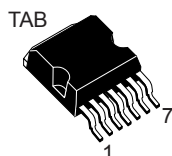
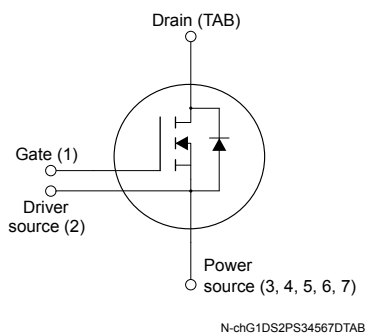


Automotive-grade silicon carbide Power MOSFET, 650 V, 55 mΩ typ., 45 A in an H²PAK-7 package



H²PAK-7



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
SCTH35N65G2V-7AG	650 V	67 mΩ	45 A

- AEC-Q101 qualified 
- Very fast and robust intrinsic body diode
- Extremely low gate charge and input capacitance
- Source sensing pin for increased efficiency

Applications

- Main inverter (electric traction)
- DC/DC converter for EV/HEV
- On board charger (OBC)

Description

This silicon carbide Power MOSFET device has been developed using ST's advanced and innovative 2nd generation SiC MOSFET technology. The device features remarkably low on-resistance per unit area and very good switching performance. The variation of switching loss is almost independent of junction temperature.

Product status link

[SCTH35N65G2V-7AG](#)

Product summary

Order code	SCTH35N65G2V-7AG
Marking	35N65AG
Package	H ² PAK-7
Packing	Tape and reel

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	650	V
V_{GS}	Gate-source voltage	-10 to 22	V
	Gate-source voltage (recommended operating range)	-5 to 18	
I_D	Drain current (continuous) at $T_C = 25\text{ °C}$	45	A
	Drain current (continuous) at $T_C = 100\text{ °C}$	35	
$I_{DM}^{(1)}$	Drain current (pulsed)	90	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ °C}$	208	W
T_{stg}	Storage temperature range	-55 to 175	°C
T_J	Operating junction temperature range		°C

1. Pulse width is limited by safe operating area.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	0.72	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	62.5	°C/W

2 Electrical characteristics

($T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

Table 3. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	650			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$			5	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = -10\text{ to }22\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 1\text{ mA}$	1.8	3.2	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 20\text{ V}$, $I_D = 20\text{ A}$		45	67	m Ω
		$V_{GS} = 18\text{ V}$, $I_D = 20\text{ A}$		55		
		$V_{GS} = 20\text{ V}$, $I_D = 20\text{ A}$, $T_J = 175\text{ }^{\circ}\text{C}$		65		

Table 4. Dynamic, based on HiP247 package option

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 400\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	1370	-	pF
C_{oss}	Output capacitance		-	125	-	pF
C_{rss}	Reverse transfer capacitance		-	30	-	pF
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $V_{GS} = 0\text{ to }20\text{ V}$, $I_D = 20\text{ A}$	-	73	-	nC
Q_{gs}	Gate-source charge		-	14	-	nC
Q_{gd}	Gate-drain charge		-	27	-	nC
R_g	Gate input resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	2	-	Ω

Table 5. Switching energy (inductive load), based on HiP247 package option

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on}	Turn-on switching energy	$V_{DD} = 400\text{ V}$, $I_D = 20\text{ A}$	-	100	-	μJ
E_{off}	Turn-off switching energy	$R_G = 10\text{ }\Omega$, $V_{GS} = -5\text{ to }20\text{ V}$	-	35	-	μJ

Table 6. Switching times, based on HiP247 package option

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$, $I_D = 20\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = -5\text{ to }20\text{ V}$	-	16	-	ns
t_f	Fall time		-	14	-	
$t_{d(off)}$	Turn-off delay time		-	35	-	
t_r	Rise time		-	9	-	

Table 7. Reverse SiC diode characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode forward voltage	$I_F = 20\text{ A}$, $V_{GS} = 0\text{ V}$	-	3.3	-	V
t_{rr}	Reverse recovery time	$V_{DD} = 400\text{ V}$, $I_F = 20\text{ A}$, $di/dt = 1000\text{ A}/\mu\text{s}$	-	18	-	ns
Q_{rr}	Reverse recovery charge		-	85	-	nC
I_{RRM}	Reverse recovery current		-	7	-	A

2.1 Electrical characteristics (curves), based on HiP247 package option

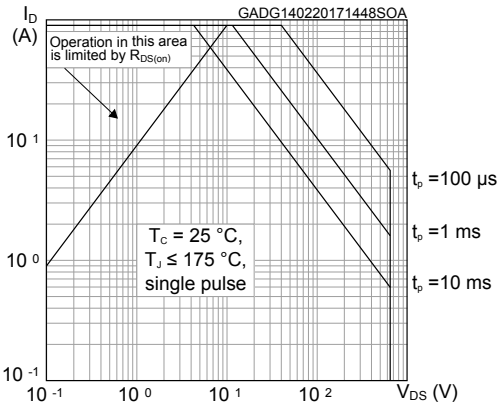
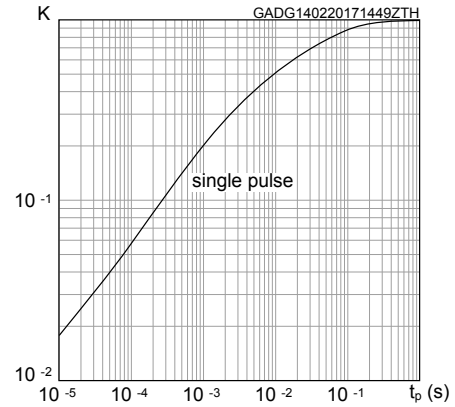
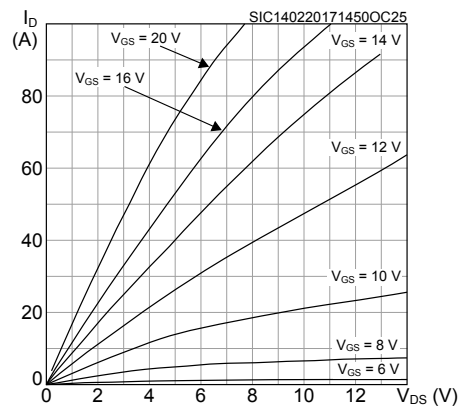
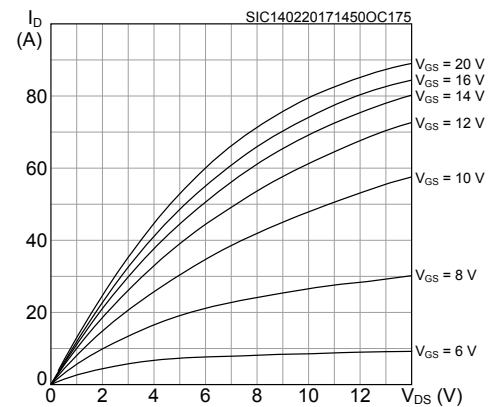
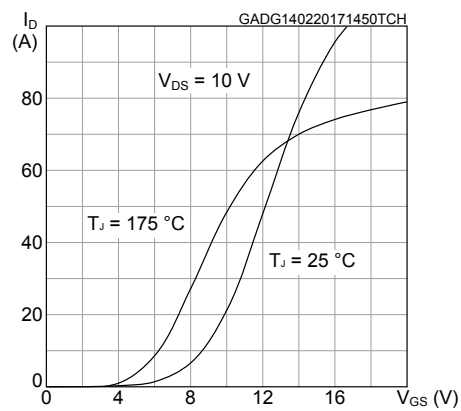
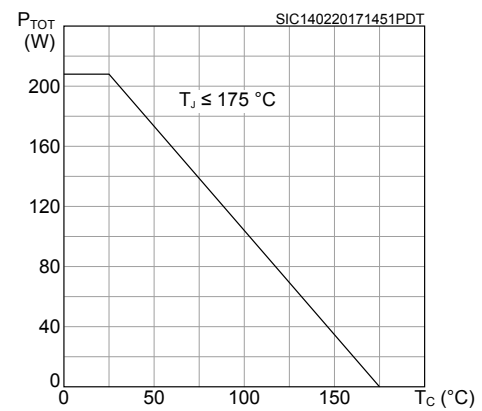
Figure 1. Safe operating area

Figure 2. Thermal impedance

Figure 3. Output characteristics (Tj = 25 °C)

Figure 4. Output characteristics (Tj = 175 °C)

Figure 5. Transfer characteristics

Figure 6. Total power dissipation


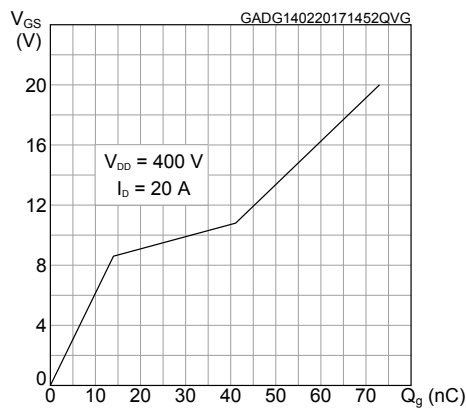
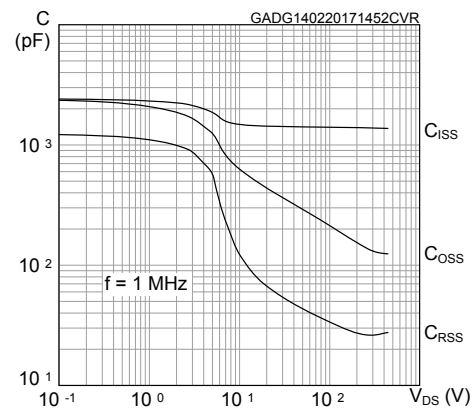
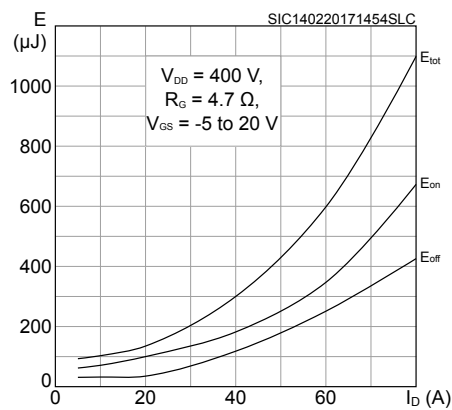
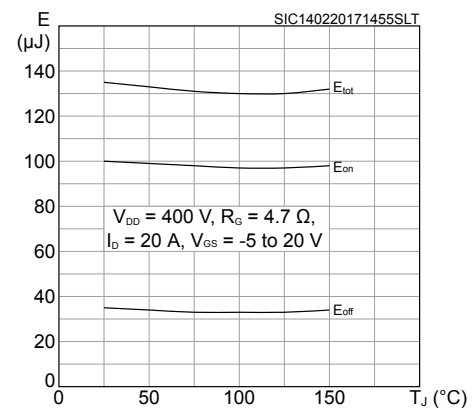
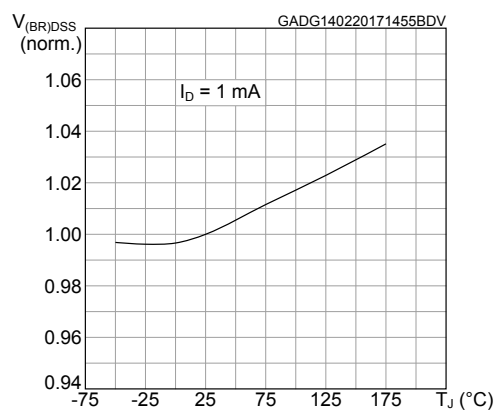
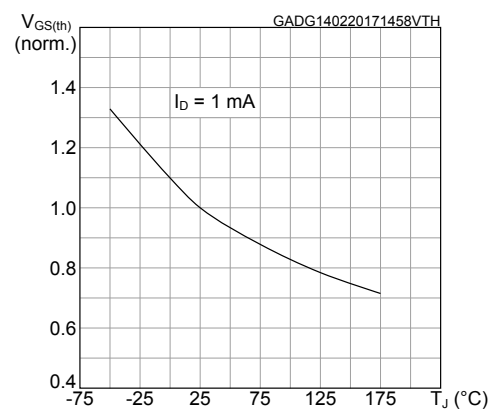
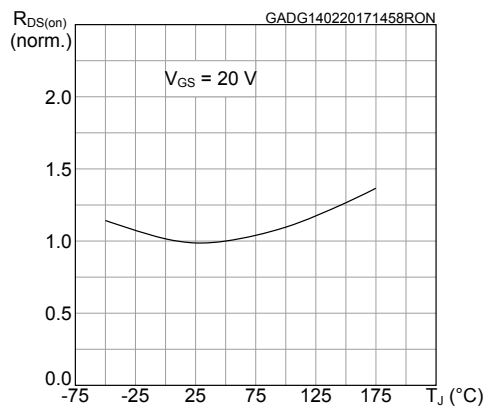
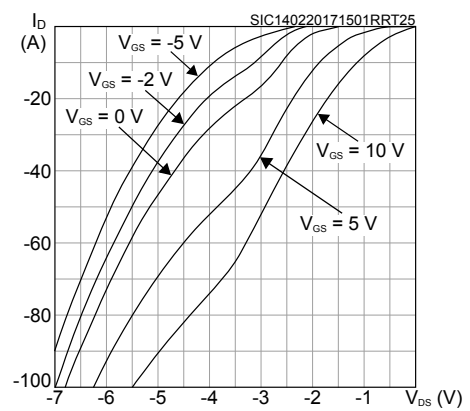
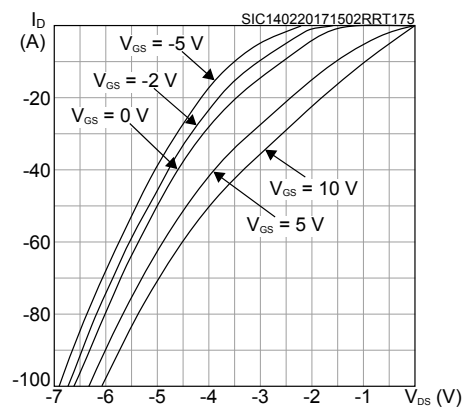
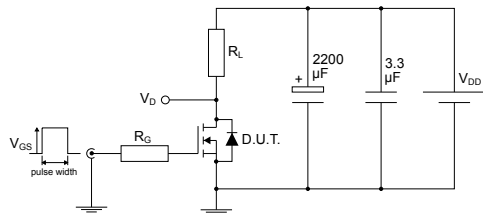
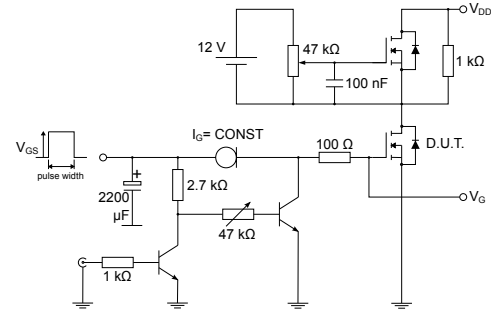
Figure 7. Gate charge vs gate-source voltage

Figure 8. Capacitance variations

Figure 9. Switching energy vs. drain current

Figure 10. Switching energy vs. junction temperature

Figure 11. Normalized $V_{(BR)DSS}$ vs. temperature

Figure 12. Normalized gate threshold voltage vs. temperature


Figure 13. Normalized on-resistance vs. temperature

Figure 14. Reverse conduction characteristics ($T_J = 25$ °C)

Figure 15. Reverse conduction characteristics ($T_J = 175$ °C)


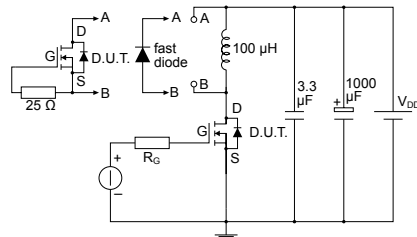
3 Test circuits

Figure 16. Test circuit for resistive load switching times


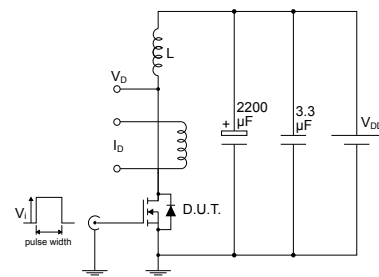
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Figure 17. Test circuit for gate charge behavior


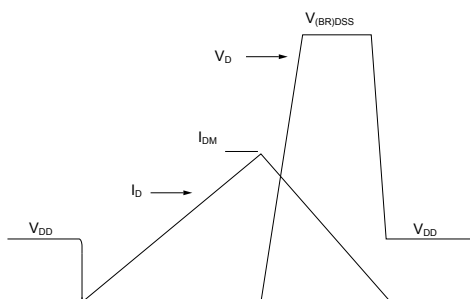
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Figure 18. Test circuit for inductive load switching and diode recovery times


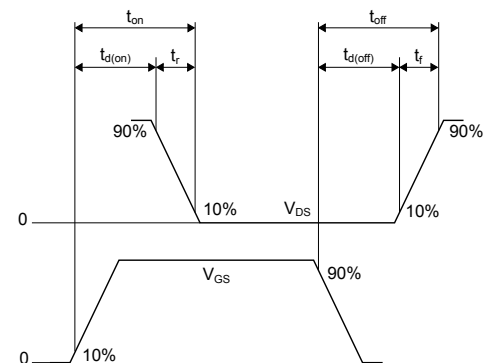
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Figure 19. Unclamped inductive load test circuit


AM01471v1

Figure 20. Unclamped inductive waveform


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Figure 21. Switching time waveform


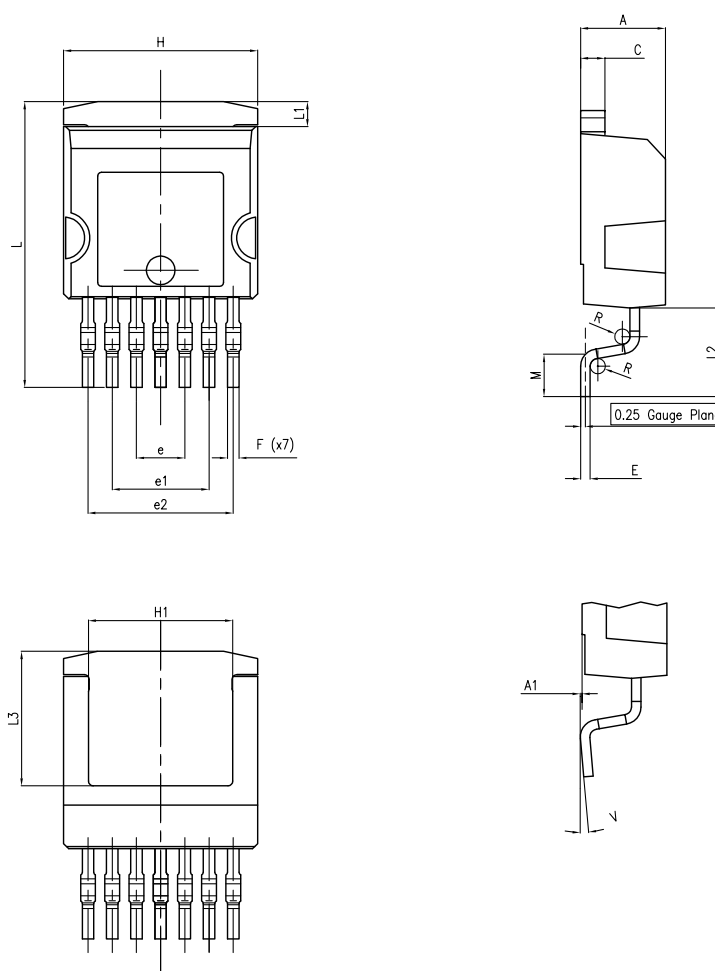
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4 Package information

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 H²PAK-7 package information

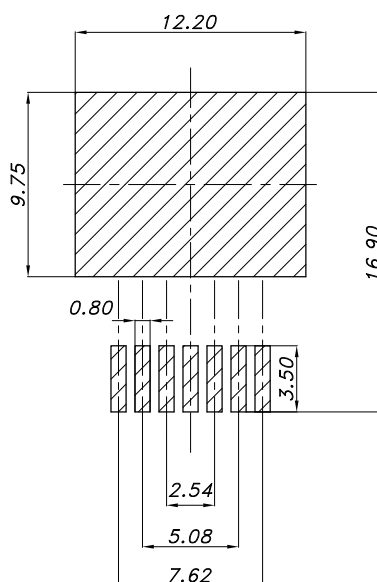
Figure 22. H²PAK-7 package outline



DM00249216_4

Table 8. H²PAK-7 package mechanical data

Dim.	mm	
	Min.	Max.
A	4.30	4.80
A1	0.03	0.20
C	1.17	1.37
e	2.34	2.74
e1	4.88	5.28
e2	7.42	7.82
E	0.45	0.60
F	0.50	0.70
H	10.00	10.40
H1	7.40	7.60
L	14.75	15.25
L1	1.27	1.40
L2	4.35	4.95
L3	6.85	7.25
M	1.90	2.50
R	0.20	0.60
V	0°	8°

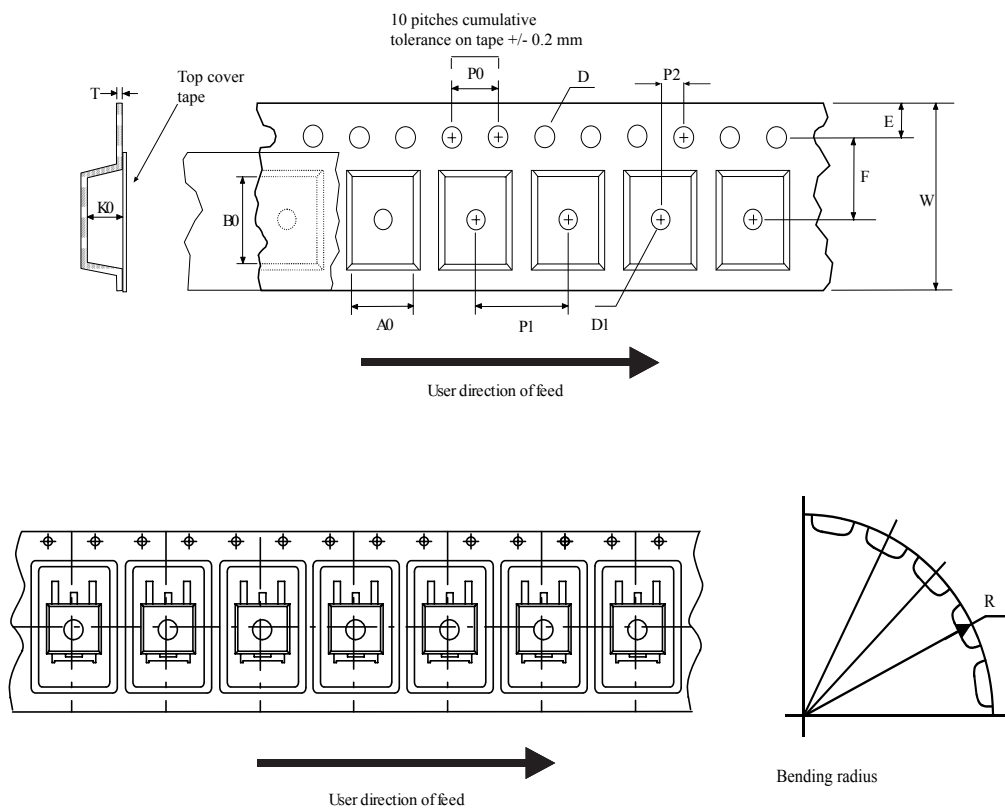
Figure 23. H²PAK-7 recommended footprint


footprint_DM00249216_4

Note: Dimensions are in mm.

4.2

Figure 24. Tape outline



AM08852v2

Figure 25. Reel outline

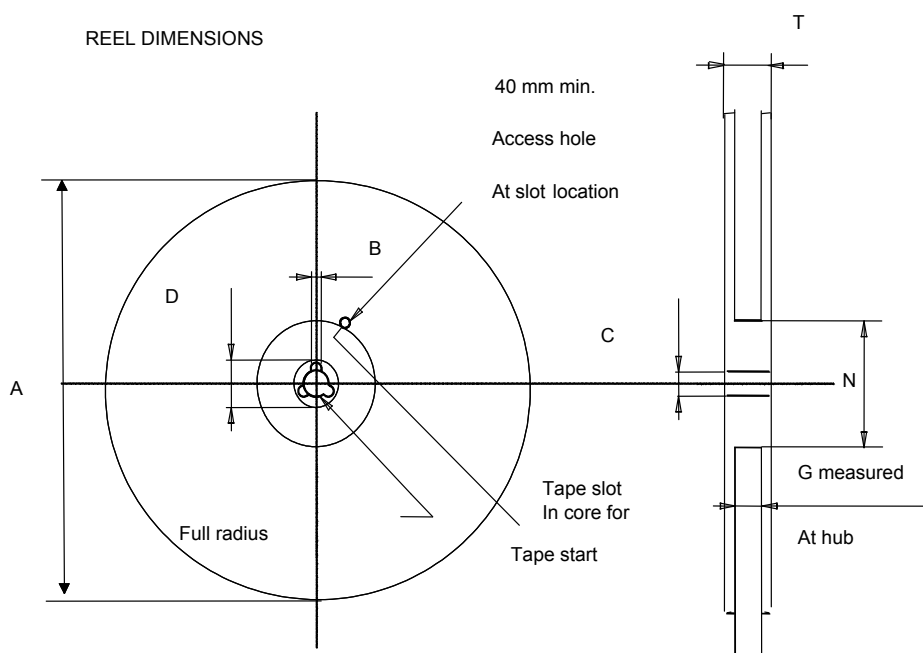


Table 9. Tape and reel mechanical data

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
17-Feb-2017	1	First release.
13-Dec-2017	2	Updated document title. Updated <i>Table 4: "On/off states"</i> . Minor text changes.
13-Dec-2018	3	Datasheet promoted from preliminary data to production data. Modified title and features on cover page. Minor text changes.
24-Jan-2020	4	Updated Table 1. Absolute maximum ratings . Minor text changes.
11-Jan-2021	5	Updated Table 7. Reverse SiC diode characteristics . Minor text changes.

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