Final datasheet

High speed DuoPack: IGBT in Trench and Fieldstop technology with soft, fast recovery antiparallel diode

Features

- V_{CE} = 1200 V
- I_C = 25 A
- Very low V_{CEsat}
- Low EMI
- Very soft, fast recovery antiparallel diode
- Maximum junction temperature T_{vjmax} = 175°C
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

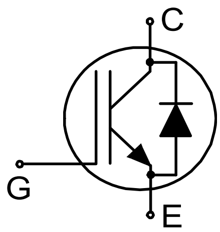
Halogen-free
Lead-free
Green
RoHS

Potential applications

- Uninterruptible power supplies
- Welding converters
- Converters with high switching frequency

Description

Package pin definition:
- Pin G – Gate
- Pin C & backside – Collector
- Pin E – Emitter



Type	**Package**	**Marking**
IKW25N120H3	PG-TO247-3	K25H1203

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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}	wave soldering 1.6 mm (0.063 in.) from case for 10 s			260	°C
Mounting torque	M	M3 screw, Maximum of mounting processes: 3			0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j\text{-}a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j\text{-}c)}$				0.46	K/W
Diode thermal resistance, junction-case	$R_{th(j\text{-}c)}$				1.49	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		1200	V
DC collector current, limited by T_{vjmax}	I_C		$T_c = 25$ °C	50	A
			$T_c = 100$ °C	25	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			100	A
Turn-off safe operating area		$V_{CE} \leq 1200$ V, $T_{vj} \leq 175$ °C		100	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10$ µs, $D < 0.01$		±30	V
Short-circuit withstand time	t_{SC}	$V_{CC} \leq 600$ V, $V_{GE} = 15$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 175$ °C		10	µs
Power dissipation	P_{tot}		$T_c = 25$ °C	326	W
			$T_c = 100$ °C	156	

Table 3 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter breakdown voltage	V_{BRCES}	I_C = 0.5 mA, V_{GE} = 0 V		1200			V
Collector-emitter saturation voltage	V_{CEsat}	I_C = 25 A, V_{GE} = 15 V	T_{vj} = 25 °C		2.05	2.4	V
			T_{vj} = 125 °C		2.5		
			T_{vj} = 175 °C		2.7		
Gate-emitter threshold voltage	V_{GEth}	I_C = 0.85 mA, V_{CE} = V_{GE}		5	5.8	6.5	V
Zero gate-voltage collector current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			250	µA
			T_{vj} = 175 °C			2500	
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				600	nA
Transconductance	g_{fs}	I_C = 25 A, V_{CE} = 20 V			13		S
Short-circuit collector current	I_{SC}	V_{CC} ≤ 600 V, V_{GE} = 15 V, t_{SC} ≤ 10 µs, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, T_{vj} = 175 °C			87		A
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			1430		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			115		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			75		pF
Gate charge	Q_G	V_{CC} = 960 V, I_C = 25 A, V_{GE} = 15 V			115		nC
Turn-on delay time	$t_{d(on)}$	V_{CC} = 600 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 23 Ω, $R_{G(off)}$ = 23 Ω	T_{vj} = 25 °C, I_C = 25 A		27		ns
			T_{vj} = 175 °C, I_C = 25 A		26		
Rise time (inductive load)	t_r	V_{CC} = 600 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 23 Ω, $R_{G(off)}$ = 23 Ω	T_{vj} = 25 °C, I_C = 25 A		41		ns
			T_{vj} = 175 °C, I_C = 25 A		35		
Turn-off delay time	$t_{d(off)}$	V_{CC} = 600 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 23 Ω, $R_{G(off)}$ = 23 Ω	T_{vj} = 25 °C, I_C = 25 A		277		ns
			T_{vj} = 175 °C, I_C = 25 A		347		
Fall time (inductive load)	t_f	V_{CC} = 600 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 23 Ω, $R_{G(off)}$ = 23 Ω	T_{vj} = 25 °C, I_C = 25 A		17		ns
			T_{vj} = 175 °C, I_C = 25 A		50		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on energy	E_{on}	V_{CC} = 600 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 23 Ω, $R_{G(off)}$ = 23 Ω	T_{vj} = 25 °C, I_C = 25 A		1.8		mJ
			T_{vj} = 175 °C, I_C = 25 A		2.6		
Turn-off energy	E_{off}	V_{CC} = 600 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 23 Ω, $R_{G(off)}$ = 23 Ω	T_{vj} = 25 °C, I_C = 25 A		0.85		mJ
			T_{vj} = 175 °C, I_C = 25 A		1.7		
Total switching energy	E_{ts}	V_{CC} = 600 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 23 Ω, $R_{G(off)}$ = 23 Ω	T_{vj} = 25 °C, I_C = 25 A		2.65		mJ
			T_{vj} = 175 °C, I_C = 25 A		4.3		
Operating junction temperature	T_{vj}			-40		175	°C

3 Diode

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}	T_{vj} ≥ 25 °C		1200	V
Diode forward current, limited by T_{vjmax}	I_F		T_c = 25 °C	25	A
			T_c = 100 °C	12.5	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			100	A

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 12.5 A	T_{vj} = 25 °C		1.8	2.35	V
			T_{vj} = 175 °C		1.85		
Diode forward voltage	V_F	I_F = 25 A	T_{vj} = 25 °C		2.4	3.05	V
			T_{vj} = 125 °C		2.6		
			T_{vj} = 175 °C		2.6		
Reverse leakage current	I_R	V_R = 1200 V	T_{vj} = 25 °C			250	µA
			T_{vj} = 175 °C			2500	

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery time	t_{rr}	V_R = 600 V, $R_{G(on)}$ = 23 Ω	T_{vj} = 25 °C, I_F = 25 A, $-di_F/dt$ = 500 A/µs		290		ns
			T_{vj} = 175 °C, I_F = 25 A, $-di_F/dt$ = 500 A/µs		505		
Diode reverse recovery charge	Q_{rr}	V_R = 600 V, $R_{G(on)}$ = 23 Ω	T_{vj} = 25 °C, I_F = 25 A, $-di_F/dt$ = 500 A/µs		1.2		µC
			T_{vj} = 175 °C, I_F = 25 A, $-di_F/dt$ = 500 A/µs		2.75		
Diode peak reverse recovery current	I_{rrm}	V_R = 600 V, $R_{G(on)}$ = 23 Ω	T_{vj} = 25 °C, I_F = 25 A, $-di_F/dt$ = 500 A/µs		10.4		A
			T_{vj} = 175 °C, I_F = 25 A, $-di_F/dt$ = 500 A/µs		12.8		
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	V_R = 600 V, $R_{G(on)}$ = 23 Ω	T_{vj} = 25 °C, I_F = 25 A, $-di_F/dt$ = 500 A/µs		-150		A/µs
			T_{vj} = 175 °C, I_F = 25 A, $-di_F/dt$ = 500 A/µs		-85		
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.

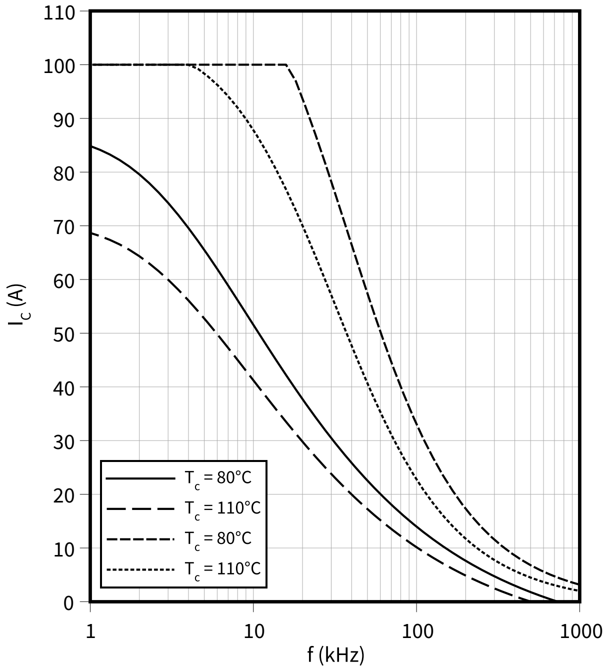
Dynamic test circuit: L_σ = 80 nH, C_σ = 67 pF from Figure E. Energy losses include “tail” and diode reverse recovery.

4 Characteristics diagrams

Collector current as a function of switching frequency

$I_C = f(f)$

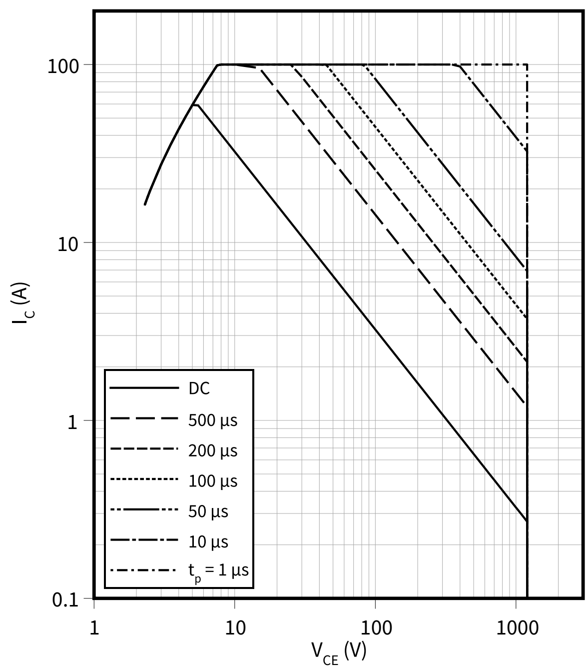
$D = 0.5$, $V_{CE} = 25$ V, $T_{vj} \leq 175$ °C, $V_{GE} = 0/15$ V, $R_G = 23\ \Omega$



Forward bias safe operating area

$I_C = f(V_{CE})$

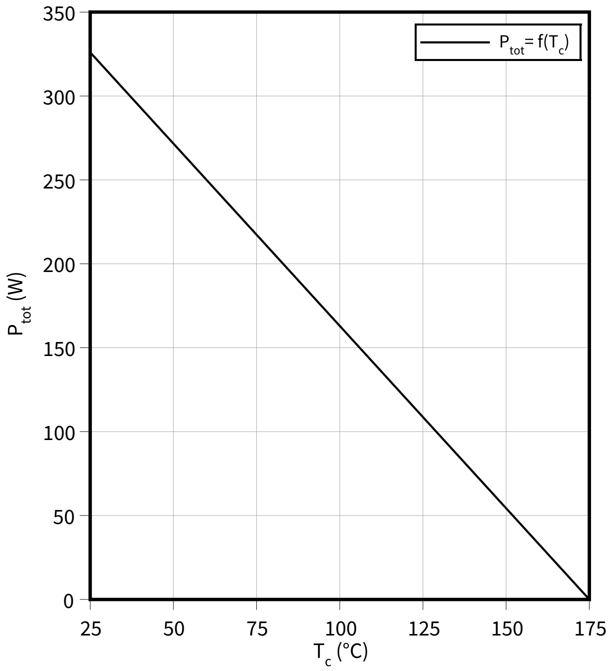
$D = 0$, $T_{vj} \leq 175$ °C, $V_{GE} = 15$ V, $T_c = 25$ °C



Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_c)$

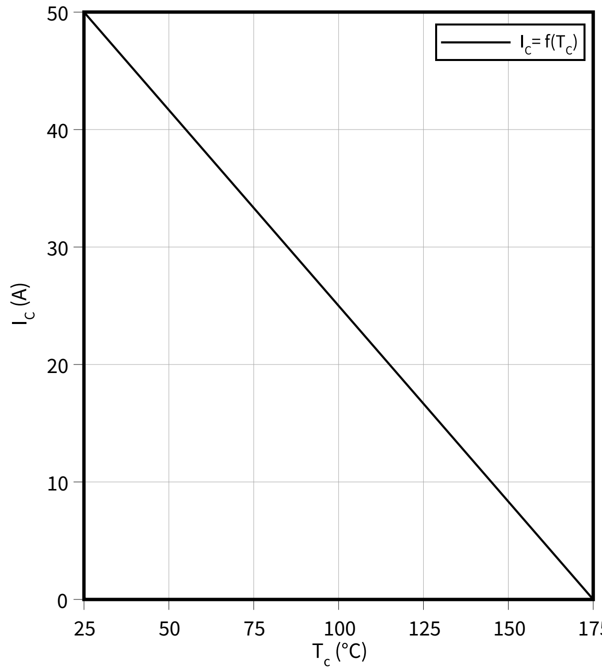
$T_{vj} \leq 175$ °C



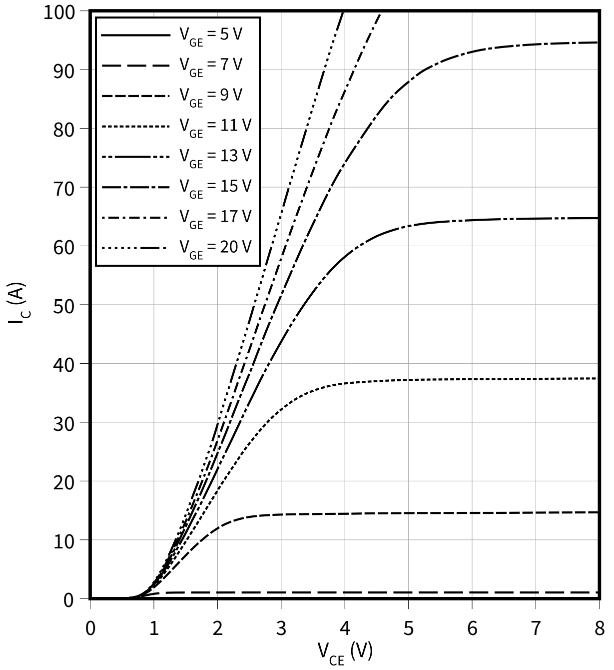
Collector current as a function of heatsink temperature

$I_C = f(T_c)$

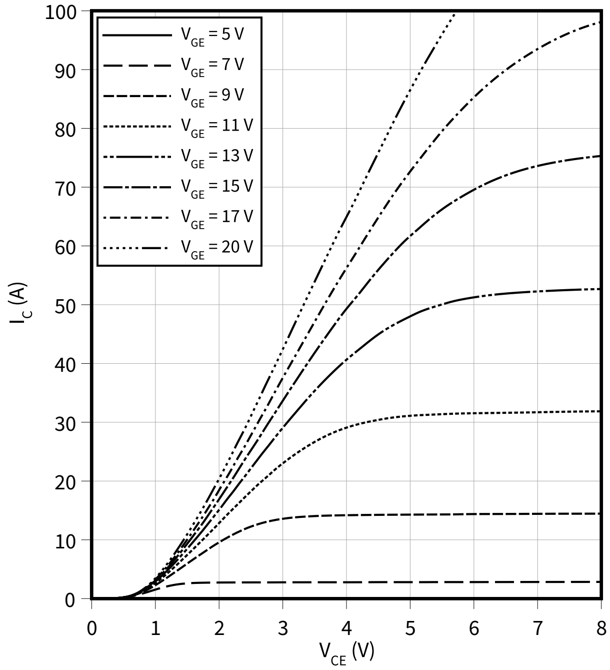
$V_{GE} \geq 15$ V, $T_{vj} \leq 175$ °C



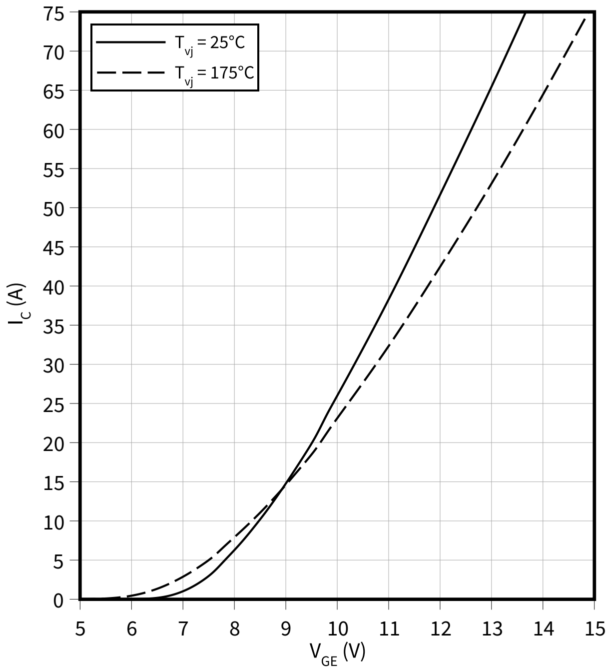
Typical output characteristic
$I_C = f(V_{CE})$
$T_{vj} = 25\ °C$



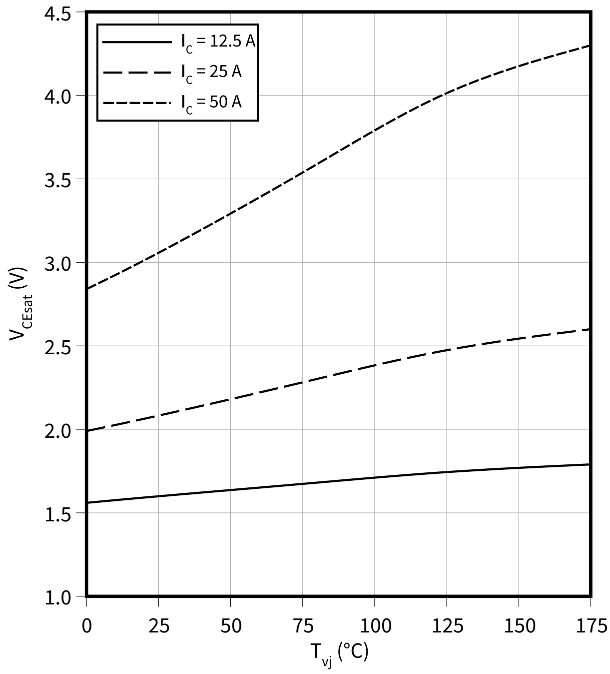
Typical output characteristic
$I_C = f(V_{CE})$
$T_{vj} = 175\ °C$



Typical transfer characteristic
$I_C = f(V_{GE})$
$V_{CE} = 20\ V$



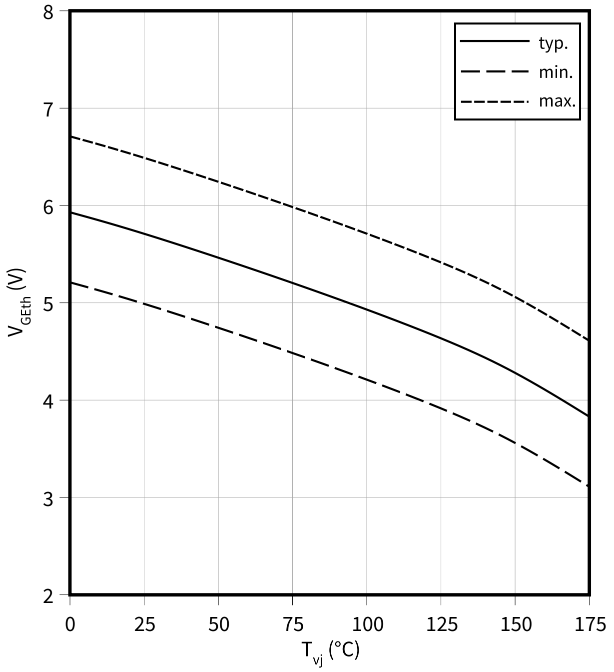
Typical collector-emitter saturation voltage as a function of junction temperature
$V_{CEsat} = f(T_{vj})$
$V_{GE} = 15\ V$



Gate-emitter threshold voltage as a function of junction temperature

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

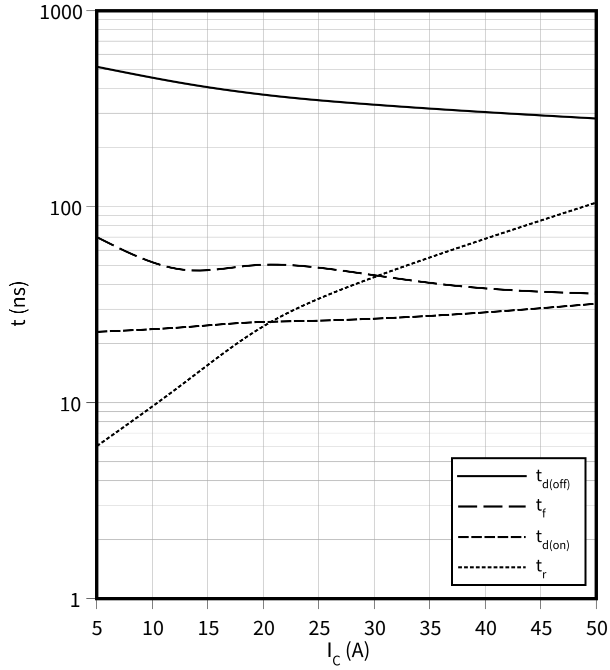
$I_C = 0.85$ mA



Typical switching times as a function of collector current

$t = f(I_C)$

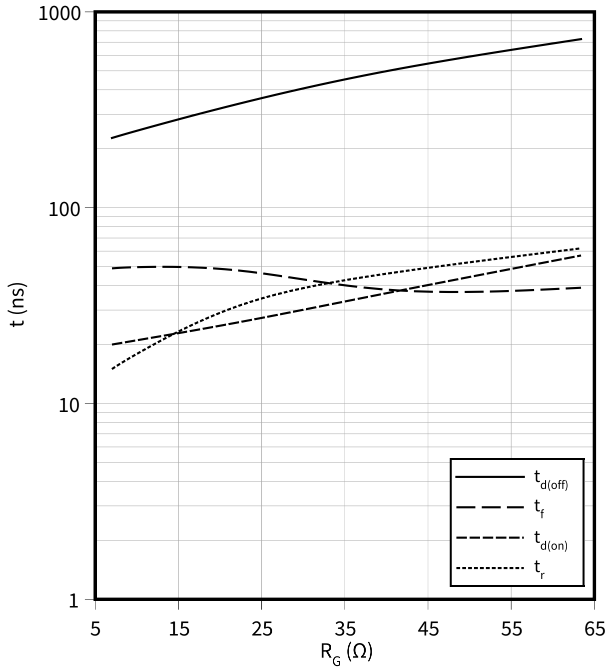
$V_{CC} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 23\ \Omega$



Typical switching times as a function of gate resistor

$t = f(R_G)$

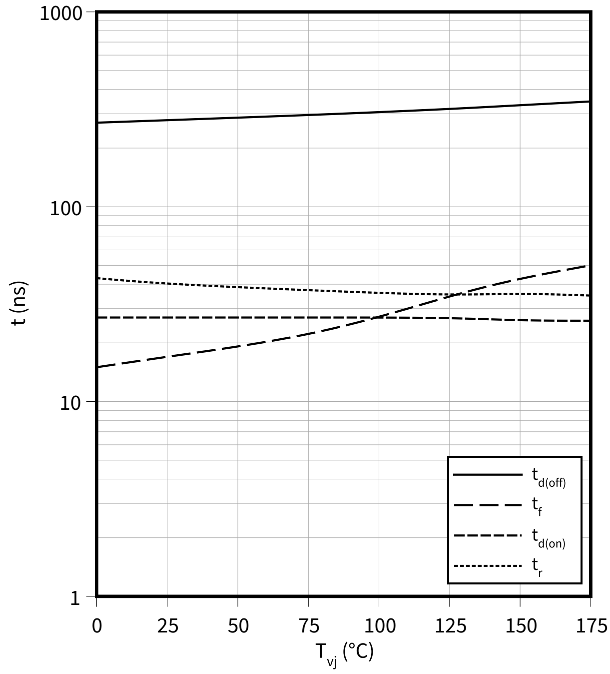
$I_C = 25$ A, $V_{CC} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

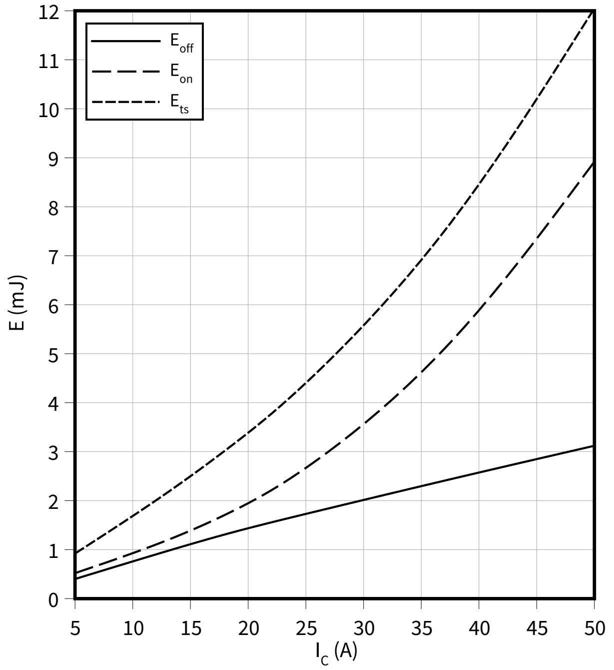
$I_C = 25$ A, $V_{CC} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 23\ \Omega$



Typical switching energy losses as a function of collector current

$E = f(I_C)$

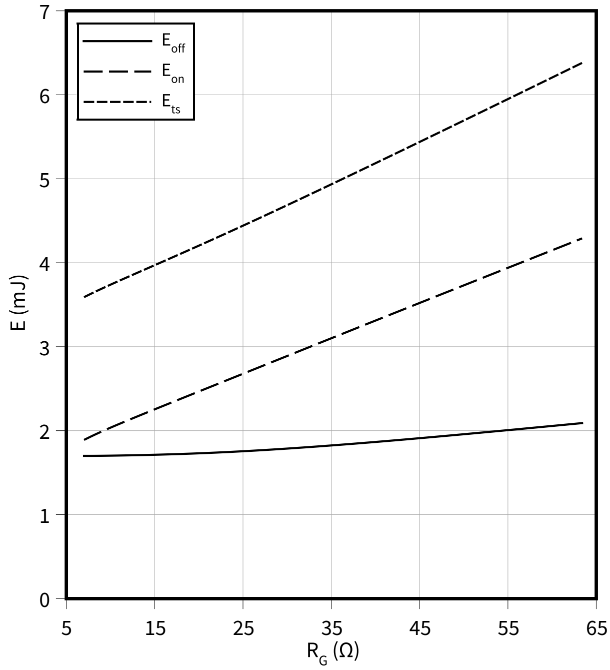
$V_{CC} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 23\ \Omega$



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

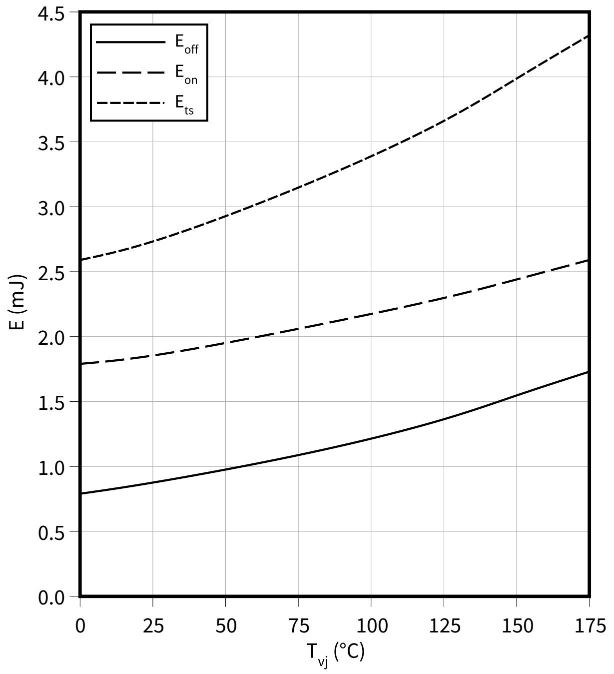
$I_C = 25$ A, $V_{CC} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

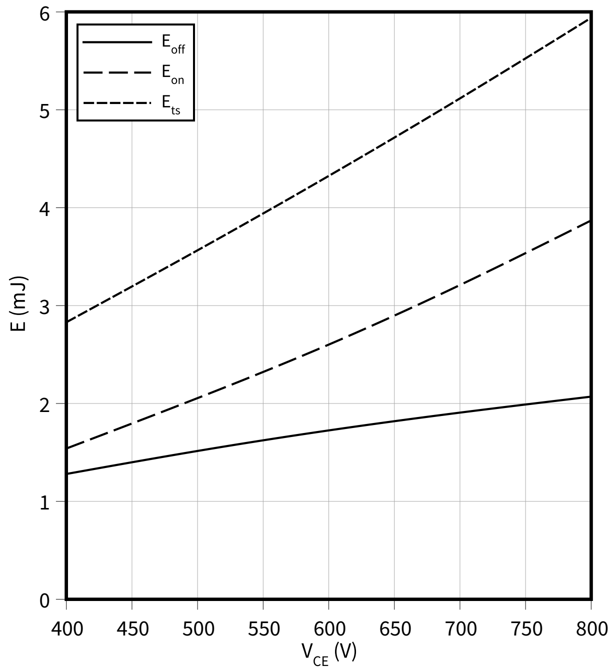
$I_C = 25$ A, $V_{CC} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 23\ \Omega$



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

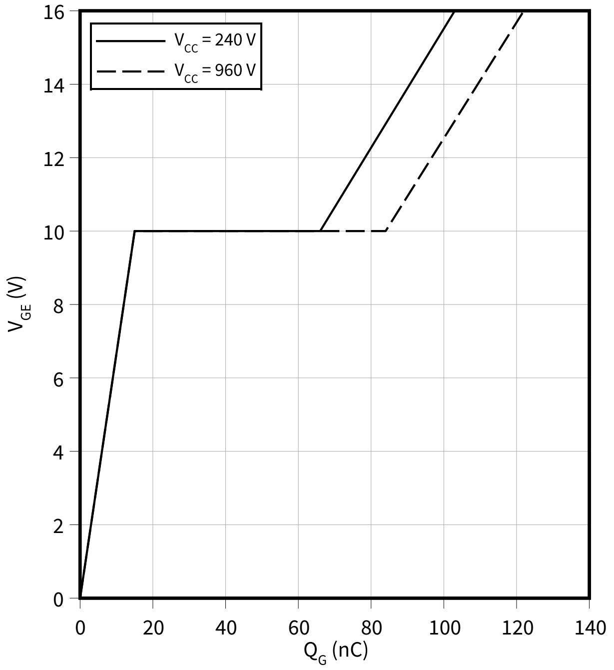
$I_C = 25$ A, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 23\ \Omega$



Typical gate charge

$V_{GE} = f(Q_G)$

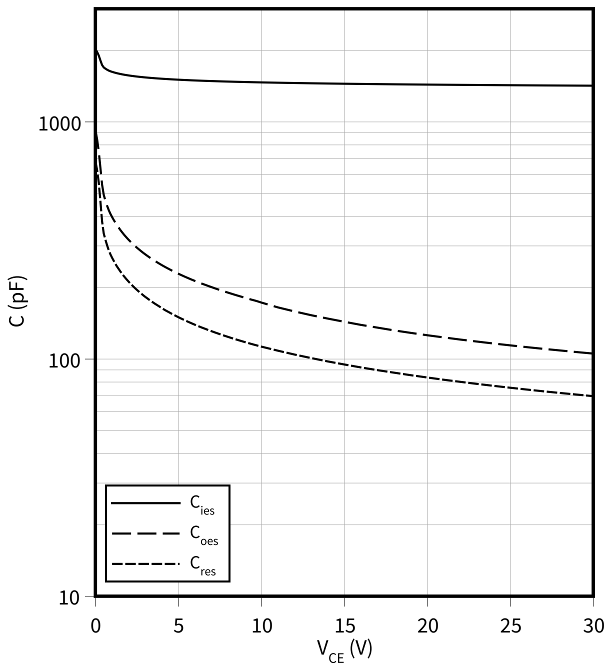
$I_C = 25$ A



Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

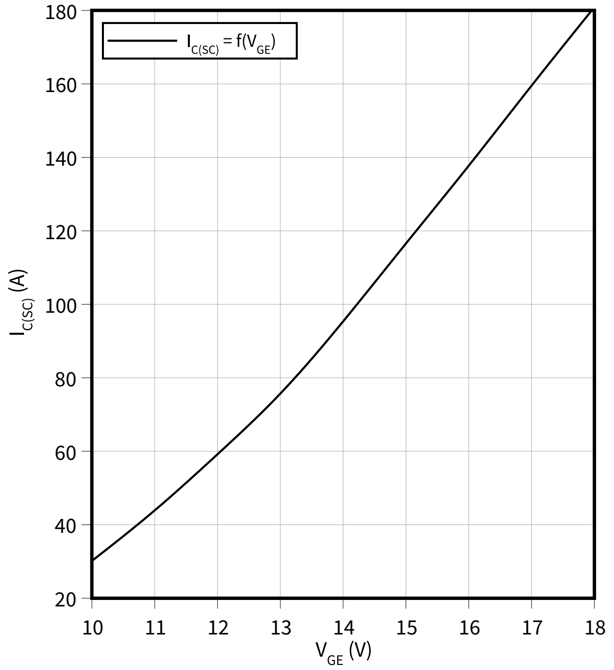
f = 1000 kHz, $V_{GE} = 0$ V



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

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

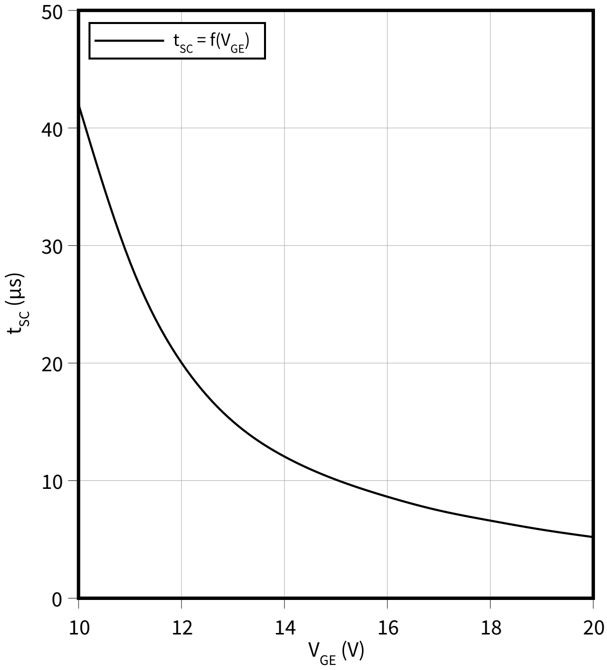
$T_{vj,\,start} = 25$ °C, $V_{CC} \leq 600$ V



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

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

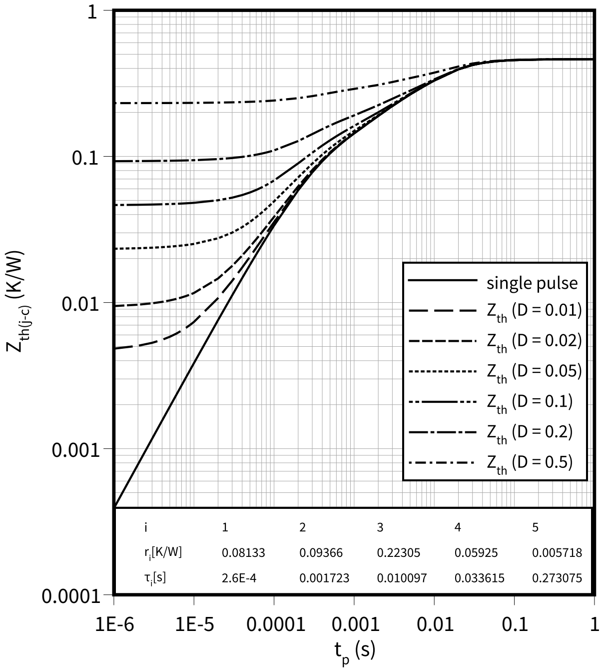
$V_{CC} \leq 600$ V, $T_{vj,\,start} \leq 150$ °C



IGBT transient thermal impedance as a function of pulse width

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

$D = t_p/T$

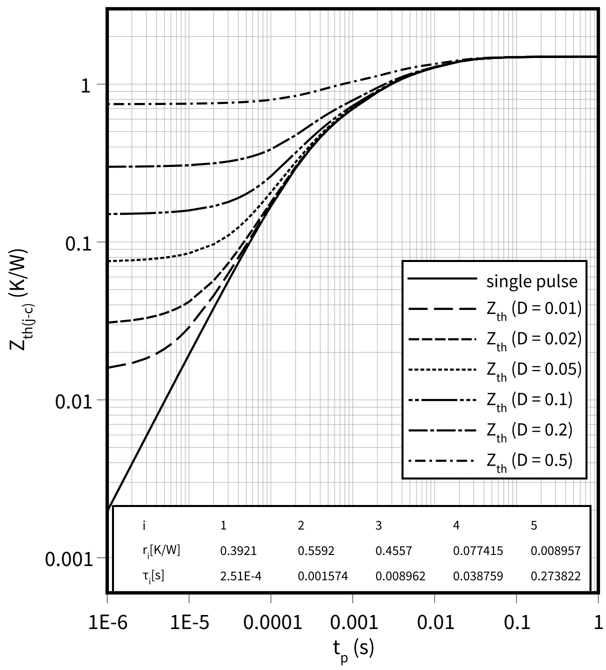


i	1	2	3	4	5
r_i[K/W]	0.08133	0.09366	0.22305	0.05925	0.005718
τ_i[s]	2.6E-4	0.001723	0.010097	0.033615	0.273075

Diode transient thermal impedance as a function of pulse width

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

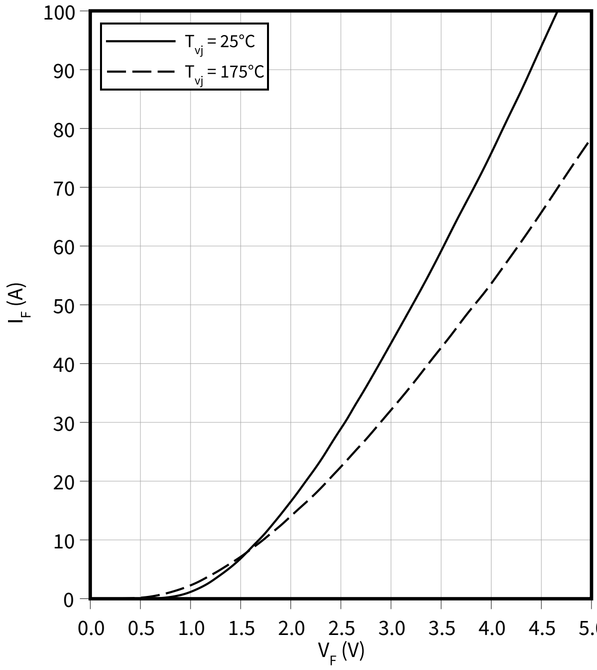
$D = t_p/T$



i	1	2	3	4	5
r_i[K/W]	0.3921	0.5592	0.4557	0.077415	0.008957
τ_i[s]	2.51E-4	0.001574	0.008962	0.038759	0.273822

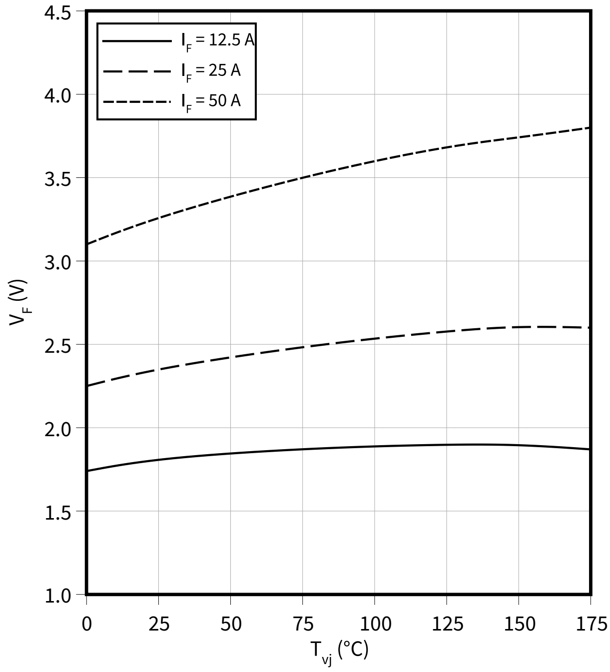
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

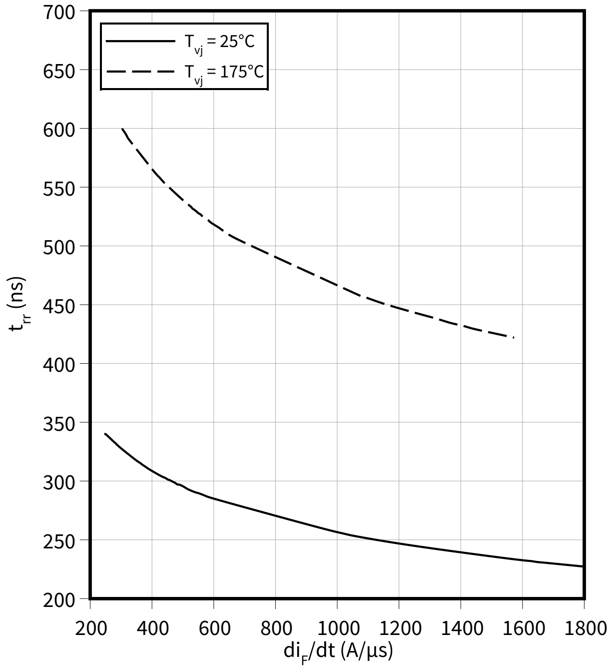
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

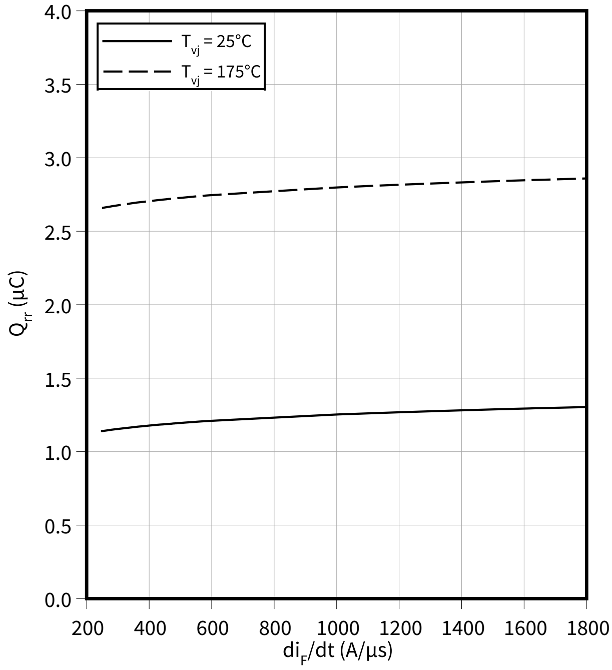
$V_R = 600\ V$, $I_F = 25\ A$



Typical reverse recovery charge as a function of diode current slope

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

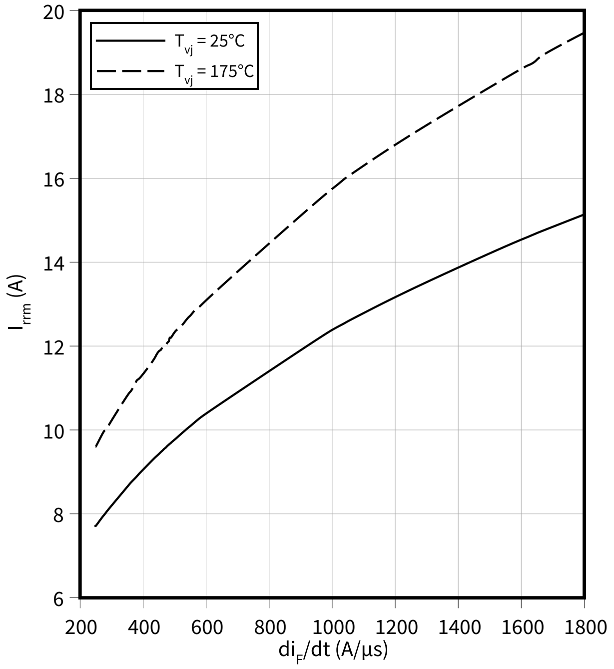
$V_R = 600\ V$, $I_F = 25\ A$



Typical reverse recovery current as a function of diode current slope

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

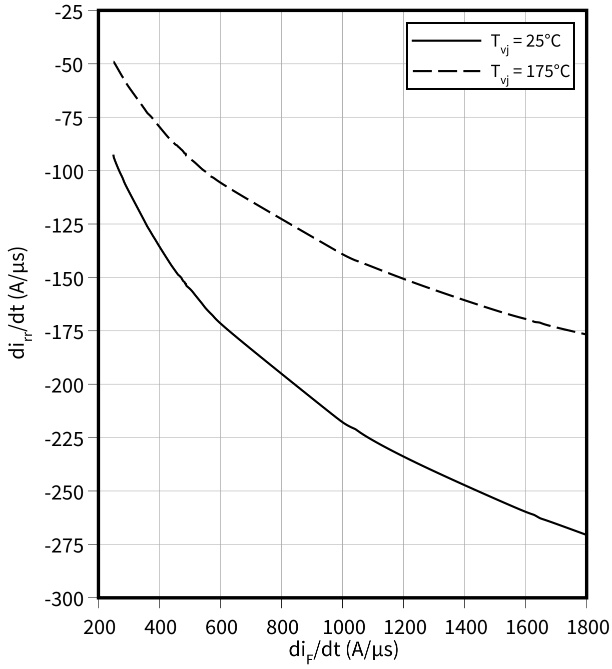
$V_R = 600\ V$, $I_F = 25\ A$



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

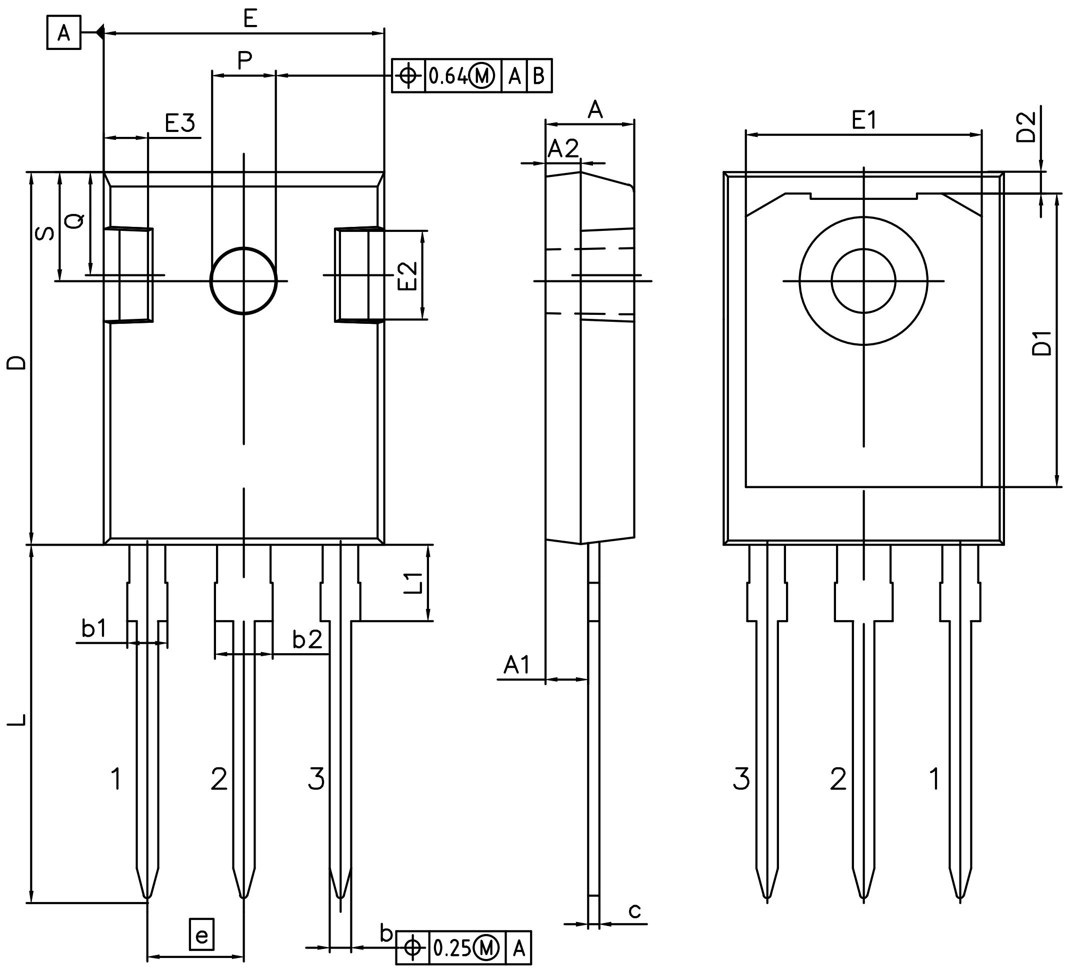
$di_{rr}/dt = f(di_F/dt)$

$V_R = 600\ V$, $I_F = 25\ A$



5 Package outlines

Package Drawing PG-TO247-3



DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.70	5.30
A1	2.20	2.60
A2	1.50	2.50
b	1.00	1.40
b1	1.60	2.41
b2	2.57	3.43
c	0.38	0.89
D	20.70	21.50
D1	13.08	17.65
D2	0.51	1.35
E	15.50	16.30
E1	12.38	14.15
E2	3.40	5.10
E3	1.00	2.60
e	5.44	
L	19.80	20.40
L1	3.85	4.50
P	3.50	3.70
Q	5.35	6.25
S	6.04	6.30

DOCUMENT NO. Z8B00003327
REVISION 06
SCALE 3:1 0 1 2 3 4 5mm
EUROPEAN PROJECTION
ISSUE DATE 25.07.2018

Figure 1

6 Testing conditions

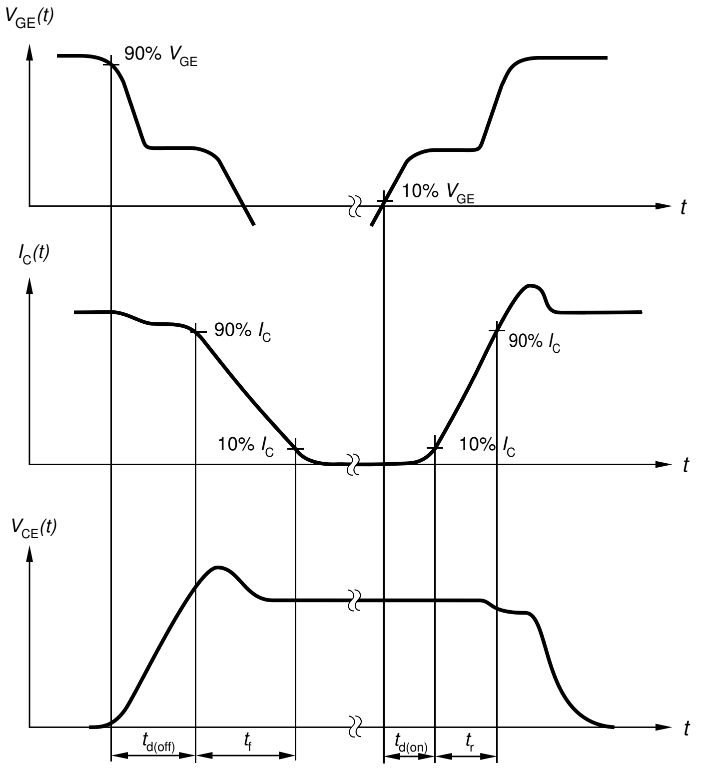


Figure A. **Definition of switching times**

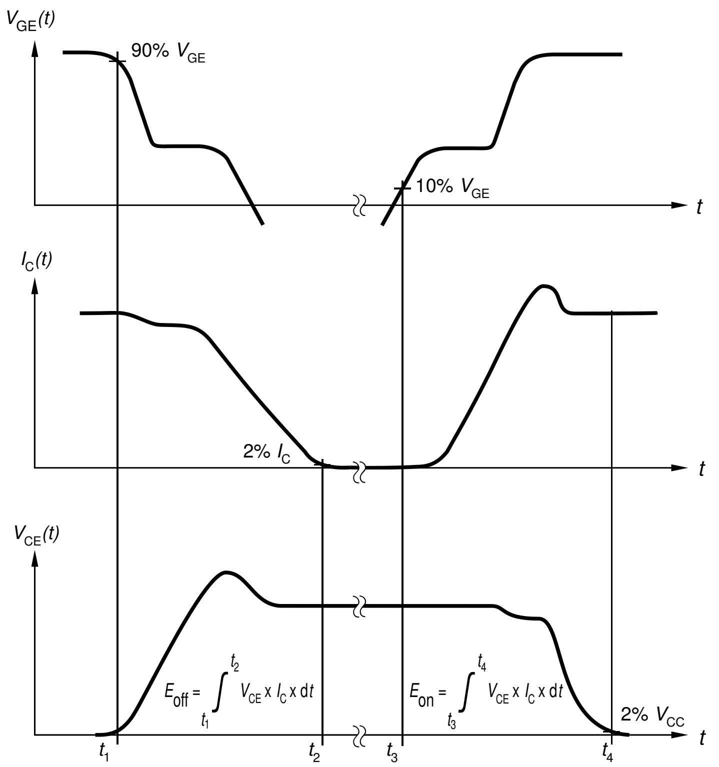


Figure B. **Definition of switching losses**

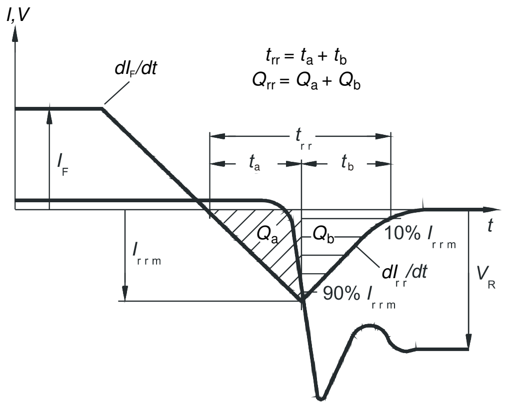


Figure C. **Definition of diode switching characteristics**

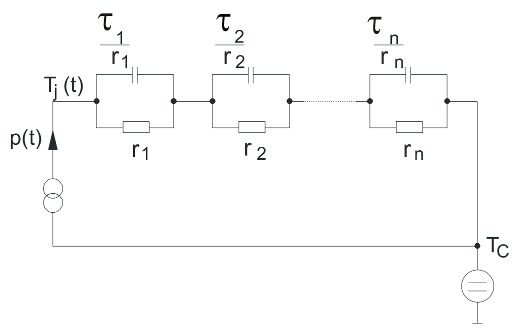


Figure D. **Thermal equivalent circuit**

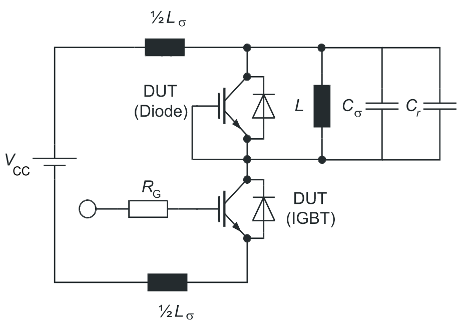


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 2

Revision history

Document revision	Date of release	Description of changes
V1.1	2009-11-27	Target datasheet
V1.2	2010-02-10	Preliminary datasheet
V2.1	2014-12-01	Final data sheet
V2.2	2015-09-23	Minor change figure 28
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
1.10	2021-09-08	Update of legend at the diagram $V_F = f(T_{vj})$
1.20	2025-06-12	Added transient Gate-emitter voltage Editorial changes

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Edition 2025-06-12

Published by

Infineon Technologies AG

81726 Munich, Germany

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Document reference
IFX-AAK486-006