

## IGBT

Low  $V_{CE(sat)}$  IGBT in TRENCHSTOP™ 5 technology copacked with RAPID 1 fast and soft antiparallel diode

## IKZ75N65EL5

650V DuoPack IGBT and diode  
Low  $V_{CE(sat)}$  series fifth generation

Data sheet

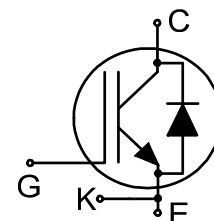
Low  $V_{CE(sat)}$  series fifth generation

## Low $V_{CE(sat)}$ IGBT in TRENCHSTOP™ 5 technology copacked with RAPID 1 fast and soft antiparallel diode

### Features and Benefits:

Low  $V_{CE(sat)}$  L5 technology offering

- Very low collector-emitter saturation voltage  $V_{CEsat}$
- Best-in-Class tradeoff between conduction and switching losses
- 650V breakdown voltage
- Low gate charge  $Q_G$
- Maximum junction temperature 175°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/>



### Applications:

- Uninterruptible power supplies
- Solar photovoltaic inverters
- Welding machines

### Package pin definition:

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



Please note: The emitter and Kelvin emitter pins are not exchangeable. Their exchange might lead to malfunction.



### Key Performance and Package Parameters

Type	$V_{CE}$	$I_C$	$V_{CEsat}, T_{vj}=25^{\circ}C$	$T_{vjmax}$	Marking	Package
IKZ75N65EL5	650V	75A	1.1V	175°C	K75EEL5	PG-TO247-4

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Low  $V_{CE(sat)}$  series fifth generation

## Maximum Ratings

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

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_{vj} \geq 25^\circ\text{C}$	$V_{CE}$	650	V
DC collector current, limited by $T_{vjmax}^{1)}$ $T_c = 25^\circ\text{C}$ $T_c = 100^\circ\text{C}$	$I_C$	100.0 100.0	A
Pulsed collector current, $t_p$ limited by $T_{vjmax}^{2)}$	$I_{Cpuls}$	300.0	A
Turn off safe operating area $V_{CE} \leq 650\text{V}$ , $T_{vj} \leq 175^\circ\text{C}$ , $t_p = 1\mu\text{s}^{2)}$	-	300.0	A
Diode forward current, limited by $T_{vjmax}$ $T_c = 25^\circ\text{C}$ value limited by bondwire $T_c = 100^\circ\text{C}$	$I_F$	90.0 89.0	A
Diode pulsed current, $t_p$ limited by $T_{vjmax}^{2)}$	$I_{Fpuls}$	300.0	A
Gate-emitter voltage Transient Gate-emitter voltage ( $t_p \leq 10\mu\text{s}$ , $D < 0.010$ )	$V_{GE}$	$\pm 20$ $\pm 30$	V
Power dissipation $T_c = 25^\circ\text{C}$ Power dissipation $T_c = 100^\circ\text{C}$	$P_{tot}$	536.0 268.0	W
Operating junction temperature	$T_{vj}$	-40...+175	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55...+150	$^\circ\text{C}$
Soldering temperature, <sup>3)</sup> wave soldering 1.6mm (0.063in.) from case for 10s		260	$^\circ\text{C}$
Mounting torque, M3 screw Maximum of mounting processes: 3	$M$	0.6	Nm

## Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b><math>R_{th}</math> Characteristics</b>						
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		-	-	0.28	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		-	-	0.46	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		-	-	40	K/W

<sup>1)</sup> Both values limited by bondwires.

<sup>2)</sup> Defined by design. Not subject to production test.

<sup>3)</sup> Package not recommended for surface mount applications.

Low  $V_{CE(sat)}$  series fifth generation**Electrical Characteristic, at  $T_{vj} = 25^{\circ}\text{C}$ , unless otherwise specified**

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>Static Characteristic</b>						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0\text{V}, I_C = 0.20\text{mA}$	650	-	-	V
Collector-emitter saturation voltage	$V_{CEsat}$	$V_{GE} = 15.0\text{V}, I_C = 75.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 100^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	-	1.10	1.35	V
			-	1.11	-	
			-	1.12	-	
Diode forward voltage	$V_F$	$V_{GE} = 0\text{V}, I_F = 75.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 100^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	-	1.40	1.70	V
			-	1.42	-	
			-	1.40	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 1.00\text{mA}, V_{CE} = 20\text{V}$	4.2	5.0	5.8	V
Zero gate voltage collector current	$I_{CES}$	$V_{CE} = 650\text{V}, V_{GE} = 0\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	-	40	$\mu\text{A}$
			-	1000	-	
			-	5000	-	
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\text{V}, V_{GE} = 20\text{V}$	-	-	100	nA
Transconductance	$g_{fs}$	$V_{CE} = 20\text{V}, I_C = 75.0\text{A}$	-	155.0	-	S

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>Dynamic Characteristic</b>						
Input capacitance	$C_{ies}$	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$ $f = 1000\text{kHz}$	-	12100	-	pF
Output capacitance	$C_{oes}$		-	150	-	
Reverse transfer capacitance	$C_{res}$		-	42	-	
Gate charge	$Q_G$	$V_{CC} = 520\text{V}, I_C = 75.0\text{A},$ $V_{GE} = 15\text{V}$	-	436.0	-	nC

**Switching Characteristic, Inductive Load**

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>IGBT Characteristic, at <math>T_{vj} = 25^{\circ}\text{C}</math></b>						
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 75.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 23.0\Omega, R_{G(off)} = 4.0\Omega,$ $L\sigma = 30\text{nH}, C\sigma = 30\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	120	-	ns
Rise time	$t_r$		-	23	-	ns
Turn-off delay time	$t_{d(off)}$		-	275	-	ns
Fall time	$t_f$		-	50	-	ns
Turn-on energy	$E_{on}$		-	1.57	-	mJ
Turn-off energy	$E_{off}$		-	3.20	-	mJ
Total switching energy	$E_{ts}$		-	4.77	-	mJ

Low  $V_{CE(sat)}$  series fifth generationDiode Characteristic, at  $T_{vj} = 25^{\circ}\text{C}$ 

Diode reverse recovery time	$t_{rr}$	$T_{vj} = 25^{\circ}\text{C},$ $V_R = 400\text{V},$ $I_F = 75.0\text{A},$ $di_F/dt = 2000\text{A}/\mu\text{s}$	-	59	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	1.30	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	37.0	-	A
Diode peak rate of fall of reverse recovery current during $t_b$	$di_{rr}/dt$		-	-2400	-	$\text{A}/\mu\text{s}$

## Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	

IGBT Characteristic, at  $T_{vj} = 150^{\circ}\text{C}$ 

Turn-on delay time	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 75.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 23.0\Omega, R_{G(off)} = 4.0\Omega,$ $L\sigma = 30\text{nH}, C\sigma = 30\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	106	-	ns
Rise time	$t_r$		-	27	-	ns
Turn-off delay time	$t_{d(off)}$		-	330	-	ns
Fall time	$t_f$		-	144	-	ns
Turn-on energy	$E_{on}$		-	2.12	-	mJ
Turn-off energy	$E_{off}$		-	5.10	-	mJ
Total switching energy	$E_{ts}$		-	7.22	-	mJ

Diode Characteristic, at  $T_{vj} = 150^{\circ}\text{C}$ 

Diode reverse recovery time	$t_{rr}$	$T_{vj} = 150^{\circ}\text{C},$ $V_R = 400\text{V},$ $I_F = 75.0\text{A},$ $di_F/dt = 2000\text{A}/\mu\text{s}$	-	79	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	2.86	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	57.0	-	A
Diode peak rate of fall of reverse recovery current during $t_b$	$di_{rr}/dt$		-	-1950	-	$\text{A}/\mu\text{s}$

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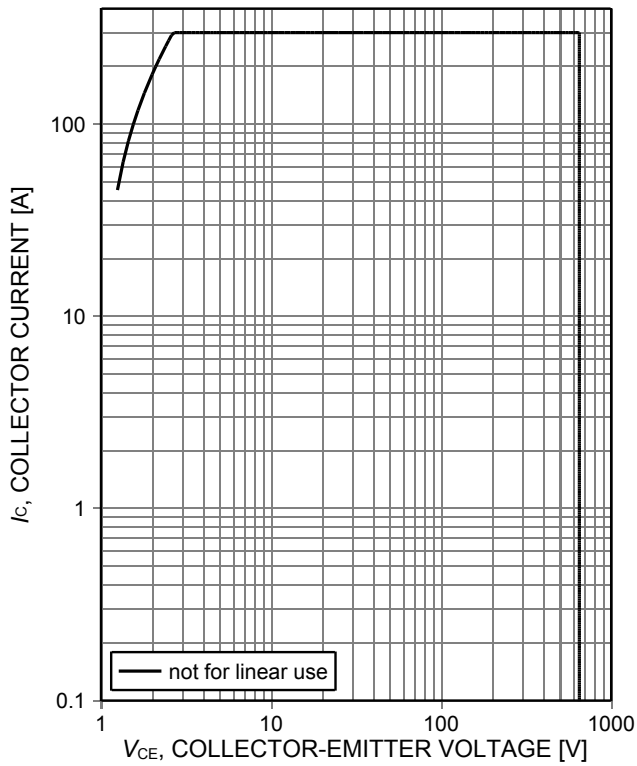


Figure 1. **Forward bias safe operating area**  
 ( $D=0$ ,  $T_C=25^\circ\text{C}$ ,  $T_{vj}\leq 175^\circ\text{C}$ ,  $V_{GE}=15\text{V}$ ,  $t_p=1\mu\text{s}$ ,  
 $I_{Cmax}$  defined by design - not subject to production test)

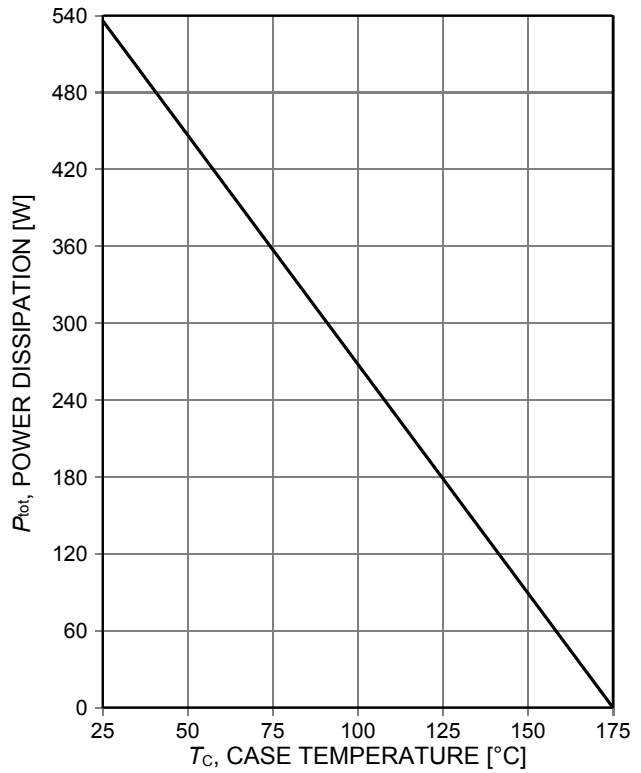


Figure 2. **Power dissipation as a function of case temperature**  
 ( $T_{vj}\leq 175^\circ\text{C}$ )

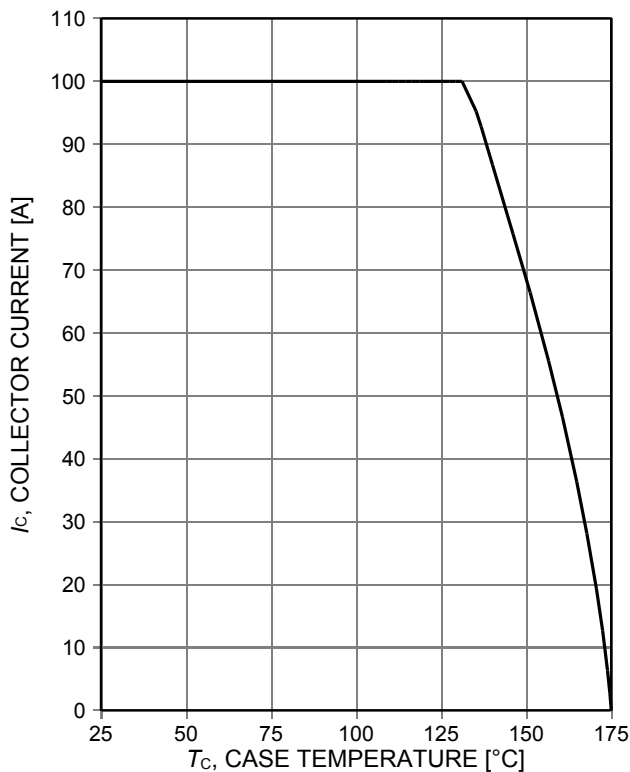


Figure 3. **Collector current as a function of case temperature**  
 ( $V_{GE}\geq 15\text{V}$ ,  $T_{vj}\leq 175^\circ\text{C}$ )

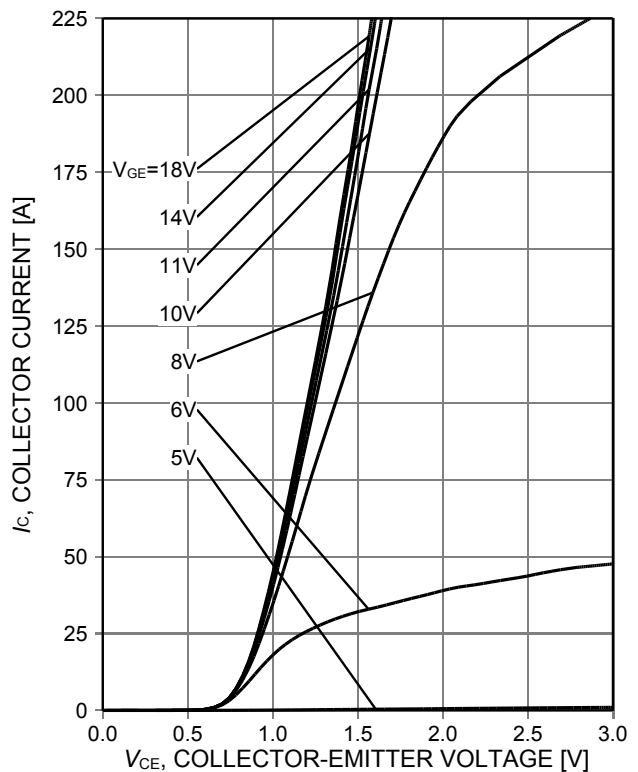


Figure 4. **Typical output characteristic**  
 ( $T_{vj}=25^\circ\text{C}$ )

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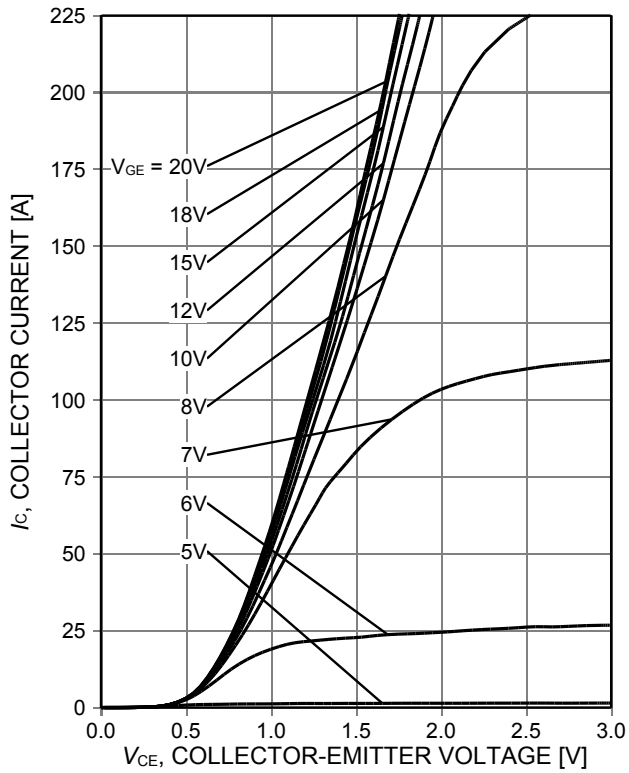


Figure 5. Typical output characteristic ( $T_{vj}=175^\circ\text{C}$ )

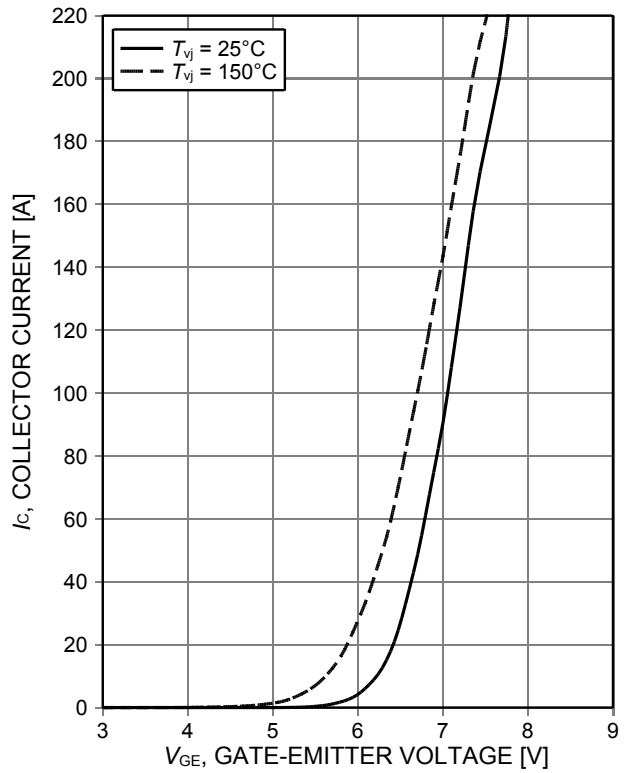


Figure 6. Typical transfer characteristic ( $V_{CE}=20\text{V}$ )

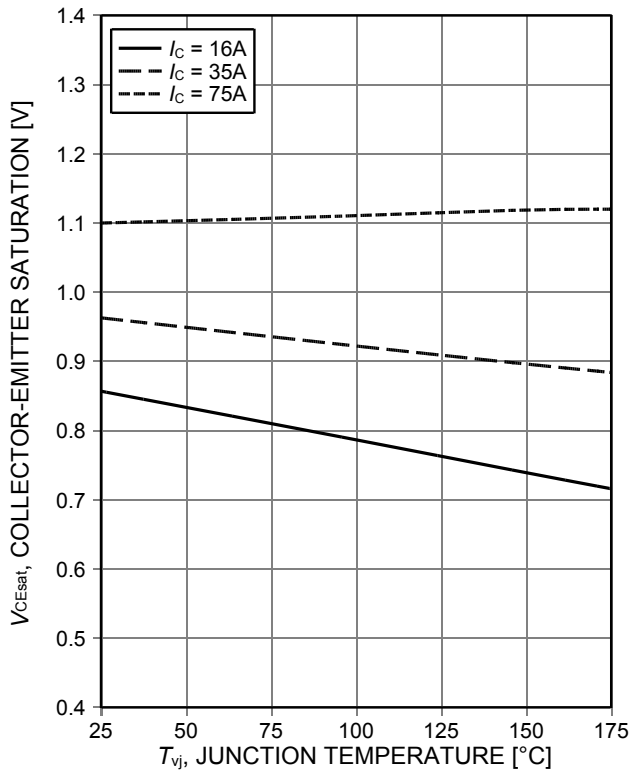


Figure 7. Typical collector-emitter saturation voltage as a function of junction temperature ( $V_{GE}=15\text{V}$ )

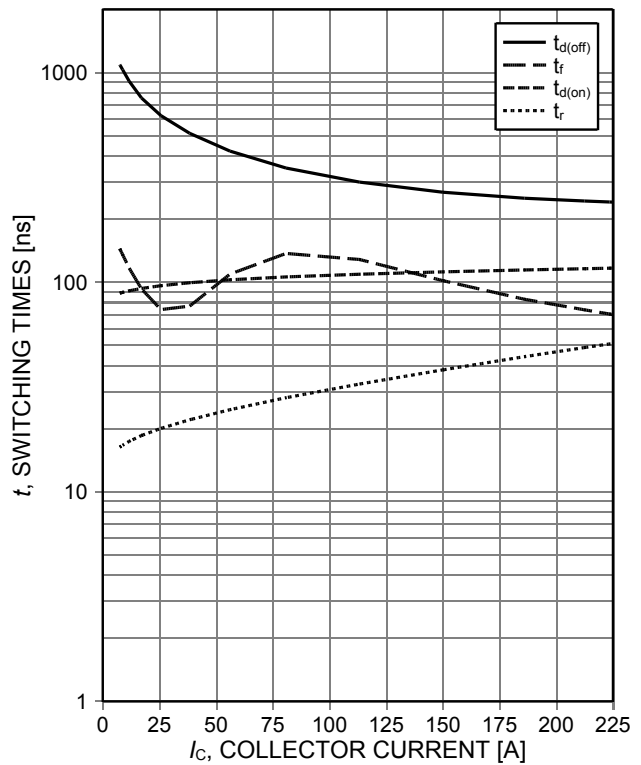


Figure 8. Typical switching times as a function of collector current (inductive load,  $T_{vj}=150^\circ\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_{G(on)}=23\Omega$ ,  $R_{G(off)}=4\Omega$ , dynamic test circuit in Figure E)

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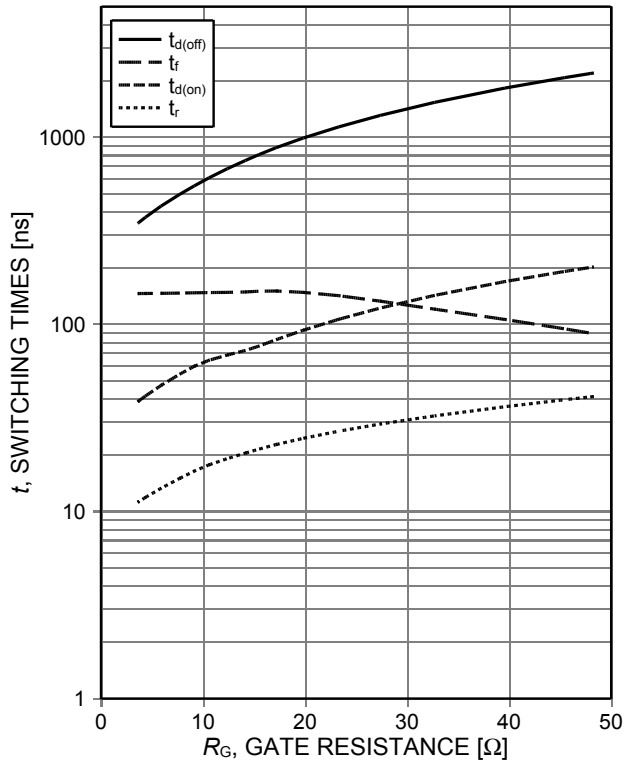


Figure 9. **Typical switching times as a function of gate resistance**  
 (inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ , dynamic test circuit in Figure E)

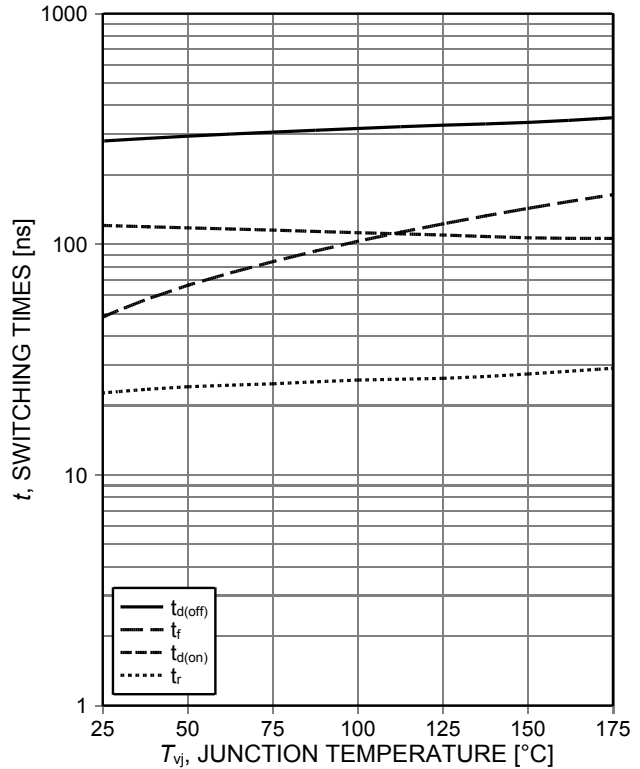


Figure 10. **Typical switching times as a function of junction temperature**  
 (inductive load,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ ,  $R_{G(on)}=23\Omega$ ,  $R_{G(off)}=4\Omega$ , dynamic test circuit in Figure E)

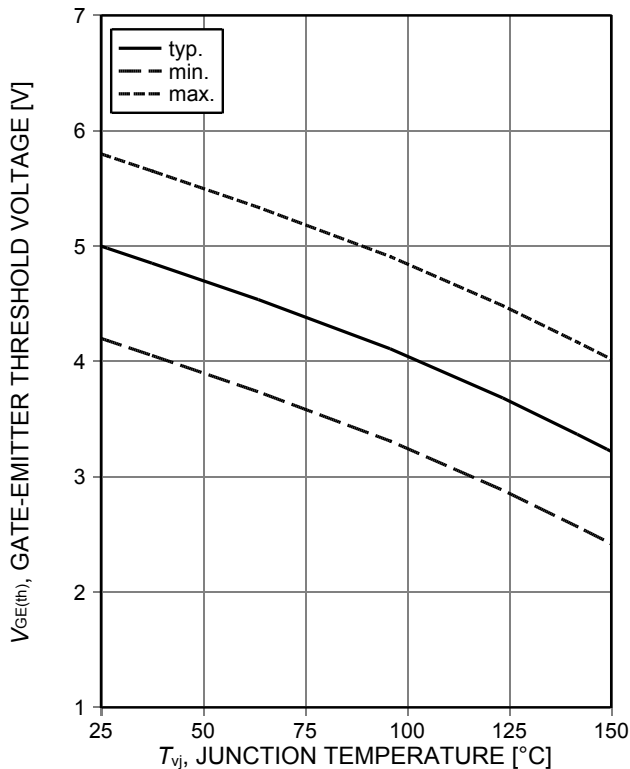


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**  
 ( $I_C=1\text{mA}$ )

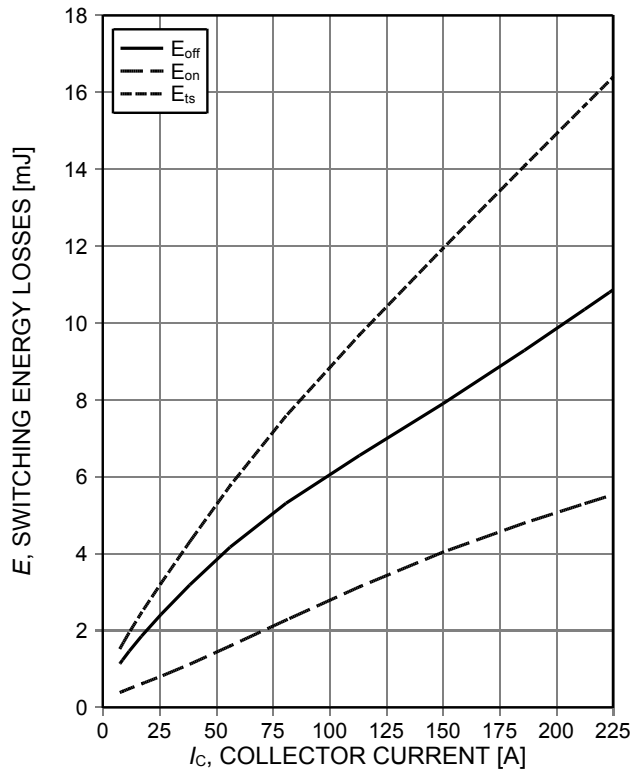


Figure 12. **Typical switching energy losses as a function of collector current**  
 (inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_{G(on)}=23\Omega$ ,  $R_{G(off)}=4\Omega$ , dynamic test circuit in Figure E)

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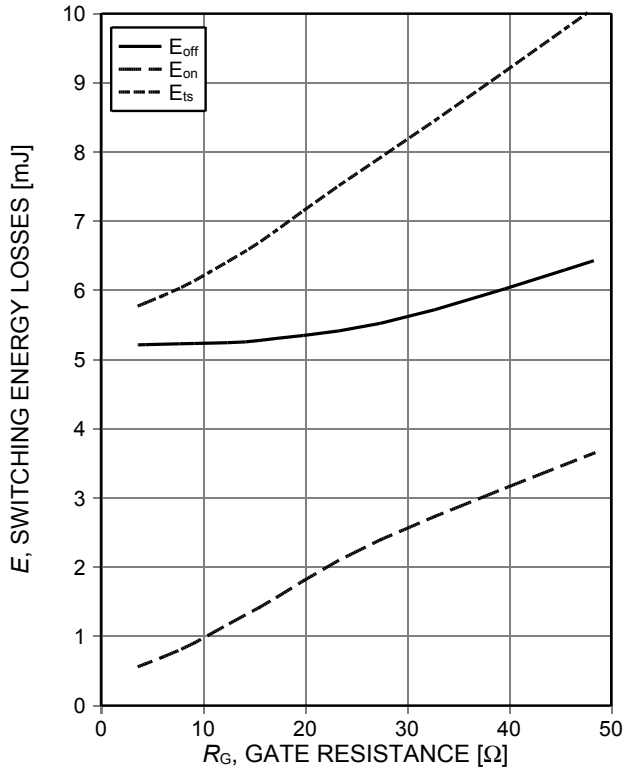


Figure 13. **Typical switching energy losses as a function of gate resistance**  
 (inductive load,  $T_{vj}=150^{\circ}C$ ,  $V_{CE}=400V$ ,  $V_{GE}=0/15V$ ,  $I_C=75A$ , dynamic test circuit in Figure E)

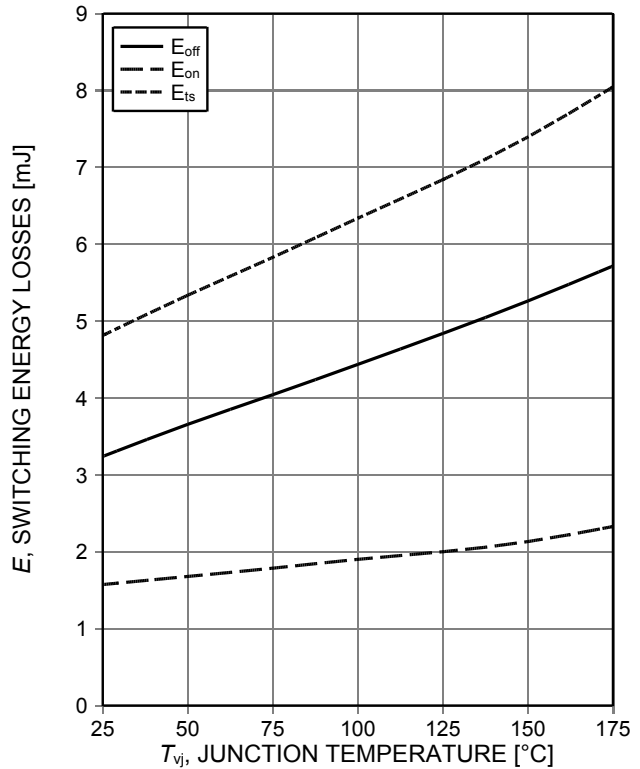


Figure 14. **Typical switching energy losses as a function of junction temperature**  
 (inductive load,  $V_{CE}=400V$ ,  $V_{GE}=0/15V$ ,  $I_C=75A$ ,  $R_{G(on)}=23\Omega$ ,  $R_{G(off)}=4\Omega$ , dynamic test circuit in Figure E)

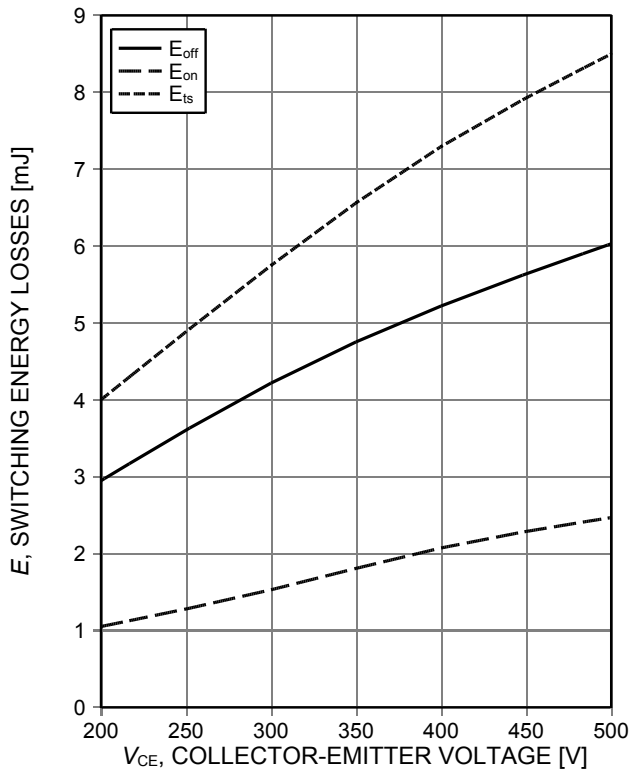


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**  
 (inductive load,  $T_{vj}=150^{\circ}C$ ,  $V_{GE}=0/15V$ ,  $I_C=75A$ ,  $R_{G(on)}=23\Omega$ ,  $R_{G(off)}=4\Omega$ , dynamic test circuit in Figure E)

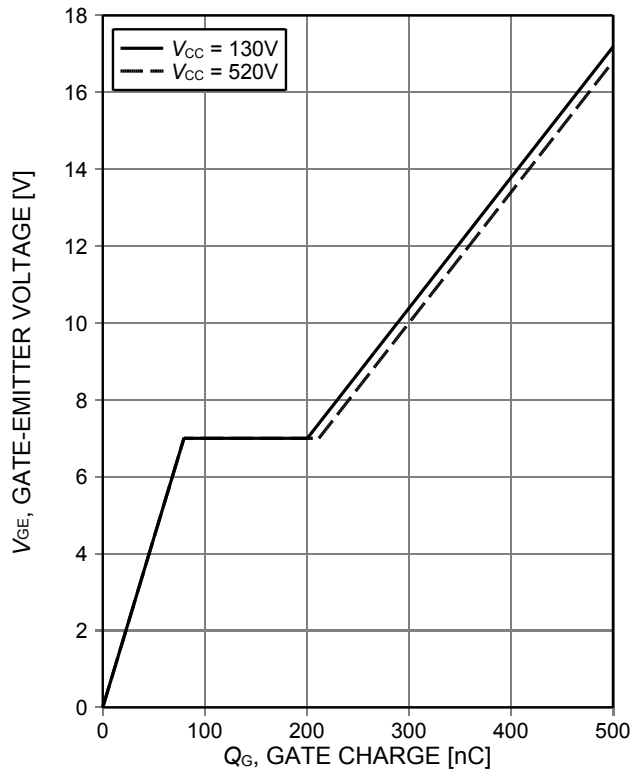


Figure 16. **Typical gate charge**  
 ( $I_C=75A$ )

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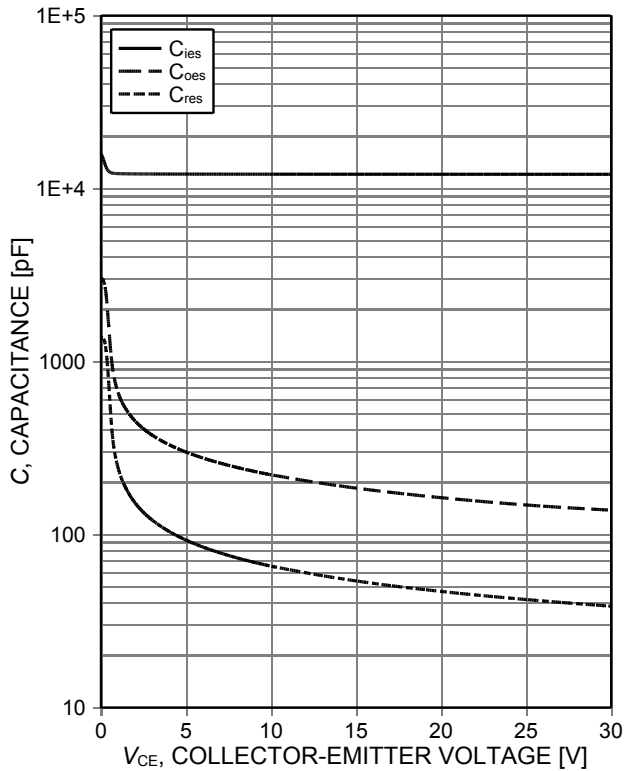


Figure 17. Typical capacitance as a function of collector-emitter voltage ( $V_{GE}=0V$ ,  $f=1MHz$ )

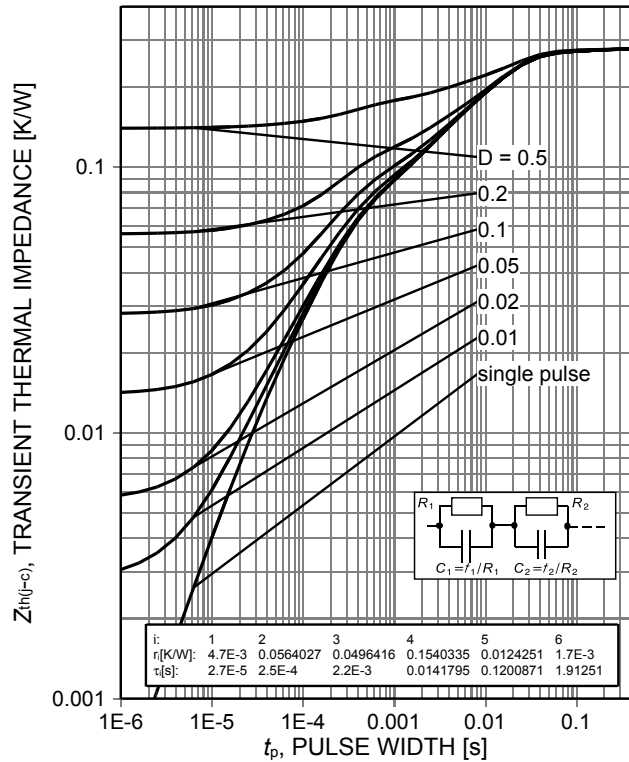


Figure 18. IGBT transient thermal impedance ( $D=t_p/T$ )

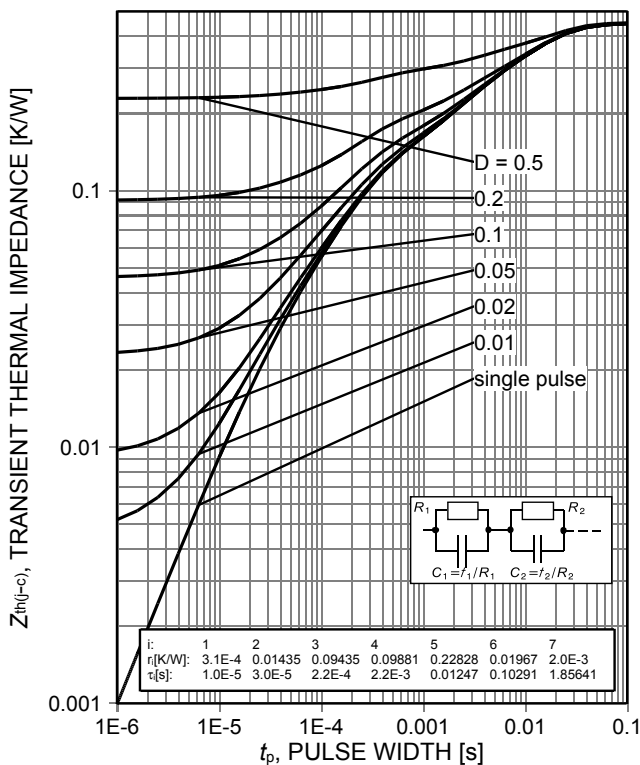


Figure 19. Diode transient thermal impedance as a function of pulse width ( $D=t_p/T$ )

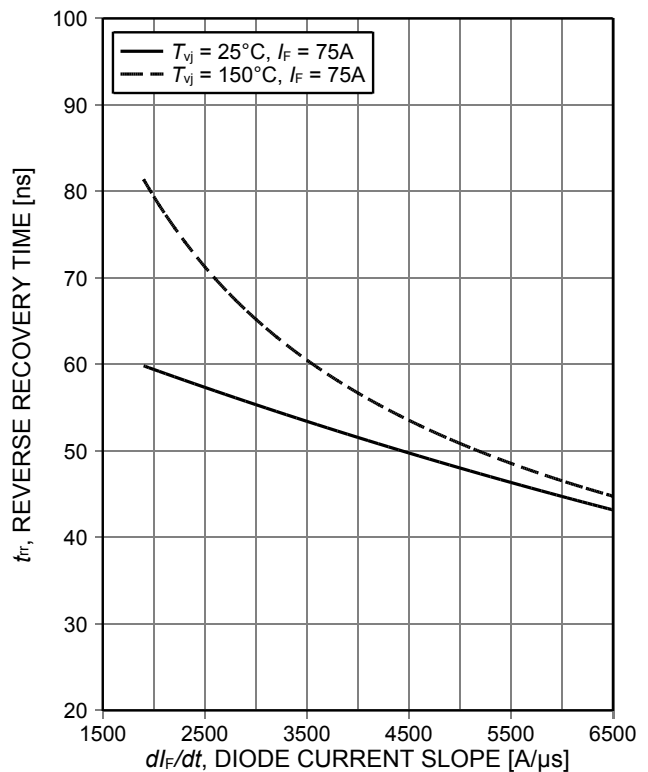


Figure 20. Typical reverse recovery time as a function of diode current slope ( $V_R=400V$ )

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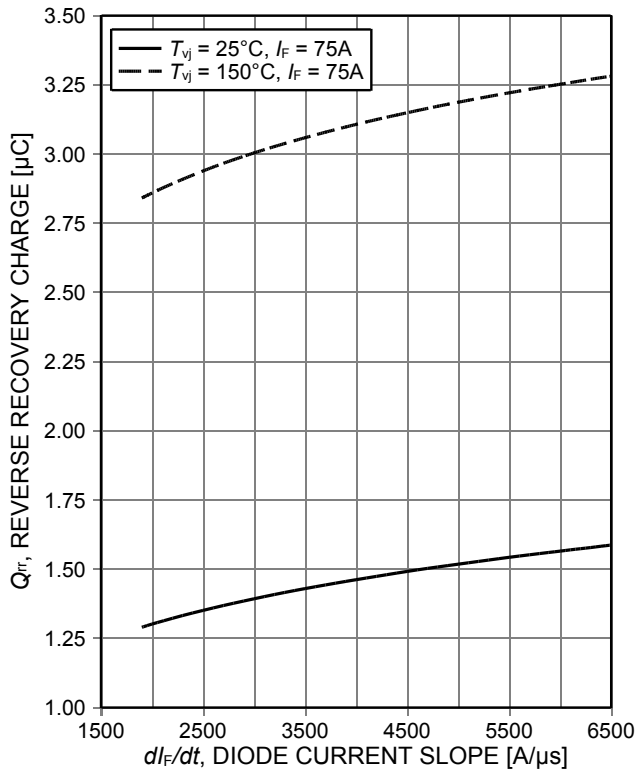


Figure 21. Typical reverse recovery charge as a function of diode current slope ( $V_R=400V$ )

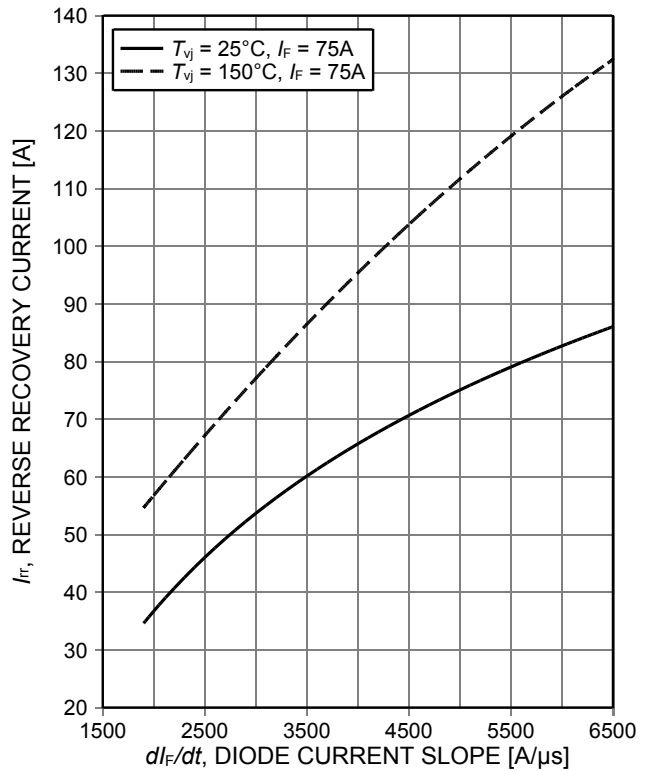


Figure 22. Typical reverse recovery current as a function of diode current slope ( $V_R=400V$ )

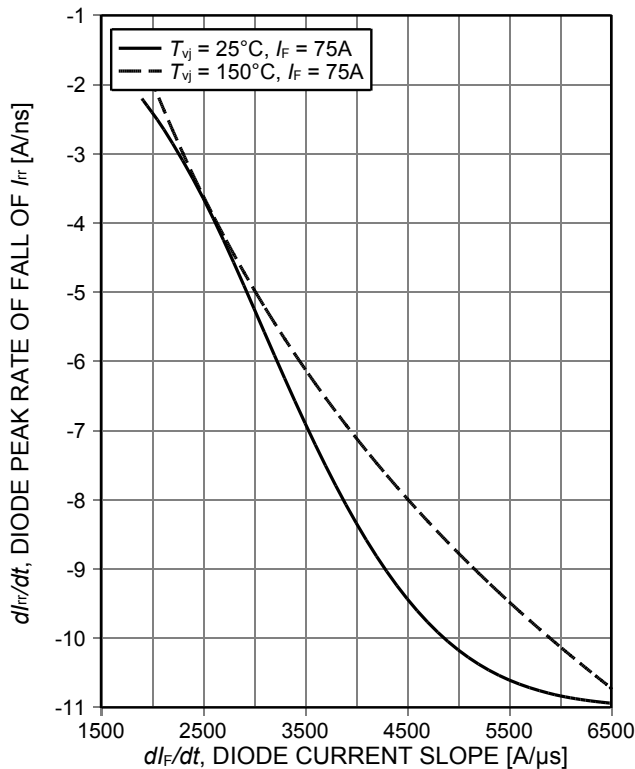


Figure 23. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope ( $V_R=400V$ )

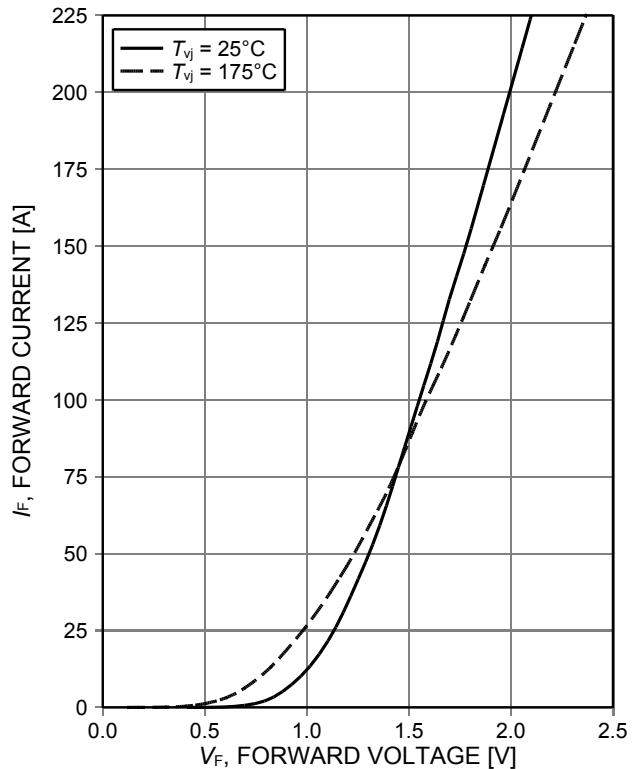


Figure 24. Typical diode forward current as a function of forward voltage

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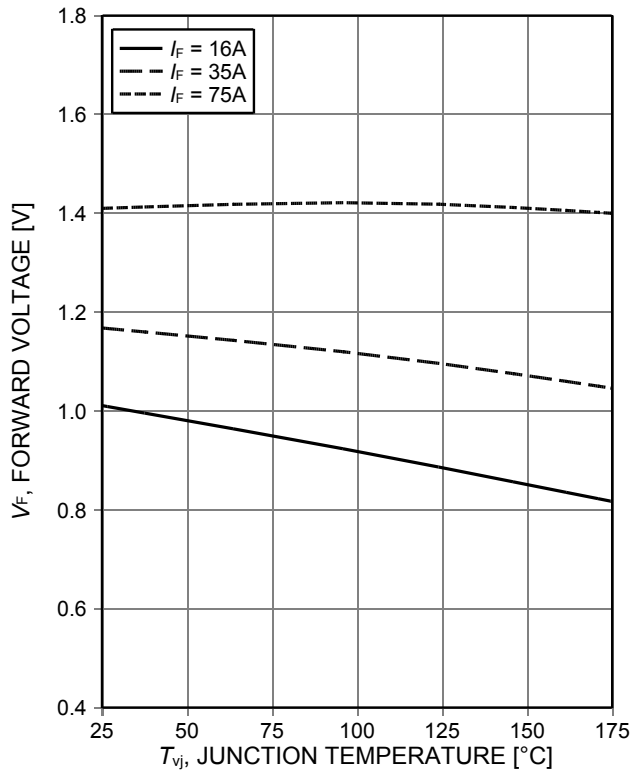
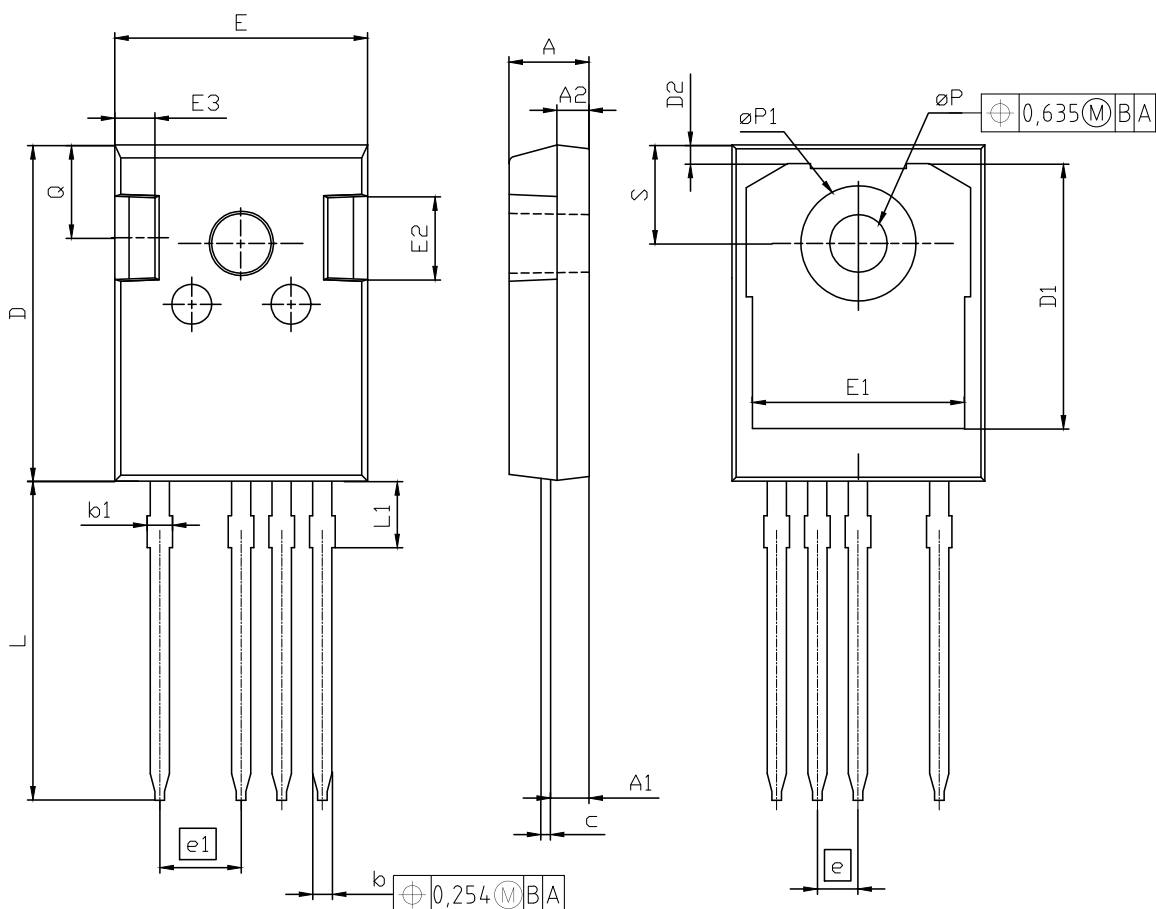


Figure 25. Typical diode forward voltage as a function of junction temperature

Low  $V_{CE(sat)}$  series fifth generation

Package Drawing PG-TO247-4



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.29	2.54	0.090	0.100
A2	1.90	2.16	0.075	0.085
b	1.07	1.33	0.042	0.052
b1	1.10	1.70	0.043	0.067
c	0.50	0.70	0.020	0.028
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.35	0.037	0.053
E	15.70	16.13	0.618	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	2.60	0.039	0.102
e	2.54 (BSC)		0.100 (BSC)	
e1	5.08		0.200	
N	4		4	
L	19.72	20.32	0.776	0.800
L1	4.02	4.40	0.158	0.173
$\varnothing P$	3.50	3.70	0.138	0.146
$\varnothing P1$	7.00	7.40	0.276	0.291
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

**DOCUMENT NO.**  
Z8B00168124

**SCALE**

**EUROPEAN PROJECTION**

**ISSUE DATE**  
29-01-2013

**REVISION**  
1

Low  $V_{CE(sat)}$  series fifth generation

Testing Conditions

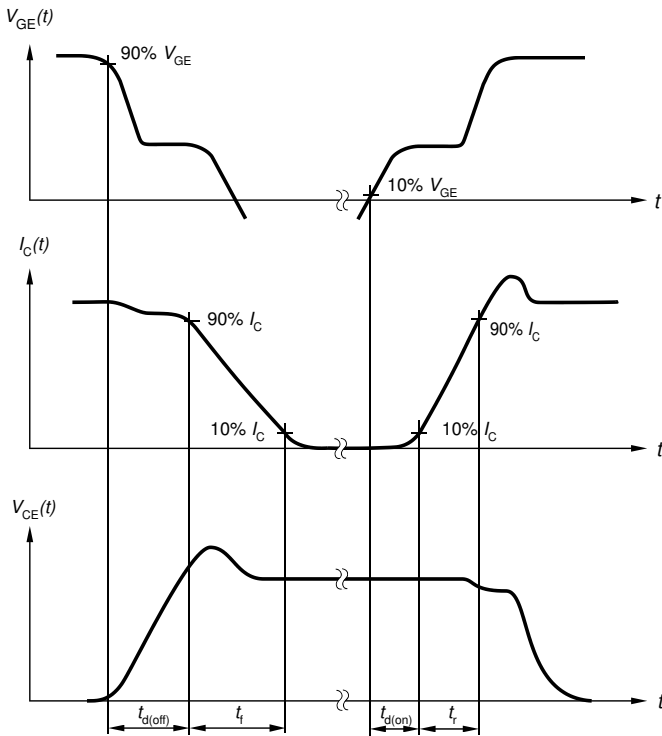


Figure A. Definition of switching times

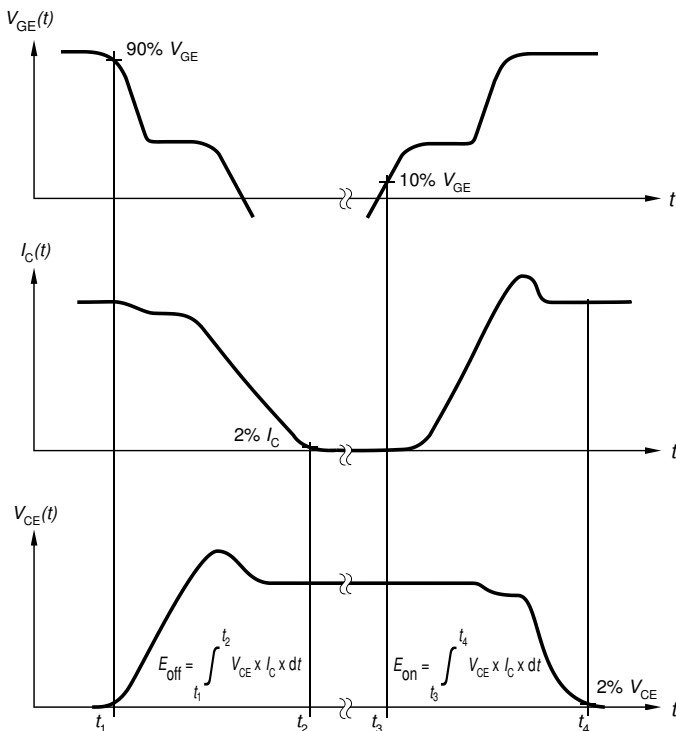


Figure B. Definition of switching losses

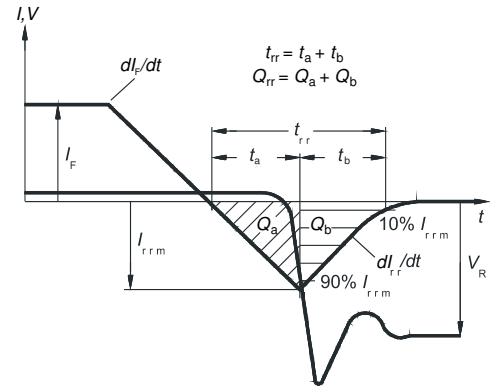


Figure C. Definition of diode switching characteristics

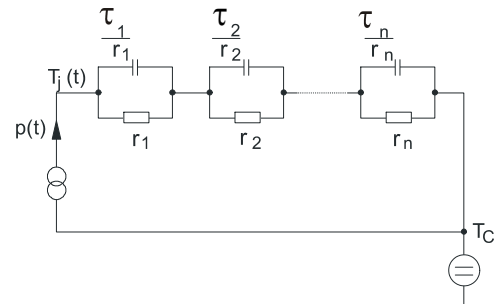


Figure D. Thermal equivalent circuit

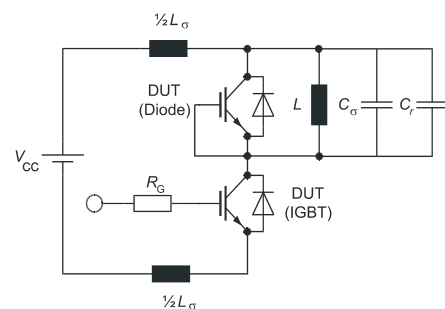


Figure E. **Dynamic test circuit**  
Parasitic inductance  $L_{\sigma}$ ,  
parasitic capacitor  $C_{\sigma}$ ,  
relief capacitor  $C_r$ ,  
(only for ZVT switching)

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Low  $V_{CE(sat)}$  series fifth generation

### Revision History

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IKZ75N65EL5

**Revision: 2020-10-07, Rev. 2.3**

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Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2014-12-10	Final data sheet
2.2	2020-10-07	VGE(th): test condition update
2.3	2020-10-07	Package picture correction

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