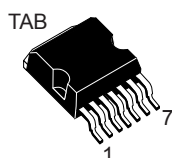
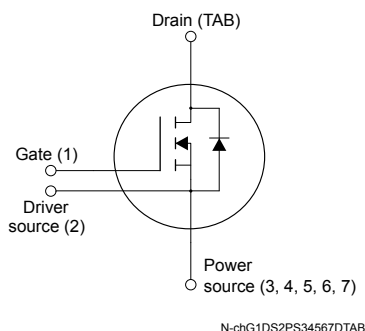


## Automotive-grade silicon carbide Power MOSFET 1200 V, 75 mΩ typ., 33 A in an H<sup>2</sup>PAK-7 package



H<sup>2</sup>PAK-7



### Features

| Order code       | V <sub>DS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> |
|------------------|-----------------|--------------------------|----------------|
| SCTH40N120G2V7AG | 1200 V          | 105 mΩ                   | 33 A           |

- AEC-Q101 qualified 
- Very fast and robust intrinsic body diode
- Extremely low gate charge and input capacitance
- Source sensing pin for increased efficiency

### Applications

- Main inverter (electric traction)
- DC/DC converter for EV/HEV
- On board charger (OBC)

### Description

This silicon carbide Power MOSFET device has been developed using ST's advanced and innovative 2<sup>nd</sup> generation SiC MOSFET technology. The device features remarkably low on-resistance per unit area and very good switching performance. The variation of switching loss is almost independent of junction temperature.

#### Product status link

[SCTH40N120G2V7AG](#)

#### Product summary

|            |                      |
|------------|----------------------|
| Order code | SCTH40N120G2V7AG     |
| Marking    | 40N120AG             |
| Package    | H <sup>2</sup> PAK-7 |
| 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 22  | V    |
|                | Gate-source voltage (recommended operating values)                                                                | -5 to 18   |      |
|                | Gate-source voltage (pulsed, $t_p = 25$ ns repetitive overshoot during switching for an accumulated time of 10 h) | -11 to 25  |      |
| $I_D$          | Drain current (continuous) at $T_C = 25$ °C                                                                       | 33         | A    |
|                | Drain current (continuous) at $T_C = 100$ °C                                                                      | 23         |      |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                                                                            | 92         | A    |
| $P_{TOT}$      | Total power dissipation at $T_C = 25$ °C                                                                          | 250        | W    |
| $T_{stg}$      | Storage temperature range                                                                                         | -55 to 175 | °C   |
| $T_J$          | Operating junction temperature range                                                                              |            | °C   |

1. Pulse width is limited by safe operating area.

**Table 2. Thermal data**

| Symbol     | Parameter                               | Value | Unit |
|------------|-----------------------------------------|-------|------|
| $R_{thJC}$ | Thermal resistance, junction-to-case    | 0.6   | °C/W |
| $R_{thJA}$ | Thermal resistance, junction-to-ambient | 50    | °C/W |

## 2 Electrical characteristics

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

**Table 3. 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   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 1200\text{ V}$                                   |      |      | 10        | $\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current         | $V_{DS} = 0\text{ V}$ , $V_{GS} = -10\text{ to }22\text{ V}$                       |      |      | $\pm 100$ | nA            |
| $V_{GS(th)}$  | Gate threshold voltage            | $V_{DS} = V_{GS}$ , $I_D = 1\text{ mA}$                                            | 1.9  | 3.2  | 5.0       | V             |
| $R_{DS(on)}$  | Static drain-source on-resistance | $V_{GS} = 18\text{ V}$ , $I_D = 20\text{ A}$                                       |      | 75   | 105       | m $\Omega$    |
|               |                                   | $V_{GS} = 18\text{ V}$ , $I_D = 20\text{ A}$ , $T_J = 175\text{ }^{\circ}\text{C}$ |      | 167  |           |               |

**Table 4. Dynamic**

| Symbol    | Parameter                    | Test conditions                                                                     | Min. | Typ. | Max. | Unit     |
|-----------|------------------------------|-------------------------------------------------------------------------------------|------|------|------|----------|
| $C_{iss}$ | Input capacitance            | $V_{DS} = 800\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$                | -    | 1230 | -    | pF       |
| $C_{oss}$ | Output capacitance           |                                                                                     | -    | 56   | -    | pF       |
| $C_{rss}$ | Reverse transfer capacitance |                                                                                     | -    | 15   | -    | pF       |
| $Q_g$     | Total gate charge            | $V_{DD} = 800\text{ V}$ , $V_{GS} = -5\text{ to }18\text{ V}$ , $I_D = 20\text{ A}$ | -    | 63   | -    | nC       |
| $Q_{gs}$  | Gate-source charge           |                                                                                     | -    | 15   | -    | nC       |
| $Q_{gd}$  | Gate-drain charge            |                                                                                     | -    | 20   | -    | nC       |
| $R_g$     | Gate input resistance        | $f = 1\text{ MHz}$ , $I_D = 0\text{ A}$                                             | -    | 1    | -    | $\Omega$ |

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

| Symbol    | Parameter                 | Test conditions                                                   | Min. | Typ. | Max. | Unit          |
|-----------|---------------------------|-------------------------------------------------------------------|------|------|------|---------------|
| $E_{on}$  | Turn-on switching energy  | $V_{DD} = 800\text{ V}$ , $I_D = 20\text{ A}$ ,                   | -    | 235  | -    | $\mu\text{J}$ |
| $E_{off}$ | Turn-off switching energy | $R_G = 4.7\text{ }\Omega$ , $V_{GS} = -5\text{ V to }18\text{ V}$ | -    | 77   | -    | $\mu\text{J}$ |

**Table 6. Switching times**

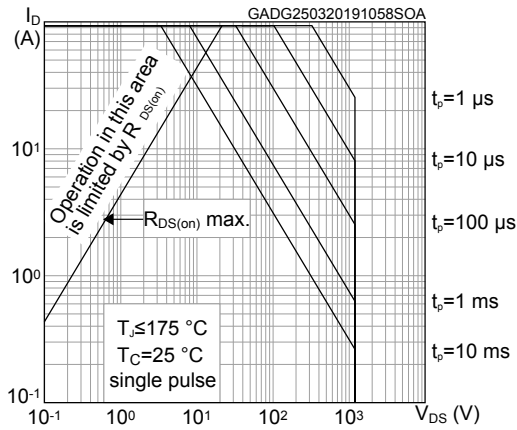
| Symbol       | Parameter           | Test conditions                                                                                                    | Min. | Typ. | Max. | Unit |
|--------------|---------------------|--------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 800\text{ V}$ , $I_D = 20\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = -5\text{ to }18\text{ V}$ | -    | 11   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                    | -    | 5    | -    |      |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                    | -    | 18   | -    |      |
| $t_f$        | Fall time           |                                                                                                                    | -    | 13   | -    |      |

**Table 7. Reverse SiC diode characteristics**

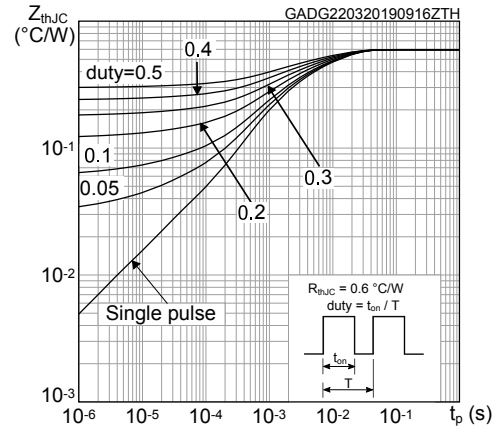
| Symbol    | Parameter                | Test conditions                                                                                                                 | Min. | Typ. | Max. | Unit |
|-----------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{SD}$  | Diode forward voltage    | $I_{SD} = 20\text{ A}$ , $V_{GS} = 0\text{ V}$                                                                                  | -    | 3.4  | -    | V    |
| $t_{rr}$  | Reverse recovery time    | $I_{SD} = 20\text{ A}$ , $di/dt = 2000\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 800\text{ V}$ , $V_{GS} = -5\text{ to }18\text{ V}$ | -    | 19   | -    | ns   |
| $Q_{rr}$  | Reverse recovery charge  |                                                                                                                                 | -    | 132  | -    | nC   |
| $I_{RRM}$ | Reverse recovery current |                                                                                                                                 | -    | 20   | -    | A    |

## 2.1 Electrical characteristics (curves)

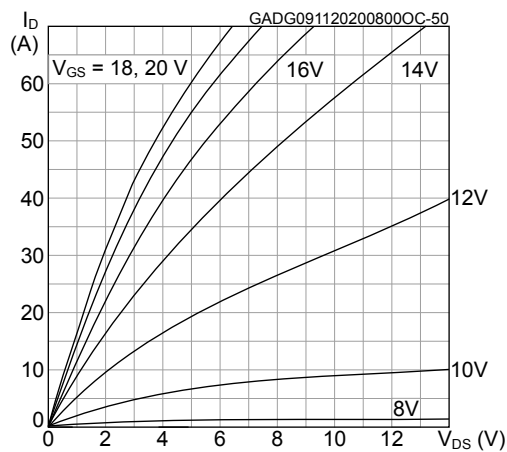
**Figure 1. Safe operating area**



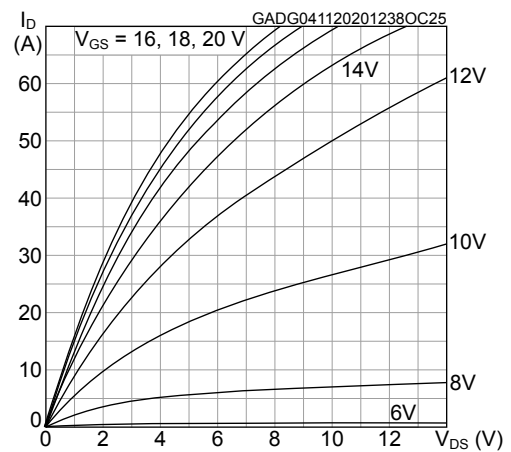
**Figure 2. Maximum transient thermal impedance**



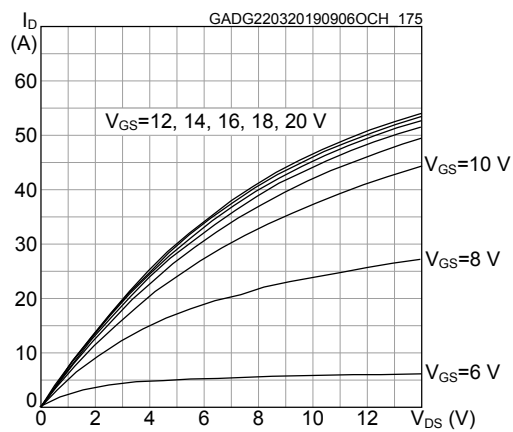
**Figure 3. Output characteristics ( $T_J = -50\text{ °C}$ )**



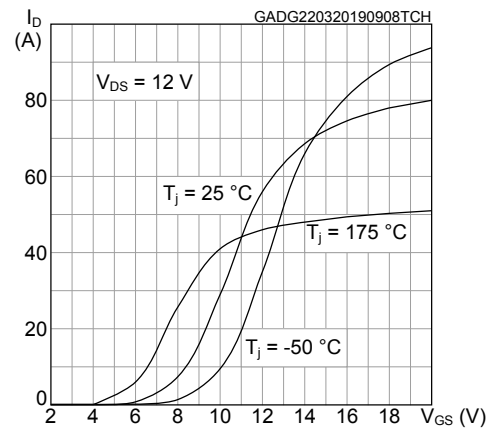
**Figure 4. Output characteristics ( $T_J = 25\text{ °C}$ )**



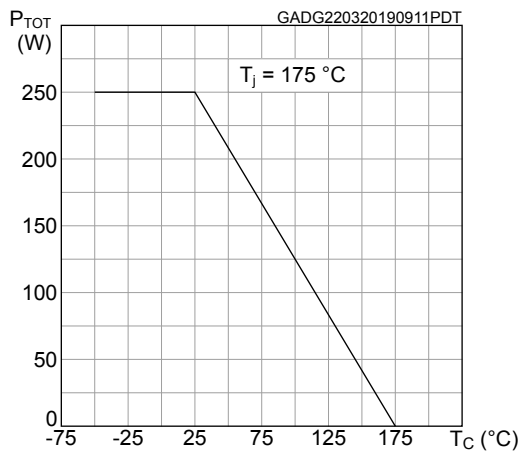
**Figure 5. Output characteristics ( $T_J = 175\text{ °C}$ )**



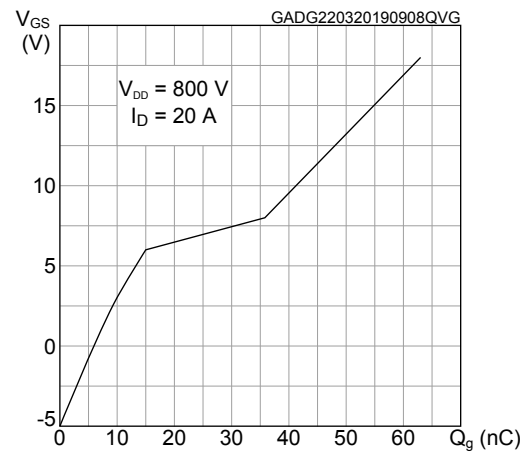
**Figure 6. Transfer characteristics**



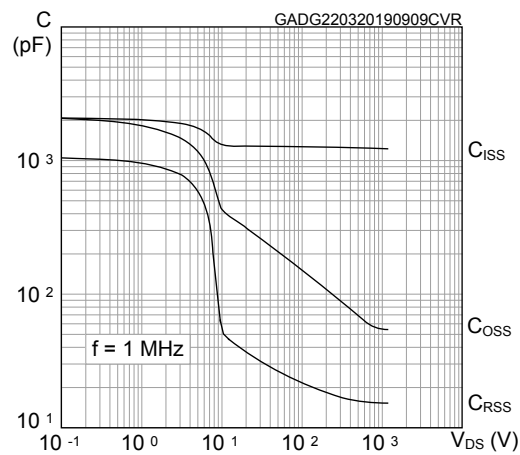
**Figure 7. Total power dissipation**



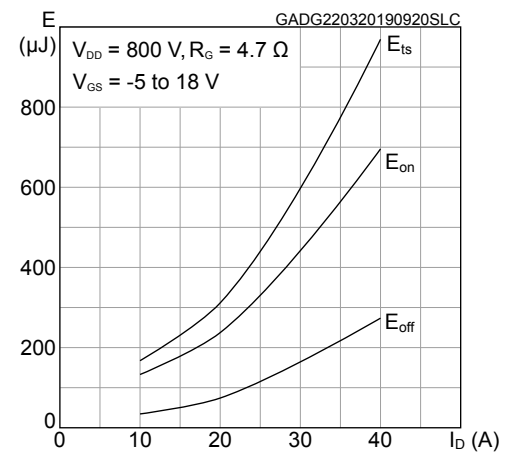
**Figure 8. Gate charge vs gate-source voltage**



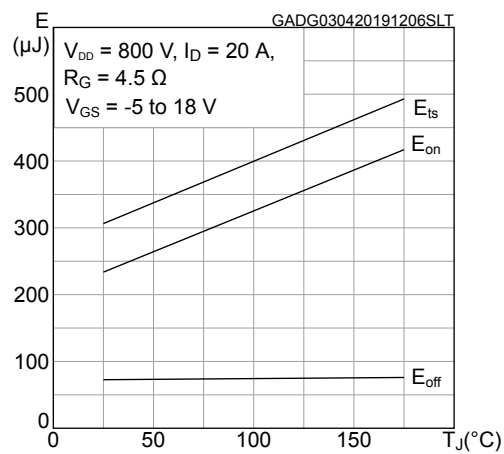
**Figure 9. Capacitance variations**



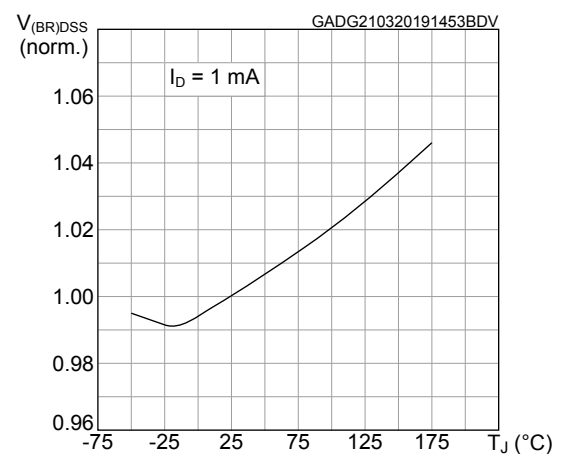
**Figure 10. Switching energy vs drain current**



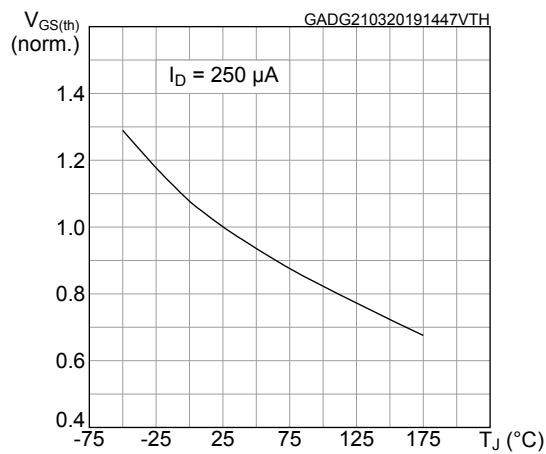
**Figure 11. Switching energy vs junction temperature**



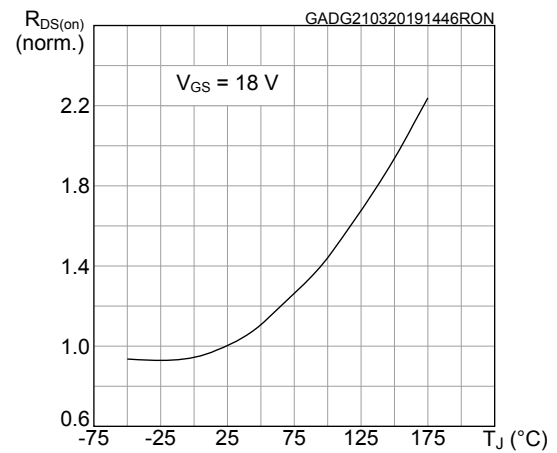
**Figure 12. Normalized  $V_{(BR)DSS}$  vs temperature**



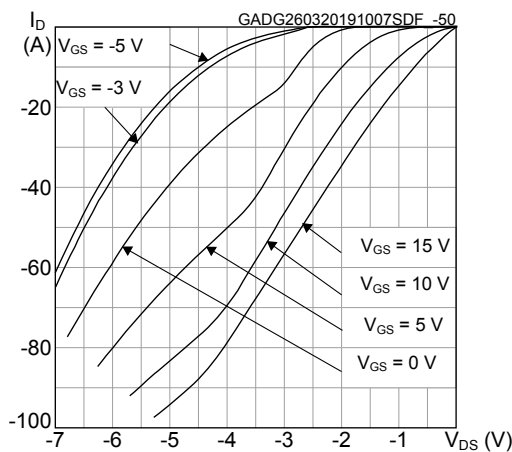
**Figure 13. Normalized gate threshold voltage vs temperature**



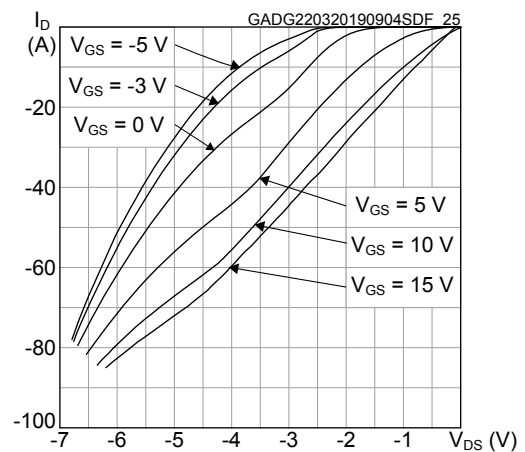
**Figure 14. Normalized on-resistance vs temperature**



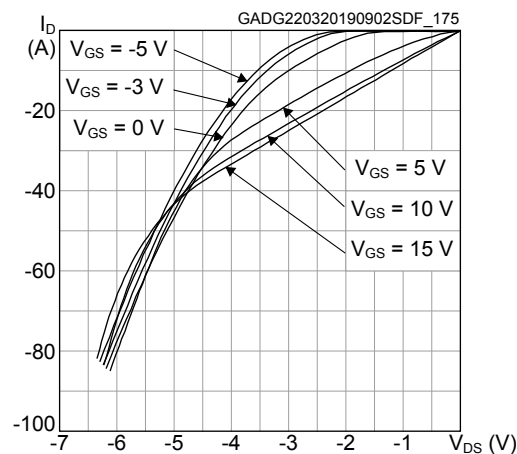
**Figure 15. Reverse conduction characteristics ( $T_J = -50^\circ C$ )**



**Figure 16. Reverse conduction characteristics ( $T_J = 25^\circ C$ )**



**Figure 17. Reverse conduction characteristics ( $T_J = 175^\circ C$ )**

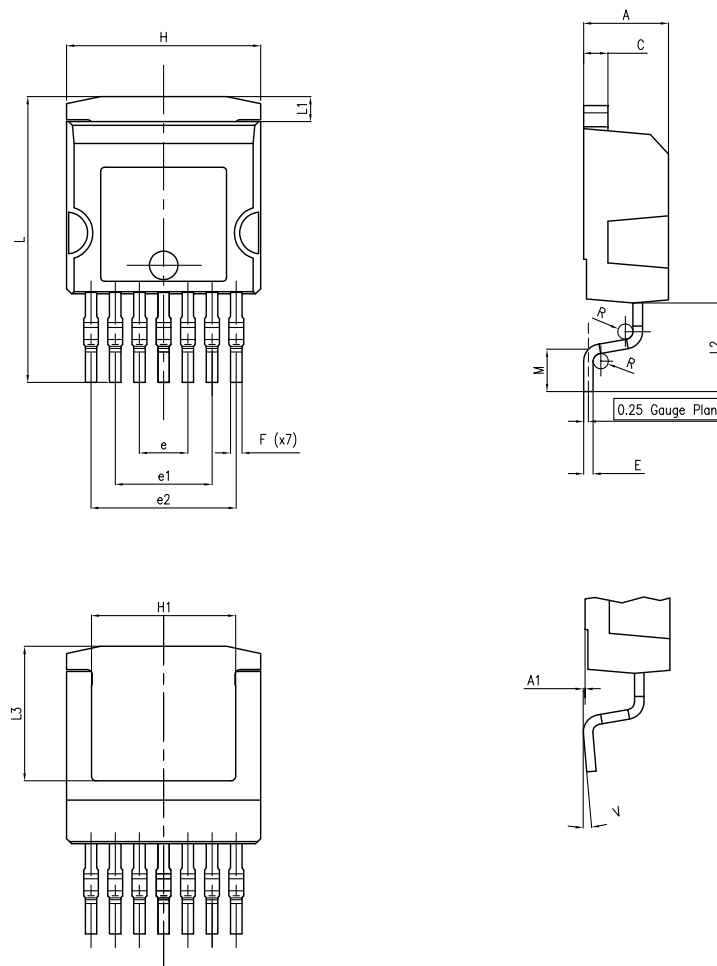


### 3 Package information

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](http://www.st.com). ECOPACK is an ST trademark.

#### 3.1 H<sup>2</sup>PAK-7 package information

**Figure 18. H<sup>2</sup>PAK-7 package outline**



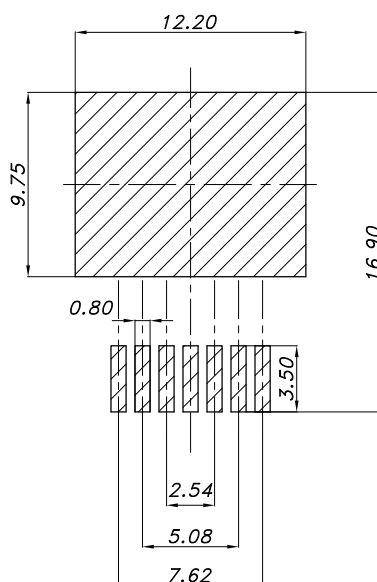
DM00249216\_4



**Table 8. H<sup>2</sup>PAK-7 package mechanical data**

| Dim. | mm    |       |
|------|-------|-------|
|      | Min.  | Max.  |
| A    | 4.30  | 4.80  |
| A1   | 0.03  | 0.20  |
| C    | 1.17  | 1.37  |
| e    | 2.34  | 2.74  |
| e1   | 4.88  | 5.28  |
| e2   | 7.42  | 7.82  |
| E    | 0.45  | 0.60  |
| F    | 0.50  | 0.70  |
| H    | 10.00 | 10.40 |
| H1   | 7.40  | 7.60  |
| L    | 14.75 | 15.25 |
| L1   | 1.27  | 1.40  |
| L2   | 4.35  | 4.95  |
| L3   | 6.85  | 7.25  |
| M    | 1.90  | 2.50  |
| R    | 0.20  | 0.60  |
| V    | 0°    | 8°    |

**Figure 19. H<sup>2</sup>PAK-7 recommended footprint**

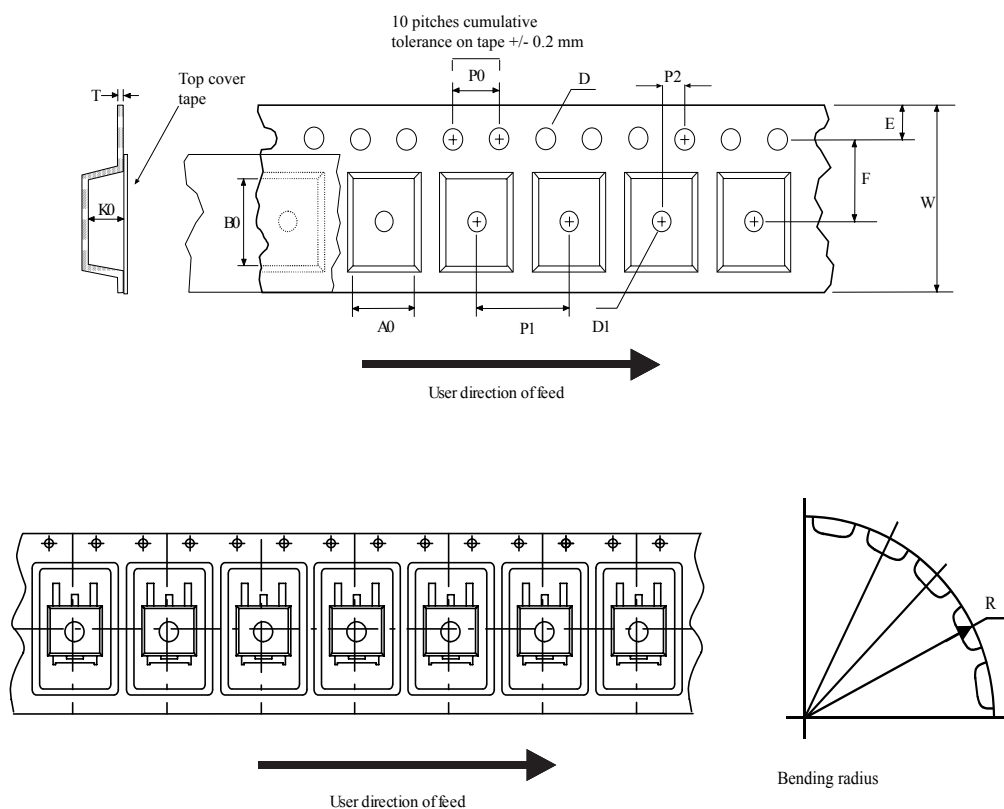


footprint\_DM00249216\_4

**Note:** Dimensions are in mm.

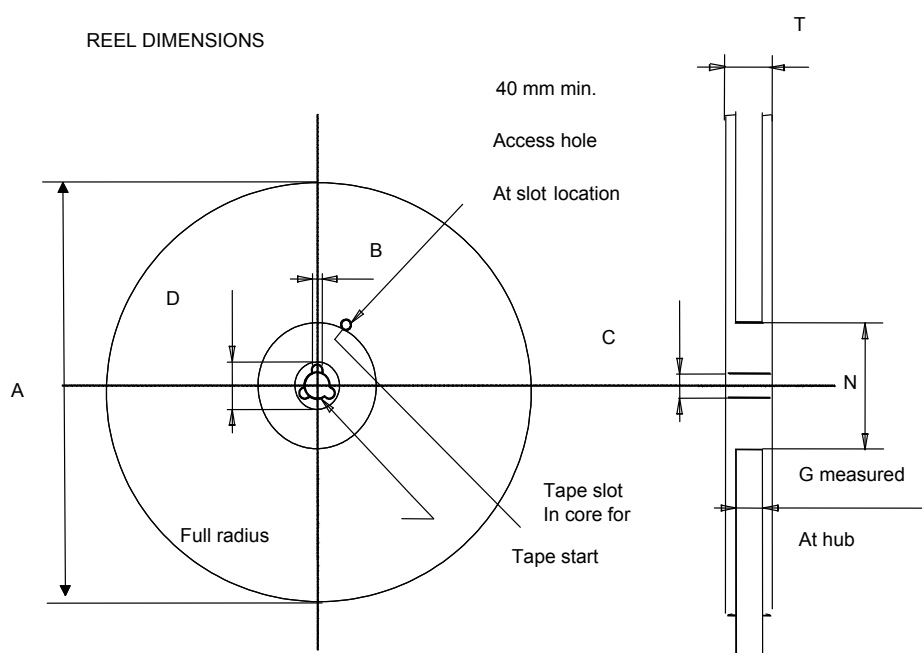
## 3.2

### Figure 20. Tape outline



AM08852v2

### Figure 21. 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        | Version | Changes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01-Apr-2019 | 1       | First release.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 24-Jul-2020 | 2       | Updated marking value in <i>Product status / summary</i> .<br>Updated <i>Table 3. On/off states</i> and <i>Table 7. Reverse SiC diode characteristics</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 24-Nov-2021 | 3       | Modified <i>Features and Applications</i> on cover page.<br>Modified <i>Table 1. Absolute maximum ratings</i> , <i>Table 2. Thermal data</i> , <i>Table 3. On/off states</i> , <i>Table 5. Switching energy (inductive load)</i> , <i>Table 6. Switching times</i> and <i>Table 7. Reverse SiC diode characteristics</i> .<br>Modified <i>Figure 1. Safe operating area</i> , <i>Figure 2. Maximum transient thermal impedance</i> , <i>Figure 3. Output characteristics (T<sub>J</sub> = -50 °C)</i> , <i>Figure 4. Output characteristics (T<sub>J</sub> = 25 °C)</i> , <i>Figure 5. Output characteristics (T<sub>J</sub> = 175 °C)</i> and <i>Figure 11. Switching energy vs junction temperature</i> .<br>Minor text changes. |

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