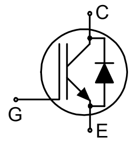
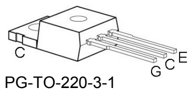
HighSpeed 2-Technology with soft, fast recovery anti-parallel EmCon HE diode



- **Designed for:**
  - SMPS
  - Lamp Ballast
  - ZVS-Converter
  - optimised for soft-switching / resonant topologies



PG-TO-220-3-1

- **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 =1A
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC[2] for target applications
- Complete product spectrum and PSpice Models : http://www.infineon.com/igbt/

Type	V_{CE}	I_C	E_{off}	T_j	Marking	Package
IKP01N120H2	1200V	1A	0.09mJ	150°C	K01H1202	PG-TO-220-3-1

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
Triangular collector current	I_C		A
T_C = 25°C, f = 140kHz		3.2	
T_C = 100°C, f = 140kHz		1.3	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	3.5	
Turn off safe operating area	-	3.5	
$V_{CE} \leq$ 1200V, $T_j \leq$ 150°C			
Diode forward current	I_F		
T_C = 25°C		3.2	
T_C = 100°C		1.3	
Gate-emitter voltage	V_{GE}	±20	V
Power dissipation	P_{tot}	28	W
T_C = 25°C			
Operating junction and storage temperature	T_j , T_{stg}	-40...+150	°C
Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	260	

[2] J-STD-020 and JESD-022

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction – case	R_{thJC}		4.5	K/W
Diode thermal resistance, Junction - case	R_{thJCD}		11	
Thermal resistance, junction – ambient	R_{thJA}	PG-TO-220-3-1	62	

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=1A T_j=25°C T_j=150°C V_{GE} = 10V, I_C=1A, T_j=25°C	 - - -	 2.2 2.5 2.4	 2.8 - -	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=30µA, V_{CE}=V_{GE}	2.1	3	3.9	
Zero gate voltage collector current	I_{CES}	V_{CE}=1200V, V_{GE}=0V T_j=25°C T_j=150°C	 - -	 - -	 20 80	µA
Diode forward voltage	V_F	V_{GE} = 0, I_F=0.5A T_j=25°C T_j=150°C	 - -	 2.0 1.75	 2.5 -	V
Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V	-	-	40	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=1A	-	0.75	-	S
Dynamic Characteristic						
Input capacitance	C_{iss}	V_{CE}=25V,	-	91.6	-	pF
Output capacitance	C_{oss}	V_{GE}=0V,	-	9.8	-	
Reverse transfer capacitance	C_{rss}	f=1MHz	-	3.4	-	
Gate charge	Q_{Gate}	V_{CC}=960V, I_C=1A V_{GE}=15V	-	8.6	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	7	-	nH

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, V_{CC}=800V, I_C=1A, V_{GE}=15V/0V, R_G=241Ω, L_σ[2)]=180nH, C_σ[2)]=40pF Energy losses include "tail" and diode [3)] reverse recovery.	-	13	-	ns
Rise time	t_r		-	6.3	-	
Turn-off delay time	$t_{d(off)}$		-	370	-	
Fall time	t_f		-	28	-	
Turn-on energy	E_{on}		-	0.08	-	mJ
Turn-off energy	E_{off}		-	0.06	-	
Total switching energy	E_{ts}		-	0.14	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	T_j=25°C, V_R=800V, I_F=1A, R_G=241Ω	-	83	-	ns
Diode reverse recovery charge	Q_{rr}		-	89	-	µC
Diode peak reverse recovery current	I_{rrm}		-	2.5	-	A
Diode current slope	di_F/dt		-	289	-	A/µs
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	178	-	

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 V_{CC}=800V, I_C=1A, V_{GE}=15V/0V, R_G=241Ω, L_σ[2)]=180nH, C_σ[2)]=40pF Energy losses include "tail" and diode [3)] reverse recovery.	-	12	-	ns
Rise time	t_r		-	8.9	-	
Turn-off delay time	$t_{d(off)}$		-	450	-	
Fall time	t_f		-	43	-	
Turn-on energy	E_{on}		-	0.11	-	mJ
Turn-off energy	E_{off}		-	0.09	-	
Total switching energy	E_{ts}		-	0.2	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	T_j=150°C V_R=800V, I_F=1A, R_G=241Ω	-	213	-	ns
Diode reverse recovery charge	Q_{rr}		-	180	-	µC
Diode peak reverse recovery current	I_{rrm}		-	2.7	-	A
Diode current slope	di_F/dt		-	240	-	A/µs
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	135	-	

[2)] Leakage inductance L_σ and stray capacity C_σ due to dynamic test circuit in figure E
[3)] Commutation diode from device IKP01N120H2

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=1A, V_{GE}=15V/0V, R_G=241Ω, C_r[2)]=1nF				mJ
		T_j=25°C	-	0.02	-	
		T_j=150°C	-	0.044	-	

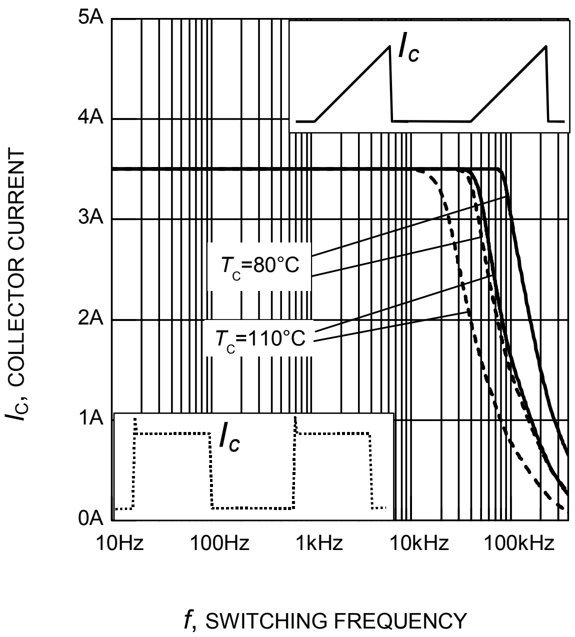


Figure 1. Collector current as a function of switching frequency
($T_j \leq 150°C$, $D = 0.5$, $V_{CE} = 800V$, $V_{GE} = +15V/0V$, $R_G = 241\Omega$)

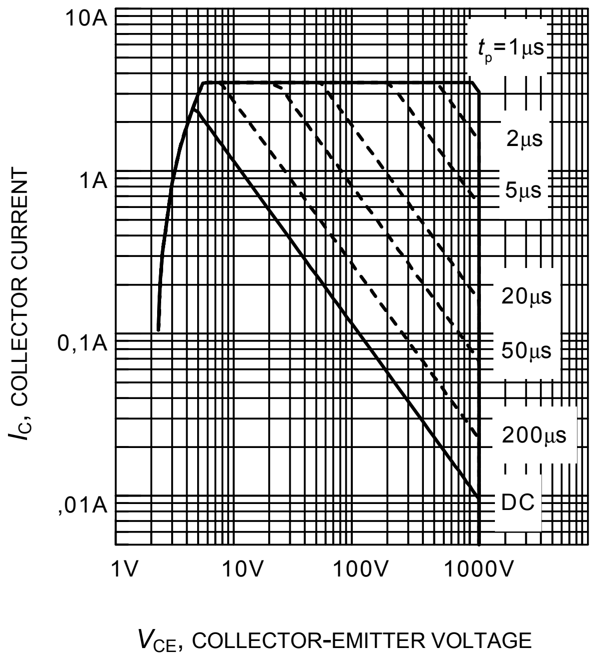


Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \leq 150°C$)

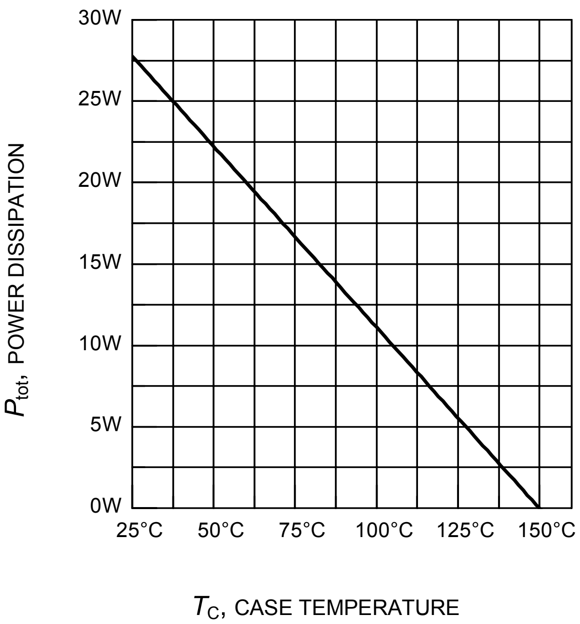


Figure 3. Power dissipation as a function of case temperature
($T_j \leq 150°C$)

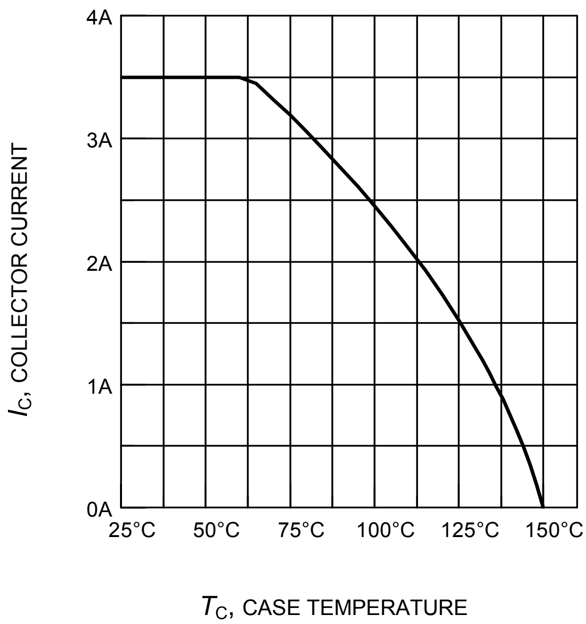


Figure 4. Collector current as a function of case temperature
($V_{GE} \leq 15V$, $T_j \leq 150°C$)

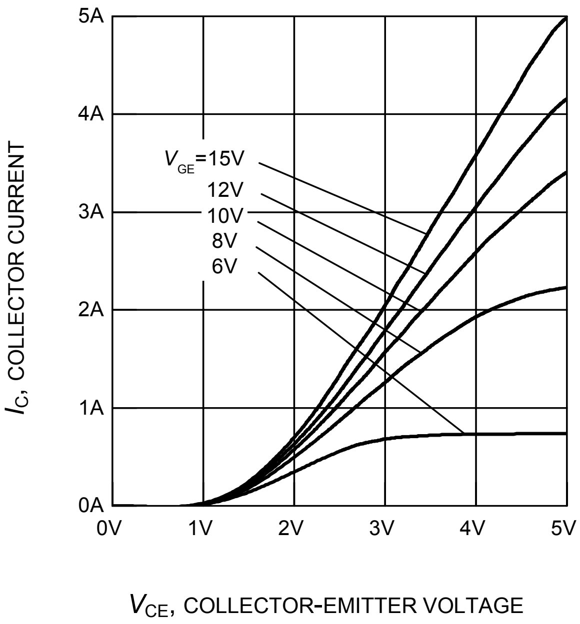


Figure 5. Typical output characteristics
(T_j = 25°C)

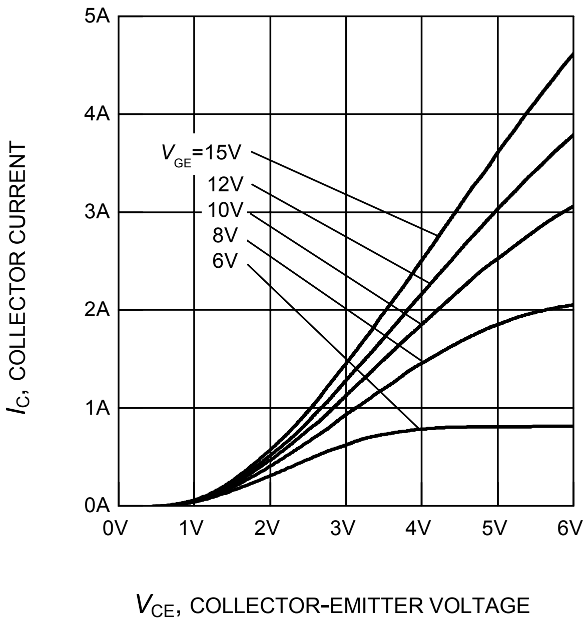


Figure 6. Typical output characteristics
(T_j = 150°C)

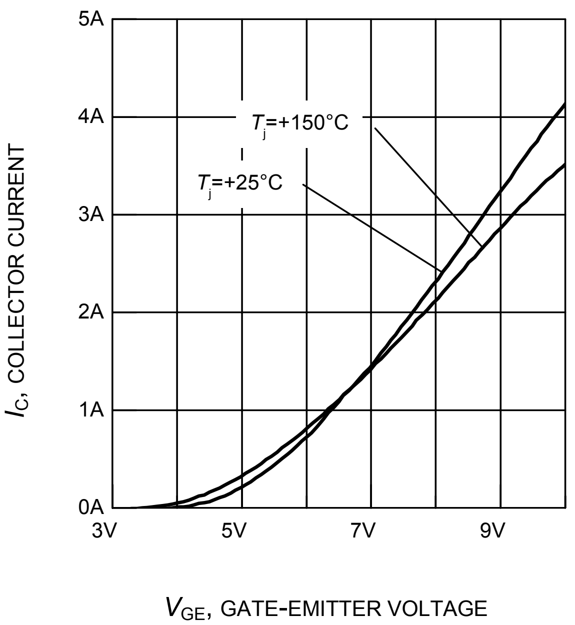


Figure 7. Typical transfer characteristics
(V_{CE} = 20V)

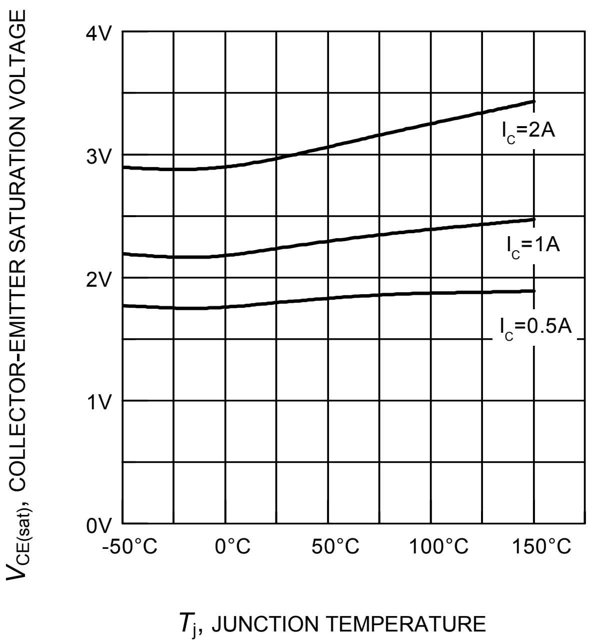
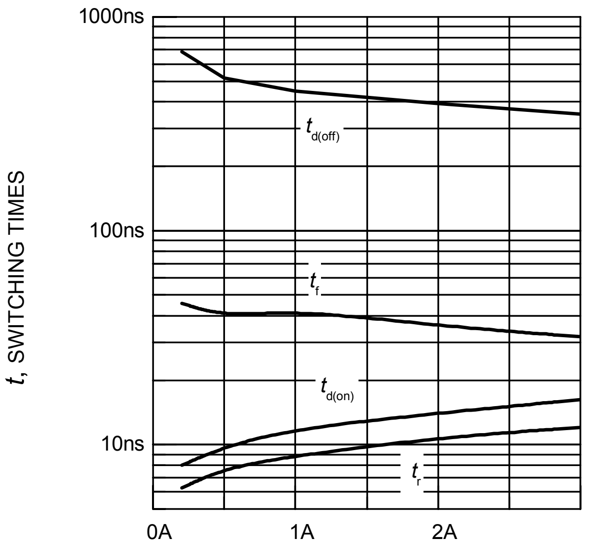
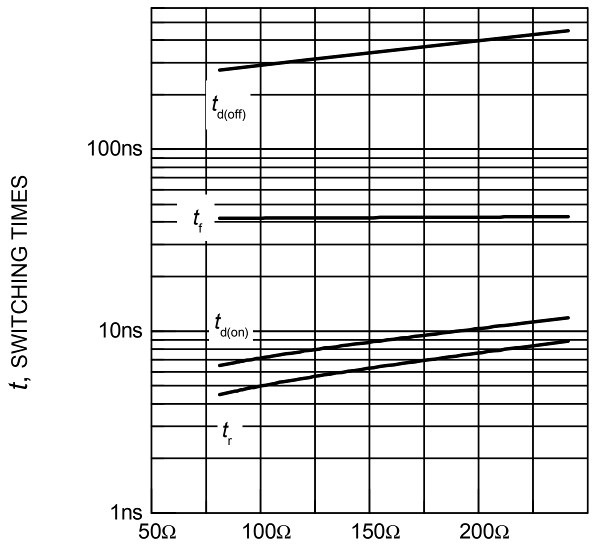


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)



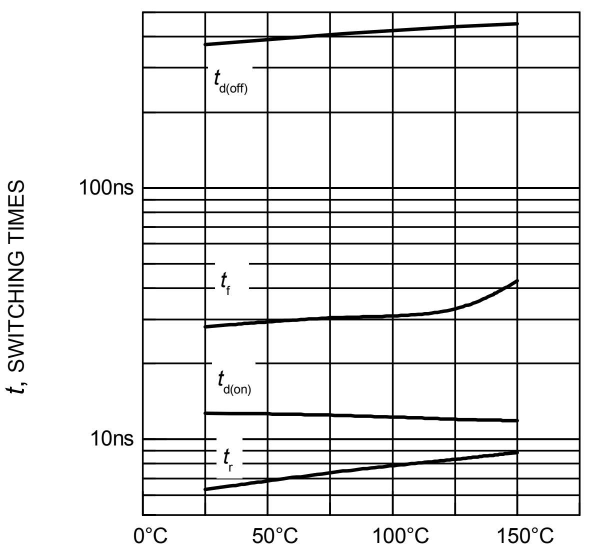
I_C, COLLECTOR CURRENT

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 = 241Ω,
dynamic test circuit in Fig.E)



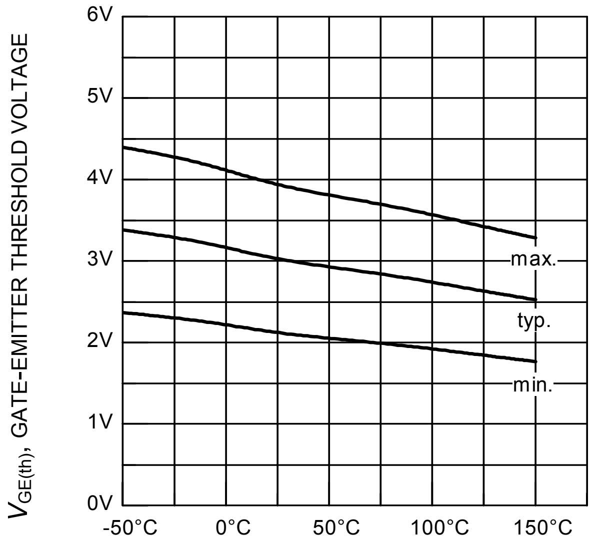
R_G, GATE RESISTOR

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 = 1A,
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 = 1A, R_G = 241Ω,
dynamic test circuit in Fig.E)



T_j, JUNCTION TEMPERATURE

Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 0.03mA)

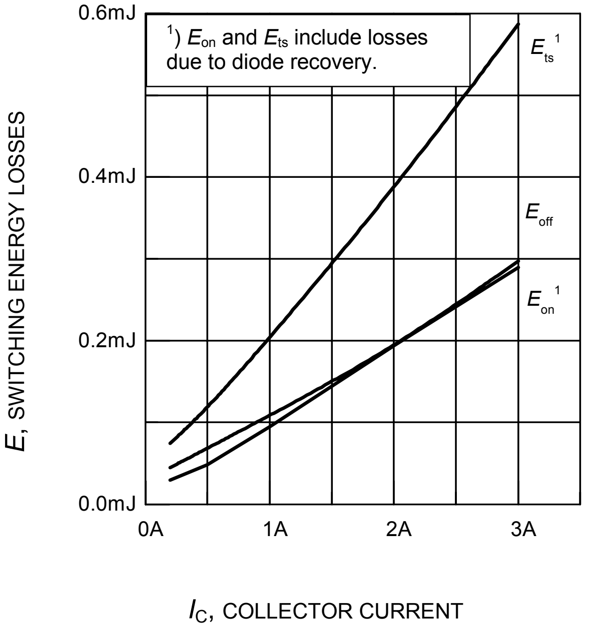


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_j = 150°C,
V_{CE} = 800V, V_{GE} = +15V/0V, R_G = 241Ω,
dynamic test circuit in Fig.E)

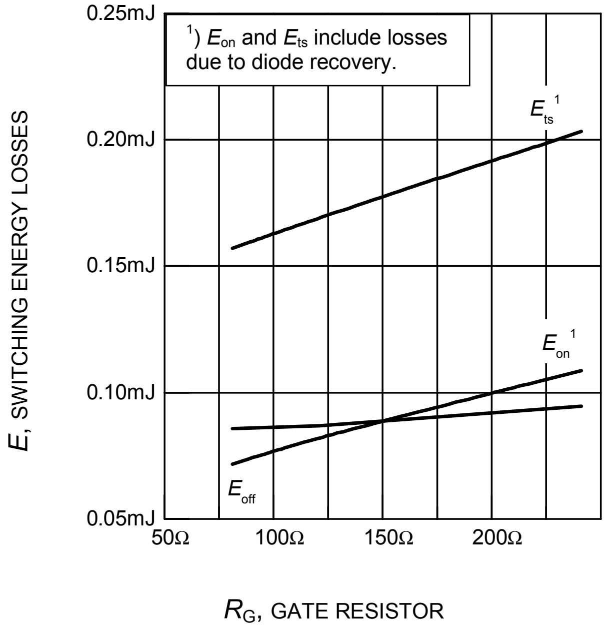


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_j = 150°C,
V_{CE} = 800V, V_{GE} = +15V/0V, I_C = 1A,
dynamic test circuit in Fig.E)

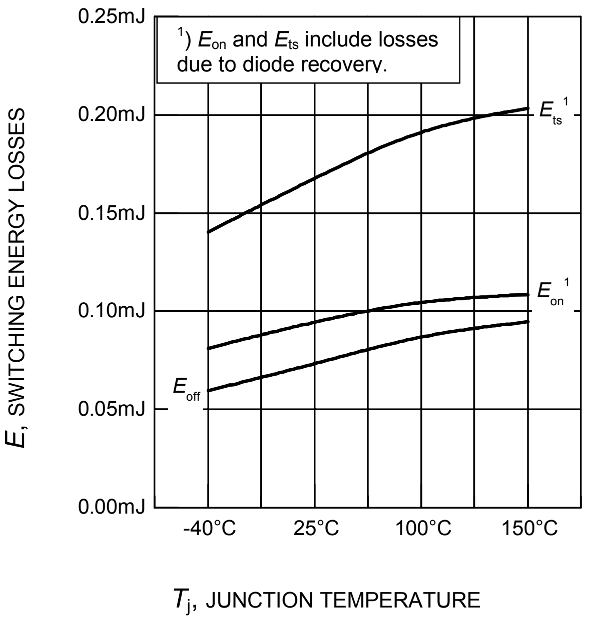


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE} = 800V,
V_{GE} = +15V/0V, I_C = 1A, R_G = 241Ω,
dynamic test circuit in Fig.E)

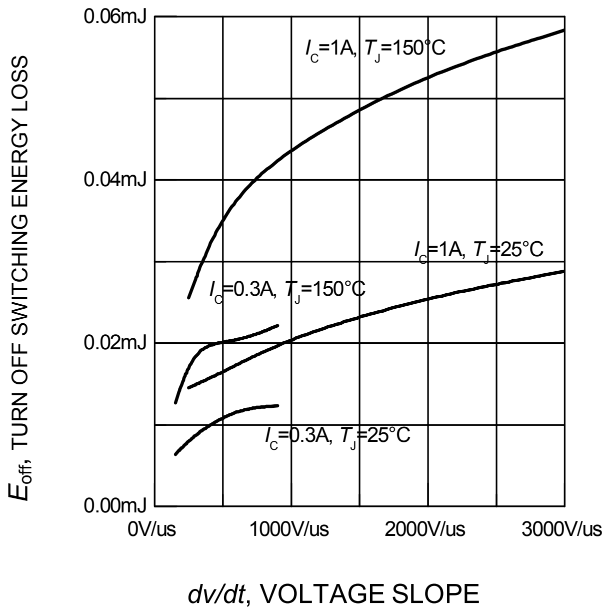


Figure 16. Typical turn off switching energy loss for soft switching
(*dynamic test circuit in Fig. E*)

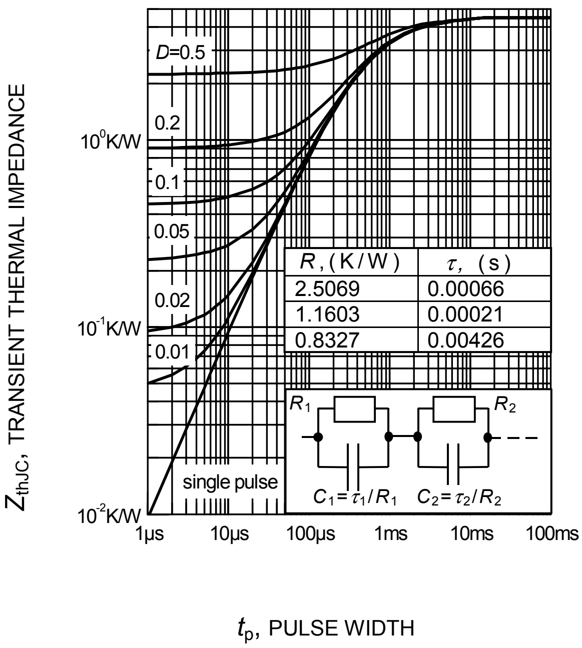


Figure 17. IGBT transient thermal impedance as a function of pulse width
($D = t_p / T$)

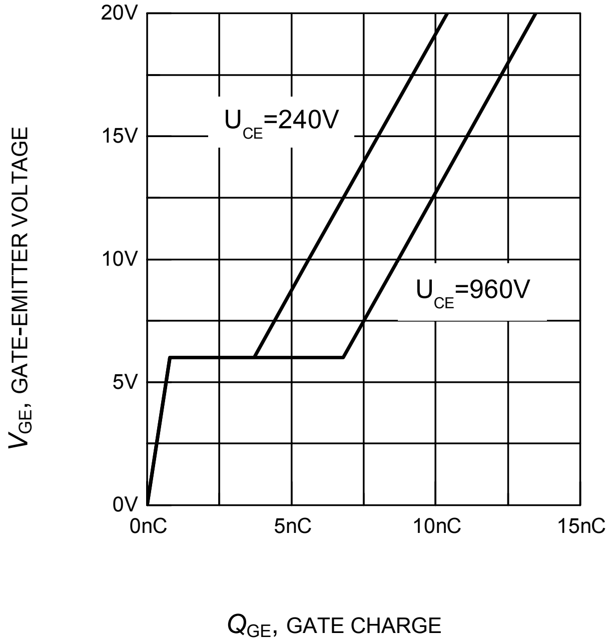


Figure 18. Typical gate charge
(I_C = 1A)

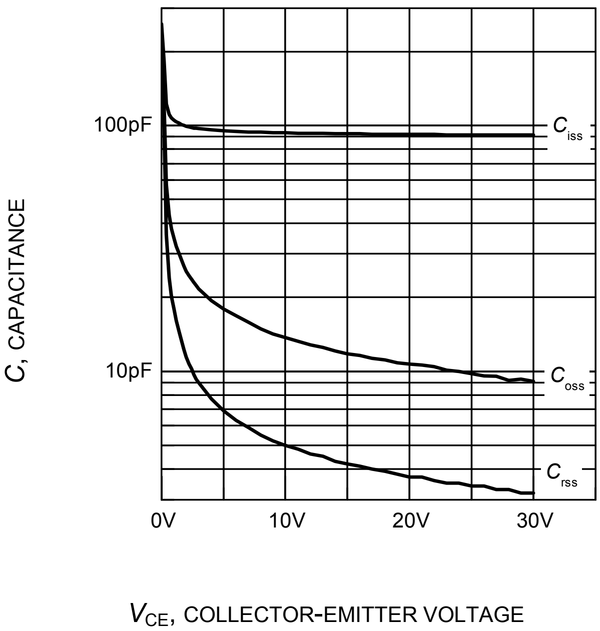


Figure 19. Typical capacitance as a function of collector-emitter voltage
(V_{GE} = 0V, f = 1MHz)

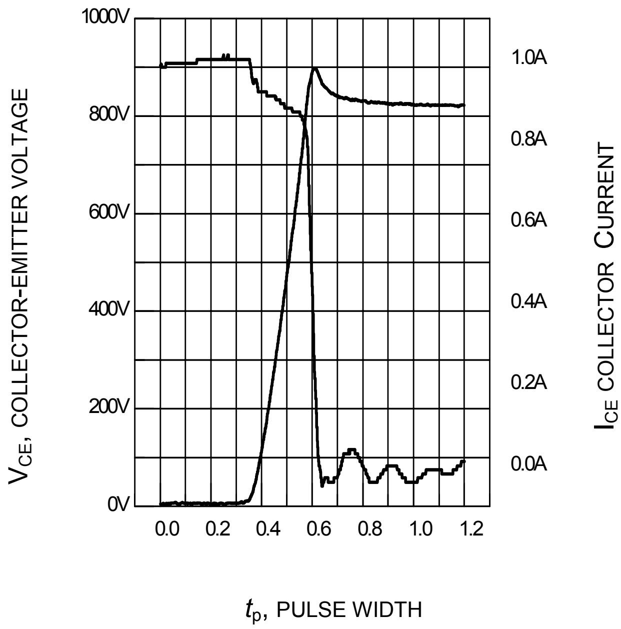


Figure 20. Typical turn off behavior, hard switching
(V_{GE}=15/0V, R_G=220Ω, T_j = 150°C,
Dynamic test circuit in Figure E)

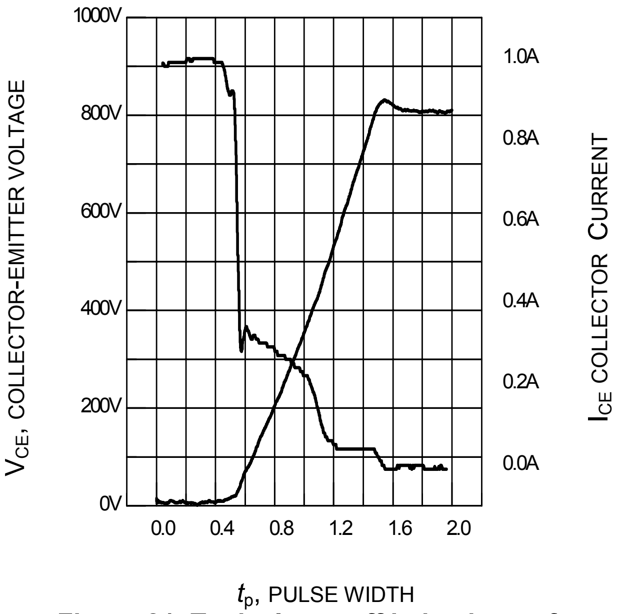


Figure 21. Typical turn off behavior, soft switching
(V_{GE}=15/0V, R_G=220Ω, T_j = 150°C, Dynamic test circuit in Figure E)

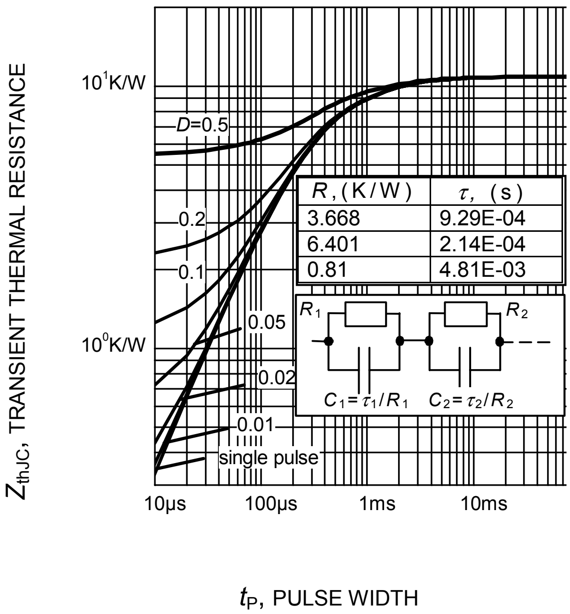


Figure 22. Diode transient thermal impedance as a function of pulse width
(D=t_P/T)

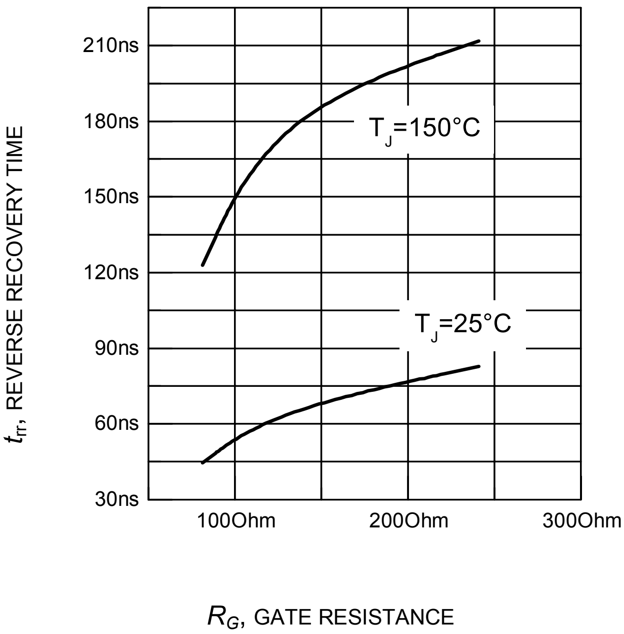


Figure 23. Typical reverse recovery time as a function of diode current slope
V_R=800V, I_F=3A,
Dynamic test circuit in Figure E)

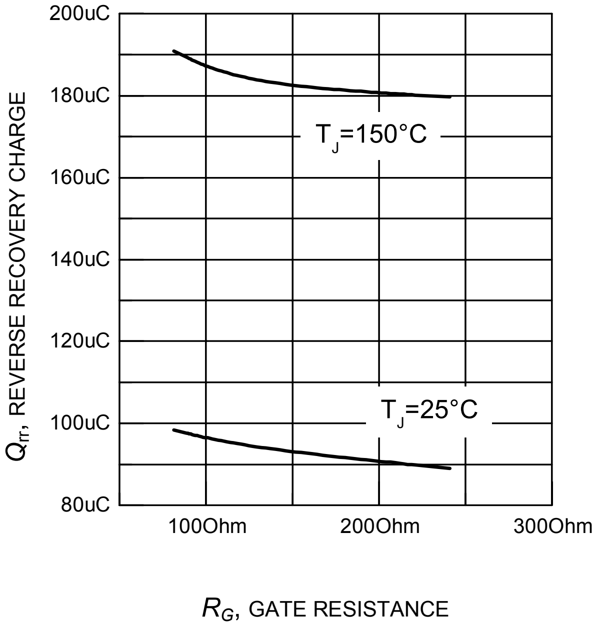


Figure 24. Typical reverse recovery charge as a function of diode current slope
(V_R=800V, I_F=3A,
Dynamic test circuit in Figure E)

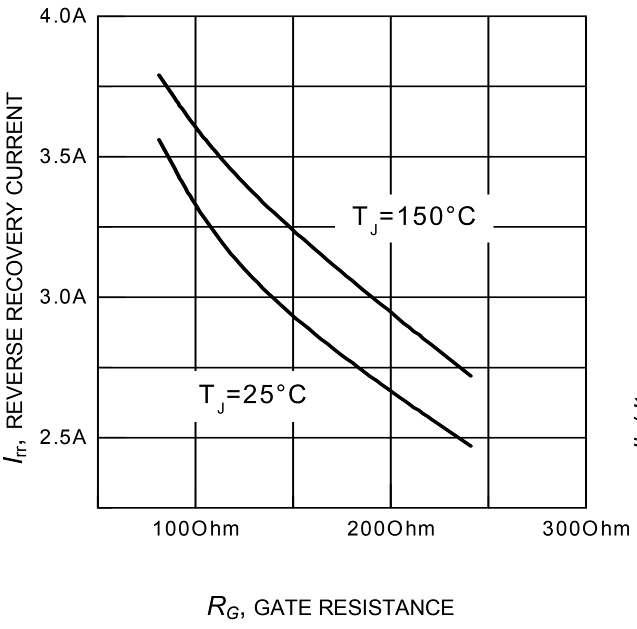


Figure 25. Typical reverse recovery current as a function of diode current slope
(V_R=800V, I_F=3A,
Dynamic test circuit in Figure E)

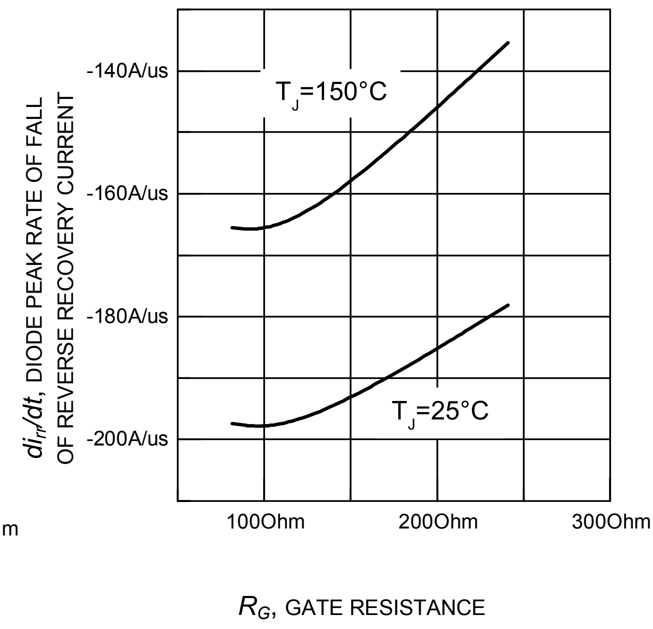


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
(V_R=800V, I_F=3A,
Dynamic test circuit in Figure E)

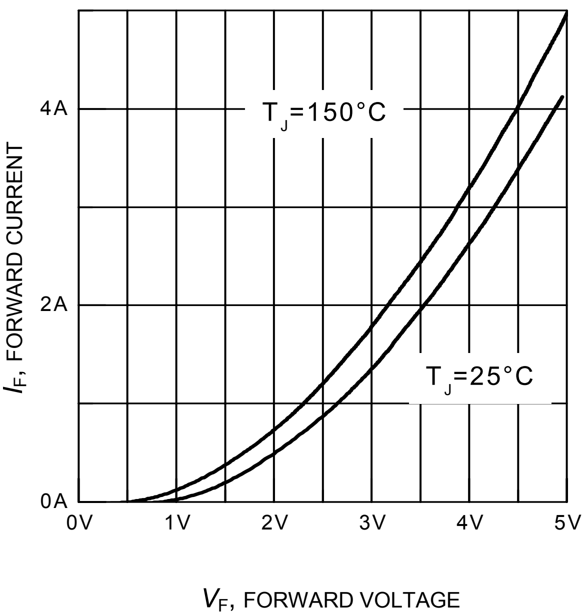


Figure 27. Typical diode forward current as a function of forward voltage

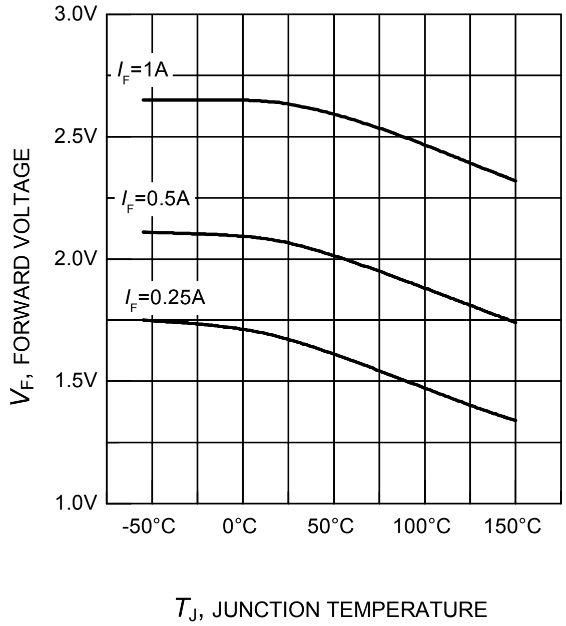
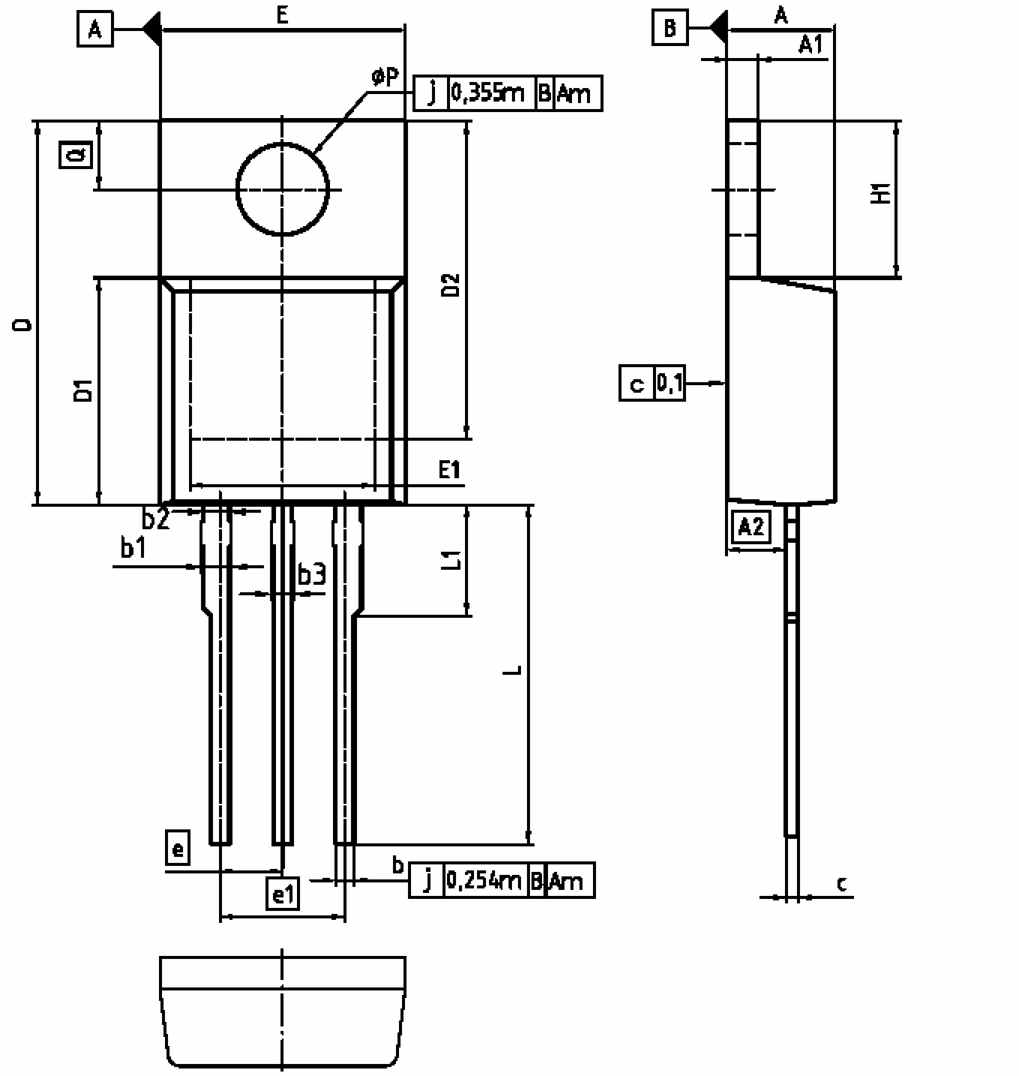


Figure 28. Typical diode forward voltage as a function of junction temperature

PG-TO220-3-1



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	1.17	1.40	0.046	0.055
A2	2.15	2.72	0.085	0.107
b	0.65	0.86	0.026	0.034
b1	0.95	1.40	0.037	0.055
b2	0.95	1.15	0.037	0.045
b3	0.65	1.15	0.026	0.045
c	0.33	0.60	0.013	0.024
D	14.81	15.95	0.583	0.628
D1	8.51	9.45	0.335	0.372
D2	12.19	13.10	0.480	0.516
E	9.70	10.36	0.382	0.408
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H1	5.90	6.90	0.232	0.272
L	13.00	14.00	0.512	0.551
L1	-	4.80	-	0.189
øP	3.60	3.89	0.142	0.153
Q	2.60	3.00	0.102	0.118

DOCUMENT NO.
Z8B00003318

SCALE 0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE
23-08-2007

REVISION
05

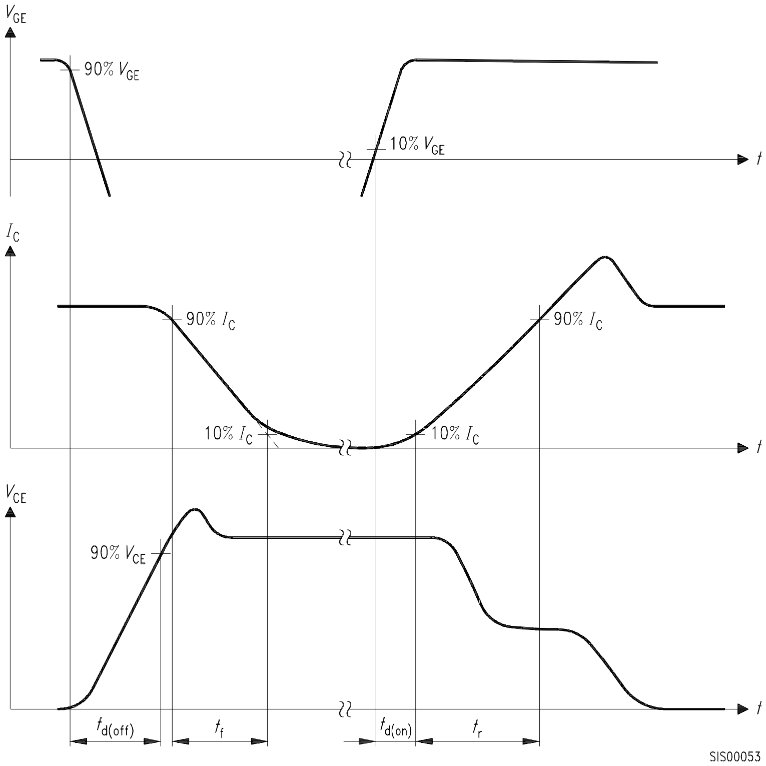


Figure A. Definition of switching times

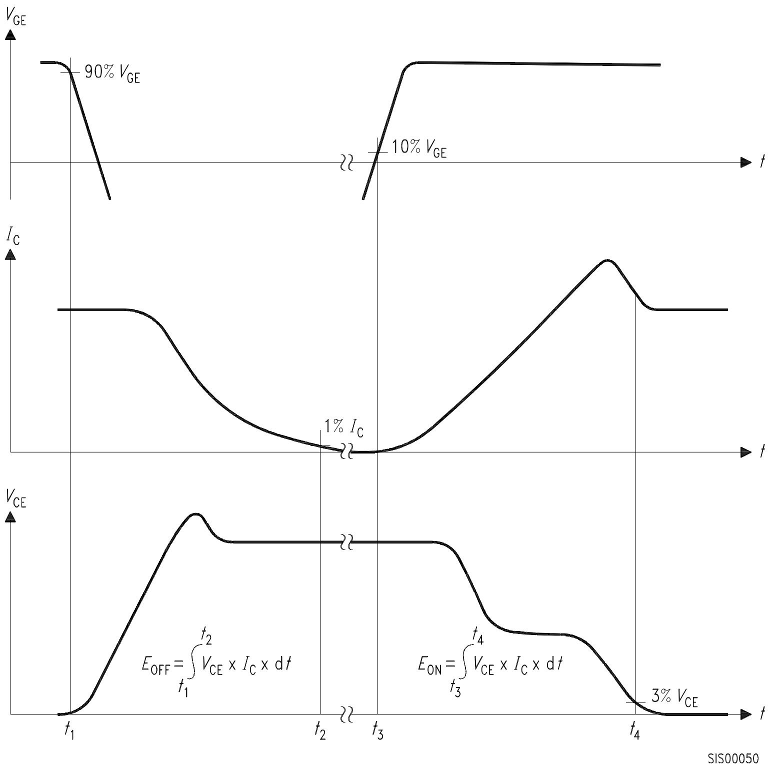


Figure B. Definition of switching losses

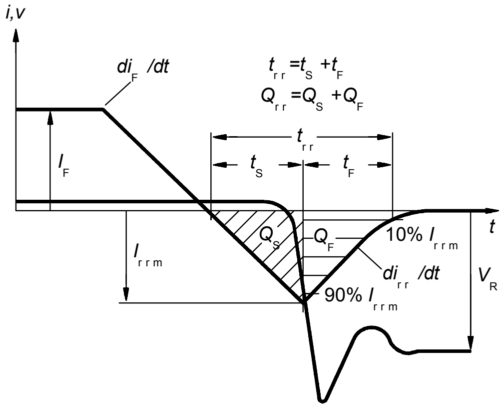


Figure C. Definition of diodes switching characteristics

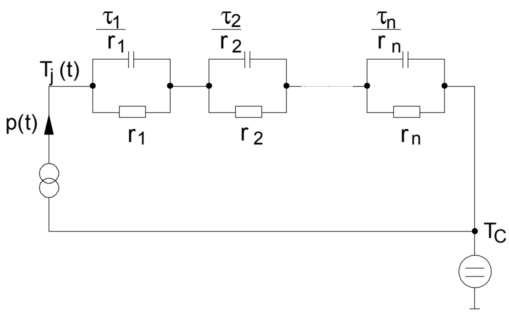


Figure D. Thermal equivalent circuit

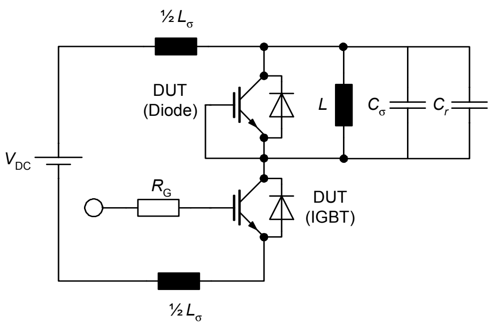


Figure E. Dynamic test circuit

Leakage inductance L_σ= 180nH,
Stray capacitor C_σ = 40pF,
Relief capacitor C_r = 1nF (only for ZVT switching)

Edition 2006-01

Published by
Infineon Technologies AG
81726 München, Germany

Attention please!

The information given in this data sheet shall in no event be regarded as a guarantee of conditions or characteristics (“Beschaffenheitsgarantie”). With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

Information

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office (**www.infineon.com**).

Warnings

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies Office.

Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.