

**SiC**

Silicon Carbide Diode

**5<sup>th</sup> Generation thinQ!™**

650V SiC Schottky Diode

**IDW40G65C5**

**Final Datasheet**

Rev. 2.2, 2013-01-15

**Power Management & Multimarket**

## 5<sup>th</sup> Generation thinQ!™ SiC Schottky Diode

IDW40G65C5

### 1 Description

ThinQ!™ Generation 5 represents Infineon leading edge technology for the SiC Schottky Barrier diodes. Thanks to the more compact design and thin-wafer technology, the new family of products shows improved efficiency over all load conditions, resulting from both the improved thermal characteristics and a lower figure of merit ( $Q_c \times V_f$ ).

The new thinQ!™ Generation 5 has been designed to complement our 650V CoolMOS™ families: this ensures meeting the most stringent application requirements in this voltage range.

#### Features

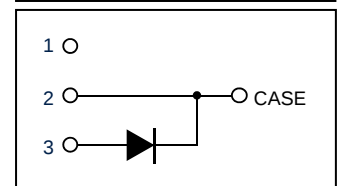
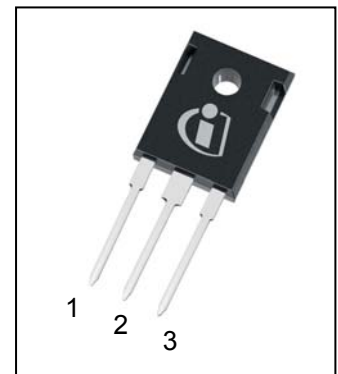
- Revolutionary semiconductor material - Silicon Carbide
- Benchmark switching behavior
- No reverse recovery/ No forward recovery
- Temperature independent switching behavior
- High surge current capability
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target applications
- Breakdown voltage tested at 88 mA<sup>2)</sup>
- Optimized for high temperature operation

#### Benefits

- System efficiency improvement over Si diodes
- System cost / size savings due to reduced cooling requirements
- Enabling higher frequency / increased power density solutions
- Higher system reliability due to lower operating temperatures
- Reduced EMI

#### Applications

- Switch mode power supply
- Power factor correction
- Solar inverter
- Uninterruptible power supply



**Table 1 Key Performance Parameters**

| Parameter                 | Value | Unit |
|---------------------------|-------|------|
| $V_{DC}$                  | 650   | V    |
| $Q_C; V_R=400V$           | 55    | nC   |
| $E_C; V_R=400V$           | 12.8  | μJ   |
| $I_F @ T_C < 110^\circ C$ | 40    | A    |

**Table 2 Pin Definition**

| Pin 1 | Pin 2 | Pin 3 |
|-------|-------|-------|
| n.c.  | C     | A     |

| Type / ordering Code | Package    | Marking | Related links                                                  |
|----------------------|------------|---------|----------------------------------------------------------------|
| IDW40G65C5           | PG-TO247-3 | D4065C5 | <a href="http://www.infineon.com/sic">www.infineon.com/sic</a> |

1) J-STD20 and JESD22

2) All devices tested under avalanche conditions for a time periode of 10ms

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## 2 Maximum ratings

**Table 3** Maximum ratings

| Parameter                                           | Symbol         | Values |      |      | Unit             | Note/Test Condition                                    |
|-----------------------------------------------------|----------------|--------|------|------|------------------|--------------------------------------------------------|
|                                                     |                | Min.   | Typ. | Max. |                  |                                                        |
| Continuous forward current                          | $I_F$          | –      | –    | 40   | A                | $T_C < 110^\circ\text{C}$ , $D=1$                      |
| Surge non-repetitive forward current, sine halfwave | $I_{F,SM}$     | –      | –    | 182  |                  | $T_C = 25^\circ\text{C}$ , $t_p=10\text{ ms}$          |
|                                                     |                | –      | –    | 153  |                  | $T_C = 150^\circ\text{C}$ , $t_p=10\text{ ms}$         |
| Non-repetitive peak forward current                 | $I_{F,max}$    | –      | –    | 1432 |                  | $T_C = 25^\circ\text{C}$ , $t_p=10\text{ }\mu\text{s}$ |
| $i^2t$ value                                        | $\int i^2 dt$  | –      | –    | 166  | A <sup>2</sup> s | $T_C = 25^\circ\text{C}$ , $t_p=10\text{ ms}$          |
|                                                     |                | –      | –    | 118  |                  | $T_C = 150^\circ\text{C}$ , $t_p=10\text{ ms}$         |
| Repetitive peak reverse voltage                     | $V_{RRM}$      | –      | –    | 650  | V                |                                                        |
| Diode dv/dt ruggedness                              | $dv/dt$        | –      | –    | 100  | V/ns             | $V_R=0..480\text{ V}$                                  |
| Power dissipation                                   | $P_{tot}$      | –      | –    | 183  | W                | $T_C = 25^\circ\text{C}$                               |
| Operating and storage temperature                   | $T_j; T_{stg}$ | -55    | –    | 175  | °C               |                                                        |
| Mounting torque                                     |                | –      | 50   | 70   | Ncm              | M3 and M4 screws                                       |

## 3 Thermal characteristics

**Table 4** Thermal characteristics TO-247-3

| Parameter                                                  | Symbol     | Values |      |      | Unit | Note/Test Condition                  |
|------------------------------------------------------------|------------|--------|------|------|------|--------------------------------------|
|                                                            |            | Min.   | Typ. | Max. |      |                                      |
| Thermal resistance, junction-case                          | $R_{thJC}$ | –      | 0.6  | 0.8  | K/W  |                                      |
| Thermal resistance, junction-ambient                       | $R_{thJA}$ | –      | –    | 62   |      | leaded                               |
| Soldering temperature, wavesoldering only allowed at leads | $T_{sold}$ | –      | –    | 260  | °C   | 1.6mm (0.063 in.) from case for 10 s |

## 4 Electrical characteristics

**Table 5 Static characteristics**

| Parameter             | Symbol   | Values |      |      | Unit          | Note/Test Condition                                |
|-----------------------|----------|--------|------|------|---------------|----------------------------------------------------|
|                       |          | Min.   | Typ. | Max. |               |                                                    |
| DC blocking voltage   | $V_{DC}$ | 650    | –    | –    | V             | $I_R = 0.22 \text{ mA}$ , $T_j = 25^\circ\text{C}$ |
| Diode forward voltage | $V_F$    | –      | 1.5  | 1.7  |               | $I_F = 40 \text{ A}$ , $T_j = 25^\circ\text{C}$    |
|                       |          | –      | 1.8  | 2.1  |               | $I_F = 40 \text{ A}$ , $T_j = 150^\circ\text{C}$   |
| Reverse current       | $I_R$    | –      | 2.2  | 220  | $\mu\text{A}$ | $V_R = 650 \text{ V}$ , $T_j = 25^\circ\text{C}$   |
|                       |          | –      | 0.5  | 150  |               | $V_R = 600 \text{ V}$ , $T_j = 25^\circ\text{C}$   |
|                       |          | –      | 8.2  | 1500 |               | $V_R = 650 \text{ V}$ , $T_j = 150^\circ\text{C}$  |

**Table 6 AC characteristics**

| Parameter               | Symbol | Values |      |      | Unit | Note/Test Condition                                                                                                 |
|-------------------------|--------|--------|------|------|------|---------------------------------------------------------------------------------------------------------------------|
|                         |        | Min.   | Typ. | Max. |      |                                                                                                                     |
| Total capacitive charge | $Q_c$  | –      | 55   |      | nC   | $V_R = 400 \text{ V}$ , $di/dt = 200 \text{ A}/\mu\text{s}$ ,<br>$I_F \leq I_{F,MAX}$ , $T_j = 150^\circ\text{C}$ . |
| Total Capacitance       | C      | –      | 1140 | –    | pF   | $V_R = 1 \text{ V}$ , $f = 1 \text{ MHz}$                                                                           |
|                         |        | –      | 147  | –    |      | $V_R = 300 \text{ V}$ , $f = 1 \text{ MHz}$                                                                         |
|                         |        | –      | 145  | –    |      | $V_R = 600 \text{ V}$ , $f = 1 \text{ MHz}$                                                                         |

## 5 Electrical characteristics diagrams

Table 7

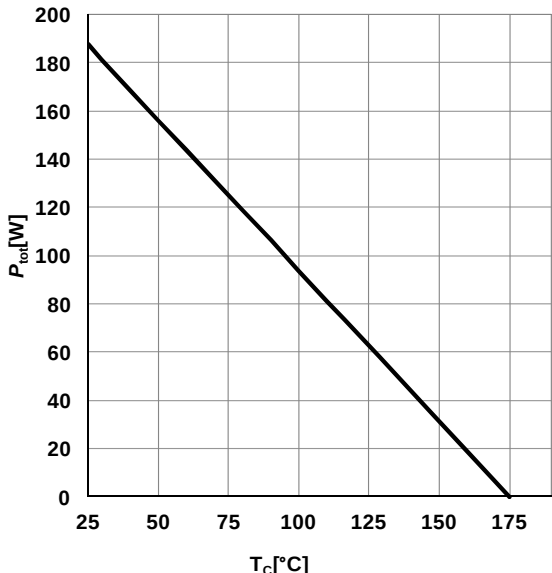
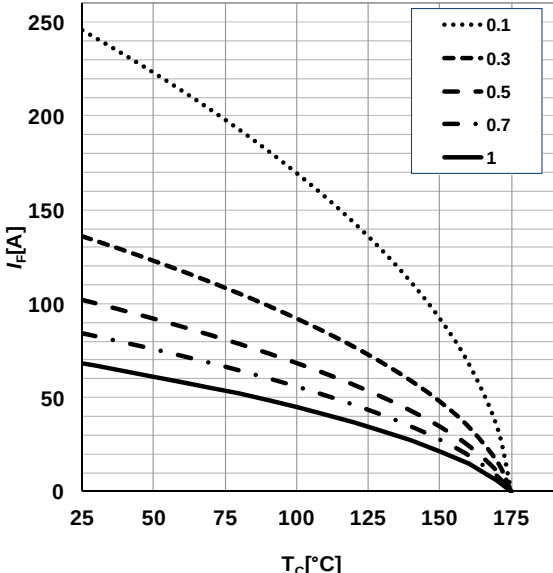
| Power dissipation                                                                  | Diode forward current                                                                                    |
|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
|  |                       |
| $P_{\text{tot}} = f(T_c); R_{\text{thJC,max}}$                                     | $I_F = f(T_c); T_j \leq 175^\circ\text{C}; R_{\text{thJC,max}}; \text{parameter } D = \text{duty cycle}$ |

Table 8

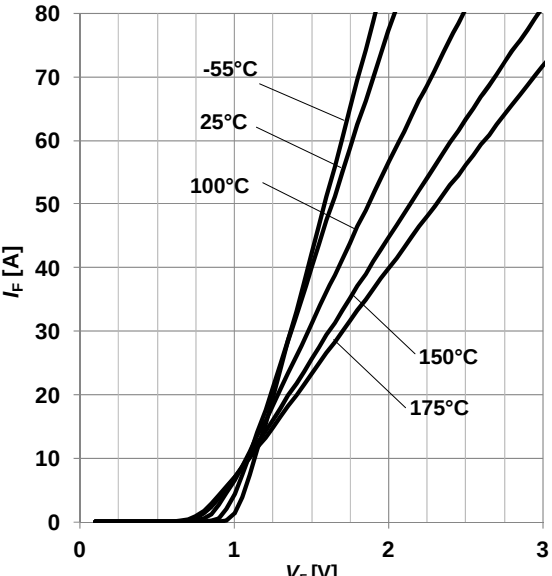
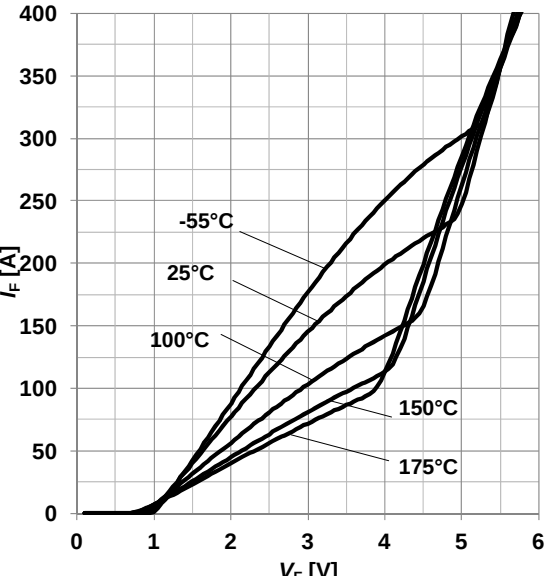
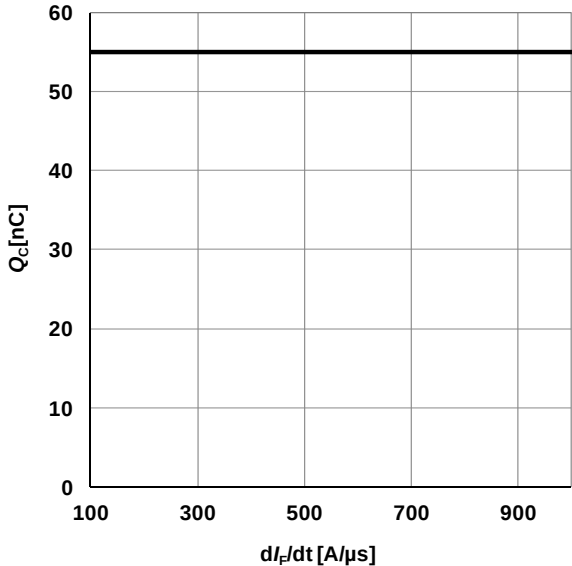
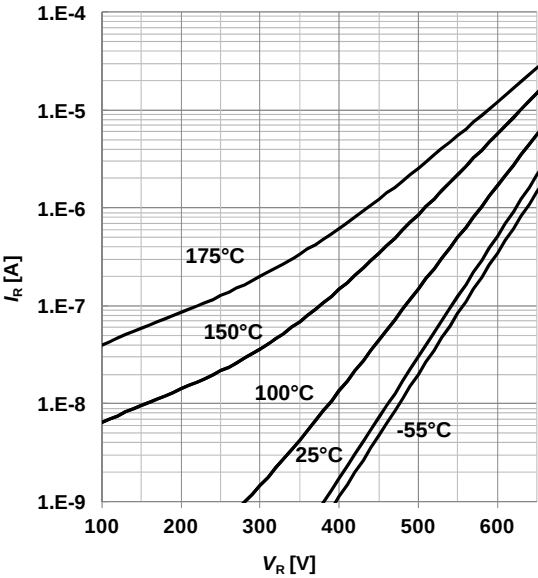
| Typical forward characteristics                                                     | Typical forward characteristics in surge current                                     |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |
| $I_F = f(V_F); t_p = 200 \mu\text{s}; \text{parameter: } T_j$                       | $I_F = f(V_F); t_p = 200 \mu\text{s}; \text{parameter: } T_j$                        |

Table 9

| Typ. capacitance charge vs. current slope <sup>1)</sup>                             | Typ. reverse current vs. reverse voltage                                           |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|    |  |
| $Q_C = f(dI_F/dt); T_J = 150^\circ\text{C}; V_R = 400\text{ V}; I_F \leq I_{F,max}$ | $I_R = f(V_R); \text{parameter: } T_J$                                             |

1) Only capacitive charge, guaranteed by design.

Table 10

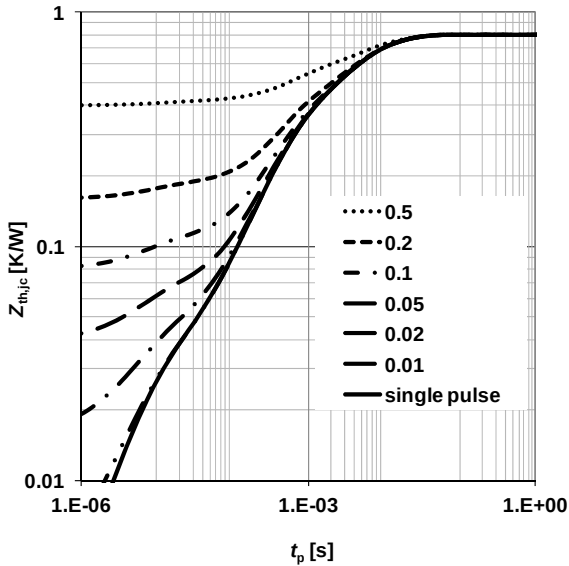
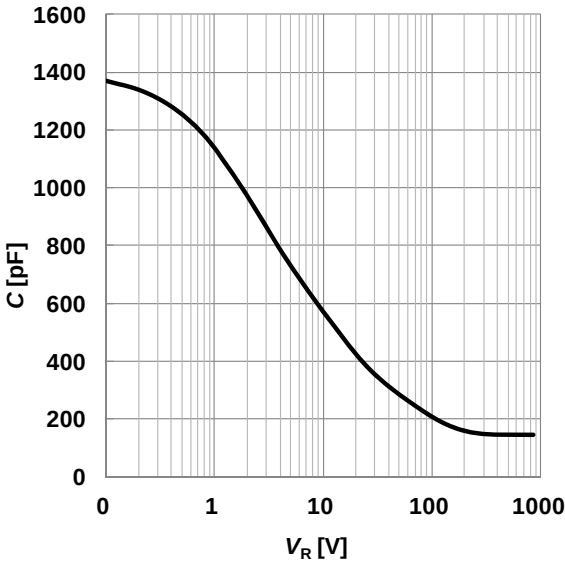
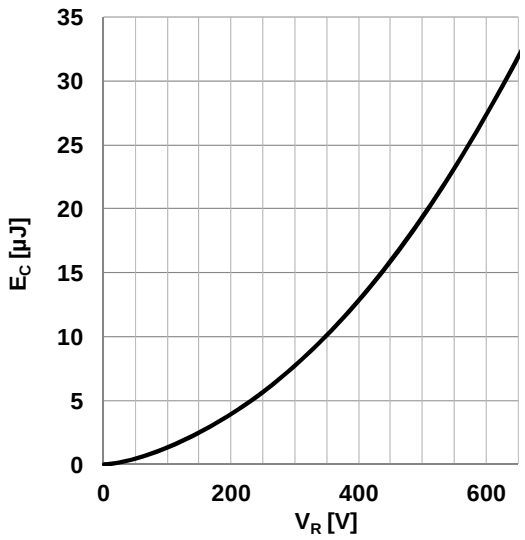
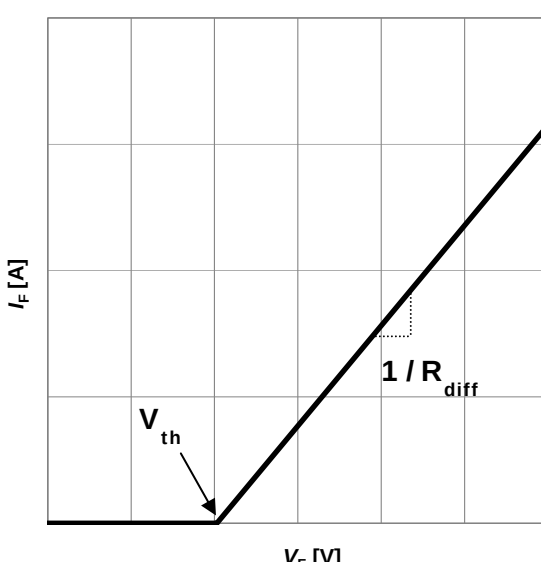
| Max. transient thermal impedance                                                    | Typ. capacitance vs. reverse voltage                                                 |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |
| $Z_{th,jc} = f(t_p); \text{parameter: } D = t_p / T$                                | $C = f(V_R); T_J = 25^\circ\text{C}; f = 1\text{ MHz}$                               |

Table 11

| Typ. capacitance stored energy                                                                                     |
|--------------------------------------------------------------------------------------------------------------------|
|  <p><math>E_C = f(V_R)</math></p> |

## 6 Simplified Forward Characteristics Model

Table 12

| Equivalent forward current curve                                                                                     | Mathematical Equation                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p><math>V_F = f(I_F)</math></p> | $V_F = V_{TH} + R_{DIFF} \cdot I_F$ $V_{TH}(T_j) = -0.001 \cdot T_j + 1.04 \text{ [V]}$ $R_{DIFF}(T_j) = 3.2 \cdot 10^{-7} \cdot T_j^2 + 3.2 \cdot 10^{-5} \cdot T_j + 0.012 \text{ [}\Omega\text{]}$ |
|                                                                                                                      | $T_j$ in °C; $-55^\circ\text{C} < T_j < 175^\circ\text{C}$ ; $I_F < 80 \text{ A}$                                                                                                                     |

## 7 Package outlines

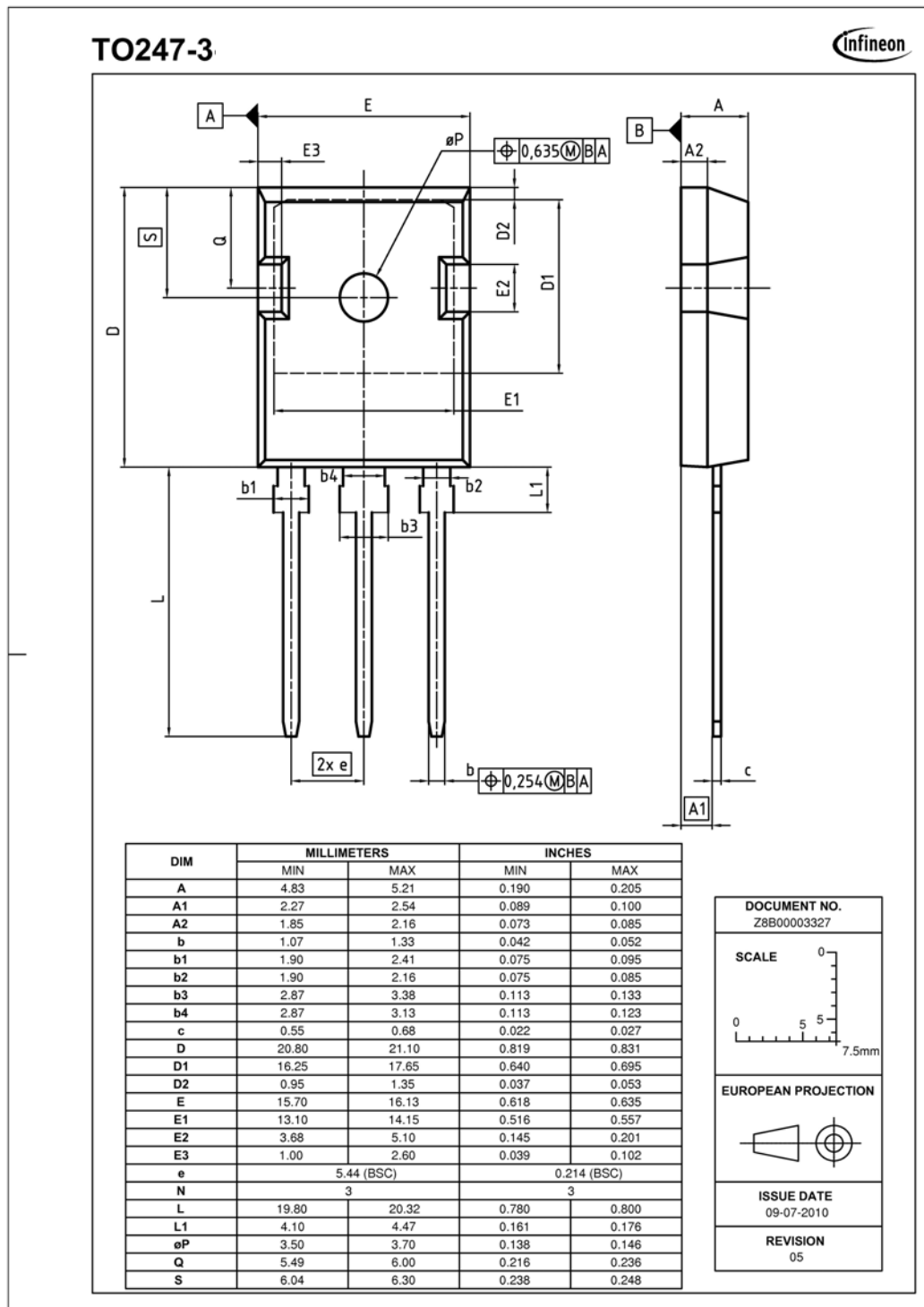


Figure 1 Outlines TO-247, dimensions in mm/inches

## 8 Revision History

### 5<sup>th</sup> Generation thinQ!™ SiC Schottky Diode

#### Revision History: 2013-01-15, Rev. 2.2

##### Previous Revision:

| Revision | Subjects (major changes since last version)                                    |
|----------|--------------------------------------------------------------------------------|
| 2.0      | Release of the final datasheet.                                                |
| 2.1      | Reverse current values, maximum diode forward voltage.                         |
| 2.2      | Reverse current values, tested avalanche current, simplified calculation model |

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