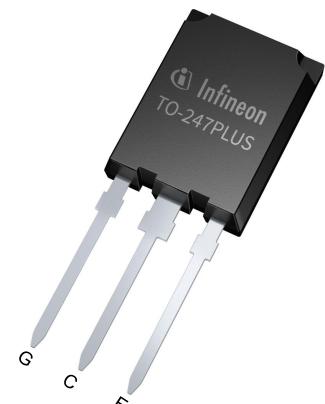


Final datasheet

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

Features

- $V_{CE} = 650 \text{ V}$
- $I_C = 120 \text{ A}$
- 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



Lead-free



Green



Halogen-free

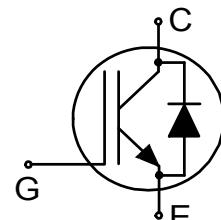


RoHS

Product validation

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

Description



Type	Package	Marking
IKQ120N65EH7	PG-T0247-3-PLUS-NN3.7	K120EEH7

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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		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	$R_{th(j-c)}$			0.23	0.3	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.31	0.4	K/W

2 IGBT

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values		Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25^\circ\text{C}$		650		V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25^\circ\text{C}$	160		A
			$T_c = 100^\circ\text{C}$	136		A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			480		A
Turn-off safe operating area		$V_{CE} \leq 650\text{ V}, t_p \leq 1\text{ }\mu\text{s}, T_{vj} \leq 175^\circ\text{C}$		480		
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}		$T_c = 25^\circ\text{C}$	498		W
			$T_c = 100^\circ\text{C}$	249		

Table 3 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 120\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25^\circ\text{C}$		1.4	V
			$T_{vj} = 175^\circ\text{C}$		1.6	

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Gate-emitter threshold voltage	$V_{GE\text{th}}$	$I_C = 1.05 \text{ mA}, V_{CE} = V_{GE}$	2.9	3.85	4.8	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 650 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25^\circ\text{C}$		35	μA
			$T_{vj} = 175^\circ\text{C}$	5500		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}$			100	nA
Transconductance	g_{fs}	$I_C = 120 \text{ A}, V_{CE} = 20 \text{ V}$		148		S
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		6644		pF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		197		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		27.5		pF
Gate charge	Q_G	$V_{CC} = 520 \text{ V}, I_C = 120 \text{ A}, V_{GE} = 15 \text{ V}$		251		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{G(on)} = 10 \Omega, R_{G(off)} = 10 \Omega$	$T_{vj} = 25^\circ\text{C}, I_C = 120 \text{ A}$		38	ns
			$T_{vj} = 175^\circ\text{C}, I_C = 120 \text{ A}$		38	
Rise time (inductive load)	t_r	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{G(on)} = 10 \Omega, R_{G(off)} = 10 \Omega$	$T_{vj} = 25^\circ\text{C}, I_C = 120 \text{ A}$		62	ns
			$T_{vj} = 175^\circ\text{C}, I_C = 120 \text{ A}$		62	
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{G(on)} = 10 \Omega, R_{G(off)} = 10 \Omega$	$T_{vj} = 25^\circ\text{C}, I_C = 120 \text{ A}$		287	ns
			$T_{vj} = 175^\circ\text{C}, I_C = 120 \text{ A}$		317	
Fall time (inductive load)	t_f	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{G(on)} = 10 \Omega, R_{G(off)} = 10 \Omega$	$T_{vj} = 25^\circ\text{C}, I_C = 120 \text{ A}$		98	ns
			$T_{vj} = 175^\circ\text{C}, I_C = 120 \text{ A}$		90	
Turn-on energy	E_{on}	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{G(on)} = 10 \Omega, R_{G(off)} = 10 \Omega$	$T_{vj} = 25^\circ\text{C}, I_C = 120 \text{ A}$		4.2	mJ
			$T_{vj} = 175^\circ\text{C}, I_C = 120 \text{ A}$		6.1	
Turn-off energy	E_{off}	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{G(on)} = 10 \Omega, R_{G(off)} = 10 \Omega$	$T_{vj} = 25^\circ\text{C}, I_C = 120 \text{ A}$		3.7	mJ
			$T_{vj} = 175^\circ\text{C}, I_C = 120 \text{ A}$		3.7	

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy	E_{ts}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 10 \Omega$, $R_{G(off)} = 10 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$, $I_c = 120 \text{ A}$		7.9	mJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$, $I_c = 120 \text{ A}$		9.8	
Operating junction temperature	T_{vj}		-40		175	${}^\circ\text{C}$

3 Diode

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	$T_c = 25 \text{ }^\circ\text{C}$		160	A
			$T_c = 100 \text{ }^\circ\text{C}$		125	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}				480	A
Power dissipation	P_{tot}		$T_c = 25 \text{ }^\circ\text{C}$		375	W
			$T_c = 100 \text{ }^\circ\text{C}$		188	

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	V
			$T_{vj} = 175 \text{ }^\circ\text{C}$		1.55	
Diode reverse recovery time	t_{rr}	$V_R = 400 \text{ V}$, $R_{G(on)} = 10 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$, $I_F = 120 \text{ A}$		82	ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$, $I_F = 120 \text{ A}$		154	
Diode reverse recovery charge	Q_{rr}	$V_R = 400 \text{ V}$, $R_{G(on)} = 10 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$, $I_F = 120 \text{ A}$		2.4	μC
			$T_{vj} = 175 \text{ }^\circ\text{C}$, $I_F = 120 \text{ A}$		6.7	
Diode peak reverse recovery current	I_{rrm}	$V_R = 400 \text{ V}$, $R_{G(on)} = 10 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$, $I_F = 120 \text{ A}$		44.5	A
			$T_{vj} = 175 \text{ }^\circ\text{C}$, $I_F = 120 \text{ A}$		67	

(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	$V_R = 400 \text{ V}$, $R_{G(on)} = 10 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_F = 120 \text{ A}$		-2320	$\text{A}/\mu\text{s}$
			$T_{vj} = 175^\circ\text{C}$, $I_F = 120 \text{ A}$		-2440	
Reverse recovery energy	E_{rec}	$V_R = 400 \text{ V}$, $R_{G(on)} = 10 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_F = 120 \text{ A}$		0.46	mJ
			$T_{vj} = 175^\circ\text{C}$, $I_F = 120 \text{ A}$		1.38	
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.

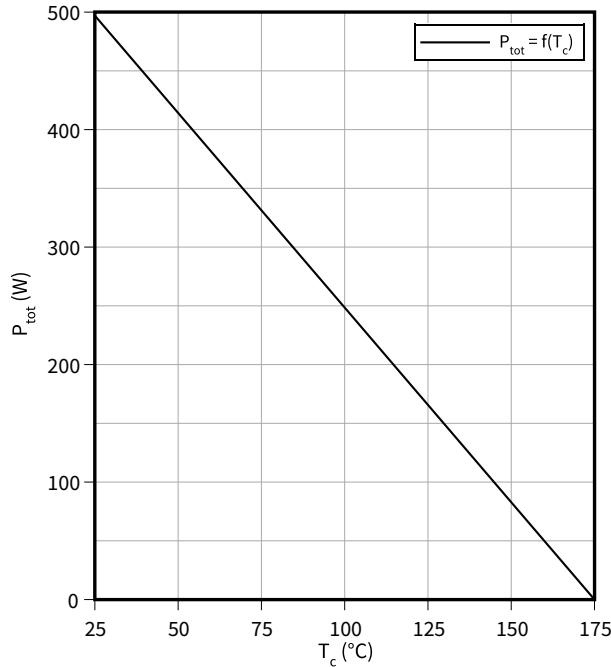
4 Characteristics diagrams

4 Characteristics diagrams

Power dissipation as a function of case temperature

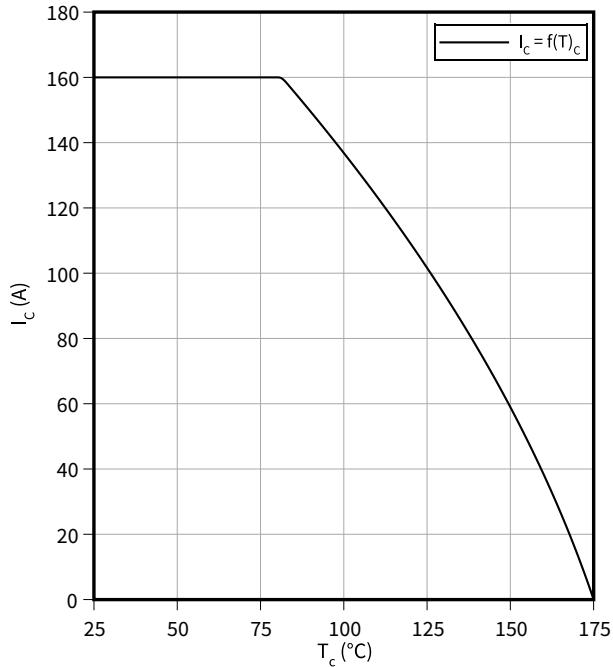
$$P_{\text{tot}} = f(T_c)$$

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

**Collector current as a function of case temperature**

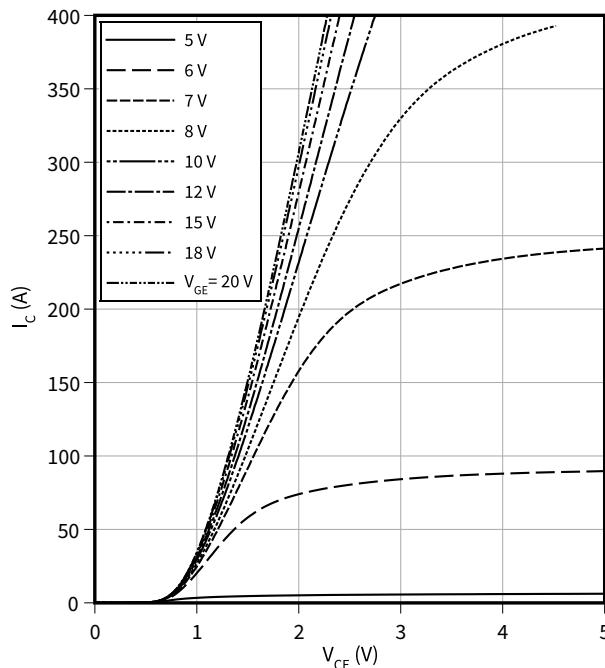
$$I_C = f(T_c)$$

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

**Typical output characteristic**

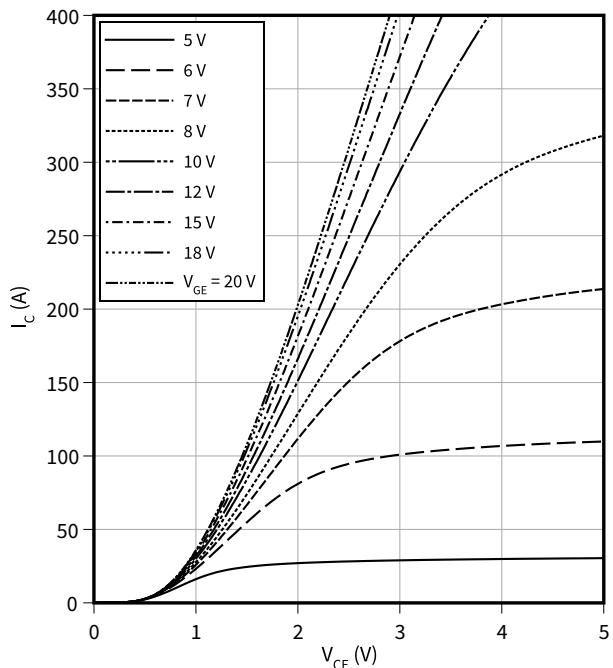
$$I_C = f(V_{CE})$$

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

**Typical output characteristic**

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

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

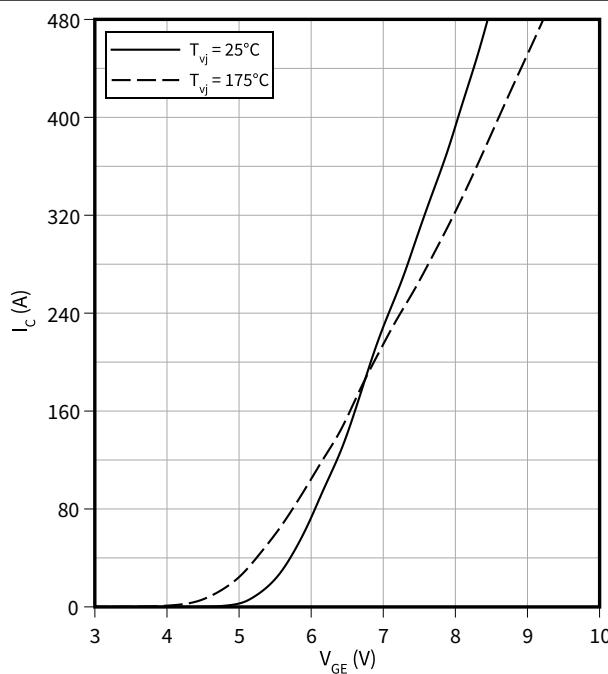


4 Characteristics diagrams

Typical transfer characteristic

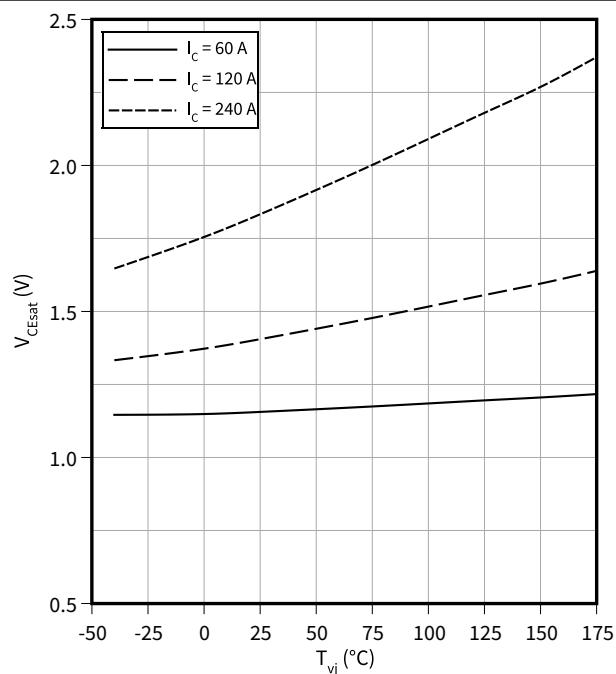
$$I_C = f(V_{GE})$$

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

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

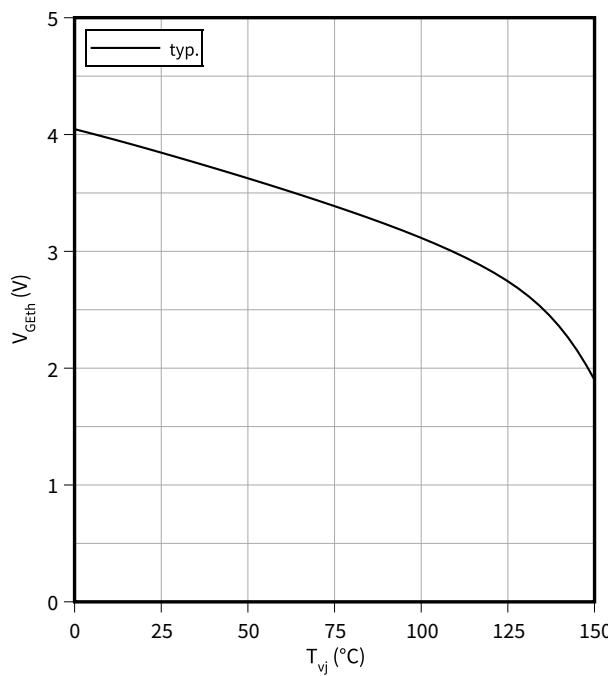
$$V_{CEsat} = f(T_{vj})$$

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

**Gate-emitter threshold voltage as a function of junction temperature**

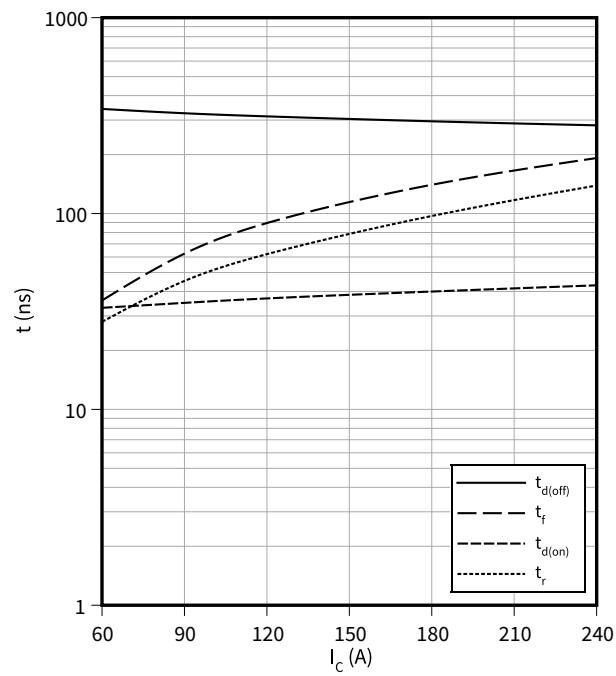
$$V_{GEth} = f(T_{vj})$$

$$I_C = 1.05 \text{ mA}$$

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

$$t = f(I_C)$$

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

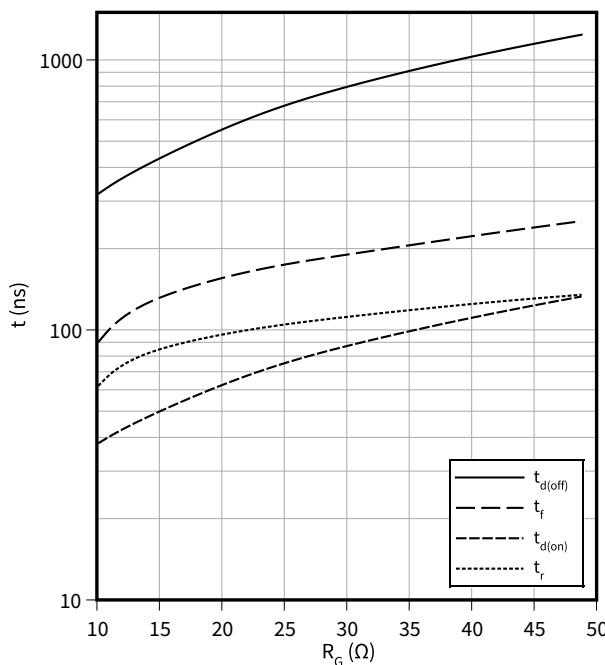


4 Characteristics diagrams

Typical switching times as a function of gate resistor

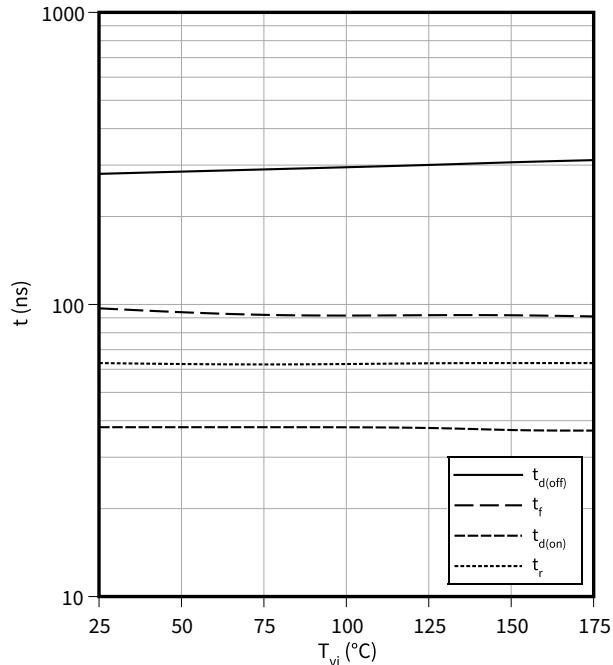
$$t = f(R_G)$$

$I_C = 120 \text{ A}$, $V_{CC} = 400 \text{ V}$, $T_{vj} = 175^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$

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

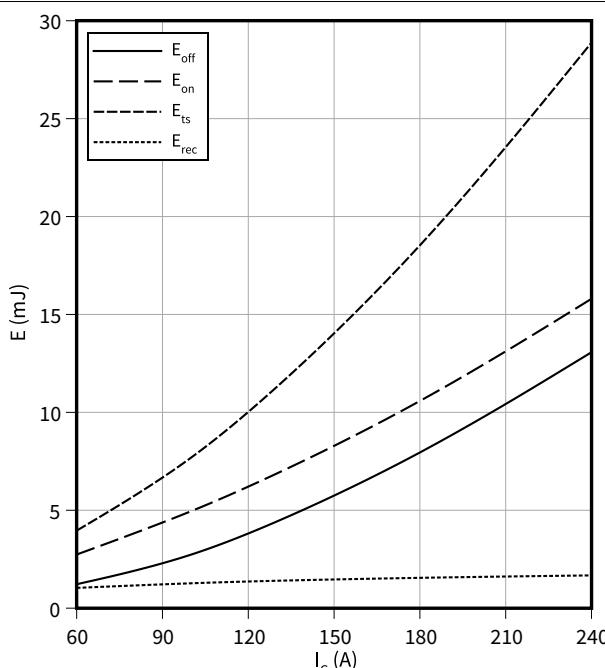
$$t = f(T_{vj})$$

$I_C = 120 \text{ A}$, $V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 10 \Omega$

**Typical switching energy losses as a function of collector current**

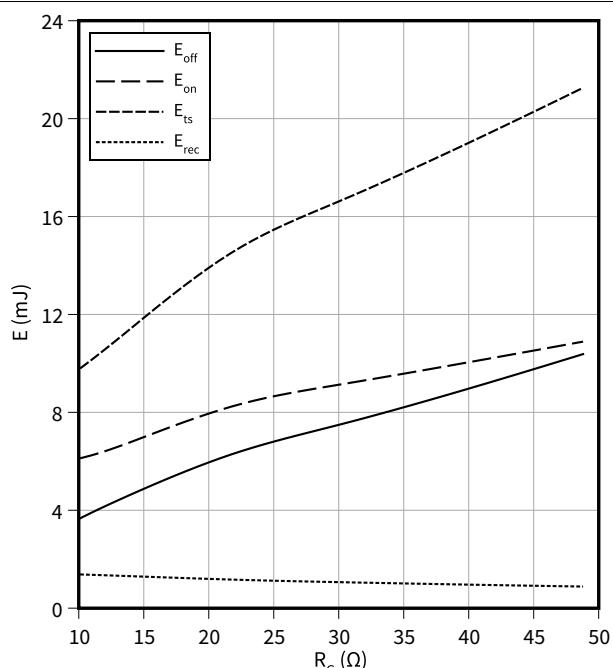
$$E = f(I_C)$$

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

**Typical switching energy losses as a function of gate resistor**

$$E = f(R_G)$$

$I_C = 120 \text{ A}$, $V_{CC} = 400 \text{ V}$, $T_{vj} = 175^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$

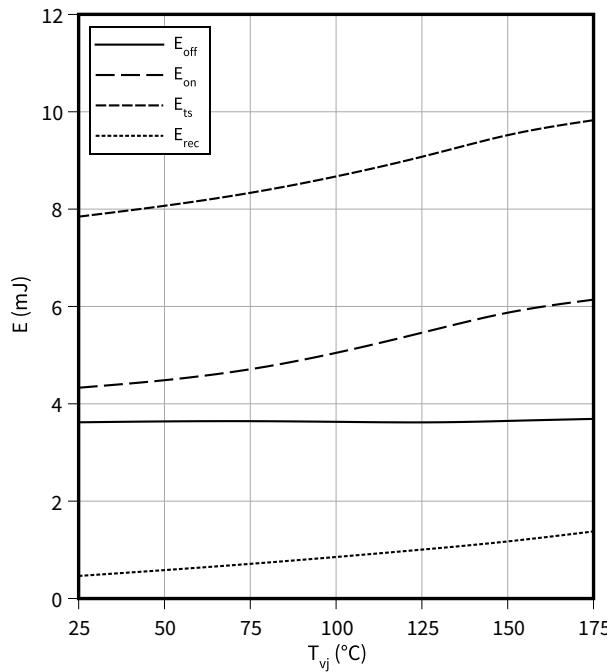


4 Characteristics diagrams

Typical switching energy losses as a function of junction temperature

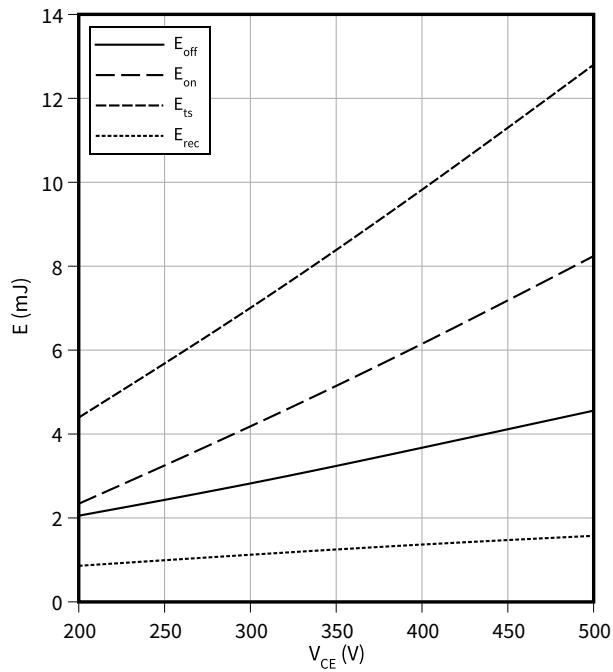
$$E = f(T_{vj})$$

$I_C = 120 \text{ A}$, $V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 10 \Omega$

**Typical switching energy losses as a function of collector-emitter voltage**

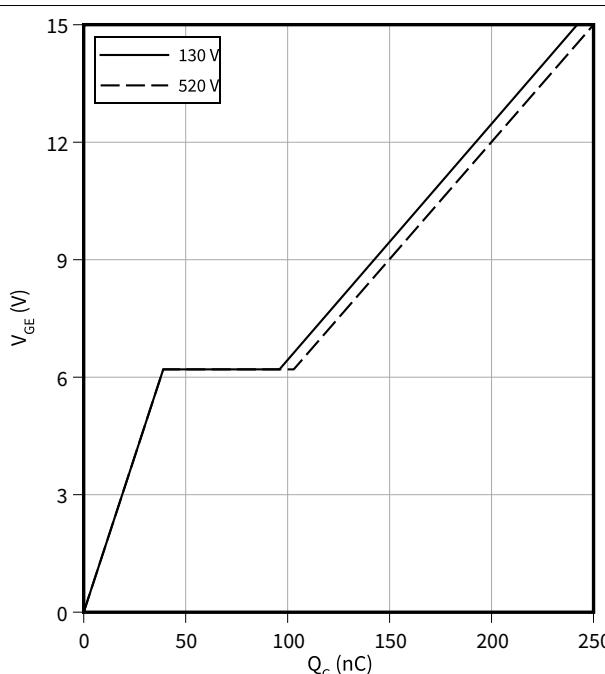
$$E = f(V_{CE})$$

$I_C = 120 \text{ A}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 10 \Omega$

**Typical gate charge**

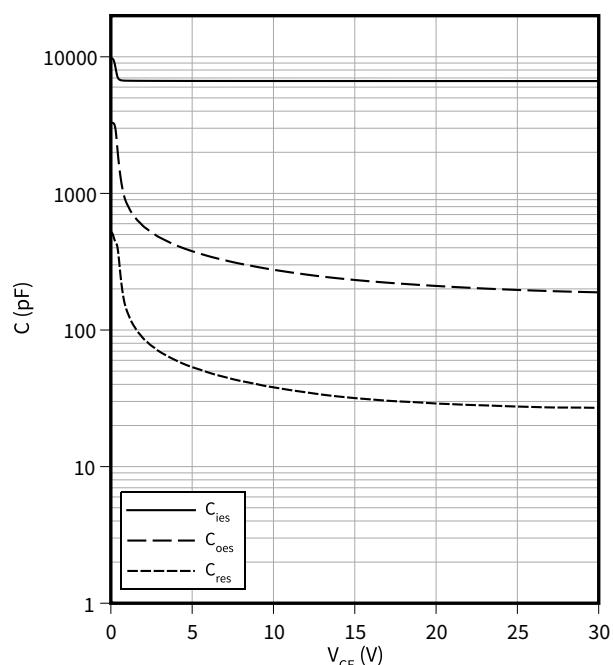
$$V_{GE} = f(Q_G)$$

$I_C = 120 \text{ A}$

**Typical capacitance as a function of collector-emitter voltage**

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

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

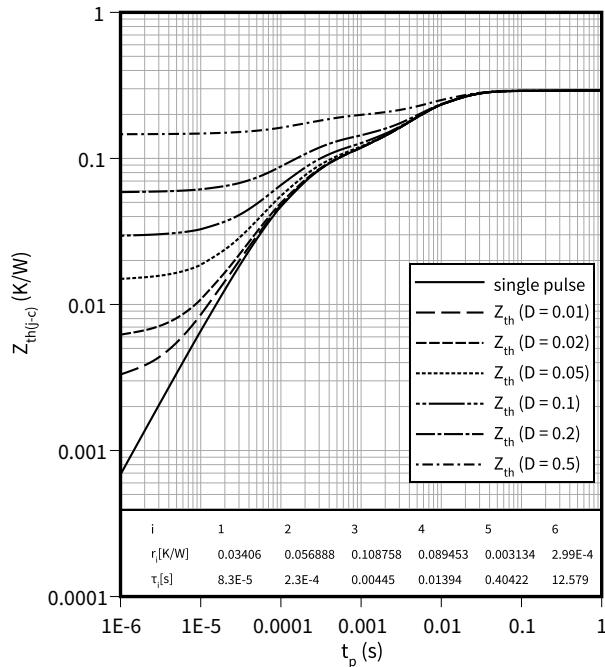


4 Characteristics diagrams

IGBT transient thermal impedance as a function of pulse width

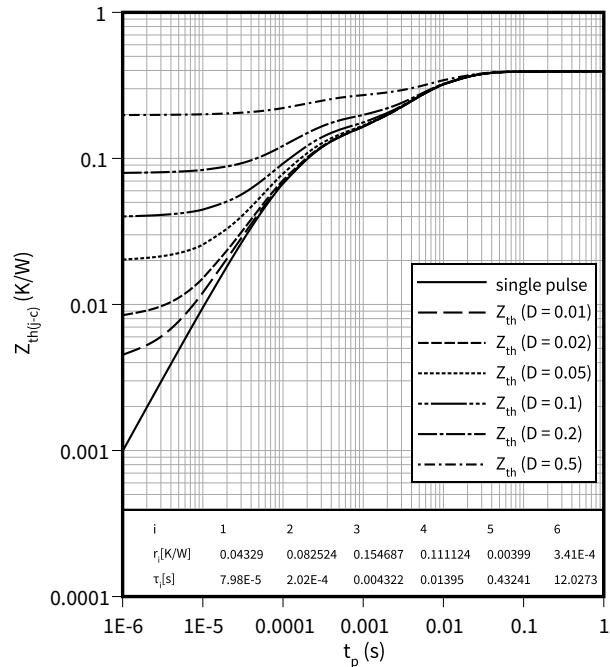
$$Z_{th(j-c)} = f(t_p)$$

$$D = t_p/T$$

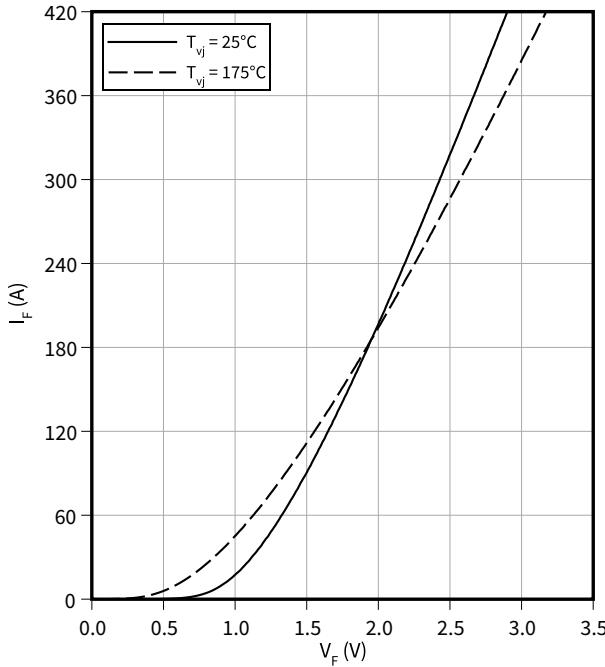
**Diode transient thermal impedance as a function of pulse width**

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

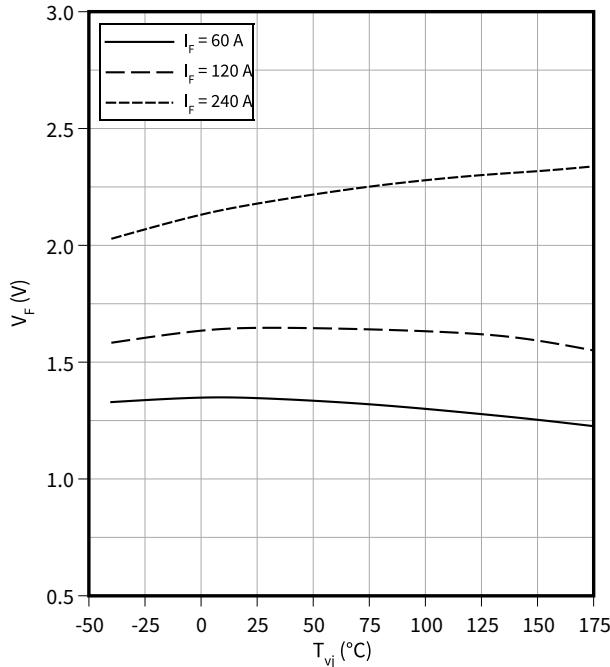
$$D = t_p/T$$

**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**

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

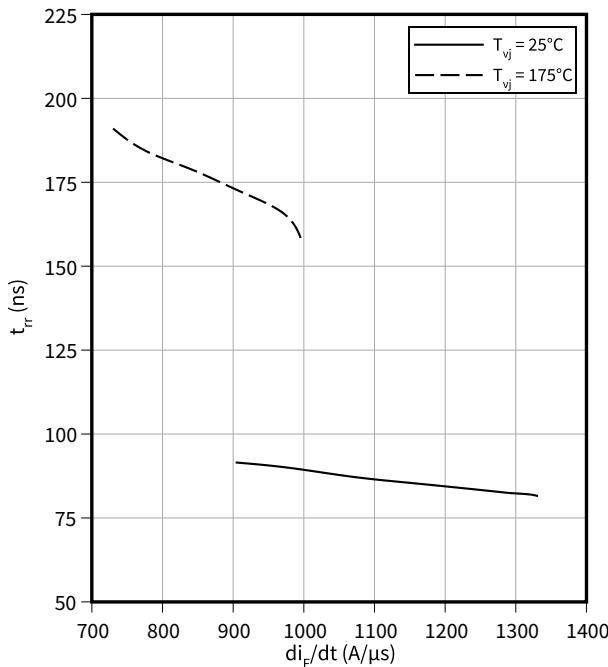


4 Characteristics diagrams

Typical reverse recovery time as a function of diode current slope

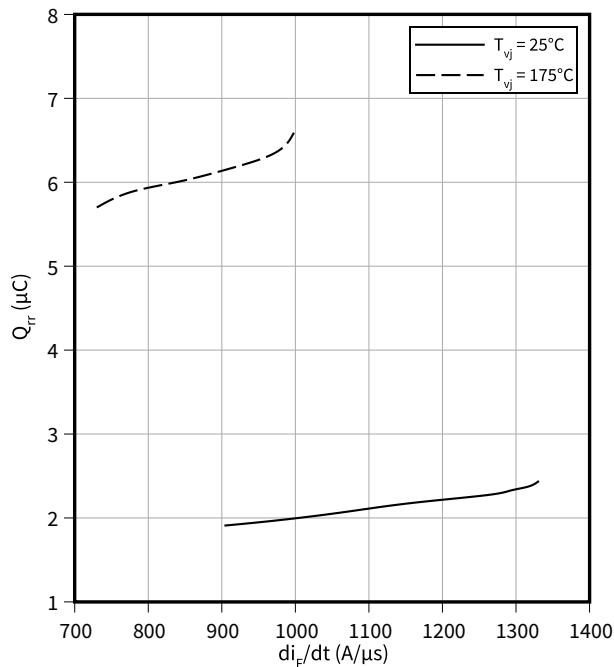
$$t_{rr} = f(di_F/dt)$$

$V_R = 400 \text{ V}$, $I_F = 120 \text{ A}$

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

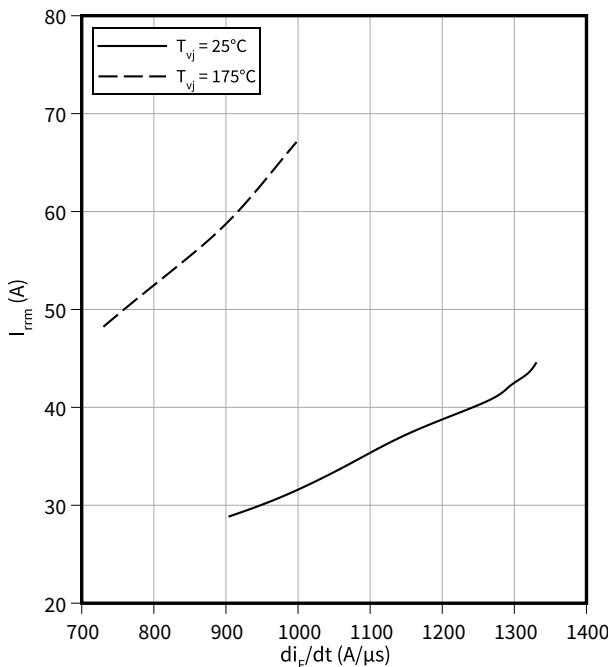
$$Q_{rr} = f(di_F/dt)$$

$V_R = 400 \text{ V}$, $I_F = 120 \text{ A}$

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

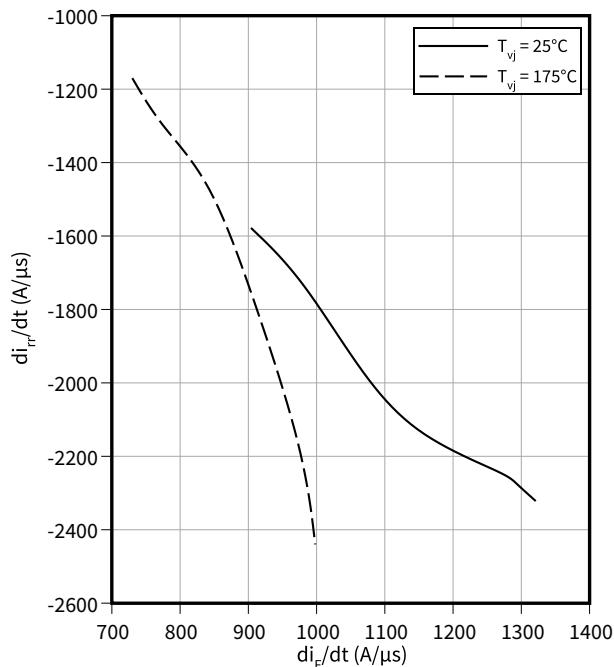
$$I_{rrm} = f(di_F/dt)$$

$V_R = 400 \text{ V}$, $I_F = 120 \text{ A}$

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

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

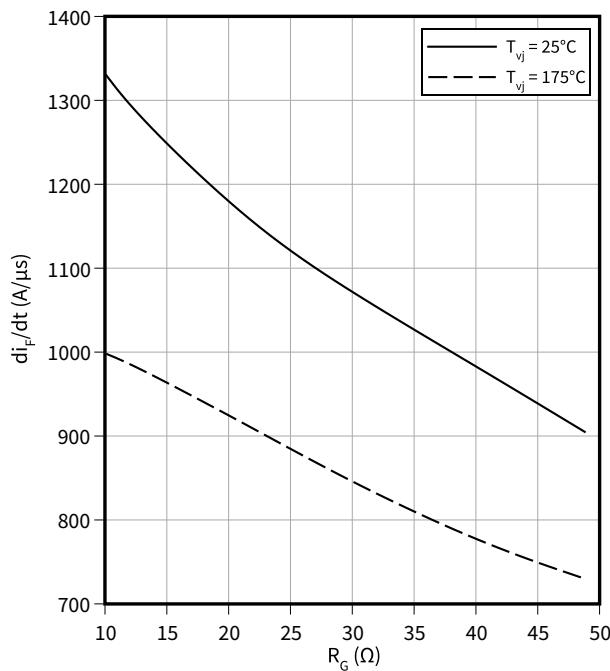
$V_R = 400 \text{ V}$, $I_F = 120 \text{ A}$



4 Characteristics diagrams

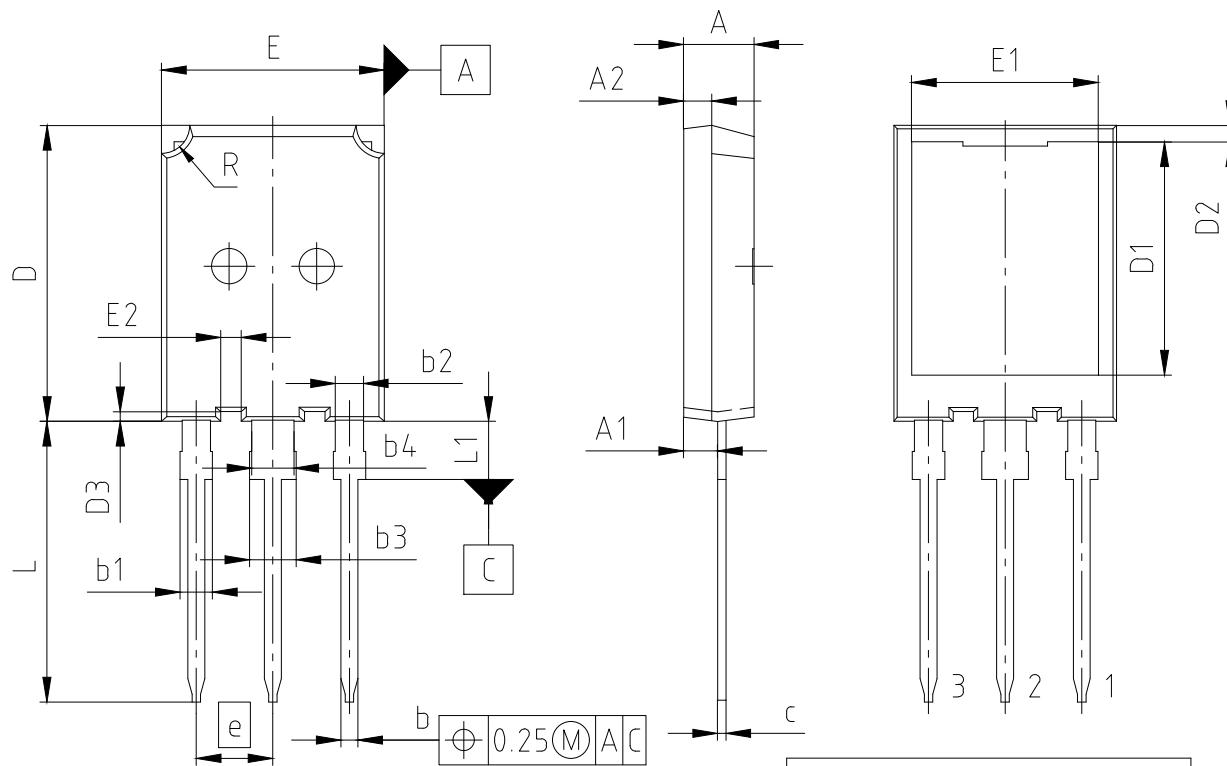
Typical diode current slope as a function of gate resistor

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

 $V_R = 400 \text{ V}, I_F = 120 \text{ A}$ 

5 Package outlines

PG-T0247-3-PLUS-NN3.7



PACKAGE - GROUP NUMBER: PG-T0247-3-U01		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.90	5.10
A1	2.31	2.51
A2	1.90	2.10
b	1.16	1.26
b1	---	2.25
b2	1.96	2.06
b3	---	3.25
b4	2.96	3.06
c	0.59	0.66
D	20.90	21.10
D1	16.25	16.85
D2	1.05	1.35
D3	0.58	0.78
E	15.70	15.90
E1	13.10	13.50
E2	1.35	1.55
e	5.44 (BSC)	
N	3	
L	19.80	20.10
L1	3.90	4.30
R	1.90	2.10

NOTE:

DIMENSIONS DO NOT INCLUDE MOLDFLASH, PROTRUSION OR GATE BURRS

Figure 1

6 Testing conditions

6 Testing conditions



Figure 2

Revision history**Revision history**

Document revision	Date of release	Description of changes
1.00	2023-01-24	Final datasheet
1.10	2023-04-27	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 energy diagrams

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**Document reference
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