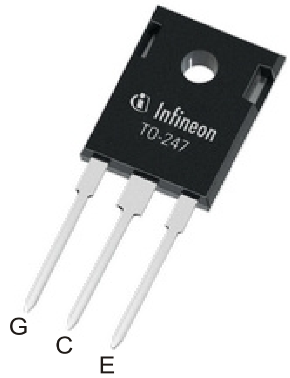
Short circuit rugged 1200 V TRENCHSTOP™ IGBT 7 technology copacked with soft and fast recovery Emitter Controlled 7 diode



Features

- V_{CE}=1200 V
- I_C=50 A
- IGBT co-packed with full current, soft and low Qrr diode
- Low saturation voltage $V_{CE(sat)}$ = 2.0 V at T_{vj}=175 °C
- Optimized for hard switching topologies (2-L inverter, 3-L NPC T-type, ...)
- Short circuit ruggedness 8 µsec
- Wide range of dv/dt controllability
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

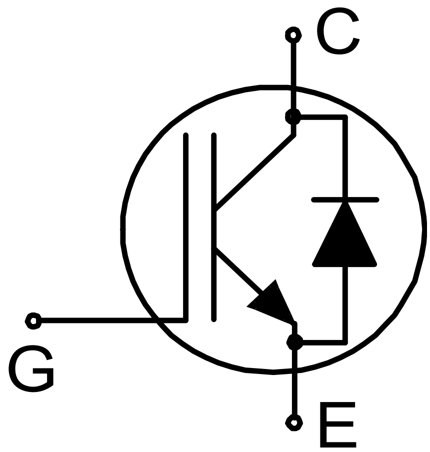
Potential applications

- Industrial Drives
- Industrial Power Supplies
- Solar Inverters

Product validation

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

Description



Type	Package	Marking
IKW50N120CS7	PG-TO247-3	K50MCS7

Table of contents

1 Package

Table 1 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Internal emitter inductance measured 5mm. (0.197in) from case	L_E			13.0		nH
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature		wave soldering 1.6mm (0.063in.) from case for 10s			260	°C
Mounting torque , M3 screw Maximum of mounting process: 3	M				0.6	Nm
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}	$T_{vj} \geq 25$ °C		1200	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_C = 25$ °C	82	A
			$T_C = 100$ °C	68	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}			150	A
Turn-off safe operating area		$V_{CE} \leq$ 1200 V, $T_{vj} \leq$ 175 °C		150	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq$ 0.5 µs, $D < 0.001$		±25	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, $T_{vj} = 150$ °C		8	µs
Power dissipation	P_{tot}		$T_C = 25$ °C	428	W
			$T_C = 100$ °C	215	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\,sat}$	$I_C = 50.0$ A, $V_{GE} = 15$ V	$T_{vj} = 25$ °C		1.65	2.00	V
			$T_{vj} = 175$ °C		2.00		

Table 3 Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Gate-emitter threshold voltage	V_{GEth}	I_C = 0.98 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.15	5.70	6.45	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			40	µA
			T_{vj} = 175 °C		4000		
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				100	nA
Transconductance	g_{fs}	I_C = 50.0 A, V_{CE} = 20 V, T_{vj} = 175 °C			21.0		S
Short circuit collector current	I_{SC}	V_{CC} ≤ 600 V, V_{GE} = 15 V, t_{SC} ≤ 8 µs, Allowed number of short circuits < 1000 , Time between short circuits ≥ 1.0 s, T_{vj} = 25 °C			300		A
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			7.2		nF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			140		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			32		pF
Gate charge	Q_G	I_C = 50.0 A, V_{GE} = 15 V, V_{CE} = 960 V			290		nC
Turn-on delay time	t_{don}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 2.3 Ω, R_{Goff} = 2.3 Ω	T_{vj} = 25 °C, I_C = 50.0 A		29		ns
			T_{vj} = 175 °C, I_C = 50.0 A		26		
Rise time (inductive load)	t_r	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 2.3 Ω, R_{Goff} = 2.3 Ω	T_{vj} = 25 °C, I_C = 50.0 A		19		ns
			T_{vj} = 175 °C, I_C = 50.0 A		19		
Turn-off delay time	t_{doff}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 2.3 Ω, R_{Goff} = 2.3 Ω	T_{vj} = 25 °C, I_C = 50.0 A		170		ns
			T_{vj} = 175 °C, I_C = 50.0 A		225		
Fall time (inductive load)	t_f	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 2.3 Ω, R_{Goff} = 2.3 Ω	T_{vj} = 25 °C, I_C = 50.0 A		100		ns
			T_{vj} = 175 °C, I_C = 50.0 A		245		
Turn-on energy	E_{on}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 2.3 Ω, R_{Goff} = 2.3 Ω	T_{vj} = 25 °C, I_C = 50.0 A		2.80		mJ
			T_{vj} = 175 °C, I_C = 50.0 A		4.30		
Turn-off energy	E_{off}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 2.3 Ω, R_{Goff} = 2.3 Ω	T_{vj} = 25 °C, I_C = 50.0 A		2.20		mJ
			T_{vj} = 175 °C, I_C = 50.0 A		4.70		

Table 3 Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Total switching energy	E_{ts}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 2.3 Ω, R_{Goff} = 2.3 Ω	T_{vj} = 25 °C, I_C = 50.0 A		5.00		mJ
			T_{vj} = 175 °C, I_C = 50.0 A		9.00		
IGBT thermal resistance, junction-case	R_{thjc}				0.25	0.35	K/W
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	limited by bondwire	T_C = 25 °C	82	A
			T_C = 100 °C	56	
Diode pulsed current, limited by T_{vjmax}	I_{Fpuls}			150	A
Power dissipation	P_{tot}		T_C = 25 °C	250	W
			T_C = 100 °C	125	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 50.0 A	T_{vj} = 25 °C		1.65	2.15	V
			T_{vj} = 175 °C		1.60		
Reverse leakage current	I_R	V_R = 1200 V	T_{vj} = 25 °C			40	µA
			T_{vj} = 175 °C		4000		
Diode reverse recovery time	t_{rr}	V_R = 600 V, R_{Gon} = 2.3 Ω	T_{vj} = 25 °C, I_F = 50.0 A		165		ns
			T_{vj} = 175 °C, I_F = 50.0 A		305		
Diode reverse recovery charge	Q_{rr}	V_R = 600 V, R_{Gon} = 2.3 Ω	T_{vj} = 25 °C, I_F = 50.0 A		3.20		µC
			T_{vj} = 175 °C, I_F = 50.0 A		8.25		

Table 5 Characteristic values (continued)

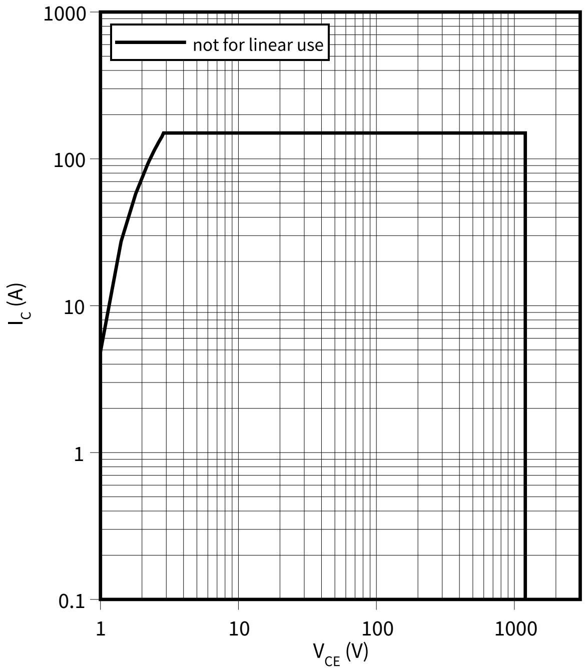
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak reverse recovery current	I_{rrm}	V_R = 600 V, R_{Gon} = 2.3 Ω	T_{vj} = 25 °C, I_F = 50.0 A		40.0		A
			T_{vj} = 175 °C, I_F = 50.0 A		54.0		
Diode peak rate off fall of reverse recovery current	dI_{rr}/dt	V_R = 600 V, R_{Gon} = 2.3 Ω	T_{vj} = 25 °C, I_F = 50.0 A		-290		A/µs
			T_{vj} = 175 °C, I_F = 50.0 A		-185		
Reverse recovery energy	E_{rec}	V_R = 600 V, R_{Gon} = 2.3 Ω	T_{vj} = 25 °C, I_F = 50.0 A		1.00		mJ
			T_{vj} = 175 °C, I_F = 50.0 A		3.10		
Diode thermal resistance, junction-case	R_{thjc}				0.45	0.60	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.*

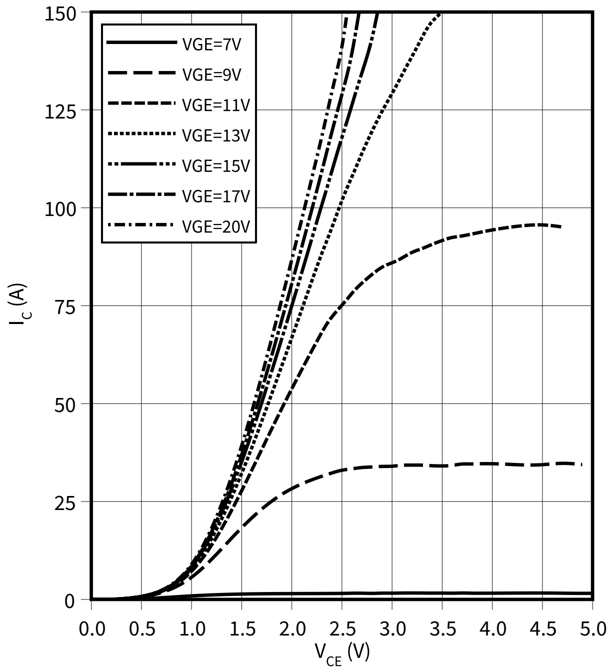
Dynamic test circuit, parasitic inductance L_{σ} = 30 nH, C_{σ} = 28 pF

4 Characteristics diagrams

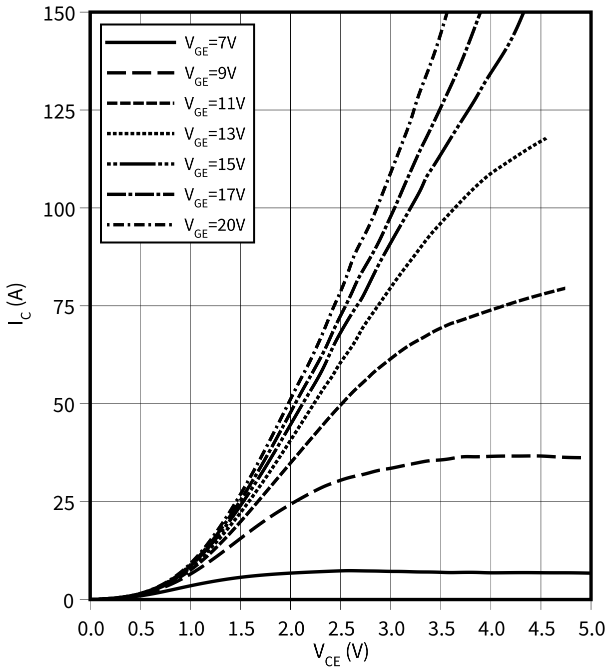
Reverse bias safe operating area, IGBT
$I_C = f(V_{CE})$
$T_{vj} \leq 175\ °C$, $V_{GE} = 15\ V$



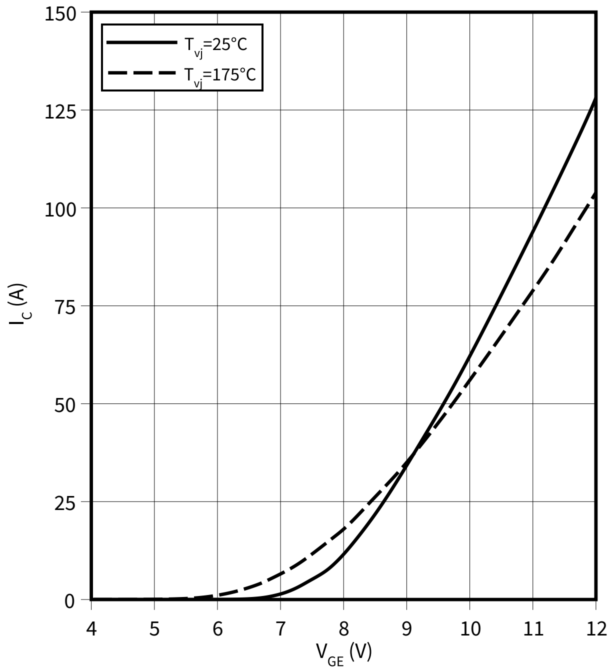
Typical output characteristic, IGBT
$I_C = f(V_{CE})$
$T_{vj} = 25\ °C$

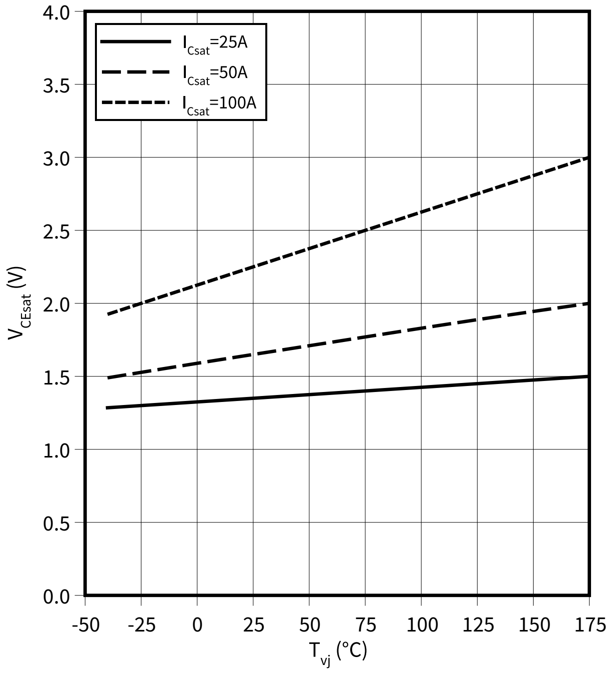
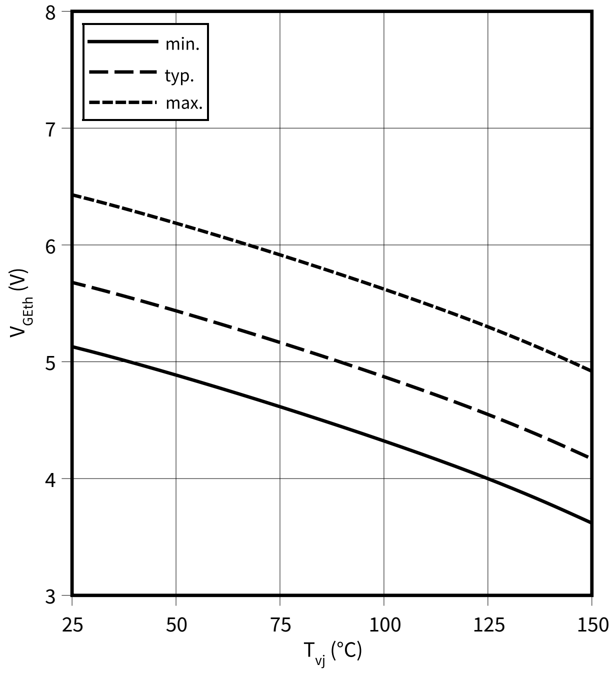
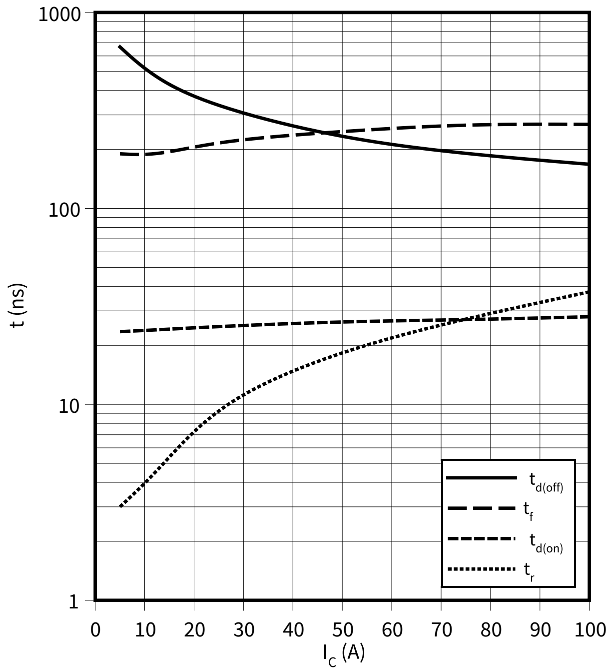
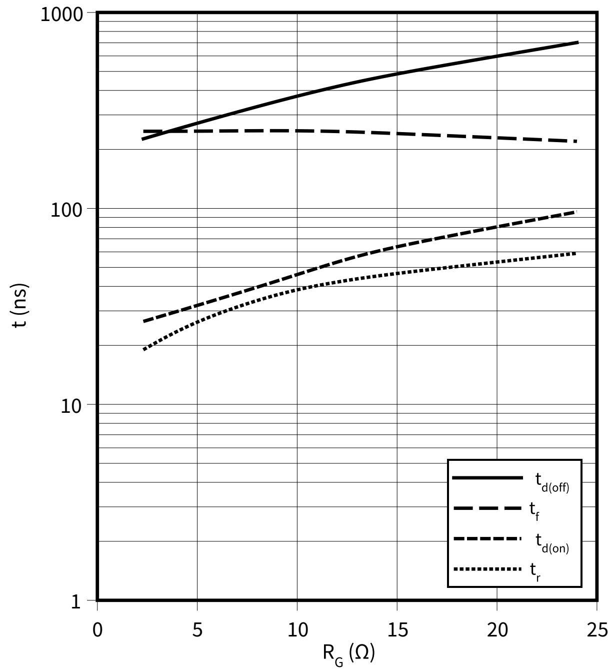


Typical output characteristic, IGBT
$I_C = f(V_{CE})$
$T_{vj} = 175\ °C$



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

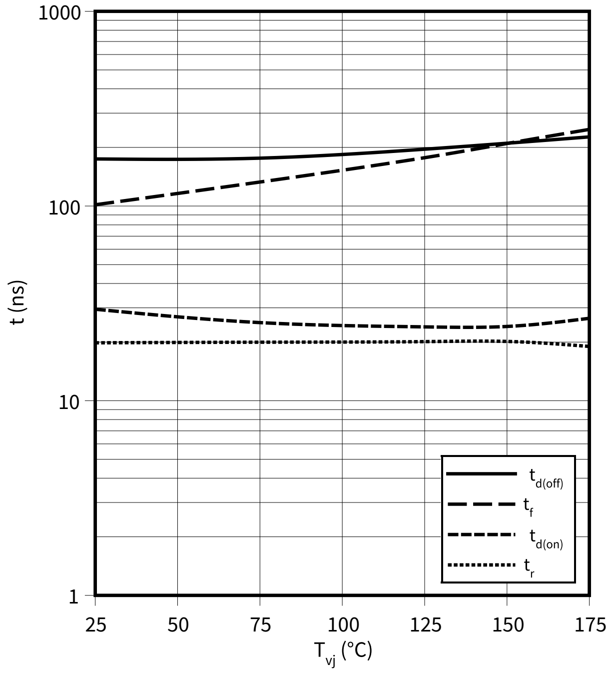


Typical collector-emitter saturation voltage as a function of junction temperature, IGBT $V_{CEsat} = f(T_{vj})$ $V_{GE} = 15$ V	**Gate-emitter threshold voltage as a function of junction temperature, IGBT** $V_{GEth} = f(T_{vj})$ $I_C = 0.98$ mA
	
Typical switching times as a function of collector current, IGBT $t = f(I_C)$ $V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 2.3$ Ω	**Typical switching times as a function of gate resistor, IGBT** $t = f(R_G)$ $I_C = 50.0$ A, $V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V
	

Typical switching times as a function of junction temperature, IGBT

$t = f(T_{vj})$

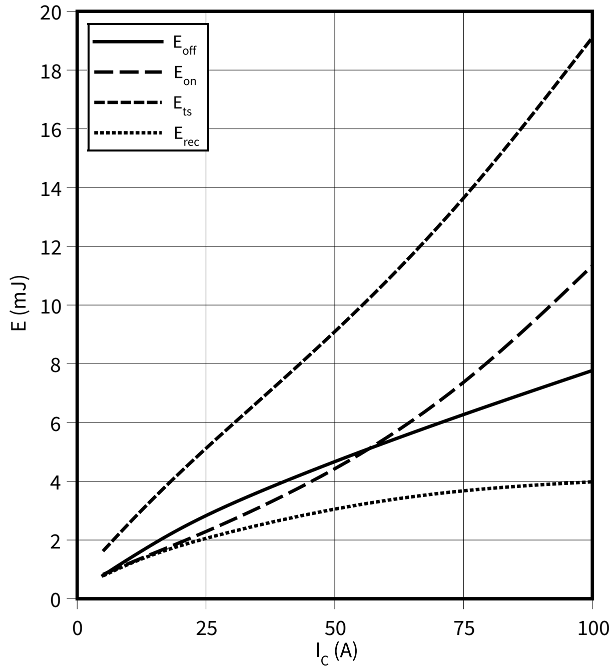
$I_C = 50.0$ A, $V_{CE} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 2.3\ \Omega$



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

$E = f(I_C)$

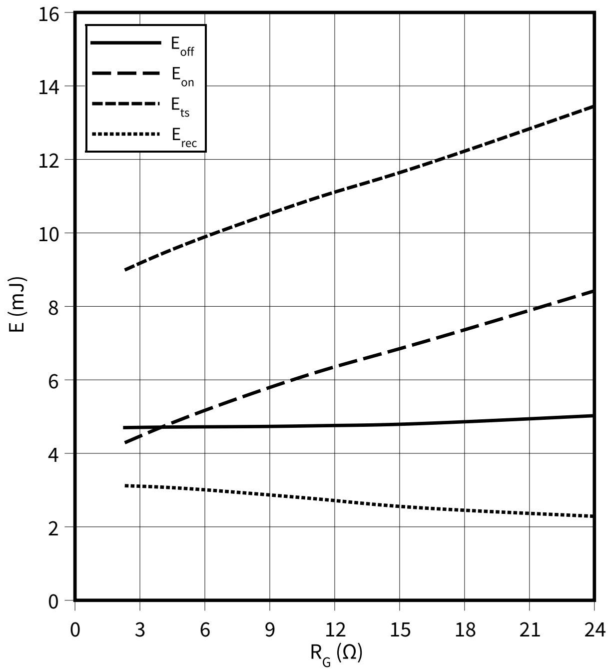
$V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 2.3\ \Omega$



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

$E = f(R_G)$

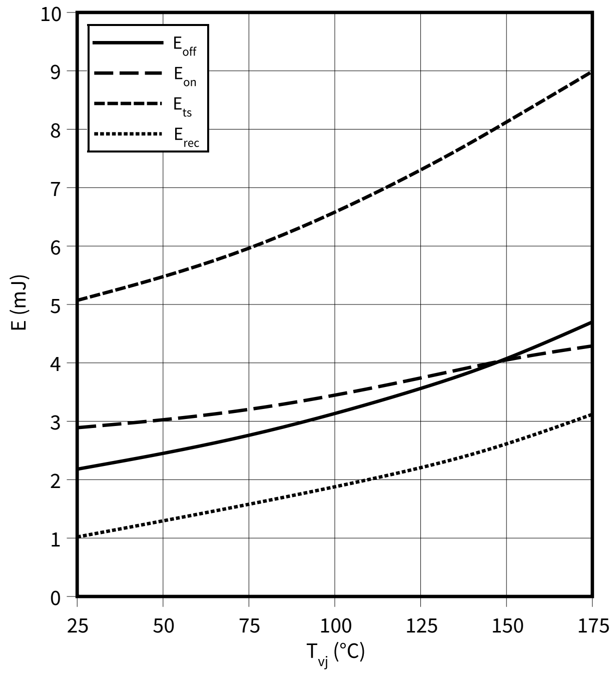
$I_C = 50.0$ A, $V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



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

$E = f(T_{vj})$

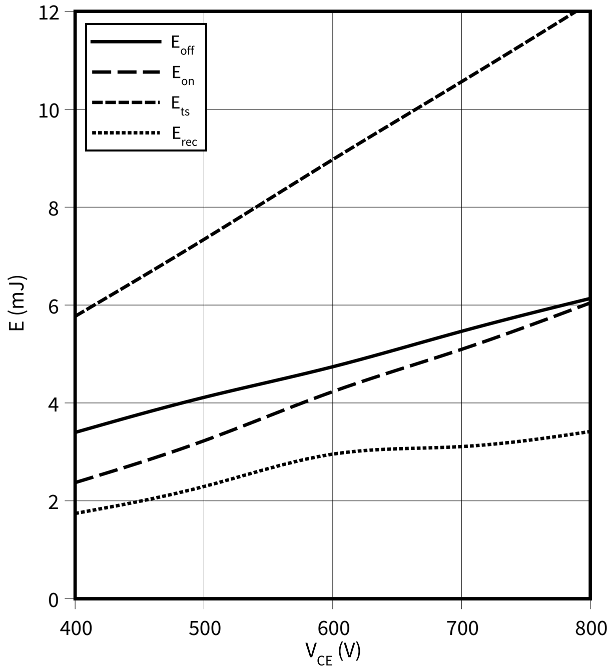
$I_C = 50.0$ A, $V_{CE} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 2.3\ \Omega$



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

$E = f(V_{CE})$

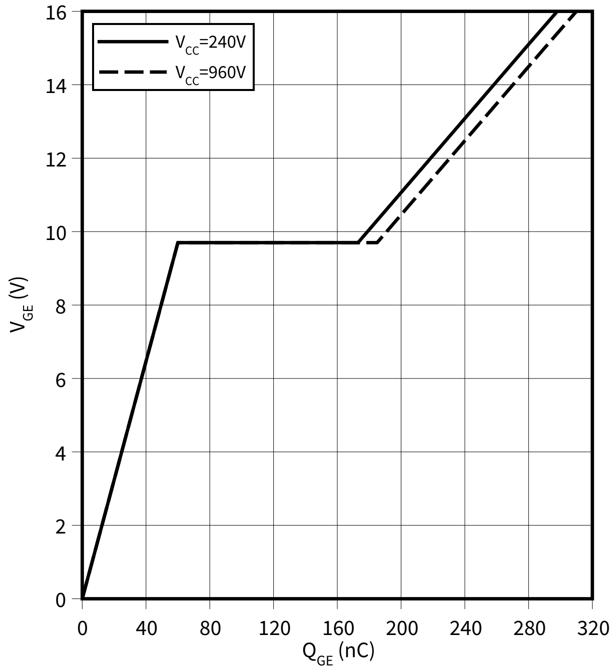
$I_C = 50.0$ A, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 2.3\ \Omega$



Typical gate charge, IGBT

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

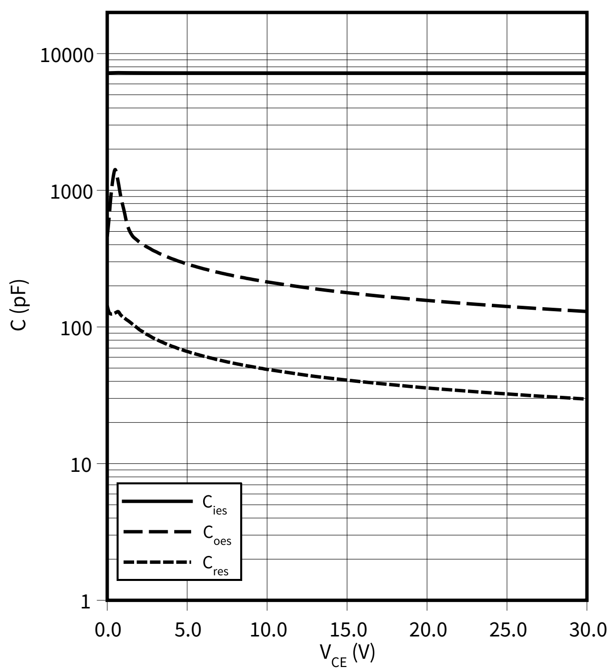
$I_C = 50.0$ A



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

$C = f(V_{CE})$

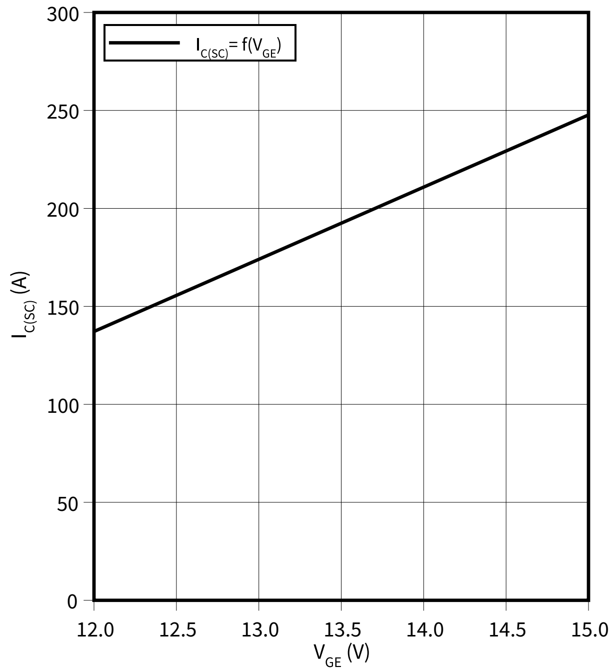
$f = 100$ kHz, $V_{GE} = 0$ V



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

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

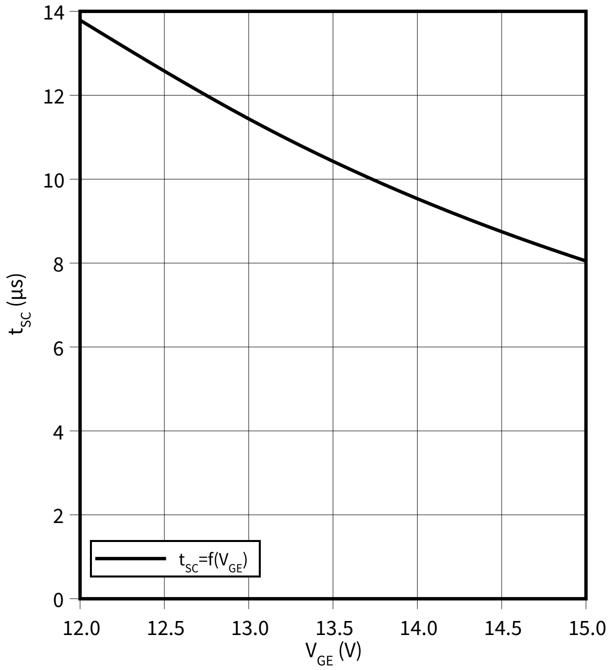
$T_{vj} = 150$ °C, $V_{CC} = 600$ V



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

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

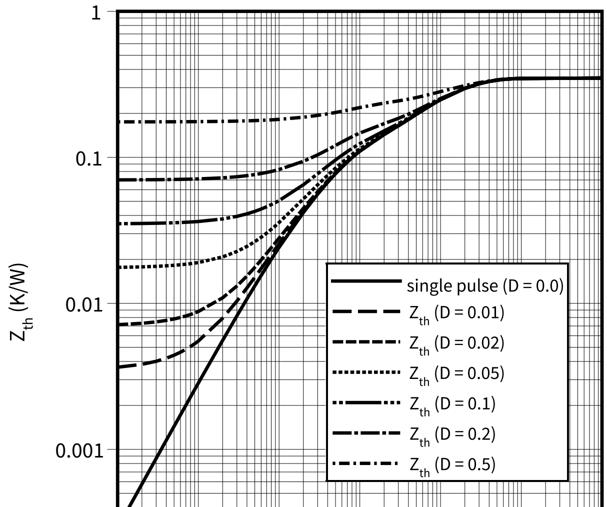
$T_{vj} \leq 150$ °C, $V_{CC} = 600$ V



IGBT transient thermal impedance, IGBT

$Z_{th} = f(t_p)$

$D = t_p/T$

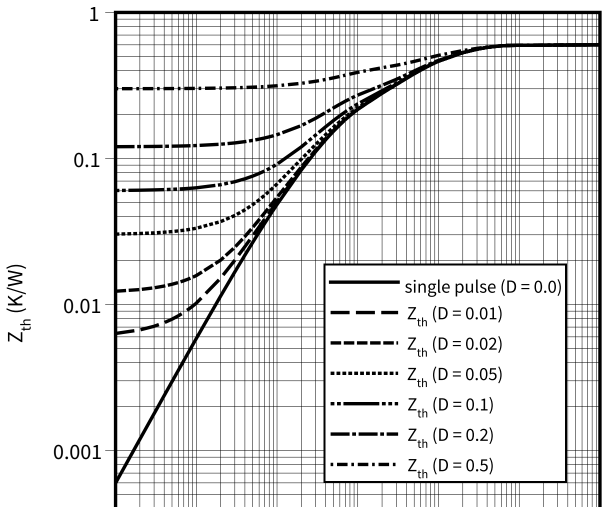


i	1	2	3	4	5	6
r_i[K/W]	0.00992	0.0858	0.108	0.143	0.00284	2.97E-4
τ_i[s]	1.06E-4	5.097E-4	0.00521	0.0183	0.594	12.6215

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

$Z_{th} = f(t_p)$

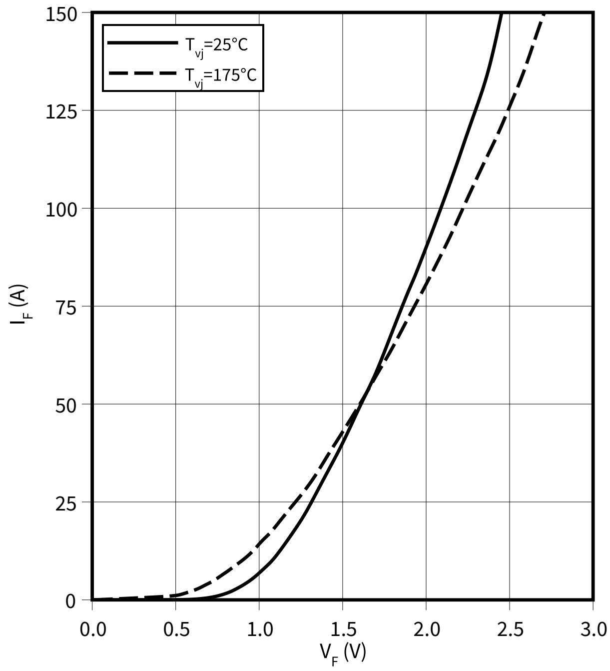
$D = t_p/T$



i	1	2	3	4	5	6
r_i[K/W]	0.0107	0.163	0.219	0.203	0.00462	3.65E-4
τ_i[s]	6.79E-5	4.329E-4	0.0040367	0.0173219	0.5122951	12.7959

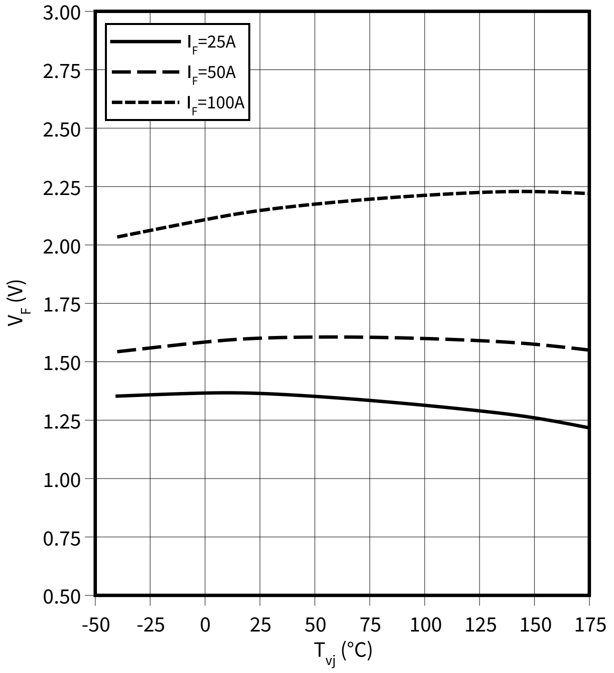
Typical diode forward current as a function of forward voltage, Diode

$I_F = f(V_F)$



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

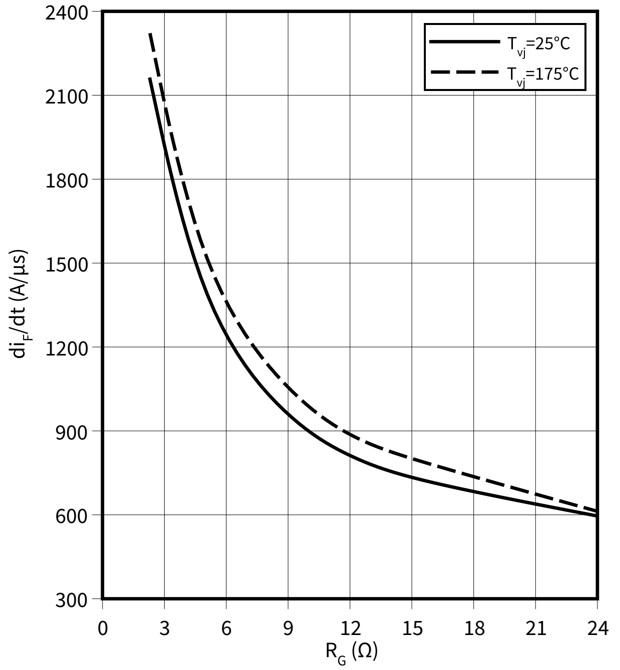
$V_F = f(T_{vj})$



Typical diode current slope as a function of gate resistor, Diode

$di_F/dt = f(R_G)$

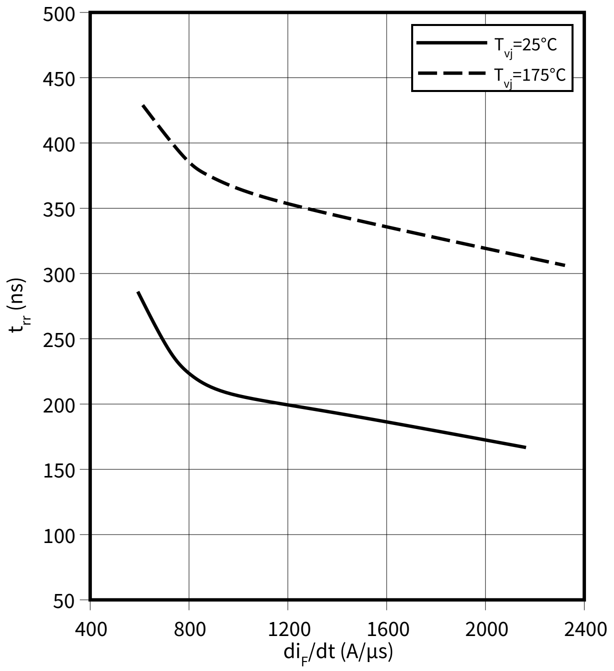
I_C = 50.0 A, V_{CE} = 600 V, V_{GE} = 0/15 V



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

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

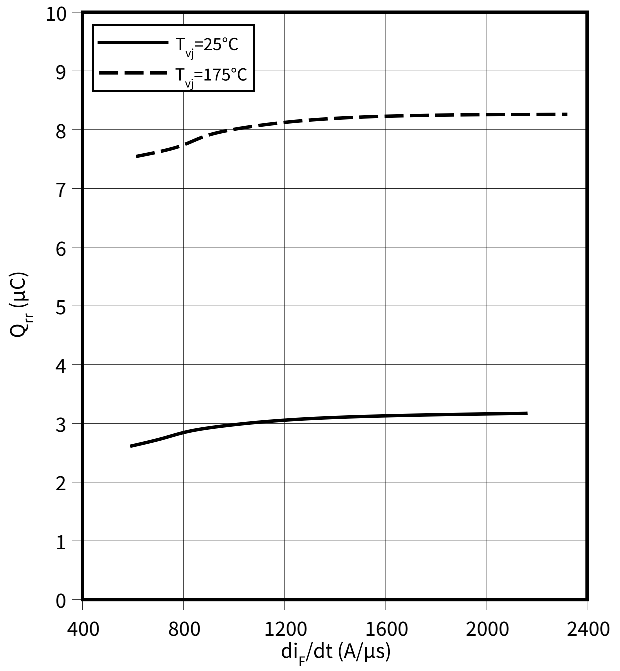
V_R = 600 V, I_F = 50.0 A



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

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

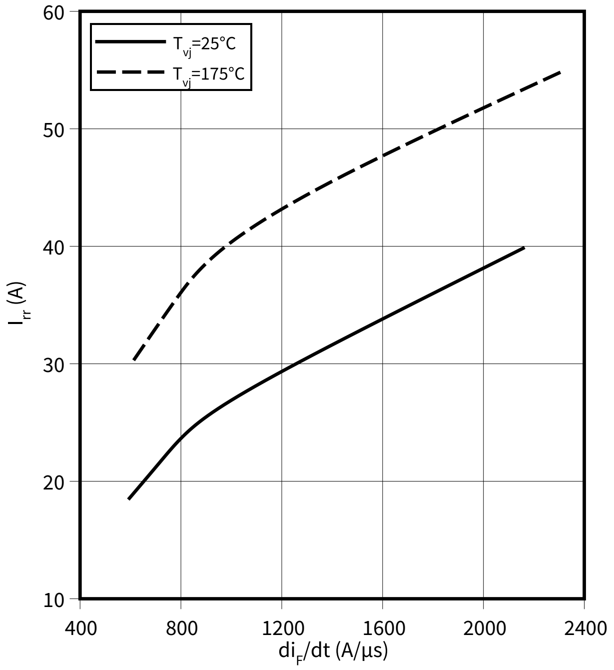
V_R = 600 V, I_F = 50.0 A



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

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

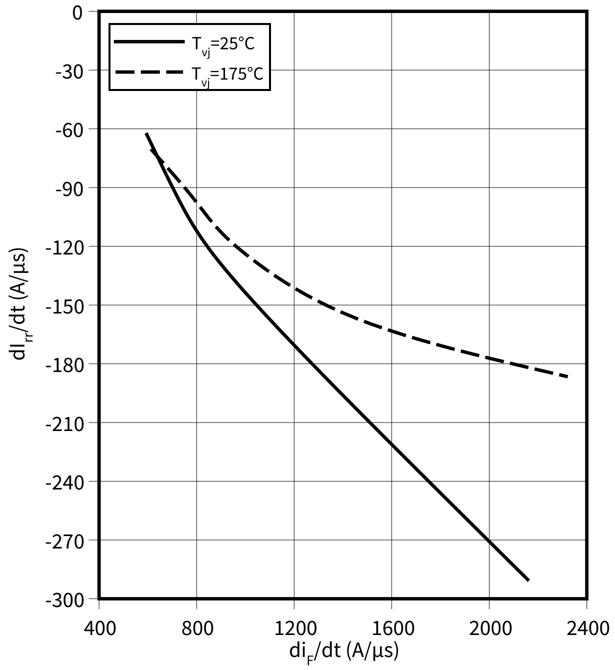
$V_R = 600\ V, I_F = 50.0\ A$



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

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

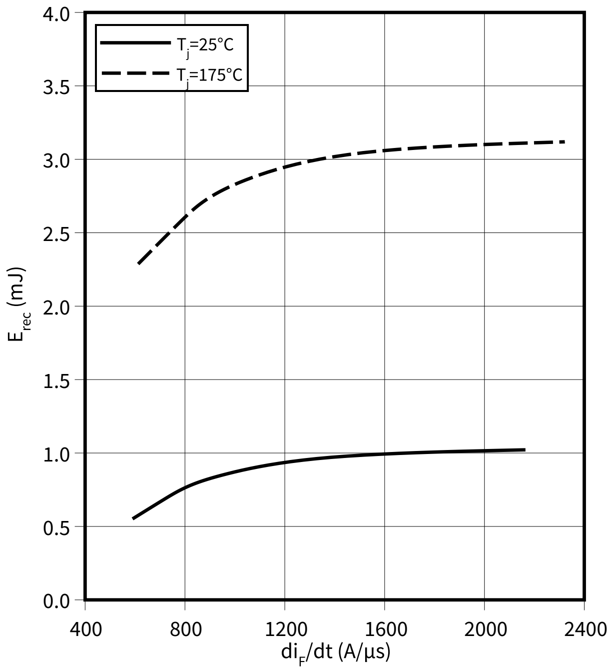
$V_R = 600\ V, I_F = 50.0\ A$



Typical reverse energy losses as a function of diode current slope, Diode

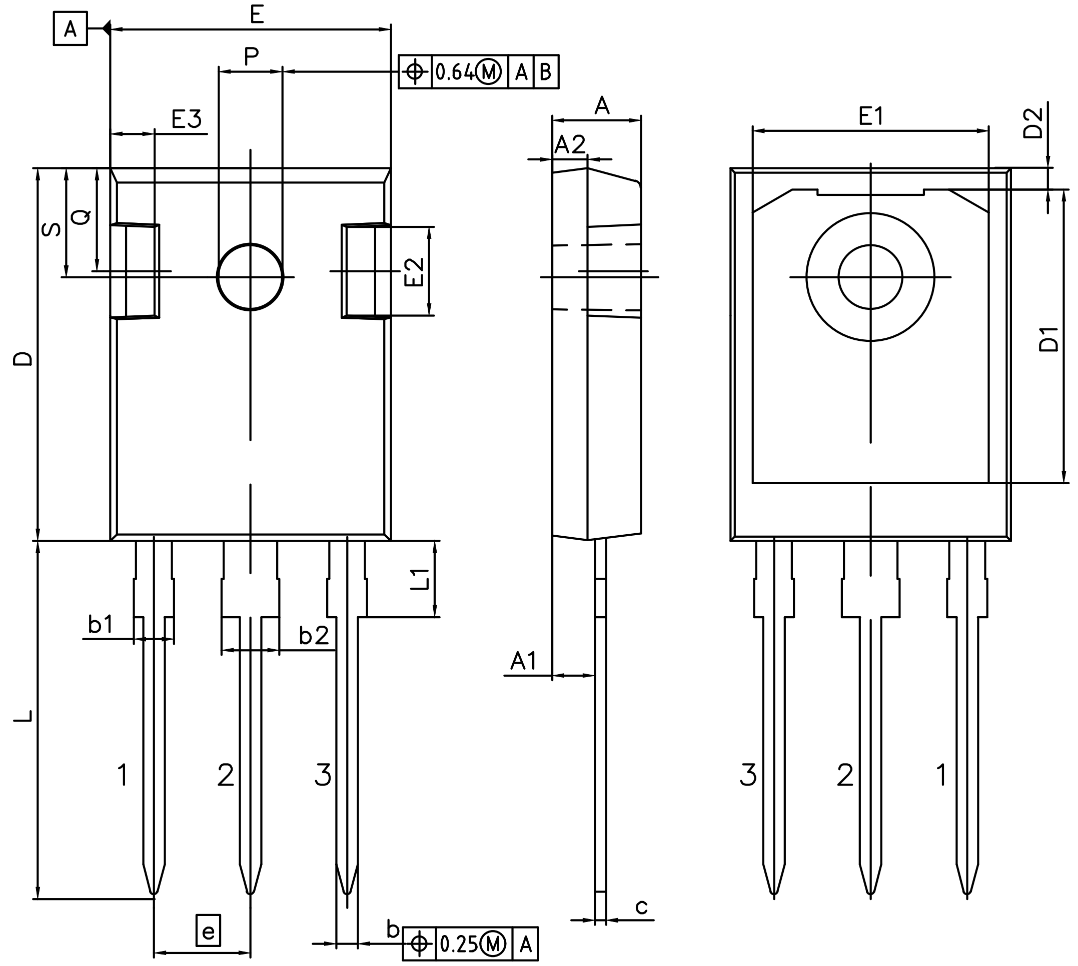
$E_{rec} = f(di_F/dt)$

$V_R = 600\ V, I_F = 50.0\ A$



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

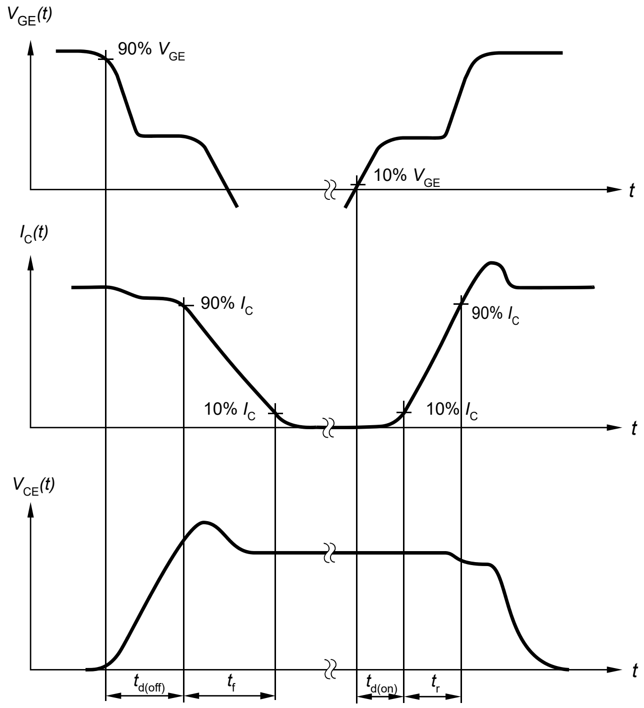


Figure A. **Definition of switching times**

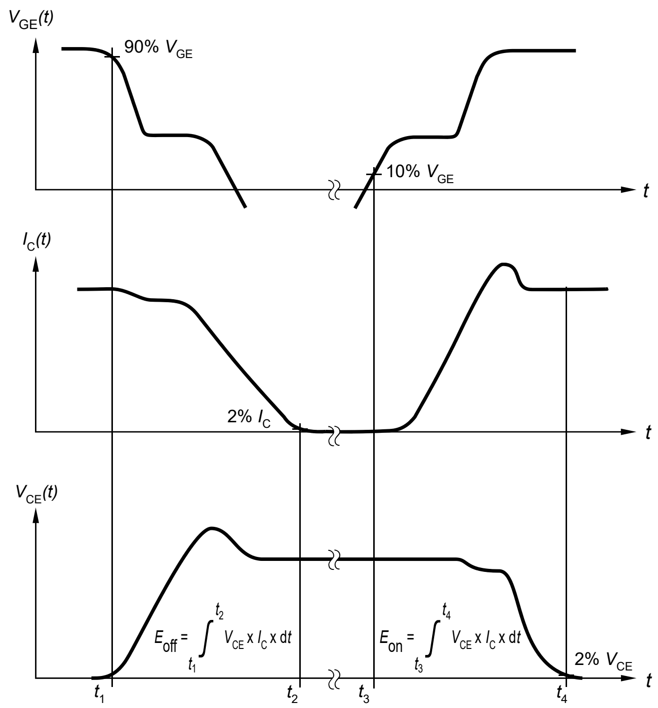


Figure B. **Definition of switching losses**

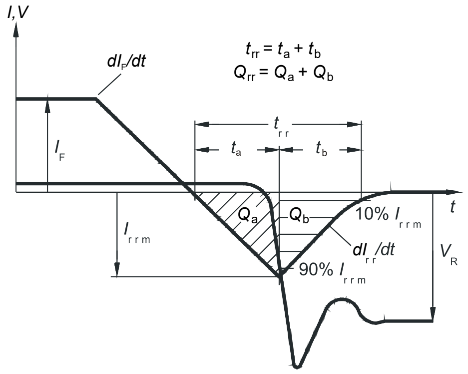


Figure C. **Definition of diode switching characteristics**

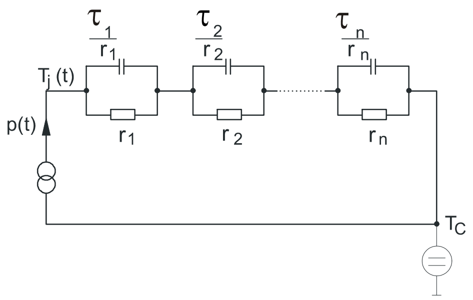


Figure D. **Thermal equivalent circuit**

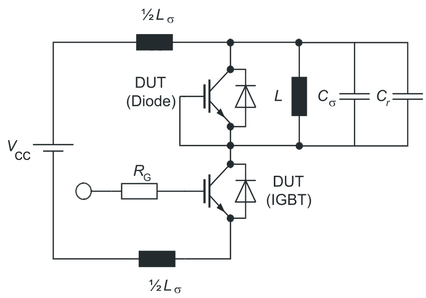


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 7

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