

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

Features

- $V_{CE} = 1200\text{ V}$
- $I_C = 15\text{ A}$
- 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



Lead-Free



Green

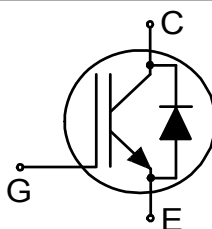


Halogen-Free



RoHS

Description



Type	Package	Marking
IKW15N120H3	PG-TO247-3	K15H1203



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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 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		$T_c = 25\text{ °C}$	30	A
			$T_c = 100\text{ °C}$	15	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}			60	A
Turn-off safe operating area		$V_{CE} \leq 1200\text{ V}$, $T_{vj} \leq 175\text{ °C}$		60	A
Gate-emitter voltage	V_{GE}			± 20	V
Short circuit withstand time	t_{SC}	$V_{CC} \leq 600\text{ V}$, 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}		$T_c = 25\text{ °C}$	217	W
			$T_c = 100\text{ °C}$	105	

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	$V_{CE\ sat}$	$I_C = 15.0\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		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}	$I_C = 0.50\ mA, V_{CE} = V_{GE}, T_{vj} = 175\ ^\circ C$		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}	$I_C = 15.0\ A, V_{CE} = 20\ V$			7.5		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 $\geq 1.0\ s, T_{vj} = 175\ ^\circ C$			52		A
Input capacitance	C_{ies}	$V_{CE} = 25\ V, V_{GE} = 0\ V, f = 1000\ kHz$			875		pF
Output capacitance	C_{oes}	$V_{CE} = 25\ V, V_{GE} = 0\ V, f = 1000\ kHz$			75		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25\ V, V_{GE} = 0\ V, f = 1000\ kHz$			45		pF
Gate charge	Q_G	$I_C = 15.0\ A, V_{GE} = 15\ V, V_{CE} = 960\ V$			75		nC
Turn-on delay time	t_{don}	$V_{CE} = 600\ V,$ $V_{GE} = +0/+15\ V,$ $R_{Gon} = 35.0\ \Omega,$ $R_{Goff} = 35.0\ \Omega,$ $L_\sigma = 95\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C,$ $I_C = 15.0\ A$		21		ns
			$T_{vj} = 175\ ^\circ C,$ $I_C = 15.0\ A$		19		
Rise time (inductive load)	t_r	$V_{CE} = 600\ V,$ $V_{GE} = +0/+15\ V,$ $R_{Gon} = 35.0\ \Omega,$ $R_{Goff} = 35.0\ \Omega,$ $L_\sigma = 95\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C,$ $I_C = 15.0\ A$		34		ns
			$T_{vj} = 175\ ^\circ C,$ $I_C = 15.0\ A$		30		
Turn-off delay time	t_{doff}	$V_{CE} = 600\ V,$ $V_{GE} = +0/+15\ V,$ $R_{Gon} = 35.0\ \Omega,$ $R_{Goff} = 35.0\ \Omega,$ $L_\sigma = 95\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C,$ $I_C = 15.0\ A$		260		ns
			$T_{vj} = 175\ ^\circ C,$ $I_C = 15.0\ A$		327		
Fall time (inductive load)	t_f	$V_{CE} = 600\ V,$ $V_{GE} = +0/+15\ V,$ $R_{Gon} = 35.0\ \Omega,$ $R_{Goff} = 35.0\ \Omega,$ $L_\sigma = 95\ nH, C_\sigma = 67\ pF$	$T_{vj} = 25\ ^\circ C,$ $I_C = 15.0\ A$		14		ns
			$T_{vj} = 175\ ^\circ C,$ $I_C = 15.0\ A$		43		

Table 3 Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-on energy	E_{on}	$V_{CE} = 600\text{ V}$, $V_{GE} = +0/+15\text{ V}$, $R_{Gon} = 35.0\ \Omega$, $R_{Goff} = 35.0\ \Omega$, $L_{\sigma} = 95\text{ nH}$, $C_{\sigma} = 67\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_C = 15.0\text{ A}$	1.10		mJ
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_C = 15.0\text{ A}$	1.60		
Turn-off energy	E_{off}	$V_{CE} = 600\text{ V}$, $V_{GE} = +0/+15\text{ V}$, $R_{Gon} = 35.0\ \Omega$, $R_{Goff} = 35.0\ \Omega$, $L_{\sigma} = 95\text{ nH}$, $C_{\sigma} = 67\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_C = 15.0\text{ A}$	0.45		mJ
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_C = 15.0\text{ A}$	0.90		
Total switching energy	E_{ts}	$V_{CE} = 600\text{ V}$, $V_{GE} = +0/+15\text{ V}$, $R_{Gon} = 35.0\ \Omega$, $R_{Goff} = 35.0\ \Omega$, $L_{\sigma} = 95\text{ nH}$, $C_{\sigma} = 67\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_C = 15.0\text{ A}$	1.55		mJ
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_C = 15.0\text{ A}$	2.50		
IGBT thermal resistance, junction-case	R_{thjc}				0.70	K/W
Operating junction temperature	T_{vj}		-40		175	$^{\circ}\text{C}$

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

3 Diode

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak reverse voltage	V_{RRM}		1200	V
Diode forward current, limited by T_{vjmax}	I_F	$T_C = 25\text{ }^{\circ}\text{C}$	15	A
		$T_C = 100\text{ }^{\circ}\text{C}$	7.5	
Diode pulsed current, limited by T_{vjmax}	I_{Fpuls}		60	A

Table 5 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 7.5\text{ A}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$	1.80	2.35	V
			$T_{vj} = 175\text{ }^{\circ}\text{C}$	1.85		

Table 5 Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 15.0\text{ A}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$		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	
Diode reverse recovery time	t_{rr}	$V_R = 600\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_F = 15.0\text{ A}$, $-di_F/dt = 500\text{ A}/\mu\text{s}$		260		ns
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_F = 15.0\text{ A}$, $-di_F/dt = 500\text{ A}/\mu\text{s}$		470		
Diode reverse recovery charge	Q_{rr}	$V_R = 600\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_F = 15.0\text{ A}$, $-di_F/dt = 500\text{ A}/\mu\text{s}$		0.80		μC
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_F = 15.0\text{ A}$, $-di_F/dt = 500\text{ A}/\mu\text{s}$		1.70		
Diode peak reverse recovery current	I_{rrm}	$V_R = 600\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_F = 15.0\text{ A}$, $-di_F/dt = 500\text{ A}/\mu\text{s}$		7.7		A
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_F = 15.0\text{ A}$, $-di_F/dt = 500\text{ A}/\mu\text{s}$		9.8		
Diode peak rate off fall of reverse recovery current	di_{rr}/dt	$V_R = 600\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_F = 15.0\text{ A}$, $-di_F/dt = 500\text{ A}/\mu\text{s}$		-110		$\text{A}/\mu\text{s}$
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_F = 15.0\text{ A}$, $-di_F/dt = 500\text{ A}/\mu\text{s}$		-80		
Diode thermal resistance, junction-case	R_{thjc}					2.12	K/W
Operating junction temperature	T_{vj}			-40		175	$^{\circ}\text{C}$

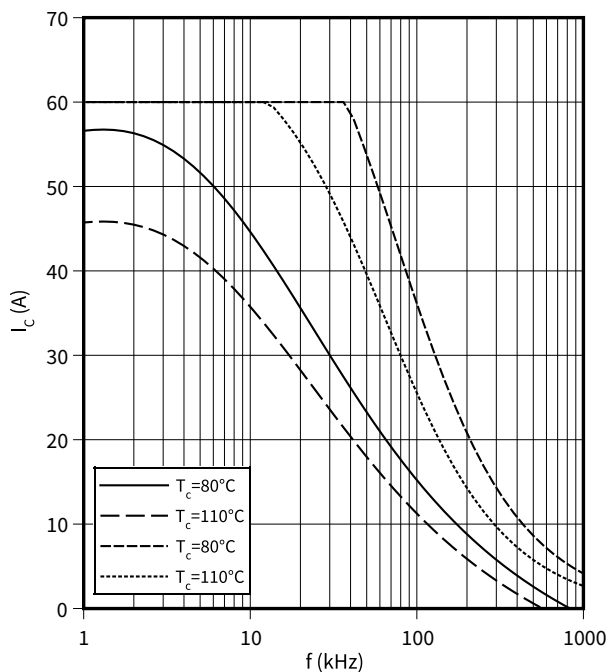
Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

4 Characteristics diagrams

Collector current as a function of switching frequency, IGBT

$$I_C = f(f)$$

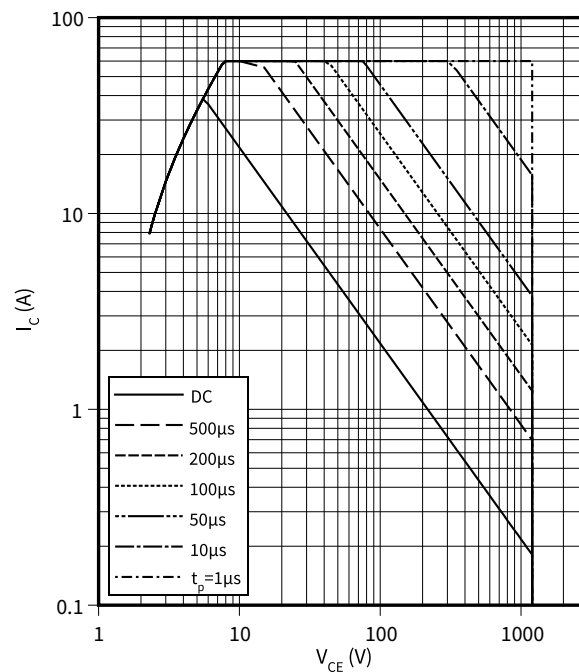
$D = 0.5$, $V_{CE} = 600 \text{ V}$, $T_{vj} \leq 175 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 35 \text{ } \Omega$



Forward bias safe operating area, IGBT

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

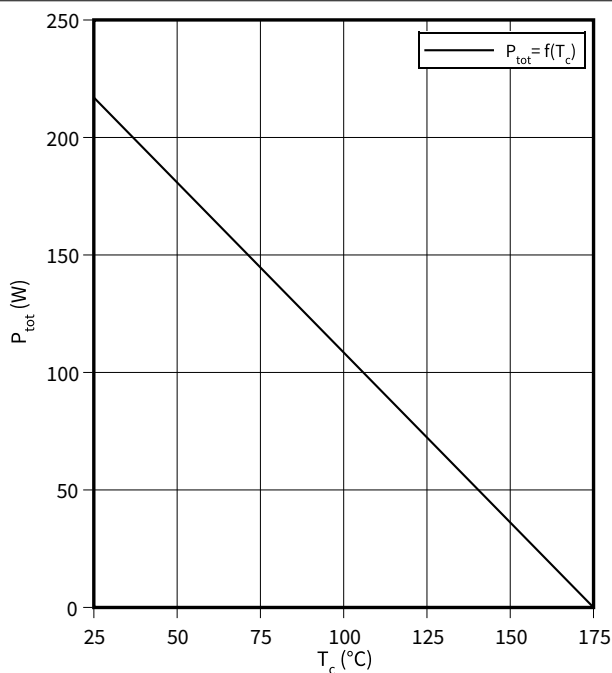
$D = 0$, $T_{vj} \leq 175 \text{ }^\circ\text{C}$, $V_{GE} = 15 \text{ V}$, $T_c = 25 \text{ }^\circ\text{C}$



Power dissipation as a function of case temperature, IGBT

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

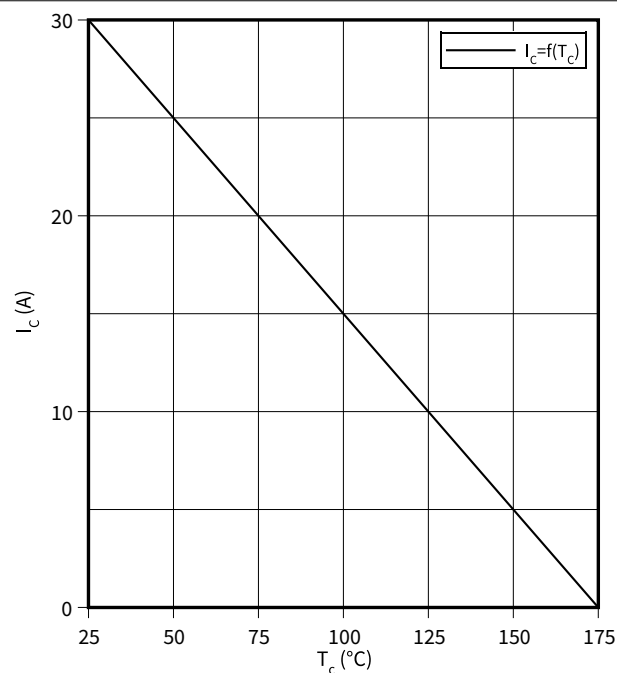
$T_{vj} \leq 175 \text{ }^\circ\text{C}$

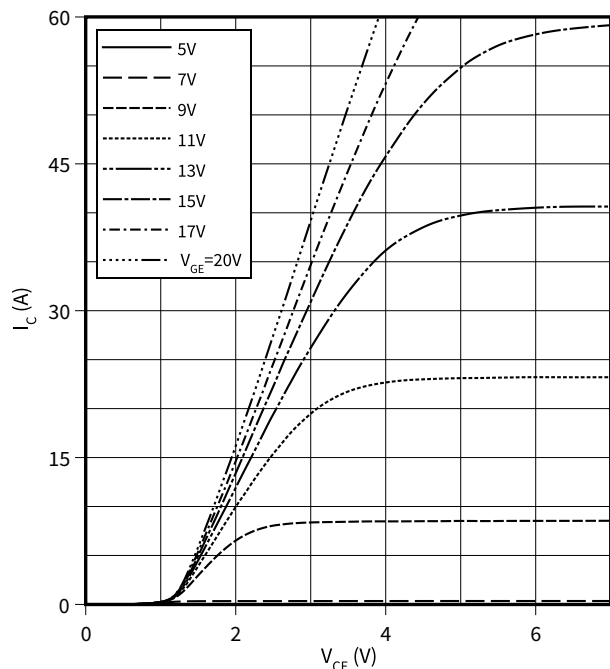
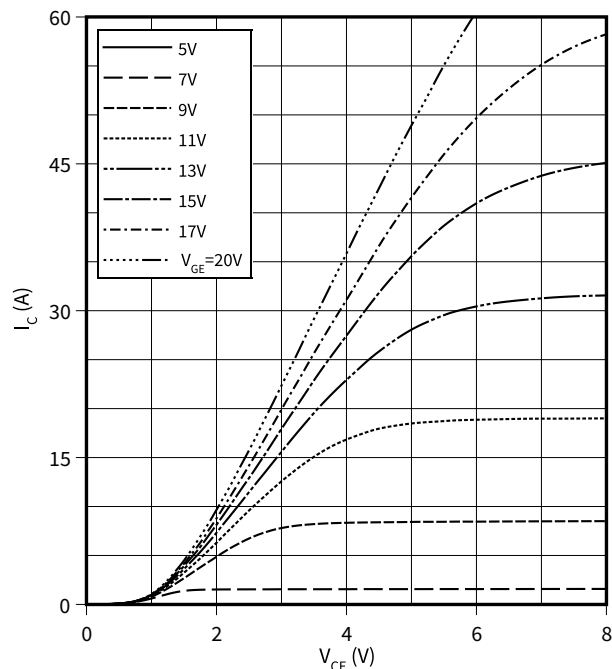
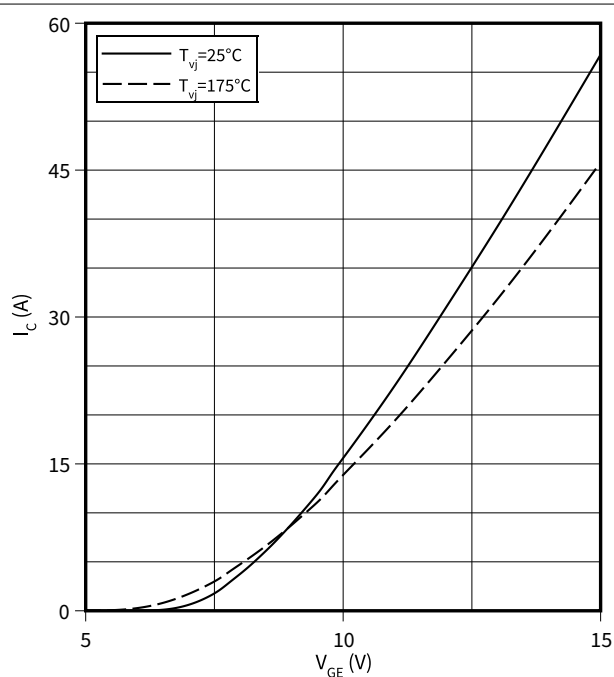
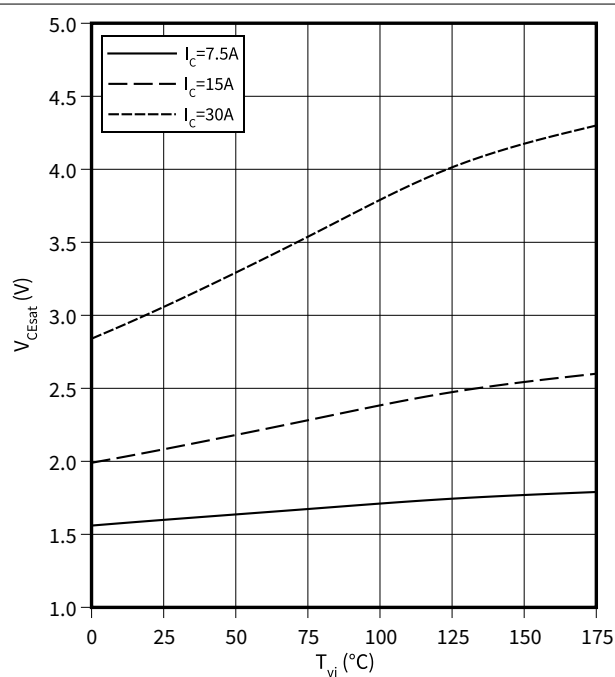


Collector current as a function of case temperature, IGBT

$$I_C = f(T_c)$$

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



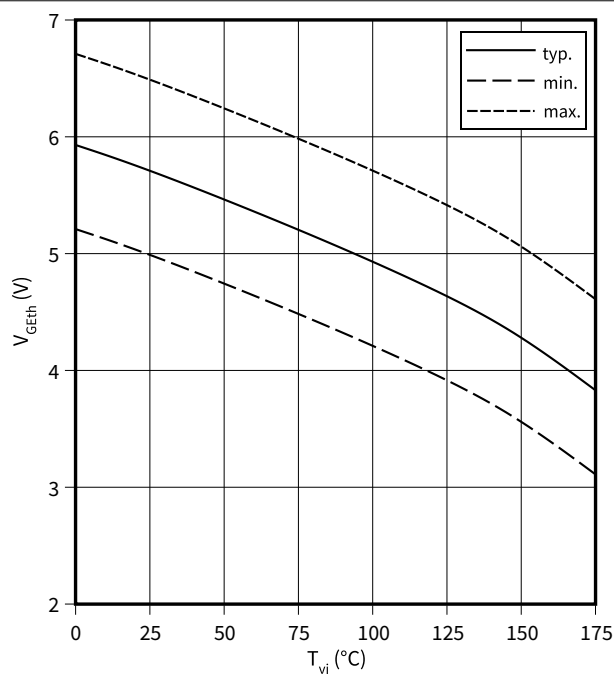
4 Characteristics diagrams
Typical output characteristic, IGBT
 $I_C = f(V_{CE})$
 $T_{vj} = 25\text{ }^{\circ}\text{C}$

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

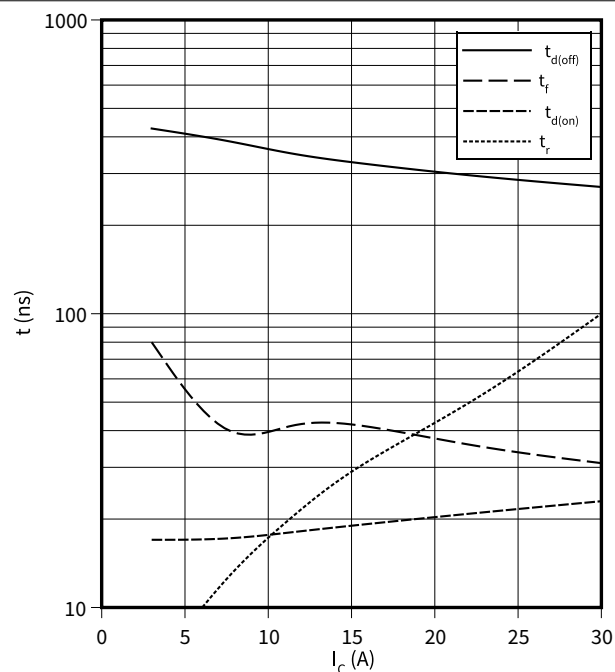
$$V_{GEth} = f(T_{vj})$$

$$I_C = 0.50 \text{ mA}$$

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

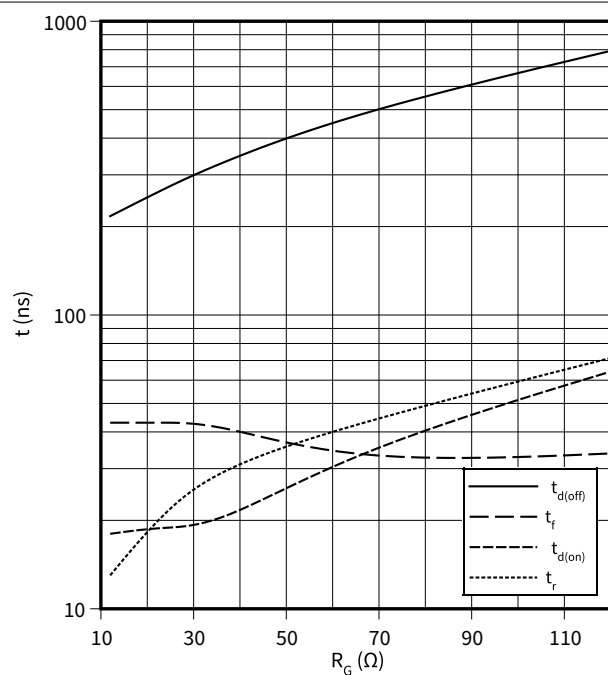
$$t = f(I_C)$$

$$V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 35 \text{ } \Omega$$

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

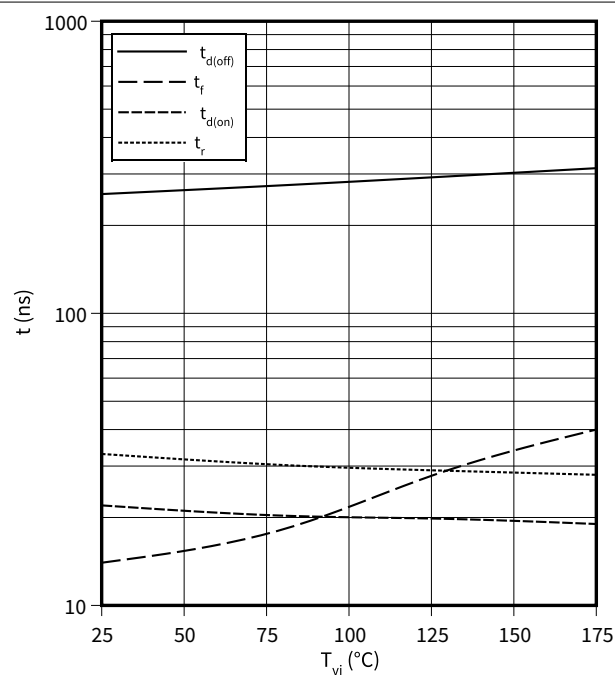
$$t = f(R_G)$$

$$I_C = 15.0 \text{ A}, V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$$

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

$$t = f(T_{vj})$$

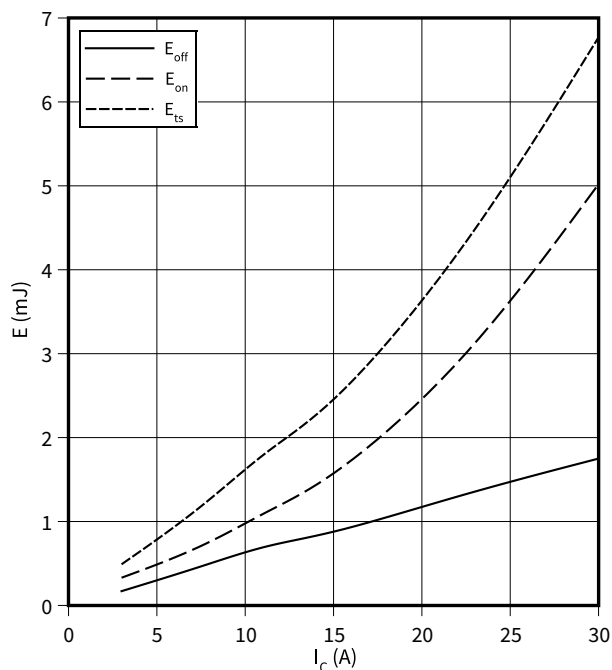
$$I_C = 15.0 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 35 \text{ } \Omega$$



4 Characteristics diagrams

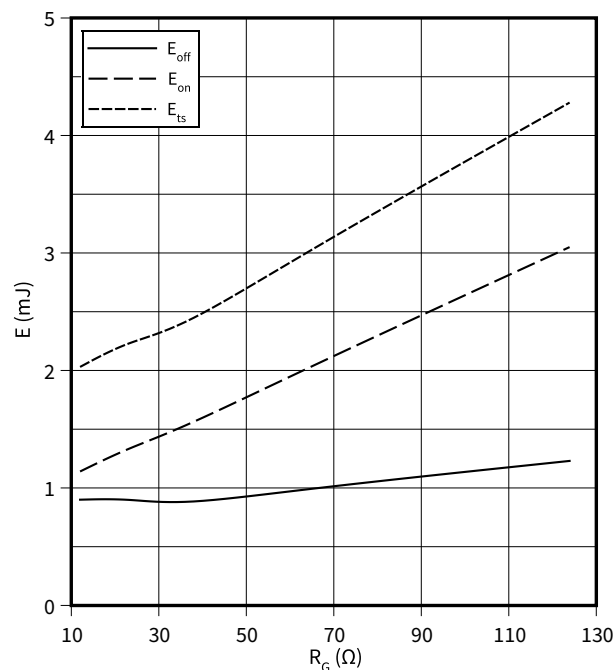
Typical switching energy losses as a function of collector current, IGBT

$$E = f(I_C)$$

 $V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ }^{\circ}\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 35 \text{ } \Omega$


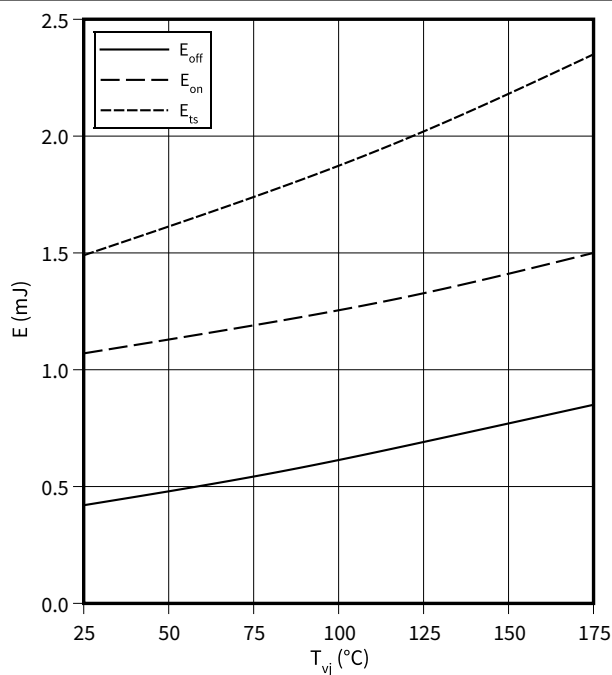
Typical switching energy losses as a function of gate resistance, IGBT

$$E = f(R_G)$$

 $I_C = 15.0 \text{ A}, V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ }^{\circ}\text{C}, V_{GE} = 0/15 \text{ V}$


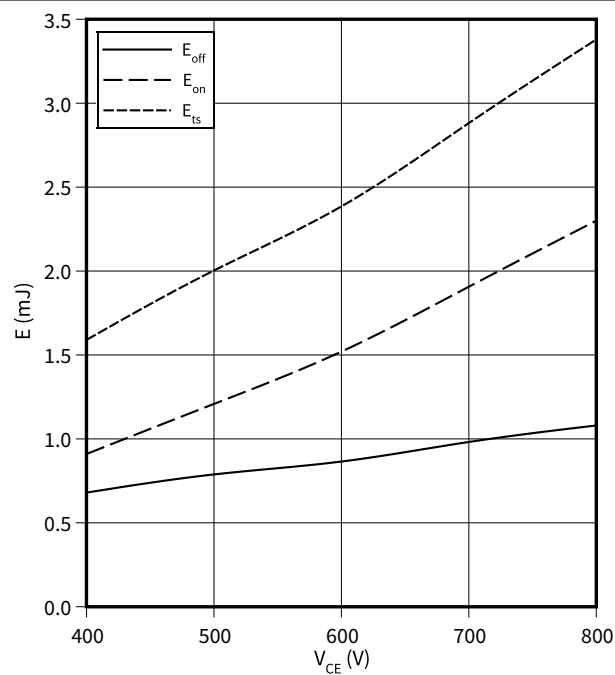
Typical switching energy losses as a function of junction temperature, IGBT

$$E = f(T_{vj})$$

 $I_C = 15.0 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 35 \text{ } \Omega$


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

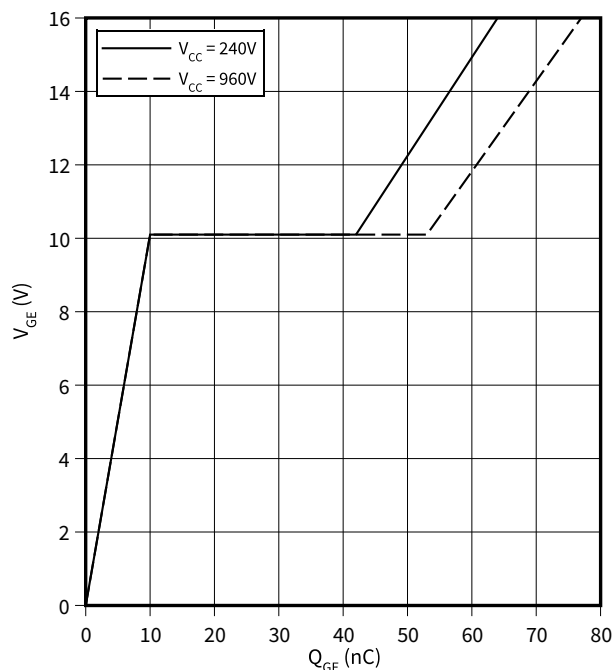
$$E = f(V_{CE})$$

 $I_C = 15.0 \text{ A}, T_{vj} = 175 \text{ }^{\circ}\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 35 \text{ } \Omega$


4 Characteristics diagrams
Typical gate charge, IGBT

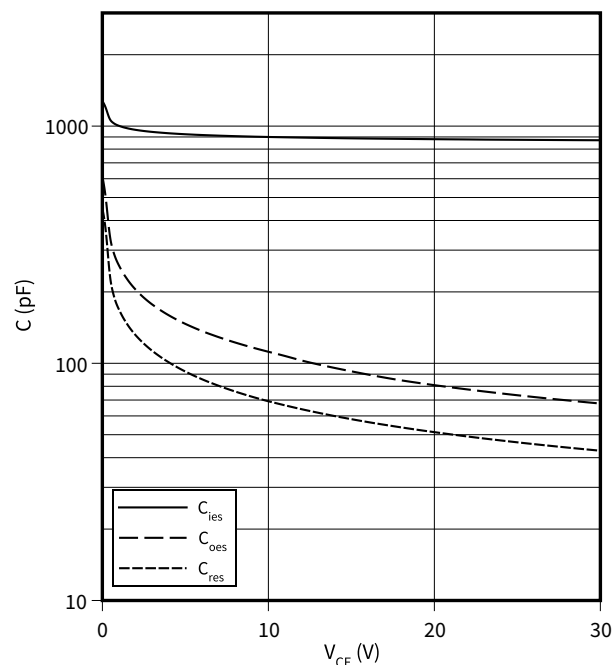
$$V_{GE} = f(Q_{GE})$$

$$I_C = 15.0 \text{ A}$$


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

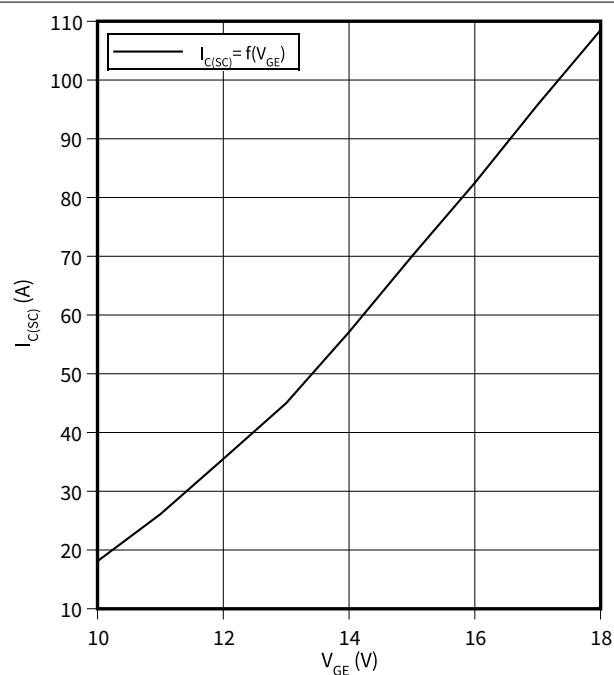
$$C = f(V_{CE})$$

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


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

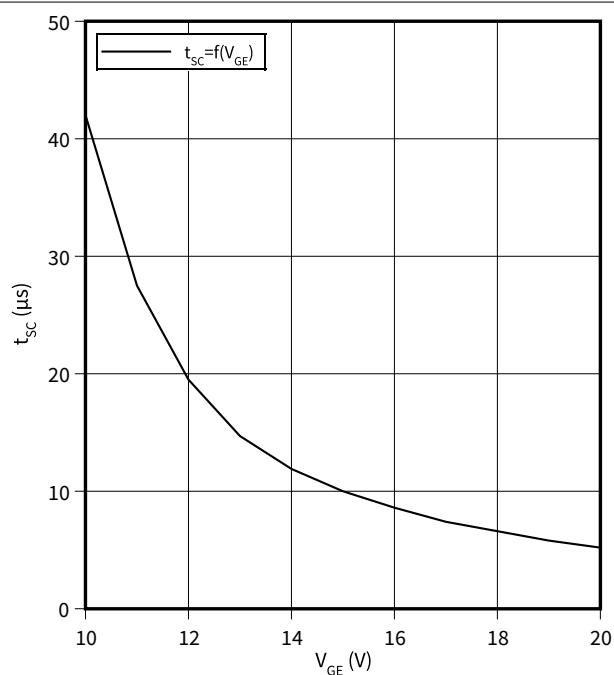
$$I_{C(SC)} = f(V_{GE})$$

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


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

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

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

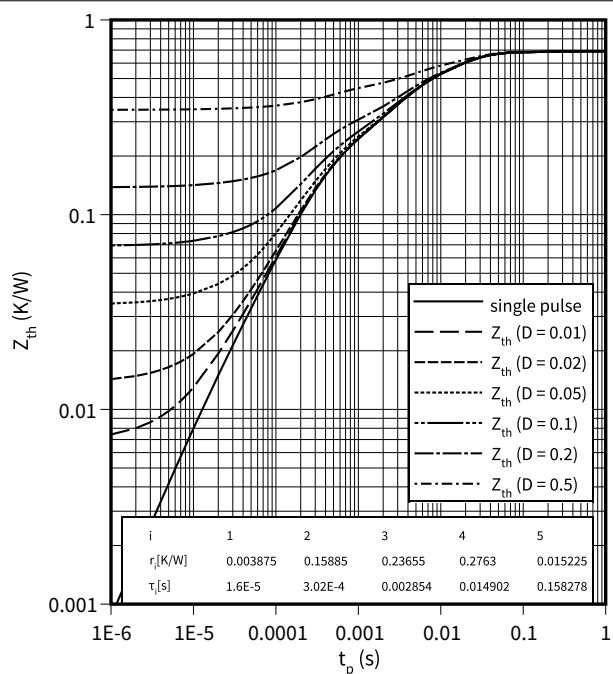


4 Characteristics diagrams

IGBT transient thermal impedance, IGBT

$$Z_{th} = f(t_p)$$

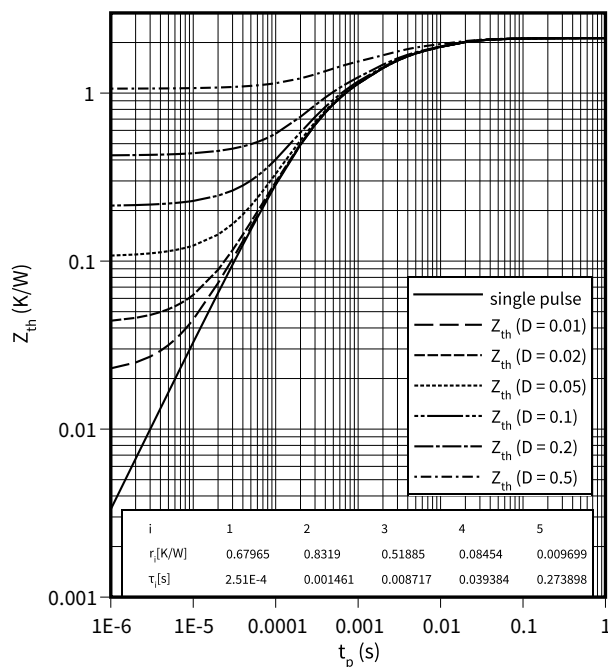
$$D = t_p/T$$



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

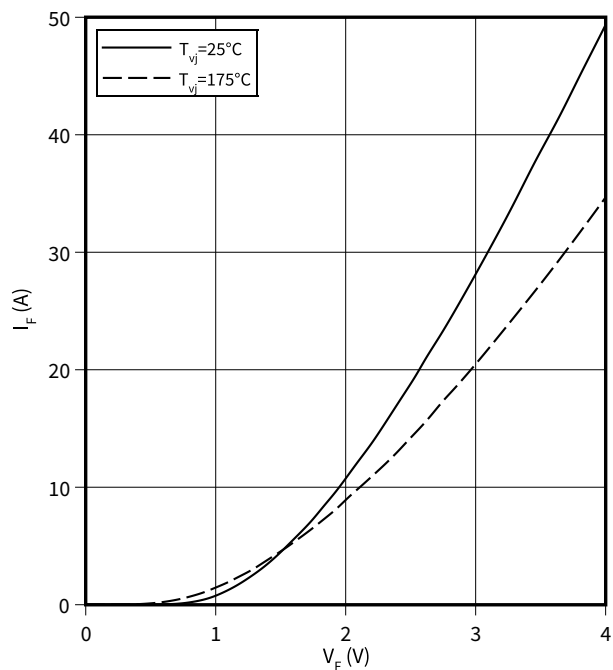
$$Z_{th} = f(t_p)$$

$$D = t_p/T$$



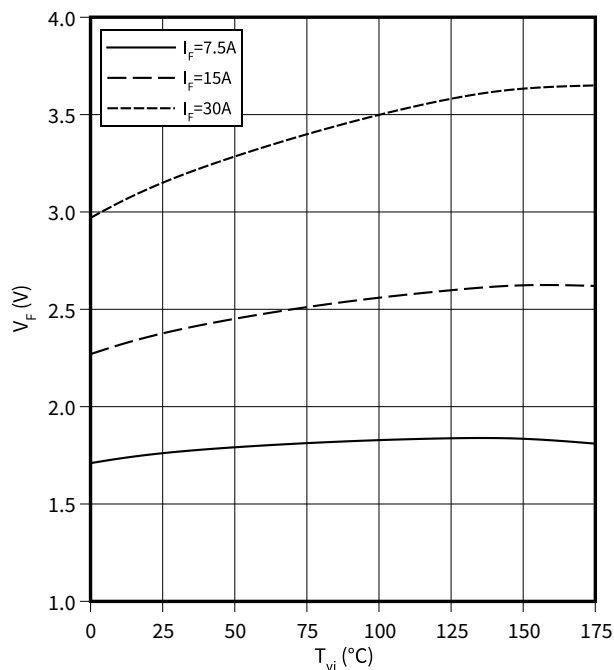
Typical diode forward current as a function of forward voltage, Diode

$$I_F = f(V_F)$$



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

$$V_F = f(T_{vj})$$

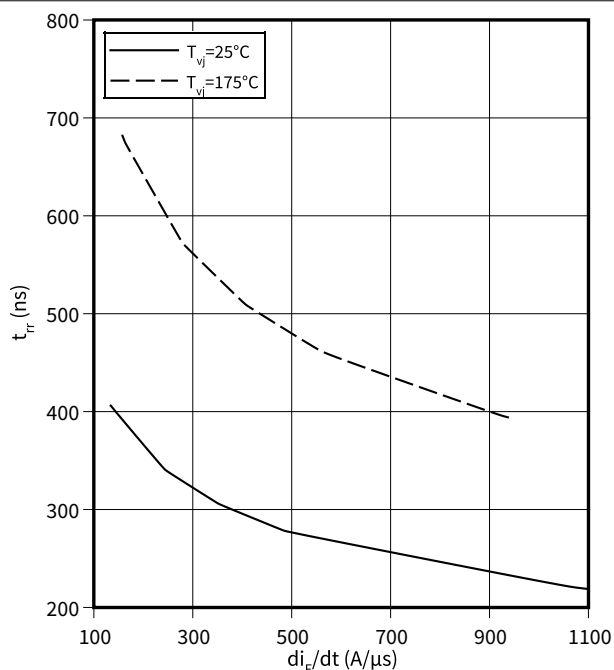


4 Characteristics diagrams

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

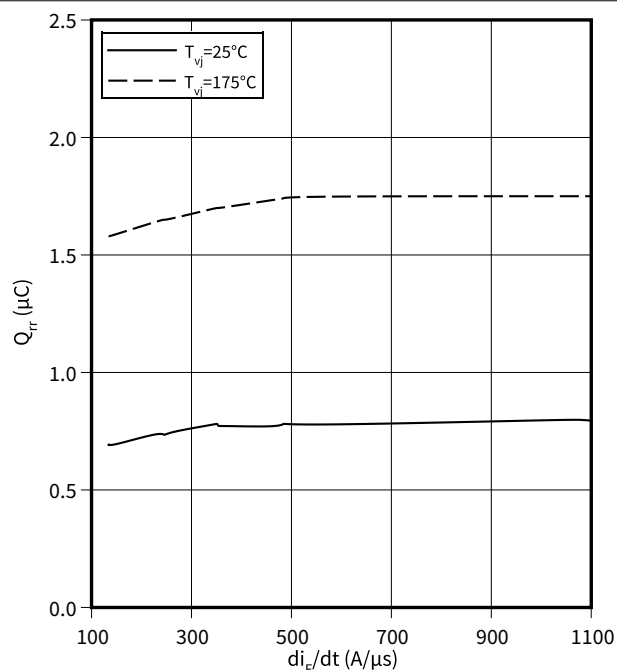
$$t_{rr} = f(di_F/dt)$$

$$V_R = 600 \text{ V}, I_F = 15 \text{ A}$$

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

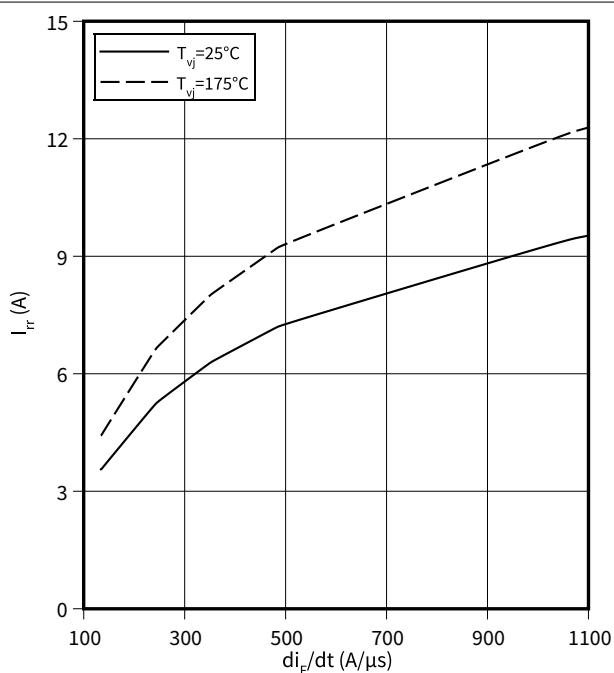
$$Q_{rr} = f(di_F/dt)$$

$$V_R = 600 \text{ V}, I_F = 15 \text{ A}$$

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

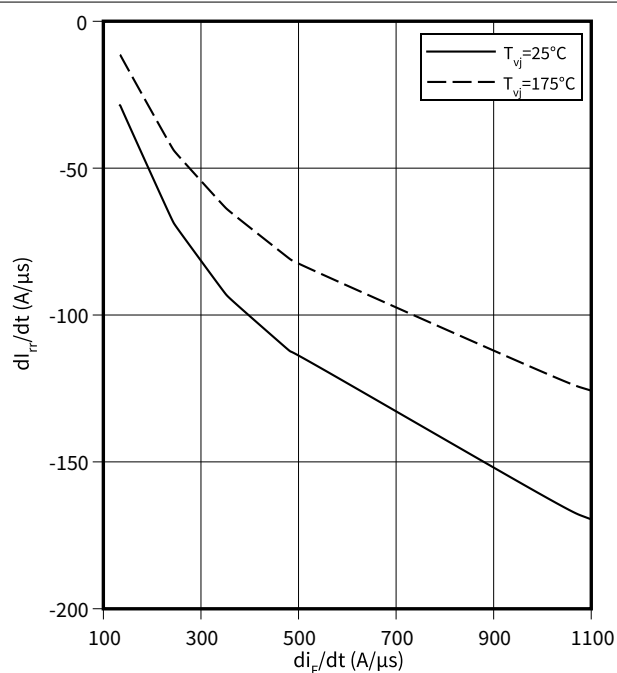
$$I_{rr} = f(di_F/dt)$$

$$V_R = 600 \text{ V}, I_F = 15 \text{ A}$$

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

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

$$V_R = 600 \text{ V}, I_F = 15 \text{ A}$$



5 Package outlines

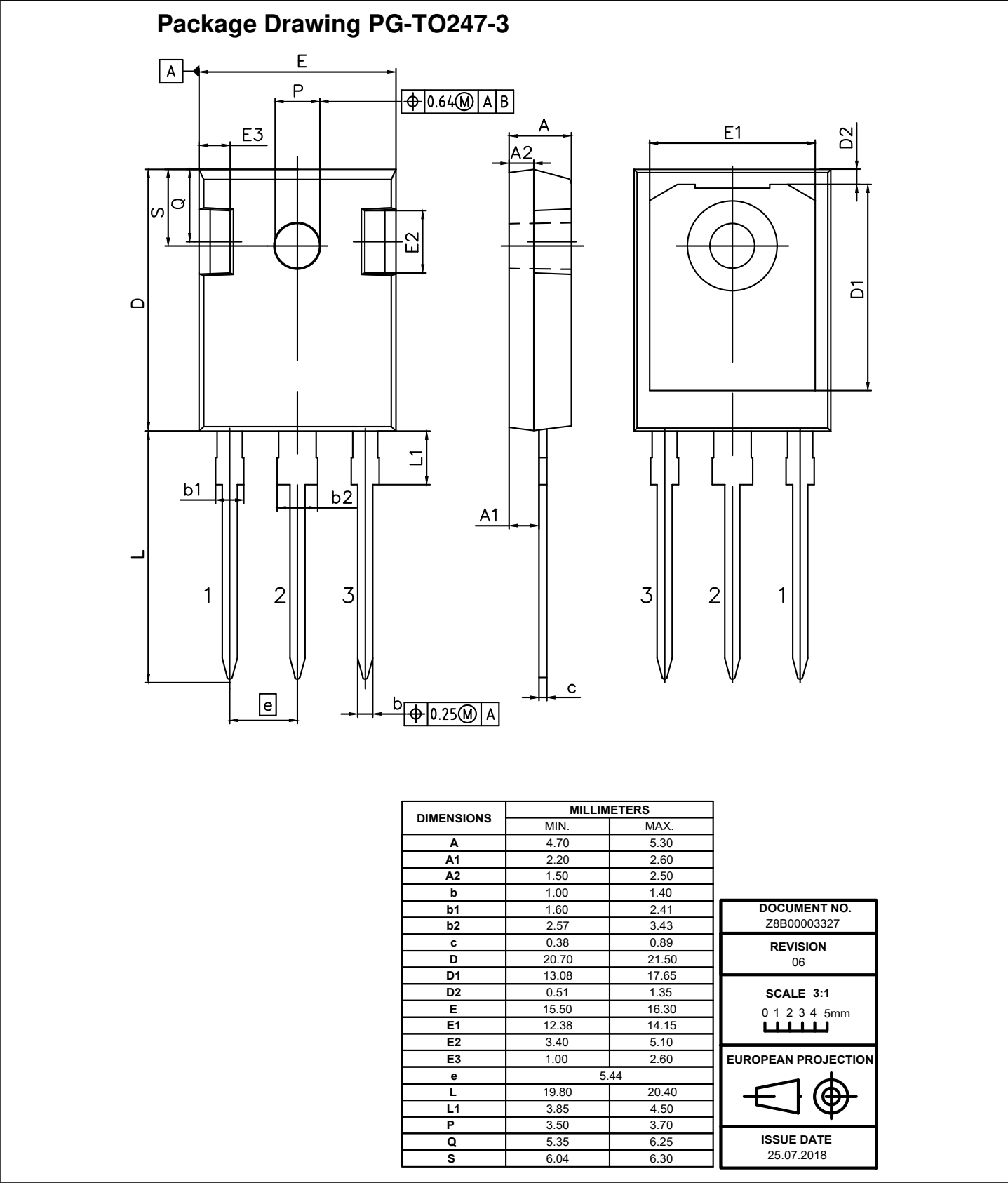


Figure 6

6 Testing conditions

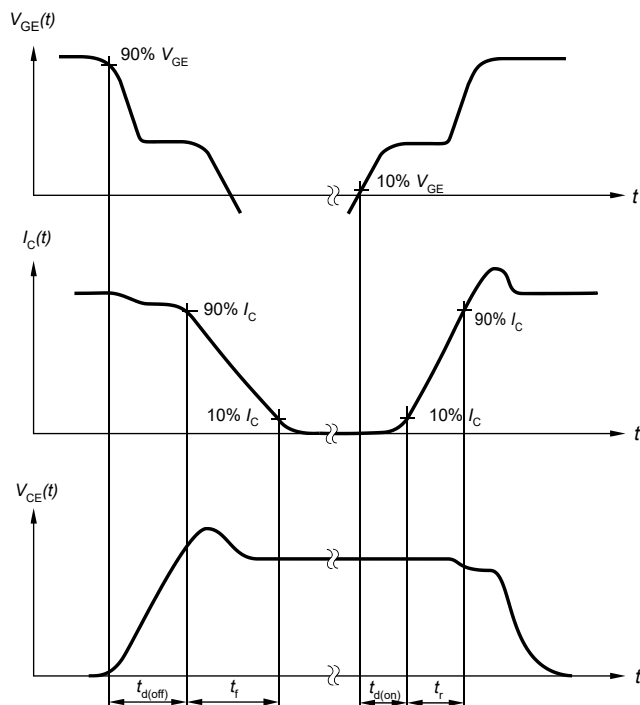


Figure A. Definition of switching times

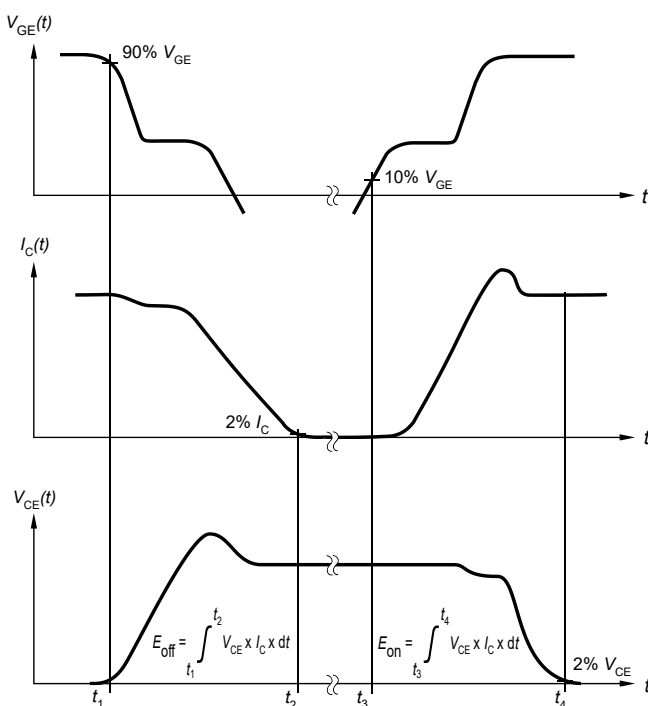


Figure B. Definition of switching losses

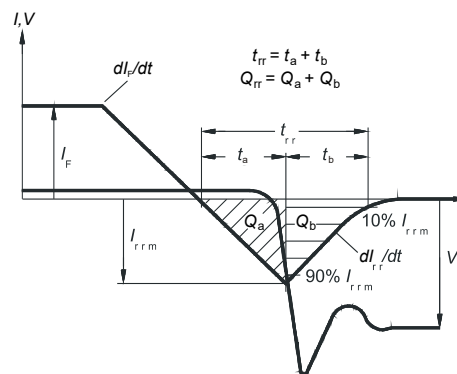


Figure C. Definition of diode switching characteristics

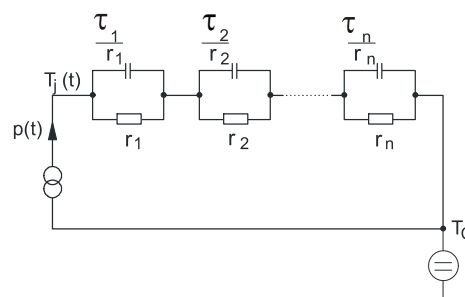


Figure D. Thermal equivalent circuit

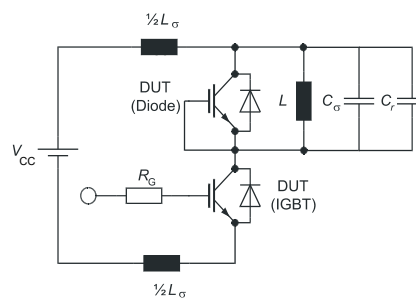


Figure E. **Dynamic test circuit**
 Parasitic inductance L_σ ,
 parasitic capacitor C_σ ,
 relief capacitor C_r ,
 (only for ZVT switching)

Figure 7

Revision history

Document revision	Date of release	Description of changes
V1.1	2009-11-27	
V1.2	2010-02-10	
V2.1	2014-12-01	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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