

## IGBT

High speed IGBT in Trench and Fieldstop technology  
recommended in combination with SiC Diode IDH15S120

## IGW40N120H3

1200V high speed switching series third generation

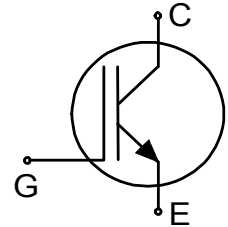
Data sheet

High speed IGBT in Trench and Fieldstop technology recommended in combination with SiC Diode IDH15S120

**Features:**

TRENCHSTOP™ technology offering

- best in class switching performance: less than 500µJ total switching losses achievable
- very low  $V_{CEsat}$
- low EMI
- 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/>



**Applications:**

- solar inverters
- uninterruptible power supplies
- welding converters
- converters with high switching frequency



**Package pin definition:**

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



**Key Performance and Package Parameters**

Type	$V_{CE}$	$I_C$	$V_{CEsat}, T_{vj}=25^{\circ}C$	$T_{vjmax}$	Marking	Package
IGW40N120H3	1200V	40A	2.05V	175°C	G40H1203	PG-TO247-3



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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	$V_{CE}$	1200	V
DC collector current, limited by $T_{vjmax}$ $T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$	$I_C$	80.0 40.0	A
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cpuls}$	160.0	A
Turn off safe operating area $V_{CE} \leq 1200\text{V}$ , $T_{vj} \leq 175^\circ\text{C}$	-	160.0	A
Gate-emitter voltage	$V_{GE}$	$\pm 20$	V
Short circuit withstand time $V_{GE} = 15.0\text{V}$ , $V_{CC} \leq 600\text{V}$ Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0\text{s}$ $T_{vj} = 175^\circ\text{C}$	$t_{SC}$	10	$\mu\text{s}$
Power dissipation $T_C = 25^\circ\text{C}$ Power dissipation $T_C = 100^\circ\text{C}$	$P_{tot}$	483.0 220.0	W
Operating junction temperature	$T_{vj}$	-40...+175	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55...+150	$^\circ\text{C}$
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s		260	$^\circ\text{C}$
Mounting torque, M3 screw Maximum of mounting processes: 3	$M$	0.6	Nm

**Thermal Resistance**

Parameter	Symbol	Conditions	Max. Value	Unit
<b>Characteristic</b>				
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		0.31	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		40	K/W

**Electrical Characteristic, at  $T_{vj} = 25^\circ\text{C}$ , unless otherwise specified**

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>Static Characteristic</b>						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0\text{V}$ , $I_C = 0.50\text{mA}$	1200	-	-	V
Collector-emitter saturation voltage	$V_{CEsat}$	$V_{GE} = 15.0\text{V}$ , $I_C = 40.0\text{A}$ $T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 175^\circ\text{C}$	- - -	2.05 2.50 2.70	2.40 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 1.00\text{mA}$ , $V_{CE} = V_{GE}$	5.0	5.8	6.5	V
Zero gate voltage collector current	$I_{CES}$	$V_{CE} = 1200\text{V}$ , $V_{GE} = 0\text{V}$ $T_{vj} = 25^\circ\text{C}$ $T_{vj} = 175^\circ\text{C}$	- -	- -	250.0 2500.0	$\mu\text{A}$
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\text{V}$ , $V_{GE} = 20\text{V}$	-	-	600	nA
Transconductance	$g_{fs}$	$V_{CE} = 20\text{V}$ , $I_C = 15.0\text{A}$	-	20.0	-	S

**Electrical Characteristic, at  $T_{vj} = 25^{\circ}\text{C}$ , unless otherwise specified**

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>Dynamic Characteristic</b>						
Input capacitance	$C_{ies}$	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$	-	2330	-	pF
Output capacitance	$C_{oes}$		-	150	-	
Reverse transfer capacitance	$C_{res}$		-	130	-	
Gate charge	$Q_G$	$V_{CC} = 960\text{V}, I_C = 40.0\text{A}, V_{GE} = 15\text{V}$	-	185.0	-	nC
Short circuit collector current Max. 1000 short circuits Time between short circuits: $\geq 1.0\text{s}$	$I_{C(SC)}$	$V_{GE} = 15.0\text{V}, V_{CC} \leq 600\text{V}, t_{SC} \leq 10\mu\text{s}, T_{vj} = 175^{\circ}\text{C}$	-	139	-	A

**Switching Characteristic, Inductive Load**

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	

**IGBT Characteristic, at  $T_{vj} = 25^{\circ}\text{C}$** 

Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C}, V_{CC} = 600\text{V}, I_C = 40.0\text{A}, V_{GE} = 0.0/15.0\text{V}, R_{G(on)} = 12.0\Omega, R_{G(off)} = 12.0\Omega, L_{\sigma} = 70\text{nH}, C_{\sigma} = 67\text{pF}, L_{\sigma}, C_{\sigma}$ from Fig. E Energy losses include "tail" and diode (IDH15S120) reverse recovery.	-	30	-	ns
Rise time	$t_r$		-	57	-	ns
Turn-off delay time	$t_{d(off)}$		-	290	-	ns
Fall time	$t_f$		-	16	-	ns
Turn-on energy	$E_{on}$		-	1.93	-	mJ
Turn-off energy	$E_{off}$		-	1.23	-	mJ
Total switching energy	$E_{ts}$		-	3.16	-	mJ

**Switching Characteristic, Inductive Load**

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	

**IGBT Characteristic, at  $T_{vj} = 175^{\circ}\text{C}$** 

Turn-on delay time	$t_{d(on)}$	$T_{vj} = 175^{\circ}\text{C}, V_{CC} = 600\text{V}, I_C = 40.0\text{A}, V_{GE} = 0.0/15.0\text{V}, R_{G(on)} = 12.0\Omega, R_{G(off)} = 12.0\Omega, L_{\sigma} = 70\text{nH}, C_{\sigma} = 67\text{pF}, L_{\sigma}, C_{\sigma}$ from Fig. E Energy losses include "tail" and diode (IDH15S120) reverse recovery.	-	29	-	ns
Rise time	$t_r$		-	49	-	ns
Turn-off delay time	$t_{d(off)}$		-	366	-	ns
Fall time	$t_f$		-	48	-	ns
Turn-on energy	$E_{on}$		-	2.21	-	mJ
Turn-off energy	$E_{off}$		-	2.66	-	mJ
Total switching energy	$E_{ts}$		-	4.87	-	mJ

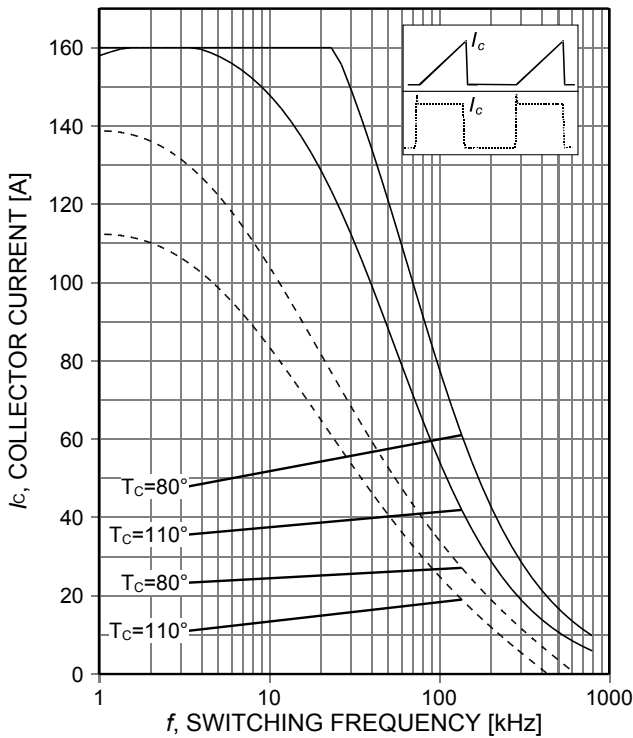


Figure 1. **Collector current as a function of switching frequency**  
 ( $T_j \leq 175^\circ\text{C}$ ,  $D=0.5$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $r_G=12\Omega$ )

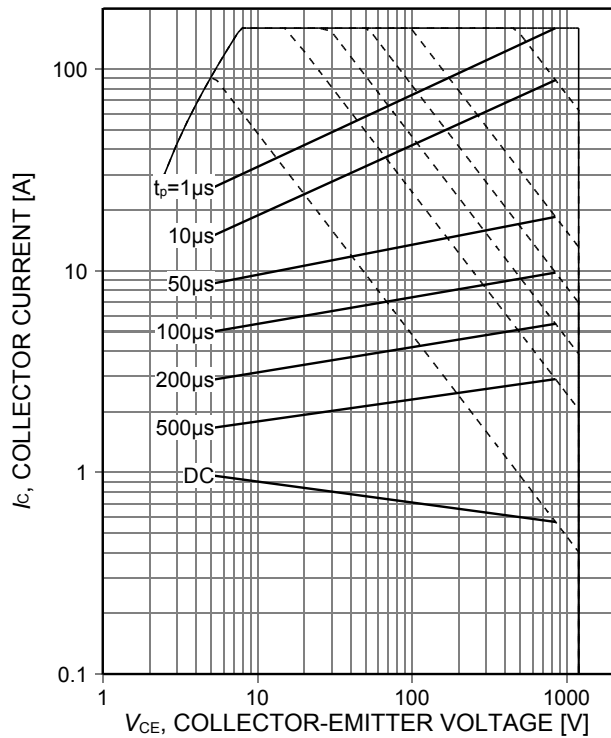


Figure 2. **Forward bias safe operating area**  
 ( $D=0$ ,  $T_c=25^\circ\text{C}$ ,  $T_j \leq 175^\circ\text{C}$ ;  $V_{GE}=15\text{V}$ )

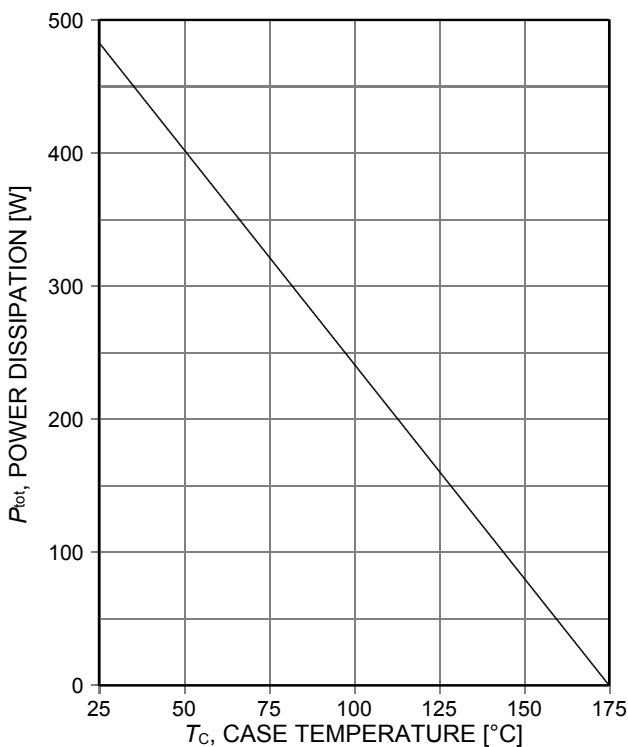


Figure 3. **Power dissipation as a function of case temperature**  
 ( $T_j \leq 175^\circ\text{C}$ )

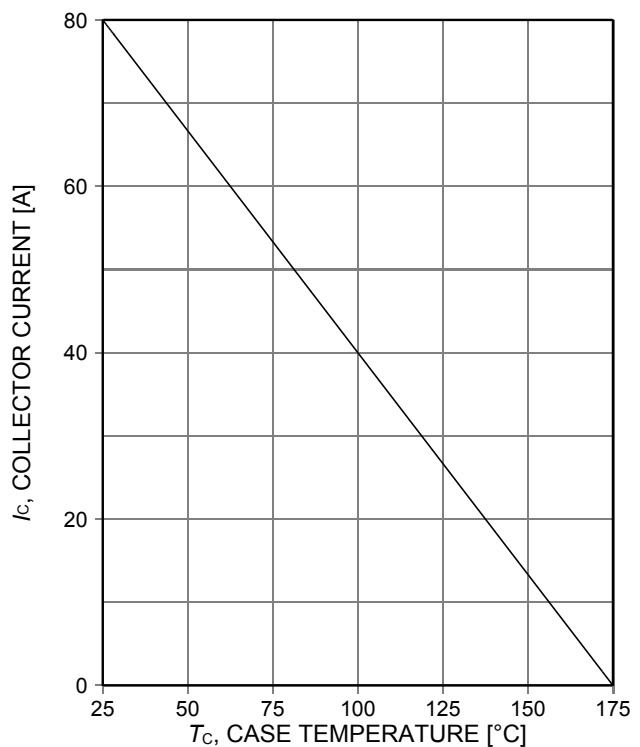


Figure 4. **Collector current as a function of case temperature**  
 ( $V_{GE} \geq 15\text{V}$ ,  $T_j \leq 175^\circ\text{C}$ )

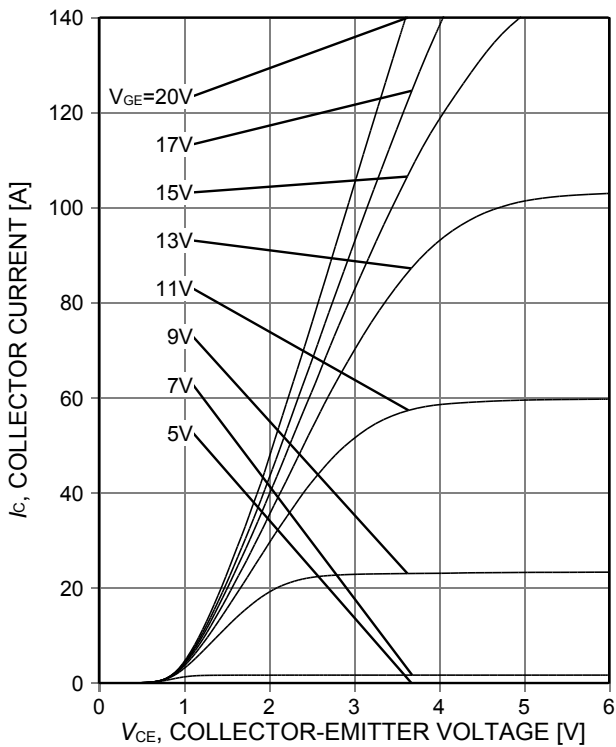


Figure 5. **Typical output characteristic**  
( $T_j=25^\circ\text{C}$ )

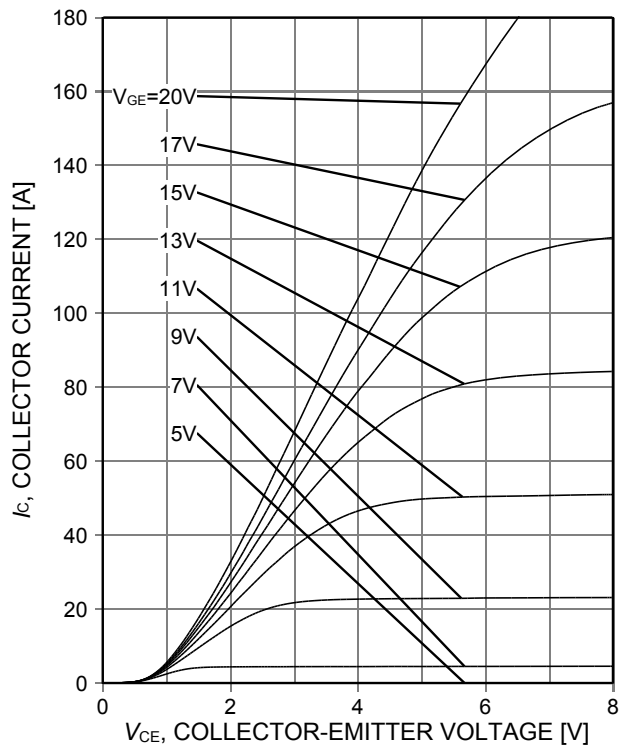


Figure 6. **Typical output characteristic**  
( $T_j=175^\circ\text{C}$ )

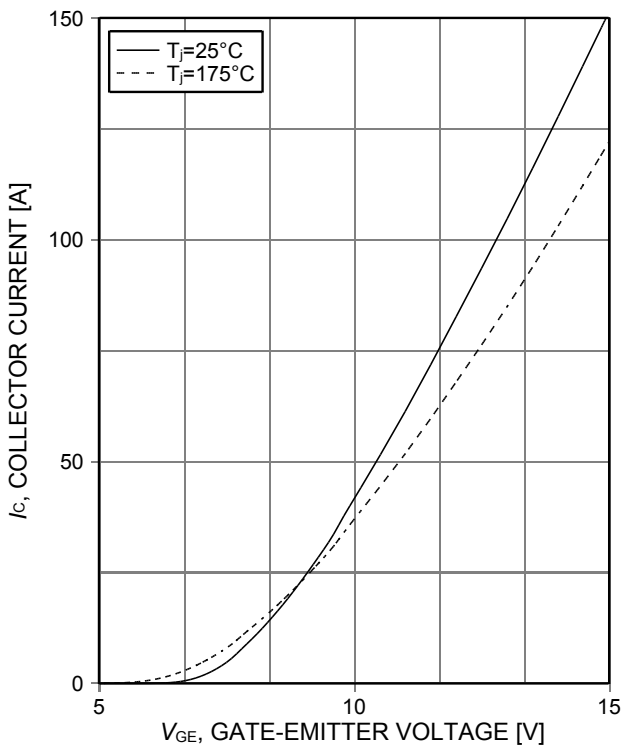


Figure 7. **Typical transfer characteristic**  
( $V_{CE}=20\text{V}$ )

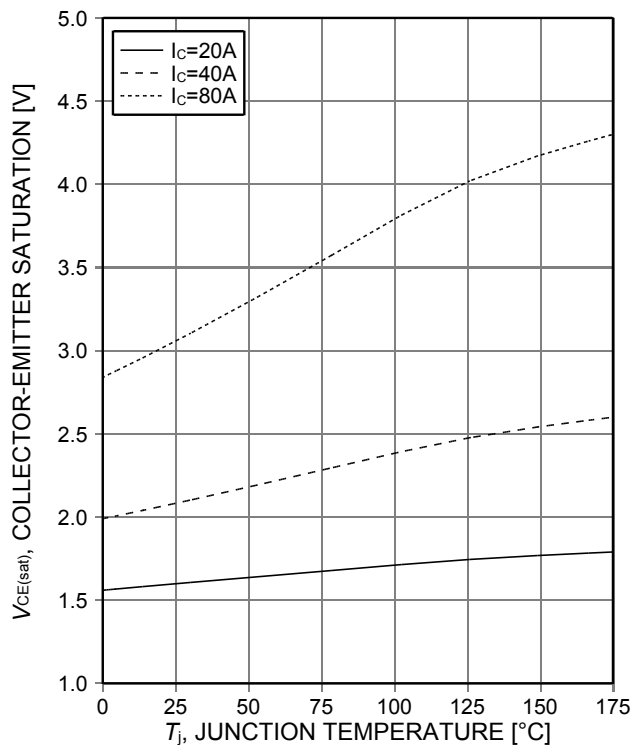


Figure 8. **Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{GE}=15\text{V}$ )

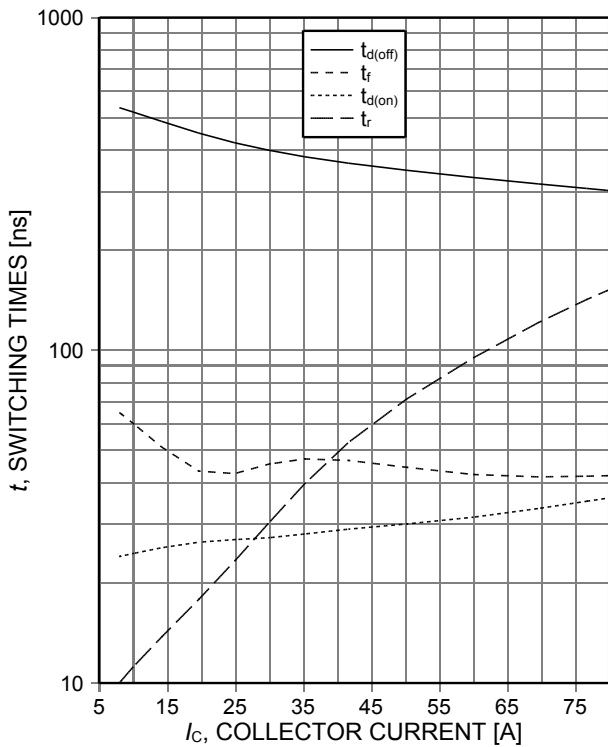


Figure 9. **Typical switching times as a function of collector current**  
(ind. load,  $T_J=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $r_G=12\Omega$ , test circuit in Fig. E)

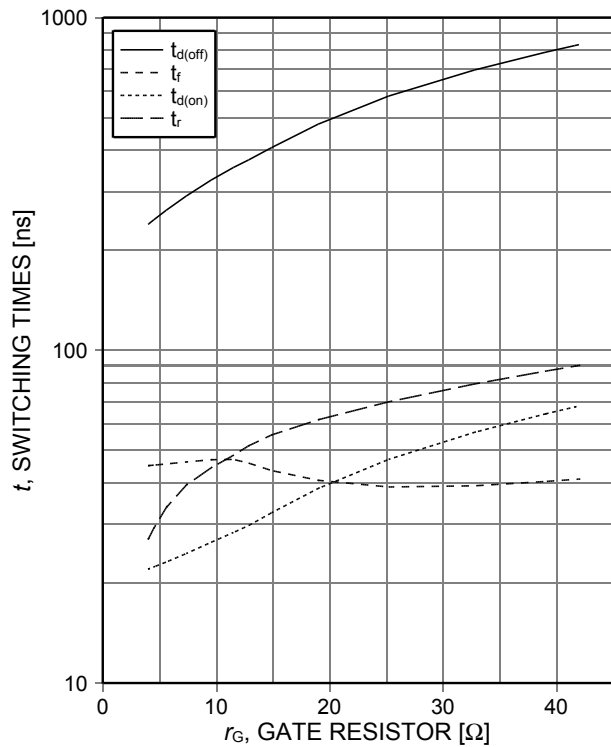


Figure 10. **Typical switching times as a function of gate resistor**  
(ind. load,  $T_J=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_C=40\text{A}$ , test circuit in Fig. E)

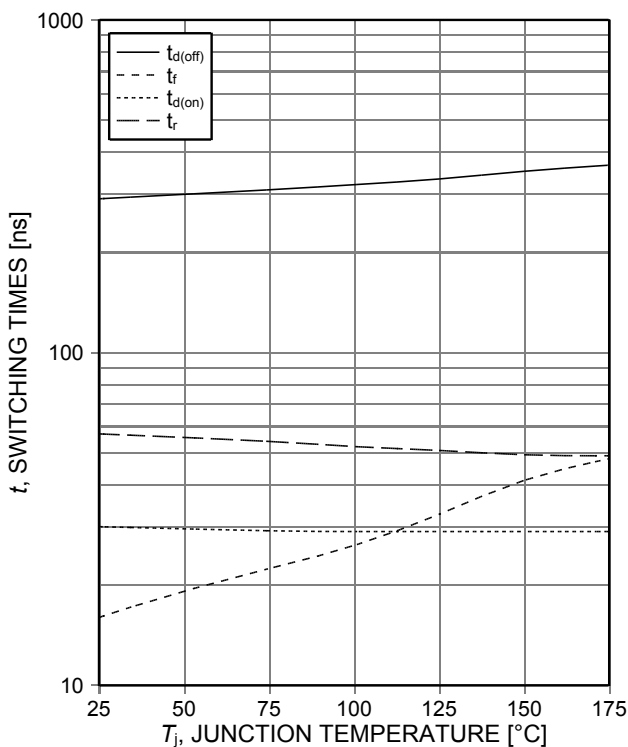


Figure 11. **Typical switching times as a function of junction temperature**  
(ind. load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_C=40\text{A}$ ,  $r_G=12\Omega$ , test circuit in Fig. E)

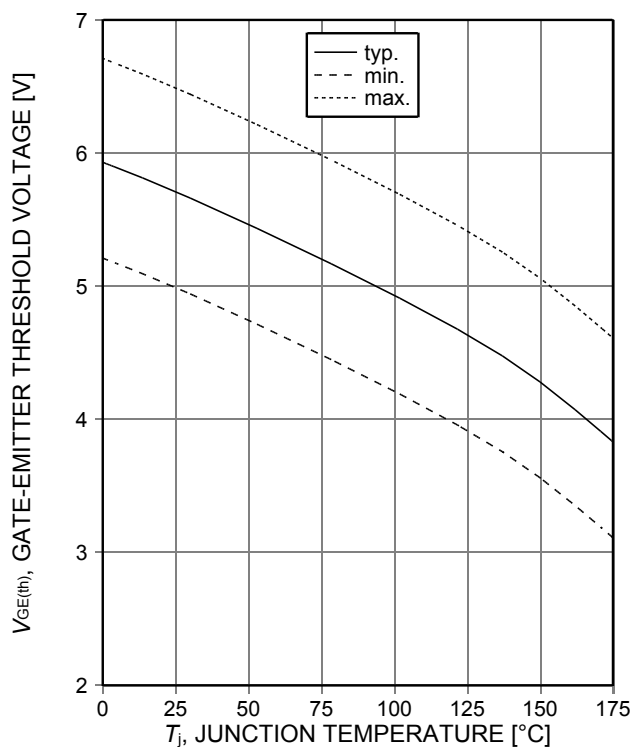


Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C=1\text{mA}$ )



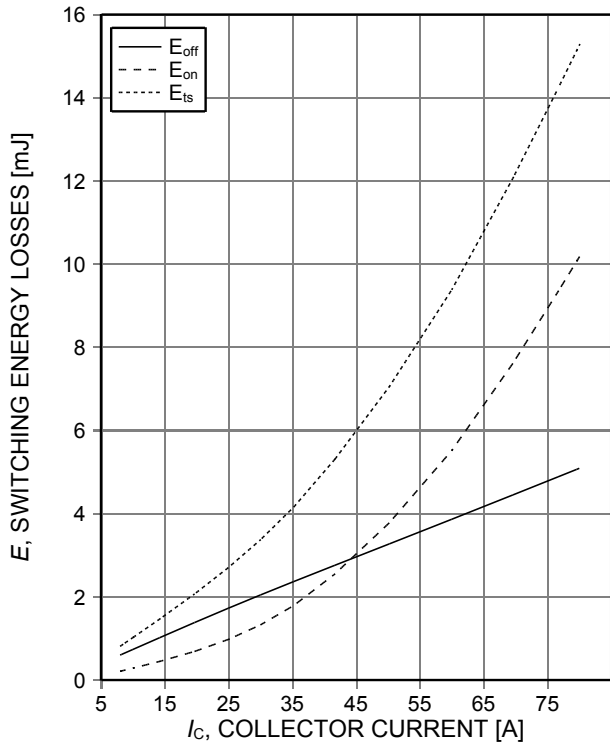


Figure 13. **Typical switching energy losses as a function of collector current**  
 (ind. load,  $T_j=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $r_G=12\Omega$ , Diode IDH15S120)

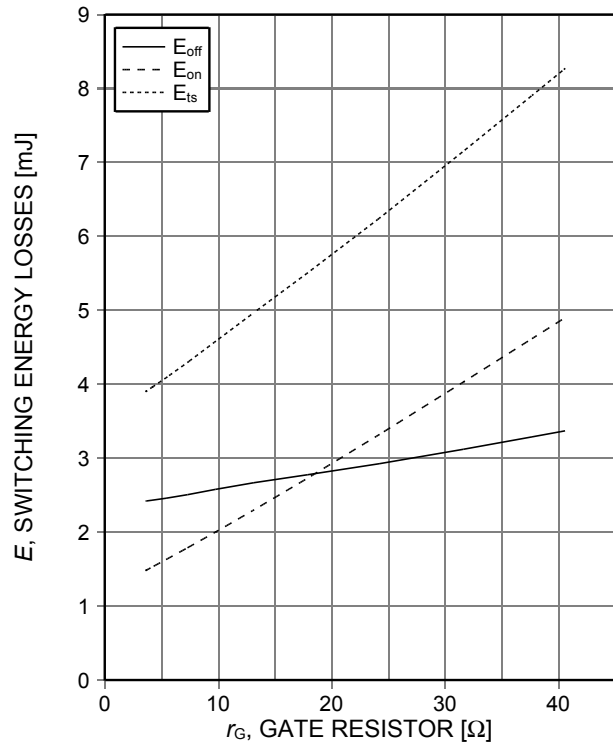


Figure 14. **Typical switching energy losses as a function of gate resistor**  
 (ind. load,  $T_j=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_c=40\text{A}$ , Diode IDH15S120)

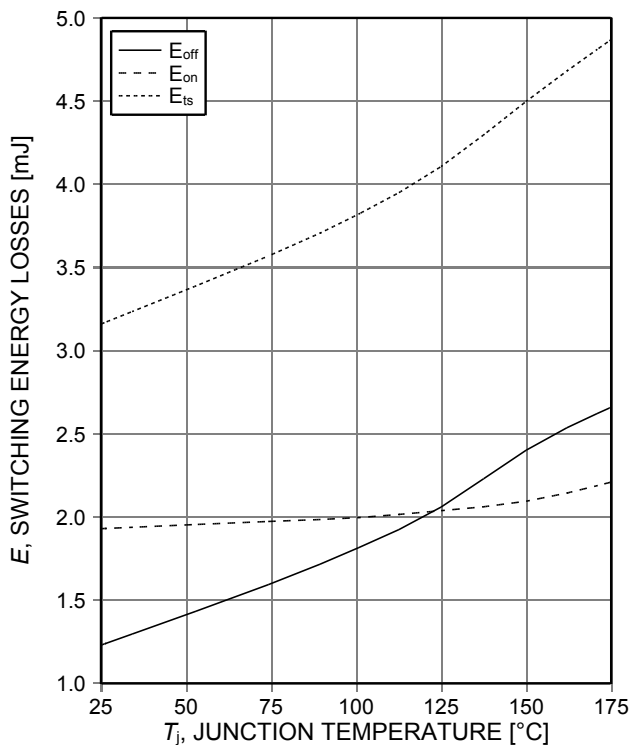


Figure 15. **Typical switching energy losses as a function of junction temperature**  
 (ind load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_c=40\text{A}$ ,  $r_G=12\Omega$ , Diode IDH15S120)

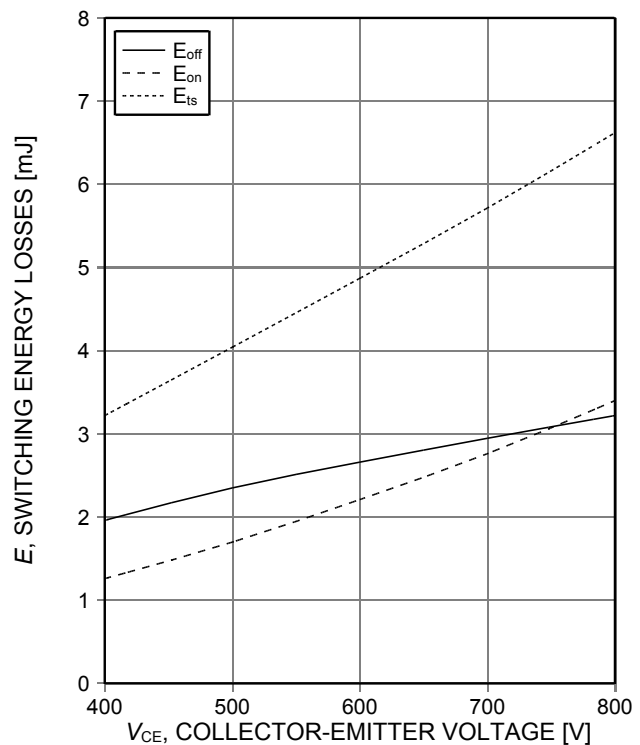


Figure 16. **Typical switching energy losses as a function of collector emitter voltage**  
 (ind. load,  $T_j=175^\circ\text{C}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_c=40\text{A}$ ,  $r_G=12\Omega$ , Diode IDH15S120)

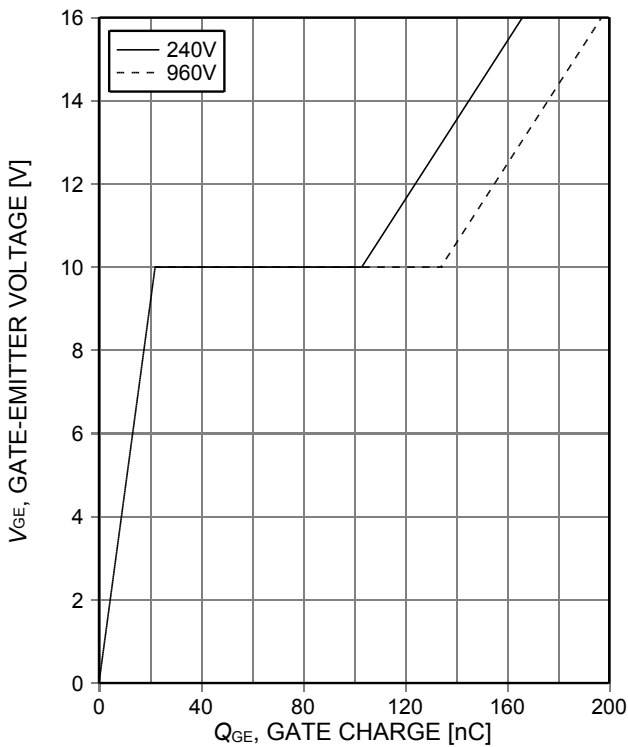


Figure 17. **Typical gate charge**  
( $I_C=40A$ )

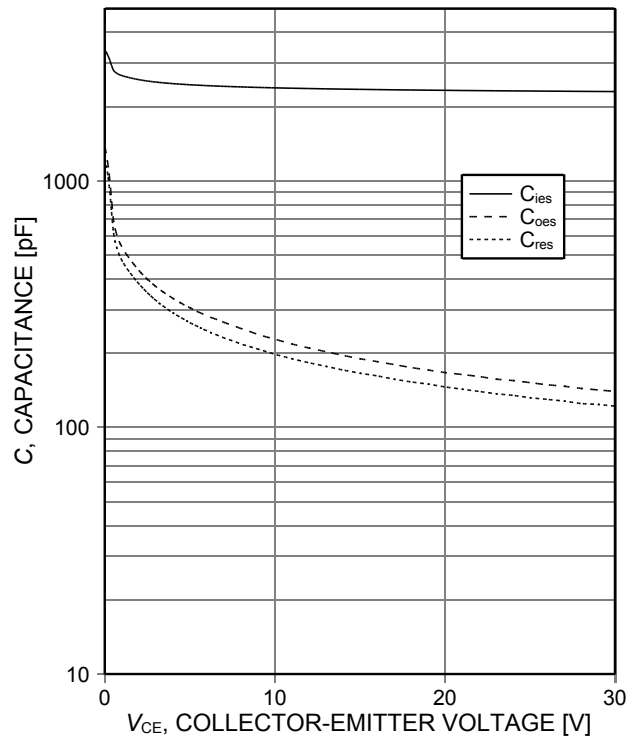


Figure 18. **Typical capacitance as a function of collector-emitter voltage**  
( $V_{GE}=0V, f=1MHz$ )

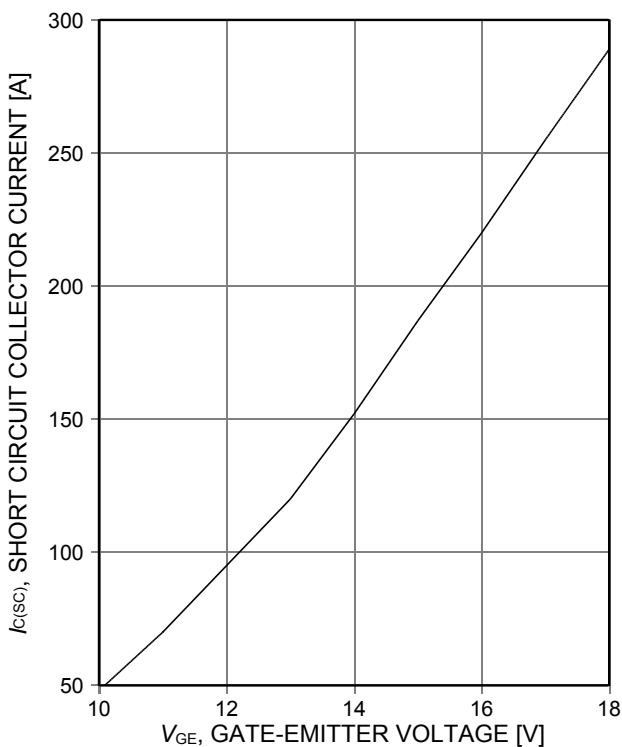


Figure 19. **Typical short circuit collector current as a function of gate-emitter voltage**  
( $V_{CE}\leq 600V$ , start at  $T_j=25^\circ C$ )

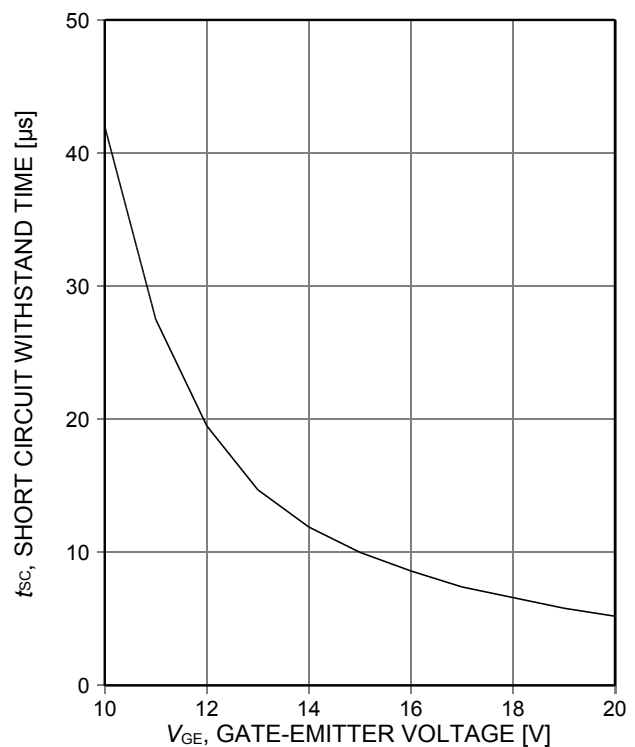


Figure 20. **Short circuit withstand time as a function of gate-emitter voltage**  
( $V_{CE}\leq 600V$ , start at  $T_j\leq 150^\circ C$ )

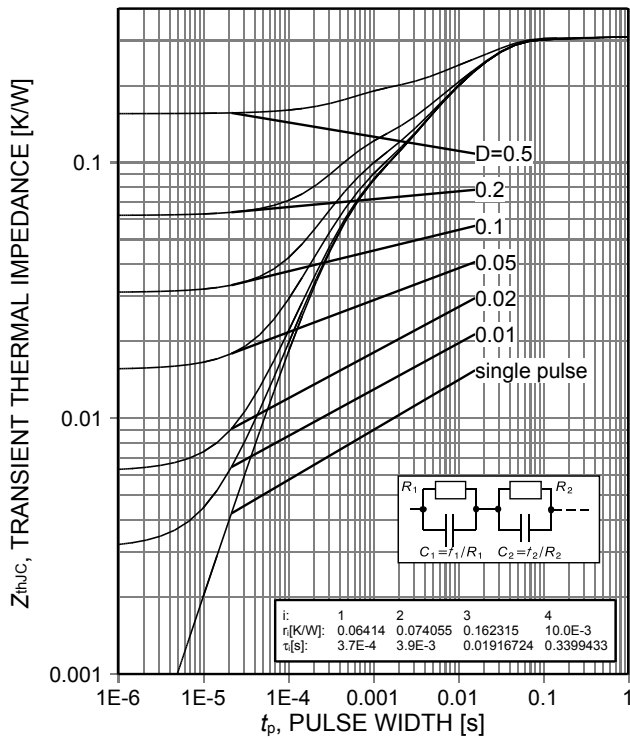
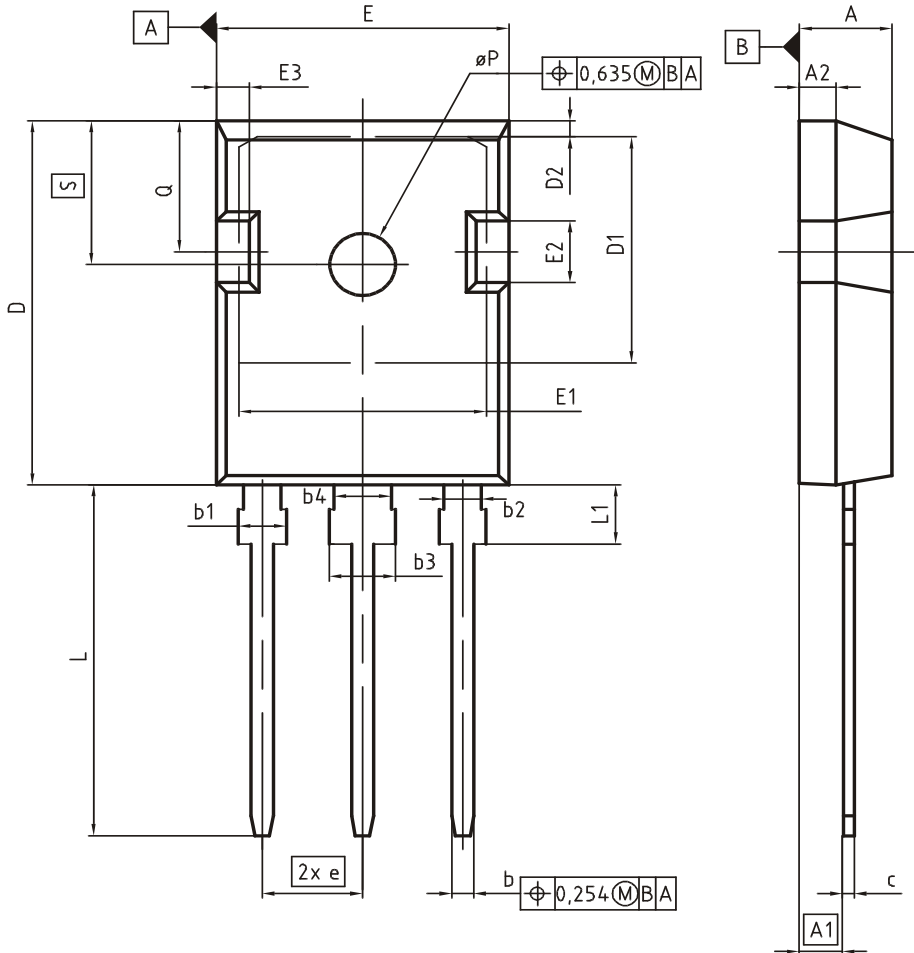


Figure 21. IGBT transient thermal impedance ( $D=t_p/T$ )

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
$\phi P$	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

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SCALE

EUROPEAN PROJECTION

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09-07-2010

REVISION  
05

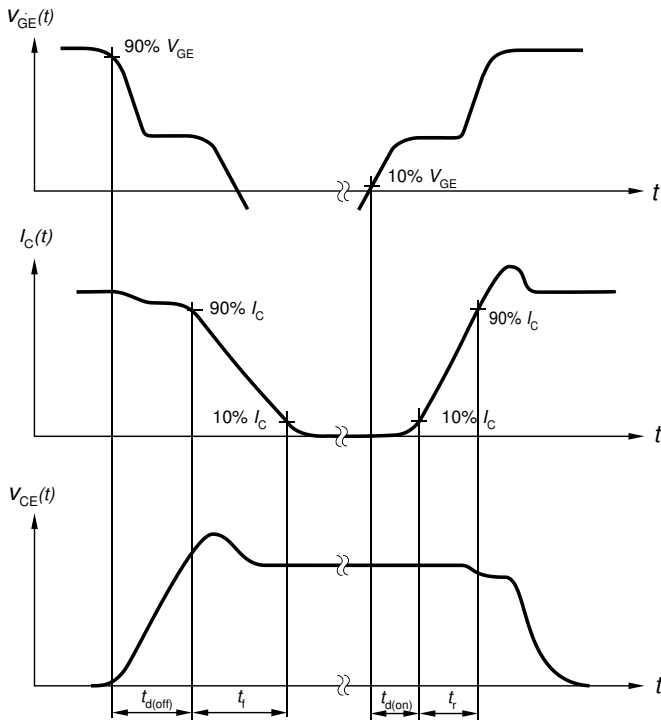


Figure A. Definition of switching times

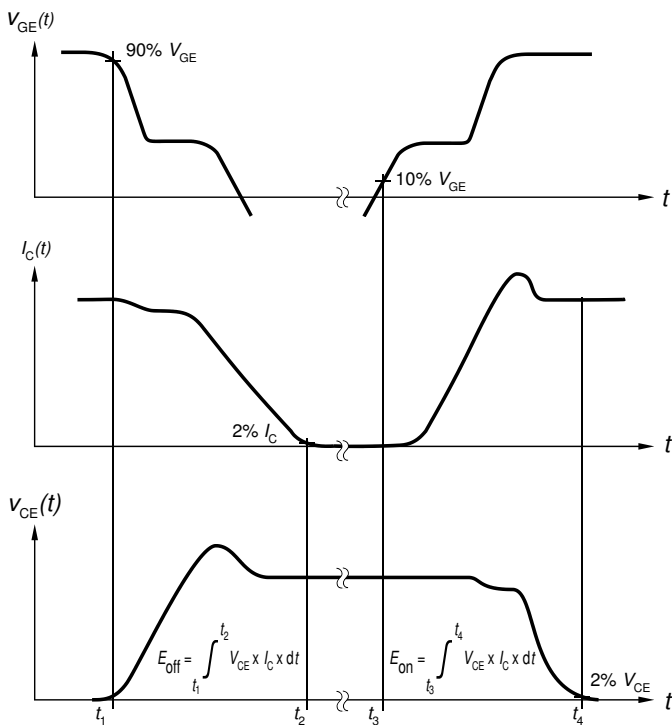


Figure B. Definition of switching losses

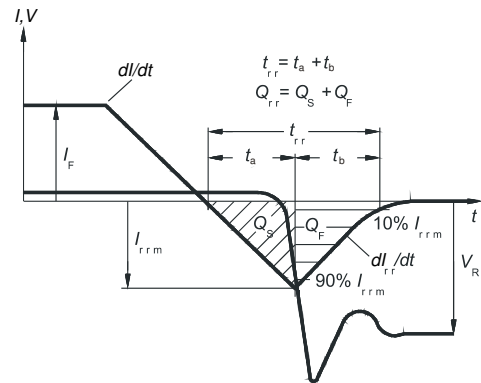


Figure C. Definition of diodes switching characteristics

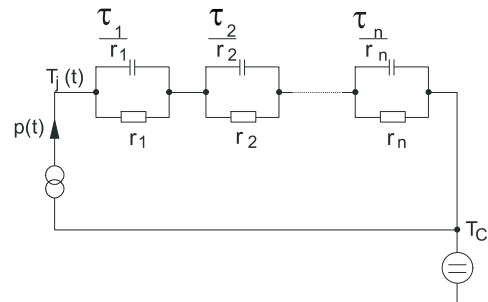


Figure D. Thermal equivalent circuit

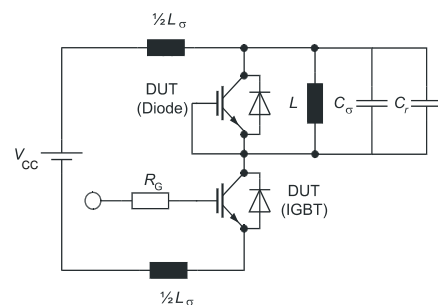


Figure E. Dynamic test circuit  
Parasitic inductance  $L_\sigma$ ,  
parasitic capacitor  $C_\sigma$ ,  
relief capacitor  $C_r$   
(only for ZVT switching)

**Revision History**

IGW40N120H3

**Revision: 2014-11-26, Rev. 2.2**

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2012-07-31	Final data sheet
2.2	2014-11-26	Minor change Figure 7

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