

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

Features

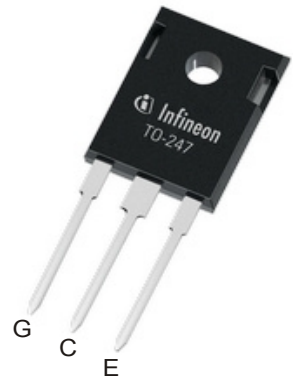
- $V_{CE} = 1200\text{ V}$
- $I_C = 50\text{ A}$
- IGBT co-packed with full current, soft and low Q_{rr} diode
- Low saturation voltage $V_{CE(sat)} = 2.0\text{ V}$ at $T_{vj} = 175\text{ °C}$
- Optimized for hard switching topologies (2-L inverter, 3-L NPC T-type, ...)
- Short circuit ruggedness $8\text{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

Potential applications

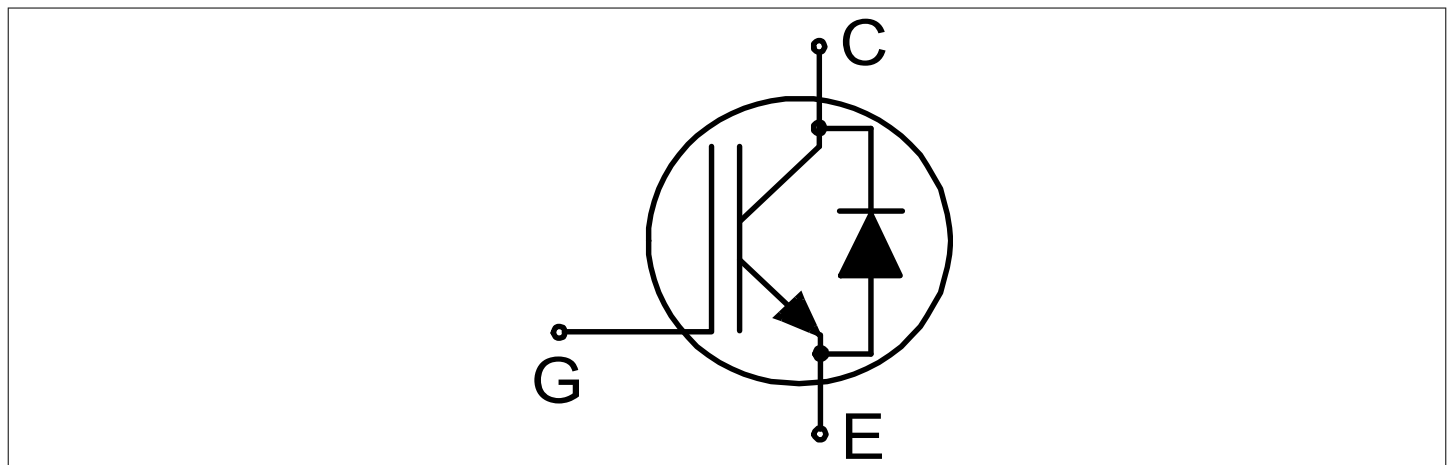
- Industrial Drives
- Industrial Power Supplies
- Solar Inverters

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

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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}		± 20	V	
Transient gate-emitter voltage	V_{GE}	$t_p \leq 0.5\text{ }\mu\text{s}, D < 0.001$	± 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	μs	
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	μA
			$T_{vj} = 175 \text{ }^\circ\text{C}$		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	μA
			$T_{vj} = 175\text{ }^\circ\text{C}$	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		μC
			$T_{vj} = 175\text{ }^\circ\text{C},$ $I_F = 50.0\text{ A}$	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/ μs
			$T_{vj} = 175 \text{ °C}, I_F = 50.0 \text{ A}$		-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	

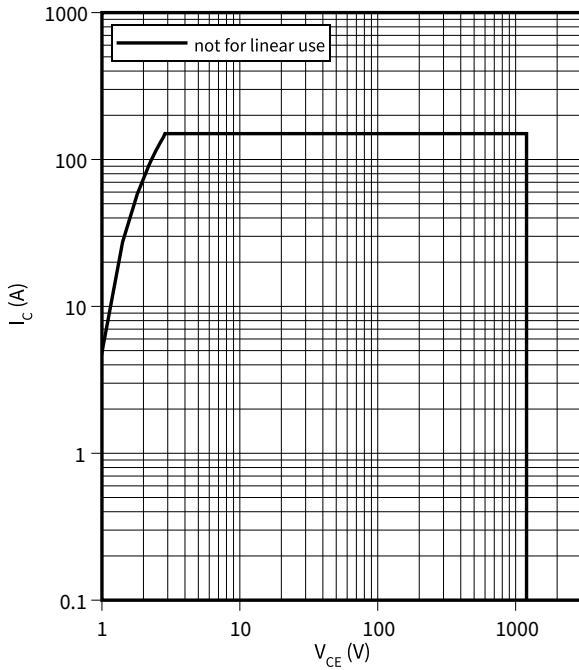
Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

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

4 Characteristics diagrams

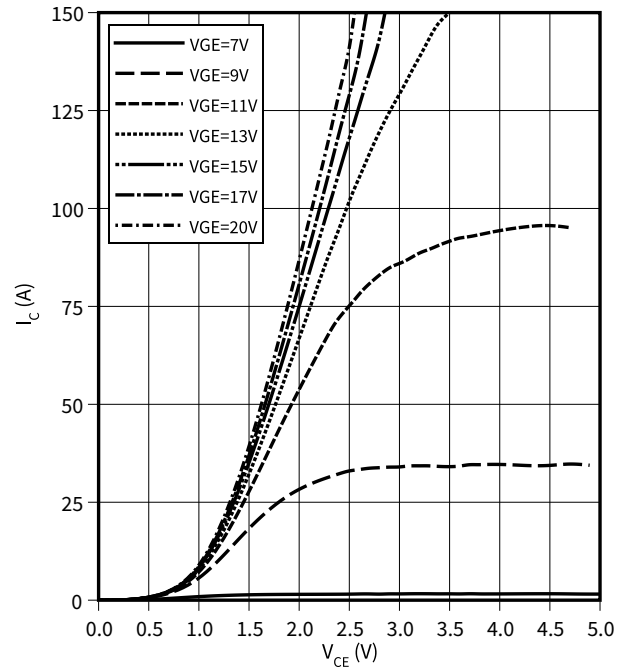
Reverse bias safe operating area, IGBT

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



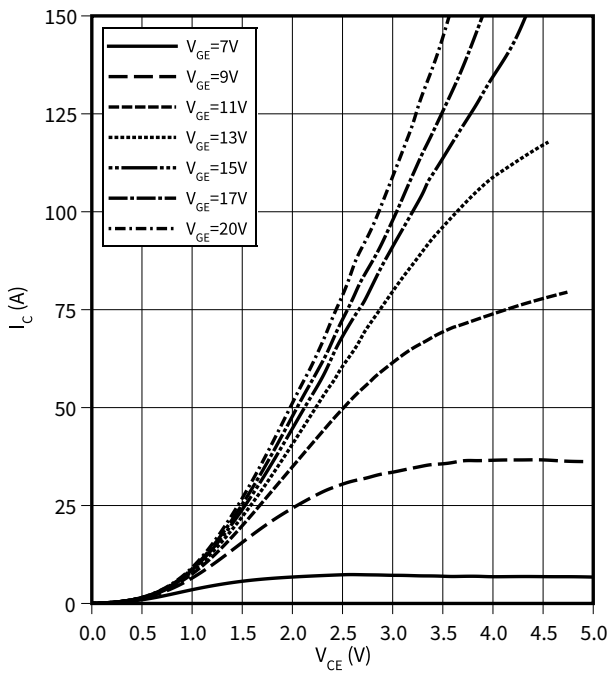
Typical output characteristic, IGBT

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



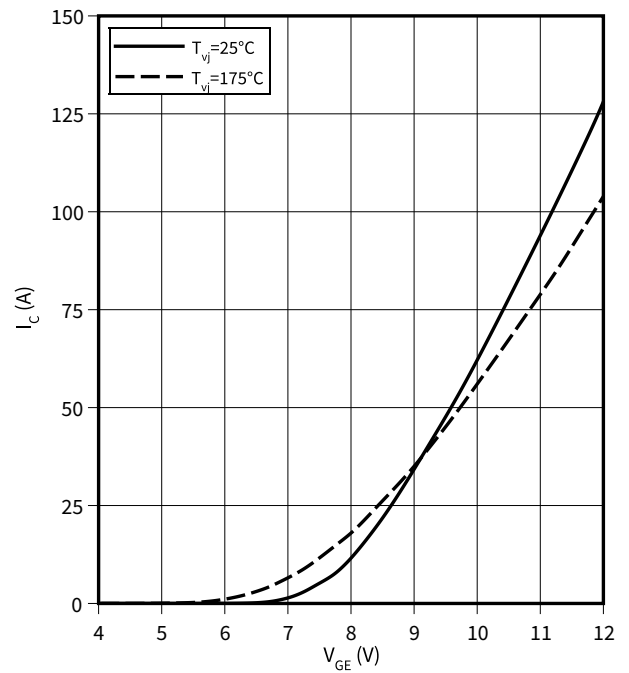
Typical output characteristic, IGBT

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



Typical transfer characteristic, IGBT

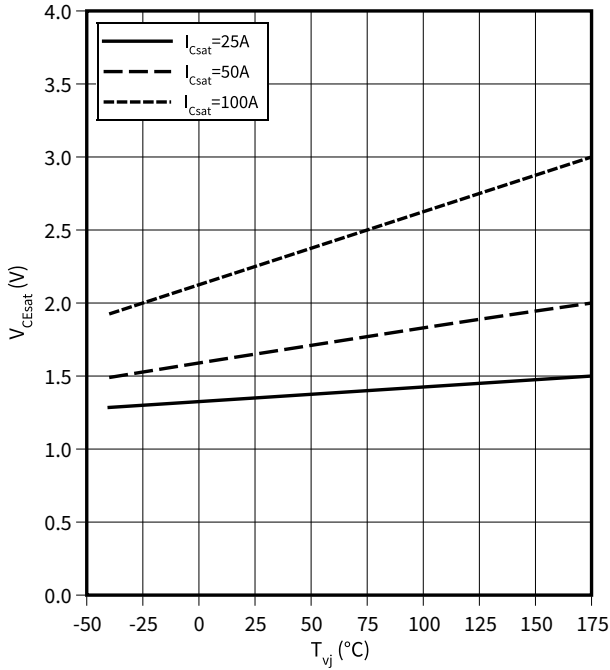
$I_C = f(V_{GE})$
 $V_{CE} = 20\text{ V}$



4 Characteristics diagrams

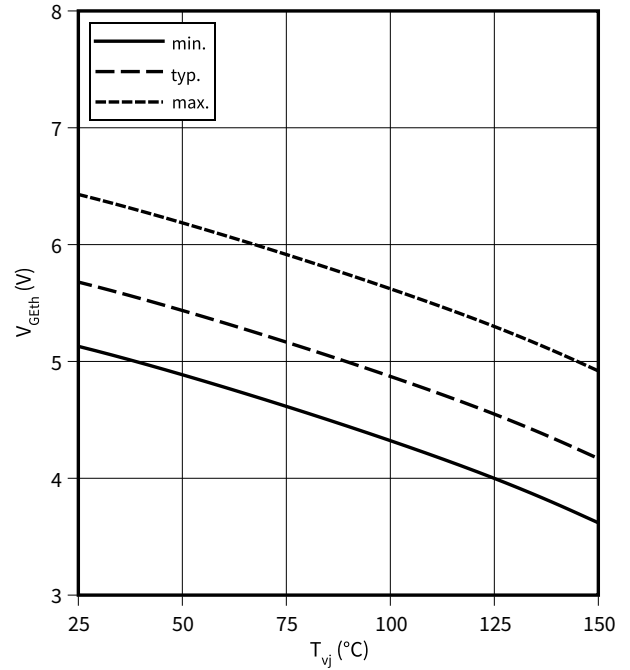
Typical collector-emitter saturation voltage as a function of junction temperature, IGBT

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



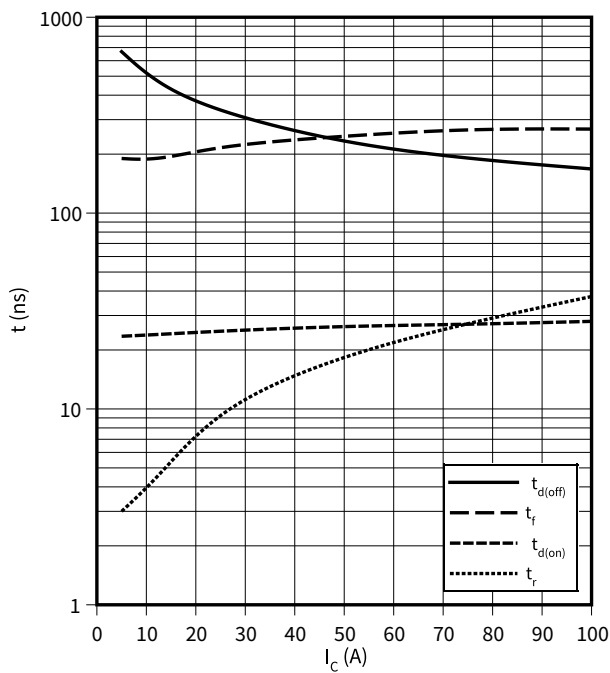
Gate-emitter threshold voltage as a function of junction temperature, IGBT

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



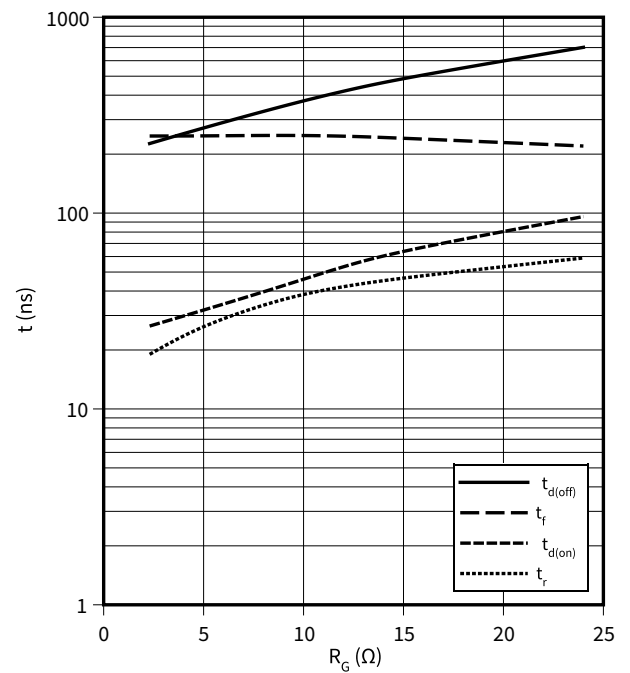
Typical switching times as a function of collector current, IGBT

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



Typical switching times as a function of gate resistor, IGBT

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

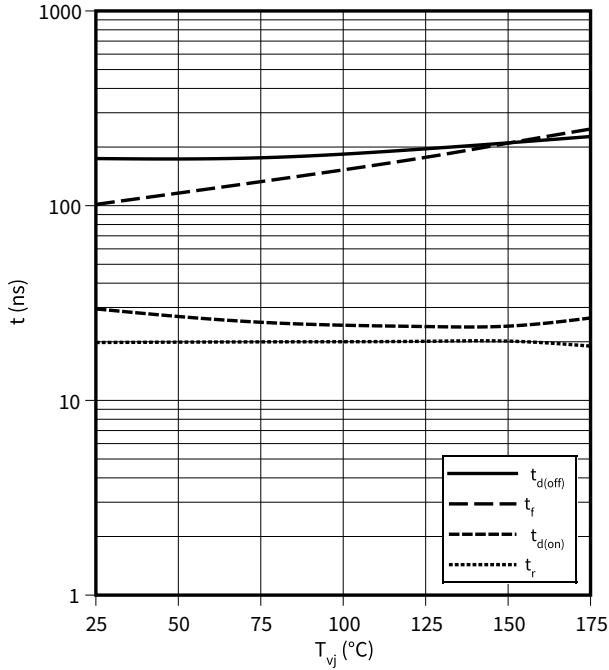


4 Characteristics diagrams

Typical switching times as a function of junction temperature, IGBT

$t = f(T_{vj})$

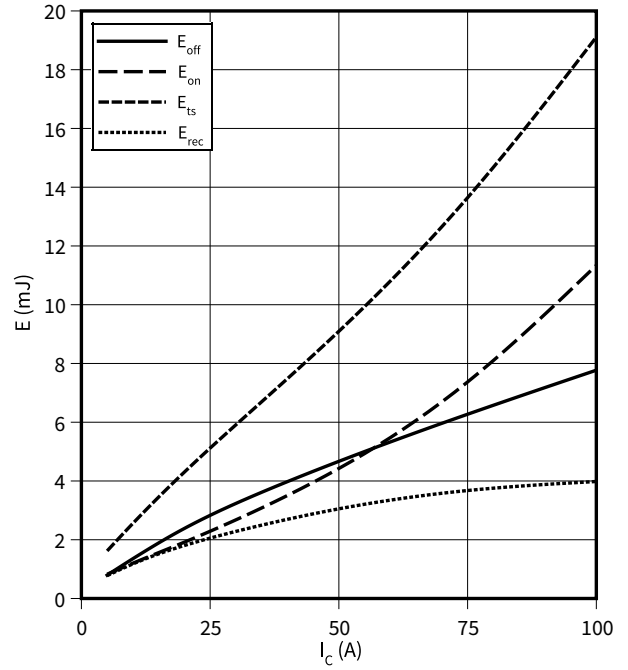
$I_C = 50.0 \text{ A}$, $V_{CE} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 2.3 \Omega$



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

$E = f(I_C)$

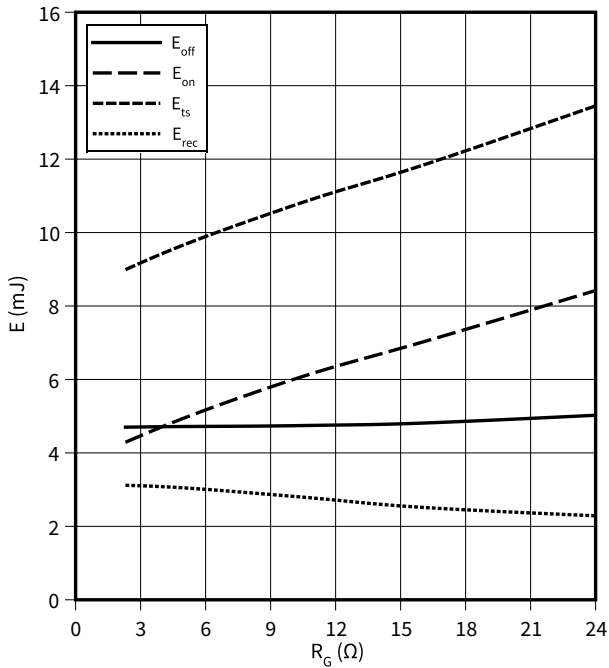
$V_{CE} = 600 \text{ V}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 2.3 \Omega$



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

$E = f(R_G)$

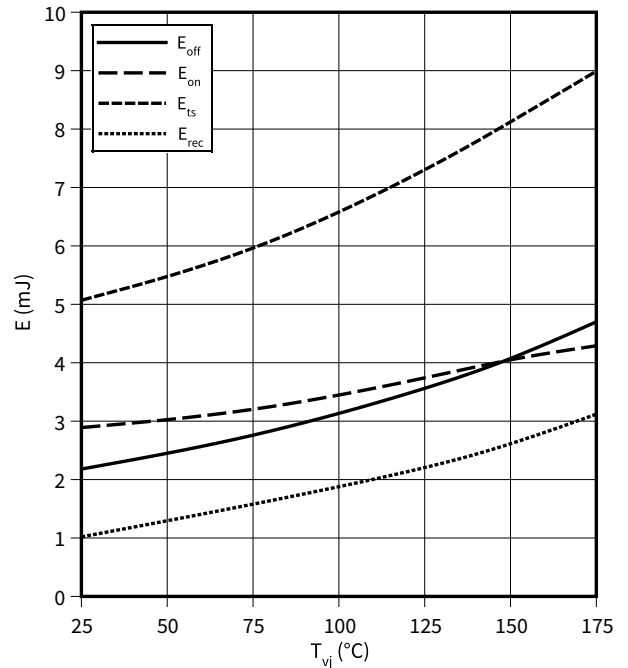
$I_C = 50.0 \text{ A}$, $V_{CE} = 600 \text{ V}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$



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

$E = f(T_{vj})$

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

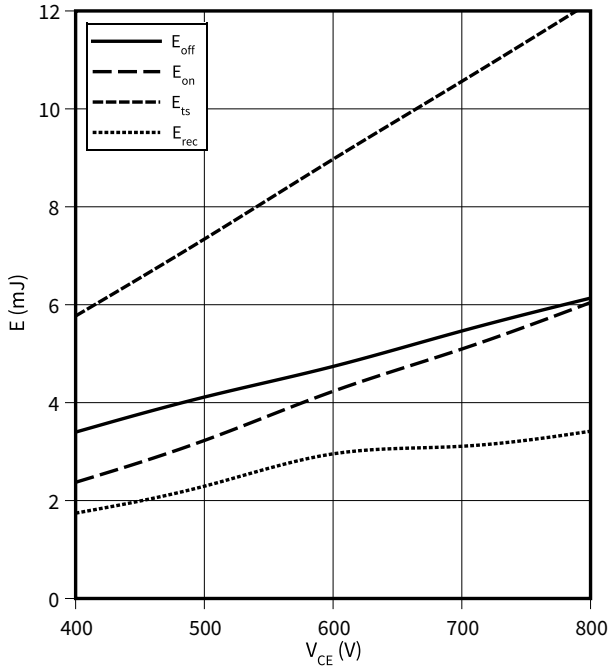


4 Characteristics diagrams

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

$E = f(V_{CE})$

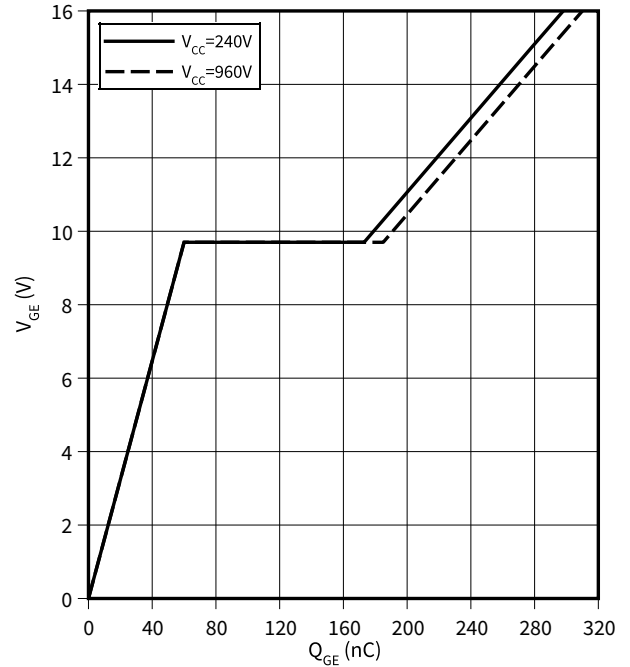
$I_C = 50.0 \text{ A}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 2.3 \text{ } \Omega$



Typical gate charge, IGBT

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

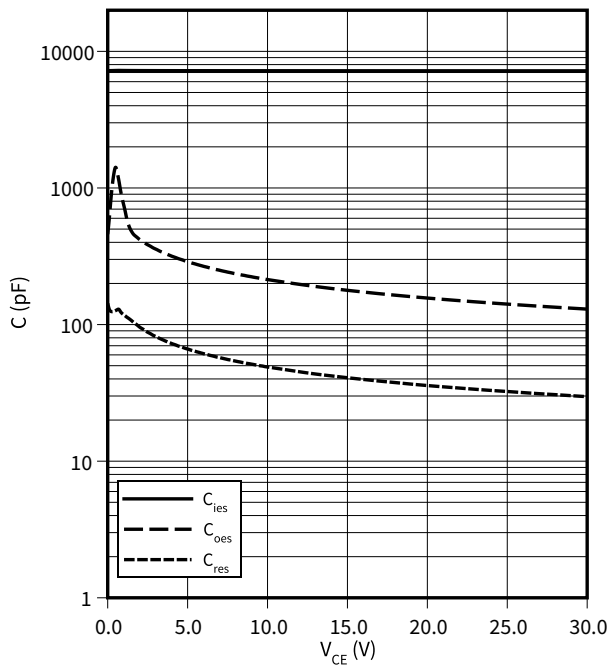
$I_C = 50.0 \text{ A}$



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

$C = f(V_{CE})$

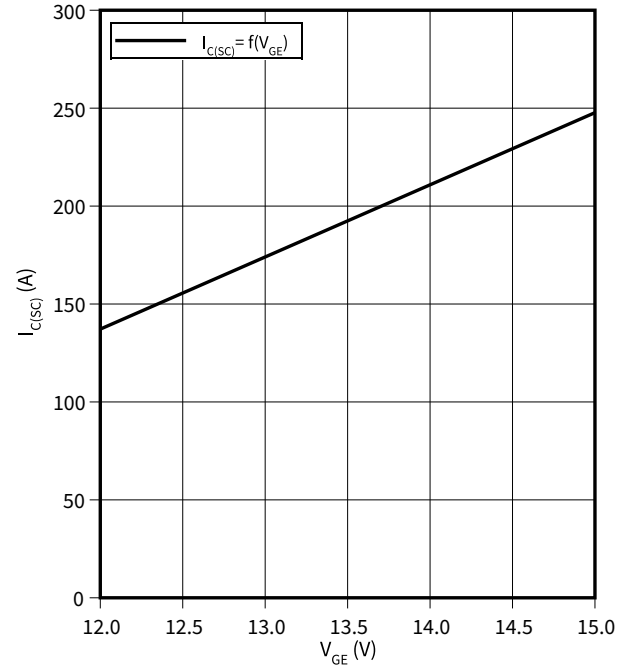
$f = 100 \text{ kHz}$, $V_{GE} = 0 \text{ V}$



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

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

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

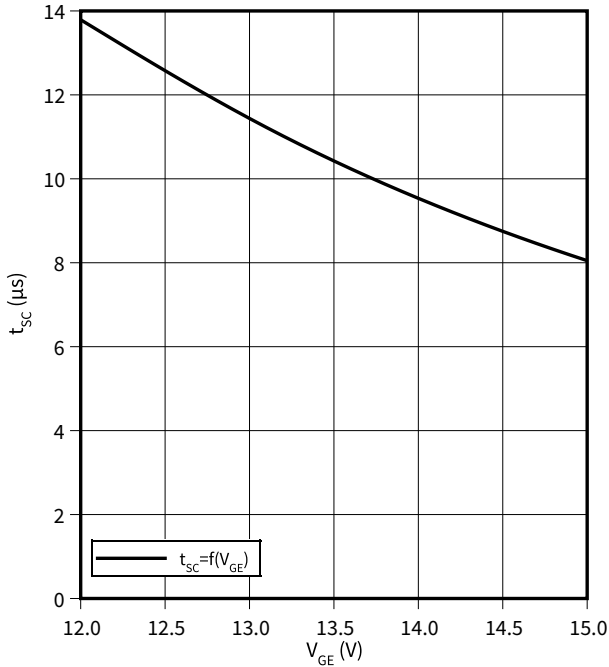


4 Characteristics diagrams

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

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

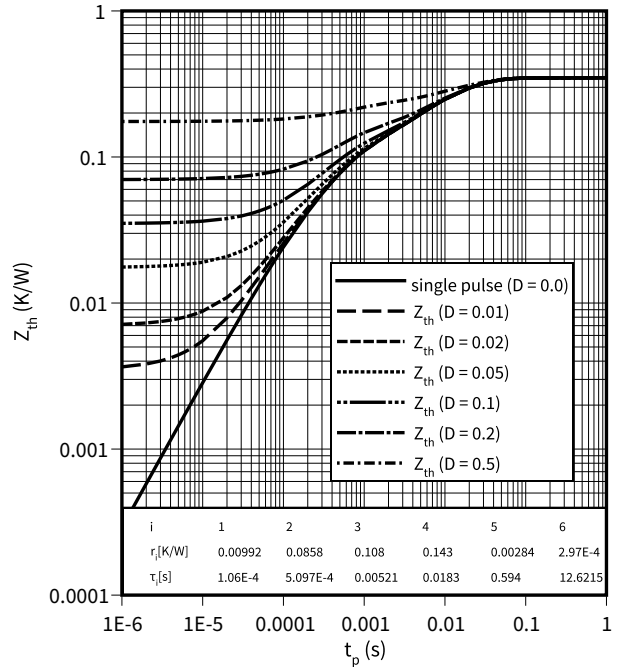
$T_{vj} \leq 150\text{ °C}$, $V_{CC} = 600\text{ V}$



IGBT transient thermal impedance, IGBT

$Z_{th} = f(t_p)$

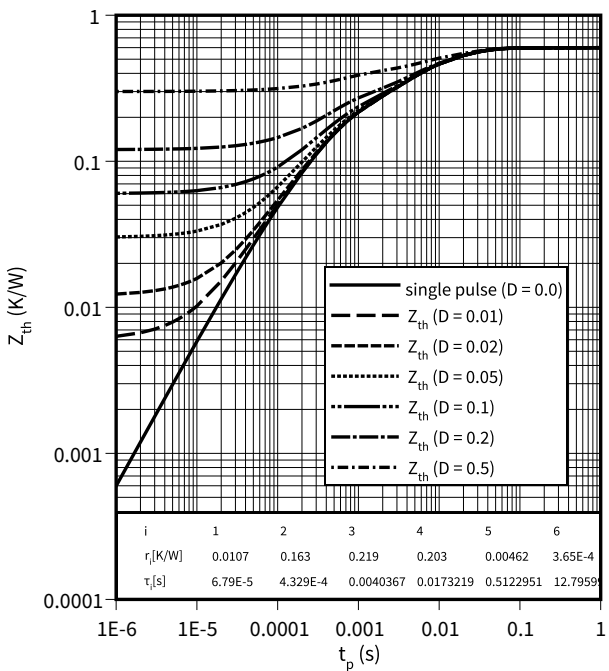
$D = t_p/T$



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

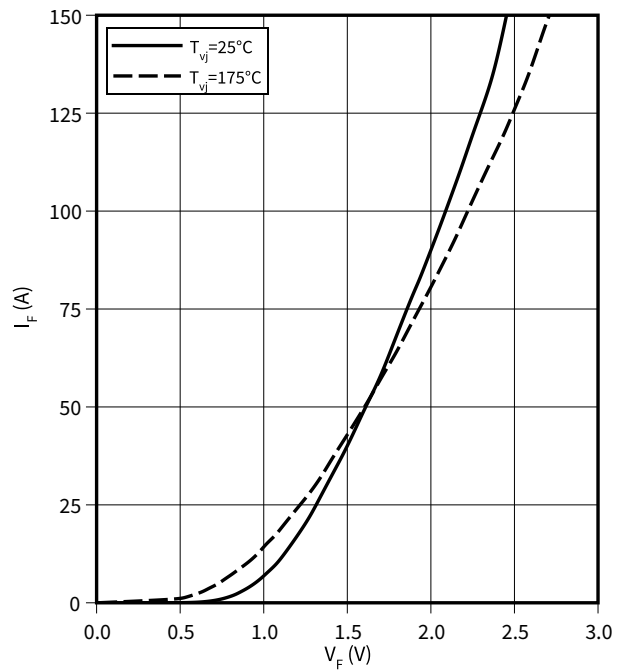
$Z_{th} = f(t_p)$

$D = t_p/T$



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

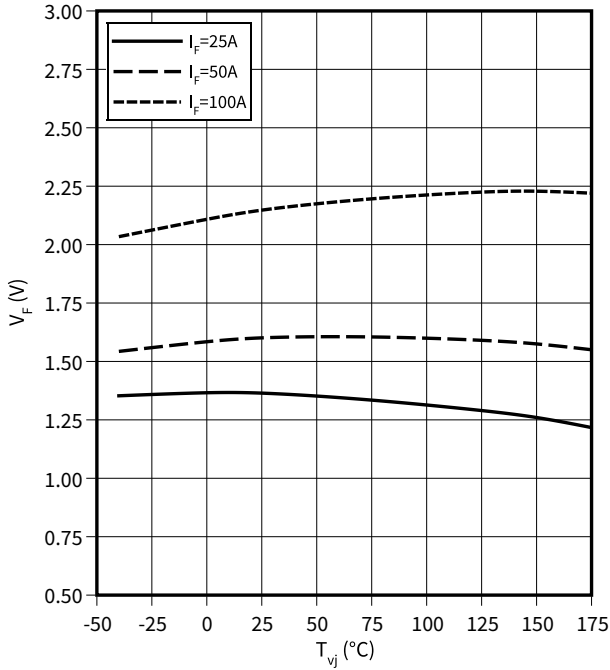
$I_F = f(V_F)$



4 Characteristics diagrams

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

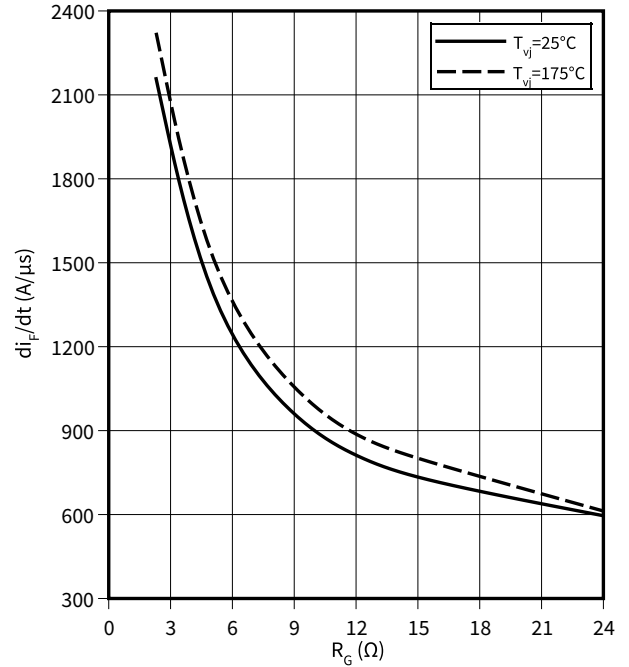
$V_F = f(T_{vj})$



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

$di_F/dt = f(R_G)$

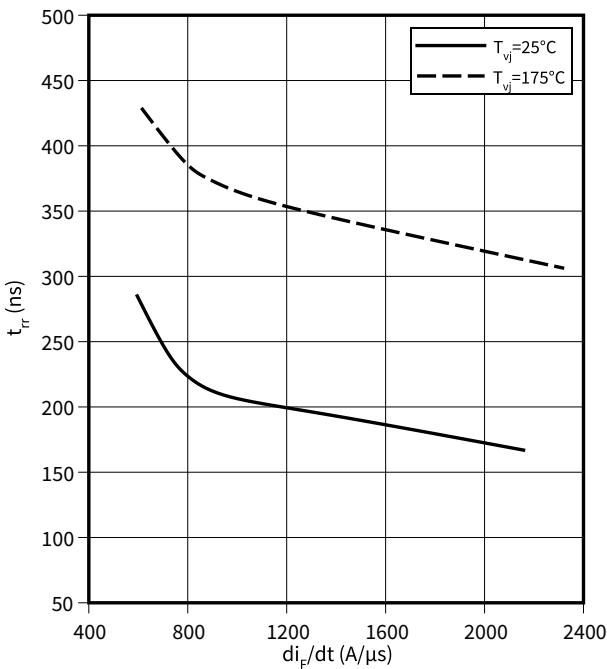
$I_C = 50.0 A, V_{CE} = 600 V, V_{GE} = 0/15 V$



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

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

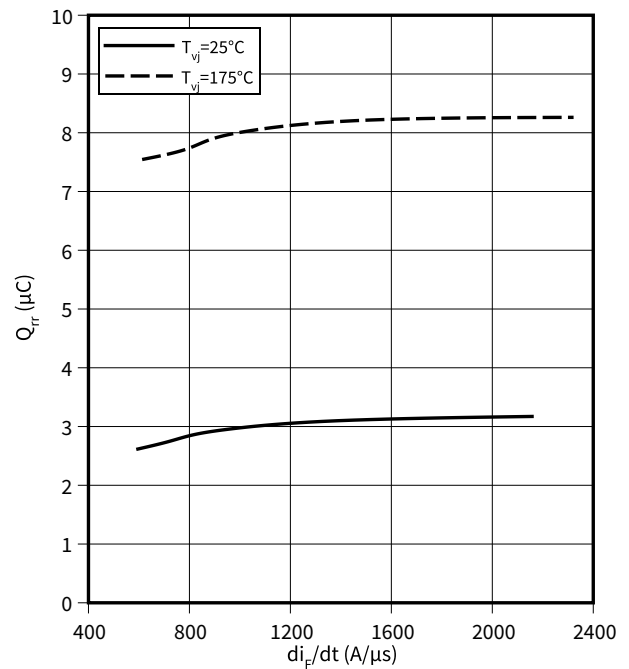
$V_R = 600 V, I_F = 50.0 A$



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

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

$V_R = 600 V, I_F = 50.0 A$

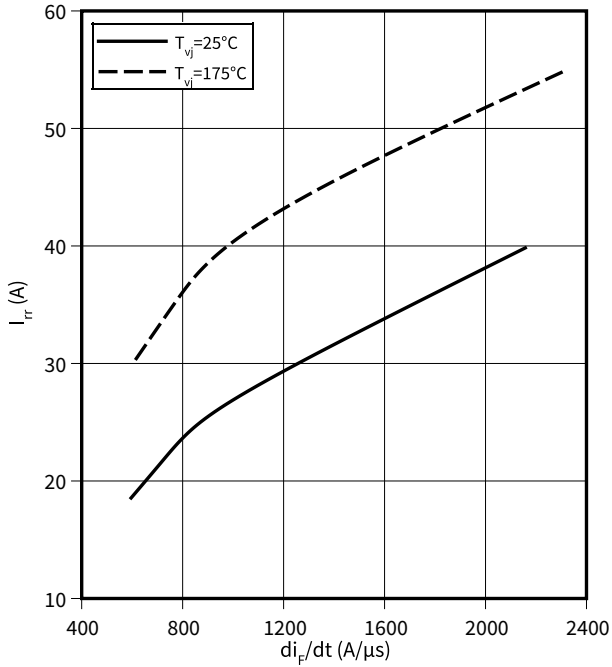


4 Characteristics diagrams

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

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

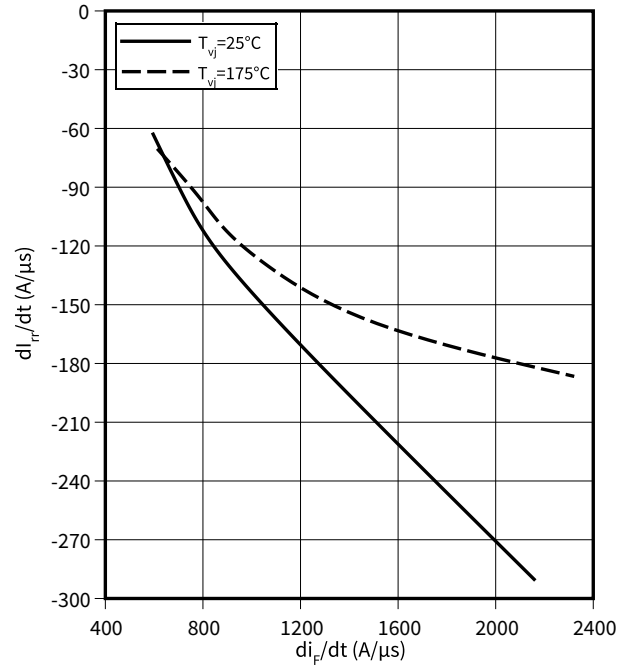
$V_R = 600\text{ V}, I_F = 50.0\text{ A}$



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

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

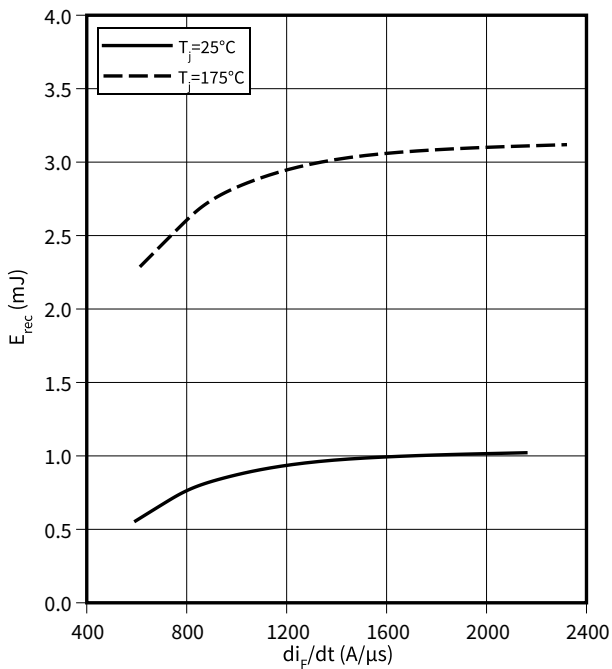
$V_R = 600\text{ V}, I_F = 50.0\text{ A}$



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

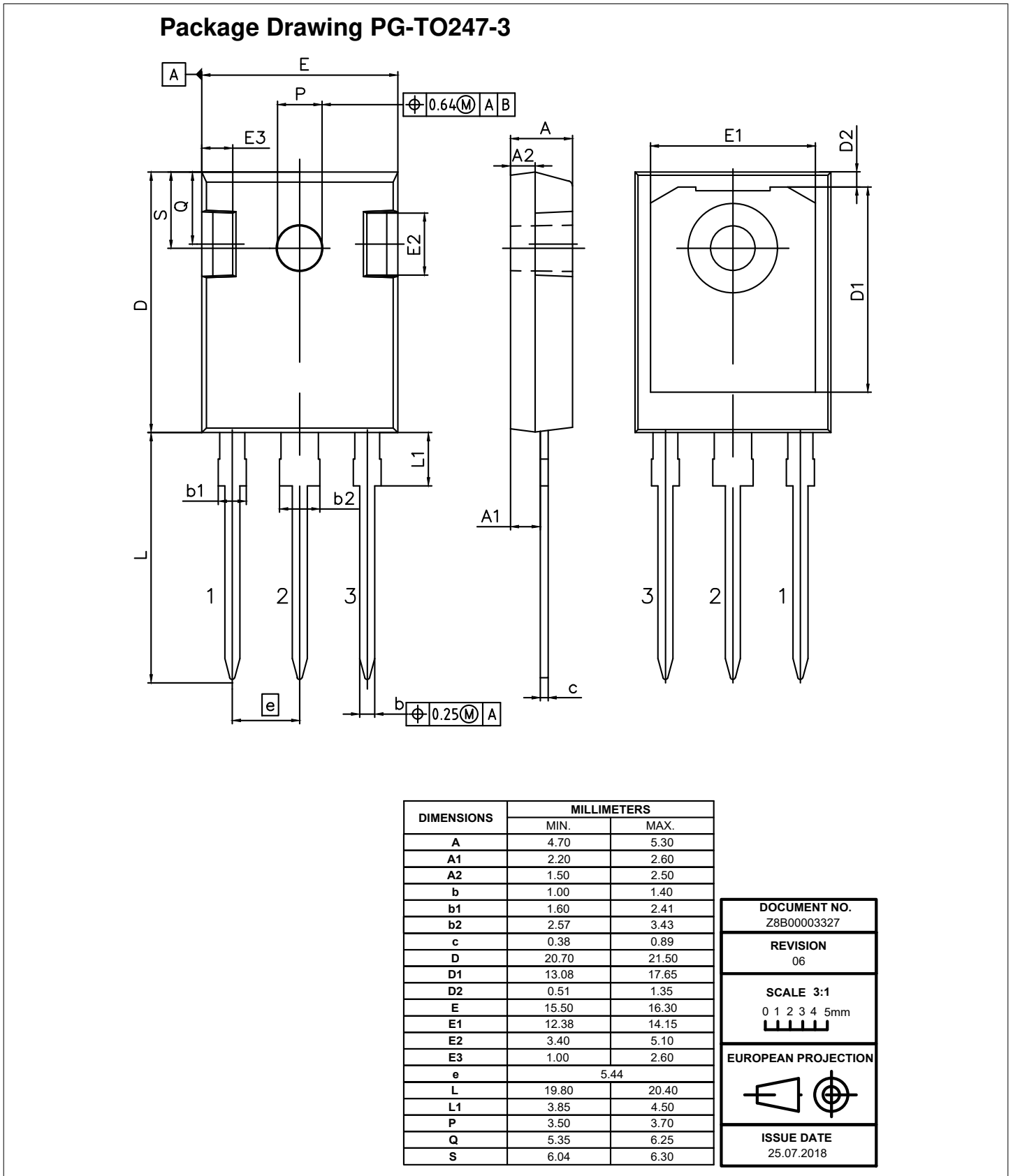


Figure 6

6 Testing conditions

6 Testing conditions

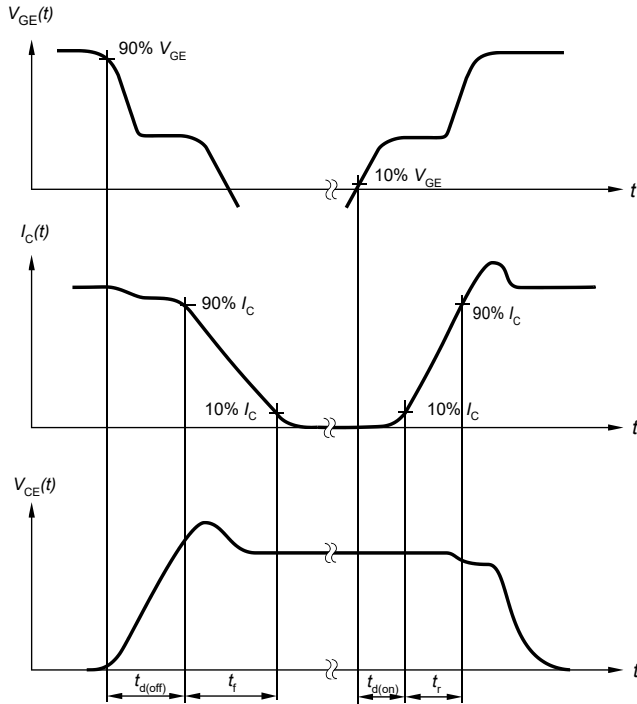


Figure A. Definition of switching times

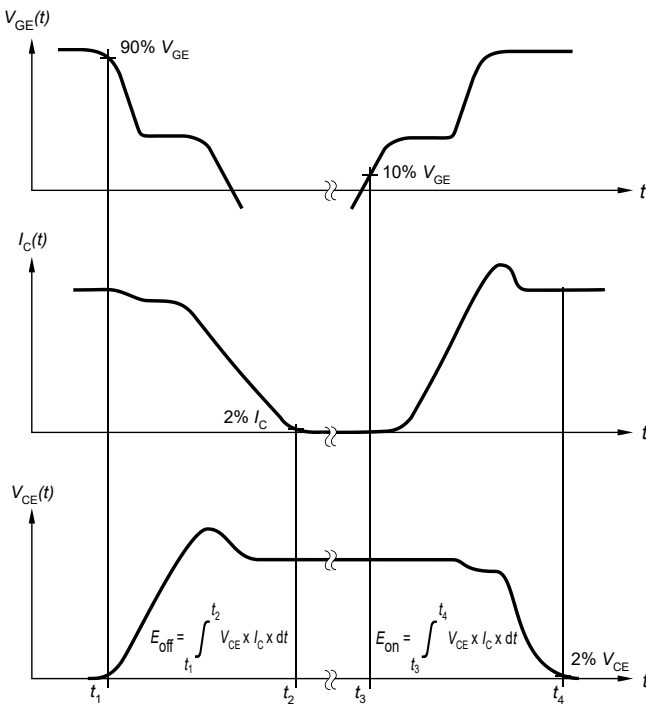


Figure B. Definition of switching losses

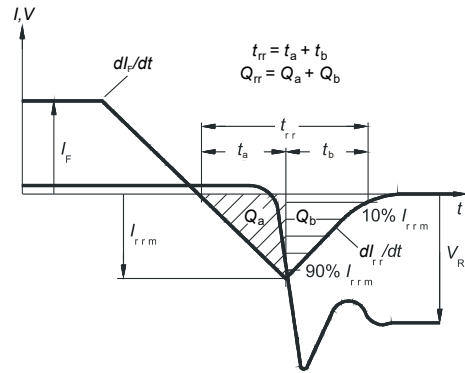


Figure C. Definition of diode switching characteristics

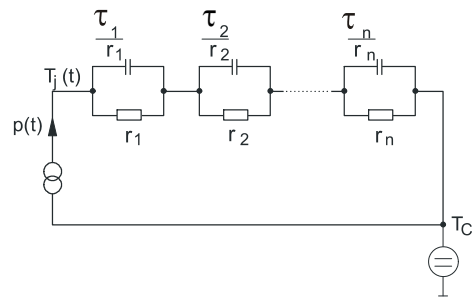


Figure D. Thermal equivalent circuit

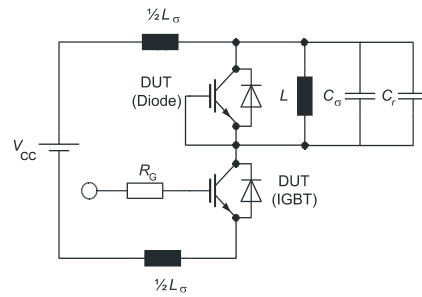


Figure E. Dynamic test circuit
 Parasitic inductance L_{σ} ,
 parasitic capacitor C_{σ} ,
 relief capacitor C_r ,
 (only for ZVT switching)

Figure 7

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