

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

Features

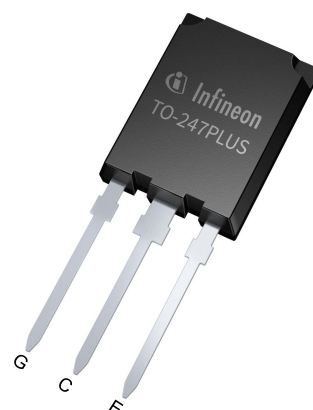
- $V_{CE} = 1200\text{ V}$
- $I_C = 120\text{ A}$
- IGBT co-packed with full current, soft and low Q_{rr} diode
- Low saturation voltage $V_{CEsat} = 2.0\text{ V}$ at $T_{vj} = 175^\circ\text{C}$
- Optimized for hard switching topologies (2-L inverter, 3-L NPC T-type, ...)
- Short circuit ruggedness $8\text{ }\mu\text{s}$
- Wide range of dv/dt controllability
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

Potential applications

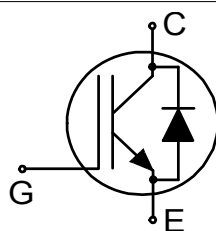
- Industrial drives
- Industrial power supplies
- Solar inverters

Product validation

- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22



Description



Type	Package	Marking
IKQ120N120CS7	PG-TO247-3-PLUS-NN3.7	K120MCS7



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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		nH
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature	T_{sold}	wave soldering 1.6 mm (0.063 in.) from case for 10 s			260	°C
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.11	0.15	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.21	0.29	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	$T_c = 25\text{ °C}$	216	A
			$T_c = 100\text{ °C}$	144	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			360	A
Turn-off safe operating area		$V_{CE} \leq 1200\text{ V}, T_{vj} \leq 175\text{ °C}$		360	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}	$T_{vj} \leq 175\text{ °C}$	$T_c = 25\text{ °C}$	1004	W
			$T_c = 100\text{ °C}$	502	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 120\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.65	2	V
			$T_{vj} = 175\text{ °C}$		2		
Gate-emitter threshold voltage	V_{GETh}	$I_C = 2.34\text{ mA}$, $V_{CE} = V_{GE}$		5.1	5.7	6.5	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 1200\text{ V}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			40	μA
			$T_{vj} = 175\text{ °C}$		10400		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = 20\text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 120\text{ A}$, $V_{CE} = 20\text{ V}$, $T_{vj} = 175\text{ °C}$			51		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 $\geq 1.0\text{ s}$, $T_{vj} = 150\text{ °C}$			720		A
Input capacitance	C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 100\text{ kHz}$			17.3		nF
Output capacitance	C_{oes}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 100\text{ kHz}$			325		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 100\text{ kHz}$			80		pF
Gate charge	Q_G	$I_C = 120\text{ A}$, $V_{GE} = 15\text{ V}$, $V_{CC} = 960\text{ V}$			710		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 600\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 1.3\text{ }\Omega$, $R_{G(off)} = 1.3\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 120\text{ A}$		44		ns
			$T_{vj} = 175\text{ °C}$, $I_C = 120\text{ A}$		42		
Rise time (inductive load)	t_r	$V_{CC} = 600\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 1.3\text{ }\Omega$, $R_{G(off)} = 1.3\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 120\text{ A}$		34		ns
			$T_{vj} = 175\text{ °C}$, $I_C = 120\text{ A}$		35		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 600\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 1.3\text{ }\Omega$, $R_{G(off)} = 1.3\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 120\text{ A}$		215		ns
			$T_{vj} = 175\text{ °C}$, $I_C = 120\text{ A}$		256		
Fall time (inductive load)	t_f	$V_{CC} = 600\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 1.3\text{ }\Omega$, $R_{G(off)} = 1.3\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 120\text{ A}$		106		ns
			$T_{vj} = 175\text{ °C}$, $I_C = 120\text{ A}$		200		
Turn-on energy	E_{on}	$V_{CC} = 600\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 1.3\text{ }\Omega$, $R_{G(off)} = 1.3\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 120\text{ A}$		10.3		mJ
			$T_{vj} = 175\text{ °C}$, $I_C = 120\text{ A}$		12.6		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-off energy	E_{off}	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 1.3 \Omega$, $R_{G(off)} = 1.3 \Omega$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 120 \text{ A}$	5.72		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 120 \text{ A}$	9.5		
Total switching energy	E_{ts}	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 1.3 \Omega$, $R_{G(off)} = 1.3 \Omega$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 120 \text{ A}$	16.1		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 120 \text{ A}$	22.1		
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
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	$T_c = 25 \text{ }^{\circ}\text{C}$	A
			$T_c = 100 \text{ }^{\circ}\text{C}$	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}		360	A
Power dissipation	P_{tot}	$T_c = 25 \text{ }^{\circ}\text{C}$	525	W
		$T_c = 100 \text{ }^{\circ}\text{C}$	263	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 120 \text{ A}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$	1.65	2.15	V
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$	1.6		
Diode reverse recovery time	t_{rr}	$V_R = 600 \text{ V}$, $R_{G(on)} = 1.3 \Omega$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_F = 120 \text{ A}$	205		ns
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_F = 120 \text{ A}$	311		
Diode reverse recovery charge	Q_{rr}	$V_R = 600 \text{ V}$, $R_{G(on)} = 1.3 \Omega$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_F = 120 \text{ A}$	8.35		μC
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_F = 120 \text{ A}$	14.9		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode peak reverse recovery current	I_{rrm}	$V_R = 600 \text{ V}, R_{G(on)} = 1.3 \text{ } \Omega$		$T_{vj} = 25 \text{ } ^\circ\text{C}, I_F = 120 \text{ A}$	65	A
				$T_{vj} = 175 \text{ } ^\circ\text{C}, I_F = 120 \text{ A}$	79	
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	$V_R = 600 \text{ V}, R_{G(on)} = 1.3 \text{ } \Omega$		$T_{vj} = 25 \text{ } ^\circ\text{C}, I_F = 120 \text{ A}$	-391	A/ μs
				$T_{vj} = 175 \text{ } ^\circ\text{C}, I_F = 120 \text{ A}$	-302	
Reverse recovery energy	E_{rec}	$V_R = 600 \text{ V}, R_{G(on)} = 1.3 \text{ } \Omega$		$T_{vj} = 25 \text{ } ^\circ\text{C}, I_F = 120 \text{ A}$	2.61	mJ
				$T_{vj} = 175 \text{ } ^\circ\text{C}, I_F = 120 \text{ A}$	5.1	
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.

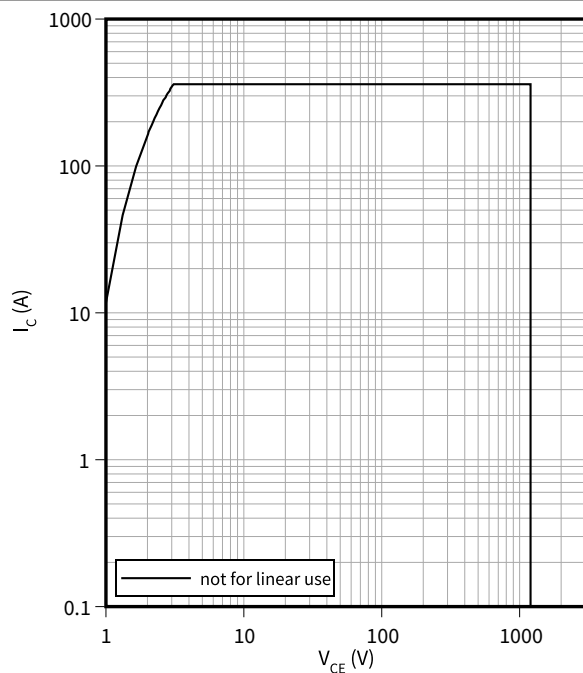
Dynamic test circuit, parasitic inductance $L_\sigma = 30 \text{ nH}$, $C_\sigma = 18 \text{ pF}$.

4 Characteristics diagrams

Reverse bias safe operating area

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

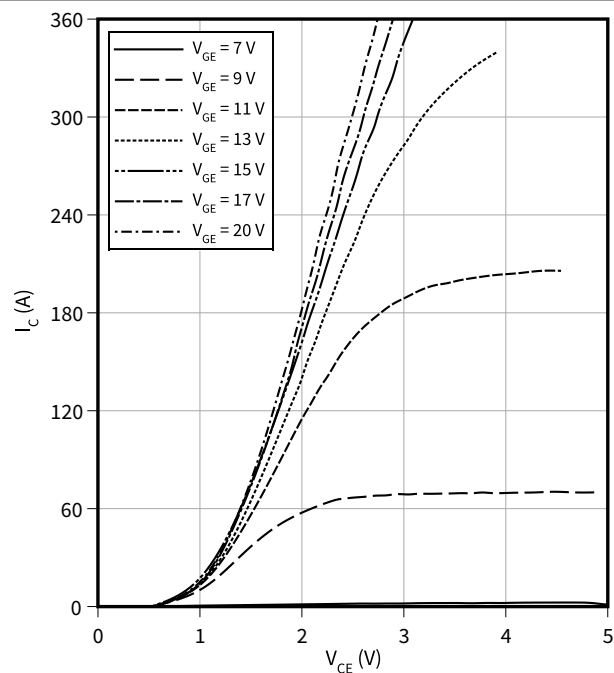
$$T_{vj} \leq 175^\circ\text{C}, V_{CE} \leq 1200\text{ V}$$



Typical output characteristic

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

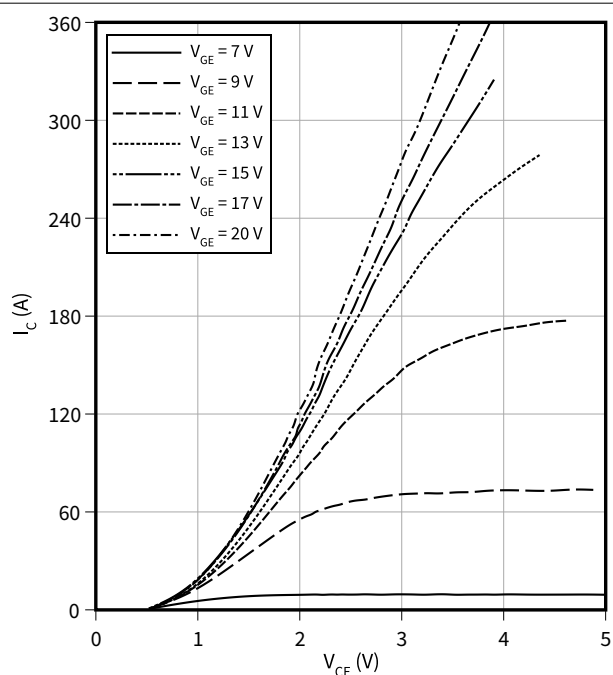
$$T_{vj} = 25^\circ\text{C}$$



Typical output characteristic

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

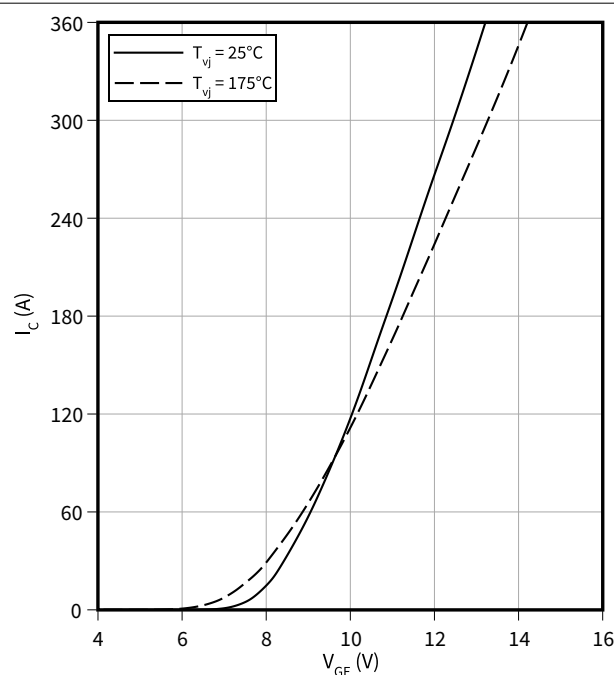
$$T_{vj} = 175^\circ\text{C}$$



Typical transfer characteristic

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

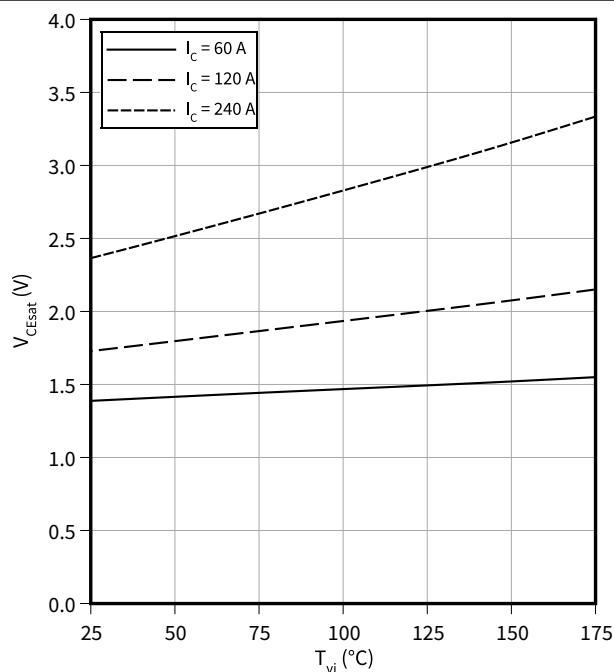
$$V_{CE} = 20\text{ V}$$



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

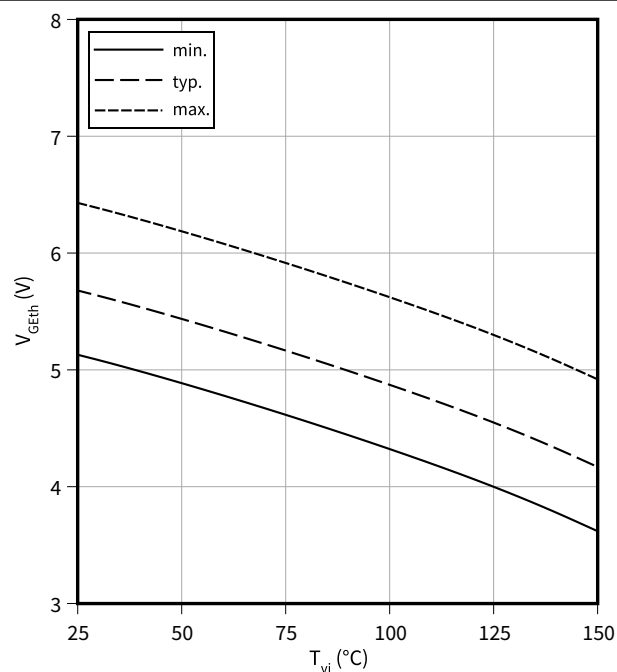
$$V_{CEsat} = f(T_{vj})$$

$$V_{GE} = 15 \text{ V}$$


Gate-emitter threshold voltage as a function of junction temperature

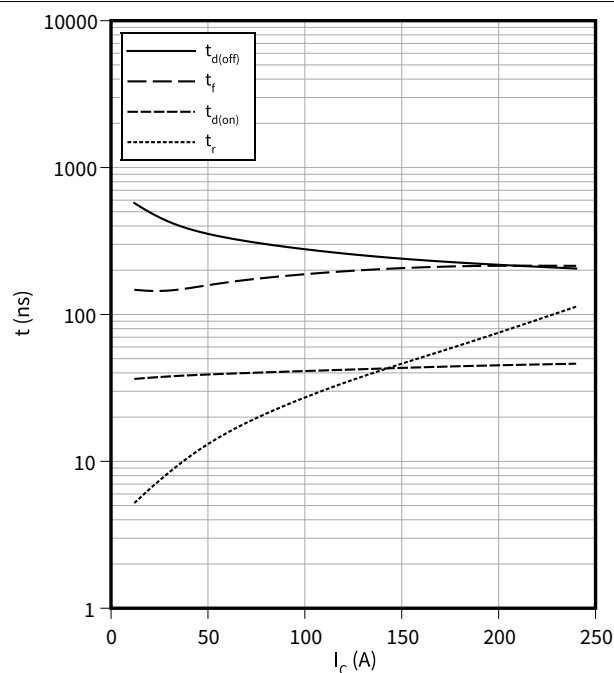
$$V_{GEth} = f(T_{vj})$$

$$I_C = 2.34 \text{ mA}$$


Typical switching times as a function of collector current

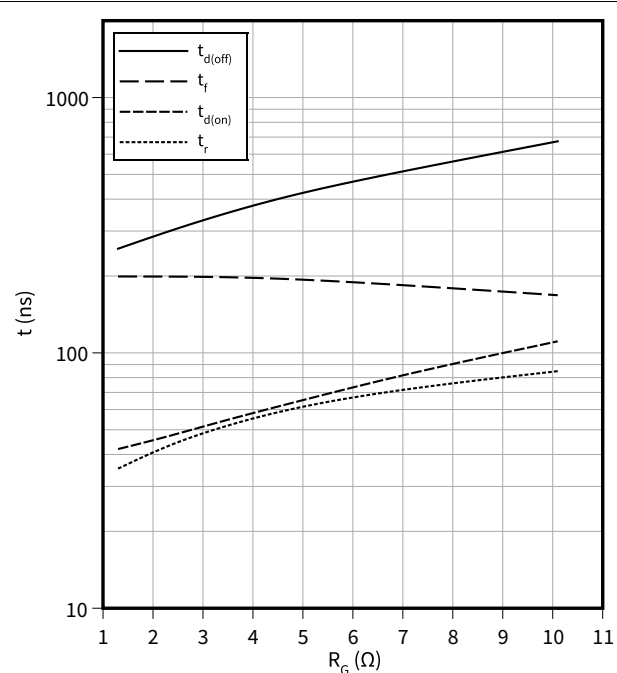
$$t = f(I_C)$$

$$V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 1.3 \text{ } \Omega$$


Typical switching times as a function of gate resistor

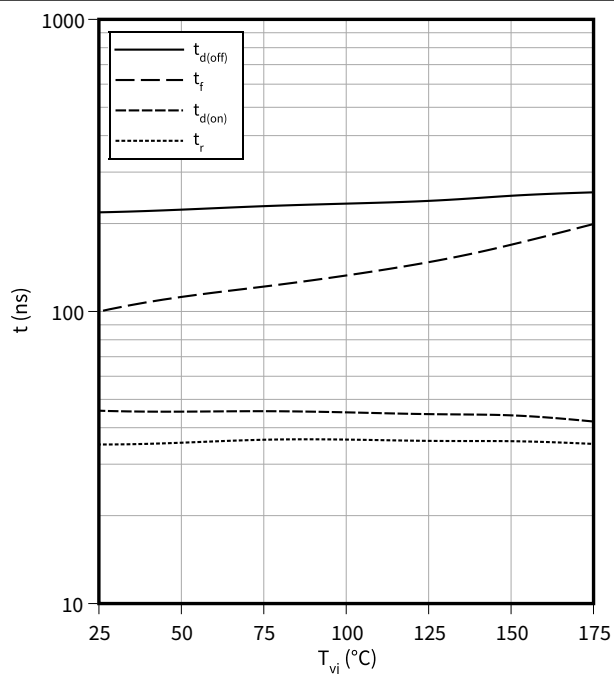
$$t = f(R_G)$$

$$I_C = 120 \text{ A}, V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$$

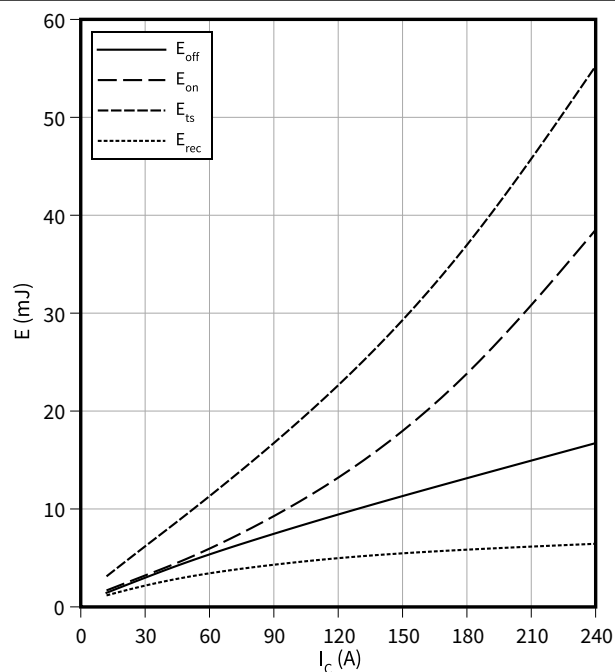


Typical switching times as a function of junction temperature

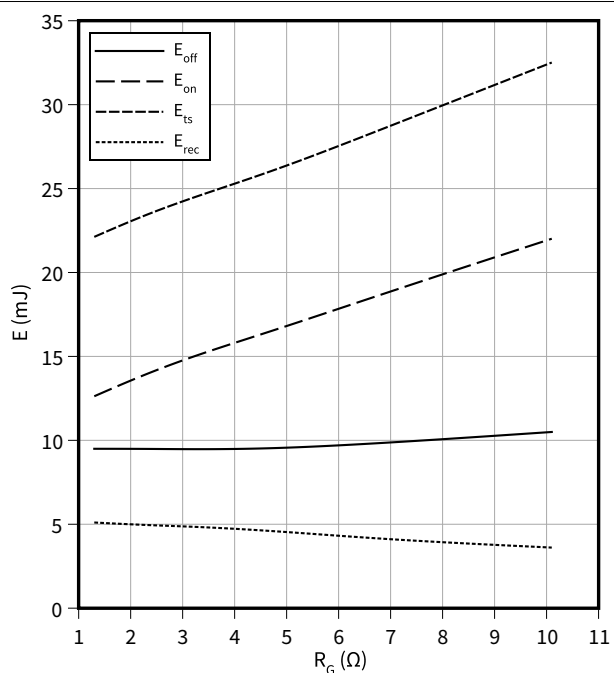
$$t = f(T_{vj})$$

 $I_C = 120 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 1.3 \Omega$

Typical switching energy losses as a function of collector current

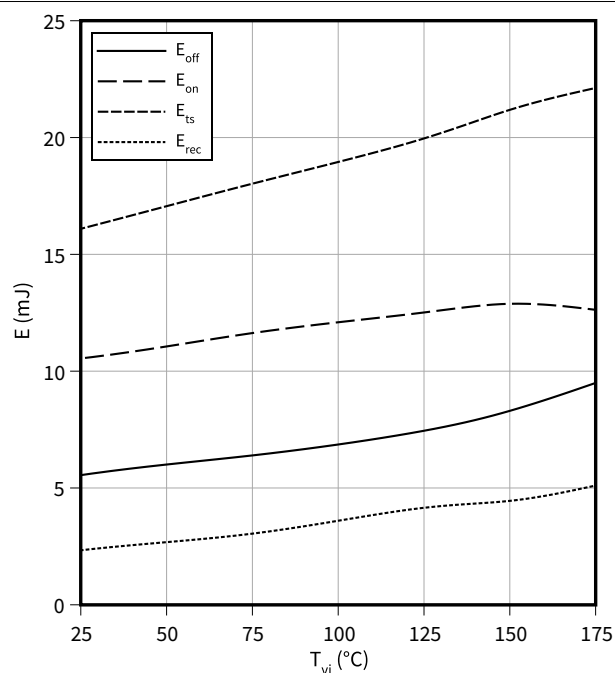
$$E = f(I_C)$$

 $V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 1.3 \Omega$

Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

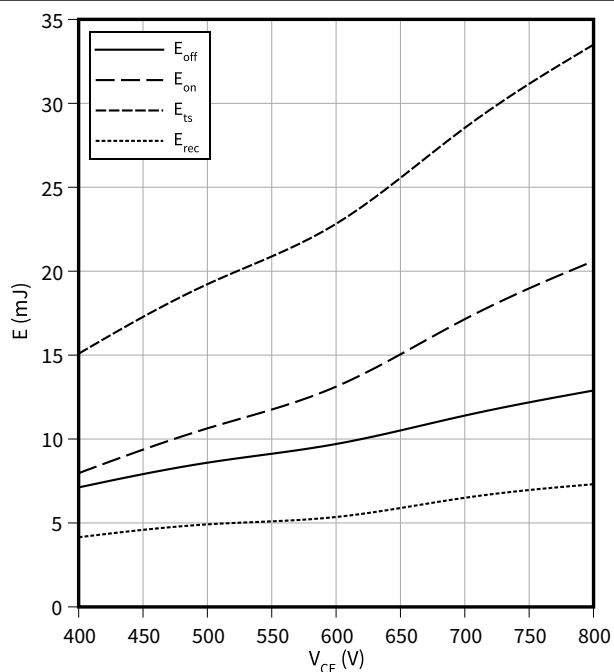
 $I_C = 120 \text{ A}, V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$

Typical switching energy losses as a function of junction temperature

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

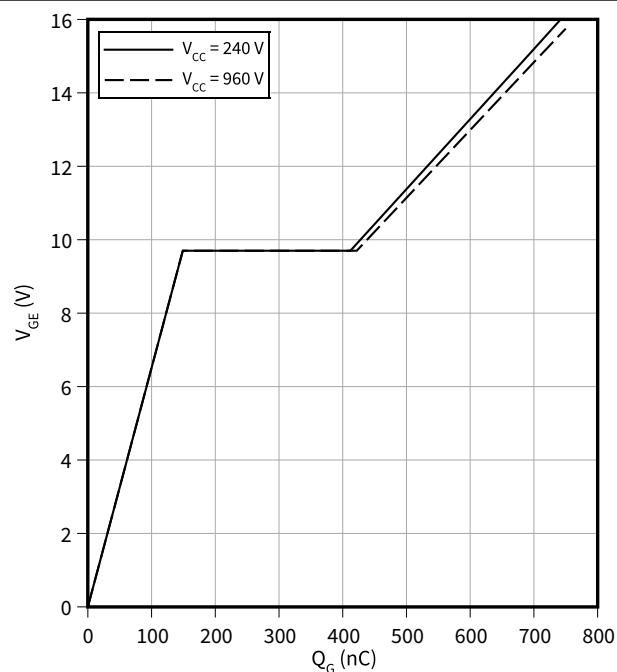
 $I_C = 120 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 1.3 \Omega$


Typical switching energy losses as a function of collector emitter voltage

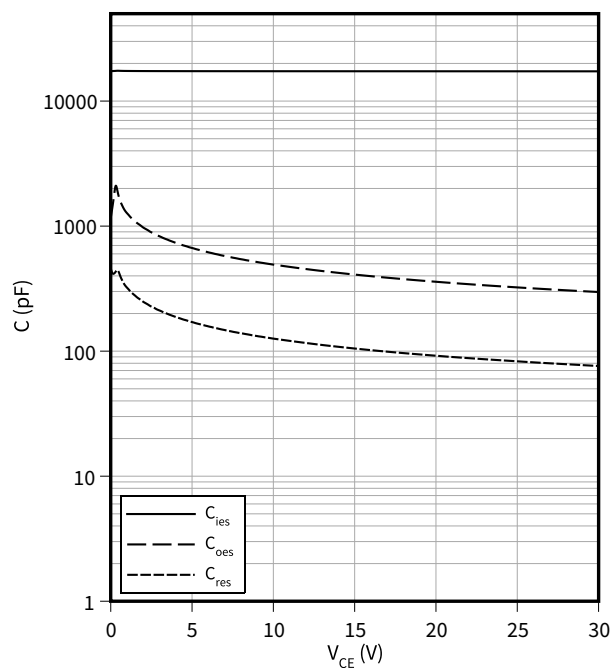
$$E = f(V_{CE})$$

 $I_C = 120 \text{ A}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 1.3 \text{ } \Omega$

Typical gate charge

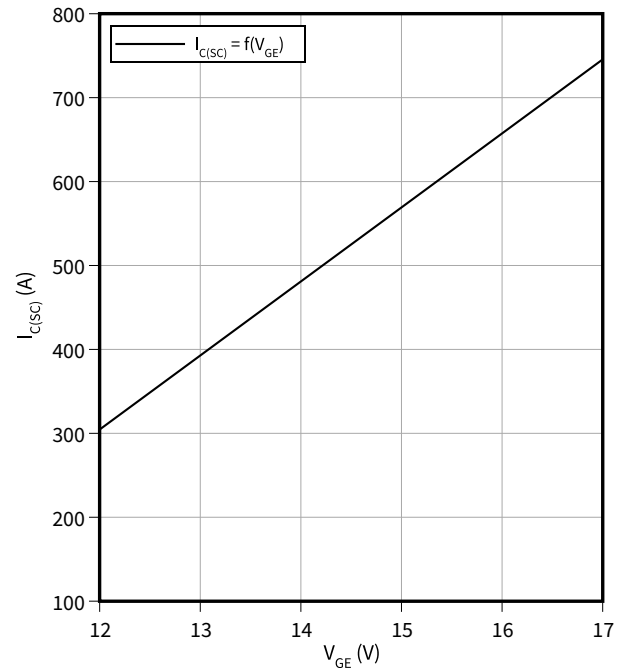
$$V_{GE} = f(Q_G)$$

 $I_C = 120 \text{ A}$

Typical capacitance as a function of collector-emitter voltage

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

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

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

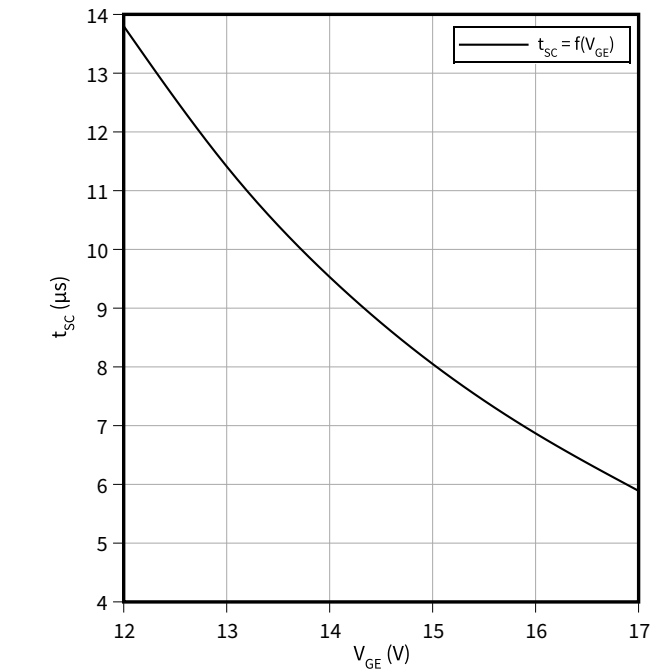
$$I_{C(SC)} = f(V_{GE})$$

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


4 Characteristics diagrams

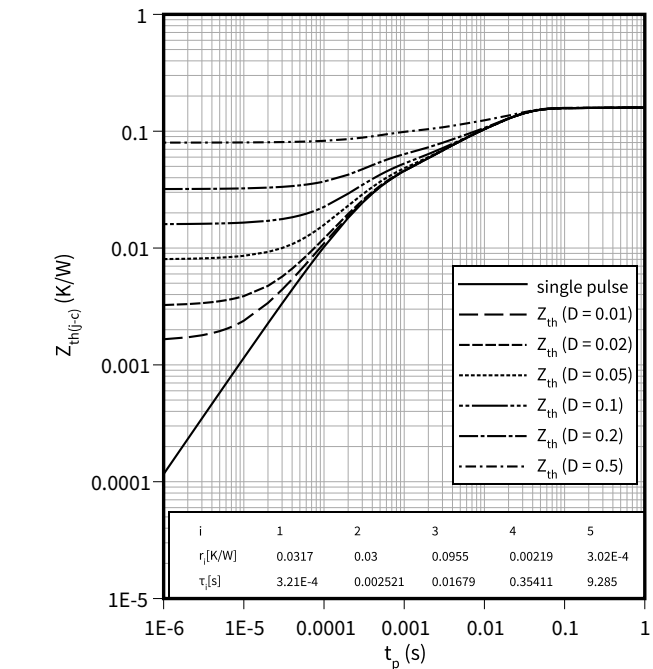
Short circuit withstand time as a function of gate-emitter voltage

$t_{SC} = f(V_{GE})$
 $T_{vj} \leq 150\text{ }^{\circ}\text{C}, V_{CC} \leq 600\text{ V}$



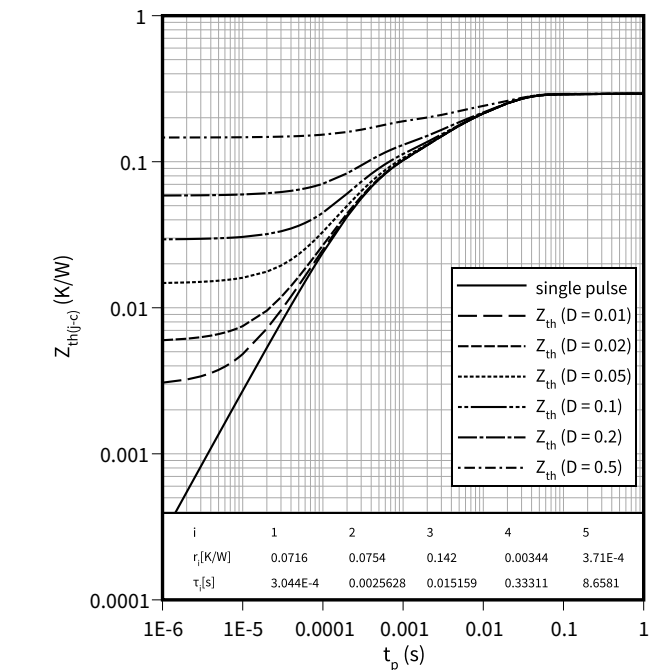
IGBT transient thermal impedance as a function of pulse width

$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



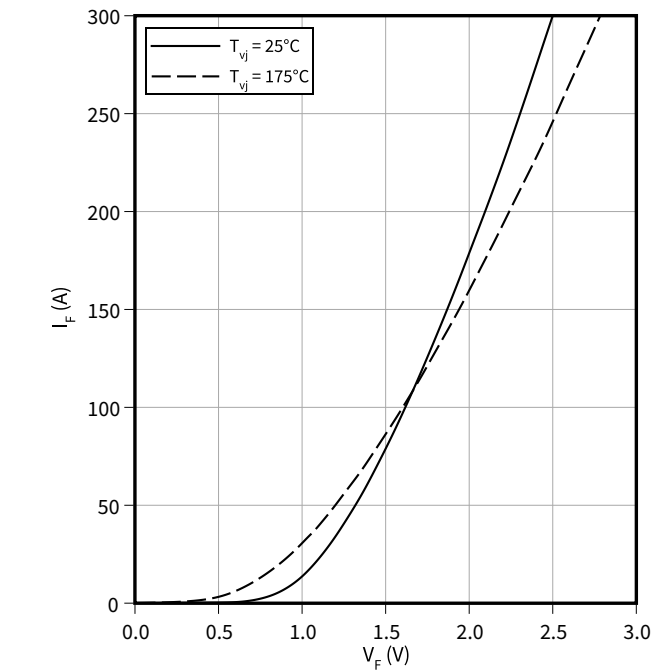
Diode transient thermal impedance as a function of pulse width

$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



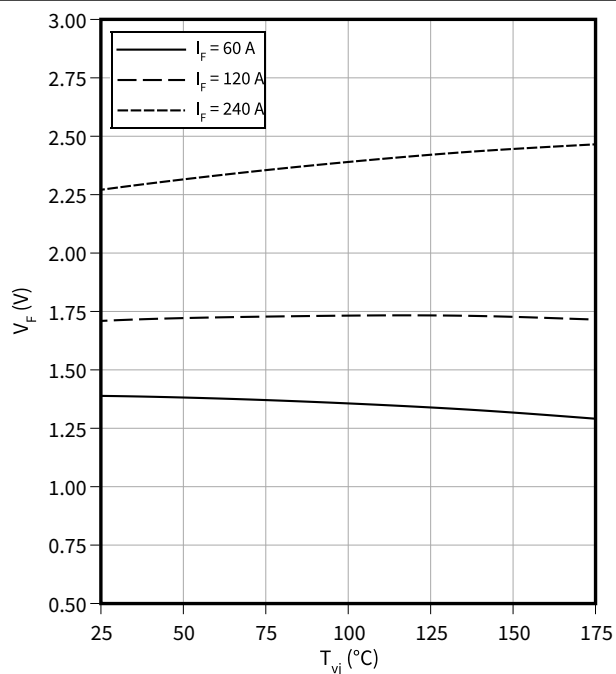
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



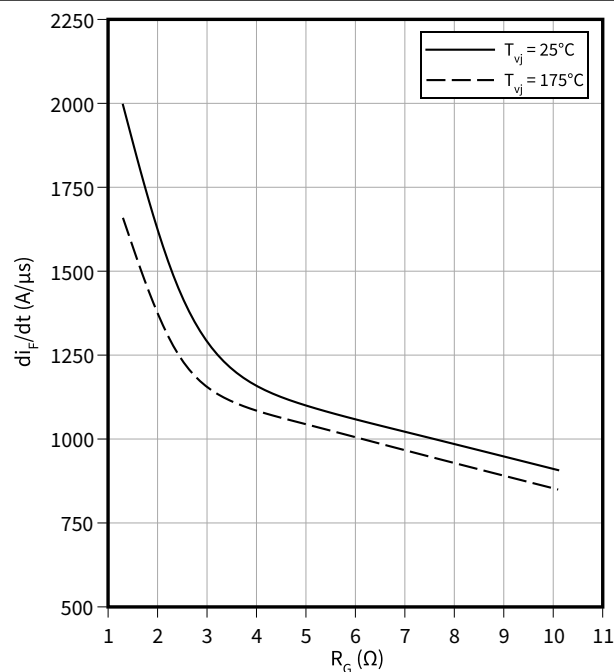
Typical diode forward voltage as a function of junction temperature

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


Typical diode current slope as a function of gate resistor

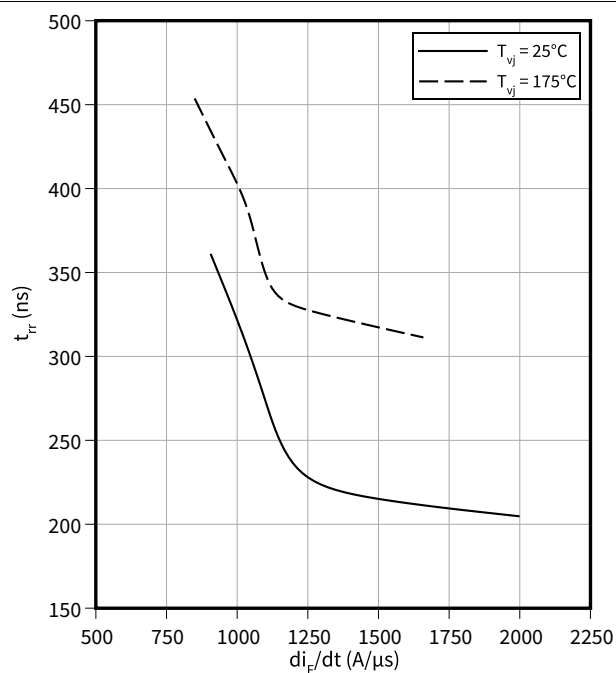
$$di_F/dt = f(R_G)$$

$$V_R = 600 \text{ V}, I_F = 120 \text{ A}$$


Typical reverse recovery time as a function of diode current slope

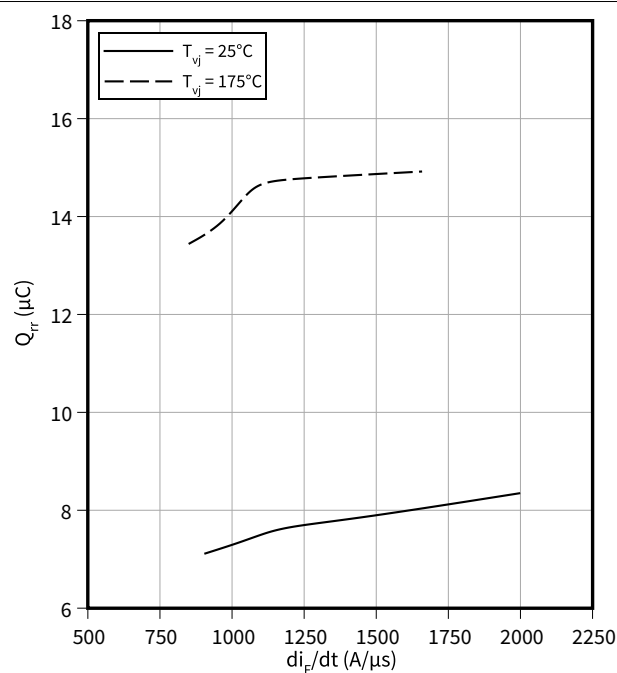
$$t_{rr} = f(di_F/dt)$$

$$V_R = 600 \text{ V}, I_F = 120 \text{ A}$$


Typical reverse recovery charge as a function of diode current slope

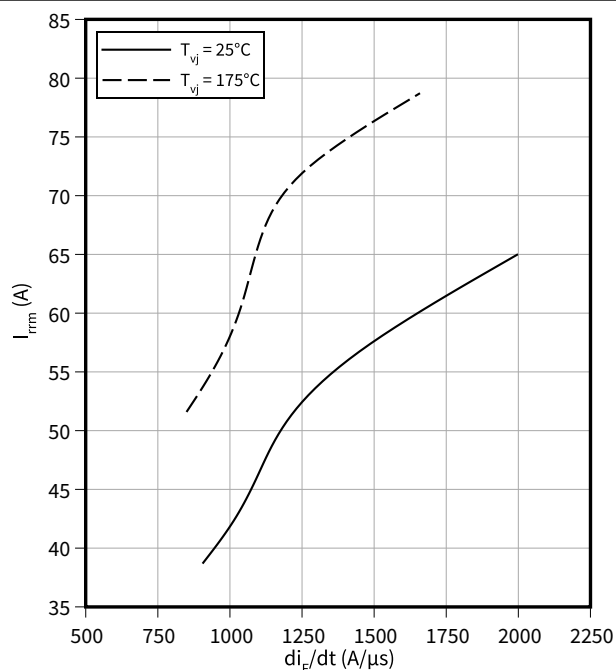
$$Q_{rr} = f(di_F/dt)$$

$$V_R = 600 \text{ V}, I_F = 120 \text{ A}$$

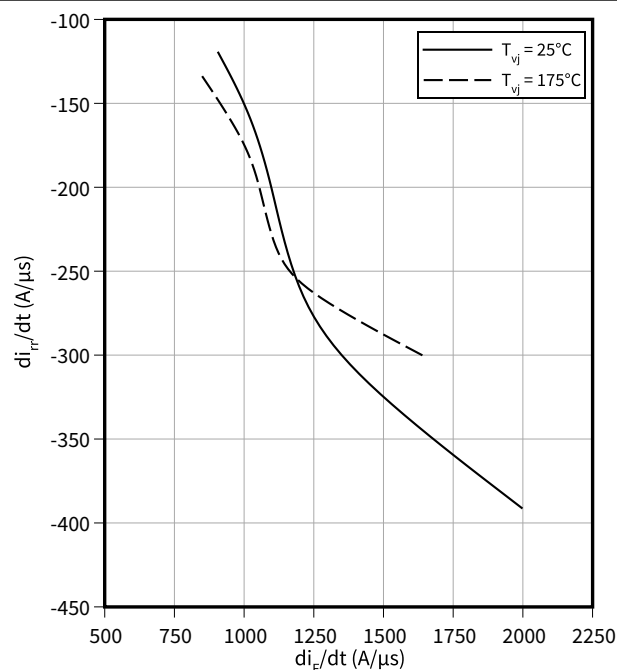


Typical reverse recovery current as a function of diode current slope

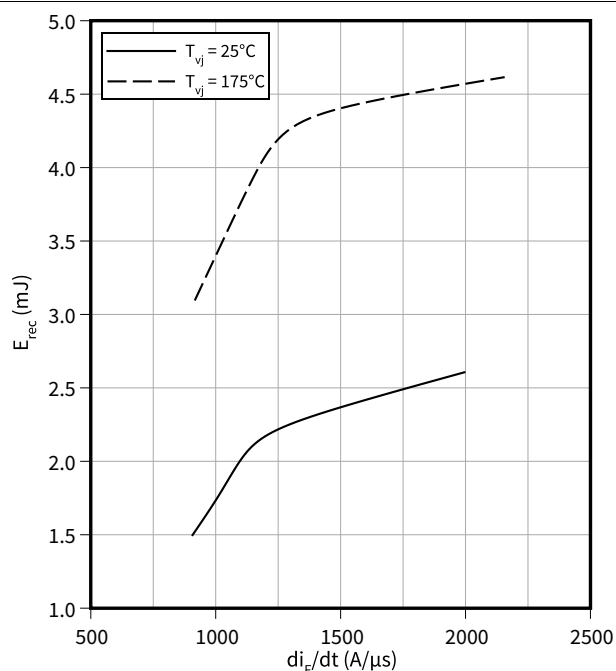
$$I_{rrm} = f(di_F/dt)$$

 $V_R = 600 \text{ V}, I_F = 120 \text{ A}$

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

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

 $V_R = 600 \text{ V}, I_F = 120 \text{ A}$

Typical reverse energy losses as a function of diode current slope

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

 $V_R = 600 \text{ V}, I_F = 120 \text{ A}$


5 Package outlines

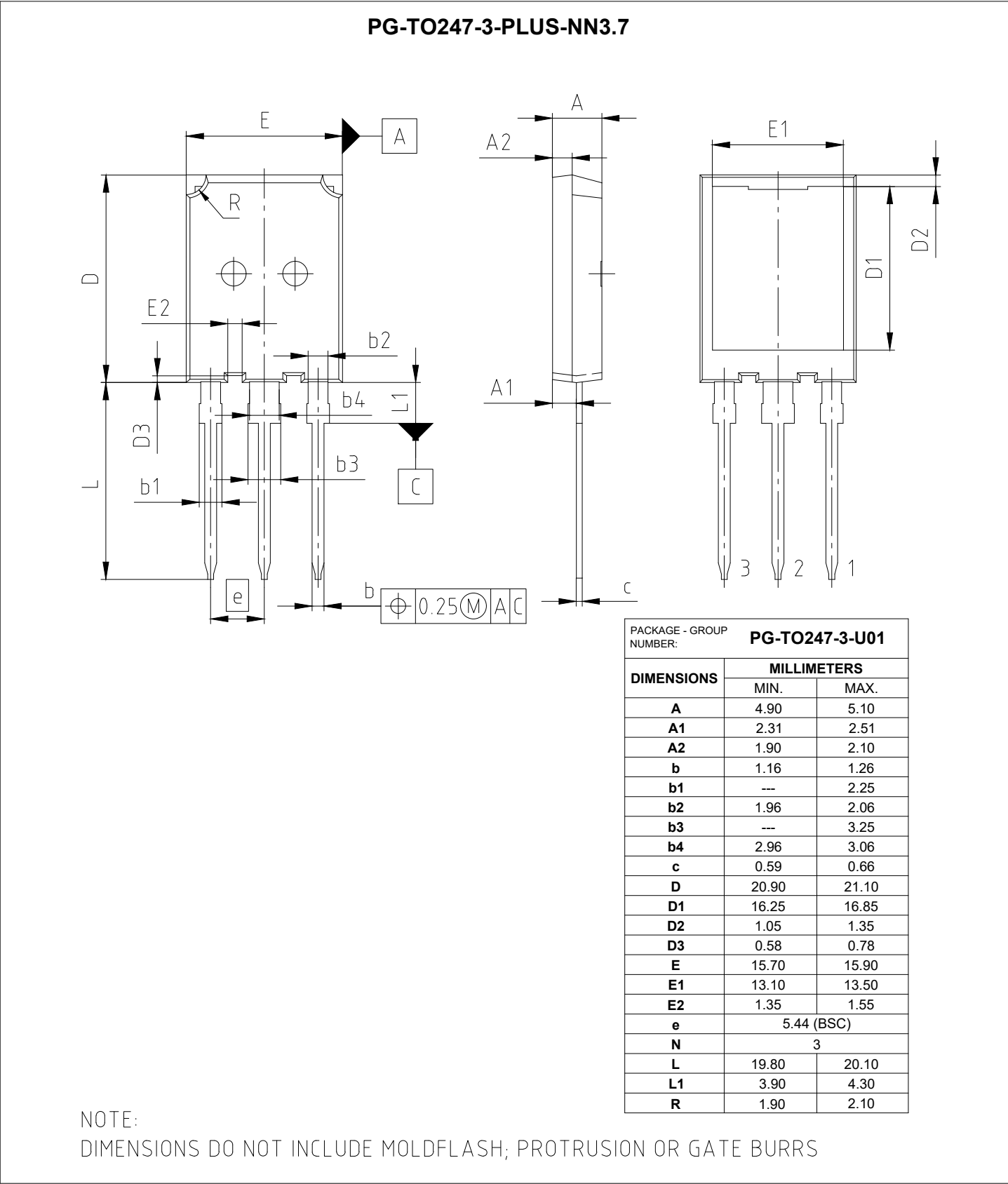


Figure 1

6 Testing conditions

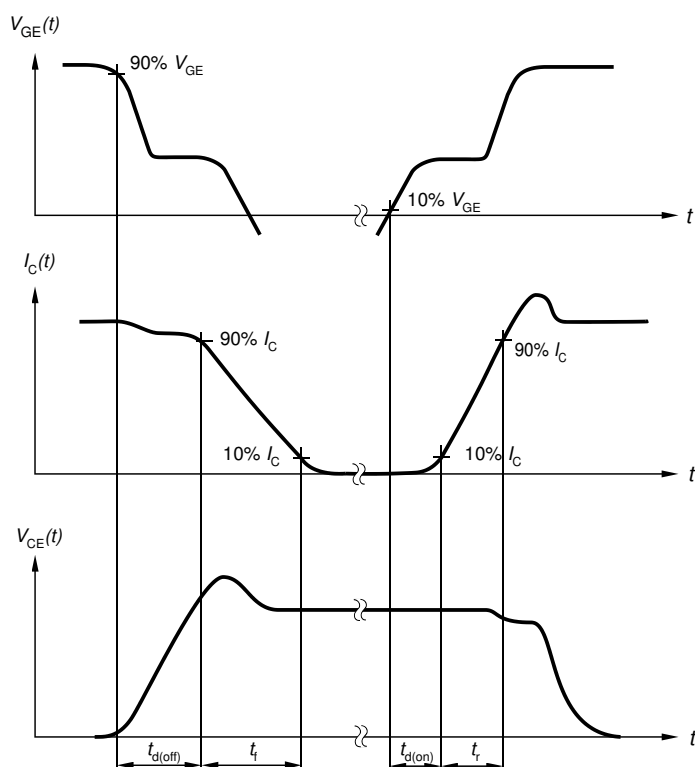


Figure A. Definition of switching times

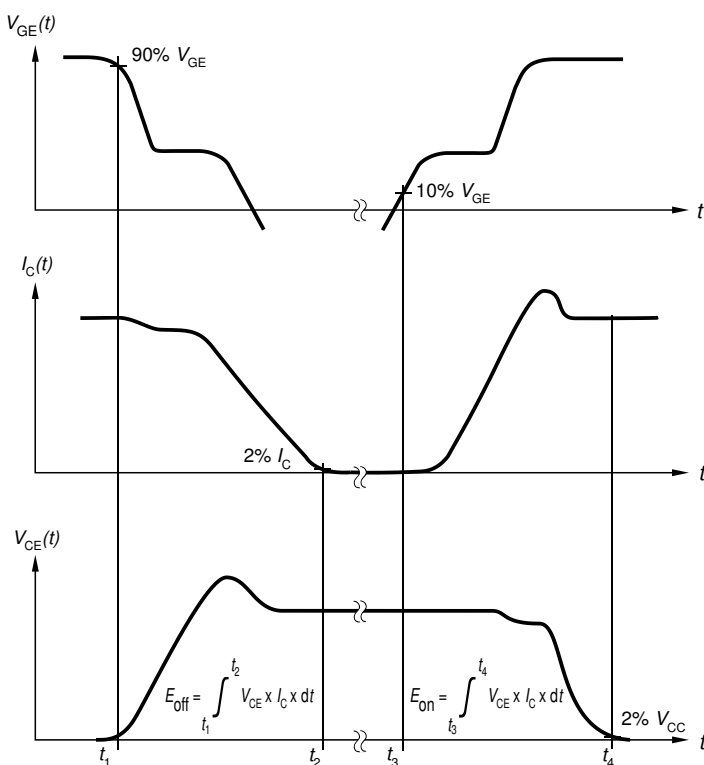


Figure B. Definition of switching losses

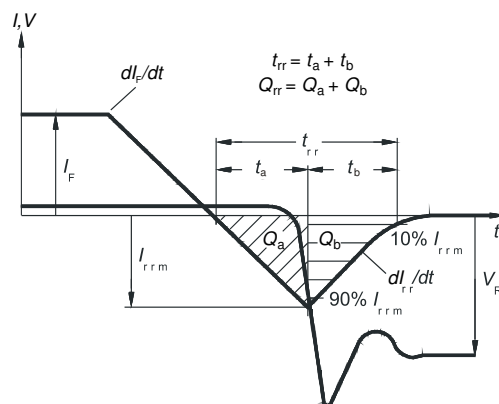


Figure C. Definition of diode switching characteristics

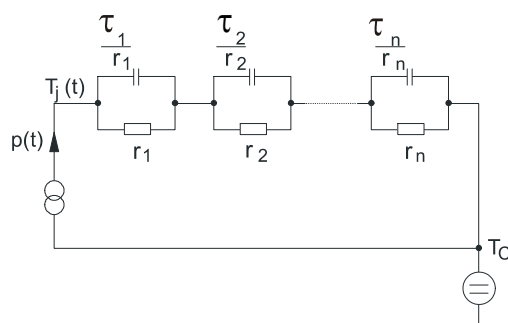


Figure D. Thermal equivalent circuit

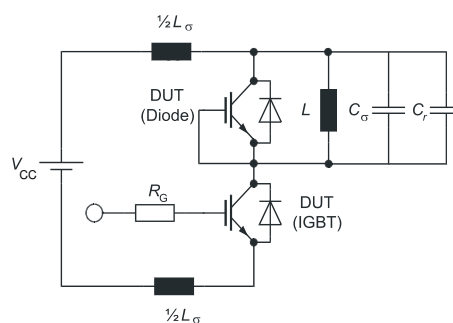


Figure E. **Dynamic test circuit**
 Parasitic inductance L_σ ,
 parasitic capacitor C_σ ,
 relief capacitor C_r ,
 (only for ZVT switching)

Revision history

Document revision	Date of release	Description of changes
0.10	2022-05-04	Target datasheet
1.00	2022-12-05	Final datasheet
1.10	2023-01-23	Correction of boundary condition of diagrams $I_{C(SC)} = f(V_{GE})$ and $t_{SC} = f(V_{GE})$ Change of product outline drawing on page 14

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