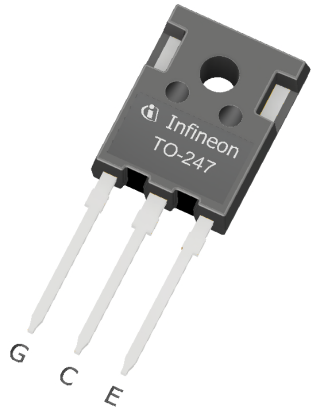
The TRENCHSTOP™ 5 WR6 family in the TO-247-3-HCC package offers improved reliability against package contamination

Features



- V_{CE} = 650 V
- I_C = 40 A
- Pin-to-pin creepage distance > 4.8 mm
- Pin-to-pin clearance distance > 3.4 mm
- Monolithic diode optimized for PFC and welding applications
- Stable temperature behavior
- Very low V_{CEsat} and low E_{off}
- Easy parallel switching capability based on positive temperature coefficient of V_{CEsat}
- Low temperature dependence of V_{CEsat} and E_{sw}
- Product spectrum and PSpice Models: http://www.infineon.com/igbt/

Potential applications

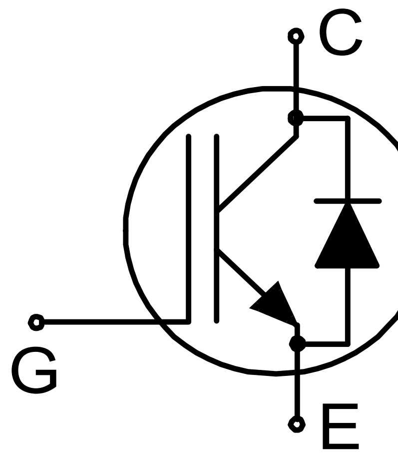
- PFC
- Welding
- ZCS applications

Product validation

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

Lead-Free
Green
Halogen-Free
RoHS

Description



Type	Package	Marking
IKWH40N65WR6	PG-TO247-3-HCC	H40EWR6

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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		$T_C = 25$ °C	75	A
			$T_C = 100$ °C	40	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}			120	A
Turn-off safe operating area		$V_{CE} \leq$ 650 V, $t_P \leq$ 1 μs, $T_{vj} \leq$ 175 °C		120	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq$ 10 μs, $D < 0.010$		±20	V
Power dissipation	P_{tot}		$T_C = 25$ °C	175	W
			$T_C = 100$ °C	78	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter breakdown voltage	V_{BRCES}	$I_C = 0.2$ mA, $V_{GE} = 0$ V		650			V
Collector-emitter saturation voltage	$V_{CE\,sat}$	$I_C = 40.0$ A, $V_{GE} = 15$ V	$T_{vj} = 25$ °C		1.55	1.85	V
			$T_{vj} = 175$ °C		1.80		

Table 3 Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Gate-emitter threshold voltage	V_{GEth}	I_C = 0.40 mA, $V_{CE} = V_{GE}$		3.20	4.00	4.80	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		0.5		mA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				100	nA
Transconductance	g_{fs}	I_C = 40.0 A, V_{CE} = 20 V			89.0		S
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			2890		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			28		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			11		pF
Gate charge	Q_G	I_C = 40.0 A, V_{GE} = 15 V, V_{CE} = 520 V			117		nC
Turn-on delay time	t_{don}	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 27.0 Ω, R_{Goff} = 27.0 Ω, L_σ = 30 nH, C_σ = 26 pF	T_{vj} = 25 °C, I_C = 40.0 A		37		ns
			T_{vj} = 175 °C, I_C = 40.0 A		34		
Rise time (inductive load)	t_r	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 27.0 Ω, R_{Goff} = 27.0 Ω, L_σ = 30 nH, C_σ = 26 pF	T_{vj} = 25 °C, I_C = 40.0 A		24		ns
			T_{vj} = 175 °C, I_C = 40.0 A		25		
Turn-off delay time	t_{doff}	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 27.0 Ω, R_{Goff} = 27.0 Ω, L_σ = 30 nH, C_σ = 26 pF	T_{vj} = 25 °C, I_C = 40.0 A		353		ns
			T_{vj} = 175 °C, I_C = 40.0 A		401		
Fall time (inductive load)	t_f	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 27.0 Ω, R_{Goff} = 27.0 Ω, L_σ = 30 nH, C_σ = 26 pF	T_{vj} = 25 °C, I_C = 40.0 A		23		ns
			T_{vj} = 175 °C, I_C = 40.0 A		18		
Turn-on energy	E_{on}	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 27.0 Ω, R_{Goff} = 27.0 Ω, L_σ = 30 nH, C_σ = 26 pF	T_{vj} = 25 °C, I_C = 40.0 A		1.09		mJ
			T_{vj} = 175 °C, I_C = 40.0 A		1.23		
Turn-off energy	E_{off}	V_{CE} = 400 V, V_{GE} = 15 V, R_{Gon} = 27.0 Ω, R_{Goff} = 27.0 Ω, L_σ = 30 nH, C_σ = 26 pF	T_{vj} = 25 °C, I_C = 40.0 A		0.57		mJ
			T_{vj} = 175 °C, I_C = 40.0 A		0.89		

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} = 27.0 Ω, R_{Goff} = 27.0 Ω, L_{σ} = 30 nH, C_{σ} = 26 pF	T_{vj} = 25 °C, I_C = 40.0 A		1.66		mJ
			T_{vj} = 175 °C, I_C = 40.0 A		2.12		
IGBT thermal resistance, junction-case	R_{thjc}					0.90	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		T_C = 25 °C	20	A
			T_C = 100 °C	11	
Diode pulsed current, limited by T_{vjmax}	I_{Fpuls}			40	A

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 10.0 A	T_{vj} = 25 °C		1.30	1.60	V
			T_{vj} = 175 °C		1.30		
Diode reverse recovery time	t_{rr}	V_R = 400 V	T_{vj} = 25 °C, I_F = 20.0 A, $-di_F/dt$ = 1460 A/µs		79		ns
			T_{vj} = 175 °C, I_F = 20.0 A, $-di_F/dt$ = 1350 A/µs		104		

Table 5 Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery charge	Q_{rr}	V_R = 400 V	T_{vj} = 25 °C, I_F = 20.0 A, $-di_F/dt$ = 1460 A/µs		1.40		µC
			T_{vj} = 175 °C, I_F = 20.0 A, $-di_F/dt$ = 1350 A/µs		2.50		
Diode peak reverse recovery current	I_{rrm}	V_R = 400 V	T_{vj} = 25 °C, I_F = 20.0 A, $-di_F/dt$ = 1460 A/µs		24.7		A
			T_{vj} = 175 °C, I_F = 20.0 A, $-di_F/dt$ = 1350 A/µs		38.3		
Diode peak rate off fall of reverse recovery current	dI_{rr}/dt	V_R = 400 V	T_{vj} = 25 °C, I_F = 20.0 A, $-di_F/dt$ = 1460 A/µs		-383		A/µs
			T_{vj} = 175 °C, I_F = 20.0 A, $-di_F/dt$ = 1350 A/µs		-821		
Diode thermal resistance, junction-case	R_{thjc}					4.20	K/W
Operating junction temperature	T_{vj}			-40		175	°C

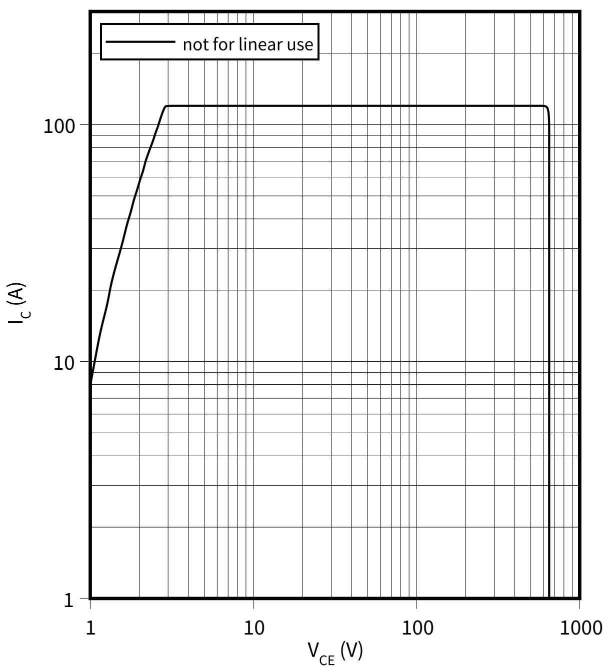
Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

4 Characteristics diagrams

Forward bias safe operating area, IGBT

$I_C = f(V_{CE})$

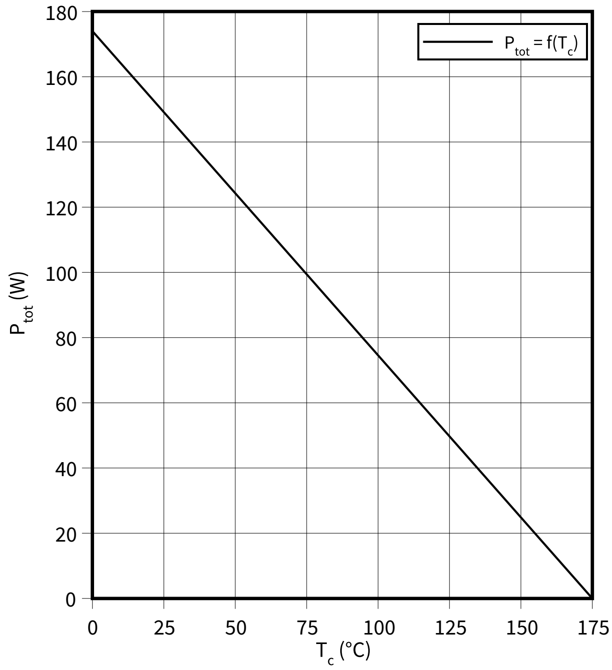
$t_p = 1\ \mu s$, $D = 0$, $T_{vj} \leq 175\ °C$, $T_C = 25\ °C$, $V_{GE} = 15\ V$



Power dissipation as a function of case temperature, IGBT

$P_{tot} = f(T_c)$

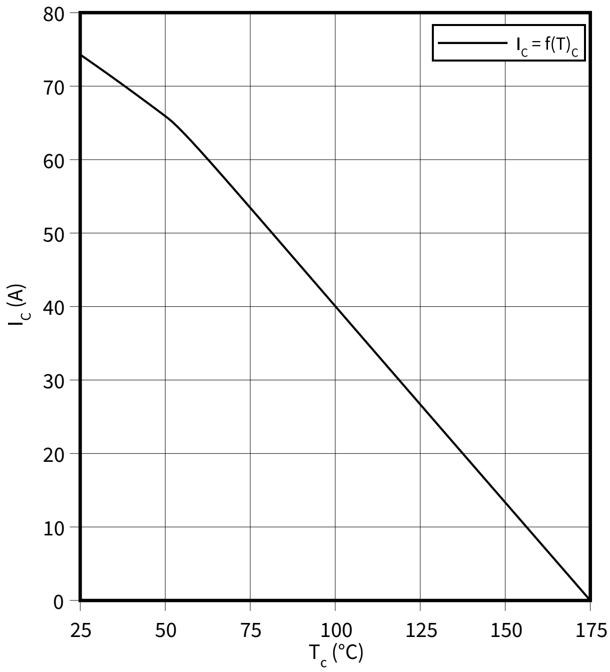
$T_{vj} \leq 175\ °C$



Collector current as a function of case temperature, IGBT

$I_C = f(T_c)$

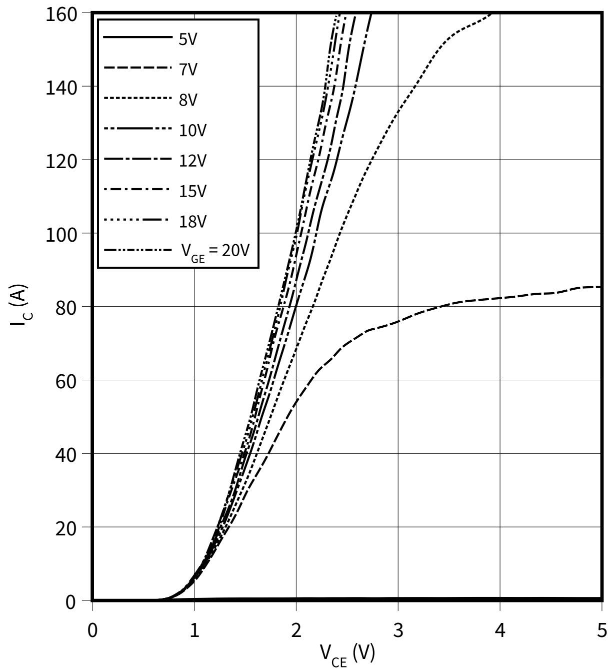
$T_{vj} \leq 175\ °C$, $V_{GE} \geq 15\ V$



Typical output characteristic, IGBT

$I_C = f(V_{CE})$

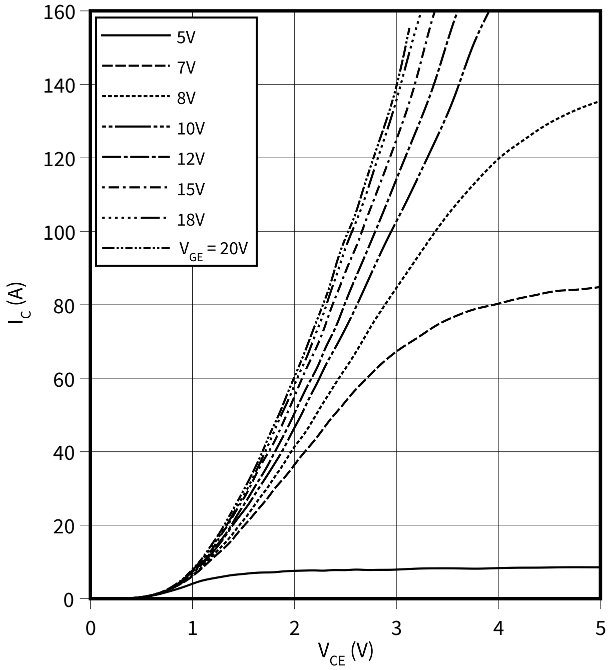
$T_{vj} = 25\ °C$



Typical output characteristic, IGBT

$I_C = f(V_{CE})$

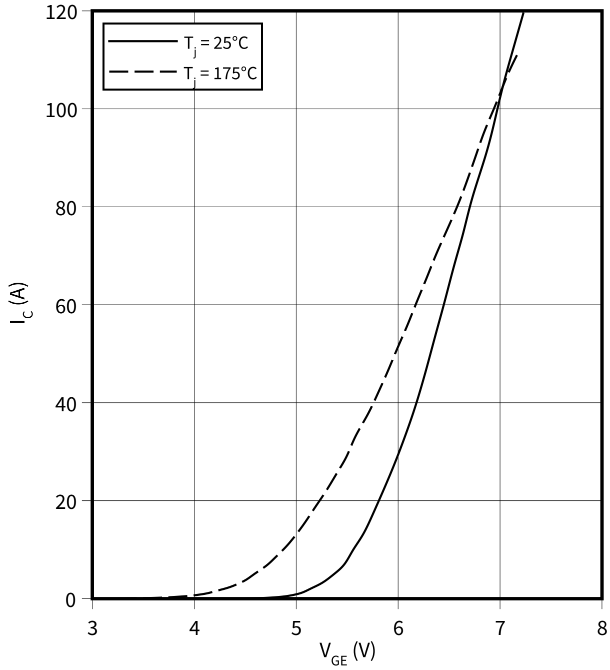
$T_{vj} = 175\ °C$



Typical transfer characteristic, IGBT

$I_C = f(V_{GE})$

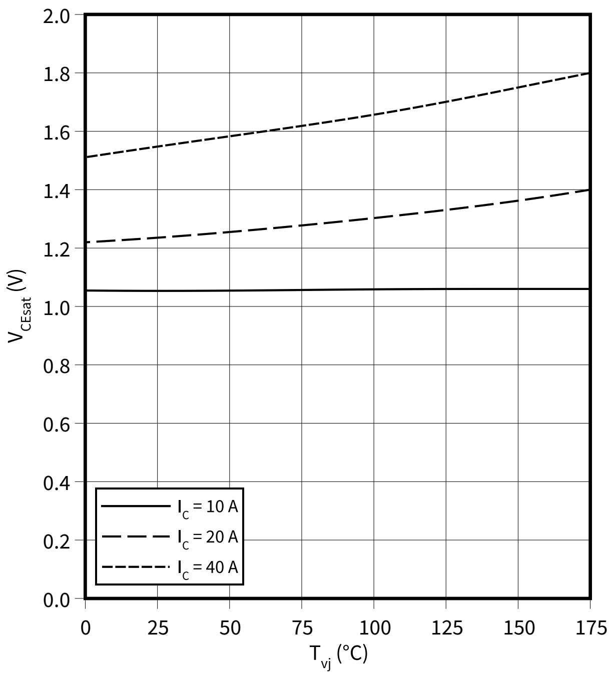
$V_{CE} = 20\ V$



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

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

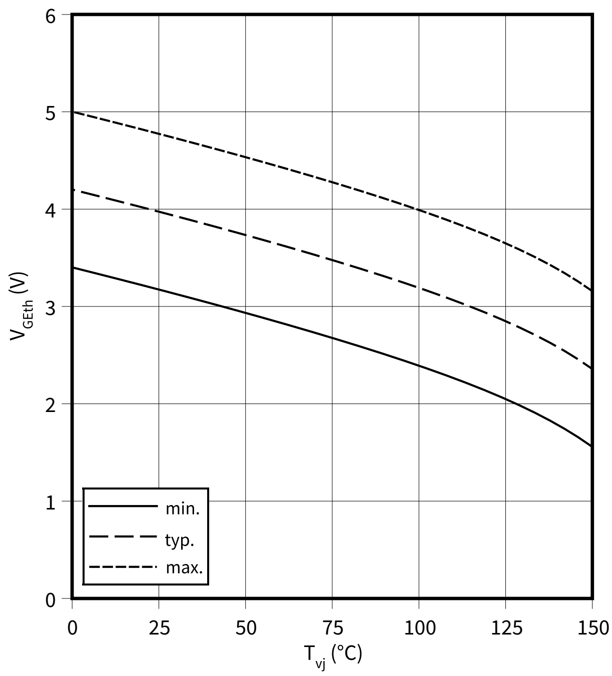
$V_{GE} = 15\ V$



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

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

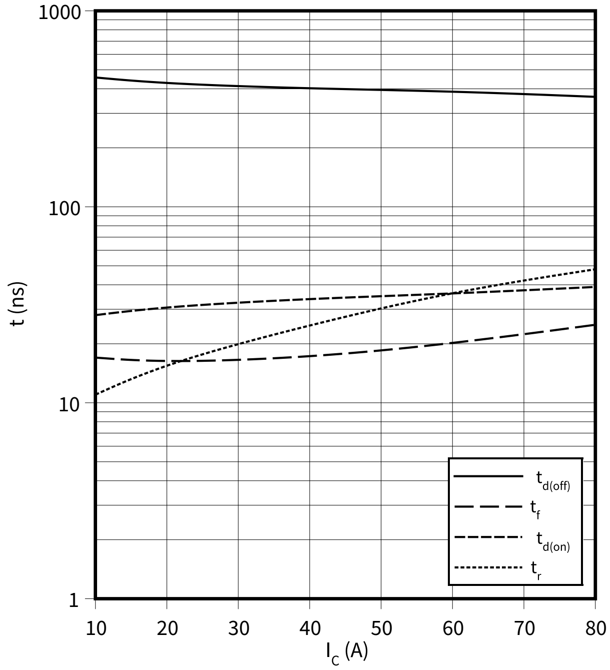
$I_C = 0.40\ mA$



Typical switching times as a function of collector current, IGBT

$t = f(I_C)$

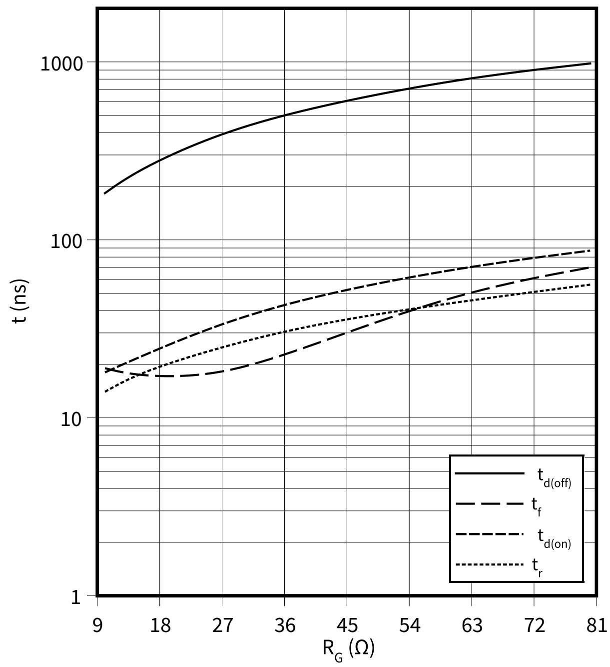
$V_{CE} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 27$ Ω



Typical switching times as a function of gate resistor, IGBT

$t = f(R_G)$

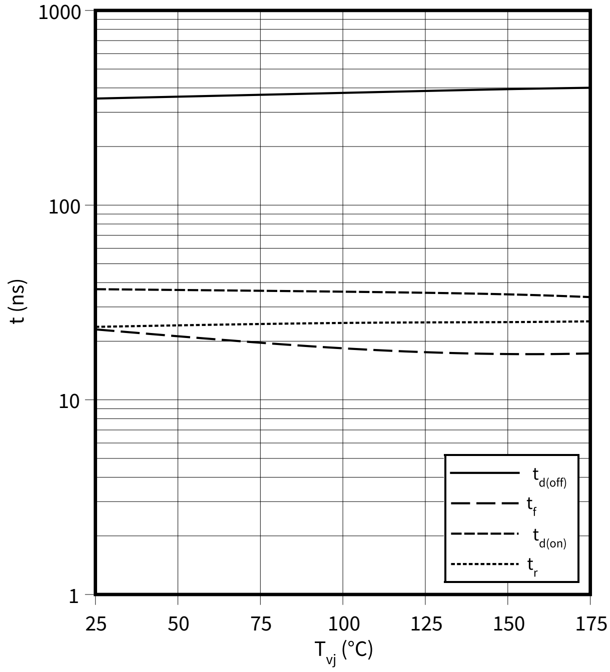
$I_C = 40.0$ A, $V_{CE} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching times as a function of junction temperature, IGBT

$t = f(T_{vj})$

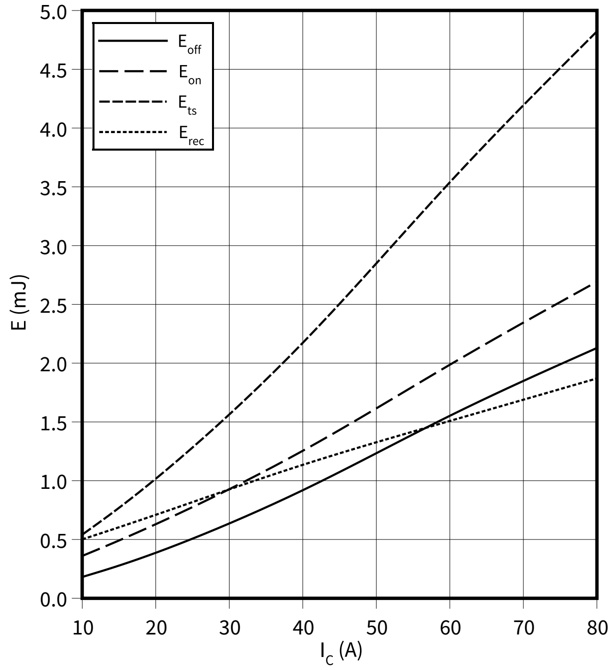
$I_C = 40.0$ A, $V_{CE} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 27$ Ω



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

$E = f(I_C)$

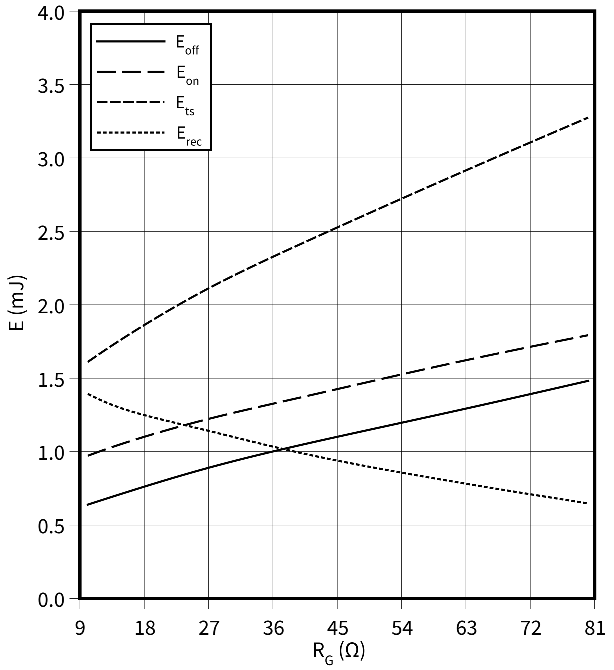
$V_{CE} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 27$ Ω



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

$E = f(R_G)$

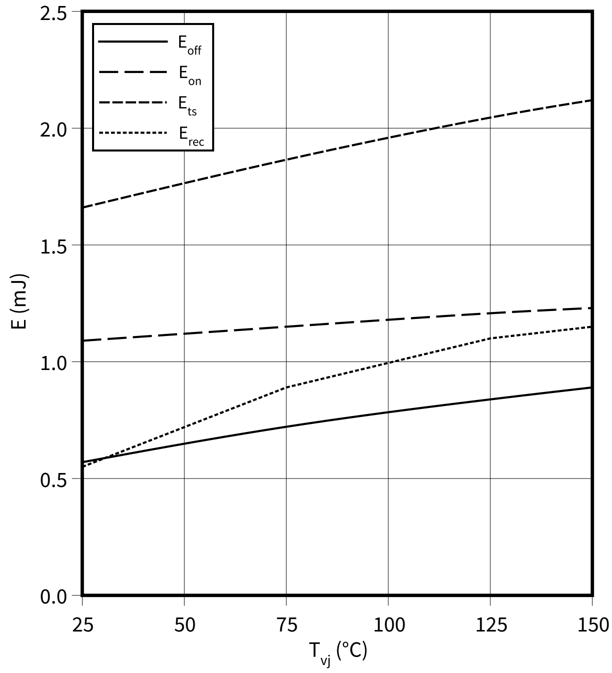
I_C = 40.0 A, V_{CE} = 400 V, T_{vj} = 175 °C, V_{GE} = 0/15 V



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

$E = f(T_{vj})$

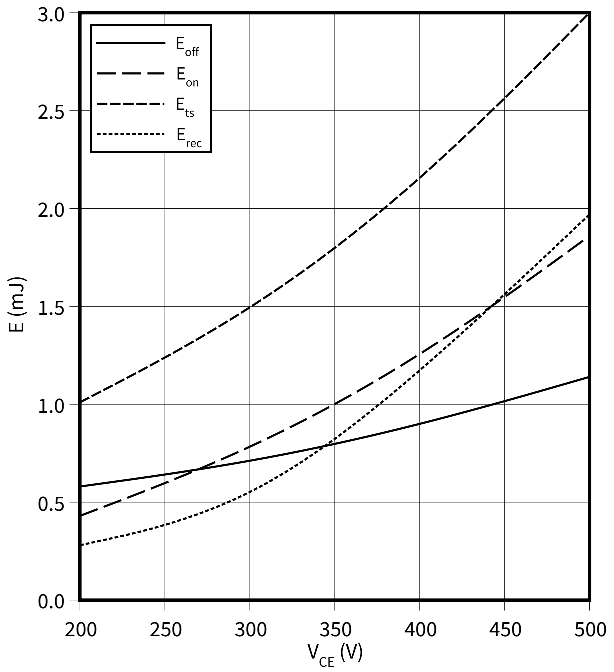
I_C = 40.0 A, V_{CE} = 400 V, V_{GE} = 0/15 V, R_G = 27 Ω



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

$E = f(V_{CE})$

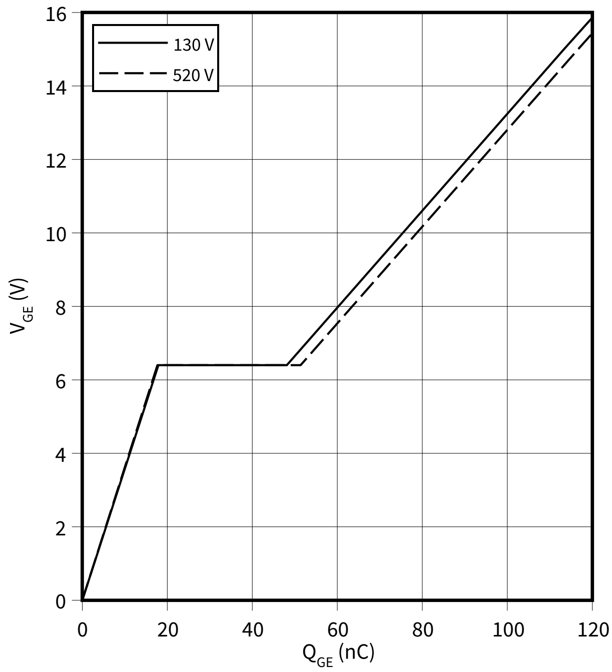
I_C = 40.0 A, T_{vj} = 175 °C, V_{GE} = 0/15 V, R_G = 27 Ω



Typical gate charge, IGBT

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

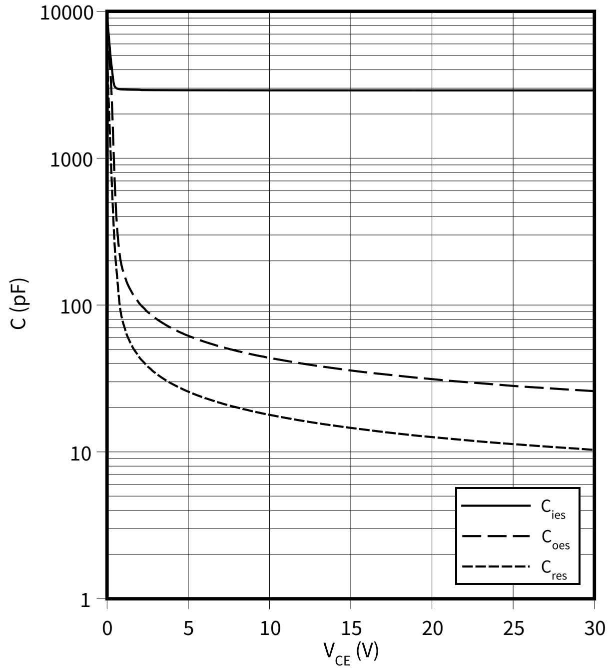
I_C = 40.0 A



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

$C = f(V_{CE})$

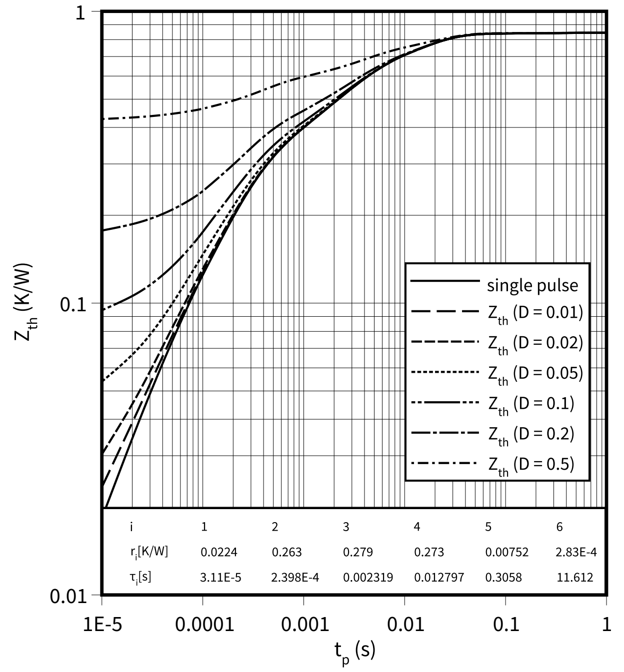
$f = 100$ kHz, $V_{GE} = 0$ V



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

$Z_{th} = f(t_p)$

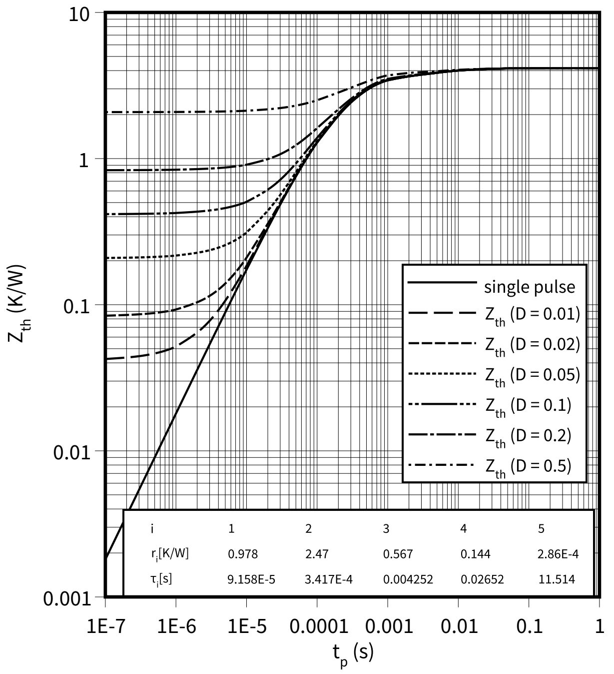
$D = t_p/T$



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

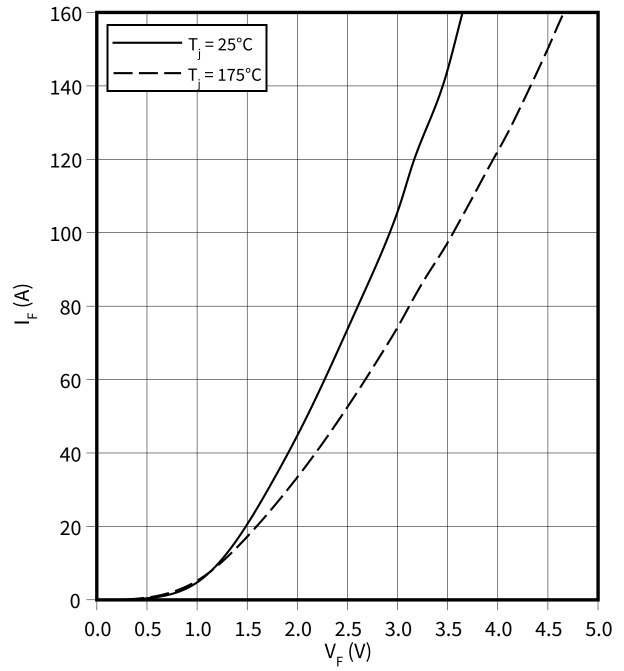
$Z_{th} = f(t_p)$

$D = t_p/T$



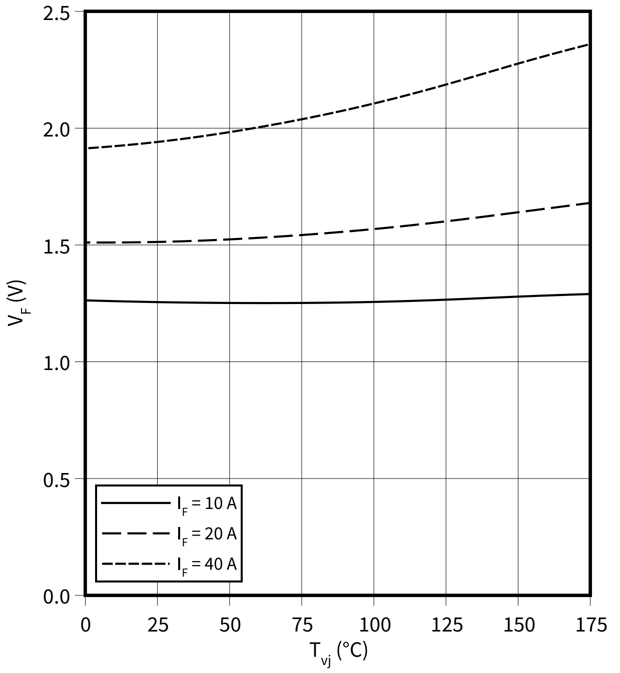
Typical diode forward current as a function of forward voltage, Diode

$I_F = f(V_F)$



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

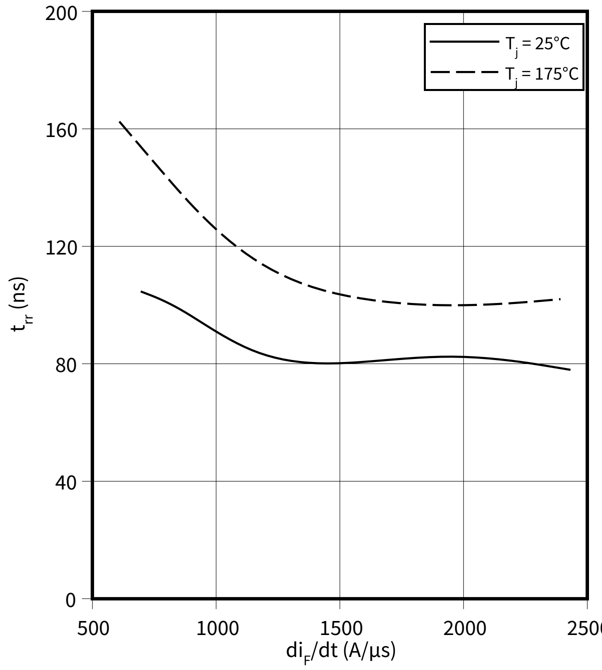
$V_F = f(T_{vj})$



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

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

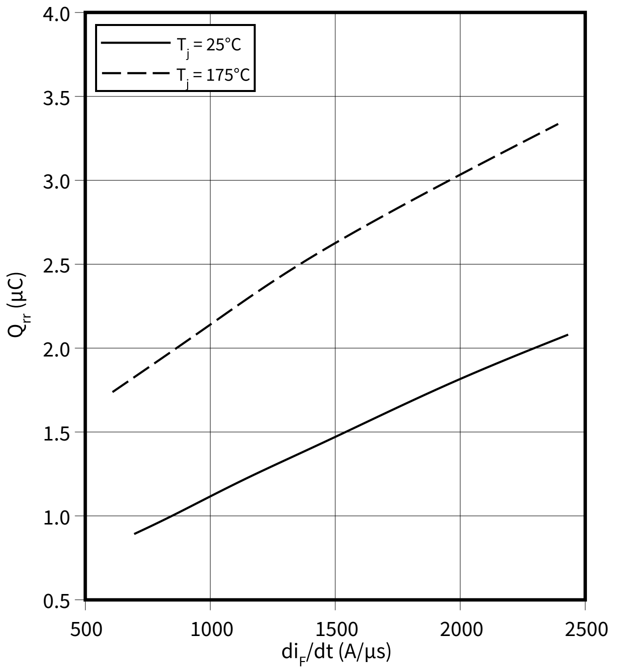
$V_R = 400$ V, $I_F = 20$ A



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

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

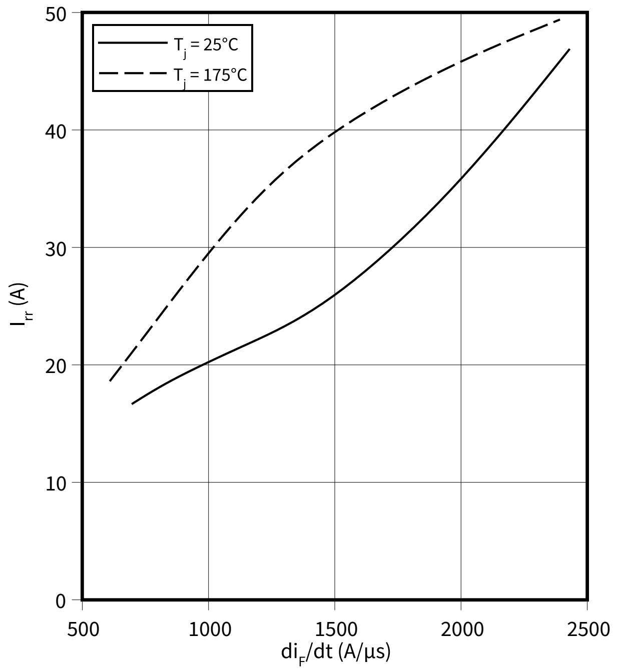
$V_R = 400$ V, $I_F = 20$ A



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

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

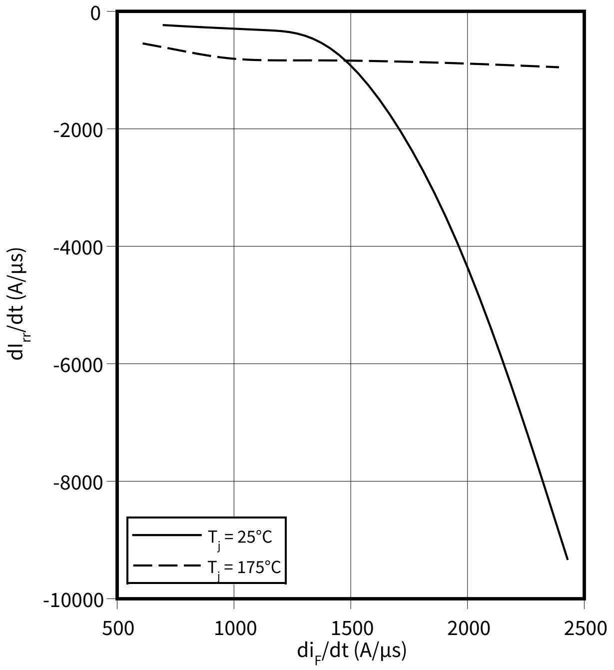
$V_R = 400$ V, $I_F = 20$ A



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

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

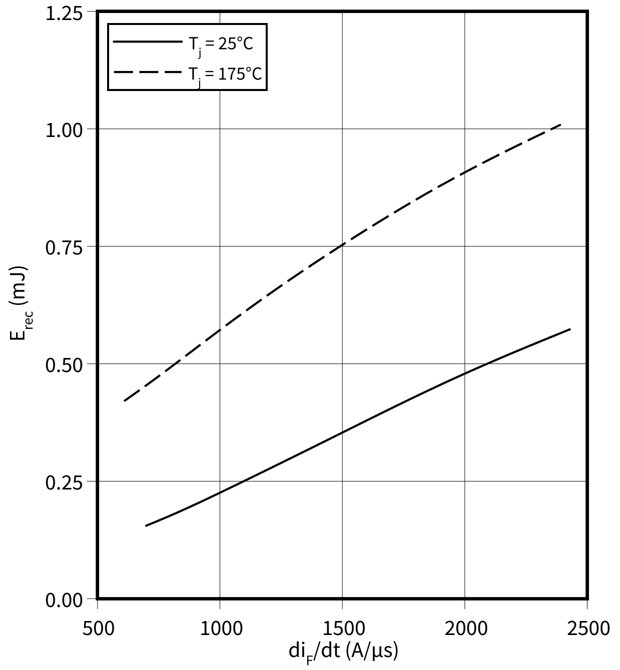
$V_R = 400$ V, $I_F = 20$ A



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

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

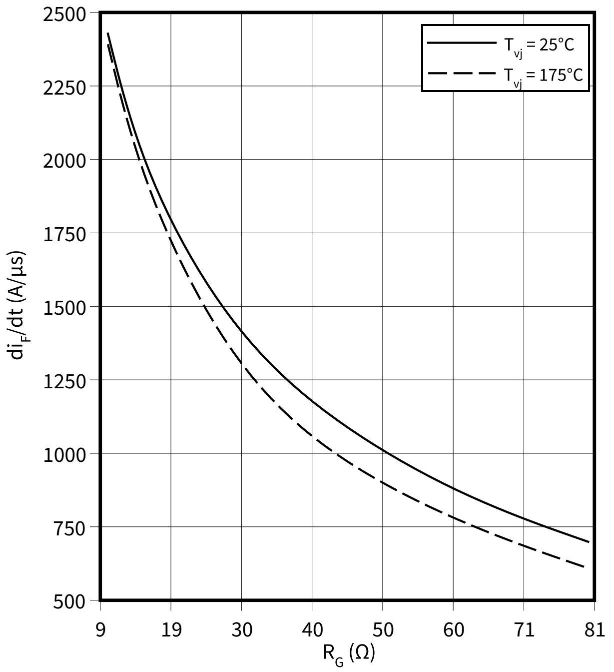
$V_R = 400$ V, $I_F = 20$ A



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

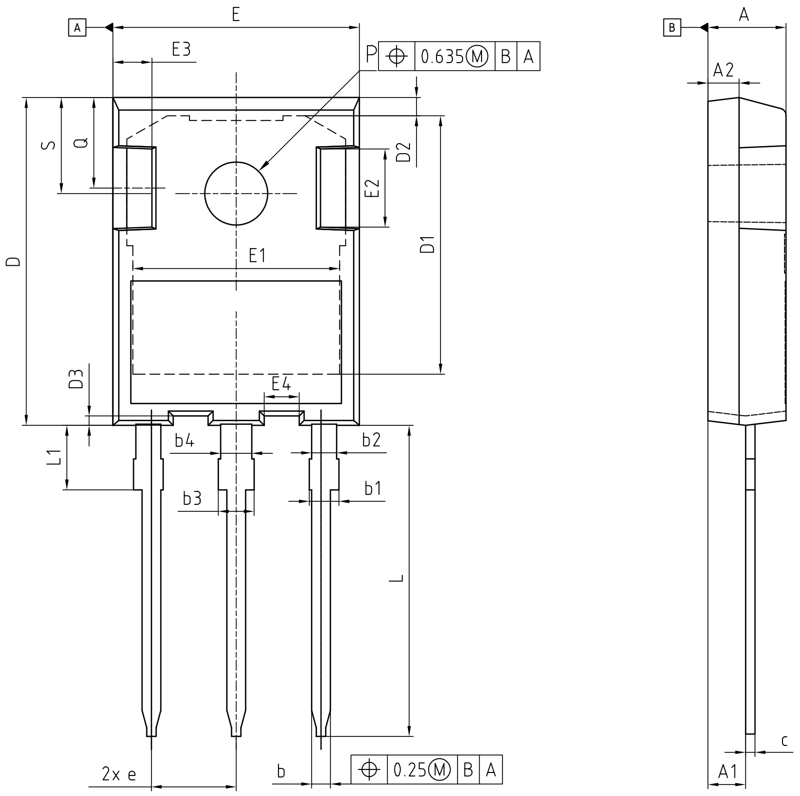
$di_F/dt = f(R_G)$

$V_R = 400$ V, $I_F = 20$ A



5 Package outlines

PG-TO247-3-HCC



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.48	2.02	0.058	0.080
b2	1.48	1.72	0.058	0.068
b3	1.84	2.42	0.072	0.095
b4	1.84	2.18	0.072	0.086
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.35	0.037	0.053
D3	0.55	0.65	0.022	0.026
E	15.70	16.13	0.618	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	2.60	0.039	0.102
E4	3.44	3.76	0.135	0.148
e	5.44 (BSC)		0.214 (BSC)	
L	19.80	20.32	0.780	0.800
L1	4.90	5.10	0.161	0.176
øP	2.40	2.60	0.138	0.146
Q	5.34	5.54	0.216	0.236
S	2.14	2.34	0.238	0.248
N	3		3	

DOCUMENT NO.
Z8B00205969

SCALE 3:1
0 1 2 3mm

EUROPEAN PROJECTION

ISSUE DATE
25.09.2020

REVISION
0

Figure 6

6 Testing conditions

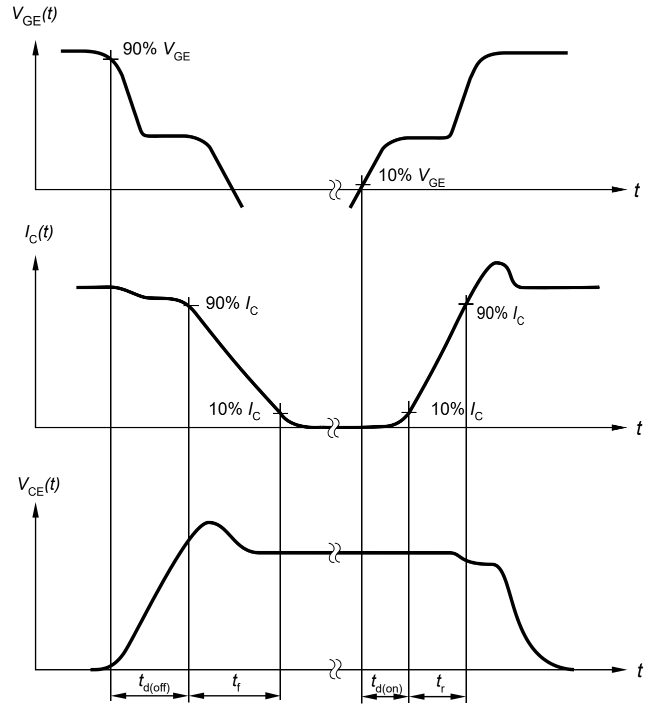


Figure A. **Definition of switching times**

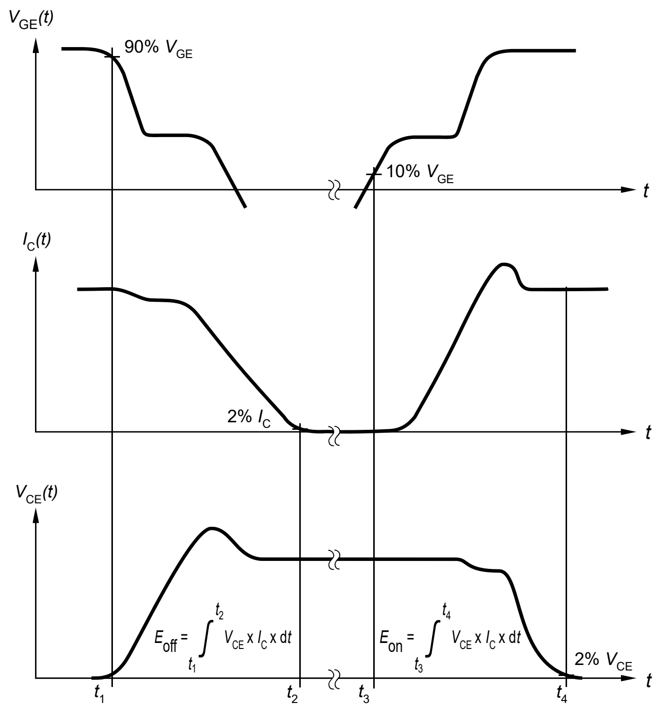


Figure B. **Definition of switching losses**

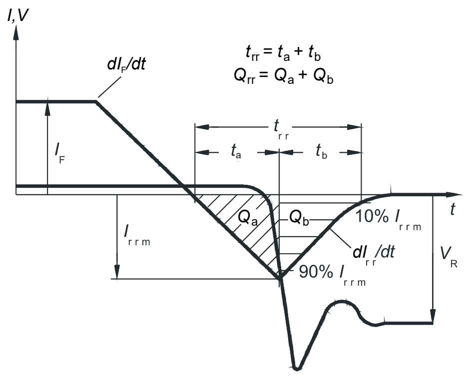


Figure C. **Definition of diode switching characteristics**

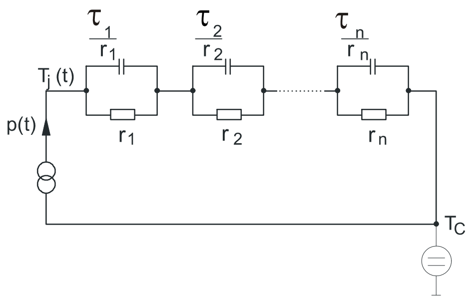


Figure D. **Thermal equivalent circuit**

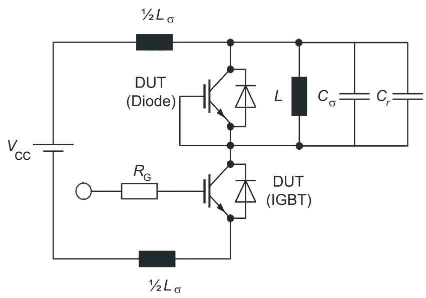


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Figure 7

Revision history

Document revision	Date of release	Description of changes
1.00	2021-05-17	Initial version
1.10	2021-05-18	Final datasheet

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Edition 2021-05-18

Published by

Infineon Technologies AG

81726 Munich, Germany

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Document reference
IFX-AAL382-004