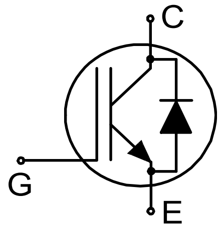
IKA15N65ET6

TRENCHSTOP™ IGBT6

IGBT in trench and field-stop technology with soft, fast recovery anti-parallel Rapid diode



Features and Benefits:

- Very low $V_{CE(sat)}$ 1.5V (typ.)
- Maximum junction temperature 175°C
- Short circuit withstand time 3µs

Trench and field-stop technology for 650V applications offers :

- very tight parameter distribution
- high ruggedness, temperature stable behavior
- low V_{CEsat} and positive temperature coefficient

- Low gate charge Q_G
- Pb-free lead plating; RoHS compliant
- Very soft, fast recovery anti-parallel Rapid diode
- Complete product spectrum and PSpice Models: www.infineon.com/igbt

Potential Applications:

Drives
- GPD (general purpose drives)

Major home appliances
- Air conditioning
- Other major home appliances

Small home appliances
- Other small home appliances

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IKA15N65ET6	650V	15A[1)]	1.5V[2)]	175°C	K15EET6	PG-TO220-3 FP

[1)] Limited by maximum junction temperature. Applicable for TO-220 Standard package.
[2)] Measured under conditions specified on page 4.

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}	650	V
DC collector current, limited by T_{vjmax}[1)] $T_c = 25°C$ $T_c = 100°C$	I_C	 17.0 11.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	57.5	A
Turn off safe operating area $V_{CE} \leq 650V$, $T_{vj} \leq 175°C$	-	57.5	A
Diode forward current, limited by T_{vjmax}[1)] $T_c = 25°C$ $T_c = 100°C$	I_F	 17.0 10.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	57.5	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu s$, $D < 0.010$)	V_{GE}	±20 ±30	V
Short circuit withstand time $V_{GE} = 15.0V$, $V_{CC} \leq 360V$ Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s $T_{vj} = 150°C$	t_{SC}	 3	µs
Power dissipation $T_c = 25°C$ Power dissipation $T_c = 100°C$	P_{tot}	45.0 22.0	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, M2.5 screw, PG-TO220-3 FP Maximum of mounting processes: 3	M	0.5	Nm
Isolation voltage RMS, $f = 50/60Hz$, $t = 1min$	V_{isol}	2500	V

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R_{th} Characteristics						
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		-	-	3.35	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		-	-	4.77	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		-	-	65	K/W

[1)] Limited by maximum junction temperature. Applicable for TO220 standard package.

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage[1]	$V_{(BR)CES}$	V_{GE} = 0V, I_C = 0.10mA	650	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 11.5A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	1.50 1.65 1.75	1.90 - -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 11.5A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	1.50 1.48 1.43	1.95 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.20mA, V_{CE} = V_{GE}	4.8	5.6	6.4	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 650V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- 450	30 -	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 11.5A	-	11.6	-	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	-	1020	-	pF
Output capacitance	C_{oes}		-	50	-	
Reverse transfer capacitance	C_{res}		-	20	-	
Gate charge	Q_G	V_{CC} = 520V, I_C = 11.5A, V_{GE} = 15V	-	37.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	7.0	-	nH
Short circuit collector current Max. 1000 short circuits Time between short circuits: ≥ 1.0s	$I_{C(SC)}$	V_{GE} = 15.0V, V_{CC} ≤ 360V, t_{SC} ≤ 3µs T_{vj} = 150°C	-	120	-	A

[1] Measured with filter network.

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 = 11.5A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 47.0Ω, $R_{G(off)}$ = 47.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 150pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	30	-	ns
Rise time	t_r		-	22	-	ns
Turn-off delay time	$t_{d(off)}$		-	117	-	ns
Fall time	t_f		-	42	-	ns
Turn-on energy	E_{on}		-	0.23	-	mJ
Turn-off energy	E_{off}		-	0.11	-	mJ
Total switching energy	E_{ts}		-	0.34	-	mJ

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

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 11.5A, di_F/dt = 400A/μs	-	69	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.21	-	μC
Diode peak reverse recovery current	I_{rrm}		-	5.1	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-265	-	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 = 11.5A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 47.0Ω, $R_{G(off)}$ = 47.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 150pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	27	-	ns
Rise time	t_r		-	23	-	ns
Turn-off delay time	$t_{d(off)}$		-	135	-	ns
Fall time	t_f		-	67	-	ns
Turn-on energy	E_{on}		-	0.32	-	mJ
Turn-off energy	E_{off}		-	0.18	-	mJ
Total switching energy	E_{ts}		-	0.50	-	mJ

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

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Diode reverse recovery time	t_{rr}	T_{vj} = 150°C, V_R = 400V, I_F = 11.5A, di_F/dt = 400A/μs	-	113	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.50	-	μC
Diode peak reverse recovery current	I_{rrm}		-	8.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-228	-	A/μs

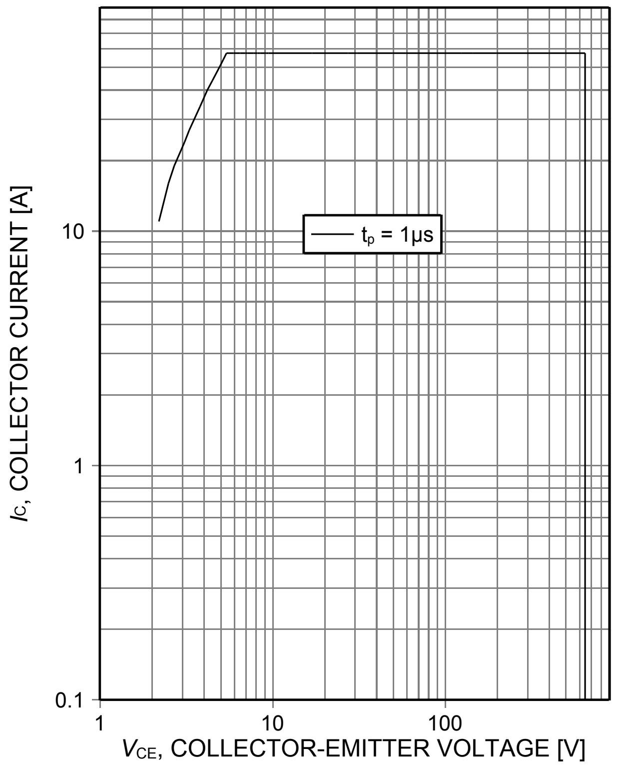


Figure 1. **Forward bias safe operating area**
(D=0, T_C=25°C, T_{vj}≤175°C; V_{GE}=15V. Recommended use at V_{GE}≥15V)

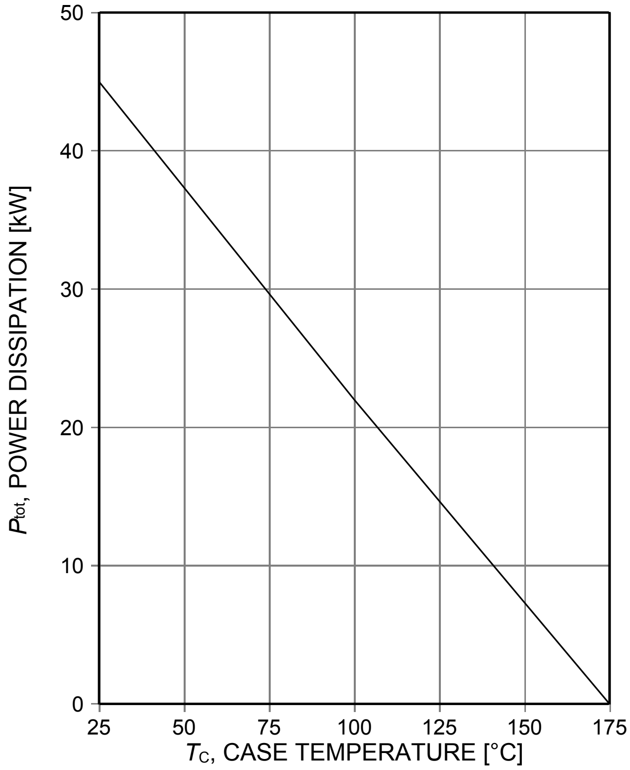


Figure 2. **Power dissipation as a function of case temperature**
(T_{vj}≤175°C)

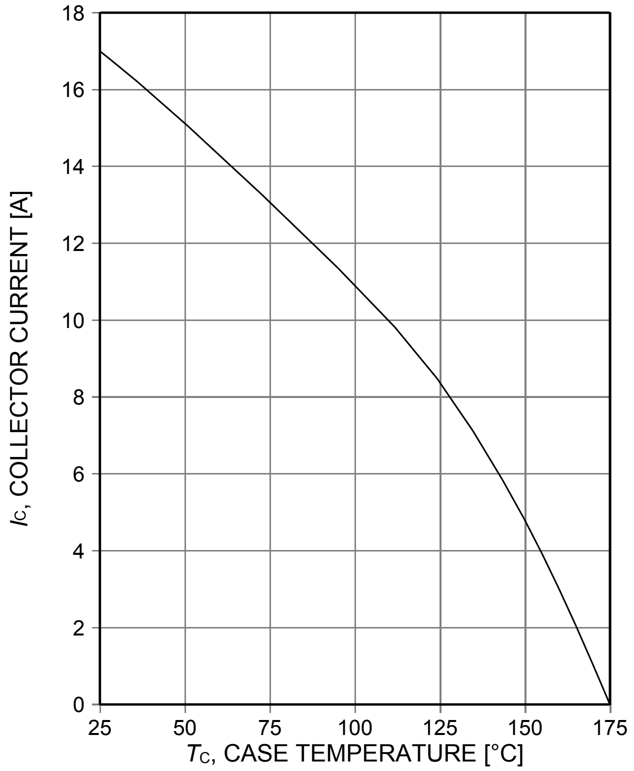


Figure 3. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_{vj}≤175°C)

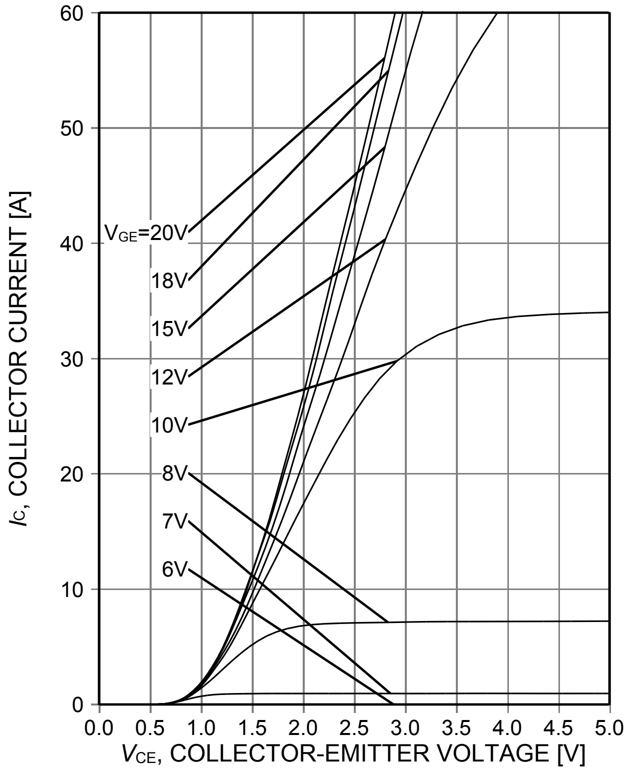


Figure 4. **Typical output characteristic**
(T_{vj}=25°C)

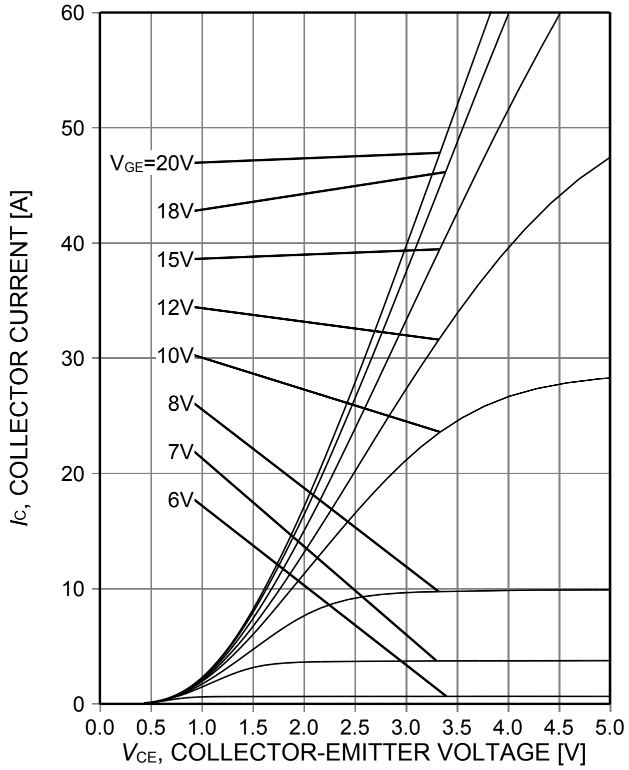


Figure 5. **Typical output characteristic**
(T_{vj}=150°C)

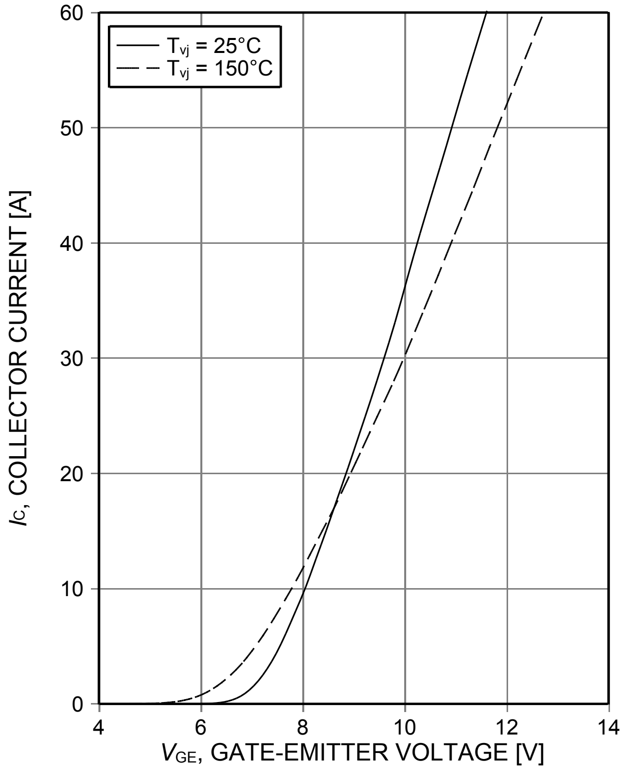


Figure 6. **Typical transfer characteristic**
(V_{CE}=50V)

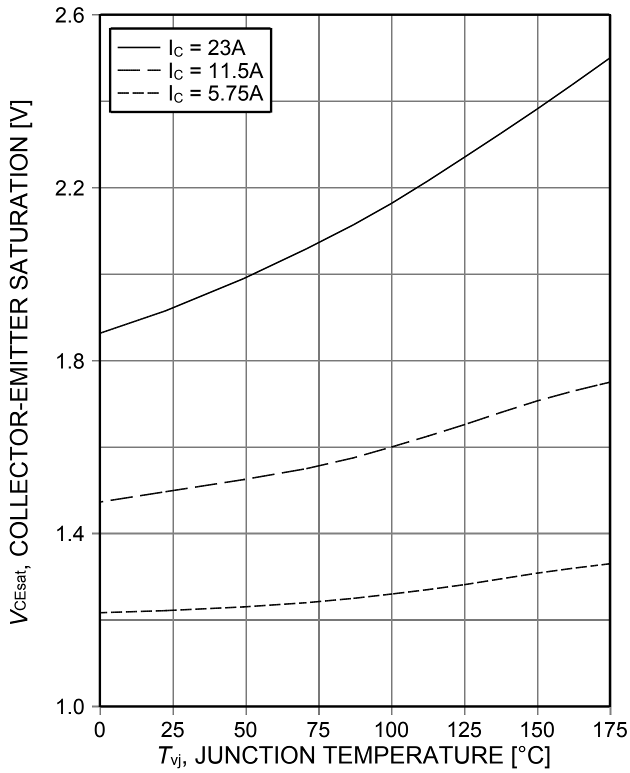


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

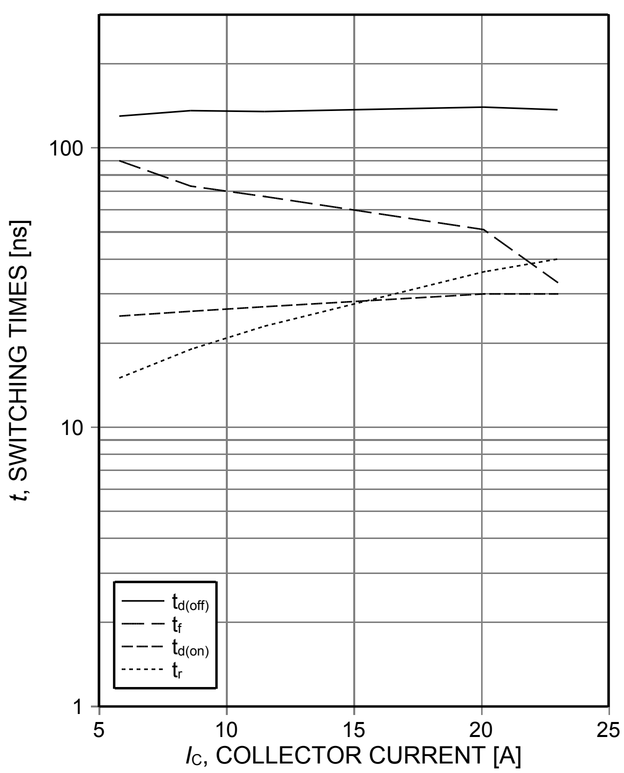


Figure 8. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, r_G=47Ω, Dynamic test circuit in Figure E)

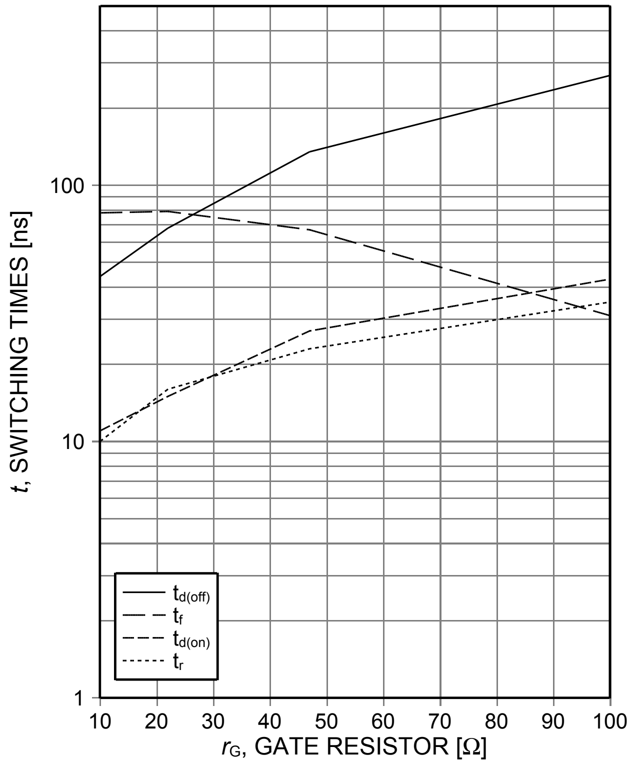


Figure 9. **Typical switching times as a function of gate resistor**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, I_C=11.5A,Dynamic test circuit in Figure E)

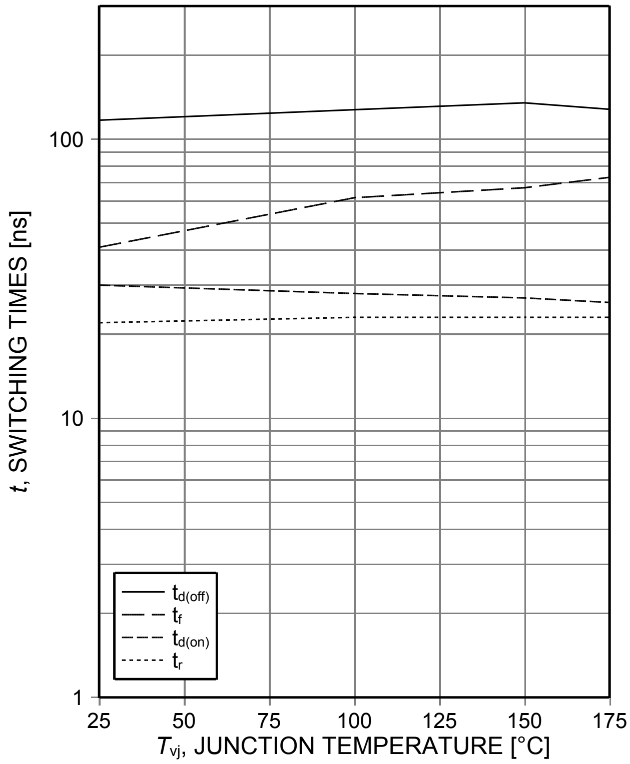


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15V, I_C=11.5A, r_G=47Ω,Dynamic test circuit in Figure E)

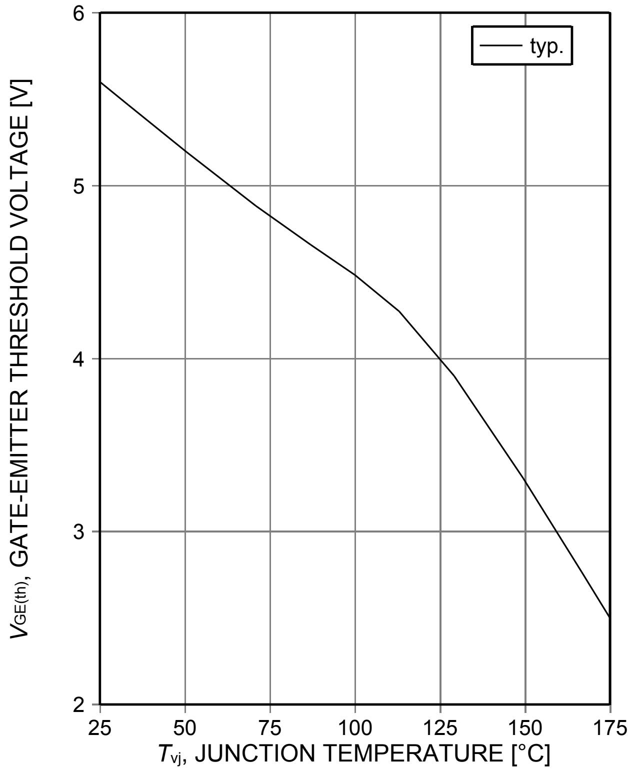


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.2mA)

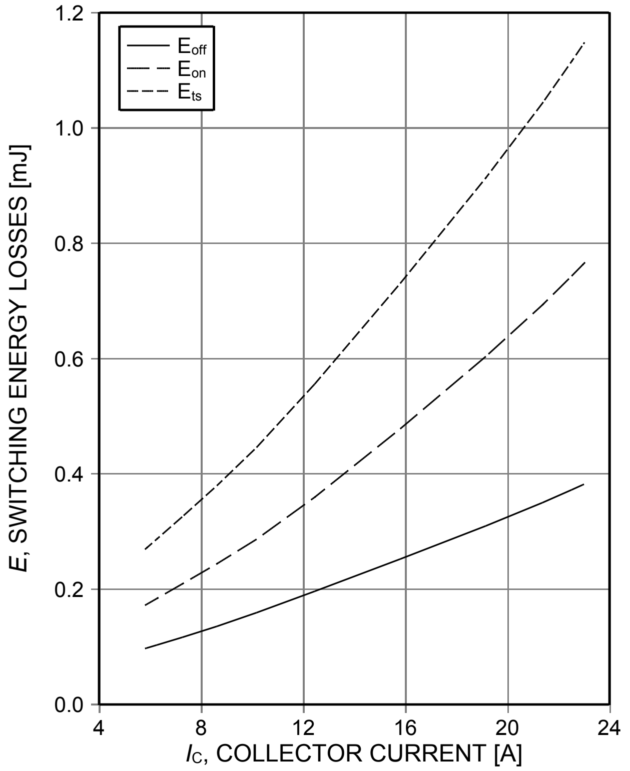


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, r_G=47Ω,Dynamic test circuit in Figure E)

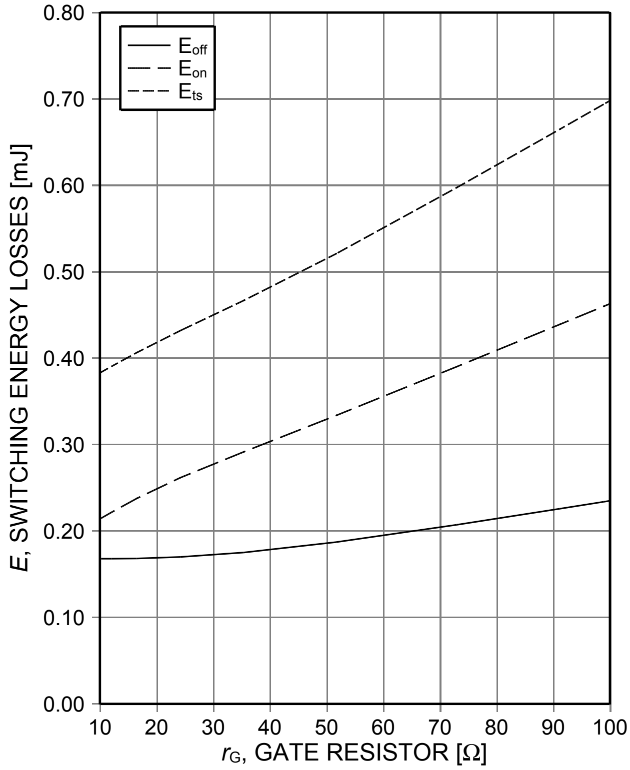


Figure 13. **Typical switching energy losses as a function of gate resistor**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, I_C=11.5A, Dynamic test circuit in Figure E)

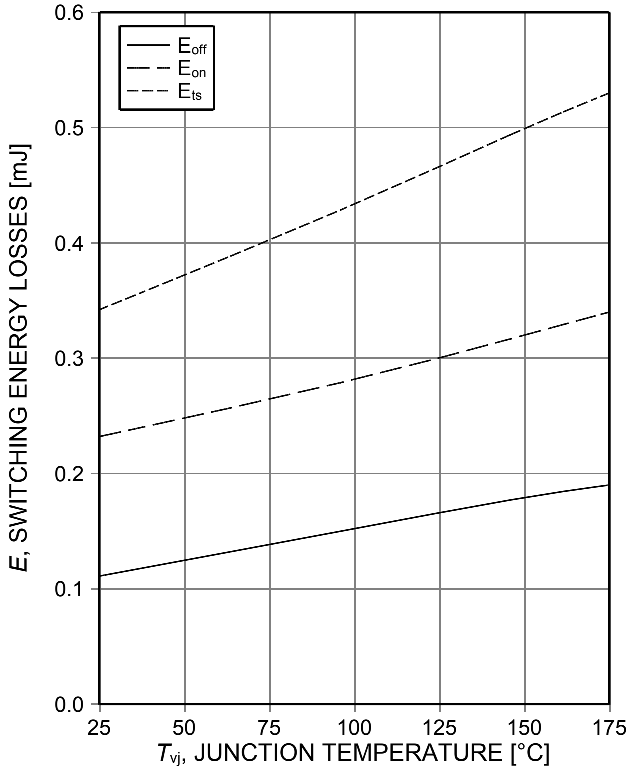


Figure 14. **Typical switching energy losses as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15V, I_C=11.5A, r_G=47Ω,Dynamic test circuit in Figure E)

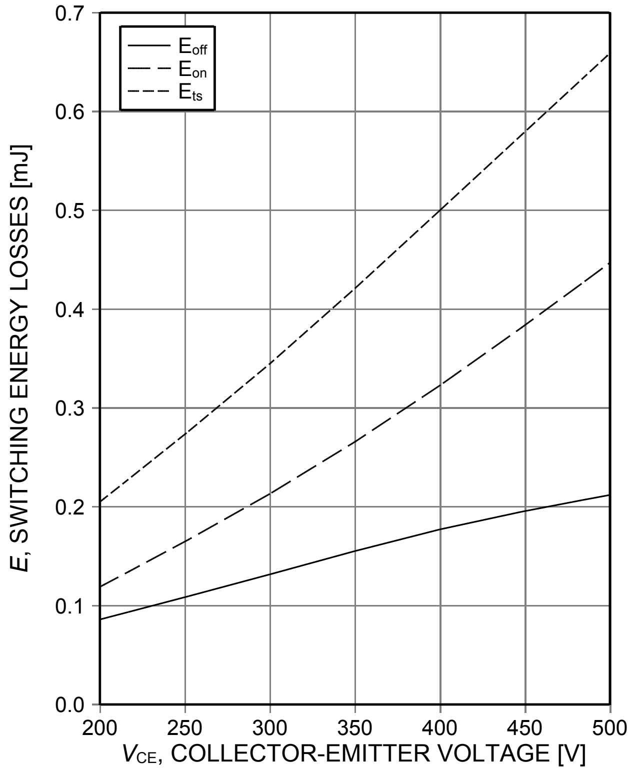


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, T_{vj}=150°C, V_{GE}=15/0V, I_C=11.5A, r_G=47Ω,Dynamic test circuit in Figure E)

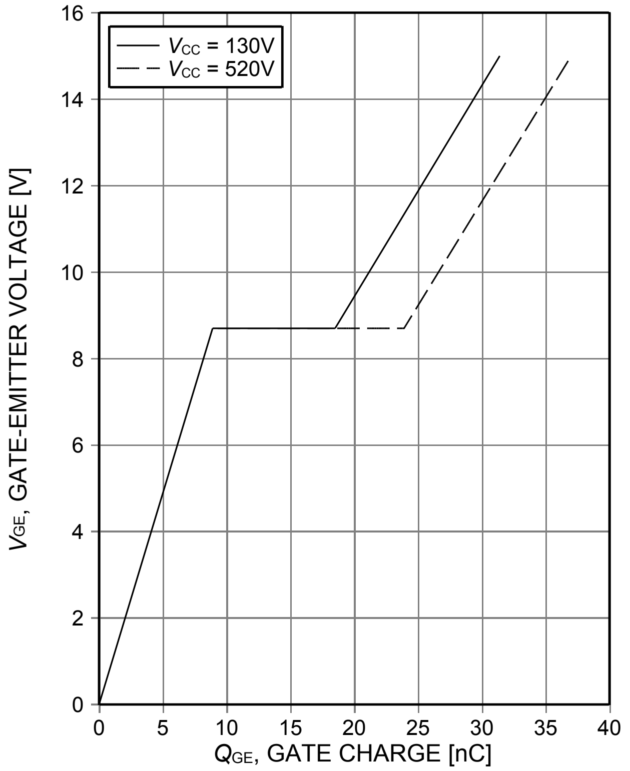


Figure 16. **Typical gate charge**
(I_C=11.5A)

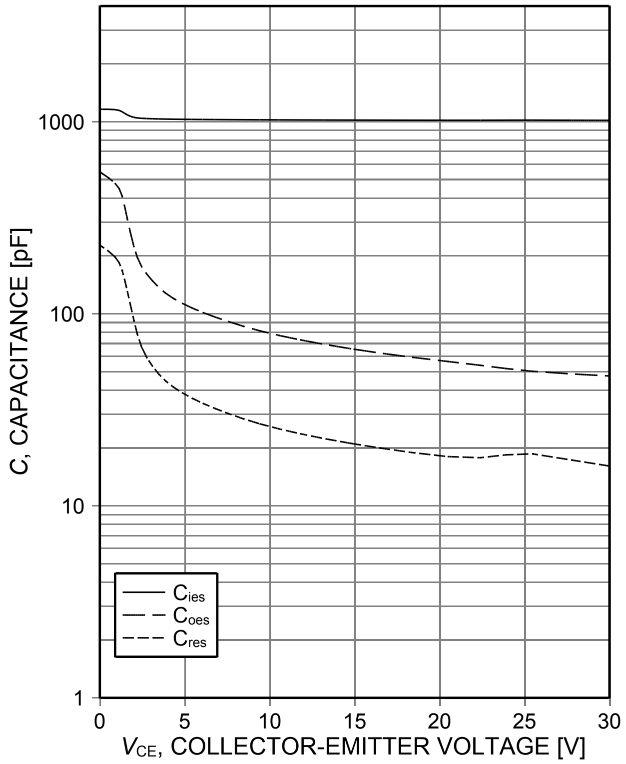


Figure 17. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

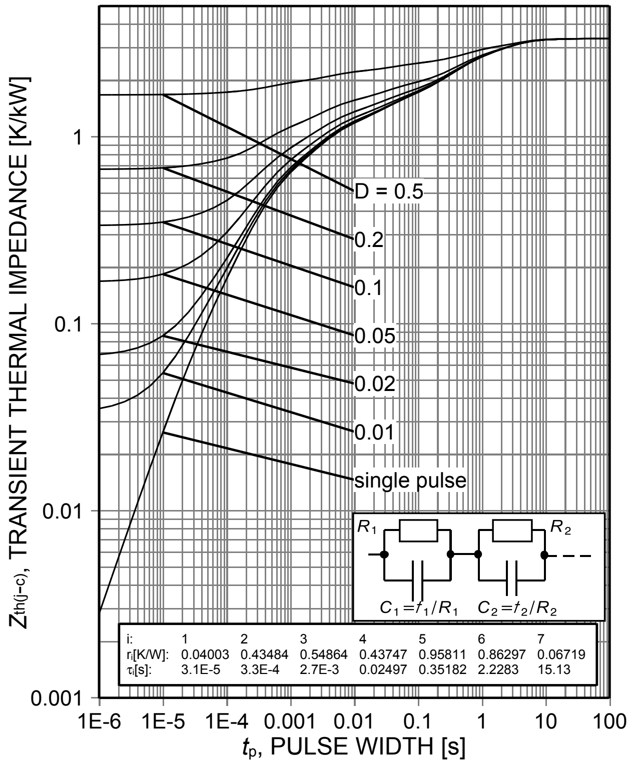


Figure 18. **IGBT transient thermal impedance**
(D=t_p/T)

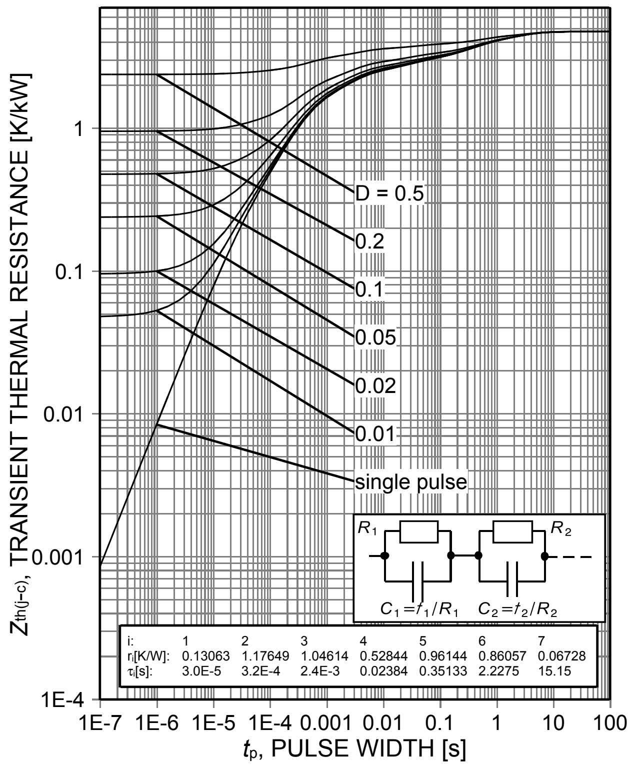


Figure 19. **Diode transient thermal impedance as a function of pulse width**
(D=t_p/T)

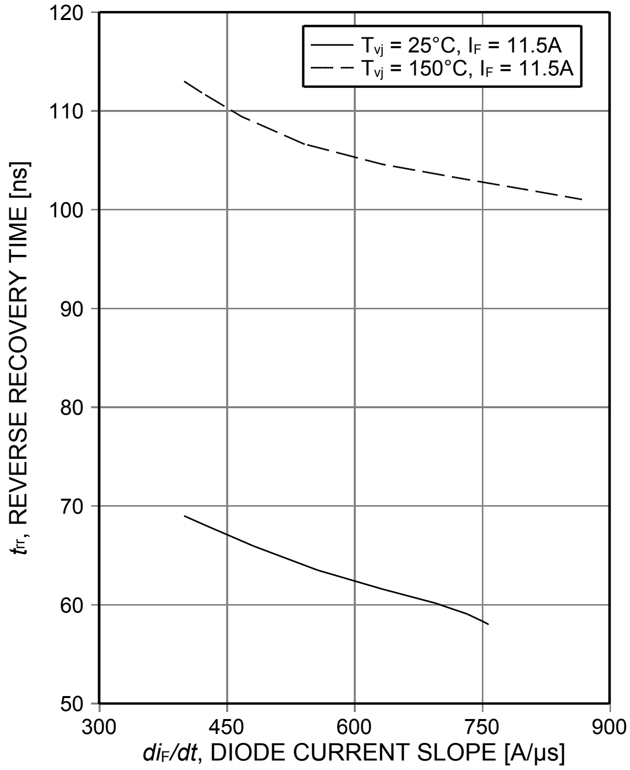


Figure 20. **Typical reverse recovery time as a function of diode current slope**
(V_R=400V)

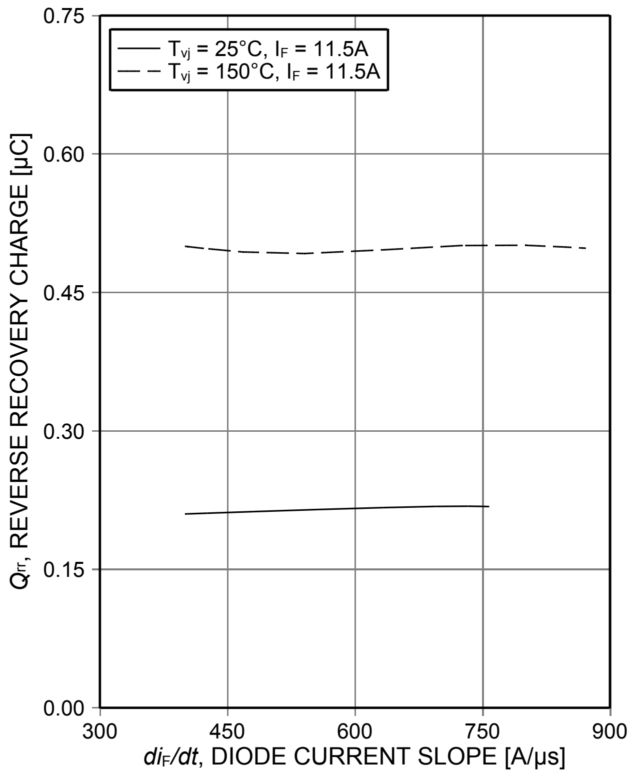


Figure 21. **Typical reverse recovery charge as a function of diode current slope**
(V_R=400V)

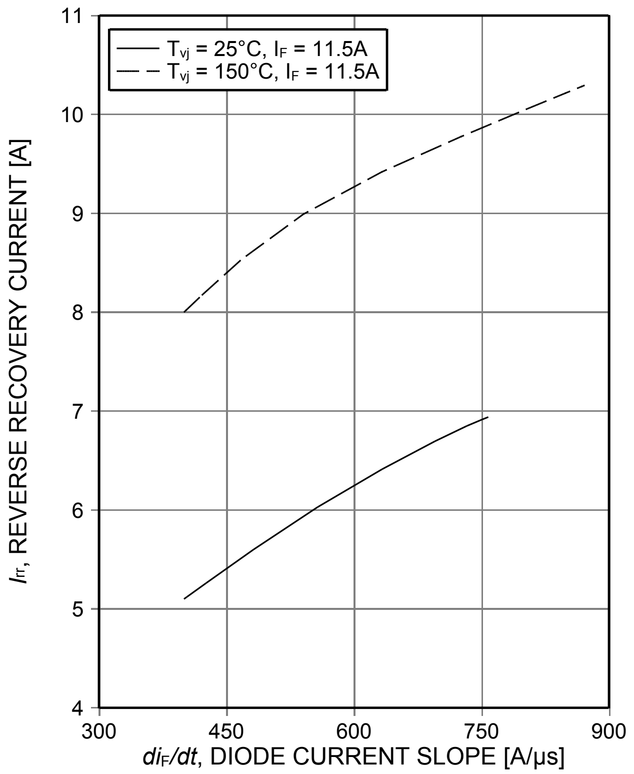


Figure 22. **Typical reverse recovery current as a function of diode current slope**
(V_R=400V)

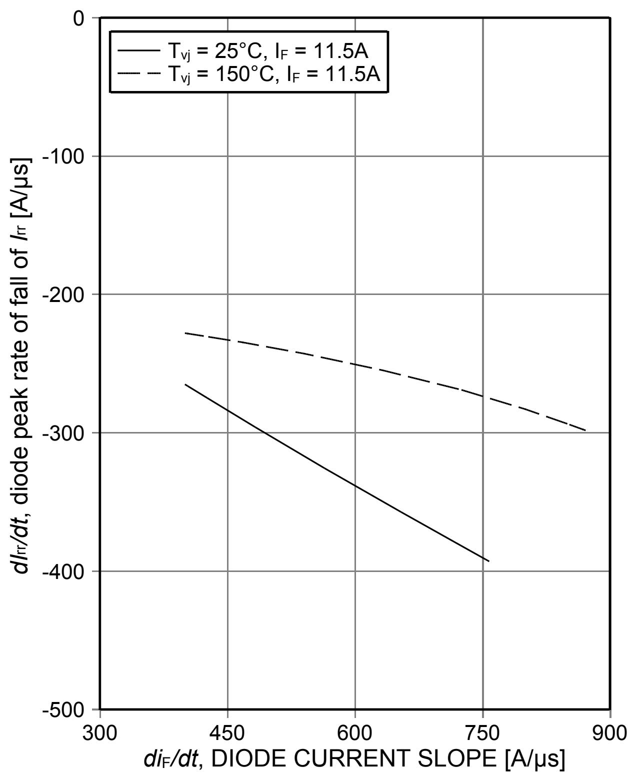


Figure 23. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=400V)

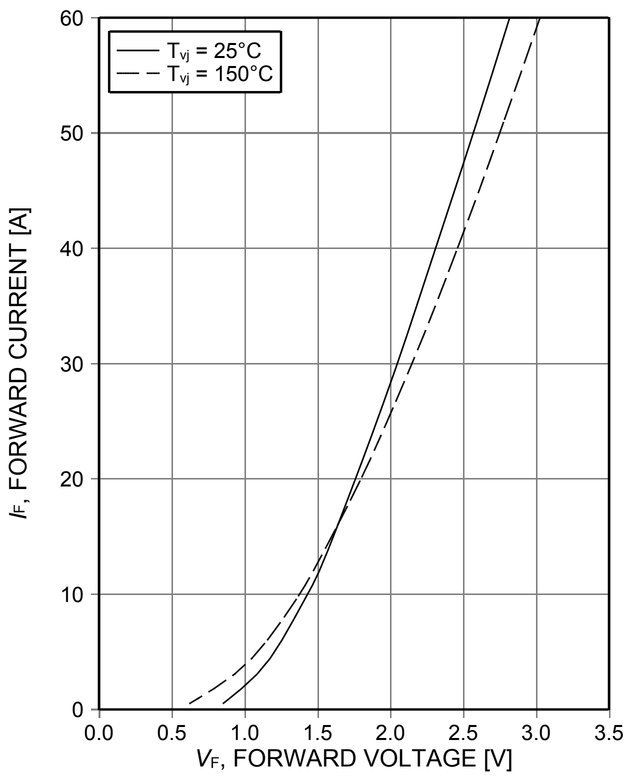


Figure 24. **Typical diode forward current as a function of forward voltage**

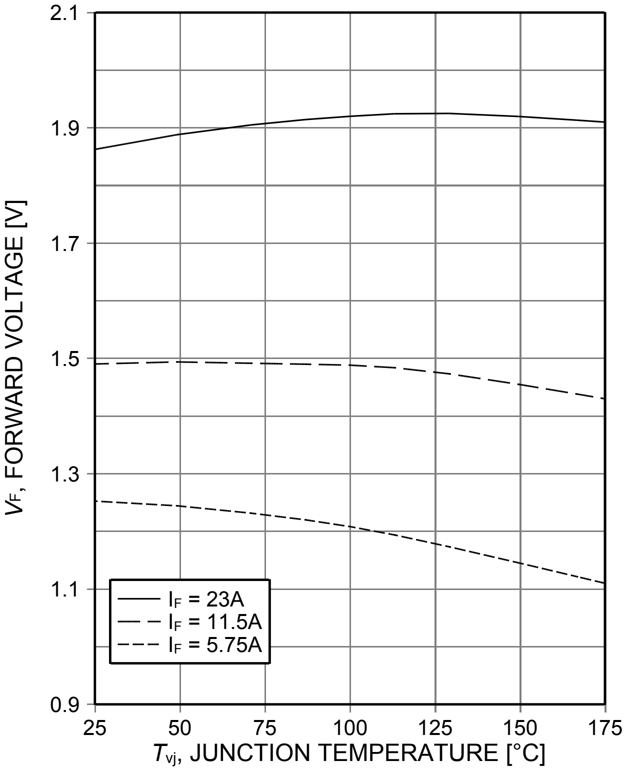
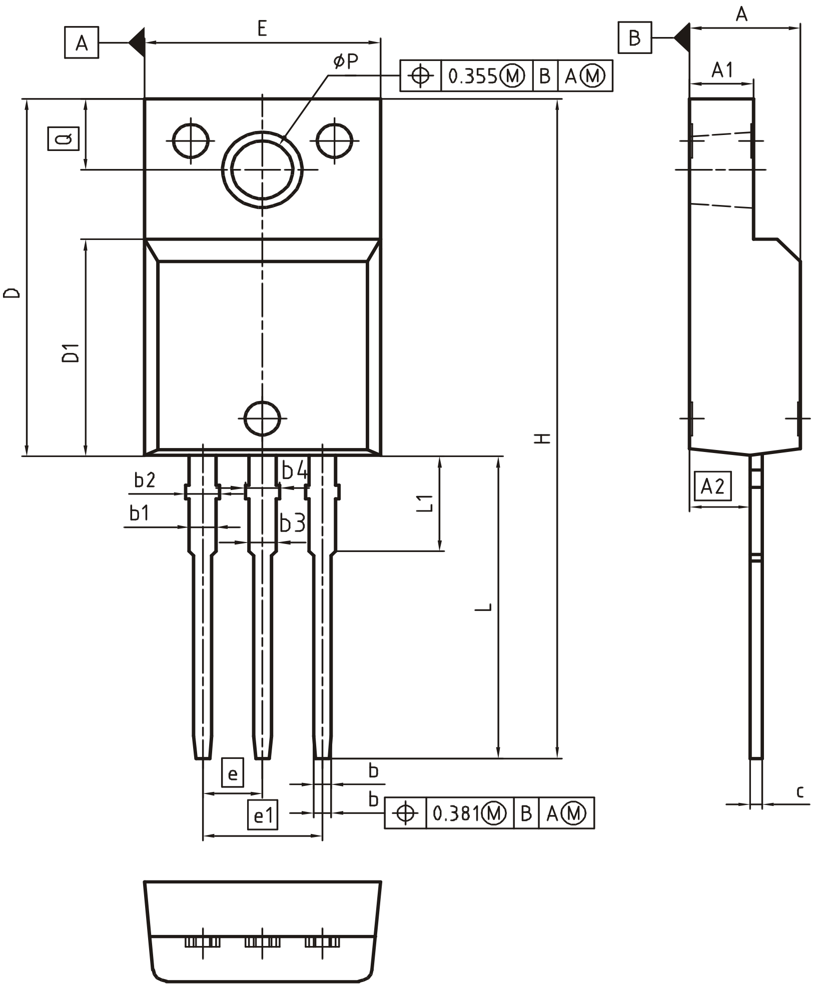


Figure 25. **Typical diode forward voltage as a function of junction temperature**

Package Drawing PG-TO220-3-FP



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.55	4.85	0.179	0.191
A1	2.55	2.85	0.100	0.112
A2	2.42	2.72	0.095	0.107
b	0.65	0.85	0.026	0.033
b1	0.95	1.33	0.037	0.052
b2	0.95	1.51	0.037	0.059
b3	0.65	1.33	0.026	0.052
b4	0.65	1.51	0.026	0.059
c	0.40	0.63	0.016	0.025
D	15.85	16.15	0.624	0.636
D1	9.53	9.83	0.375	0.387
E	10.35	10.65	0.407	0.419
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H	29.45	29.75	1.159	1.171
L	13.45	13.75	0.530	0.541
L1	3.15	3.45	0.124	0.136
øP	2.95	3.20	0.116	0.126
Q	3.15	3.50	0.124	0.138

DOCUMENT NO.
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EUROPEAN PROJECTION
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REVISION 03

Testing Conditions

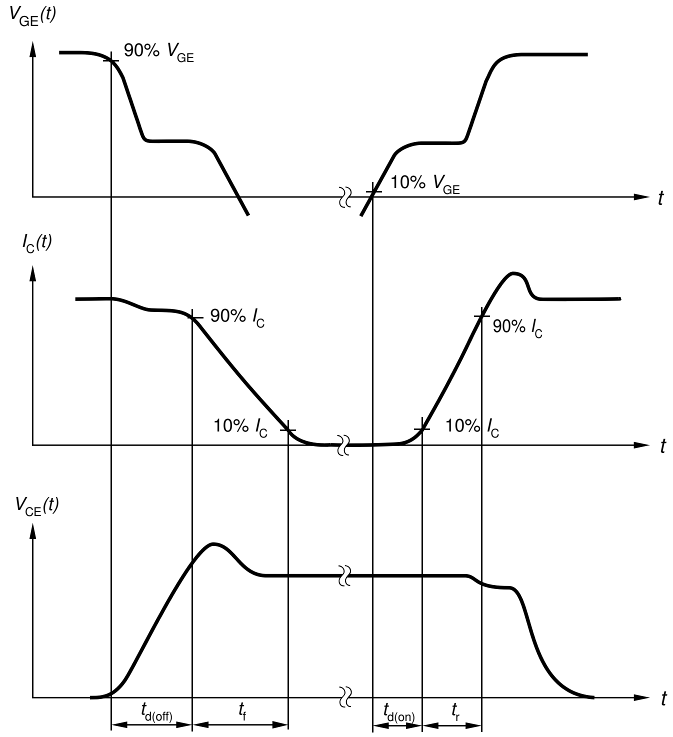

Figure A. **Definition of switching times**

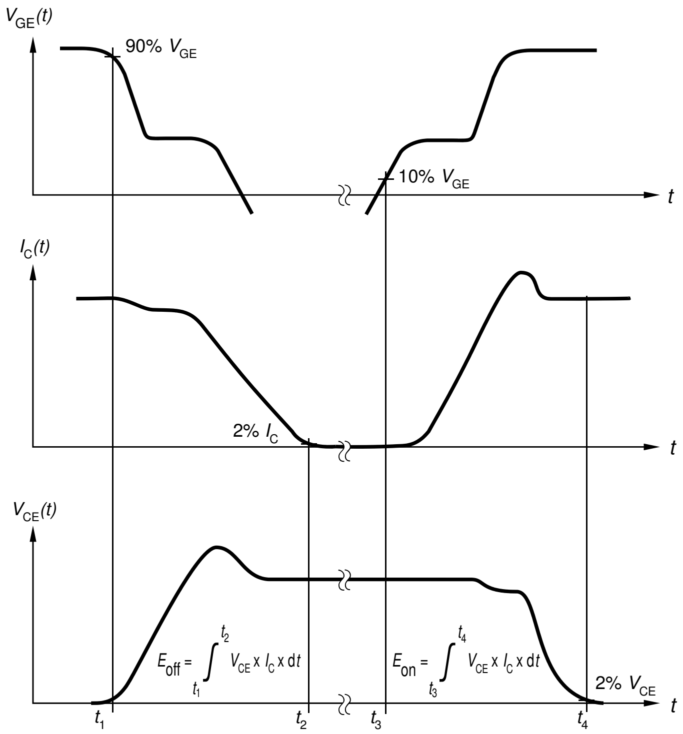

Figure B. **Definition of switching losses**

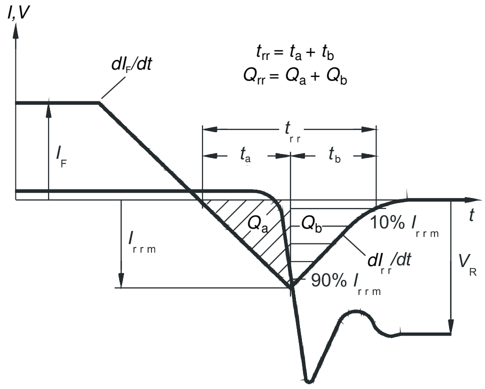

Figure C. **Definition of diode switching characteristics**

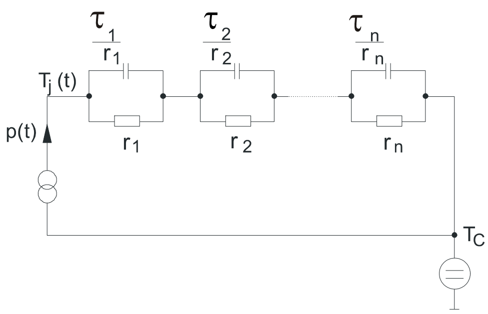

Figure D. **Thermal equivalent circuit**

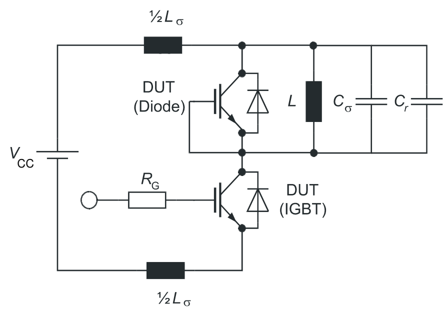

Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

IKA15N65ET6

Revision: 2017-11-30, Rev. 2.2

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2017-09-11	Final Datasheet
2.2	2017-11-30	New Gfs Value at VCE=20V

Trademarks

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Живое партнерство

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- *Специальные условия для постоянных клиентов.*
- *Подбор аналогов.*
- *Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.*

- *Приемлемые сроки поставки, возможна ускоренная поставка.*
- *Доставку товара в любую точку России и стран СНГ.*
- *Комплексную поставку.*
- *Работу по проектам и поставку образцов.*
- *Формирование склада под заказчика.*

- *Сертификаты соответствия на поставляемую продукцию (по желанию клиента).*
- *Тестирование поставляемой продукции.*
- *Поставку компонентов, требующих военную и космическую приемку.*
- *Входной контроль качества.*
- *Наличие сертификата ISO.*

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- *Регистрацию проекта у производителя компонентов.*
- *Техническую поддержку проекта.*
- *Защиту от снятия компонента с производства.*
- *Оценку стоимости проекта по компонентам.*
- *Изготовление тестовой платы монтаж и пусконаладочные работы.*

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