

## Final datasheet

### The Soft 650 V Emitter Controlled Si Diode 7 offers improved reliability for both Industrial and Home Appliance applications

#### Features

- $V_{RRM} = 650\text{ V}$
- $I_F = 40\text{ A}$
- Low and temperature stable forward voltage ( $V_F$ )
- Very soft and fast recovery
- Low reverse recovery current ( $I_{rrm}$ )
- Humidity robust design
- Cosmic ray ruggedness
- Maximum junction temperature  $T_{vjmax} = 175^\circ\text{C}$
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: <http://www.infineon.com/ec7/>

#### Potential applications

- String and micro inverter
- Datacenter UPS
- Offline UPS/Residential UPS
- Online UPS/Industrial UPS
- Residential aircon
- Welding

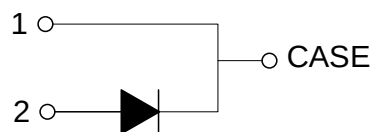
#### Product validation

- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

#### Description

Pin definition:

- Pin 1 and backside - Cathode
- Pin 2 - Anode



| Type        | Package              | Marking |
|-------------|----------------------|---------|
| IDWD40E65E7 | PG-TO247-2-STD-NA8.8 | E40EE7  |



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## 1 Package

## 1 Package

Table 1 Characteristic values

| Parameter                                                       | Symbol        | Note or test condition                               | Values |      |      | Unit |
|-----------------------------------------------------------------|---------------|------------------------------------------------------|--------|------|------|------|
|                                                                 |               |                                                      | Min.   | Typ. | Max. |      |
| Internal emitter inductance measured 5 mm (0.197 in.) from case | $L_E$         |                                                      |        | 13   |      | nH   |
| Storage temperature                                             | $T_{stg}$     |                                                      | -55    |      | 150  | °C   |
| Soldering temperature                                           | $T_{sold}$    | wave soldering 1.6 mm (0.063 in.) from case for 10 s |        |      | 260  | °C   |
| Mounting torque                                                 | $M$           | M3 screw, Maximum of mounting processes: 3           |        |      | 0.6  | Nm   |
| Thermal resistance, junction-ambient                            | $R_{th(j-a)}$ |                                                      |        |      | 40   | K/W  |
| Diode thermal resistance, junction-case                         | $R_{th(j-c)}$ |                                                      |        |      | 0.95 | K/W  |

## 2 Diode

Table 2 Maximum rated values

| Parameter                                                 | Symbol       | Note or test condition     |                       | Values | Unit |
|-----------------------------------------------------------|--------------|----------------------------|-----------------------|--------|------|
| Repetitive peak reverse voltage                           | $V_{RRM}$    | $T_{vj} \geq 25\text{ °C}$ |                       | 650    | V    |
| Diode forward current, limited by $T_{vjmax}$             | $I_F$        | limited by bondwire        | $T_c = 25\text{ °C}$  | 50     | A    |
|                                                           |              |                            | $T_c = 100\text{ °C}$ | 49     |      |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$        | $I_{Fpulse}$ |                            |                       | 160    | A    |
| Diode surge non repetitive forward current, sine halfwave | $I_{FSM}$    | $t_p = 10\text{ ms}$       | $T_c = 25\text{ °C}$  | 149    | A    |
| Power dissipation                                         | $P_{tot}$    |                            | $T_c = 25\text{ °C}$  | 159    | W    |
|                                                           |              |                            | $T_c = 100\text{ °C}$ | 79     |      |

Table 3 Characteristic values

| Parameter             | Symbol | Note or test condition |                          | Values |      |      | Unit |
|-----------------------|--------|------------------------|--------------------------|--------|------|------|------|
|                       |        |                        |                          | Min.   | Typ. | Max. |      |
| Diode forward voltage | $V_F$  | $I_F = 40\text{ A}$    | $T_{vj} = 25\text{ °C}$  |        | 1.65 | 2.1  | V    |
|                       |        |                        | $T_{vj} = 125\text{ °C}$ |        | 1.6  |      |      |
|                       |        |                        | $T_{vj} = 175\text{ °C}$ |        | 1.55 |      |      |

(table continues...)

Table 3 (continued) Characteristic values

| Parameter                           | Symbol    | Note or test condition |                                                                                                  | Values |      |      | Unit          |
|-------------------------------------|-----------|------------------------|--------------------------------------------------------------------------------------------------|--------|------|------|---------------|
|                                     |           |                        |                                                                                                  | Min.   | Typ. | Max. |               |
| Reverse leakage current             | $I_R$     | $V_R = 650 \text{ V}$  | $T_{vj} = 25 \text{ °C}$                                                                         |        |      | 20   | $\mu\text{A}$ |
|                                     |           |                        | $T_{vj} = 175 \text{ °C}$                                                                        |        | 309  |      |               |
| Diode reverse recovery time         | $t_{rr}$  | $V_R = 400 \text{ V}$  | $T_{vj} = 25 \text{ °C}$ ,<br>$I_F = 40 \text{ A}$ ,<br>$-di_F/dt = 1000 \text{ A}/\mu\text{s}$  |        | 89   |      | ns            |
|                                     |           |                        | $T_{vj} = 25 \text{ °C}$ ,<br>$I_F = 20 \text{ A}$ ,<br>$-di_F/dt = 1000 \text{ A}/\mu\text{s}$  |        | 69.9 |      |               |
|                                     |           |                        | $T_{vj} = 175 \text{ °C}$ ,<br>$I_F = 40 \text{ A}$ ,<br>$-di_F/dt = 1000 \text{ A}/\mu\text{s}$ |        | 146  |      |               |
|                                     |           |                        | $T_{vj} = 175 \text{ °C}$ ,<br>$I_F = 20 \text{ A}$ ,<br>$-di_F/dt = 1000 \text{ A}/\mu\text{s}$ |        | 110  |      |               |
| Diode reverse recovery charge       | $Q_{rr}$  | $V_R = 400 \text{ V}$  | $T_{vj} = 25 \text{ °C}$ ,<br>$I_F = 40 \text{ A}$ ,<br>$-di_F/dt = 1000 \text{ A}/\mu\text{s}$  |        | 0.86 |      | $\mu\text{C}$ |
|                                     |           |                        | $T_{vj} = 25 \text{ °C}$ ,<br>$I_F = 20 \text{ A}$ ,<br>$-di_F/dt = 1000 \text{ A}/\mu\text{s}$  |        | 0.6  |      |               |
|                                     |           |                        | $T_{vj} = 175 \text{ °C}$ ,<br>$I_F = 40 \text{ A}$ ,<br>$-di_F/dt = 1000 \text{ A}/\mu\text{s}$ |        | 2.37 |      |               |
|                                     |           |                        | $T_{vj} = 175 \text{ °C}$ ,<br>$I_F = 20 \text{ A}$ ,<br>$-di_F/dt = 1000 \text{ A}/\mu\text{s}$ |        | 1.73 |      |               |
| Diode peak reverse recovery current | $I_{rrm}$ | $V_R = 400 \text{ V}$  | $T_{vj} = 25 \text{ °C}$ ,<br>$I_F = 40 \text{ A}$ ,<br>$-di_F/dt = 1000 \text{ A}/\mu\text{s}$  |        | 15.7 |      | A             |
|                                     |           |                        | $T_{vj} = 25 \text{ °C}$ ,<br>$I_F = 20 \text{ A}$ ,<br>$-di_F/dt = 1000 \text{ A}/\mu\text{s}$  |        | 14.5 |      |               |
|                                     |           |                        | $T_{vj} = 175 \text{ °C}$ ,<br>$I_F = 40 \text{ A}$ ,<br>$-di_F/dt = 1000 \text{ A}/\mu\text{s}$ |        | 26.9 |      |               |
|                                     |           |                        | $T_{vj} = 175 \text{ °C}$ ,<br>$I_F = 20 \text{ A}$ ,<br>$-di_F/dt = 1000 \text{ A}/\mu\text{s}$ |        | 24.7 |      |               |

(table continues...)

Table 3 (continued) Characteristic values

| Parameter                                           | Symbol       | Note or test condition |                                                                                               | Values |       |      | Unit                   |
|-----------------------------------------------------|--------------|------------------------|-----------------------------------------------------------------------------------------------|--------|-------|------|------------------------|
|                                                     |              |                        |                                                                                               | Min.   | Typ.  | Max. |                        |
| Diode peak rate of fall of reverse recovery current | $di_{rr}/dt$ | $V_R = 400\text{ V}$   | $T_{vj} = 25\text{ °C}$ ,<br>$I_F = 40\text{ A}$ ,<br>$-di_F/dt = 1000\text{ A}/\mu\text{s}$  |        | 656   |      | $\text{A}/\mu\text{s}$ |
|                                                     |              |                        | $T_{vj} = 25\text{ °C}$ ,<br>$I_F = 20\text{ A}$ ,<br>$-di_F/dt = 1000\text{ A}/\mu\text{s}$  |        | 847   |      |                        |
|                                                     |              |                        | $T_{vj} = 175\text{ °C}$ ,<br>$I_F = 40\text{ A}$ ,<br>$-di_F/dt = 1000\text{ A}/\mu\text{s}$ |        | 418   |      |                        |
|                                                     |              |                        | $T_{vj} = 175\text{ °C}$ ,<br>$I_F = 20\text{ A}$ ,<br>$-di_F/dt = 1000\text{ A}/\mu\text{s}$ |        | 650   |      |                        |
| Reverse recovery energy                             | $E_{rec}$    | $V_R = 400\text{ V}$   | $T_{vj} = 25\text{ °C}$ ,<br>$I_F = 40\text{ A}$ ,<br>$-di_F/dt = 1000\text{ A}/\mu\text{s}$  |        | 0.141 |      | mJ                     |
|                                                     |              |                        | $T_{vj} = 25\text{ °C}$ ,<br>$I_F = 20\text{ A}$ ,<br>$-di_F/dt = 1000\text{ A}/\mu\text{s}$  |        | 0.099 |      |                        |
|                                                     |              |                        | $T_{vj} = 175\text{ °C}$ ,<br>$I_F = 40\text{ A}$ ,<br>$-di_F/dt = 1000\text{ A}/\mu\text{s}$ |        | 0.49  |      |                        |
|                                                     |              |                        | $T_{vj} = 175\text{ °C}$ ,<br>$I_F = 20\text{ A}$ ,<br>$-di_F/dt = 1000\text{ A}/\mu\text{s}$ |        | 0.35  |      |                        |
| Operating junction temperature                      | $T_{vj}$     |                        |                                                                                               | -40    |       | 175  | °C                     |

Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

Electrical Characteristic at  $T_{vj} = 25\text{ °C}$ , unless otherwise specified.

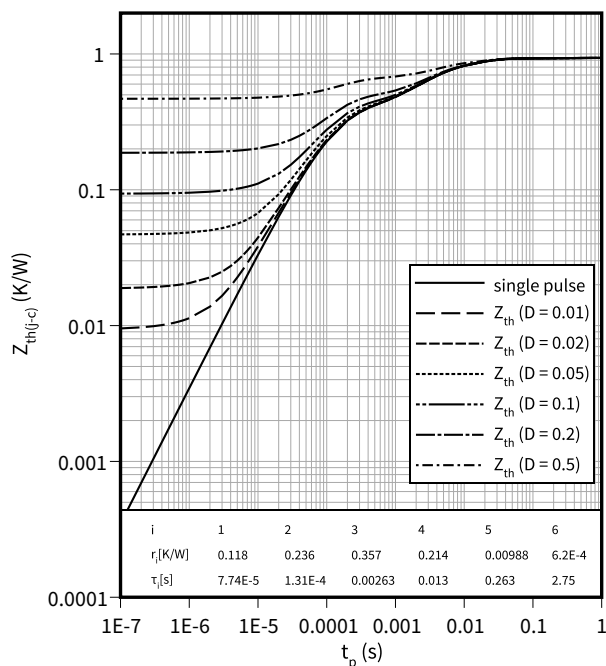
Dynamic test circuit, parasitic inductance  $L_\sigma = 30\text{ nH}$ , parasitic capacitor  $C_\sigma = 18\text{ pF}$  from Fig. E.

### 3 Characteristics diagrams

#### Diode transient thermal impedance as a function of pulse width

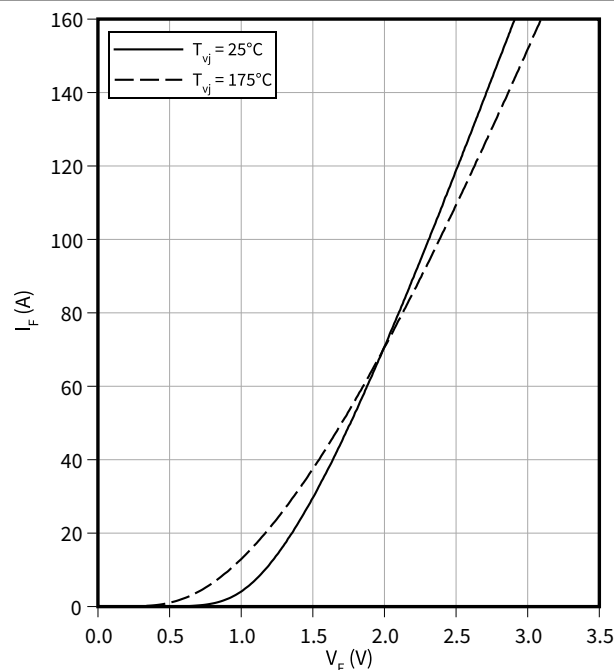
$$Z_{th(j-c)} = f(t_p)$$

$$D = t_p / T$$



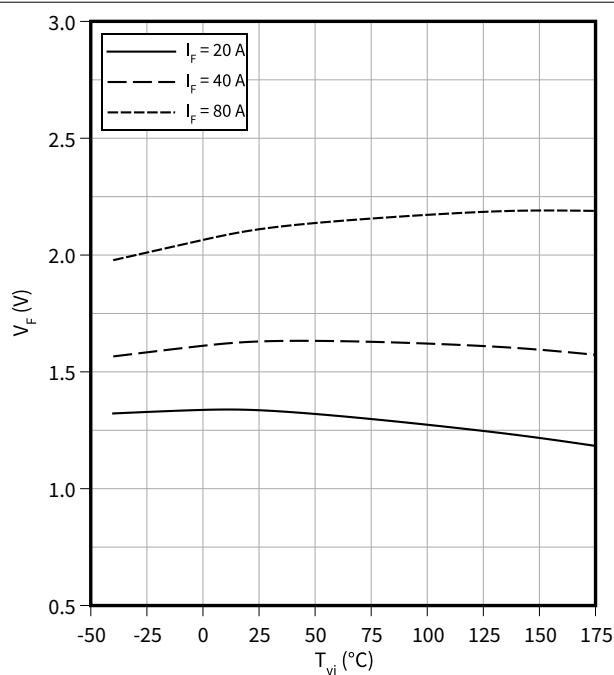
#### Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$



#### Typical diode forward voltage as a function of junction temperature

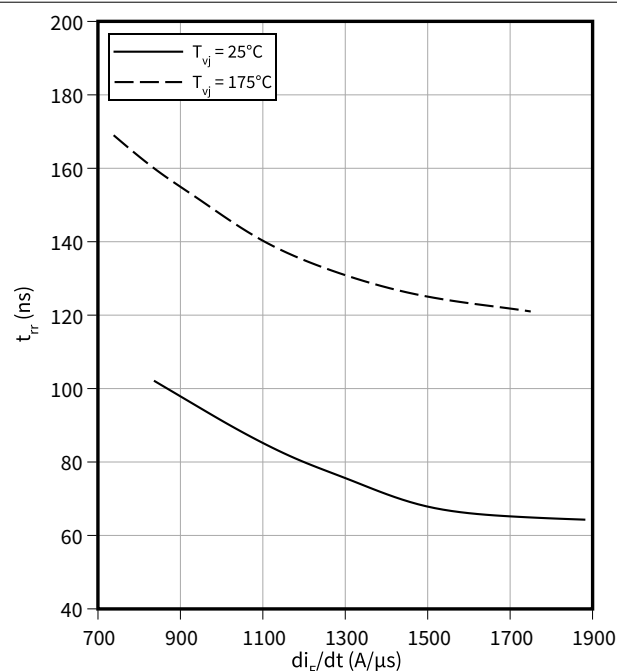
$$V_F = f(T_{vj})$$



#### Typical reverse recovery time as a function of diode current slope

$$t_{rr} = f(di_F/dt)$$

$$V_R = 400 \text{ V}, I_F = 40 \text{ A}$$

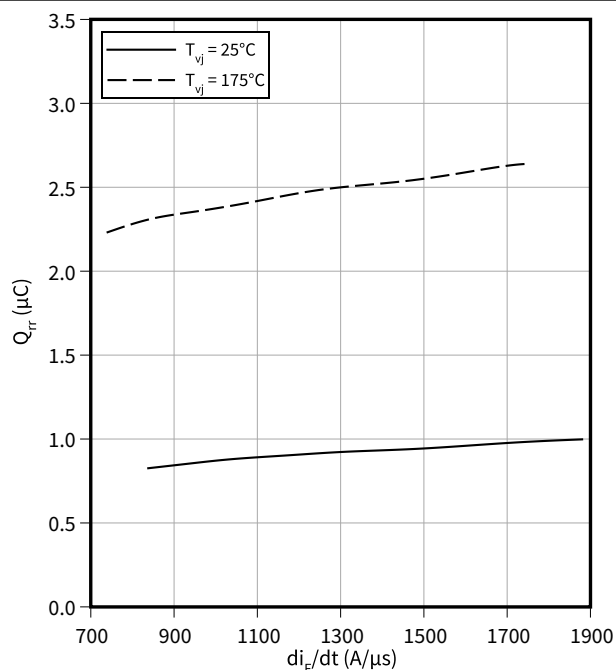


## 3 Characteristics diagrams

**Typical reverse recovery charge as a function of diode current slope**

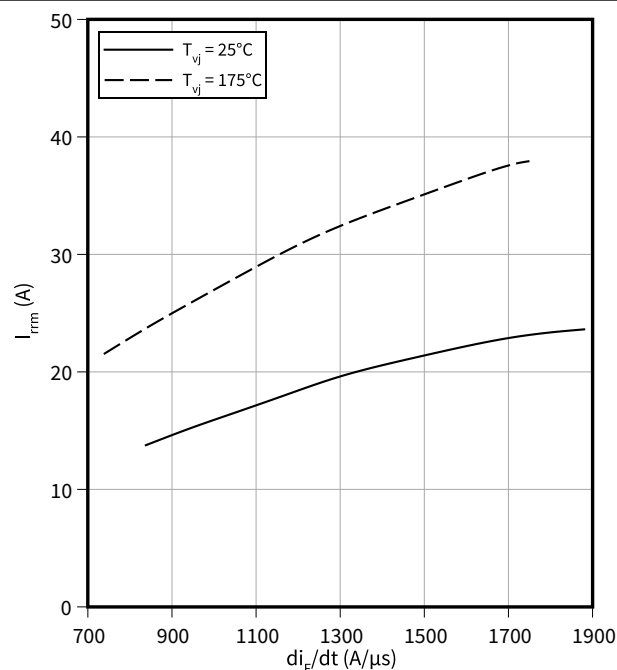
$$Q_{rr} = f(di_F/dt)$$

$$V_R = 400 \text{ V}, I_F = 40 \text{ A}$$

**Typical reverse recovery current as a function of diode current slope**

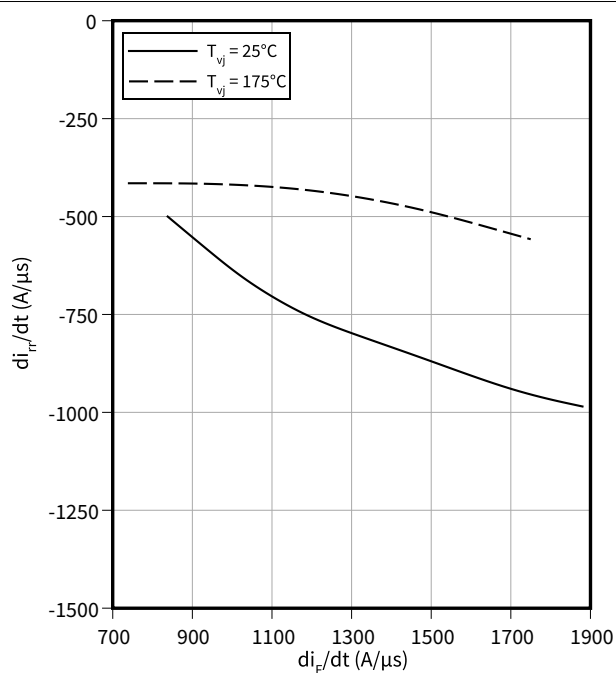
$$I_{rrm} = f(di_F/dt)$$

$$V_R = 400 \text{ V}, I_F = 40 \text{ A}$$

**Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**

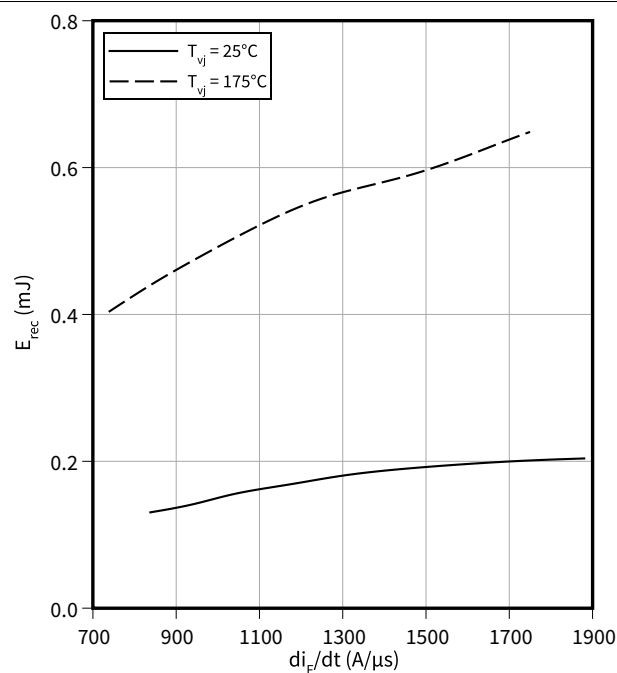
$$di_{rr}/dt = f(di_F/dt)$$

$$V_R = 400 \text{ V}, I_F = 40 \text{ A}$$

**Typical reverse energy losses as a function of diode current slope**

$$E_{rec} = f(di_F/dt)$$

$$V_R = 400 \text{ V}, I_F = 40 \text{ A}$$



4 Package outlines

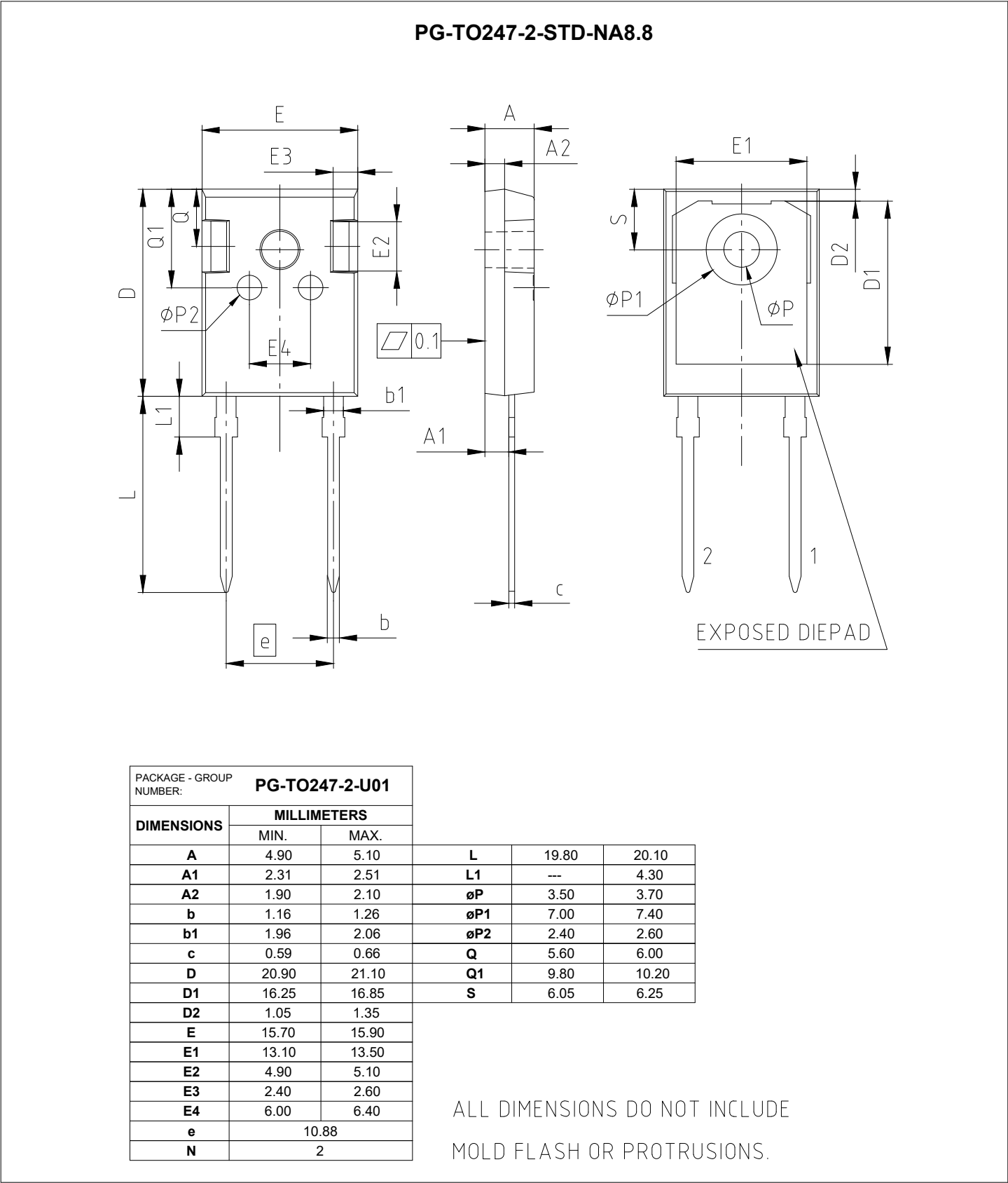


Figure 1



## 5 Testing conditions

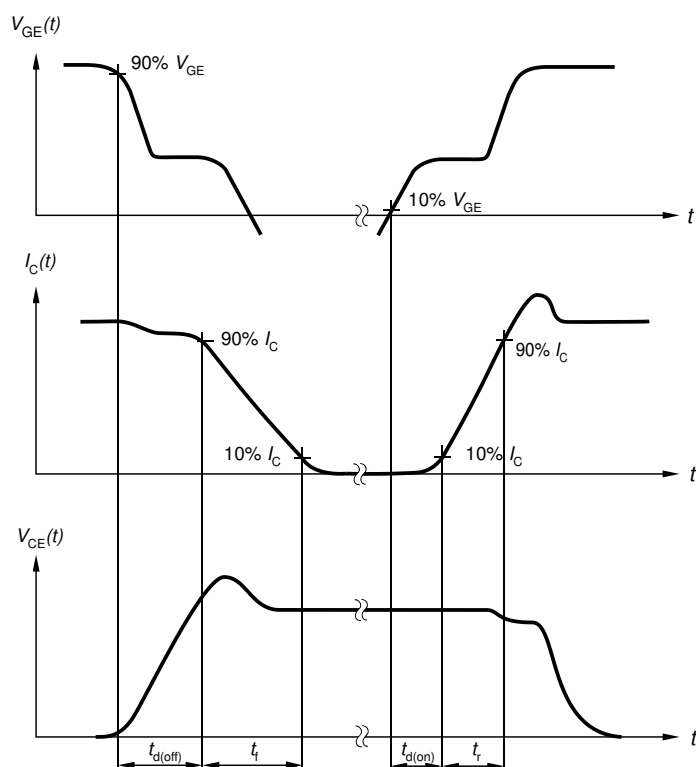


Figure A. Definition of switching times

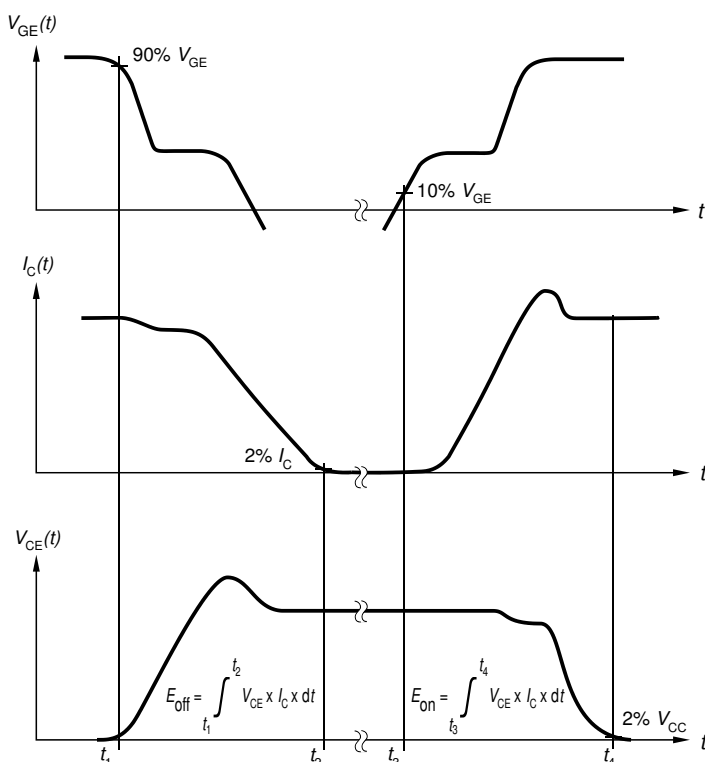


Figure B. Definition of switching losses

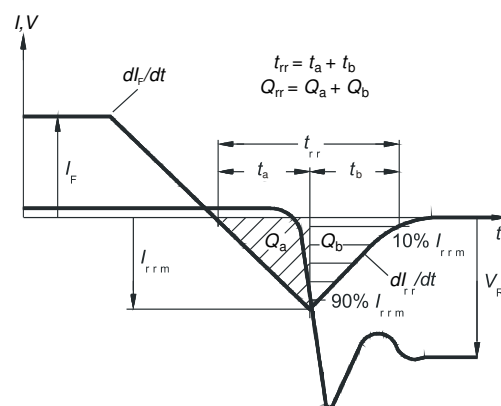


Figure C. Definition of diode switching characteristics

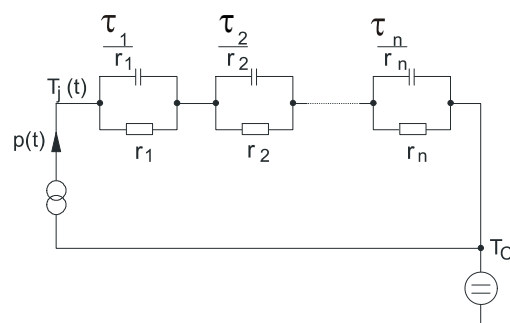


Figure D. Thermal equivalent circuit

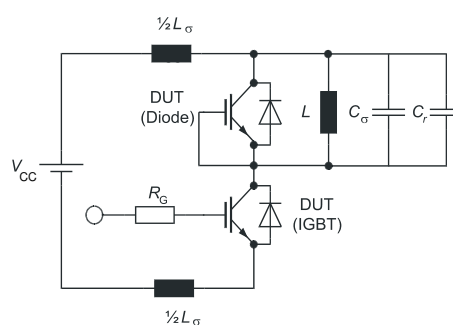


Figure E. **Dynamic test circuit**  
Parasitic inductance  $L_\sigma$ ,  
parasitic capacitor  $C_\sigma$ ,  
relief capacitor  $C_r$ ,  
(only for ZVT switching)

**Revision history**

| Document revision | Date of release | Description of changes                                             |
|-------------------|-----------------|--------------------------------------------------------------------|
| 0.10              | 2023-04-26      | Preliminary datasheet                                              |
| 1.00              | 2023-05-02      | Final datasheet                                                    |
| 1.10              | 2023-11-09      | Update of diode forward current $I_F$<br>Update of graph on page 6 |

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