Preliminary datasheet

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

Features

- V_{CE} = 750 V
- I_C = 120 A
- Suitable for 470 V V_{DC} systems and increase overvoltage margin for 400 V V_{DC} systems
- Very low V_{CEsat} = 1.3 V (typ.) at I_{Cnom} = 120 A, 25°C
- Short circuit robust t_{sc} = 5 µs at V_{CE} = 470 V, V_{GE} = 15 V
- Up to 40% less System R_{th} due to reflow capability, increased power output
- Self limiting current under short circuit condition
- Positive thermal coefficient and very tight parameter distribution for easy paralleling
- Reduction of number of paralleled devices required
- Excellent current sharing in parallel operation
- Smooth switching characteristics
- Low gate charge Q_G
- Simple gate drive design
- Co-packed with fast soft recovery emitter controlled 3 diode
- Low EMI signature
- TO247PLUS package with high creepage distance
- High reliability and operating lifetime
- Resistive weldable pins for direct busbar connections
- Drop-in replacement for I_C = 120 A, T_c = 100°C devices

Lead-free

Green

Halogen-free

RoHS

AEC Qualified

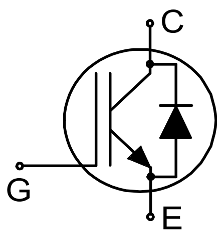
Potential applications

- xEV traction inverter
- DC-link discharge switch
- Automotive aux-drives

Product validation

- Qualified for automotive applications. Product Validation according to AEC-Q101
- Qualified Reflow device according to JEDEC J-STA-020 MSL2

Description



Type	Package	Marking
AIKQB120N75CP2	PG-TO247-3-PLUS-NN8.5	AKQB12FCP

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 (MSL2 according to JEDEC J-STA-020)			260	°C
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.2	0.26	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.35	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		$T_c = 25$ °C	150	A
			$T_c = 100$ °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}	$V_{CC} \leq 470$ V, $V_{GE} = -8/15$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 25$ °C		5	µs
Power dissipation	P_{tot}	$T_{vj} = 175$ °C	$T_c = 25$ °C	577	W
			$T_c = 100$ °C	288	

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		1.3	1.65	V
			$T_{vj} = 175$ °C		1.6		
Gate-emitter threshold voltage	V_{GEth}	$I_C = 1.6$ mA, $V_{CE} = V_{GE}$		5	5.75	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		4		mA
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			90		S
Short-circuit collector current	I_{SC}	$V_{CC} \leq 470$ V, $V_{GE} = -8/15$ V, $t_{SC} \leq 5$ µs, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 25$ °C			750		A
Input capacitance	C_{ies}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			13125		pF
Output capacitance	C_{oes}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			337		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			59		pF
Gate charge	Q_G	$V_{CC} = 600$ V, $I_C = 120$ A, $V_{GE} = -8/15$ V			731		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 470$ V, $V_{GE} = -8/15$ V, $R_{G(on)} = 5\ \Omega$, $R_{G(off)} = 5\ \Omega$	$T_{vj} = 25$ °C, $I_C = 120$ A		71		ns
			$T_{vj} = 175$ °C, $I_C = 120$ A		50		
Rise time (inductive load)	t_r	$V_{CC} = 470$ V, $V_{GE} = -8/15$ V, $R_{G(on)} = 5\ \Omega$, $R_{G(off)} = 5\ \Omega$	$T_{vj} = 25$ °C, $I_C = 120$ A		69		ns
			$T_{vj} = 175$ °C, $I_C = 120$ A		68		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 470$ V, $V_{GE} = -8/15$ V, $R_{G(on)} = 5\ \Omega$, $R_{G(off)} = 5\ \Omega$	$T_{vj} = 25$ °C, $I_C = 120$ A		244		ns
			$T_{vj} = 175$ °C, $I_C = 120$ A		226		
Fall time (inductive load)	t_f	$V_{CC} = 470$ V, $V_{GE} = -8/15$ V, $R_{G(on)} = 5\ \Omega$, $R_{G(off)} = 5\ \Omega$	$T_{vj} = 25$ °C, $I_C = 120$ A		50.5		ns
			$T_{vj} = 175$ °C, $I_C = 120$ A		67		
Turn-on energy[1)]	E_{on}	$V_{CC} = 470$ V, $V_{GE} = -8/15$ V, $R_{G(on)} = 5\ \Omega$, $R_{G(off)} = 5\ \Omega$	$T_{vj} = 25$ °C, $I_C = 120$ A		6.82		mJ
			$T_{vj} = 175$ °C, $I_C = 120$ A		7.3		

(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} = 470 V, V_{GE} = -8/15 V, $R_{G(on)}$ = 5 Ω, $R_{G(off)}$ = 5 Ω	T_{vj} = 25 °C, I_C = 120 A		3.8		mJ
			T_{vj} = 175 °C, I_C = 120 A		4.7		
Total switching energy	E_{ts}	V_{CC} = 470 V, V_{GE} = -8/15 V, $R_{G(on)}$ = 5 Ω, $R_{G(off)}$ = 5 Ω	T_{vj} = 25 °C, I_C = 120 A		10.3		mJ
			T_{vj} = 175 °C, I_C = 120 A		12.1		
Operating junction temperature	T_{vj}			-40		175	°C

1) includes reverse recovery losses

3 Diode

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Diode forward current, limited by T_{vjmax}	I_F		T_c = 25 °C	150	A
			T_c = 100 °C	120	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			360	A
Power dissipation	P_{tot}	T_{vj} = 175 °C	T_c = 25 °C	333	W
			T_c = 100 °C	167	

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		1.72	2	V
			T_{vj} = 175 °C		1.9		
Diode reverse recovery charge	Q_{rr}	V_R = 470 V	T_{vj} = 25 °C, I_F = 120 A, $-di_F/dt$ = 1055 A/µs		3.6		µC
			T_{vj} = 175 °C, I_F = 120 A, $-di_F/dt$ = 1070 A/µs		5.3		

(table continues...)

Table 5 **(continued) Characteristic values**

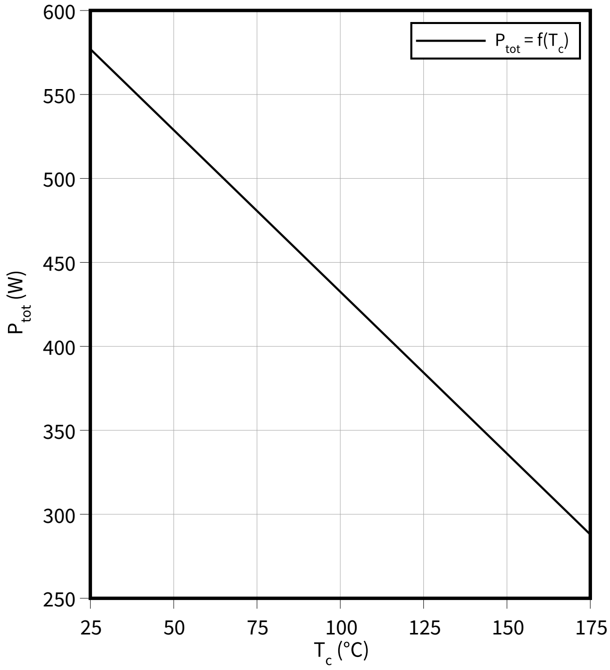
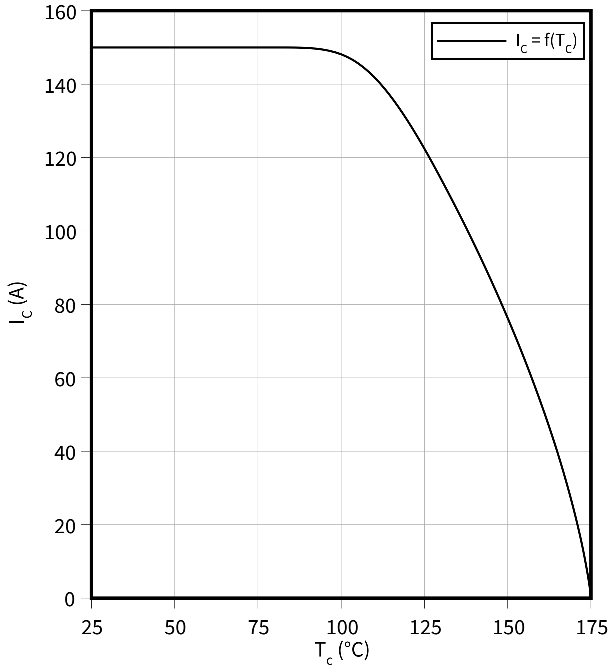
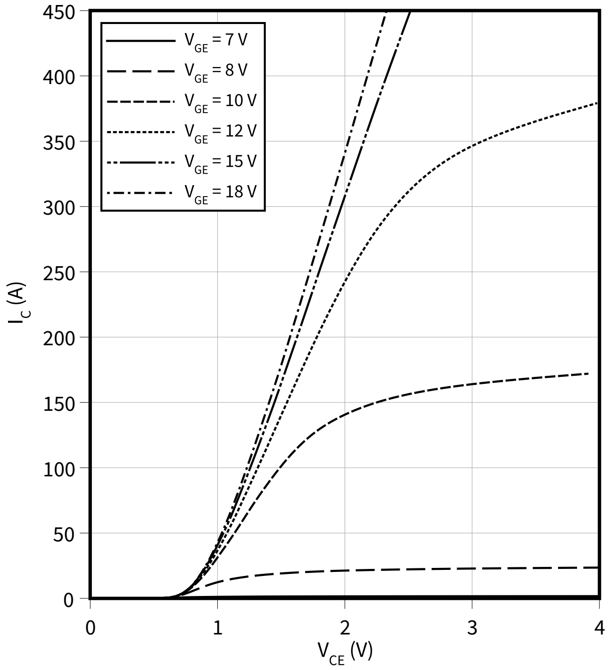
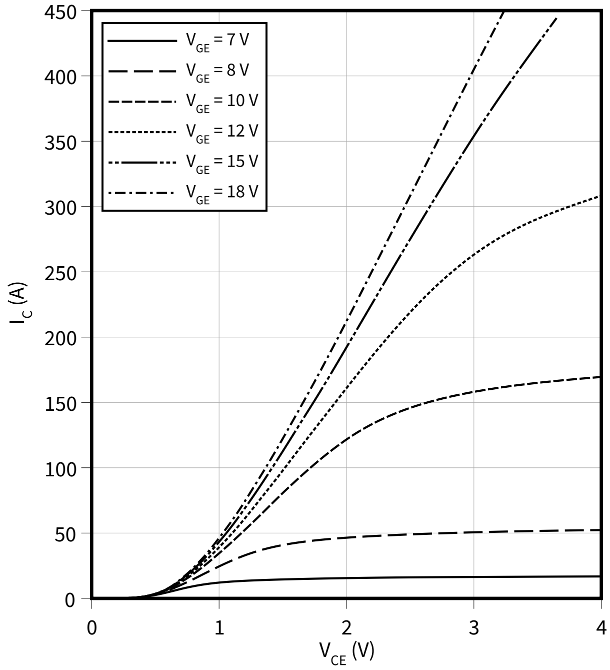
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak reverse recovery current	I_{rrm}	V_R = 470 V	T_{vj} = 25 °C, I_F = 120 A, $-di_F/dt$ = 1055 A/µs		33		A
			T_{vj} = 175 °C, I_F = 120 A, $-di_F/dt$ = 1070 A/µs		43		
Reverse recovery energy	E_{rec}	V_R = 470 V, L_σ = 50 nH, C_σ = 30 pF	T_{vj} = 25 °C, I_F = 120 A, $-di_F/dt$ = 1055 A/µs		1.2		mJ
			T_{vj} = 175 °C, I_F = 120 A, $-di_F/dt$ = 1070 A/µs		1.6		
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 = 50 nH, parasitic capacitor C_σ = 30 pF from Fig. E. Energy losses include “tail” and diode reverse recovery.

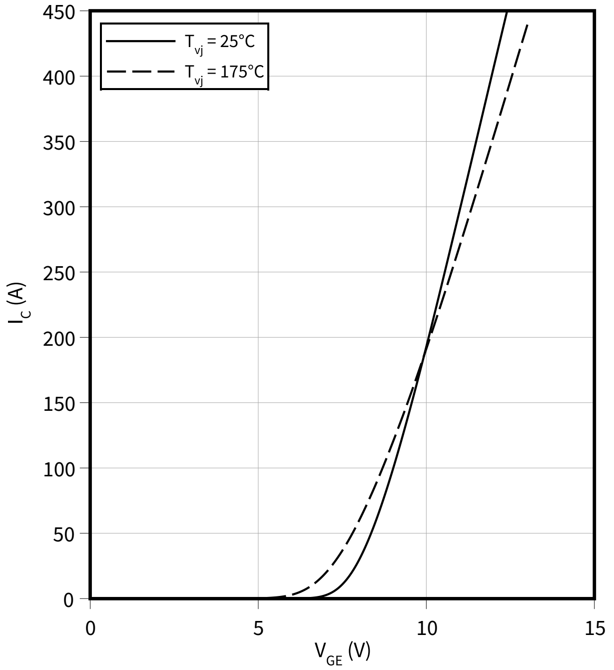
4 Characteristics diagrams

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** $I_C = f(T_c)$ $T_{vj} \leq 175$ °C, $V_{GE} = 15$ V
	
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

$I_C = f(V_{GE})$

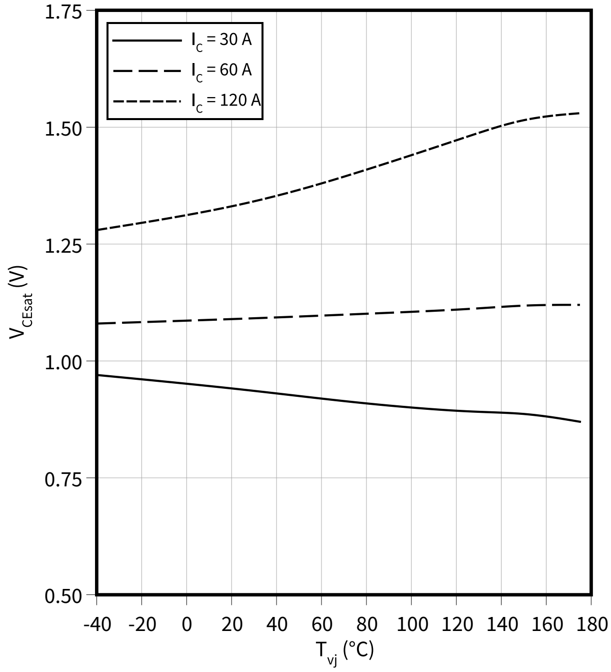
$V_{CE} = 20$ V



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

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

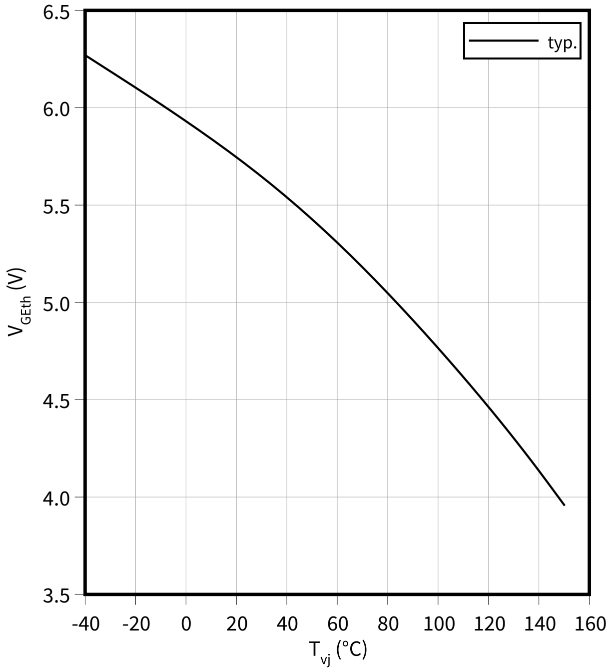
$V_{GE} = 15$ V



Gate-emitter threshold voltage as a function of junction temperature

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

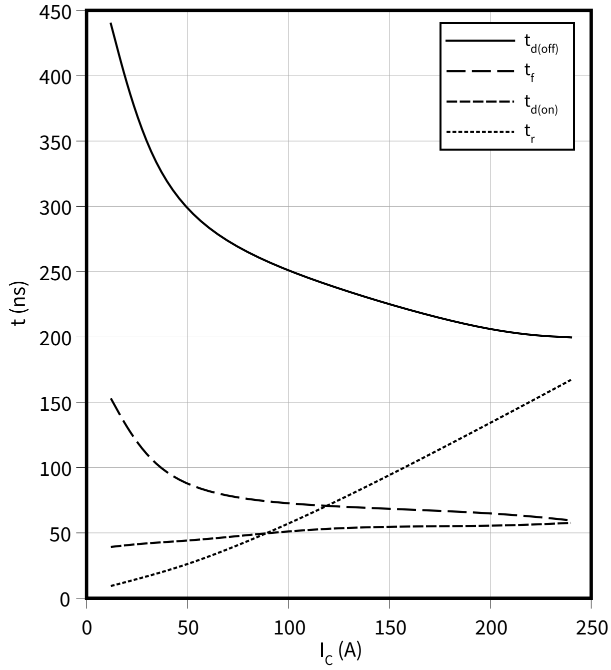
$I_C = 1.6$ mA



Typical switching times as a function of collector current

$t = f(I_C)$

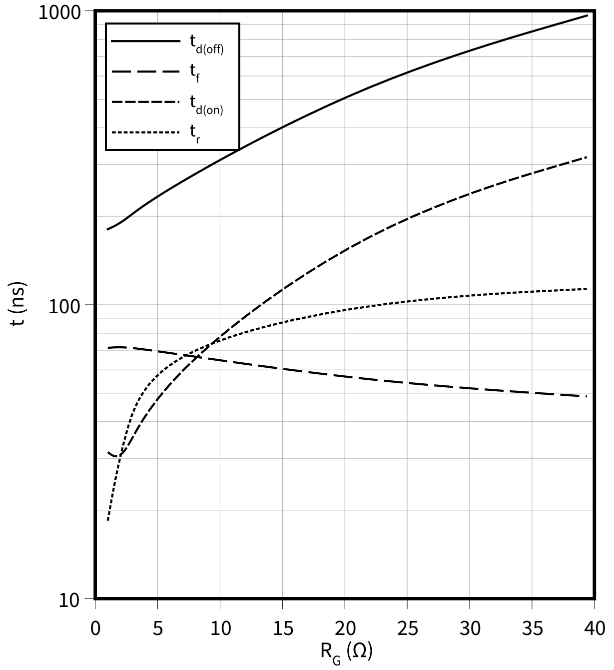
$V_{CC} = 470$ V, $T_{vj} = 175$ °C, $V_{GE} = -8/15$ V, $R_G = 5\ \Omega$



Typical switching times as a function of gate resistor

$t = f(R_G)$

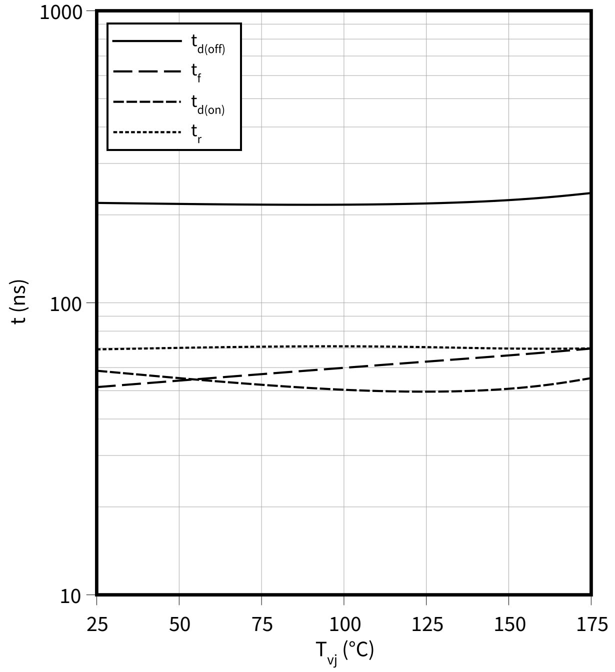
$I_C = 120$ A, $V_{CC} = 470$ V, $T_{vj} = 175$ °C, $V_{GE} = -8/15$ V



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

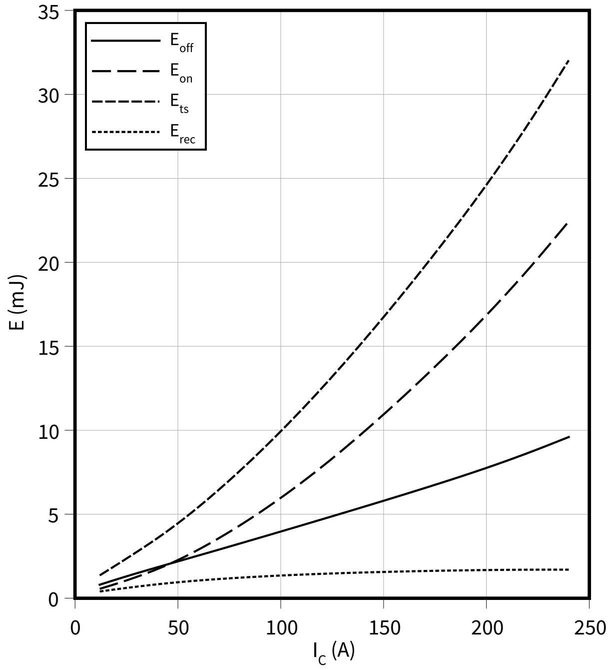
$I_C = 120$ A, $V_{CC} = 470$ V, $V_{GE} = -8/15$ V, $R_G = 5$ Ω



Typical switching energy losses as a function of collector current

$E = f(I_C)$

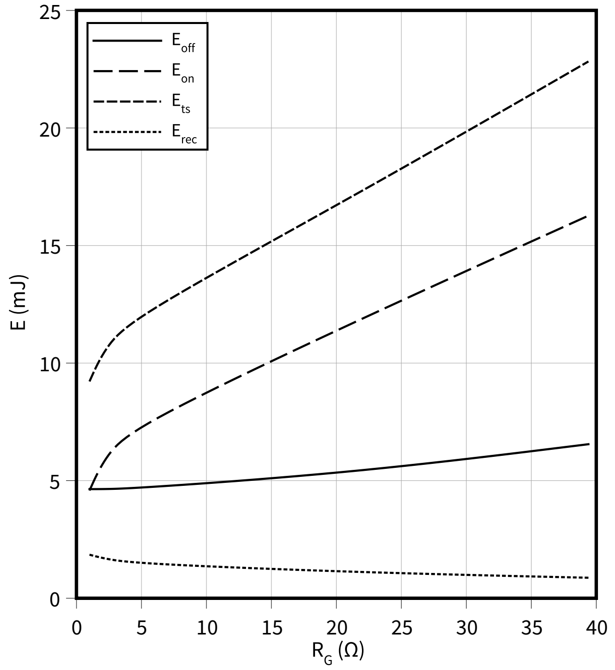
$V_{CC} = 470$ V, $T_{vj} = 175$ °C, $V_{GE} = -8/15$ V, $R_G = 5$ Ω



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

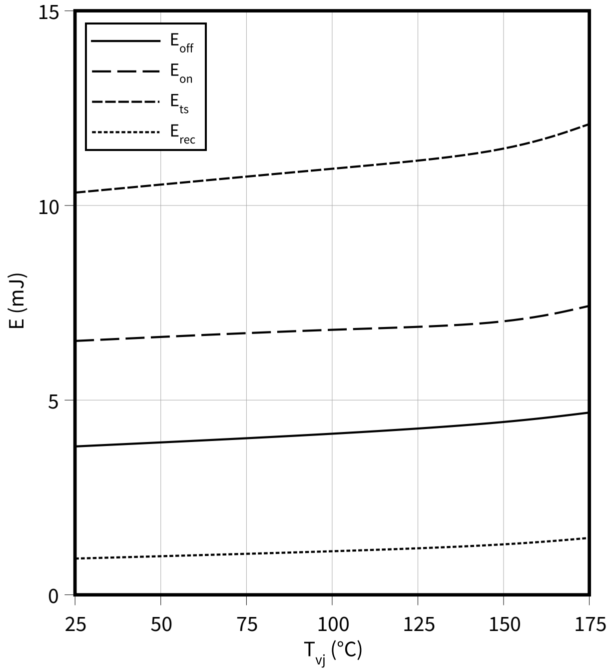
$I_C = 120$ A, $V_{CC} = 470$ V, $T_{vj} = 175$ °C, $V_{GE} = -8/15$ V



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

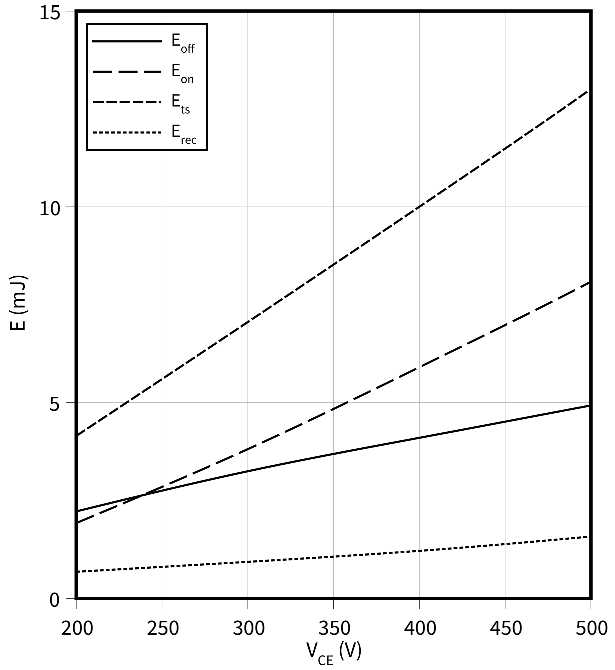
I_C = 120 A, V_{CC} = 470 V, V_{GE} = -8/15 V, R_G = 5 Ω



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

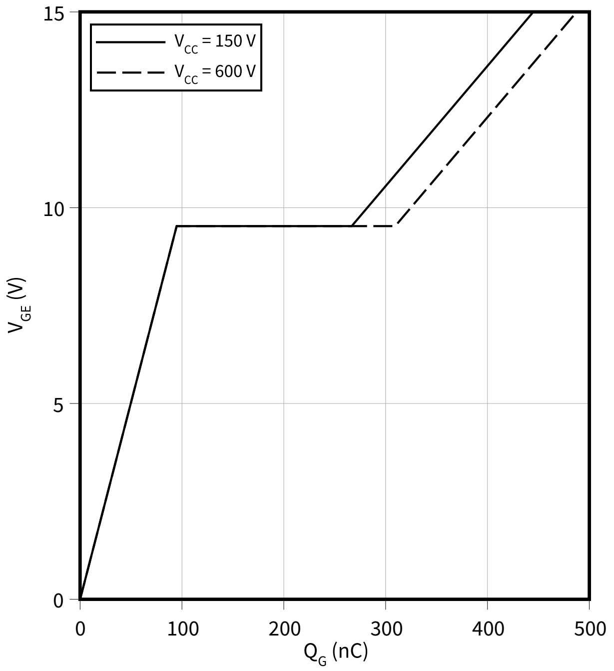
I_C = 120 A, T_{vj} = 175 °C, V_{GE} = -8/15 V, R_G = 5 Ω



Typical gate charge

$V_{GE} = f(Q_G)$

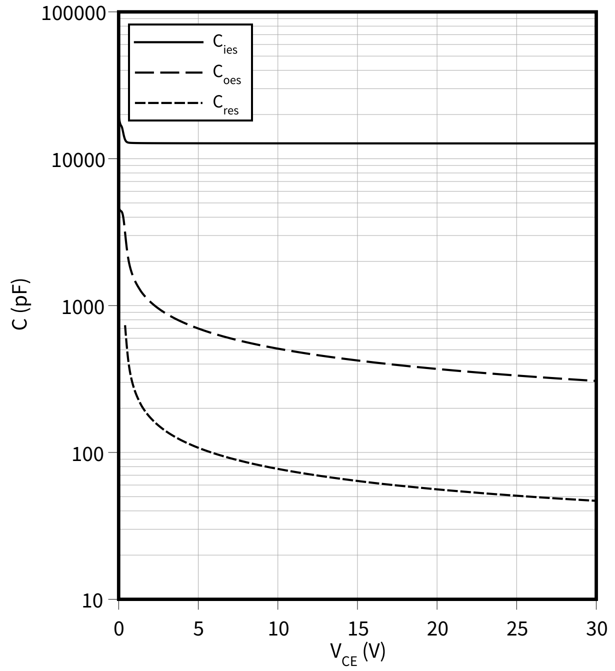
I_C = 120 A



Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

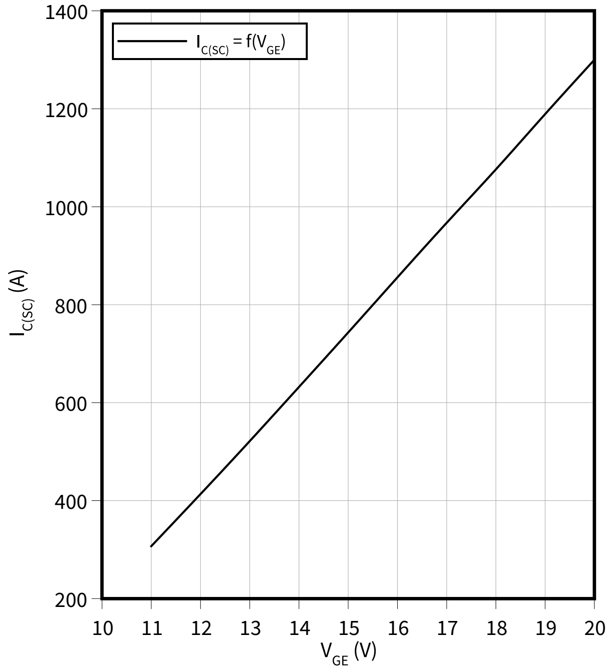
f = 100 kHz, V_{GE} = 0 V



Typical short circuit collector current as a function of gate-emitter voltage

$I_{C(SC)} = f(V_{GE})$

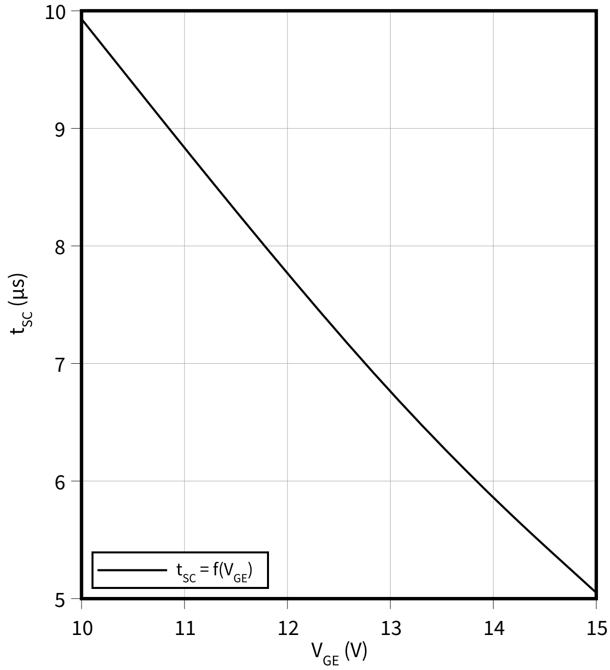
$T_{vj} \leq 175\ °C$, $V_{CC} \leq 470\ V$



Short circuit withstand time as a function of gate-emitter voltage

$t_{SC} = f(V_{GE})$

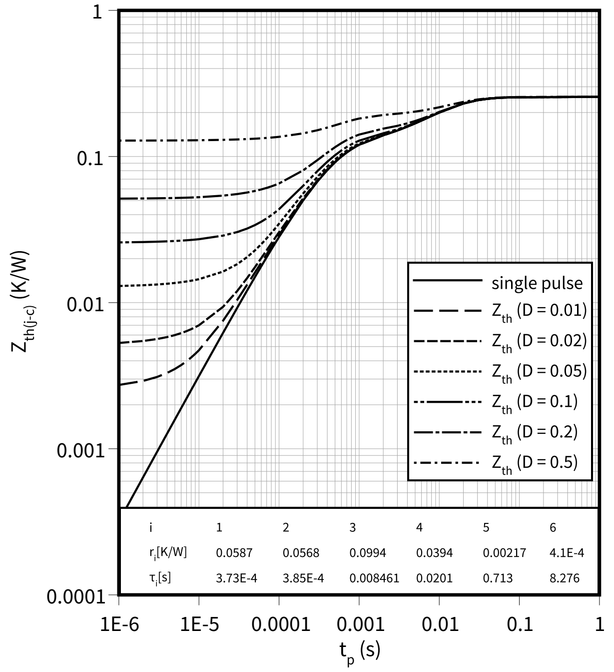
$T_{vj} \leq 175\ °C$, $V_{CC} \leq 470\ V$



IGBT transient thermal impedance as a function of pulse width

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

$D = t_p/T$

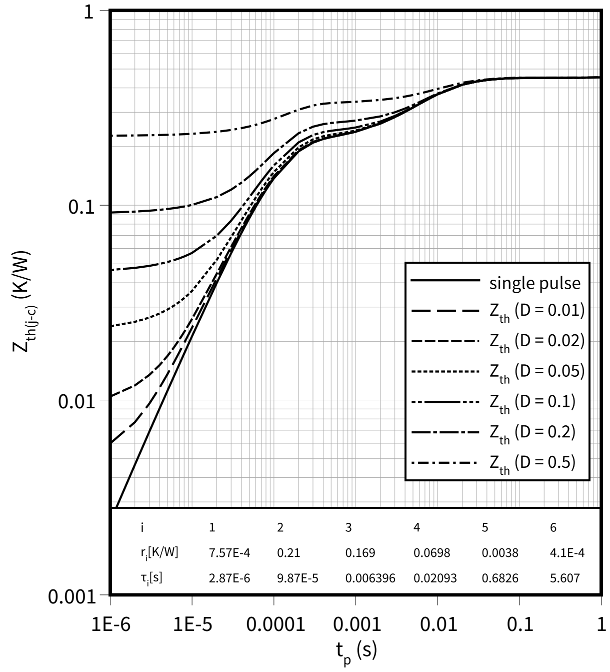


i	1	2	3	4	5	6
r_i[K/W]	0.0587	0.0568	0.0994	0.0394	0.00217	4.1E-4
$τ_i$[s]	3.73E-4	3.85E-4	0.008461	0.0201	0.713	8.276

Diode transient thermal impedance as a function of pulse width

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

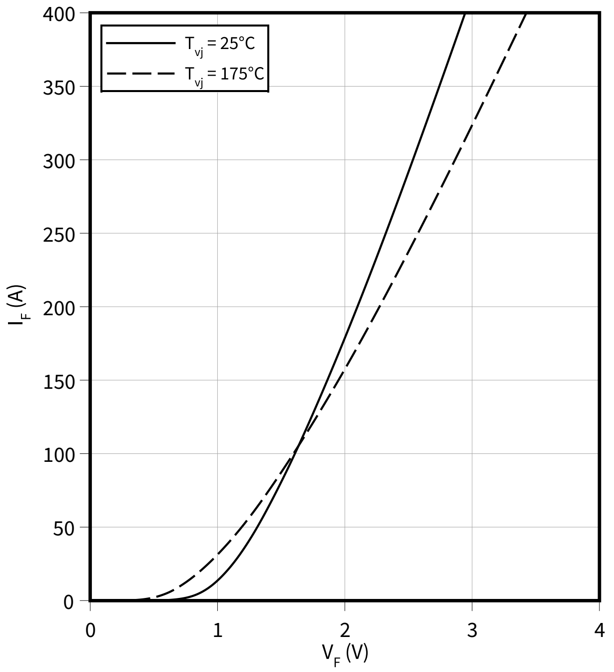
$D = t_p/T$



i	1	2	3	4	5	6
r_i[K/W]	7.57E-4	0.21	0.169	0.0698	0.0038	4.1E-4
$τ_i$[s]	2.87E-6	9.87E-5	0.006396	0.02093	0.6826	5.607

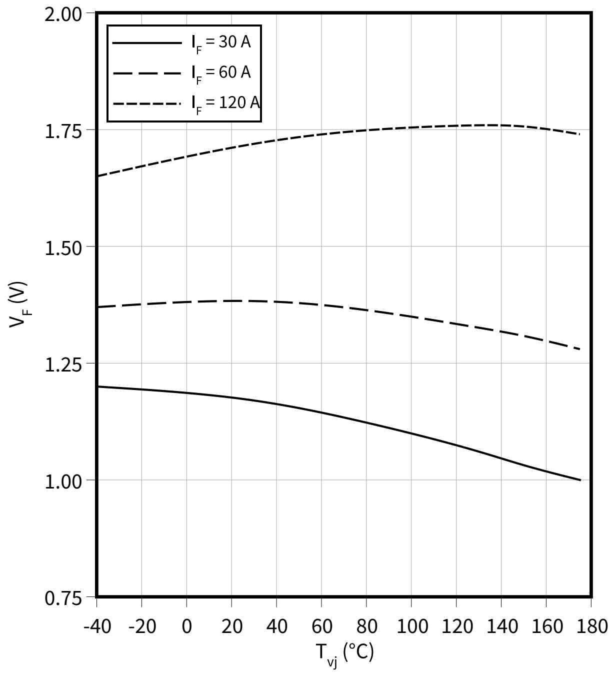
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

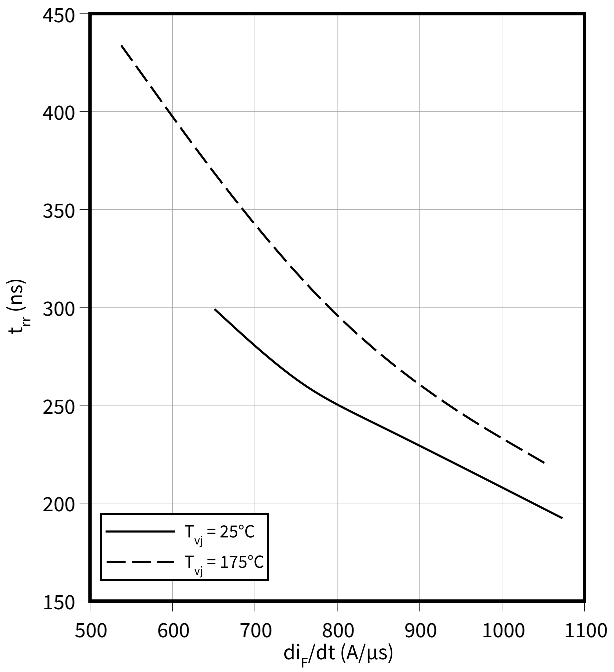
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

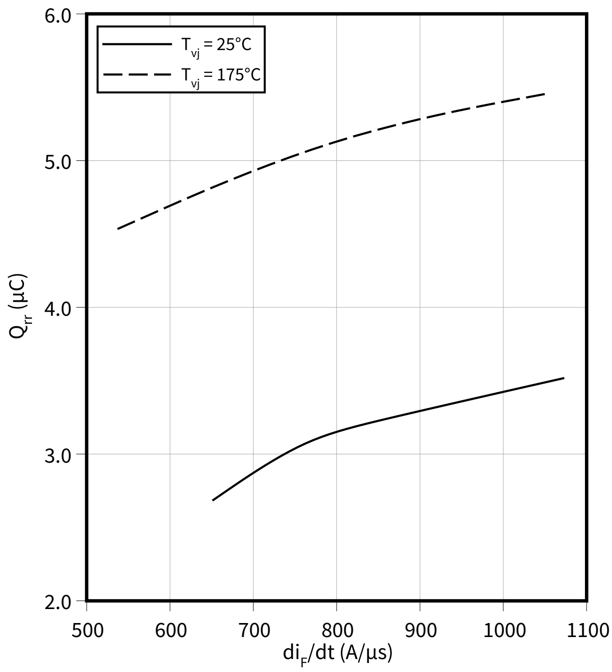
V_R = 470 V, I_F = 120 A



Typical reverse recovery charge as a function of diode current slope

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

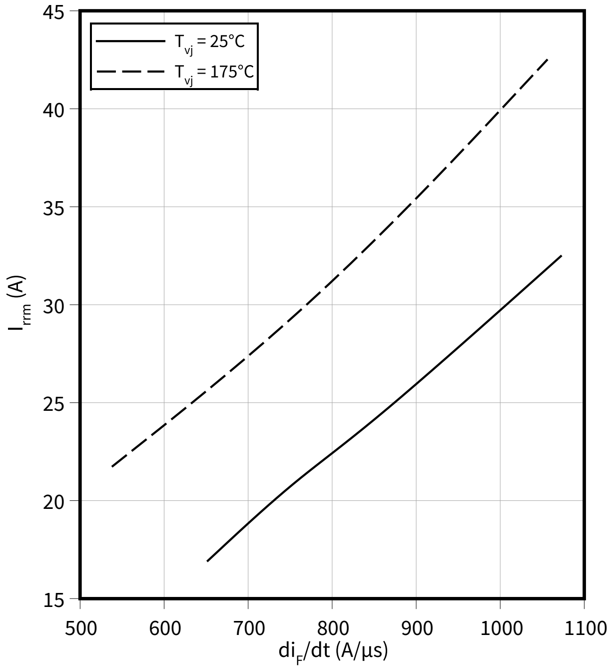
V_R = 470 V, I_F = 120 A



Typical reverse recovery current as a function of diode current slope

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

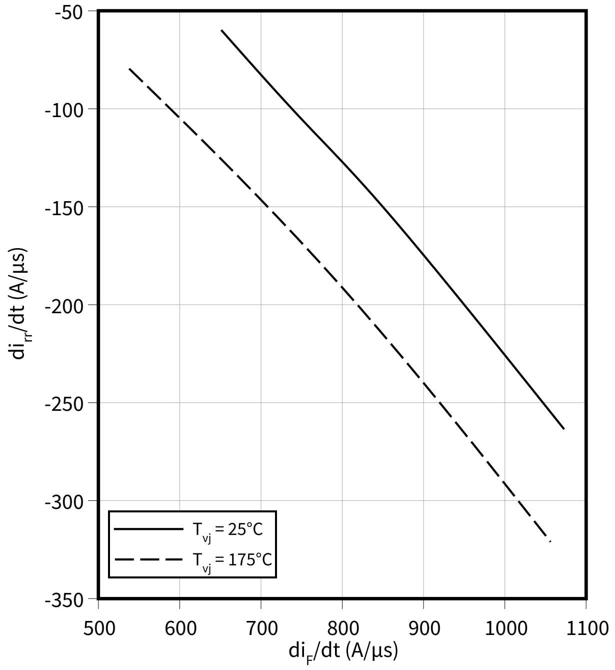
$V_R = 470\ V$, $I_F = 120\ A$



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

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

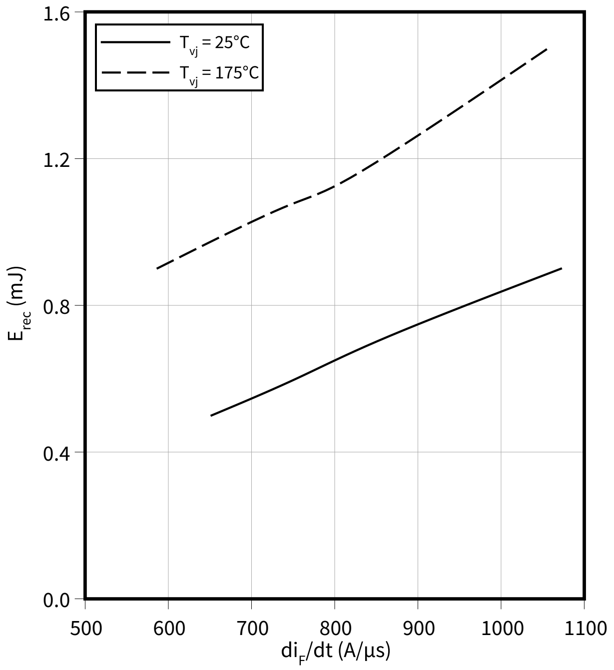
$V_R = 470\ V$, $I_F = 120\ A$



Typical reverse energy losses as a function of diode current slope

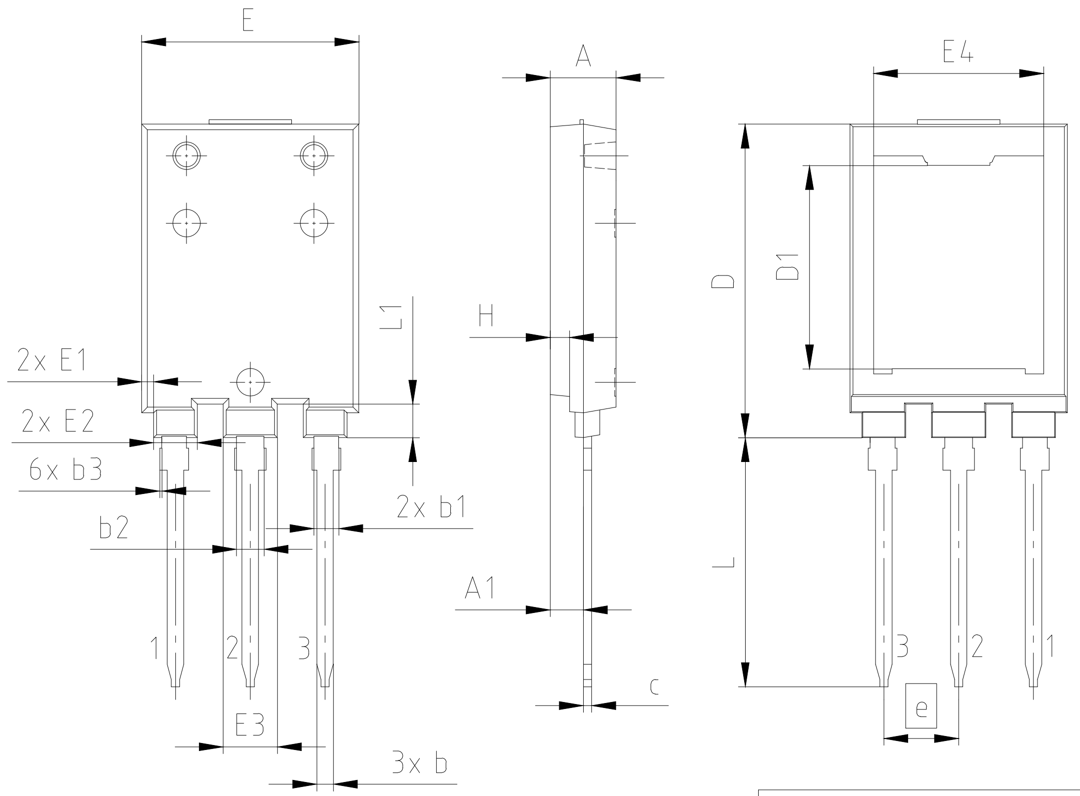
$E_{rec} = f(di_F/dt)$

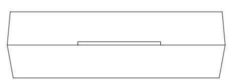
$V_R = V$, $I_F = 120\ A$



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

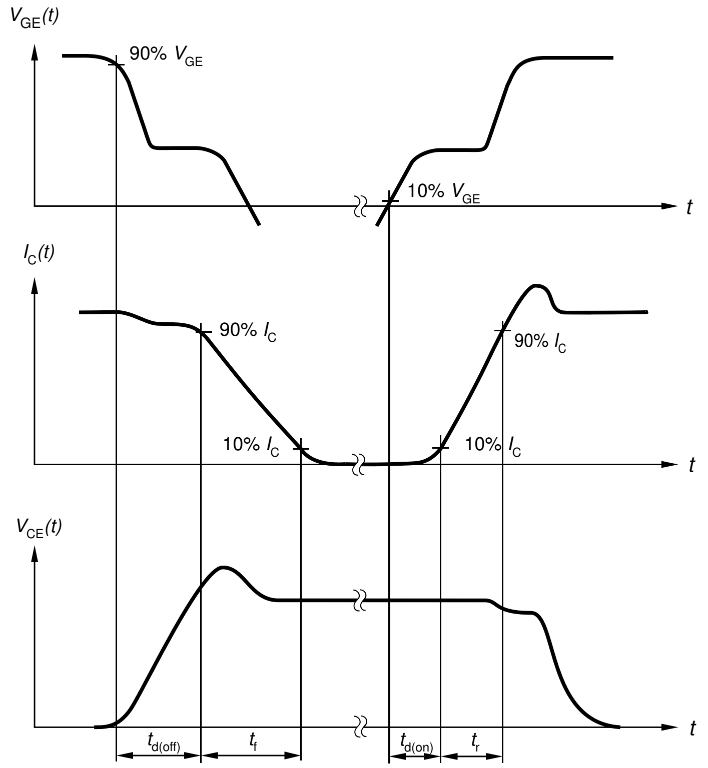


Figure A. **Definition of switching times**

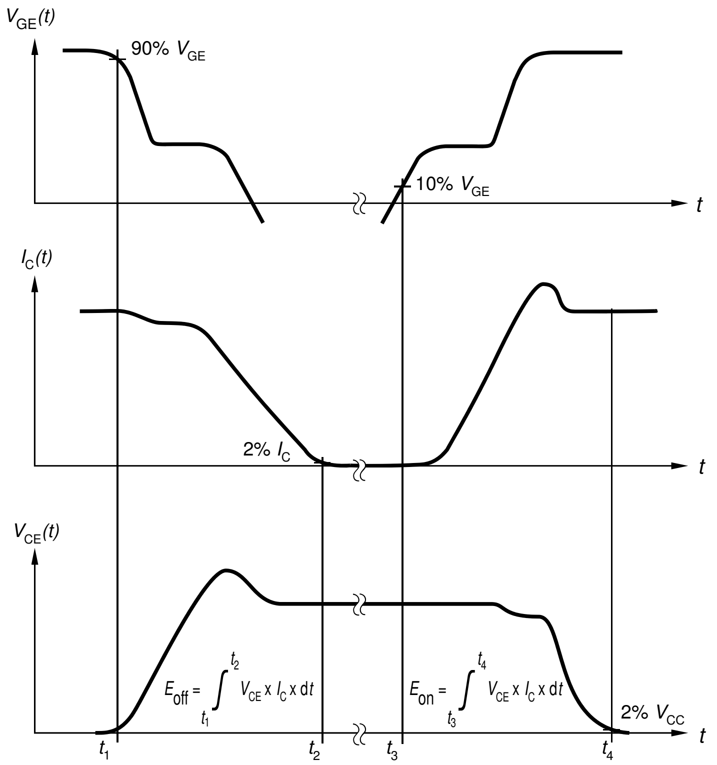


Figure B. **Definition of switching losses**

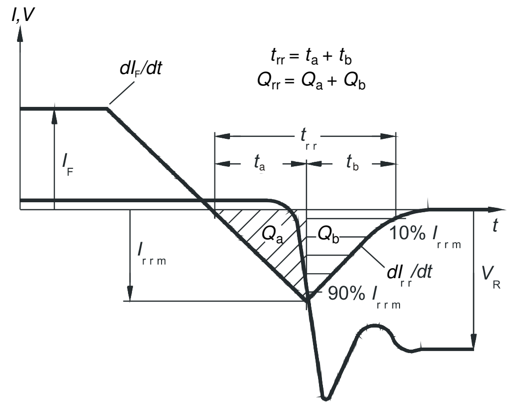


Figure C. **Definition of diode switching characteristics**

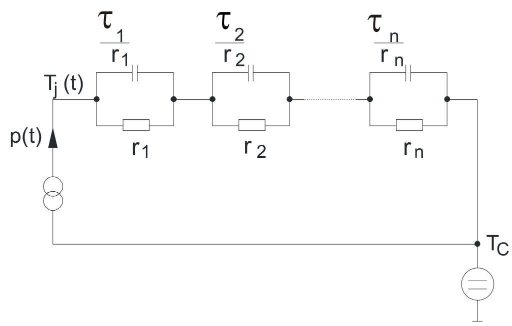


Figure D. **Thermal equivalent circuit**

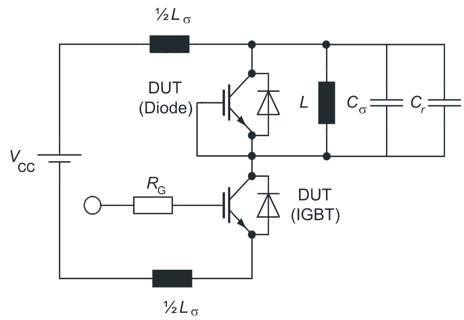


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ},
parasitic capacitor C_{σ},
relief capacitor C_r,
(only for ZVT switching)

Figure 2

Revision history

Document revision	Date of release	Description of changes
0.10	2023-02-21	Target datasheet
0.20	2024-02-21	Preliminary datasheet

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