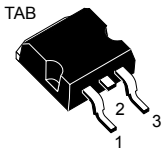
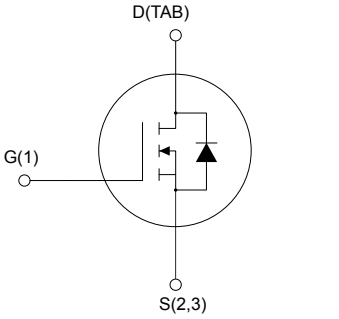
# SCT30N120H

Datasheet

## Silicon carbide Power MOSFET 1200 V, 42 A, 90 mΩ (typ., $T_J$=150 °C), in an H²PAK-2 package




**H²PAK-2**




## Features

- Very tight variation of on-resistance vs temperature
- Very high operating temperature capability ($T_J$ = 175 °C)
- Very fast and robust intrinsic body diode
- Low capacitance

## Applications

- Solar inverters, UPS
- Motor drives
- High voltage DC-DC converters
- Switch mode power supplies

## Description

This silicon carbide Power MOSFET is produced exploiting the advanced, innovative properties of wide bandgap materials. This results in unsurpassed on-resistance per unit area and very good switching performance almost independent of temperature. The outstanding thermal properties of the SiC material allow designers to use an industry-standard outline with significantly improved thermal capability. These features render the device perfectly suitable for high-efficiency and high power density applications.

| Product status link |
|---|
| SCT30N120H |

| Product summary | |
|---|---|
| **Order code** | SCT30N120H |
| **Marking** | SCT30N120 |
| **Package** | H²PAK-2 |
| **Packing** | Tape and reel |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage | 1200 | V |
| $V_{GS}$ | Gate-source voltage | -10 to 25 | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C (limited by die) | 42 | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 30 | A |
| $I_{DM}$ (1) | Drain current (pulsed) | 90 | A |
| $P_{TOT}$ | Total power dissipation at $T_C$ = 25 °C | 230 | W |
| $T_{stg}$ | Storage temperature range | -55 to 175 | °C |
| $T_j$ | Operating junction temperature range | | °C |

1. *Pulse width limited by safe operating area.*

**Table 2. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal resistance junction-case | 0.65 | °C/W |
| $R_{thj\text{-}pcb}$ (1) | Thermal resistance junction-pcb | 35 | °C/W |

1. *When mounted on 1 inch² FR-4 board, 2 oz Cu.*

# 2 Electrical characteristics

($T_{CASE}$ = 25 °C unless otherwise specified).

**Table 3. On/off states**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{DSS}$ | Zero gate voltage drain current | $V_{DS}$ = 1200 V; $V_{GS}$ = 0 V | | 1 | 25 | µA |
| $I_{GSS}$ | Gate-body leakage current | $V_{DS}$ = 0 V; $V_{GS}$ = -10 to 22 V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 1 mA | 1.8 | 3.5 | | V |
| $R_{DS(on)}$ | Static drain-source on- resistance | $V_{GS}$ = 20 V, $I_D$ = 20 A | | 80 | 100 | mΩ |
| | | $V_{GS}$ = 20 V, $I_D$ = 20 A, $T_J$ = 150°C | | 90 | | mΩ |

**Table 4. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 400 V, f = 1 MHz, $V_{GS}$ = 0 V | - | 1700 | - | pF |
| $C_{oss}$ | Output capacitance | | - | 130 | - | pF |
| $C_{rss}$ | Reverse transfer capacitance | | - | 25 | - | pF |
| $Q_g$ | Total gate charge | $V_{DD}$ = 800 V, $I_D$ = 20 A, $V_{GS}$ = 0 to 20 V | - | 105 | - | nC |
| $Q_{gs}$ | Gate-source charge | | - | 16 | - | nC |
| $Q_{gd}$ | Gate-drain charge | | - | 40 | - | nC |
| $R_g$ | Gate input resistance | f = 1 MHz open drain | - | 5 | - | Ω |

**Table 5. Switching energy (inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $E_{on}$ | Turn-on switching energy | $V_{DD}$ = 800 V, $I_D$ = 20 A, $R_G$ = 6.8 Ω, $V_{GS}$ = -2 to 20 V | - | 500 | - | µJ |
| $E_{off}$ | Turn-off switching energy | | - | 350 | - | µJ |
| $E_{on}$ | Turn-on switching energy | $V_{DD}$ = 800 V, $I_D$ = 20 A, $R_G$ = 6.8 Ω, $V_{GS}$ = -2 to 20 V $T_J$ = 150°C | - | 500 | - | µJ |
| $E_{off}$ | Turn-off switching energy | | - | 400 | - | µJ |

**Table 6. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 800 V, $I_D$ = 20 A, $R_G$ = 0 Ω, $V_{GS}$ = -2 to 20 V | - | 19 | - | ns |
| $t_f$ | Fall time | | - | 28 | - | ns |
| $t_{d(off)}$ | Turn-off delay time | | - | 45 | - | ns |
| $t_r$ | Rise time | | - | 20 | - | ns |

**Table 7. Reverse SiC diode characteristics**

| Symbol | Parameter | Test conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{SD}$ | Diode forward voltage | $I_F$ = 10 A, $V_{GS}$ = 0 V | - | 3.5 | - | V |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$ = 20 A, di/dt = 100 A/µs<br>$V_{DD}$ = 800 V | - | 140 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | - | 140 | - | nC |
| $I_{RRM}$ | Reverse recovery current | | - | 2 | - | A |

## 2.1 Electrical characteristics (curves)

**Figure 1. Normalized thermal impedance**

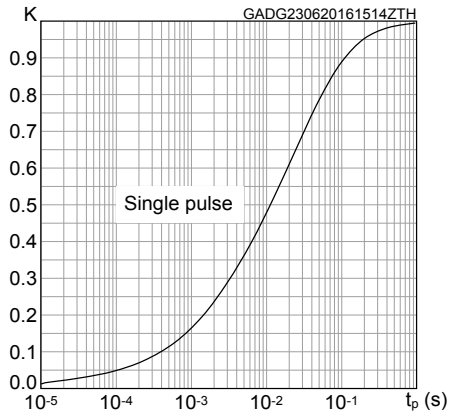



**Figure 2. Output characteristics ($T_J$ = 25°C)**

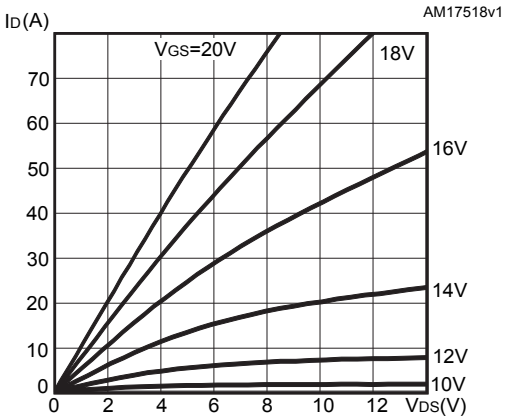



**Figure 3. Output characteristics ($T_J$ = 150°C)**

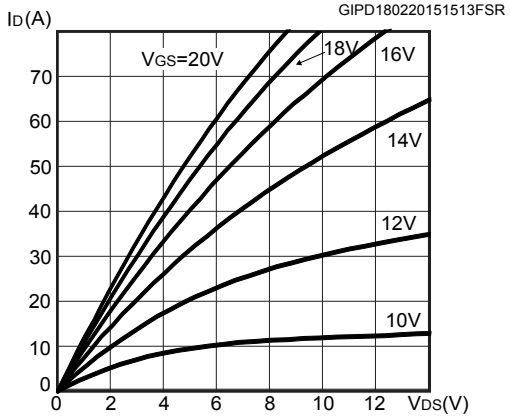



**Figure 4. Transfer characteristics**

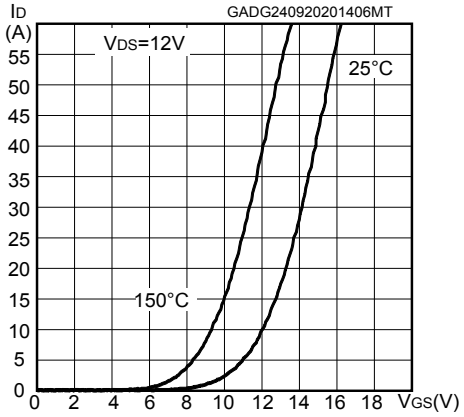



**Figure 5. Total power dissipation**

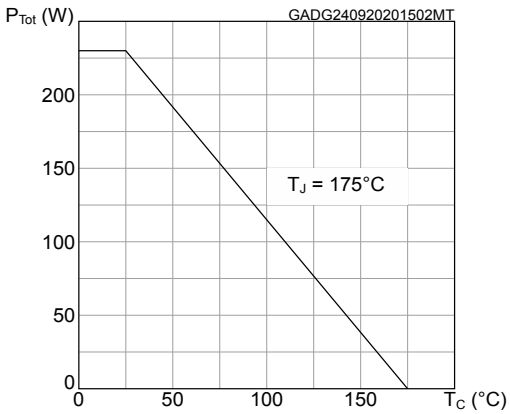



**Figure 6. Gate charge vs gate-source voltage**

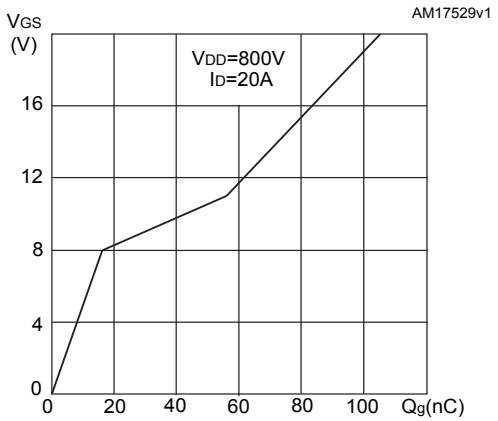


**Figure 7. Capacitance variations**

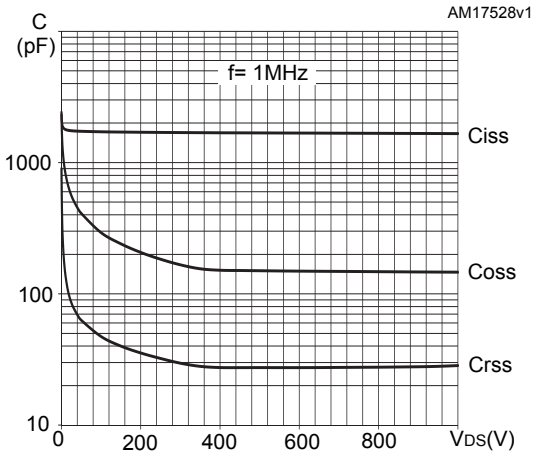



**Figure 8. Switching energy vs drain current**

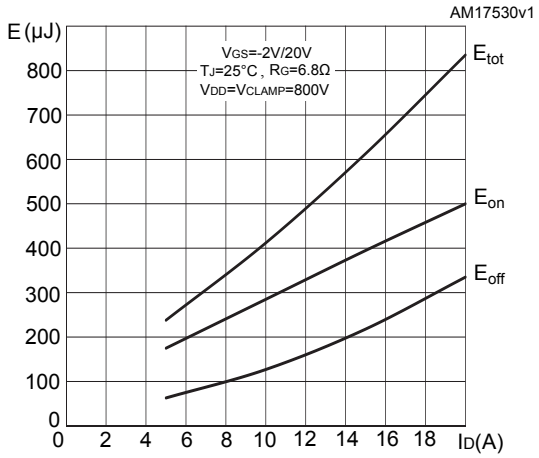



**Figure 9. Switching energy vs junction temperature**

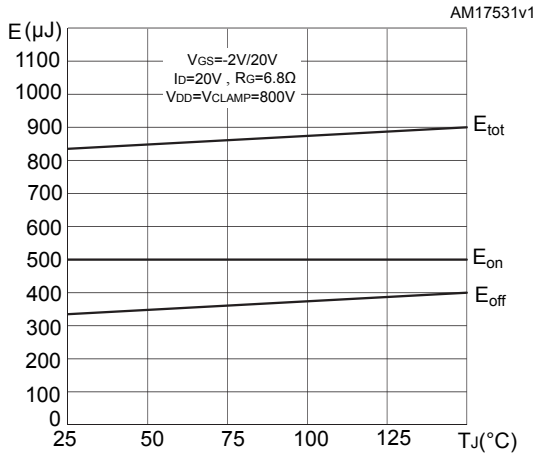



**Figure 10. Normalized $V_{(BR)DSS}$ vs temperature**

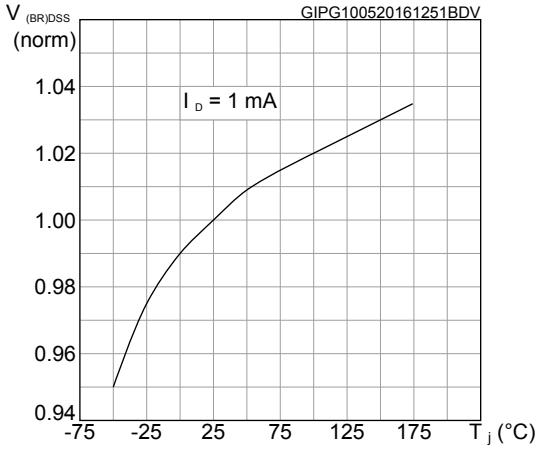



**Figure 11. Normalized gate threshold voltage vs temperature**

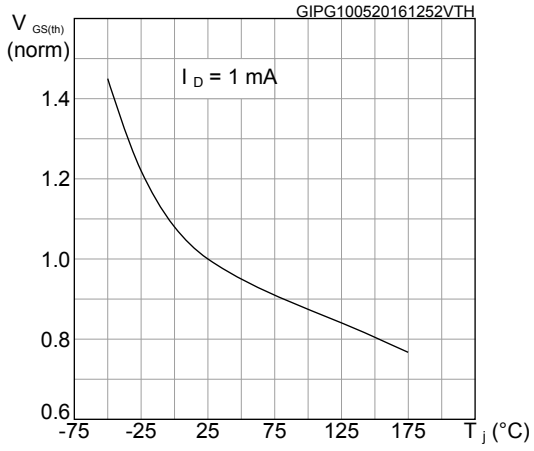



**Figure 12. Normalized on-resistance vs temperature**

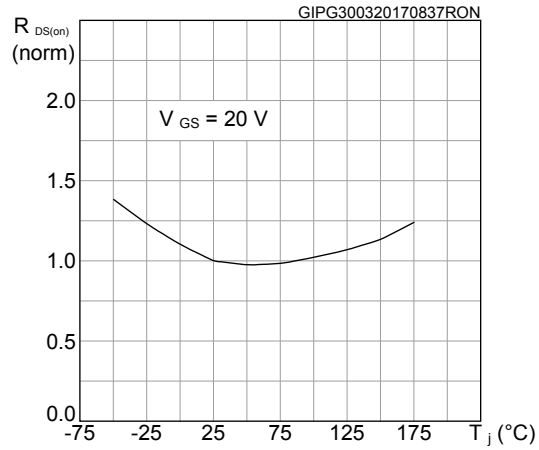


Figure 13. Body diode characteristics ($T_J$ = -50°C)

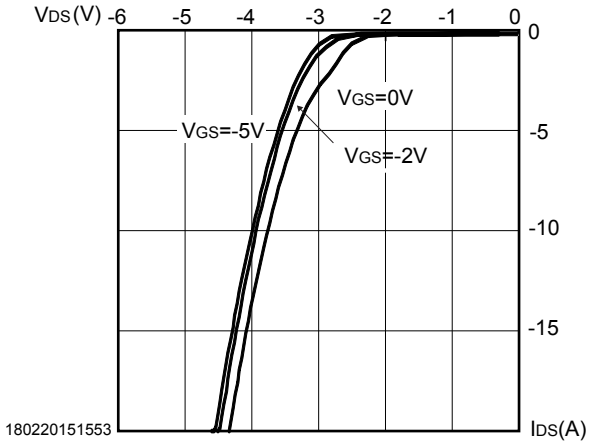



Figure 14. Body diode characteristics ($T_J$ = 25°C)

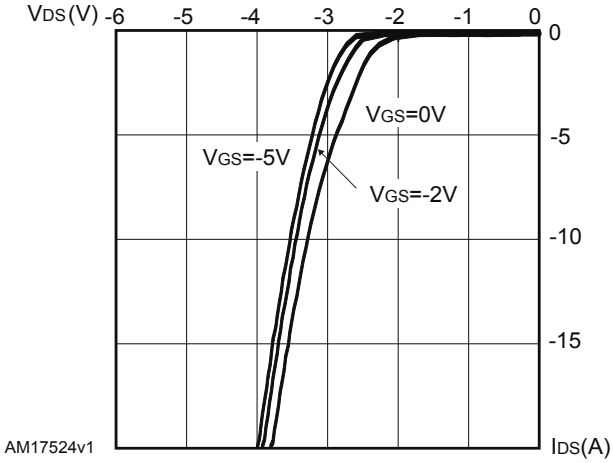



Figure 15. Body diode characteristics ($T_J$ = 150°C)

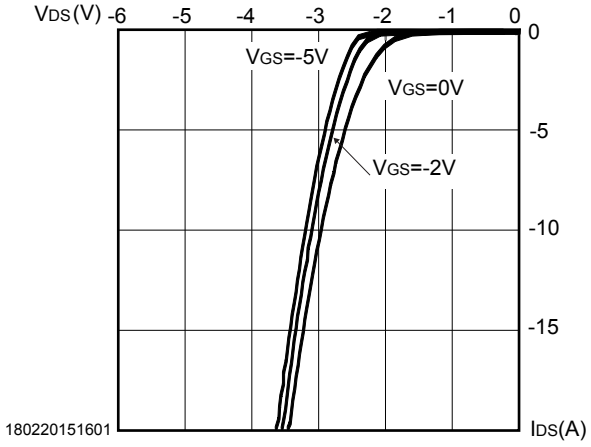



Figure 16. 3rd quadrant characteristics ($T_J$ = -50°C)

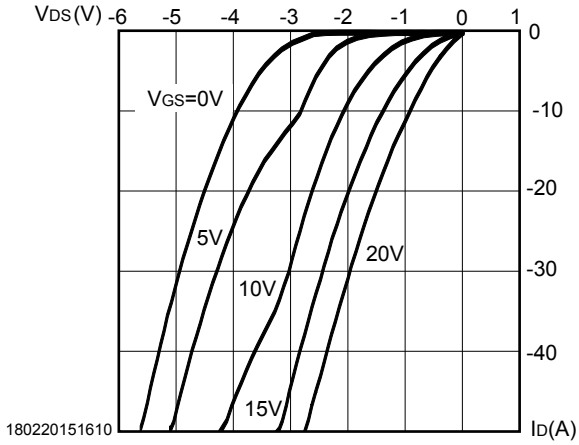



Figure 17. 3rd quadrant characteristics ($T_J$ = 25°C)

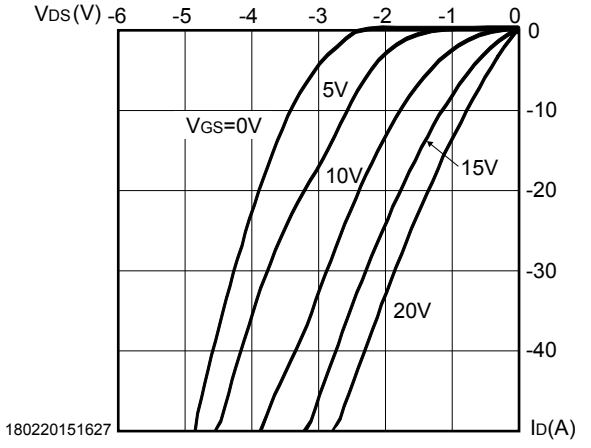
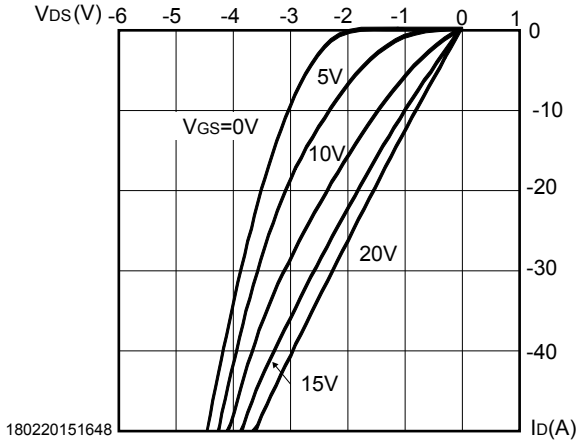



Figure 18. 3rd quadrant characteristics ($T_J$ = 150°C)



# 3 Test circuits

**Figure 19. Switching test waveforms for transition times**

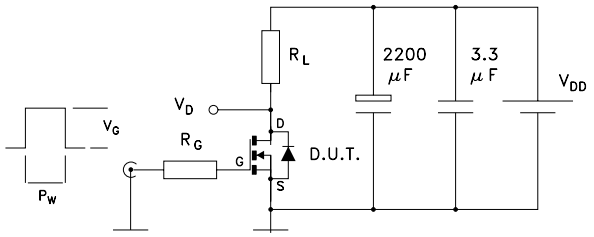



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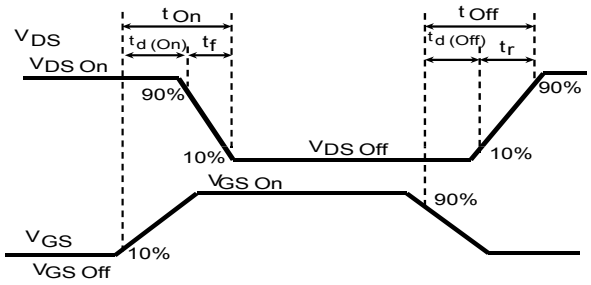
**Figure 20. Clamped inductive switching waveform**

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# 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 21. H²PAK-2 package outline**

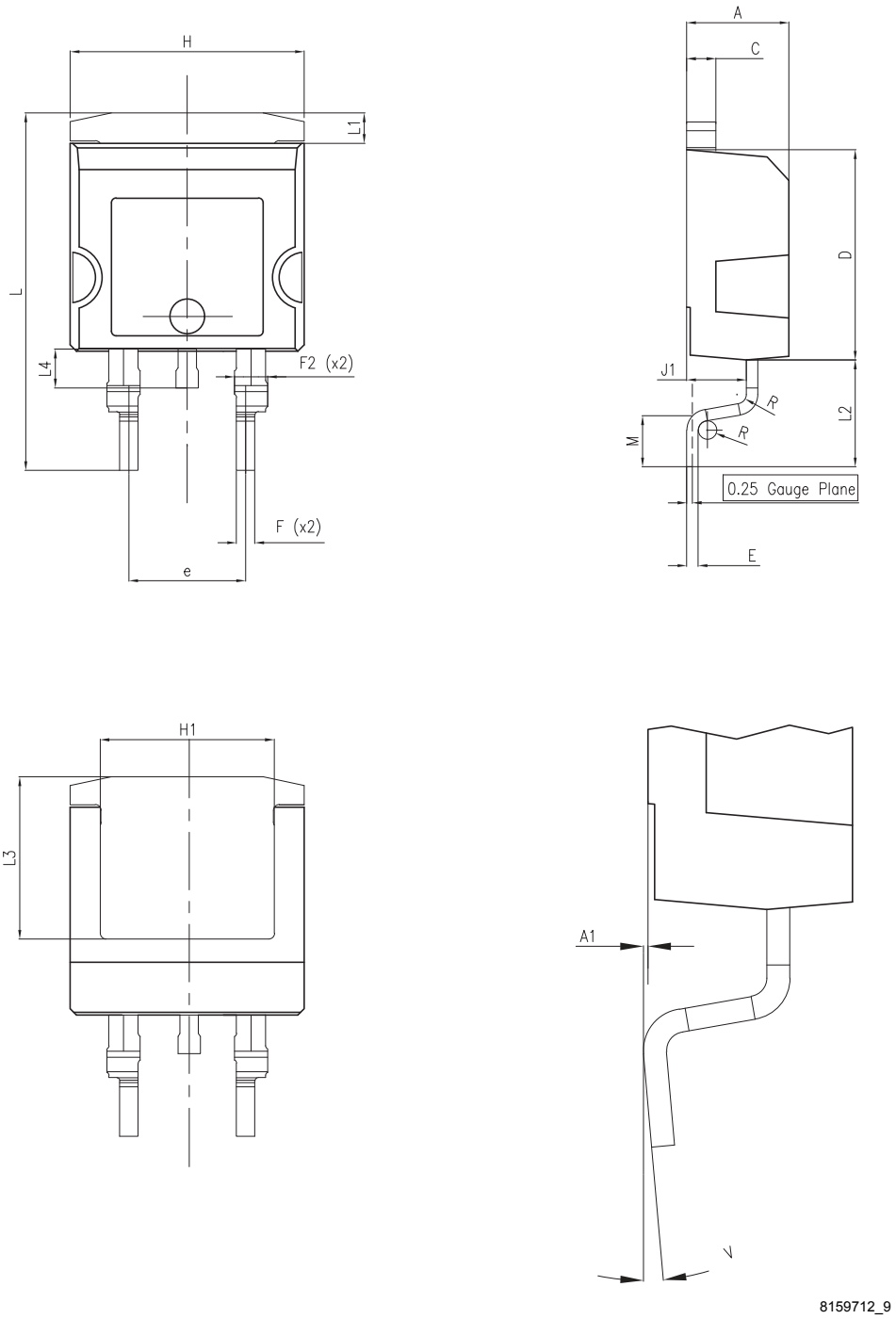
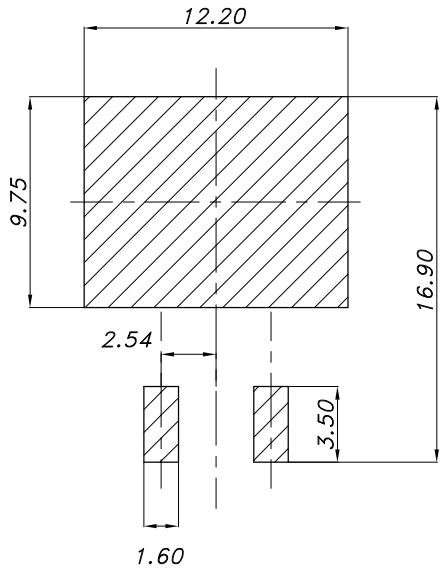


Table 8. H²PAK-2 package mechanical data

| 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

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*Note: Dimensions are in mm.*

## 4.2 H²PAK-2 packing information

**Figure 23. Tape outline**

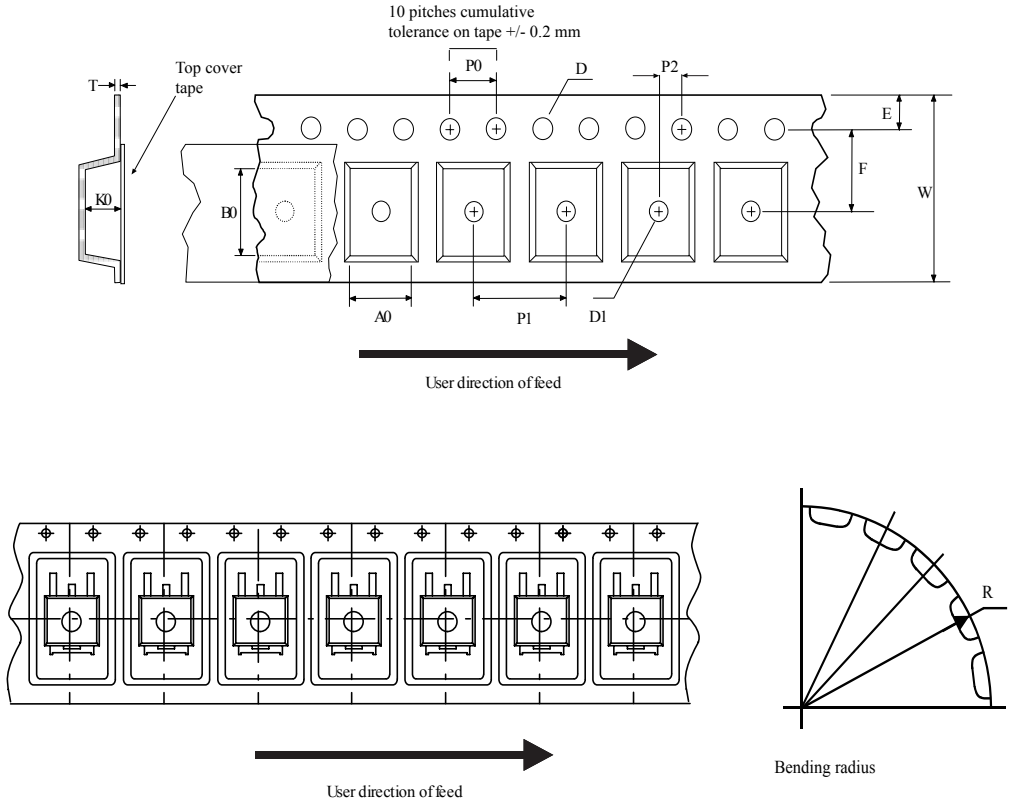

Figure 24. **Reel outline**

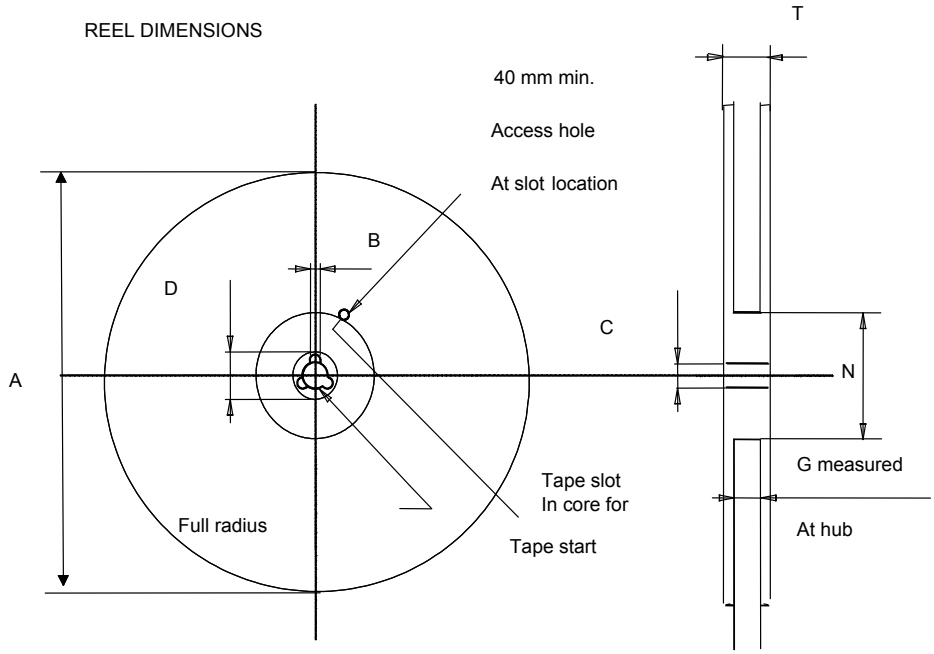


Table 9. **Tape and reel mechanical data**

| 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 | 0.25 | 0.35 | | | |
| W | 23.7 | 24.3 | | | |

## Revision history

Table 10. **Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 31-Jul-2015 | 1 | First release |
| 12-Oct-2015 | 2 | Updated *Table 2*, *Table 3* and *Table 4.*<br>Added *Figure 2: Safe operating area.* |
| 01-Oct-2020 | 3 | Updated features in cover page.<br>Updated Section 1 Electrical ratings, Section 2 Electrical characteristics, Electrical characteristics (curves) and Section 4.1 H²PAK-2 package information.<br>Added Section 3 Test circuits.<br>Minor text changes. |

# Contents

1 **Electrical ratings** . . . . . 2

2 **Electrical characteristics** . . . . . 3

2.1 Electrical characteristics (curves) . . . . . 5

3 **Test circuits** . . . . . 8

4 **Package information** . . . . . 9

4.1 H²PAK-2 package information . . . . . 9

4.2 H²PAK-2 packing information . . . . . 11

**Revision history** . . . . . 13

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