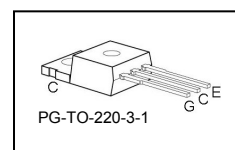
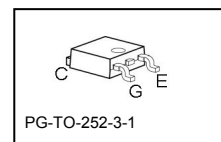
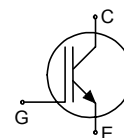


## HighSpeed 2-Technology

- **Designed for:**
  - SMPS
  - Lamp Ballast
  - ZVS-Converter
  - optimised for soft-switching / resonant topologies
- **2<sup>nd</sup> 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  $I_C = 1A$



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

Type	$V_{CE}$	$I_C$	$E_{off}$	$T_j$	Marking	Package
IGP01N120H2	1200V	1A	0.09mJ	150°C	G01H1202	PG-TO-220-3-1
IGD01N120H2	1200V	1A	0.09mJ	150°C	G1H1202	PG-TO-252-3-11

### Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	$V_{CE}$	1200	V
Triangular collector current	$I_C$		A
$T_C = 25^\circ\text{C}, f = 140\text{kHz}$		3.2	
$T_C = 100^\circ\text{C}, f = 140\text{kHz}$		1.3	
Pulsed collector current, $t_p$ limited by $T_{jmax}$	$I_{Cpuls}$	3.5	
Turn off safe operating area	-	3.5	
$V_{CE} \leq 1200\text{V}, T_j \leq 150^\circ\text{C}$			
Gate-emitter voltage	$V_{GE}$	$\pm 20$	V
Power dissipation	$P_{tot}$	28	W
$T_C = 25^\circ\text{C}$			
Operating junction and storage temperature	$T_j, T_{stg}$	-40...+150	°C
Soldering temperature	-		
PG-TO-252: Reflow soldering, MSL3		260	
Others: wavesoldering, 1.6 mm (0.063 in.) from case for 10s		260	

<sup>2</sup> J-STD-020 and JESD-022

### Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
<b>Characteristic</b>				
IGBT thermal resistance, junction – case	$R_{thJC}$		4.5	K/W
Thermal resistance, junction – ambient	$R_{thJA}$	PG-TO-220-3-1	62	
SMD version, device on PCB <sup>1)</sup>	$R_{thJA}$	PG-TO-252-3-1	50	

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

Parameter	Symbol	Conditions	Value			Unit	
			min.	Typ.	max.		
<b>Static Characteristic</b>							
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=300\mu A$	1200	-	-	V	
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=1A$ $T_j=25^\circ C$ $T_j=150^\circ C$	-	2.2	2.8		
			$V_{GE} = 10V, I_C=1A,$ $T_j=25^\circ C$	-	2.5		-
				-	2.4		-
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=30\mu A, V_{CE}=V_{GE}$	2.1	3	3.9		
Zero gate voltage collector current	$I_{CES}$	$V_{CE}=1200V, V_{GE}=0V$ $T_j=25^\circ C$ $T_j=150^\circ C$	-	-	20	$\mu A$	
			-	-	80		
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	
<b>Dynamic Characteristic</b>							
Input capacitance	$C_{iss}$	$V_{CE}=25V,$ $V_{GE}=0V,$ $f=1MHz$	-	91.6	-	pF	
Output capacitance	$C_{oss}$		-	9.8	-		
Reverse transfer capacitance	$C_{rss}$		-	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	

<sup>1)</sup> Device on 50mm\*50mm\*1.5mm epoxy PCB FR4 with 6cm<sup>2</sup> (one layer, 70 $\mu$ m thick) copper area for collector connection. PCB is vertical without blown air.

**Switching Characteristic, Inductive Load, at  $T_j=25^\circ\text{C}$**

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
<b>IGBT Characteristic</b>						
Turn-on delay time	$t_{d(on)}$	$T_j=25^\circ\text{C}$ , $V_{CC}=800\text{V}$ , $I_C=1\text{A}$ , $V_{GE}=15\text{V}/0\text{V}$ , $R_G=241\Omega$ , $L_\sigma^{2)}=180\text{nH}$ , $C_\sigma^{2)}=40\text{pF}$ Energy losses include "tail" and diode <sup>3)</sup> 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	-	

**Switching Characteristic, Inductive Load, at  $T_j=150^\circ\text{C}$**

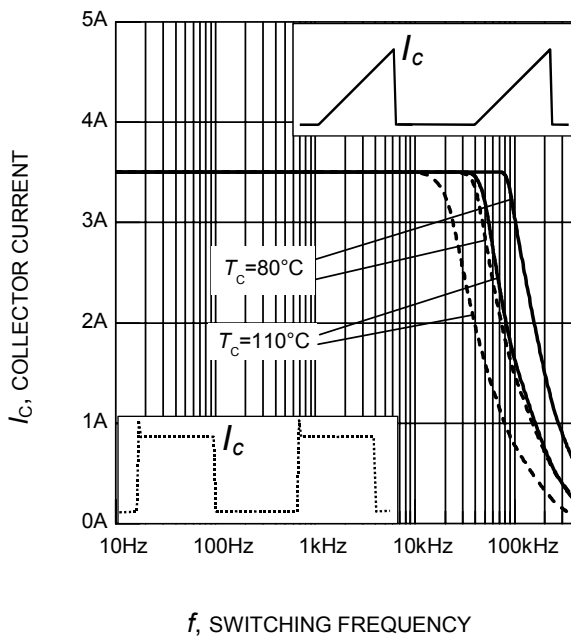
Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
<b>IGBT Characteristic</b>						
Turn-on delay time	$t_{d(on)}$	$T_j=150^\circ\text{C}$ $V_{CC}=800\text{V}$ , $I_C=1\text{A}$ , $V_{GE}=15\text{V}/0\text{V}$ , $R_G=241\Omega$ , $L_\sigma^{2)}=180\text{nH}$ , $C_\sigma^{2)}=40\text{pF}$ Energy losses include "tail" and diode <sup>4)</sup> 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	-	

**Switching Energy ZVT, Inductive Load**

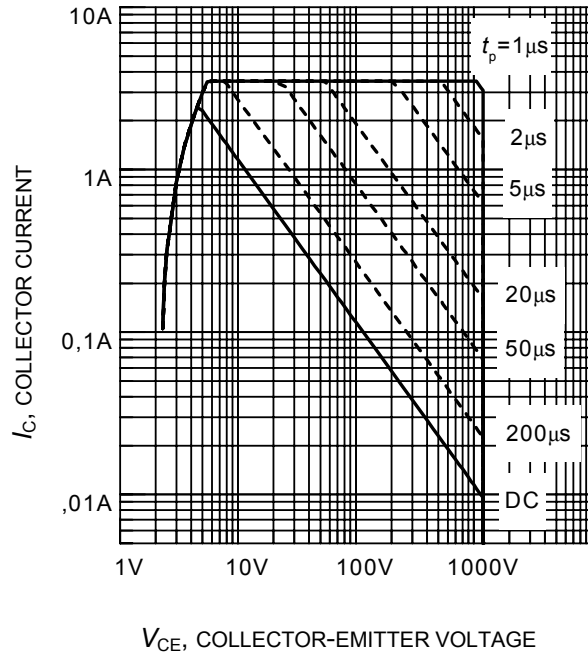
Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
<b>IGBT Characteristic</b>						
Turn-off energy	$E_{off}$	$V_{CC}=800\text{V}$ , $I_C=1\text{A}$ , $V_{GE}=15\text{V}/0\text{V}$ , $R_G=241\Omega$ , $C_r^{2)}=1\text{nF}$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	-	0.02 0.044	-	mJ
			-		-	

<sup>2)</sup> Leakage inductance  $L_\sigma$  and stray capacity  $C_\sigma$  due to dynamic test circuit in figure E

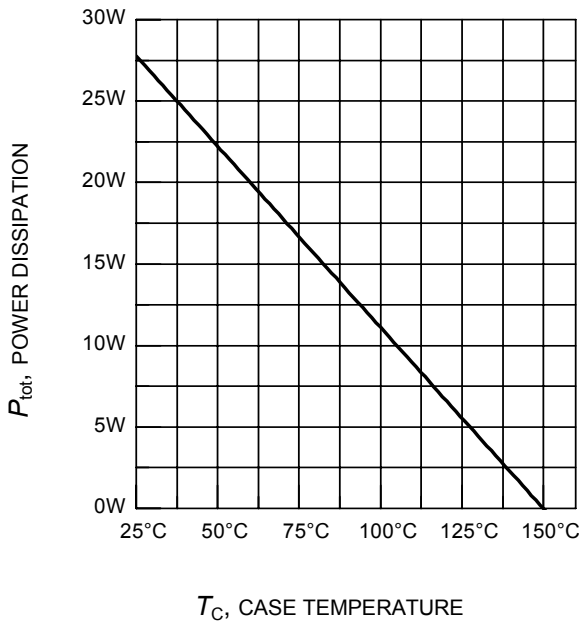
<sup>4)</sup> Commutation diode from device IKP01N120H2



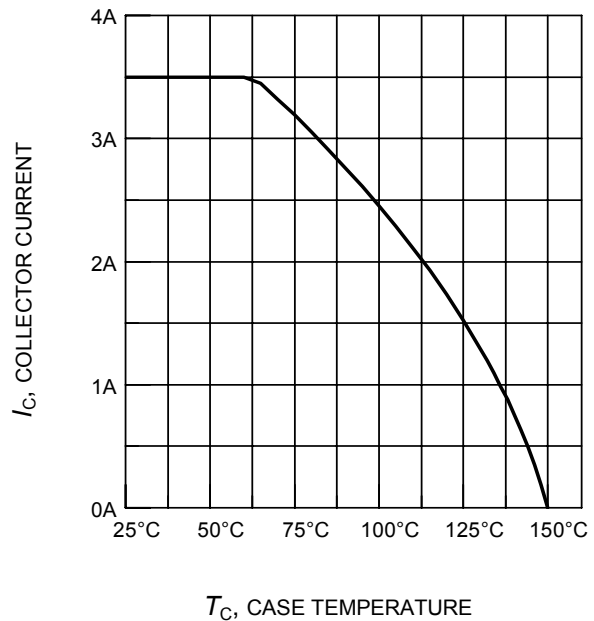
**Figure 1. Collector current as a function of switching frequency**  
( $T_j \leq 150^\circ\text{C}$ ,  $D = 0.5$ ,  $V_{CE} = 800\text{V}$ ,  $V_{GE} = +15\text{V}/0\text{V}$ ,  $R_G = 241\Omega$ )



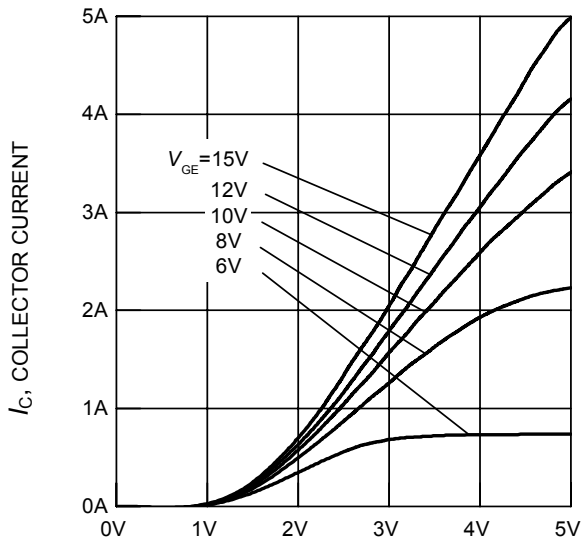
**Figure 2. Safe operating area**  
( $D = 0$ ,  $T_C = 25^\circ\text{C}$ ,  $T_j \leq 150^\circ\text{C}$ )



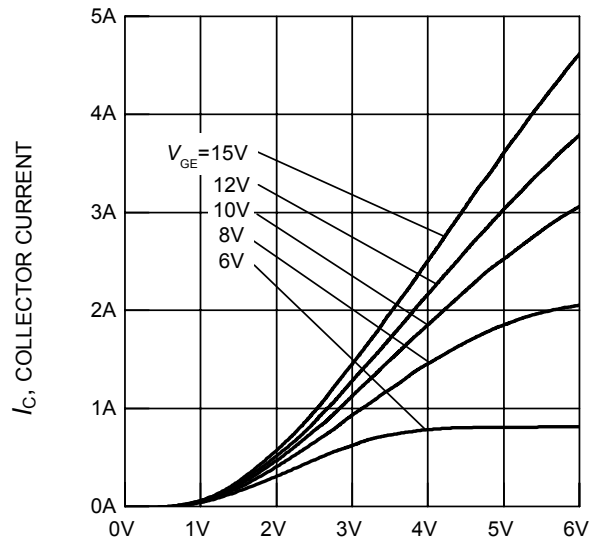
**Figure 3. Power dissipation as a function of case temperature**  
( $T_j \leq 150^\circ\text{C}$ )



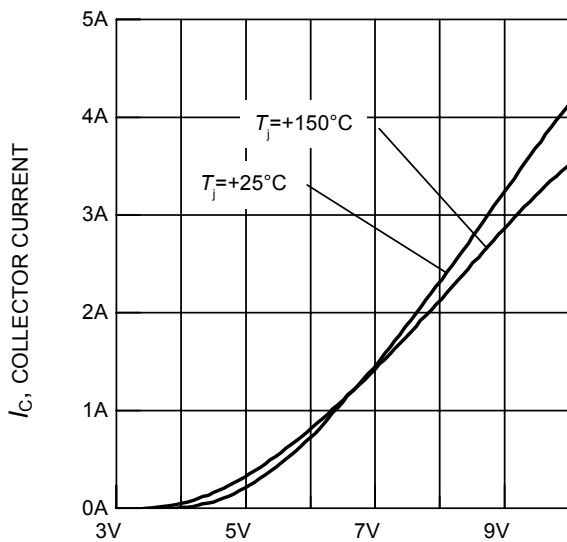
**Figure 4. Collector current as a function of case temperature**  
( $V_{GE} \leq 15\text{V}$ ,  $T_j \leq 150^\circ\text{C}$ )



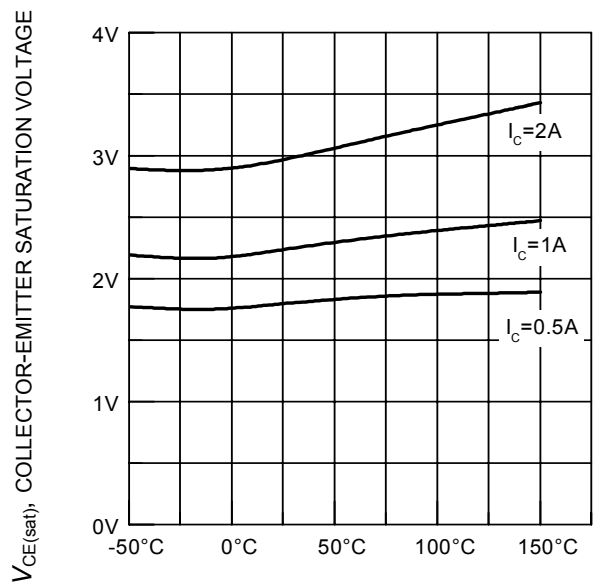
$V_{CE}$ , COLLECTOR-EMITTER VOLTAGE  
**Figure 5. Typical output characteristics**  
( $T_j = 25^\circ\text{C}$ )



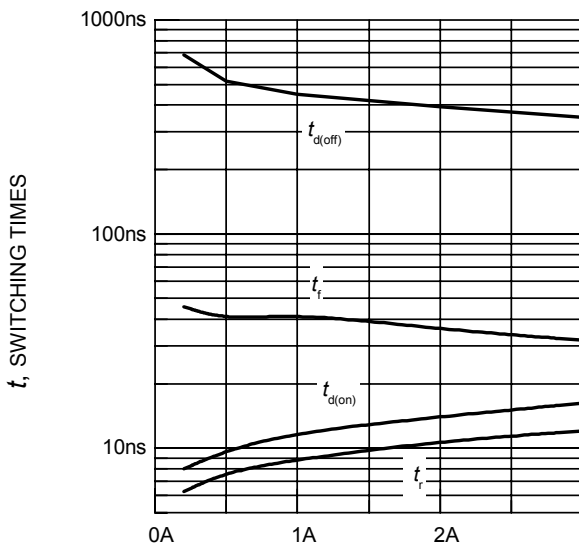
$V_{CE}$ , COLLECTOR-EMITTER VOLTAGE  
**Figure 6. Typical output characteristics**  
( $T_j = 150^\circ\text{C}$ )



$V_{GE}$ , GATE-EMITTER VOLTAGE  
**Figure 7. Typical transfer characteristics**  
( $V_{CE} = 20\text{V}$ )



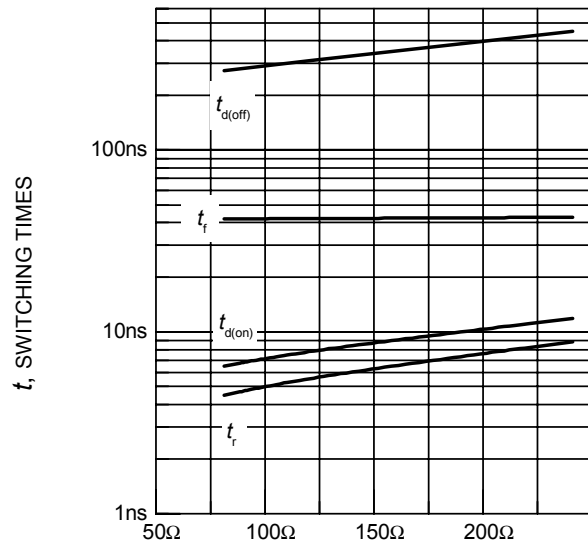
$T_j$ , JUNCTION TEMPERATURE  
**Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{GE} = 15\text{V}$ )



$I_C$ , COLLECTOR CURRENT

**Figure 9. Typical switching times as a function of collector current**

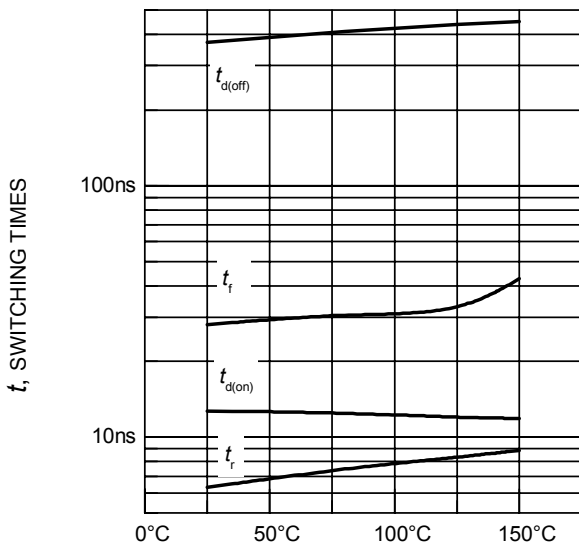
(inductive load,  $T_j = 150^\circ\text{C}$ ,  
 $V_{CE} = 800\text{V}$ ,  $V_{GE} = +15\text{V}/0\text{V}$ ,  $R_G = 241\Omega$ ,  
dynamic test circuit in Fig.E)



$R_G$ , GATE RESISTOR

**Figure 10. Typical switching times as a function of gate resistor**

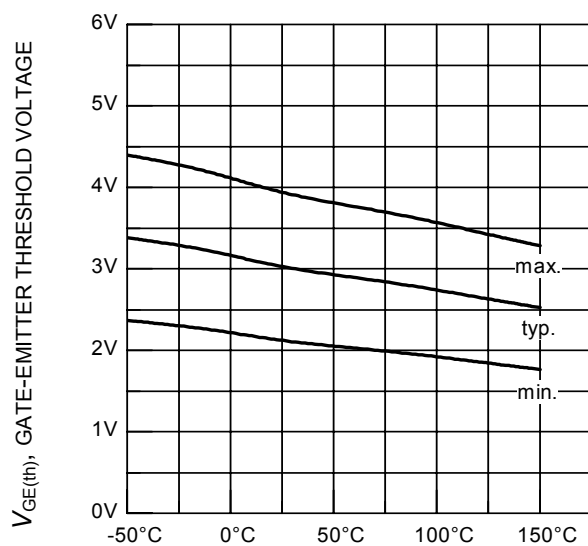
(inductive load,  $T_j = 150^\circ\text{C}$ ,  
 $V_{CE} = 800\text{V}$ ,  $V_{GE} = +15\text{V}/0\text{V}$ ,  $I_C = 1\text{A}$ ,  
dynamic test circuit in Fig.E)



$T_j$ , JUNCTION TEMPERATURE

**Figure 11. Typical switching times as a function of junction temperature**

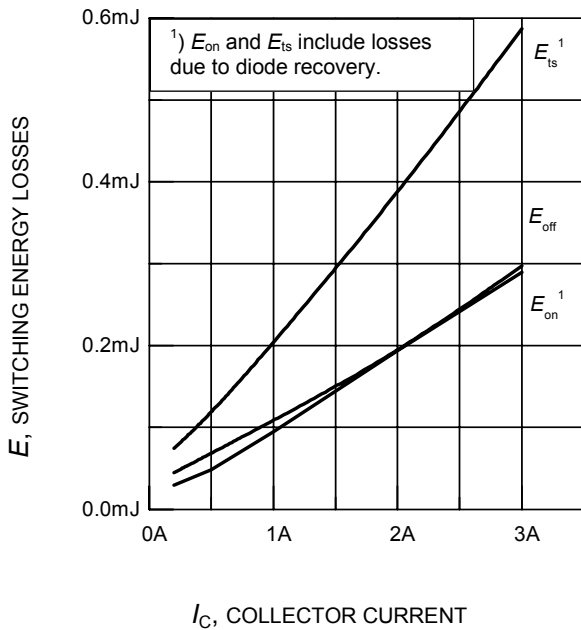
(inductive load,  $V_{CE} = 800\text{V}$ ,  
 $V_{GE} = +15\text{V}/0\text{V}$ ,  $I_C = 1\text{A}$ ,  $R_G = 241\Omega$ ,  
dynamic test circuit in Fig.E)



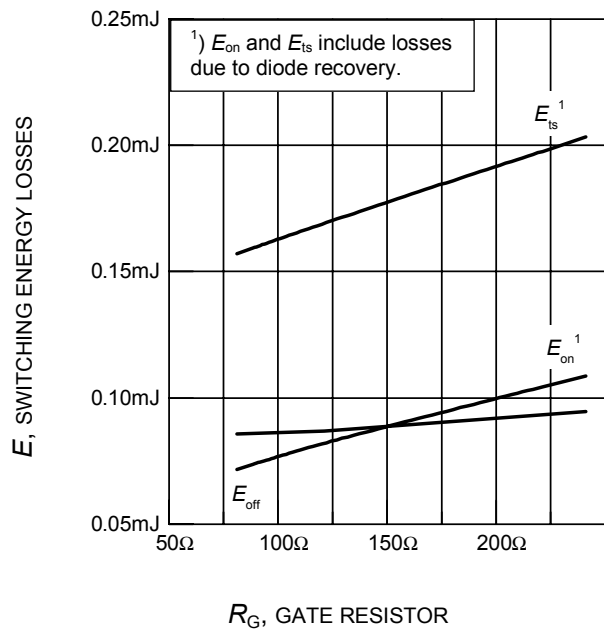
$T_j$ , JUNCTION TEMPERATURE

**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**

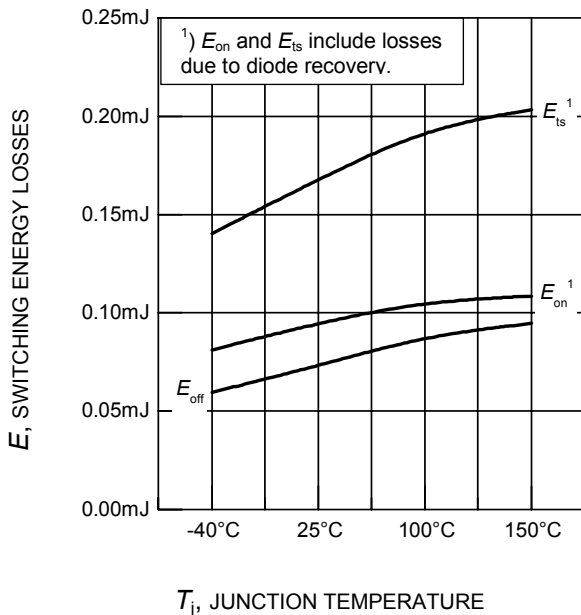
( $I_C = 0.03\text{mA}$ )



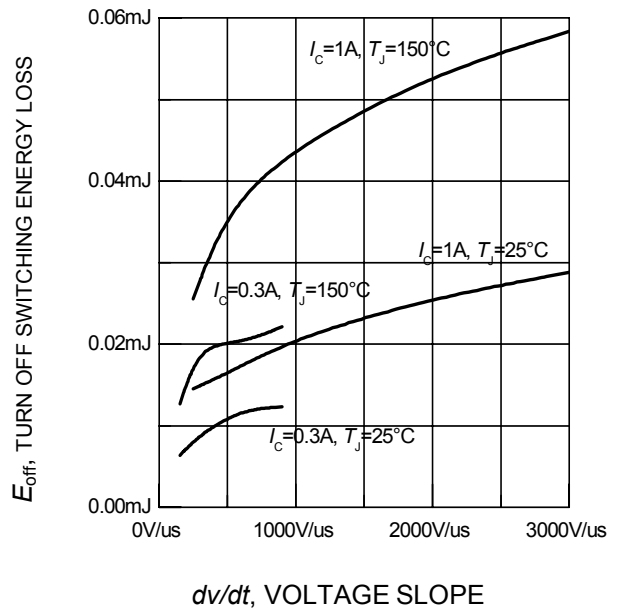
$I_C$ , COLLECTOR CURRENT  
**Figure 13. Typical switching energy losses as a function of collector current**  
(inductive load,  $T_j = 150^\circ\text{C}$ ,  $V_{CE} = 800\text{V}$ ,  $V_{GE} = +15\text{V}/0\text{V}$ ,  $R_G = 241\Omega$ , dynamic test circuit in Fig.E )



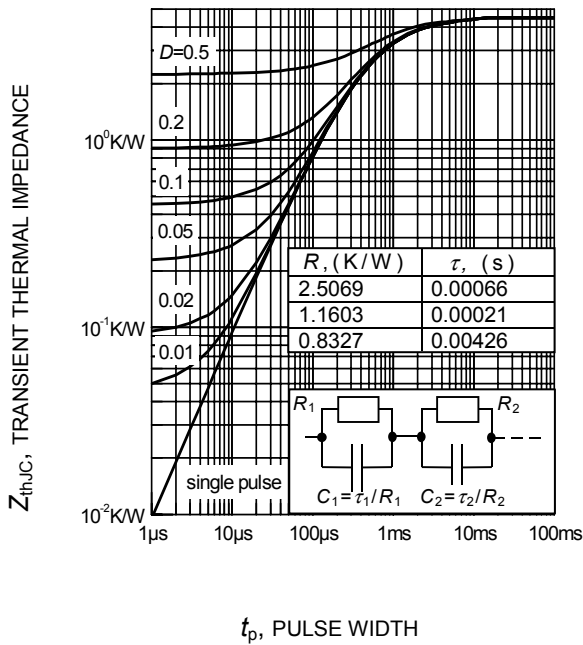
$R_G$ , GATE RESISTOR  
**Figure 14. Typical switching energy losses as a function of gate resistor**  
(inductive load,  $T_j = 150^\circ\text{C}$ ,  $V_{CE} = 800\text{V}$ ,  $V_{GE} = +15\text{V}/0\text{V}$ ,  $I_C = 1\text{A}$ , dynamic test circuit in Fig.E )



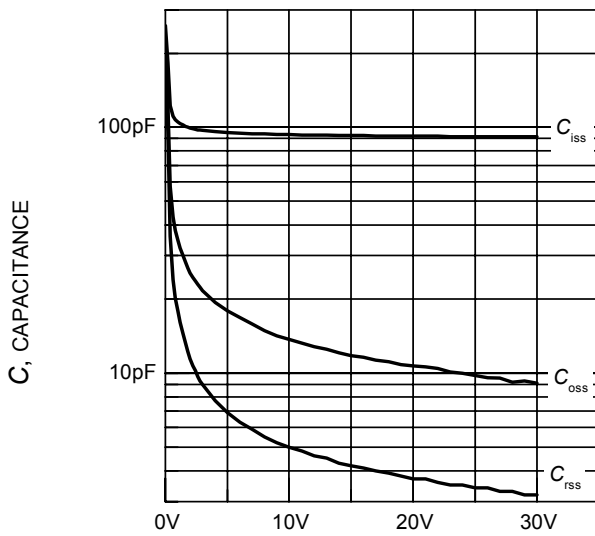
$T_j$ , JUNCTION TEMPERATURE  
**Figure 15. Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{CE} = 800\text{V}$ ,  $V_{GE} = +15\text{V}/0\text{V}$ ,  $I_C = 1\text{A}$ ,  $R_G = 241\Omega$ , dynamic test circuit in Fig.E )



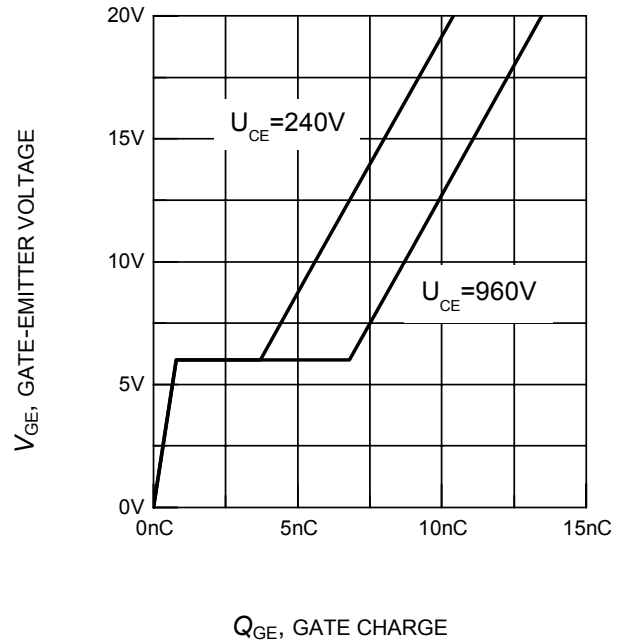
$dv/dt$ , VOLTAGE SLOPE  
**Figure 16. Typical turn off switching energy loss for soft switching**  
(dynamic test circuit in Fig. E)



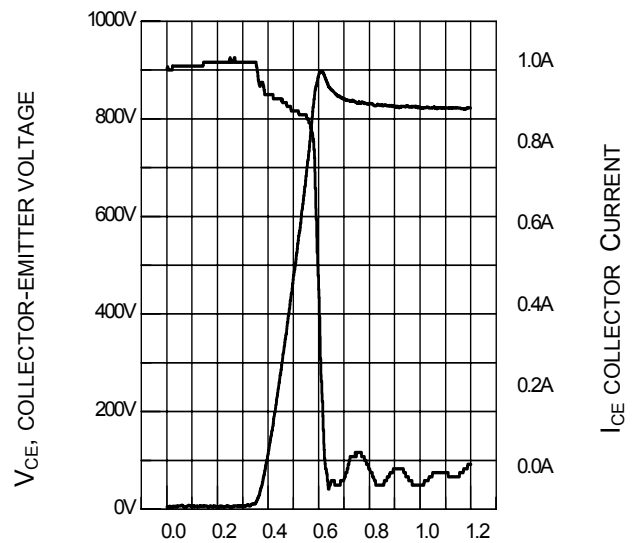
**Figure 17. IGBT transient thermal impedance as a function of pulse width**  
( $D = t_p / T$ )



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

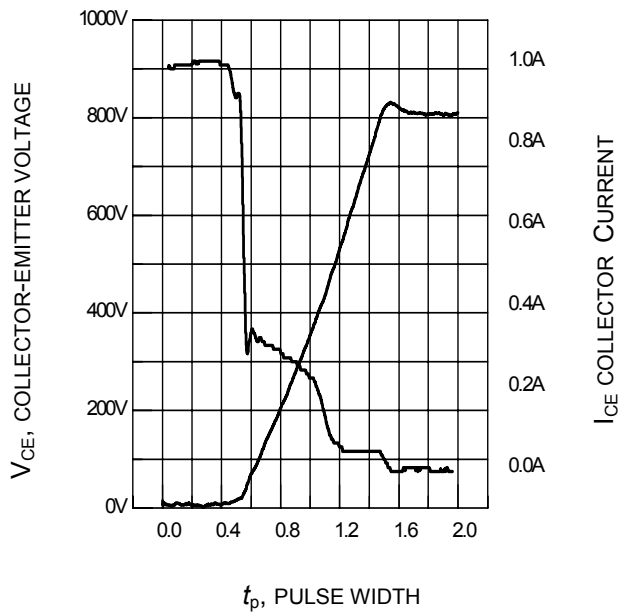


**Figure 18. Typical gate charge**  
( $I_C = 1A$ )



**Figure 20. Typical turn off behavior, hard switching**  
( $V_{GE} = 15/0V, R_G = 220\Omega, T_j = 150^\circ C,$   
Dynamic test circuit in Figure E)

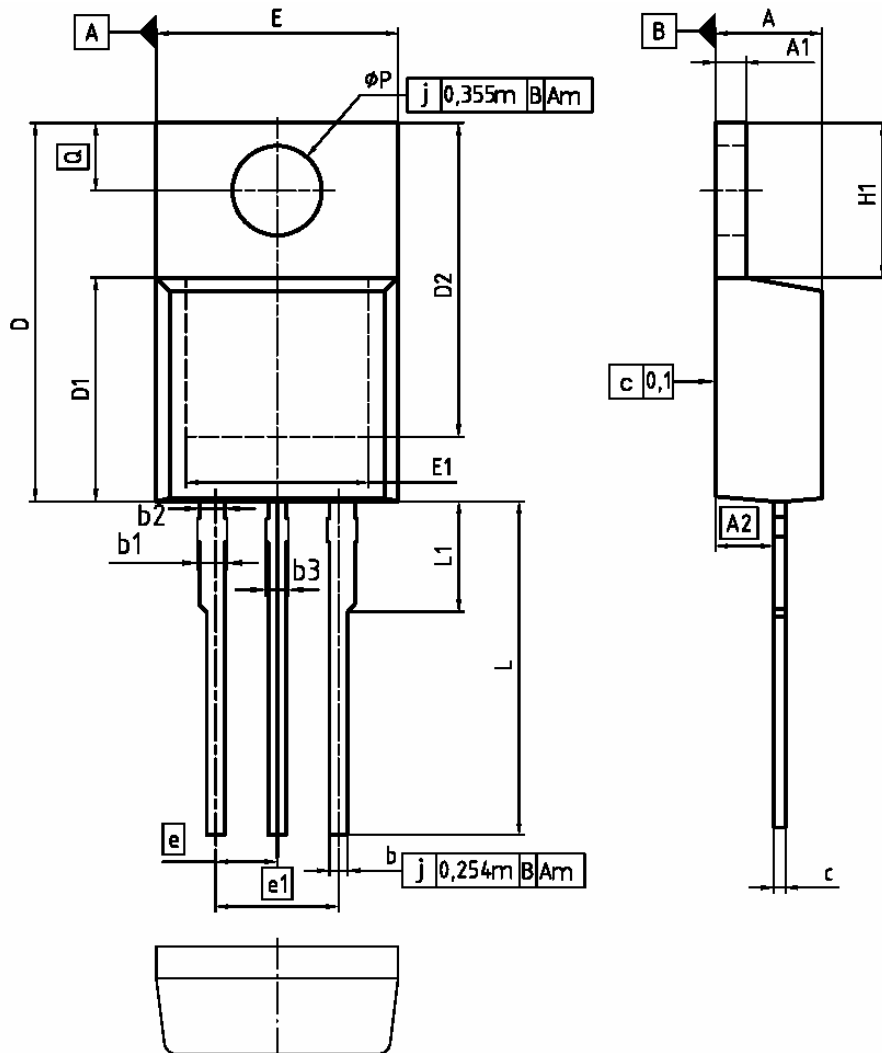




**Figure 21. Typical turn off behavior, soft switching**

( $V_{GE}=15/0V$ ,  $R_G=220\Omega$ ,  $T_j = 150^\circ C$ ,  
Dynamic test circuit in Figure E)

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	0.85	1.15	0.028	0.045
c	0.33	0.80	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
phi P	3.60	3.80	0.142	0.153
Q	2.60	3.00	0.102	0.118

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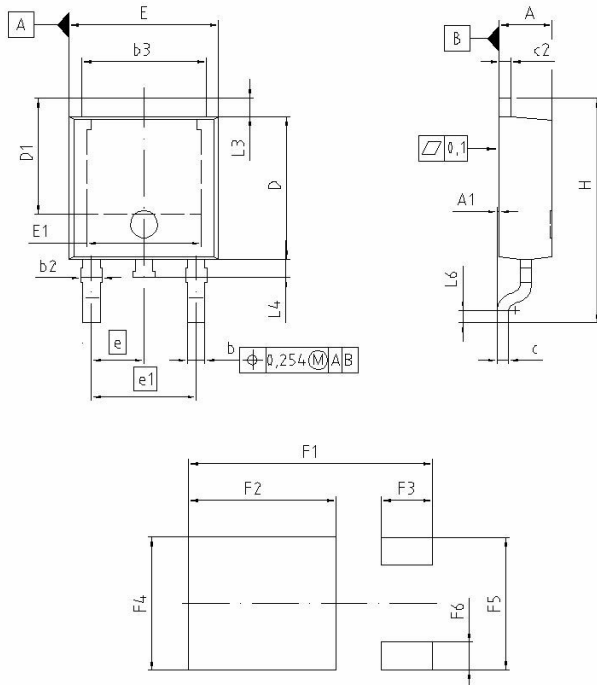
SCALE

EUROPEAN PROJECTION

ISSUE DATE  
23-08-2007

REVISION  
05

P-TO252-3-11



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.184	2.388	0.086	0.094
A1	0.000	0.150	0.000	0.006
b	0.635	0.889	0.025	0.035
b2	0.650	1.150	0.025	0.045
b3	5.004	5.500	0.197	0.217
c	0.460	0.580	0.018	0.023
c2	0.460	0.980	0.018	0.039
D	5.969	6.223	0.235	0.245
D1	5.020	5.320	0.198	0.209
E	6.400	6.731	0.252	0.265
E1	4.900	5.100	0.193	0.201
e	2,286		0.090	
e1	4,572		0.180	
N	3		3	
H	9.400	10.084	0.370	0.397
L3	0.900	1.118	0.035	0.044
L4	0.650	1.016	0.026	0.040
L6	0.510	0.686	0.020	0.027
F1	10.500	10.700	0.413	0.421
F2	6.300	6.500	0.248	0.256
F3	2.100	2.300	0.083	0.091
F4	5.700	5.900	0.224	0.232
F5	5.860	5.860	0.222	0.231
F6	1.100	1.300	0.043	0.051

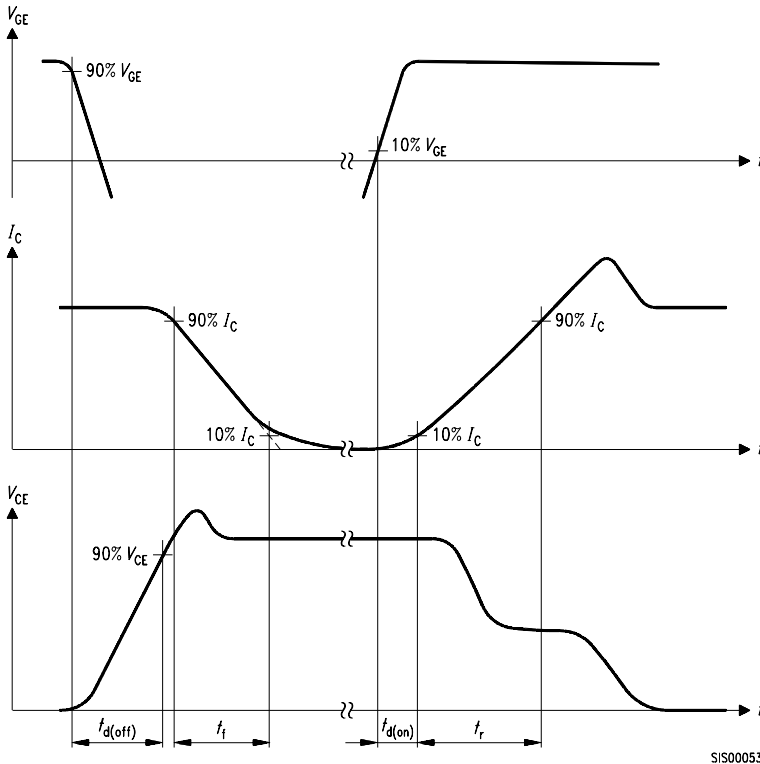


Figure A. Definition of switching times

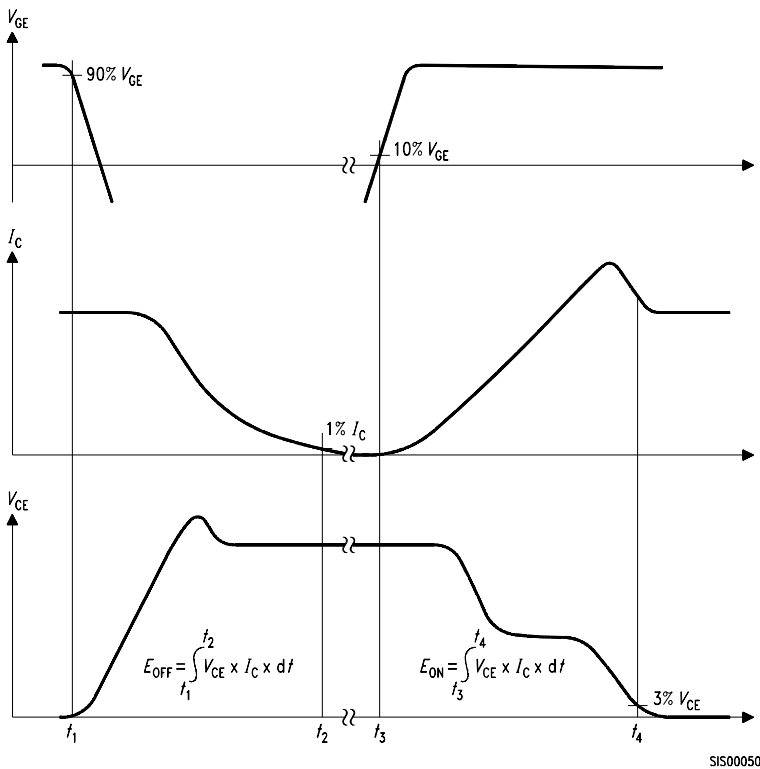


Figure B. Definition of switching losses

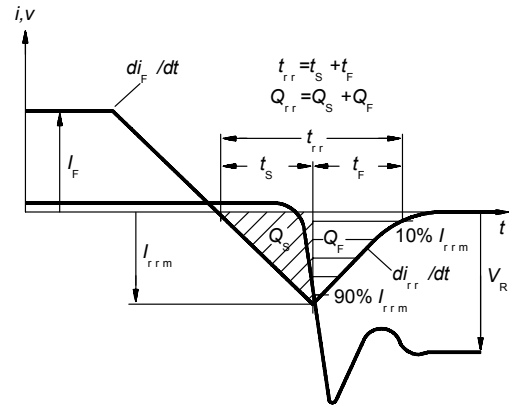


Figure C. Definition of diodes switching characteristics

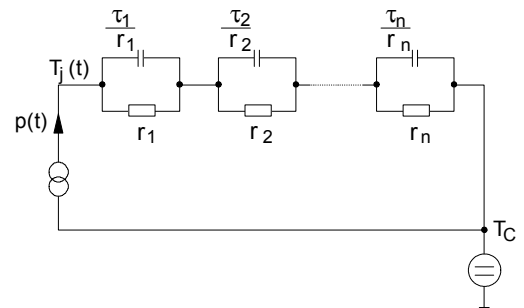


Figure D. Thermal equivalent circuit

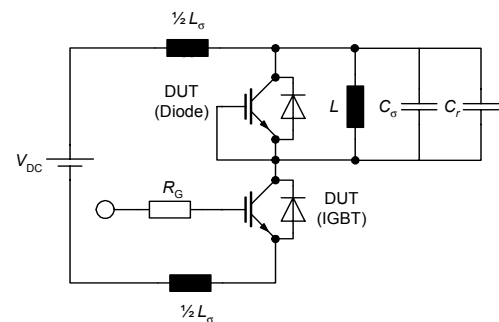


Figure E. Dynamic test circuit  
Leakage inductance  $L_{\sigma} = 180\text{nH}$ ,  
Stray capacitor  $C_{\sigma} = 40\text{pF}$ ,  
Relief capacitor  $C_r = 1\text{nF}$  (only for ZVT switching)

**Edition 2006-01**

**Published by**  
**Infineon Technologies AG**  
**81726 München, Germany**

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