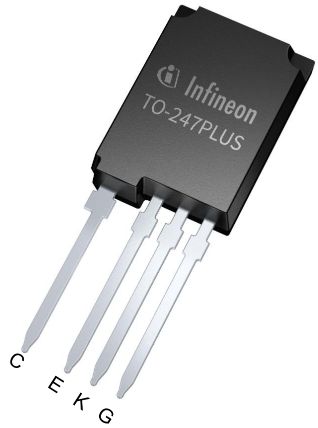
Final datasheet

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

Features

- V_{CE} = 650 V
- I_C = 120 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

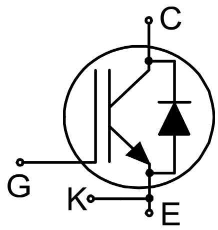
- Industrial UPS
- EV-Charging
- String inverter
- Welding

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
IKY120N65EH7	PG-TO247-4-PLUS-NN5.1	K120EEH7

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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	$R_{th(j-c)}$			0.23	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}	$T_{vj} \geq 25$ °C		650	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25$ °C	160	A
			$T_c = 100$ °C	159	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			480	A
Turn-off safe operating area		$V_{CE} \leq 650$ V, $t_p \leq 1$ µs, $T_{vj} \leq 175$ °C		480	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10$ µs, $D < 0.01$		±30	V
Power dissipation	P_{tot}		$T_c = 25$ °C	498	W
			$T_c = 100$ °C	248	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 120$ A, $V_{GE} = 15$ V	$T_{vj} = 25$ °C		1.4	1.65	V
			$T_{vj} = 175$ °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 = 1.05 mA, V_{CE} = V_{GE}		2.9	3.85	4.8	V
Zero gate-voltage collector current	I_{CES}	V_{CE} = 650 V, V_{GE} = 0 V	T_{vj} = 25 °C			35	µA
			T_{vj} = 175 °C		5500		
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				100	nA
Transconductance	g_{fs}	I_C = 120 A, V_{CE} = 20 V			152		S
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			6525		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			188.9		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			25.8		pF
Gate charge	Q_G	V_{CC} = 520 V, I_C = 120 A, V_{GE} = 15 V			244		nC
Turn-on delay time	$t_{d(on)}$	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω	T_{vj} = 25 °C, I_C = 120 A		25		ns
			T_{vj} = 175 °C, I_C = 120 A		23		
Rise time (inductive load)	t_r	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω	T_{vj} = 25 °C, I_C = 120 A		17		ns
			T_{vj} = 175 °C, I_C = 120 A		23		
Turn-off delay time	$t_{d(off)}$	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω	T_{vj} = 25 °C, I_C = 120 A		175		ns
			T_{vj} = 175 °C, I_C = 120 A		195		
Fall time (inductive load)	t_f	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω	T_{vj} = 25 °C, I_C = 120 A		19		ns
			T_{vj} = 175 °C, I_C = 120 A		23		
Turn-on energy	E_{on}	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω	T_{vj} = 25 °C, I_C = 120 A		1.7		mJ
			T_{vj} = 175 °C, I_C = 120 A		2.8		
Turn-off energy	E_{off}	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω	T_{vj} = 25 °C, I_C = 120 A		1.5		mJ
			T_{vj} = 175 °C, I_C = 120 A		2.7		

(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 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω	T_{vj} = 25 °C, I_C = 120 A		3.2		mJ
			T_{vj} = 175 °C, I_C = 120 A		5.5		
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 °C	160	A
			T_c = 100 °C	125	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			480	A
Power dissipation	P_{tot}		T_c = 25 °C	342	W
			T_c = 175 °C	189	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 120 A	T_{vj} = 25 °C		1.65	2	V
			T_{vj} = 175 °C		1.55		
Diode reverse recovery time	t_{rr}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 120 A		64		ns
			T_{vj} = 175 °C, I_F = 120 A		159		
Diode reverse recovery charge	Q_{rr}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 120 A		2.8		µC
			T_{vj} = 175 °C, I_F = 120 A		6.9		
Diode peak reverse recovery current	I_{rrm}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 120 A		85.7		A
			T_{vj} = 175 °C, I_F = 120 A		132		

(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 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 120 A		-2470		A/µs
			T_{vj} = 175 °C, I_F = 120 A		-2060		
Reverse recovery energy	E_{rec}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 120 A		0.7		mJ
			T_{vj} = 175 °C, I_F = 120 A		2.22		
Operating junction temperature	T_{vj}			-40		175	°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°C, unless otherwise specified.

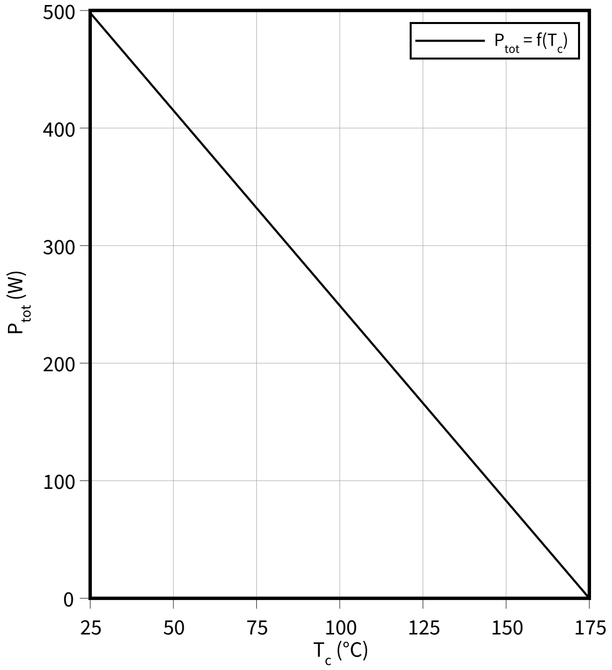
Dynamic test circuit, parasitic inductance L_σ = 8 nH, parasitic capacitor C_σ = 30 pF from Fig. E. Energy losses include "tail" and diode reverse recovery.

4 Characteristics diagrams

Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$

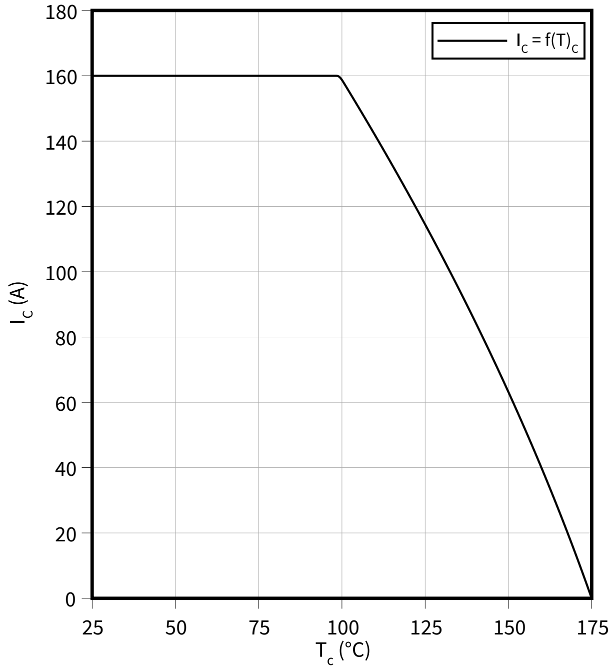
$T_{vj} \leq 175$ °C



Collector current as a function of case temperature

$I_C = f(T_c)$

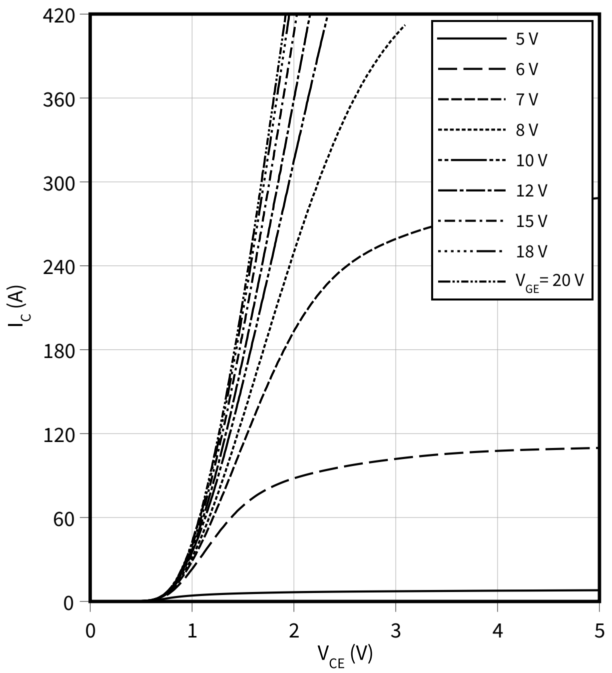
$V_{GE} \geq 15$ V, $T_{vj} \leq 175$ °C



Typical output characteristic

$I_C = f(V_{CE})$

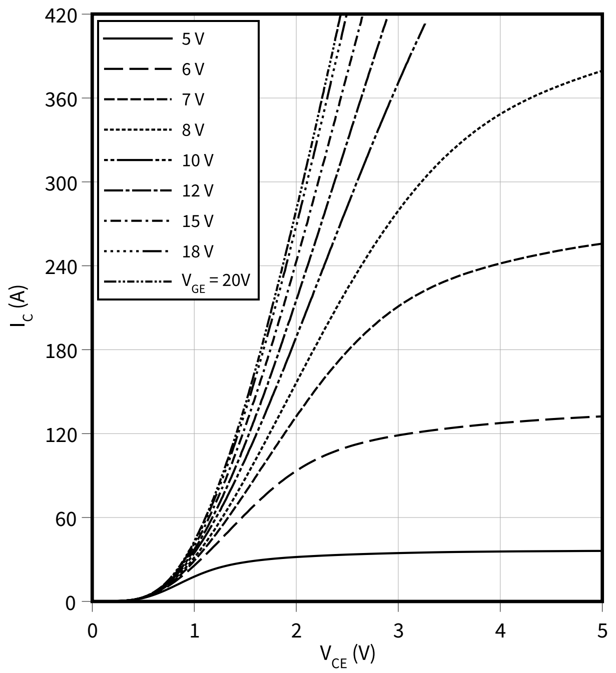
$T_{vj} = 25$ °C



Typical output characteristic

$I_C = f(V_{CE})$

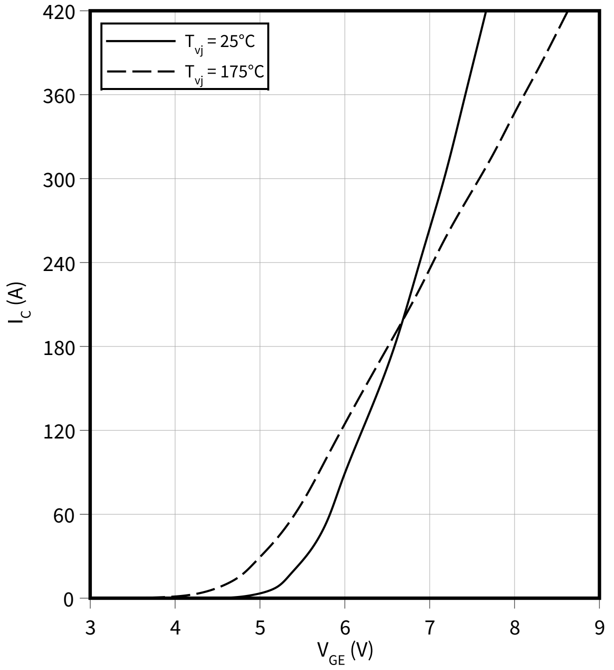
$T_{vj} = 175$ °C



Typical transfer characteristic

$I_C = f(V_{GE})$

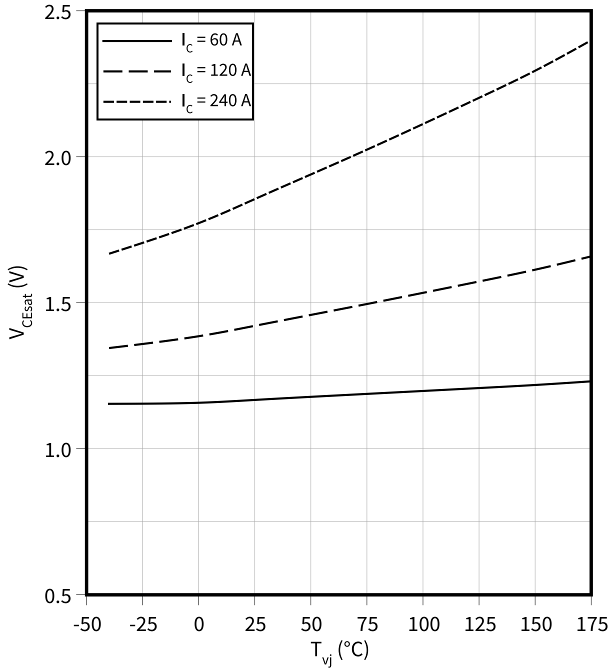
$V_{CE} = 20$ V



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

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

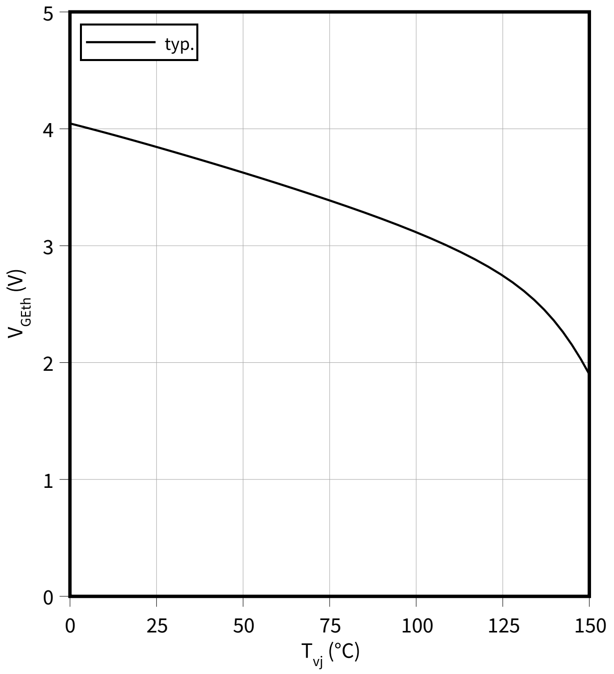
$V_{GE} = 15$ V



Gate-emitter threshold voltage as a function of junction temperature

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

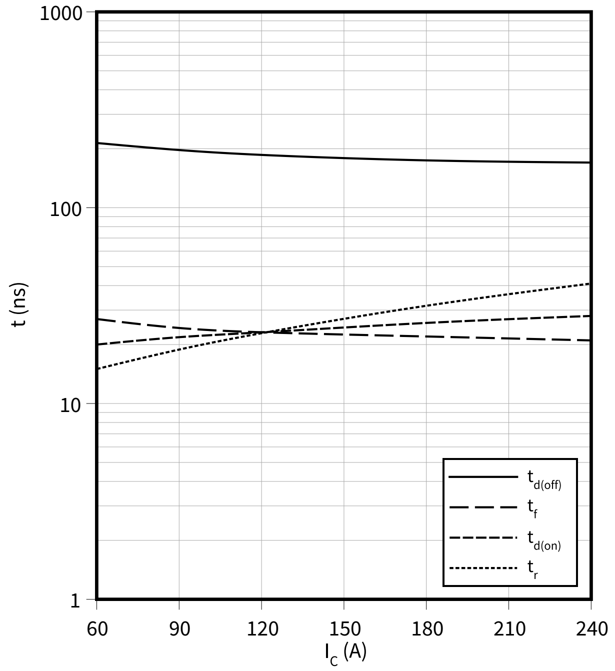
$I_C = 1.05$ mA



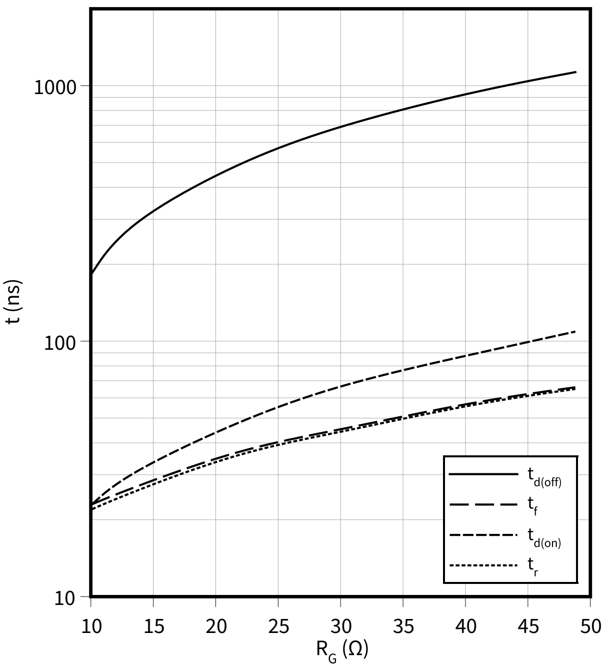
Typical switching times as a function of collector current

$t = f(I_C)$

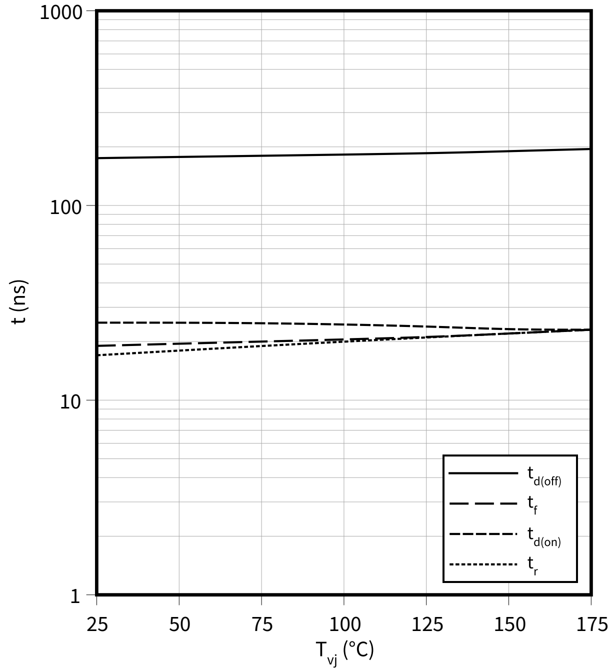
$V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$



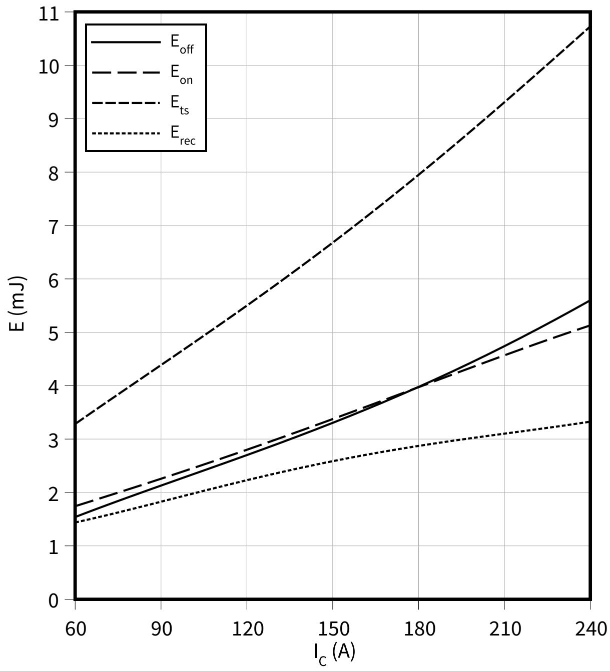
Typical switching times as a function of gate resistor
$t = f(R_G)$
I_C = 120 A, V_{CC} = 400 V, T_{vj} = 175 °C, V_{GE} = 0/15 V



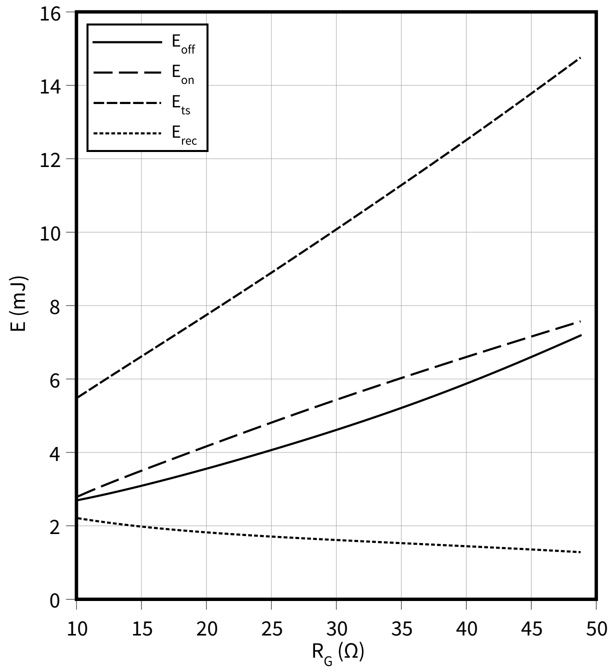
Typical switching times as a function of junction temperature
$t = f(T_{vj})$
I_C = 120 A, V_{CC} = 400 V, V_{GE} = 0/15 V, R_G = 10 Ω



Typical switching energy losses as a function of collector current
$E = f(I_C)$
V_{CC} = 400 V, T_{vj} = 175 °C, V_{GE} = 0/15 V, R_G = 10 Ω



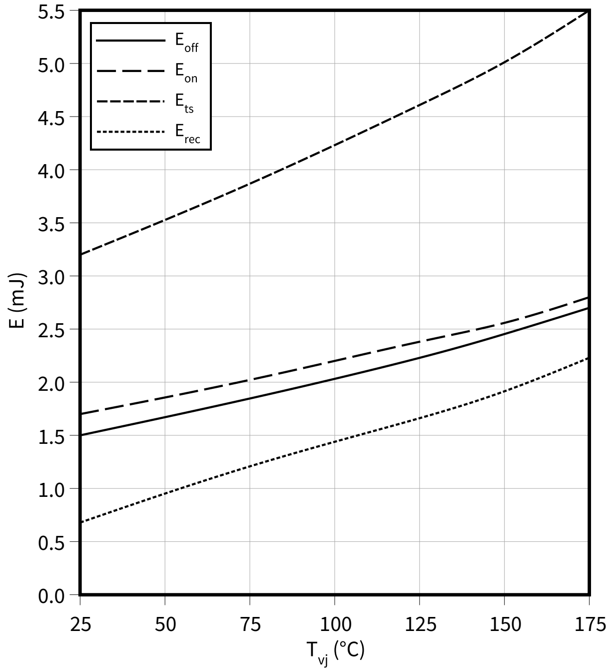
Typical switching energy losses as a function of gate resistor
$E = f(R_G)$
I_C = 120 A, V_{CC} = 400 V, T_{vj} = 175 °C, V_{GE} = 0/15 V



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

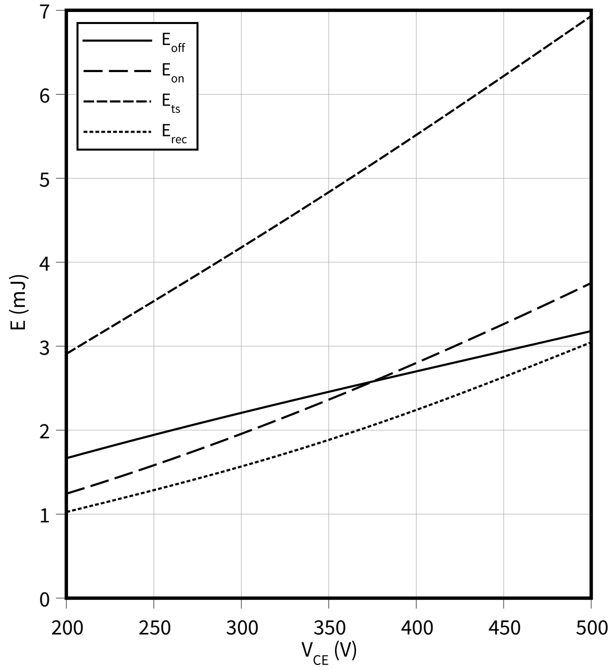
$I_C = 120$ A, $V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

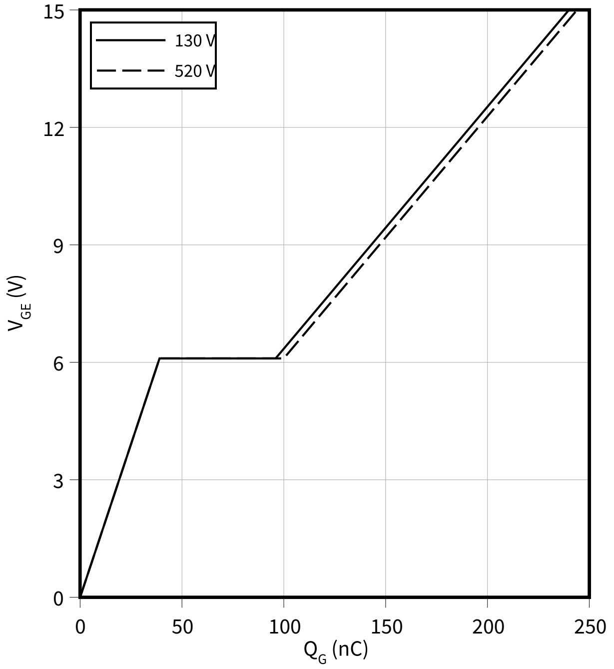
$I_C = 120$ A, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$



Typical gate charge

$V_{GE} = f(Q_G)$

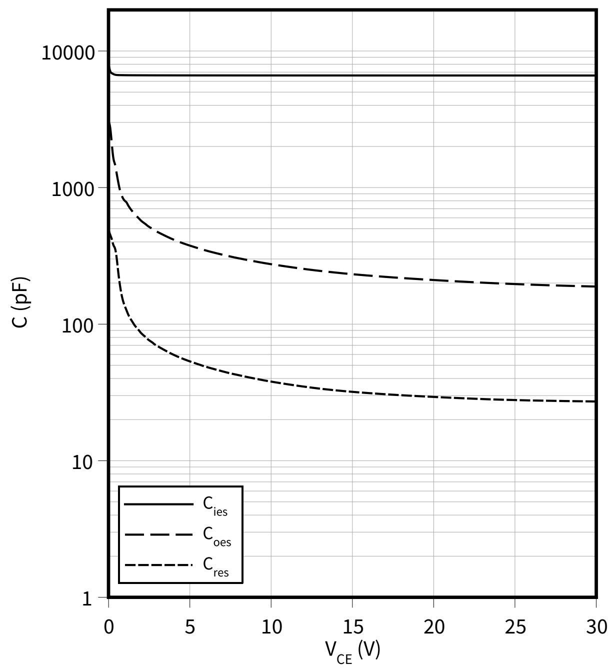
$I_C = 120$ A



Typical capacitance as a function of collector-emitter voltage

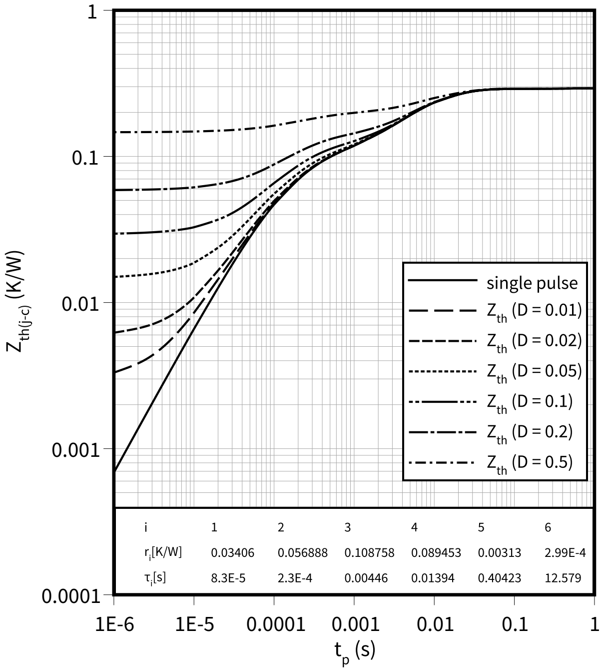
$C = f(V_{CE})$

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



IGBT transient thermal impedance as a function of pulse width

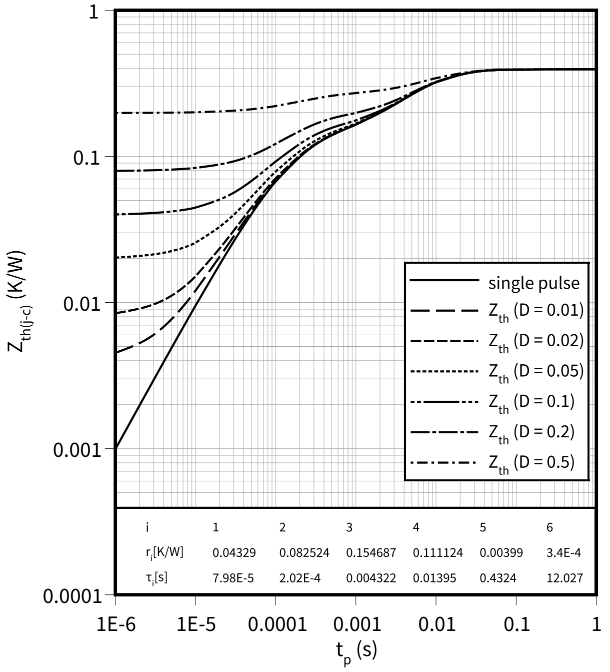
$Z_{th(j-c)} = f(t_p)$
$D = t_p/T$



i	1	2	3	4	5	6
r_i[K/W]	0.03406	0.056888	0.108758	0.089453	0.00313	2.99E-4
τ_i[s]	8.3E-5	2.3E-4	0.00446	0.01394	0.40423	12.579

Diode transient thermal impedance as a function of pulse width

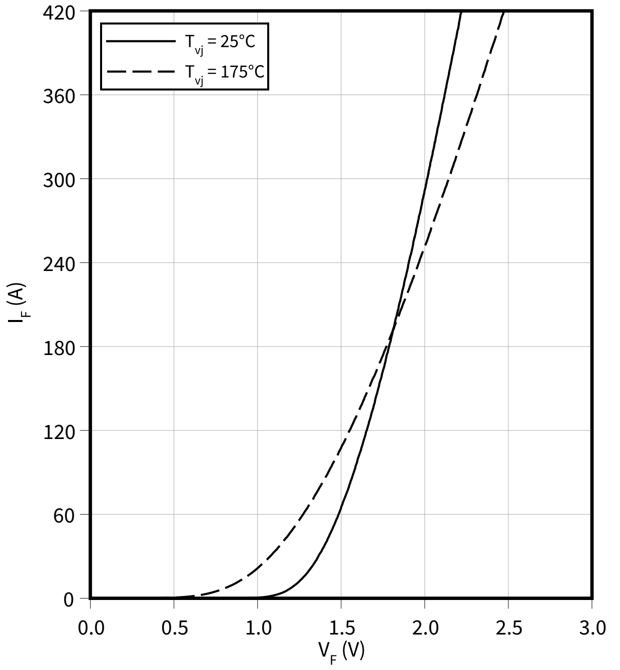
$Z_{th(j-c)} = f(t_p)$
$D = t_p/T$



i	1	2	3	4	5	6
r_i[K/W]	0.04329	0.082524	0.154687	0.111124	0.00399	3.4E-4
τ_i[s]	7.98E-5	2.02E-4	0.004322	0.01395	0.4324	12.027

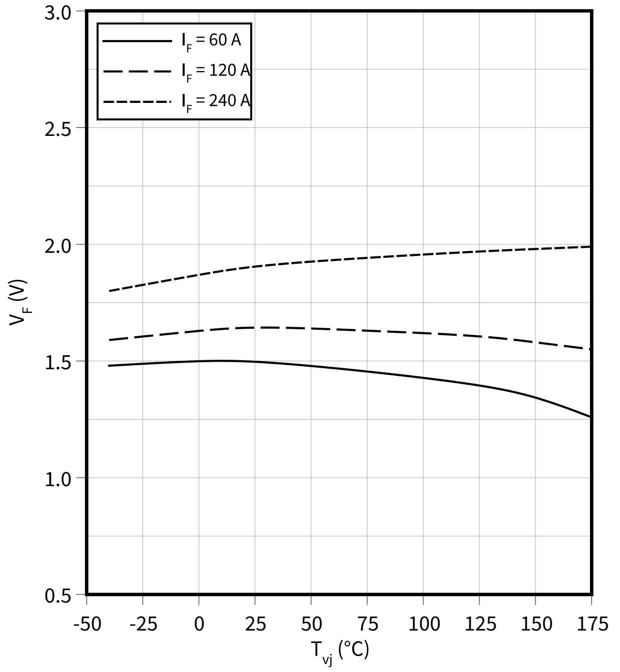
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

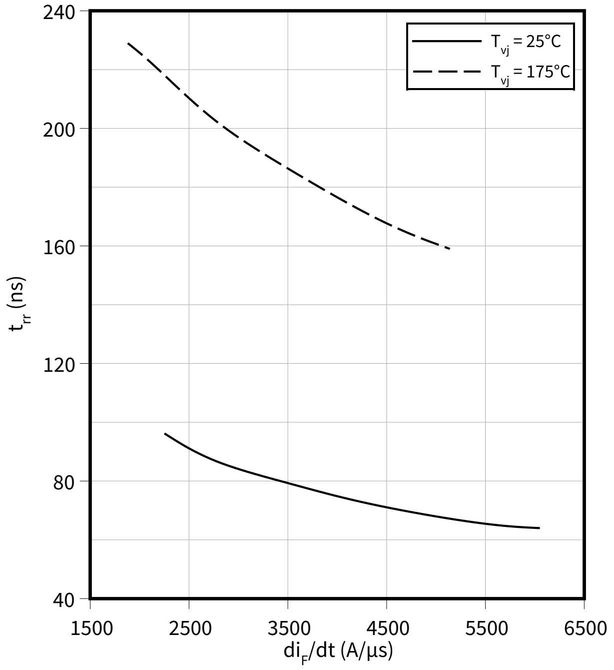
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

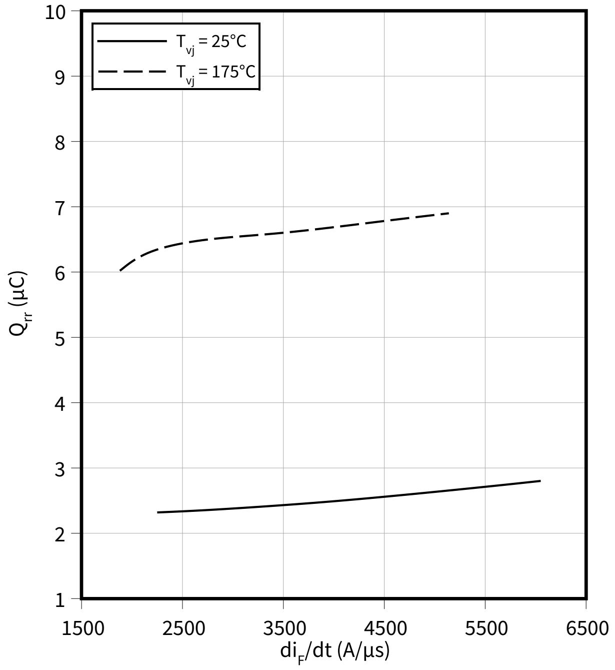
$V_R = 400$ V, $I_F = 120$ A



Typical reverse recovery charge as a function of diode current slope

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

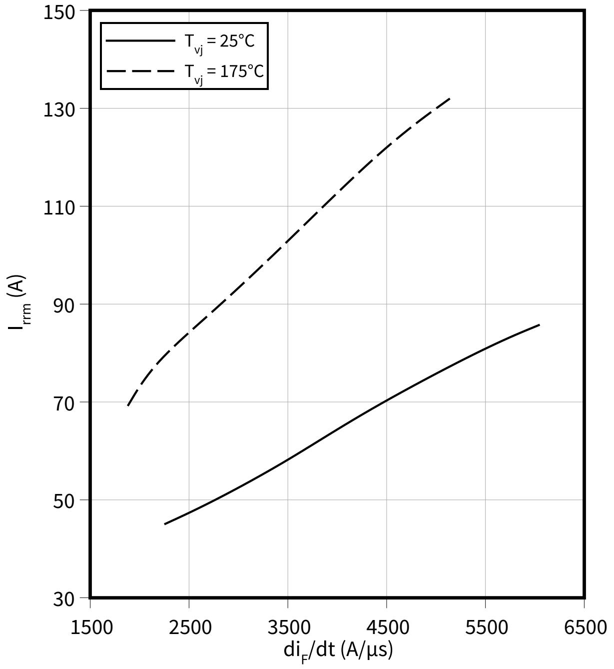
$V_R = 400$ V, $I_F = 120$ A



Typical reverse recovery current as a function of diode current slope

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

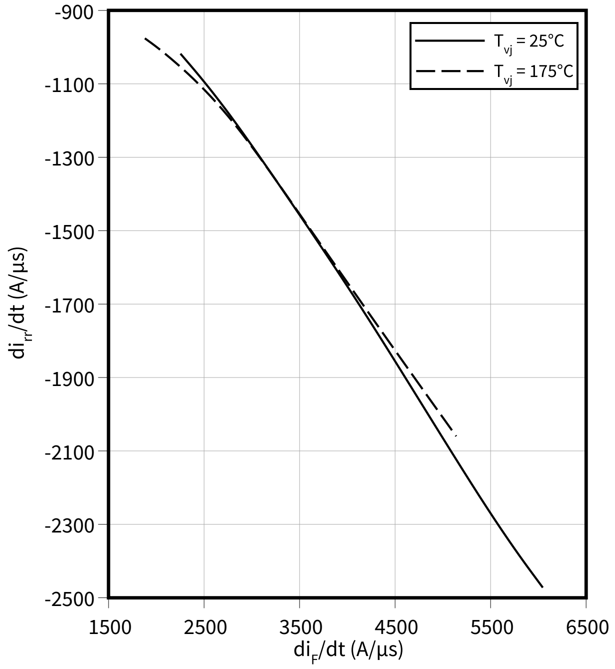
$V_R = 400$ V, $I_F = 120$ A



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

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

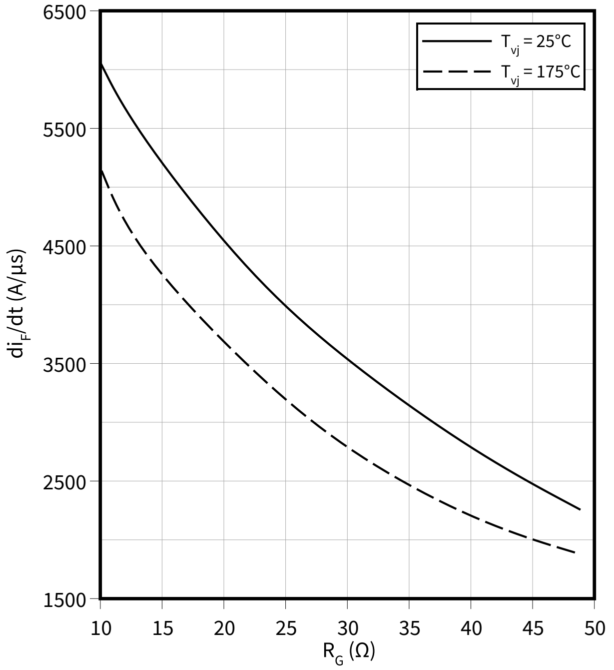
$V_R = 400$ V, $I_F = 120$ A



Typical diode current slope as a function of gate resistor

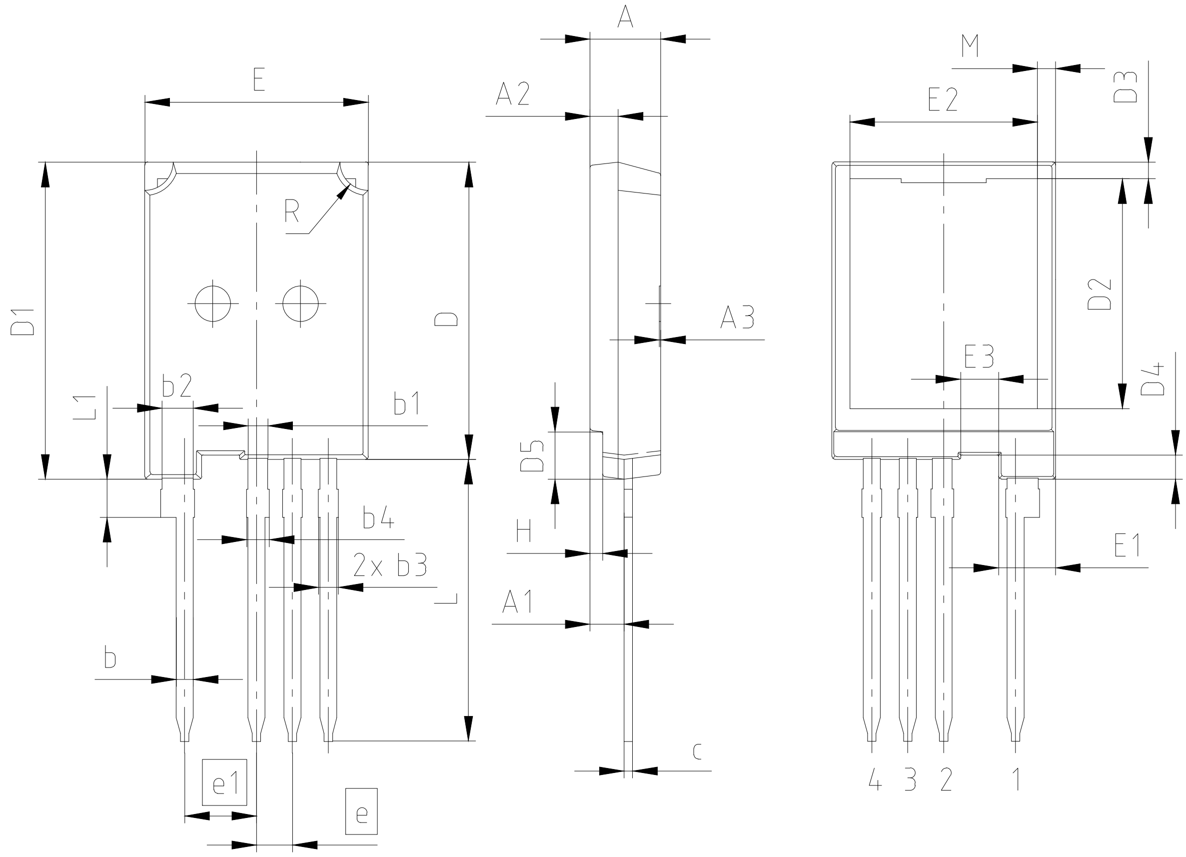
$di_F/dt = f(R_G)$

$V_R = 400$ V, $I_F = 120$ A



5 Package outlines

PG-TO247-4-PLUS-NN5.1



NOTES:
PACKAGE SURFACE ROUTE BETWEEN PIN 1 & PIN 2 WILL BE 5.1 mm MIN.
ALL b... AND c DIMENSIONS INCLUDING PLATING EXPECT AREA OF CUTTING

PACKAGE - GROUP NUMBER:	PG-TO247-4-U10				
DIMENSIONS	**MILLIMETERS**		**DIMENSIONS**	**MILLIMETERS**	
	MIN.	MAX.		MIN.	MAX.
A	4.90	5.10	**E**	15.70	15.90
A1	2.31	2.51	**E1**	3.90	4.10
A2	1.90	2.10	**E2**	13.10	13.50
b	1.16	1.29	**E3**	2.58	2.78
b1	1.36	1.49	**e**	2.54	
b2	2.16	2.29	**e1**	5.08	
b3	1.16	1.45	**H**	0.80	1.00
b4	1.16	1.65	**N**	4	
c	0.59	0.66	**L**	19.80	20.10
D	20.90	21.10	**L1**	2.55	2.85
D1	22.30	22.50	**M**	0.97	1.57
D2	15.95	16.55	**R**	1.90	2.10
D3	1.00	1.35			
D4	1.60	1.80			
D5	3.24	3.44			

Figure 1

6 Testing conditions

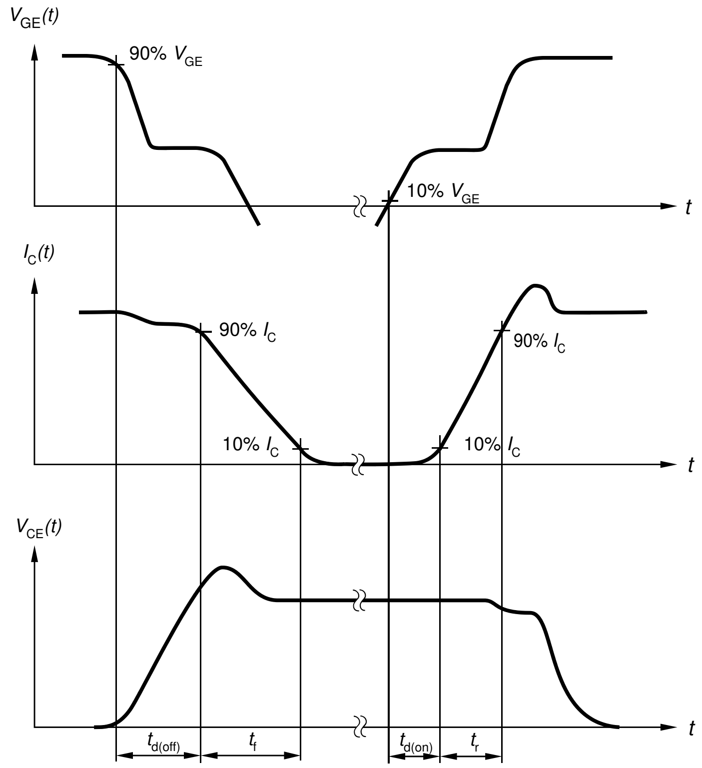


Figure A. **Definition of switching times**

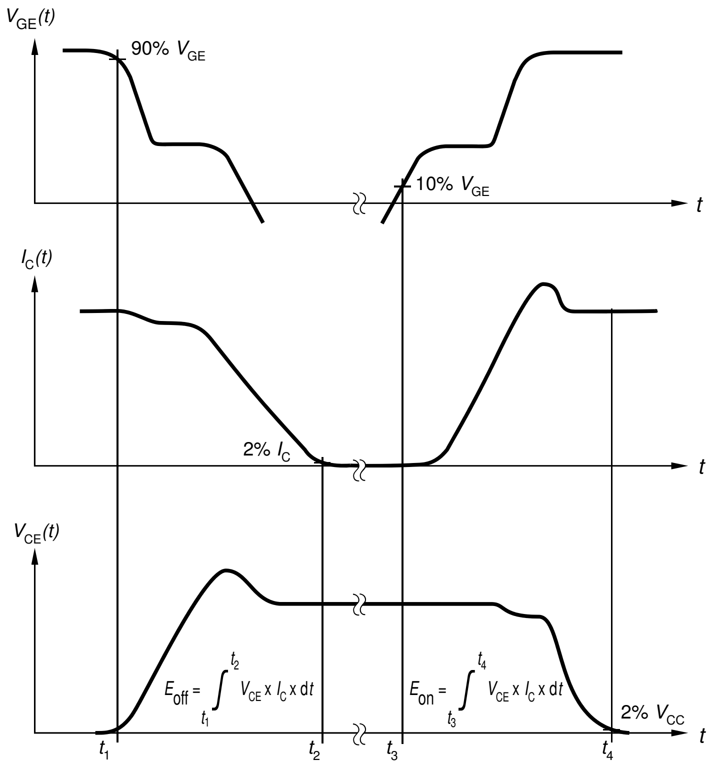


Figure B. **Definition of switching losses**

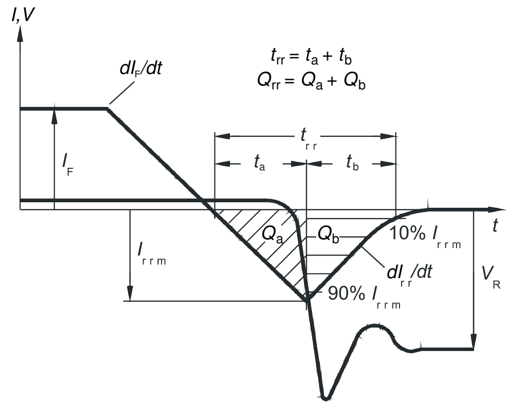


Figure C. **Definition of diode switching characteristics**

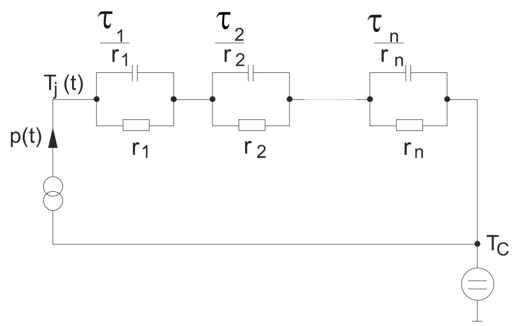


Figure D. **Thermal equivalent circuit**

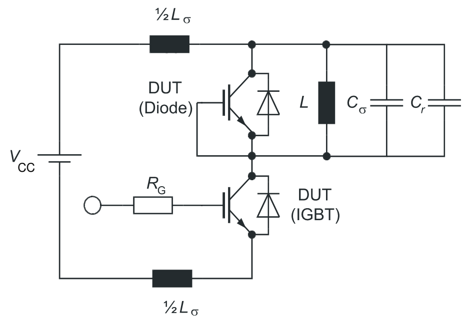


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 2

Revision history

Document revision	Date of release	Description of changes
1.00	2023-04-27	Final datasheet
1.10	2023-11-15	Update of energy diagrams

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