

IGBT

High speed DuoPack: IGBT in Trench and Fieldstop technology with soft, fast recovery anti-parallel diode

IKB20N60H3

600V high speed switching series third generation

Data sheet

High speed IGBT in Trench and Fieldstop technology

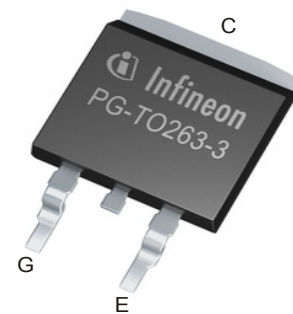
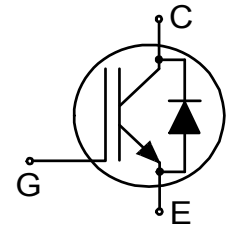
Features:

TRENCHSTOP™ technology offering

- very low V_{CEsat}
- low EMI
- Very soft, fast recovery anti-parallel diode
- maximum junction temperature 175°C
- qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- complete product spectrum and PSpice Models:
<http://www.infineon.com/igbt/>

Applications:

- uninterruptible power supplies
- welding converters
- converters with high switching frequency



Key Performance and Package Parameters

Type	V_{CE}	I_C	$V_{CEsat}, T_{vj}=25^{\circ}C$	T_{vjmax}	Marking	Package
IKB20N60H3	600V	20A	1.95V	175°C	K20H603	PG-TO263-3



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Maximum ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_{vj} \geq 25^{\circ}\text{C}$	V_{CE}	600	V
DC collector current, limited by T_{vjmax} $T_C = 25^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$	I_C	40.0 20.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	80.0	A
Turn off safe operating area $V_{CE} \leq 600\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}$	-	80.0	A
Diode forward current, limited by T_{vjmax} $T_C = 25^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$	I_F	20.0 10.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	80.0	A
Gate-emitter voltage	V_{GE}	± 20	V
Short circuit withstand time $V_{GE} = 15.0\text{V}$, $V_{CC} \leq 400\text{V}$ Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0\text{s}$ $T_{vj} = 150^{\circ}\text{C}$	t_{SC}	5	μs
Power dissipation $T_C = 25^{\circ}\text{C}$ Power dissipation $T_C = 100^{\circ}\text{C}$	P_{tot}	170.0 85.0	W
Operating junction temperature	T_{vj}	-40...+175	$^{\circ}\text{C}$
Storage temperature	T_{stg}	-55...+150	$^{\circ}\text{C}$
Soldering temperature, reflow soldering (MSL1 according to JEDEC J-STA-020)		260	$^{\circ}\text{C}$

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		0.88	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		1.89	K/W
Thermal resistance, min. footprint junction - ambient	$R_{th(j-a)}$		65	K/W
Thermal resistance, 6cm ² Cu on PCB junction - ambient	$R_{th(j-a)}$		40	K/W

Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0\text{V}, I_C = 2.00\text{mA}$	600	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	$V_{GE} = 15.0\text{V}, I_C = 20.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	1.95 2.30 2.50	2.40 -	V
Diode forward voltage	V_F	$V_{GE} = 0\text{V}, I_F = 10.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	1.65 1.67 1.65	2.05 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.29\text{mA}, V_{CE} = V_{GE}$	4.1	5.1	5.7	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 600\text{V}, V_{GE} = 0\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	-	40.0 1500.0	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{V}, V_{GE} = 20\text{V}$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE} = 20\text{V}, I_C = 20.0\text{A}$	-	10.9	-	S

Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristic						
Input capacitance	C_{ies}	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$	-	1100	-	pF
Output capacitance	C_{oes}		-	70	-	
Reverse transfer capacitance	C_{res}		-	32	-	
Gate charge	Q_G	$V_{CC} = 480\text{V}, I_C = 20.0\text{A},$ $V_{GE} = 15\text{V}$	-	120.0	-	nC
Short circuit collector current Max. 1000 short circuits Time between short circuits: $\geq 1.0\text{s}$	$I_{C(SC)}$	$V_{GE} = 15.0\text{V}, V_{CC} \leq 400\text{V},$ $t_{SC} \leq 5\mu\text{s}$ $T_{vj} = 150^{\circ}\text{C}$	-	120	-	A

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at $T_{vj} = 25^{\circ}\text{C}$						
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 20.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $r_G = 14.6\Omega, L_{\sigma} = 75\text{nH},$ $C_{\sigma} = 30\text{pF}$ L_{σ}, C_{σ} from Fig. E Energy losses include "tail" and diode reverse recovery.	-	16	-	ns
Rise time	t_r		-	20	-	ns
Turn-off delay time	$t_{d(off)}$		-	194	-	ns
Fall time	t_f		-	11	-	ns
Turn-on energy	E_{on}		-	0.45	-	mJ
Turn-off energy	E_{off}		-	0.24	-	mJ
Total switching energy	E_{ts}		-	0.69	-	mJ

Diode reverse recovery time	t_{rr}	$T_{vj} = 25^{\circ}\text{C}$, $V_R = 400\text{V}$, $I_F = 10.0\text{A}$, $di_F/dt = 1000\text{A}/\mu\text{s}$	-	112	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.39	-	μC
Diode peak reverse recovery current	I_{rrm}		-	11.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-750	-	$\text{A}/\mu\text{s}$

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	

IGBT Characteristic, at $T_{vj} = 175^{\circ}\text{C}$

Turn-on delay time	$t_{d(on)}$	$T_{vj} = 175^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 20.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $r_G = 14.6\Omega$, $L\sigma = 75\text{nH}$, $C\sigma = 30\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	16	-	ns
Rise time	t_r		-	15	-	ns
Turn-off delay time	$t_{d(off)}$		-	227	-	ns
Fall time	t_f		-	14	-	ns
Turn-on energy	E_{on}		-	0.60	-	mJ
Turn-off energy	E_{off}		-	0.36	-	mJ
Total switching energy	E_{ts}		-	0.96	-	mJ

Diode reverse recovery time	t_{rr}	$T_{vj} = 175^{\circ}\text{C}$, $V_R = 400\text{V}$, $I_F = 10.0\text{A}$, $di_F/dt = 1000\text{A}/\mu\text{s}$	-	191	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.91	-	μC
Diode peak reverse recovery current	I_{rrm}		-	14.2	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-500	-	$\text{A}/\mu\text{s}$

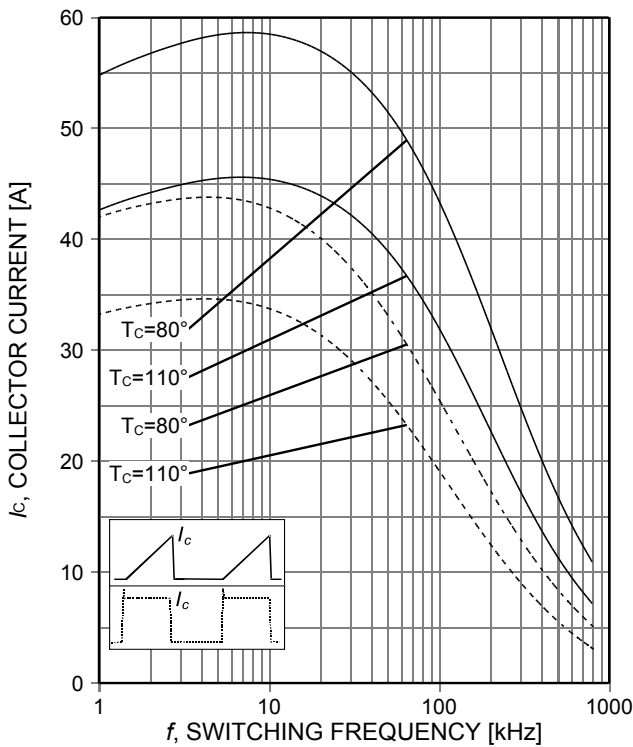


Figure 1. **Collector current as a function of switching frequency**
 ($T_j \leq 175^\circ\text{C}$, $D=0.5$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=14,6\Omega$)

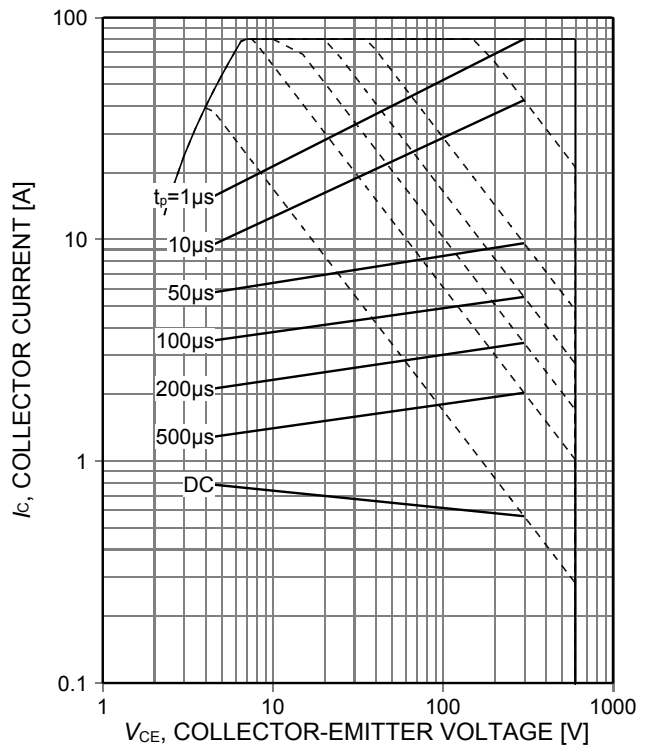


Figure 2. **Forward bias safe operating area**
 ($D=0$, $T_C=25^\circ\text{C}$, $T_j \leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$)

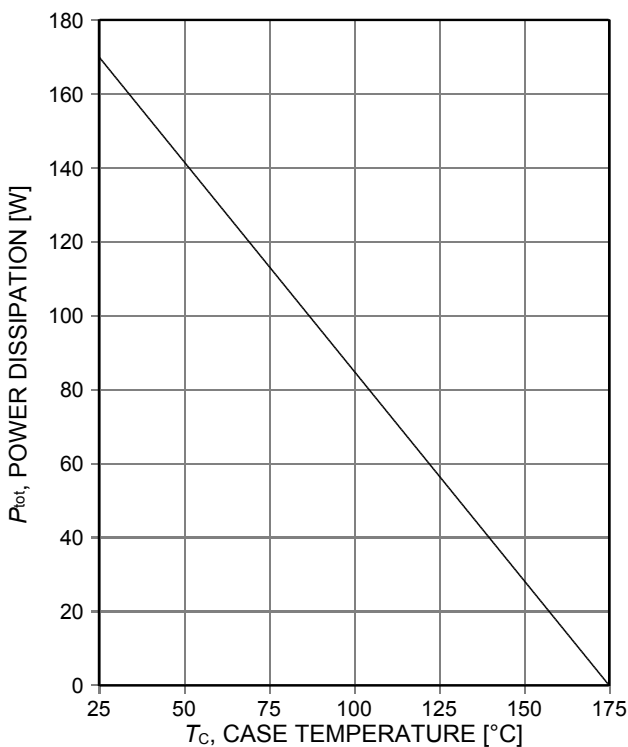


Figure 3. **Power dissipation as a function of case temperature**
 ($T_j \leq 175^\circ\text{C}$)

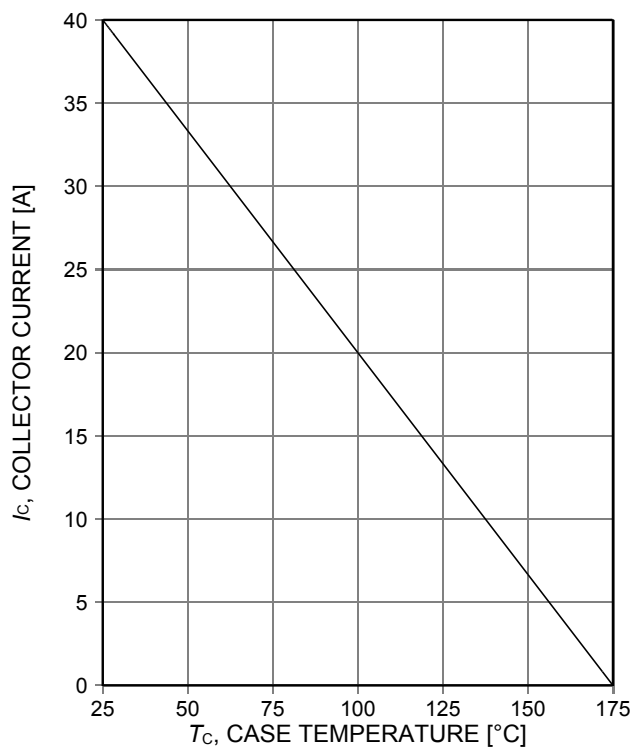


Figure 4. **Collector current as a function of case temperature**
 ($V_{GE} \geq 15\text{V}$, $T_j \leq 175^\circ\text{C}$)

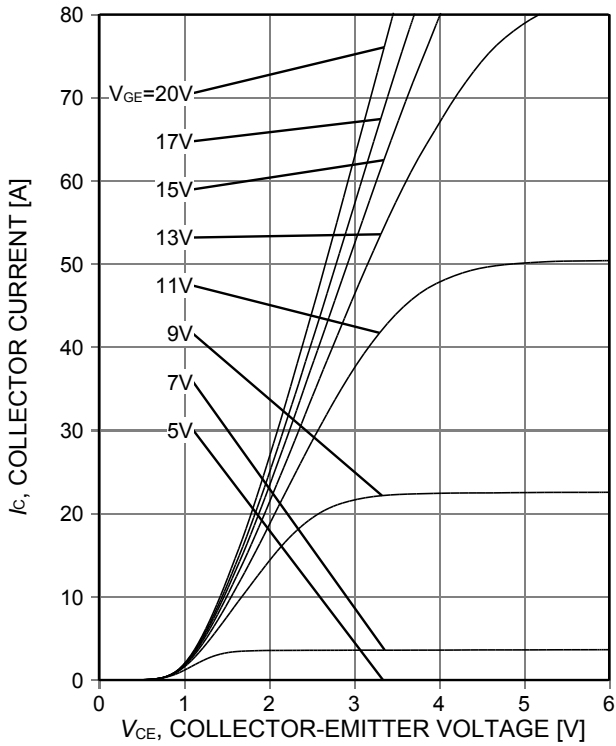


Figure 5. Typical output characteristic ($T_j=25^\circ\text{C}$)

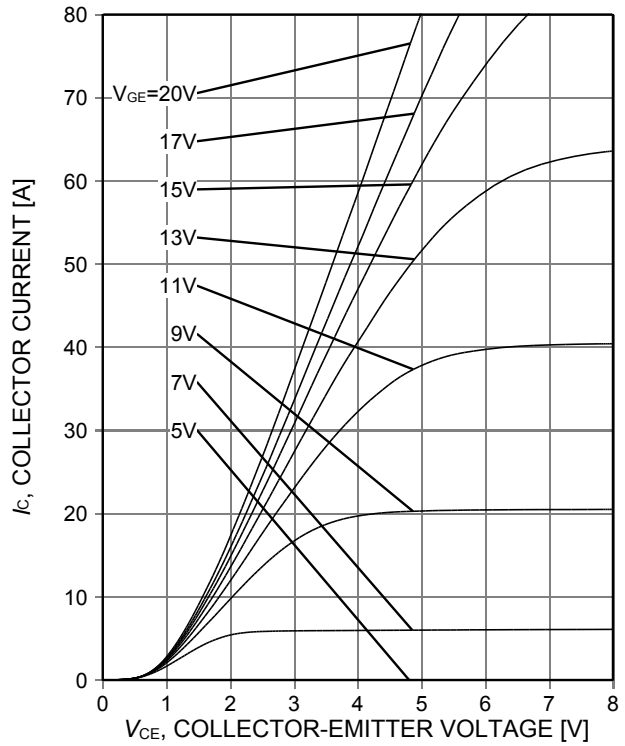


Figure 6. Typical output characteristic ($T_j=175^\circ\text{C}$)

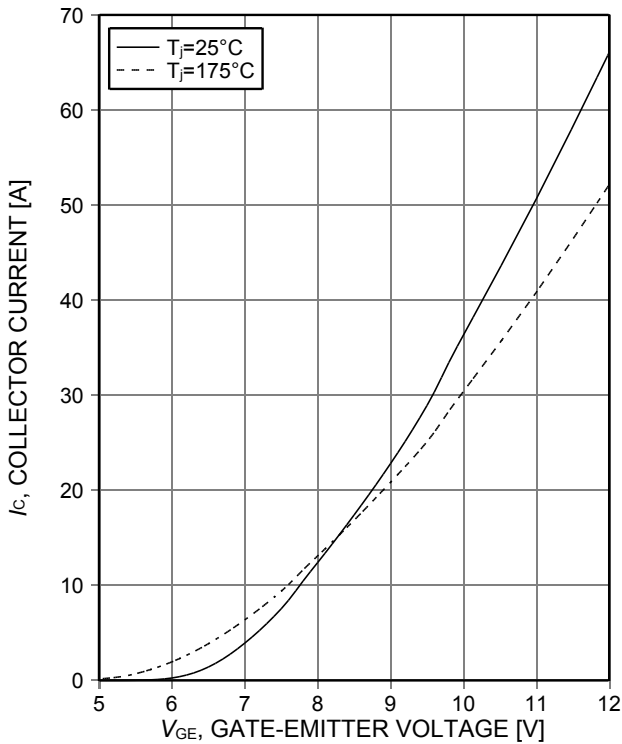


Figure 7. Typical transfer characteristic ($V_{CE}=20\text{V}$)

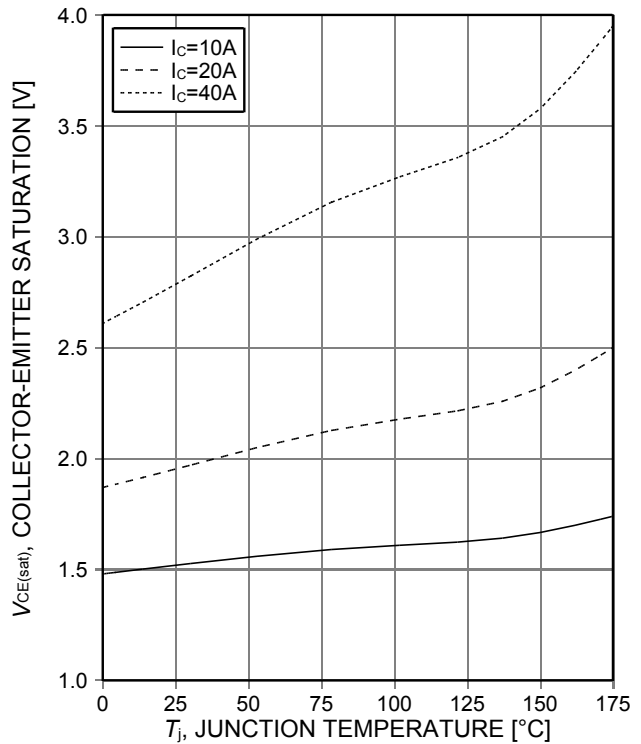


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature ($V_{GE}=15\text{V}$)

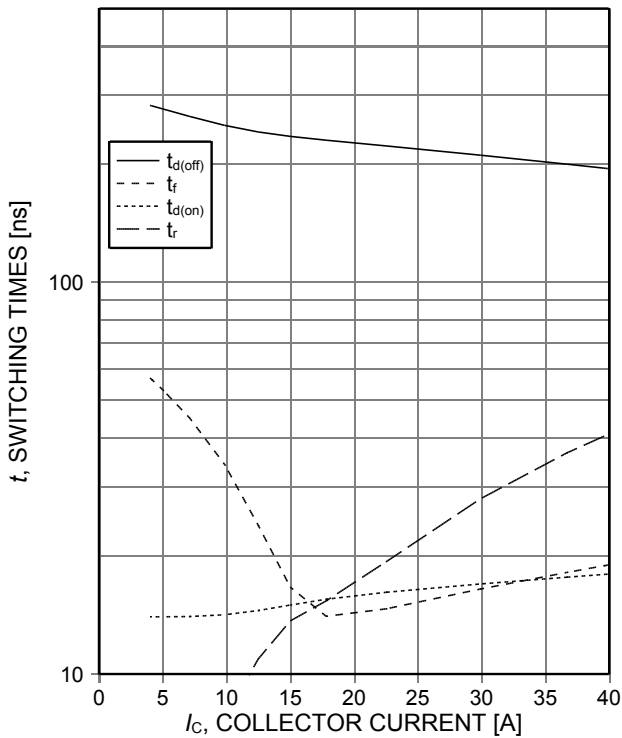


Figure 9. **Typical switching times as a function of collector current**
 (ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=14,6\Omega$, test circuit in Fig. E)

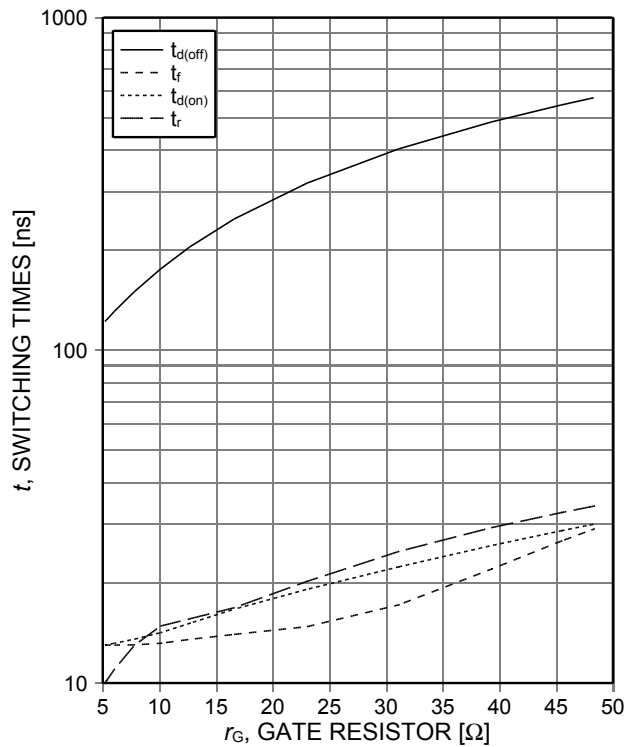


Figure 10. **Typical switching times as a function of gate resistor**
 (ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=20\text{A}$, test circuit in Fig. E)

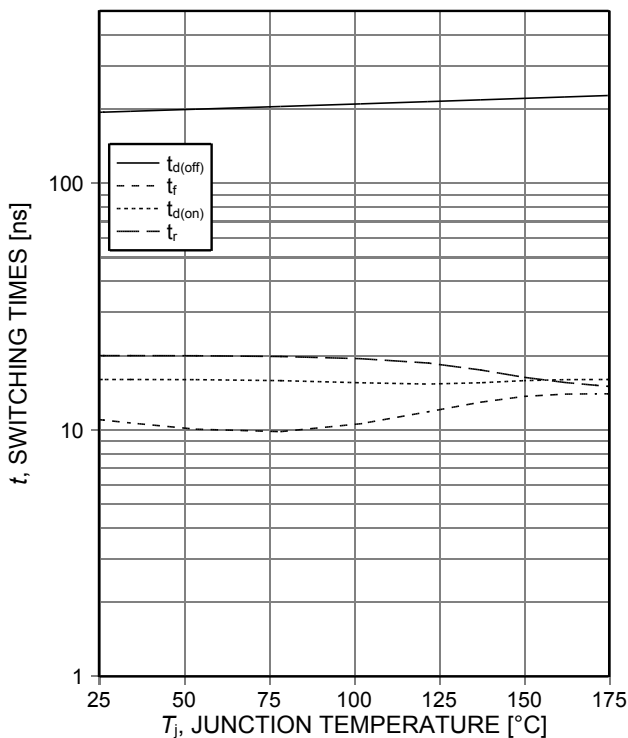


Figure 11. **Typical switching times as a function of junction temperature**
 (ind. load, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=20\text{A}$, $r_G=14,6\Omega$, test circuit in Fig. E)

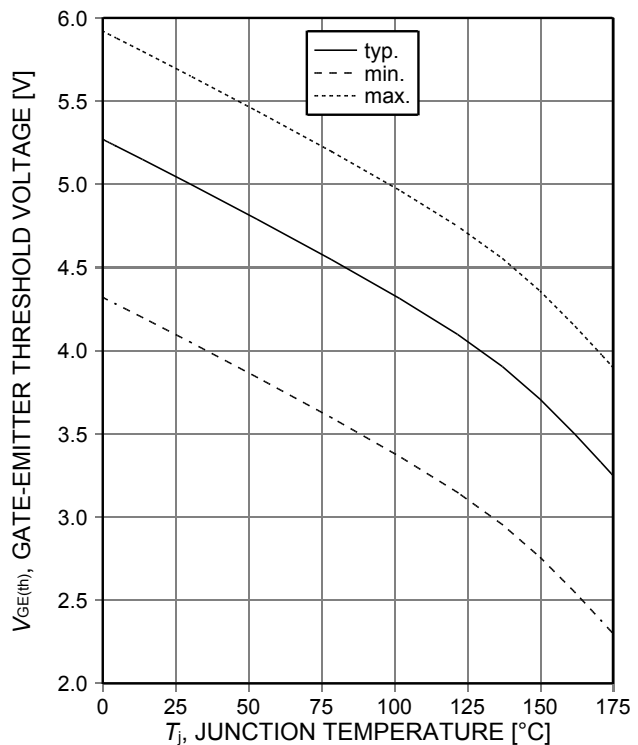


Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**
 ($I_C=0.29\text{mA}$)

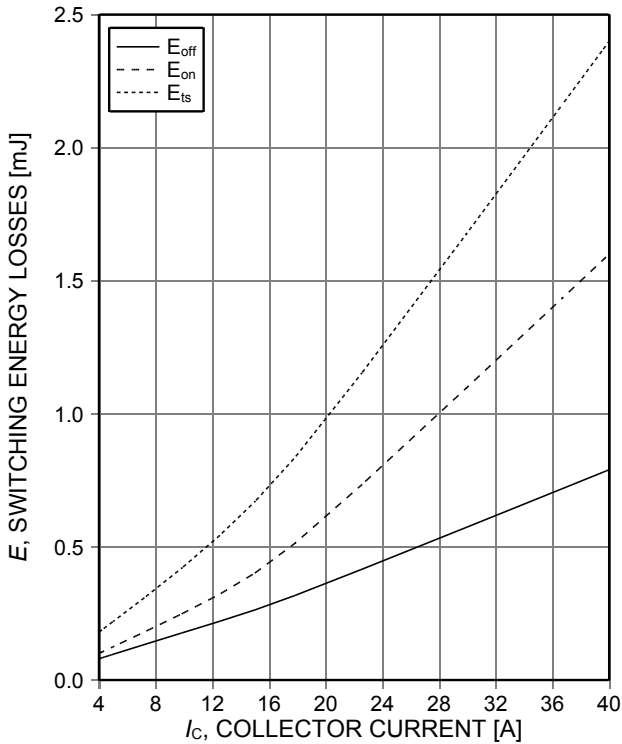


Figure 13. Typical switching energy losses as a function of collector current (ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=14,6\Omega$, test circuit in Fig. E)

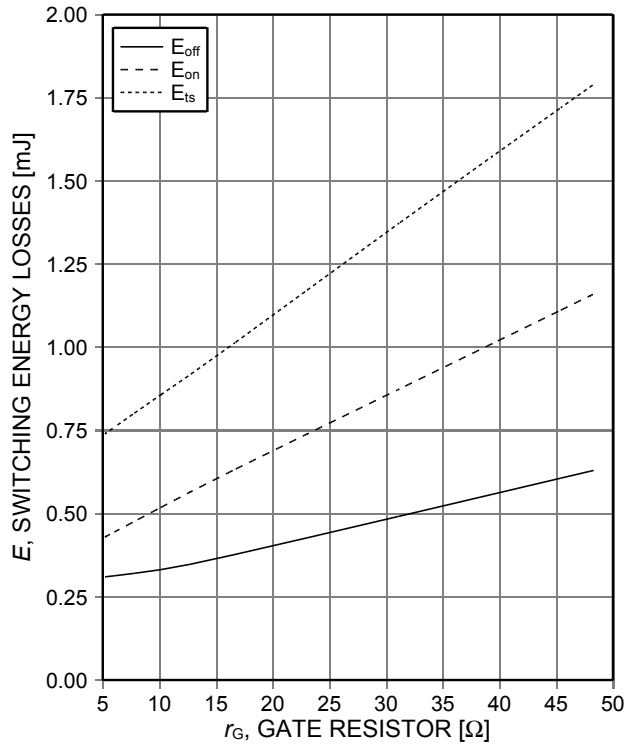


Figure 14. Typical switching energy losses as a function of gate resistor (ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_c=20\text{A}$, test circuit in Fig. E)

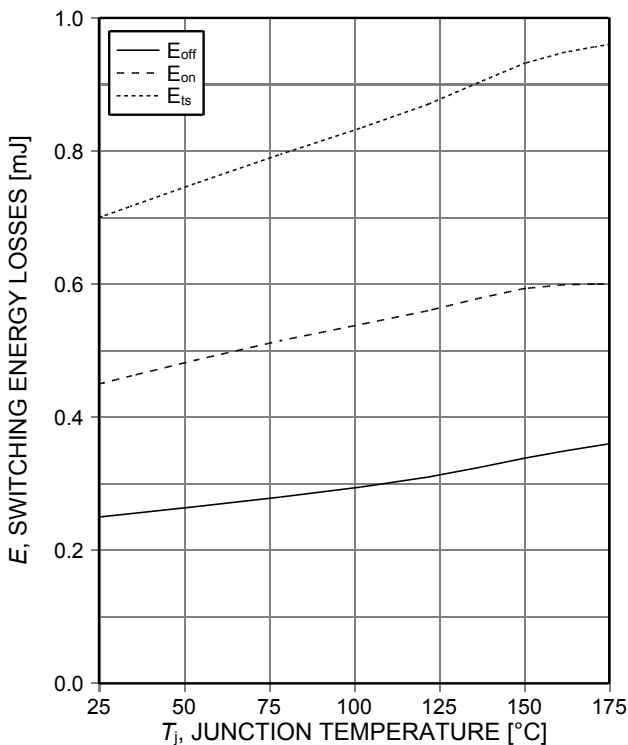


Figure 15. Typical switching energy losses as a function of junction temperature (ind load, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_c=20\text{A}$, $r_G=14,6\Omega$, test circuit in Fig. E)

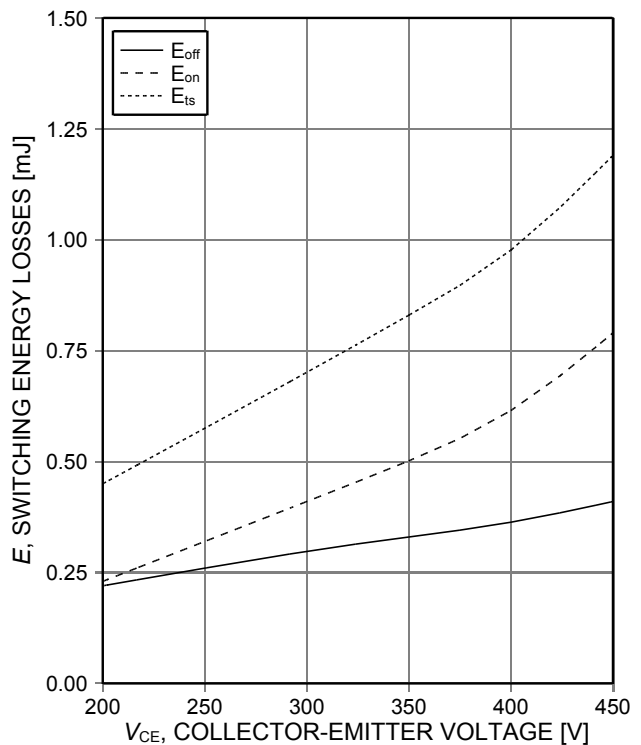


Figure 16. Typical switching energy losses as a function of collector emitter voltage (ind. load, $T_j=175^\circ\text{C}$, $V_{GE}=15/0\text{V}$, $I_c=20\text{A}$, $r_G=14,6\Omega$, test circuit in Fig. E)

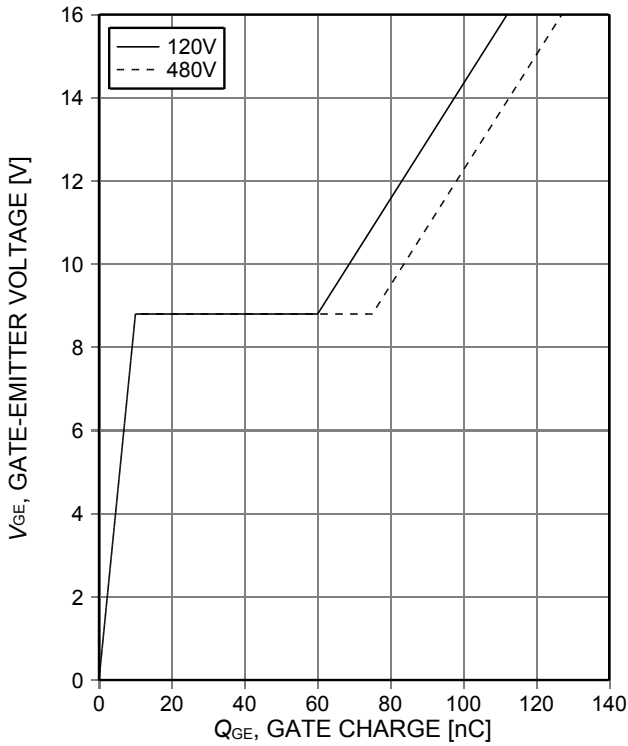


Figure 17. **Typical gate charge**
($I_C=20A$)

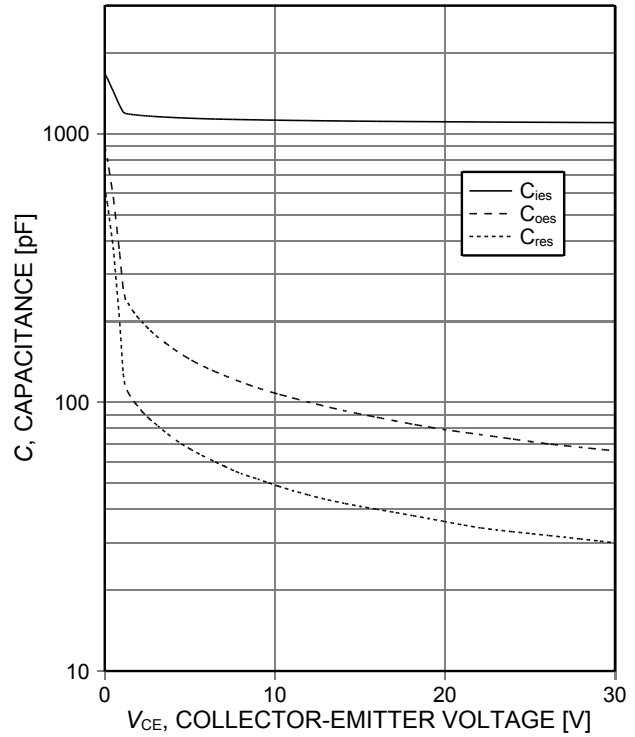


Figure 18. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}=0V$, $f=1MHz$)

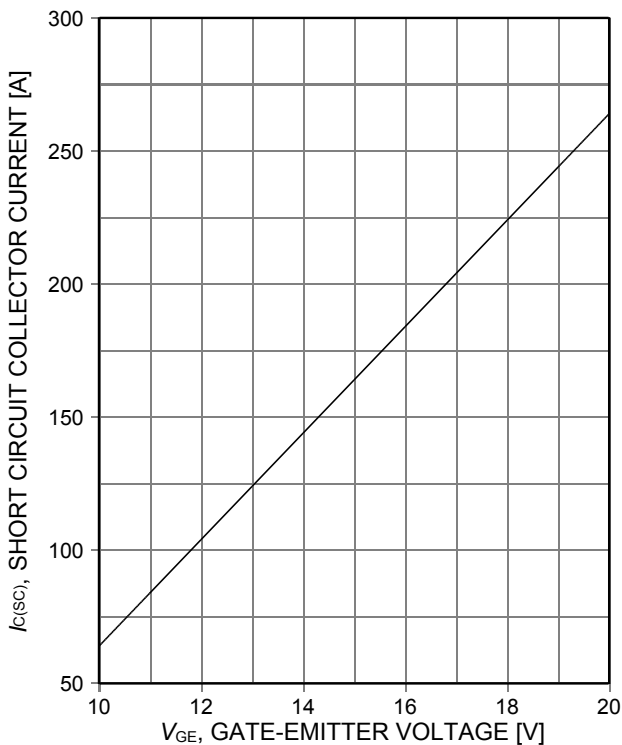


Figure 19. **Typical short circuit collector current as a function of gate-emitter voltage**
($V_{CE}\leq 400V$, start at $T_j=25^\circ C$)

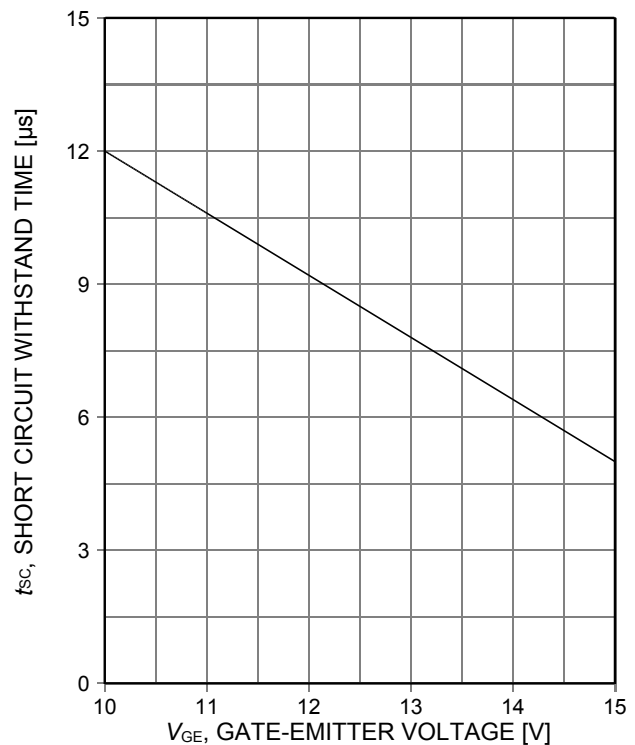


Figure 20. **Short circuit withstand time as a function of gate-emitter voltage**
($V_{CE}\leq 400V$, start at $T_j\leq 150^\circ C$)

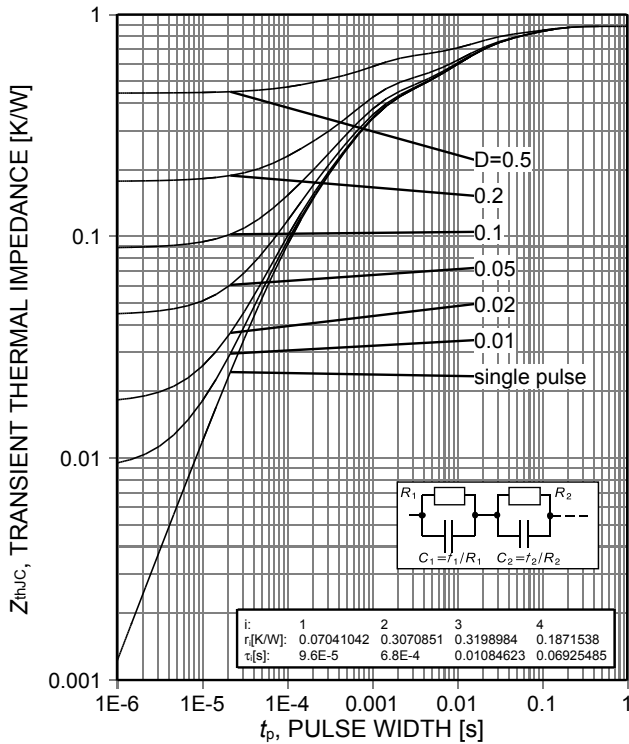


Figure 21. IGBT transient thermal impedance ($D=t_p/T$)

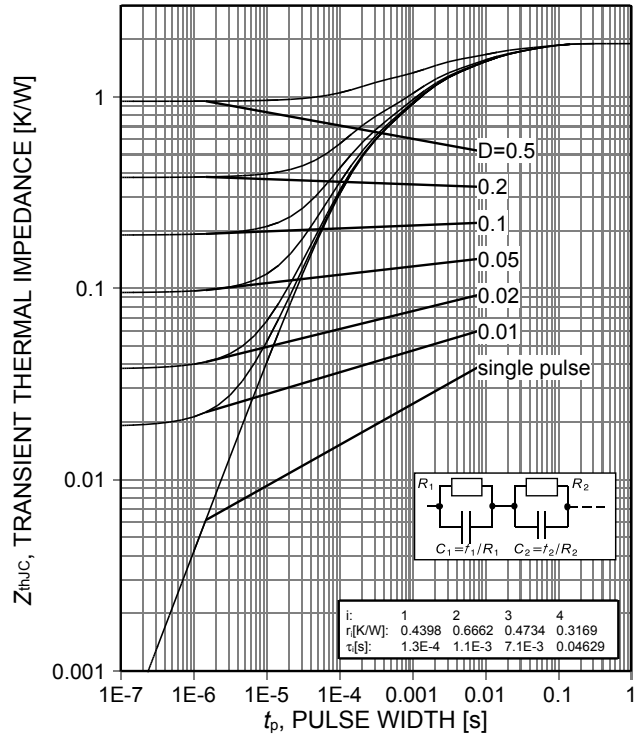


Figure 22. Diode transient thermal impedance as a function of pulse width ($D=t_p/T$)

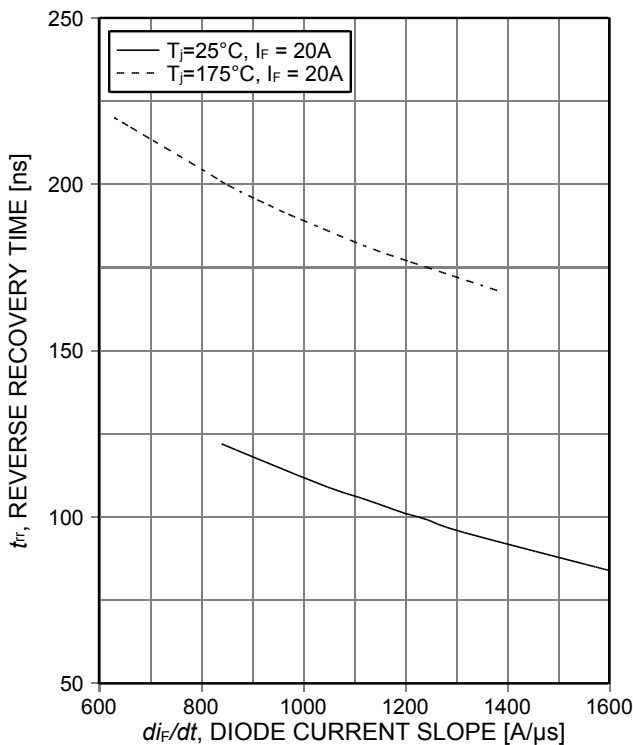


Figure 23. Typical reverse recovery time as a function of diode current slope ($V_R=400V$)

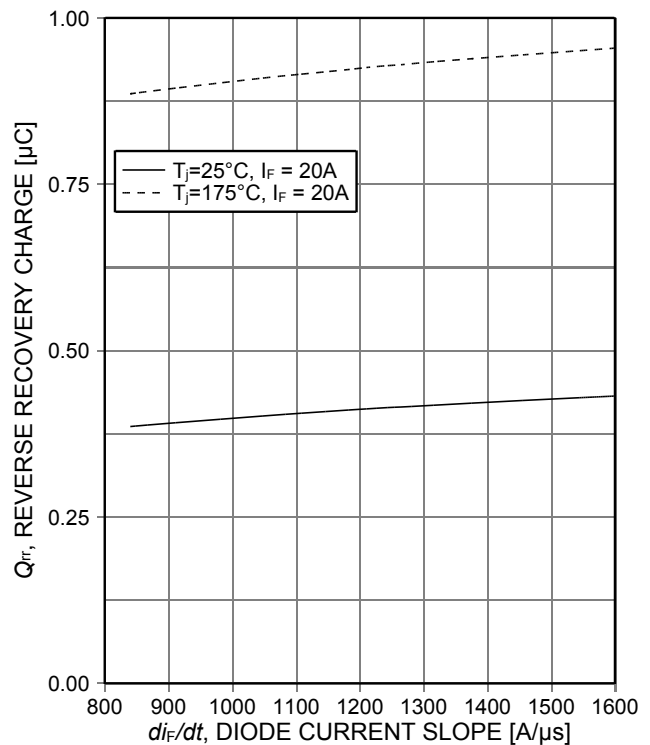


Figure 24. Typical reverse recovery charge as a function of diode current slope ($V_R=400V$)

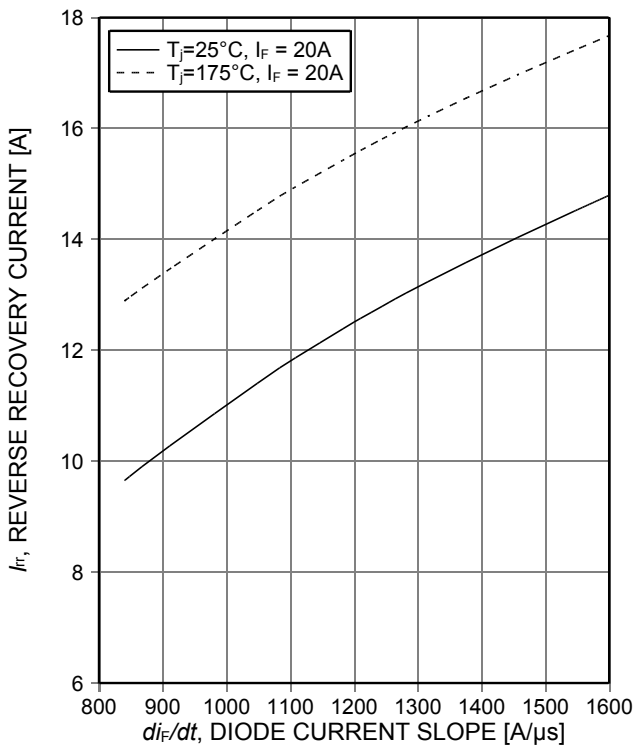


Figure 25. Typical reverse recovery current as a function of diode current slope ($V_R=400V$)

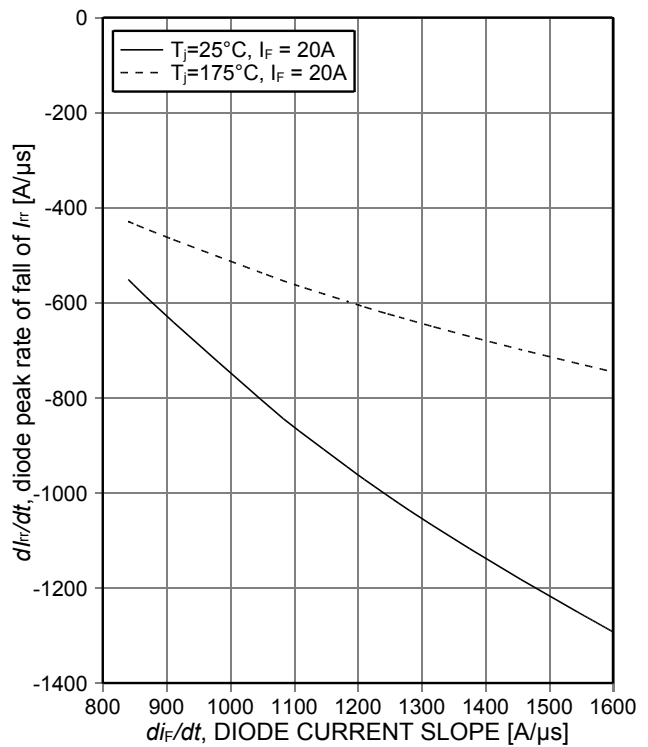


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope ($V_R=400V$)

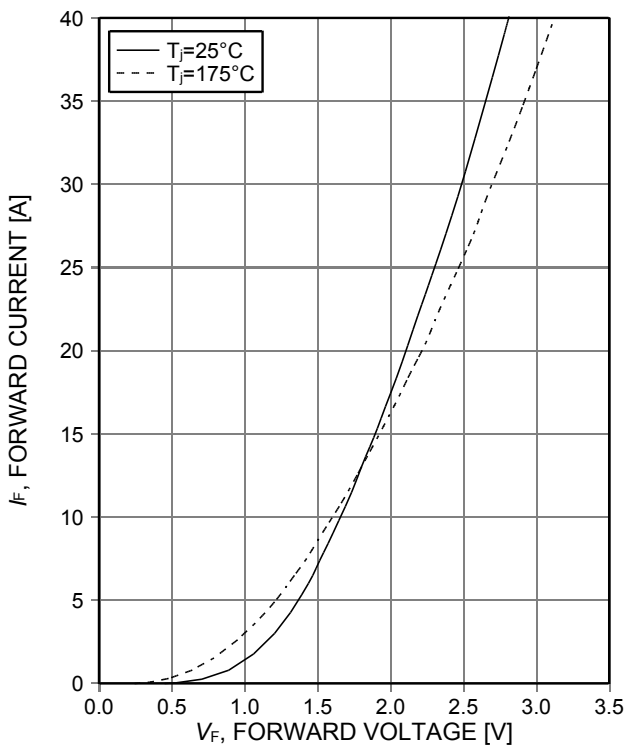


Figure 27. Typical diode forward current as a function of forward voltage

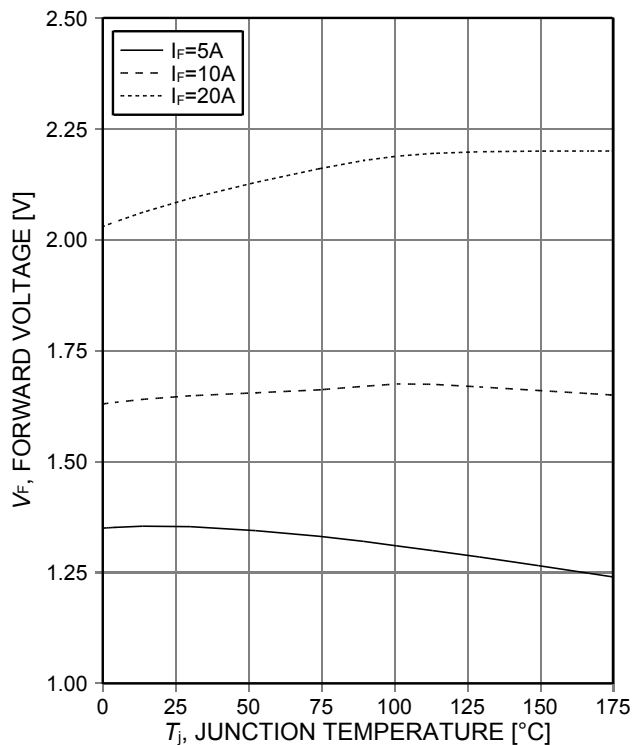
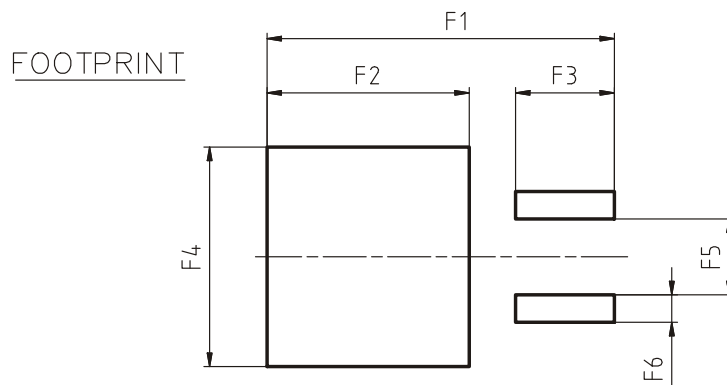
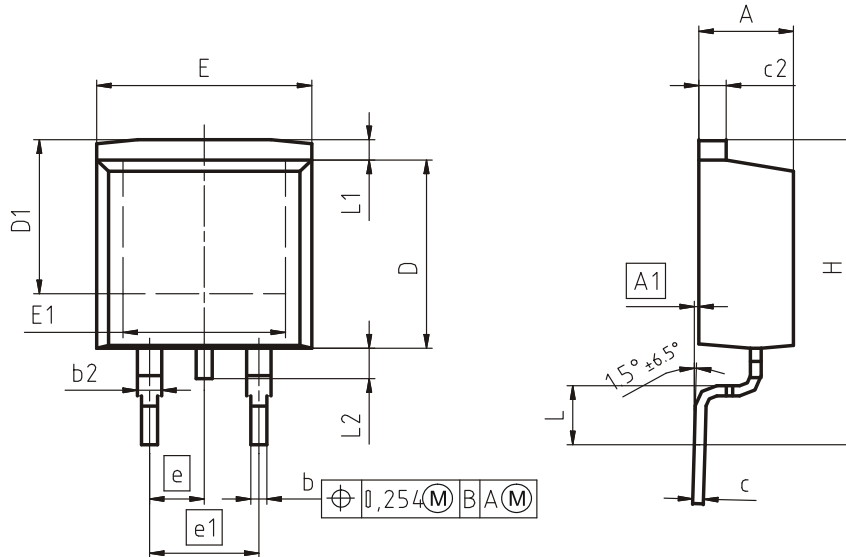


Figure 28. Typical diode forward voltage as a function of junction temperature

PG-TO263-3



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	0.00	0.25	0.000	0.010
b	0.65	0.85	0.026	0.033
b2	0.95	1.15	0.037	0.045
c	0.33	0.65	0.013	0.026
c2	1.17	1.40	0.046	0.055
D	8.51	9.45	0.335	0.372
D1	7.10	7.90	0.280	0.311
E	9.80	10.31	0.386	0.406
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	2		2	
H	14.61	15.88	0.575	0.625
L	2.29	3.00	0.090	0.118
L1	0.70	1.60	0.028	0.063
L2	1.00	1.78	0.039	0.070
F1	16.05	16.25	0.632	0.640
F2	9.30	9.50	0.366	0.374
F3	4.50	4.70	0.177	0.185
F4	10.70	10.90	0.421	0.429
F5	3.65	3.85	0.144	0.152
F6	1.25	1.45	0.049	0.057

DOCUMENT NO.
Z8B00003324

SCALE

7.5mm

EUROPEAN PROJECTION

ISSUE DATE
30-08-2007

REVISION
01

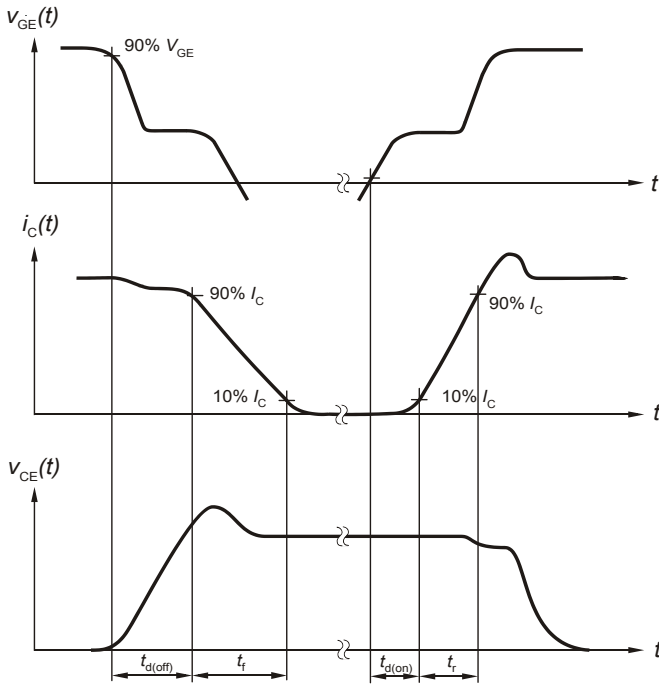


Figure A. Definition of switching times

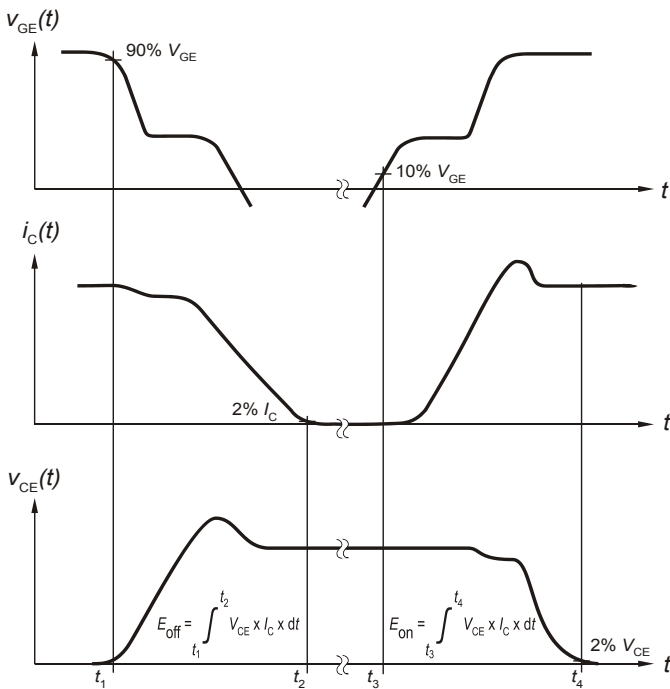


Figure B. Definition of switching losses

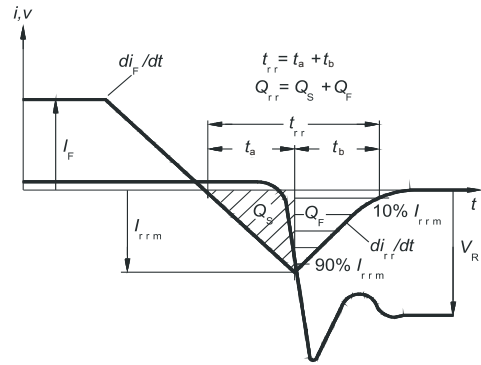


Figure C. Definition of diodes switching characteristics

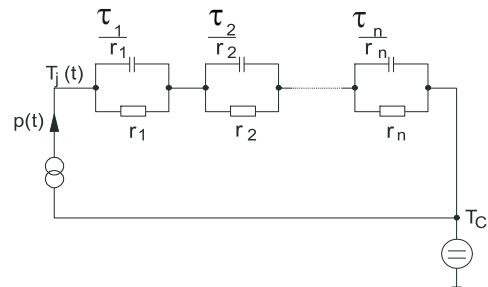


Figure D. Thermal equivalent circuit

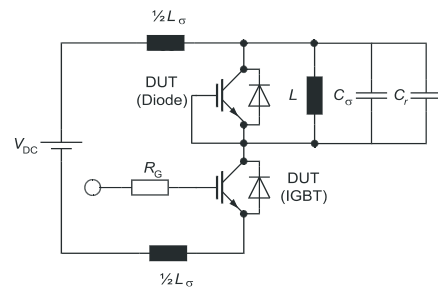


Figure E. Dynamic test circuit
Parasitic inductance L_σ ,
Parasitic capacitor C_σ ,
Relief capacitor C_r
(only for ZVT switching)