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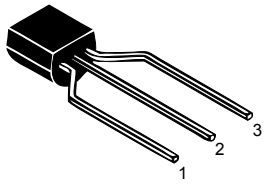
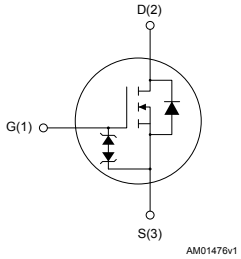
STQ2HNK60ZR-AP

Datasheet

N-channel 600 V, 3.5 Ω typ., 500 mA SuperMESH Power MOSFET in a TO-92 package



TO-92 ammopack



Features

Order codes	V_{DS}	$R_{DS(on)}$ max.	I_D
STQ2HNK60ZR-AP	600 V	4.8 Ω	500 mA

- 100% avalanche tested
- Gate charge minimized
- Very low intrinsic capacitance
- Zener-protected

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
STQ2HNK60ZR-AP

Product summary	
Order code	STQ2HNK60ZR-AP
Marking	Q2HNK60ZR
Package	TO-92
Packing	Ammopack

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_C = 25 °C	500	mA
	Drain current (continuous) at T_C = 100 °C	320	
I_{DM} (1)	Drain current (pulsed)	2	A
P_{TOT}	Total power dissipation at T_L = 25 °C	3	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s, T_C = 25 °C)	2.5	kV
ESD	Gate-source human body model (R = 1.5 kΩ, C = 100 pF)	2	kV
dv/dt(2)	Peak diode recovery voltage slope	4.5	V/ns
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range		°C

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 2 A, di/dt ≤ 200 A/µs, V_{DS} (peak) ≤ $V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJL}	Thermal resistance, junction-to-lead	40	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	120	°C/W

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (t_p limited by T_J max)	2	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}; V_{DD} = 50 V)	120	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	V_{GS} = 0 V, I_D = 1 mA	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 = 1 A		3.5	4.8	Ω

1. *Specified By Design – Not tested in production.*

Table 5. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0 V	-	280		pF
C_{oss}	Output capacitance		-	38		pF
C_{rss}	Reverse transfer capacitance		-	7		pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	30		pF
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 2 A, V_{GS} = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior)	-	11	15 (2)	nC
Q_{gs}	Gate-source charge		-	2.25		nC
Q_{gd}	Gate-drain charge		-	6		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 = 1 A, R_G = 4.7 Ω , V_{GS} = 10 V (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	10	-	ns
t_r	Rise time		-	30	-	ns
$t_{d(off)}$	Turn-off delay time		-	23	-	ns
t_f	Fall time		-	50	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		2	A
I_{SDM} (1)	Source-drain current (pulsed)		-		8	A
V_{SD} (2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 2 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 2 A, di/dt = 100 A/µs, V_{DD} = 20 V (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	178		ns
Q_{rr}	Reverse recovery charge		-	445		nC
I_{RRM}	Reverse recovery current		-	5		A
t_{rr}	Reverse recovery time	I_{SD} = 2 A, di/dt = 100 A/µs, V_{DD} = 20 V, T_J = 150 °C (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	200		ns
Q_{rr}	Reverse recovery charge		-	500		nC
I_{RRM}	Reverse recovery current		-	5		A

1. *Pulse width is 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

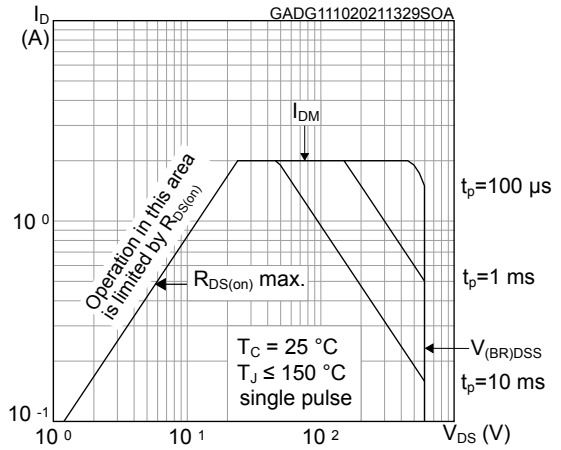


Figure 2. Thermal impedance

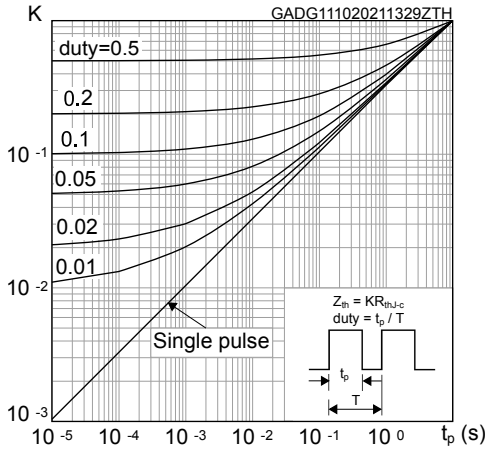


Figure 3. Output characteristics

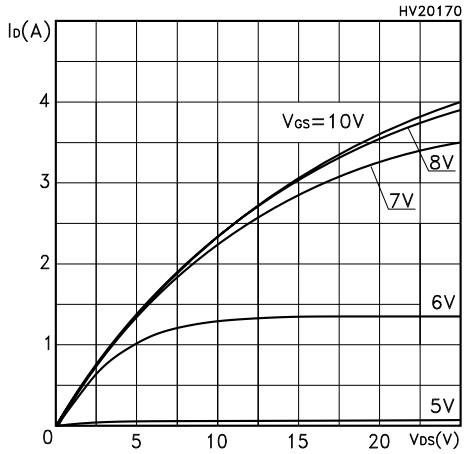


Figure 4. Transfer characteristics

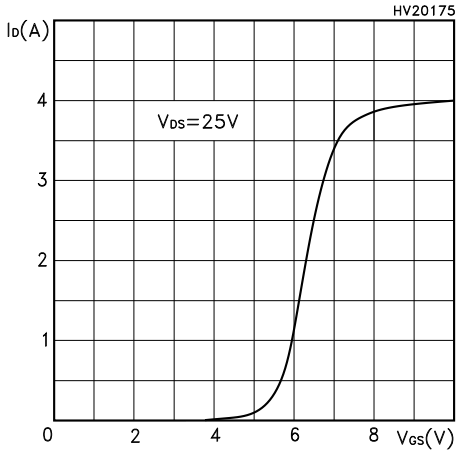


Figure 5. Normalized $V_{(BR)DSS}$ vs temperature

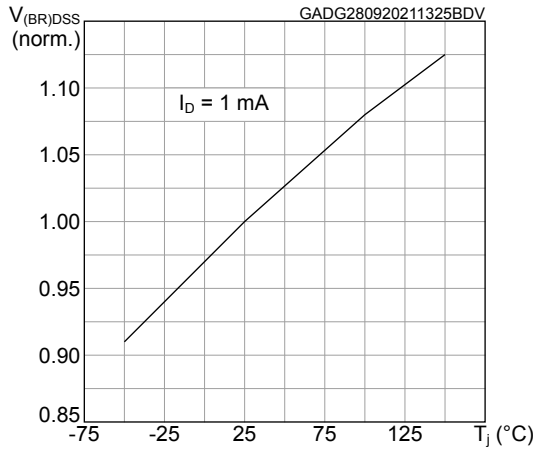


Figure 6. Static drain-source on-resistance

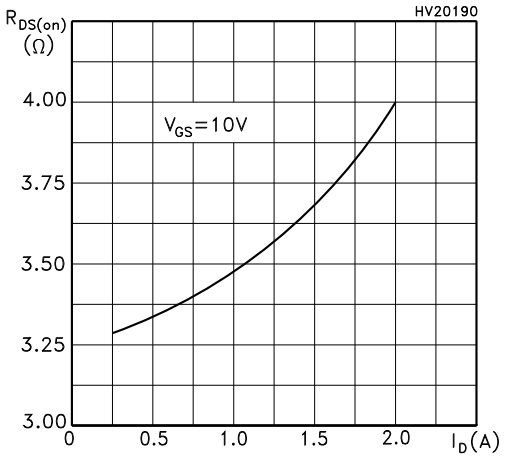


Figure 7. Gate charge vs gate-source voltage

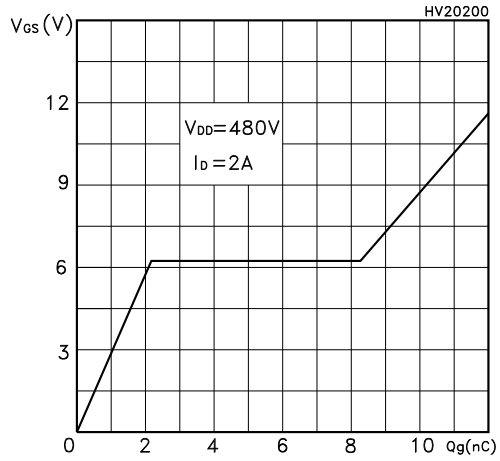


Figure 8. Capacitance variations

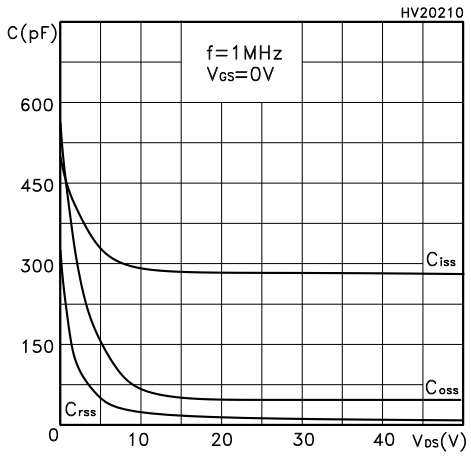


Figure 9. Normalized gate threshold voltage vs temperature

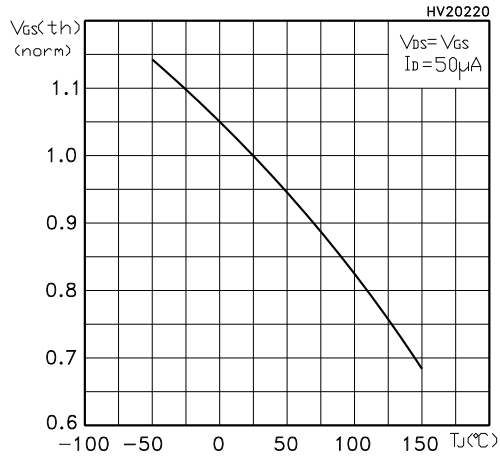


Figure 10. Normalized on-resistance vs temperature

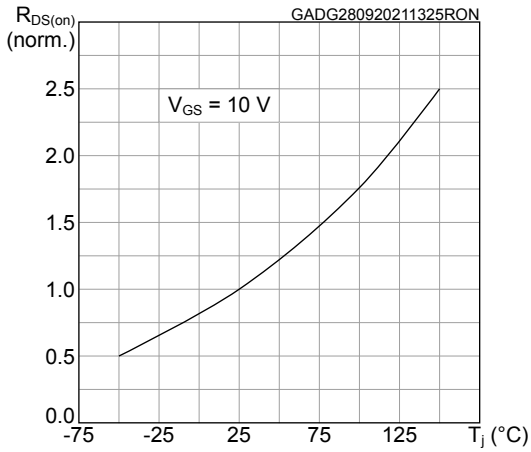


Figure 11. Source-drain diode forward characteristics

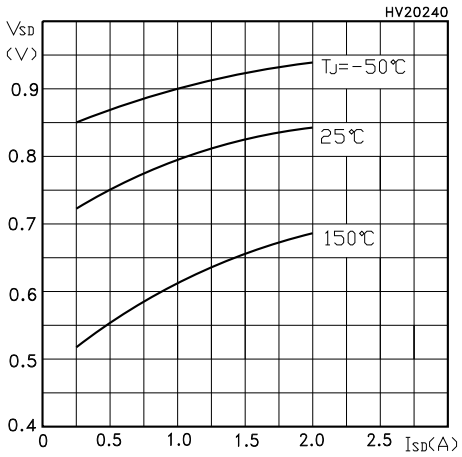
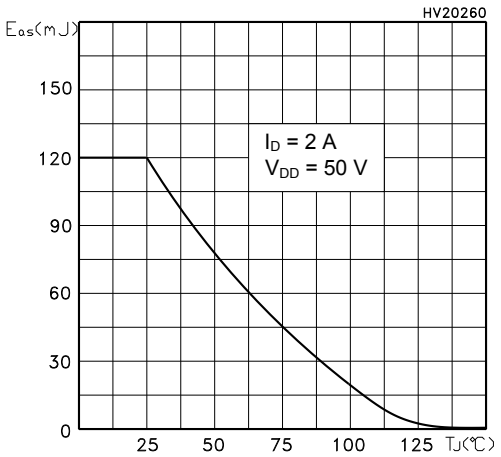


Figure 12. Maximum avalanche energy vs temperature



3 Test circuits

Figure 13. Test circuit for resistive load switching times

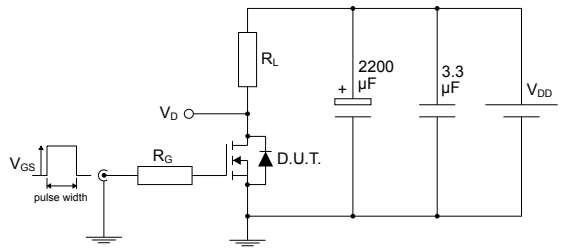


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Figure 14. Test circuit for gate charge behavior

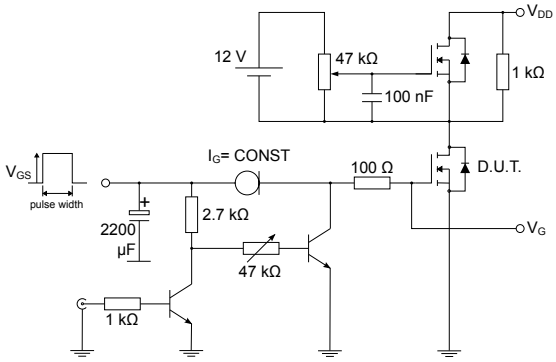

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Figure 15. Test circuit for inductive load switching and diode recovery times

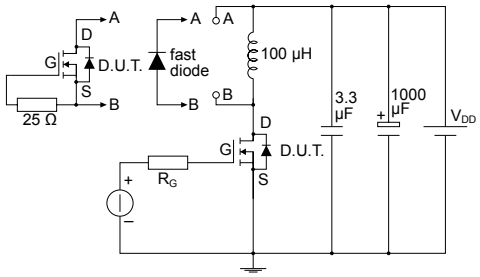

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Figure 16. Unclamped inductive load test circuit

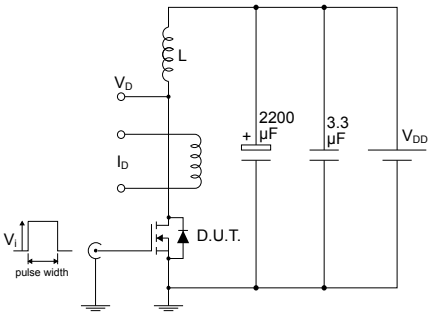

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Figure 17. Unclamped inductive waveform

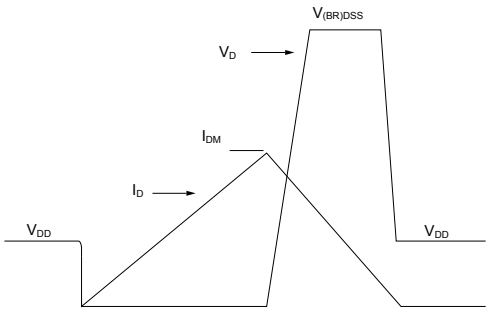

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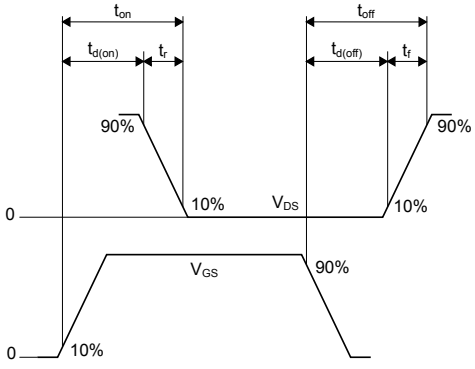
Figure 18. Switching time waveform



AM01473v1

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 TO-92 ammopack package information

Figure 19. **TO-92 ammopack package outline**

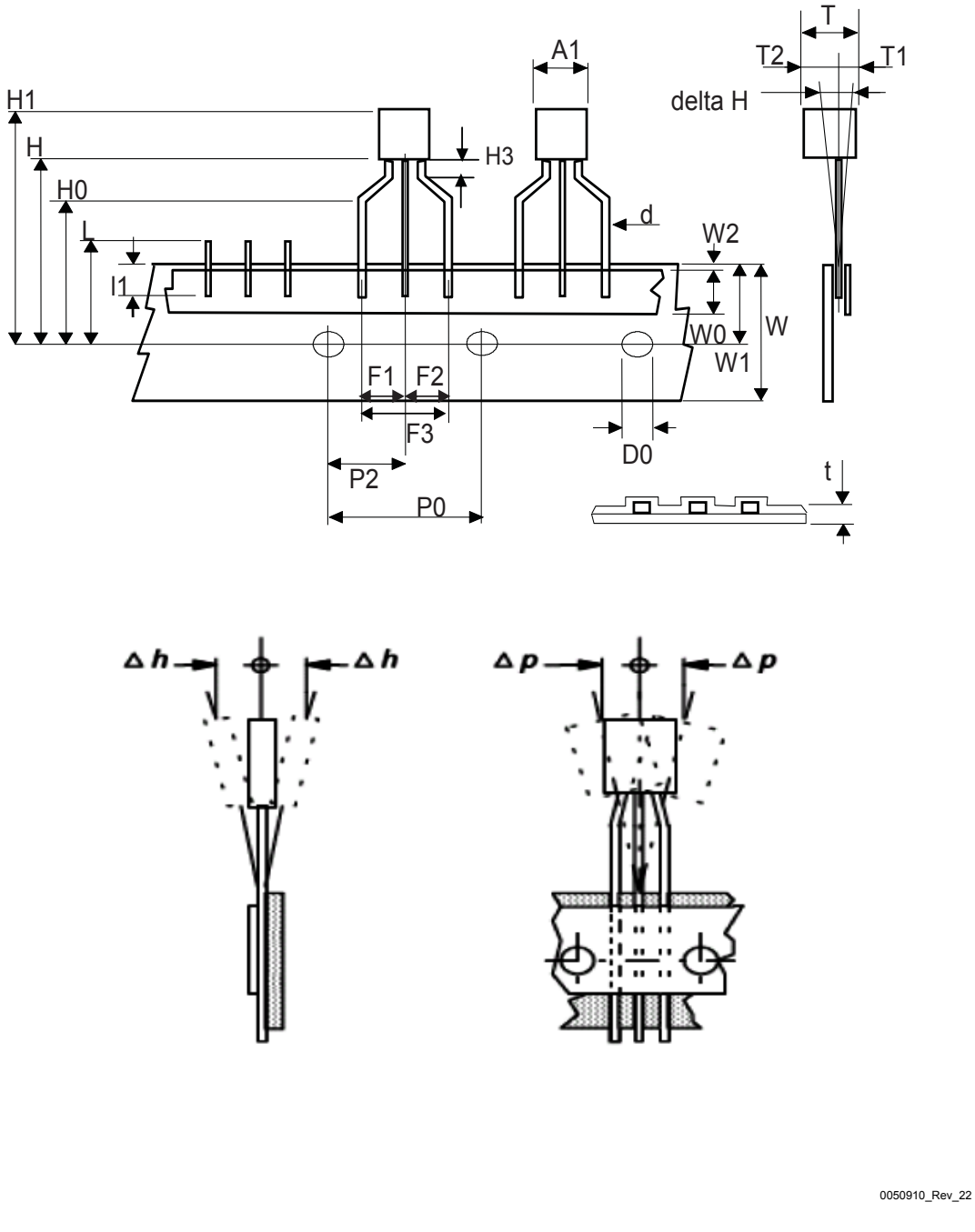


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Table 8. **TO-92 ammopack mechanical data**

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

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
12-Oct-2021	1	First release. Part number previously included in datasheet DS3646.

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