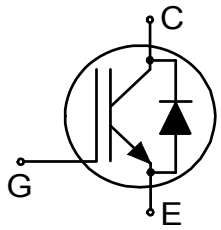
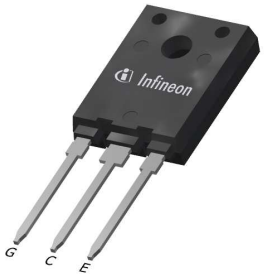
TRENCHSTOP™ 5 Advanced Isolation

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





Fully isolated package TO-247

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/

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
IKFW75N65EH5	650V	60A	1.65V	175°C	K75EEH5	PG-HSIP247-3-2

Table of Contents

Description 1
Table of Contents 2
Maximum Ratings 3
Thermal Resistance 3
Electrical Characteristics 4
Electrical Characteristics Diagrams 6
Package Drawing 12
Testing Conditions 13
Revision History 14
Disclaimer 15

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, $T_{vj} \geq 25°C$	V_{CE}	650	V
DC collector current, limited by T_{vjmax} T_h = 25°C value limited by bondwire T_h = 65°C T_h = 65°C	I_C	80.0 66.0 104.0[1]	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	240.0	A
Turn off safe operating area $V_{CE} \leq 650V$, $T_{vj} \leq 175°C$, t_p = 1µs	-	240.0	A
Diode forward current, limited by T_{vjmax} T_h = 25°C value limited by bondwire T_h = 65°C	I_F	80.0 74.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	240.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10µs$, $D < 0.010$)	V_{GE}	±20 ±30	V
Power dissipation T_h = 25°C Power dissipation T_h = 65°C	P_{tot}	148.0 109.0	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 = 50/60Hz, t = 1min[2]	V_{isol}	2500	V

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R_{th} Characteristics						
IGBT thermal resistance,[3] junction - heatsink	$R_{th(j-h)}$		-	0.86	1.01	K/W
Diode thermal resistance,[3] junction - heatsink	$R_{th(j-h)}$		-	0.97	1.14	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		-	-	65	K/W

[1] Equivalent current rating in TO-247-3 at T_h = 65°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_a = 25°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 = 60.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.65 1.95	2.10 -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 60.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.45 1.39	1.70 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.60mA, 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 2000	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 60.0A	-	72.0	-	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 = 1000kHz	-	3600	-	pF
Output capacitance	C_{oes}		-	105	-	
Reverse transfer capacitance	C_{res}		-	13	-	
Gate charge	Q_G	V_{CC} = 520V, I_C = 60.0A, V_{GE} = 15V	-	144.0	-	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 = 60.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 12.0Ω, $R_{G(off)}$ = 12.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	30	-	ns
Rise time	t_r		-	35	-	ns
Turn-off delay time	$t_{d(off)}$		-	206	-	ns
Fall time	t_f		-	42	-	ns
Turn-on energy	E_{on}		-	1.80	-	mJ
Turn-off energy	E_{off}		-	0.60	-	mJ
Total switching energy	E_{ts}		-	2.40	-	mJ

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

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 60.0A, di_F/dt = 1000A/µs	-	75	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.40	-	µC
Diode peak reverse recovery current	I_{rrm}		-	23.5	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-1150	-	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 = 60.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 12.0Ω, $R_{G(off)}$ = 12.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	29	-	ns
Rise time	t_r		-	36	-	ns
Turn-off delay time	$t_{d(off)}$		-	228	-	ns
Fall time	t_f		-	36	-	ns
Turn-on energy	E_{on}		-	2.40	-	mJ
Turn-off energy	E_{off}		-	0.72	-	mJ
Total switching energy	E_{ts}		-	3.12	-	mJ

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

Diode reverse recovery time	t_{rr}	T_{vj} = 150°C, V_R = 400V, I_F = 60.0A, di_F/dt = 1000A/µs	-	118	-	ns
Diode reverse recovery charge	Q_{rr}		-	3.40	-	µC
Diode peak reverse recovery current	I_{rrm}		-	36.5	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-1700	-	A/µs

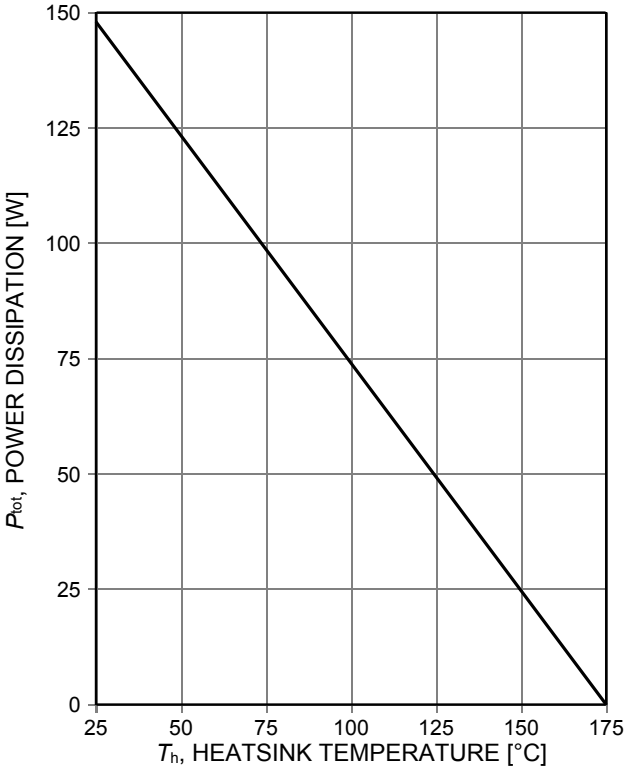


Figure 1. **Power dissipation as a function of heatsink temperature**
(T_j≤175°C)

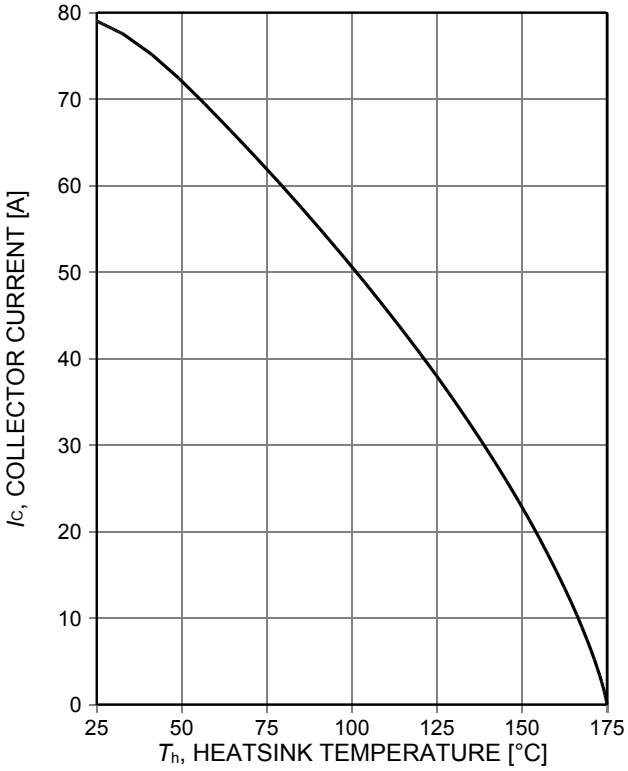


Figure 2. **Collector current as a function of heatsink temperature**
(V_{GE}≥15V, T_j≤175°C)

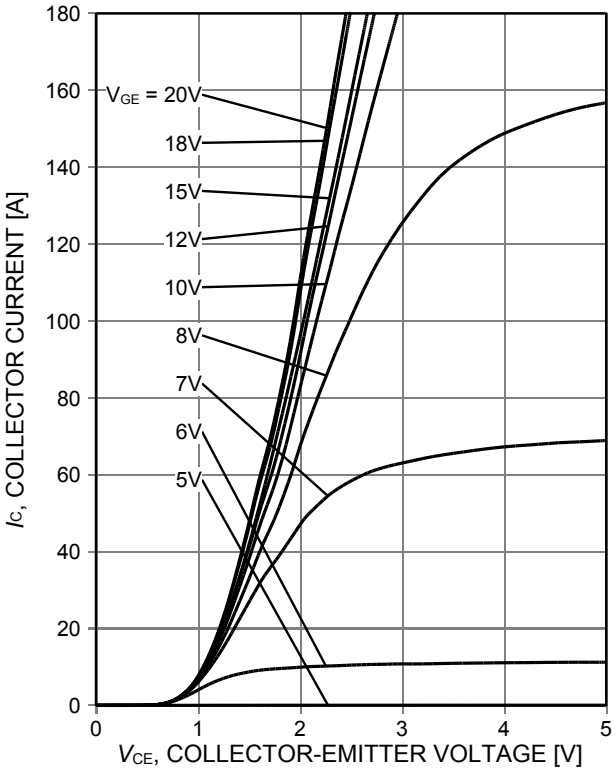


Figure 3. **Typical output characteristic**
(T_j=25°C)

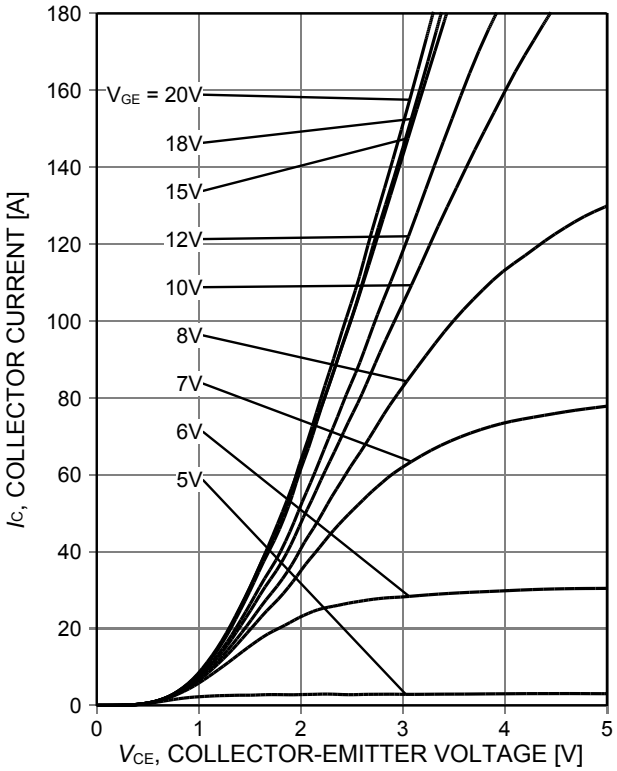


Figure 4. **Typical output characteristic**
(T_j=175°C)

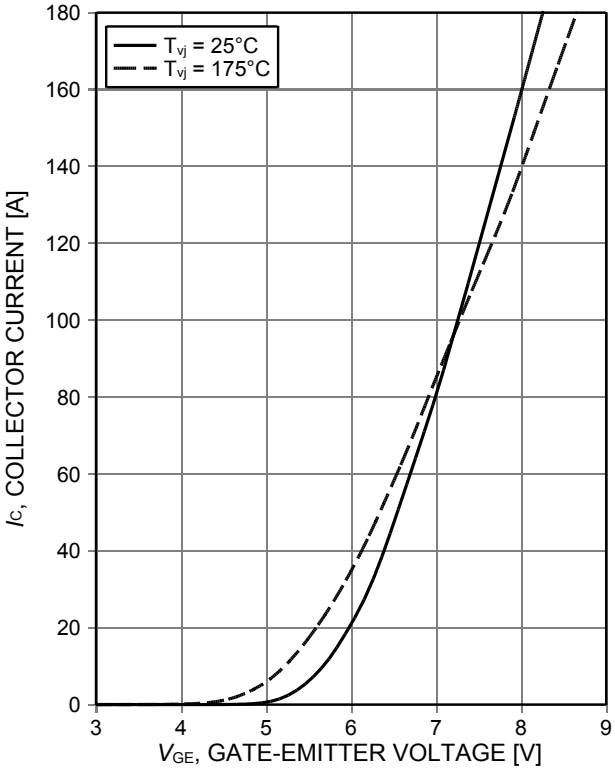


Figure 5. **Typical transfer characteristic**
(V_{CE}=20V)

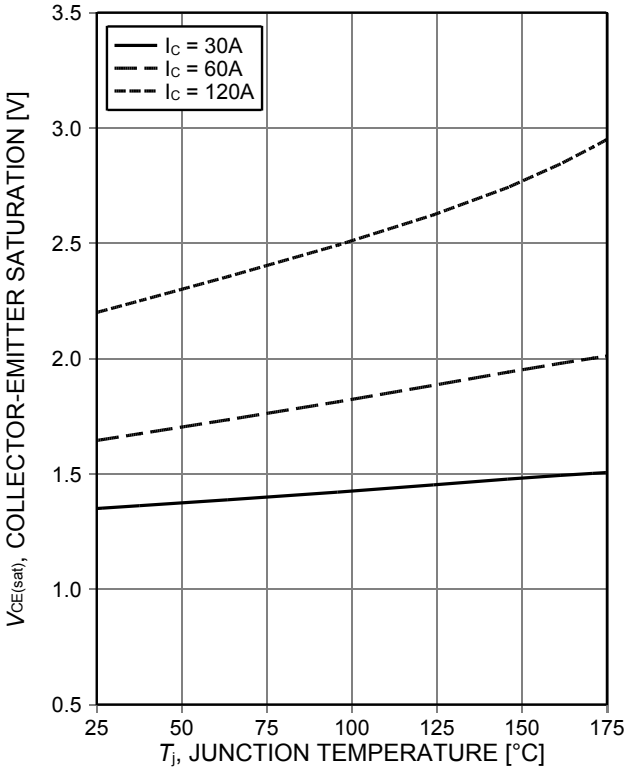


Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

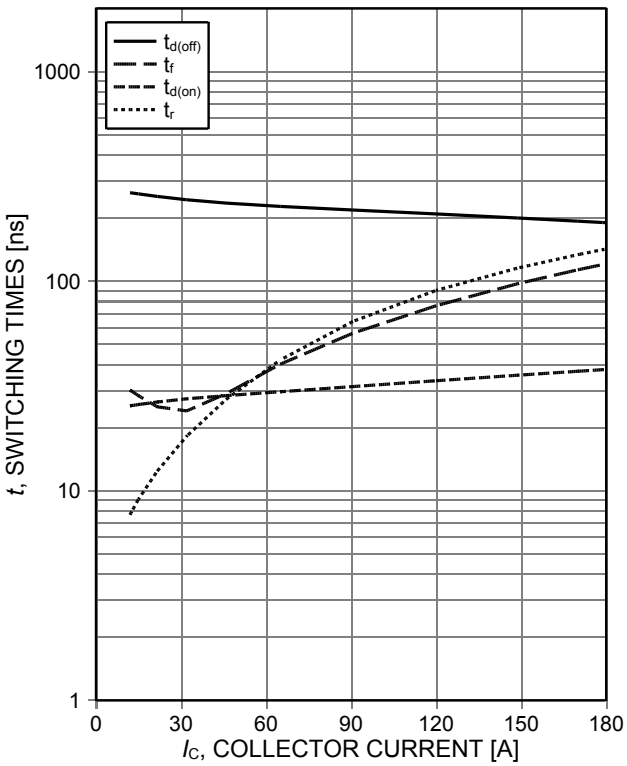


Figure 7. **Typical switching times as a function of collector current**
(ind. load, T_j=150°C, V_{CE}=400V, V_{GE}=0/15V, R_G=12Ω, test circuit in Fig. E)

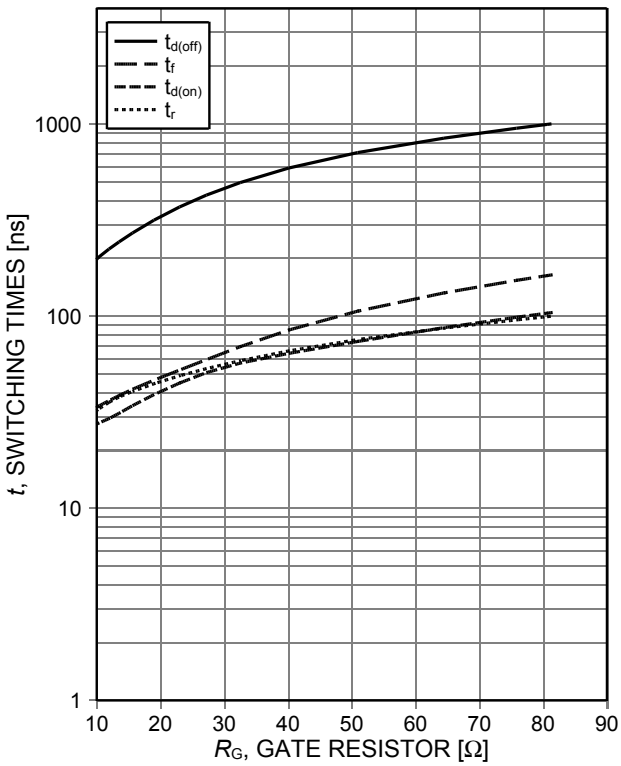


Figure 8. **Typical switching times as a function of gate resistor**
(ind. load, T_j=150°C, V_{CE}=400V, V_{GE}=0/15V, I_C=60A, test circuit in Fig. E)

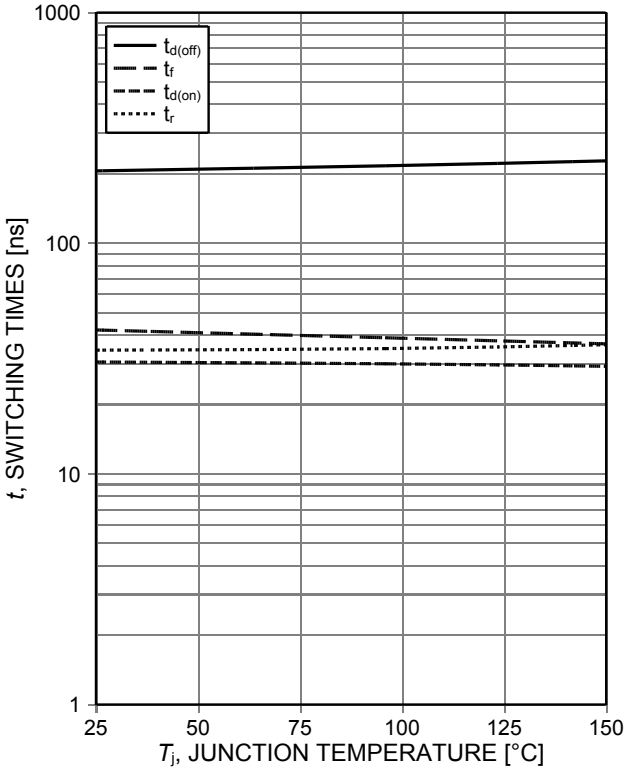


Figure 9. **Typical switching times as a function of junction temperature**
(ind. load, V_{CE}=400V, V_{GE}=0/15V, I_C=60A, r_G=12Ω, test circuit in Fig. E)

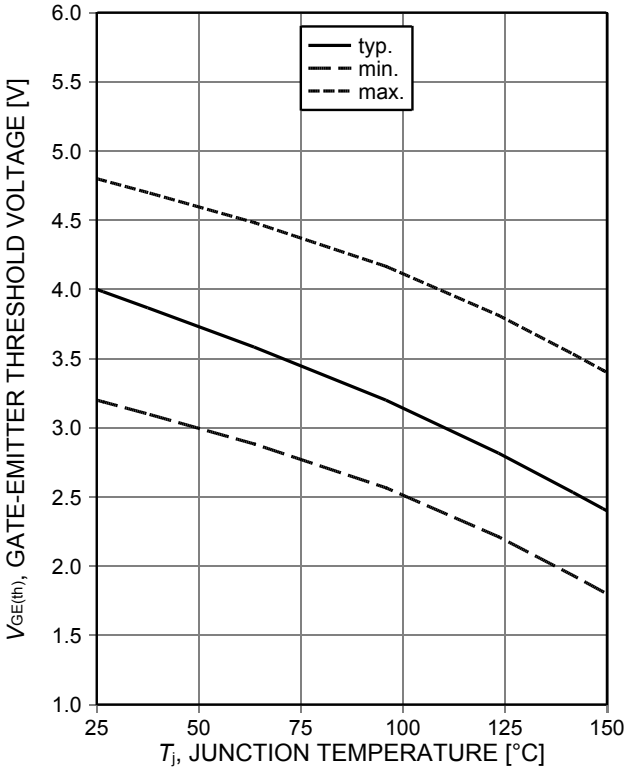


Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.6mA)

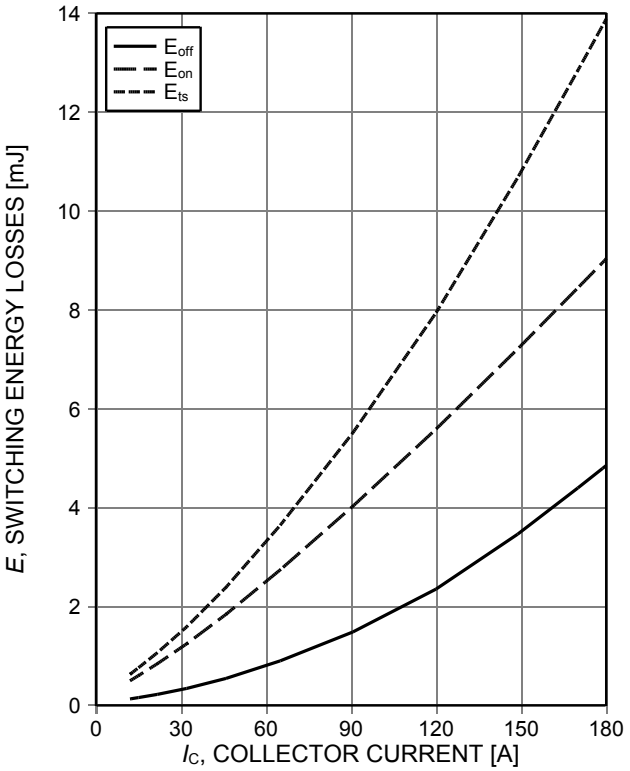


Figure 11. **Typical switching energy losses as a function of collector current**
(ind. load, T_j=150°C, V_{CE}=400V, V_{GE}=0/15V, R_G=12Ω, test circuit in Fig. E)

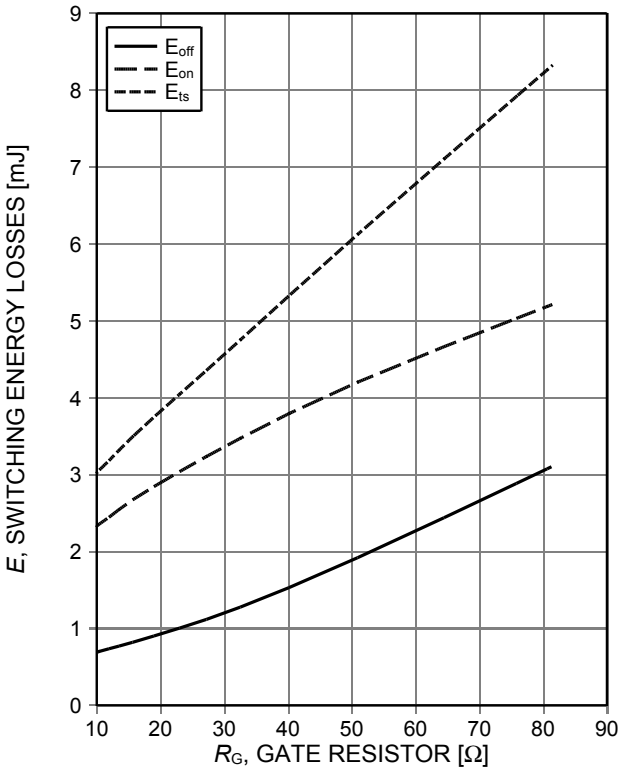


Figure 12. **Typical switching energy losses as a function of gate resistor**
(ind. load, T_j=150°C, V_{CE}=400V, V_{GE}=0/15V, I_C=60A, test circuit in Fig. E)

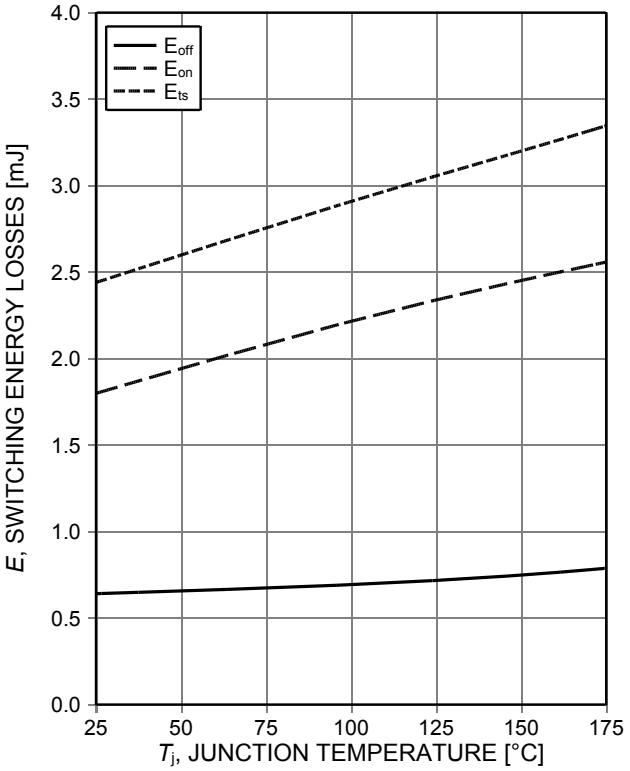


Figure 13. **Typical switching energy losses as a function of junction temperature**
(ind load, V_{CE}=400V, V_{GE}=0/15V, I_C=60A, R_G=12Ω, test circuit in Fig. E)

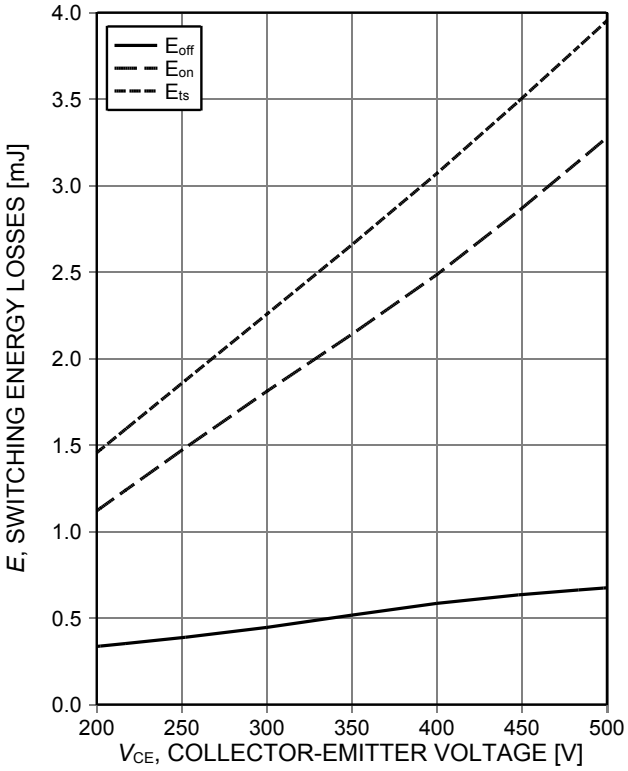


Figure 14. **Typical switching energy losses as a function of collector emitter voltage**
(ind. load, T_j=150°C, V_{GE}=0/15V, I_C=60A, R_G=12Ω, test circuit in Fig. E)

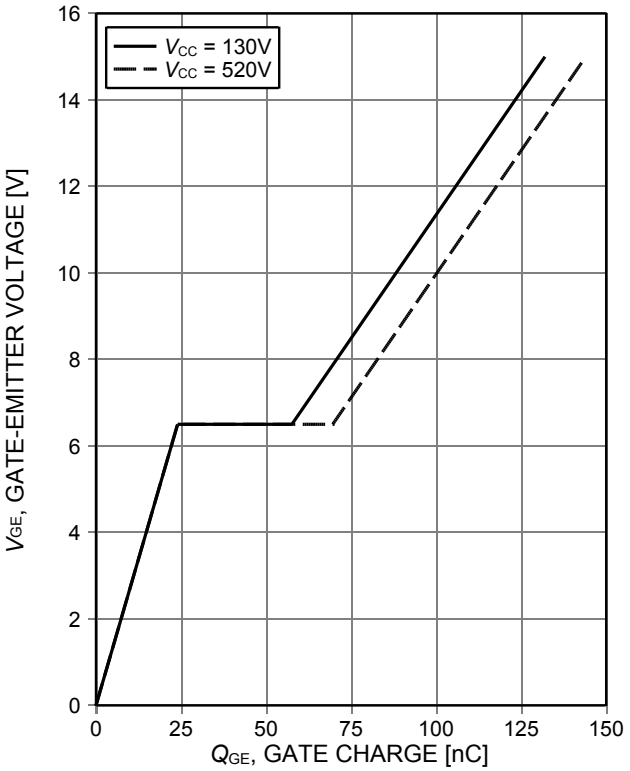


Figure 15. **Typical gate charge**
(I_C=60A)

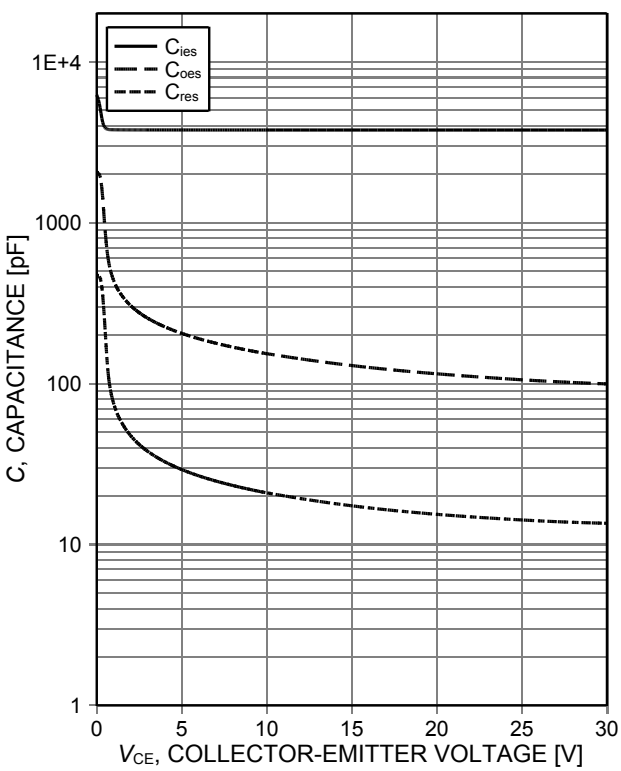


Figure 16. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

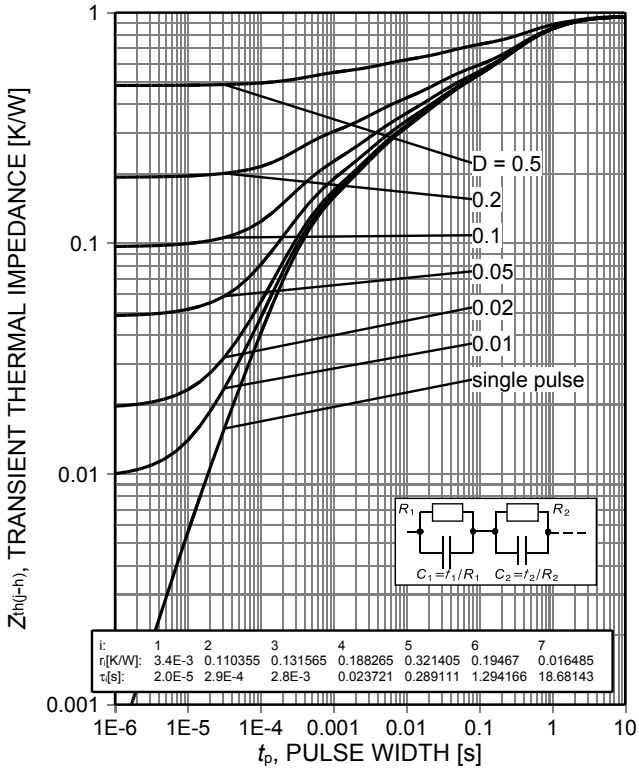


Figure 17. **IGBT transient thermal impedance as a function of pulse width** ($D=t_p/T$)

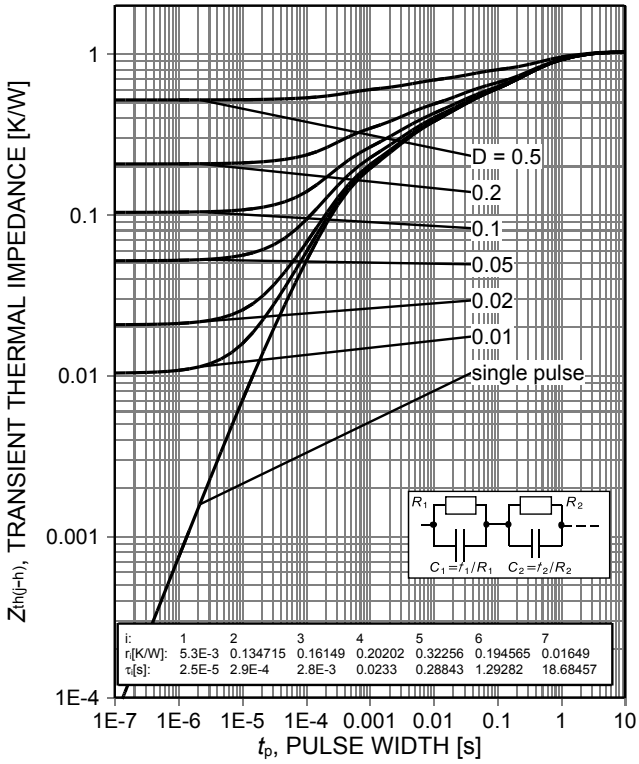


Figure 18. **Diode transient thermal impedance as a function of pulse width** ($D=t_p/T$)

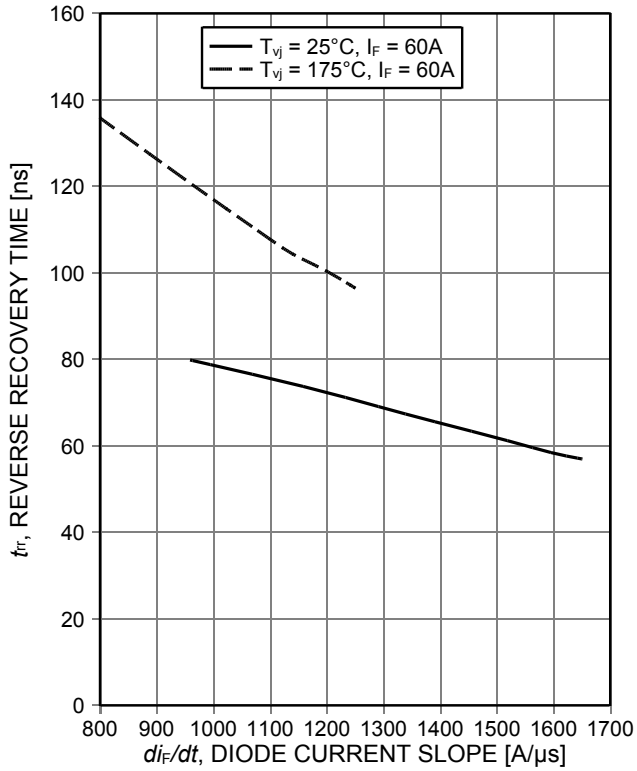


Figure 19. **Typical reverse recovery time as a function of diode current slope** (V_R=400V)

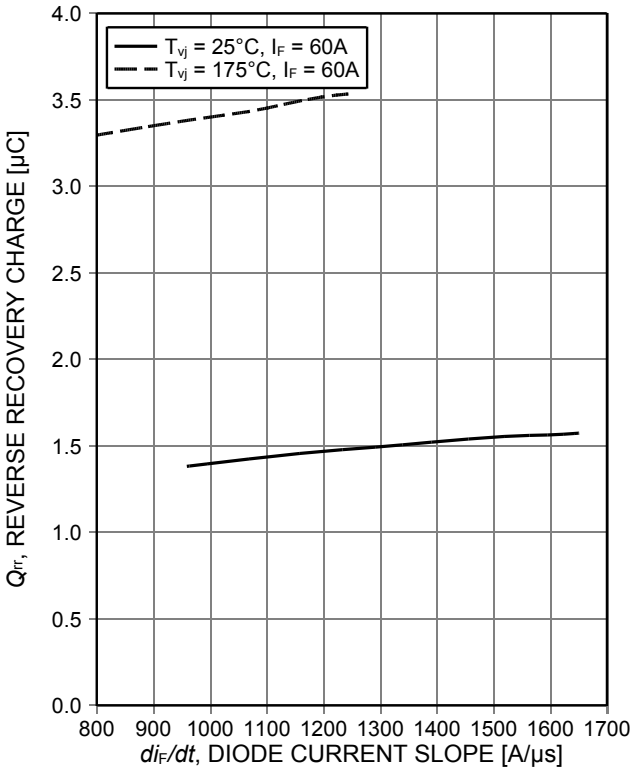


Figure 20. **Typical reverse recovery charge as a function of diode current slope** (V_R=400V)

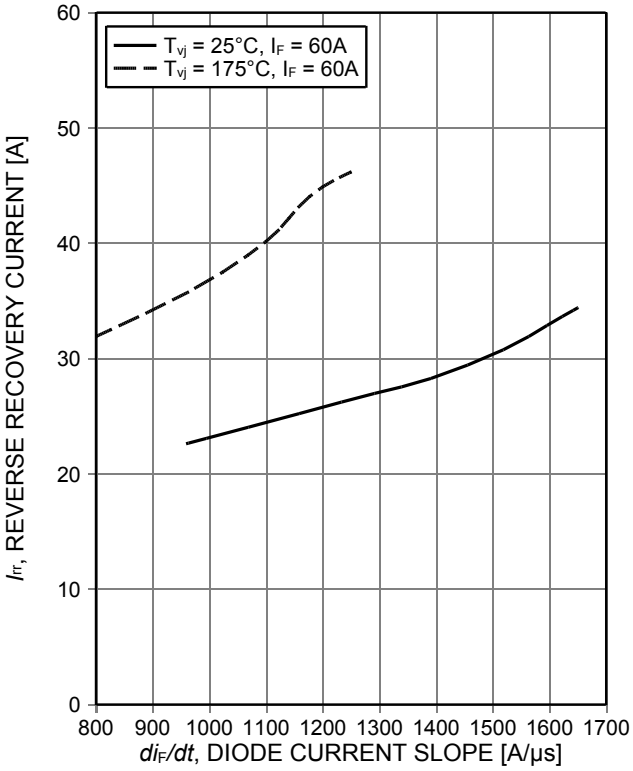


Figure 21. **Typical reverse recovery current as a function of diode current slope** (V_R=400V)

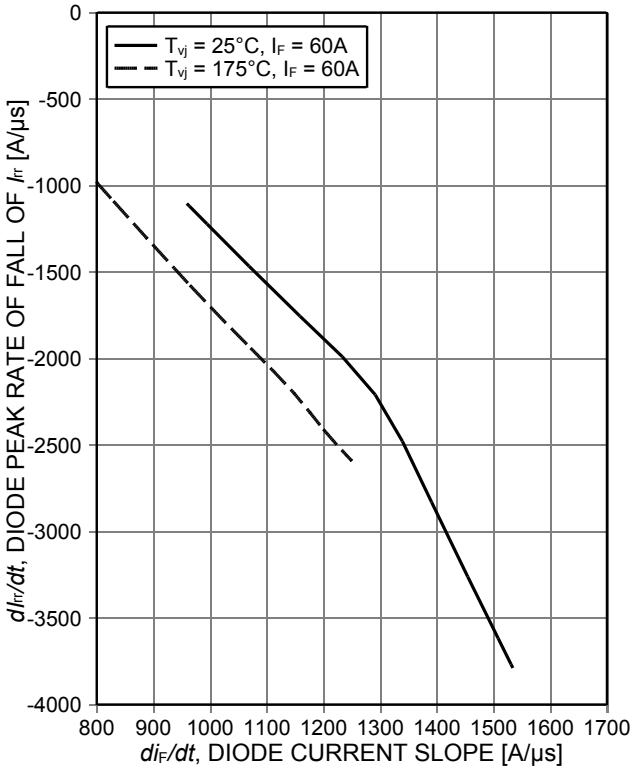


Figure 22. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope** (V_R=400V)

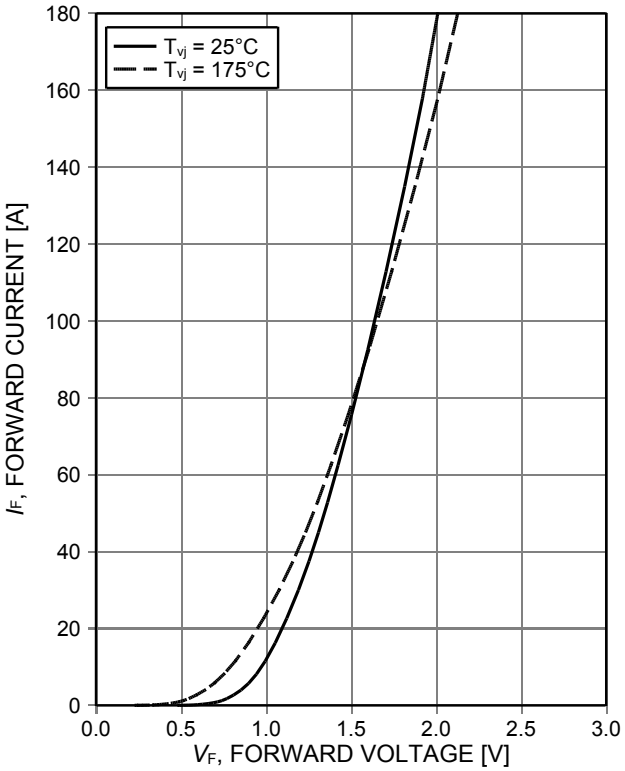


Figure 23. **Typical diode forward current as a function of forward voltage**

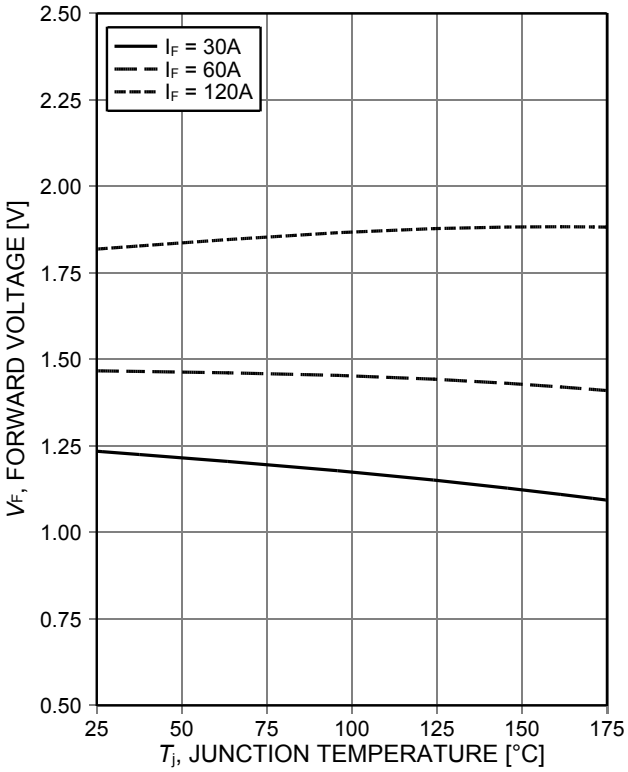
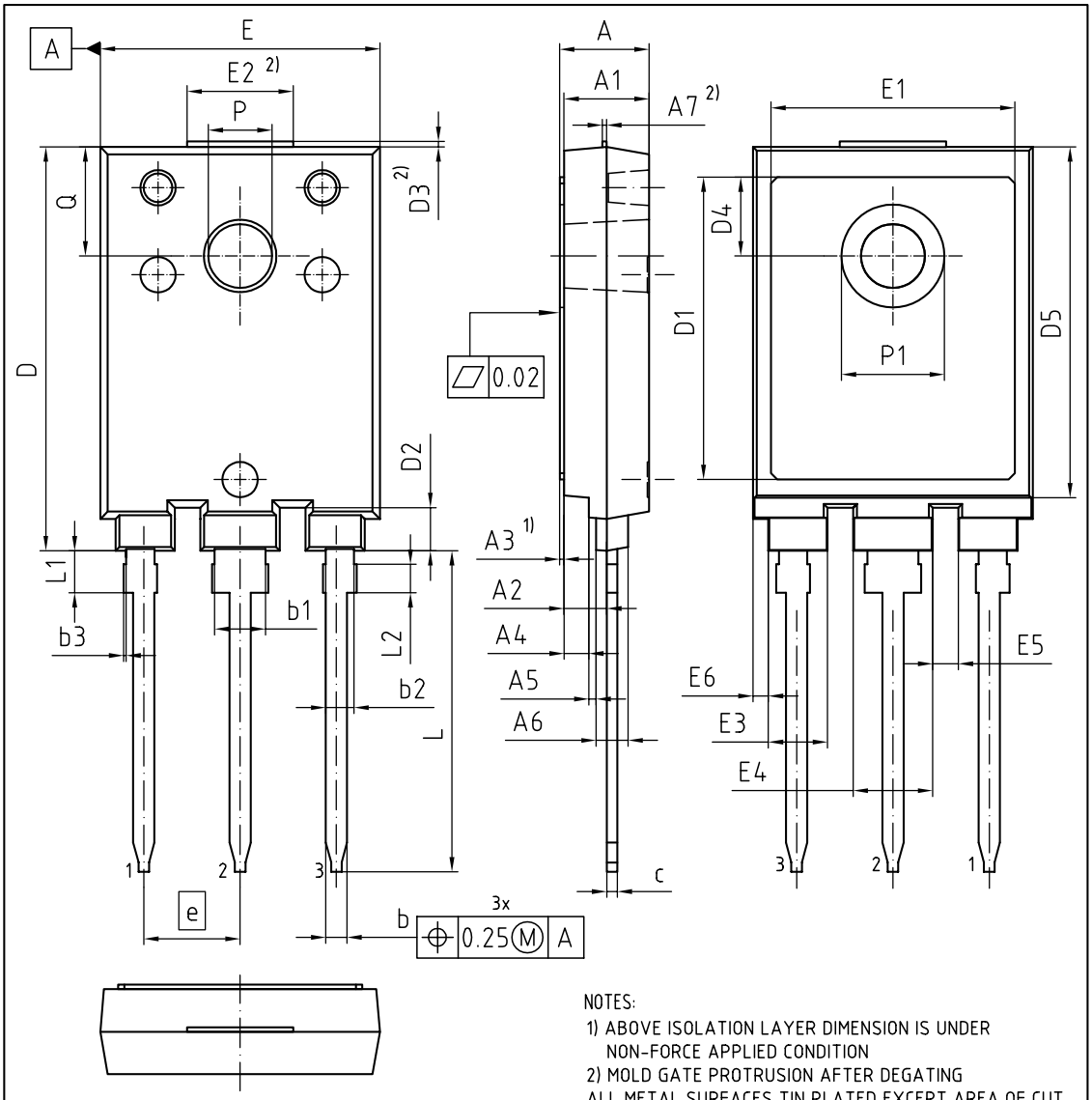


Figure 24. **Typical diode forward voltage as a function of junction temperature**

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

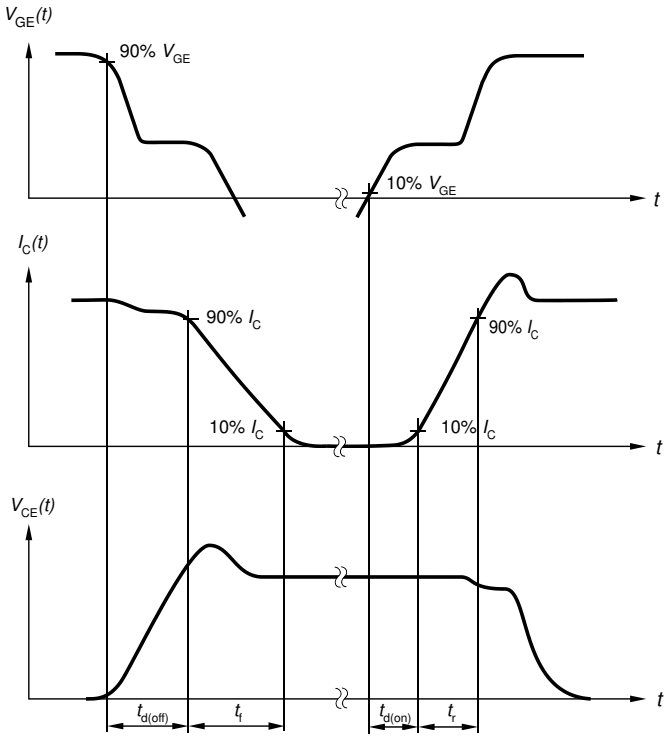


Figure A. **Definition of switching times**

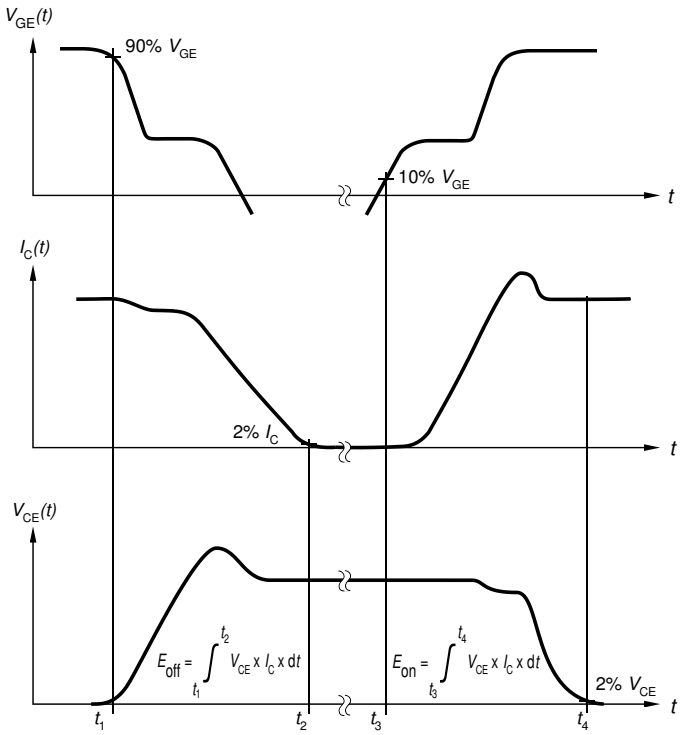


Figure B. **Definition of switching losses**

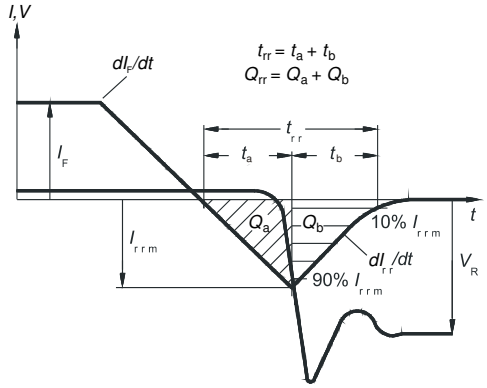


Figure C. **Definition of diode switching characteristics**

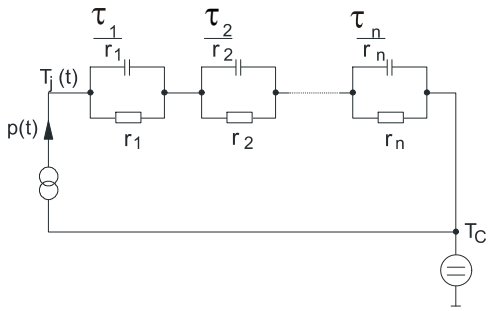


Figure D. **Thermal equivalent circuit**

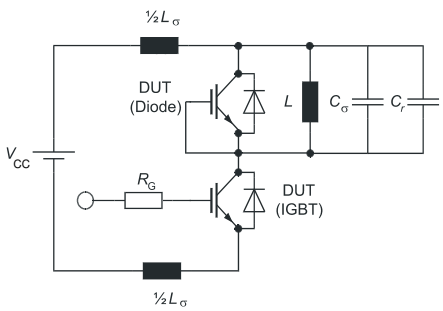


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

IKFW75N65EH5

Revision: 2020-07-24, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2020-07-24	Final Data Sheet

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

Published by
Infineon Technologies AG
81726 München, Germany
© Infineon Technologies AG 2020.
All Rights Reserved.

Important Notice
The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie"). With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (www.infineon.com).

Please note that this product is not qualified according to the AEC Q100 or AEC Q101 documents of the Automotive Electronics Council.

Warnings
Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.