

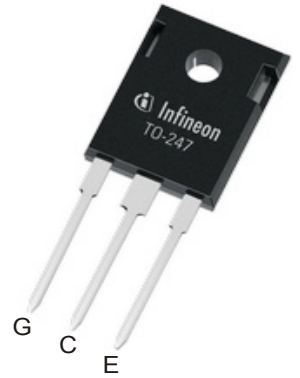
High speed DuoPack: IGBT in Trench and Fieldstop technology with soft, fast recovery antiparallel diode

Features

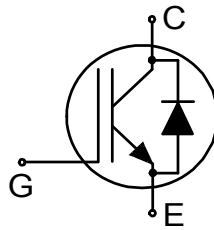
- $V_{CE} = 1200\text{ V}$
- $I_C = 40\text{ A}$
- Very low $V_{CE,sat}$
- Low EMI
- Very soft, fast recovery antiparallel diode
- Maximum junction temperature $T_{vjmax} = 175^\circ\text{C}$
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- Complete product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

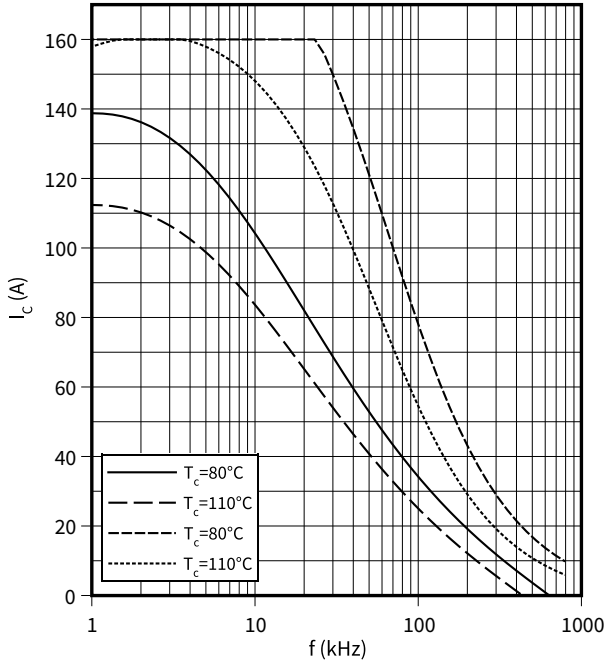
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery time	t_{rr}	$V_R = 600\text{ V}$	$T_{vj} = 25\text{ °C},$ $I_F = 40.0\text{ A},$ $-di_F/dt = 500\text{ A}/\mu\text{s}$		355		ns
			$T_{vj} = 175\text{ °C},$ $I_F = 40.0\text{ A},$ $-di_F/dt = 500\text{ A}/\mu\text{s}$		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
			$T_{vj} = 175\text{ °C},$ $I_F = 40.0\text{ A},$ $-di_F/dt = 500\text{ A}/\mu\text{s}$		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
			$T_{vj} = 175\text{ °C},$ $I_F = 40.0\text{ A},$ $-di_F/dt = 500\text{ A}/\mu\text{s}$		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		$\text{A}/\mu\text{s}$
			$T_{vj} = 175\text{ °C},$ $I_F = 40.0\text{ A},$ $-di_F/dt = 500\text{ A}/\mu\text{s}$		-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

$$I_C = f(f)$$

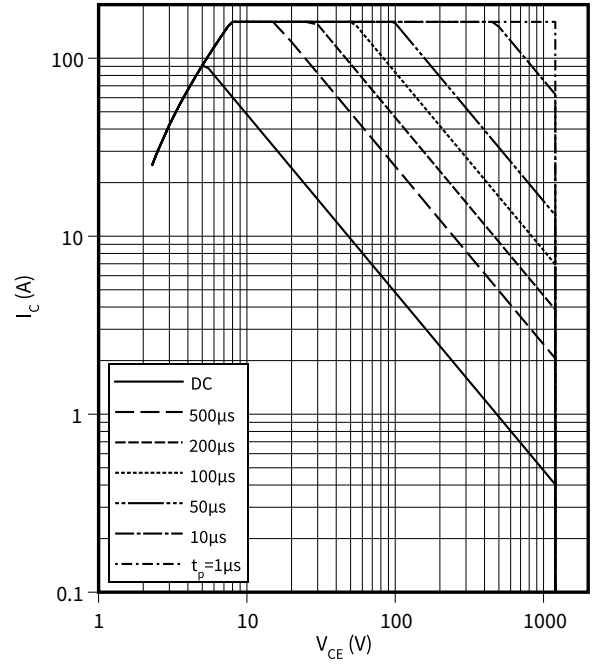
$D = 0.5, V_{CE} = 600 \text{ V}, T_{vj} \leq 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 12 \text{ } \Omega$



Forward bias safe operating area, IGBT

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

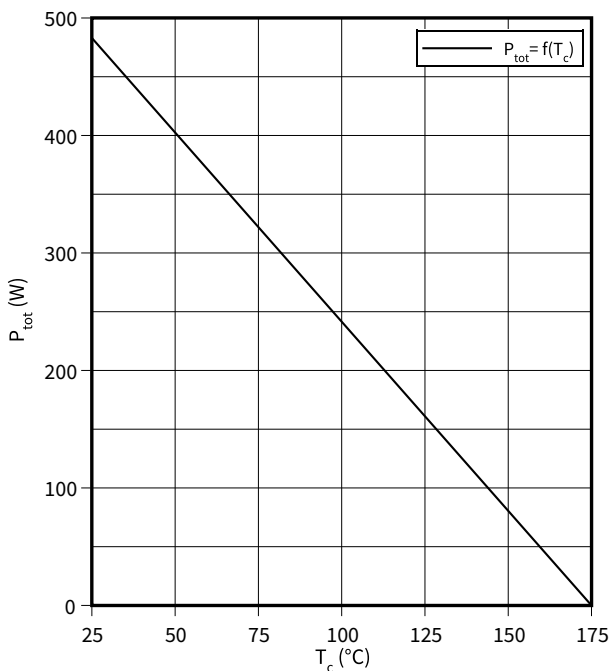
$D = 0, T_{vj} \leq 175 \text{ }^\circ\text{C}, V_{GE} = 15 \text{ V}, T_C = 25 \text{ }^\circ\text{C}$



Power dissipation as a function of case temperature, IGBT

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

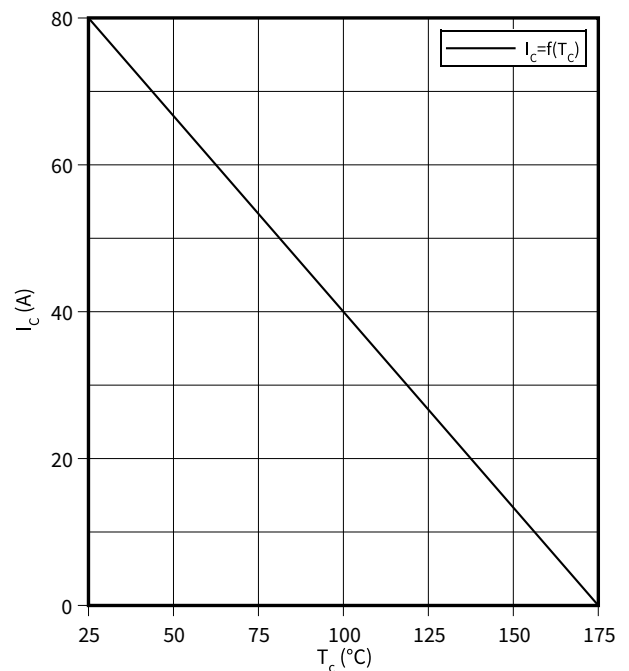
$T_{vj} \leq 175 \text{ }^\circ\text{C}$



Collector current as a function of case temperature, IGBT

$$I_C = f(T_C)$$

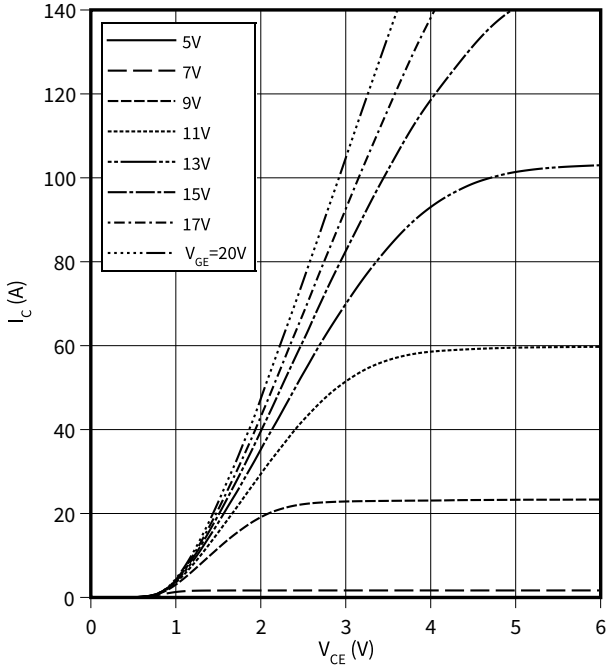
$T_{vj} \leq 175 \text{ }^\circ\text{C}, V_{GE} \geq 15 \text{ V}$



4 Characteristics diagrams

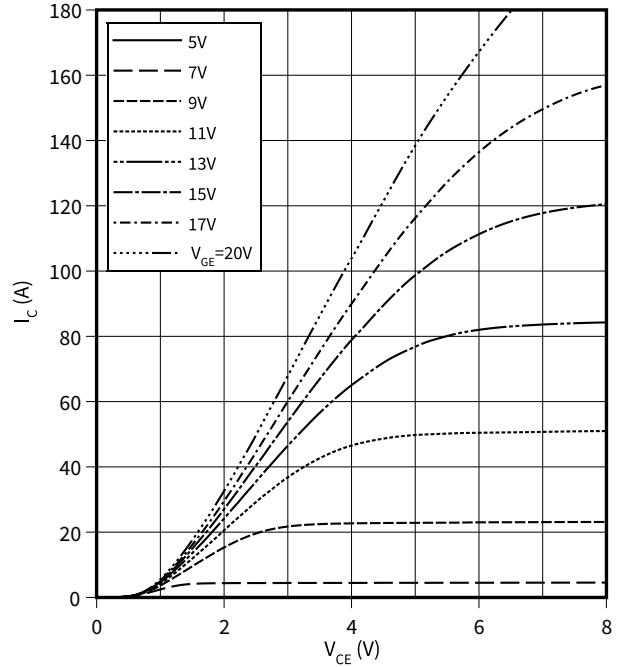
Typical output characteristic, IGBT

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



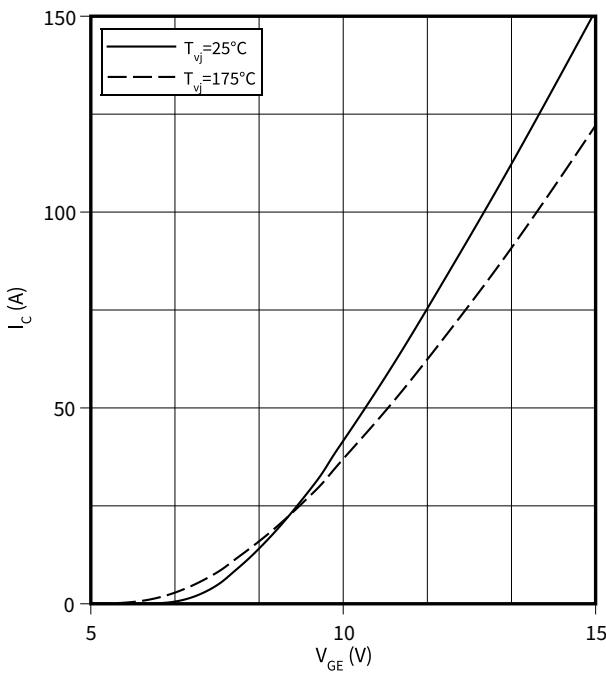
Typical output characteristic, IGBT

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



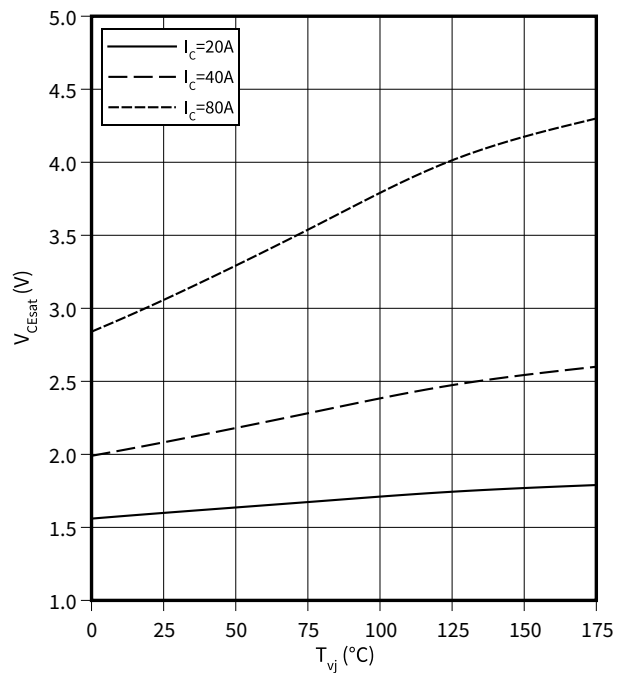
Typical transfer characteristic, IGBT

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



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

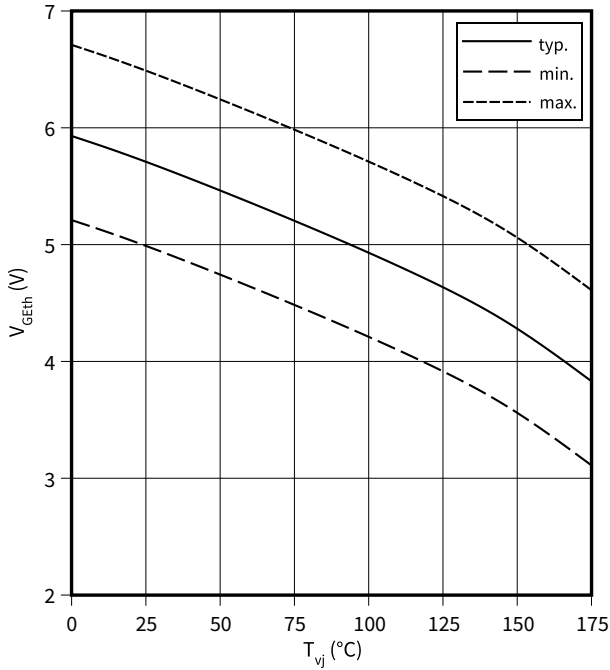
$V_{CEsat} = f(T_{vj})$
 $V_{GE} = 15\text{ V}$



4 Characteristics diagrams

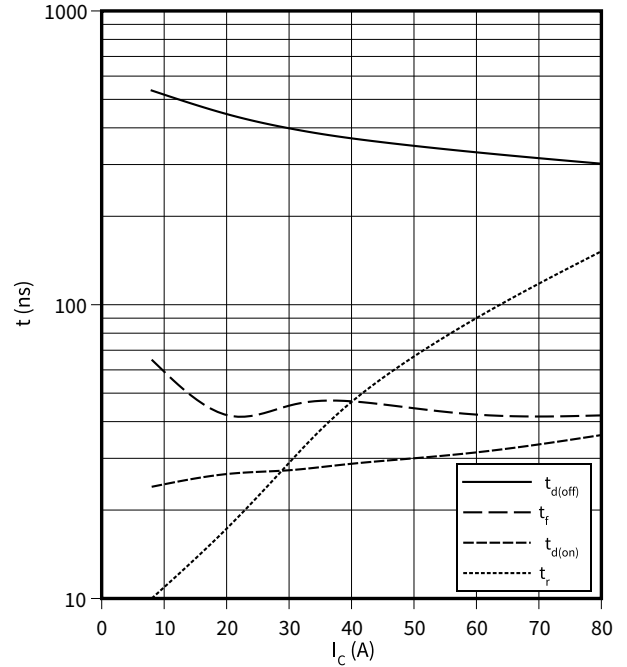
Gate-emitter threshold voltage as a function of junction temperature, IGBT

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



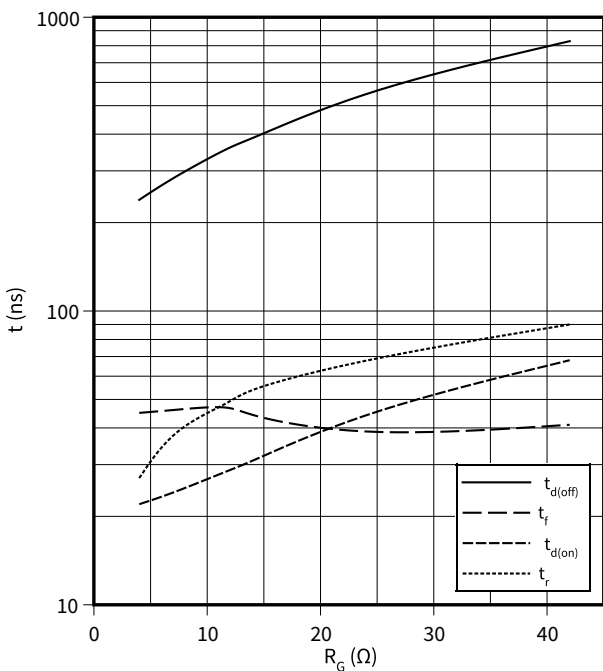
Typical switching times as a function of collector current, IGBT

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



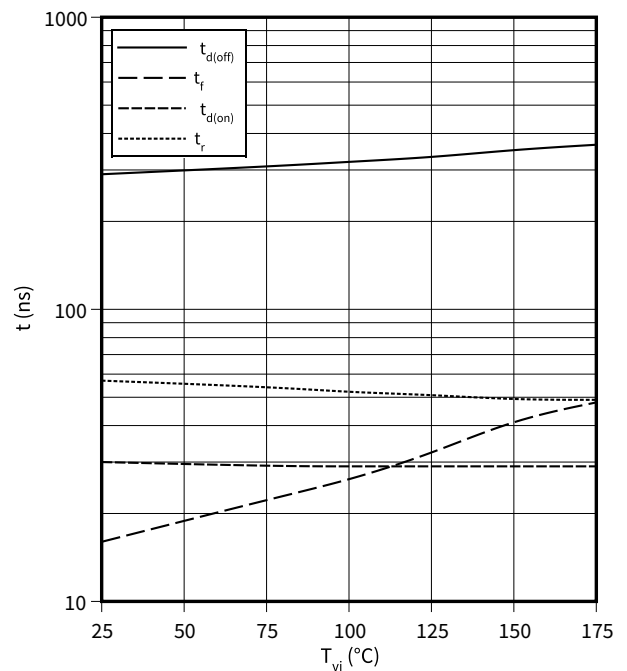
Typical switching times as a function of gate resistance, IGBT

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



Typical switching times as a function of junction temperature, IGBT

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

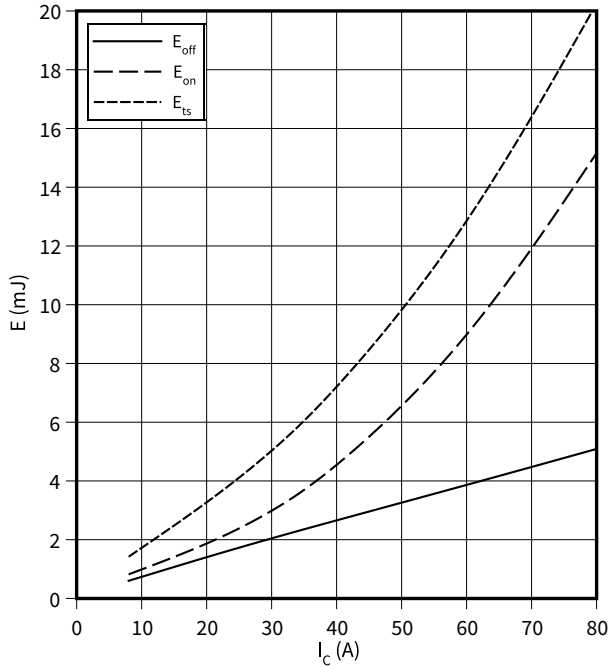


4 Characteristics diagrams

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

$E = f(I_C)$

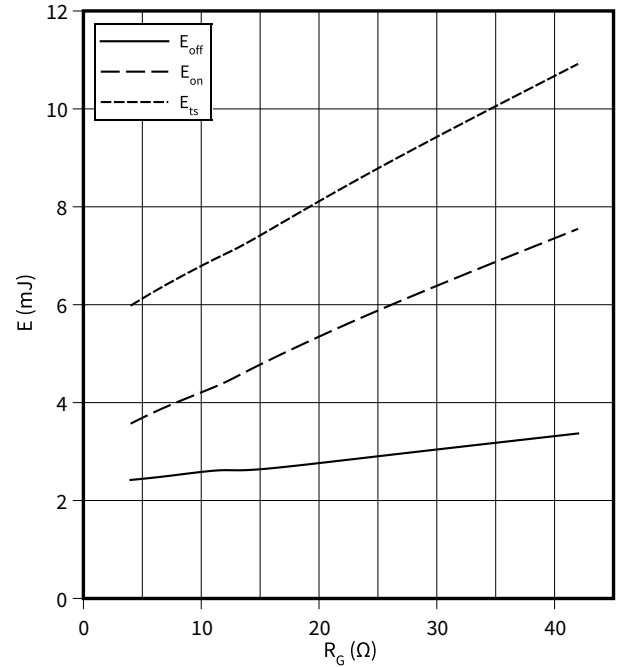
$V_{CE} = 600\text{ V}, T_{vj} = 175\text{ }^\circ\text{C}, V_{GE} = 0/15\text{ V}, R_G = 12\text{ }\Omega$



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

$E = f(R_G)$

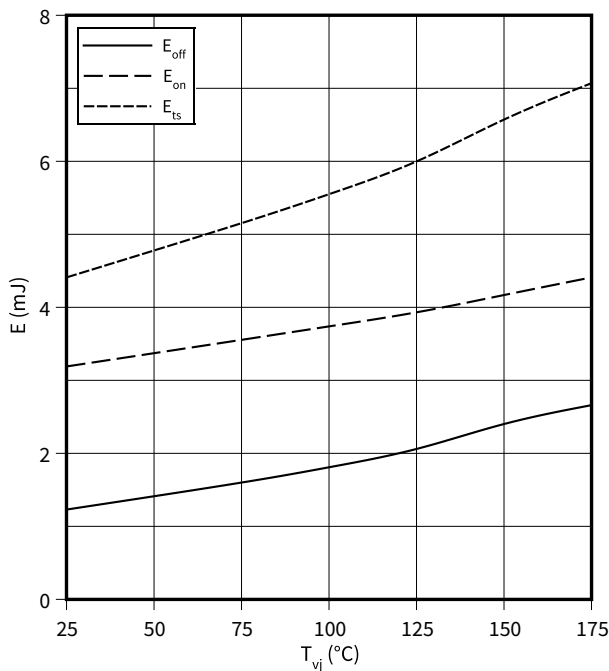
$I_C = 40.0\text{ A}, V_{CE} = 600\text{ V}, T_{vj} = 175\text{ }^\circ\text{C}, V_{GE} = 0/15\text{ V}$



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

$E = f(T_{vj})$

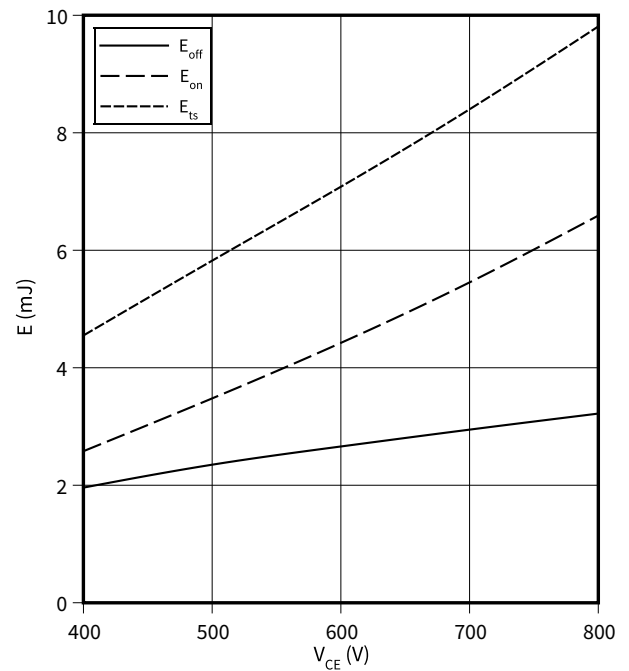
$I_C = 40.0\text{ A}, V_{CE} = 600\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 12\text{ }\Omega$



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

$E = f(V_{CE})$

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

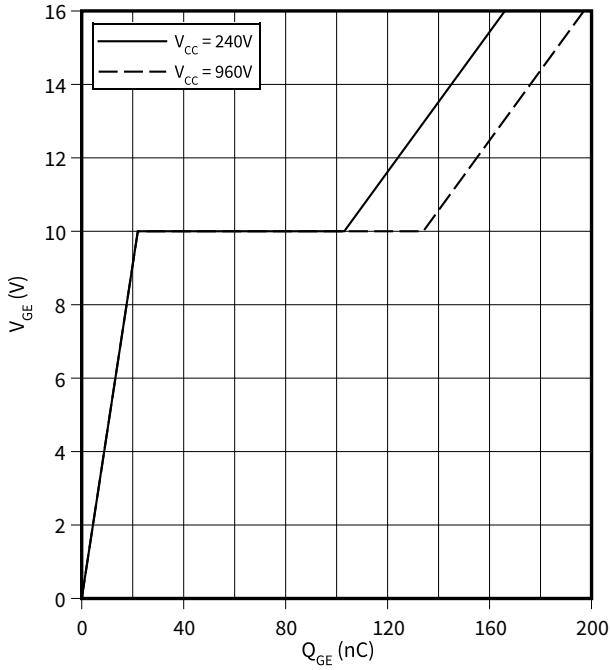


4 Characteristics diagrams

Typical gate charge, IGBT

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

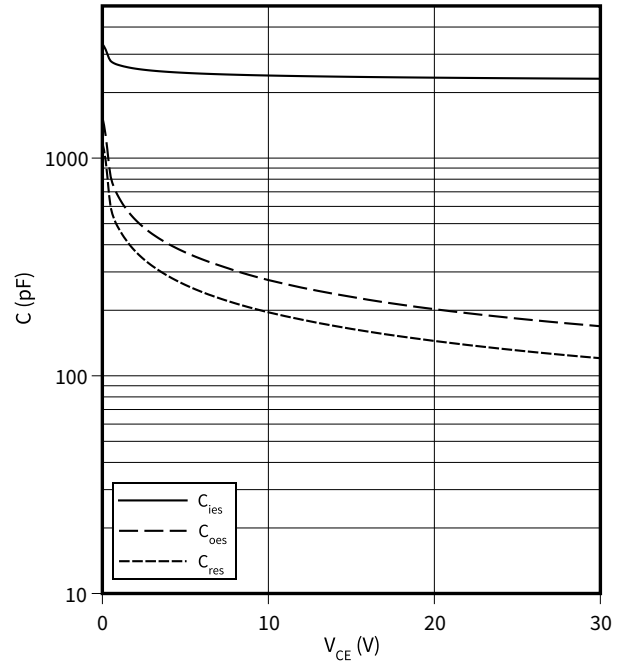
$I_C = 40.0 \text{ A}$



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

$C = f(V_{CE})$

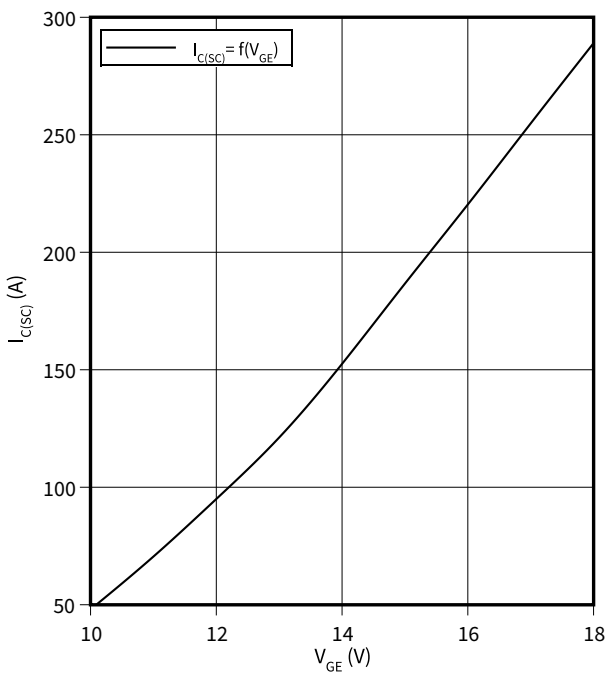
$f = 1000 \text{ kHz}, V_{GE} = 0 \text{ V}$



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

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

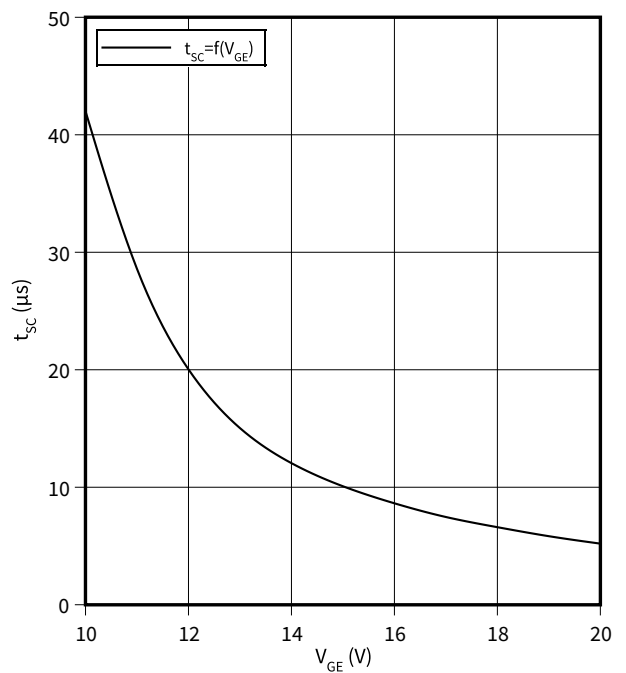
$V_{CE} \leq 600 \text{ V}, T_{vj, start} = 25 \text{ }^\circ\text{C}$



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

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

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

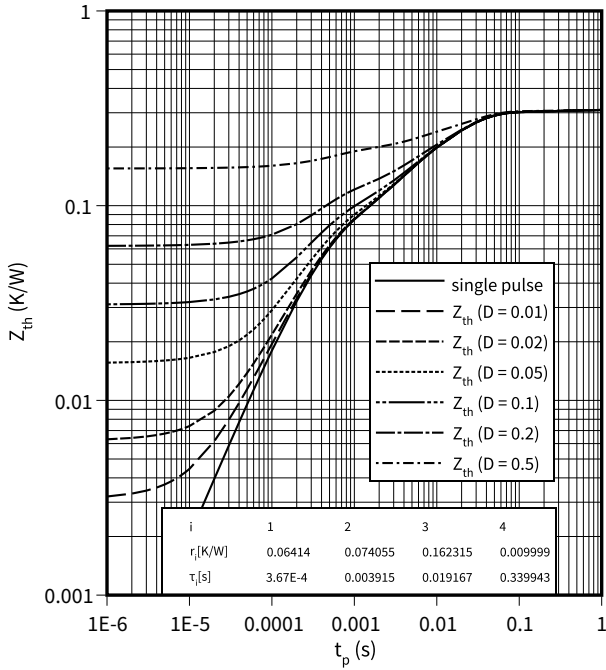


4 Characteristics diagrams

IGBT transient thermal impedance, IGBT

$Z_{th} = f(t_p)$

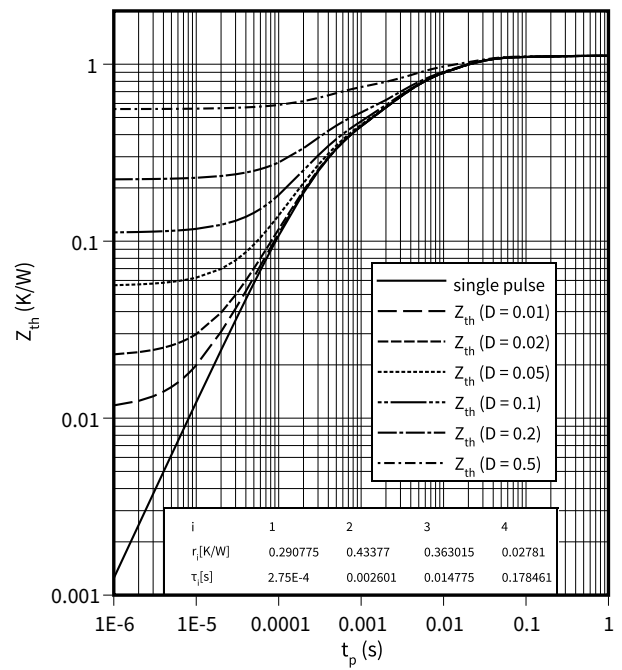
$D = t_p/T$



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

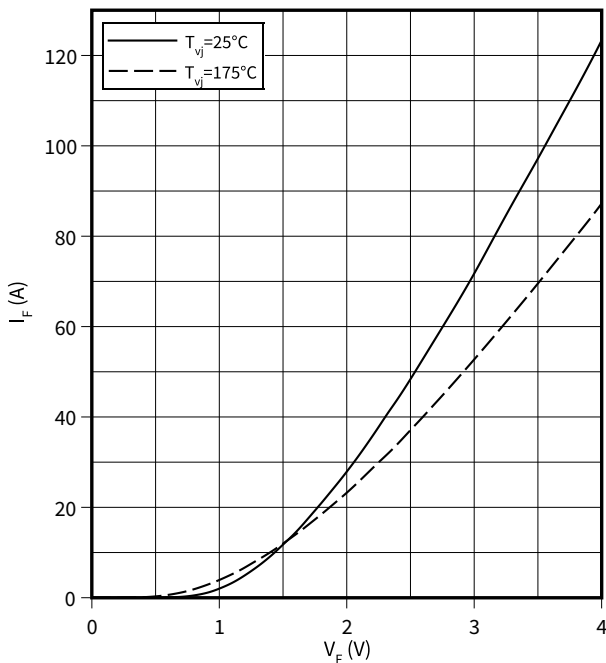
$Z_{th} = f(t_p)$

$D = t_p/T$



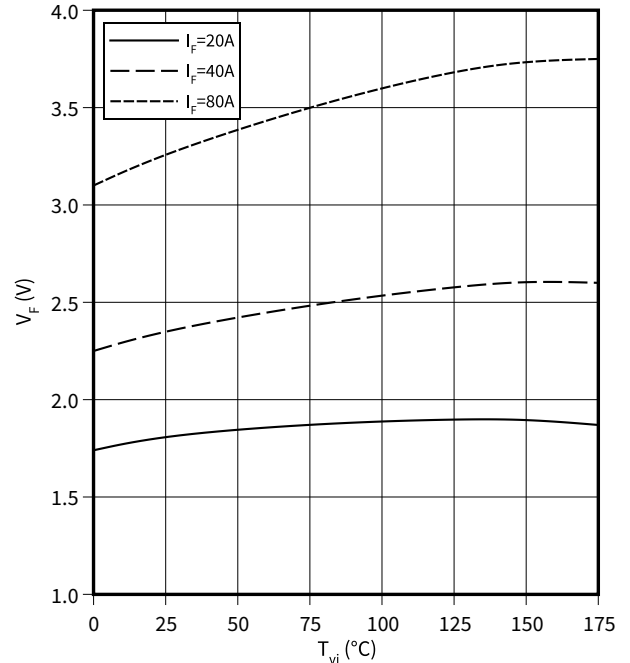
Typical diode forward current as a function of forward voltage, Diode

$I_F = f(V_F)$



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

$V_F = f(T_{vj})$

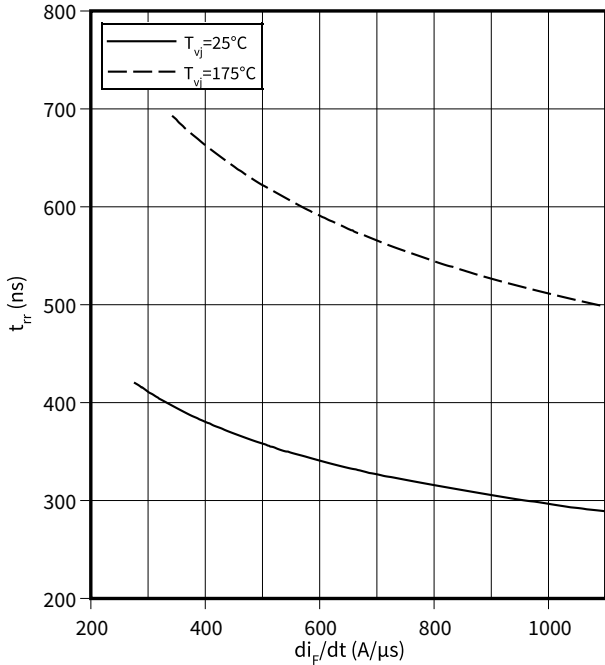


4 Characteristics diagrams

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

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

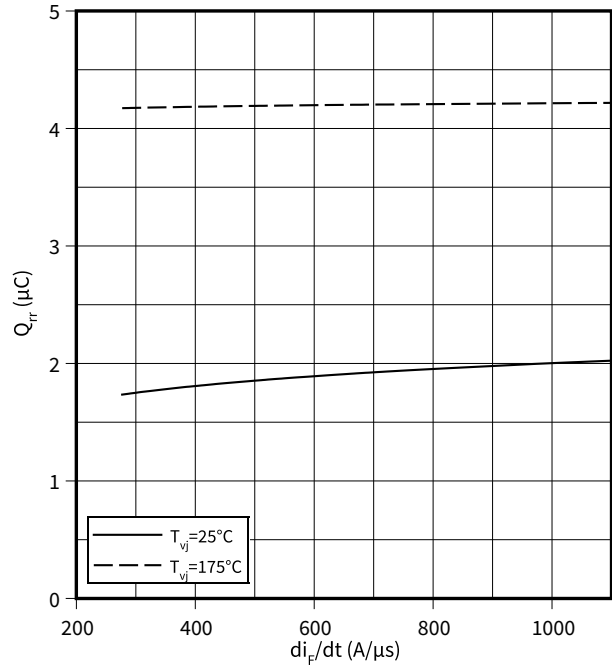
$V_R = 600\text{ V}, I_F = 40\text{ A}$



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

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

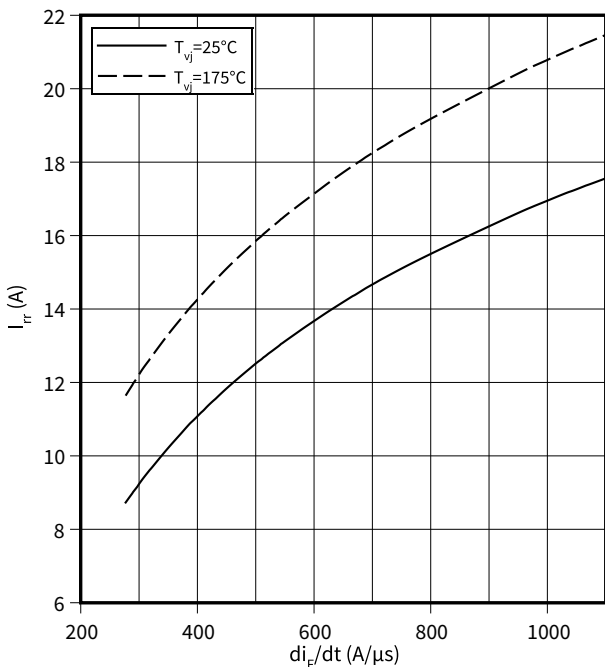
$V_R = 600\text{ V}, I_F = 40\text{ A}$



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

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

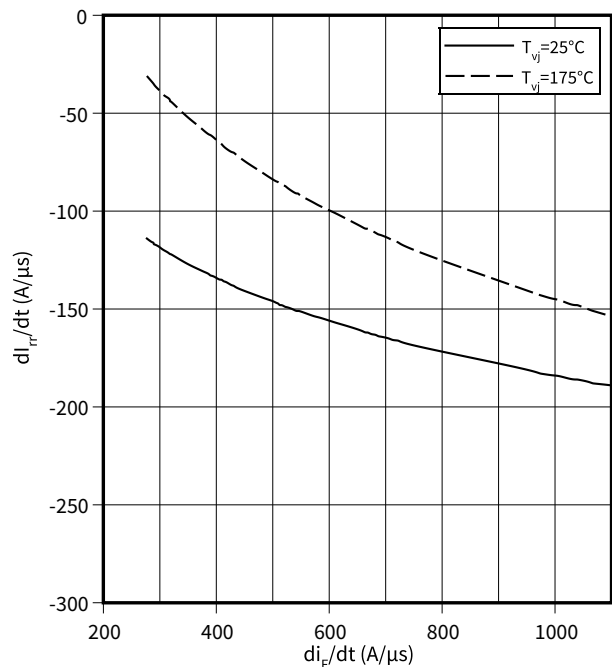
$V_R = 600\text{ V}, I_F = 40\text{ A}$



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

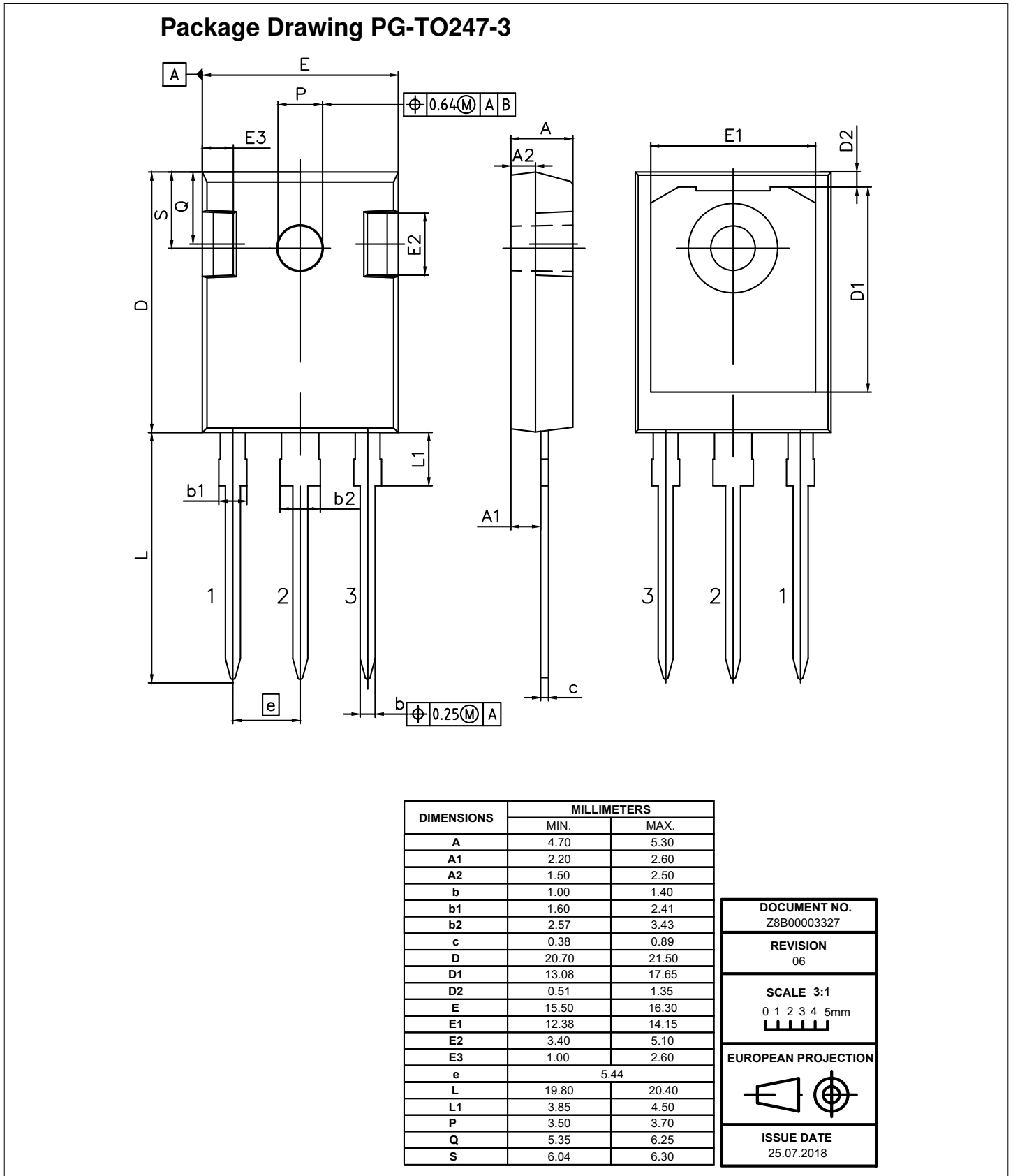


Figure 6

6 Testing conditions

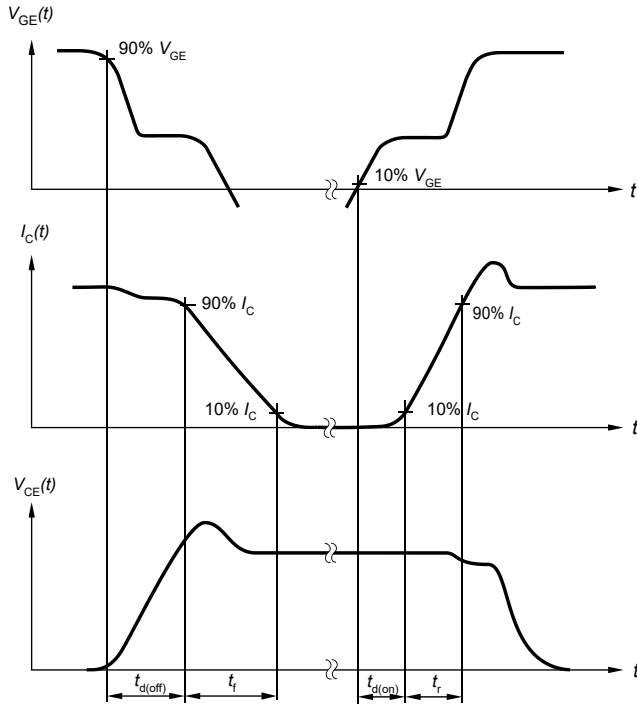


Figure A. Definition of switching times

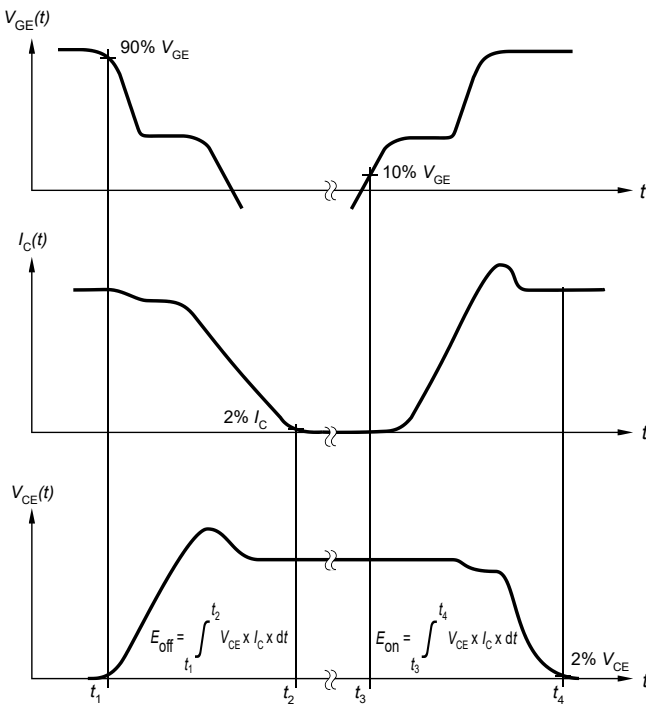


Figure B. Definition of switching losses

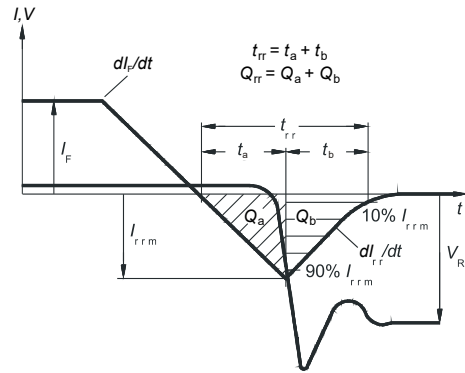


Figure C. Definition of diode switching characteristics

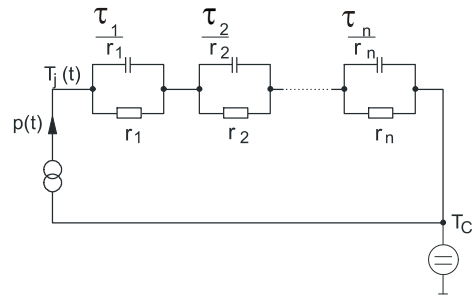


Figure D. Thermal equivalent circuit

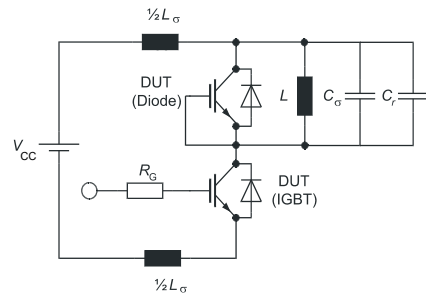


Figure E. Dynamic test circuit
 Parasitic inductance L_{σ} ,
 parasitic capacitor C_{σ} ,
 relief capacitor C_r ,
 (only for ZVT switching)

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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