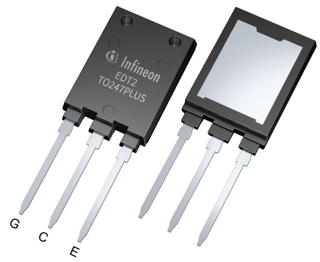
AIKQB160N75CP2

Short circuit rugged 750 V EDT2 IGBT in reflow-solderable package

Final datasheet

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



Halogen-free

RoHS

AEC Qualified

Features

- V_{CE} = 750 V
- I_C = 160 A
- Suitable for 470 V V_{DC} systems and increased overvoltage margin for 400 V V_{DC} systems
- Very low V_{CEsat} = 1.4 V (typ.) at I_{Cnom} = 160 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
- Drop-in replacement for I_C = 160 A, T_c = 100°C devices
- 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 diode (Emcon3)
- Low EMI signature
- TO247PLUS package with high creepage distance
- High reliability and operating lifetime
- Resistive weldable pins for direct busbar connections

Potential applications

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

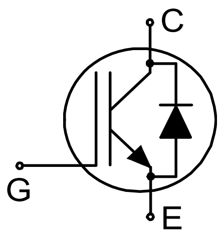
Product validation

- Qualified for automotive applications. Product Validation according to AEC-Q101
- Qualified Reflow device 260°C according to JEDEC J-STD-020 MSL2

Description

Package pin definition:

- Pin C & backside - collector
- Pin E - emitter
- Pin G - gate



Type	Package	Marking
AIKQB160N75CP2	PG-TO247-3-PLUS-NN8.5	AKQB16FCP

Table of contents

1 Package

Table 1 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Internal emitter inductance	L_E	simulated starting from L2 at 1 MHz		4.3		nH
Collector-emitter loop inductance	L_{CE}	simulated starting from L2 at 1 MHz		6		nH
Main emitter pin resistance	R_E	Simulated starting from L2 at 10 kHz		0.43		mΩ
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature	T_{sold}	reflow soldering (MSL2 according to JEDEC J-STD-020)			260	°C
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.15	0.2[1)]	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.28	0.36[1)]	K/W

1) Defined by simulation, not subject to production test

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	200	A
			$T_c = 100$ °C	160	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			480	A
Turn-off safe operating area		$V_{CE} \leq 750$ V, $T_{vj} \leq 175$ °C		480	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	750	W
			$T_c = 100$ °C	375	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	I_C = 160 A, V_{GE} = 15 V	T_{vj} = 25 °C	1.2	1.4	1.55	V
			T_{vj} = 175 °C		1.6		
Gate-emitter threshold voltage	V_{GEth}	I_C = 2.15 mA, V_{CE} = V_{GE}		5.2	5.8	6.4	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		5000		
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				100	nA
Transconductance	g_{fs}	I_C = 160 A, V_{CE} = 20 V			115		S
Short-circuit collector current	I_{SC}	V_{CC} ≤ 470 V, V_{GE} = -8/15 V, t_{SC} ≤ 5 µs, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, T_{vj} = 25 °C			1000		A
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			16450		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			435		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			76		pF
Gate charge	Q_G	V_{CC} = 600 V, I_C = 160 A, V_{GE} = -8/15 V			975		nC
Turn-on delay time	$t_{d(on)}$	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 = 160 A		72		ns
			T_{vj} = 175 °C, I_C = 160 A		71.3		
Rise time (inductive load)	t_r	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 = 160 A		101.3		ns
			T_{vj} = 175 °C, I_C = 160 A		99		
Turn-off delay time	$t_{d(off)}$	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 = 160 A		279		ns
			T_{vj} = 175 °C, I_C = 160 A		313		
Fall time (inductive load)	t_f	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 = 160 A		48		ns
			T_{vj} = 175 °C, I_C = 160 A		73		
Turn-on energy[1)]	E_{on}	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 = 160 A		10.6		mJ
			T_{vj} = 175 °C, I_C = 160 A		12		

(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 = 160 A		5.1		mJ
			T_{vj} = 175 °C, I_C = 160 A		6.8		
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 = 160 A		15.7		mJ
			T_{vj} = 175 °C, I_C = 160 A		18.8		
Operating junction temperature	T_{vj}			-40		175	°C

1) includes IGBT losses caused by the reverse recovery current

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	200	A
			T_c = 100 °C	160	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			480	A
Power dissipation	P_{tot}	T_{vj} = 175 °C	T_c = 25 °C	417	W
			T_c = 100 °C	208	

Table 5 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 160 A	T_{vj} = 25 °C	1.6	1.8	2	V
			T_{vj} = 175 °C		1.9		
Diode reverse recovery charge	Q_{rr}	V_R = 470 V, $R_{G(on)}$ = 5 Ω	T_{vj} = 25 °C, I_F = 160 A, $-di_F/dt$ = 1141 A/µs		3.5		µC
			T_{vj} = 175 °C, I_F = 160 A, $-di_F/dt$ = 1150 A/µs		7.1		

(table continues...)

Table 5 (continued) Characteristic values

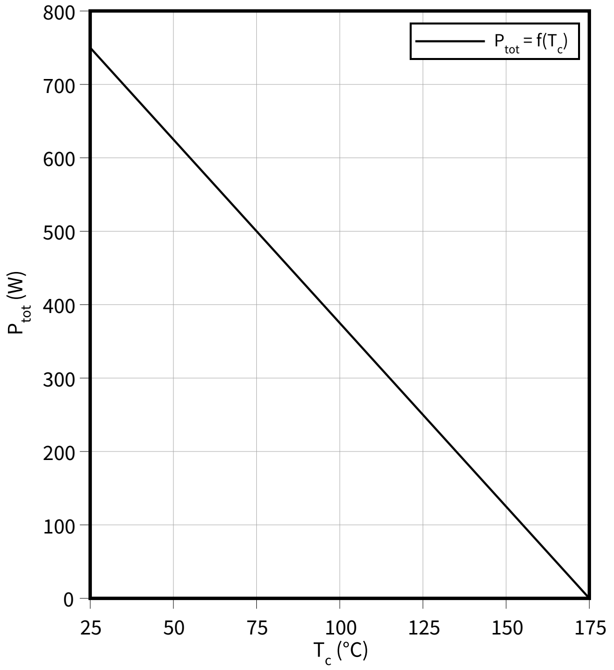
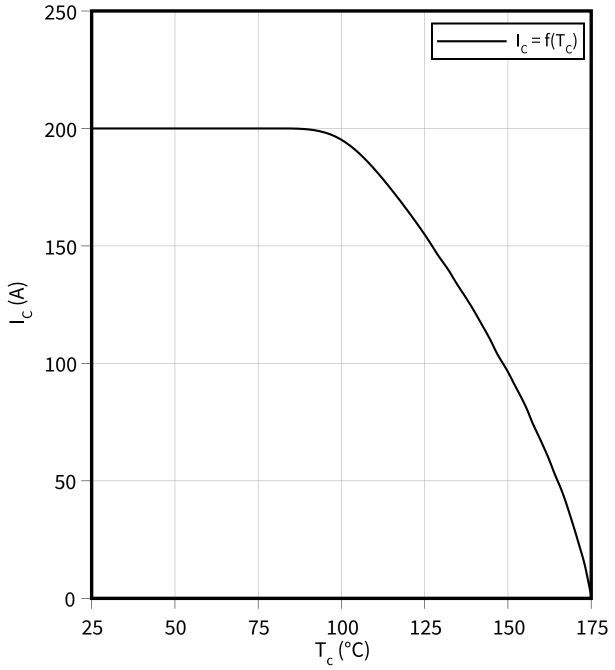
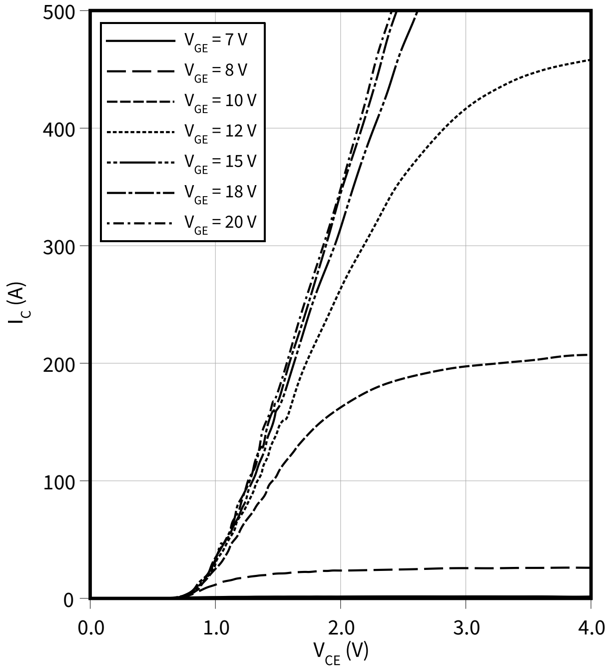
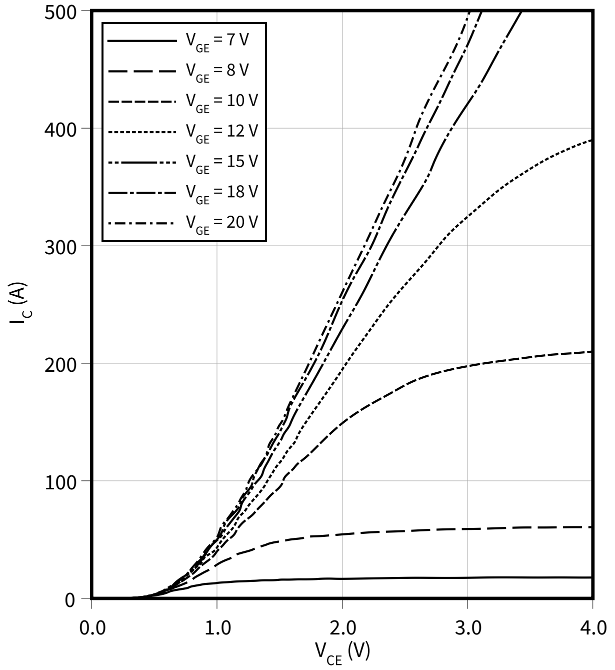
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak reverse recovery current	I_{rrm}	V_R = 470 V, $R_{G(on)}$ = 5 Ω	T_{vj} = 25 °C, I_F = 160 A, $-di_F/dt$ = 1141 A/µs		35.4		A
			T_{vj} = 175 °C, I_F = 160 A, $-di_F/dt$ = 1150 A/µs		54.9		
Reverse recovery energy	E_{rec}	V_R = 470 V, $R_{G(on)}$ = 5 Ω, $L_σ$ = 50 nH, $C_σ$ = 30 pF	T_{vj} = 25 °C, I_F = 160 A, $-di_F/dt$ = 1141 A/µs		0.9		mJ
			T_{vj} = 175 °C, I_F = 160 A, $-di_F/dt$ = 1150 A/µs		1.9		
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.

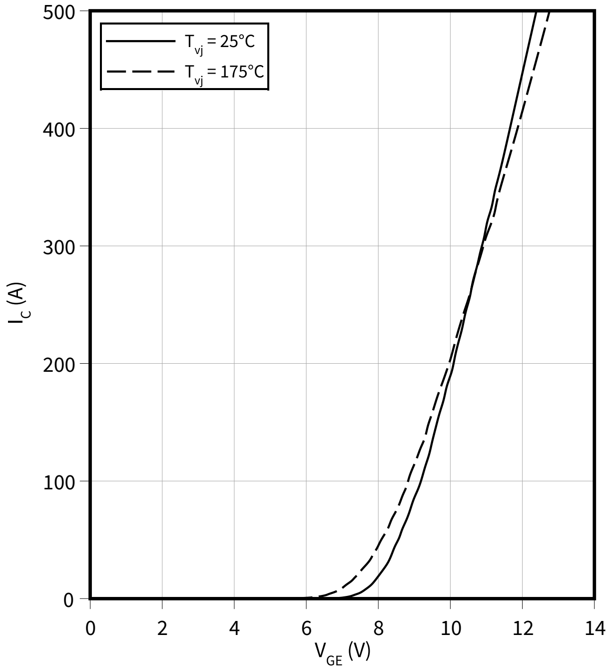
4 Characteristics diagrams

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

$I_C = f(V_{GE})$

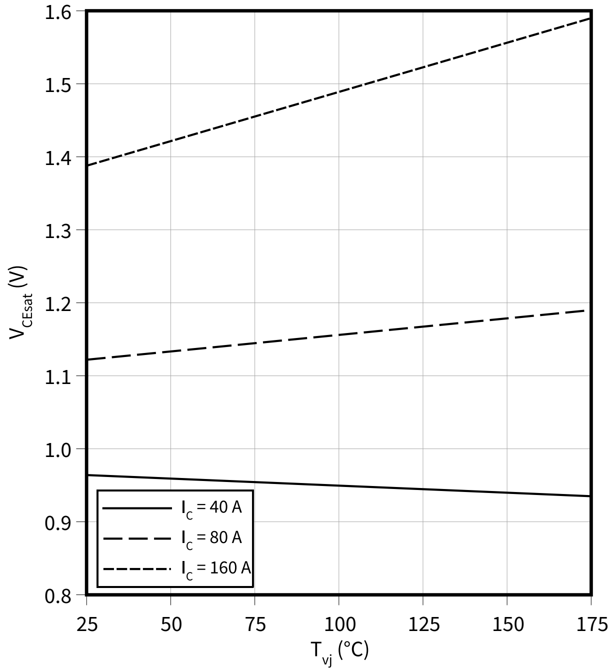
$V_{CE} = 20$ V



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

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

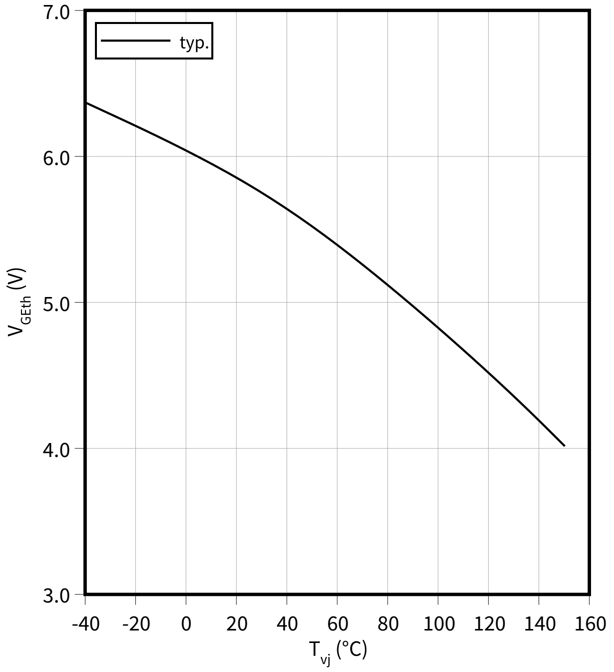
$V_{GE} = 15$ V



Gate-emitter threshold voltage as a function of junction temperature

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

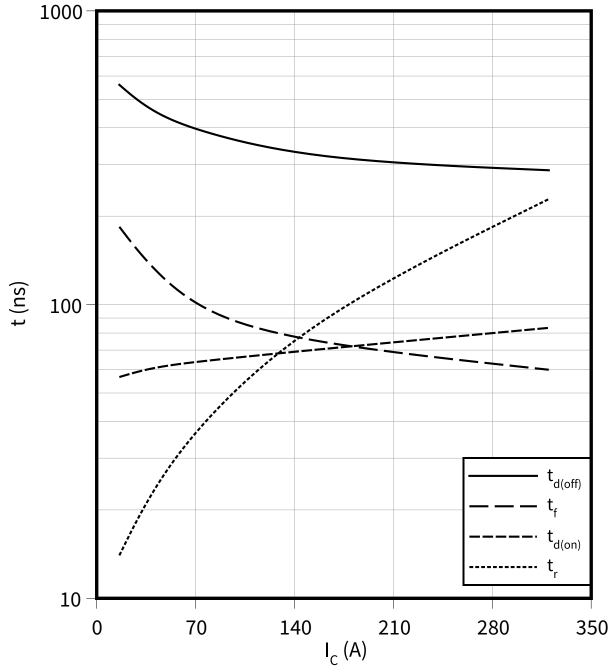
$I_C = 2$ mA



Typical switching times as a function of collector current

$t = f(I_C)$

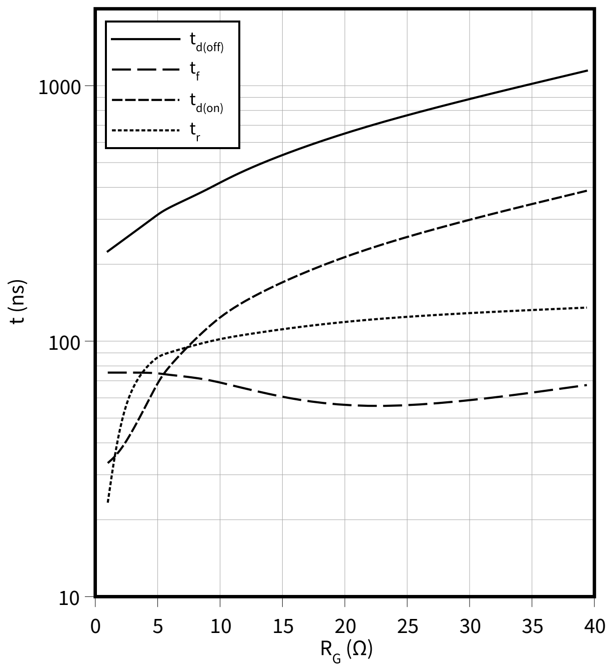
$V_{CC} = 470$ V, $T_{vj} = 175$ °C, $V_{GE} = -8/15$ V, $R_G = 5\ \Omega$



Typical switching times as a function of gate resistor

$t = f(R_G)$

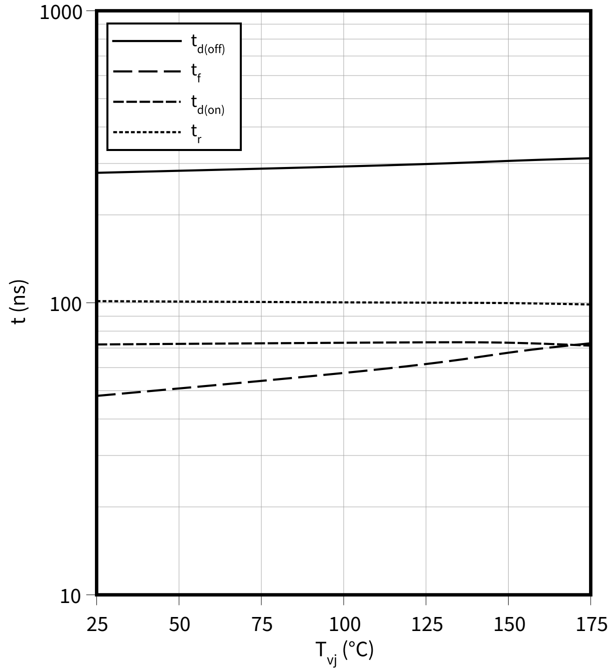
I_C = 160 A, V_{CC} = 470 V, T_{vj} = 175 °C, V_{GE} = -8/15 V



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

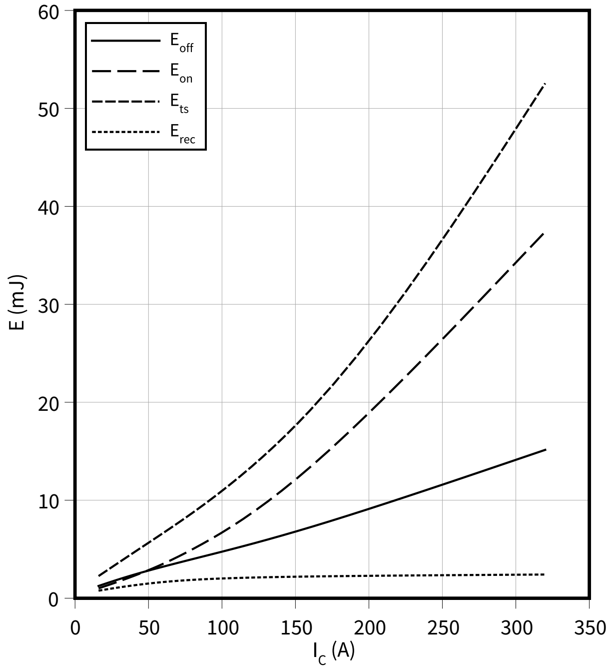
I_C = 160 A, V_{CC} = 470 V, V_{GE} = -8/15 V, R_G = 5 Ω



Typical switching energy losses as a function of collector current

$E = f(I_C)$

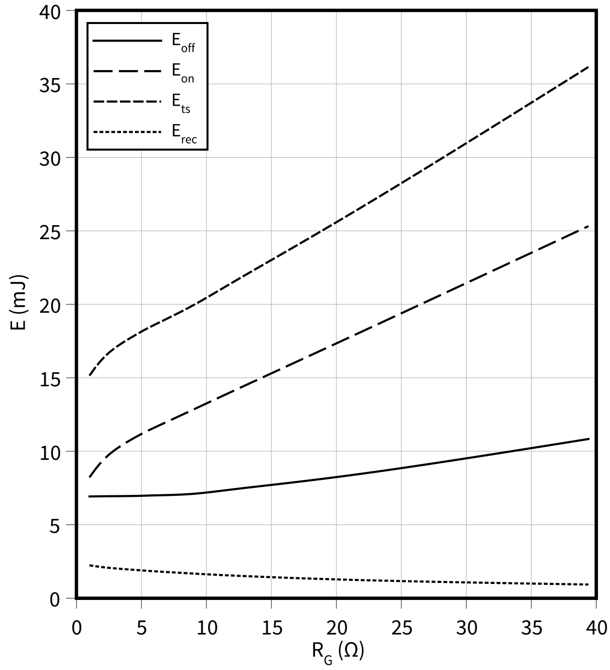
V_{CC} = 470 V, T_{vj} = 175 °C, V_{GE} = -8/15 V, R_G = 5 Ω



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

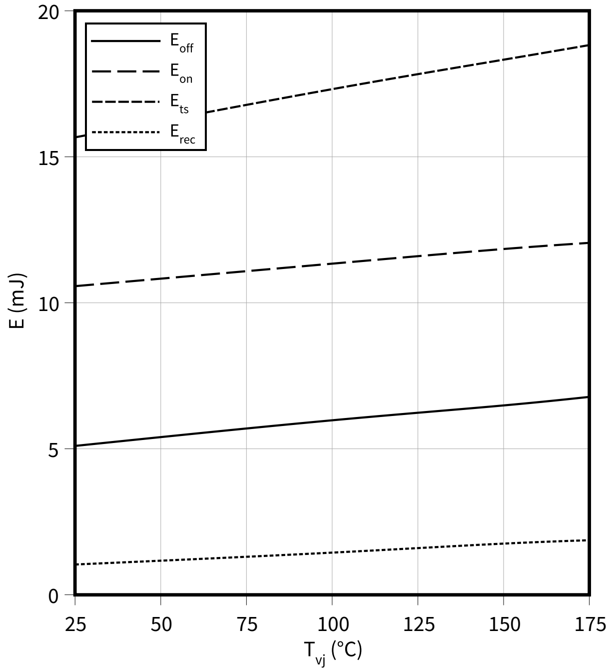
I_C = 160 A, V_{CC} = 470 V, T_{vj} = 175 °C, V_{GE} = -8/15 V



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

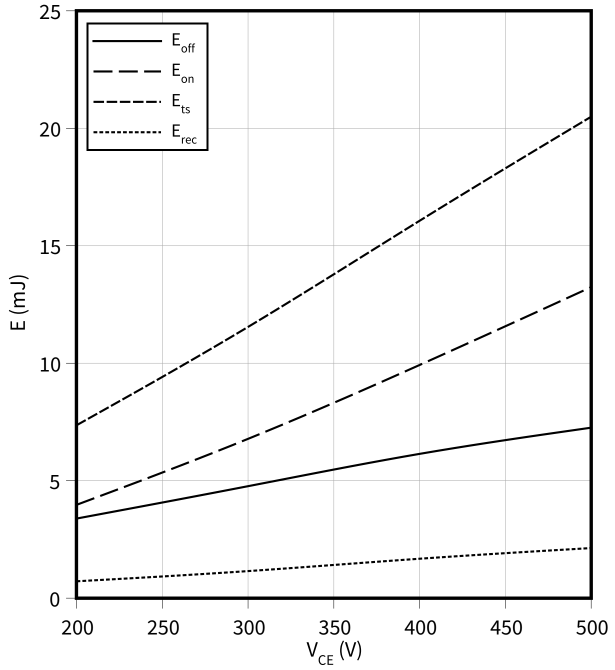
I_C = 160 A, V_{CC} = 470 V, V_{GE} = -8/15 V, R_G = 5 Ω



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

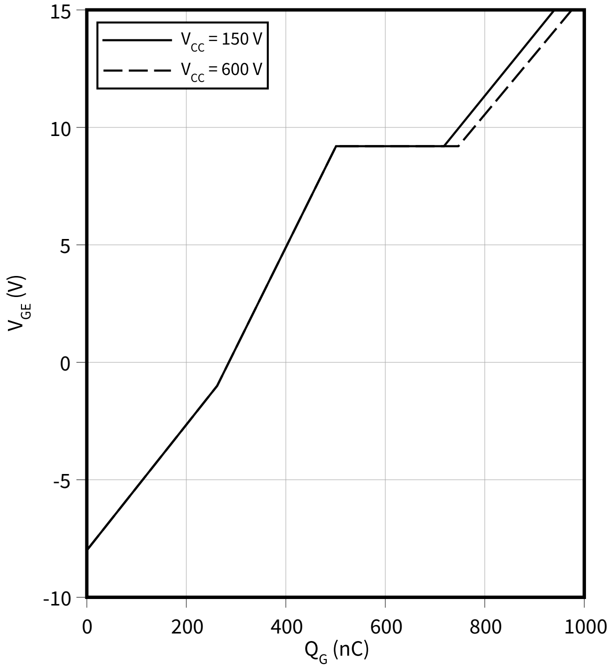
I_C = 160 A, T_{vj} = 175 °C, V_{GE} = -8/15 V, R_G = 5 Ω



Typical gate charge

$V_{GE} = f(Q_G)$

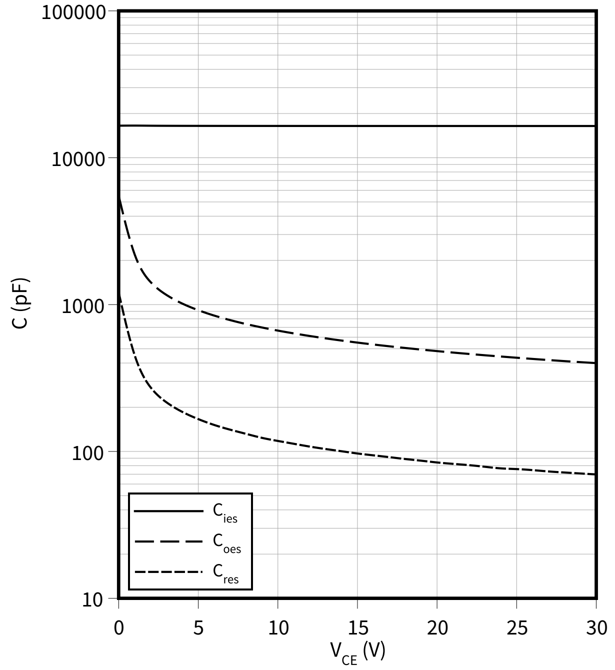
I_C = 160 A



Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

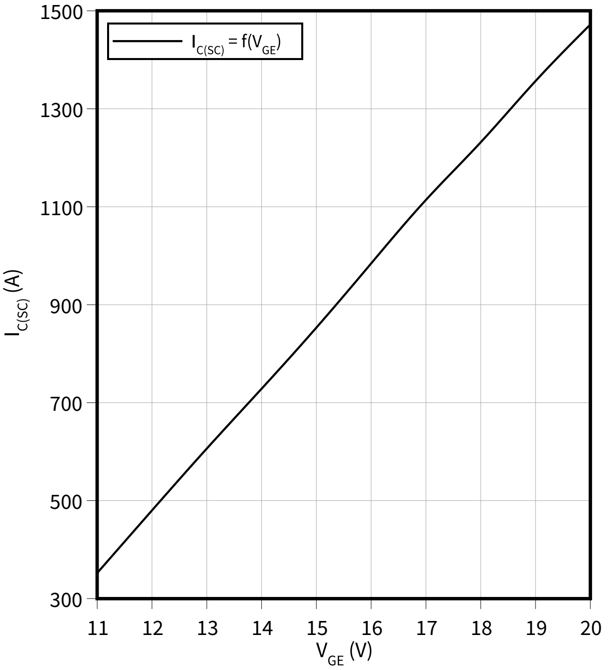
f = 1000 kHz, V_{GE} = 0 V



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

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

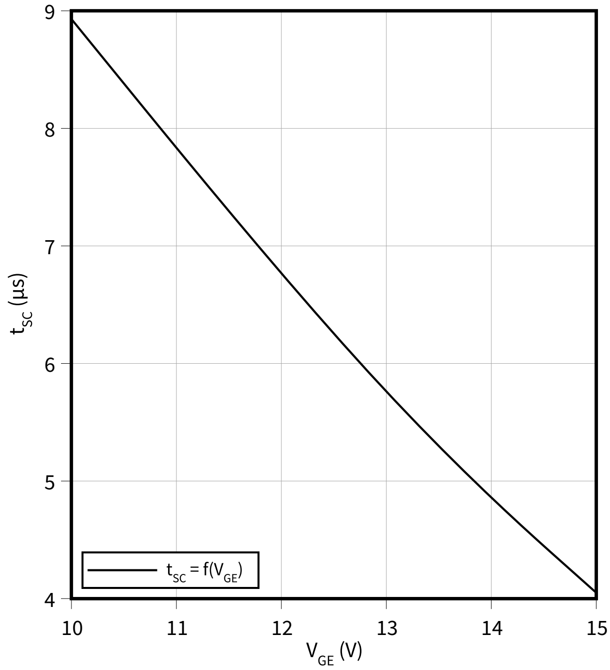
$V_{CE} \leq 470$ V, $T_{vj} \leq 175$ °C



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

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

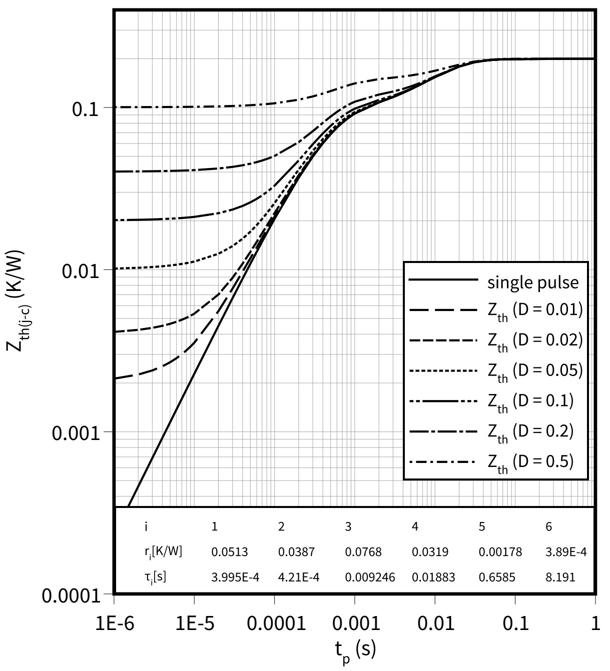
$T_{vj} \leq 175$ °C, $V_{CE} \leq 470$ V



IGBT transient thermal impedance as a function of pulse width

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

$D = t_p/T$

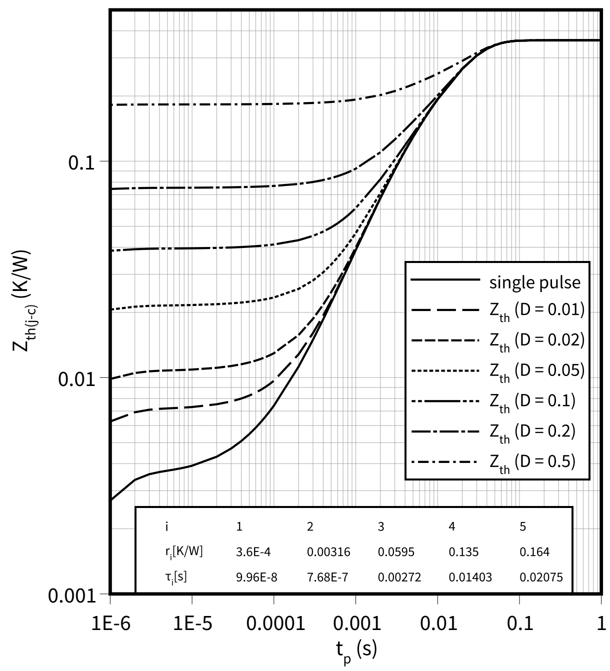


i	1	2	3	4	5	6
r_i[K/W]	0.0513	0.0387	0.0768	0.0319	0.00178	3.89E-4
τ_i[s]	3.995E-4	4.21E-4	0.009246	0.01883	0.6585	8.191

Diode transient thermal impedance as a function of pulse width

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

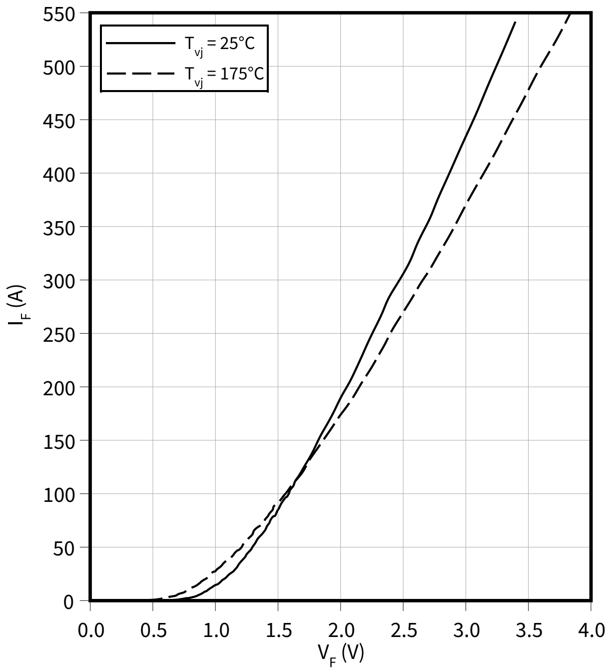
$D = t_p/T$



i	1	2	3	4	5
r_i[K/W]	3.6E-4	0.00316	0.0595	0.135	0.164
τ_i[s]	9.96E-8	7.68E-7	0.00272	0.01403	0.02075

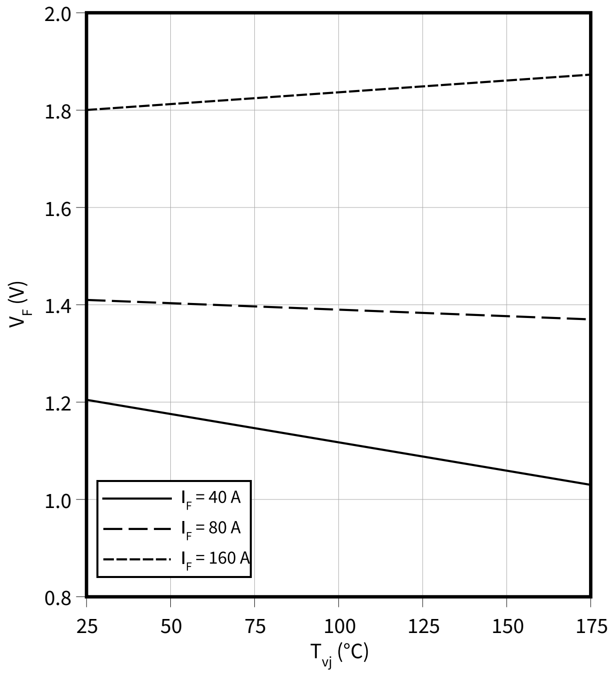
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

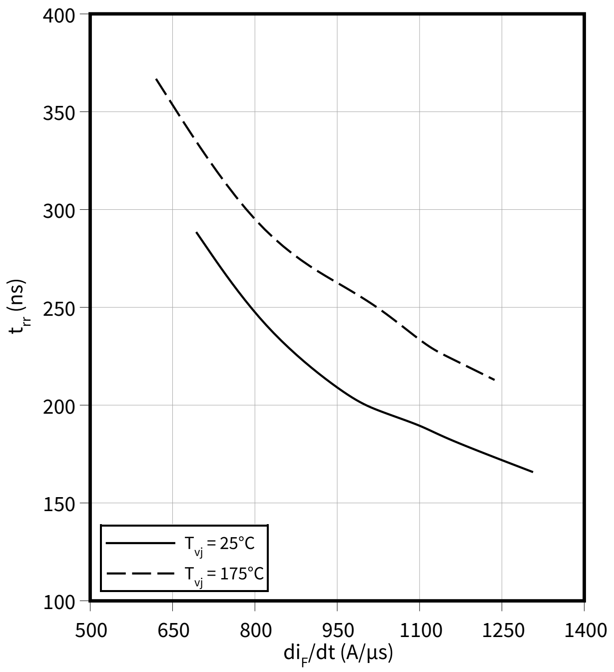
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

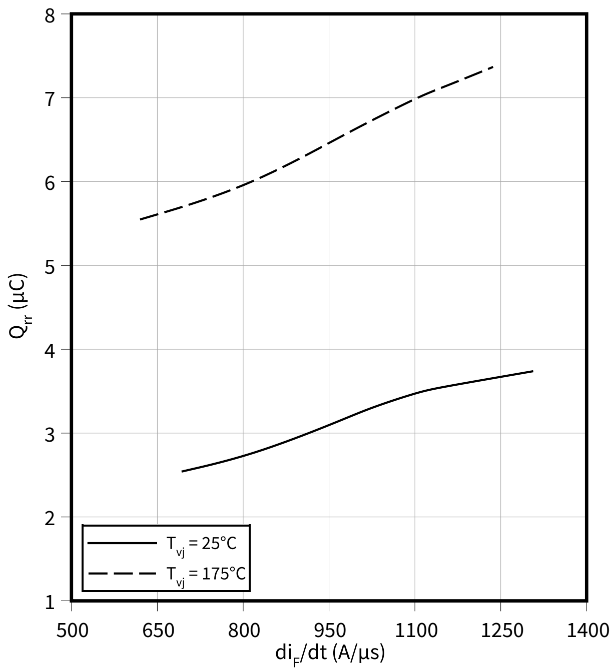
$V_R = 470$ V, $I_F = 160$ A

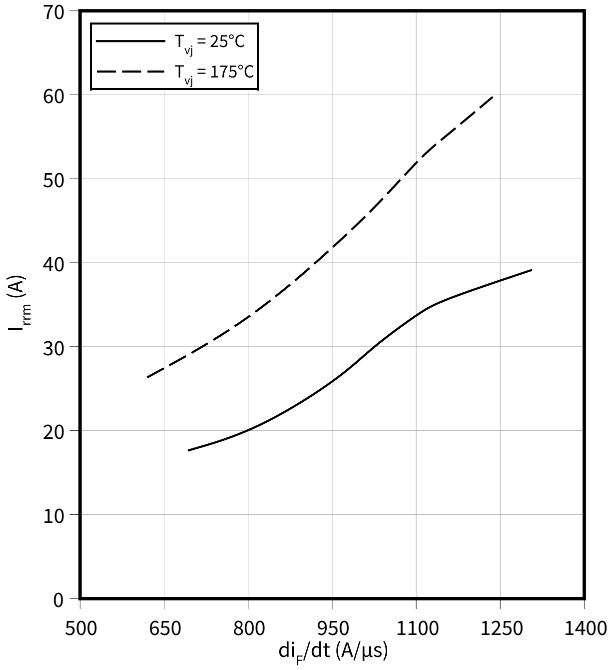
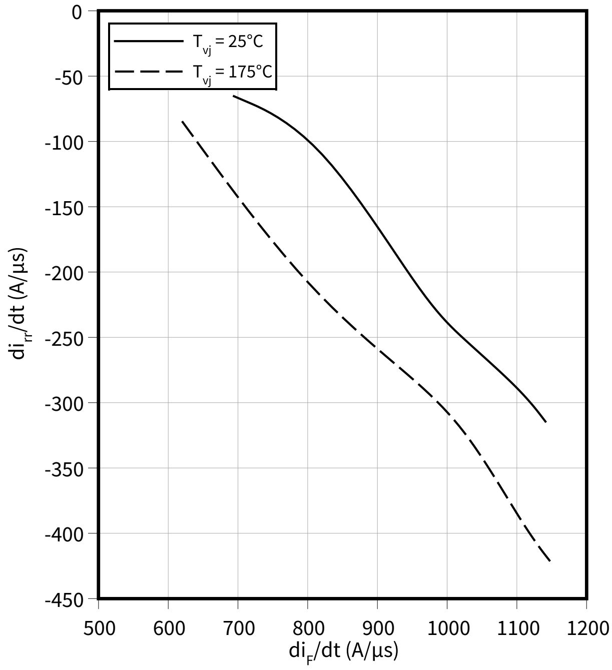
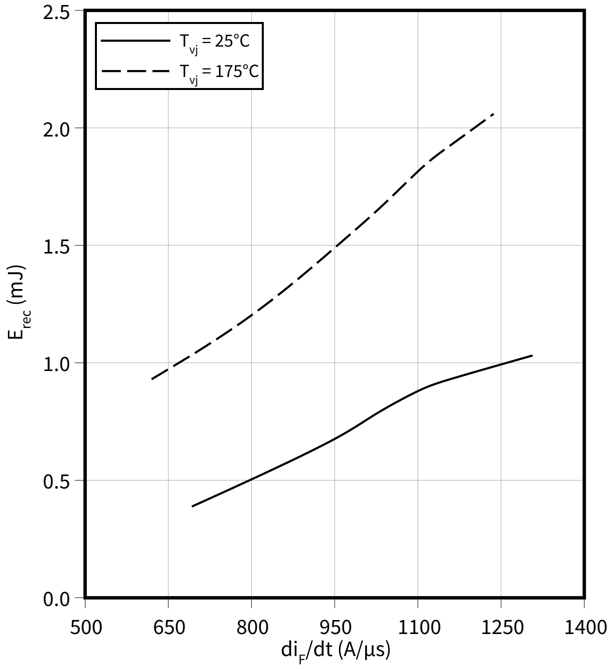
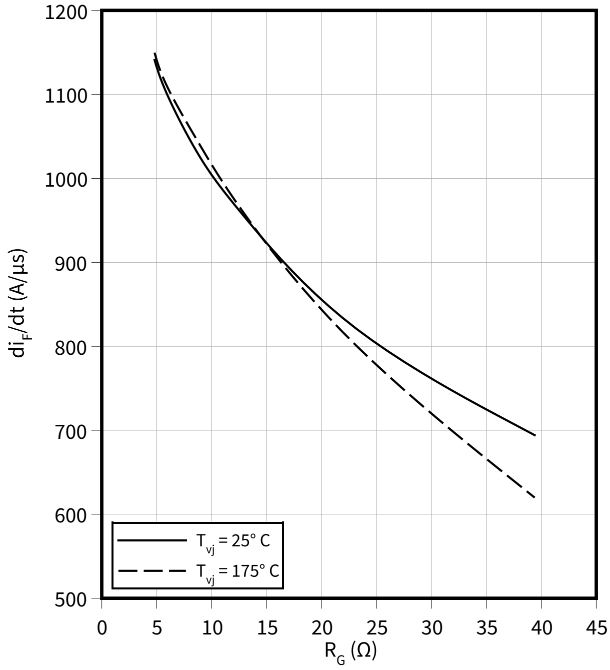


Typical reverse recovery charge as a function of diode current slope

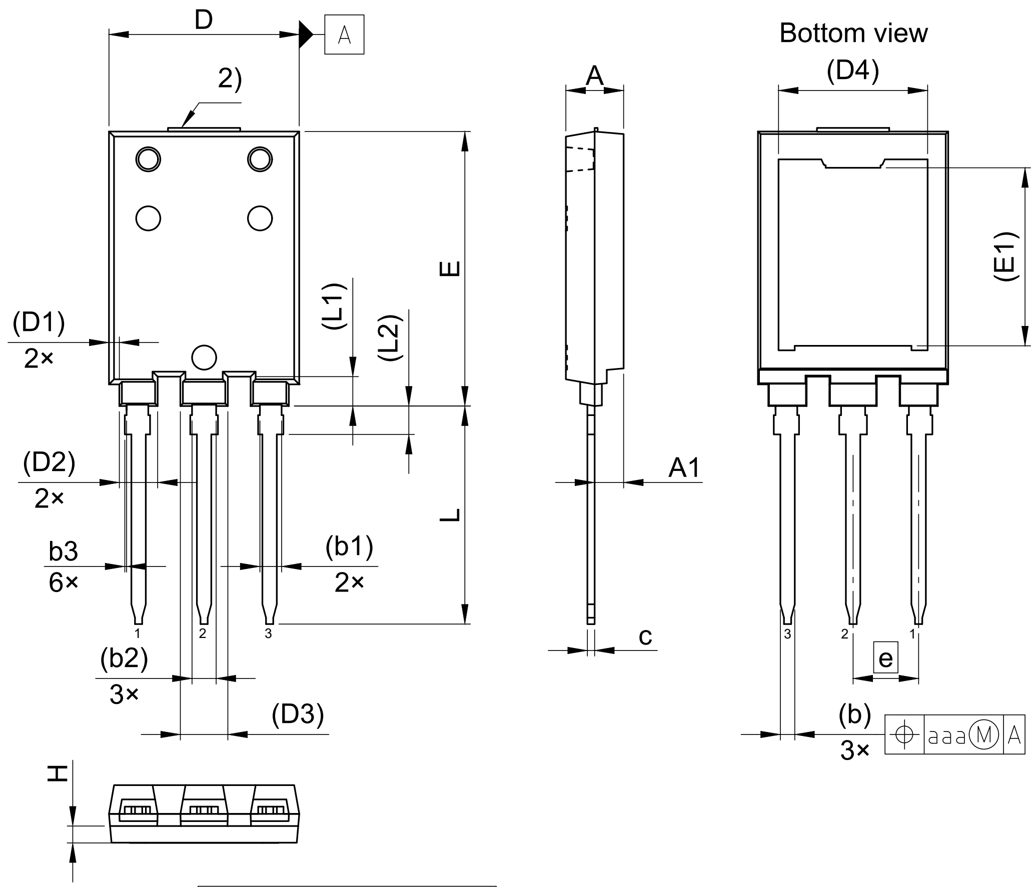
$Q_{rr} = f(di_F/dt)$

$V_R = 470$ V, $I_F = 160$ A



Typical reverse recovery current as a function of diode current slope $I_{rrm} = f(di_F/dt)$ $V_R = 470$ V, $I_F = 160$ 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, $I_F = 160$ A
	
Typical reverse energy losses as a function of diode current slope $E_{rec} = f(di_F/dt)$ $V_R = 470$ V, $I_F = 160$ A	**Typical diode current slope as a function of gate resistor** $di_F/dt = f(R_G)$ $V_R = 470$ V, $I_F = 160$ A
	

5 Package outlines



PACKAGE - GROUP NUMBER: **PG-TO247-3-U02**		
DIMENSIONS	**MILLIMETERS**	
	MIN.	MAX.
A	4.7	4.9
A1	2.16	2.66
b	1.2	
b1	1.8	
b2	2	
b3	0	0.15
c	0.5	0.7
D	15.7	15.9
D1	0.86	
D2	3.18	

DIMENSIONS	**MILLIMETERS**	
	MIN.	MAX.
D3	3.94	
D4	12.38	
E	22.7	22.9
E1	14.79	
e	5.44	
H	1.3	1.5
L	18.01	18.21
L1	2.44	
L2	2.36	
aaa	0.25	

1) All metal surfaces tin plated except area of cut
2) Mold gate protrusion after degating
All dimensions are in units mm
The drawing is in compliance with ISO 128-30, Projection Method 3 [⌖ ⊲]
Drawing according to ISO 8015, general tolerances

Figure 1

6 Testing conditions

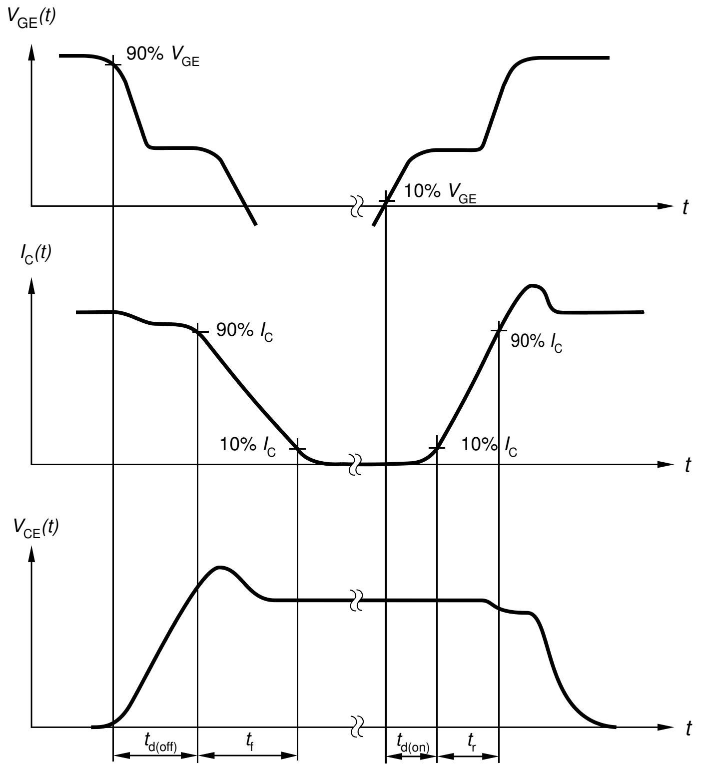


Figure A. **Definition of switching times**

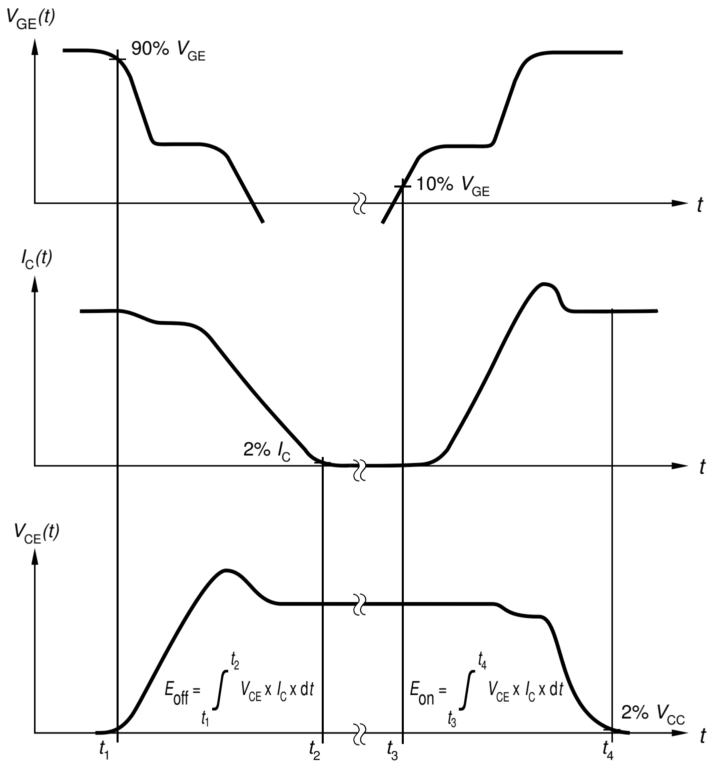


Figure B. **Definition of switching losses**

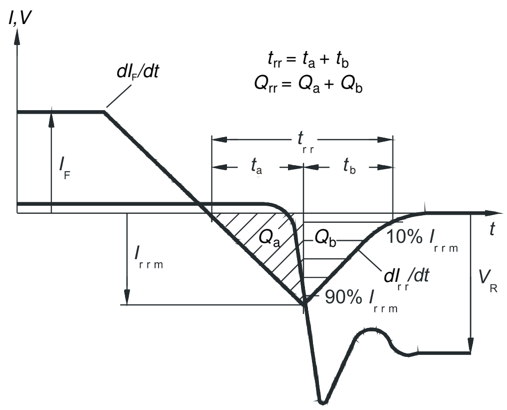


Figure C. **Definition of diode switching characteristics**

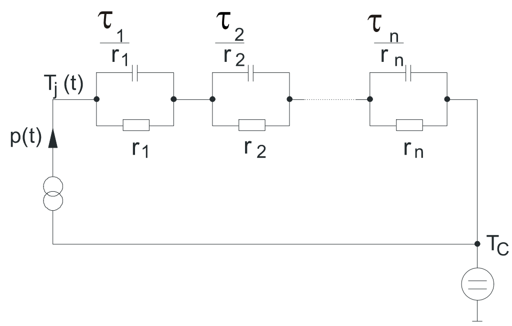


Figure D. **Thermal equivalent circuit**

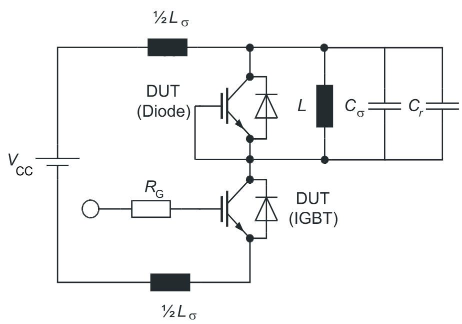


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 2

Revision history

Document revision	Date of release	Description of changes
0.10	2023-02-21	Target datasheet
0.20	2024-02-22	Preliminary datasheet
1.00	2024-07-24	Final datasheet

Trademarks

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

Edition 2024-07-25

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-ABB424-003