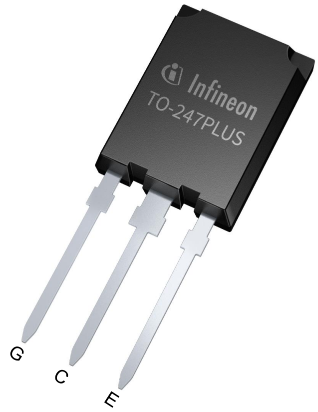
EDT2 IGBT and emitter controlled diode in TO247PLUS package

Features

- V_{CE} = 750 V
- I_C = 200 A
- Best-in-class highest power density, I_C = 200 A
- 750 V collector-emitter blocking voltage capability
- Suitable for 470 V V_{DC} systems and increase overvoltage margin for 400 V V_{DC} systems
- Very low $V_{CE(sat)}$, 1.30 V at I_{Cnom} = 200 A, 25°C
- Short circuit robust t_{sc} = 5 µs at V_{CE} = 470 V, V_{GE} = 15 V
- Self limiting current under short circuit condition
- Positive thermal coefficient and very tight parameter distribution for easy paralleling
- A Reduced number of parallel devices is required due to I_{nom} = 200 A
- Excellent current sharing in parallel operation
- Smooth switching characteristics, low EMI signature
- Low gate charge Q_G
- Simple gate drive design
- Co-packed with fast soft recovery emitter controlled 3 diode
- TO247PLUS package with high creepage distance
- High reliability



AEC Qualified

Lead-Free

Green

Halogen-Free

RoHS

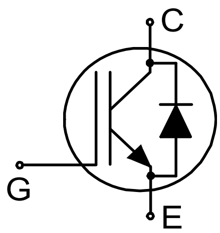
Potential applications

- xEV Inverter
- DC-link discharge switch
- Automotive aux-drives

Product validation

- Qualified for automotive applications
- Qualified according to AEC-Q101

Description



Type	Package	Marking
AIKQ200N75CP2	PG-TO247PLUS-3	AKQ20FCP

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			13.0		nH
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature		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

2 IGBT

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}			750	V
DC collector current, limited by T_{vjmax}	I_C		T_c = 25 °C	200	A
			T_c = 100 °C	200	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			600	A
Turn-off safe operating area		V_{CE} ≤ 750 V, t_p = 1 µs, T_{vj} ≤ 175 °C		600	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	t_p<0.1 µs, D<0.01		±30	V
Short-circuit withstand time	t_{SC}	V_{CC} ≤ 470 V, V_{GE}=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_c = 25 °C	1071	W
			T_c = 100 °C	535	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	I_C = 200 A, V_{GE}=15 V	T_{vj} = 25 °C		1.3	1.5	V
			T_{vj} = 175 °C		1.6		
Gate-emitter threshold voltage	V_{GEth}	I_C = 2.60 mA, V_{CE} = V_{GE}, T_{vj}=25 °C		5	5.8	6.5	V

(table continues...)

Table 3 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
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 = 200 A, V_{CE}=20 V			140		S
Short-circuit collector current	I_{SC}	V_{CC} ≤ 470 V, V_{GE}=15 V, t_{SC} ≤ 5 µs, Allowed number of short circuits < 1000 , Time between short circuits ≥ 1.0 s, T_{vj}=25 °C			1100		A
Input capacitance	C_{ies}	V_{CE}=25 V, V_{GE}=0 V, f=100 kHz			21250		pF
Output capacitance	C_{oes}	V_{CE}=25 V, V_{GE}=0 V, f=100 kHz			535		pF
Reverse transfer capacitance	C_{res}	V_{CE}=25 V, V_{GE}=0 V, f=100 kHz			93		pF
Gate charge	Q_G	I_C = 200 A, V_{GE}=15 V, V_{CE}=600 V			1256		nC
Turn-on delay time	t_{don}	V_{CE} = 470 V, V_{GE} = -8/15 V, R_{Gon} = 5.0 Ω, R_{Goff} = 5.0 Ω, $L_σ$=50 nH, $C_σ$=30 pF	T_{vj} = 25 °C, I_C = 200 A		89		ns
			T_{vj} = 175 °C, I_C = 200 A		85		
Rise time (inductive load)	t_r	V_{CE} = 470 V, V_{GE} = -8/15 V, R_{Gon} = 5.0 Ω, R_{Goff} = 5.0 Ω, $L_σ$=50 nH, $C_σ$=30 pF	T_{vj} = 25 °C, I_C = 200 A		120		ns
			T_{vj} = 175 °C, I_C = 200 A		117		
Turn-off delay time	t_{doff}	V_{CE} = 470 V, V_{GE} = -8/15 V, R_{Gon} = 5.0 Ω, R_{Goff} = 5.0 Ω, $L_σ$=50 nH, $C_σ$=30 pF	T_{vj} = 25 °C, I_C = 200 A		266		ns
			T_{vj} = 175 °C, I_C = 200 A		284		
Fall time (inductive load)	t_f	V_{CE} = 470 V, V_{GE} = -8/15 V, R_{Gon} = 5.0 Ω, R_{Goff} = 5.0 Ω, $L_σ$=50 nH, $C_σ$=30 pF	T_{vj} = 25 °C, I_C = 200 A		46		ns
			T_{vj} = 175 °C, I_C = 200 A		60		
Turn-on energy[1)]	E_{on}	V_{CE} = 470 V, V_{GE} = -8/15 V, R_{Gon} = 5.0 Ω, R_{Goff} = 5.0 Ω, $L_σ$=50 nH, $C_σ$=30 pF	T_{vj} = 25 °C, I_C = 200 A		15.3		mJ
			T_{vj} = 175 °C, I_C = 200 A		16.3		
Turn-off energy	E_{off}	V_{CE} = 470 V, V_{GE} = -8/15 V, R_{Gon} = 5.0 Ω, R_{Goff} = 5.0 Ω, $L_σ$=50 nH, $C_σ$=30 pF	T_{vj} = 25 °C, I_C = 200 A		7		mJ
			T_{vj} = 175 °C, I_C = 200 A		8.1		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values Min.	Typ.	Max.	Unit
Total switching energy	E_{ts}	V_{CE} = 470 V, V_{GE} = -8/15 V, R_{Gon} = 5.0 Ω, R_{Goff} = 5.0 Ω, $L_σ$=50 nH, $C_σ$=30 pF	T_{vj} = 25 °C, I_C = 200 A		22.3		mJ
			T_{vj} = 175 °C, I_C = 200 A		24.4		
IGBT thermal resistance, junction to case[2)]	R_{thjc}					0.14	K/W
Operating junction temperature	T_{vj}			-40		175	°C

1) Includes reverse recovery losses
2) Not subject to production test - specified by simulation

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	200	
Diode pulsed current, limited by T_{vjmax}	I_{Fpulse}			600	A
Power dissipation	P_{tot}		T_C = 25 °C	576	W
			T_C = 100 °C	288	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values Min.	Typ.	Max.	Unit
Diode forward voltage	V_F	I_F = 200 A	T_{vj}=25 °C		1.8	1.95	V
			T_{vj}=175 °C		1.9		
Diode reverse recovery charge	Q_{rr}	V_R<470 V, R_{Gon} = 4.8 Ω	T_{vj} = 25 °C, I_F = 200 A, $-di_F/dt$ = 1060 A/µs		4.700		µC
			T_{vj} = 175 °C, I_F = 200 A, $-di_F/dt$ = 1110 A/µs		7.500		

(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_{Gon} = 4.8 Ω	T_{vj} = 25 °C, I_F = 200 A, -di_F/dt = 1060 A/µs		41.0		A
			T_{vj} = 175 °C, I_F = 200 A, -di_F/dt = 1110 A/µs		56.0		
Reverse recovery energy	E_{rec}	V_R<470 V, V_{GE} = -8/15 V, R_{Gon} = 4.8 Ω, $L_σ$ = 50 nH, $C_σ$ = 30 pF	-di_F/dt = 1060 A/µs , T_{vj}=25 °C		1.32		mJ
			-di_F/dt = 1110 A/µs , T_{vj}=175 °C		2.16		
Diode thermal resistance, junction to case[1)]	R_{thjc}					0.26	K/W
Operating junction temperature	T_{vj}			-40		175	°C

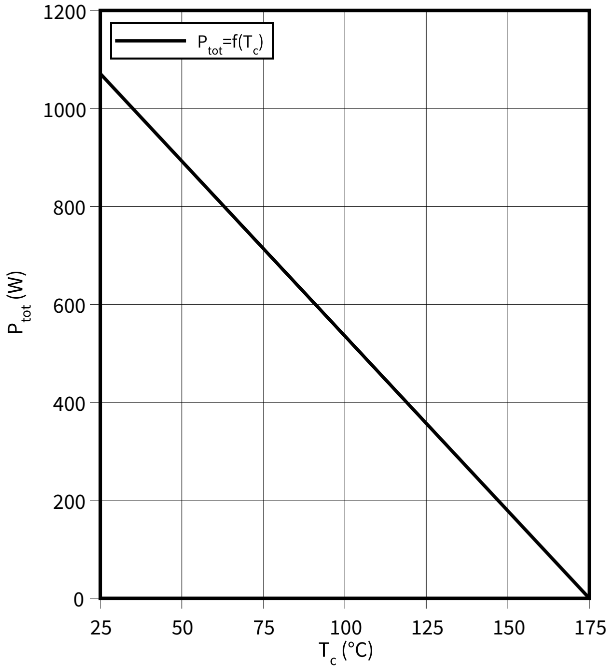
1) Not subject to test

4 Characteristics diagrams

Power dissipation as a function of case temperature, IGBT

$P_{tot} = f(T_c)$

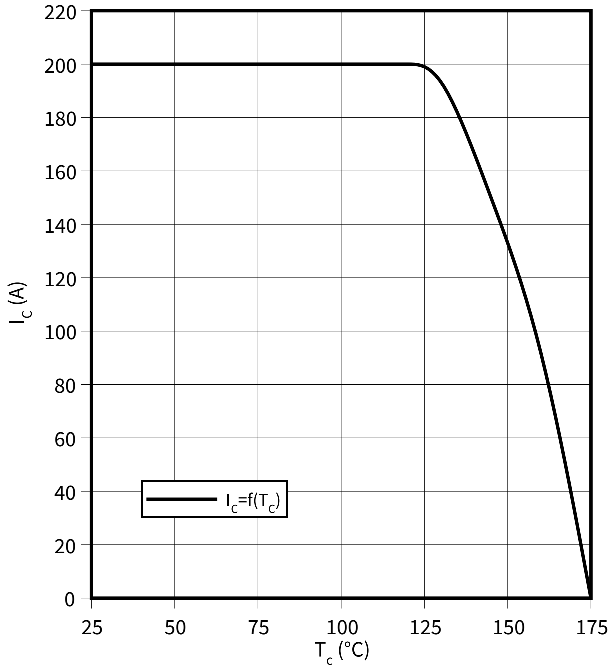
$T_{vj} \leq 175$ °C



Collector current as a function of case temperature, IGBT

$I_C = f(T_c)$

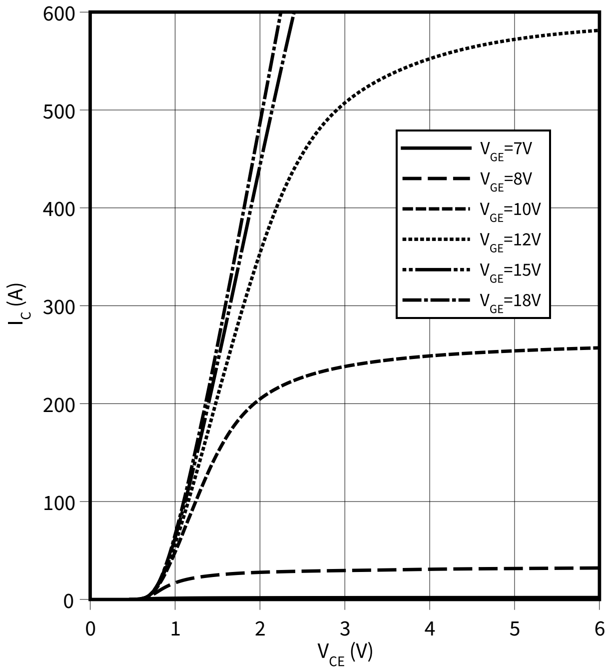
$T_{vj} \leq 175$ °C, $V_{GE} = 15$ V



Typical output characteristic, IGBT

$I_C = f(V_{CE})$

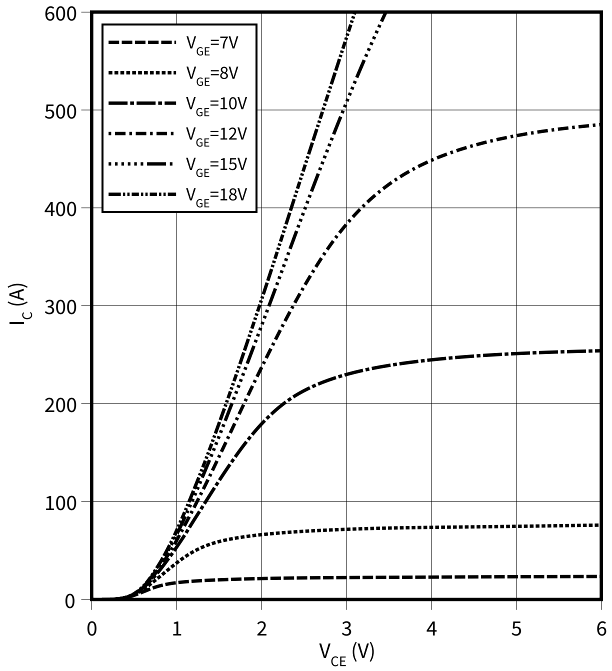
$T_{vj} = 25$ °C



Typical output characteristic, IGBT

$I_C = f(V_{CE})$

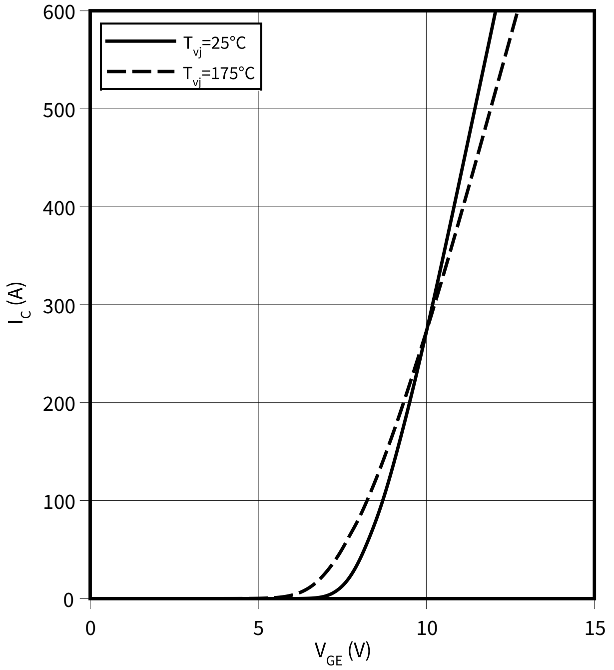
$T_{vj} = =175$ °C



Typical transfer characteristic, IGBT

$I_C = f(V_{GE})$

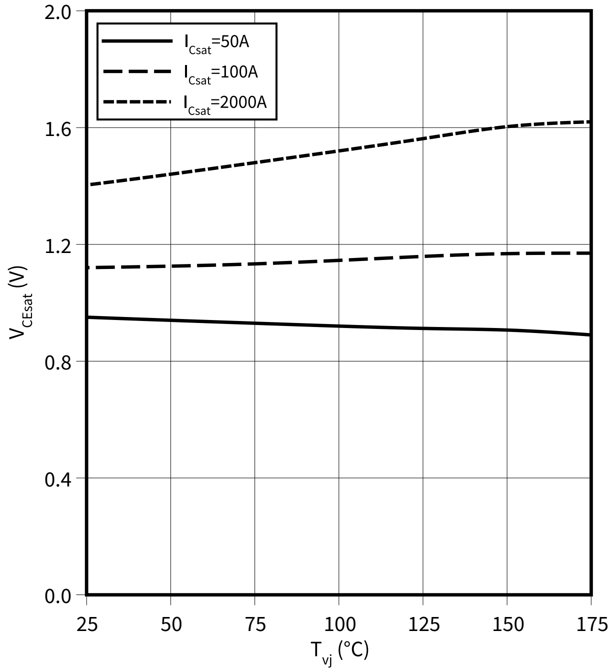
$V_{CE} = 20\ V$



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

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

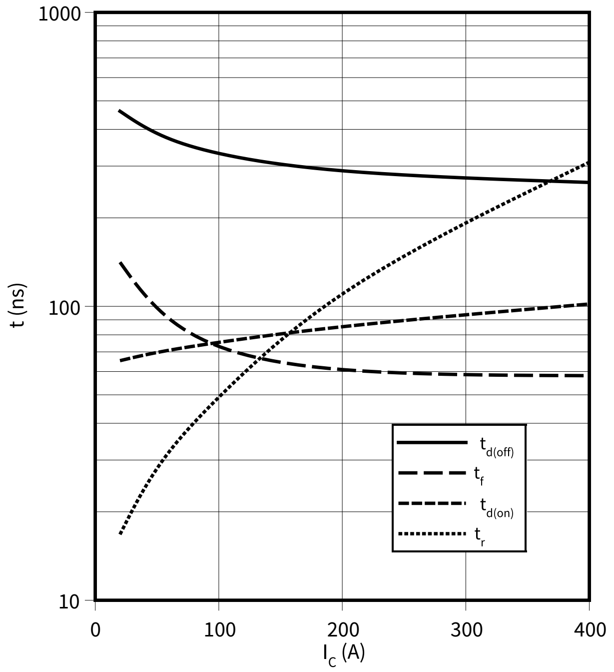
$V_{GE} = 15\ V$



Typical switching times as a function of collector current, IGBT

$t = f(I_C)$

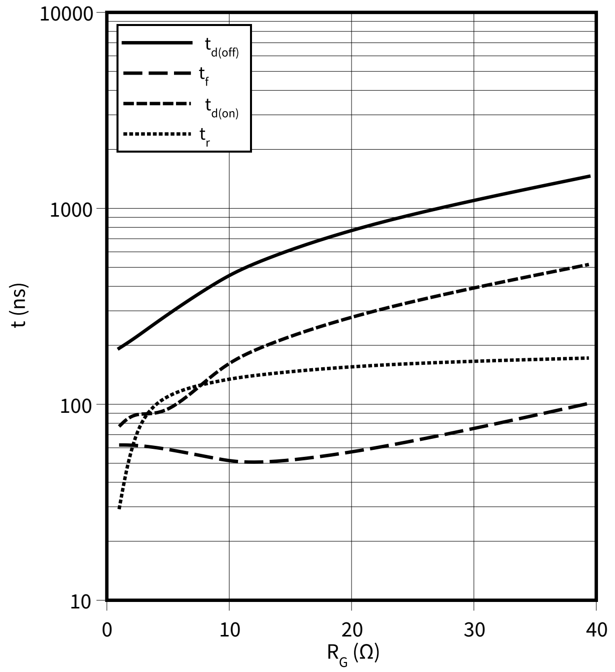
$R_{Goff} = 5.0\ \Omega$, $V_{CE} = 470\ V$, $T_{vj} = 175\ °C$, $V_{GE} = -8/15\ V$, $R_{Gon} = 5.0\ \Omega$



Typical switching times as a function of gate resistor, IGBT

$t = f(R_G)$

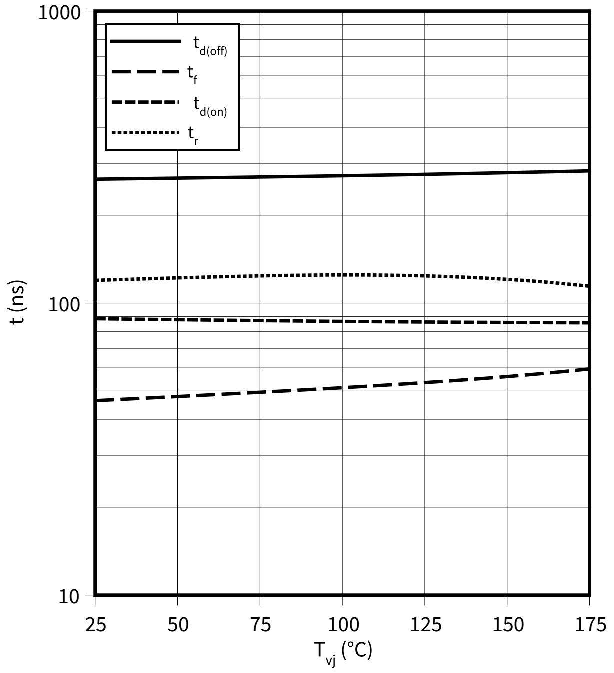
$I_C = 200\ A$, $V_{CE} = 470\ V$, $T_{vj} = 175\ °C$, $V_{GE} = -8/15\ V$



Typical switching times as a function of junction temperature, IGBT

$t = f(T_{vj})$

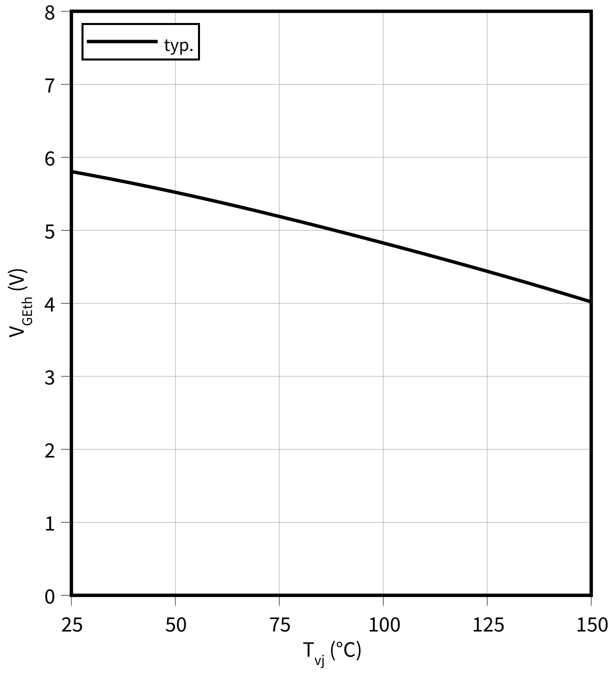
I_C = 200 A, R_{Goff} = 5.0 Ω, V_{CE} = 470 V, V_{GE} = -8/15 V, R_{Gon} = 5.0 Ω



Typical Gate-emitter threshold voltage as a function of junction temperature, IGBT

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

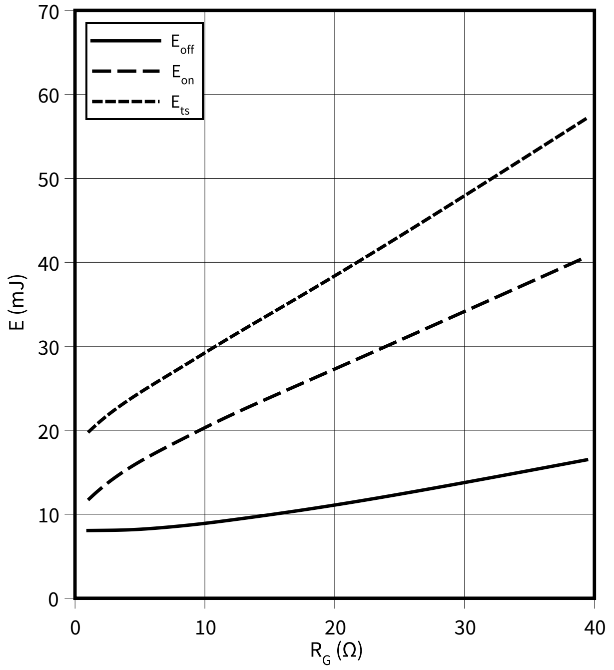
I_C = 2.60 mA



Typical switching energy losses as a function of gate resistor, IGBT

$E = f(R_G)$

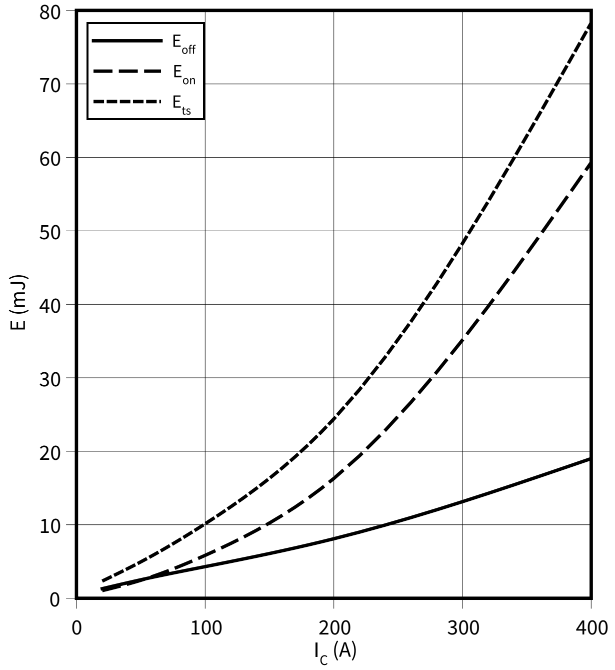
I_C = 200 A, V_{CE} = 470 V, T_{vj} = 175 °C, V_{GE} = -8/15 V



Typical switching energy losses as a function of collector current, IGBT

$E = f(I_C)$

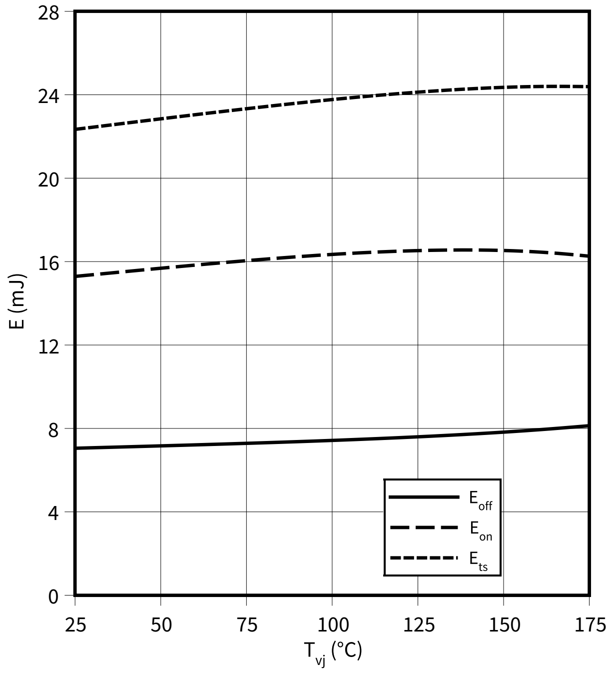
R_{Goff} = 5.0 Ω, V_{CE} = 470 V, T_{vj} = 175 °C, V_{GE} = -8/15 V, R_{Gon} = 5.0 Ω



Typical switching energy losses as a function of junction temperature, IGBT

$E = f(T_{vj})$

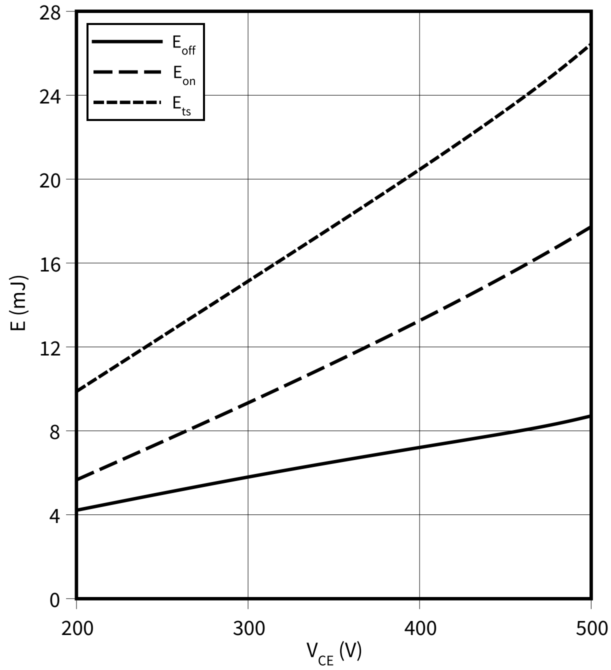
I_C = 200 A, R_{Goff} = 5.0 Ω, V_{CE} = 470 V, V_{GE} = -8/15 V, R_{Gon} = 5.0 Ω



Typical switching energy losses as a function of collector emitter voltage, IGBT

$E = f(V_{CE})$

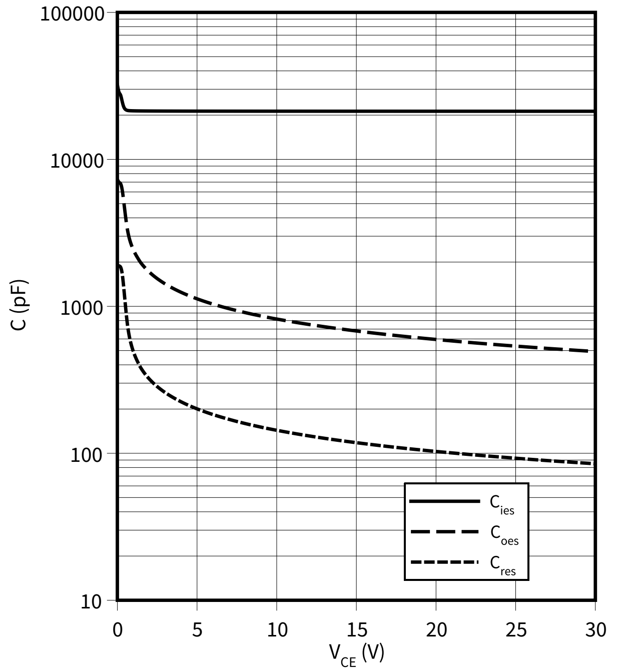
I_C = 200 A, R_{Goff} = 5.0 Ω, T_{vj} ≤ 175 °C, V_{GE} = -8/15 V, R_{Gon} = 5.0 Ω



Typical capacitance as a function of collector-emitter voltage, IGBT

$C = f(V_{CE})$

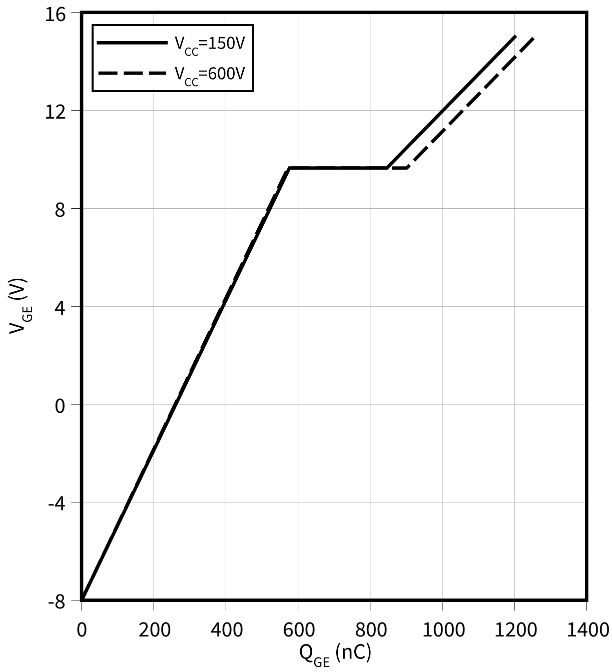
f = 100 kHz, V_{GE} = 0 V



Typical gate charge, IGBT

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

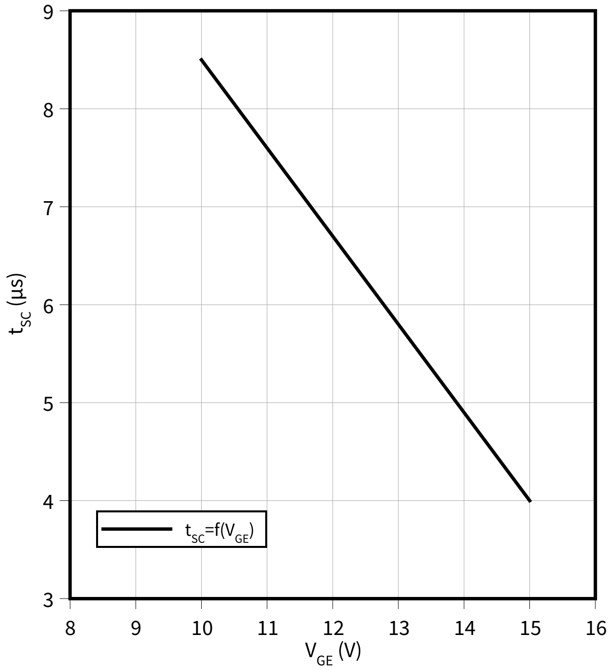
I_C = 200 A



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

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

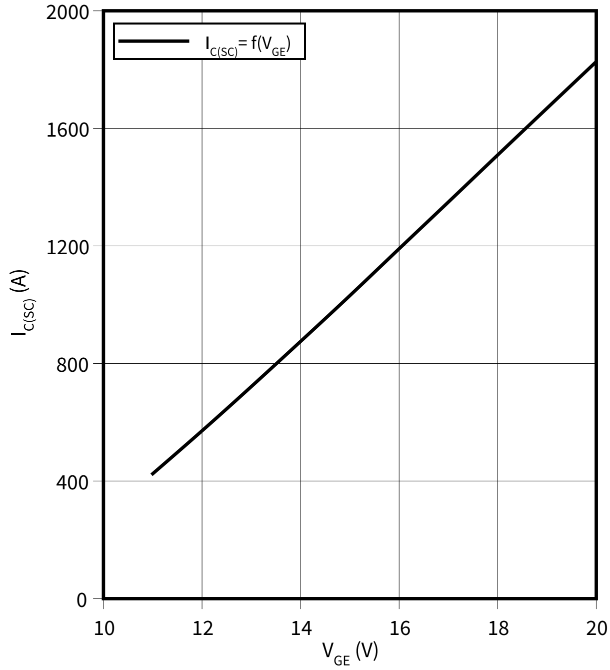
$T_{vj} \leq 175$ °C, $V_{CC} \leq 470$ V



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

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

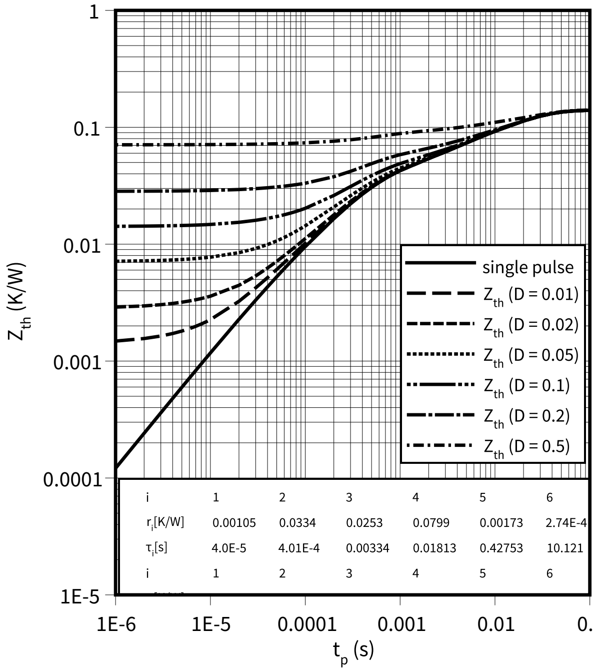
$T_{vj} \leq 175$ °C, $V_{CC} \leq 470$ V



IGBT transient thermal impedance as a function of pulse width, IGBT

$Z_{th} = f(t_p)$

$D = t_p/T$

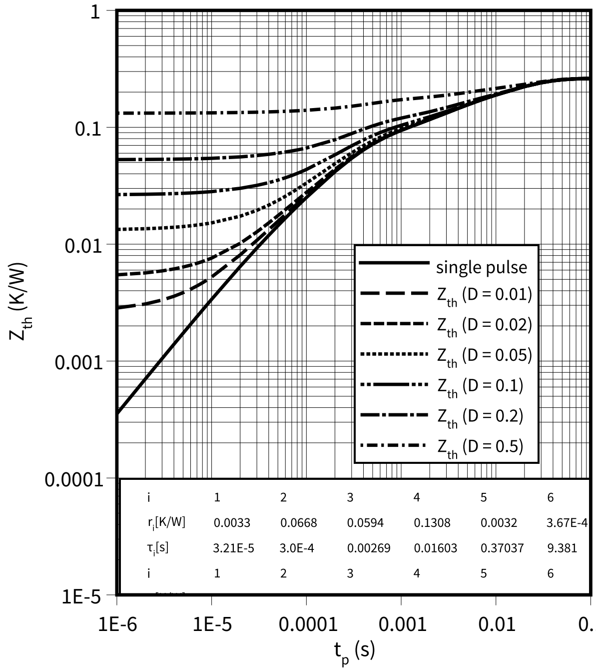


i	1	2	3	4	5	6
r_i[K/W]	0.00105	0.0334	0.0253	0.0799	0.00173	2.74E-4
τ_i[s]	4.0E-5	4.01E-4	0.00334	0.01813	0.42753	10.121
i	1	2	3	4	5	6

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

$Z_{th} = f(t_p)$

$D = t_p/T$

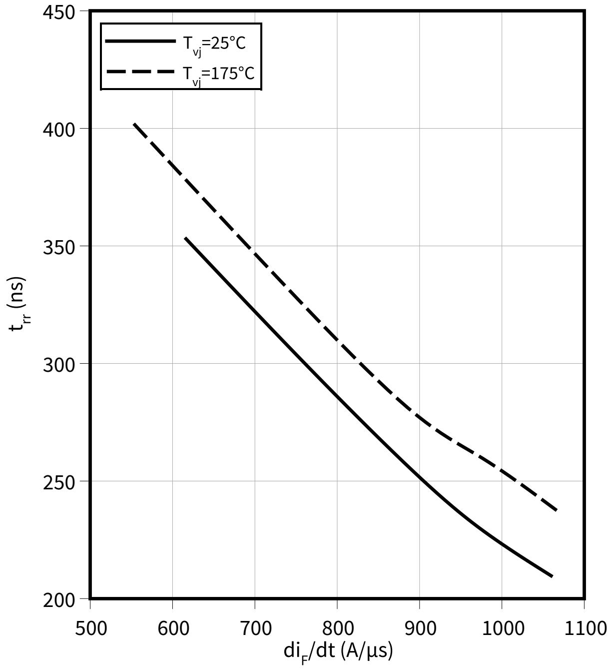


i	1	2	3	4	5	6
r_i[K/W]	0.0033	0.0668	0.0594	0.1308	0.0032	3.67E-4
τ_i[s]	3.21E-5	3.0E-4	0.00269	0.01603	0.37037	9.381
i	1	2	3	4	5	6

Typical reverse recovery time as a function of diode current slope, Diode

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

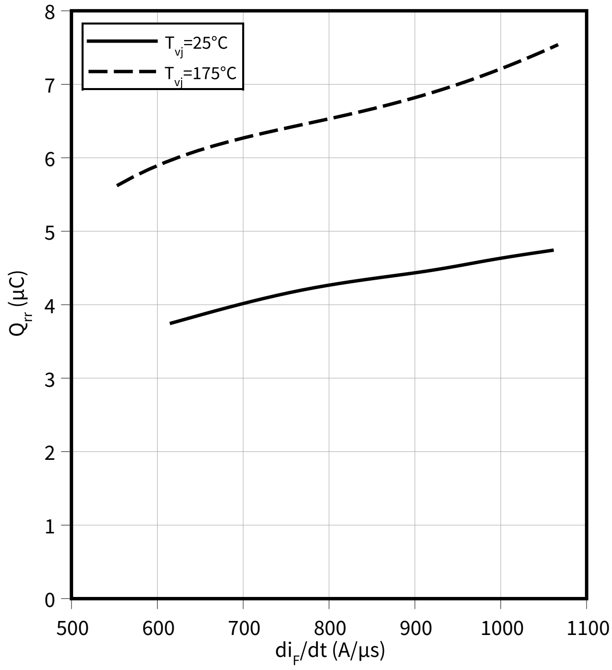
$V_R < 470$ V, $I_F = 200$ A



Typical reverse recovery charge as a function of diode current slope, Diode

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

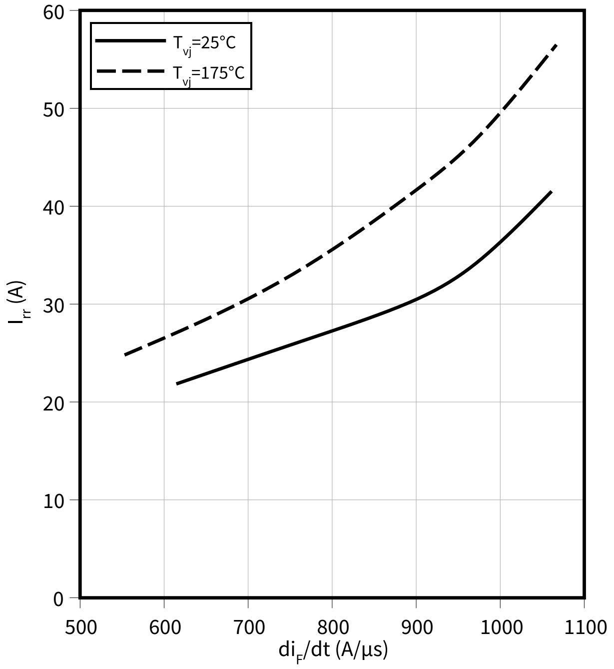
$V_R < 470$ V, $I_F = 200$ A



Typical reverse recovery current as a function of diode current slope, Diode

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

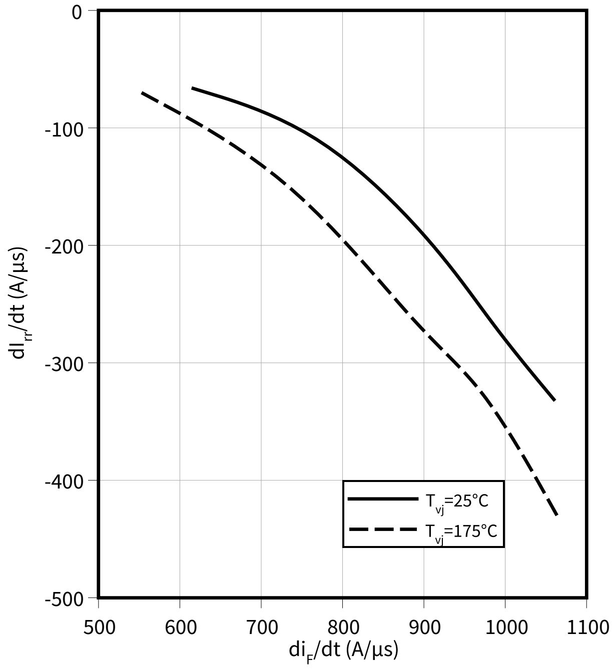
$V_R < 470$ V, $I_F = 200$ A

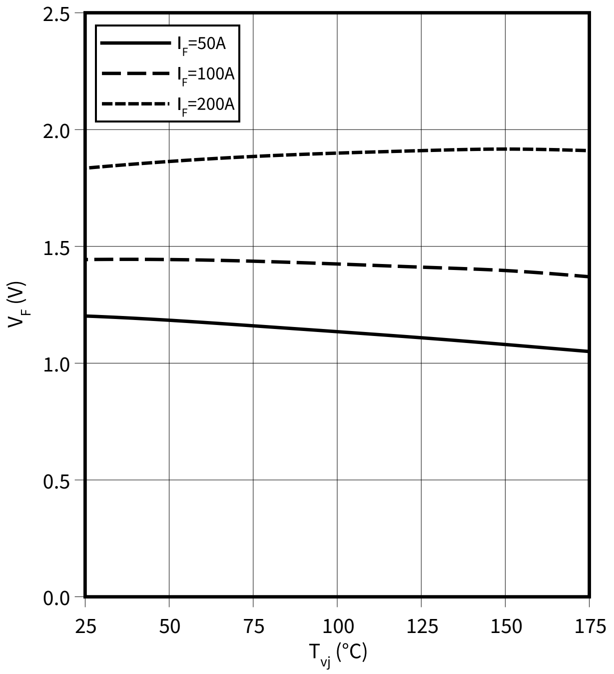
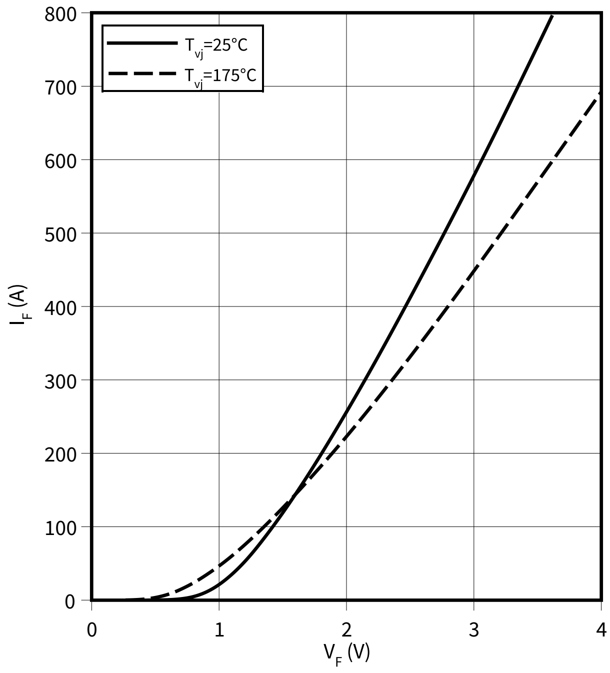


Typical diode peak rate of fall of reverse recovery current as a function of diode current slope, Diode

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

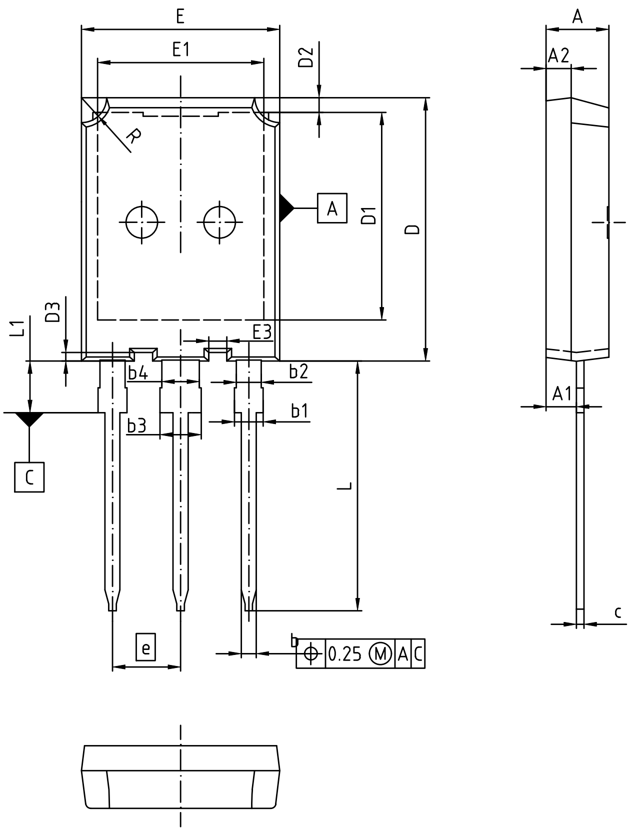
$V_R < 470$ V, $I_F = 200$ A



Typical diode forward voltage as a function of junction temperature, Diode $V_F = f(T_{vj})$	**Typical diode forward current as a function of forward voltage, Diode** $I_F = f(V_F)$
	

5 Package outlines

Package Drawing PG-TO247PLUS-3



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.96	2.25	0.077	0.089
b2	1.96	2.06	0.077	0.081
c	0.59	0.66	0.023	0.026
D	20.90	21.10	0.823	0.831
D1	16.25	16.85	0.640	0.663
D2	1.05	1.35	0.041	0.053
D3	0.58	0.78	0.023	0.031
E	15.70	15.90	0.618	0.626
E1	13.10	13.50	0.516	0.531
E3	1.35	1.55	0.053	0.061
e	5.44 (BSC)		0.214 (BSC)	
N	3		3	
L	19.80	20.10	0.780	0.791
L1	-	4.30	-	0.169
R	1.90	2.10	0.075	0.083

DOCUMENT NO.
Z8B00174295

SCALE 0 5 7.5mm

EUROPEAN PROJECTION

ISSUE DATE
13-08-2014

REVISION
01

Figure 1

6 Testing conditions

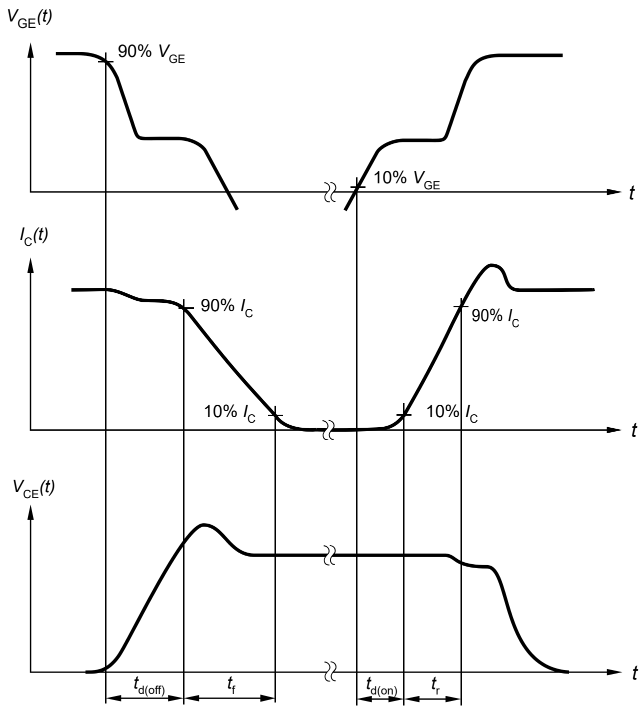


Figure A. **Definition of switching times**

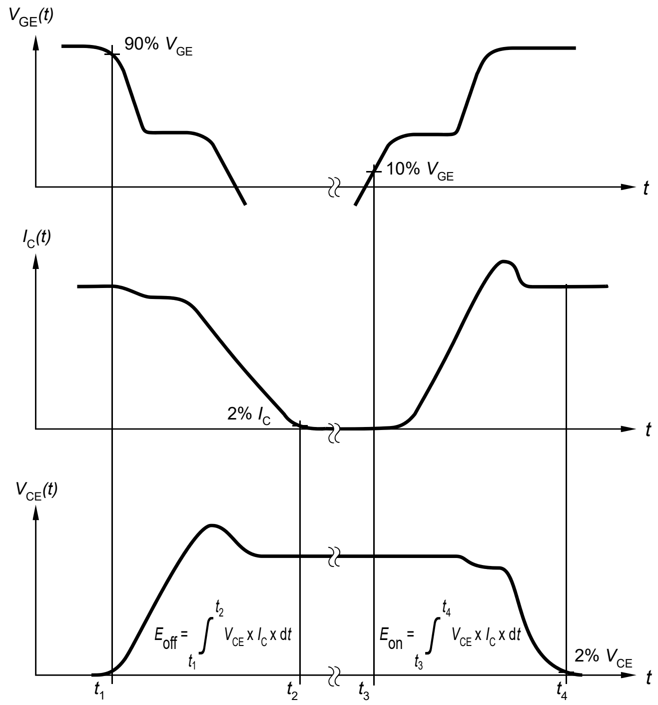


Figure B. **Definition of switching losses**

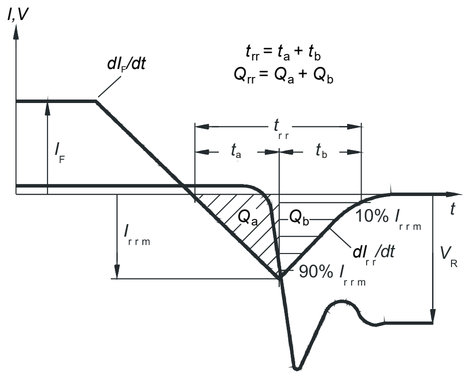


Figure C. **Definition of diode switching characteristics**

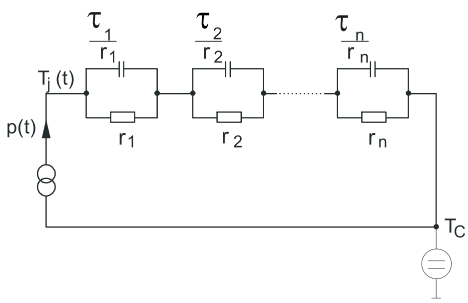


Figure D. **Thermal equivalent circuit**

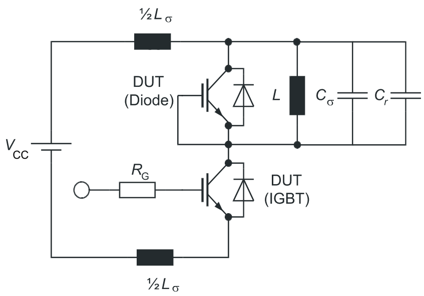


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ},
parasitic capacitor C_{σ},
relief capacitor C_{r},
(only for ZVT switching)

Figure 2

Revision history

Document revision	Date of release	Description of changes
V0.1	2020-10-09	Target
V0.2	2020-11-02	Updated marking on page1
V0.1		Target
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	2022-02-15	Final datasheet

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