

600 V Reverse Conducting Drive 2 offering cost effective IGBT with monolithically integrated diode

Features

- $V_{CE} = 600\text{ V}$
- $I_C = 1\text{ A}$
- Very tight parameter distribution
- Operating range of 1 to 20 kHz
- Maximum junction temperature 150°C
- Short circuit capability of $3\text{ }\mu\text{s}$
- Humidity robust design
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: <http://www.infineon.com/rc-d2>

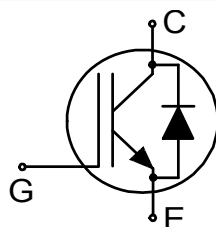
Potential applications

- Ceiling fan
- Countertop appliances - mixing
- Kitchen hood
- Refrigerators
- Residential aircon indoor unit
- Washing machines
- General purpose drives (GPD)

Product validation

- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

Description



Type	Package	Marking
IKN01N60RC2	PG-SOT223-3	K1DRC2

Table of contents

	Description	1
	Features	1
	Potential applications	1
	Product validation	1
	Table of contents	2
1	Package	3
2	IGBT	3
3	Diode	5
4	Characteristics diagrams	7
5	Package outlines	14
6	Testing conditions	15
	Revision history	16
	Disclaimer	17

1 Package

Table 1 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature	T_{sold}	wave soldering / reflow soldering (MSL1 according to JEDEC J-STA-020)			260	°C
Thermal resistance, min.footprint junction-ambient	$R_{th(j-a)}$				160	K/W
Thermal resistance, 6 cm ² Cu on PCB junction to ambient	$R_{th(j-a)}$				75	K/W
IGBT thermal resistance, junction-case ¹⁾	$R_{th(j-c)}$				24.4	K/W
Diode thermal resistance, junction-case ¹⁾	$R_{th(j-c)}$				43.5	K/W

1) R_{th}/Z_{th} based on single cooling pulse. Please be aware that a correct R_{th} measurement of the diode, is not possible using a thermocouple.

2 IGBT

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25\text{ °C}$		600	V
DC collector current, limited by T_{vjmax} ¹⁾	I_C		$T_c = 25\text{ °C}$	2.2	A
			$T_c = 100\text{ °C}$	1.3	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			3	A
Turn-off safe operating area		$V_{CE} \leq 600\text{ V}$, $t_p = 1\text{ }\mu\text{s}$, $T_{vj} \leq 150\text{ °C}$		3	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10\text{ }\mu\text{s}$, $D < 0.01$		±30	V
Short-circuit withstand time	t_{SC}	$V_{CC} \leq 400\text{ V}$, $V_{GE} = 15\text{ V}$, Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}$, $T_{vj} = 150\text{ °C}$		3	μs
Power dissipation	P_{tot}		$T_c = 25\text{ °C}$	5.1	W
			$T_c = 100\text{ °C}$	2	

1) DPAK equivalent

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 1\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		2	2.3	V
			$T_{vj} = 150\text{ °C}$		2.3		
Gate-emitter threshold voltage	V_{GETh}	$I_C = 10\text{ }\mu\text{A}$, $V_{CE} = V_{GE}$		4.3	5	5.7	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 600\text{ V}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			25	μA
			$T_{vj} = 150\text{ °C}$			2500	
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = 20\text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 1\text{ A}$, $V_{CE} = 20\text{ V}$			0.5		S
Input capacitance	C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1000\text{ kHz}$			55		pF
Output capacitance	C_{oes}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1000\text{ kHz}$			4		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1000\text{ kHz}$			2.5		pF
Gate charge	Q_G	$I_C = 1\text{ A}$, $V_{CC} = 480\text{ V}$, $V_{GE} = 15\text{ V}$			9		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{Gon} = 49\text{ }\Omega$, $R_{Goff} = 49\text{ }\Omega$, $L_\sigma = 30\text{ nH}$, $C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}$, $I_C = 1\text{ A}$		5.6		ns
			$T_{vj} = 150\text{ °C}$, $I_C = 1\text{ A}$		6		
Rise time (inductive load)	t_r	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{Gon} = 49\text{ }\Omega$, $R_{Goff} = 49\text{ }\Omega$, $L_\sigma = 30\text{ nH}$, $C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}$, $I_C = 1\text{ A}$		4		ns
			$T_{vj} = 150\text{ °C}$, $I_C = 1\text{ A}$		4		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{Gon} = 49\text{ }\Omega$, $R_{Goff} = 49\text{ }\Omega$, $L_\sigma = 30\text{ nH}$, $C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}$, $I_C = 1\text{ A}$		80		ns
			$T_{vj} = 150\text{ °C}$, $I_C = 1\text{ A}$		100		
Fall time (inductive load)	t_f	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{Gon} = 49\text{ }\Omega$, $R_{Goff} = 49\text{ }\Omega$, $L_\sigma = 30\text{ nH}$, $C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}$, $I_C = 1\text{ A}$		10		ns
			$T_{vj} = 150\text{ °C}$, $I_C = 1\text{ A}$		10		
Turn-on energy	E_{on}	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{Gon} = 49\text{ }\Omega$, $R_{Goff} = 49\text{ }\Omega$, $L_\sigma = 30\text{ nH}$, $C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}$, $I_C = 1\text{ A}$		25.1		μJ
			$T_{vj} = 150\text{ °C}$, $I_C = 1\text{ A}$		34.3		
Turn-off energy	E_{off}	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{Gon} = 49\text{ }\Omega$, $R_{Goff} = 49\text{ }\Omega$, $L_\sigma = 30\text{ nH}$, $C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}$, $I_C = 1\text{ A}$		13.5		μJ
			$T_{vj} = 150\text{ °C}$, $I_C = 1\text{ A}$		22.7		
Total switching energy	E_{ts}	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{Gon} = 49\text{ }\Omega$, $R_{Goff} = 49\text{ }\Omega$, $L_\sigma = 30\text{ nH}$, $C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}$, $I_C = 1\text{ A}$		38.7		μJ
			$T_{vj} = 150\text{ °C}$, $I_C = 1\text{ A}$		57		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Operating junction temperature	T_{vj}		-40		150	°C

Note: Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified

3 Diode

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}	$T_{vj} \geq 25^{\circ}\text{C}$		600	V
Diode forward current, limited by T_{vjmax} ¹⁾	I_F		$T_c = 25^{\circ}\text{C}$	2	A
			$T_c = 100^{\circ}\text{C}$	1	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			3	A

1) DPAK equivalent

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 1\text{ A}$	$T_{vj} = 25^{\circ}\text{C}$		1.85	2.2	V
			$T_{vj} = 150^{\circ}\text{C}$		1.9		
Diode reverse recovery time	t_{rr}	$V_R = 400\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$, $I_F = 1\text{ A}$, $-di_F/dt = 272\text{ A}/\mu\text{s}$		59.5		ns
			$T_{vj} = 150^{\circ}\text{C}$, $I_F = 1\text{ A}$, $-di_F/dt = 236\text{ A}/\mu\text{s}$		89.3		
Diode reverse recovery charge	Q_{rr}	$V_R = 400\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$, $I_F = 1\text{ A}$, $-di_F/dt = 272\text{ A}/\mu\text{s}$		0.06		μC
			$T_{vj} = 150^{\circ}\text{C}$, $I_F = 1\text{ A}$, $-di_F/dt = 236\text{ A}/\mu\text{s}$		0.11		
Diode peak reverse recovery current	I_{rrm}	$V_R = 400\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$, $I_F = 1\text{ A}$, $-di_F/dt = 272\text{ A}/\mu\text{s}$		1.9		A
			$T_{vj} = 150^{\circ}\text{C}$, $I_F = 1\text{ A}$, $-di_F/dt = 236\text{ A}/\mu\text{s}$		2.4		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	$V_R = 400 \text{ V}$	$T_{vj} = 25 \text{ °C}, I_F = 1 \text{ A}, -di_F/dt = 272 \text{ A}/\mu\text{s}$		38.7		$\text{A}/\mu\text{s}$
			$T_{vj} = 150 \text{ °C}, I_F = 1 \text{ A}, -di_F/dt = 236 \text{ A}/\mu\text{s}$		30.9		
Operating junction temperature	T_{vj}			-40		150	$^{\circ}\text{C}$

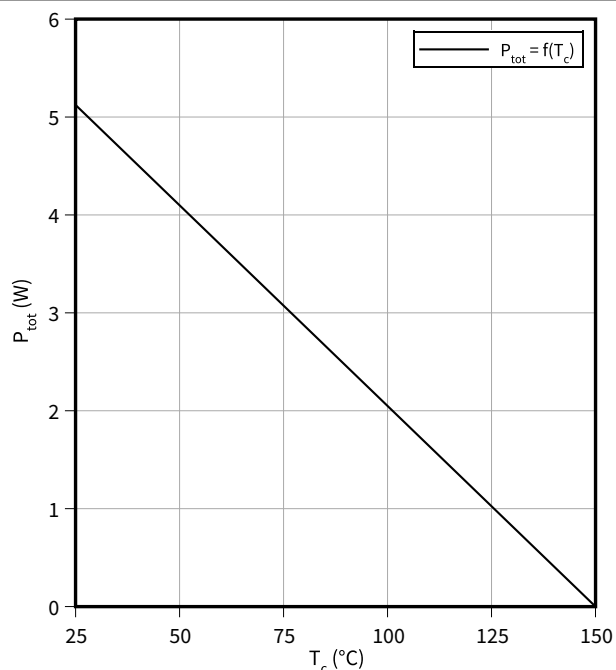
Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

4 Characteristics diagrams

Power dissipation as a function of heatsink temperature

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

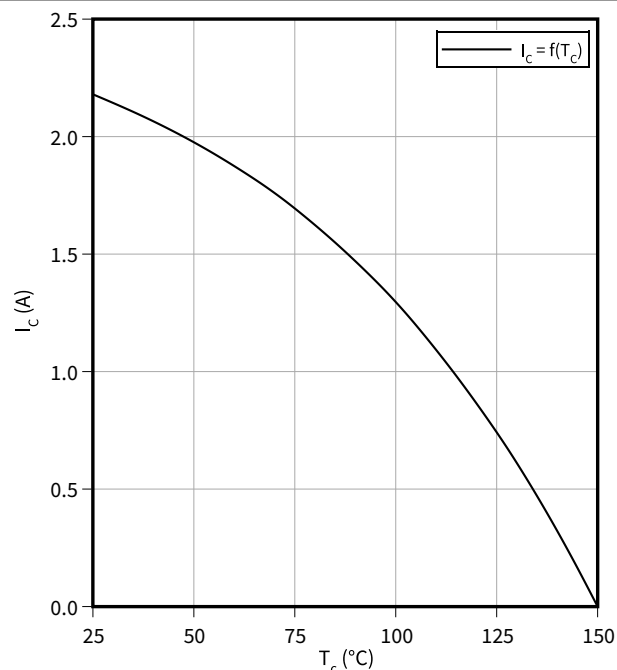
$$T_{vj} \leq 150^\circ\text{C}$$



Collector current as a function of heatsink temperature

$$I_c = f(T_c)$$

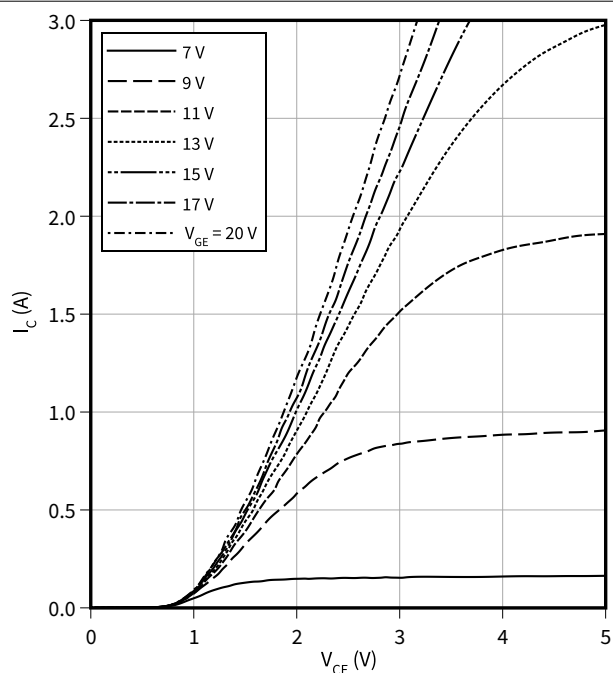
$$T_{vj} \leq 150^\circ\text{C}, V_{GE} \geq 15\text{ V}$$



Typical output characteristic

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

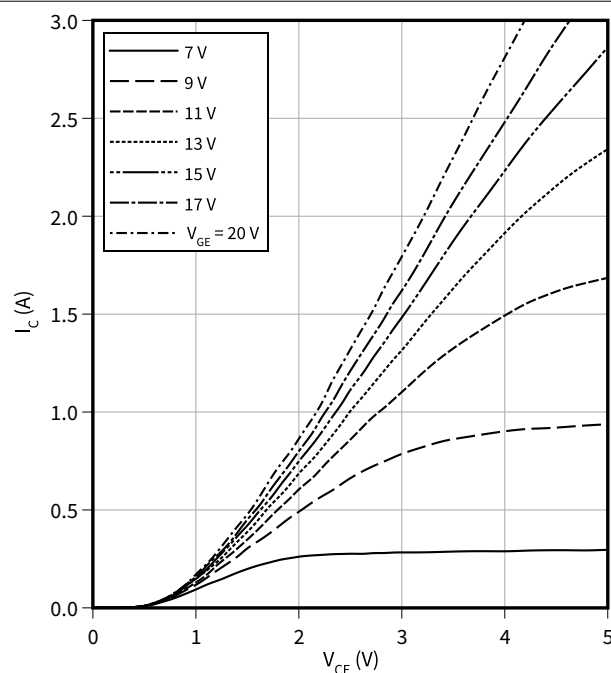
$$T_{vj} = 25^\circ\text{C}$$



Typical output characteristic

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

$$T_{vj} = 150^\circ\text{C}$$

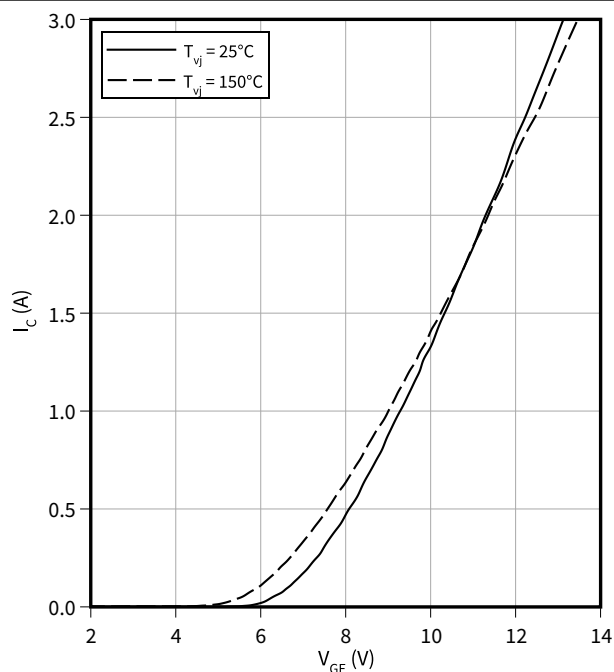


4 Characteristics diagrams

Typical transfer characteristic

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

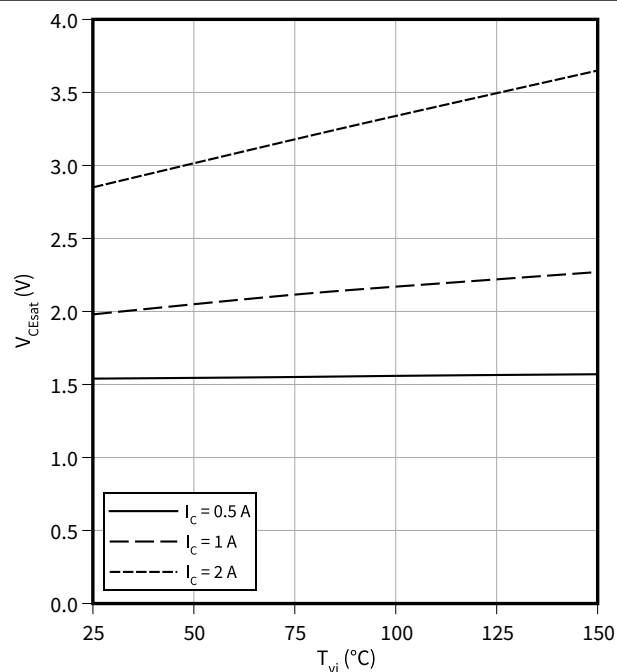
$$V_{CE} = 20 \text{ V}$$



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

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

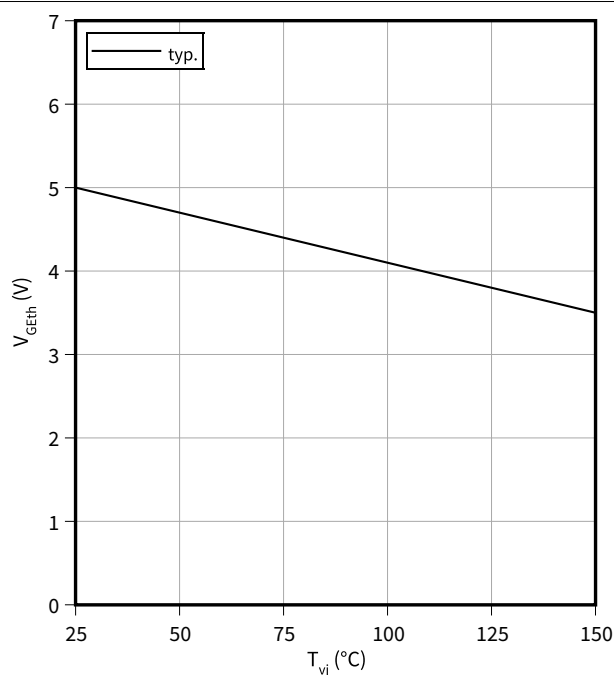
$$V_{GE} = 15 \text{ V}$$



Gate-emitter threshold voltage as a function of junction temperature

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

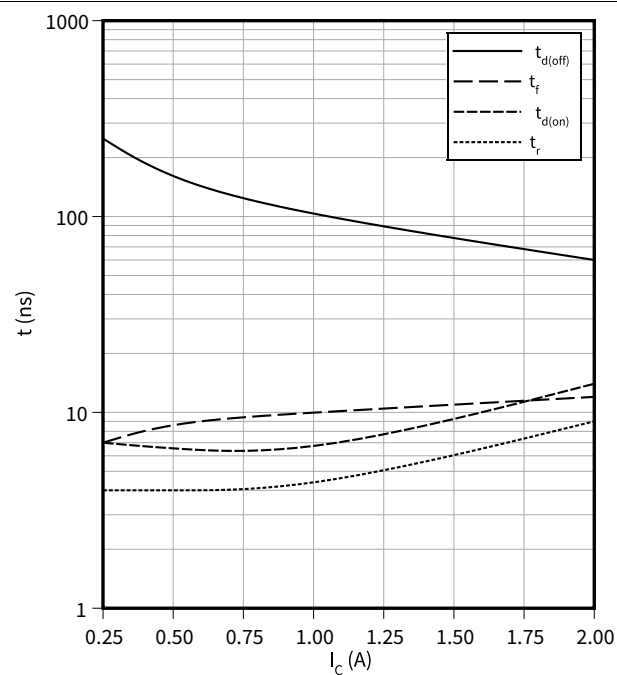
$$I_C = 10 \mu\text{A}$$



Typical switching times as a function of collector current

$$t = f(I_C)$$

$$V_{CC} = 400 \text{ V}, T_{vj} = 150^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 49 \Omega$$

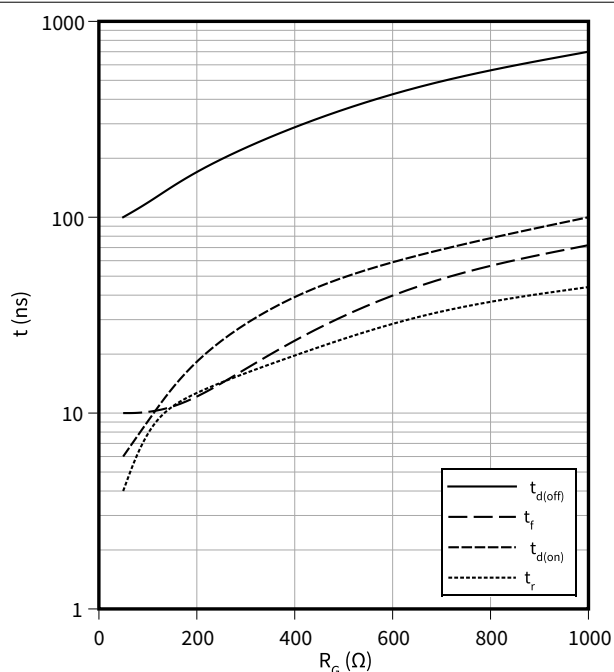


4 Characteristics diagrams

Typical switching times as a function of gate resistor

$$t = f(R_G)$$

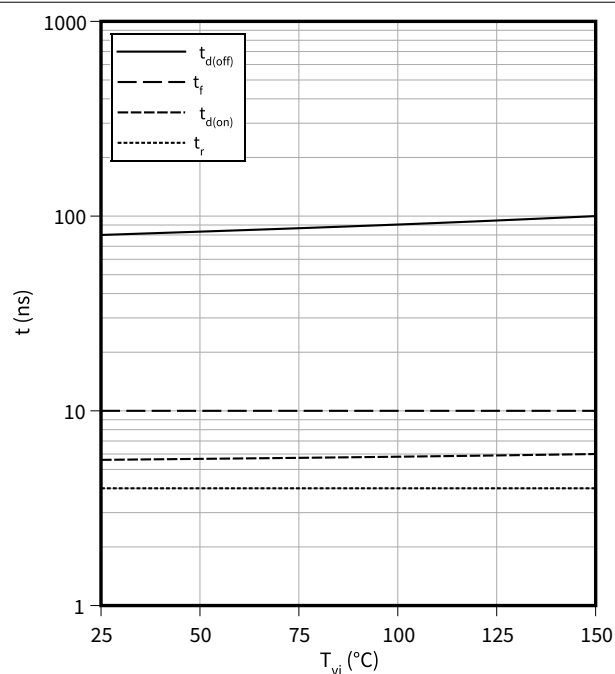
$I_C = 1 \text{ A}$, $V_{CC} = 400 \text{ V}$, $T_{vj} = 150 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$



Typical switching times as a function of junction temperature

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

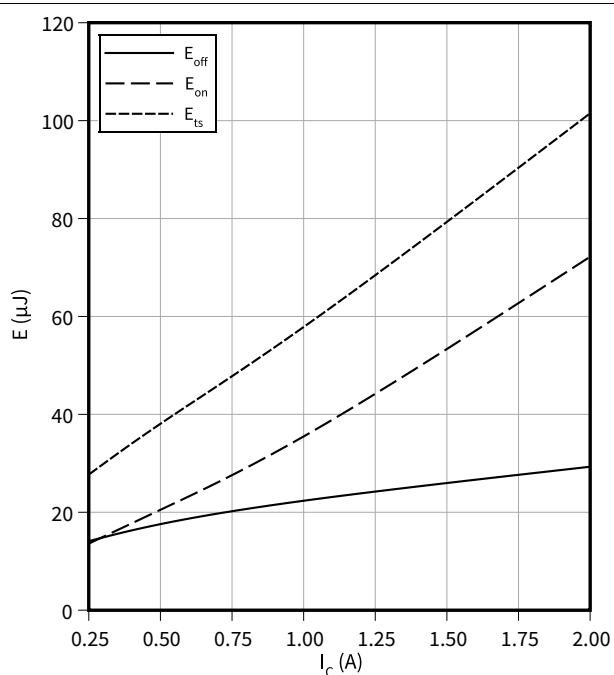
$I_C = 1 \text{ A}$, $V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 49 \text{ } \Omega$



Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

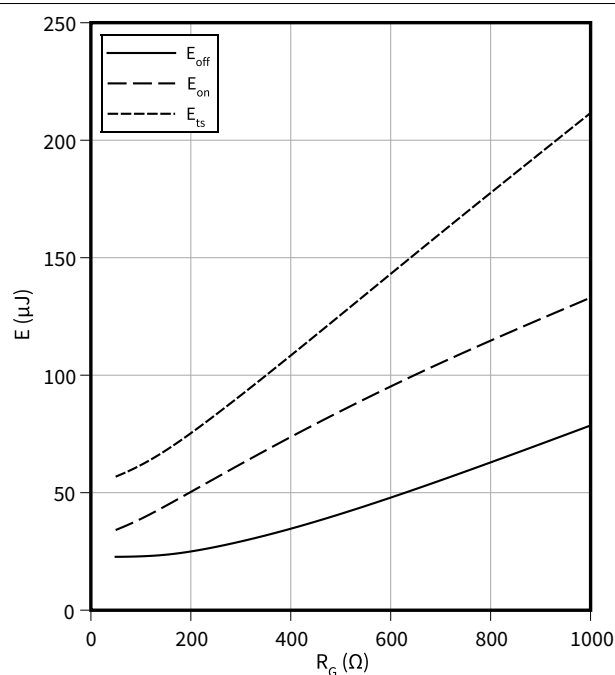
$V_{CC} = 400 \text{ V}$, $T_{vj} = 150 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 49 \text{ } \Omega$



Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

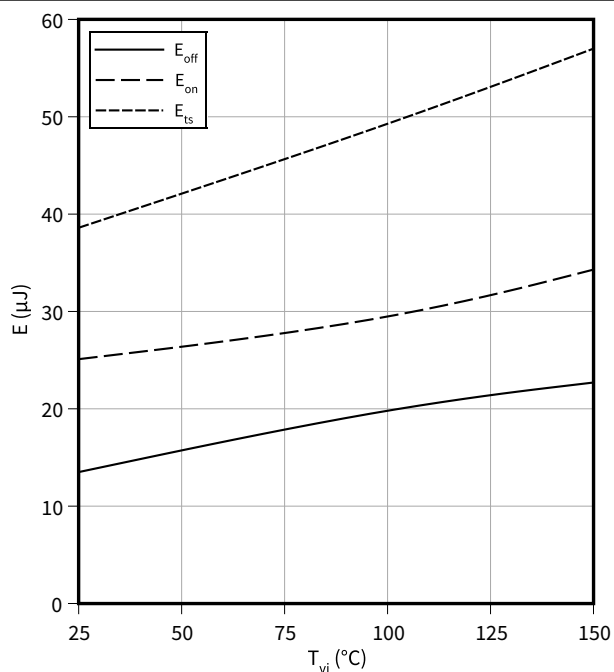
$I_C = 1 \text{ A}$, $V_{CC} = 400 \text{ V}$, $T_{vj} = 150 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$



Typical switching energy losses as a function of junction temperature

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

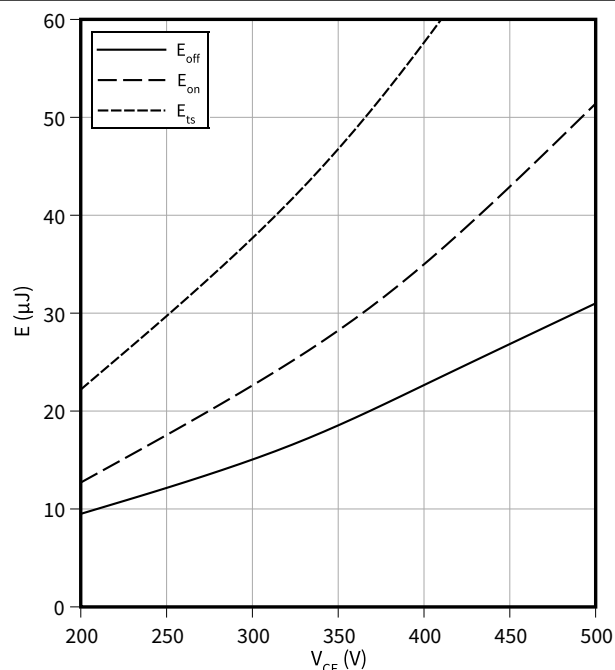
$I_C = 1 \text{ A}$, $V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 49 \Omega$



Typical switching energy losses as a function of collector emitter voltage

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

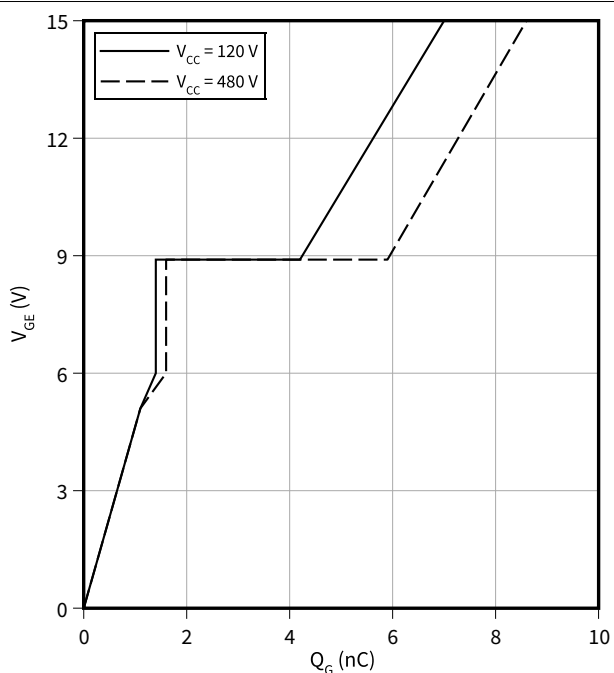
$I_C = 1 \text{ A}$, $T_{vj} = 150 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 49 \Omega$



Typical gate charge

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

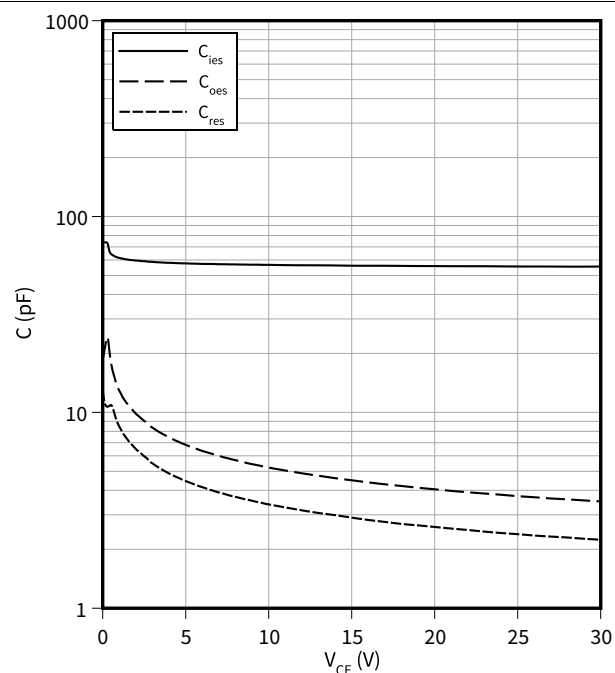
$I_C = 1 \text{ A}$



Typical capacitance as a function of collector-emitter voltage

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

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

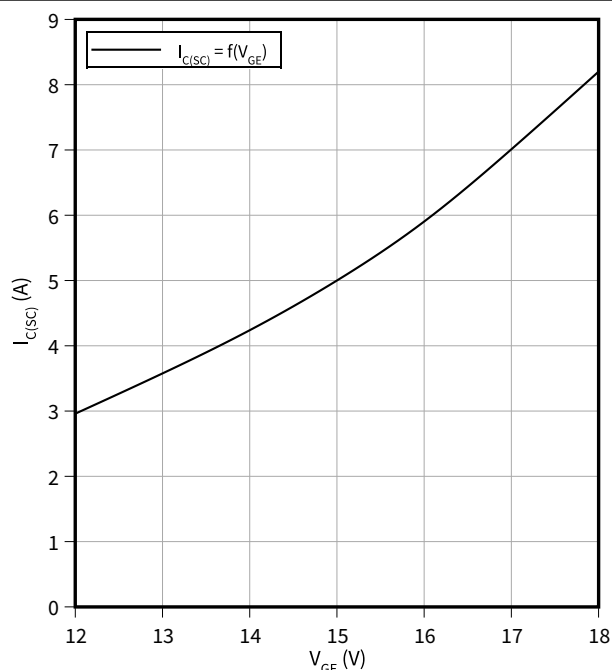


4 Characteristics diagrams

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

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

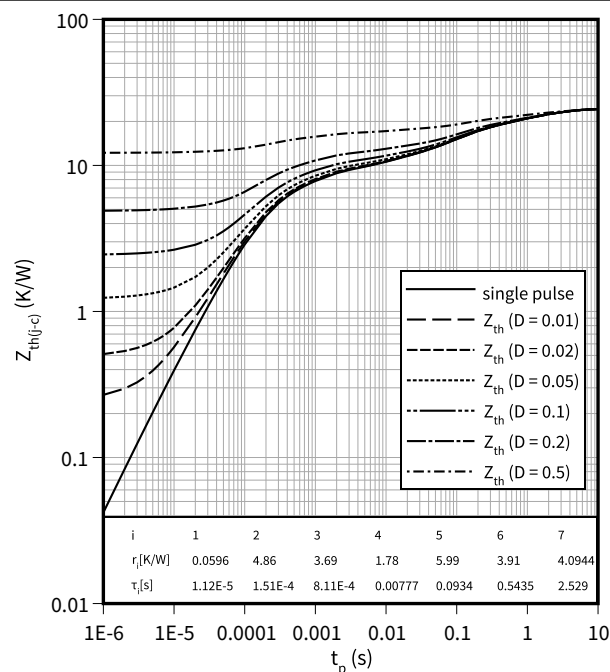
$T_{vj} \leq 150\text{ }^{\circ}\text{C}$, $V_{CC} \leq 400\text{ V}$



IGBT transient thermal impedance as a function of pulse width

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

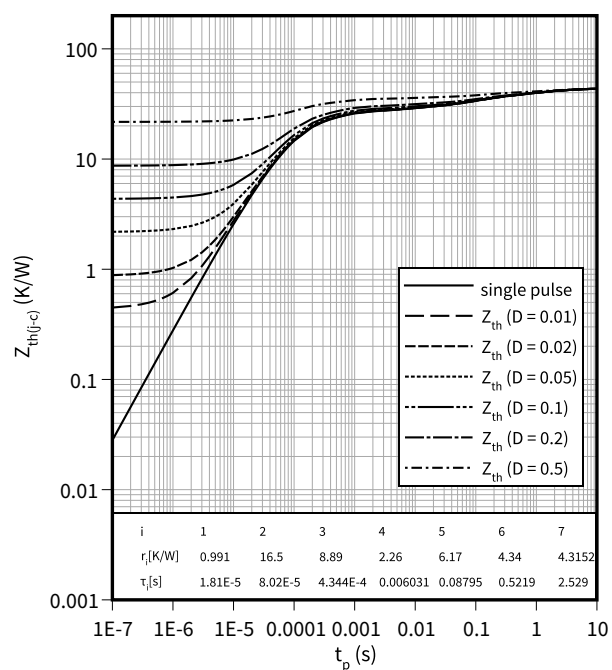
$$D = t_p/T$$



Diode transient thermal impedance as a function of pulse width

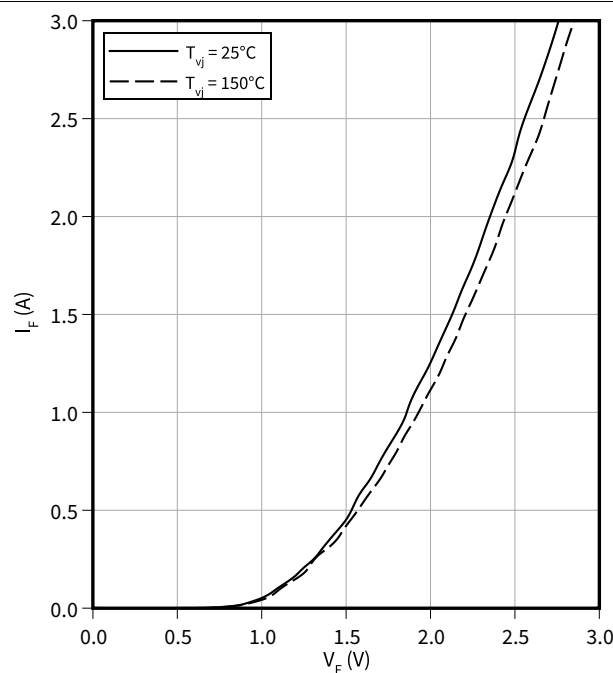
$$Z_{th(j-c)} = f(t_p)$$

$$D = t_p/T$$



Typical diode forward current as a function of forward voltage

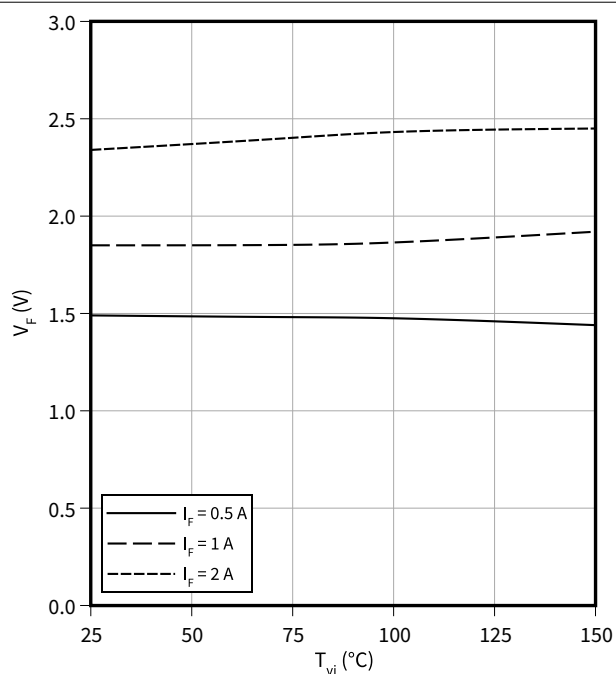
$$I_F = f(V_F)$$



4 Characteristics diagrams

Typical diode forward voltage as a function of junction temperature

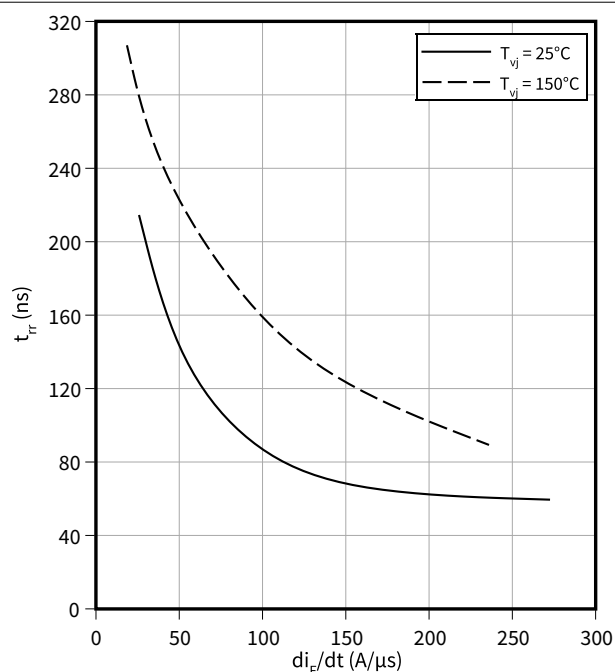
$$V_F = f(T_{vj})$$



Typical reverse recovery time as a function of diode current slope

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

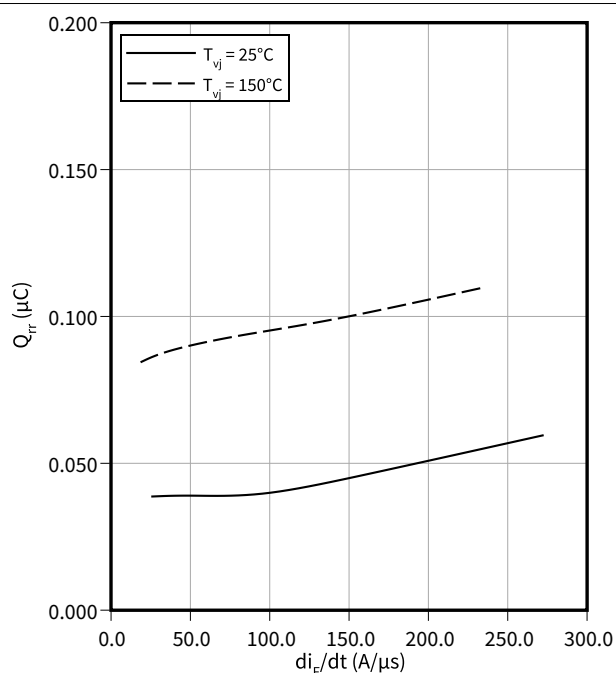
$$V_R = 400 \text{ V}, I_F = 1 \text{ A}$$



Typical reverse recovery charge as a function of diode current slope

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

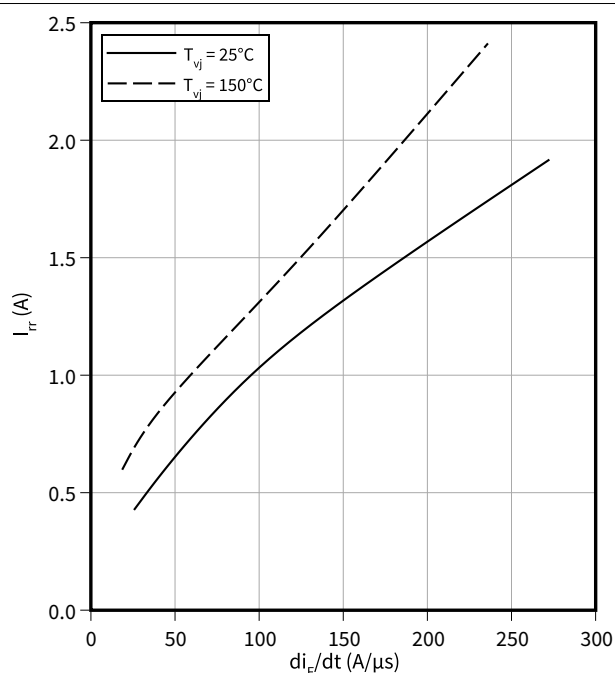
$$V_R = 400 \text{ V}, I_F = 1 \text{ A}$$



Typical reverse recovery current as a function of diode current slope

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

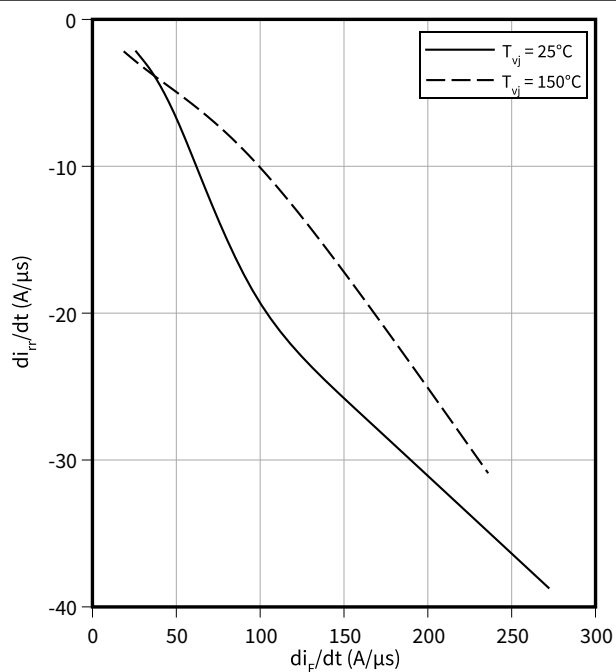
$$V_R = 400 \text{ V}, I_F = 1 \text{ A}$$



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

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

$V_R = 400 \text{ V}$, $I_F = 1 \text{ A}$



5 Package outlines

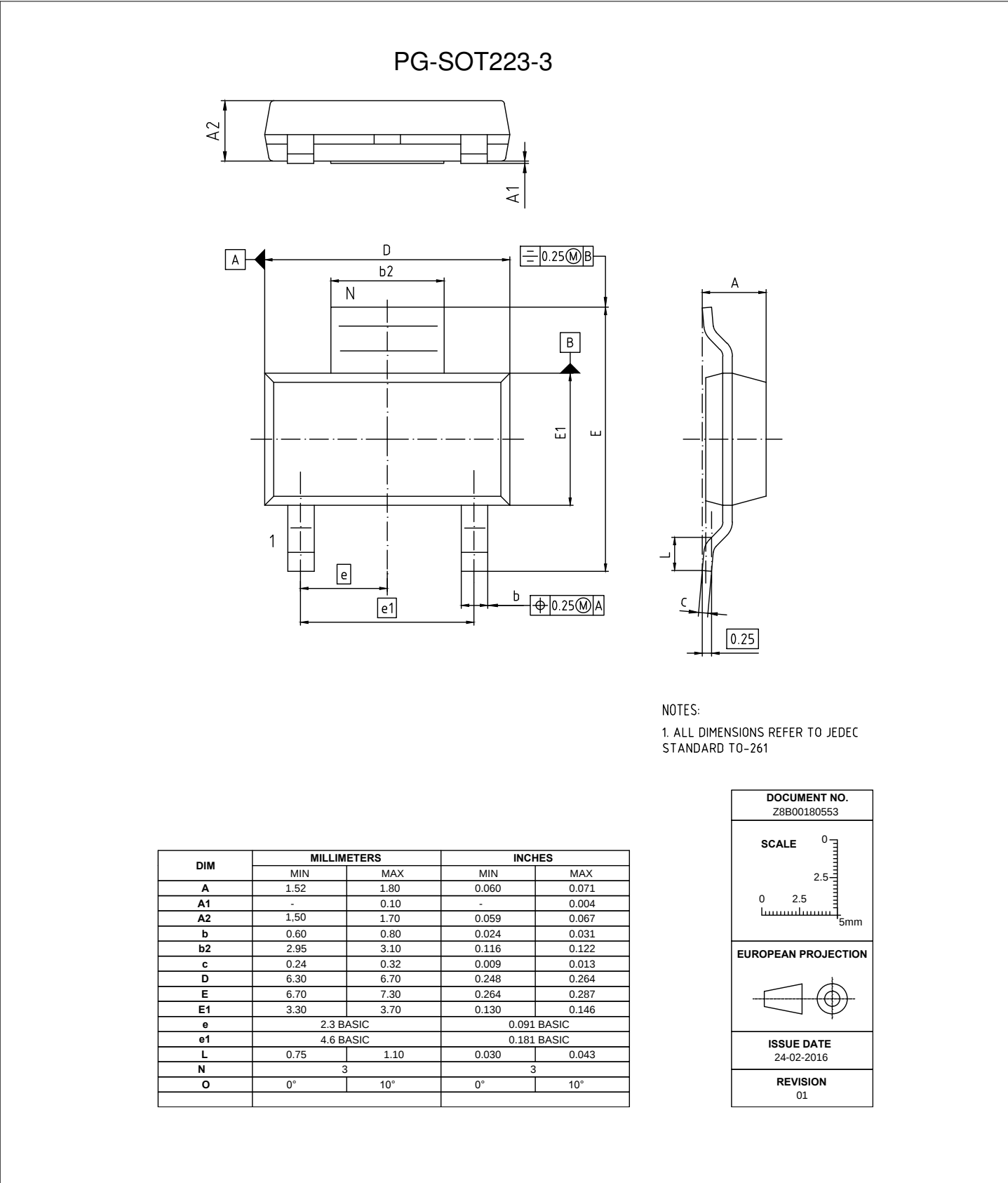


Figure 1

6 Testing conditions

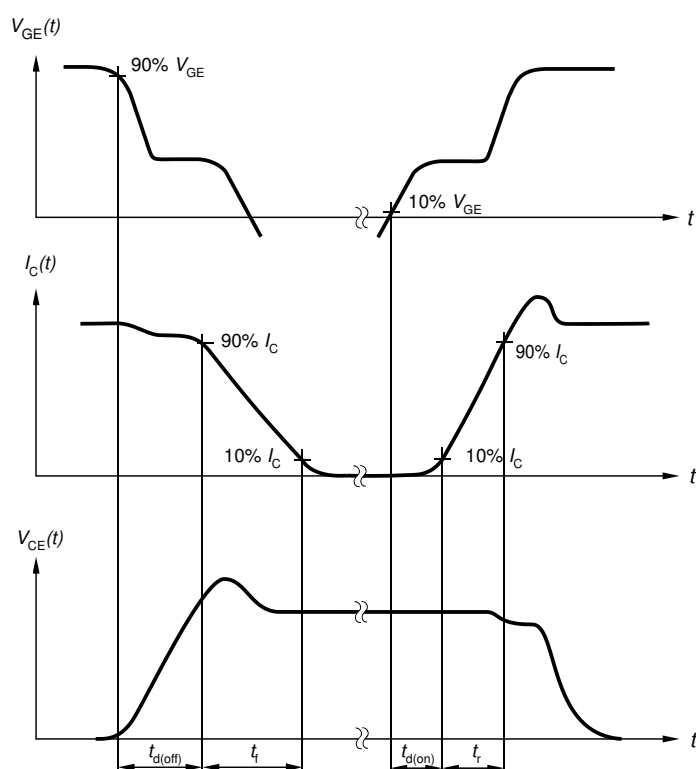


Figure A. Definition of switching times

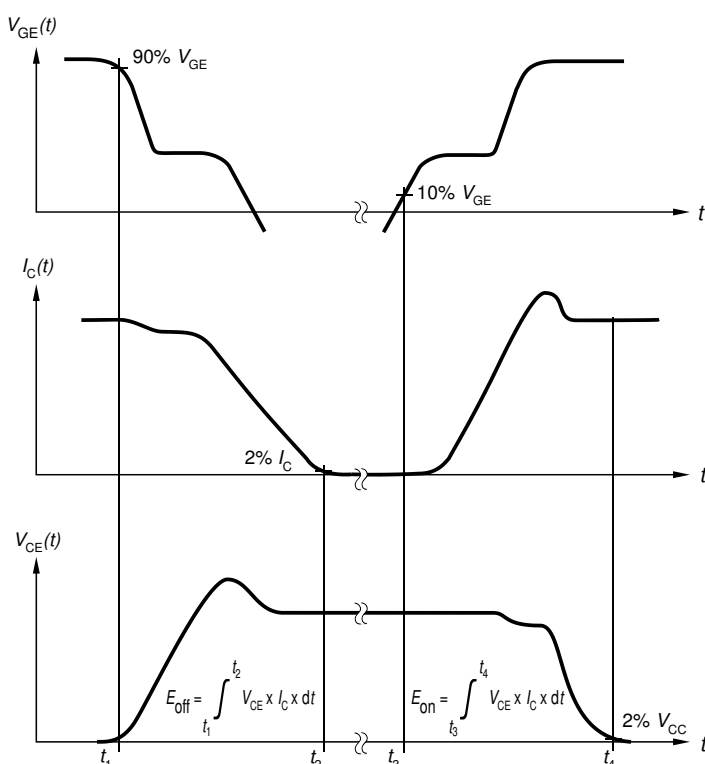


Figure B. Definition of switching losses

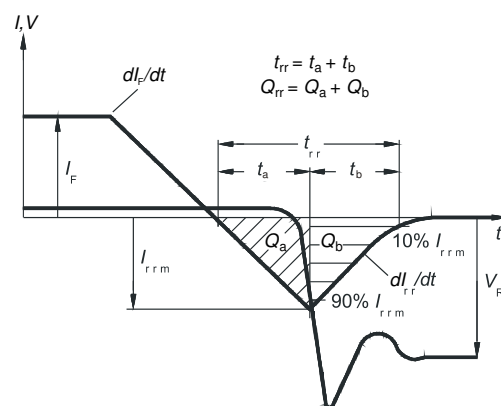


Figure C. Definition of diode switching characteristics

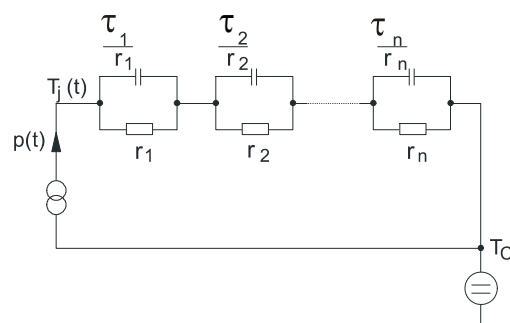


Figure D. Thermal equivalent circuit

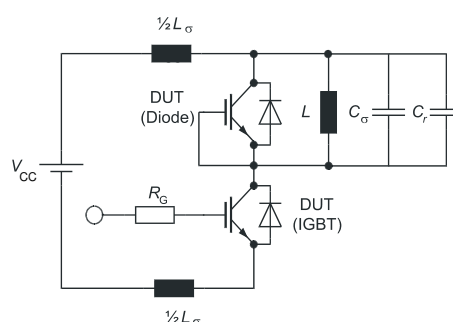


Figure E. **Dynamic test circuit**
 Parasitic inductance L_{σ} ,
 parasitic capacitor C_{σ} ,
 relief capacitor C_r ,
 (only for ZVT switching)

Revision history

Document revision	Date of release	Description of changes
1.00	2021-09-27	Final datasheet
1.01	2021-10-15	Change of Potential Applications
1.10	2022-09-21	Add of wave soldering conditions

Trademarks

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

Edition 2022-09-21

Published by

Infineon Technologies AG
81726 Munich, Germany

© 2022 Infineon Technologies AG
All Rights Reserved.

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

Email: erratum@infineon.com

Document reference
IFX-ABB683-003

Important notice

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenhheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

Please note that this product is not qualified according to the AEC Q100 or AEC Q101 documents of the Automotive Electronics Council.

Warnings

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Infineon:](#)

[IKN01N60RC2ATMA1](#)