



**THE DATASHEET OF  
IKWH30N65WR5XKSA1**



### TRENCHSTOP™ 5 WR5 technology in enhanced creepage and clearance package offers improved reliability against package contamination

#### Features

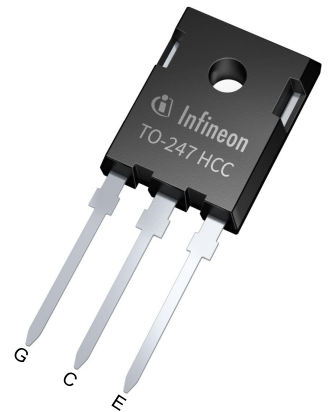
- $V_{CE} = 650\text{ V}$
- $I_C = 30\text{ A}$
- Pin-to-pin creepage distance > 4.8 mm
- Pin-to-pin clearance distance > 3.4 mm
- Monolithic diode optimized for PFC and welding applications
- Stable temperature behavior
- Very low  $V_{CEsat}$  and low  $E_{off}$
- Easy parallel switching capability based on positive temperature coefficient of  $V_{CEsat}$
- Low temperature dependence of  $V_{CEsat}$  and  $E_{sw}$
- Product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

#### Potential applications

- PFC
- Welding
- ZCS applications

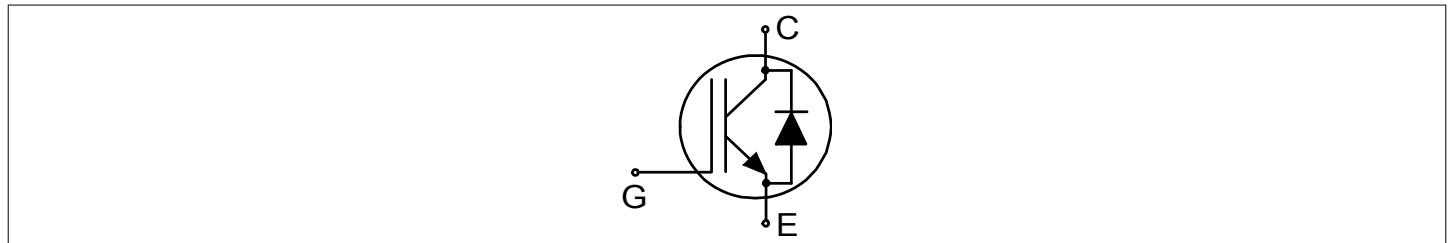
#### Product validation

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



- Lead-Free
- Green
- Halogen-Free
- RoHS

#### Description



Type	Package	Marking
IKWH30N65WR5	PG-TO247-3-STD-N4.8	H30EWR5

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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	$L_E$			13.0		nH
Storage temperature	$T_{stg}$		-55		150	°C
Soldering temperature		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

## 2 IGBT

**Table 2** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Collector-emitter voltage	$V_{CE}$	$T_{vj} \geq 25\text{ °C}$	650	V	
DC collector current, limited by $T_{vjmax}$	$I_C$		$T_c = 25\text{ °C}$	75	A
			$T_c = 100\text{ °C}$	49	
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cpulse}$		90	A	
Turn-off safe operating area		$V_{CE} \leq 650\text{ V}$ , $t_p \leq 1\text{ }\mu\text{s}$ , $T_{vj} \leq 175\text{ °C}$	90	A	
Gate-emitter voltage	$V_{GE}$		$\pm 20$	V	
Transient gate-emitter voltage	$V_{GE}$	$t_p \leq 10\text{ }\mu\text{s}$ , $D < 0.01$	$\pm 30$	V	
Power dissipation	$P_{tot}$		$T_c = 25\text{ °C}$	190	W
			$T_c = 100\text{ °C}$	95	

**Table 3** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter breakdown voltage	$V_{BRCES}$	$I_C = 0.2\text{ mA}$ , $V_{GE} = 0\text{ V}$	650			V
Collector-emitter saturation voltage	$V_{CEsat}$	$I_C = 30\text{ A}$ , $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	1.4	1.7	V
			$T_{vj} = 175\text{ °C}$	1.65		
Gate-emitter threshold voltage	$V_{GEth}$	$I_C = 0.3\text{ mA}$ , $V_{CE} = V_{GE}$	3.2	4	4.8	V

(table continues...)  
 Datasheet

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Zero gate-voltage collector current	$I_{CES}$	$V_{CE} = 650 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		40	$\mu\text{A}$
			$T_{vj} = 175 \text{ }^\circ\text{C}$		0.5	$\text{mA}$
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}$			100	$\text{nA}$
Transconductance	$g_{fs}$	$I_C = 30 \text{ A}, V_{CE} = 20 \text{ V}$		67		$\text{S}$
Input capacitance	$C_{ies}$	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		3230		$\text{pF}$
Output capacitance	$C_{oes}$	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		32		$\text{pF}$
Reverse transfer capacitance	$C_{res}$	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		13		$\text{pF}$
Gate charge	$Q_G$	$I_C = 30 \text{ A}, V_{GE} = 15 \text{ V}, V_{CC} = 520 \text{ V}$		133		$\text{nC}$
Turn-on delay time	$t_{don}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 27 \text{ } \Omega, R_{Goff} = 27 \text{ } \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 28 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		41	$\text{ns}$
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		33	
Rise time (inductive load)	$t_r$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 27 \text{ } \Omega, R_{Goff} = 27 \text{ } \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 28 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		20	$\text{ns}$
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		21	
Turn-off delay time	$t_{doff}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 27 \text{ } \Omega, R_{Goff} = 27 \text{ } \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 28 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		398	$\text{ns}$
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		458	
Fall time (inductive load)	$t_f$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 27 \text{ } \Omega, R_{Goff} = 27 \text{ } \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 28 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		18	$\text{ns}$
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		18	
Turn-on energy	$E_{on}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 27 \text{ } \Omega, R_{Goff} = 27 \text{ } \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 28 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		0.87	$\text{mJ}$
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		1.04	
Turn-off energy	$E_{off}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 27 \text{ } \Omega, R_{Goff} = 27 \text{ } \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 28 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		0.4	$\text{mJ}$
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		0.7	
Total switching energy	$E_{ts}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 27 \text{ } \Omega, R_{Goff} = 27 \text{ } \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 28 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		1.27	$\text{mJ}$
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 30 \text{ A}$		1.74	

(table continues...)

**Table 3** (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
IGBT thermal resistance, junction to case	$R_{thjc}$				0.8	K/W
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	
Repetitive peak reverse voltage	$V_{RRM}$	$T_{vj} \geq 25^{\circ}\text{C}$	650	V	
Diode forward current, limited by $T_{vjmax}$	$I_F$		$T_c = 25^{\circ}\text{C}$	23	A
			$T_c = 100^{\circ}\text{C}$	13	
Diode pulsed current, limited by $T_{vjmax}$	$I_{Fpulse}$		45	A	

**Table 5** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Diode forward voltage	$V_F$	$I_F = 12\text{ A}$	$T_{vj} = 25^{\circ}\text{C}$		1.3	1.6	V
			$T_{vj} = 175^{\circ}\text{C}$		1.35		
Diode reverse recovery charge	$Q_{rr}$	$V_R = 400\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ , $I_F = 15\text{ A}$ , $-di_F/dt = 1400\text{ A}/\mu\text{s}$		1.9		$\mu\text{C}$
			$T_{vj} = 175^{\circ}\text{C}$ , $I_F = 15\text{ A}$ , $-di_F/dt = 1300\text{ A}/\mu\text{s}$		2.6		
Diode peak reverse recovery current	$I_{rrm}$	$V_R = 400\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ , $I_F = 15\text{ A}$ , $-di_F/dt = 1400\text{ A}/\mu\text{s}$		28.6		A
			$T_{vj} = 175^{\circ}\text{C}$ , $I_F = 15\text{ A}$ , $-di_F/dt = 1300\text{ A}/\mu\text{s}$		39		
Diode thermal resistance, junction to case	$R_{thjc}$				3.3	K/W	

(table continues...)

**Table 5** (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Operating junction temperature	$T_{vj}$		-40		175	°C

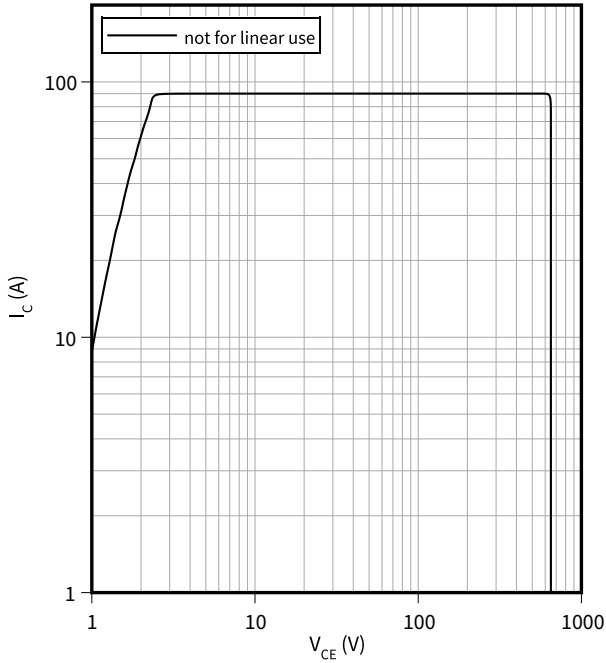
*Note:* For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

## 4 Characteristics diagrams

### Reverse bias safe operating area

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

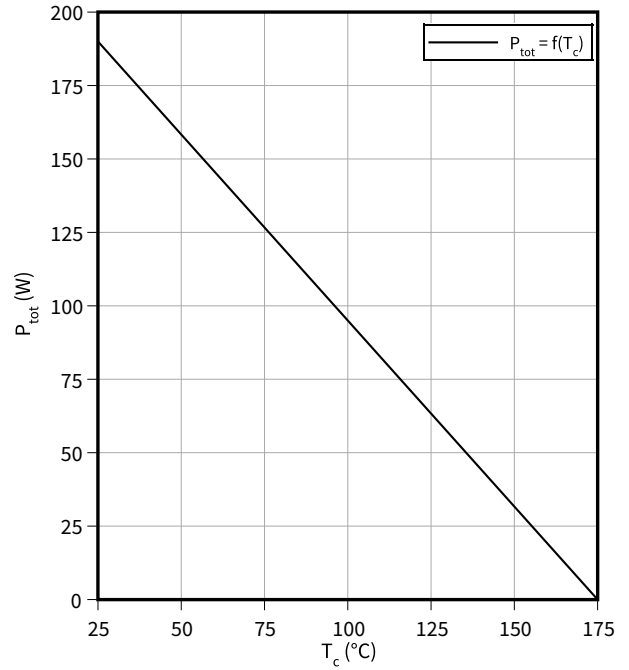
$t_p = 1 \mu s, D = 0, T_{vj} \leq 175 \text{ }^\circ\text{C}, T_c = 25 \text{ }^\circ\text{C}, V_{GE} = 15 \text{ V}$



### Power dissipation as a function of case temperature

$$P_{tot} = f(T_c)$$

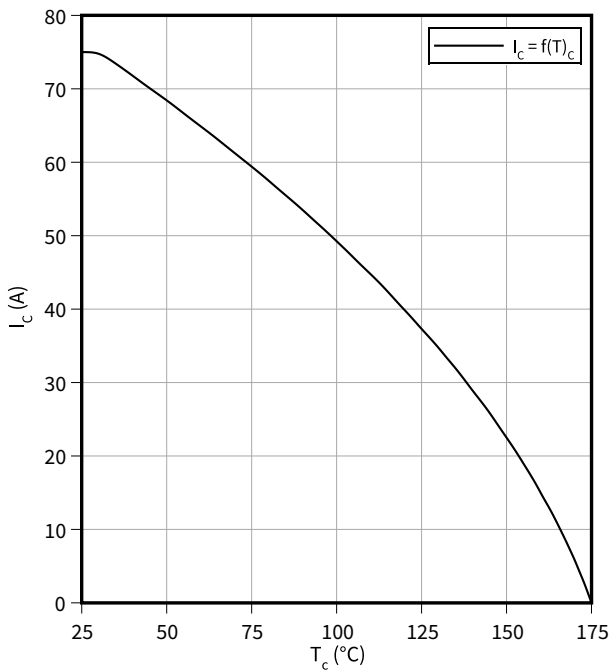
$T_{vj} \leq 175 \text{ }^\circ\text{C}$



### Collector current as a function of case temperature

$$I_C = f(T_c)$$

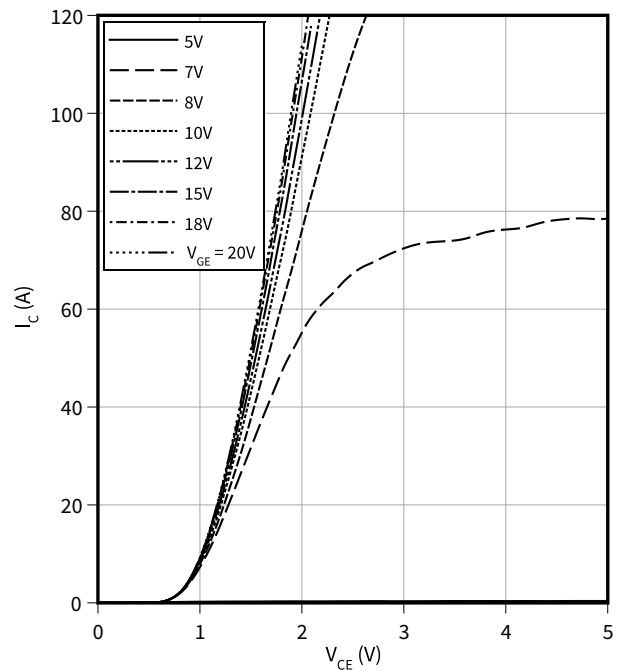
$T_{vj} \leq 175 \text{ }^\circ\text{C}, V_{GE} \geq 15 \text{ V}$



### Typical output characteristic

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

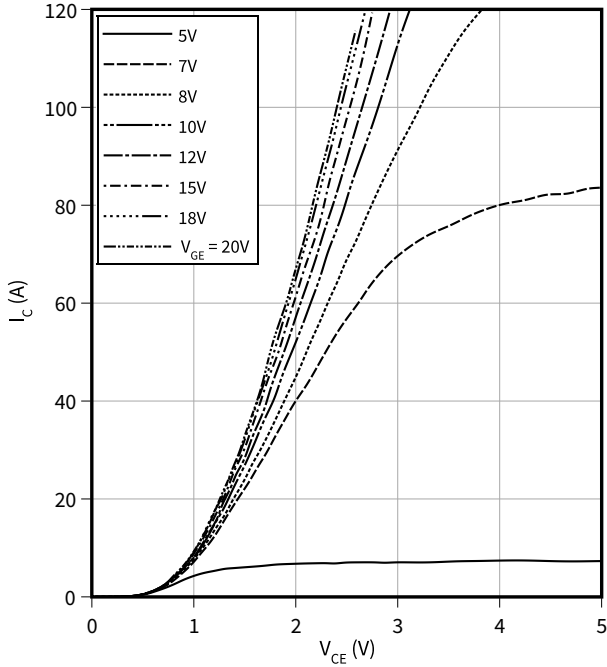
$T_{vj} = 25 \text{ }^\circ\text{C}$



4 Characteristics diagrams

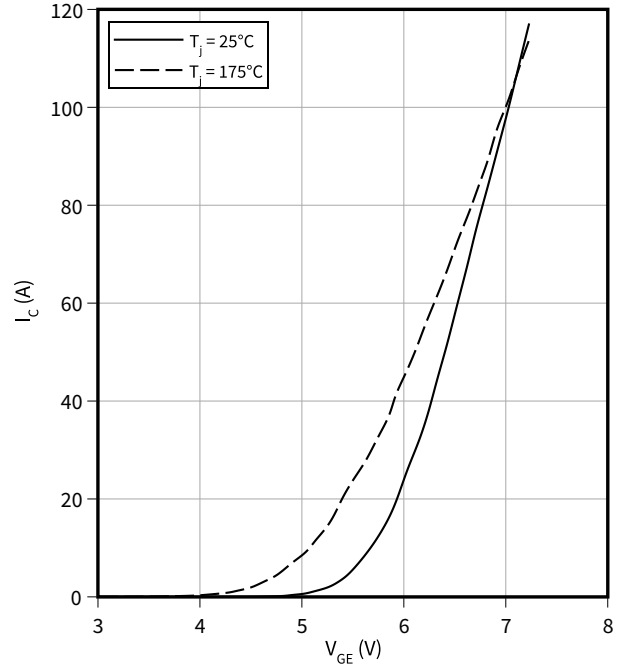
**Typical output characteristic**

$I_C = f(V_{CE})$   
 $T_{vj} = 175\text{ °C}$



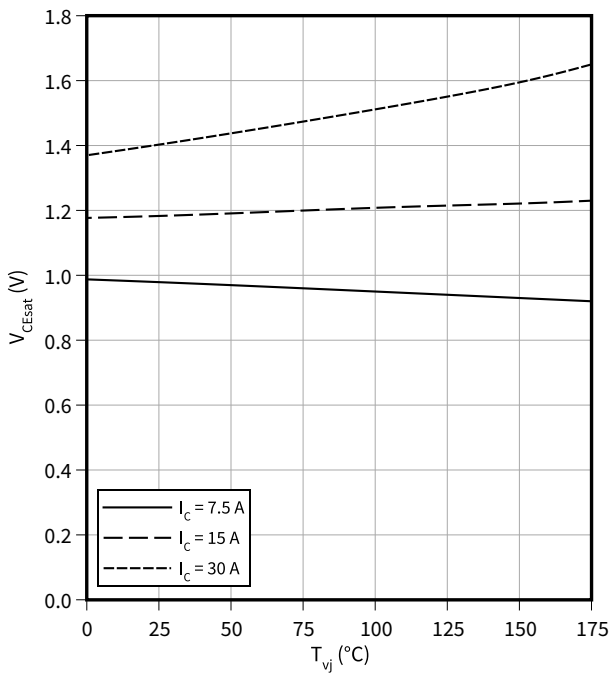
**Typical transfer characteristic**

$I_C = f(V_{GE})$   
 $V_{CE} = 20\text{ V}$



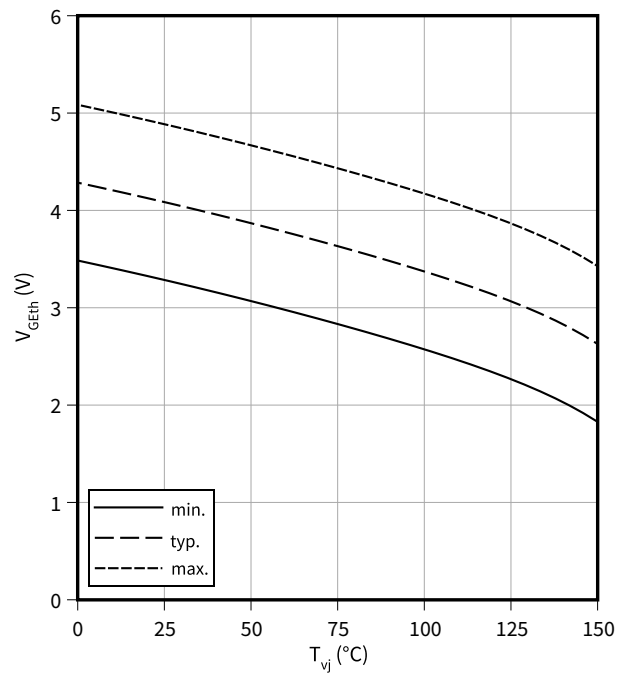
**Typical collector-emitter saturation voltage as a function of junction temperature**

$V_{CEsat} = f(T_{vj})$   
 $V_{GE} = 15\text{ V}$



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

$V_{GEth} = f(T_{vj})$   
 $I_C = 0.2\text{ mA}$

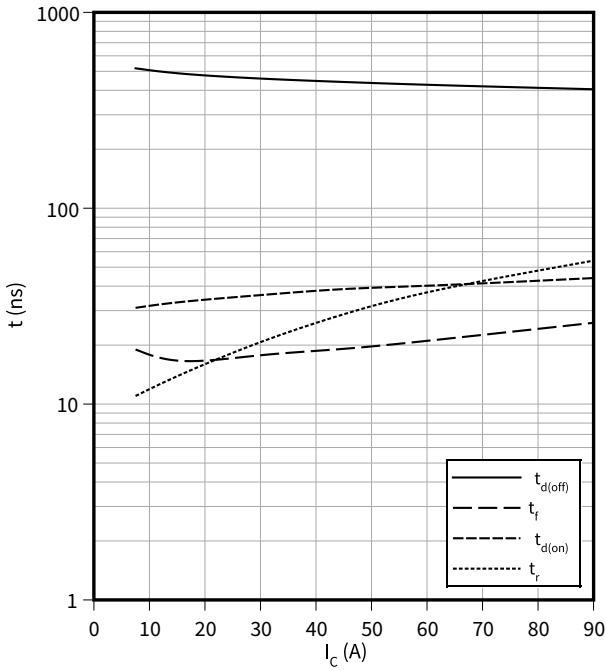


4 Characteristics diagrams

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

$t = f(I_C)$

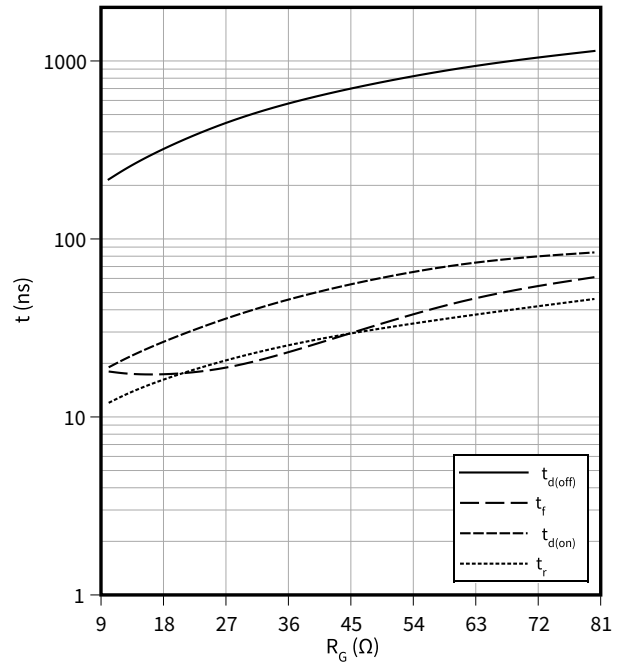
$V_{CC} = 400\text{ V}, T_{vj} = 175\text{ °C}, V_{GE} = 0/15\text{ V}, R_G = 27\text{ }\Omega$



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

$t = f(R_G)$

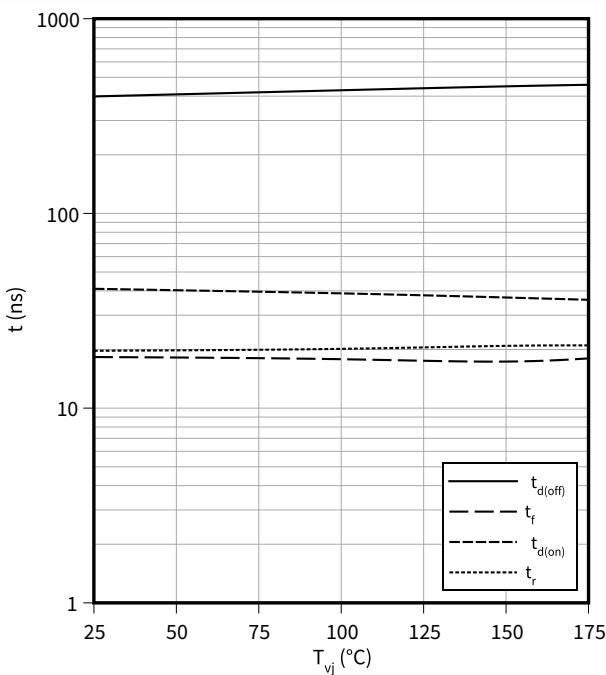
$I_C = 30\text{ A}, V_{CC} = 400\text{ V}, T_{vj} = 175\text{ °C}, V_{GE} = 0/15\text{ V}$



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

$t = f(T_{vj})$

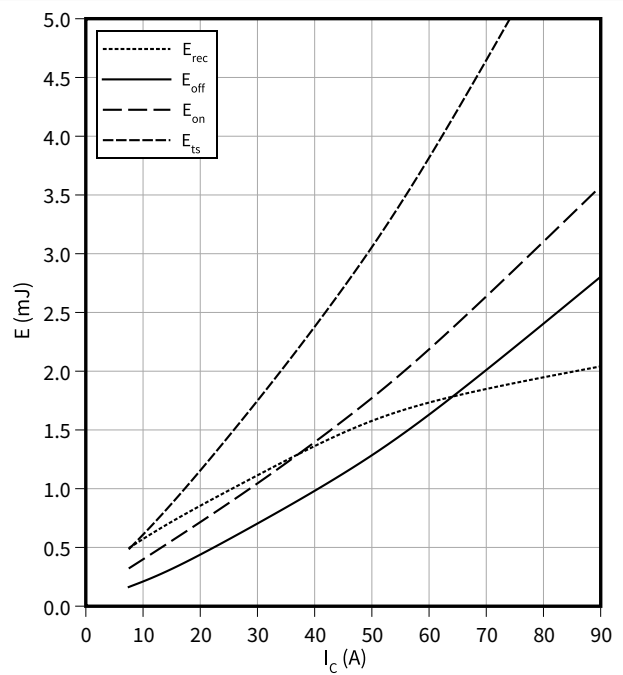
$I_C = 30\text{ A}, V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 27\text{ }\Omega$



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

$E = f(I_C)$

$V_{CC} = 400\text{ V}, T_{vj} = 175\text{ °C}, V_{GE} = 0/15\text{ V}, R_G = 27\text{ }\Omega$

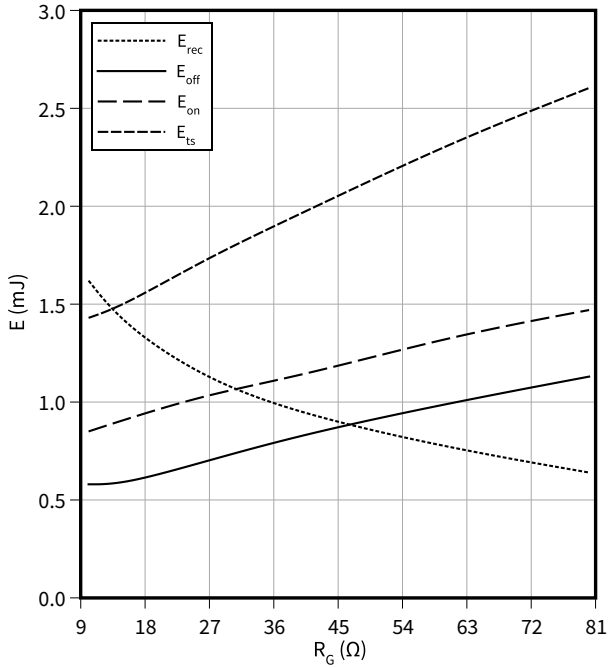


4 Characteristics diagrams

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

$E = f(R_G)$

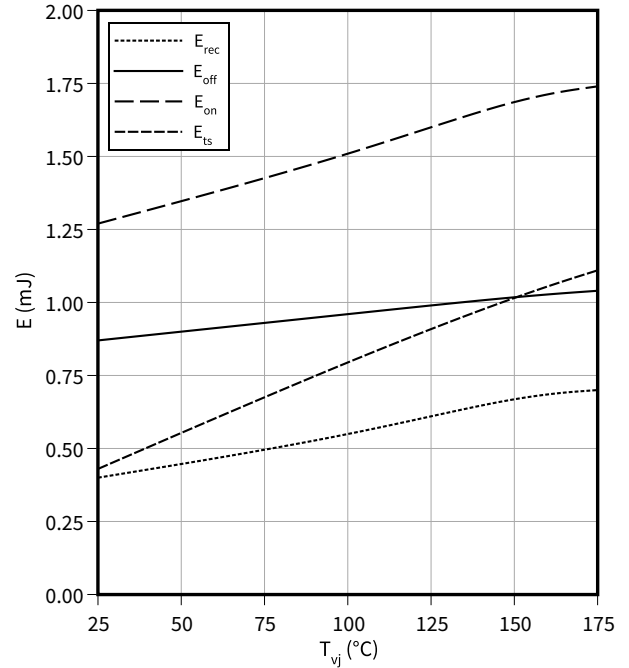
$I_C = 30\text{ A}, V_{CC} = 400\text{ V}, T_{vj} = 175\text{ }^\circ\text{C}, V_{GE} = 0/15\text{ V}$



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

$E = f(T_{vj})$

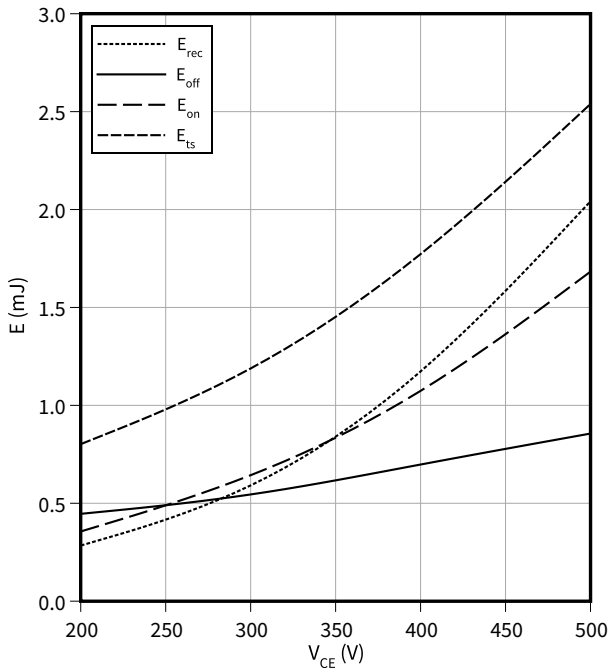
$I_C = 30\text{ A}, V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 27\text{ }\Omega$



**Typical switching energy losses as a function of collector emitter voltage**

$E = f(V_{CE})$

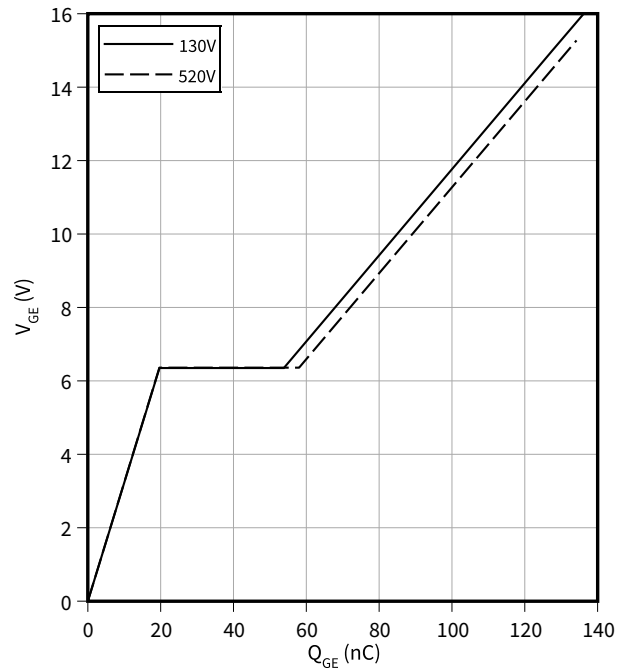
$I_C = 30\text{ A}, T_{vj} = 175\text{ }^\circ\text{C}, V_{GE} = 0/15\text{ V}, R_G = 27\text{ }\Omega$



**Typical gate charge**

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

$I_C = 30\text{ A}$

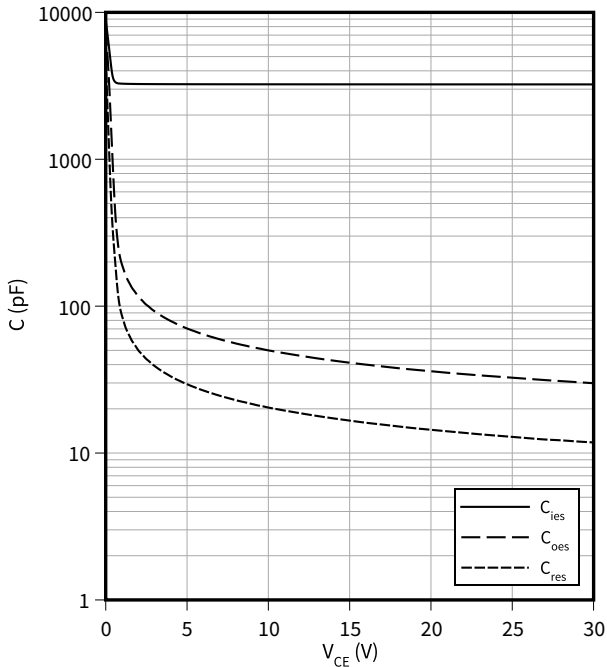


4 Characteristics diagrams

**Typical capacitance as a function of collector-emitter voltage**

$C = f(V_{CE})$

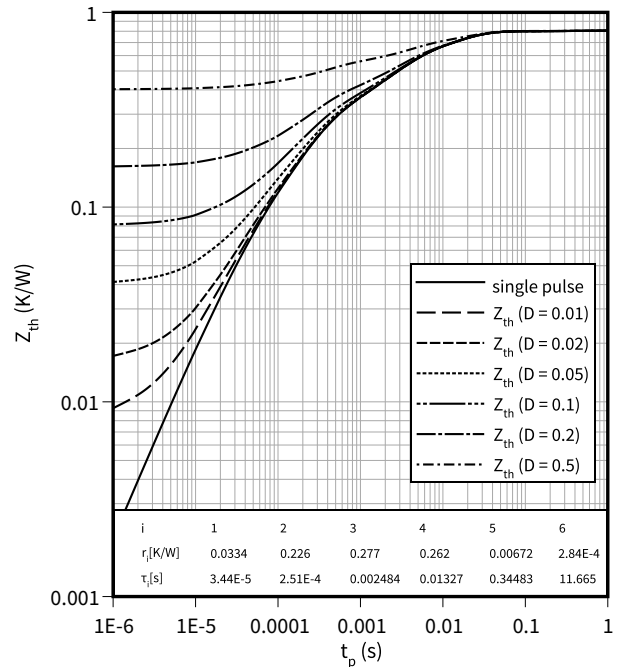
$V_{GE} = 0\text{ V}, f = 100\text{ kHz}$



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

$Z_{th} = f(t_p)$

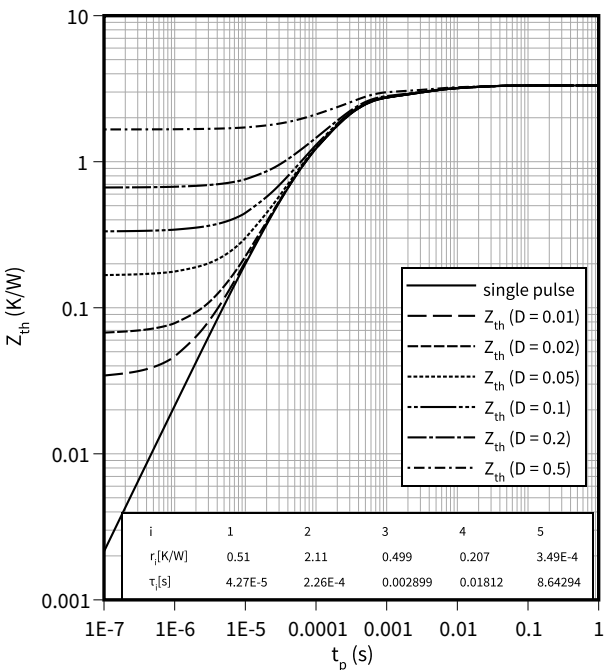
$D = t_p/T$



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

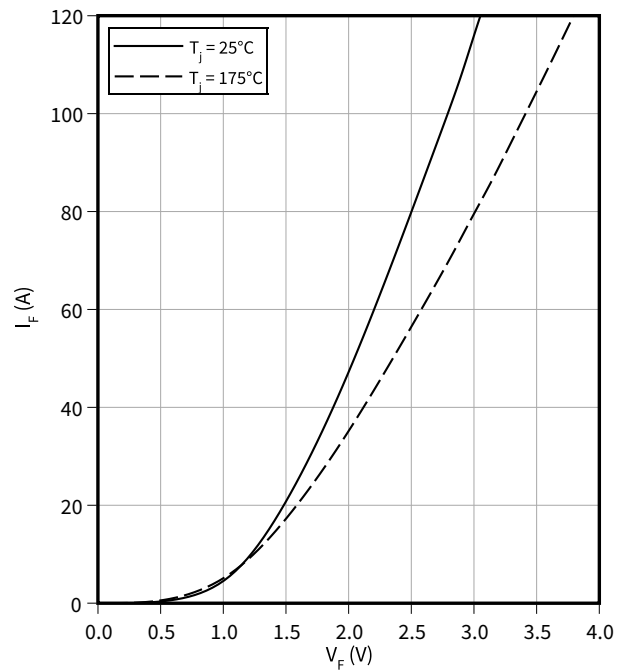
$Z_{th} = f(t_p)$

$D = t_p/T$



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

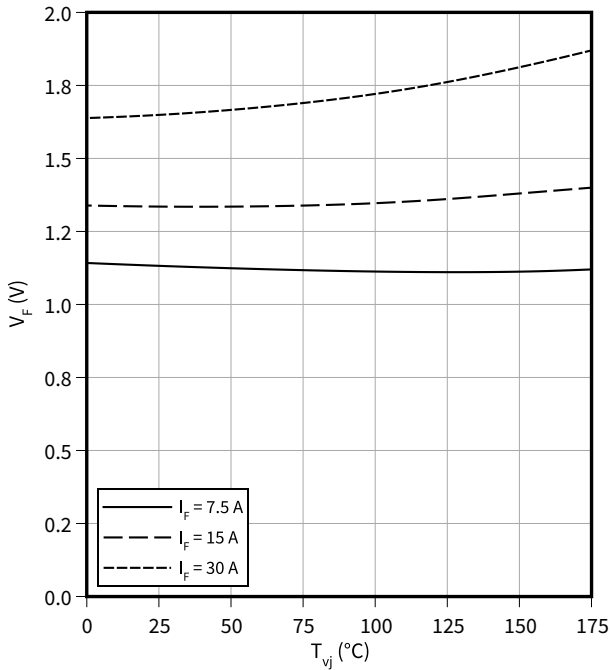
$I_F = f(V_F)$



4 Characteristics diagrams

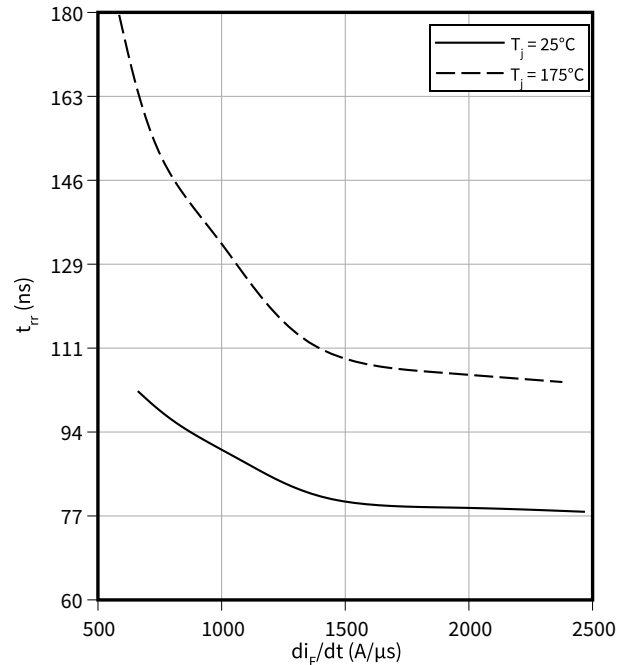
**Typical diode forward voltage as a function of junction temperature**

$V_F = f(T_{vj})$



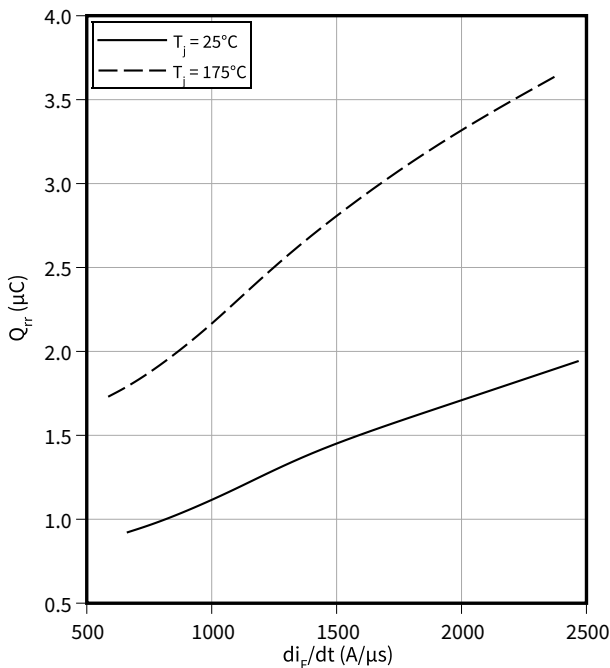
**Typical reverse recovery time as a function of diode current slope**

$t_{rr} = f(di_F/dt)$   
 $V_R = 400$  V,  $I_F = 15$  A



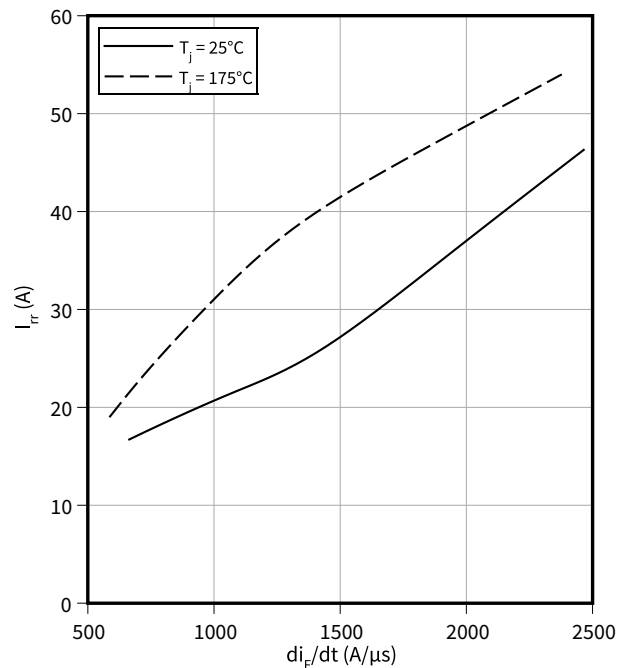
**Typical reverse recovery charge as a function of diode current slope**

$Q_{rr} = f(di_F/dt)$   
 $V_R = 400$  V,  $I_F = 15$  A



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

$I_{rr} = f(di_F/dt)$   
 $V_R = 400$  V,  $I_F = 15$  A

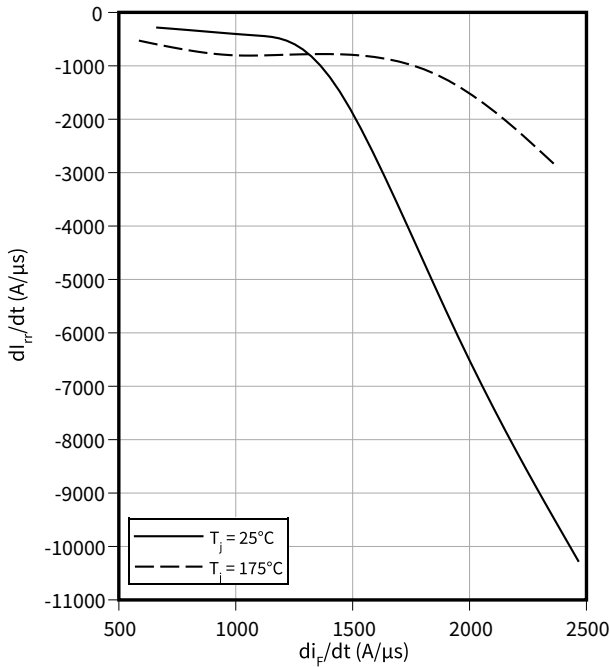


**4 Characteristics diagrams**

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

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

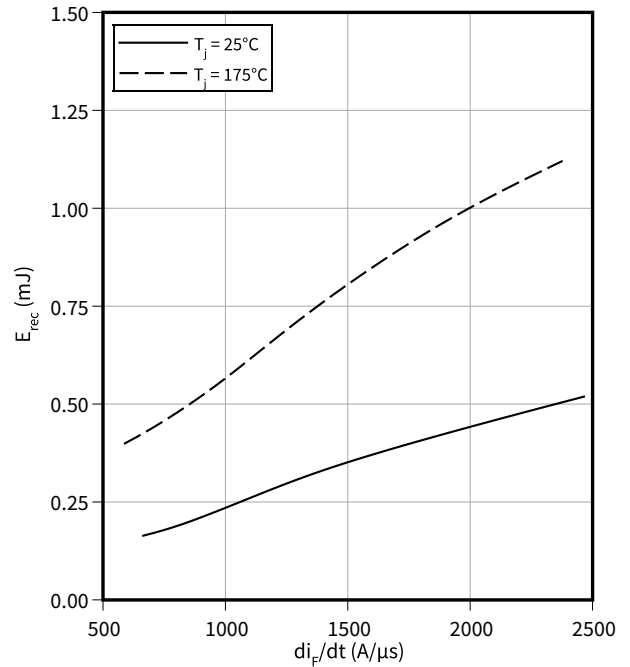
$V_R = 400\text{ V}, I_F = 15\text{ A}$



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

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

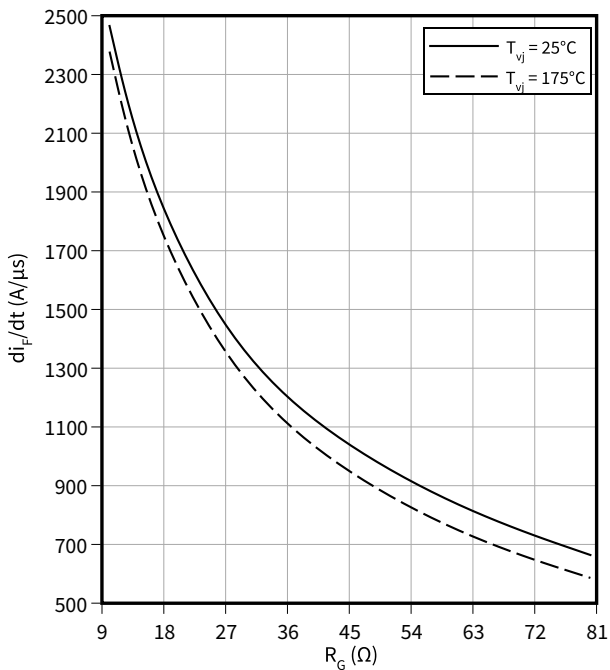
$V_R = 400\text{ V}, I_F = 15\text{ A}$



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

$di_F/dt = f(R_G)$

$V_R = 400\text{ V}, I_F = 15\text{ A}$



5 Package outlines

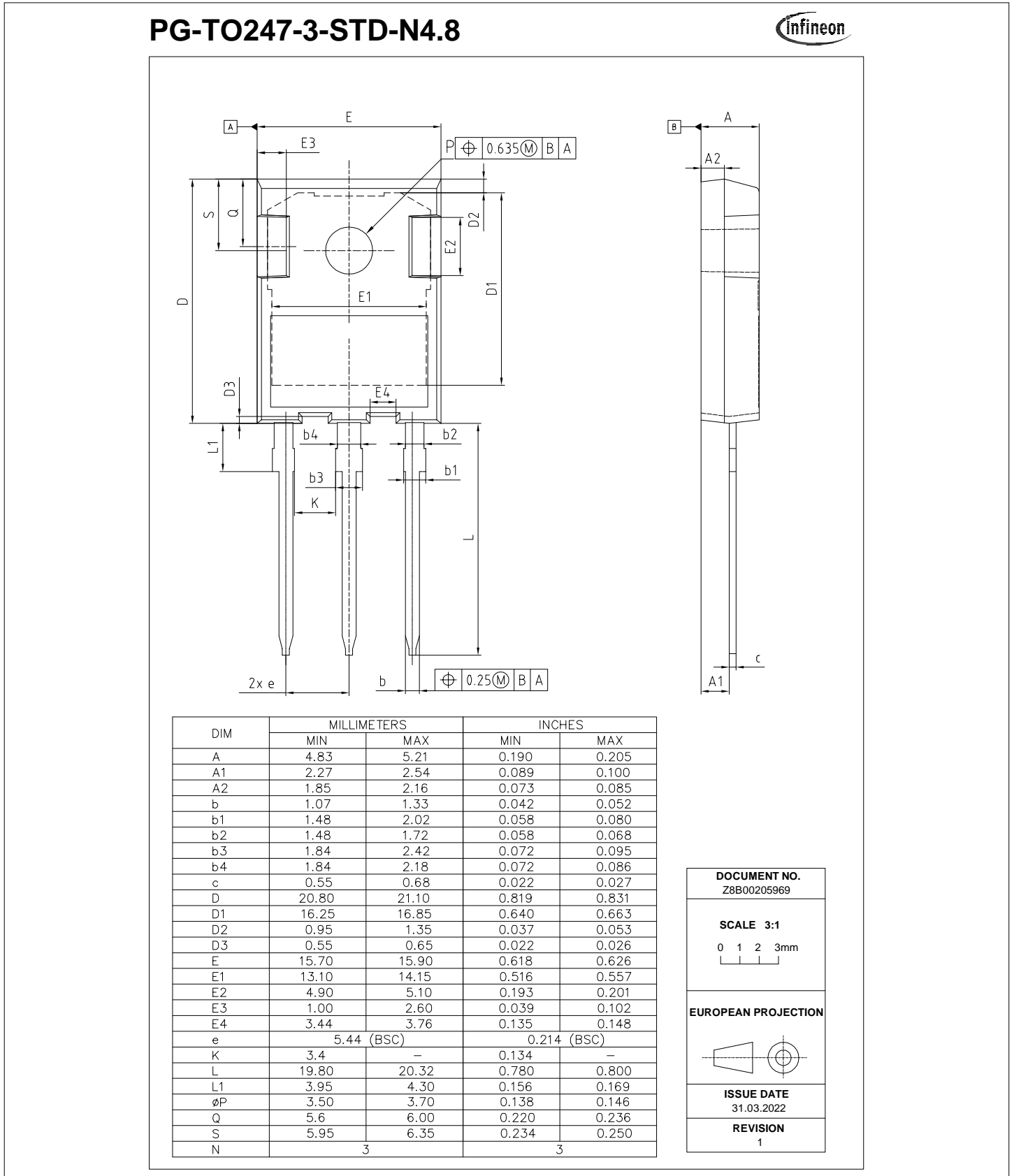


Figure 1

## 6 Testing conditions

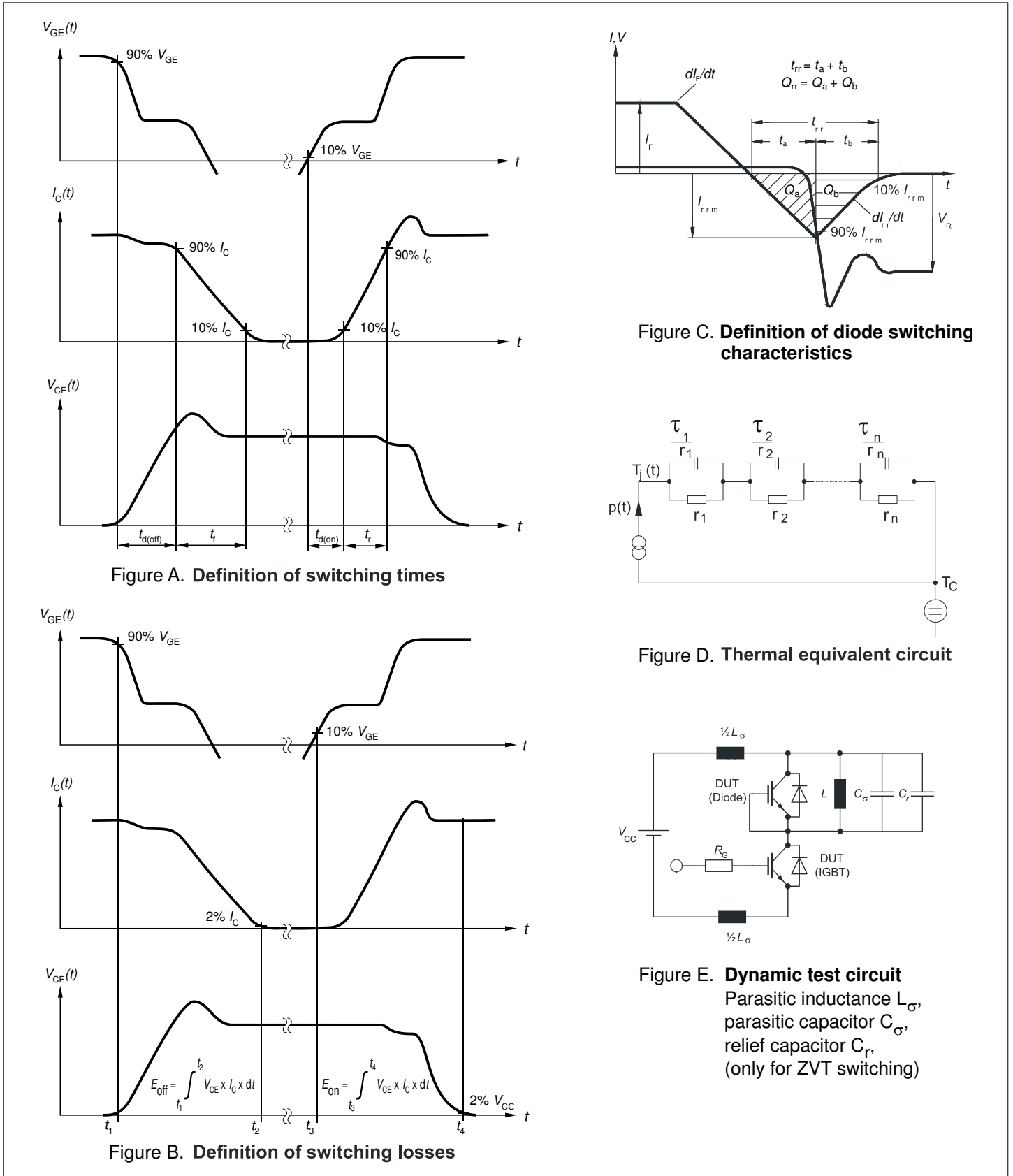


Figure 2

## Revision history

Document revision	Date of release	Description of changes
1.00	2021-05-17	Final datasheet
1.10	2021-05-18	Update of diagram $E = f(T_{vj})$
1.20	2021-06-29	Update of diagram $E = f(T_{vj})$
1.30	2022-04-05	<p>Update of “DC collector current, limited by <math>T_{vjmax}</math>” in table “Maximum rated values”, for 25°C and 100°C</p> <p>Transient gate-emitter voltage <math>V_{GE}</math> in table “Maximum rated values” of IGBT changed to <math>\pm 30V</math></p> <p>Update of diagram “Collector current as a function of case temperature”, <math>I_C = f(T_c)</math></p> <p>“Forward bias safe operating area” diagram renamed to “Reverse bias safe operating area”</p> <p>Correction of package outline dimensions</p> <p>Change package name to marketing name</p>

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