

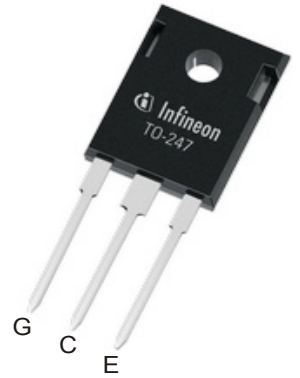
## High speed DuoPack: IGBT in Trench and Fieldstop technology with soft, fast recovery antiparallel diode

### Features

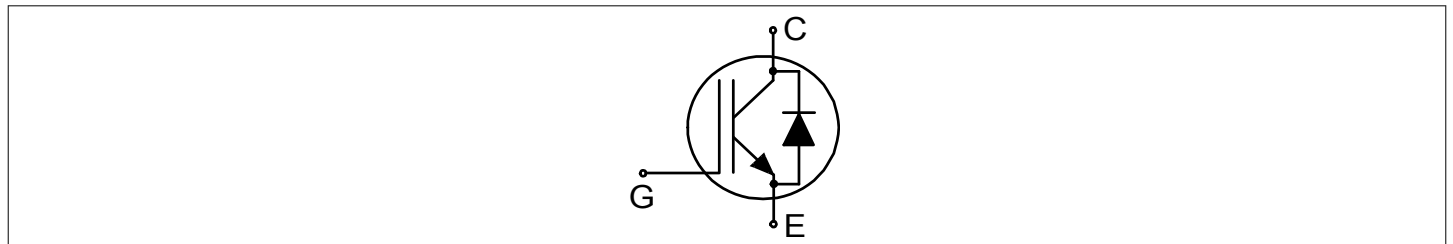
- $V_{CE} = 1200\text{ V}$
- $I_C = 15\text{ A}$
- Very low  $V_{CE,sat}$
- Low EMI
- Very soft, fast recovery antiparallel diode
- Maximum junction temperature  $T_{vjmax} = 175^\circ\text{C}$
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

### Potential applications

- Uninterruptible power supplies
- Welding converters
- Converters with high switching frequency



### Description



Type	Package	Marking
IKW15N120H3	PG-TO247-3	K15H1203

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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, M3 screw Maximum of mounting processes: 3	$M$				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	$V_{CE}$		1200	V
DC collector current, limited by $T_{vjmax}$	$I_C$	$T_c = 25\text{ °C}$	30	A
		$T_c = 100\text{ °C}$	15	
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cpuls}$		60	A
Turn-off safe operating area		$V_{CE} \leq 1200\text{ V}$ , $T_{vj} \leq 175\text{ °C}$	60	A
Gate-emitter voltage	$V_{GE}$		$\pm 20$	V
Short circuit withstand time	$t_{SC}$	$V_{CC} \leq 600\text{ V}$ , Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}$ , $T_{vj} = 175\text{ °C}$	10	$\mu\text{s}$
Power dissipation	$P_{tot}$	$T_c = 25\text{ °C}$	217	W
		$T_c = 100\text{ °C}$	105	

**Table 3** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter breakdown voltage	$V_{BRCES}$	$I_C = 0.5\text{ mA}$ , $V_{GE} = 0\text{ V}$	1200			V

**Table 3 Characteristic values (continued)**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\ sat}$	$I_C = 15.0\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$	2.05	2.40	V
			$T_{vj} = 125\ ^\circ C$	2.50		
			$T_{vj} = 175\ ^\circ C$	2.70		
Gate-emitter threshold voltage	$V_{GEth}$	$I_C = 0.50\ mA, V_{CE} = V_{GE}, T_{vj} = 175\ ^\circ C$	5.00	5.80	6.50	V
Zero gate voltage collector current	$I_{CES}$	$V_{CE} = 1200\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$		250	$\mu A$
			$T_{vj} = 175\ ^\circ C$		2500	
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\ V, V_{GE} = 20\ V$			600	nA
Transconductance	$g_{fs}$	$I_C = 15.0\ A, V_{CE} = 20\ V$		7.5		S
Short circuit collector current	$I_{SC}$	$V_{CC} \leq 600\ V, V_{GE} = 15\ V, t_{SC} \leq 10\ \mu s$ , Allowed number of short circuits < 1000 , Time between short circuits $\geq 1.0\ s, T_{vj} = 175\ ^\circ C$		52		A
Input capacitance	$C_{ies}$	$V_{CE} = 25\ V, V_{GE} = 0\ V, f = 1000\ kHz$		875		pF
Output capacitance	$C_{oes}$	$V_{CE} = 25\ V, V_{GE} = 0\ V, f = 1000\ kHz$		75		pF
Reverse transfer capacitance	$C_{res}$	$V_{CE} = 25\ V, V_{GE} = 0\ V, f = 1000\ kHz$		45		pF
Gate charge	$Q_G$	$I_C = 15.0\ A, V_{GE} = 15\ V, V_{CE} = 960\ V$		75		nC
Turn-on delay time	$t_{don}$	$V_{CE} = 600\ V,$ $V_{GE} = +0/+15\ V,$ $R_{Gon} = 35.0\ \Omega,$ $R_{Goff} = 35.0\ \Omega,$ $L_\sigma = 95\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C,$ $I_C = 15.0\ A$	21		ns
			$T_{vj} = 175\ ^\circ C,$ $I_C = 15.0\ A$	19		
Rise time (inductive load)	$t_r$	$V_{CE} = 600\ V,$ $V_{GE} = +0/+15\ V,$ $R_{Gon} = 35.0\ \Omega,$ $R_{Goff} = 35.0\ \Omega,$ $L_\sigma = 95\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C,$ $I_C = 15.0\ A$	34		ns
			$T_{vj} = 175\ ^\circ C,$ $I_C = 15.0\ A$	30		
Turn-off delay time	$t_{doff}$	$V_{CE} = 600\ V,$ $V_{GE} = +0/+15\ V,$ $R_{Gon} = 35.0\ \Omega,$ $R_{Goff} = 35.0\ \Omega,$ $L_\sigma = 95\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C,$ $I_C = 15.0\ A$	260		ns
			$T_{vj} = 175\ ^\circ C,$ $I_C = 15.0\ A$	327		
Fall time (inductive load)	$t_f$	$V_{CE} = 600\ V,$ $V_{GE} = +0/+15\ V,$ $R_{Gon} = 35.0\ \Omega,$ $R_{Goff} = 35.0\ \Omega,$ $L_\sigma = 95\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C,$ $I_C = 15.0\ A$	14		ns
			$T_{vj} = 175\ ^\circ C,$ $I_C = 15.0\ A$	43		

**Table 3** Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-on energy	$E_{on}$	$V_{CE} = 600\text{ V}$ , $V_{GE} = +0/+15\text{ V}$ , $R_{Gon} = 35.0\ \Omega$ , $R_{Goff} = 35.0\ \Omega$ , $L_{\sigma} = 95\text{ nH}$ , $C_{\sigma} = 67\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$ , $I_C = 15.0\text{ A}$	1.10		mJ
			$T_{vj} = 175\text{ }^{\circ}\text{C}$ , $I_C = 15.0\text{ A}$	1.60		
Turn-off energy	$E_{off}$	$V_{CE} = 600\text{ V}$ , $V_{GE} = +0/+15\text{ V}$ , $R_{Gon} = 35.0\ \Omega$ , $R_{Goff} = 35.0\ \Omega$ , $L_{\sigma} = 95\text{ nH}$ , $C_{\sigma} = 67\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$ , $I_C = 15.0\text{ A}$	0.45		mJ
			$T_{vj} = 175\text{ }^{\circ}\text{C}$ , $I_C = 15.0\text{ A}$	0.90		
Total switching energy	$E_{ts}$	$V_{CE} = 600\text{ V}$ , $V_{GE} = +0/+15\text{ V}$ , $R_{Gon} = 35.0\ \Omega$ , $R_{Goff} = 35.0\ \Omega$ , $L_{\sigma} = 95\text{ nH}$ , $C_{\sigma} = 67\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$ , $I_C = 15.0\text{ A}$	1.55		mJ
			$T_{vj} = 175\text{ }^{\circ}\text{C}$ , $I_C = 15.0\text{ A}$	2.50		
IGBT thermal resistance, junction-case	$R_{thjc}$				0.70	K/W
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	$V_{RRM}$		1200	V	
Diode forward current, limited by $T_{vjmax}$	$I_F$		$T_C = 25\text{ }^{\circ}\text{C}$	15	A
			$T_C = 100\text{ }^{\circ}\text{C}$	7.5	
Diode pulsed current, limited by $T_{vjmax}$	$I_{Fpuls}$		60	A	

**Table 5** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	$V_F$	$I_F = 7.5\text{ A}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$	1.80	2.35	V
			$T_{vj} = 175\text{ }^{\circ}\text{C}$	1.85		

**Table 5** Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	$V_F$	$I_F = 15.0 \text{ A}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		2.40	3.05	V
					2.60		
					2.60		
Reverse leakage current	$I_R$	$V_R = 1200 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$			250	$\mu\text{A}$
						2500	
Diode reverse recovery time	$t_{rr}$	$V_R = 600 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_F = 15.0 \text{ A}$ , $-di_F/dt = 500 \text{ A}/\mu\text{s}$		260		ns
					470		
Diode reverse recovery charge	$Q_{rr}$	$V_R = 600 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_F = 15.0 \text{ A}$ , $-di_F/dt = 500 \text{ A}/\mu\text{s}$		0.80		$\mu\text{C}$
					1.70		
Diode peak reverse recovery current	$I_{rrm}$	$V_R = 600 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_F = 15.0 \text{ A}$ , $-di_F/dt = 500 \text{ A}/\mu\text{s}$		7.7		A
					9.8		
Diode peak rate off fall of reverse recovery current	$di_{rr}/dt$	$V_R = 600 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_F = 15.0 \text{ A}$ , $-di_F/dt = 500 \text{ A}/\mu\text{s}$		-110		$\text{A}/\mu\text{s}$
					-80		
Diode thermal resistance, junction-case	$R_{thjc}$					2.12	K/W
Operating junction temperature	$T_{vj}$			-40		175	$^\circ\text{C}$

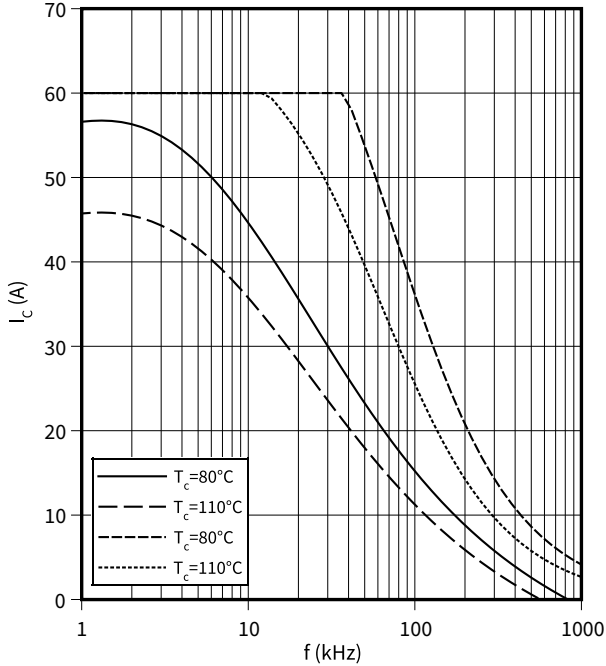
*Note:* For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

## 4 Characteristics diagrams

### Collector current as a function of switching frequency, IGBT

$$I_C = f(f)$$

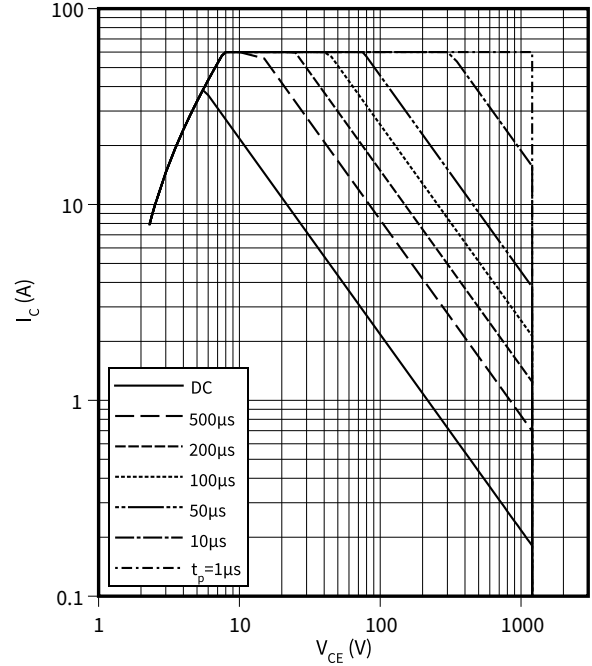
$D = 0.5, V_{CE} = 600 \text{ V}, T_{vj} \leq 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 35 \text{ } \Omega$



### Forward bias safe operating area, IGBT

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

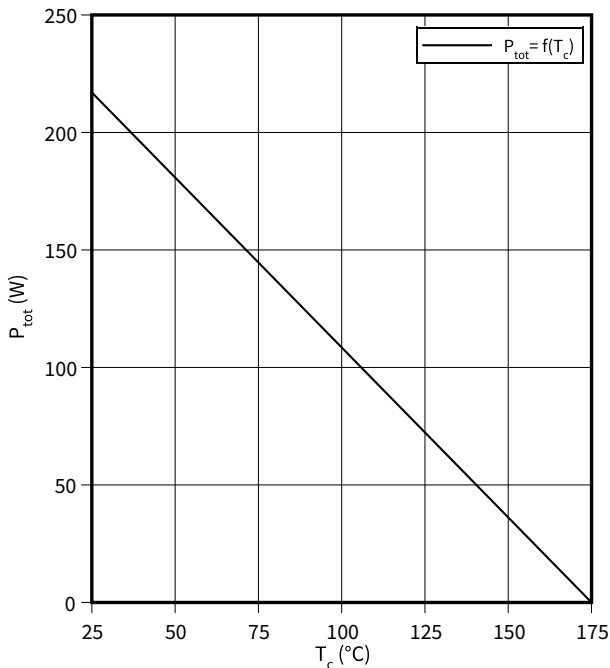
$D = 0, T_{vj} \leq 175 \text{ }^\circ\text{C}, V_{GE} = 15 \text{ V}, T_c = 25 \text{ }^\circ\text{C}$



### Power dissipation as a function of case temperature, IGBT

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

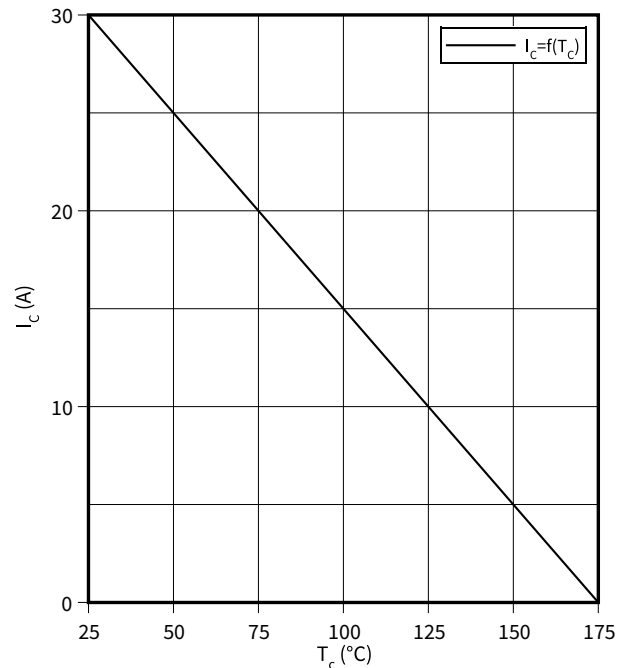
$T_{vj} \leq 175 \text{ }^\circ\text{C}$



### Collector current as a function of case temperature, IGBT

$$I_C = f(T_c)$$

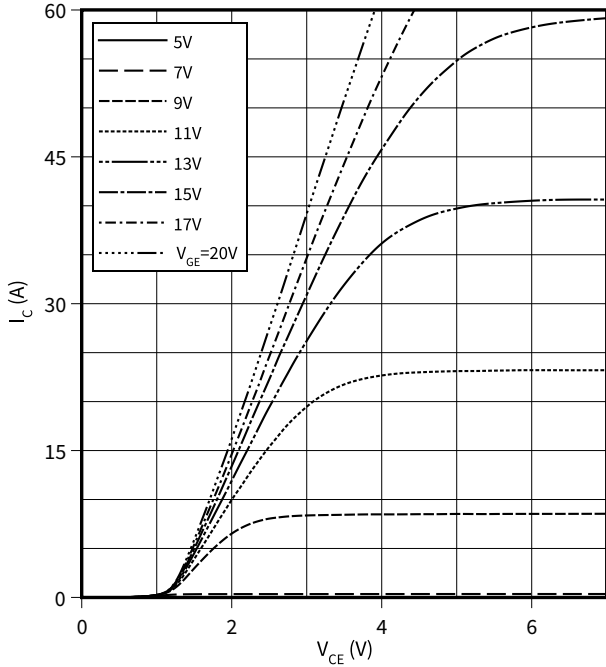
$T_{vj} \leq 175 \text{ }^\circ\text{C}, V_{GE} \geq 15 \text{ V}$



4 Characteristics diagrams

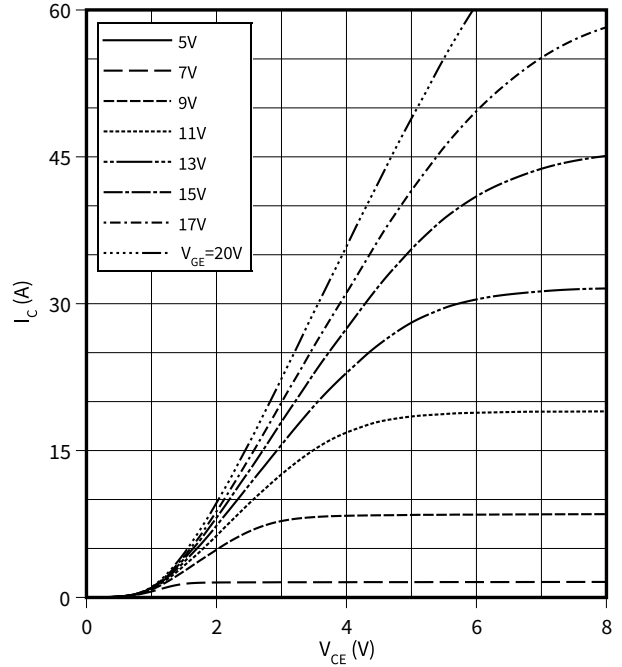
**Typical output characteristic, IGBT**

$I_C = f(V_{CE})$   
 $T_{vj} = 25\text{ }^\circ\text{C}$



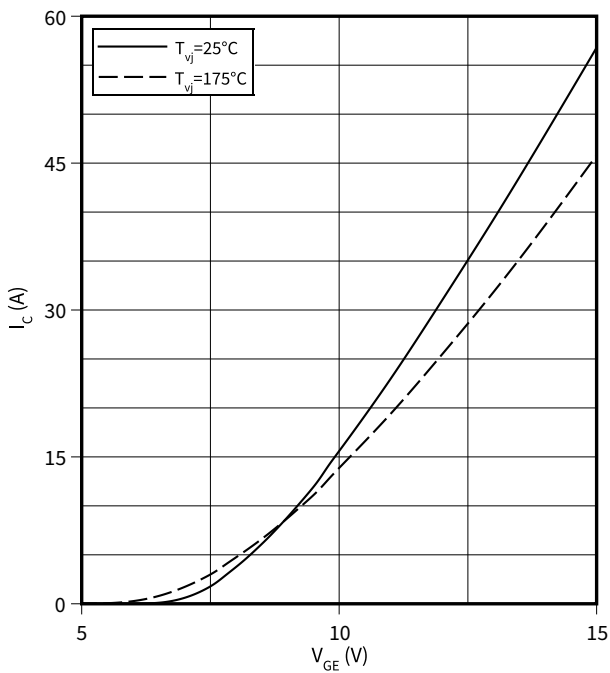
**Typical output characteristic, IGBT**

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



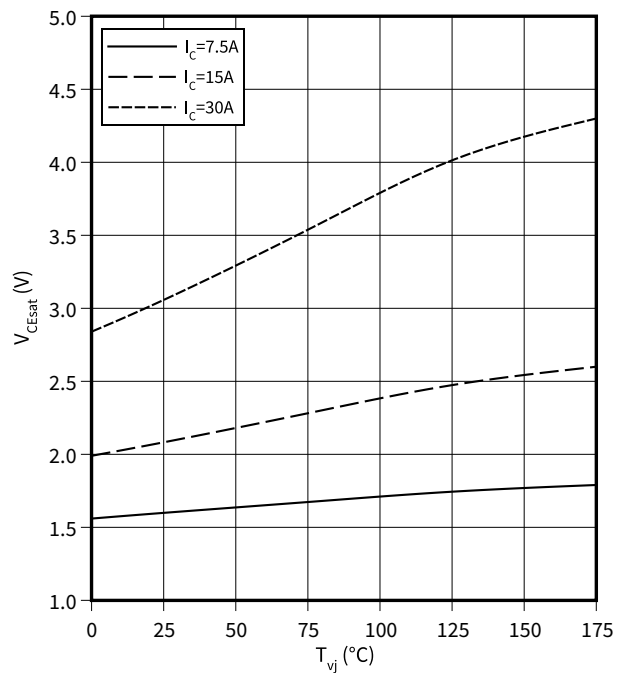
**Typical transfer characteristic, IGBT**

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



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

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

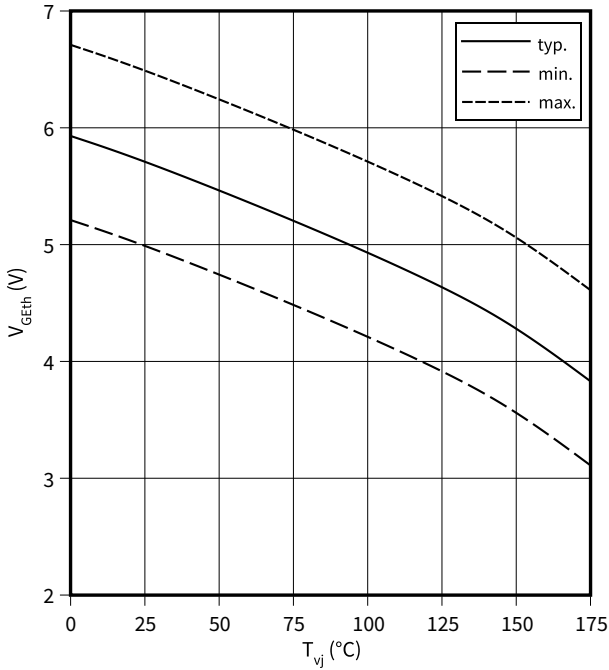




4 Characteristics diagrams

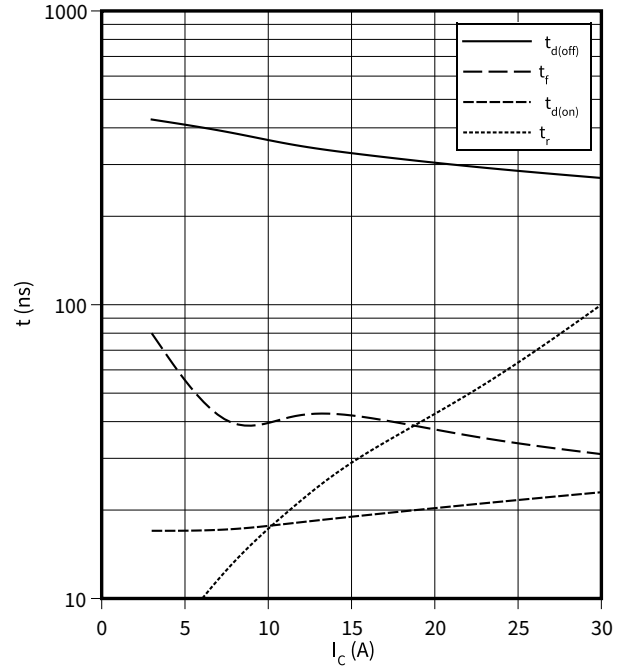
**Gate-emitter threshold voltage as a function of junction temperature, IGBT**

$V_{GEth} = f(T_{vj})$   
 $I_C = 0.50 \text{ mA}$



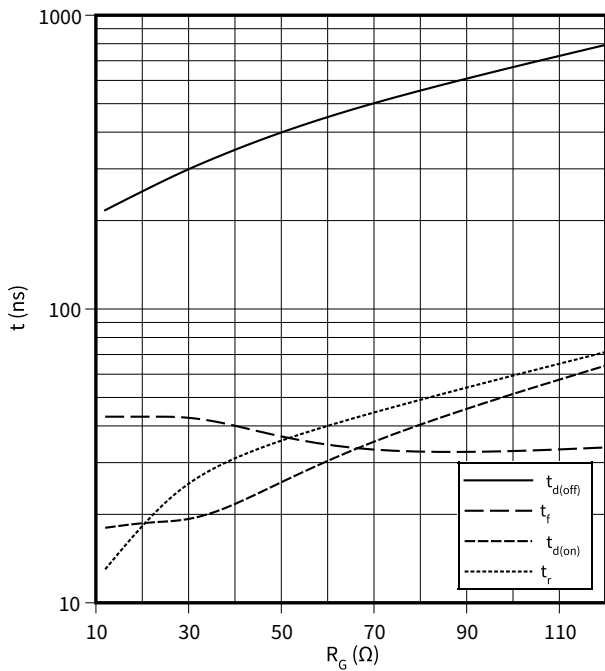
**Typical switching times as a function of collector current, IGBT**

$t = f(I_C)$   
 $V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 35 \text{ } \Omega$



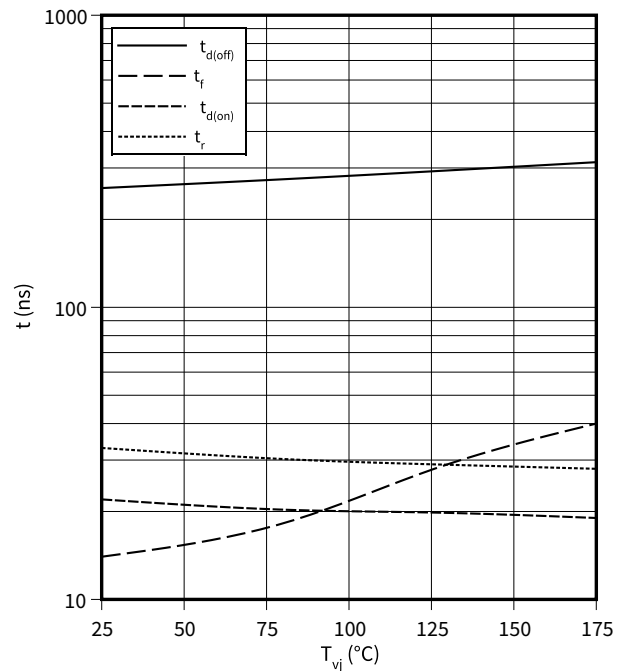
**Typical switching times as a function of gate resistance, IGBT**

$t = f(R_G)$   
 $I_C = 15.0 \text{ A}, V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$



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

$t = f(T_{vj})$   
 $I_C = 15.0 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 35 \text{ } \Omega$

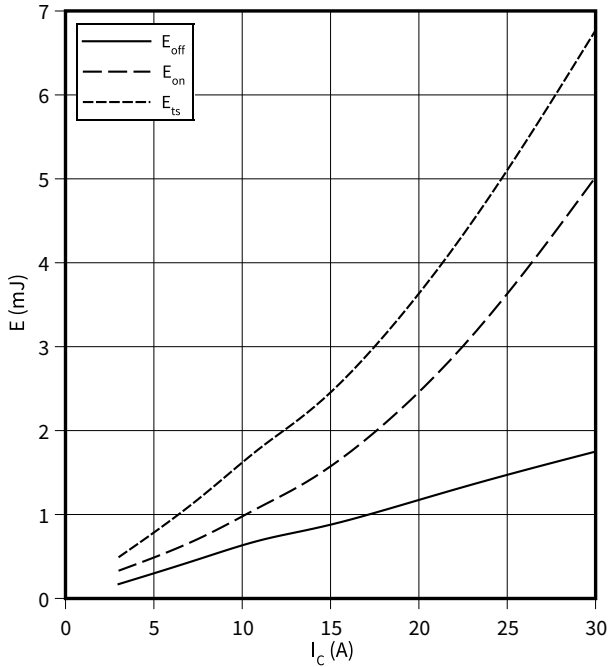


4 Characteristics diagrams

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

$E = f(I_C)$

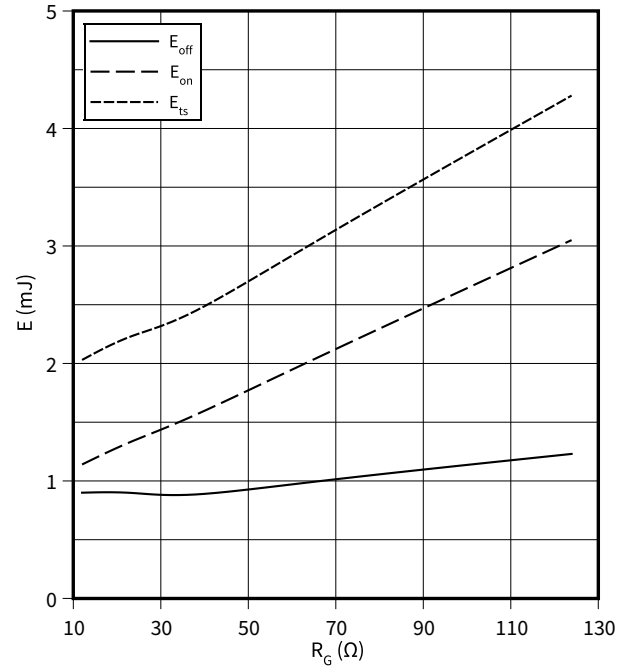
$V_{CE} = 600\text{ V}, T_{vj} = 175\text{ }^\circ\text{C}, V_{GE} = 0/15\text{ V}, R_G = 35\text{ }\Omega$



**Typical switching energy losses as a function of gate resistance, IGBT**

$E = f(R_G)$

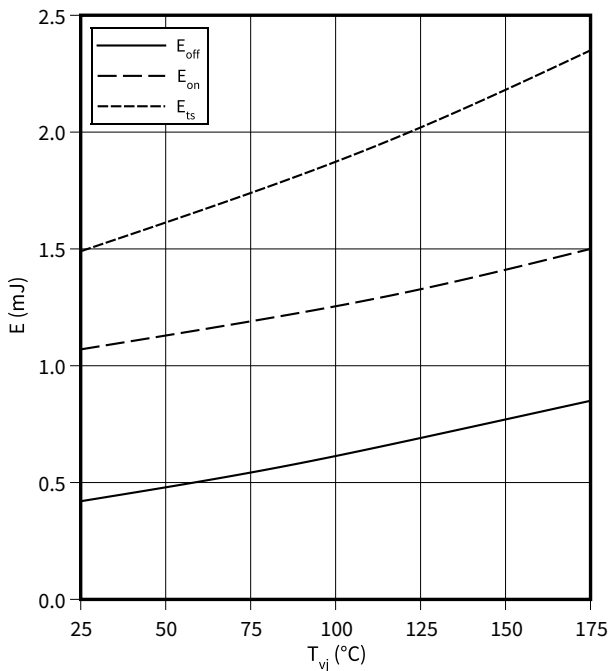
$I_C = 15.0\text{ A}, V_{CE} = 600\text{ V}, T_{vj} = 175\text{ }^\circ\text{C}, V_{GE} = 0/15\text{ V}$



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

$E = f(T_{vj})$

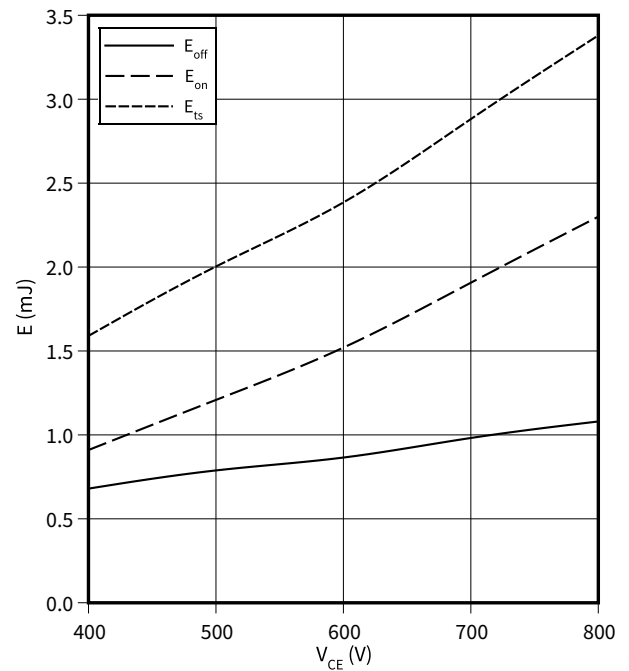
$I_C = 15.0\text{ A}, V_{CE} = 600\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 35\text{ }\Omega$



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

$E = f(V_{CE})$

$I_C = 15.0\text{ A}, T_{vj} = 175\text{ }^\circ\text{C}, V_{GE} = 0/15\text{ V}, R_G = 35\text{ }\Omega$

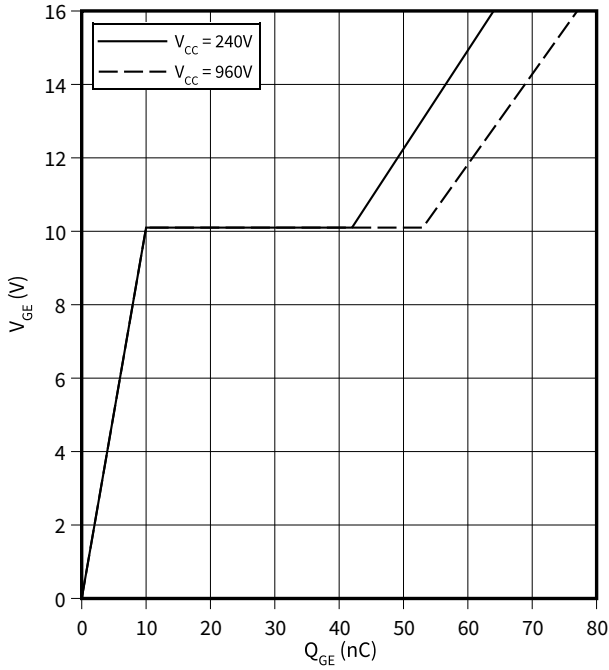


**4 Characteristics diagrams**

**Typical gate charge, IGBT**

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

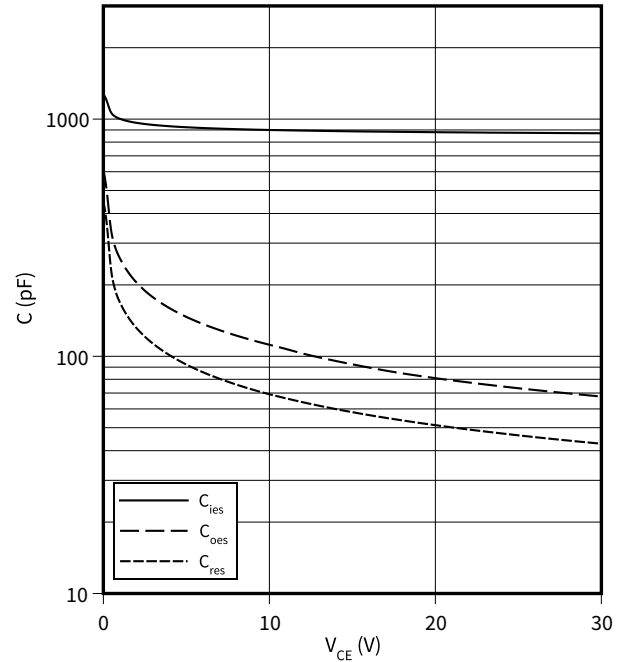
$I_C = 15.0 \text{ A}$



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

$C = f(V_{CE})$

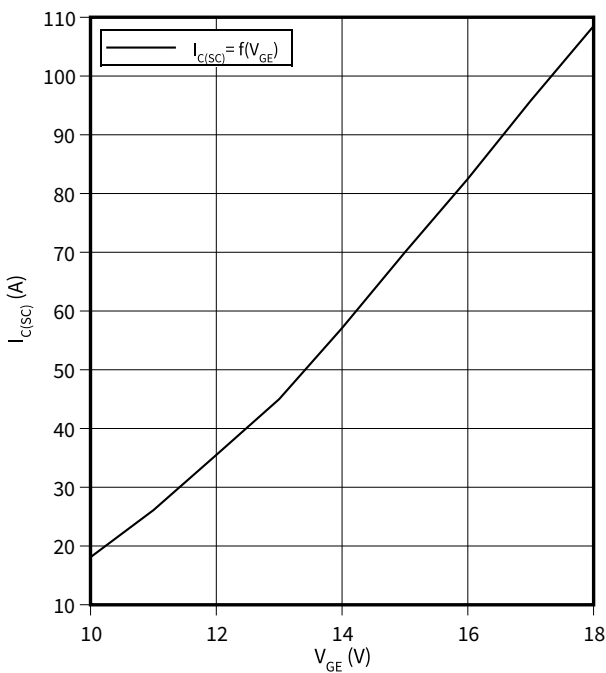
$f = 1000 \text{ kHz}, V_{GE} = 0 \text{ V}$



**Typical short circuit collector current as a function of gate-emitter voltage, IGBT**

$I_{C(SC)} = f(V_{GE})$

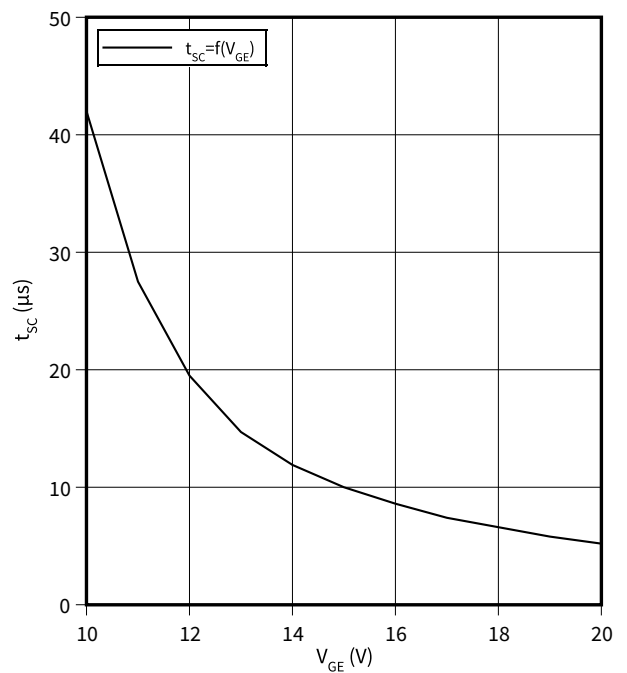
$V_{CE} \leq 600 \text{ V}, T_{vj, start} = 25 \text{ }^\circ\text{C}$



**Short circuit withstand time as a function of gate-emitter voltage, IGBT**

$t_{SC} = f(V_{GE})$

$V_{CE} \leq 600 \text{ V}, T_{vj} \leq 175 \text{ }^\circ\text{C}$

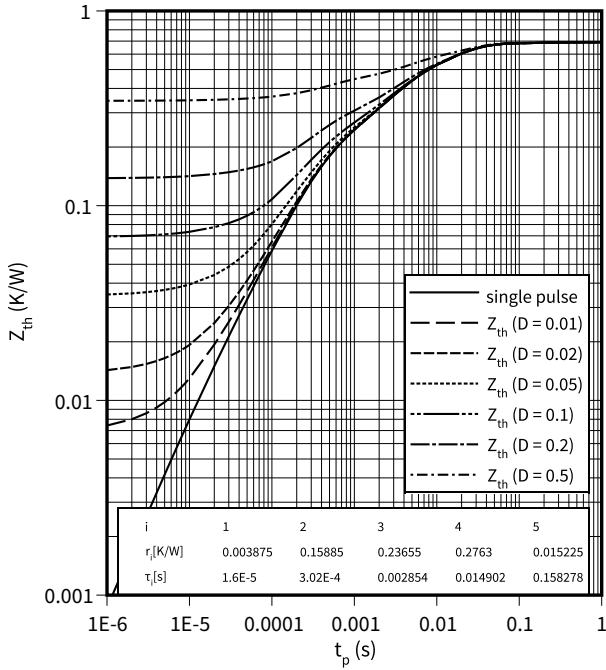


4 Characteristics diagrams

**IGBT transient thermal impedance, IGBT**

$Z_{th} = f(t_p)$

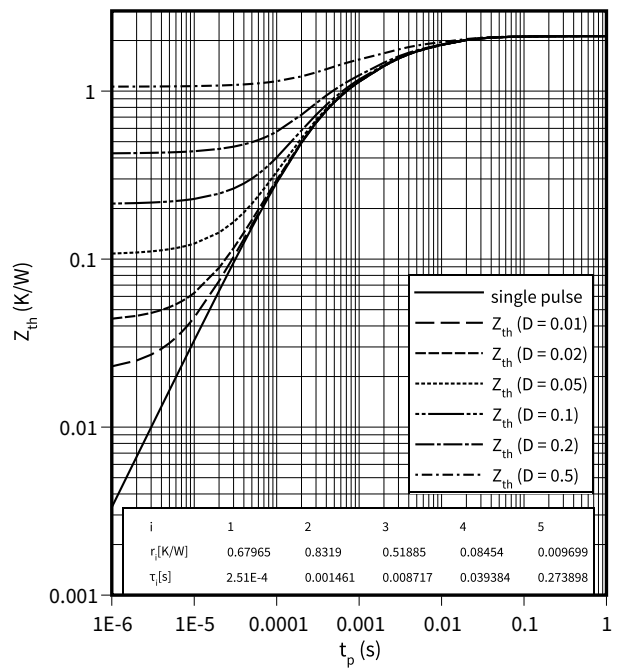
$D = t_p/T$



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

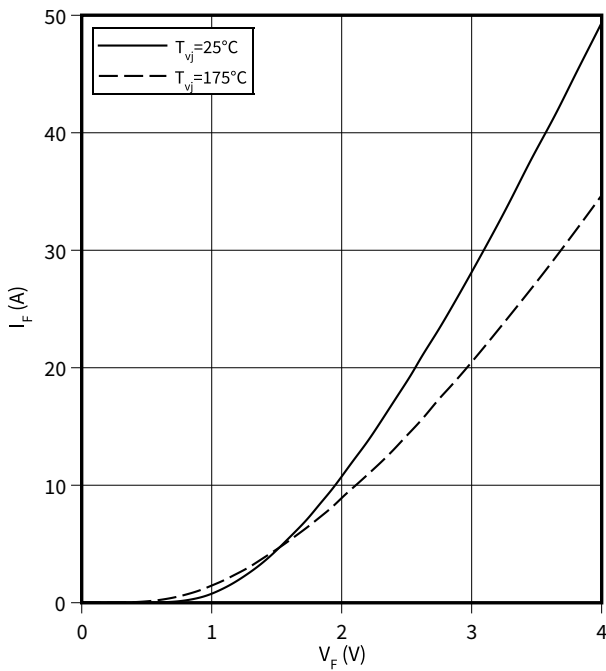
$Z_{th} = f(t_p)$

$D = t_p/T$



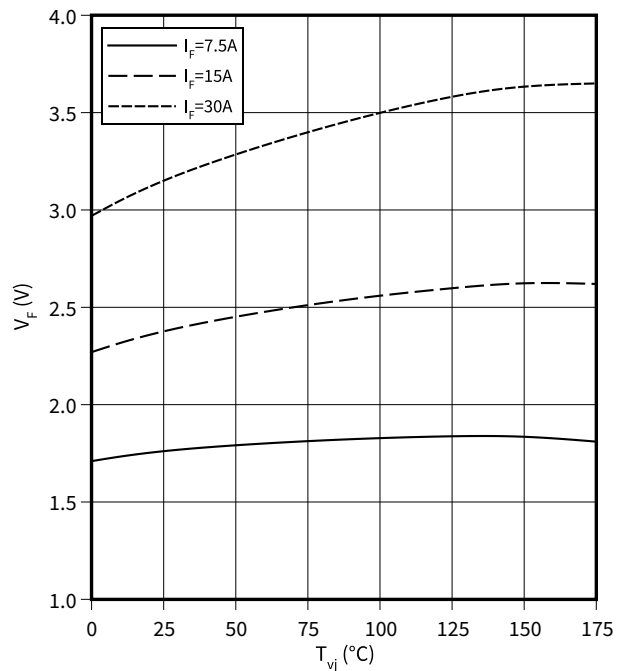
**Typical diode forward current as a function of forward voltage, Diode**

$I_F = f(V_F)$



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

$V_F = f(T_{vj})$

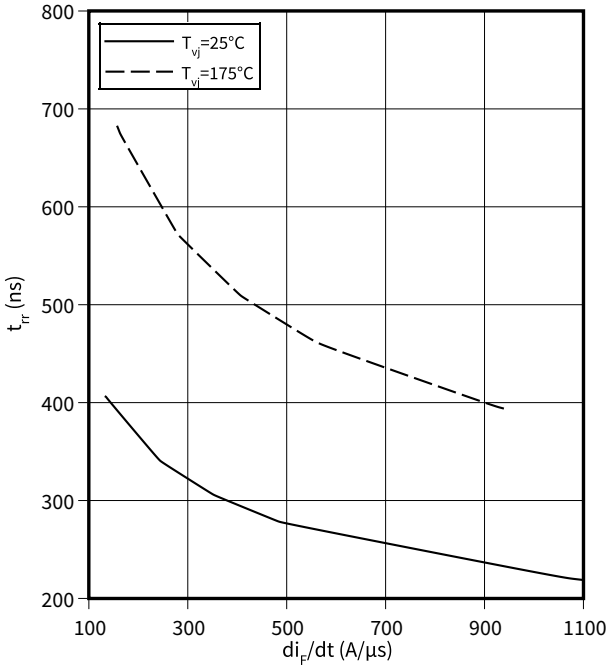


**4 Characteristics diagrams**

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

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

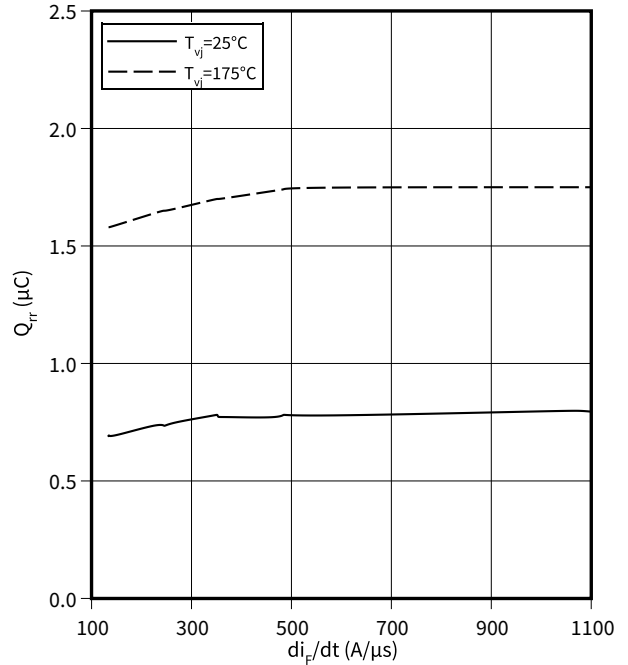
$V_R = 600\text{ V}, I_F = 15\text{ A}$



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

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

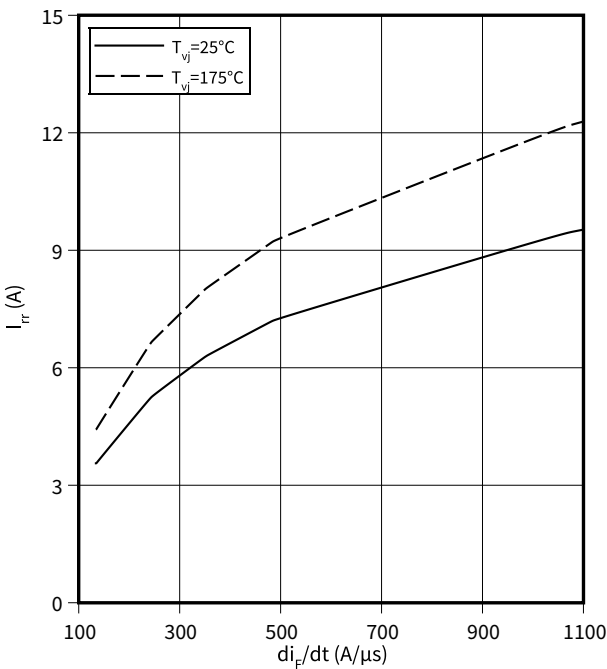
$V_R = 600\text{ V}, I_F = 15\text{ A}$



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

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

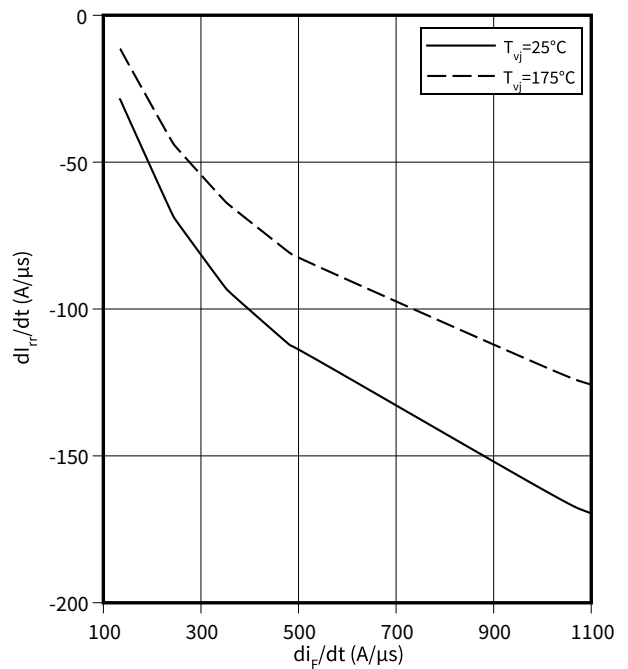
$V_R = 600\text{ V}, I_F = 15\text{ A}$



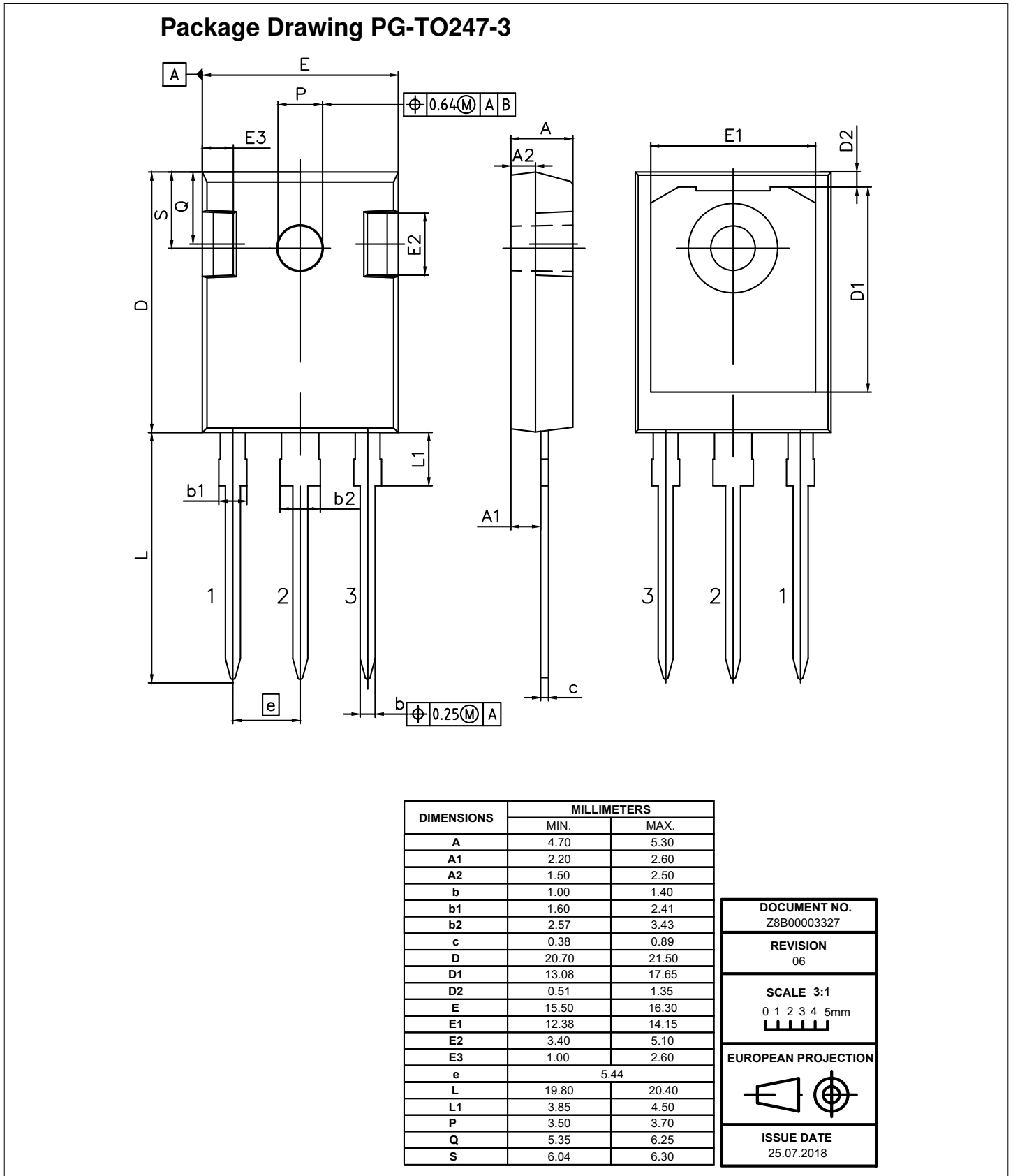
**Typical diode peak rate of fall of reverse recovery current as a function of diode current slope, Diode**

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

$V_R = 600\text{ V}, I_F = 15\text{ A}$



**5 Package outlines**



**Figure 6**

## 6 Testing conditions

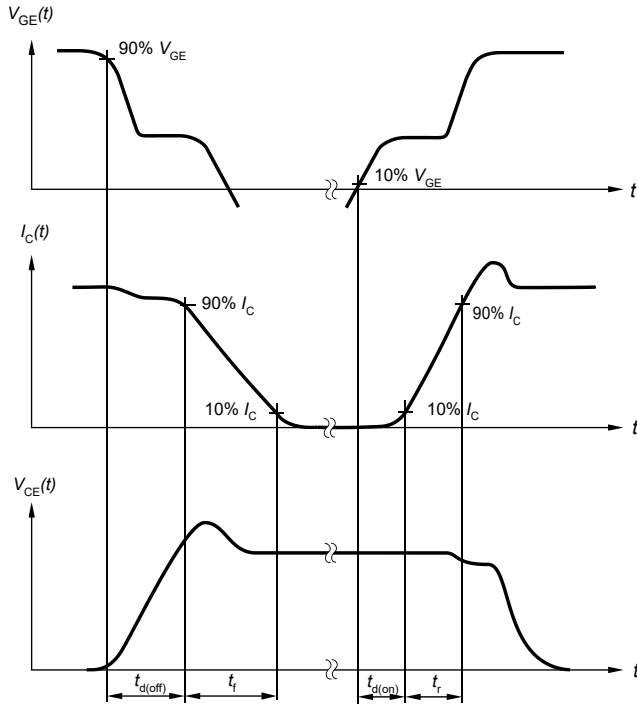


Figure A. Definition of switching times

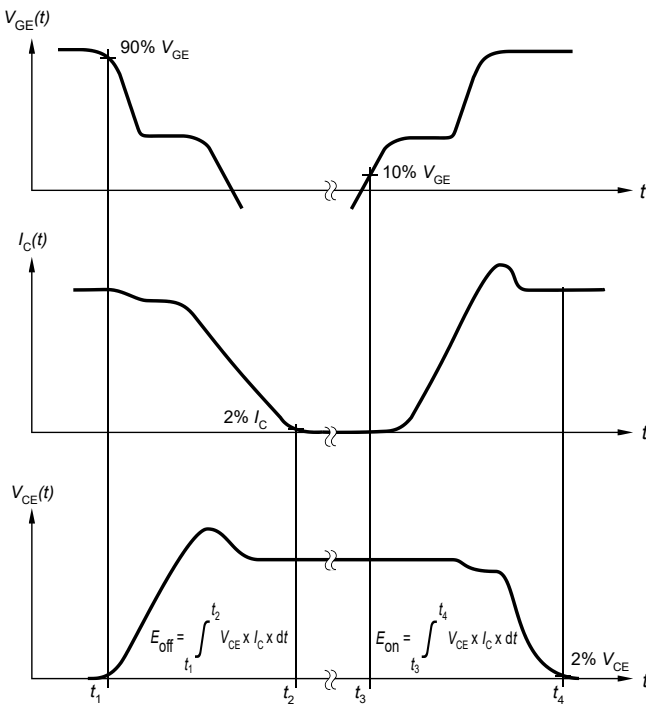


Figure B. Definition of switching losses

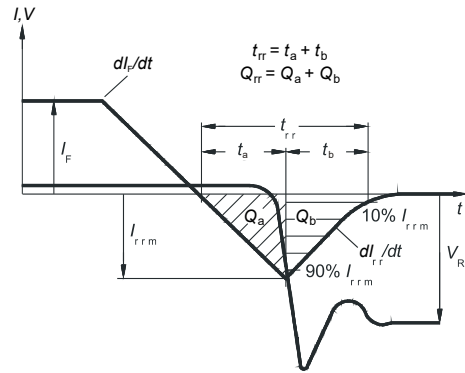


Figure C. Definition of diode switching characteristics

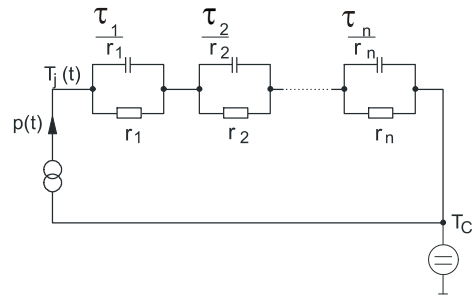


Figure D. Thermal equivalent circuit

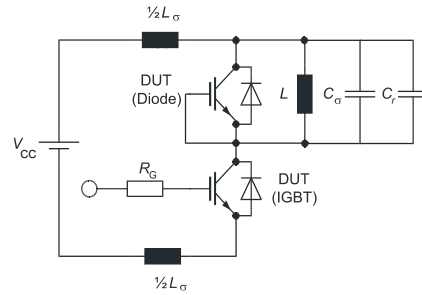


Figure E. **Dynamic test circuit**  
 Parasitic inductance  $L_{\sigma}$ ,  
 parasitic capacitor  $C_{\sigma}$ ,  
 relief capacitor  $C_r$ ,  
 (only for ZVT switching)

Figure 7

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**Revision history****Revision history**

<b>Document revision</b>	<b>Date of release</b>	<b>Description of changes</b>
V1.1	2009-11-27	
V1.2	2010-02-10	
V2.1	2014-12-01	Final data sheet
V2.2		Minor change figure 28
1.10	2021-09-08	Update of legend at the diagram $V_F = f(T_{vj})$