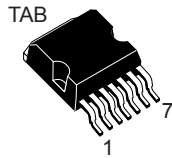
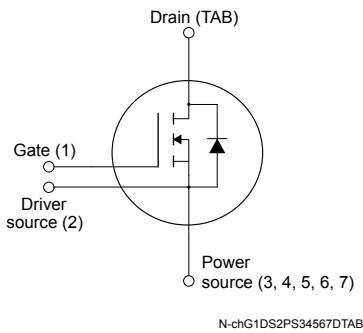



Automotive-grade silicon carbide Power MOSFET 650 V, 40 mΩ typ., 30 A in an H²PAK-7 package


H²PAK-7


Features

Order code	V _{DS}	R _{DS(on)} typ.	I _D
SCT040H65G3AG	650 V	40 mΩ	30 A

- AEC-Q101 qualified 
- Very low R_{DS(on)} over the entire temperature range
- High speed switching performances
- Very fast and robust intrinsic body diode
- 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 3rd generation SiC MOSFET technology. The device features a very low R_{DS(on)} over the entire temperature range combined with low capacitances and very high switching operations, which improve application performance in frequency, energy efficiency, system size and weight reduction.

Product status link

[SCT040H65G3AG](#)

Product summary

Order code	SCT040H65G3AG
Marking	40H65G3AG
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 values)	-5 to 18	
	Gate-source transient voltage, $t_p < 1 \mu s$, $t \leq 10$ hours over lifetime	-11 to 25	
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25 \text{ }^\circ\text{C}$	30	A
	Drain current (continuous) at $T_C = 100 \text{ }^\circ\text{C}$	30	
$I_{DM}^{(2)}$	Drain current (pulsed)	160	A
P_{TOT}	Total power dissipation at $T_C = 25 \text{ }^\circ\text{C}$	221	W
T_{stg}	Storage temperature range	-55 to 175	$^\circ\text{C}$
T_J	Operating junction temperature range		$^\circ\text{C}$

- I_D is limited by package.
- Pulse width is limited by safe operating area.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	0.68	$^\circ\text{C/W}$
R_{thJA}	Thermal resistance, junction-to-ambient	50	$^\circ\text{C/W}$

2 Electrical characteristics

$T_C = 25\text{ °C}$ 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	$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$			10	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	3.0	4.2	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 15\text{ V}$, $I_D = 20\text{ A}$		50		m Ω
		$V_{GS} = 18\text{ V}$, $I_D = 20\text{ A}$		40	63	
		$V_{GS} = 18\text{ V}$, $I_D = 20\text{ A}$, $T_J = 175\text{ °C}$		50		

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 400\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	920	-	pF
C_{oss}	Output capacitance		-	94	-	pF
C_{riss}	Reverse transfer capacitance		-	13	-	pF
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $V_{GS} = -5\text{ to }18\text{ V}$, $I_D = 20\text{ A}$	-	39.5	-	nC
Q_{gs}	Gate-source charge		-	11.5	-	nC
Q_{gd}	Gate-drain charge		-	14.5	-	nC
R_g	Gate input resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	1.4	-	Ω

Table 5. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on}	Turn-on switching energy	$V_{DD} = 400\text{ V}$, $I_D = 20\text{ A}$, $R_G = 15\text{ }\Omega$,	-	79	-	μJ
E_{off}	Turn-off switching energy	$V_{GS} = -5\text{ V to }18\text{ V}$	-	67	-	μJ

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$, $I_D = 20\text{ A}$, $R_G = 15\text{ }\Omega$, $V_{GS} = -5\text{ to }18\text{ V}$	-	10	-	ns
t_r	Rise time		-	17	-	ns
$t_{d(off)}$	Turn-off delay time		-	26	-	ns
t_f	Fall time		-	8	-	ns

Table 7. Reverse SiC diode characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Continuous diode forward current	$T_C = 25\text{ °C}$	-		30	A
		$T_C = 100\text{ °C}$	-		30	
V_{SD}	Diode forward voltage	$I_{SD} = 20\text{ A}, V_{GS} = 0\text{ V}$	-	2.8		V
t_{rr}	Reverse recovery time	$I_{SD} = 20\text{ A}, di/dt = 1000\text{ A}/\mu\text{s},$ $V_{DD} = 400\text{ V}$	-	18		ns
Q_{rr}	Reverse recovery charge		-	97		nC
I_{RRM}	Reverse recovery current		-	9		A

1. I_{SD} is limited by package.

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

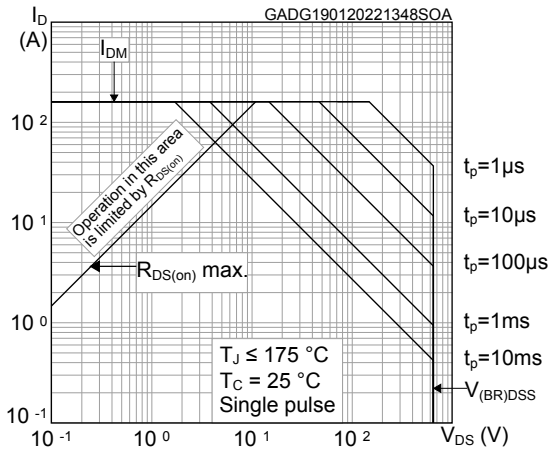


Figure 2. Maximum transient thermal impedance

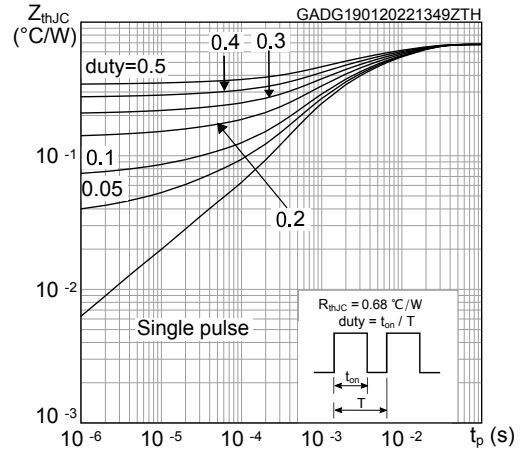


Figure 3. Typical output characteristics ($T_J = 25\text{ °C}$)

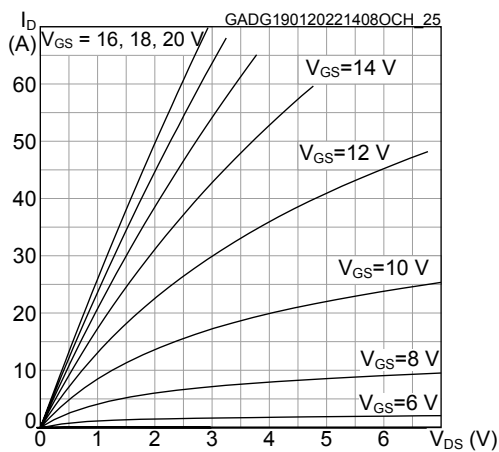


Figure 4. Typical output characteristics ($T_J = 175\text{ °C}$)

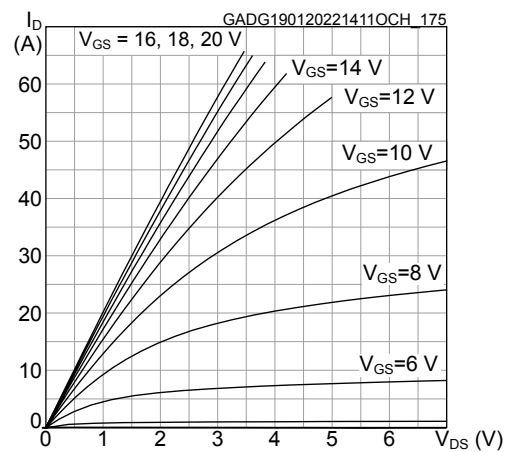


Figure 5. Typical transfer characteristics

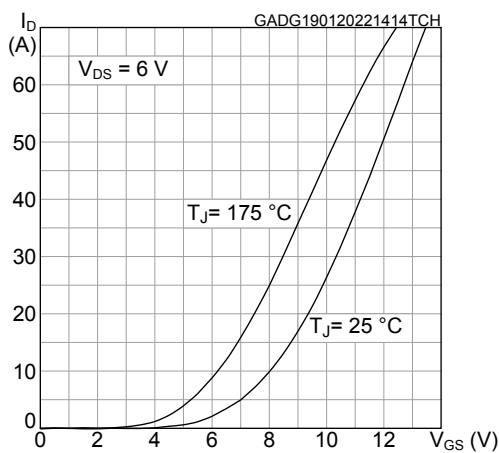


Figure 6. Total power dissipation

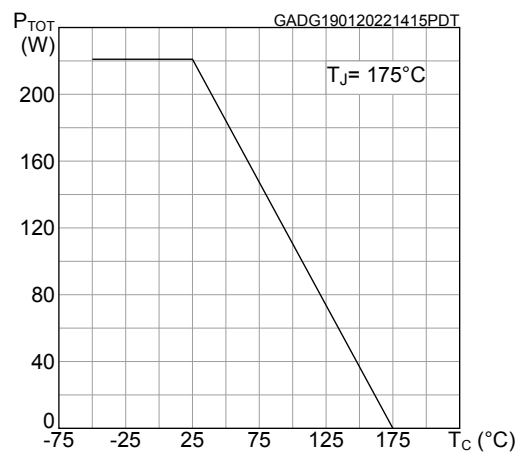


Figure 7. Typical gate charge characteristics

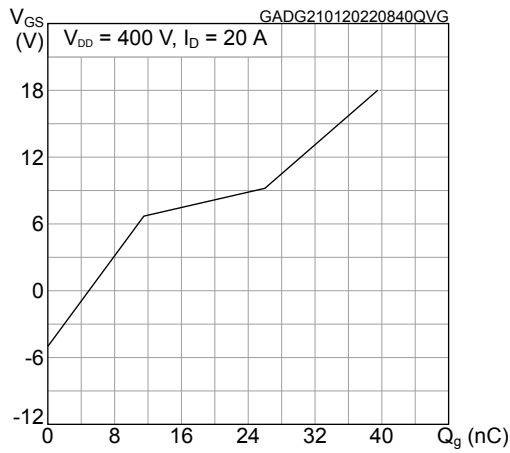


Figure 8. Typical capacitance characteristics

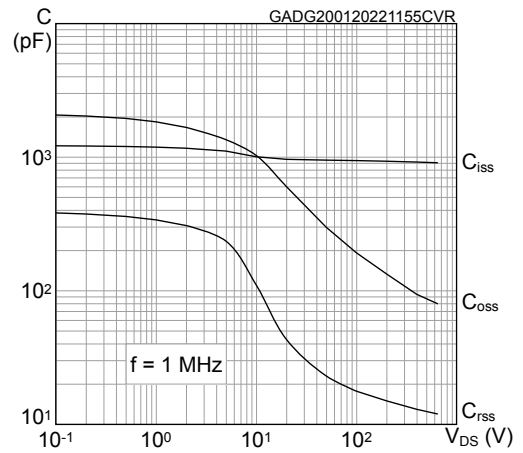


Figure 9. Typical switching energy vs drain current

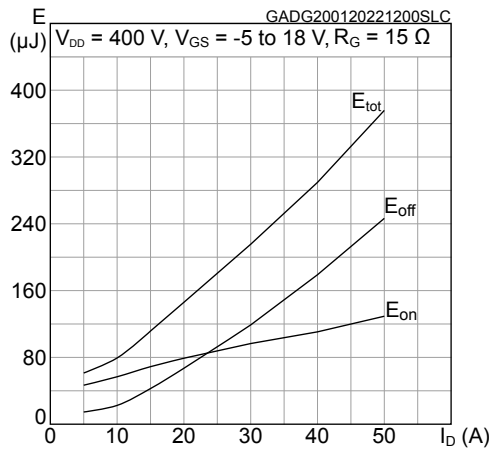


Figure 10. Typical switching energy vs gate resistance

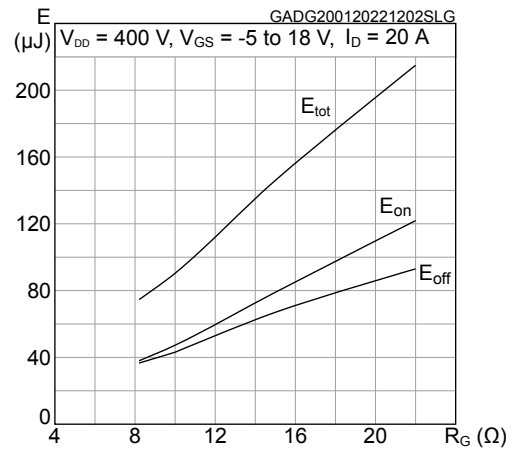


Figure 11. Normalized breakdown voltage vs temperature

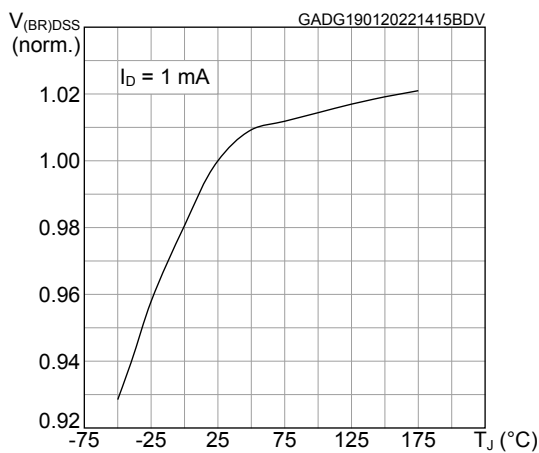


Figure 12. Normalized gate threshold vs temperature

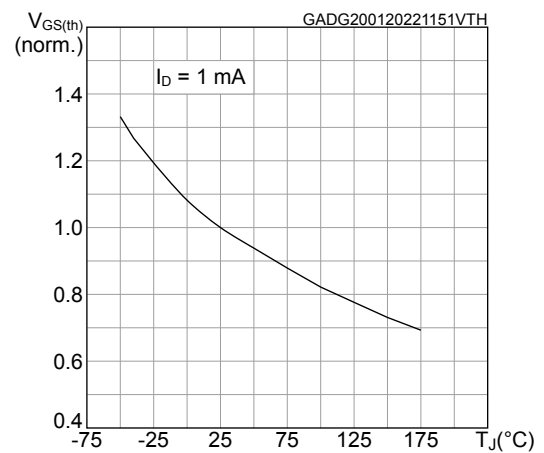


Figure 13. Normalized on-resistance vs temperature

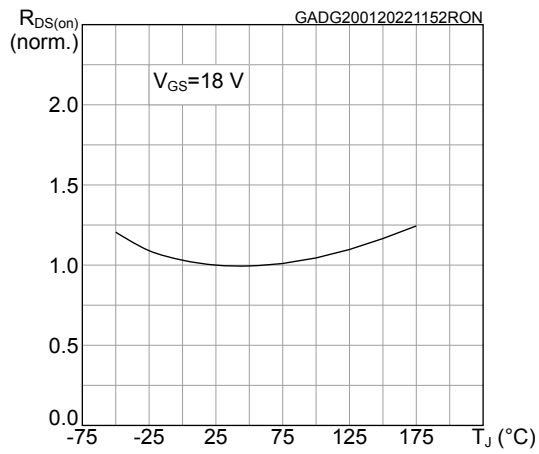


Figure 14. Typical reverse conduction characteristics ($T_J = 25$ °C)

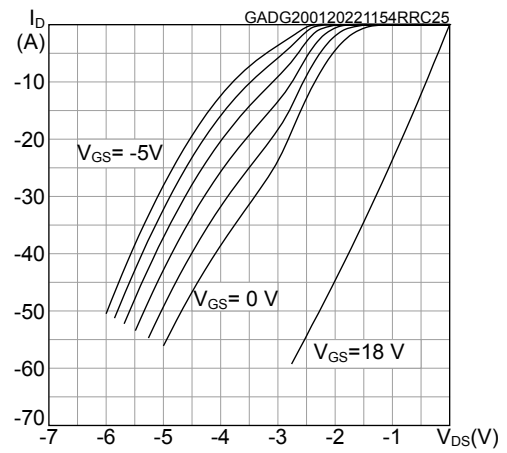
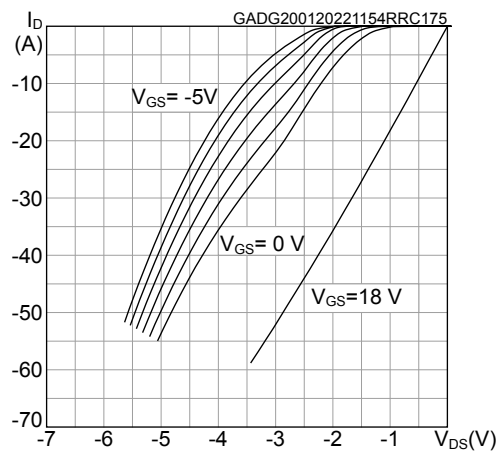


Figure 15. Typical reverse conduction characteristics ($T_J = 175$ °C)

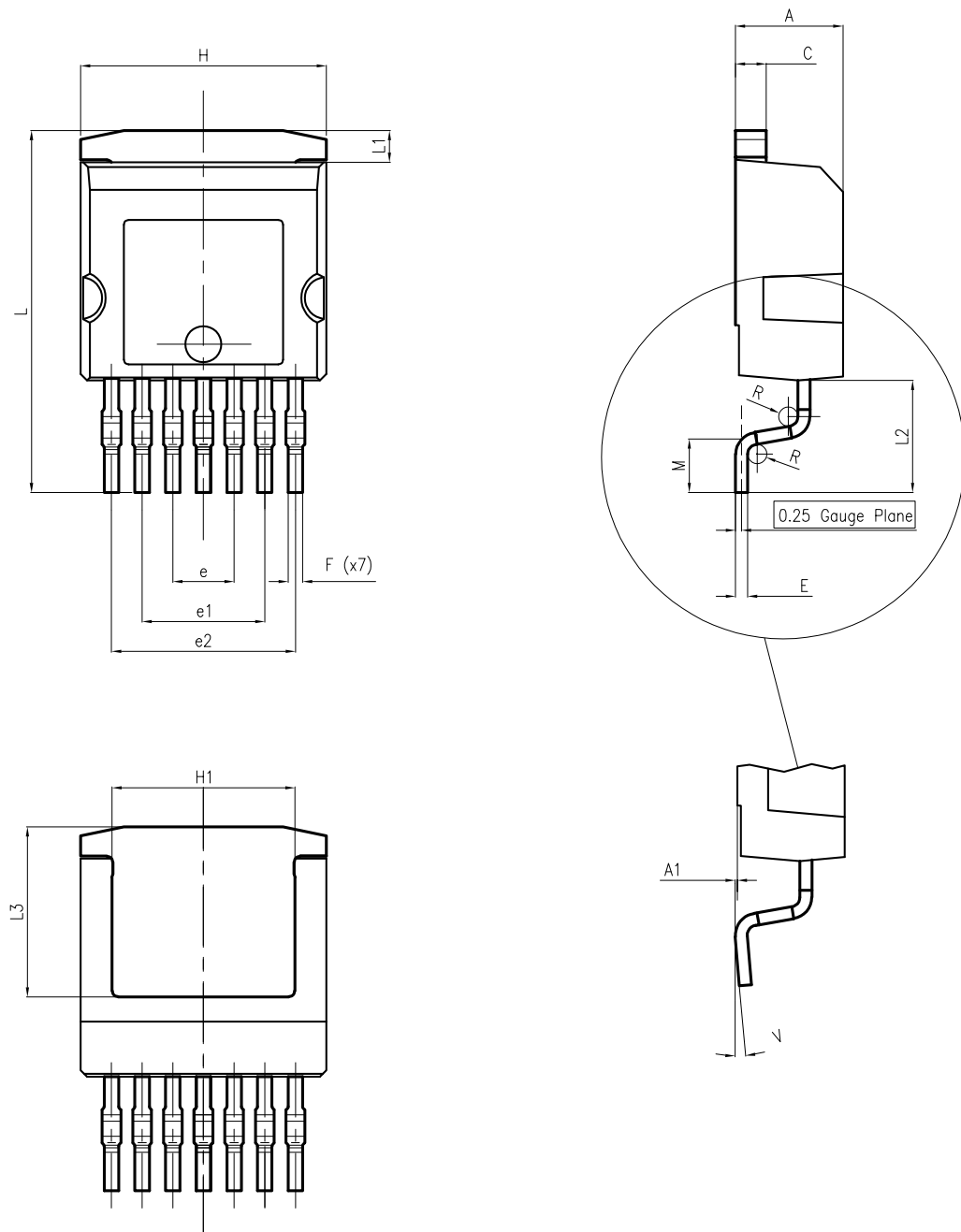


3 Package information

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.

3.1 H²PAK-7 package information

Figure 16. H²PAK-7 package outline

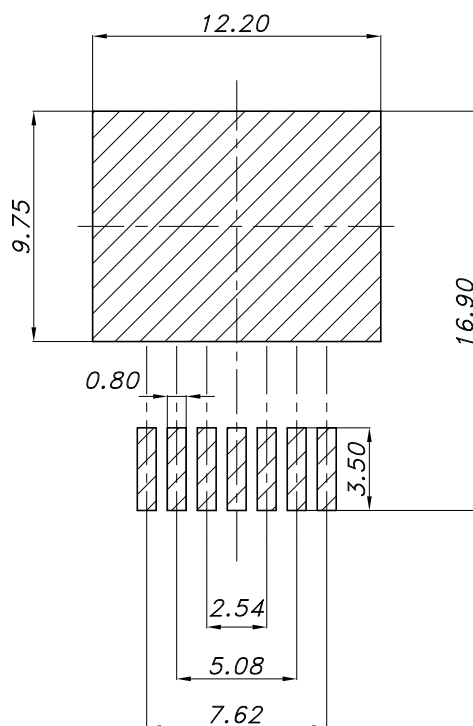


DM00249216_6

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	8.00
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 17. H²PAK-7 recommended footprint

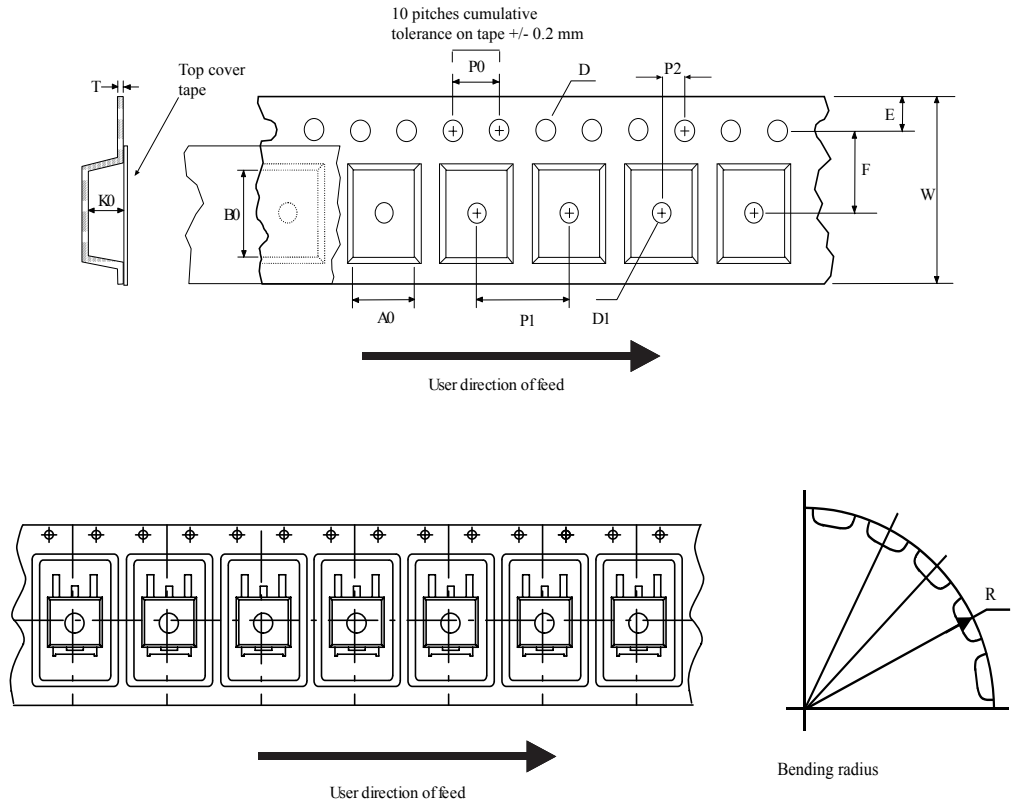


footprint_DM00249216_6

Note: Dimensions are in mm.

3.2 Packing information

Figure 18. Tape outline



AM08852v2

Figure 19. Reel outline

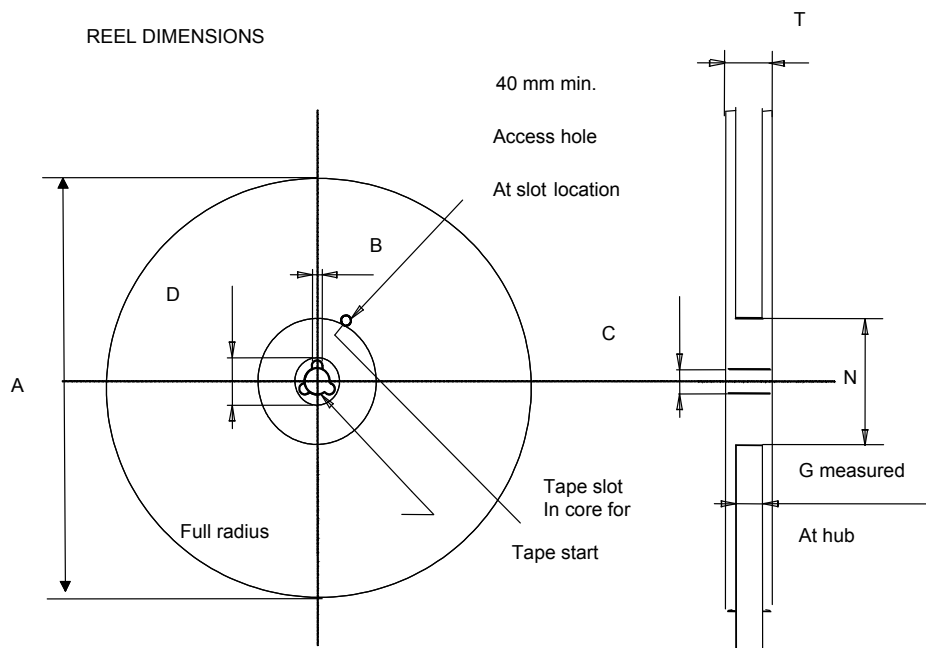


Table 9. Tape and reel mechanical data

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	Revision	Changes
03-Dec-2021	1	First release.
21-Jan-2022	2	Modified <i>Section 1 Electrical ratings, Table 4. Dynamic, Table 5. Switching energy (inductive load), Table 6. Switching times and Table 7. Reverse SiC diode characteristics.</i> Added <i>Section 2.1 Electrical characteristics (curves).</i> Minor text changes.
04-Dec-2023	3	Updated Table 3. On/off states.

Contents

1	Electrical ratings	2
2	Electrical characteristics	3
2.1	Electrical characteristics (curves)	5
3	Package information	8
3.1	H ² PAK-7 package information	8
3.2	Packing information	10
	Revision history	12

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