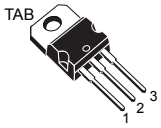
STH12N120K5-2, STP12N120K5
STW12N120K5, STWA12N120K5

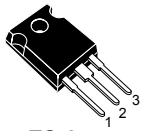
Datasheet

N-channel 1200 V, 620 mΩ typ., 12 A MDmesh K5 Power MOSFETs in H²PAK-2, TO-220, TO-247 and TO-247 long leads packages

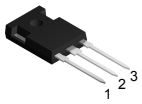
H²PAK-2



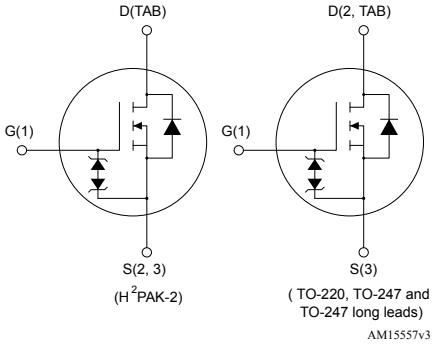
TO-220



TO-247



TO-247 long leads



Features

Order codes	V_{DS}	$R_{DS(on)}$ max.	I_D
STH12N120K5-2	1200 V	690 mΩ	12 A
STP12N120K5			
STW12N120K5			
STWA12N120K5			

- Very low FoM (figure of merit)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

These very high voltage N-channel Power MOSFETs are 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.

STPOWER

Product status links
STH12N120K5-2
STP12N120K5
STW12N120K5
STWA12N120K5

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	12	A
	Drain current (continuous) at T_C = 100 °C	7.6	
I_{DM}(1)	Drain current (pulsed)	48	A
P_{TOT}	Total power dissipation at T_C = 25 °C	250	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 limited by safe operating area.*
2. *I_{SD} ≤ 12 A, V_{DS} (peak) < $V_{(BR)DSS}$, di/dt = 100 A/µs.*
3. *V_{DD} = 960 V.*

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		H²PAK-2	TO-220	TO-247, TO-247 long leads	
R_{thJC}	Thermal resistance, junction-to-case	0.5			°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	30(1)	62.5	50	°C/W

1. *When mounted on a standard 1 inch² 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.)	4	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	215	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	1200			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 1200 V			1	µA
		V_{GS} = 0 V, V_{DS} = 1200 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 = 100 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 6 A		620	690	mΩ

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} = 100 V, f = 1 kHz, V_{GS} = 0 V	-	1370	-	pF
C_{oss}	Output capacitance		-	110	-	pF
C_{rss}	Reverse transfer capacitance		-	0.6	-	pF
$C_{o(tr)}$ (1)	Equivalent capacitance, time-related	V_{DS} = 0 to 960 V, V_{GS} = 0 V	-	128	-	pF
$C_{o(er)}$ (2)	Equivalent capacitance, energy-related		-	42	-	pF
R_g	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	3	-	Ω
Q_g	Total gate charge	V_{DD} = 960 V, I_D = 12 A, V_{GS} = 0 to 10 V (see Figure 16. Test circuit for gate charge behavior)	-	44.2	-	nC
Q_{gs}	Gate-source charge		-	7.3	-	nC
Q_{gd}	Gate-drain charge		-	30	-	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} = 600 V, I_D = 6 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)	-	23	-	ns
t_r	Rise time		-	11	-	ns
$t_{d(off)}$	Turn-off delay time		-	68.5	-	ns
t_f	Fall time		-	18.5	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		12	A
I_{SDM}(1)	Source-drain current (pulsed)		-		48	A
V_{SD}(2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 12 A	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 12 A, di/dt = 100 A/µs, V_{DD} = 60 V (see Figure 17. Test circuit for inductive load switching and diode recovery times)	-	630		ns
Q_{rr}	Reverse recovery charge		-	12.6		µC
I_{RRM}	Reverse recovery current		-	40		A
t_{rr}	Reverse recovery time	I_{SD} = 12 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_J = 150 °C (see Figure 17. Test circuit for inductive load switching and diode recovery times)	-	892		ns
Q_{rr}	Reverse recovery charge		-	15.6		µC
I_{RRM}	Reverse recovery current		-	35		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 for H²PAK-2 and TO-220

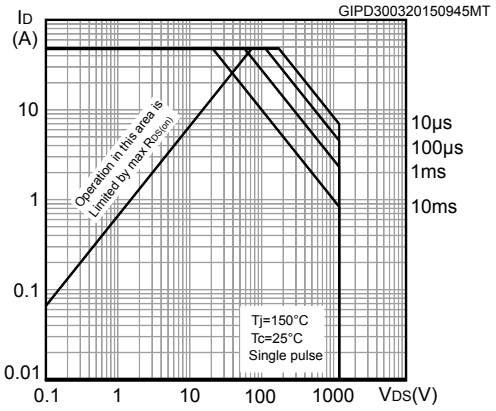


Figure 2. Normalized transient thermal impedance for H²PAK-2 and TO-220

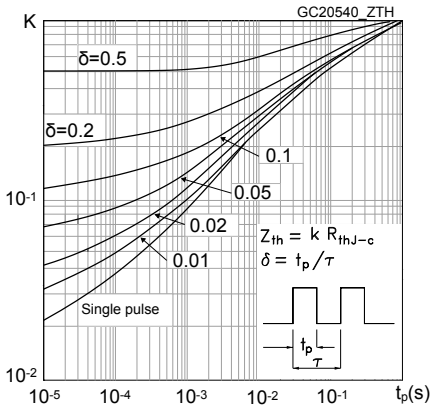


Figure 3. Safe operating area for TO-247 and TO-247 long leads

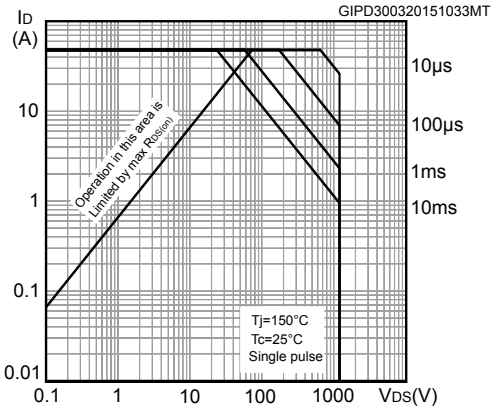


Figure 4. Normalized transient thermal impedance for TO-247 and TO-247 long leads

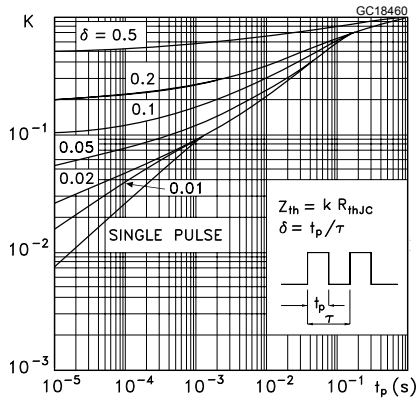


Figure 5. Typical output characteristics

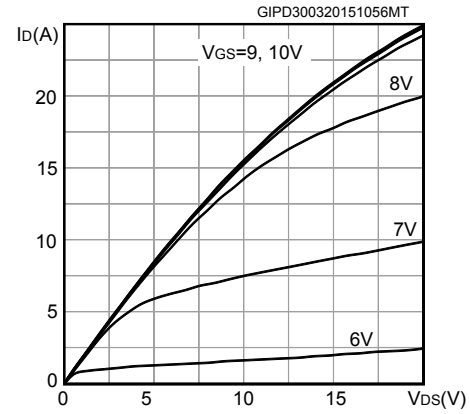


Figure 6. Typical transfer characteristics

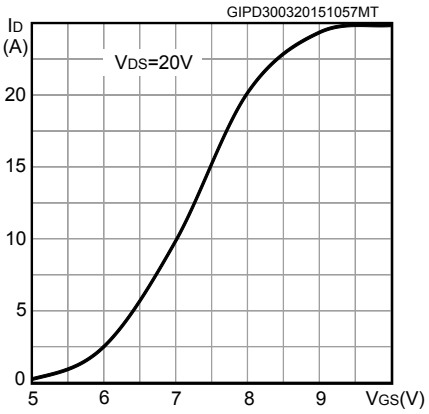


Figure 7. Typical gate charge characteristics

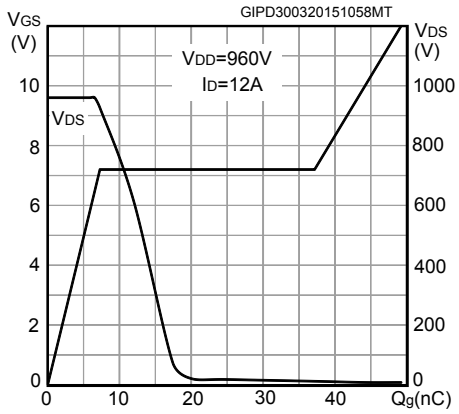


Figure 8. Typical capacitance characteristics

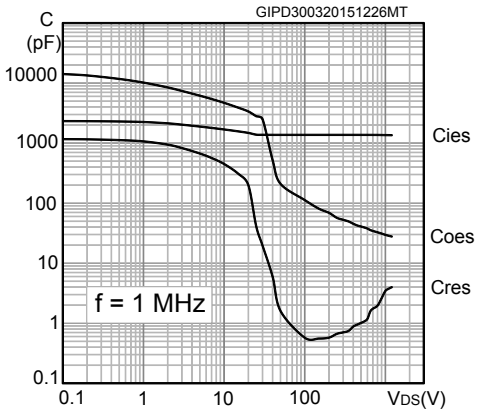


Figure 9. Typical drain-source on-resistance

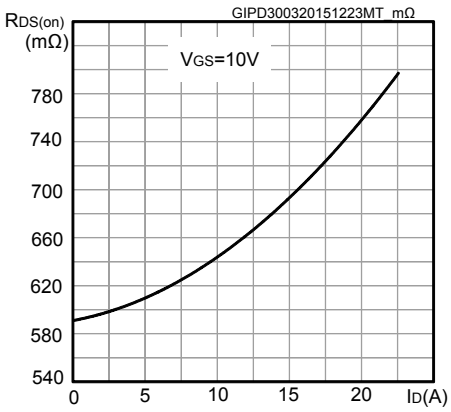


Figure 10. Normalized on-resistance vs temperature

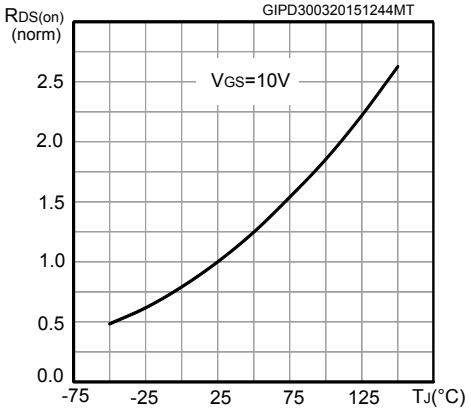


Figure 11. Normalized gate threshold vs temperature

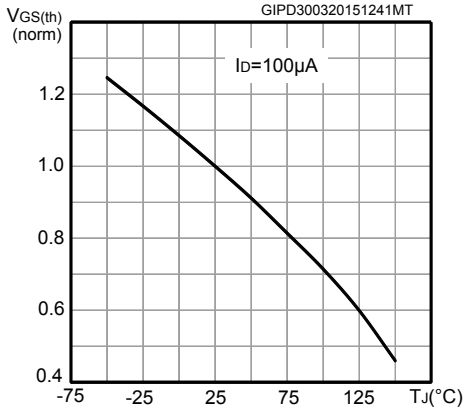


Figure 12. Normalized breakdown voltage vs temperature

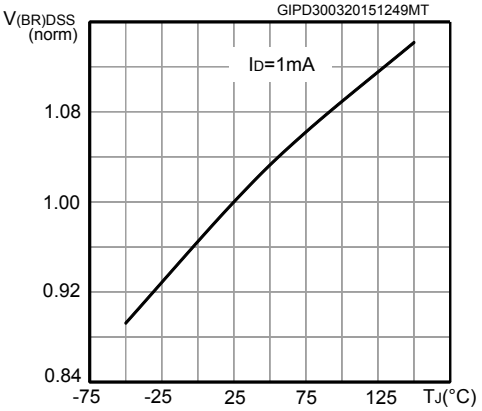


Figure 13. Typical reverse diode forward characteristics

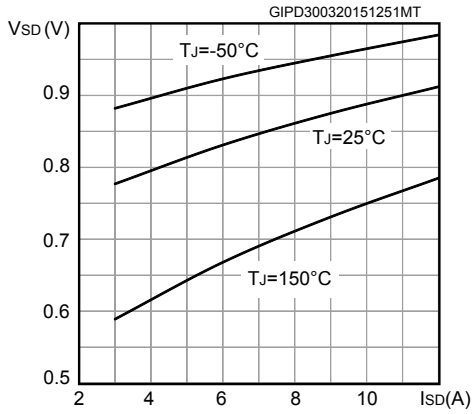
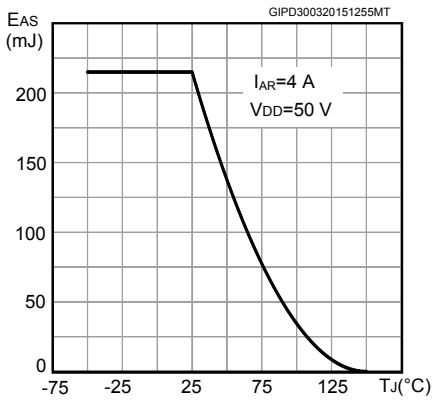
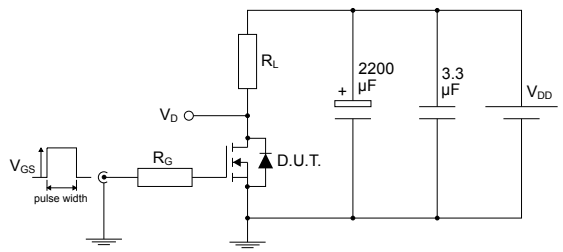


Figure 14. Maximum output capacitance stored energy



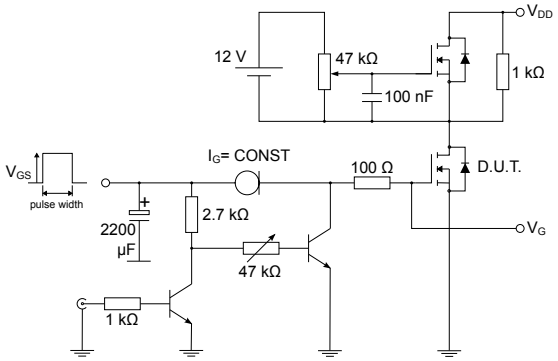
3 Test circuits

Figure 15. Test circuit for resistive load switching times



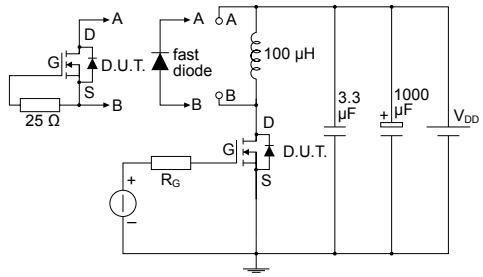
AM01468v1

Figure 16. Test circuit for gate charge behavior



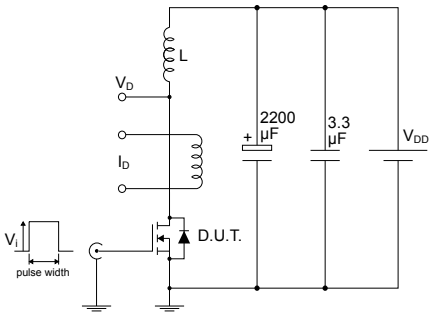
AM01469v1

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



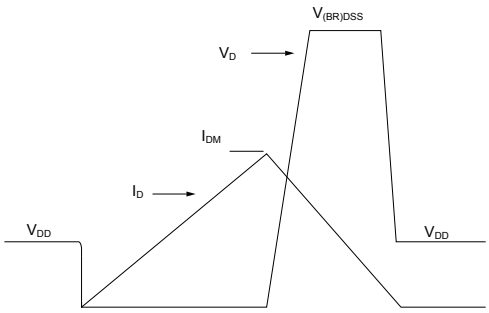
AM01470v1

Figure 18. Unclamped inductive load test circuit



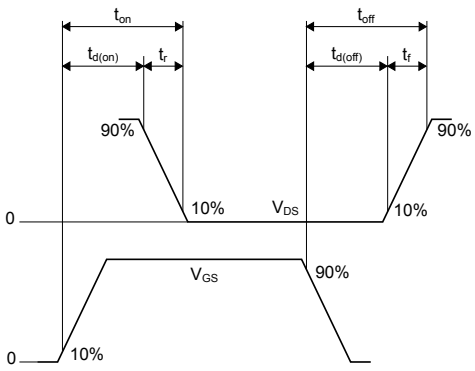
AM01471v1

Figure 19. Unclamped inductive waveform



AM01472v1

Figure 20. 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 H²PAK-2 package information

Figure 21. H²PAK-2 package outline

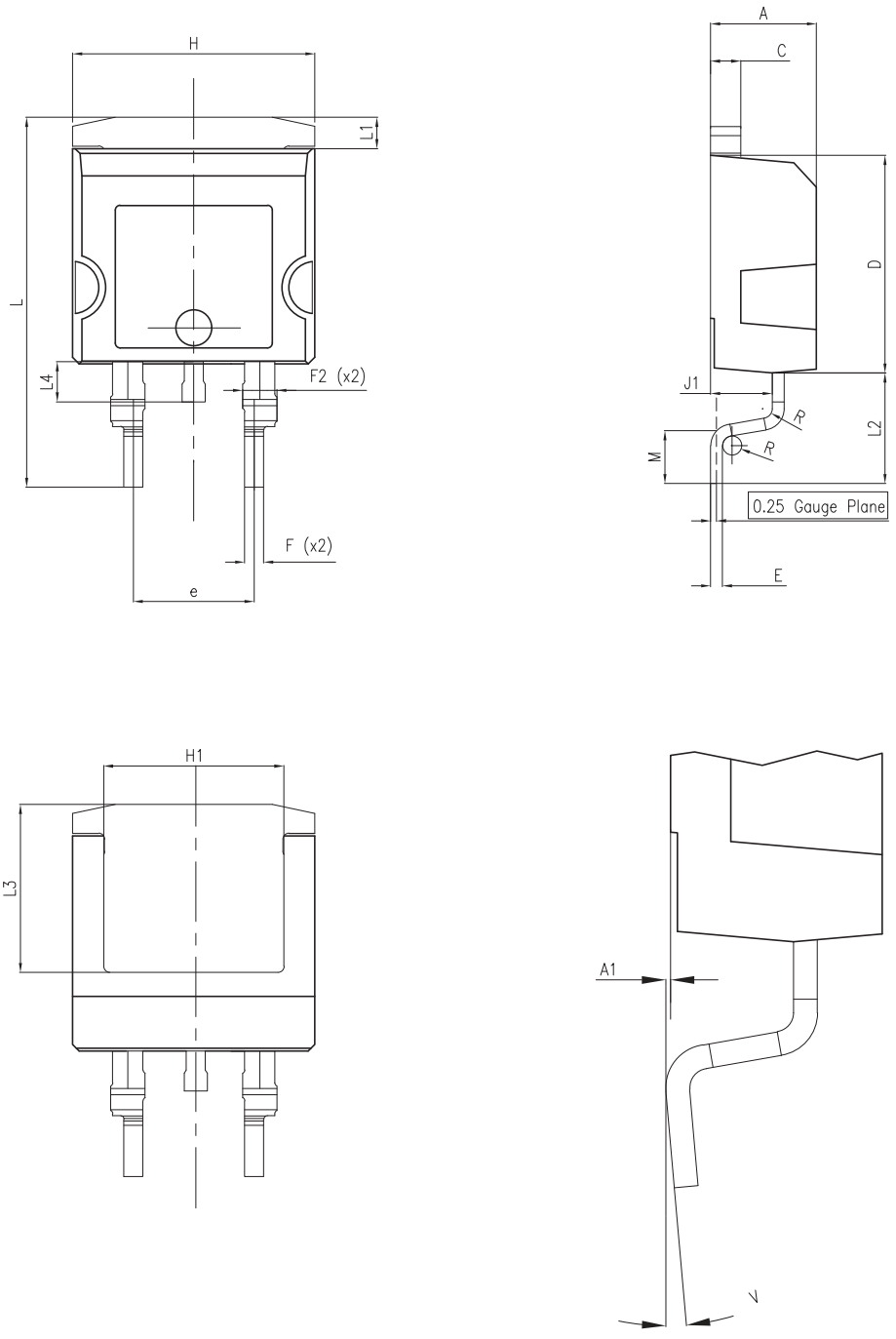
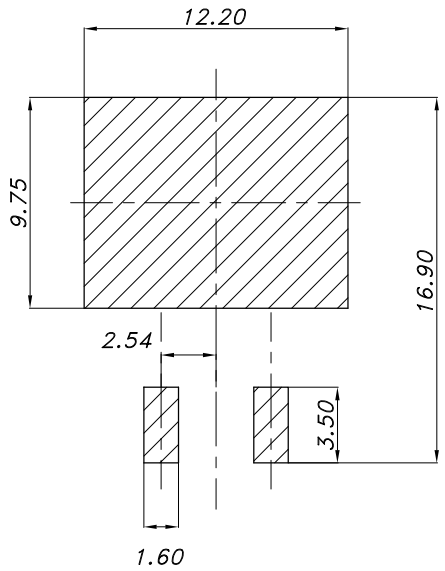


Table 8. **H²PAK-2 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.30		4.70
A1	0.03		0.20
C	1.17		1.37
D	8.95		9.35
e	4.98		5.18
E	0.50		0.90
F	0.78		0.85
F2	1.14		1.70
H	10.00		10.40
H1	7.40	-	7.80
J1	2.49		2.69
L	15.30		15.80
L1	1.27		1.40
L2	4.93		5.23
L3	6.85		7.25
L4	1.50		1.70
M	2.60		2.90
R	0.20		0.60
V	0°		8°

Figure 22. **H²PAK-2 recommended footprint**



8159712_10

Note: Dimensions are in mm.

4.2 Packing information

Figure 23. **Tape outline**

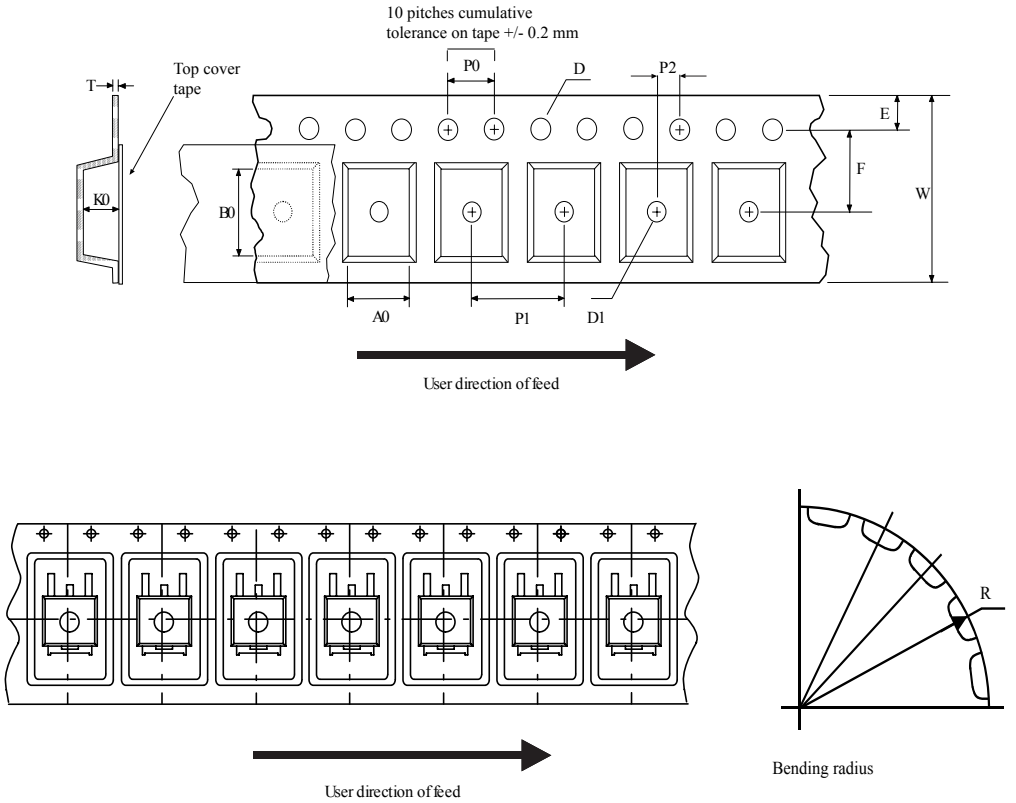


Figure 24. **Reel outline**

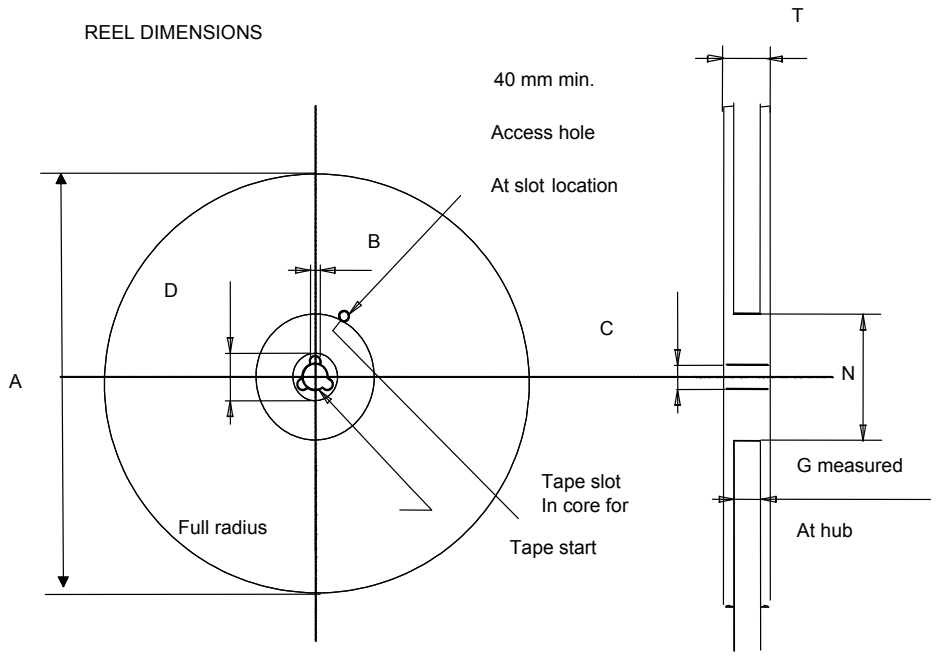


Table 9. Tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.30	0.40			
W	23.7	24.3			

4.3 TO-220 type A package information

Figure 25. **TO-220 type A package outline**

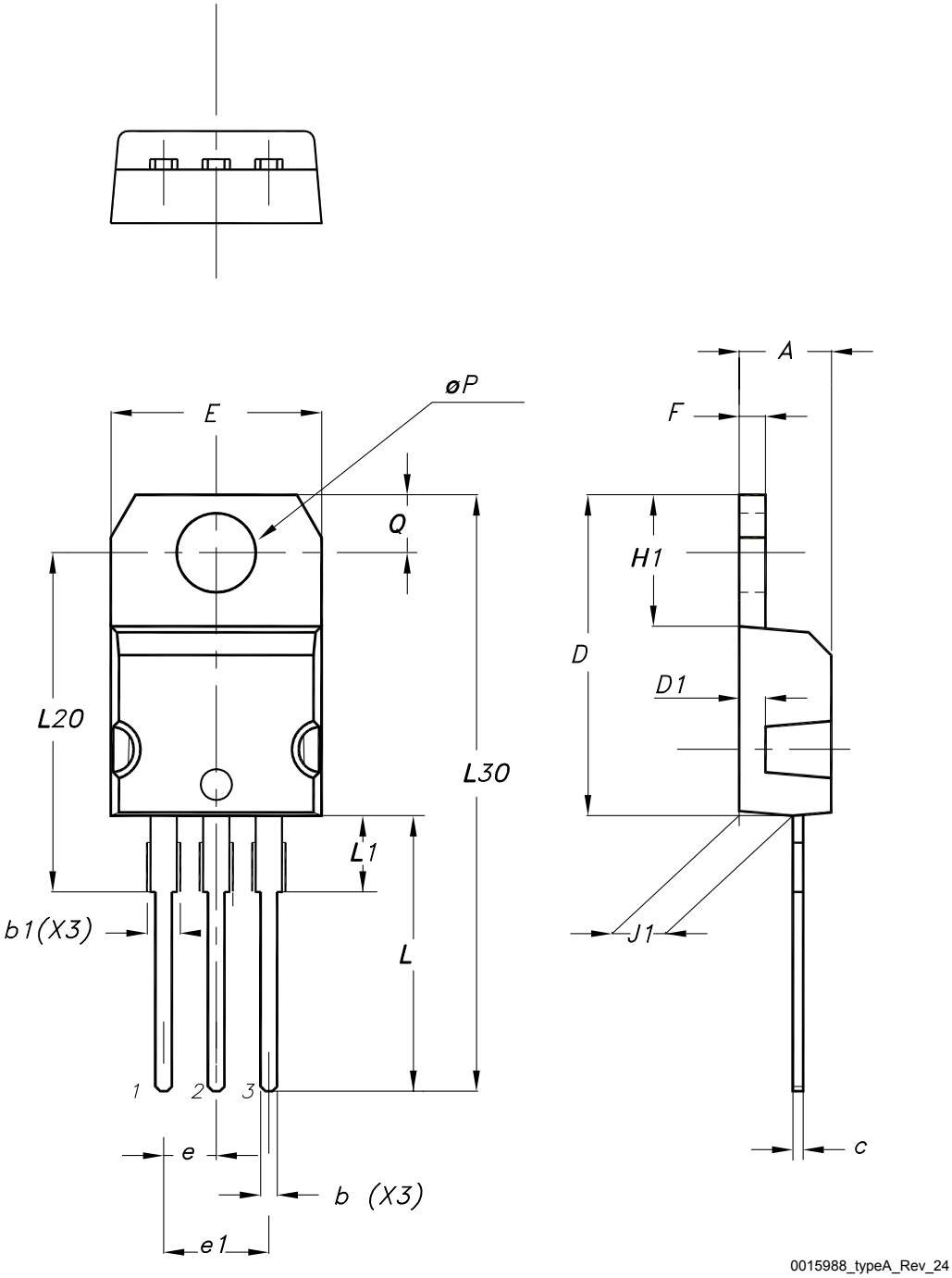
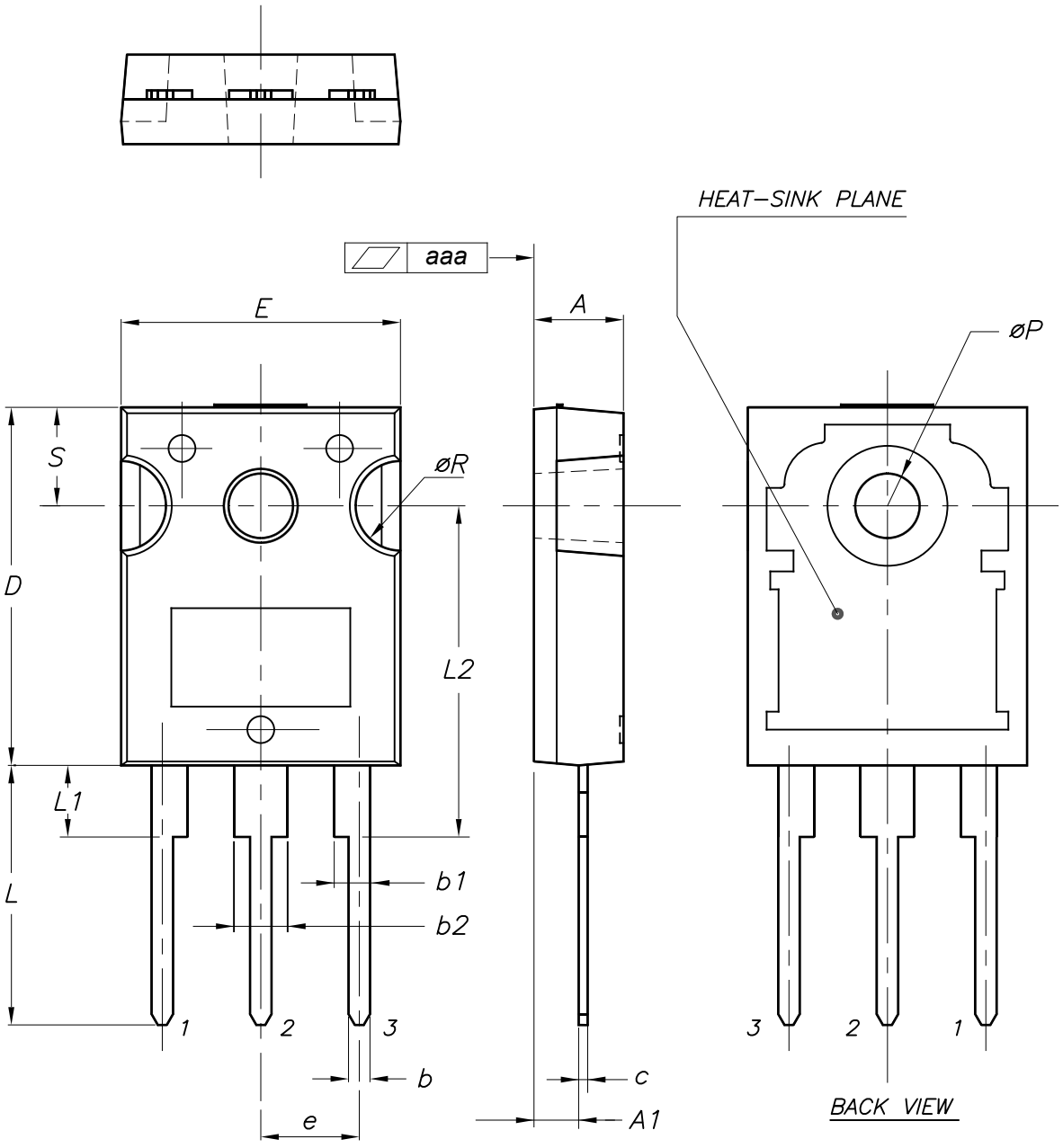


Table 10. **TO-220 type A package mechanical data**

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

4.4 TO-247 package information

Figure 26. **TO-247 package outline**



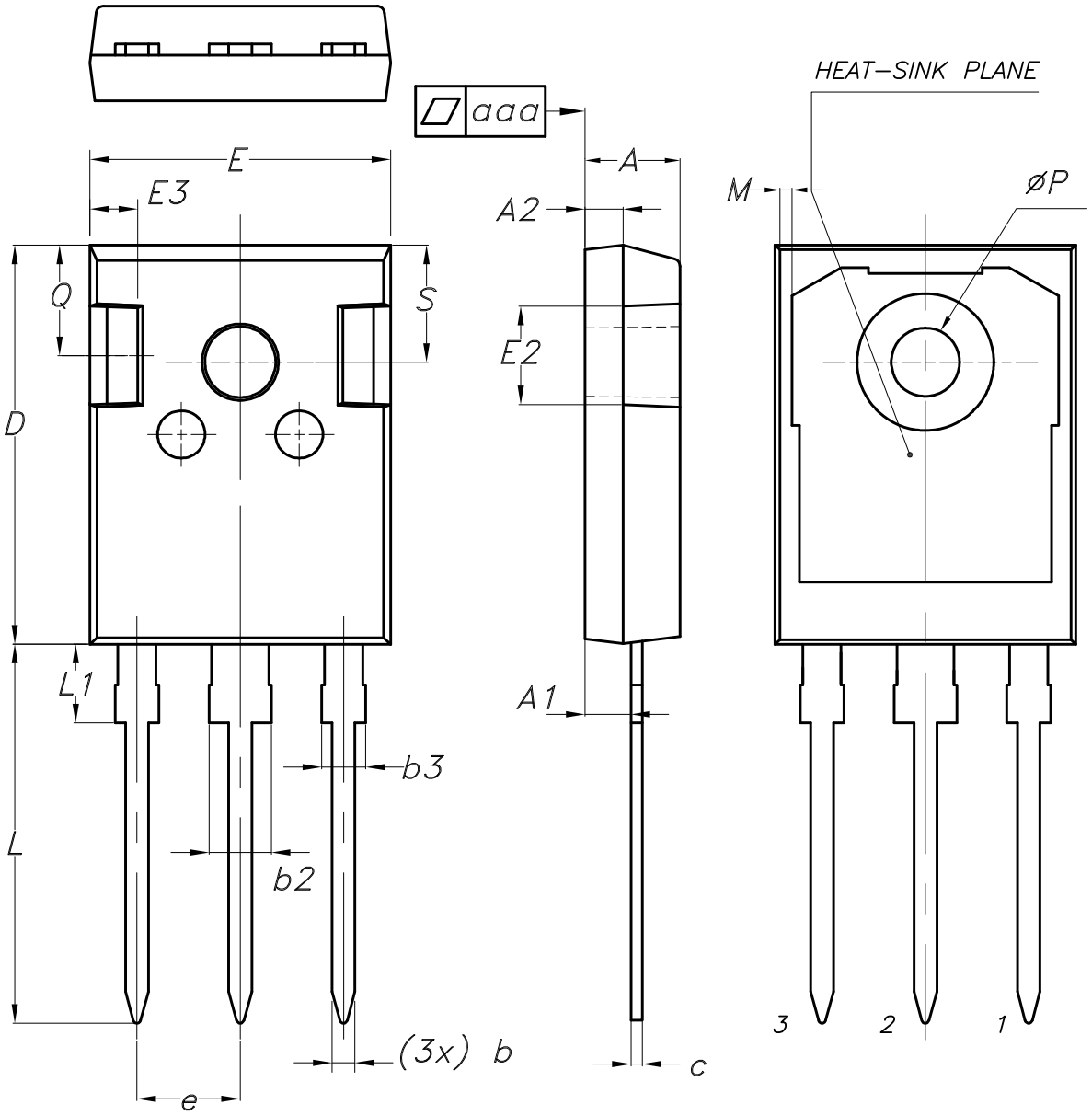
0075325_10

Table 11. **TO-247 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70
aaa		0.04	0.10

4.5 TO-247 long leads package information

Figure 27. **TO-247 long leads package outline**



8463846_6

Table 12. **TO-247 long leads package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16		1.26
b2			3.25
b3			2.25
c	0.59		0.66
D	20.90	21.00	21.10
E	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
M	0.35		0.95
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25
aaa		0.04	0.10

5 Ordering information

Table 13. **Order codes**

Order codes	Marking	Package	Packing
STH12N120K5-2	12N120K5	H²PAK-2	Tape and reel
STP12N120K5		TO-220	Tube
STW12N120K5		TO-247	
STWA12N120K5		TO-247 long leads	

Revision history

Table 14. **Document revision history**

Date	Revision	Changes
23-Aug-2011	1	First release.
17-Jan-2013	2	• Minor text changes • Added: H^2PAK package • The part number STB12N120K5 has been moved to a separate datasheet • Updated: *Section package information* • Updated: mechanical data for TO-247 package
16-May-2014	3	• The part numbers STFW12N120K5 has been moved to a separate datasheet • Added: TO-247 long leads package • Modified: I_{AR}, E_{AS}, dv/dt values in *Table 2: "Absolute maximum ratings"* • Modified: the entire typical values in *Table 5: "Dynamic"*, *Table 6: "Switching times"* and *Table 7: "Source drain diode"* • Added: *Section 2.1: "Electrical characteristics (curves)"* • Minor text changes
08-Apr-2015	4	Updated title and description in cover page. Updated *Table 4: "On/off states"*, *Table 5: "Dynamic"*, *Figure 9: "Static drain-source on-resistance"* and *Figure 10: "Capacitance variations"*. Minor text change.
24-Mar-2025	5	Updated Section 4: Package information. Minor text changes.

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