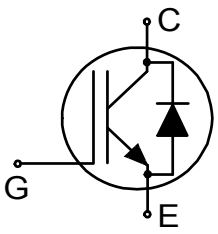
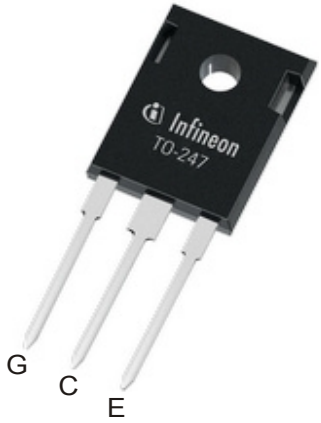
Sixth generation, high speed soft switching series

High speed soft switching TRENCHSTOP™ IGBT 6 in Trench and Fieldstop technology copacked with soft and fast recovery anti-parallel diode



Features:

1200V TRENCHSTOP™ IGBT6 technology offering:
• High efficiency in hard switching and resonant topologies
• Easy paralleling capability due to positive temperature coefficient in V_{CEsat}
• 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
• 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
IKW40N120CS6	1200V	40A	1.85V	175°C	K40MCS6	PG-TO247-3

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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}	1200	V
DC collector current, limited by T_{vjmax} $T_c = 25°C$ $T_c = 100°C$	I_C	 80.0 40.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	160.0	A
Turn off safe operating area $V_{CE} \leq 1200V$, $T_{vj} \leq 175°C$	-	160.0	A
Diode forward current, limited by T_{vjmax} $T_c = 25°C$ $T_c = 100°C$	I_F	 80.0 40.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	160.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 0.5\mu s$, $D < 0.001$)	V_{GE}	±20 25	V
Short circuit withstand time $V_{GE} = 15.0V$, $V_{CC} \leq 500V$ 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}	500.0 250.0	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, M3 screw Maximum of mounting processes: 3	M	0.6	Nm

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R_{th} Characteristics						
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		-	-	0.30	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		-	-	0.78	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		-	-	40	K/W

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Static Characteristic						
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 40.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	 - - -	 1.85 2.15 2.25	 2.15 - -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 40.0A T_{vj} = 25°C T_{vj} = 175°C	 - -	 2.20 2.25	 2.55 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 1.90mA, V_{CE} = V_{GE}	5.1	5.7	6.3	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 1200V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	 - -	 - 1600	 850 -	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	600	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 40.0A	-	32.0	-	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	-	2700	-	pF
Output capacitance	C_{oes}		-	185	-	
Reverse transfer capacitance	C_{res}		-	120	-	
Gate charge	Q_G	V_{CC} = 960V, I_C = 40.0A, V_{GE} = 15V	-	285.0	-	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 = 40.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 9.0Ω, $R_{G(off)}$ = 9.0Ω, Lσ = 70nH, Cσ = 67pF Lσ, Cσ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	27	-	ns
Rise time	t_r		-	39	-	ns
Turn-off delay time	$t_{d(off)}$		-	315	-	ns
Fall time	t_f		-	27	-	ns
Turn-on energy	E_{on}		-	2.55	-	mJ
Turn-off energy	E_{off}		-	1.55	-	mJ
Total switching energy	E_{ts}		-	4.10	-	mJ

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

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 600V, I_F = 40.0A, di_F/dt = 700A/µs, $L\sigma$ = 70nH, $C\sigma$ = 67pF	-	400	-	ns
Diode reverse recovery charge	Q_{rr}		-	2.65	-	µC
Diode peak reverse recovery current	I_{rrm}		-	18.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-65	-	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 = 40.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 9.0Ω, $R_{G(off)}$ = 9.0Ω, $L\sigma$ = 70nH, $C\sigma$ = 67pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	27	-	ns
Rise time	t_r		-	38	-	ns
Turn-off delay time	$t_{d(off)}$		-	390	-	ns
Fall time	t_f		-	55	-	ns
Turn-on energy	E_{on}		-	3.50	-	mJ
Turn-off energy	E_{off}		-	2.95	-	mJ
Total switching energy	E_{ts}		-	6.45	-	mJ

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

Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 600V, I_F = 40.0A, di_F/dt = 800A/µs, $L\sigma$ = 70nH, $C\sigma$ = 67pF	-	720	-	ns
Diode reverse recovery charge	Q_{rr}		-	6.40	-	µC
Diode peak reverse recovery current	I_{rrm}		-	27.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-70	-	A/µs

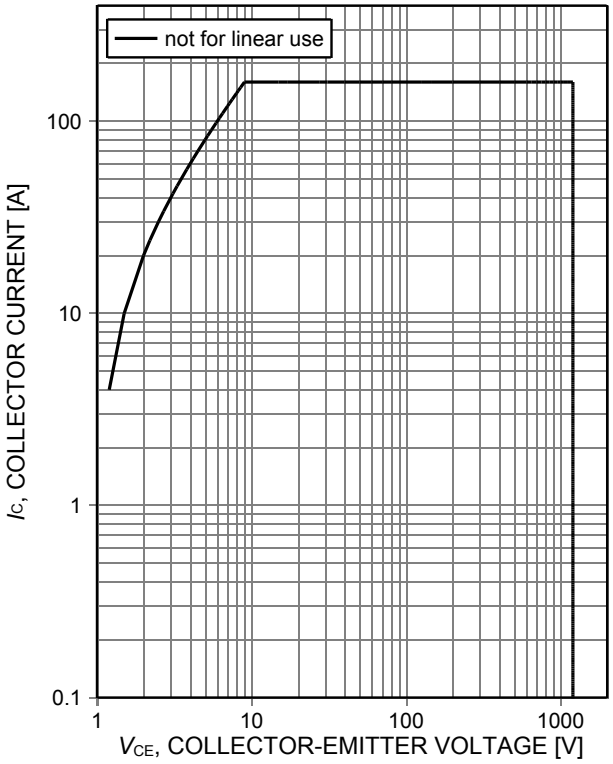


Figure 1. **Forward bias safe operating area** (D=0, T_{vj}≤175°C; V_{GE}=15V, pulse width limited by T_{vjmax})

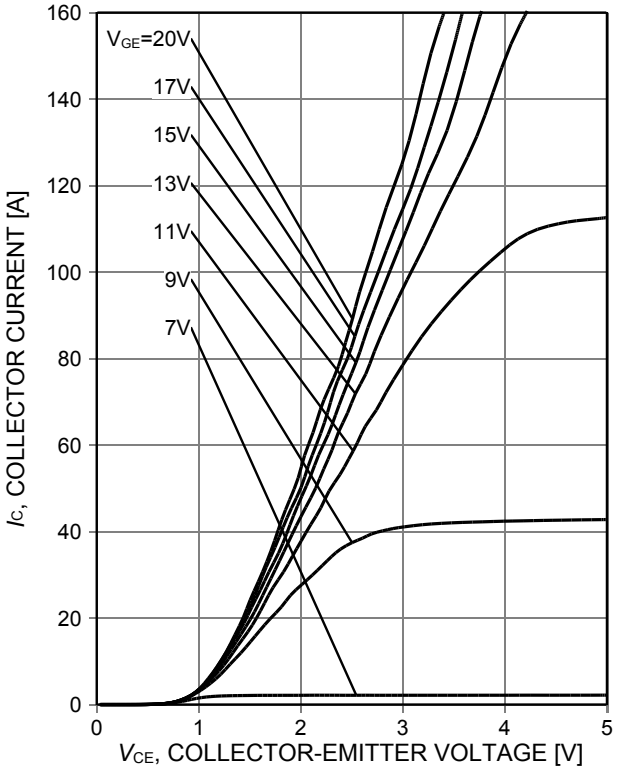


Figure 2. **Typical output characteristic** (T_{vj}=25°C)

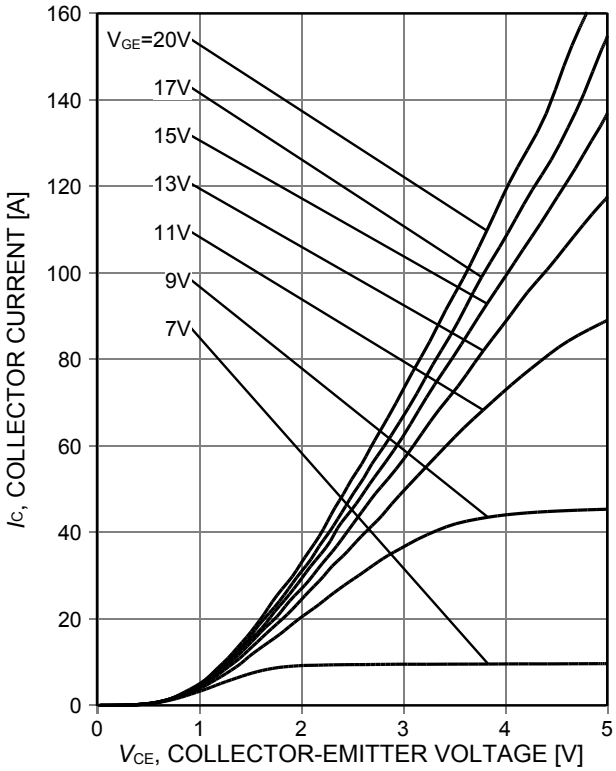


Figure 3. **Typical output characteristic** (T_{vj}=175°C)

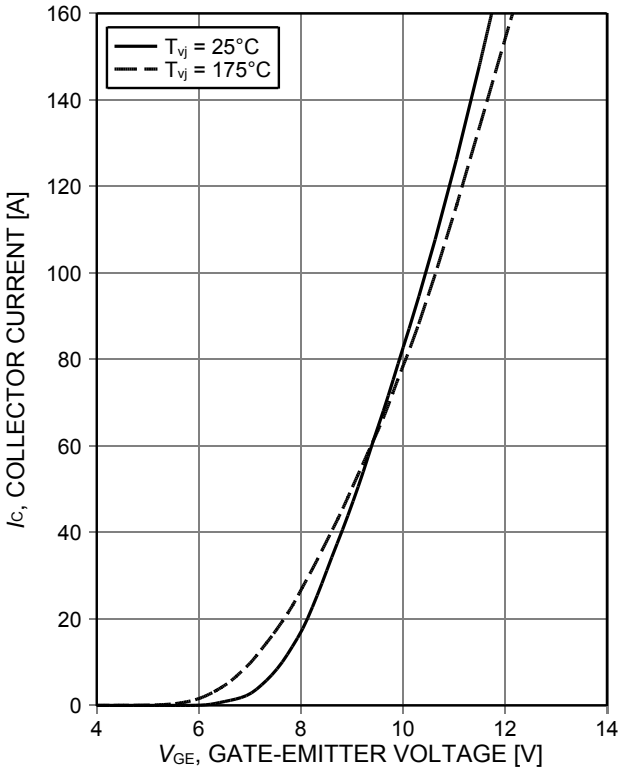


Figure 4. **Typical transfer characteristic** (V_{CE}=20V)

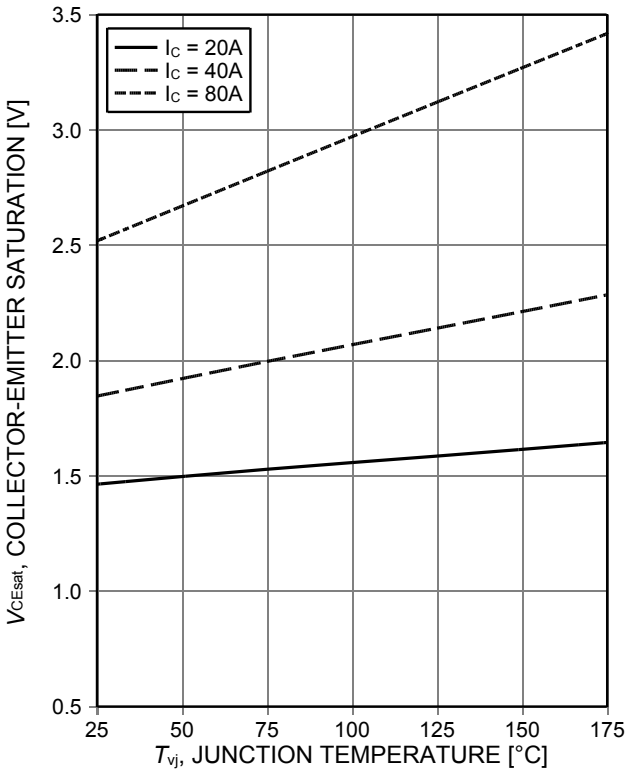


Figure 5. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

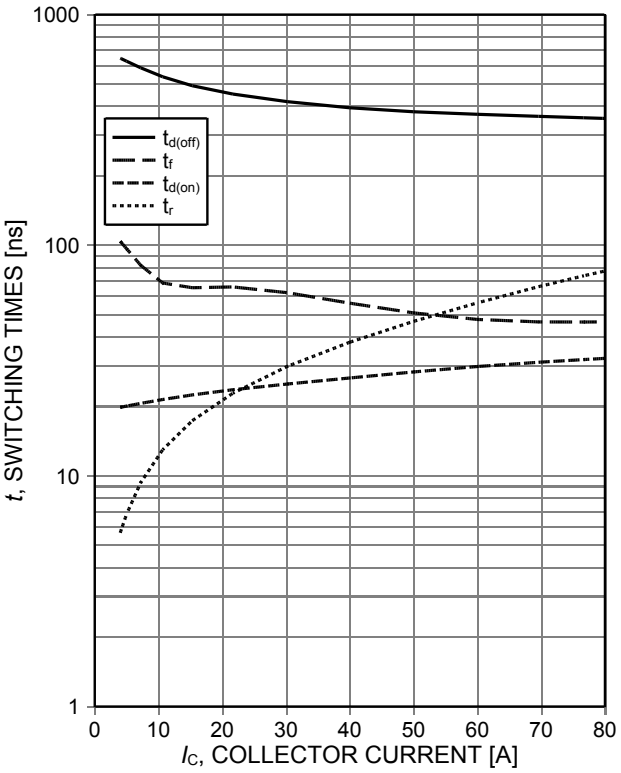


Figure 6. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=0/15V, R_G=9Ω, Dynamic test circuit in Figure E)

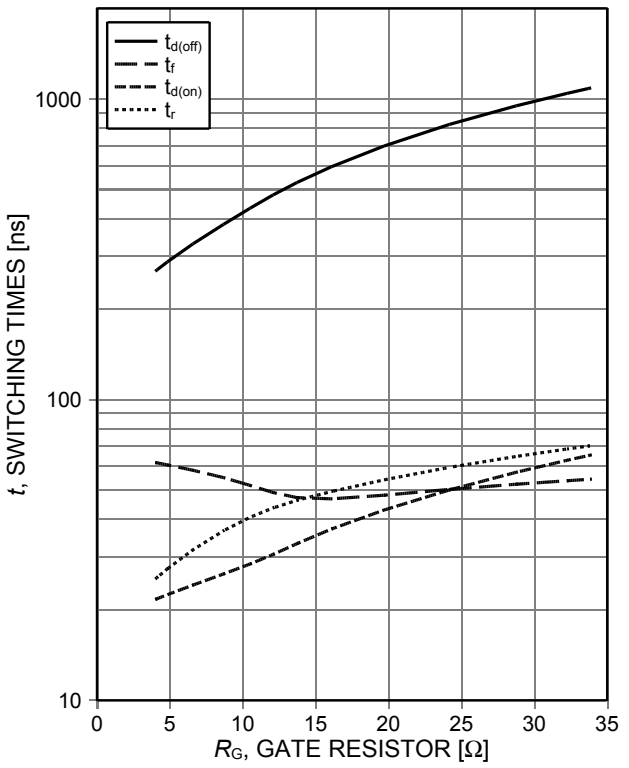


Figure 7. **Typical switching times as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=0/15V, I_C=40A, Dynamic test circuit in Figure E)

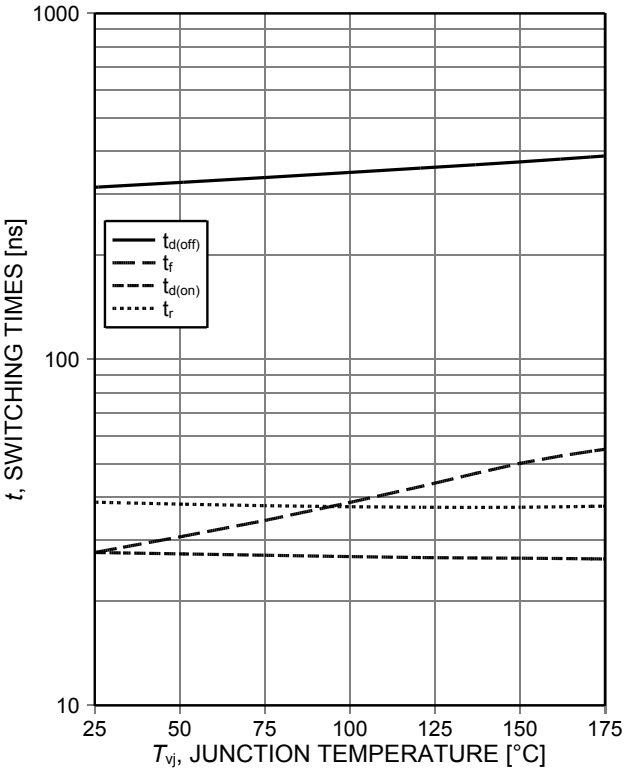


Figure 8. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=600V, V_{GE}=0/15V, I_C=40A, R_G=9Ω, Dynamic test circuit in Figure E)

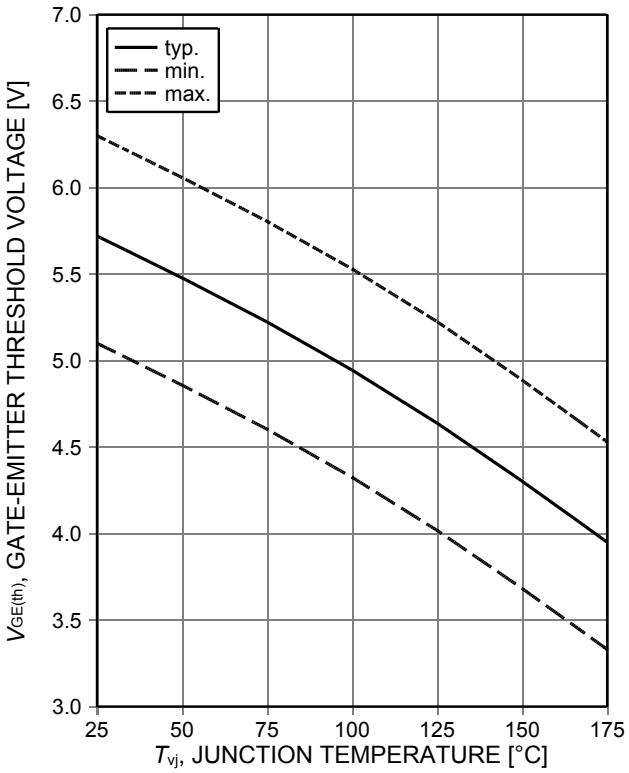


Figure 9. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=1.9mA)

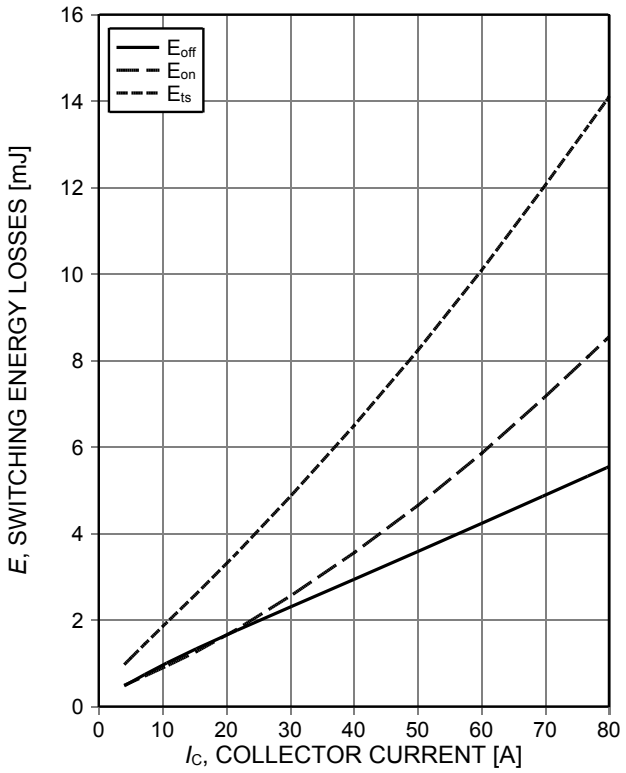


Figure 10. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=0/15V, R_G=9Ω, Dynamic test circuit in Figure E)

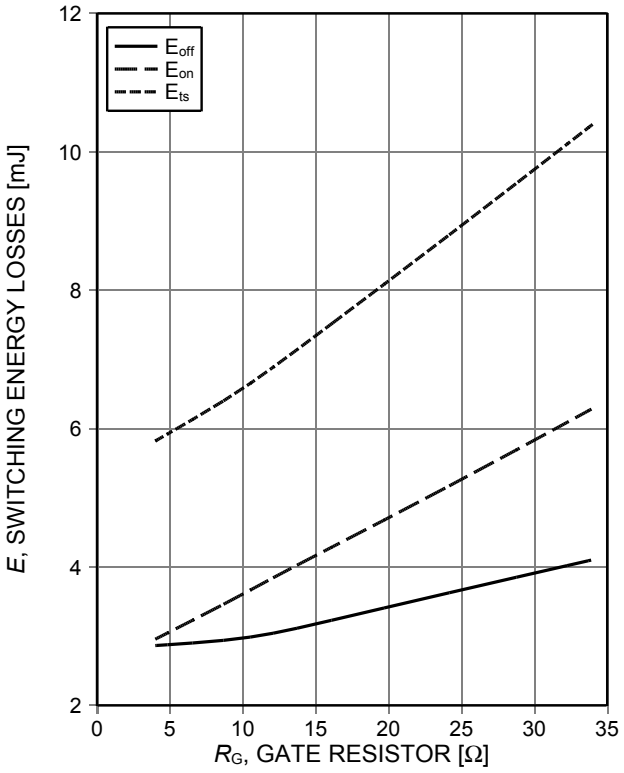


Figure 11. **Typical switching energy losses as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=0/15V, I_C=40A, Dynamic test circuit in Figure E)

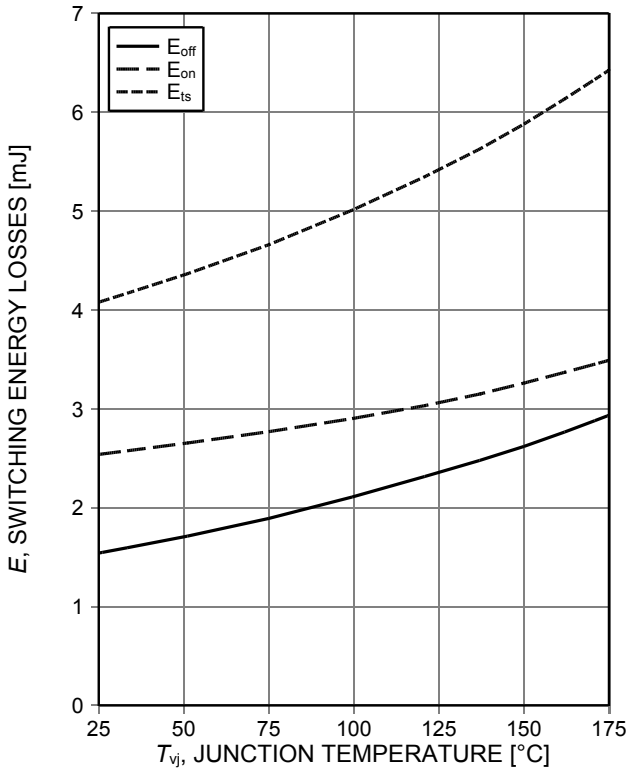


Figure 12. **Typical switching energy losses as a function of junction temperature**
(inductive load, V_{CE}=600V, V_{GE}=0/15V, I_C=40A, R_G=9Ω, Dynamic test circuit in Figure E)

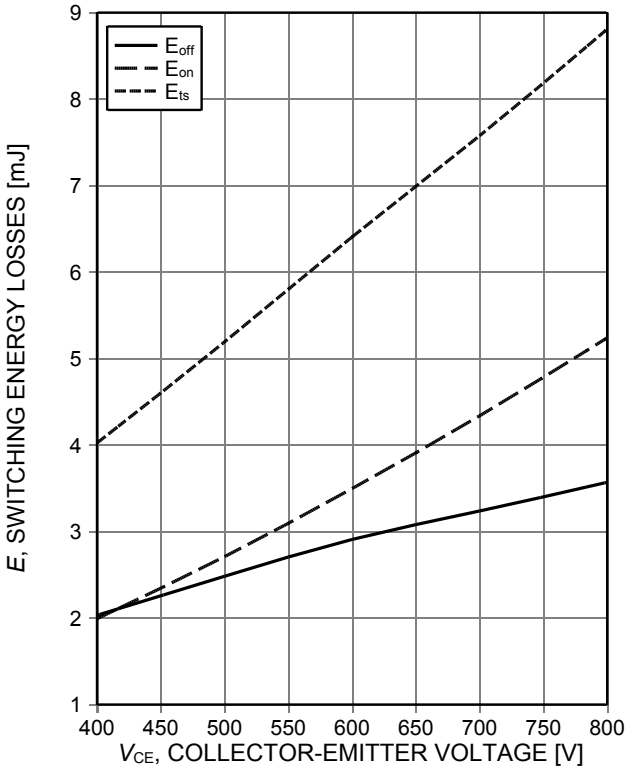


Figure 13. **Typical switching energy losses as a function of collector emitter voltage** (inductive load, T_{vj}=175°C, V_{GE}=0/15V, I_C=40A, R_G=9Ω, Dynamic test circuit in Figure E)

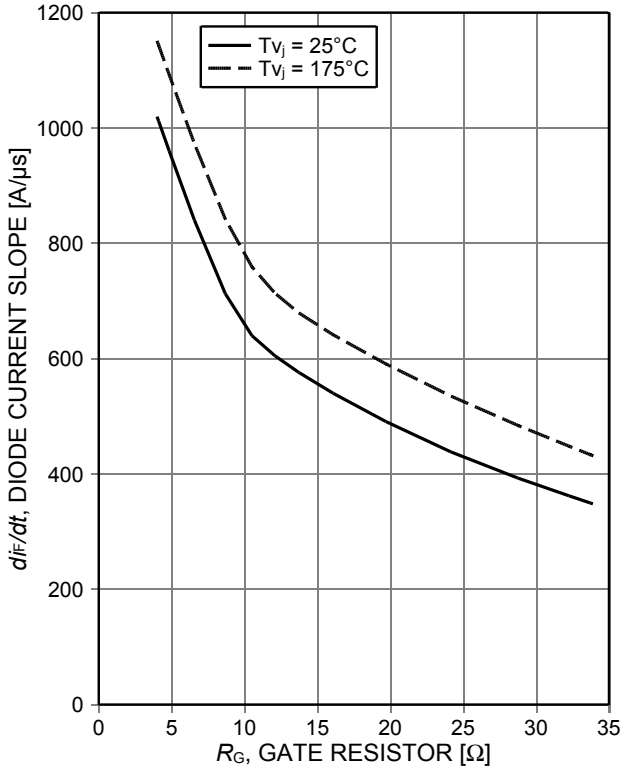


Figure 14. **Typical diode current slope as a function of gate resistor** (inductive load, V_{CE}=600V, V_{GE}=0/15V, I_C=40A, Dynamic test circuit in Figure E)

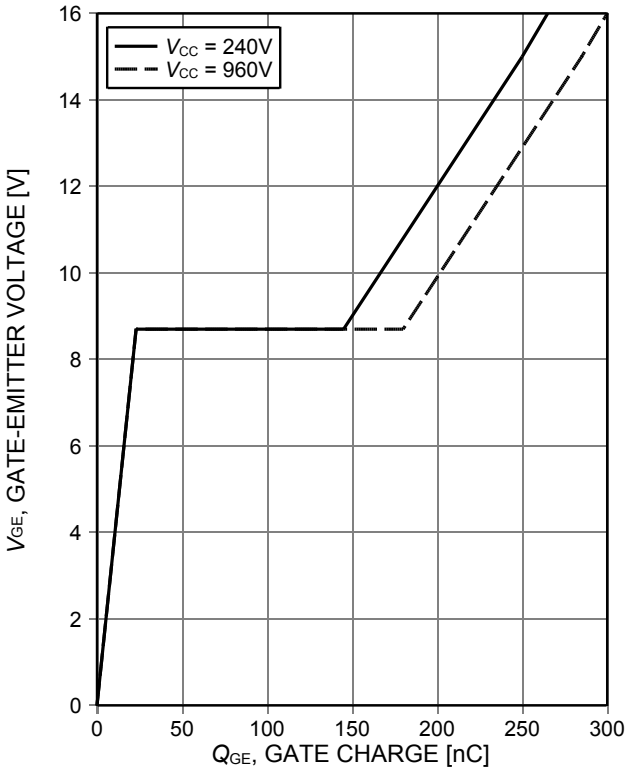


Figure 15. **Typical gate charge** (I_C=40A)

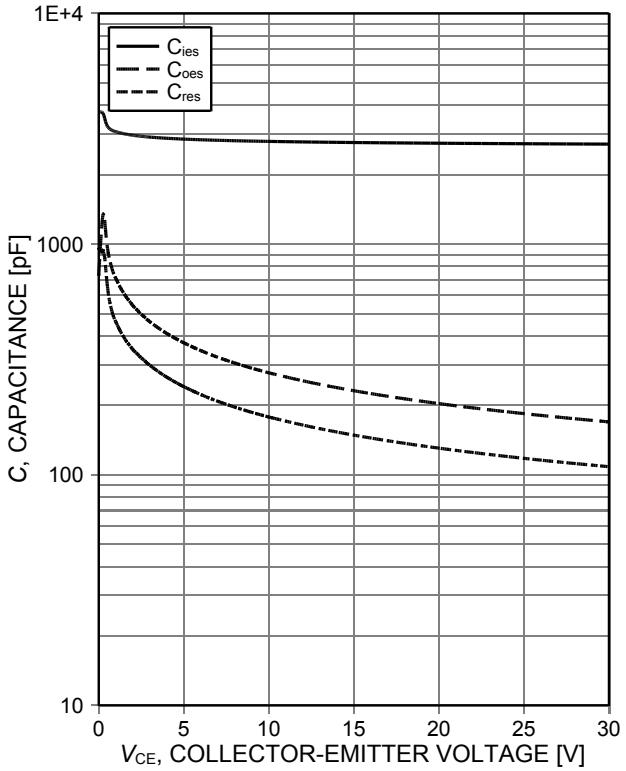


Figure 16. **Typical capacitance as a function of collector-emitter voltage** (V_{GE}=0V, f=1MHz)

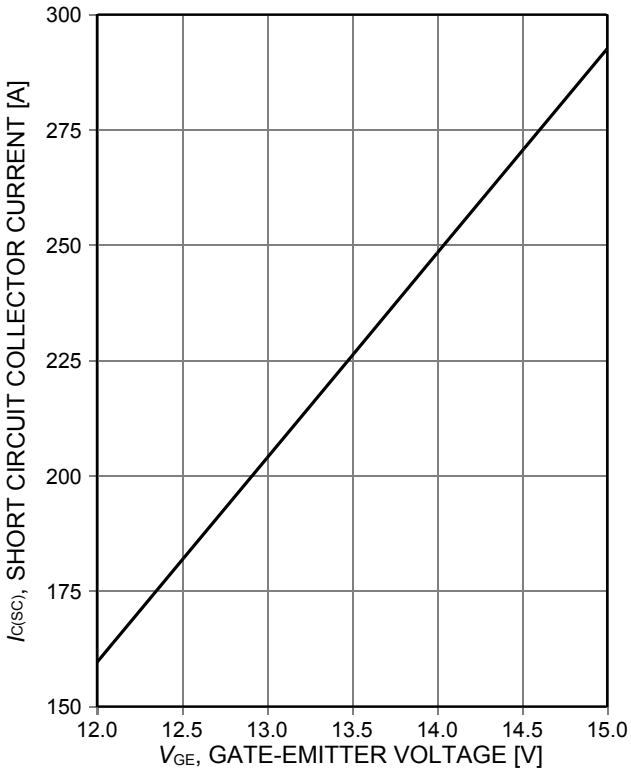


Figure 17. **Typical short circuit collector current as a function of gate-emitter voltage**
(V_{CE}≤500V, T_{vj}≤175°C)

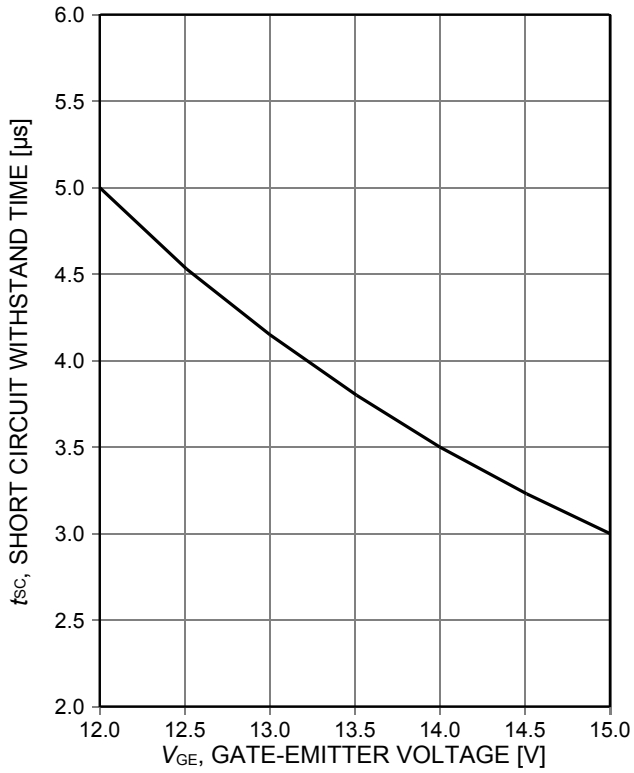


Figure 18. **Short circuit withstand time as a function of gate-emitter voltage**
(V_{CE}≤500V, start at T_{vj}≤175°C)

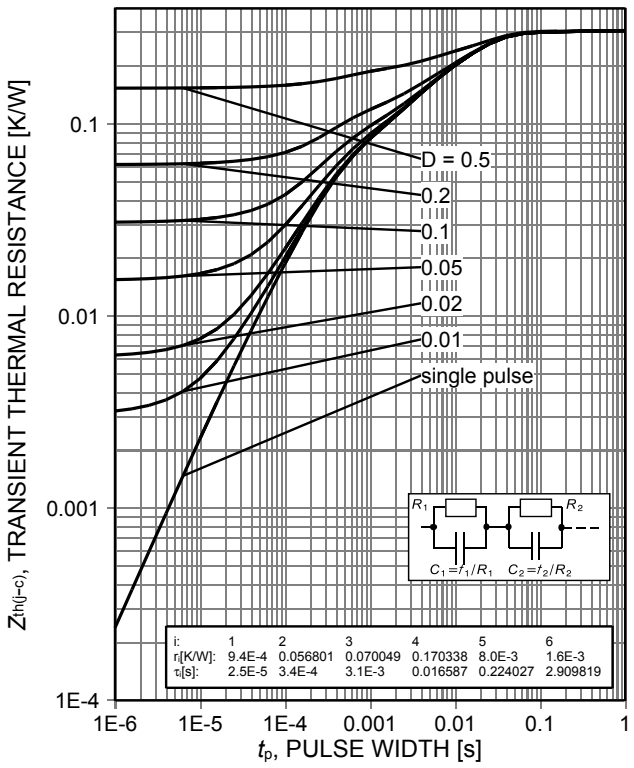


Figure 19. **IGBT transient thermal resistance**
($D=t_p/T$)

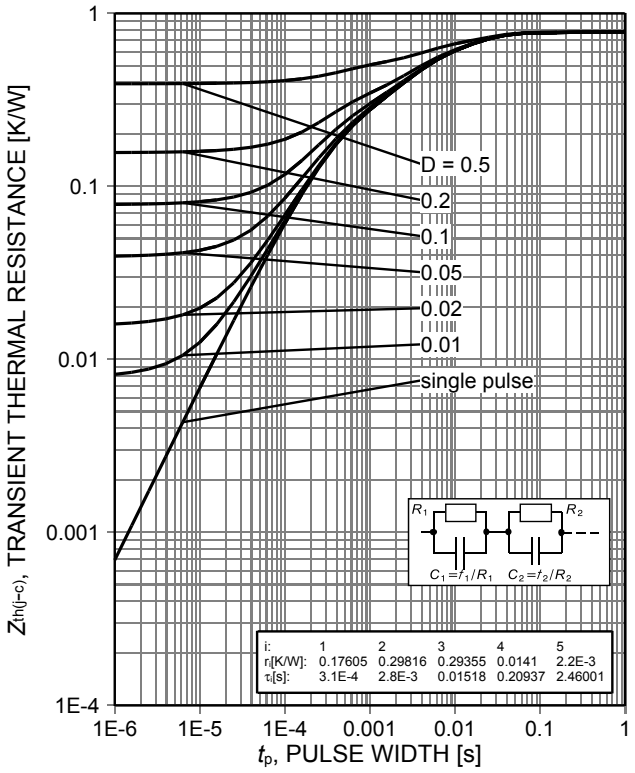


Figure 20. **Diode transient thermal impedance as a function of pulse width**
($D=t_p/T$)

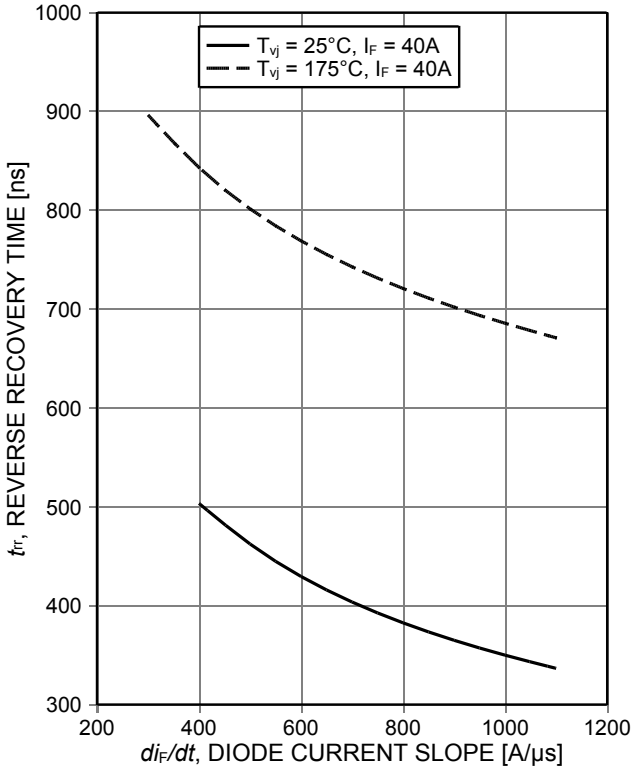


Figure 21. **Typical reverse recovery time as a function of diode current slope**
(V_R=600V)

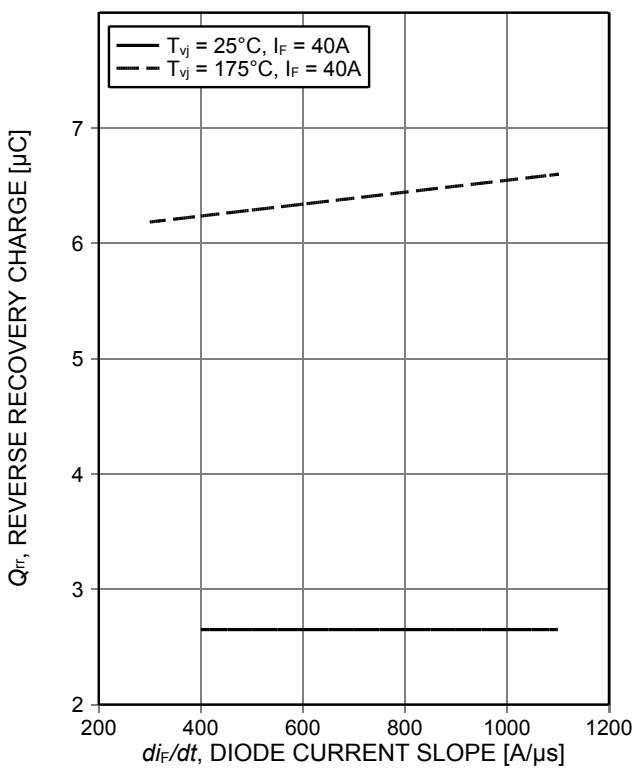


Figure 22. **Typical reverse recovery charge as a function of diode current slope**
(V_R=600V)

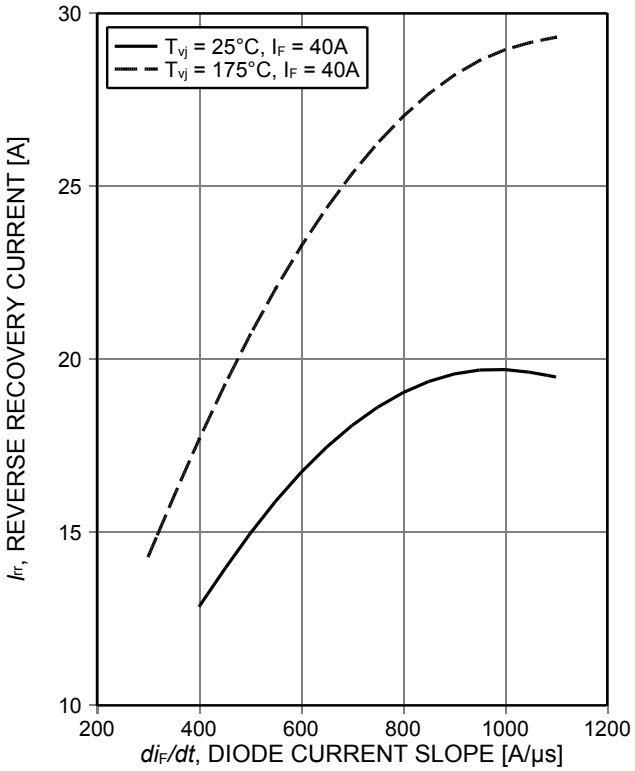


Figure 23. **Typical reverse recovery current as a function of diode current slope**
(V_R=600V)

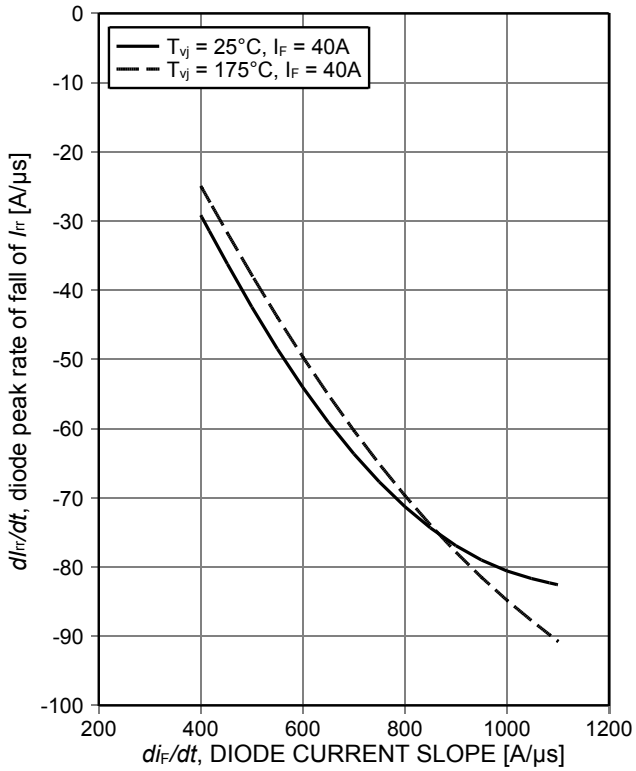


Figure 24. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=600V)

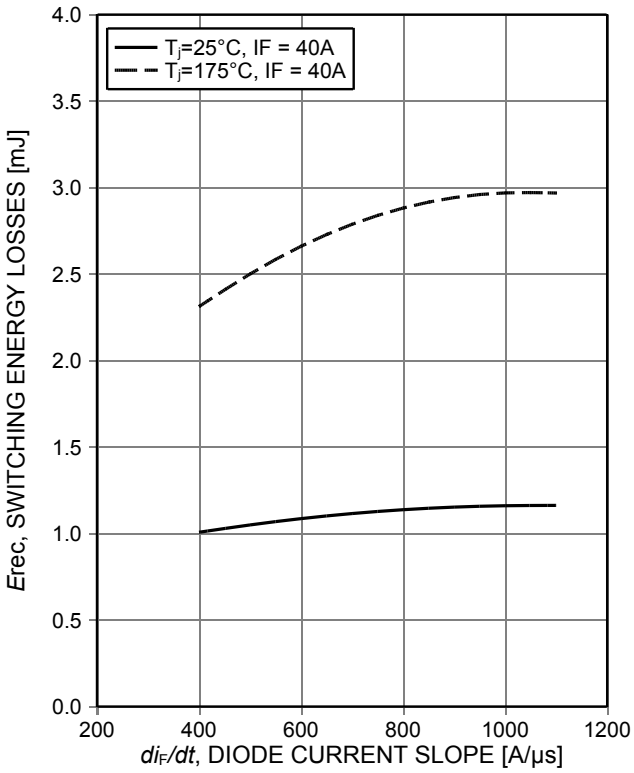


Figure 25. **Typical reverse energy losses as a function of diode current slope**
(V_R=600V)

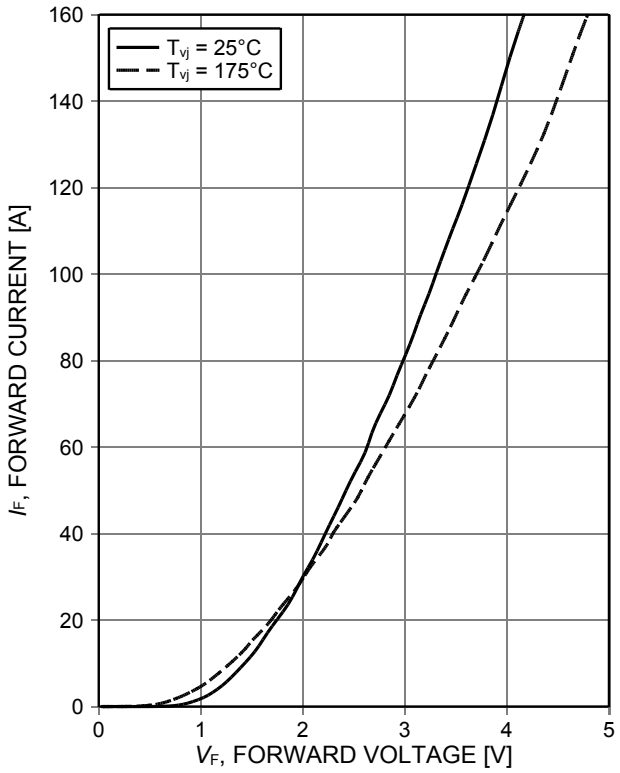


Figure 26. **Typical diode forward current as a function of forward voltage**

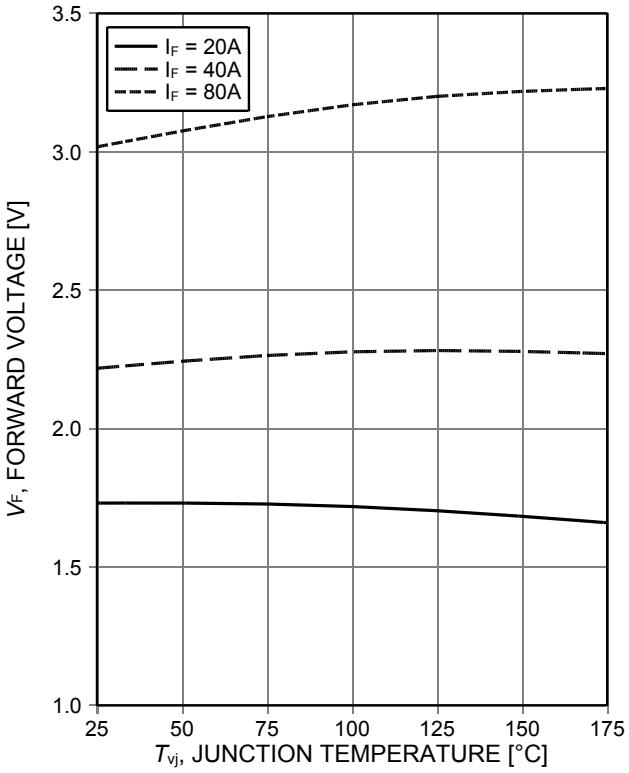
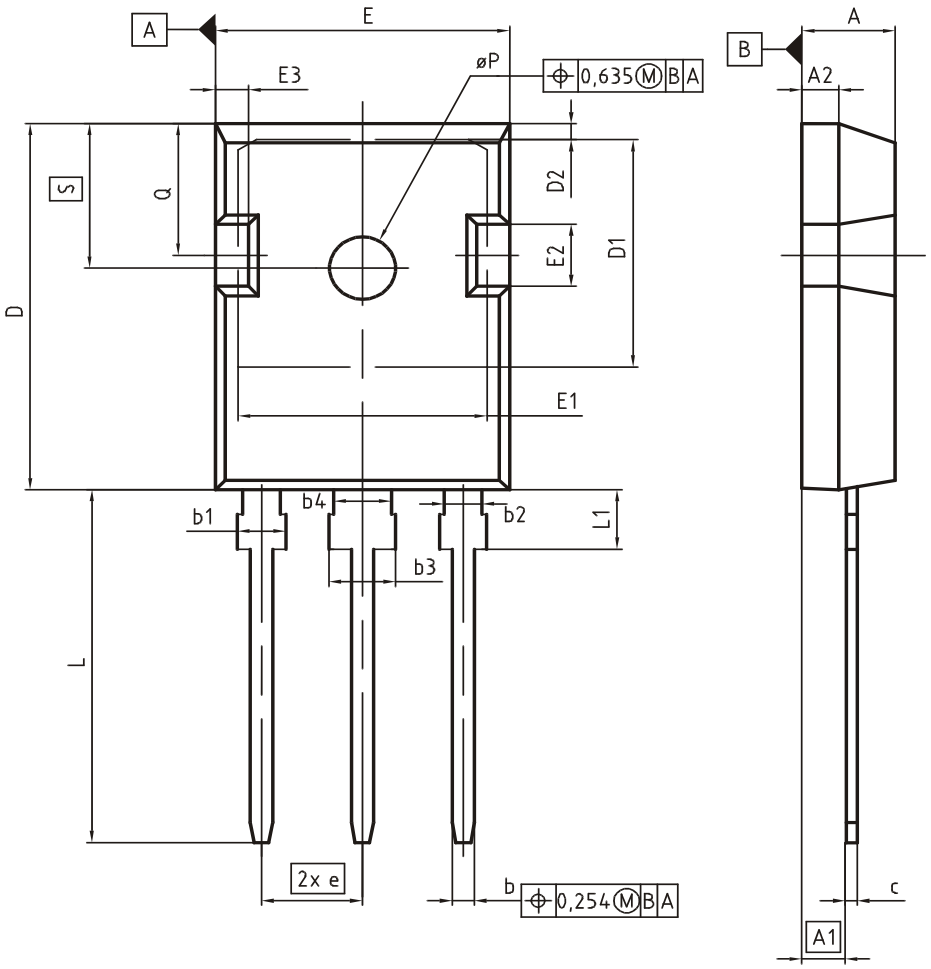


Figure 27. **Typical diode forward voltage as a function of junction temperature**

Package Drawing PG-TO247-3



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.35	0.037	0.053
E	15.70	16.13	0.618	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	2.60	0.039	0.102
e	5.44 (BSC)		0.214 (BSC)	
N	3		3	
L	19.80	20.32	0.780	0.800
L1	4.10	4.47	0.161	0.176
øP	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

DOCUMENT NO.	Z8B00003327
SCALE	0 5 5 7.5mm
EUROPEAN PROJECTION	
ISSUE DATE	09-07-2010
REVISION	05

Testing Conditions

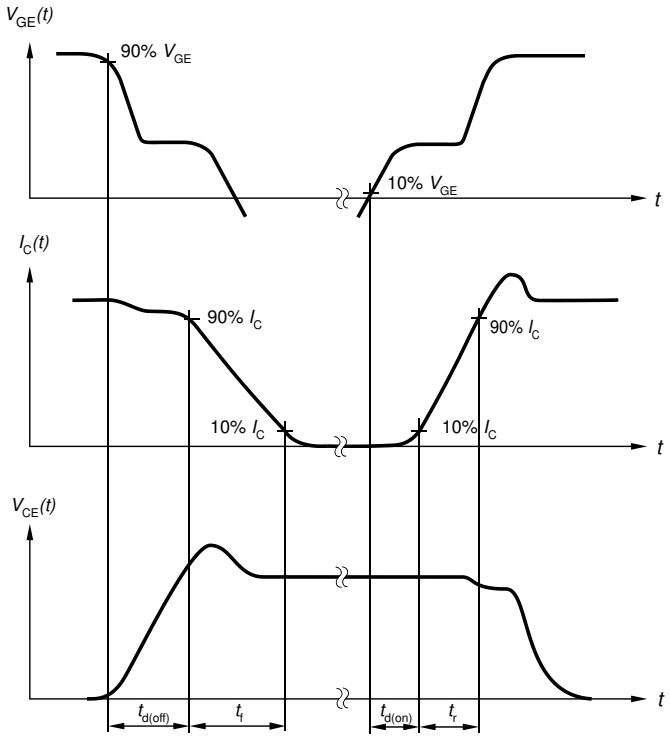


Figure A. **Definition of switching times**

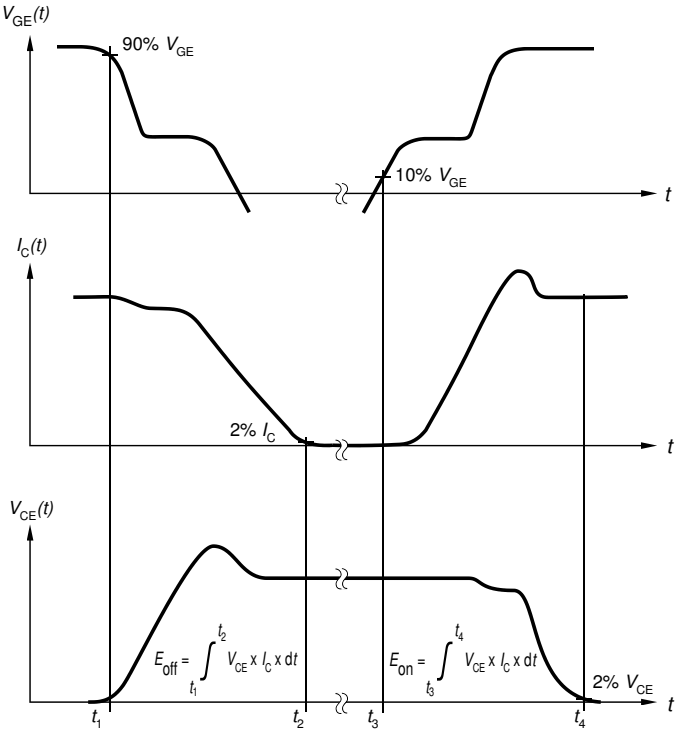


Figure B. **Definition of switching losses**

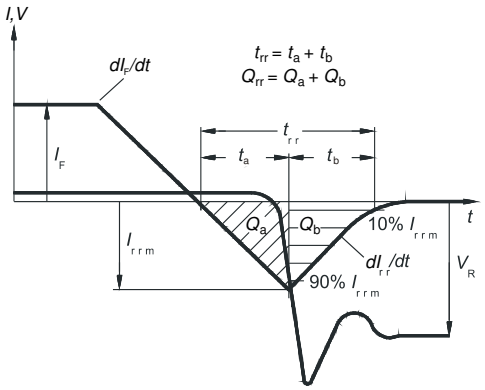


Figure C. **Definition of diode switching characteristics**

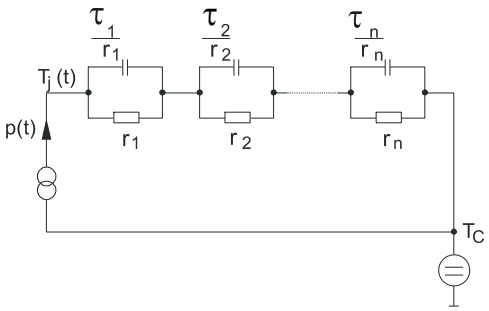


Figure D. **Thermal equivalent circuit**

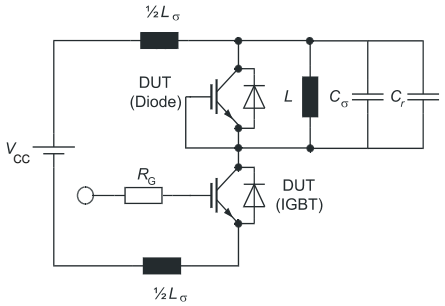


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

IKW40N120CS6

Revision: 2018-05-07, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2018-05-07	Final data sheet

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