

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

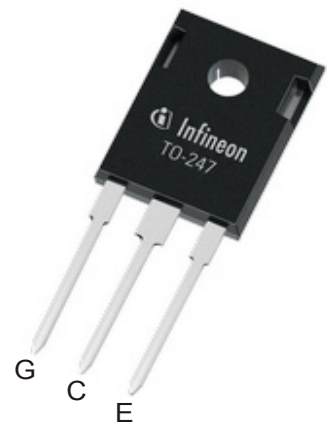
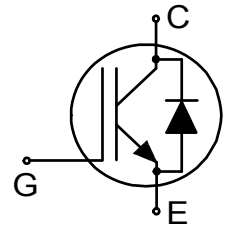
Features and Benefits:

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



Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat} , $T_{vj}=25^\circ\text{C}$	T_{vjmax}	Marking	Package
IKW75N65EL5	650V	75A	1.1V	175°C	K75EEL5	PG-TO247-3

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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	80.0 80.0	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}	± 20 ± 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, ³⁾ 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.	
R _{th} Characteristics						
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

¹⁾ Both values limited by bondwires.

²⁾ Defined by design. Not subject to production test.

³⁾ Package not recommended for surface mount applications.

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

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

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristic						
Input capacitance	C _{ies}	V _{CE} = 25V, V _{GE} = 0V f = 1000kHz	-	12100	-	pF
Output capacitance	C _{oes}		-	150	-	
Reverse transfer capacitance	C _{res}		-	42	-	
Gate charge	Q _G	V _{CC} = 520V, I _C = 75.0A, V _{GE} = 15V	-	436.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L _E		-	13.0	-	nH

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at $T_{vj} = 25^{\circ}\text{C}$						
Turn-on delay time	$t_{d(\text{on})}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 75.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(\text{on})} = 4.0\Omega, R_{G(\text{off})} = 4.0\Omega,$ $L\sigma = 40\text{nH}, C\sigma = 30\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	40	-	ns
Rise time	t_r		-	11	-	ns
Turn-off delay time	$t_{d(\text{off})}$		-	275	-	ns
Fall time	t_f		-	50	-	ns
Turn-on energy	E_{on}		-	1.61	-	mJ
Turn-off energy	E_{off}		-	3.20	-	mJ
Total switching energy	E_{ts}		-	4.81	-	mJ

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

Diode reverse recovery time	t_{rr}	$T_{vj} = 25^{\circ}\text{C},$ $V_R = 400\text{V},$ $I_F = 75.0\text{A},$ $di_F/dt = 1500\text{A}/\mu\text{s}$	-	114	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.37	-	μC
Diode peak reverse recovery current	I_{rrm}		-	29.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-2170	-	$\text{A}/\mu\text{s}$

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	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 75.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 4.0\Omega, R_{G(off)} = 4.0\Omega,$ $L\sigma = 40\text{nH}, C\sigma = 30\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	39	-	ns
Rise time	t_r		-	14	-	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}	$T_{vj} = 150^{\circ}\text{C},$ $V_R = 400\text{V},$ $I_F = 75.0\text{A},$ $di_F/dt = 1500\text{A}/\mu\text{s}$	-	95	-	ns
Diode reverse recovery charge	Q_{rr}		-	2.43	-	μC
Diode peak reverse recovery current	I_{rrm}		-	40.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-2900	-	$\text{A}/\mu\text{s}$

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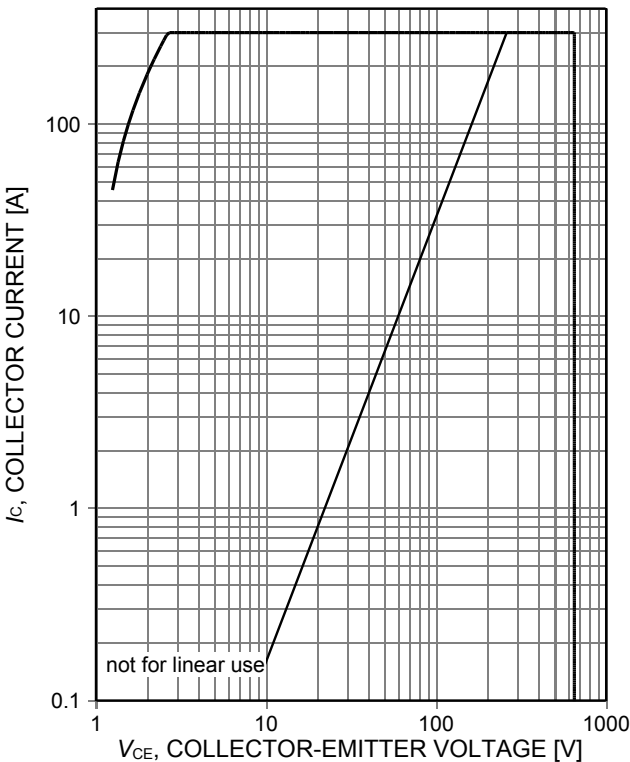


Figure 1. **Forward bias safe operating area**
($D=0$, $T_C=25^{\circ}\text{C}$, $T_{vj}\leq 175^{\circ}\text{C}$, $V_{GE}=15\text{V}$, $t_p=1\mu\text{s}$,
 I_{Cmax} defined by design - not subject to
production test)

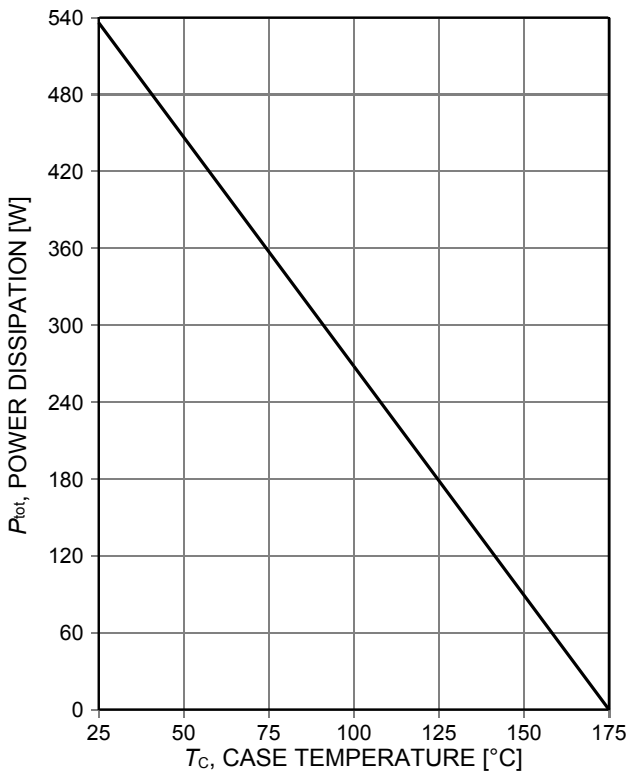


Figure 2. **Power dissipation as a function of case temperature**
($T_{vj}\leq 175^{\circ}\text{C}$)

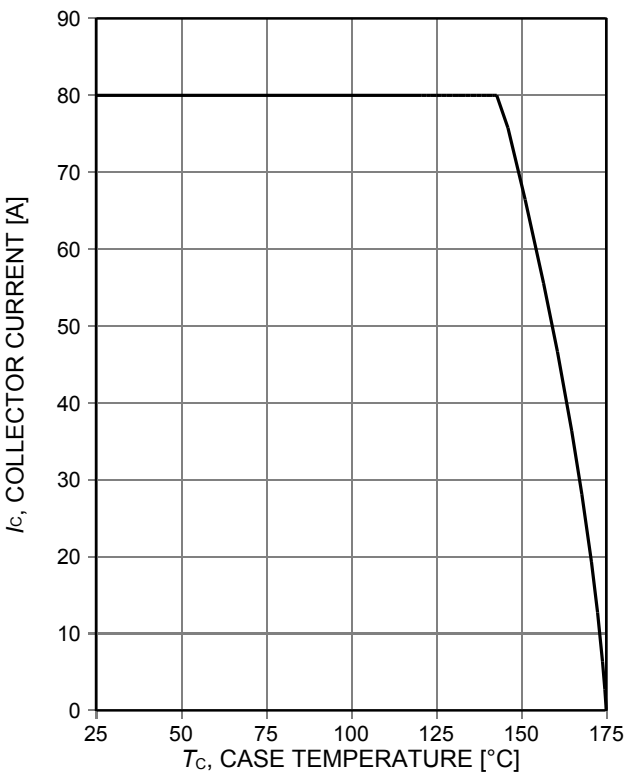


Figure 3. **Collector current as a function of case temperature**
($V_{GE}\geq 15\text{V}$, $T_{vj}\leq 175^{\circ}\text{C}$)

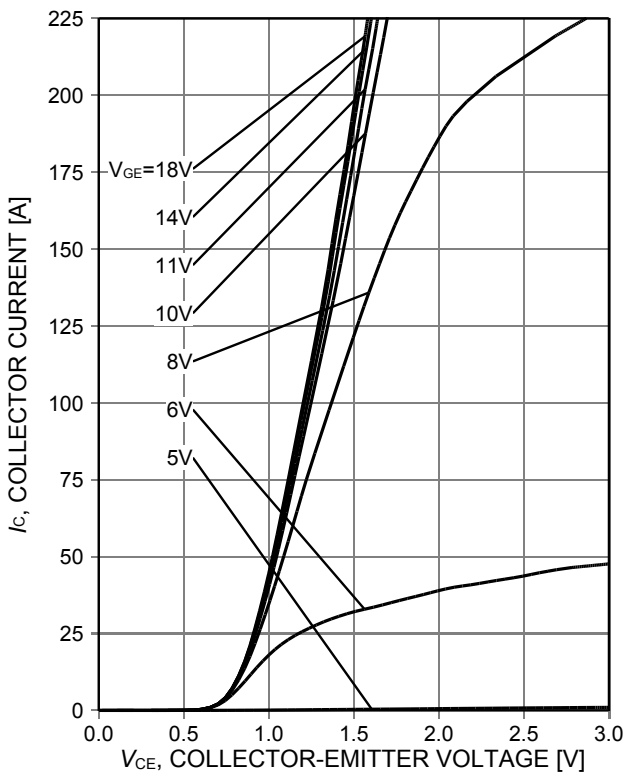


Figure 4. **Typical output characteristic**
($T_{vj}=25^{\circ}\text{C}$)

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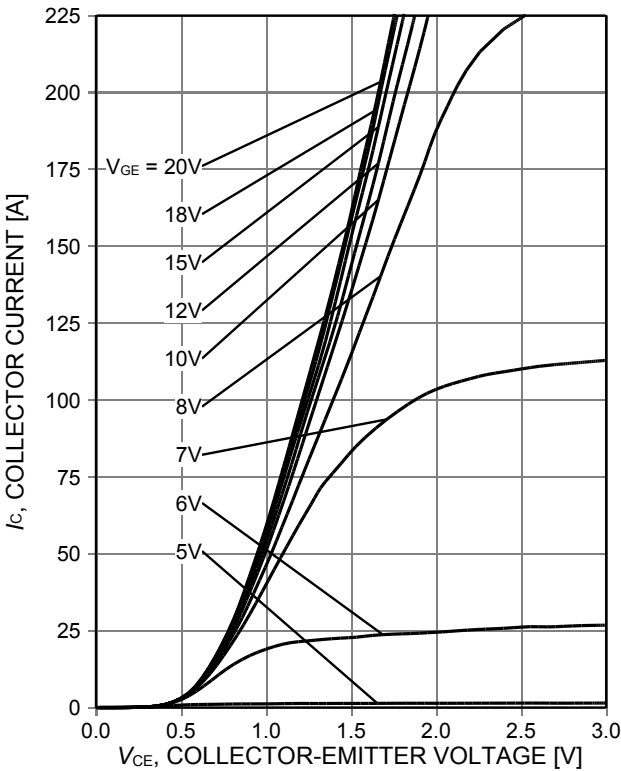


Figure 5. **Typical output characteristic**
($T_{vj}=175^{\circ}\text{C}$)

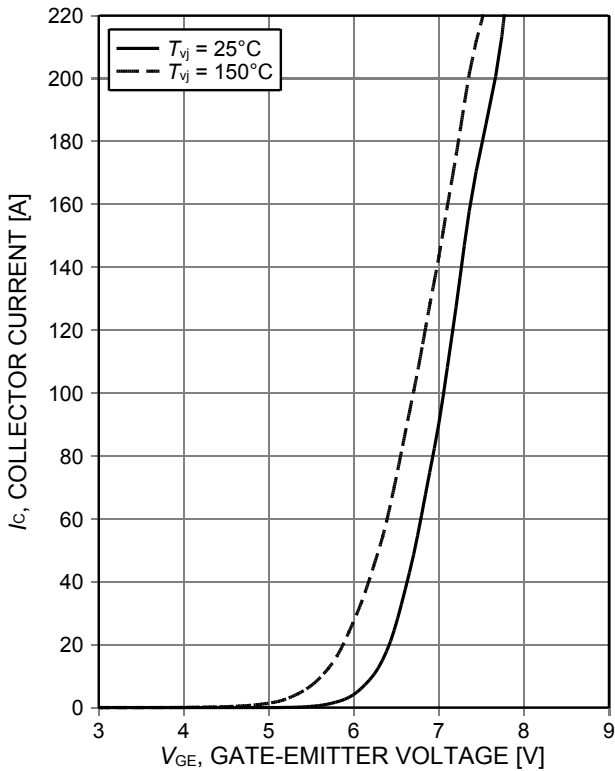


Figure 6. **Typical transfer characteristic**
($V_{CE}=20\text{V}$)

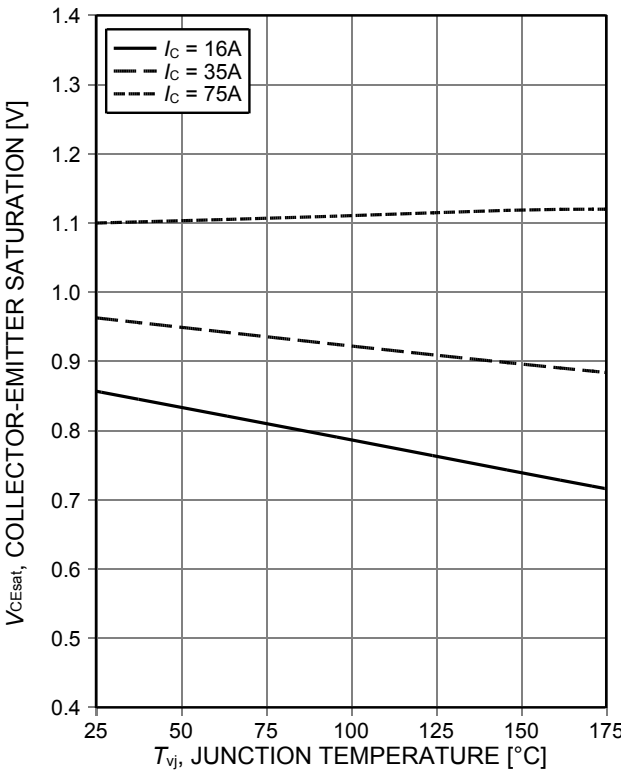


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15\text{V}$)

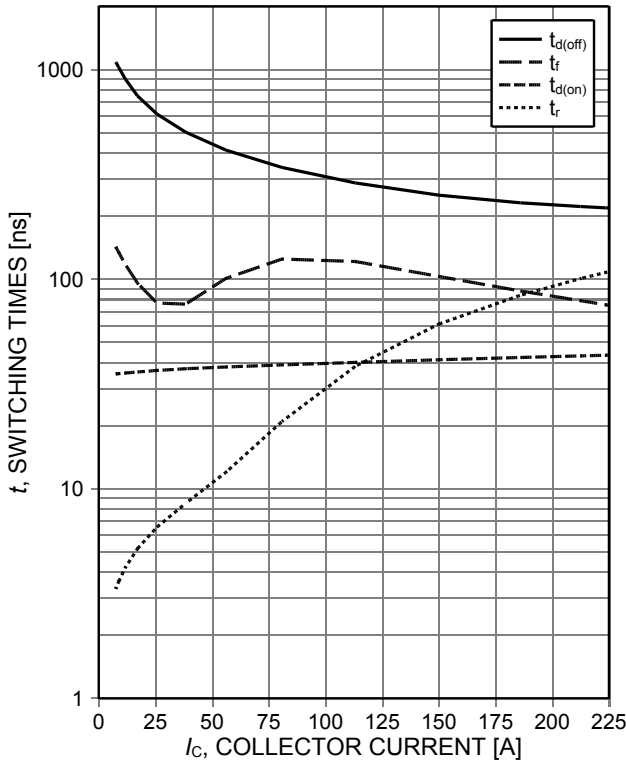


Figure 8. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_{G(on)}=4\Omega$, $R_{G(off)}=4\Omega$, dynamic test circuit in Figure E)

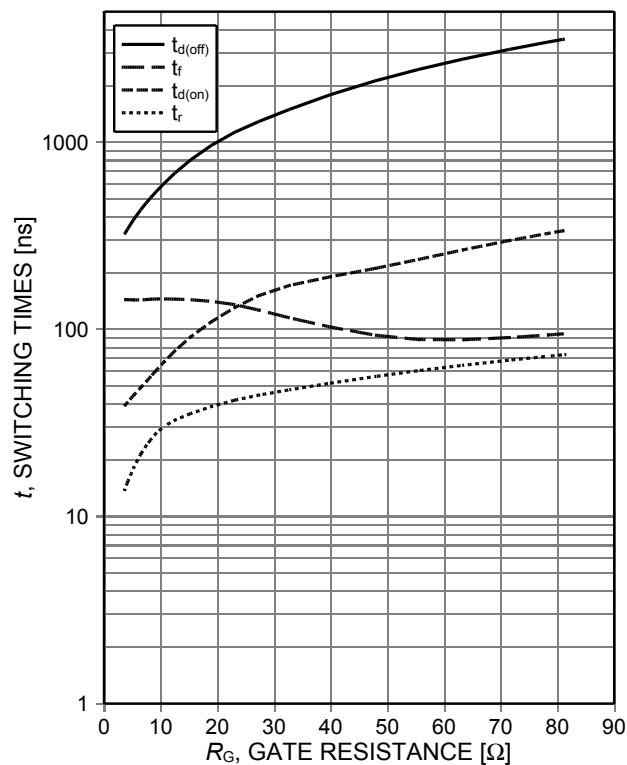
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Figure 9. **Typical switching times as a function of gate resistance**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=75\text{A}$, dynamic test circuit in Figure E)

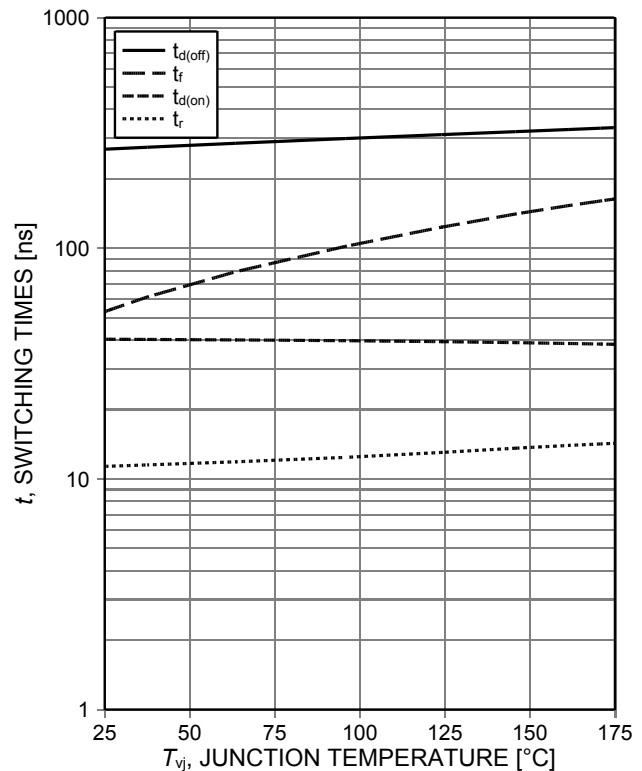


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=75\text{A}$, $R_{G(on)}=4\Omega$, $R_{G(off)}=4\Omega$, dynamic test circuit in Figure E)

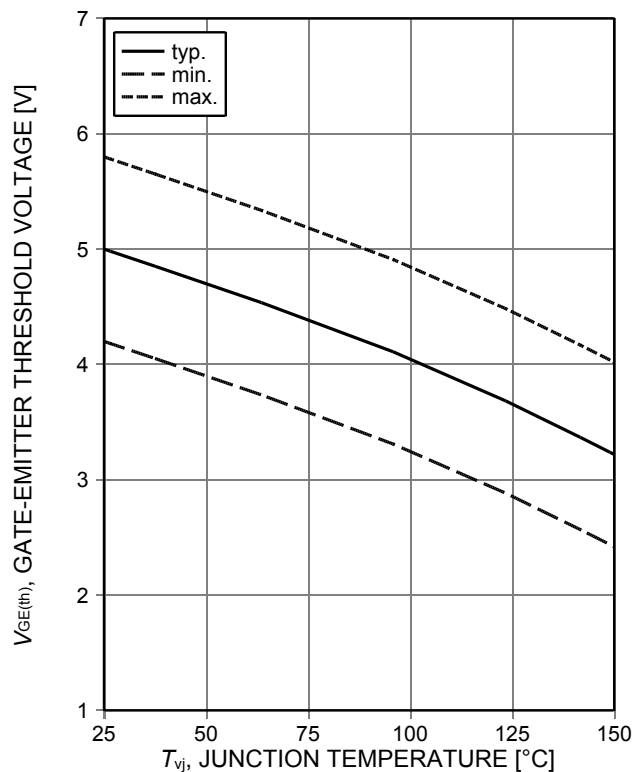


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C=1\text{mA}$)

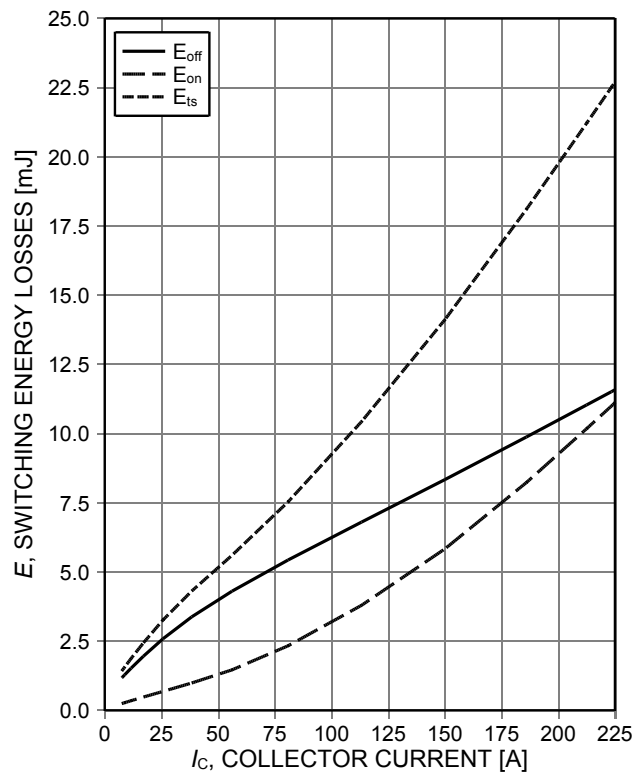


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_{G(on)}=4\Omega$, $R_{G(off)}=4\Omega$, dynamic test circuit in Figure E)

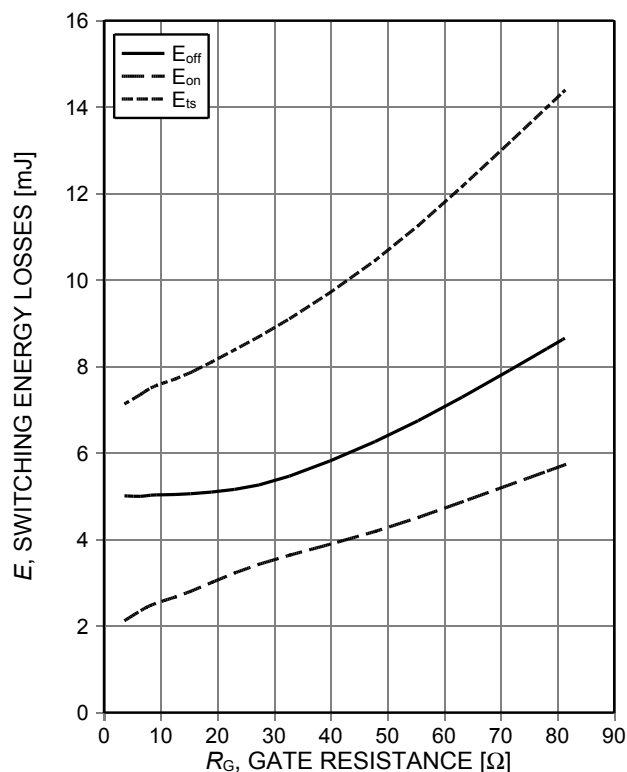
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Figure 13. **Typical switching energy losses as a function of gate resistance**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=75\text{A}$, dynamic test circuit in Figure E)

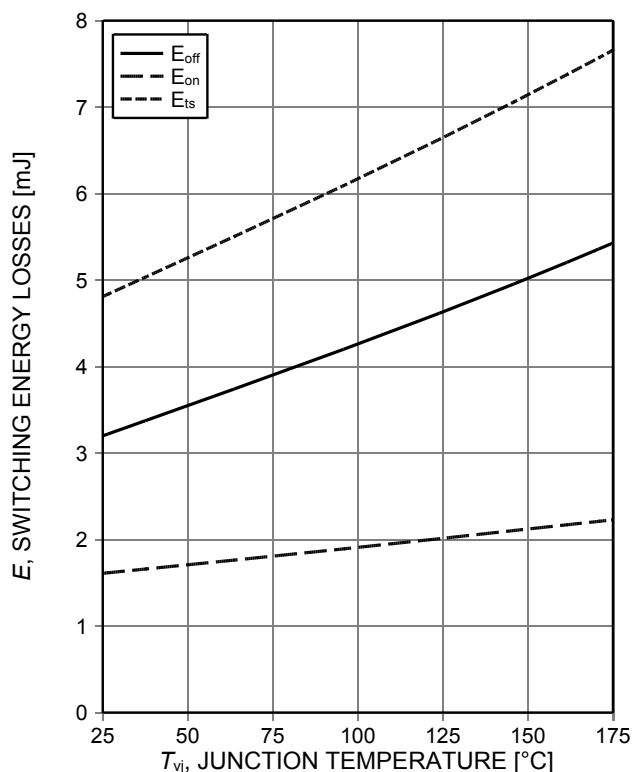


Figure 14. **Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=75\text{A}$, $R_{G(on)}=4\Omega$, $R_{G(off)}=4\Omega$, dynamic test circuit in Figure E)

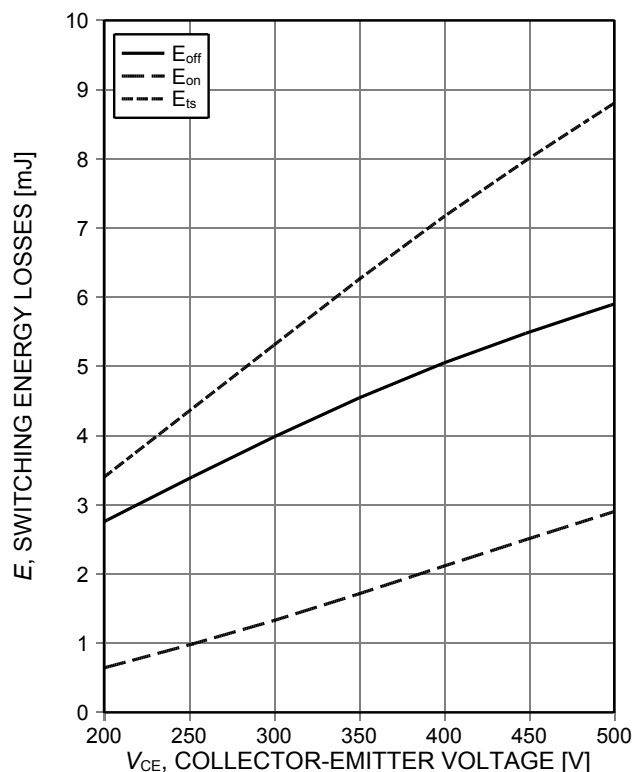


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=75\text{A}$, $R_{G(on)}=4\Omega$, $R_{G(off)}=4\Omega$, dynamic test circuit in Figure E)

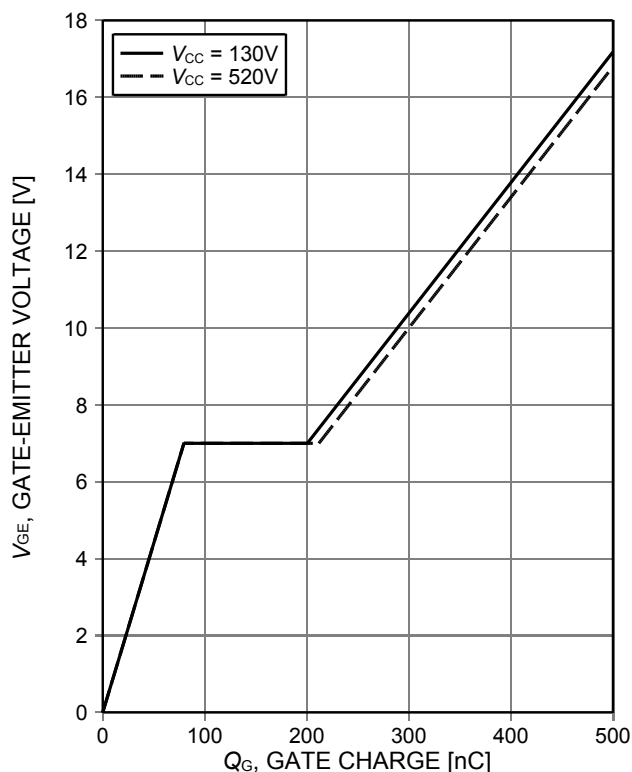


Figure 16. **Typical gate charge**
($I_C=75\text{A}$)

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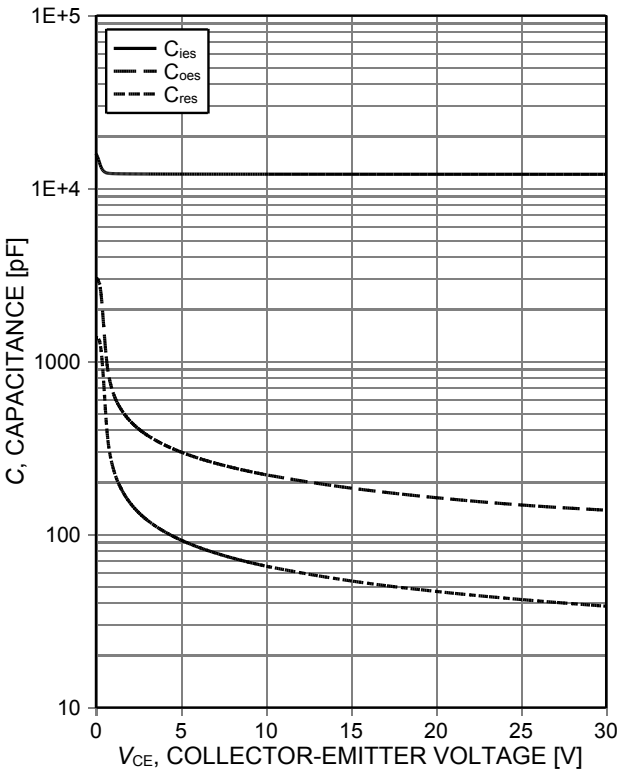


Figure 17. Typical capacitance as a function of collector-emitter voltage ($V_{GE}=0V$, $f=1MHz$)

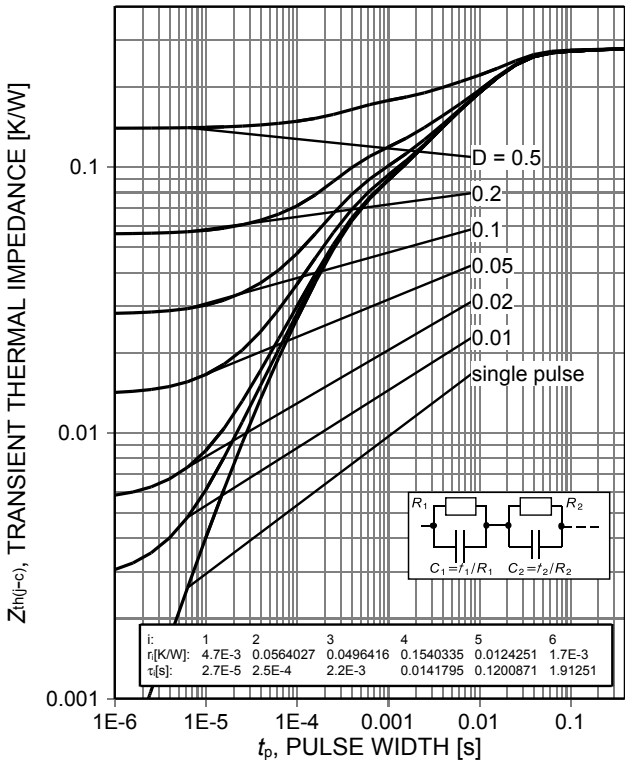


Figure 18. IGBT transient thermal impedance ($D=t_p/T$)

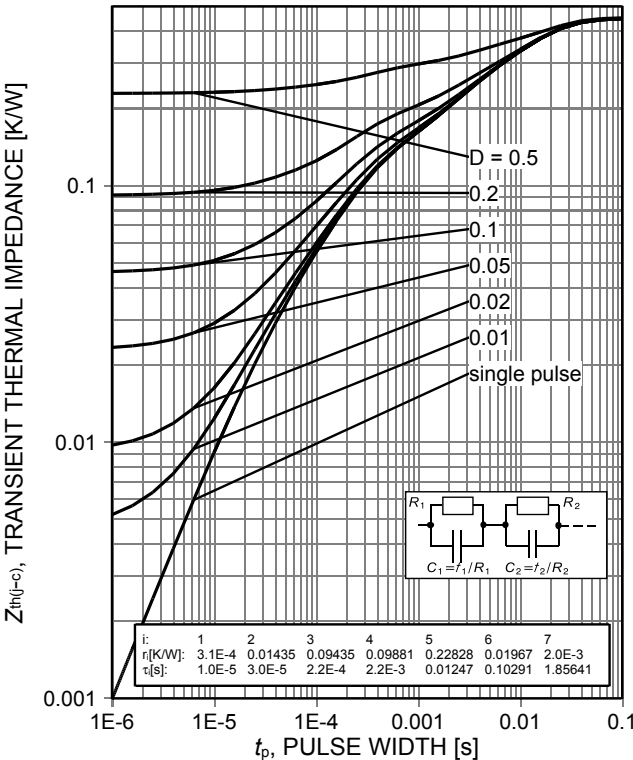


Figure 19. Diode transient thermal impedance as a function of pulse width ($D=t_p/T$)

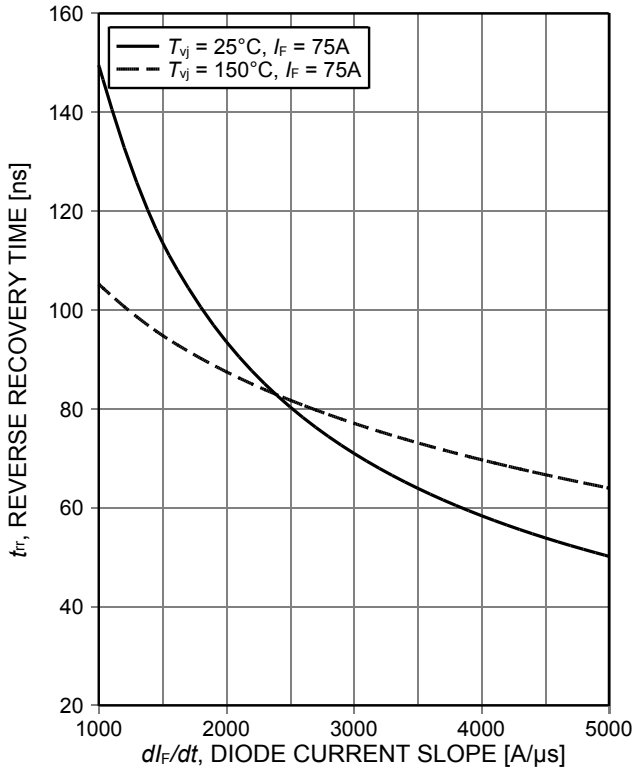


Figure 20. Typical reverse recovery time as a function of diode current slope ($V_R=400V$)

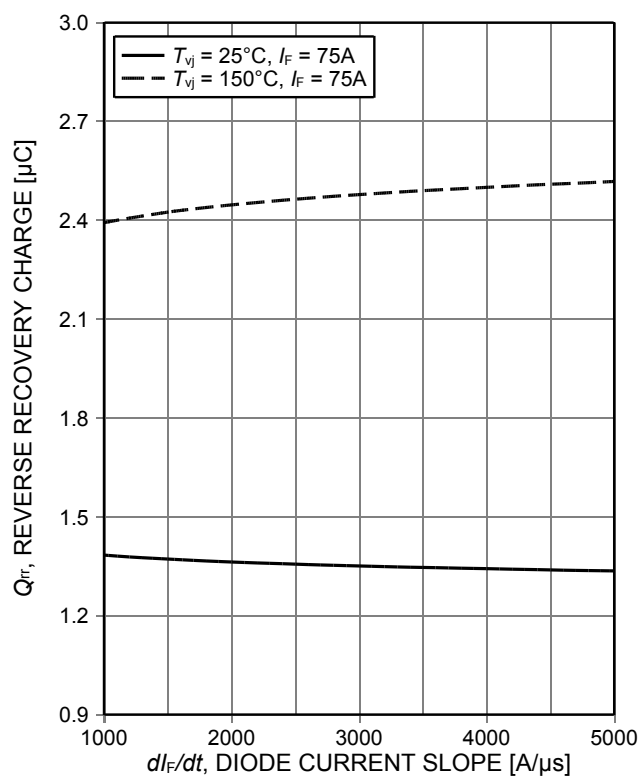
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Figure 21. Typical reverse recovery charge as a function of diode current slope ($V_R=400V$)

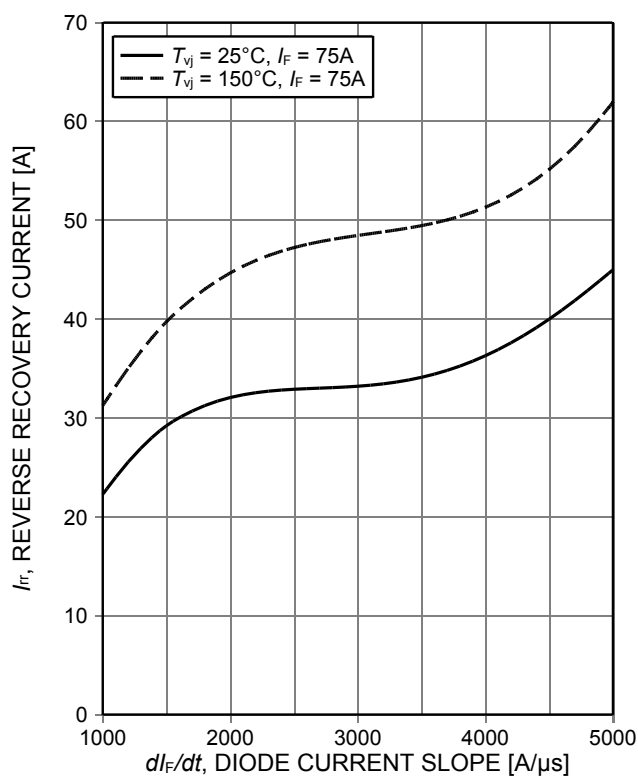


Figure 22. Typical reverse recovery current as a function of diode current slope ($V_R=400V$)

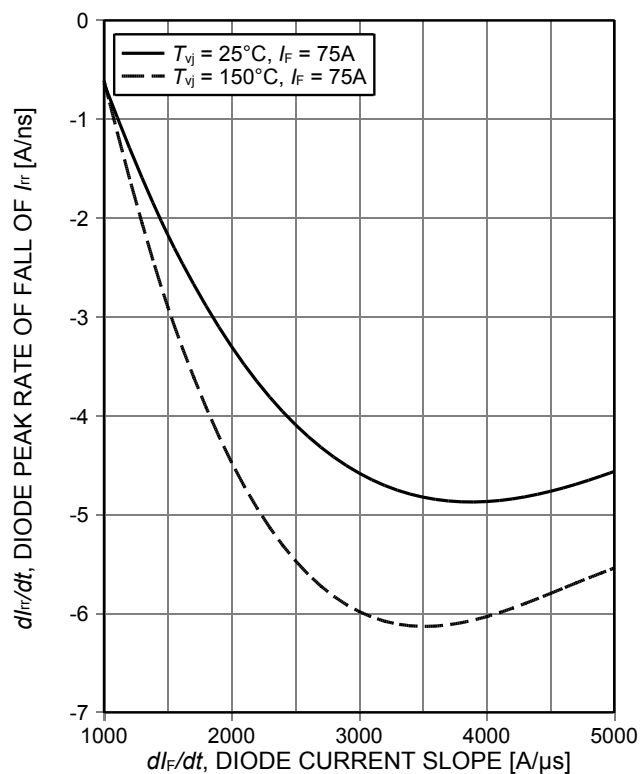


Figure 23. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope ($V_R=400V$)

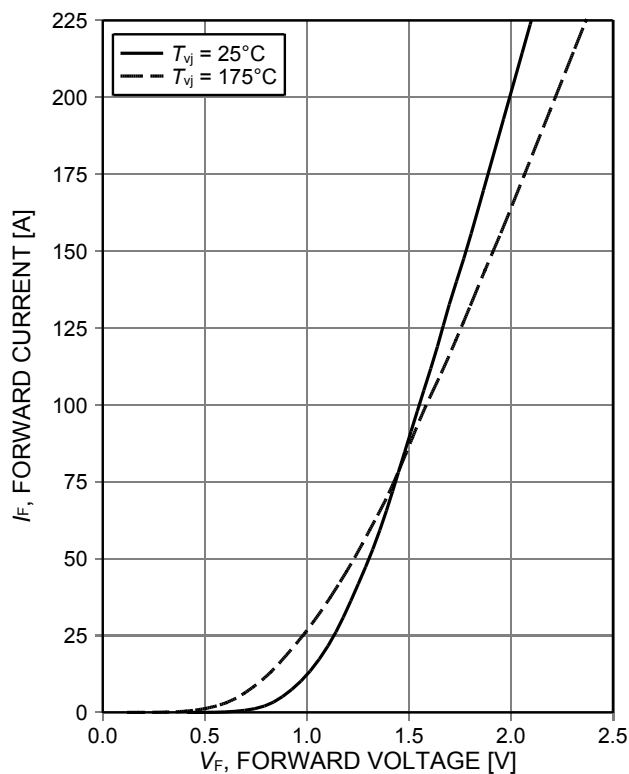


Figure 24. Typical diode forward current as a function of forward voltage

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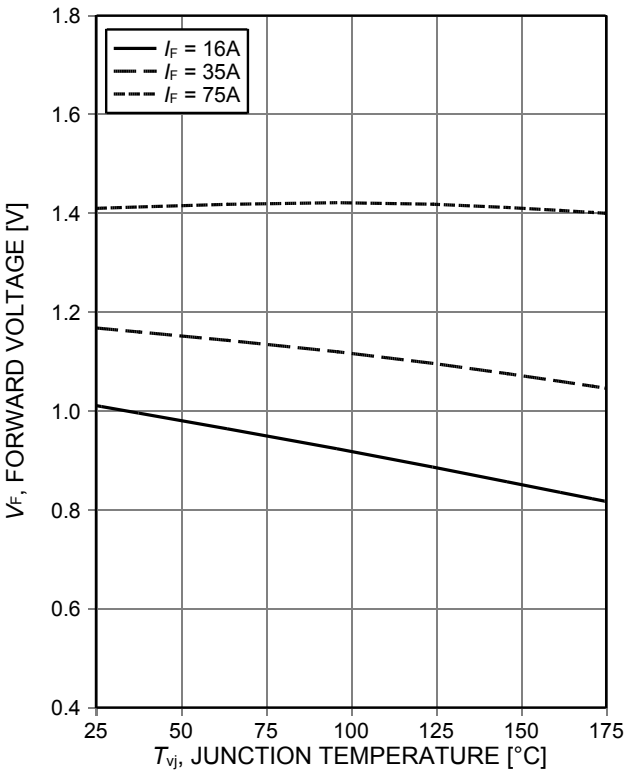
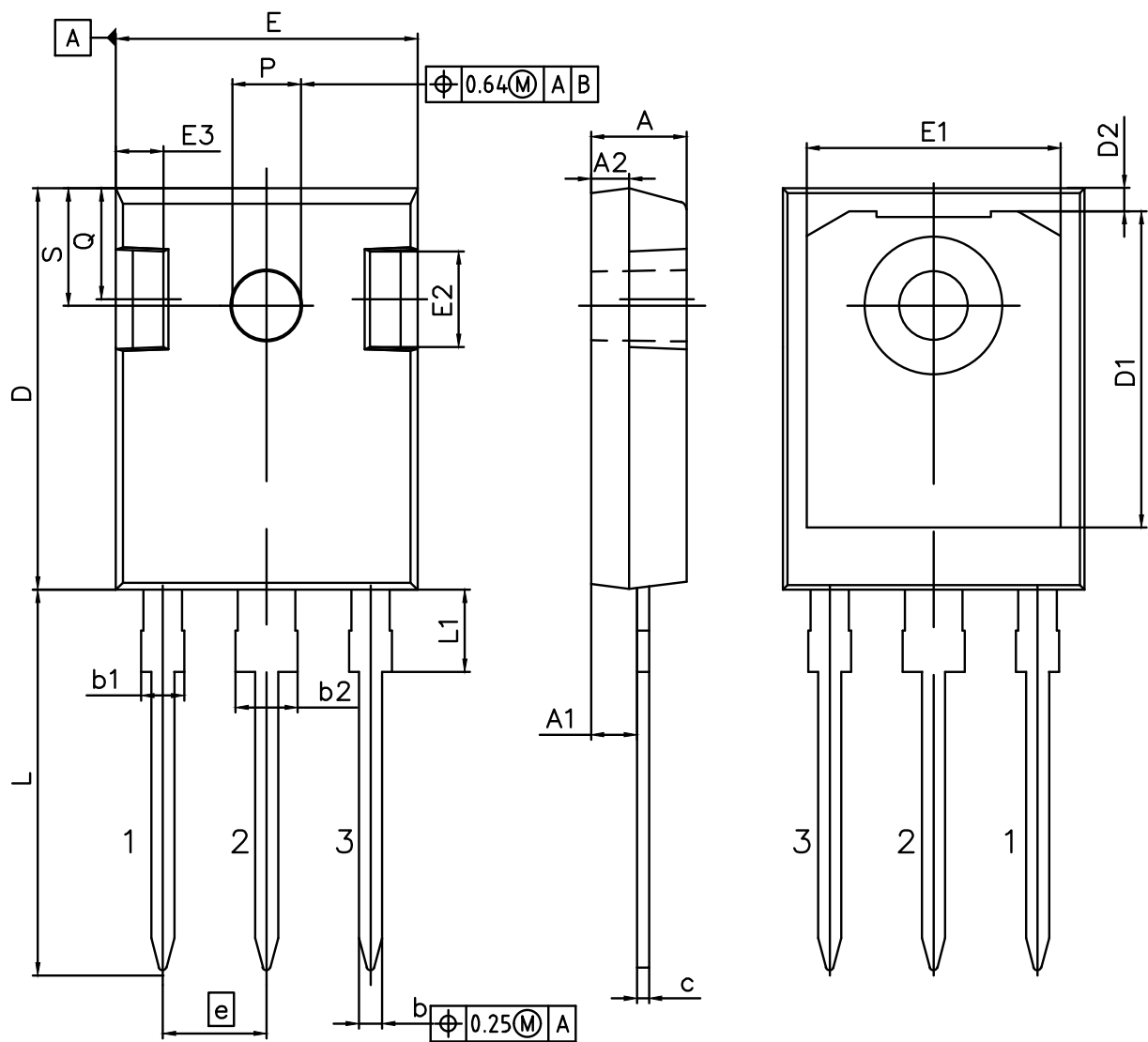


Figure 25. Typical diode forward voltage as a function of junction temperature

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Package Drawing PG-TO247-3



DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.70	5.30
A1	2.20	2.60
A2	1.50	2.50
b	1.00	1.40
b1	1.60	2.41
b2	2.57	3.43
c	0.38	0.89
D	20.70	21.50
D1	13.08	17.65
D2	0.51	1.35
E	15.50	16.30
E1	12.38	14.15
E2	3.40	5.10
E3	1.00	2.60
e	5.44	
L	19.80	20.40
L1	3.85	4.50
P	3.50	3.70
Q	5.35	6.25
S	6.04	6.30

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EUROPEAN PROJECTION
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Testing Conditions

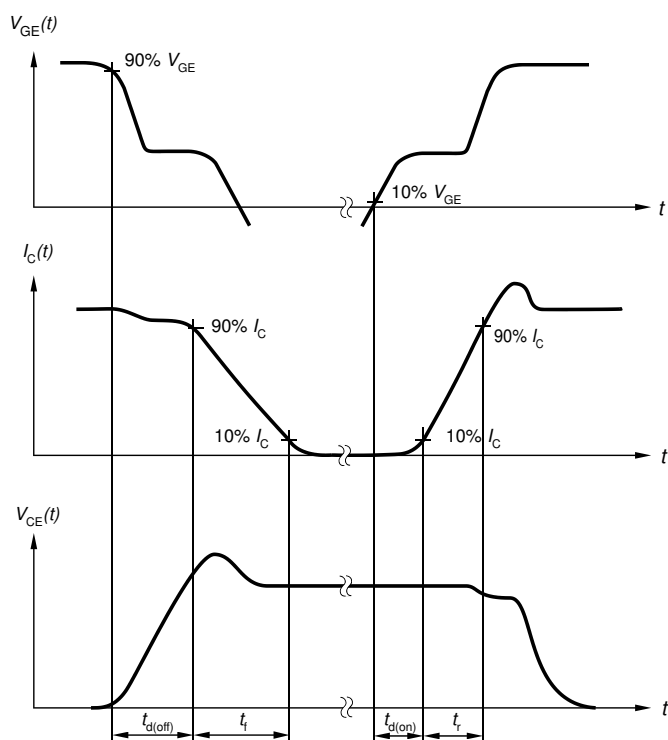


Figure A. Definition of switching times

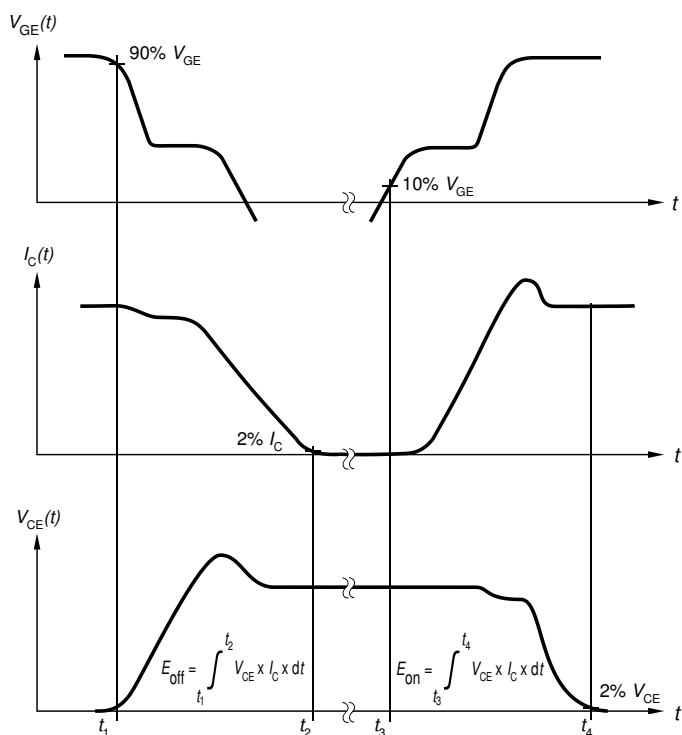


Figure B. Definition of switching losses

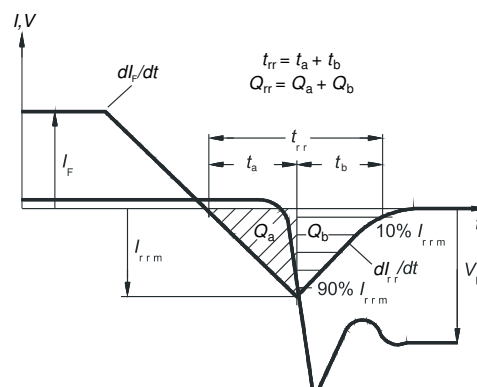


Figure C. Definition of diode switching characteristics

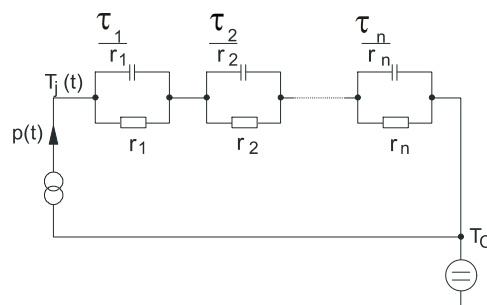


Figure D. Thermal equivalent circuit

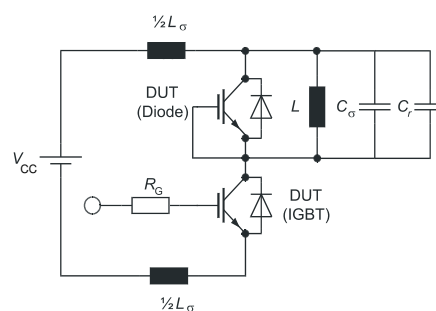


Figure E. **Dynamic test circuit**
 Parasitic inductance L_{σ} ,
 parasitic capacitor C_{σ} ,
 relief capacitor C_r ,
 (only for ZVT switching)

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Revision History

IKW75N65EL5

Revision: 2020-10-07, Rev. 2.2

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

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