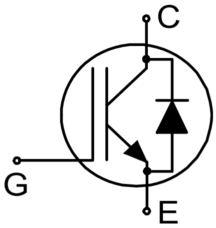
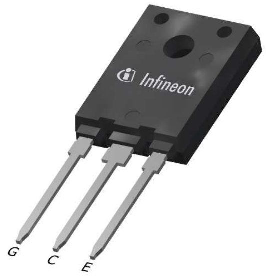
High speed 5 IGBT in TRENCHSTOP™ 5 technology copacked with RAPID 1 fast and soft antiparallel diode in fully isolated package



Features and Benefits:

TRENCHSTOP™ 5 technology offering
- Best-in-Class efficiency in hard switching and resonant topologies
- Plug and play replacement of previous generation IGBTs
- 650V breakdown voltage
- Low gate charge Q_G
- Very soft, fast recovery antiparallel diode
- Maximum junction temperature 175°C
- 2500V_{RMS} electrical isolation, 50/60Hz, t=1min
- 100% tested isolated mounting surface
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/



Fully isolated package TO-247

Potential Applications:

- Residential and Commercial Aircon PFC
- Welding converters
- Mid to high range switching frequency converters

Product Validation:

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

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IKFW50N65DH5	650V	50A	1.8V	175°C	K50EDH5	PG-HSIP247-3-2

Table of Contents

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, $T_{\mathrm{vj}} \geq 25°\mathrm{C}$	V_{CE}	650	V
DC collector current, limited by T_{vjmax} $T_{\mathrm{h}} = 25°\mathrm{C}$ $T_{\mathrm{h}} = 65°\mathrm{C}$ $T_{\mathrm{h}} = 65°\mathrm{C}$	I_{C}	59.0 49.0 69.0[1]	A
Pulsed collector current, t_{p} limited by T_{vjmax}	I_{Cpuls}	160.0	A
Turn off safe operating area $V_{\mathrm{CE}} \leq 650\mathrm{V}$, $T_{\mathrm{vj}} \leq 175°\mathrm{C}$, $t_{\mathrm{p}} = 1\mu\mathrm{s}$	-	160.0	A
Diode forward current, limited by T_{vjmax} $T_{\mathrm{h}} = 25°\mathrm{C}$ $T_{\mathrm{h}} = 65°\mathrm{C}$	I_{F}	40.0 32.0	A
Diode pulsed current, t_{p} limited by T_{vjmax}	I_{Fpuls}	160.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_{\mathrm{p}} \leq 10\mu\mathrm{s}$, $D < 0.010$)	V_{GE}	±20 ±30	V
Power dissipation $T_{\mathrm{h}} = 25°\mathrm{C}$ Power dissipation $T_{\mathrm{h}} = 65°\mathrm{C}$	P_{tot}	124.0 91.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°C
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s		260	°C
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6	Nm
Isolation voltage RMS, $f = 50/60\mathrm{Hz}$, $t = 1\mathrm{min}$[2]	V_{isol}	2500	V

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R_{th} Characteristics						
IGBT thermal resistance,[3] junction - heatsink	$R_{\mathrm{th(j\text{-}h)}}$		-	1.03	1.21	K/W
Diode thermal resistance,[3] junction - heatsink	$R_{\mathrm{th(j\text{-}h)}}$		-	1.64	1.93	K/W
Thermal resistance junction - ambient	$R_{\mathrm{th(j\text{-}a)}}$		-	-	65	K/W

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[1] Equivalent current rating in TO-247-3 at $T_{\mathrm{h}} = 65°\mathrm{C}$ using reference insulation material: 152µm, 0.9 W/mK, standard polyimide based reinforced carrier insulator

[2] For a proper handling and assembly of the advanced isolation device in the application refer to the note at the package drawing.

[3] At force on body F = 500N, $T_{\mathrm{h}} = 25°\mathrm{C}$

Electrical Characteristic, at T_{vj} = 25°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 = 0.50mA	650	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 50.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.80 2.25	2.25 -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 25.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.50 1.45	1.90 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.50mA, 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°C T_{vj} = 175°C	- -	- -	40 4000	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 50.0A	-	50.0	-	S

Electrical Characteristic, at T_{vj} = 25°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	-	2347	-	pF
Output capacitance	C_{oes}		-	57	-	
Reverse transfer capacitance	C_{res}		-	9	-	
Gate charge	Q_G	V_{CC} = 520V, I_C = 50.0A, V_{GE} = 15V	-	95.0	-	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°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 50.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 12.2Ω, $R_{G(off)}$ = 12.2Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	23	-	ns
Rise time	t_r		-	36	-	ns
Turn-off delay time	$t_{d(off)}$		-	131	-	ns
Fall time	t_f		-	20	-	ns
Turn-on energy	E_{on}		-	1.46	-	mJ
Turn-off energy	E_{off}		-	0.63	-	mJ
Total switching energy	E_{ts}		-	2.09	-	mJ

Diode Characteristic, at T_{vj} = 25°C

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 25.0A, di_F/dt = 1000A/µs	-	68	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.55	-	µC
Diode peak reverse recovery current	I_{rrm}		-	12.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-834	-	A/µs

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 150°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 150°C, V_{CC} = 400V, I_C = 50.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 12.2Ω, $R_{G(off)}$ = 12.2Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	21	-	ns
Rise time	t_r		-	36	-	ns
Turn-off delay time	$t_{d(off)}$		-	155	-	ns
Fall time	t_f		-	22	-	ns
Turn-on energy	E_{on}		-	1.74	-	mJ
Turn-off energy	E_{off}		-	0.71	-	mJ
Total switching energy	E_{ts}		-	2.45	-	mJ

Diode Characteristic, at T_{vj} = 150°C

Diode reverse recovery time	t_{rr}	T_{vj} = 150°C, V_R = 400V, I_F = 25.0A, di_F/dt = 1000A/µs	-	104	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.43	-	µC
Diode peak reverse recovery current	I_{rrm}		-	19.8	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-637	-	A/µs

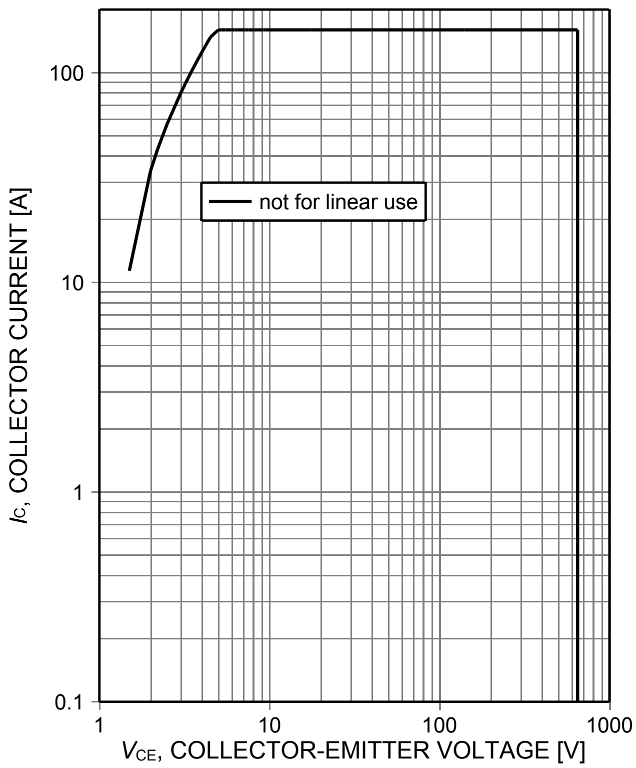


Figure 1. **Forward bias safe operating area**
(D=0, T_h=25°C, T_j≤175°C, V_{GE}=15V, t_p≤1μs)

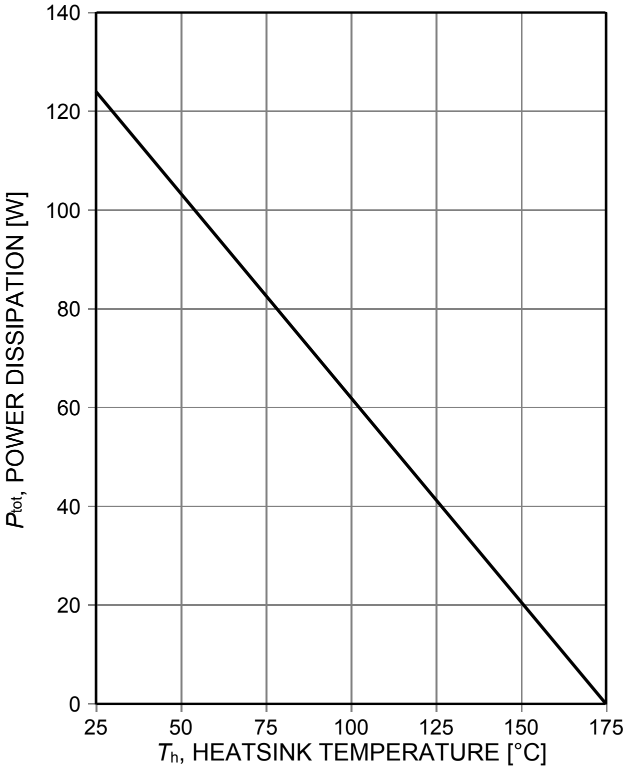


Figure 2. **Power dissipation as a function of heatsink temperature**
(T_j≤175°C)

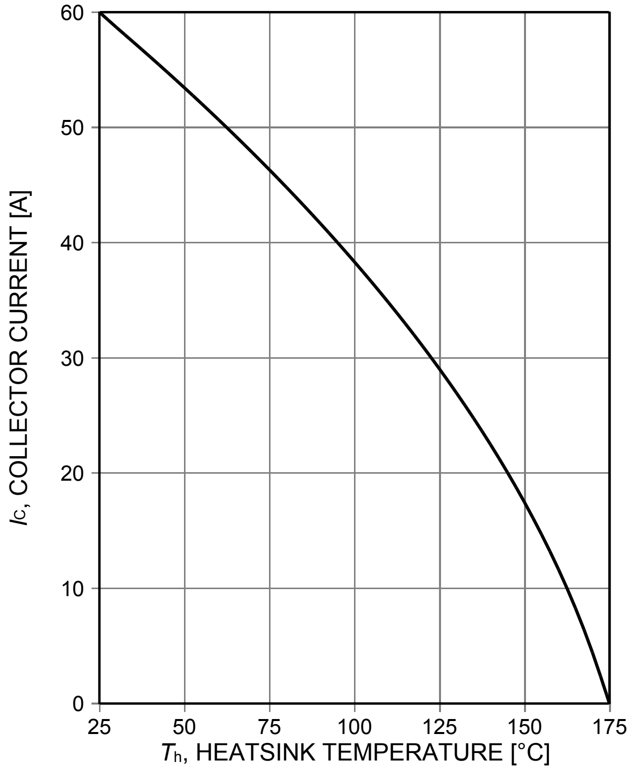


Figure 3. **Collector current as a function of heatsink temperature**
(V_{GE}≥15V, T_j≤175°C)

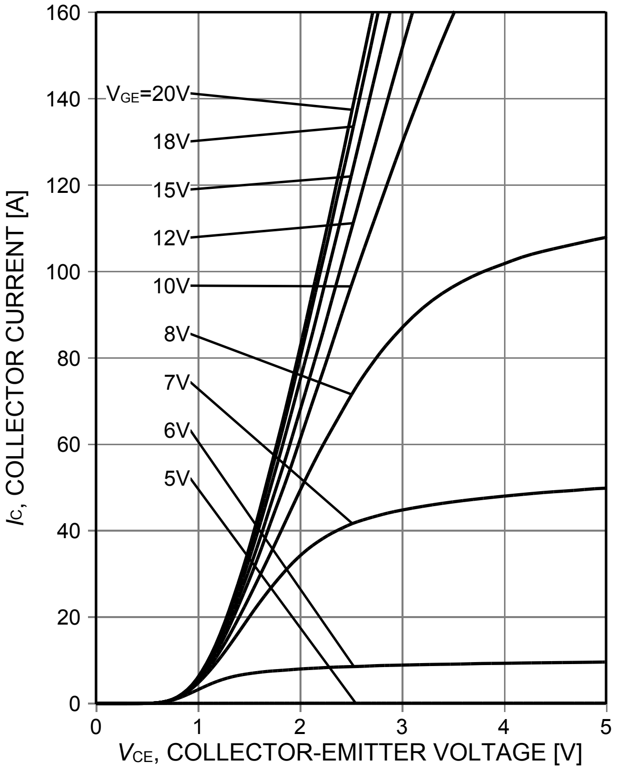


Figure 4. **Typical output characteristic**
(T_j=25°C)

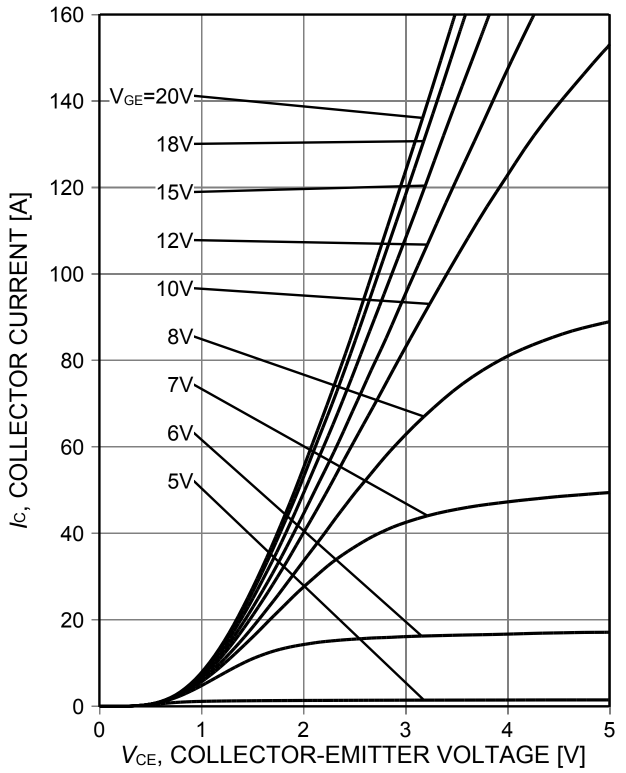


Figure 5. **Typical output characteristic**
(T_{j}=150°C)

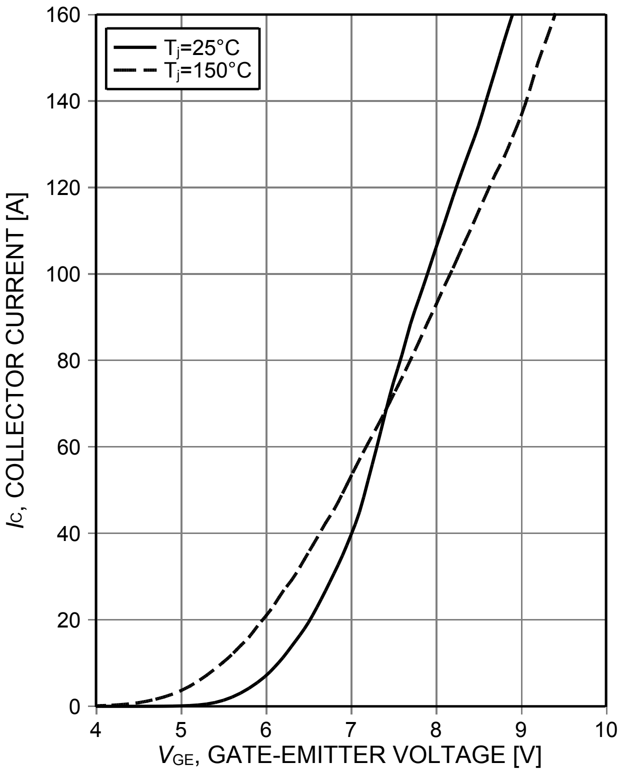


Figure 6. **Typical transfer characteristic**
(V_{CE}=20V)

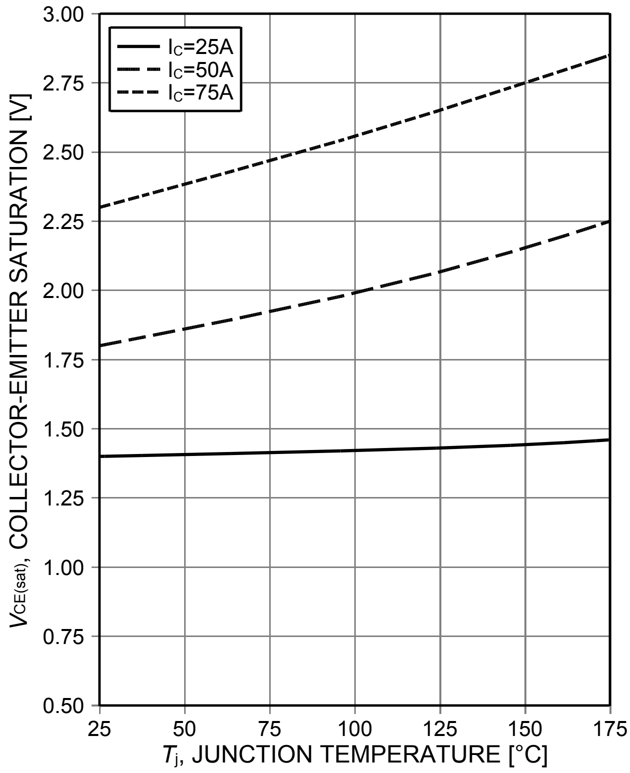


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

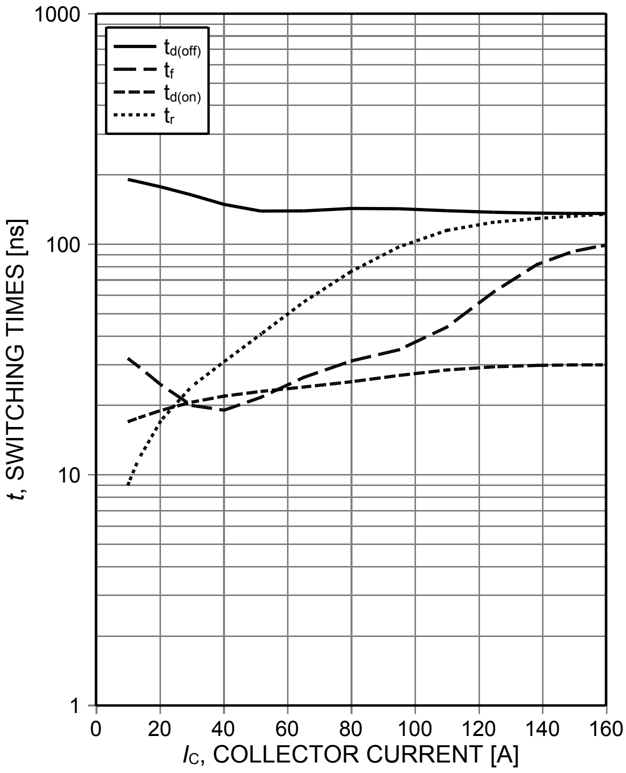


Figure 8. **Typical switching times as a function of collector current**
(ind. load, T_{j}=150°C, V_{CE}=400V, V_{GE}=0/15V, R_{G}=12.2Ω, test circuit in Fig. E)

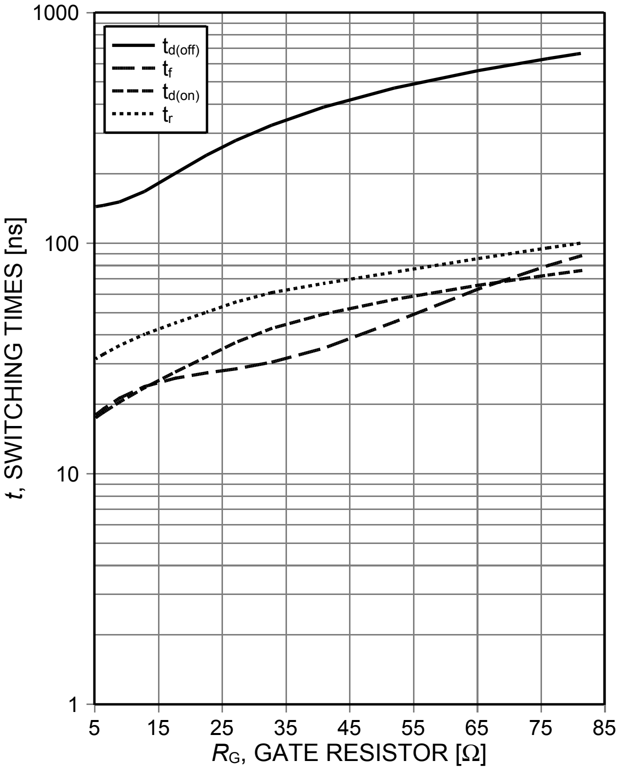


Figure 9. **Typical switching times as a function of gate resistor**
(ind. load, T_j=150°C, V_{CE}=400V, V_{GE}=0/15V, I_C=50A, test circuit in Fig. E)

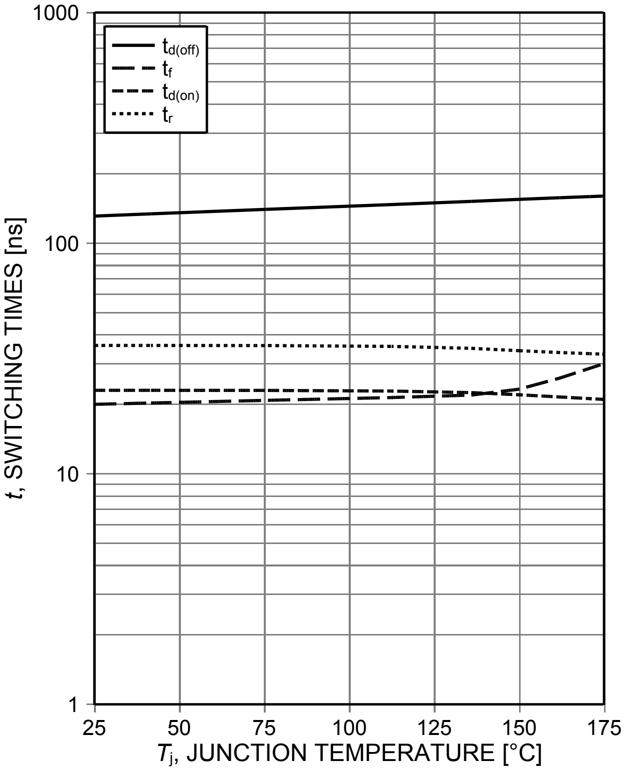


Figure 10. **Typical switching times as a function of junction temperature**
(ind. load, V_{CE}=400V, V_{GE}=0/15V, I_C=50A, r_G=12.2Ω, test circuit in Fig. E)

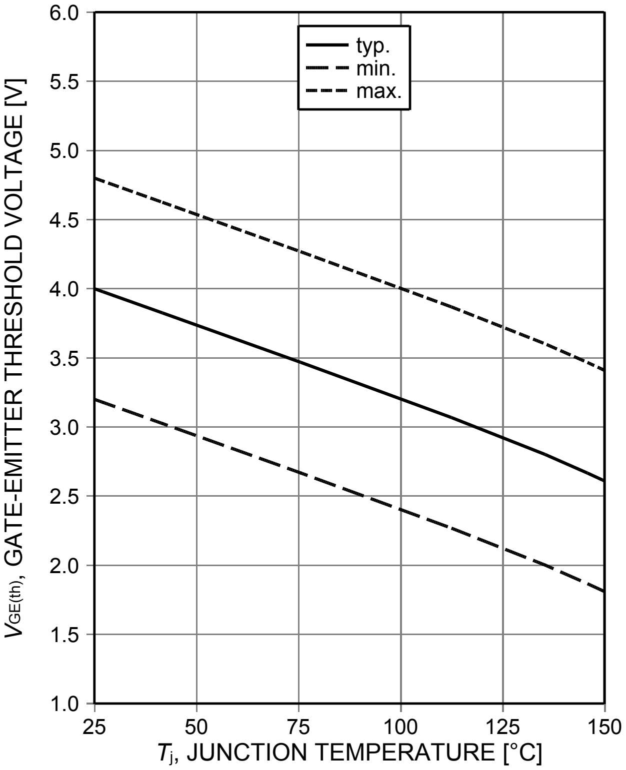


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.5mA)

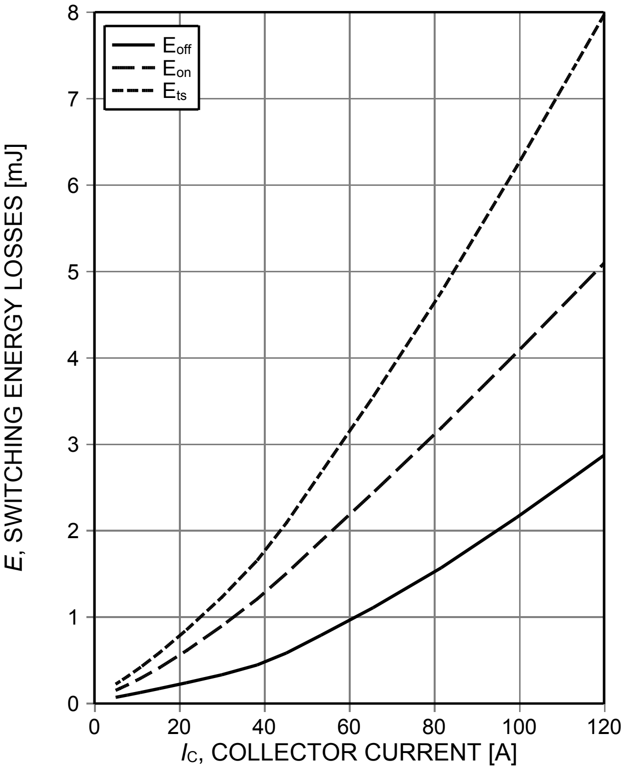


Figure 12. **Typical switching energy losses as a function of collector current**
(ind. load, T_j=150°C, V_{CE}=400V, V_{GE}=0/15V, R_G=12.2Ω, test circuit in Fig. E)

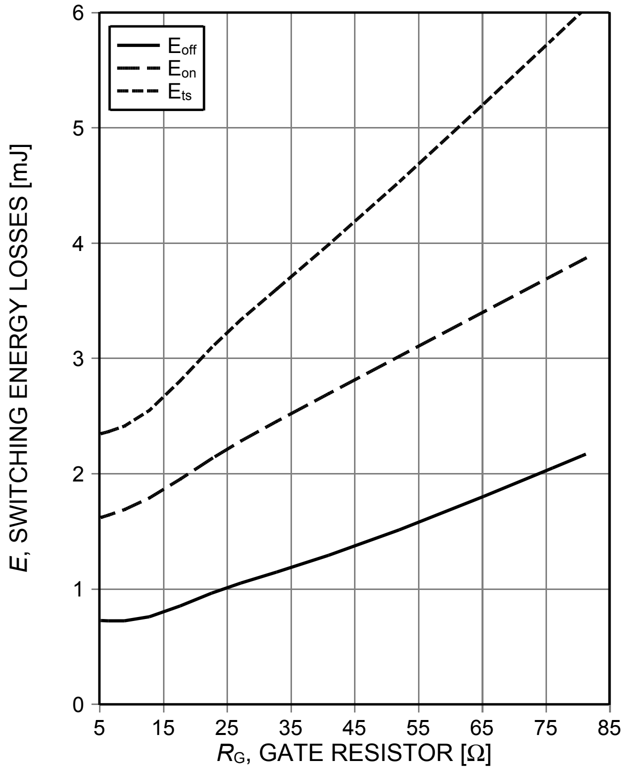


Figure 13. **Typical switching energy losses as a function of gate resistor**
(ind. load, T_j=150°C, V_{CE}=400V, V_{GE}=0/15V, I_C=50A, test circuit in Fig. E)

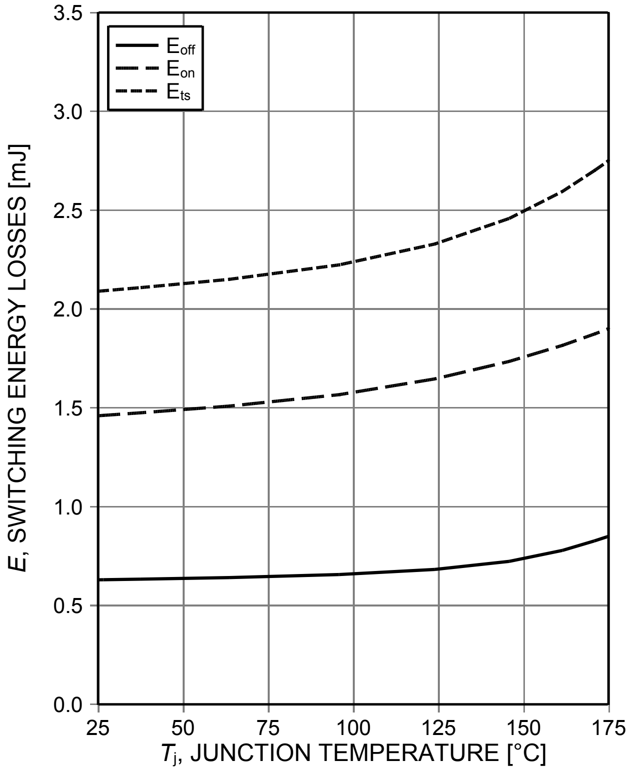


Figure 14. **Typical switching energy losses as a function of junction temperature**
(ind load, V_{CE}=400V, V_{GE}=0/15V, I_C=50A, R_G=12.2Ω, test circuit in Fig. E)

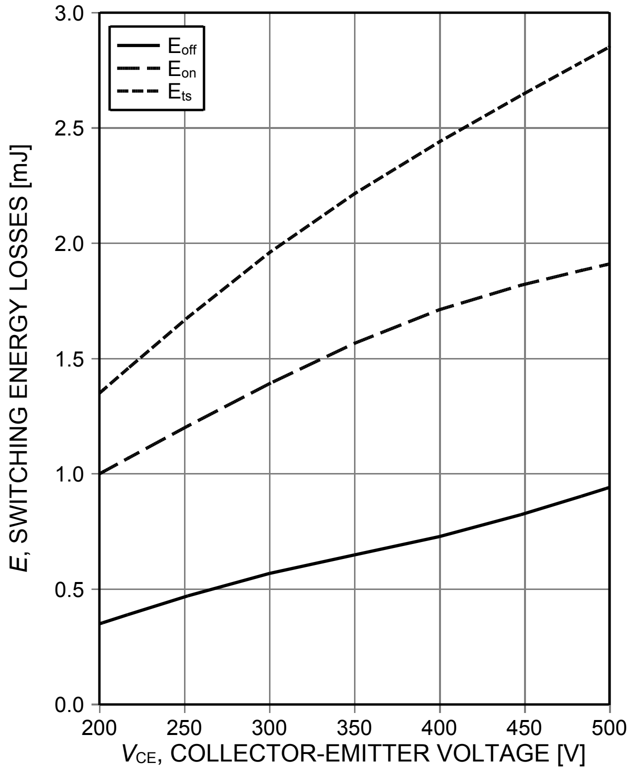


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(ind. load, T_j=150°C, V_{GE}=0/15V, I_C=50A, R_G=12.2Ω, test circuit in Fig. E)

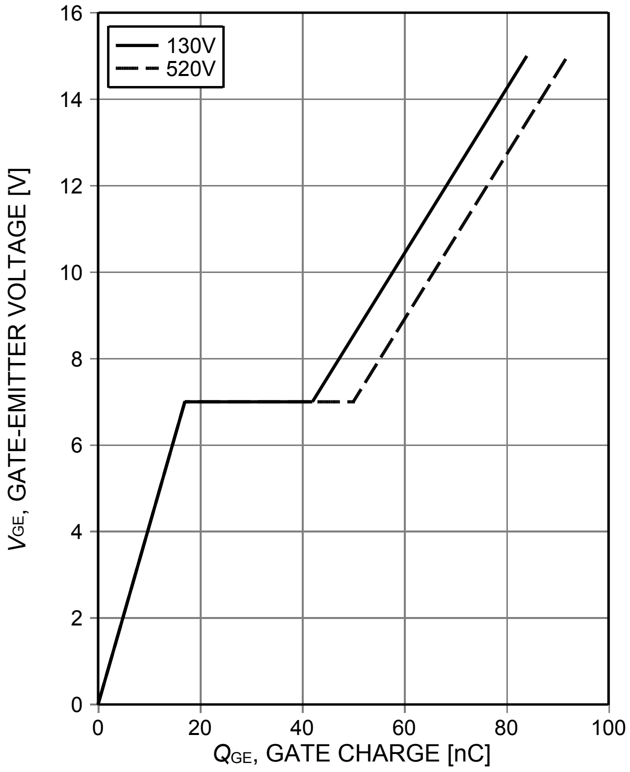


Figure 16. **Typical gate charge**
(I_C=50A)

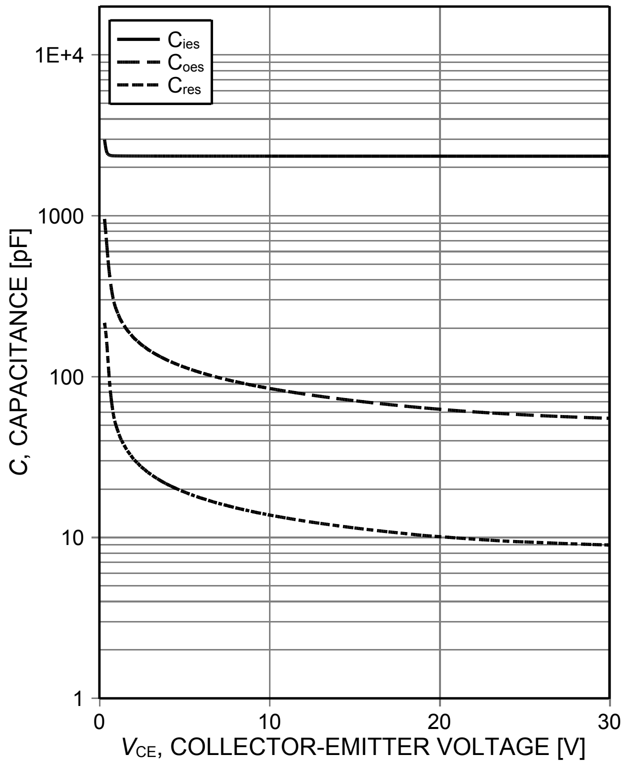
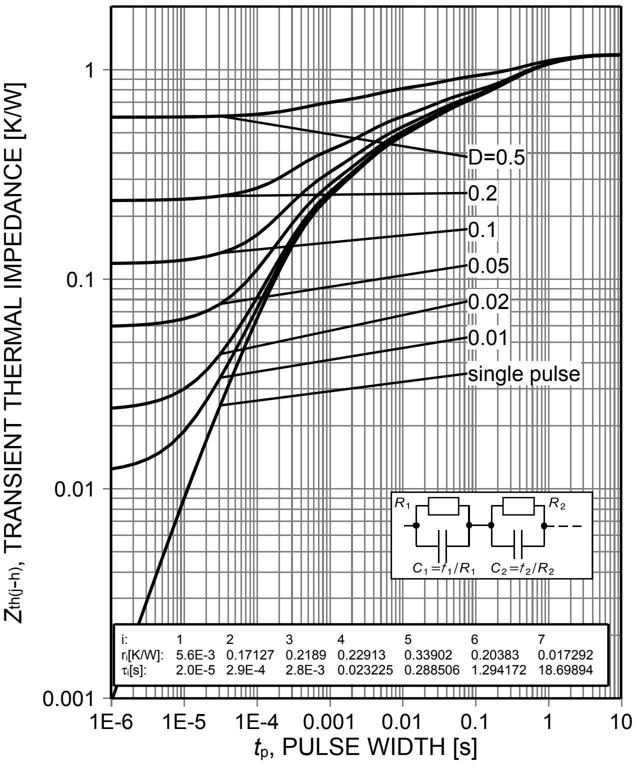
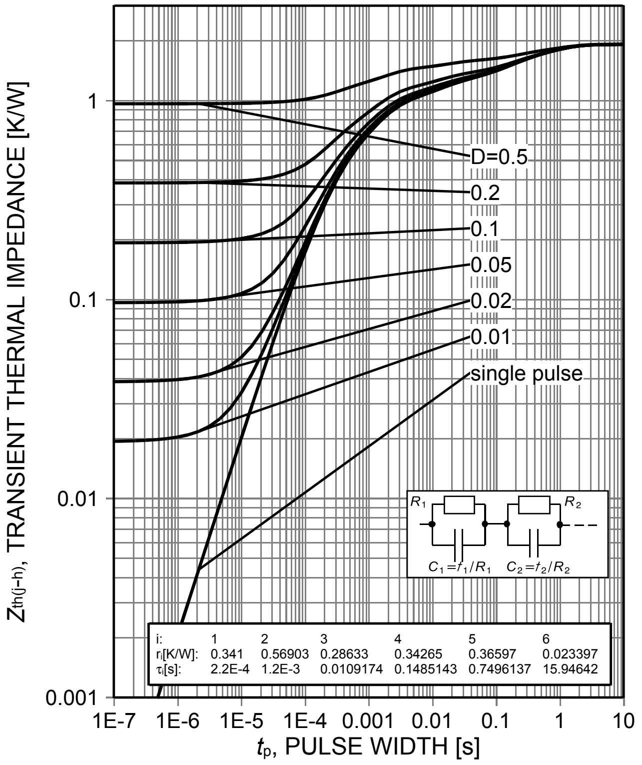


Figure 17. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)



i:	1	2	3	4	5	6	7
r_i[K/W]:	5.6E-3	0.17127	0.2189	0.22913	0.33902	0.20383	0.017292
τ_i[s]:	2.0E-5	2.9E-4	2.8E-3	0.023225	0.288506	1.294172	18.69894

Figure 18. **IGBT transient thermal impedance as a function of pulse width**
(D=t_p/T)



i:	1	2	3	4	5	6
r_i[K/W]:	0.341	0.56903	0.28633	0.34265	0.36597	0.023397
τ_i[s]:	2.2E-4	1.2E-3	0.0109174	0.1485143	0.7496137	15.94642

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

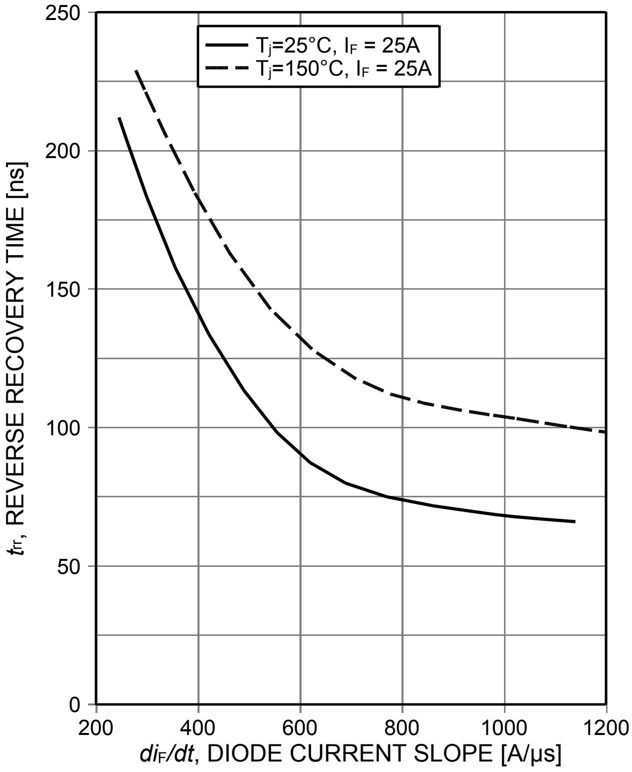


Figure 20. **Typical reverse recovery time as a function of diode current slope**
(V_R=400V)

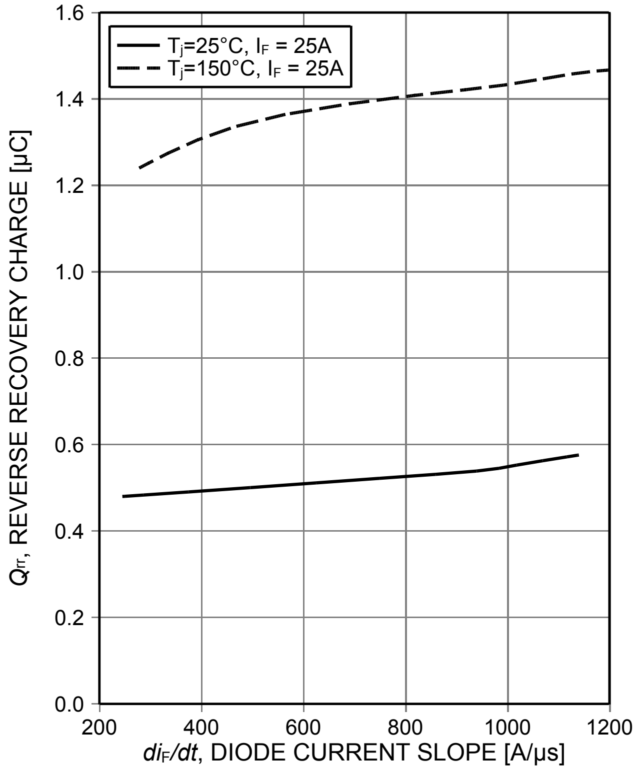


Figure 21. **Typical reverse recovery charge as a function of diode current slope**
(V_R=400V)

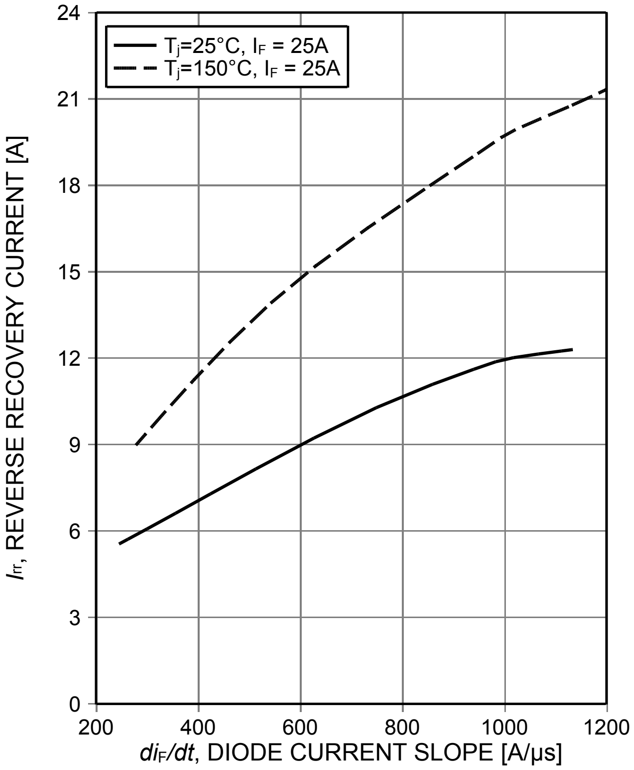


Figure 22. **Typical reverse recovery current as a function of diode current slope**
(V_R=400V)

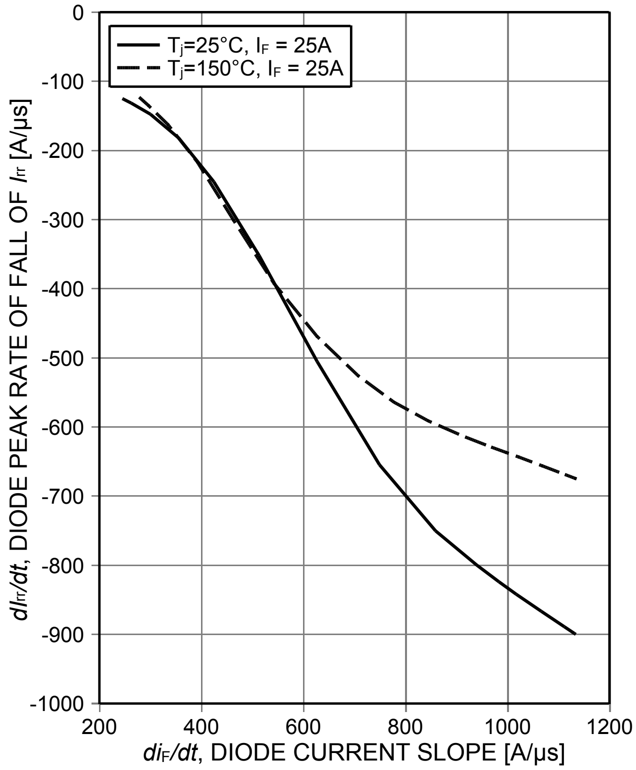


Figure 23. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=400V)

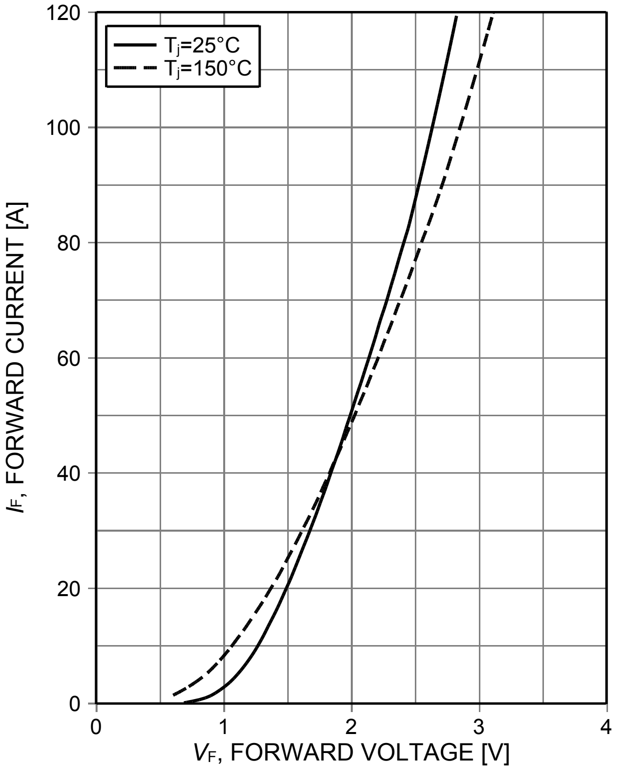
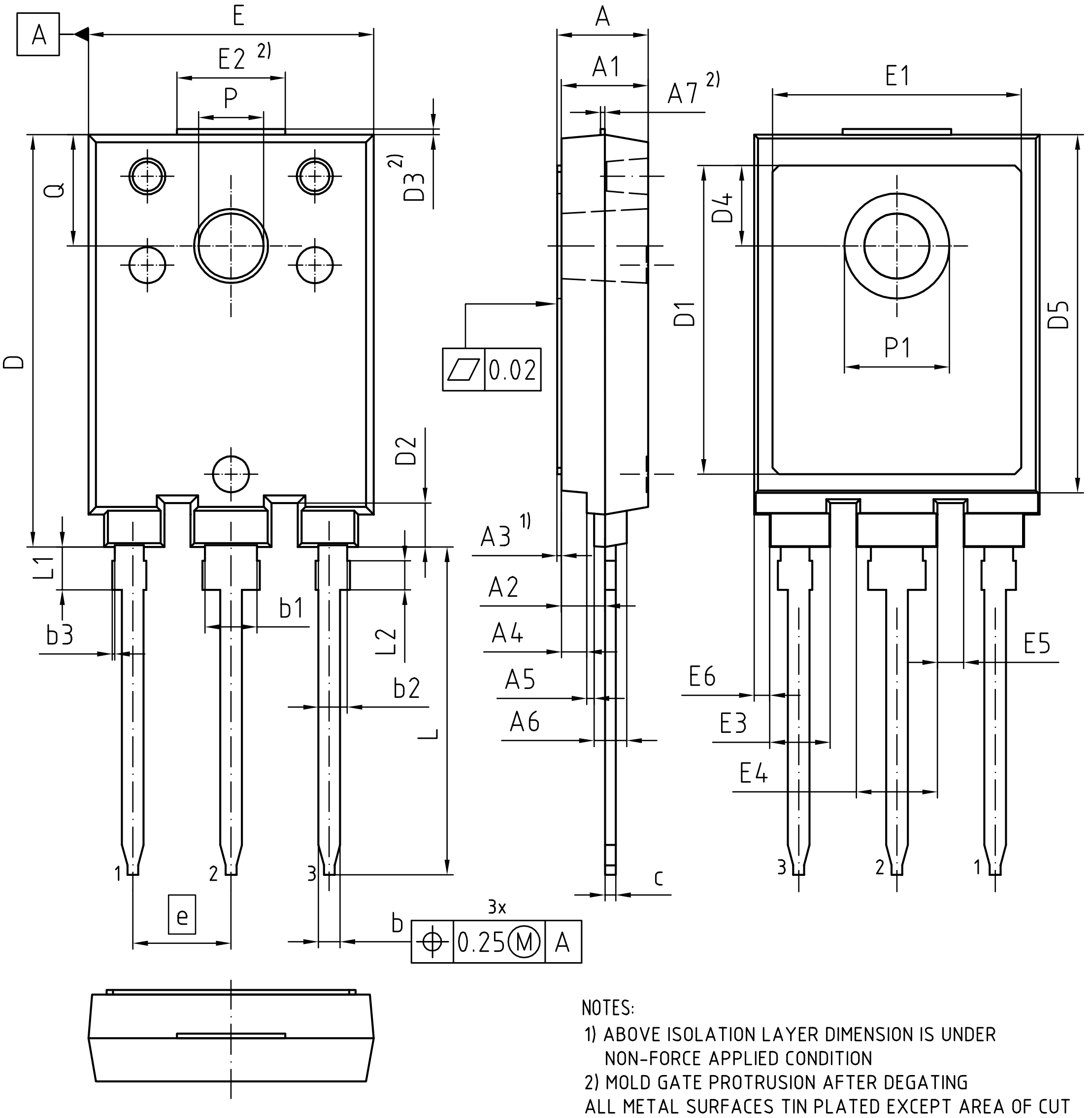


Figure 24. **Typical diode forward current as a function of forward voltage**

PG-HSIP247-3-2



NOTES:
1) ABOVE ISOLATION LAYER DIMENSION IS UNDER NON-FORCE APPLIED CONDITION
2) MOLD GATE PROTRUSION AFTER DEGATING
ALL METAL SURFACES TIN PLATED EXCEPT AREA OF CUT

DIMENSIONS	MILLIMETERS		DIMENSIONS	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	-	5.18	**e**	5.44	
A1	4.70	4.90	**E**	15.70	15.90
A2	2.16	2.66	**E1**	13.68	13.88
A3	0.20	0.28	**E2**	(6.00)	
A4	1.30	1.50	**E3**	3.24	3.44
A5	0.31	0.51	**E4**	4.39	4.59
A6	1.70	1.90	**E5**	(1.45)	
A7	(0.25)		**E6**	0.76	0.96
b	1.10	1.30	**L**	18.01	18.21
b1	(2.88)		**L1**	2.26	2.46
b2	(1.60)		**L2**	1.50	1.70
b3	-	0.15	**P**	3.50	3.70
c	0.50	0.70	**P1**	5.70	5.90
D	22.70	22.90	**Q**	6.06	6.26
D1	16.96	17.16			
D2	2.34	2.54			
D3	-	0.30			
D4	4.35	4.55			
D5	19.70	19.90			

DOCUMENT NO.
Z8B00195711

REVISION
01

SCALE 3:1
0 1 2 3 4 5 6 7 8mm

EUROPEAN PROJECTION

ISSUE DATE
28.06.2019

Testing Conditions

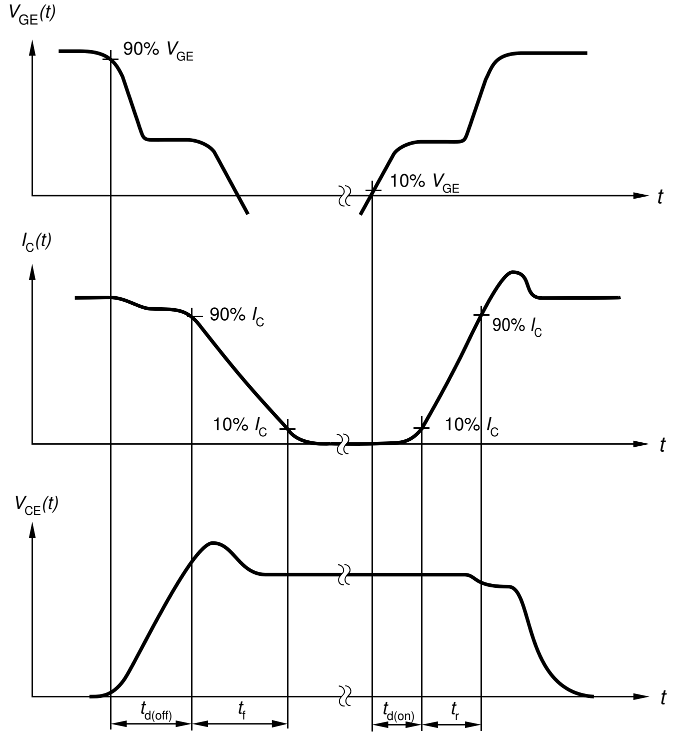


Figure A. **Definition of switching times**

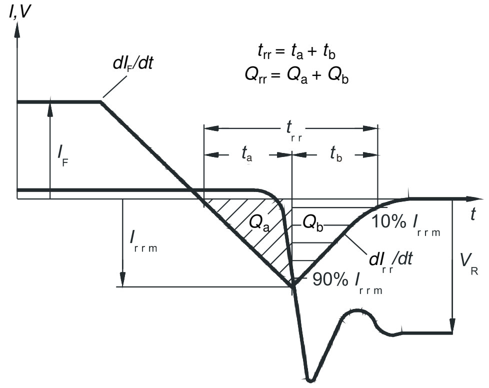


Figure C. **Definition of diode switching characteristics**

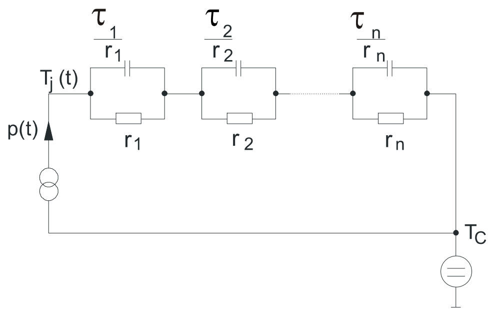


Figure D. **Thermal equivalent circuit**

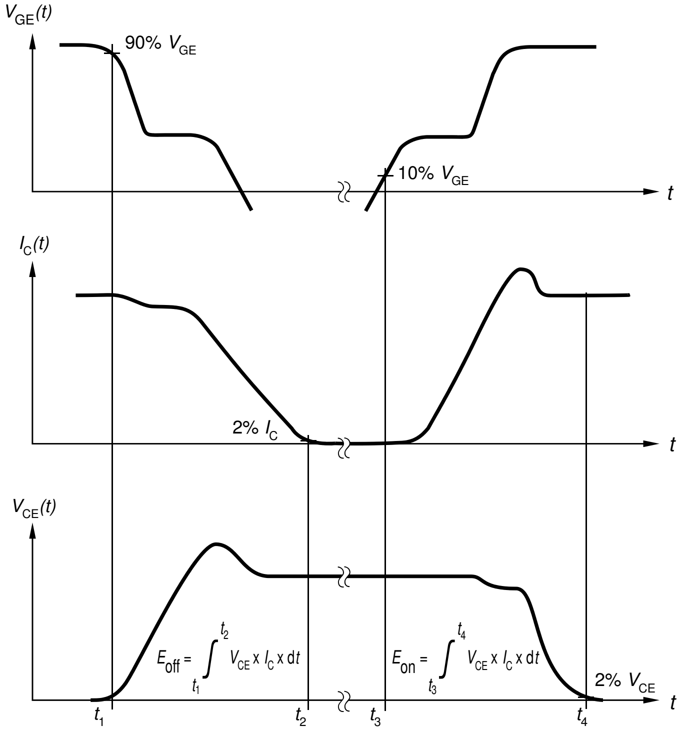


Figure B. **Definition of switching losses**

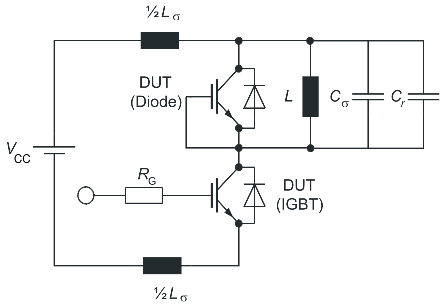


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

IKFW50N65DH5

Revision: 2019-07-08, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2019-07-08	Final Data Sheet

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