

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

Features

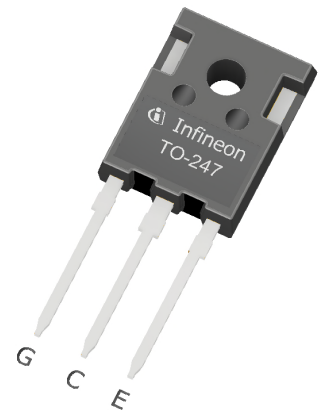
- $V_{CE} = 650\text{ V}$
- $I_C = 30\text{ A}$
- Pin-to-pin creepage distance > 4.8 mm
- Pin-to-pin clearance distance > 3.4 mm
- Monolithic diode optimized for PFC and welding applications
- Stable temperature behavior
- Very low V_{CEsat} and low E_{off}
- Easy parallel switching capability based 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

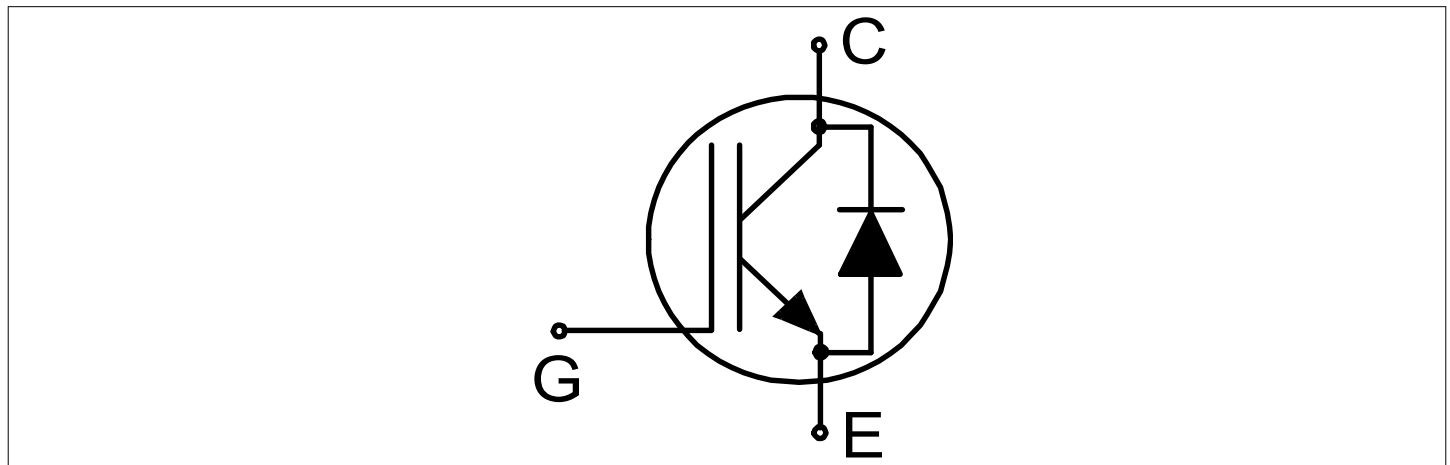
Product validation

- 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
IKWH30N65WR6	PG-TO247-3-HCC	H30EWR6

Table of contents

	Description	1
	Features	1
	Potential applications	1
	Product validation	1
	Table of contents	2
1	Package	3
2	IGBT	3
3	Diode	5
4	Characteristics diagrams	7
5	Package outlines	14
6	Testing conditions	15
	Revision history	16
	Disclaimer	17

1 Package

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}	$T_{vj} \geq 25\text{ °C}$	650	V	
DC collector current, limited by T_{vjmax}	I_C		$T_C = 25\text{ °C}$	60	A
			$T_C = 100\text{ °C}$	30	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}		90	A	
Turn-off safe operating area		$V_{CE} \leq 650\text{ V}$, $t_p \leq 1\text{ }\mu\text{s}$, $T_{vj} \leq 175\text{ °C}$	90	A	
Gate-emitter voltage	V_{GE}		± 20	V	
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10\text{ }\mu\text{s}$, $D < 0.010$	± 20	V	
Power dissipation	P_{tot}		$T_C = 25\text{ °C}$	165	W
			$T_C = 100\text{ °C}$	83	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter breakdown voltage	V_{BRces}	$I_C = 0.2\text{ mA}$, $V_{GE} = 0\text{ V}$	650			V
Collector-emitter saturation voltage	$V_{CE\text{ sat}}$	$I_C = 30.0\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	1.45	1.75	V
			$T_{vj} = 175\text{ °C}$	1.70		

Table 3 Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Gate-emitter threshold voltage	V_{GEth}	$I_C = 0.30 \text{ mA}, V_{CE} = V_{GE}$	3.20	4.00	4.80	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 650 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		40	μA
			$T_{vj} = 175 \text{ }^\circ\text{C}$		0.5	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}$			100	nA
Transconductance	g_{fs}	$I_C = 30.0 \text{ A}, V_{CE} = 20 \text{ V}$		75.0		S
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		2700		pF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		27		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		11		pF
Gate charge	Q_G	$I_C = 30.0 \text{ A}, V_{GE} = 15 \text{ V}, V_{CE} = 520 \text{ V}$		111		nC
Turn-on delay time	t_{don}	$V_{CE} = 400 \text{ V}, V_{GE} = 15 \text{ V},$ $R_{Gon} = 27.0 \text{ } \Omega,$ $R_{Goff} = 27.0 \text{ } \Omega,$ $L_\sigma = 30 \text{ nH}, C_\sigma = 23 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 30.0 \text{ A}$		35	ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 30.0 \text{ A}$		31	
Rise time (inductive load)	t_r	$V_{CE} = 400 \text{ V}, V_{GE} = 15 \text{ V},$ $R_{Gon} = 27.0 \text{ } \Omega,$ $R_{Goff} = 27.0 \text{ } \Omega,$ $L_\sigma = 30 \text{ nH}, C_\sigma = 23 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 30.0 \text{ A}$		18	ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 30.0 \text{ A}$		20	
Turn-off delay time	t_{doff}	$V_{CE} = 400 \text{ V}, V_{GE} = 15 \text{ V},$ $R_{Gon} = 27.0 \text{ } \Omega,$ $R_{Goff} = 27.0 \text{ } \Omega,$ $L_\sigma = 30 \text{ nH}, C_\sigma = 23 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 30.0 \text{ A}$		334	ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 30.0 \text{ A}$		375	
Fall time (inductive load)	t_f	$V_{CE} = 400 \text{ V}, V_{GE} = 15 \text{ V},$ $R_{Gon} = 27.0 \text{ } \Omega,$ $R_{Goff} = 27.0 \text{ } \Omega,$ $L_\sigma = 30 \text{ nH}, C_\sigma = 23 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 30.0 \text{ A}$		16	ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 30.0 \text{ A}$		16	
Turn-on energy	E_{on}	$V_{CE} = 400 \text{ V}, V_{GE} = 15 \text{ V},$ $R_{Gon} = 27.0 \text{ } \Omega,$ $R_{Goff} = 27.0 \text{ } \Omega,$ $L_\sigma = 30 \text{ nH}, C_\sigma = 23 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 30.0 \text{ A}$		0.82	mJ
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 30.0 \text{ A}$		0.92	
Turn-off energy	E_{off}	$V_{CE} = 400 \text{ V}, V_{GE} = 15 \text{ V},$ $R_{Gon} = 27.0 \text{ } \Omega,$ $R_{Goff} = 27.0 \text{ } \Omega,$ $L_\sigma = 30 \text{ nH}, C_\sigma = 23 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 30.0 \text{ A}$		0.38	mJ
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 30.0 \text{ A}$		0.63	

Table 3 Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy	E_{ts}	$V_{CE} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $R_{Gon} = 27.0\ \Omega$, $R_{Goff} = 27.0\ \Omega$, $L_{\sigma} = 30\text{ nH}$, $C_{\sigma} = 23\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_C = 30.0\text{ A}$	1.20		mJ
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_C = 30.0\text{ A}$	1.55		
IGBT thermal resistance, junction-case	R_{thjc}				0.90	K/W
Operating junction temperature	T_{vj}		-40		175	$^{\circ}\text{C}$

Note: Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified.

3 Diode

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	V_{RRM}	$T_{vj} \geq 25\text{ }^{\circ}\text{C}$	650	V	
Diode forward current, limited by T_{vjmax}	I_F		$T_C = 25\text{ }^{\circ}\text{C}$	20	A
			$T_C = 100\text{ }^{\circ}\text{C}$	11	
Diode pulsed current, limited by T_{vjmax}	I_{Fpuls}		30	A	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 10.0\text{ A}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$	1.30	1.60	V
			$T_{vj} = 175\text{ }^{\circ}\text{C}$	1.35		
Diode reverse recovery time	t_{rr}	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_F = 15.0\text{ A}$, $-di_F/dt = 1460\text{ A}/\mu\text{s}$	82		ns
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_F = 15.0\text{ A}$, $-di_F/dt = 1400\text{ A}/\mu\text{s}$	94		

Table 5 Characteristic values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery charge	Q_{rr}	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ °C},$ $I_F = 15.0\text{ A},$ $-di_F/dt = 1460\text{ A}/\mu\text{s}$		1.40		μC
					2.20		
Diode peak reverse recovery current	I_{rrm}	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ °C},$ $I_F = 15.0\text{ A},$ $-di_F/dt = 1460\text{ A}/\mu\text{s}$		24.0		A
					28.8		
Diode peak rate off fall of reverse recovery current	di_{rr}/dt	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ °C},$ $I_F = 15.0\text{ A},$ $-di_F/dt = 1460\text{ A}/\mu\text{s}$		-700		$\text{A}/\mu\text{s}$
					-830		
Diode thermal resistance, junction-case	R_{thjc}					4.20	K/W
Operating junction temperature	T_{vj}			-40		175	$^{\circ}\text{C}$

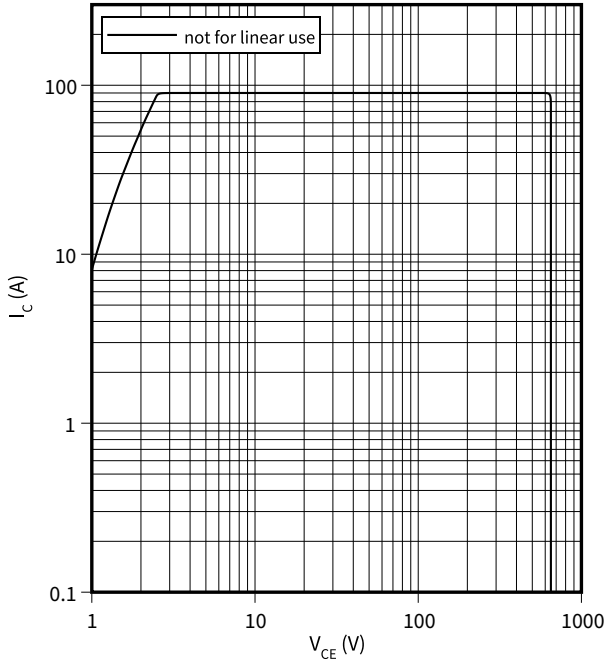
Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

4 Characteristics diagrams

Forward bias safe operating area, IGBT

$$I_C = f(V_{CE})$$

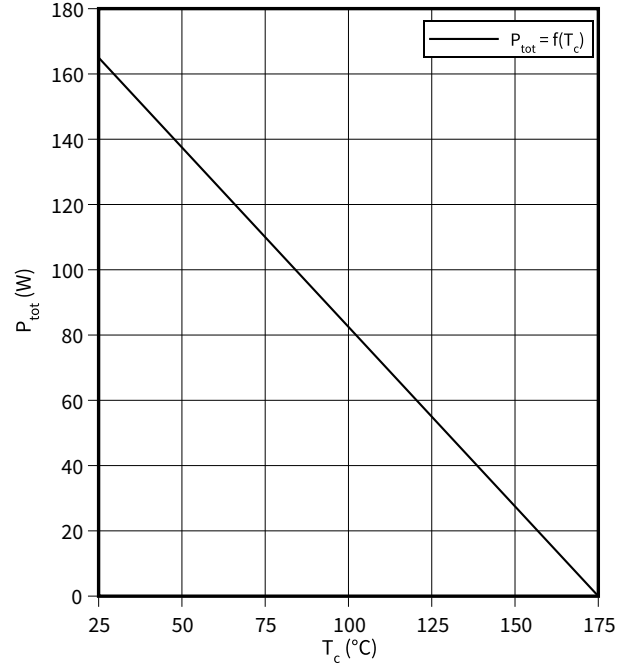
$t_p = 1 \mu s, D = 0, T_{vj} \leq 175^\circ C, T_C = 25^\circ C, V_{GE} = 15 V$



Power dissipation as a function of case temperature, IGBT

$$P_{tot} = f(T_c)$$

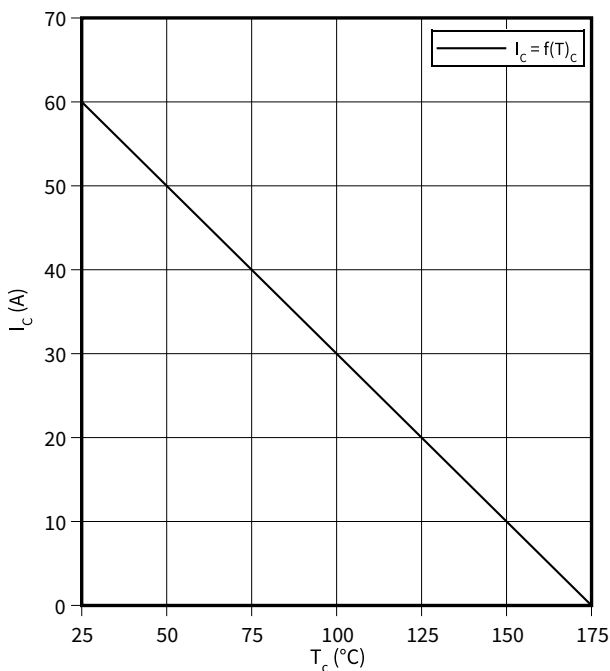
$T_{vj} \leq 175^\circ C$



Collector current as a function of case temperature, IGBT

$$I_C = f(T_c)$$

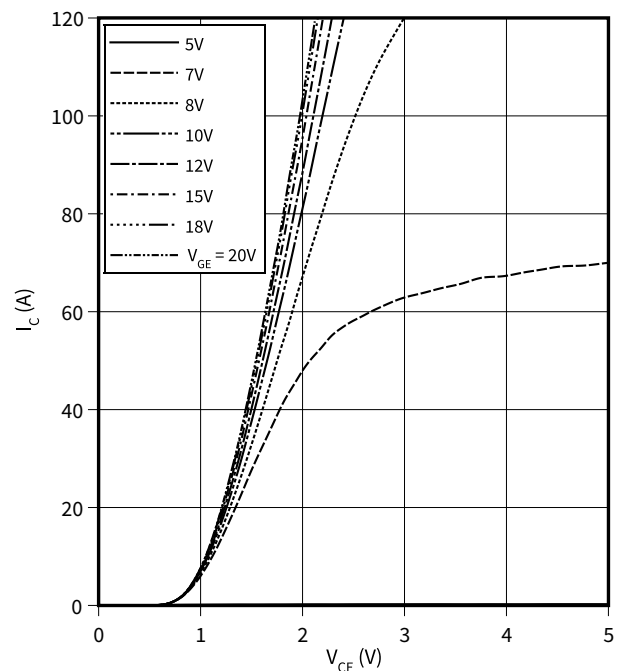
$T_{vj} \leq 175^\circ C, V_{GE} \geq 15 V$



Typical output characteristic, IGBT

$$I_C = f(V_{CE})$$

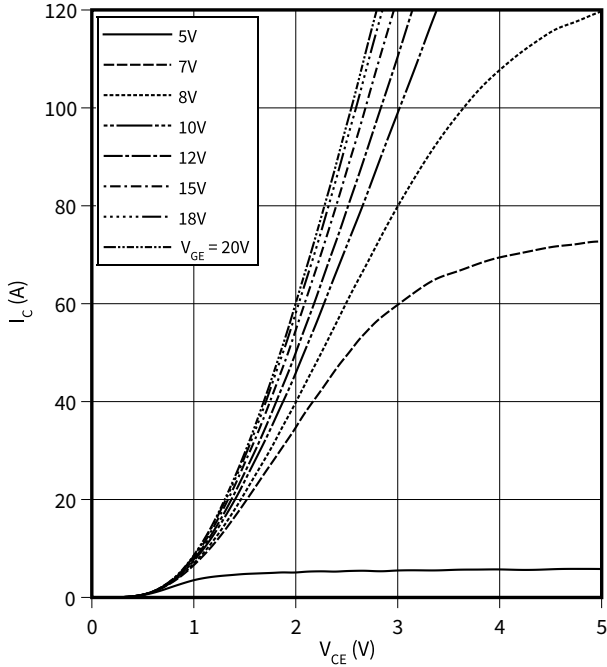
$T_{vj} = 25^\circ C$



4 Characteristics diagrams

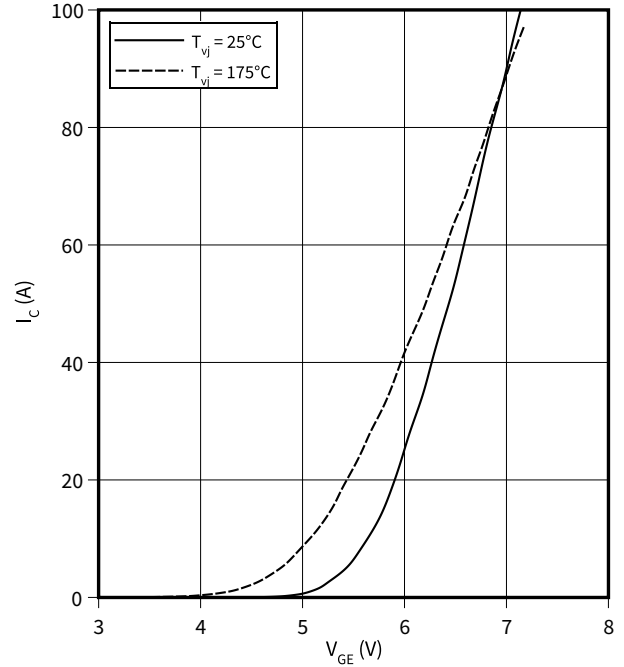
Typical output characteristic, IGBT

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



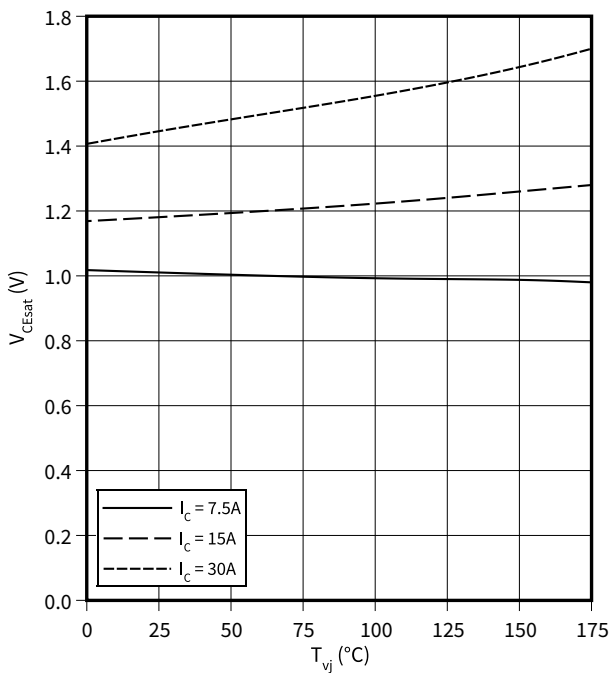
Typical transfer characteristic, IGBT

$I_C = f(V_{GE})$
 $V_{CE} = 20\text{ V}$



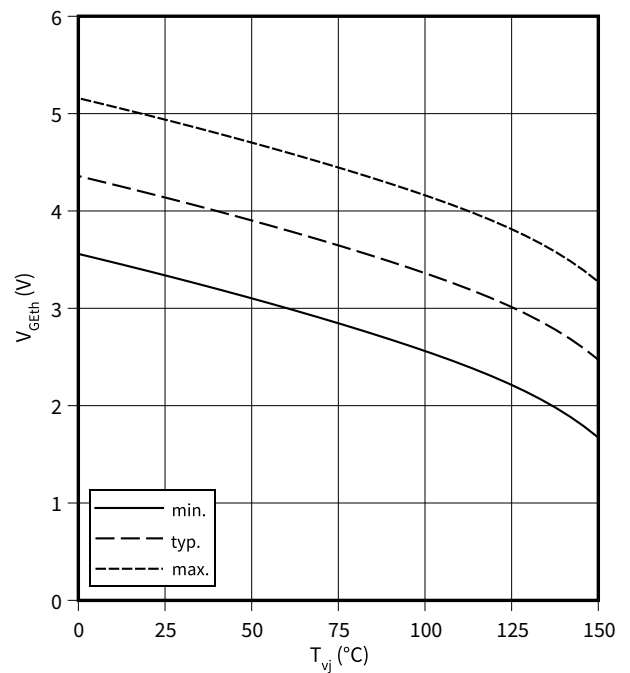
Typical collector-emitter saturation voltage as a function of junction temperature, IGBT

$V_{CEsat} = f(T_{vj})$
 $V_{GE} = 15\text{ V}$



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

$V_{GEth} = f(T_{vj})$
 $I_C = 0.30\text{ mA}$

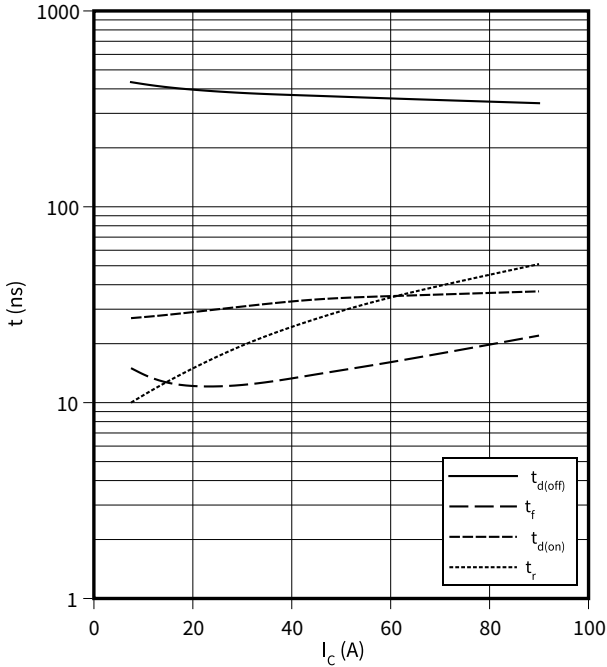


4 Characteristics diagrams

Typical switching times as a function of collector current, IGBT

$t = f(I_C)$

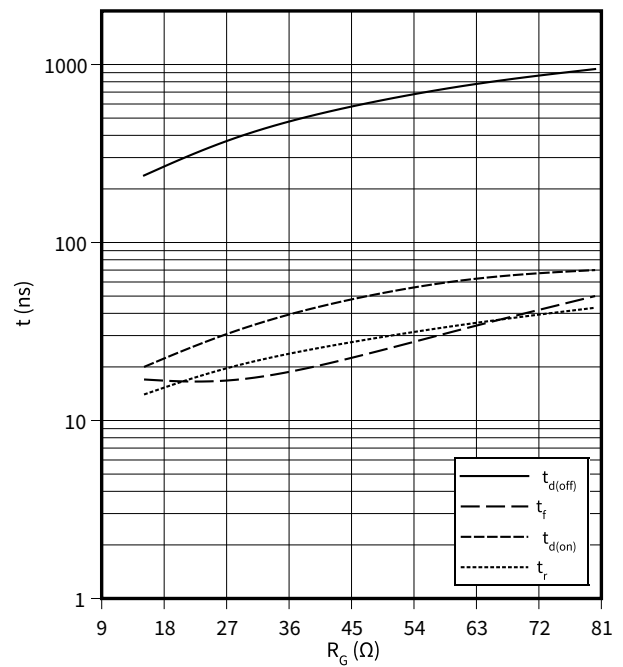
$V_{CE} = 400 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 27 \text{ } \Omega$



Typical switching times as a function of gate resistor, IGBT

$t = f(R_G)$

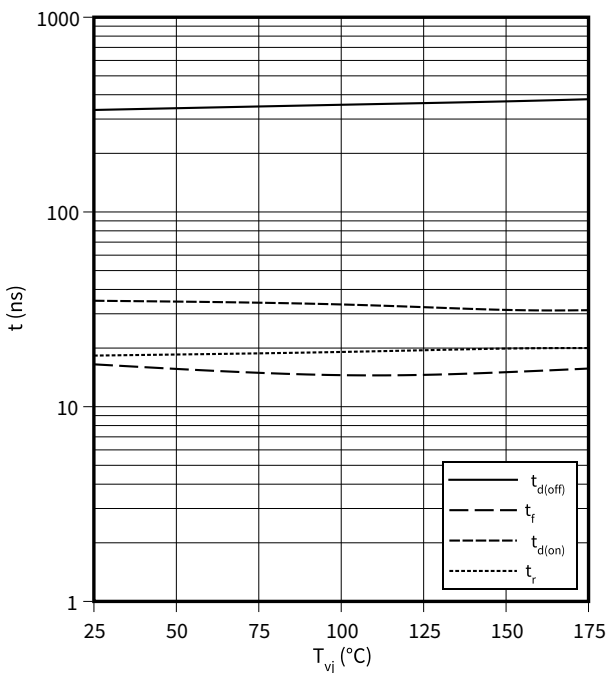
$I_C = 30.0 \text{ A}, V_{CE} \leq 650 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}$



Typical switching times as a function of junction temperature, IGBT

$t = f(T_{vj})$

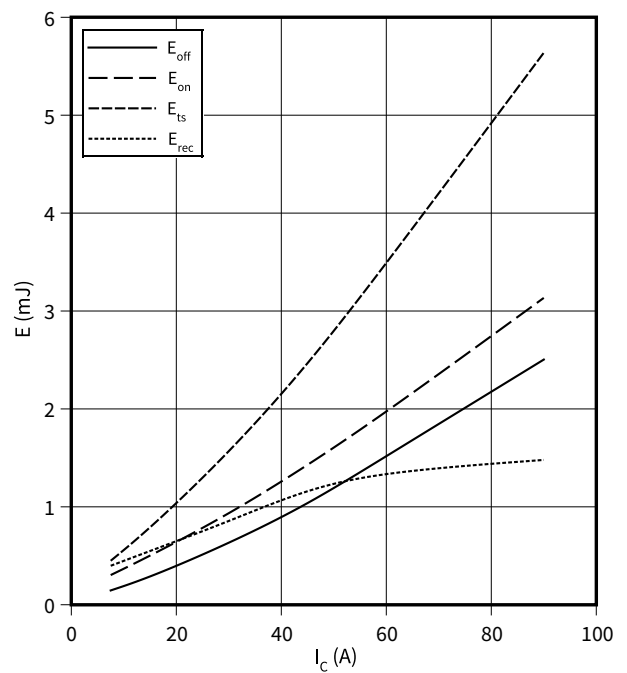
$I_C = 30.0 \text{ A}, V_{CE} \leq 650 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 27 \text{ } \Omega$



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

$E = f(I_C)$

$V_{CE} \leq 650 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 27 \text{ } \Omega$

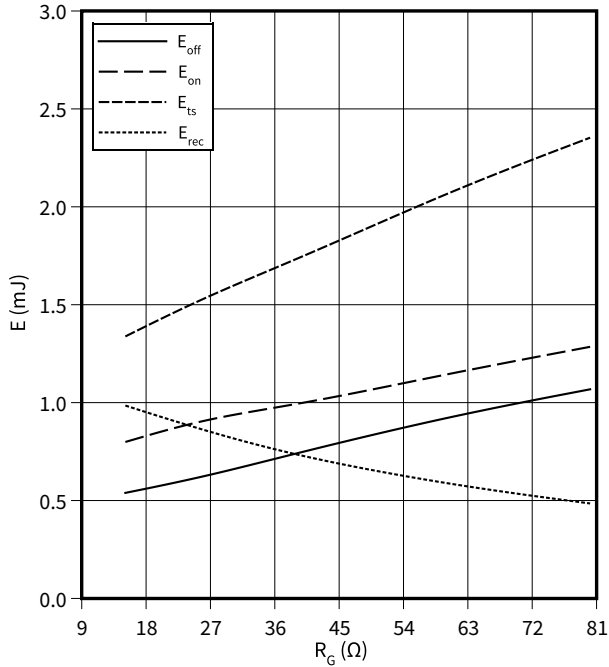


4 Characteristics diagrams

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

$E = f(R_G)$

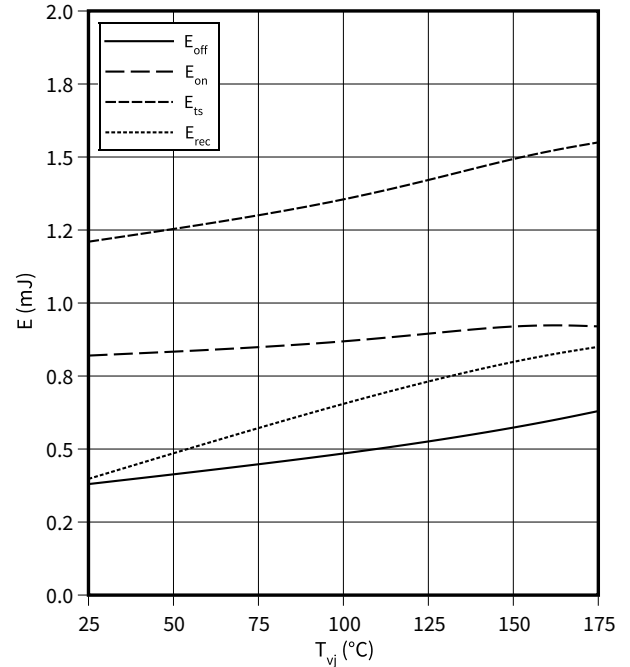
$I_C = 30.0 \text{ A}$, $V_{CE} \leq 650 \text{ V}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$



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

$E = f(T_{vj})$

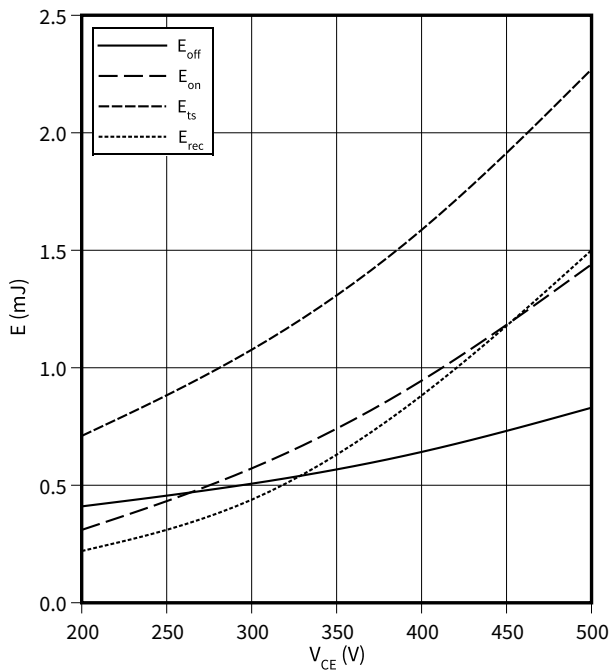
$I_C = 30.0 \text{ A}$, $V_{CE} \leq 650 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 27 \text{ } \Omega$



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

$E = f(V_{CE})$

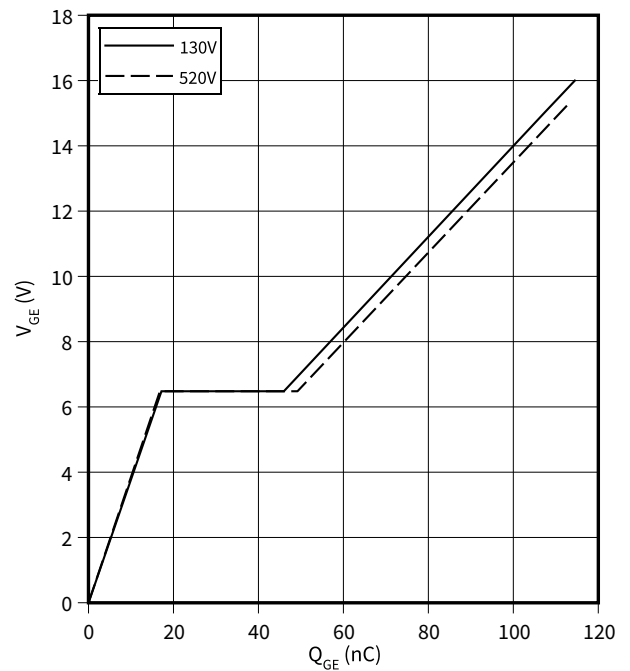
$I_C = 30.0 \text{ A}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 27 \text{ } \Omega$



Typical gate charge, IGBT

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

$I_C = 30.0 \text{ A}$

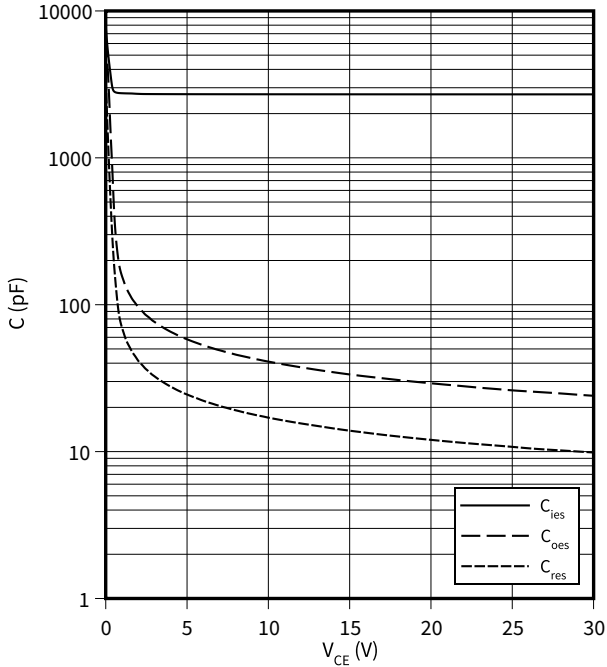


4 Characteristics diagrams

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

$C = f(V_{CE})$

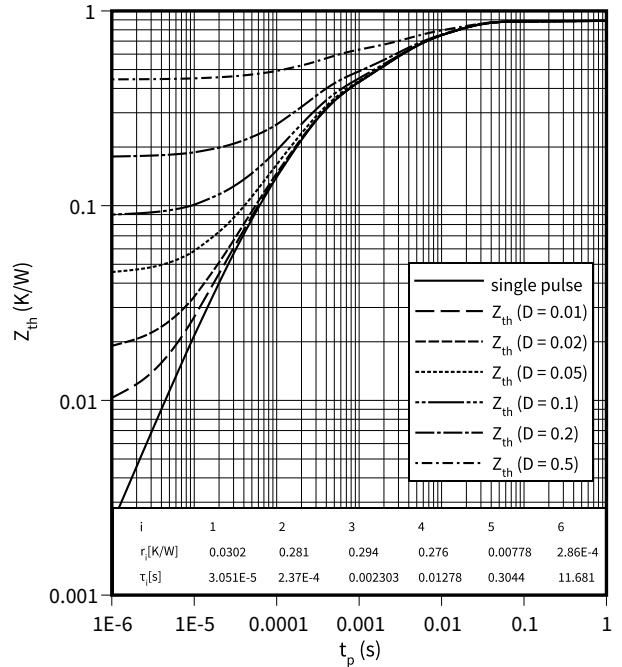
$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}$



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

$Z_{th} = f(t_p)$

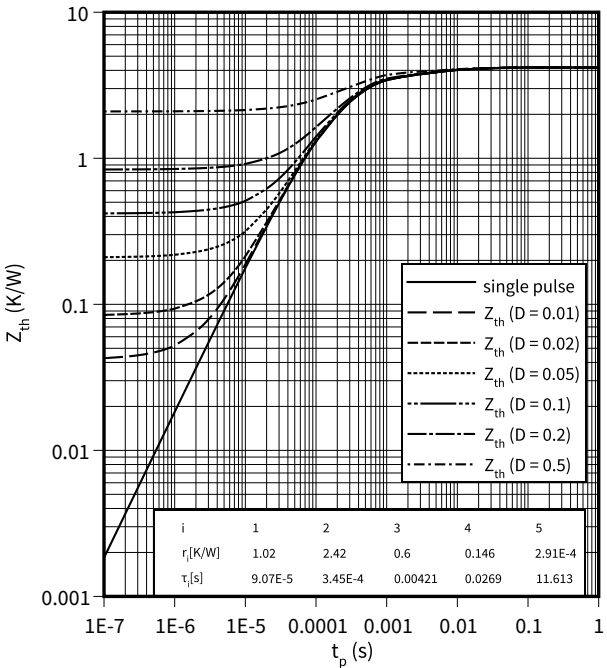
$D = t_p/T$



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

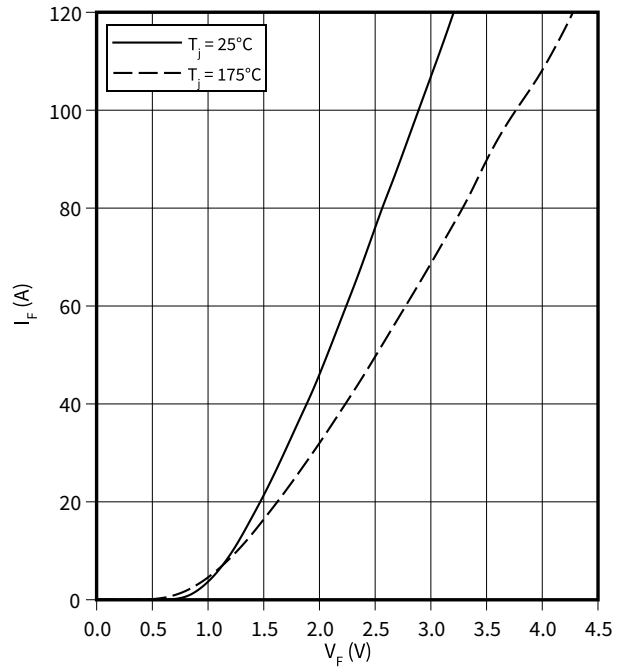
$Z_{th} = f(t_p)$

$D = t_p/T$



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

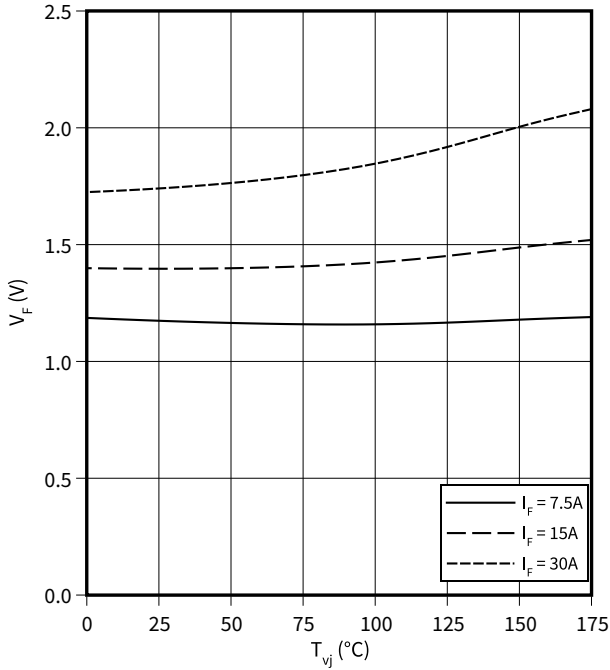
$I_F = f(V_F)$



4 Characteristics diagrams

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

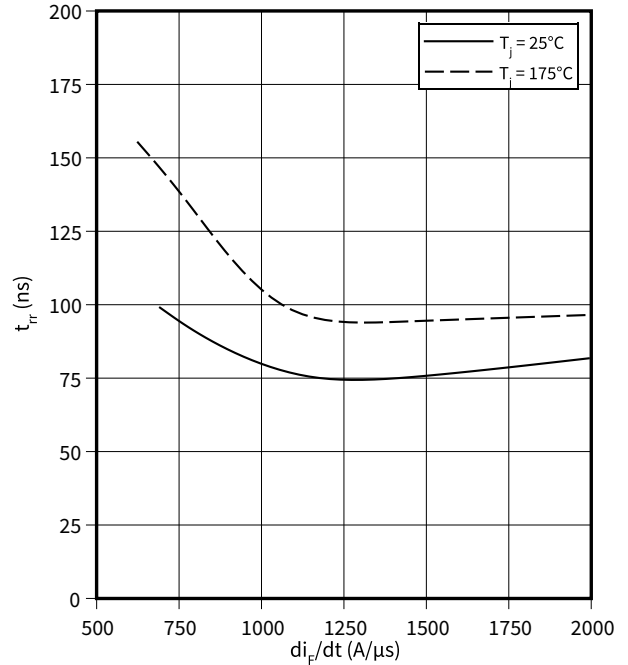
$V_F = f(T_{vj})$



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

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

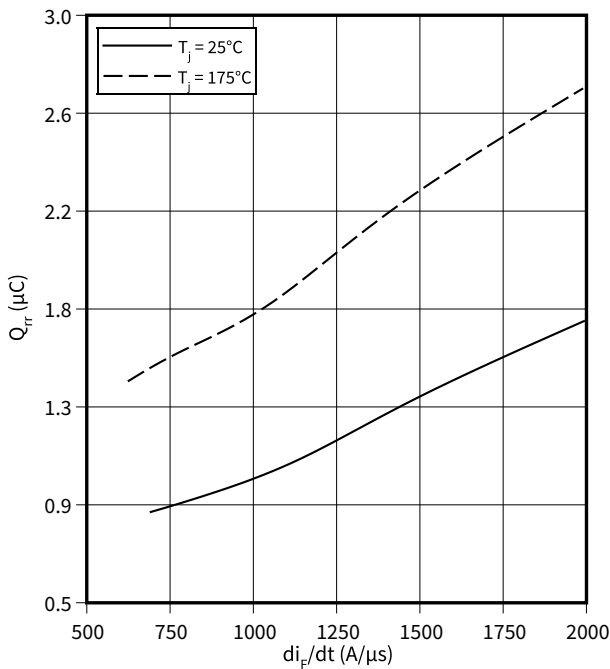
$V_R = 400 V, I_F = 15 A$



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

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

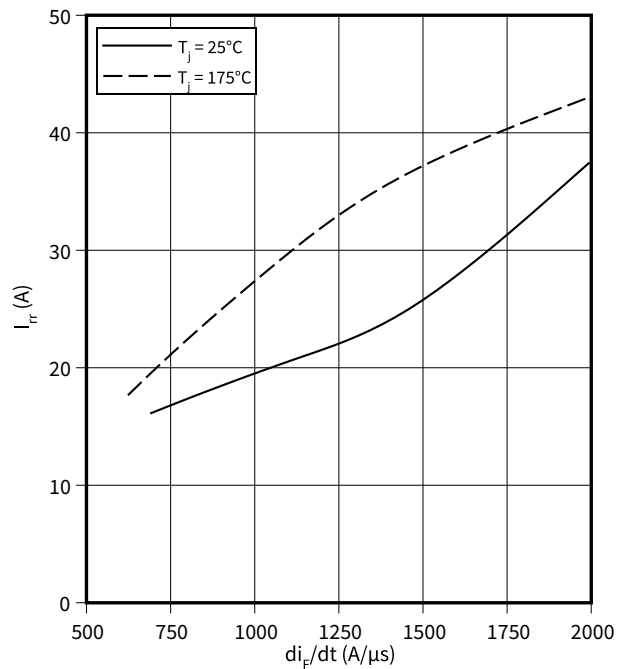
$V_R = 400 V, I_F = 15 A$



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

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

$V_R = 400 V, I_F = 15 A$

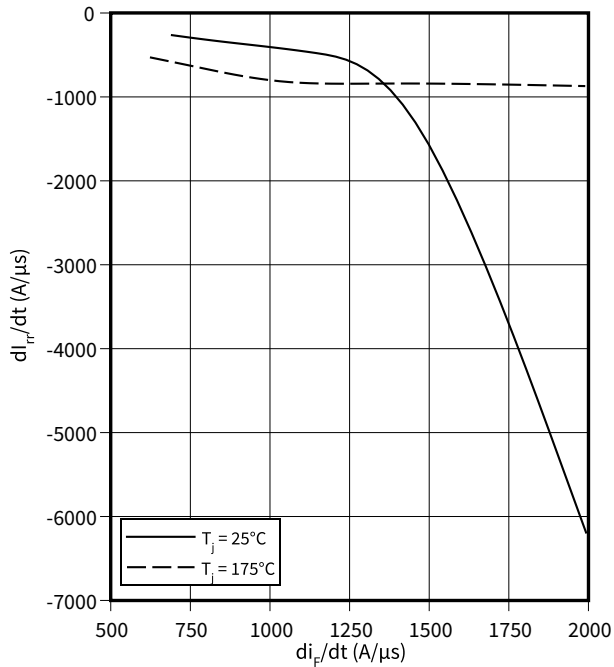


4 Characteristics diagrams

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

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

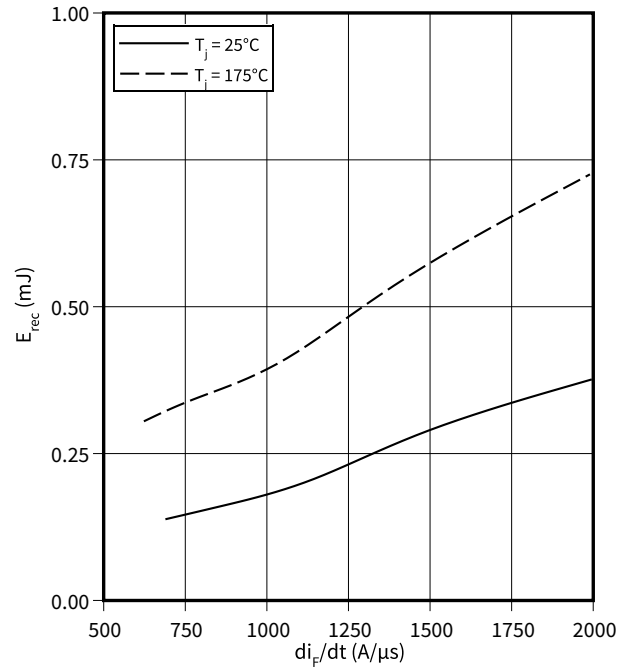
$V_R = 400\text{ V}, I_F = 15\text{ A}$



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

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

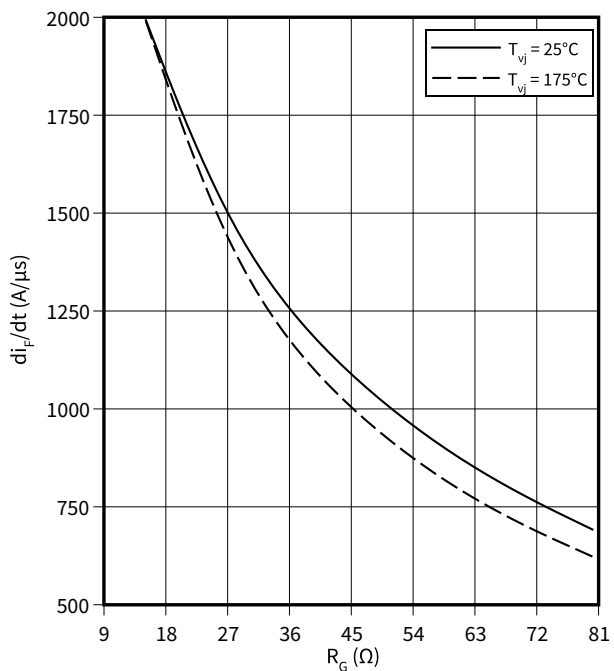
$V_R = 400\text{ V}, I_F = 15\text{ A}$



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

$di_F/dt = f(R_G)$

$V_R = 400\text{ V}, I_F = 15\text{ A}$



5 Package outlines

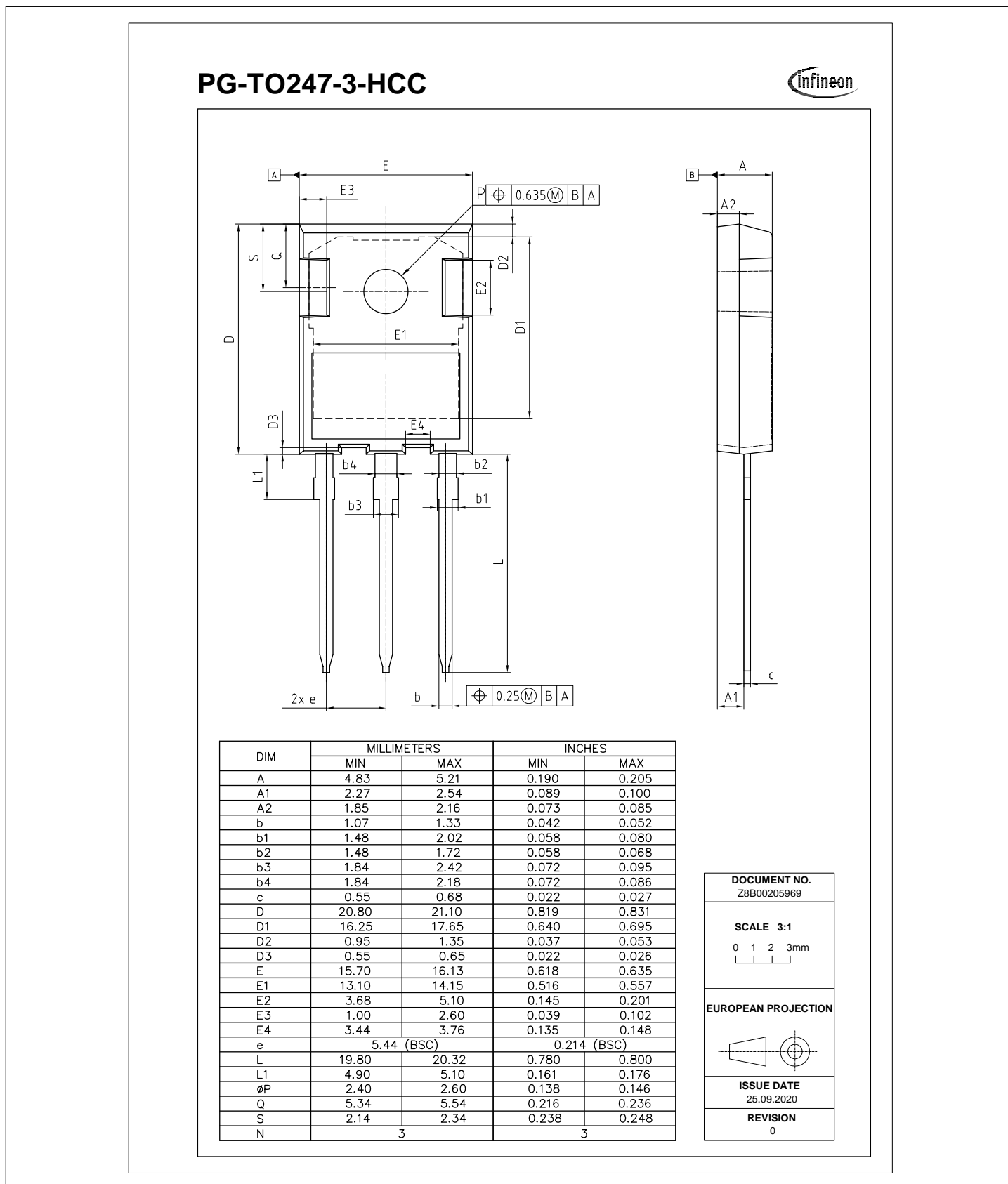


Figure 6

6 Testing conditions

6 Testing conditions

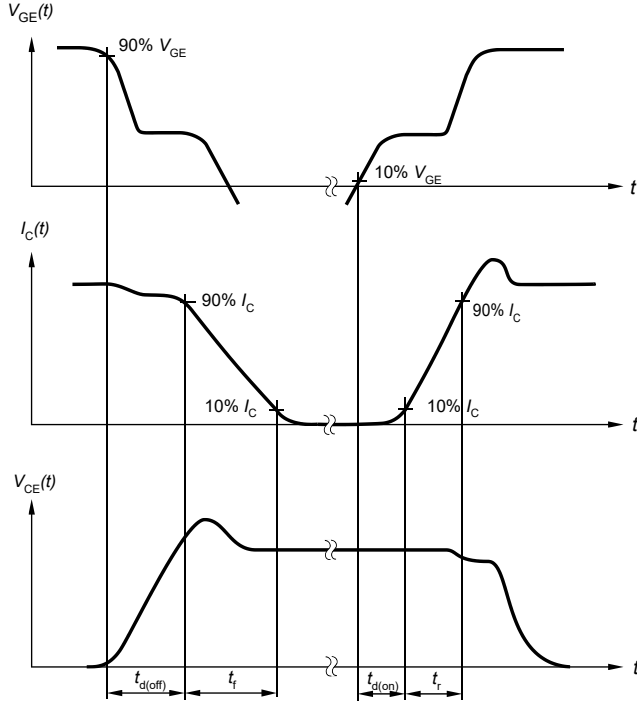


Figure A. Definition of switching times

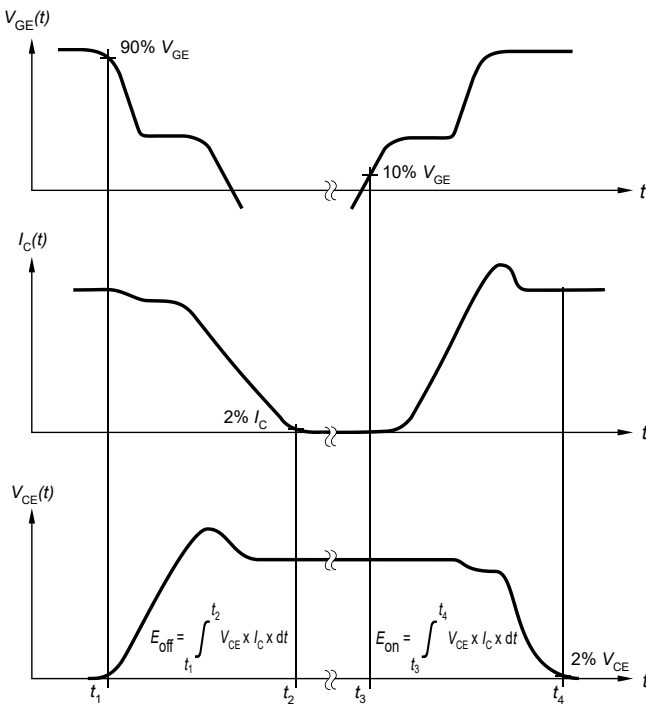


Figure B. Definition of switching losses

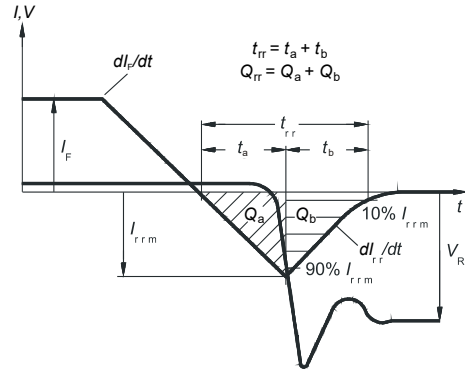


Figure C. Definition of diode switching characteristics

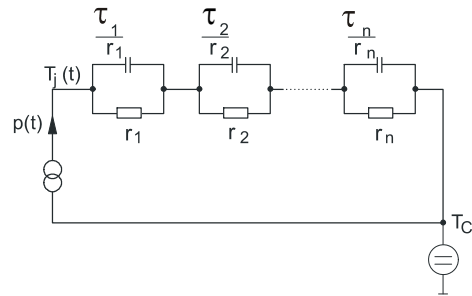


Figure D. Thermal equivalent circuit

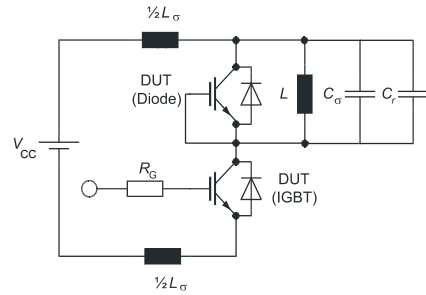


Figure E. **Dynamic test circuit**
 Parasitic inductance L_σ ,
 parasitic capacitor C_σ ,
 relief capacitor C_r ,
 (only for ZVT switching)

Figure 7

Revision history

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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