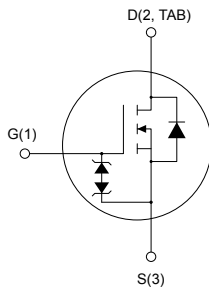
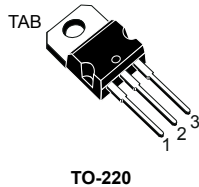


## N-channel 800 V, 3.6 $\Omega$ typ., 2.5 A SuperMESH Power MOSFET in a TO-220 package



AM01476v1\_tab



### Product status link

[STP3NK80Z](#)

### Product summary

<b>Order code</b>	STP3NK80Z
<b>Marking</b>	P3NK80Z
<b>Package</b>	TO-220
<b>Packing</b>	Tube

### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$
STP3NK80Z	800 V	4.5 $\Omega$	2.5 A

- 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.

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	800	V
$V_{GS}$	Gate-source voltage	±30	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ °C}$	2.5	A
	Drain current (continuous) at $T_C = 100\text{ °C}$	1.57	
$I_{DM}^{(1)}$	Drain current (pulsed)	10	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ °C}$	70	W
ESD	Gate-source, human body model ( $R = 1.5\text{ k}\Omega$ , $C = 100\text{ pF}$ )	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.  $I_{SD} \leq 2.5\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DS}(\text{Peak}) < V_{(BR)DSS}$ ,  $V_{DD} = 640\text{ V}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case	1.78	°C/W
$R_{thJA}$	Thermal resistance, junction-to-ambient	62.5	°C/W

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width is limited by $T_J$ max.)	2.5	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ °C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	170	mJ

## 2 Electrical characteristics

$T_C = 25\text{ °C}$  unless otherwise specified.

**Table 4. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	800			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 800\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 800\text{ V}$ , $T_C = 125\text{ °C}^{(1)}$			50	
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 50\text{ }\mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on- resistance	$V_{GS} = 10\text{ V}$ , $I_D = 1.25\text{ A}$		3.6	4.5	$\Omega$

1. Specified by design, not tested in production.

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	-	485	-	pF
$C_{oss}$	Output capacitance		-	57	-	pF
$C_{rSS}$	Reverse transfer capacitance		-	11	-	pF
$C_{oss\ eq}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ to }640\text{ V}$	-	22	-	pF
$Q_g$	Total gate charge	$V_{DD} = 640\text{ V}$ , $I_D = 2.5\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	19	-	nC
$Q_{gs}$	Gate-source charge		-	3.2	-	nC
$Q_{gd}$	Gate-drain charge		-	10.8	-	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%.

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$ , $I_D = 1.25\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	17	-	ns
$t_r$	Rise time		-	27	-	ns
$t_{d(off)}$	Turn-off delay time		-	36	-	ns
$t_f$	Fall time		-	40	-	ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		2.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		10	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 2.5 \text{ A}$ , $V_{GS} = 0 \text{ V}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 2.5 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$	-	384		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 50 \text{ V}$	-	1.6		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	8.4		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 2.5 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ ,	-	474		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 50 \text{ V}$ , $T_J = 150 \text{ }^\circ\text{C}$	-	2.1		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	8.8		A

1. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

2. Pulse width is limited by safe operating area.

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

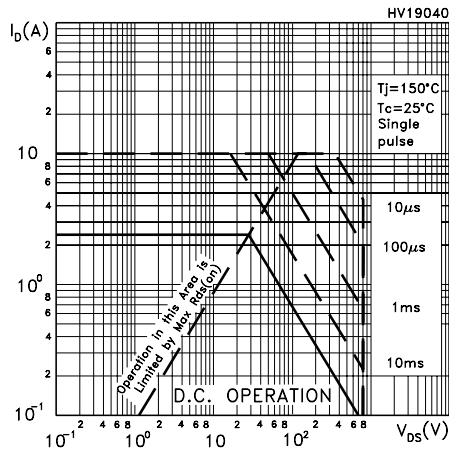


Figure 2. Thermal impedance

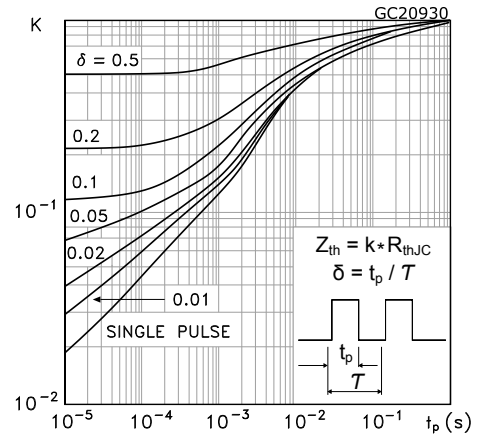


Figure 3. Output characteristics

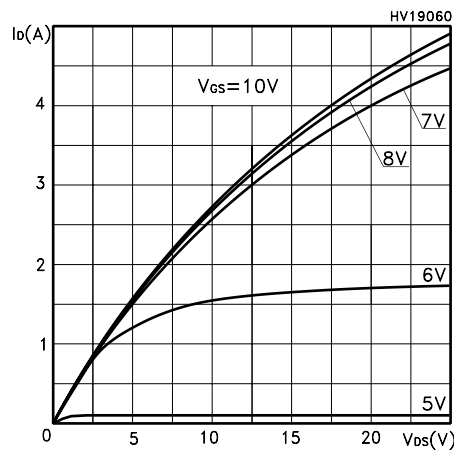


Figure 4. Transfer characteristics

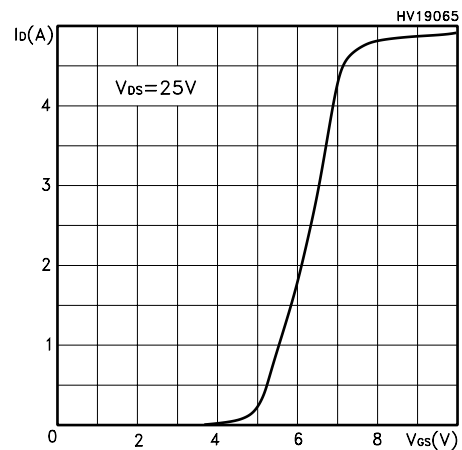


Figure 5. Static drain-source on-resistance

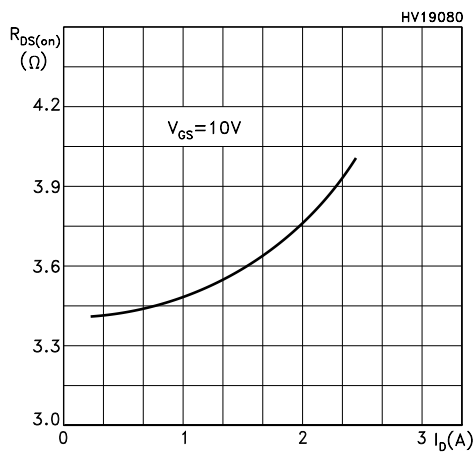
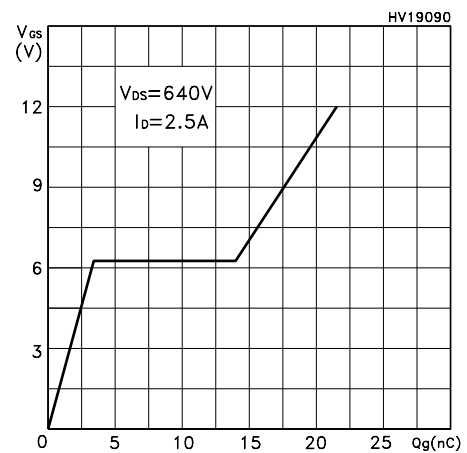
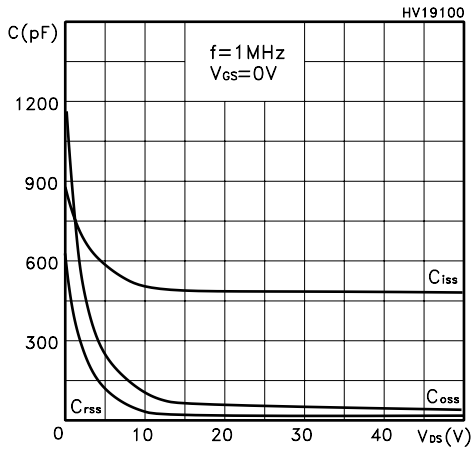


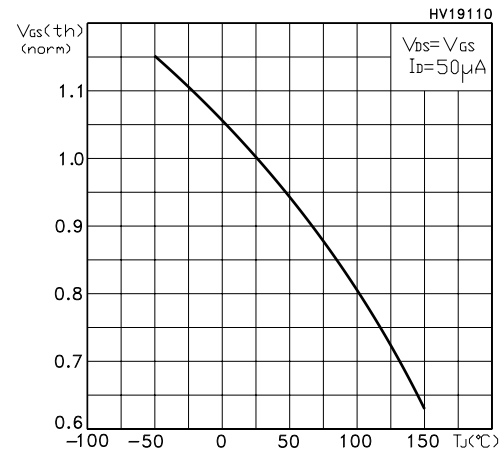
Figure 6. Gate charge vs gate-source voltage



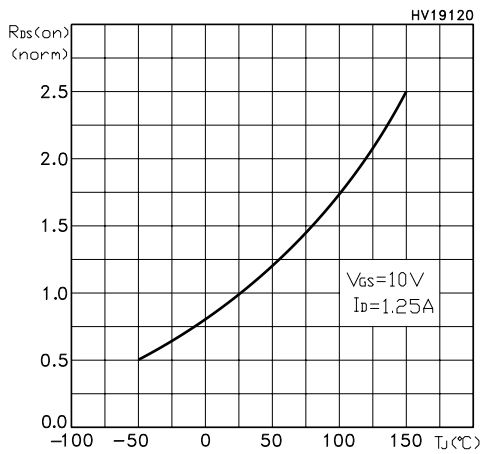
**Figure 7. Capacitance variations**



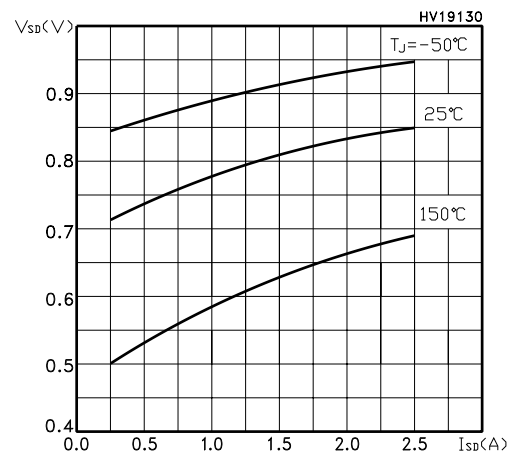
**Figure 8. Normalized gate threshold voltage vs temperature**



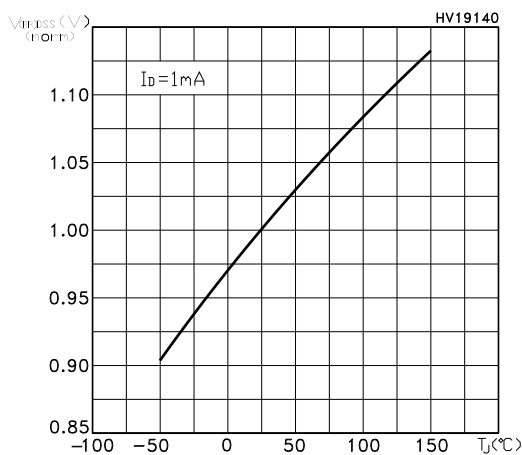
**Figure 9. Normalized on-resistance vs temperature**



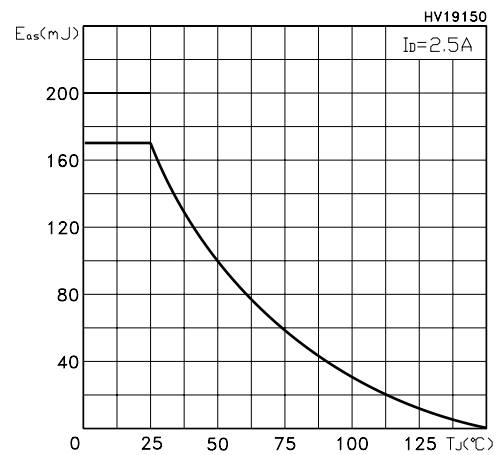
**Figure 10. Source-drain diode forward characteristics**



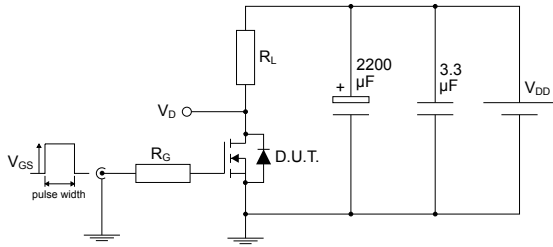
**Figure 11. Normalized  $V_{(BR)DSS}$  vs temperature**



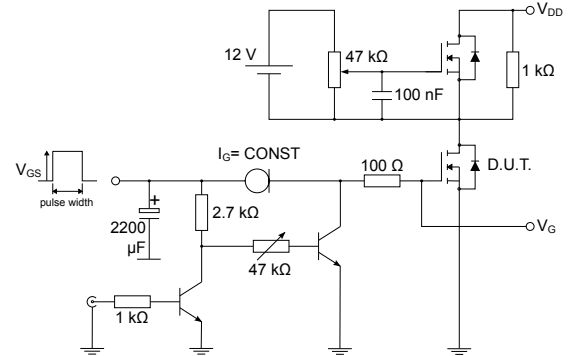
**Figure 12. Maximum avalanche energy vs temperature**



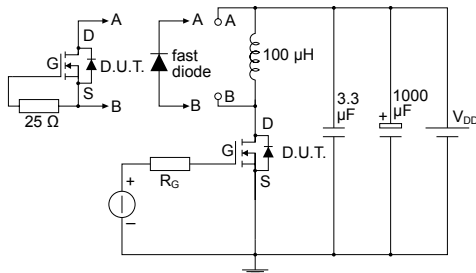
### 3 Test circuits

**Figure 13. Test circuit for resistive load switching times**


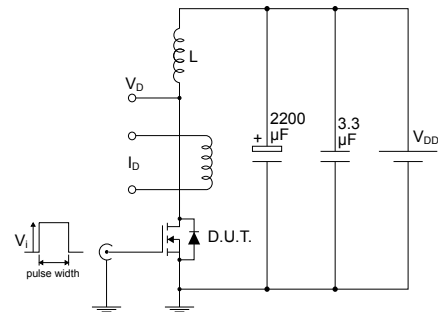
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**Figure 14. Test circuit for gate charge behavior**


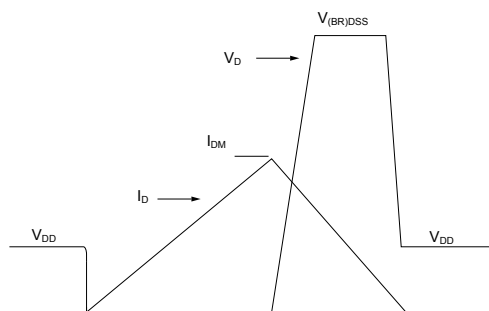
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**Figure 15. Test circuit for inductive load switching and diode recovery times**


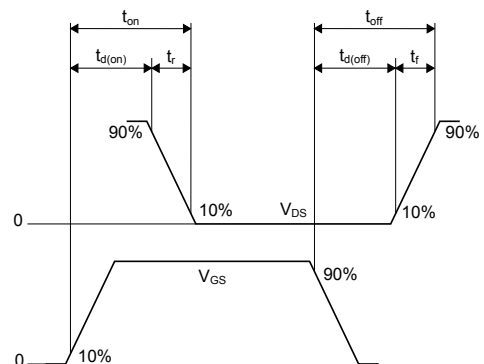
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**Figure 16. Unclamped inductive load test circuit**


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**Figure 17. Unclamped inductive waveform**


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**Figure 18. Switching time waveform**


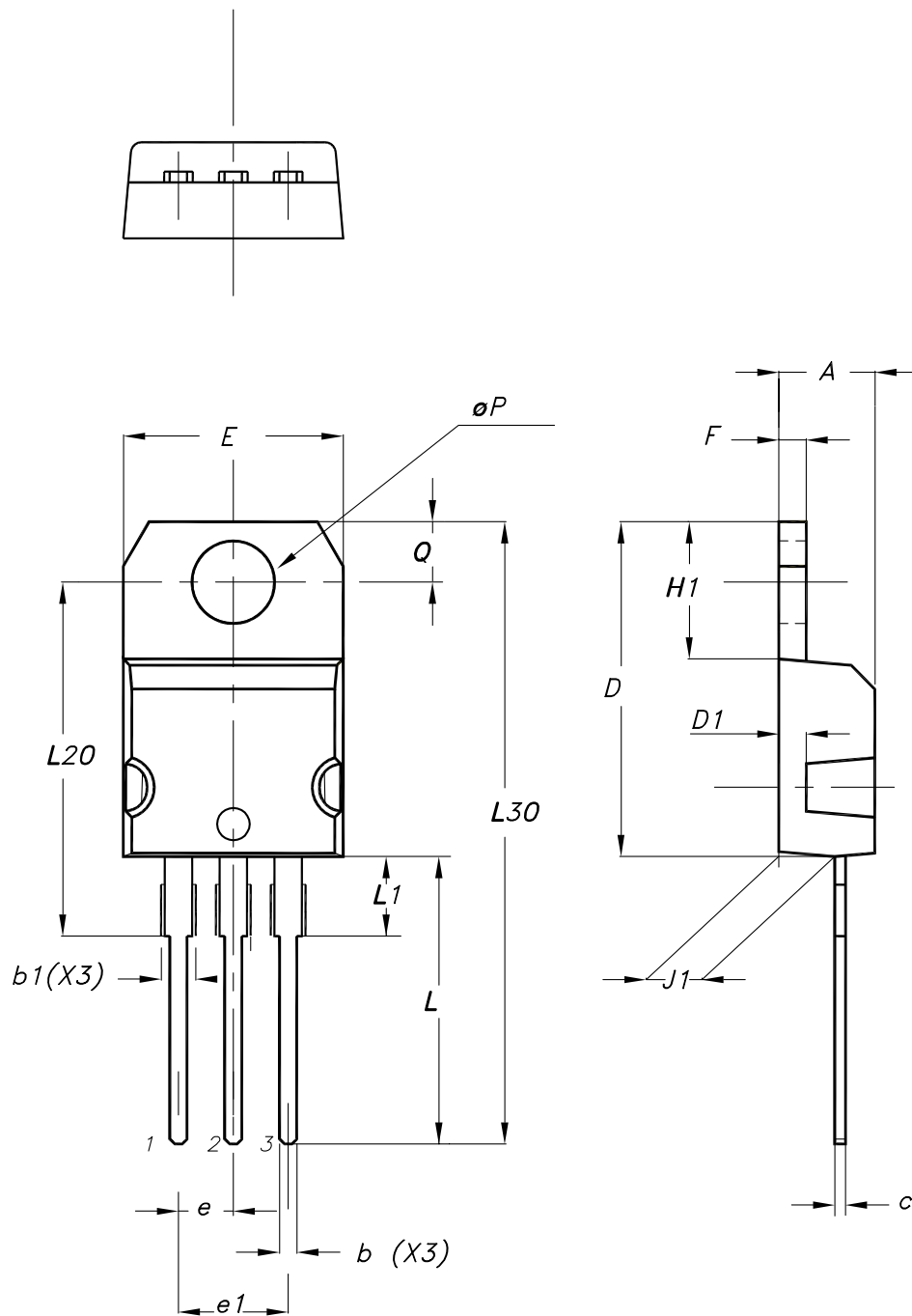
AM01473v1

## 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](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 TO-220 type A package information

Figure 19. TO-220 type A package outline



0015988\_typeA\_Rev\_23



**Table 8. TO-220 type A package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95
Slug flatness		0.03	0.10

## Revision history

**Table 9. Document revision history**

Date	Revision	Changes
27-Jun-2023	1	First release. The part number STP3NK80Z was previously inserted in the DS3337.

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