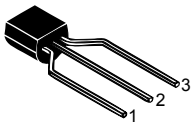
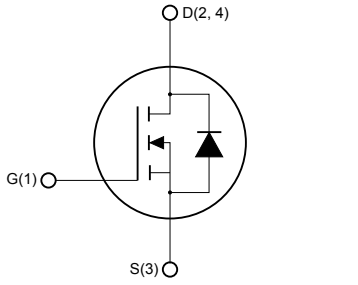
N-channel 600 V, 7.3 Ω typ., 0.4 A SuperMESH™ Power MOSFETs in a SOT-223 and TO-92 packages

SOT-223



TO-92 (Ammopack)



Int_schem_nTnZ_SOT_223

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	Package
STN1HNK60	600 V	8.5 Ω	0.4 A	SOT-223
STQ1HNK60R-AP				TO-92

- Extremely high dv/dt capability
- 100% avalanche tested
- Gate charge minimized

Applications

- Switching applications

Description

These high-voltage devices are Zener-protected N-channel Power MOSFETs developed using the SuperMESH™ technology by STMicroelectronics, an optimization of the well-established PowerMESH™. In addition to a significant reduction in on-resistance, these devices are designed to ensure a high level of dv/dt capability for the most demanding applications.

Product status
STN1HNK60
STQ1HNK60R-AP

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		SOT-223	TO-92	
V_{DS}	Drain-source voltage	600		V
V_{DGR}	Drain-gate voltage (R_{GS} = 20 kΩ)	600		V
V_{GS}	Gate- source voltage	±30		V
I_D	Drain current (continuous) at T_C = 25 °C	0.4		A
I_D	Drain current (continuous) at T_C = 100 °C	0.25		A
I_{DM} (1)	Drain current (pulsed)	1.6		A
P_{TOT}	Total dissipation at T_C = 25 °C	3.3	3	W
dv/dt (2)	Peak diode recovery voltage slope	3		V/ns
T_j	Operating junction temperature range	-55 to 150		°C
T_{stg}	Storage temperature range			

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 0.4 A, di/dt ≤ 100 A/µs, V_{DD} ≤ $V_{(BR)DSS}$.*

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		SOT-223	TO-92	
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient		120	°C/W
$R_{thj\text{-}lead}$	Thermal resistance junction-lead		40	°C/W
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb	37.87		°C/W

1. *When mounted on FR-4 board of 1 in^2, 2 oz Cu, t < 10 s.*

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j Max)	0.4	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	25	mJ

2 Electrical characteristics

(T_{CASE} = 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	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ±30 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2.25	3	3.7	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 0.5 A		7.3	8.5	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} = 25 V, f = 1 MHz, V_{GS} = 0 V	-	156		pF
C_{oss}	Output capacitance			23.5		
C_{rss}	Reverse transfer capacitance			3.8		
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 1 A, V_{GS} = 0 to 10 V (see Figure 16. Test circuit for gate charge behavior)	-	7	10	nC
Q_{gs}	Gate-source charge			1.1		
Q_{gd}	Gate-drain charge			3.7		

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 = 0.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 15. Test circuit for resistive load switching times and Figure 20. Switching time waveform)	-	6.5	-	ns
t_r	Rise time			5		
$t_{d(off)}$	Turn-off delay time			19		
t_f	Fall time			25		

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		0.4	A
I_{SDM} (1)	Source-drain current (pulsed)				1.6	
V_{SD} (2)	Forward on voltage	I_{SD} = 0.4 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 1.0 A, di/dt = 100 A/µs	-	140		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 25 V (see Figure 17. Test circuit for inductive load switching and diode recovery times)		240		nC
I_{RRM}	Reverse recovery current			3.3		A
t_{rr}	Reverse recovery time	I_{SD} = 1.0 A, di/dt = 100 A/µs	-	229		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 25 V, T_J = 150 °C (see Figure 17. Test circuit for inductive load switching and diode recovery times)		377		nC
I_{RRM}	Reverse recovery current			3.3		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 SOT-223

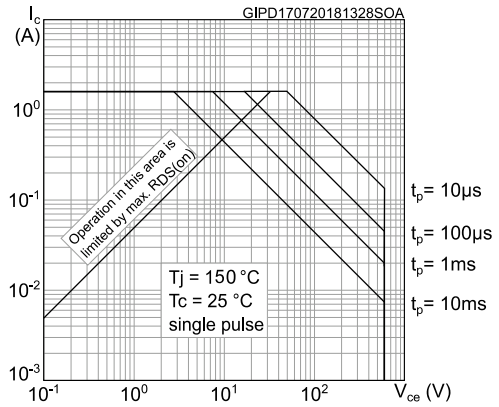


Figure 2. Thermal impedance for SOT-223

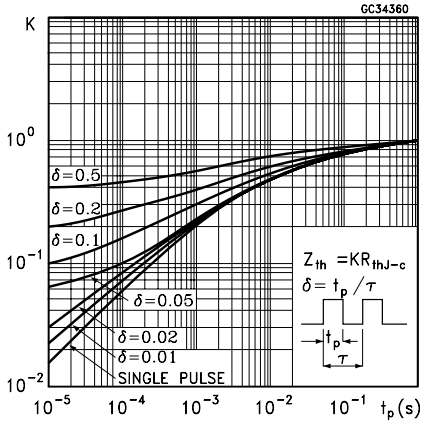


Figure 3. Safe operating area for TO-92

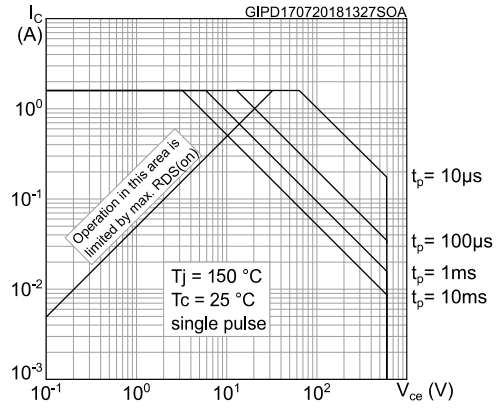


Figure 4. Thermal impedance for TO-92

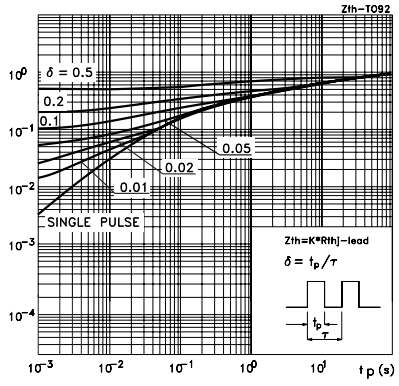


Figure 5. Output characterisics

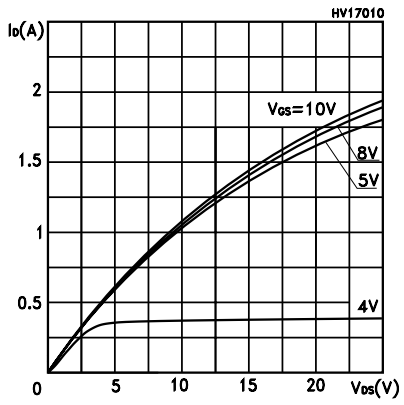


Figure 6. Transfer characteristics

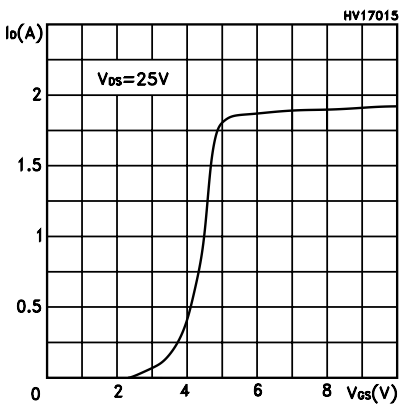


Figure 7. Gate charge vs gate-source voltage

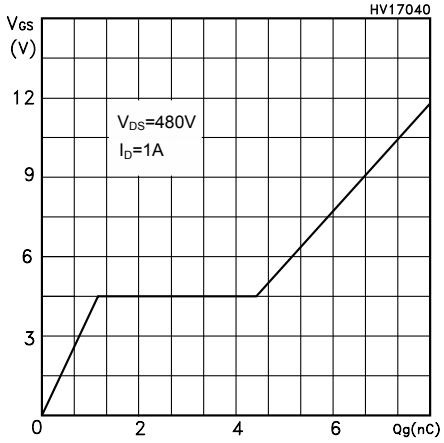


Figure 8. Capacitance variations

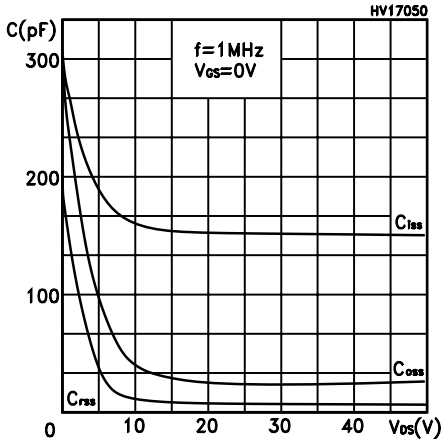


Figure 9. Static drain-source on-resistance

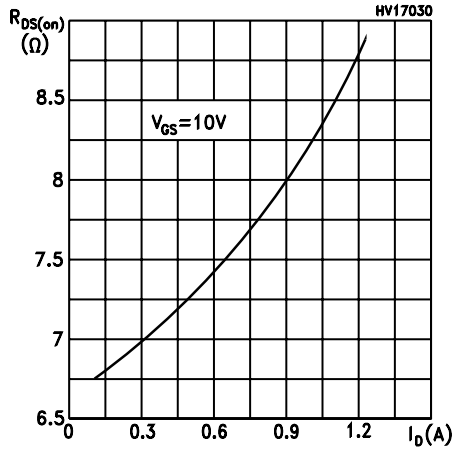


Figure 10. Normalized gate thereshold voltage vs temperature

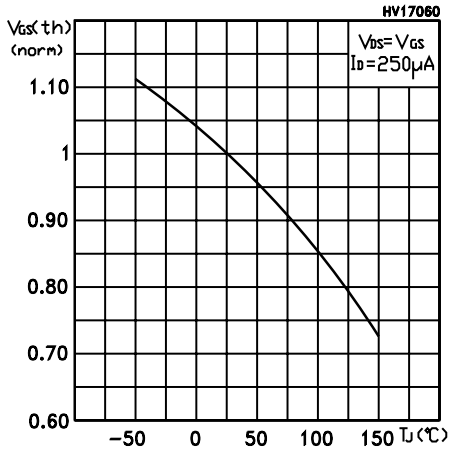


Figure 11. Normalized on-resistance vs temperature

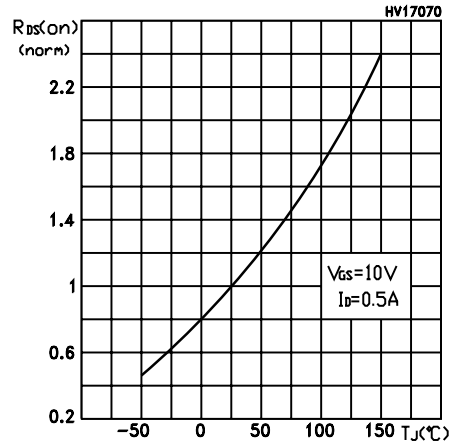


Figure 12. Source-drain forward characteristics

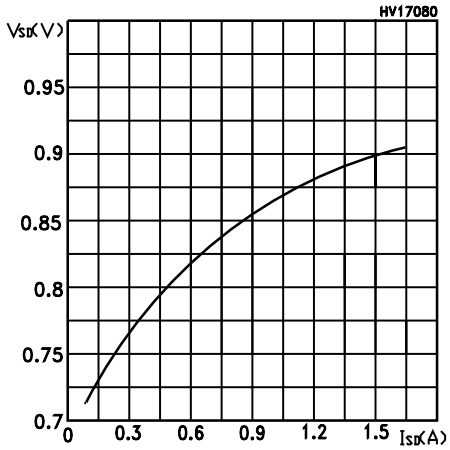


Figure 13. Normalized $V_{(BR)DSS}$ vs Temperature

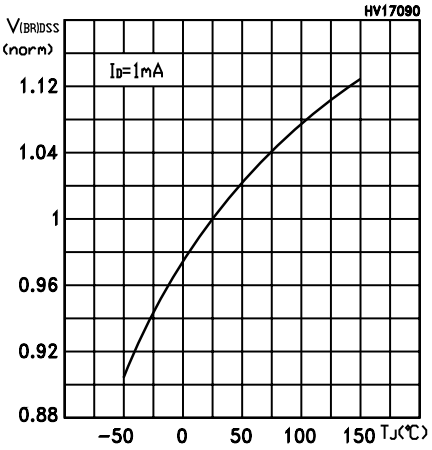
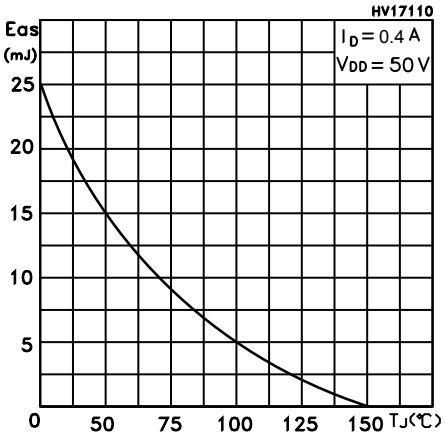


Figure 14. Maximum avalanche energy vs temperature



3 Test circuits

Figure 15. Test circuit for resistive load switching times

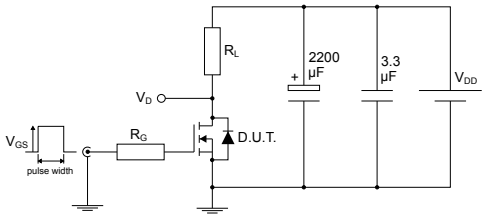


Figure 16. Test circuit for gate charge behavior

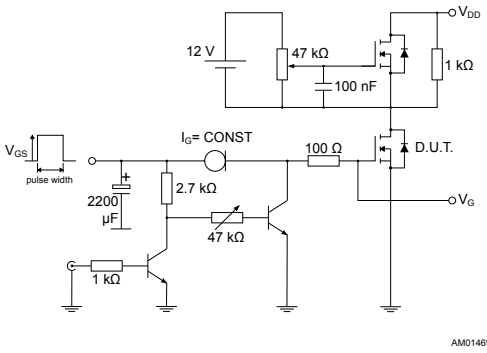


Figure 17. Test circuit for inductive load switching and diode recovery times

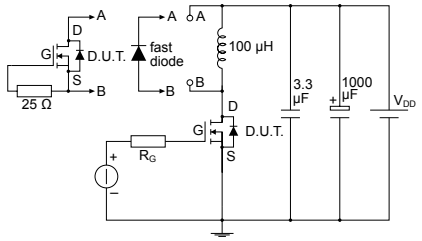


Figure 18. Unclamped inductive load test circuit

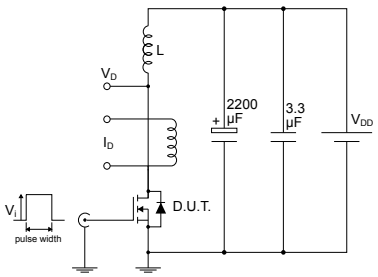


Figure 19. Unclamped inductive waveform

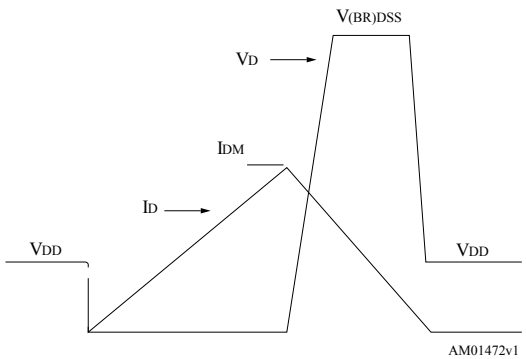
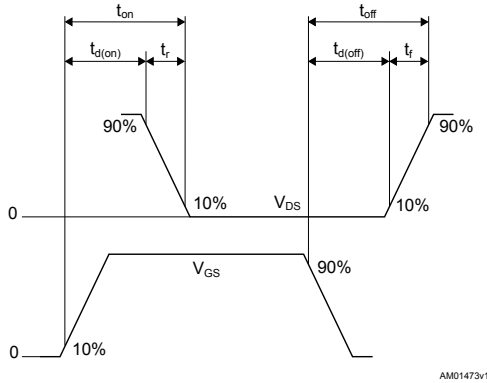


Figure 20. Switching time waveform



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 SOT-223 package information

Figure 21. SOT-223 package outline

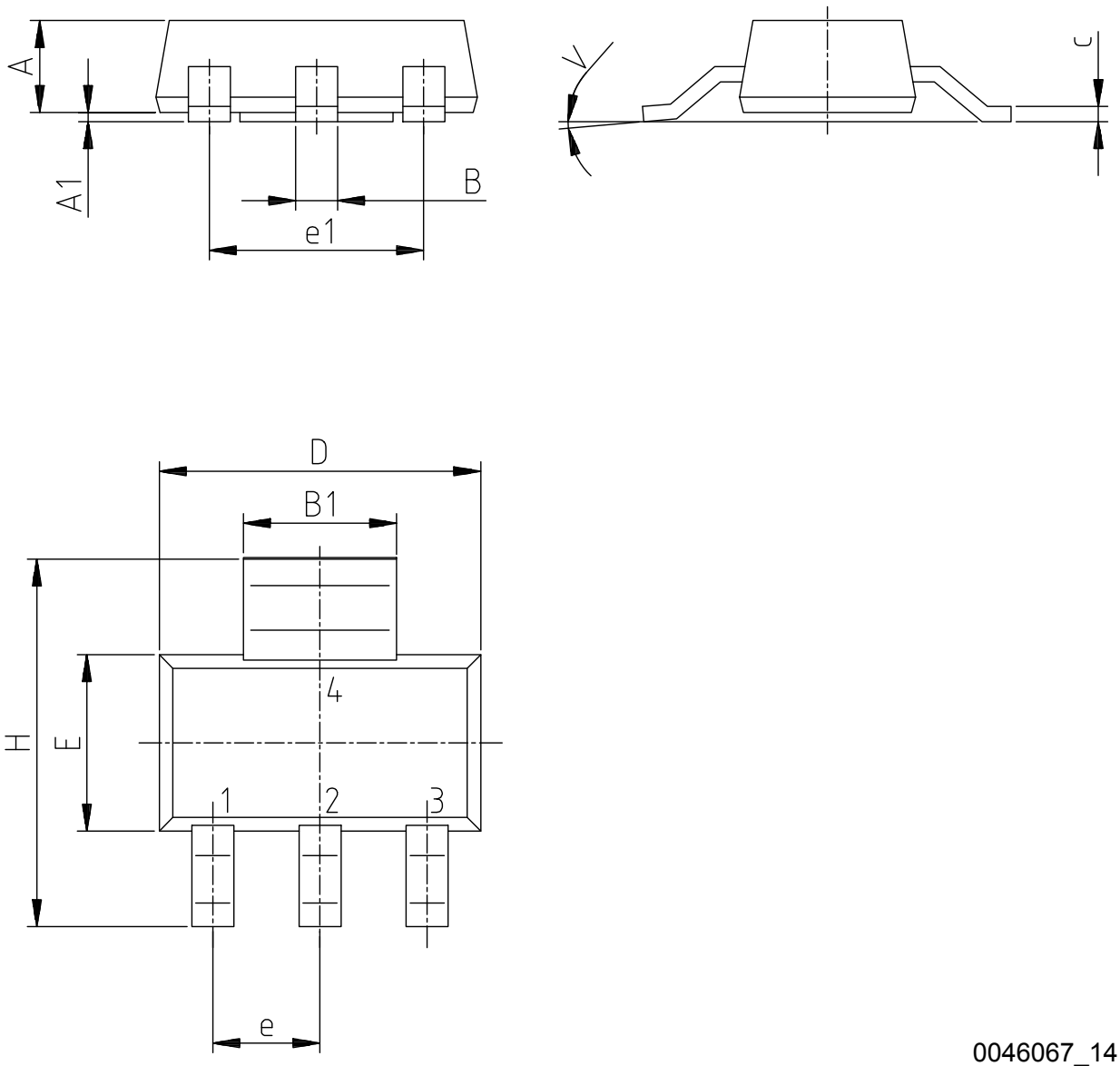
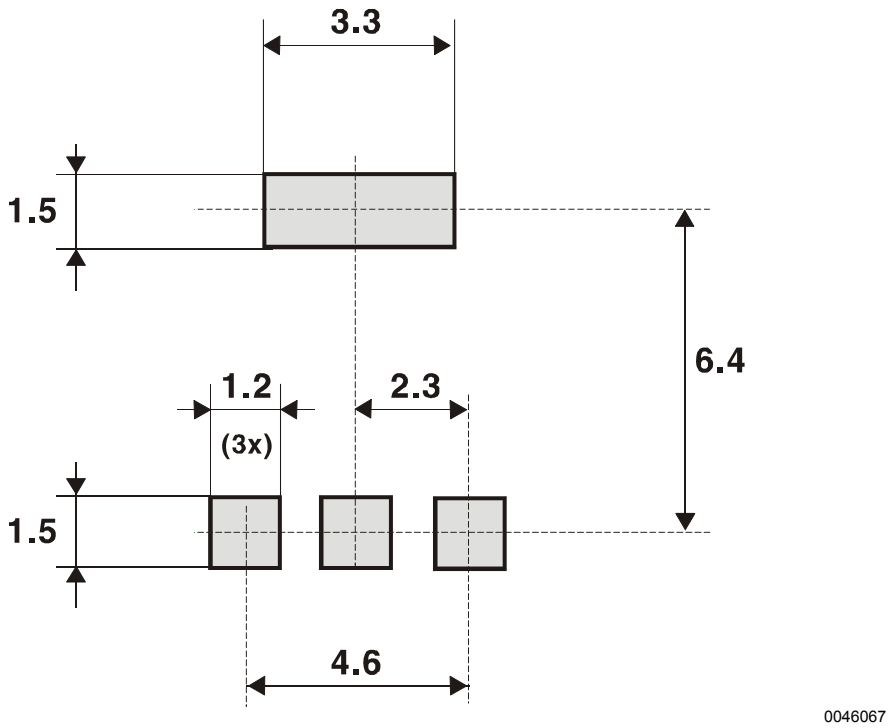


Table 8. **SOT-223 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A			1.8
A1	0.02		0.1
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	7.0	7.3
V			10°

Figure 22. **SOT-223 recommended footprint (dimensions are in mm)**



4.2 TO-92 Ammopack package information

Figure 23. **TO-92 Ammopack package outline**

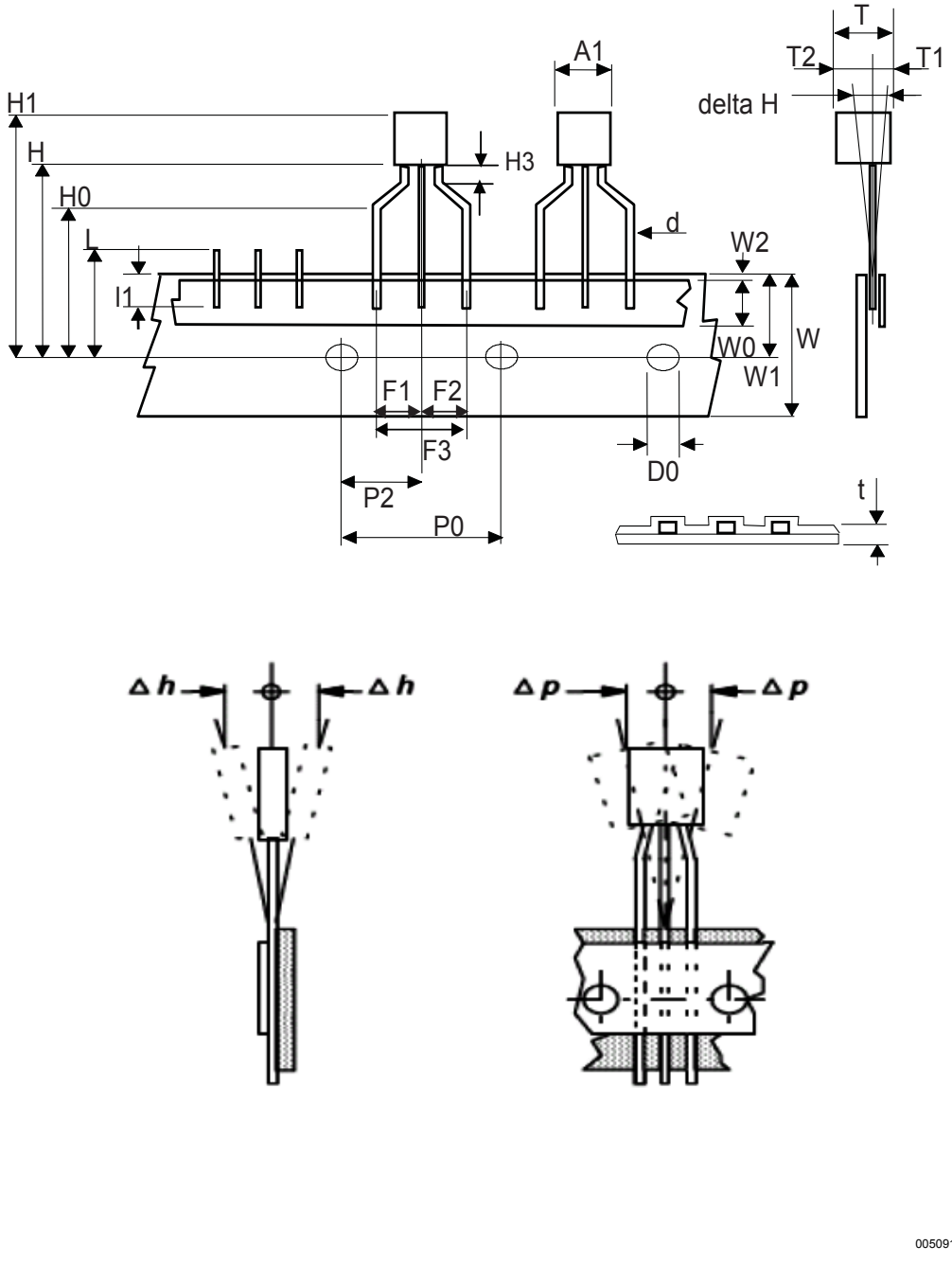


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Table 9. **TO-92 Ammopack mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A1			4.80
T			3.80
T1			1.60
T2			2.30
d	0.45	0.47	0.48
P0	12.50	12.70	12.90
P2	5.65	6.35	7.05
F1, F2	2.40	2.50	2.94
F3	4.98	5.08	5.48
delta H	-2.00		2.00
W	17.50	18.00	19.00
W0	5.50	6.00	6.50
W1	8.50	9.00	9.25
W2			0.50
H		18.50	21.00
H0	15.50	16.00	18.20
H1		25.00	27.00
H3	0.50	1.00	2.00
D0	3.80	4.00	4.20
t			0.90
L			11.00
I1	3.00		
delta P	-1.00		1.00

5 Ordering information

Table 10. **Order codes**

Order code	Marking	Package	Packing
STN1HNK60	N1HNK60	SOT-223	Tape and reel
STQ1HNK60R-AP	1HNK60R	TO-92	Ammopak

Revision history

Table 11. **Document revision history**

Date	Version	Changes
20-Aug-2018	1	Initial release.

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