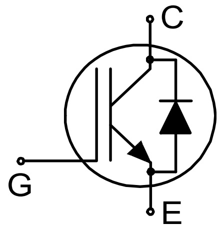
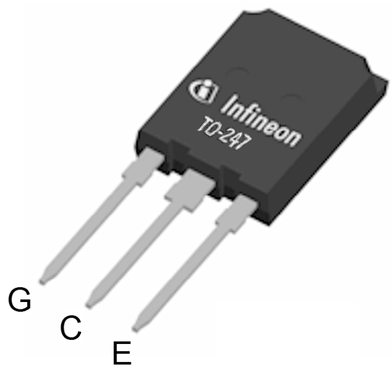
TRENCHSTOP™ series

Low Loss DuoPack : IGBT in TRENCHSTOP™ and Fieldstop technology with soft, fast recovery anti-parallel Emitter Controlled diode



Features:

- Very low $V_{CE(sat)}$ 1.5V (typ.)
- Maximum junction temperature 175°C
- Short circuit withstand time 5µs
- TRENCHSTOP™ and Fieldstop technology for 600V applications offers:
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
  - high switching speed
- Positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Low gate charge Q_G
- Increased current capability
- Green package
- Very soft, fast recovery anti-parallel Emitter Controlled HE diode



Applications:

- General purpose inverters
- Uninterruptible power supplies
- Motor drives
- Medium to low switching frequency power converters

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IKQ100N60T	600V	100A	1.5V	175°C	K100T60	PG-TO247-3-46

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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} $T_c = 25°C$ value limited by bondwire $T_c = 130°C$	I_C	160.0 100.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	400.0	A
Turn off safe operating area $V_{CE} \leq 600V$, $T_{vj} \leq 175°C$, $t_p = 1µs$	-	400.0	A
Diode forward current, limited by T_{vjmax} $T_c = 25°C$ value limited by bondwire $T_c = 117°C$	I_F	160.0 100.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	400.0	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}	714.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°C
Soldering temperature,[1)] 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,[2)] junction - case	$R_{th(j-c)}$		-	-	0.21	K/W
Diode thermal resistance,[2)] junction - case	$R_{th(j-c)}$		-	-	0.35	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		-	-	40	K/W

[1)] Package not recommended for surface mount application

[2)] Thermal resistance of thermal grease $R_{th(c-s)}$ (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			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 = 100.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.50 1.90	2.00 -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 100.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.65 1.60	2.05 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 1.20mA, V_{CE} = V_{GE}	4.1	4.9	5.7	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 600V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- 2500	40 -	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 100.0A	-	63.0	-	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	-	6230	-	pF
Output capacitance	C_{oes}		-	360	-	
Reverse transfer capacitance	C_{res}		-	175	-	
Gate charge	Q_G	V_{CC} = 480V, I_C = 100.0A, V_{GE} = 15V	-	610.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13.0	-	nH
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} = 150°C	-	802	-	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 = 100.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 3.6Ω, $R_{G(off)}$ = 3.6Ω, $L\sigma$ = 63nH, $C\sigma$ = 31pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	30	-	ns
Rise time	t_r		-	38	-	ns
Turn-off delay time	$t_{d(off)}$		-	290	-	ns
Fall time	t_f		-	31	-	ns
Turn-on energy	E_{on}		-	3.10	-	mJ
Turn-off energy	E_{off}		-	2.50	-	mJ
Total switching energy	E_{ts}		-	5.60	-	mJ

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

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 100.0A, di_F/dt = 1000A/µs	-	230	-	ns
Diode reverse recovery charge	Q_{rr}		-	2.80	-	µC
Diode peak reverse recovery current	I_{rrm}		-	23.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-450	-	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 = 100.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 3.6Ω, $R_{G(off)}$ = 3.6Ω, $L\sigma$ = 63nH, $C\sigma$ = 31pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	31	-	ns
Rise time	t_r		-	52	-	ns
Turn-off delay time	$t_{d(off)}$		-	351	-	ns
Fall time	t_f		-	42	-	ns
Turn-on energy	E_{on}		-	6.00	-	mJ
Turn-off energy	E_{off}		-	3.70	-	mJ
Total switching energy	E_{ts}		-	9.70	-	mJ

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

Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 400V, I_F = 100.0A, di_F/dt = 1000A/µs	-	328	-	ns
Diode reverse recovery charge	Q_{rr}		-	8.70	-	µC
Diode peak reverse recovery current	I_{rrm}		-	48.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-847	-	A/µs

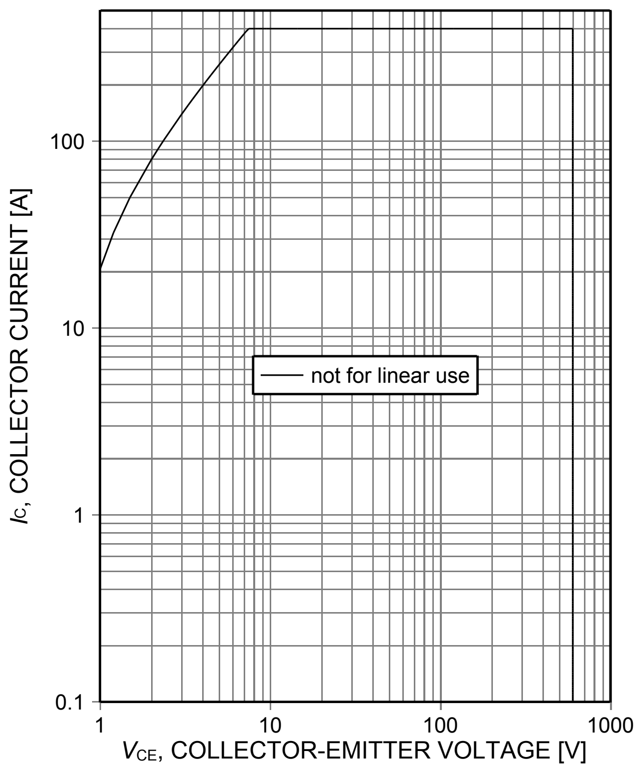


Figure 1. **Safe operating area**
(D=0, T_C=25°C, T_j≤175°C, V_{GE}=0/15V, t_p=1µs)

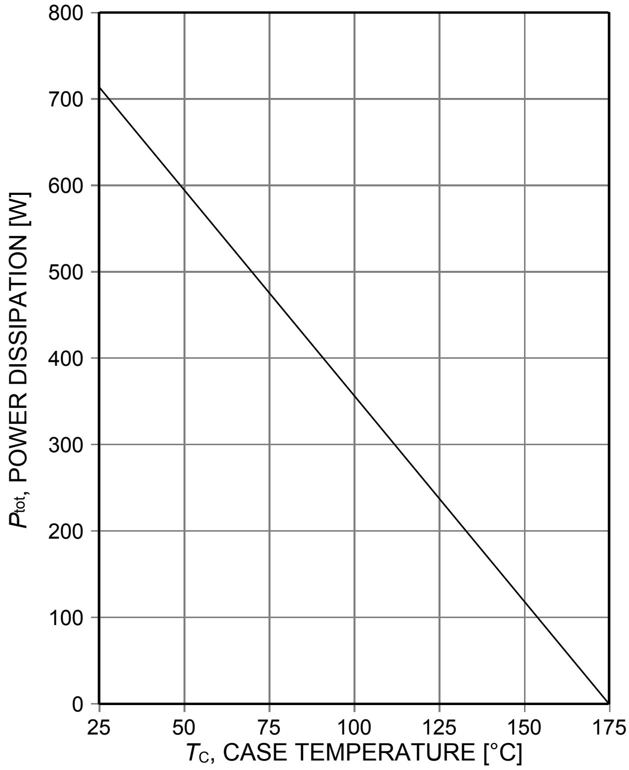


Figure 2. **Power dissipation as a function of case temperature**
(T_j≤175°C)

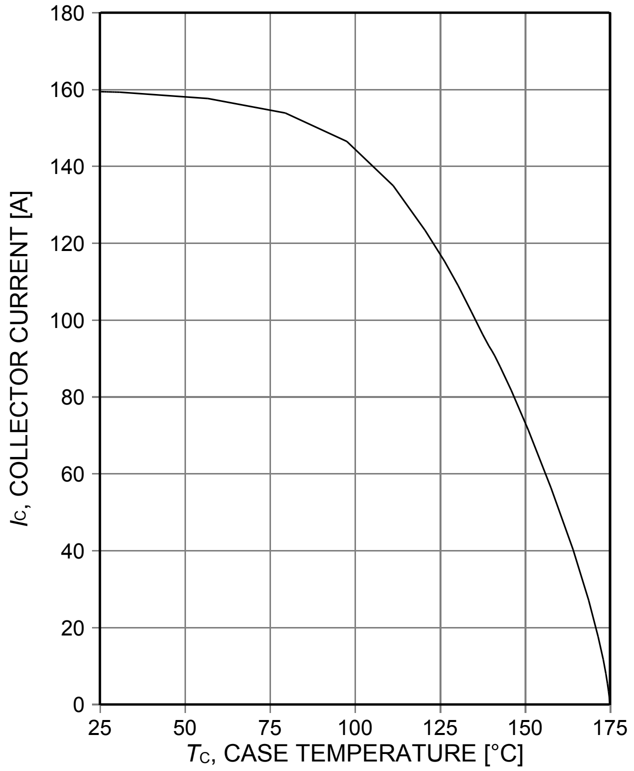


Figure 3. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_j≤175°C)

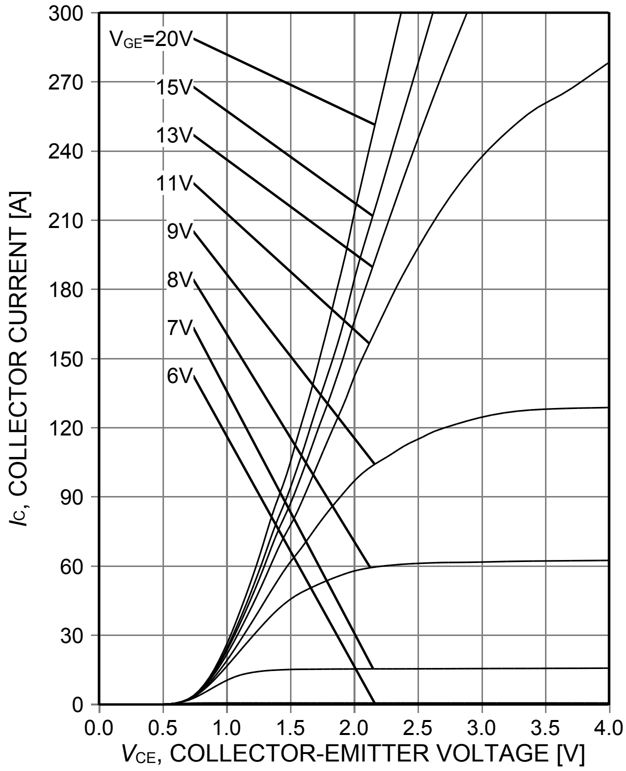


Figure 4. **Typical output characteristic**
(T_j=25°C)

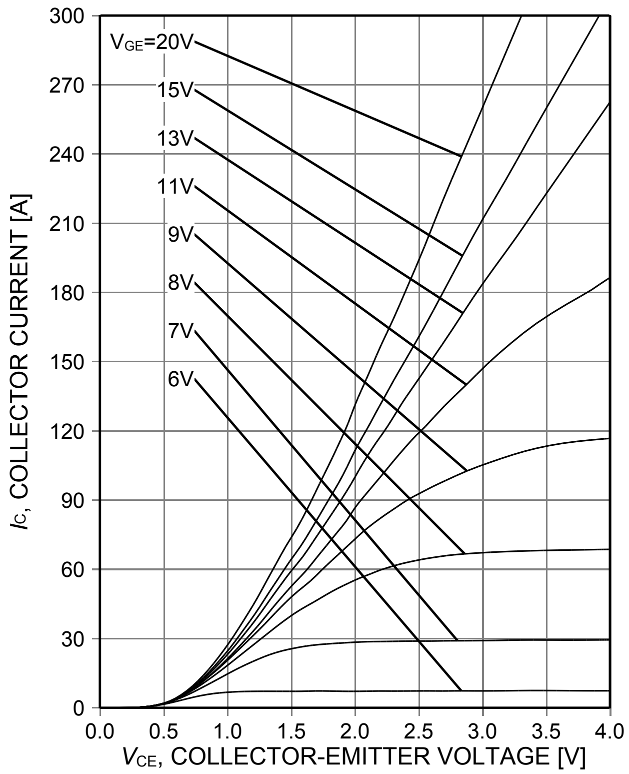


Figure 5. **Typical output characteristic**
(T_j=175°C)

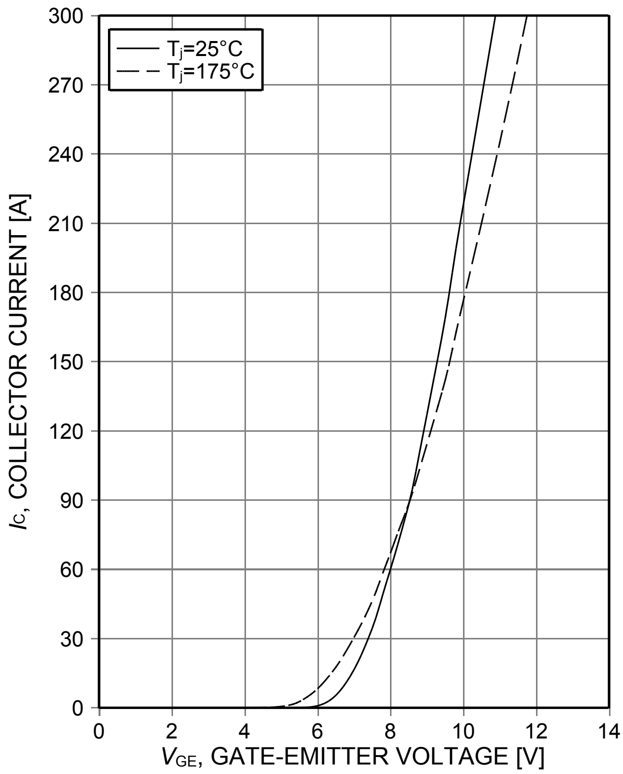


Figure 6. **Typical transfer characteristic**
(V_{CE}=20V)

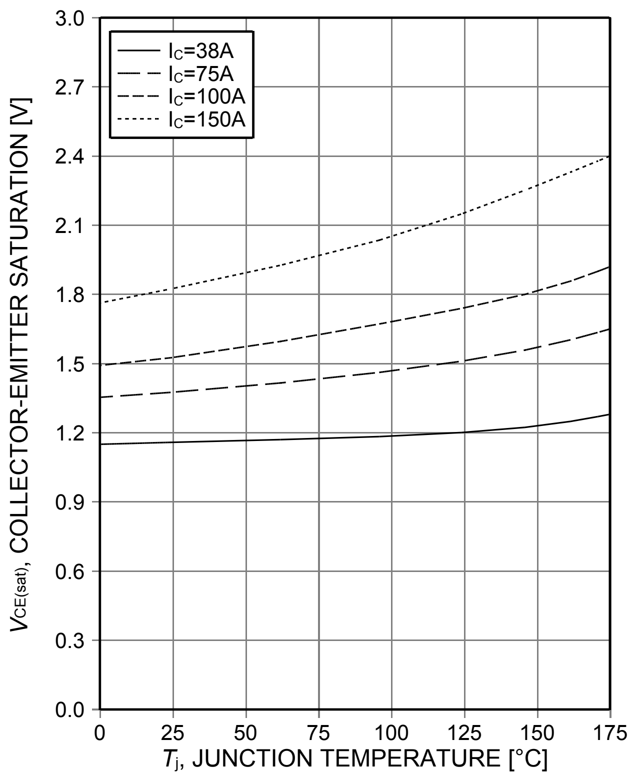


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

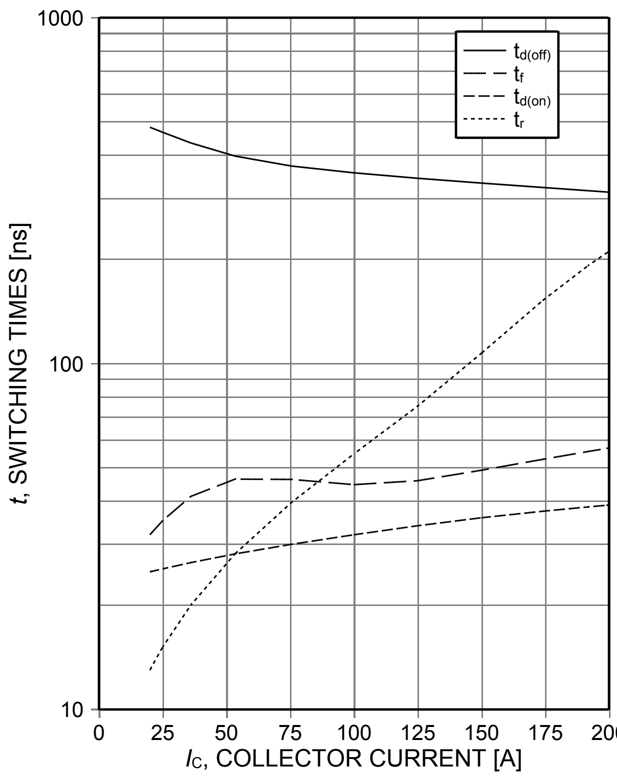


Figure 8. **Typical switching times as a function of collector current**
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=3,6Ω,Dynamic test circuit in Figure E)

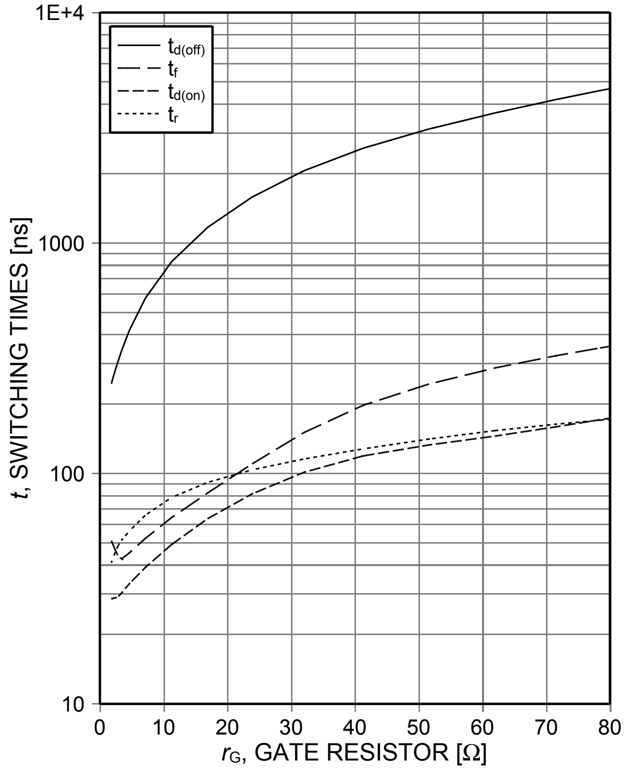


Figure 9. **Typical switching times as a function of gate resistor**
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=100A,Dynamic test circuit in Figure E)

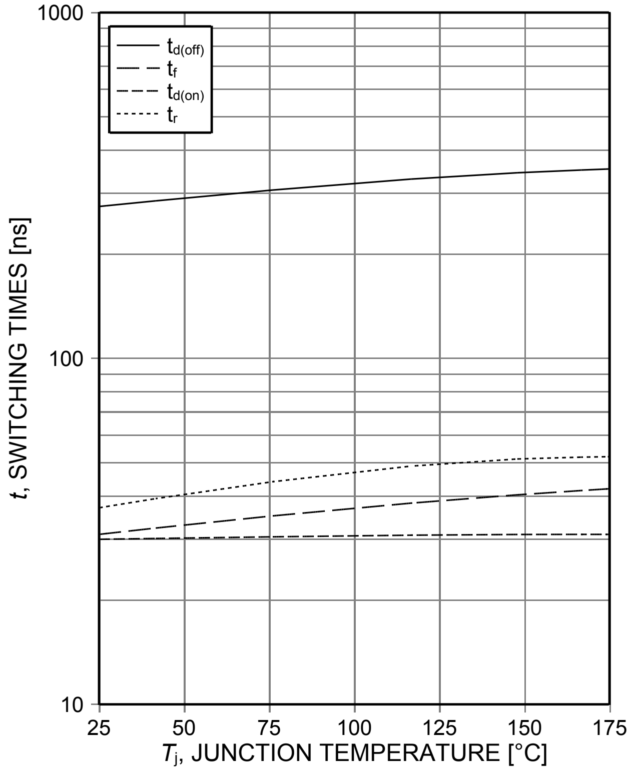


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=100A, r_G=3,6Ω,Dynamic test circuit in Figure E)

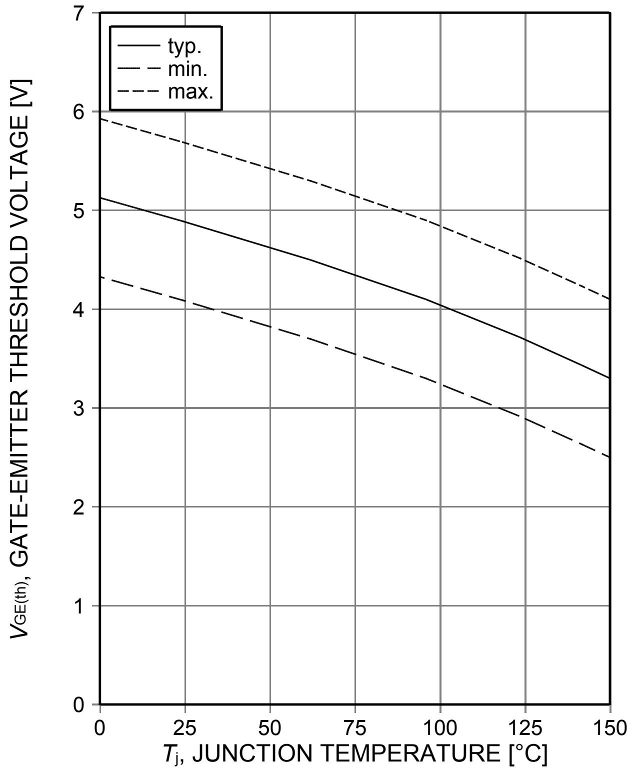


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=1.2mA)

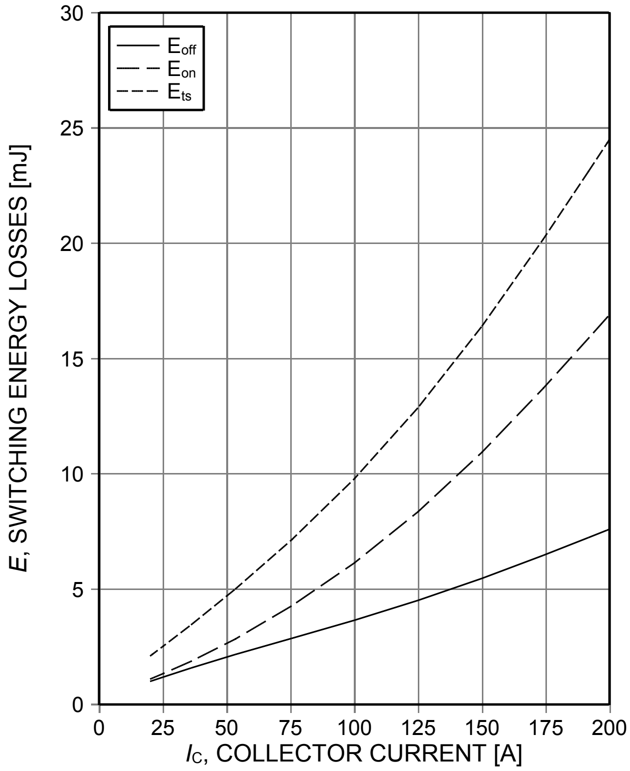


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=3,6Ω,Dynamic test circuit in Figure E)

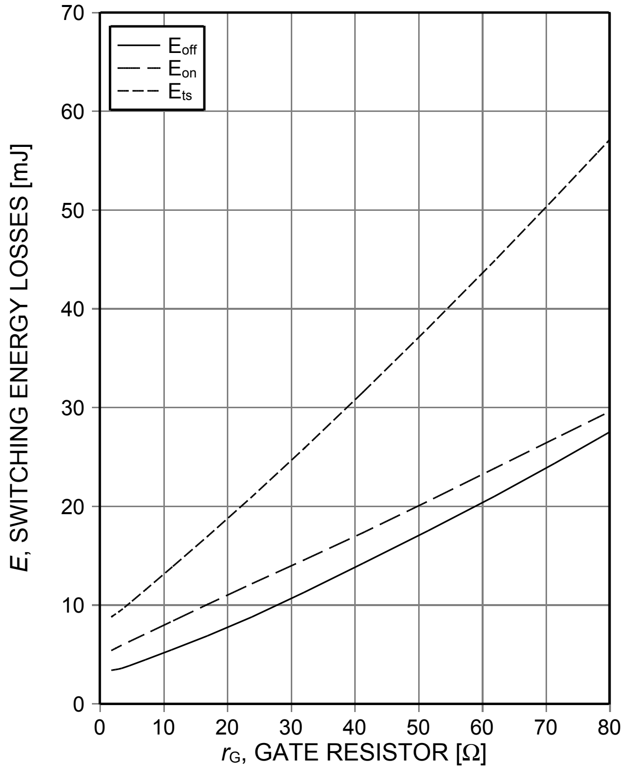


Figure 13. **Typical switching energy losses as a function of gate resistor**
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=100A,Dynamic test circuit in Figure E)

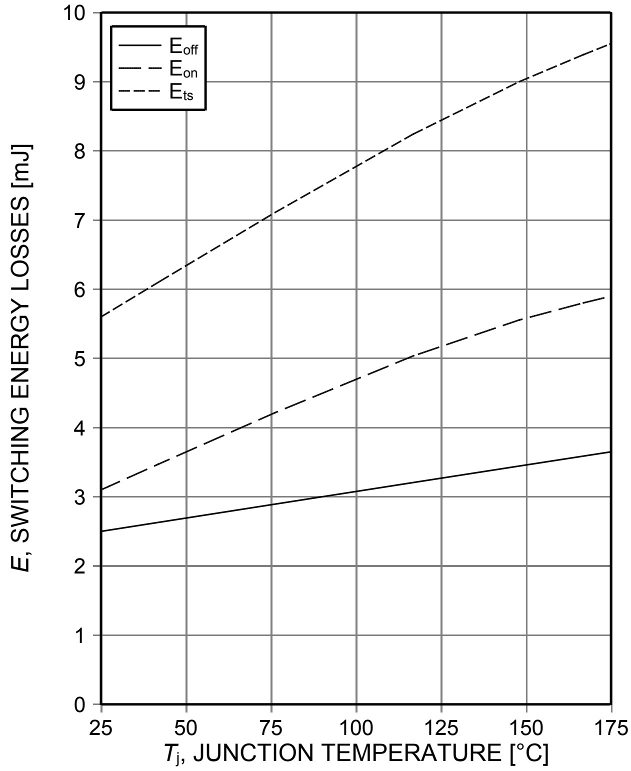


Figure 14. **Typical switching energy losses as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=100A, r_G=3,6Ω,Dynamic test circuit in Figure E)

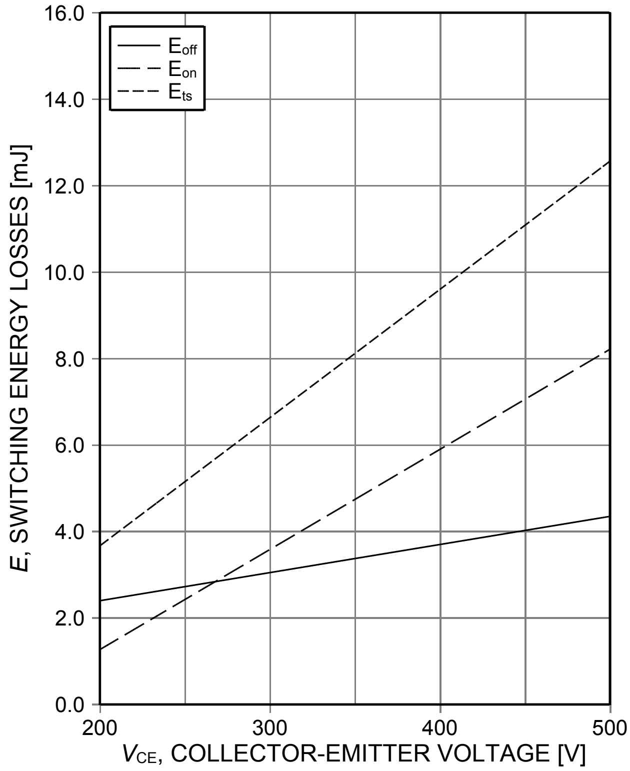


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, T_j=175°C, V_{GE}=15/0V, I_C=100A, R_G=3,6Ω, Dynamic test circuit in Figure E)

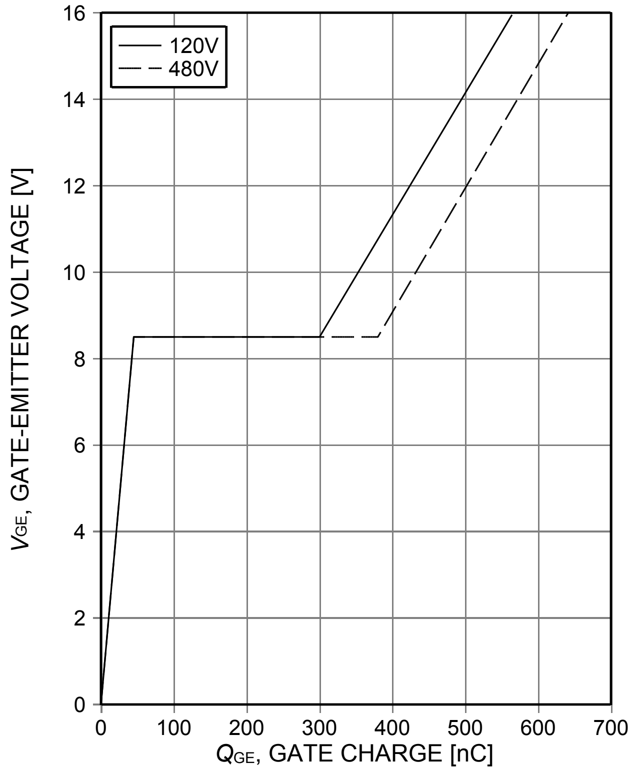


Figure 16. **Typical gate charge**
(I_C=100A)

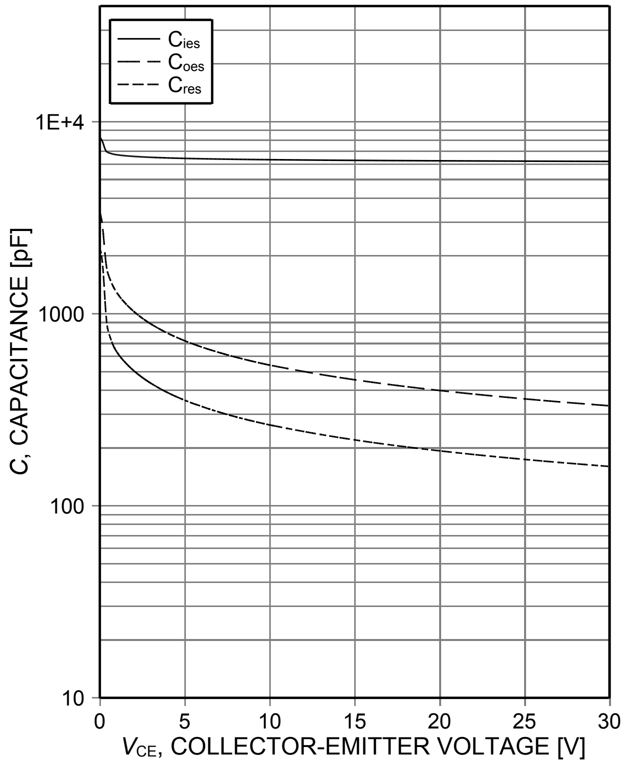


Figure 17. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

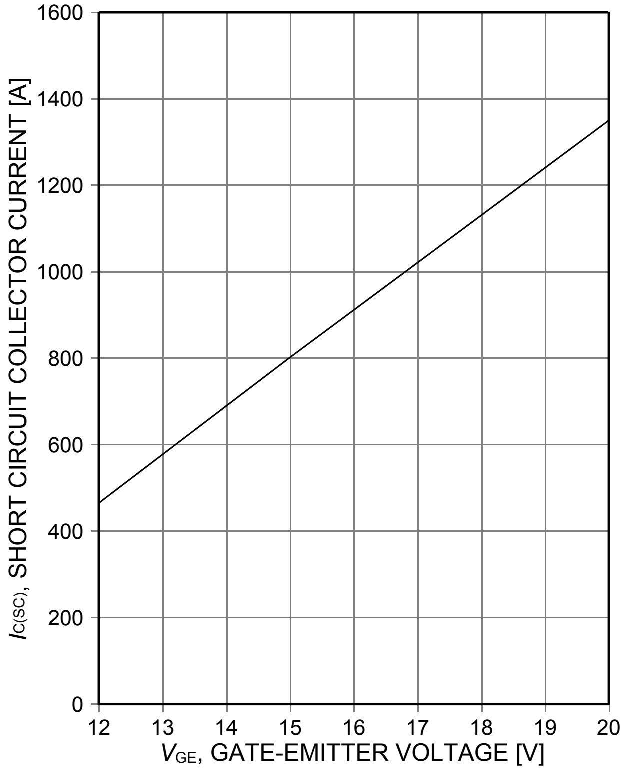


Figure 18. **Typical short circuit collector current as a function of gate-emitter voltage**
(V_{CE}≤400V, T_j≤150°C)

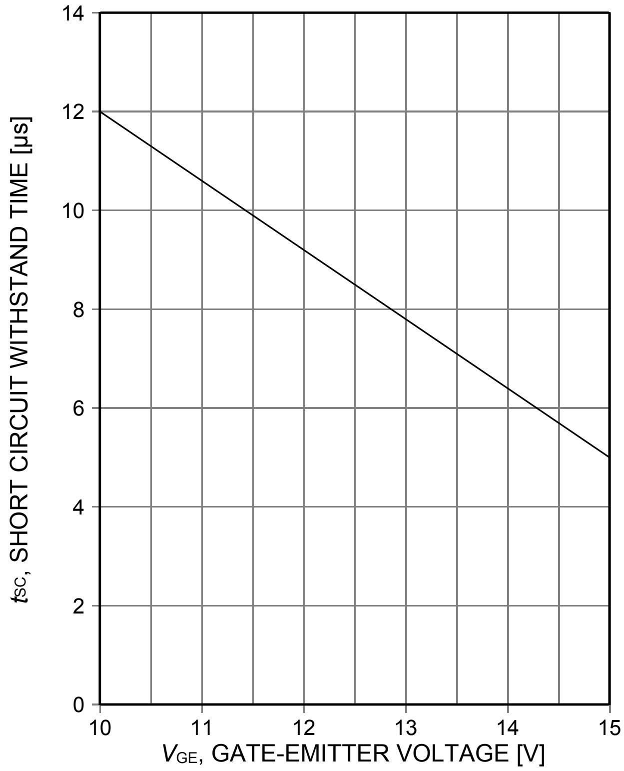


Figure 19. **Short circuit withstand time as a function of gate-emitter voltage**
(V_{CE}=400V, start at T_j=25°C, $T_j$max≤150°C)

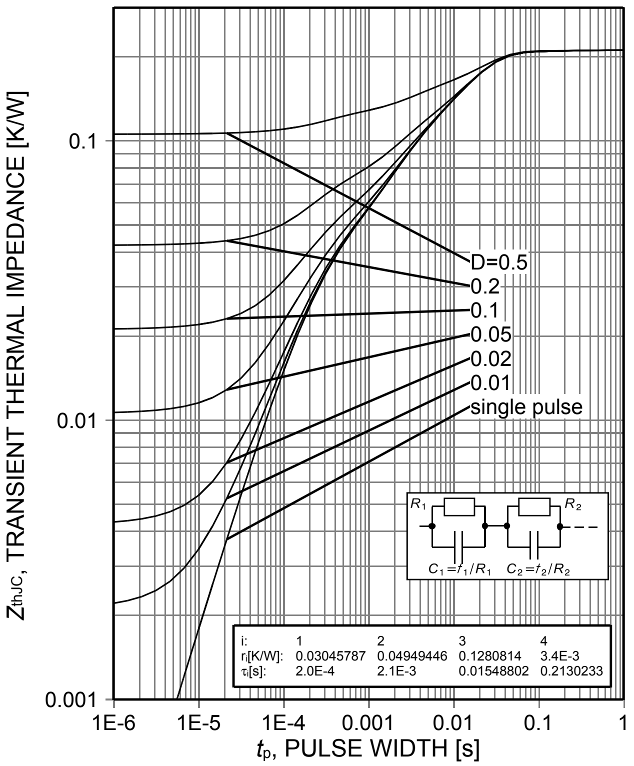


Figure 20. **IGBT transient thermal impedance as a function of pulse width for different duty cycles *D***
(D=t_p/T)

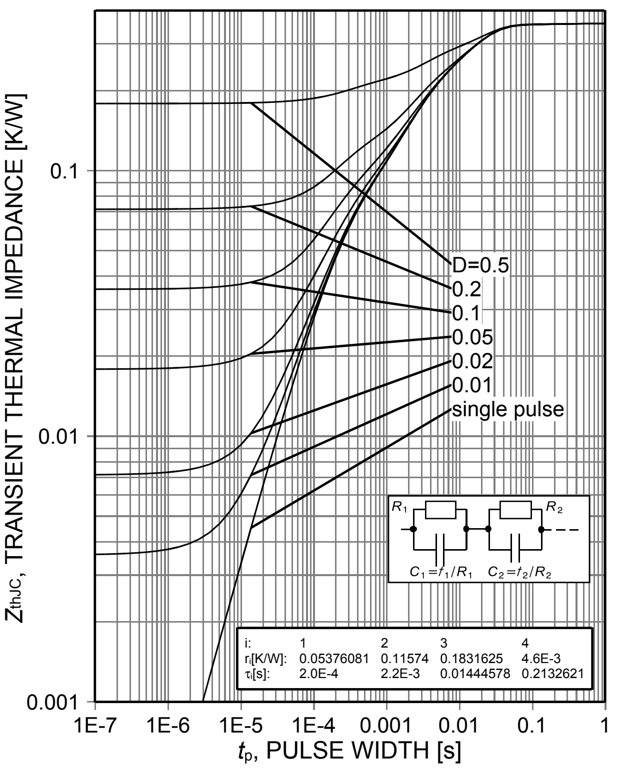


Figure 21. **Diagnostic transient thermal impedance as a function of pulse width for different duty cycles *D***
($D=t_p/T$)

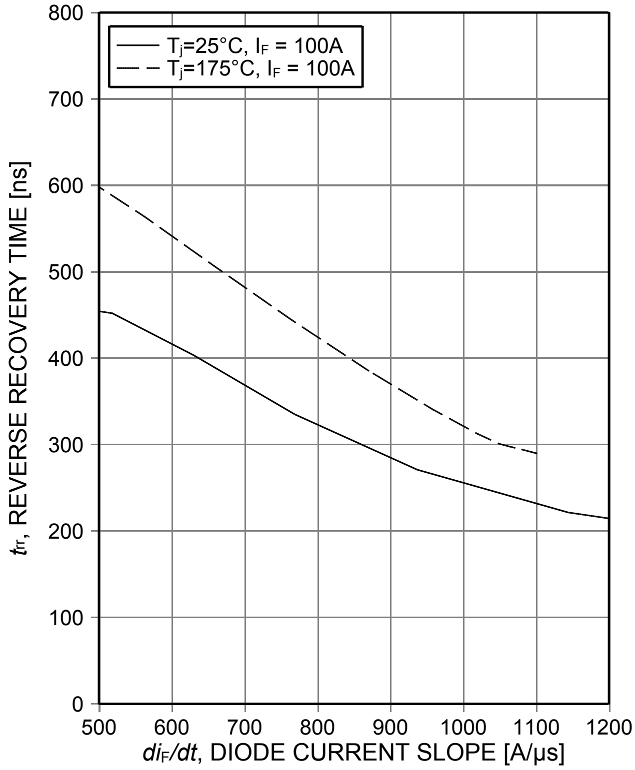


Figure 22. **Typical reverse recovery time as a function of diode current slope**
(V_R=400V,Dynamic test circuit in Figure E)

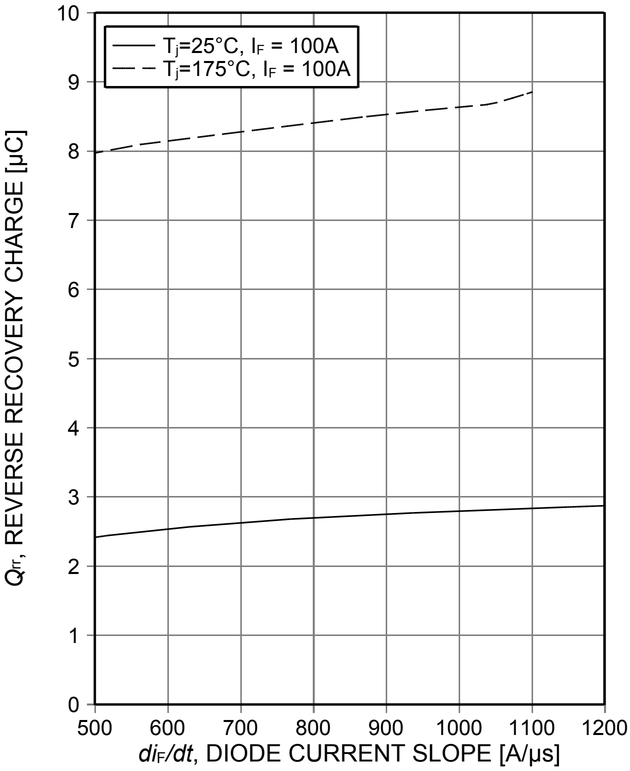


Figure 23. **Typical reverse recovery charge as a function of diode current slope**
(V_R=400V, Dynamic test circuit in Figure E)

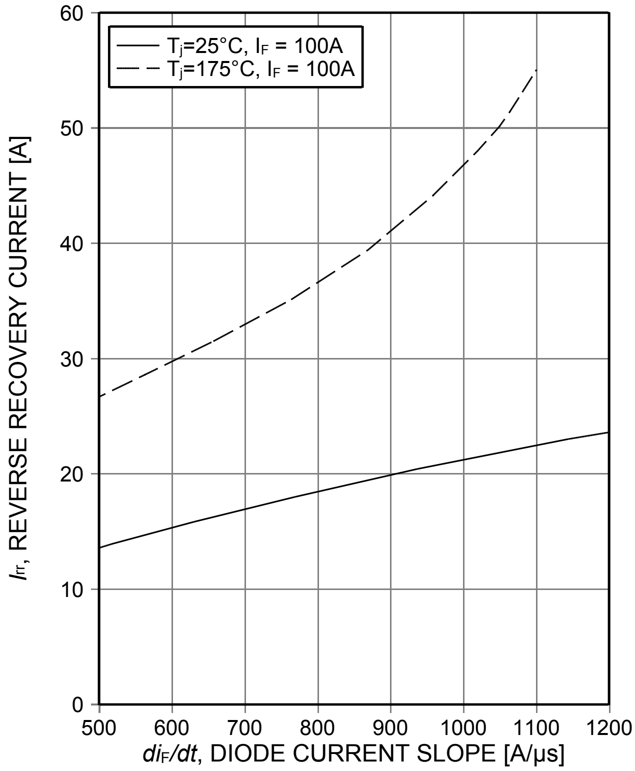


Figure 24. **Typical reverse recovery current as a function of diode current slope**
(V_R=400V, Dynamic test circuit in Figure E)

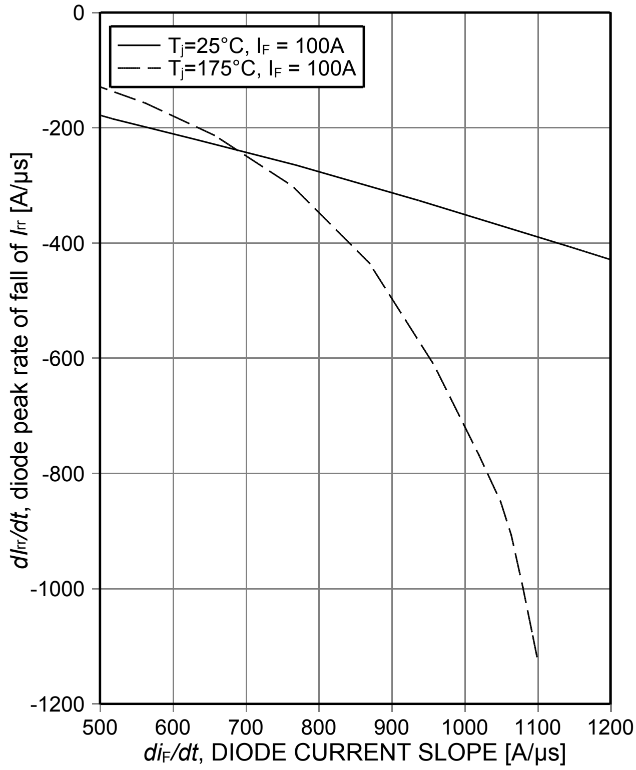


Figure 25. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=400V, Dynamic test circuit in Figure E)

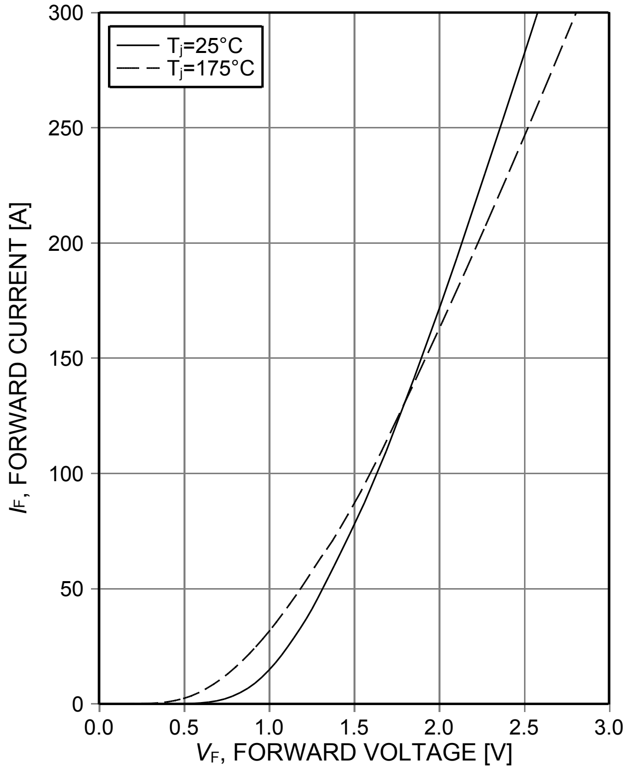


Figure 26. **Typical diode forward current as a function of forward voltage**

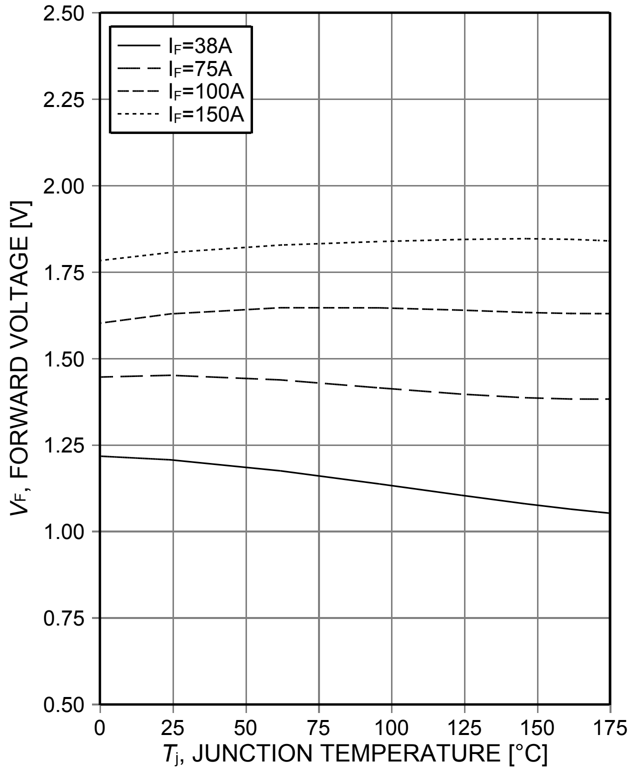
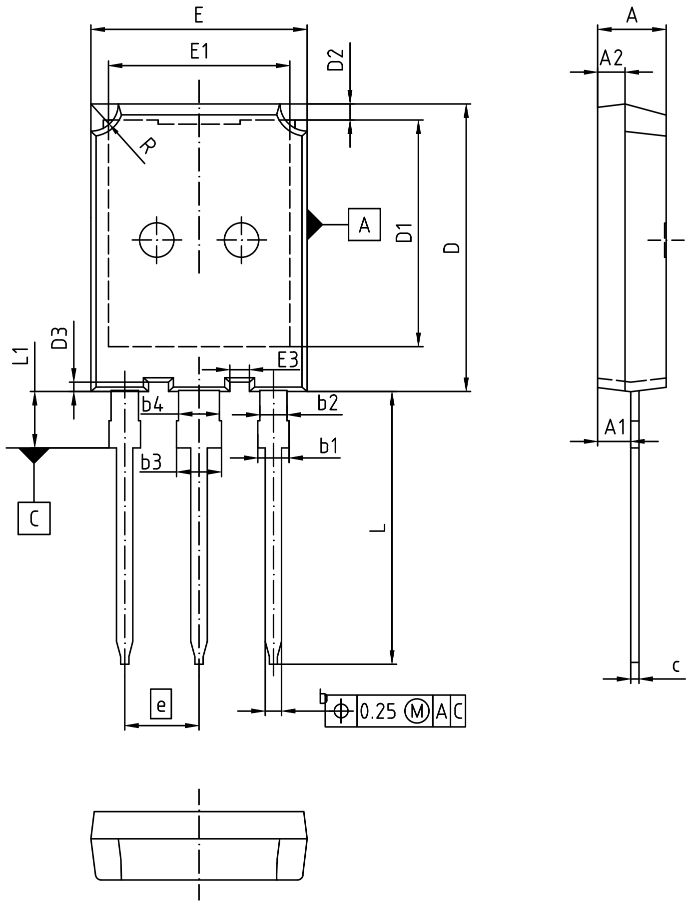


Figure 27. **Typical diode forward voltage as a function of junction temperature**

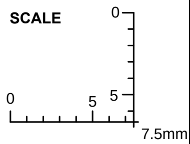
Package Drawing PG-TO247-3-46



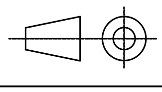
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.96	2.25	0.077	0.089
b2	1.96	2.06	0.077	0.081
c	0.59	0.66	0.023	0.026
D	20.90	21.10	0.823	0.831
D1	16.25	16.85	0.640	0.663
D2	1.05	1.35	0.041	0.053
D3	0.58	0.78	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

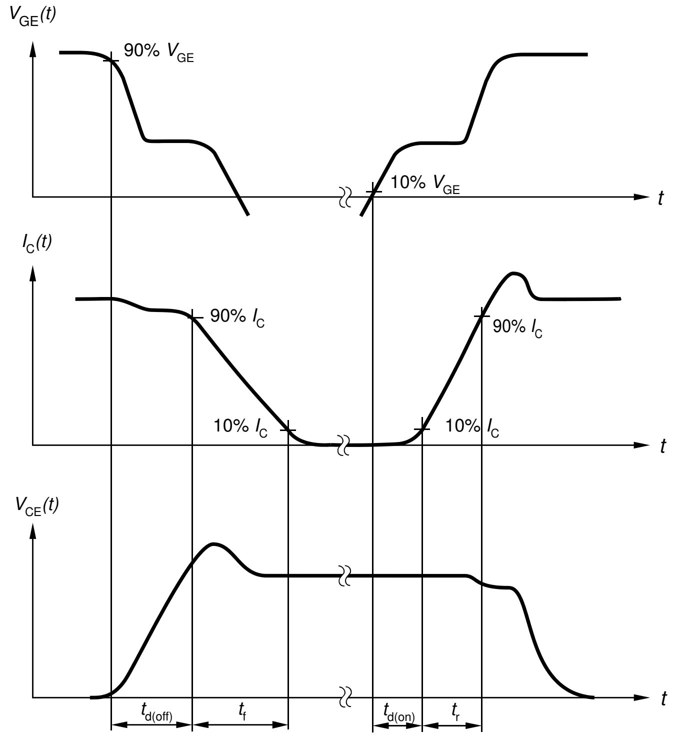


Figure A. **Definition of switching times**

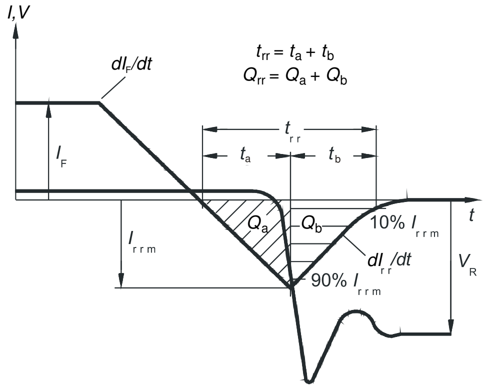


Figure C. **Definition of diode switching characteristics**

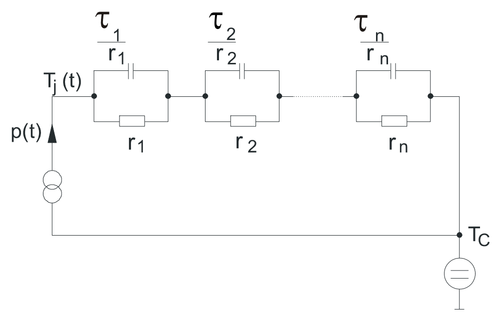


Figure D. **Thermal equivalent circuit**

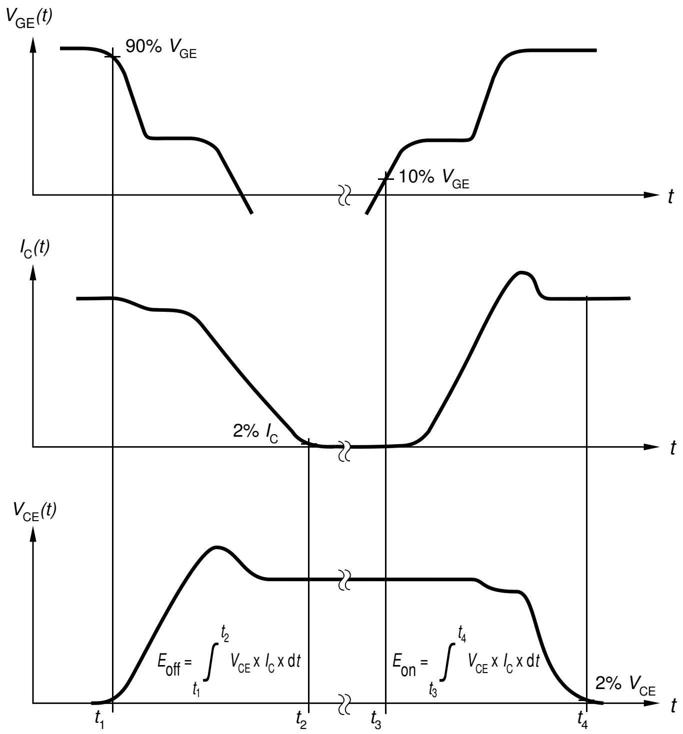


Figure B. **Definition of switching losses**

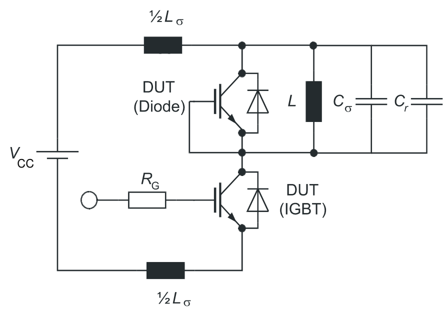


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ},
parasitic capacitor C_{σ},
relief capacitor C_r,
(only for ZVT switching)

Revision History

IKQ100N60T

Revision: 2017-11-15, Rev. 2.3

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2014-11-03	Final data sheet
2.2	2014-11-18	Update of Transconductance gfs
2.3	2017-11-15	Minor change Fig. 20 and Fig. 21

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