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

Features

- V_{CE} = 650 V
- I_C = 50 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

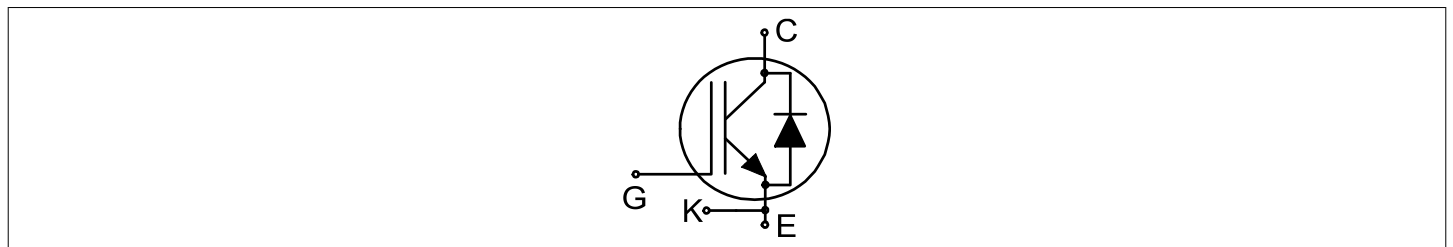- Industrial UPS
- EV-Charging
- String inverter
- Welding

Product validation

- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22
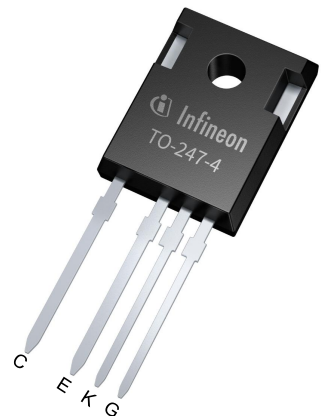
- Lead-free
- Green
- Halogen-free
- RoHS

Description

Type	Package	Marking
IKZA50N65EH7	PG-TO247-4-STD-NT3.7	K50EEH7

Table of contents

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}	$T_{vj} \geq 25\,°C$		650	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25\,°C$	80	A
			$T_c = 100\,°C$	76	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			200	A
Turn-off safe operating area		$V_{CE} \leq 650\,V$, $t_p \leq 1\,µs$, $T_{vj} \leq 175\,°C$		200	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10\,µs$, $D < 0.01$		±30	V
Power dissipation	P_{tot}		$T_c = 25\,°C$	250	W
			$T_c = 100\,°C$	124	

Table 3   Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 50\,A$, $V_{GE} = 15\,V$	$T_{vj} = 25\,°C$		1.4	1.65	V
			$T_{vj} = 175\,°C$		1.6		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Gate-emitter threshold voltage	V_{GEth}	$I_C = 0.44$ mA, $V_{CE} = V_{GE}$		2.9	3.85	4.8	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 650$ V, $V_{GE} = 0$ V	$T_{vj} = 25\ °C$			15	µA
			$T_{vj} = 175\ °C$		1500		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0$ V, $V_{GE} = 20$ V				100	nA
Transconductance	g_{fs}	$I_C = 50$ A, $V_{CE} = 20$ V			79		S
Input capacitance	C_{ies}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			2591		pF
Output capacitance	C_{oes}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			87.1		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			11.4		pF
Gate charge	Q_G	$V_{CC} = 520$ V, $I_C = 50$ A, $V_{GE} = 15$ V			103		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25\ °C$, $I_C = 50$ A		15		ns
			$T_{vj} = 175\ °C$, $I_C = 50$ A		14		
Rise time (inductive load)	t_r	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25\ °C$, $I_C = 50$ A		9		ns
			$T_{vj} = 175\ °C$, $I_C = 50$ A		12		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25\ °C$, $I_C = 50$ A		142		ns
			$T_{vj} = 175\ °C$, $I_C = 50$ A		175		
Fall time (inductive load)	t_f	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25\ °C$, $I_C = 50$ A		14		ns
			$T_{vj} = 175\ °C$, $I_C = 50$ A		18		
Turn-on energy	E_{on}	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25\ °C$, $I_C = 50$ A		0.44		mJ
			$T_{vj} = 175\ °C$, $I_C = 50$ A		0.79		
Turn-off energy	E_{off}	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25\ °C$, $I_C = 50$ A		0.49		mJ
			$T_{vj} = 175\ °C$, $I_C = 50$ A		0.97		

(table continues...)

Table 3 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Total switching energy	E_{ts}	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω	T_{vj} = 25 °C, I_C = 50 A		0.93		mJ
			T_{vj} = 175 °C, I_C = 50 A		1.76		
Operating junction temperature	T_{vj}			-40		175	°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 °C	80	A
			T_c = 100 °C	59	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			200	A
Power dissipation	P_{tot}		T_c = 25 °C	186	W
			T_c = 100 °C	94	

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 50 A	T_{vj} = 25 °C		1.65	2	V
			T_{vj} = 175 °C		1.55		
Diode reverse recovery time	t_{rr}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 50 A		54.6		ns
			T_{vj} = 175 °C, I_F = 50 A		86.4		
Diode reverse recovery charge	Q_{rr}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 50 A		1.28		µC
			T_{vj} = 175 °C, I_F = 50 A		3.4		
Diode peak reverse recovery current	I_{rrm}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 50 A		43.3		A
			T_{vj} = 175 °C, I_F = 50 A		75.9		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	$V_R = 400$ V, $R_{G(on)} = 10$ Ω	$T_{vj} = 25$ °C, $I_F = 50$ A		-1240		A/µs
			$T_{vj} = 175$ °C, $I_F = 50$ A		-1670		
Reverse recovery energy	E_{rec}	$V_R = 400$ V, $R_{G(on)} = 10$ Ω	$T_{vj} = 25$ °C, $I_F = 50$ A		0.36		mJ
			$T_{vj} = 175$ °C, $I_F = 50$ A		0.97		
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 $T_{vj} = 25$°C, unless otherwise specified.

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

4 Characteristics diagrams

Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$

$T_{vj} \leq 175\ °C$
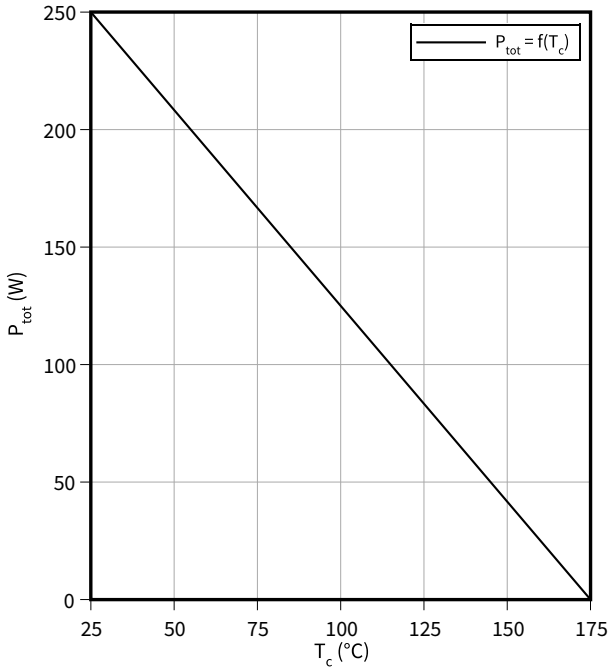
Collector current as a function of case temperature

$I_C = f(T_c)$

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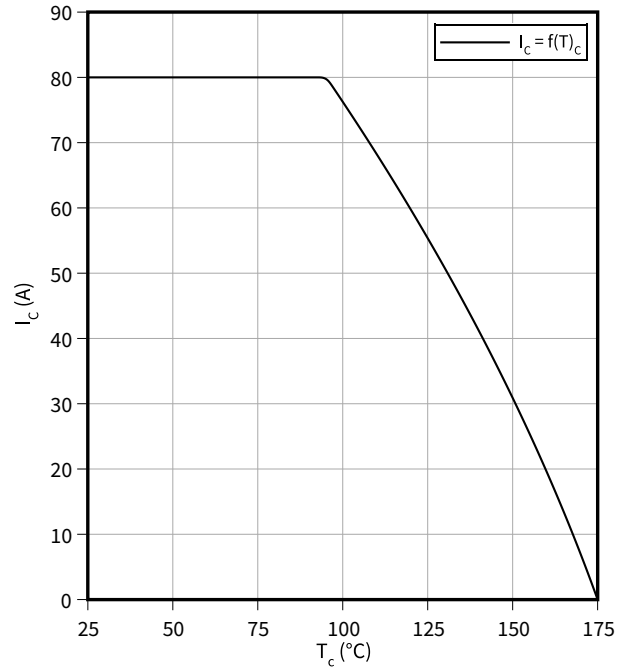
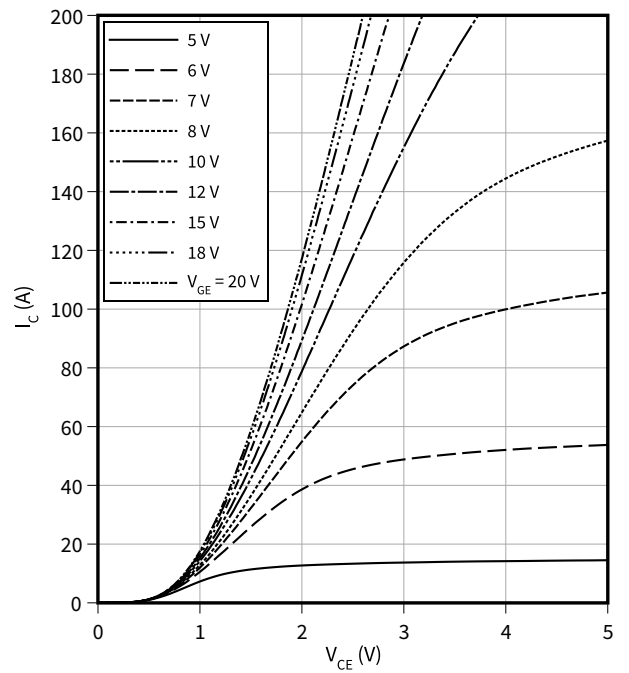## Typical output characteristic

$I_C = f(V_{CE})$

$T_{vj} = 25\ °C$

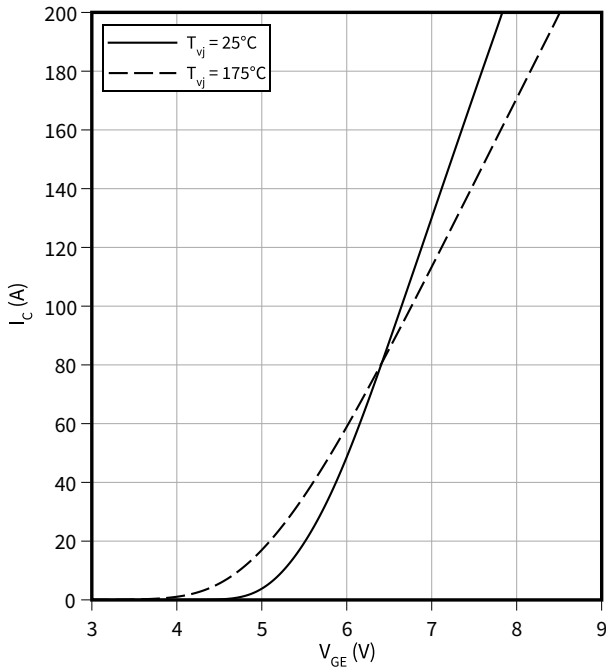## Typical output characteristic

$I_C = f(V_{CE})$

$T_{vj} = 175\ °C$

Typical transfer characteristic

$I_C = f(V_{GE})$

$V_{CE} = 20\ V$

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

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

$V_{GE} = 15\ V$
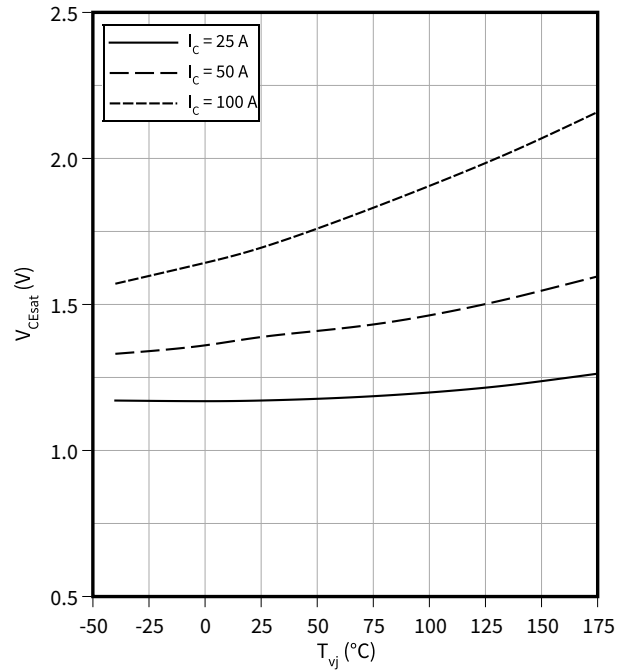
Gate-emitter threshold voltage as a function of junction temperature

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

$I_C = 0.44\ mA$
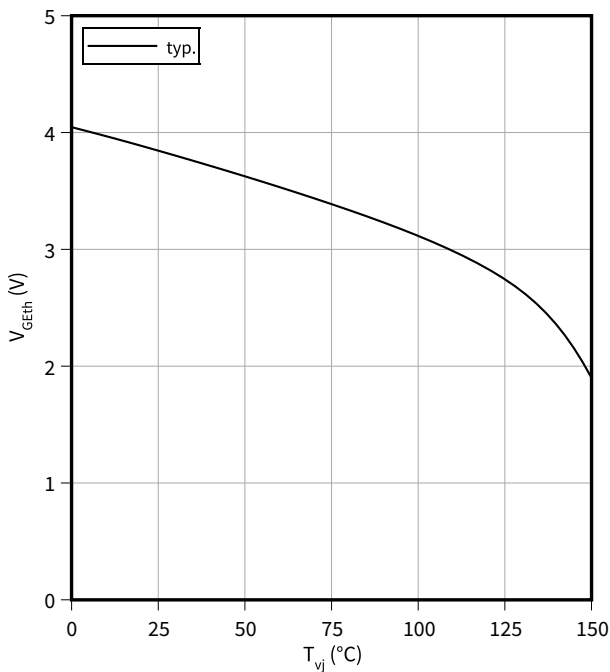
Typical switching times as a function of collector current

$t = f(I_C)$

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

Typical switching times as a function of gate resistor

$t = f(R_G)$

$I_C = 50$ A, $V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V
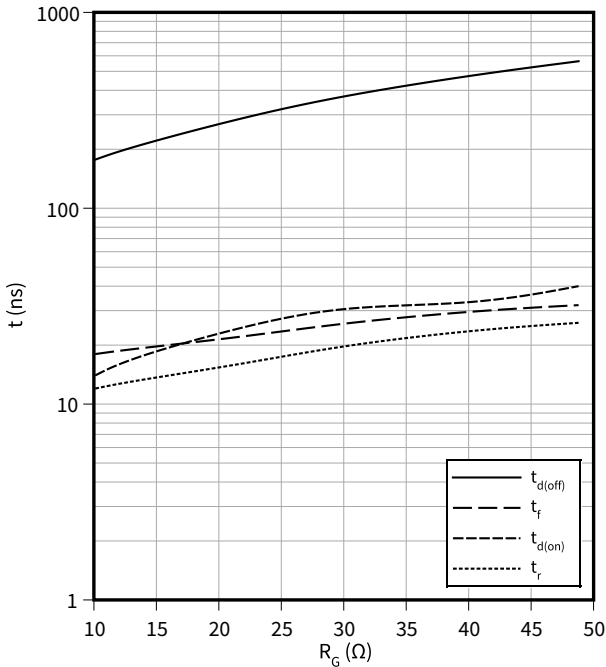
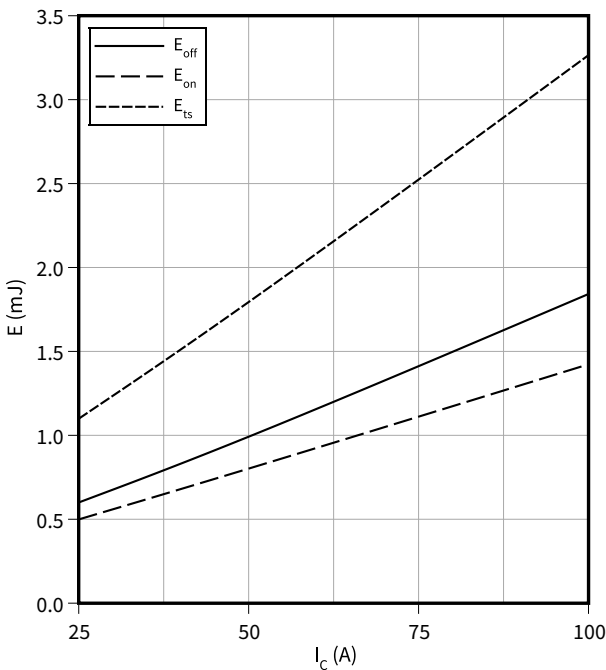**Typical switching times as a function of junction temperature**

$t = f(T_{vj})$

$I_C = 50$ A, $V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 10$ Ω
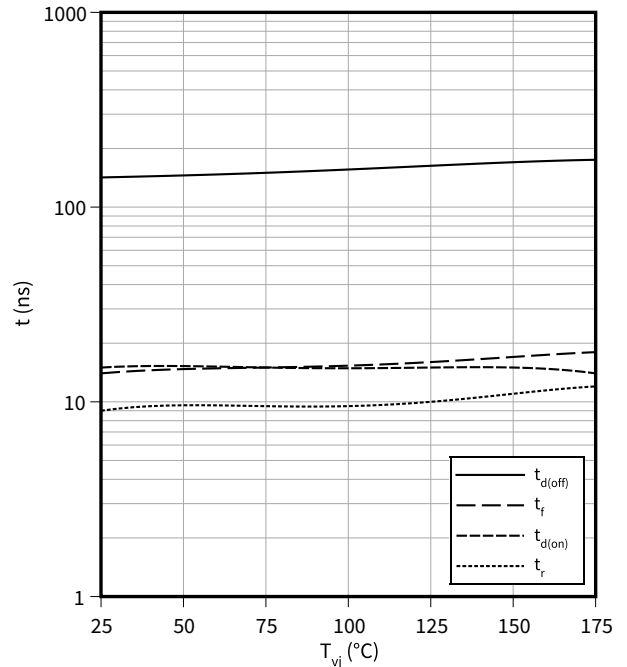
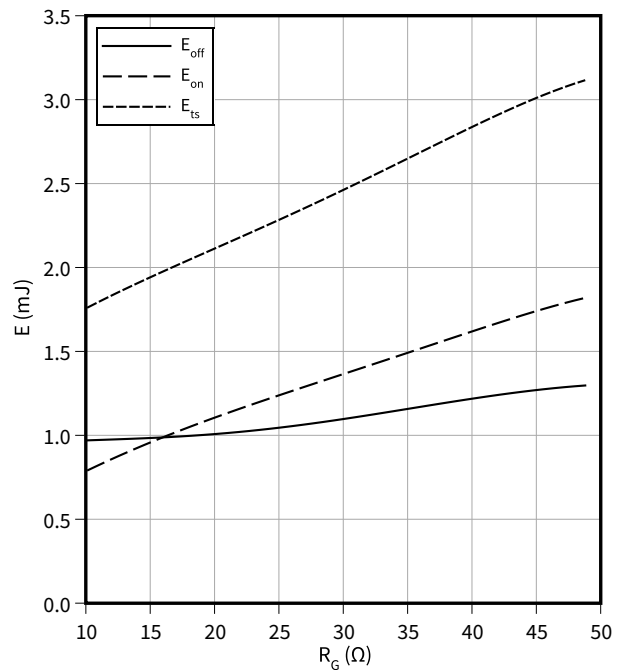**Typical switching energy losses as a function of collector current**

$E = f(I_C)$

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

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

$I_C = 50$ A, $V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V
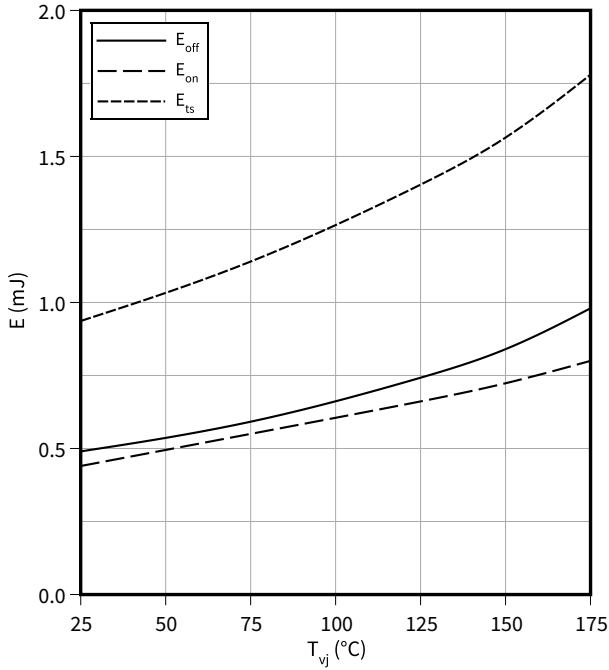
Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$
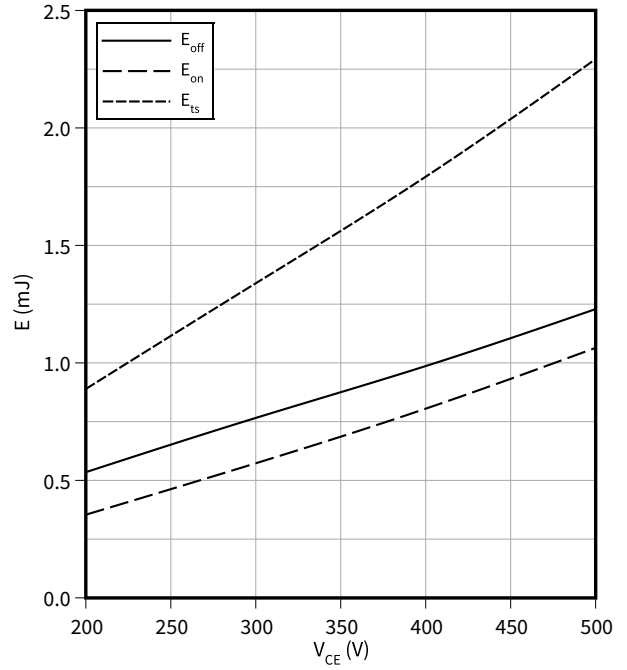
$I_C = 50$ A, $V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 10$ Ω

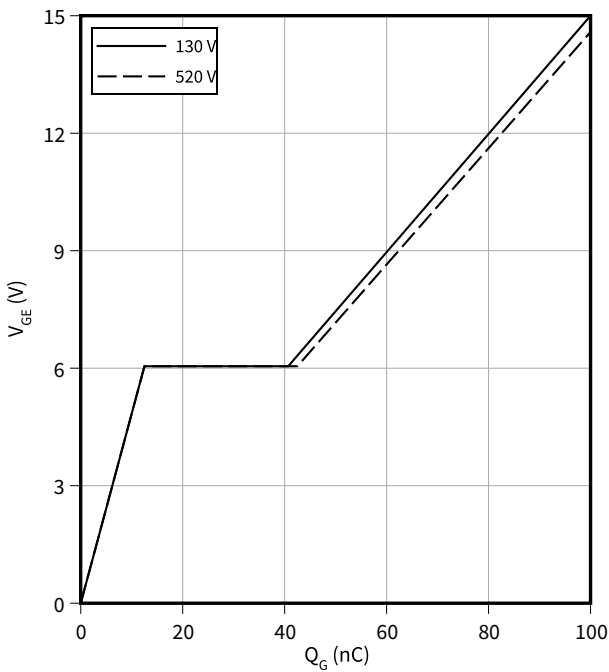**Typical switching energy losses as a function of collector emitter voltage**

$E = f(V_{CE})$

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

Typical gate charge

$V_{GE} = f(Q_G)$
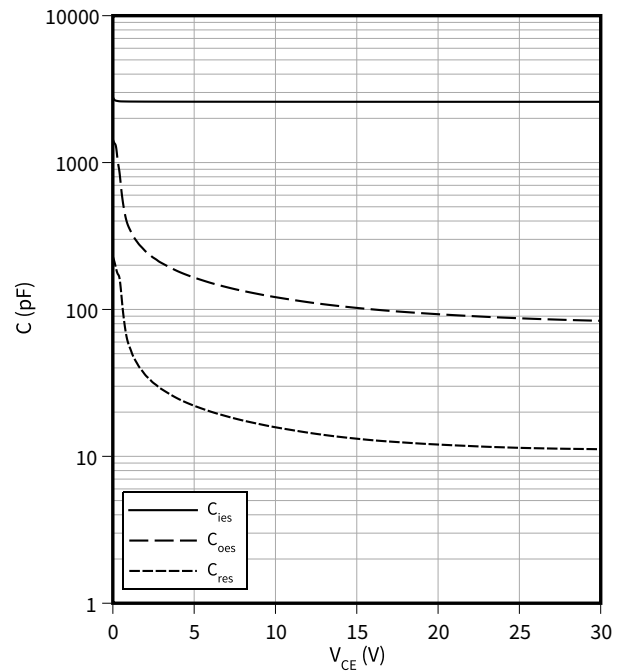
$I_C = 50$ A

Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

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

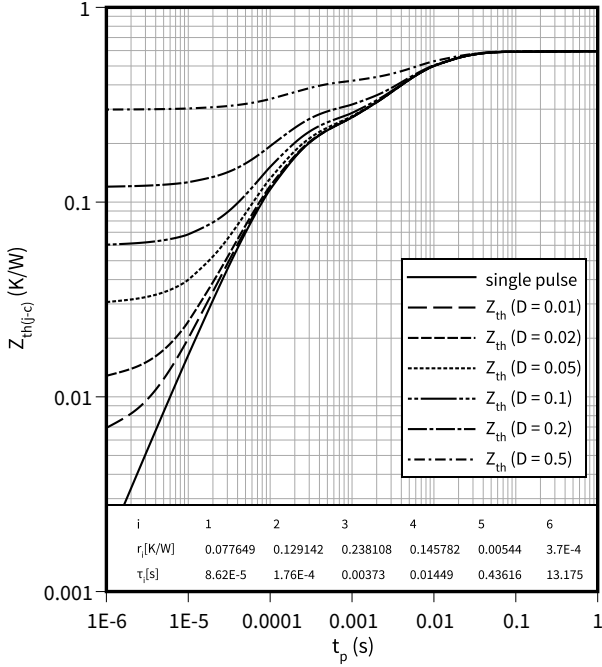## IGBT transient thermal impedance as a function of pulse width

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

$D = t_p/T$

i	1	2	3	4	5	6
$r_i[K/W]$	0.077649	0.129142	0.238108	0.145782	0.00544	3.7E-4
$\tau_i[s]$	8.62E-5	1.76E-4	0.00373	0.01449	0.43616	13.175

Diode transient thermal impedance as a function of pulse width

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

$D = t_p/T$

i	1	2	3	4	5	6
$r_i[K/W]$	0.106509	0.194142	0.309075	0.180986	0.007217	3.16E-4
$\tau_i[s]$	8.51E-5	1.5E-4	0.00307	0.01449	0.35	3.195

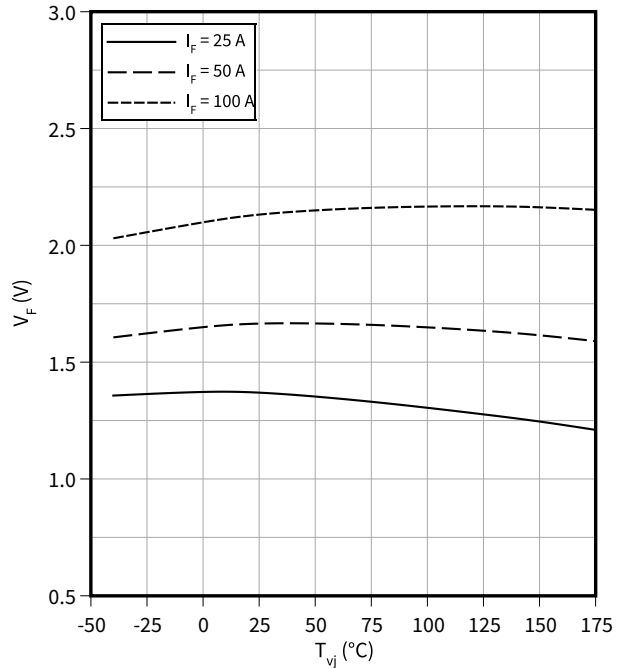## Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$
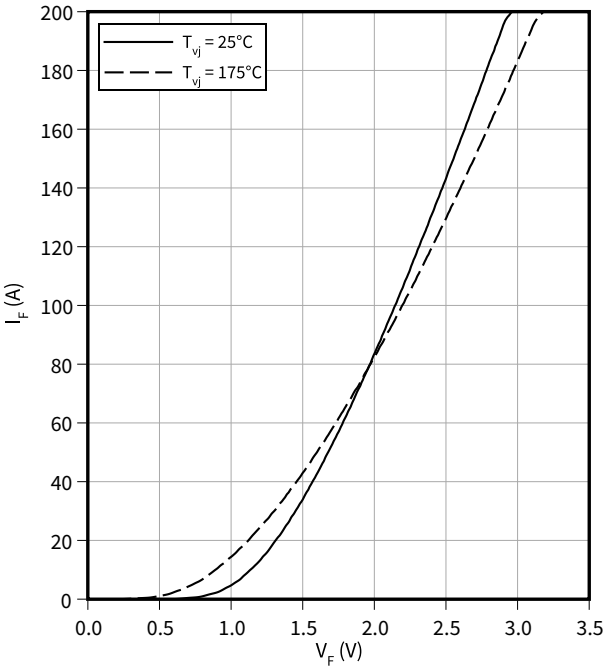
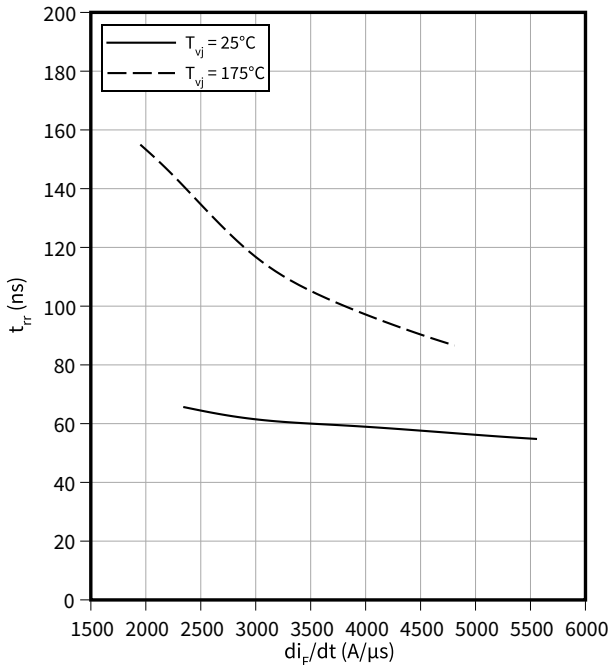## Typical diode forward voltage as a function of junction temperature

$V_F = f(T_{vj})$

Typical reverse recovery time as a function of diode current slope
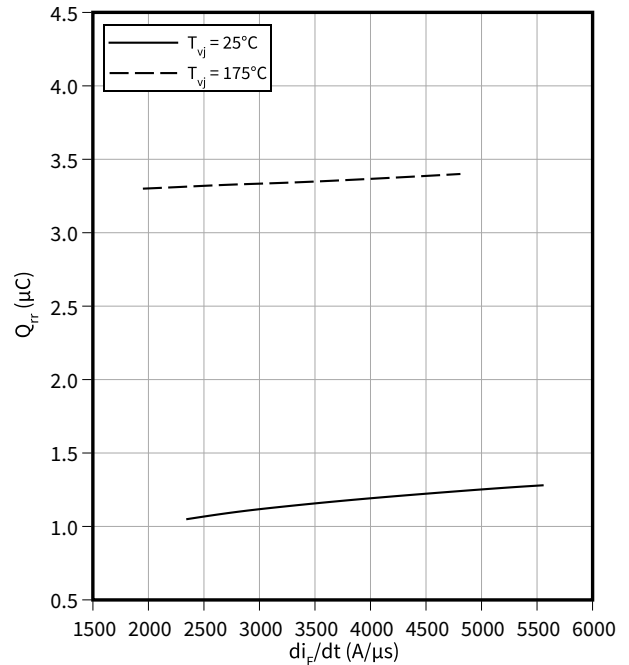
$t_{rr} = f(di_F/dt)$

$V_R = 400 \text{ V}, I_F = 50 \text{ A}$

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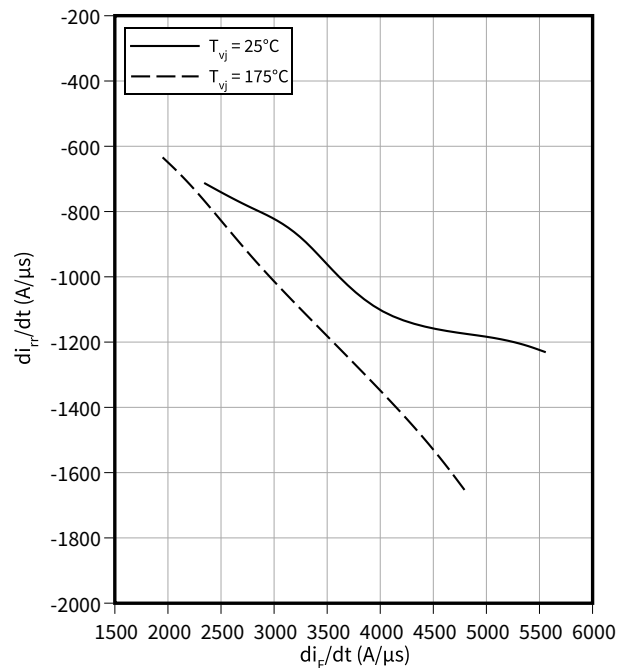
$I_{rrm} = f(di_F/dt)$

$V_R = 400 \text{ V}, I_F = 50 \text{ A}$
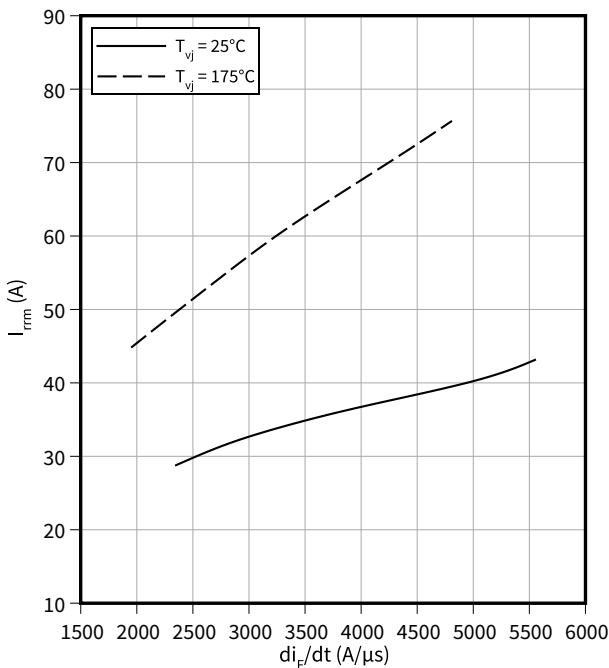
Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
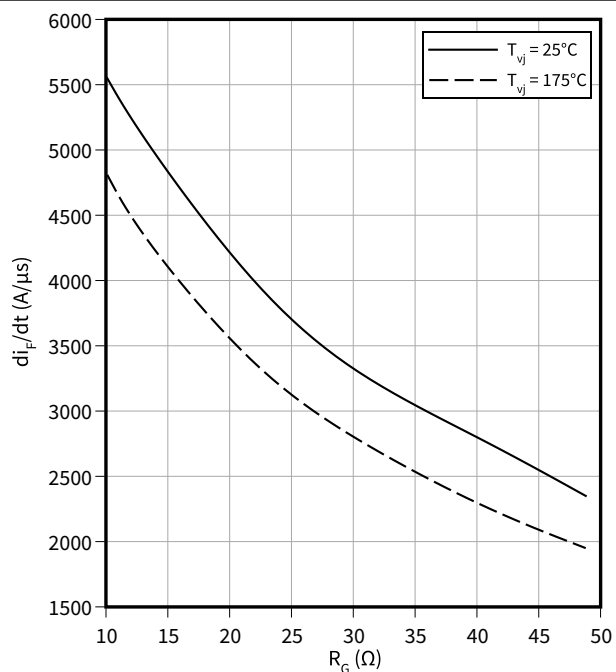
$di_{rr}/dt = f(di_F/dt)$

$V_R = 400 \text{ V}, I_F = 50 \text{ A}$

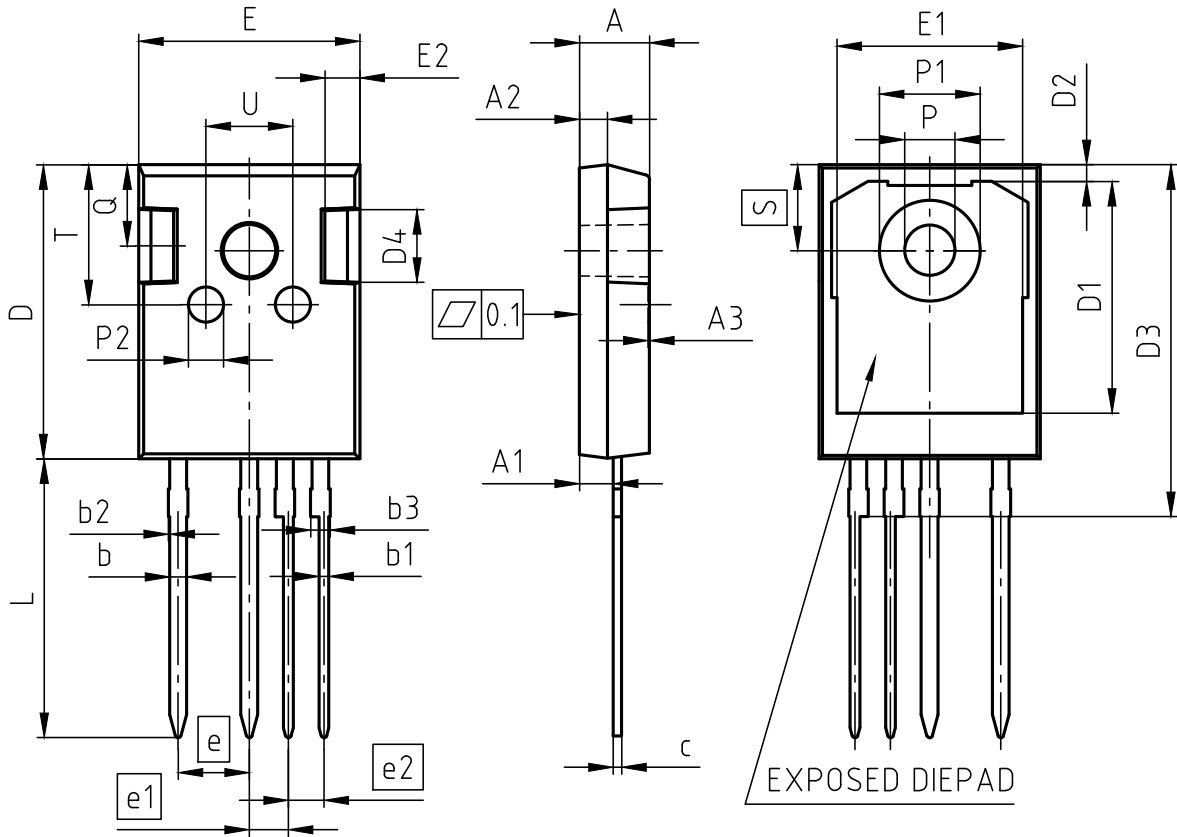**Typical diode current slope as a function of gate resistor**

$di_F/dt = f(R_G)$

$V_R = 400 \text{ V}, I_F = 50 \text{ A}$

5 Package outlines

PG-TO247-4-STD-NT3.7

NOTES:
ALL DIMENSIONS DO NOT INCLUDE MOLD FLASH
OR PROTRUSIONS.

PACKAGE - GROUP NUMBER:	**PG-TO247-4-U02**					
DIMENSIONS	**MILLIMETERS**		**DIMENSIONS**	**MILLIMETERS**	
	MIN.	MAX.		MIN.	MAX.
A	4.90	5.10	E	15.70	15.90
A1	2.31	2.51	E1	13.10	13.50
A2	1.90	2.10	E2	2.40	2.60
A3	0.05	0.25	e	5.08	
b	1.10	1.30	e1	2.79	
b1	0.65	0.79	e2	2.54	
b2	---	0.20	N	4	
b3	1.34	1.44	L	19.80	20.10
c	0.58	0.66	øP	3.50	3.70
D	20.90	21.10	øP1	7.00	7.40
D1	16.25	16.85	øP2	2.40	2.60
D2	1.05	1.35	Q	5.60	6.00
D3	24.97	25.27	S	6.15	
D4	4.90	5.10	T	9.80	10.20
			U	6.00	6.40

Figure 1

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)
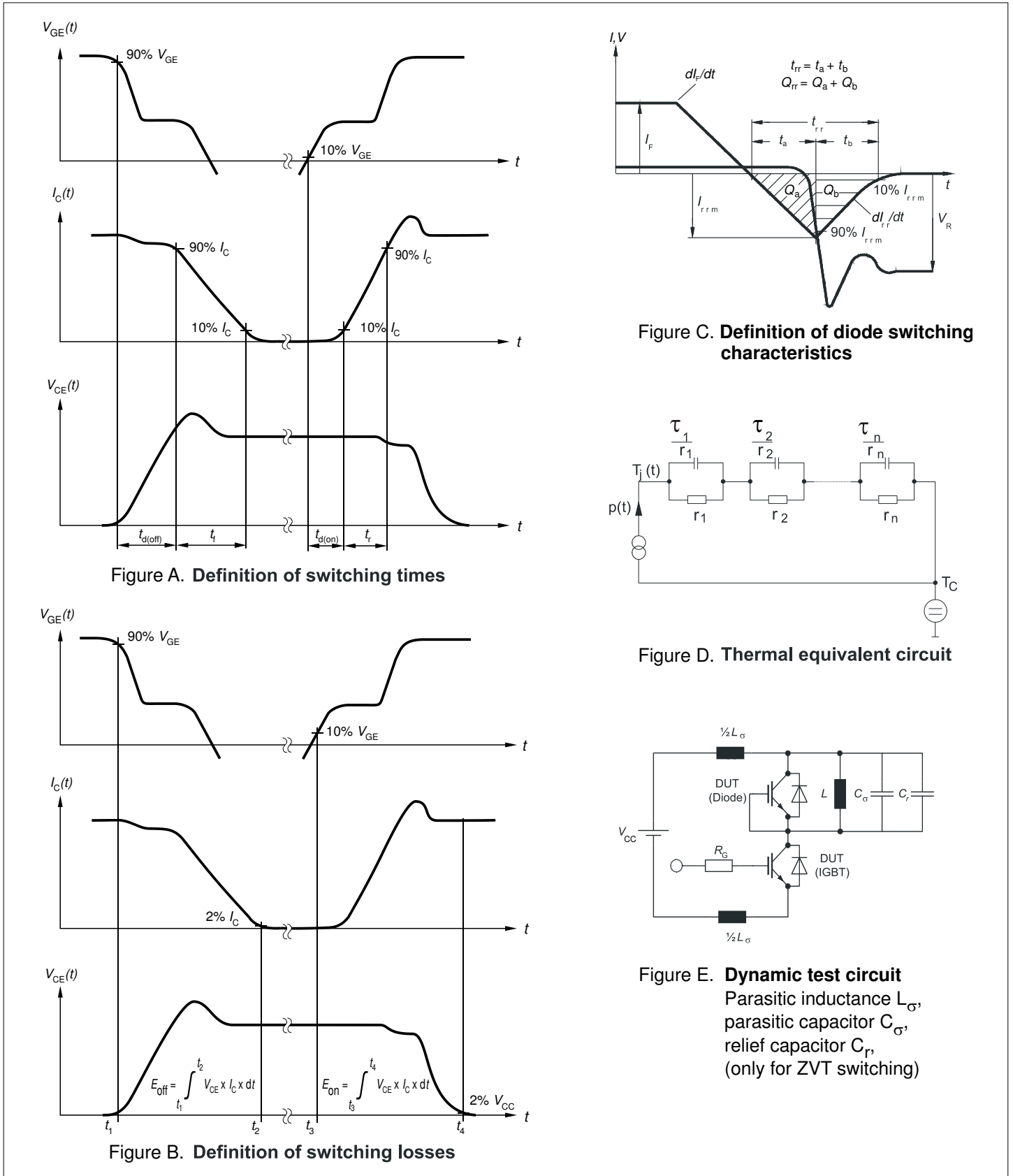
Figure 2

Revision history

Document revision	Date of release	Description of changes
1.00	2023-04-27	Final datasheet

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