

Final datasheet

High speed and low saturation voltage 650 V TRENCHSTOP™ IGBT7 technology copacked with soft, fast recovery Emitter Controlled 7 diode

Features

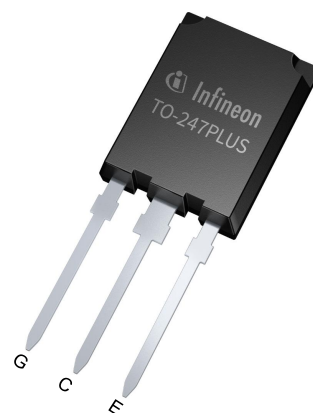
- $V_{CE} = 650\text{ V}$
- $I_C = 150\text{ A}$
- Low switching losses
- Very low collector-emitter saturation voltage V_{CEsat}
- Very soft, fast recovery antiparallel diode
- Smooth switching behavior
- Humidity robustness
- Optimized for hard switching, two- and three-level topologies
- Complete 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



Lead-free



Green

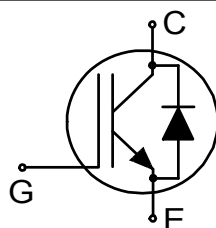


Halogen-free



RoHS

Description



Type	Package	Marking
IKQ150N65EH7	PG-TO247-3-PLUS-NN3.7	K150EEH7



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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	$R_{th(j-c)}$			0.19	0.24	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.26	0.33	K/W

2 IGBT

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25\text{ °C}$		650	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25\text{ °C}$	160	A
			$T_c = 100\text{ °C}$	160	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			600	A
Turn-off safe operating area		$V_{CE} \leq 650\text{ V}, t_p \leq 1\text{ }\mu\text{s}, T_{vj} \leq 175\text{ °C}$		600	A
Gate-emitter voltage	V_{GE}			± 20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10\text{ }\mu\text{s}, D < 0.01$		± 30	V
Power dissipation	P_{tot}		$T_c = 25\text{ °C}$	621	W
			$T_c = 100\text{ °C}$	307	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 150\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.4	1.65	V
			$T_{vj} = 175\text{ °C}$		1.6		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Gate-emitter threshold voltage	V_{GEth}	$I_C = 1.32 \text{ mA}$, $V_{CE} = V_{GE}$	2.9	3.85	4.8	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 650 \text{ V}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		50	μA
			$T_{vj} = 175 \text{ °C}$		8600	
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = 20 \text{ V}$			100	nA
Transconductance	g_{fs}	$I_C = 150 \text{ A}$, $V_{CE} = 20 \text{ V}$		181		S
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$		8128		pF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$		236		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$		32.8		pF
Gate charge	Q_G	$V_{CC} = 520 \text{ V}$, $I_C = 150 \text{ A}$, $V_{GE} = 15 \text{ V}$		301		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 10 \text{ }\Omega$, $R_{G(off)} = 10 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 150 \text{ A}$		45	ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 150 \text{ A}$		42	
Rise time (inductive load)	t_r	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 10 \text{ }\Omega$, $R_{G(off)} = 10 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 150 \text{ A}$		79	ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 150 \text{ A}$		78	
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 10 \text{ }\Omega$, $R_{G(off)} = 10 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 150 \text{ A}$		341	ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 150 \text{ A}$		375	
Fall time (inductive load)	t_f	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 10 \text{ }\Omega$, $R_{G(off)} = 10 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 150 \text{ A}$		120	ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 150 \text{ A}$		119	
Turn-on energy	E_{on}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 10 \text{ }\Omega$, $R_{G(off)} = 10 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 150 \text{ A}$		5.8	mJ
			$T_{vj} = 175 \text{ °C}$, $I_C = 150 \text{ A}$		8	
Turn-off energy	E_{off}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 10 \text{ }\Omega$, $R_{G(off)} = 10 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 150 \text{ A}$		5.4	mJ
			$T_{vj} = 175 \text{ °C}$, $I_C = 150 \text{ A}$		5.2	

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy	E_{ts}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 10 \text{ } \Omega$, $R_{G(off)} = 10 \text{ } \Omega$		11.2		mJ
				13.2		
Operating junction temperature	T_{vj}		-40		175	°C

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}		600	A
Power dissipation	P_{tot}	$T_c = 25 \text{ } ^\circ\text{C}$	452	W
		$T_c = 100 \text{ } ^\circ\text{C}$	234	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 150 \text{ A}$		$T_{vj} = 25 \text{ } ^\circ\text{C}$	1.65	V
				$T_{vj} = 175 \text{ } ^\circ\text{C}$	1.55	
Diode reverse recovery time	t_{rr}	$V_R = 400 \text{ V}$, $R_{G(on)} = 10 \text{ } \Omega$		$T_{vj} = 25 \text{ } ^\circ\text{C}$, $I_F = 150 \text{ A}$	84	ns
				$T_{vj} = 175 \text{ } ^\circ\text{C}$, $I_F = 150 \text{ A}$	162	
Diode reverse recovery charge	Q_{rr}	$V_R = 400 \text{ V}$, $R_{G(on)} = 10 \text{ } \Omega$		$T_{vj} = 25 \text{ } ^\circ\text{C}$, $I_F = 150 \text{ A}$	2.4	μC
				$T_{vj} = 175 \text{ } ^\circ\text{C}$, $I_F = 150 \text{ A}$	7.1	
Diode peak reverse recovery current	I_{rrm}	$V_R = 400 \text{ V}$, $R_{G(on)} = 10 \text{ } \Omega$		$T_{vj} = 25 \text{ } ^\circ\text{C}$, $I_F = 150 \text{ A}$	45	A
				$T_{vj} = 175 \text{ } ^\circ\text{C}$, $I_F = 150 \text{ A}$	69	

(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	$V_R = 400 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$		$T_{vj} = 25 \text{ } ^\circ\text{C}, I_F = 150 \text{ A}$	-2240	A/ μs
				$T_{vj} = 175 \text{ } ^\circ\text{C}, I_F = 150 \text{ A}$	-2260	
Reverse recovery energy	E_{rec}	$V_R = 400 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$		$T_{vj} = 25 \text{ } ^\circ\text{C}, I_F = 150 \text{ A}$	0.46	mJ
				$T_{vj} = 175 \text{ } ^\circ\text{C}, I_F = 150 \text{ A}$	1.45	
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.

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

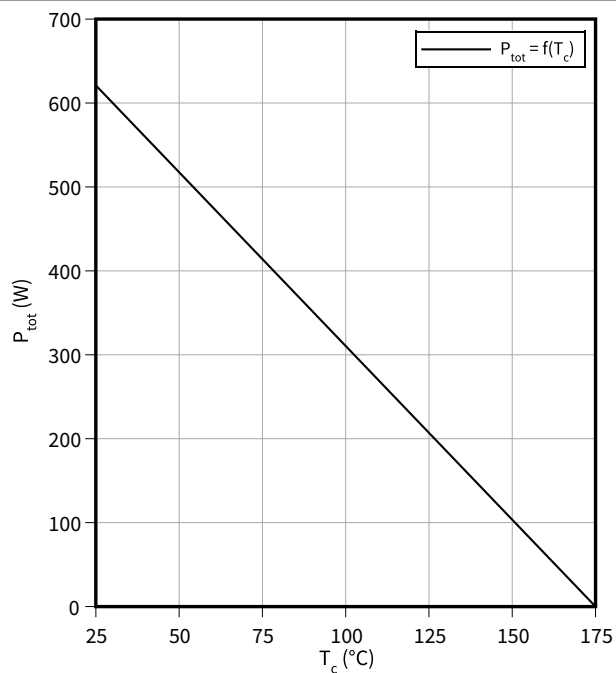
Dynamic test circuit, parasitic inductance $L_\sigma = 8 \text{ nH}$, parasitic capacitor $C_\sigma = 30 \text{ pF}$ from Fig. E. Energy losses include "tail" and diode reverse recovery.

4 Characteristics diagrams

Power dissipation as a function of case temperature

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

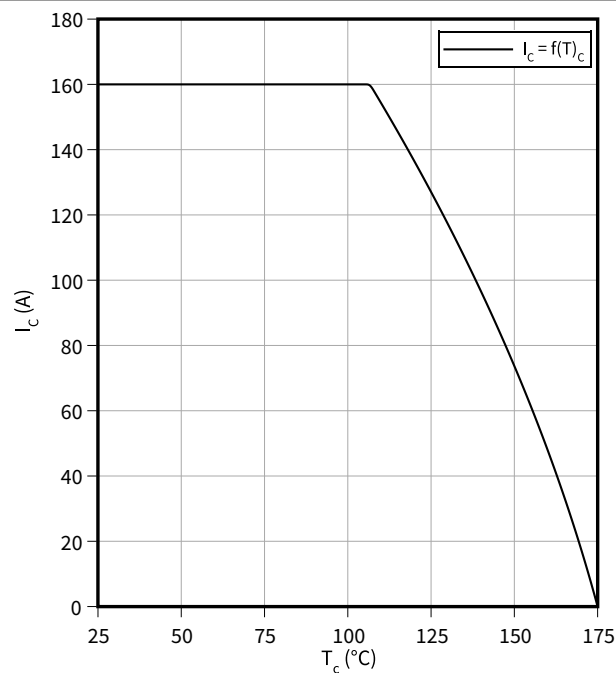
$$T_{vj} \leq 175^\circ\text{C}$$



Collector current as a function of case temperature

$$I_c = f(T_c)$$

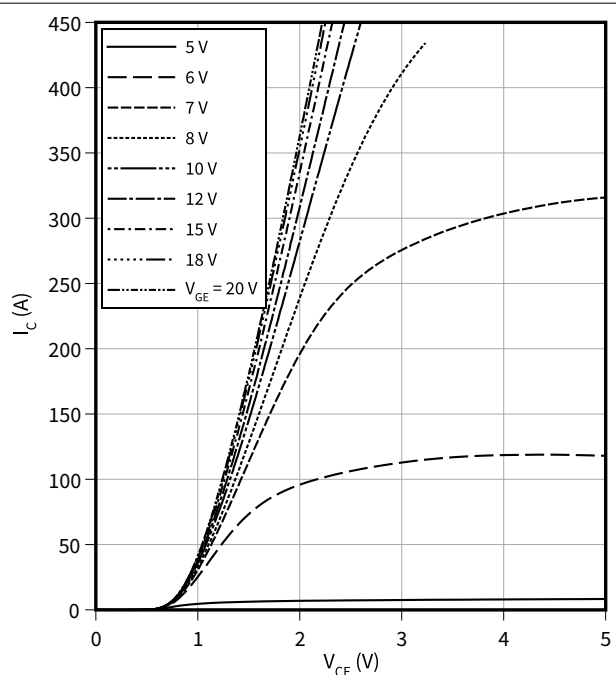
$$T_{vj} \leq 175^\circ\text{C}, V_{GE} \geq 15\text{ V}$$



Typical output characteristic

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

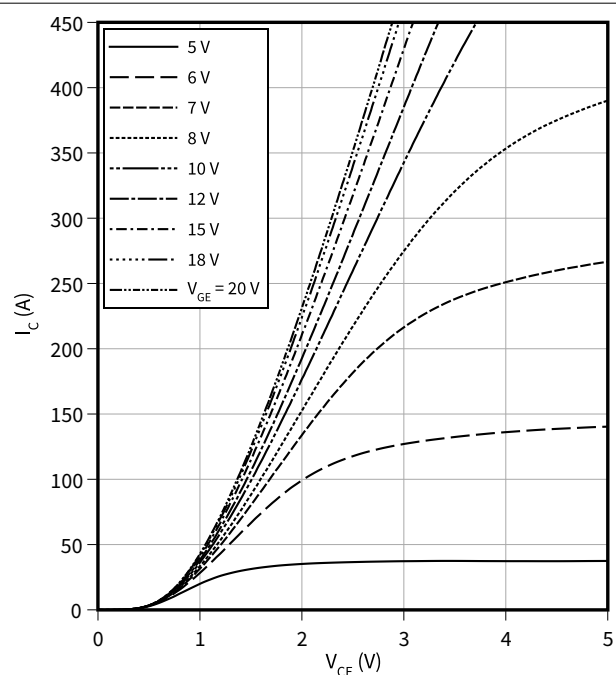
$$T_{vj} = 25^\circ\text{C}$$



Typical output characteristic

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

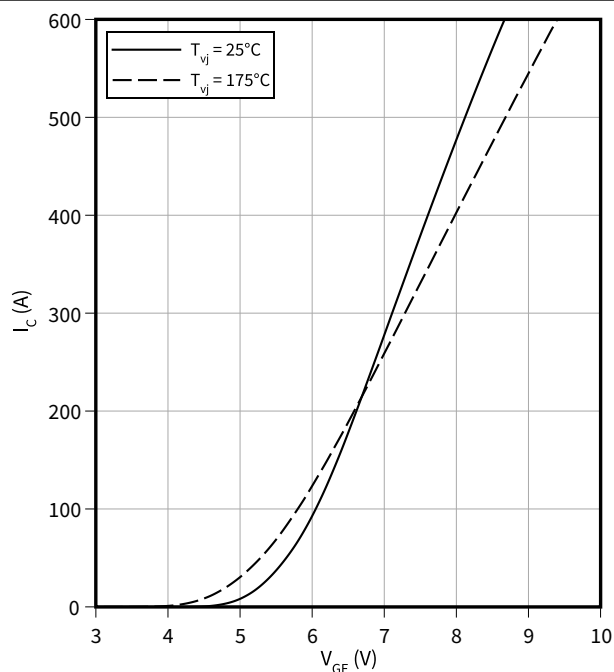
$$T_{vj} = 175^\circ\text{C}$$



4 Characteristics diagrams
Typical transfer characteristic

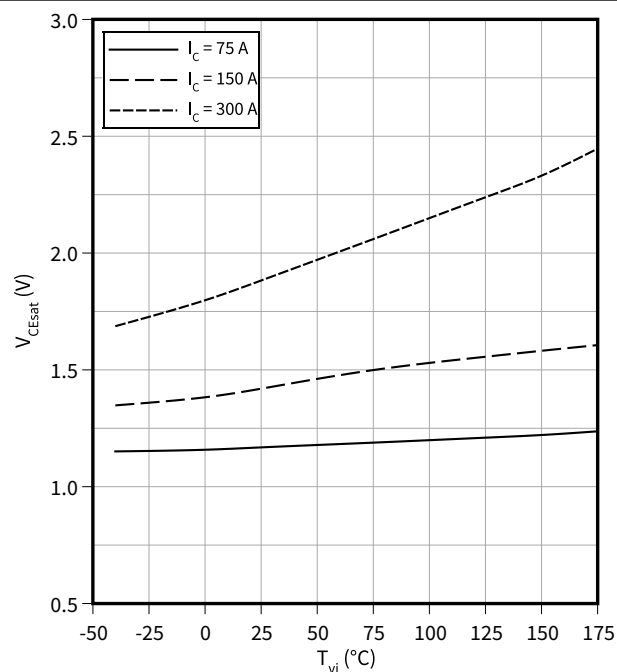
$$I_C = f(V_{GE})$$

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


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

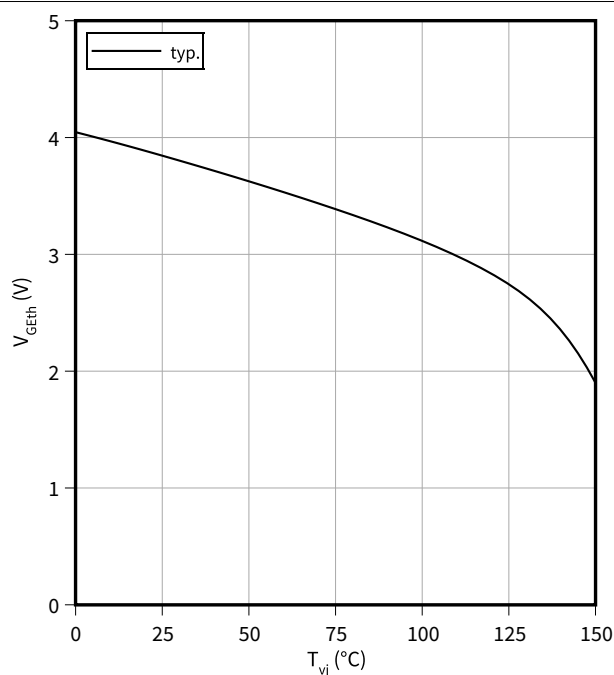
$$V_{CEsat} = f(T_{vj})$$

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


Gate-emitter threshold voltage as a function of junction temperature

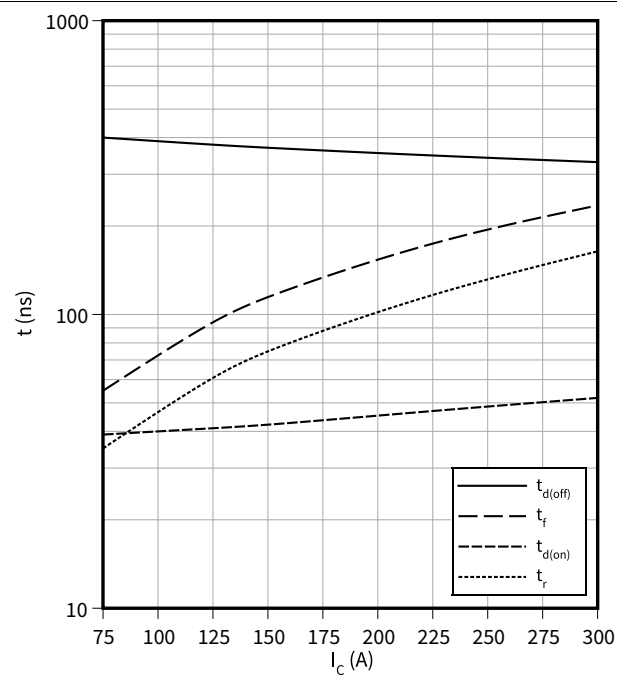
$$V_{GEth} = f(T_{vj})$$

$$I_C = 1.32 \text{ mA}$$


Typical switching times as a function of collector current

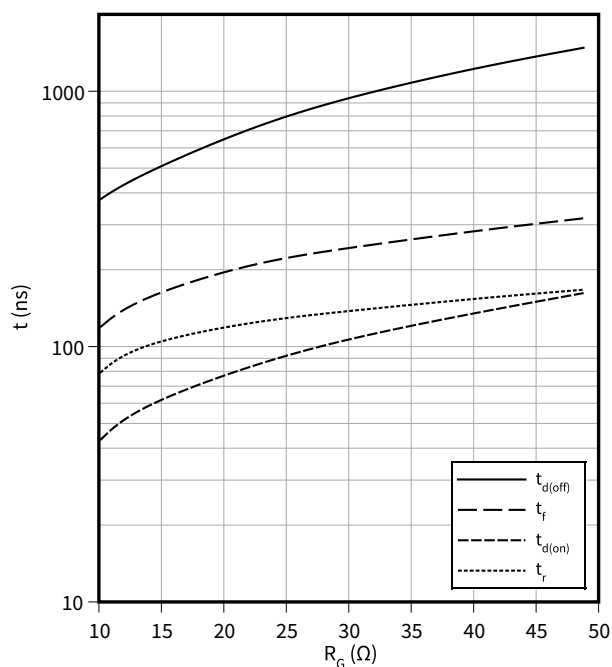
$$t = f(I_C)$$

$$V_{CC} = 400 \text{ V}, T_{vj} = 175^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 10 \Omega$$

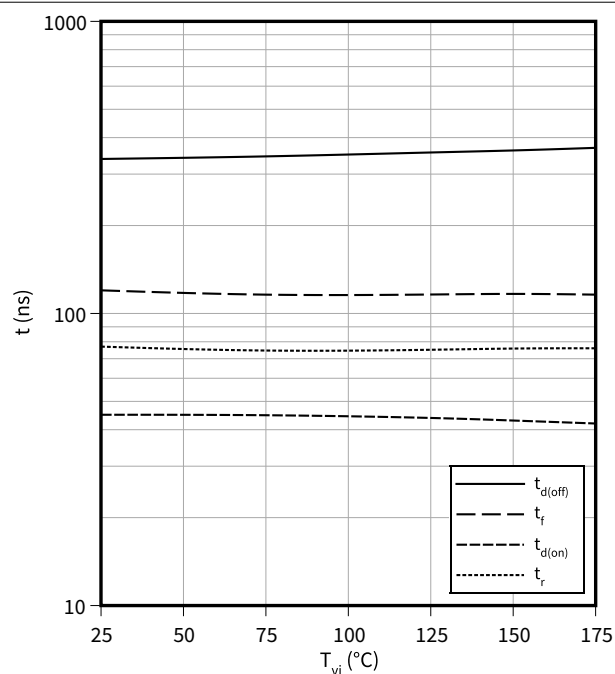


4 Characteristics diagrams
Typical switching times as a function of gate resistor

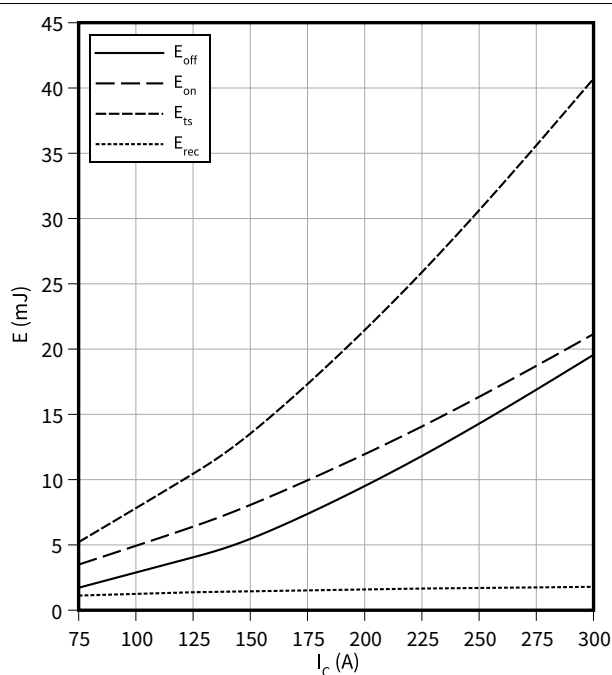
$$t = f(R_G)$$

 $I_C = 150 \text{ A}, V_{CC} = 400 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$

Typical switching times as a function of junction temperature

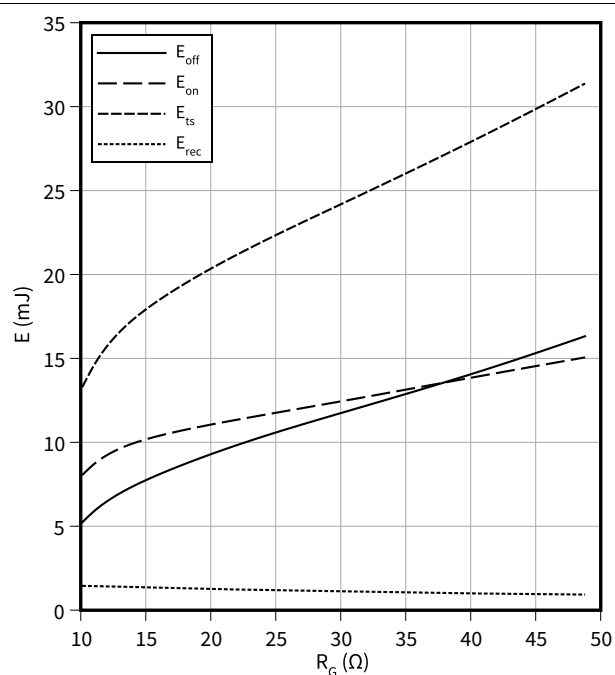
$$t = f(T_{vj})$$

 $I_C = 150 \text{ A}, V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 10 \text{ } \Omega$

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

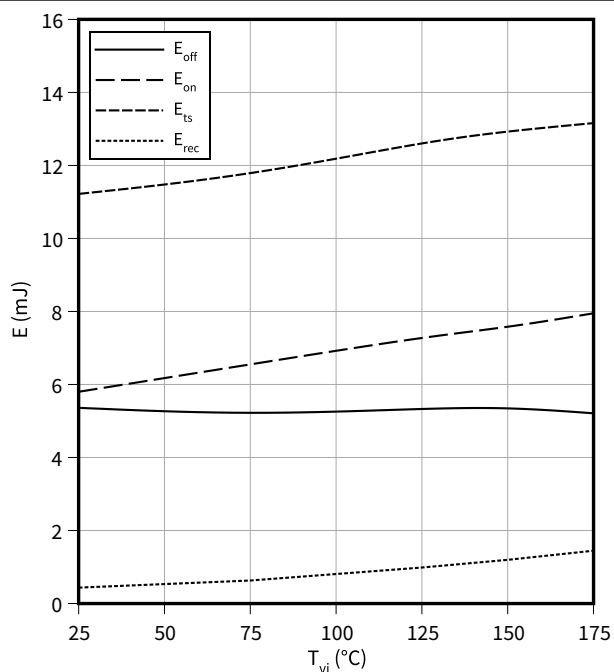
 $V_{CC} = 400 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 10 \text{ } \Omega$

Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

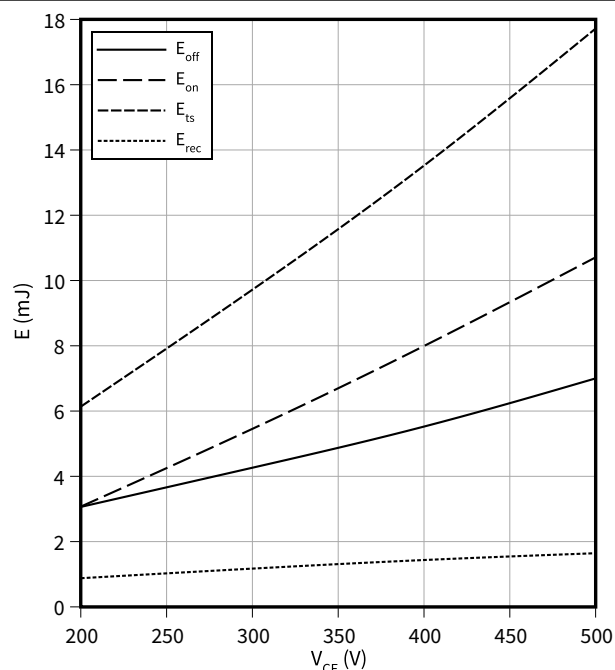
 $I_C = 150 \text{ A}, V_{CC} = 400 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$


4 Characteristics diagrams
Typical switching energy losses as a function of junction temperature

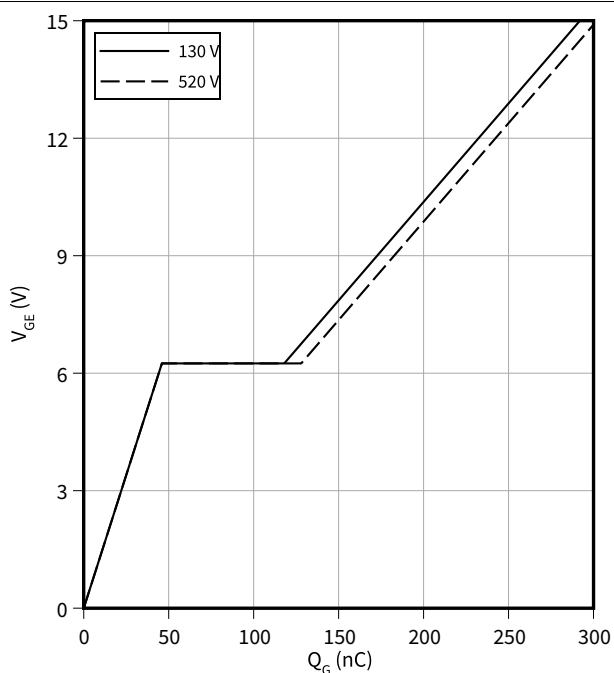
$$E = f(T_{vj})$$

 $I_C = 150 \text{ A}, V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 10 \Omega$

Typical switching energy losses as a function of collector emitter voltage

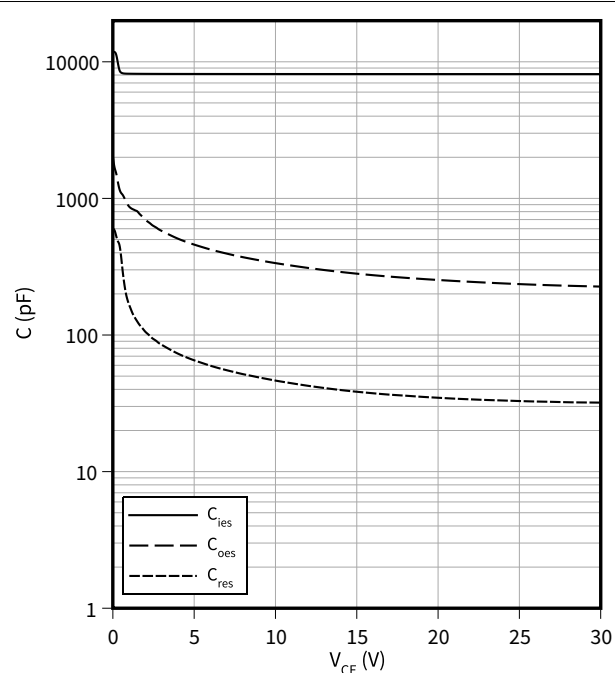
$$E = f(V_{CE})$$

 $I_C = 150 \text{ A}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 10 \Omega$

Typical gate charge

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

 $I_C = 150 \text{ A}$

Typical capacitance as a function of collector-emitter voltage

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

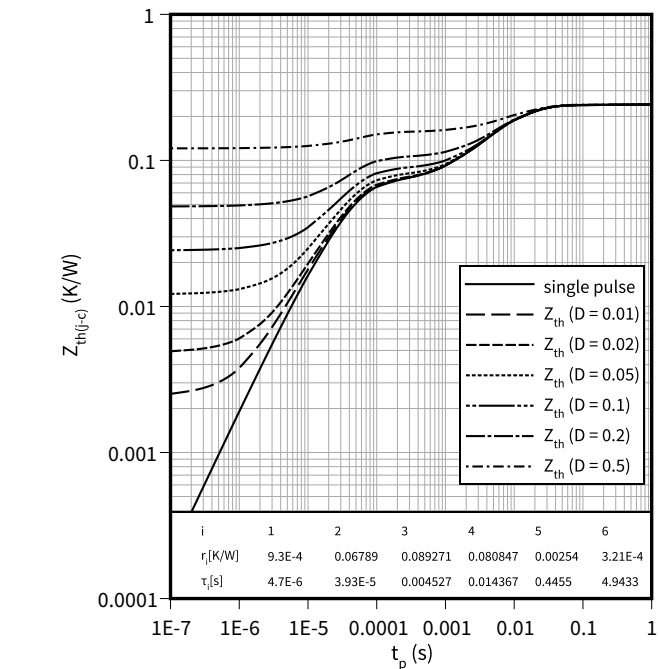
 $f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}$


4 Characteristics diagrams

IGBT transient thermal impedance as a function of pulse width

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

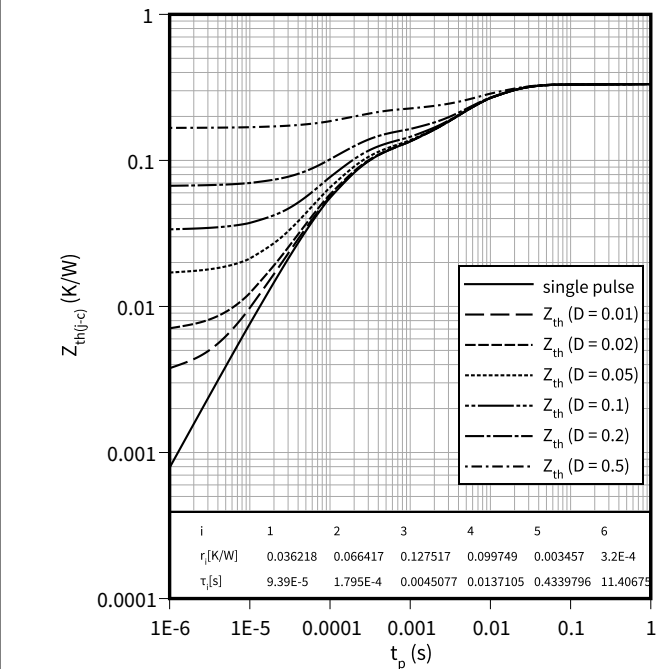
$$D = t_p/T$$



Diode transient thermal impedance as a function of pulse width

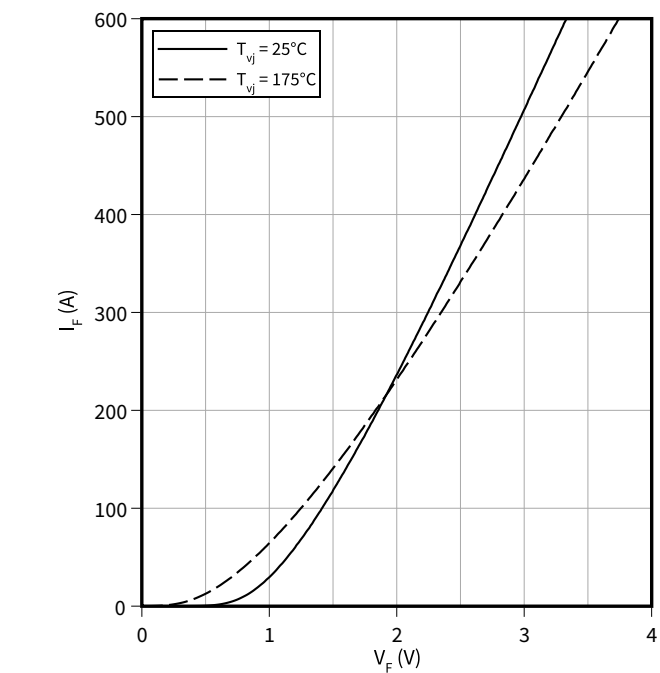
$$Z_{th(j-c)} = f(t_p)$$

$$D = t_p/T$$



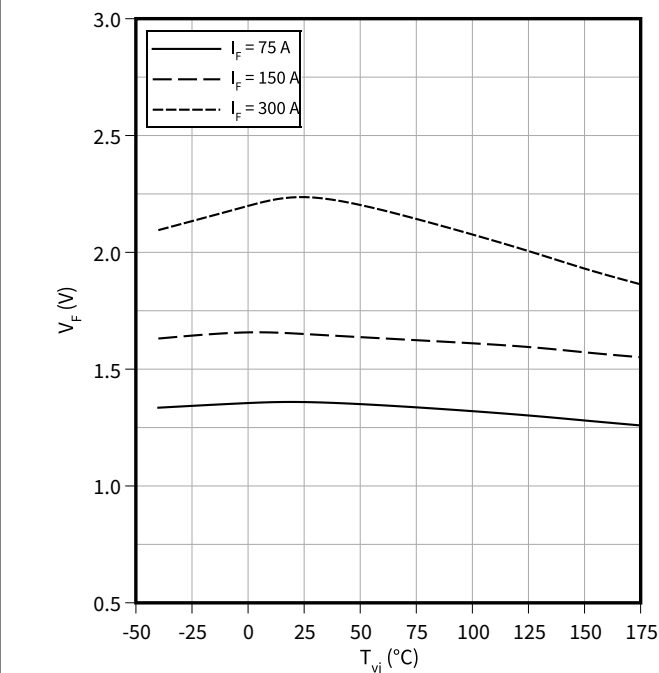
Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$



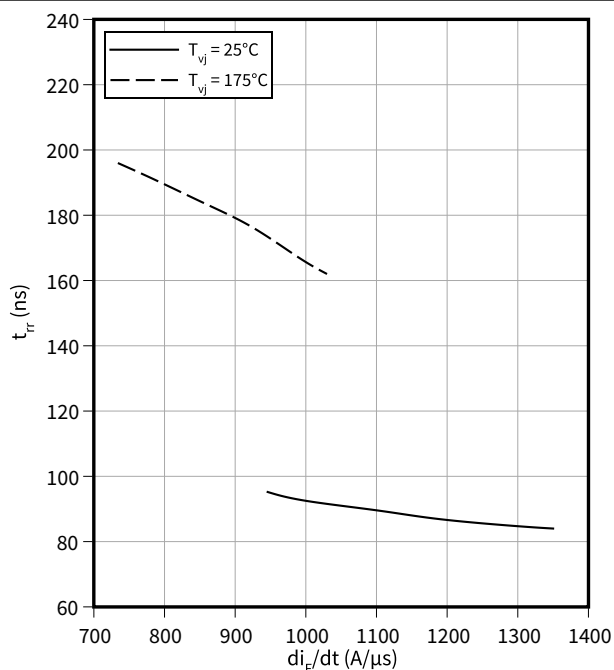
Typical diode forward voltage as a function of junction temperature

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

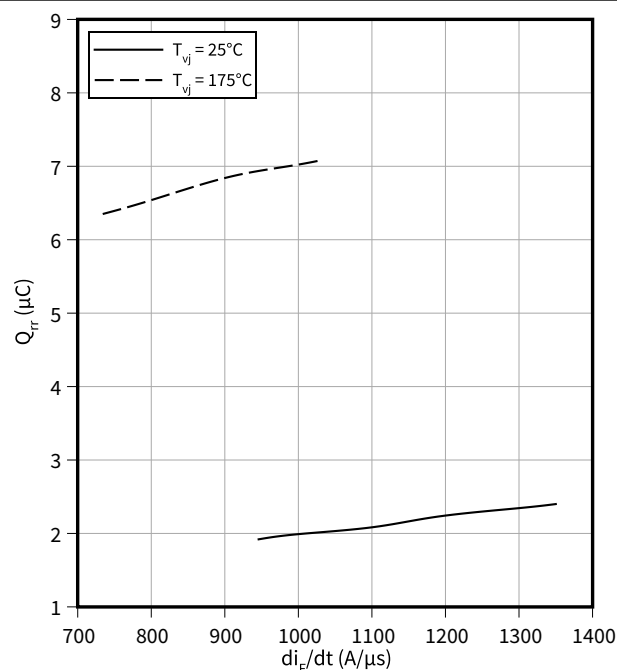


4 Characteristics diagrams
Typical reverse recovery time as a function of diode current slope

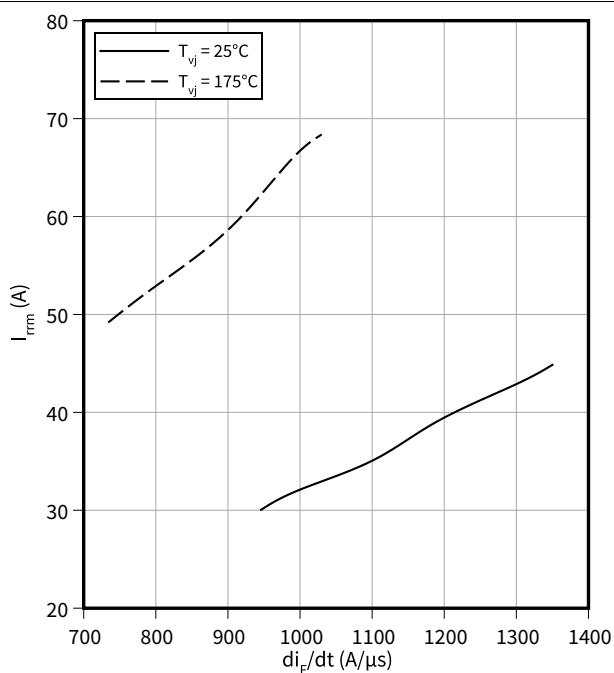
$$t_{rr} = f(di_F/dt)$$

 $V_R = 400 \text{ V}, I_F = 150 \text{ A}$

Typical reverse recovery charge as a function of diode current slope

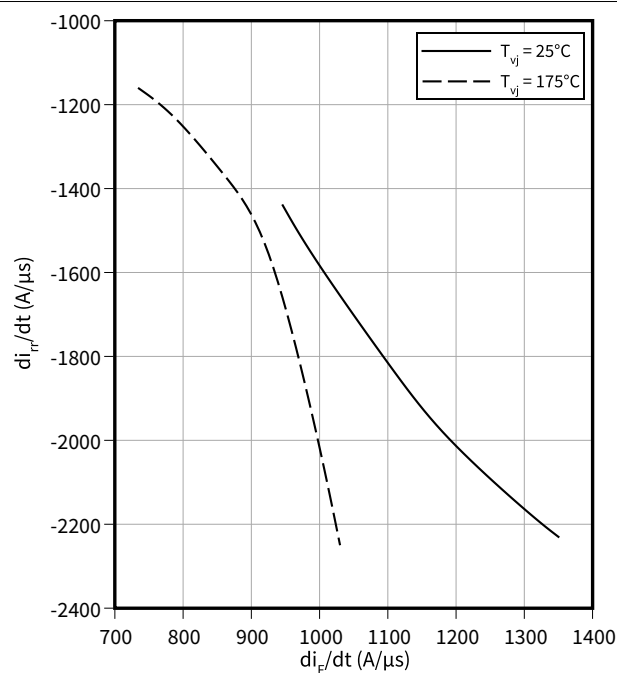
$$Q_{rr} = f(di_F/dt)$$

 $V_R = 400 \text{ V}, I_F = 150 \text{ A}$

Typical reverse recovery current as a function of diode current slope

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

 $V_R = 400 \text{ V}, I_F = 150 \text{ A}$

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

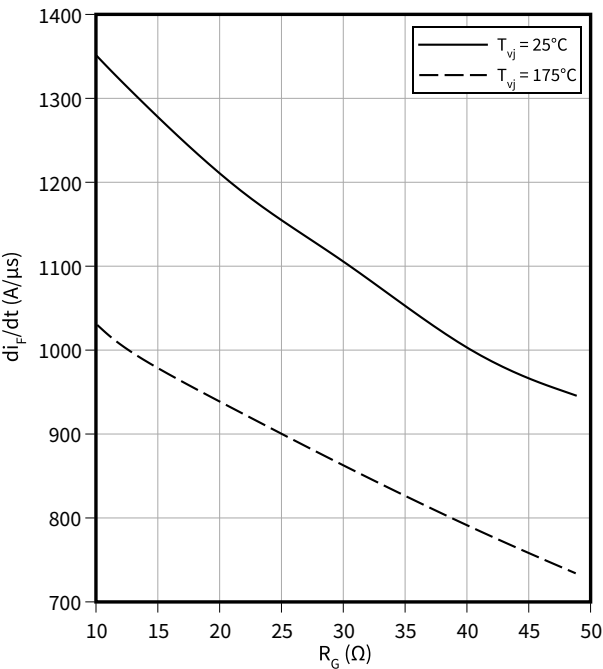
$$di_{rr}/dt = f(di_F/dt)$$

 $V_R = 400 \text{ V}, I_F = 150 \text{ A}$


4 Characteristics diagrams

Typical diode current slope as a function of gate resistor

$di_F/dt = f(R_G)$
 $V_R = 400\text{ V}, I_F = 150\text{ A}$



5 Package outlines

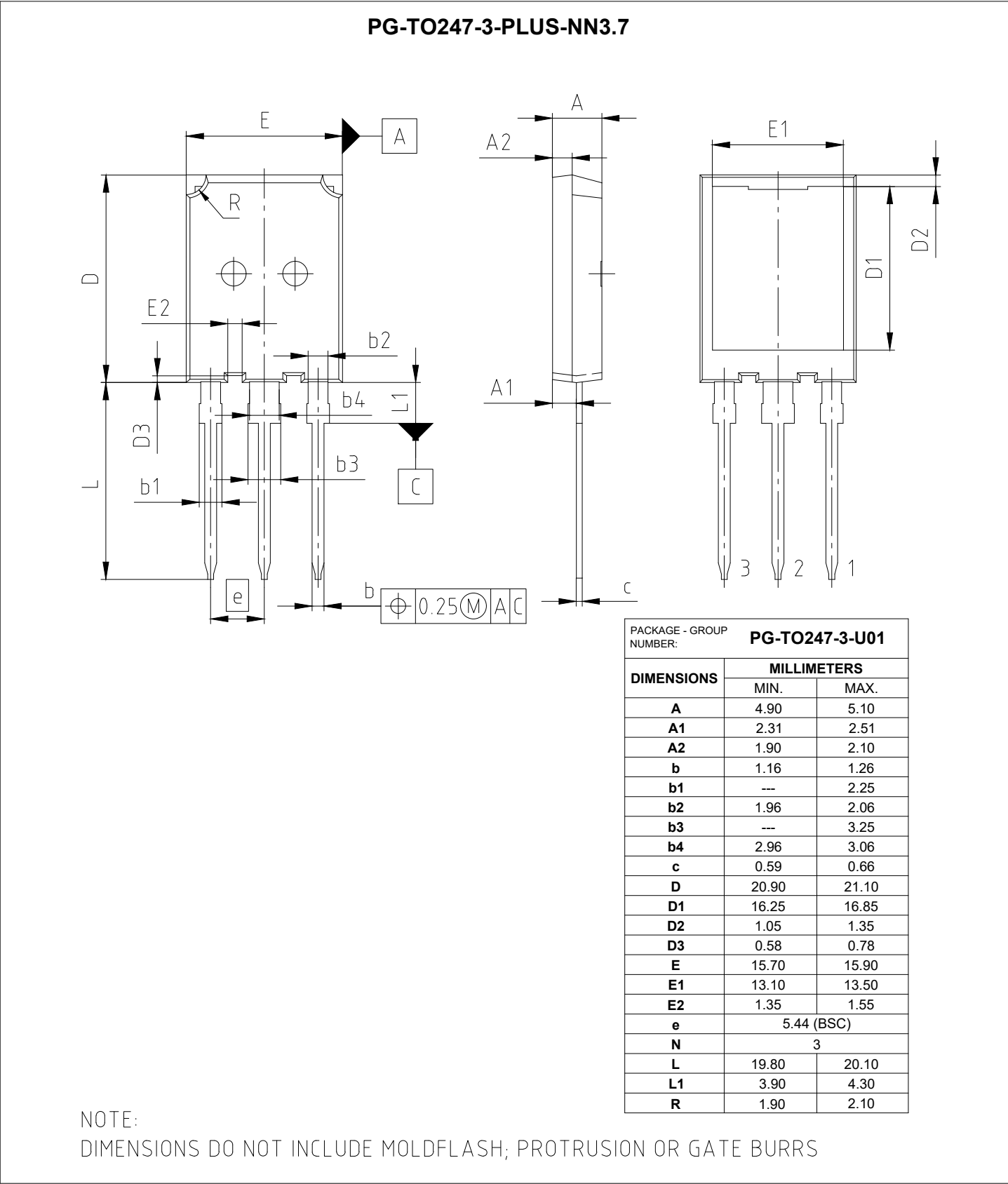


Figure 1

6 Testing conditions



Figure A. Definition of switching times

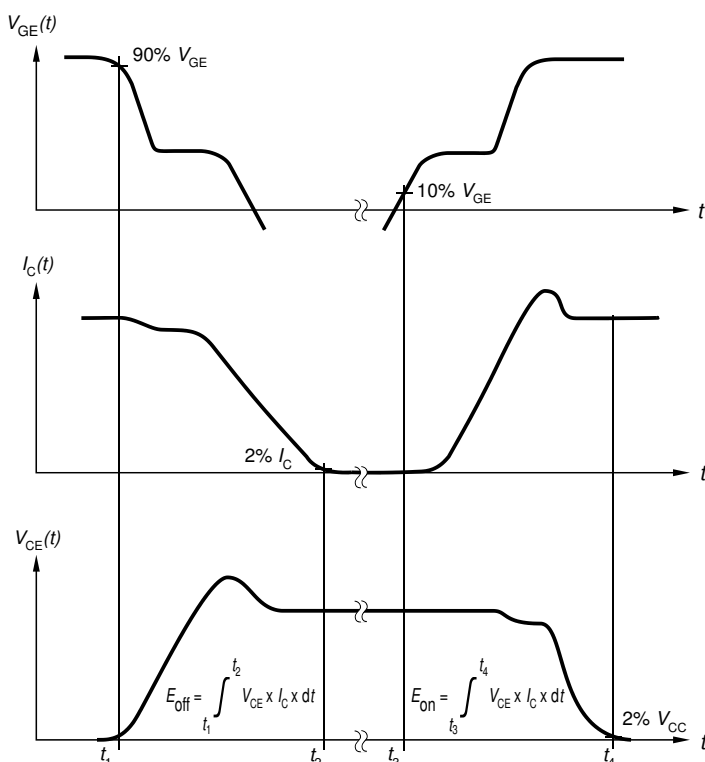


Figure B. Definition of switching losses

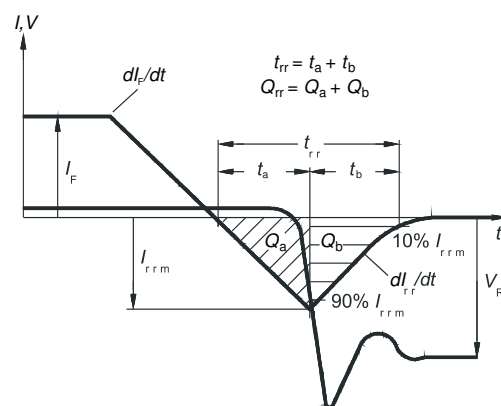


Figure C. Definition of diode switching characteristics

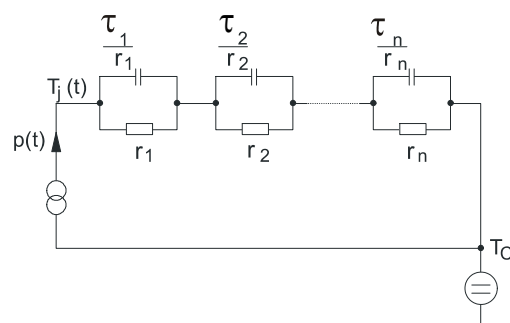


Figure D. Thermal equivalent circuit

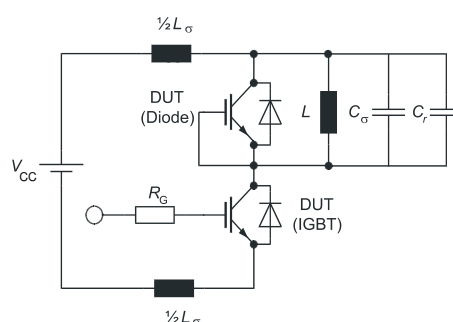


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ ,
parasitic capacitor C_σ ,
relief capacitor C_r ,
(only for ZVT switching)

Revision history

Document revision	Date of release	Description of changes
1.00	2023-01-24	Final datasheet
1.10	2023-04-25	Correction of switching values in Table 3 Update of diagrams $t = f(R_G)$ and $E = f(R_G)$
1.20	2023-11-15	Update of E_{ts} temperature conditions in Table 3 Update of energy diagrams

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