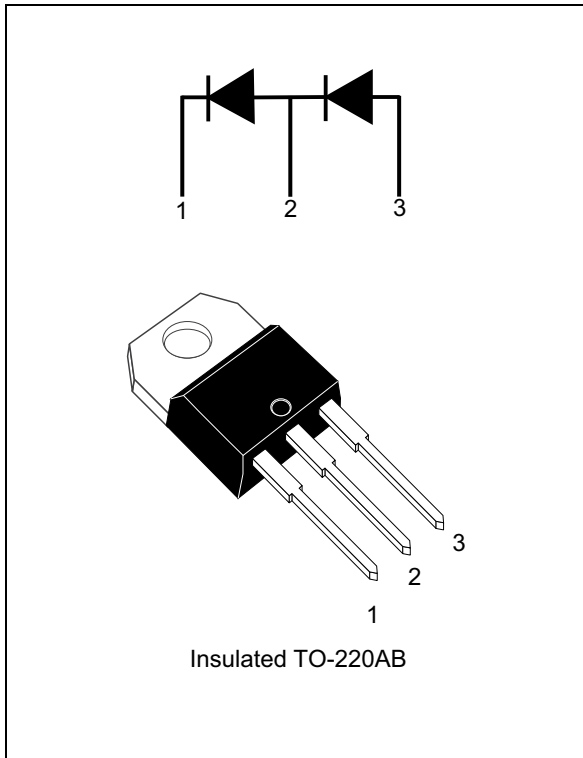


## Dual 650 V power Schottky silicon carbide diode in series

Datasheet - production data



### Description

The SiC diode is an ultrahigh performance power Schottky diode. It is manufactured using a silicon carbide substrate. The wide band gap material allows the design of a Schottky diode structure with a 650 V rating. Due to the Schottky construction, no recovery is shown at turn-off and ringing patterns are negligible. The minimal capacitive turn-off behavior is independent of temperature.

Especially suited for use in specific bridge-less topologies, this dual 650 V rectifier will boost the performance in hard switching conditions. Its high forward surge capability ensures a good robustness during transient phases.

**Table 1. Device summary (per diode)**

| Symbol       | Value  |
|--------------|--------|
| $I_{F(AV)}$  | 6 A    |
| $V_{RRM}$    | 650 V  |
| $T_j$ (max.) | 175 °C |

### Features

- No or negligible reverse recovery
- Switching behavior independent of temperature
- Suited for specific bridge-less topologies
- High forward surge capability
- Insulated package:
  - Capacitance: 7 pF
  - Insulated voltage: 2500 V rms

# 1 Characteristics

**Table 2. Absolute ratings (limiting values at 25 °C unless otherwise specified (per diode))**

| Symbol       | Parameter                                     |  | Value       | Unit |
|--------------|---|--|-------------|------|
| $V_{RRM}$    | Repetitive peak reverse voltage               |  | 650         | V    |
| $I_{F(RMS)}$ | Forward rms current                           |  | 22          | A    |
| $I_{F(AV)}$  | Average forward current                       | $T_c = 100\text{ °C}^{(1)}$ , DC current                       | 6           | A    |
| $I_{FSM}$    | Surge non repetitive forward current          | $t_p = 10\text{ ms}$ sinusoidal, $T_c = 25\text{ °C}$          | 60          | A    |
|              |   | $t_p = 10\text{ ms}$ sinusoidal, $T_c = 125\text{ °C}$         | 52          |      |
|              |   | $t_p = 10\text{ }\mu\text{s}$ sinusoidal, $T_c = 25\text{ °C}$ | 400         |      |
| $I_{FRM}$    | Repetitive peak forward current               | $T_c = 100\text{ °C}^{(1)}$ , $\delta = 0.1$                   | 25          | A    |
| $T_{stg}$    | Storage temperature range                     |  | -55 to +175 | °C   |
| $T_j$        | Operating junction temperature <sup>(2)</sup> |  | -40 to +175 | °C   |

- Value based on  $R_{th(j-c)}$  max (per diode)
- $\frac{dP_{tot}}{dT_j} < \frac{1}{R_{th(j-a)}}$  condition to avoid thermal runaway for a diode on its own heatsink

**Table 3. Thermal resistance**

| Symbol        | Parameter        |           | Typ. | Max. | Unit |
|---------------|------------------|-----------|------|------|------|
| $R_{th(j-c)}$ | Junction to case | Per diode | 3.8  | 4.8  | °C/W |
|               |                  | Total     | 2.05 | 2.55 |      |
| $R_{th(c)}$   | Coupling         |           |      | 0.3  | °C/W |

When the diodes are used simultaneously:

$$\Delta T_{j(\text{diode1})} = P_{(\text{diode1})} \times R_{th(j-c)} \text{ (per diode)} + P_{(\text{diode2})} \times R_{th(c)}$$

**Table 4. Static electrical characteristics (per diode)**

| Symbol      | Parameter               | Tests conditions      |                    | Min. | Typ. | Max. | Unit          |
|-------------|-------------------------|-----------------------|--------------------|------|------|------|---------------|
| $I_R^{(1)}$ | Reverse leakage current | $T_j = 25\text{ °C}$  | $V_R = V_{RRM}$    | -    | 5    | 60   | $\mu\text{A}$ |
|             |                         | $T_j = 150\text{ °C}$ |                    | -    | 50   | 250  |               |
| $V_F^{(2)}$ | Forward voltage drop    | $T_j = 25\text{ °C}$  | $I_F = 6\text{ A}$ | -    | 1.56 | 1.75 | V             |
|             |                         | $T_j = 150\text{ °C}$ |                    | -    | 1.98 | 2.5  |               |

- Pulse test:  $t_p = 10\text{ ms}$ ,  $\delta < 2\%$
- Pulse test:  $t_p = 500\text{ }\mu\text{s}$ ,  $\delta < 2\%$

To evaluate the conduction losses use the following equation:

$$P = 1.35 \times I_{F(AV)} + 0.192 \times I_{F(RMS)}^2$$

Table 5. Dynamic electrical characteristics

| Symbol         | Parameter               | Test conditions  | Typ. | Unit |
|----------------|-------------------------|--|------|------|
| $Q_{Cj}^{(1)}$ | Total capacitive charge | $V_R = 400\text{ V}$   | 18   | nC   |
| $C_j$          | Total capacitance       | $V_R = 0\text{ V}, T_C = 25\text{ }^\circ\text{C}, F = 1\text{ MHz}$   | 300  | pF   |
|                |                         | $V_R = 400\text{ V}, T_C = 25\text{ }^\circ\text{C}, F = 1\text{ MHz}$ | 30   |      |

1. Most accurate value for the capacitive charge:  $Q_{Cj} = \int_0^{V_{OUT}} C_j(V_R).dV_R$

Figure 1. Forward voltage drop versus forward current (typical values, low level, per diode)

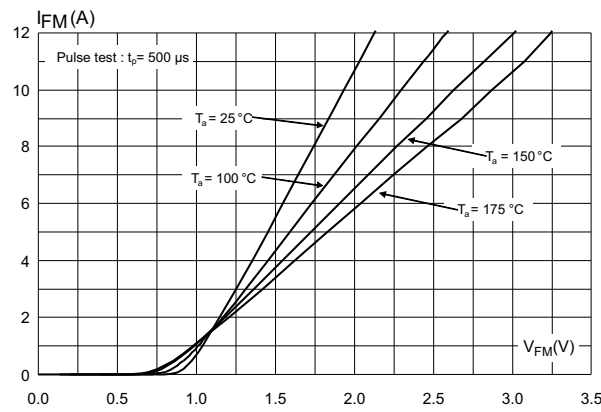


Figure 2. Forward voltage drop versus forward current (typical values, high level, per diode)

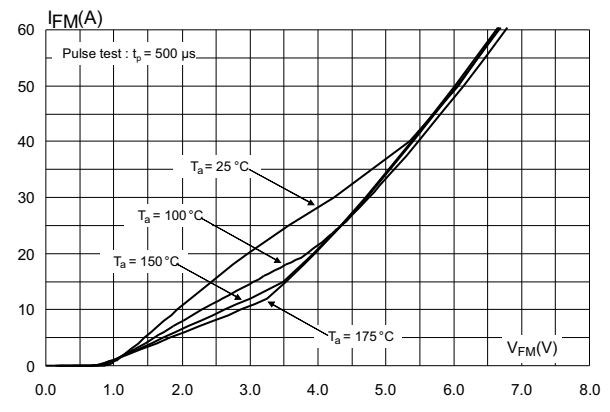


Figure 3. Reverse leakage current versus reverse voltage applied (typical values, per diode)

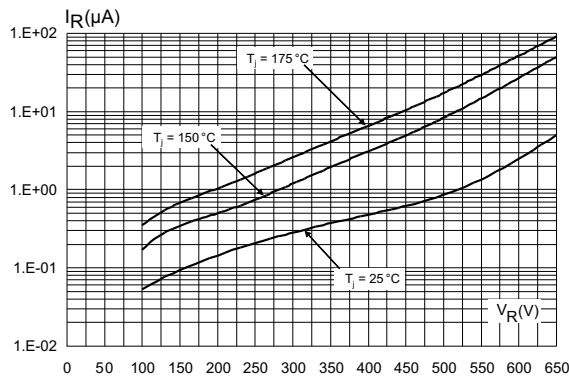
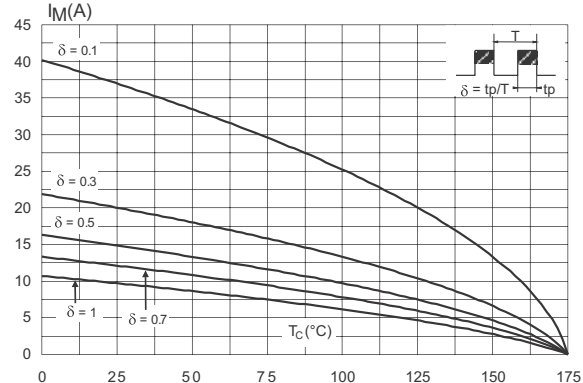
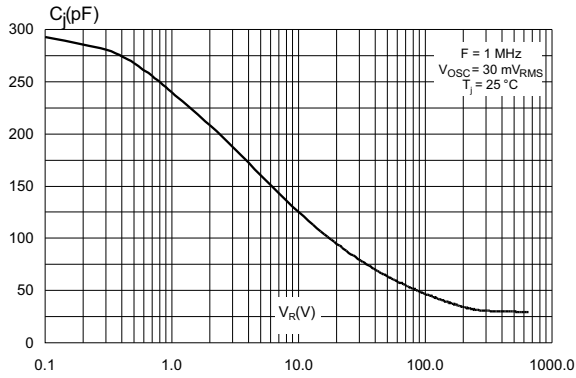


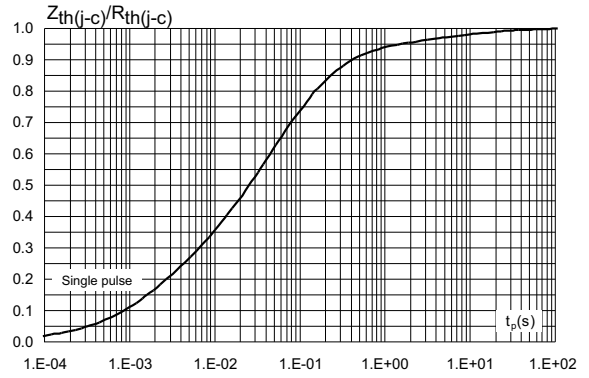
Figure 4. Peak forward current versus case temperature (per diode)



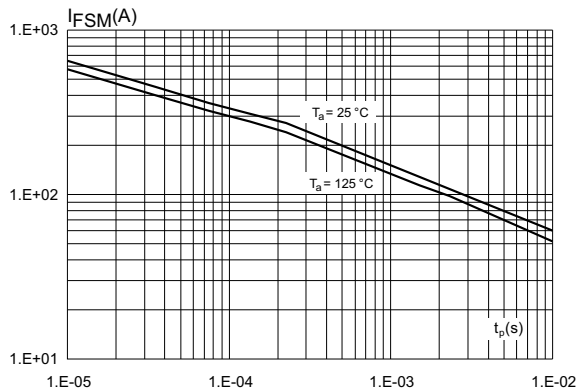
**Figure 5. Junction capacitance versus reverse voltage applied (typical values, per diode)**



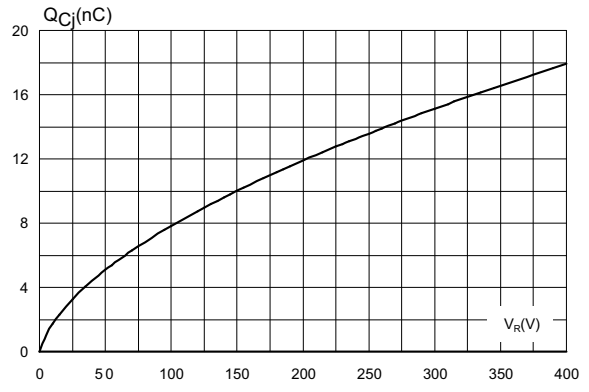
**Figure 6. Relative variation of thermal impedance junction to case versus pulse duration**



**Figure 7. Non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform, per diode)**



**Figure 8. Total capacitive charges versus reverse voltage applied (typical values, per diode)**



## 2 Package information

- Epoxy meets UL94, V0
- Lead-free package
- Cooling method: by conduction (C)
- Recommended torque value: 0.4 to 0.6 N·m

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

### 2.1 Insulated TO-220AB package information

Figure 9. Insulated TO-220AB package outline

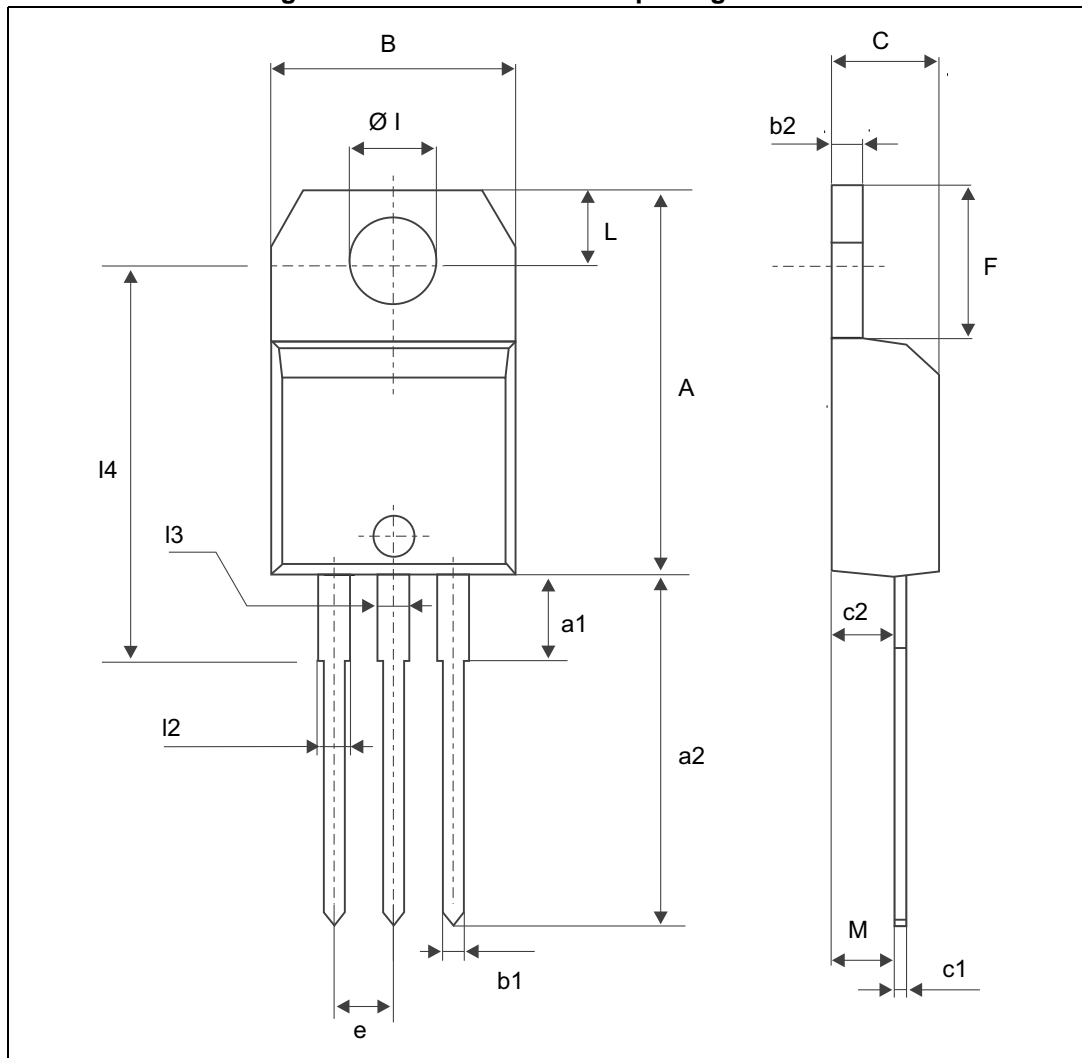


Table 6. Insulated TO-220AB package mechanical data

| Ref. | Dimensions  |       |       |        |       |       |
|------|-------------|-------|-------|--------|-------|-------|
|      | Millimeters |       |       | Inches |       |       |
|      | Min.        | Typ.  | Max.  | Min.   | Typ.  | Max.  |
| A    | 15.20       |       | 15.90 | 0.598  |       | 0.625 |
| a1   |             | 3.75  |       |        | 0.147 |       |
| a2   | 13.00       |       | 14.00 | 0.511  |       | 0.551 |
| B    | 10.00       |       | 10.40 | 0.393  |       | 0.409 |
| b1   | 0.61        |       | 0.88  | 0.024  |       | 0.034 |
| b2   | 1.23        |       | 1.32  | 0.048  |       | 0.051 |
| C    | 4.40        |       | 4.60  | 0.173  |       | 0.181 |
| c1   | 0.49        |       | 0.70  | 0.019  |       | 0.027 |
| c2   | 2.40        |       | 2.72  | 0.094  |       | 0.107 |
| e    | 2.40        |       | 2.70  | 0.094  |       | 0.106 |
| F    | 6.20        |       | 6.60  | 0.244  |       | 0.259 |
| ØI   | 3.75        |       | 3.85  | 0.147  |       | 0.151 |
| I4   | 15.80       | 16.40 | 16.80 | 0.622  | 0.646 | 0.661 |
| L    | 2.65        |       | 2.95  | 0.104  |       | 0.116 |
| I2   | 1.14        |       | 1.70  | 0.044  |       | 0.066 |
| I3   | 1.14        |       | 1.70  | 0.044  |       | 0.066 |
| M    |             | 2.60  |       |        | 0.102 |       |

### 3 Ordering information

**Table 7. Ordering information**

| Order code   | Marking       | Package               | Weight | Base qty | Delivery mode |
|--------------|---------------|-----------------------|--------|----------|---------------|
| STPSC6TH13TI | STPSC 6TH13TI | Insulated<br>TO-220AB | 2.3g   | 50       | Tube          |

### 4 Revision history

**Table 8. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 24-Jun-2013 | 1        | First issue.   |
| 07-Nov-2013 | 2        | Updated Figure 1 and Figure 2.   |
| 05-Jan-2016 | 3        | Updated <a href="#">Table 7</a> .<br>Format updated to current standard. |

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