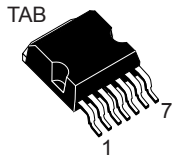
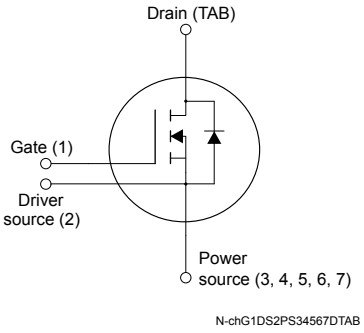
SCTH35N65G2V-7AG

Datasheet

Automotive-grade silicon carbide Power MOSFET, 650 V, 45 A, 55 mΩ (typ., T_J = 25 °C) in an H^2PAK-7 package



H²PAK-7



Features

Order code	V_{DS}	$R_{DS(on)}$ typ.	I_D
SCTH35N65G2V-7AG	650 V	55 mΩ	45 A

- AEC-Q101 qualified
- Very fast and robust intrinsic body diode
- Low capacitance

Applications

- Switching mode power supply
- EV chargers
- DC-DC converters

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	H²PAK-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 °C	45	A
	Drain current (continuous) at T_C = 100 °C	35	
I_{DM}(1)	Drain current (pulsed)	90	A
P_{TOT}	Total power dissipation at T_C = 25 °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
$R_{thj\text{-}case}$	Thermal resistance junction-case	0.72	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	62.5	°C/W

2 Electrical characteristics

(T_C = 25 °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 V, I_D = 1 mA	650			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 650 V			50	µA
		V_{GS} = 0 V, V_{DS} = 650 V, T_J = 175 °C(1)			100	
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = -10 to 22 V			±250	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 1 mA	1.8	3.2		V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 20 V, I_D = 20 A		45	67	mΩ
		V_{GS} = 18 V, I_D = 20 A		55		
		V_{GS} = 20 V, I_D = 20 A, T_J = 175 °C		65		

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

Table 4. Dynamic

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

Table 5. Switching energy (inductive load)

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

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 400 V, I_D = 20 A, R_G = 4.7 Ω, V_{GS} = -5 to 20 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 A, V_{GS} = 0 V	-	4.5	-	V
t_{rr}	Reverse recovery time	V_{DD} = 400 V, I_F = 20 A, di/dt = 1000 A/µs	-	18	-	ns
Q_{rr}	Reverse recovery charge		-	85	-	nC
I_{RRM}	Reverse recovery current		-	7	-	A

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

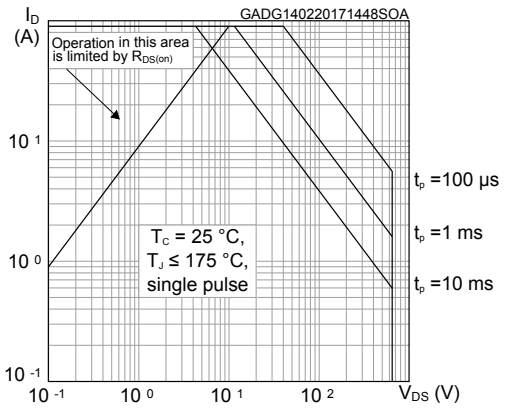


Figure 2. Thermal impedance

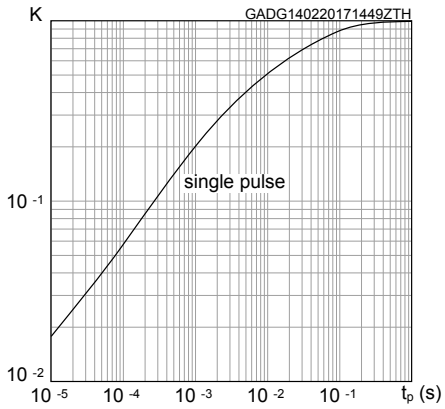


Figure 3. Output characteristics (T_J= 25 °C)

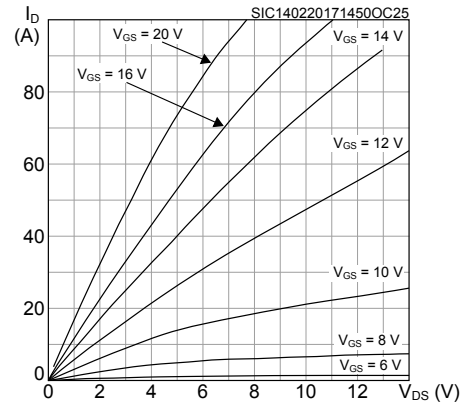


Figure 4. Output characteristics (T_J= 175 °C)

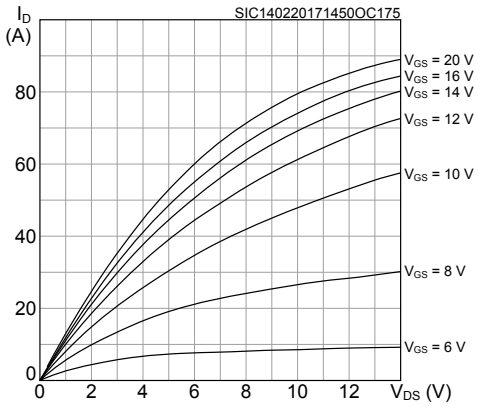


Figure 5. Transfer characteristics

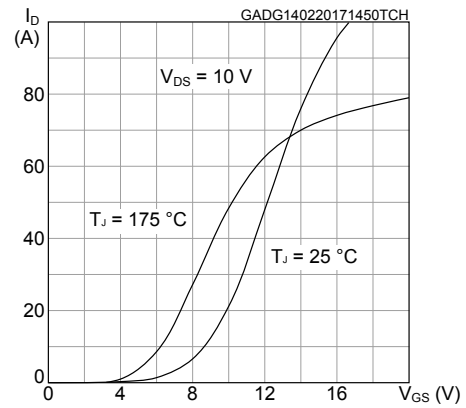


Figure 6. Total power dissipation

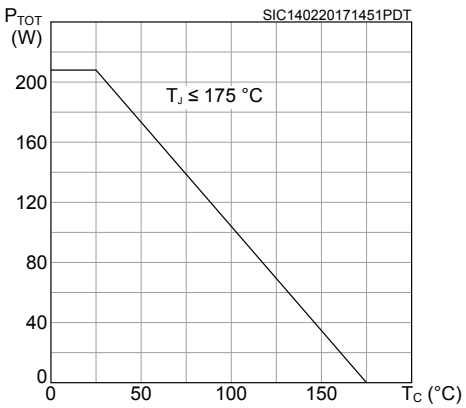


Figure 7. Gate charge vs gate-source voltage

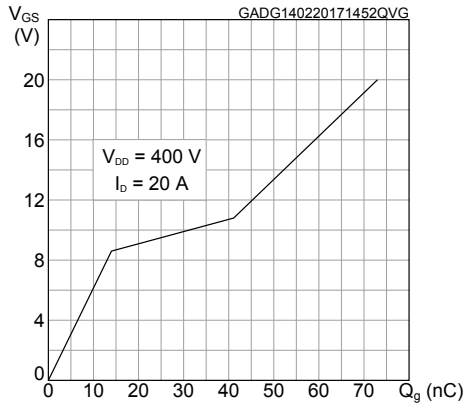


Figure 8. Capacitance variations

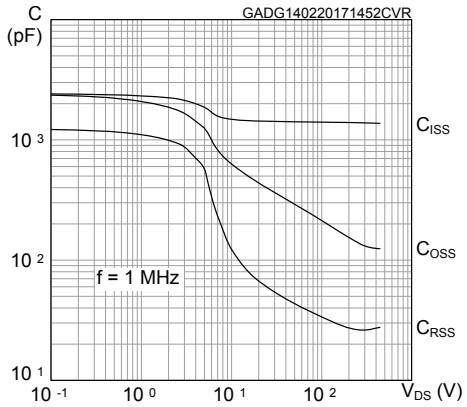


Figure 9. Switching energy vs. drain current

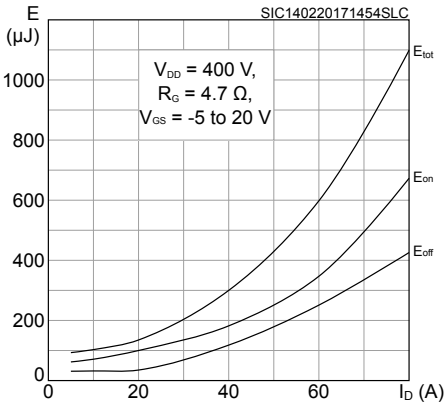


Figure 10. Switching energy vs. junction temperature

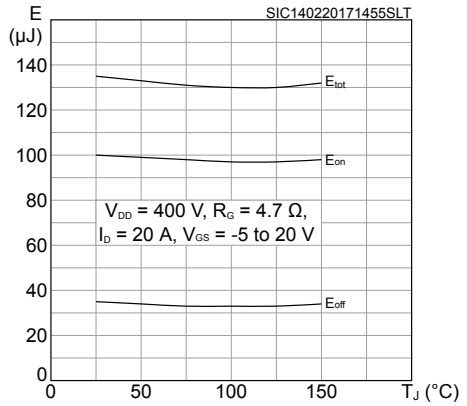


Figure 11. Normalized $V_{(BR)DSS}$ vs. temperature

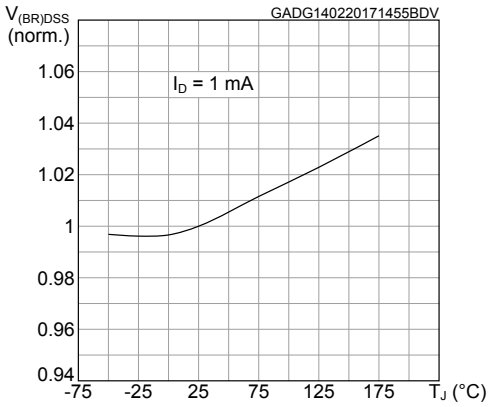


Figure 12. Normalized gate threshold voltage vs. temperature

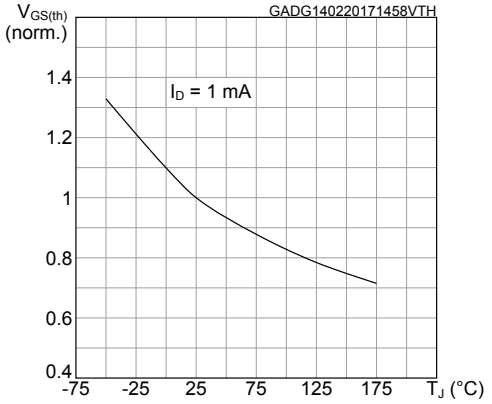


Figure 13. Normalized on-resistance vs. temperature

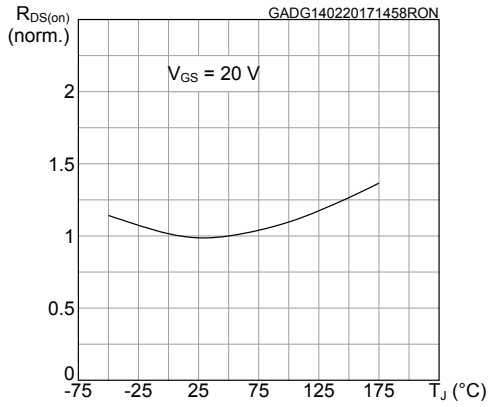


Figure 14. Reverse conduction characteristics (T_J= 25 °C)

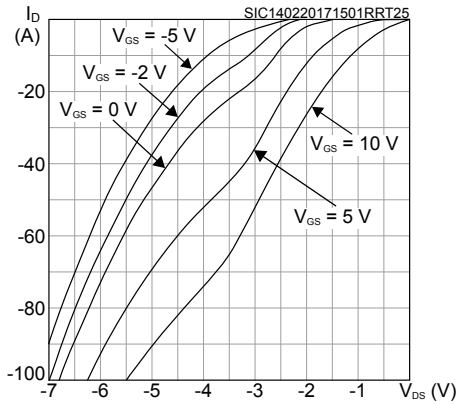
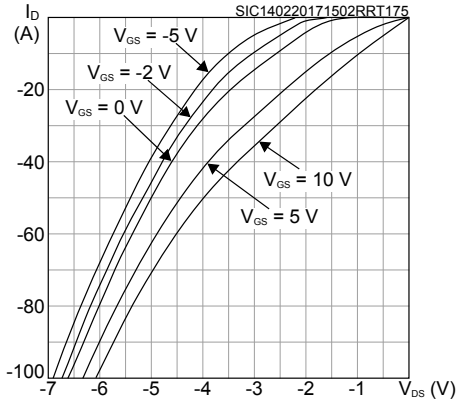


Figure 15. Reverse conduction characteristics (T_J= 175 °C)



3 Test circuits

Figure 16. Test circuit for resistive load switching times

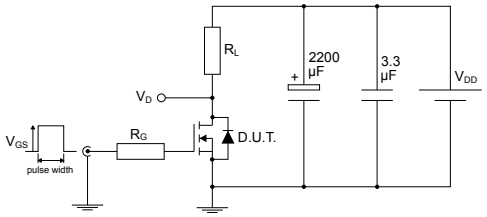


Figure 17. Test circuit for gate charge behavior

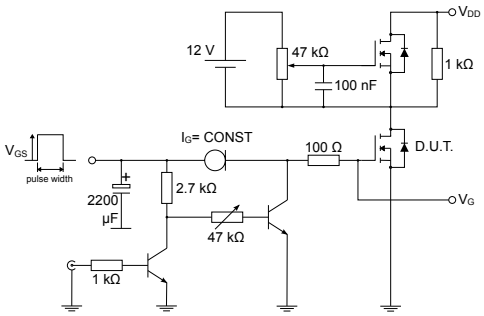


Figure 18. Test circuit for inductive load switching and diode recovery times

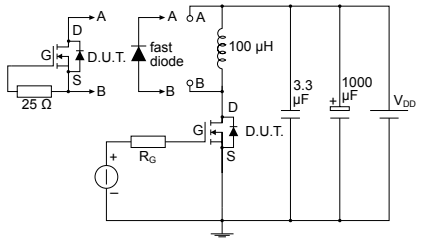


Figure 19. Unclamped inductive load test circuit

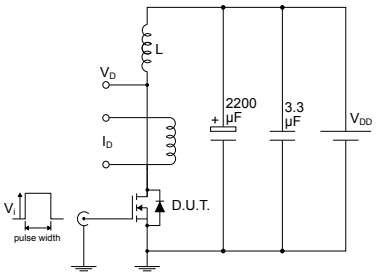


Figure 20. Unclamped inductive waveform

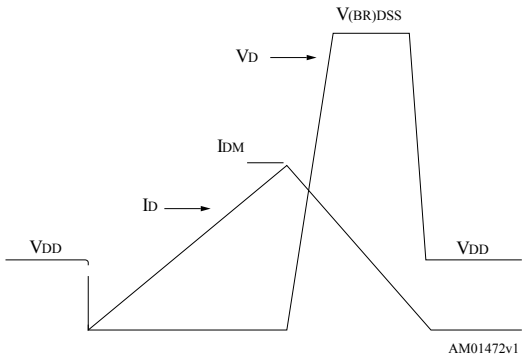
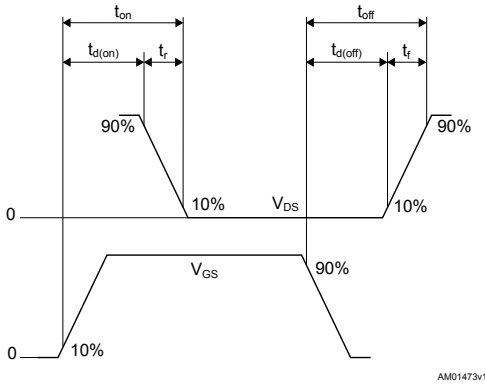


Figure 21. Switching time waveform



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 H²PAK-7 package information

Figure 22. H²PAK-7 package outline

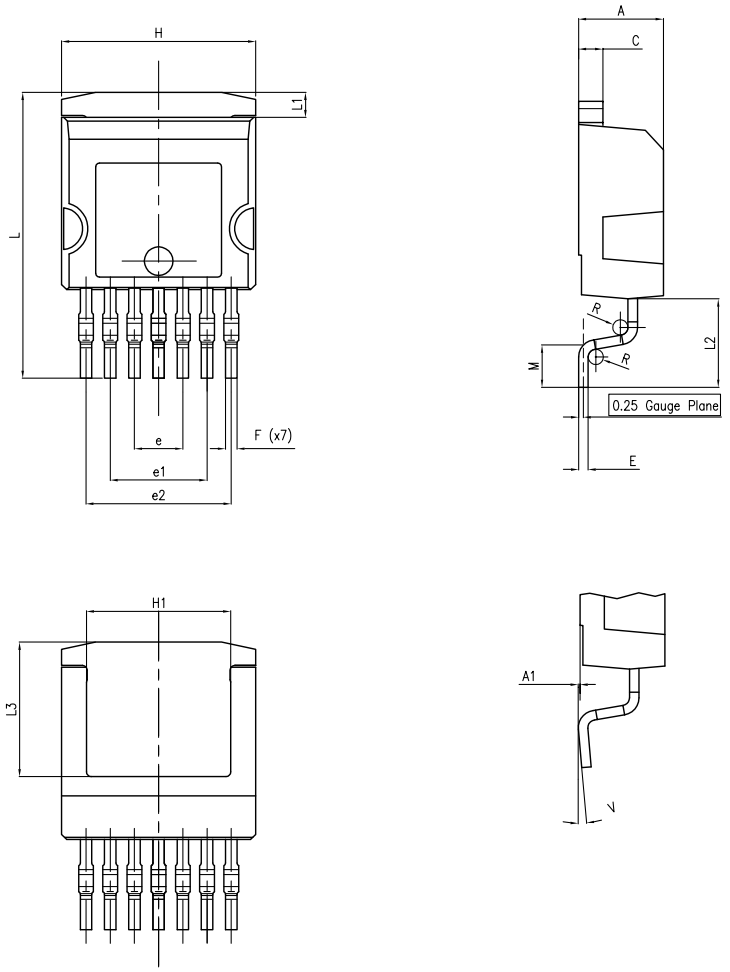
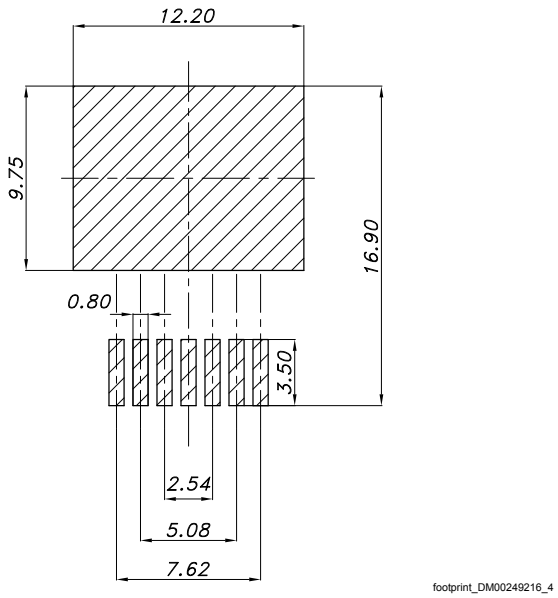


Table 8. **H²PAK-7 package mechanical data**

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**



Note: Dimensions are in mm.

4.2 Packing information

Figure 24. **Tape outline**

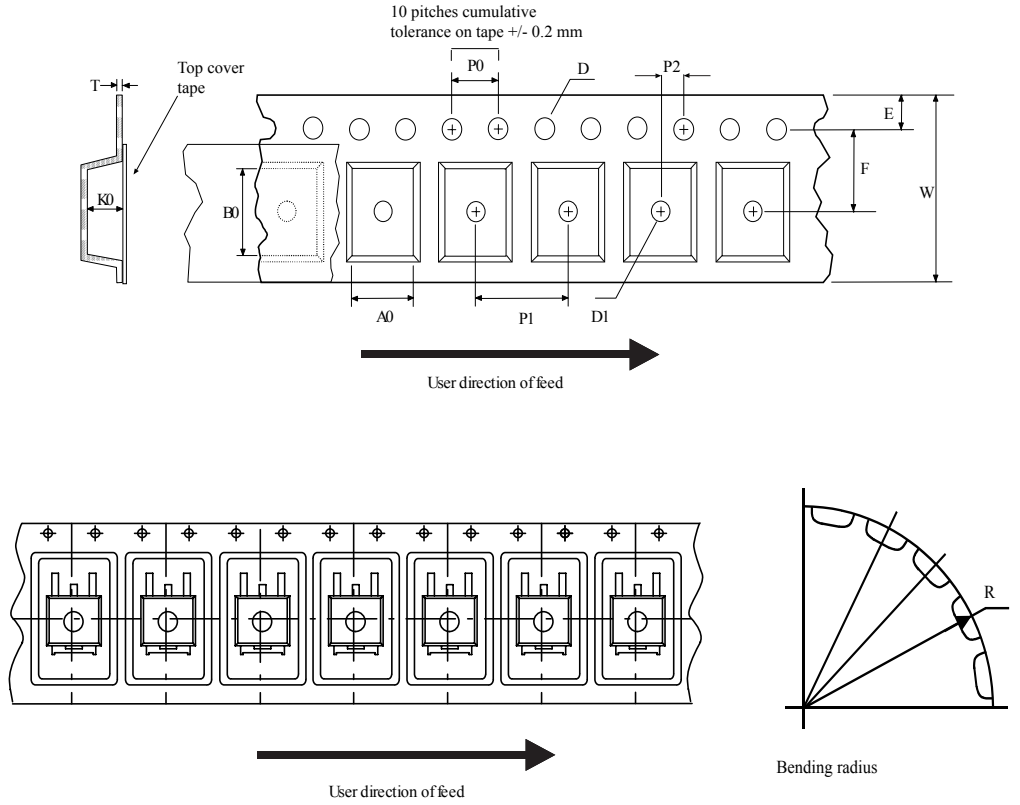


Figure 25. **Reel outline**

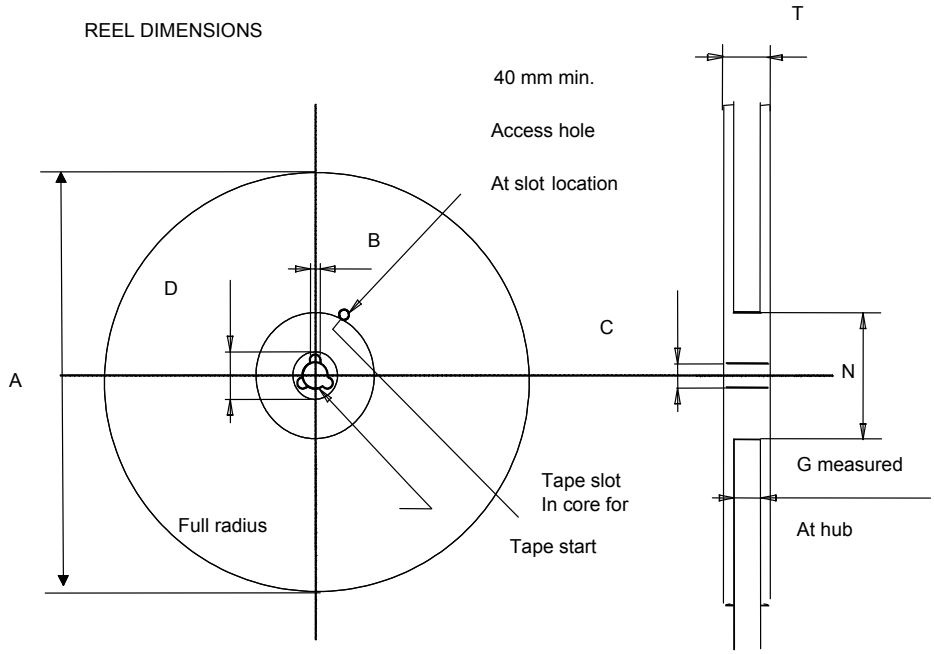


Table 9. **Tape and reel mechanical data**

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 *Table 4: "On/off states"*. 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.

Contents