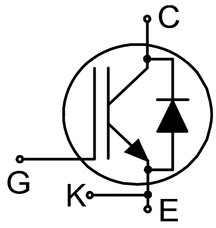
High speed switching series third generation IGBT

Low switching losses IGBT in Highspeed3 technology copacked with soft, fast recovery full current rated anti-parallel Emitter Controlled diode

Features:

High speed H3 technology offers:
- Ultra-low loss switching losses thanks to Kelvin emitter pin package in combination with High speed H3 technology
- High efficiency in hard switching and resonant topologies
- 10µsec short circuit withstand time at T_{vj}=175°C
- Easy paralleling capability due to positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Low Gate Charge Q_G
- Very soft, fast recovery full current anti-parallel diode
- Maximum junction temperature 175°C
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/



Applications:

- Industrial UPS
- Charger
- Energy Storage
- Three-level Solar String Inverter

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
IKY50N120CH3	1200V	50A	2V	175°C	K50MCH3	PG-TO247-4-2

Table of Contents

High speed switching series third generation IGBT

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}	1200	V
DC collector current, limited by T_{vjmax} $T_C = 25°C$ $T_C = 135°C$	I_C	100.0 50.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	200.0	A
Turn off safe operating area $V_{CE} \leq 1200V$, $T_{vj} \leq 175°C$, $t_p = 1µs$	-	200.0	A
Diode forward current, limited by T_{vjmax} $T_C = 25°C$ $T_C = 100°C$	I_F	100.0 50.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	200.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10µs$, $D < 0.010$)	V_{GE}	±20 ±30	V
Short circuit withstand time $V_{GE} = 15.0V$, $V_{CC} \leq 600V$ Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s $T_{vj} = 175°C$	t_{SC}	10	µs
Power dissipation $T_C = 25°C$ Power dissipation $T_C = 135°C$	P_{tot}	652.0 173.0	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

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R_{th} Characteristics						
IGBT thermal resistance,[1] junction - case	$R_{th(j-C)}$		-	-	0.23	K/W
Diode thermal resistance,[1] junction - case	$R_{th(j-C)}$		-	-	0.42	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		-	-	40	K/W

[1] Thermal resistance of thermal grease $R_{th(c-s)}$ (case to heat sink) of more than 0.1K/W not included.

High speed switching series third generation IGBT

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	1200	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 50.0A T_{vj} = 25°C T_{vj} = 175°C	- -	2.00 2.50	2.35 -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 50.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.90 1.85	2.30 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 1.25mA, V_{CE} = V_{GE}	5.1	5.8	6.5	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 1200V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- 4000	350 -	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	-	17.0	-	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	-	3269	-	pF
Output capacitance	C_{oes}		-	355	-	
Reverse transfer capacitance	C_{res}		-	199	-	
Gate charge	Q_G	V_{CC} = 960V, I_C = 50.0A, V_{GE} = 15V	-	235.0	-	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} = 600V, I_C = 50.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 10.0Ω, $R_{G(off)}$ = 10.0Ω, $L\sigma$ = 90nH, $C\sigma$ = 67pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	32	-	ns
Rise time	t_r		-	28	-	ns
Turn-off delay time	$t_{d(off)}$		-	296	-	ns
Fall time	t_f		-	29	-	ns
Turn-on energy	E_{on}		-	2.30	-	mJ
Turn-off energy	E_{off}		-	1.90	-	mJ
Total switching energy	E_{ts}		-	4.20	-	mJ

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

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 600V, I_F = 50.0A, di_F/dt = 1200A/µs	-	255	-	ns
Diode reverse recovery charge	Q_{rr}		-	3.40	-	µC
Diode peak reverse recovery current	I_{rrm}		-	33.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-620	-	A/µs

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 175°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 175°C, V_{CC} = 600V, I_C = 50.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 10.0Ω, $R_{G(off)}$ = 10.0Ω, $L\sigma$ = 90nH, $C\sigma$ = 67pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	31	-	ns
Rise time	t_r		-	31	-	ns
Turn-off delay time	$t_{d(off)}$		-	397	-	ns
Fall time	t_f		-	65	-	ns
Turn-on energy	E_{on}		-	4.30	-	mJ
Turn-off energy	E_{off}		-	4.00	-	mJ
Total switching energy	E_{ts}		-	8.30	-	mJ

Diode Characteristic, at T_{vj} = 175°C

Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 600V, I_F = 50.0A, di_F/dt = 1200A/µs	-	370	-	ns
Diode reverse recovery charge	Q_{rr}		-	8.80	-	µC
Diode peak reverse recovery current	I_{rrm}		-	52.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-460	-	A/µs

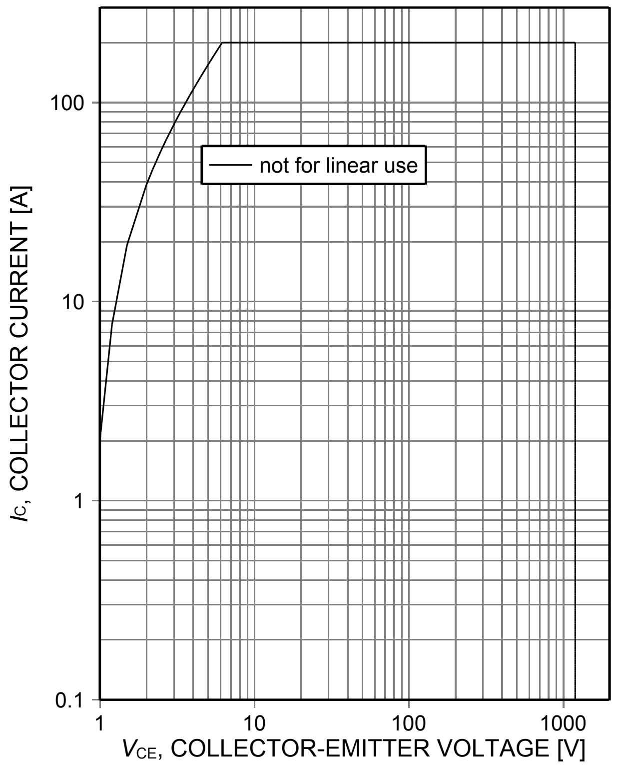


Figure 1. **Forward bias safe operating area**
(D=0, T_C=25°C, T_{vj}≤175°C; V_{GE}=15V)

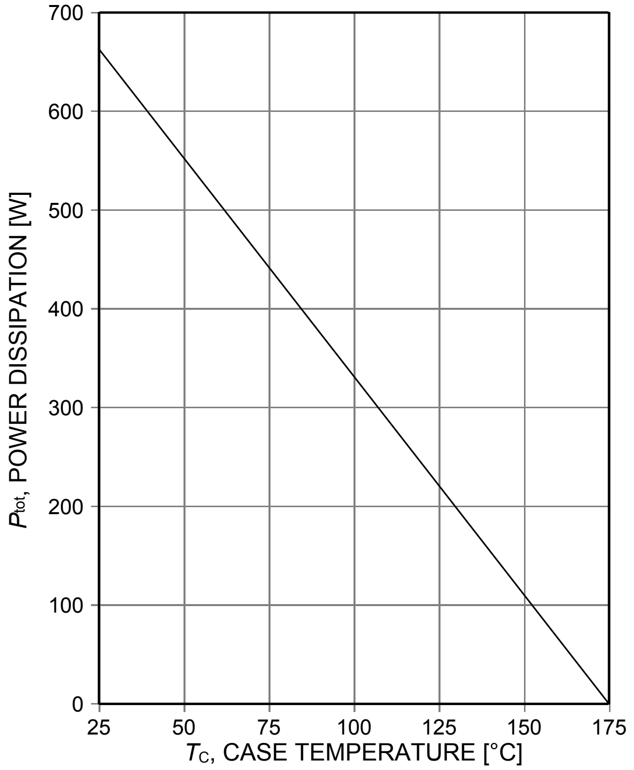


Figure 2. **Power dissipation as a function of case temperature**
(T_{vj}≤175°C)

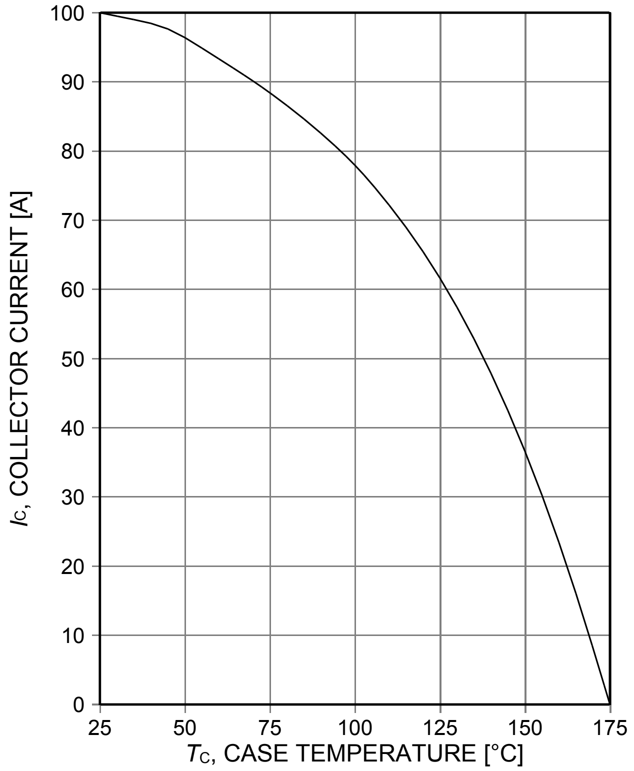


Figure 3. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_{vj}≤175°C)

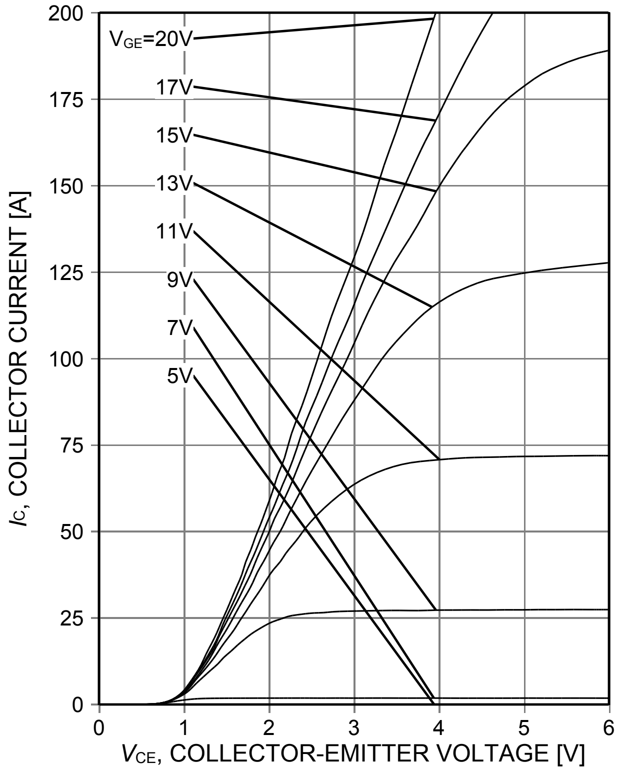


Figure 4. **Typical output characteristic**
(T_{vj}=25°C)

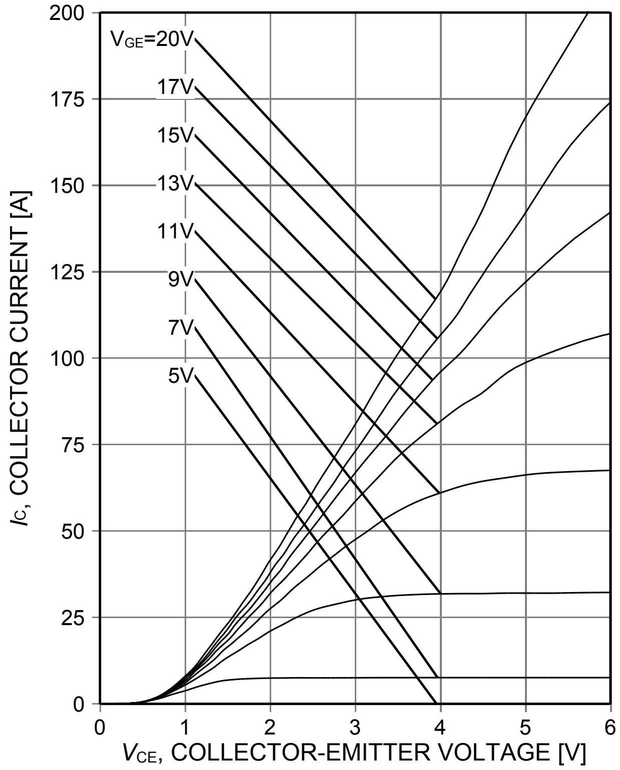


Figure 5. **Typical output characteristic**
(T_{vj}=175°C)

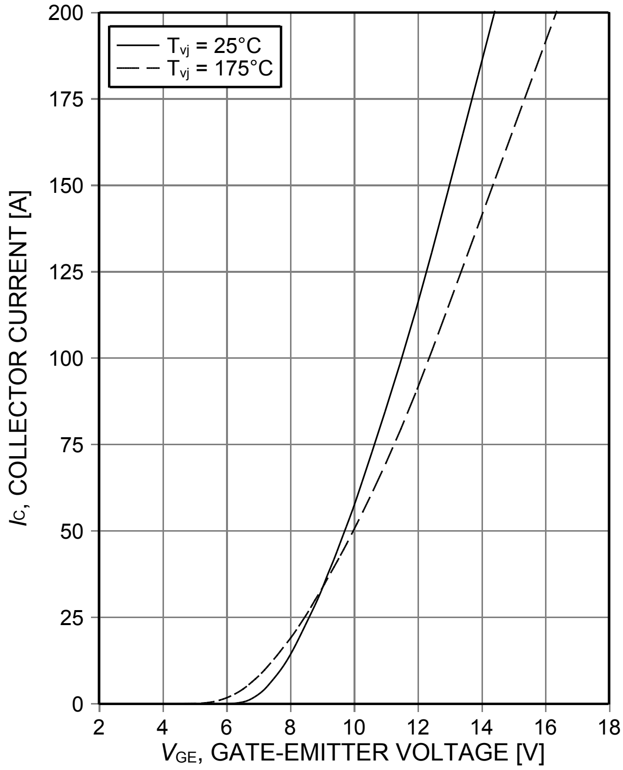


Figure 6. **Typical transfer characteristic**
(V_{CE}=20V)

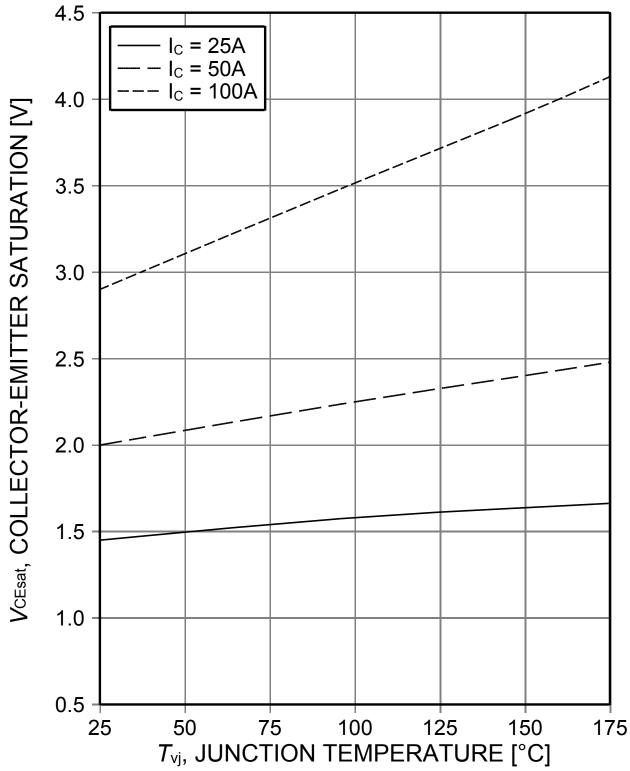


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

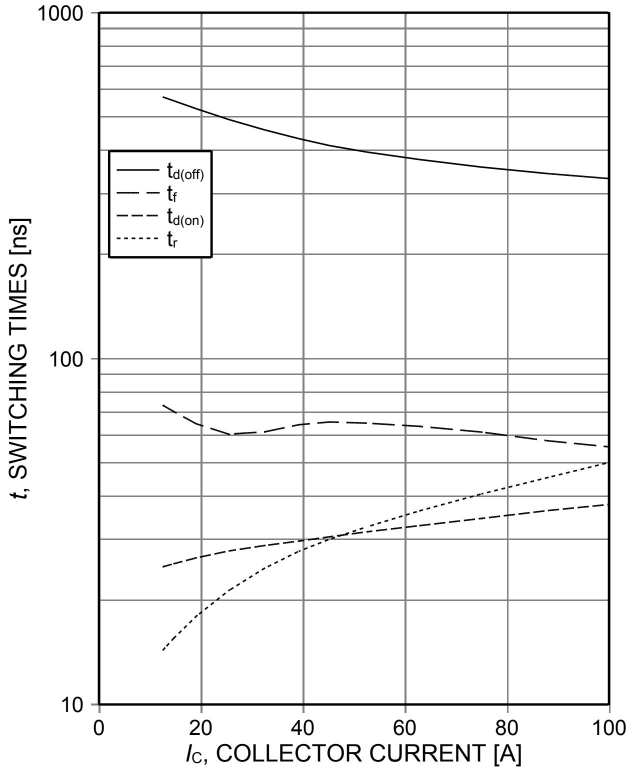


Figure 8. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=0/15V, R_G=10Ω, Dynamic test circuit in Figure E)

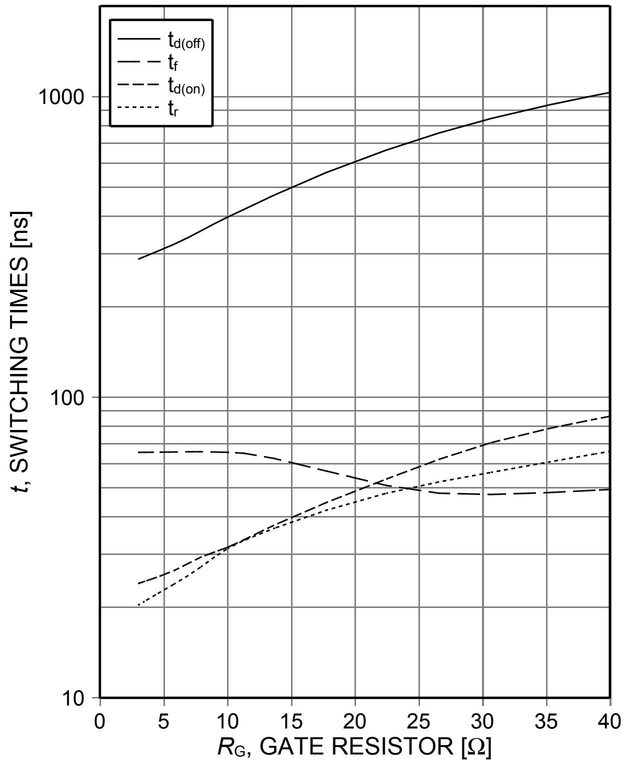


Figure 9. **Typical switching times as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=0/15V, I_C=50A, Dynamic test circuit in Figure E)

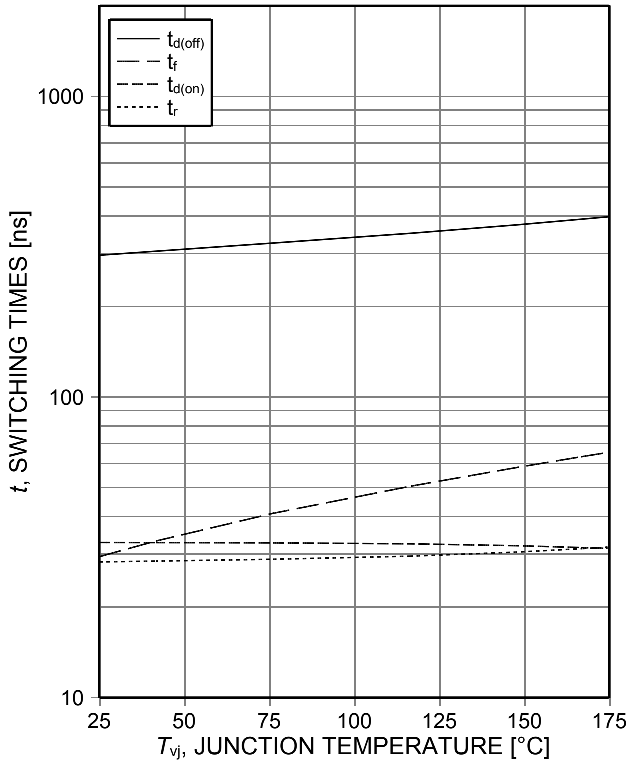


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=600V, V_{GE}=0/15V, I_C=50A, R_G=10Ω, Dynamic test circuit in Figure E)

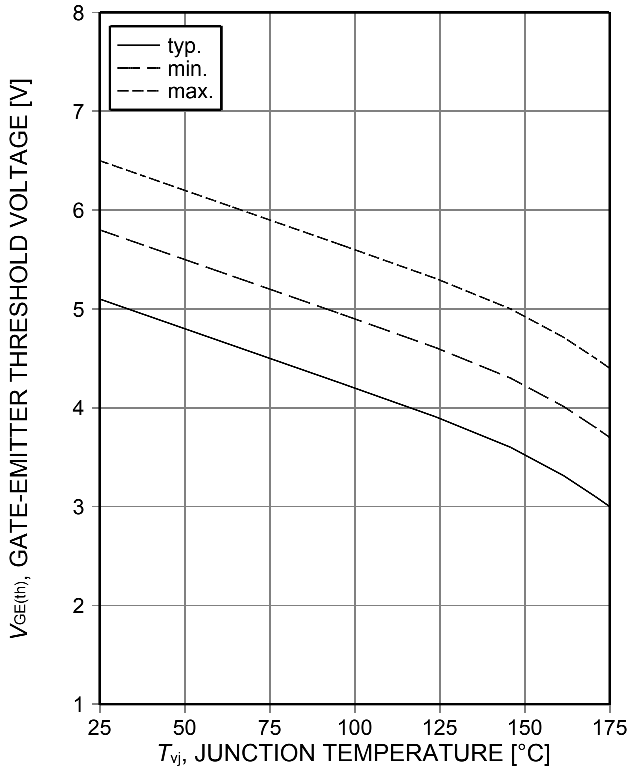


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=1,25 mA)

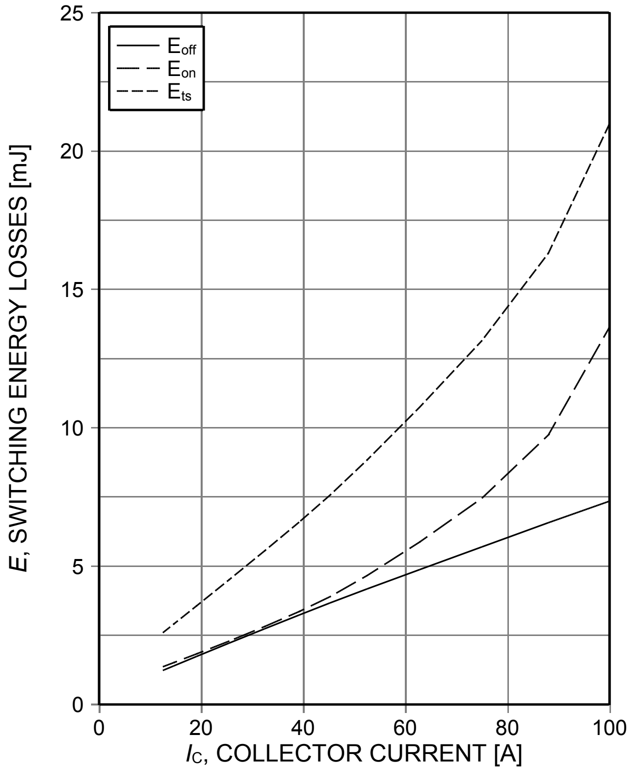


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=0/15V, R_G=10Ω, Dynamic test circuit in Figure E)

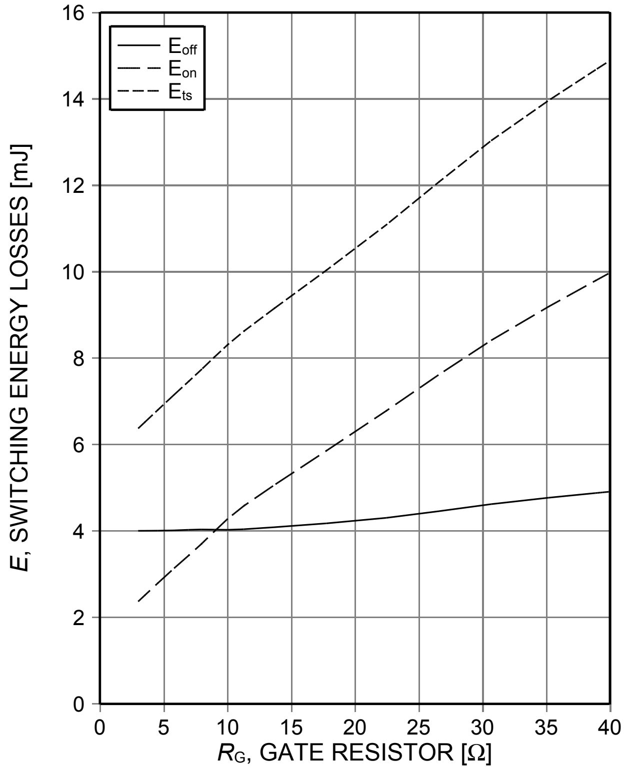


Figure 13. **Typical switching energy losses as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=0/15V, I_C=50A, Dynamic test circuit in Figure E)

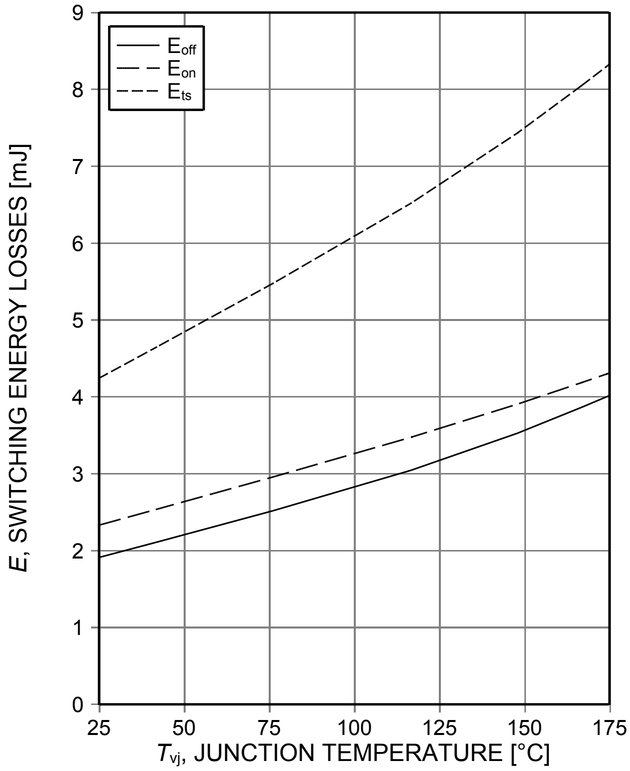


Figure 14. **Typical switching energy losses as a function of junction temperature**
(inductive load, V_{CE}=600V, V_{GE}=0/15V, I_C=50A, R_G=10Ω, Dynamic test circuit in Figure E)

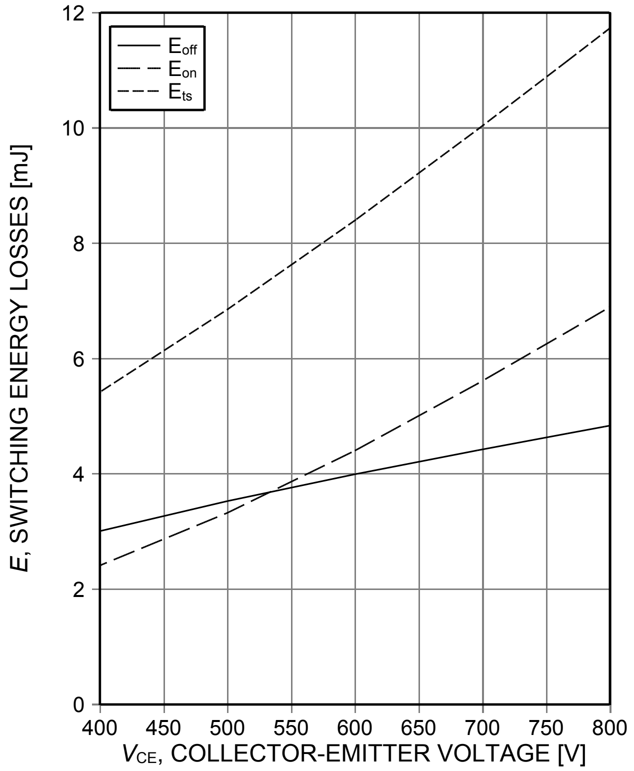


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, T_{vj}=175°C, V_{GE}=0/15V, I_C=50A, R_G=10Ω, Dynamic test circuit in Figure E)

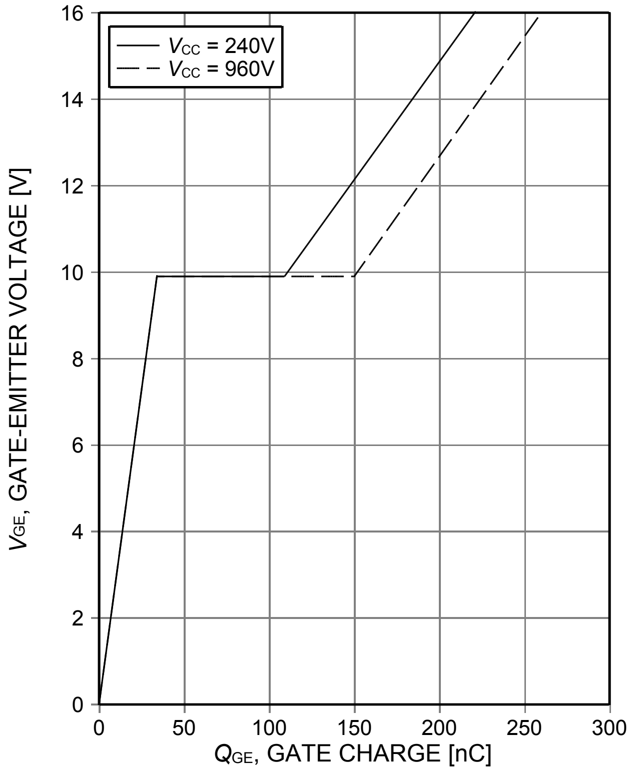


Figure 16. **Typical gate charge**
(I_C=50A)

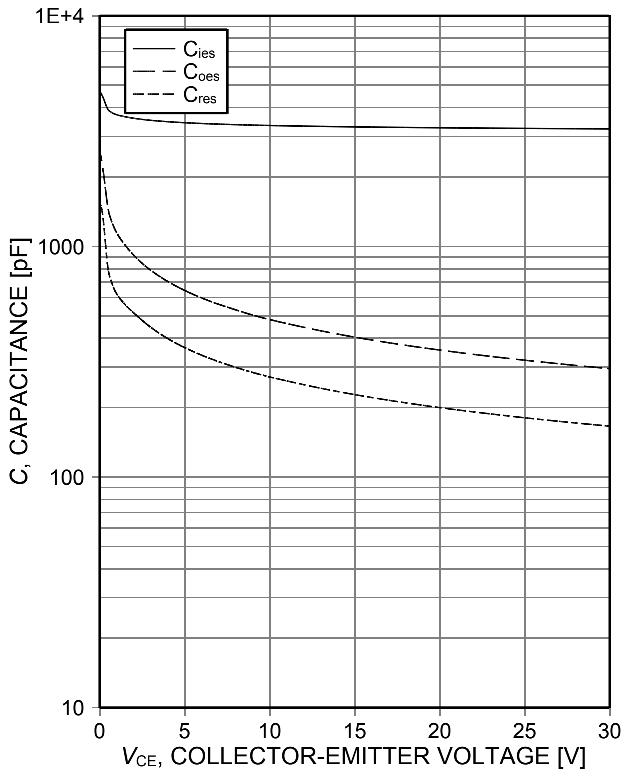


Figure 17. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

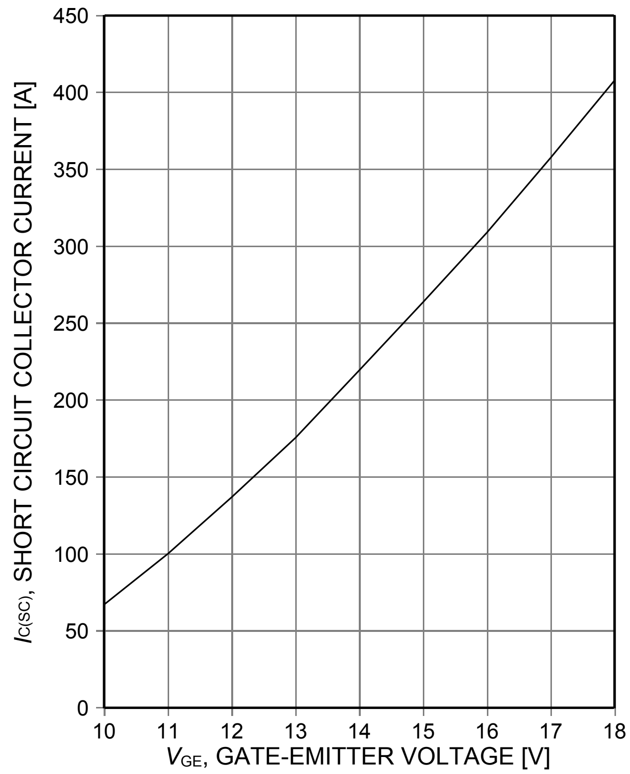


Figure 18. **Typical short circuit collector current as a function of gate-emitter voltage**
(V_{CE}≤600V, T_{vj}≤175°C)

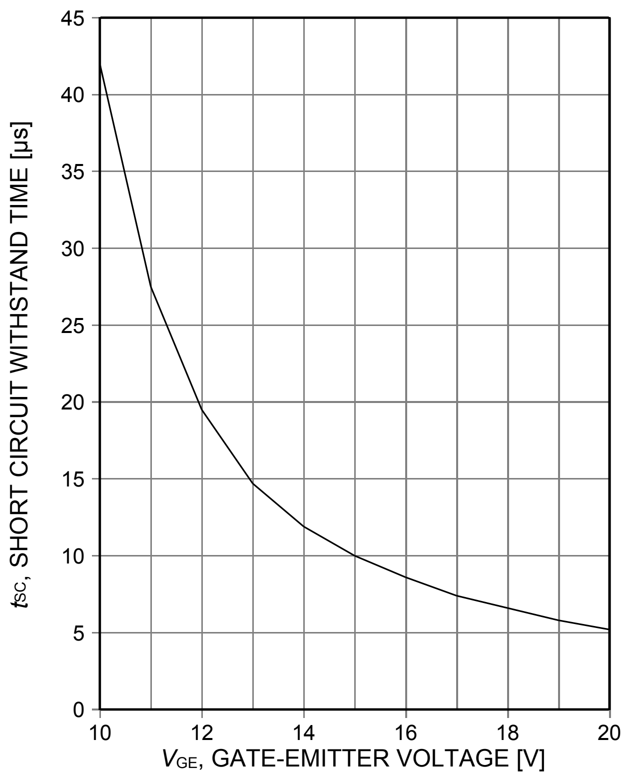


Figure 19. **Short circuit withstand time as a function of gate-emitter voltage**
(V_{CE}≤600V, start at T_{vj}≤175°C)

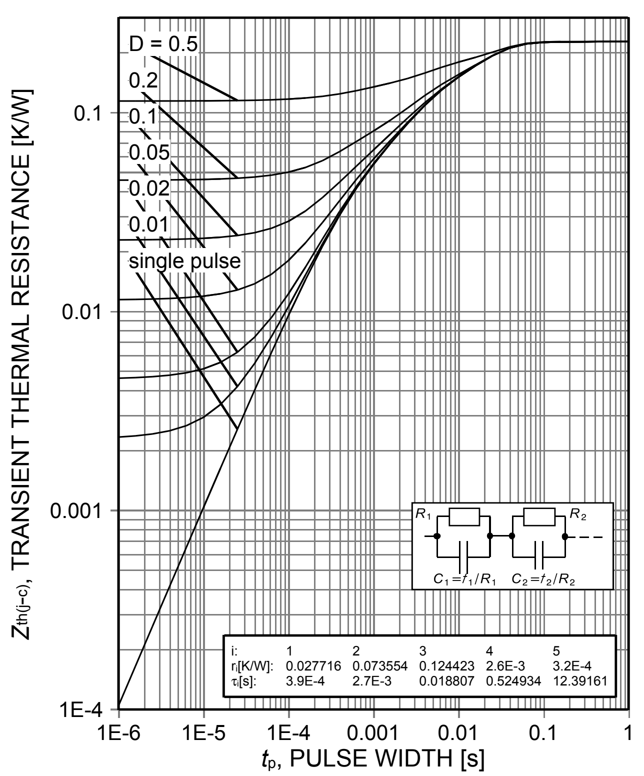


Figure 20. **IGBT transient thermal resistance**
(D=t_p/T)

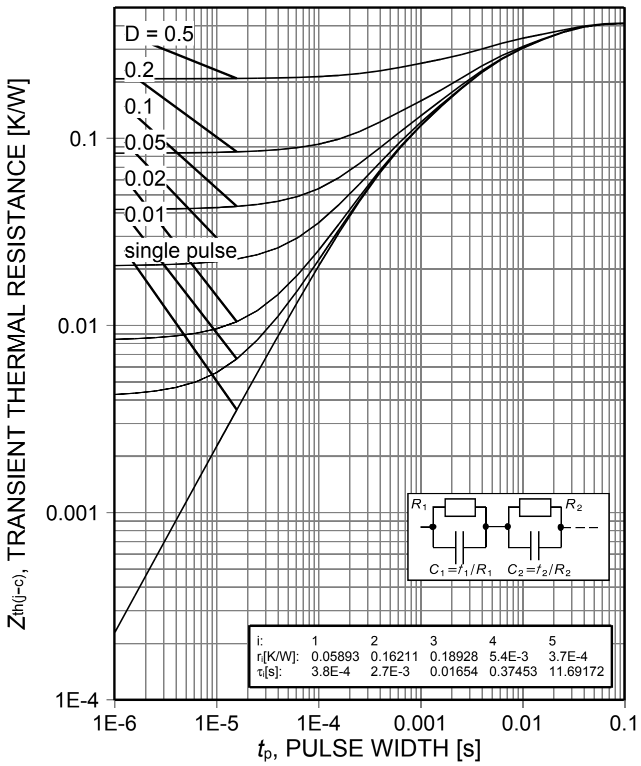


Figure 21. **Diode transient thermal impedance as a function of pulse width**
(D=t_p/T)

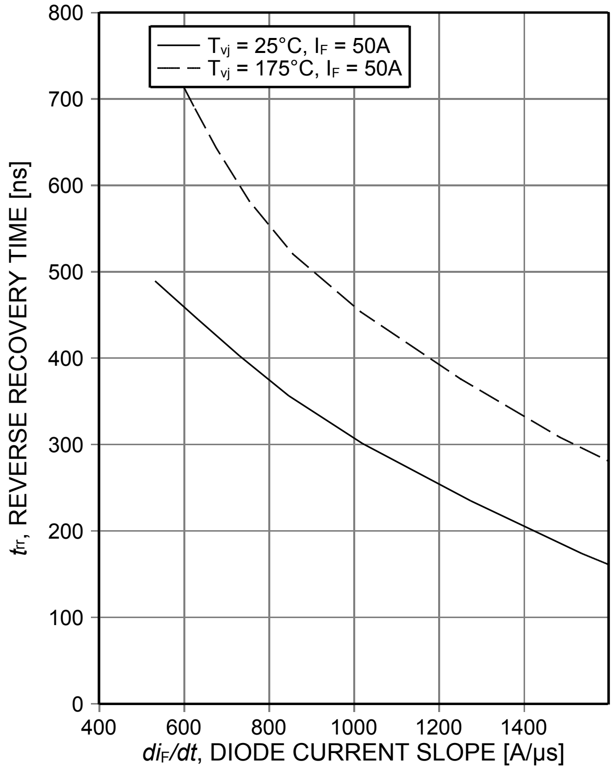


Figure 22. **Typical reverse recovery time as a function of diode current slope**
(V_R=600V)

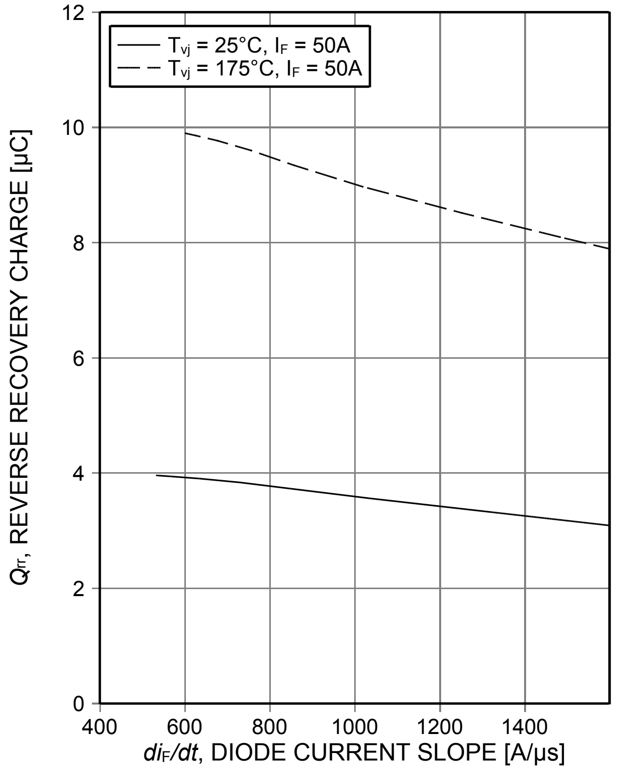


Figure 23. **Typical reverse recovery charge as a function of diode current slope**
(V_R=600V)

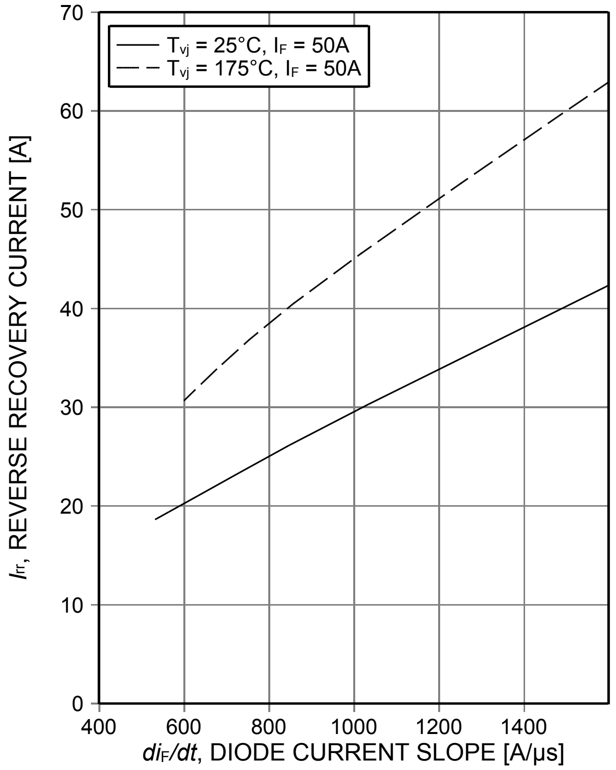


Figure 24. **Typical reverse recovery current as a function of diode current slope**
(V_R=600V)

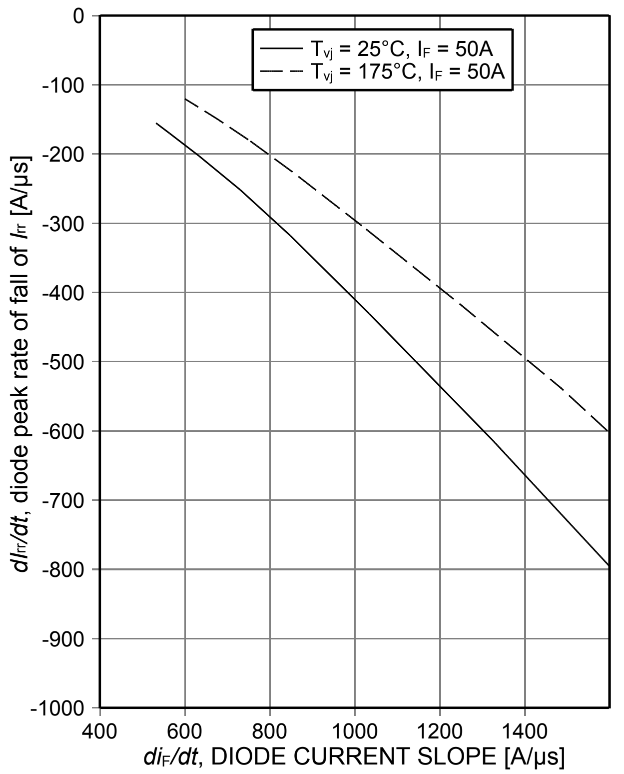


Figure 25. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=600V)

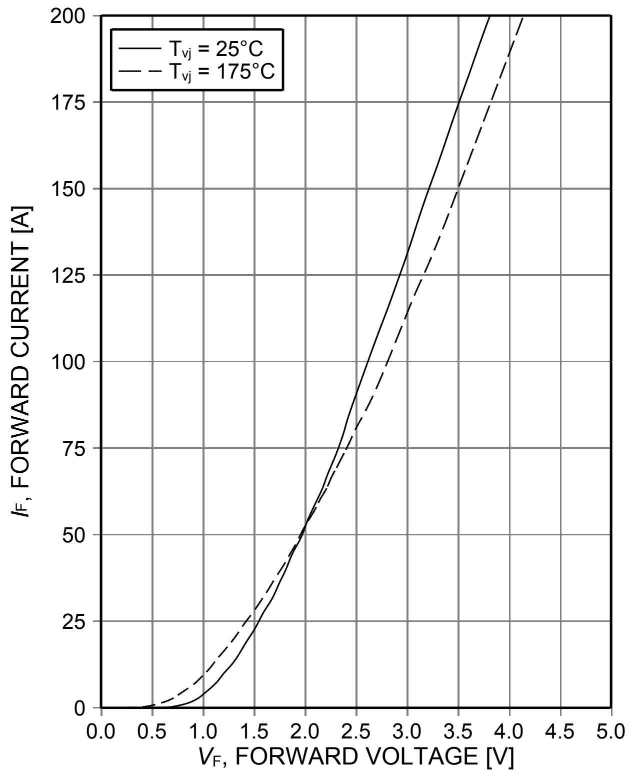


Figure 26. **Typical diode forward current as a function of forward voltage**

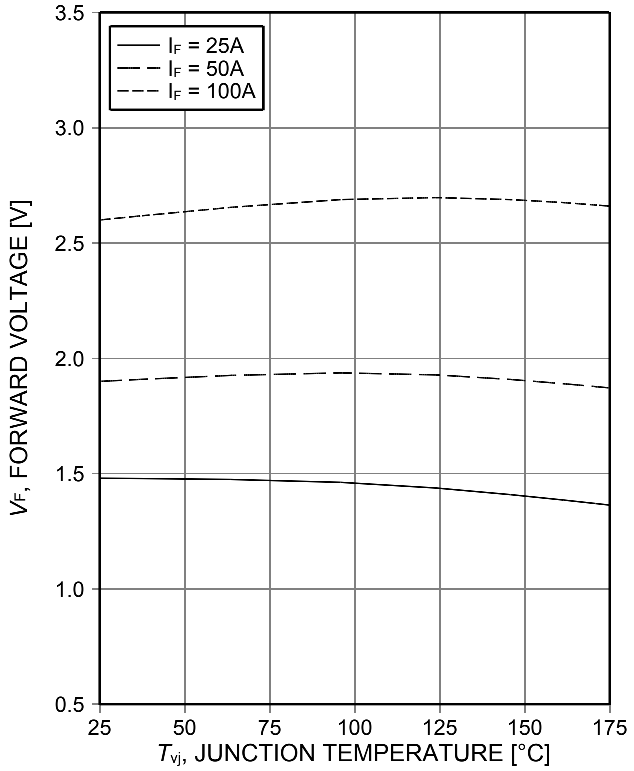


Figure 27. **Typical diode forward voltage as a function of junction temperature**

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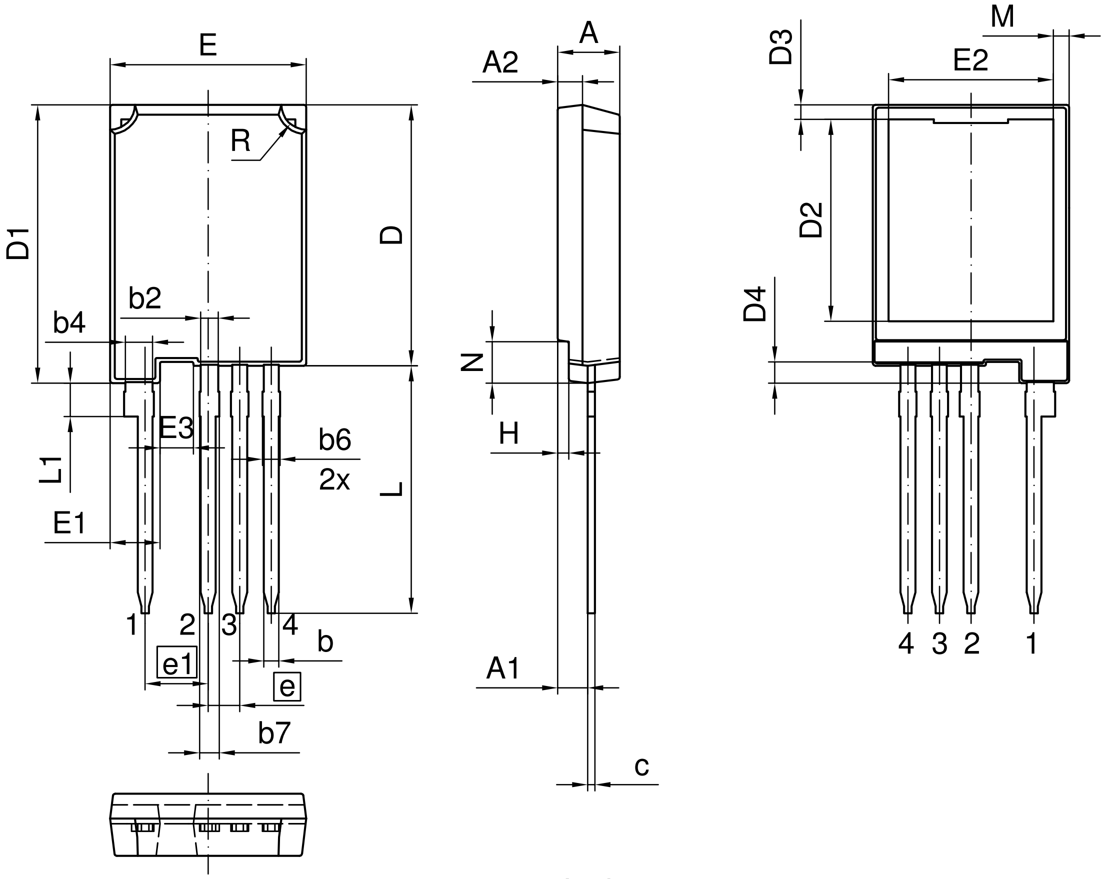


NOTES:

PACKAGE SURFACE ROUTE BETWEEN PIN 1 & PIN 2 WILL BE 5.1mm MIN.

ALL b... AND c DIMENSIONS INCLUDING PLATING EXCEPT AREA OF CUTTING

DIMENSION	MILLIMETERS	
	MIN.	MAX.
A	4.9	5.1
A1	2.31	2.51
A2	1.9	2.1
b	1.16	1.29
b2	1.36	1.49
b4	2.16	2.29
b6	1.16	1.45
b7	1.16	1.65
c	0.59	0.66
D	20.9	21.1
D1	22.3	22.5
D2	15.95	16.55
D3	1	1.35
D4	1.6	1.8
E	15.7	15.9
E1	3.9	4.1
E2	13.1	13.5
E3	2.58	2.78
e	2.54	
e1	5.08	
H	0.8	1
L	19.8	20.1
L1	2.55	2.85
M	0.97	1.57
N	3.24	3.44
R	1.9	2.1

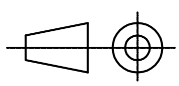
DOCUMENT NO.
Z8B00182798

REVISION
01

SCALE 2:1

0 5 10mm

EUROPEAN PROJECTION



ISSUE DATE
23.09.2016

Testing Conditions

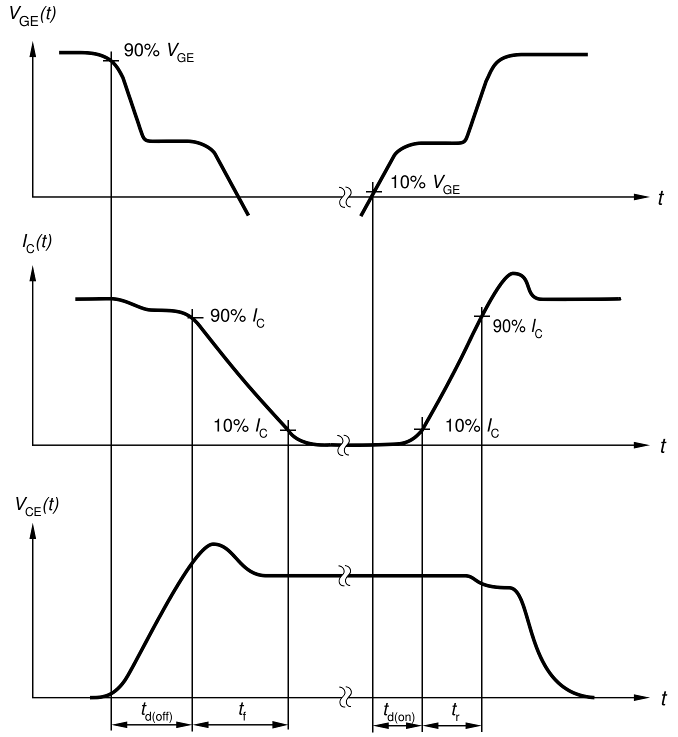


Figure A. **Definition of switching times**

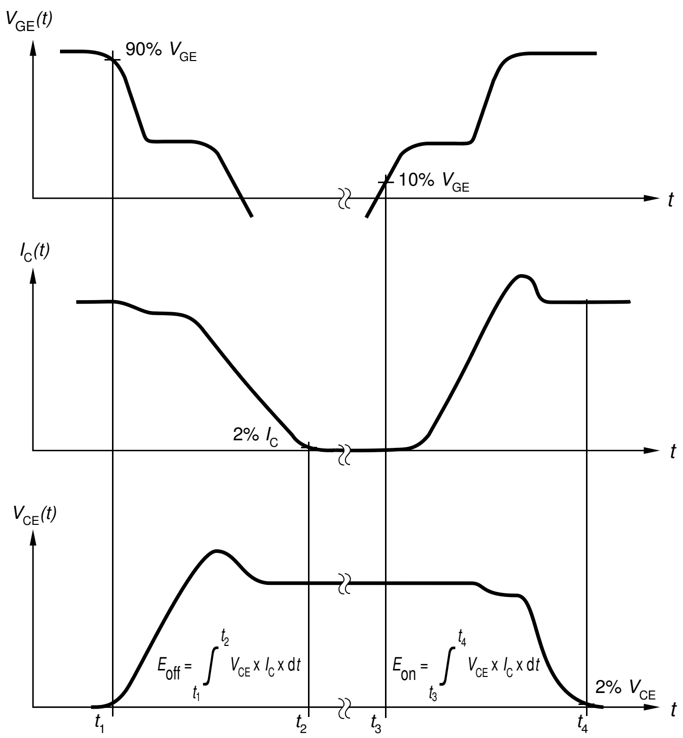


Figure B. **Definition of switching losses**

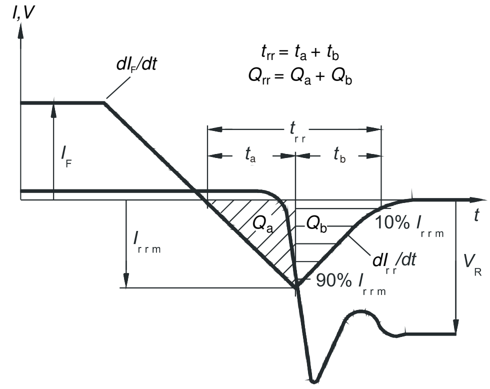


Figure C. **Definition of diode switching characteristics**

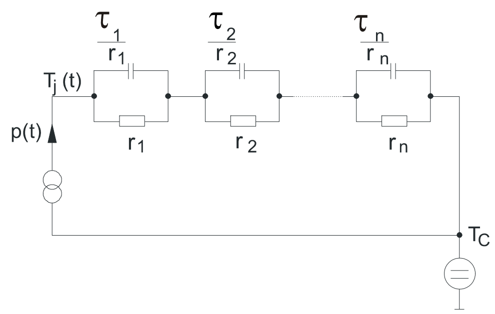


Figure D. **Thermal equivalent circuit**

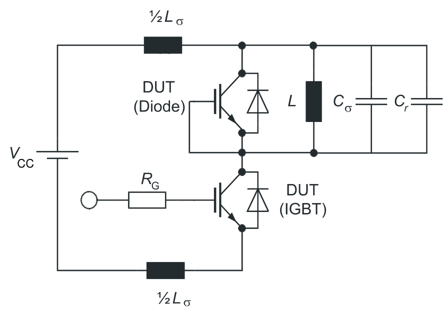


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

IKY50N120CH3

Revision: 2017-06-09, Rev. 2.2

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2017-04-26	Final data sheet
2.2	2017-06-09	Update Figure 26

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