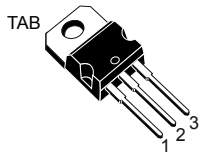
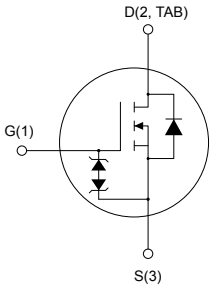
N-channel 800 V, 3.5 Ω typ., 2 A MDmesh K5 Power MOSFET in a TO-220 package



TO-220



AM01476v1_tab

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STP2N80K5	800 V	4.5 Ω	2 A

- Industry's lowest $R_{DS(on)}$ x area
- Industry's best FoM (figure of merit)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This very high voltage N-channel Power MOSFET is designed using MDmesh K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Product status link
STP2N80K5

Product summary	
Order code	STP2N80K5
Marking	2N80K5
Package	TO-220
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	±30	V
I_D	Drain current (continuous) at T_C = 25 °C	2	A
	Drain current (continuous) at T_C = 100 °C	1.3	
I_{DM}(1)	Drain current (pulsed)	8	A
P_{TOT}	Total power dissipation at T_C = 25 °C	45	W
dv/dt(2)	Peak diode recovery voltage slope	4.5	V/ns
dv/dt(3)	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range		°C

1. *Pulse width is limited by safe operating area.*
2. *I_{SD} ≤ 2 A, di/dt = 100 A/µs, V_{DS} (peak) < $V_{(BR)DSS}$.*
3. *V_{DS} ≤ 640 V.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	2.78	°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 non-repetitive (pulse width limited by T_J max.)	0.5	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	60.5	mJ

2 Electrical characteristics

T_C = 25 °C unless otherwise specified.

Table 4. On/off-state

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	800			V
I_{DSS}	Zero gate voltage drain current	V_{DS} = 800 V, V_{GS} = 0 V			1	µA
		V_{DS} = 800 V, V_{GS} = 0 V, T_C = 125 °C(1)			50	
I_{GSS}	Gate body leakage current	V_{GS} = ±20 V, V_{DS} = 0 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 100 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 1 A		3.5	4.5	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} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	105	-	pF
C_{oss}	Output capacitance		-	8	-	pF
C_{rss}	Reverse transfer capacitance		-	0.5	-	pF
$C_{o(tr)}$(1)	Equivalent capacitance time related	V_{GS} = 0 V, V_{DS} = 0 to 640 V	-	16	-	pF
$C_{o(er)}$(2)	Equivalent capacitance energy related		-	7	-	pF
R_g	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	18	-	Ω
Q_g	Total gate charge	V_{DD} = 640 V, I_D = 2 A, V_{GS} = 0 to 10 V (see Figure 15. Test circuit for gate charge behavior)	-	5	-	nC
Q_{gs}	Gate-source charge		-	1	-	nC
Q_{gd}	Gate-drain charge		-	3.7	-	nC

1. *$C_{o(tr)}$ is a constant capacitance value that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.*
2. *$C_{o(er)}$ is a constant capacitance value that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.*

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 = 1 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	8	-	ns
t_r	Rise time		-	12	-	ns
$t_{d(off)}$	Turn-off delay time		-	19	-	ns
t_f	Fall time		-	32	-	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	I_{SD} = 2 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 2 A, di/dt = 100 A/µs, V_{DD} = 60 V (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	255		ns
Q_{rr}	Reverse recovery charge		-	1		µC
I_{RRM}	Reverse recovery current		-	8		A
t_{rr}	Reverse recovery time	I_{SD} = 2 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_J = 150 °C (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	285		ns
Q_{rr}	Reverse recovery charge		-	1.45		µC
I_{RRM}	Reverse recovery current		-	7.5		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

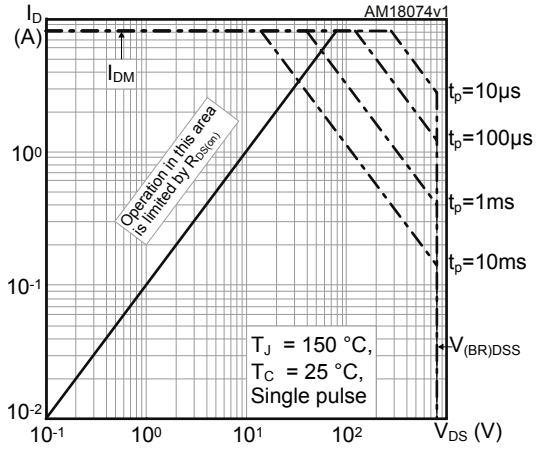


Figure 2. Thermal impedance

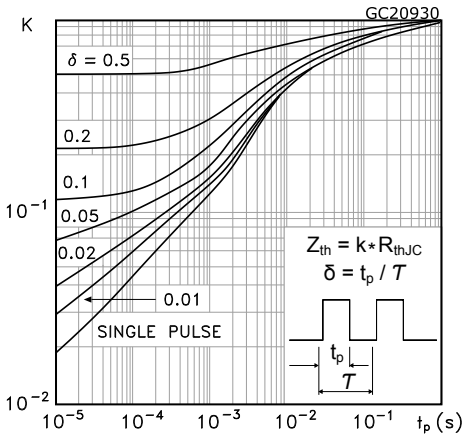


Figure 3. Output characteristics

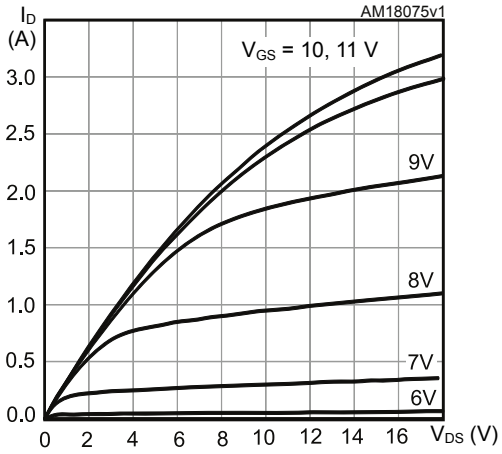


Figure 4. Transfer characteristics

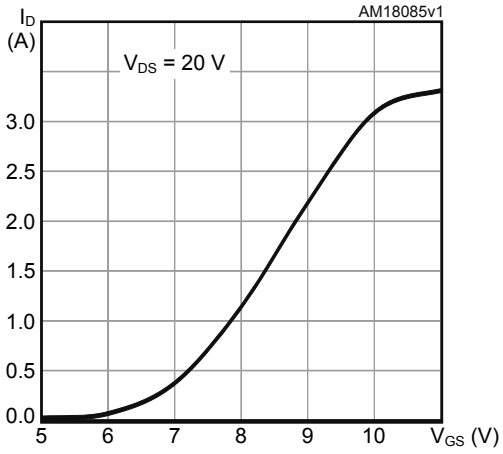


Figure 5. Gate charge vs gate-source voltage

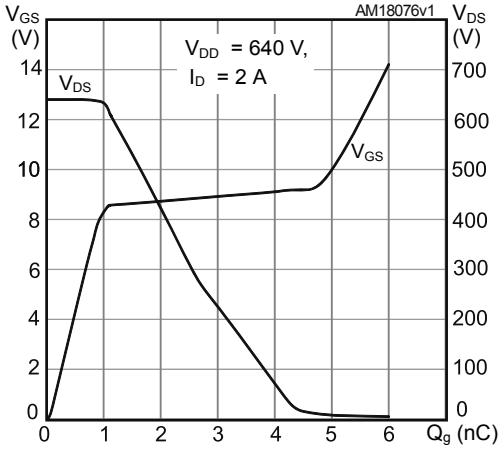


Figure 6. Static drain-source on-resistance

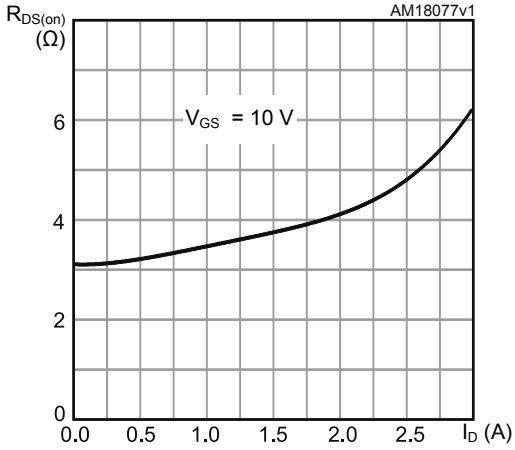


Figure 7. Capacitance variations

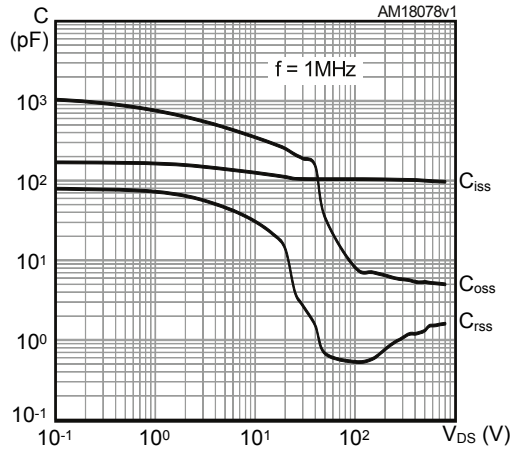


Figure 8. Output capacitance stored energy

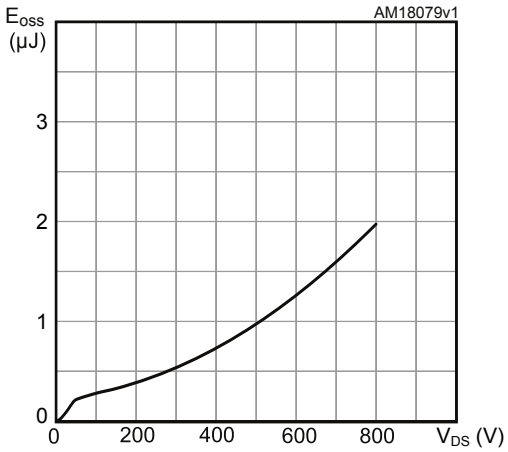


Figure 9. Normalized gate threshold voltage vs temperature

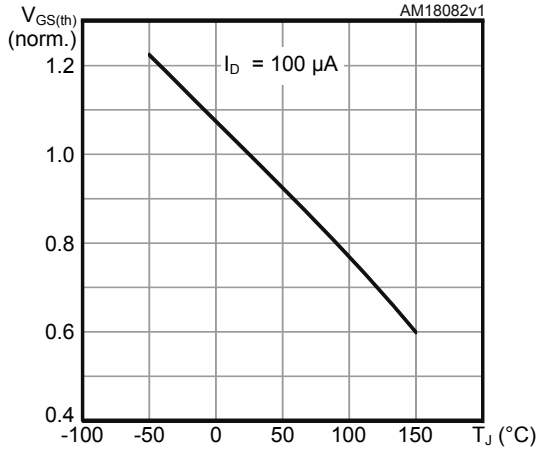


Figure 10. Normalized on-resistance vs temperature

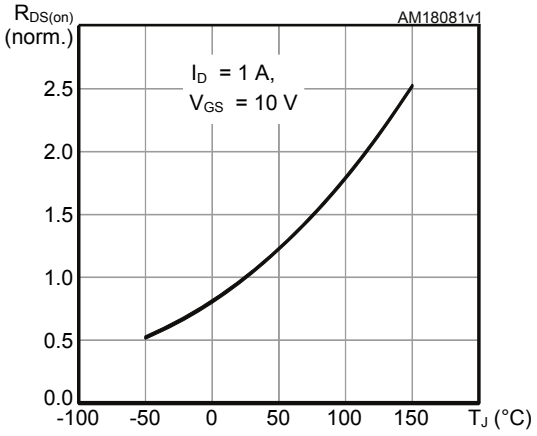


Figure 11. Normalized $V_{(BR)DSS}$ vs temperature

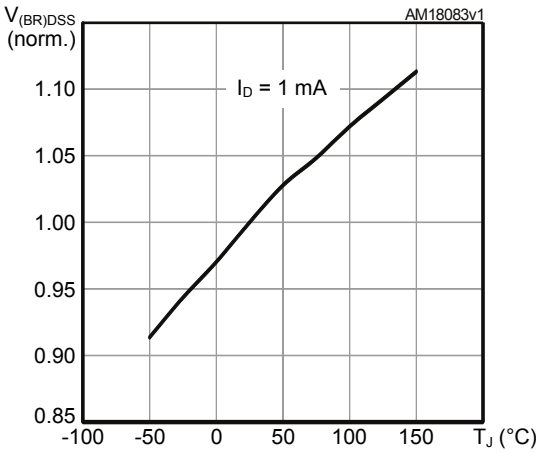


Figure 12. Source-drain diode forward characteristics

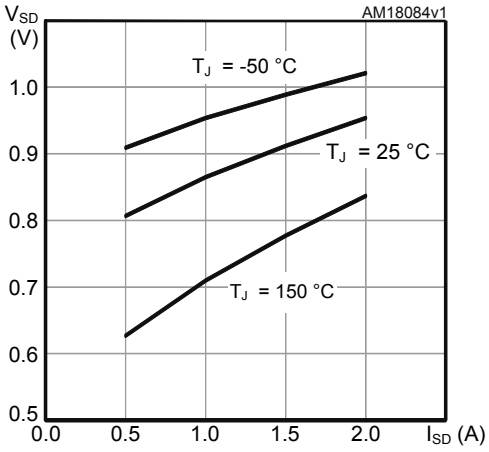
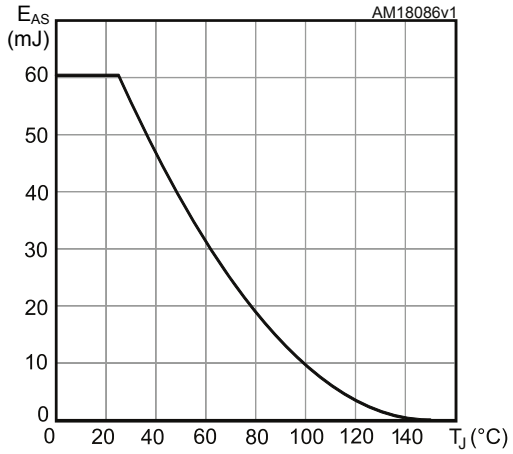
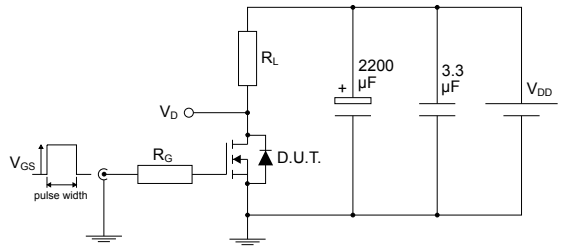


Figure 13. **Maximum avalanche energy vs starting T_J**



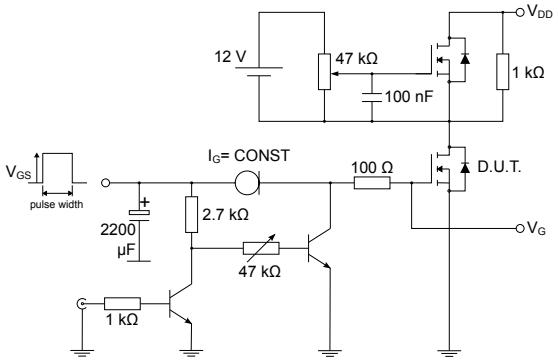
3 Test circuits

Figure 14. Test circuit for resistive load switching times



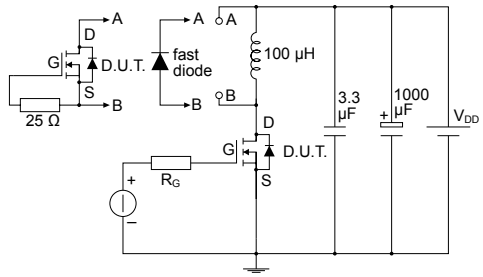
AM01468v1

Figure 15. Test circuit for gate charge behavior



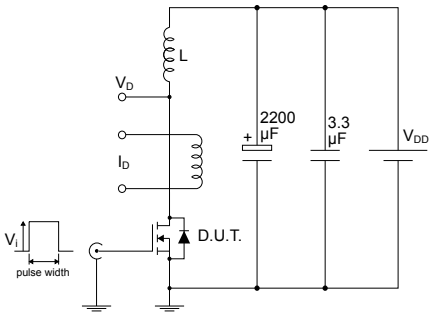
AM01469v1

Figure 16. Test circuit for inductive load switching and diode recovery times



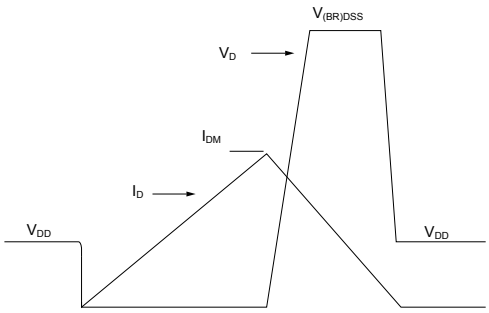
AM01470v1

Figure 17. Unclamped inductive load test circuit



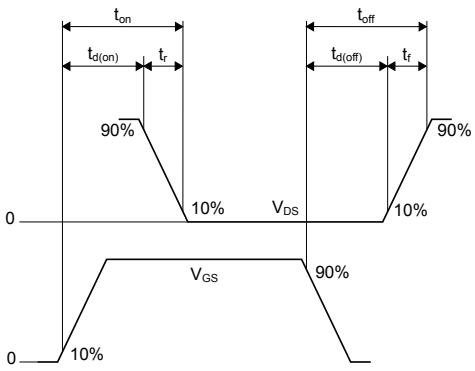
AM01471v1

Figure 18. Unclamped inductive waveform



AM01472v1

Figure 19. 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-220 type A package information

Figure 20. TO-220 type A package outline

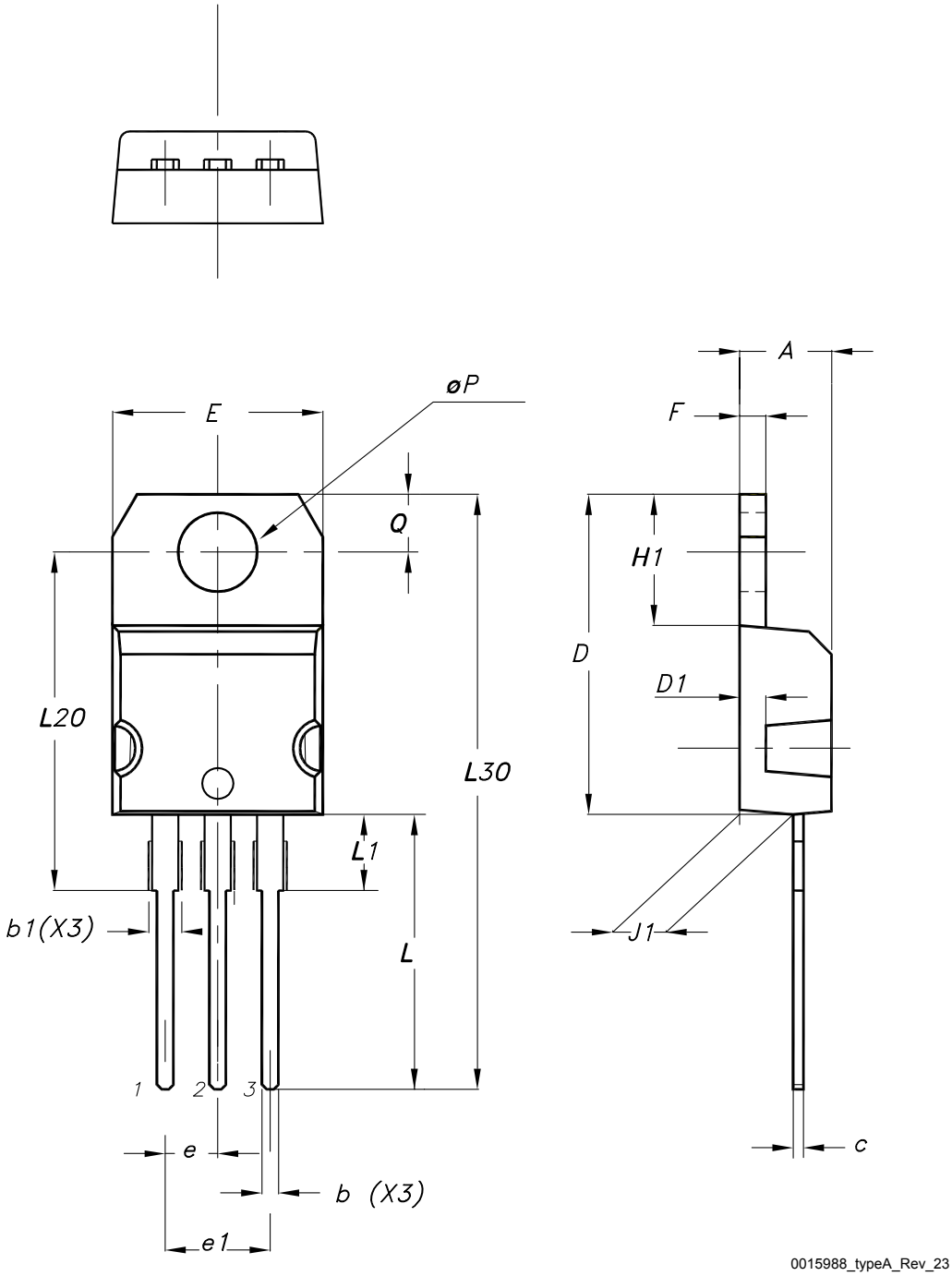
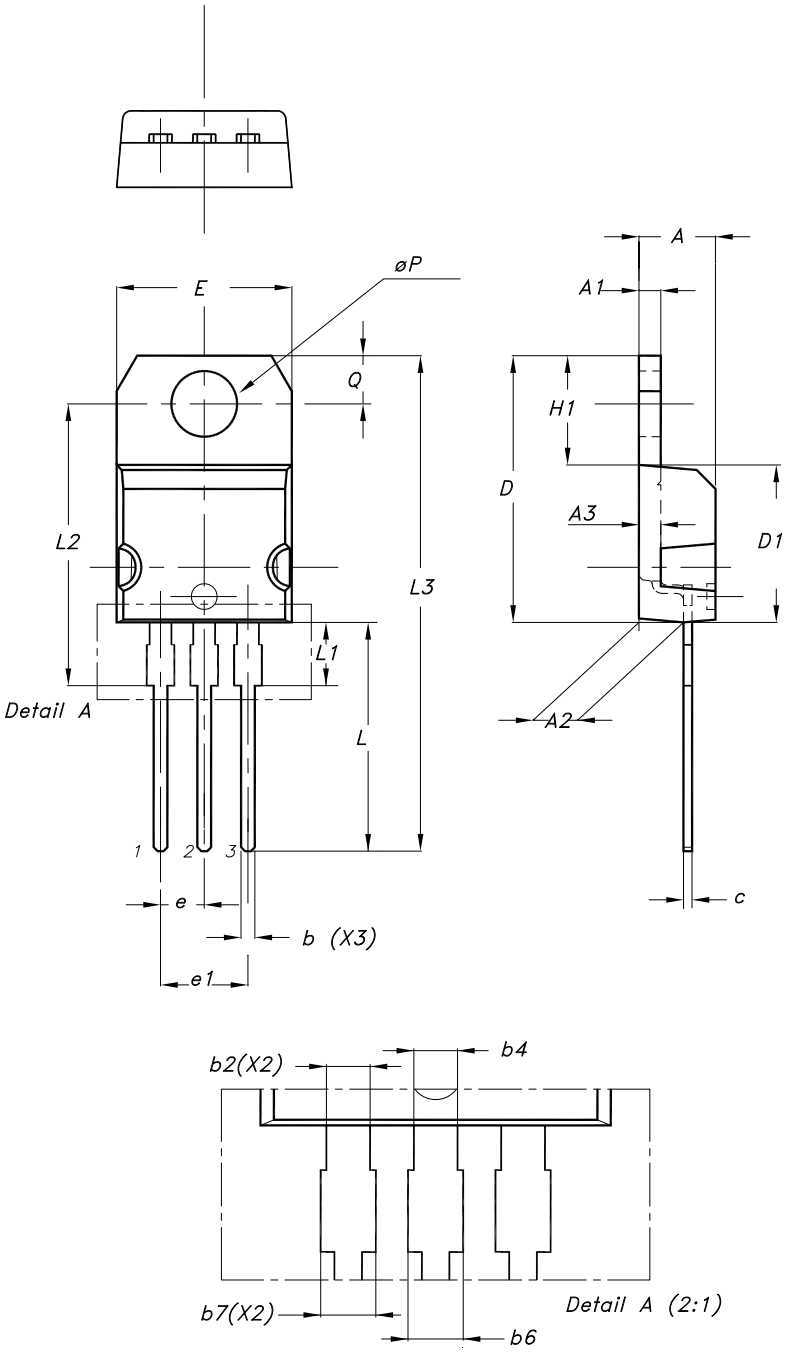


Table 8. **TO-220 type A package mechanical data**

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

4.2 TO-220 type H package information

Figure 21. **TO-220 type H package outline**



0015988_H_23

Table 9. **TO-220 type H package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40	4.45	4.50
A1	1.22		1.32
A2	2.49	2.59	2.69
A3	1.17	1.27	1.37
b	0.78		0.87
b2	1.25		1.34
b4	1.20		1.29
b6			1.50
b7			1.45
c	0.49		0.56
D	15.40	15.50	15.60
D1	9.05	9.15	9.25
E	10.08	10.18	10.28
e	2.44	2.54	2.64
e1	4.98	5.08	5.18
H1	6.25	6.35	6.45
L	13.20	13.40	13.60
L1	3.50	3.70	3.90
L2	16.30	16.40	16.50
L3	28.70	28.90	29.10
∅P	3.75	3.80	3.85
Q	2.70	2.80	2.90
Slug flatness		0.03	0.10

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
07-Dec-2023	1	First release. The part number STP2N80K5 was previously inserted in the DS9820.

Contents