

High speed 1200 V TRENCHSTOP™ IGBT 7 Technology co-packed with full rated current, soft-commutating, ultra-fast recovery and low Q_{rr} emitter controlled 7 Rapid diode

Features

- $V_{CE} = 1200\text{ V}$
- $I_C = 140\text{ A}$
- Maximum junction temperature $T_{vjmax} = 175^\circ\text{C}$
- Best-in-class high speed IGBT co-packed with full rated current, low Q_{rr} and soft-commutating high speed diode
- Low saturation voltage $V_{CEsat} = 1.7\text{ V}$ at $T_{vj} = 25^\circ\text{C}$
- Optimized for high efficiency in high speed hard switching topologies (2-L inverter, 3-L NPC T-type, ...)
- Easy paralleling capability due to positive temperature coefficient in V_{CEsat}
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

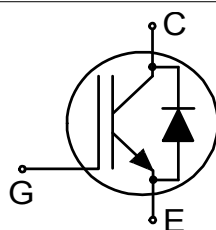
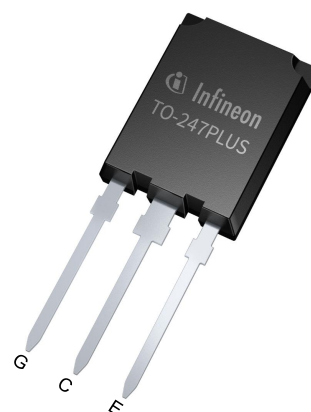
Potential applications

- Industrial UPS
- EV-Charging
- String inverter
- Welding

Product validation

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

Description



Type	Package	Marking
IKQ140N120CH7	PG-TO247-3-PLUS-NN3.7	K140MCH7



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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	$R_{th(j-c)}$			0.12	0.16	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.21	0.27	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	$T_c = 25\text{ °C}$	175	A
			$T_c = 100\text{ °C}$	154	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			560	A
Turn-off safe operating area		$V_{CC} \leq 800\text{ V}$, $V_{CE,peak} < 1200\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{Goff} \geq 2.9\text{ }\Omega$, $T_{vj} \leq 175\text{ °C}$		560	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
Power dissipation	P_{tot}		$T_c = 25\text{ °C}$	962	W
			$T_c = 100\text{ °C}$	481	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 140\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.7	2.15	V
			$T_{vj} = 175\text{ °C}$		2		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Gate-emitter threshold voltage	V_{GEth}	$I_C = 2.24 \text{ mA}$, $V_{CE} = V_{GE}$	4.7	5.5	6.2	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
			$T_{vj} = 175 \text{ °C}$	17500		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = 20 \text{ V}$			100	nA
Transconductance	g_{fs}	$I_C = 140 \text{ A}$, $V_{CE} = 20 \text{ V}$		251		S
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$		18.5		nF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$		317		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$		94		pF
Gate charge	Q_G	$I_C = 140 \text{ A}$, $V_{GE} = 15 \text{ V}$, $V_{CC} = 960 \text{ V}$		970		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \text{ }\Omega$, $R_{G(off)} = 4.8 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 140 \text{ A}$	68		ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 140 \text{ A}$	63		
Rise time (inductive load)	t_r	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \text{ }\Omega$, $R_{G(off)} = 4.8 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 140 \text{ A}$	55		ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 140 \text{ A}$	46		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \text{ }\Omega$, $R_{G(off)} = 4.8 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 140 \text{ A}$	541		ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 140 \text{ A}$	619		
Fall time (inductive load)	t_f	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \text{ }\Omega$, $R_{G(off)} = 4.8 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 140 \text{ A}$	21		ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 140 \text{ A}$	92		
Turn-on energy	E_{on}	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \text{ }\Omega$, $R_{G(off)} = 4.8 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 140 \text{ A}$	8.84		mJ
			$T_{vj} = 175 \text{ °C}$, $I_C = 140 \text{ A}$	11.8		
Turn-off energy	E_{off}	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \text{ }\Omega$, $R_{G(off)} = 4.8 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 140 \text{ A}$	3.38		mJ
			$T_{vj} = 175 \text{ °C}$, $I_C = 140 \text{ A}$	6.71		

(table continues...)

Table 3 (continued) **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy	E_{ts}	$V_{CC} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{G(on)} = 4.8 \Omega$, $R_{G(off)} = 4.8 \Omega$		12.2		mJ
				18.5		
Operating junction temperature	T_{vj}		-40		175	°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	$T_c = 25^\circ\text{C}$	A
			$T_c = 91^\circ\text{C}$	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}		560	A
Power dissipation	P_{tot}	$T_c = 25^\circ\text{C}$	549	W
		$T_c = 100^\circ\text{C}$	275	

Table 5 **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 140 \text{ A}$		2.5	3	V
				2.3		
Diode reverse recovery time	t_{rr}	$V_R = 600 \text{ V}$, $R_{G(on)} = 4.8 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_F = 140 \text{ A}$	144		ns
			$T_{vj} = 175^\circ\text{C}$, $I_F = 140 \text{ A}$	227		
Diode reverse recovery charge	Q_{rr}	$V_R = 600 \text{ V}$, $R_{G(on)} = 4.8 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_F = 140 \text{ A}$	3.82		μC
			$T_{vj} = 175^\circ\text{C}$, $I_F = 140 \text{ A}$	11.5		
Diode peak reverse recovery current	I_{rrm}	$V_R = 600 \text{ V}$, $R_{G(on)} = 4.8 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_F = 140 \text{ A}$	53		A
			$T_{vj} = 175^\circ\text{C}$, $I_F = 140 \text{ A}$	101		

(table continues...)

Table 5 (continued) Characteristic values

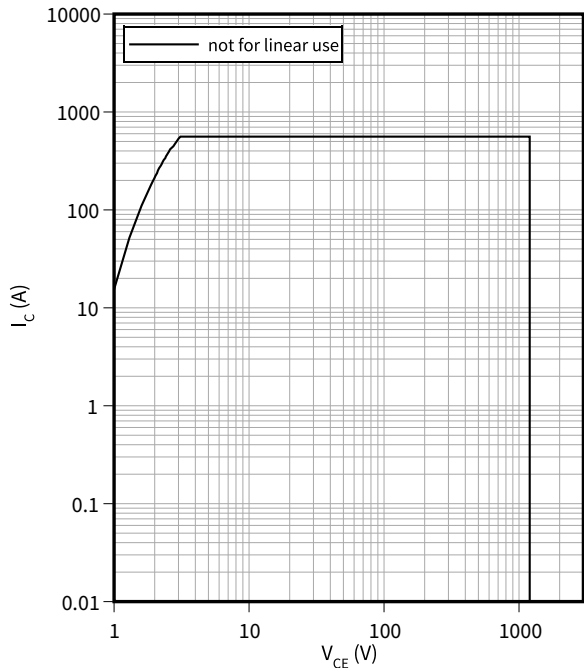
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	$V_R = 600 \text{ V}, R_{G(on)} = 4.8 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C}, I_F = 140 \text{ A}$		-529		A/ μs
			$T_{vj} = 175 \text{ } ^\circ\text{C}, I_F = 140 \text{ A}$		-646		
Reverse recovery energy	E_{rec}	$V_R = 600 \text{ V}, R_{G(on)} = 4.8 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C}$		1.12		mJ
			$T_{vj} = 175 \text{ } ^\circ\text{C}$		3.81		
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

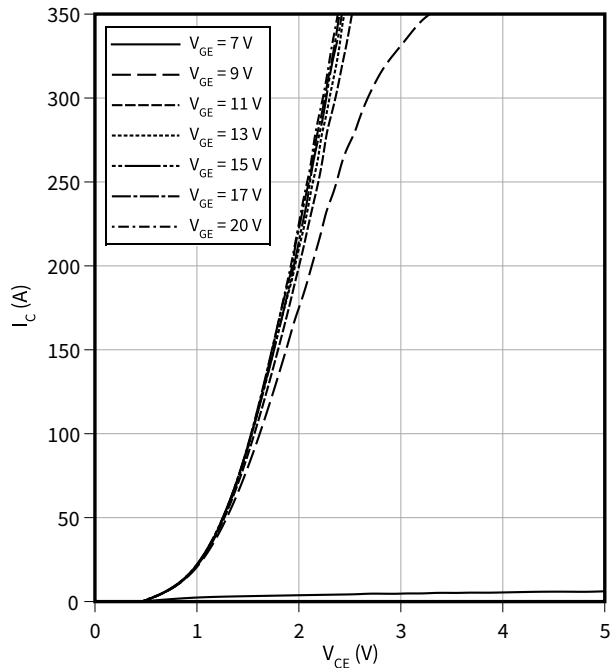
Reverse bias safe operating area

$I_C = f(V_{CE})$
 $T_{vj} \leq 175\text{ °C}, V_{GE} = 0/15\text{ V}$



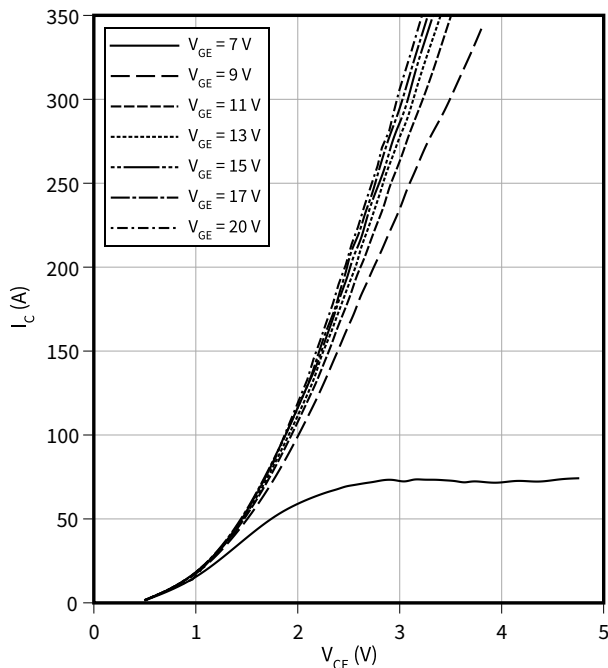
Typical output characteristic

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



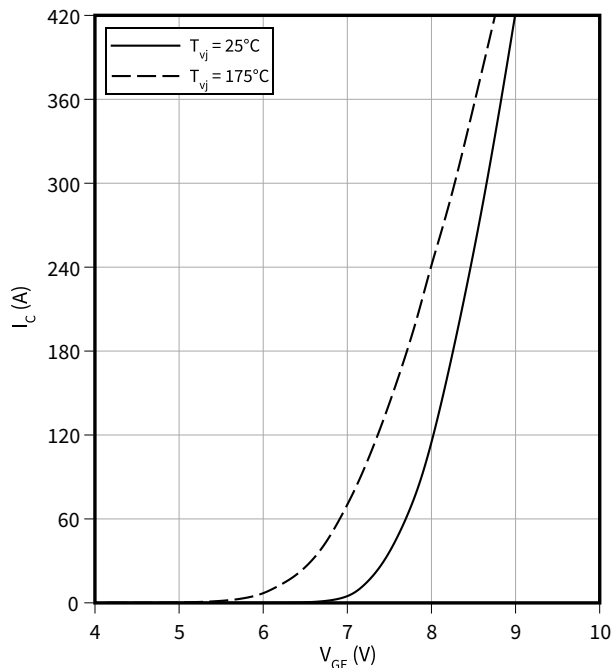
Typical output characteristic

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



Typical transfer characteristic

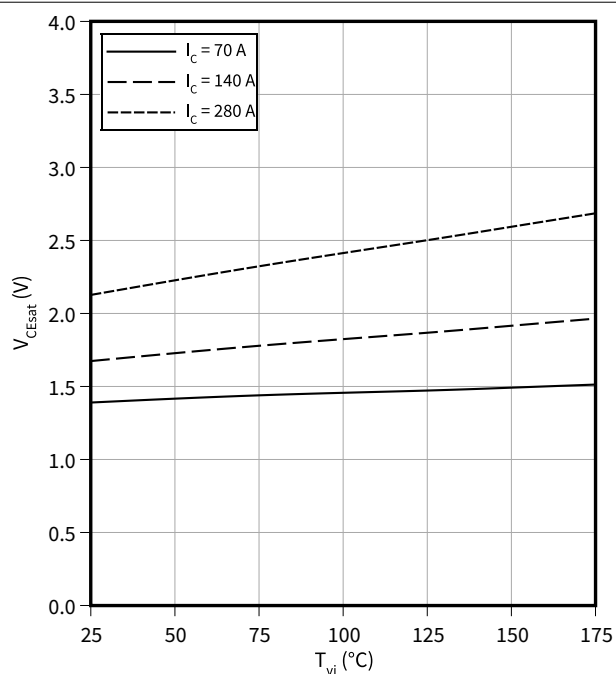
$I_C = f(V_{GE})$
 $V_{CE} = 20\text{ V}$



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

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

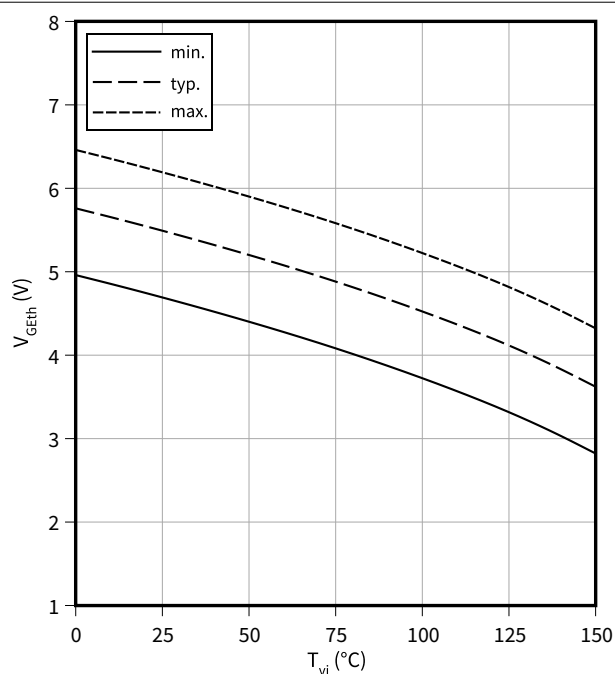
$$V_{GE} = 15 \text{ V}$$



Gate-emitter threshold voltage as a function of junction temperature

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

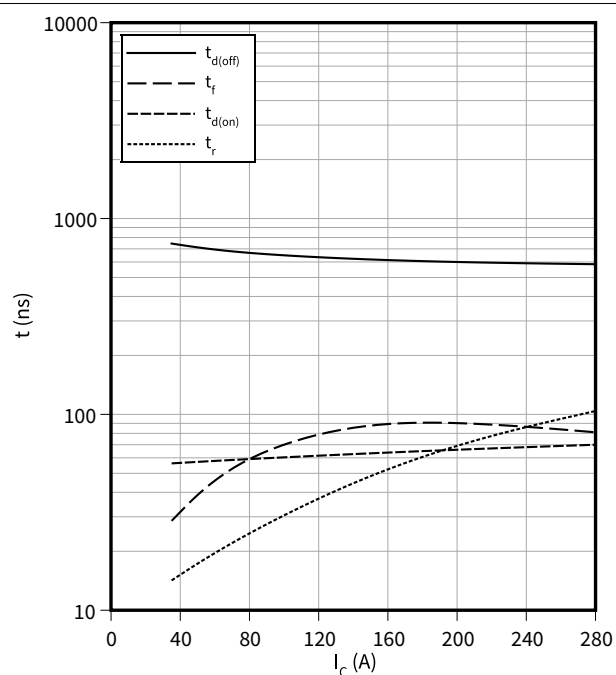
$$I_C = 2.24 \text{ mA}$$



Typical switching times as a function of collector current

$$t = f(I_C)$$

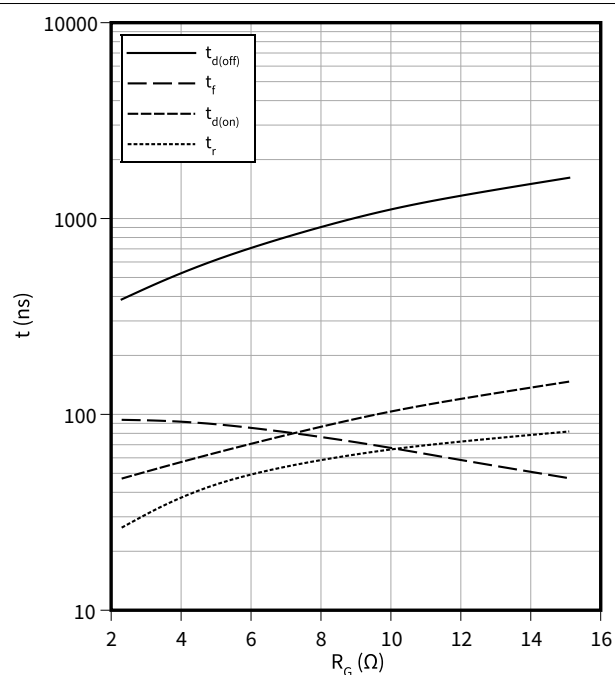
$$V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 4.8 \text{ } \Omega$$



Typical switching times as a function of gate resistor

$$t = f(R_G)$$

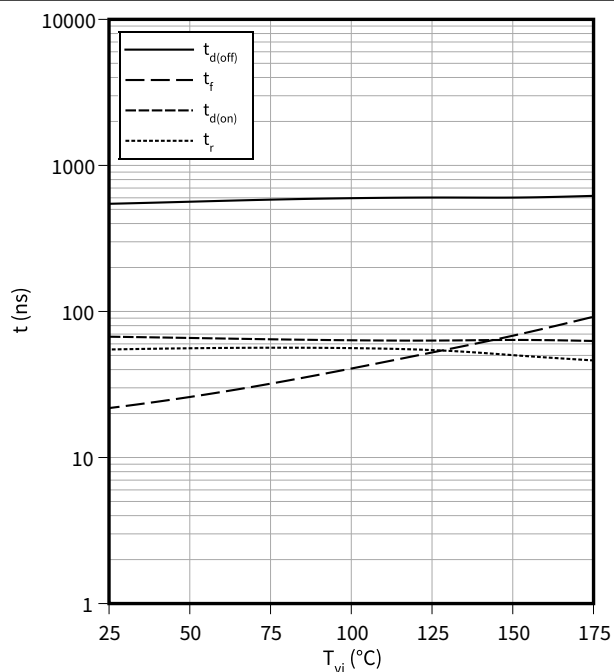
$$I_C = 140 \text{ A}, V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$$



Typical switching times as a function of junction temperature

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

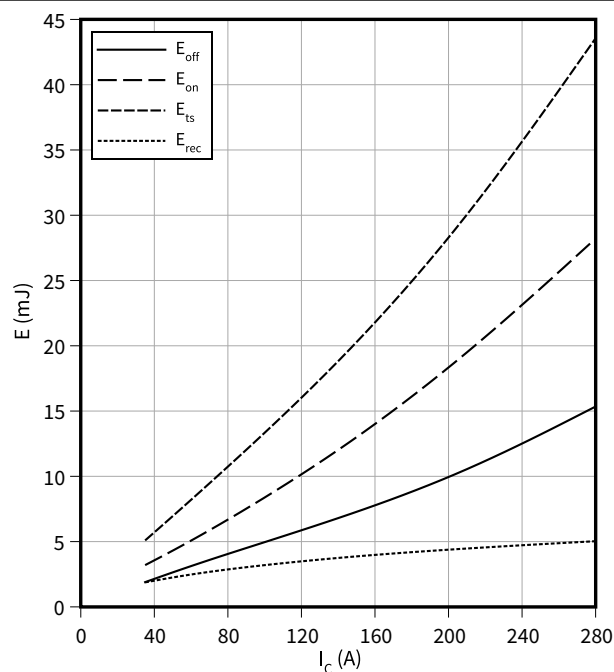
$I_C = 140 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 4.8 \Omega$



Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

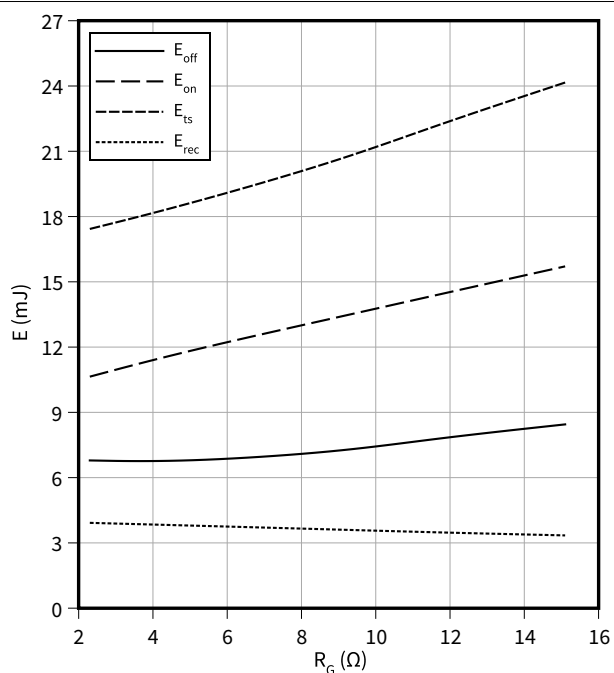
$V_{CC} = 600 \text{ V}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 4.8 \Omega$



Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

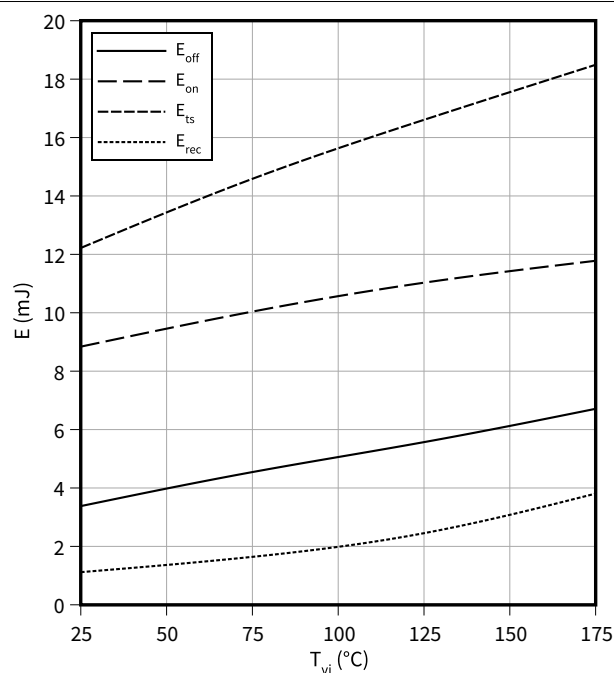
$I_C = 140 \text{ A}$, $V_{CC} = 600 \text{ V}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$



Typical switching energy losses as a function of junction temperature

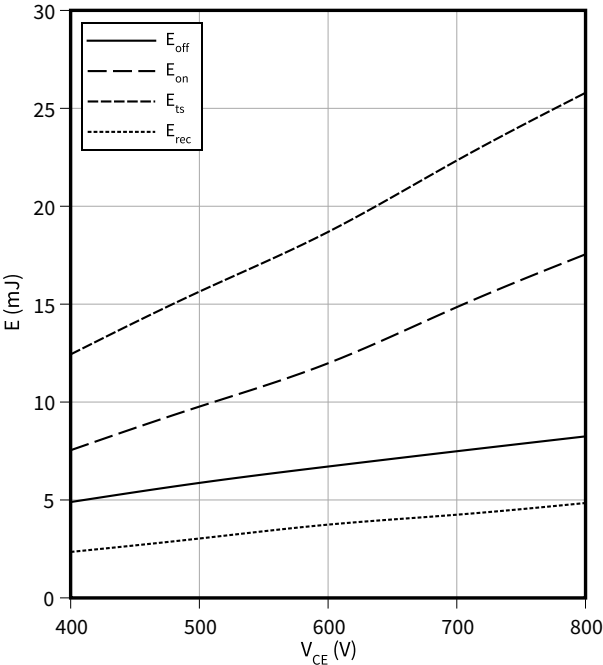
$$E = f(T_{vj})$$

$I_C = 140 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 4.8 \Omega$



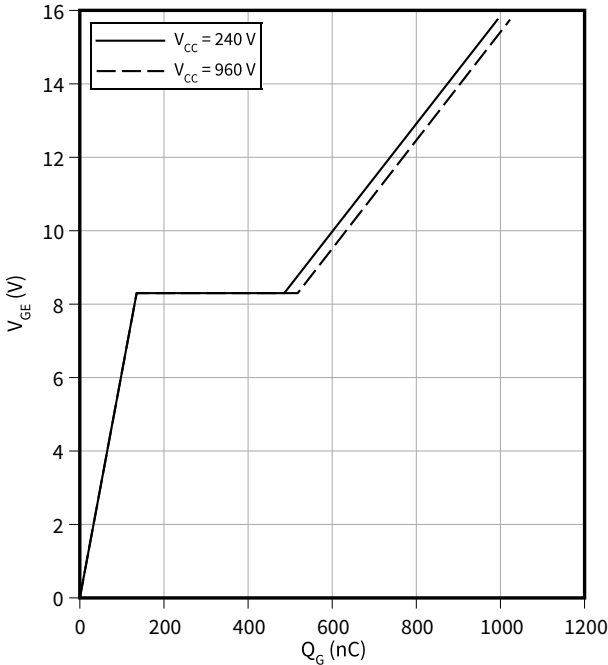
Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$
 $I_C = 140\text{ A}$, $V_{GE} = 0/15\text{ V}$, $T_{vj} = 175\text{ }^{\circ}\text{C}$, $R_G = 4.8\text{ }\Omega$



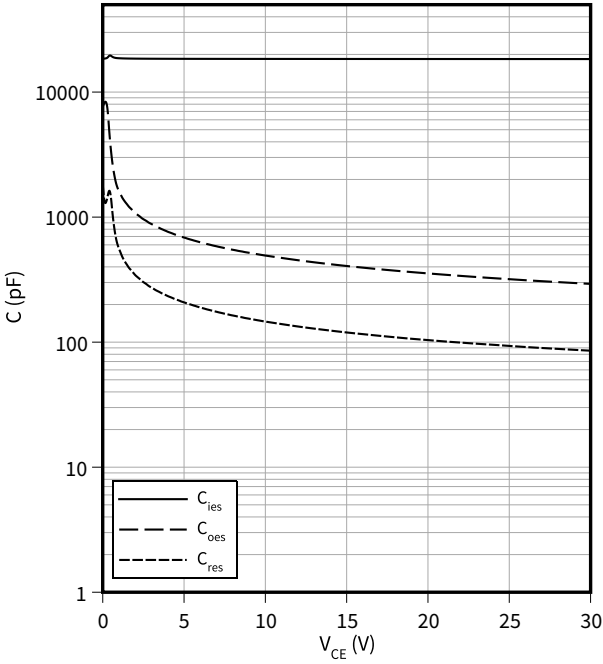
Typical gate charge

$V_{GE} = f(Q_G)$
 $I_C = 140\text{ A}$



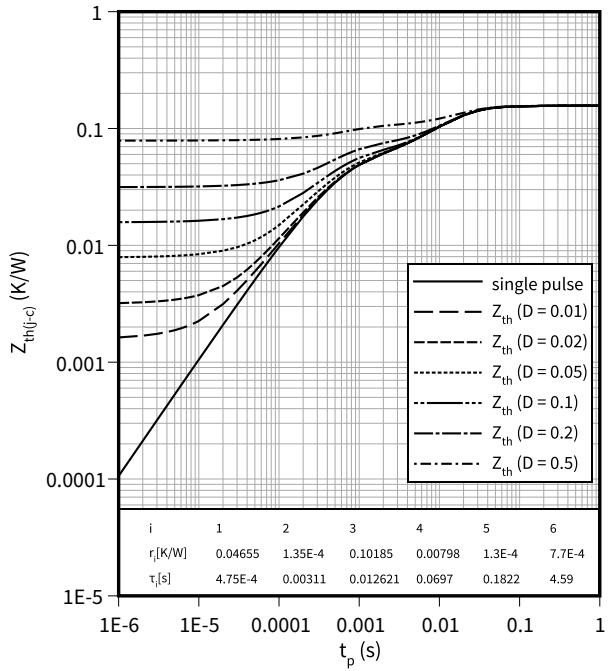
Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$
 $f = 100\text{ kHz}$, $V_{GE} = 0\text{ V}$



IGBT transient thermal impedance as a function of pulse width

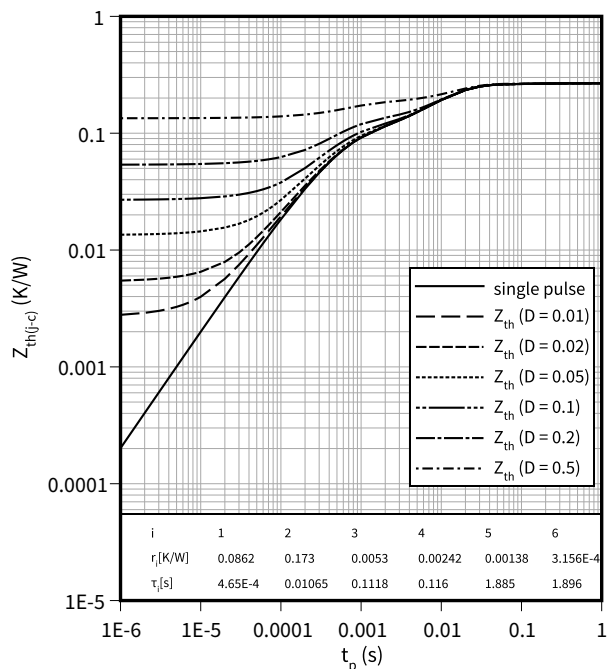
$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



Diode transient thermal impedance as a function of pulse width

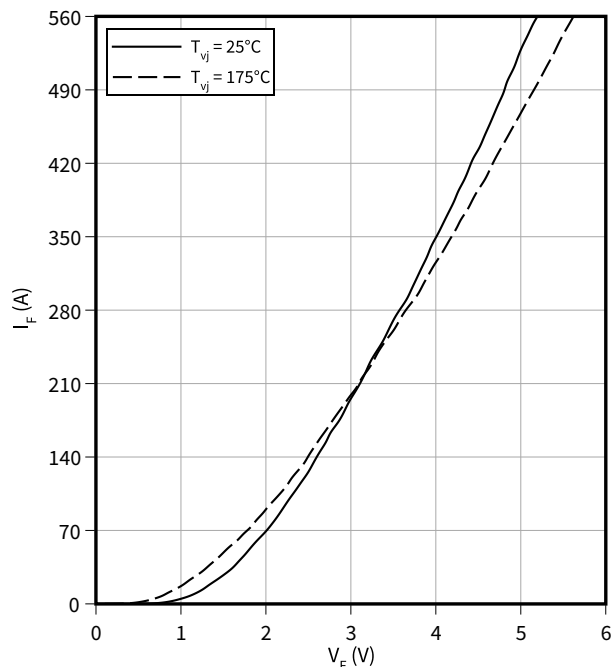
$$Z_{th(j-c)} = f(t_p)$$

$$D = t_p / T$$



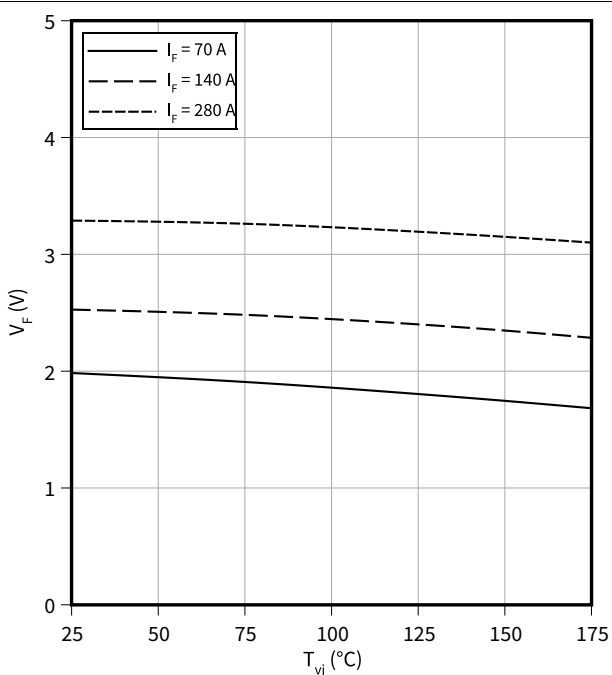
Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$



Typical diode forward voltage as a function of junction temperature

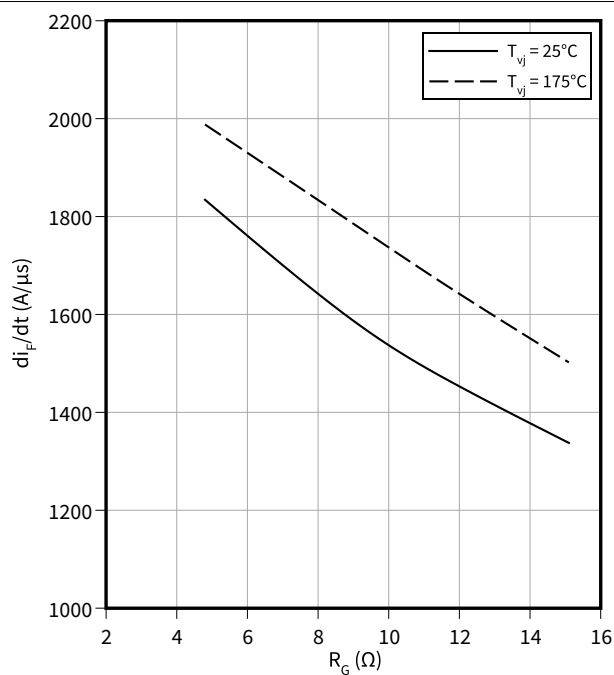
$$V_F = f(T_{vj})$$



Typical diode current slope as a function of gate resistor

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

$$V_R = 600 \text{ V}, I_F = 140 \text{ A}$$

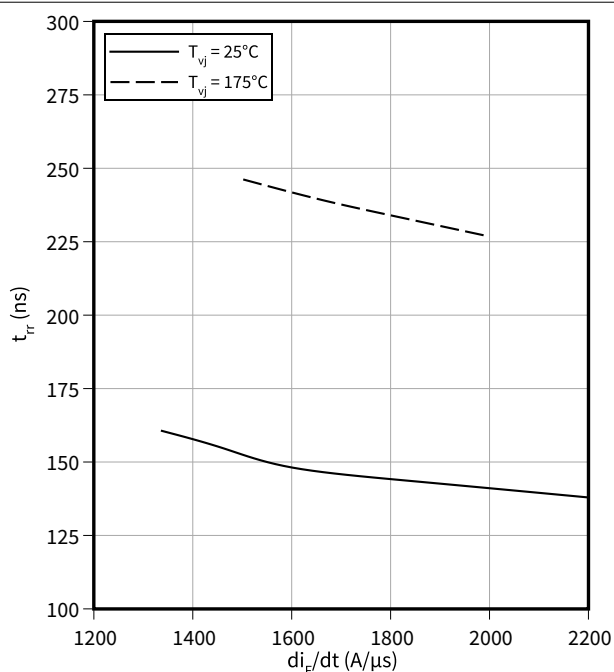


4 Characteristics diagrams

Typical reverse recovery time as a function of diode current slope

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

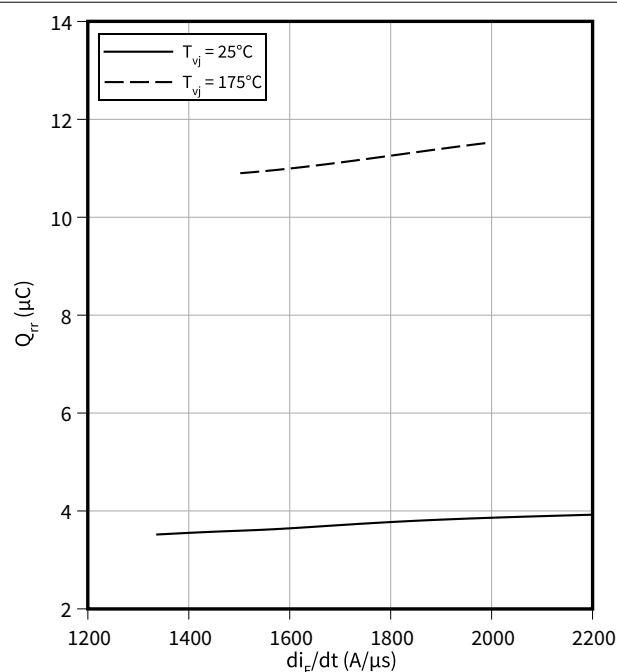
$V_R = 600 \text{ V}$, $I_F = 140 \text{ A}$



Typical reverse recovery charge as a function of diode current slope

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

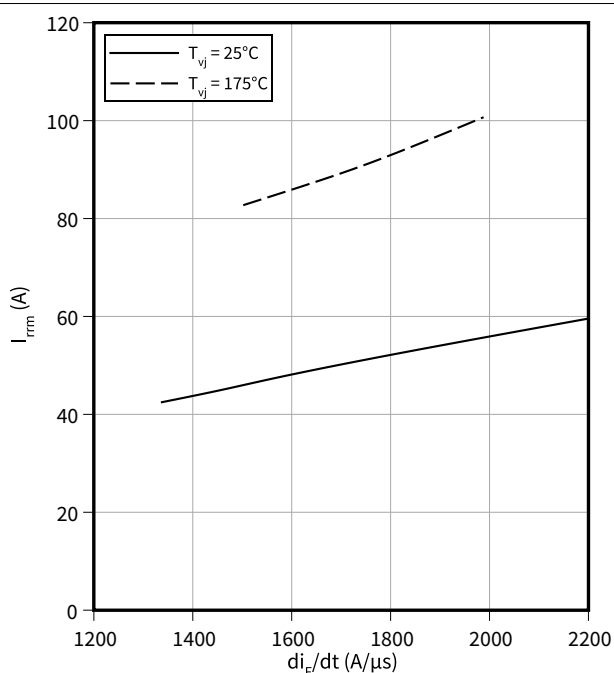
$V_R = 600 \text{ V}$, $I_F = 140 \text{ A}$



Typical reverse recovery current as a function of diode current slope

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

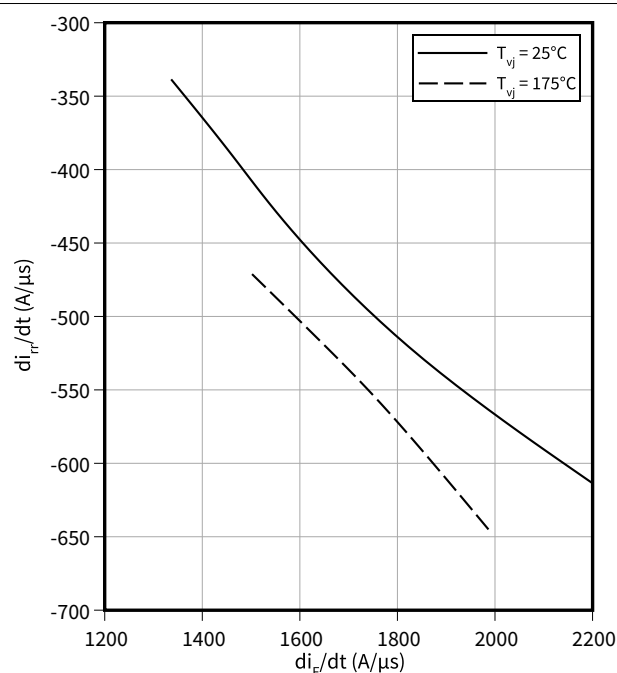
$V_R = 600 \text{ V}$, $I_F = 140 \text{ A}$



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

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

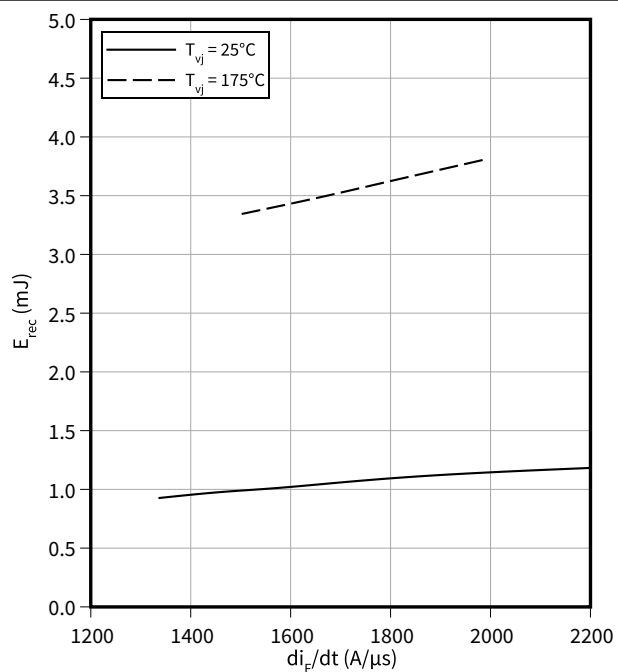
$V_R = 600 \text{ V}$, $I_F = 140 \text{ A}$



Typical reverse energy losses as a function of diode current slope

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

$V_R = 600 \text{ V}$, $I_F = 140 \text{ A}$



5 Package outlines

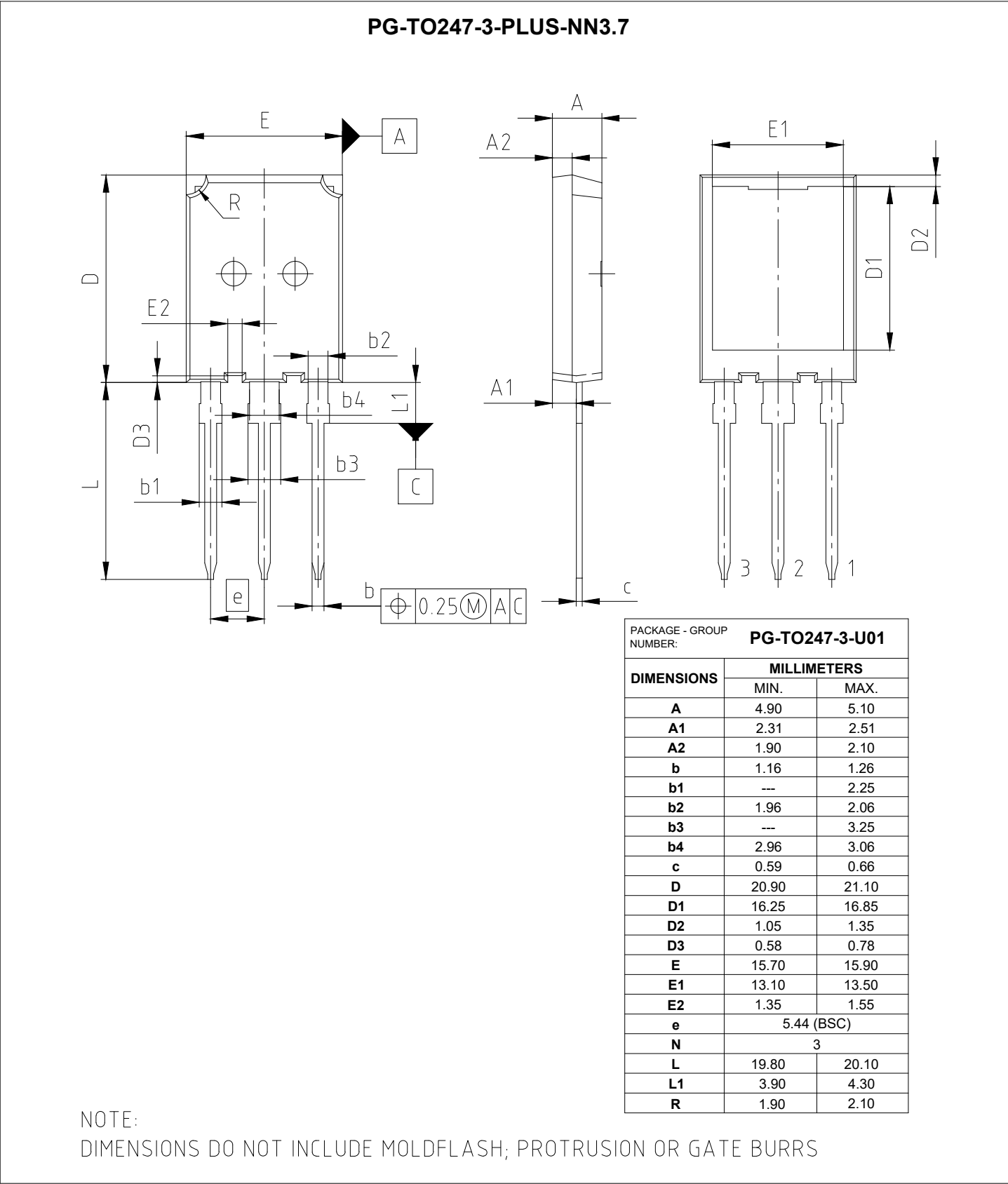


Figure 1

6 Testing conditions

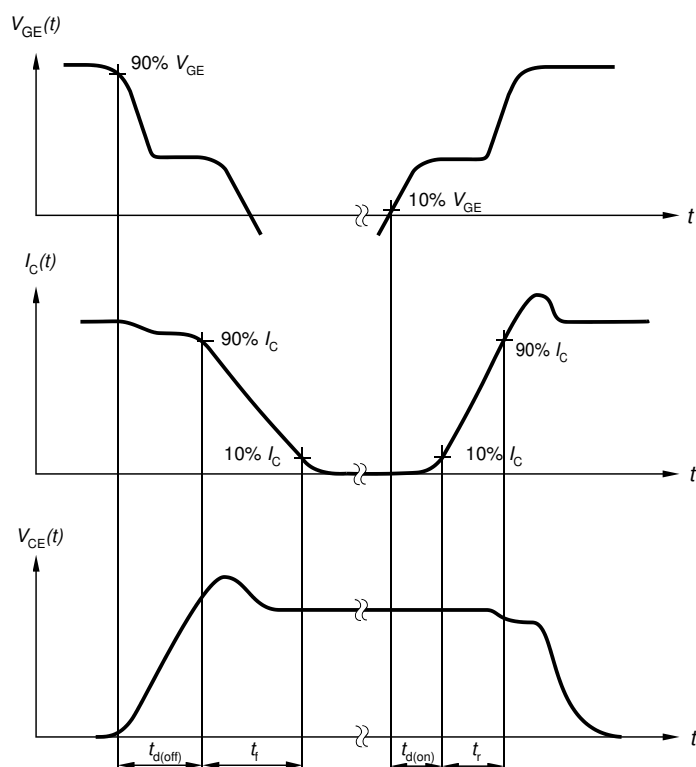


Figure A. Definition of switching times

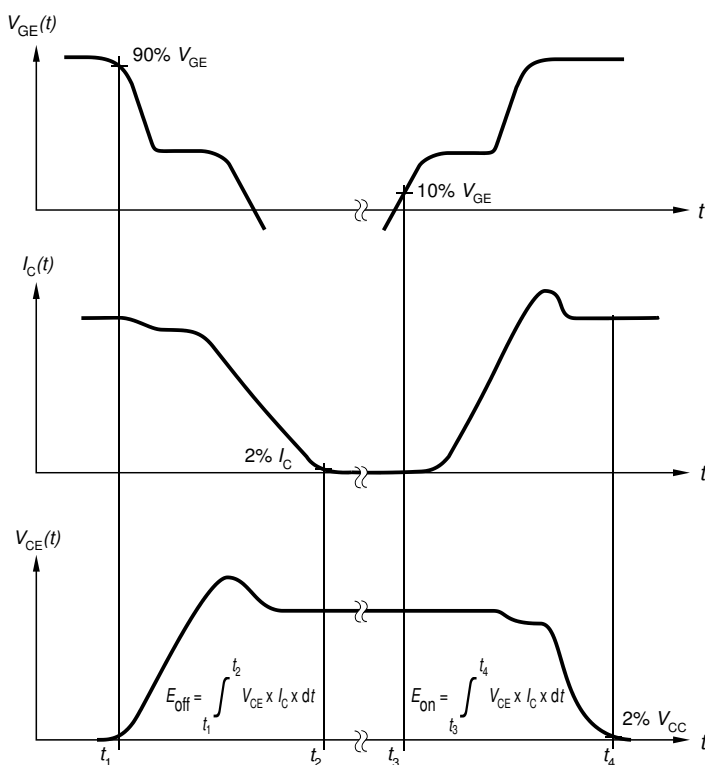


Figure B. Definition of switching losses

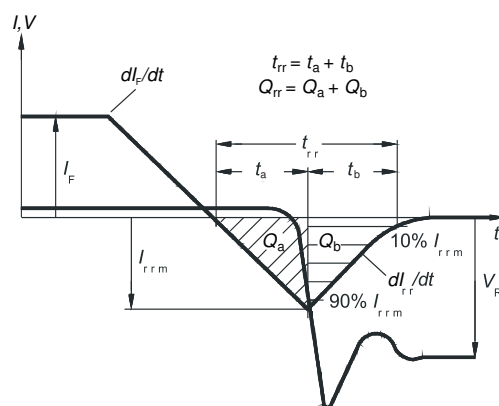


Figure C. Definition of diode switching characteristics

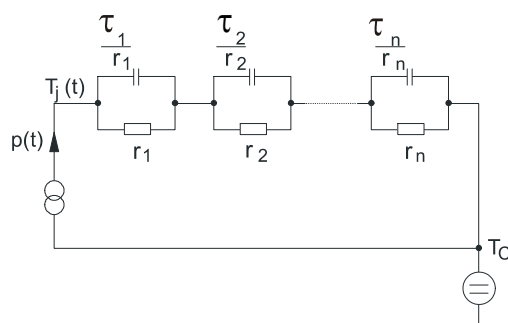


Figure D. Thermal equivalent circuit

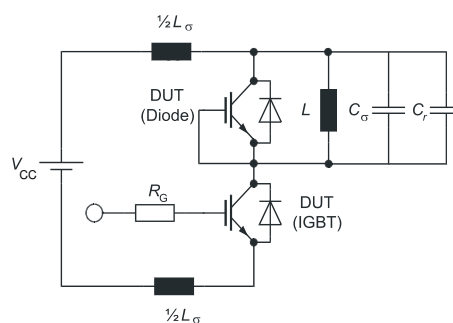


Figure E. **Dynamic test circuit**
 Parasitic inductance L_{σ} ,
 parasitic capacitor C_{σ} ,
 relief capacitor C_r ,
 (only for ZVT switching)

Revision history

Document revision	Date of release	Description of changes
0.10	2022-05-02	Target datasheet
0.20	2022-06-01	Editorial changes
1.00	2022-11-25	Final datasheet
1.10	2023-01-20	Change of product outline drawing on page 14

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