IGBT

IGBT with integrated diode in packages offering space saving advantage

IKD06N60R

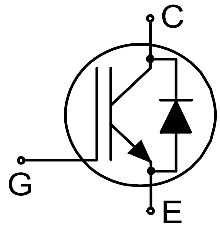
600V TRENCHSTOP^{TM} RC-Series for hard switching applications

Data sheet

Industrial Power Control

TRENCHSTOP™ RC-Series for hard switching applications

IGBT with integrated diode in packages offering space saving advantage



Features:

TRENCHSTOP™ Reverse Conducting (RC) technology for 600V applications offering
- Optimised V_{CEsat} and V_F for low conduction losses
- Smooth switching performance leading to low EMI levels
- Very tight parameter distribution
- Operating range of 1 to 20kHz
- Maximum junction temperature 175°C
- Short circuit capability of 5µs
- Best in class current versus package size performance
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant (for PG-TO252: solder temperature 260°C, MSL1)
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

Applications:

- Consumer motor drives

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IKD06N60R	600V	6A	1.65V	175°C	K06R60	PG-TO252-3

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, $T_{vj} \geq 25°C$	V_{CE}	600	V
DC collector current, limited by T_{vjmax} $T_c = 25°C$ $T_c = 100°C$	I_C	12.0 6.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	18.0	A
Turn off safe operating area $V_{CE} \leq 600V$, $T_{vj} \leq 175°C$, $t_p = 1µs$	-	18.0	A
Diode forward current, limited by T_{vjmax} $T_c = 25°C$ $T_c = 100°C$	I_F	12.0 6.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	18.0	A
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time $V_{GE} = 15.0V$, $V_{CC} \leq 400V$ Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s $T_{vj} = 150°C$	t_{SC}	5	µs
Power dissipation $T_c = 25°C$	P_{tot}	100.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°C
Soldering temperature, reflow soldering (MSL1 according to JEDEC J-STA-020)		260	°C

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R_{th} Characteristics						
IGBT thermal resistance,[1] junction - case	$R_{th(j-c)}$		-	-	1.50	K/W
Diode thermal resistance,[2] junction - case	$R_{th(j-c)}$		-	-	3.60	K/W
Thermal resistance, min. footprint junction - ambient	$R_{th(j-a)}$		-	-	75	K/W
Thermal resistance, 6cm² Cu on PCB junction - ambient	$R_{th(j-a)}$		-	-	50	K/W

[1] Rth/Zth based on single cooling pulse. Please be aware that a correct Rth measurement of the IGBT, is not possible using a thermocouple.
[2] Rth/Zth based on single cooling pulse. Please be aware that a correct Rth measurement of the Diode, is not possible using a thermocouple.

TRENCHSTOP[TM] RC-Series for hard switching applications

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 = 0.20mA	600	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 6.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.65 1.85	2.10 -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 6.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.70 1.70	2.10 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.11mA, V_{CE} = V_{GE}	4.3	5.0	5.7	V
Zero gate voltage collector current[1)]	I_{CES}	V_{CE} = 600V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- -	40 1000	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 6.0A	-	3.4	-	S
Integrated gate resistor	r_G			none		Ω

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	-	470	-	pF
Output capacitance	C_{oes}		-	24	-	
Reverse transfer capacitance	C_{res}		-	14	-	
Gate charge	Q_G	V_{CC} = 480V, I_C = 6.0A, V_{GE} = 15V	-	48.0	-	nC
Short circuit collector current Max. 1000 short circuits Time between short circuits: ≥ 1.0s	$I_{C(SC)}$	V_{GE} = 15.0V, V_{CC} ≤ 400V, t_{SC} ≤ 5µs T_{vj} = 25°C	-	46	-	A

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 = 6.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 23.0Ω, $R_{G(off)}$ = 23.0Ω, $L\sigma$ = 60nH, $C\sigma$ = 40pF $L\sigma$, $C\sigma$ from Fig. E	-	12	-	ns
Rise time	t_r		-	7	-	ns
Turn-off delay time	$t_{d(off)}$		-	127	-	ns
Fall time	t_f		-	152	-	ns
Turn-on energy	E_{on}		-	0.11	-	mJ
Turn-off energy	E_{off}		-	0.22	-	mJ
Total switching energy	E_{ts}		-	0.33	-	mJ

[1)] Not subject to production test - verified by design/characterization

TRENCHSTOP™ RC-Series for hard switching applications

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

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 6.0A, di_F/dt = 800A/µs	-	68	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.37	-	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		-	-211	-	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} = 400V, I_C = 6.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 23.0Ω, $R_{G(off)}$ = 23.0Ω, $L\sigma$ = 60nH, $C\sigma$ = 40pF $L\sigma$, $C\sigma$ from Fig. E	-	12	-	ns
Rise time	t_r		-	10	-	ns
Turn-off delay time	$t_{d(off)}$		-	164	-	ns
Fall time	t_f		-	171	-	ns
Turn-on energy	E_{on}		-	0.20	-	mJ
Turn-off energy	E_{off}		-	0.36	-	mJ
Total switching energy	E_{ts}		-	0.56	-	mJ

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

Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 400V, I_F = 6.0A, di_F/dt = 800A/µs	-	74	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.80	-	µC
Diode peak reverse recovery current	I_{rrm}		-	17.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-237	-	A/µs

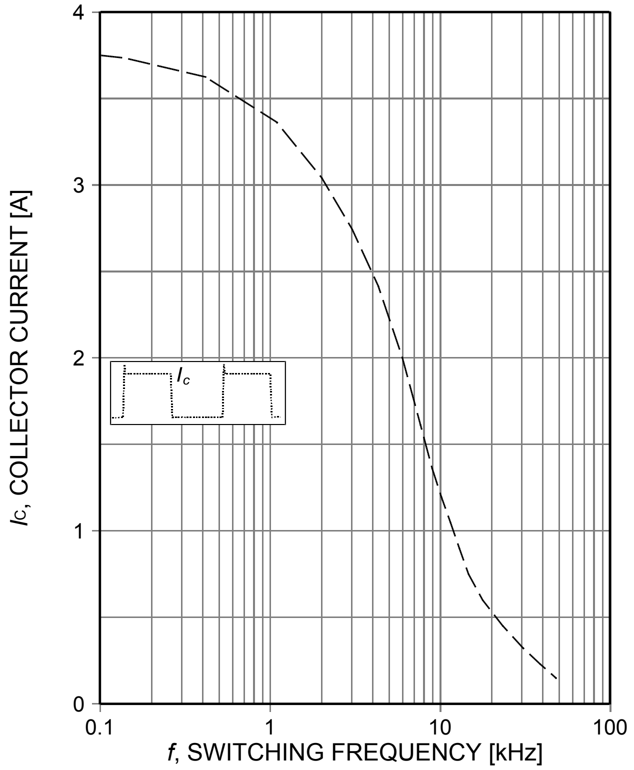


Figure 1. **Collector current as a function of switching frequency**
(T_{vj}≤175°C, T_a=55°C, D=0.5, V_{CE}=400V, V_{GE}=15/0V, r_G=23Ω, PCB mounting, 6cm2 Cu, Ptot=2,4W)

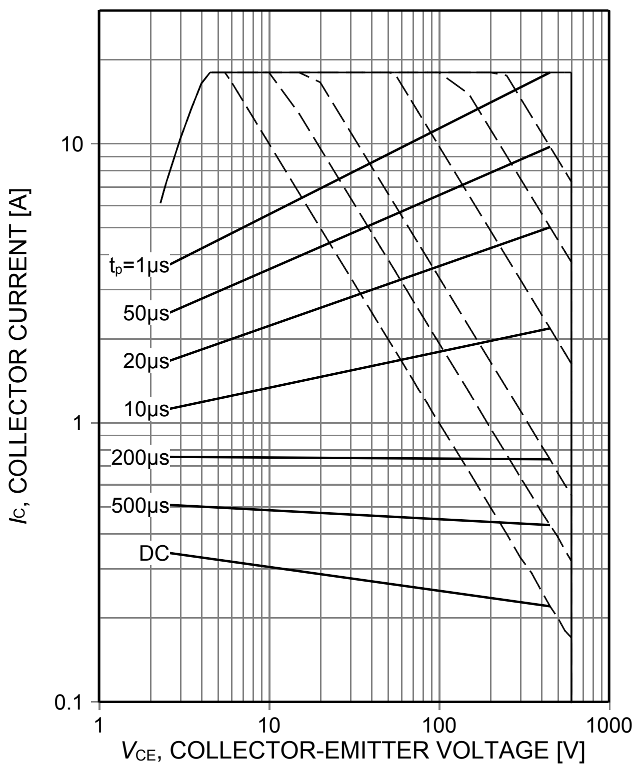


Figure 2. **Forward bias safe operating area**
(D=0, T_C=25°C, T_{vj}≤175°C; V_{GE}=15V)

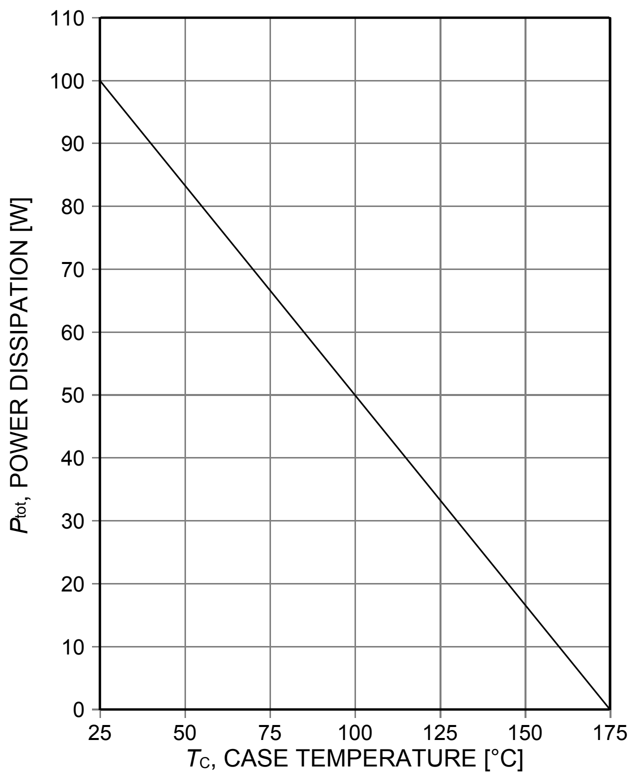


Figure 3. **Power dissipation as a function of case temperature**
(T_{vj}≤175°C)

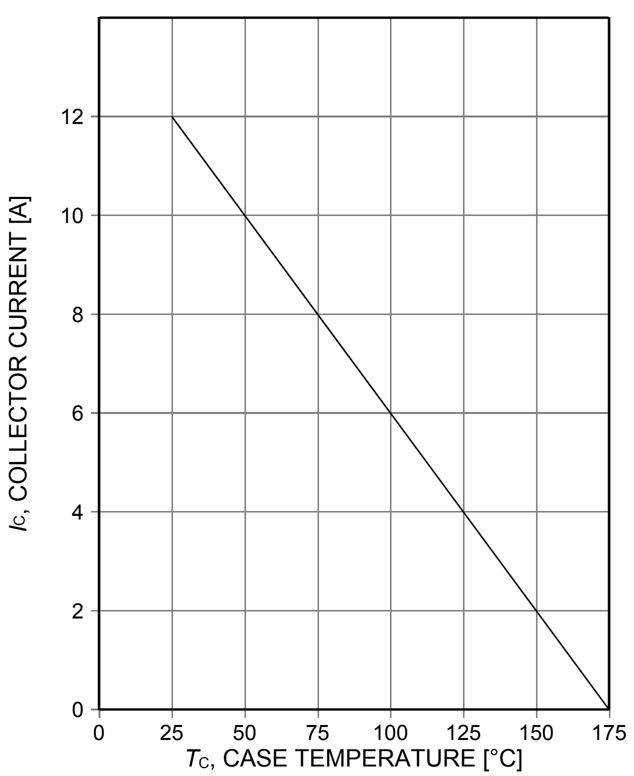


Figure 4. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_{vj}≤175°C)

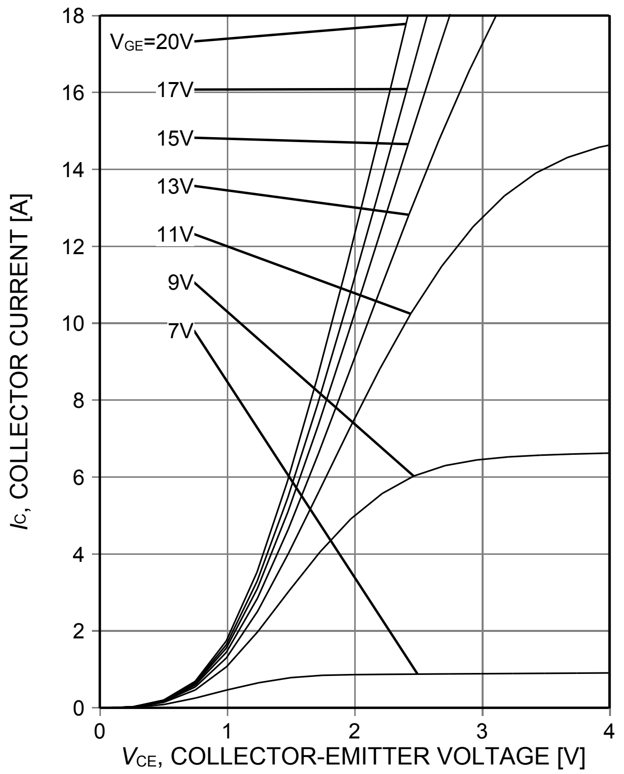


Figure 5. **Typical output characteristic**
(T_{vj}=25°C)

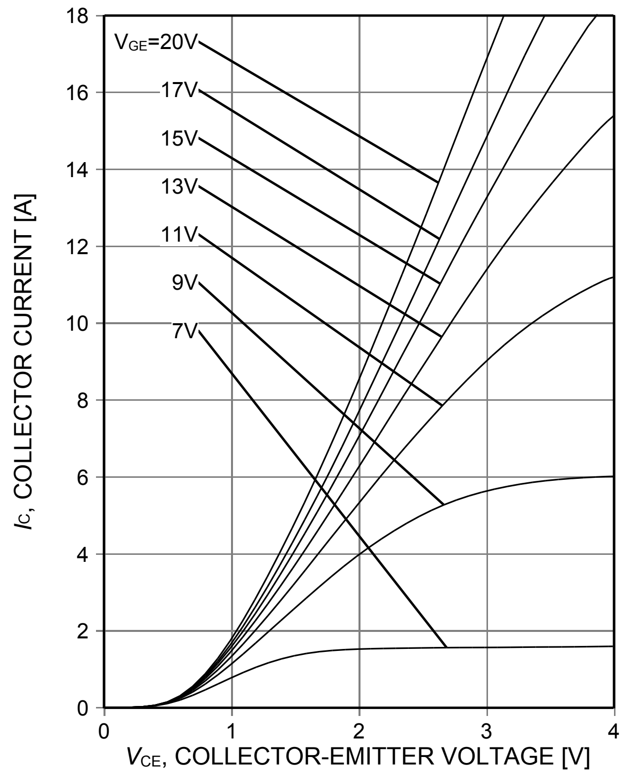


Figure 6. **Typical output characteristic**
(T_{vj}=175°C)

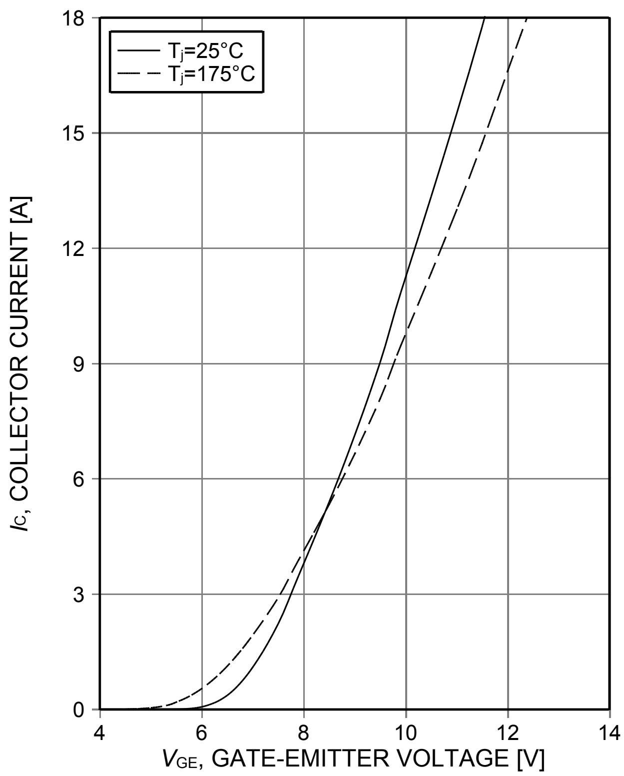


Figure 7. **Typical transfer characteristic**
(V_{CE}=10V)

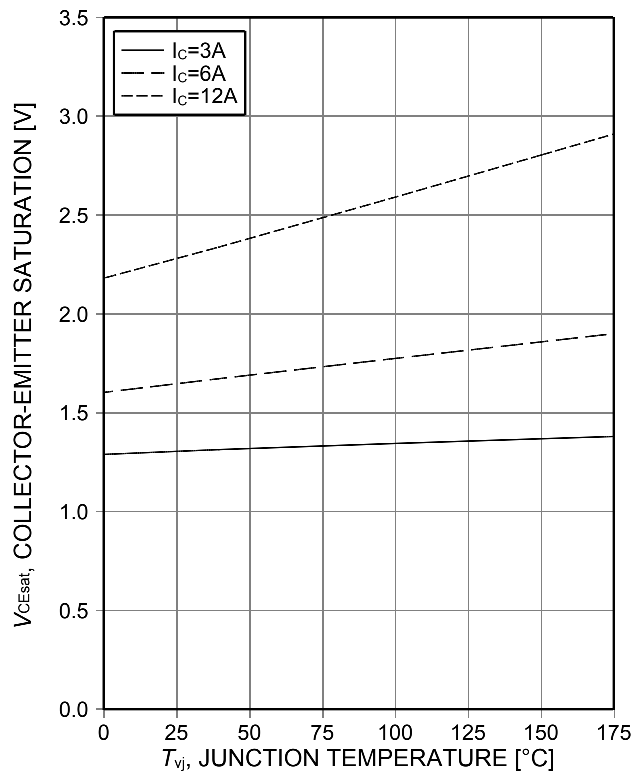


Figure 8. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

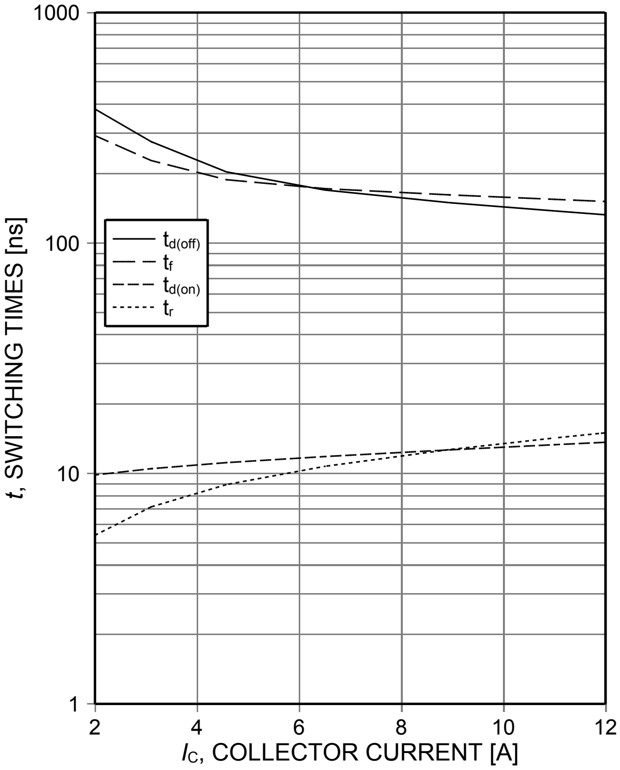


Figure 9. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=23Ω, Dynamic test circuit in Figure E)

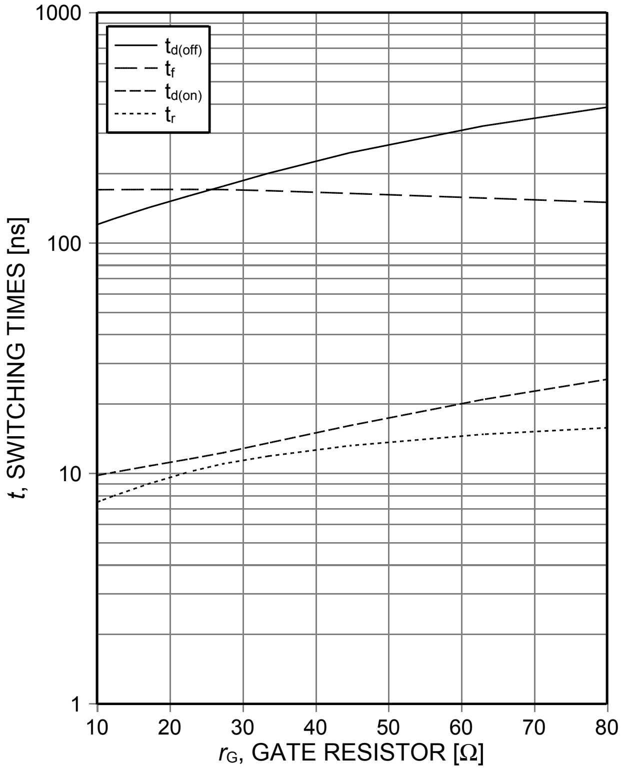


Figure 10. **Typical switching times as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=6A, Dynamic test circuit in Figure E)

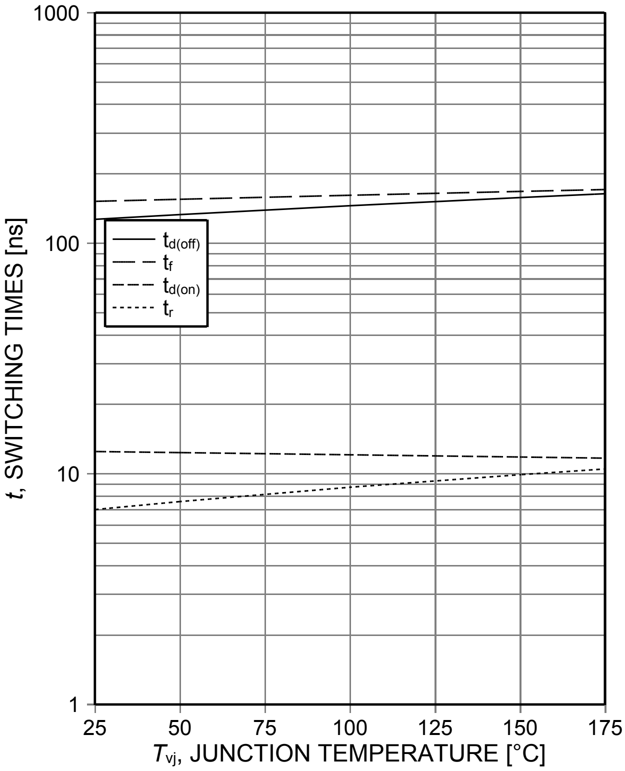


Figure 11. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=6A, r_G=23Ω, Dynamic test circuit in Figure E)

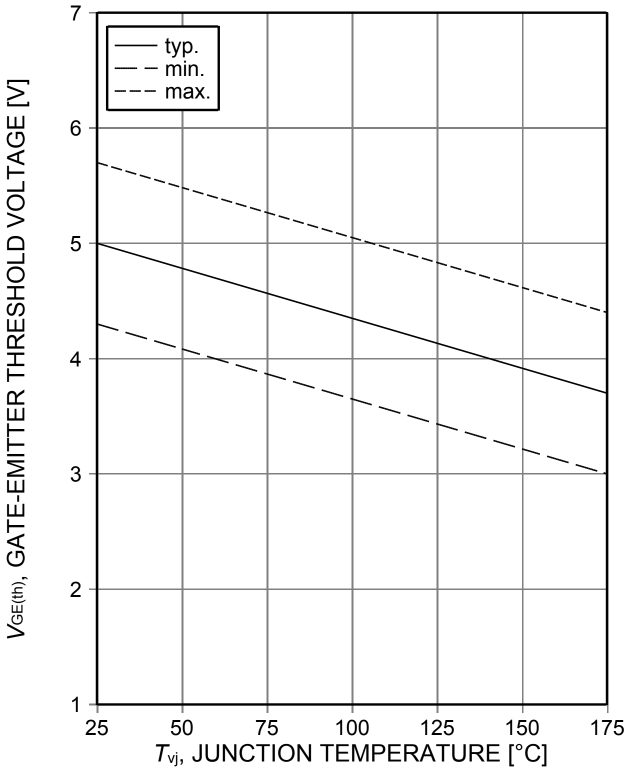


Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.11mA)

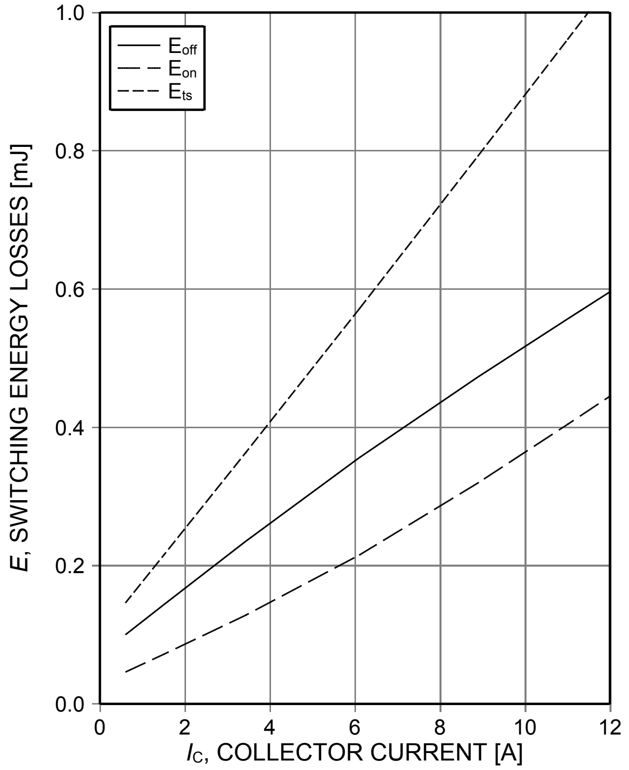


Figure 13. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=23Ω, Dynamic test circuit in Figure E)

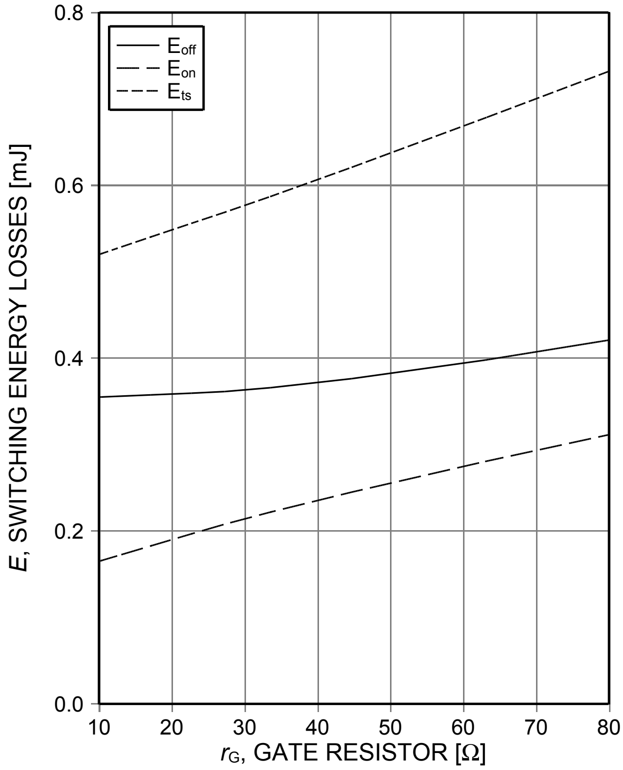


Figure 14. **Typical switching energy losses as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=6A, Dynamic test circuit in Figure E)

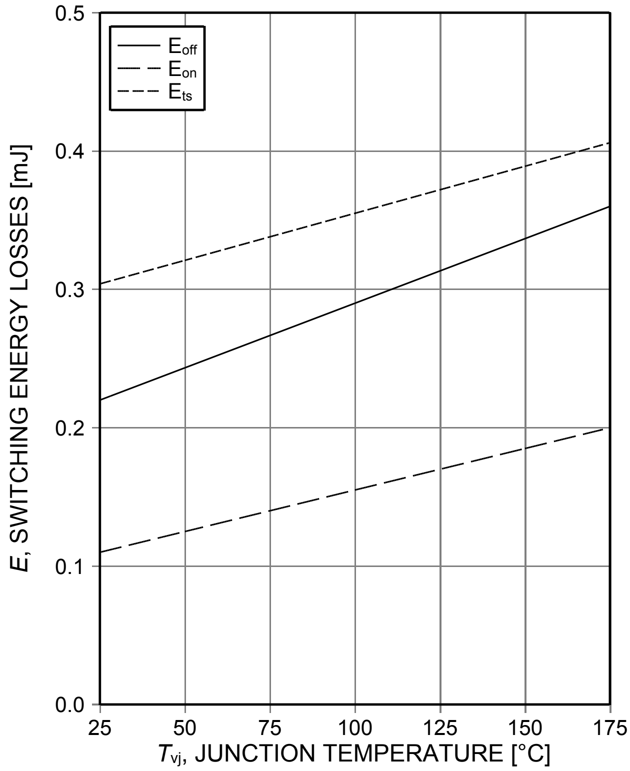


Figure 15. **Typical switching energy losses as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=6A, r_G=23Ω, Dynamic test circuit in Figure E)

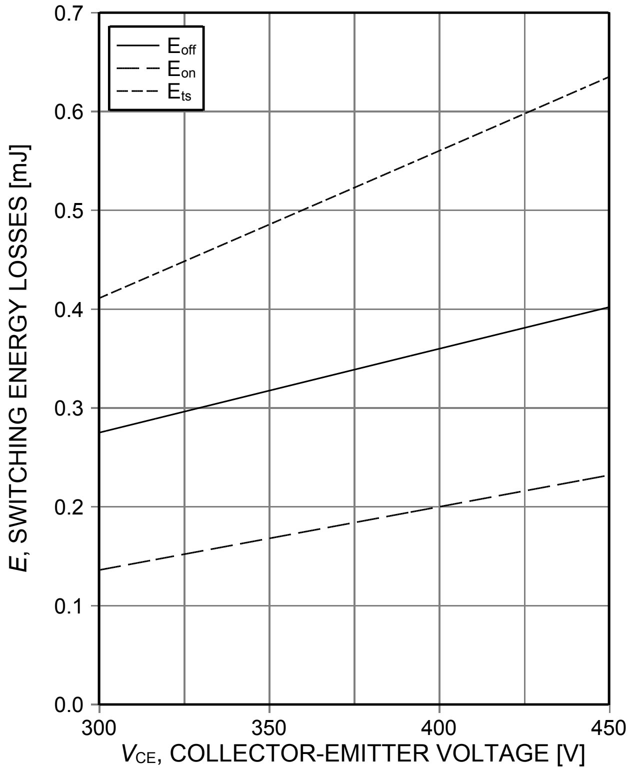


Figure 16. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, T_{vj}=175°C, V_{GE}=15/0V, I_C=6A, r_G=23Ω, Dynamic test circuit in Figure E)

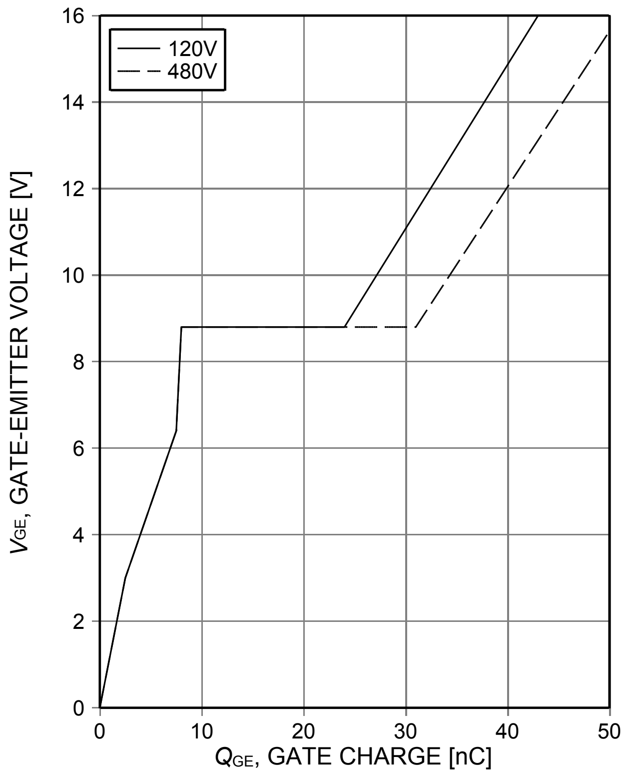


Figure 17. **Typical gate charge**
(I_C=6A)

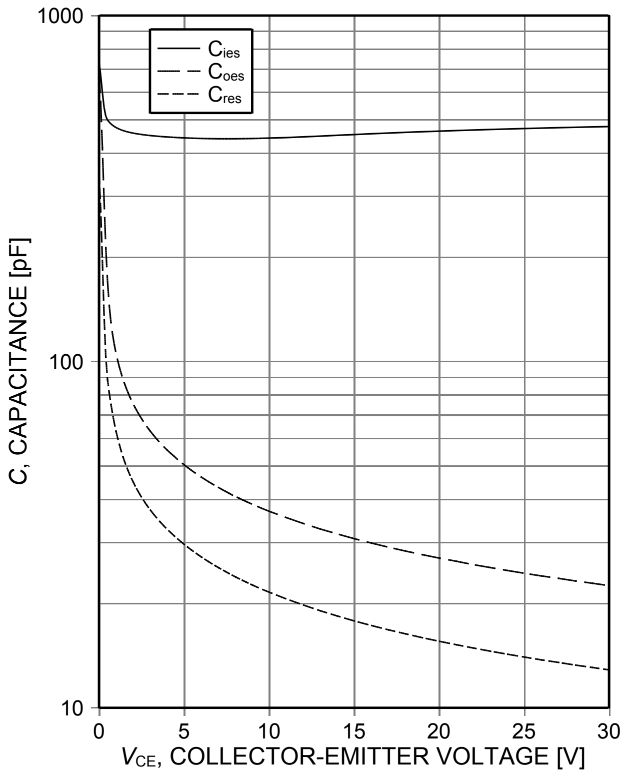


Figure 18. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

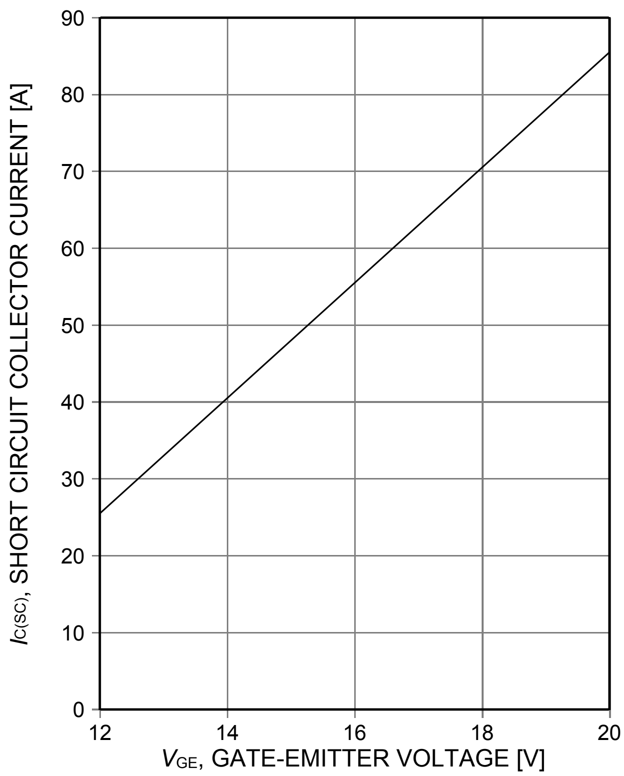


Figure 19. **Typical short circuit collector current as a function of gate-emitter voltage**
(V_{CE}≤400V, start at T_{vj}=25°C)

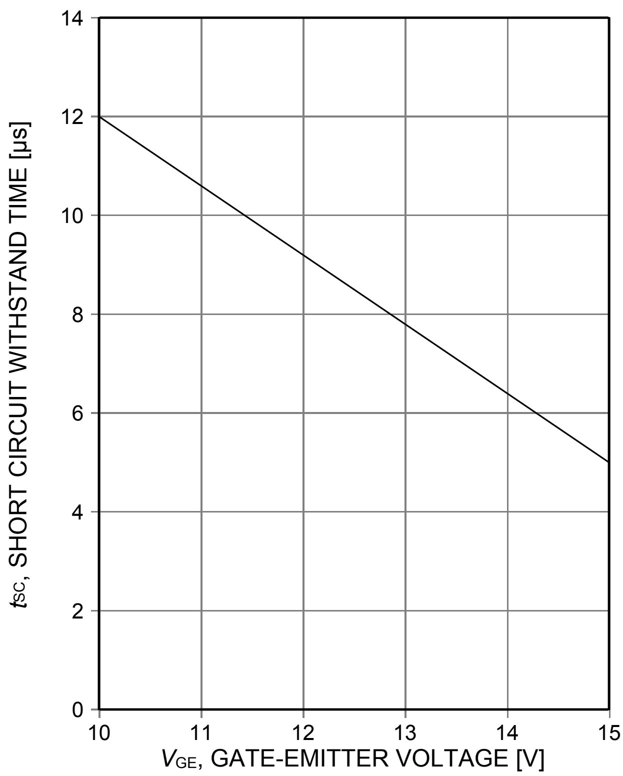


Figure 20. **Short circuit withstand time as a function of gate-emitter voltage**
(V_{CE}≤400V, start at T_{vj}≤150°C)

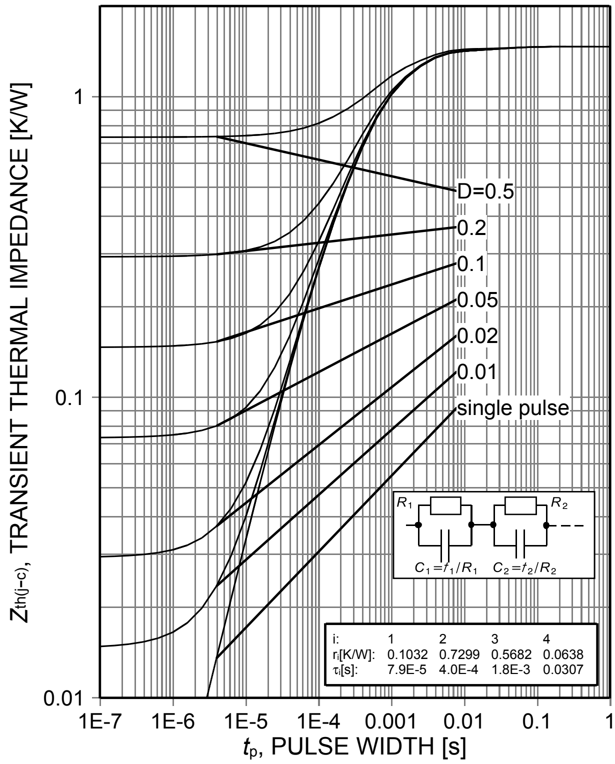


Figure 21. **IGBT transient thermal impedance as a function of pulse width [1] (see page 4)** ($D=t_p$/T)

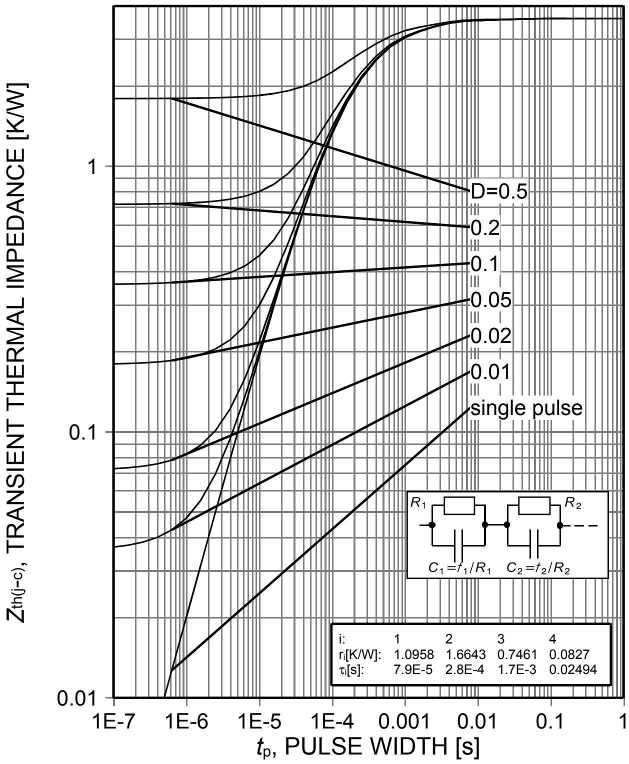


Figure 22. **Diode transient thermal impedance as a function of pulse width [2] (see page 4)** ($D=t_p$/T)

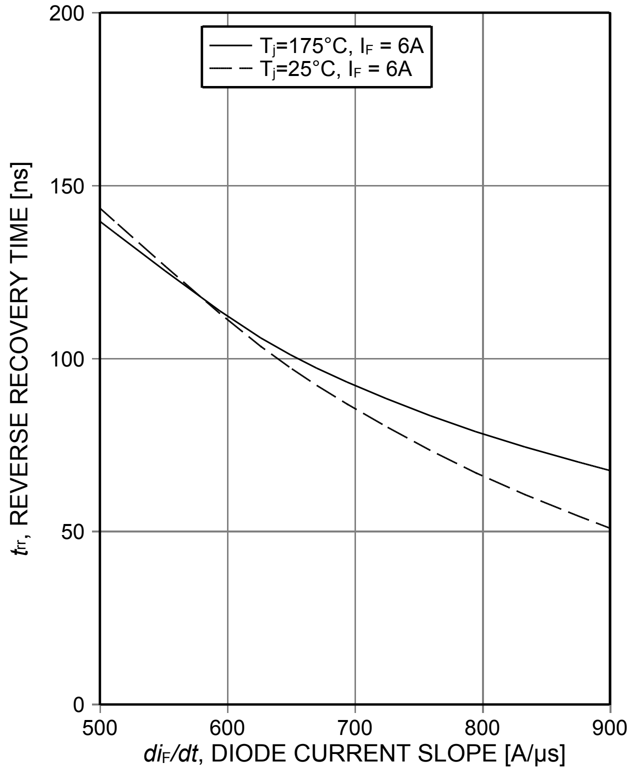


Figure 23. **Typical reverse recovery time as a function of diode current slope** (V_R=400V)

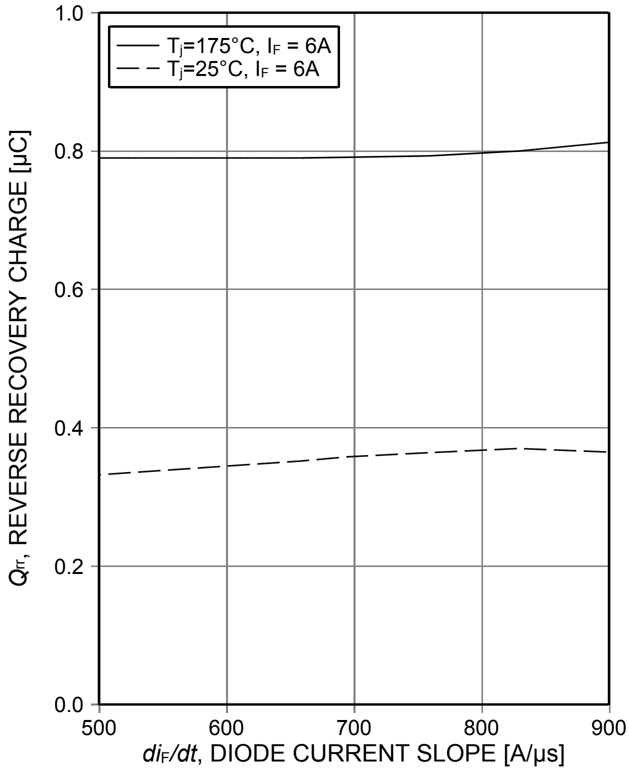


Figure 24. **Typical reverse recovery charge as a function of diode current slope** (V_R=400V)

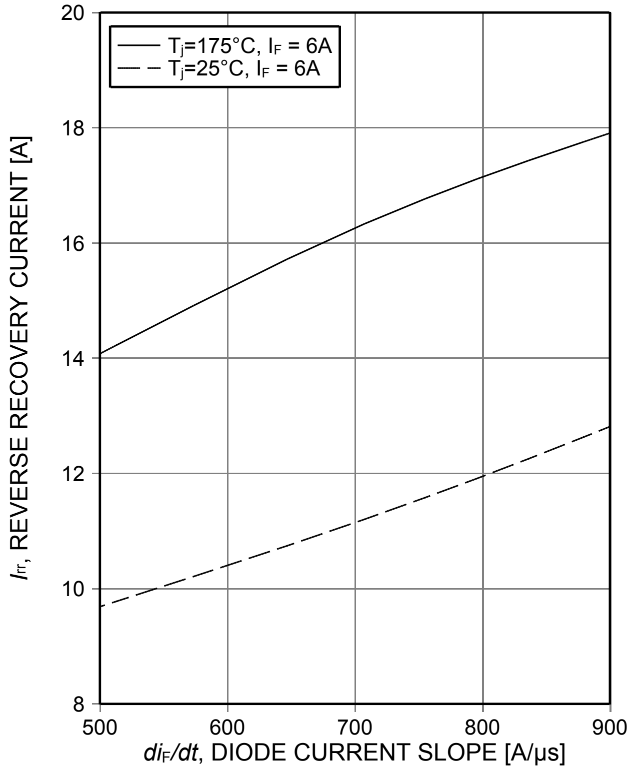


Figure 25. **Typical reverse recovery current as a function of diode current slope**
(V_R=400V)

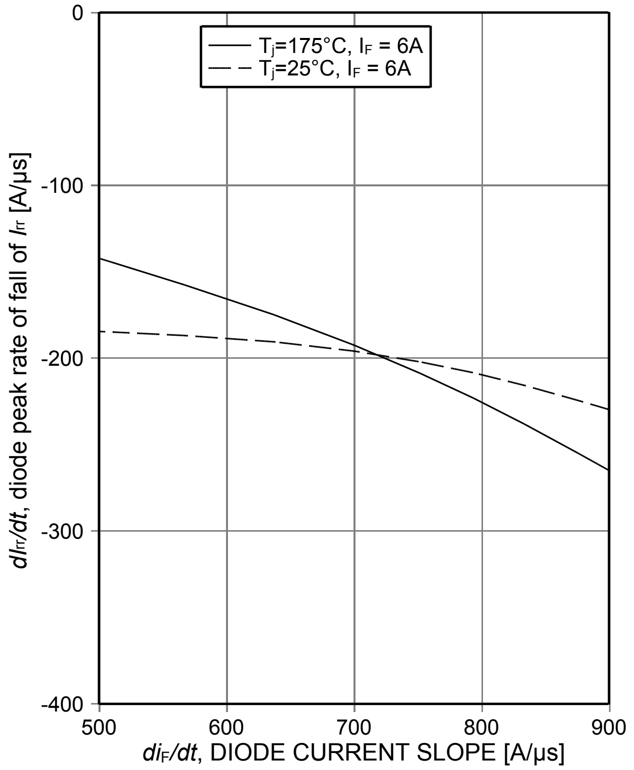


Figure 26. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=400V)

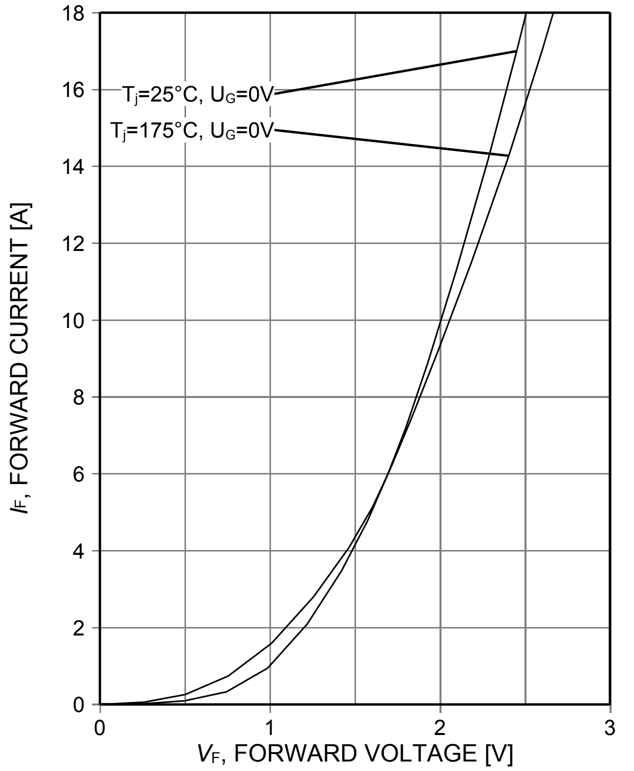


Figure 27. **Typical diode forward current as a function of forward voltage**

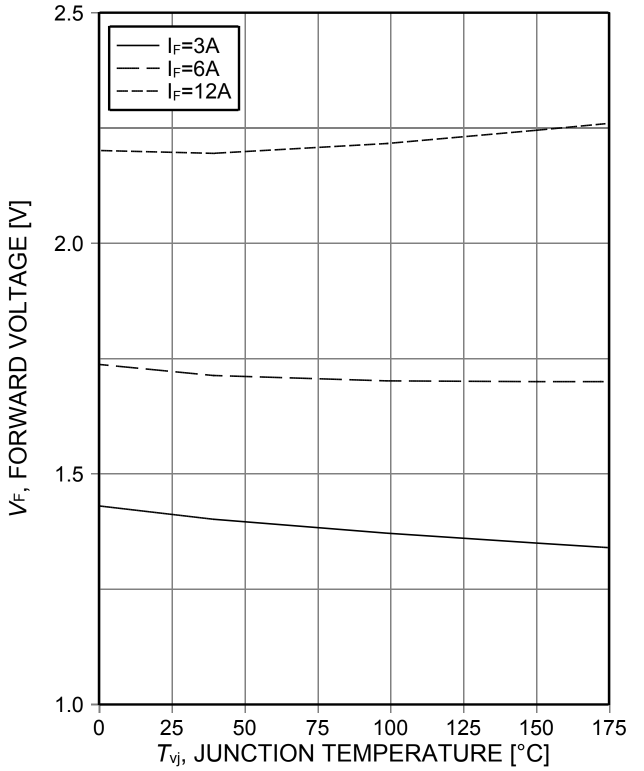
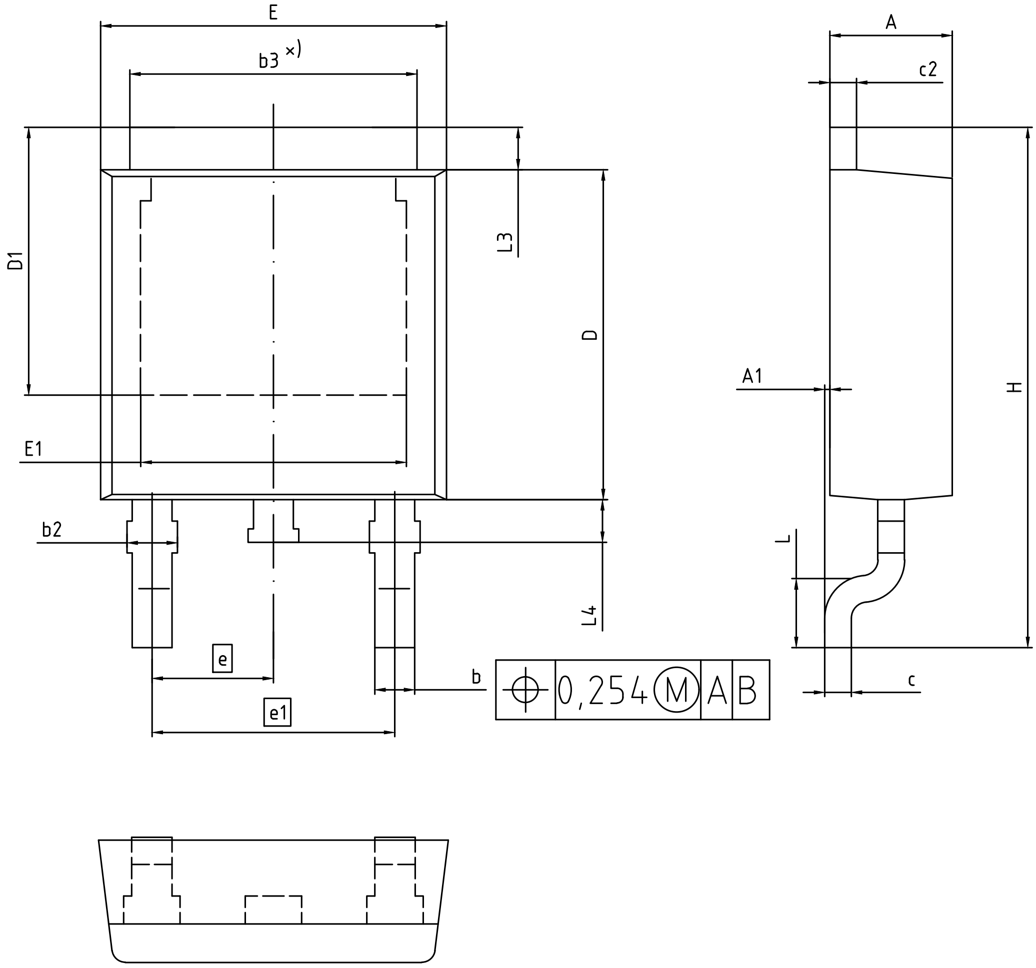


Figure 28. **Typical diode forward voltage as a function of junction temperature**

Package Drawing PG-TO252-3



NOTES:
1. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-252 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

DIM	MILLIMETERS	
	MIN	MAX
A	2.16	2.41
A1	0.00	0.15
b	0.64	0.89
b2	0.65	1.15
b3	4,95	5.50
c	0.46	0.61
c2	0.40	0.98
D	5.97	6.22
D1	5.02	5.84
E	6.35	6.73
E1	4.32	5.21
e	2.29 (BSC)	
e1	4.57 (BSC)	
N	3	
H	9.40	10.48
L	1.18	1.78
L3	0.89	1.27
L4	0.51	1.02

DOCUMENT NO.
Z8B00003328

SCALE
0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE
05-02-2016

REVISION
06

Testing Conditions

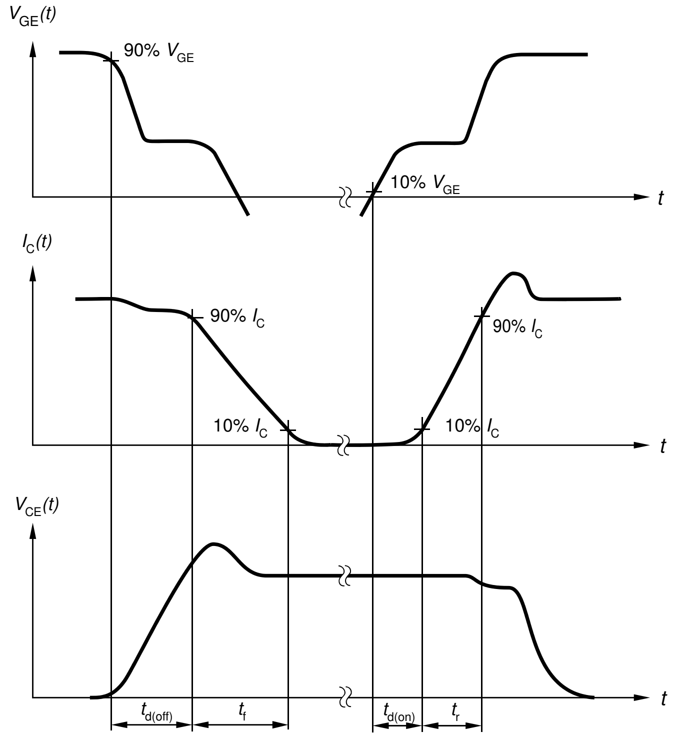


Figure A. **Definition of switching times**

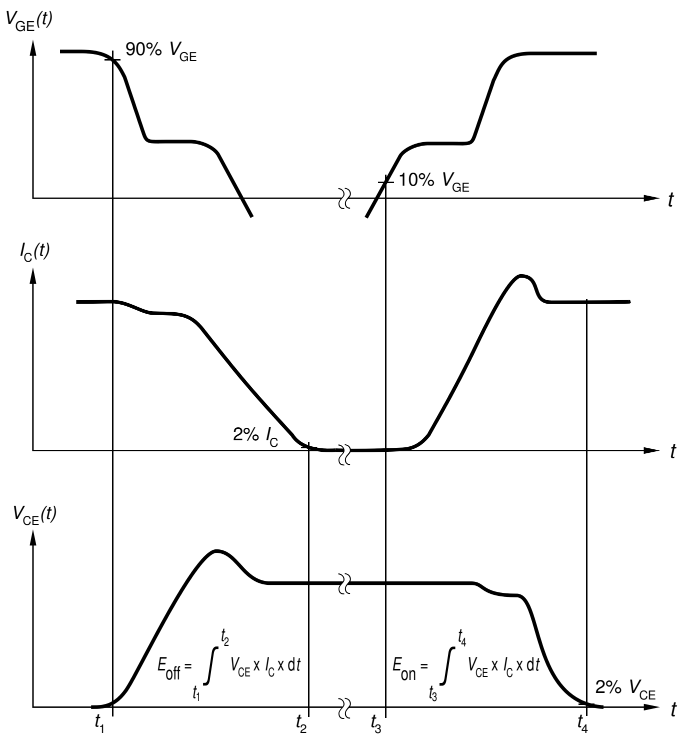


Figure B. **Definition of switching losses**

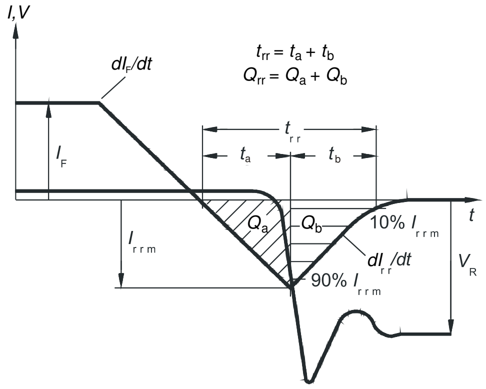


Figure C. **Definition of diode switching characteristics**

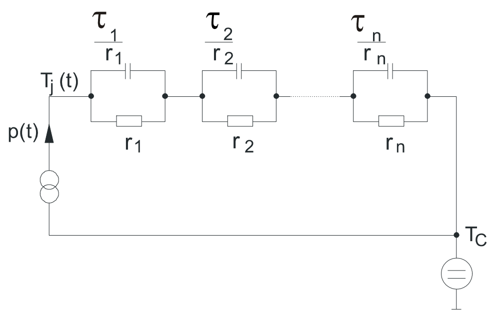


Figure D. **Thermal equivalent circuit**

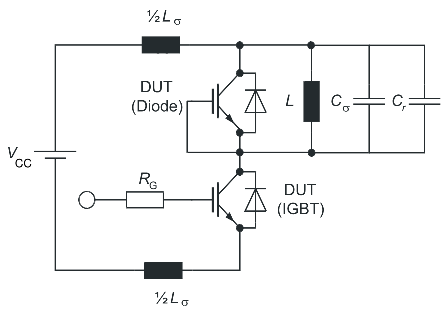


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

IKD06N60R

Revision: 2014-03-12, Rev. 2.5

Previous Revision

Revision	Date	Subjects (major changes since last revision)
1.2	2010-01-12	-
2.1	2011-01-17	Release of final datasheet
2.2	2013-02-19	Change package
2.3	2013-12-10	Neu value ICES max limit at 175°C
2.4	2014-02-26	Without PB free logo
2.5	2014-03-12	Storage temp -55...+150°C

Trademarks

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Данный компонент на территории Российской Федерации

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