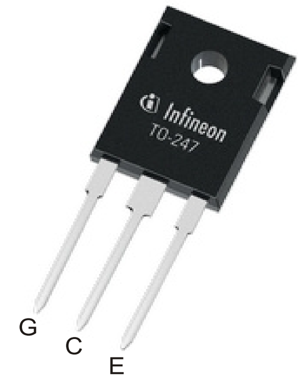
High speed DuoPack: IGBT in Trench and Fieldstop technology with soft, fast recovery antiparallel diode

Features

- V_{CE} = 1200 V
- I_C = 15 A
- Very low $V_{CE,sat}$
- 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/

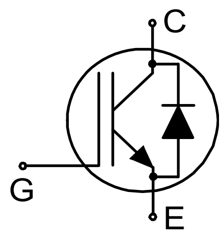


Lead-Free
Green
Halogen-Free
RoHS

Potential applications

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

Description



Type	Package	Marking
IKW15N120H3	PG-TO247-3	K15H1203

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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			13.0		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
Mounting torque, M3 screw Maximum of mounting processes: 3	M				0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j\text{-}a)}$				40	K/W

2 IGBT

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}			1200	V
DC collector current, limited by T_{vjmax}	I_C		$T_c = 25\ °C$	30	A
			$T_c = 100\ °C$	15	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}			60	A
Turn-off safe operating area		$V_{CE} \leq 1200\ V$, $T_{vj} \leq 175\ °C$		60	A
Gate-emitter voltage	V_{GE}			±20	V
Short circuit withstand time	t_{SC}	$V_{CC} \leq 600\ V$, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 175\ °C$		10	µs
Power dissipation	P_{tot}		$T_c = 25\ °C$	217	W
			$T_c = 100\ °C$	105	

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

Table 3 **Characteristic values (continued)**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\ sat}$	I_C = 15.0 A, V_{GE} = 15 V	T_{vj} = 25 °C		2.05	2.40	V
Collector-emitter saturation voltage	$V_{CE\ sat}$	I_C = 15.0 A, V_{GE} = 15 V	T_{vj} = 125 °C		2.50		V
Collector-emitter saturation voltage	$V_{CE\ sat}$	I_C = 15.0 A, V_{GE} = 15 V	T_{vj} = 175 °C		2.70		V
Gate-emitter threshold voltage	V_{GEth}	I_C = 0.50 mA, V_{CE} = V_{GE}, T_{vj} = 175 °C		5.00	5.80	6.50	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			250	µA
Zero gate voltage collector current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 175 °C			2500	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				600	nA
Transconductance	g_{fs}	I_C = 15.0 A, V_{CE} = 20 V			7.5		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			52		A
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			875		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			75		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			45		pF
Gate charge	Q_G	I_C = 15.0 A, V_{GE} = 15 V, V_{CE} = 960 V			75		nC
Turn-on delay time	t_{don}	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, $L_σ$ = 95 nH, $C_σ$ = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		21		ns
Turn-on delay time	t_{don}	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, $L_σ$ = 95 nH, $C_σ$ = 67 pF	T_{vj} = 175 °C, I_C = 15.0 A		19		ns
Rise time (inductive load)	t_r	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, $L_σ$ = 95 nH, $C_σ$ = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		34		ns
Rise time (inductive load)	t_r	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, $L_σ$ = 95 nH, $C_σ$ = 67 pF	T_{vj} = 175 °C, I_C = 15.0 A		30		ns
Turn-off delay time	t_{doff}	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, $L_σ$ = 95 nH, $C_σ$ = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		260		ns
Turn-off delay time	t_{doff}	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, $L_σ$ = 95 nH, $C_σ$ = 67 pF	T_{vj} = 175 °C, I_C = 15.0 A		327		ns
Fall time (inductive load)	t_f	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, $L_σ$ = 95 nH, $C_σ$ = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		14		ns
Fall time (inductive load)	t_f	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, $L_σ$ = 95 nH, $C_σ$ = 67 pF	T_{vj} = 175 °C, I_C = 15.0 A		43		ns

Table 3 **Characteristic values (continued)**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on energy	E_{on}	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, L_σ = 95 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		1.10		mJ
			T_{vj} = 175 °C, I_C = 15.0 A		1.60		
Turn-off energy	E_{off}	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, L_σ = 95 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		0.45		mJ
			T_{vj} = 175 °C, I_C = 15.0 A		0.90		
Total switching energy	E_{ts}	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, L_σ = 95 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		1.55		mJ
			T_{vj} = 175 °C, I_C = 15.0 A		2.50		
IGBT thermal resistance, junction-case	R_{thjc}					0.70	K/W
Operating junction temperature	T_{vj}			-40		175	°C

Note: *Electrical Characteristic, at T_{vj} = 25°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}			1200	V
Diode forward current, limited by T_{vjmax}	I_F		T_c = 25 °C	15	A
			T_c = 100 °C	7.5	
Diode pulsed current, limited by T_{vjmax}	I_{Fpuls}			60	A

Table 5 **Characteristic values**

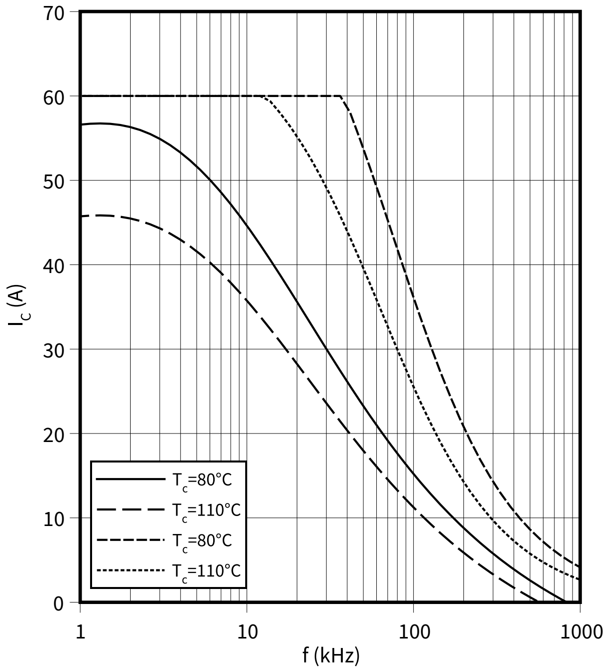
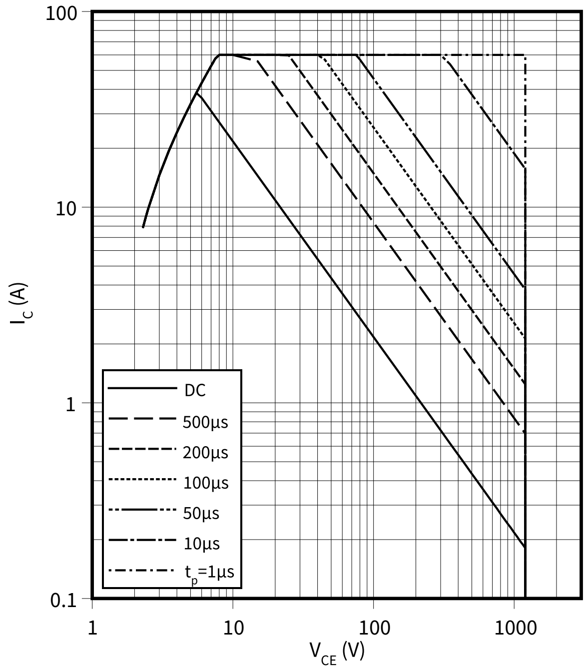
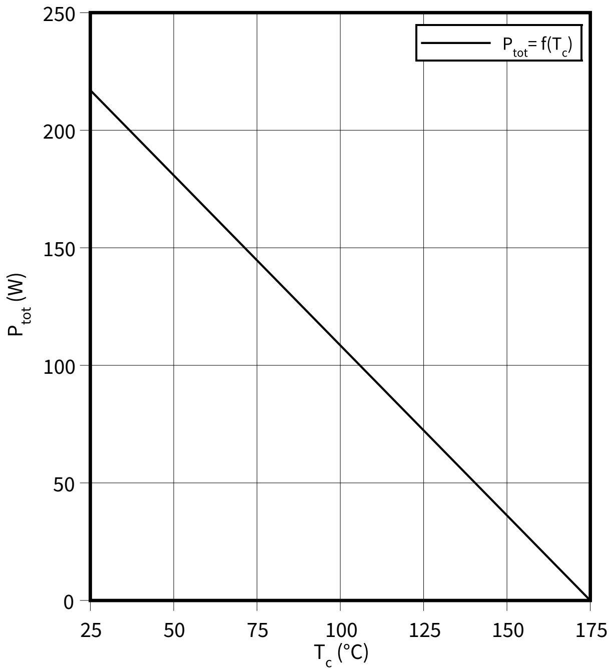
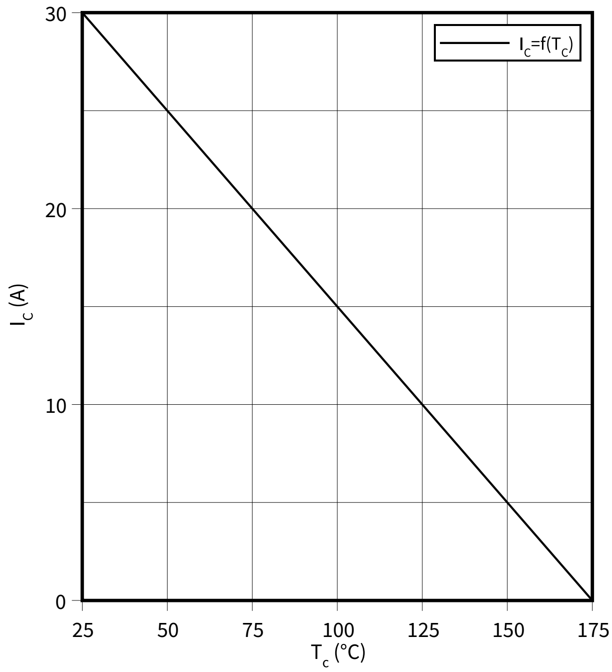
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 7.5 A	T_{vj} = 25 °C		1.80	2.35	V
			T_{vj} = 175 °C		1.85		

Table 5 **Characteristic values (continued)**

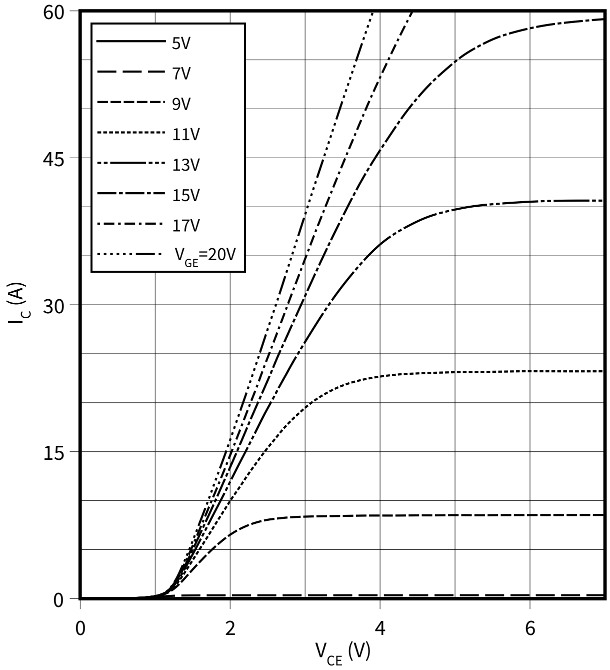
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 15.0 A	T_{vj} = 25 °C		2.40	3.05	V
			T_{vj} = 125 °C		2.60		
			T_{vj} = 175 °C		2.60		
Reverse leakage current	I_R	V_R = 1200 V	T_{vj} = 25 °C			250	µA
			T_{vj} = 175 °C			2500	
Diode reverse recovery time	t_{rr}	V_R = 600 V	T_{vj} = 25 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		260		ns
			T_{vj} = 175 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		470		
Diode reverse recovery charge	Q_{rr}	V_R = 600 V	T_{vj} = 25 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		0.80		µC
			T_{vj} = 175 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		1.70		
Diode peak reverse recovery current	I_{rrm}	V_R = 600 V	T_{vj} = 25 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		7.7		A
			T_{vj} = 175 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		9.8		
Diode peak rate off fall of reverse recovery current	dI_{rr}/dt	V_R = 600 V	T_{vj} = 25 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		-110		A/µs
			T_{vj} = 175 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		-80		
Diode thermal resistance, junction-case	R_{thjc}					2.12	K/W
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.*

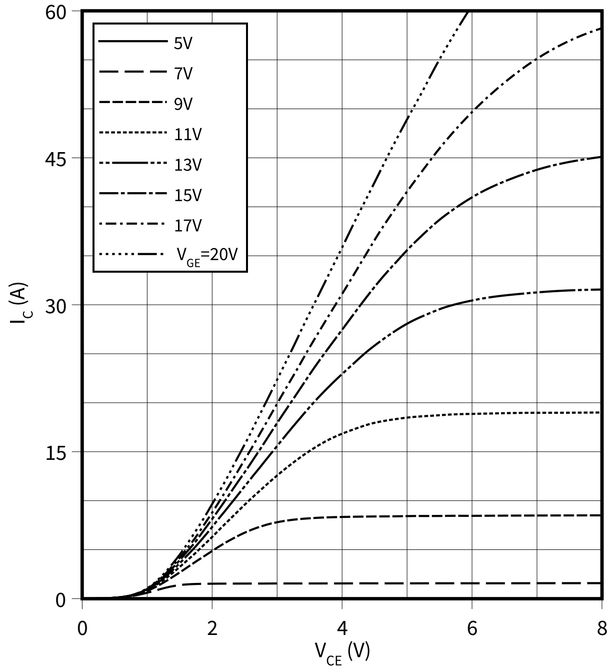
4 Characteristics diagrams

Collector current as a function of switching frequency, IGBT $I_C = f(f)$ $D = 0.5$, $V_{CE} = 600$ V, $T_{vj} \leq 175$ °C, $V_{GE} = 0/15$ V, $R_G = 35\ \Omega$	**Forward bias safe operating area, IGBT** $I_C = f(V_{CE})$ $D = 0$, $T_{vj} \leq 175$ °C, $V_{GE} = 15$ V, $T_c = 25$ °C
	
Power dissipation as a function of 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, $V_{GE} \geq 15$ V
	

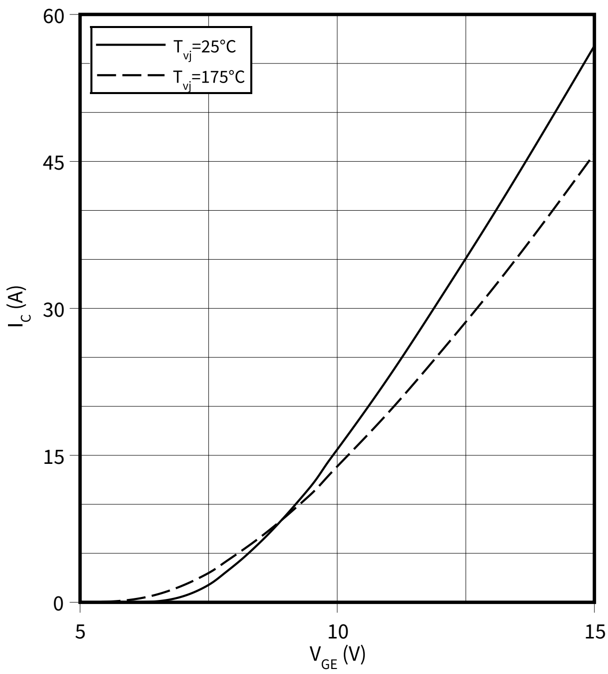
Typical output characteristic, IGBT
$I_C = f(V_{CE})$
$T_{vj} = 25\ °C$



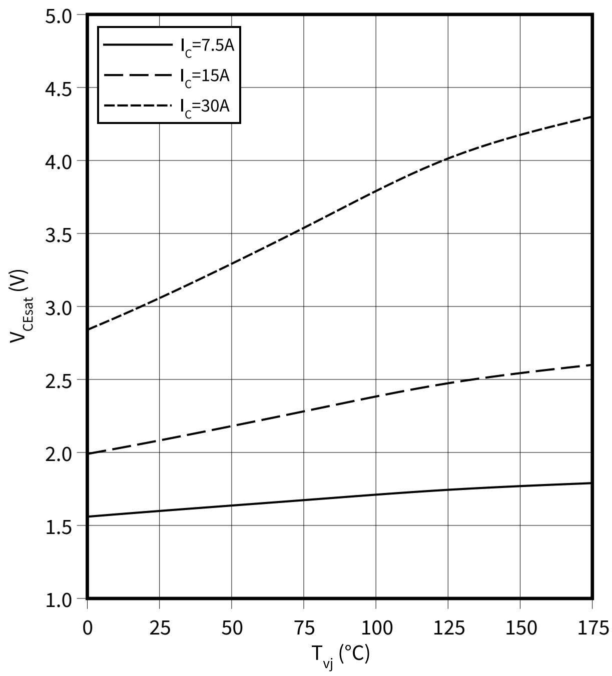
Typical output characteristic, IGBT
$I_C = f(V_{CE})$
$T_{vj} = 175\ °C$



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



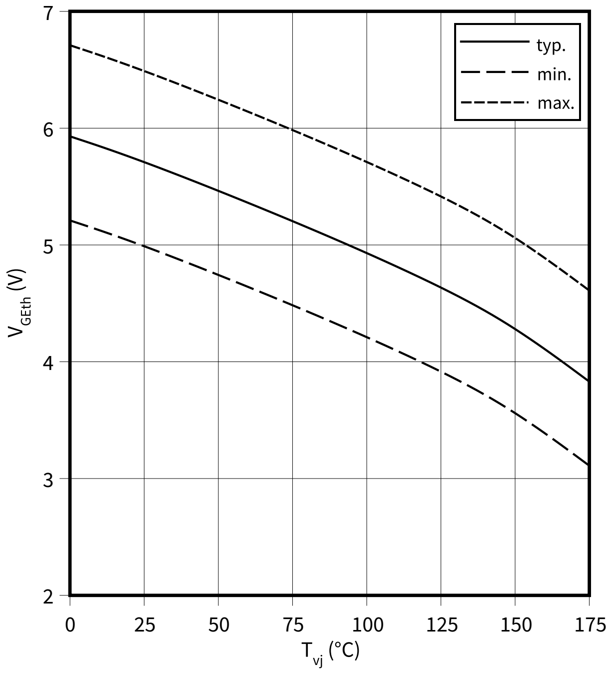
Typical collector-emitter saturation voltage as a function of junction temperature, IGBT
$V_{CEsat} = f(T_{vj})$
$V_{GE} = 15\ V$



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

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

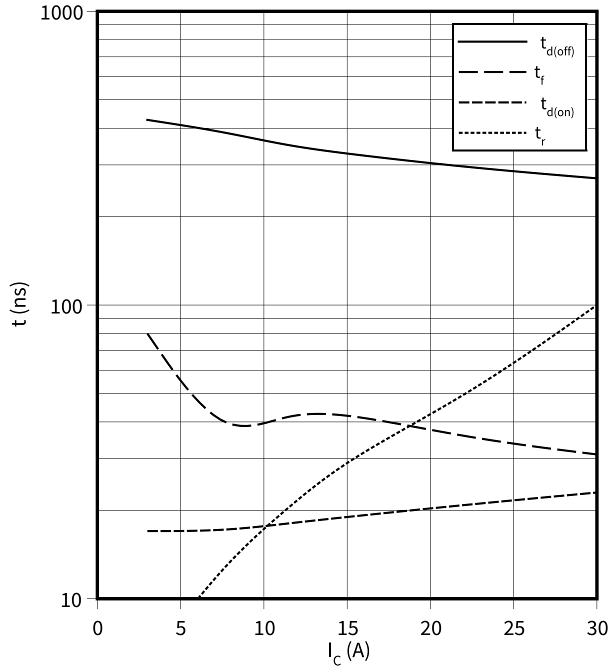
$I_C = 0.50$ mA



Typical switching times as a function of collector current, IGBT

$t = f(I_C)$

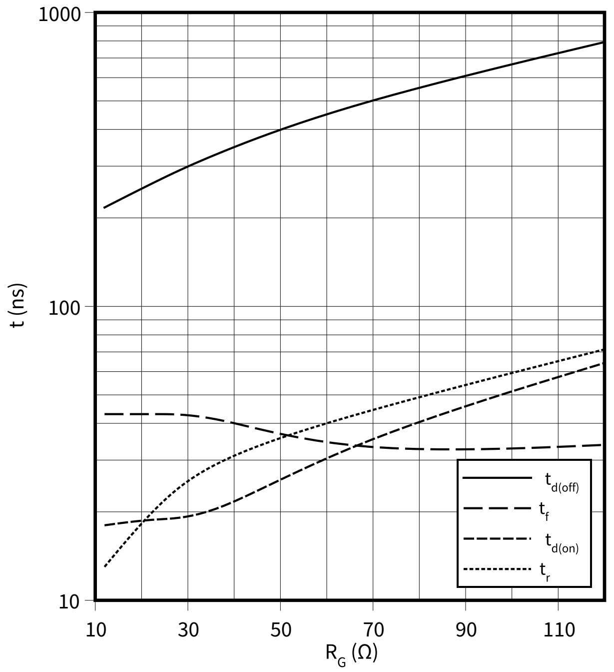
$V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 35\ \Omega$



Typical switching times as a function of gate resistance, IGBT

$t = f(R_G)$

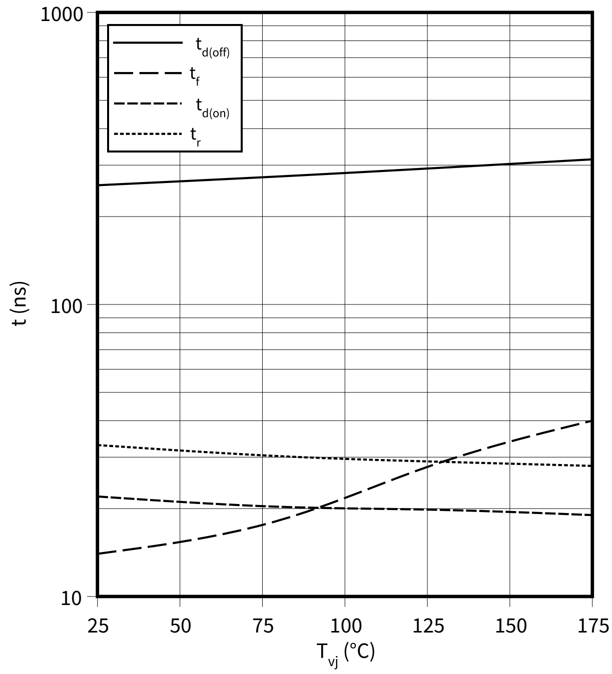
$I_C = 15.0$ A, $V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching times as a function of junction temperature, IGBT

$t = f(T_{vj})$

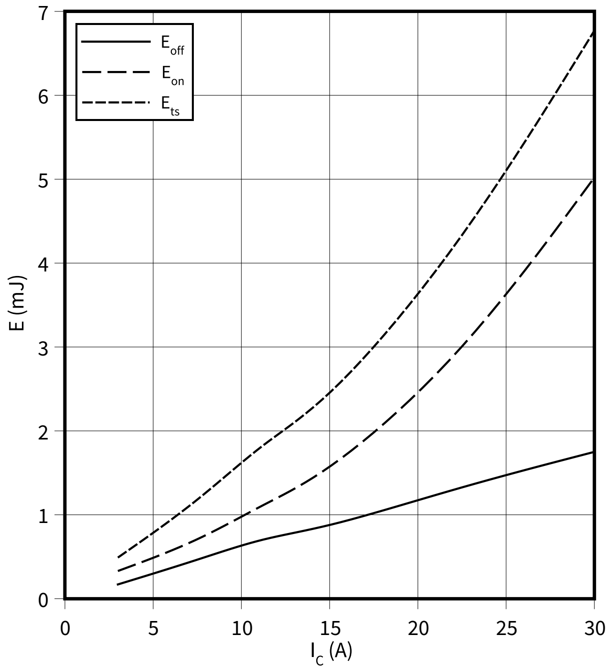
$I_C = 15.0$ A, $V_{CE} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 35\ \Omega$



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

$E = f(I_C)$

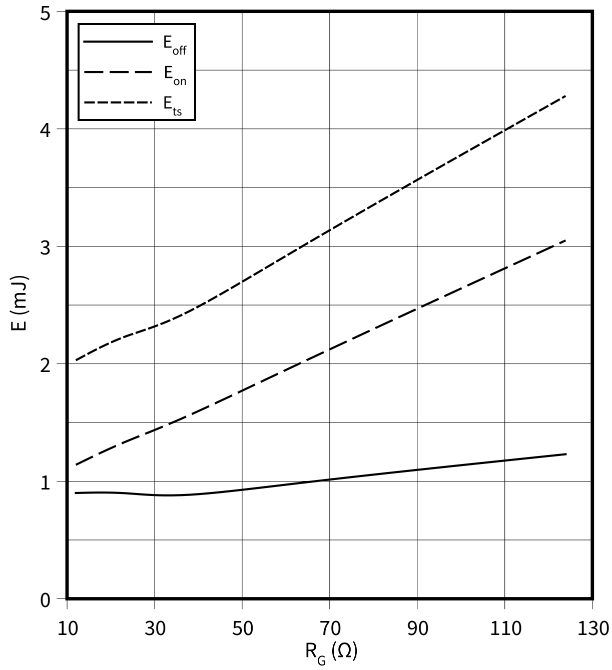
V_{CE} = 600 V, T_{vj} = 175 °C, V_{GE} = 0/15 V, R_G = 35 Ω



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

$E = f(R_G)$

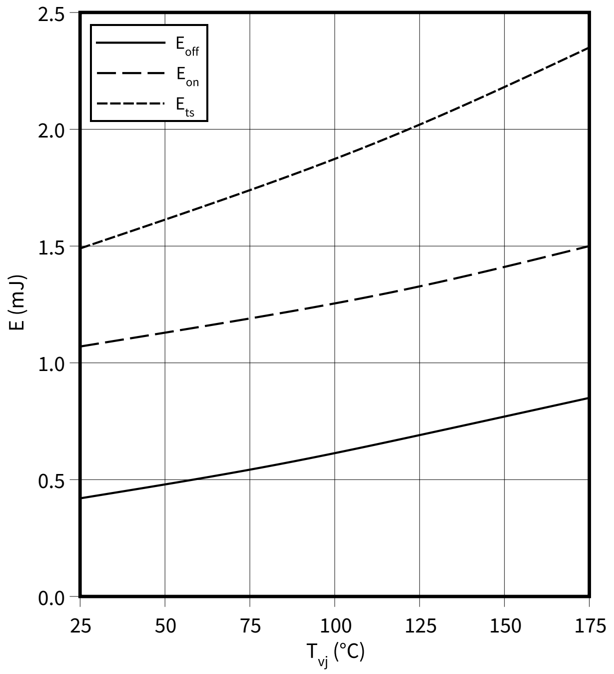
I_C = 15.0 A, V_{CE} = 600 V, T_{vj} = 175 °C, V_{GE} = 0/15 V



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

$E = f(T_{vj})$

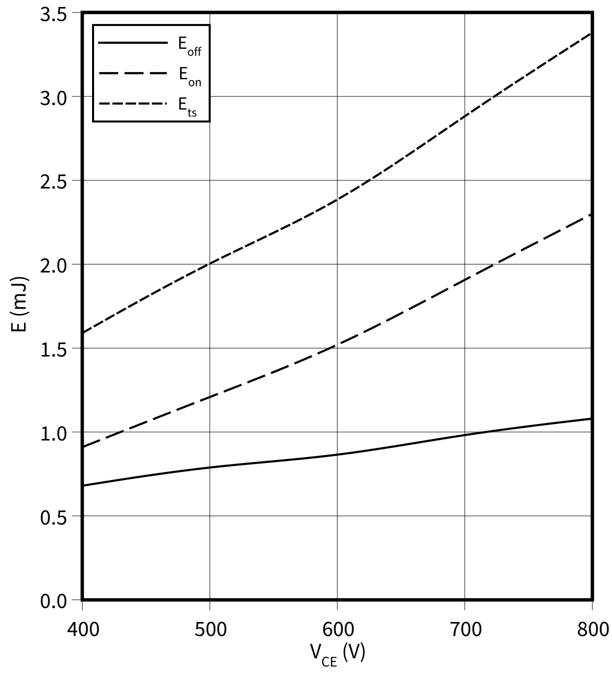
I_C = 15.0 A, V_{CE} = 600 V, V_{GE} = 0/15 V, R_G = 35 Ω



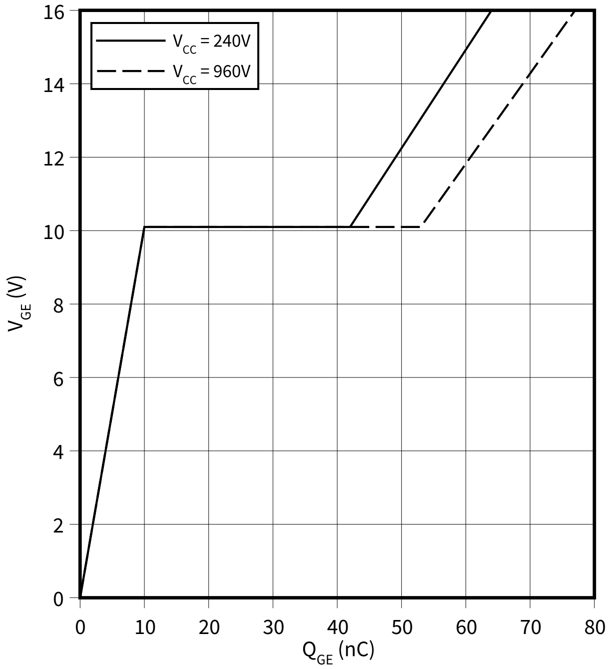
Typical switching energy losses as a function of collector emitter voltage, IGBT

$E = f(V_{CE})$

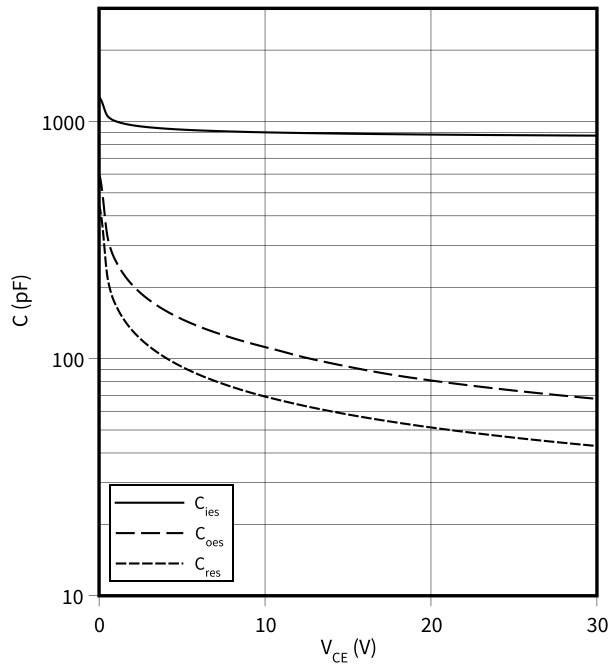
I_C = 15.0 A, T_{vj} = 175 °C, V_{GE} = 0/15 V, R_G = 35 Ω



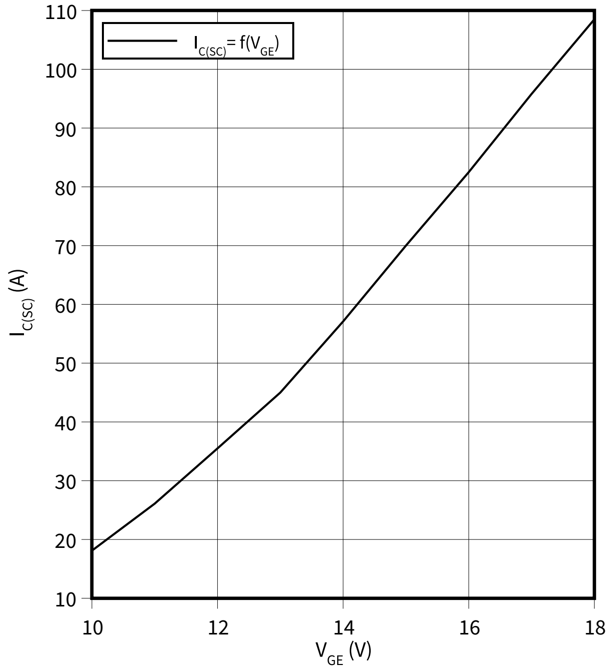
Typical gate charge, IGBT
$V_{GE} = f(Q_{GE})$
$I_C = 15.0$ A



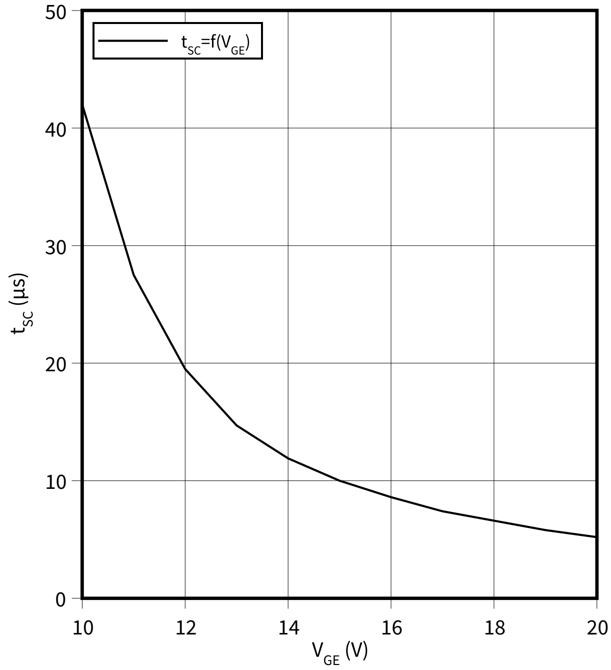
Typical capacitance as a function of collector-emitter voltage, IGBT
$C = f(V_{CE})$
f = 1000 kHz, $V_{GE} = 0$ V



Typical short circuit collector current as a function of gate-emitter voltage, IGBT
$I_{C(SC)} = f(V_{GE})$
$V_{CE} \leq 600$ V, $T_{vj,\,start} = 25$ °C

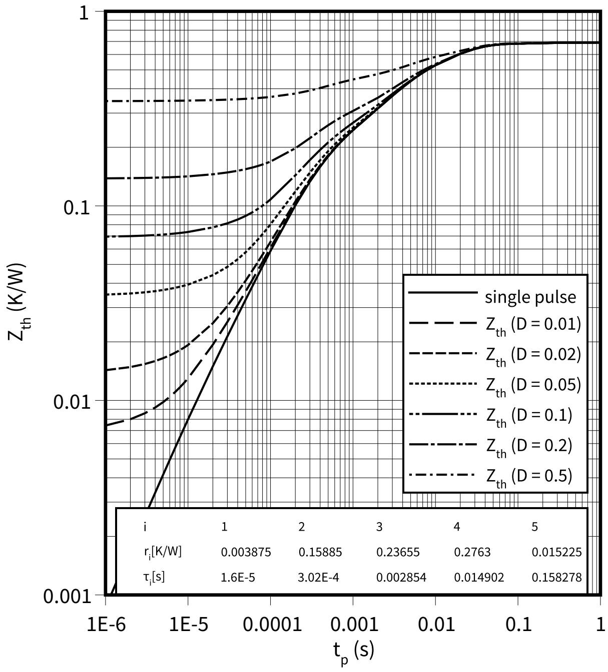


Short circuit withstand time as a function of gate-emitter voltage, IGBT
$t_{SC} = f(V_{GE})$
$V_{CE} \leq 600$ V, $T_{vj} \leq 175$ °C



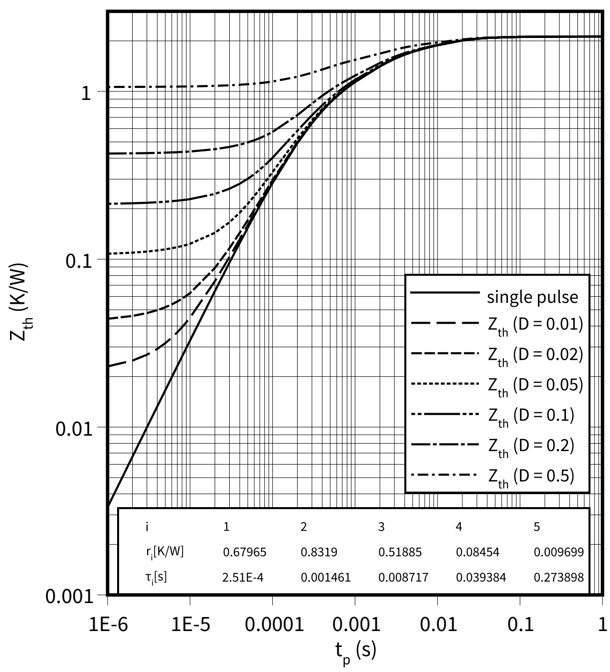
IGBT transient thermal impedance, IGBT

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



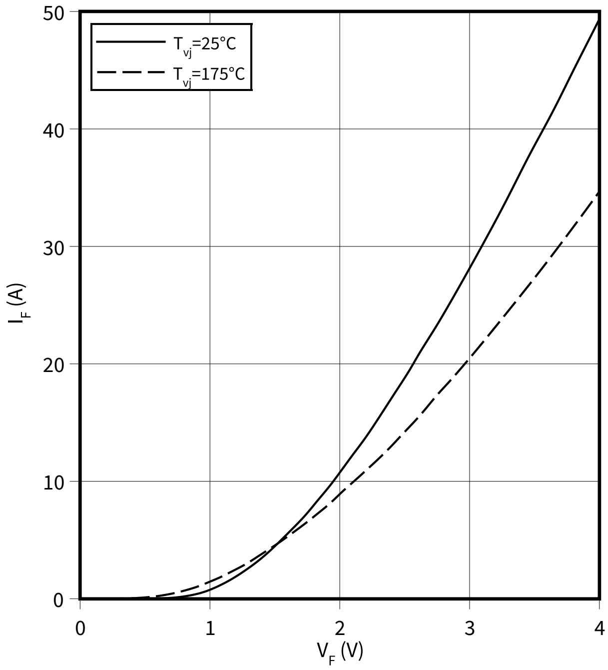
Diode transient thermal impedance as a function of pulse width, Diode

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



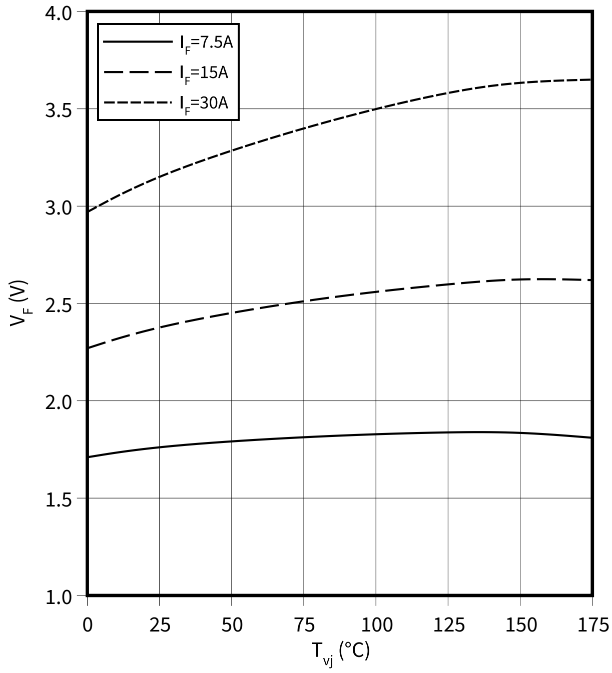
Typical diode forward current as a function of forward voltage, Diode

$I_F = f(V_F)$

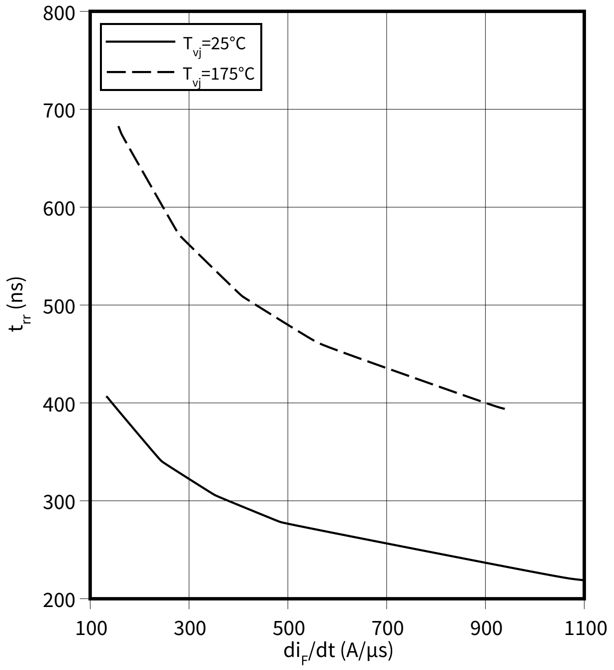


Typical diode forward voltage as a function of junction temperature, Diode

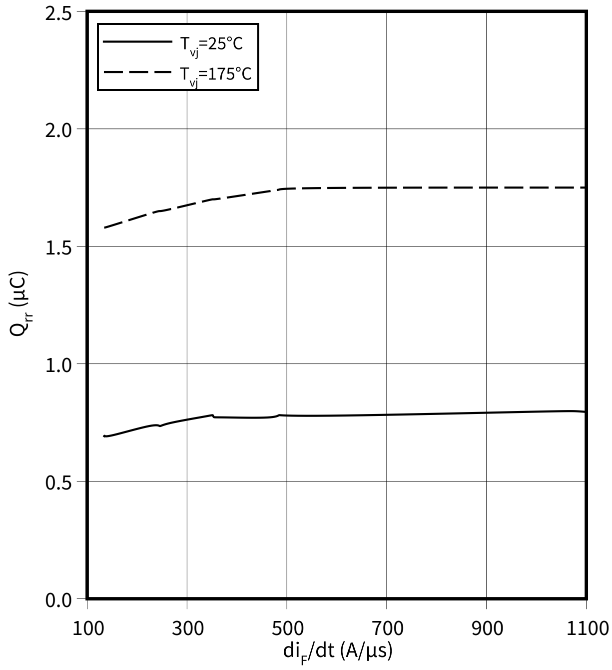
$V_F = f(T_{vj})$



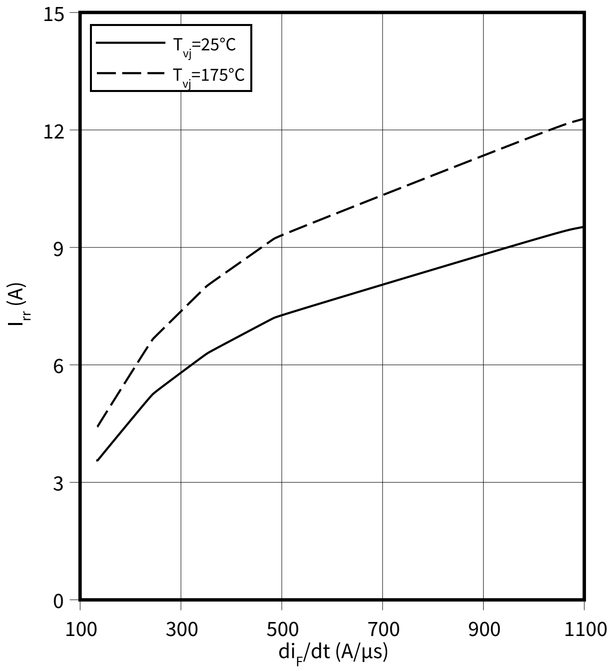
Typical reverse recovery time as a function of diode current slope, Diode
$t_{rr} = f(di_F/dt)$
$V_R = 600$ V, $I_F = 15$ A



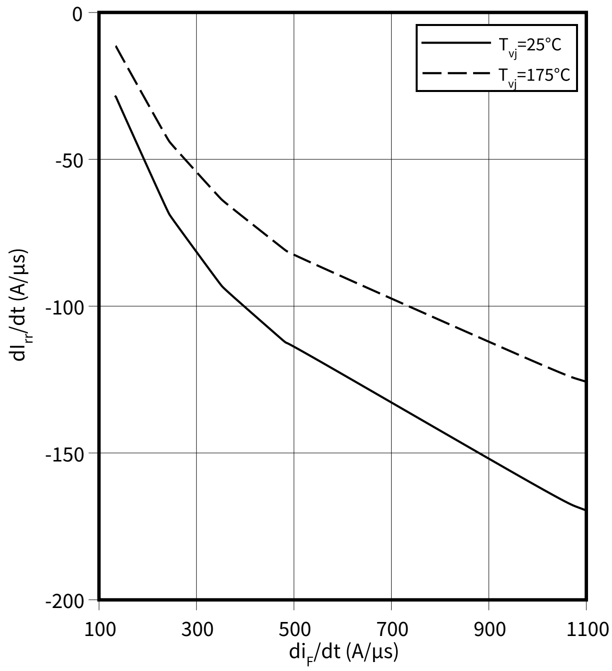
Typical reverse recovery charge as a function of diode current slope, Diode
$Q_{rr} = f(di_F/dt)$
$V_R = 600$ V, $I_F = 15$ A



Typical reverse recovery current as a function of diode current slope, Diode
$I_{rr} = f(di_F/dt)$
$V_R = 600$ V, $I_F = 15$ A

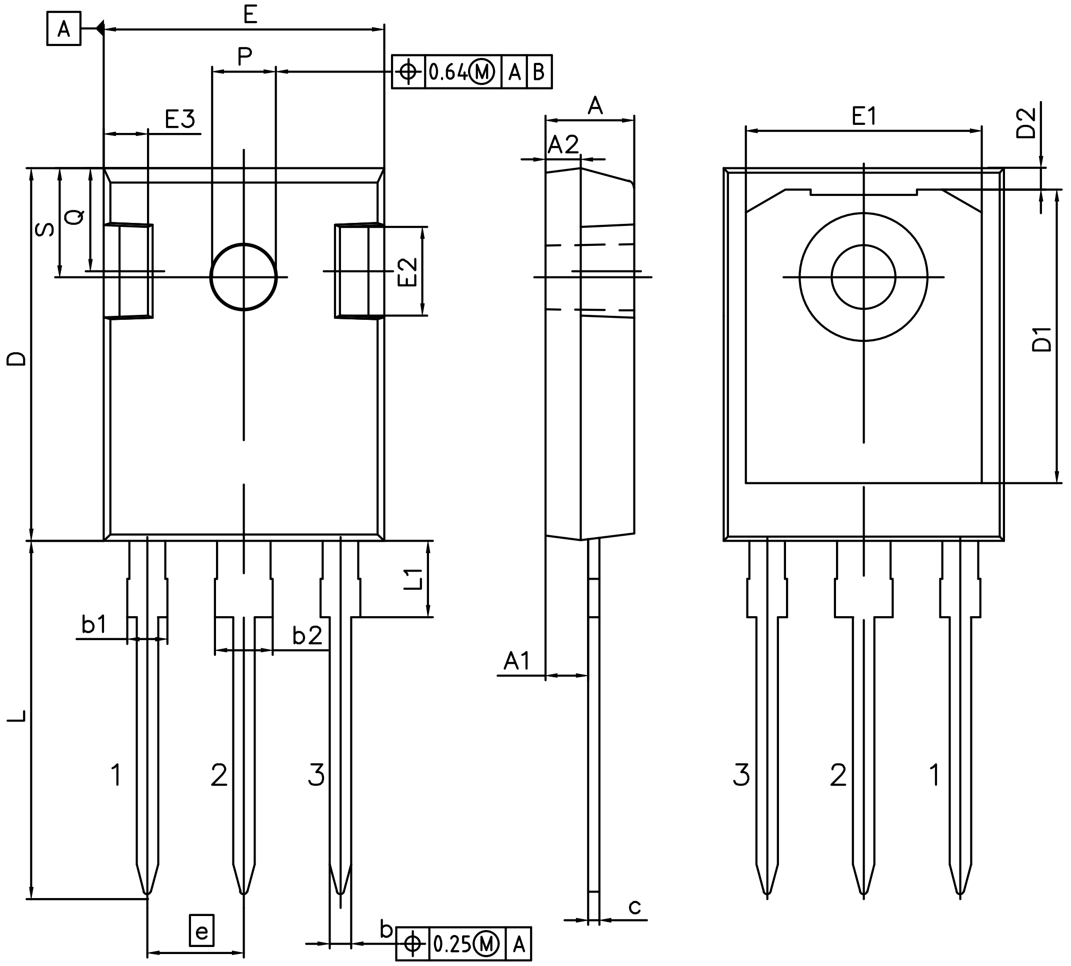


Typical diode peak rate of fall of reverse recovery current as a function of diode current slope, Diode
$dI_{rr}/dt = f(di_F/dt)$
$V_R = 600$ V, $I_F = 15$ A



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 6

6 Testing conditions

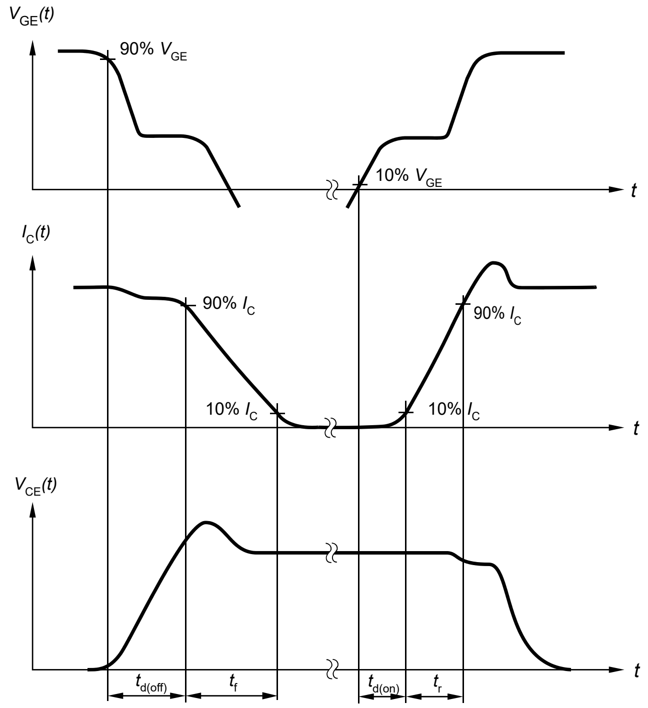


Figure A. **Definition of switching times**

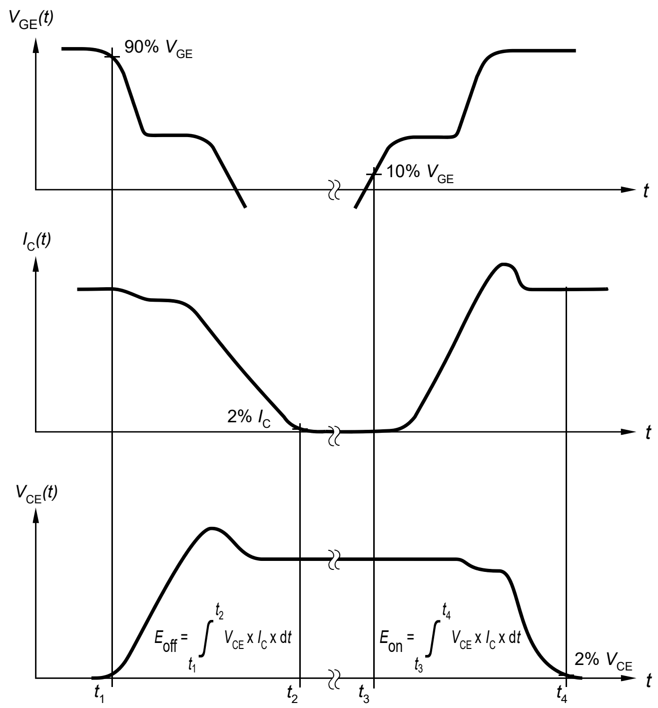


Figure B. **Definition of switching losses**

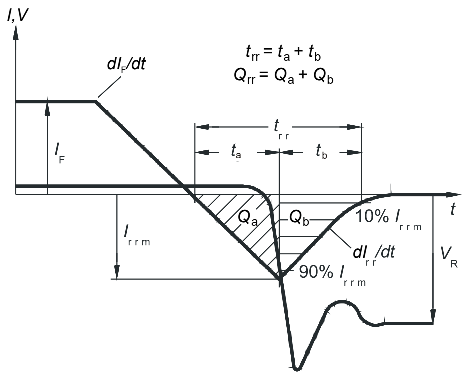


Figure C. **Definition of diode switching characteristics**

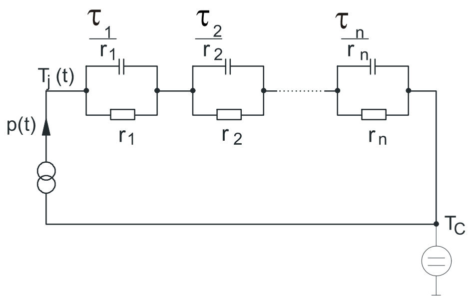


Figure D. **Thermal equivalent circuit**

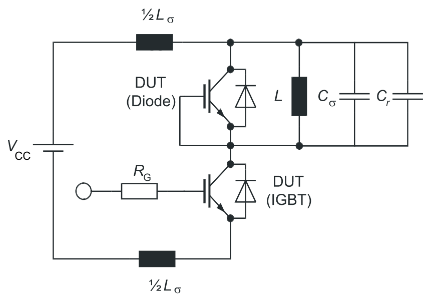


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 7

Revision history

Document revision	Date of release	Description of changes
V1.1	2009-11-27	
V1.2	2010-02-10	
V2.1	2014-12-01	Final data sheet
V2.2		Minor change figure 28
1.10	2021-09-08	Update of legend at the diagram $V_F = f(T_{vj})$

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