

## Highly insulated module

### Features

- Electrical features
  - $V_{CES} = 4500\text{ V}$
  - $I_{C\text{ nom}} = 400\text{ A} / I_{CRM} = 800\text{ A}$
  - High DC stability
  - High surge current capability
  - High dynamic robustness
- Mechanical features
  - High creepage and clearance distances
  - ALSiC base plate for increased thermal cycling capability
  - Package with enhanced insulation of 10.4 kV AC 60 s
  - Package with CTI > 600



### Potential applications

- Motor drives
- Multi-level inverter
- Traction drives
- Wind turbines
- Medium-voltage converters
- High-power converters

### Product validation

- Qualified for industrial applications according to the relevant tests of IEC 60747, 60749 and 60068

### Description

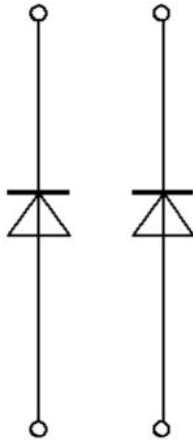


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## 1 Package

**Table 1** Insulation coordination

| Parameter                            | Symbol      | Note or test condition                         | Values | Unit |
|--------------------------------------|-------------|------------------------------------------------|--------|------|
| Isolation test voltage               | $V_{ISOL}$  | RMS, $f = 50 \text{ Hz}$ , $t = 60 \text{ s}$  | 10.4   | kV   |
| Partial discharge extinction voltage | $V_{isol}$  | RMS, $f = 50 \text{ Hz}$ , $Q_{PD}$ typ. 10 pC | 3.5    | kV   |
| DC stability                         | $V_{CE(D)}$ | $T_{vj}=25^{\circ}\text{C}$ , 100 Fit          | 3000   | V    |
| Material of module baseplate         |             |                                                | AlSiC  |      |
| Internal isolation                   |             | basic insulation (class 1, IEC 61140)          | AlN    |      |
| Creepage distance                    | $d_{Creep}$ | terminal to heatsink                           | 64.0   | mm   |
| Creepage distance                    | $d_{Creep}$ | terminal to terminal                           | 56.0   | mm   |
| Clearance                            | $d_{Clear}$ | terminal to heatsink                           | 40.0   | mm   |
| Clearance                            | $d_{Clear}$ | terminal to terminal                           | 26.0   | mm   |
| Comparative tracking index           | $CTI$       |                                                | > 600  |      |

**Table 2** Characteristic values

| Parameter                                | Symbol        | Note or test condition                         | Values    |      |      | Unit |
|------------------------------------------|---------------|------------------------------------------------|-----------|------|------|------|
|                                          |               |                                                | Min.      | Typ. | Max. |      |
| Stray inductance module                  | $L_{sCE}$     |                                                |           | 25   |      | nH   |
| Module lead resistance, terminals - chip | $R_{AA'+CC'}$ | $T_C=25^{\circ}\text{C}$ , per switch          |           | 0.37 |      | mΩ   |
| Storage temperature                      | $T_{stg}$     |                                                | -55       |      | 125  | °C   |
| Mounting torque for module mounting      | $M$           | - Mounting according to valid application note | M6, Screw | 4.25 | 5.75 | Nm   |
| Terminal connection torque               | $M$           | - Mounting according to valid application note | M8, Screw | 8    | 10   | Nm   |
| Weight                                   | $G$           |                                                |           | 1000 |      | g    |

Note: Dynamic data valid in conjunction with FZ400R45KL3\_B5 module

## 2 Diode, Inverter

**Table 3** Maximum rated values

| Parameter                       | Symbol    | Note or test condition         | Values | Unit |
|---------------------------------|-----------|--------------------------------|--------|------|
| Repetitive peak reverse voltage | $V_{RRM}$ | $T_{vj} = -40^{\circ}\text{C}$ | 4500   | V    |
|                                 |           | $T_{vj} = 25^{\circ}\text{C}$  | 4500   |      |
|                                 |           | $T_{vj} = 125^{\circ}\text{C}$ | 4500   |      |

(table continues...)

**Table 3** (continued) Maximum rated values

| Parameter                       | Symbol      | Note or test condition                      |                           | Values | Unit                  |
|---------------------------------|-------------|---------------------------------------------|---------------------------|--------|-----------------------|
| Continuous DC forward current   | $I_F$       |                                             |                           | 400    | A                     |
| Repetitive peak forward current | $I_{FRM}$   | $t_P = 1 \text{ ms}$                        |                           | 800    | A                     |
| $I^2t$ - value                  | $I^2t$      | $t_P = 10 \text{ ms}$ , $V_R = 0 \text{ V}$ | $T_{vj} = 125 \text{ °C}$ | 65     | $\text{kA}^2\text{s}$ |
| Maximum power dissipation       | $P_{RQM}$   |                                             | $T_{vj} = 125 \text{ °C}$ | 800    | kW                    |
| Minimum turn-on time            | $t_{onmin}$ |                                             |                           | 10     | $\mu\text{s}$         |

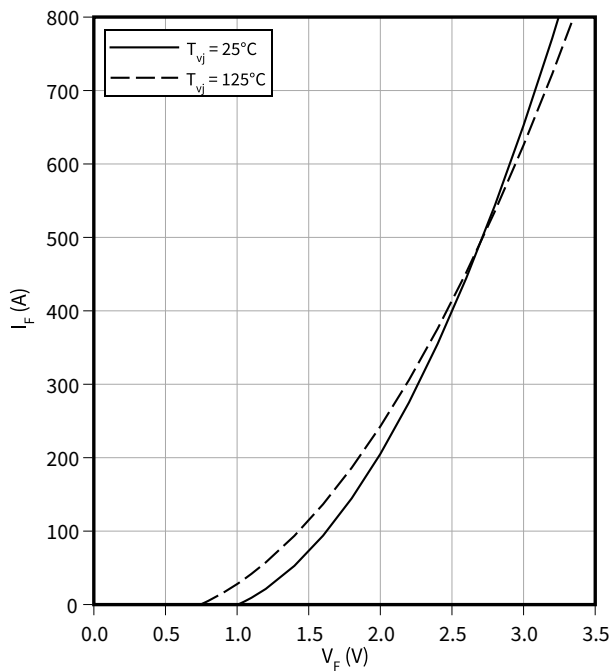
**Table 4** Characteristic values

| Parameter                              | Symbol      | Note or test condition                                                                                                                               | Values                    |      |      | Unit               |
|----------------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------|------|--------------------|
|                                        |             |                                                                                                                                                      | Min.                      | Typ. | Max. |                    |
| Forward voltage                        | $V_F$       | $I_F = 400 \text{ A}$ , $V_{GE} = 0 \text{ V}$                                                                                                       | $T_{vj} = 25 \text{ °C}$  | 2.50 | 3.10 | V                  |
|                                        |             |                                                                                                                                                      | $T_{vj} = 125 \text{ °C}$ | 2.50 | 3.00 |                    |
| Peak reverse recovery current          | $I_{RM}$    | $V_R = 2800 \text{ V}$ , $I_F = 400 \text{ A}$ ,<br>$V_{GE} = -15 \text{ V}$ , $-di_F/dt = 1670 \text{ A}/\mu\text{s}$ ( $T_{vj} = 125 \text{ °C}$ ) | $T_{vj} = 25 \text{ °C}$  | 500  |      | A                  |
|                                        |             |                                                                                                                                                      | $T_{vj} = 125 \text{ °C}$ | 570  |      |                    |
| Recovered charge                       | $Q_r$       | $V_R = 2800 \text{ V}$ , $I_F = 400 \text{ A}$ ,<br>$V_{GE} = -15 \text{ V}$ , $-di_F/dt = 1670 \text{ A}/\mu\text{s}$ ( $T_{vj} = 125 \text{ °C}$ ) | $T_{vj} = 25 \text{ °C}$  | 390  |      | $\mu\text{C}$      |
|                                        |             |                                                                                                                                                      | $T_{vj} = 125 \text{ °C}$ | 700  |      |                    |
| Reverse recovery energy                | $E_{rec}$   | $V_R = 2800 \text{ V}$ , $I_F = 400 \text{ A}$ ,<br>$V_{GE} = -15 \text{ V}$ , $-di_F/dt = 1670 \text{ A}/\mu\text{s}$ ( $T_{vj} = 125 \text{ °C}$ ) | $T_{vj} = 25 \text{ °C}$  | 590  |      | mJ                 |
|                                        |             |                                                                                                                                                      | $T_{vj} = 125 \text{ °C}$ | 1200 |      |                    |
| Thermal resistance, junction to case   | $R_{thJC}$  | per diode                                                                                                                                            |                           |      | 51.0 | K/kW               |
| Thermal resistance, case to heat sink  | $R_{thCH}$  | per diode                                                                                                                                            |                           | 42.0 |      | K/kW               |
| Temperature under switching conditions | $T_{vj op}$ |                                                                                                                                                      | -50                       |      | 125  | $^{\circ}\text{C}$ |

3 Characteristics diagrams

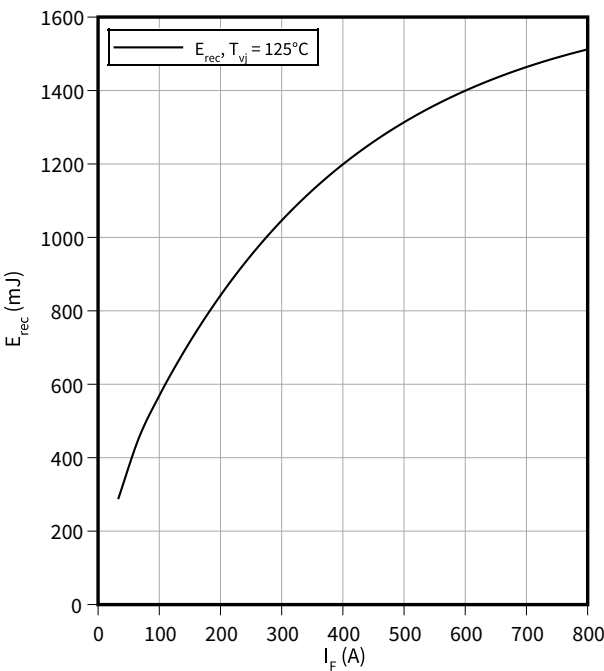
Forward characteristic (typical), Diode, Inverter

$I_F = f(V_F)$



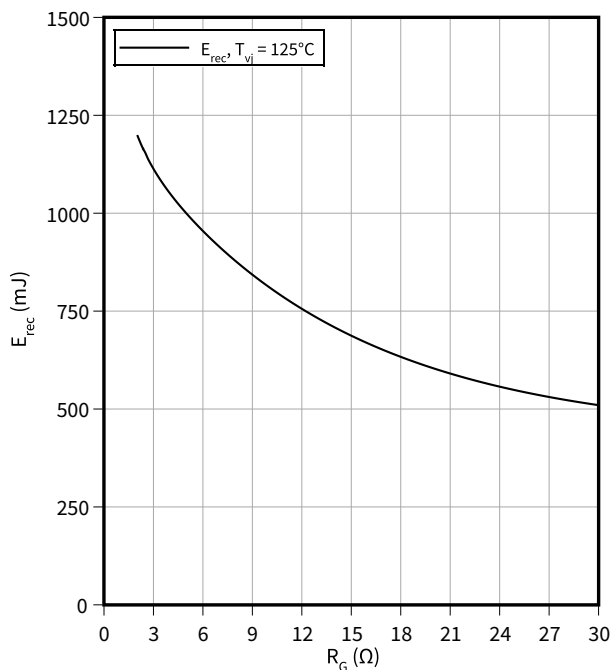
Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$   
 $V_{CE} = 2800\text{ V}, R_{Gon} = R_{Gon}(\text{IGBT})$



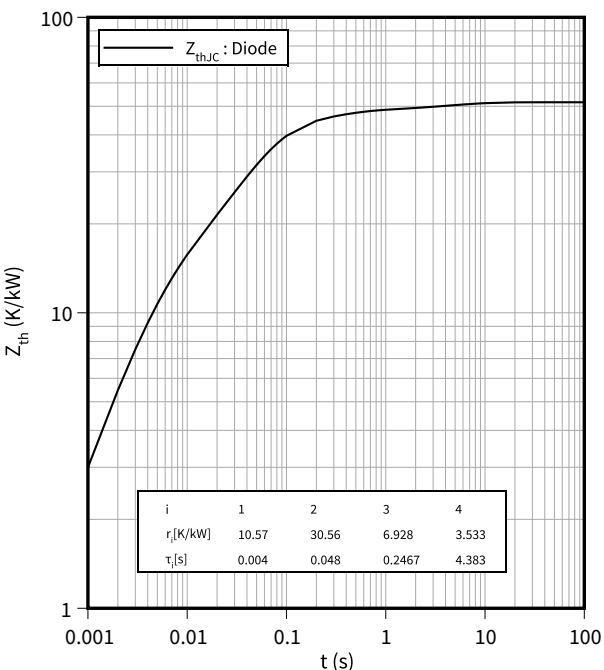
Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$   
 $V_{CE} = 2800\text{ V}, I_F = 400\text{ A}$



Transient thermal impedance, Diode, Inverter

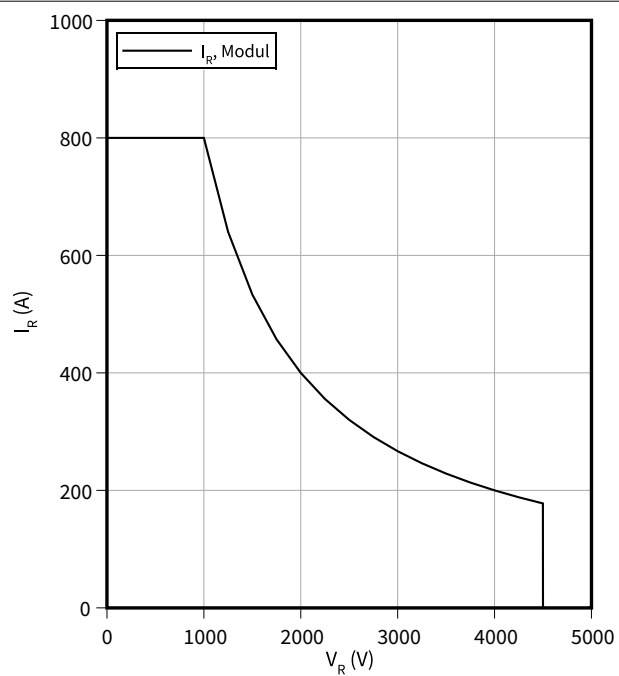
$Z_{th} = f(t)$



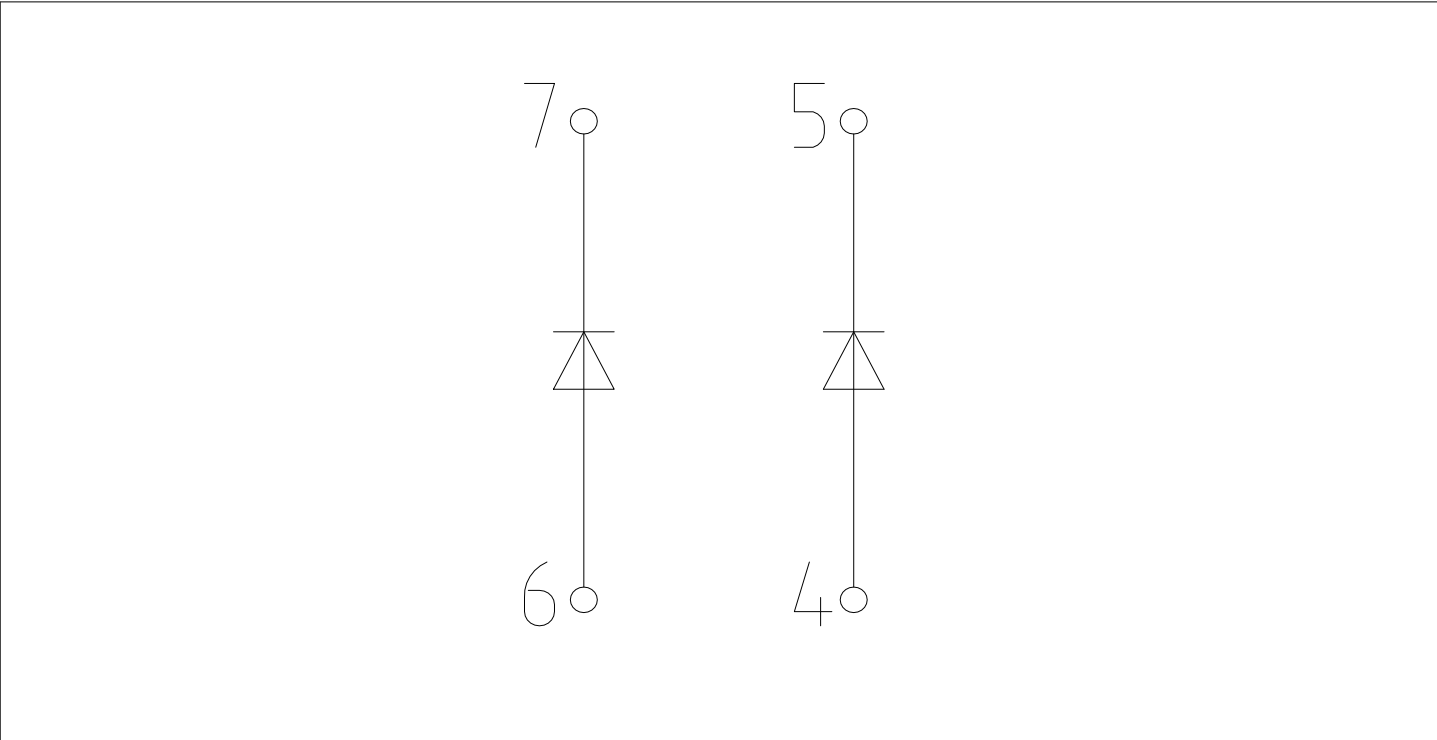
**Safe operating area (SOA), Diode, Inverter**

$$I_R = f(V_R)$$

$$T_{vj} = 125\text{ °C}$$



4      **Circuit diagram**



**Figure 1**

5 Package outlines

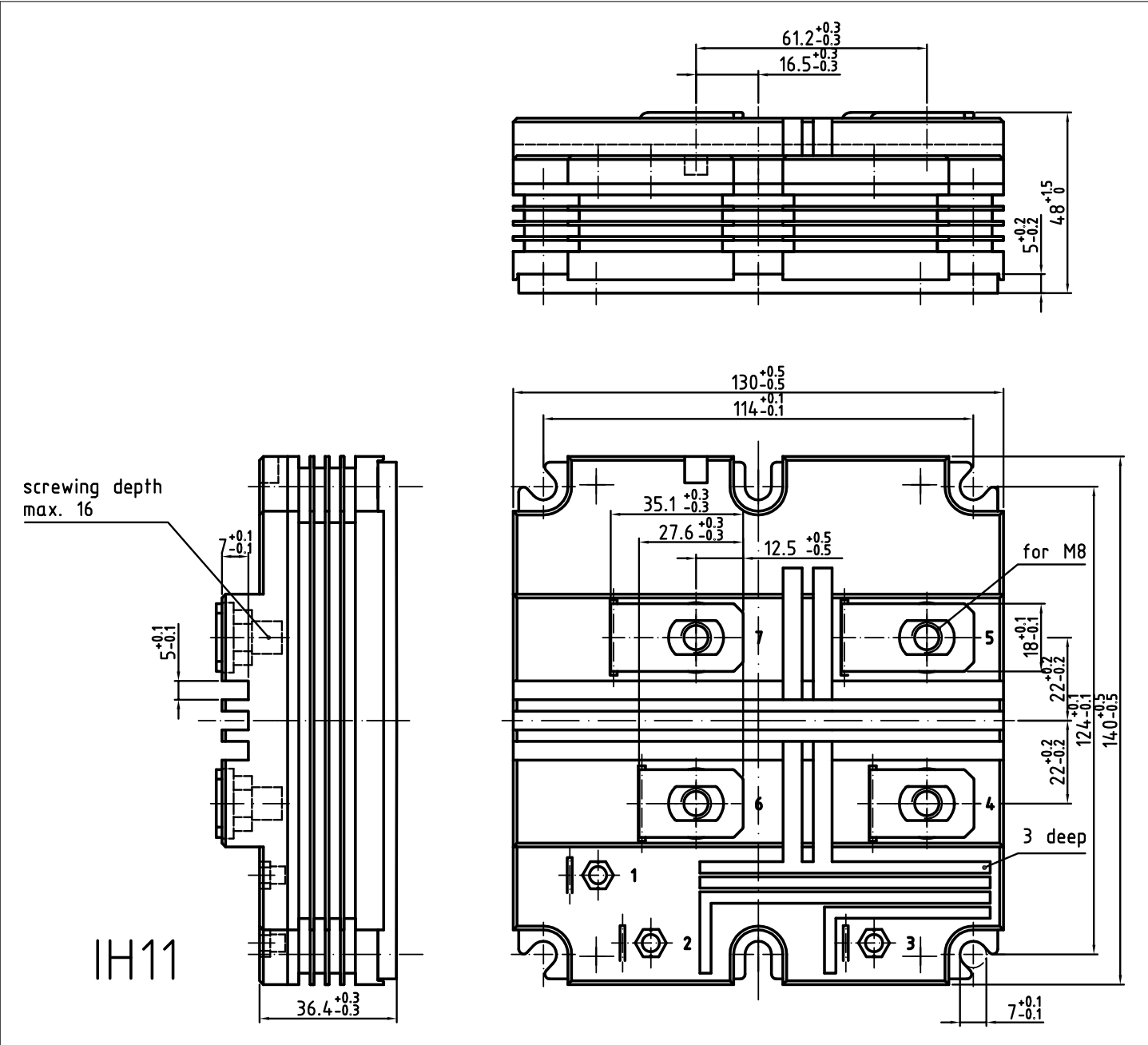


Figure 2



6            **Module label code**

| Module label code |                                                                                                               |                                                                                                                |                 |
|-------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------|
| Code format       | Data Matrix                                                                                                   |                                                                                                                | Barcode Code128 |
| Encoding          | ASCII text                                                                                                    |                                                                                                                | Code Set A      |
| Symbol size       | 16x16                                                                                                         |                                                                                                                | 23 digits       |
| Standard          | IEC24720 and IEC16022                                                                                         |                                                                                                                | IEC8859-1       |
| Code content      | <i>Content</i>                                                                                                | <i>Digit</i>                                                                                                   | <i>Example</i>  |
|                   | Module serial number                                                                                          | 1 – 5                                                                                                          | 71549           |
|                   | Module material number                                                                                        | 6 - 11                                                                                                         | 142846          |
|                   | Production order number                                                                                       | 12 - 19                                                                                                        | 55054991        |
|                   | Date code (production year)                                                                                   | 20 – 21                                                                                                        | 15              |
|                   | Date code (production week)                                                                                   | 22 – 23                                                                                                        | 30              |
| Example           |                                                                                                               |                                                                                                                |                 |
|                   | <br>71549142846550549911530 | <br>71549142846550549911530 |                 |

Figure 3

## Revision history

| Document revision | Date of release | Description of changes                                                                                                                              |
|-------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| V1.0              | 2012-09-07      | Target datasheet                                                                                                                                    |
| V2.0              | 2013-06-12      | Preliminary datasheet                                                                                                                               |
| V3.0              | 2013-07-29      | Final datasheet                                                                                                                                     |
| V3.1              | 2018-01-15      | Final datasheet                                                                                                                                     |
| n/a               | 2020-09-01      | Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy |
| 1.10              | 2022-04-12      | Final datasheet                                                                                                                                     |

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