

**High speed and low saturation voltage 650 V TRENCHSTOP™ IGBT7 technology copacked with soft, fast recovery Emitter Controlled 7 diode**

**Features**

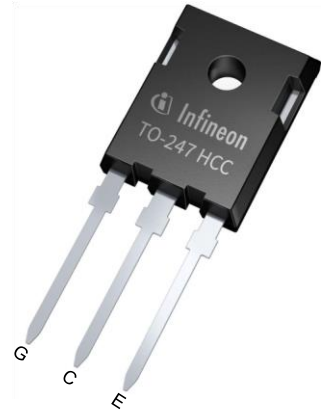
- $V_{CE} = 650\text{ V}$
- $I_C = 50\text{ A}$
- Low switching losses
- Very low collector-emitter saturation voltage  $V_{CEsat}$
- Very soft, fast recovery antiparallel diode
- Smooth switching behavior
- Humidity robustness
- Optimized for hard switching, two- and three-level topologies
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

**Potential applications**

- Industrial UPS
- EV-Charging
- String inverter
- Welding

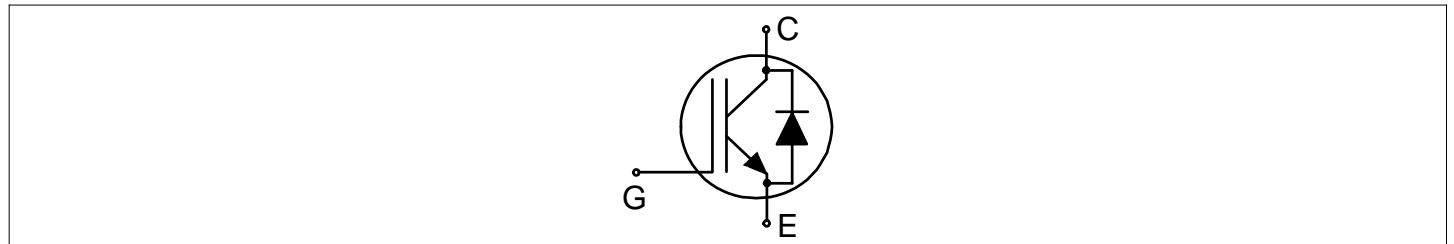
**Product validation**

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



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

**Description**



Type	Package	Marking
IKWH50N65EH7	PG-TO247-3-STD-NN4.8	K50EEH7

Datasheet [Please read the sections "Important notice" and "Warnings" at the end of this document](#) [www.infineon.com](http://www.infineon.com)

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## 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		nH
Storage temperature	$T_{stg}$		-55		150	°C
Soldering temperature	$T_{sold}$	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
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.46	0.6	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.61	0.8	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
			$T_c = 100 \text{ °C}$	65	
				200	A
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cpulse}$			A	
Turn-off safe operating area		$V_{CE} \leq 650 \text{ V}$ , $t_p \leq 1 \text{ }\mu\text{s}$ , $T_{vj} \leq 175 \text{ °C}$	200	A	
Gate-emitter voltage	$V_{GE}$		$\pm 20$	V	
Transient gate-emitter voltage	$V_{GE}$	$t_p \leq 10 \text{ }\mu\text{s}$ , $D < 0.01$	$\pm 30$	V	
Power dissipation	$P_{tot}$	$T_c = 25 \text{ °C}$	249	W	
		$T_c = 100 \text{ °C}$	123		

Table 3 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	

# IKWH50N65EH7

## High speed and low saturation voltage 650 V TRENCHSTOP™ IGBT7 technology



Collector-emitter saturation voltage	$V_{CEsat}$	$I_C = 50\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.4	1.65	V
			$T_{vj} = 175\text{ °C}$		1.6		

(table continues...)

## (continued) Characteristic values

2 IGBT

Table 3

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Gate-emitter threshold voltage	$V_{GEth}$	$I_C = 0.44 \text{ mA}$ , $V_{CE} = V_{GE}$	2.9	3.85	4.8	V
Zero gate-voltage collector current	$I_{CES}$	$V_{CE} = 650 \text{ V}$ , $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		15	$\mu\text{A}$
			$T_{vj} = 175 \text{ °C}$		1500	
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0 \text{ V}$ , $V_{GE} = 20 \text{ V}$			100	nA
Transconductance	$g_{fs}$	$I_C = 50 \text{ A}$ , $V_{CE} = 20 \text{ V}$		67		S
Input capacitance	$C_{ies}$	$V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ , $f = 100 \text{ kHz}$		2566		pF
Output capacitance	$C_{oes}$	$V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ , $f = 100 \text{ kHz}$		84		pF
Reverse transfer capacitance	$C_{res}$	$V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ , $f = 100 \text{ kHz}$		10.7		pF
Gate charge	$Q_G$	$V_{CC} = 520 \text{ V}$ , $I_C = 50 \text{ A}$ , $V_{GE} = 15 \text{ V}$		102		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400 \text{ V}$ , $V_{GE} = 0/15 \text{ V}$ , $R_{G(on)} = 10 \text{ }\Omega$ , $R_{G(off)} = 10 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$ , $I_C = 50 \text{ A}$		19	ns
			$T_{vj} = 175 \text{ °C}$ , $I_C = 50 \text{ A}$		21	
Rise time (inductive load)	$t_r$	$V_{CC} = 400 \text{ V}$ , $V_{GE} = 0/15 \text{ V}$ , $R_{G(on)} = 10 \text{ }\Omega$ , $R_{G(off)} = 10 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$ , $I_C = 50 \text{ A}$		29	ns
			$T_{vj} = 175 \text{ °C}$ , $I_C = 50 \text{ A}$		41	
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400 \text{ V}$ , $V_{GE} = 0/15 \text{ V}$ , $R_{G(on)} = 10 \text{ }\Omega$ , $R_{G(off)} = 10 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$ , $I_C = 50 \text{ A}$		147	ns
			$T_{vj} = 175 \text{ °C}$ , $I_C = 50 \text{ A}$		172	
Fall time (inductive load)	$t_f$	$V_{CC} = 400 \text{ V}$ , $V_{GE} = 0/15 \text{ V}$ , $R_{G(on)} = 10 \text{ }\Omega$ , $R_{G(off)} = 10 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$ , $I_C = 50 \text{ A}$		42	ns
			$T_{vj} = 175 \text{ °C}$ , $I_C = 50 \text{ A}$		59	
Turn-on energy	$E_{on}$	$V_{CC} = 400 \text{ V}$ , $V_{GE} = 0/15 \text{ V}$ , $R_{G(on)} = 10 \text{ }\Omega$ , $R_{G(off)} = 10 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$ , $I_C = 50 \text{ A}$		1.27	mJ
			$T_{vj} = 175 \text{ °C}$ , $I_C = 50 \text{ A}$		2.1	

## (continued) Characteristic values

Turn-off energy	$E_{off}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \Omega,$ $R_{G(off)} = 10 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 50 \text{ A}$	0.65	mJ
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 50 \text{ A}$	0.95	

(table continues...)

3 Diode

Table 3

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy	$E_{ts}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \Omega,$ $R_{G(off)} = 10 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 50 \text{ A}$	1.92	mJ	
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 50 \text{ A}$	3.05		
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	
Diode forward current, limited by $T_{vjmax}$	$I_F$	limited by bondwire	$T_c = 25 \text{ }^\circ\text{C}$	80	A
			$T_c = 100 \text{ }^\circ\text{C}$	59	
Diode pulsed current, $t_p$ limited by $T_{vjmax}$	$I_{Fpulse}$		200	A	
Power dissipation	$P_{tot}$		$T_c = 25 \text{ }^\circ\text{C}$	187	W
			$T_c = 100 \text{ }^\circ\text{C}$	92	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	$V_F$	$I_F = 50 \text{ A}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	1.65	2	V
			$T_{vj} = 175 \text{ }^\circ\text{C}$	1.55		
Diode reverse recovery time	$t_{rr}$	$V_R = 400 \text{ V}, R_{G(on)} = 10 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_F = 50 \text{ A}$	76	ns	
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_F = 50 \text{ A}$	115		

## (continued) Characteristic values

Diode reverse recovery charge	$Q_{rr}$	$V_R = 400 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 50 \text{ A}$	1.12	$\mu\text{C}$
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 50 \text{ A}$	2.41	
Diode peak reverse recovery current	$I_{rrm}$	$V_R = 400 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 50 \text{ A}$	24.3	A
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 50 \text{ A}$	33.8	

(table continues...)

3 Diode

Table 5

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode peak rate of fall of reverse recovery current	$di_{rr}/dt$	$V_R = 400 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 50 \text{ A}$		-1480	$\text{A}/\mu\text{s}$
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 50 \text{ A}$		-861	
Reverse recovery energy	$E_{rec}$	$V_R = 400 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 50 \text{ A}$		0.25	mJ
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 50 \text{ A}$		0.51	
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.

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

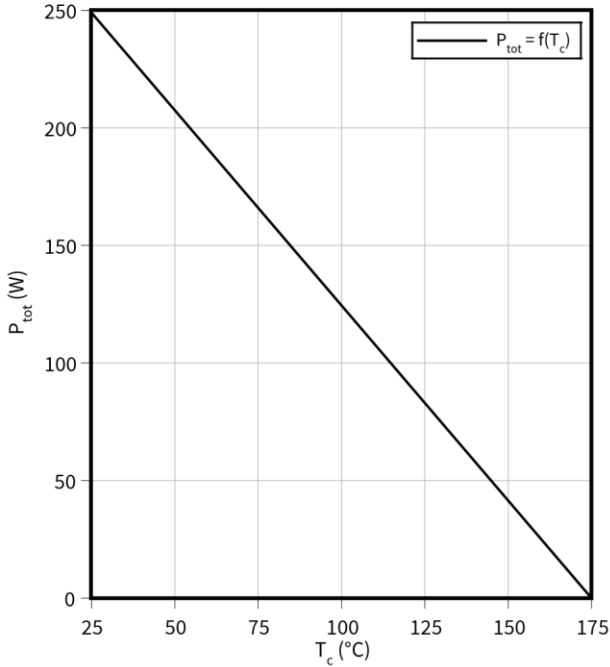
Dynamic test circuit, parasitic inductance  $L_\sigma = 8 \text{ nH}$ , parasitic capacitor  $C_\sigma = 30 \text{ pF}$  from Fig. E. Energy losses include "tail" and diode reverse recovery.

4 Characteristics diagrams

**4 Characteristics diagrams**

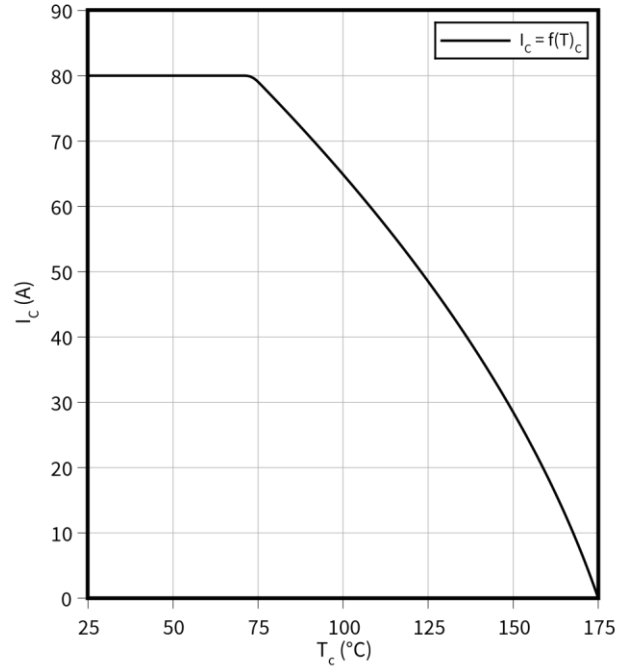
**Power dissipation as a function of case temperature**

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



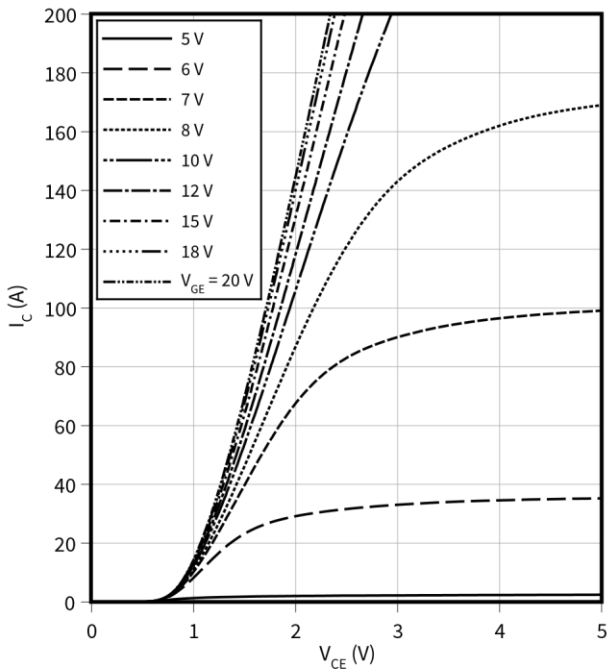
**Collector current as a function of case temperature**

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



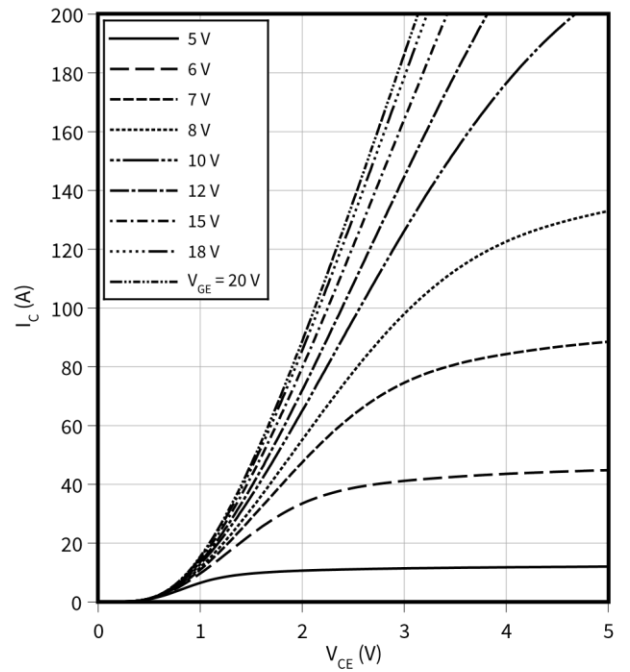
**Typical output characteristic**

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



**Typical output characteristic**

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

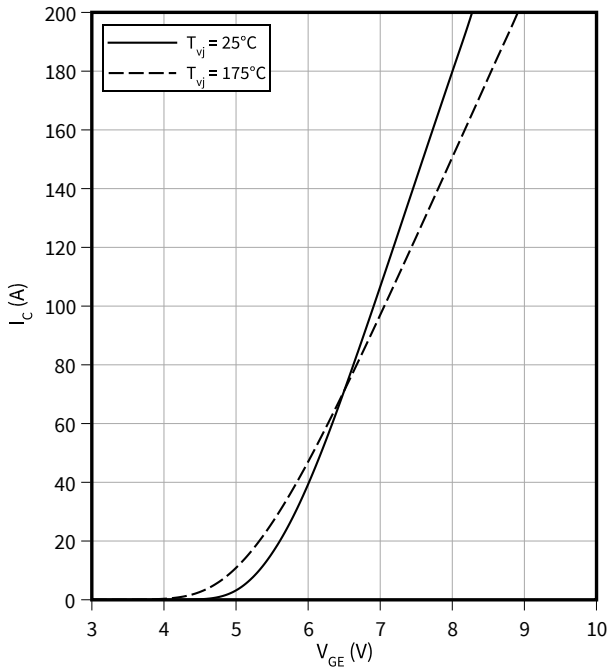




**Typical transfer characteristic**

$I_C = f(V_{GE})$

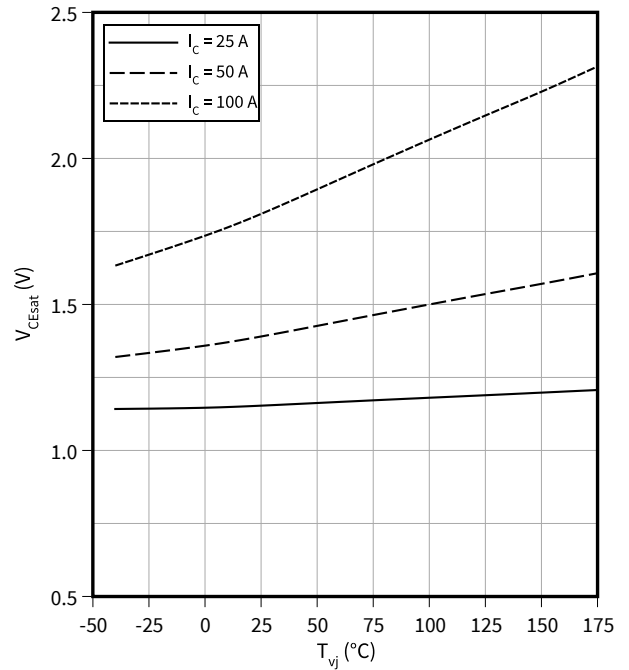
$V_{CE} = 20\text{ V}$



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

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

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



**Gate-emitter threshold voltage as a function of junction temperature**

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

$I_C = 0.44\text{ mA}$

**Typical switching times as a function of collector current**

$t = f(I_C)$

$V_{CC} = 400\text{ V}, T_{vj} = 175^\circ\text{C}, V_{GE} = 0/15\text{ V}, R_G = 10\ \Omega$

0

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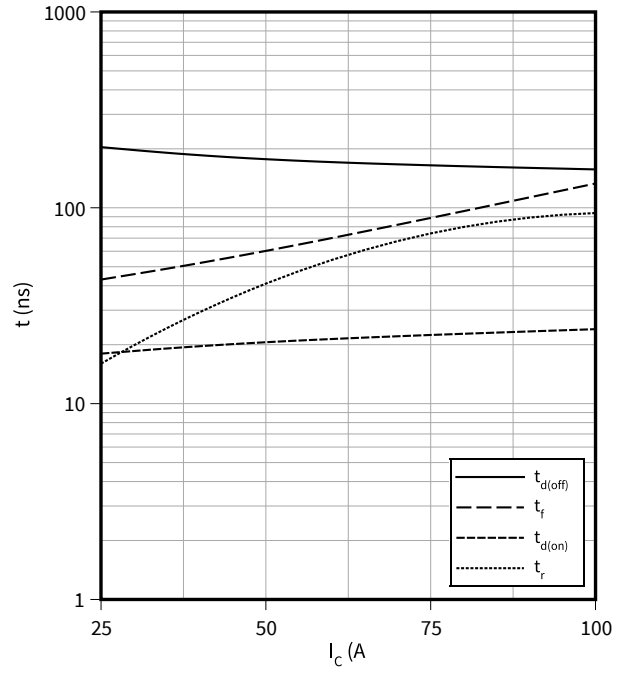
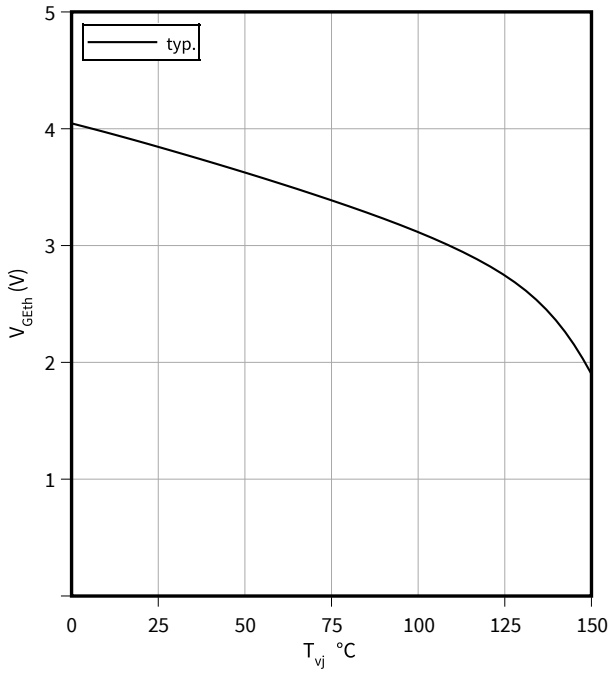
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**4 Characteristics diagrams**



**Typical switching times as a function of gate resistor**

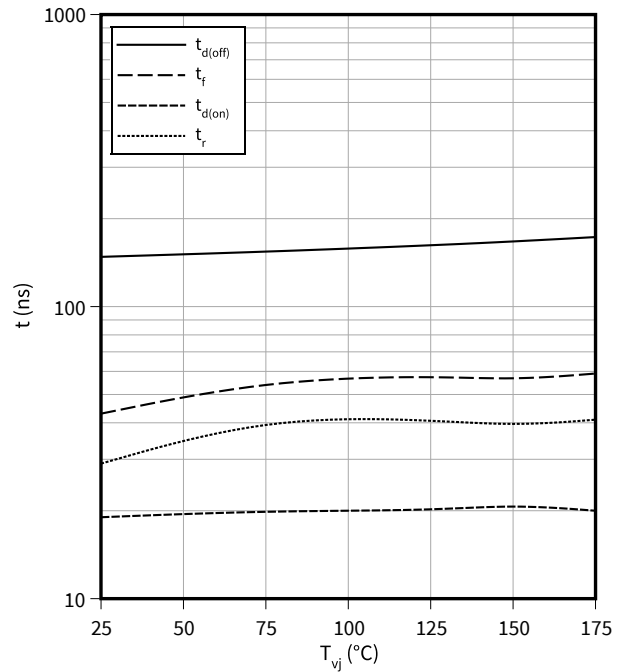
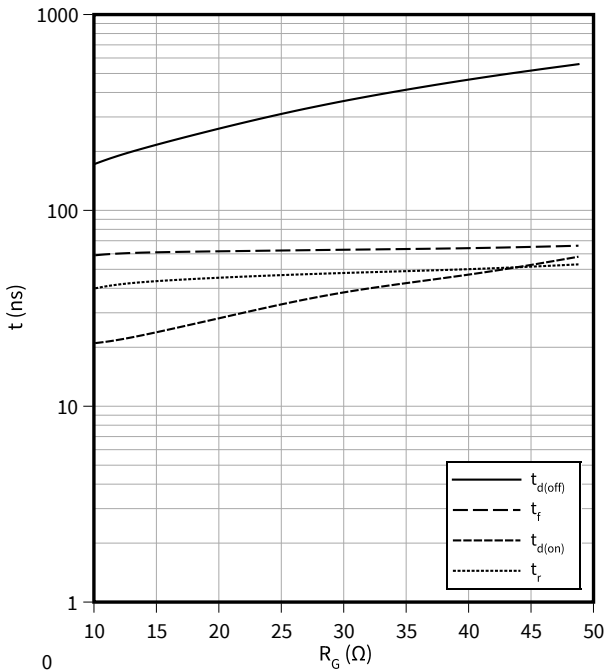
$t = f(R_G)$

$I_C = 50\text{ A}, V_{CC} = 400\text{ V}, T_{vj} = 175\text{ }^{\circ}C, V_{GE} = 0/15\text{ V}$

**Typical switching times as a function of junction temperature**

$t = f(T_{vj})$

$I_C = 50\text{ A}, V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 10\text{ }\Omega$



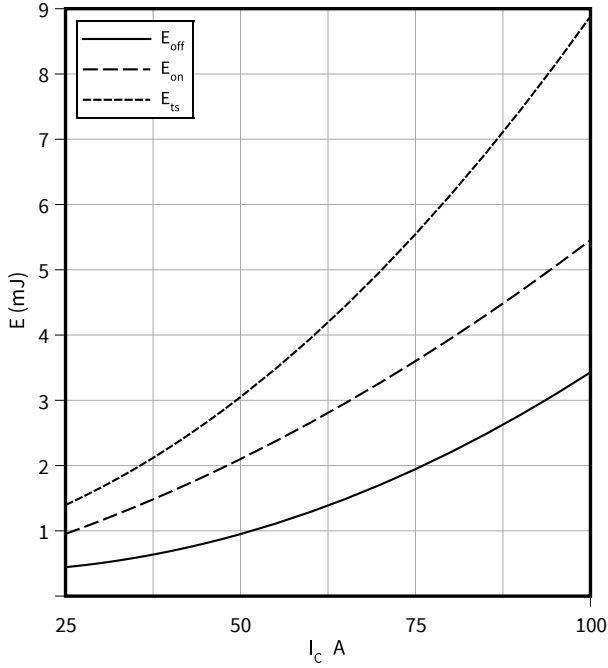
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**Typical switching energy losses as a function of collector current**

$E = f(I_C)$

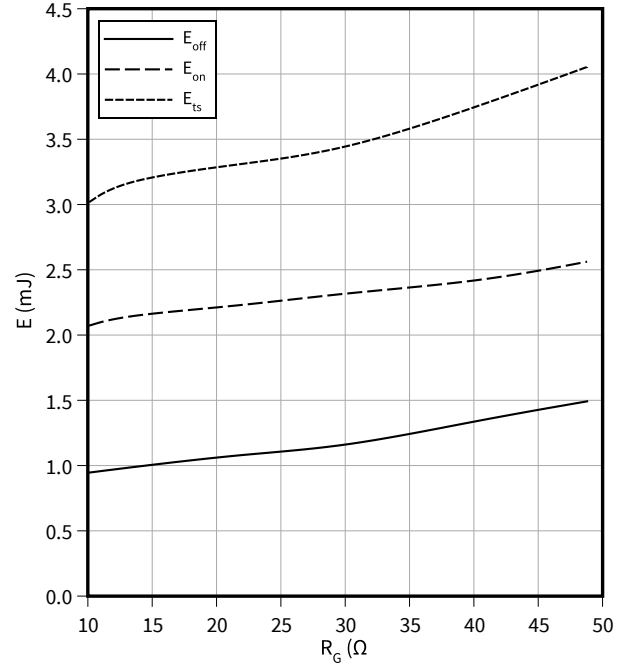
$V_{CC} = 400\text{ V}$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{GE} = 0/15\text{ V}$ ,  $R_G = 10\text{ }\Omega$



**Typical switching energy losses as a function of gate resistor**

$E = f(R_G)$

$I_C = 50\text{ A}$ ,  $V_{CC} = 400\text{ V}$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{GE} = 0/15\text{ V}$



**Typical switching energy losses as a function of junction temperature**

$E = f(T_{vj})$

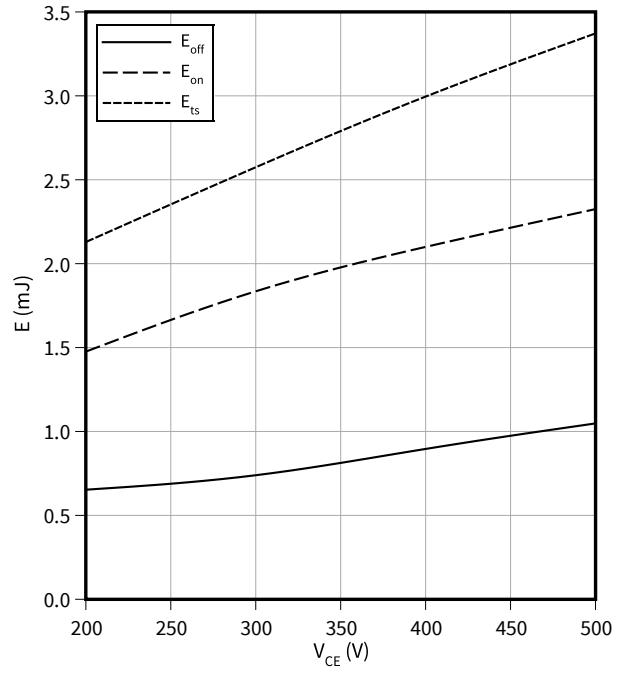
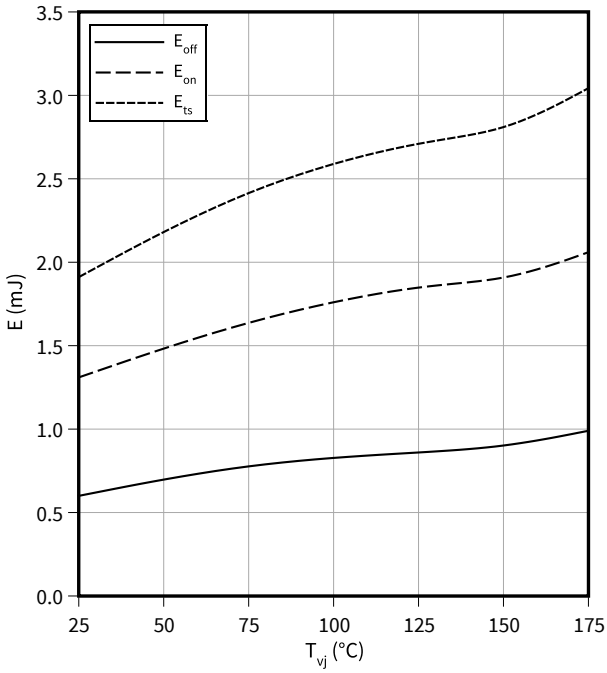
$I_C = 50\text{ A}$ ,  $V_{CC} = 400\text{ V}$ ,  $V_{GE} = 0/15\text{ V}$ ,  $R_G = 10\text{ }\Omega$

**Typical switching energy losses as a function of collector emitter voltage**

$E = f(V_{CE})$

$I_C = 50\text{ A}$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{GE} = 0/15\text{ V}$ ,  $R_G = 10\text{ }\Omega$

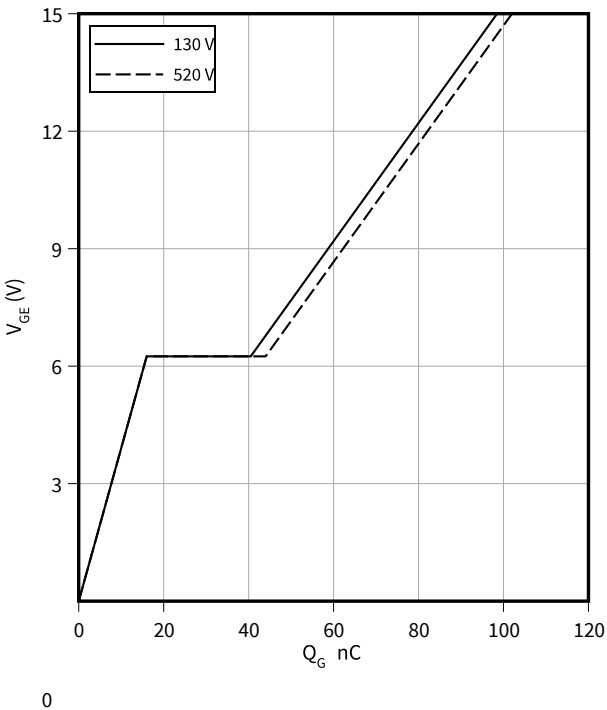
**4 Characteristics diagrams**



**Typical gate charge**

$V_{GE} = f(Q_G)$

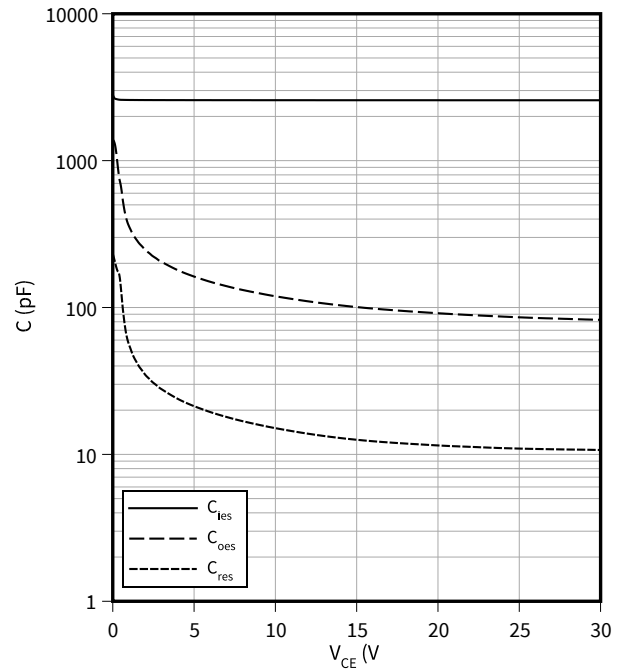
$I_C = 50 \text{ A}$



**Typical capacitance as a function of collector-emitter voltage**

$C = f(V_{CE})$

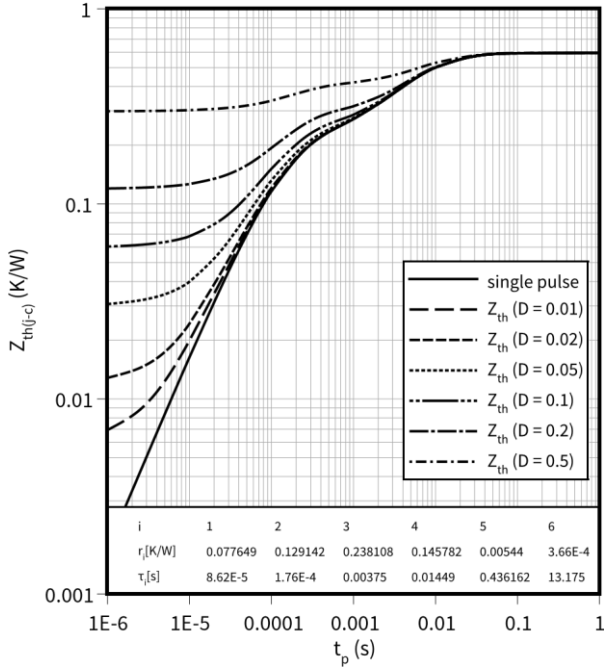
$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}$



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

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

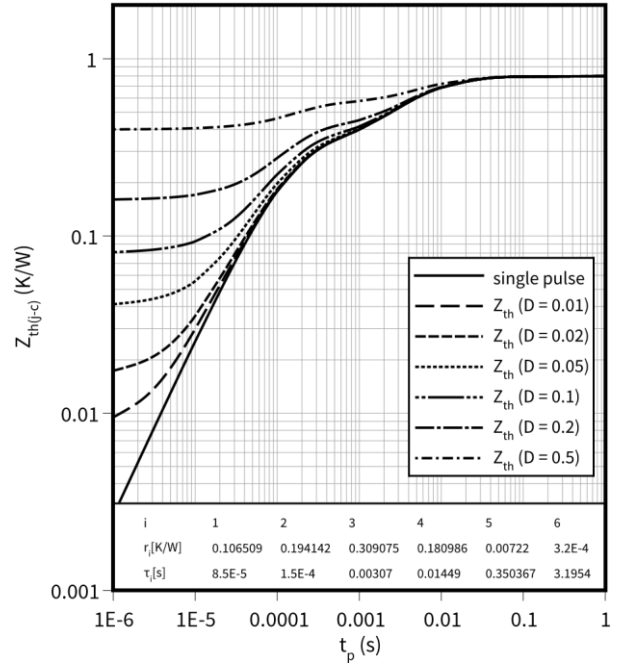
$D = t_p/T$



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

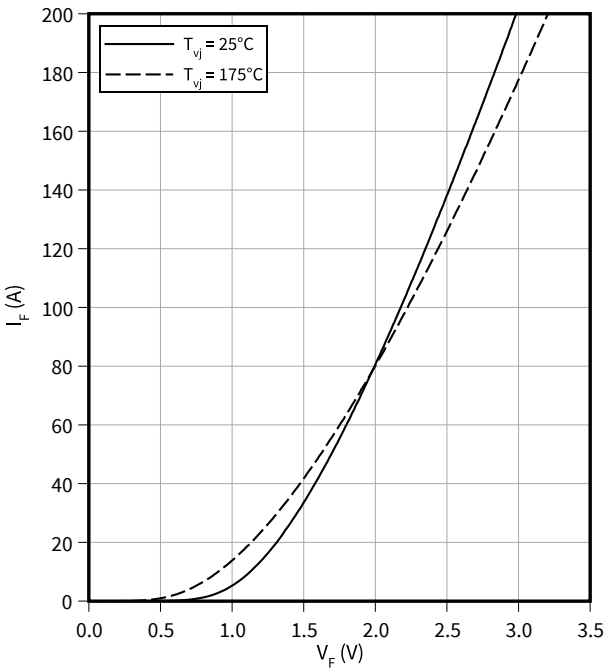
$Z_{th(j-c)} = f(t_p)$

$D = t_p/T$



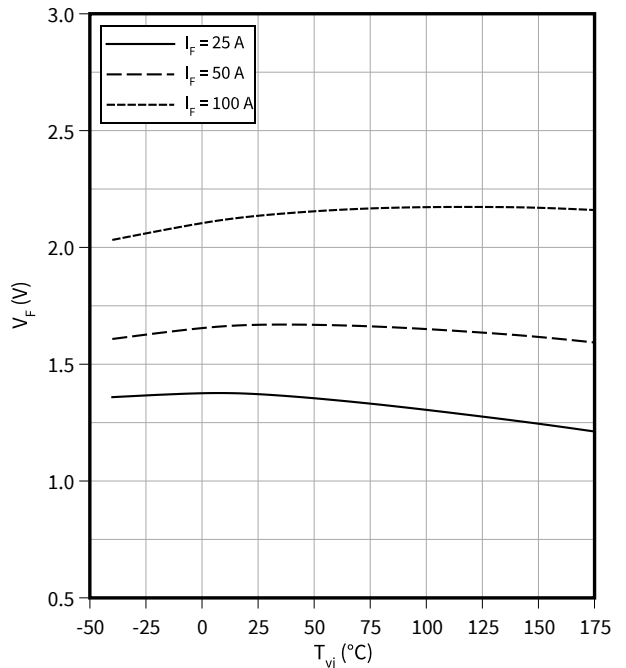
**Typical diode forward current as a function of forward voltage**

$I_F = f(V_F)$



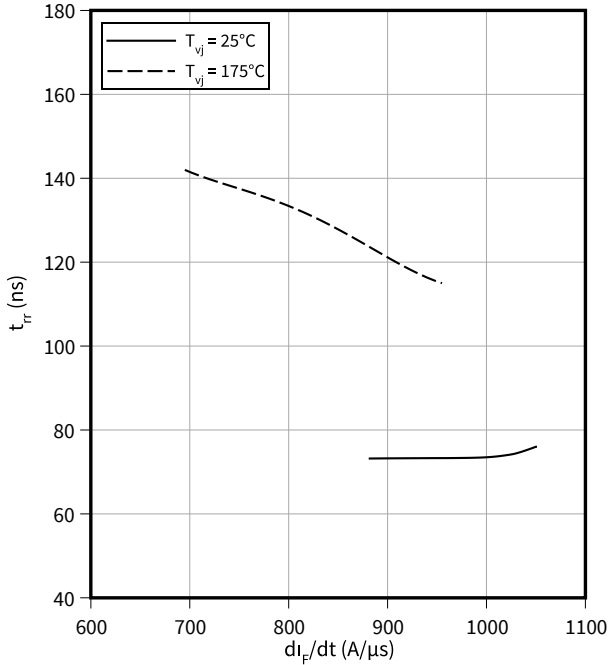
**Typical diode forward voltage as a function of junction temperature**

$V_F = f(T_{vj})$



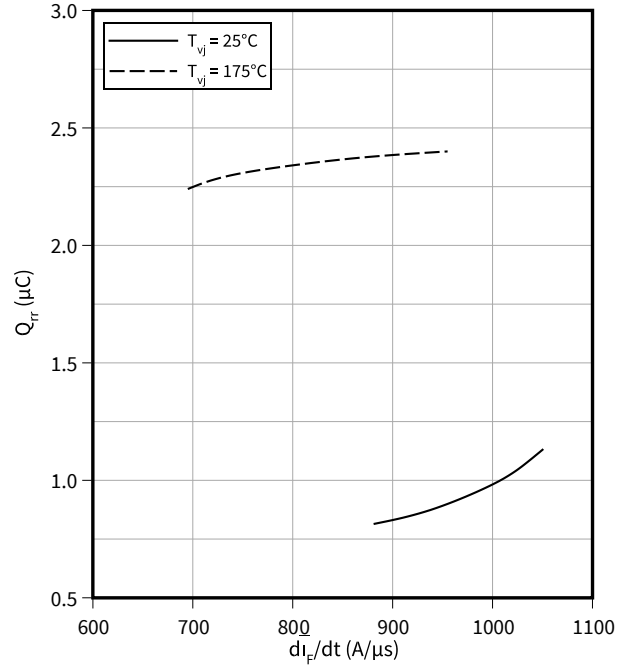
**Typical reverse recovery time as a function of diode current slope**

$t_{rr} = f(di_F/dt) V_R = 400 \text{ V}, I_F = 50 \text{ A}$



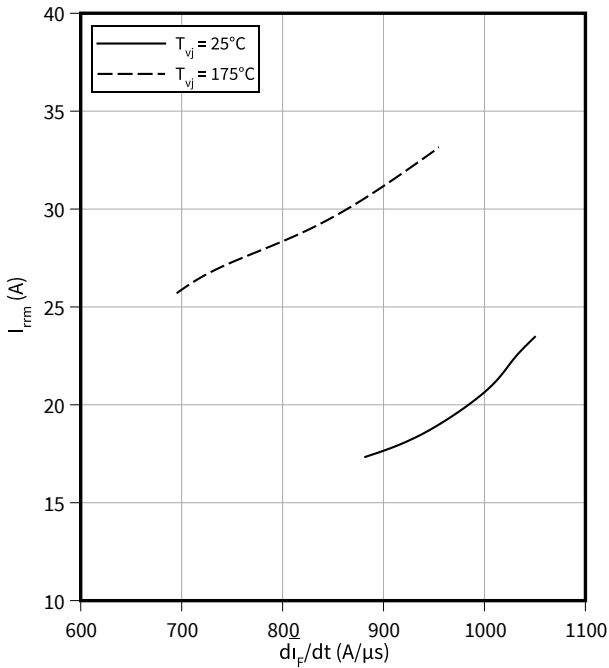
**Typical reverse recovery charge as a function of diode current slope**

$Q_{rr} = f(di_F/dt) V_R = 400 \text{ V}, I_F = 50 \text{ A}$



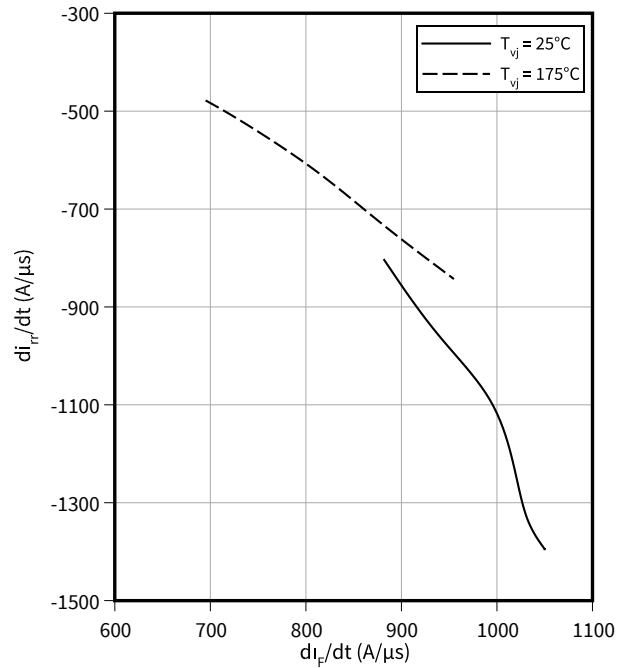
**Typical reverse recovery current as a function of diode current slope**

$I_{rrm} = f(di_F/dt) V_R = 400 \text{ V}, I_F = 50 \text{ A}$



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

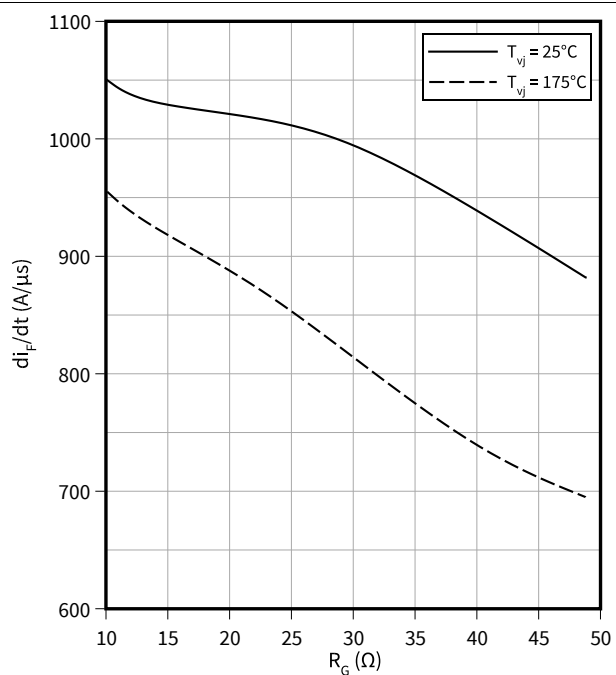
$di_{rr}/dt = f(di_F/dt) V_R = 400 \text{ V}, I_F = 50 \text{ A}$



4 Characteristics diagrams

**Typical diode current slope as a function of gate resistor**

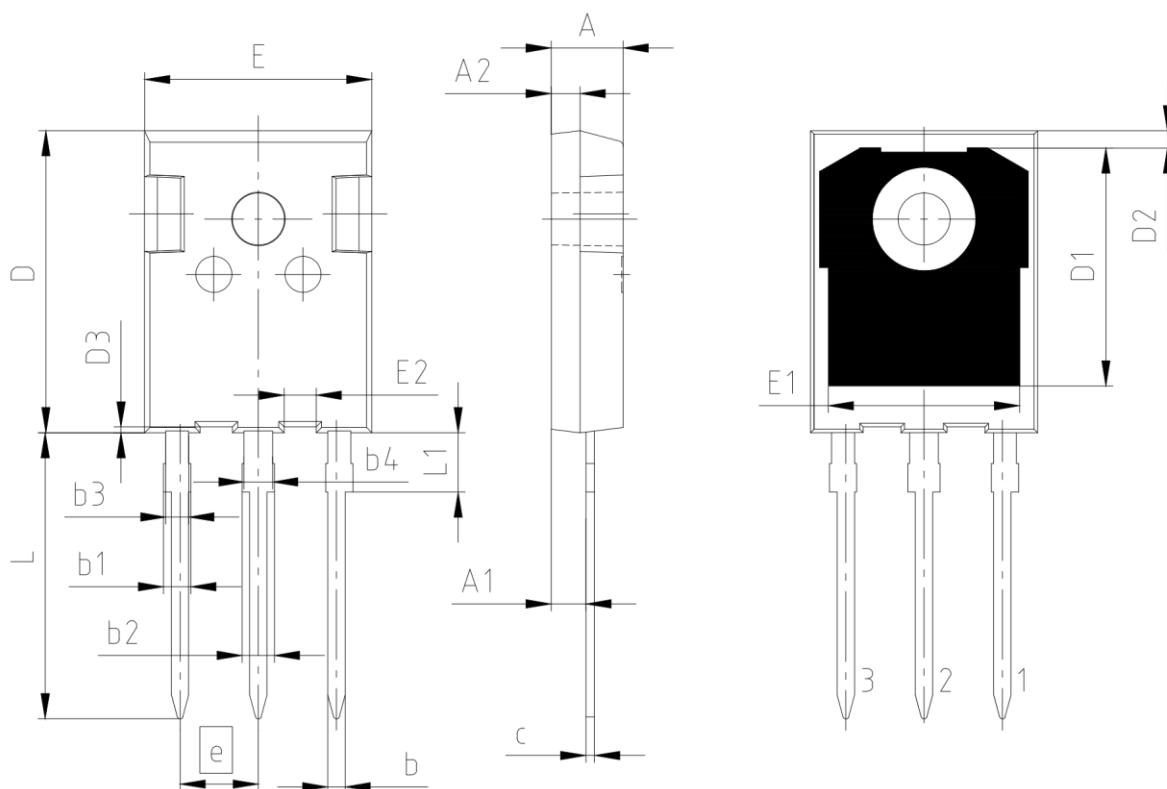
$di_F/dt = f(R_G)$   $V_R = 400$  V,  $I_F = 50$  A



5 Package outlines

**5 Package outlines**

**PG-TO247-3-STD-NN4.8**



PACKAGE - GROUP NUMBER:		<b>PG-TO247-3-U04</b>	
DIMENSIONS	MILLIMETERS		
	MIN.	MAX.	
<b>A</b>	4.90	5.10	
<b>A1</b>	2.31	2.51	
<b>A2</b>	1.90	2.10	
<b>b</b>	1.16	1.26	
<b>b1</b>		1.90	
<b>b2</b>		2.30	
<b>b3</b>	1.55	1.65	
<b>b4</b>	1.96	2.06	
<b>c</b>	0.59	0.66	
<b>D</b>	20.90	21.10	
<b>D1</b>	16.25	16.85	
<b>D2</b>	1.05	1.35	
<b>D3</b>	0.55	0.65	
<b>E</b>	15.70	15.90	
<b>E1</b>	13.10	13.50	
<b>E2</b>	2.14	2.34	
<b>e</b>	5.44		
<b>N</b>	3		
<b>L</b>	19.80	20.10	
<b>L1</b>	3.95	4.30	



**Figure 1**

6 Testing conditions

## 6 Testing conditions

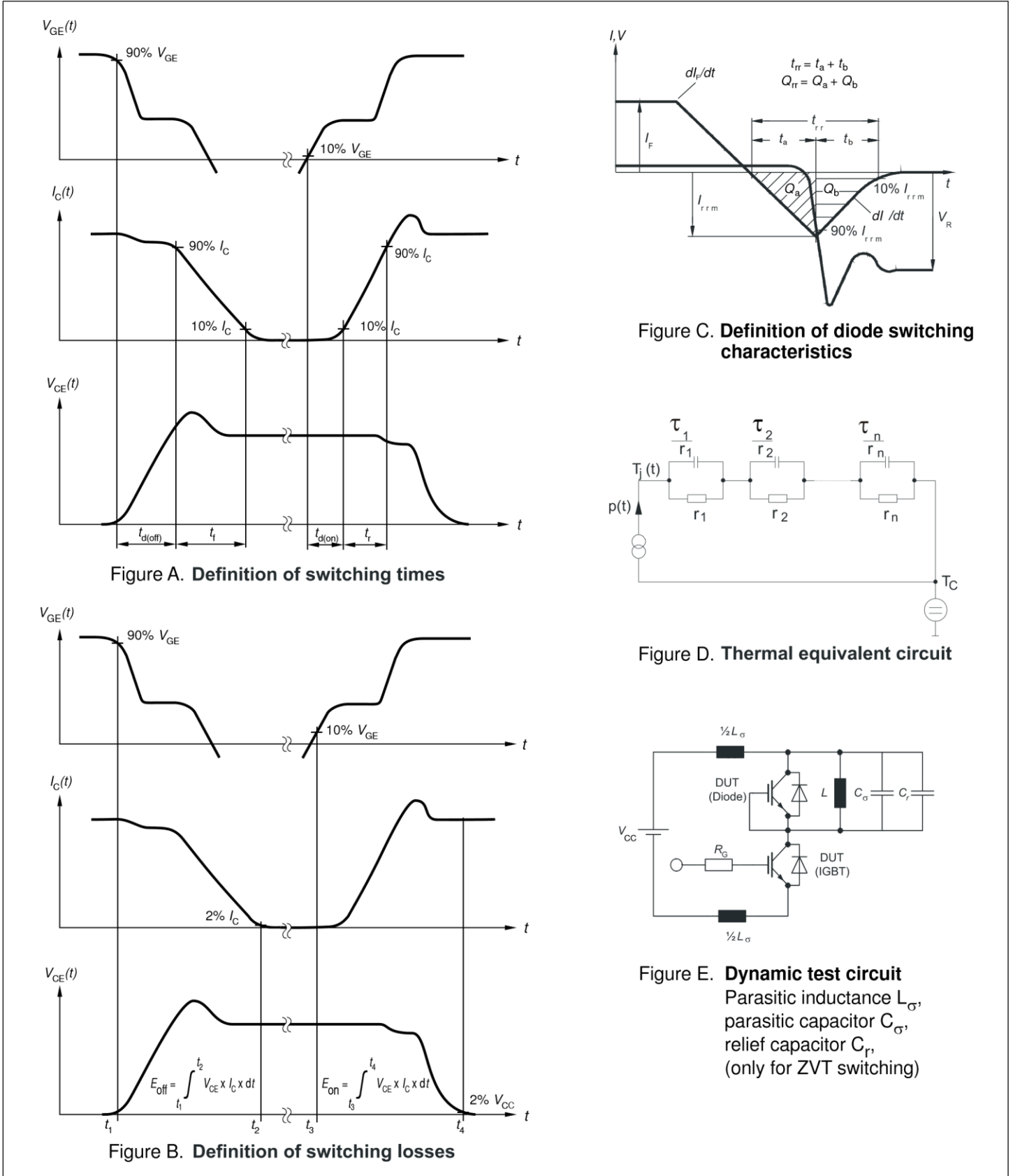


Figure 2

**Revision history****Revision history**

<b>Document revision</b>	<b>Date of release</b>	<b>Description of changes</b>
1.00	2023-04-27	Final datasheet

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