

Short circuit rugged 750 V EDT2 IGBT in reflow-solderable package co-packed with soft and fast recovery diode

Features

- $V_{CE} = 750\text{ V}$
- $I_C = 200\text{ A}$
- Low saturation voltage $V_{CEsat} = 1.4\text{ V}$
- Low switching losses
- Short circuit ruggedness $3\text{ }\mu\text{s}$
- IGBT co-packed with full current, soft and fast recovery diode
- Optimized for hard switching topologies up to 10 kHz
- Package backside suitable for reflow soldering at 245°C , 3 times
- Plating of pins further enable electrical resistance welding
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

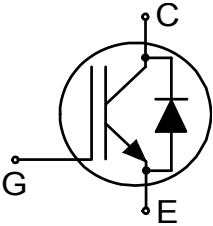
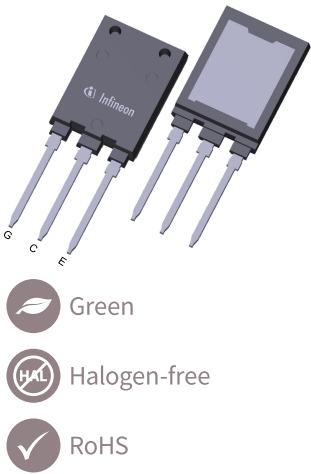
Potential applications

- CAV Powertrain Control Modules
- General purpose drives (GPD)

Product validation

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

Description



Type	Package	Marking
IKQB200N75CP2	PG-TO247-3-PLUS-NN8.5	K200GCP2



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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}	reflow soldering (MSL1 according to JEDEC J-STA-020)			245	°C
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$				0.16	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$				0.3	K/W

2 IGBT

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25\text{ °C}$		750	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25\text{ °C}$	200	A
			$T_c = 120\text{ °C}$	200	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			600	A
Turn-off safe operating area		$V_{CE} \leq 750\text{ V}, T_{vj} \leq 175\text{ °C}$		600	A
Gate-emitter voltage	V_{GE}			± 20	V
Transient gate-emitter voltage	V_{GE}	$t_p = 10\text{ }\mu\text{s}, D < 0.01$		± 30	V
Short-circuit withstand time	t_{SC}	$V_{CC} \leq 450\text{ V}, V_{GE} = 15\text{ V}$, Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}$, $T_{vj} = 125\text{ °C}$		3	μs
Power dissipation	P_{tot}	$T_c = 25\text{ °C}$		937	W
		$T_c = 120\text{ °C}$		344	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 200 \text{ A}$, $V_{GE} = 15 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		1.4	1.65	V
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$		1.7		
Gate-emitter threshold voltage	V_{GETh}	$I_C = 2.6 \text{ mA}$, $V_{CE} = V_{GE}$		5	5.8	6.5	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 750 \text{ V}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$			200	μA
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$		6000		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = 20 \text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 200 \text{ A}$, $V_{CE} = 20 \text{ V}$			140		S
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			21280		pF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			540		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			95		pF
Gate charge	Q_G	$V_{CC} = 600 \text{ V}$, $I_C = 200 \text{ A}$, $V_{GE} = 15 \text{ V}$			797		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 450 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \text{ } \Omega$, $R_{G(off)} = 4.8 \text{ } \Omega$, $L_{\sigma} = 30 \text{ nH}$, $C_{\sigma} = 144 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$		95		ns
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$		87		
Rise time (inductive load)	t_r	$V_{CC} = 450 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \text{ } \Omega$, $R_{G(off)} = 4.8 \text{ } \Omega$, $L_{\sigma} = 30 \text{ nH}$, $C_{\sigma} = 144 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$		97		ns
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$		92		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 450 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \text{ } \Omega$, $R_{G(off)} = 4.8 \text{ } \Omega$, $L_{\sigma} = 30 \text{ nH}$, $C_{\sigma} = 144 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$		407		ns
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$		468		
Fall time (inductive load)	t_f	$V_{CC} = 450 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \text{ } \Omega$, $R_{G(off)} = 4.8 \text{ } \Omega$, $L_{\sigma} = 30 \text{ nH}$, $C_{\sigma} = 144 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$		46		ns
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$		57		
Turn-on energy	E_{on}	$V_{CC} = 450 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \text{ } \Omega$, $R_{G(off)} = 4.8 \text{ } \Omega$, $L_{\sigma} = 30 \text{ nH}$, $C_{\sigma} = 144 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$		14.4		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$		17.3		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-off energy	E_{off}	$V_{CC} = 450 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \Omega$, $R_{G(off)} = 4.8 \Omega$, $L_{\sigma} = 30 \text{ nH}$, $C_{\sigma} = 144 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$	6.9		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$	9.9		
Total switching energy	E_{ts}	$V_{CC} = 450 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \Omega$, $R_{G(off)} = 4.8 \Omega$, $L_{\sigma} = 30 \text{ nH}$, $C_{\sigma} = 144 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$	21.3		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 200 \text{ A}$	27.2		
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}	$T_{vj} \geq 25 \text{ }^{\circ}\text{C}$	750	V
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	$T_c = 25 \text{ }^{\circ}\text{C}$	A
			$T_c = 60 \text{ }^{\circ}\text{C}$	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}		600	A
Power dissipation	P_{tot}	$T_c = 25 \text{ }^{\circ}\text{C}$	500	W
		$T_c = 120 \text{ }^{\circ}\text{C}$	183	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 200 \text{ A}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$	1.8	2	V
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$	1.9		
Diode reverse recovery time	t_{rr}	$V_R = 450 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_F = 200 \text{ A}$, $-di_F/dt = 1000 \text{ A}/\mu\text{s}$	239		ns
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_F = 200 \text{ A}$, $-di_F/dt = 1000 \text{ A}/\mu\text{s}$	318		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery charge	Q_{rr}	$V_R = 450 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_F = 200 \text{ A}$, $-di_F/dt = 1000 \text{ A}/\mu\text{s}$		4.8		μC
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_F = 200 \text{ A}$, $-di_F/dt = 1000 \text{ A}/\mu\text{s}$		10.7		
Diode peak reverse recovery current	I_{rrm}	$V_R = 450 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_F = 200 \text{ A}$, $-di_F/dt = 1000 \text{ A}/\mu\text{s}$		37.4		A
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_F = 200 \text{ A}$, $-di_F/dt = 1000 \text{ A}/\mu\text{s}$		57.3		
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	$V_R = 450 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_F = 200 \text{ A}$, $-di_F/dt = 1000 \text{ A}/\mu\text{s}$		400		$\text{A}/\mu\text{s}$
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_F = 200 \text{ A}$, $-di_F/dt = 1000 \text{ A}/\mu\text{s}$		454		
Operating junction temperature	T_{vj}			-40		175	$^{\circ}\text{C}$

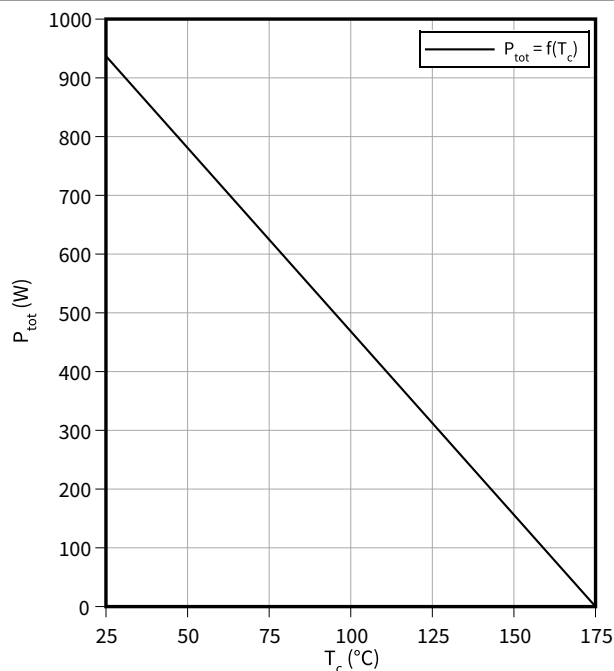
Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

4 Characteristics diagrams

Power dissipation as a function of case temperature

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

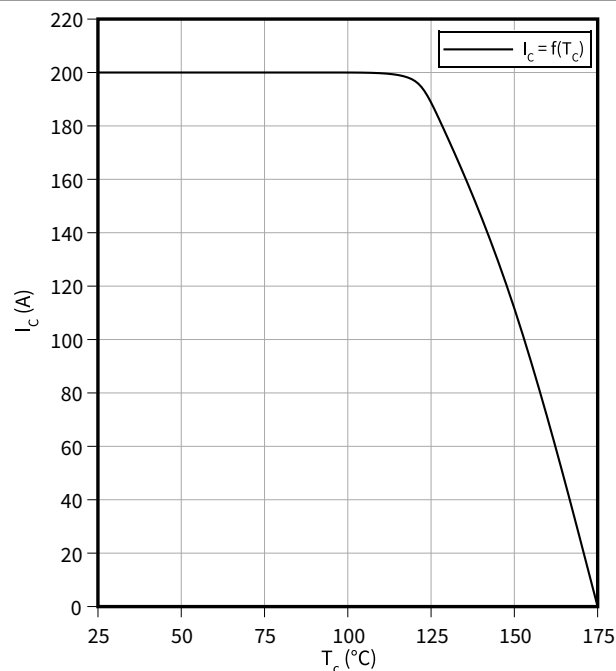
$$T_{vj} \leq 175^\circ\text{C}$$



Collector current as a function of case temperature

$$I_c = f(T_c)$$

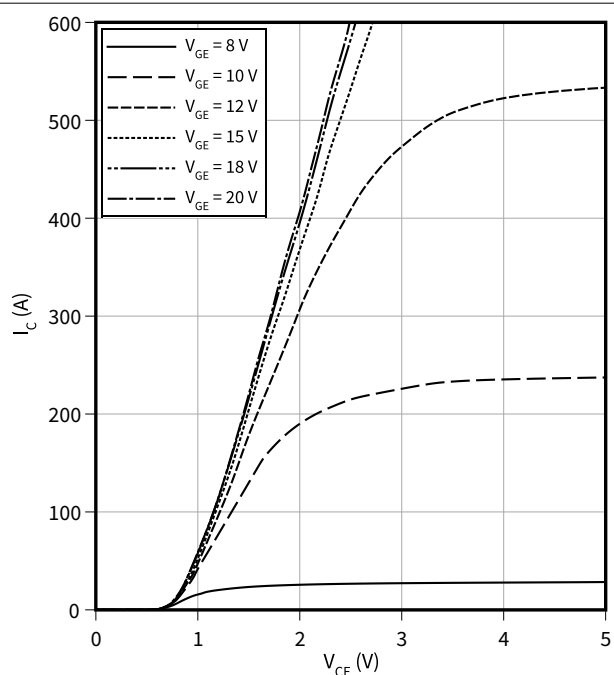
$$T_{vj} \leq 175^\circ\text{C}, V_{GE} \geq 15\text{ V}$$



Typical output characteristic

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

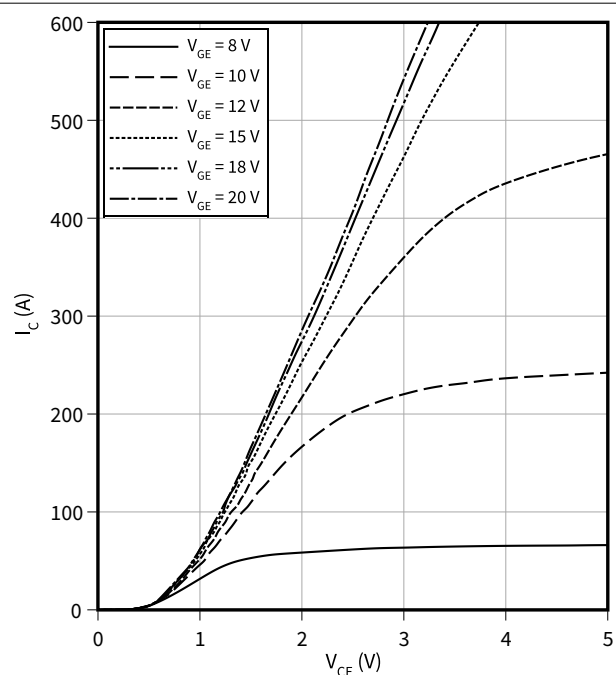
$$T_{vj} = 25^\circ\text{C}$$



Typical output characteristic

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

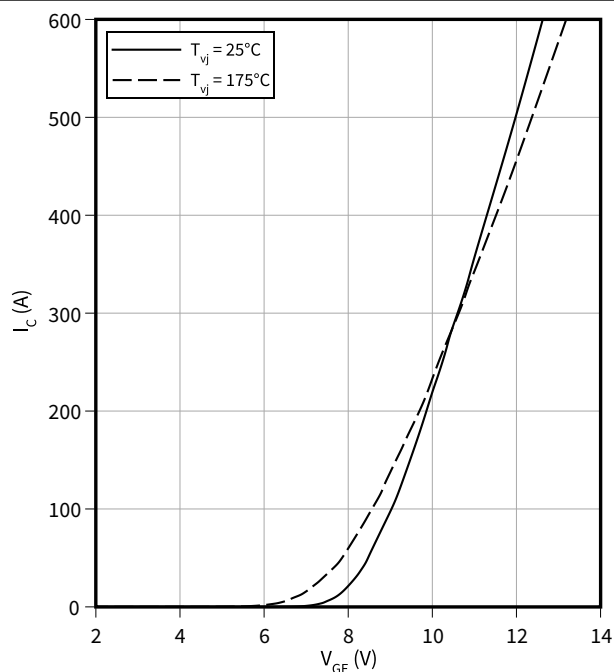
$$T_{vj} = 175^\circ\text{C}$$



Typical transfer characteristic

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

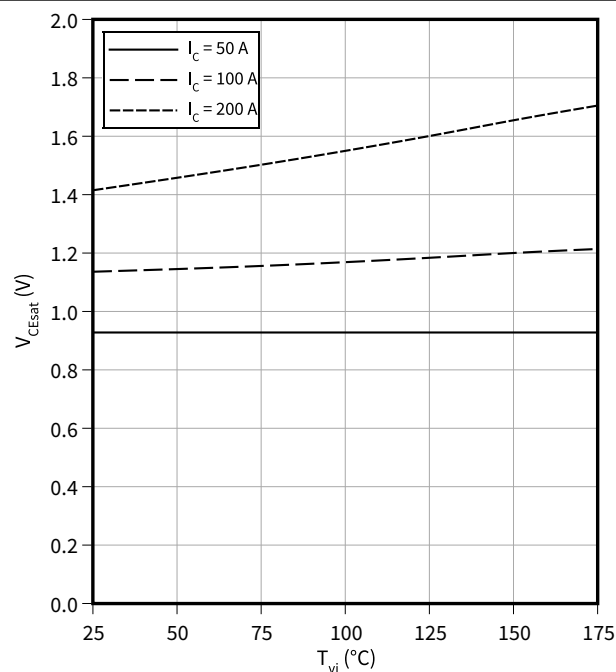
$$V_{CE} = 20 \text{ V}$$



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

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

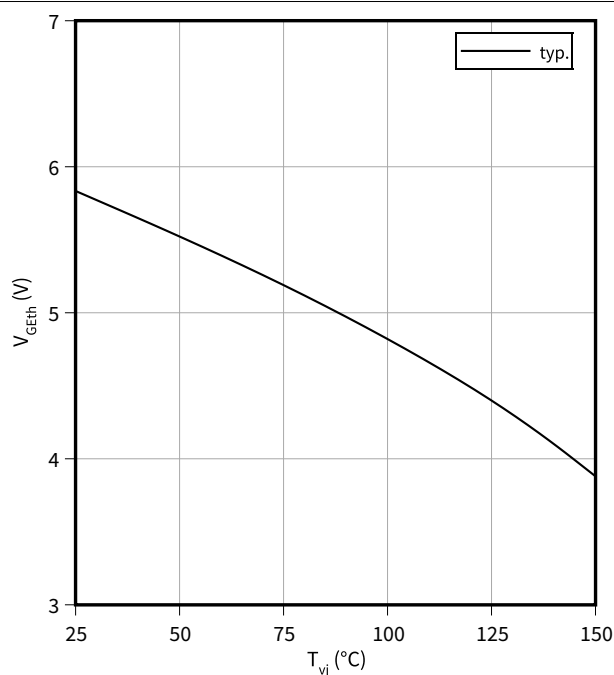
$$V_{GE} = 15 \text{ V}$$



Gate-emitter threshold voltage as a function of junction temperature

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

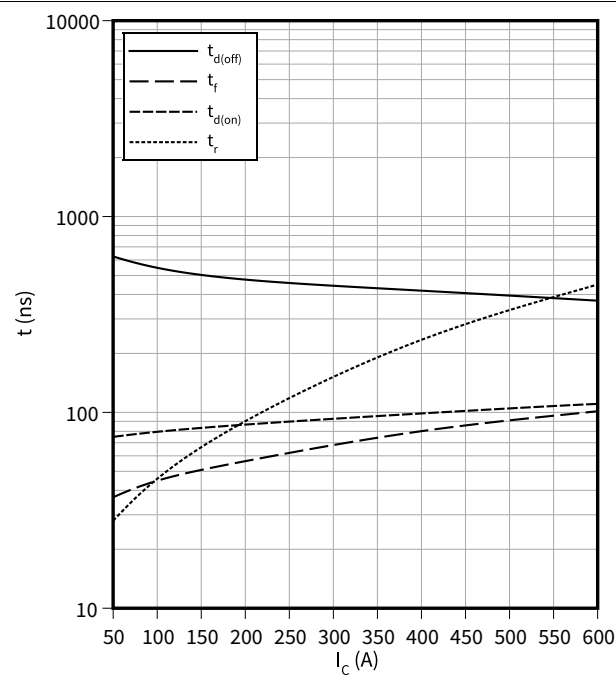
$$I_C = 2.6 \text{ mA}$$



Typical switching times as a function of collector current

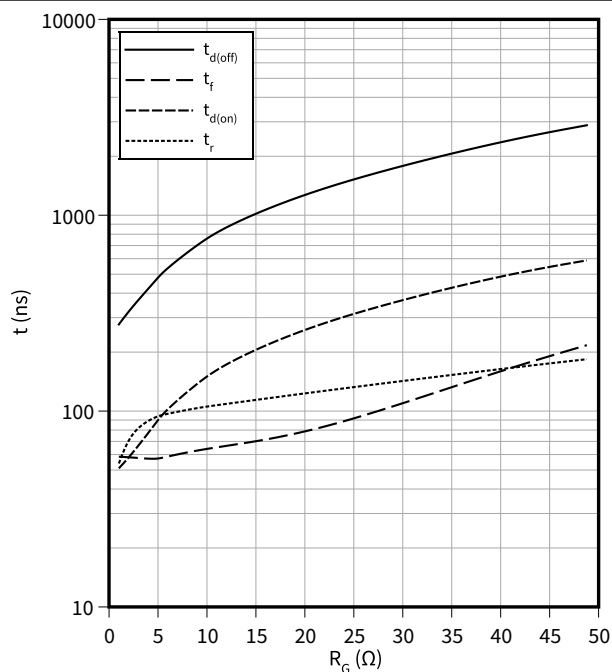
$$t = f(I_C)$$

$$V_{CC} = 450 \text{ V}, T_{vj} = 175^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 4.8 \Omega$$

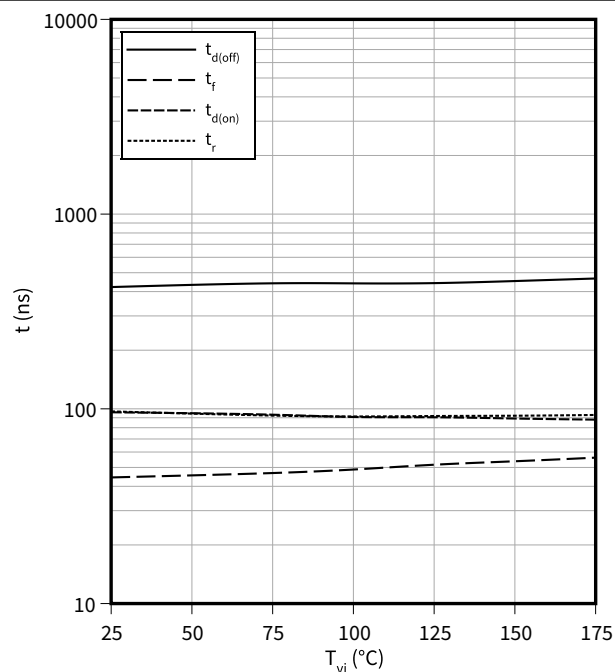


4 Characteristics diagrams
Typical switching times as a function of gate resistor

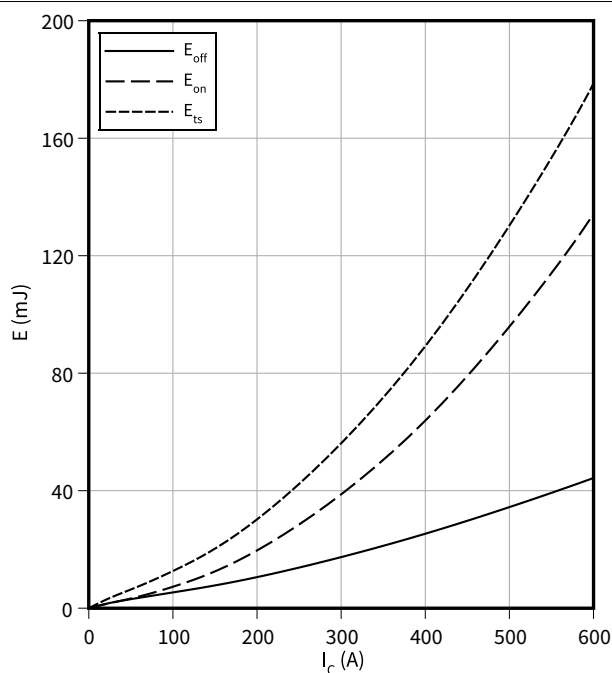
$$t = f(R_G)$$

 $I_C = 200 \text{ A}, V_{CC} = 450 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}$

Typical switching times as a function of junction temperature

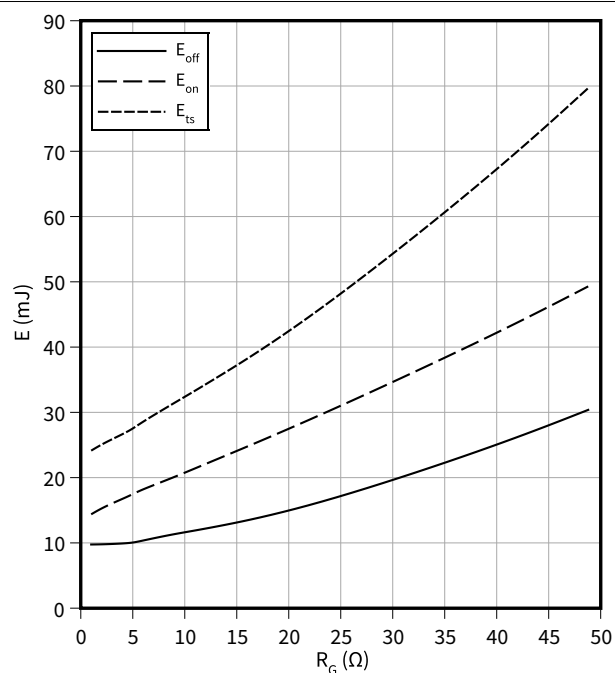
$$t = f(T_{vj})$$

 $I_C = 200 \text{ A}, V_{CC} = 450 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 4.8 \text{ } \Omega$

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

 $V_{CC} = 450 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 4.8 \text{ } \Omega$

Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

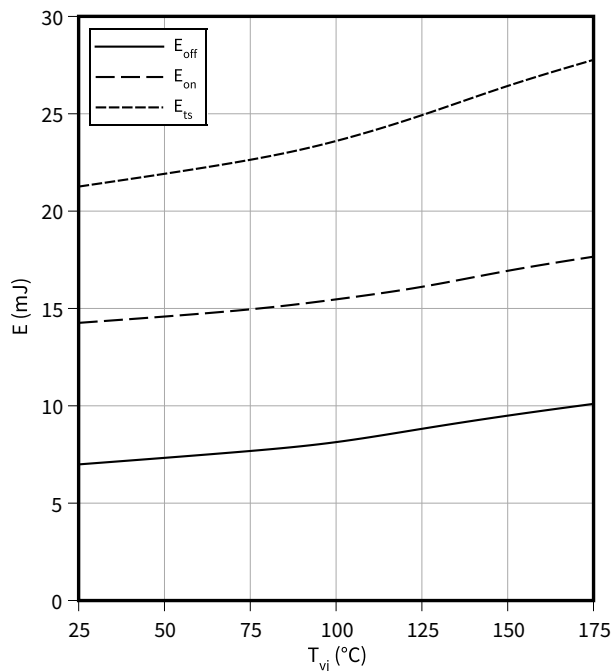
 $I_C = 200 \text{ A}, V_{CC} = 450 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}$


4 Characteristics diagrams

Typical switching energy losses as a function of junction temperature

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

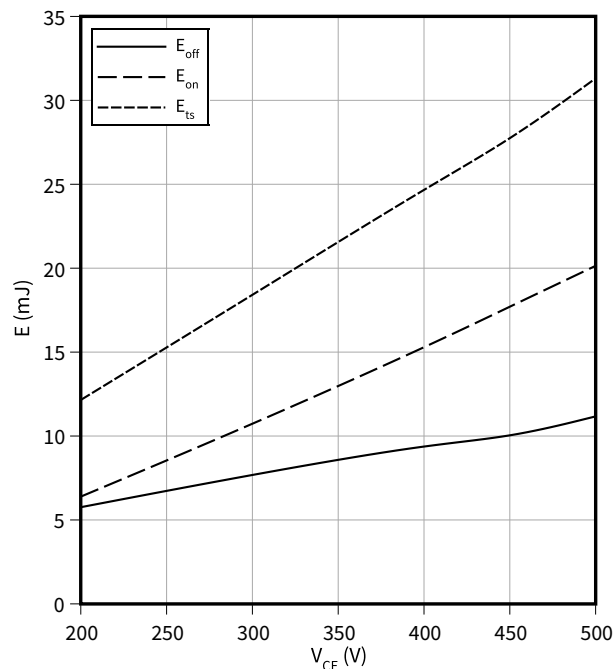
$I_C = 200 \text{ A}$, $V_{CE} = 450 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 4.8 \Omega$



Typical switching energy losses as a function of collector emitter voltage

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

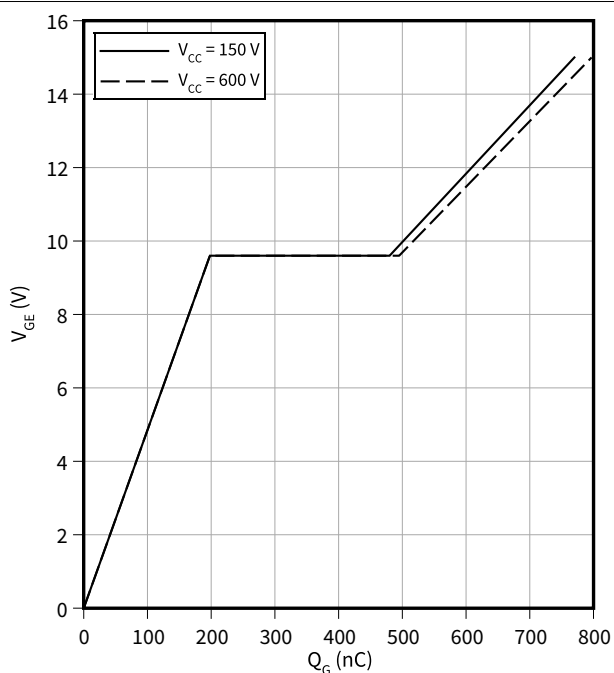
$I_C = 200 \text{ A}$, $V_{GE} = 0/15 \text{ V}$, $T_{vj} = 175 \text{ °C}$, $R_G = 4.8 \Omega$



Typical gate charge

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

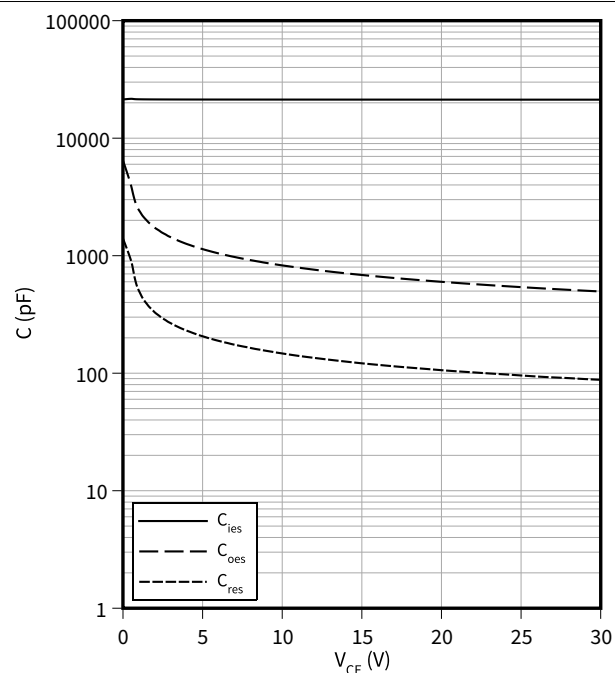
$I_C = 200 \text{ A}$



Typical capacitance as a function of collector-emitter voltage

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

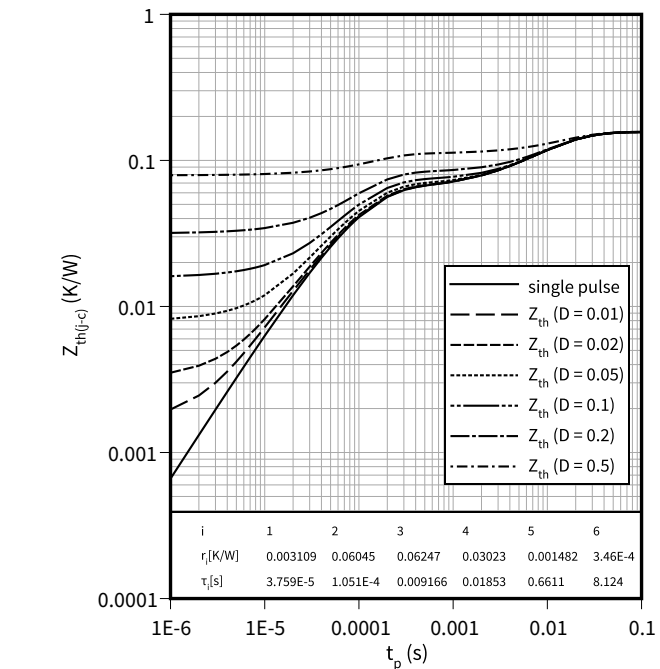
$f = 100 \text{ kHz}$, $V_{GE} = 0 \text{ V}$



4 Characteristics diagrams

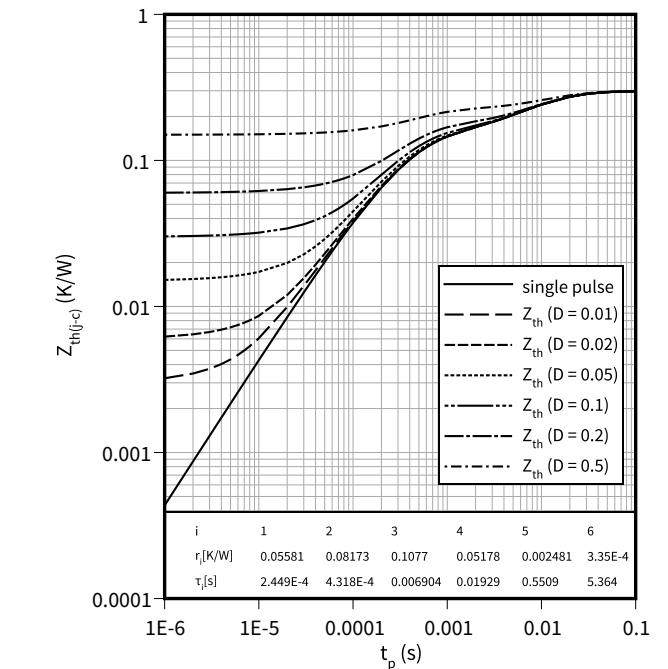
IGBT transient thermal impedance as a function of pulse width

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



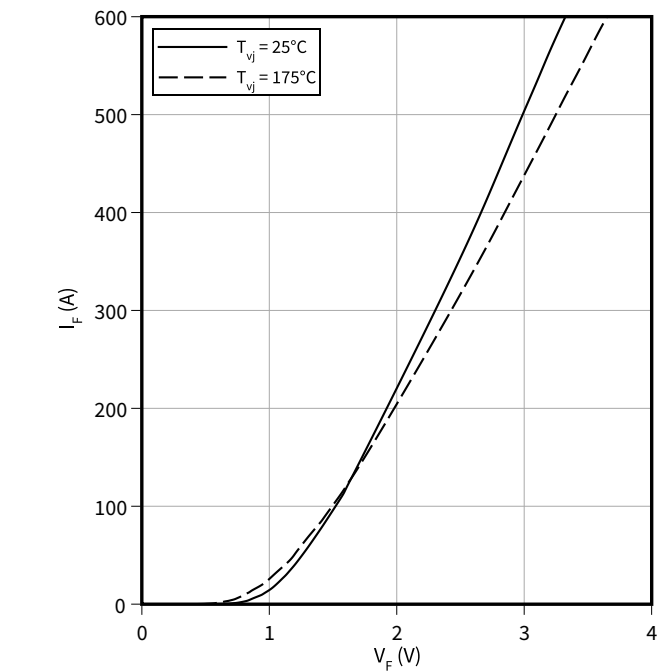
Diode transient thermal impedance as a function of pulse width

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



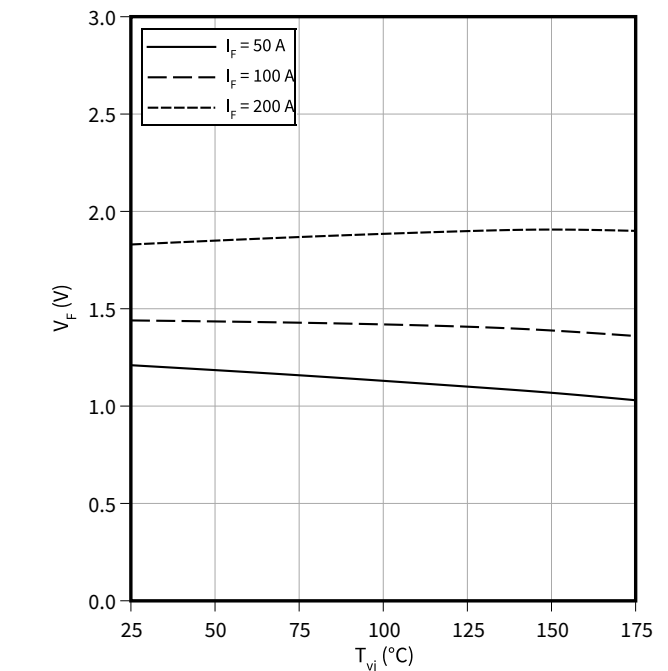
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



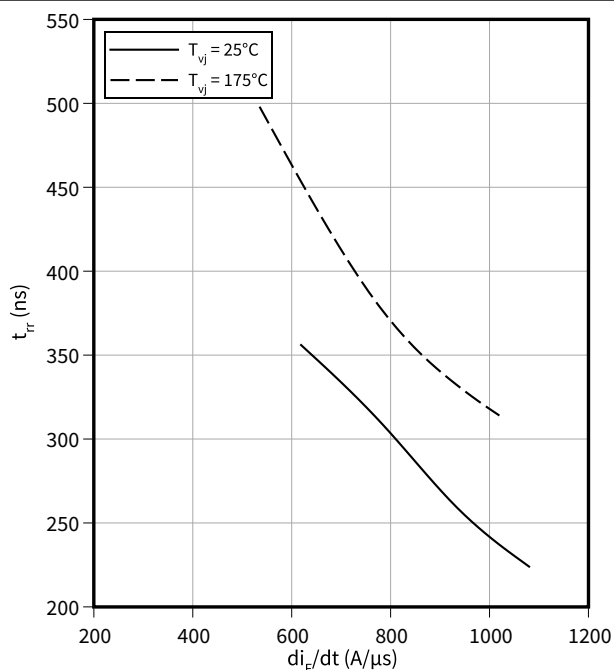
Typical diode forward voltage as a function of junction temperature

$V_F = f(T_{vj})$

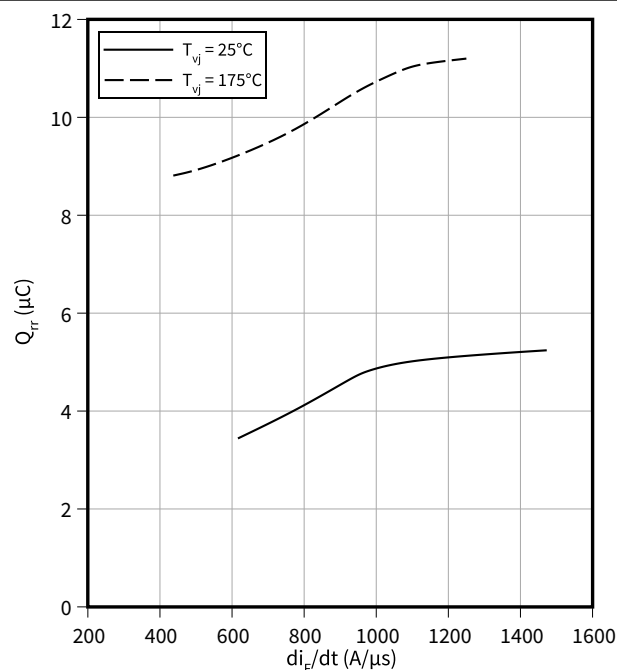


4 Characteristics diagrams
Typical reverse recovery time as a function of diode current slope

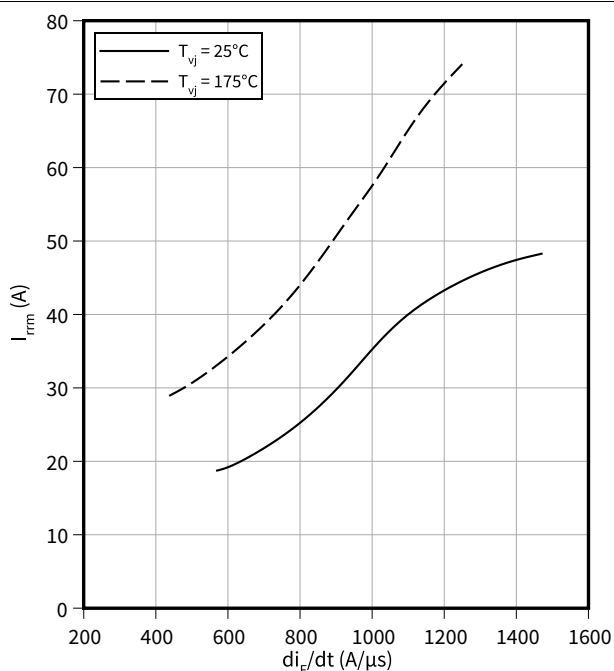
$$t_{rr} = f(di_F/dt)$$

 $V_R = 450 \text{ V}, I_F = 200 \text{ A}$

Typical reverse recovery charge as a function of diode current slope

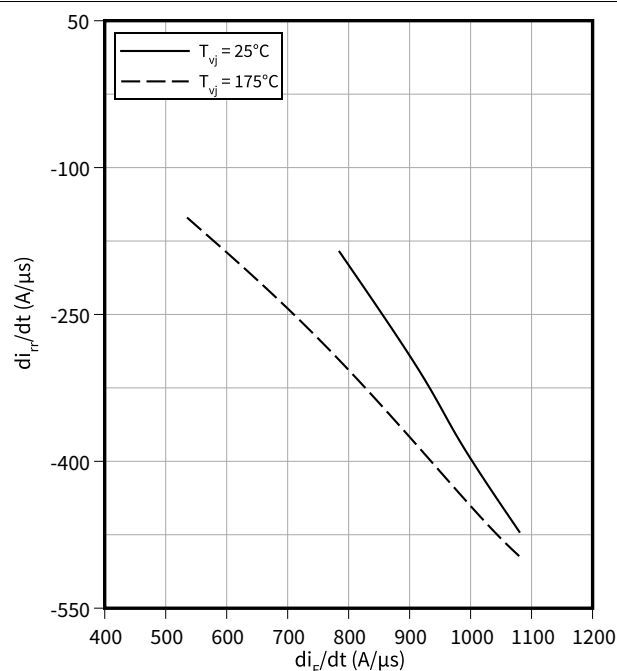
$$Q_{rr} = f(di_F/dt)$$

 $V_R = 450 \text{ V}, I_F = 200 \text{ A}$

Typical reverse recovery current as a function of diode current slope

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

 $V_R = 450 \text{ V}, I_F = 200 \text{ A}$

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

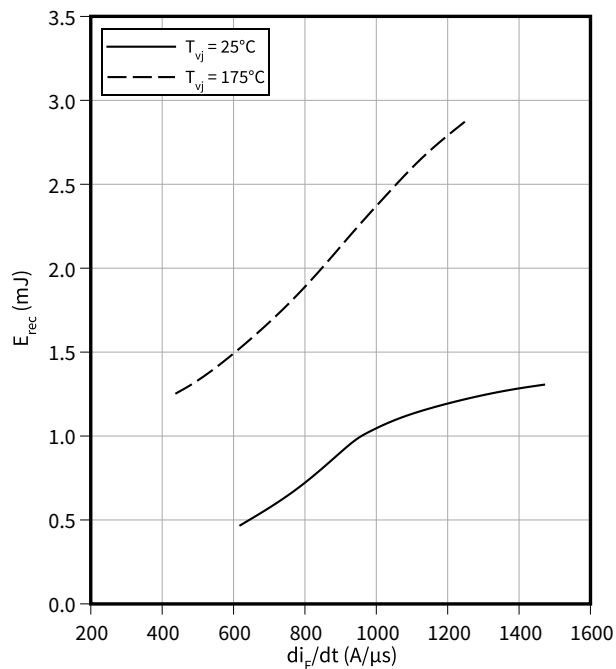
$$di_{rr}/dt = f(di_F/dt)$$

 $V_R = 450 \text{ V}, I_F = 200 \text{ A}$


Typical reverse energy losses as a function of diode current slope

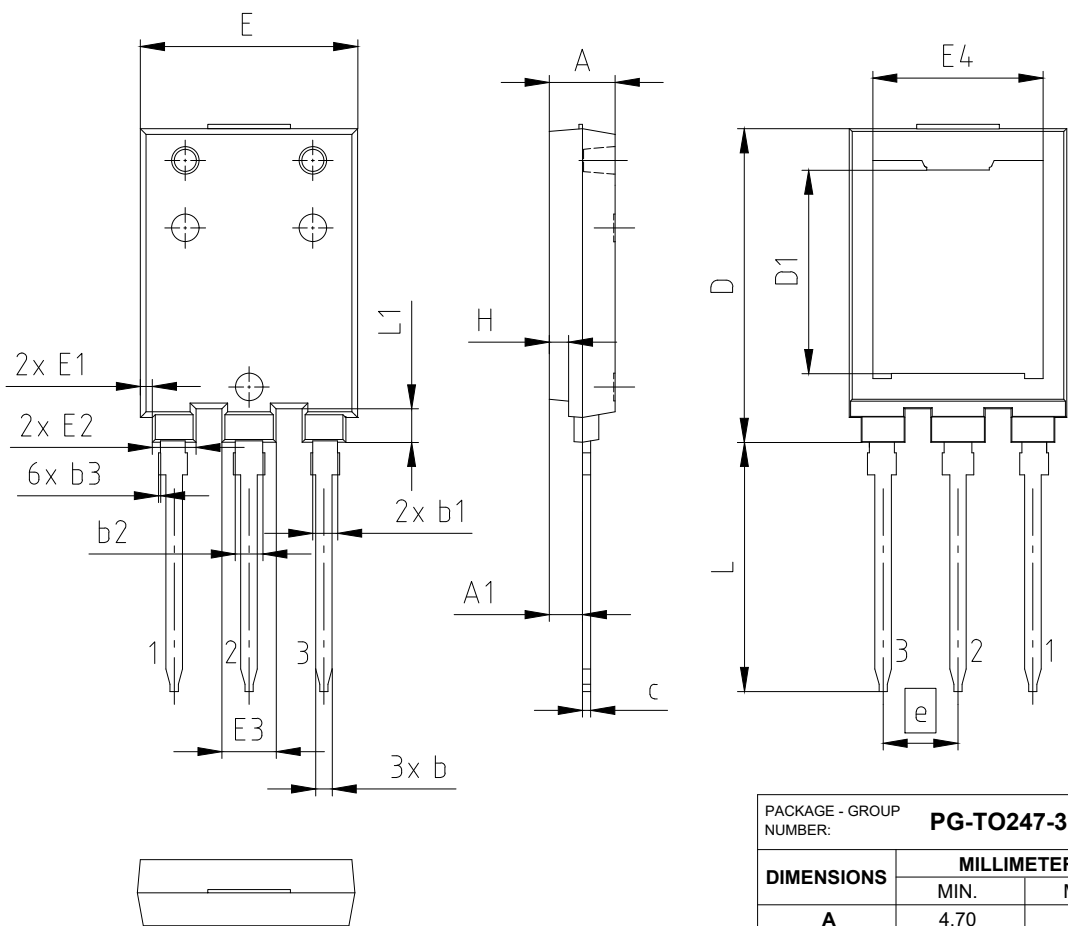
$$E_{\text{rec}} = f(di_F/dt)$$

$$V_R = 450 \text{ V}, I_F = 200 \text{ A}$$



5 Package outlines

PG-TO247-3-PLUS-NN8.5



PACKAGE - GROUP NUMBER: PG-TO247-3-U02		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.70	4.90
A1	2.16	2.66
b	1.10	1.30
b1	1.80	
b2	2.00	
b3	0.00	0.15
c	0.50	0.70
D	22.70	22.90
D1	14.69	14.89
E	15.70	15.90
E1	0.76	0.96
E2	3.08	3.28
E3	3.84	4.04
E4	12.28	12.48
e	5.44	
N	3	
H	1.30	1.50
L	18.01	18.21
L1	2.34	2.54
aaa	0.25	

NOTES:
(1) ALL METAL SURFACES TIN PLATED EXCEPT AREA OF CUT
(2) MOLD GATE PROTRUSION AFTER DEGATING.

Figure 1

6 Testing conditions

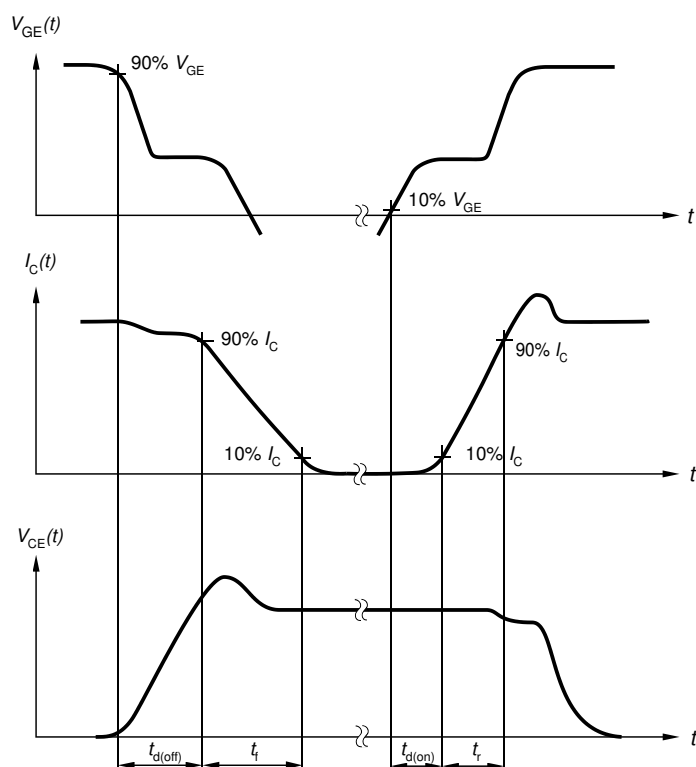


Figure A. Definition of switching times

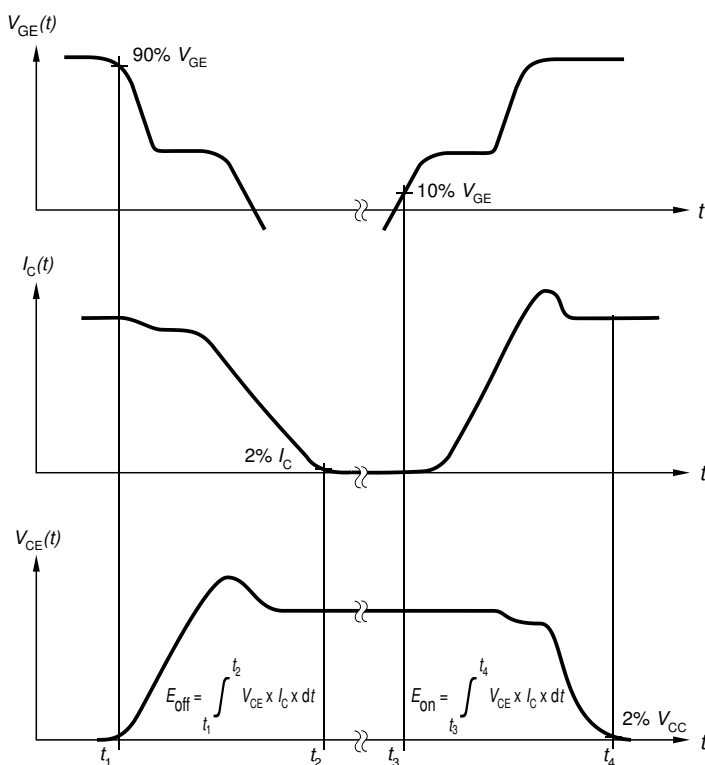


Figure B. Definition of switching losses

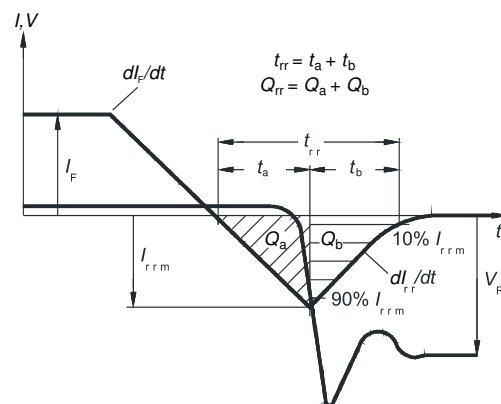


Figure C. Definition of diode switching characteristics

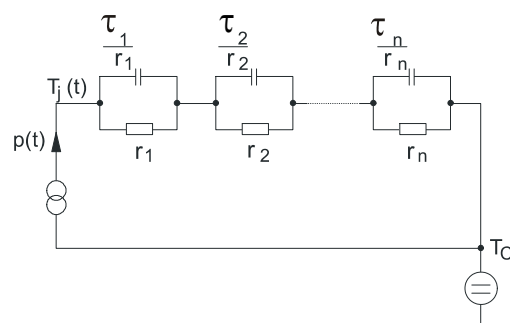


Figure D. Thermal equivalent circuit

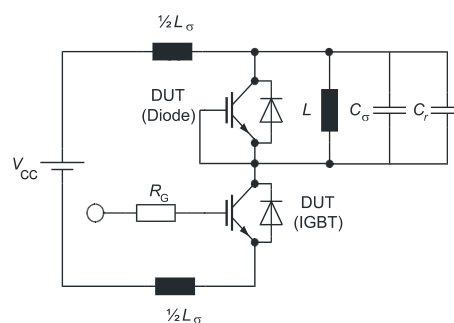


Figure E. Dynamic test circuit
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)

Revision history

Document revision	Date of release	Description of changes
V0.1		Target Data Sheet
n/a	2020-11-30	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.00	2022-11-23	Final datasheet
1.10	2023-06-30	Editorial changes on cover page

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