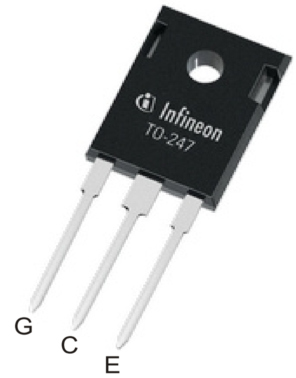
Low Loss Duopack: IGBT 7 with Trench and Fieldstop technology

Features

- V_{CE} = 650 V
- I_C = 50 A
- Very Low V_{CEsat}
- Low turn-off losses
- Short tail current
- Reduced EMI
- Humidity robust design
- 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

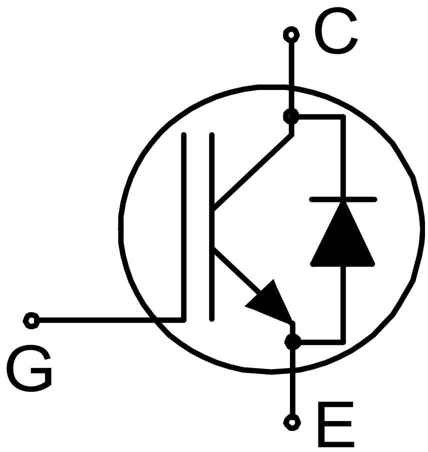
Product validation

- 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			13.0		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	$R_{th(j-a)}$				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		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_{Cpuls}			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, $D < 0.010$		±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=150A, V_{CC}=400V, T_c=25°C, V_{GE}=20V, L=80µH, R_G=10Ω

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		1.35	1.65	V
			T_{vj} = 125 °C		1.50		
			T_{vj} = 175 °C		1.60		
Gate-emitter threshold voltage	V_{GEth}	I_C = 0.50 mA, V_{CE} = V_{GE}		4.30	5.00	5.70	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 = 50.0 A, V_{CE} = 20 V			26		S
Short circuit collector current	I_{SC}	V_{GE} = 15 V, t_{SC} ≤ 3 µs, Allowed number of short circuits < 1000 , Time between short circuits ≥ 1.0 s			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 = 50.0 A, V_{GE} = 15 V, V_{CE} = 520 V			290		nC
Turn-on delay time	t_{don}	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 9.0 Ω, R_{Goff} = 9.0 Ω, $L_σ$ = 32 nH, $C_σ$ = 30 pF	T_{vj} = 25 °C, I_C = 50.0 A		26		ns
			T_{vj} = 25 °C, I_C = 25.0 A		24		
			T_{vj} = 175 °C, I_C = 50.0 A		30		
			T_{vj} = 175 °C, I_C = 25.0 A		27		
Rise time (inductive load)	t_r	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 9.0 Ω, R_{Goff} = 9.0 Ω, $L_σ$ = 32 nH, $C_σ$ = 30 pF	T_{vj} = 25 °C, I_C = 50.0 A		20		ns
			T_{vj} = 25 °C, I_C = 25.0 A		11		
			T_{vj} = 175 °C, I_C = 50.0 A		23		
			T_{vj} = 175 °C, I_C = 25.0 A		14		

Table 3 Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off delay time	t_{doff}	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 9.0 Ω, R_{Goff} = 9.0 Ω, L_{σ} = 32 nH, C_{σ} = 30 pF	T_{vj} = 25 °C, I_C = 50.0 A		350		ns
			T_{vj} = 25 °C, I_C = 25.0 A		370		
			T_{vj} = 175 °C, I_C = 50.0 A		410		
			T_{vj} = 175 °C, I_C = 25.0 A		450		
Fall time (inductive load)	t_f	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 9.0 Ω, R_{Goff} = 9.0 Ω, L_{σ} = 32 nH, C_{σ} = 30 pF	T_{vj} = 25 °C, I_C = 50.0 A		14		ns
			T_{vj} = 25 °C, I_C = 25.0 A		12		
			T_{vj} = 175 °C, I_C = 50.0 A		30		
			T_{vj} = 175 °C, I_C = 25.0 A		40		
Turn-on energy	E_{on}	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 9.0 Ω, R_{Goff} = 9.0 Ω, L_{σ} = 32 nH, C_{σ} = 30 pF	T_{vj} = 25 °C, I_C = 50.0 A		1.20		mJ
			T_{vj} = 25 °C, I_C = 25.0 A		0.51		
			T_{vj} = 175 °C, I_C = 50.0 A		1.91		
			T_{vj} = 175 °C, I_C = 25.0 A		0.88		
Turn-off energy	E_{off}	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 9.0 Ω, R_{Goff} = 9.0 Ω, L_{σ} = 32 nH, C_{σ} = 30 pF	T_{vj} = 25 °C, I_C = 50.0 A		0.85		mJ
			T_{vj} = 25 °C, I_C = 25.0 A		0.38		
			T_{vj} = 175 °C, I_C = 50.0 A		1.40		
			T_{vj} = 175 °C, I_C = 25.0 A		0.69		

Table 3 Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Total switching energy	E_{ts}	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 9.0 Ω, R_{Goff} = 9.0 Ω, $L_σ$ = 32 nH, $C_σ$ = 30 pF	T_{vj} = 25 °C, I_C = 50.0 A		2.05		mJ
			T_{vj} = 25 °C, I_C = 25.0 A		0.89		
			T_{vj} = 175 °C, I_C = 50.0 A		3.31		
			T_{vj} = 175 °C, I_C = 25.0 A		1.57		
IGBT thermal resistance, junction-case	R_{thjc}					0.55	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}	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, limited by T_{vjmax} [1)]	I_{Fpuls}			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 = 50.0 A	T_{vj} = 25 °C		1.65	2.00	V
			T_{vj} = 125 °C		1.60		
			T_{vj} = 175 °C		1.55		
Reverse leakage current	I_R	V_R = 650 V	T_{vj} = 25 °C			40	µA
			T_{vj} = 175 °C		1000		

Table 5 Characteristic values (continued)

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 = 50.0 A, $-di_F/dt$ = 1720 A/µs		93		ns
			T_{vj} = 25 °C, I_F = 25.0 A, $-di_F/dt$ = 2340 A/µs		62		
			T_{vj} = 175 °C, I_F = 50.0 A, $-di_F/dt$ = 1680 A/µs		140		
			T_{vj} = 175 °C, I_F = 25.0 A, $-di_F/dt$ = 2000 A/µs		105		
Diode reverse recovery charge	Q_{rr}	V_R = 400 V	T_{vj} = 25 °C, I_F = 50.0 A, $-di_F/dt$ = 1720 A/µs		1.05		µC
			T_{vj} = 25 °C, I_F = 25.0 A, $-di_F/dt$ = 2340 A/µs		0.74		
			T_{vj} = 175 °C, I_F = 50.0 A, $-di_F/dt$ = 1680 A/µs		2.70		
			T_{vj} = 175 °C, I_F = 25.0 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 = 50.0 A, $-di_F/dt$ = 1720 A/µs		21.0		A
			T_{vj} = 25 °C, I_F = 25.0 A, $-di_F/dt$ = 2340 A/µs		25.0		
			T_{vj} = 175 °C, I_F = 50.0 A, $-di_F/dt$ = 1680 A/µs		33.0		
			T_{vj} = 175 °C, I_F = 25.0 A, $-di_F/dt$ = 2000 A/µs		34.0		

Table 5 Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak rate off fall of reverse recovery current	dI_{rr}/dt	V_R = 400 V	T_{vj} = 25 °C, I_F = 50.0 A, $-di_F/dt$ = 1720 A/µs		-260		A/µs
			T_{vj} = 25 °C, I_F = 25.0 A, $-di_F/dt$ = 2340 A/µs		-490		
			T_{vj} = 175 °C, I_F = 50.0 A, $-di_F/dt$ = 1680 A/µs		-290		
			T_{vj} = 175 °C, I_F = 25.0 A, $-di_F/dt$ = 2000 A/µs		-415		
Diode thermal resistance, junction-case	R_{thjc}					0.80	K/W
Operating junction temperature	T_{vj}			-40		175	°C

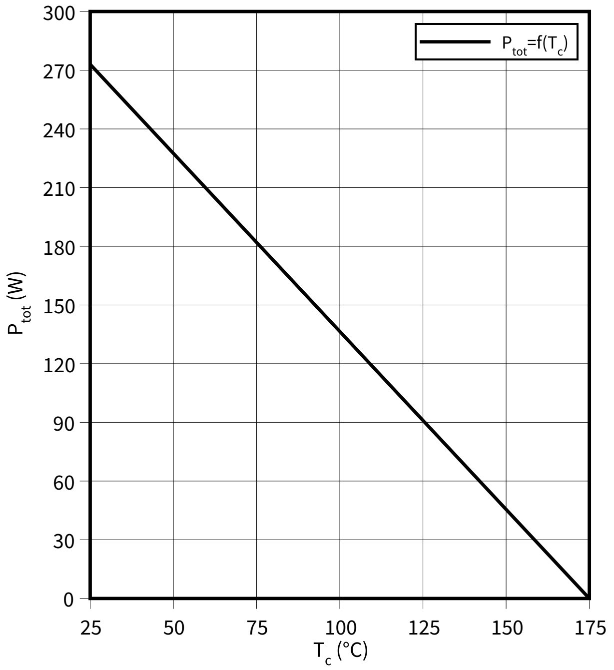
Note: *For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.*

4 Characteristics diagrams

Power dissipation as a function of case temperature, IGBT

$P_{tot} = f(T_c)$

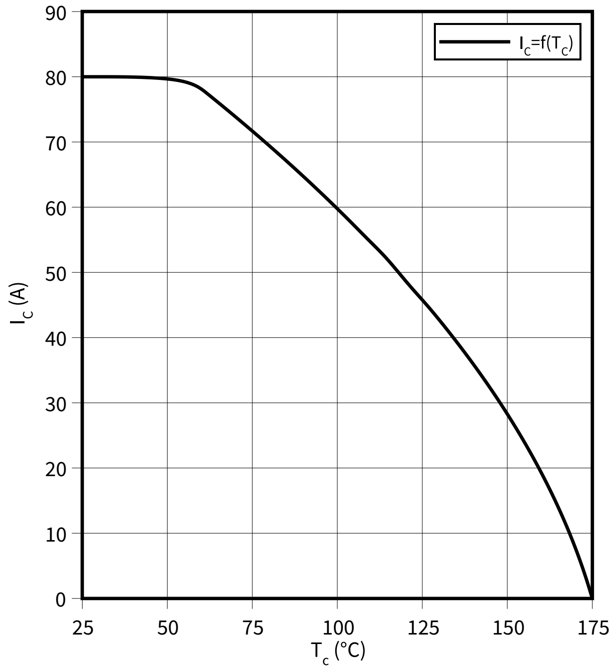
$T_{vj} \leq 175\ °C$



Collector current as a function of case temperature, IGBT

$I_C = f(T_c)$

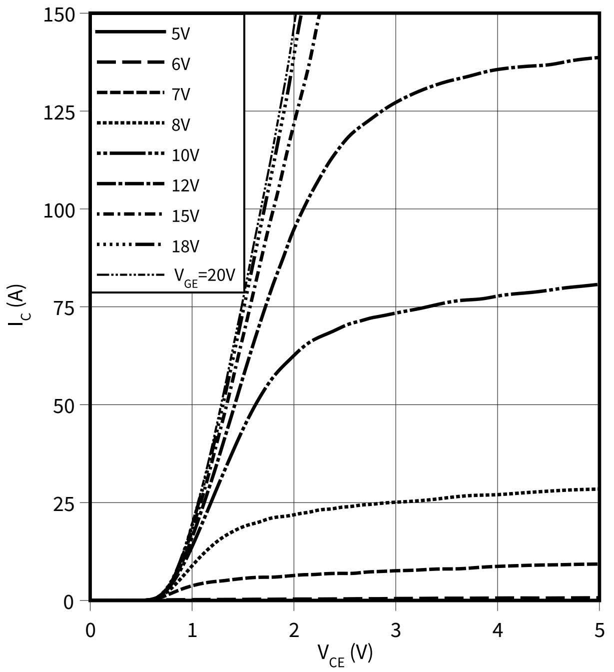
$T_{vj} \leq 175\ °C, V_{GE} \geq 15\ V$



Typical output characteristic, IGBT

$I_C = f(V_{CE})$

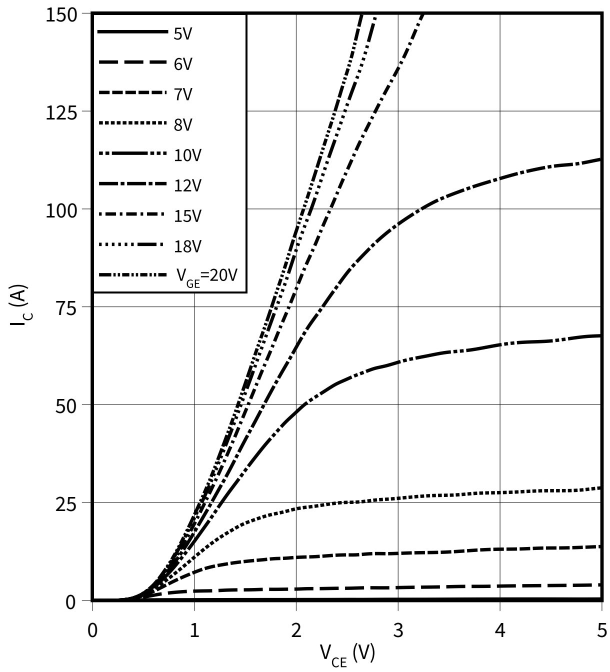
$T_{vj} = 25\ °C$



Typical output characteristic, IGBT

$I_C = f(V_{CE})$

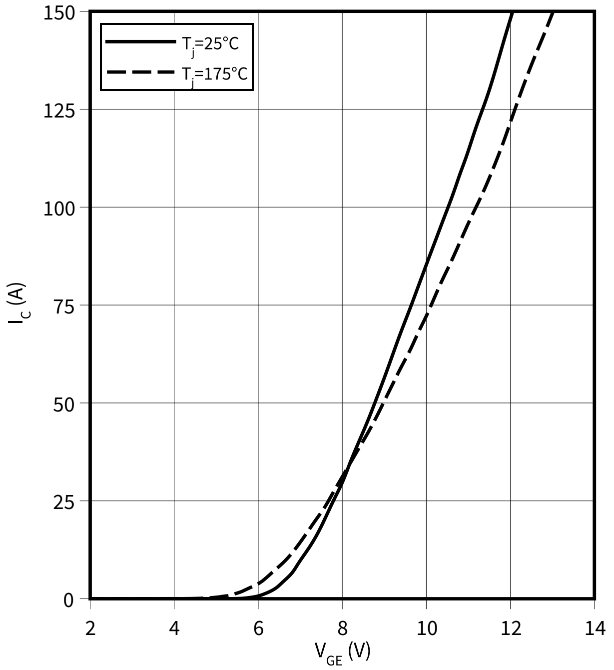
$T_{vj} = 175\ °C$



Typical transfer characteristic, IGBT

$I_C = f(V_{GE})$

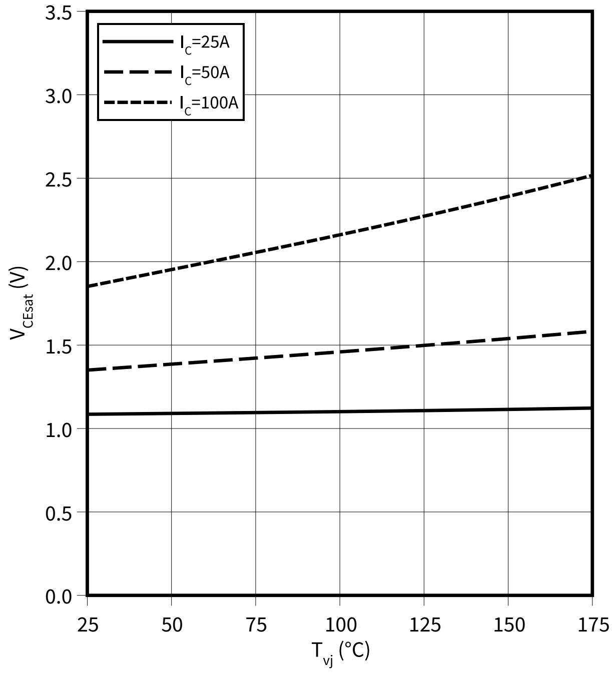
$V_{CE} = 20$ V



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

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

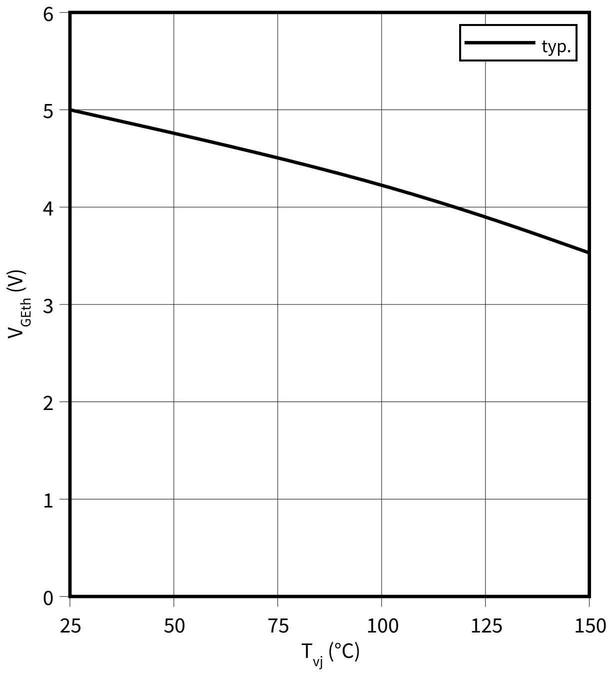
$V_{GE} = 15$ V



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

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

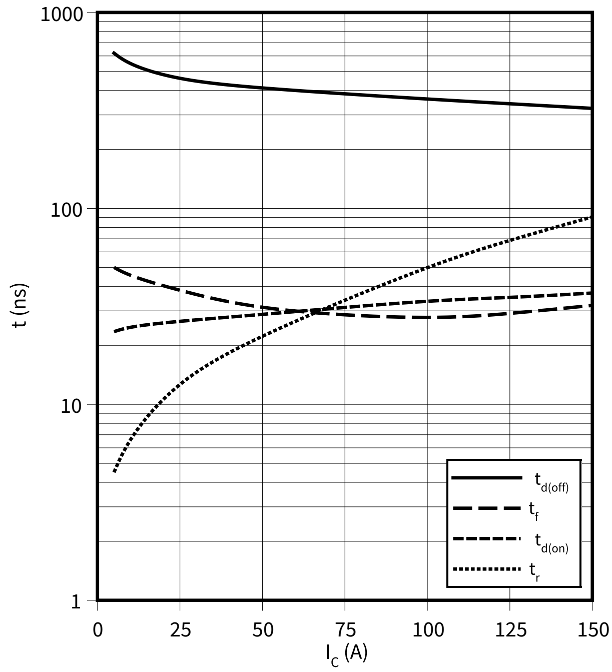
$I_C = 0.50$ mA



Typical switching times as a function of collector current, IGBT

$t = f(I_C)$

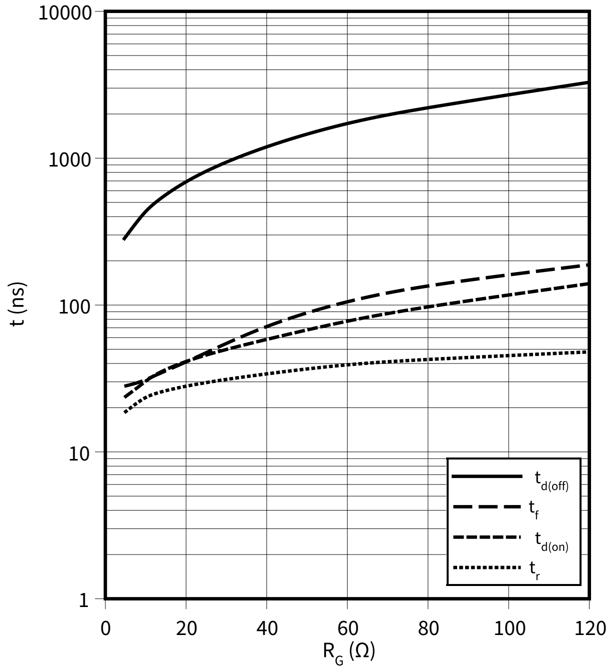
$V_{CE} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 9$ Ω



Typical switching times as a function of gate resistor, IGBT

$t = f(R_G)$

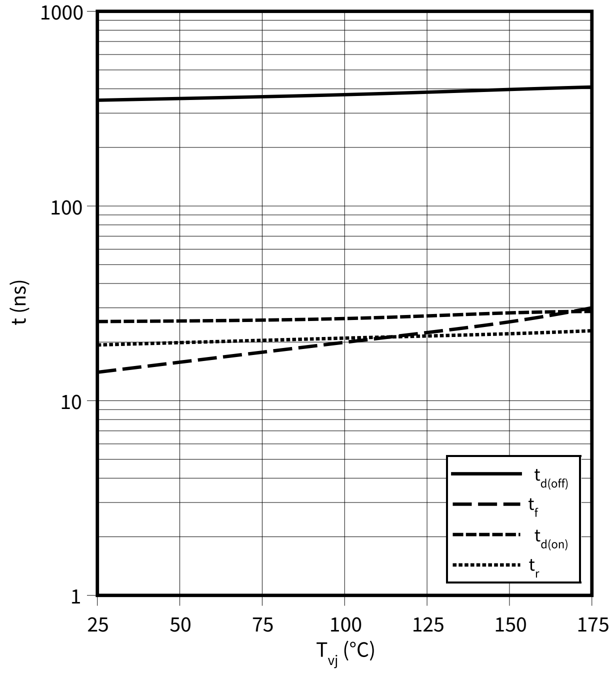
I_C = 50.0 A, V_{CE} = 400 V, T_{vj} = 175 °C, V_{GE} = 0/15 V



Typical switching times as a function of junction temperature, IGBT

$t = f(T_{vj})$

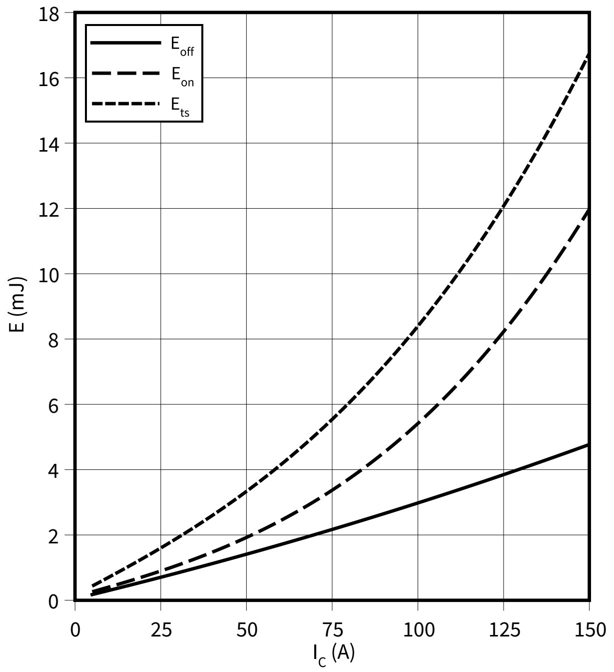
I_C = 50.0 A, V_{CE} = 400 V, V_{GE} = 0/15 V, R_G = 9 Ω



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

$E = f(I_C)$

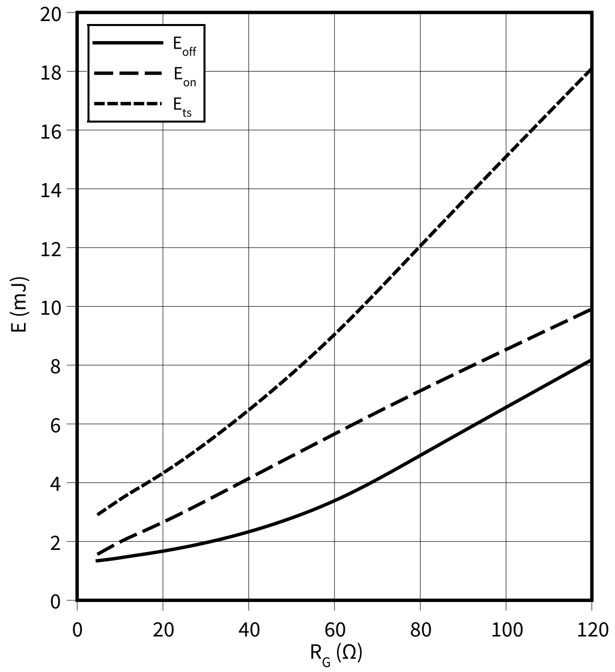
V_{CE} = 400 V, T_{vj} = 175 °C, V_{GE} = 0/15 V, R_G = 9 Ω



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

$E = f(R_G)$

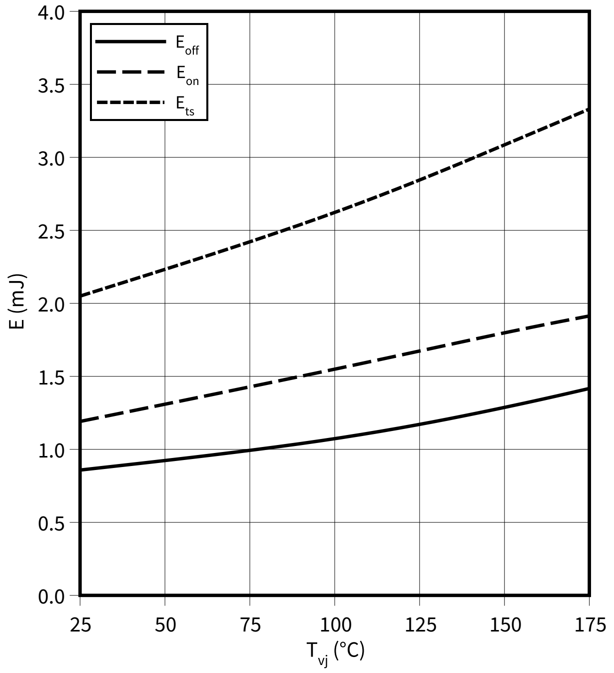
I_C = 50.0 A, V_{CE} = 400 V, T_{vj} = 175 °C, V_{GE} = 0/15 V



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

$E = f(T_{vj})$

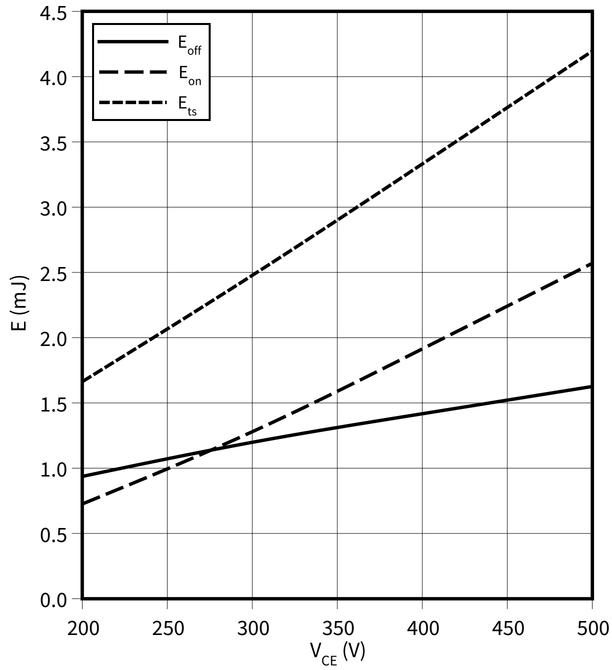
$I_C = 50.0$ A, $V_{CE} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 9\ \Omega$



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

$E = f(V_{CE})$

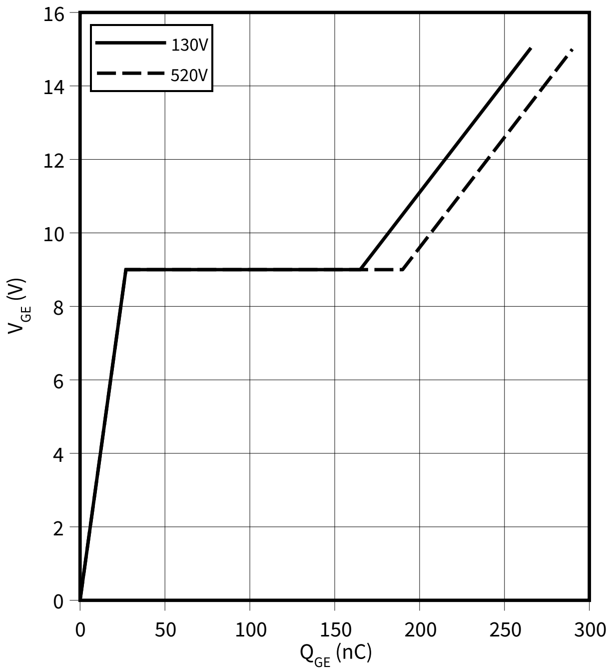
$I_C = 50.0$ A, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 9\ \Omega$



Typical gate charge, IGBT

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

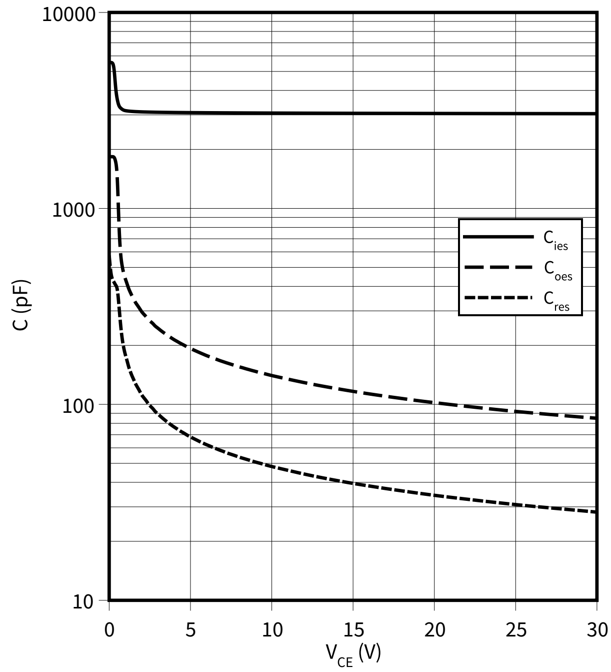
$I_C = 50.0$ A



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

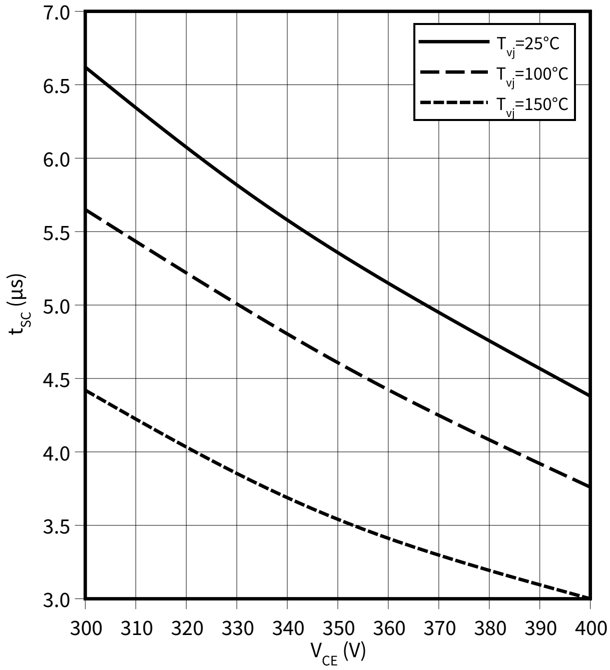
$C = f(V_{CE})$

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



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

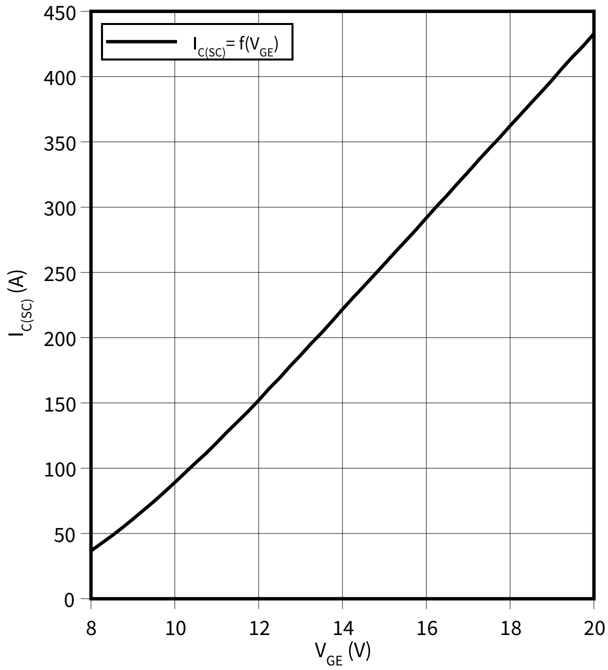
$t_{SC} = f(V_{CE})$



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

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

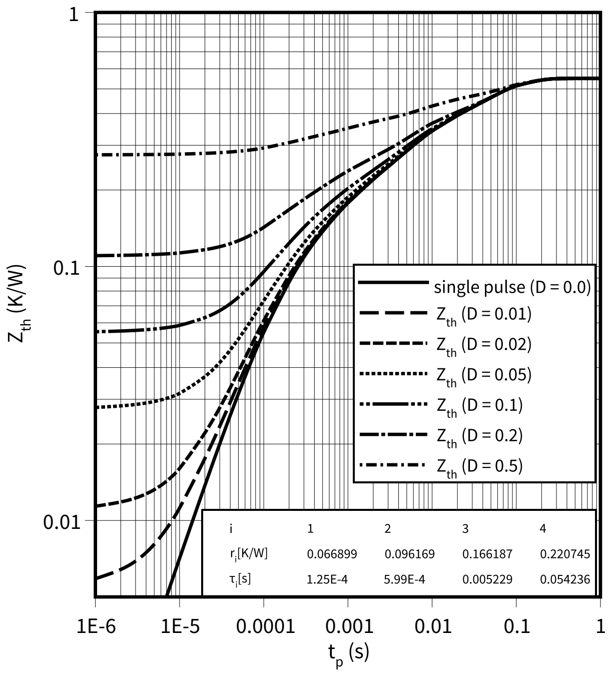
$V_{CE} = 400$ V, $T_{vj} = 150$ °C



IGBT transient thermal resistance, IGBT

$Z_{th} = f(t_p)$

$D = t_p/T$

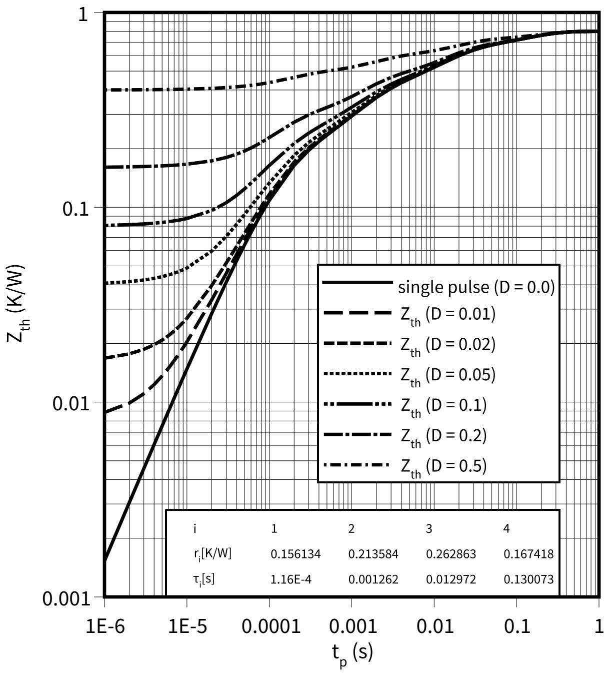


i	1	2	3	4
r_i[K/W]	0.066899	0.096169	0.166187	0.220745
τ_i[s]	1.25E-4	5.99E-4	0.005229	0.054236

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

$Z_{th} = f(t_p)$

$D = t_p/T$

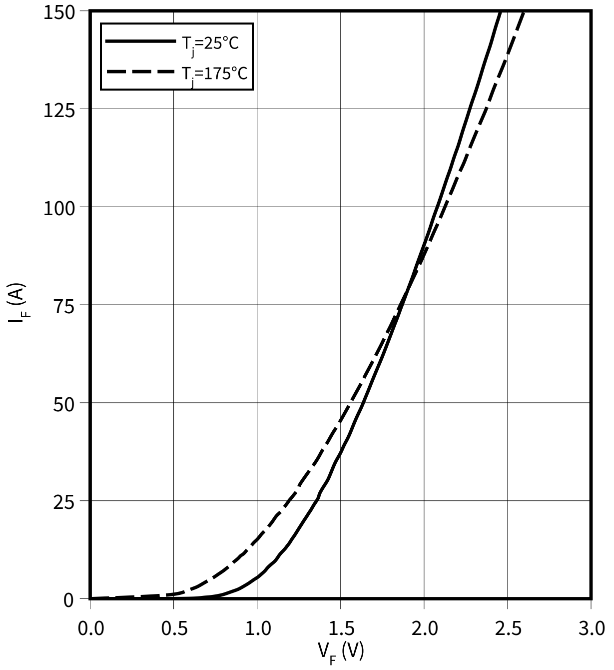


i	1	2	3	4
r_i[K/W]	0.156134	0.213584	0.262863	0.167418
τ_i[s]	1.16E-4	0.001262	0.012972	0.130073

4 Characteristics diagrams

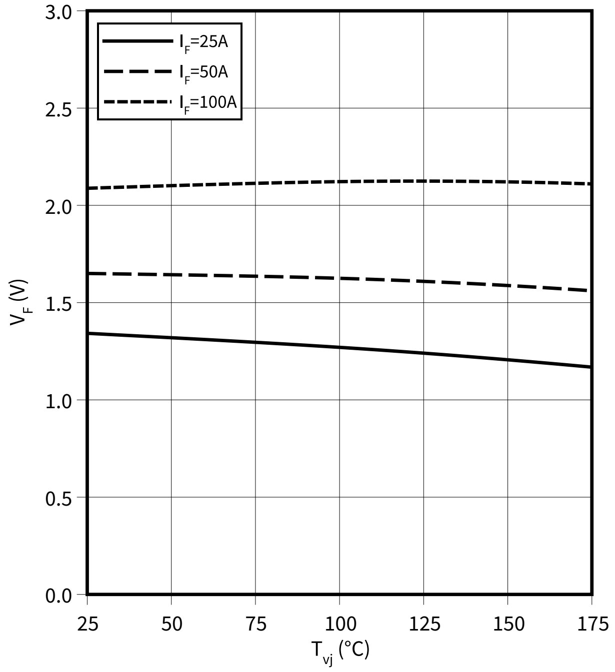
Typical diode forward current as a function of forward voltage, Diode

$I_F = f(V_F)$



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

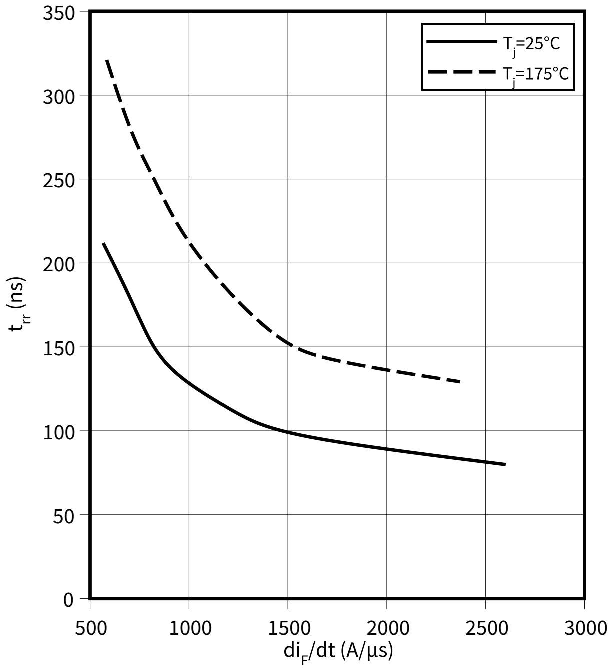
$V_F = f(T_{vj})$



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

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

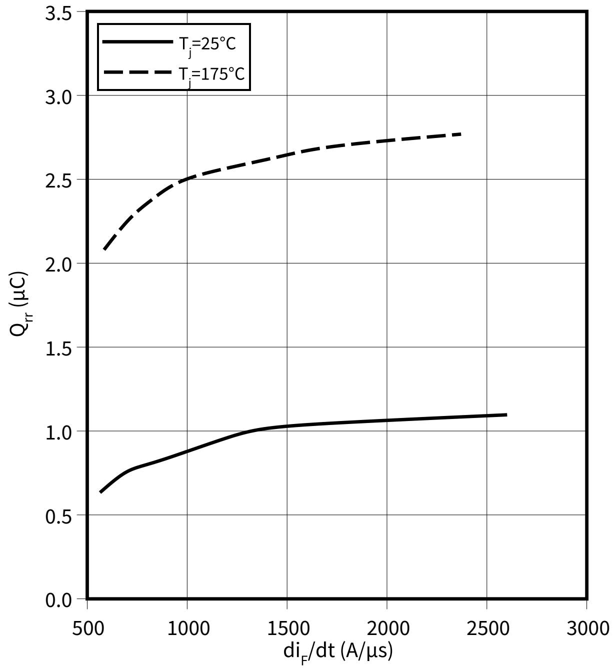
$V_R = 400$ V, $I_F = 50$ A

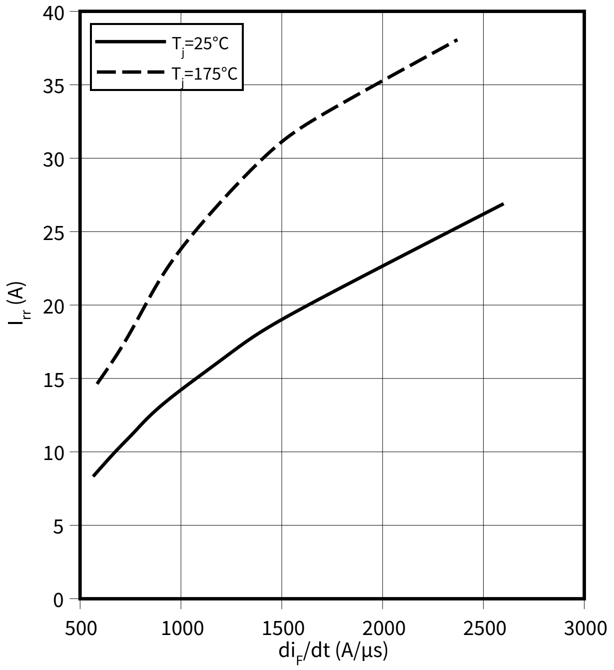
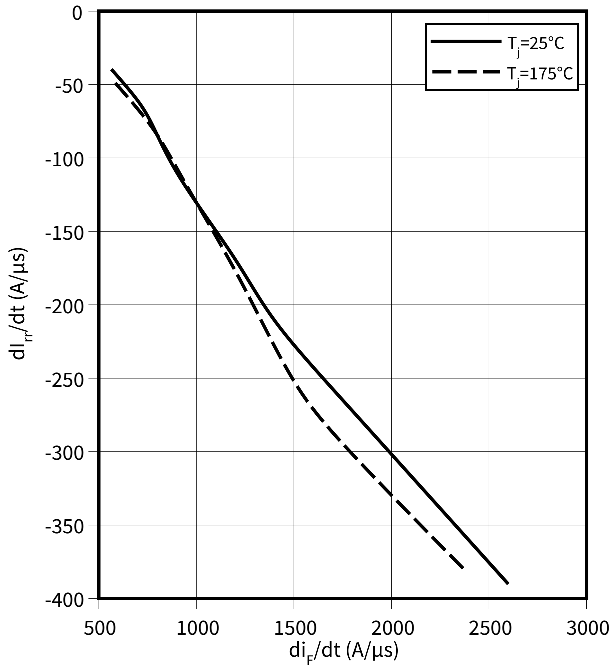


Typical reverse recovery charge as a function of diode current slope, Diode

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

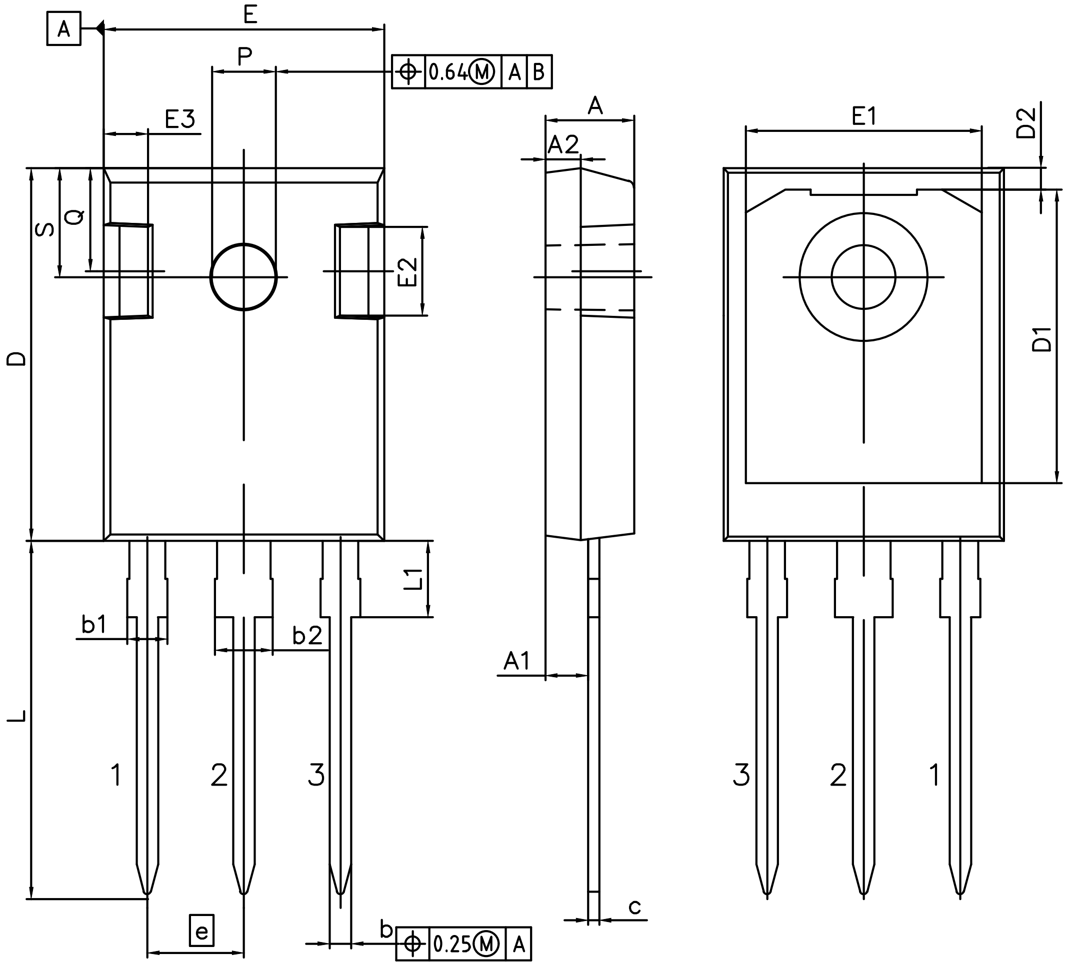
$V_R = 400$ V, $I_F = 50$ A



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

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

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Z8B00003327

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06

SCALE 3:1
0 1 2 3 4 5mm

EUROPEAN PROJECTION

ISSUE DATE
25.07.2018

Figure 6

6 Testing conditions

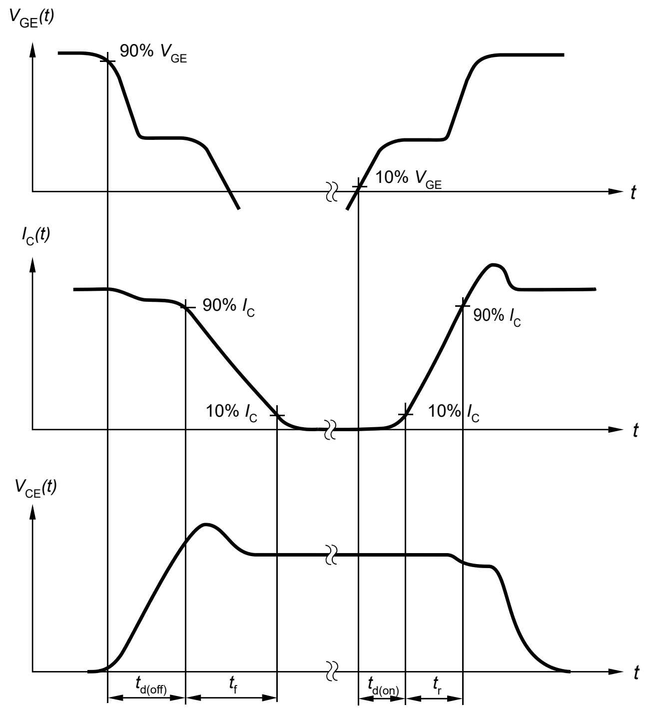

Figure A. **Definition of switching times**

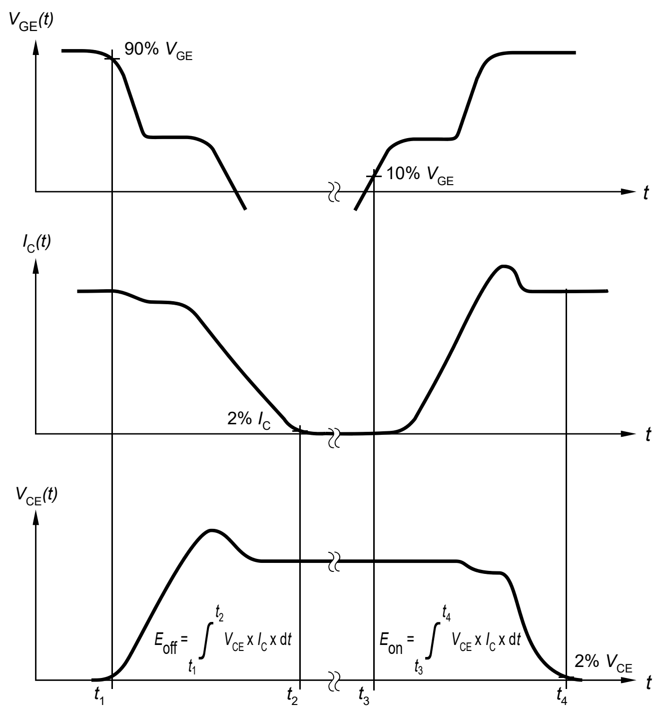

Figure B. **Definition of switching losses**

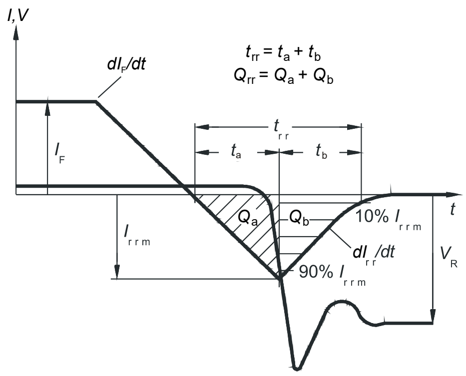

Figure C. **Definition of diode switching characteristics**

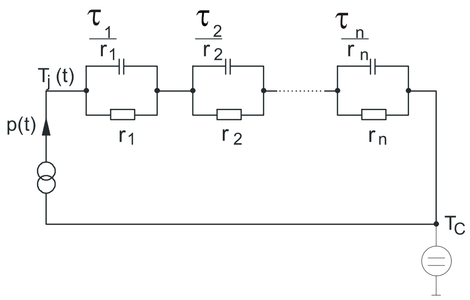

Figure D. **Thermal equivalent circuit**

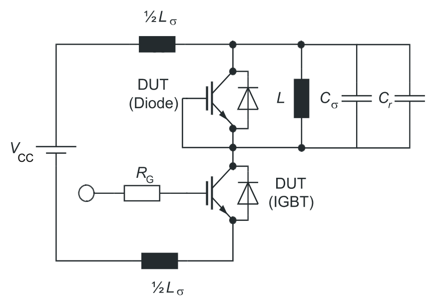

Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 7

Revision history

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

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