

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/>



- Lead-free
- Green
- Halogen-free
- RoHS

Potential applications

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

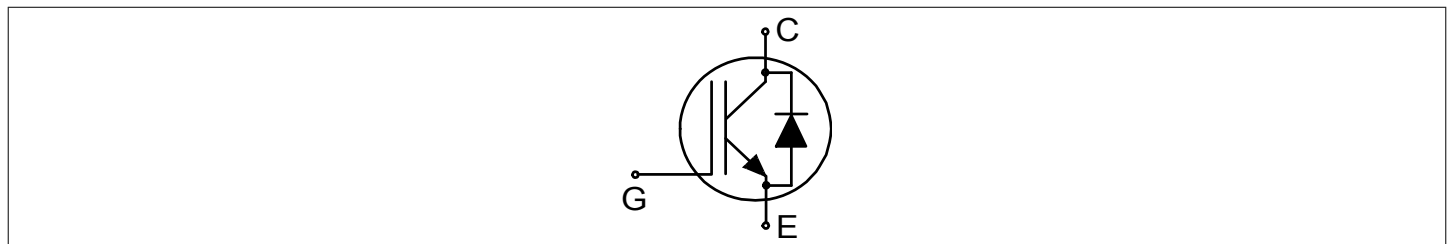
Product validation

- 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



Type	Package	Marking
IKW75N65SS5	PG-TO247-3	K75ESS5

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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	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}	$T_{vj} \geq 25\text{ °C}$	650	V	
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25\text{ °C}$	80	A
			$T_c = 100\text{ °C}$	80	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}		300	A	
Turn-off safe operating area		$V_{CE} \leq 650\text{ V}$, $t_p = 1\text{ }\mu\text{s}$, $T_{vj} \leq 175\text{ °C}$	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}		$T_c = 25\text{ °C}$	395	W
			$T_c = 100\text{ °C}$	197	

Table 3 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 75\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.35	1.7	V
			$T_{vj} = 125\text{ °C}$		1.55		
			$T_{vj} = 175\text{ °C}$		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}	$V_{CE} = 650\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			1900	μA
			$T_{vj} = 175\text{ °C}$		3000		
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 480\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			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	$t_{d(on)}$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{Gon} = 5.6\ \Omega, R_{Goff} = 5.6\ \Omega, L_\sigma = 30\text{ nH}, C_\sigma = 30\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 75\text{ A}$		22		ns
			$T_{vj} = 25\text{ °C}, I_C = 37.5\text{ A}$		21		
			$T_{vj} = 150\text{ °C}, I_C = 75\text{ A}$		22		
			$T_{vj} = 150\text{ °C}, I_C = 37.5\text{ A}$		20		
Rise time (inductive load)	t_r	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{Gon} = 5.6\ \Omega, R_{Goff} = 5.6\ \Omega, L_\sigma = 30\text{ nH}, C_\sigma = 30\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 75\text{ A}$		13		ns
			$T_{vj} = 25\text{ °C}, I_C = 37.5\text{ A}$		8		
			$T_{vj} = 150\text{ °C}, I_C = 75\text{ A}$		15		
			$T_{vj} = 150\text{ °C}, I_C = 37.5\text{ A}$		8		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{Gon} = 5.6\ \Omega, R_{Goff} = 5.6\ \Omega, L_\sigma = 30\text{ nH}, C_\sigma = 30\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 75\text{ A}$		145		ns
			$T_{vj} = 25\text{ °C}, I_C = 37.5\text{ A}$		155		
			$T_{vj} = 150\text{ °C}, I_C = 75\text{ A}$		168		
			$T_{vj} = 150\text{ °C}, I_C = 37.5\text{ A}$		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	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{Gon} = 5.6\ \Omega,$ $R_{Goff} = 5.6\ \Omega, L_{\sigma} = 30\text{ nH},$ $C_{\sigma} = 30\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 75\text{ A}$		21		ns
			$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 37.5\text{ A}$		26		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 75\text{ A}$		24		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 37.5\text{ A}$		33		
Turn-on energy	E_{on}	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{Gon} = 5.6\ \Omega,$ $R_{Goff} = 5.6\ \Omega, L_{\sigma} = 30\text{ nH},$ $C_{\sigma} = 30\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 75\text{ A}$		0.45		mJ
			$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 37.5\text{ A}$		0.2		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 75\text{ A}$		0.57		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 37.5\text{ A}$		0.25		
Turn-off energy	E_{off}	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{Gon} = 5.6\ \Omega,$ $R_{Goff} = 5.6\ \Omega, L_{\sigma} = 30\text{ nH},$ $C_{\sigma} = 30\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 75\text{ A}$		0.75		mJ
			$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 37.5\text{ A}$		0.42		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 75\text{ A}$		1.24		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 37.5\text{ A}$		0.75		
Total switching energy	E_{ts}	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{Gon} = 5.6\ \Omega,$ $R_{Goff} = 5.6\ \Omega, L_{\sigma} = 30\text{ nH},$ $C_{\sigma} = 30\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 75\text{ A}$		1.2		mJ
			$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 37.5\text{ A}$		0.62		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 75\text{ A}$		1.81		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 37.5\text{ A}$		1		
IGBT thermal resistance, junction-case	$R_{th(j-c)}$				0.38	K/W	
Operating junction temperature	T_{vj}		-40		175	$^{\circ}\text{C}$	

3 Diode

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	V_{RRM}	$T_{vj} \geq 25\text{ °C}$	650	V	
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	$T_c = 25\text{ °C}$	80	A
			$T_c = 100\text{ °C}$	57	
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	$I_F = 60\text{ A}$	$T_{vj} = 25\text{ °C}$	1.35	1.5	V
			$T_{vj} = 125\text{ °C}$	1.55		
			$T_{vj} = 175\text{ °C}$	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.

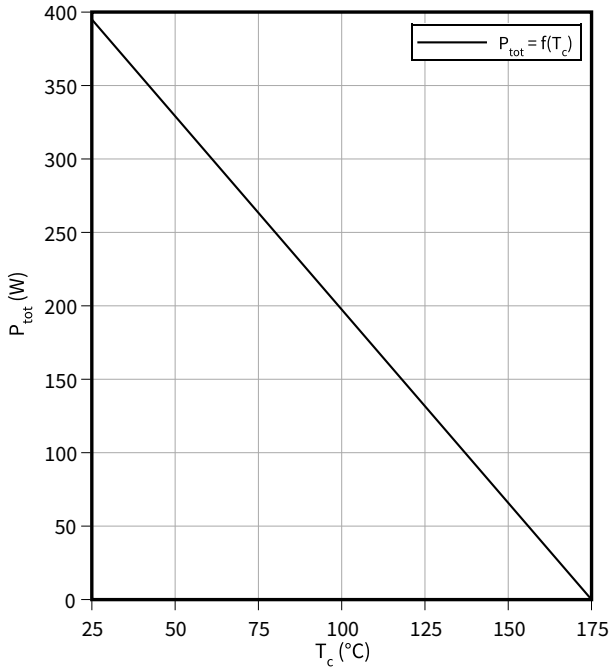
Electrical Characteristic at $T_{vj} = 25\text{ °C}$, unless otherwise specified.

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

4 Characteristics diagrams

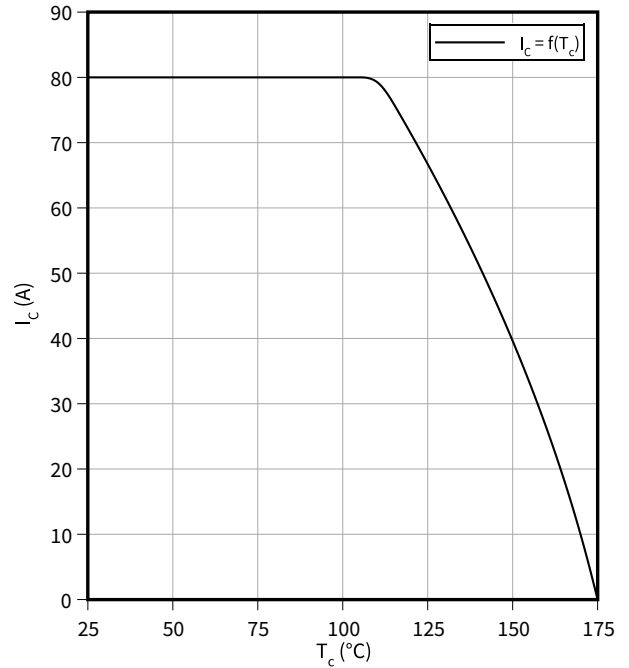
Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$
 $T_{vj} \leq 175\text{ °C}$



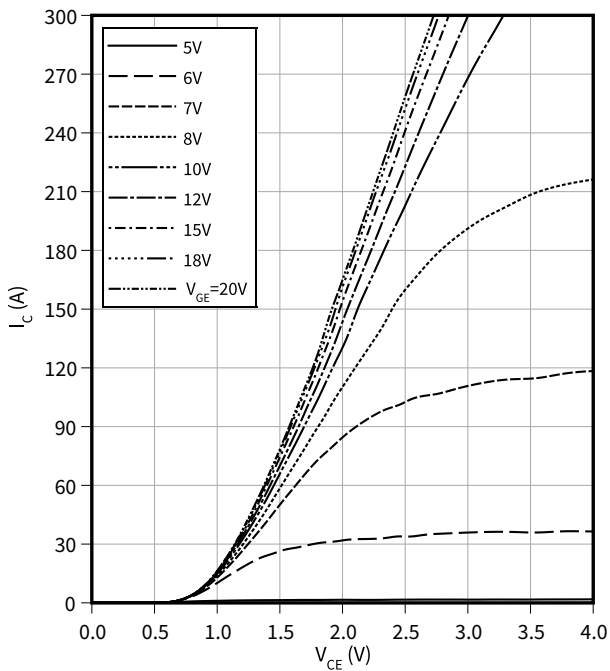
Collector current as a function of case temperature

$I_C = f(T_c)$
 $T_{vj} \leq 175\text{ °C}, V_{GE} \geq 15\text{ V}$



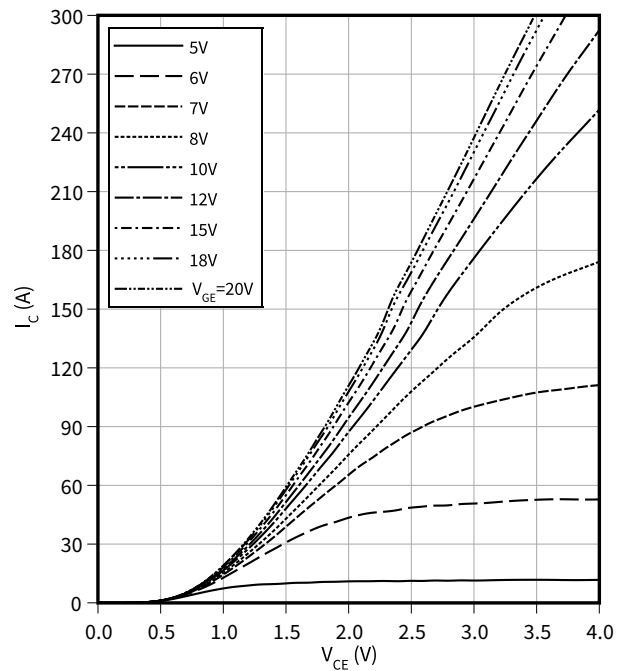
Typical output characteristic

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



Typical output characteristic

$I_C = f(V_{CE})$
 $T_{vj} = 150\text{ °C}$

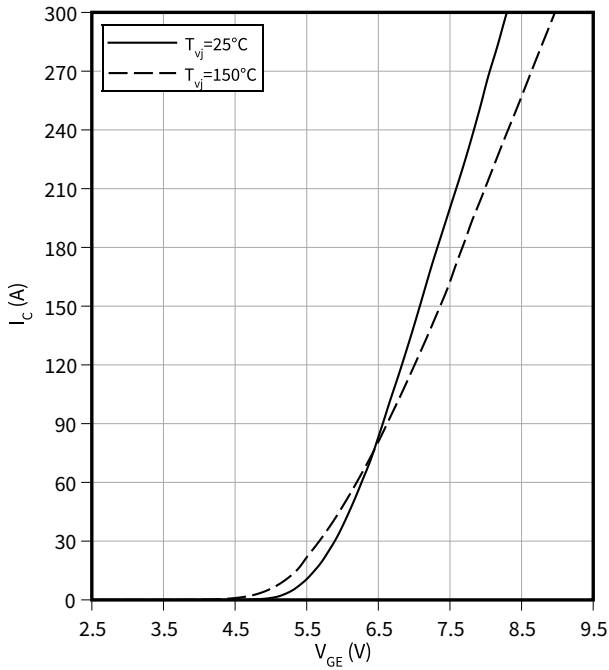


4 Characteristics diagrams

Typical transfer characteristic

$I_C = f(V_{GE})$

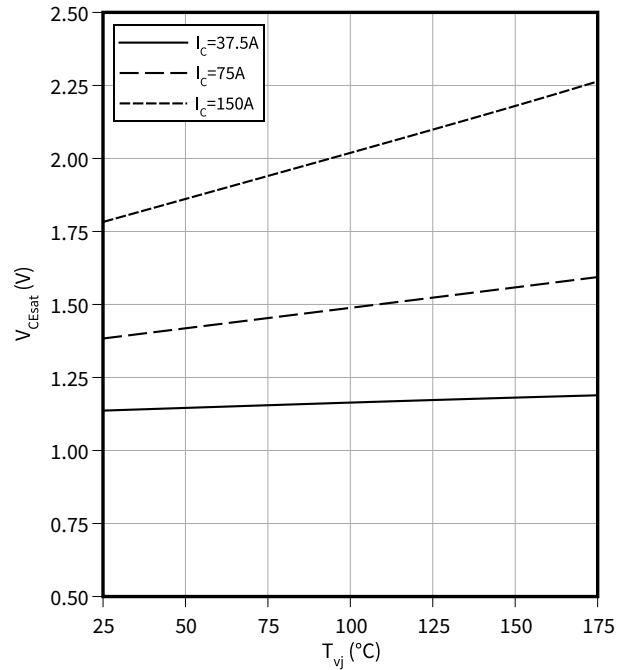
$V_{CE} = 20\text{ V}$



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

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

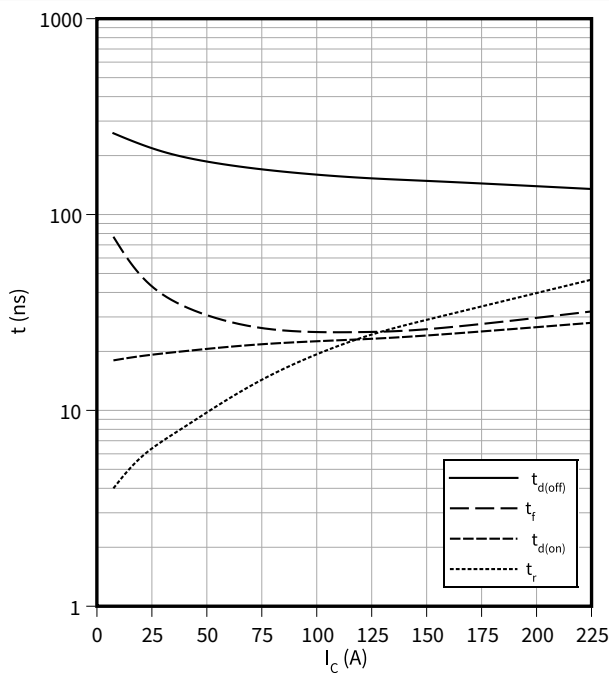
$V_{GE} = 15\text{ V}$



Typical switching times as a function of collector current

$t = f(I_C)$

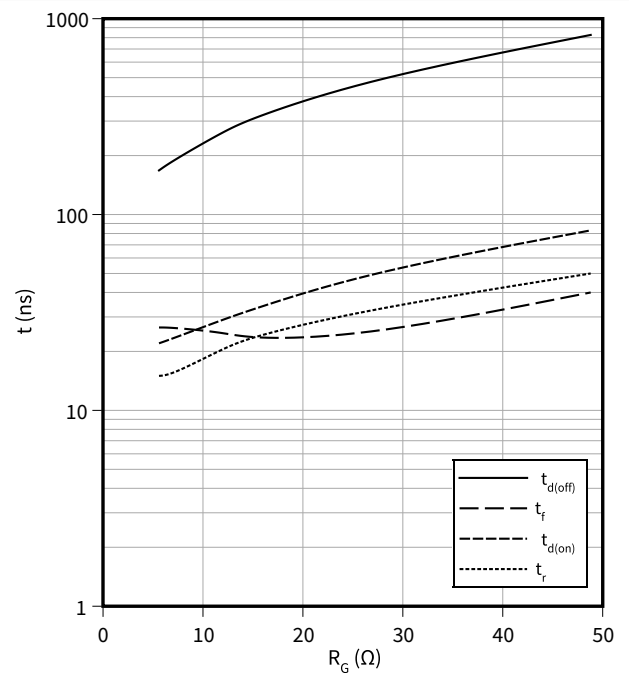
$V_{CC} = 400\text{ V}, T_{vj} = 150^\circ\text{C}, V_{GE} = 0/15\text{ V}, R_G = 5.6\ \Omega$



Typical switching times as a function of gate resistor

$t = f(R_G)$

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

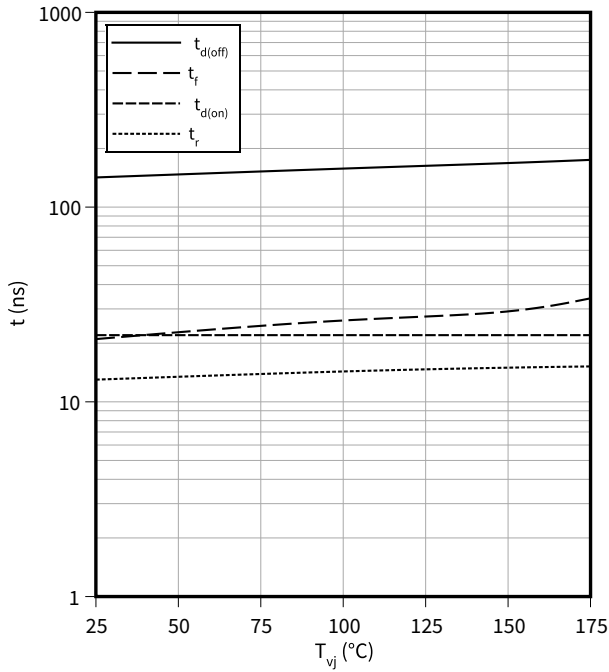


4 Characteristics diagrams

Typical switching times as a function of junction temperature

$t = f(T_{vj})$

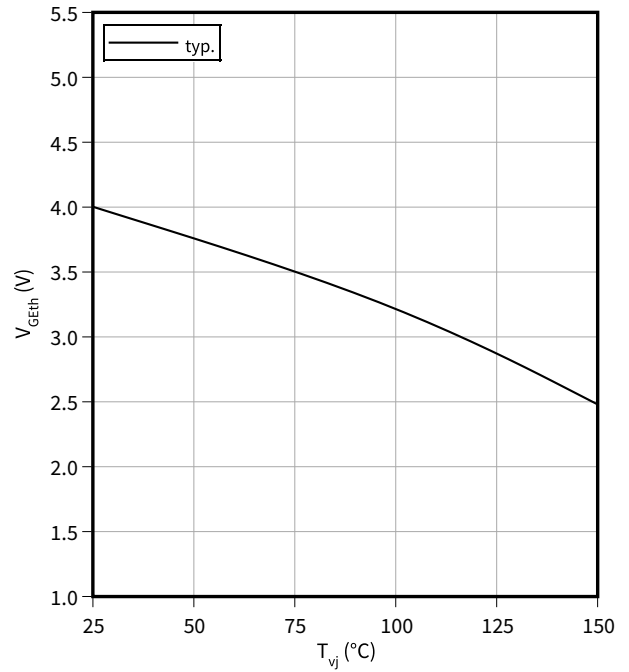
$I_C = 75 \text{ A}$, $V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 5.6 \Omega$



Gate-emitter threshold voltage as a function of junction temperature

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

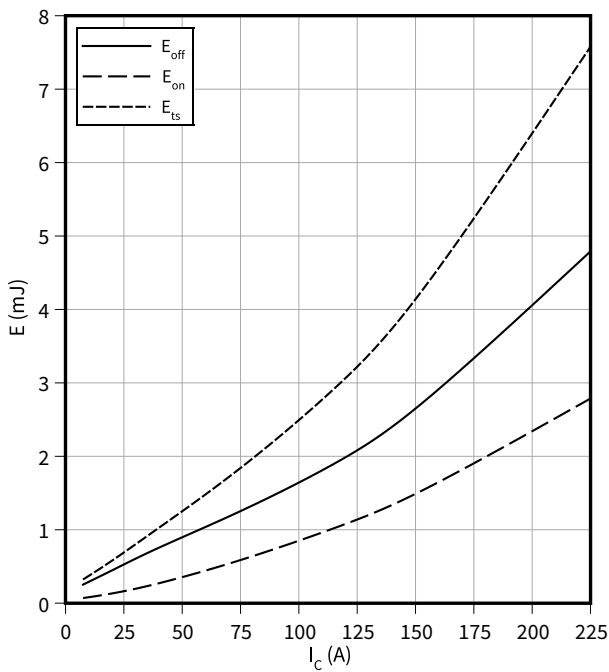
$I_C = 0.75 \text{ mA}$



Typical switching energy losses as a function of collector current

$E = f(I_C)$

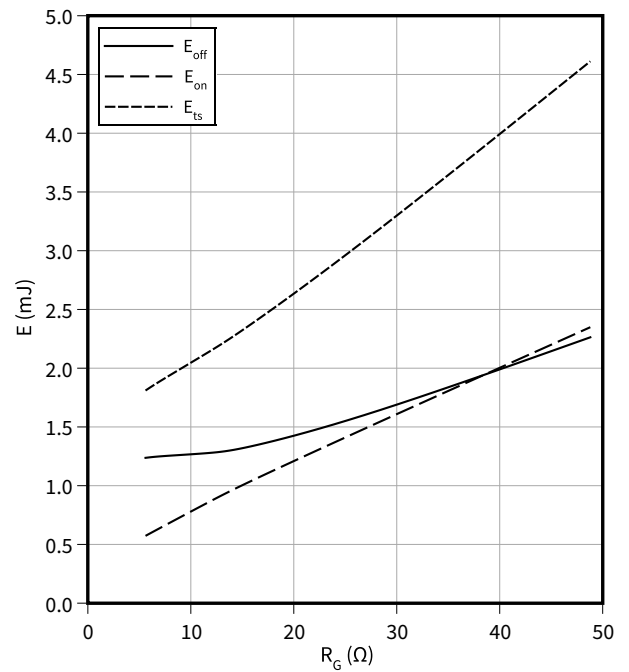
$V_{CC} = 400 \text{ V}$, $T_{vj} = 150 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 5.6 \Omega$



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

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

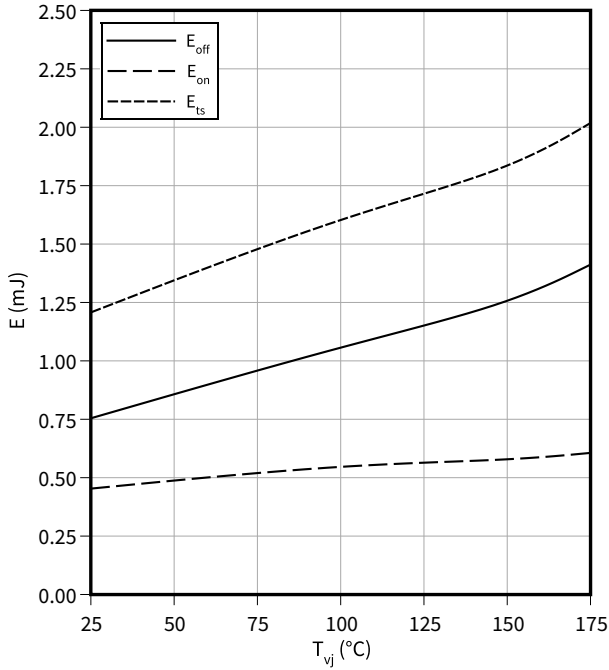


4 Characteristics diagrams

Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

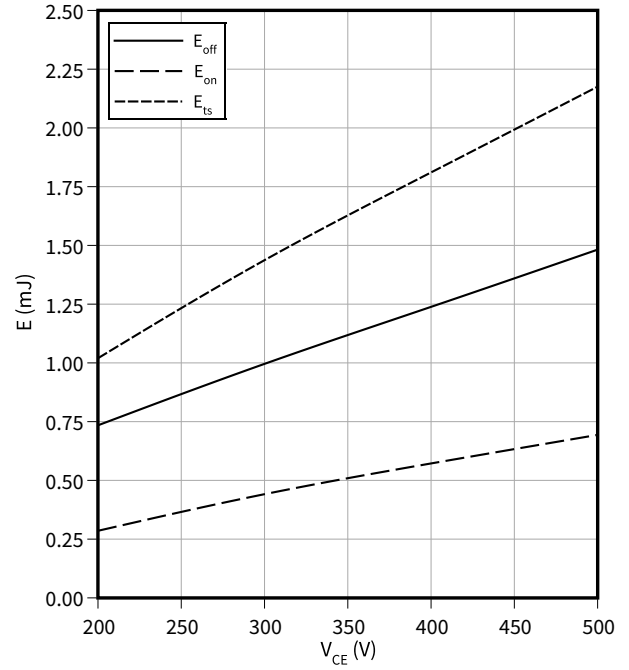
$I_C = 75\text{ A}$, $V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_G = 5.6\ \Omega$



Typical switching energy losses as a function of collector emitter voltage

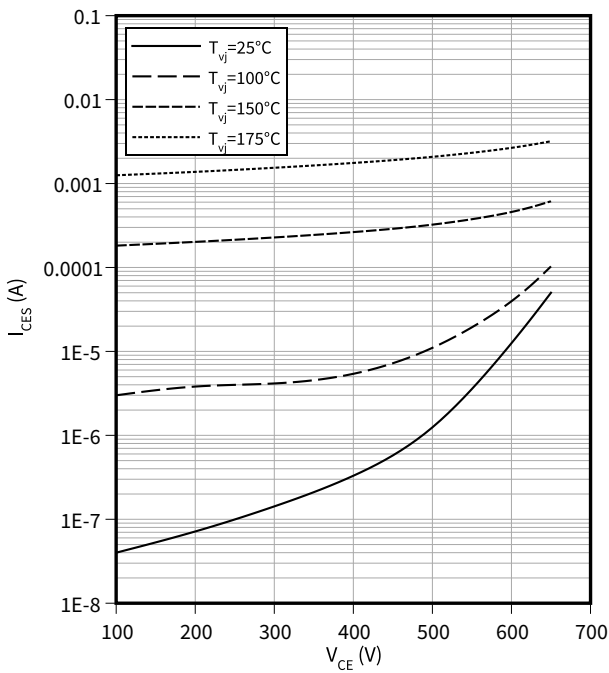
$E = f(V_{CE})$

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



Typ. reverse current vs. reverse voltage as a function of Tvj

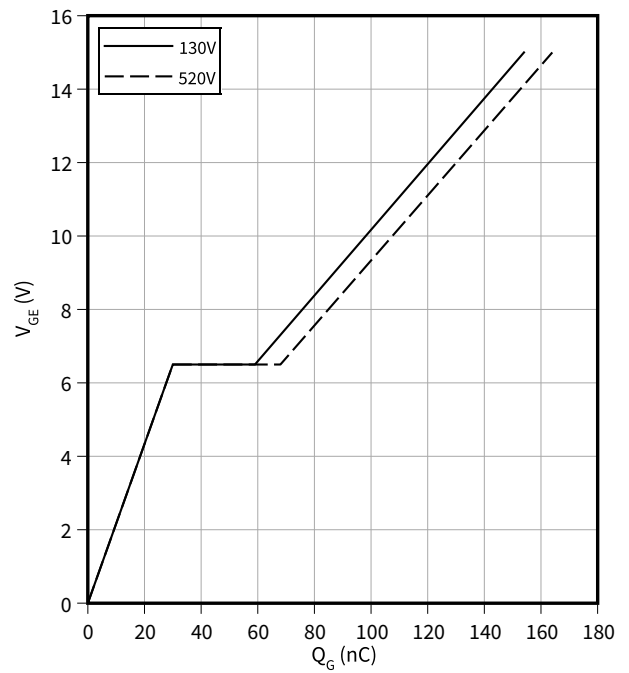
$I_{CES} = f(V_{CE})$



Typical gate charge

$V_{GE} = f(Q_G)$

$I_C = 75\text{ A}$

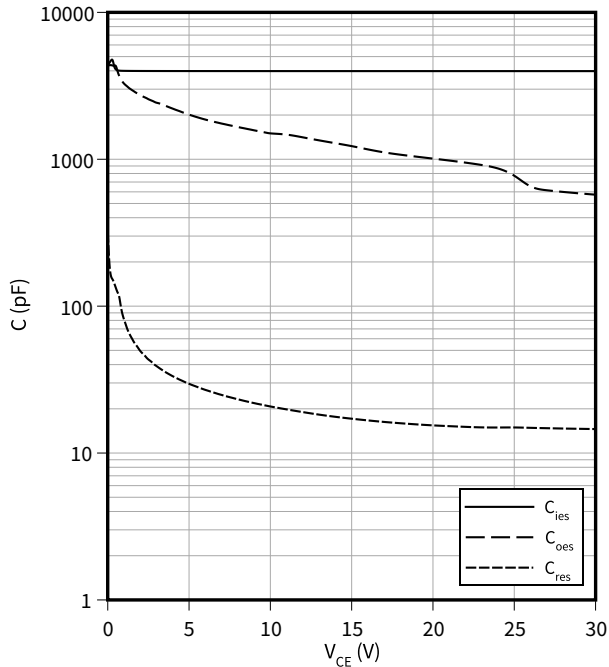


4 Characteristics diagrams

Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

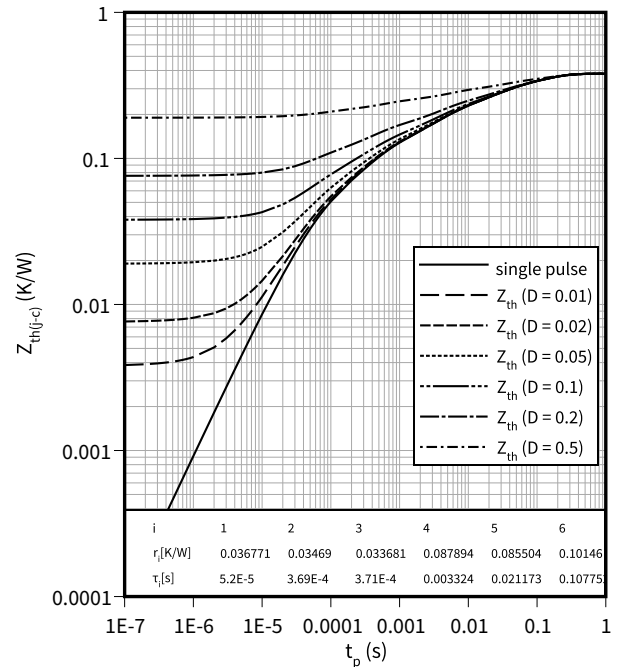
$f = 250 \text{ kHz}, V_{GE} = 0 \text{ V}$



IGBT transient thermal impedance as a function of pulse width

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

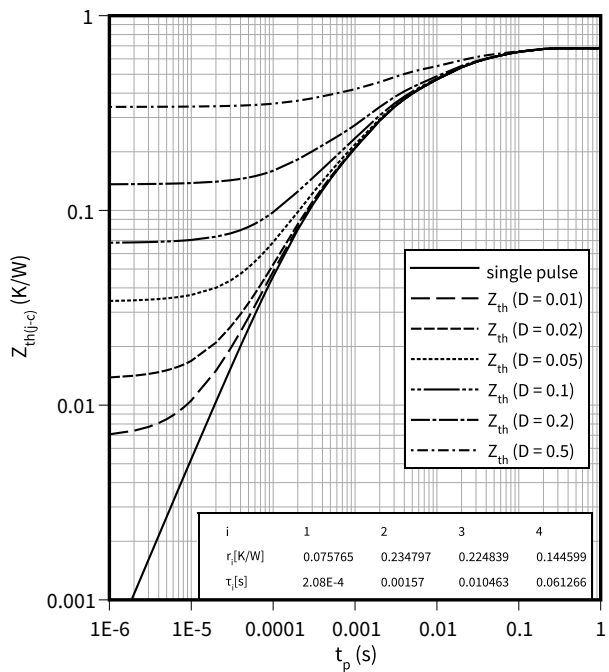
$D = t_p/T$



Diode transient thermal impedance as a function of pulse width

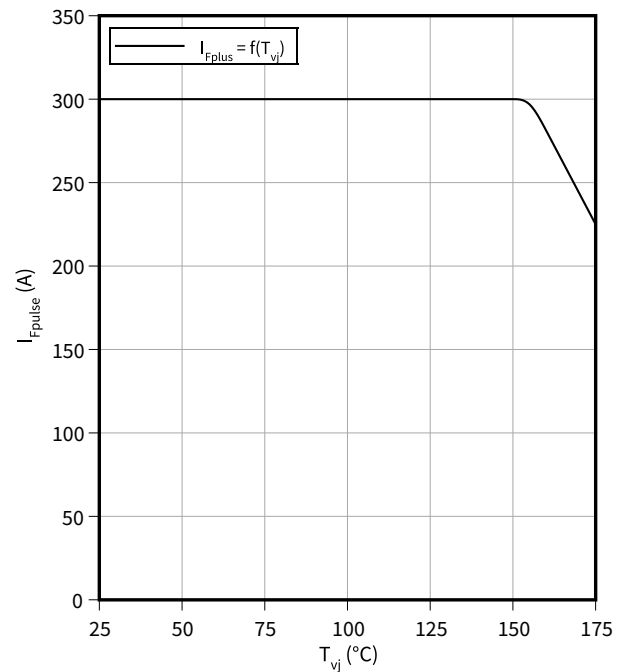
$Z_{th(j-c)} = f(t_p)$

$D = t_p/T$



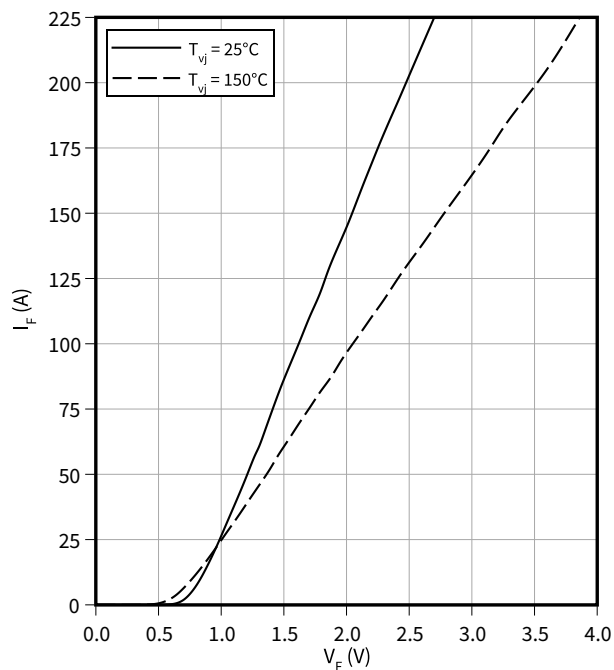
Maximum pulse current as a function of junction temperature

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



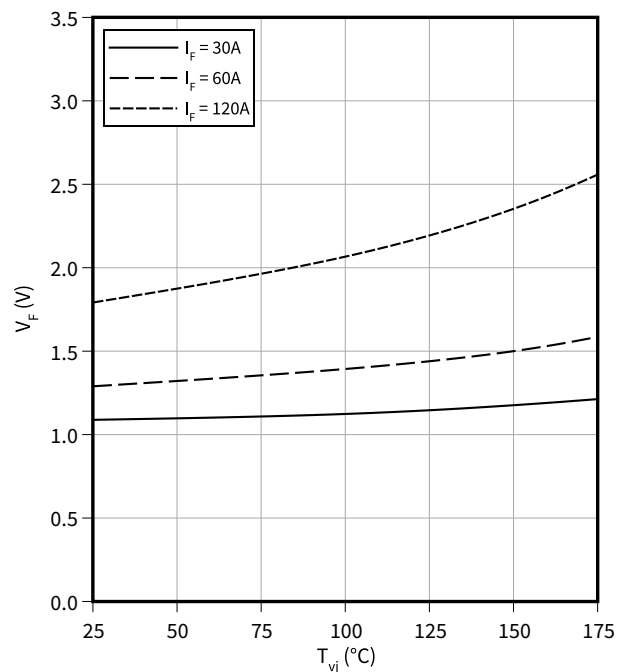
Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$



Typical diode forward voltage as a function of junction temperature

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



5 Package outlines

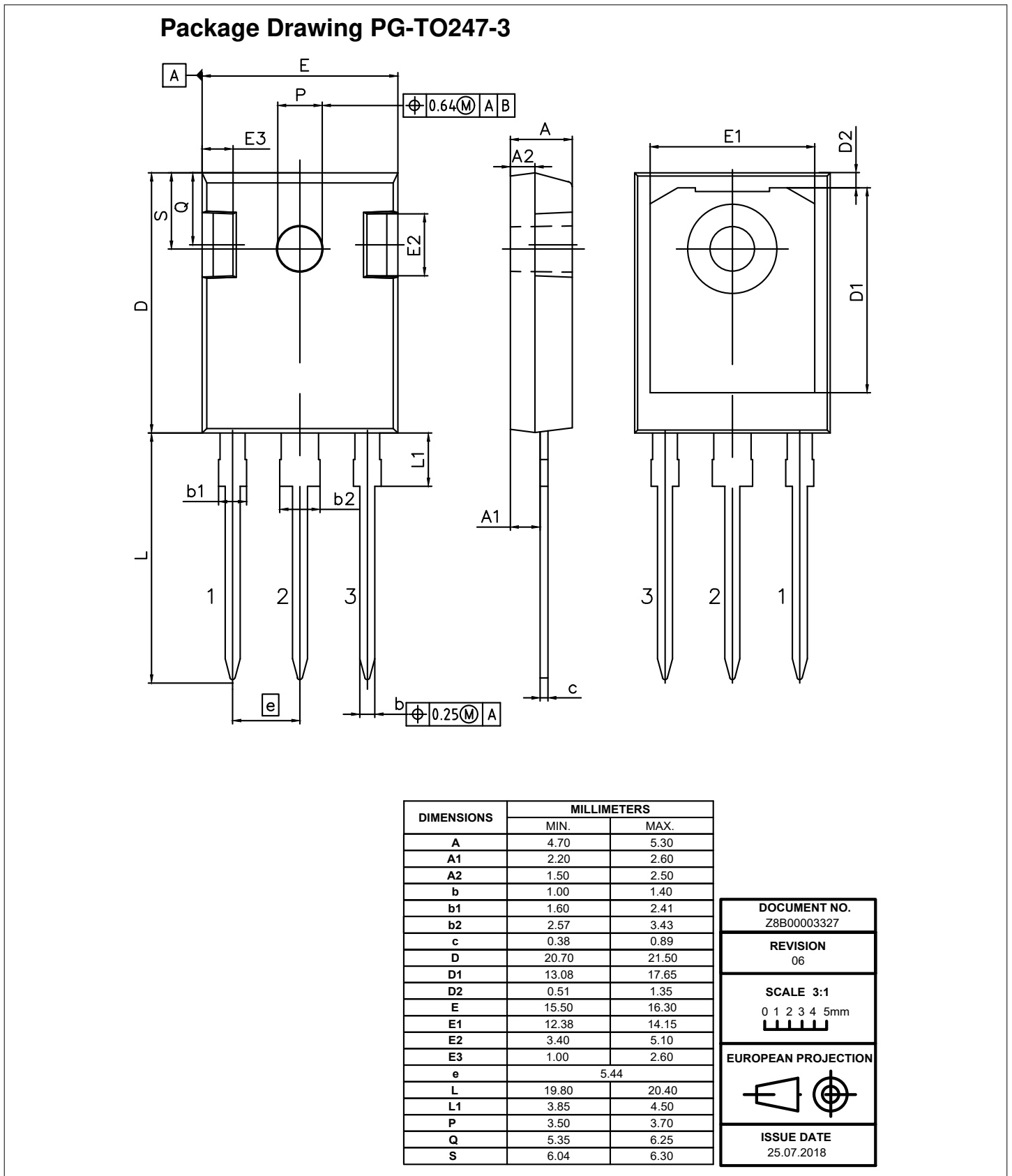


Figure 1

6 Testing conditions

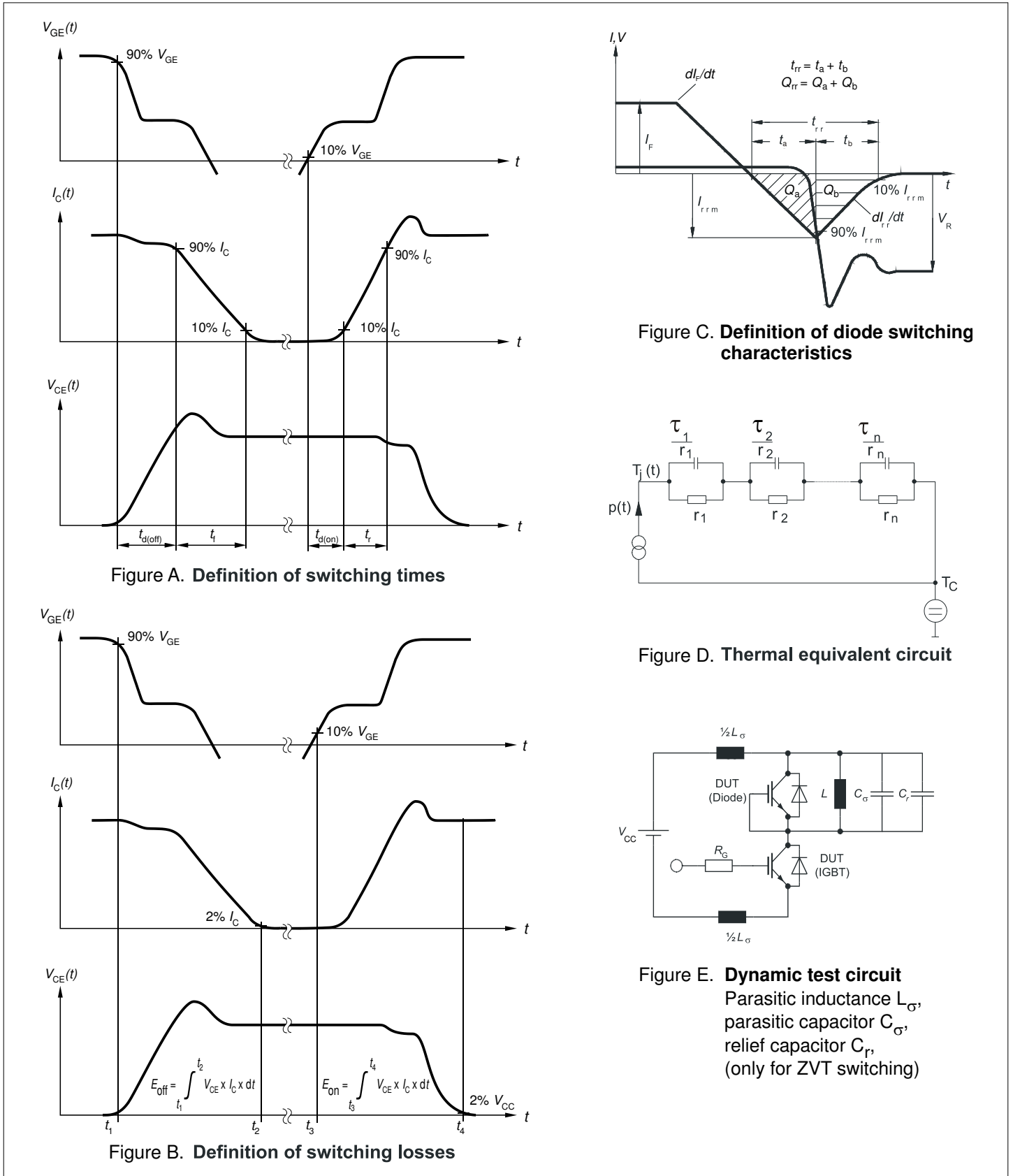


Figure 2

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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