IGBT

High speed 5 FAST IGBT in TRENCHSTOP™ 5 technology

IGP30N65F5

650V IGBT high speed switching series fifth generation

Data sheet

High speed 5 FAST IGBT in TRENCHSTOP™ 5 technology

Features and Benefits:

High speed F5 technology offering
• Best-in-Class efficiency in hard switching and resonant topologies
• 650V breakdown voltage
• Low gate charge Q_G
• Ideal fit with SIC Schottky Diode in boost converters
• 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/
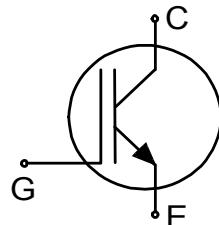
Target Applications:

• Solar converters
• Uninterruptible power supplies
• Welding converters
• Mid to high range switching frequency converters

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IGP30N65F5	650V	30A	1.6V	175°C	G30EF5	PG-TO220-3

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Maximum Ratings

For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_{vj} \geq 25°C$	V_{CE}	650	V
DC collector current, limited by T_{vjmax} $T_C = 25°C$ $T_C = 100°C$	I_C	55.0 35.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	90.0	A
Turn off safe operating area $V_{CE} \leq 650V$, $T_{vj} \leq 175°C$, $t_p = 1\mu s$	-	90.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu s$, D < 0.010)	V_{GE}	±20 ±30	V
Power dissipation $T_C = 25°C$ Power dissipation $T_C = 100°C$	P_{tot}	188.0 93.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°C
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s		260	°C
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6	Nm

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		0.80	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		62	K/W

Electrical Characteristic, at T_{vj} = 25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0V$, $I_C = 0.20mA$	650	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	$V_{GE} = 15.0V$, $I_C = 30.0A$ $T_{vj} = 25°C$ $T_{vj} = 125°C$ $T_{vj} = 175°C$	- - -	1.60 1.80 1.90	2.10 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.30mA$, $V_{CE} = V_{GE}$	3.2	4.0	4.8	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 650V$, $V_{GE} = 0V$ $T_{vj} = 25°C$ $T_{vj} = 175°C$	- -	- -	40.0 4000.0	µA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0V$, $V_{GE} = 20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE} = 20V$, $I_C = 30.0A$	-	38.0	-	S

Electrical Characteristic, at T_{vj} = 25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristic						
Input capacitance	C_{ies}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	-	1800	-	pF
Output capacitance	C_{oes}		-	45	-	
Reverse transfer capacitance	C_{res}		-	9	-	
Gate charge	Q_G	V_{CC} = 520V, I_C = 30.0A, V_{GE} = 15V	-	65.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	7.0	-	nH

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 25°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 15.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 23.0Ω, $R_{G(off)}$ = 23.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	19	-	ns
Rise time	t_r		-	9	-	ns
Turn-off delay time	$t_{d(off)}$		-	170	-	ns
Fall time	t_f		-	10	-	ns
Turn-on energy	E_{on}		-	0.28	-	mJ
Turn-off energy	E_{off}		-	0.07	-	mJ
Total switching energy	E_{ts}		-	0.35	-	mJ
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 5.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 23.0Ω, $R_{G(off)}$ = 23.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	18	-	ns
Rise time	t_r		-	4	-	ns
Turn-off delay time	$t_{d(off)}$		-	174	-	ns
Fall time	t_f		-	15	-	ns
Turn-on energy	E_{on}		-	0.09	-	mJ
Turn-off energy	E_{off}		-	0.02	-	mJ
Total switching energy	E_{ts}		-	0.11	-	mJ

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 150°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 150°C, V_{CC} = 400V, I_C = 15.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 23.0Ω, $R_{G(off)}$ = 23.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	18	-	ns
Rise time	t_r		-	10	-	ns
Turn-off delay time	$t_{d(off)}$		-	203	-	ns
Fall time	t_f		-	3	-	ns
Turn-on energy	E_{on}		-	0.38	-	mJ
Turn-off energy	E_{off}		-	0.12	-	mJ
Total switching energy	E_{ts}		-	0.50	-	mJ
Turn-on delay time	$t_{d(on)}$	T_{vj} = 150°C, V_{CC} = 400V, I_C = 5.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 23.0Ω, $R_{G(off)}$ = 23.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	16	-	ns
Rise time	t_r		-	5	-	ns
Turn-off delay time	$t_{d(off)}$		-	230	-	ns
Fall time	t_f		-	9	-	ns
Turn-on energy	E_{on}		-	0.15	-	mJ
Turn-off energy	E_{off}		-	0.04	-	mJ
Total switching energy	E_{ts}		-	0.19	-	mJ
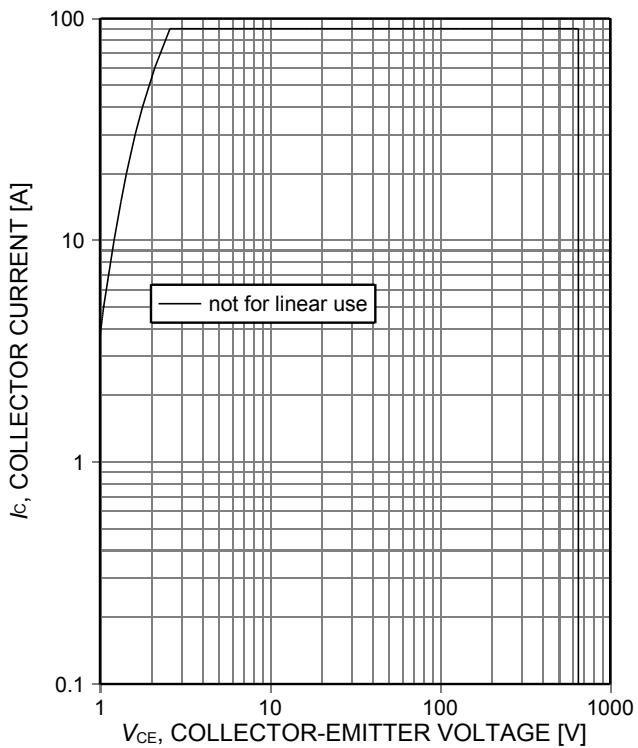
Figure 1. **Forward bias safe operating area**
(D=0, T_C=25°C, T_{vj}≤175°C, V_{GE}=15V, t_p=1μs.
Recommended use at V_{GE}≥7.5V)
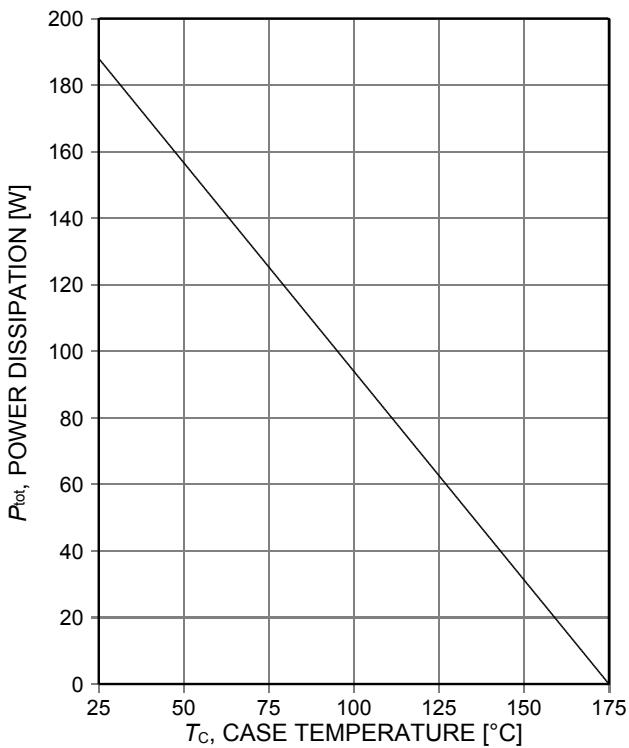

Figure 2. **Power dissipation as a function of case temperature**
(T_{vj}≤175°C)
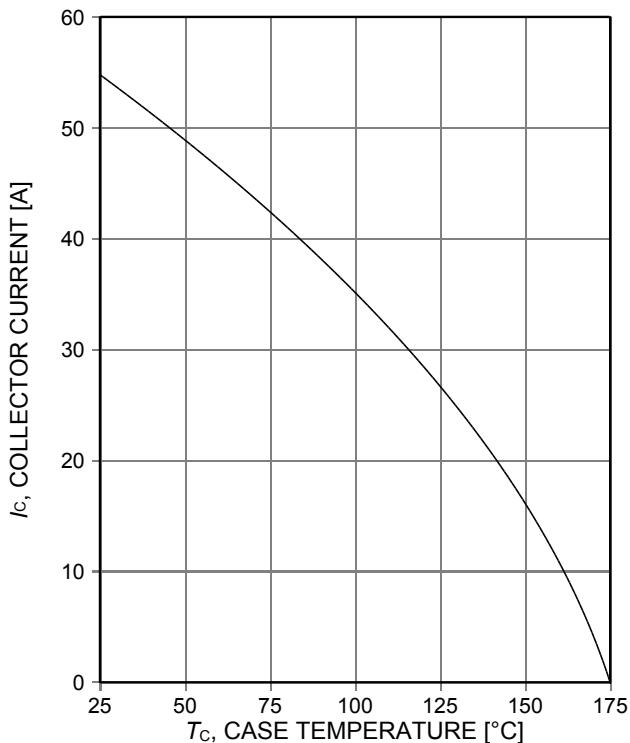
Figure 3. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_{vj}≤175°C)
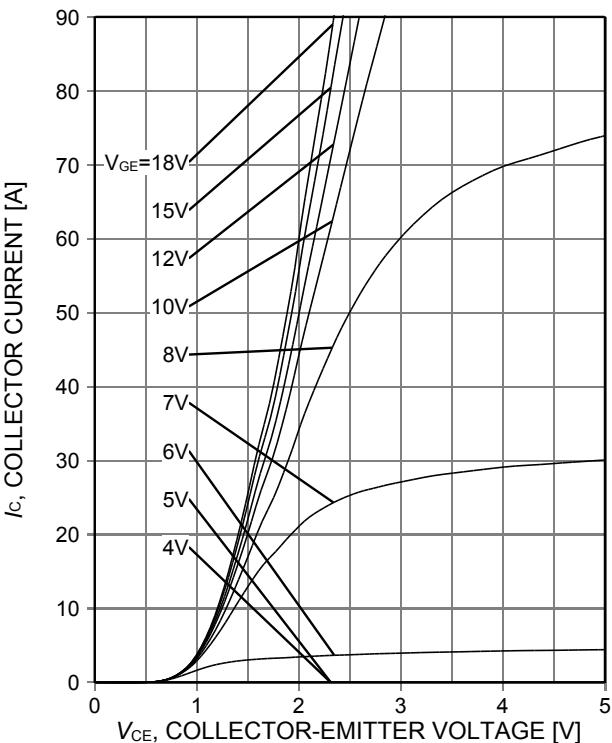
Figure 4. **Typical output characteristic**
(T_{vj}=25°C)

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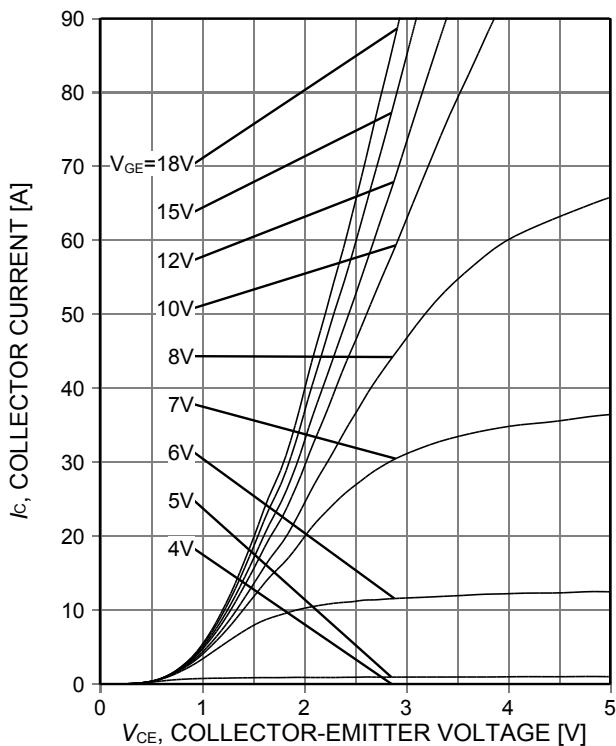
Figure 5. **Typical output characteristic**
(T_{vj}=150°C)
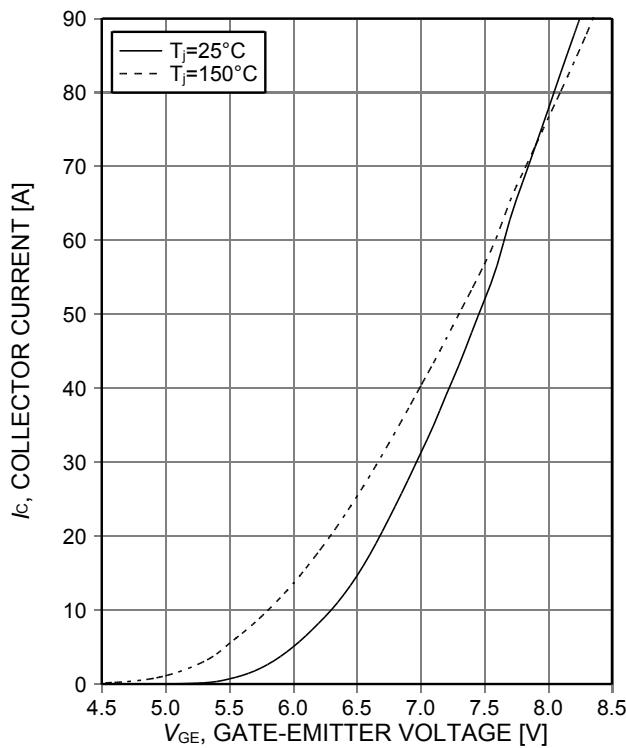
Figure 6. **Typical transfer characteristic**
(V_{CE}=20V)
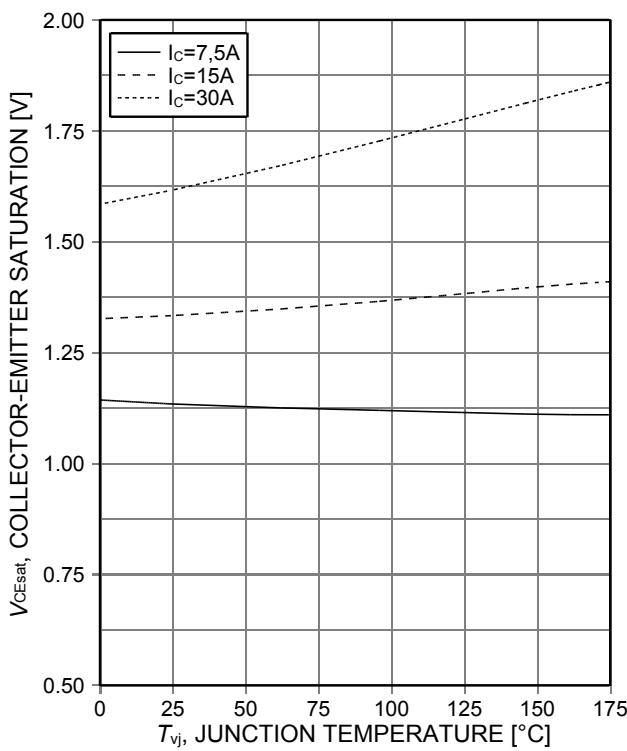
Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)
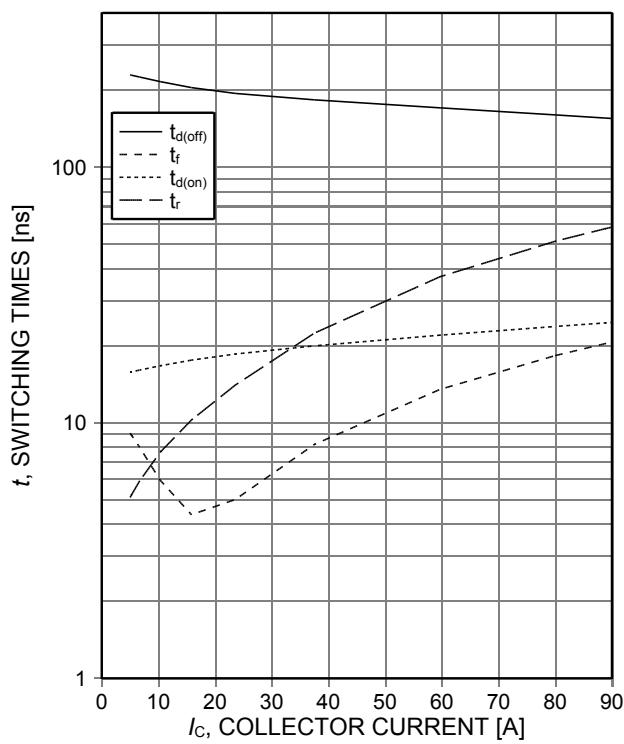
Figure 8. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, r_G=23Ω, Dynamic test circuit in Figure E)

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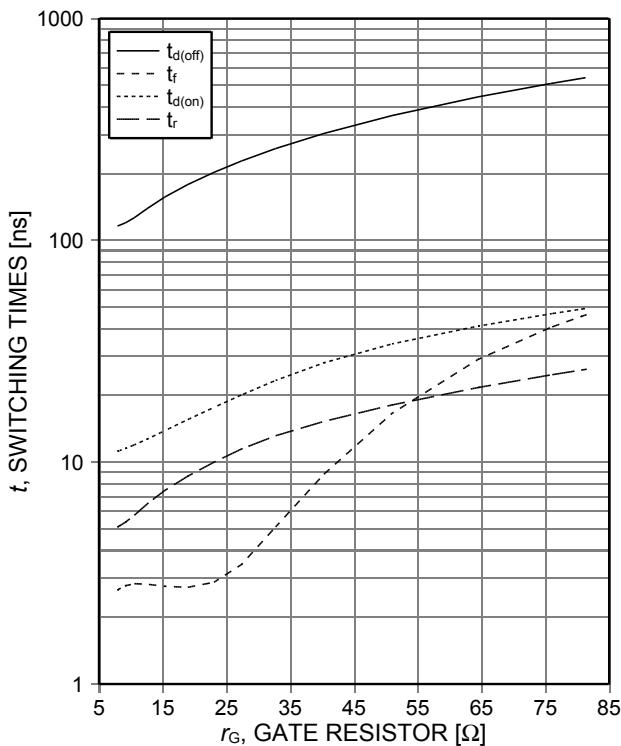
Figure 9. **Typical switching times as a function of gate resistor**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, I_{C}=15A,Dynamic test circuit in Figure E)
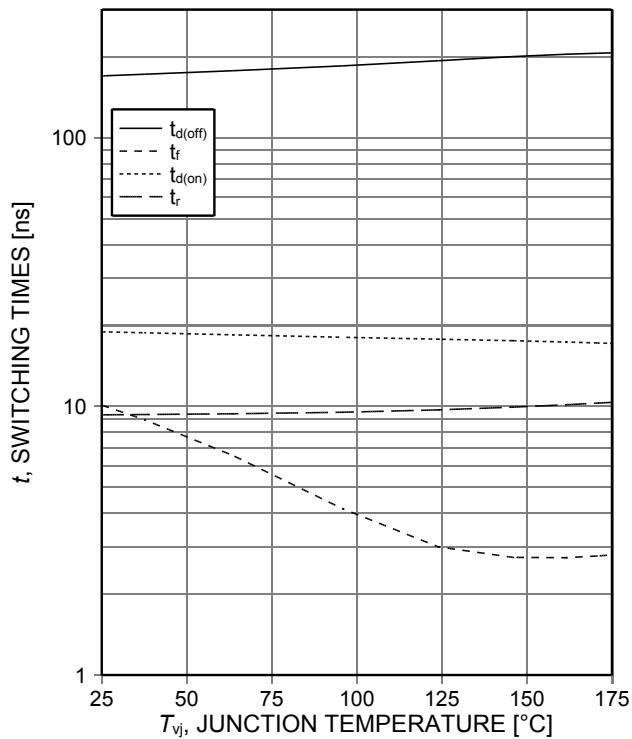
Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_{C}=15A, r_{G}=23Ω,Dynamic test circuit in Figure E)
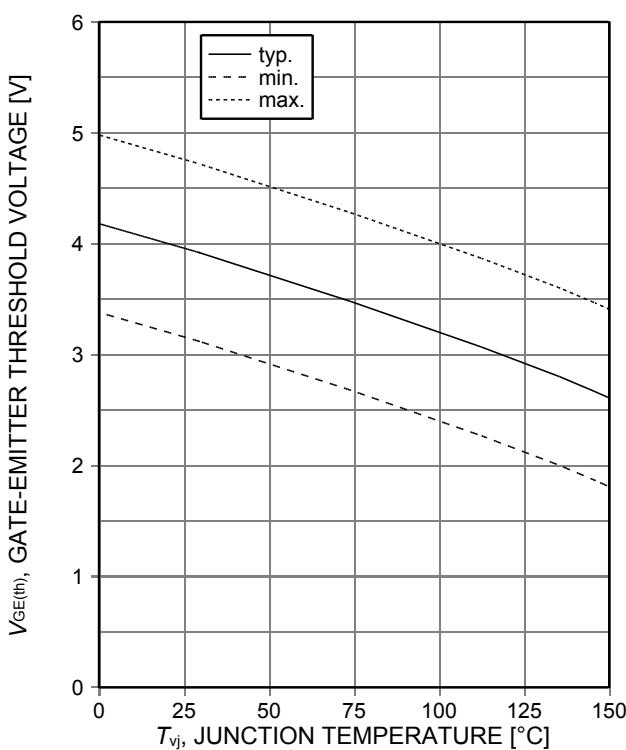
Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
(I_{C}=0.3mA)
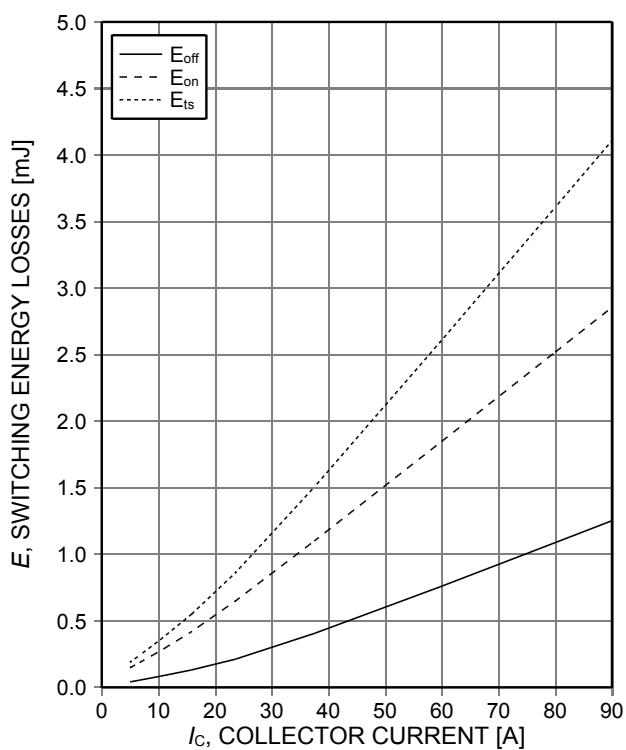
Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, r_{G}=23Ω,Dynamic test circuit in Figure E)

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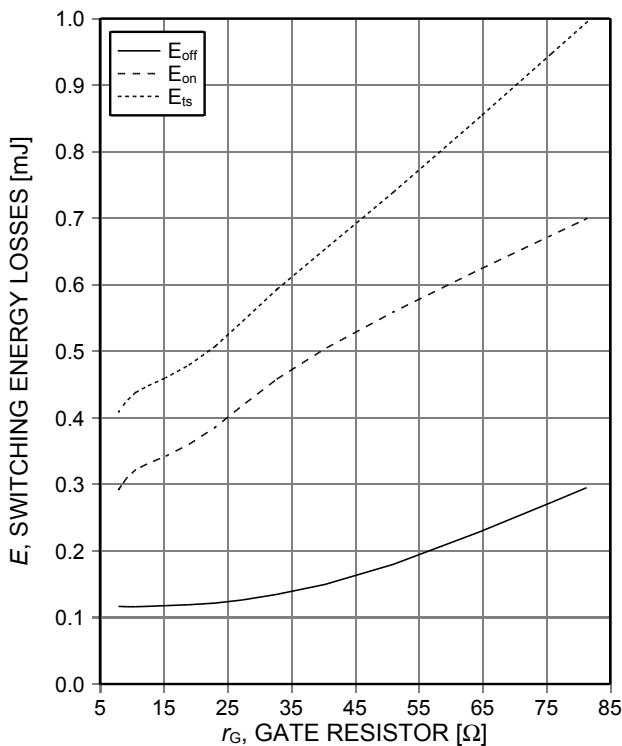
Figure 13. **Typical switching energy losses as a function of gate resistor** (inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, I_C=15A, Dynamic test circuit in Figure E)
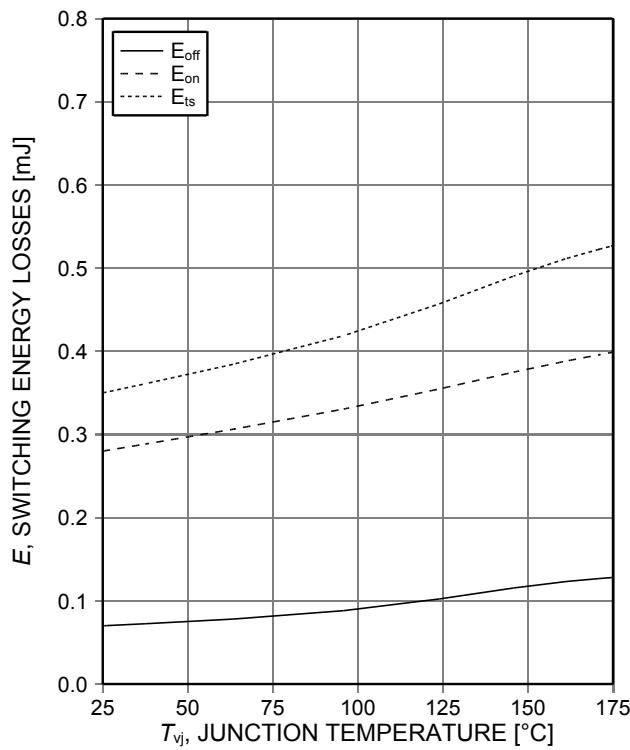

Figure 14. **Typical switching energy losses as a function of junction temperature** (inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=15A, r_G=23Ω,Dynamic test circuit in Figure E)
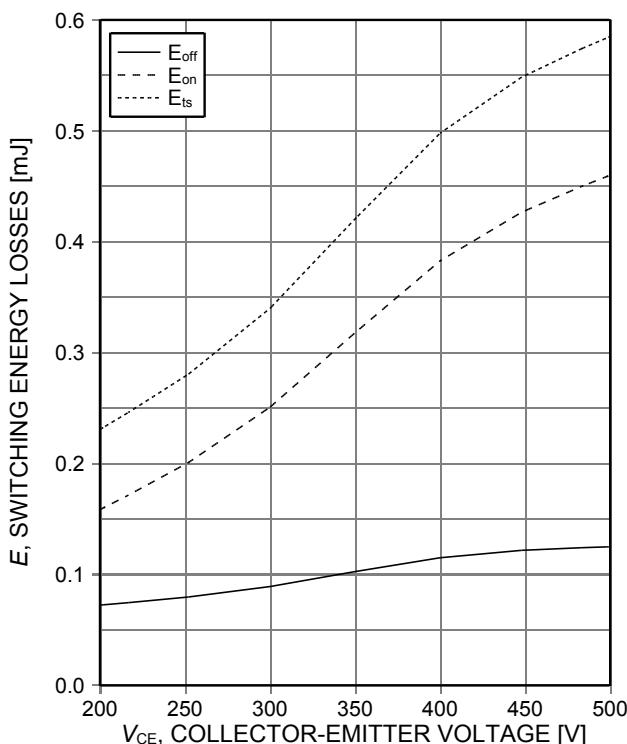

Figure 15. **Typical switching energy losses as a function of collector emitter voltage** (inductive load, T_{vj}=150°C, V_{GE}=15/0V, I_C=15A, r_G=23Ω,Dynamic test circuit in Figure E)
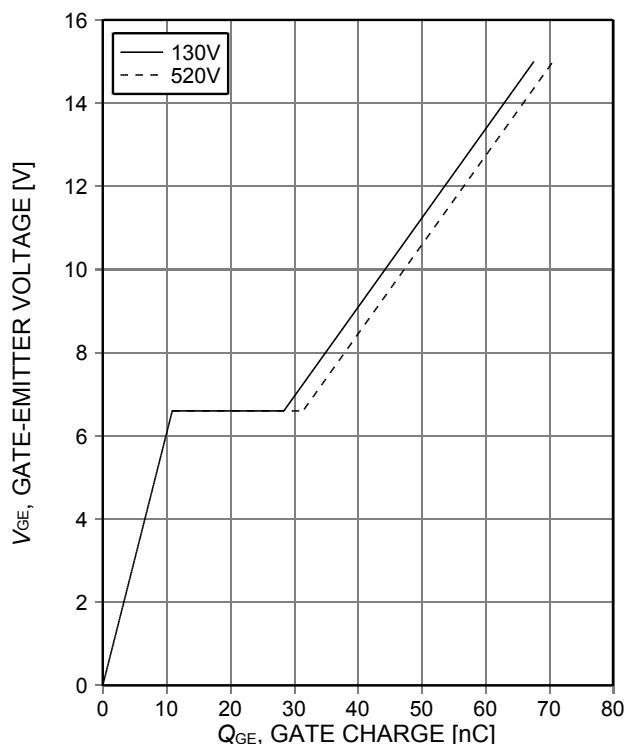
Figure 16. **Typical gate charge** (I_C=30A)

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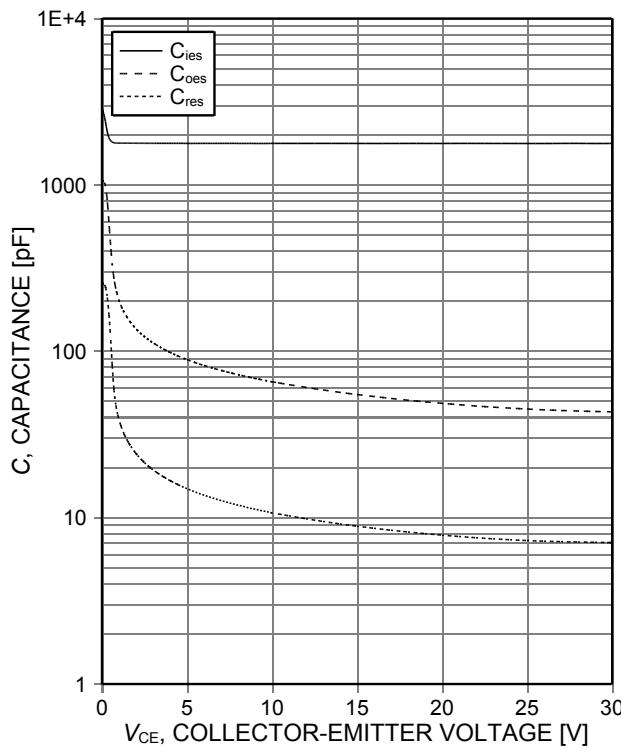
Figure 17. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)
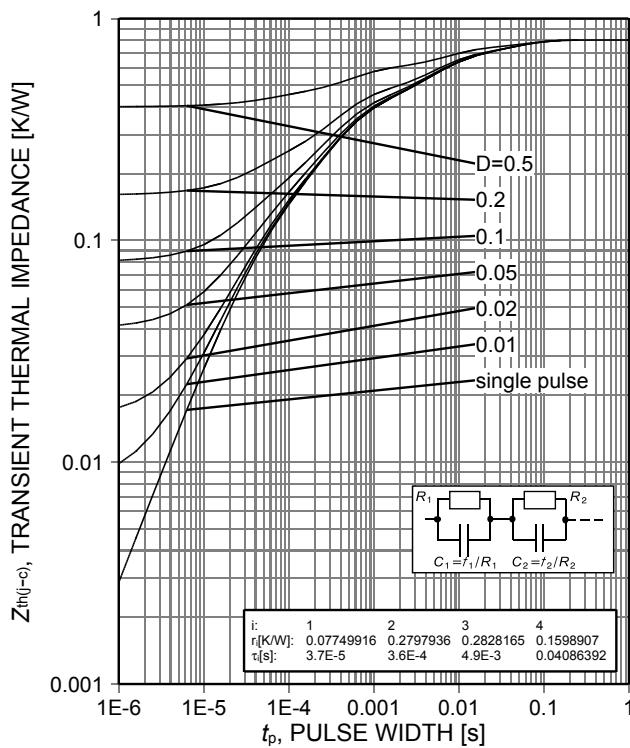
Figure 18. **IGBT transient thermal impedance**
(D=t_p/T)

i:	1	2	3	4
r[K/W]:	0.07749916	0.2797936	0.2828165	0.1598907
τ[s]:	3.7E-5	3.6E-4	4.9E-3	0.04086392

PG-TO220-3

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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Z8B00003318

SCALE

EUROPEAN PROJECTION

ISSUE DATE
30-07-2009

REVISION
06

$V_{GE}(t)$

90% V_{GE}

10% V_{GE}

t

$I_C(t)$

90% I_C

90% I_C

10% I_C

10% I_C

t

$V_{CE}(t)$

t

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

Figure A. Definition of switching times

$V_{GE}(t)$

90% V_{GE}

10% V_{GE}

t

$I_C(t)$

2% I_C

t

$V_{CE}(t)$

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

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

2% V_{CE}

t

t_1 | t_2 | t_3 | t_4
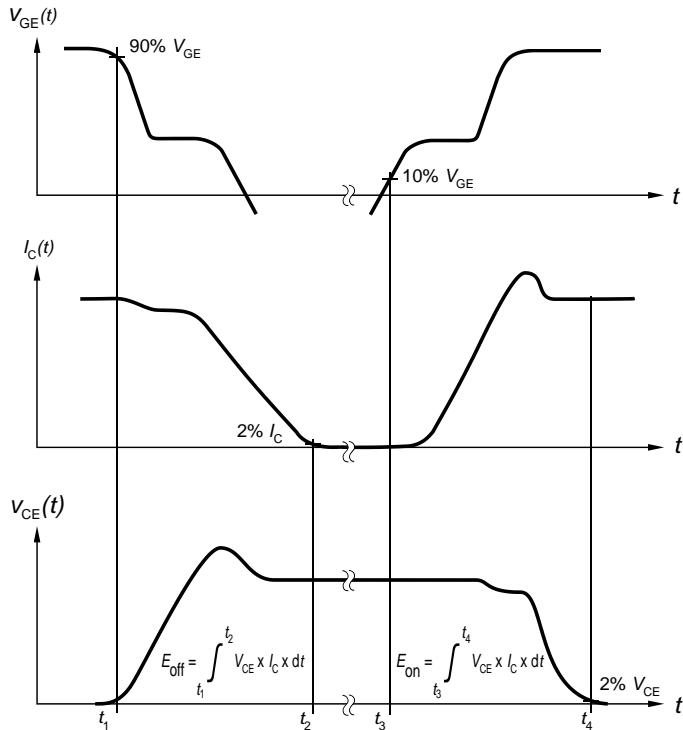
Figure B. Definition of switching losses

I, V

dI_F/dt

I_F

$t_{rr} = t_a + t_b$

$Q_{rr} = Q_S + Q_F$

t_{rr}

t_a | t_b

I_{rrm}

Q_S | Q_F

10% I_{rrm}

t

dI_{rr}/dt

V_R

90% I_{rrm}
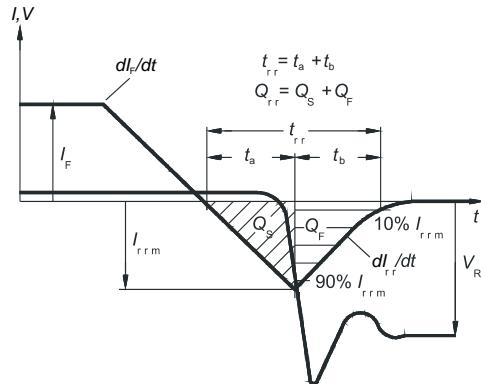
Figure C. Definition of diode switching characteristics

$\dfrac{\tau_1}{r_1}$ | $\dfrac{\tau_2}{r_2}$ | $\dfrac{\tau_n}{r_n}$

$T_j(t)$

$p(t)$

r_1 | r_2 | r_n

T_C
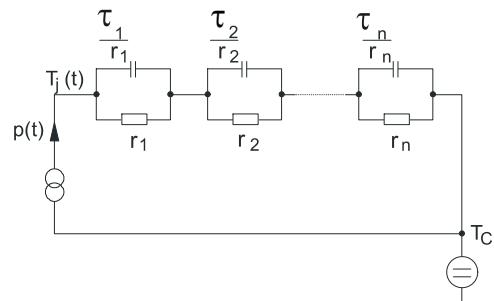
Figure D. Thermal equivalent circuit

$\tfrac{1}{2}L_\sigma$

DUT (Diode)

L | C_σ | C_r

V_{CC}

R_G

DUT (IGBT)

$\tfrac{1}{2}L_\sigma$
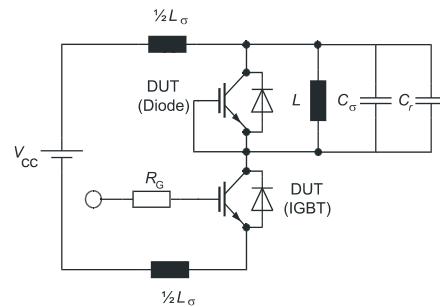
Figure E. Dynamic test circuit
Parasitic inductance L_σ,
parasitic capacitor L_σ,
relief capacitor C_r,
(only for ZVT switching)

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