# IKB03N120H2

HighSpeed 2-Technology with soft, fast recovery anti-parallel Emitter Controlled HE diode

- Designed for frequency inverters for washing machines, fans, pumps and vacuum cleaners

- **2nd generation HighSpeed-Technology for 1200V applications offers:**
  - loss reduction in resonant circuits
  - temperature stable behavior
  - parallel switching capability
  - tight parameter distribution
  - E_{off} optimized for I_C =3A

- Qualified according to JEDEC[2] for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models : http://www.infineon.com/igbt/

PG-TO263-3-2
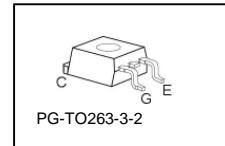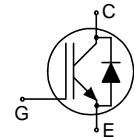
Type	V_{CE}	I_C	E_{off}	T_j	Marking	Package
IKB03N120H2	1200V	3A	0.15mJ	150°C	K03H1202	PG-TO263-3-2

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
Triangular collector current	I_C		A
$T_C = 25°C$, $f = 140$kHz		9.6	
$T_C = 100°C$, $f = 140$kHz		3.9	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	9.9	
Turn off safe operating area	-	9.9	
$V_{CE} \leq 1200$V, $T_j \leq 150°C$			
Diode forward current	I_F		
$T_C = 25°C$		9.6	
$T_C = 100°C$		3.9	
Gate-emitter voltage	V_{GE}	± 20	V
Power dissipation	P_{tot}	62.5	W
$T_C = 25°C$			
Operating junction and storage temperature	T_j , T_{stg}	-40...+150	°C
Soldering temperature (reflow soldering, MSL1)	-	260	

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction – case	R_{thJC}		2.0	K/W
Diode thermal resistance, junction - case	R_{thJCD}		3.2	
Thermal resistance, junction – ambient[1]	R_{thJA}		40	

Electrical Characteristic, at T_j = 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=300µA	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15V, I_C=3A				
		T_j=25°C	-	2.2	2.8	
		T_j=150°C	-	2.5	-	
		V_{GE} = 10V, I_C=3A, T_j=25°C	-	2.4	-	
Diode forward voltage	V_F	V_{GE} = 0, I_F=2A				
		T_j=25°C	-	2.0	2.5	
		T_j=150°C	-	1.75	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=90µA, V_{CE}=V_{GE}	2.1	3	3.9	
Zero gate voltage collector current	I_{CES}	V_{CE}=1200V, V_{GE}=0V				µA
		T_j=25°C	-	-	20	
		T_j=150°C	-	-	80	
Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=3A	-	2	-	S
Dynamic Characteristic						
Input capacitance	C_{iss}	V_{CE}=25V,	-	205	-	pF
Output capacitance	C_{oss}	V_{GE}=0V,	-	24	-	
Reverse transfer capacitance	C_{rss}	f=1MHz	-	7	-	
Gate charge	Q_{Gate}	V_{CC}=960V, I_C=3A V_{GE}=15V	-	22	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	7	-	nH

[1] Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6cm^2 (one layer, 70µm thick) copper area for collector connection. PCB is vertical without blown air.

Switching Characteristic, Inductive Load, at T_j=25 °C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_j=25°C,	-	9.2	-	ns
Rise time	t_r	V_{CC}=800V, I_C=3A,	-	5.2	-	
Turn-off delay time	$t_{d(off)}$	V_{GE}=15V/0V,	-	281	-	
Fall time	t_f	R_G=82Ω,	-	29	-	
Turn-on energy	E_{on}	$L_\sigma{}^{2)}$=180nH,	-	0.14	-	mJ
Turn-off energy	E_{off}	$C_\sigma{}^{2)}$=40pF	-	0.15	-	
Total switching energy	E_{ts}	Energy losses include "tail" and diode $^{4)}$ reverse recovery.	-	0.29	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	T_j=25°C,	-	42	-	ns
Diode reverse recovery charge	Q_{rr}	V_R=800V, I_F=3A,	-	0.23	-	µC
Diode peak reverse recovery current	I_{rrm}	R_G=82Ω	-	10.3	-	A
Diode current slope	di_F/dt		-	993	-	A/µs
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	1180	-	

Switching Characteristic, Inductive Load, at T_j=150 °C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_j=150°C	-	9.4	-	ns
Rise time	t_r	V_{CC}=800V,	-	6.7	-	
Turn-off delay time	$t_{d(off)}$	I_C=3A,	-	340	-	
Fall time	t_f	V_{GE}=15V/0V,	-	63	-	
Turn-on energy	E_{on}	R_G=82Ω,	-	0.22	-	mJ
Turn-off energy	E_{off}	$L_\sigma{}^{2)}$=180nH,	-	0.26	-	
Total switching energy	E_{ts}	$C_\sigma{}^{2)}$=40pF Energy losses include "tail" and diode $^{3)}$ reverse recovery.	-	0.48	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	T_j=150°C	-	125	-	ns
Diode reverse recovery charge	Q_{rr}	V_R=800V, I_F=3A,	-	0.51	-	µC
Diode peak reverse recovery current	I_{rrm}	R_G=82Ω	-	12	-	A
Diode current slope	di_F/dt		-	829	-	A/µs
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	540	-	

$^{2)}$ Leakage inductance L_σ and stray capacity C_σ due to dynamic test circuit in figure E
$^{4)}$ Commutation diode from device IKP03N120H2

Switching Energy ZVT, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-off energy	E_{off}	V_{CC}=800V, I_C=3A, V_{GE}=15V/0V, R_G=82Ω, $C_r{}^{2)}$=4nF				mJ
		T_j=25°C	-	0.05	-	
		T_j=150°C	-	0.09	-	
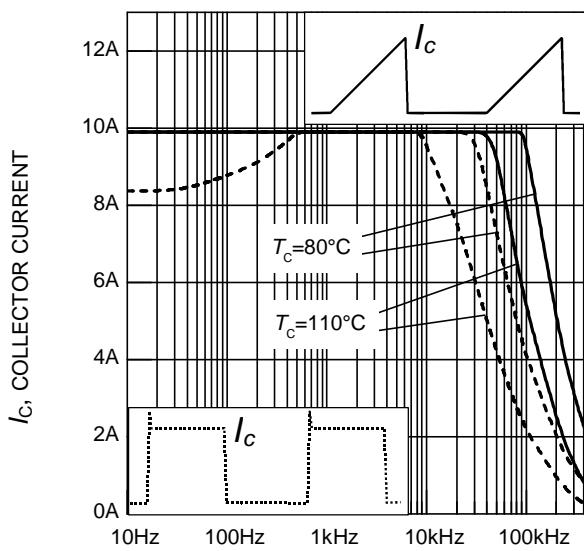
Figure 1. Collector current as a function of switching frequency
($T_{\mathrm{j}} \leq 150°C$, $D = 0.5$, $V_{\mathrm{CE}} = 800V$, $V_{\mathrm{GE}} = +15V/0V$, $R_{\mathrm{G}} = 82\Omega$)

f, SWITCHING FREQUENCY

I_{C}, COLLECTOR CURRENT

$T_{\mathrm{C}} = 80°C$
$T_{\mathrm{C}} = 110°C$
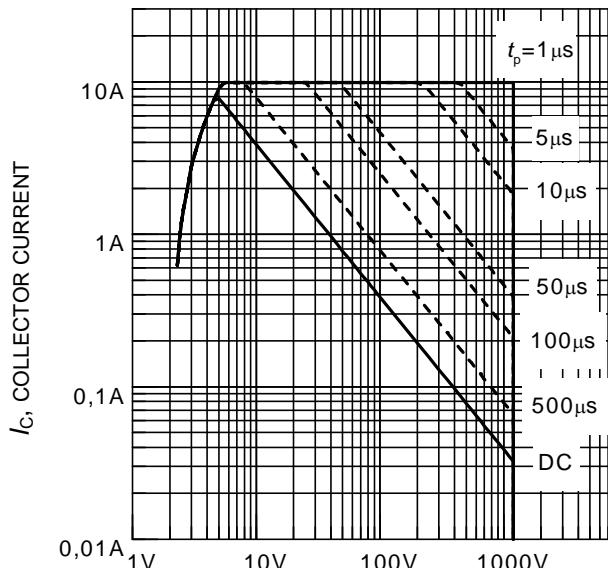
Figure 2. Safe operating area
($D = 0$, $T_{\mathrm{C}} = 25°C$, $T_{\mathrm{j}} \leq 150°C$)

V_{CE}, COLLECTOR-EMITTER VOLTAGE

I_{C}, COLLECTOR CURRENT

$t_{\mathrm{p}} = 1\,\mu s$
$5\,\mu s$
$10\,\mu s$
$50\,\mu s$
$100\,\mu s$
$500\,\mu s$
DC
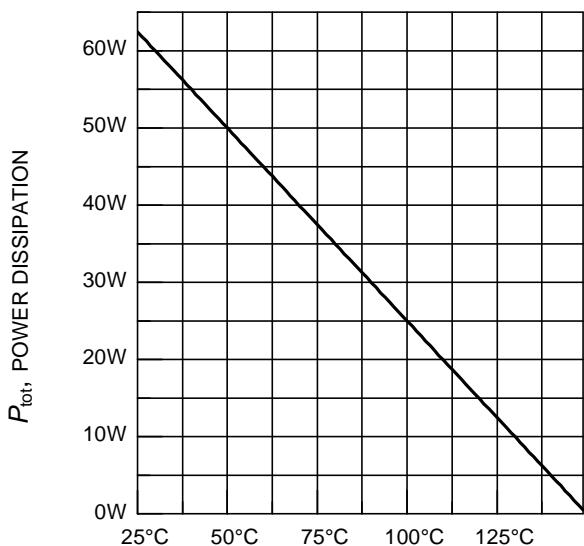
Figure 3. Power dissipation as a function of case temperature
($T_{\mathrm{j}} \leq 150°C$)

T_{C}, CASE TEMPERATURE

P_{tot}, POWER DISSIPATION
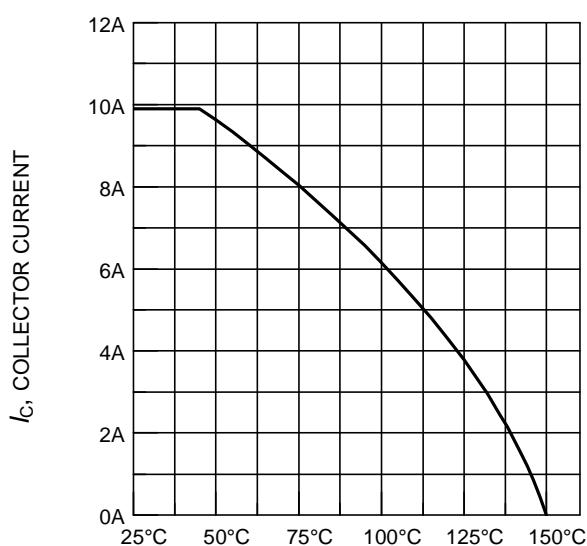
Figure 4. Collector current as a function of case temperature
($V_{\mathrm{GE}} \leq 15V$, $T_{\mathrm{j}} \leq 150°C$)

T_{C}, CASE TEMPERATURE

I_{C}, COLLECTOR CURRENT
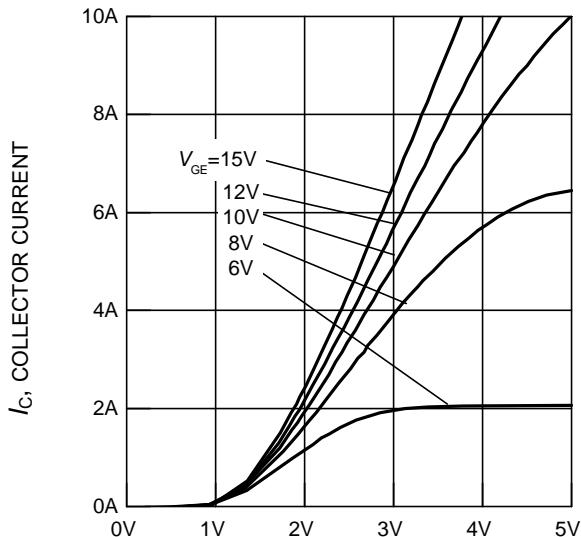
V_{CE}, COLLECTOR-EMITTER VOLTAGE
Figure 5. Typical output characteristics
(T_i = 25°C)
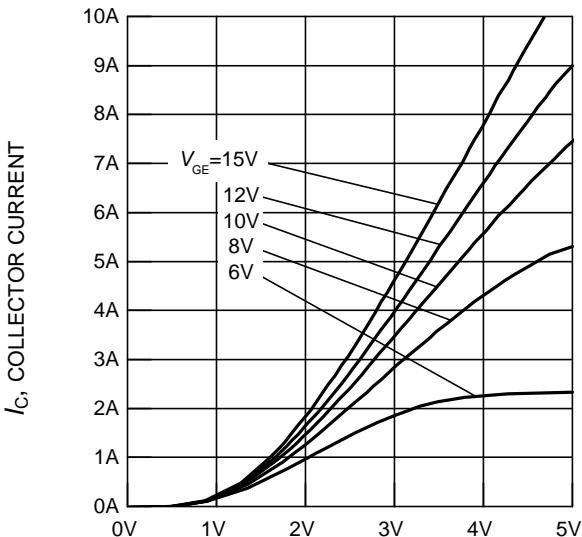
V_{CE}, COLLECTOR-EMITTER VOLTAGE
Figure 6. Typical output characteristics
(T_i = 150°C)
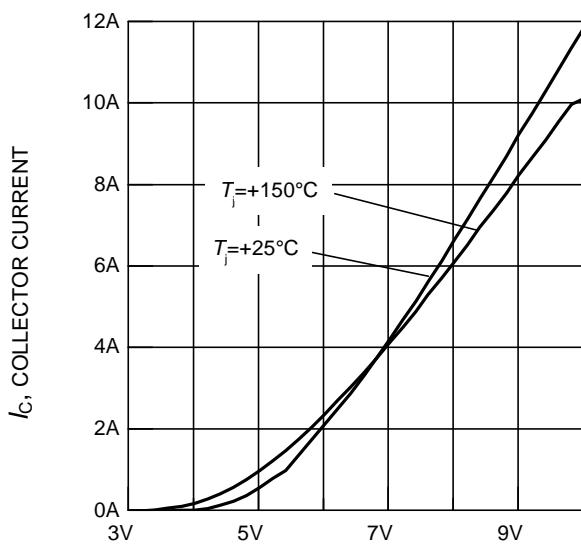
V_{GE}, GATE-EMITTER VOLTAGE
Figure 7. Typical transfer characteristics
(V_{CE} = 20V)
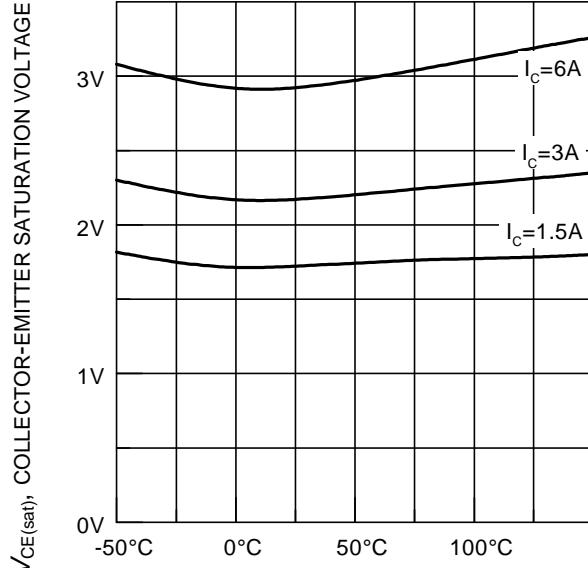
T_j, JUNCTION TEMPERATURE
**Figure 8. Typical collector-emitter
saturation voltage as a function of junction
temperature**
(V_{GE} = 15V)

I_C, COLLECTOR CURRENT
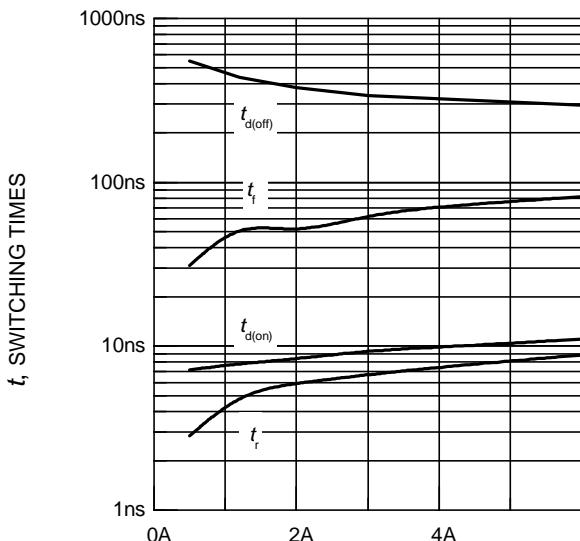
Figure 9. Typical switching times as a function of collector current
(inductive load, T_j = 150°C,
V_{CE} = 800V, V_{GE} = +15V/0V, R_G = 82Ω,
dynamic test circuit in Fig.E)
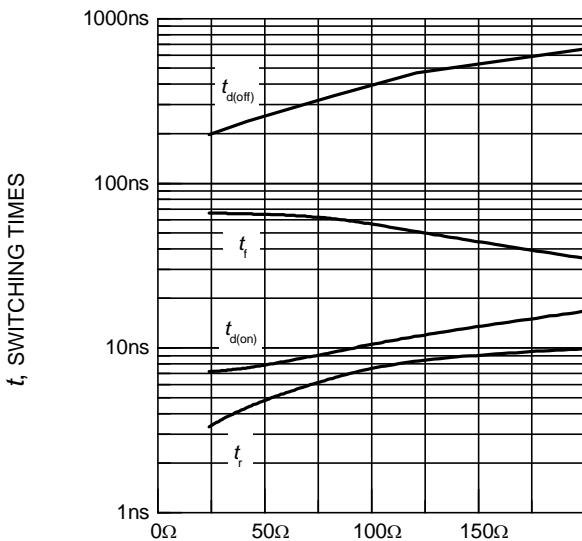
R_G, GATE RESISTOR

Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_j = 150°C,
V_{CE} = 800V, V_{GE} = +15V/0V, I_C = 3A,
dynamic test circuit in Fig.E)

T_j, JUNCTION TEMPERATURE
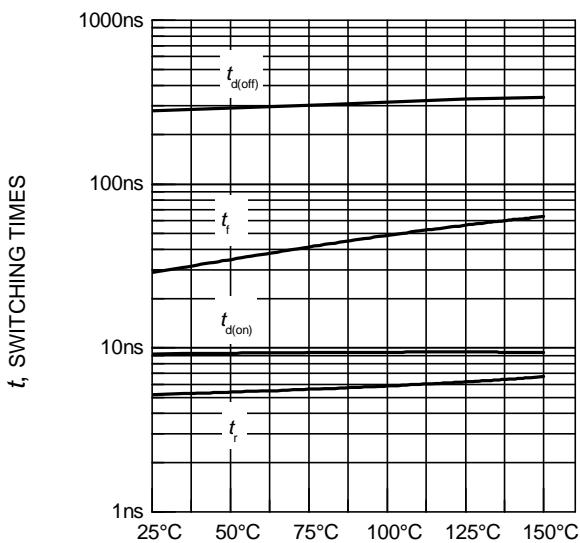
Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE} = 800V,
V_{GE} = +15V/0V, I_C = 3A, R_G = 82Ω,
dynamic test circuit in Fig.E)

T_j, JUNCTION TEMPERATURE
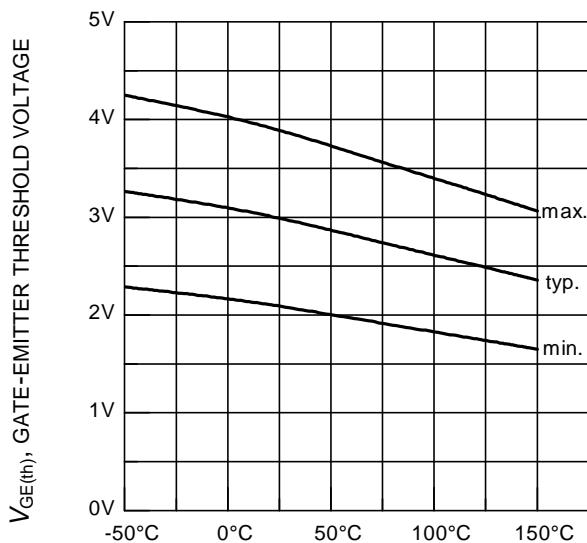
Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 0.09mA)
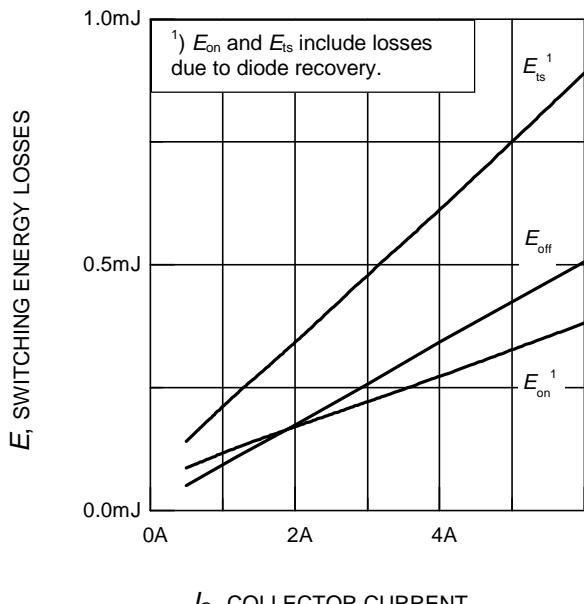
I_C, COLLECTOR CURRENT

Figure 13. Typical switching energy losses as a function of collector current (inductive load, T_j = 150°C, V_{CE} = 800V, V_{GE} = +15V/0V, R_G = 82Ω, dynamic test circuit in Fig.E)
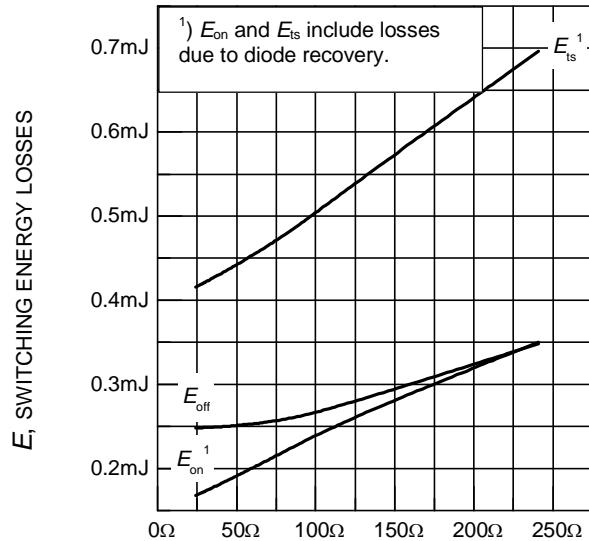
R_G, GATE RESISTOR

Figure 14. Typical switching energy losses as a function of gate resistor (inductive load, T_j = 150°C, V_{CE} = 800V, V_{GE} = +15V/0V, I_C = 3A, dynamic test circuit in Fig.E)
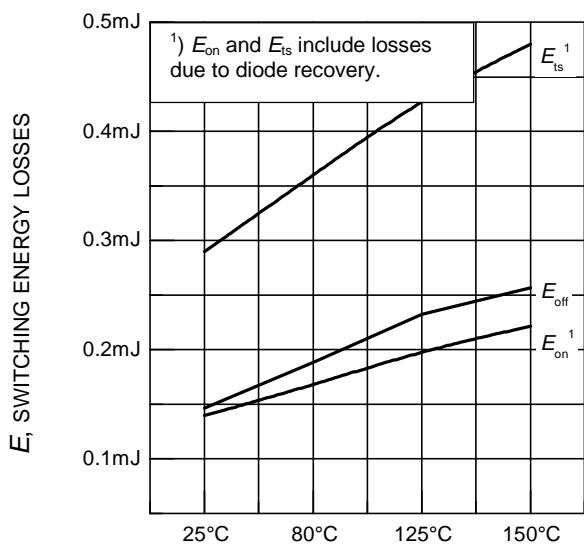
T_j, JUNCTION TEMPERATURE

Figure 15. Typical switching energy losses as a function of junction temperature (inductive load, V_{CE} = 800V, V_{GE} = +15V/0V, I_C = 3A, R_G = 82Ω, dynamic test circuit in Fig.E)
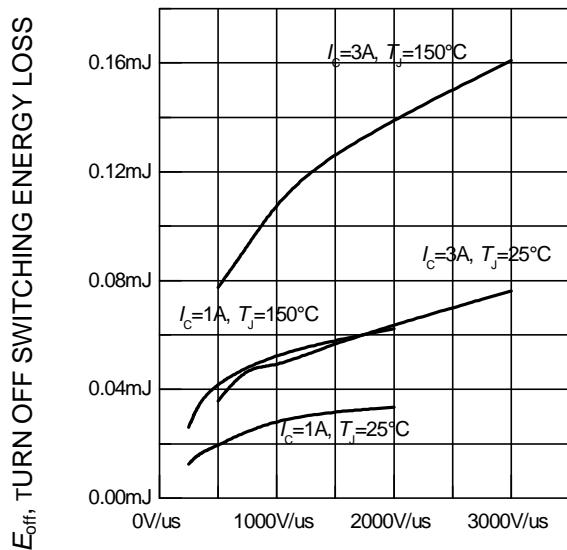
dv/dt, VOLTAGE SLOPE

Figure 16. Typical turn off switching energy loss for soft switching (*dynamic test circuit in Fig. E*)

$$R_1 \quad \boxed{} \quad \boxed{} \quad R_2$$
$$C_1 = \tau_1/R_1 \quad C_2 = \tau_2/R_2$$

R, (K/W)	τ, (s)
1.082517	0.000795
0.328671	0.000179
0.588811	0.004631
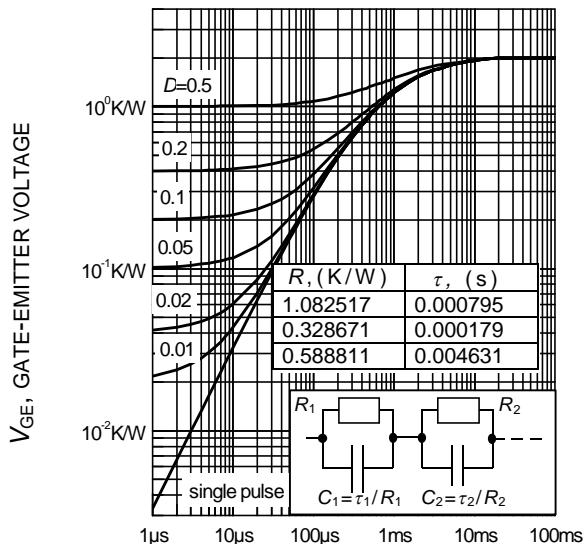
Q_{GE}, GATE CHARGE

**Figure 17. Typical gate charge**
(I_C = 3A)
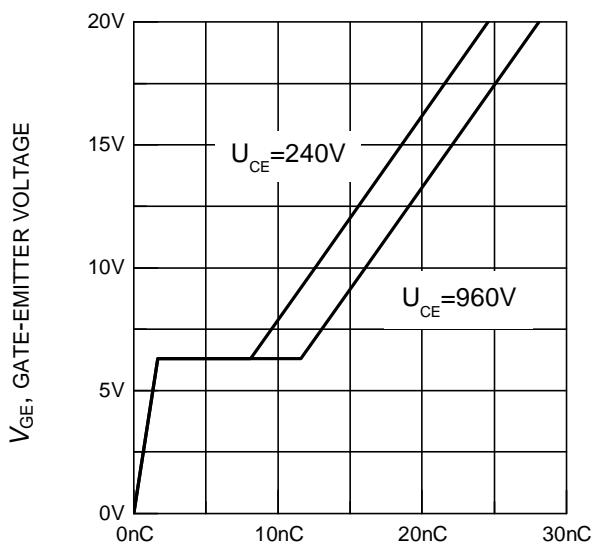
Q_{GE}, GATE CHARGE

Figure 17. Typical gate charge
(I_C = 3A)
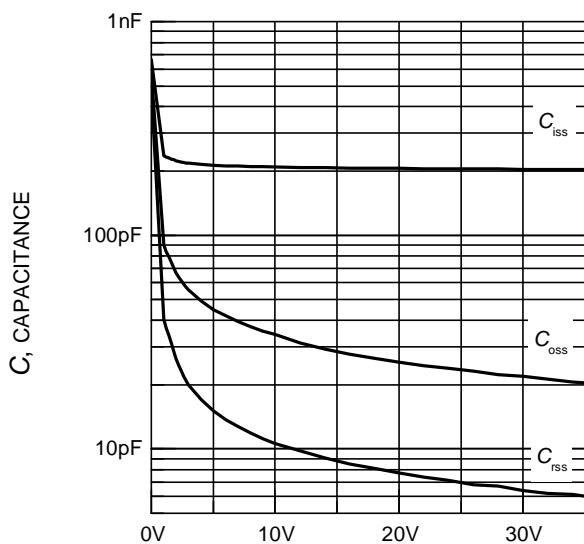
V_{CE}, COLLECTOR-EMITTER VOLTAGE

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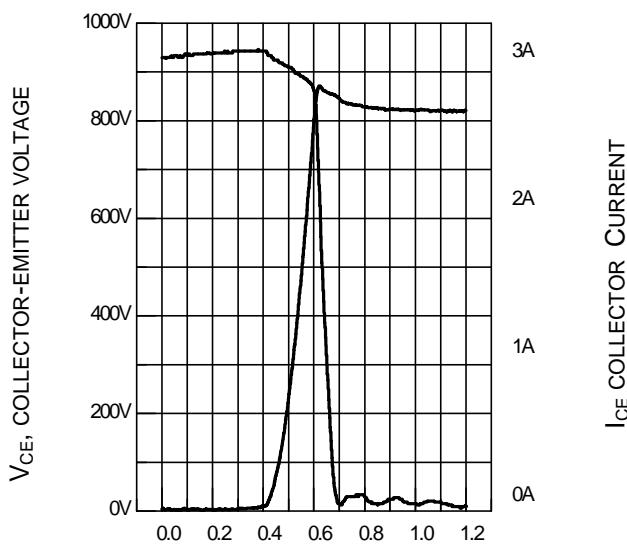
t_p, PULSE WIDTH

Figure 20. Typical turn off behavior, hard switching
(V_{GE}=15/0V, R_G=82Ω, T_j = 150°C, Dynamic test circuit in Figure E)
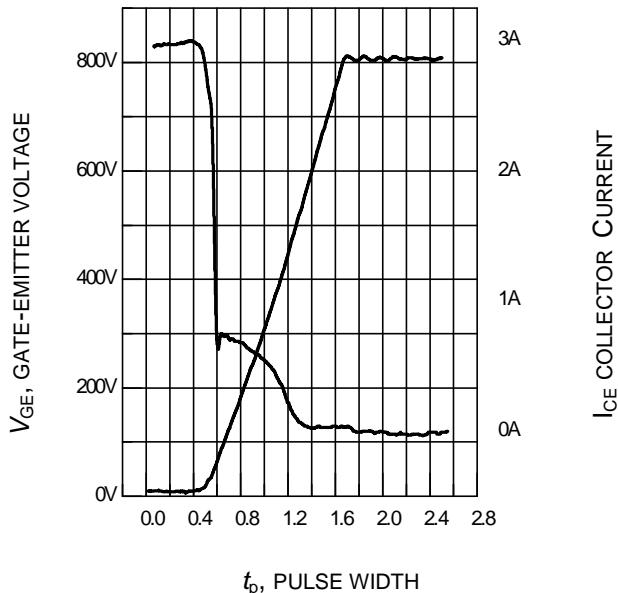
Figure 21. Typical turn off behavior, soft switching
(V_{GE}=15/0V, R_G=82Ω, T_j = 150°C, Dynamic test circuit in Figure E)
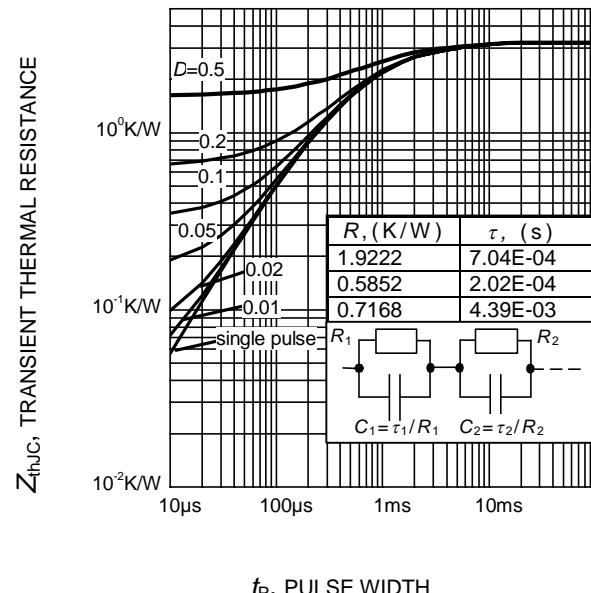
Figure 22. Diode transient thermal impedance as a function of pulse width ($D=t_P/T$)
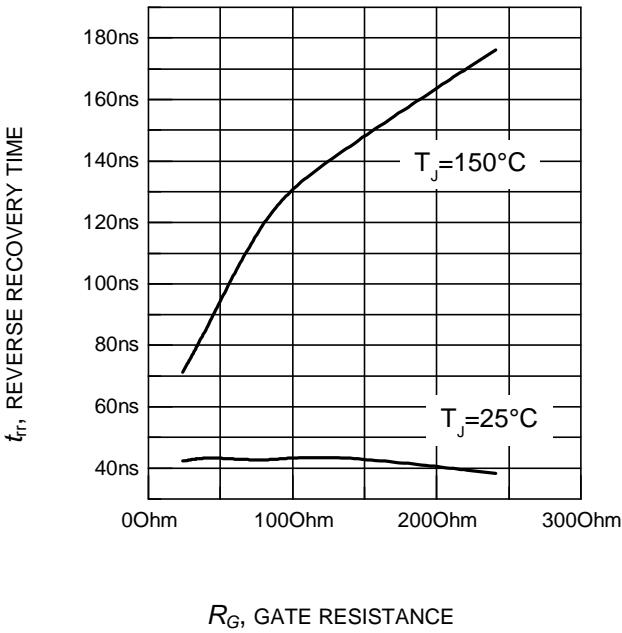

Figure 23. Typical reverse recovery time as a function of diode current slope
V_R=800V, I_F=3A, Dynamic test circuit in Figure E)
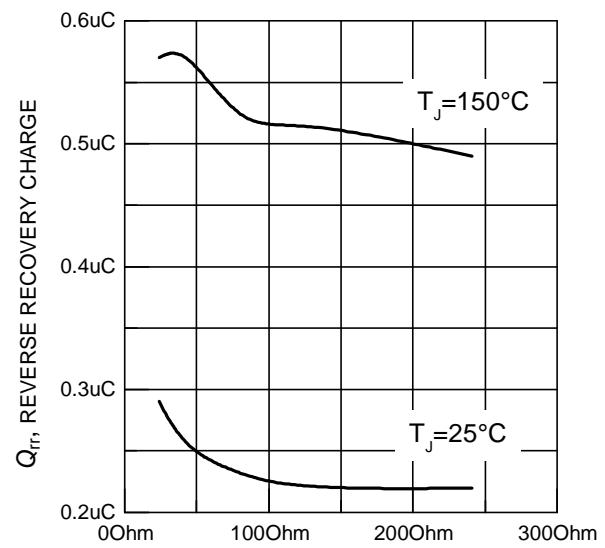
Figure 24. Typical reverse recovery charge as a function of diode current slope
(V_R=800V, I_F=3A, Dynamic test circuit in Figure E)
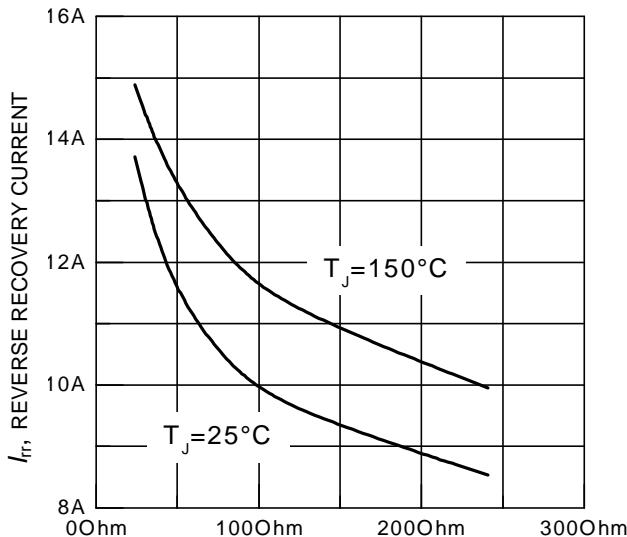
R_G, GATE RESISTANCE

Figure 25. Typical reverse recovery current as a function of diode current slope
(V_R=800V, I_F=3A,
Dynamic test circuit in Figure E)
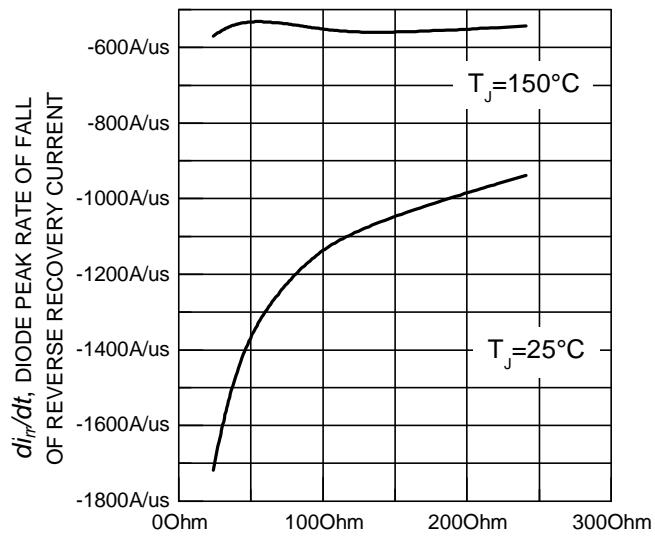
R_G, GATE RESISTANCE

Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
(V_R=800V, I_F=3A,
Dynamic test circuit in Figure E)
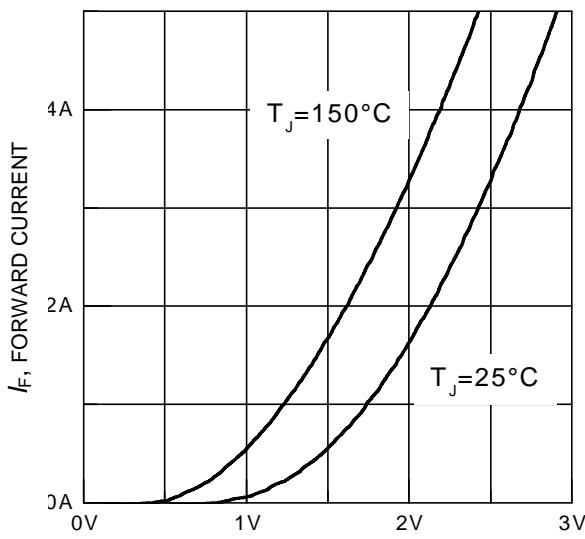

V_F, FORWARD VOLTAGE

Figure 27. Typical diode forward current as a function of forward voltage
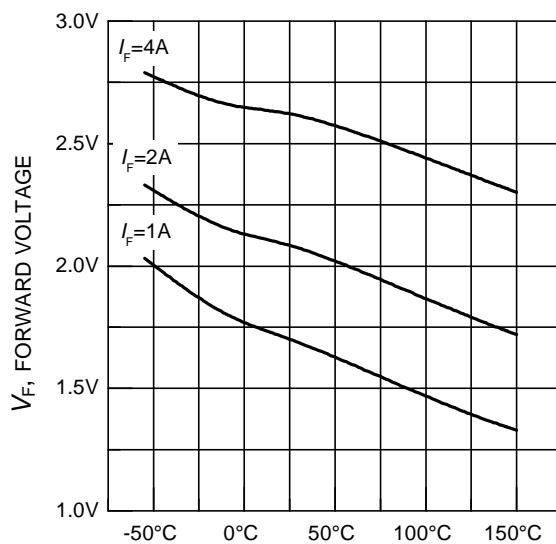
T_J, JUNCTION TEMPERATURE

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

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FOOTPRINT
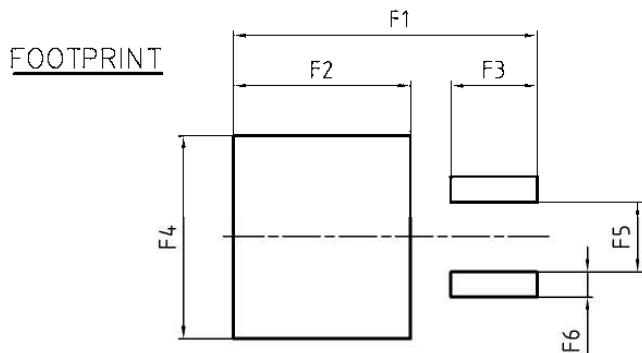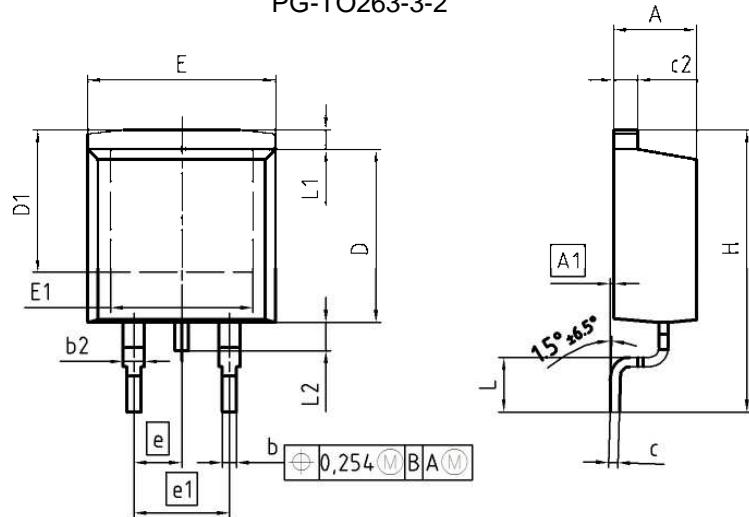
| DIM | MILLIMETERS | | INCHES | |
---	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	0.00	0.25	0.000	0.010
b	0.65	0.85	0.026	0.033
b2	0.95	1.15	0.037	0.045
c	0.33	0.65	0.013	0.026
c2	1.17	1.40	0.046	0.055
D	8.51	9.45	0.335	0.372
D1	7.10	7.90	0.280	0.311
E	9.80	10.31	0.386	0.406
E1	6.50	8.60	0.256	0.339
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

$$E_{OFF} = \int_{t_1}^{t_2} V_{CE} \times I_C \times dt$$

$$E_{ON} = \int_{t_3}^{t_4} V_{CE} \times I_C \times dt$$

Figure C. Definition of diodes switching characteristics

$$t_{rr} = t_S + t_F$$
$$Q_{rr} = Q_S + Q_F$$
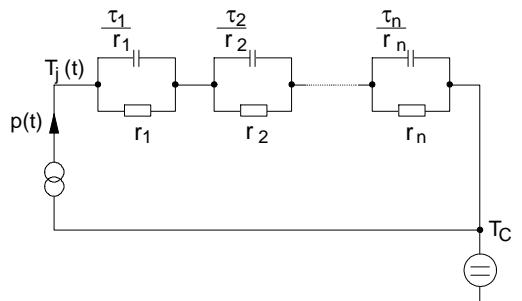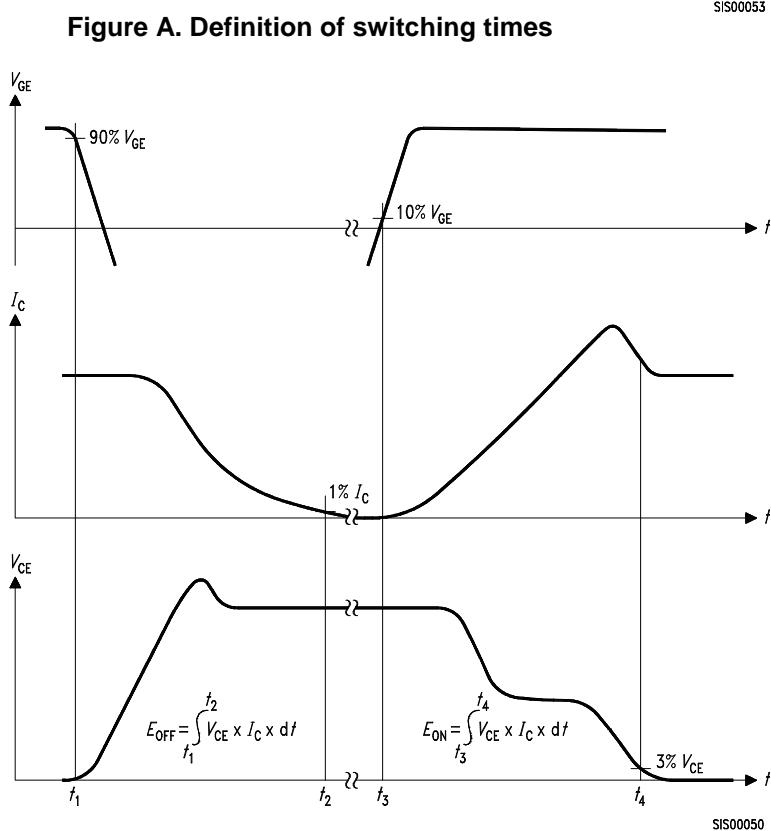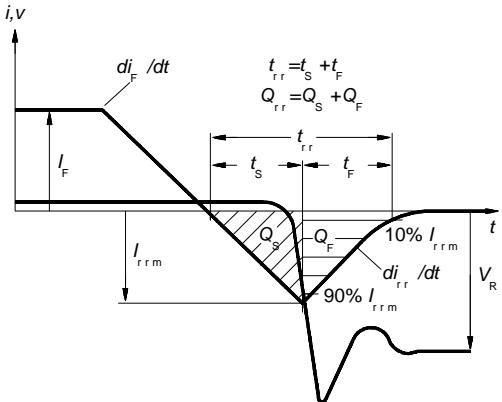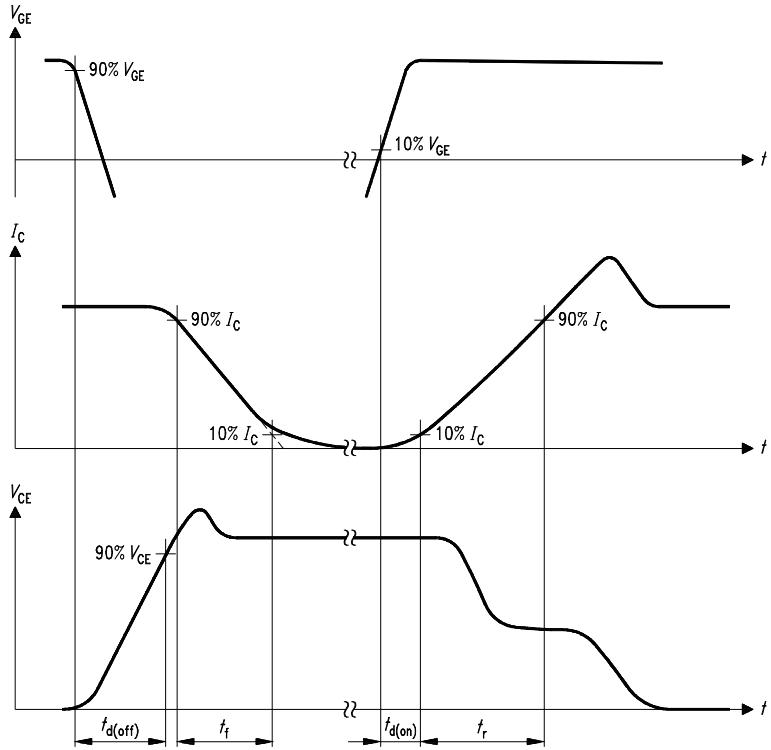
Figure D. Thermal equivalent circuit
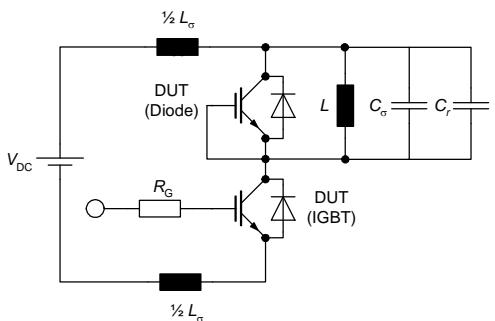
Figure E. Dynamic test circuit
Leakage inductance L_σ = 180nH,
Stray capacitor C_σ = 40pF,
Relief capacitor C_r = 4nF (only for ZVT switching)