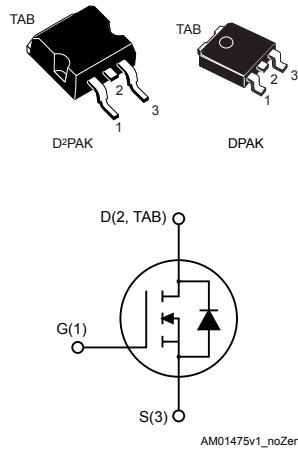


N-channel 650 V, 0.308 Ω typ., 11 A MDmesh™ M5 Power MOSFETs in D²PAK and DPAK packages



Features

Order code	V_{DS} @ T_{Jmax}	$R_{DS(on)}$ max.	I_D
STB15N65M5	710 V	0.34 Ω	11 A
STD15N65M5			

- 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 MOSFET 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
STB15N65M5
STD15N65M5

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 $T_C = 25\text{ }^{\circ}\text{C}$	11	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	6.9	A
$I_{DM}^{(1)}$	Drain current (pulsed)	44	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	85	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. $I_{SD} \leq 11\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DD} = 400\text{ V}$, $V_{DS(peak)} < V_{(BR)DSS}$.

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D ² PAK	PAK	
$R_{thj-case}$	Thermal resistance junction-case	1.47		$^{\circ}\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	30	50	$^{\circ}\text{C}/\text{W}$

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

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_{jmax})	2.5	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	160	mJ

2 Electrical characteristics

($T_{CASE} = 25\text{ }^{\circ}\text{C}$ 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	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}$ ⁽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	$V_{GS} = 10\text{ V}$, $I_D = 5.5\text{ A}$		0.308	0.34	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	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	816	-	pF
C_{oss}	Output capacitance			23		
C_{rss}	Reverse transfer capacitance			2.6		
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }520\text{ V}$, $V_{GS} = 0\text{ V}$	-	70	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related			21		
R_g	Gate input resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	5	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}$, $I_D = 5.5\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 17. Test circuit for gate charge behavior)	-	22	-	nC
Q_{gs}	Gate-source charge			5.5		
Q_{gd}	Gate-drain charge			11		

1. $C_{o(tr)}$ is a constant capacitance value that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

2. $C_{o(er)}$ is a constant capacitance value that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(v)}$	Voltage delay time	$V_{DD} = 400\text{ V}$, $I_D = 7\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 18. Test circuit for inductive load switching and diode recovery times and Figure 21. Switching time waveform)	-	30	-	ns
$t_{r(v)}$	Voltage rise time			8		
$t_{c(off)}$	Crossing time			12.5		
$t_{f(i)}$	Current fall time			11		

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		11	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				44	
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 11\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see Figure 18. Test circuit for inductive load switching and diode recovery times)	-	247		ns
Q_{rr}	Reverse recovery charge			2.4		μC
I_{RRM}	Reverse recovery current			19.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 18. Test circuit for inductive load switching and diode recovery times)	-	312		ns
Q_{rr}	Reverse recovery charge			3		μC
I_{RRM}	Reverse recovery current			19		A

1. Pulse width limited by safe operating area.

2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics curves

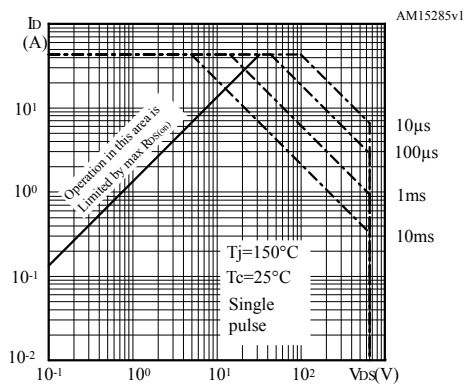
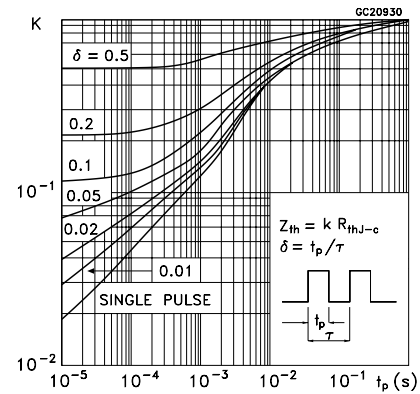
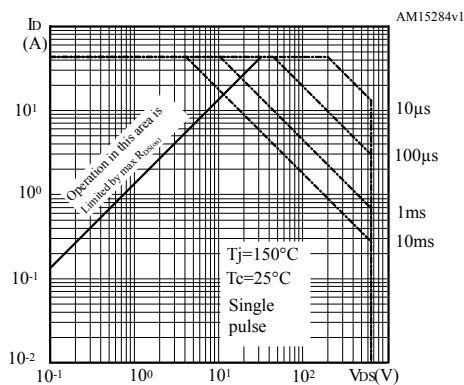
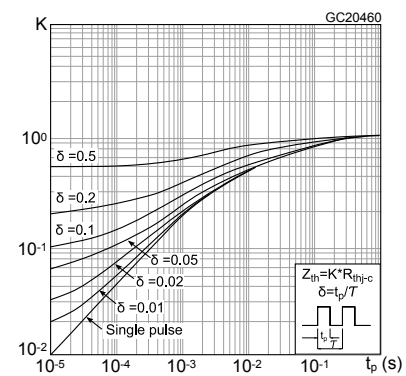
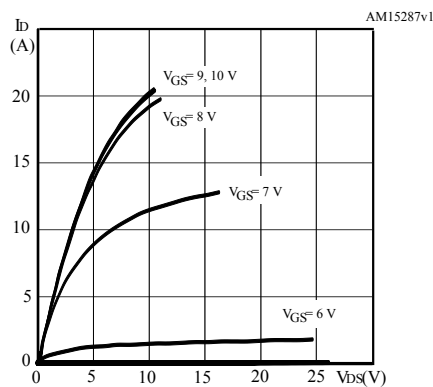
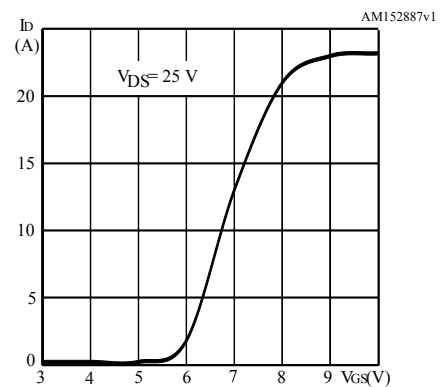
Figure 1. Safe operating area for D²PAK

Figure 2. Thermal impedance for D²PAK

Figure 3. Safe operating area for DPAK

Figure 4. Thermal impedance for DPAK

Figure 5. Output characteristics

Figure 6. Transfer characteristics


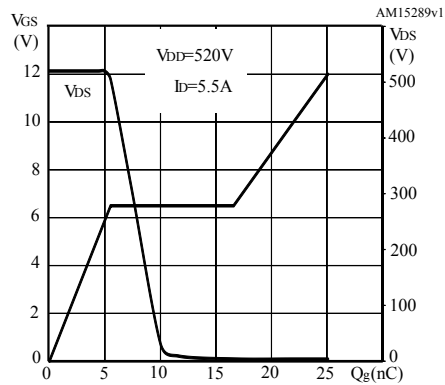
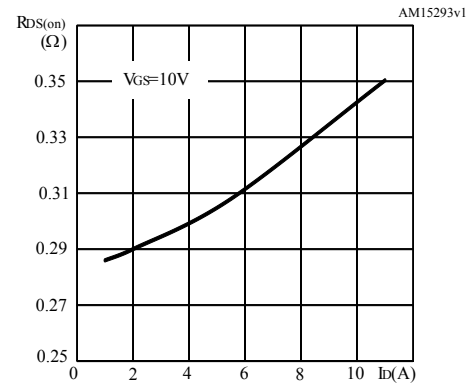
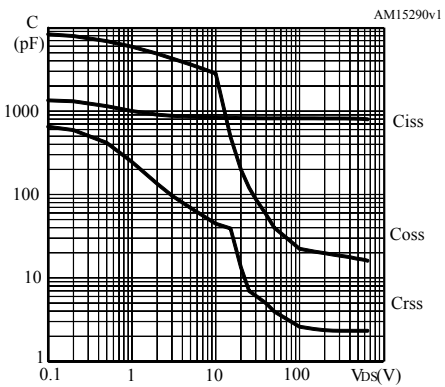
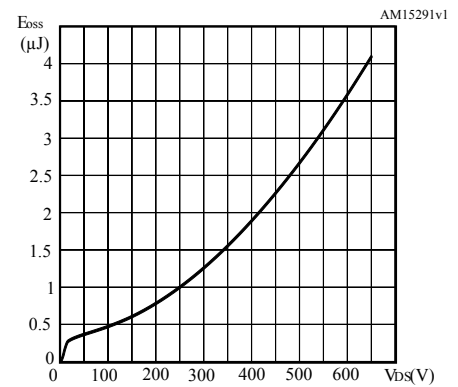
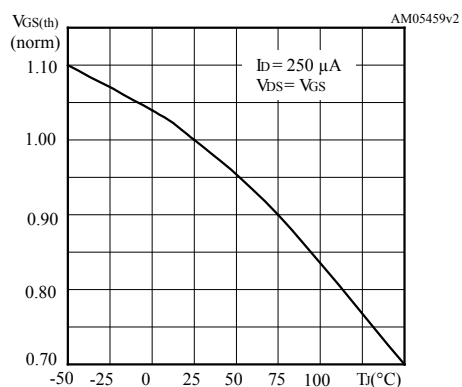
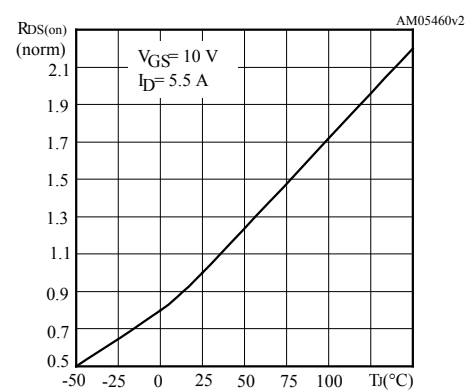
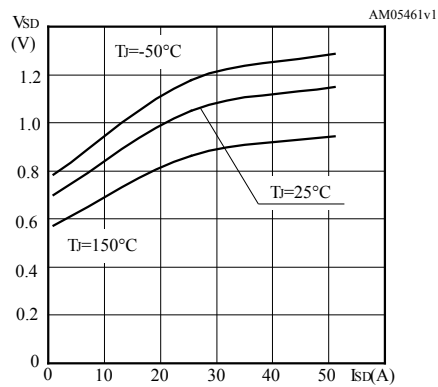
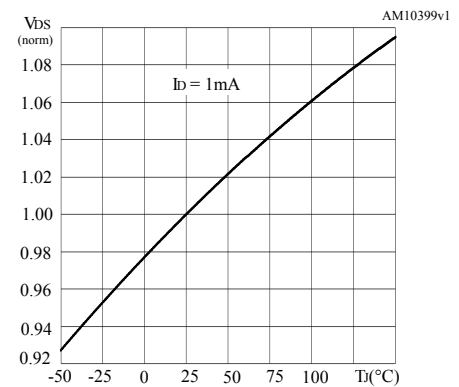
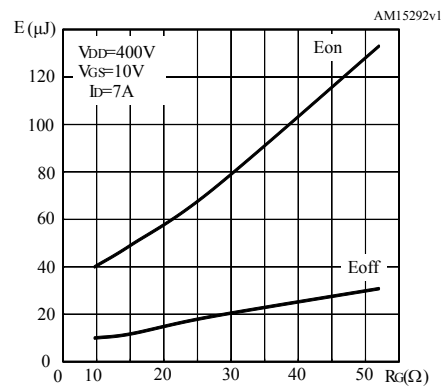
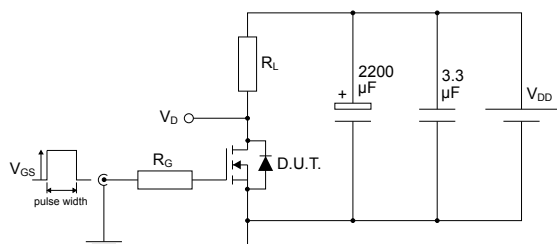
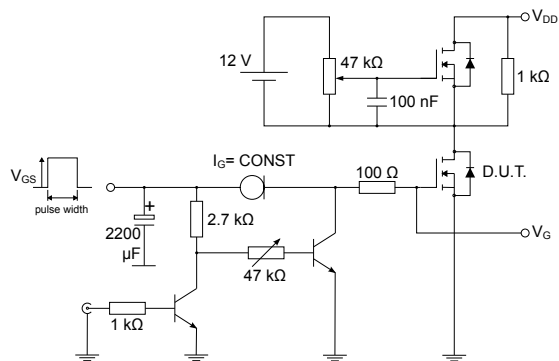
Figure 7. Gate charge vs gate-source voltage

Figure 8. Static drain-source on resistance

Figure 9. Output capacitance stored energy

Figure 10. Capacitance variations

Figure 11. Normalized gate threshold voltage vs temperature

Figure 12. Normalized on-resistance vs temperature


Figure 13. Source-drain diode forward characteristics

Figure 14. Normalized $V_{(BR)DSS}$ vs temperature

Figure 15. Switching losses vs gate resistance


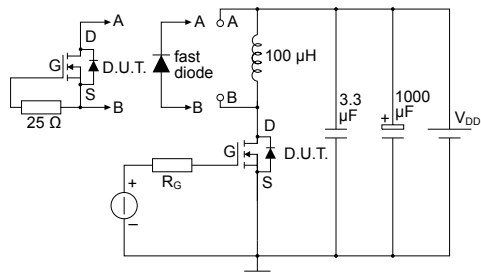
3 Test circuits

Figure 16. Test circuit for resistive load switching times


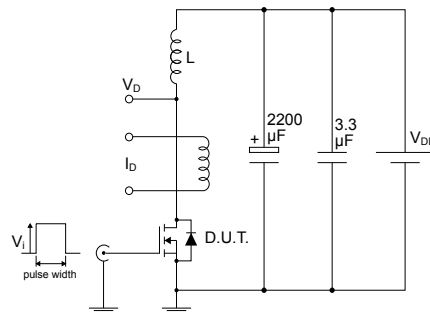
AM01468v1

Figure 17. Test circuit for gate charge behavior


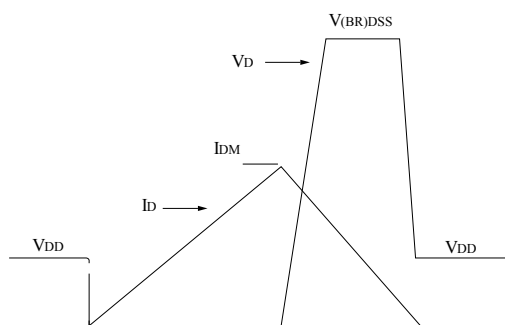
AM01469v1

Figure 18. Test circuit for inductive load switching and diode recovery times


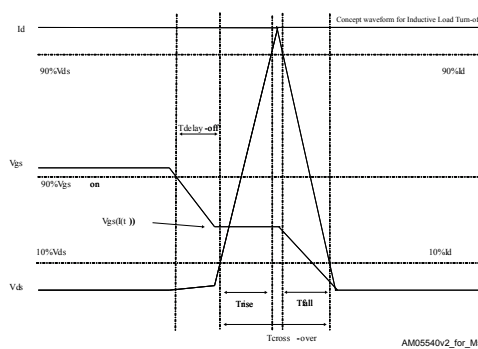
AM01470v1

Figure 19. Unclamped inductive load test circuit


AM01471v1

Figure 20. Unclamped inductive waveform


AM01472v1

Figure 21. Switching time waveform


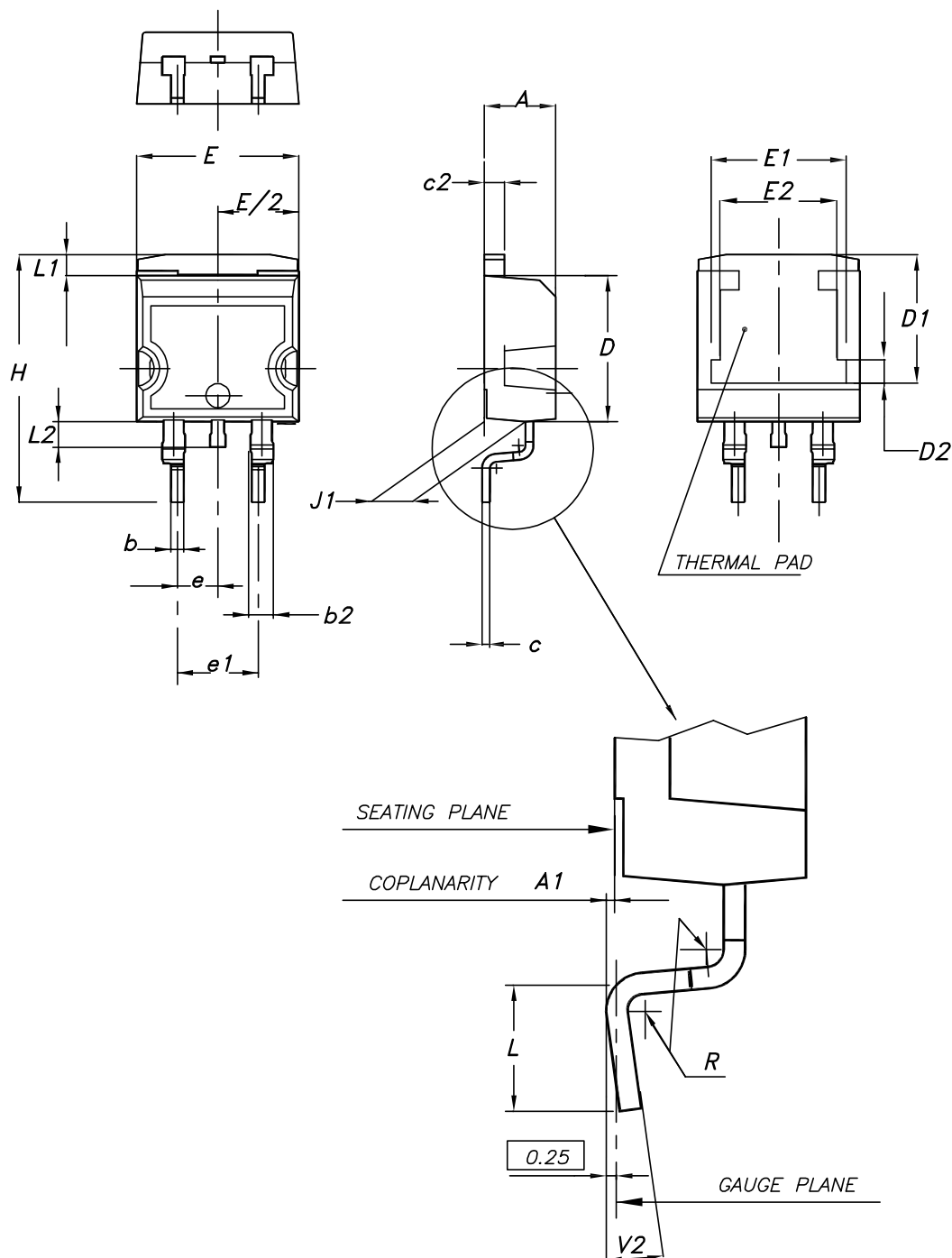
AM05540v2_for_M5

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

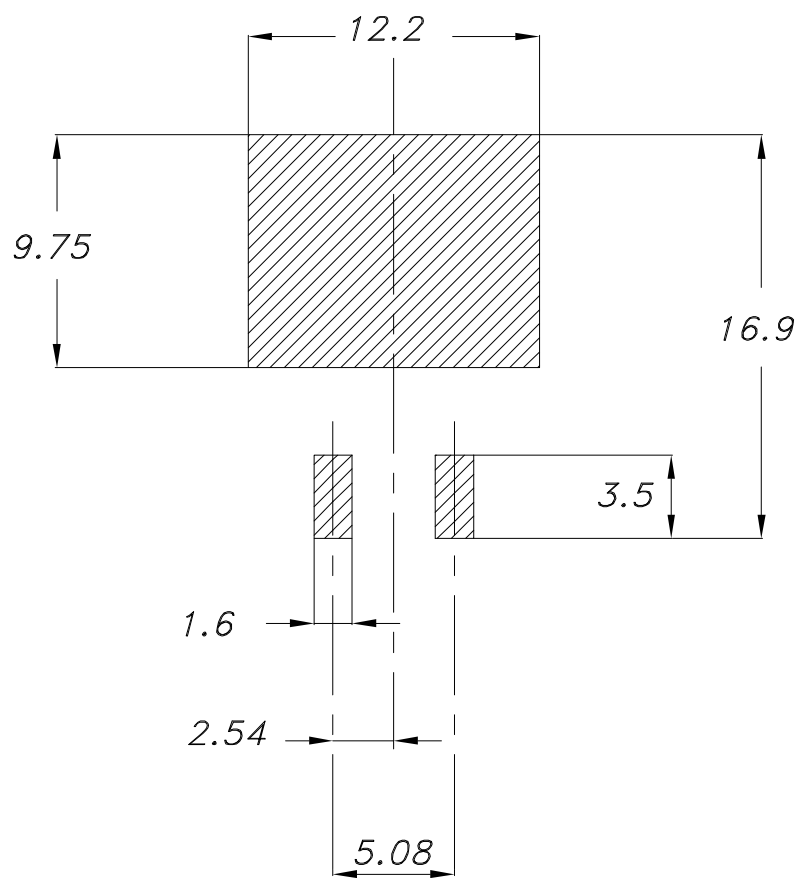


0079457_25

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°

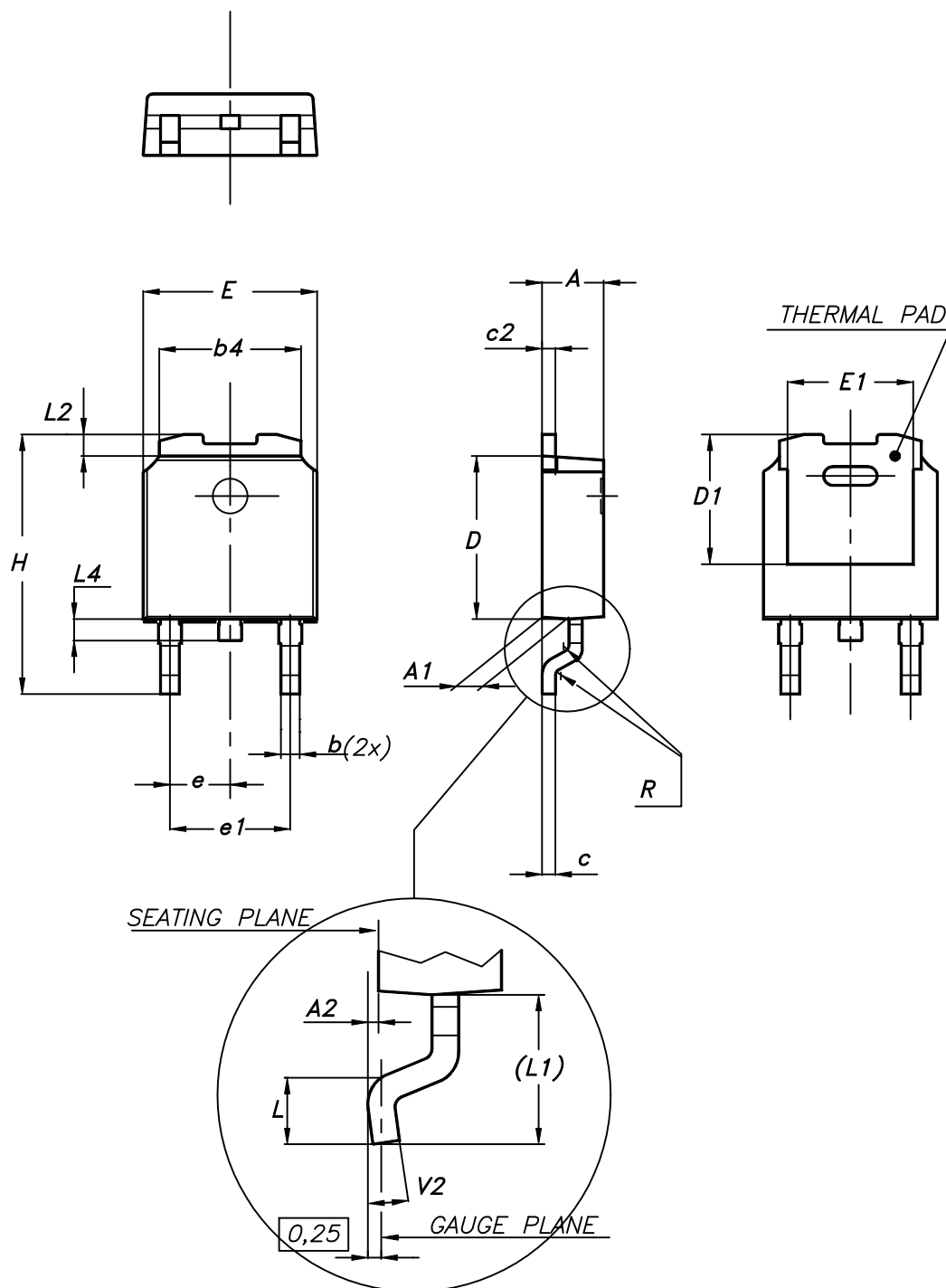
Figure 23. D²PAK (TO-263) recommended footprint (dimensions are in mm)



Footprint

4.2 DPAK (TO-252) type A2 package information

Figure 24. DPAK (TO-252) type A2 package outline



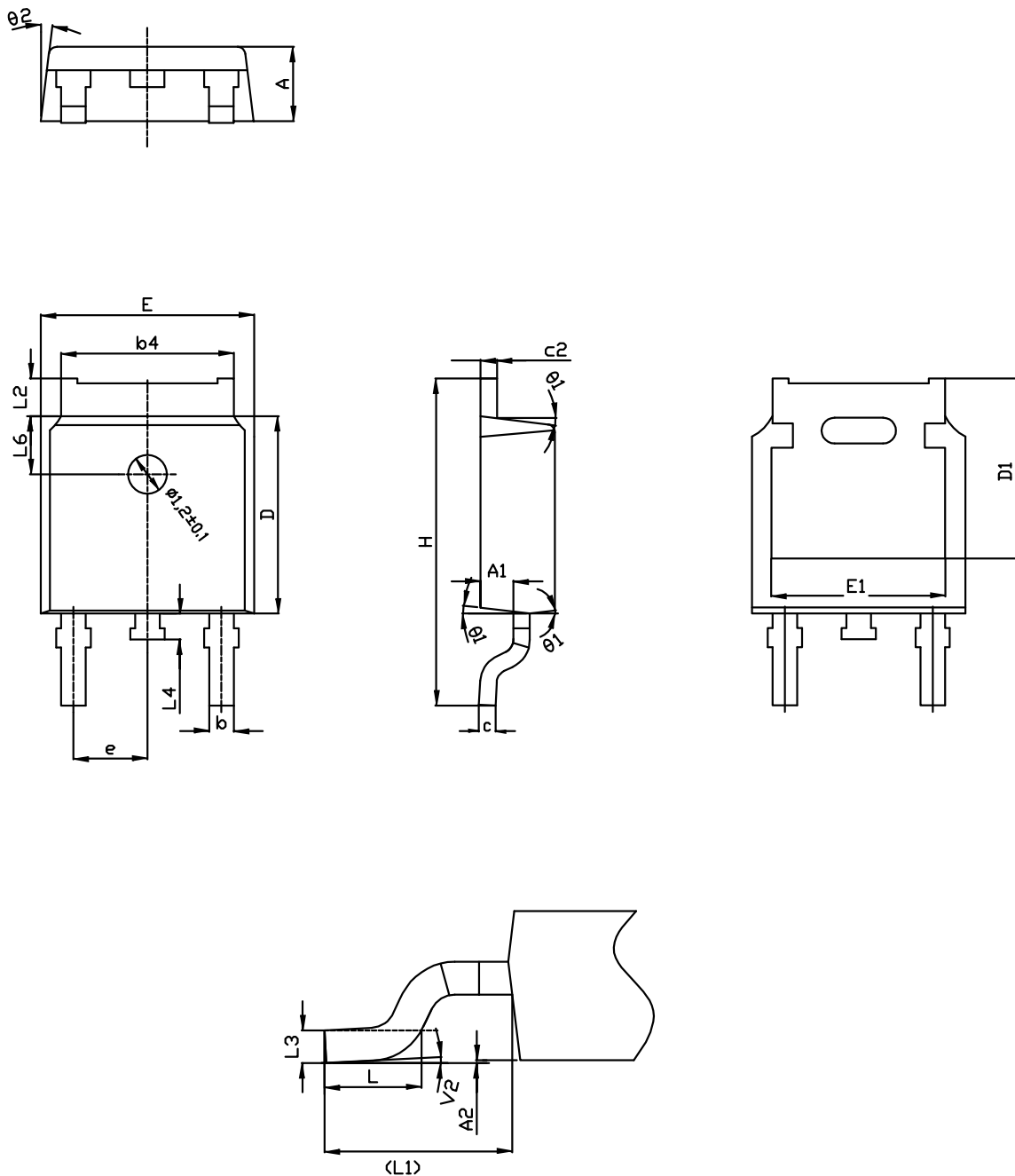
0068772_type-A2_rev25

Table 9. 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°

4.3 DPAK (TO-252) type C2 package information

Figure 25. DPAK (TO-252) type C2 package outline

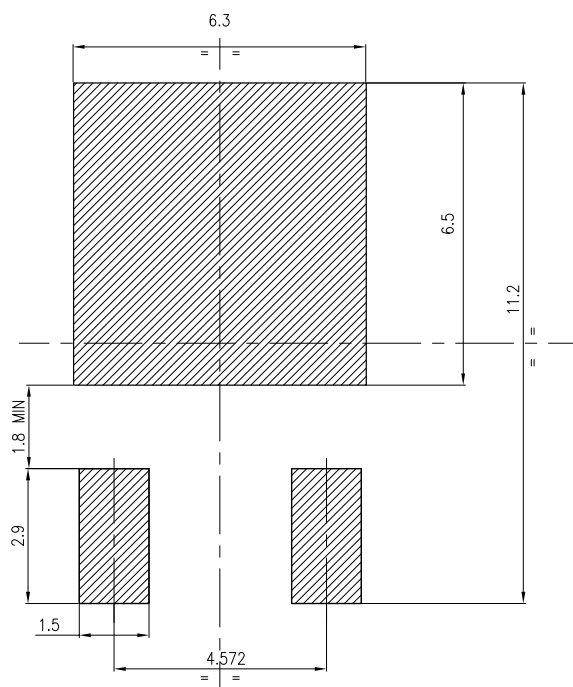


0068772_C2_25

Table 10. 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°

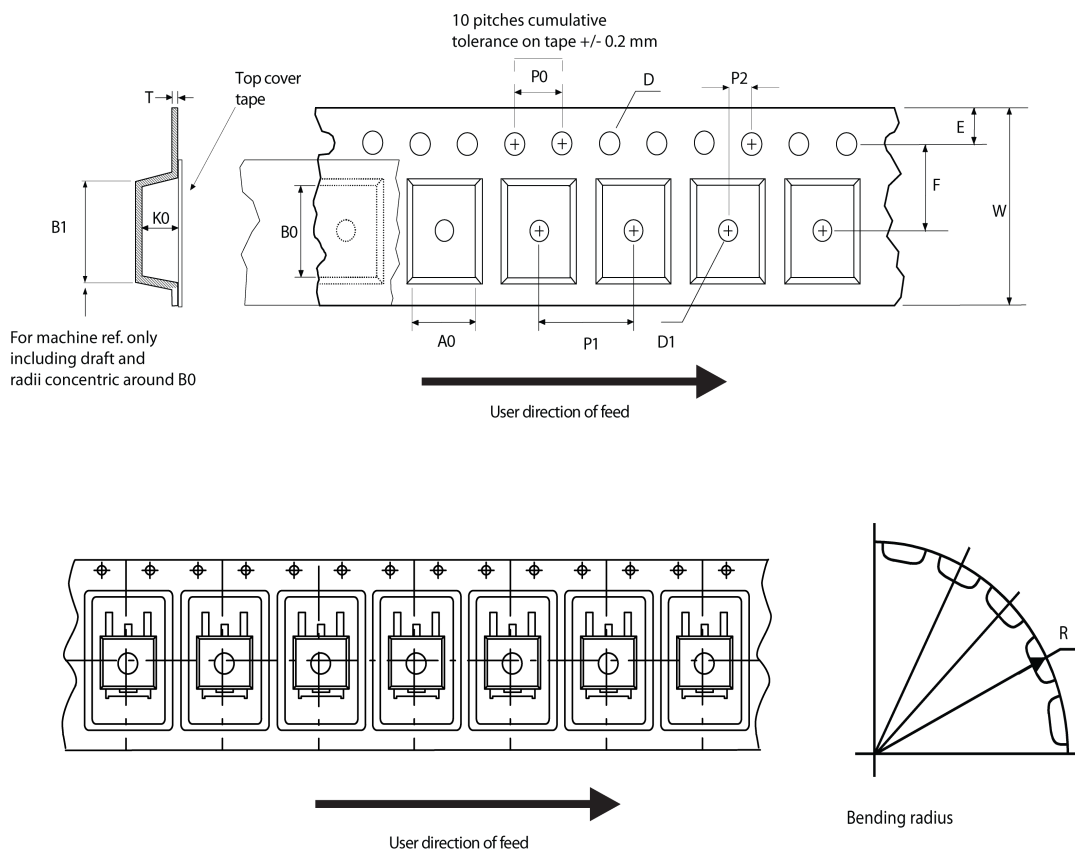
Figure 26. PAK (TO-252) recommended footprint (dimensions are in mm)



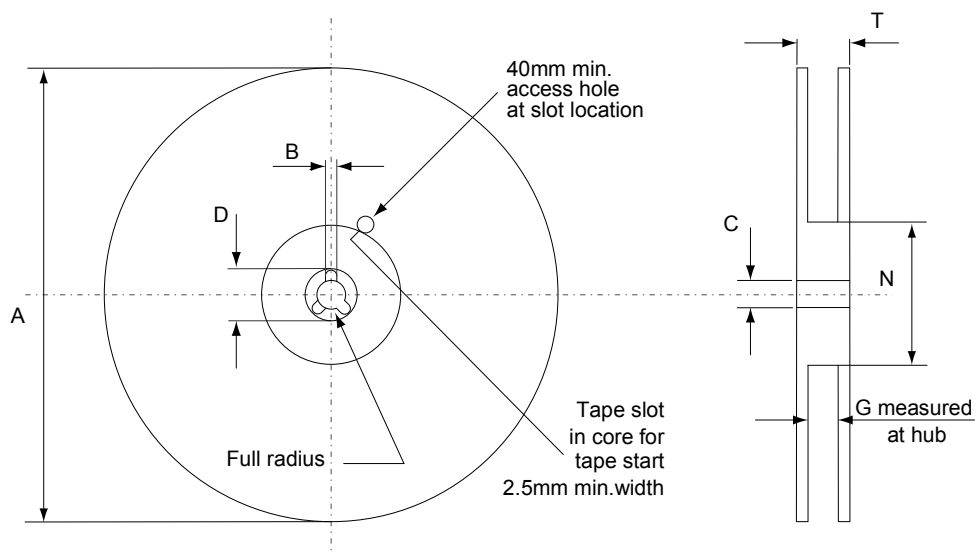
FP_0068772_25

4.4 D²PAK and DPAK packing information

Figure 27. Tape outline



AM08852v1

Figure 28. Reel outline


AM06038v1

Table 11. 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 12. 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 13. Order codes

Order code	Marking	Package	Packing
STB15N65M5	15N65M5	D ² PAK	Tape and reel
STD15N65M5		DPAK	

Revision history

Table 14. Document revision history

Date	Version	Changes
09-Nov-2012	1	First release.
15-May-2018	2	Removed maturity status indication from cover page. The document status is production data. Updated Section 1 Electrical ratings , Section 2 Electrical characteristics and Section 2.1 Electrical characteristics curves . Minor text changes.

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	PAK (TO-252) type A2 package information	12
4.3	PAK (TO-252) type C2 package information	14
4.4	D ² PAK and PAK packing information	17
5	Ordering information	21
	Revision history	22

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2018 STMicroelectronics – All rights reserved