

N-channel 1200 V, 0.62 Ω typ., 12 A MDmesh K5 Power MOSFETs
in H²PAK-2, TO-220, TO-247 and TO-247 long leads

Datasheet - production data

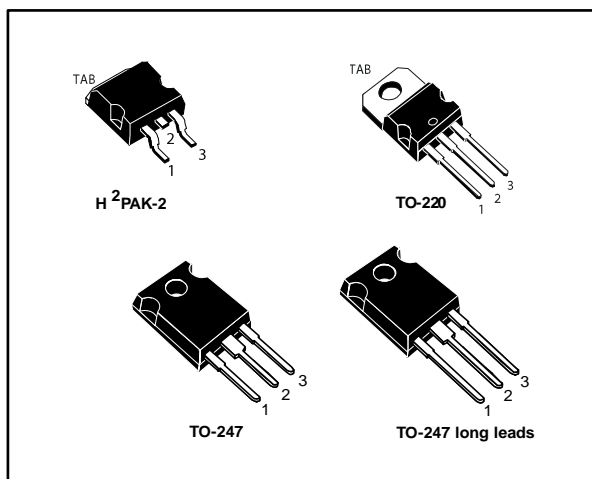
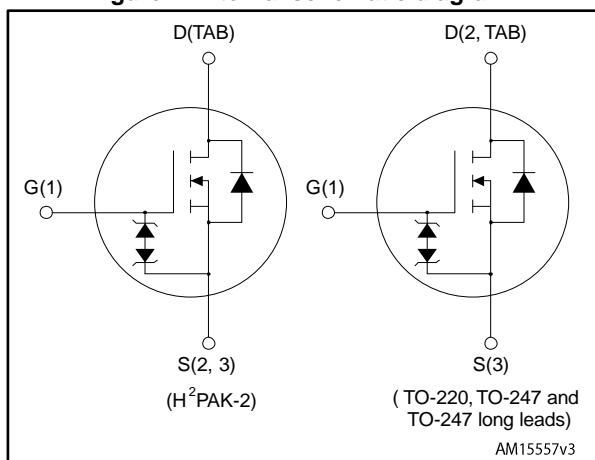


Figure 1: Internal schematic diagram



Features

| Order codes | V _{DS} | R _{DS(on)} max. | I _D | P _{TOT} |
|---------------|-----------------|--------------------------|----------------|------------------|
| STH12N120K5-2 | 1200 V | 0.69 Ω | 12 A | 250 W |
| STP12N120K5 | | | | |
| STW12N120K5 | | | | |
| STWA12N120K5 | | | | |

- Worldwide best 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.

Table 1: Device summary

| Order code | 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 | |

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1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|--------------------|---|-------------|------------------|
| V_{GS} | Gate-source voltage | ± 30 | V |
| I_D | Drain current at $T_C = 25\text{ }^\circ\text{C}$ | 12 | A |
| I_D | Drain current at $T_C = 100\text{ }^\circ\text{C}$ | 7.6 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 48 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$ | 250 | W |
| $I_{AR}^{(2)}$ | Max current during repetitive or single pulse avalanche | 4 | A |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy | 215 | mJ |
| $dv/dt^{(4)}$ | Peak diode recovery voltage slope | 4.5 | V/ns |
| $dv/dt^{(5)}$ | MOSFET dv/dt ruggedness | 50 | V/ns |
| T_j T_{stg} | Operating junction temperature Storage temperature | - 55 to 150 | $^\circ\text{C}$ |

Notes:

⁽¹⁾Pulse width limited by safe operating area.

⁽²⁾Pulse width limited by T_{Jmax} .

⁽³⁾Starting $T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$

⁽⁴⁾ $I_{SD} \leq 12\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{Peak} \leq V_{(BR)DSS}$

⁽⁵⁾ $V_{DS} \leq 960\text{ V}$

Table 3: Thermal data

| Symbol | Parameter | Value | | | Unit |
|----------------|--------------------------------------|----------------------|--------|-----------------------------|---------------------------|
| | | H ² PAK-2 | TO-220 | TO-247 TO-247 long leads | |
| $R_{thj-case}$ | Thermal resistance junction-case max | 0.5 | | | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$ | Thermal resistance junction-amb max | | 62.5 | 50 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}$ | Thermal resistance junction-pcb max | 30 | | | $^\circ\text{C}/\text{W}$ |

2 Electrical characteristics

(T_{CASE} = 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 _{DS} = 1200 V, T _C = 125 °C | | | 50 | μA |
| 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 | | 0.62 | 0.69 | Ω |

Table 5: Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|--|------|------|------|------|
| C _{iss} | Input capacitance | V _{GS} = 0 V, V _{DS} = 100 V, f = 1 MHz | - | 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 _{GS} = 0, V _{DS} = 0 to 960 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 | - | 44.2 | - | nC |
| Q _{gs} | Gate-source charge | V _{GS} = 10 V | - | 7.3 | - | nC |
| Q _{gd} | Gate-drain charge | (see Figure 18: "Gate charge test circuit") | - | 30 | - | nC |

Notes:

⁽¹⁾Time-related 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⁾Energy-related is defined as a constant equivalent capacitance giving the same stored energy as C_{oss} when V_{DS} increases 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 | $V_{DD} = 600\text{ V}$, $I_D = 6\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 20: "Unclamped inductive load test circuit") | - | 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} | Source-drain current (pulsed) | | - | | 48 | A |
| $V_{SD}^{(1)}$ | Forward on voltage | $I_{SD} = 12\text{ A}$, $V_{GS} = 0\text{ V}$ | - | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 12\text{ A}$, $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$, (see Figure 19: "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 | $I_{SD} = 12\text{ A}$, $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 19: "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 |

Notes:

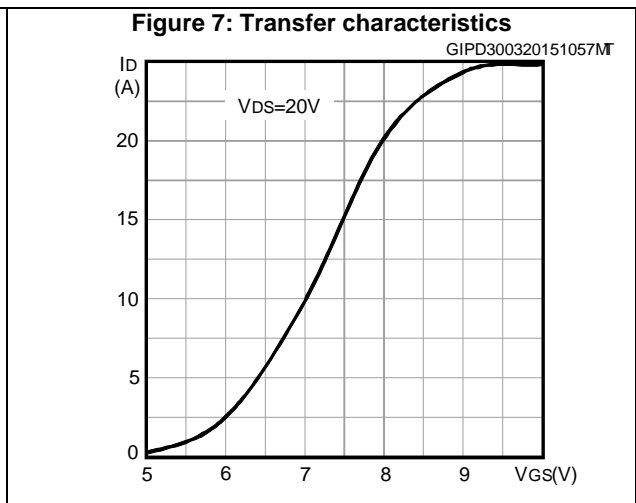
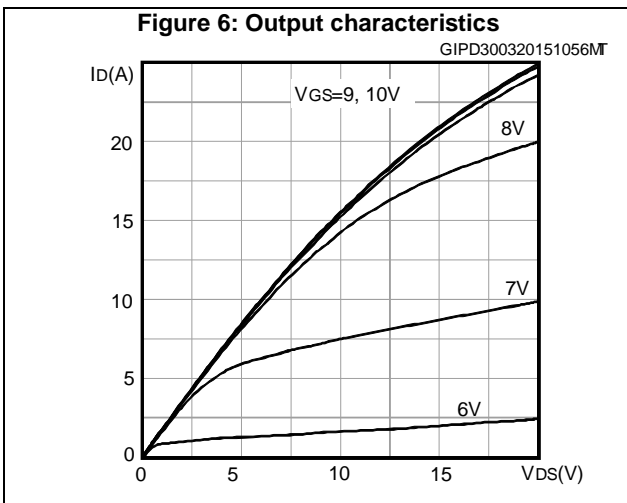
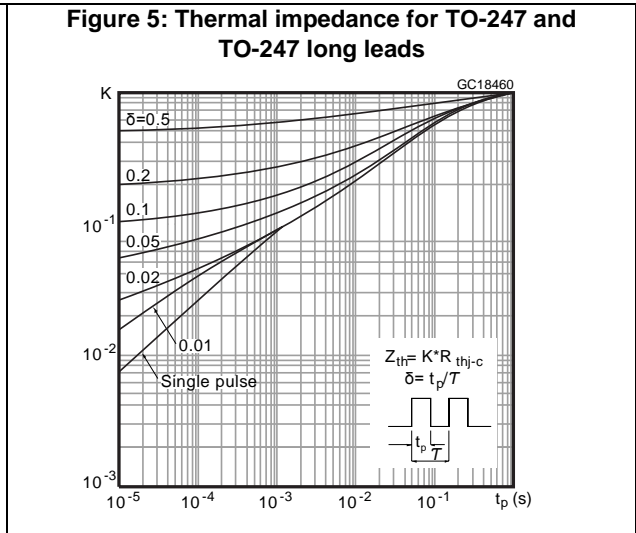
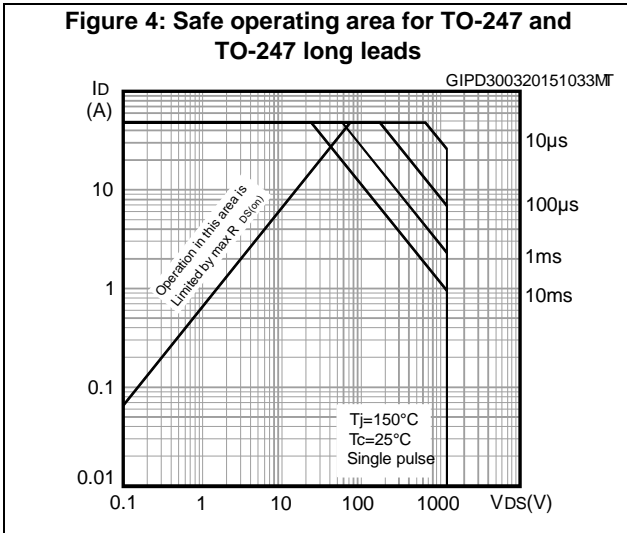
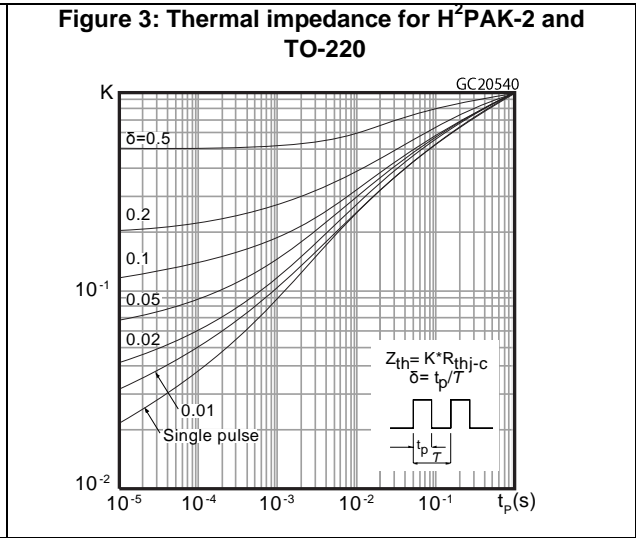
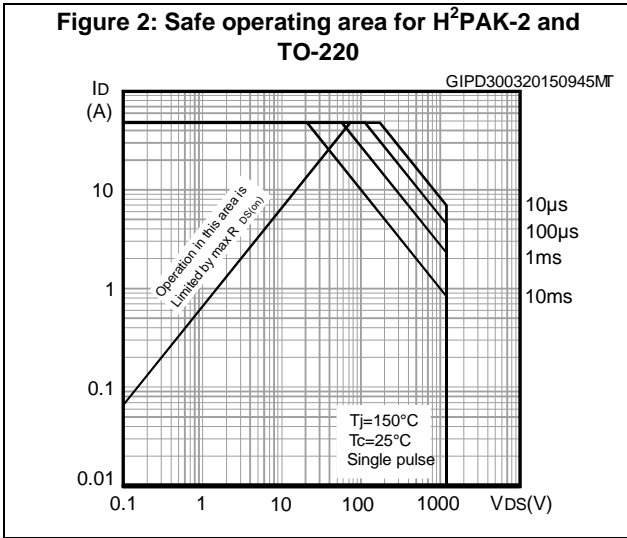
⁽¹⁾Pulsed: pulse duration = 300 μs , duty cycle 1.5%

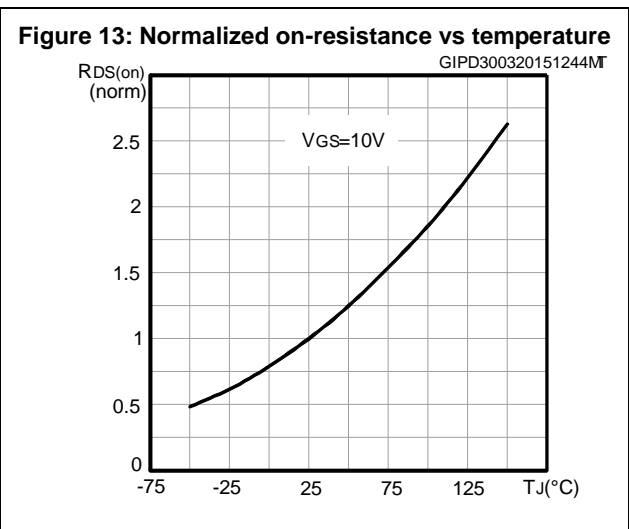
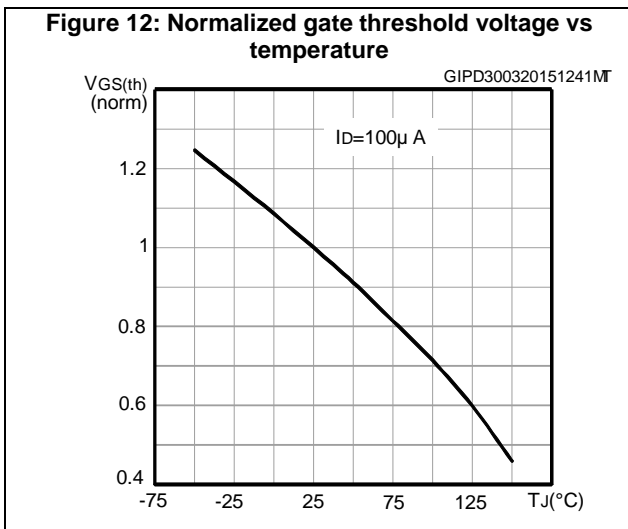
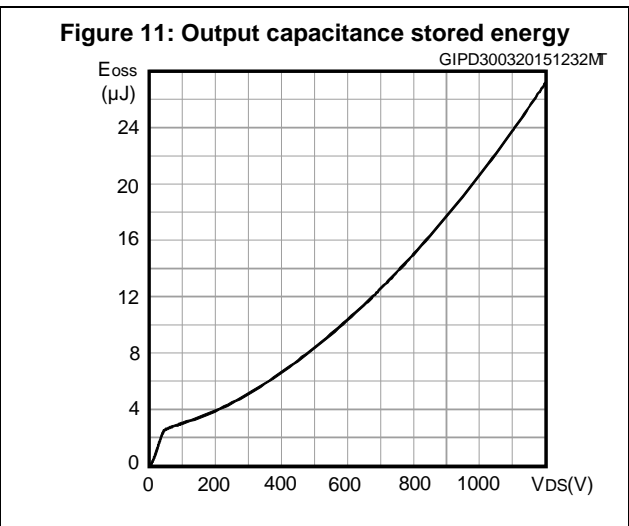
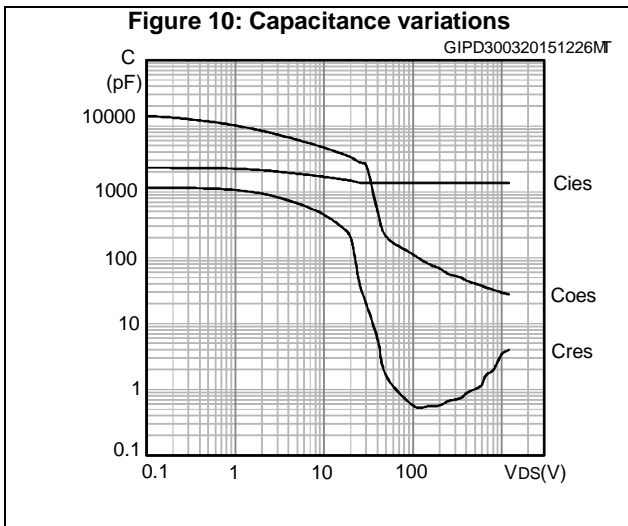
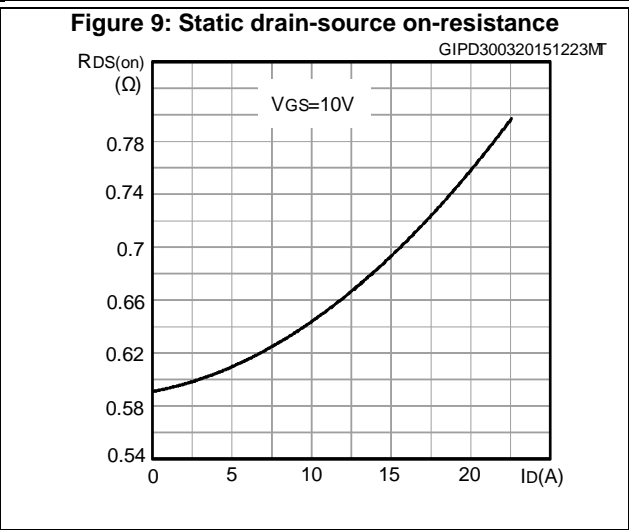
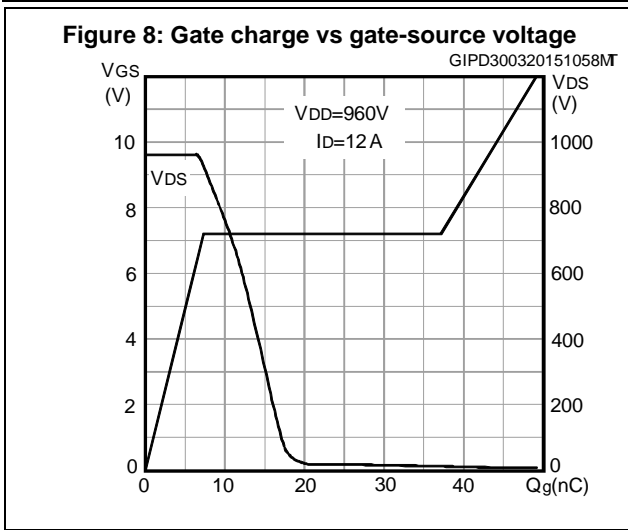
Table 8: Gate-source Zener diode

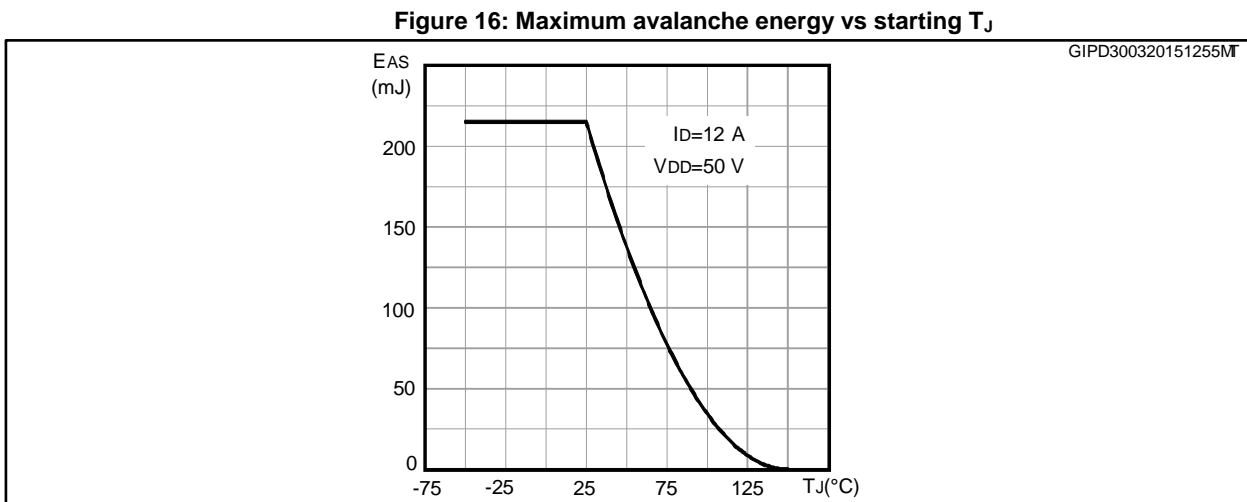
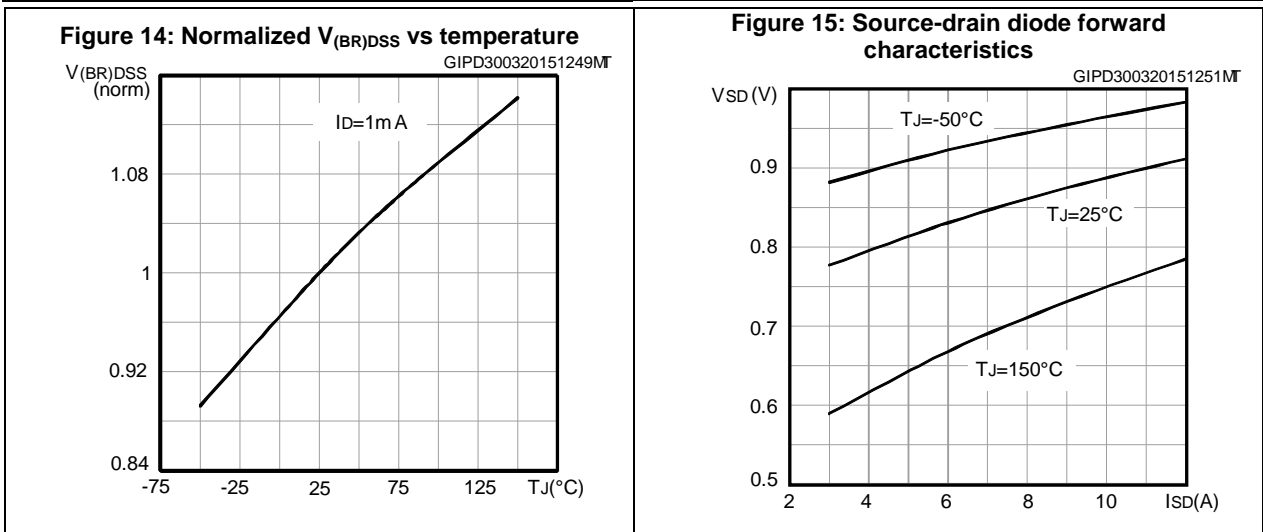
| Symbol | Parameter | Test conditions | Min | Typ. | Max. | Unit |
|---------------|-------------------------------|---|-----|------|------|------|
| $V_{(BR)GSO}$ | Gate-source breakdown voltage | $I_{GS} = \pm 1\text{ mA}$, $I_D = 0\text{ A}$ | 30 | - | - | V |

The built-in back-to-back Zener diodes have been specifically designed to enhance the ESD capability of the device. The Zener voltage is appropriate for efficient and cost-effective intervention to protect the device integrity. These integrated Zener diodes thus eliminate the need for external components.

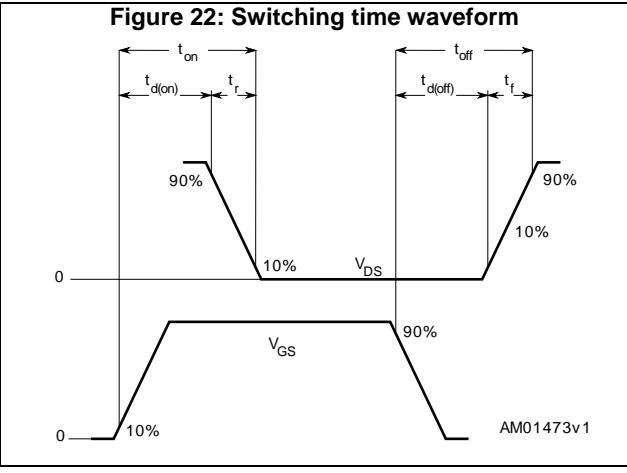
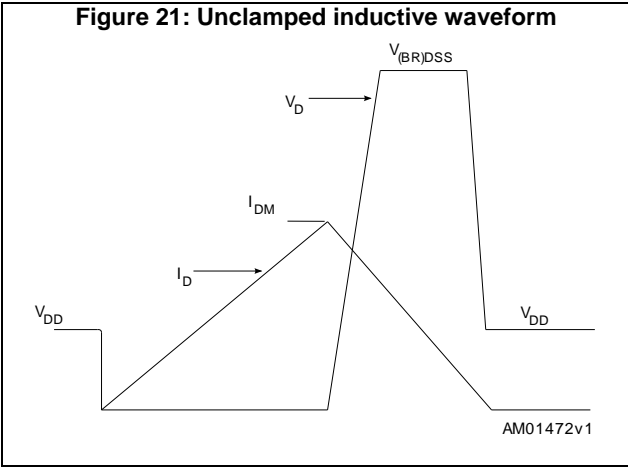
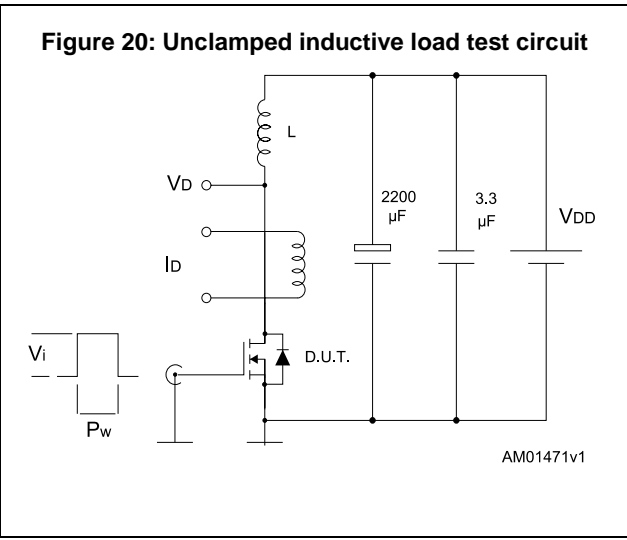
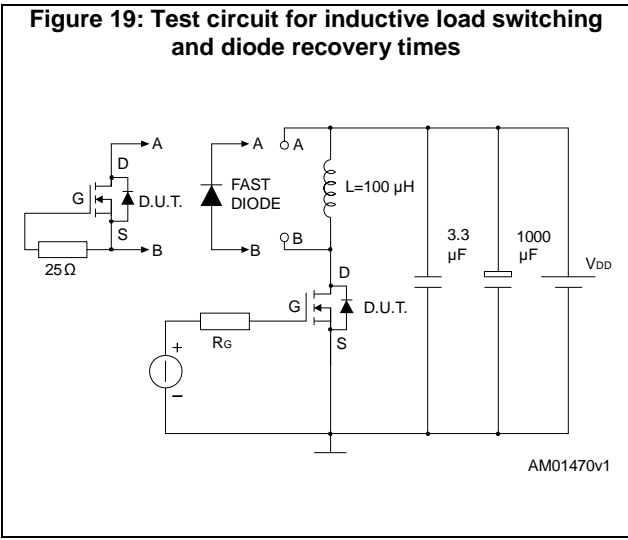
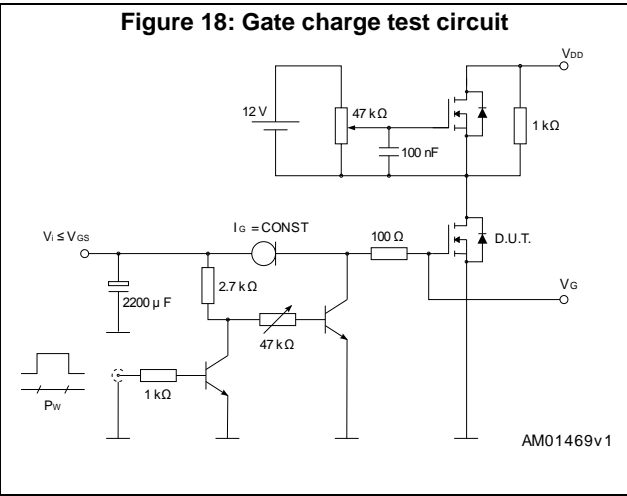
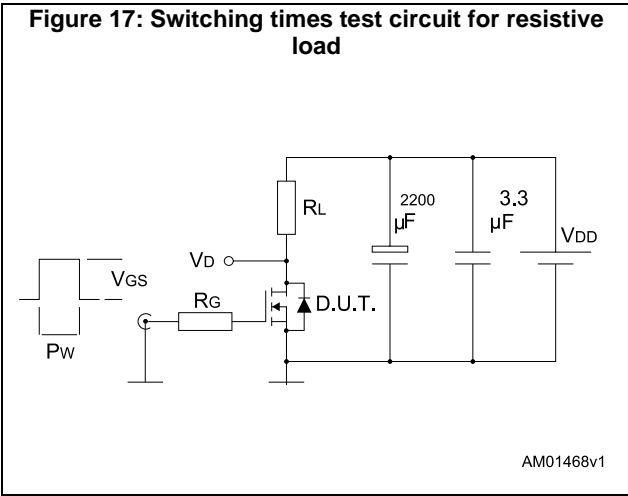
2.1 Electrical characteristics (curves)







3 Test circuits



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 H²PAK-2 package information

Figure 23: H²PAK-2 package outline

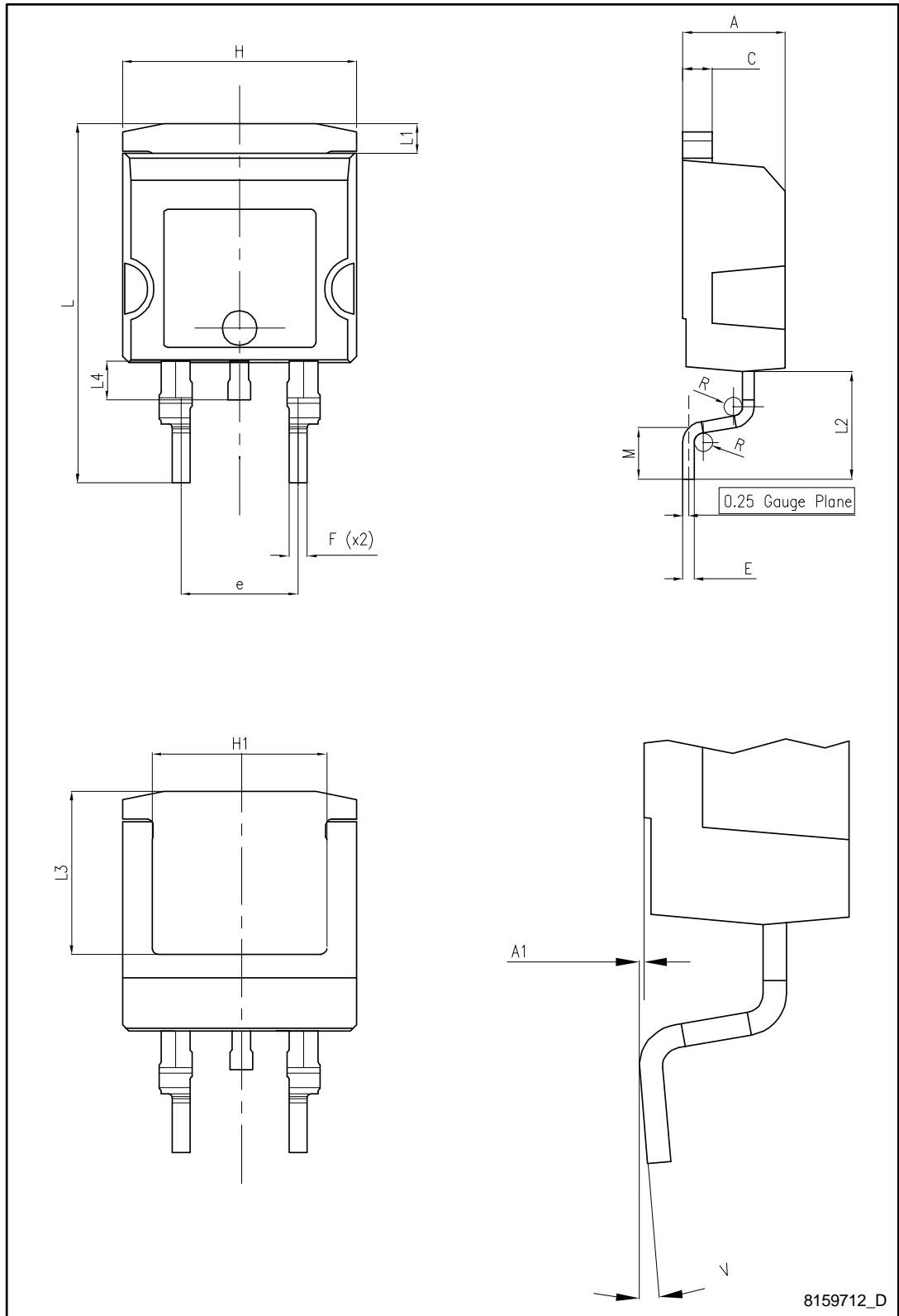
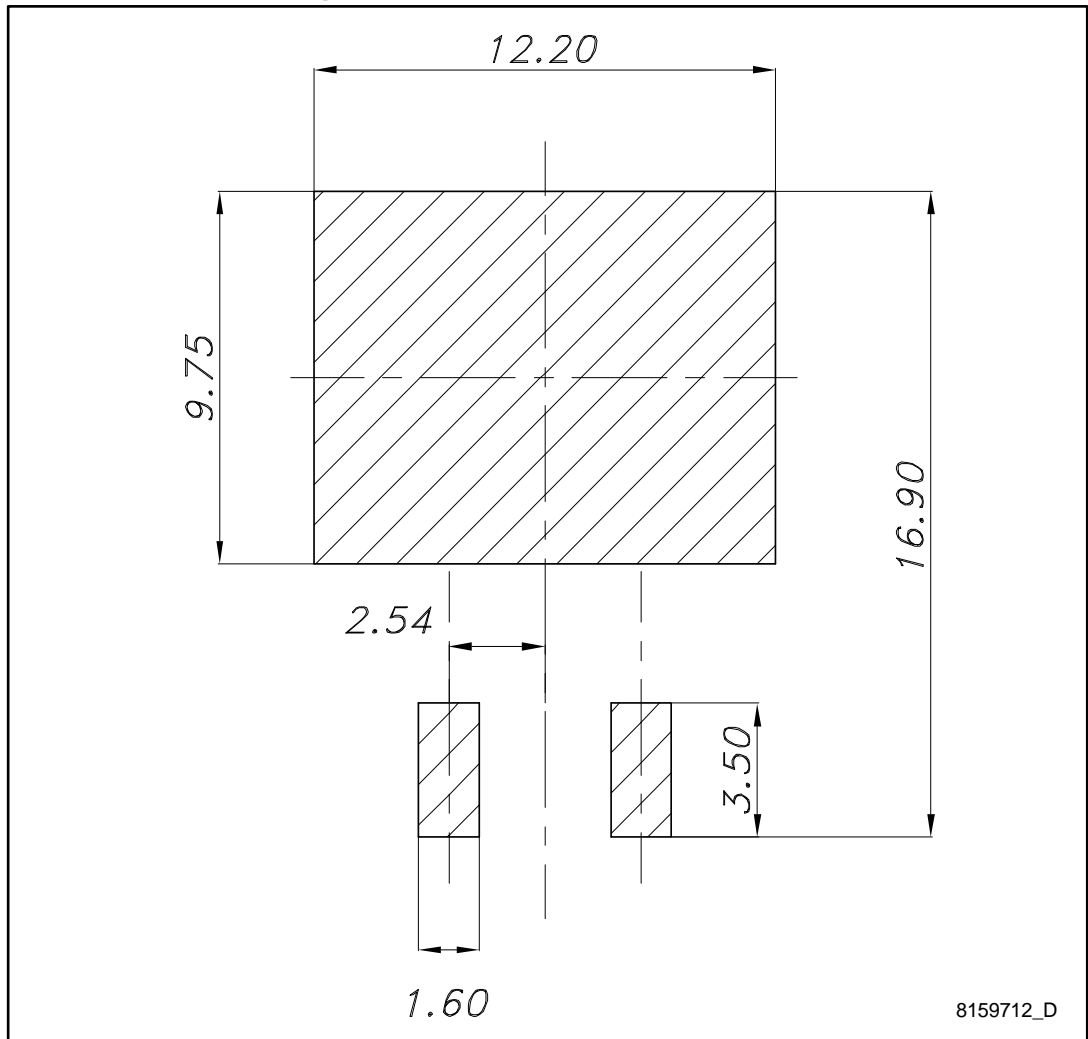


Table 9: H²PAK-2 mechanical data

| Dim. | mm | | |
|------|-------|------|-------|
| | Min. | Typ. | Max. |
| A | 4.30 | | 4.80 |
| A1 | 0.03 | | 0.20 |
| C | 1.17 | | 1.37 |
| e | 4.98 | | 5.18 |
| E | 0.50 | | 0.90 |
| F | 0.78 | | 0.85 |
| H | 10.00 | | 10.40 |
| H1 | 7.40 | | 7.80 |
| L | 15.30 | | 15.80 |
| L1 | 1.27 | | 1.40 |
| L2 | 4.93 | | 5.23 |
| L3 | 6.85 | | 7.25 |
| L4 | 1.5 | | 1.7 |
| M | 2.6 | | 2.9 |
| R | 0.20 | | 0.60 |
| V | 0° | | 8° |

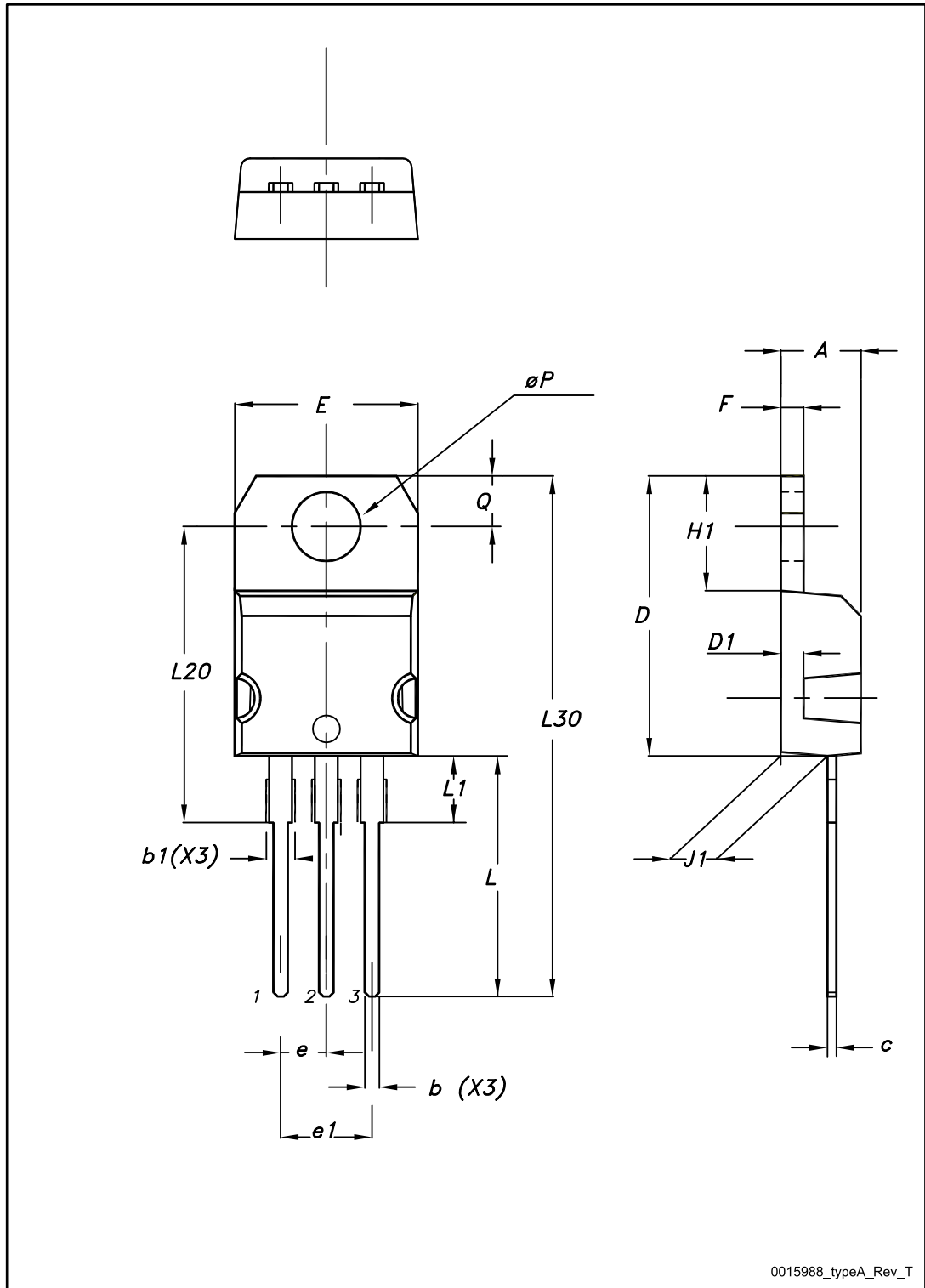
Figure 24: H²PAK-2 recommended footprint



8159712_D

4.2 TO-220 type A package information

Figure 25: TO-220 type A package outline



0015988_typeA_Rev_T

Table 10: TO-220 type A mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.70 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10 | | 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 | | 14 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| øP | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |

4.3 TO-247 package information

Figure 26: TO-247 package outline

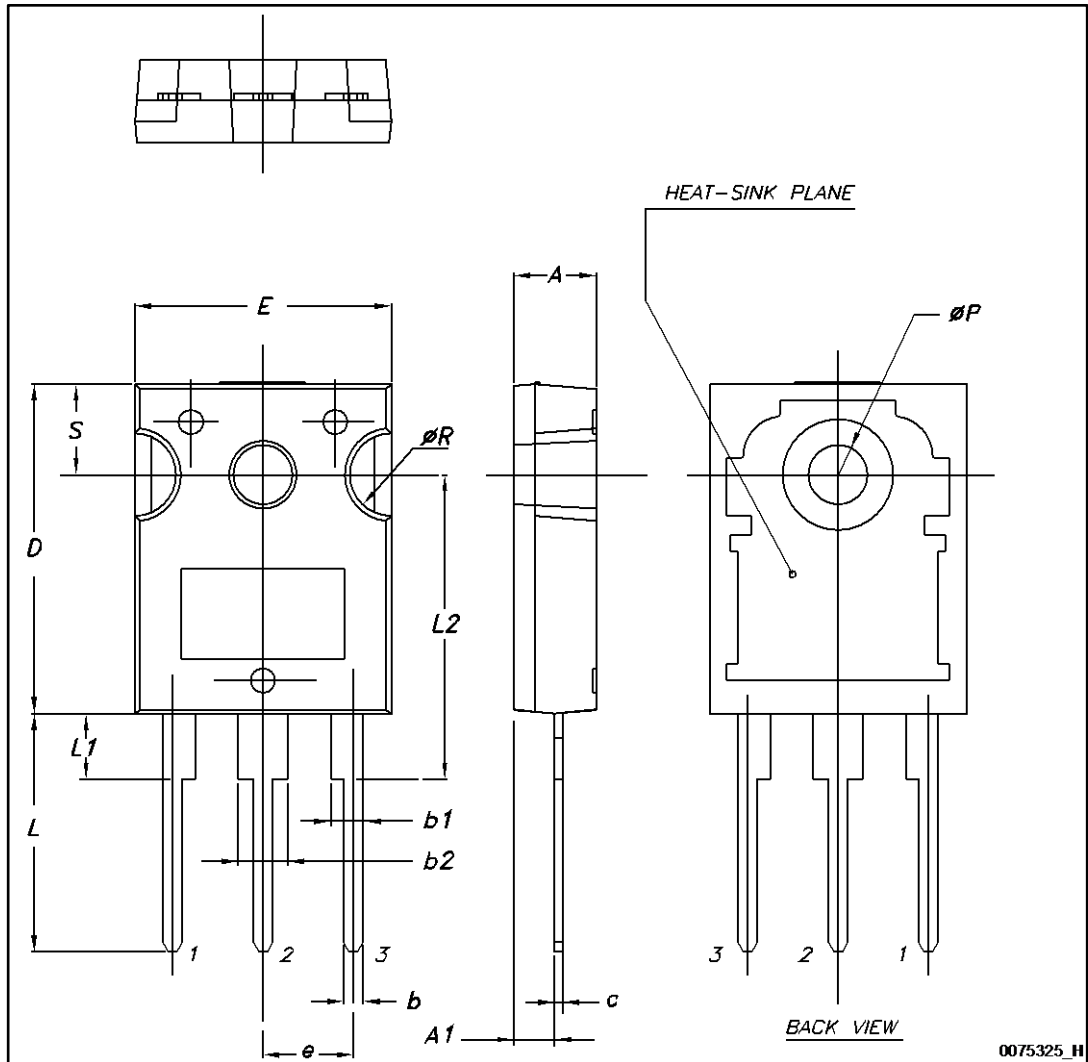


Table 11: TO-247 mechanical data

| 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 |

4.4 TO-247 long leads package information

Figure 27: TO-247 long leads package outline

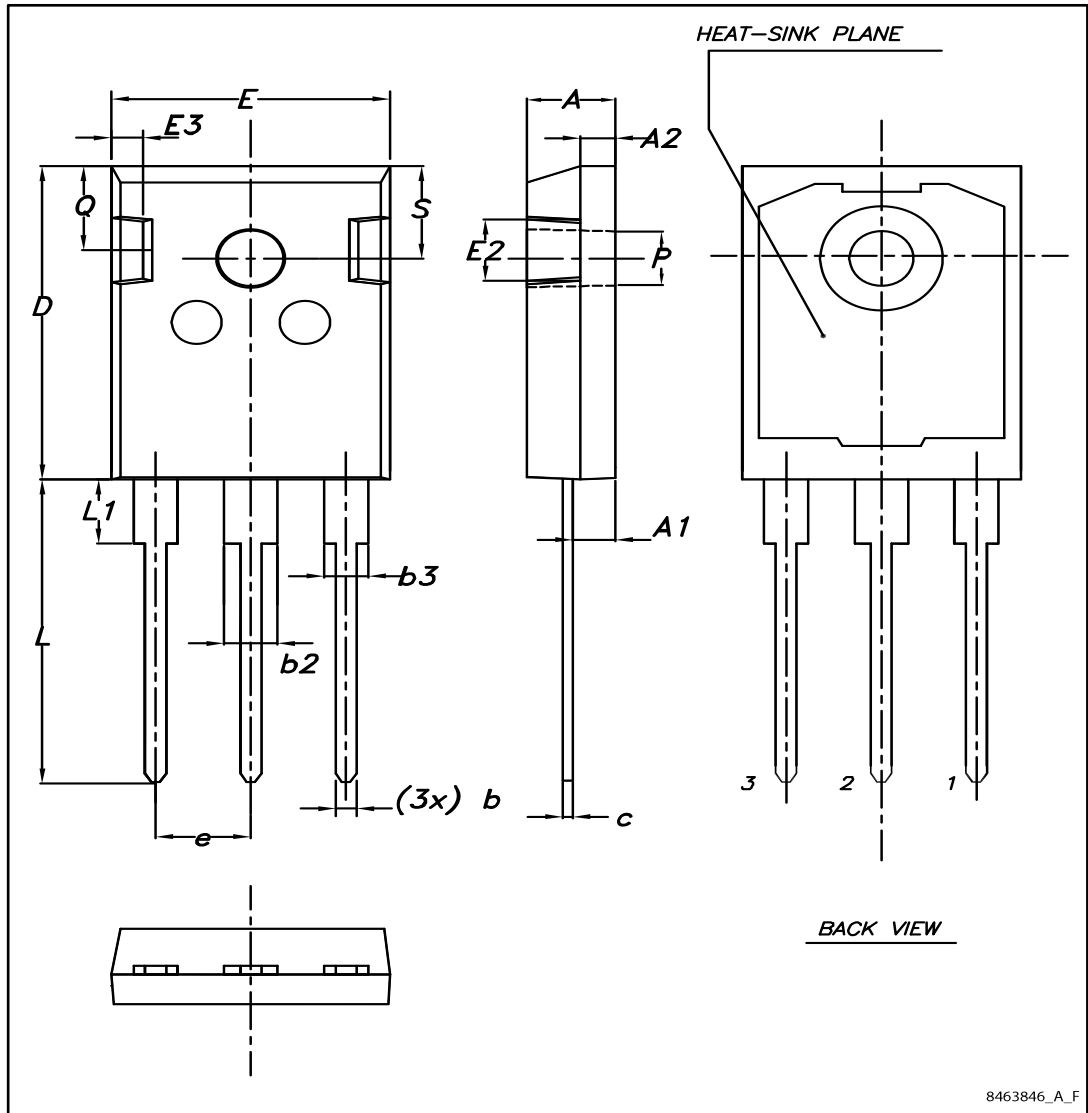


Table 12: TO-247 long leads mechanical data

| 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 |
| P | 3.50 | 3.60 | 3.70 |
| Q | 5.60 | | 6.00 |
| S | 6.05 | 6.15 | 6.25 |

5 Revision history

Table 13: Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 23-Aug-2011 | 1 | First release. |
| 17-Jan-2013 | 2 | <ul style="list-style-type: none"> • Minor text changes • Added: H²PAK package • The part number STB12N120K5 has been moved to a separate datasheet • Updated: • Updated: mechanical data for TO-247 package |
| 16-May-2014 | 3 | <ul style="list-style-type: none"> • 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 | <p>Updated title, silhouette 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".</p> <p>Minor text change.</p> |

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- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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