

CoolSiC™ Hybrid Discrete - TRENCHSTOP™ 5 S5 IGBT co-packed with full-rated 6th generation CoolSiC™ diode

Features

- $V_{CE} = 650 \text{ V}$
- $I_C = 75 \text{ A}$
- Ultra-low switching losses due to the combination of TRENCHSTOP™ 5 and CoolSiC™ technology
- Very low on-state losses
- Benchmark efficiency in hard switching topologies
- Plug-and-play replacement of pure silicon devices
- Maximum junction temperature $T_{vjmax} = 175^\circ\text{C}$
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

Potential applications

- Industrial SMPS
- Industrial UPS
- Solar string inverter
- Energy storage
- Charger

Product validation

- Qualified for applications listed above based on the test conditions in the relevant tests of JEDEC20/22

Description

Package pin definition:

- Pin G - gate
- Pin C & backside - collector
- Pin E - emitter



Lead-free



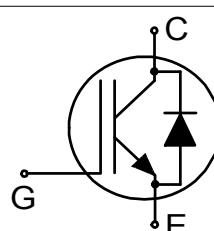
Green



Halogen-free



RoHS



Type	Package	Marking
IKW75N65SS5	PG-T0247-3	K75ESS5

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	6
4 Characteristics diagrams	7
5 Package outlines	13
6 Testing conditions	14
Revision history	15
Disclaimer	16

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	M	M3 screw Maximum of mounting process: 3			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}	$T_{vj} \geq 25^\circ\text{C}$		650		V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25^\circ\text{C}$	80		A
			$T_c = 100^\circ\text{C}$	80		
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			300		A
Turn-off safe operating area		$V_{CE} \leq 650\text{ V}, t_p = 1\text{ }\mu\text{s}, T_{vj} \leq 175^\circ\text{C}$		300		A
Gate-emitter voltage	V_{GE}			±20		V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10\text{ }\mu\text{s}, D < 0.01$		±30		V
Power dissipation	P_{tot}		$T_c = 25^\circ\text{C}$	395		
			$T_c = 100^\circ\text{C}$	197		W

Table 3 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CESat}	$I_C = 75\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25^\circ\text{C}$		1.35	1.7
			$T_{vj} = 125^\circ\text{C}$		1.55	
			$T_{vj} = 175^\circ\text{C}$		1.65	
Gate-emitter threshold voltage	V_{GETh}	$I_C = 0.75\text{ mA}, V_{CE} = V_{GE}$	3.2	4	4.8	V

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 650 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		1900	μA
			$T_{vj} = 175 \text{ }^\circ\text{C}$		3000	
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 480 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		50	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}$			100	nA
Transconductance	g_{fs}	$I_C = 75 \text{ A}, V_{CE} = 20 \text{ V}$		100		s
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 250 \text{ kHz}$		4000		pF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 250 \text{ kHz}$		785		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 250 \text{ kHz}$		15		pF
Gate charge	Q_G	$I_C = 75 \text{ A}, V_{GE} = 15 \text{ V}, V_{CC} = 520 \text{ V}$		164		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 5.6 \Omega, R_{Goff} = 5.6 \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 75 \text{ A}$		22	ns
			$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 37.5 \text{ A}$		21	
			$T_{vj} = 150 \text{ }^\circ\text{C}, I_C = 75 \text{ A}$		22	
			$T_{vj} = 150 \text{ }^\circ\text{C}, I_C = 37.5 \text{ A}$		20	
Rise time (inductive load)	t_r	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 5.6 \Omega, R_{Goff} = 5.6 \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 75 \text{ A}$		13	ns
			$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 37.5 \text{ A}$		8	
			$T_{vj} = 150 \text{ }^\circ\text{C}, I_C = 75 \text{ A}$		15	
			$T_{vj} = 150 \text{ }^\circ\text{C}, I_C = 37.5 \text{ A}$		8	
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 5.6 \Omega, R_{Goff} = 5.6 \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 75 \text{ A}$		145	ns
			$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 37.5 \text{ A}$		155	
			$T_{vj} = 150 \text{ }^\circ\text{C}, I_C = 75 \text{ A}$		168	
			$T_{vj} = 150 \text{ }^\circ\text{C}, I_C = 37.5 \text{ A}$		195	

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Fall time (inductive load)	t_f	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{Gon} = 5.6 \Omega$, $R_{Goff} = 5.6 \Omega$, $L_\sigma = 30 \text{ nH}$, $C_\sigma = 30 \text{ pF}$	$T_{vj} = 25^\circ\text{C}$, $I_C = 75 \text{ A}$		21	ns
			$T_{vj} = 25^\circ\text{C}$, $I_C = 37.5 \text{ A}$		26	
			$T_{vj} = 150^\circ\text{C}$, $I_C = 75 \text{ A}$		24	
			$T_{vj} = 150^\circ\text{C}$, $I_C = 37.5 \text{ A}$		33	
Turn-on energy	E_{on}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{Gon} = 5.6 \Omega$, $R_{Goff} = 5.6 \Omega$, $L_\sigma = 30 \text{ nH}$, $C_\sigma = 30 \text{ pF}$	$T_{vj} = 25^\circ\text{C}$, $I_C = 75 \text{ A}$		0.45	mJ
			$T_{vj} = 25^\circ\text{C}$, $I_C = 37.5 \text{ A}$		0.2	
			$T_{vj} = 150^\circ\text{C}$, $I_C = 75 \text{ A}$		0.57	
			$T_{vj} = 150^\circ\text{C}$, $I_C = 37.5 \text{ A}$		0.25	
Turn-off energy	E_{off}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{Gon} = 5.6 \Omega$, $R_{Goff} = 5.6 \Omega$, $L_\sigma = 30 \text{ nH}$, $C_\sigma = 30 \text{ pF}$	$T_{vj} = 25^\circ\text{C}$, $I_C = 75 \text{ A}$		0.75	mJ
			$T_{vj} = 25^\circ\text{C}$, $I_C = 37.5 \text{ A}$		0.42	
			$T_{vj} = 150^\circ\text{C}$, $I_C = 75 \text{ A}$		1.24	
			$T_{vj} = 150^\circ\text{C}$, $I_C = 37.5 \text{ A}$		0.75	
Total switching energy	E_{ts}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{Gon} = 5.6 \Omega$, $R_{Goff} = 5.6 \Omega$, $L_\sigma = 30 \text{ nH}$, $C_\sigma = 30 \text{ pF}$	$T_{vj} = 25^\circ\text{C}$, $I_C = 75 \text{ A}$		1.2	mJ
			$T_{vj} = 25^\circ\text{C}$, $I_C = 37.5 \text{ A}$		0.62	
			$T_{vj} = 150^\circ\text{C}$, $I_C = 75 \text{ A}$		1.81	
			$T_{vj} = 150^\circ\text{C}$, $I_C = 37.5 \text{ A}$		1	
IGBT thermal resistance, junction-case	$R_{th(j-c)}$				0.38	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}	$T_{vj} \geq 25^\circ\text{C}$		650		V
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	$T_c = 25^\circ\text{C}$	80		A
			$T_c = 100^\circ\text{C}$	57		A
Diode pulsed current, t_p limited by T_{vjmax} ¹⁾	I_{Fpulse}			225		A

1) Pulse current level depends on T_{vj} of diode chip, see also Fig. "Maximum pulse current as a function of junction temperature"

Table 5 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 60\text{ A}$	$T_{vj} = 25^\circ\text{C}$		1.35	1.5
			$T_{vj} = 125^\circ\text{C}$		1.55	
			$T_{vj} = 175^\circ\text{C}$		1.65	
Diode thermal resistance, junction-case	$R_{th(j-c)}$				0.68	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.

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

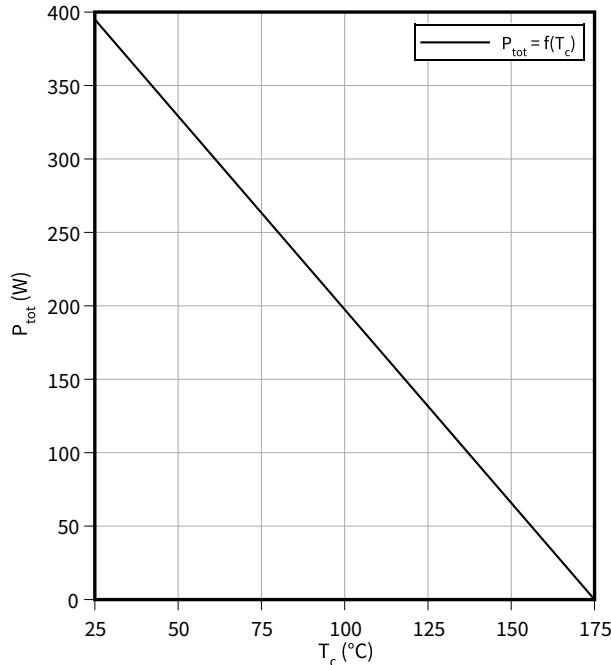
Dynamic test circuit, parasitic inductance L_o , parasitic capacitor C_o from Fig. E. Energy losses include "tail" and diode reverse recovery.

4 Characteristics diagrams

Power dissipation as a function of case temperature

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

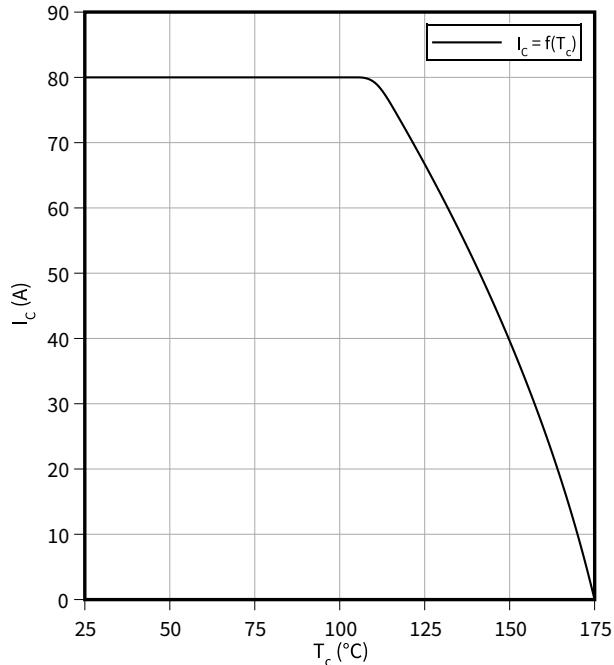
$T_{vj} \leq 175^\circ\text{C}$



Collector current as a function of case temperature

$$I_C = f(T_c)$$

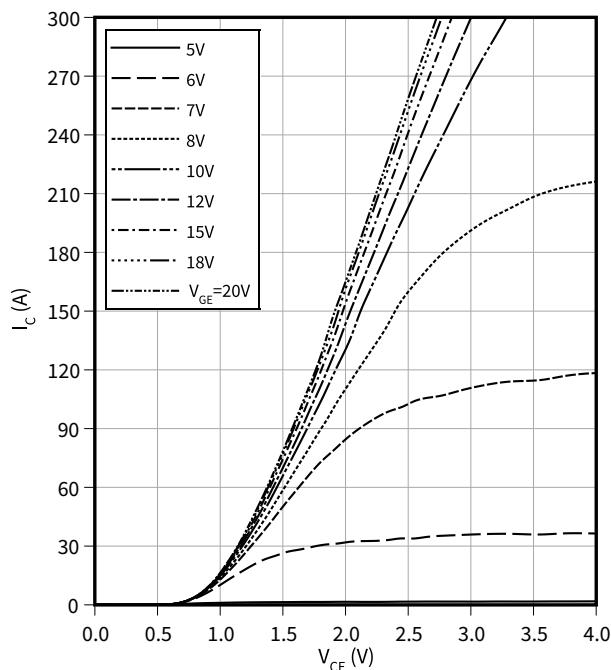
$T_{vj} \leq 175^\circ\text{C}, V_{GE} \geq 15\text{ V}$



Typical output characteristic

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

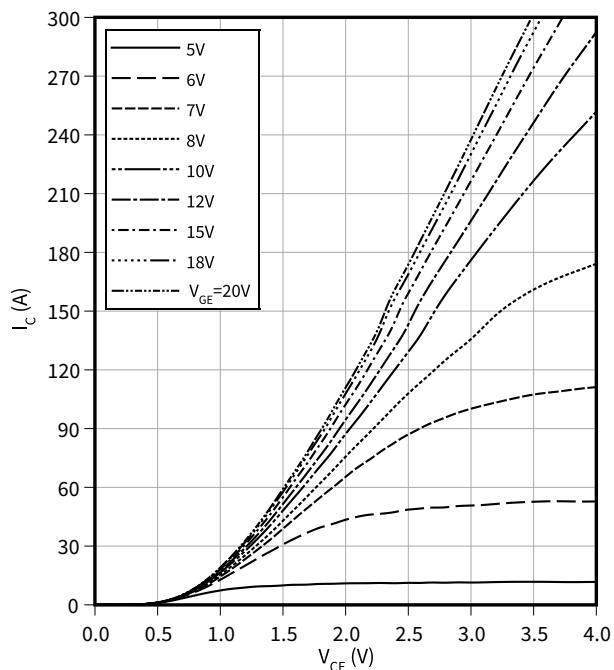
$T_{vj} = 25^\circ\text{C}$



Typical output characteristic

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

$T_{vj} = 150^\circ\text{C}$

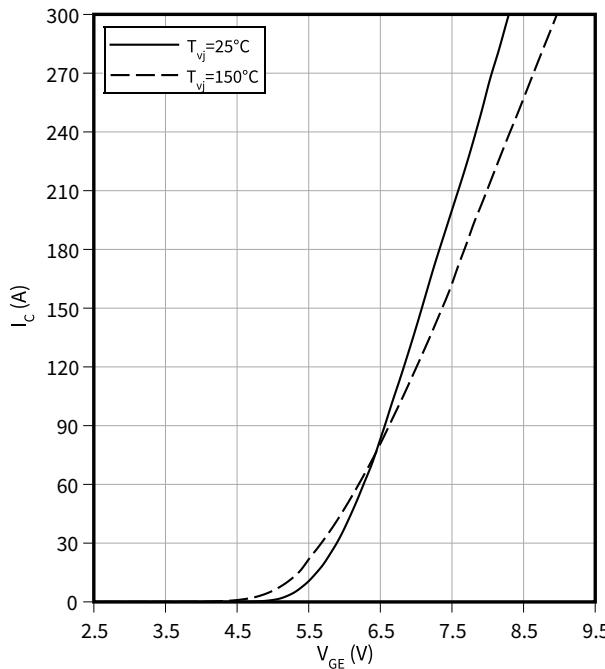


4 Characteristics diagrams

Typical transfer characteristic

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

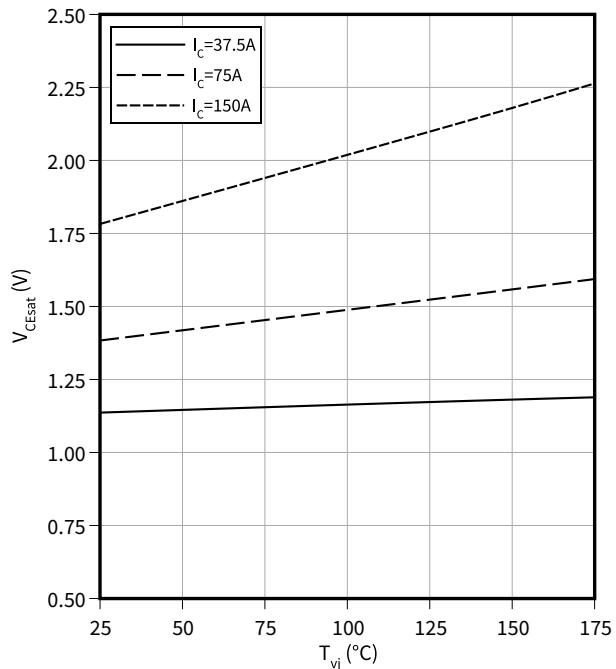
$$V_{CE} = 20 \text{ V}$$



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

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

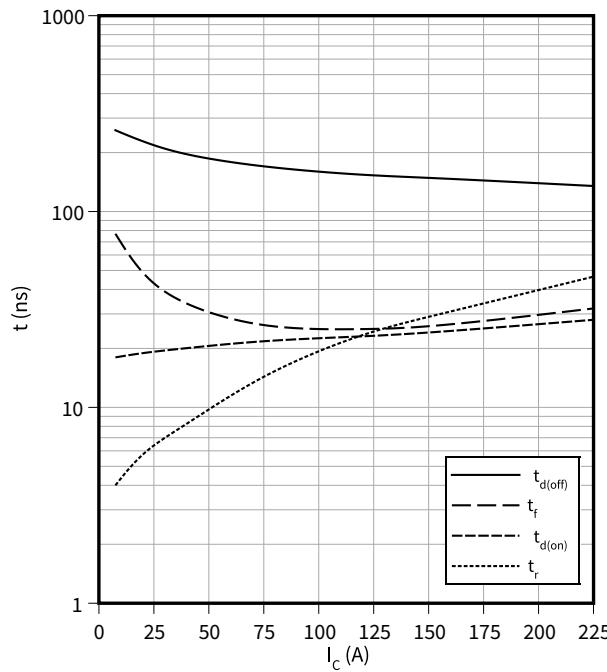
$$V_{GE} = 15 \text{ V}$$



Typical switching times as a function of collector current

$$t = f(I_C)$$

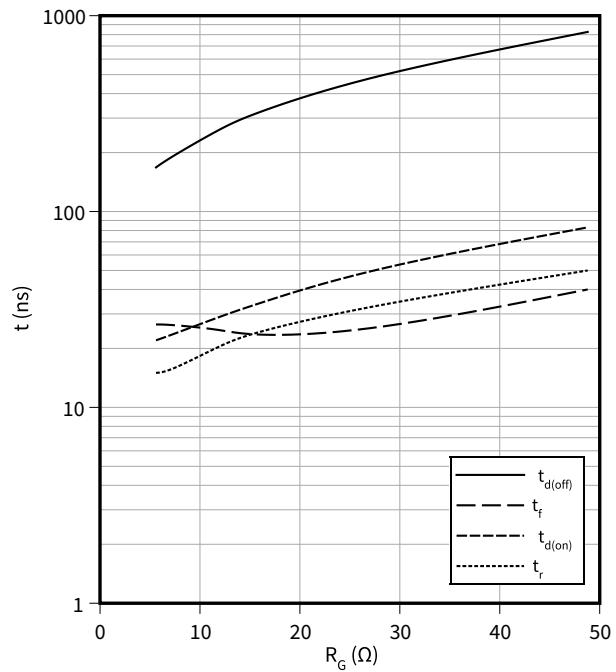
$$V_{CC} = 400 \text{ V}, T_{vj} = 150 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 5.6 \Omega$$



Typical switching times as a function of gate resistor

$$t = f(R_G)$$

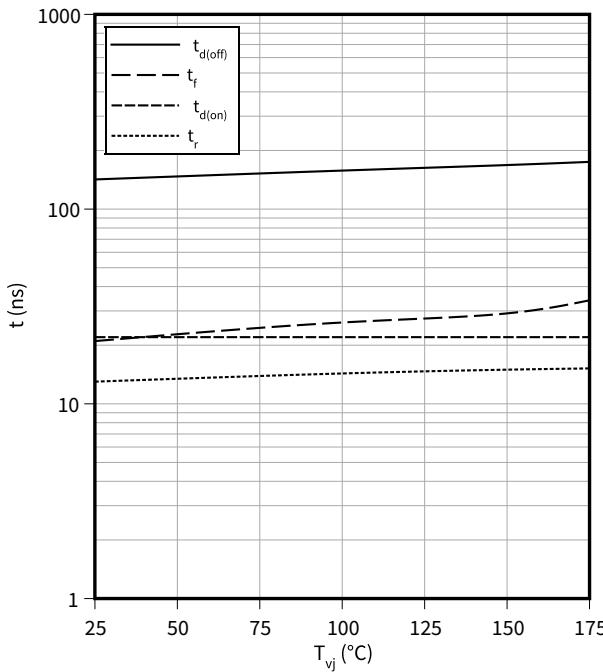
$$I_C = 75 \text{ A}, V_{CC} = 400 \text{ V}, T_{vj} = 150 \text{ °C}, V_{GE} = 0/15 \text{ V}$$



4 Characteristics diagrams

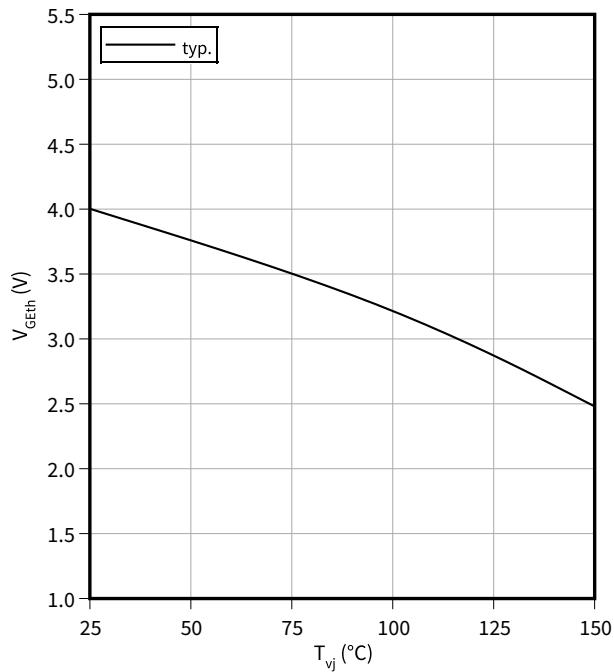
Typical switching times as a function of junction temperature

$t = f(T_{vj})$
 $I_C = 75 \text{ A}$, $V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 5.6 \Omega$



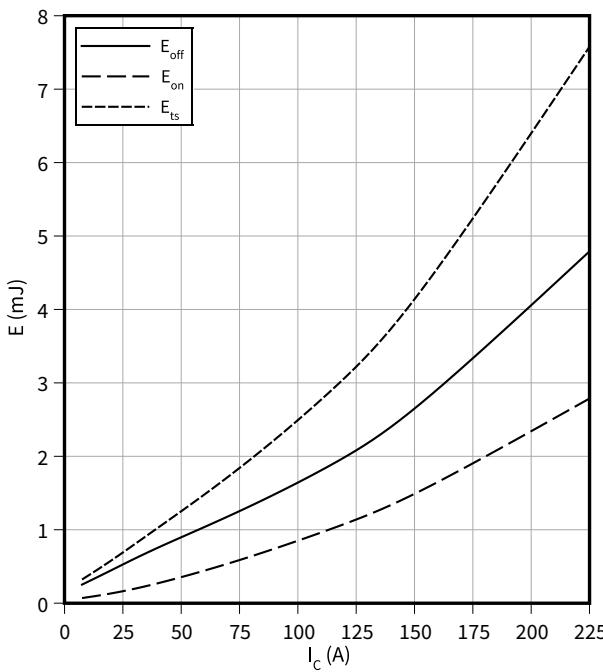
Gate-emitter threshold voltage as a function of junction temperature

$V_{GEth} = f(T_{vj})$
 $I_C = 0.75 \text{ mA}$



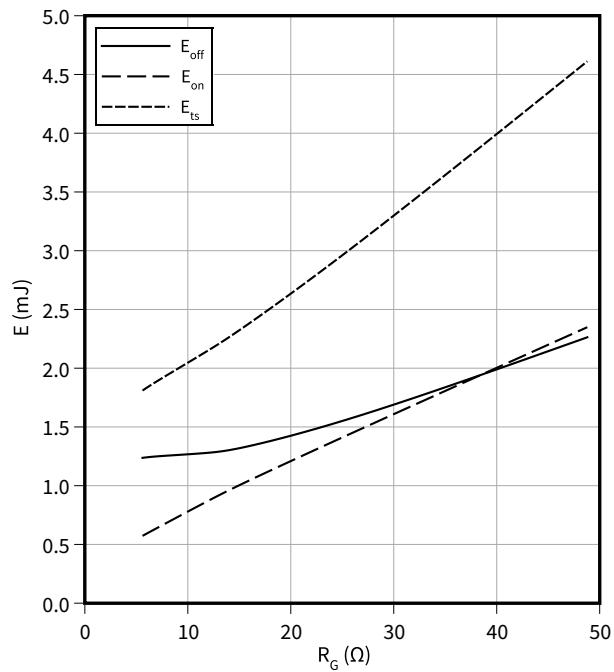
Typical switching energy losses as a function of collector current

$E = f(I_C)$
 $V_{CC} = 400 \text{ V}$, $T_{vj} = 150 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 5.6 \Omega$



Typical switching energy losses as a function of gate resistor

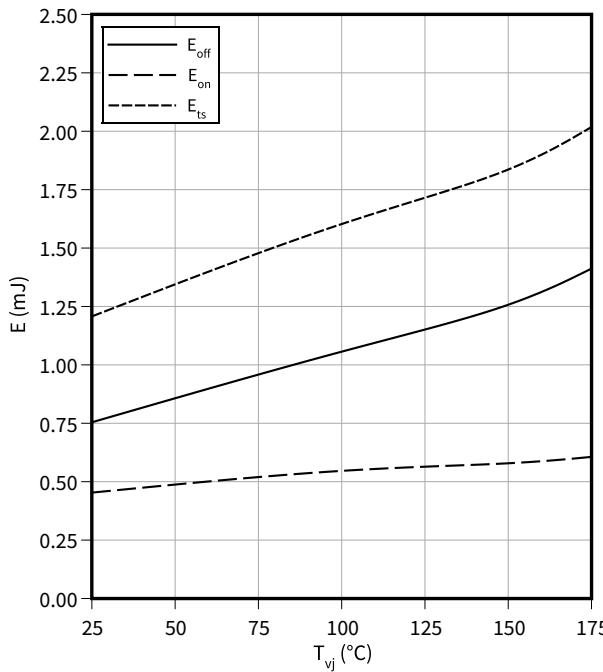
$E = f(R_G)$
 $I_C = 75 \text{ A}$, $V_{CC} = 400 \text{ V}$, $T_{vj} = 150 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$



4 Characteristics diagrams

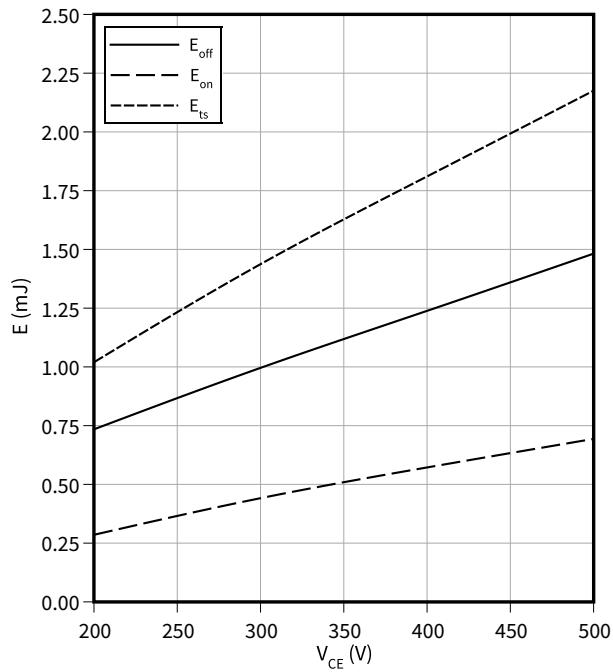
Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$
 $I_C = 75 \text{ A}$, $V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 5.6 \Omega$



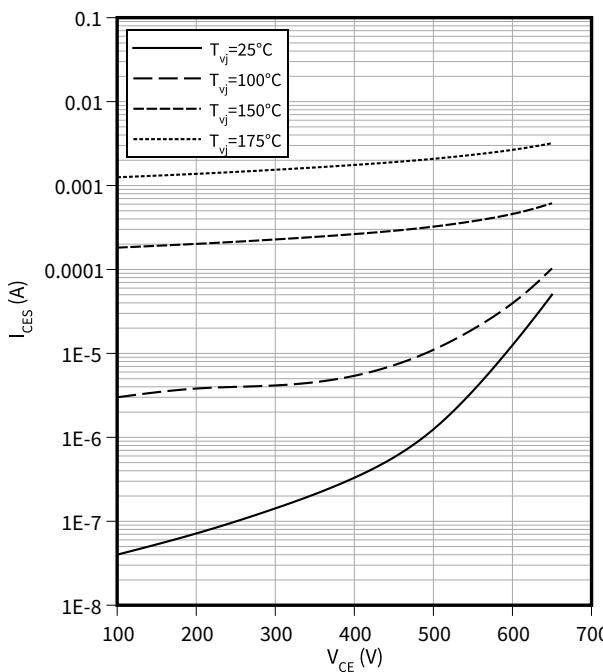
Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$
 $I_C = 75 \text{ A}$, $T_{vj} = 150 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 5.6 \Omega$



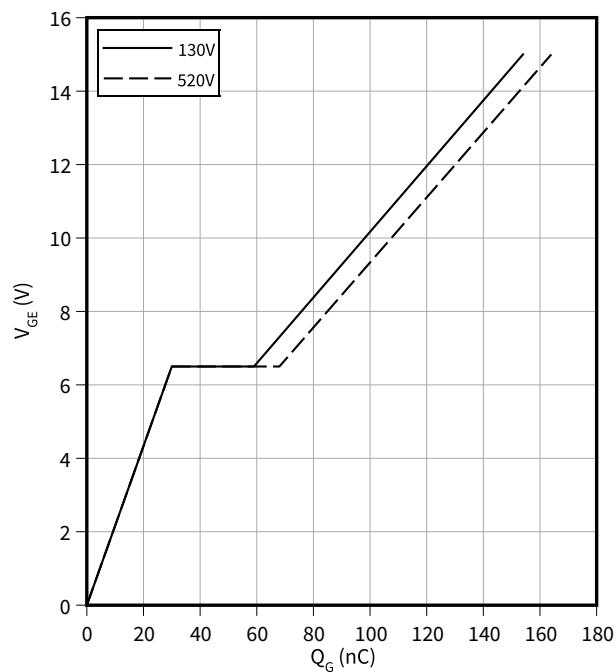
Typ. reverse current vs. reverse voltage as a function of T_{vj}

$I_{CES} = f(V_{CE})$



Typical gate charge

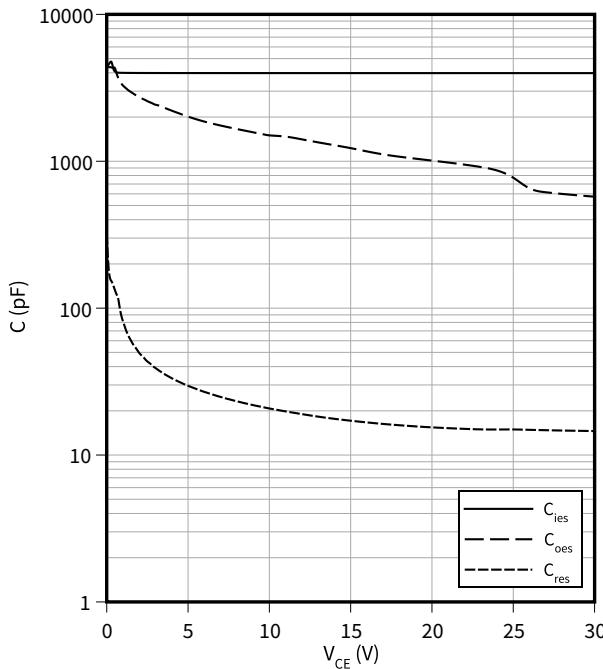
$V_{GE} = f(Q_G)$
 $I_C = 75 \text{ A}$



4 Characteristics diagrams

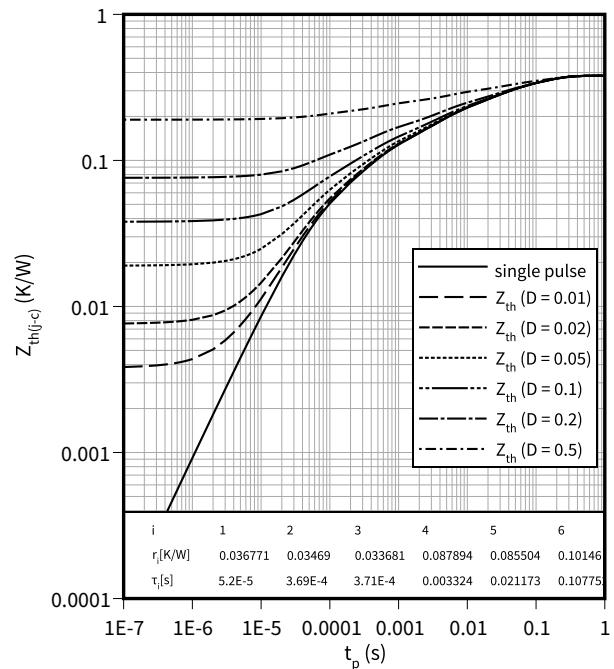
Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$
 $f = 250 \text{ kHz}, V_{GE} = 0 \text{ V}$



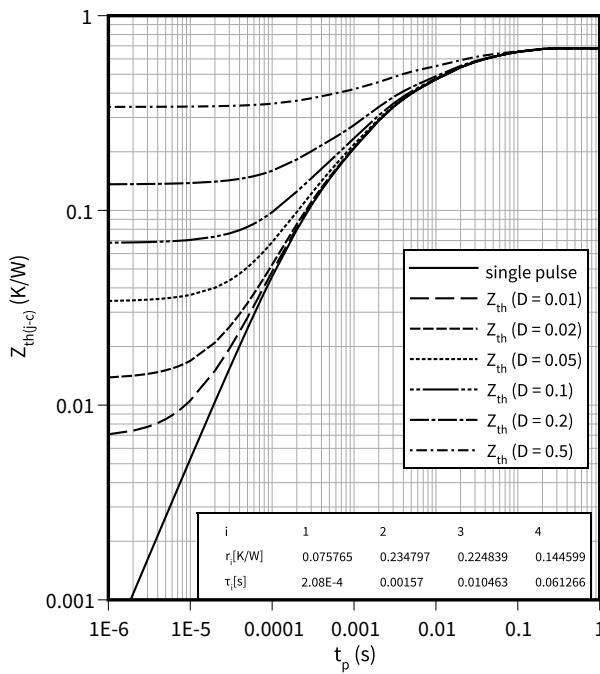
IGBT transient thermal impedance as a function of pulse width

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



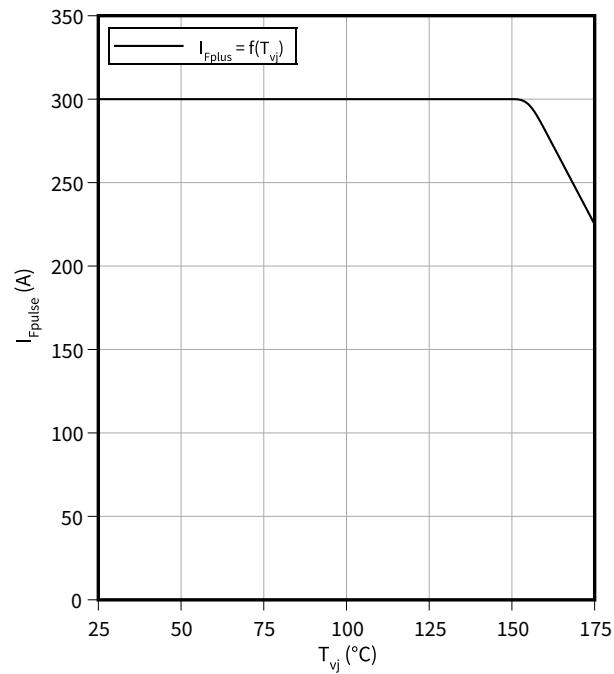
Diode transient thermal impedance as a function of pulse width

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



Maximum pulse current as a function of junction temperature

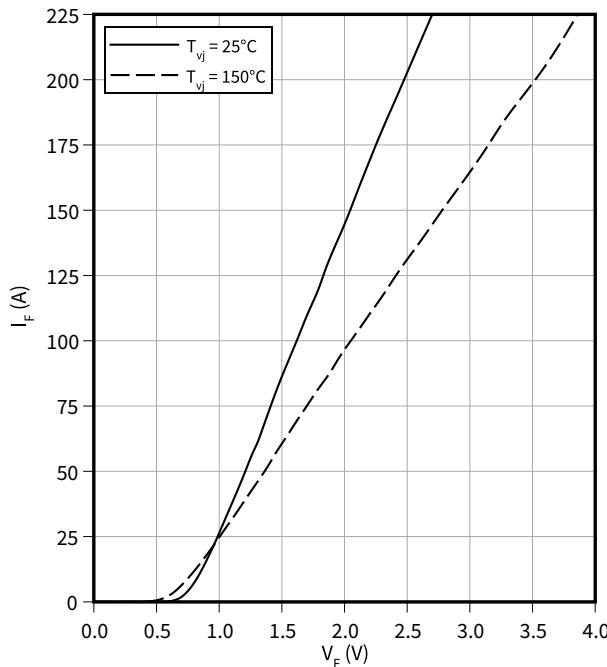
$I_{Fpulse} = f(T_{vj})$



4 Characteristics diagrams

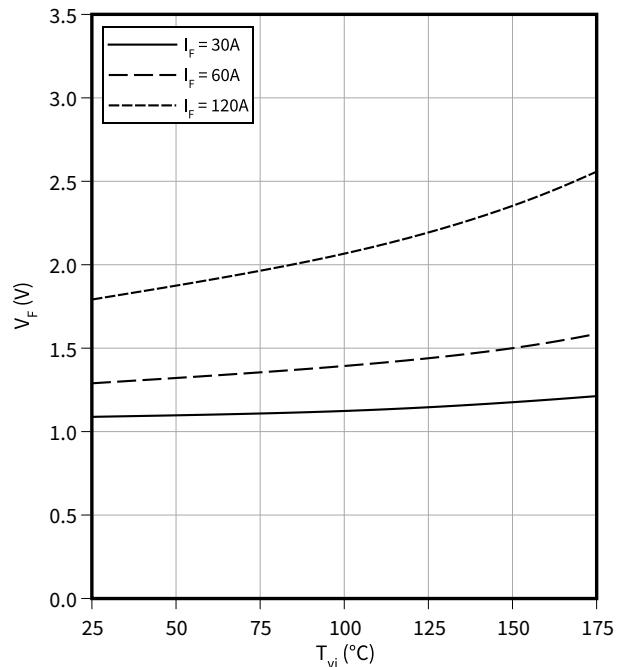
Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$



Typical diode forward voltage as a function of junction temperature

$$V_F = f(T_{vj})$$



5 Package outlines

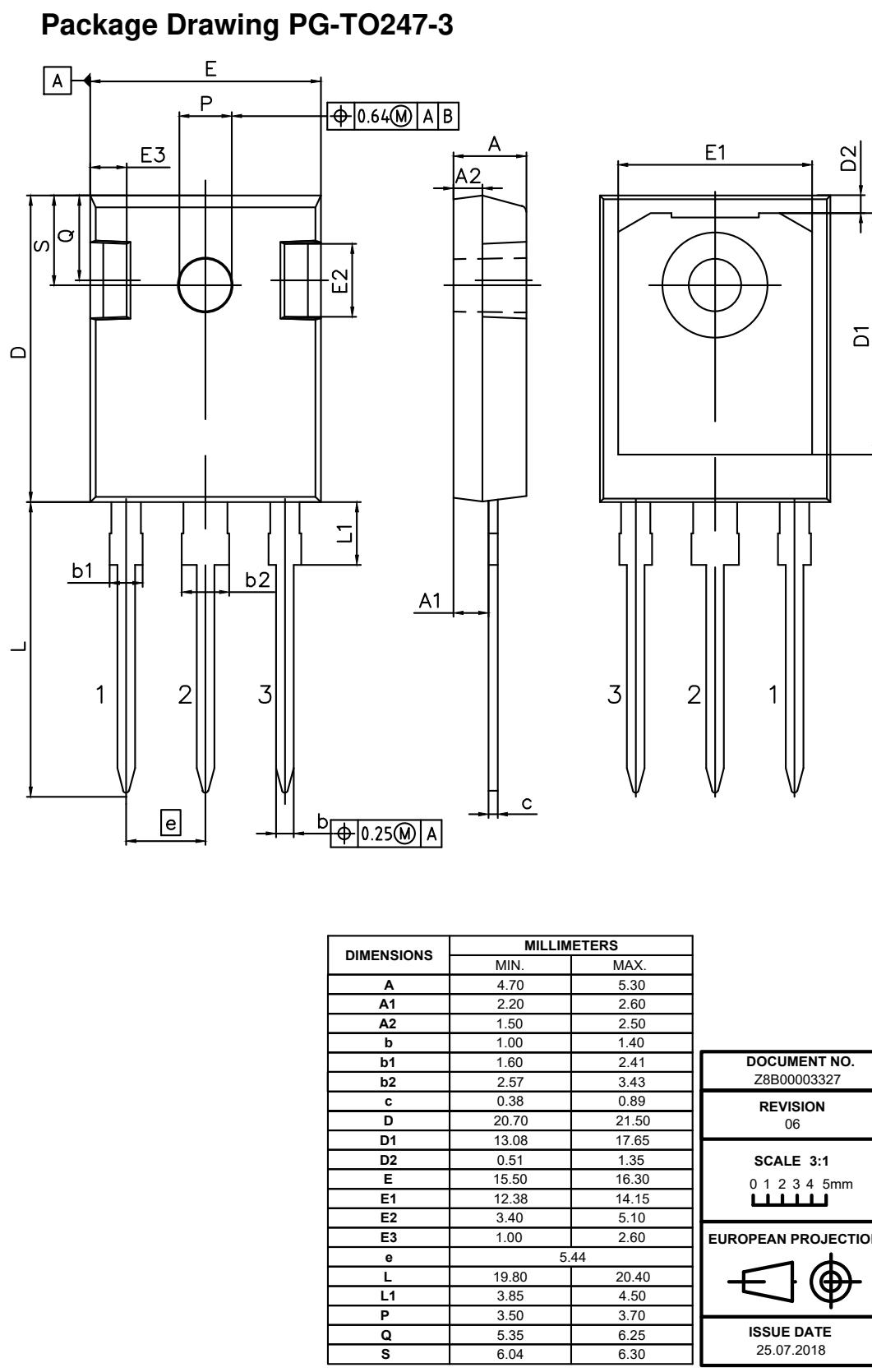


Figure 1

6 Testing conditions

6 Testing conditions

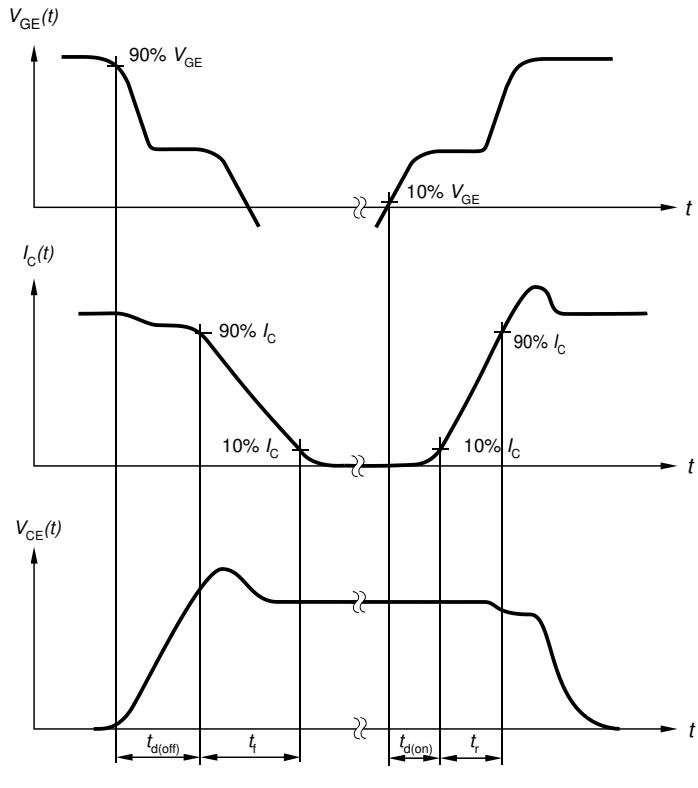


Figure A. Definition of switching times

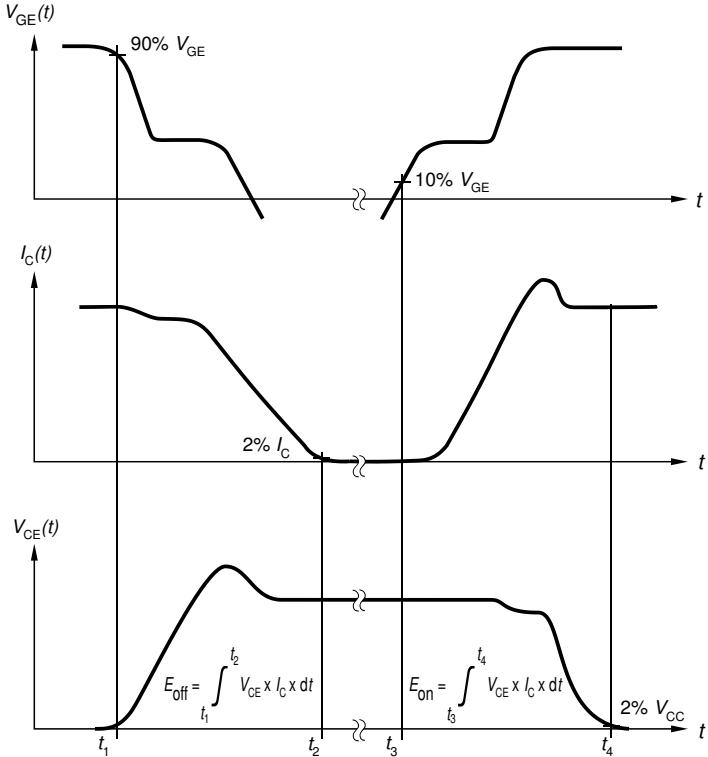


Figure B. Definition of switching losses

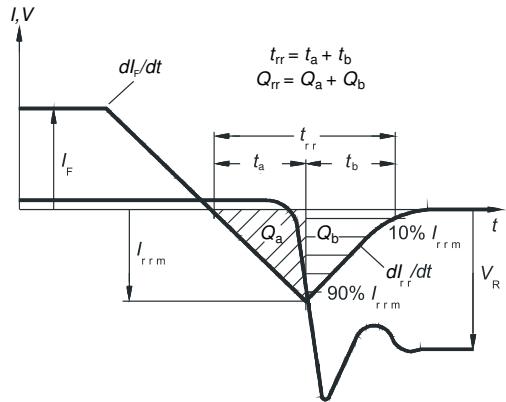


Figure C. Definition of diode switching characteristics

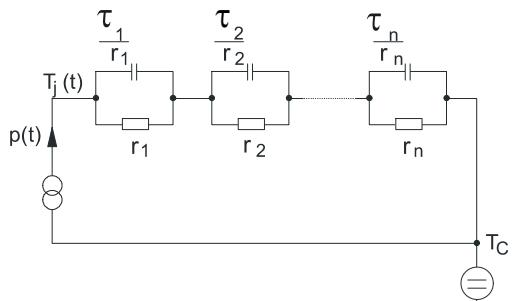


Figure D. Thermal equivalent circuit

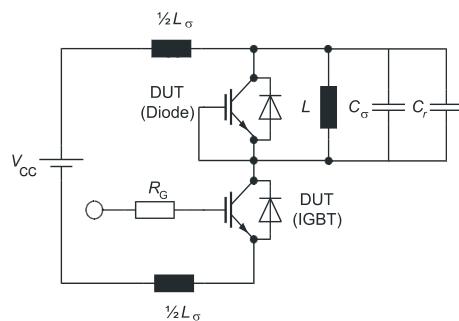


Figure E. Dynamic test circuit
Parasitic inductance L_σ ,
parasitic capacitor C_σ ,
relief capacitor C_r ,
(only for ZVT switching)

Figure 2

Revision history

Revision history

Document revision	Date of release	Description of changes
V1.1	2020-03-20	Preliminary Data Sheet
V2.1	2020-07-27	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
1.10	2022-09-22	Rename of product family name from “Hybrid CoolSiC™ IGBT” to “CoolSiC™ hybrid discrete”

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Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.