

**High speed 1200 V TRENCHSTOP™ IGBT 7 Technology co-packed with full rated current, soft-commutating, ultra-fast recovery and low  $Q_{rr}$  emitter controlled 7 Rapid diode**

### Features

- $V_{CE} = 1200\text{ V}$
- $I_C = 40\text{ A}$
- Maximum junction temperature  $T_{vjmax} = 175^\circ\text{C}$
- Best-in-class high speed IGBT co-packed with full rated current, low  $Q_{rr}$  and soft-commutating high speed diode
- Low saturation voltage  $V_{CEsat} = 1.7\text{ V}$  at  $T_{vj} = 25^\circ\text{C}$
- Optimized for high efficiency in high speed hard switching topologies (2-L inverter, 3-L NPC T-type, ...)
- Easy paralleling capability due to positive temperature coefficient in  $V_{CEsat}$
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

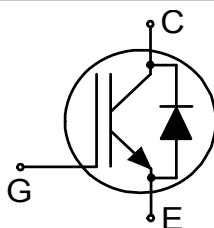
### Potential applications

- Industrial UPS
- EV-Charging
- String inverter
- Welding

### Product validation

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

### Description



| Type         | Package              | Marking |
|--------------|----------------------|---------|
| IKW40N120CH7 | PG-TO247-3-STD-NN2.5 | K40MCH7 |



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## 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 process: 3             |        |      | 0.6  | Nm   |
| Thermal resistance, junction-ambient                            | $R_{th(j-a)}$ |                                                      |        |      | 40   | K/W  |
| IGBT thermal resistance, junction-case                          | $R_{th(j-c)}$ |                                                      |        | 0.35 | 0.46 | K/W  |
| Diode thermal resistance, junction-case                         | $R_{th(j-c)}$ |                                                      |        | 0.6  | 0.78 | K/W  |

## 2 IGBT

**Table 2** Maximum rated values

| Parameter                                              | Symbol       | Note or test condition                                                                                                                                 |                       | Values   | Unit |
|--------------------------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------|------|
| Collector-emitter voltage                              | $V_{CE}$     | $T_{vj} \geq 25\text{ °C}$                                                                                                                             |                       | 1200     | V    |
| DC collector current, limited by $T_{vjmax}$           | $I_C$        | limited by bondwire                                                                                                                                    | $T_C = 25\text{ °C}$  | 82       | A    |
|                                                        |              |                                                                                                                                                        | $T_C = 100\text{ °C}$ | 67       |      |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$ | $I_{Cpulse}$ |                                                                                                                                                        |                       | 160      | A    |
| Turn-off safe operating area                           |              | $V_{CC} \leq 800\text{ V}$ , $V_{CE,peak} < 1200\text{ V}$ , $V_{GE} = 0/15\text{ V}$ , $R_{Goff} \geq 10\text{ }\Omega$ , $T_{vj} \leq 175\text{ °C}$ |                       | 160      | A    |
| Gate-emitter voltage                                   | $V_{GE}$     |                                                                                                                                                        |                       | $\pm 20$ | V    |
| Transient gate-emitter voltage                         | $V_{GE}$     | $t_p \leq 0.5\text{ }\mu\text{s}$ , $D < 0.001$                                                                                                        |                       | $\pm 25$ | V    |
| Power dissipation                                      | $P_{tot}$    |                                                                                                                                                        | $T_C = 25\text{ °C}$  | 330      | W    |
|                                                        |              |                                                                                                                                                        | $T_C = 100\text{ °C}$ | 165      |      |

**Table 3** Characteristic values

| Parameter                            | Symbol      | Note or test condition                       |                          | Values |      |      | Unit |
|--------------------------------------|-------------|----------------------------------------------|--------------------------|--------|------|------|------|
|                                      |             |                                              |                          | Min.   | Typ. | Max. |      |
| Collector-emitter saturation voltage | $V_{CEsat}$ | $I_C = 40\text{ A}$ , $V_{GE} = 15\text{ V}$ | $T_{vj} = 25\text{ °C}$  |        | 1.7  | 2.15 | V    |
|                                      |             |                                              | $T_{vj} = 175\text{ °C}$ |        | 2    |      |      |

(table continues...)  
 Datasheet

**Table 3 (continued) Characteristic values**

| Parameter                           | Symbol       | Note or test condition                                                                                                          | Values                                              |      |      | Unit          |
|-------------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|------|------|---------------|
|                                     |              |                                                                                                                                 | Min.                                                | Typ. | Max. |               |
| Gate-emitter threshold voltage      | $V_{GEth}$   | $I_C = 0.64 \text{ mA}$ , $V_{CE} = V_{GE}$                                                                                     | 4.7                                                 | 5.5  | 6.2  | V             |
| Zero gate-voltage collector current | $I_{CES}$    | $V_{CE} = 1200 \text{ V}$ , $V_{GE} = 0 \text{ V}$                                                                              | $T_{vj} = 25 \text{ °C}$                            |      | 40   | $\mu\text{A}$ |
|                                     |              |                                                                                                                                 | $T_{vj} = 175 \text{ °C}$                           | 2600 |      |               |
| Gate-emitter leakage current        | $I_{GES}$    | $V_{CE} = 0 \text{ V}$ , $V_{GE} = 20 \text{ V}$                                                                                |                                                     |      | 100  | nA            |
| Transconductance                    | $g_{fs}$     | $I_C = 40 \text{ A}$ , $V_{CE} = 20 \text{ V}$                                                                                  |                                                     | 79   |      | S             |
| Input capacitance                   | $C_{ies}$    | $V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ , $f = 100 \text{ kHz}$                                                        |                                                     | 5    |      | nF            |
| Output capacitance                  | $C_{oes}$    | $V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ , $f = 100 \text{ kHz}$                                                        |                                                     | 108  |      | pF            |
| Reverse transfer capacitance        | $C_{res}$    | $V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ , $f = 100 \text{ kHz}$                                                        |                                                     | 29   |      | pF            |
| Gate charge                         | $Q_G$        | $I_C = 40 \text{ A}$ , $V_{GE} = 15 \text{ V}$ , $V_{CC} = 960 \text{ V}$                                                       |                                                     | 290  |      | nC            |
| Turn-on delay time                  | $t_{d(on)}$  | $V_{CC} = 600 \text{ V}$ , $V_{GE} = 0/15 \text{ V}$ ,<br>$R_{G(on)} = 10 \text{ }\Omega$ ,<br>$R_{G(off)} = 10 \text{ }\Omega$ | $T_{vj} = 25 \text{ °C}$ ,<br>$I_C = 40 \text{ A}$  | 36   |      | ns            |
|                                     |              |                                                                                                                                 | $T_{vj} = 175 \text{ °C}$ ,<br>$I_C = 40 \text{ A}$ | 32   |      |               |
| Rise time (inductive load)          | $t_r$        | $V_{CC} = 600 \text{ V}$ , $V_{GE} = 0/15 \text{ V}$ ,<br>$R_{G(on)} = 10 \text{ }\Omega$ ,<br>$R_{G(off)} = 10 \text{ }\Omega$ | $T_{vj} = 25 \text{ °C}$ ,<br>$I_C = 40 \text{ A}$  | 22   |      | ns            |
|                                     |              |                                                                                                                                 | $T_{vj} = 175 \text{ °C}$ ,<br>$I_C = 40 \text{ A}$ | 21   |      |               |
| Turn-off delay time                 | $t_{d(off)}$ | $V_{CC} = 600 \text{ V}$ , $V_{GE} = 0/15 \text{ V}$ ,<br>$R_{G(on)} = 10 \text{ }\Omega$ ,<br>$R_{G(off)} = 10 \text{ }\Omega$ | $T_{vj} = 25 \text{ °C}$ ,<br>$I_C = 40 \text{ A}$  | 336  |      | ns            |
|                                     |              |                                                                                                                                 | $T_{vj} = 175 \text{ °C}$ ,<br>$I_C = 40 \text{ A}$ | 420  |      |               |
| Fall time (inductive load)          | $t_f$        | $V_{CC} = 600 \text{ V}$ , $V_{GE} = 0/15 \text{ V}$ ,<br>$R_{G(on)} = 10 \text{ }\Omega$ ,<br>$R_{G(off)} = 10 \text{ }\Omega$ | $T_{vj} = 25 \text{ °C}$ ,<br>$I_C = 40 \text{ A}$  | 45   |      | ns            |
|                                     |              |                                                                                                                                 | $T_{vj} = 175 \text{ °C}$ ,<br>$I_C = 40 \text{ A}$ | 114  |      |               |
| Turn-on energy                      | $E_{on}$     | $V_{CC} = 600 \text{ V}$ , $V_{GE} = 0/15 \text{ V}$ ,<br>$R_{G(on)} = 10 \text{ }\Omega$ ,<br>$R_{G(off)} = 10 \text{ }\Omega$ | $T_{vj} = 25 \text{ °C}$ ,<br>$I_C = 40 \text{ A}$  | 1.69 |      | mJ            |
|                                     |              |                                                                                                                                 | $T_{vj} = 175 \text{ °C}$ ,<br>$I_C = 40 \text{ A}$ | 2.44 |      |               |
| Turn-off energy                     | $E_{off}$    | $V_{CC} = 600 \text{ V}$ , $V_{GE} = 0/15 \text{ V}$ ,<br>$R_{G(on)} = 10 \text{ }\Omega$ ,<br>$R_{G(off)} = 10 \text{ }\Omega$ | $T_{vj} = 25 \text{ °C}$ ,<br>$I_C = 40 \text{ A}$  | 0.92 |      | mJ            |
|                                     |              |                                                                                                                                 | $T_{vj} = 175 \text{ °C}$ ,<br>$I_C = 40 \text{ A}$ | 2.13 |      |               |

(table continues...)

**Table 3** (continued) Characteristic values

| Parameter                      | Symbol   | Note or test condition                                                                                          | Values |      |      | Unit |
|--------------------------------|----------|-----------------------------------------------------------------------------------------------------------------|--------|------|------|------|
|                                |          |                                                                                                                 | Min.   | Typ. | Max. |      |
| Total switching energy         | $E_{ts}$ | $V_{CC} = 600 \text{ V}$ , $V_{GE} = 0/15 \text{ V}$ ,<br>$R_{G(on)} = 10 \Omega$ ,<br>$R_{G(off)} = 10 \Omega$ |        | 2.61 |      | mJ   |
|                                |          |                                                                                                                 |        | 4.57 |      |      |
| Operating junction temperature | $T_{vj}$ |                                                                                                                 | -40    |      | 175  | °C   |

Note: Electrical Characteristic, at  $T_{vj} = 25^\circ\text{C}$ , unless otherwise specified.

### 3 Diode

**Table 4** Maximum rated values

| Parameter                                          | Symbol       | Note or test condition    | Values | Unit |
|----------------------------------------------------|--------------|---------------------------|--------|------|
| Diode forward current, limited by $T_{vjmax}$      | $I_F$        | $T_c = 25^\circ\text{C}$  | 66     | A    |
|                                                    |              | $T_c = 100^\circ\text{C}$ | 42     |      |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$ | $I_{Fpulse}$ |                           | 160    | A    |
| Power dissipation                                  | $P_{tot}$    | $T_c = 25^\circ\text{C}$  | 192    | W    |
|                                                    |              | $T_c = 100^\circ\text{C}$ | 96     |      |

**Table 5** Characteristic values

| Parameter                           | Symbol    | Note or test condition                          | Values |      |      | Unit          |
|-------------------------------------|-----------|-------------------------------------------------|--------|------|------|---------------|
|                                     |           |                                                 | Min.   | Typ. | Max. |               |
| Diode forward voltage               | $V_F$     | $I_F = 40 \text{ A}$                            |        | 2.5  | 3    | V             |
|                                     |           |                                                 |        | 2.3  |      |               |
| Diode reverse recovery time         | $t_{rr}$  | $V_R = 600 \text{ V}$ , $R_{G(on)} = 10 \Omega$ |        | 120  |      | ns            |
|                                     |           |                                                 |        | 185  |      |               |
| Diode reverse recovery charge       | $Q_{rr}$  | $V_R = 600 \text{ V}$ , $R_{G(on)} = 10 \Omega$ |        | 1.27 |      | $\mu\text{C}$ |
|                                     |           |                                                 |        | 3.25 |      |               |
| Diode peak reverse recovery current | $I_{rrm}$ | $V_R = 600 \text{ V}$ , $R_{G(on)} = 10 \Omega$ |        | 27   |      | A             |
|                                     |           |                                                 |        | 43   |      |               |

(table continues...)

**Table 5** (continued) Characteristic values

| Parameter                                           | Symbol       | Note or test condition                                |                                                            | Values |      |      | Unit             |
|-----------------------------------------------------|--------------|-------------------------------------------------------|------------------------------------------------------------|--------|------|------|------------------|
|                                                     |              |                                                       |                                                            | Min.   | Typ. | Max. |                  |
| Diode peak rate of fall of reverse recovery current | $di_{rr}/dt$ | $V_R = 600 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$ | $T_{vj} = 25 \text{ } ^\circ\text{C}, I_F = 40 \text{ A}$  |        | -348 |      | A/ $\mu\text{s}$ |
|                                                     |              |                                                       | $T_{vj} = 175 \text{ } ^\circ\text{C}, I_F = 40 \text{ A}$ |        | -405 |      |                  |
| Reverse recovery energy                             | $E_{rec}$    | $V_R = 600 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$ | $T_{vj} = 25 \text{ } ^\circ\text{C}, I_F = 40 \text{ A}$  |        | 0.37 |      | mJ               |
|                                                     |              |                                                       | $T_{vj} = 175 \text{ } ^\circ\text{C}, I_F = 40 \text{ A}$ |        | 1.09 |      |                  |
| Operating junction temperature                      | $T_{vj}$     |                                                       |                                                            | -40    |      | 175  | $^\circ\text{C}$ |

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

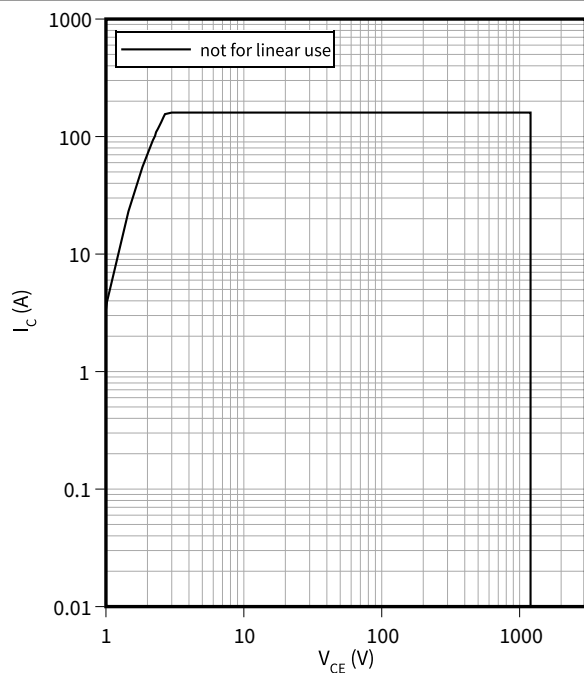
Dynamic test circuit, parasitic inductance  $L_\sigma = 30 \text{ nH}$ ,  $C_\sigma = 18 \text{ pF}$

## 4 Characteristics diagrams

### Reverse bias safe operating area

$$I_C = f(V_{CE})$$

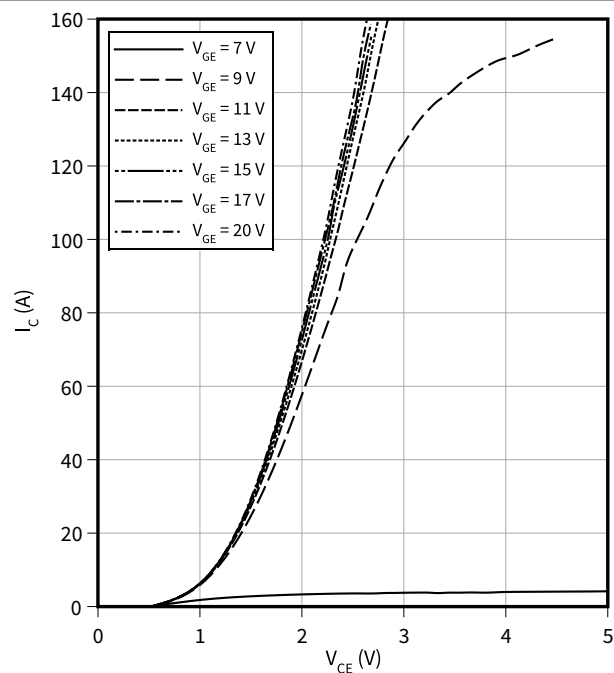
$$T_{vj} \leq 175^\circ\text{C}, V_{GE} = 0/15\text{ V}$$



### Typical output characteristic

$$I_C = f(V_{CE})$$

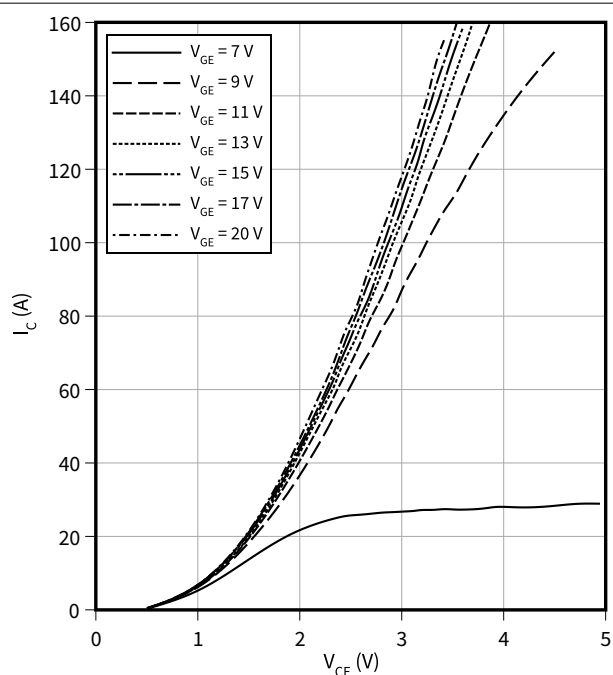
$$T_{vj} = 25^\circ\text{C}$$



### Typical output characteristic

$$I_C = f(V_{CE})$$

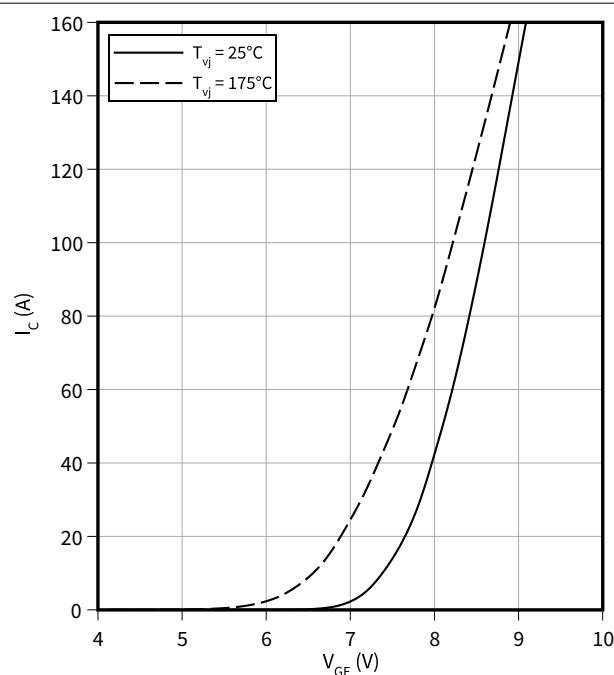
$$T_{vj} = 175^\circ\text{C}$$



### Typical transfer characteristic

$$I_C = f(V_{GE})$$

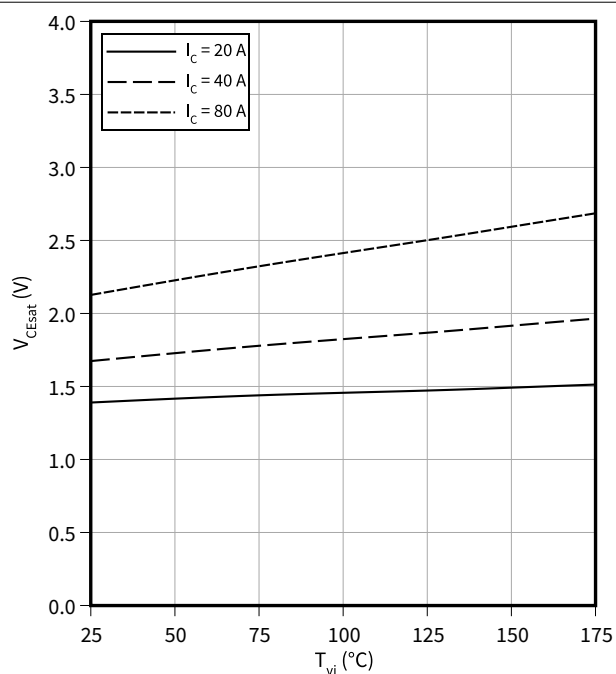
$$V_{CE} = 20\text{ V}$$



**Typical collector-emitter saturation voltage as a function of junction temperature**

$$V_{CEsat} = f(T_{vj})$$

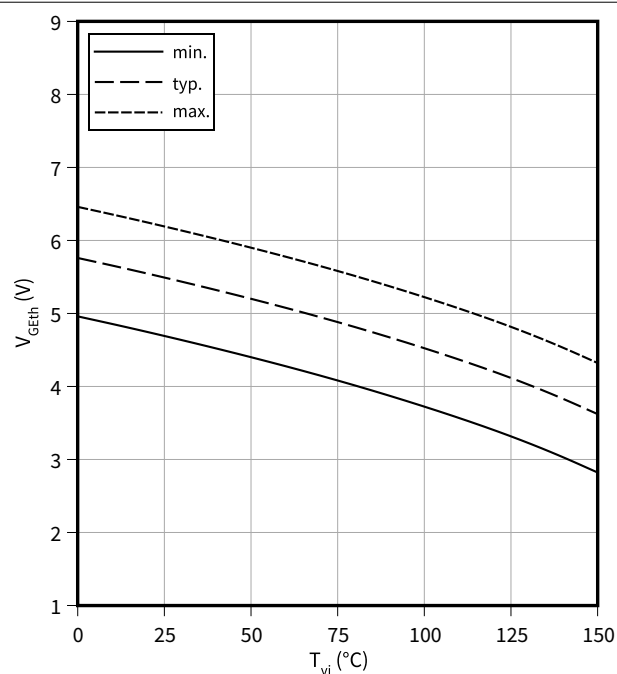
$$V_{GE} = 15 \text{ V}$$



**Gate-emitter threshold voltage as a function of junction temperature**

$$V_{GEth} = f(T_{vj})$$

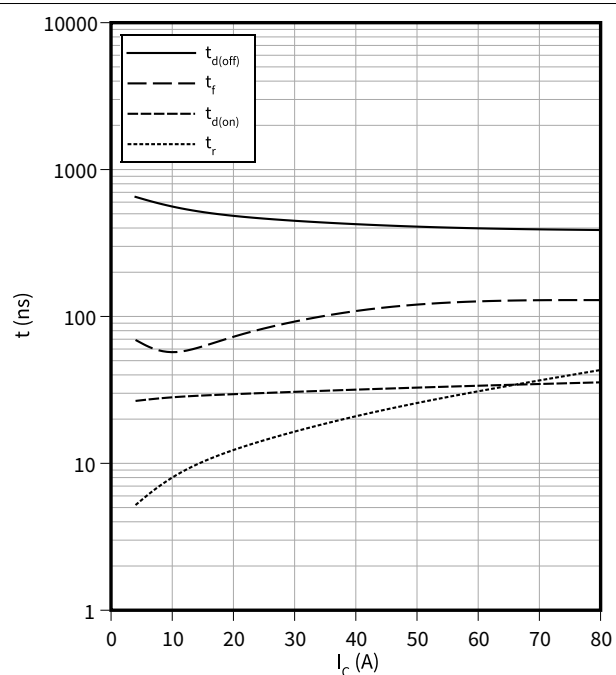
$$I_C = 0.64 \text{ mA}$$



**Typical switching times as a function of collector current**

$$t = f(I_C)$$

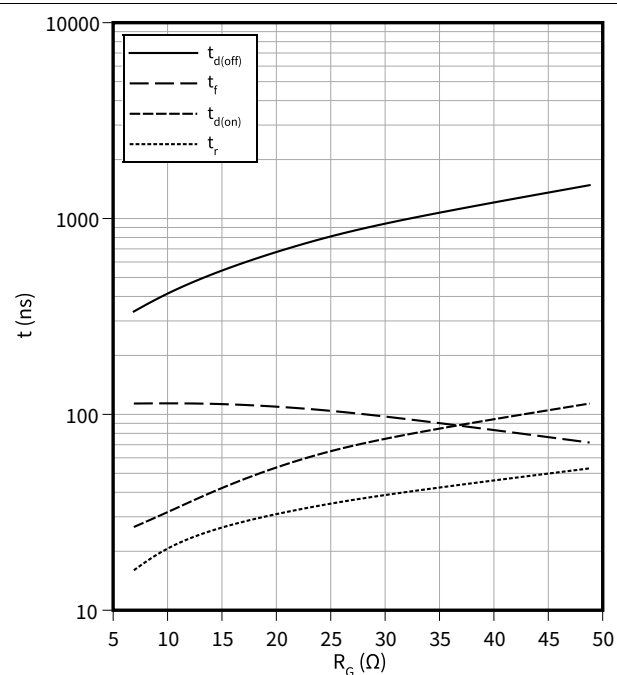
$$V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 10 \text{ } \Omega$$



**Typical switching times as a function of gate resistor**

$$t = f(R_G)$$

$$I_C = 40 \text{ A}, V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$$

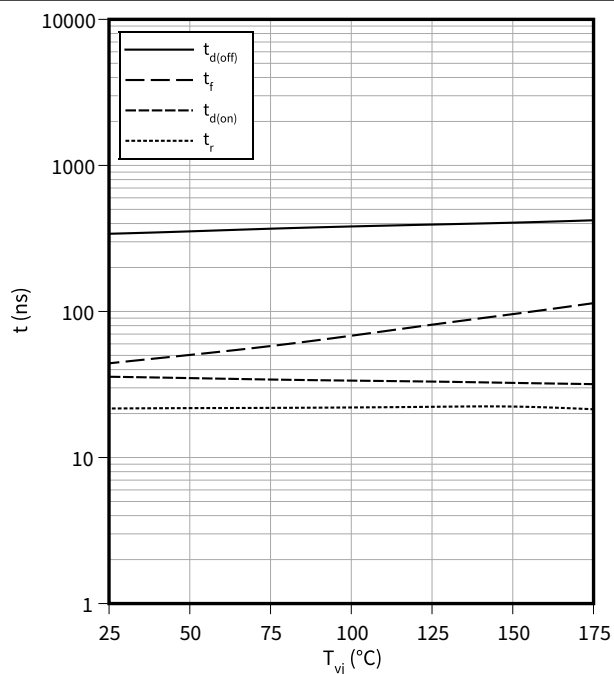




**Typical switching times as a function of junction temperature**

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

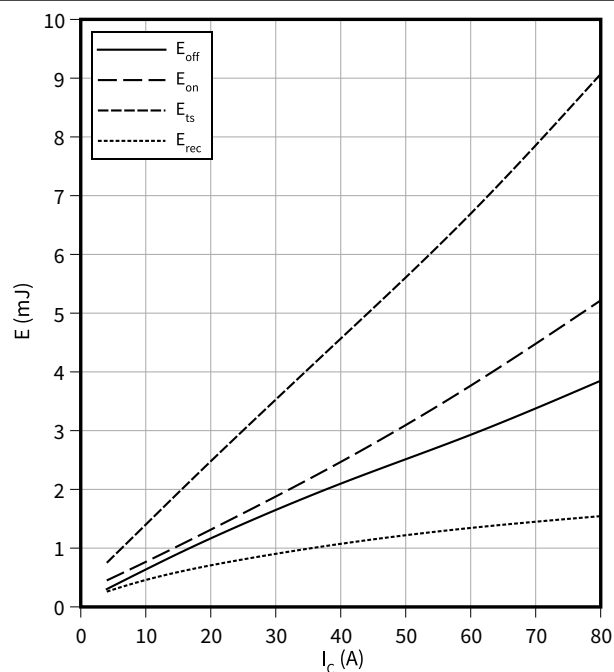
$I_C = 40 \text{ A}$ ,  $V_{CC} = 600 \text{ V}$ ,  $V_{GE} = 0/15 \text{ V}$ ,  $R_G = 10 \Omega$



**Typical switching energy losses as a function of collector current**

$$E = f(I_C)$$

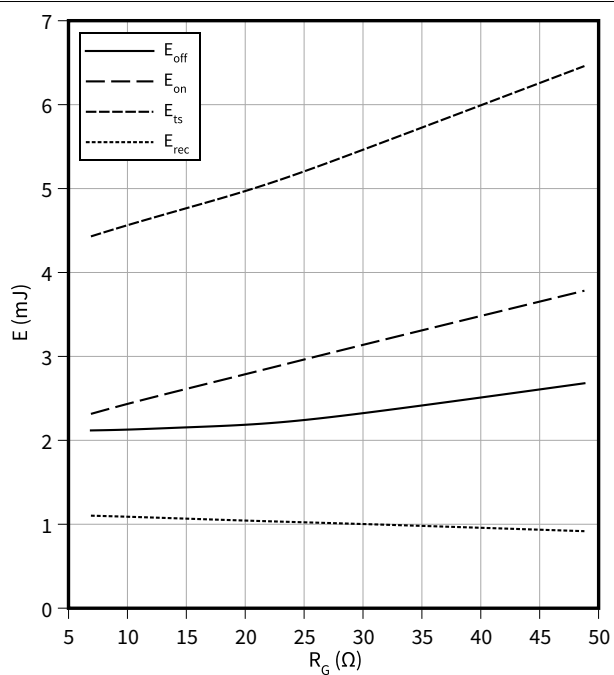
$V_{CC} = 600 \text{ V}$ ,  $T_{vj} = 175 \text{ °C}$ ,  $V_{GE} = 0/15 \text{ V}$ ,  $R_G = 10 \Omega$



**Typical switching energy losses as a function of gate resistor**

$$E = f(R_G)$$

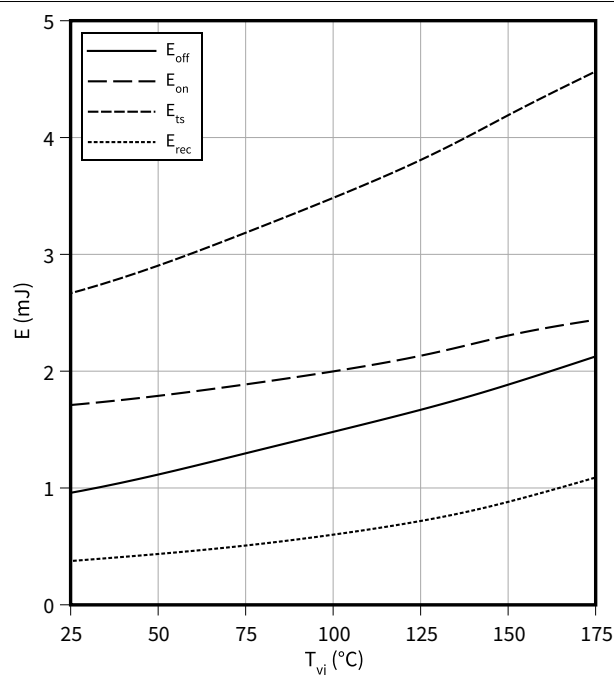
$I_C = 40 \text{ A}$ ,  $V_{CC} = 600 \text{ V}$ ,  $T_{vj} = 175 \text{ °C}$ ,  $V_{GE} = 0/15 \text{ V}$



**Typical switching energy losses as a function of junction temperature**

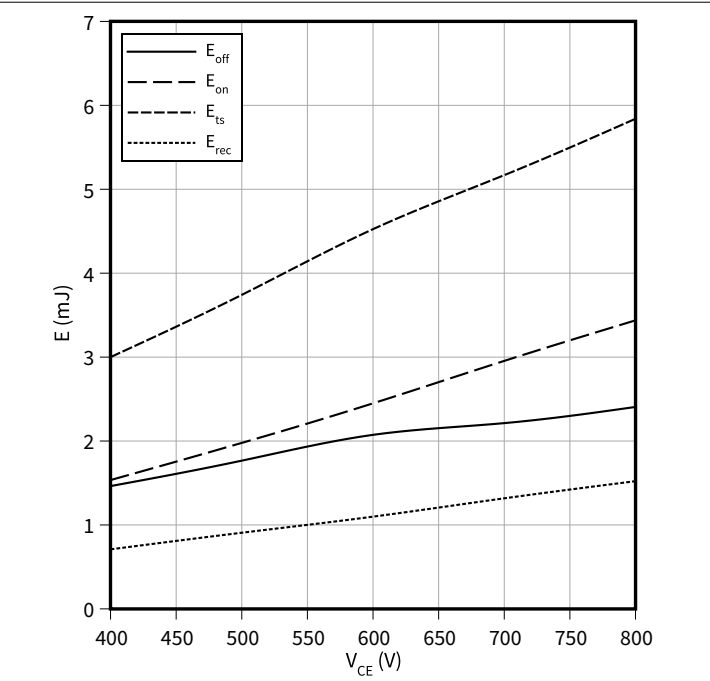
$$E = f(T_{vj})$$

$I_C = 40 \text{ A}$ ,  $V_{CC} = 600 \text{ V}$ ,  $V_{GE} = 0/15 \text{ V}$ ,  $R_G = 10 \Omega$



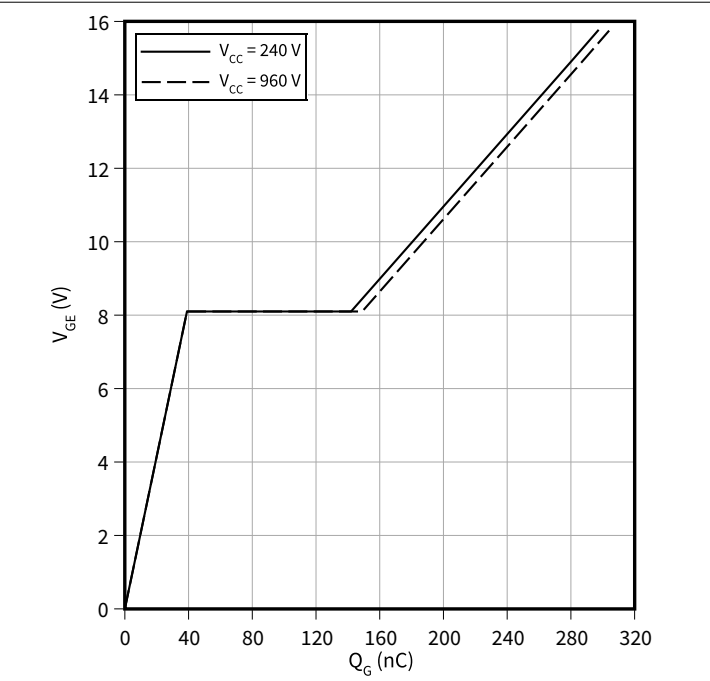
Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$   
 $I_C = 40\text{ A}$ ,  $T_{vj} = 175\text{ }^{\circ}\text{C}$ ,  $V_{GE} = 0/15\text{ V}$ ,  $R_G = 10\text{ }\Omega$



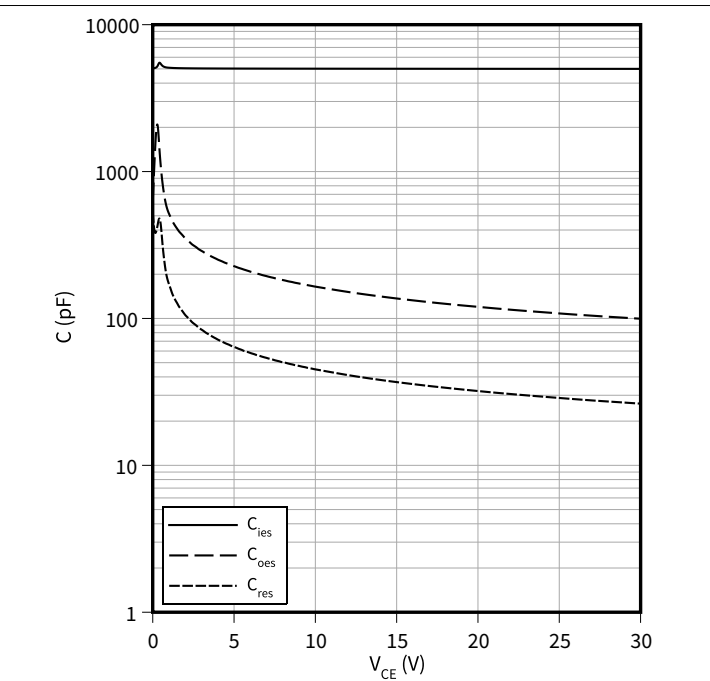
Typical gate charge

$V_{GE} = f(Q_G)$   
 $I_C = 40\text{ A}$



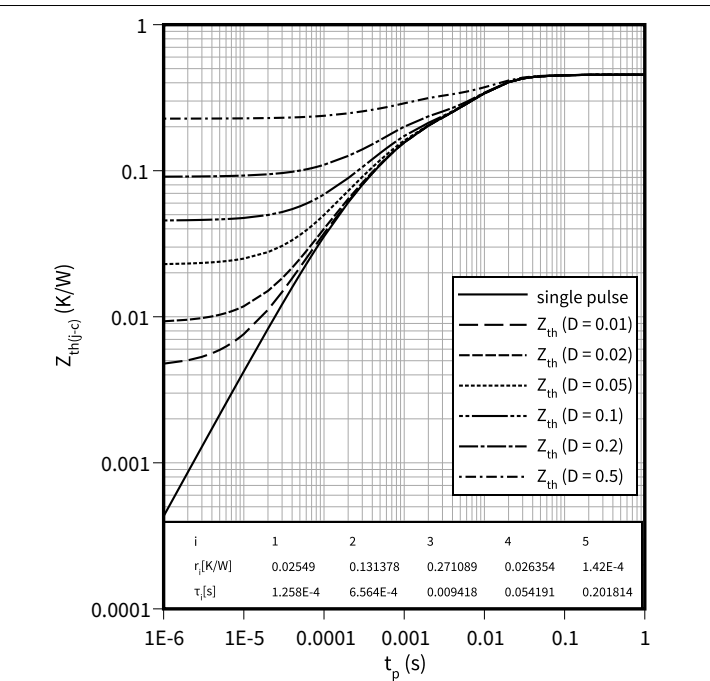
Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$   
 $f = 100\text{ kHz}$ ,  $V_{GE} = 0\text{ V}$



IGBT transient thermal impedance as a function of pulse width

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

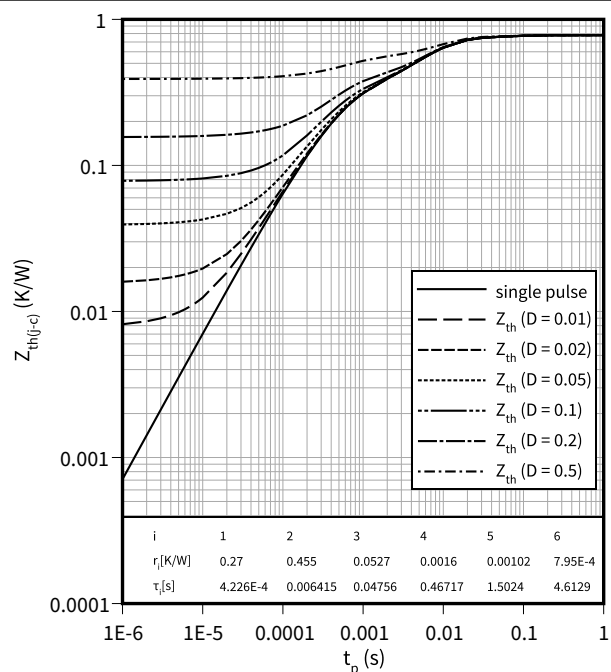


4 Characteristics diagrams

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

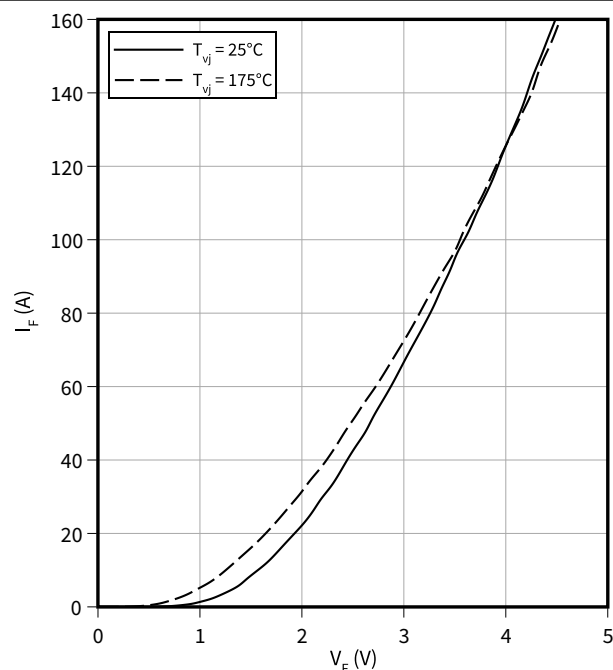
$$Z_{th(j-c)} = f(t_p)$$

$$D = t_p / T$$



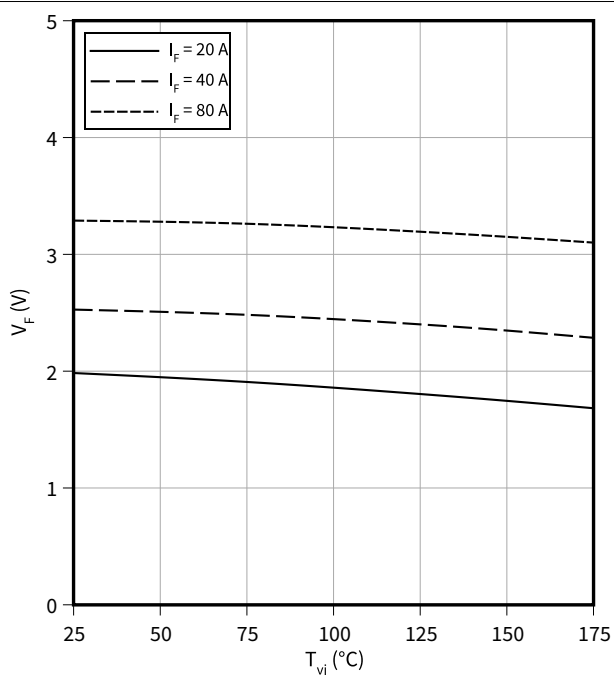
**Typical diode forward current as a function of forward voltage**

$$I_F = f(V_F)$$



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

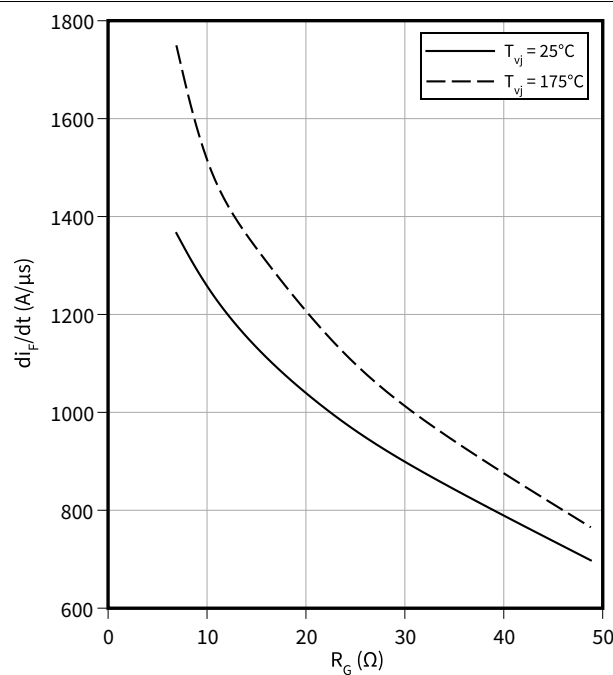
$$V_F = f(T_{vj})$$



**Typical diode current slope as a function of gate resistor**

$$di_F/dt = f(R_G)$$

$$V_R = 600 \text{ V}, I_F = 40 \text{ A}$$

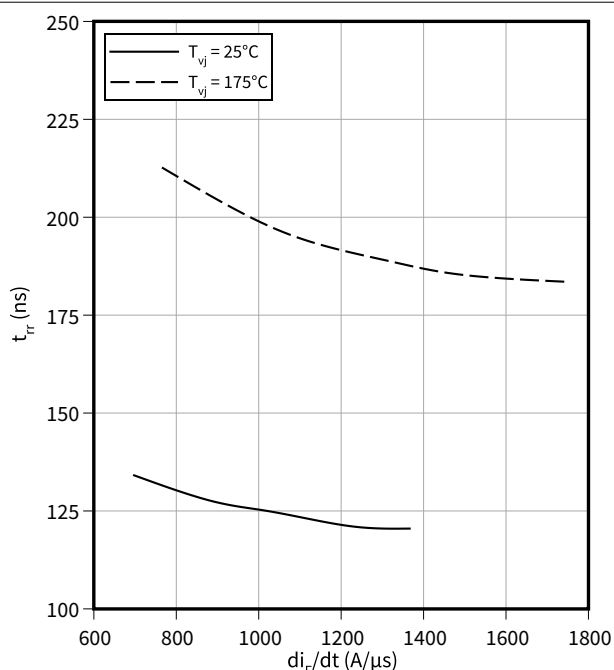


4 Characteristics diagrams

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

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

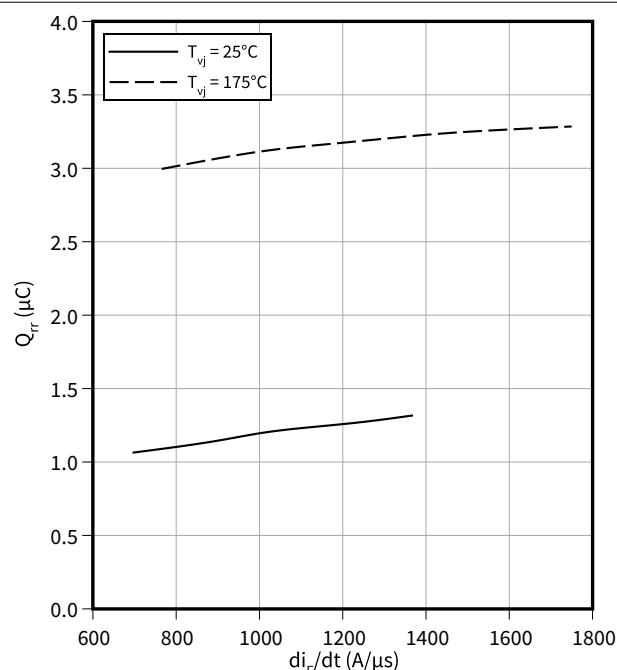
$V_R = 600 \text{ V}$ ,  $I_F = 40 \text{ A}$



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

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

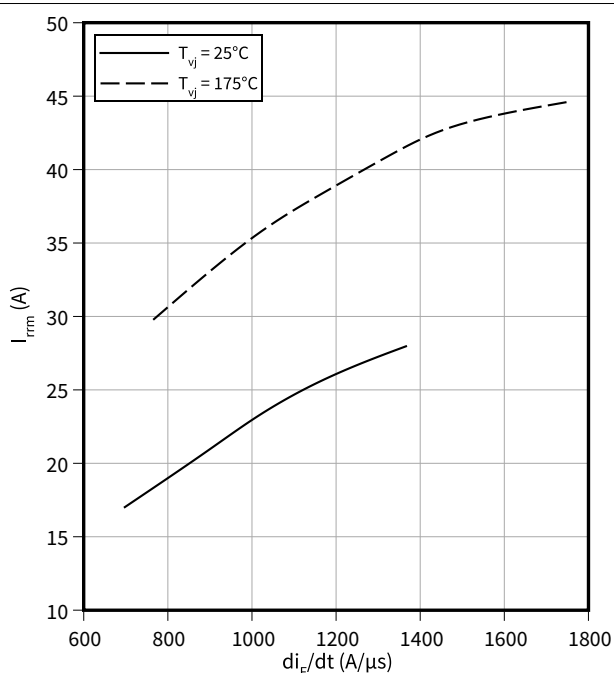
$V_R = 600 \text{ V}$ ,  $I_F = 40 \text{ A}$



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

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

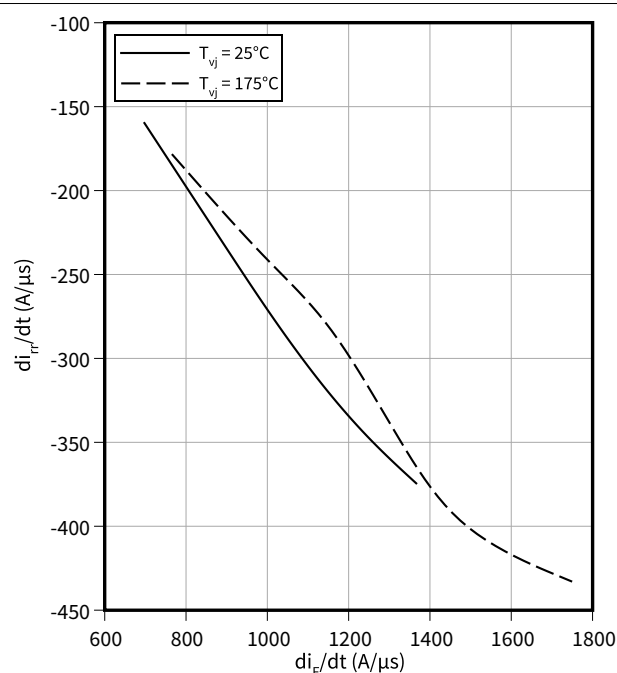
$V_R = 600 \text{ V}$ ,  $I_F = 40 \text{ A}$



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

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

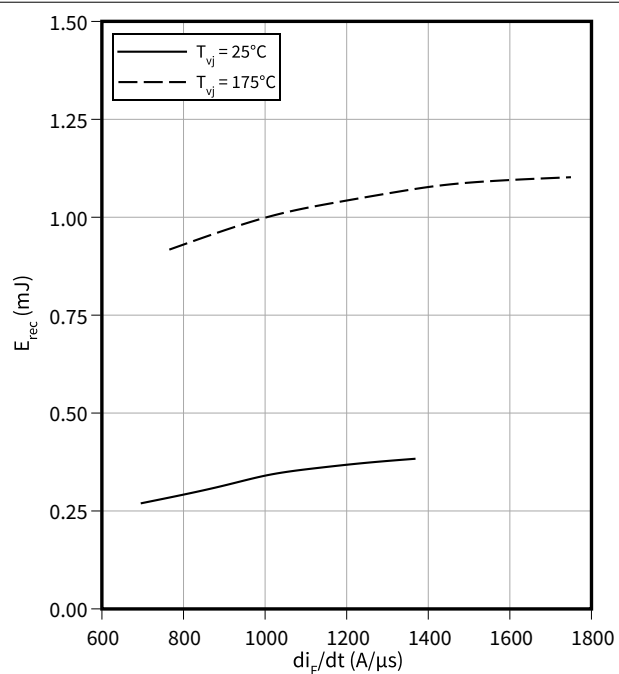
$V_R = 600 \text{ V}$ ,  $I_F = 40 \text{ A}$



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

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

$V_R = 600 \text{ V}$ ,  $I_F = 40 \text{ A}$



5 Package outlines

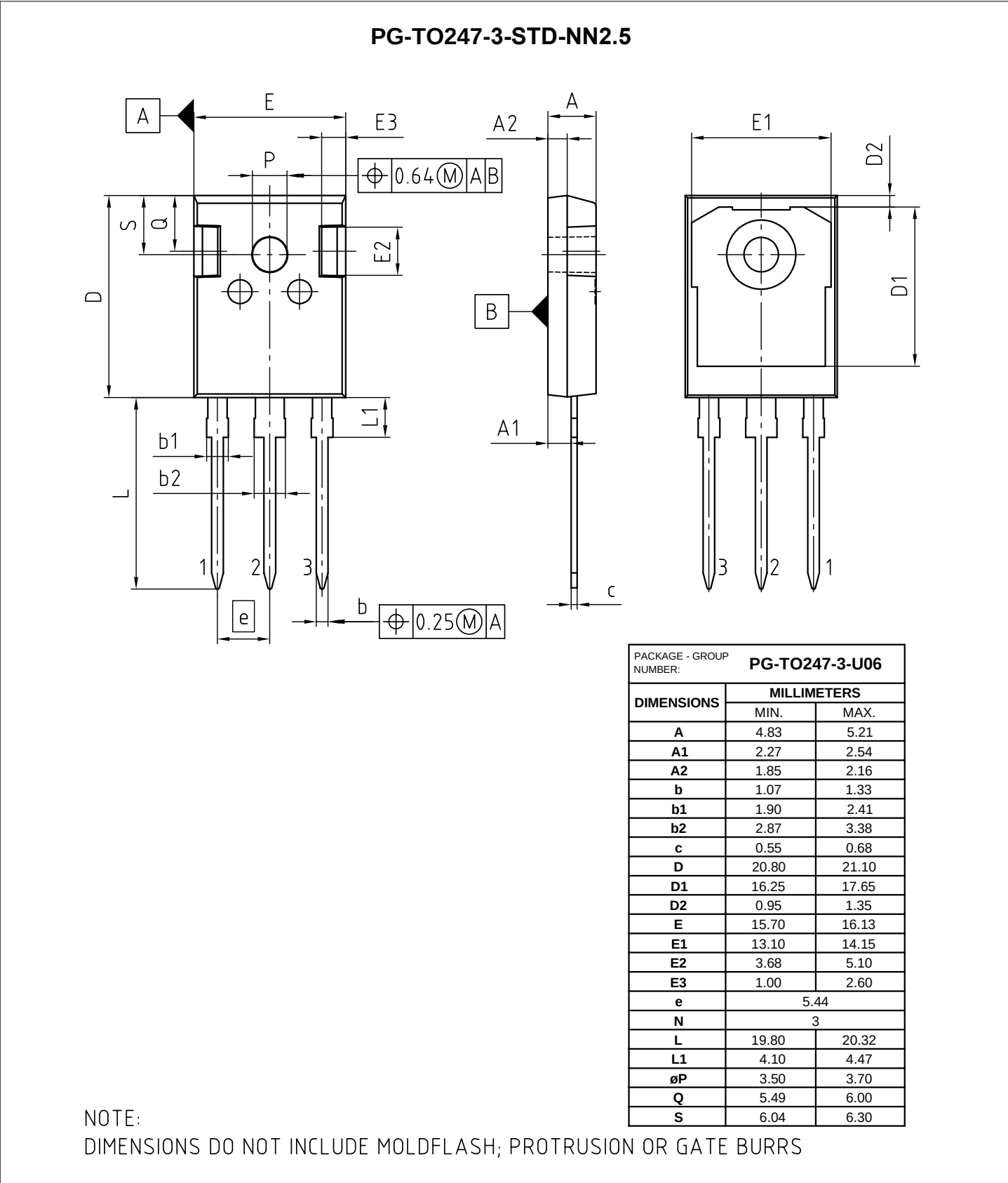


Figure 1

## 6 Testing conditions

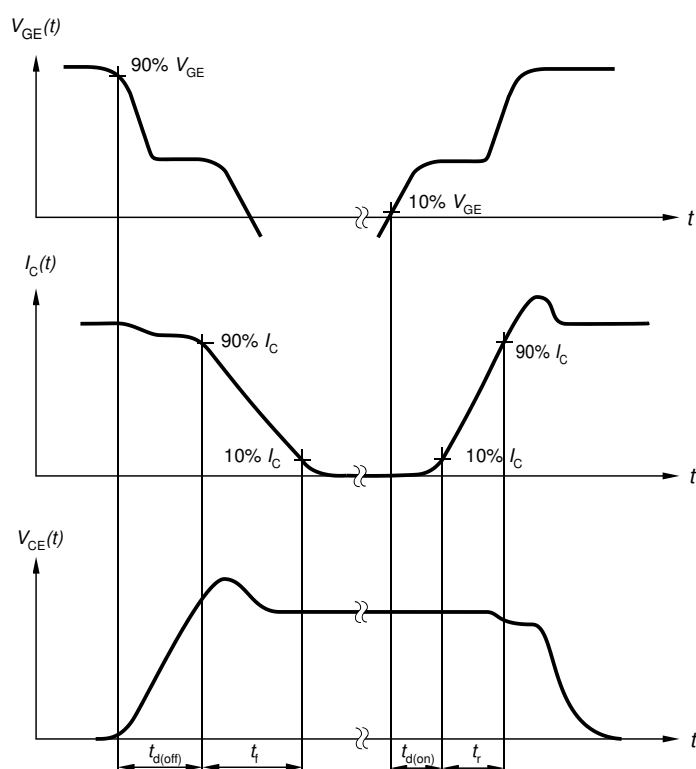


Figure A. Definition of switching times

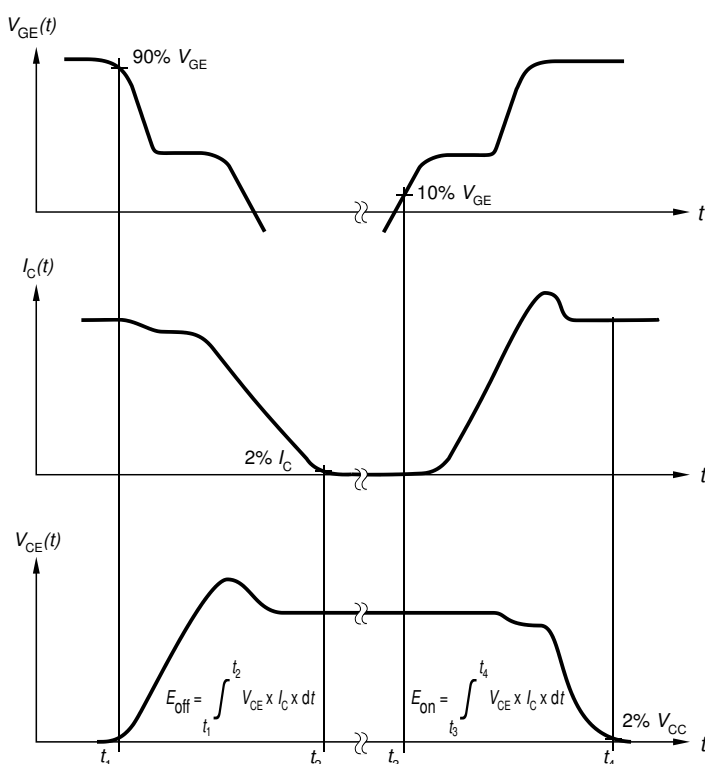


Figure B. Definition of switching losses

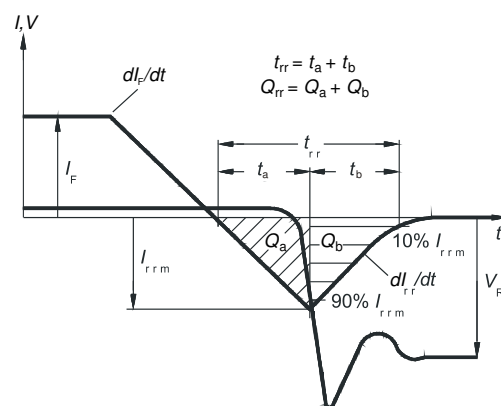


Figure C. Definition of diode switching characteristics

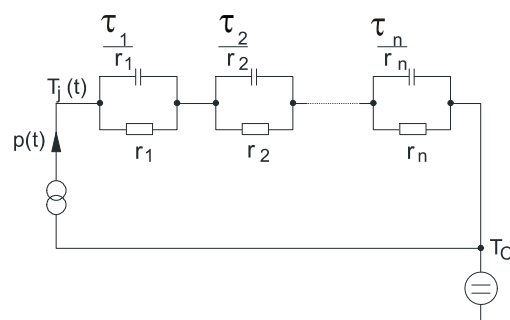


Figure D. Thermal equivalent circuit

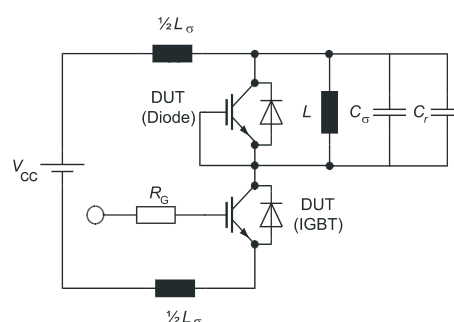


Figure E. **Dynamic test circuit**  
 Parasitic inductance  $L_\sigma$ ,  
 parasitic capacitor  $C_\sigma$ ,  
 relief capacitor  $C_r$ ,  
 (only for ZVT switching)

## Revision history

| Document revision | Date of release | Description of changes           |
|-------------------|-----------------|----------------------------------|
| 0.10              | 2022-05-02      | Target datasheet                 |
| 0.20              | 2022-05-31      | Editorial changes                |
| 1.00              | 2022-11-02      | Final datasheet                  |
| 1.10              | 2022-11-25      | Update of potential applications |



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