## HighSpeed 2-Technology

- **Designed for:**
  - SMPS
  - Lamp Ballast
  - ZVS-Converter
  - optimised for soft-switching / resonant topologies
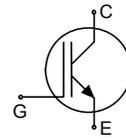
- **2nd generation HighSpeed-Technology for 1200V applications offers:**
  - loss reduction in resonant circuits
  - temperature stable behavior
  - parallel switching capability
  - tight parameter distribution
  - E_{off} optimized for I_C =3A
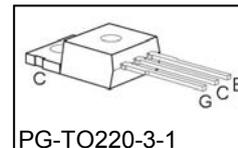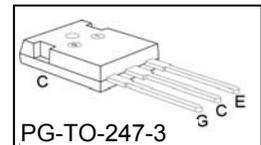
- Qualified according to JEDEC[2] for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models : http://www.infineon.com/igbt/

PG-TO-247-3

PG-TO220-3-1

Type	V_{CE}	I_C	E_{off}	T_j	Marking	Package
IGW03N120H2	1200V	3A	0.15mJ	150°C	G03H1202	PG-TO-247-3
IGP03N120H2	1200V	3A	0.15mJ	150°C	G03H1202	PG-TO-220-3-1

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
Triangular collector current T_C = 25°C, f = 140kHz T_C = 100°C, f = 140kHz	I_C	 9.6 3.9	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	9.9	
Turn off safe operating area $V_{CE} \leq$ 1200V, $T_j \leq$ 150°C	-	9.9	
Gate-emitter voltage	V_{GE}	$\pm$20	V
Power dissipation T_C = 25°C	P_{tot}	62.5	W
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

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Rev. 2.6 Febr. 08

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction – case	R_{thJC}		2.0	K/W
Thermal resistance, junction – ambient	R_{thJA}	PG-TO-220-3-1 PG-TO-247-3	62 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	-	
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	PG-TO-220-3-1 PG-TO-247-3	- -	7 13	- -	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,	-	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, $C_{\sigma}{}^{2)}$=40pF	-	0.14	-	mJ
Turn-off energy	E_{off}	Energy losses include	-	0.15	-	
Total switching energy	E_{ts}	"tail" and diode [3] reverse recovery.	-	0.29	-	

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, $L_{\sigma}{}^{2)}$=180nH,	-	0.22	-	mJ
Turn-off energy	E_{off}	$C_{\sigma}{}^{2)}$=40pF	-	0.26	-	
Total switching energy	E_{ts}	Energy losses include "tail" and diode [3] reverse recovery.	-	0.48	-	

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	-	

[2] Leakage inductance L_{σ} and stray capacity C_{σ} due to dynamic test circuit in figure E
[3] Commutation diode from device IKP03N120H2

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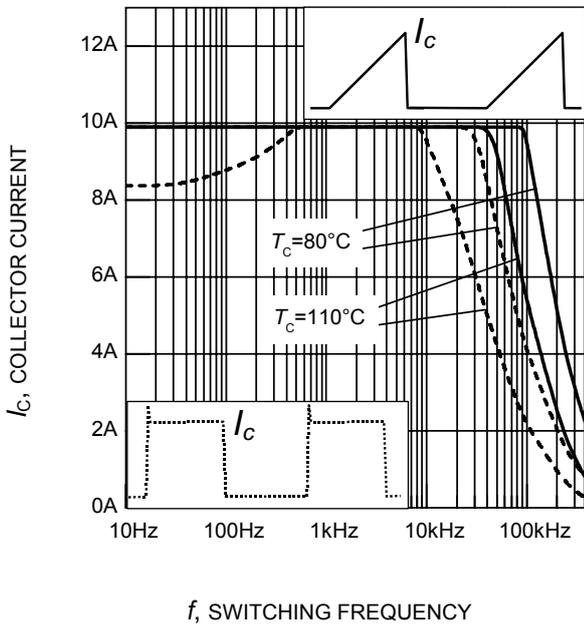
Figure 1. Collector current as a function of switching frequency
($T_j \le 150°C$, $D = 0.5$, $V_{CE} = 800V$,
$V_{GE} = +15V/0V$, $R_G = 82\Omega$)

f, SWITCHING FREQUENCY

I$_C$, COLLECTOR CURRENT

T_C=80°C

T_C=110°C
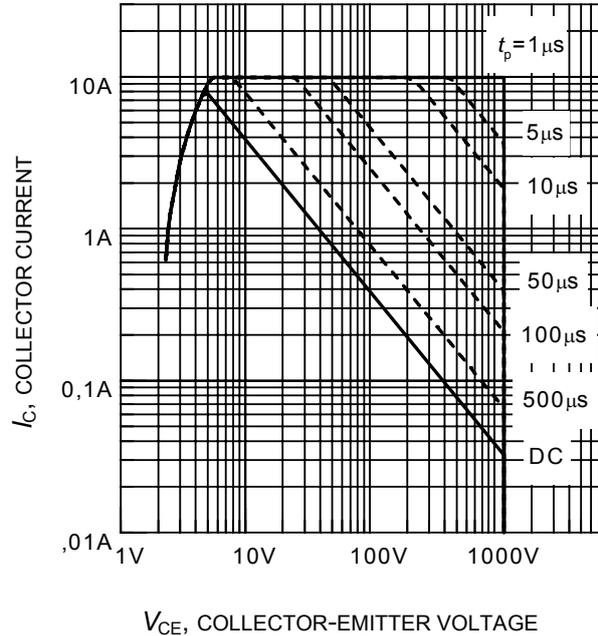
Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \le 150°C$)

V_{CE}, COLLECTOR-EMITTER VOLTAGE

I$_C$, COLLECTOR CURRENT

t_p = 1 µs
5 µs
10 µs
50 µs
100 µs
500 µs
DC
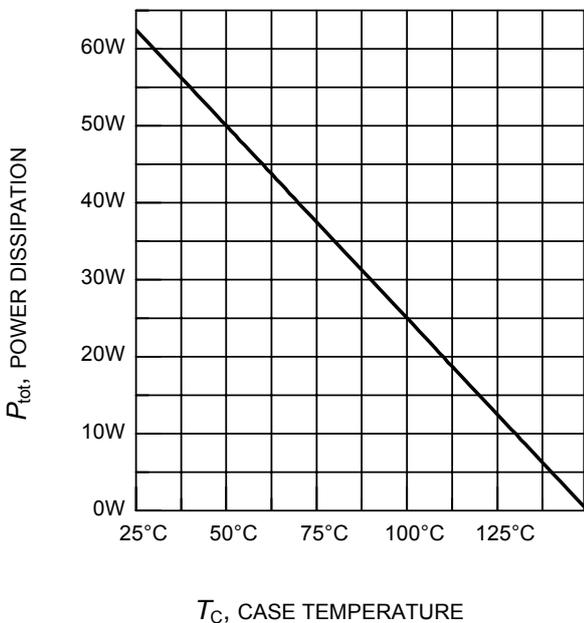
Figure 3. Power dissipation as a function of case temperature
($T_j \le 150°C$)

T_C, CASE TEMPERATURE

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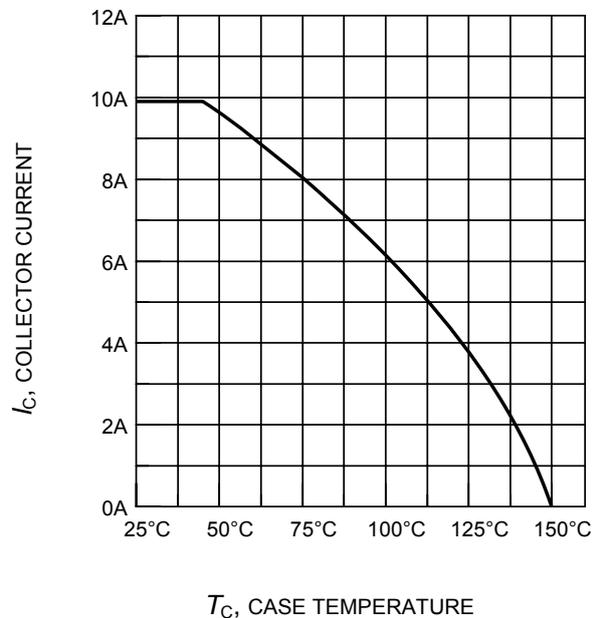
Figure 4. Collector current as a function of case temperature
($V_{GE} \le 15V$, $T_j \le 150°C$)

T_C, CASE TEMPERATURE

I$_C$, COLLECTOR CURRENT
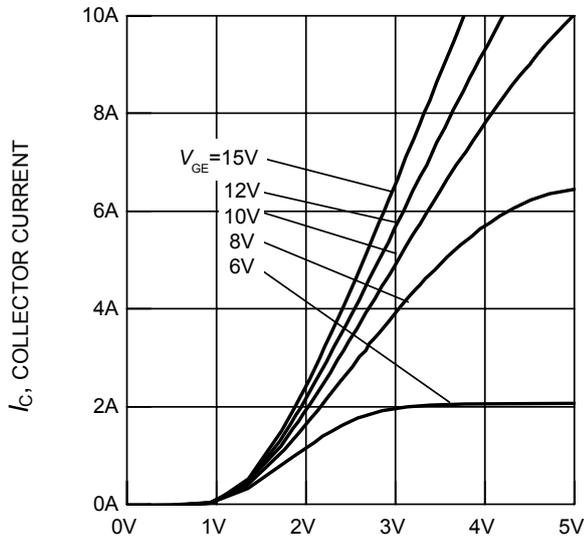
Figure 5. Typical output characteristics
(T_{j} = 25°C)

Figure 6. Typical output characteristics
(T_{j} = 150°C)
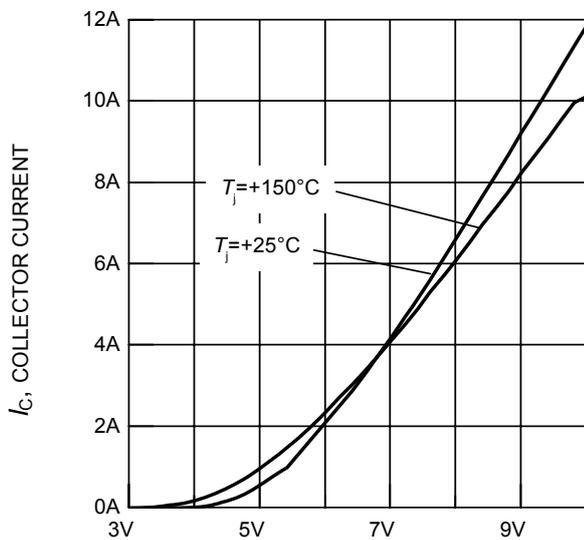
Figure 7. Typical transfer characteristics
(V_{CE} = 20V)
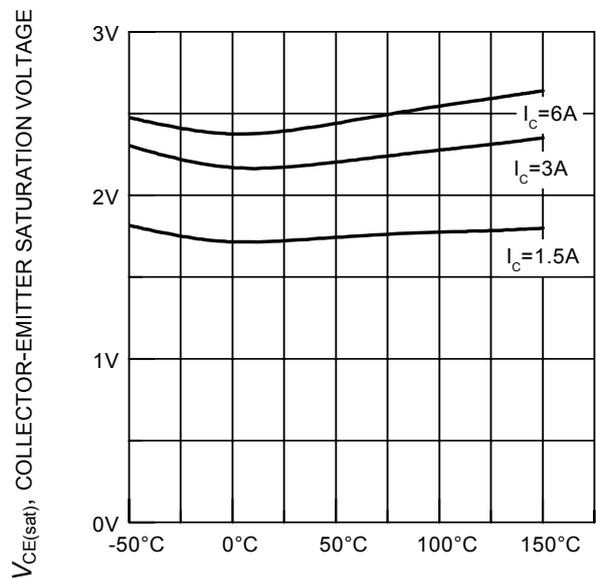
Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)
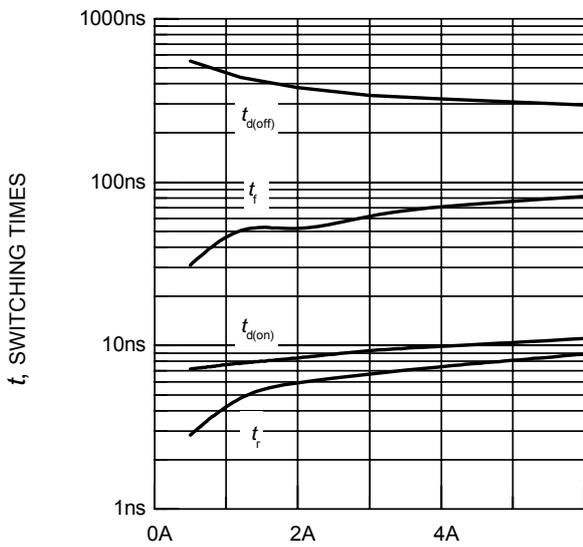
I_C, COLLECTOR CURRENT

**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 = 82Ω,
dynamic test circuit in Fig.E)
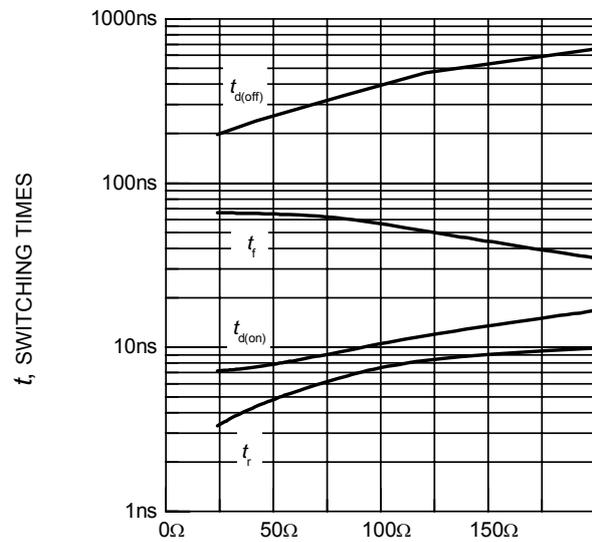
R_G, GATE RESISTOR

**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)
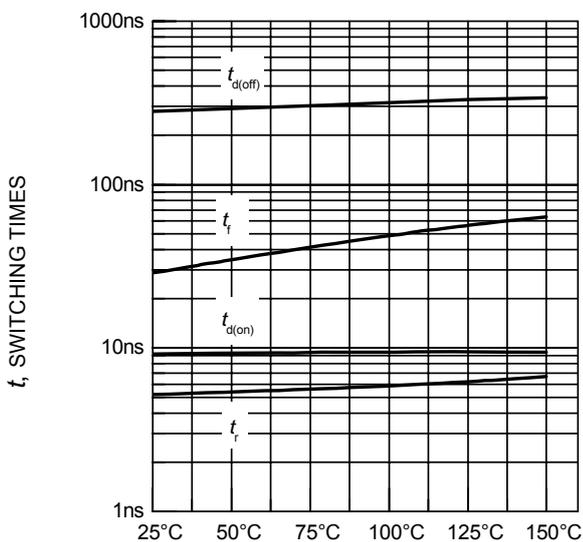
T_j, JUNCTION TEMPERATURE

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)
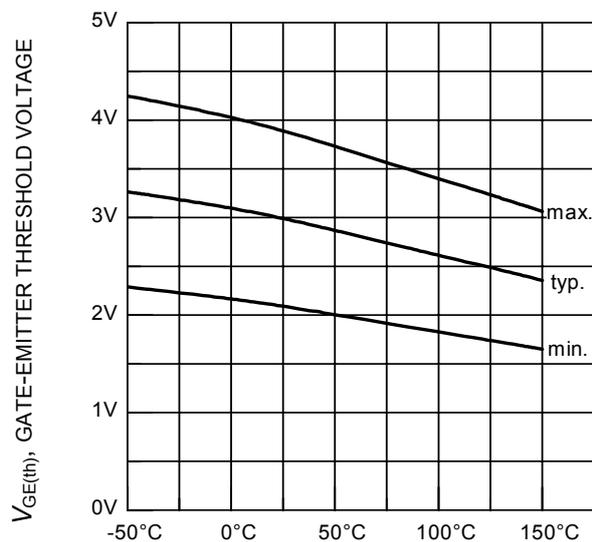
T_j, JUNCTION TEMPERATURE

**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**
(I_C = 0.09mA)
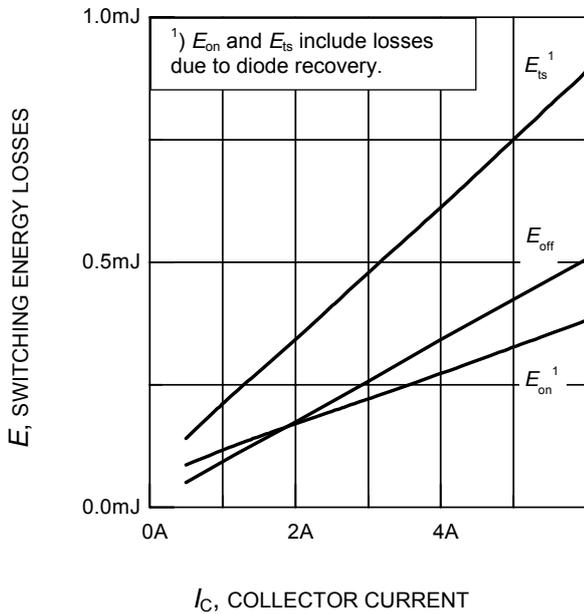
Figure 13. Typical switching energy losses as a function of collector current (inductive load, T_j = 150°C, V_{CE} = 800V, V_{GE} = +15V/0V, R_G = 82Ω, dynamic test circuit in Fig.E)

**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)
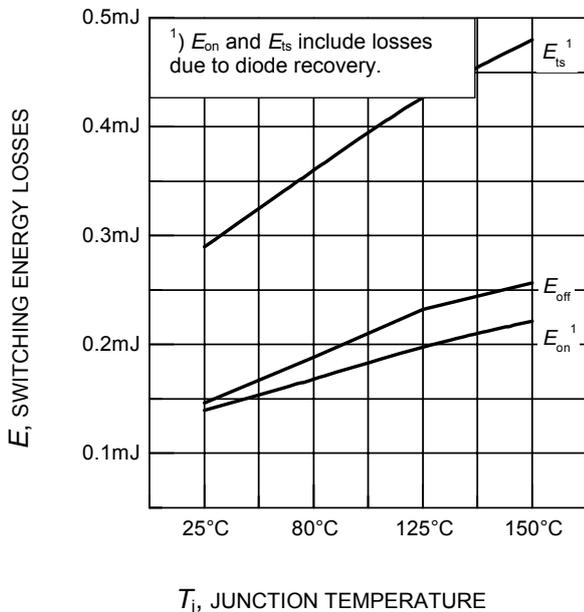

Figure 15. Typical switching energy losses as a function of junction temperature (inductive load, V_{CE} = 800V, V_{GE} = +15V/0V, I_C = 3A, R_G = 82Ω, dynamic test circuit in Fig.E)
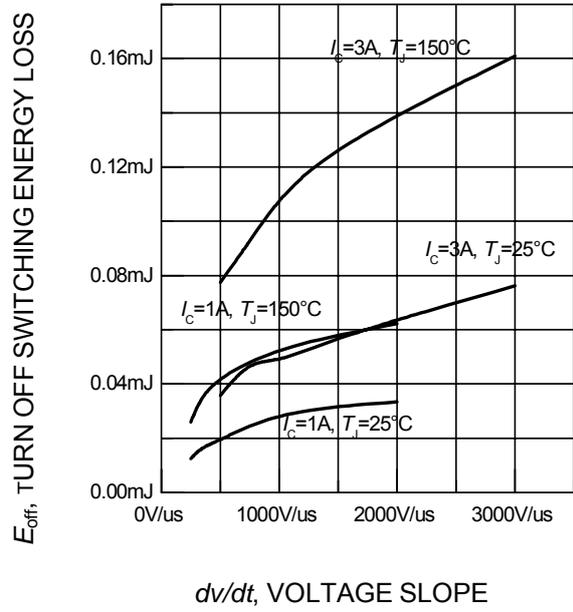
Figure 16. Typical turn off switching energy loss for soft switching (*dynamic test circuit in Fig. E*)
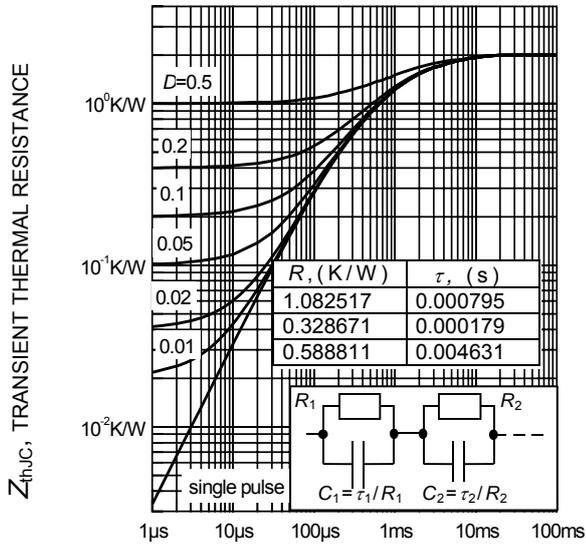
Q_{GE}, GATE CHARGE
Figure 16. IGBT transient thermal resistance
($D = t_p / T$)

R, (K / W)	τ, (s)
1.082517	0.000795
0.328671	0.000179
0.588811	0.004631
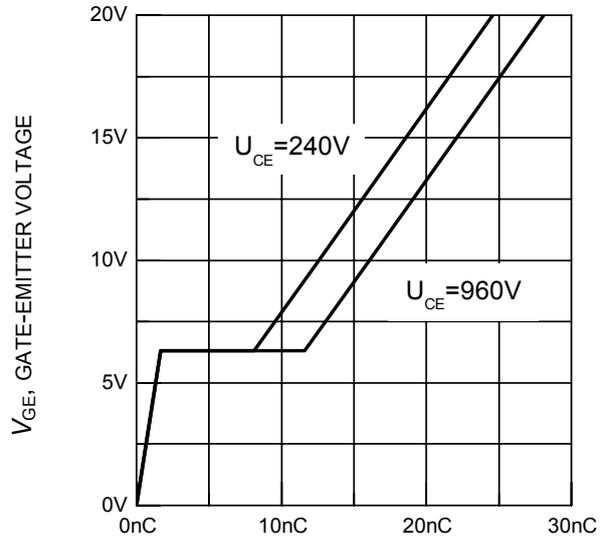
Q_{GE}, GATE CHARGE
Figure 17. Typical gate charge
(I_C = 3A)
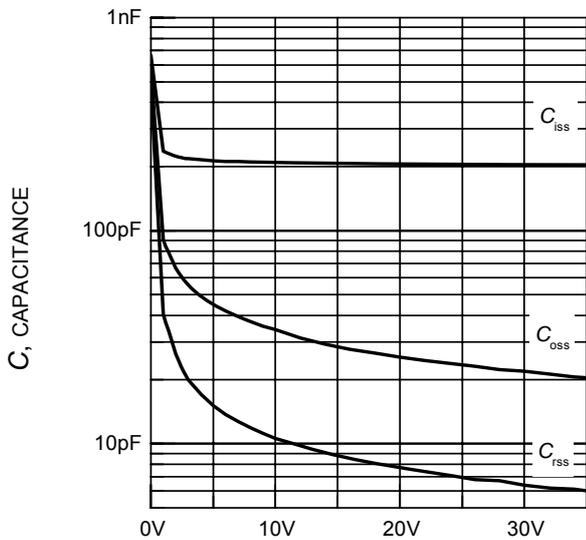
V_{CE}, COLLECTOR-EMITTER VOLTAGE
Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE} = 0V, f = 1MHz)
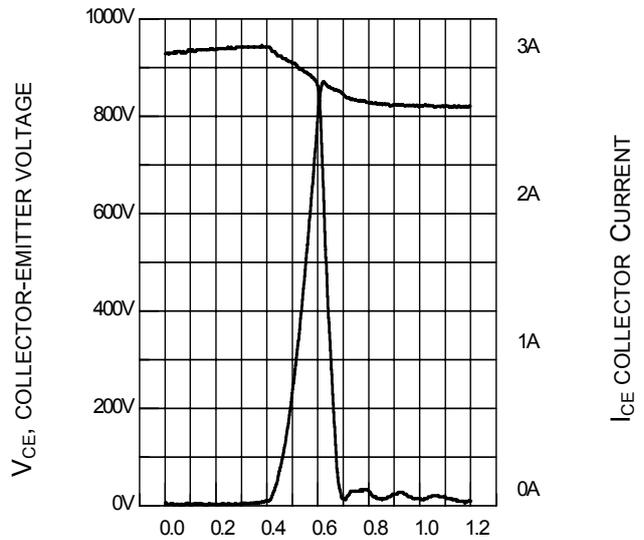
t_p, PULSE WIDTH
Figure 20. Typical turn off behavior, hard switching
(V_{GE}=15/0V, R_G=82Ω, T_j = 150°C, Dynamic test circuit in Figure E)

t_p, PULSE WIDTH
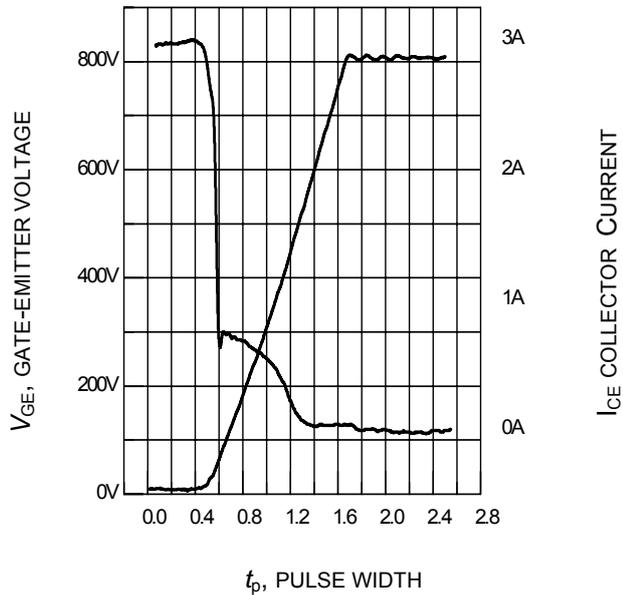
**Figure 21. Typical turn off behavior, soft switching**
(V_{GE}=15/0V, R_G=82Ω, T_j = 150°C,
Dynamic test circuit in Figure E)

PG-TO247-3
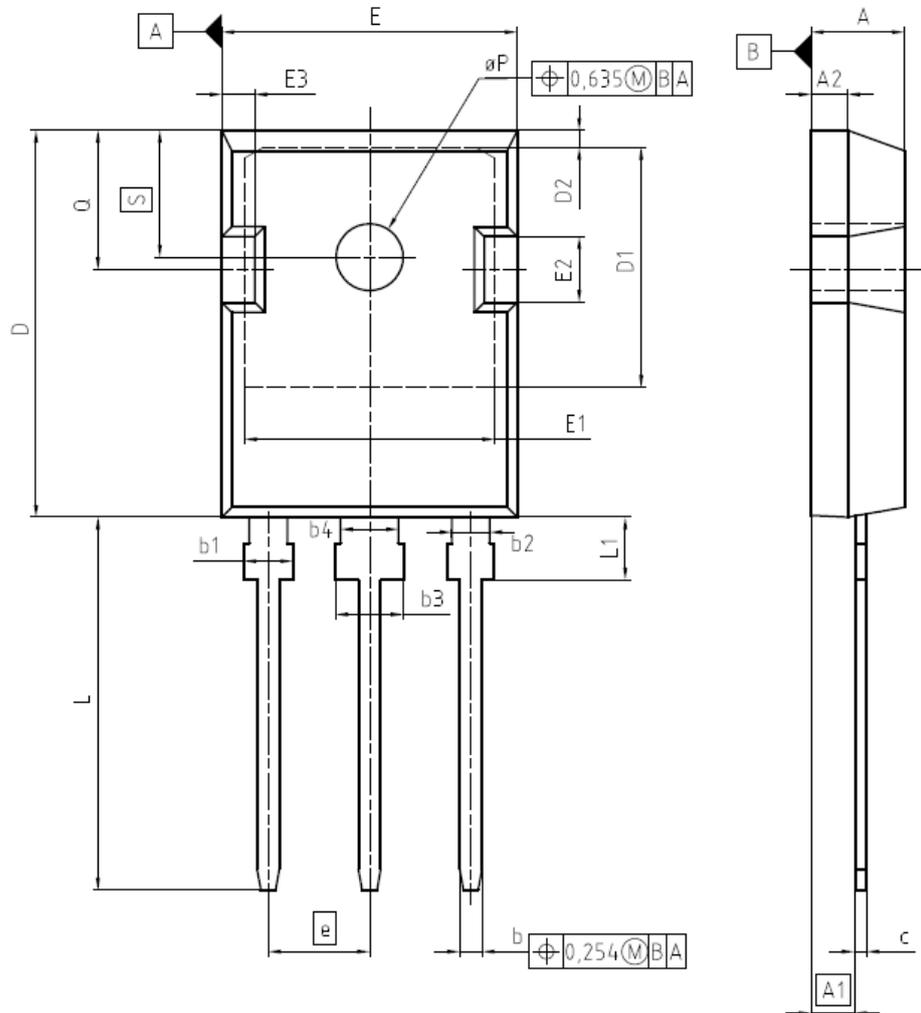
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4,90	5,16	0,193	0,203
A1	2.27	2.53	0.089	0.099
A2	1.85	2.11	0.073	0.083
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.82	21.10	0.820	0.831
D1	16.25	17.65	0.640	0.695
D2	1.05	1.35	0.041	0.053
E	15.70	16.03	0.618	0.631
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.68	2.60	0.066	0.102
e	5.44		0.214	
N	3		3	
L	19.80	20.31	0.780	0.799
L1	4.17	4.47	0.164	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

7.5mm

EUROPEAN PROJECTION

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03

PG-TO220-3-1
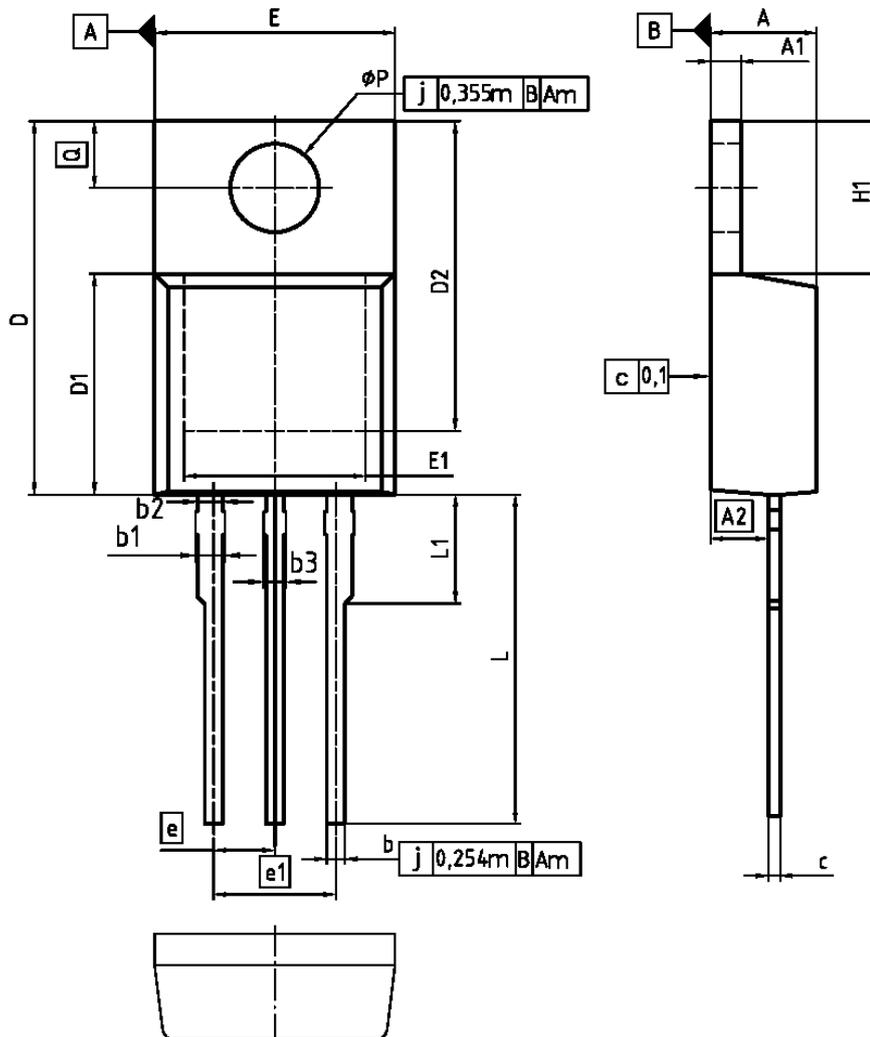
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	1.17	1.40	0.046	0.055
A2	2.15	2.72	0.085	0.107
b	0.65	0.86	0.026	0.034
b1	0.95	1.40	0.037	0.055
b2	0.95	1.15	0.037	0.045
b3	0.65	1.15	0.026	0.045
c	0.33	0.60	0.013	0.024
D	14.81	15.95	0.583	0.628
D1	8.51	9.45	0.335	0.372
D2	12.19	13.10	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

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SCALE

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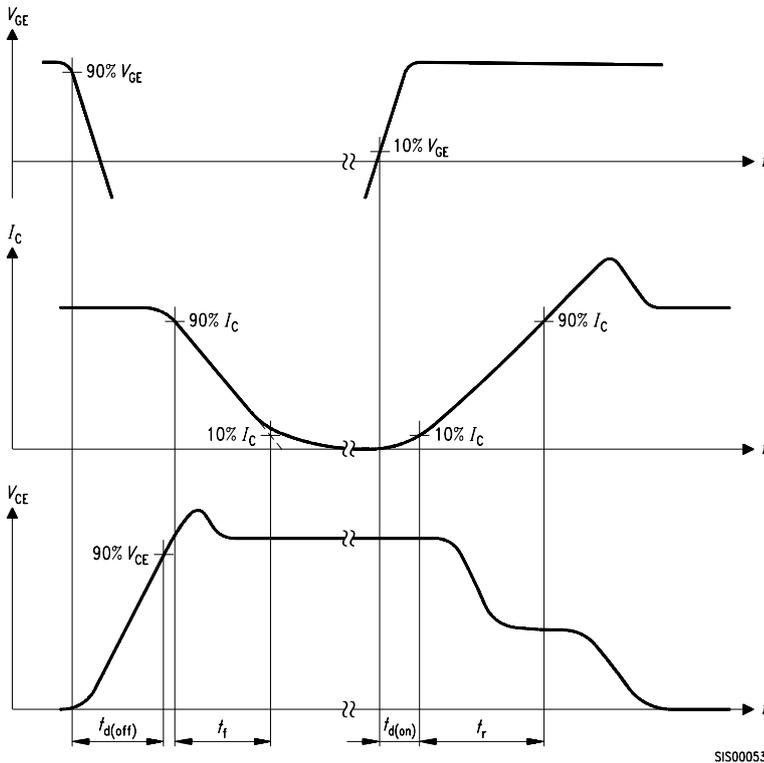
Figure A. Definition of switching times

V_{GE}

90% V_{GE}

10% V_{GE}

I_C

90% I_C

90% I_C

10% I_C

10% I_C

V_{CE}

90% V_{CE}

$t_{d(off)}$ t_f $t_{d(on)}$ t_r

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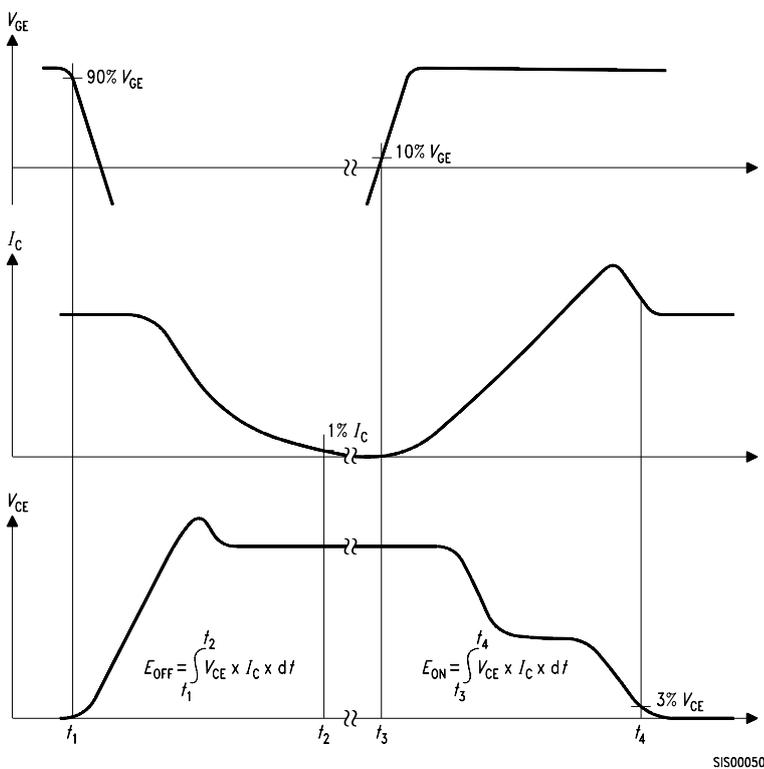
Figure B. Definition of switching losses

V_{GE}

90% V_{GE}

10% V_{GE}

I_C

1% I_C

V_{CE}

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

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

3% V_{CE}

t_1 t_2 t_3 t_4

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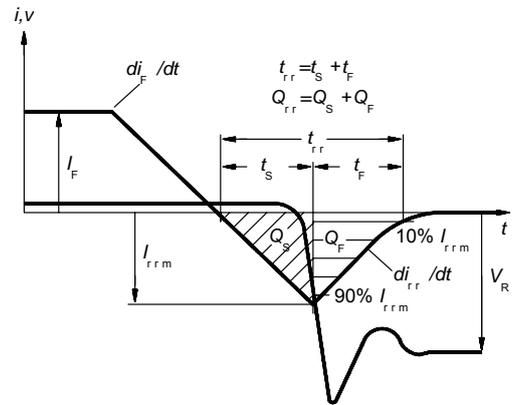
Figure C. Definition of diodes switching characteristics

di_F/dt

$t_{rr} = t_S + t_F$

$Q_{rr} = Q_S + Q_F$

t_{rr}

t_S t_F

I_F

I_{rrm}

Q_S Q_F

10% I_{rrm}

di_{rr}/dt

90% I_{rrm}

V_R
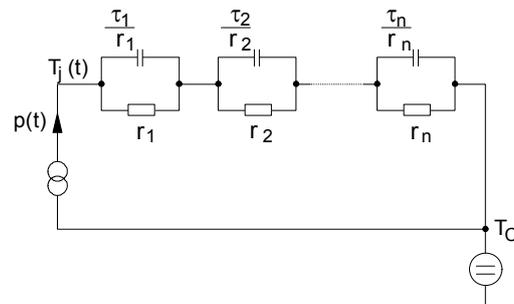
Figure D. Thermal equivalent circuit

τ_1 τ_2 τ_n

r_1 r_2 r_n

$T_j(t)$

p(t)

r_1 r_2 r_n

T_C
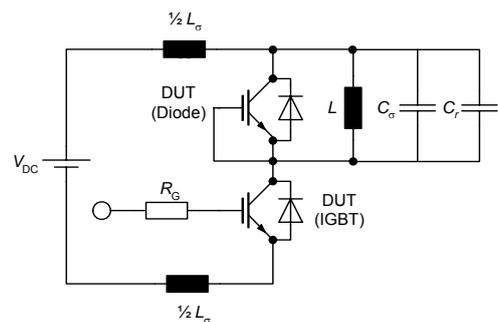

Figure E. Dynamic test circuit
Leakage inductance L_σ= 180nH,
Stray capacitor C_σ = 40pF,
Relief capacitor C_r = 4nF (only for ZVT switching)

½ L_σ

DUT (Diode)

L C_σ C_r

V_{DC}

R_G

DUT (IGBT)

½ L_σ

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.

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