

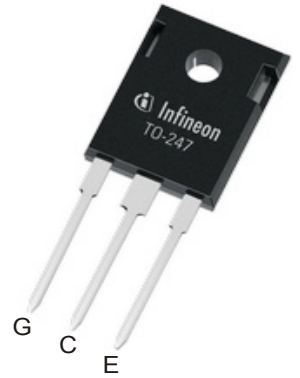
High speed DuoPack: IGBT in Trench and Fieldstop technology with soft, fast recovery antiparallel diode

Features

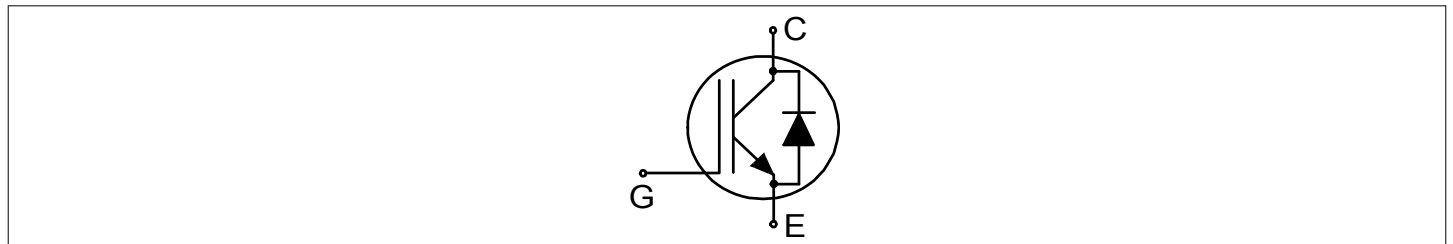
- $V_{CE} = 1200\text{ V}$
- $I_C = 40\text{ A}$
- Very low $V_{CE,sat}$
- Low EMI
- Very soft, fast recovery antiparallel diode
- Maximum junction temperature $T_{vjmax} = 175^\circ\text{C}$
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- Complete product 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
IKW40N120H3	PG-TO247-3	K40H1203

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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	$T_c = 25\text{ °C}$	80	A
		$T_c = 100\text{ °C}$	40	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}		160	A
Turn-off safe operating area		$V_{CE} \leq 1200\text{ V}$, $T_{vj} \leq 175\text{ °C}$	160	A
Gate-emitter voltage	V_{GE}		± 20	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 $\geq 1.0\text{ s}$, $T_{vj} = 175\text{ °C}$	10	μs
Power dissipation	P_{tot}	$T_c = 25\text{ °C}$	483	W
		$T_c = 100\text{ °C}$	220	

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	$V_{CE\ sat}$	$I_C = 40.0\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		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}	$I_C = 1.00\ mA, V_{CE} = V_{GE}, T_{vj} = 175\ ^\circ C$		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	μA
			$T_{vj} = 175\ ^\circ C$			2500	
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\ V, V_{GE} = 20\ V$				600	nA
Transconductance	g_{fs}	$I_C = 40.0\ A, V_{CE} = 20\ V$			20.0		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 $\geq 1.0\ s, T_{vj} = 175\ ^\circ C$			139		A
Input capacitance	C_{ies}	$V_{CE} = 25\ V, V_{GE} = 0\ V, f = 1000\ kHz$			2330		pF
Output capacitance	C_{oes}	$V_{CE} = 25\ V, V_{GE} = 0\ V, f = 1000\ kHz$			185		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25\ V, V_{GE} = 0\ V, f = 1000\ kHz$			130		pF
Gate charge	Q_G	$I_C = 40.0\ A, V_{GE} = 15\ V, V_{CE} = 960\ V$			185		nC
Turn-on delay time	t_{don}	$V_{CE} = 600\ V, V_{GE} = 15\ V, R_{Gon} = 12.0\ \Omega, R_{Goff} = 12.0\ \Omega, L_\sigma = 70\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C, I_C = 40.0\ A$		30		ns
			$T_{vj} = 175\ ^\circ C, I_C = 40.0\ A$		29		
Rise time (inductive load)	t_r	$V_{CE} = 600\ V, V_{GE} = 15\ V, R_{Gon} = 12.0\ \Omega, R_{Goff} = 12.0\ \Omega, L_\sigma = 70\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C, I_C = 40.0\ A$		57		ns
			$T_{vj} = 175\ ^\circ C, I_C = 40.0\ A$		49		
Turn-off delay time	t_{doff}	$V_{CE} = 600\ V, V_{GE} = 15\ V, R_{Gon} = 12.0\ \Omega, R_{Goff} = 12.0\ \Omega, L_\sigma = 70\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C, I_C = 40.0\ A$		290		ns
			$T_{vj} = 175\ ^\circ C, I_C = 40.0\ A$		366		
Fall time (inductive load)	t_f	$V_{CE} = 600\ V, V_{GE} = 15\ V, R_{Gon} = 12.0\ \Omega, R_{Goff} = 12.0\ \Omega, L_\sigma = 70\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C, I_C = 40.0\ A$		16		ns
			$T_{vj} = 175\ ^\circ C, I_C = 40.0\ A$		48		
Turn-on energy	E_{on}	$V_{CE} = 600\ V, V_{GE} = 15\ V, R_{Gon} = 12.0\ \Omega, R_{Goff} = 12.0\ \Omega, L_\sigma = 70\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C, I_C = 40.0\ A$		3.20		mJ
			$T_{vj} = 175\ ^\circ C, I_C = 40.0\ A$		4.40		

Table 3 Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Turn-off energy	E_{off}	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V},$ $R_{Gon} = 12.0\ \Omega,$ $R_{Goff} = 12.0\ \Omega,$ $L_{\sigma} = 70\text{ nH}, C_{\sigma} = 67\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 40.0\text{ A}$		1.20		mJ
			$T_{vj} = 175\text{ }^{\circ}\text{C},$ $I_C = 40.0\text{ A}$		2.60		
Total switching energy	E_{ts}	$V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V},$ $R_{Gon} = 12.0\ \Omega,$ $R_{Goff} = 12.0\ \Omega,$ $L_{\sigma} = 70\text{ nH}, C_{\sigma} = 67\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 40.0\text{ A}$		4.40		mJ
			$T_{vj} = 175\text{ }^{\circ}\text{C},$ $I_C = 40.0\text{ A}$		7.00		
IGBT thermal resistance, junction-case	R_{thjc}				0.31		K/W
Operating junction temperature	T_{vj}		-40		175		$^{\circ}\text{C}$

Note: Electrical Characteristic, at $T_{vj} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified.

3 Diode

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	V_{RRM}	$T_{vj} \geq 25\text{ }^{\circ}\text{C}$	1200	V	
Diode forward current, limited by T_{vjmax}	I_F		$T_c = 25\text{ }^{\circ}\text{C}$	40	A
			$T_c = 100\text{ }^{\circ}\text{C}$	20	
Diode pulsed current, limited by T_{vjmax}	I_{Fpuls}		160	A	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Diode forward voltage	V_F	$I_F = 20.0\text{ A}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$		1.80	2.35	V
			$T_{vj} = 175\text{ }^{\circ}\text{C}$		1.85		
Diode forward voltage	V_F	$I_F = 40.0\text{ A}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$		2.40	3.05	V
			$T_{vj} = 125\text{ }^{\circ}\text{C}$		2.60		
			$T_{vj} = 175\text{ }^{\circ}\text{C}$		2.60		
Reverse leakage current	I_R	$V_R = 1200\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$			250	μA
			$T_{vj} = 175\text{ }^{\circ}\text{C}$			2500	

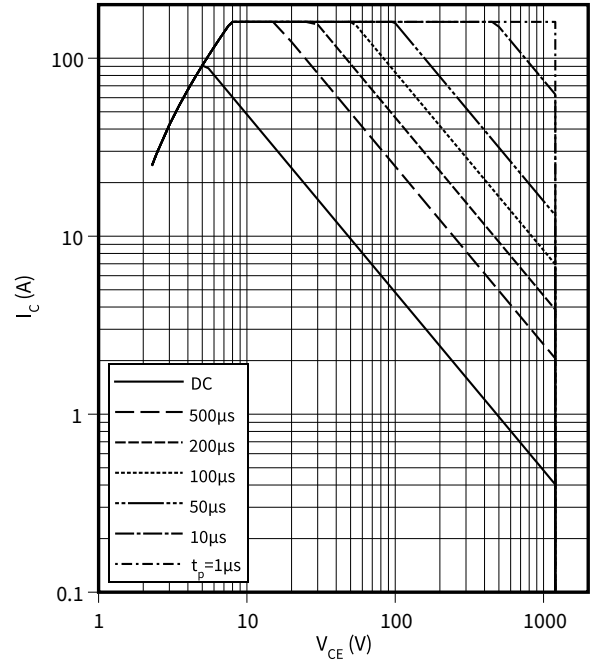
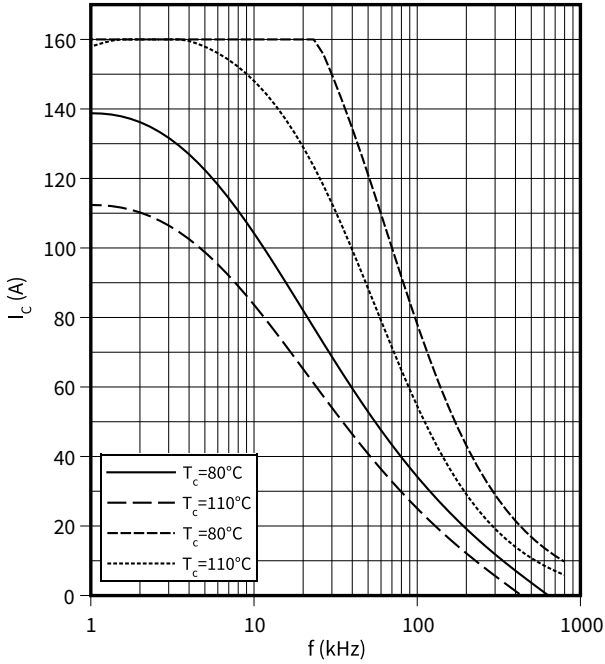
Table 5 Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery time	t_{rr}	$V_R = 600\text{ V}$	$T_{vj} = 25\text{ °C},$ $I_F = 40.0\text{ A},$ $-di_F/dt = 500\text{ A}/\mu\text{s}$		355		ns
					639		
Diode reverse recovery charge	Q_{rr}	$V_R = 600\text{ V}$	$T_{vj} = 25\text{ °C},$ $I_F = 40.0\text{ A},$ $-di_F/dt = 500\text{ A}/\mu\text{s}$		1.90		μC
					4.30		
Diode peak reverse recovery current	I_{rrm}	$V_R = 600\text{ V}$	$T_{vj} = 25\text{ °C},$ $I_F = 40.0\text{ A},$ $-di_F/dt = 500\text{ A}/\mu\text{s}$		12.8		A
					16.0		
Diode peak rate off fall of reverse recovery current	di_{rr}/dt	$V_R = 600\text{ V}$	$T_{vj} = 25\text{ °C},$ $I_F = 40.0\text{ A},$ $-di_F/dt = 500\text{ A}/\mu\text{s}$		-105		$\text{A}/\mu\text{s}$
					-84		
Diode thermal resistance, junction-case	R_{thjc}					1.11	K/W
Operating junction temperature	T_{vj}			-40		175	$^{\circ}\text{C}$

4 Characteristics diagrams

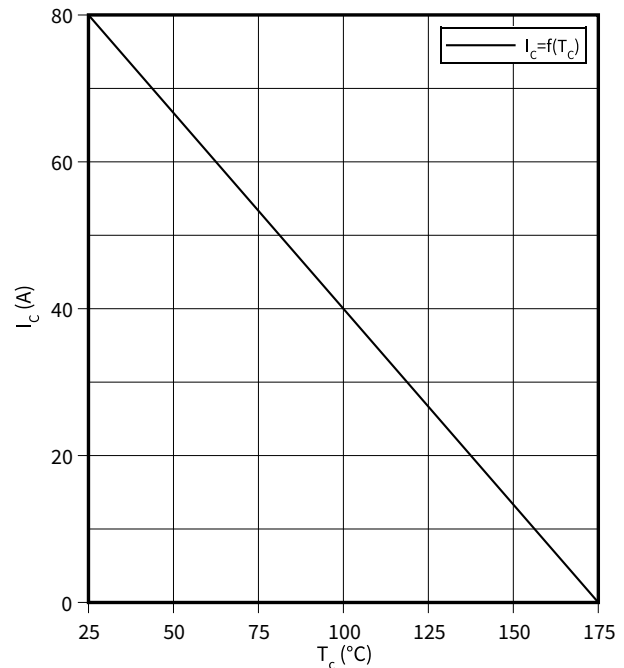
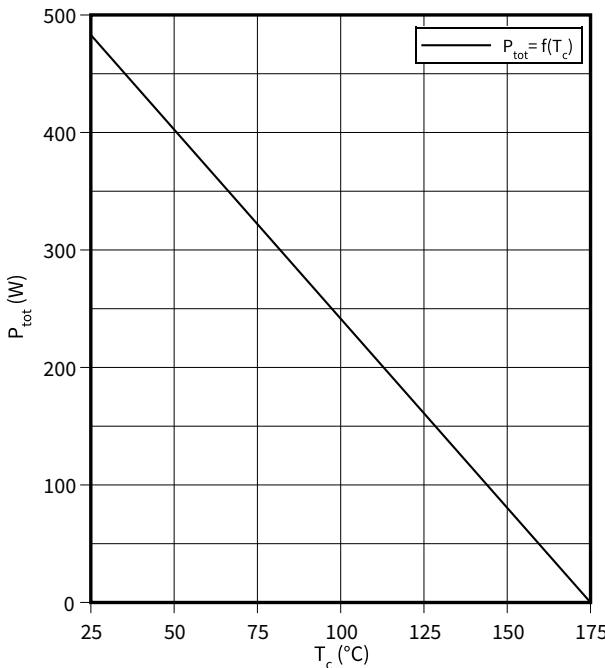
Collector current as a function of switching frequency, IGBT
 $I_C = f(f)$
 $D = 0.5, V_{CE} = 600\text{ V}, T_{vj} \leq 175\text{ }^\circ\text{C}, V_{GE} = 0/15\text{ V}, R_G = 12\text{ }\Omega$

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
 $P_{tot} = f(T_C)$
 $T_{vj} \leq 175\text{ }^\circ\text{C}$

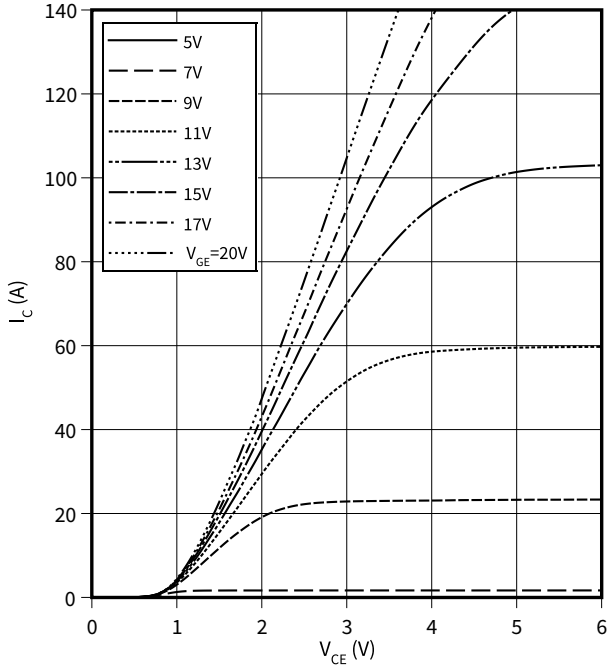
Collector current as a function of case temperature, IGBT
 $I_C = f(T_C)$
 $T_{vj} \leq 175\text{ }^\circ\text{C}, V_{GE} \geq 15\text{ V}$



4 Characteristics diagrams

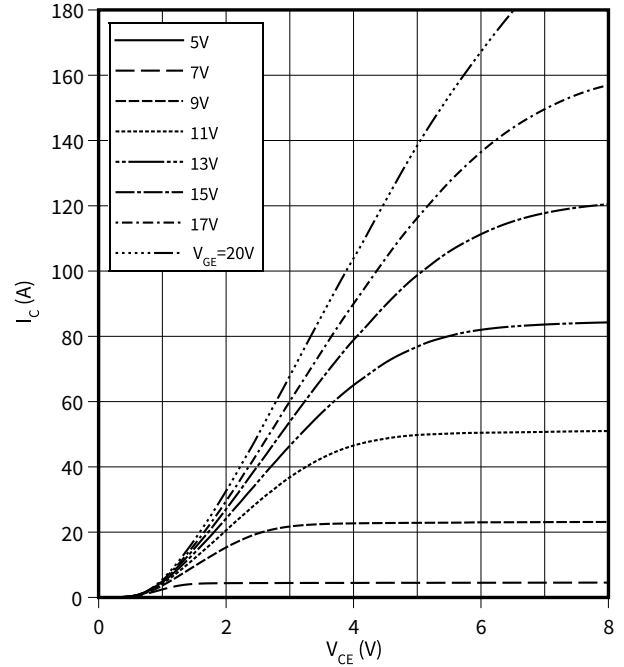
Typical output characteristic, IGBT

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



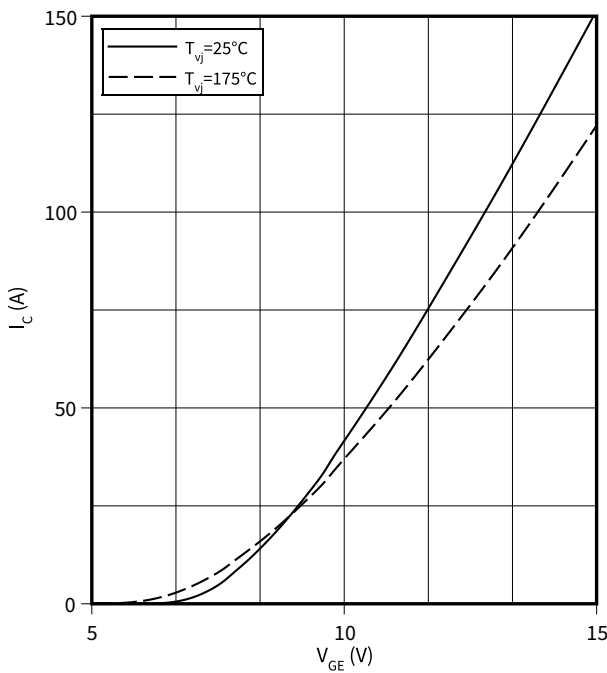
Typical output characteristic, IGBT

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



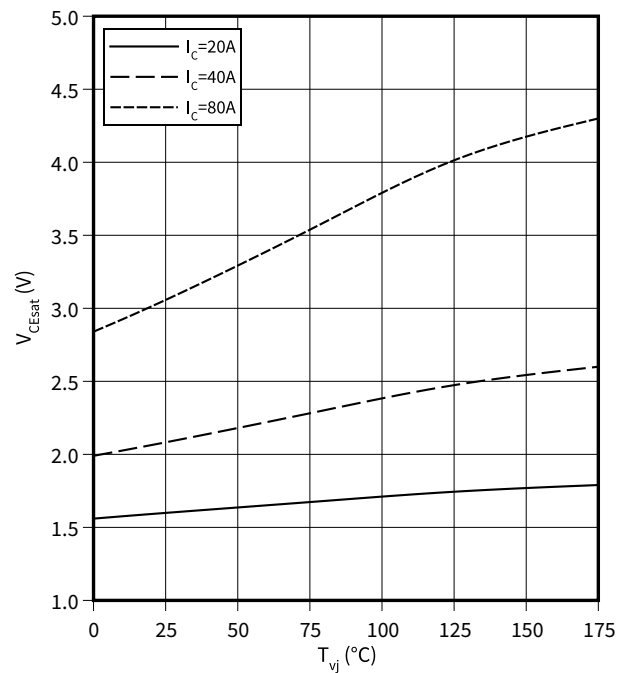
Typical transfer characteristic, IGBT

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



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

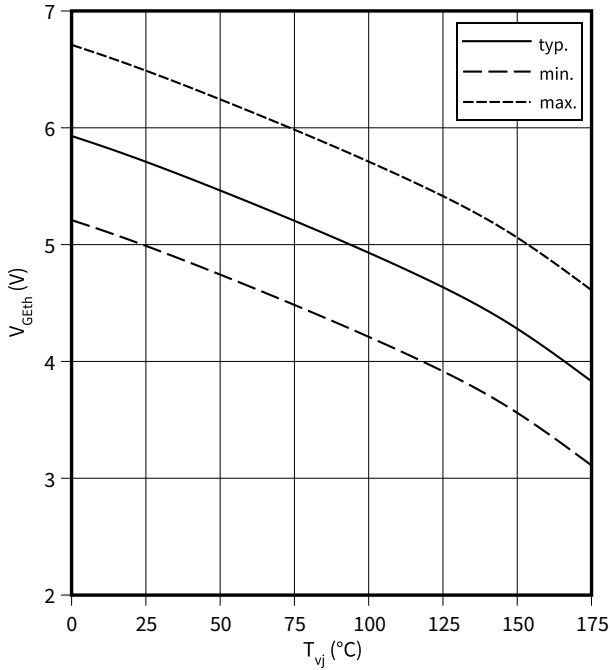
$V_{CEsat} = f(T_{vj})$
 $V_{GE} = 15\text{ V}$



4 Characteristics diagrams

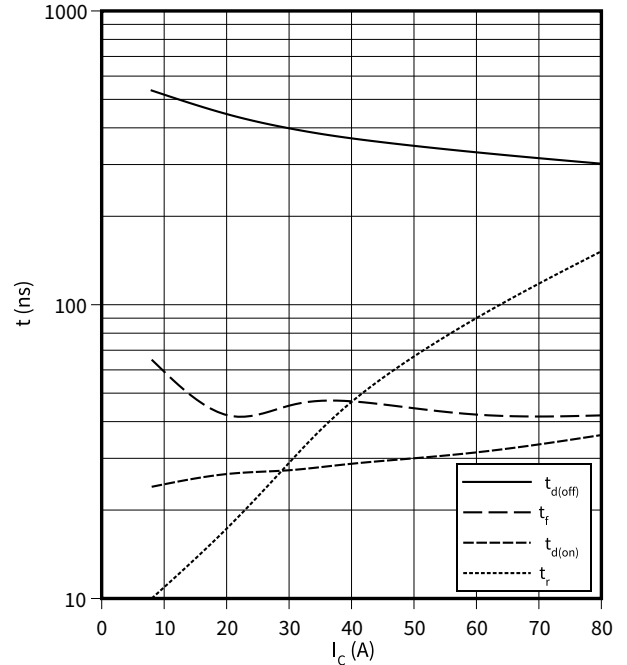
Gate-emitter threshold voltage as a function of junction temperature, IGBT

$V_{GEth} = f(T_{vj})$
 $I_C = 1.00 \text{ mA}$



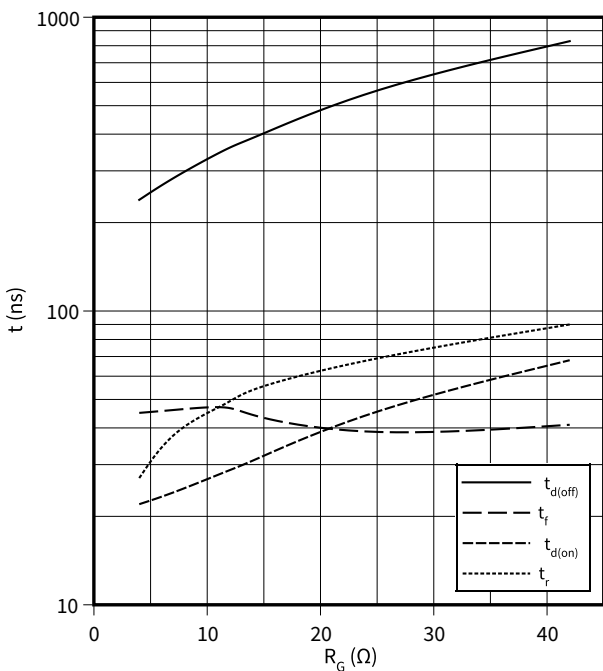
Typical switching times as a function of collector current, IGBT

$t = f(I_C)$
 $V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 12 \text{ } \Omega$



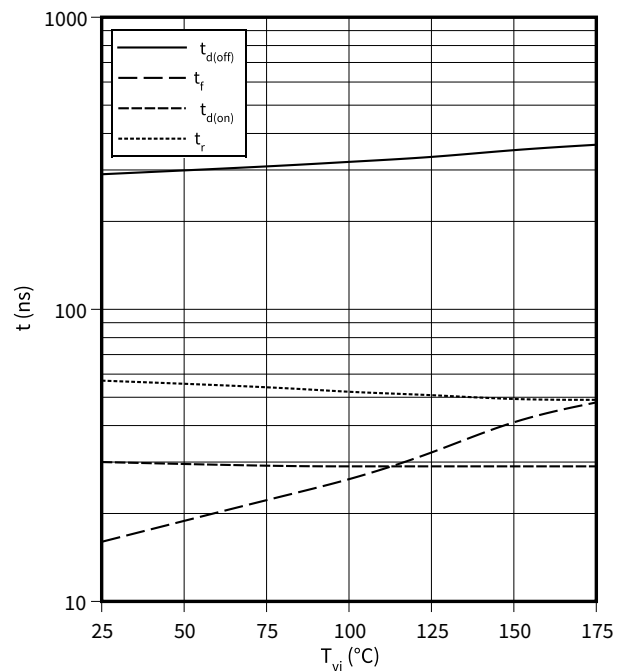
Typical switching times as a function of gate resistance, IGBT

$t = f(R_G)$
 $I_C = 40.0 \text{ A}, V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$



Typical switching times as a function of junction temperature, IGBT

$t = f(T_{vj})$
 $I_C = 40.0 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 12 \text{ } \Omega$

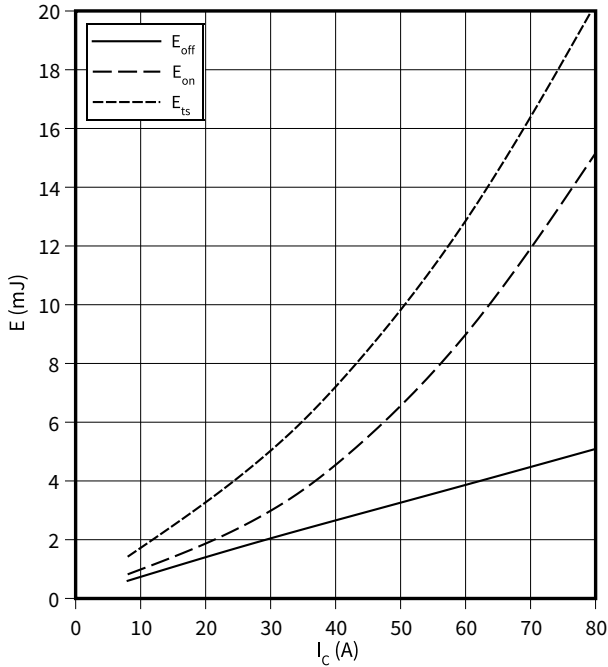


4 Characteristics diagrams

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

$E = f(I_C)$

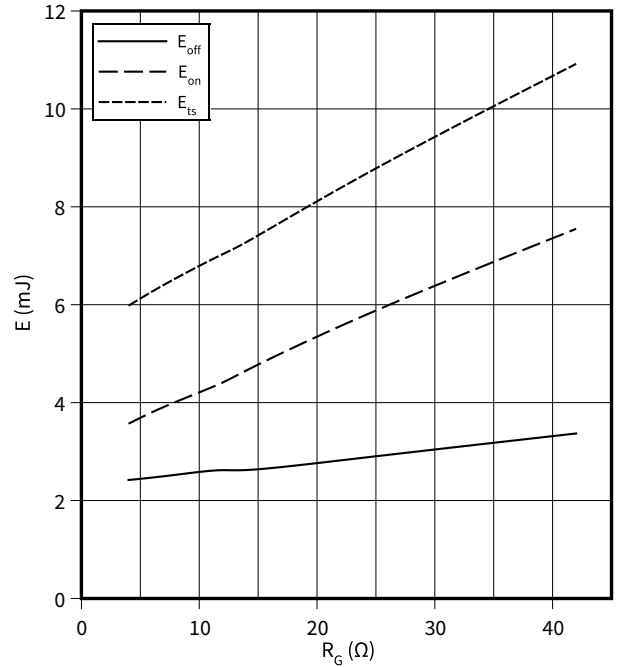
$V_{CE} = 600\text{ V}, T_{vj} = 175\text{ °C}, V_{GE} = 0/15\text{ V}, R_G = 12\text{ }\Omega$



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

$E = f(R_G)$

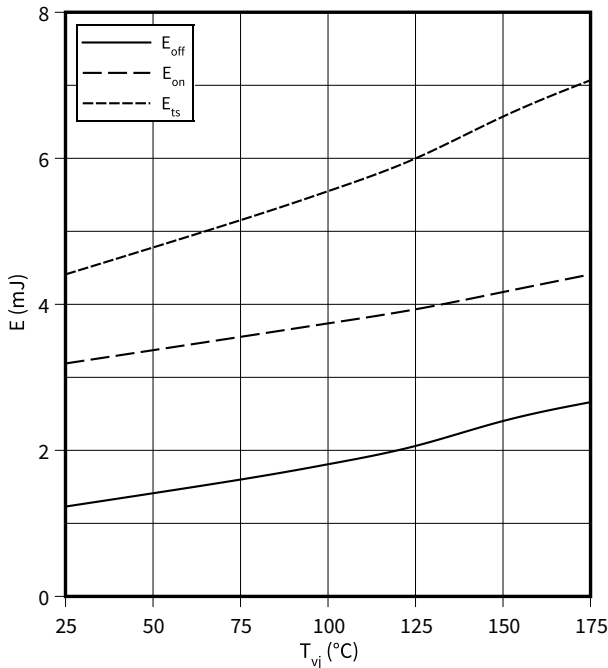
$I_C = 40.0\text{ A}, V_{CE} = 600\text{ V}, T_{vj} = 175\text{ °C}, V_{GE} = 0/15\text{ V}$



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

$E = f(T_{vj})$

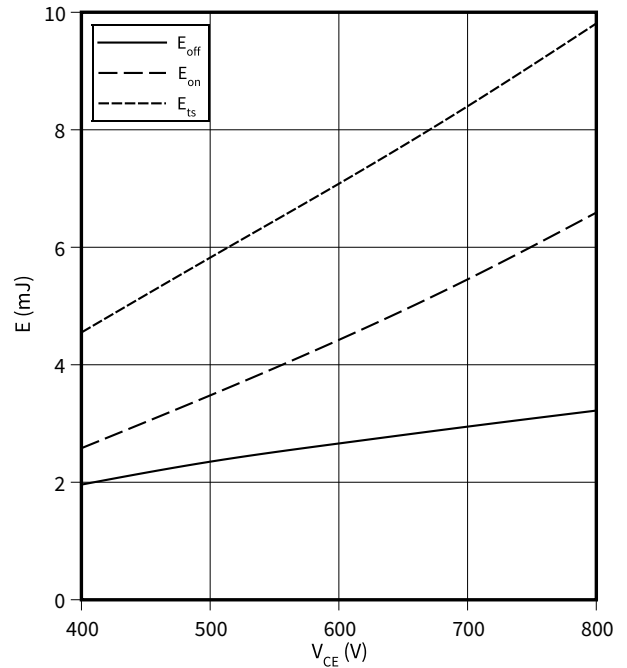
$I_C = 40.0\text{ A}, V_{CE} = 600\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 12\text{ }\Omega$



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

$E = f(V_{CE})$

$I_C = 40.0\text{ A}, T_{vj} = 175\text{ °C}, V_{GE} = 0/15\text{ V}, R_G = 12\text{ }\Omega$

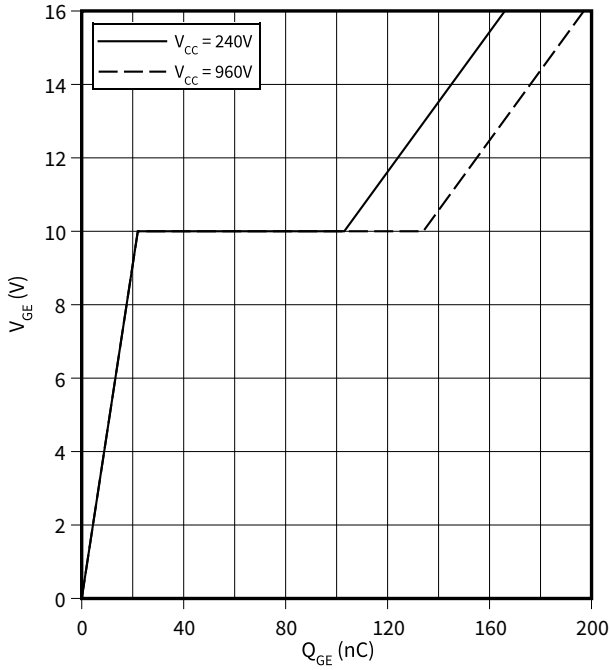


4 Characteristics diagrams

Typical gate charge, IGBT

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

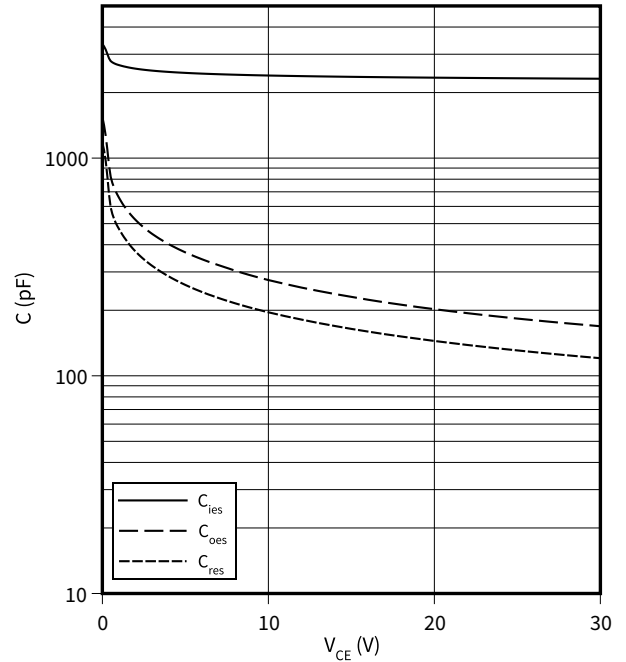
$I_C = 40.0 \text{ A}$



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

$C = f(V_{CE})$

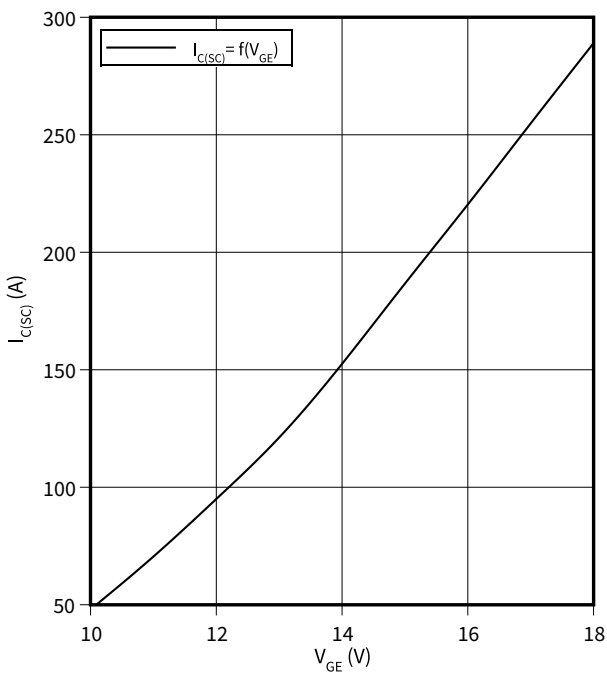
$f = 1000 \text{ kHz}, V_{GE} = 0 \text{ V}$



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

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

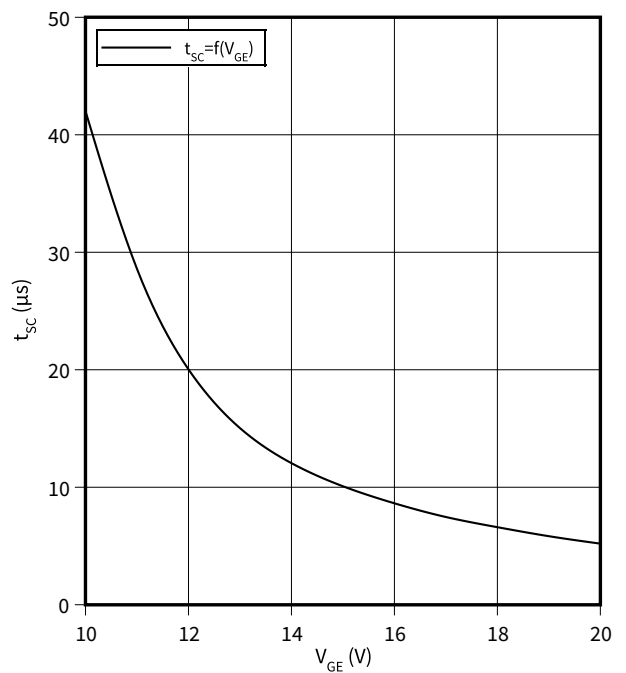
$V_{CE} \leq 600 \text{ V}, T_{vj, start} = 25 \text{ }^\circ\text{C}$



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

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

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

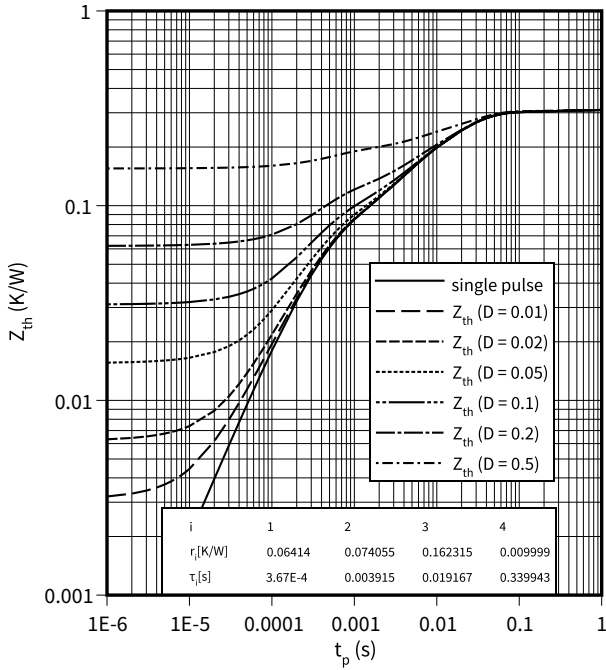


4 Characteristics diagrams

IGBT transient thermal impedance, IGBT

$Z_{th} = f(t_p)$

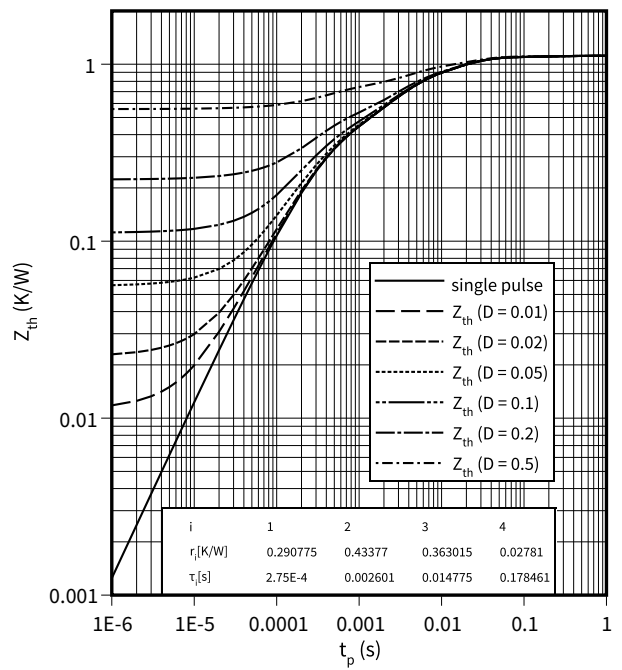
$D = t_p/T$



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

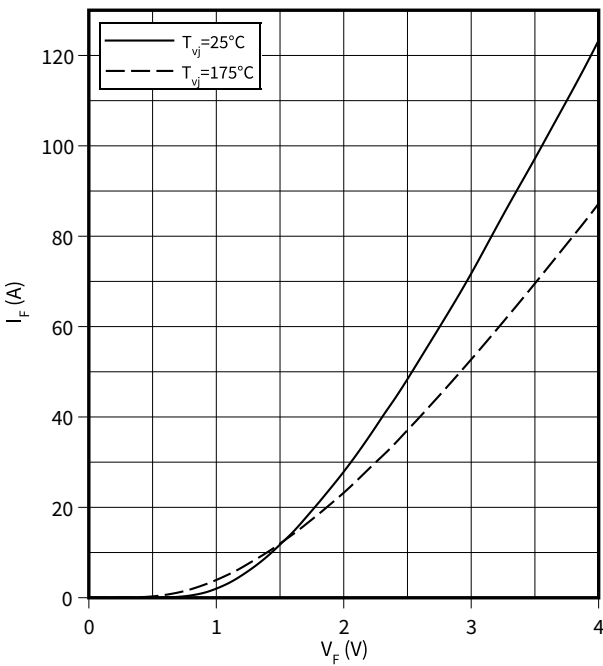
$Z_{th} = f(t_p)$

$D = t_p/T$



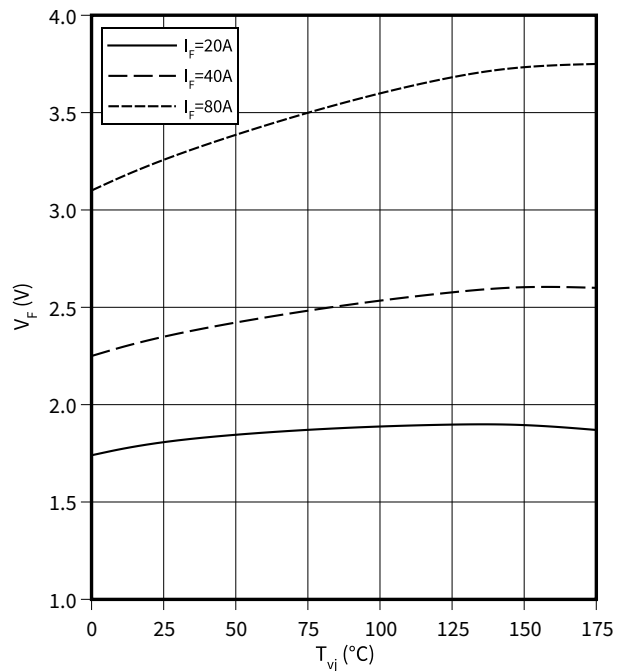
Typical diode forward current as a function of forward voltage, Diode

$I_F = f(V_F)$



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

$V_F = f(T_{vj})$

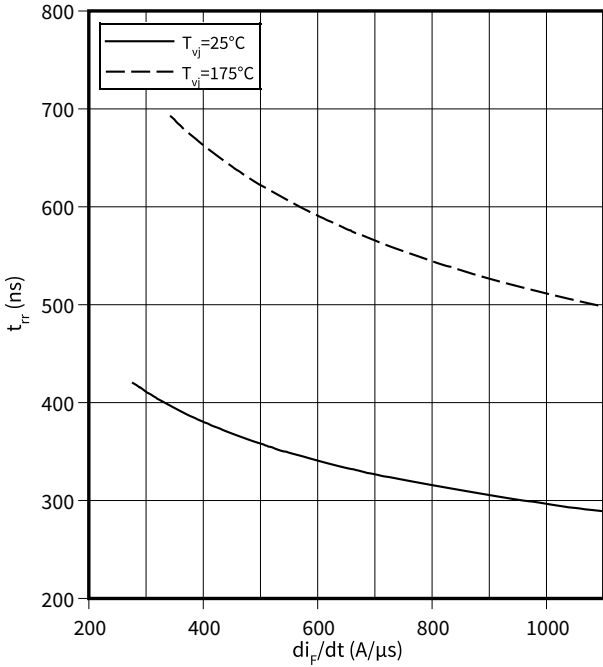


4 Characteristics diagrams

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

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

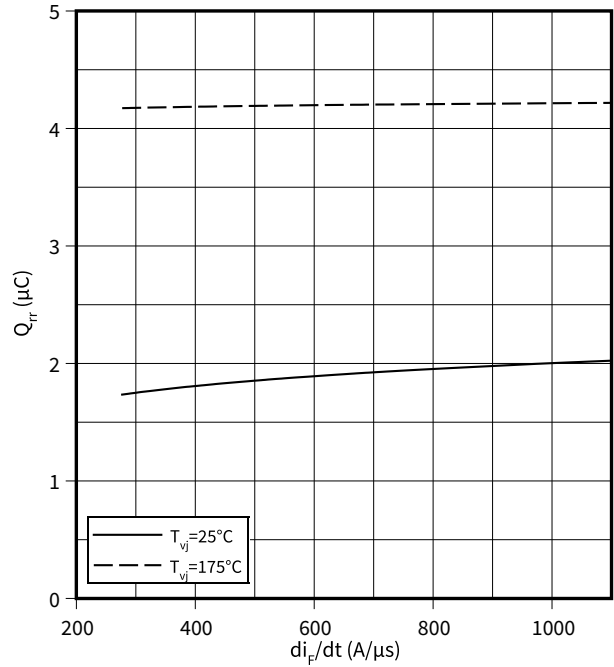
$V_R = 600\text{ V}, I_F = 40\text{ A}$



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

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

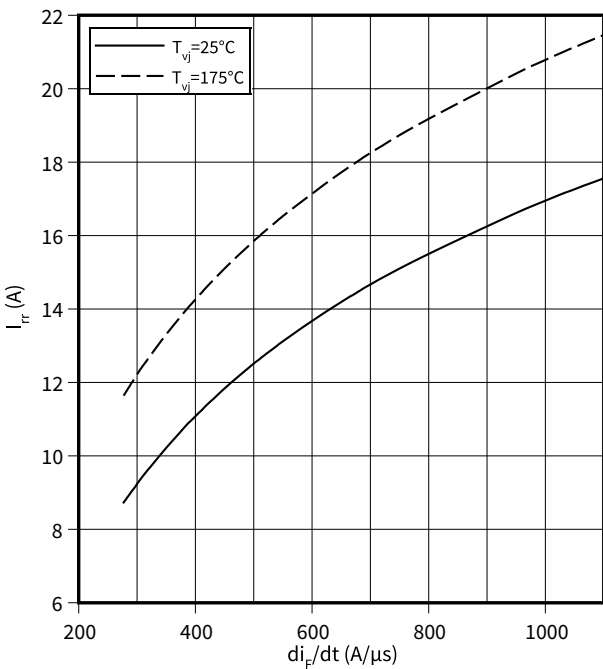
$V_R = 600\text{ V}, I_F = 40\text{ A}$



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

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

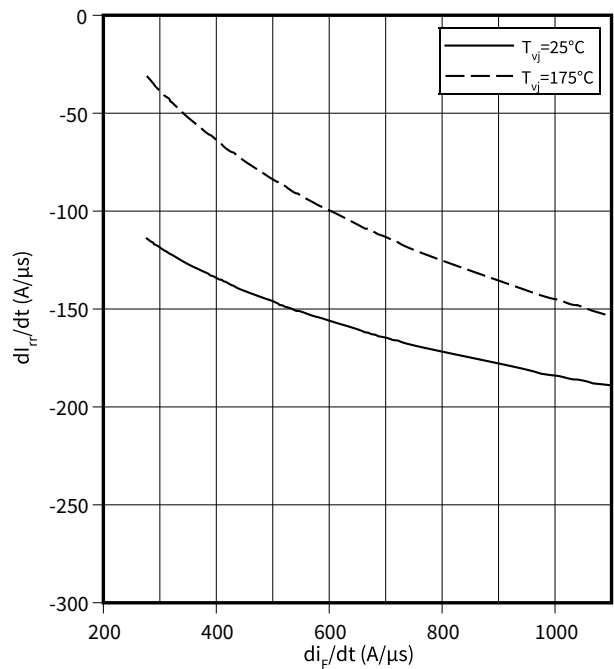
$V_R = 600\text{ V}, I_F = 40\text{ A}$



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

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

$V_R = 600\text{ V}, I_F = 40\text{ A}$



5 Package outlines

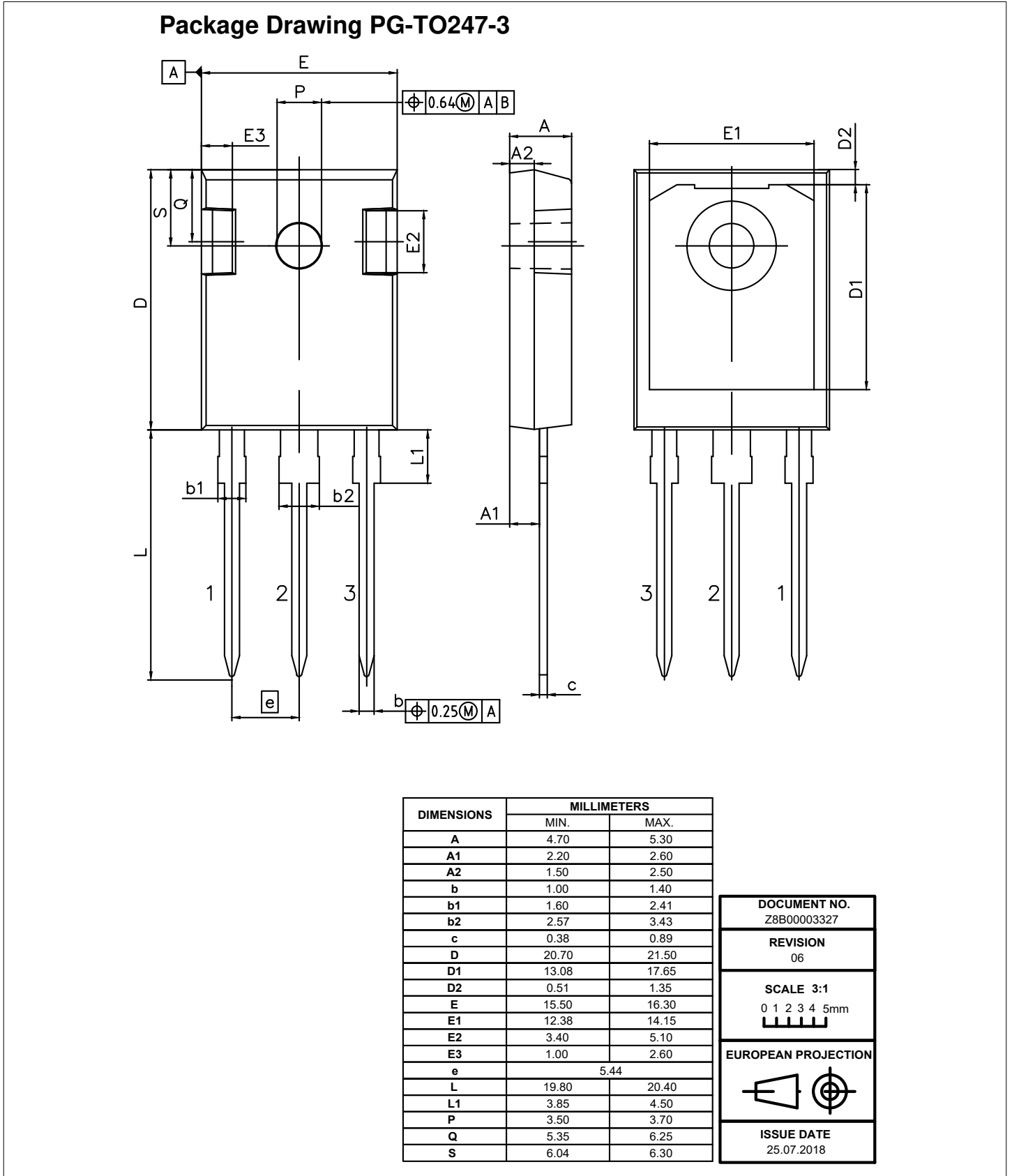


Figure 6

6 Testing conditions

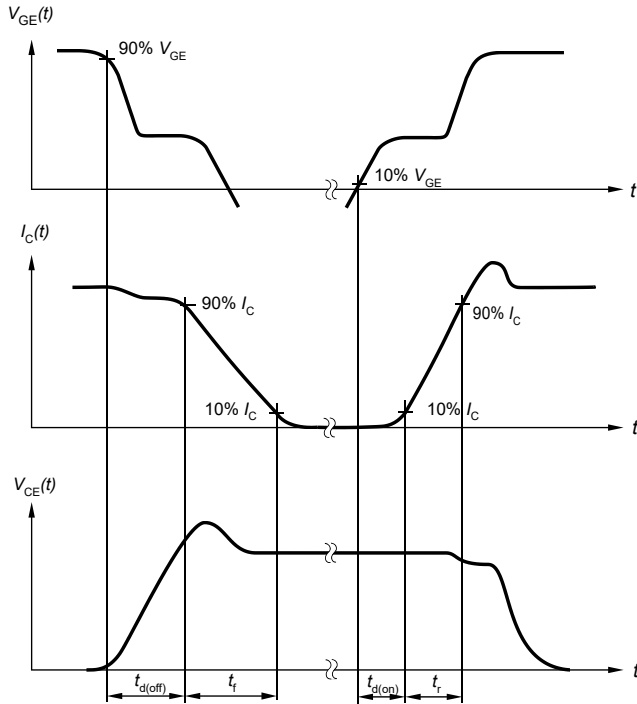


Figure A. Definition of switching times

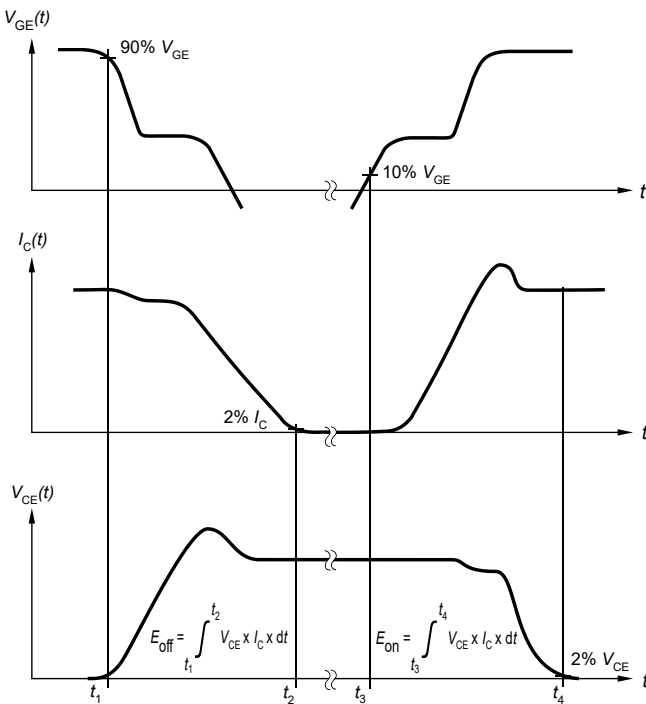


Figure B. Definition of switching losses

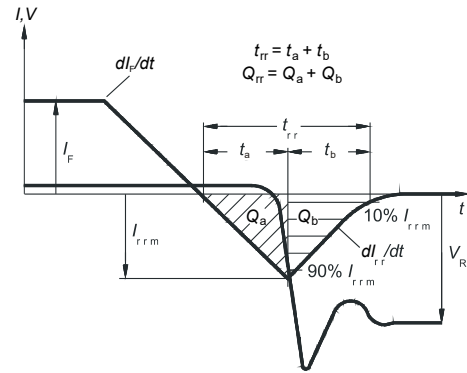


Figure C. Definition of diode switching characteristics

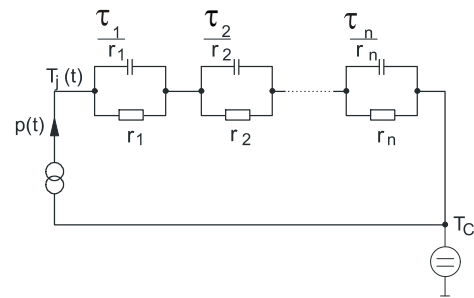


Figure D. Thermal equivalent circuit

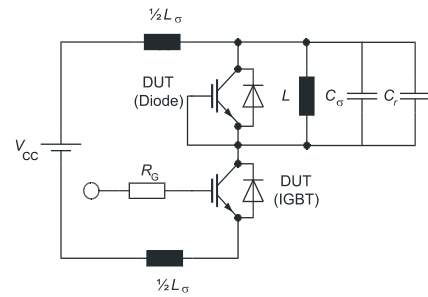


Figure E. **Dynamic test circuit**
 Parasitic inductance L_{σ} ,
 parasitic capacitor C_{σ} ,
 relief capacitor C_r ,
 (only for ZVT switching)

Figure 7

Revision history

Revision history

Document revision	Date of release	Description of changes
V1.1	2009-12-03	
V1.2	2010-02-10	
V2.1	2014-11-26	Final data sheet
V2.2		Minor change figure 28
1.10	2021-09-08	Update of legend at the diagram $V_F = f(T_{vj})$

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