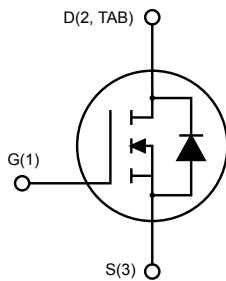


## N-channel 650 V, 0.230 $\Omega$ typ., 12 A MDmesh™ M5 Power MOSFET in a DPAK package


**DPAK**


AM01475v1\_noZen

### Features

Order codes	$V_{DS}$ at $T_{jmax}$ .	$R_{DS(on)}$ max.	$I_D$
STD16N65M5	710 V	0.279 $\Omega$	12 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

[STD16N65M5](#)

#### Product summary

<b>Order code</b>	STD16N65M5
<b>Marking</b>	16N65M5
<b>Package</b>	DPAK
<b>Packing</b>	Tape and reel

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 25$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	12	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	7.3	A
$I_{DM}^{(1)}$	Drain current (pulsed)	48	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	90	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$T_j$	Operating junction temperature range	-55 to 150	$^\circ\text{C}$
$T_{stg}$	Storage temperature range		

1. Pulse width limited by safe operating area.

2.  $I_{SD} \leq 12\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DD} = 400\text{ V}$ ,  $V_{DS(peak)} < V_{(BR)DSS}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	1.38	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	50	$^\circ\text{C}/\text{W}$

1. When mounted on 1inch<sup>2</sup> FR-4 board, 2 oz Cu.

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ Max)	4	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	200	mJ

## 2 Electrical characteristics

( $T_{CASE} = 25\text{ °C}$  unless otherwise specified)

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$ , $V_{GS} = 0\text{ V}$	650			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$ ,			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$ , $T_C = 125\text{ °C}$ <sup>(1)</sup>			100	$\mu\text{A}$
$I_{GSS}$	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	$V_{GS} = 10\text{ V}$ , $I_D = 6\text{ A}$		0.230	0.279	$\Omega$

1. Defined by design, not subject to production test.

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	1250	-	$\text{pF}$
$C_{oss}$	Output capacitance			30		
$C_{riss}$	Reverse transfer capacitance			3		
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }520\text{ V}$ , $V_{GS} = 0\text{ V}$	-	100	-	$\text{pF}$
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related			30		
$R_g$	Gate input resistance	$f = 1\text{ MHz}$ open drain	-	2	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}$ , $I_D = 12\text{ A}$ , $V_{GS} = 0$ to $10\text{ V}$ (see Figure 15. Test circuit for gate charge behavior)	-	31	-	nC
$Q_{gs}$	Gate-source charge			8		
$Q_{gd}$	Gate-drain charge			12		

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
$t_{d(v)}$	Voltage delay time	$V_{DD} = 400\text{ V}$ , $I_D = 8\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 16. Test circuit for inductive load switching and diode recovery times and Figure 19. Switching time waveform)	-	25	-	ns
$t_{r(v)}$	Voltage rise time			7		
$t_{f(i)}$	Current fall time			6		
$t_{c(off)}$	Crossing time			8		

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		12	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				48	
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 12\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 12\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$	-	300		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100\text{ V}$ (see Figure 16. Test circuit for inductive load switching and diode recovery times)		3.5		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			23		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 12\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$	-	350		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100\text{ V}$ (see Figure 16. Test circuit for inductive load switching and diode recovery times)		4		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			24		A

1. Pulse width limited by safe operating area.

2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics curves

Figure 1. Safe operating area

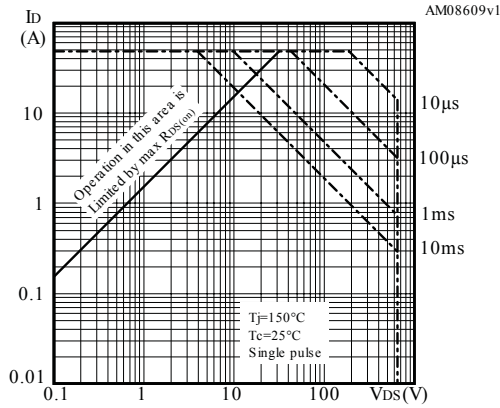


Figure 2. Thermal impedance

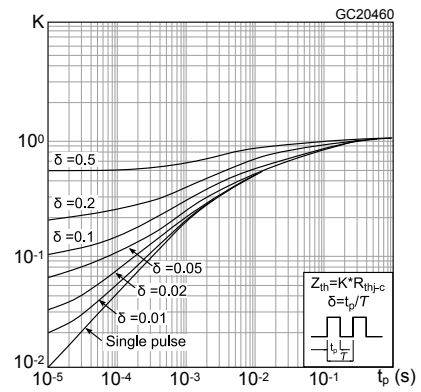


Figure 3. Output characteristics

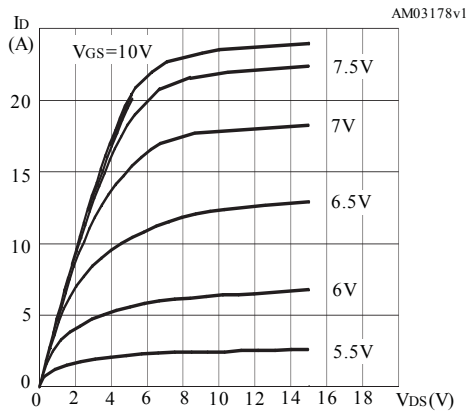


Figure 4. Transfer characteristics

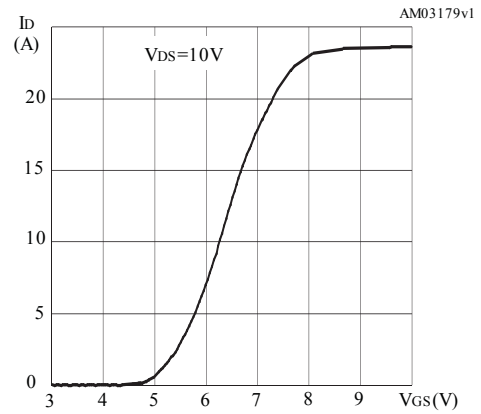


Figure 5. Normalized  $V_{(BR)DSS}$  vs temperature

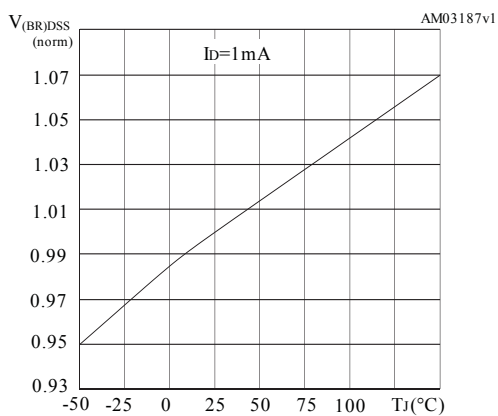
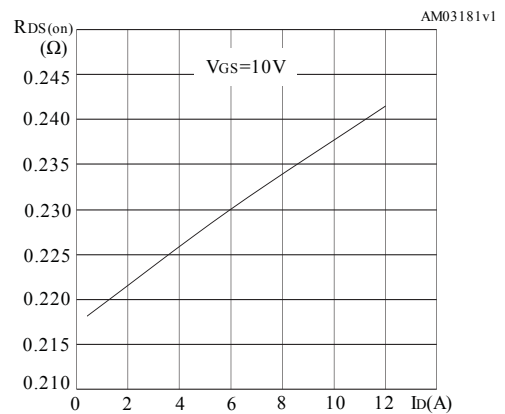
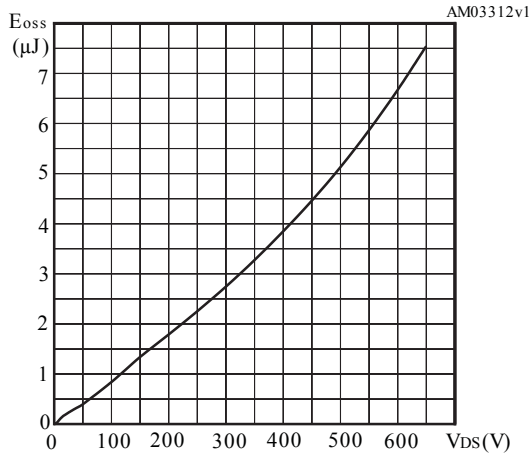


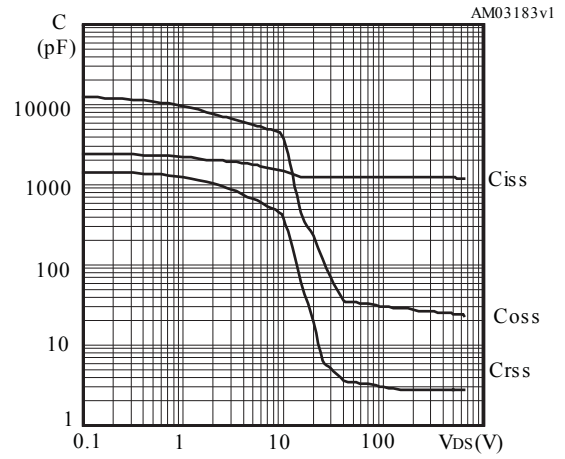
Figure 6. Static drain-source on resistance



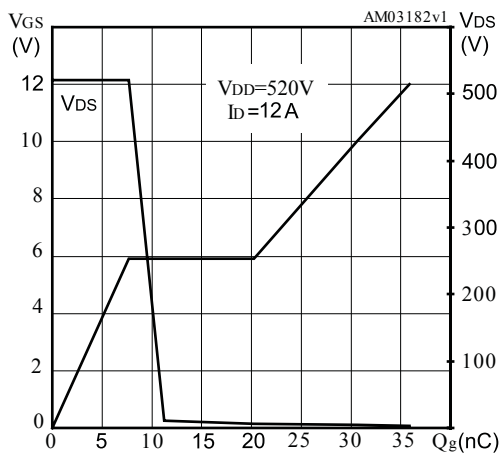
**Figure 7. Output capacitance stored energy**



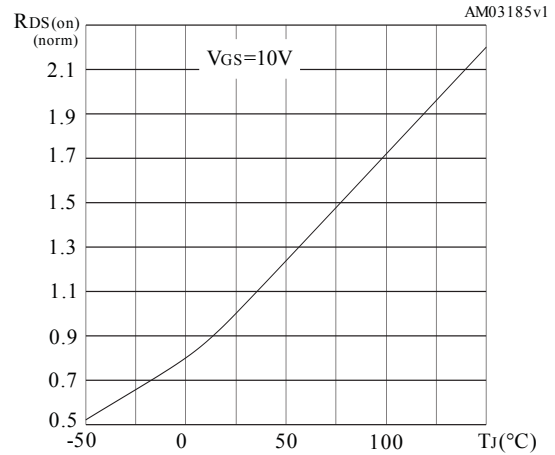
**Figure 8. Capacitance variations**



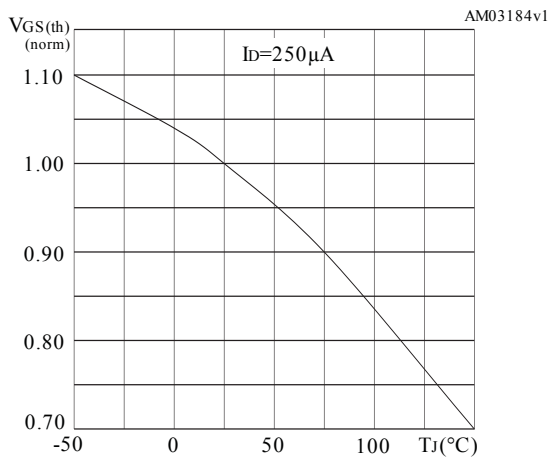
**Figure 9. Gate charge vs gate-source voltage**



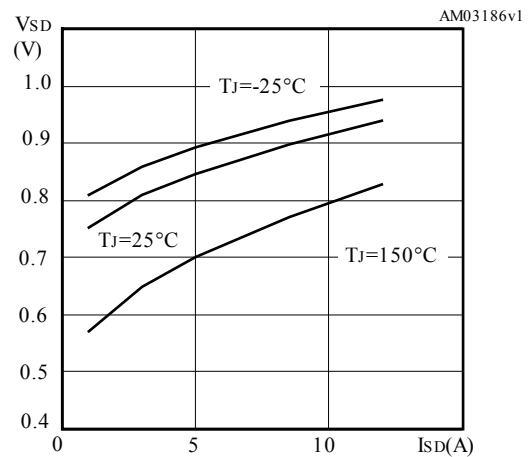
**Figure 10. Normalized on resistance vs temperature**



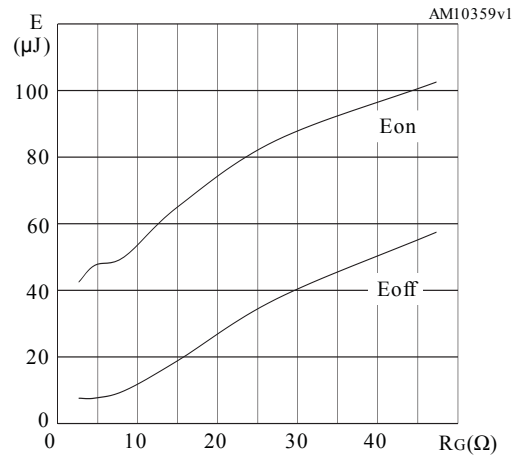
**Figure 11. Normalized gate threshold voltage vs temperature**



**Figure 12. Source-drain diode forward characteristics**

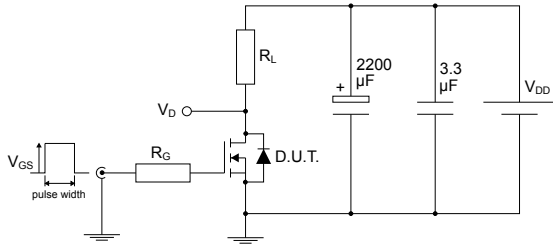


**Figure 13. Switching energy vs gate resistance**

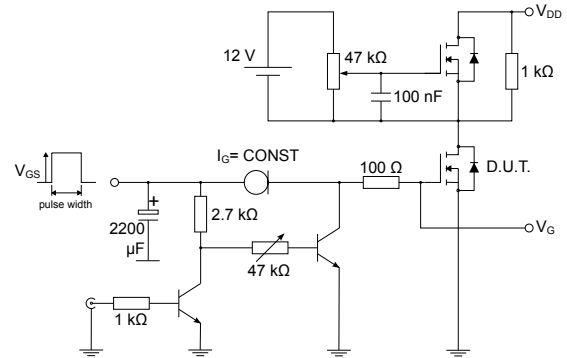


# Eon including reverse recovery of a SiC diode.

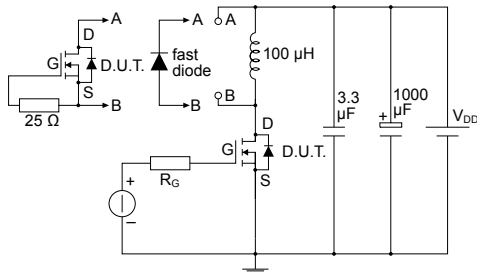
### 3 Test circuits

**Figure 14. Test circuit for resistive load switching times**


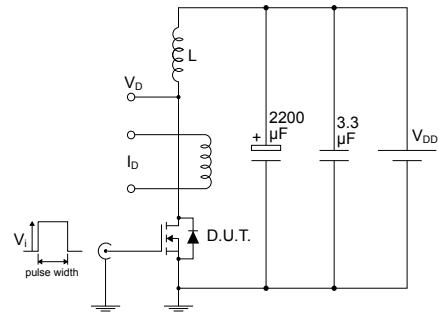
AM01488v1

**Figure 15. Test circuit for gate charge behavior**


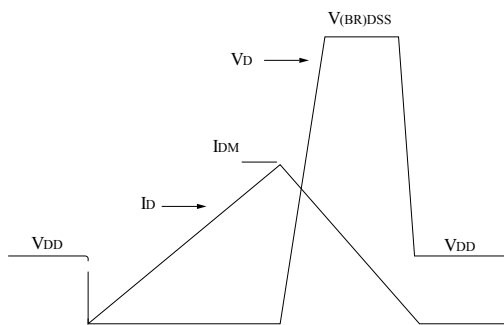
AM01469v1

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


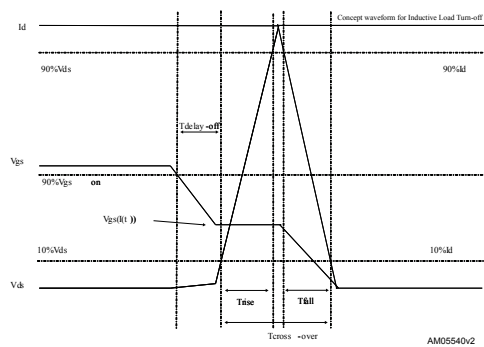
AM01470v1

**Figure 17. Unclamped inductive load test circuit**


AM01471v1

**Figure 18. Unclamped inductive waveform**


AM01472v1

**Figure 19. Switching time waveform**


AM05540v2



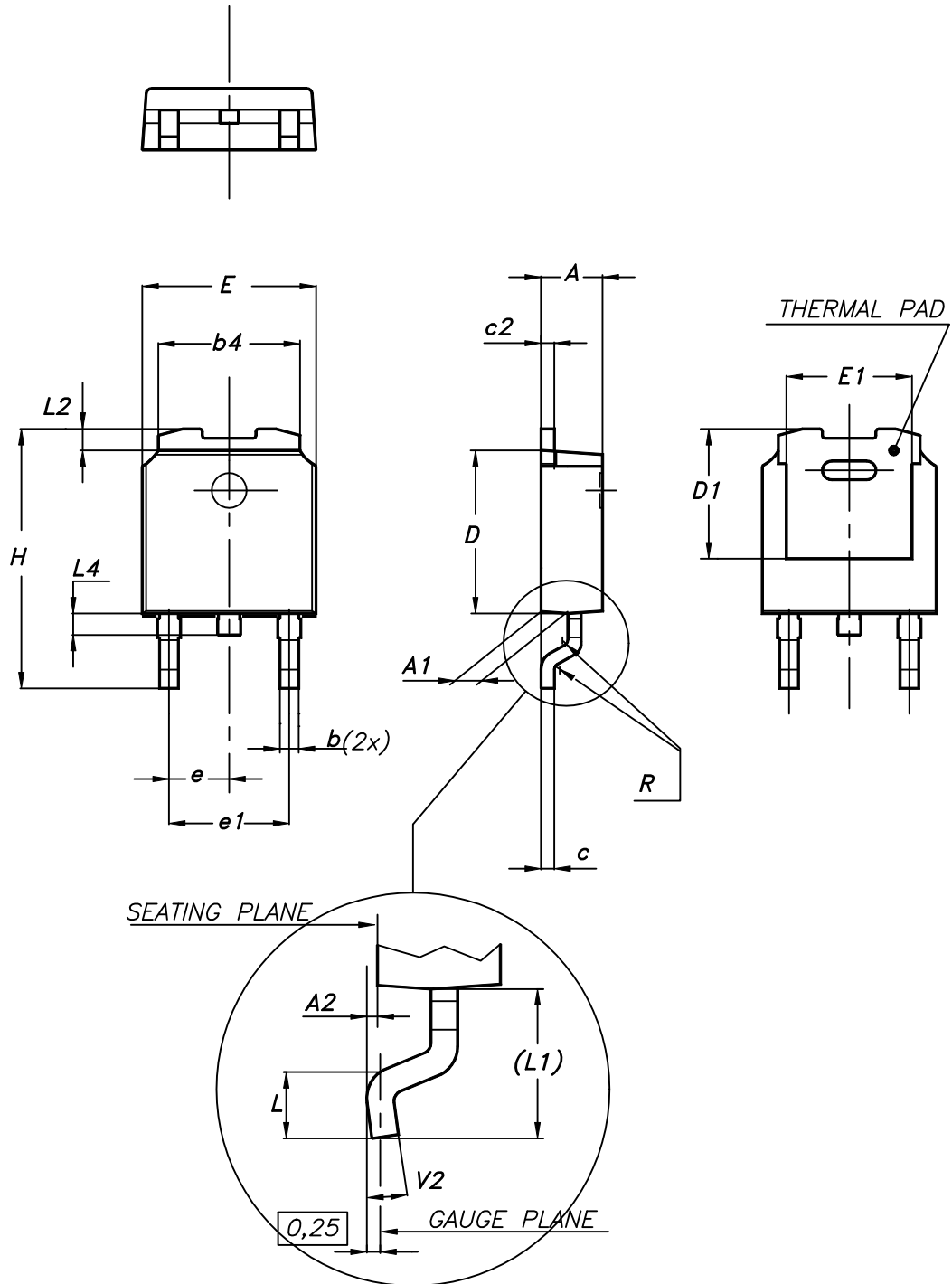
## 4 Package information

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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](http://www.st.com). ECOPACK® is an ST trademark.

### 4.1 DPAK (TO-252) type A2 package information

Figure 20. DPAK (TO-252) type A2 package outline



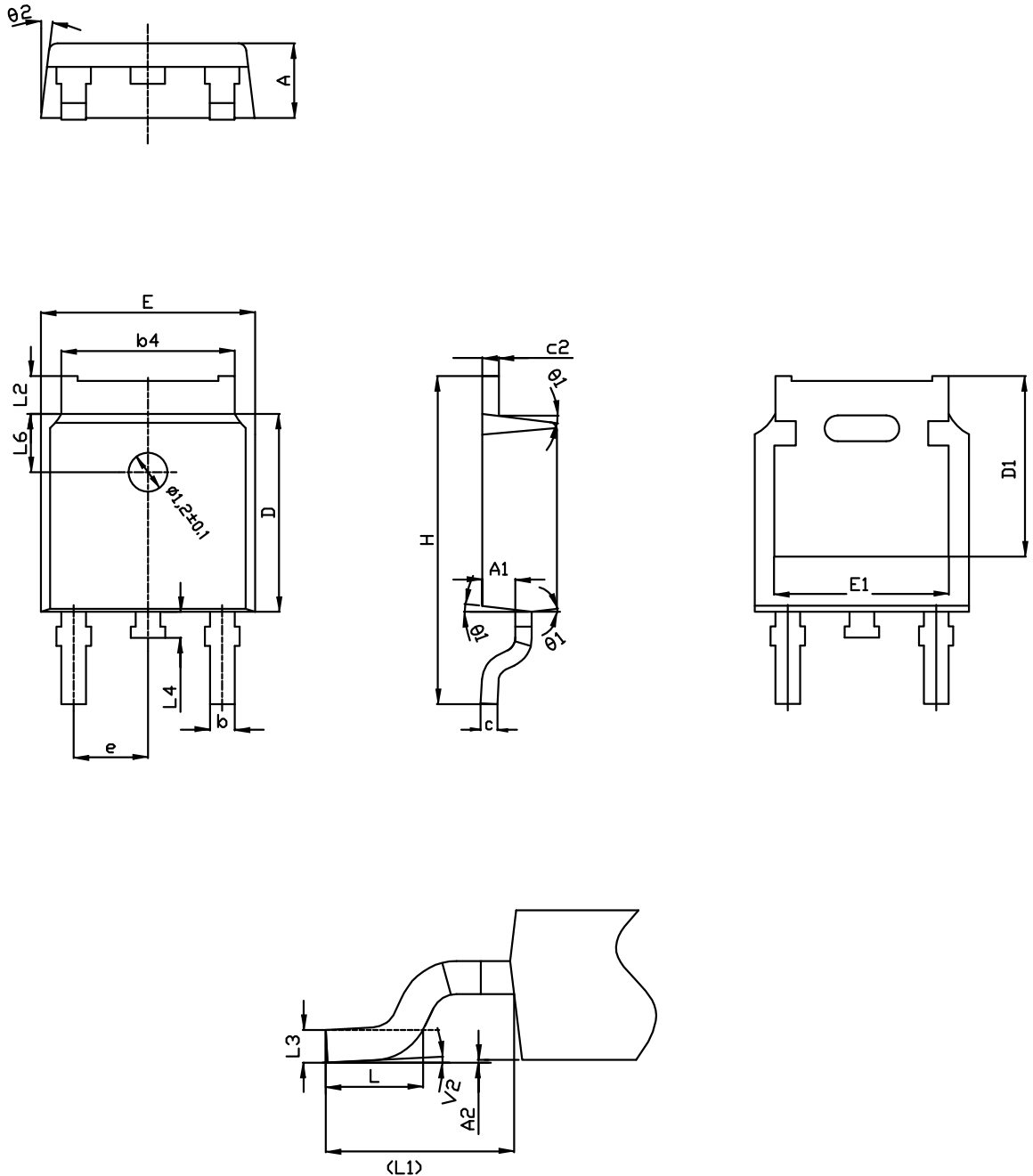
0068772\_type-A2\_rev25

**Table 8. DPAK (TO-252) type A2 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	5.10	5.20	5.30
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°

## 4.2 DPAK (TO-252) type C2 package information

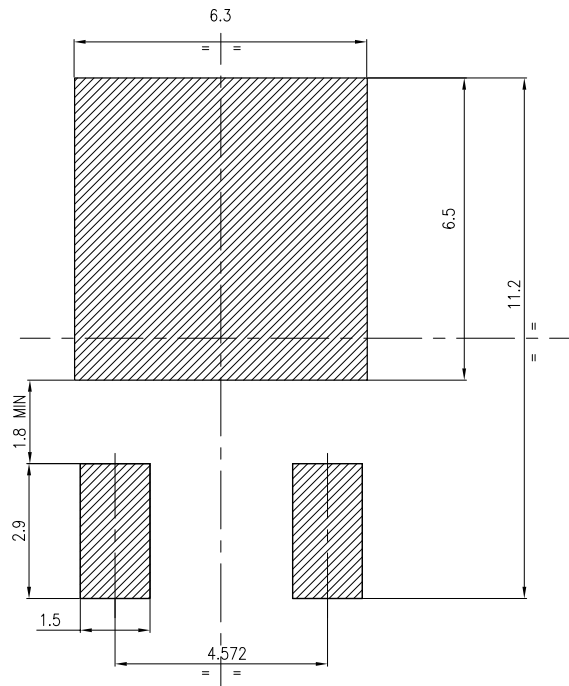
Figure 21. DPAK (TO-252) type C2 package outline



0068772\_C2\_25

**Table 9. DPAK (TO-252) type C2 mechanical data**

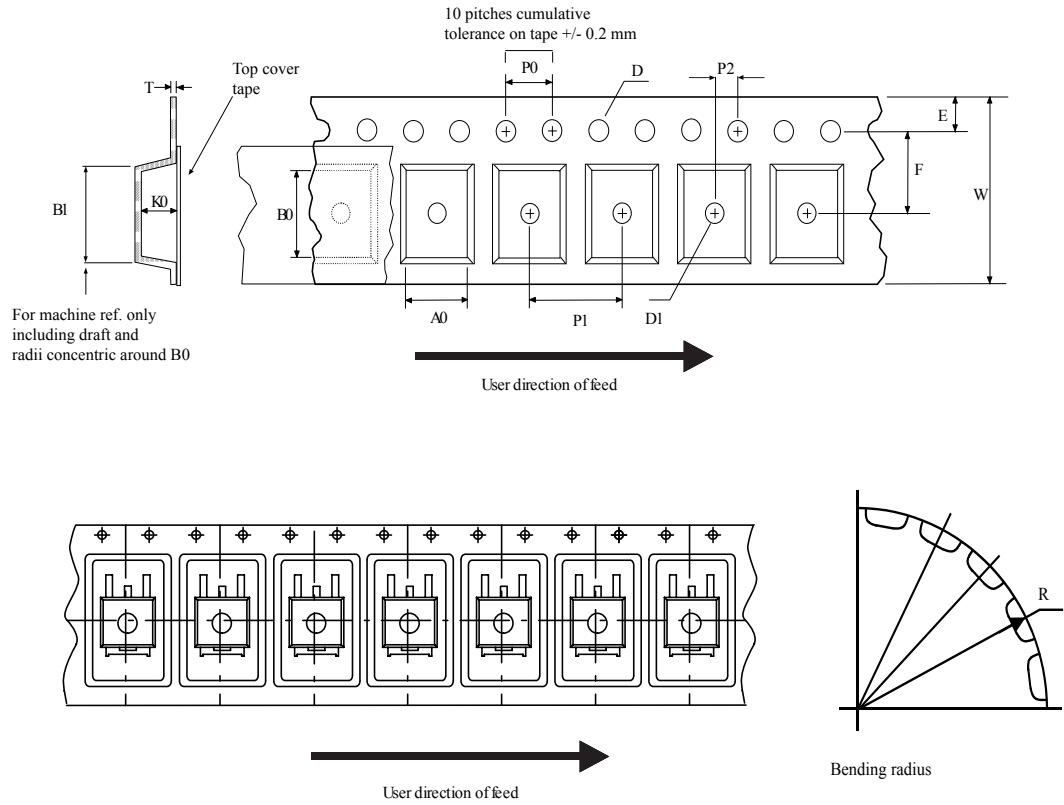
Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.38
A1	0.90	1.01	1.10
A2	0.00		0.10
b	0.72		0.85
b4	5.13	5.33	5.46
c	0.47		0.60
c2	0.47		0.60
D	6.00	6.10	6.20
D1	5.10		5.60
E	6.50	6.60	6.70
E1	5.20		5.50
e	2.186	2.286	2.386
H	9.80	10.10	10.40
L	1.40	1.50	1.70
L1	2.90 REF		
L2	0.90		1.25
L3	0.51 BSC		
L4	0.60	0.80	1.00
L6	1.80 BSC		
θ1	5°	7°	9°
θ2	5°	7°	9°
V2	0°		8°

**Figure 22. DPAK (TO-252) recommended footprint (dimensions are in mm)**


FP\_0068772\_25

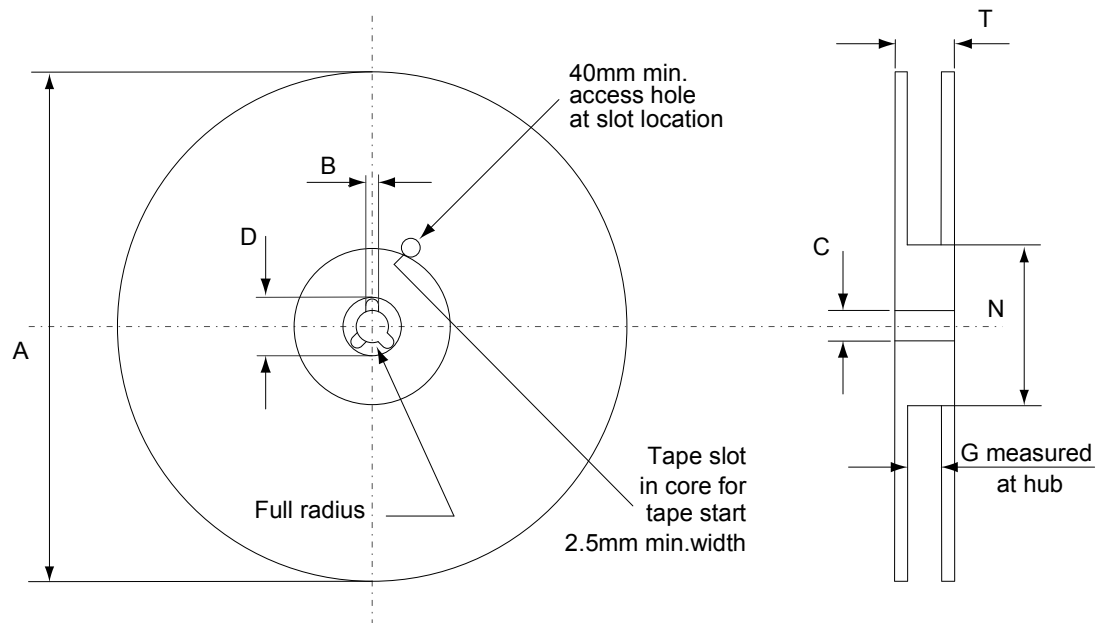
### 4.3 DPAK (TO-252) packing information

Figure 23. DPAK (TO-252) tape outline



AM08852v1

**Figure 24. DPAK (TO-252) reel outline**



AM06038v1

**Table 10. DPAK (TO-252) tape and reel mechanical data**

Dim.	Tape		Dim.	Reel	
	mm			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			



## Revision history

**Table 11. Document revision history**

Date	Version	Changes
09-Nov-2010	1	First release.
14-Oct-2011	2	Modified <i>Section 2.1: Electrical characteristics (curves)</i> : – <i>Figure 6, Figure 7, Figure 8, Figure 9, Figure 13 and Figure 14</i> – Added <i>Figure 15</i> Updated $R_{DS(on)}$ value in coverpage and in <i>Table 4</i> Updated values in <i>Table 6</i> Updated <i>Section 4: Package mechanical data</i> and <i>Section 5: Packaging mechanical data</i> . Minor text changes.
20-Nov-2018	3	Removed maturity status indication from cover page. The document status is production data. The part number STB16N65M5 has been moved to a separate datasheet. Updated <a href="#">Section 4 Package information</a> . Minor text changes.

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