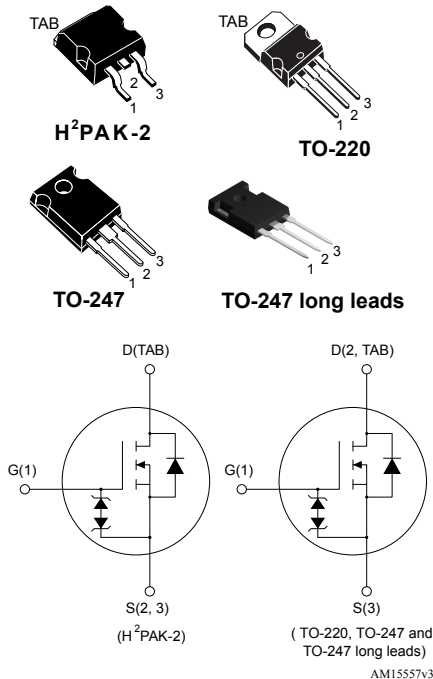




STH12N120K5-2, STP12N120K5 STW12N120K5, STWA12N120K5

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



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.



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 $T_C = 25\text{ }^\circ\text{C}$	12	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	7.6	
$I_{DM}^{(1)}$	Drain current (pulsed)	48	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	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	$^\circ\text{C}$
T_J	Operating junction temperature range		$^\circ\text{C}$

1. Pulse width limited by safe operating area.

2. $I_{SD} \leq 12\text{ A}$, $V_{DS}(\text{peak}) < V_{(BR)DSS}$, $di/dt = 100\text{ A}/\mu\text{s}$.

3. $V_{DD} = 960\text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		H ² PAK-2	TO-220	TO-247, TO-247 long leads	
R_{thJC}	Thermal resistance, junction-to-case	0.5			$^\circ\text{C}/\text{W}$
R_{thJA}	Thermal resistance, junction-to-ambient	30 ⁽¹⁾	62.5	50	$^\circ\text{C}/\text{W}$

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 $T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	215	mJ

2 Electrical characteristics

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

Table 4. On/off-states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	1200			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 1200\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 1200\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}$ ⁽¹⁾			50	
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 6\text{ A}$		620	690	m 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	$V_{DS} = 100\text{ V}$, $f = 1\text{ kHz}$, $V_{GS} = 0\text{ V}$	-	1370	-	pF
C_{oss}	Output capacitance		-	110	-	pF
C_{rss}	Reverse transfer capacitance		-	0.6	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance, time-related	$V_{DS} = 0\text{ to }960\text{ V}$, $V_{GS} = 0\text{ V}$	-	128	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance, energy-related		-	42	-	pF
R_g	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	3	-	Ω
Q_g	Total gate charge	$V_{DD} = 960\text{ V}$, $I_D = 12\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (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	$V_{DD} = 600\text{ V}$, $I_D = 6\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	23	-	ns
t_r	Rise time		-	11	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 15. Test circuit for resistive load switching times and Figure 20. Switching time waveform)	-	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	$V_{GS} = 0\text{ V}$, $I_{SD} = 12\text{ A}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (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	$I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (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)

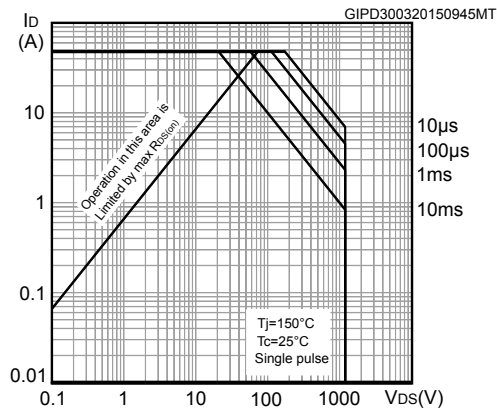
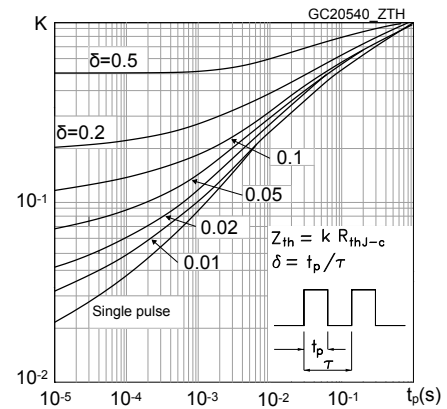
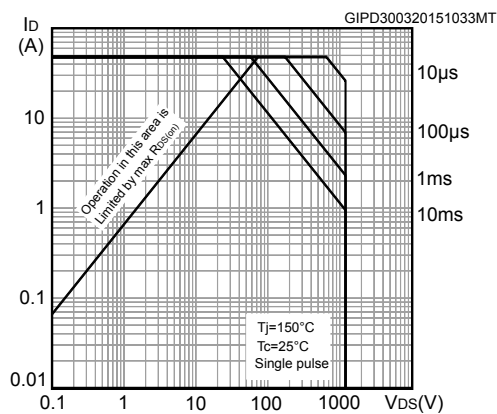
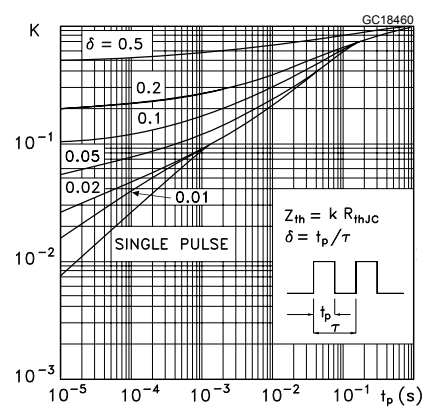
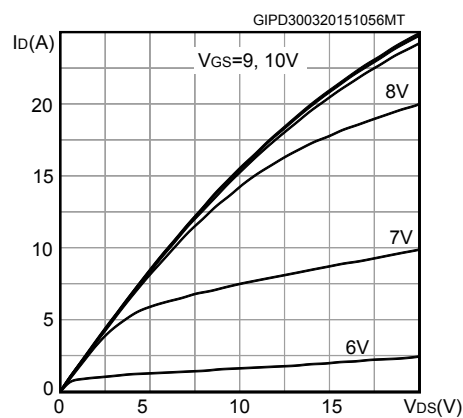
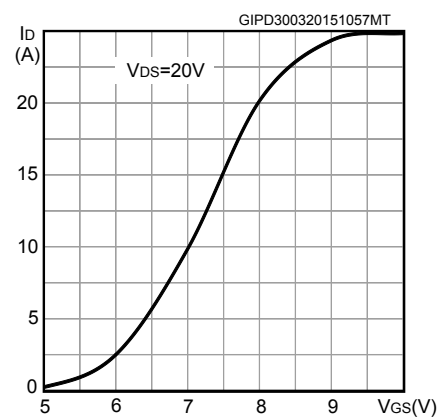
Figure 1. Safe operating area for H²PAK-2 and TO-220

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


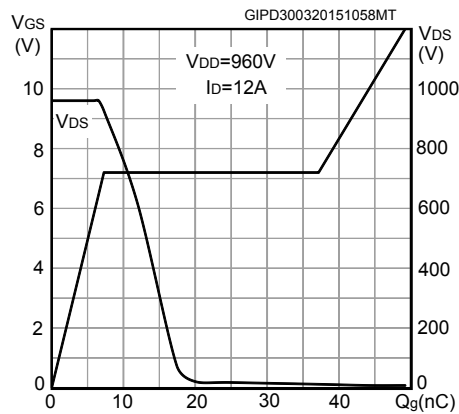
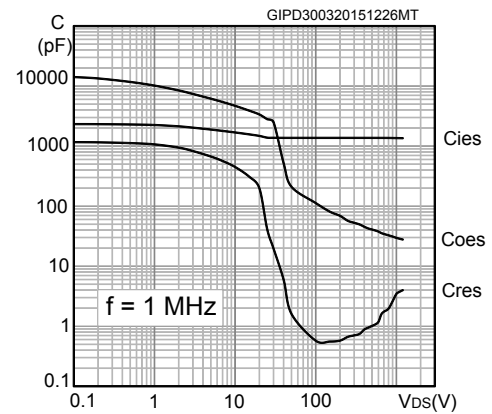
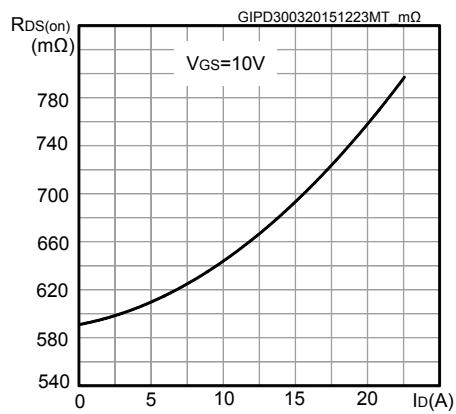
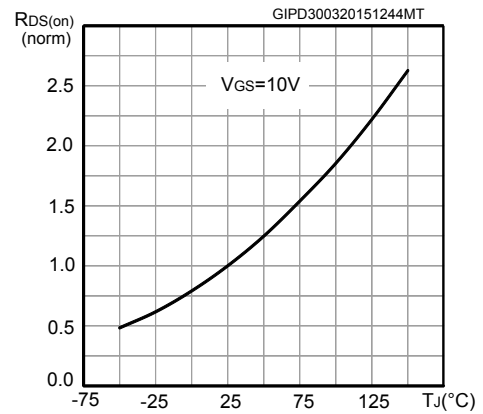
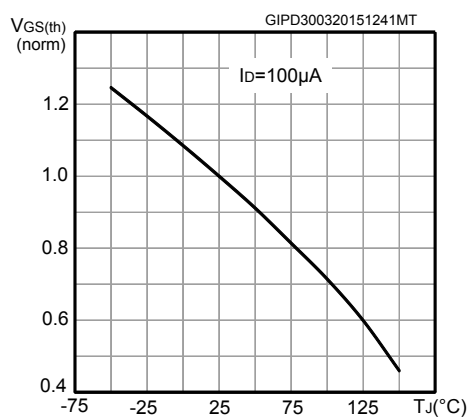
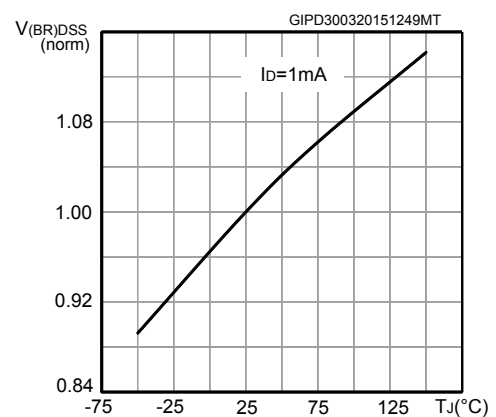
Figure 7. Typical gate charge characteristics

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

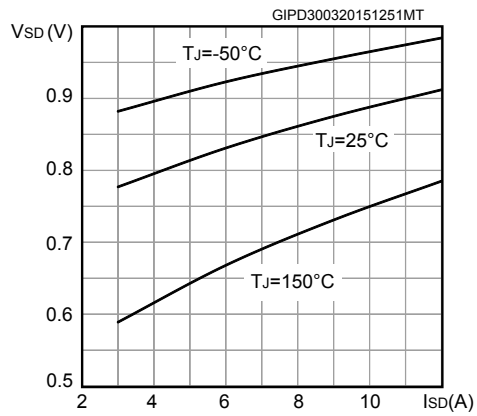
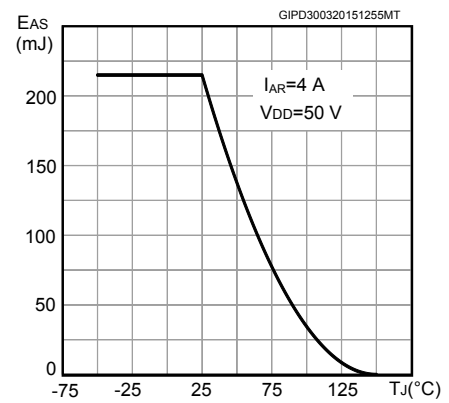
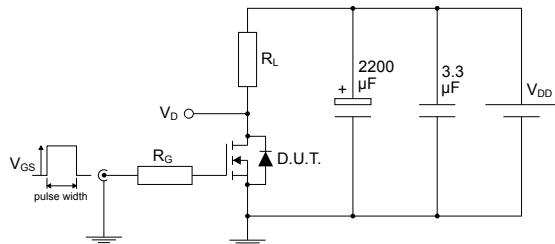


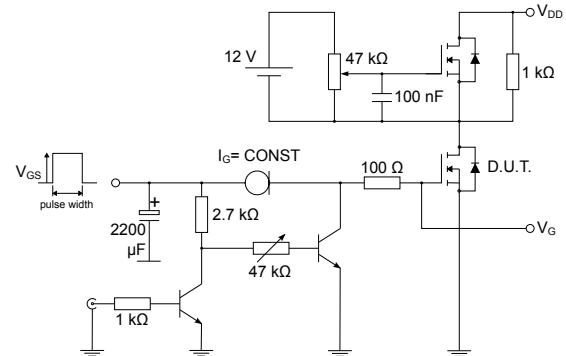
Figure 14. Maximum output capacitance stored energy



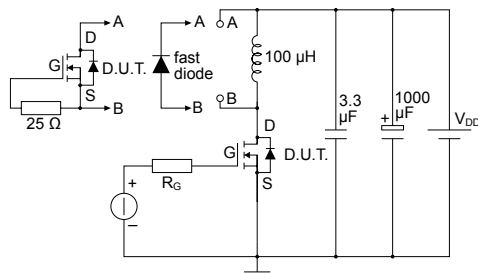
3 Test circuits

Figure 15. Test circuit for resistive load switching times


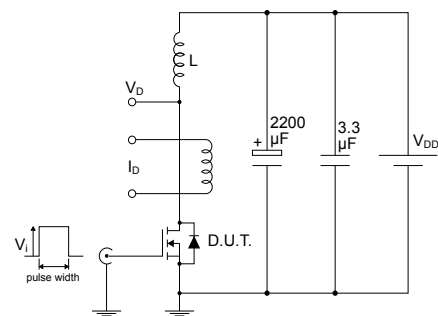
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Figure 16. Test circuit for gate charge behavior


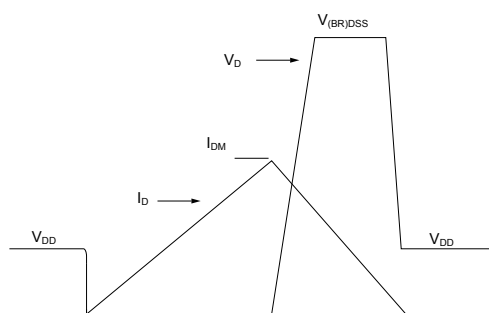
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Figure 17. Test circuit for inductive load switching and diode recovery times


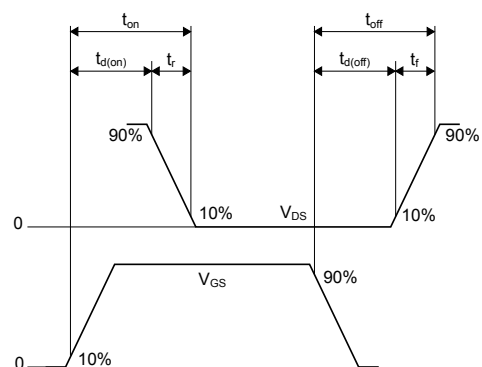
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Figure 18. Unclamped inductive load test circuit


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Figure 19. Unclamped inductive waveform


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Figure 20. Switching time waveform


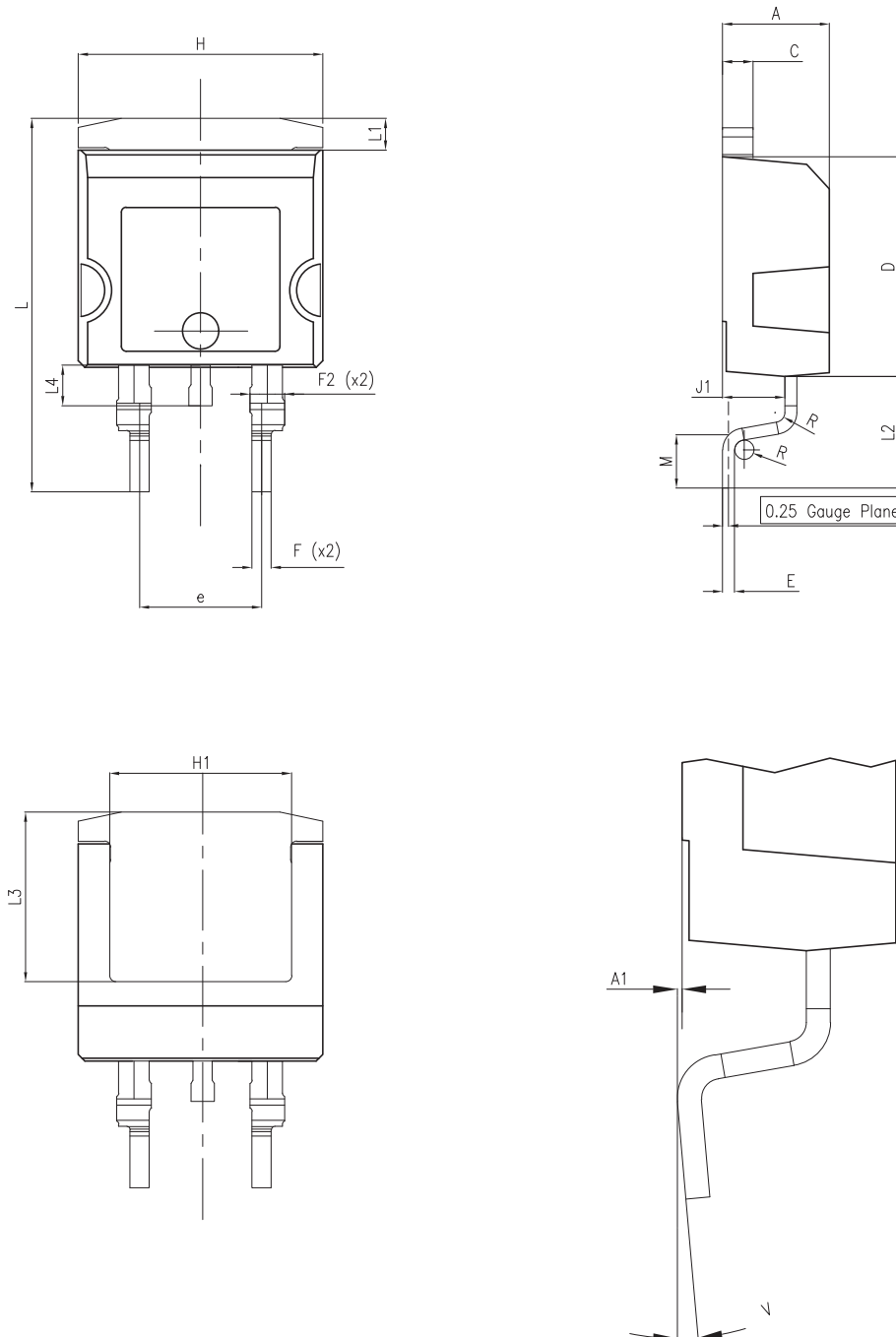
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4 Package information

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

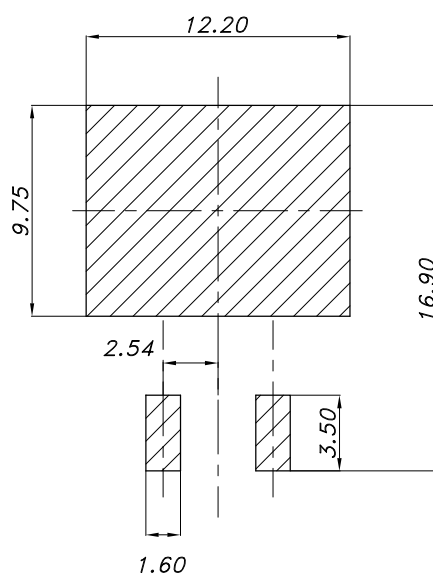
Figure 21. H²PAK-2 package outline



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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


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Note: Dimensions are in mm.

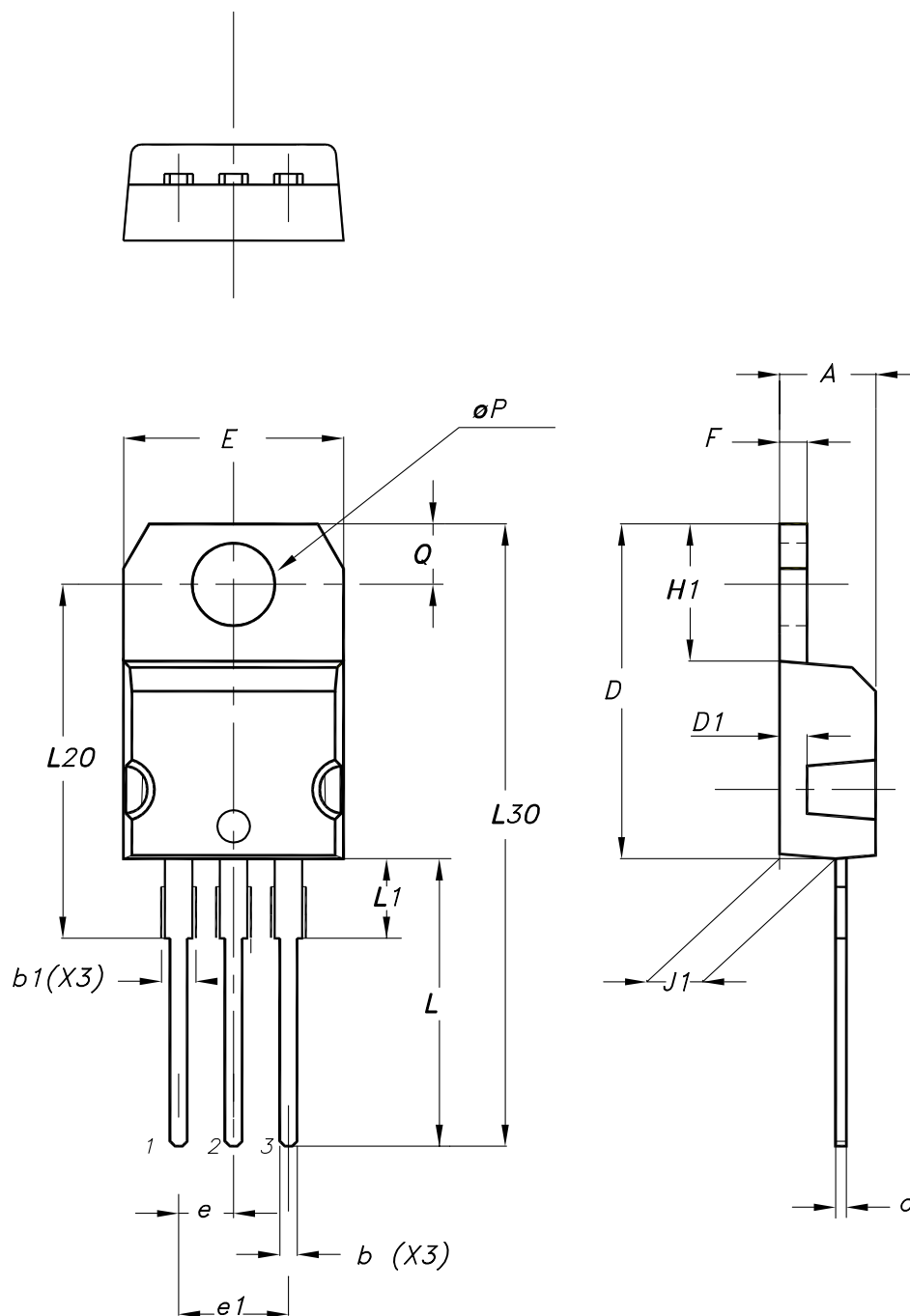


Table 9. Tape and reel mechanical data

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



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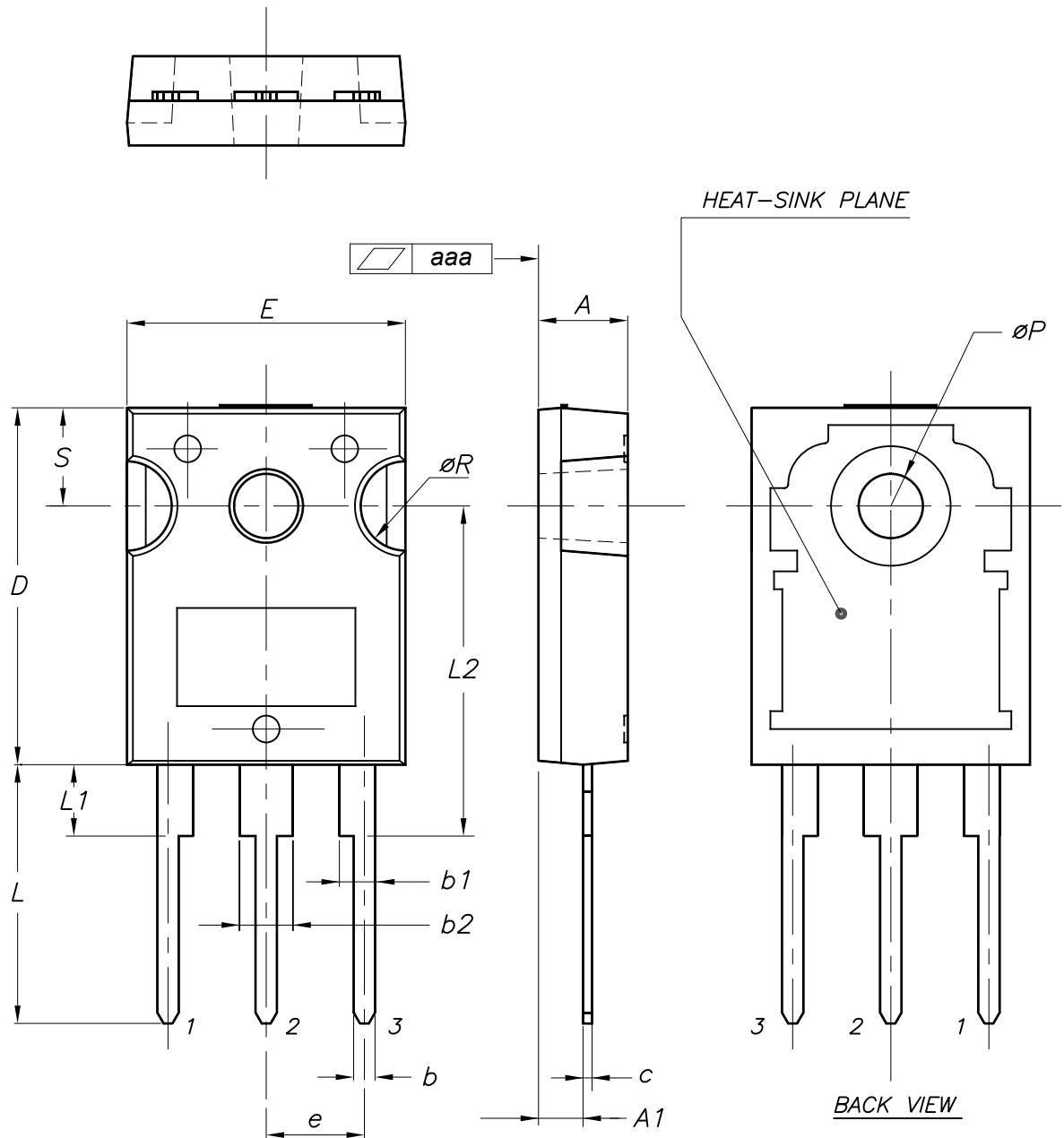


Table 10. TO-220 type A package mechanical data

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



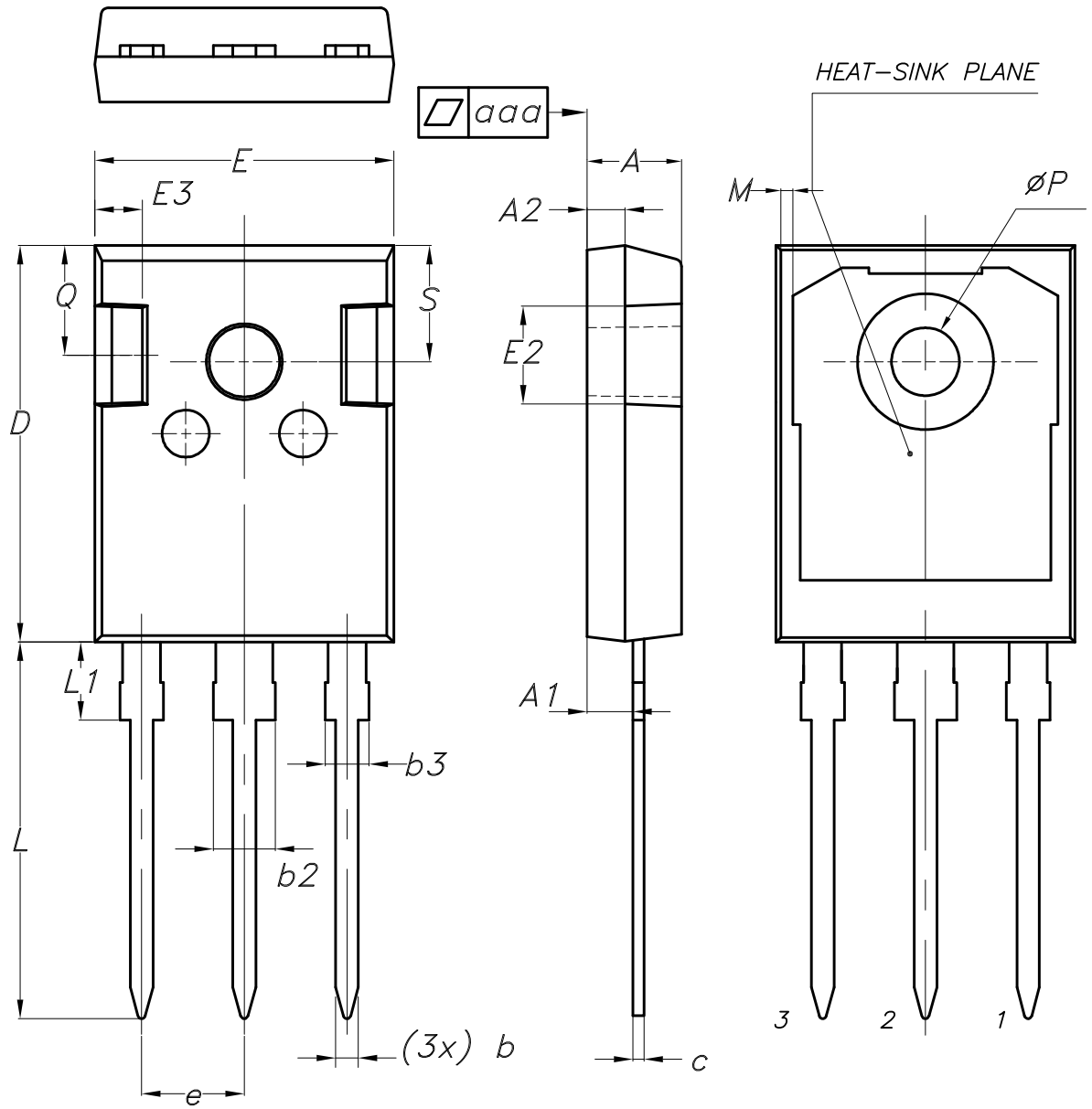
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Table 11. TO-247 package mechanical data

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



BACK VIEW

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	H ² PAK-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: H²PAK package - The part number STB12N120K5 has been moved to a separate datasheet - Updated: <i>Section package information</i> - 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 <i>Table 2: "Absolute maximum ratings"</i> - Modified: the entire typical values in <i>Table 5: "Dynamic"</i>, <i>Table 6: "Switching times"</i> and <i>Table 7: "Source drain diode"</i> - Added: <i>Section 2.1: "Electrical characteristics (curves)"</i> - Minor text changes
08-Apr-2015	4	Updated title and description in cover page. Updated <i>Table 4: "On/off states"</i>, <i>Table 5: "Dynamic"</i>, <i>Figure 9: "Static drain-source on-resistance"</i> and <i>Figure 10: "Capacitance variations"</i>. Minor text change.
24-Mar-2025	5	Updated Section 4: Package information. Minor text changes.



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4.2	Packing information	11
4.3	TO-220 type A package information	13
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4.5	TO-247 long leads package information	17
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