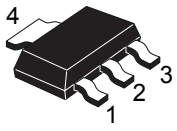
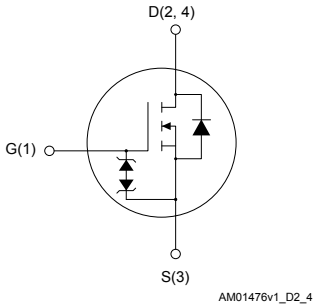
STN1NK60Z

Datasheet

N-channel 600 V, 11 Ω typ., 0.3 A SuperMESH Power MOSFET in a SOT-223 package



SOT-223



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STN1NK60Z	600 V	15 Ω	0.3 A

- Extremely high dv/dt capability
- Gate charge minimized
- Improved ESD capability
- Zener-protected
- 100% avalanche tested

Applications

- Switching applications

Description

This high-voltage device is a Zener-protected N-channel Power MOSFET developed using the SuperMESH technology by STMicroelectronics, an optimization of the well-established PowerMESH. In addition to a significant reduction in on-resistance, this device is designed to ensure a high level of dv/dt capability for the most demanding applications.

Product status link
STN1NK60Z

Product summary	
Order code	STN1NK60Z
Marking	1NK60Z
Package	SOT-223
Packing	Tape and reel

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	600	V
V_{GS}	Gate- source voltage	±30	V
I_D	Drain current (continuous) at T_A = 25 °C	0.3	A
I_D	Drain current (continuous) at T_A = 100 °C	0.2	A
I_{DM} (1)	Drain current (pulsed)	1.2	A
P_{TOT}	Total dissipation at T_A = 25 °C	3.3	W
ESD	Human body model C = 100 pF, R = 1.5 kΩ	800	V
dv/dt (2)	Peak diode recovery voltage slope	4.5	V/ns
T_J	Operating junction temperature range	-55 to 150	°C
T_{stg}	Storage temperature range		°C

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 0.3 A, di/dt ≤ 200 A/µs, V_{DD} = 480 V.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJA} (1)	Thermal resistance, junction-to-ambient	38	°C/W

1. *When mounted on a standard 1 inch^2 area of FR-4 PCB with 2-oz copper.*

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J max.)	0.3	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	60	mJ

2 Electrical characteristics

T_C = 25 °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 mA, V_{GS} = 0 V	600	-	-	V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V	-	-	1	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_C = 125 °C(1)	-	-	50	
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±20 V	-	-	±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 50 µA	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 0.3 A	-	11	15	Ω

1. *Specified by design, not tested in production.*

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0 V	-	94	-	pF
C_{oss}	Output capacitance		-	17.6	-	pF
C_{rss}	Reverse transfer capacitance		-	2.8	-	pF
$C_{oss\ eq.}$(1)	Equivalent output capacitance	V_{GS} = 0, V_{DS} = 0 to 480 V	-	11	-	pF
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 0.8 A, V_{GS} = 0 to 10 V (see the Figure 14. Test circuit for gate charge behavior)	-	4.9	6.9(2)	nC
Q_{gs}	Gate-source charge		-	1	-	nC
Q_{gd}	Gate-drain charge		-	2.7	-	nC

1. *$C_{oss\ eq.}$ 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. *Specified by design, not tested in production.*

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 0.3 A, R_G = 4.7 Ω, V_{GS} = 10 V (see the Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	5.5	-	ns
t_r	Rise time		-	5	-	ns
$t_{d(off)}$	Turn-off delay time		-	13	-	ns
t_f	Fall time		-	28	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-	-	0.3	A
I_{SDM} (1)	Source-drain current (pulsed)		-	-	1.2	A
V_{SD} (2)	Forward on voltage	I_{SD} = 0.8 A, V_{GS} = 0 V	-	-	1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 0.8 A, di/dt = 100 A/µs, V_{DD} = 20 V	-	135	-	ns
Q_{rr}	Reverse recovery charge	(see the Figure 15. Test circuit for inductive load switching and diode recovery times)	-	216	-	nC
I_{RRM}	Reverse recovery current		-	3.2	-	A
t_{rr}	Reverse recovery time	I_{SD} = 0.8 A, di/dt = 100 A/µs	-	140	-	ns
Q_{rr}	Reverse recovery charge	V_{DD} = 20 V, T_J = 150 °C	-	224	-	nC
I_{RRM}	Reverse recovery current	(see the Figure 15. Test circuit for inductive load switching and diode recovery times)	-	3.2	-	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

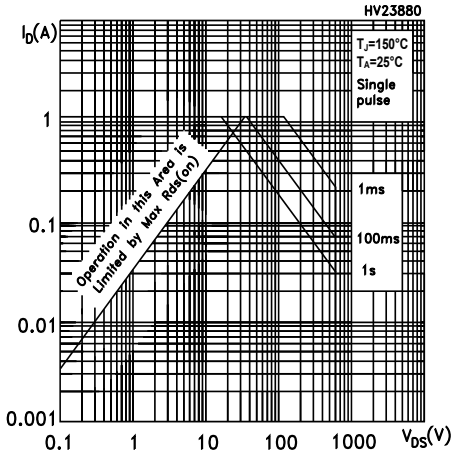


Figure 2. Normalized transient thermal impedance

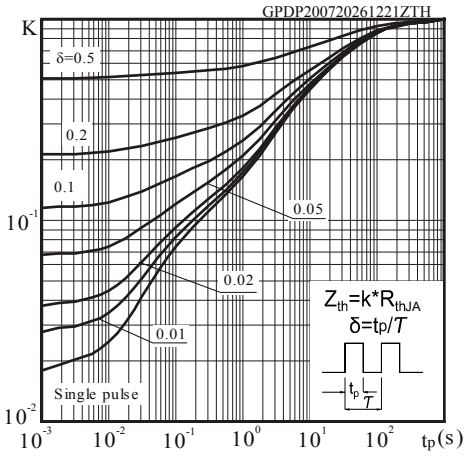


Figure 3. Typical output characteristics

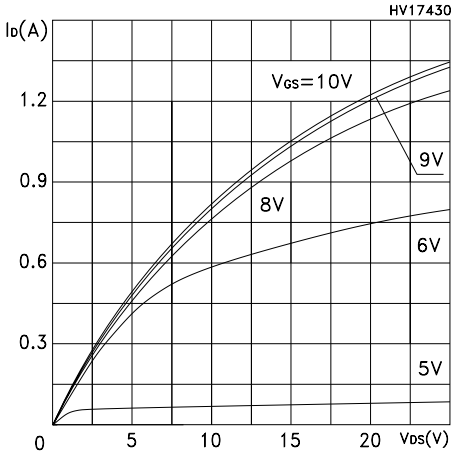


Figure 4. Typical transfer characteristics

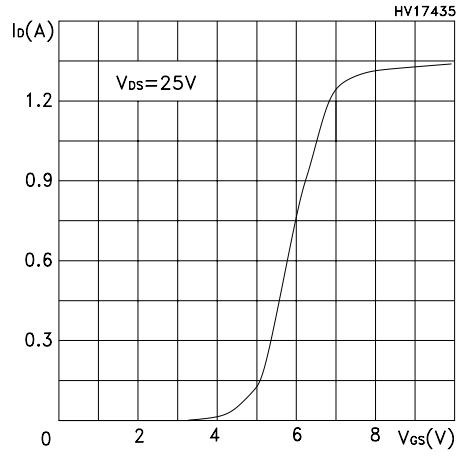


Figure 5. Typical gate charge characteristics

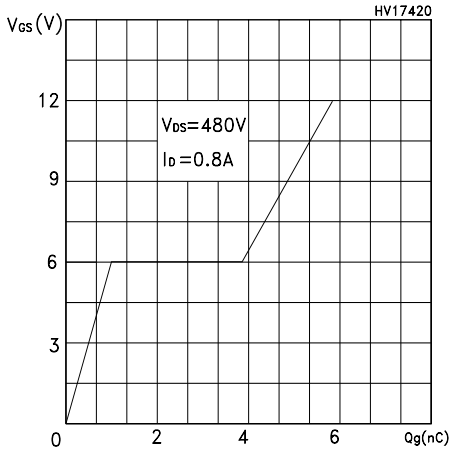


Figure 6. Typical capacitance characteristics

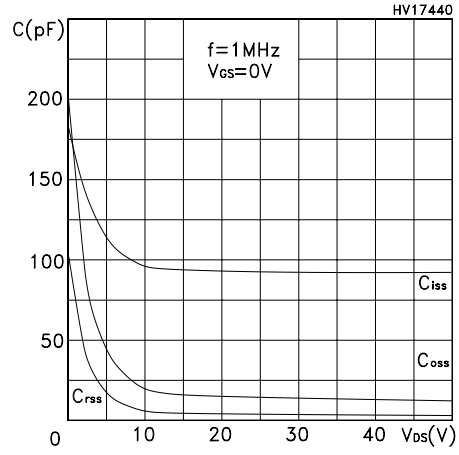


Figure 7. Typical static drain-source on-resistance

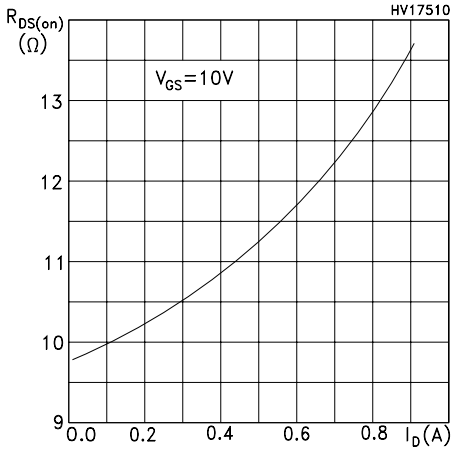


Figure 8. Normalized gate thereshold vs temperature

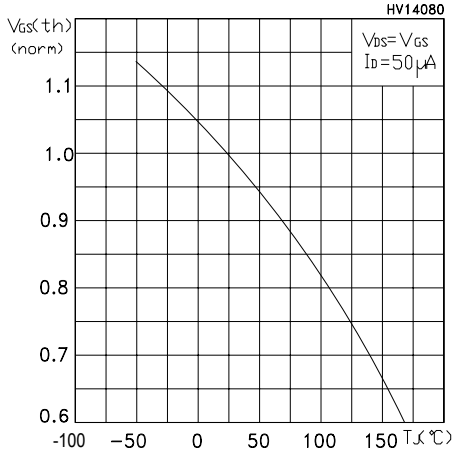


Figure 9. Normalized on-resistance vs temperature

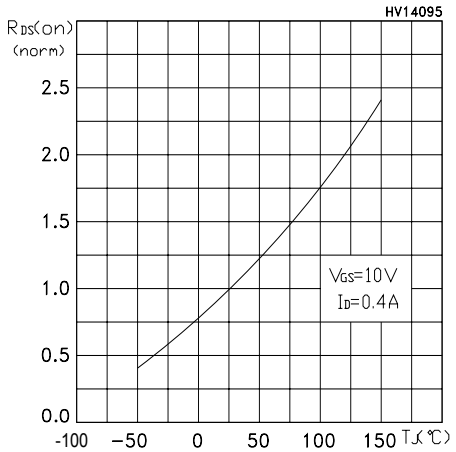


Figure 10. Typical reverse diode forward characteristics

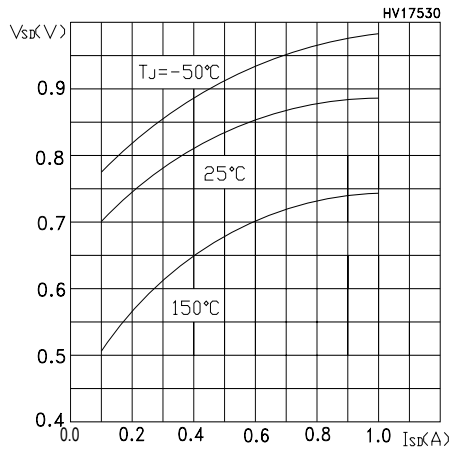


Figure 11. Normalized breakdown voltage vs temperature

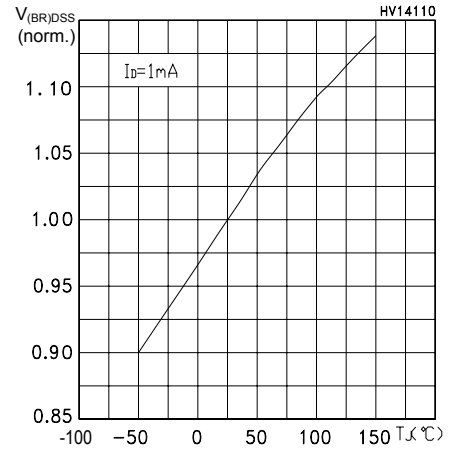
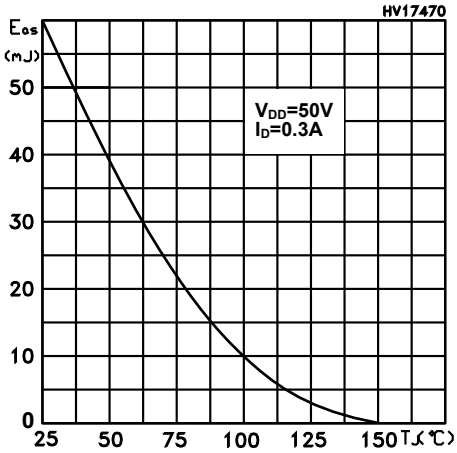
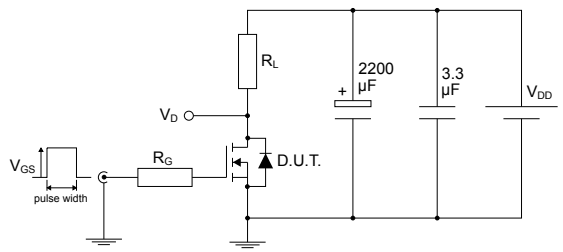


Figure 12. Maximum avalanche energy vs temperature



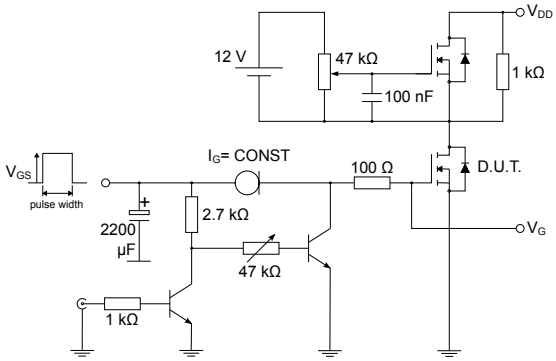
3 Test circuits

Figure 13. Test circuit for resistive load switching times



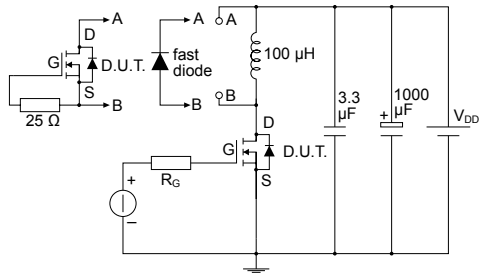
AM01468v1

Figure 14. Test circuit for gate charge behavior



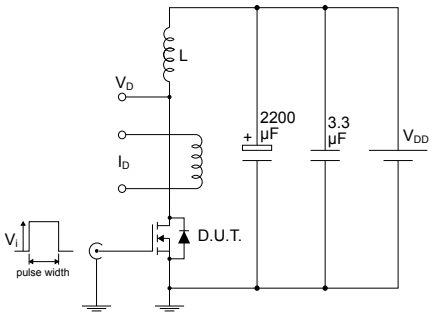
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Figure 15. Test circuit for inductive load switching and diode recovery times



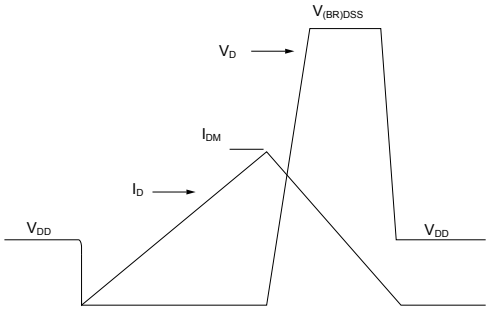
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Figure 16. Unclamped inductive load test circuit



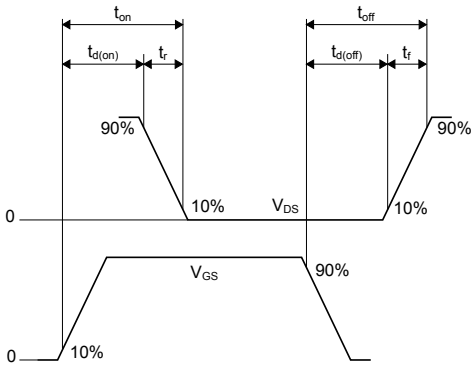
AM01471v1

Figure 17. Unclamped inductive waveform



AM01472v1

Figure 18. Switching time waveform



AM01473v1

4 Package information

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 SOT-223 package information

Figure 19. SOT-223 package outline

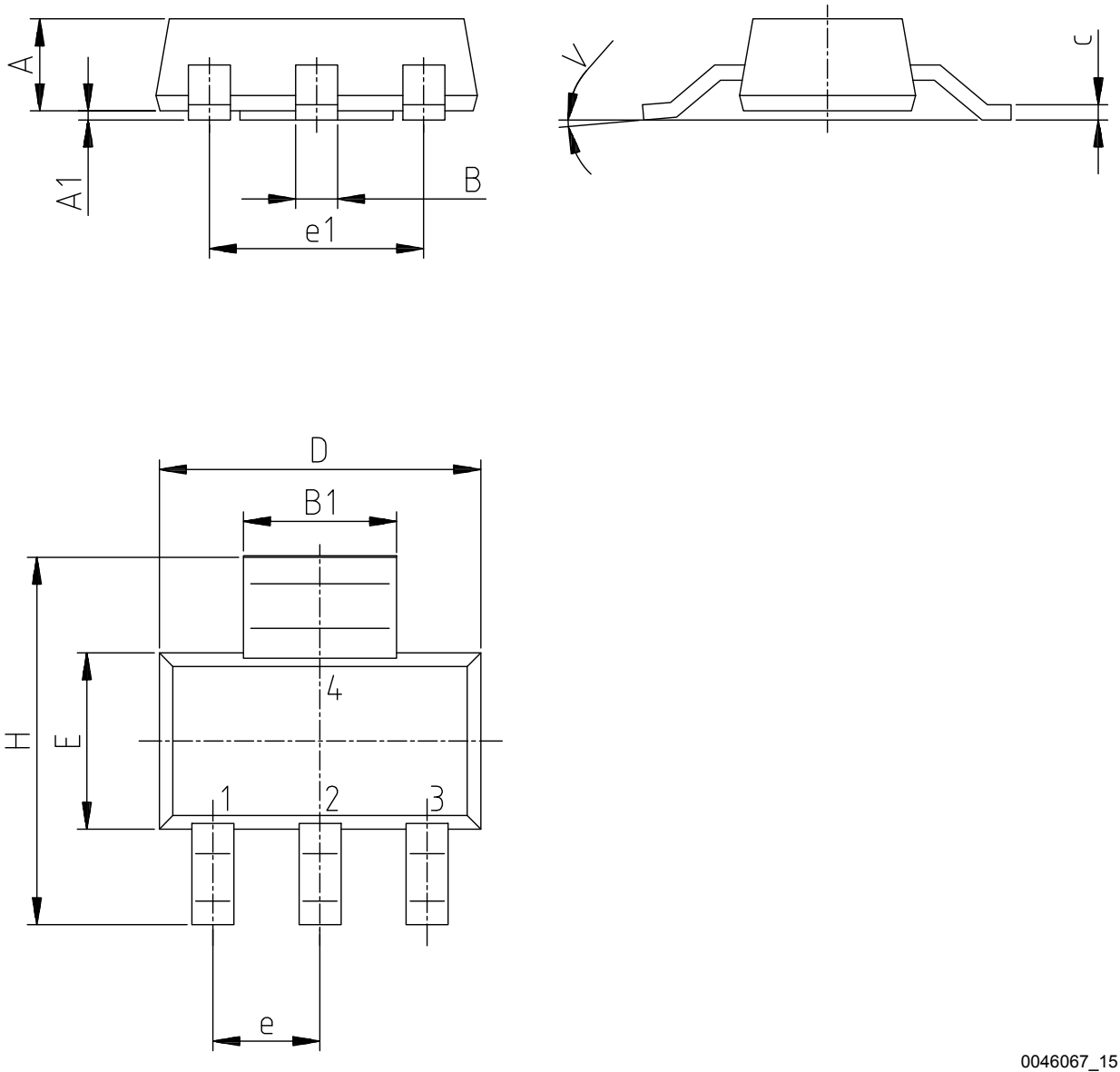
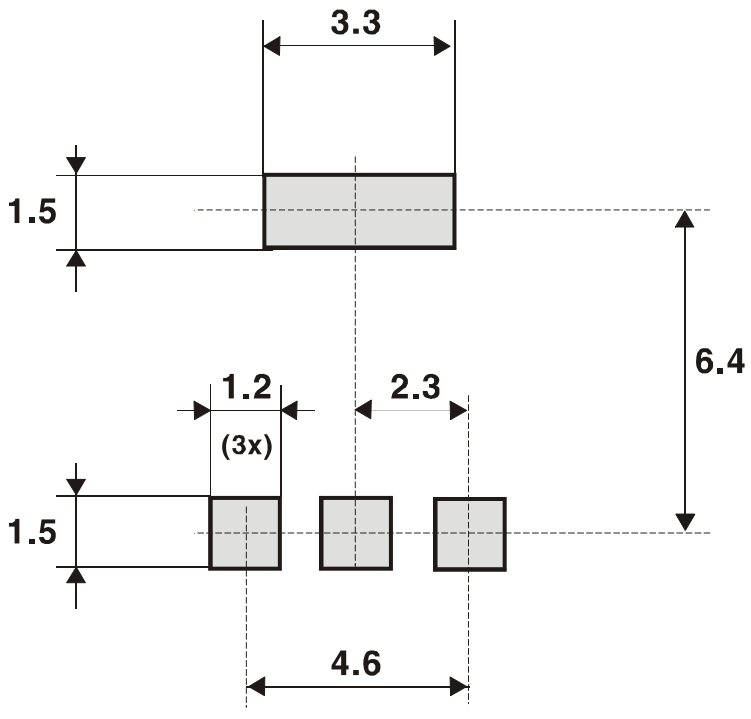


Table 8. **SOT-223 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A			1.8
B	0.6	0.7	0.85
B1	2.9	3	3.15
c	0.24	0.26	0.35
D	6.3	6.5	6.7
e		2.3	
e1		4.6	
E	3.3	3.5	3.7
H	6.7	7	7.3
V			10 deg
A1	0.02		0.1

Figure 20. **SOT-223 recommended footprint (dimensions are in mm)**



4.2 SOT-223 packing information

Figure 21. **SOT-223 tape outline**

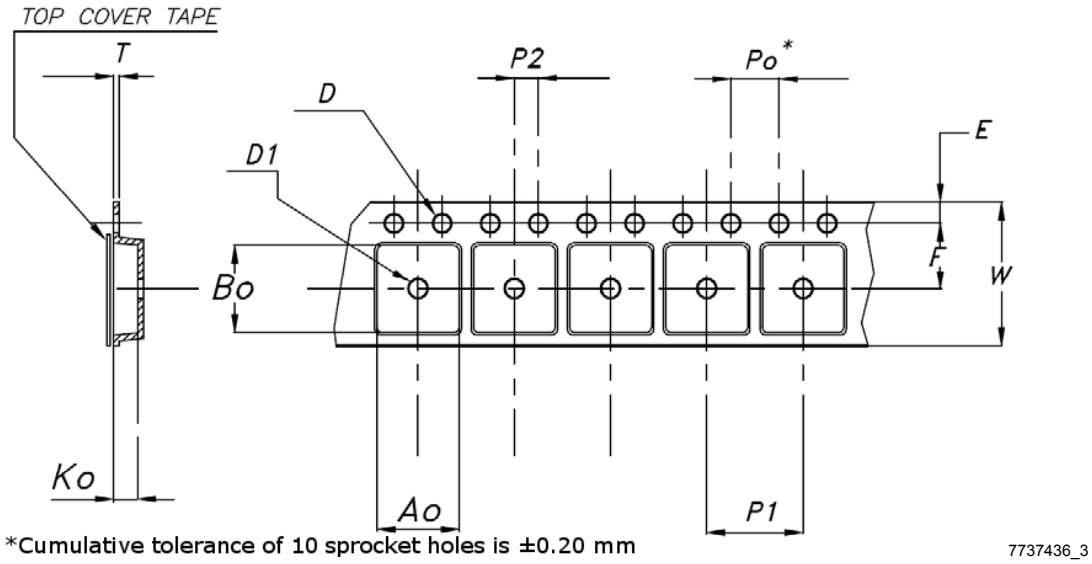


Figure 22. **SOT-223 reel outline**

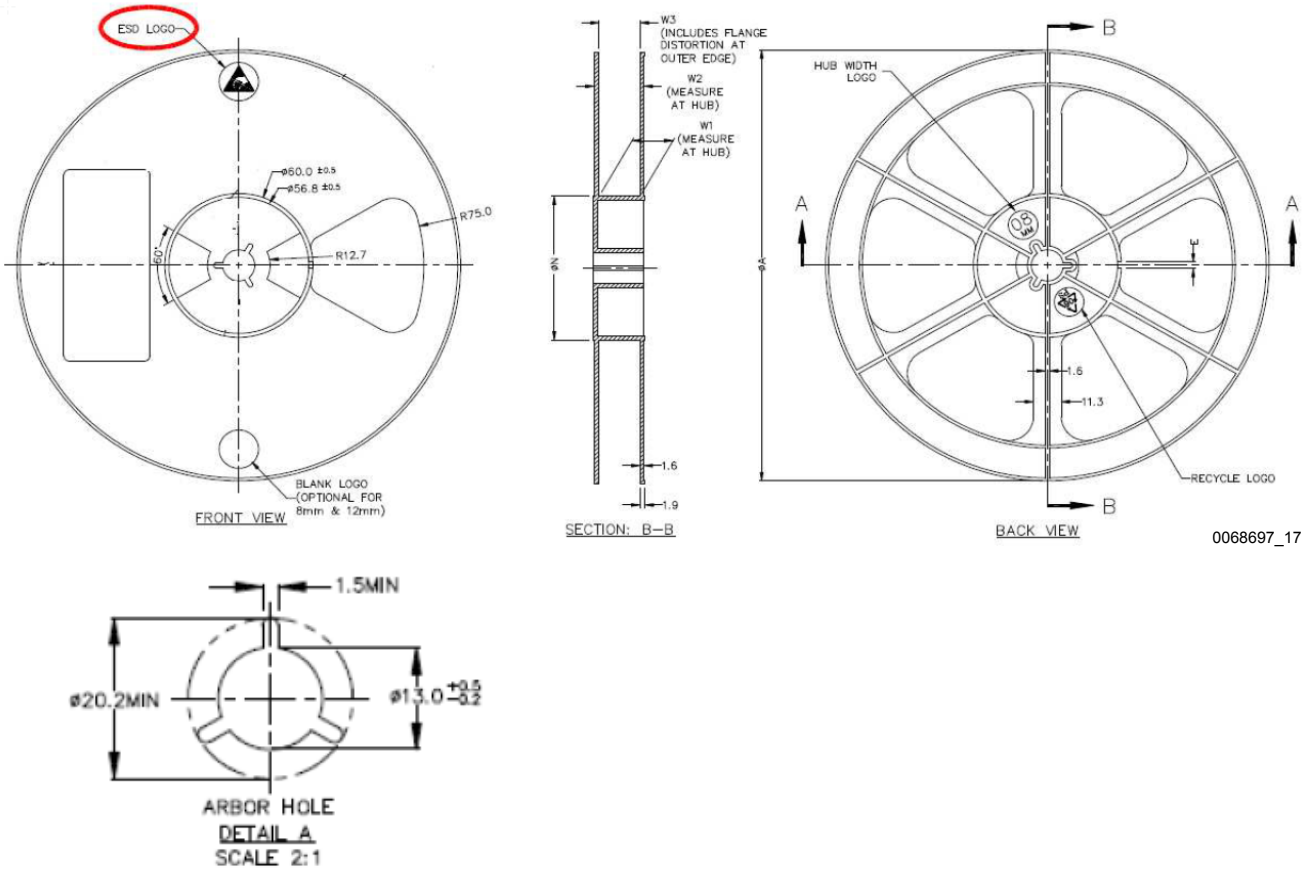
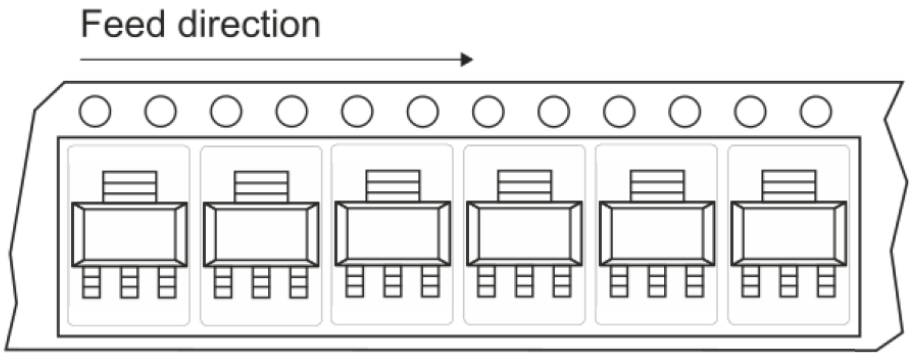


Table 9. **SOT-223 tape and reel mechanical data**

Tape				Tape		
Dim.	mm			Dim.	mm	
	Min.	Typ.	Max.		Min.	Max.
A0	6.75	6.85	6.95	A		180
B0	7.30	7.40	7.50	N	60	
K0	1.80	1.90	2.00	W1		12.4
F	5.40	5.50	5.60	W2		18.4
E	1.65	1.75	1.85	W3	11.9	15.4
W	11.7	12.0	12.3			
P2	1.90	2.00	2.10	Base quantity pcs		1000
P0	3.90	4.00	4.10	Bulk quantity pcs		1000
P1	7.90	8.00	8.10			
T	0.25	0.30	0.35			
DΦ	1.50	1.55	1.60			
D1Φ	1.50	1.60	1.70			

Figure 23. **SOT-223 package orientation in carrier tape**



0050115_20

Revision history

Table 10. **Document revision history**

Date	Version	Changes
15-Feb-2005	7	Modified *Figure 4*.
07-Sep-2005	8	Inserted ecopack indication.
22-Feb-2006	9	The document has been reformatted.
01-Jun-2007	10	Order code table on first page has been updated.
19-Jul-2007	11	*Table 1: Device summary* has been updated.
05-Jan-2011	12	Corrected *Figure 2: Safe operating area for SOT-223* and *Figure 3: Thermal impedance for SOT-223*.
05-Jun-2014	13	Updated title. Updated derating factor in *Table 2: Absolute maximum ratings*. Updated *Section 4: Package mechanical data*. Minor text changes.
04-Jul-2014	14	Updated *Section 3: Test circuits*.
21-Jul-2026	15	The part number STQ1NK60ZR-AP has been moved to a separate datasheet and the document has been updated accordingly. Updated Section 4: Package information. Minor text changes.

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