

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

**Features**

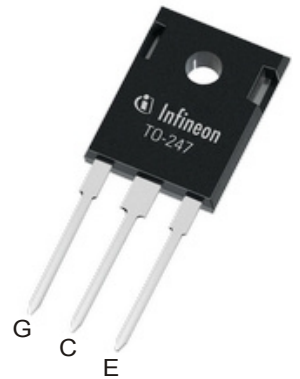
- $V_{CE}=1200\text{ V}$
- $I_C=50\text{ A}$
- IGBT co-packed with full current, soft and low  $Q_{rr}$  diode
- Low saturation voltage  $V_{CE(sat)} = 2.0\text{ V}$  at  $T_{vj}=175\text{ °C}$
- Optimized for hard switching topologies (2-L inverter, 3-L NPC T-type, ...)
- Short circuit ruggedness 8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

**Potential applications**

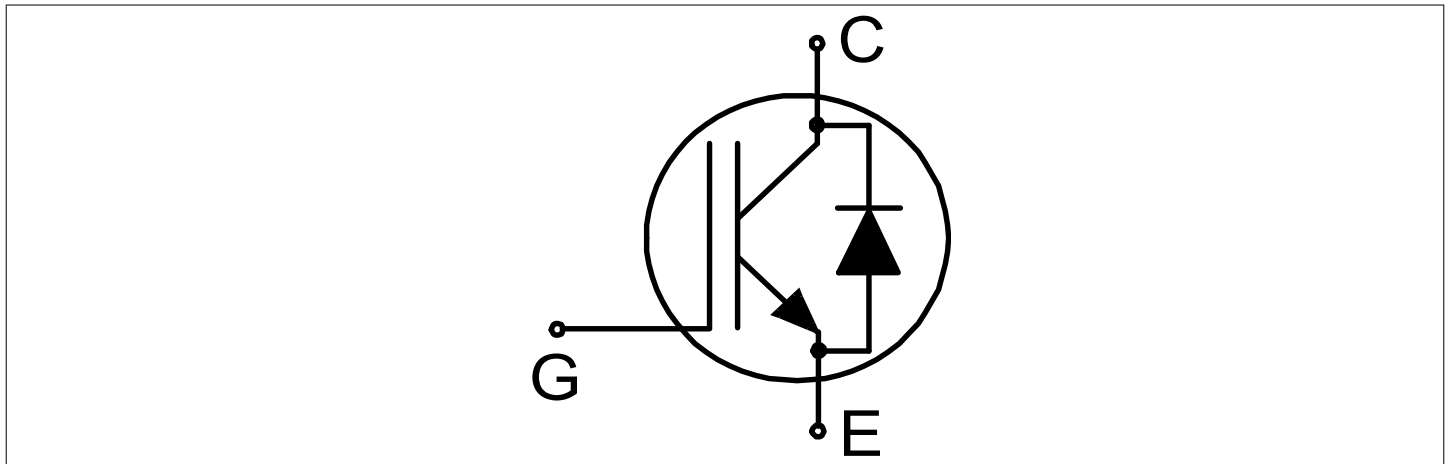
- Industrial Drives
- Industrial Power Supplies
- Solar Inverters

**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

## Table of contents

	<b>Description</b> .....	1
	<b>Features</b> .....	1
	<b>Potential applications</b> .....	1
	<b>Product validation</b> .....	1
	<b>Table of contents</b> .....	2
<b>1</b>	<b>Package</b> .....	3
<b>2</b>	<b>IGBT</b> .....	3
<b>3</b>	<b>Diode</b> .....	5
<b>4</b>	<b>Characteristics diagrams</b> .....	7
<b>5</b>	<b>Package outlines</b> .....	14
<b>6</b>	<b>Testing conditions</b> .....	15
	<b>Disclaimer</b> .....	16

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	$V_{GEth}$	$I_C = 0.98 \text{ mA}$ , $V_{CE} = V_{GE}$ , $T_{vj} = 25 \text{ }^\circ\text{C}$	5.15	5.70	6.45	V
Zero gate voltage collector current	$I_{CES}$	$V_{CE} = 1200 \text{ V}$ , $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		40	$\mu\text{A}$
			$T_{vj} = 175 \text{ }^\circ\text{C}$		4000	
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0 \text{ V}$ , $V_{GE} = 20 \text{ V}$			100	nA
Transconductance	$g_{fs}$	$I_C = 50.0 \text{ A}$ , $V_{CE} = 20 \text{ V}$ , $T_{vj} = 175 \text{ }^\circ\text{C}$		21.0		S
Short circuit collector current	$I_{SC}$	$V_{CC} \leq 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $t_{SC} \leq 8 \text{ } \mu\text{s}$ , Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0 \text{ s}$ , $T_{vj} = 25 \text{ }^\circ\text{C}$		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	$t_{don}$	$V_{CE} = 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $R_{Gon} = 2.3 \text{ } \Omega$ , $R_{Goff} = 2.3 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_C = 50.0 \text{ A}$		29	ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$ , $I_C = 50.0 \text{ A}$		26	
Rise time (inductive load)	$t_r$	$V_{CE} = 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $R_{Gon} = 2.3 \text{ } \Omega$ , $R_{Goff} = 2.3 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_C = 50.0 \text{ A}$		19	ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$ , $I_C = 50.0 \text{ A}$		19	
Turn-off delay time	$t_{doff}$	$V_{CE} = 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $R_{Gon} = 2.3 \text{ } \Omega$ , $R_{Goff} = 2.3 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_C = 50.0 \text{ A}$		170	ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$ , $I_C = 50.0 \text{ A}$		225	
Fall time (inductive load)	$t_f$	$V_{CE} = 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $R_{Gon} = 2.3 \text{ } \Omega$ , $R_{Goff} = 2.3 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_C = 50.0 \text{ A}$		100	ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$ , $I_C = 50.0 \text{ A}$		245	
Turn-on energy	$E_{on}$	$V_{CE} = 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $R_{Gon} = 2.3 \text{ } \Omega$ , $R_{Goff} = 2.3 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_C = 50.0 \text{ A}$		2.80	mJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$ , $I_C = 50.0 \text{ A}$		4.30	
Turn-off energy	$E_{off}$	$V_{CE} = 600 \text{ V}$ , $V_{GE} = 15 \text{ V}$ , $R_{Gon} = 2.3 \text{ } \Omega$ , $R_{Goff} = 2.3 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_C = 50.0 \text{ A}$		2.20	mJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$ , $I_C = 50.0 \text{ A}$		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/ $\mu$ 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

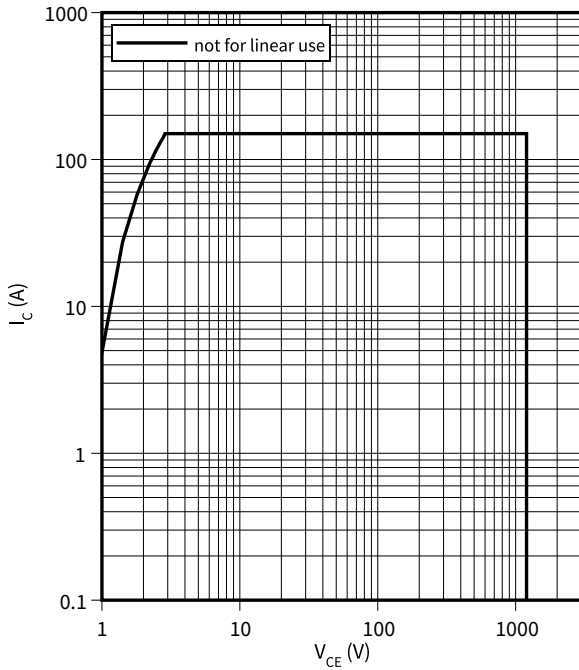
*Note:* For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

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

## 4 Characteristics diagrams

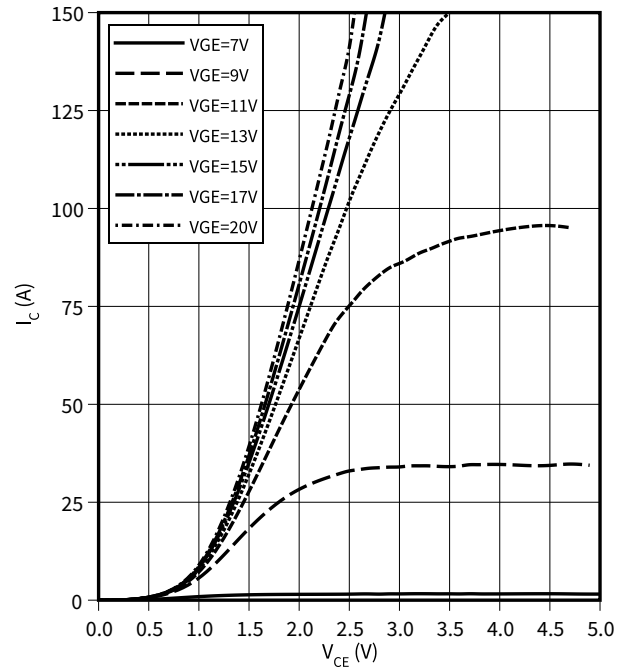
### Reverse bias safe operating area, IGBT

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



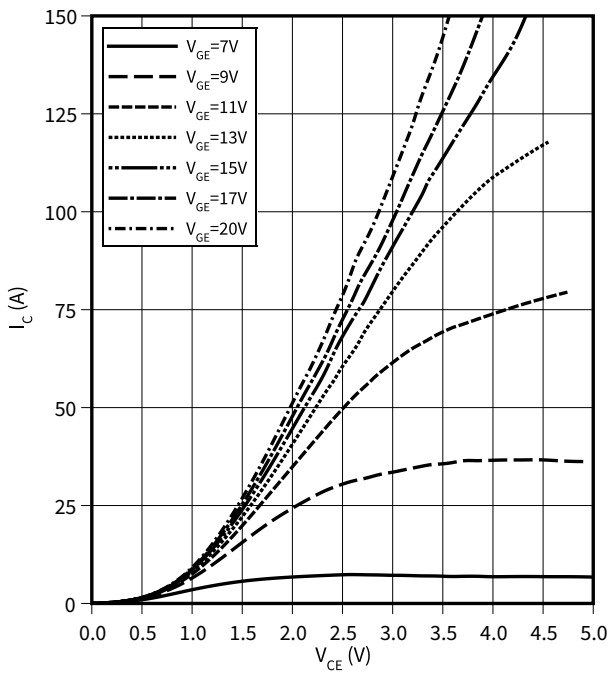
### Typical output characteristic, IGBT

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



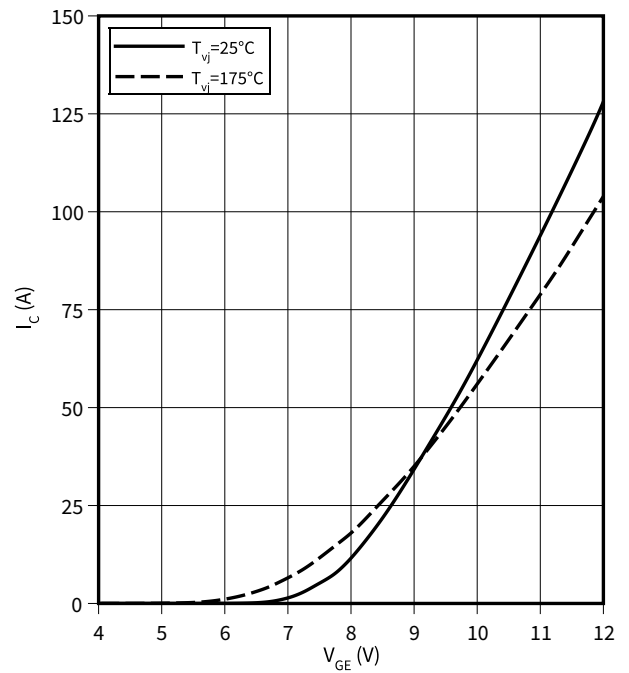
### Typical output characteristic, IGBT

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



### Typical transfer characteristic, IGBT

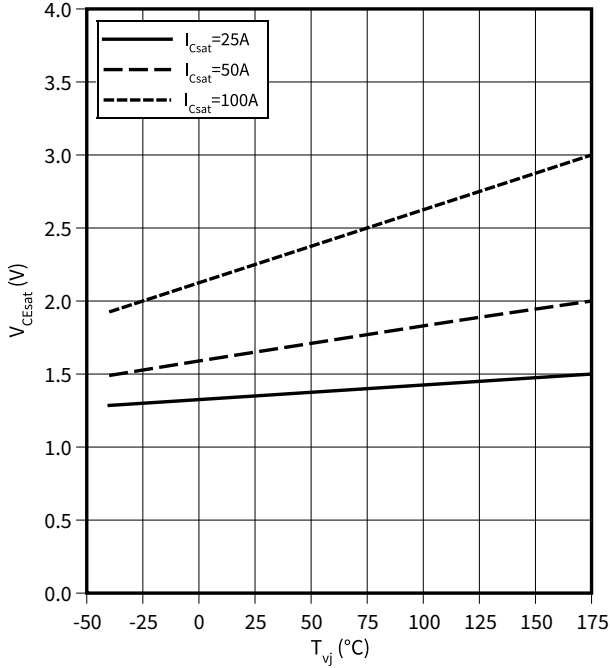
$I_C = f(V_{GE})$   
 $V_{CE} = 20\text{ V}$



**4 Characteristics diagrams**

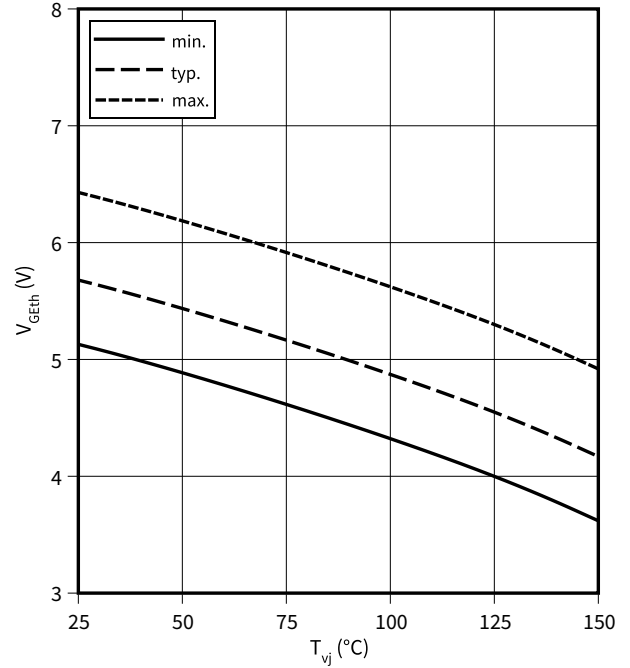
**Typical collector-emitter saturation voltage as a function of junction temperature, IGBT**

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



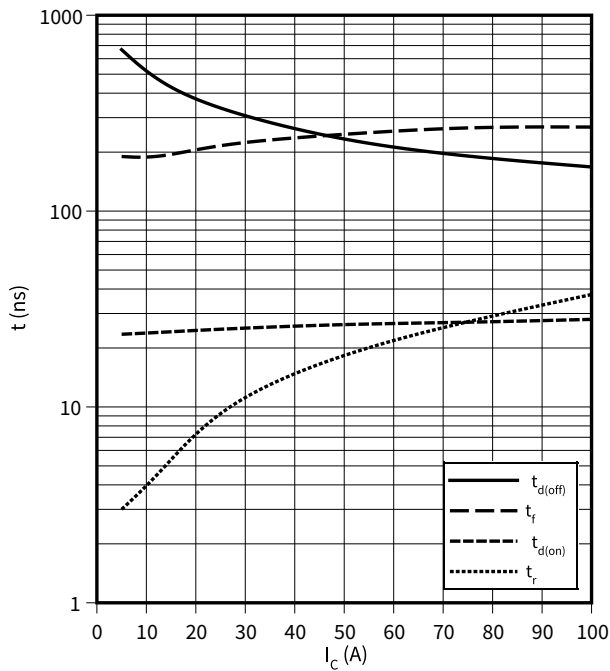
**Gate-emitter threshold voltage as a function of junction temperature, IGBT**

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



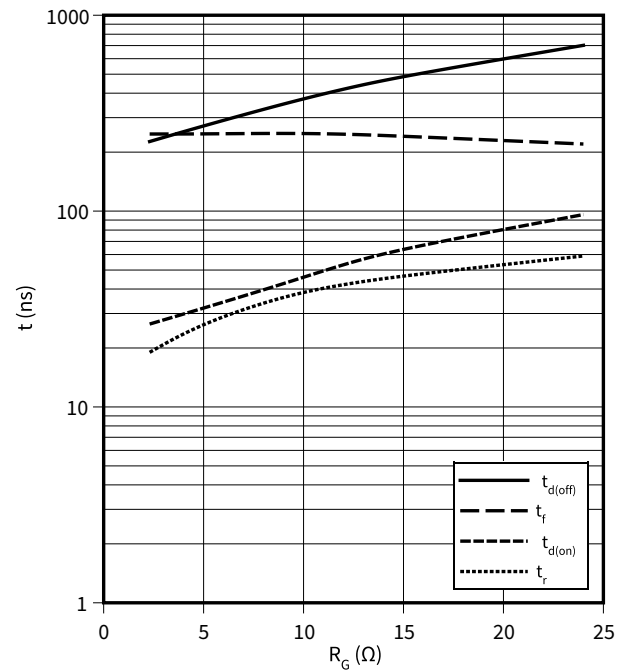
**Typical switching times as a function of collector current, IGBT**

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



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

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



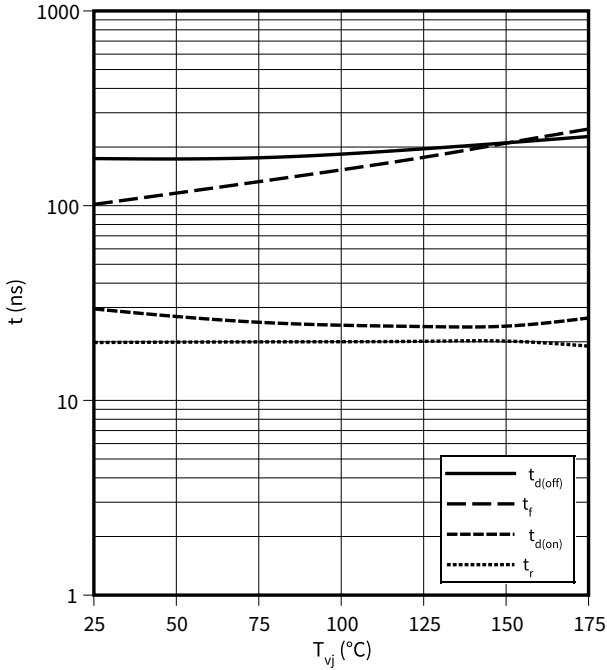


4 Characteristics diagrams

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

$t = f(T_{vj})$

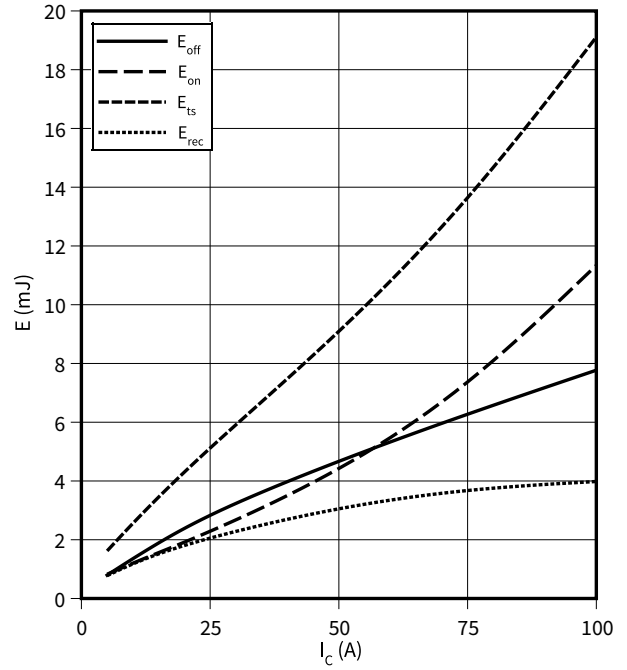
$I_C = 50.0 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 2.3 \Omega$



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

$E = f(I_C)$

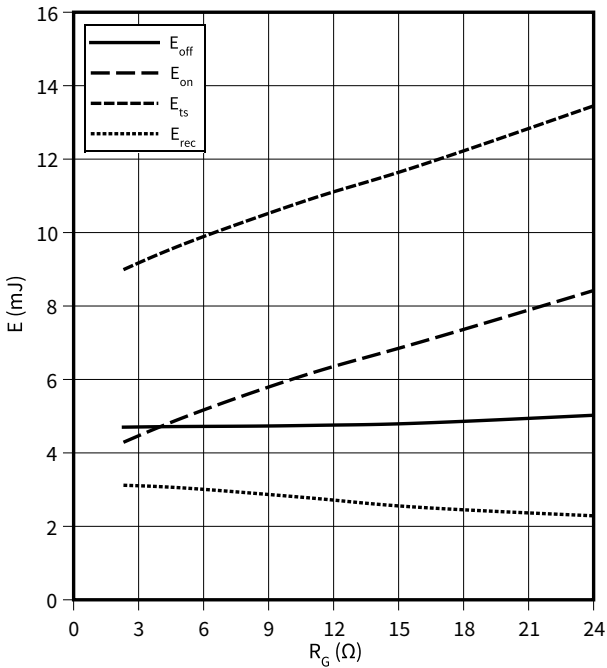
$V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 2.3 \Omega$



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

$E = f(R_G)$

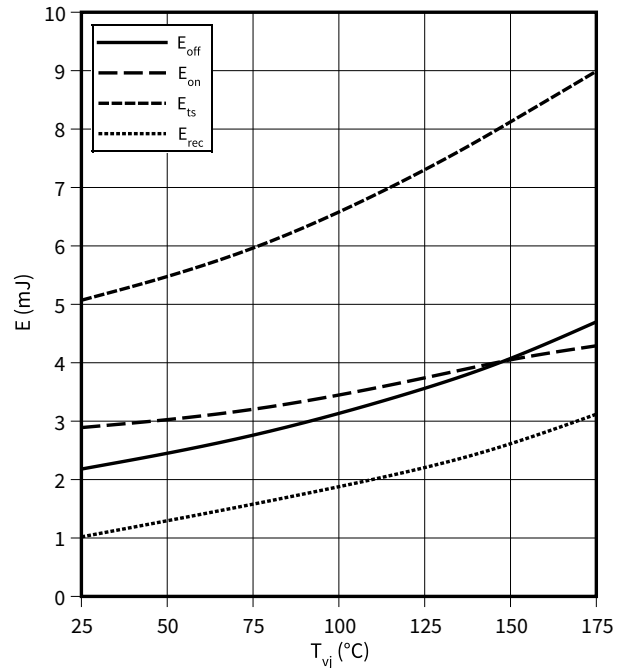
$I_C = 50.0 \text{ A}, V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$



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

$E = f(T_{vj})$

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

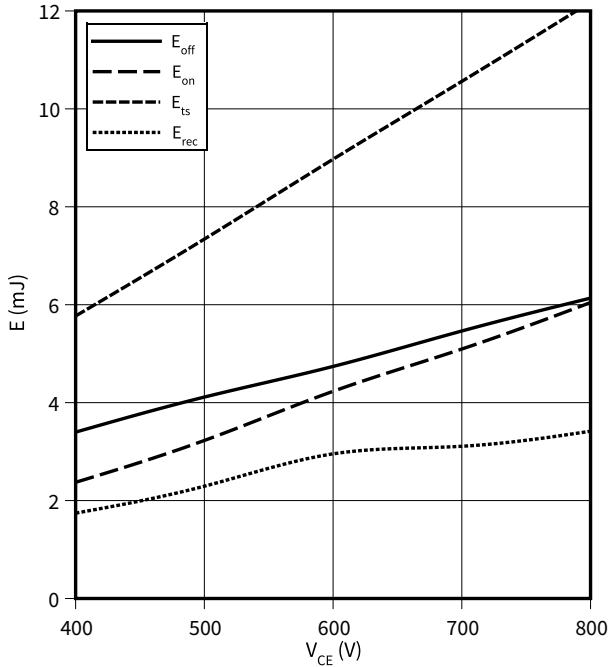


4 Characteristics diagrams

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

$E = f(V_{CE})$

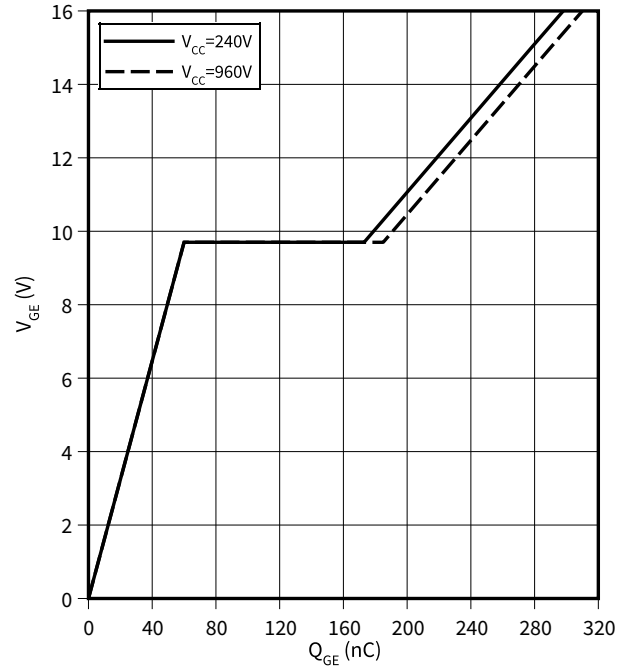
$I_C = 50.0 \text{ A}$ ,  $T_{vj} = 175 \text{ }^\circ\text{C}$ ,  $V_{GE} = 0/15 \text{ V}$ ,  $R_G = 2.3 \text{ } \Omega$



**Typical gate charge, IGBT**

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

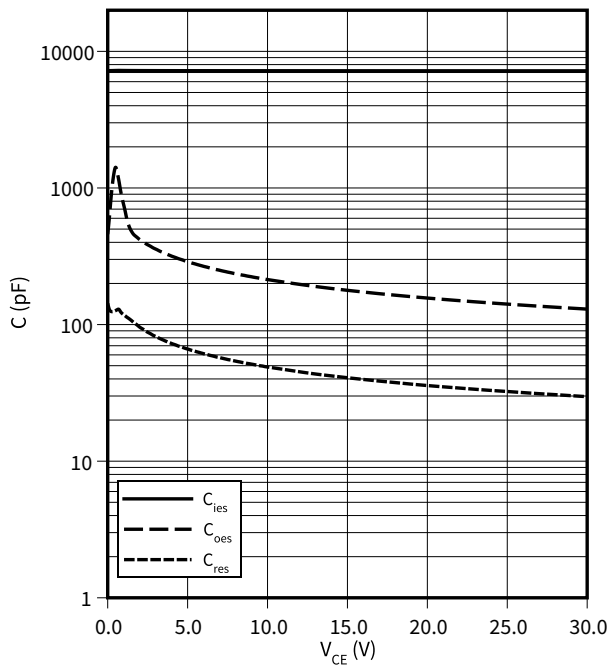
$I_C = 50.0 \text{ A}$



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

$C = f(V_{CE})$

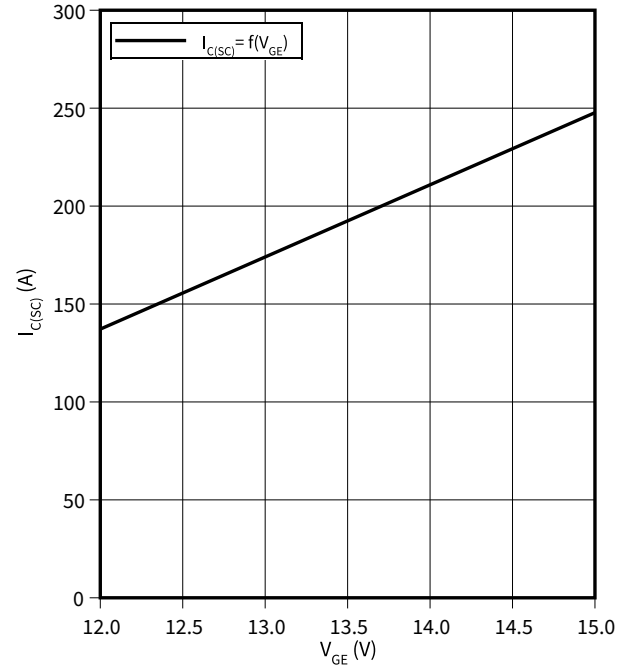
$f = 100 \text{ kHz}$ ,  $V_{GE} = 0 \text{ V}$



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

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

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

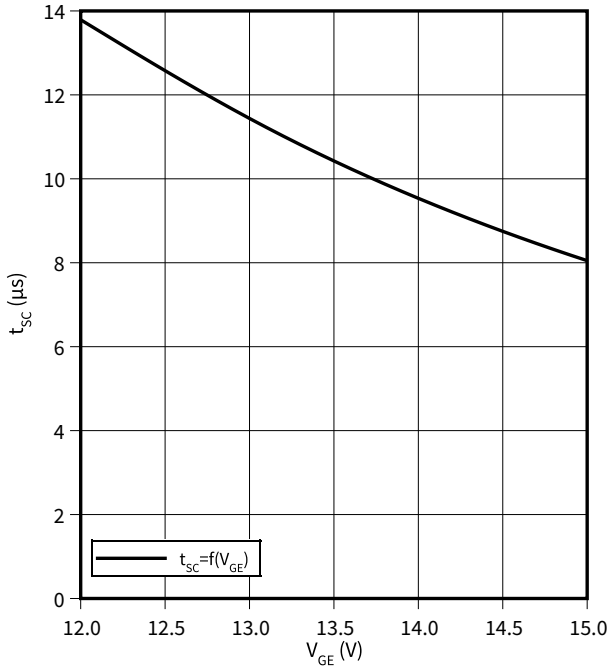


4 Characteristics diagrams

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

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

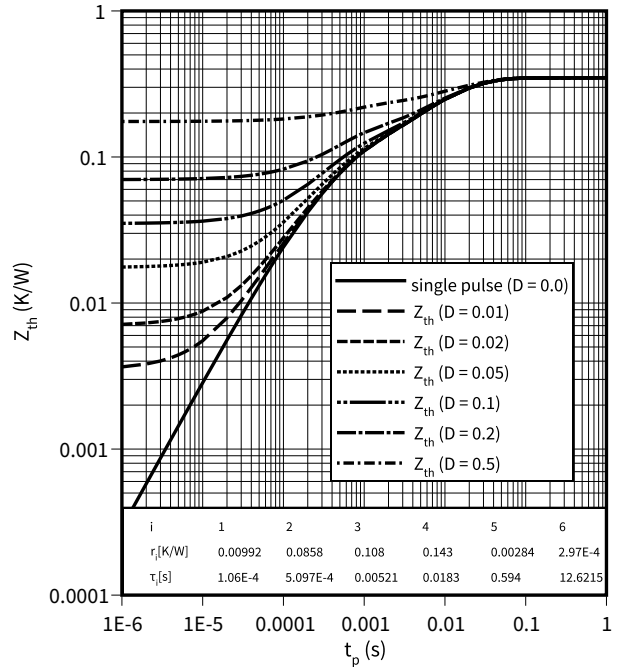
$T_{vj} \leq 150\text{ °C}$ ,  $V_{CC} = 600\text{ V}$



**IGBT transient thermal impedance, IGBT**

$Z_{th} = f(t_p)$

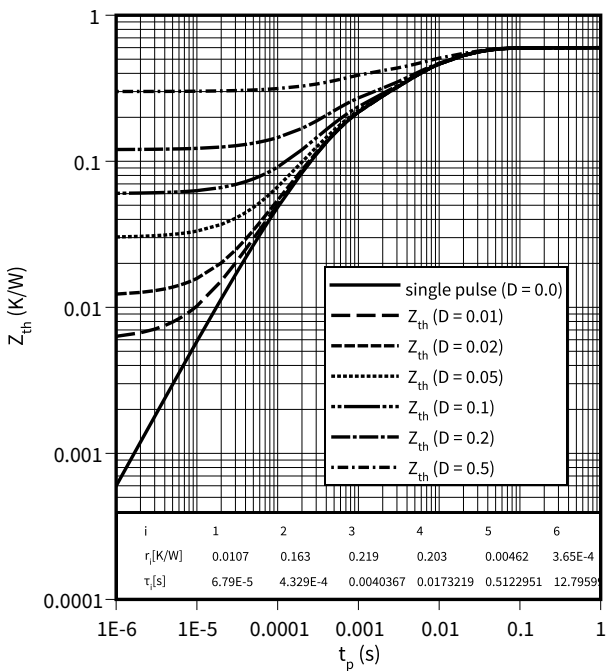
$D = t_p/T$



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

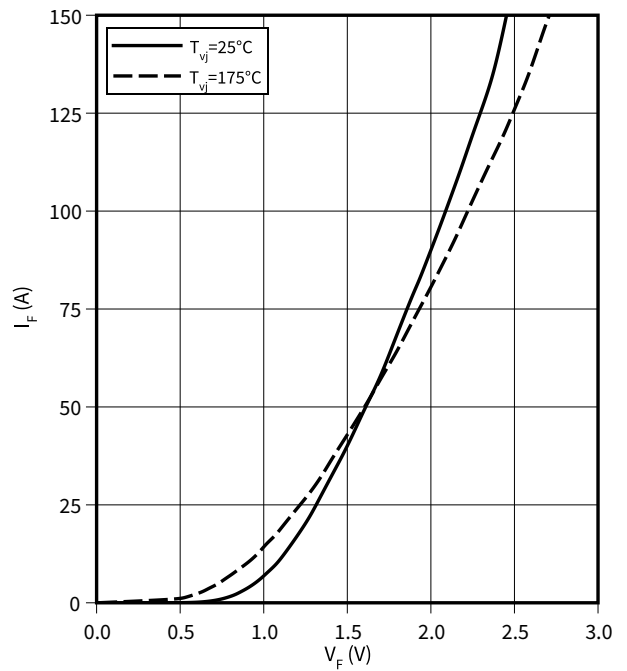
$Z_{th} = f(t_p)$

$D = t_p/T$



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

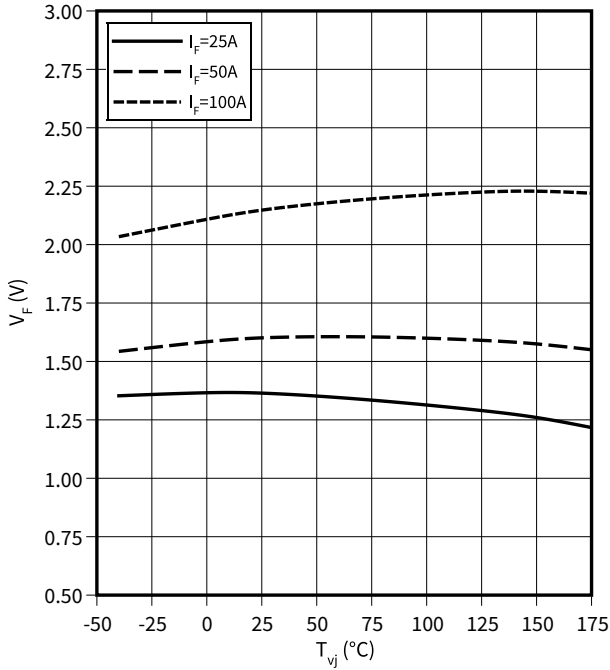
$I_F = f(V_F)$



4 Characteristics diagrams

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

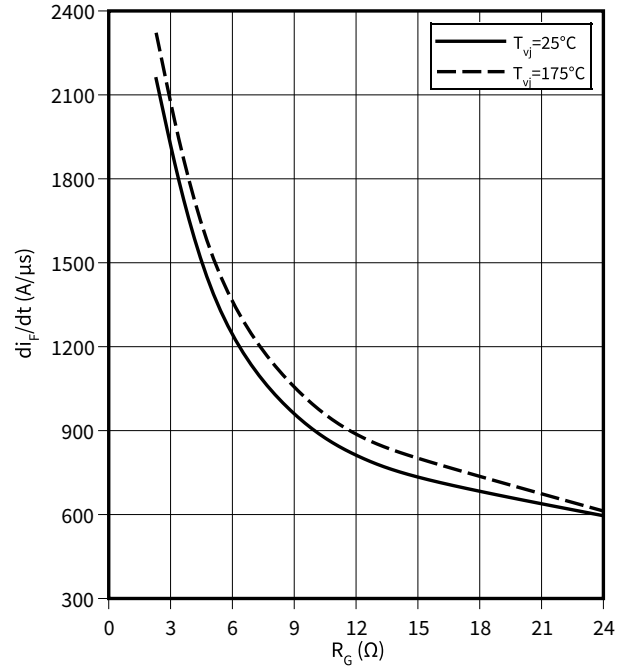
$V_F = f(T_{vj})$



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

$di_F/dt = f(R_G)$

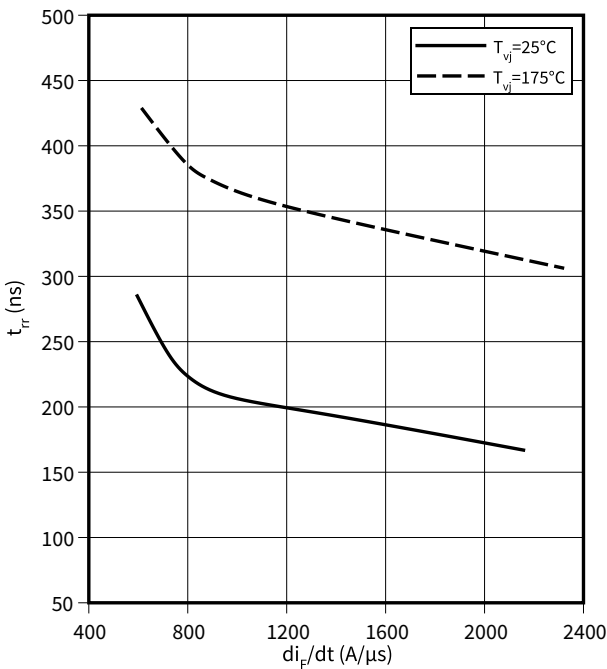
$I_C = 50.0 A, V_{CE} = 600 V, V_{GE} = 0/15 V$



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

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

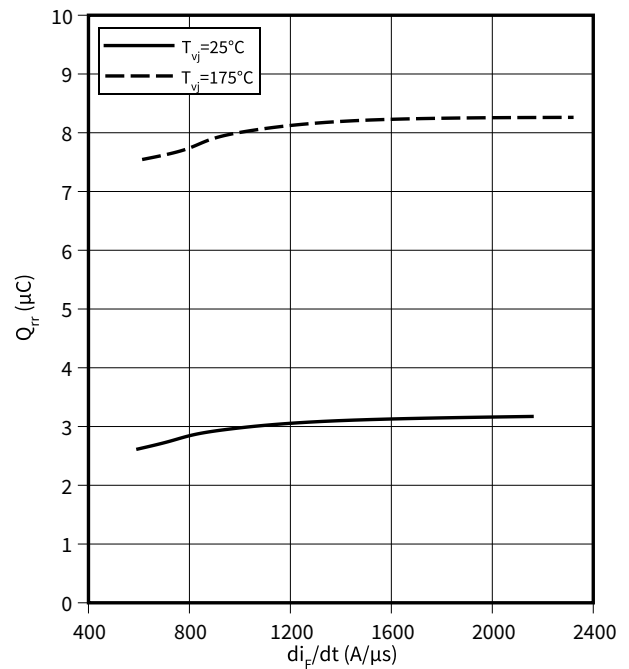
$V_R = 600 V, I_F = 50.0 A$



**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**

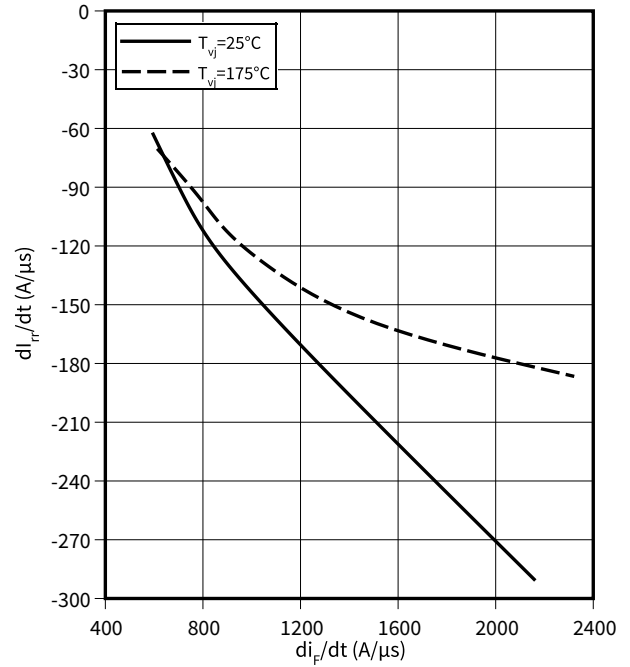
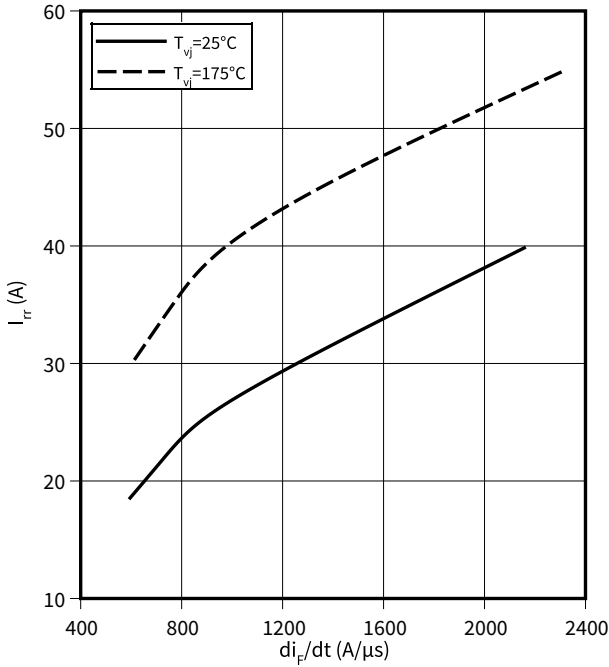
$I_{rr} = f(di_F/dt)$

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

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

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

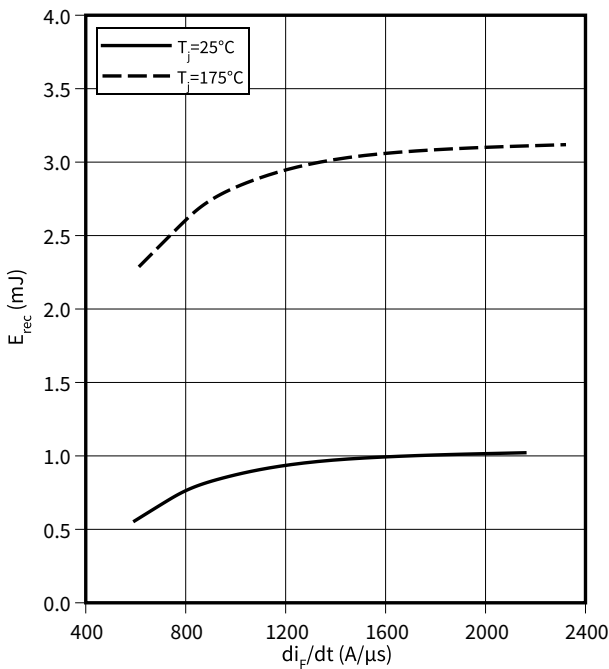
$V_R = 600\text{ V}, I_F = 50.0\text{ A}$



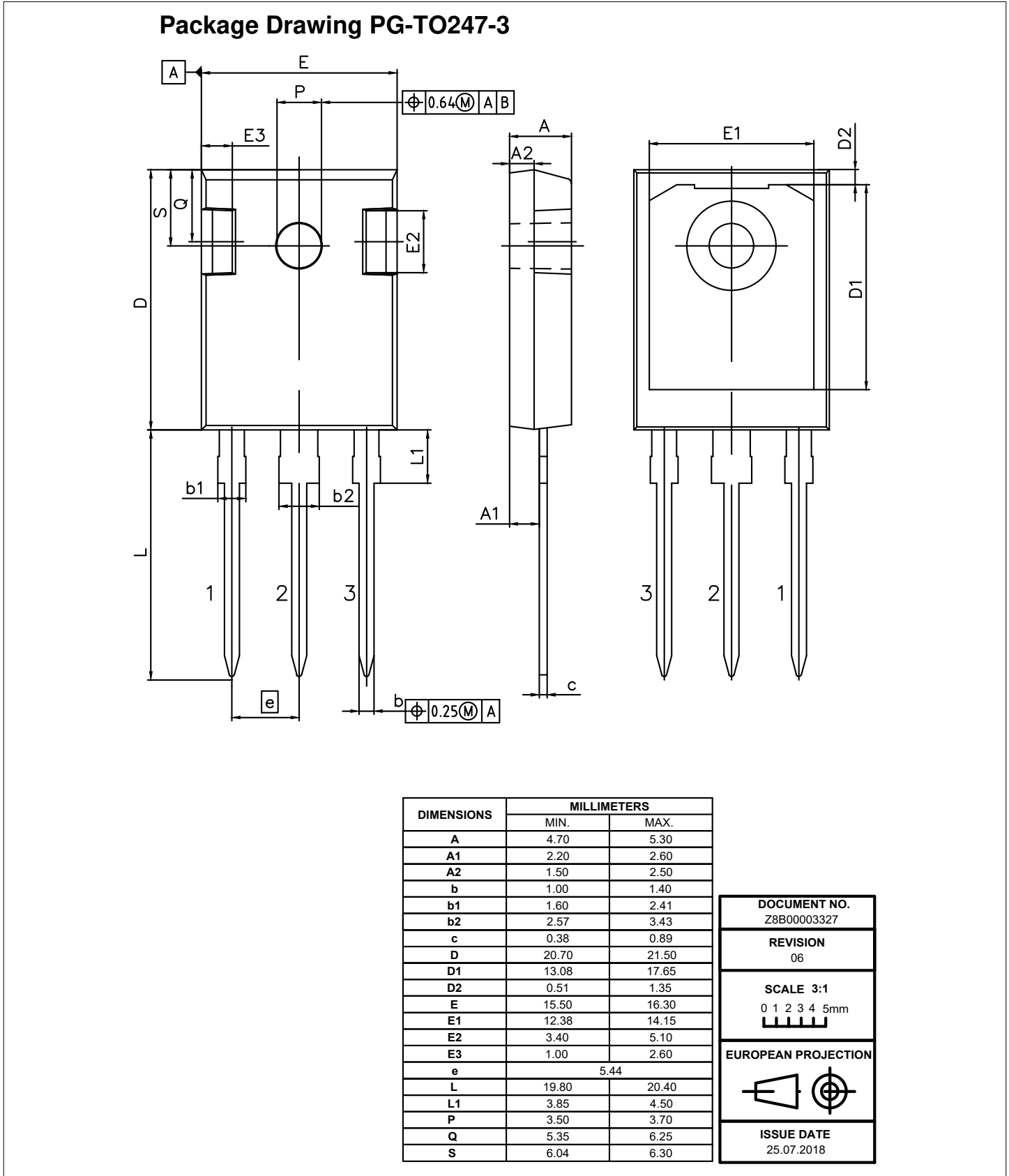
**Typical reverse energy losses as a function of diode current slope, Diode**

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

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



**5 Package outlines**



**Figure 6**

6 Testing conditions

**6 Testing conditions**

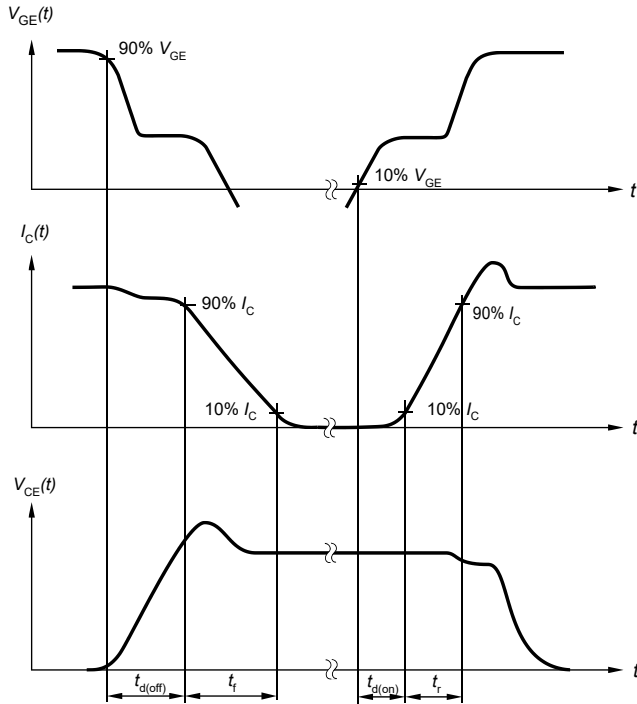


Figure A. Definition of switching times

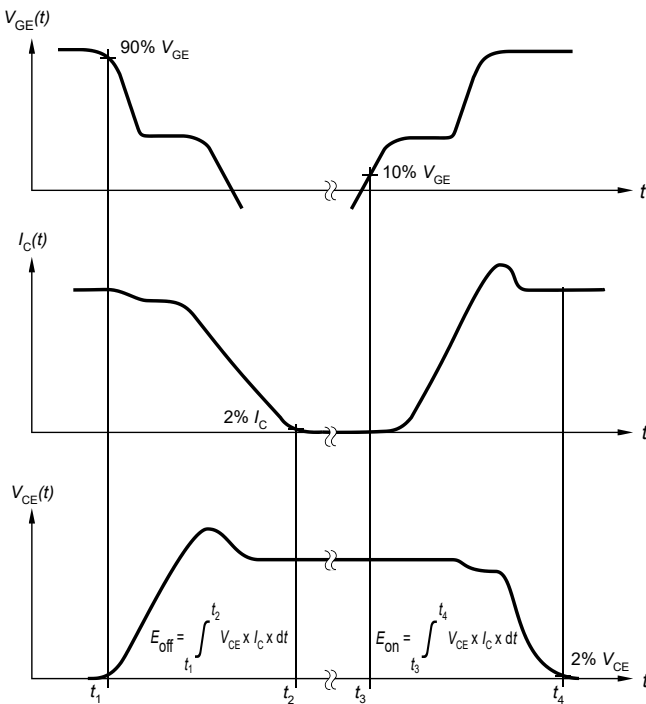


Figure B. Definition of switching losses

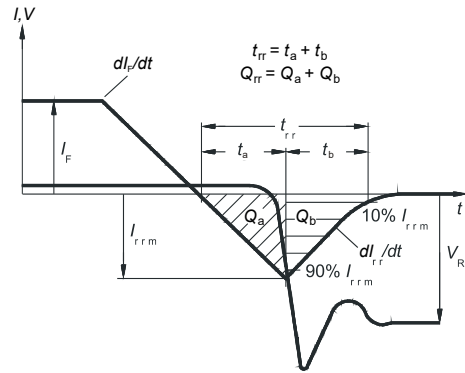


Figure C. Definition of diode switching characteristics

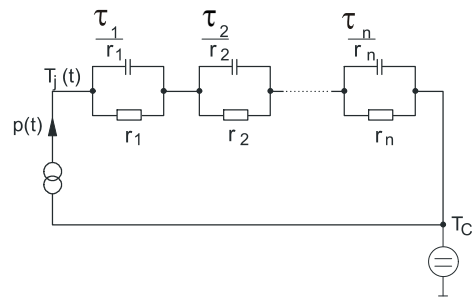


Figure D. Thermal equivalent circuit

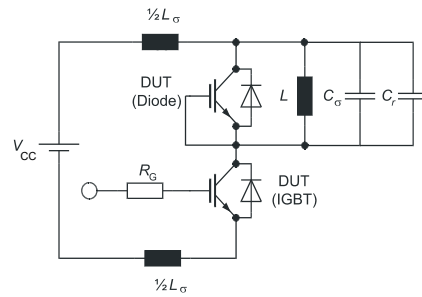


Figure E. **Dynamic test circuit**  
 Parasitic inductance  $L_\sigma$ ,  
 parasitic capacitor  $C_\sigma$ ,  
 relief capacitor  $C_r$ ,  
 (only for ZVT switching)

**Figure 7**

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