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### Short circuit rugged 1200 V TRENCHSTOP™ IGBT 7 technology copacked with soft and fast recovery Emitter Controlled 7 diode

#### Features

- $V_{CE}=1200\text{ V}$
- $I_C=50\text{ A}$
- IGBT co-packed with full current, soft and low  $Q_{rr}$  diode
- Low saturation voltage  $V_{CE(sat)} = 2.0\text{ V}$  at  $T_{vj}=175\text{ °C}$
- Optimized for hard switching topologies (2-L inverter, 3-L NPC T-type, ...)
- Short circuit ruggedness  $8\text{ }\mu\text{sec}$
- Wide range of  $dv/dt$  controllability
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

#### Potential applications

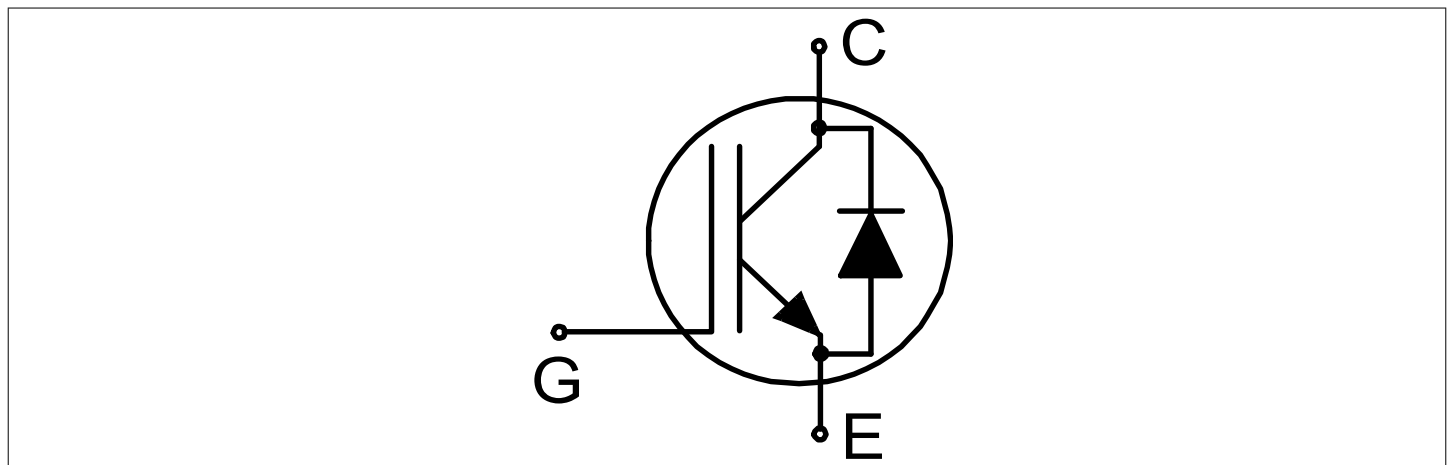
- Industrial Drives
- Industrial Power Supplies
- Solar Inverters

#### Product validation

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



#### Description



Type	Package	Marking
IKW50N120CS7	PG-TO247-3	K50MCS7

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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 5mm. (0.197in) from case	$L_E$			13.0		nH
Storage temperature	$T_{stg}$		-55		150	°C
Soldering temperature		wave soldering 1.6mm (0.063in.) from case for 10s			260	°C
Mounting torque , M3 screw Maximum of mounting process: 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	$V_{CE}$	$T_{vj} \geq 25\text{ °C}$	1200	V	
DC collector current, limited by $T_{vjmax}$	$I_C$	limited by bondwire	$T_C = 25\text{ °C}$	82	A
			$T_C = 100\text{ °C}$	68	
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cpuls}$		150	A	
Turn-off safe operating area		$V_{CE} \leq 1200\text{ V}, T_{vj} \leq 175\text{ °C}$	150	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	
Short circuit withstand time	$t_{SC}$	$V_{CC} \leq 600\text{ V}, V_{GE} = 15\text{ V}$ , Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}, T_{vj} = 150\text{ °C}$	8	$\mu\text{s}$	
Power dissipation	$P_{tot}$		$T_C = 25\text{ °C}$	428	W
			$T_C = 100\text{ °C}$	215	

**Table 3** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\text{ sat}}$	$I_C = 50.0\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	1.65	2.00	V
			$T_{vj} = 175\text{ °C}$	2.00		

**Table 3** Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Gate-emitter threshold voltage	$V_{GEth}$	$I_C = 0.98 \text{ mA}$ , $V_{CE} = V_{GE}$ , $T_{vj} = 25 \text{ °C}$	5.15	5.70	6.45	V
Zero gate voltage collector current	$I_{CES}$	$V_{CE} = 1200 \text{ V}$ , $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		40	$\mu\text{A}$
			$T_{vj} = 175 \text{ °C}$		4000	
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0 \text{ V}$ , $V_{GE} = 20 \text{ V}$			100	nA
Transconductance	$g_{fs}$	$I_C = 50.0 \text{ A}$ , $V_{CE} = 20 \text{ V}$ , $T_{vj} = 175 \text{ °C}$		21.0		S
Short circuit collector current	$I_{SC}$	$V_{CC} \leq 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $t_{SC} \leq 8 \mu\text{s}$ , Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0 \text{ s}$ , $T_{vj} = 25 \text{ °C}$		300		A
Input capacitance	$C_{ies}$	$V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ , $f = 100 \text{ kHz}$		7.2		nF
Output capacitance	$C_{oes}$	$V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ , $f = 100 \text{ kHz}$		140		pF
Reverse transfer capacitance	$C_{res}$	$V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ , $f = 100 \text{ kHz}$		32		pF
Gate charge	$Q_G$	$I_C = 50.0 \text{ A}$ , $V_{GE} = 15 \text{ V}$ , $V_{CE} = 960 \text{ V}$		290		nC
Turn-on delay time	$t_{don}$	$V_{CE} = 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $R_{Gon} = 2.3 \Omega$ , $R_{Goff} = 2.3 \Omega$	$T_{vj} = 25 \text{ °C}$ , $I_C = 50.0 \text{ A}$		29	ns
			$T_{vj} = 175 \text{ °C}$ , $I_C = 50.0 \text{ A}$		26	
Rise time (inductive load)	$t_r$	$V_{CE} = 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $R_{Gon} = 2.3 \Omega$ , $R_{Goff} = 2.3 \Omega$	$T_{vj} = 25 \text{ °C}$ , $I_C = 50.0 \text{ A}$		19	ns
			$T_{vj} = 175 \text{ °C}$ , $I_C = 50.0 \text{ A}$		19	
Turn-off delay time	$t_{doff}$	$V_{CE} = 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $R_{Gon} = 2.3 \Omega$ , $R_{Goff} = 2.3 \Omega$	$T_{vj} = 25 \text{ °C}$ , $I_C = 50.0 \text{ A}$		170	ns
			$T_{vj} = 175 \text{ °C}$ , $I_C = 50.0 \text{ A}$		225	
Fall time (inductive load)	$t_f$	$V_{CE} = 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $R_{Gon} = 2.3 \Omega$ , $R_{Goff} = 2.3 \Omega$	$T_{vj} = 25 \text{ °C}$ , $I_C = 50.0 \text{ A}$		100	ns
			$T_{vj} = 175 \text{ °C}$ , $I_C = 50.0 \text{ A}$		245	
Turn-on energy	$E_{on}$	$V_{CE} = 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $R_{Gon} = 2.3 \Omega$ , $R_{Goff} = 2.3 \Omega$	$T_{vj} = 25 \text{ °C}$ , $I_C = 50.0 \text{ A}$		2.80	mJ
			$T_{vj} = 175 \text{ °C}$ , $I_C = 50.0 \text{ A}$		4.30	
Turn-off energy	$E_{off}$	$V_{CE} = 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $R_{Gon} = 2.3 \Omega$ , $R_{Goff} = 2.3 \Omega$	$T_{vj} = 25 \text{ °C}$ , $I_C = 50.0 \text{ A}$		2.20	mJ
			$T_{vj} = 175 \text{ °C}$ , $I_C = 50.0 \text{ A}$		4.70	

**Table 3** Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Total switching energy	$E_{ts}$	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V},$ $R_{Gon} = 2.3\ \Omega, R_{Goff} = 2.3\ \Omega$	$T_{vj} = 25\text{ }^\circ\text{C},$ $I_C = 50.0\text{ A}$		5.00		mJ
			$T_{vj} = 175\text{ }^\circ\text{C},$ $I_C = 50.0\text{ A}$		9.00		
IGBT thermal resistance, junction-case	$R_{thjc}$			0.25	0.35	K/W	
Operating junction temperature	$T_{vj}$		-40		175	$^\circ\text{C}$	

### 3 Diode

**Table 4** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	$V_{RRM}$	$T_{vj} \geq 25\text{ }^\circ\text{C}$	1200	V	
Diode forward current, limited by $T_{vjmax}$	$I_F$	limited by bondwire	$T_C = 25\text{ }^\circ\text{C}$	82	A
			$T_C = 100\text{ }^\circ\text{C}$	56	
Diode pulsed current, limited by $T_{vjmax}$	$I_{Fpuls}$		150	A	
Power dissipation	$P_{tot}$		$T_C = 25\text{ }^\circ\text{C}$	250	W
			$T_C = 100\text{ }^\circ\text{C}$	125	

**Table 5** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	$V_F$	$I_F = 50.0\text{ A}$	$T_{vj} = 25\text{ }^\circ\text{C}$	1.65	2.15	V
			$T_{vj} = 175\text{ }^\circ\text{C}$	1.60		
Reverse leakage current	$I_R$	$V_R = 1200\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		40	$\mu\text{A}$
			$T_{vj} = 175\text{ }^\circ\text{C}$	4000		
Diode reverse recovery time	$t_{rr}$	$V_R = 600\text{ V}, R_{Gon} = 2.3\ \Omega$	$T_{vj} = 25\text{ }^\circ\text{C},$ $I_F = 50.0\text{ A}$	165		ns
			$T_{vj} = 175\text{ }^\circ\text{C},$ $I_F = 50.0\text{ A}$	305		
Diode reverse recovery charge	$Q_{rr}$	$V_R = 600\text{ V}, R_{Gon} = 2.3\ \Omega$	$T_{vj} = 25\text{ }^\circ\text{C},$ $I_F = 50.0\text{ A}$	3.20		$\mu\text{C}$
			$T_{vj} = 175\text{ }^\circ\text{C},$ $I_F = 50.0\text{ A}$	8.25		

**Table 5** Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Diode peak reverse recovery current	$I_{rrm}$	$V_R = 600 \text{ V}, R_{Gon} = 2.3 \Omega$	$T_{vj} = 25 \text{ °C}, I_F = 50.0 \text{ A}$		40.0		A
			$T_{vj} = 175 \text{ °C}, I_F = 50.0 \text{ A}$		54.0		
Diode peak rate off fall of reverse recovery current	$di_{rr}/dt$	$V_R = 600 \text{ V}, R_{Gon} = 2.3 \Omega$	$T_{vj} = 25 \text{ °C}, I_F = 50.0 \text{ A}$		-290		A/ $\mu\text{s}$
			$T_{vj} = 175 \text{ °C}, I_F = 50.0 \text{ A}$		-185		
Reverse recovery energy	$E_{rec}$	$V_R = 600 \text{ V}, R_{Gon} = 2.3 \Omega$	$T_{vj} = 25 \text{ °C}, I_F = 50.0 \text{ A}$		1.00		mJ
			$T_{vj} = 175 \text{ °C}, I_F = 50.0 \text{ A}$		3.10		
Diode thermal resistance, junction-case	$R_{thjc}$			0.45	0.60		K/W
Operating junction temperature	$T_{vj}$		-40		175		°C

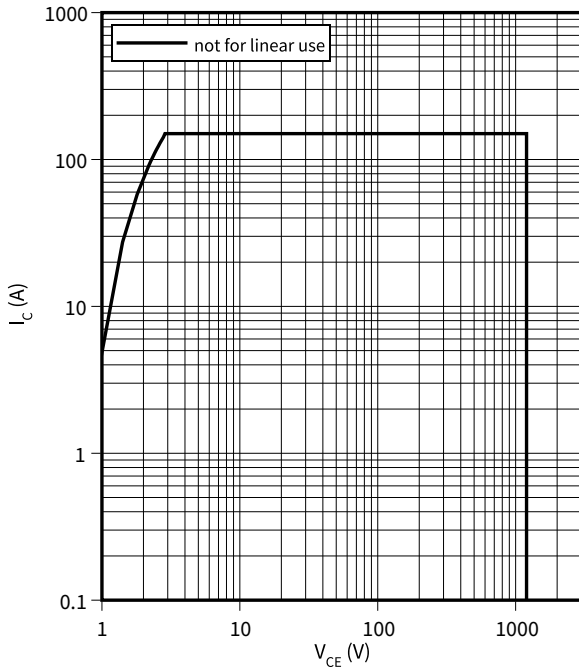
*Note:* For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

*Dynamic test circuit, parasitic inductance  $L_\sigma = 30 \text{ nH}$ ,  $C_\sigma = 28 \text{ pF}$*

## 4 Characteristics diagrams

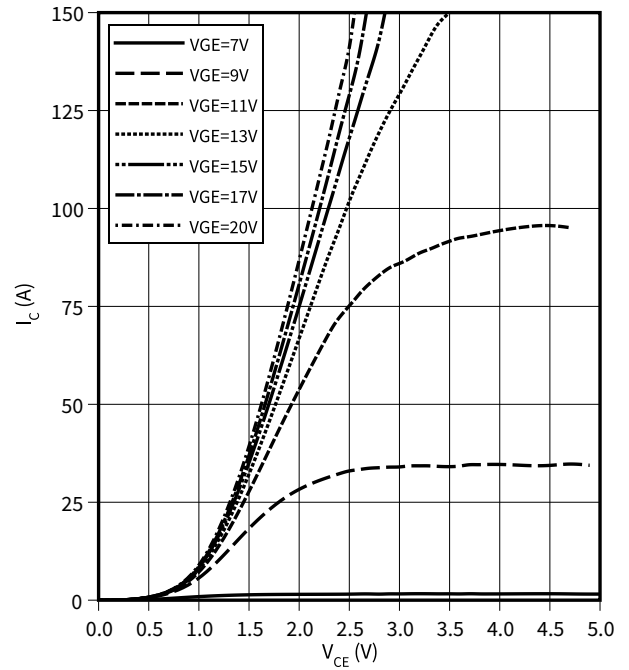
### Reverse bias safe operating area, IGBT

$I_C = f(V_{CE})$   
 $T_{vj} \leq 175\text{ °C}$ ,  $V_{GE} = 15\text{ V}$



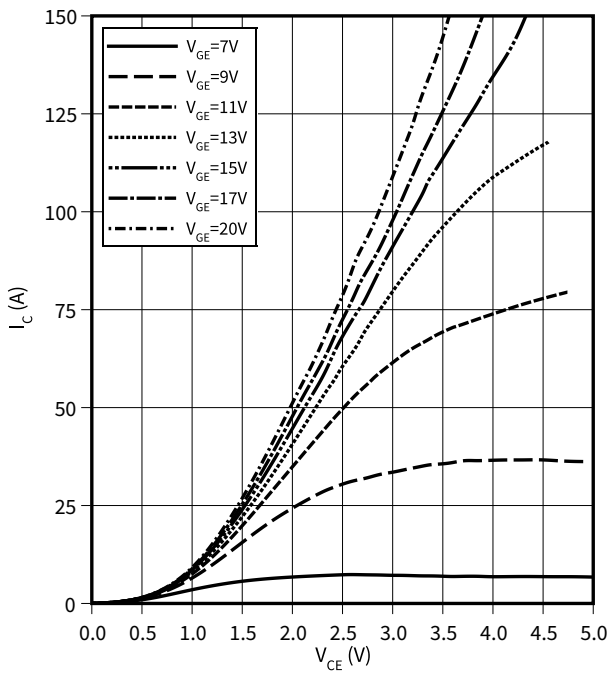
### Typical output characteristic, IGBT

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



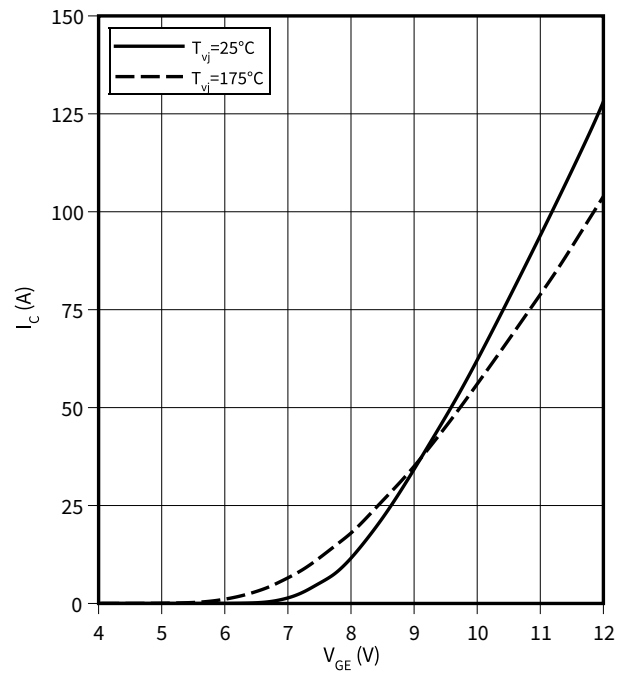
### Typical output characteristic, IGBT

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



### Typical transfer characteristic, IGBT

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

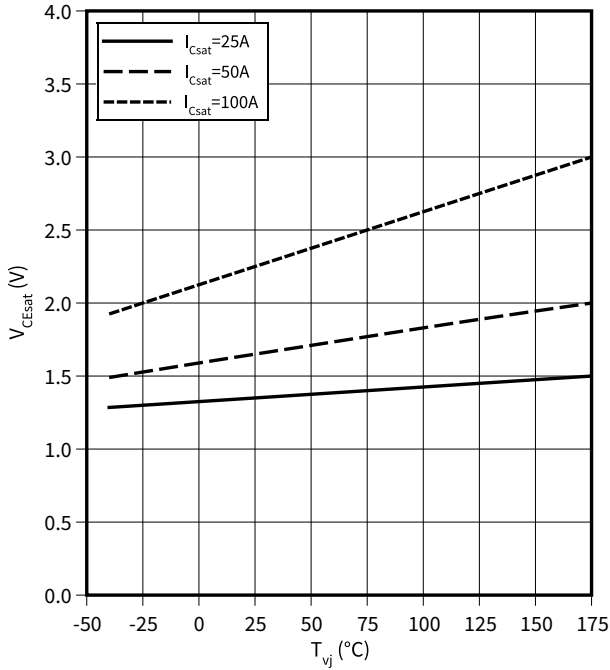




**4 Characteristics diagrams**

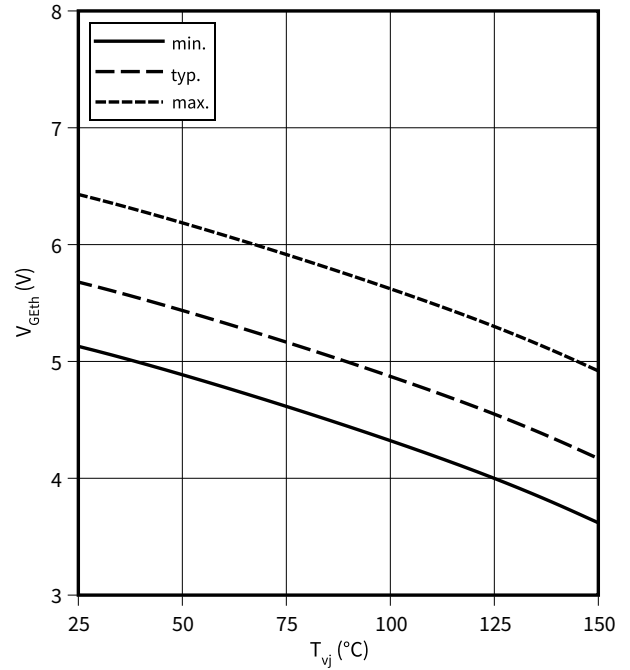
**Typical collector-emitter saturation voltage as a function of junction temperature, IGBT**

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



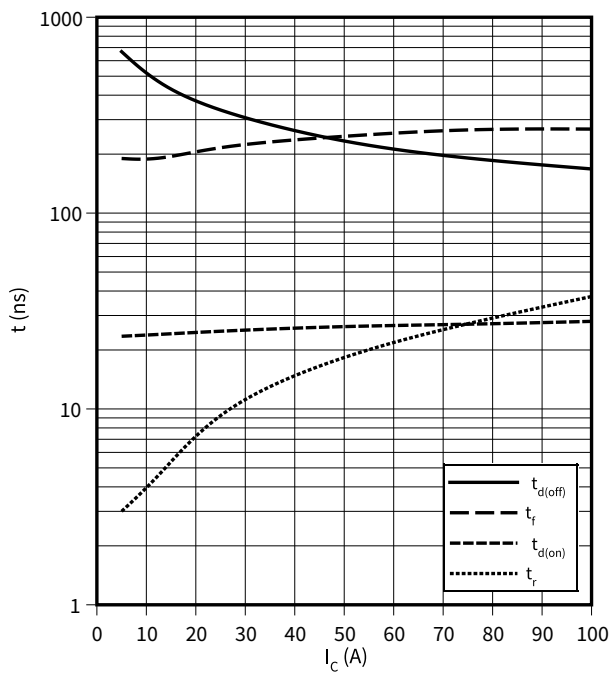
**Gate-emitter threshold voltage as a function of junction temperature, IGBT**

$V_{GETh} = f(T_{vj})$   
 $I_C = 0.98 \text{ mA}$



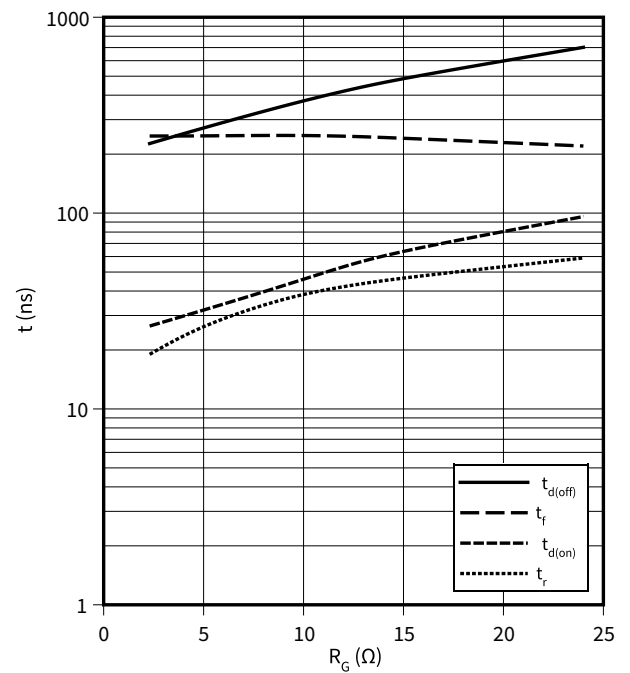
**Typical switching times as a function of collector current, IGBT**

$t = f(I_C)$   
 $V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 2.3 \text{ } \Omega$



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

$t = f(R_G)$   
 $I_C = 50.0 \text{ A}, V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$

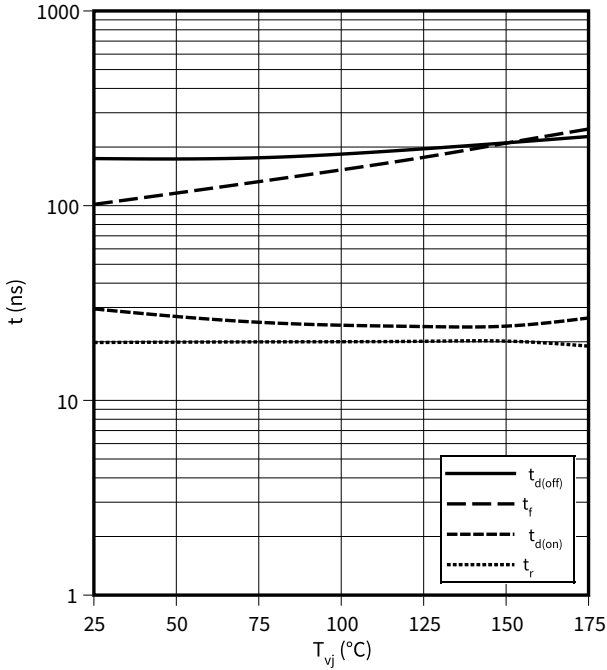


4 Characteristics diagrams

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

$t = f(T_{vj})$

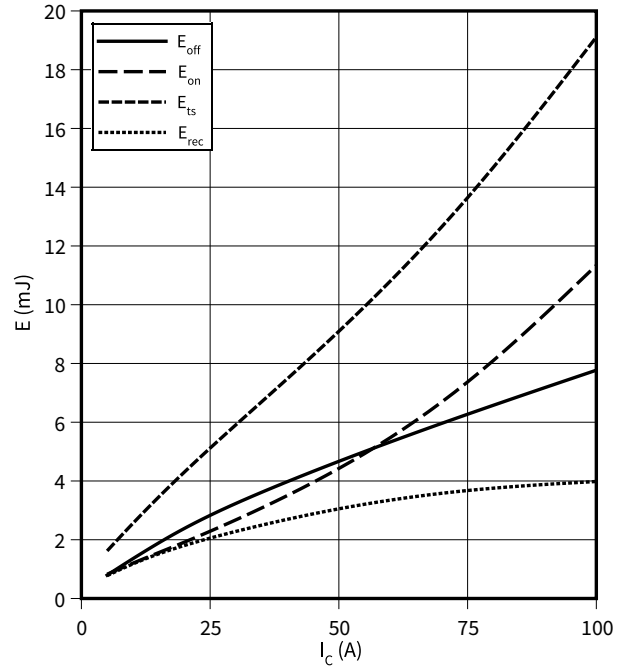
$I_C = 50.0 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 2.3 \text{ } \Omega$



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

$E = f(I_C)$

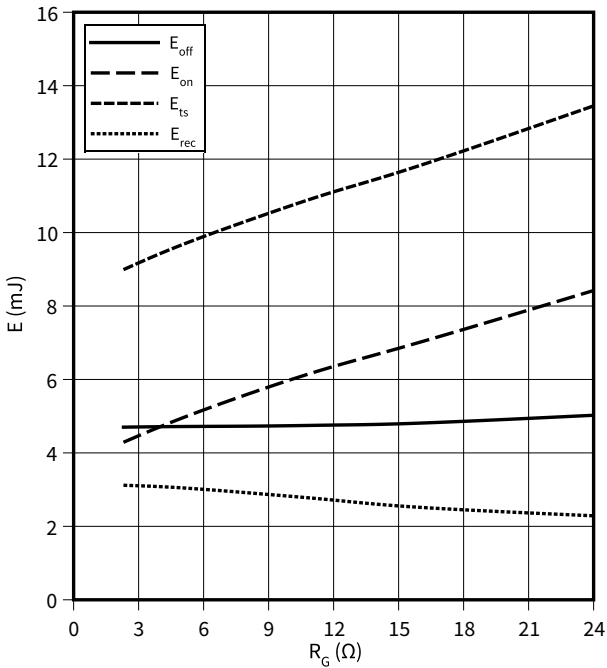
$V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ } ^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 2.3 \text{ } \Omega$



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

$E = f(R_G)$

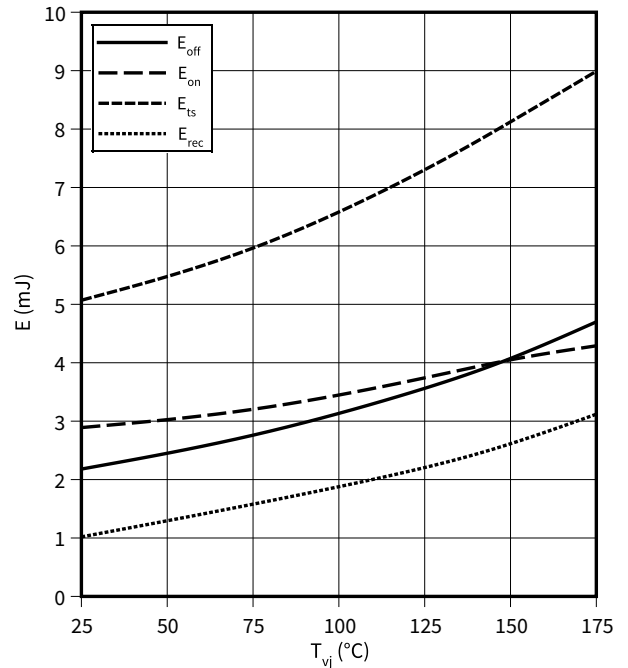
$I_C = 50.0 \text{ A}, V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ } ^\circ\text{C}, V_{GE} = 0/15 \text{ V}$



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

$E = f(T_{vj})$

$I_C = 50.0 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 2.3 \text{ } \Omega$

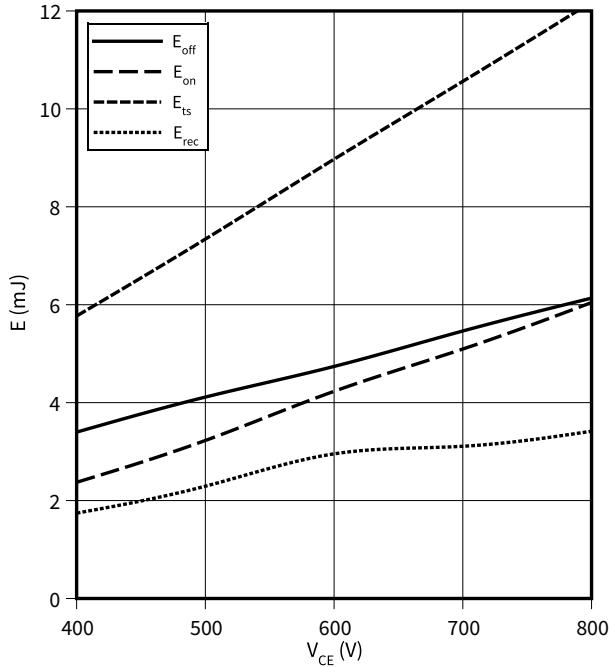


4 Characteristics diagrams

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

$E = f(V_{CE})$

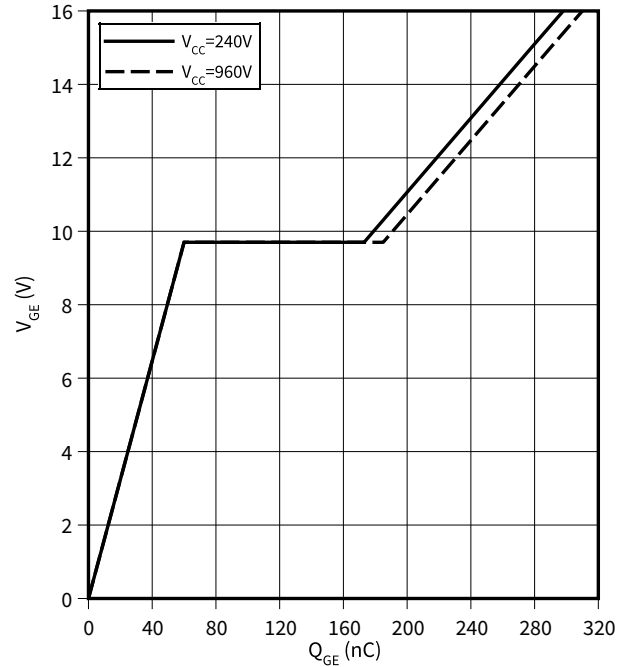
$I_C = 50.0 \text{ A}$ ,  $T_{vj} = 175 \text{ °C}$ ,  $V_{GE} = 0/15 \text{ V}$ ,  $R_G = 2.3 \text{ } \Omega$



**Typical gate charge, IGBT**

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

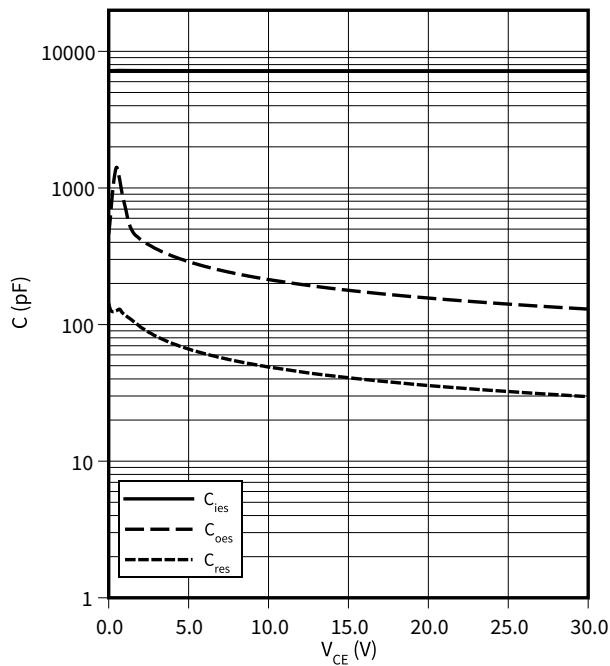
$I_C = 50.0 \text{ A}$



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

$C = f(V_{CE})$

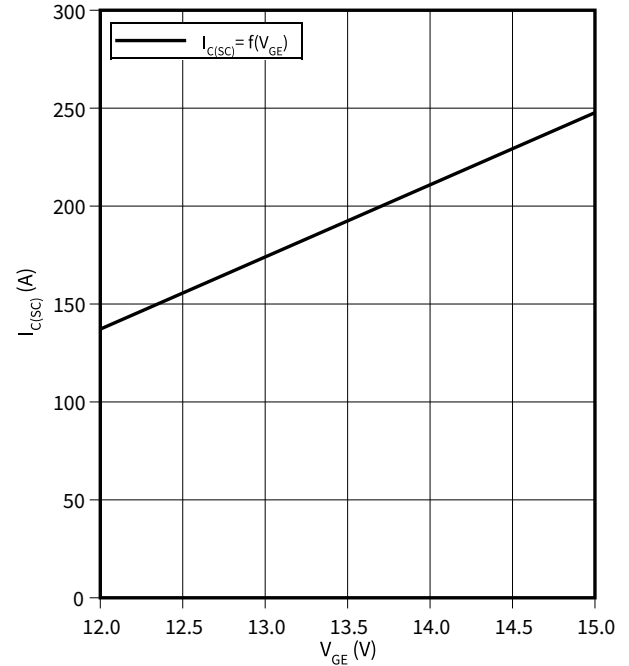
$f = 100 \text{ kHz}$ ,  $V_{GE} = 0 \text{ V}$



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

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

$T_{vj} = 150 \text{ °C}$ ,  $V_{CC} = 600 \text{ V}$

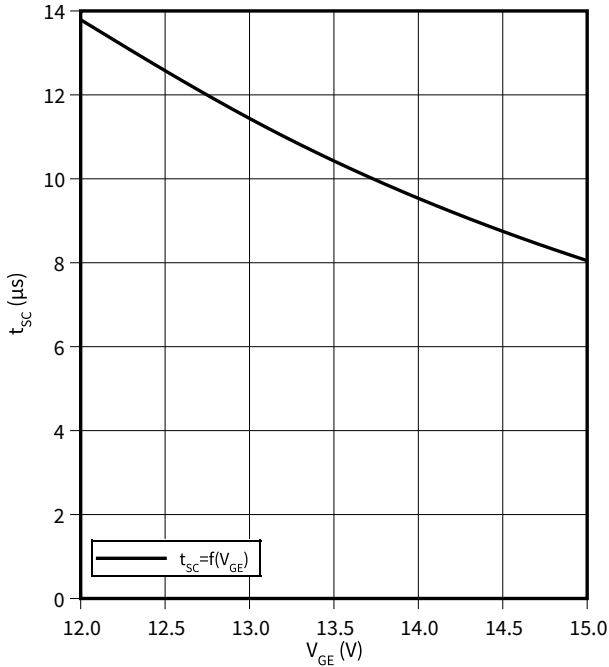


4 Characteristics diagrams

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

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

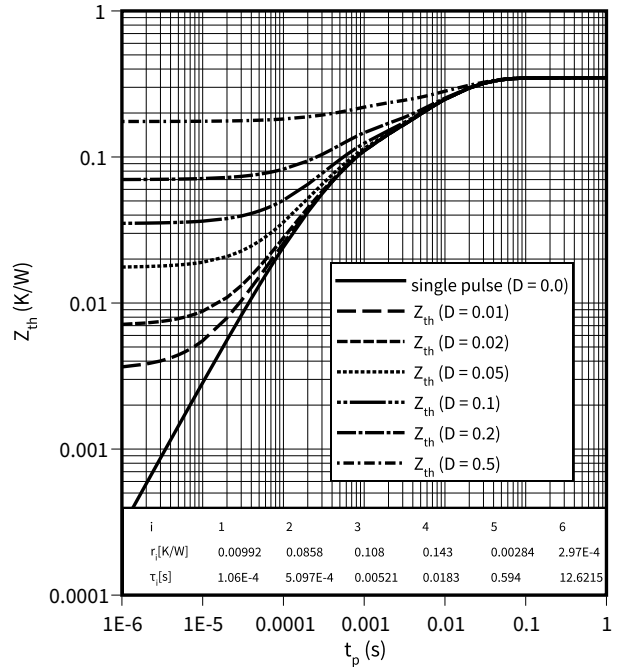
$T_{vj} \leq 150\text{ °C}$ ,  $V_{CC} = 600\text{ V}$



**IGBT transient thermal impedance, IGBT**

$Z_{th} = f(t_p)$

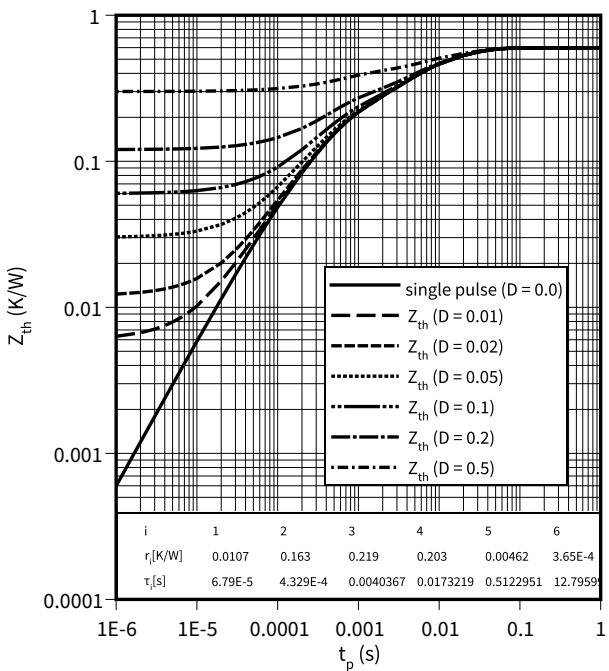
$D = t_p/T$



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

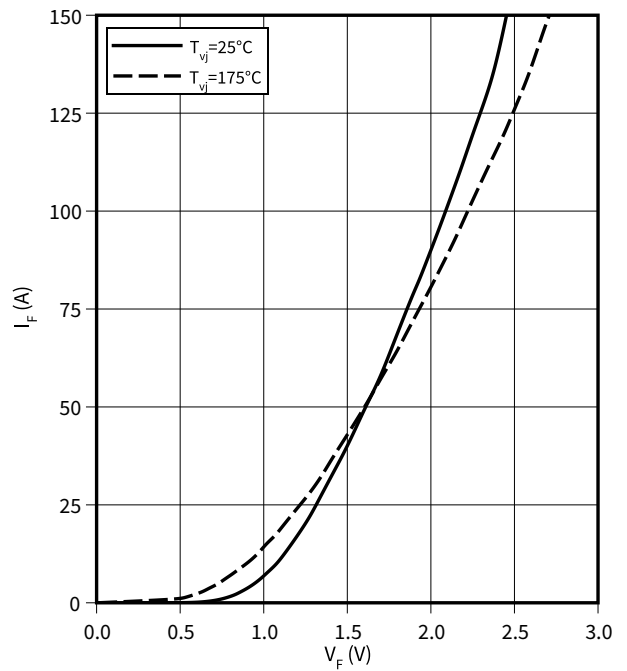
$Z_{th} = f(t_p)$

$D = t_p/T$



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

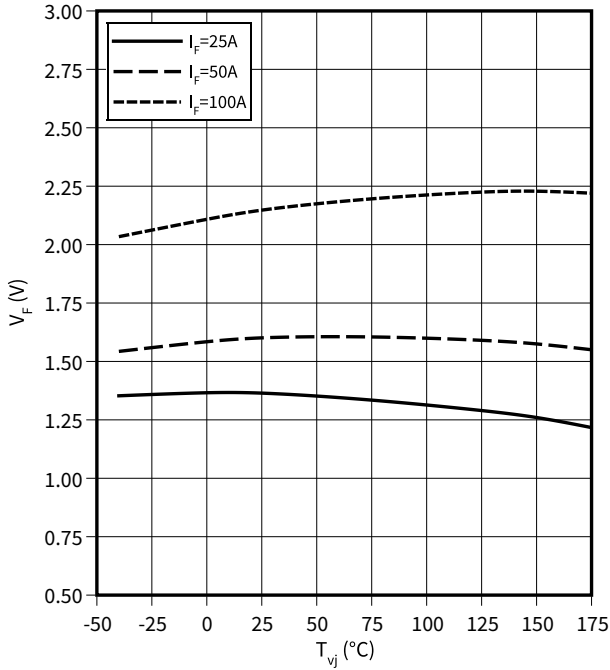
$I_F = f(V_F)$



4 Characteristics diagrams

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

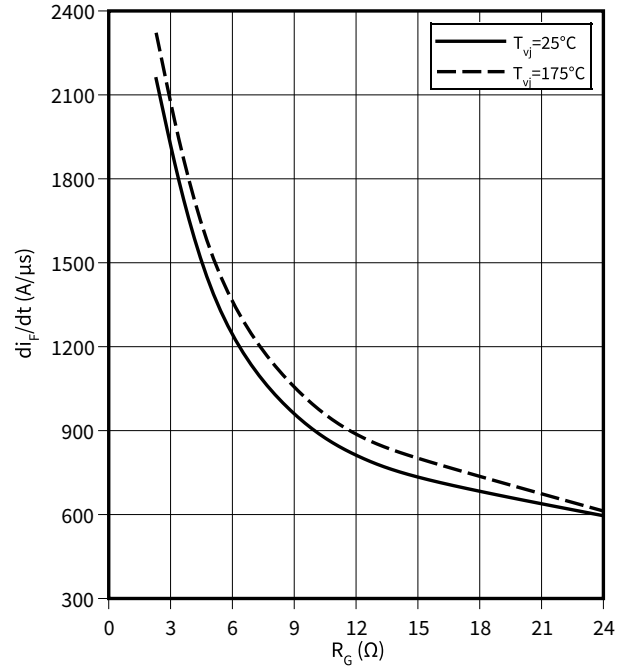
$V_F = f(T_{vj})$



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

$di_F/dt = f(R_G)$

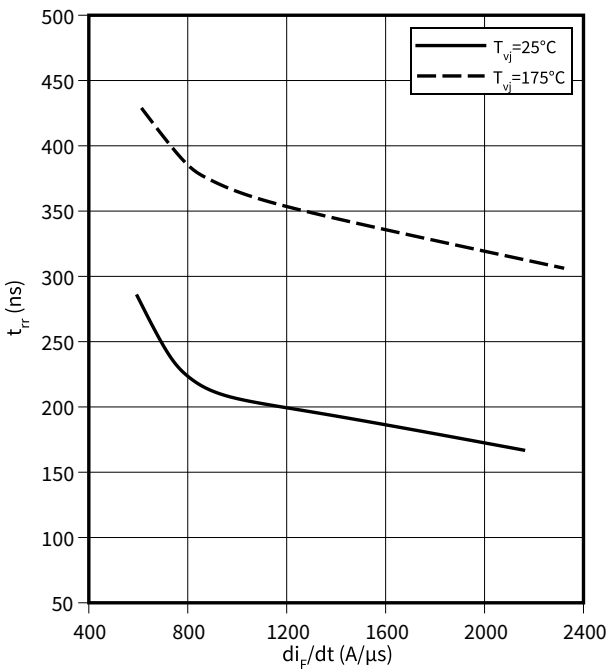
$I_C = 50.0 A, V_{CE} = 600 V, V_{GE} = 0/15 V$



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

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

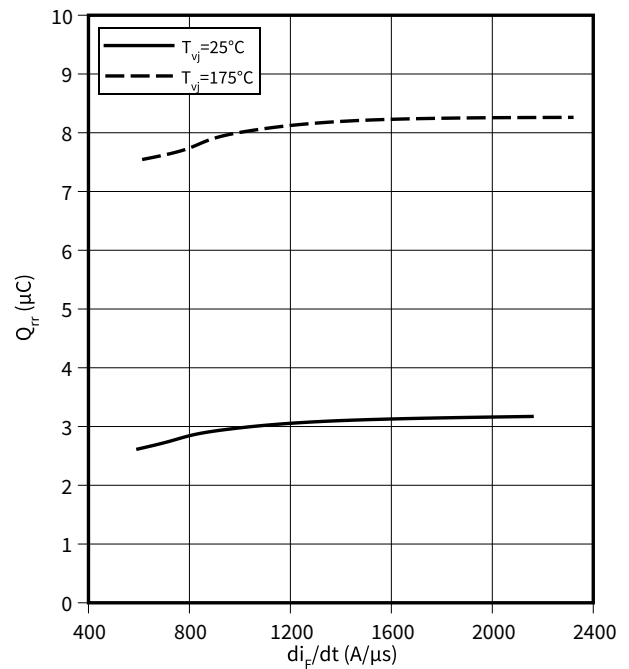
$V_R = 600 V, I_F = 50.0 A$



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

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

$V_R = 600 V, I_F = 50.0 A$

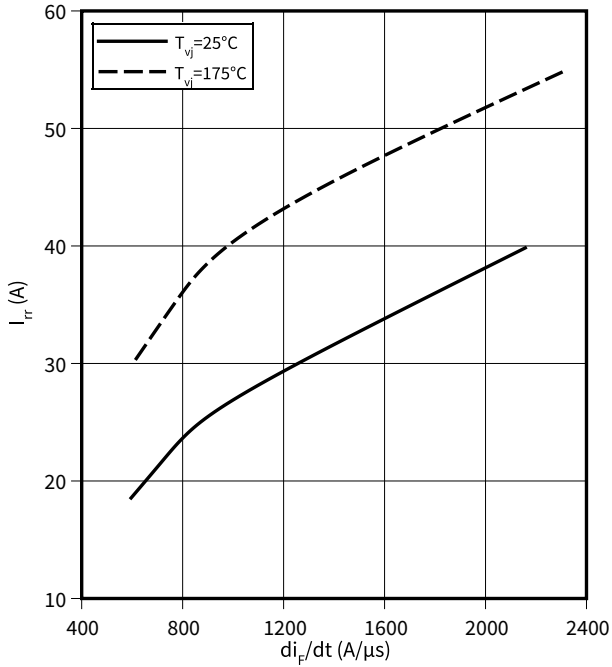


**4 Characteristics diagrams**

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

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

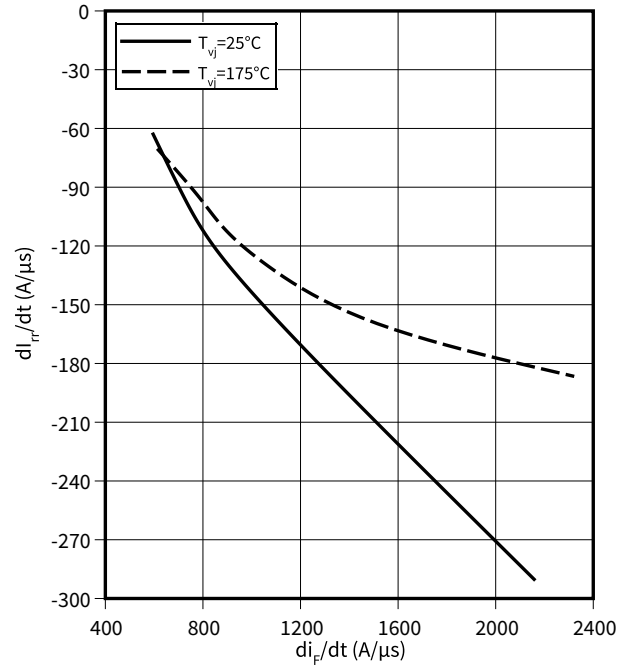
$V_R = 600\text{ V}, I_F = 50.0\text{ A}$



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

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

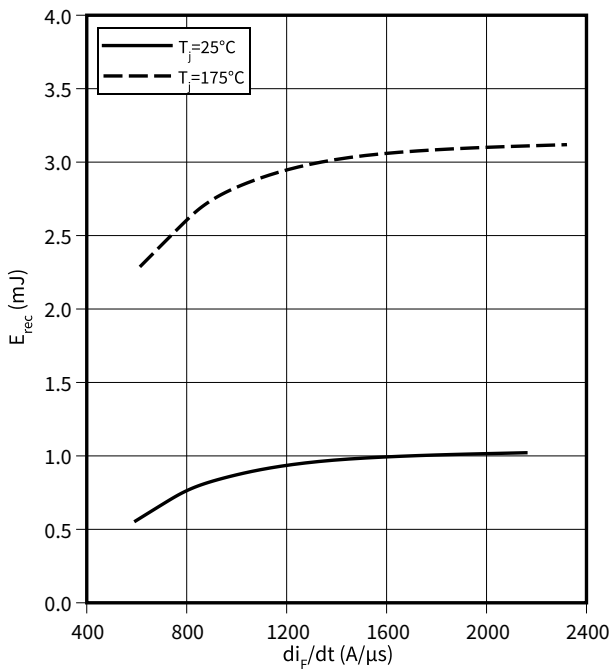
$V_R = 600\text{ V}, I_F = 50.0\text{ A}$



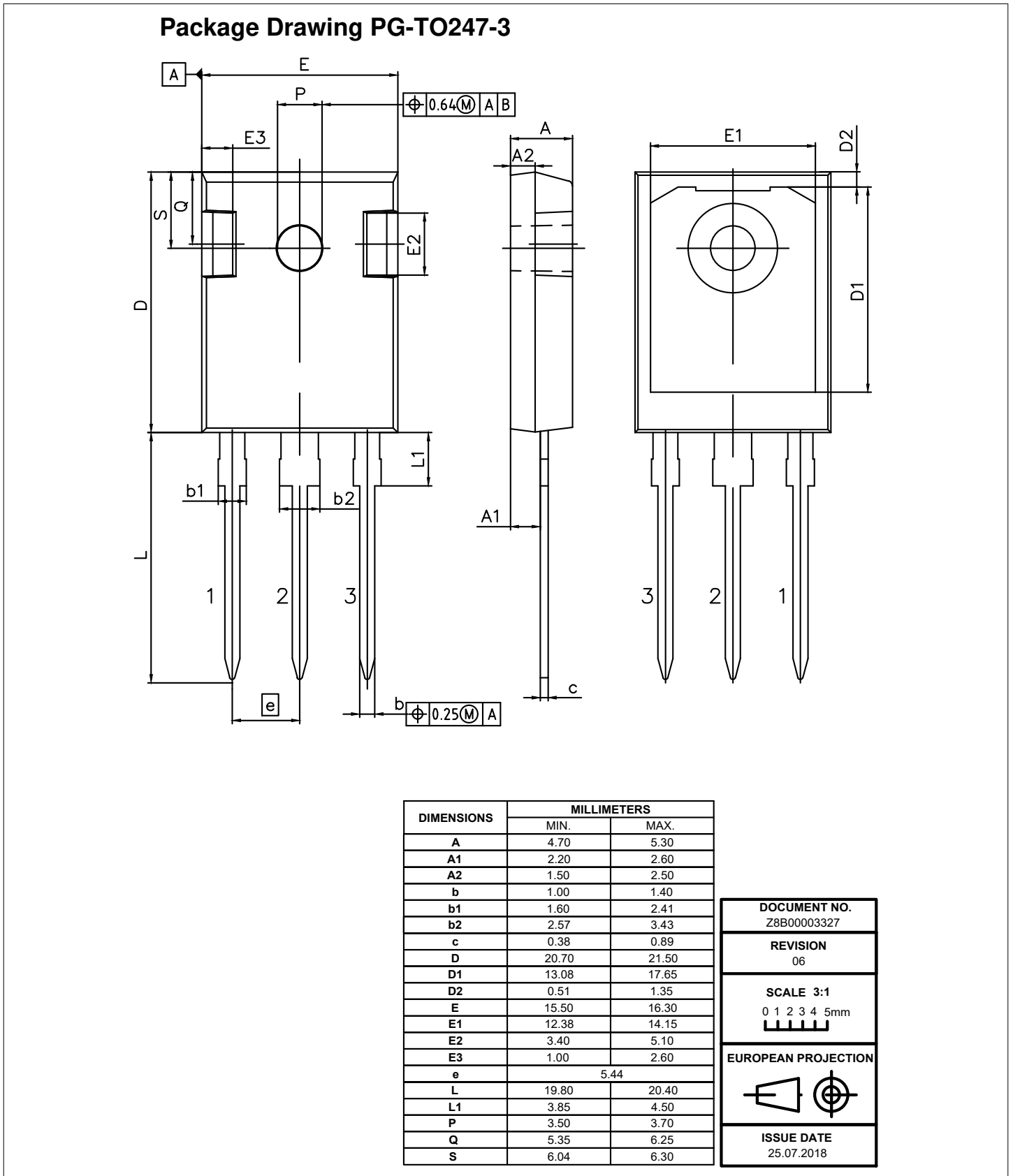
**Typical reverse energy losses as a function of diode current slope, Diode**

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

$V_R = 600\text{ V}, I_F = 50.0\text{ A}$



**5 Package outlines**



**Figure 6**

## 6 Testing conditions

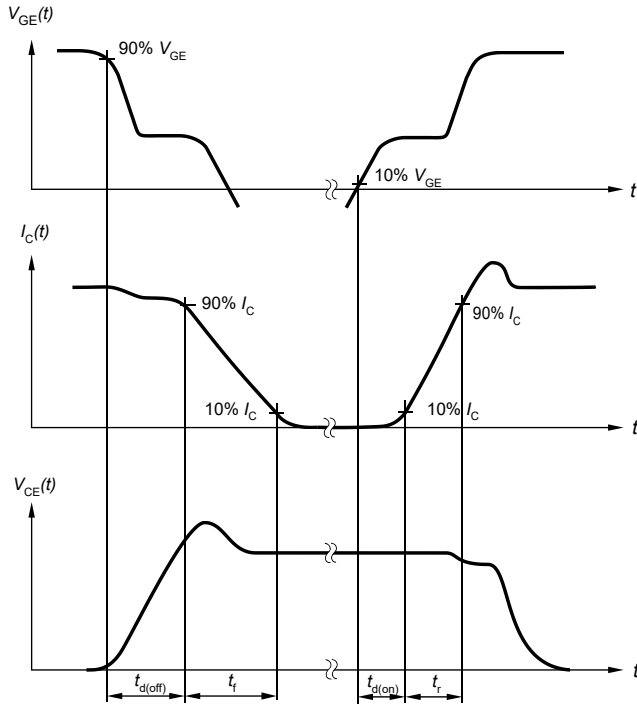


Figure A. Definition of switching times

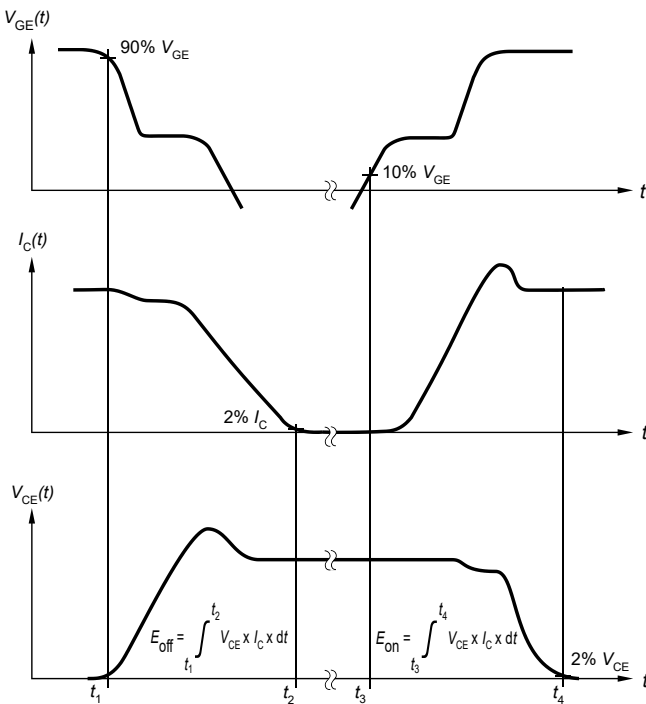


Figure B. Definition of switching losses

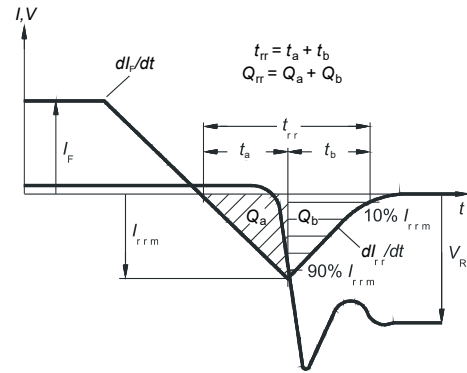


Figure C. Definition of diode switching characteristics

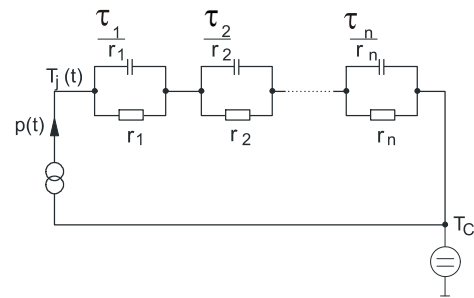


Figure D. Thermal equivalent circuit

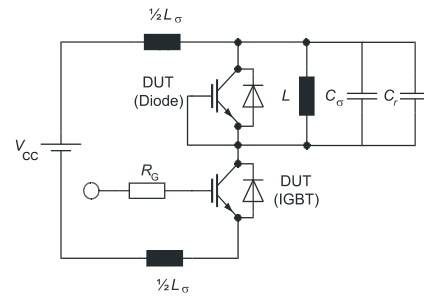


Figure E. Dynamic test circuit  
 Parasitic inductance  $L_\sigma$ ,  
 parasitic capacitor  $C_\sigma$ ,  
 relief capacitor  $C_r$ ,  
 (only for ZVT switching)

Figure 7



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