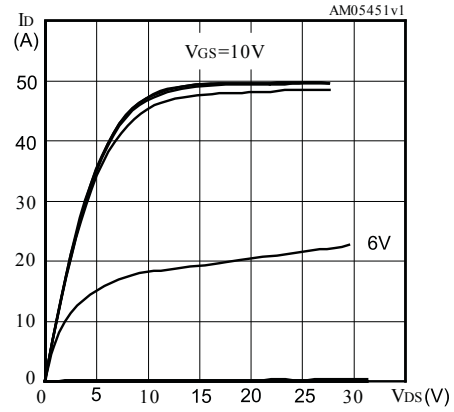


Figure 4. Transfer characteristics

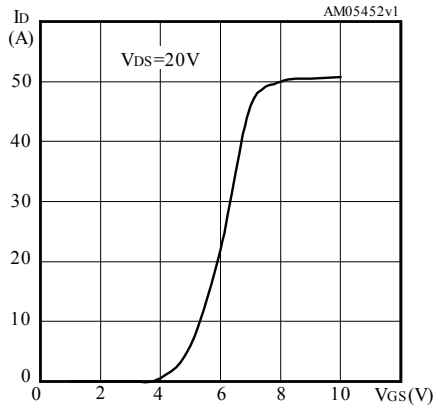


Figure 5. Gate charge vs gate-source voltage

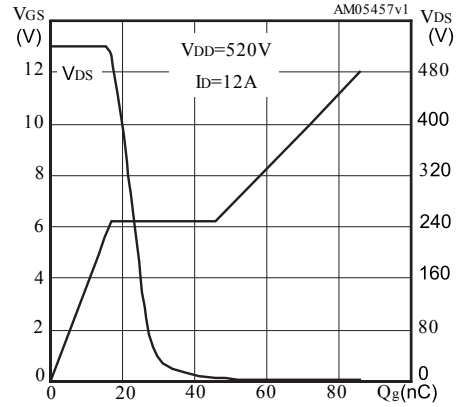


Figure 6. Static drain-source on resistance

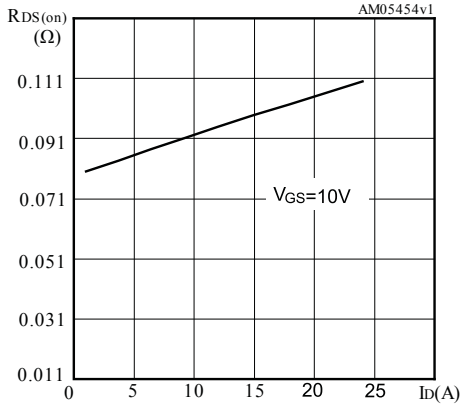


Figure 7. Capacitance variations

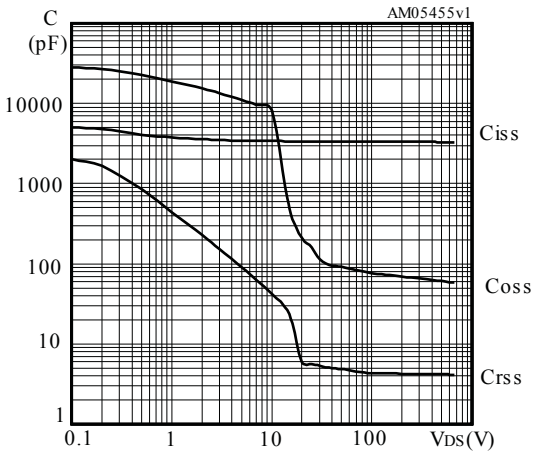


Figure 8. Output capacitance stored energy

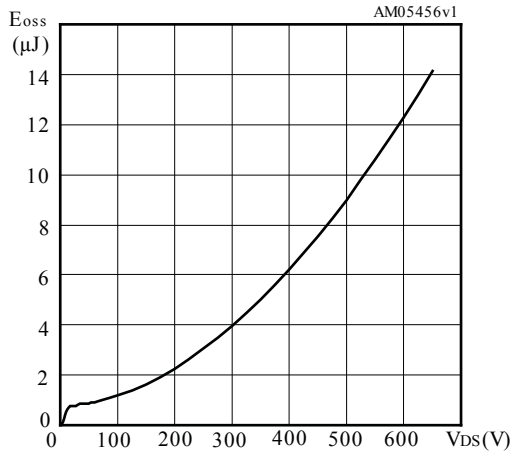


Figure 9. Normalized gate threshold voltage vs temperature

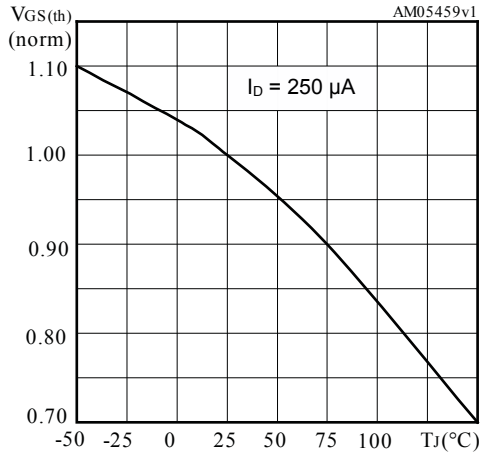


Figure 10. Normalized on resistance vs temperature

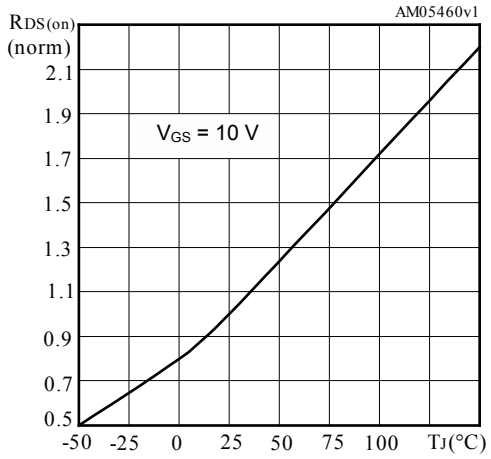


Figure 11. Source-drain diode forward characteristics

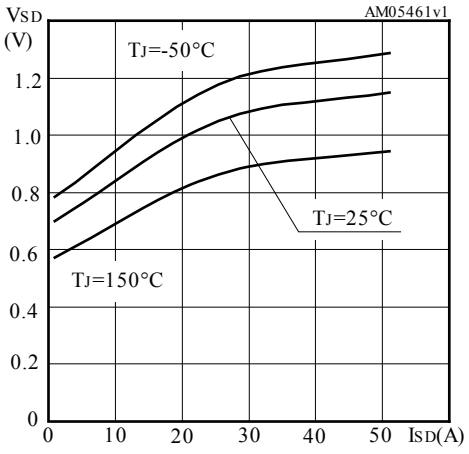


Figure 12. Normalized $V_{(BR)DSS}$ vs temperature

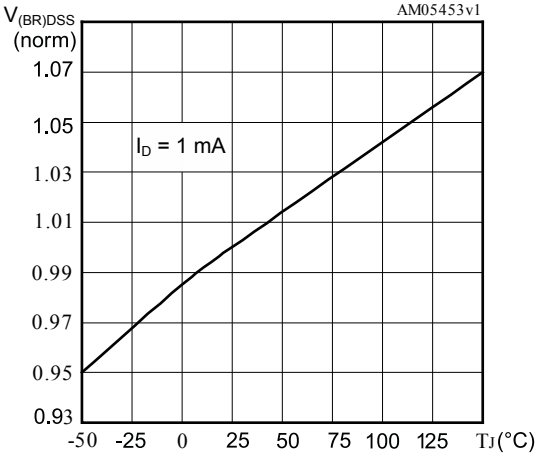
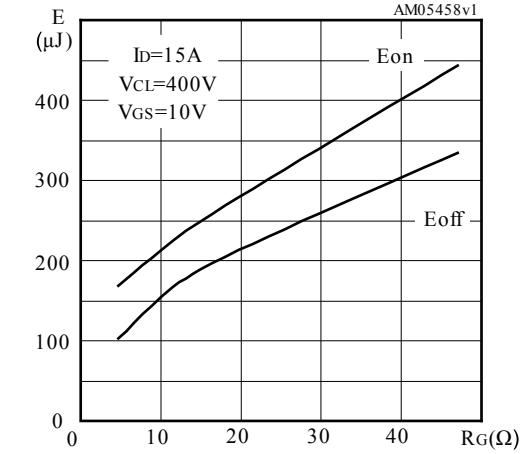


Figure 13. Switching energy vs gate resistance



* Eon including reverse recovery of a SiC diode.

3 Test circuits

Figure 14. Test circuit for resistive load switching times

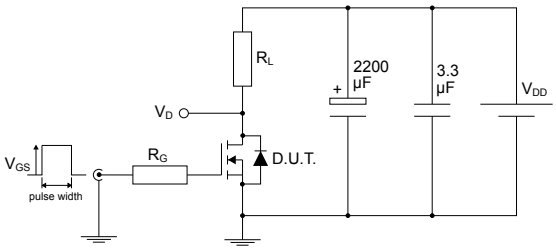


Figure 15. Test circuit for gate charge behavior

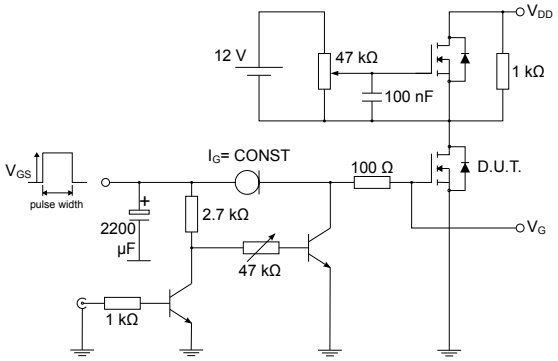


Figure 16. Test circuit for inductive load switching and diode recovery times

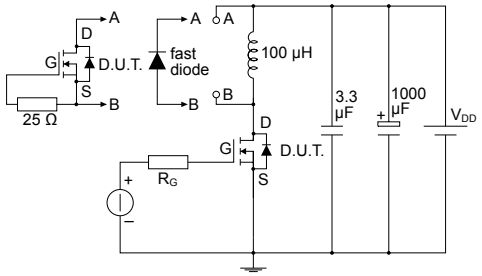


Figure 17. Unclamped inductive load test circuit

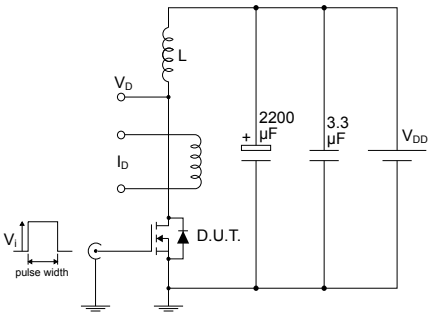


Figure 18. Unclamped inductive waveform

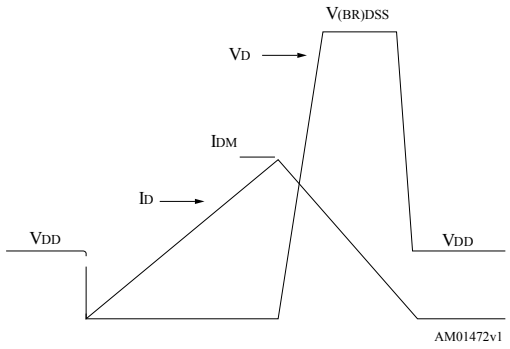
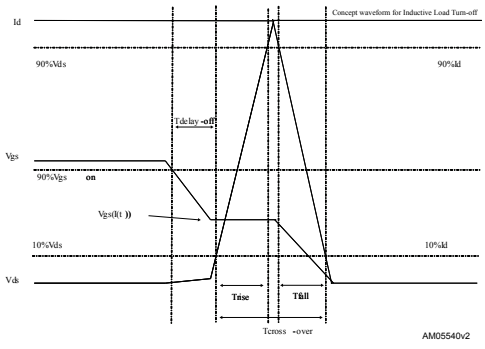


Figure 19. Switching time waveform



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

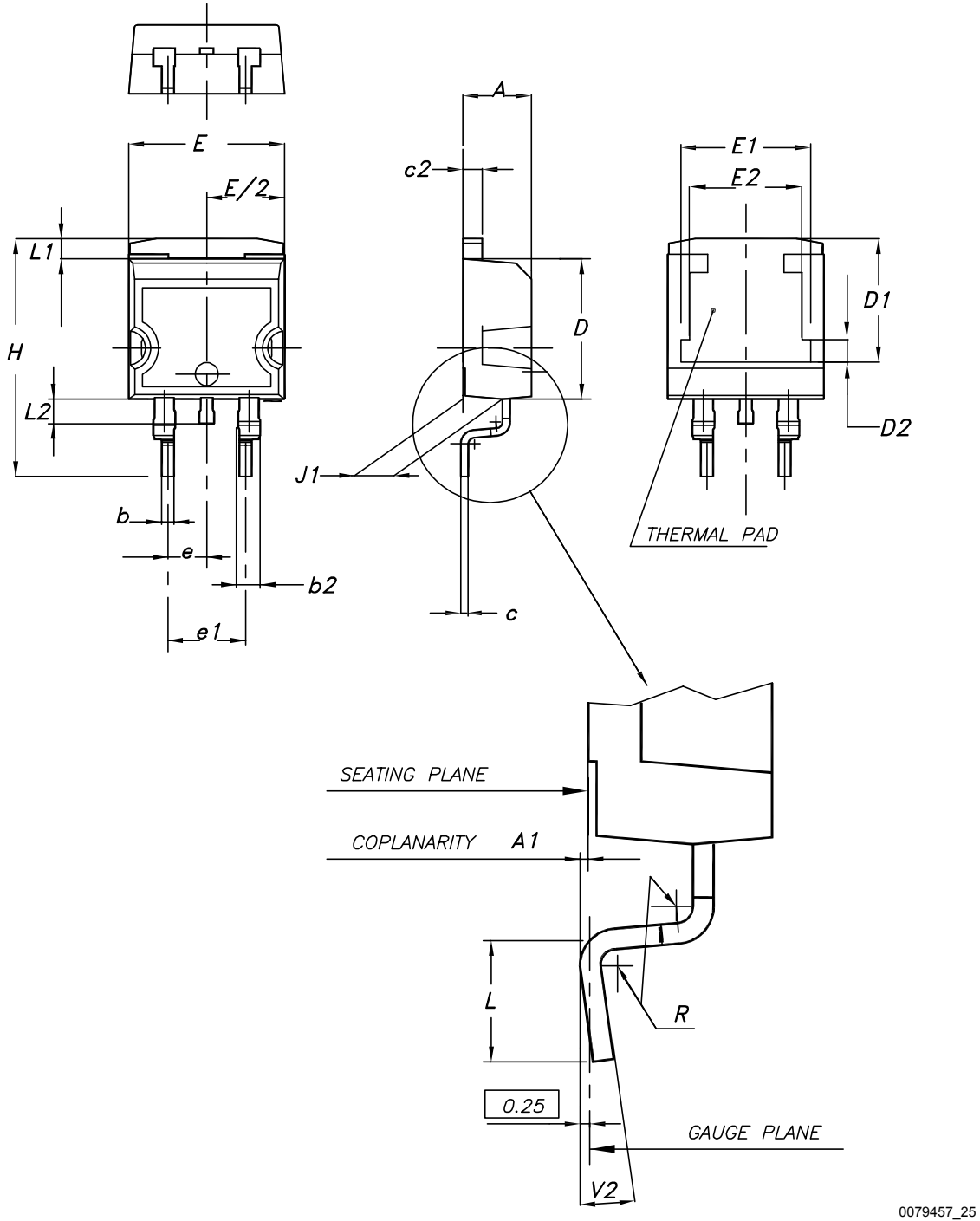
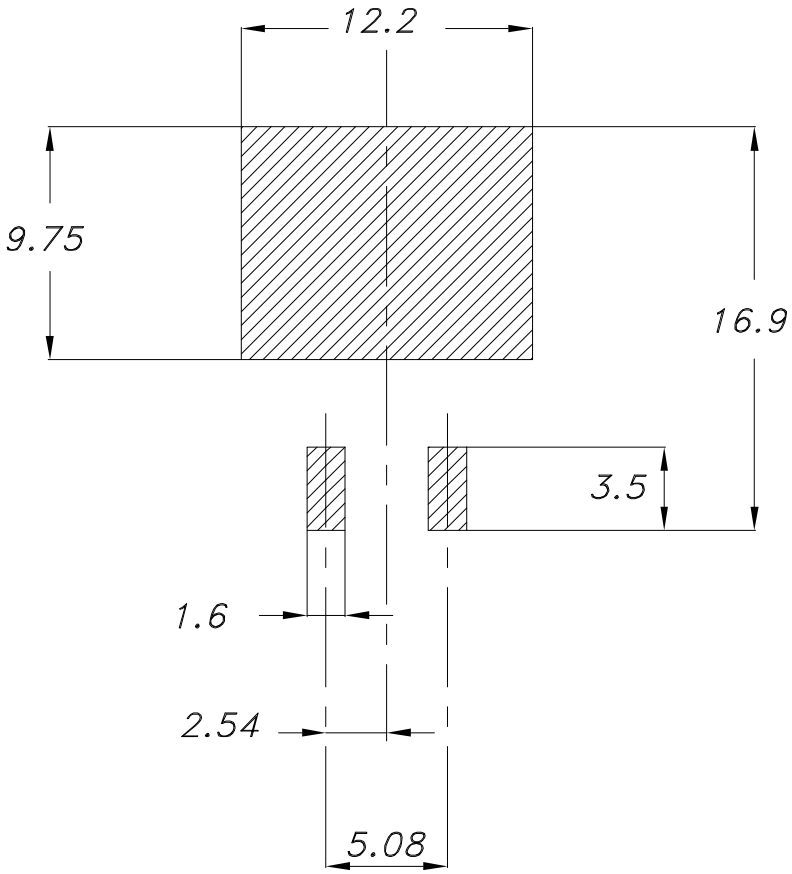


Table 8. D²PAK (TO-263) type A package mechanical data

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



Footprint

4.2 D²PAK packing information

Figure 22. D²PAK tape outline

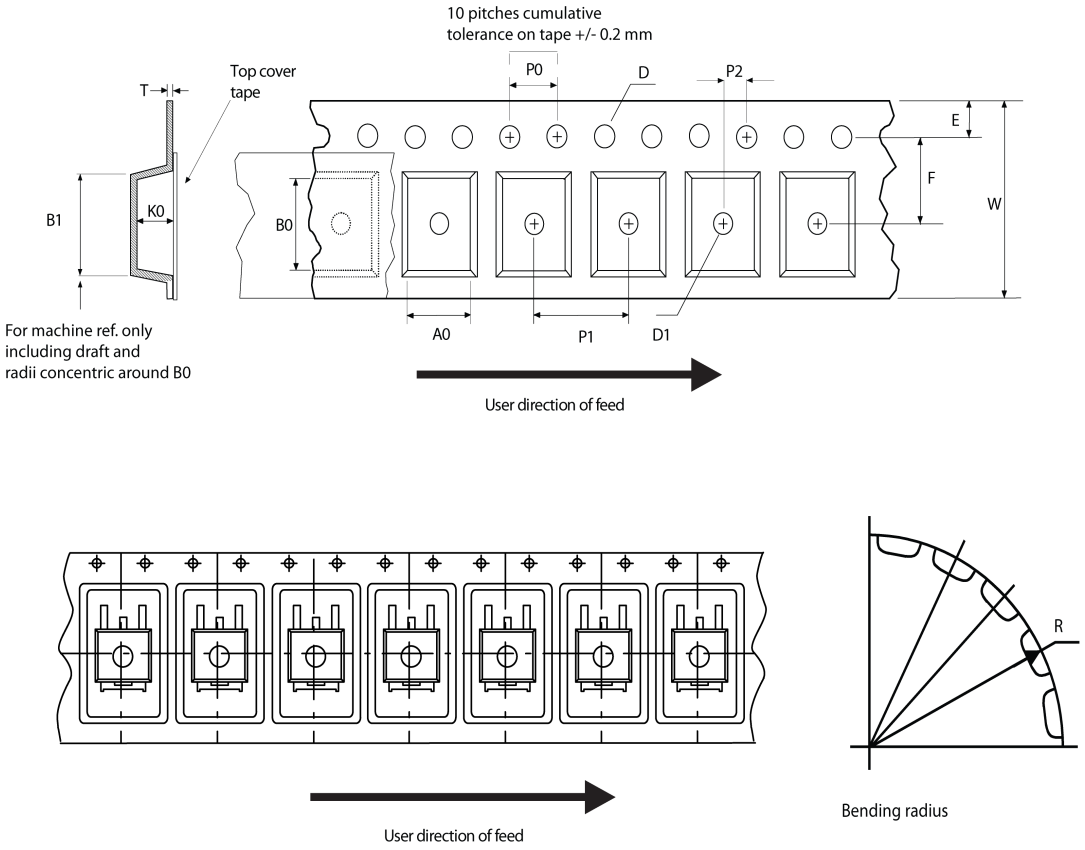
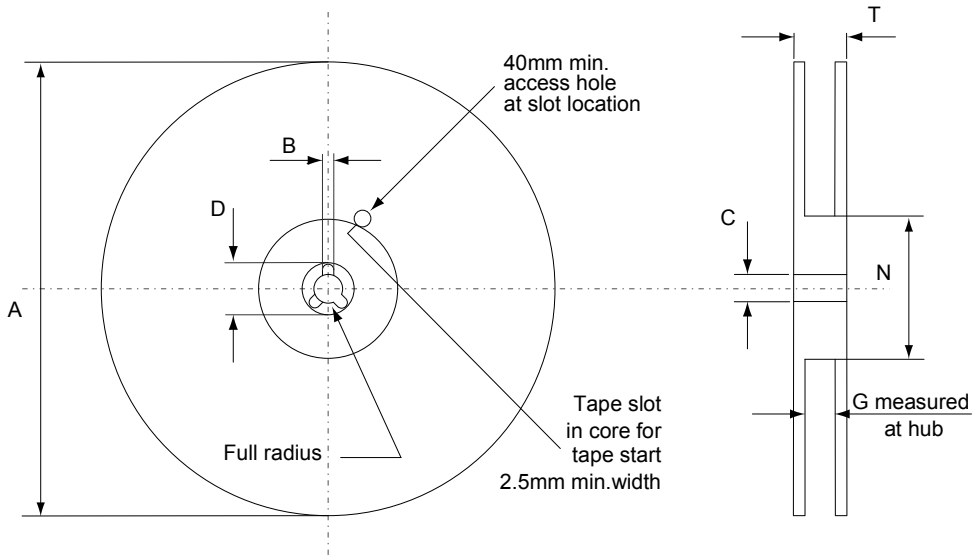


Figure 23. **D²PAK reel outline**



AM06038v1

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			

Revision history

Table 10. **Document revision history**

Date	Version	Changes
16-Jan-2009	1	First release
01-Sep-2009	2	Document status promoted from preliminary data to datasheet.
30-Sep-2009	3	Corrected V_{GS} value on Table 2: Absolute maximum ratings
06-Oct-2011	4	$C_{o(er)}$ and $C_{o(tr)}$ values changed in *Table 5: Dynamic* *Table 6: Switching times* parameters updates *Figure 24: Switching time waveform* has been corrected Minor text changes *Section 4: Package mechanical data* has been modified. Added: – *Table 8: D²PAK (TO-263) mechanical data*, *Figure 25: D²PAK (TO-263) drawing* and *Figure 26: D²PAK footprint*; – *Table 9: TO-220FP mechanical data*, and *Figure 27: TO-220FP drawing*; – *Table 10: I²PAK (TO-262) mechanical data*, and *Figure 28: I²PAK (TO-262) drawing*; – *Table 11: TO-220 type A mechanical data*, and *Figure 29: TO-220 type A drawing*; – *Table 12: TO-247 mechanical data*, and *Figure 30: TO-247 drawing*; *Section 5: Packaging mechanical data* has been modified. Added: – *Table 13: D²PAK (TO-263) tape and reel mechanical data*, *Figure 31: Tape* and *Figure 32: Reel;*
02-Nov-2018	5	The part numbers STF32N65M5, STI32N65M5, STP32N65M5, STW32N65M5 have been moved to a separate datasheet. Content reworked to improve readability, no technical changes.

Contents

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