

Preliminary datasheet

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

Features

- $V_{CE} = 750\text{ V}$
- $I_C = 160\text{ A}$
- Suitable for $470\text{ V } V_{DC}$ systems and increase overvoltage margin for $400\text{ V } V_{DC}$ systems
- Very low $V_{CEsat} = 1.4\text{ V (typ.)}$ at $I_{Cnom} = 160\text{ A}$, 25°C
- Short circuit robust $t_{sc} = 5\text{ }\mu\text{s}$ at $V_{CE} = 470\text{ V}$, $V_{GE} = 15\text{ V}$
- 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 $I_C = 160\text{ A}$, $T_c = 100^\circ\text{C}$ devices



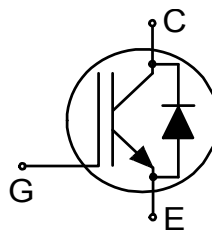
Potential applications

- 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
AIKQB160N75CP2	PG-TO247-3-PLUS-NN8.5	AKQB16FCP



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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}	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	$R_{th(j-c)}$			0.15	0.2	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.28	0.36	K/W

2 IGBT

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25\text{ °C}$		750	V
DC collector current, limited by T_{vjmax}	I_C		$T_c = 25\text{ °C}$	200	A
			$T_c = 100\text{ °C}$	160	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			480	A
Turn-off safe operating area		$V_{CE} \leq 750\text{ V}, T_{vj} \leq 175\text{ °C}$		480	A
Gate-emitter voltage	V_{GE}			± 20	V
Transient gate-emitter voltage	V_{GE}	$t_p = 10\text{ }\mu\text{s}, D < 0.01$		± 30	V
Short-circuit withstand time	t_{SC}	$V_{CC} \leq 470\text{ V}, V_{GE} = -8/15\text{ V}$, Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}, T_{vj} = 25\text{ °C}$		5	μs
Power dissipation	P_{tot}	$T_{vj} = 175\text{ °C}$	$T_c = 25\text{ °C}$	750	W
			$T_c = 100\text{ °C}$	375	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 160\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.4	1.65	V
			$T_{vj} = 175\text{ °C}$		1.6		
Gate-emitter threshold voltage	V_{GETh}	$I_C = 2.15\text{ mA}$, $V_{CE} = V_{GE}$		5	5.75	6.5	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 750\text{ V}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			200	μA
			$T_{vj} = 175\text{ °C}$		4.5		mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = 20\text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 160\text{ A}$, $V_{CE} = 20\text{ V}$			115		S
Short-circuit collector current	I_{SC}	$V_{CC} \leq 470\text{ V}$, $V_{GE} = -8/15\text{ V}$, $t_{SC} \leq 5\text{ }\mu\text{s}$, Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}$, $T_{vj} = 25\text{ °C}$			1000		A
Input capacitance	C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 100\text{ kHz}$			17264		pF
Output capacitance	C_{oes}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 100\text{ kHz}$			435		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 100\text{ kHz}$			76		pF
Gate charge	Q_G	$V_{CC} = 600\text{ V}$, $I_C = 160\text{ A}$, $V_{GE} = -8/15\text{ V}$			1020		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 470\text{ V}$, $V_{GE} = -8/15\text{ V}$, $R_{G(on)} = 5\text{ }\Omega$, $R_{G(off)} = 5\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 160\text{ A}$		72.3		ns
			$T_{vj} = 175\text{ °C}$, $I_C = 160\text{ A}$		67.5		
Rise time (inductive load)	t_r	$V_{CC} = 470\text{ V}$, $V_{GE} = -8/15\text{ V}$, $R_{G(on)} = 5\text{ }\Omega$, $R_{G(off)} = 5\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 160\text{ A}$		97.5		ns
			$T_{vj} = 175\text{ °C}$, $I_C = 160\text{ A}$		92.5		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 470\text{ V}$, $V_{GE} = -8/15\text{ V}$, $R_{G(on)} = 5\text{ }\Omega$, $R_{G(off)} = 5\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 160\text{ A}$		216		ns
			$T_{vj} = 175\text{ °C}$, $I_C = 160\text{ A}$		255		
Fall time (inductive load)	t_f	$V_{CC} = 470\text{ V}$, $V_{GE} = -8/15\text{ V}$, $R_{G(on)} = 5\text{ }\Omega$, $R_{G(off)} = 5\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 160\text{ A}$		37.4		ns
			$T_{vj} = 175\text{ °C}$, $I_C = 160\text{ A}$		63.5		
Turn-on energy ¹⁾	E_{on}	$V_{CC} = 470\text{ V}$, $V_{GE} = -8/15\text{ V}$, $R_{G(on)} = 5\text{ }\Omega$, $R_{G(off)} = 5\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 160\text{ A}$		12.4		mJ
			$T_{vj} = 175\text{ °C}$, $I_C = 160\text{ A}$		13.2		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-off energy	E_{off}	$V_{CC} = 470 \text{ V}$, $V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \Omega$, $R_{G(off)} = 5 \Omega$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 160 \text{ A}$	5.7		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 160 \text{ A}$	6.6		
Total switching energy	E_{ts}	$V_{CC} = 470 \text{ V}$, $V_{GE} = -8/15 \text{ V}$, $R_{G(on)} = 5 \Omega$, $R_{G(off)} = 5 \Omega$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 160 \text{ A}$	18.1		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 160 \text{ A}$	19.8		
Operating junction temperature	T_{vj}		-40		175	$^{\circ}\text{C}$

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

Table 5 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 160 \text{ A}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$	1.8	2	V
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$	1.9		
Diode reverse recovery charge	Q_{rr}	$V_R = 470 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_F = 160 \text{ A}$, $-di_F/dt = 1058 \text{ A}/\mu\text{s}$	3.8		μC
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_F = 160 \text{ A}$, $-di_F/dt = 1090 \text{ A}/\mu\text{s}$	6.1		

(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}	$V_R = 470 \text{ V}$	$T_{vj} = 25^\circ\text{C}$, $I_F = 160 \text{ A}$, $-di_F/dt = 1058 \text{ A}/\mu\text{s}$		33.3		A
			$T_{vj} = 175^\circ\text{C}$, $I_F = 160 \text{ A}$, $-di_F/dt = 1090 \text{ A}/\mu\text{s}$		45.5		
Reverse recovery energy	E_{rec}	$V_R = 470 \text{ V}$, $L_\sigma = 50 \text{ nH}$, $C_\sigma = 30 \text{ pF}$	$T_{vj} = 25^\circ\text{C}$, $I_F = 160 \text{ A}$, $-di_F/dt = 1058 \text{ A}/\mu\text{s}$		1.1		mJ
			$T_{vj} = 175^\circ\text{C}$, $I_F = 160 \text{ A}$, $-di_F/dt = 1090 \text{ A}/\mu\text{s}$		1.8		
Operating junction temperature	T_{vj}			-40		175	$^\circ\text{C}$

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 $T_{vj} = 25^\circ\text{C}$, unless otherwise specified.

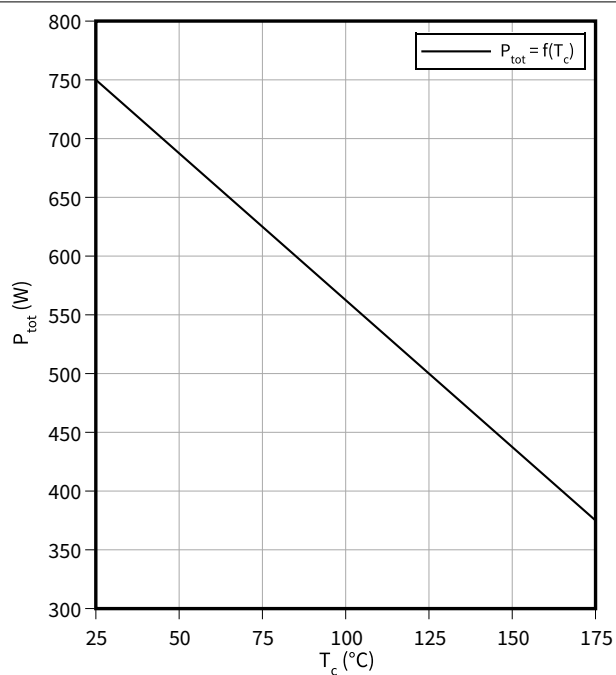
Dynamic test circuit, parasitic inductance $L_\sigma = 50 \text{ nH}$, parasitic capacitor $C_\sigma = 30 \text{ pF}$ from Fig. E. Energy losses include "tail" and diode reverse recovery.

4 Characteristics diagrams

Power dissipation as a function of case temperature

$$P_{\text{tot}} = f(T_c)$$

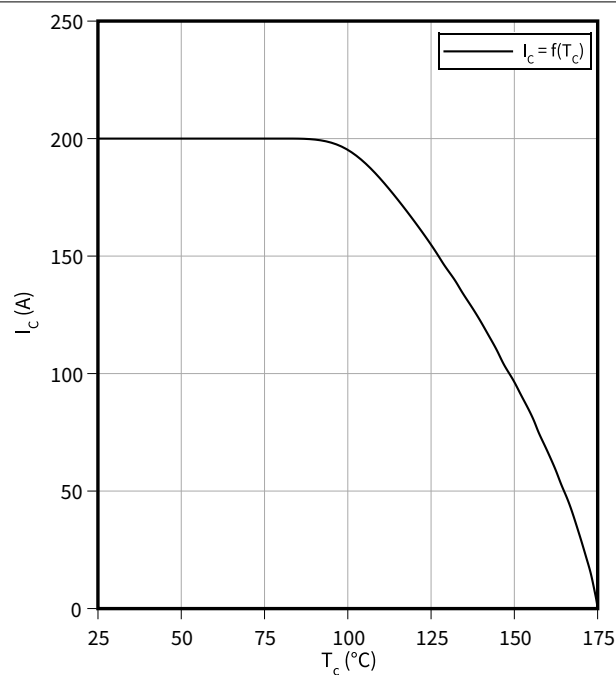
$$T_{vj} \leq 175^\circ\text{C}$$



Collector current as a function of case temperature

$$I_C = f(T_c)$$

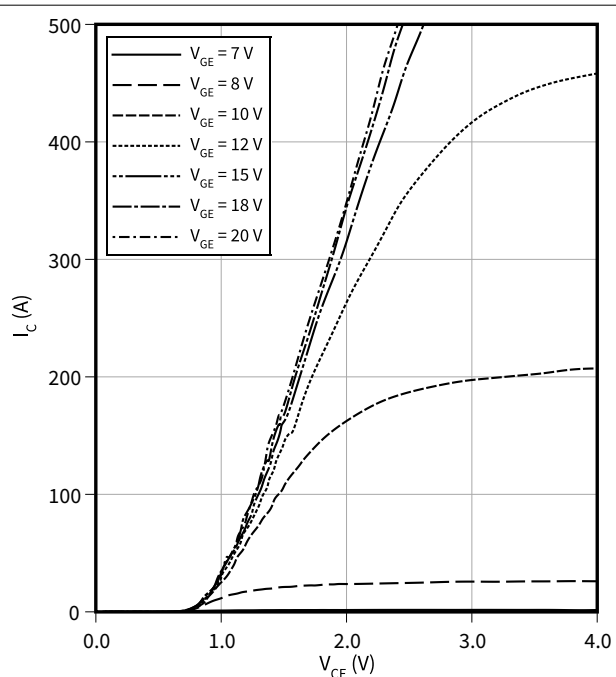
$$T_{vj} \leq 175^\circ\text{C}, V_{GE} = 15\text{ V}$$



Typical output characteristic

$$I_C = f(V_{CE})$$

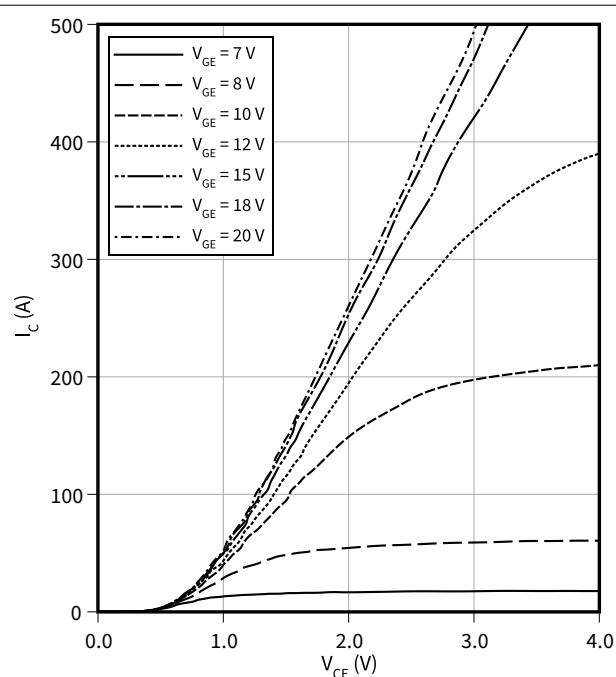
$$T_{vj} = 25^\circ\text{C}$$



Typical output characteristic

$$I_C = f(V_{CE})$$

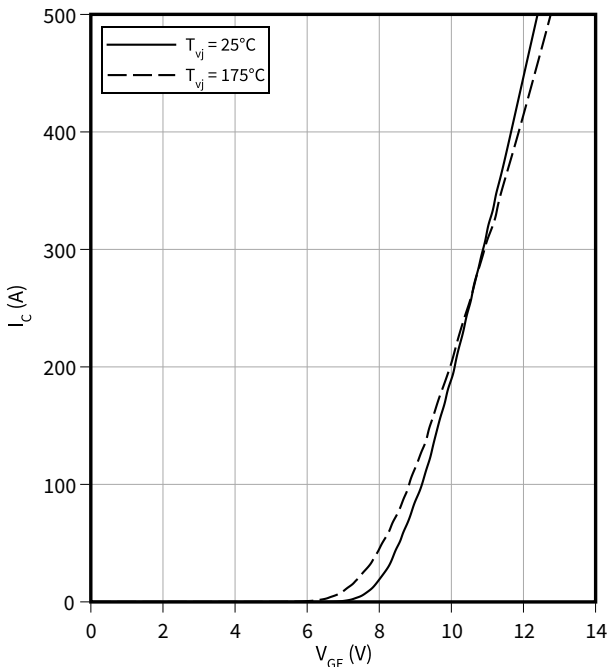
$$T_{vj} = 175^\circ\text{C}$$



4 Characteristics diagrams

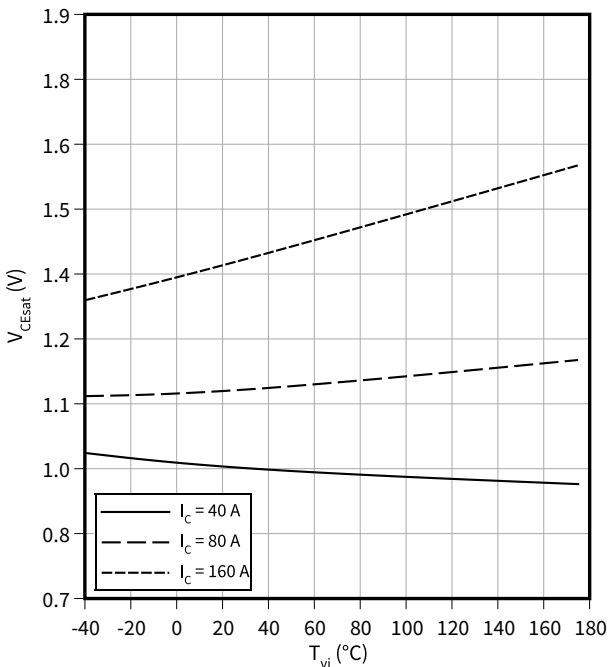
Typical transfer characteristic

$I_C = f(V_{GE})$
 $V_{CE} = 20\text{ V}$



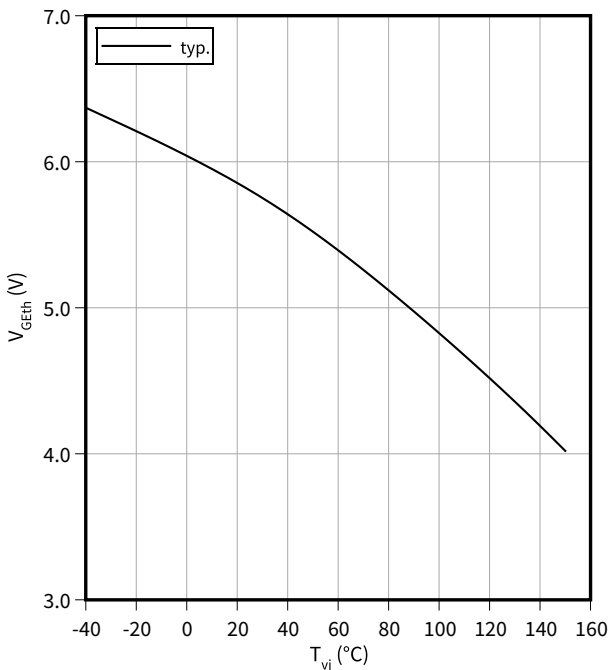
Typical collector-emitter saturation voltage as a function of junction temperature

$V_{CEsat} = f(T_{vj})$
 $V_{GE} = 15\text{ V}$



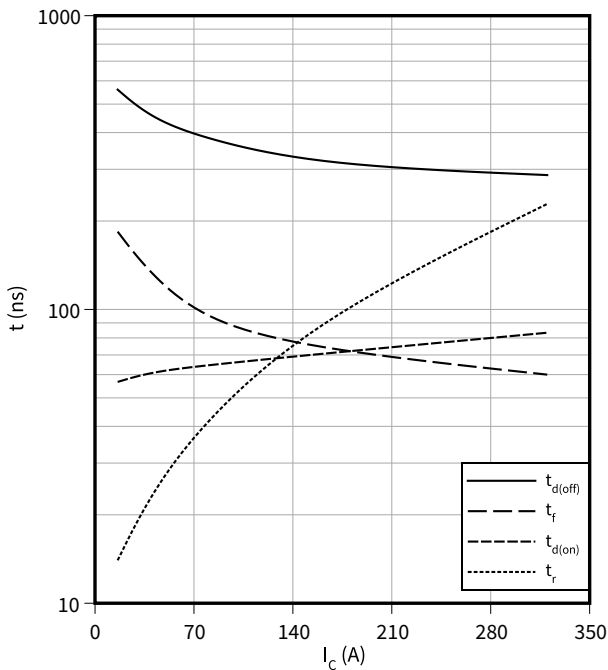
Gate-emitter threshold voltage as a function of junction temperature

$V_{GETh} = f(T_{vj})$
 $I_C = 2\text{ mA}$



Typical switching times as a function of collector current

$t = f(I_C)$
 $V_{CC} = 470\text{ V}$, $T_{vj} = 175^\circ\text{C}$, $V_{GE} = -8/15\text{ V}$, $R_G = 5\ \Omega$

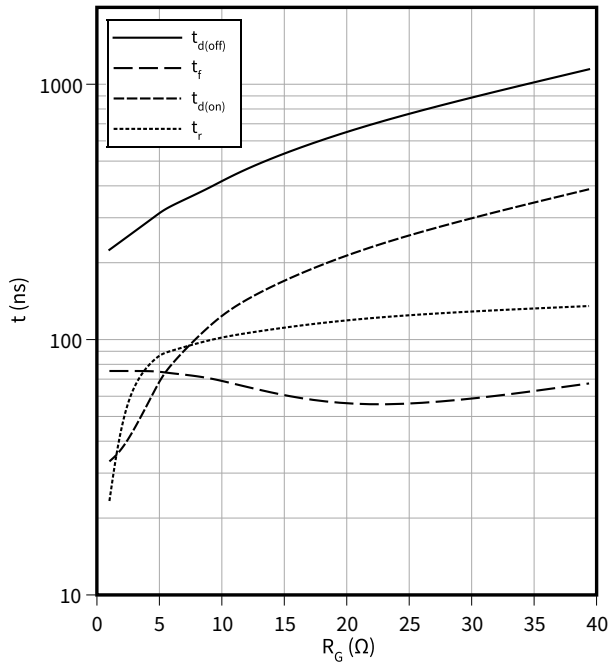


4 Characteristics diagrams

Typical switching times as a function of gate resistor

$$t = f(R_G)$$

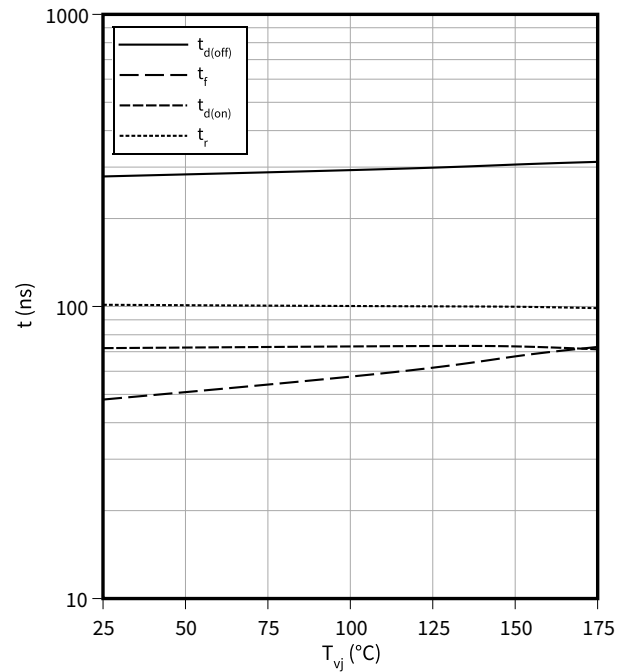
$$I_C = 160 \text{ A}, V_{CC} = 470 \text{ V}, T_{vj} = 175 \text{ }^{\circ}\text{C}, V_{GE} = -8/15 \text{ V}$$



Typical switching times as a function of junction temperature

$$t = f(T_{vj})$$

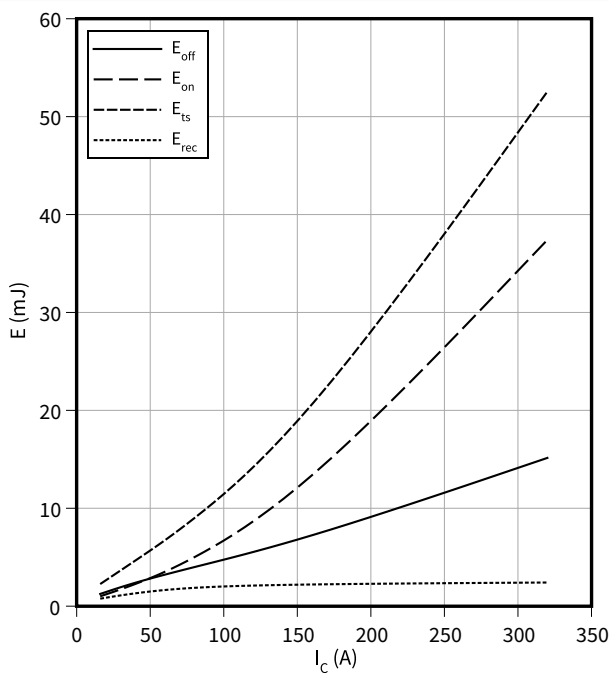
$$I_C = 160 \text{ A}, V_{CC} = 470 \text{ V}, V_{GE} = -8/15 \text{ V}, R_G = 5 \text{ } \Omega$$



Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

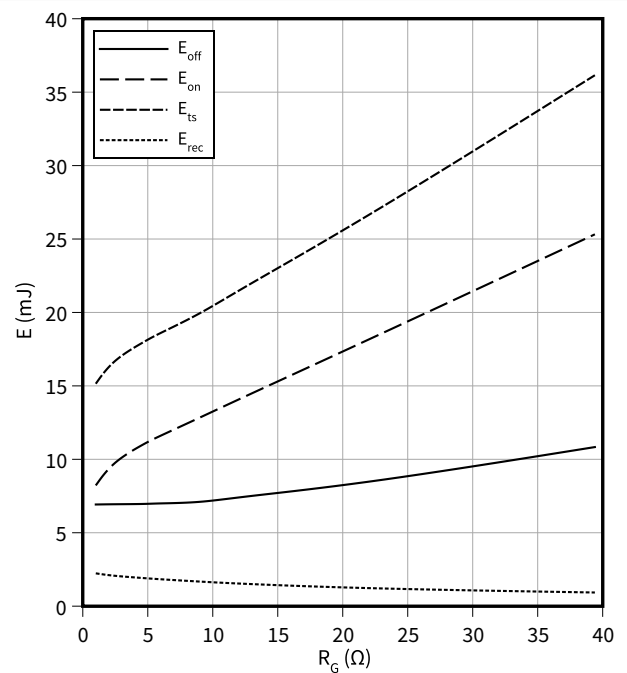
$$V_{CC} = 470 \text{ V}, T_{vj} = 175 \text{ }^{\circ}\text{C}, V_{GE} = -8/15 \text{ V}, R_G = 5 \text{ } \Omega$$



Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

$$I_C = 160 \text{ A}, V_{CC} = 470 \text{ V}, T_{vj} = 175 \text{ }^{\circ}\text{C}, V_{GE} = -8/15 \text{ V}$$

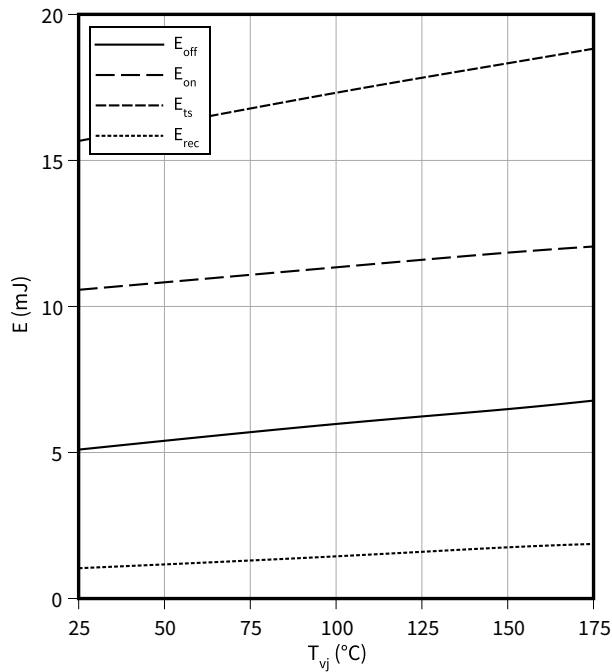


4 Characteristics diagrams

Typical switching energy losses as a function of junction temperature

$$E = f(T_{vj})$$

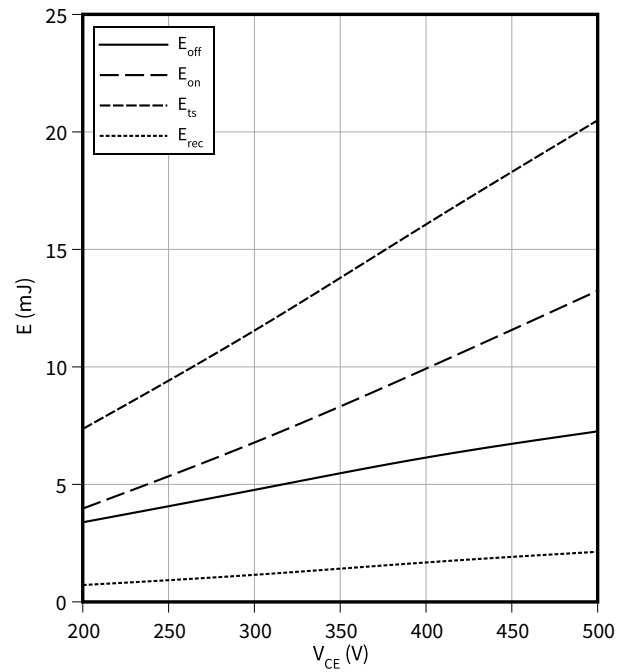
$I_C = 160 \text{ A}$, $V_{CC} = 470 \text{ V}$, $V_{GE} = -8/15 \text{ V}$, $R_G = 5 \Omega$



Typical switching energy losses as a function of collector emitter voltage

$$E = f(V_{CE})$$

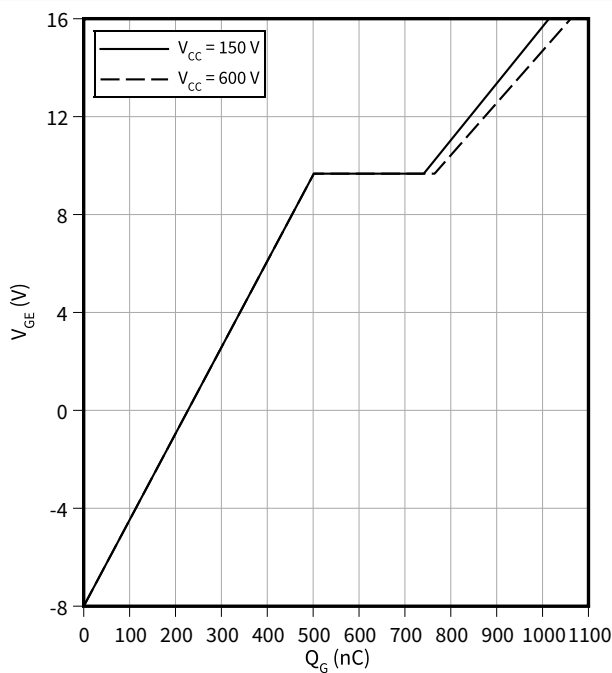
$I_C = 160 \text{ A}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = -8/15 \text{ V}$, $R_G = 5 \Omega$



Typical gate charge

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

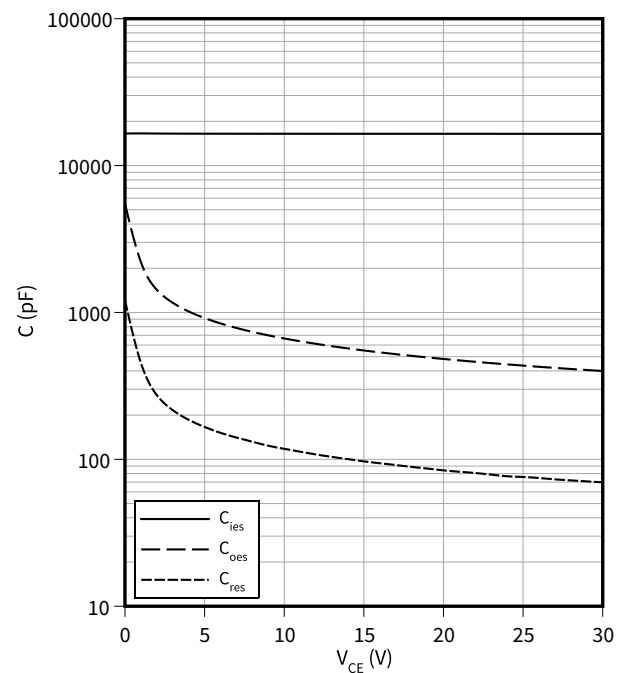
$I_C = 160 \text{ A}$



Typical capacitance as a function of collector-emitter voltage

$$C = f(V_{CE})$$

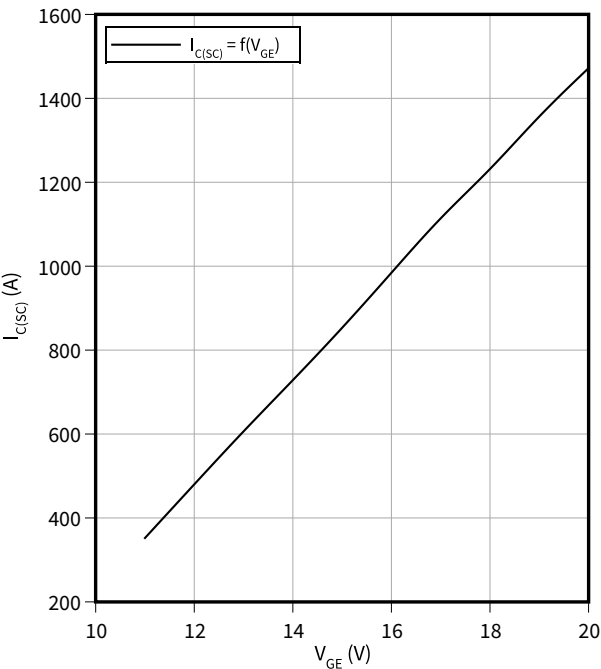
$f = 1000 \text{ kHz}$, $V_{GE} = 0 \text{ V}$



4 Characteristics diagrams

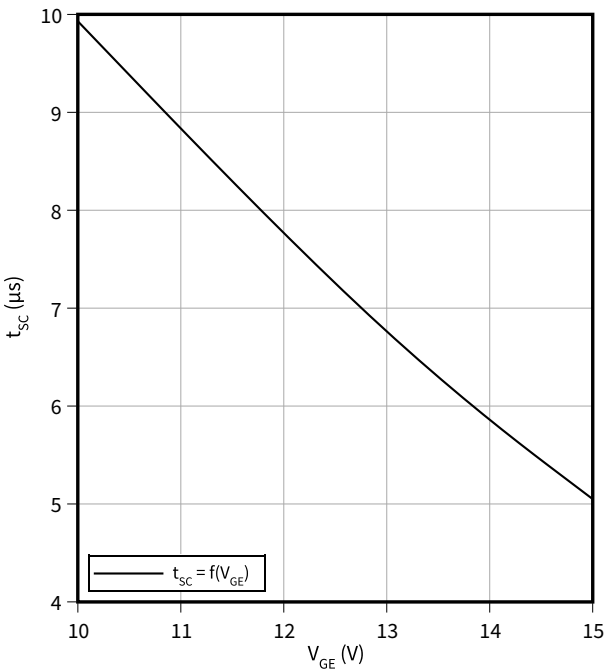
Typical short circuit collector current as a function of gate-emitter voltage

$I_{C(SC)} = f(V_{GE})$
 $V_{CC} \leq 470\text{ V}, T_{vj} \leq 175\text{ }^{\circ}\text{C}$



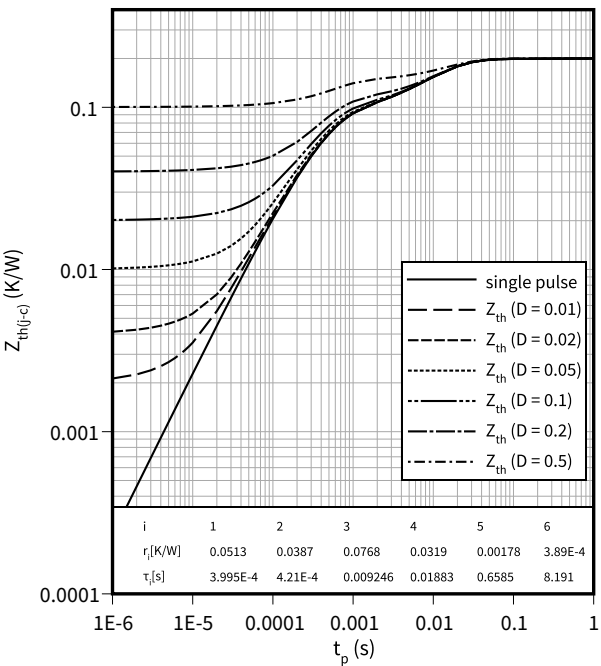
Short circuit withstand time as a function of gate-emitter voltage

$t_{SC} = f(V_{GE})$
 $T_{vj} \leq 175\text{ }^{\circ}\text{C}, V_{CC} \leq 470\text{ V}$



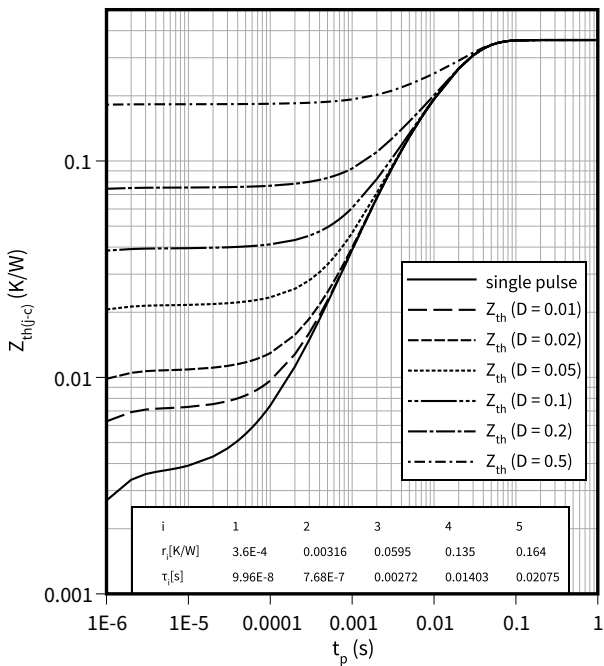
IGBT transient thermal impedance as a function of pulse width

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



Diode transient thermal impedance as a function of pulse width

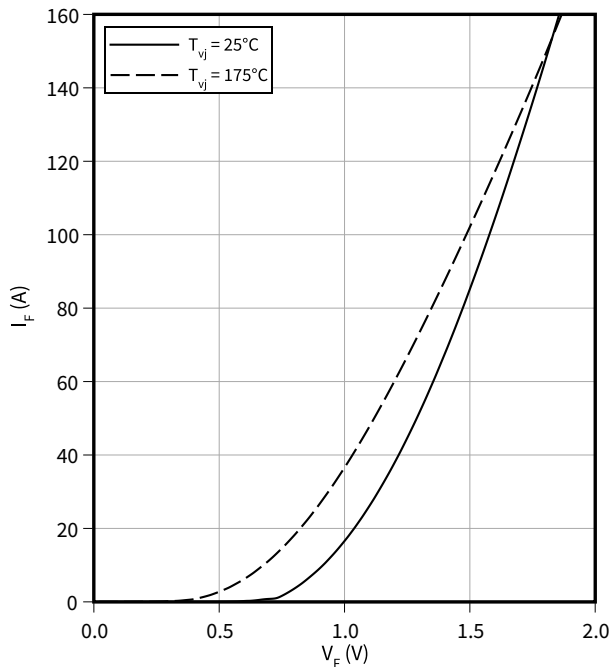
$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



4 Characteristics diagrams

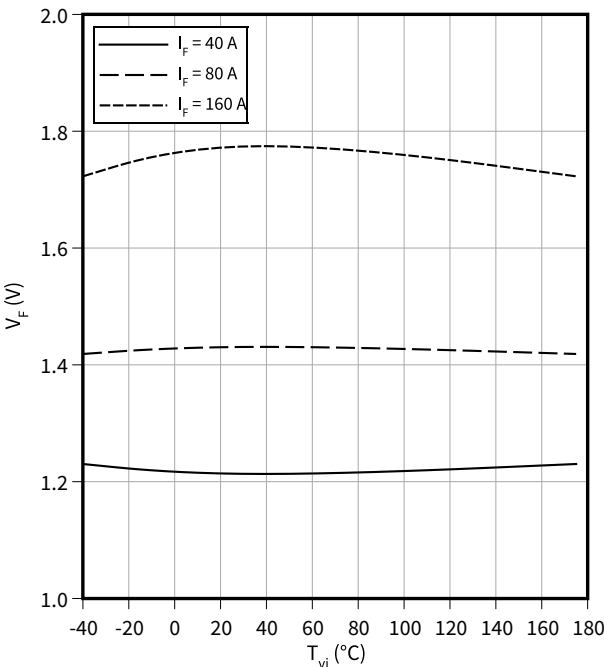
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

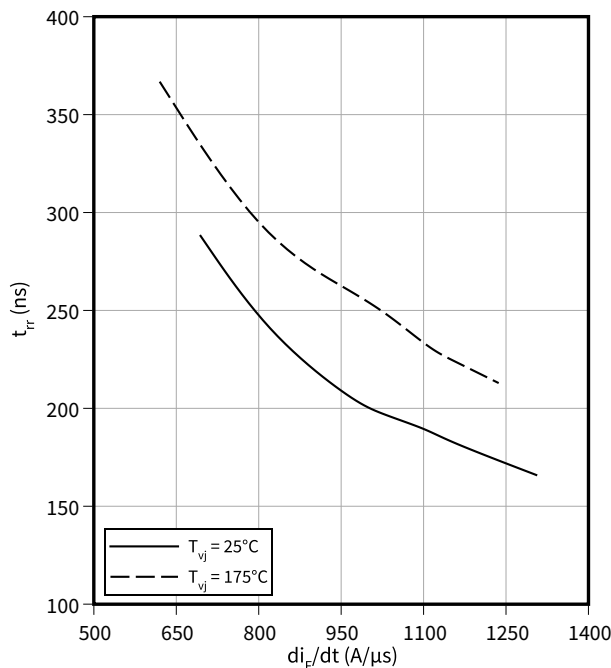
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

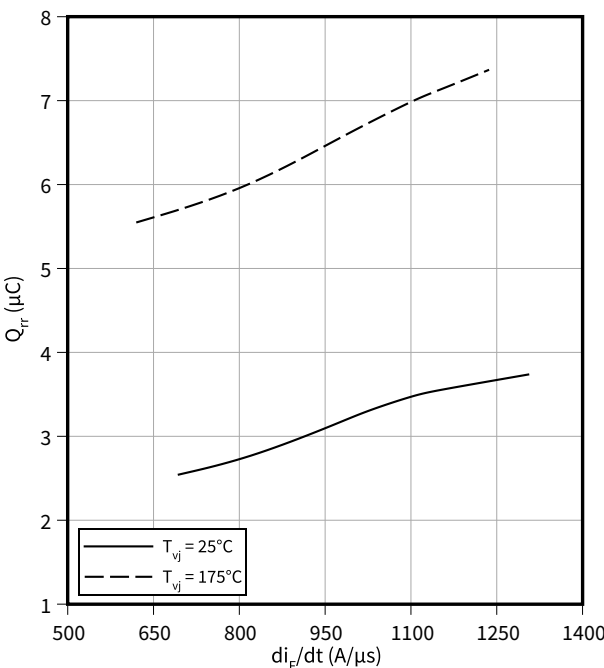
$V_R = 470\text{ V}, I_F = 160\text{ A}$



Typical reverse recovery charge as a function of diode current slope

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

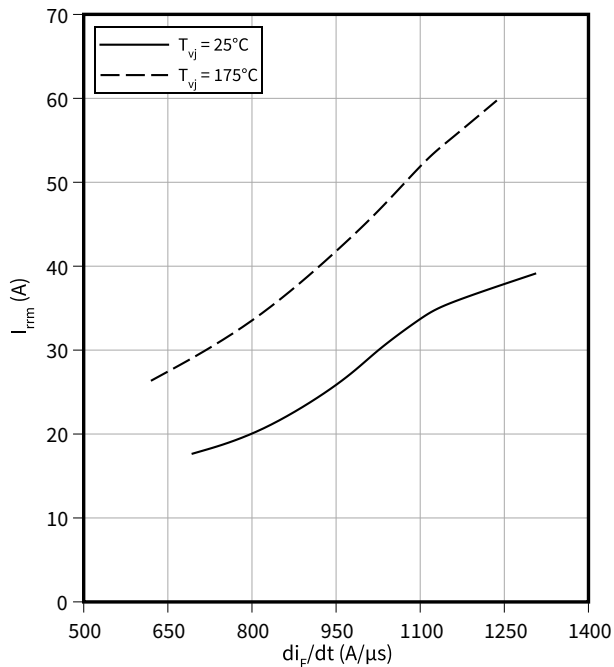
$V_R = 470\text{ V}, I_F = 160\text{ A}$



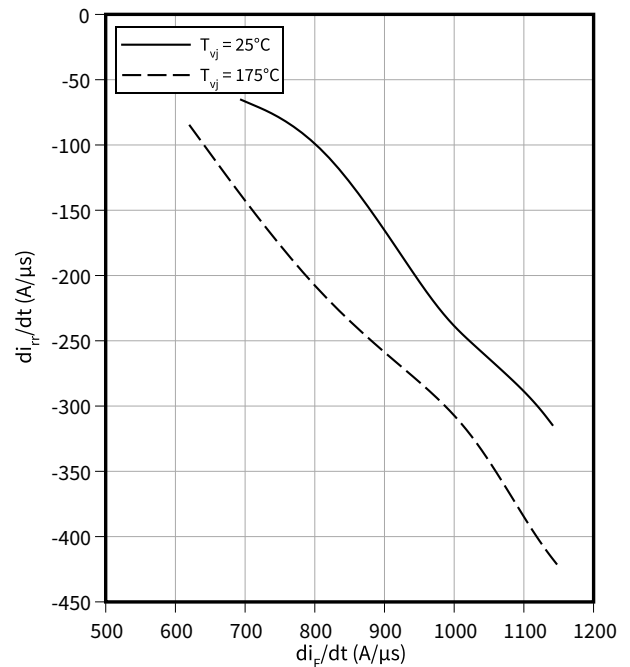
4 Characteristics diagrams

Typical reverse recovery current as a function of diode current slope

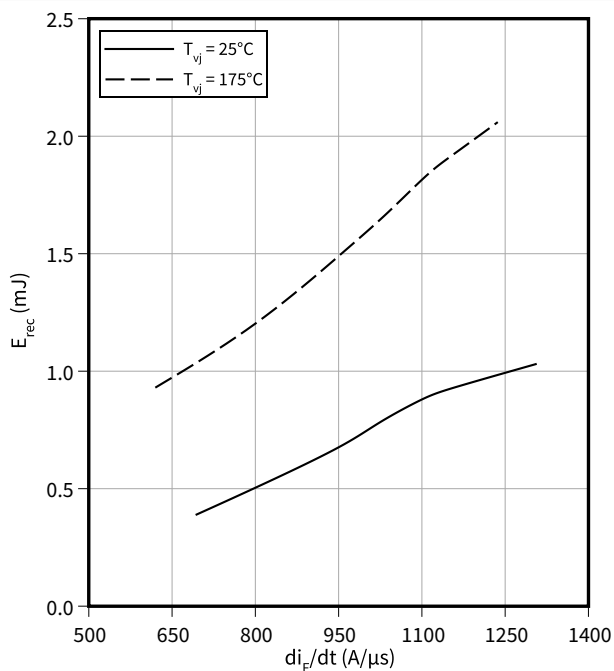
$$I_{rrm} = f(di_F/dt)$$

 $V_R = 470 \text{ V}, I_F = 160 \text{ A}$
**Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**

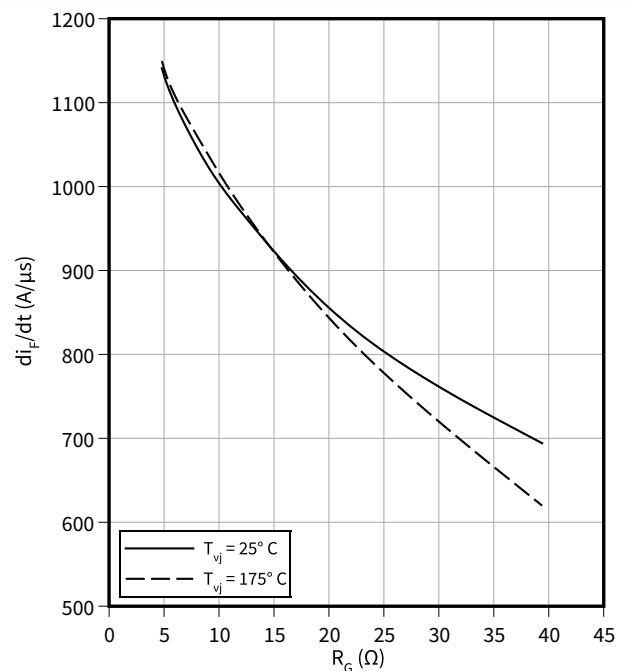
$$di_{rr}/dt = f(di_F/dt)$$

 $V_R = 470 \text{ V}, I_F = 160 \text{ A}$
**Typical reverse energy losses as a function of diode current slope**

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

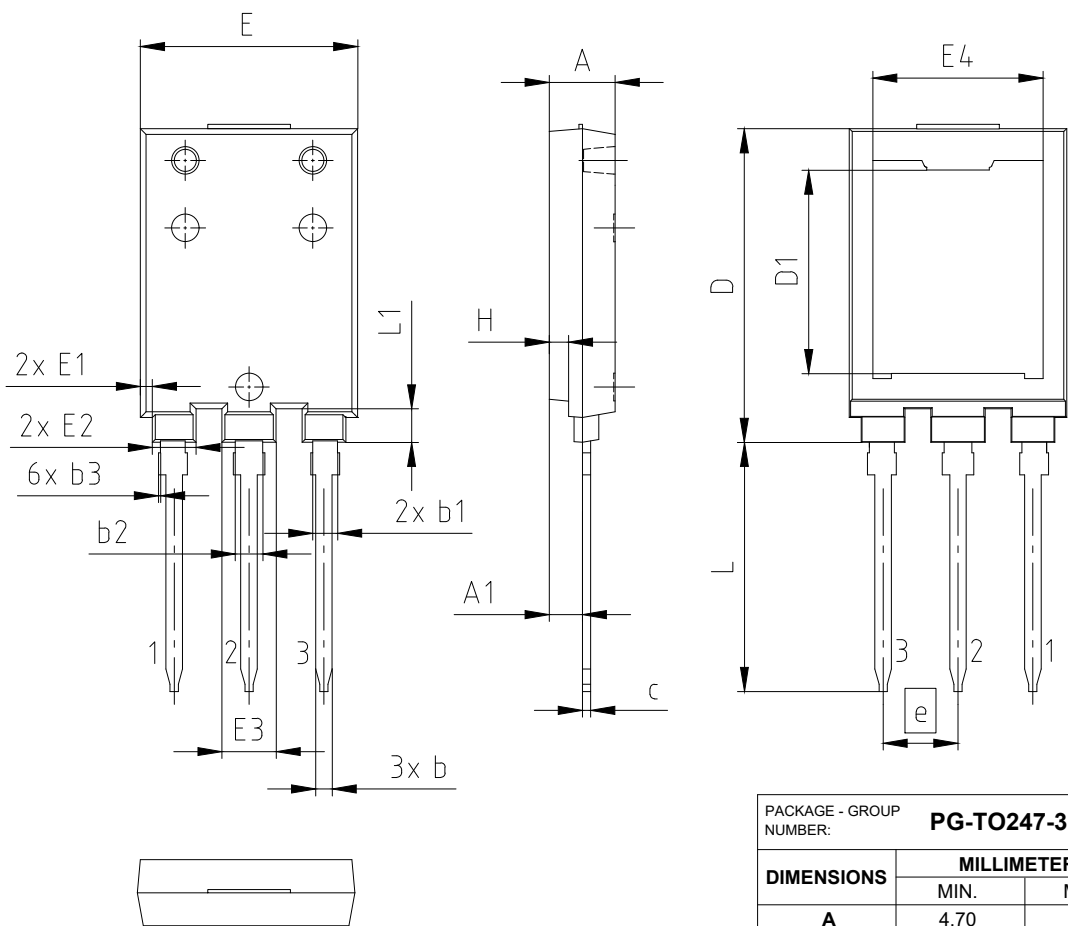
 $V_R = 470 \text{ V}, I_F = 160 \text{ A}$
**Typical diode current slope as a function of gate resistor**

$$di_F/dt = f(R_G)$$

 $V_R = 470 \text{ V}, I_F = 160 \text{ A}$


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

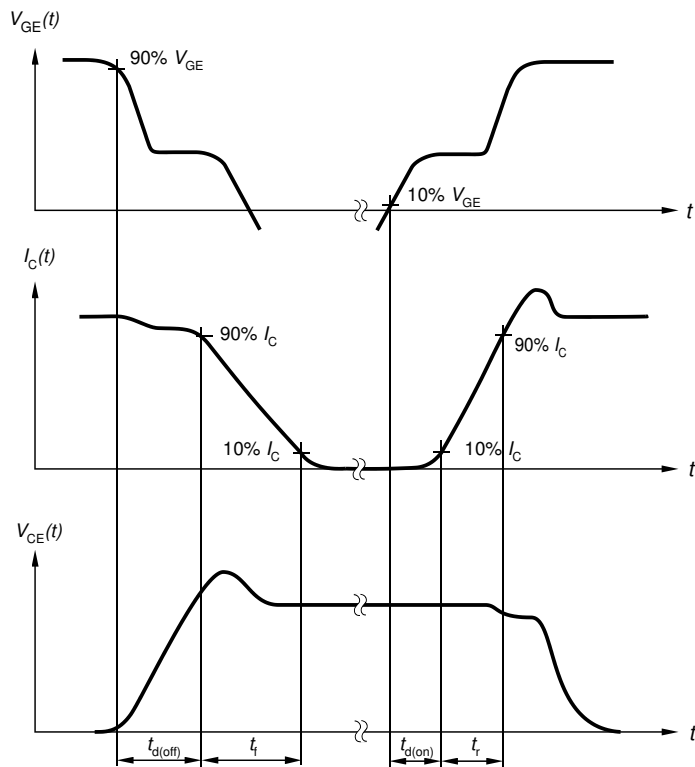


Figure A. Definition of switching times

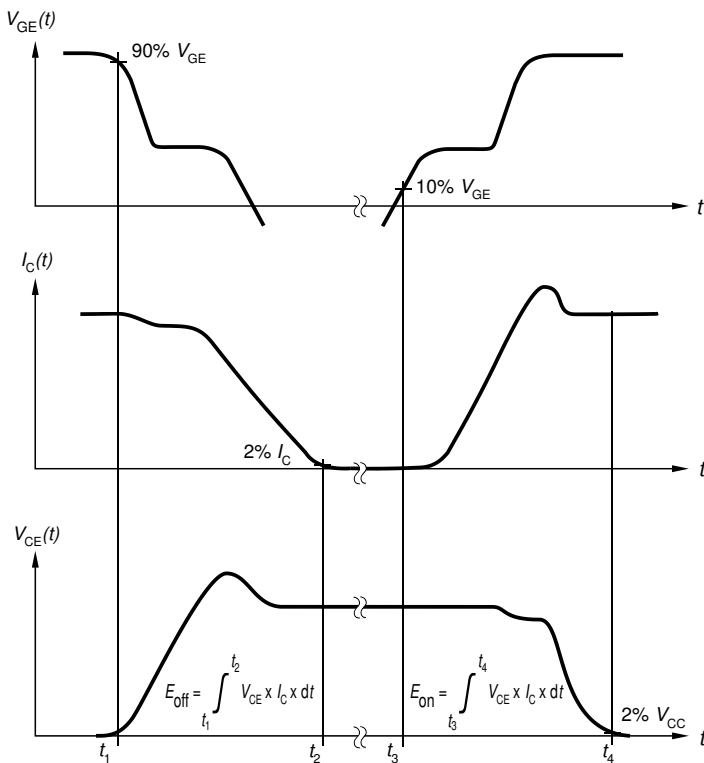


Figure B. Definition of switching losses

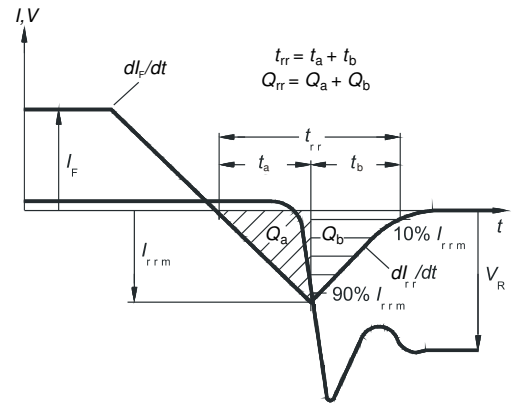


Figure C. Definition of diode switching characteristics

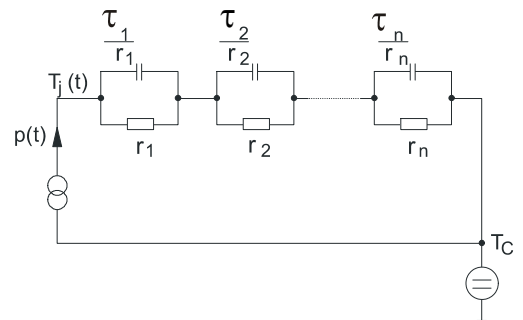


Figure D. Thermal equivalent circuit

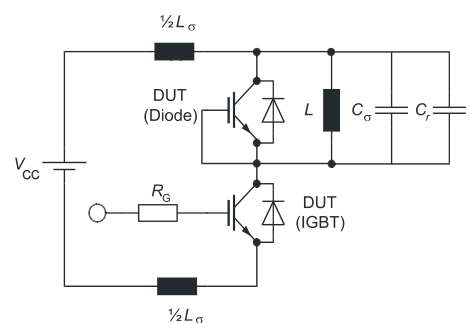


Figure E. **Dynamic test circuit**
 Parasitic inductance L_{σ} ,
 parasitic capacitor C_{σ} ,
 relief capacitor C_r ,
 (only for ZVT switching)

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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