IGBT

High speed 5 FAST IGBT in TRENCHSTOP™ 5 technology

IGP40N65F5, IGW40N65F5

650V IGBT high speed switching series fifth generation

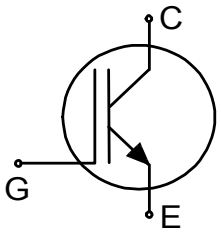
Data sheet

Industrial Power Control

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 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

Package pin definition:

• Pin 1 - gate
• Pin 2 & backside - collector
• Pin 3 - emitter

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IGW40N65F5	650V	40A	1.6V	175°C	G40F655	PG-TO247-3
IGP40N65F5	650V	40A	1.6V	175°C	G40F655	PG-TO220-3

Table of Contents

Maximum ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	650	V
DC collector current, limited by T_{vjmax} T_C = 25°C T_C = 100°C	I_C	 74.0 46.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	120.0	A
Turn off safe operating area $V_{CE} \le 650V$, $T_{vj} \le 175°C$	-	120.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \le 10\mu s$, D < 0.010)	V_{GE}	±20 ±30	V
Power dissipation T_C = 25°C Power dissipation T_C = 100°C	P_{tot}	255.0 120.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°C
Soldering temperature, wave soldering 1.6 mm (0.063 in.) from case for 10s	 PG-TO247-pinGCE PG-TO220-3	 260 260	°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	$R_{th(j-c)}$		0.60	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$	PG-TO247-pinGCE PG-TO220-3	40 62	K/W

Electrical Characteristic, at T_{vj} = 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 = 0.20mA	650	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 40.0A 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 = 0.40mA, 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 2000.0	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 40.0A	-	50.0	-	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	-	2500	-	pF
Output capacitance	C_{oes}		-	40	-	
Reverse transfer capacitance	C_{res}		-	9	-	
Gate charge	Q_G	V_{CC} = 520V, I_C = 40.0A, V_{GE} = 15V	-	95.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E	PG-TO247-pinGCE PG-TO220-3	-	13.0	-	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 = 20.0A, V_{GE} = 0.0/15.0V, r_G = 15.0Ω, $L\sigma$ = 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		-	13	-	ns
Turn-off delay time	$t_{d(off)}$		-	160	-	ns
Fall time	t_f		-	16	-	ns
Turn-on energy	E_{on}		-	0.36	-	mJ
Turn-off energy	E_{off}		-	0.10	-	mJ
Total switching energy	E_{ts}		-	0.46	-	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 = 15.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	20	-	ns
Rise time	t_r		-	4	-	ns
Turn-off delay time	$t_{d(off)}$		-	175	-	ns
Fall time	t_f		-	10	-	ns
Turn-on energy	E_{on}		-	0.07	-	mJ
Turn-off energy	E_{off}		-	0.03	-	mJ
Total switching energy	E_{ts}		-	0.10	-	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 = 20.0A, V_{GE} = 0.0/15.0V, r_G = 15.0Ω, $L\sigma$ = 30nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	20	-	ns
Rise time	t_r		-	14	-	ns
Turn-off delay time	$t_{d(off)}$		-	185	-	ns
Fall time	t_f		-	15	-	ns
Turn-on energy	E_{on}		-	0.50	-	mJ
Turn-off energy	E_{off}		-	0.16	-	mJ
Total switching energy	E_{ts}		-	0.66	-	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 = 15.0Ω, $L\sigma$ = 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		-	5	-	ns
Turn-off delay time	$t_{d(off)}$		-	220	-	ns
Fall time	t_f		-	12	-	ns
Turn-on energy	E_{on}		-	0.14	-	mJ
Turn-off energy	E_{off}		-	0.05	-	mJ
Total switching energy	E_{ts}		-	0.19	-	mJ

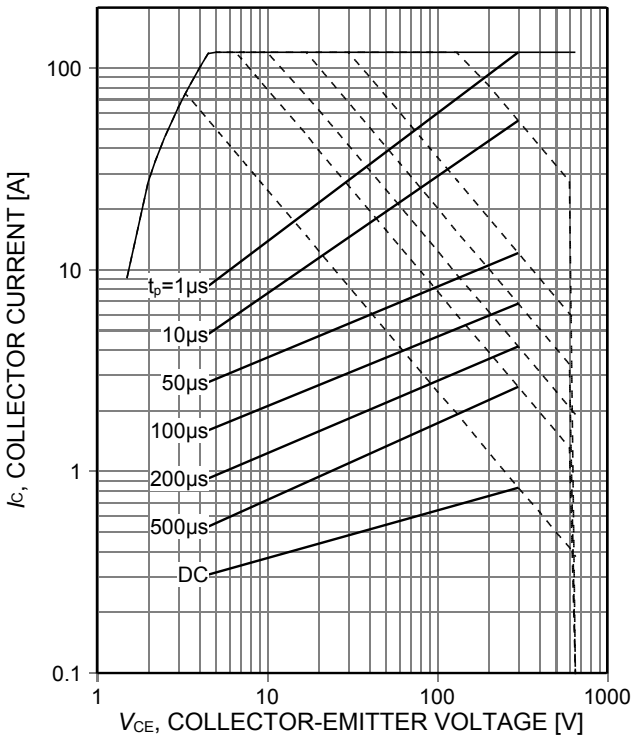


Figure 1. **Forward bias safe operating area**
(D=0, T_C=25°C, T_{vj}≤175°C; V_{GE}=15V.
Recommended use at V_{GE}≥7.5V)

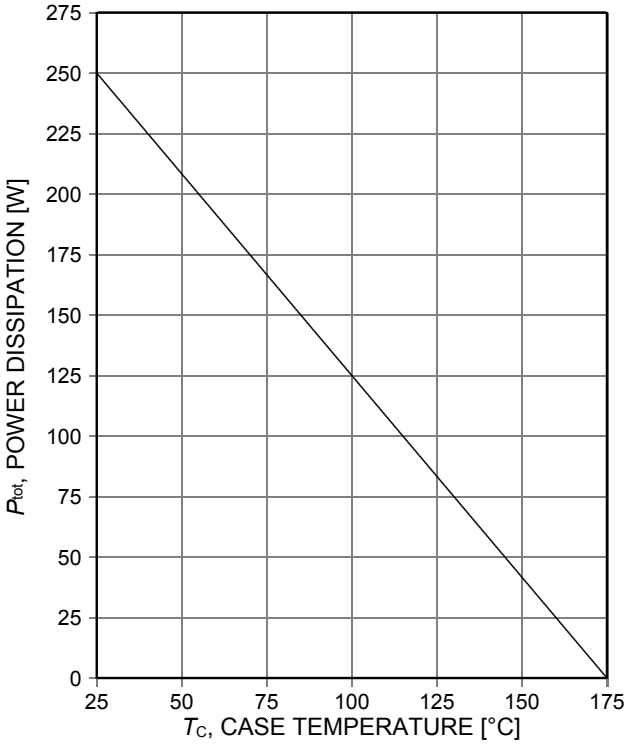


Figure 2. **Power dissipation as a function of case temperature**
(T_{vj}≤175°C)

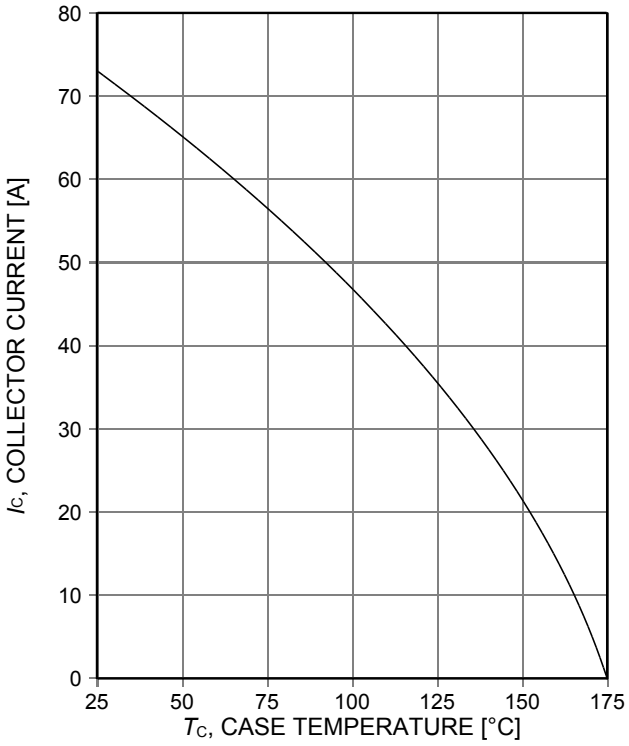


Figure 3. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_{vj}≤175°C)

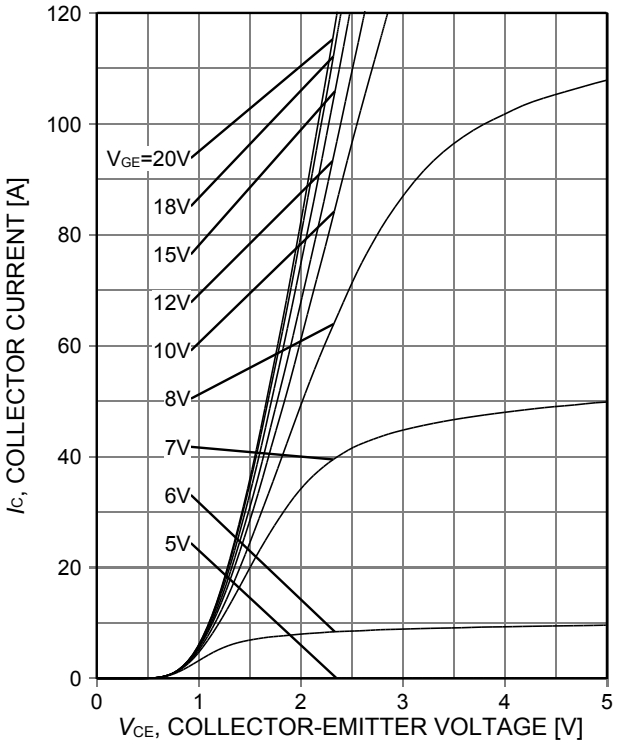


Figure 4. **Typical output characteristic**
(T_{vj}=25°C)

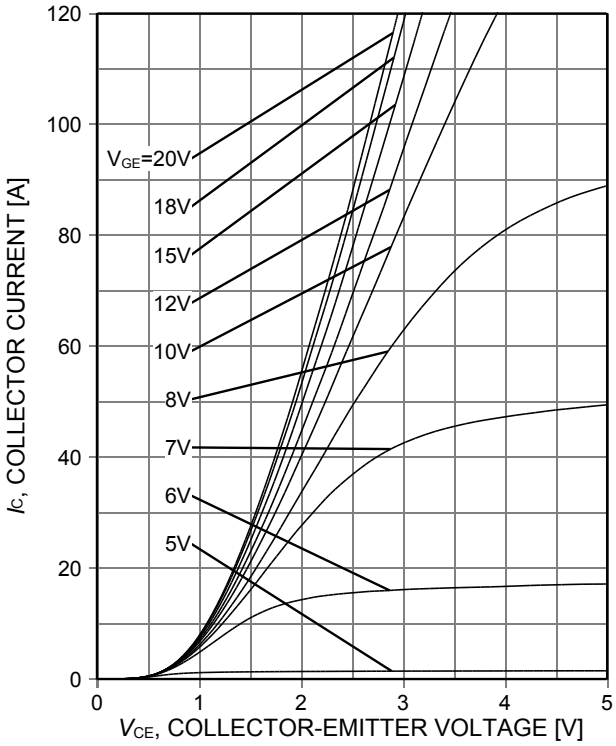


Figure 5. **Typical output characteristic**
(T_{vj}=150°C)

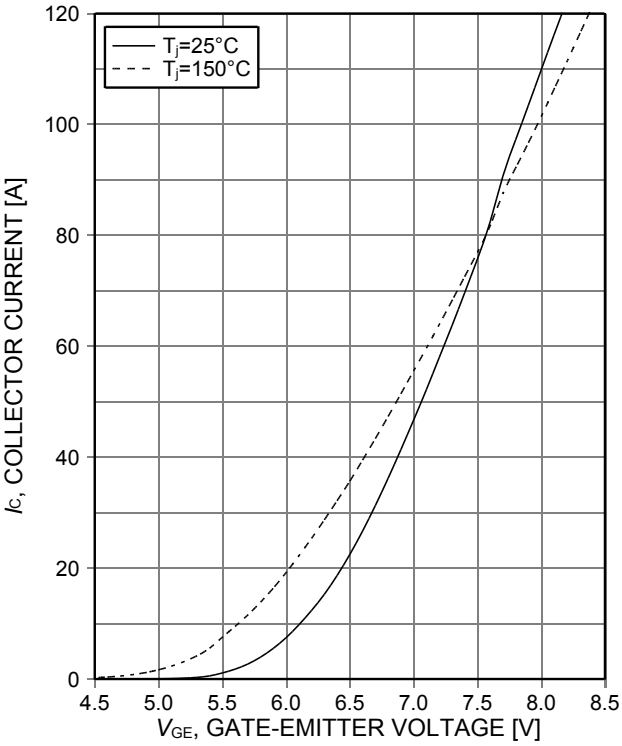


Figure 6. **Typical transfer characteristic**
(V_{CE}=20V)

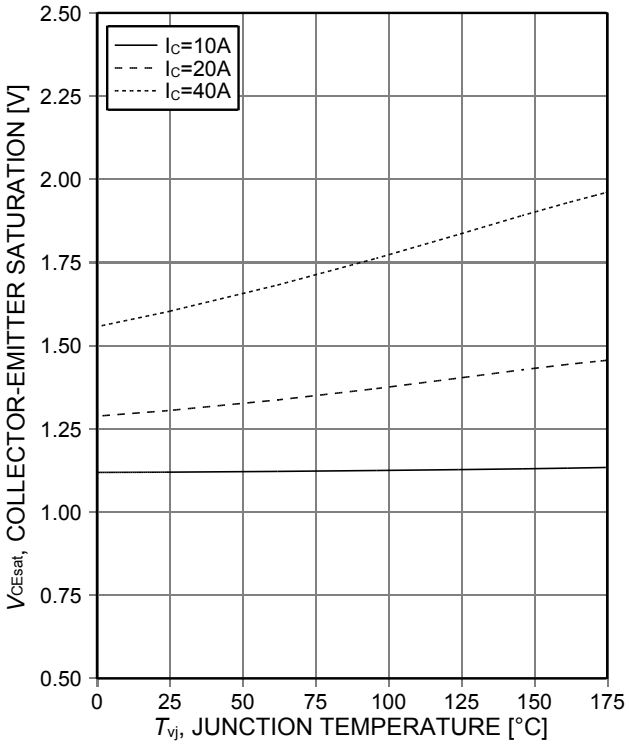


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

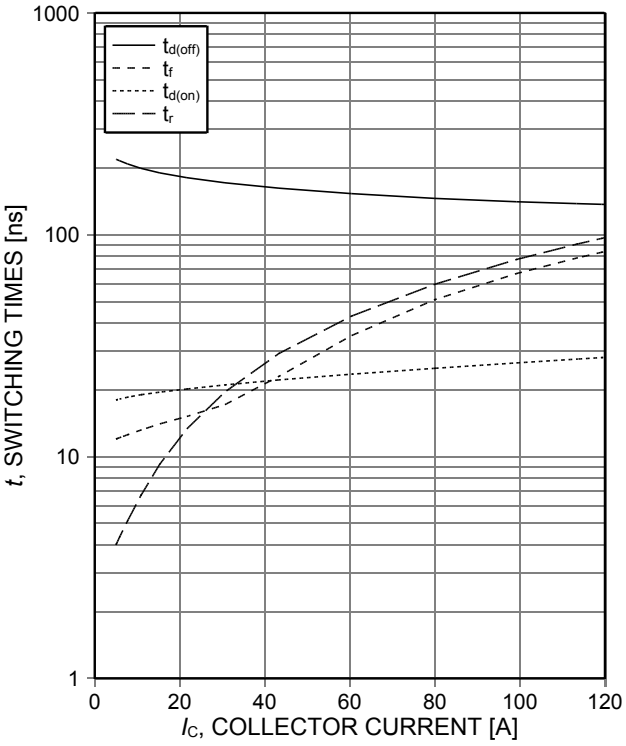


Figure 8. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, r_G=15Ω, Dynamic test circuit in Figure E)

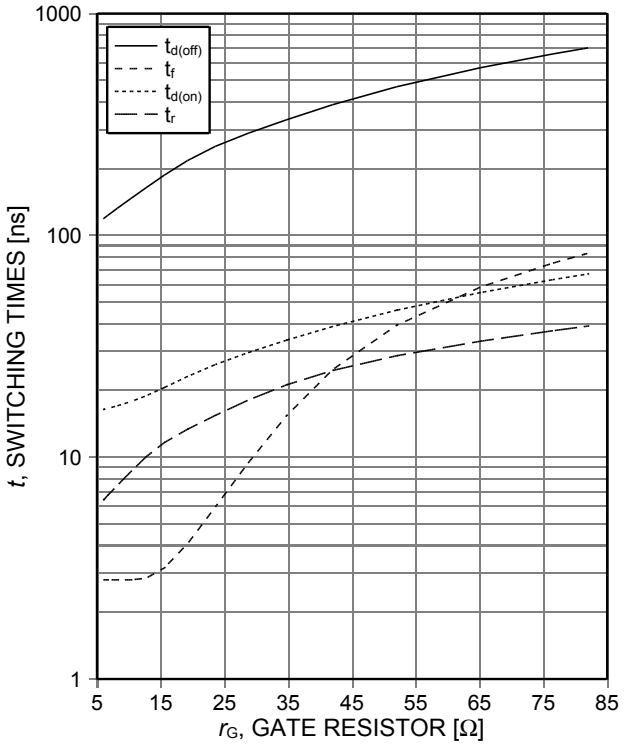


Figure 9. **Typical switching times as a function of gate resistor**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, I_C=20A,Dynamic test circuit in Figure E)

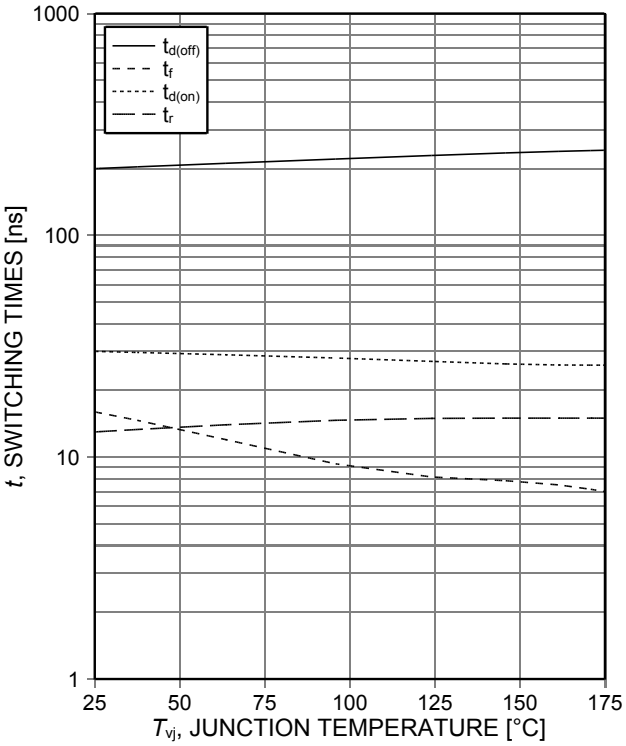


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=20A, r_G=15Ω,Dynamic test circuit in Figure E)

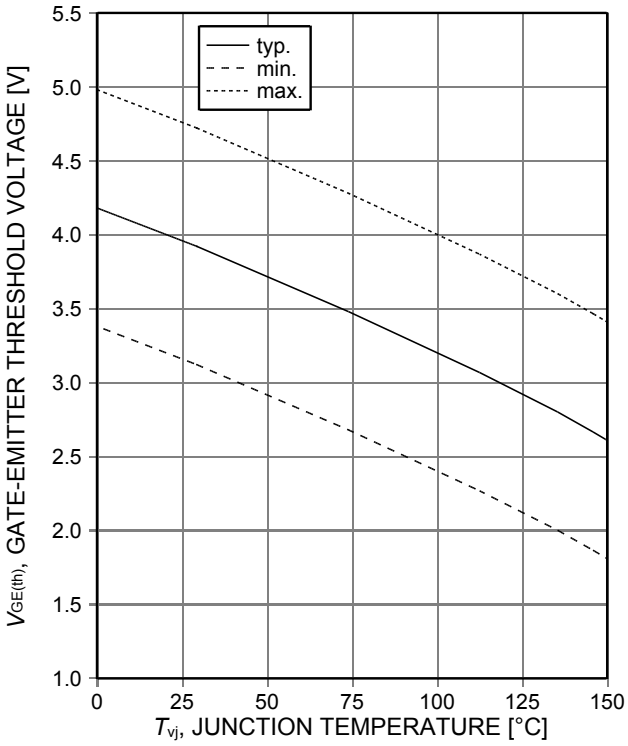


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.4mA)

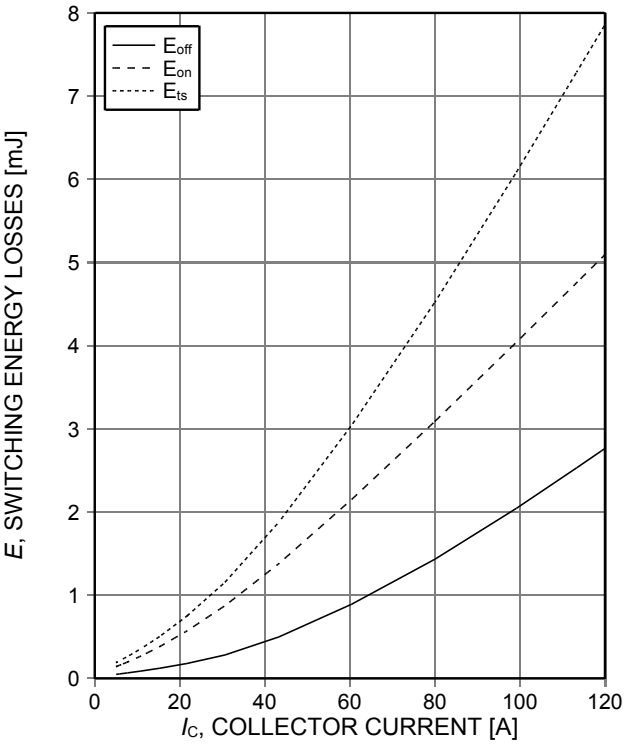


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, r_G=15Ω,Dynamic test circuit in Figure E)

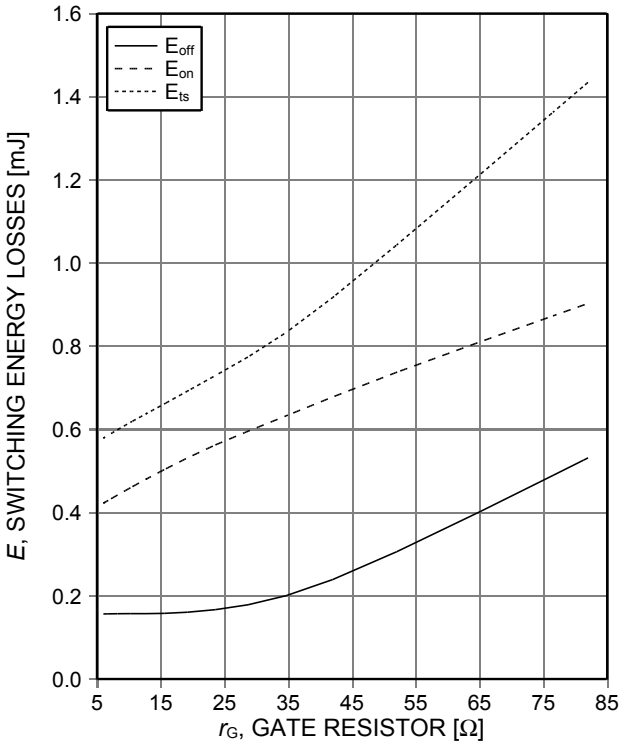


Figure 13. **Typical switching energy losses as a function of gate resistor** (inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=15/0V, I_C=20A, Dynamic test circuit in Figure E)

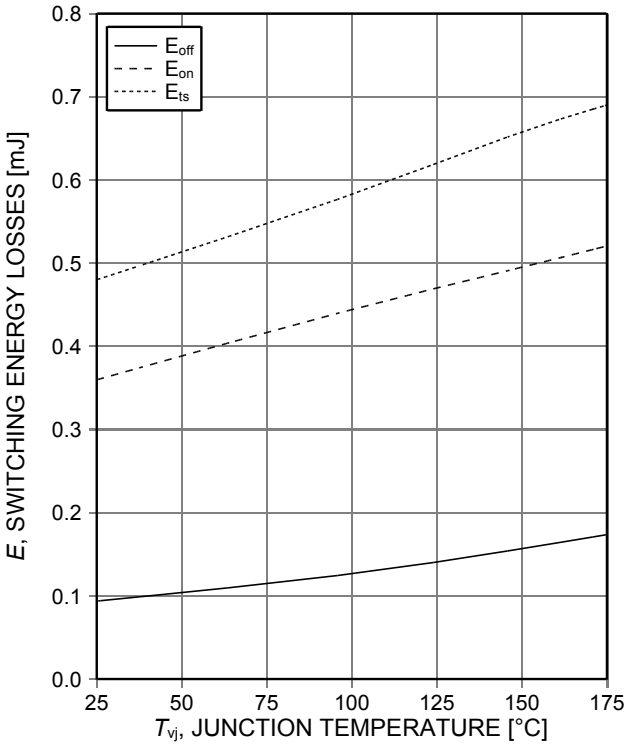


Figure 14. **Typical switching energy losses as a function of junction temperature** (inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=20A, r_G=15Ω,Dynamic test circuit in Figure E)

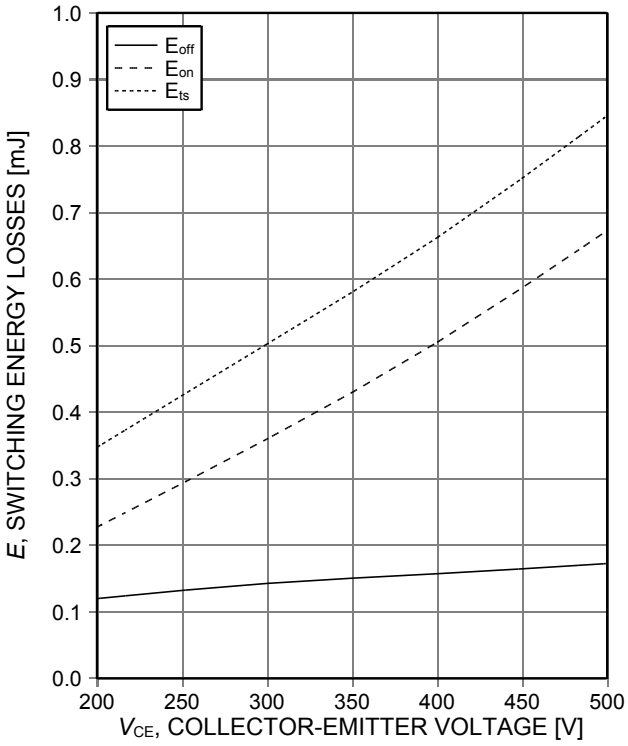


Figure 15. **Typical switching energy losses as a function of collector emitter voltage** (inductive load, T_{vj}=150°C, V_{GE}=15/0V, I_C=20A, r_G=15Ω,Dynamic test circuit in Figure E)

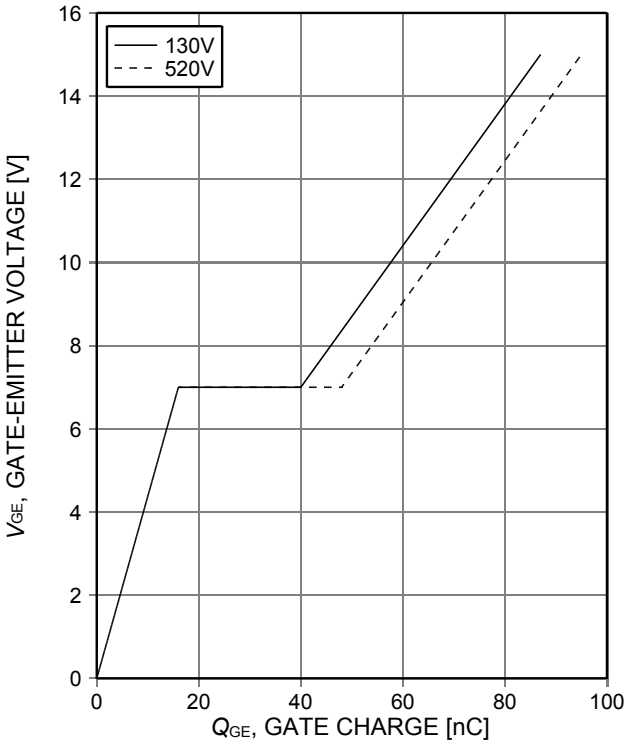


Figure 16. **Typical gate charge** (I_C=40A)

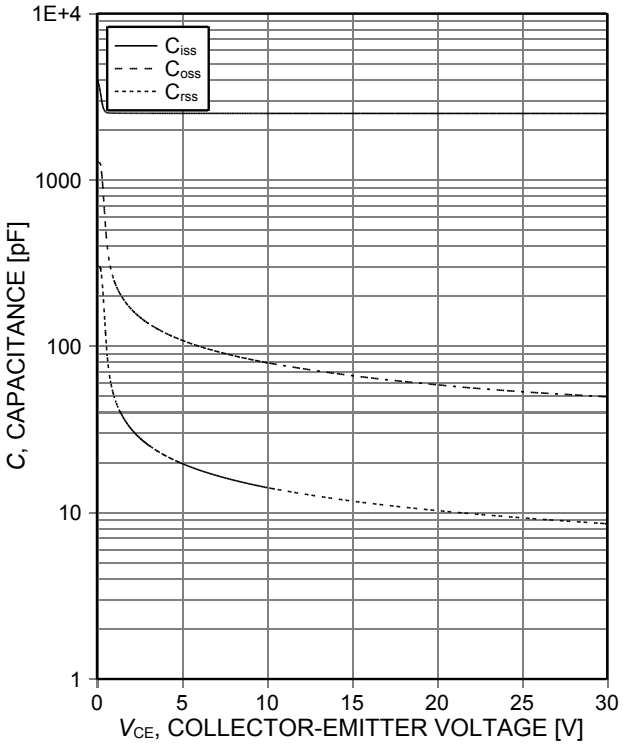


Figure 17. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

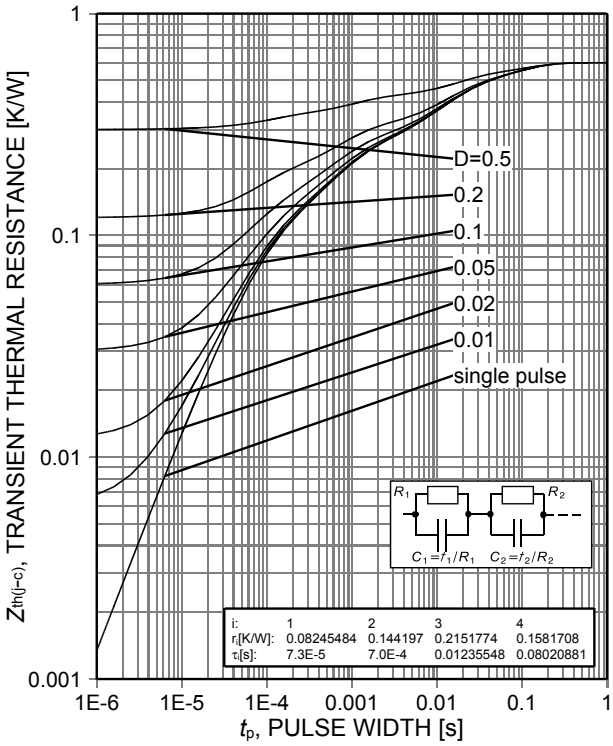
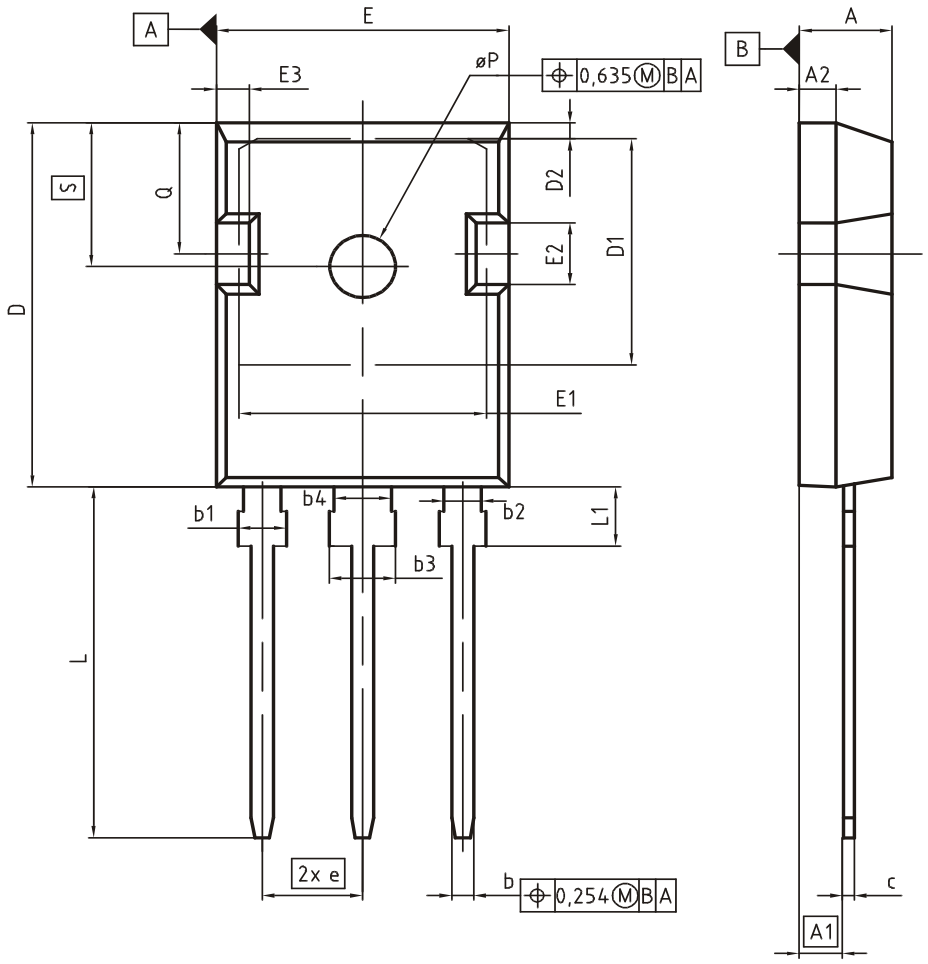


Figure 18. **IGBT transient thermal resistance**
($D=t_p/T$)

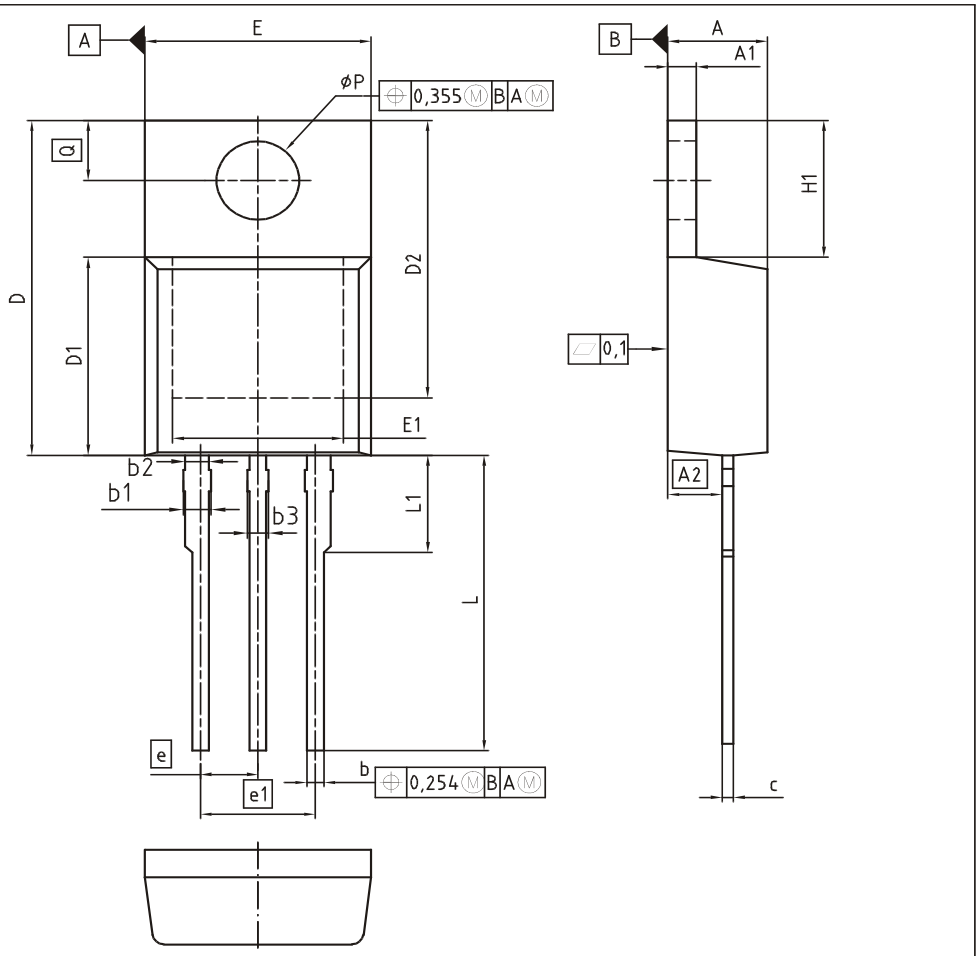
PG-TO247-3



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
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	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.35	0.037	0.053
E	15.70	16.13	0.618	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	2.60	0.039	0.102
e	5.44 (BSC)		0.214 (BSC)	
N	3		3	
L	19.80	20.32	0.780	0.800
L1	4.10	4.47	0.161	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	0 5 5 7.5mm
EUROPEAN PROJECTION	
ISSUE DATE	09-07-2010
REVISION	05

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

DOCUMENT NO.
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SCALE 0 2.5 0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE
30-07-2009

REVISION
06

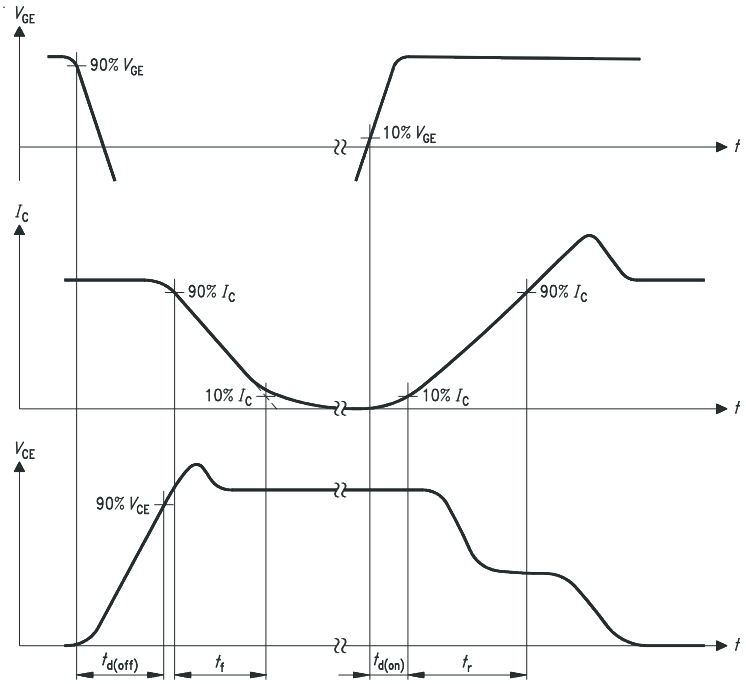

Figure A. Definition of switching times

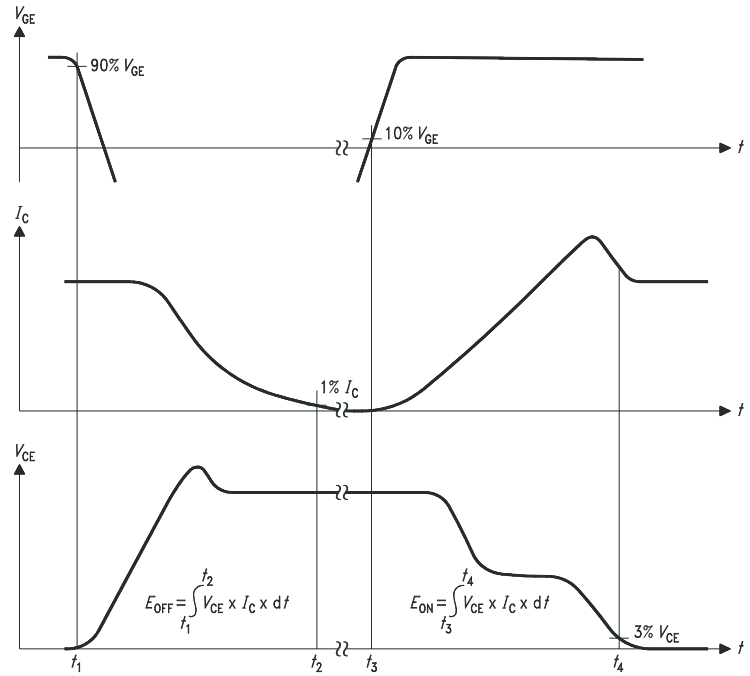

Figure B. Definition of switching losses

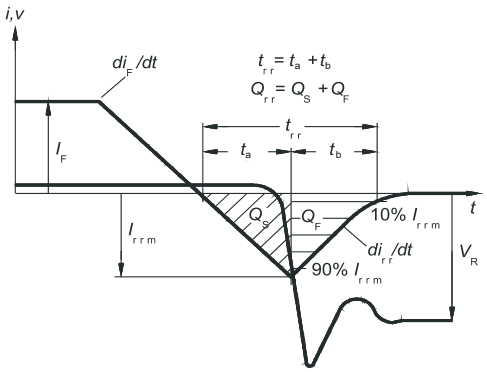

Figure C. Definition of diodes switching characteristics

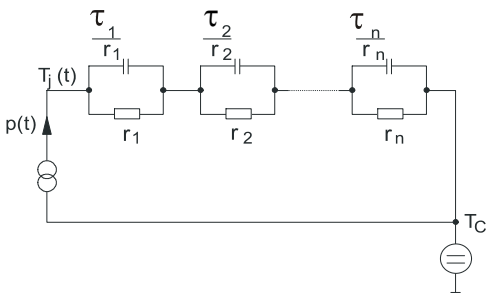

Figure D. Thermal equivalent circuit

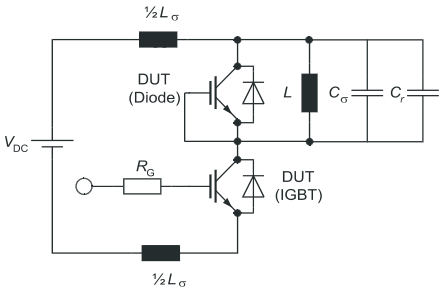

Figure E. Dynamic test circuit
Parasitic inductance L_σ,
Parasitic capacitor C_σ,
Relief capacitor C_r
(only for ZVT switching)

Revision History

IGW40N65F5, IGP40N65F5

Revision: 2012-11-09, Rev. 1.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
1.1	2012-11-09	Preliminary data sheet

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