

IGBT

High speed 5 FAST IGBT in TRENCHSTOP™ 5 technology copacked with RAPID 1 fast and soft antiparallel diode

IKP30N65F5

650V DuoPack IGBT and diode
High speed switching series fifth generation

Data sheet

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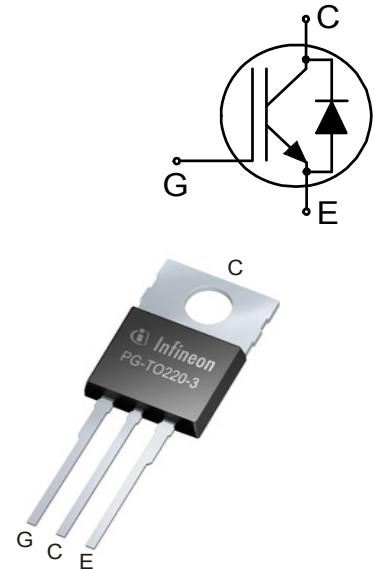
Features and Benefits:

High speed F5 technology offering

- Best-in-Class efficiency in hard switching and resonant topologies
- 650V breakdown voltage
- Low gate charge Q_G
- IGBT copacked with RAPID 1 fast and soft antiparallel diode
- 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:

- Solar converters
- Uninterruptible power supplies
- Welding converters
- Mid to high range switching frequency converters



Key Performance and Package Parameters

Type	V_{CE}	I_C	$V_{CEsat}, T_{vj}=25^{\circ}C$	T_{vjmax}	Marking	Package
IKP30N65F5	650V	30A	1.6V	175°C	K30EF5	PG-TO220-3

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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} $T_C = 25^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$	I_C	55.0 35.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	90.0	A
Turn off safe operating area $V_{CE} \leq 650\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}$	-	90.0	A
Diode forward current, limited by T_{vjmax} $T_C = 25^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$	I_F	36.0 21.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	90.0	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}	188.0 93.0	W
Operating junction temperature	T_{vj}	$-40 \dots +175$	$^{\circ}\text{C}$
Storage temperature	T_{stg}	$-55 \dots +150$	$^{\circ}\text{C}$
Soldering temperature, 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	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		0.80	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		1.80	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		62	K/W

Electrical 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}	$V_{GE} = 15.0V, I_C = 30.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 175^{\circ}C$	- - -	1.60 1.80 1.90	2.10 - -	V
Diode forward voltage	V_F	$V_{GE} = 0V, I_F = 15.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 175^{\circ}C$	- - -	1.35 1.30 1.30	1.80 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.30mA, V_{CE} = V_{GE}$	3.2	4.0	4.8	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 650V, V_{GE} = 0V$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	- -	40.0 4000.0	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0V, V_{GE} = 20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE} = 20V, I_C = 30.0A$	-	38.0	-	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}	$V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$	-	1800	-	pF
Output capacitance	C_{oes}		-	45	-	
Reverse transfer capacitance	C_{res}		-	9	-	
Gate charge	Q_G	$V_{CC} = 520V, I_C = 30.0A, V_{GE} = 15V$	-	65.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	7.0	-	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	$t_{d(\text{on})}$	$T_{vj} = 25^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 15.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(\text{on})} = 23.0\Omega$, $R_{G(\text{off})} = 23.0\Omega$, $L_{\sigma} = 30\text{nH}$, $C_{\sigma} = 30\text{pF}$ L_{σ} , C_{σ} from Fig. E Energy losses include “tail” and diode reverse recovery.	-	19	-	ns
Rise time	t_r		-	9	-	ns
Turn-off delay time	$t_{d(\text{off})}$		-	170	-	ns
Fall time	t_f		-	10	-	ns
Turn-on energy	E_{on}		-	0.28	-	mJ
Turn-off energy	E_{off}		-	0.07	-	mJ
Total switching energy	E_{ts}		-	0.35	-	mJ

Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 5.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 23.0\Omega$, $R_{G(off)} = 23.0\Omega$, $L_{\sigma} = 30\text{nH}$, $C_{\sigma} = 30\text{pF}$ L_{σ} , C_{σ} from Fig. E Energy losses include "tail" and diode reverse recovery.	-	18	-	ns
Rise time	t_r		-	4	-	ns
Turn-off delay time	$t_{d(off)}$		-	174	-	ns
Fall time	t_f		-	15	-	ns
Turn-on energy	E_{on}		-	0.09	-	mJ
Turn-off energy	E_{off}		-	0.02	-	mJ
Total switching energy	E_{ts}		-	0.11	-	mJ

Diode Characteristic, at $T_{vj} = 25^{\circ}\text{C}$

Diode reverse recovery time	t_{rr}	$T_{vj} = 25^{\circ}\text{C}$, $V_R = 400\text{V}$, $I_F = 15.0\text{A}$, $di_F/dt = 1600\text{A}/\mu\text{s}$	-	55	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.41	-	μC
Diode peak reverse recovery current	I_{rrm}		-	14.4	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-399	-	$\text{A}/\mu\text{s}$
Diode reverse recovery time	t_{rr}	$T_{vj} = 25^{\circ}\text{C}$, $V_R = 400\text{V}$, $I_F = 5.0\text{A}$, $di_F/dt = 1300\text{A}/\mu\text{s}$	-	29	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.22	-	μC
Diode peak reverse recovery current	I_{rrm}		-	12.6	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-820	-	$\text{A}/\mu\text{s}$

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	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 15.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 23.0\Omega$, $R_{G(off)} = 23.0\Omega$, $L_{\sigma} = 30\text{nH}$, $C_{\sigma} = 30\text{pF}$ L_{σ} , C_{σ} from Fig. E Energy losses include "tail" and diode reverse recovery.	-	18	-	ns
Rise time	t_r		-	10	-	ns
Turn-off delay time	$t_{d(off)}$		-	203	-	ns
Fall time	t_f		-	3	-	ns
Turn-on energy	E_{on}		-	0.38	-	mJ
Turn-off energy	E_{off}		-	0.12	-	mJ
Total switching energy	E_{ts}		-	0.50	-	mJ
Turn-on delay time	$t_{d(on)}$		-	16	-	ns
Rise time	t_r		-	5	-	ns
Turn-off delay time	$t_{d(off)}$	$T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 5.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 23.0\Omega$, $R_{G(off)} = 23.0\Omega$, $L_{\sigma} = 30\text{nH}$, $C_{\sigma} = 30\text{pF}$ L_{σ} , C_{σ} from Fig. E Energy losses include "tail" and diode reverse recovery.	-	230	-	ns
Fall time	t_f		-	9	-	ns
Turn-on energy	E_{on}		-	0.15	-	mJ
Turn-off energy	E_{off}		-	0.04	-	mJ
Total switching energy	E_{ts}		-	0.19	-	mJ

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

Diode reverse recovery time	t_{rr}	$T_{vj} = 150^{\circ}\text{C},$ $V_R = 400\text{V},$ $I_F = 15.0\text{A},$ $di_F/dt = 1600\text{A}/\mu\text{s}$	-	83	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.90	-	μC
Diode peak reverse recovery current	I_{rrm}		-	19.3	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-288	-	$\text{A}/\mu\text{s}$
Diode reverse recovery time	t_{rr}	$T_{vj} = 150^{\circ}\text{C},$ $V_R = 400\text{V},$ $I_F = 5.0\text{A},$ $di_F/dt = 1300\text{A}/\mu\text{s}$	-	51	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.49	-	μC
Diode peak reverse recovery current	I_{rrm}		-	17.7	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-538	-	$\text{A}/\mu\text{s}$

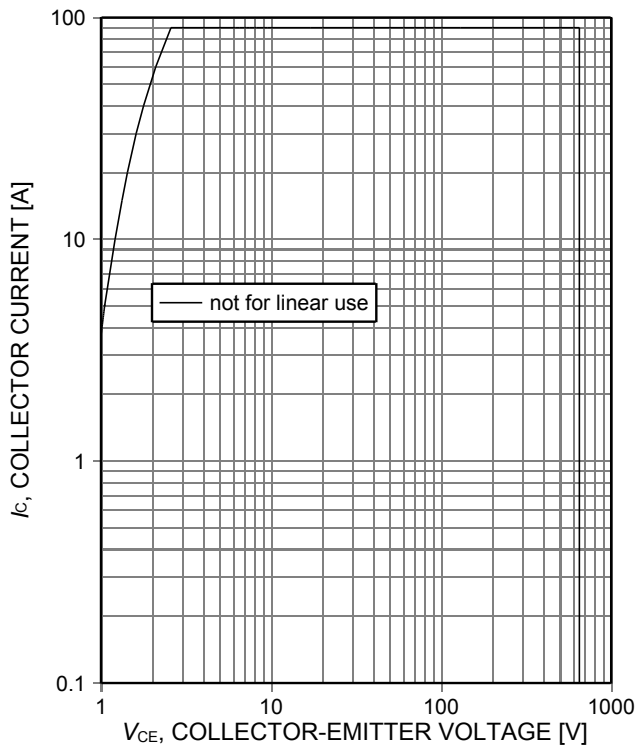


Figure 1. **Forward bias safe operating area**
($D=0$, $T_C=25^\circ\text{C}$, $T_{vj}\leq 175^\circ\text{C}$, $V_{GE}=15\text{V}$, $t_p=1\mu\text{s}$.
Recommended use at $V_{GE}\geq 7.5\text{V}$)

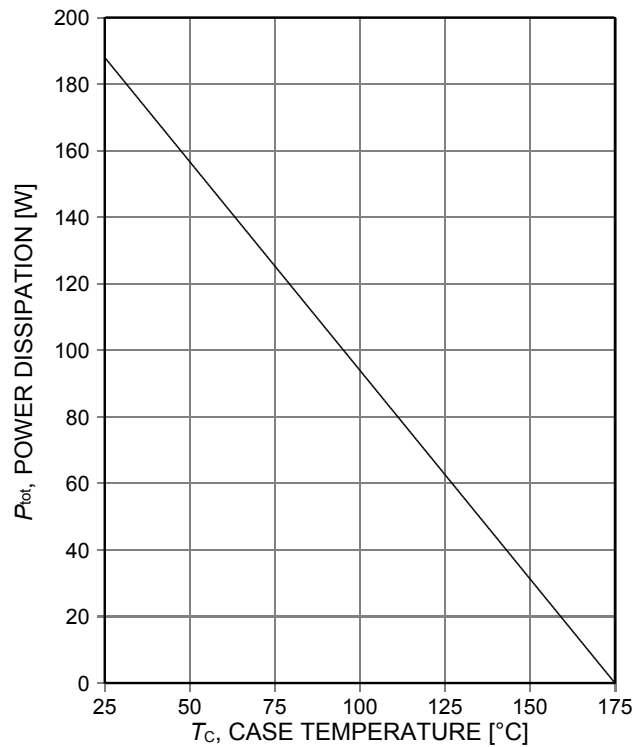


Figure 2. **Power dissipation as a function of case temperature**
($T_{vj}\leq 175^\circ\text{C}$)

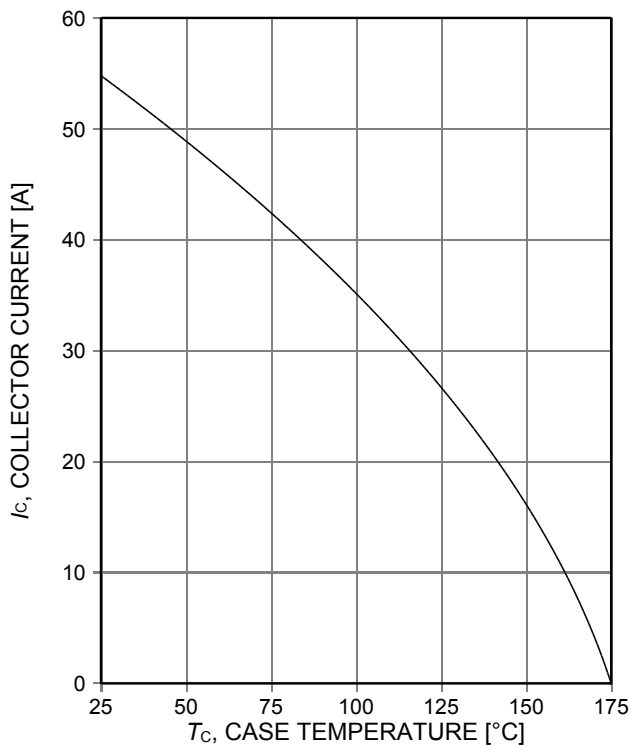


Figure 3. **Collector current as a function of case temperature**
($V_{GE}\geq 15\text{V}$, $T_{vj}\leq 175^\circ\text{C}$)

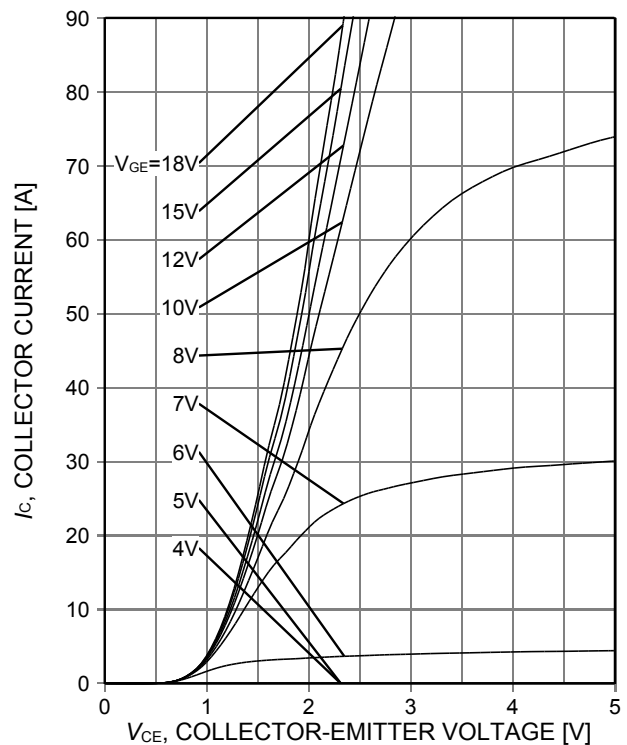


Figure 4. **Typical output characteristic**
($T_{vj}=25^\circ\text{C}$)

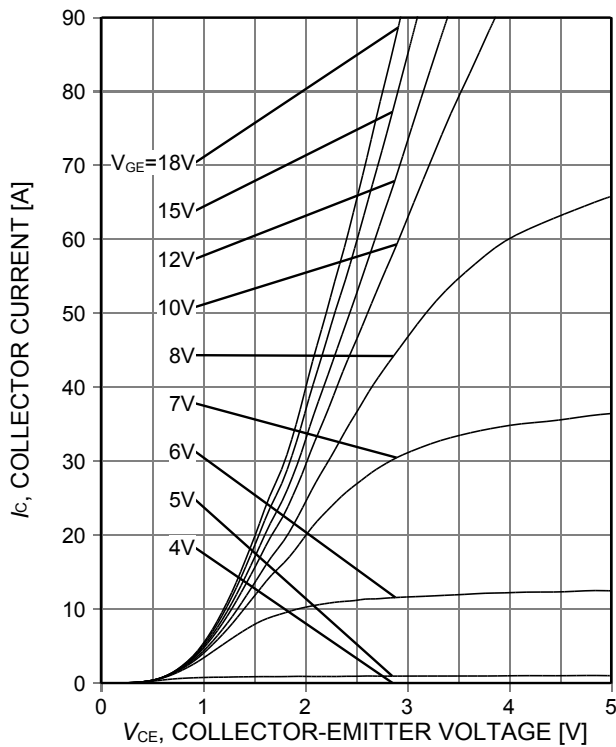


Figure 5. **Typical output characteristic**
($T_{vj}=150^{\circ}\text{C}$)

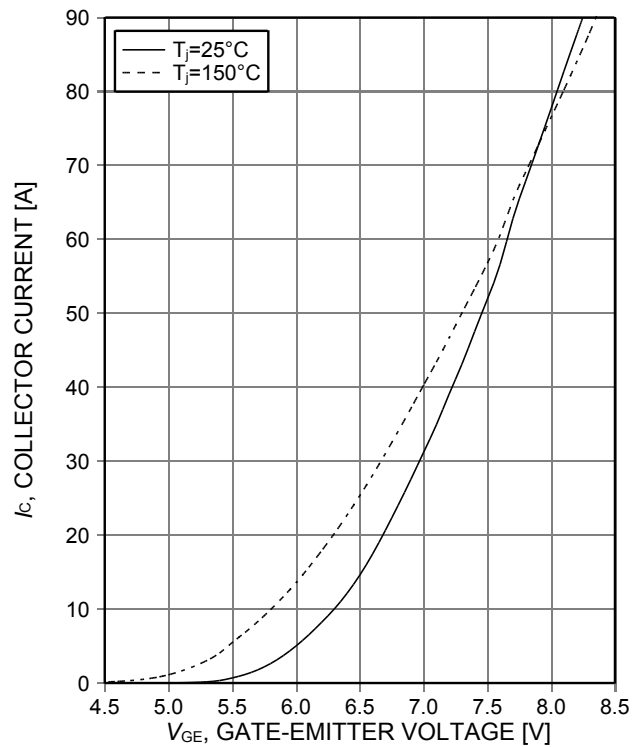


Figure 6. **Typical transfer characteristic**
($V_{CE}=20\text{V}$)

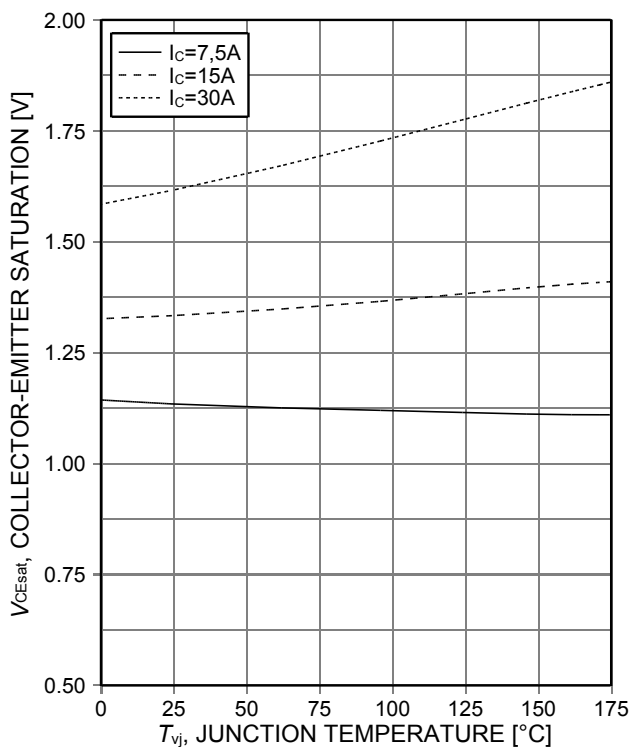


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15\text{V}$)

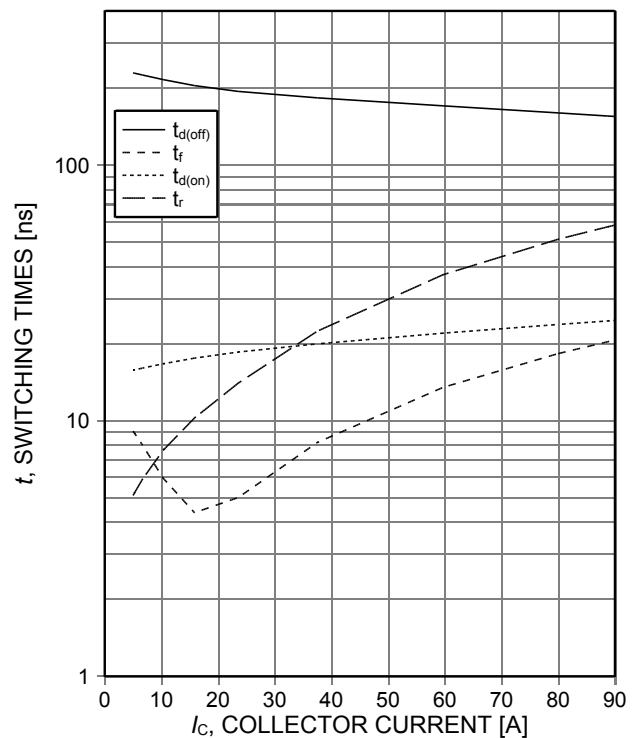


Figure 8. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=23\Omega$, Dynamic test circuit in Figure E)

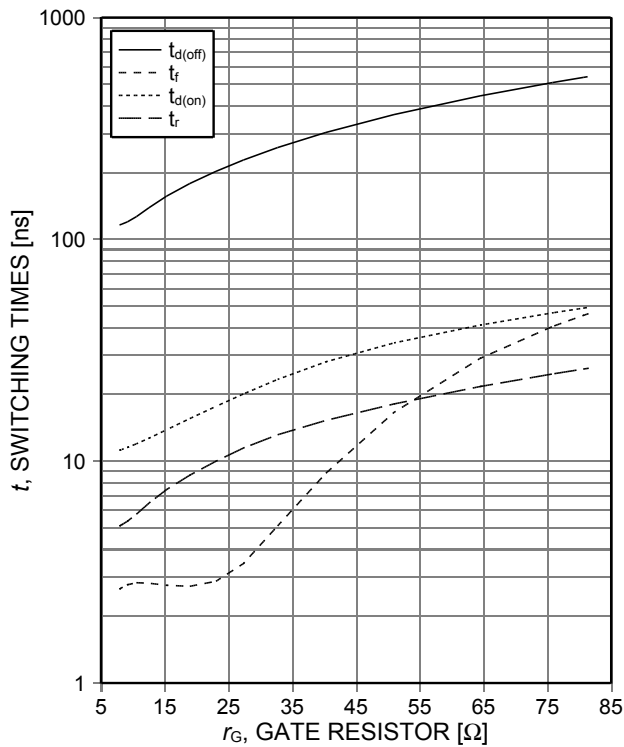


Figure 9. **Typical switching times as a function of gate resistor**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=15\text{A}$, Dynamic test circuit in Figure E)

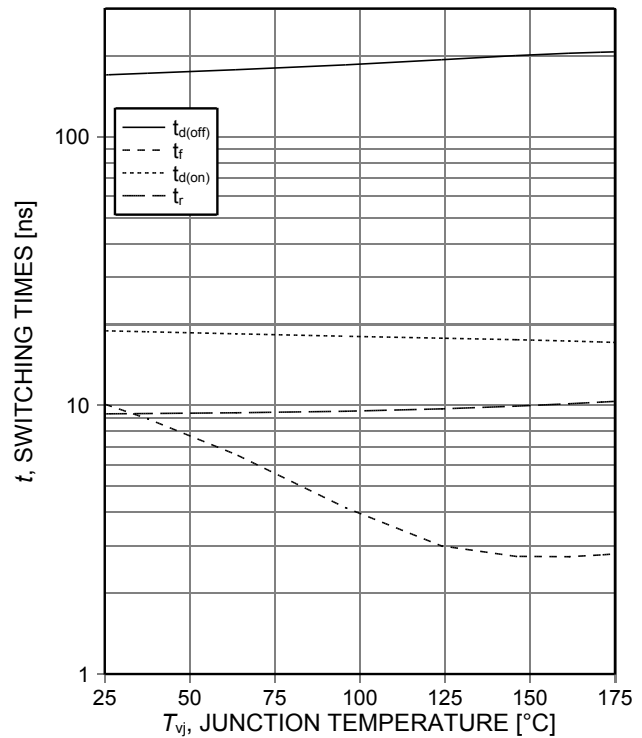


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=15\text{A}$, $r_G=23\Omega$, Dynamic test circuit in Figure E)

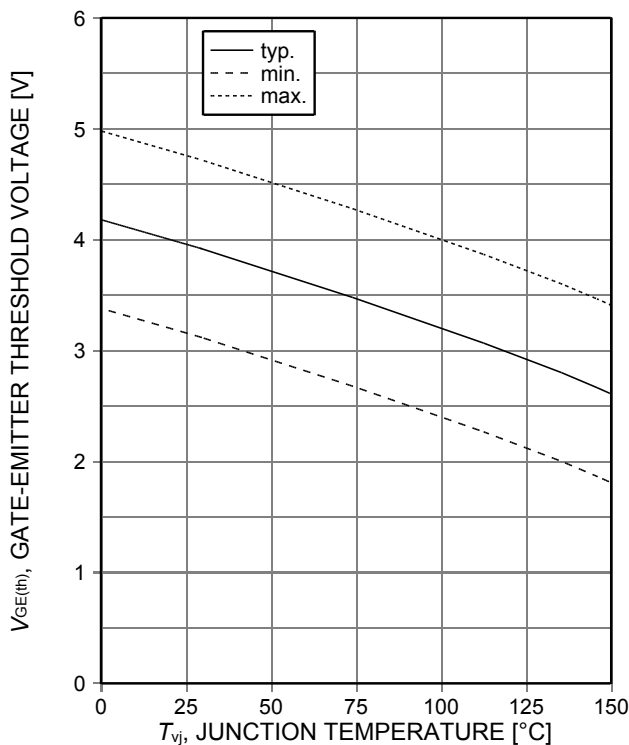


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C=0.3\text{mA}$)

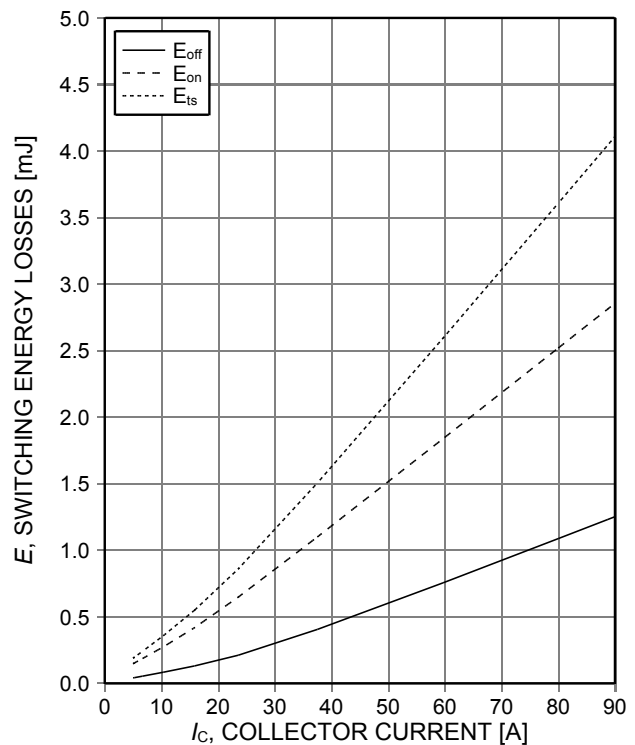


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=23\Omega$, Dynamic test circuit in Figure E)

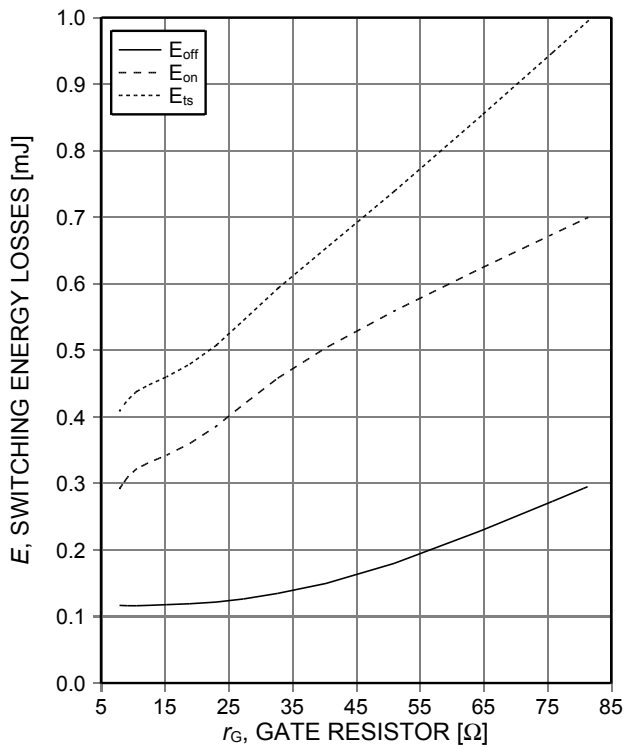


Figure 13. **Typical switching energy losses as a function of gate resistor**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=15\text{A}$, Dynamic test circuit in Figure E)

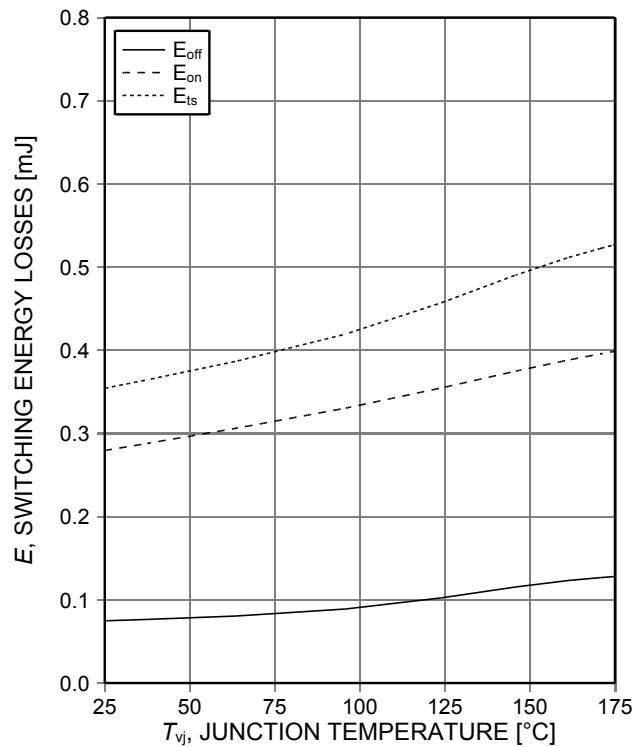


Figure 14. **Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=15\text{A}$, $r_G=23\Omega$, Dynamic test circuit in Figure E)

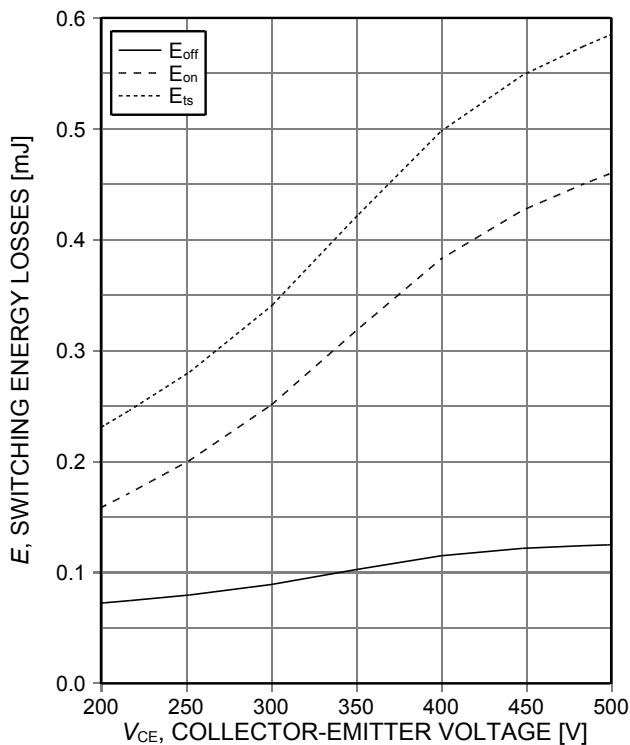


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{GE}=15/0\text{V}$, $I_C=15\text{A}$, $r_G=23\Omega$, Dynamic test circuit in Figure E)

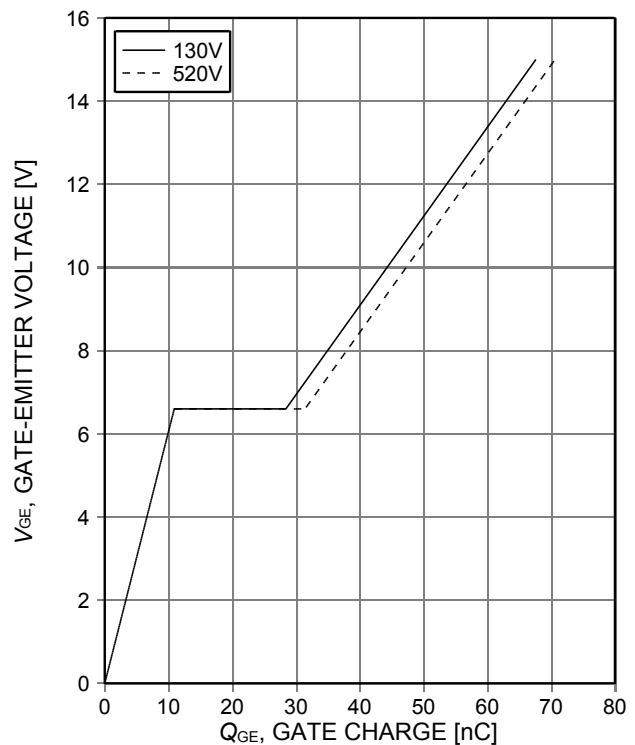


Figure 16. **Typical gate charge**
($I_C=30\text{A}$)

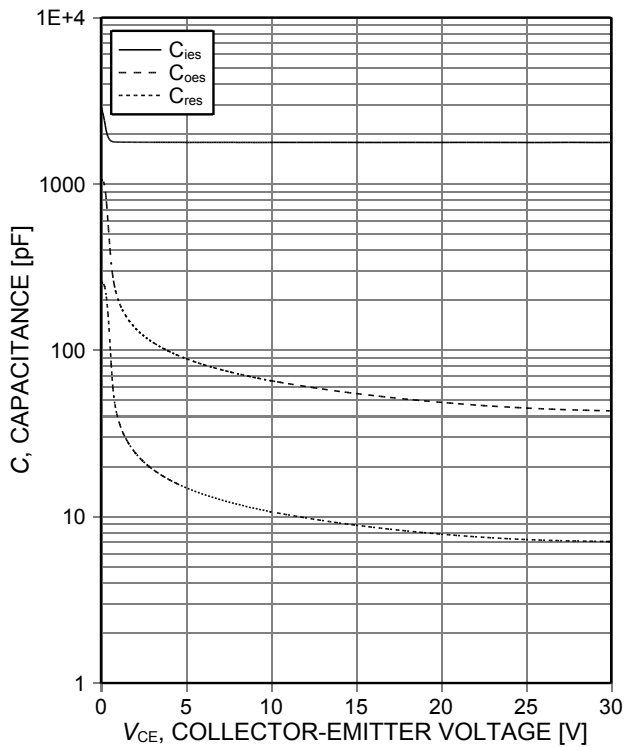


Figure 17. Typical capacitance as a function of collector-emitter voltage ($V_{GE}=0V$, $f=1MHz$)

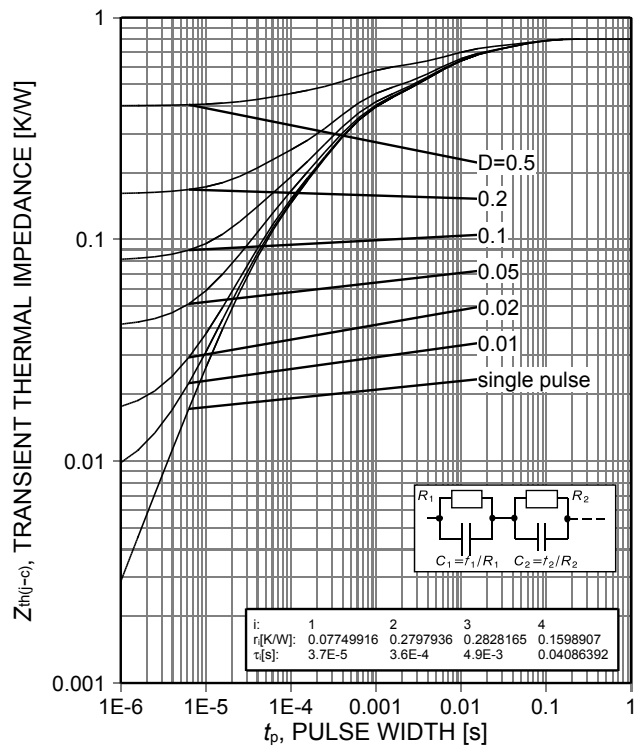


Figure 18. IGBT transient thermal impedance ($D=t_p/T$)

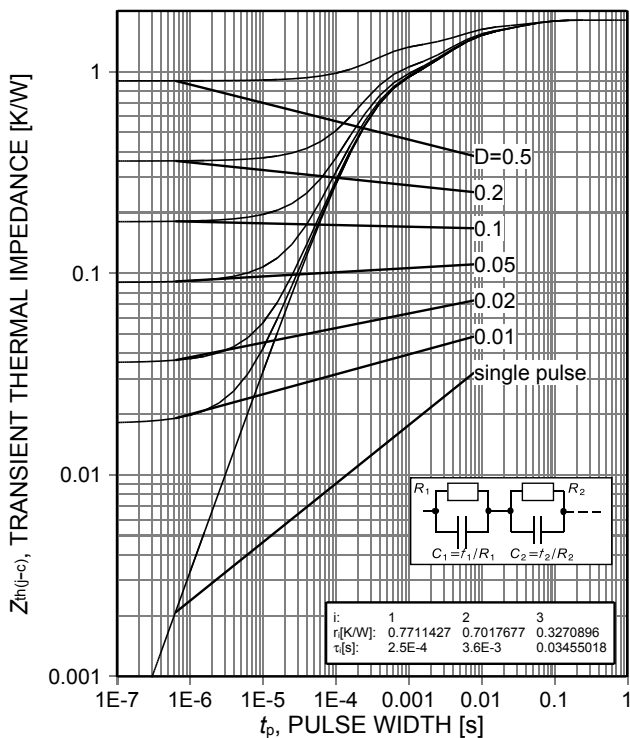


Figure 19. Diode transient thermal impedance as a function of pulse width ($D=t_p/T$)

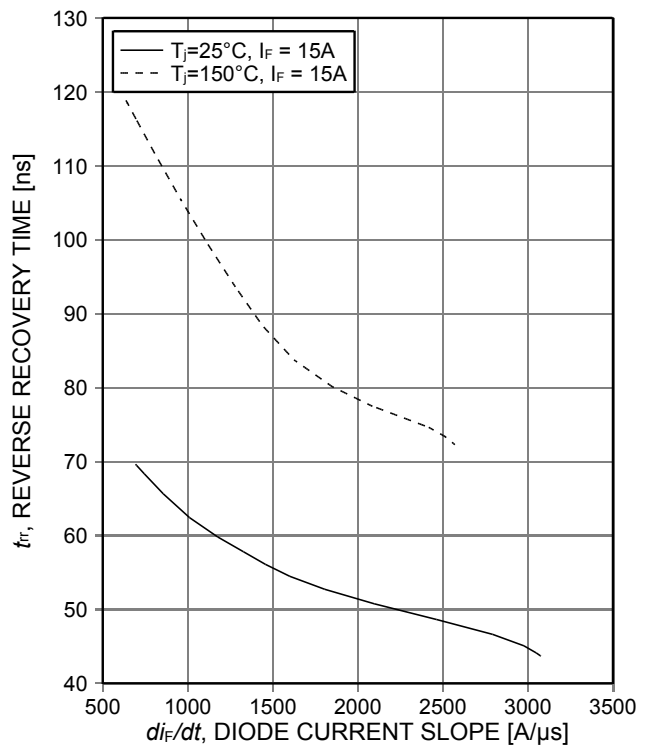


Figure 20. Typical reverse recovery time as a function of diode current slope ($V_R=400V$)

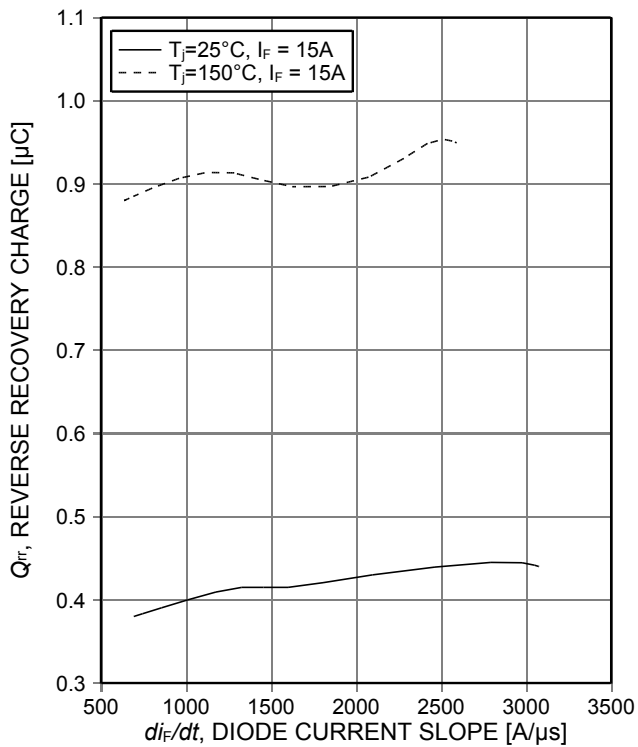


Figure 21. **Typical reverse recovery charge as a function of diode current slope**
($V_R=400V$)

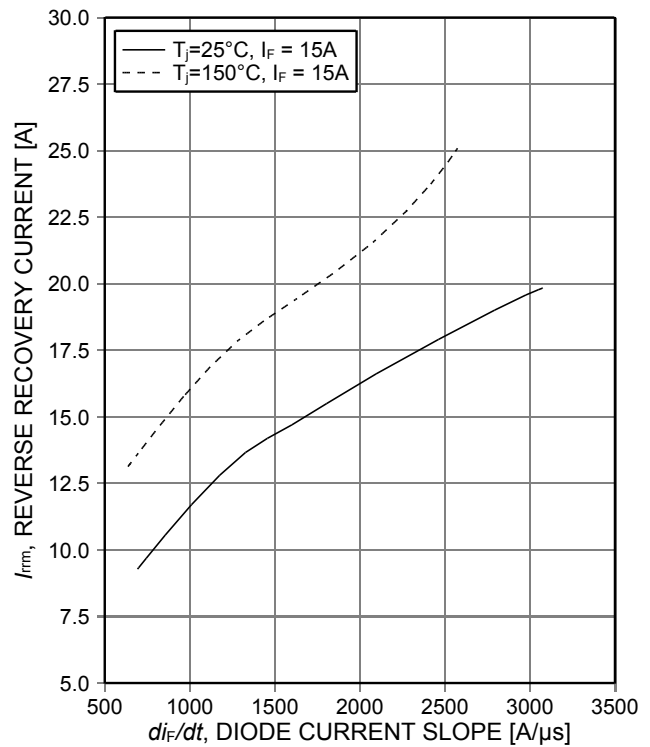


Figure 22. **Typical peak reverse recovery current as a function of diode current slope**
($V_R=400V$)

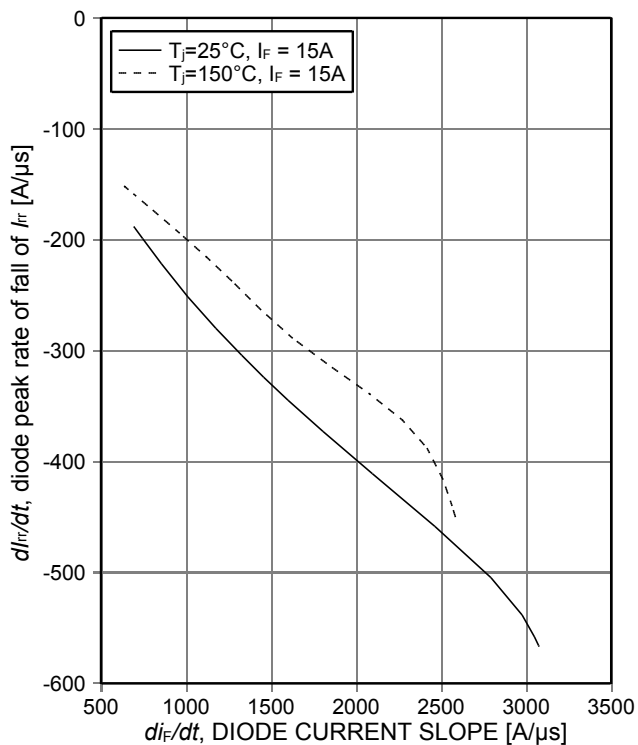


Figure 23. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
($V_R=400V$)

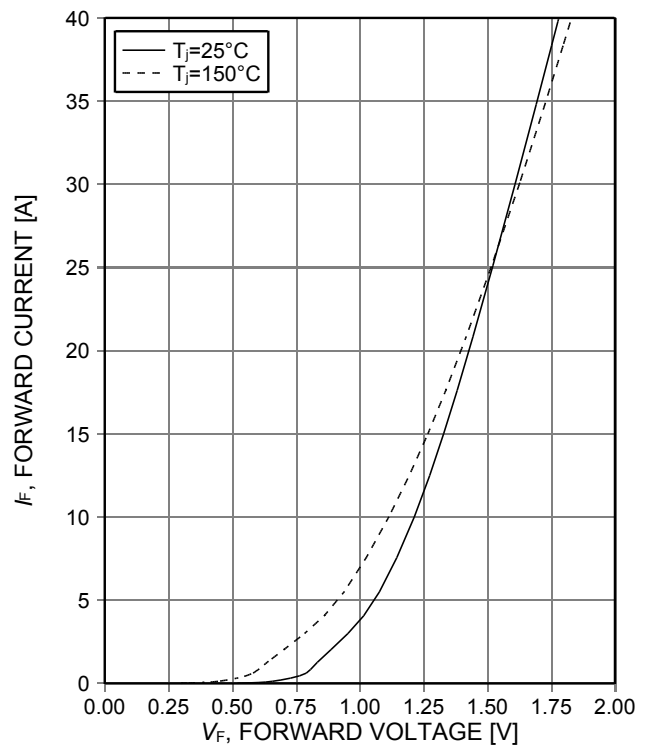


Figure 24. **Typical diode forward current as a function of forward voltage**

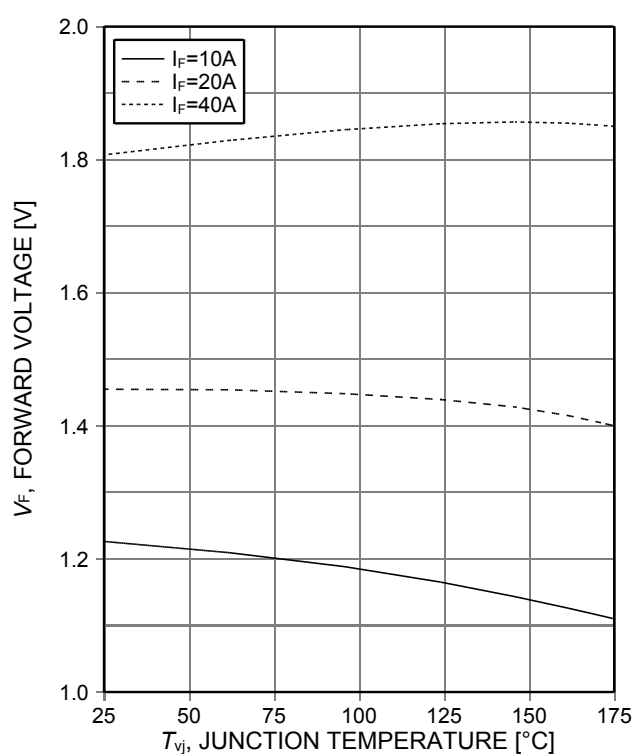
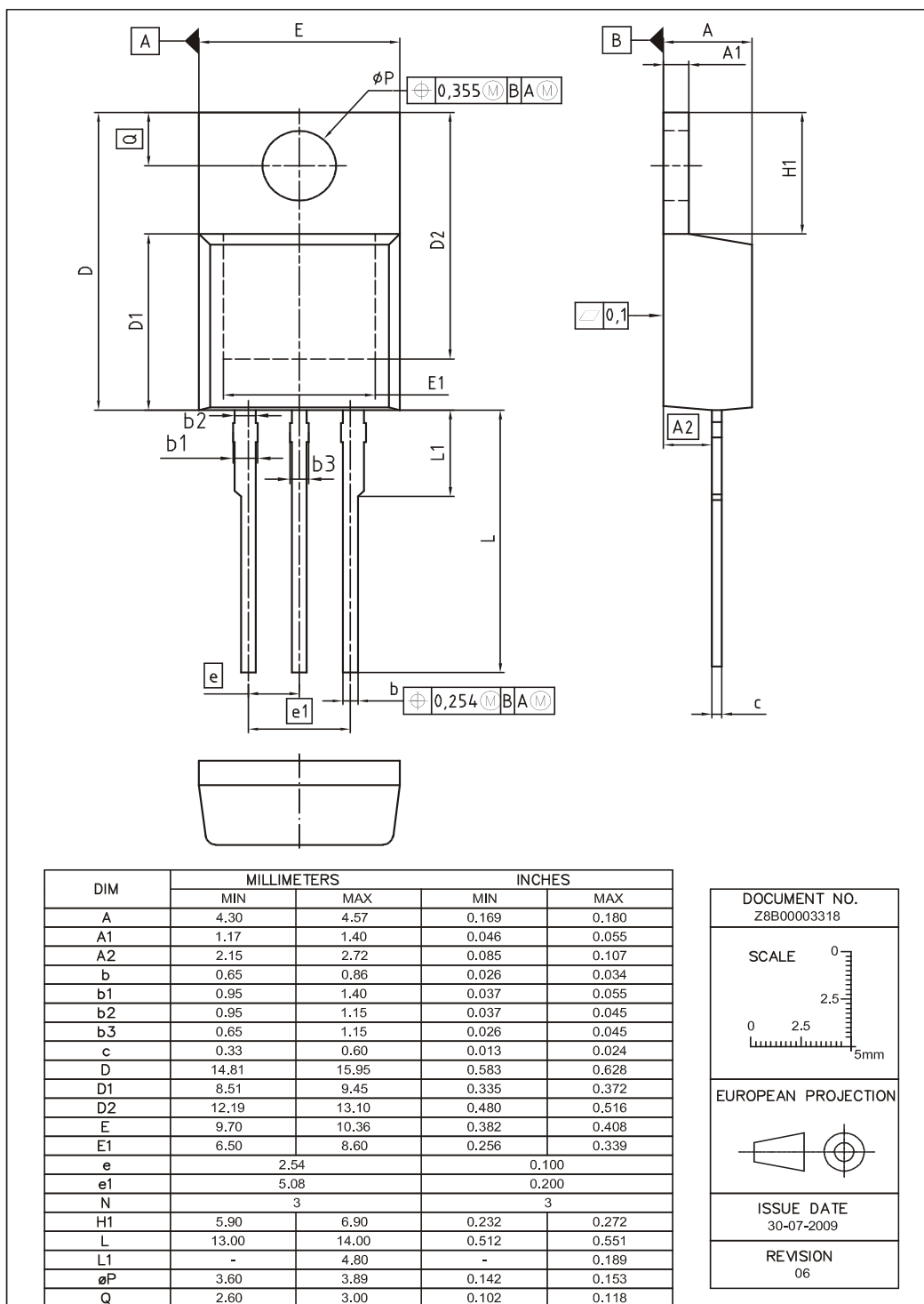


Figure 25. **Typical diode forward voltage as a function of junction temperature**

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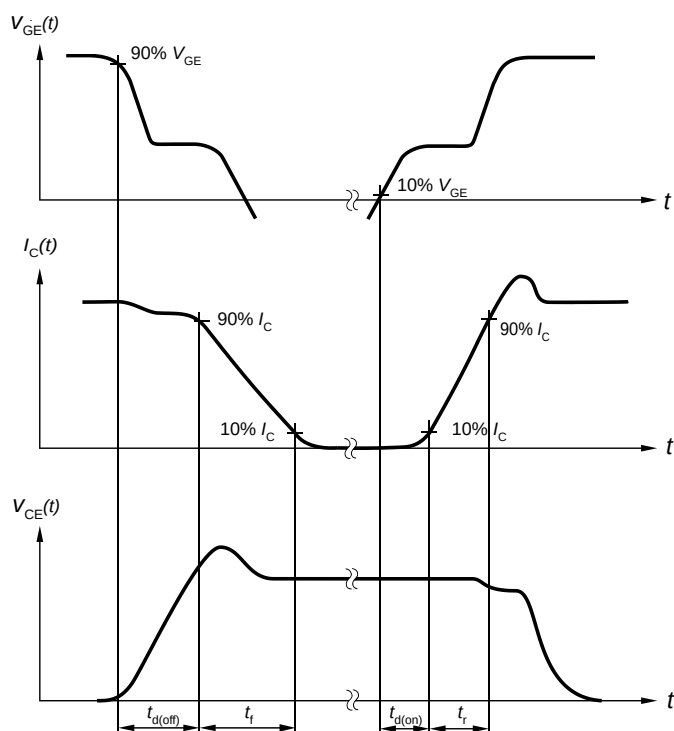


Figure A. Definition of switching times

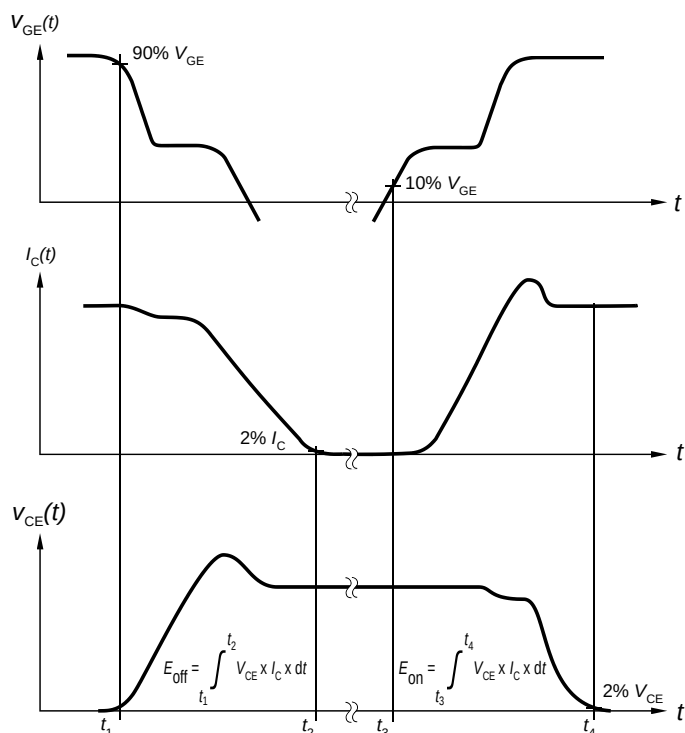


Figure B. Definition of switching losses

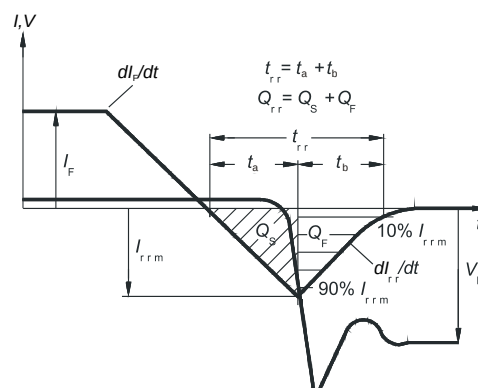


Figure C. **Definition of diode switching characteristics**

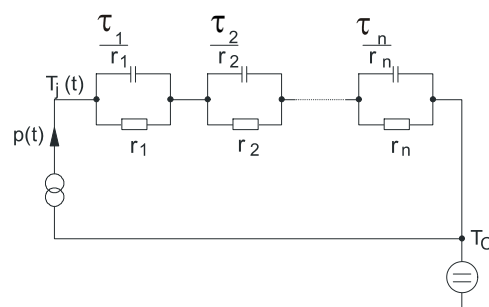


Figure D. Thermal equivalent circuit

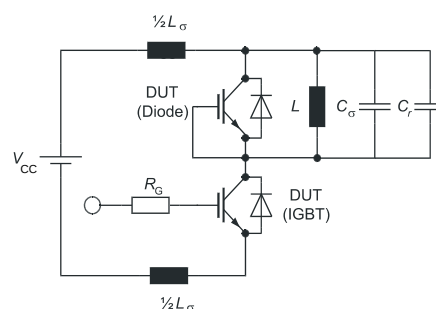


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ} ,
parasitic capacitor L_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)

Revision History

IKP30N65F5

Revision: 2014-12-04, Rev. 2.2

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2014-06-11	Final data sheet
2.2	2014-12-04	Minor changes Fig.1 and Fig.14

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