

**TRENCHSTOP™ 5 WR6 technology in enhanced creepage and clearance package offers improved reliability against package contamination**

**Features**

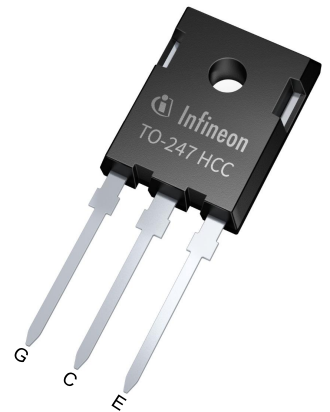
- $V_{CE} = 650\text{ V}$
- $I_C = 30\text{ A}$
- Pin-to-pin creepage distance > 4.8 mm
- Pin-to-pin clearance distance > 3.4 mm
- Monolithic diode optimized for PFC and welding applications
- Stable temperature behavior
- Very low  $V_{CEsat}$  and low  $E_{off}$
- Easy parallel switching capability 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

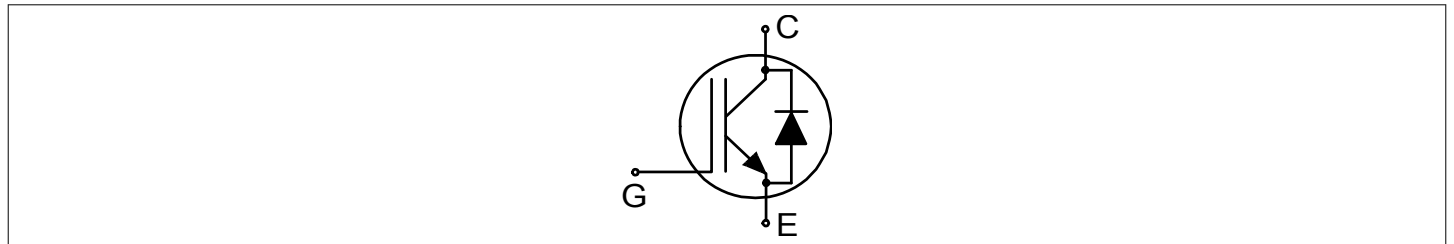
**Product validation**

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



- Lead-free
- Green
- Halogen-free
- RoHS

**Description**



Type	Package	Marking
IKWH30N65WR6	PG-TO247-3-STD-NN4.8	H30EWR6

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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	$R_{th(j-c)}$				0.9	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$				4.2	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 $T_{vjmax}$	$I_C$	$T_c = 25\text{ °C}$	67	A
		$T_c = 100\text{ °C}$	42	
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cpulse}$		90	A
Turn-off safe operating area		$V_{CE} \leq 650\text{ V}, T_{vj} \leq 175\text{ °C}$	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	$P_{tot}$	$T_c = 25\text{ °C}$	165	W
		$T_c = 100\text{ °C}$	83	

**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

**(table continues...)**

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CEsat}$	$I_C = 30\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.45	1.75	V
			$T_{vj} = 175\text{ °C}$		1.7		
Gate-emitter threshold voltage	$V_{GETh}$	$I_C = 0.3\text{ mA}, V_{CE} = V_{GE}$		3.2	4	4.8	V
Zero gate-voltage collector current	$I_{CES}$	$V_{CE} = 650\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			40	$\mu\text{A}$
			$T_{vj} = 175\text{ °C}$		0.5		mA
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\text{ V}, V_{GE} = 20\text{ V}$				100	nA
Transconductance	$g_{fs}$	$I_C = 30\text{ A}, V_{CE} = 20\text{ V}$			75		S
Input capacitance	$C_{ies}$	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 100\text{ kHz}$			2700		pF
Output capacitance	$C_{oes}$	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 100\text{ kHz}$			27		pF
Reverse transfer capacitance	$C_{res}$	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 100\text{ kHz}$			11		pF
Gate charge	$Q_G$	$I_C = 30\text{ A}, V_{GE} = 15\text{ V}, V_{CC} = 520\text{ V}$			111		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{G(on)} = 27\ \Omega, R_{G(off)} = 27\ \Omega, L_\sigma = 30\text{ nH}, C_\sigma = 23\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 30\text{ A}$		35		ns
			$T_{vj} = 175\text{ °C}, I_C = 30\text{ A}$		31		
Rise time (inductive load)	$t_r$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{G(on)} = 27\ \Omega, R_{G(off)} = 27\ \Omega, L_\sigma = 30\text{ nH}, C_\sigma = 23\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 30\text{ A}$		18		ns
			$T_{vj} = 175\text{ °C}, I_C = 30\text{ A}$		20		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{G(on)} = 27\ \Omega, R_{G(off)} = 27\ \Omega, L_\sigma = 30\text{ nH}, C_\sigma = 23\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 30\text{ A}$		334		ns
			$T_{vj} = 175\text{ °C}, I_C = 30\text{ A}$		375		
Fall time (inductive load)	$t_f$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{G(on)} = 27\ \Omega, R_{G(off)} = 27\ \Omega, L_\sigma = 30\text{ nH}, C_\sigma = 23\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 30\text{ A}$		16		ns
			$T_{vj} = 175\text{ °C}, I_C = 30\text{ A}$		16		
Turn-on energy	$E_{on}$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{G(on)} = 27\ \Omega, R_{G(off)} = 27\ \Omega, L_\sigma = 30\text{ nH}, C_\sigma = 23\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 30\text{ A}$		0.82		mJ
			$T_{vj} = 175\text{ °C}, I_C = 30\text{ A}$		0.92		

(table continues...)

**Table 3 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-off energy	$E_{off}$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{G(on)} = 27\ \Omega,$ $R_{G(off)} = 27\ \Omega, L_{\sigma} = 30\text{ nH},$ $C_{\sigma} = 23\text{ pF}$	$T_{vj} = 25\ ^\circ\text{C},$ $I_C = 30\text{ A}$		0.38	mJ
			$T_{vj} = 175\ ^\circ\text{C},$ $I_C = 30\text{ A}$		0.63	
Total switching energy	$E_{ts}$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{G(on)} = 27\ \Omega,$ $R_{G(off)} = 27\ \Omega, L_{\sigma} = 30\text{ nH},$ $C_{\sigma} = 23\text{ pF}$	$T_{vj} = 25\ ^\circ\text{C},$ $I_C = 30\text{ A}$		1.2	mJ
			$T_{vj} = 175\ ^\circ\text{C},$ $I_C = 30\text{ A}$		1.55	
Operating junction temperature	$T_{vj}$		-40		175	$^\circ\text{C}$

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 $T_{vjmax}$	$I_F$		$T_C = 25\ ^\circ\text{C}$	20	A
			$T_C = 100\ ^\circ\text{C}$	11	
Diode pulsed current, $t_p$ limited by $T_{vjmax}$	$I_{Fpulse}$		30	A	

**Table 5 Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Diode forward voltage	$V_F$	$I_F = 10\text{ A}$	$T_{vj} = 25\ ^\circ\text{C}$		1.3	1.6	V
			$T_{vj} = 175\ ^\circ\text{C}$		1.35		
Diode reverse recovery time	$t_{rr}$	$V_R = 400\text{ V}$	$T_{vj} = 25\ ^\circ\text{C},$ $I_F = 15\text{ A},$ $-di_F/dt = 1460\text{ A}/\mu\text{s}$		82		ns
			$T_{vj} = 175\ ^\circ\text{C},$ $I_F = 15\text{ A},$ $-di_F/dt = 1400\text{ A}/\mu\text{s}$		94		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery charge	$Q_{rr}$	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ °C},$ $I_F = 15\text{ A},$ $-di_F/dt = 1460\text{ A}/\mu\text{s}$		1.4		$\mu\text{C}$
					2.2		
Diode peak reverse recovery current	$I_{rrm}$	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ °C},$ $I_F = 15\text{ A},$ $-di_F/dt = 1460\text{ A}/\mu\text{s}$		24		A
					28.8		
Diode peak rate of fall of reverse recovery current	$di_{rr}/dt$	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ °C},$ $I_F = 15\text{ A},$ $-di_F/dt = 1460\text{ A}/\mu\text{s}$		700		$\text{A}/\mu\text{s}$
					830		
Operating junction temperature	$T_{vj}$			-40		175	$^{\circ}\text{C}$

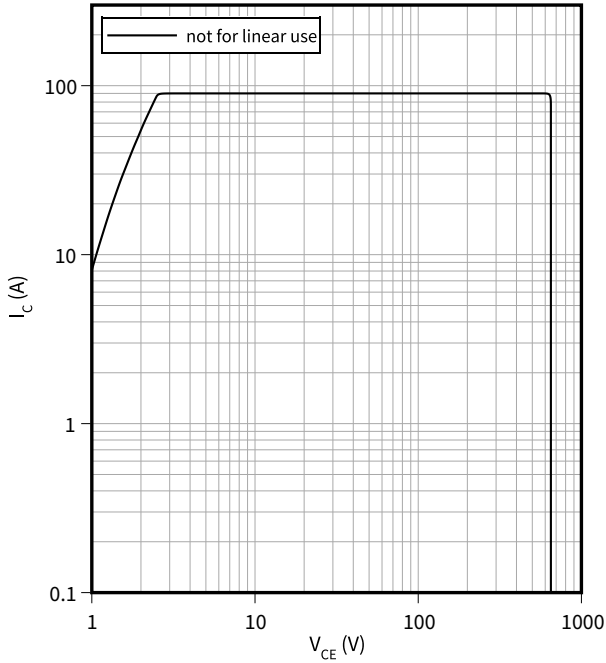
Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

## 4 Characteristics diagrams

### Reverse bias safe operating area

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

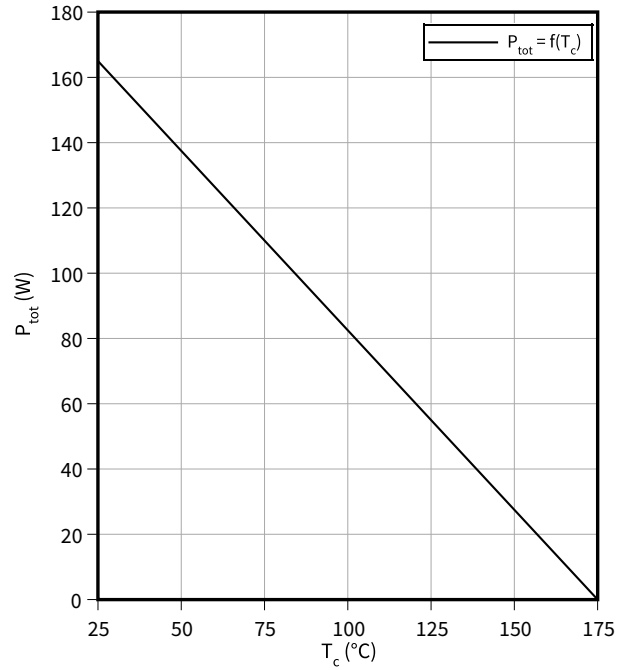
$$T_{vj} \leq 175\text{ °C}, T_c = 25\text{ °C}, V_{GE} = 15\text{ V}$$



### Power dissipation as a function of case temperature

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

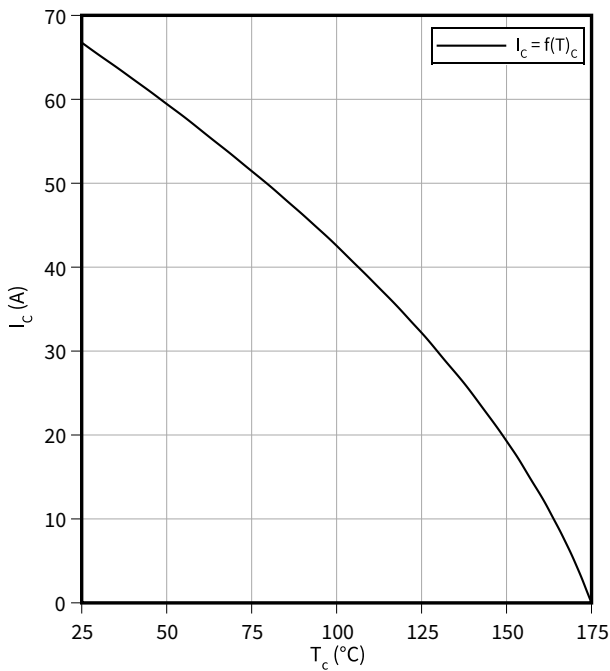
$$T_{vj} \leq 175\text{ °C}$$



### Collector current as a function of case temperature

$$I_C = f(T_c)$$

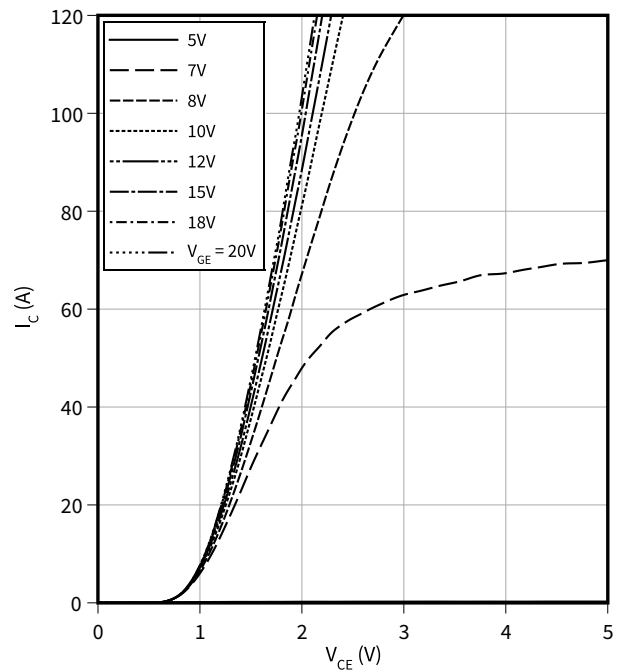
$$T_{vj} \leq 175\text{ °C}, V_{GE} \geq 15\text{ V}$$



### Typical output characteristic

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

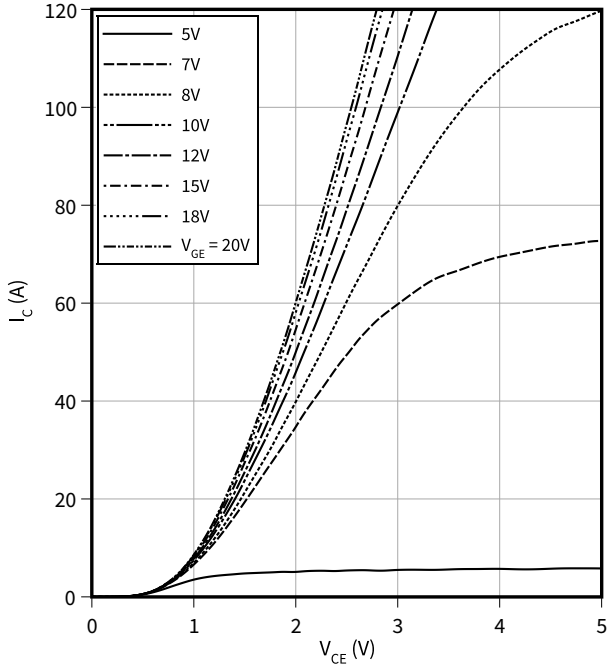
$$T_{vj} = 25\text{ °C}$$



4 Characteristics diagrams

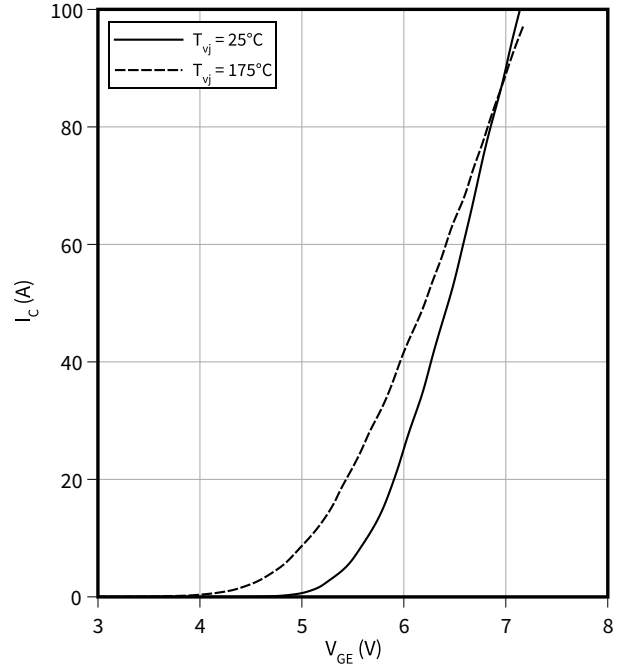
**Typical output characteristic**

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



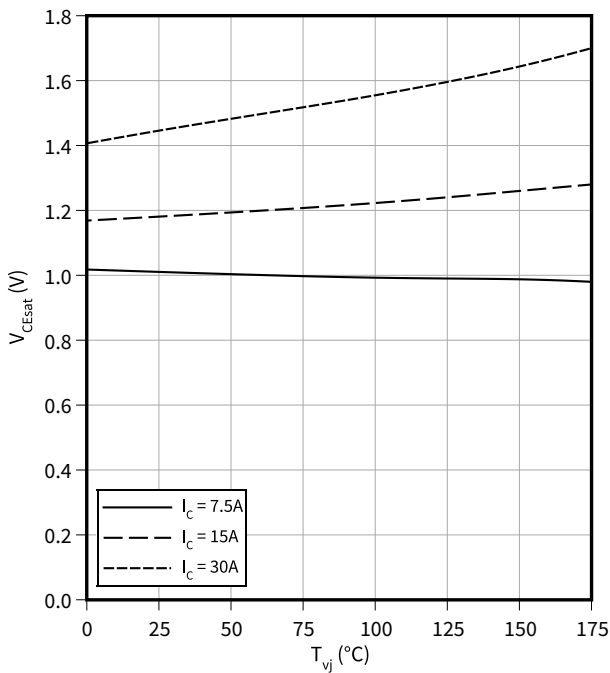
**Typical transfer characteristic**

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



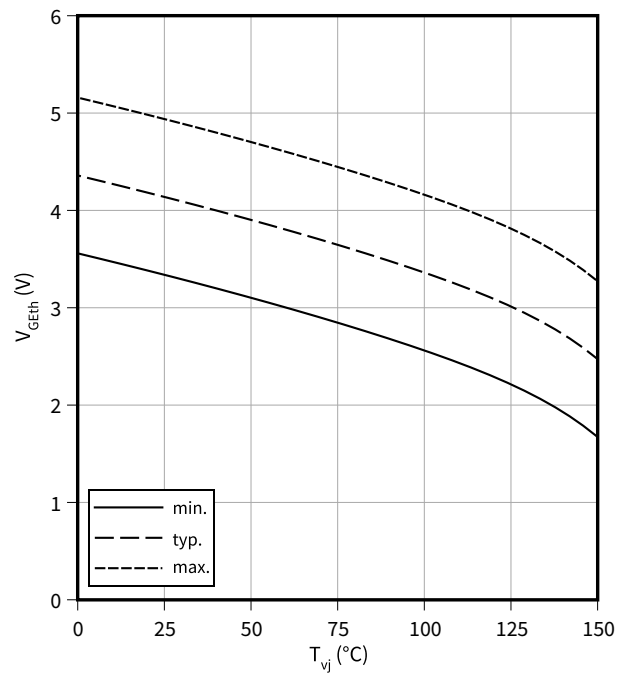
**Typical collector-emitter saturation voltage as a function of junction temperature**

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



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

$V_{GETh} = f(T_{vj})$   
 $I_C = 0.3\text{ mA}$

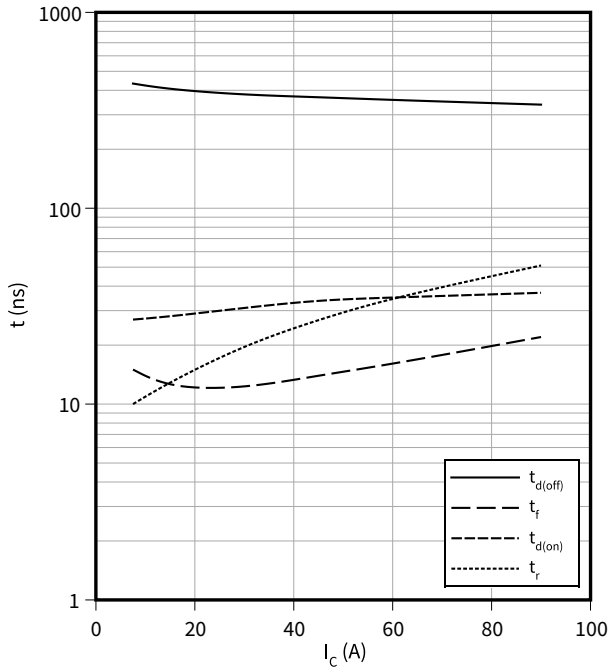




**Typical switching times as a function of collector current**

$t = f(I_C)$

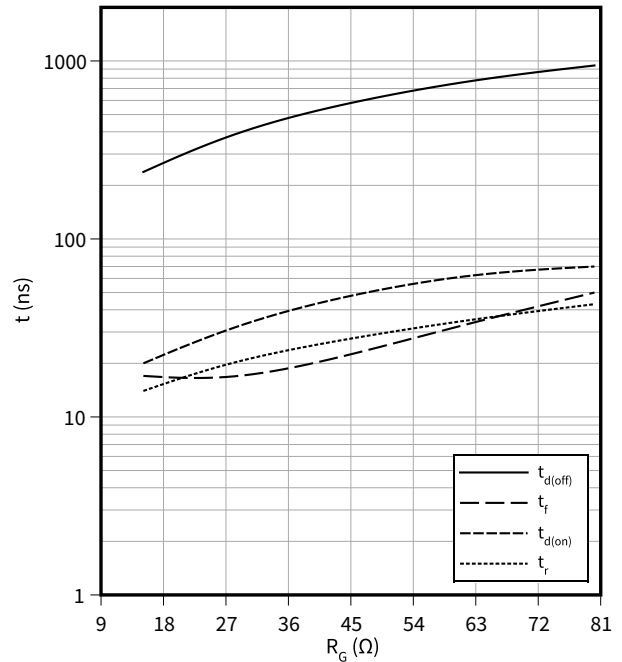
$V_{CC} = 400\text{ V}, T_{vj} = 175\text{ °C}, V_{GE} = 0/15\text{ V}, R_G = 27\ \Omega$



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

$t = f(R_G)$

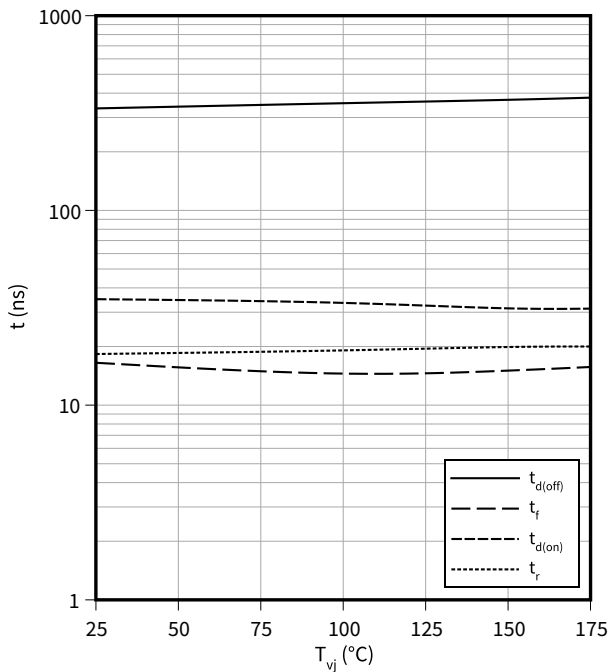
$I_C = 30\text{ A}, V_{CC} = 400\text{ V}, T_{vj} = 175\text{ °C}, V_{GE} = 0/15\text{ V}$



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

$t = f(T_{vj})$

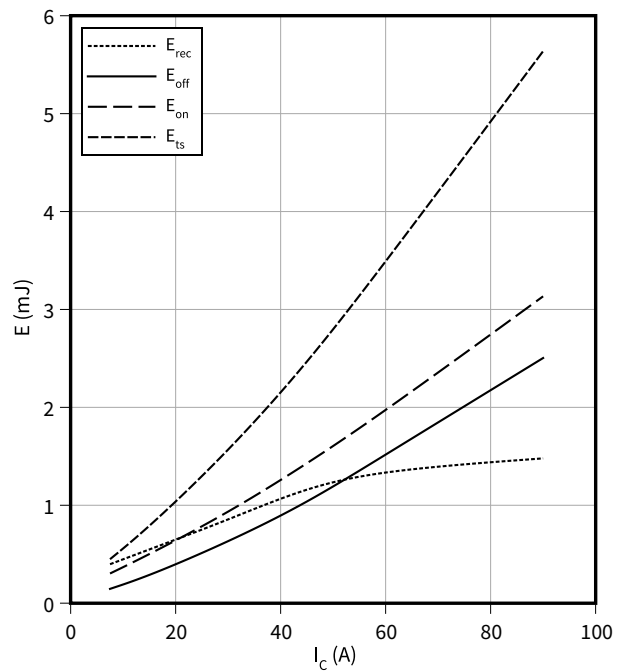
$I_C = 30\text{ A}, V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 27\ \Omega$



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

$E = f(I_C)$

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

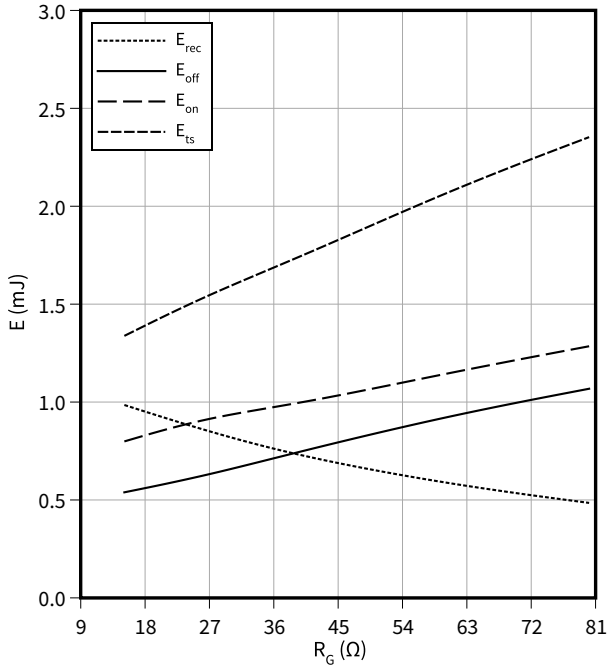


4 Characteristics diagrams

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

$E = f(R_G)$

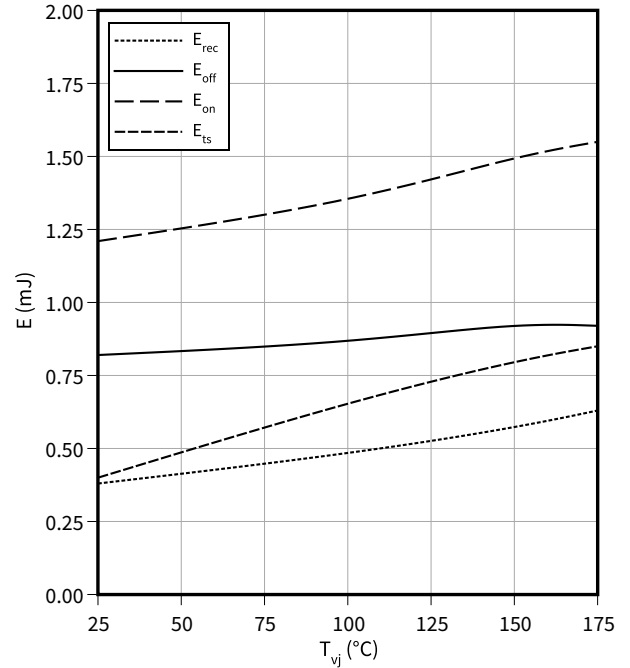
$I_C = 30\text{ A}, V_{CC} = 400\text{ V}, T_{vj} = 175\text{ }^\circ\text{C}, V_{GE} = 0/15\text{ V}$



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

$E = f(T_{vj})$

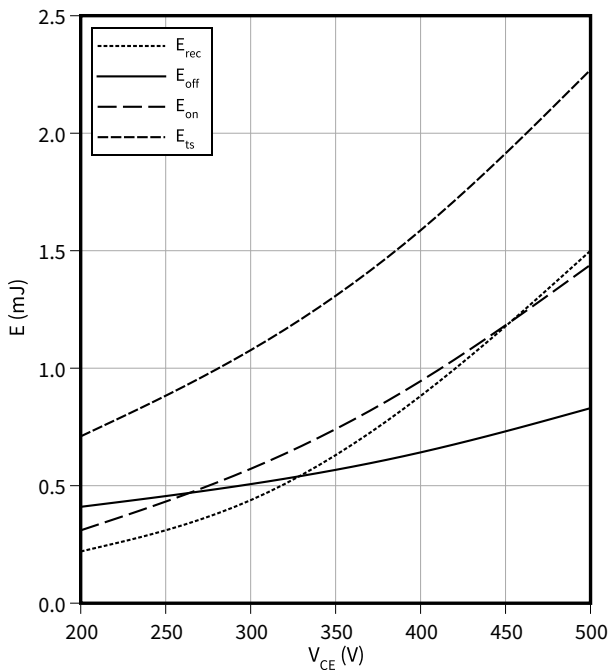
$I_C = 30\text{ A}, V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 27\text{ }^\circ\Omega$



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

$E = f(V_{CE})$

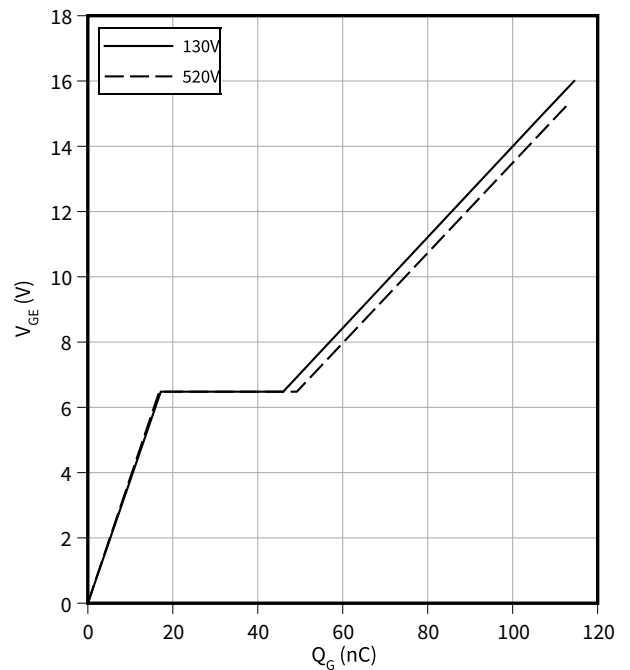
$I_C = 30\text{ A}, T_{vj} = 175\text{ }^\circ\text{C}, V_{GE} = 0/15\text{ V}, R_G = 27\text{ }^\circ\Omega$



**Typical gate charge**

$V_{GE} = f(Q_G)$

$I_C = 30\text{ A}$

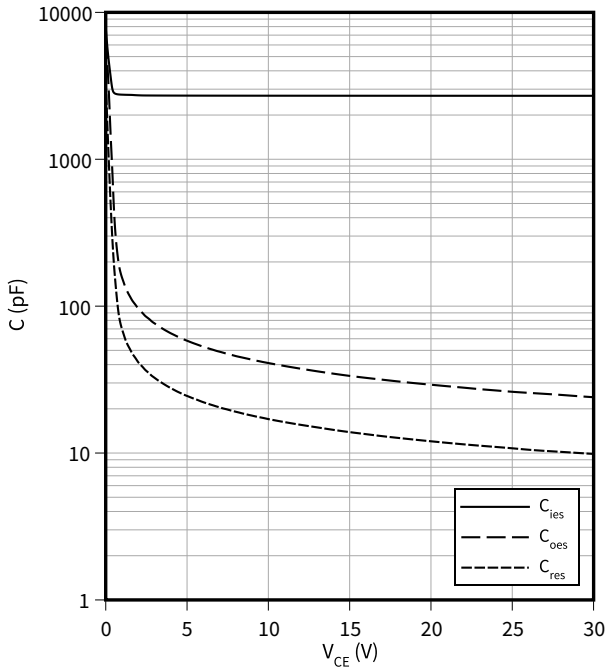


4 Characteristics diagrams

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

$C = f(V_{CE})$

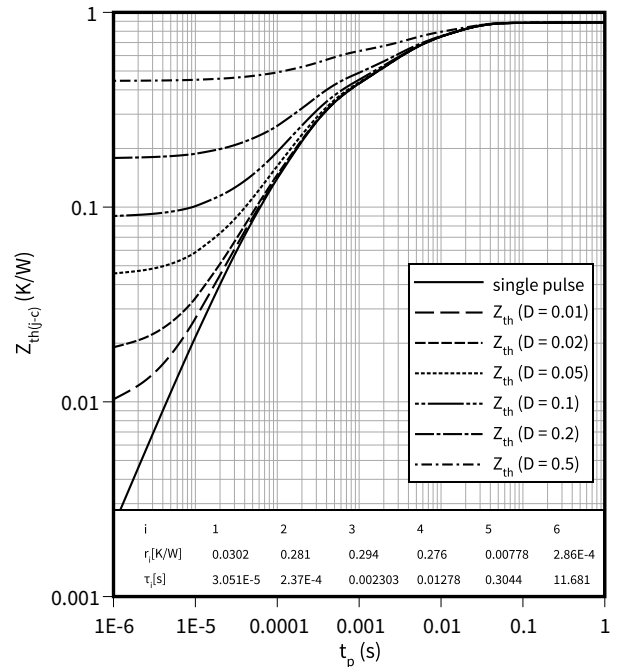
$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}$



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

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

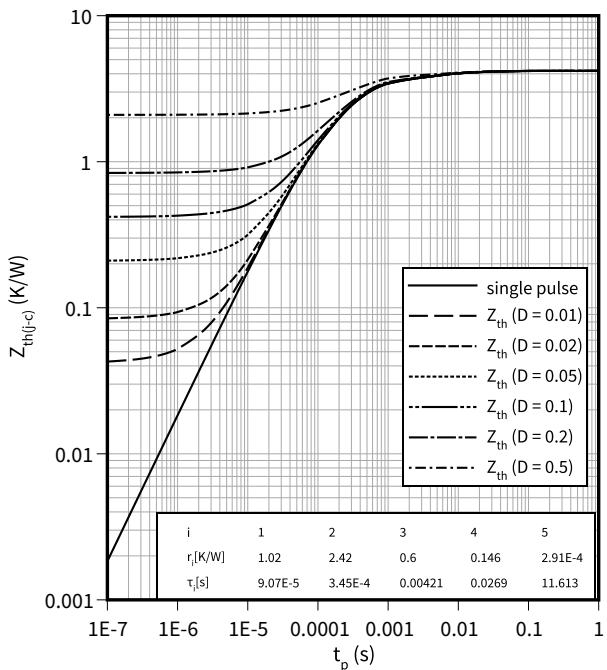
$D = t_p/T$



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

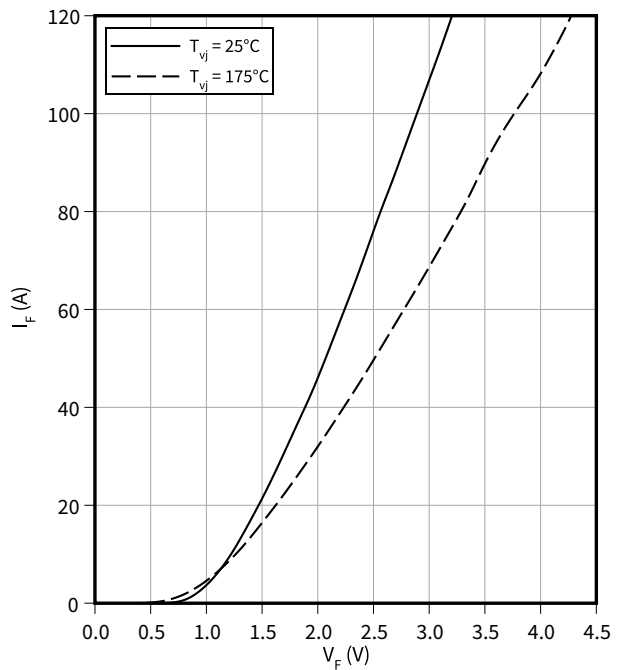
$Z_{th(j-c)} = f(t_p)$

$D = t_p/T$



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

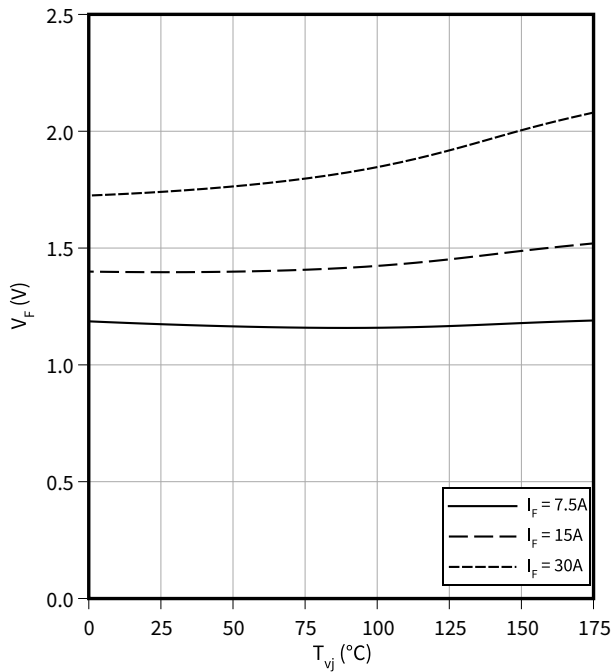
$I_F = f(V_F)$



4 Characteristics diagrams

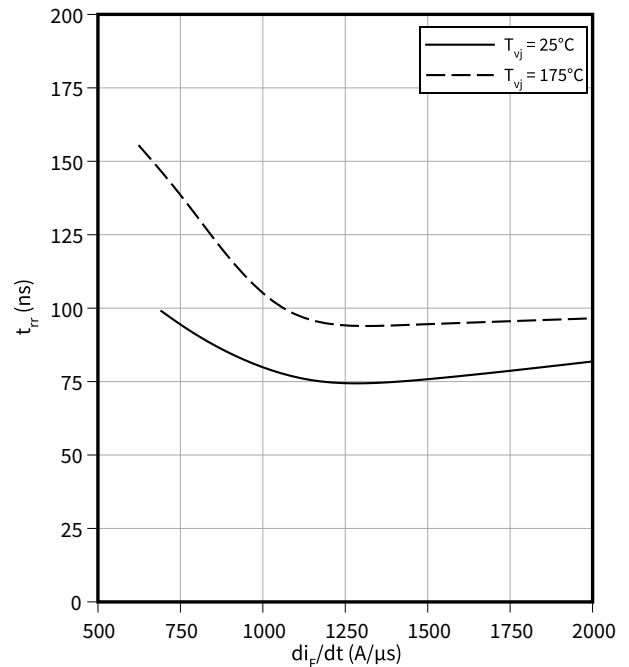
**Typical diode forward voltage as a function of junction temperature**

$V_F = f(T_{vj})$



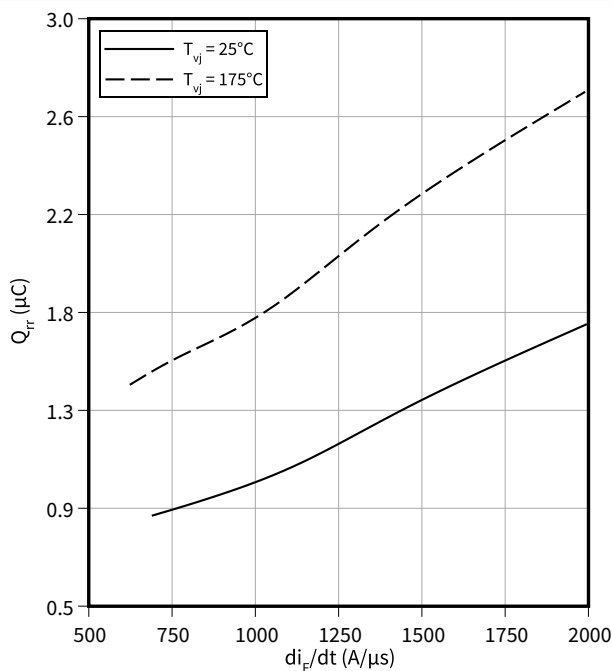
**Typical reverse recovery time as a function of diode current slope**

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



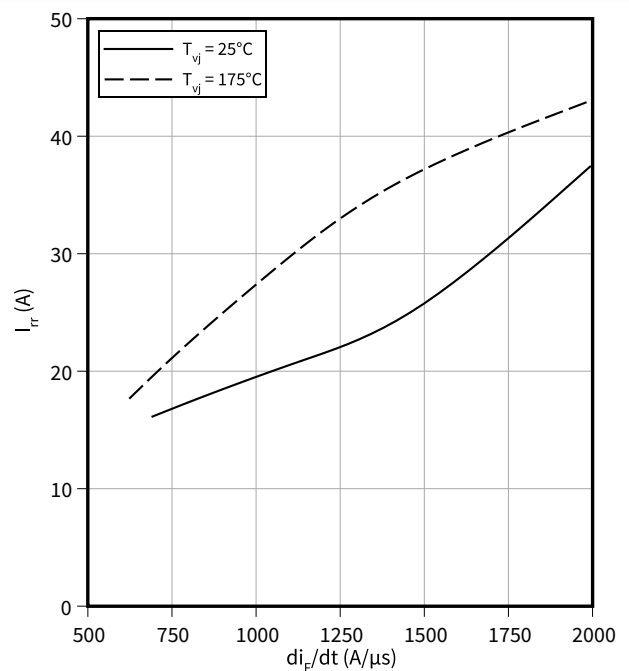
**Typical reverse recovery charge as a function of diode current slope**

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



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

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

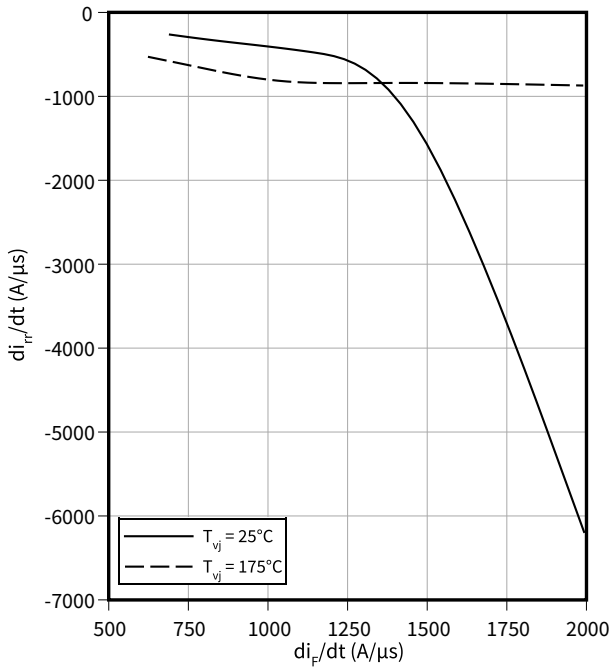


4 Characteristics diagrams

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

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

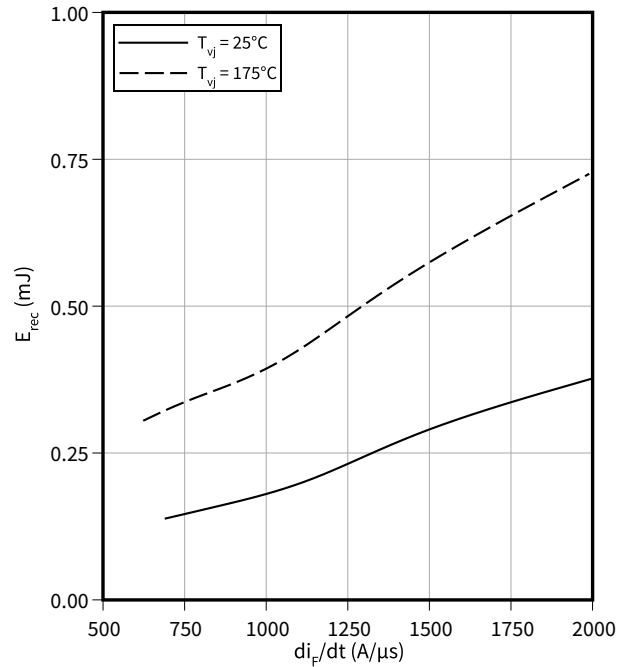
$V_R = 400\text{ V}, I_F = 15\text{ A}$



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

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

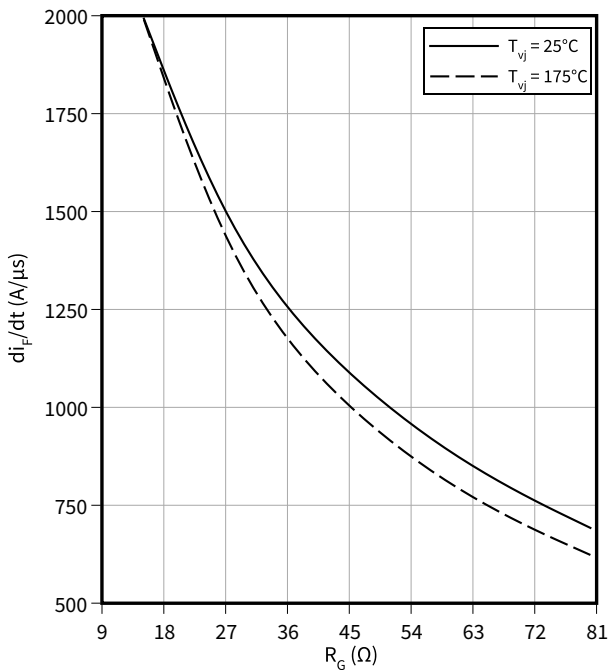
$V_R = 400\text{ V}, I_F = 15\text{ A}$



**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

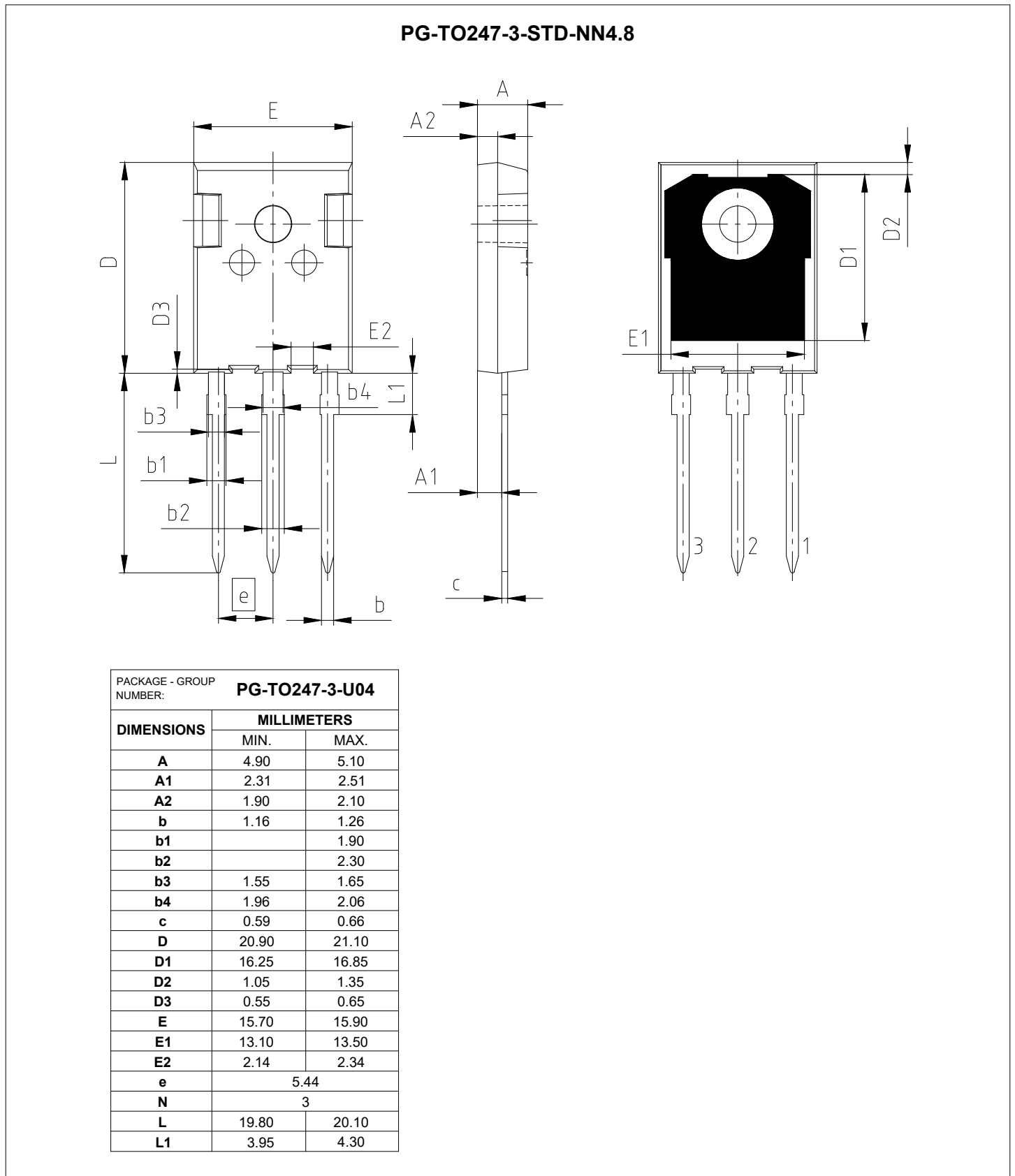


Figure 1

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	2022-12-06	<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> <p>Editorial changes</p>