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

Lead-free
Green
Halogen-free
RoHS

Features

- V_{CE} = 750 V
- I_C = 120 A
- Low saturation voltage V_{CEsat} = 1.4 V
- Low switching losses
- Short circuit ruggedness 3 µs
- 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/

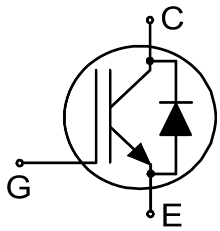
Potential applications

- 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
IKQB120N75CP2	PG-TO247-3-PLUS-NN8.5	K120GCP2

Table of contents

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	$R_{th(j-c)}$				0.26	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$				0.45	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		750	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25$ °C	150	A
			$T_c = 120$ °C	120	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			360	A
Turn-off safe operating area		$V_{CE} \leq 750$ V, $T_{vj} \leq 175$ °C		360	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p = 10$ µs, $D < 0.01$		±30	V
Short-circuit withstand time	t_{SC}	$V_{CC} \leq 450$ V, $V_{GE} = 15$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 125$ °C		3	µs
Power dissipation	P_{tot}		$T_c = 25$ °C	577	W
			$T_c = 120$ °C	211	

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		1.7		
Gate-emitter threshold voltage	V_{GEth}	$I_C = 1.6$ mA, $V_{CE} = V_{GE}$		5	5.8	6.5	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 750$ V, $V_{GE} = 0$ V	$T_{vj} = 25$ °C			200	µA
			$T_{vj} = 175$ °C		6000		
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			87		S
Input capacitance	C_{ies}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			12980		pF
Output capacitance	C_{oes}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			339		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			59		pF
Gate charge	Q_G	$I_C = 120$ A, $V_{GE} = 15$ V, $V_{CC} = 600$ V			481		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4.8$ Ω, $R_{G(off)} = 4.8$ Ω, $L_σ = 144$ nH, $C_σ = 30$ pF	$T_{vj} = 25$ °C, $I_C = 120$ A		57		ns
			$T_{vj} = 175$ °C, $I_C = 120$ A		54		
Rise time (inductive load)	t_r	$V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4.8$ Ω, $R_{G(off)} = 4.8$ Ω, $L_σ = 144$ nH, $C_σ = 30$ pF	$T_{vj} = 25$ °C, $I_C = 120$ A		50		ns
			$T_{vj} = 175$ °C, $I_C = 120$ A		50		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4.8$ Ω, $R_{G(off)} = 4.8$ Ω, $L_σ = 144$ nH, $C_σ = 30$ pF	$T_{vj} = 25$ °C, $I_C = 120$ A		285		ns
			$T_{vj} = 175$ °C, $I_C = 120$ A		346		
Fall time (inductive load)	t_f	$V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4.8$ Ω, $R_{G(off)} = 4.8$ Ω, $L_σ = 144$ nH, $C_σ = 30$ pF	$T_{vj} = 25$ °C, $I_C = 120$ A		33		ns
			$T_{vj} = 175$ °C, $I_C = 120$ A		55		
Turn-on energy	E_{on}	$V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4.8$ Ω, $R_{G(off)} = 4.8$ Ω, $L_σ = 144$ nH, $C_σ = 30$ pF	$T_{vj} = 25$ °C, $I_C = 120$ A		6.4		mJ
			$T_{vj} = 175$ °C, $I_C = 120$ A		8.7		

(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 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 4.8 Ω, $R_{G(off)}$ = 4.8 Ω, L_{σ} = 144 nH, C_{σ} = 30 pF	T_{vj} = 25 °C, I_C = 120 A		3.4		mJ
			T_{vj} = 175 °C, I_C = 120 A		5.5		
Total switching energy	E_{ts}	V_{CC} = 450 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 4.8 Ω, $R_{G(off)}$ = 4.8 Ω, L_{σ} = 144 nH, C_{σ} = 30 pF	T_{vj} = 25 °C, I_C = 120 A		9.8		mJ
			T_{vj} = 175 °C, I_C = 120 A		14.2		
Operating junction temperature	T_{vj}			-40		175	°C

Note: *Electrical Characteristic, at T_{vj} = 25°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} ≥ 25 °C		750	V
Diode forward current, limited by T_{vjmax}	I_F		T_c = 25 °C	150	A
			T_c = 75 °C	120	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			360	A
Power dissipation	P_{tot}		T_c = 25 °C	333	W
			T_c = 120 °C	122	

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		1.8	2	V
			T_{vj} = 175 °C		1.9		
Diode reverse recovery time	t_{rr}	V_R = 450 V	T_{vj} = 25 °C, I_F = 120 A, $-di_F/dt$ = 1000 A/μs		259		ns
			T_{vj} = 175 °C, I_F = 120 A, $-di_F/dt$ = 1000 A/μs		325		

(table continues...)

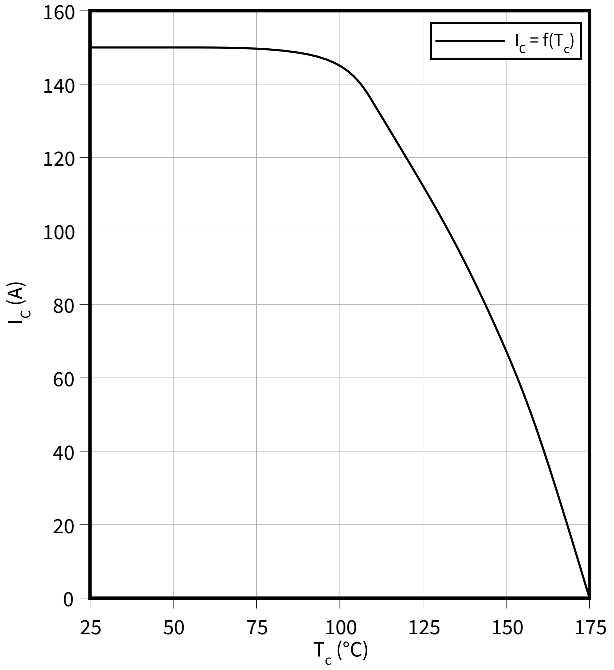
Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery charge	Q_{rr}	V_R = 450 V	T_{vj} = 25 °C, I_F = 120 A, $-di_F/dt$ = 1000 A/µs		3.2		µC
			T_{vj} = 175 °C, I_F = 120 A, $-di_F/dt$ = 1000 A/µs		7.8		
Diode peak reverse recovery current	I_{rrm}	V_R = 450 V	T_{vj} = 25 °C, I_F = 120 A, $-di_F/dt$ = 1000 A/µs		24.2		A
			T_{vj} = 175 °C, I_F = 120 A, $-di_F/dt$ = 1000 A/µs		42		
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	V_R = 450 V	T_{vj} = 25 °C, I_F = 120 A, $-di_F/dt$ = 1000 A/µs		290		A/µs
			T_{vj} = 175 °C, I_F = 120 A, $-di_F/dt$ = 1000 A/µs		250		
Operating junction temperature	T_{vj}			-40		175	°C

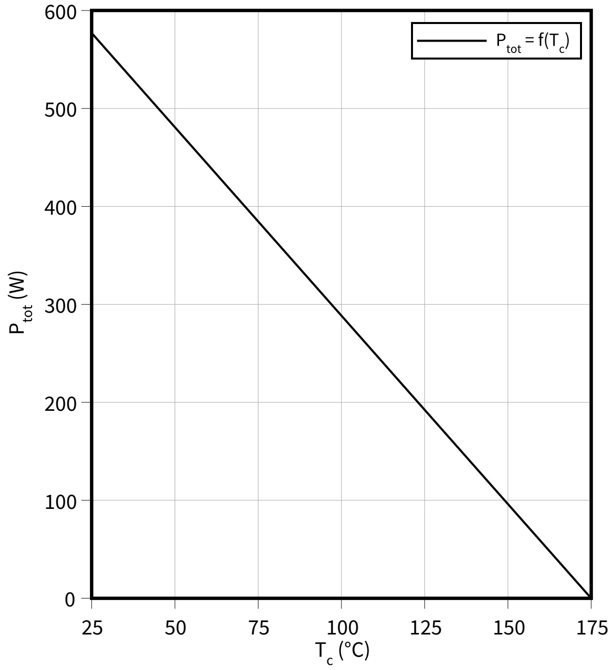
Note: *For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.*

4 Characteristics diagrams

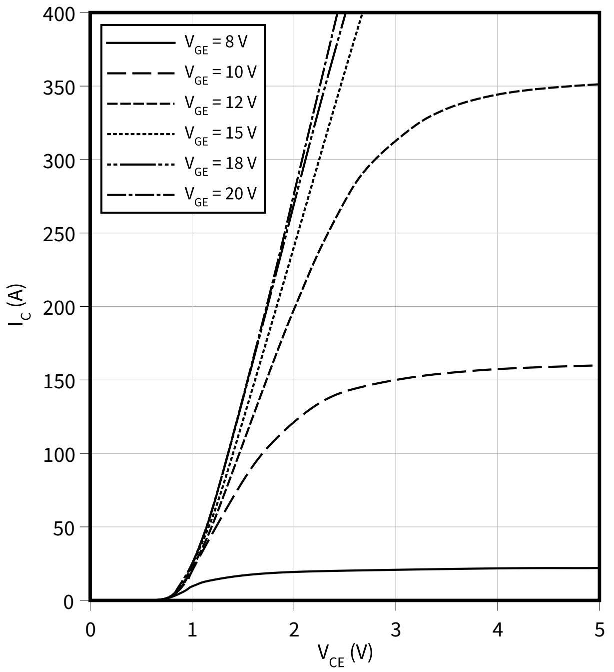
Collector current as a function of case temperature
$I_C = f(T_c)$
$T_{vj} \leq 175$ °C, $V_{GE} \geq 15$ V



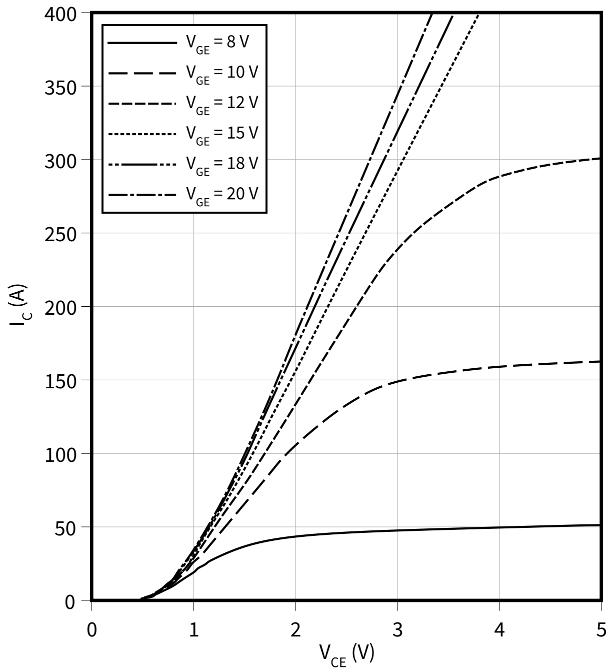
Power dissipation as a function of case temperature
$P_{tot} = f(T_c)$
$T_{vj} \leq 175$ °C



Typical output characteristic
$I_C = f(V_{CE})$
$T_{vj} = 25$ °C



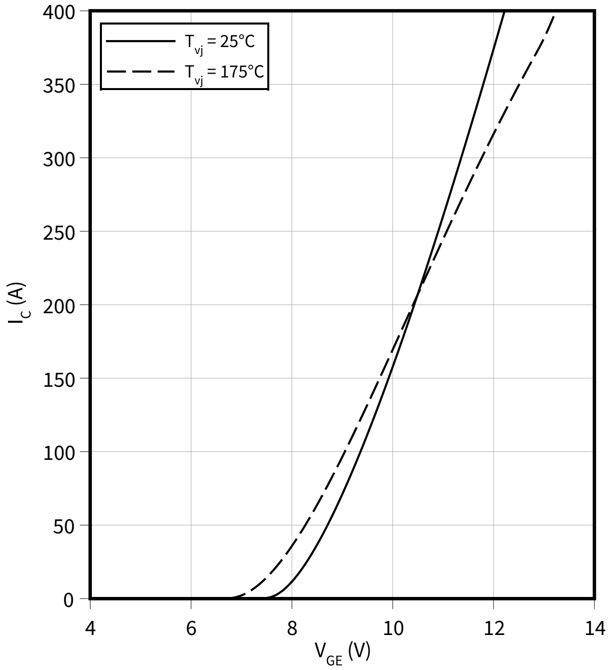
Typical output characteristic
$I_C = f(V_{CE})$
$T_{vj} = 175$ °C



Typical transfer characteristic

$I_C = f(V_{GE})$

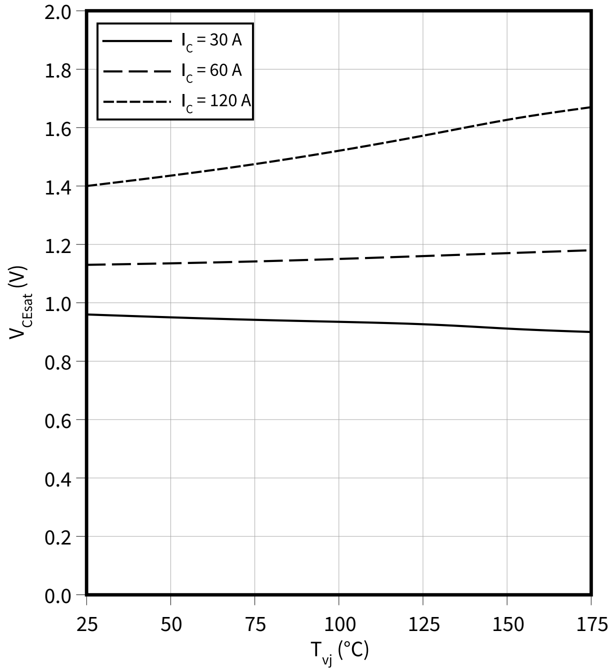
$V_{CE} = 20$ V



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

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

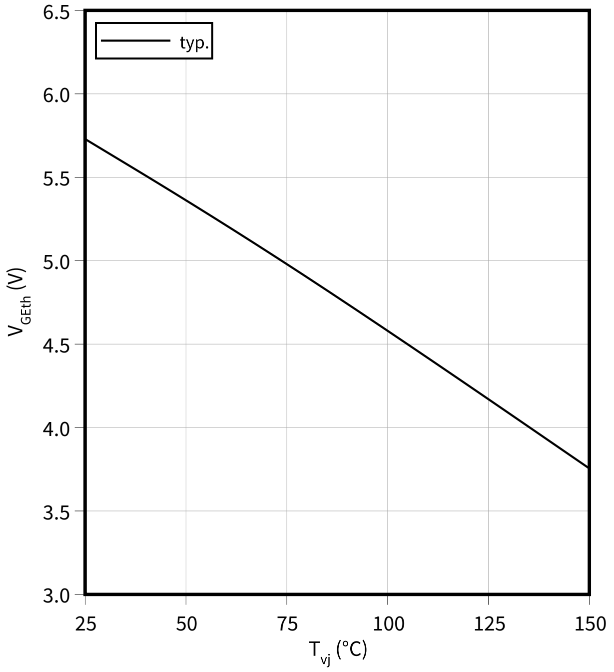
$V_{GE} = 15$ V



Gate-emitter threshold voltage as a function of junction temperature

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

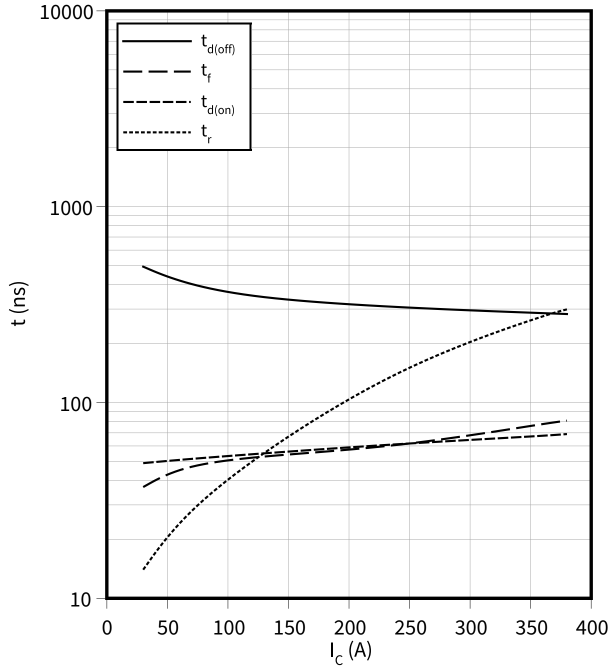
$I_C = 1.6$ mA



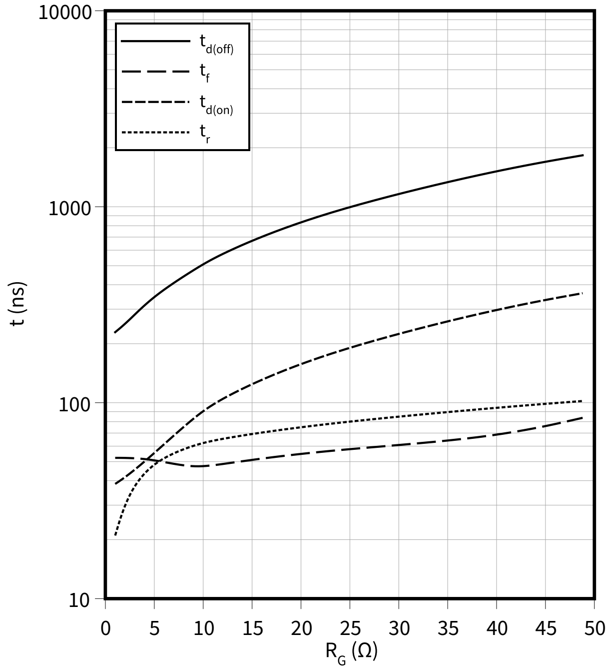
Typical switching times as a function of collector current

$t = f(I_C)$

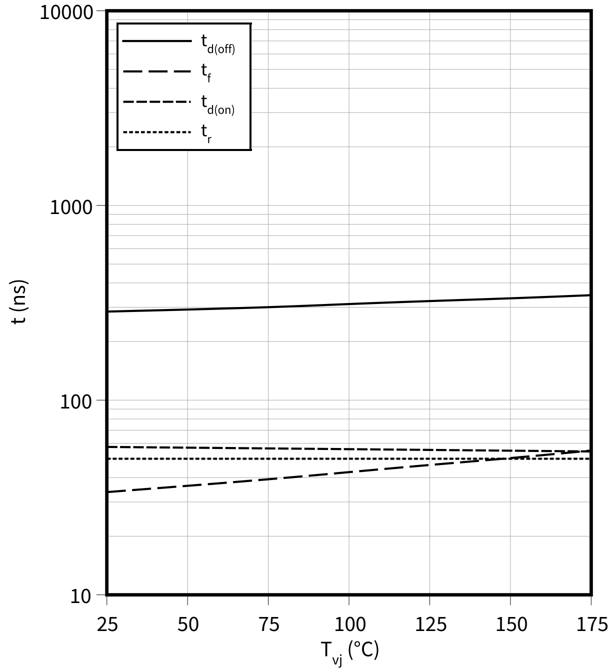
$V_{CC} = 450$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 4.8\ \Omega$



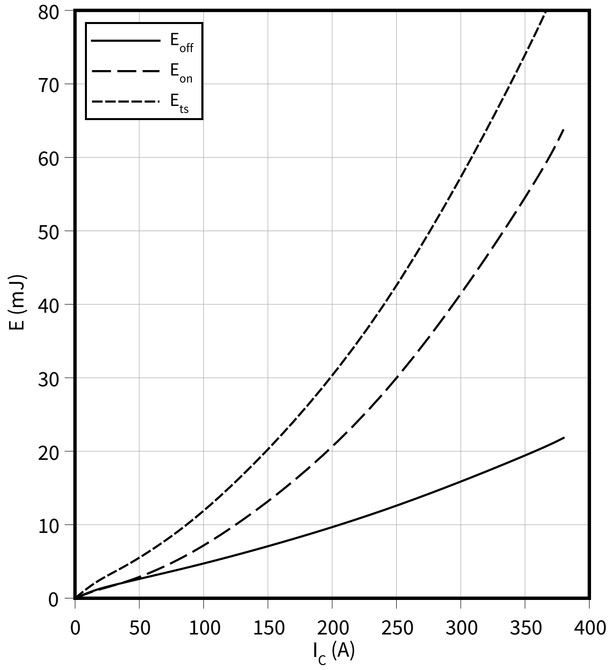
Typical switching times as a function of gate resistor
$t = f(R_G)$
$I_C = 120$ A, $V_{CC} = 450$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



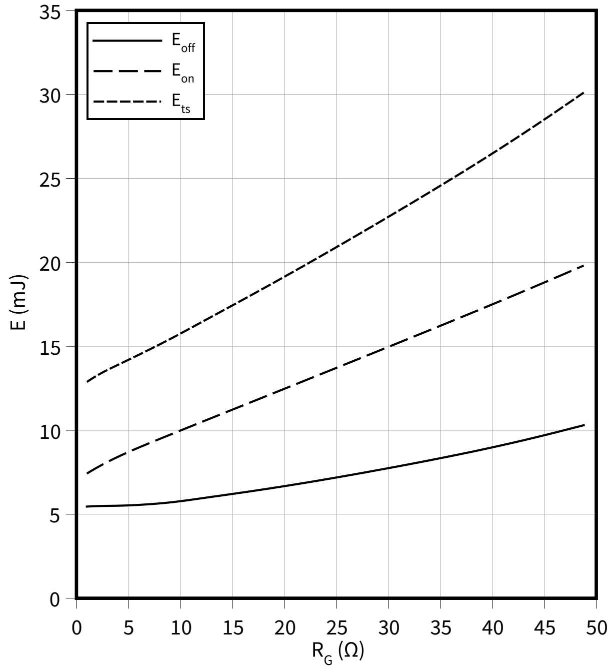
Typical switching times as a function of junction temperature
$t = f(T_{vj})$
$I_C = 120$ A, $V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_G = 4.8$ Ω



Typical switching energy losses as a function of collector current
$E = f(I_C)$
$V_{CC} = 450$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 4.8$ Ω



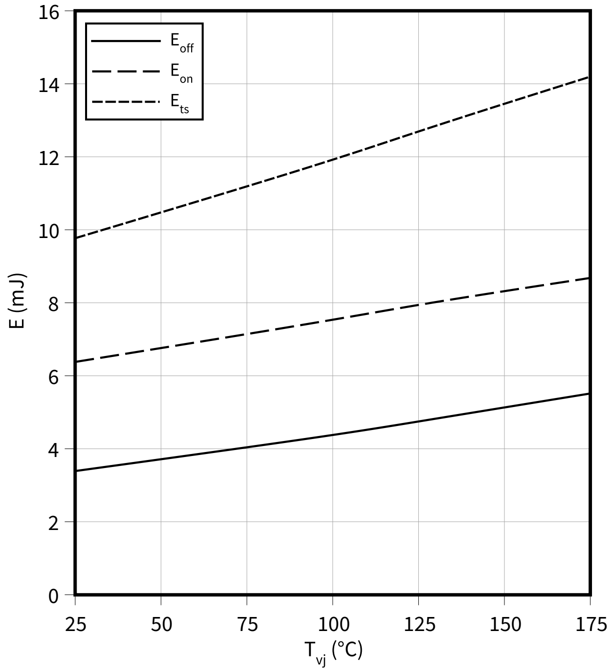
Typical switching energy losses as a function of gate resistor
$E = f(R_G)$
$I_C = 120$ A, $V_{CC} = 450$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

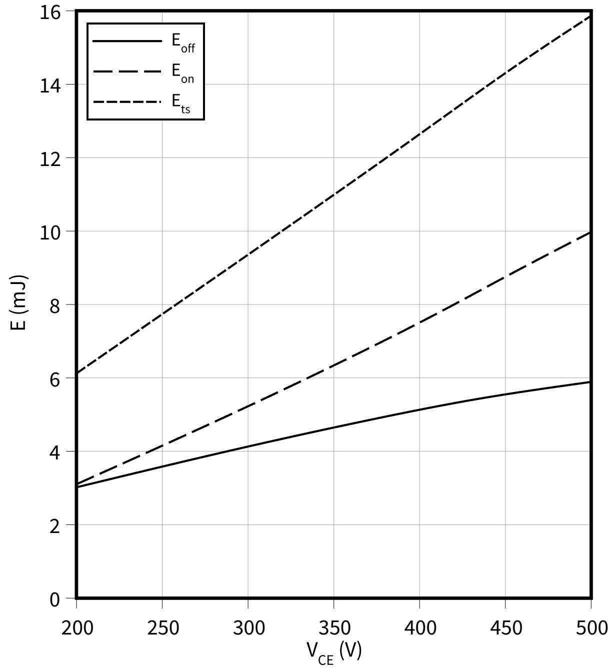
I_C = 120 A, V_{CC} = 450 V, V_{GE} = 0/15 V, R_G = 4.8 Ω



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

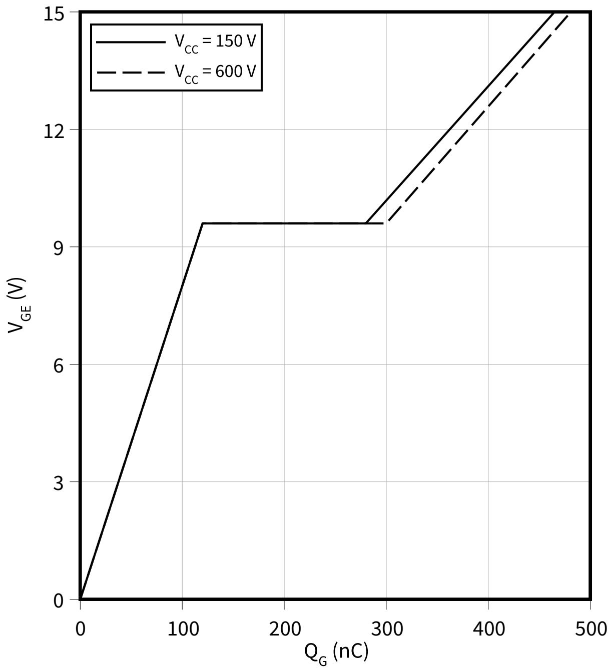
I_C = 120 A, V_{GE} = 0/15 V, T_{vj} = 175 °C, R_G = 4.8 Ω



Typical gate charge

$V_{GE} = f(Q_G)$

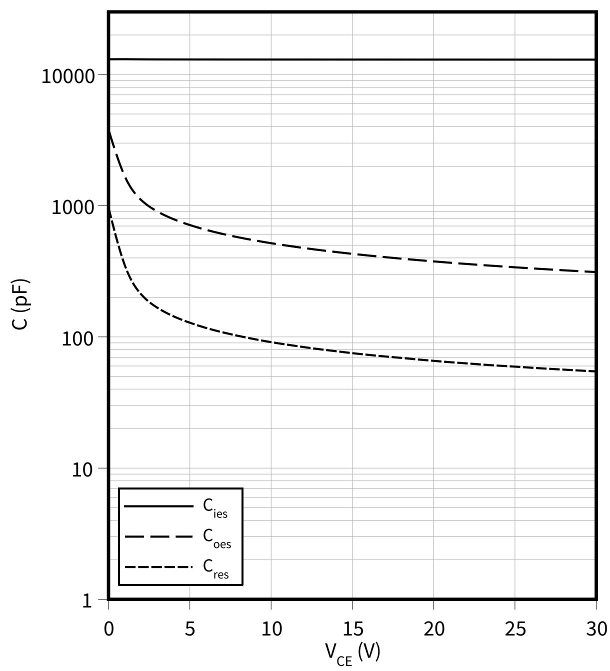
I_C = 120 A



Typical capacitance as a function of collector-emitter voltage

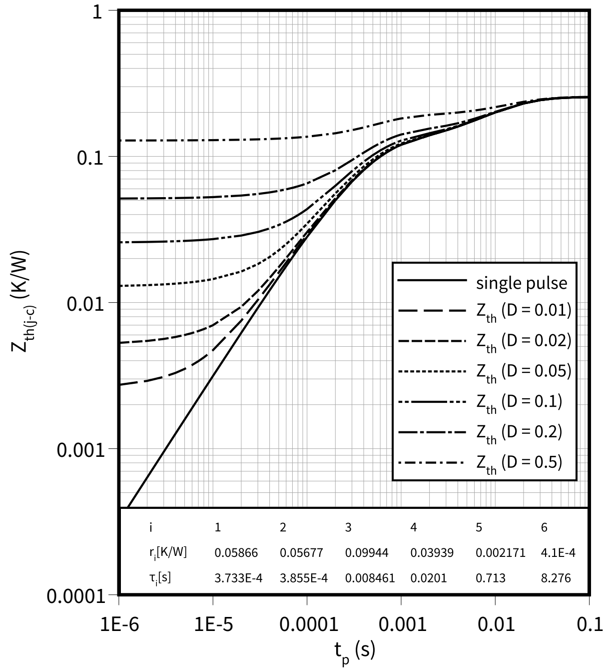
$C = f(V_{CE})$

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



IGBT transient thermal impedance as a function of pulse width

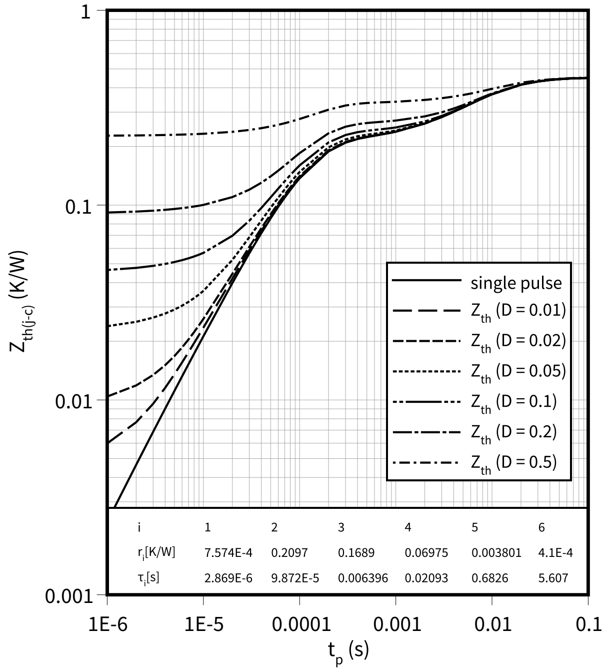
$Z_{th(j\text{-}c)} = f(t_p)$
$D = t_p/T$



i	1	2	3	4	5	6
r_i[K/W]	0.05866	0.05677	0.09944	0.03939	0.002171	4.1E-4
τ_i[s]	3.733E-4	3.855E-4	0.008461	0.0201	0.713	8.276

Diode transient thermal impedance as a function of pulse width

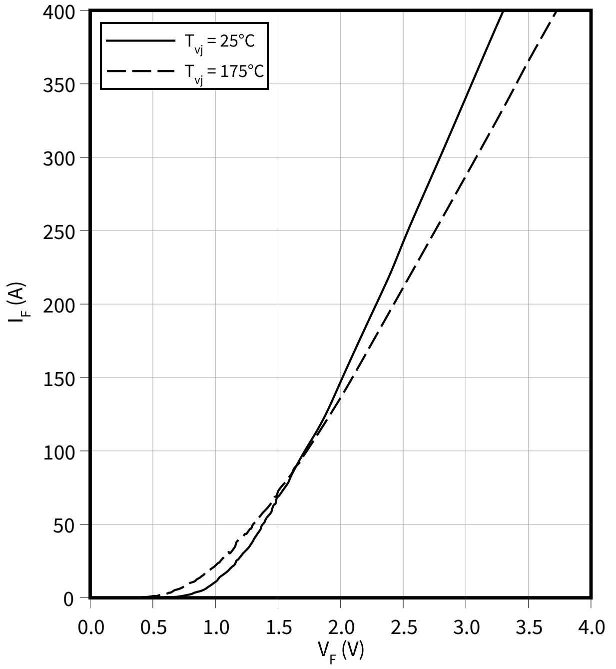
$Z_{th(j\text{-}c)} = f(t_p)$
$D = t_p/T$



i	1	2	3	4	5	6
r_i[K/W]	7.574E-4	0.2097	0.1689	0.06975	0.003801	4.1E-4
τ_i[s]	2.869E-6	9.872E-5	0.006396	0.02093	0.6826	5.607

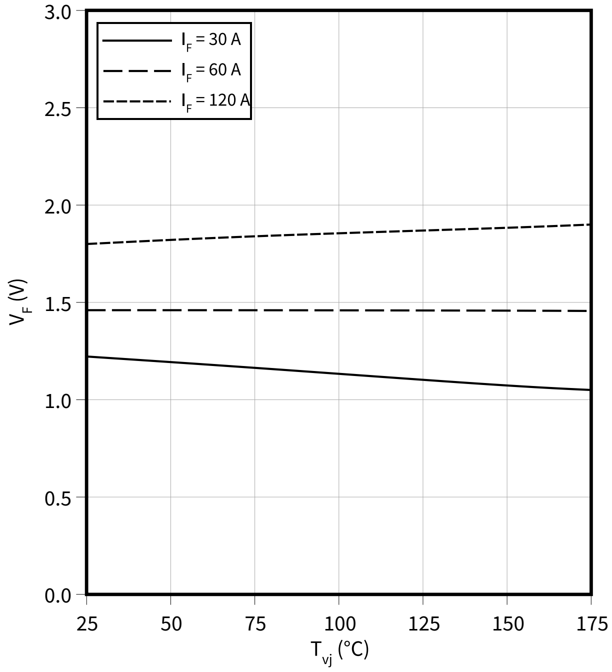
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

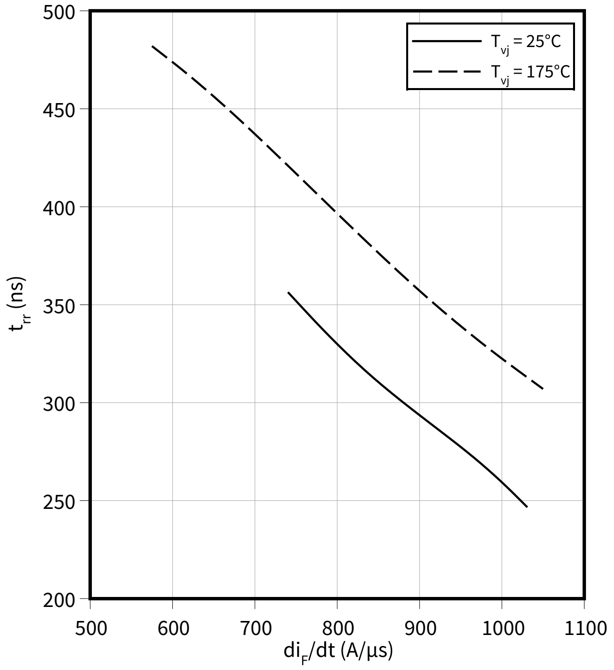
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

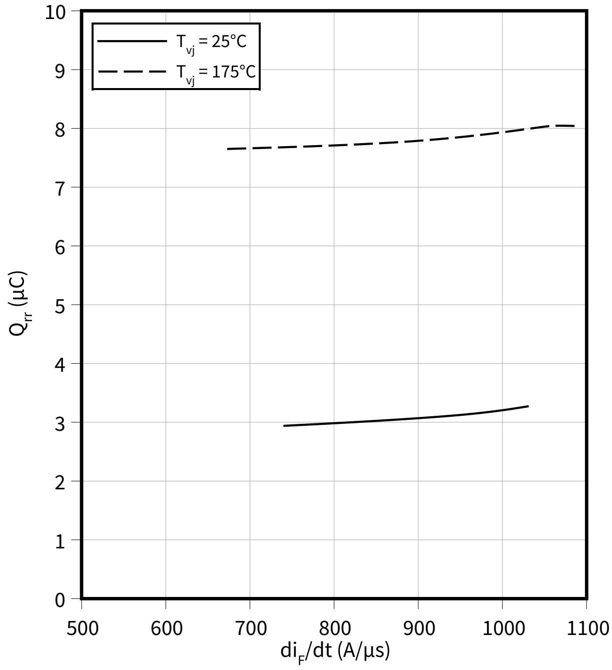
$V_R = 450$ V, $I_F = 120$ A



Typical reverse recovery charge as a function of diode current slope

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

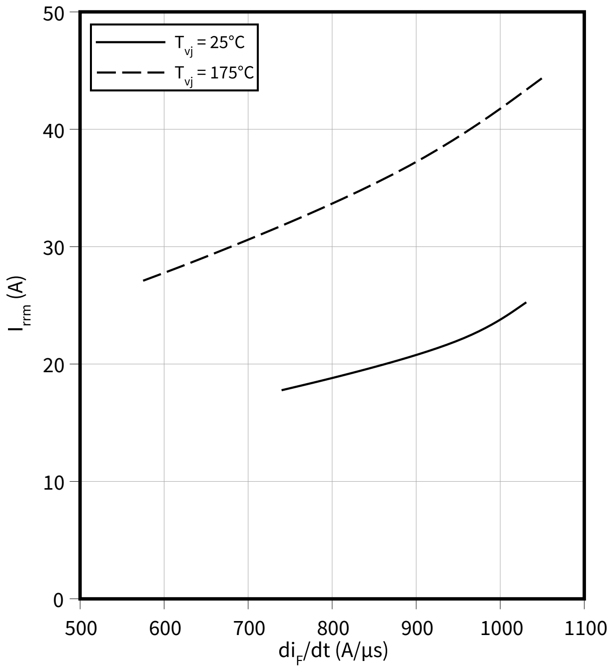
$V_R = 450$ V, $I_F = 120$ A



Typical reverse recovery current as a function of diode current slope

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

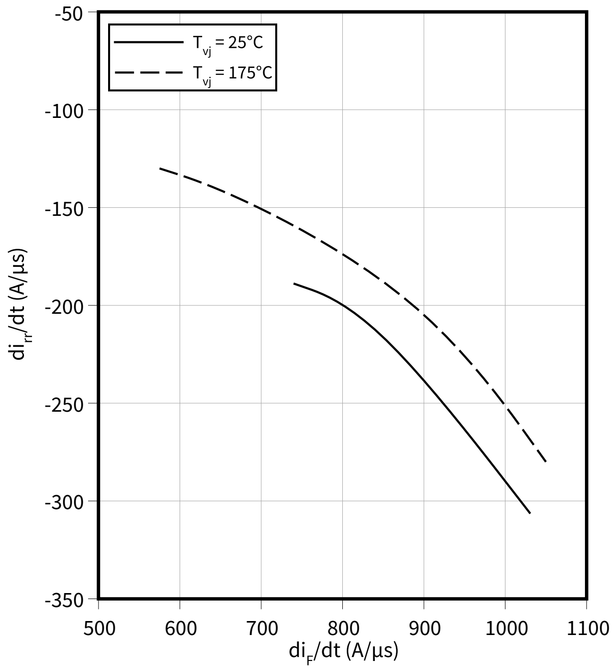
$V_R = 450$ V, $I_F = 120$ A



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

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

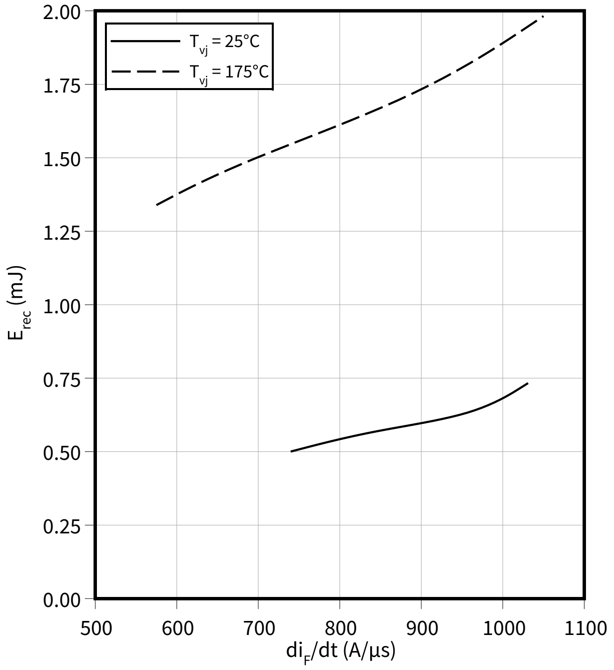
$V_R = 450$ V, $I_F = 120$ A



Typical reverse energy losses as a function of diode current slope

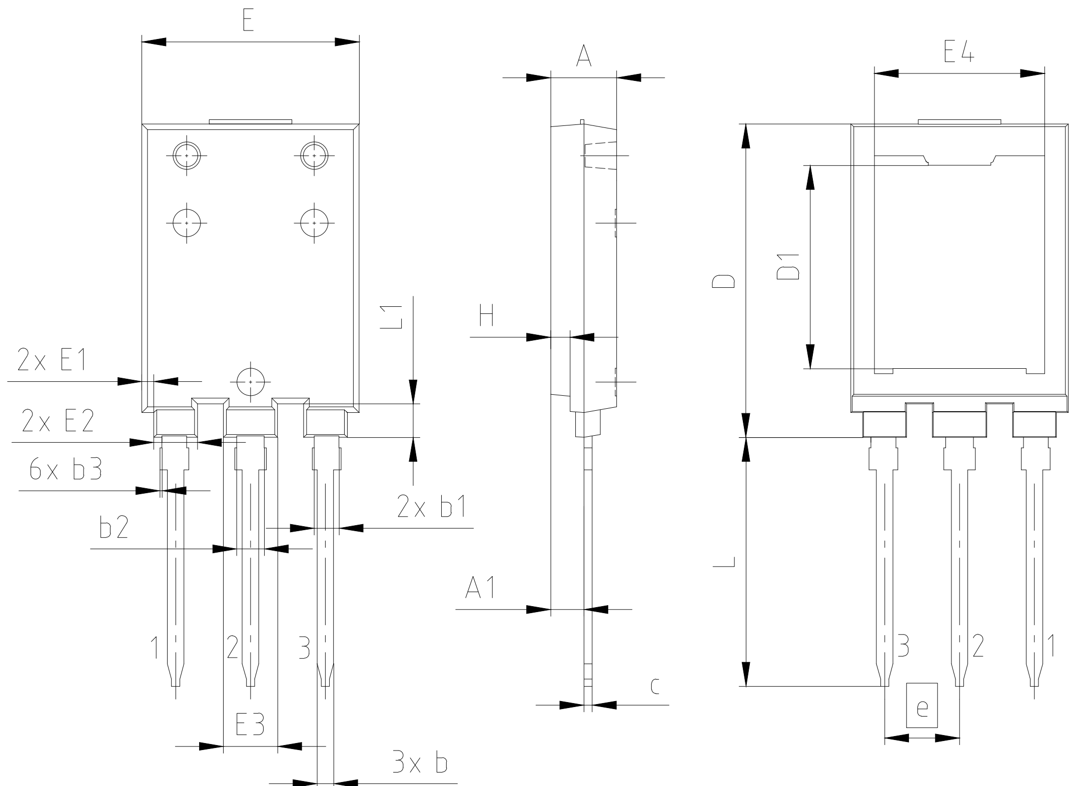
$E_{rec} = f(di_F/dt)$

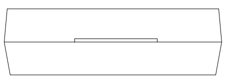
$V_R = 450$ V, $I_F = 120$ A



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

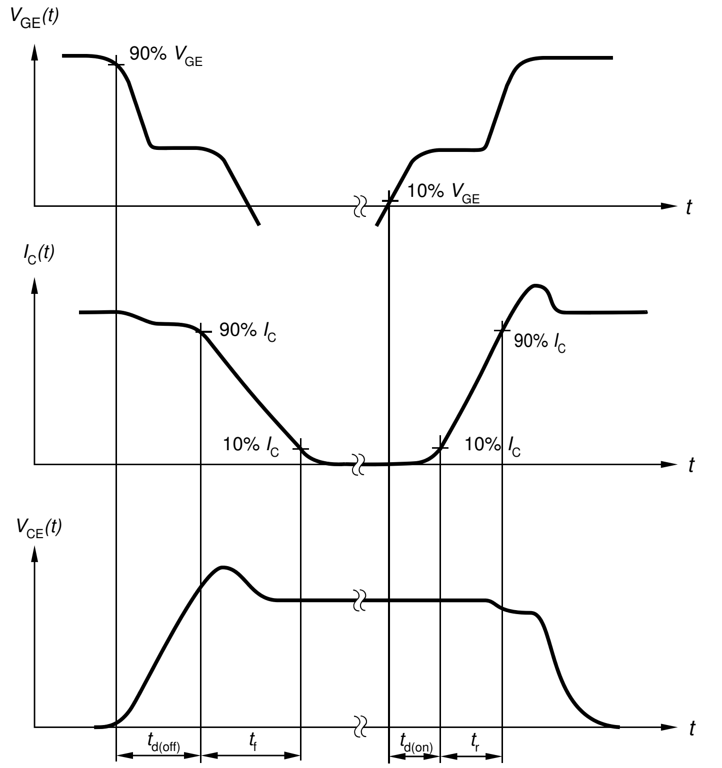


Figure A. **Definition of switching times**

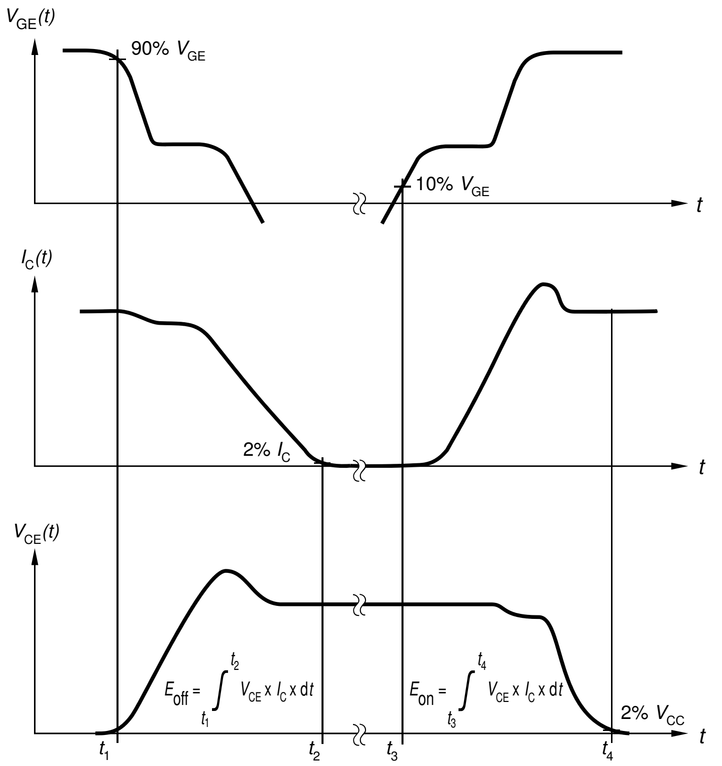


Figure B. **Definition of switching losses**

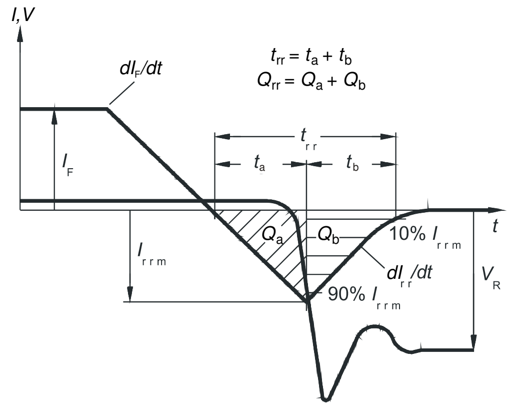


Figure C. **Definition of diode switching characteristics**

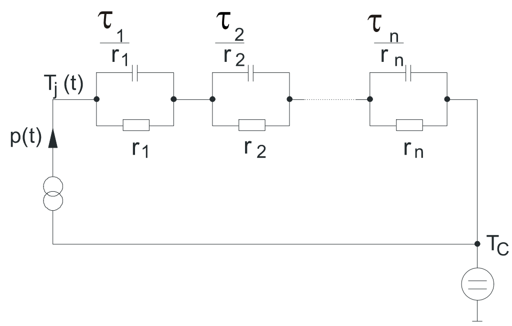


Figure D. **Thermal equivalent circuit**

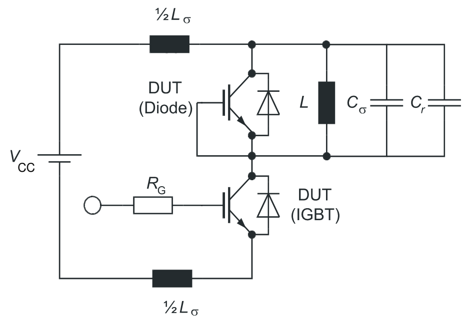


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 2

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

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

Edition 2022-11-23

Published by

Infineon Technologies AG

81726 Munich, Germany

Do you have a question about any aspect of this document?

Email: erratum@infineon.com

Document reference
IFX-AAL445-002