Low loss Duopack: IGBT 7 with Trench and Fieldstop technology

Features

- V_{CE} = 650 V
- I_C = 50 A
- Very low $V_{CE,sat}$
- Low turn-off losses
- Short tail current
- Reduced 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/igbt7/

Lead-free
Green
Halogen-free
RoHS

Potential applications

- Servo drives
- General purpose drives (GPD)
- Industrial UPS
- Industrial SMPS
- Solar optimizer
- Solar string inverter

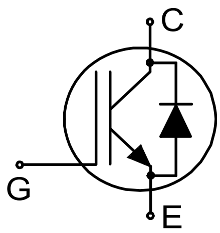
Product validation

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

Description

Package pin definition:

- Pin C & backside - Collector
- Pin E - Emitter
- Pin G - Gate



Type	Package	Marking
IKW50N65ET7	PG-TO247-3	K50EET7

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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	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$				0.55	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$				0.8	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		650	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25$ °C	80	A
			$T_c = 100$ °C	59.7	
Pulsed collector current, t_p limited by T_{vjmax} [1)]	I_{Cpulse}			150	A
Turn-off safe operating area[2)]		$V_{CE} \leq 650$ V, $t_p = 1$ µs, $T_{vj} \leq 175$ °C		150	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}	$V_{GE} = 15$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s	$V_{CC} \leq 330$ V, $T_{vj} = 100$ °C	5	µs
			$V_{CC} \leq 400$ V, $T_{vj} = 150$ °C	3	
Power dissipation	P_{tot}		$T_c = 25$ °C	273	W
			$T_c = 100$ °C	136	

1) Defined by design. Not subject to production test.
2) Clamped inductive load current test for each device, $I_C = 150$ A, $V_{CC} = 400$ V, $T_c = 25$°C, $V_{GE} = 20$ V, L = 80 µH, $R_G = 10\ \Omega$

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	I_C = 50 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.35	1.65	V
			T_{vj} = 125 °C		1.5		
			T_{vj} = 175 °C		1.6		
Gate-emitter threshold voltage	V_{GEth}	I_C = 0.5 mA, V_{CE} = V_{GE}		4.3	5	5.7	V
Zero gate-voltage collector current	I_{CES}	V_{CE} = 650 V, V_{GE} = 0 V	T_{vj} = 25 °C			40	µA
			T_{vj} = 175 °C		1000		
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				100	nA
Transconductance	g_{fs}	I_C = 50 A, V_{CE} = 20 V			26		S
Short-circuit collector current	I_{SC}	V_{CC} ≤ 400 V, V_{GE} = 15 V, t_{SC} ≤ 3 µs, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, T_{vj} = 150 °C			255		A
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			3050		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			92		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			31		pF
Gate charge	Q_G	I_C = 50 A, V_{GE} = 15 V, V_{CC} = 520 V			290		nC
Turn-on delay time	$t_{d(on)}$	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 9 Ω, $R_{G(off)}$ = 9 Ω, $L_σ$ = 32 nH, $C_σ$ = 30 pF	T_{vj} = 25 °C, I_C = 50 A		26		ns
			T_{vj} = 25 °C, I_C = 25 A		24		
			T_{vj} = 175 °C, I_C = 50 A		30		
			T_{vj} = 175 °C, I_C = 25 A		27		
Rise time (inductive load)	t_r	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 9 Ω, $R_{G(off)}$ = 9 Ω, $L_σ$ = 32 nH, $C_σ$ = 30 pF	T_{vj} = 25 °C, I_C = 50 A		20		ns
			T_{vj} = 25 °C, I_C = 25 A		11		
			T_{vj} = 175 °C, I_C = 50 A		23		
			T_{vj} = 175 °C, I_C = 25 A		14		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off delay time	$t_{d(off)}$	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 9 Ω, $R_{G(off)}$ = 9 Ω, $L_σ$ = 32 nH, $C_σ$ = 30 pF	T_{vj} = 25 °C, I_C = 50 A		350		ns
			T_{vj} = 25 °C, I_C = 25 A		370		
			T_{vj} = 175 °C, I_C = 50 A		410		
			T_{vj} = 175 °C, I_C = 25 A		450		
Fall time (inductive load)	t_f	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 9 Ω, $R_{G(off)}$ = 9 Ω, $L_σ$ = 32 nH, $C_σ$ = 30 pF	T_{vj} = 25 °C, I_C = 50 A		14		ns
			T_{vj} = 25 °C, I_C = 25 A		12		
			T_{vj} = 175 °C, I_C = 50 A		30		
			T_{vj} = 175 °C, I_C = 25 A		40		
Turn-on energy	E_{on}	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 9 Ω, $R_{G(off)}$ = 9 Ω, $L_σ$ = 32 nH, $C_σ$ = 30 pF	T_{vj} = 25 °C, I_C = 50 A		1.2		mJ
			T_{vj} = 25 °C, I_C = 25 A		0.51		
			T_{vj} = 175 °C, I_C = 50 A		1.91		
			T_{vj} = 175 °C, I_C = 25 A		0.88		
Turn-off energy	E_{off}	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 9 Ω, $R_{G(off)}$ = 9 Ω, $L_σ$ = 32 nH, $C_σ$ = 30 pF	T_{vj} = 25 °C, I_C = 50 A		0.85		mJ
			T_{vj} = 25 °C, I_C = 25 A		0.38		
			T_{vj} = 175 °C, I_C = 50 A		1.4		
			T_{vj} = 175 °C, I_C = 25 A		0.69		

(table continues...)

Table 3 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Total switching energy	E_{ts}	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 9 Ω, $R_{G(off)}$ = 9 Ω, L_{σ} = 32 nH, C_{σ} = 30 pF	T_{vj} = 25 °C, I_C = 50 A		2.05		mJ
			T_{vj} = 25 °C, I_C = 25 A		0.89		
			T_{vj} = 175 °C, I_C = 50 A		3.31		
			T_{vj} = 175 °C, I_C = 25 A		1.57		
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		650	V
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	T_c = 25 °C	80	A
			T_c = 100 °C	50	
Diode pulsed current, t_p limited by T_{vjmax} [1)]	I_{Fpulse}			150	A

1) Defined by design. Not subject to production test.

Table 5 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 50 A	T_{vj} = 25 °C		1.65	2	V
			T_{vj} = 125 °C		1.6		
			T_{vj} = 175 °C		1.55		

(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 = 400 V	T_{vj} = 25 °C, I_F = 50 A, $-di_F/dt$ = 1720 A/µs		93		ns
			T_{vj} = 25 °C, I_F = 25 A, $-di_F/dt$ = 2340 A/µs		62		
			T_{vj} = 175 °C, I_F = 50 A, $-di_F/dt$ = 1680 A/µs		140		
			T_{vj} = 175 °C, I_F = 25 A, $-di_F/dt$ = 2000 A/µs		105		
Diode reverse recovery charge	Q_{rr}	V_R = 400 V	T_{vj} = 25 °C, I_F = 50 A, $-di_F/dt$ = 1720 A/µs		1.05		µC
			T_{vj} = 25 °C, I_F = 25 A, $-di_F/dt$ = 2340 A/µs		0.74		
			T_{vj} = 175 °C, I_F = 50 A, $-di_F/dt$ = 1680 A/µs		2.7		
			T_{vj} = 175 °C, I_F = 25 A, $-di_F/dt$ = 2000 A/µs		1.95		
Diode peak reverse recovery current	I_{rrm}	V_R = 400 V	T_{vj} = 25 °C, I_F = 50 A, $-di_F/dt$ = 1720 A/µs		21		A
			T_{vj} = 25 °C, I_F = 25 A, $-di_F/dt$ = 2340 A/µs		25		
			T_{vj} = 175 °C, I_F = 50 A, $-di_F/dt$ = 1680 A/µs		33		
			T_{vj} = 175 °C, I_F = 25 A, $-di_F/dt$ = 2000 A/µs		34		

(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 V	T_{vj} = 25 °C, I_F = 50 A, $-di_F/dt$ = 1720 A/µs		260		A/µs
			T_{vj} = 25 °C, I_F = 25 A, $-di_F/dt$ = 2340 A/µs		490		
			T_{vj} = 175 °C, I_F = 50 A, $-di_F/dt$ = 1680 A/µs		290		
			T_{vj} = 175 °C, I_F = 25 A, $-di_F/dt$ = 2000 A/µs		415		
Operating junction temperature	T_{vj}			-40		175	°C

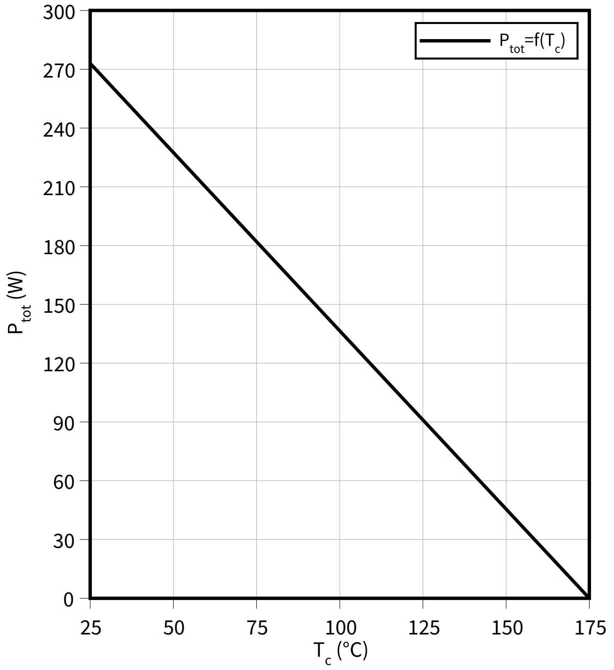
Note: *Maximum rated values: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.*

Electrical Characteristic, at T_{vj} = 25°C, unless otherwise specified.

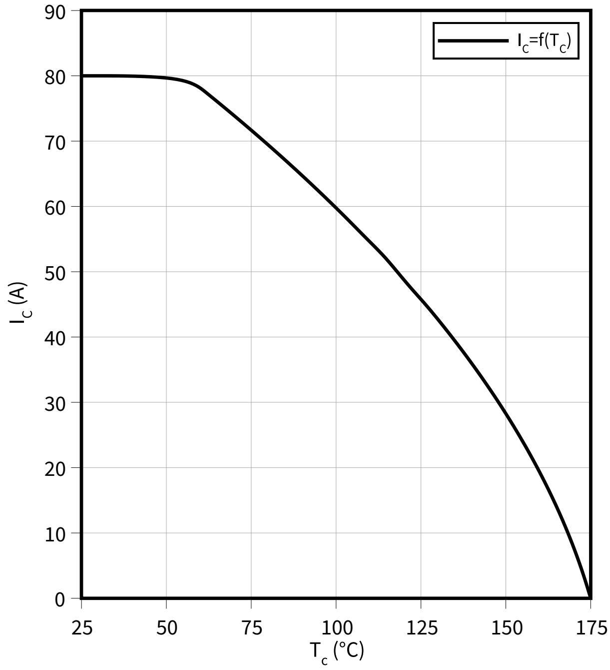
Dynamic test circuit, L_σ, C_σ from Fig. E. Energy losses include “tail” and diode reverse recovery.

4 Characteristics diagrams

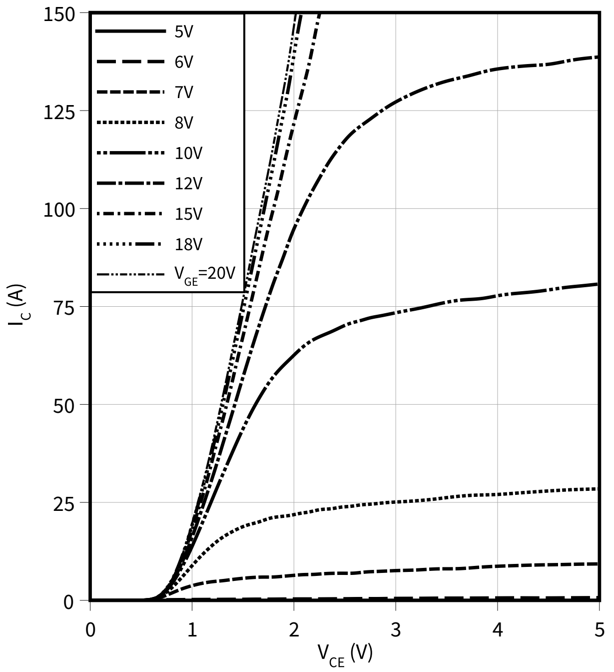
Power dissipation as a function of case temperature
$P_{tot} = f(T_c)$
$T_{vj} \leq 175\ °C$



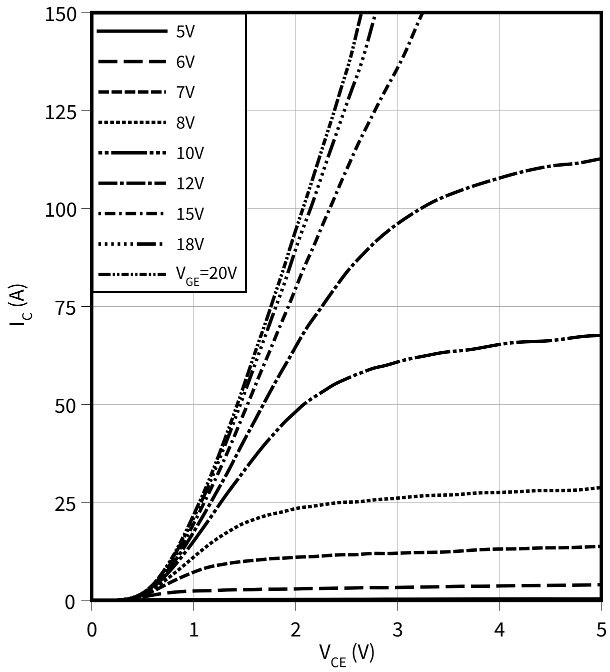
Collector current as a function of case temperature
$I_C = f(T_c)$
$T_{vj} \leq 175\ °C$, $V_{GE} \geq 15\ V$



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



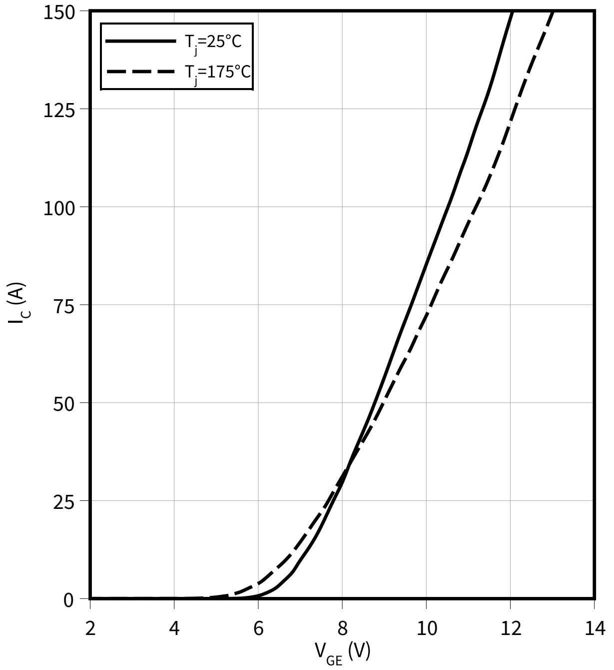
Typical output characteristic
$I_C = f(V_{CE})$
$T_{vj} = 175\ °C$



Typical transfer characteristic

$I_C = f(V_{GE})$

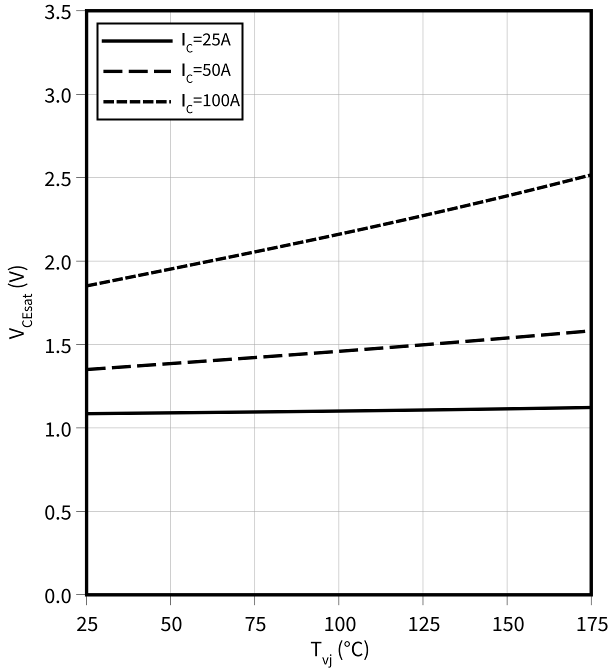
$V_{CE} = 20$ V



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

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

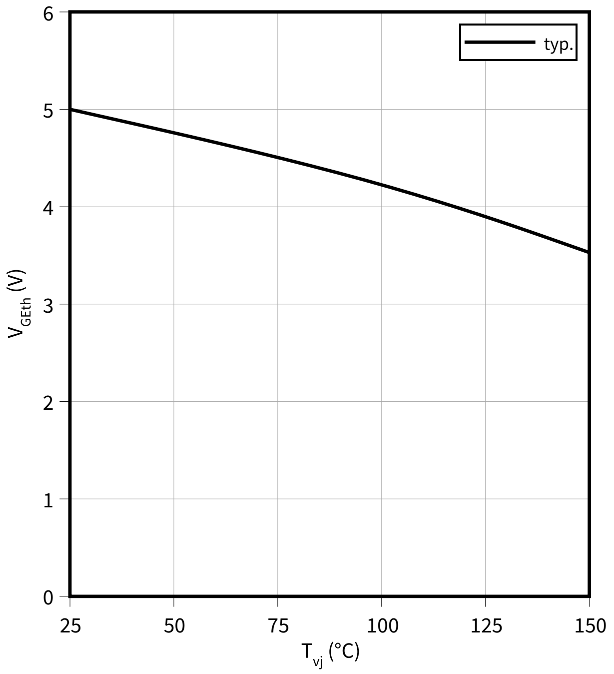
$V_{GE} = 15$ V



Gate-emitter threshold voltage as a function of junction temperature

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

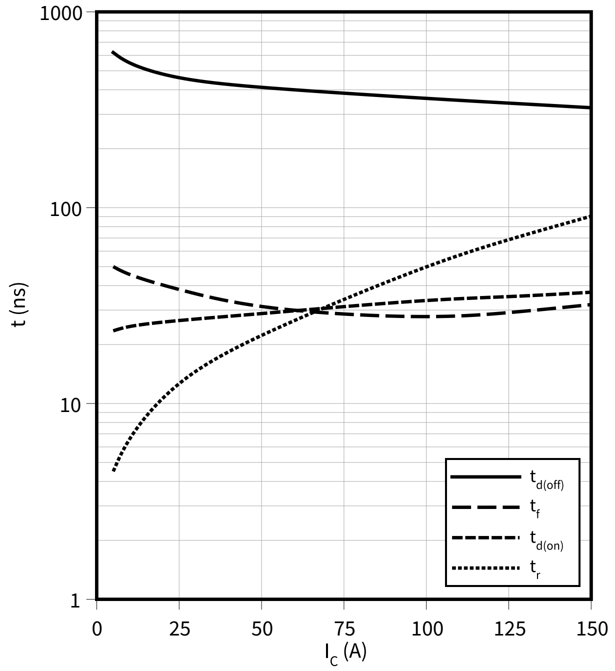
$I_C = 0.5$ mA



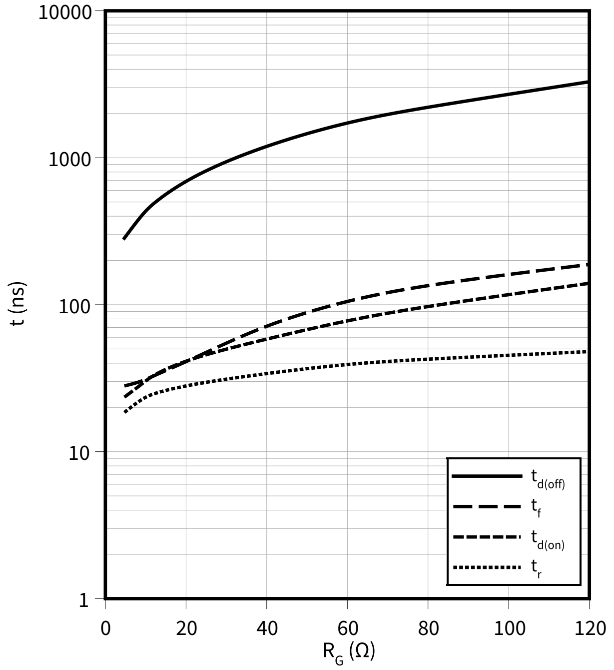
Typical switching times as a function of collector current

$t = f(I_C)$

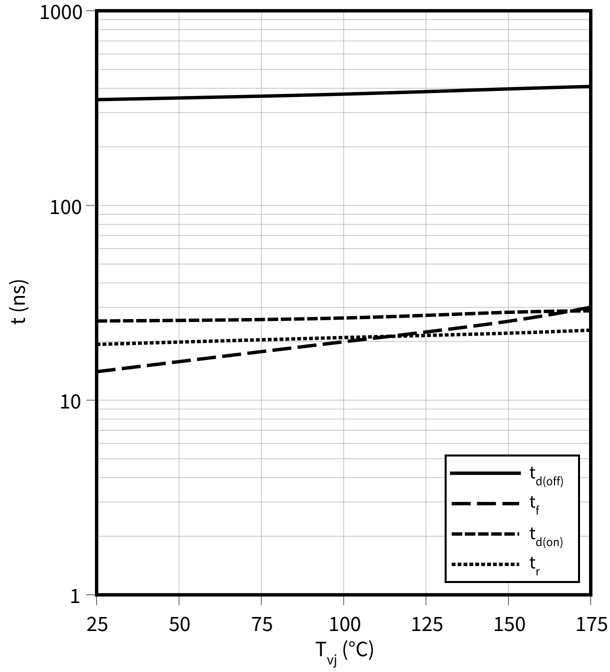
$V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 9\ \Omega$



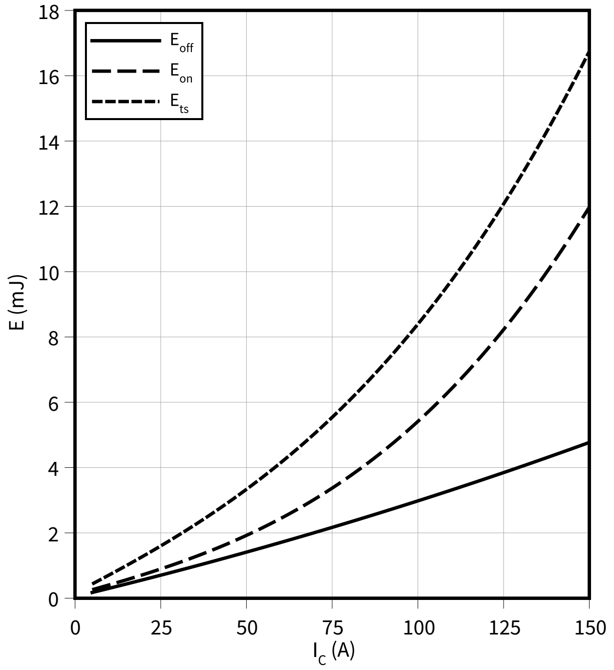
Typical switching times as a function of gate resistor
t = f(R_G)
I_C = 50 A, V_{CC} = 400 V, T_{vj} = 175 °C, V_{GE} = 0/15 V



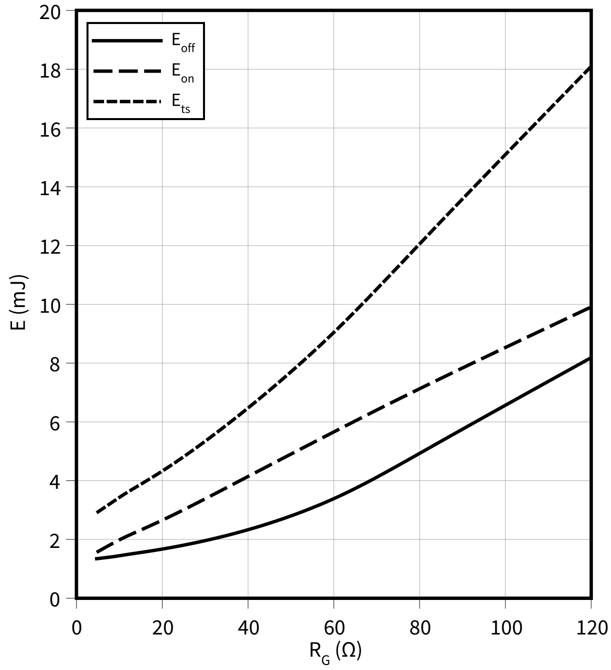
Typical switching times as a function of junction temperature
t = f(T_{vj})
I_C = 50 A, V_{CC} = 400 V, V_{GE} = 0/15 V, R_G = 9 Ω



Typical switching energy losses as a function of collector current
E = f(I_C)
V_{CC} = 400 V, T_{vj} = 175 °C, V_{GE} = 0/15 V, R_G = 9 Ω



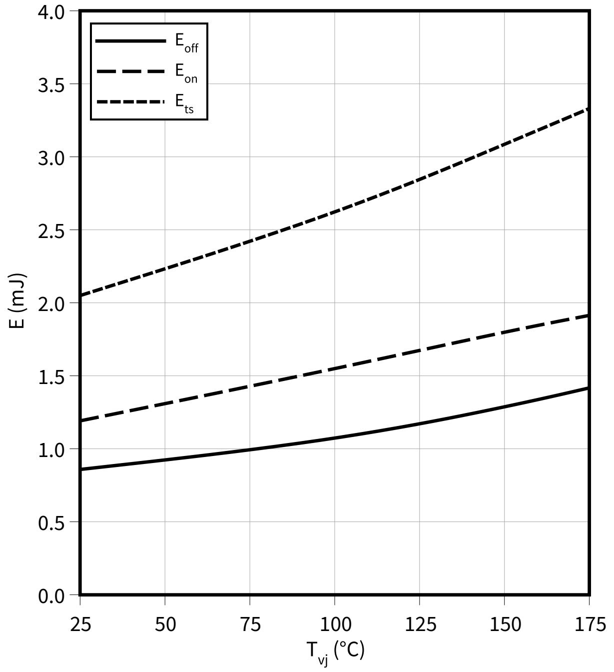
Typical switching energy losses as a function of gate resistor
E = f(R_G)
I_C = 50 A, V_{CC} = 400 V, T_{vj} = 175 °C, V_{GE} = 0/15 V



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

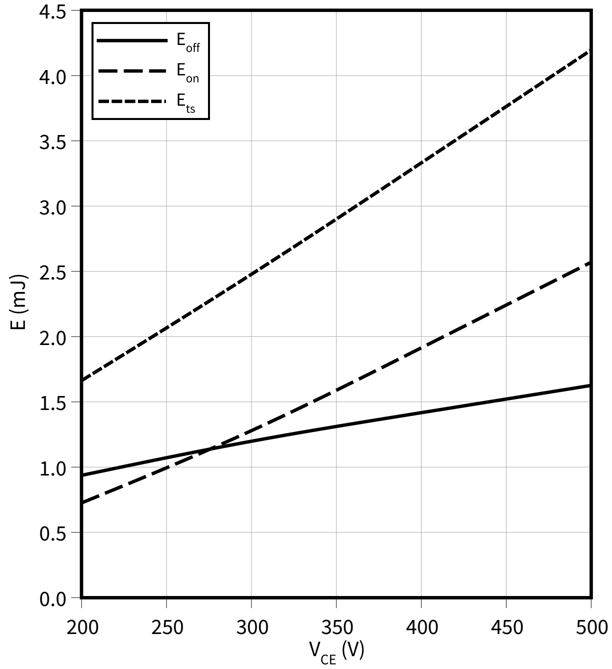
$I_C = 50$ A, $V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 9\ \Omega$



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

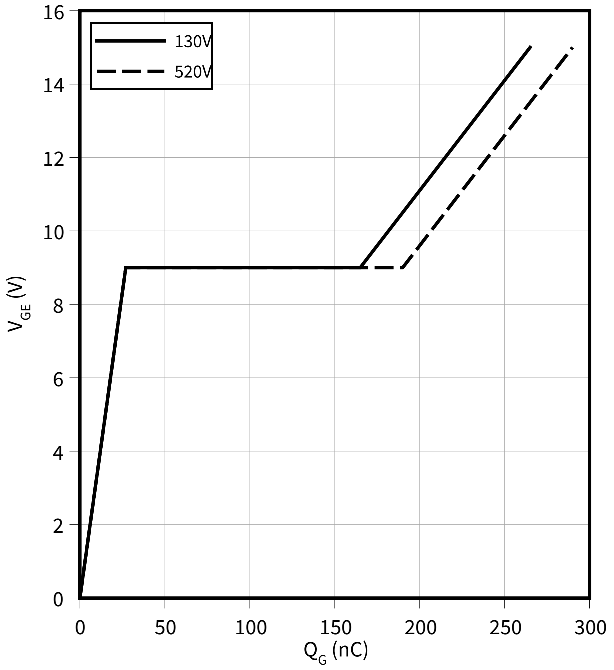
$I_C = 50$ A, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 9\ \Omega$



Typical gate charge

$V_{GE} = f(Q_G)$

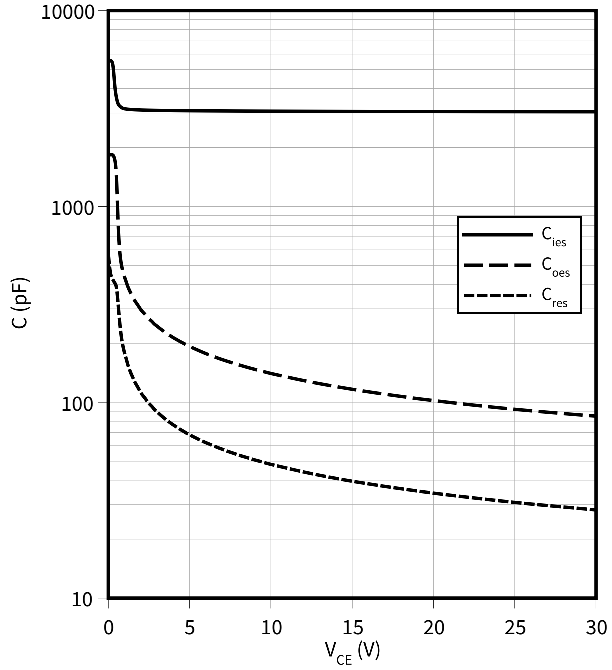
$I_C = 50$ A



Typical capacitance as a function of collector-emitter voltage

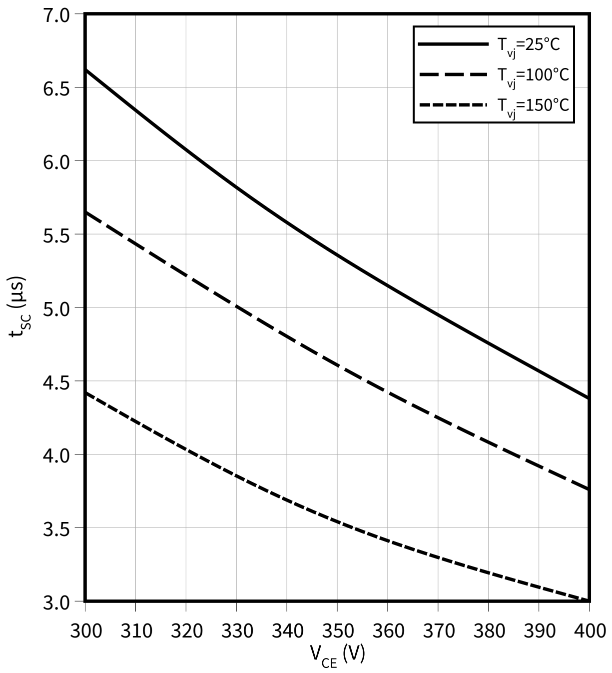
$C = f(V_{CE})$

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



Typical short circuit safe operating range as a function of collector-emitter voltage

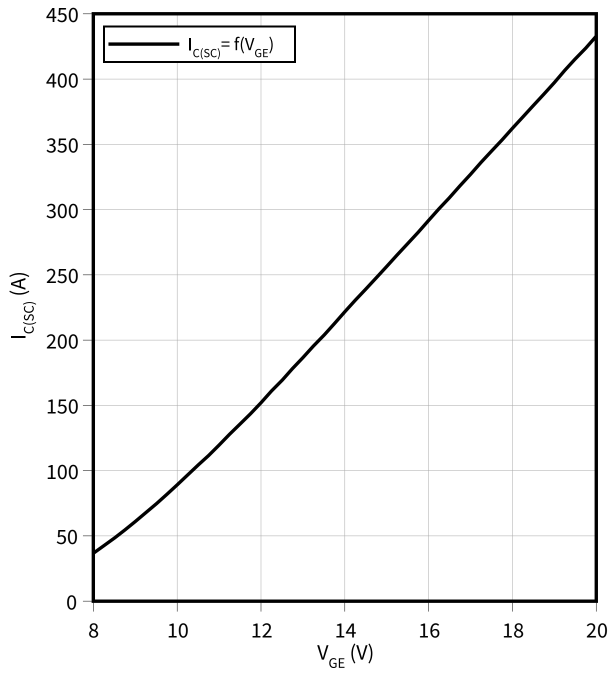
$t_{SC} = f(V_{CE})$



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

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

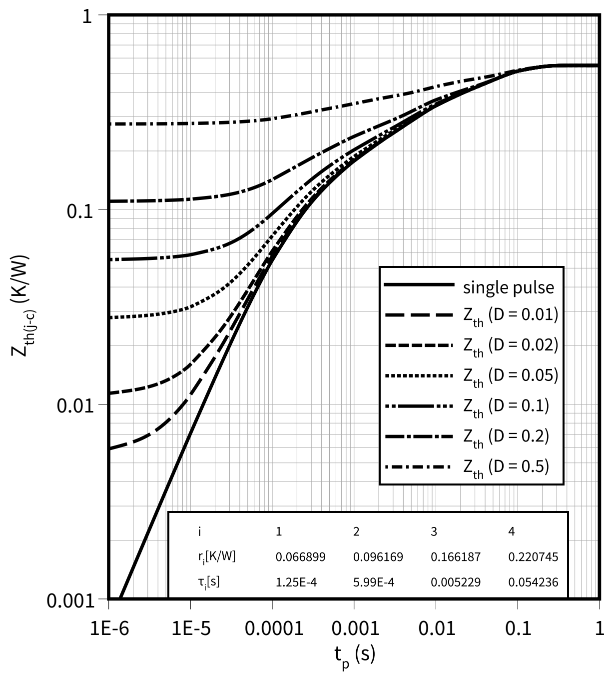
$V_{CE} \leq 400$ V, $T_{vj} = 150$ °C



IGBT transient thermal impedance as a function of pulse width

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

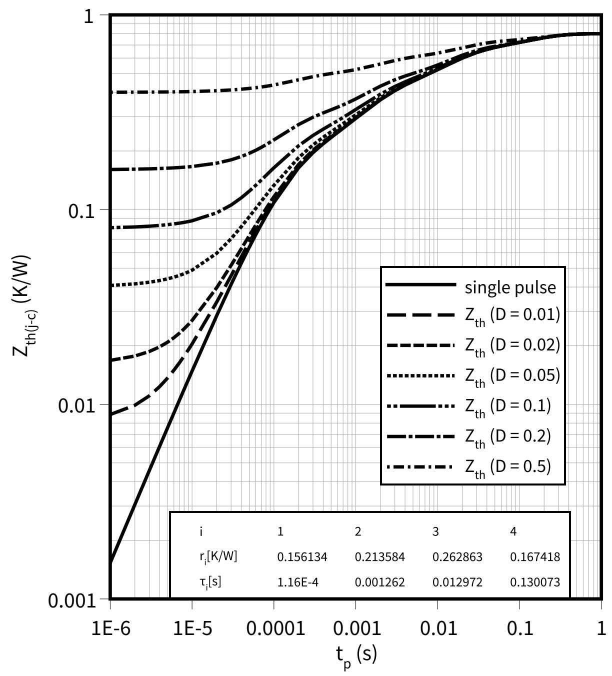
$D = t_p/T$



Diode transient thermal impedance as a function of pulse width

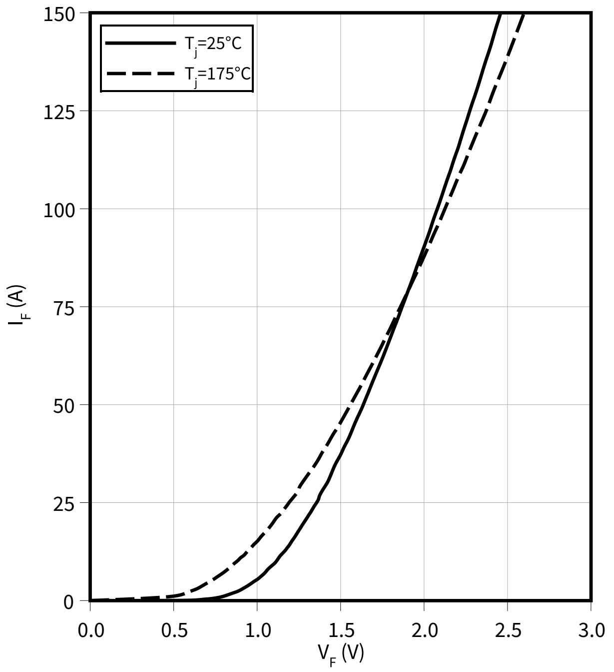
$Z_{th(j-c)} = f(t_p)$

$D = t_p/T$



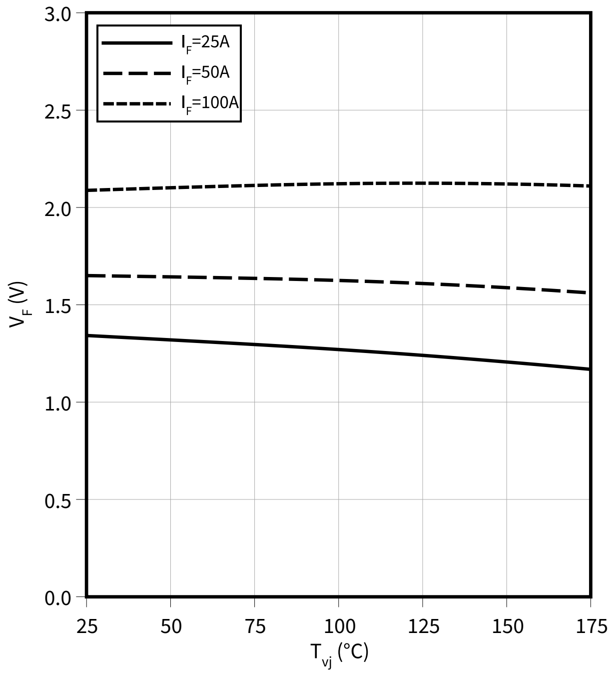
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

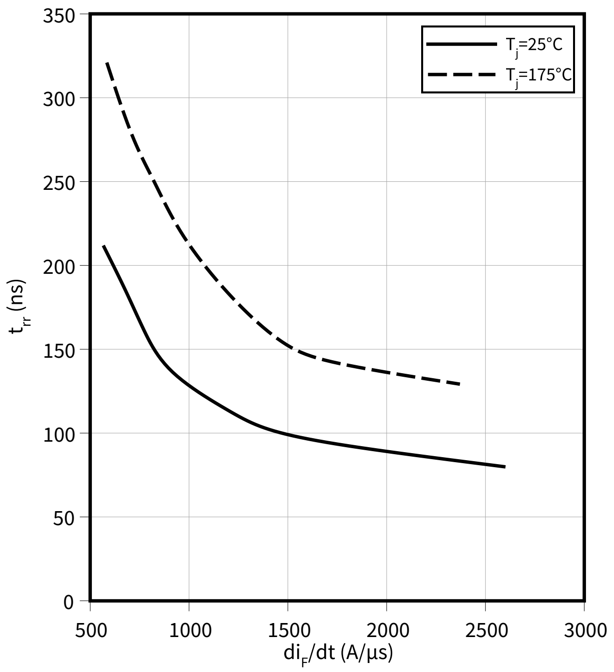
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

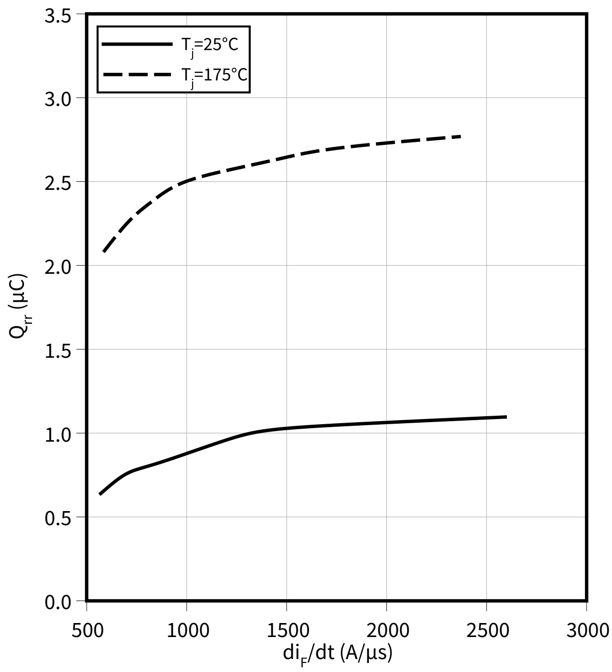
$V_R = 400$ V, $I_F = 50$ A

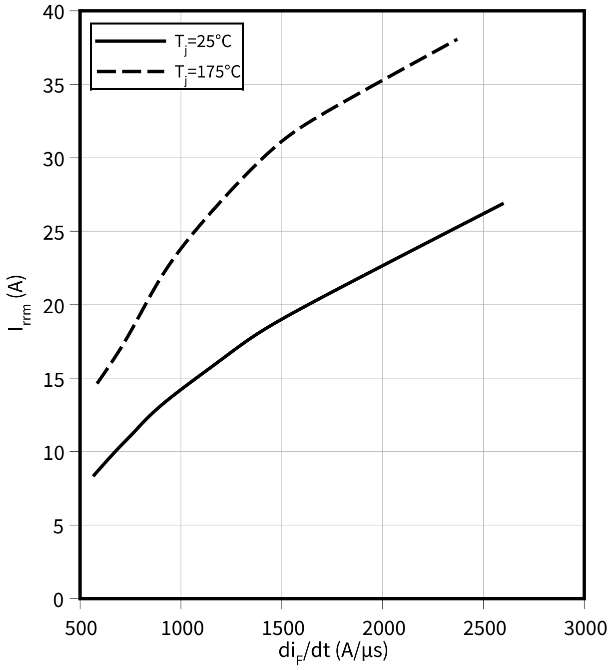
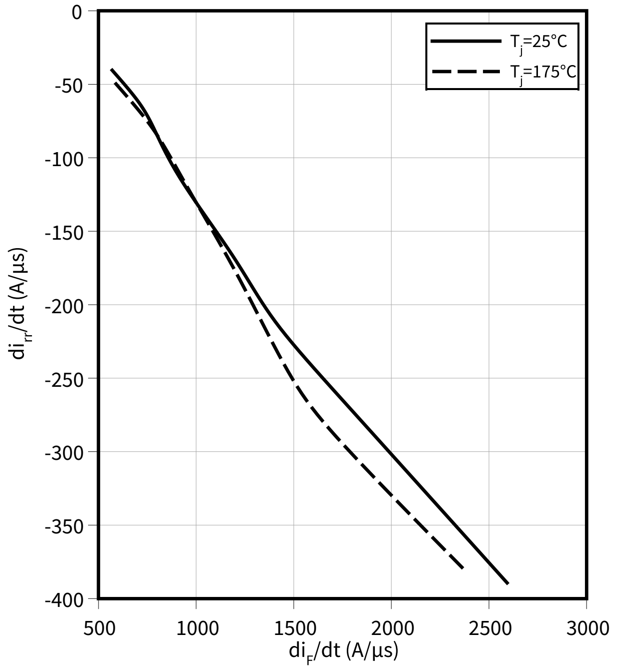


Typical reverse recovery charge as a function of diode current slope

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

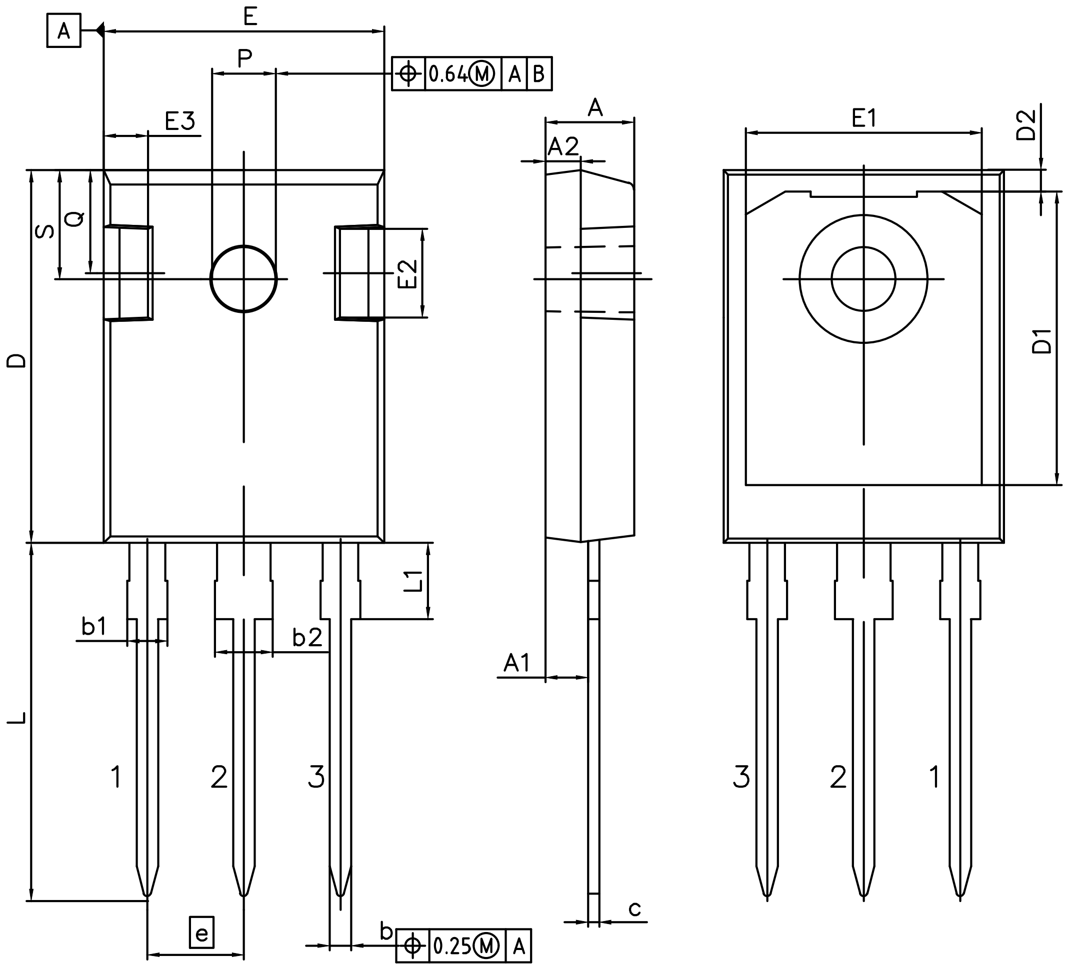
$V_R = 400$ V, $I_F = 50$ A



Typical reverse recovery current as a function of diode current slope $I_{rrm} = f(di_F/dt)$ $V_R = 400$ V, $I_F = 50$ A	**Typical diode peak rate of fall of reverse recovery current as a function of diode current slope** $di_{rr}/dt = f(di_F/dt)$ $V_R = 400$ V, $I_F = 50$ 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

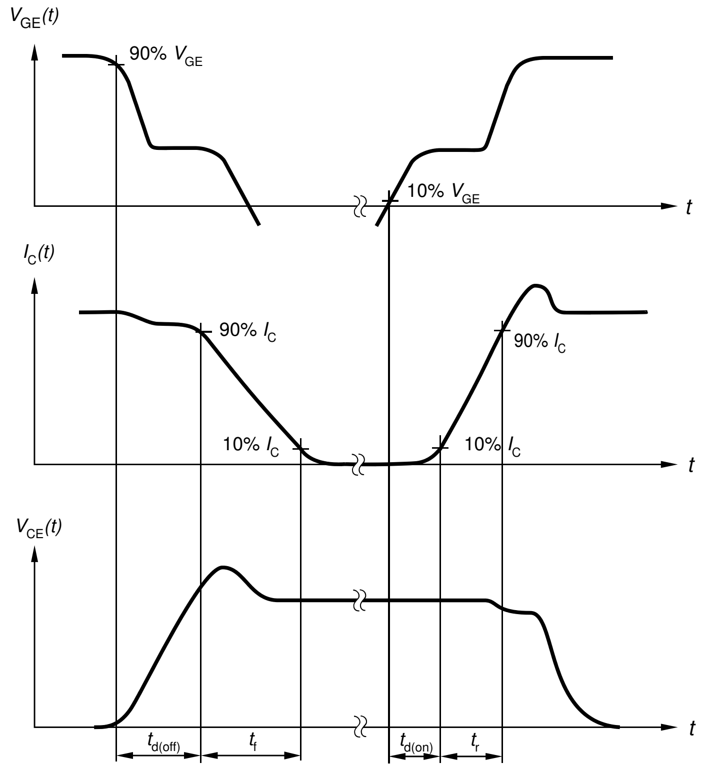


Figure A. **Definition of switching times**

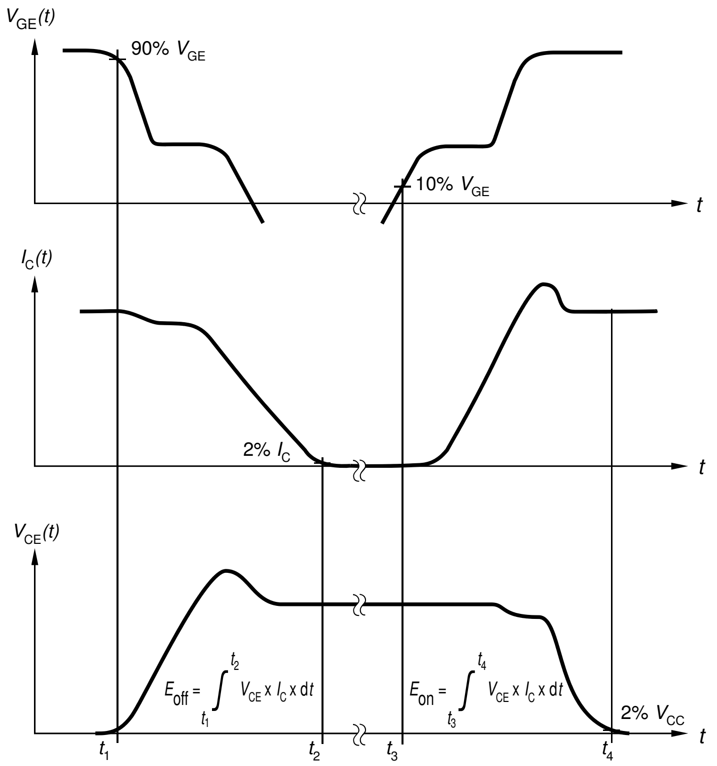


Figure B. **Definition of switching losses**

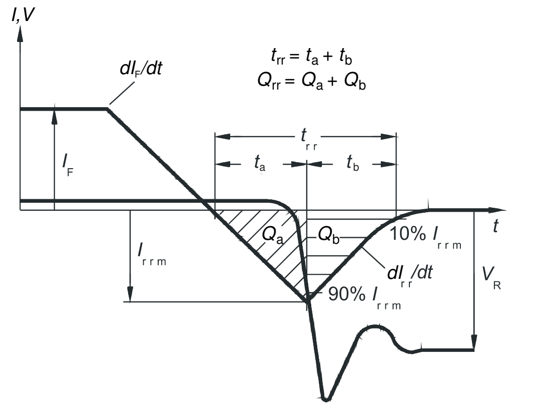


Figure C. **Definition of diode switching characteristics**

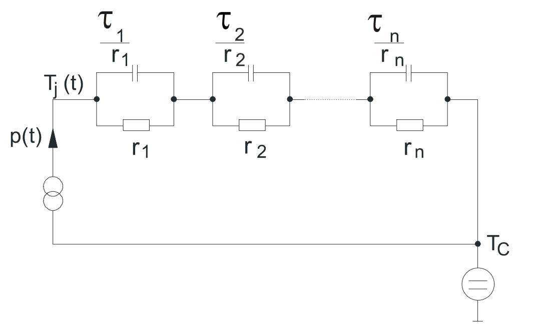


Figure D. **Thermal equivalent circuit**

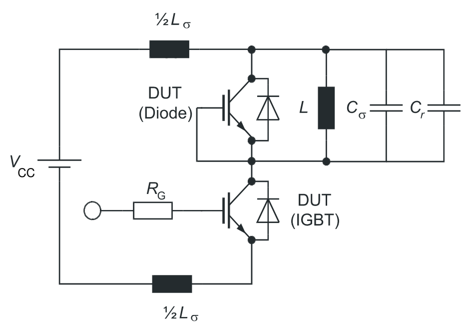


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 2

Revision history

Document revision	Date of release	Description of changes
V0.1	2019-10-25	Target Data Sheet
V1.1	2020-04-20	Preliminary data sheet
V2.1	2020-05-12	Final data sheet
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
1.00	2021-06-29	Change of potential applications and new diagram added (t_{SC} as function of V_{CE})
1.10	2023-01-26	Feature list corrections Editorial changes

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