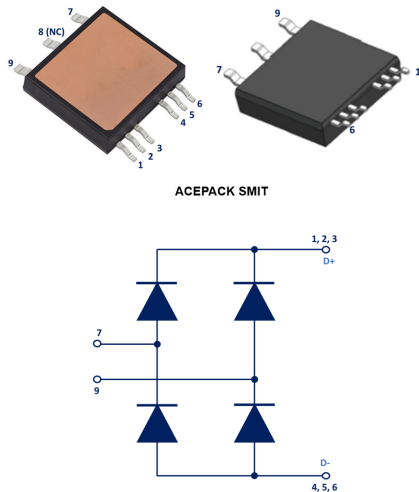


## Automotive 600 V ultrafast bridge module



### Features

- PPAP capable 
- Ultrafast with soft recovery behaviour
- Operating  $T_j$  from  $-40\text{ }^{\circ}\text{C}$  to  $+175\text{ }^{\circ}\text{C}$
- SMD with isolated top side cooling
- Low thermal resistance
- Backside in insulated ceramic
- Dice chips on direct bond copper (DBC) substrate
- ECOPACK2 compliant
- MSL: Level 3
- Insulation voltage (UL 1557)<sup>(1)</sup>:  $V_{RMS} = 4000\text{ V}$
- Die is AECQ-101 qualified
- AQG324 recommendation

1.  $V_{RMS}$  4000 V under qualification

### Applications

- Output rectification
- On board charger
- Charging station

### Description

The ultrafast bridge rectifier is a high-performance device, generally used in a full wave rectification of an output stage of a DC/DC converter in automotive applications.

Thanks to the high thermal capability of the ACEPACK SMIT package, this integrated module will increase the power density in the application, through very high thermal performances (top side cooling) and insulation done by an embedded ceramic. Especially suited for use in charger applications, either integrated in the vehicle or in a charging station, this rectifier will enhance the performance of the targeted application.

#### Product status link

STTH120RQ06-M2Y

#### Product summary

| Symbol         | Value                                   |
|----------------|-----------------------------------------|
| $I_F(AV)$      | 60 A                                    |
| $V_{RRM}$      | 600 V                                   |
| $V_F(typ.)$    | 1.45 V                                  |
| $t_{rr(max.)}$ | 35 ns                                   |
| $T_j$          | $-40$ to $+175\text{ }^{\circ}\text{C}$ |

# 1 Characteristics

**Table 1. Absolute ratings (limiting values at 25 °C, unless otherwise specified)**

| Symbol       | Parameter                                                                     | Value                                  | Unit |
|--------------|-------------------------------------------------------------------------------|----------------------------------------|------|
| $V_{RRM}$    | Repetitive peak reverse voltage ( $T_j = -40\text{ °C}$ to $+175\text{ °C}$ ) | 600                                    | V    |
| $I_{F(RMS)}$ | Forward rms current, per diode                                                | 85                                     | A    |
| $I_{F(AV)}$  | Average forward current per diode, $\delta = 0.5$ , square wave               | $T_C = 65\text{ °C}$<br>60             | A    |
| $I_{D(AV)}$  | Bridge output current, $\delta = 0.5$ , square wave                           | $T_C = 65\text{ °C}$<br>120            | A    |
| $I_{FSM}$    | Surge non repetitive forward current                                          | $t_p = 10\text{ ms}$ sinusoidal<br>400 | A    |
| $T_{stg}$    | Storage temperature range                                                     | -65 to +175                            | °C   |
| $T_j$        | Operating junction temperature range                                          | -40 to +175                            | °C   |

**Table 2. Thermal resistance parameter**

| Symbol        | Parameter                       | Typ. | Max. value | Unit |
|---------------|---------------------------------|------|------------|------|
| $R_{th(j-c)}$ | Junction to case per diode (DC) | 0.57 | 0.7        | °C/W |

For more information, please refer to the following application note related to the thermal management:

- [AN5384: ACEPACK SMIT module package guidelines for mounting and thermal management](#)

**Table 3. Static electrical characteristics**

| Symbol      | Parameter               | Test conditions       | Min. | Typ. | Max. | Unit          |
|-------------|-------------------------|-----------------------|------|------|------|---------------|
| $I_R^{(1)}$ | Reverse leakage current | $T_j = 25\text{ °C}$  | -    |      | 80   | $\mu\text{A}$ |
|             |                         | $T_j = 150\text{ °C}$ | -    | 160  | 1600 |               |
| $V_F^{(2)}$ | Forward voltage drop    | $T_j = 25\text{ °C}$  | -    |      | 2.45 | V             |
|             |                         | $T_j = 150\text{ °C}$ | -    | 1.15 | 1.45 |               |
|             |                         | $T_j = 25\text{ °C}$  | -    |      | 2.95 |               |
|             |                         | $T_j = 150\text{ °C}$ | -    | 1.45 | 1.85 |               |

1. Pulse test:  $t_p = 5\text{ ms}$ ,  $\delta < 2\%$

2. Pulse test:  $t_p = 380\text{ }\mu\text{s}$ ,  $\delta < 2\%$

To evaluate the conduction losses, use the following equation:

$$P = 1.05 \times I_{F(AV)} + 0.013 \times I_{F(RMS)}^2$$

**Table 4. Dynamic electrical characteristics**

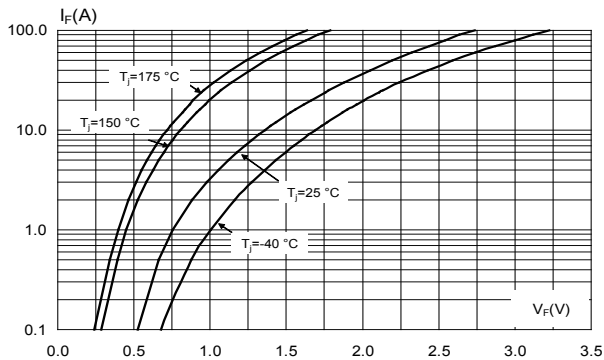
| Symbol   | Parameter                | Test conditions                                                                                             | Min. | Typ. | Max. | Unit |
|----------|--------------------------|-------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{rr}$ | Reverse recovery time    | $T_j = 25\text{ °C}$<br>$I_F = 0.5\text{ A}$ , $I_{rr} = 0.25\text{ A}$ , $I_R = 1\text{ A}$                | -    |      | 35   | ns   |
|          |                          | $I_F = 1\text{ A}$ , $V_R = 30\text{ V}$ , $dI_F/dt = -50\text{ A}/\mu\text{s}$                             | -    | 50   | 65   |      |
| $I_{RM}$ | Reverse recovery current | $T_j = 125\text{ °C}$<br>$I_F = 60\text{ A}$ , $V_R = 400\text{ V}$ , $dI_F/dt = -200\text{ A}/\mu\text{s}$ | -    | 12   | 16   | A    |
| $Q_{rr}$ | Reverse recovery charge  |                                                                                                             | -    | 660  |      | nC   |
| $t_{rr}$ | Reverse recovery time    |                                                                                                             | -    | 92   |      | ns   |

For more information, please refer to the following application notes related to the power losses:

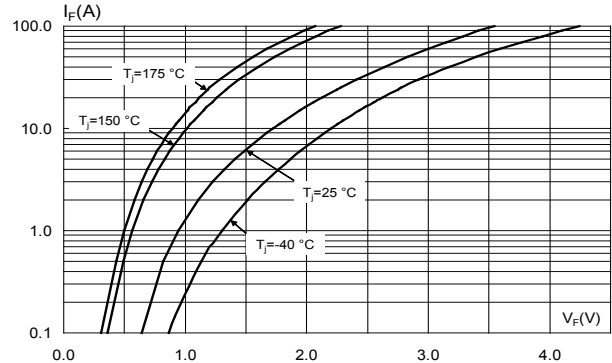
- [AN604](#): Calculation of conduction losses in a power rectifier
- [AN5028](#): Calculation of turn-off power losses generated by an ultrafast diode

## 1.1 Characteristics (curves)

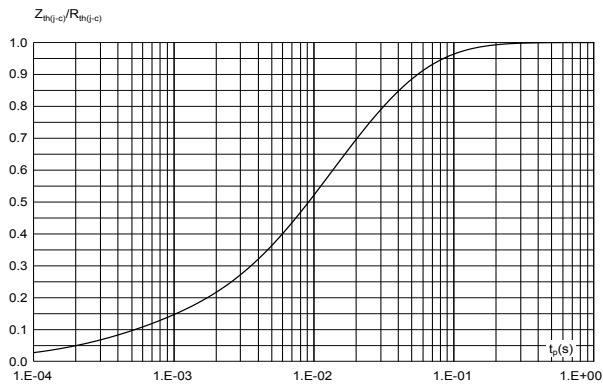
**Figure 1. Forward voltage drop versus forward current (typical values)**



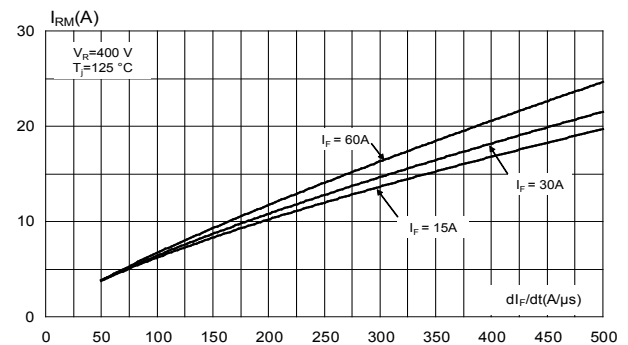
**Figure 2. Forward voltage drop versus forward current (maximum values)**

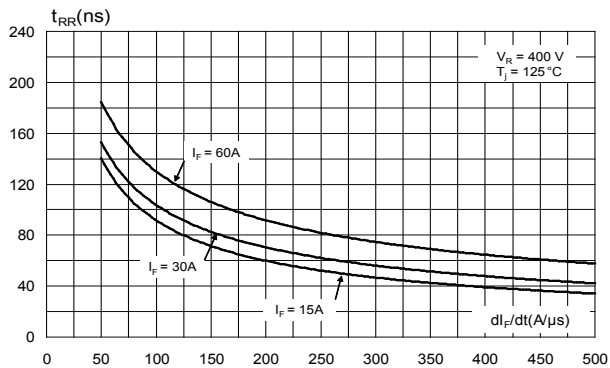
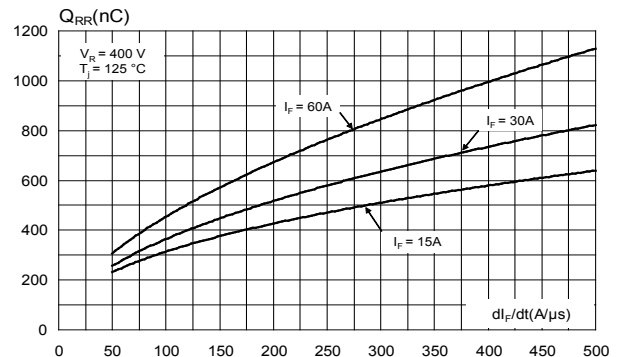
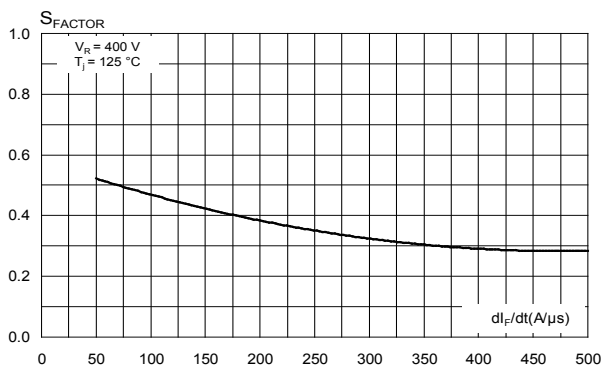
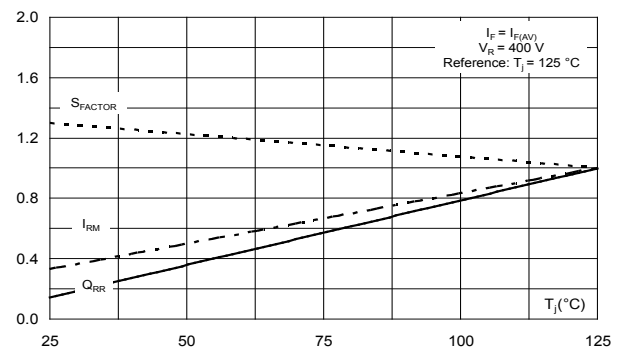
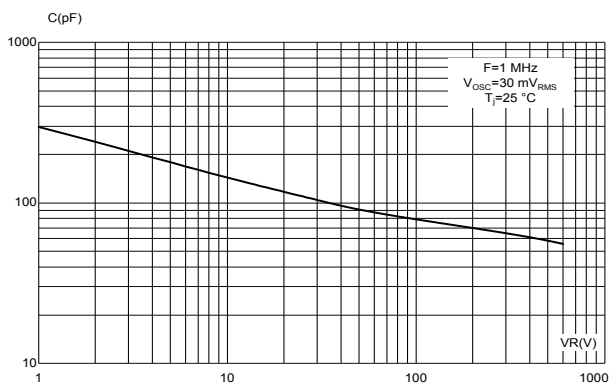
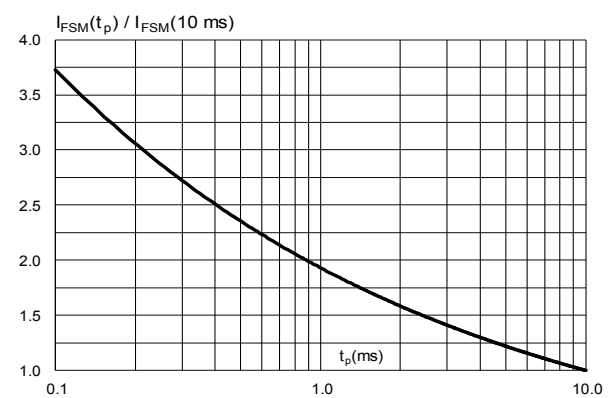


**Figure 3. Relative variation of thermal impedance junction to case versus pulse duration**

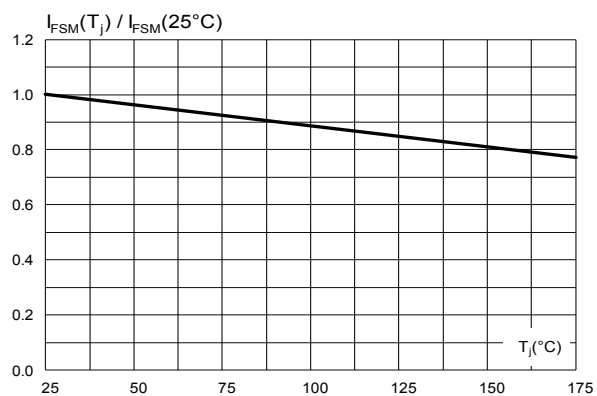


**Figure 4. Peak reverse recovery current versus  $di_F/dt$  (typical values)**

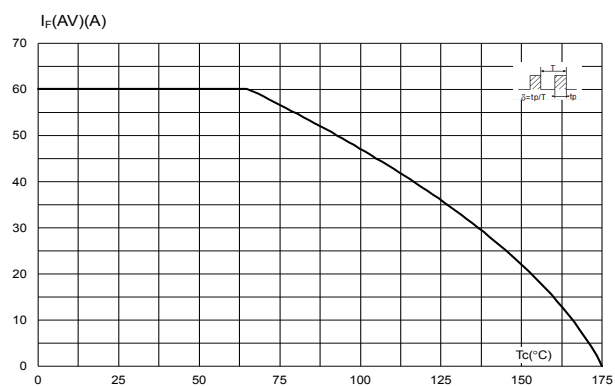


**Figure 5. Reverse recovery time versus  $di_F/dt$  (typical values)**

**Figure 6. Reverse recovery charges versus  $di_F/dt$  (typical values)**

**Figure 7. Reverse recovery softness factor versus  $di_F/dt$  (typical values)**

**Figure 8. Relative variations of dynamic parameters versus junction temperature**

**Figure 9. Junction capacitance versus reverse voltage applied (typical values)**

**Figure 10. Relative variation of non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform)**


**Figure 11. Relative variation of non-repetitive peak surge forward current versus initial junction temperature (sinusoidal waveform)**



**Figure 12. Average forward current versus case temperature ( $\delta = 0.5$ )**



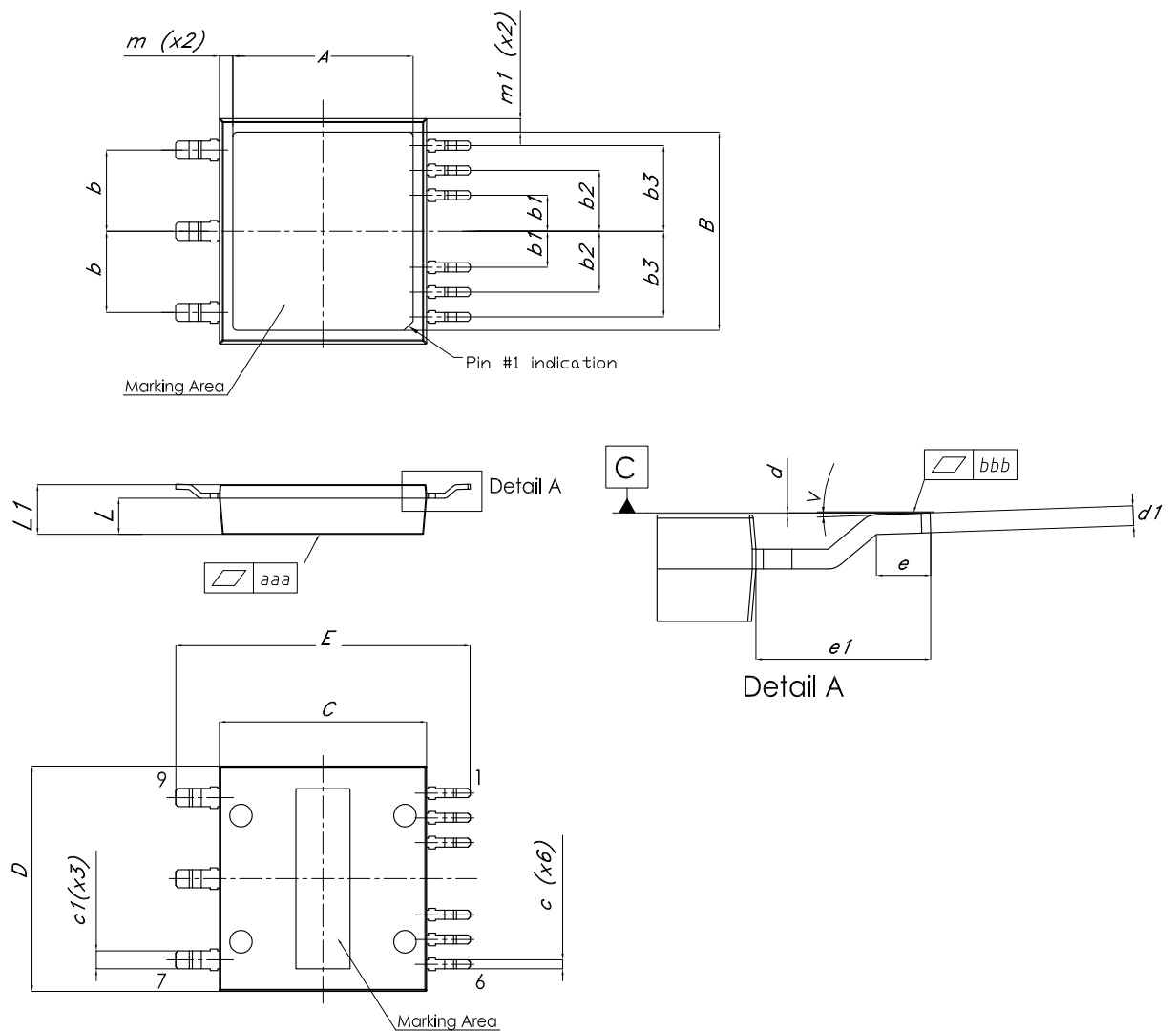
## 2 Package information

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.

### 2.1 ACEPACK SMIT package information

- Lead-free package leads finishing
- Halogen-free molding compound resin meets UL94 standard level V0

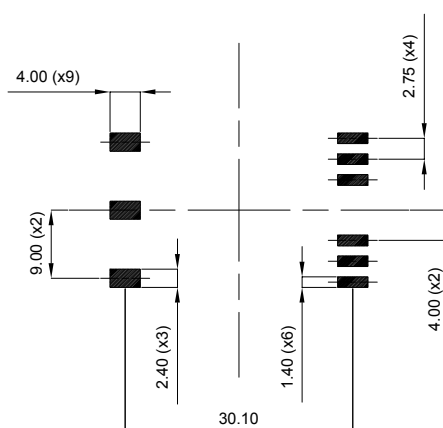
**Figure 13. ACEPACK SMIT package outline**



DM00447519\_Rev.6

**Table 5. ACEPACK SMIT package mechanical data**

| Dim. | mm    |       |       | Inches (for reference only) |        |        |
|------|-------|-------|-------|-----------------------------|--------|--------|
|      | Min.  | Typ.  | Max.  | Min.                        | Typ.   | Max.   |
| A    | 19.50 | 20.00 | 20.50 | 0.7677                      | 0.7874 | 0.8071 |
| B    | 21.50 | 22.00 | 22.50 | 0.8465                      | 0.8661 | 0.8858 |
| C    | 22.80 | 23.00 | 23.20 | 0.8976                      | 0.9055 | 0.9134 |
| D    | 24.80 | 25.00 | 25.20 | 0.9764                      | 0.9843 | 0.9921 |
| E    | 32.20 | 32.70 | 33.20 | 1.2677                      | 1.2874 | 1.3071 |
| b    |       | 9.00  |       |                             | 0.3543 |        |
| b1   |       | 4.00  |       |                             | 0.1575 |        |
| b2   |       | 6.75  |       |                             | 0.2657 |        |
| b3   |       | 9.50  |       |                             | 0.3740 |        |
| c    | 0.95  | 1.00  | 1.10  | 0.0374                      | 0.0394 | 0.0433 |
| c1   | 1.95  | 2.00  | 2.10  | 0.0768                      | 0.0787 | 0.0827 |
| d    | 0.00  |       | 0.15  | 0.0000                      | 0.0000 | 0.0059 |
| d1   | 0.45  | 0.55  | 0.65  | 0.0177                      | 0.0217 | 0.0256 |
| e    | 1.30  | 1.50  | 1.70  | 0.0512                      | 0.0591 | 0.0669 |
| e1   | 4.65  | 4.85  | 5.05  | 0.1831                      | 0.1909 | 0.1988 |
| L    | 3.95  | 4.00  | 4.05  | 0.1555                      | 0.1575 | 0.1594 |
| L1   | 5.40  | 5.50  | 5.60  | 0.2126                      | 0.2165 | 0.2205 |
| m    | 1.30  | 1.50  | 1.80  | 0.0512                      | 0.0591 | 0.0709 |
| m1   | 1.30  | 1.50  | 1.80  | 0.0512                      | 0.0591 | 0.0709 |
| V    | 0°    | 2°    | 4°    | 0°                          | 2°     | 4°     |
| aaa  | 0.01  |       | 0.05  |                             | 0.0004 | 0.0020 |
| bbb  | 0.00  |       | 0.10  |                             | 0.0000 | 0.0039 |

**Figure 14. ACEPACK SMIT recommended footprint (dimensions are in mm)**


DM00447519\_FP\_Rev.5

**Note:** Recommended pressing force on package to the heatsink: 50 N as described in application note [AN5384](#).  
 For more information, please refer to [TN1173](#): Packing information for IPAD, protection, rectifiers, thyristors and AC Switches.

### 3 Ordering information

**Table 6. Ordering information**

| Order code      | Marking         | Package      | Weight | Base qty. | Delivery mode |
|-----------------|-----------------|--------------|--------|-----------|---------------|
| STTH120RQ06-M2Y | STTH120RQ06-M2Y | ACEPACK SMIT | 8.1 g  | 200       | Tape and reel |



## Revision history

Table 7. Document revision history

| Date        | Revision | Changes                   |
|-------------|----------|---------------------------|
| 26-Jun-2024 | 1        | Initial release.          |
| 03-Jul-2024 | 2        | Updated <i>Features</i> . |

**IMPORTANT NOTICE – READ CAREFULLY**

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgment.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, refer to [www.st.com/trademarks](http://www.st.com/trademarks). All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2024 STMicroelectronics – All rights reserved