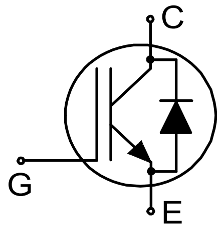
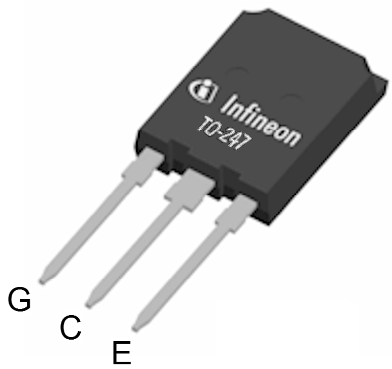
TRENCHSTOP™ 2 low $V_{ce(sat)}$ second generation IGBT

Low $V_{ce(sat)}$ IGBT in TRENCHSTOP™ 2 technology copacked with soft, fast recovery full current rated anti-parallel Emitter Controlled Diode

Features:

TRENCHSTOP™ 2 technology offers:
- Very low $V_{CE(sat)}$, 1.75V at nominal current
- 10µsec short circuit withstand time at T_{vj}=175°C
- Easy paralleling capability due to positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- 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:

- GPD (General Purpose Drives)
- Servo Drives
- Commercial Vehicles
- Agricultural Vehicles
- Three-level Solar String Inverter
- Welding

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
IKQ50N120CT2	1200V	50A	1.75V	175°C	K50MCT2	PG-TO247-3-46

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TRENCHSTOP™ 2 low $V_{ce(sat)}$ second 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} $T_C = 25°C$ value limited by bondwire $T_C = 134°C$	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} $T_C = 25°C$ value limited by bondwire $T_C = 100°C$	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 $T_C = 134°C$	P_{tot}	652.0 151.0	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 Rth(c-s) (case to heat sink) of more than 0.1K/W not included.

Electrical Characteristic, at T_{vj} = 25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
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	- -	1.75 2.30	2.15 -	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	-	19.0	-	S

Electrical Characteristic, at T_{vj} = 25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
Dynamic Characteristic						
Input capacitance	C_{ies}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	-	3270	-	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 min.	Value typ.	Value max.	Unit
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.	-	34	-	ns
Rise time	t_r		-	46	-	ns
Turn-off delay time	$t_{d(off)}$		-	312	-	ns
Fall time	t_f		-	50	-	ns
Turn-on energy	E_{on}		-	3.80	-	mJ
Turn-off energy	E_{off}		-	3.30	-	mJ
Total switching energy	E_{ts}		-	7.10	-	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 = 800A/µs	-	410	-	ns
Diode reverse recovery charge	Q_{rr}		-	3.90	-	µC
Diode peak reverse recovery current	I_{rrm}		-	22.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-160	-	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.	-	33	-	ns
Rise time	t_r		-	46	-	ns
Turn-off delay time	$t_{d(off)}$		-	420	-	ns
Fall time	t_f		-	110	-	ns
Turn-on energy	E_{on}		-	5.80	-	mJ
Turn-off energy	E_{off}		-	5.40	-	mJ
Total switching energy	E_{ts}		-	11.20	-	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 = 800A/µs	-	590	-	ns
Diode reverse recovery charge	Q_{rr}		-	8.60	-	µC
Diode peak reverse recovery current	I_{rrm}		-	30.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-122	-	A/µs

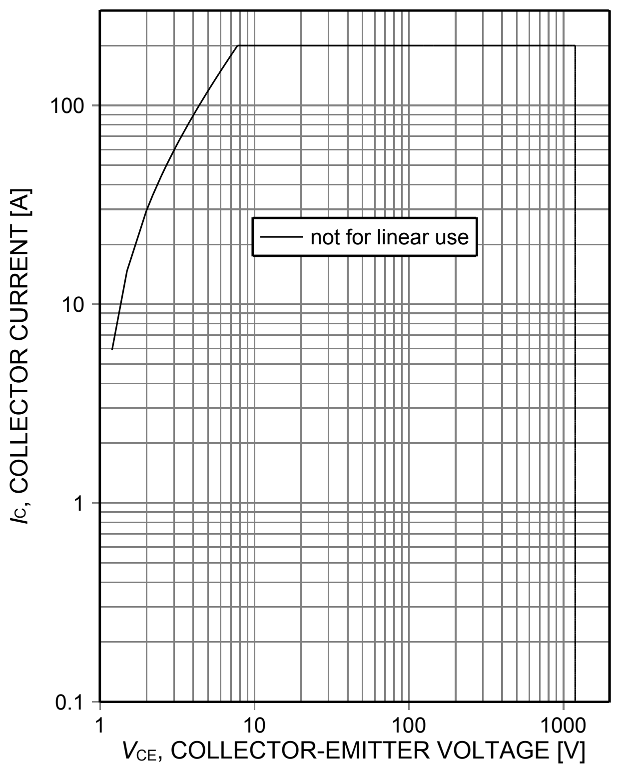


Figure 1. **Forward bias safe operating area**
(D=0, T_C=25°C, T_{vj}≤175°C; V_{GE}=15V)

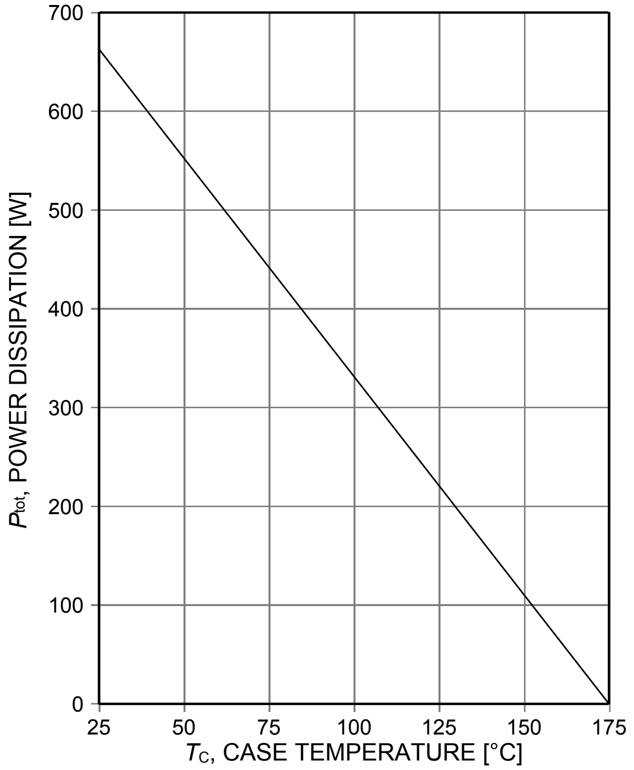


Figure 2. **Power dissipation as a function of case temperature**
(T_{vj}≤175°C)

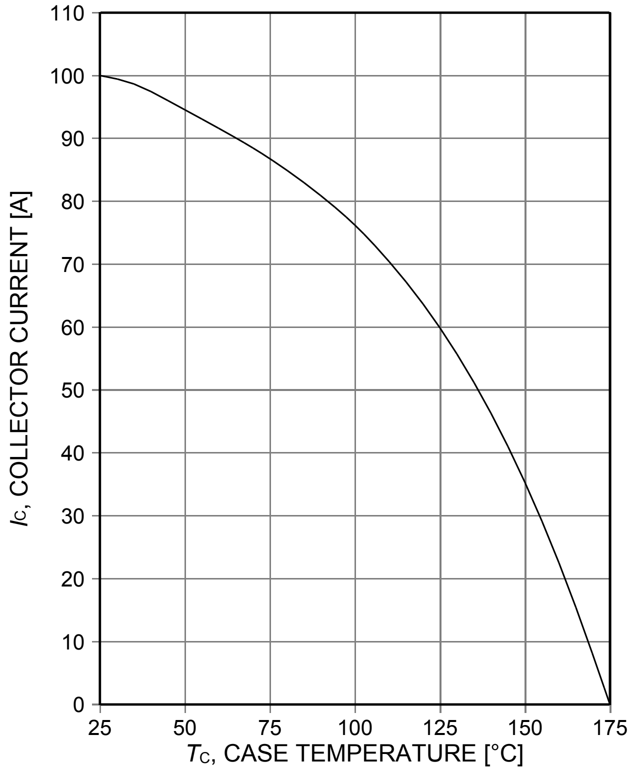


Figure 3. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_{vj}≤175°C)

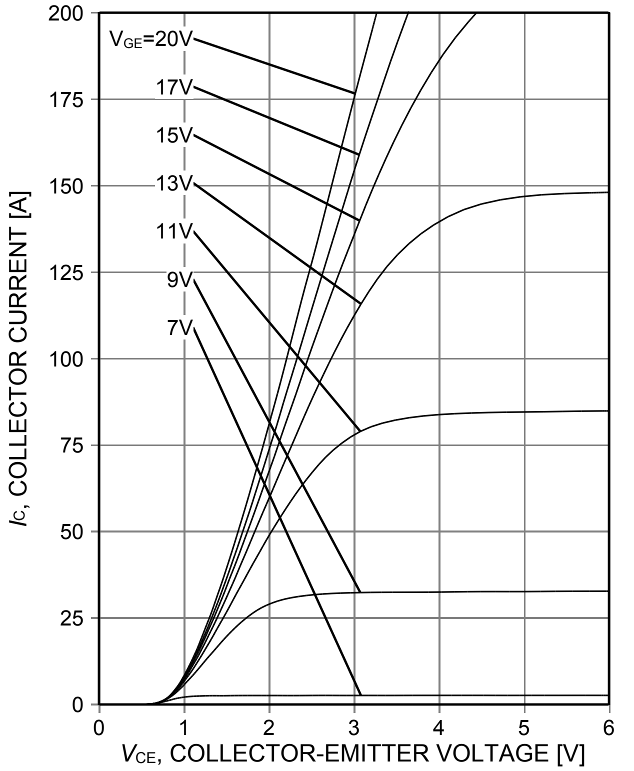


Figure 4. **Typical output characteristic**
(T_{vj}=25°C)

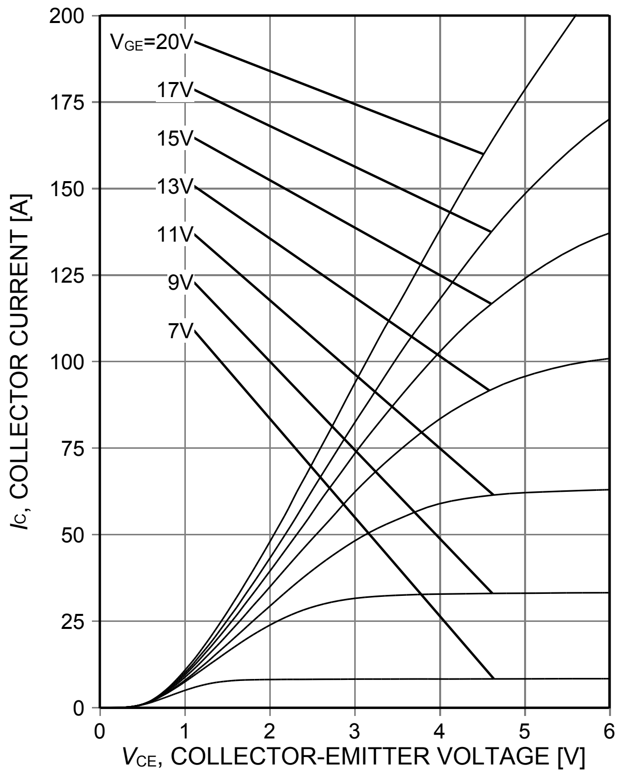


Figure 5. **Typical output characteristic**
(T_{vj}=175°C)

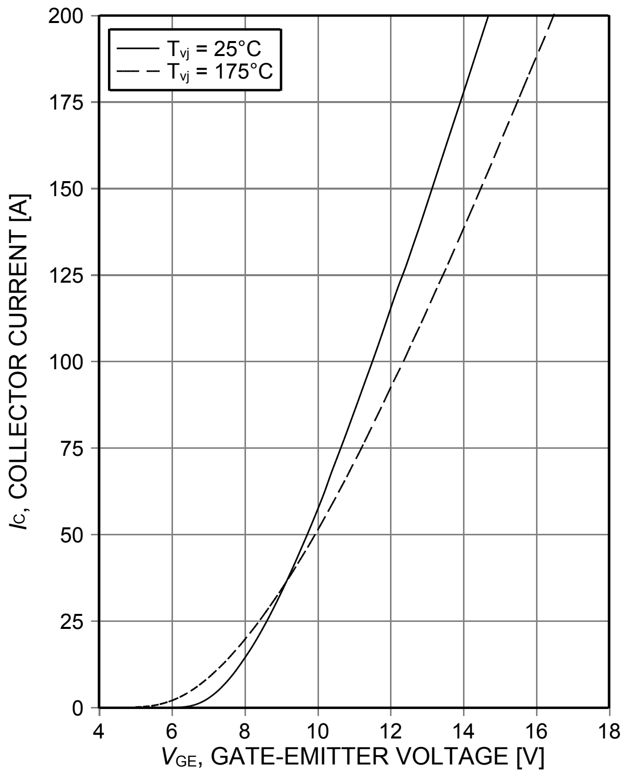


Figure 6. **Typical transfer characteristic**
(V_{CE}=20V)

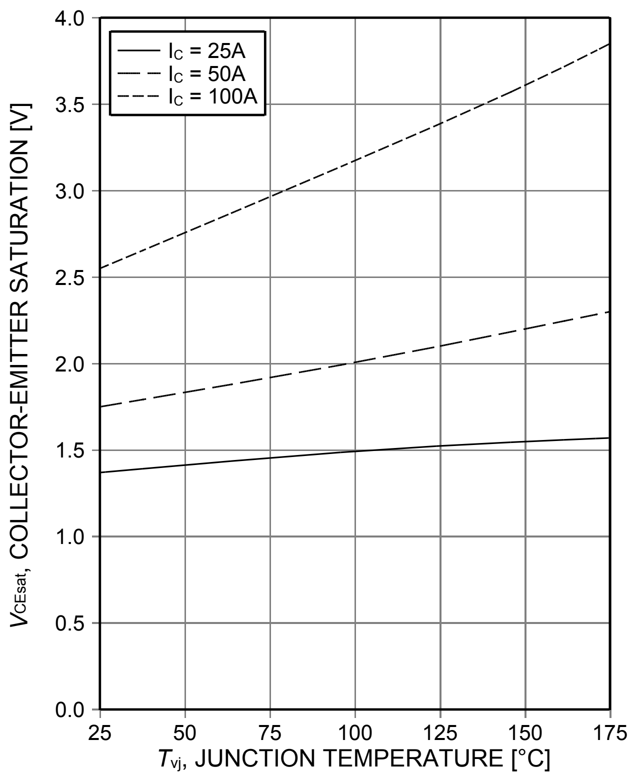


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

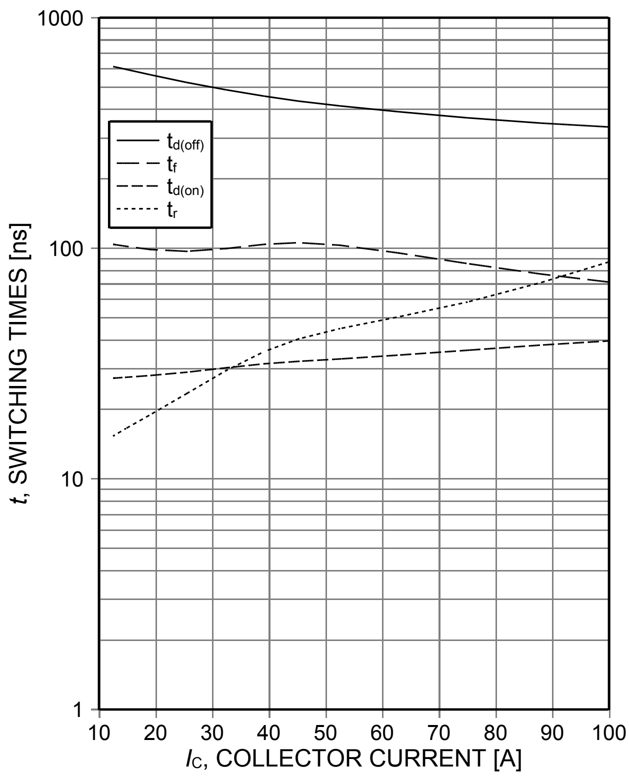


Figure 8. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=15/0V, r_G=10Ω, Dynamic test circuit in Figure E)

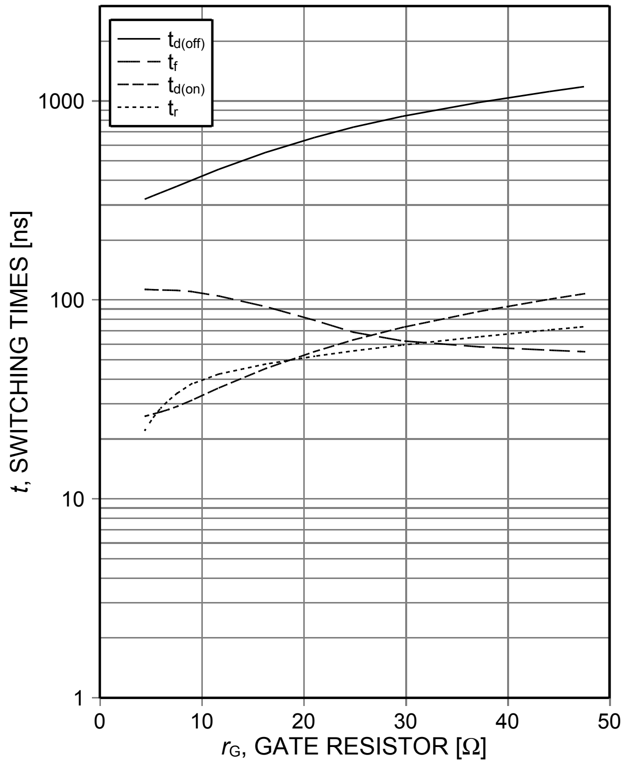


Figure 9. **Typical switching times as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=15/0V, I_C=50A, Dynamic test circuit in Figure E)

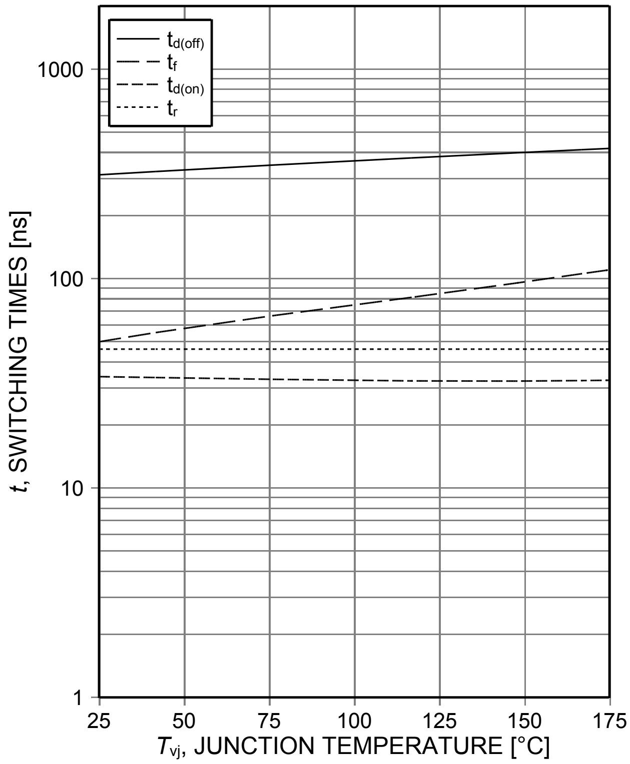


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=600V, V_{GE}=15/0V, I_C=50A, r_G=10Ω, Dynamic test circuit in Figure E)

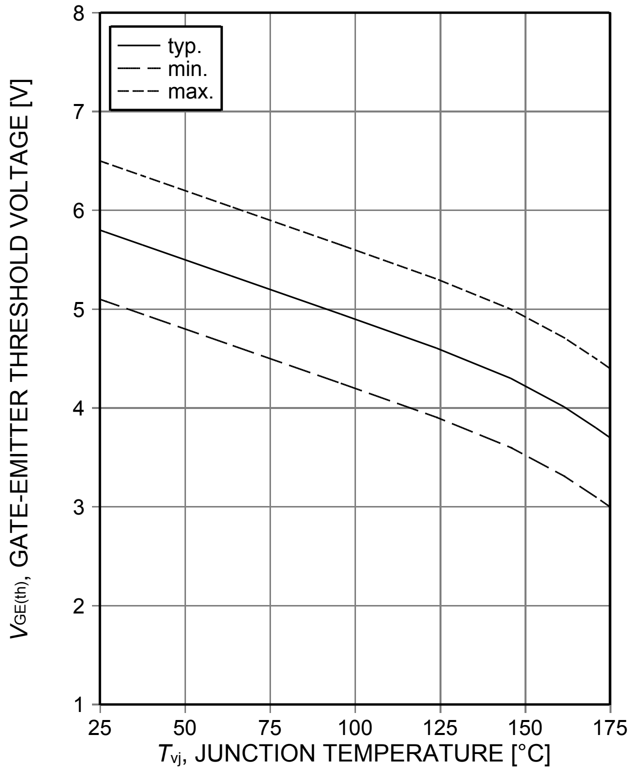


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=1.25mA)

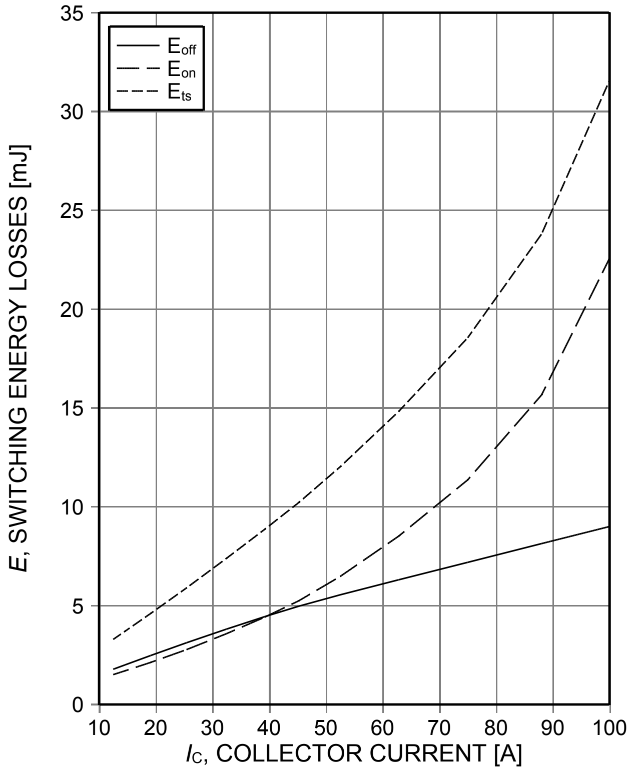


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=15/0V, r_G=10Ω, Dynamic test circuit in Figure E)

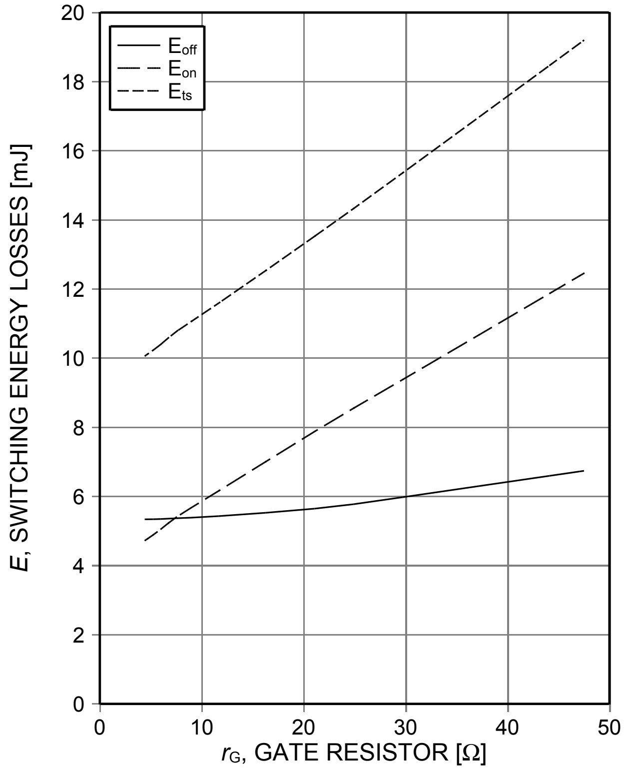


Figure 13. **Typical switching energy losses as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=15/0V, I_C=50A, Dynamic test circuit in Figure E)

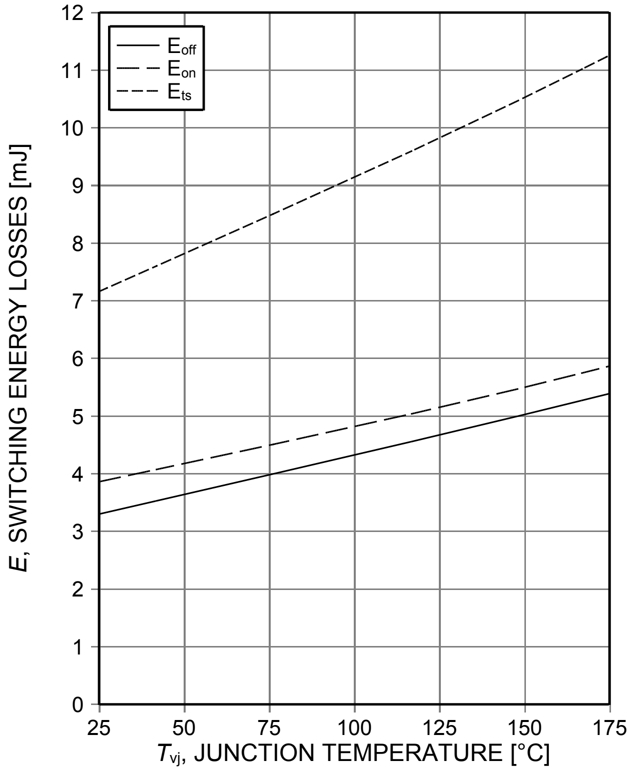


Figure 14. **Typical switching energy losses as a function of junction temperature**
(inductive load, V_{CE}=600V, V_{GE}=15/0V, I_C=50A, r_G=10Ω, Dynamic test circuit in Figure E)

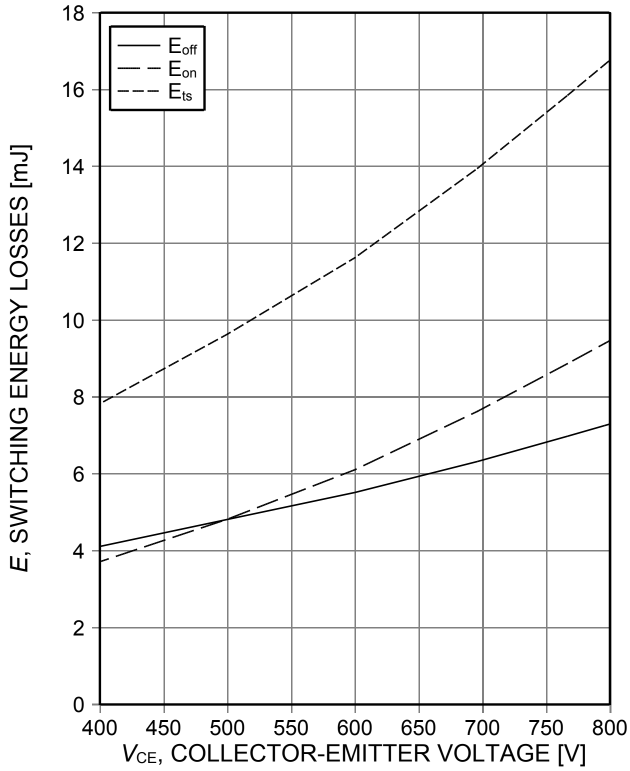


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, T_{vj}=175°C, V_{GE}=15/0V, I_C=50A, r_G=10Ω, Dynamic test circuit in Figure E)

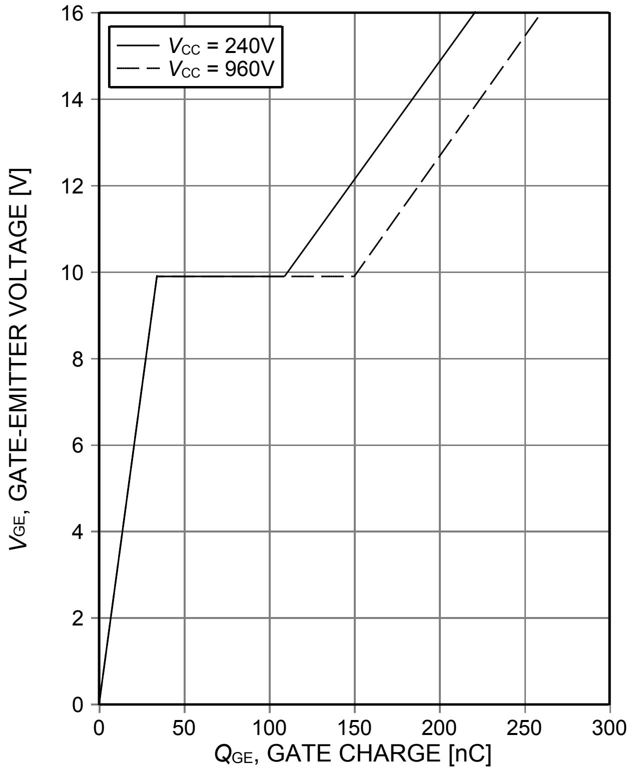


Figure 16. **Typical gate charge**
(I_C=50A)

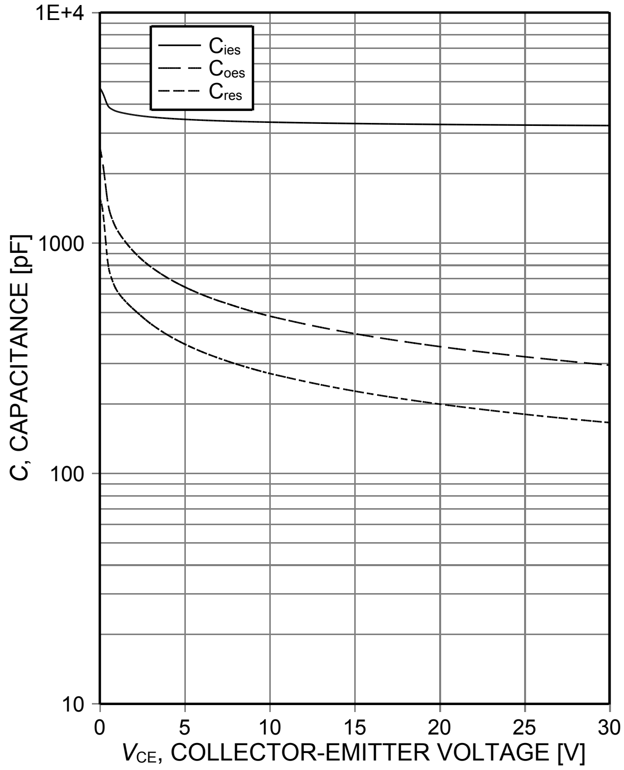


Figure 17. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

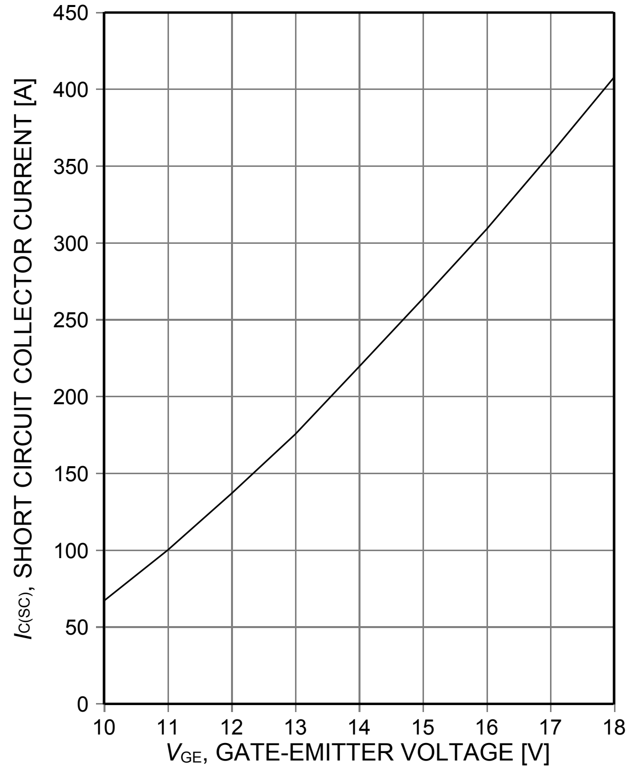


Figure 18. **Typical short circuit collector current as a function of gate-emitter voltage**
(V_{CE}≤600V, T_{vj}≤175°C)

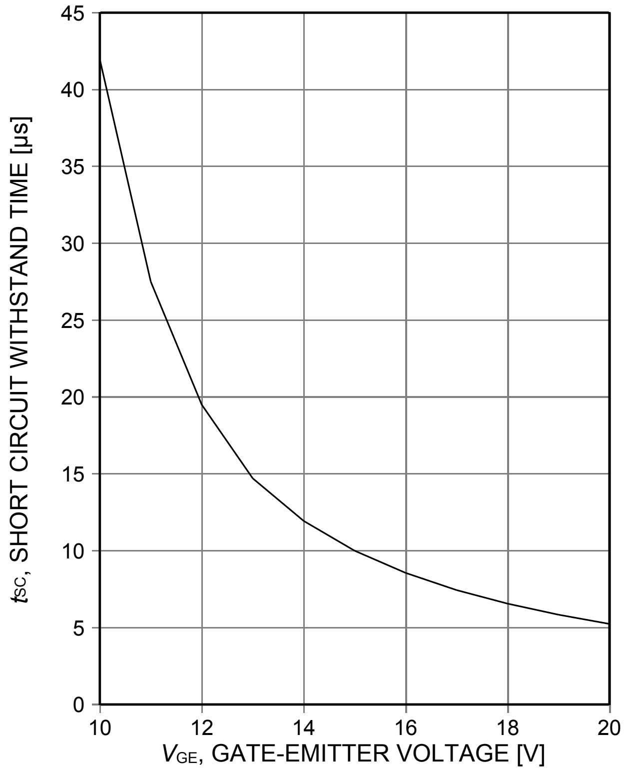


Figure 19. **Short circuit withstand time as a function of gate-emitter voltage**
(V_{CE}≤600V, start at T_{vj}≤175°C)

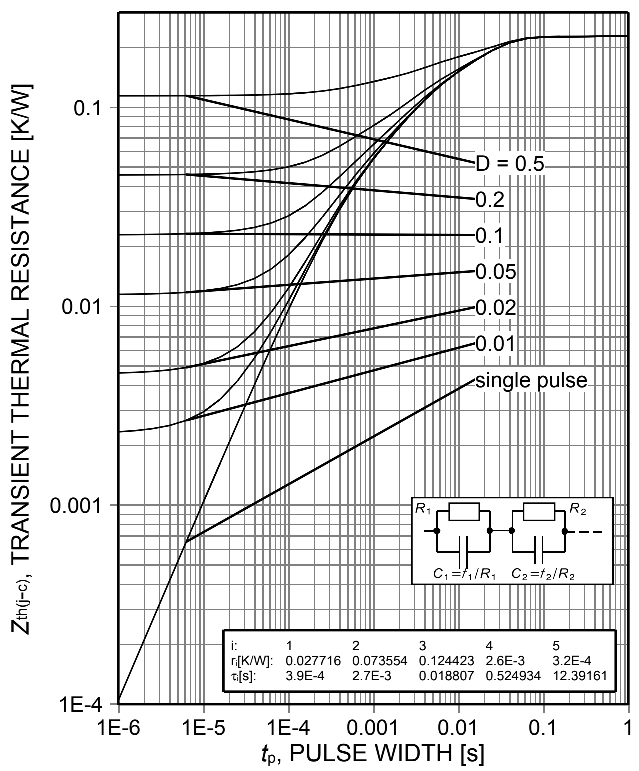


Figure 20. **IGBT transient thermal resistance**
(D=t_p/T)

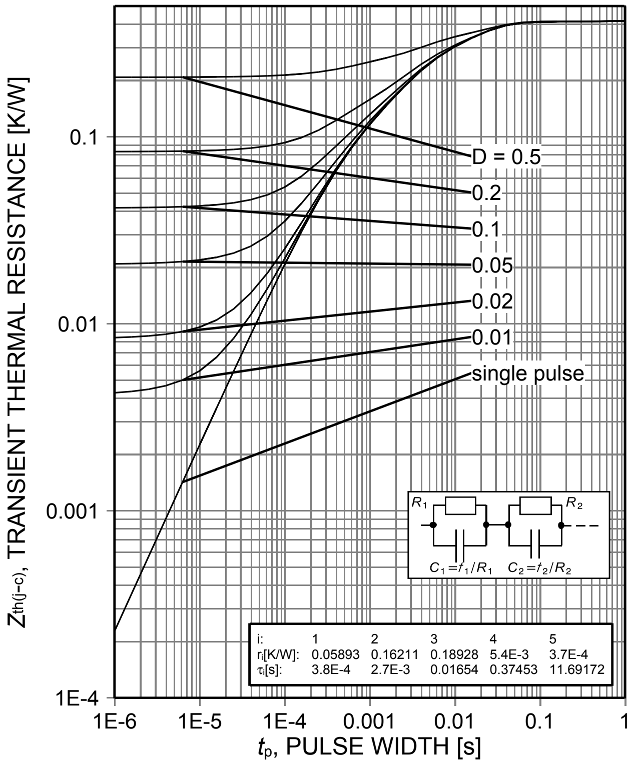


Figure 21. **Diode transient thermal impedance as a function of pulse width**
($D=t_p/T$)

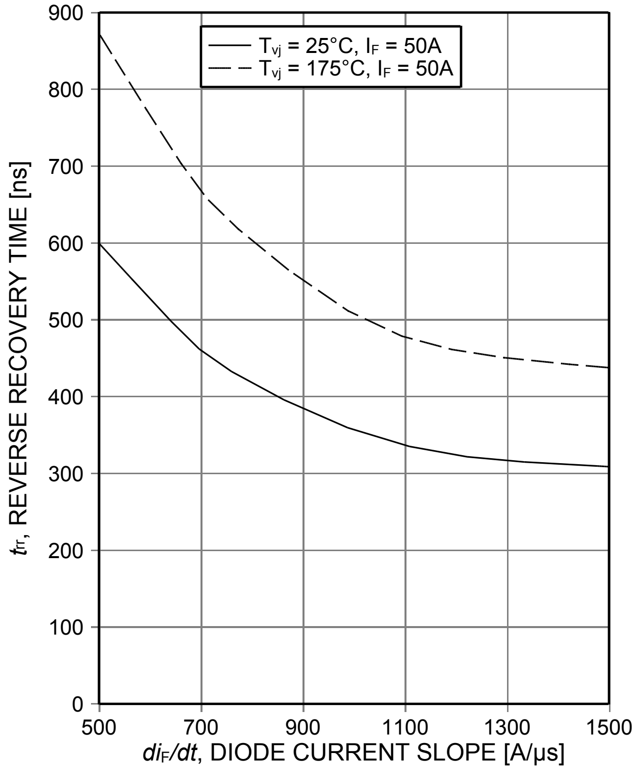


Figure 22. **Typical reverse recovery time as a function of diode current slope**
(V_R=600V)

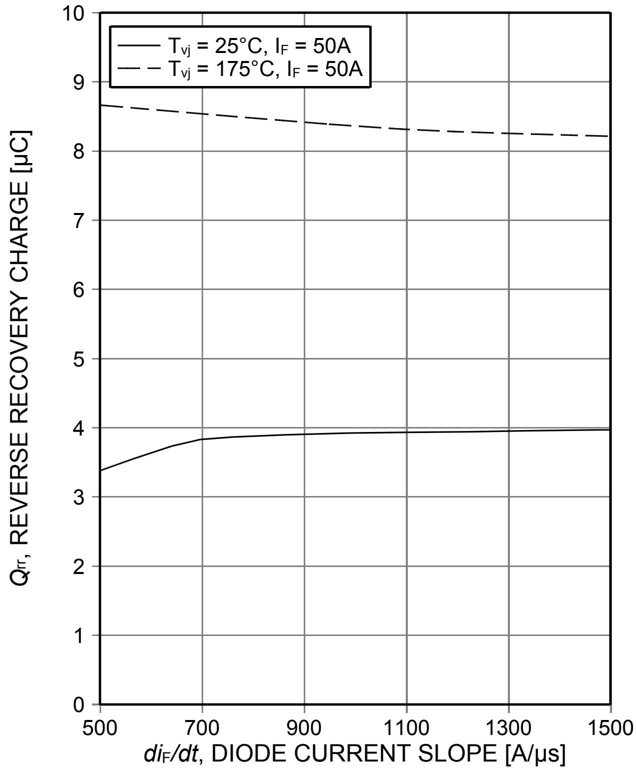


Figure 23. **Typical reverse recovery charge as a function of diode current slope**
(V_R=600V)

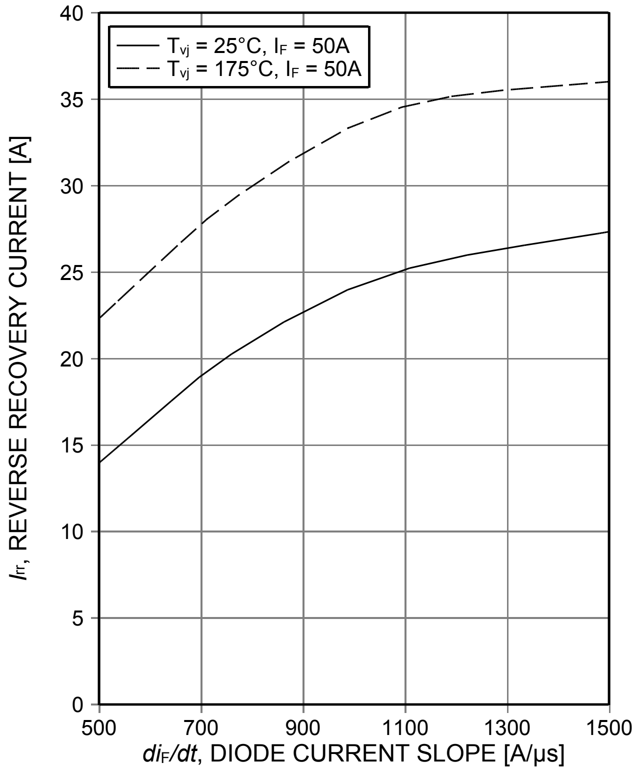


Figure 24. **Typical reverse recovery current as a function of diode current slope**
(V_R=600V)

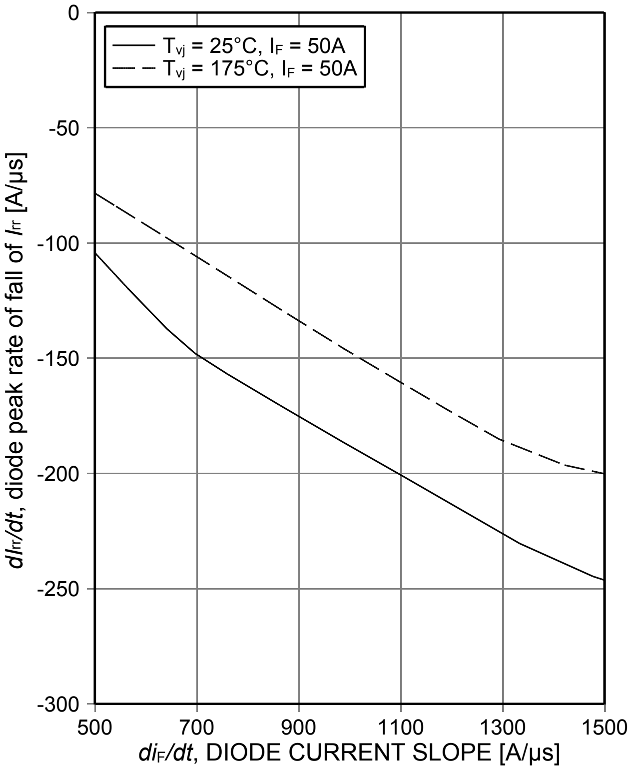


Figure 25. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=600V)

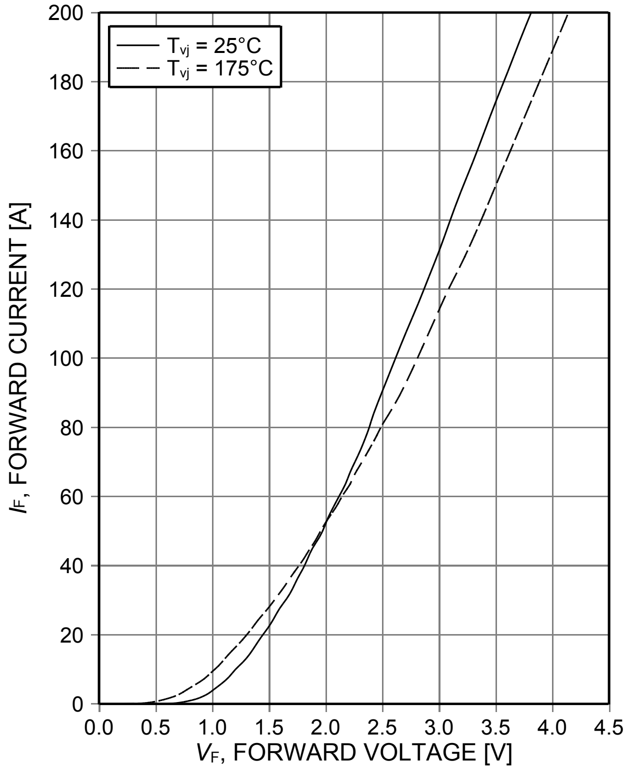


Figure 26. **Typical diode forward current as a function of forward voltage**

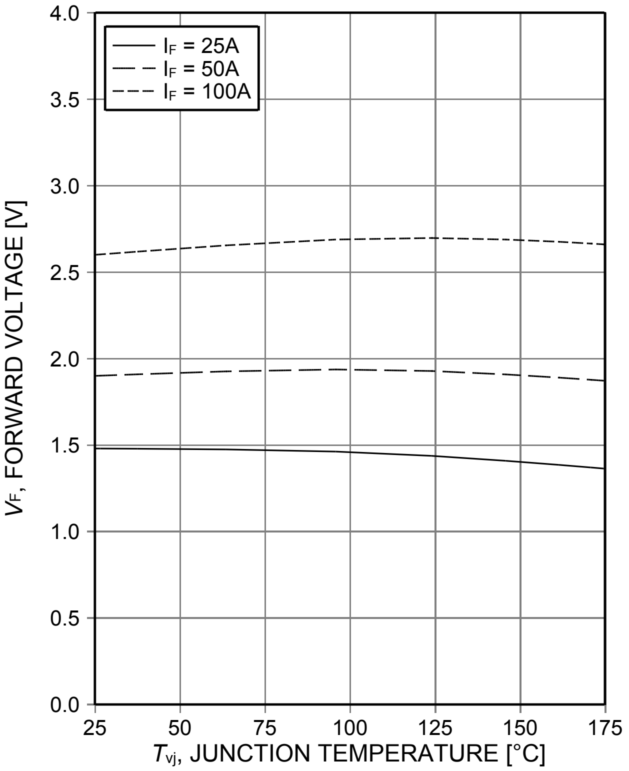
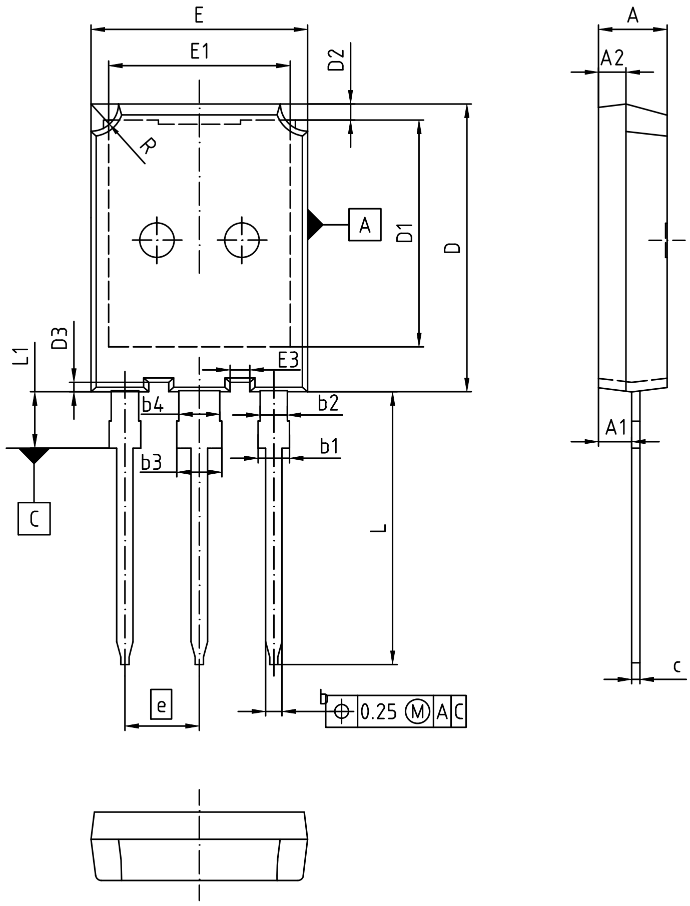


Figure 27. **Typical diode forward voltage as a function of junction temperature**

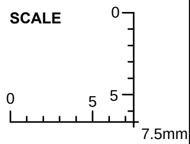
Package Drawing PG-TO247-3-46



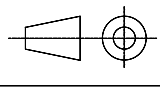
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.96	2.25	0.077	0.089
b2	1.96	2.06	0.077	0.081
c	0.59	0.66	0.023	0.026
D	20.90	21.10	0.823	0.831
D1	16.25	16.85	0.640	0.663
D2	1.05	1.35	0.041	0.053
D3	0.58	0.78	0.023	0.031
E	15.70	15.90	0.618	0.626
E1	13.10	13.50	0.516	0.531
E3	1.35	1.55	0.053	0.061
e	5.44 (BSC)		0.214 (BSC)	
N	3		3	
L	19.80	20.10	0.780	0.791
L1	-	4.30	-	0.169
R	1.90	2.10	0.075	0.083

DOCUMENT NO.
Z8B00174295

SCALE



EUROPEAN PROJECTION



ISSUE DATE
13-08-2014

REVISION
01

Testing Conditions

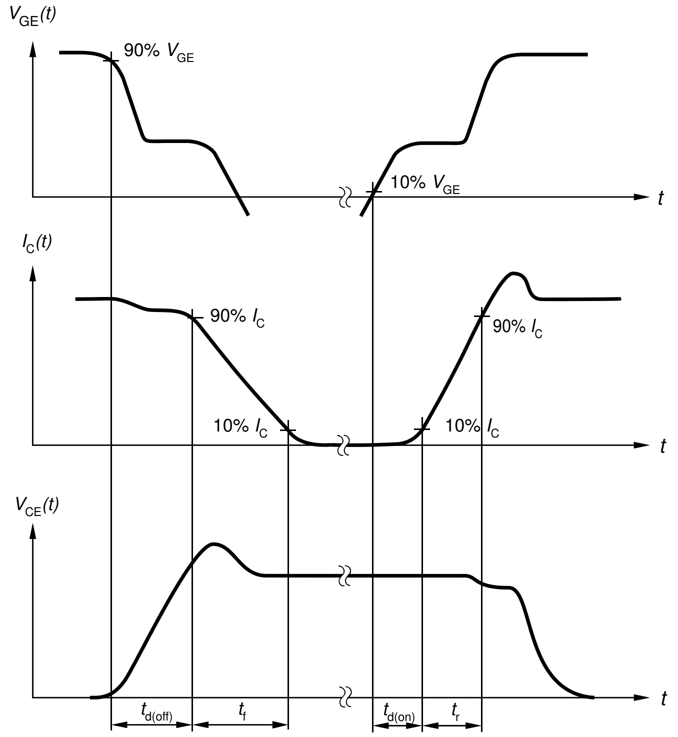


Figure A. **Definition of switching times**

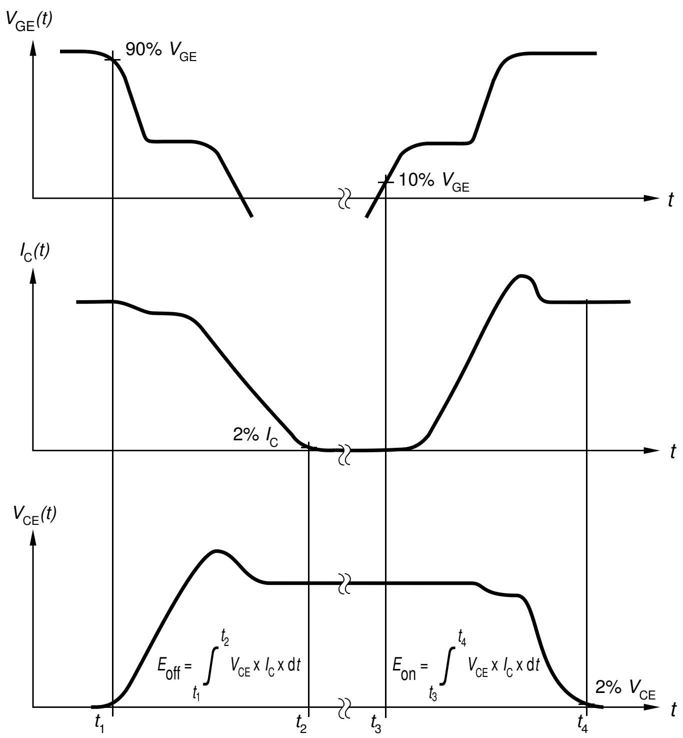


Figure B. **Definition of switching losses**

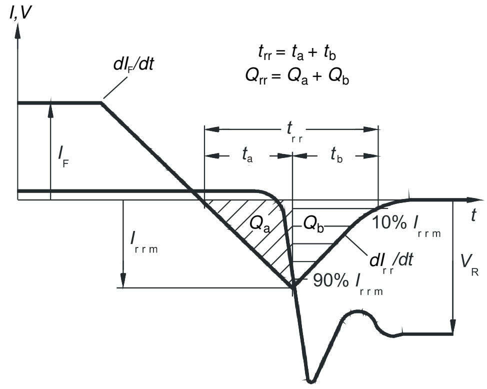


Figure C. **Definition of diode switching characteristics**

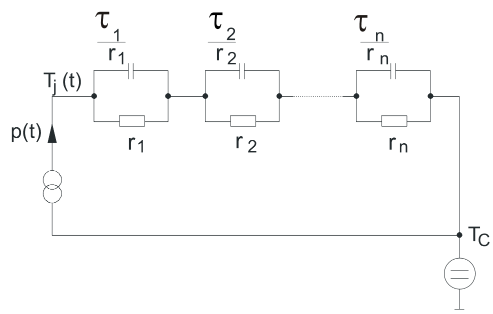


Figure D. **Thermal equivalent circuit**

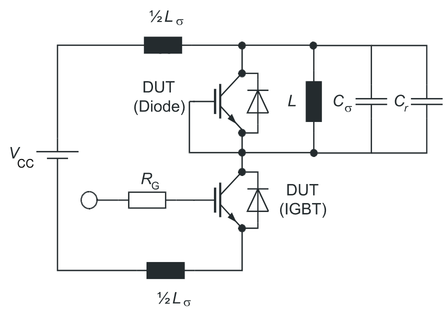


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

IKQ50N120CT2

Revision: 2017-06-09, Rev. 2.2

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2017-05-12	Final data sheet
2.2	2017-06-09	Update Figure 26

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